INDEX

GENERAL INFORMATION

1. HOW TO READ ELECTRICAL WIRING DIAGRAM..... 3
2. 2. LAYOUT OF ELECTRICAL SYSTEM. 6

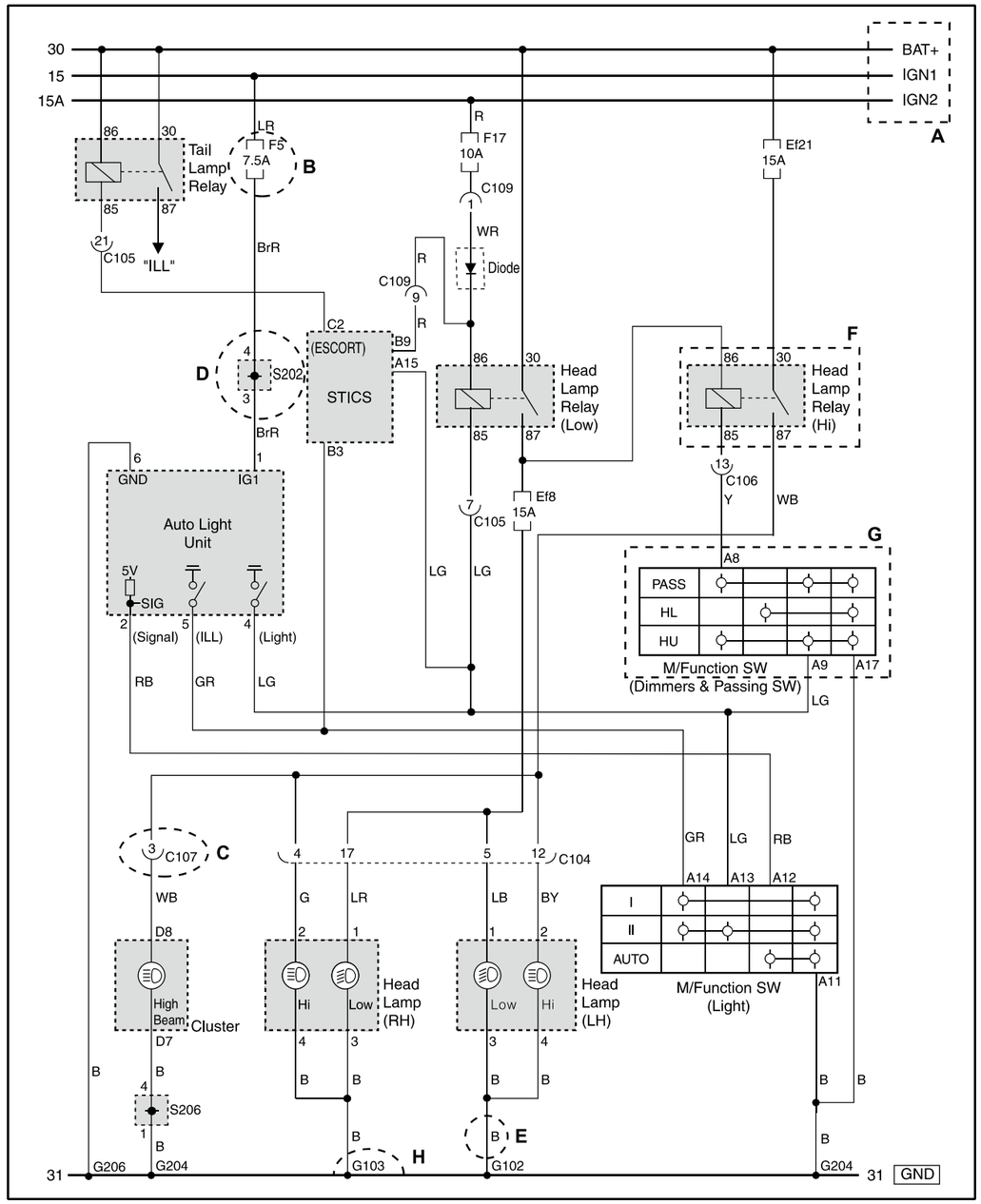
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GENERAL INFORMATION

1. HOW TO READ ELECTRICAL WIRING DIAGRAM

1) HOW TO READ ELECTRICAL WIRING DIAGRAM



2) CONTENTS OF ELECTRICAL WIRING DIAGRAM (CIRCUIT)

Position	Explanation
A	- Upper horizontal lines : Power supply lines - Power supply lines : 30, 15, 15A, 15C, 58
B	- Ef20 or F2 : Fuse Number ·Ef20 : Fuse No #20 in engine room compartment ·F2 : Fuse No #2 in passenger room compartment
C	- Connector (C101 ~ C903) ·Connector No C203 terminal No1 ·Refer to Major Connector Position (Section 2)
D	- S201 : Splice pack (S201 ~ S207) ·Refer to Major Splice Pack Position (Section2)
E	- Wiring Harness Color ·Refer to Wiring Harness Color Abbreviation
F	- Internal circuit of component (Relay) (Component Name and Terminal Number)
G	- Internal circuit of component (Switch) (Component Name, Terminal Number and Connecting Wiring Circuit)
H	- Lower horizontal line : Ground line ·Ground position (G101 ~ G402) ·B : Body Ground ·Refer to Major Ground Position (Section2)

Modification basis	
Application basis	
Affected VIN	

3) CIRCUIT IDENTIFICATION SYMBOL

Identification Symbol	Meaning
C	Connector
D	Diode
Ef	Fuse in engine room fuse & relay box
F	Fuse in passenger room fuse box
G	Ground
S	Splice pack (Junction connector)

4) FUNCTION OF POWER SUPPLY LINE (NUMBER)

Power supply No.	Power supply condition
15	Battery Voltage (B+) supply in Ignition Switch "ON" and "ST" (IGN 1)
15A	Battery Voltage (B+) supply in Ignition Switch "ON" (IGN 2)
15C	Battery Voltage (B+) supply in Ignition Switch "ON" and "ACC"
30	Battery Voltage (B+) supply directly regardless of Ignition Switch
31	Ground connected to battery (-)
58	Battery Voltage (B+) supply in Head Lamp Switch 1st and 2nd step (Illumination circuit)

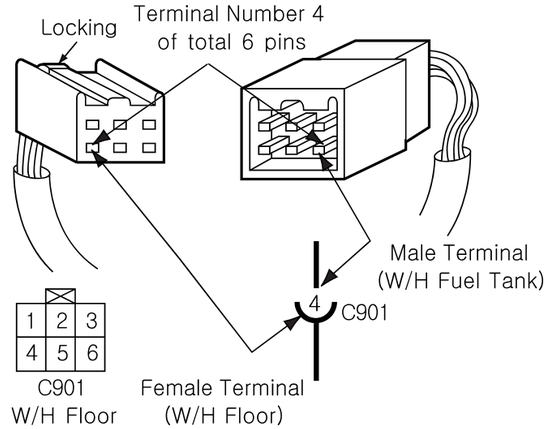
5) WIRING HARNESS COLOR IDENTIFICATION

Abbreviation	Color	Abbreviation	Color
Br	Brown	Sb	Sky Blue
G	Green	R	Red
V	Violet	L	Blue
P	Pink	Y	Yellow
W	White	Gr	Gray
Gr	Orange	B	Black
Lg	Light Green		

6) HOW TO CHECK TERMINAL NUMBER OF CONNECTOR

▶ **Terminal number is given based on Female Terminal Male Connector**

- ex) Terminal Number 4 of C901 connection



Modification basis	
Application basis	
Affected VIN	

7) PART LOCATION ACCORDING TO PART NUMBER

▶ **Ex.) C 1 0 2**

- C : Symbol character for connector

Symbol Character	Description
C	Connector (Connecting part that connects two wiring harness)
D	Diode
G	Ground
S	Splice pack (Joint connector that connects various wiring harness)

- 1 : Part location number

- Part number according to locating section

Part Numbe	Location
☐ 1☐☐	Engine compartment
☐ 2☐☐	Instrument panel
☐ 3☐☐	Passenger compartment
☐ 4☐☐	Tailgate
☐ 5☐☐	Underbody

- In the locating section, the assignment for part number startsfrom left bottom and proceeds clockwise.
- In the fuse and relay box or the instrument panel, the partnumber is assigned from left top to light bottom.

8) ELECTRIC SYMBOLS

Items	Symbols	Items	Symbols
Resistance		Lamp	
Rheostat		Single Bulb	
Coil, Inductance		Double Bulb	
Condenser, Capacitor		Transistor : PNP type	
Ground, Earth		Transistor : NPN type	
Diode		~Meter, ~Gauge	
Zener Diode		Voltmeter	V
Photo Diode		Amperemeter	A
Light Emitting Diode		Switch	
Battery		Thermistor	
Disconnected Wire		Junction Point	
Fuse		Fusible Link	
Motor	M	Connector	No.
Speaker		Horn	

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INDEX

WIRING HARNESS

0000-00 WIRING HARNESS,
COMPONENTS LOCATION..... 3

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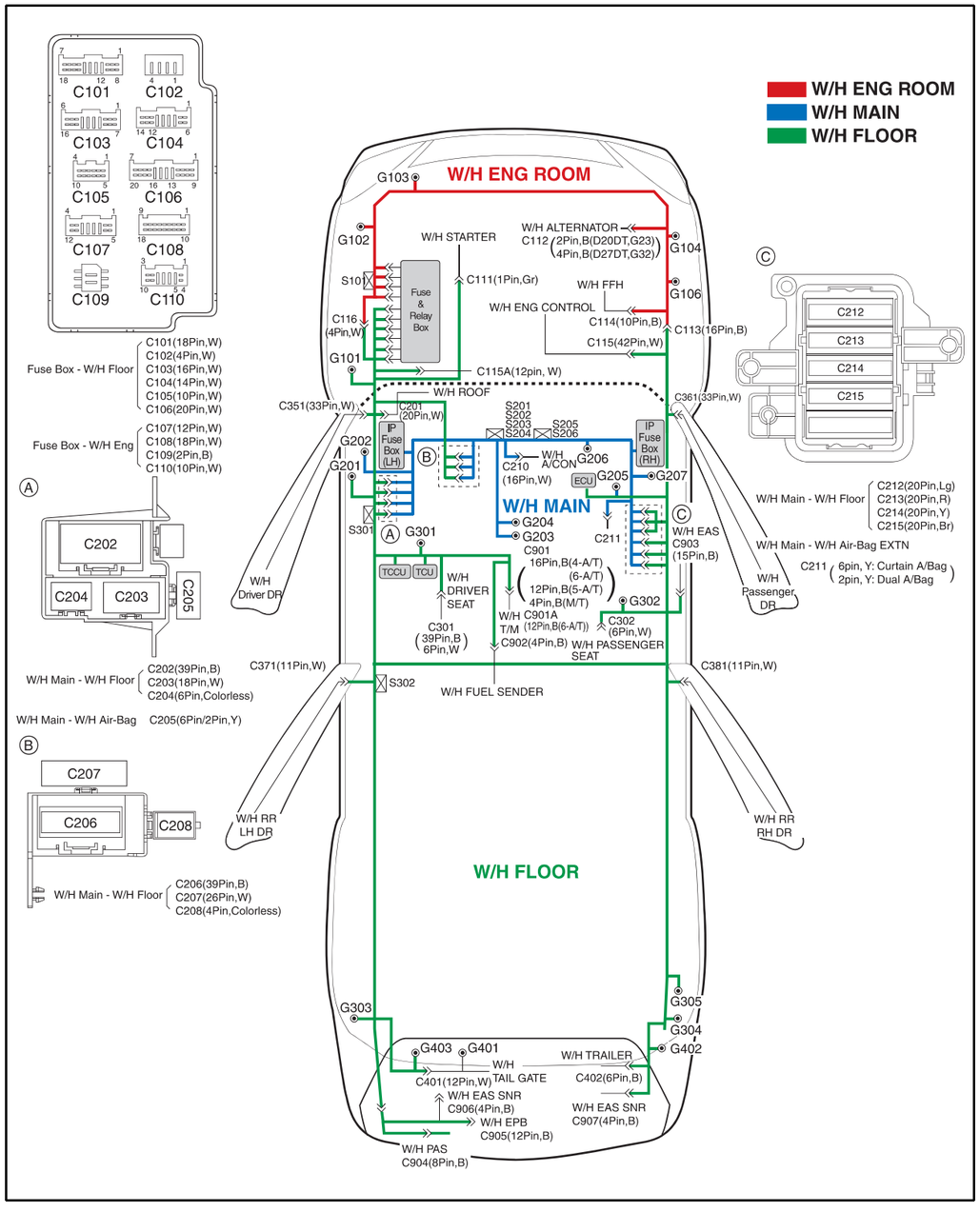
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WIRING HARNESS

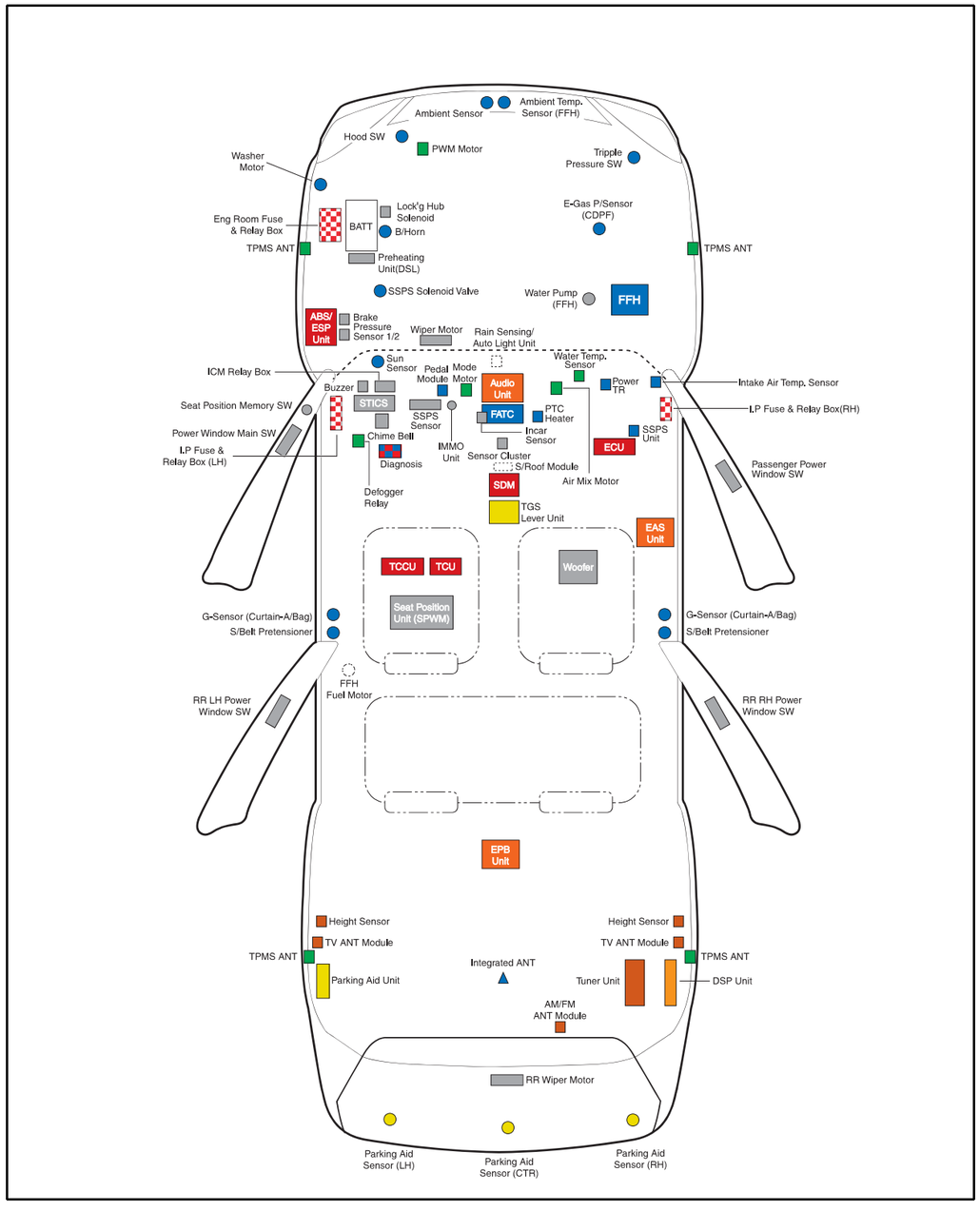
SGN 0000-00

WIRING HARNESS, COMPONENTS LOCATION

1) WIRING HARNESS



2) COMPONENTS LOCATION



Modification basis	
Application basis	
Affected VIN	

3) CONNECTOR, GROUND & SPLICE PACK INFORMATION

▶ CONNECTOR

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109 (2Pin, Black)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (10Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C111 (1Pin, Gray)	W/H Floor - Starter Motor	Under the Preheating Time Relay	Solenoid
C112 (2Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D20DT/GSL 2.3
C112 (4Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D27DT/GSL 3.2
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C114 (10Pin, Black)	W/H Eng - W/H FFH	Right Eng Room Dash PNL	FFH
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C115A (12Pin, White)	W/H Eng - W/H Floor	Beside ABS/ESP Unit	D20/D27DT(EU IV)
C116 (4Pin, White)	W/H Eng - W/H Floor	Inside Fuse & Relay Box	ABS, ESP, TPMS
C201 (20Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C205 (2Pin, Yellow)	W/H Main - W/H A/Bag	Driver Cowl Side C/Holder	Curtain A/Bag
C205 (6Pin, Yellow)	W/H Main - W/H A/Bag	Driver Cowl Side C/Holder	C/Holder
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C208 (4Pin, Colorless)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C211 (2Pin, Yellow)	W/H Main - W/H A/Bag	Passenger Cowl Side C/Holder	Curtain A/Bag
C211 (6Pin, Yellow)	W/H Main - W/H A/Bag	Passenger Cowl Side C/Holder	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C215 (20Pin, Brown)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C301 (39Pin, Black)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/ Memory
C301 (6Pin, White)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/O Memory
C302 (6Pin, White)	W/H Floor - W/H Passenger Seat	Under the Passenger Seat	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” Pillar	
C371 (11Pin, White)	W/H Floor - W/H RR LH DR	Under the LH “B” Pillar	
C381 (11Pin, White)	W/H Floor - W/H RR RH DR	Under the RH “B” Pillar	
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
C402 (6Pin, Black)	W/H Floor - W/H Trailer	Under RH Bumper	
C901 (16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	4-A/T, 6-A/T
C901 (12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	5-A/T
C901 (4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C901A (12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	6-A/T
C902 (4Pin, Black)	W/H Floor - W/H Fuel Sender	Upper the T/M	
C903 (15Pin, Black)	W/H Floor - W/H EAS	Lower the Passenger	
C904 (8Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	
C905 (12Pin, Black)	W/H Floor - W/H EPB	Under LH Bumper	
C906 (4Pin, Black)	W/H Floor - W/H EAS Sensor	Under LH Bumper	
C907 (4Pin, Black)	W/H Floor - W/H EAS Sensor	Under RH Bumper	

Modification basis	
Application basis	
Affected VIN	

▶ GROUND

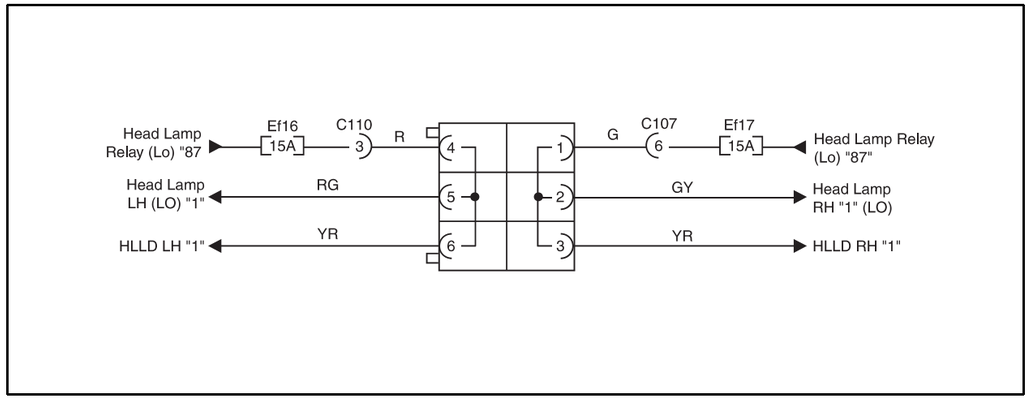
Connector Number	Connecting Wiring Harness	Connector Position	Remark
G101	W/H Floor	ABS/ESP Modulator	ABS/ESP
G102	W/H Eng Room	Behind LH Head Lamp	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	GSL 2.3, DSL M/T
G104	W/H Eng Room	Behind RH Head Lamp	
G106	W/H Eng Room	RH Fender PNL (Beside C113)	GSL
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G202	W/H Main	Under the Driver “A” Pillar	
G203	W/H Main	Beside A/Bag Unit	A/Bag
G204	W/H Main	Backside TGS Lever Unit	
G205	W/H Main	RH Eng ECU	ECU
G206	W/H Main	LH Eng ECU	PTC
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Passenger Seat	
G303	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G304	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
G305	W/H Floor	Passenger QTR PNL	Audio
G401	W/H T/Gate	Center the T/Gate	
G402	W/H Floor	Upper the RH T/Gate	
G403	W/H Floor	Upper the LH T/Gate	

▶ SPLICE PACK

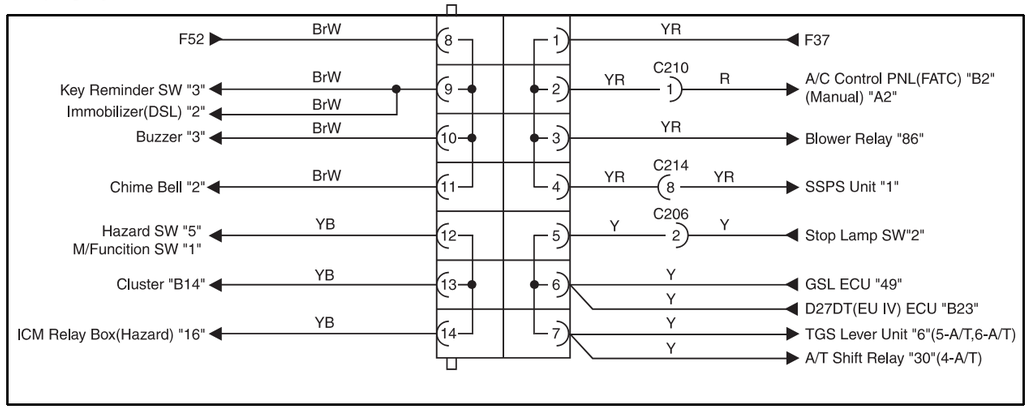
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
S101 (6Pin, Black)	W/H Eng	Inside the Eng Room Fuse & Relay Box	Head Lamp
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

4) SPLICE PACK CIRCUIT

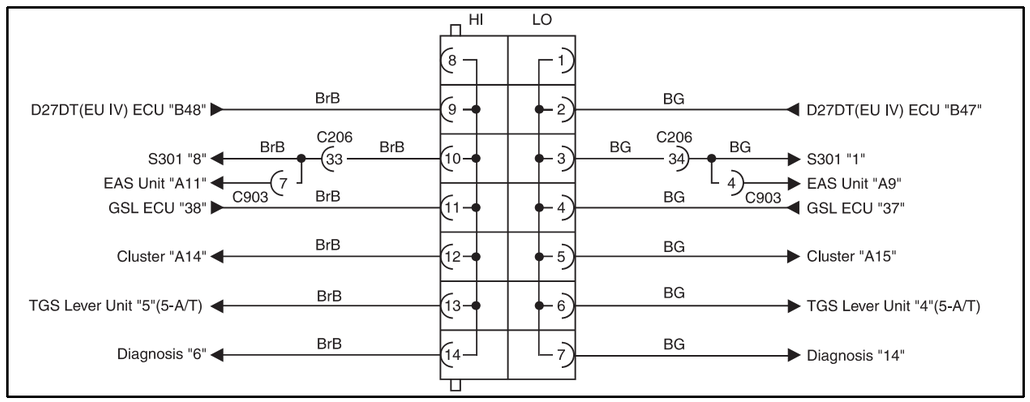
▶ S101



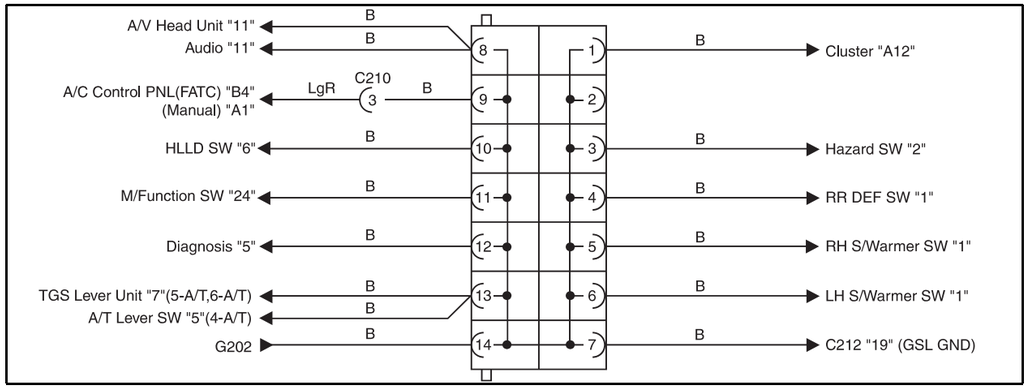
▶ S201



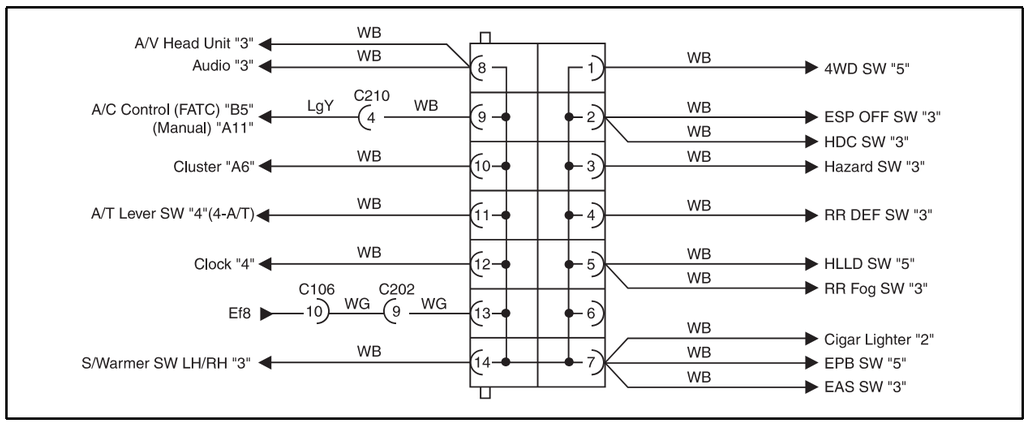
▶ S202 (CAN)



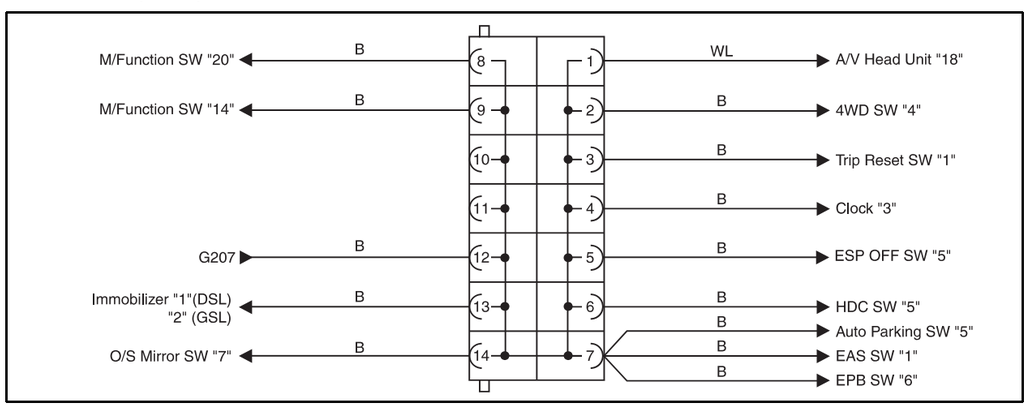
▶ S203 (GND)



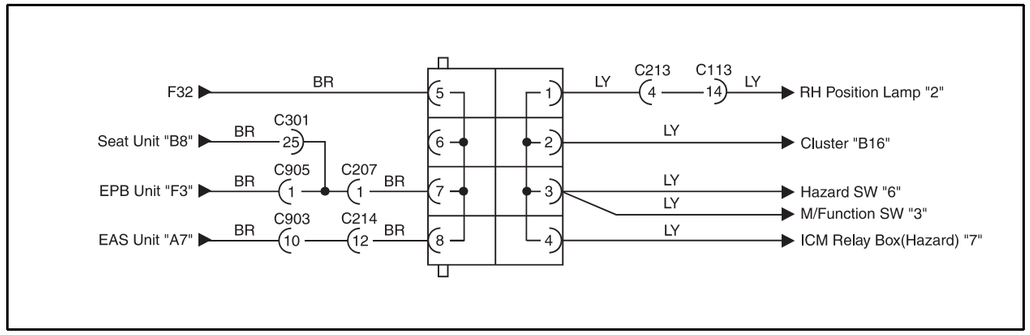
▶ S204 (ILL+)



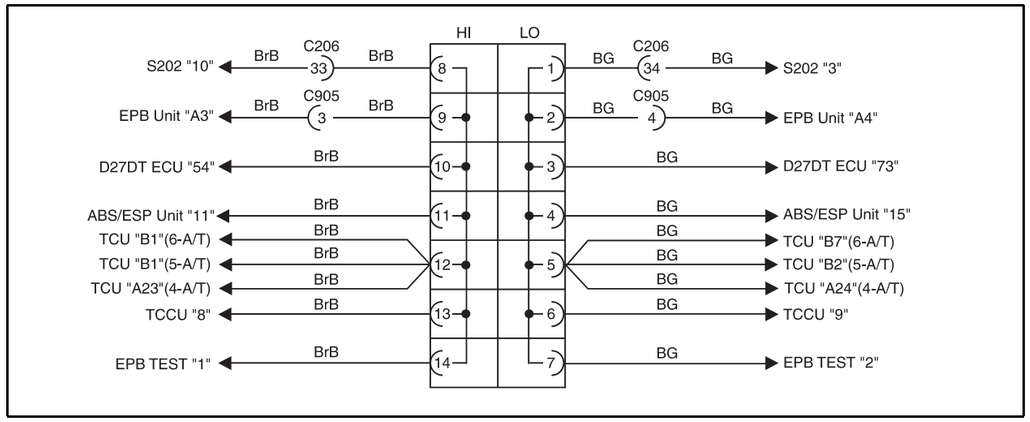
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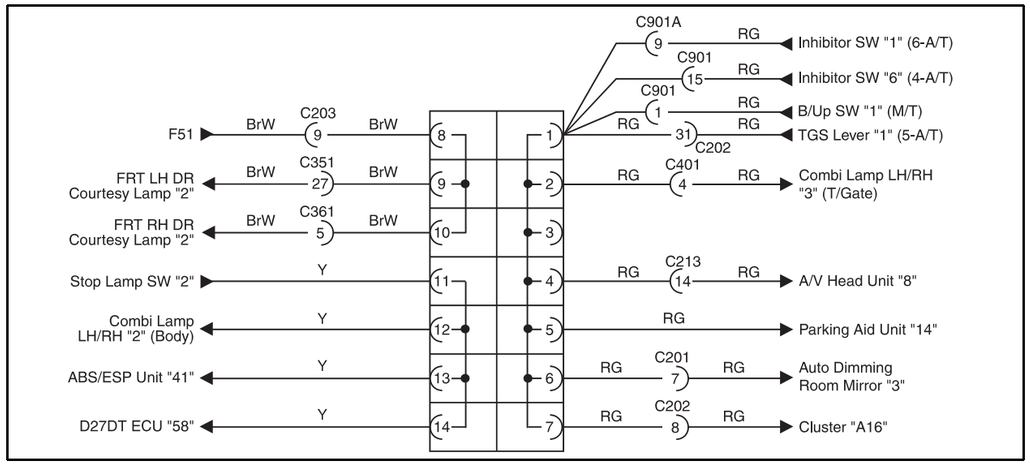
▶ S206



▶ S301 (CAN)



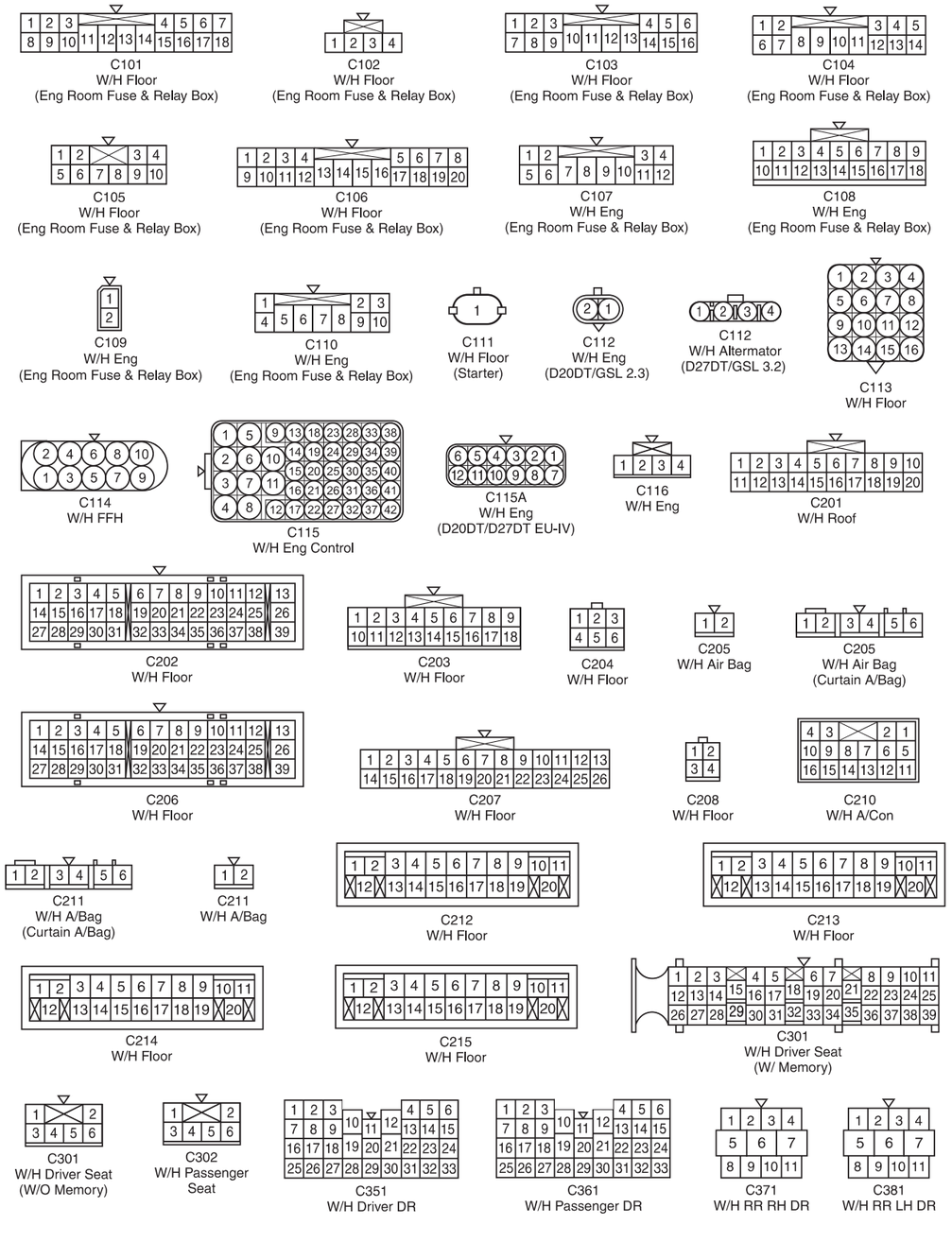
▶ S302



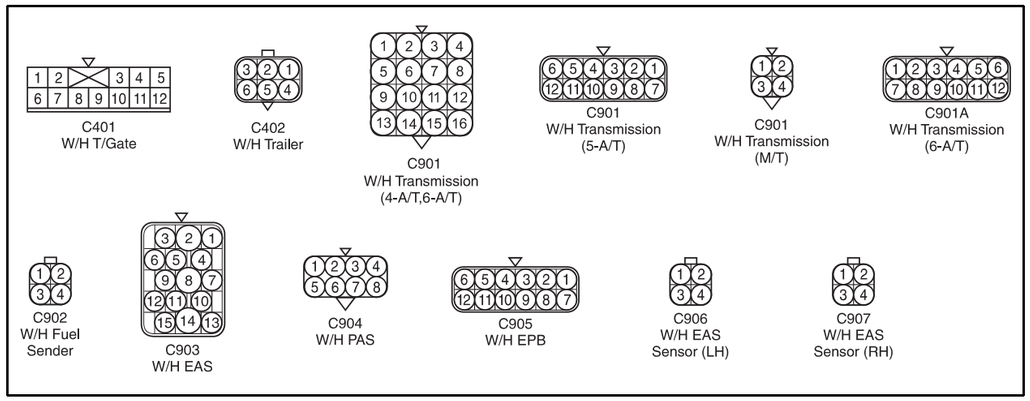
Modification basis	
Application basis	
Affected VIN	

5) CONNECTOR

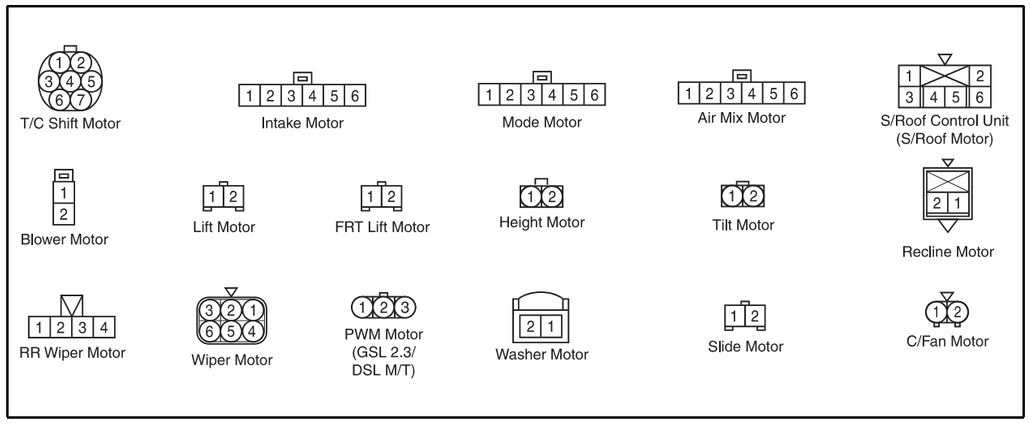
▶ WIRNING CONNECTOR



▶ WIRNING CONNECTOR

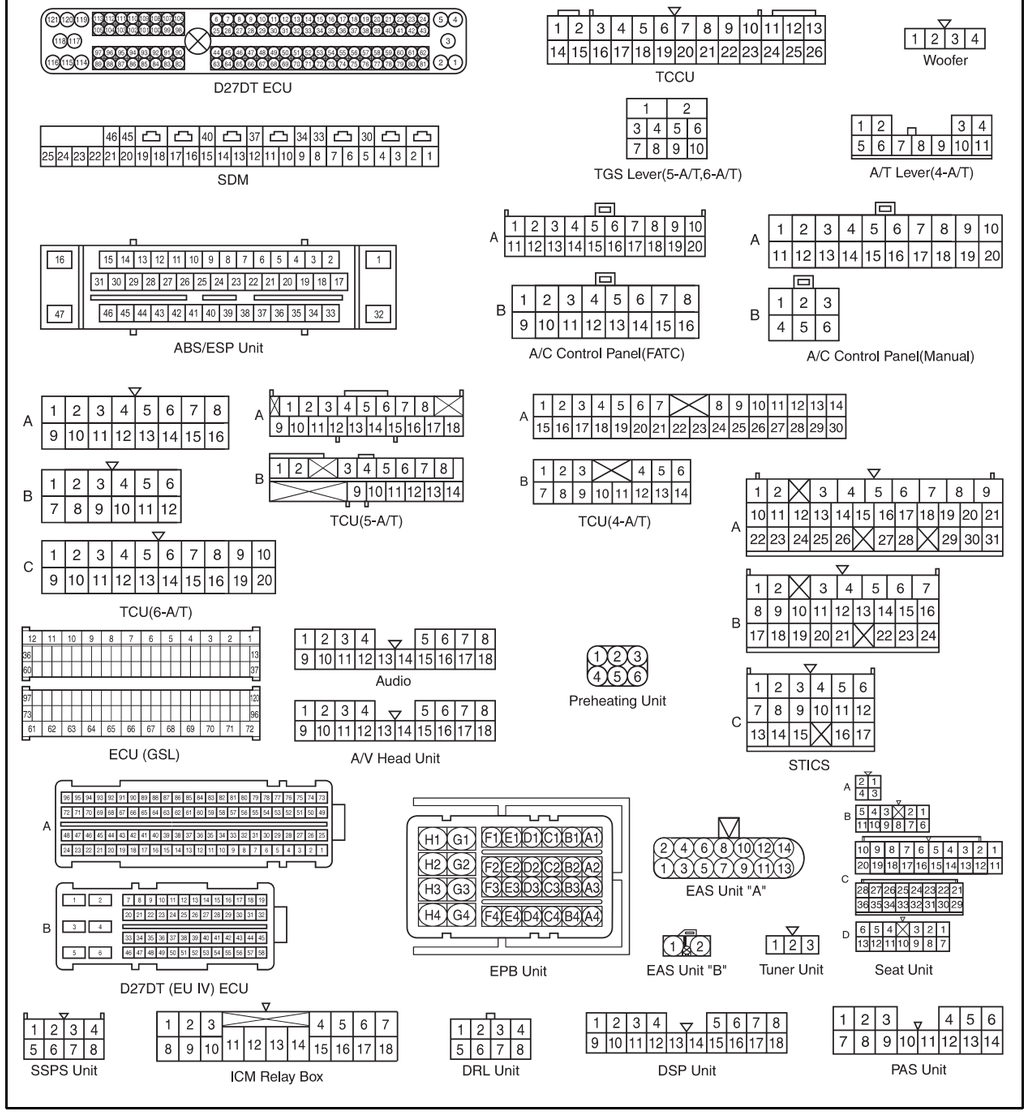


▶ MODE CONNECTOR

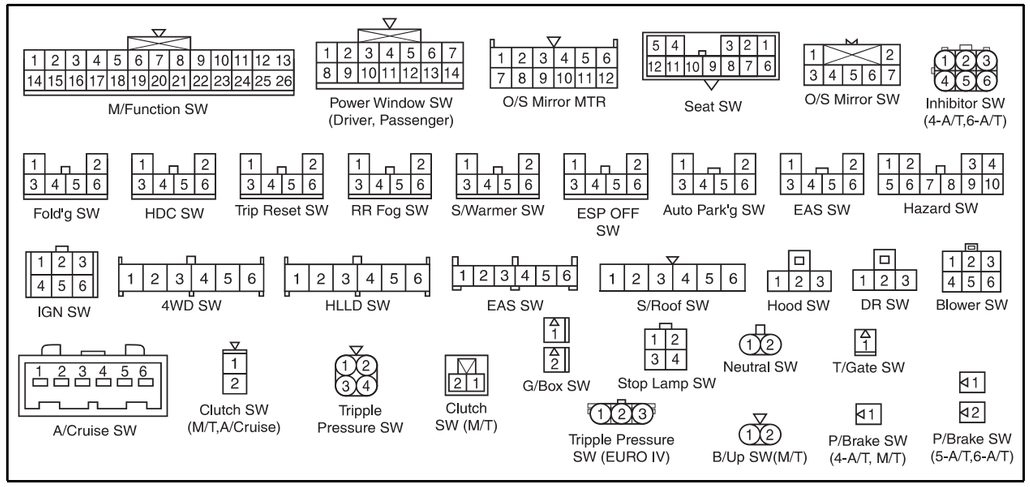


Modification basis	
Application basis	
Affected VIN	

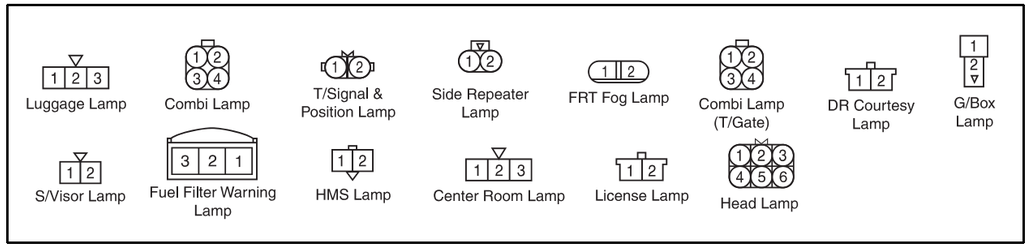
▶ UNIT CONNECTOR



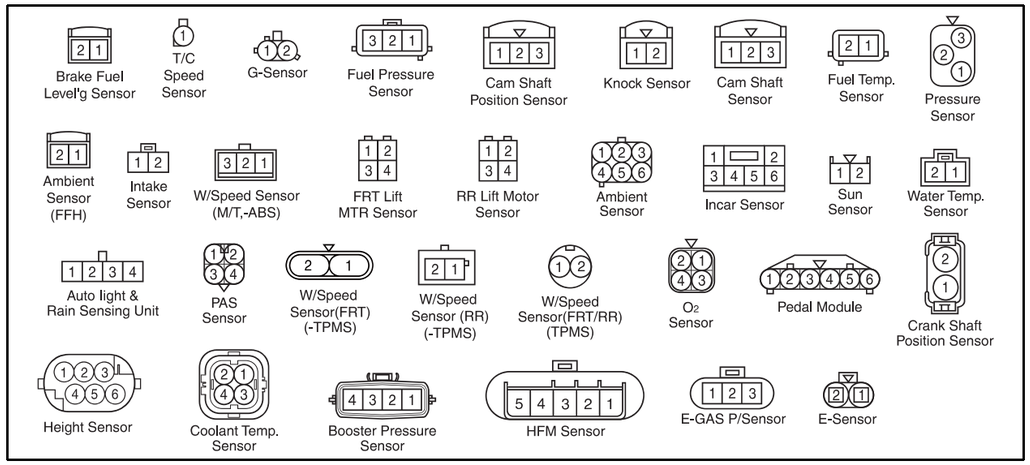
▶ SWITCH CONNECTOR



▶ LAMP CONNECTOR

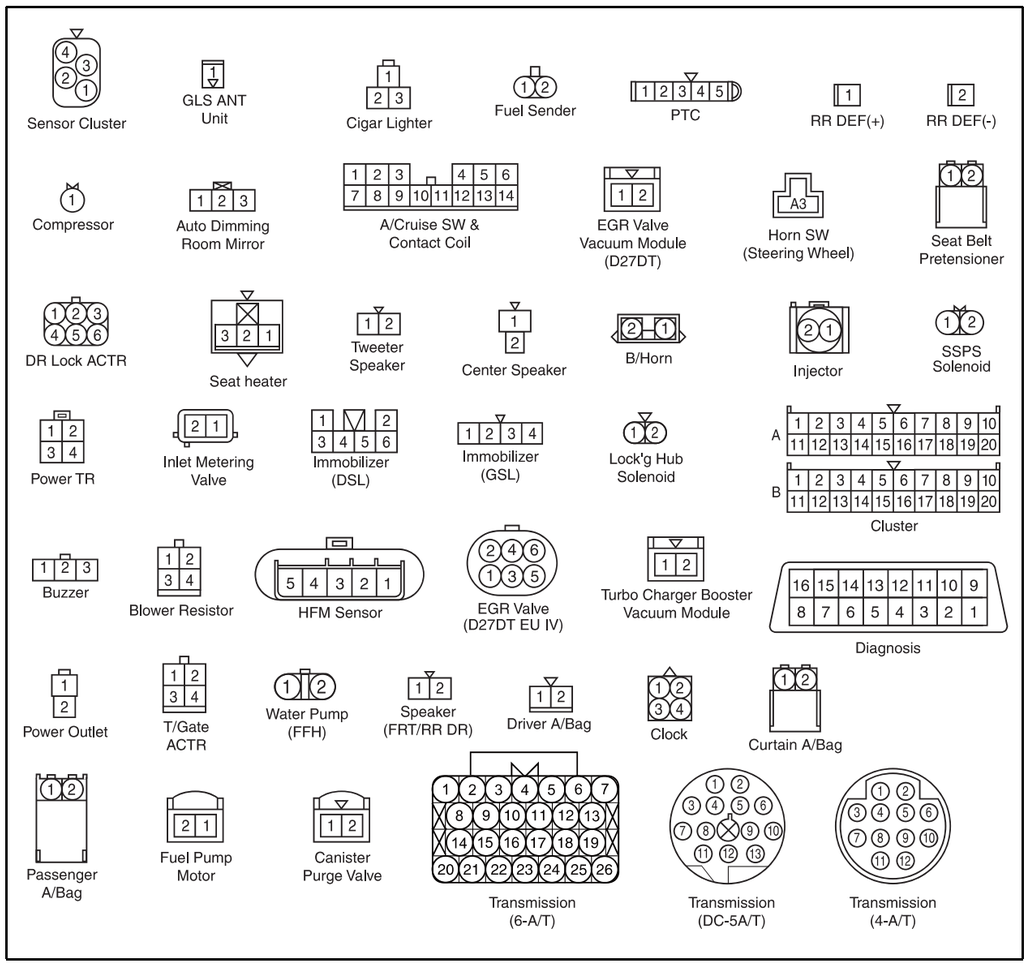


▶ SENSOR CONNECTOR



Modification basis	
Application basis	
Affected VIN	

▶ **ETC.**



Modification basis	
Application basis	
Affected VIN	

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POWER DISTRIBUTION

8410-02/8410-04/8401-06

FUSE/RELAY

8210-00 ENGINE ROOM FUSE / RELAY BOX..... 3
8410-00 I/P - LH FUSE / RELAY BOX..... 5
8401-00 I/P - RH FUSE / RELAY BOX..... 6

ELECTRICITY DIVIDE

8210-00 ENGINE ROOM FUSE / RELAY BOX CIRCUIT..... 7
8410-00 I/P - LH FUSE / RELAY BOX CIRCUIT..... 12
8410-00 I/P - RH FUSE / RELAY BOX CIRCUIT..... 16
8410-00 ICM RELAY BOX CIRCUIT..... 18

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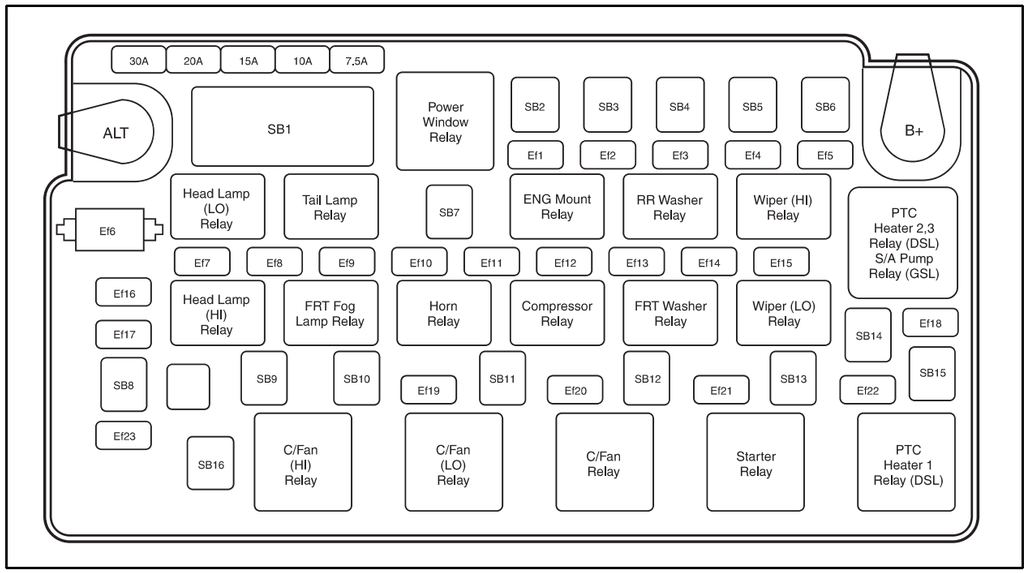
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FUSE / RELAY

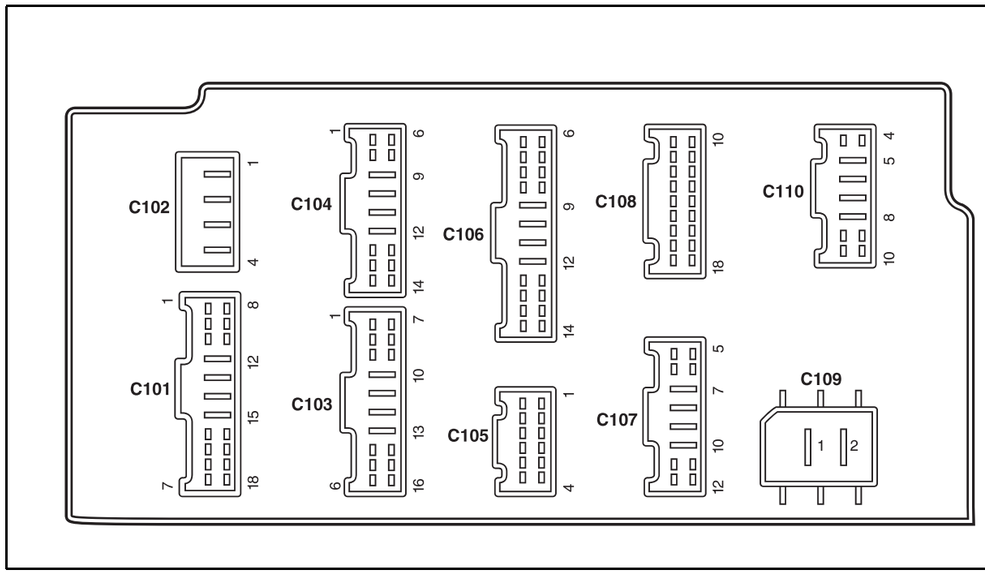
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ENGINE ROOM FUSE / RELAY BOX

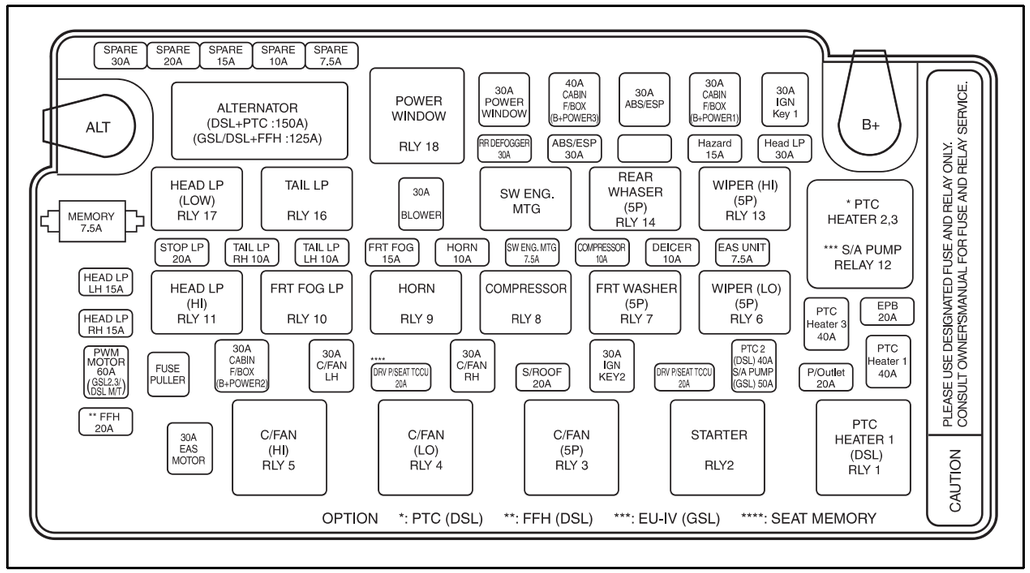
1) UPPER



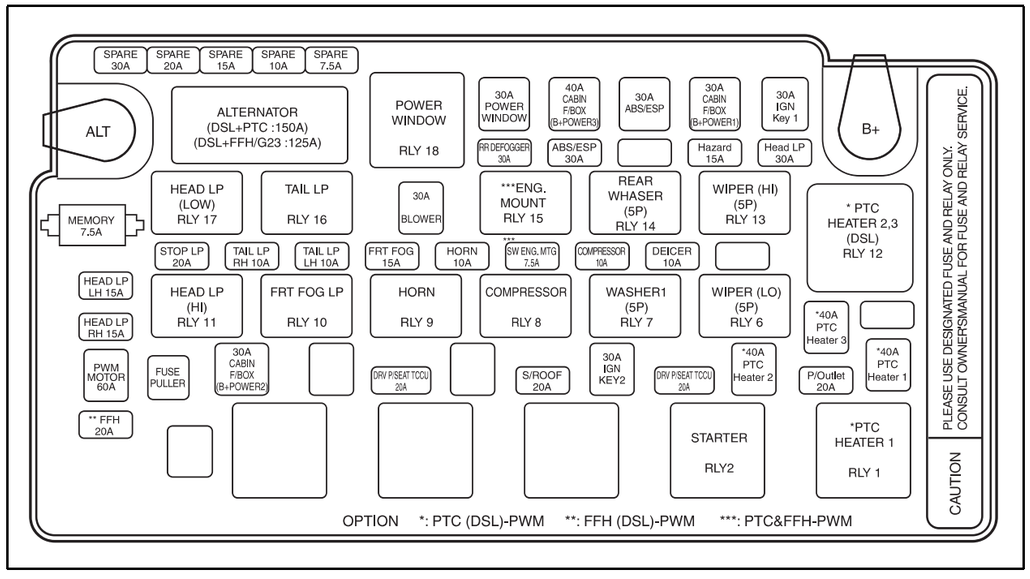
2) LOW



3) ENGINE ROOM FUSE / RELAY BOX



4) ENGINE ROOM FUSE / RELAY BOX (RUSSIA)



Modification basis	
Application basis	
Affected VIN	

5) USAGE OF FUSE IN ENGINE ROOM FUSE BOX

Fuse No.	Capacity	Usage	Fuse No.	Capacity	Usage
SB1	150A/125A	Alternator (PTC/FFH)	Ef4	15A	Hazard
SB2	30A	Power Window	Ef5	30A	Head Lamp
SB3	40A	IP-RH Fuse Box (B+) F65~F71	Ef6	7.5A	Memory
SB4	30A	ABS/ESP	Ef7	20A	Stop Lamp
SB5	30A	IP-LH Fuse Box (B+) F44~F50	Ef8	10A	Tail Lamp (RH)
SB6	30A	IGN Key 1	Ef9	10A	Tail Lamp (LH)
SB7	30A	Blower Motor	Ef10	15A	FRT Fog
SB8	60A	P.W.M Motor (GSL 2.3, DSL M/T)	Ef11	10A	Horn
SB9	30A	IP-LH Fuse Box (B+) F51~F55	Ef12	7.5A	Hub Solenoid
SB10	30A	C/Fan LH	Ef13	10A	Compressor
SB11	30A	C/Fan RH	Ef14	10A	Deicer
SB12	30A	IGN Key 2	Ef15	7.5A	EAS
SB13	40A	P.T.C Heater 2 (DSL)	Ef16	15A	Head Lamp (LH)
	50A	S/Air Pump (GSL)	Ef17	15A	Head Lamp (RH)
SB14	40A	P.T.C Heater 3 (DSL)	Ef18	20A	EPB
SB15	40A	P.T.C Heater 1 (DSL)	Ef19	20A	Driver P/Seat (Memory)
SB16	30A	EAS	Ef20	20A	S/Roof
Ef1	30A	RR Defogger	Ef21	20A	Driver P/Seat
Ef2	30A	ABS/ESP	Ef22	20A	P/Outlet
Ef3	-	-	Ef23	20A	FFH

6) ENGINE ROOM FUSE BOX CONNECTOR NUMBER

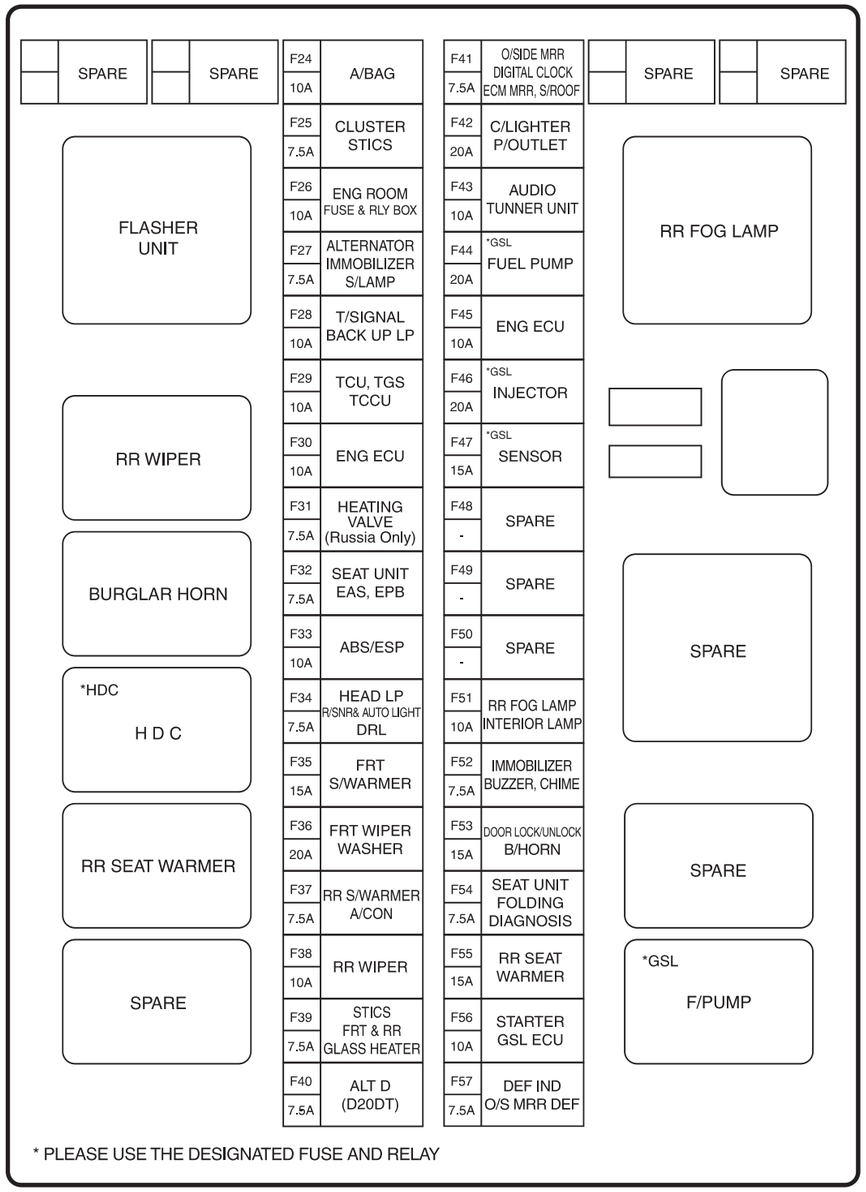
Connector No.	Pin No.	Connector Color
C101	18	White
C102	4	White
C103	16	White
C104	14	White
C105	10	White
C106	20	White
C107	12	White
C108	18	White
C109	2	Black
C110	10	White

Modification basis	
Application basis	
Affected VIN	

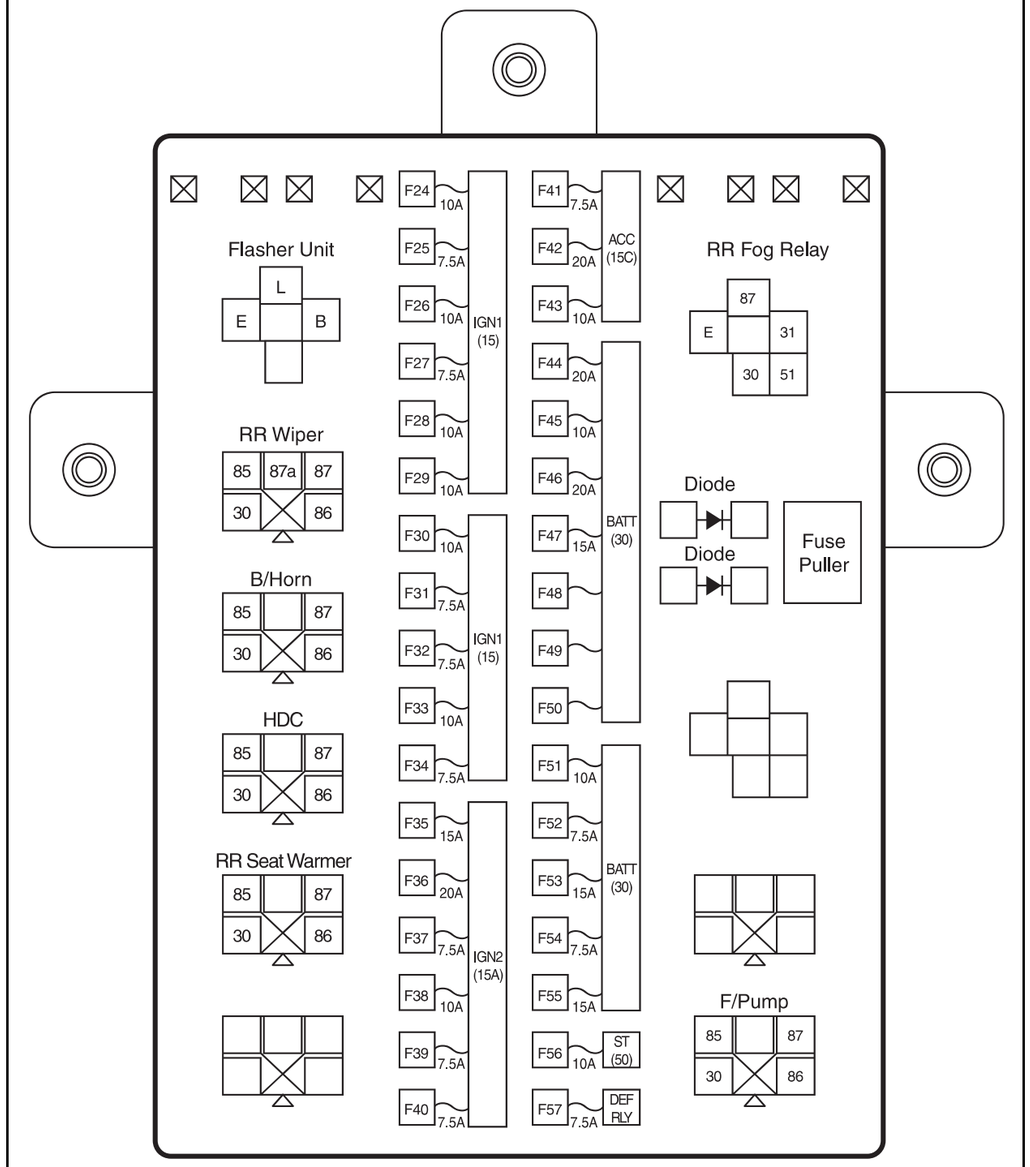
S.G.N. 8410-00

I/P - LH FUSE / RELAY BOX

1) I/P - LH FUSE / RELAY BOX



2) POWER SUPPLY

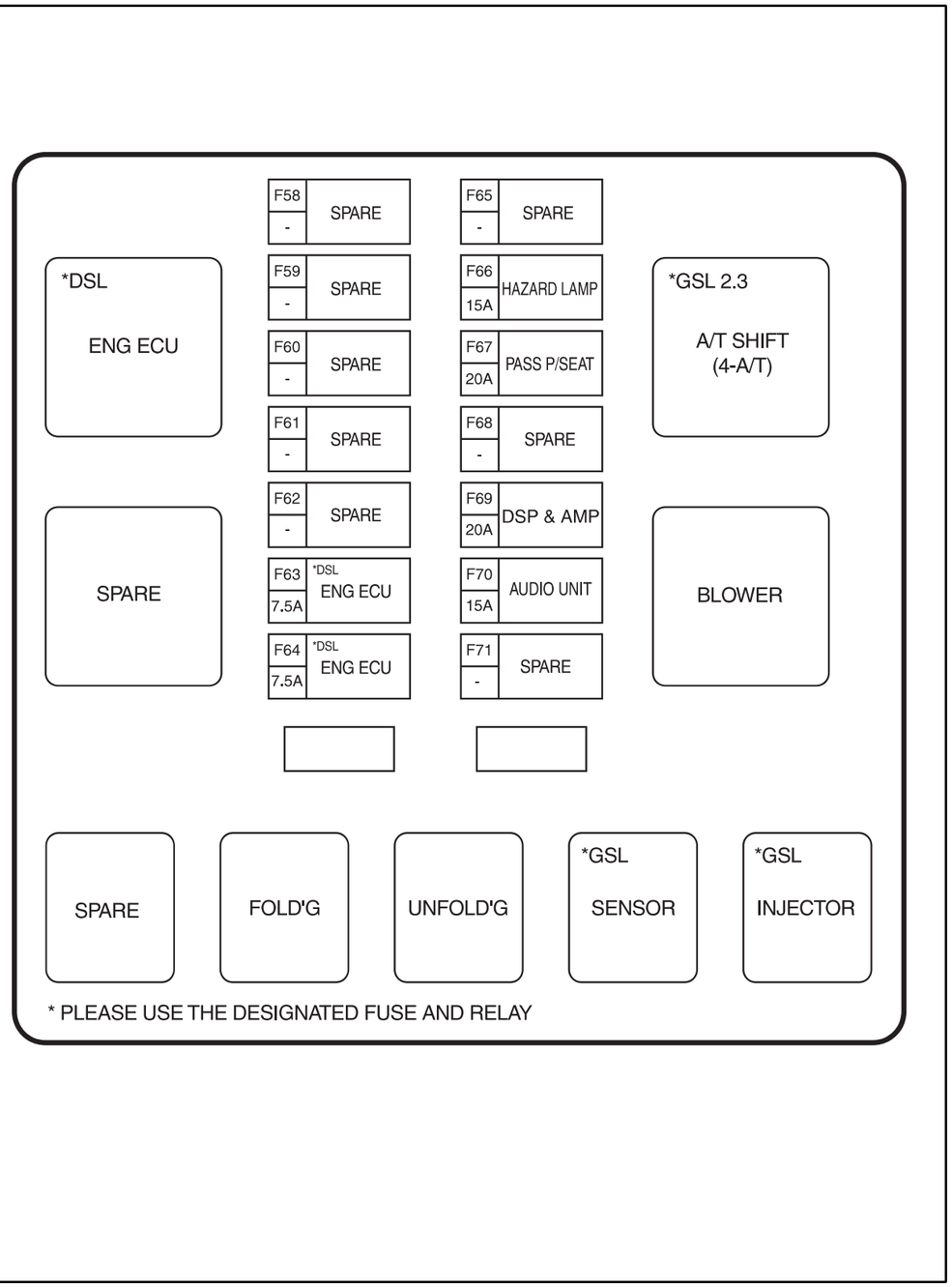


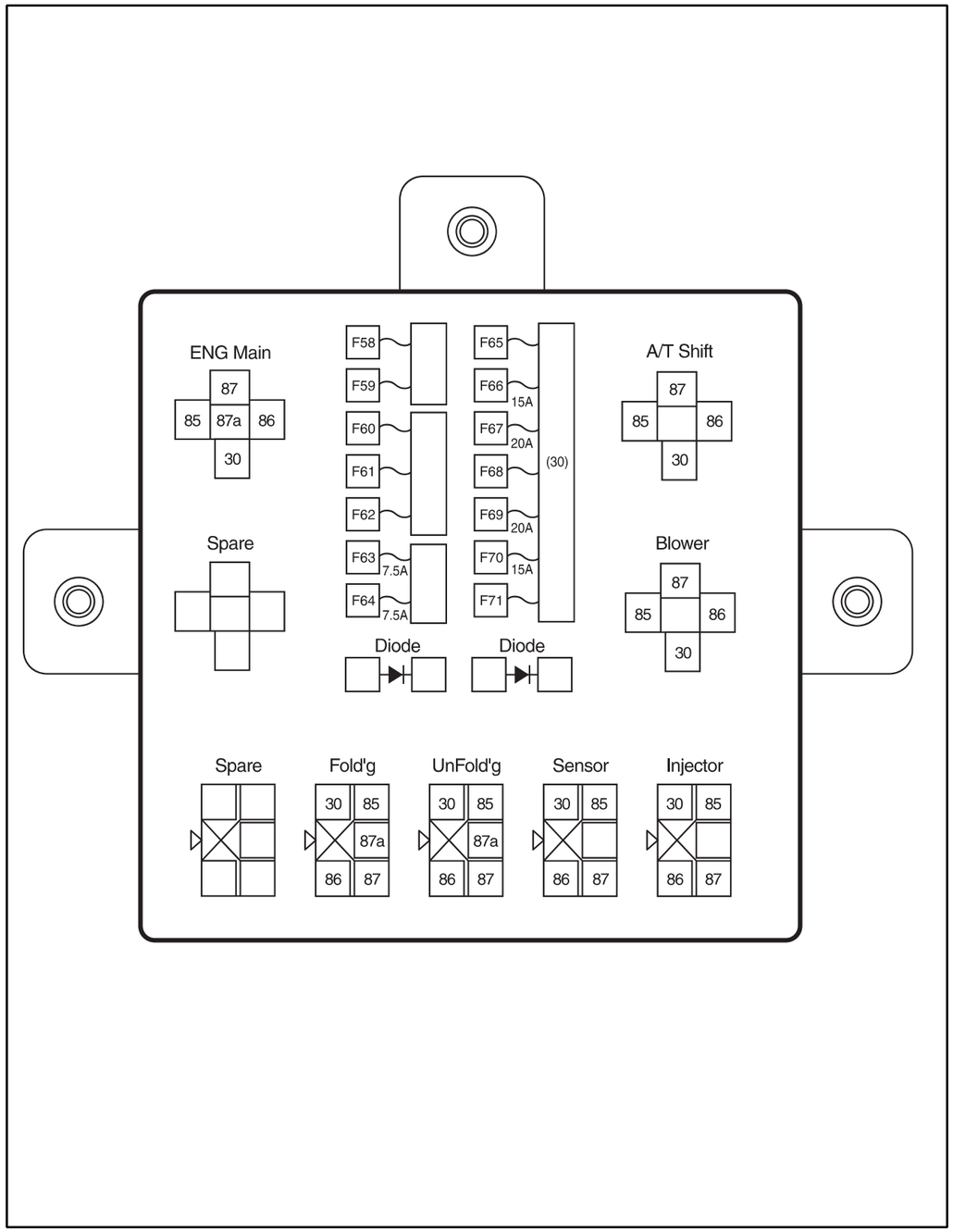
Modification basis	
Application basis	
Affected VIN	

S.G.N. 8410-00

I/P - RH FUSE / RELAY BOX

1) I/P - RH FUSE / RELAY BOX





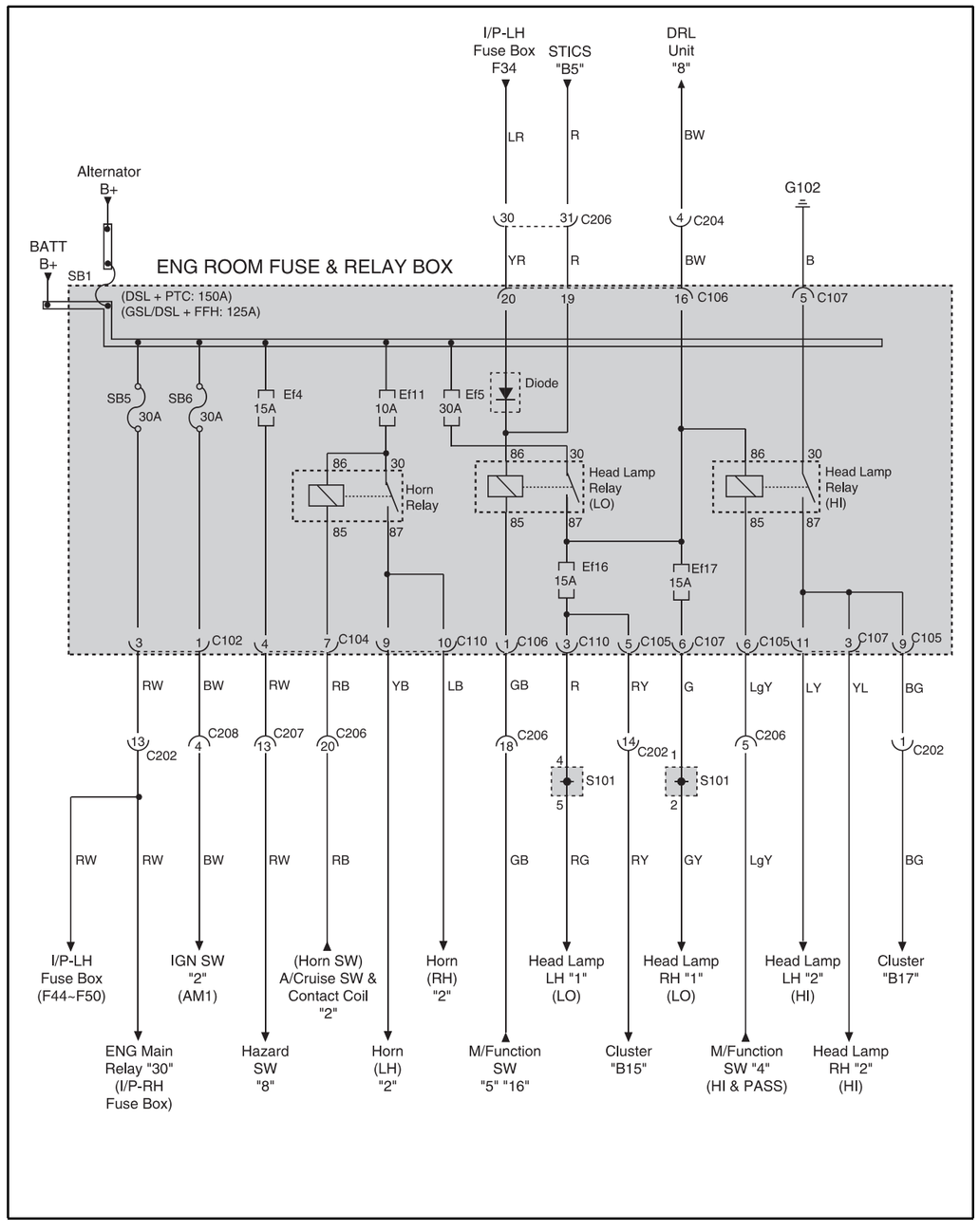
Modification basis	
Application basis	
Affected VIN	

ELECTRICITY DIVIDE

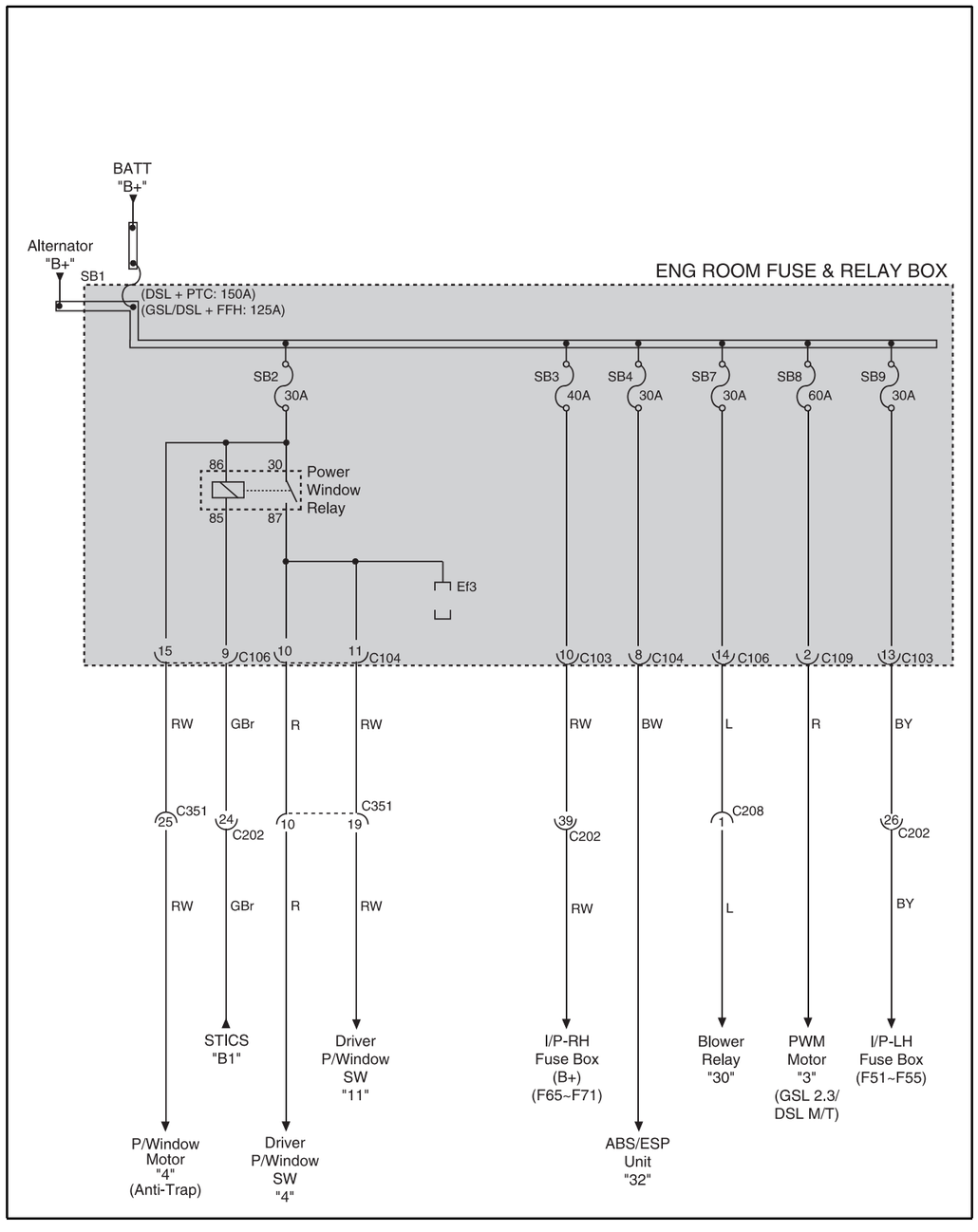
SGN 8210-00

ENGINE ROOM FUSE / RELAY BOX CIRCUIT

1) SB5, SB6, Ef4, Ef5, Ef11, HORN RELAY, HEAD LAMP RELAY (HI, LO)

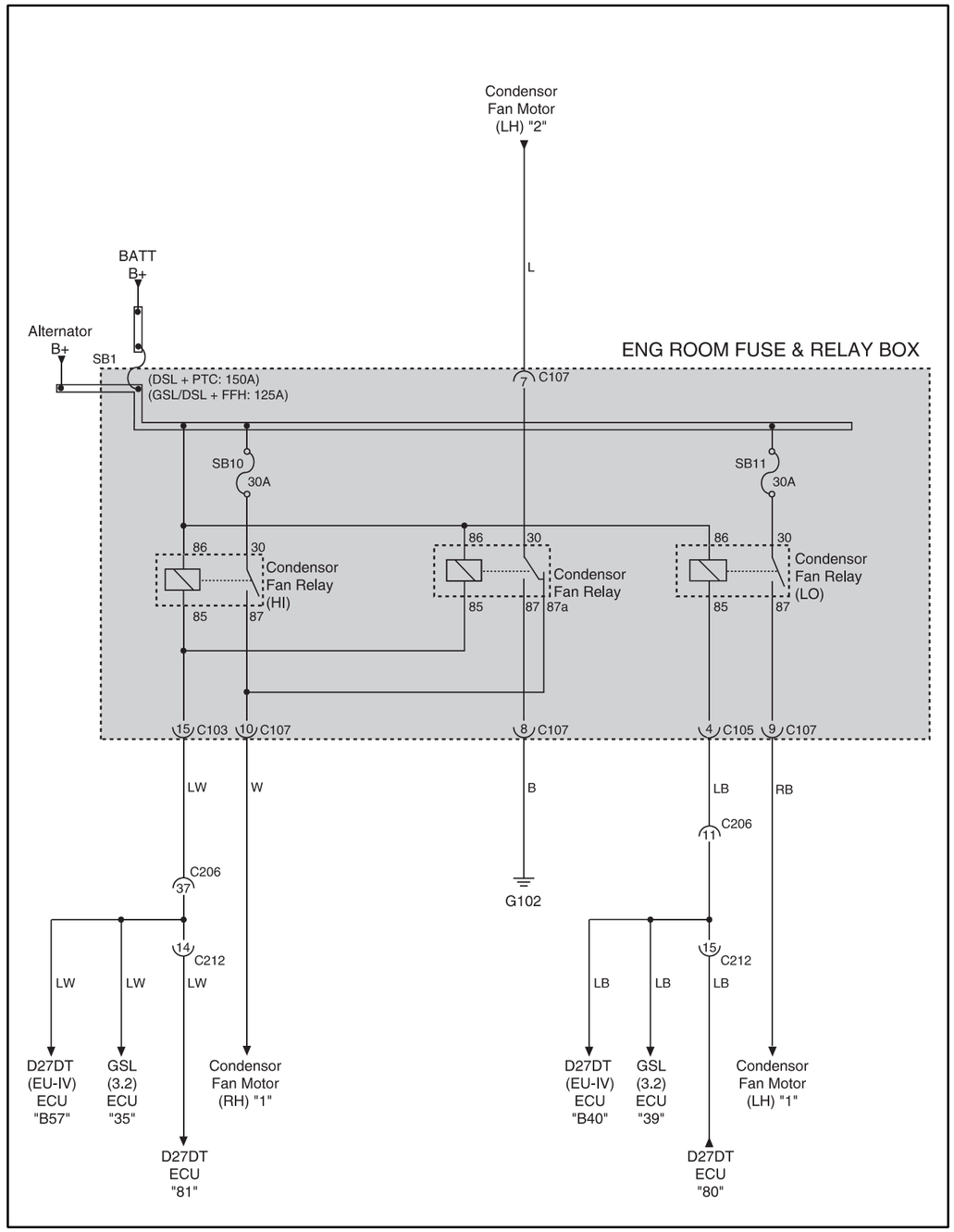


2) SB2 ~ SB4, SB7 ~ SB9, Ef3, P/WINDOW RELAY

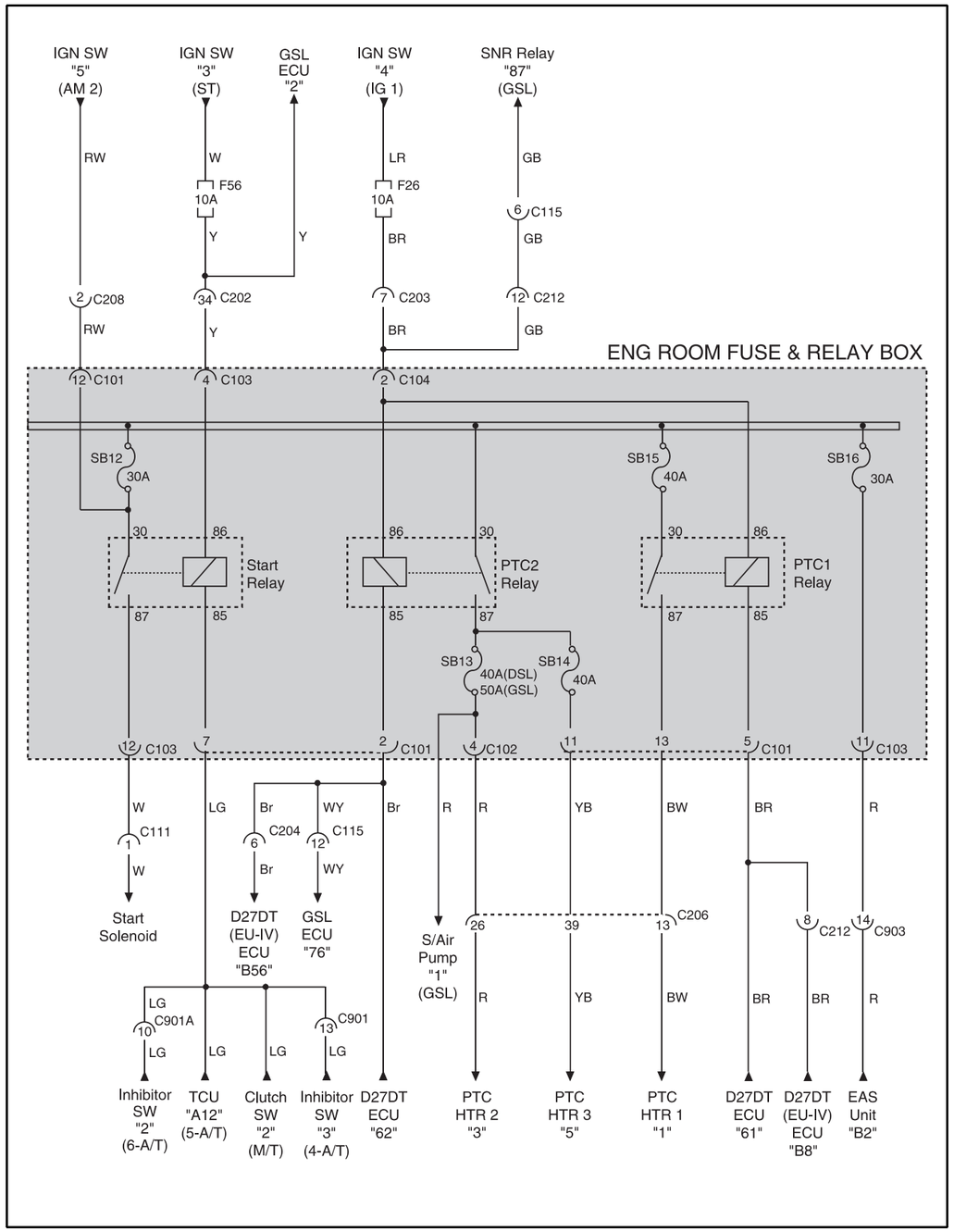


Modification basis	
Application basis	
Affected VIN	

3) SB10 ~ SB11, CONDENSOR FAN RELAY (HI, LO)

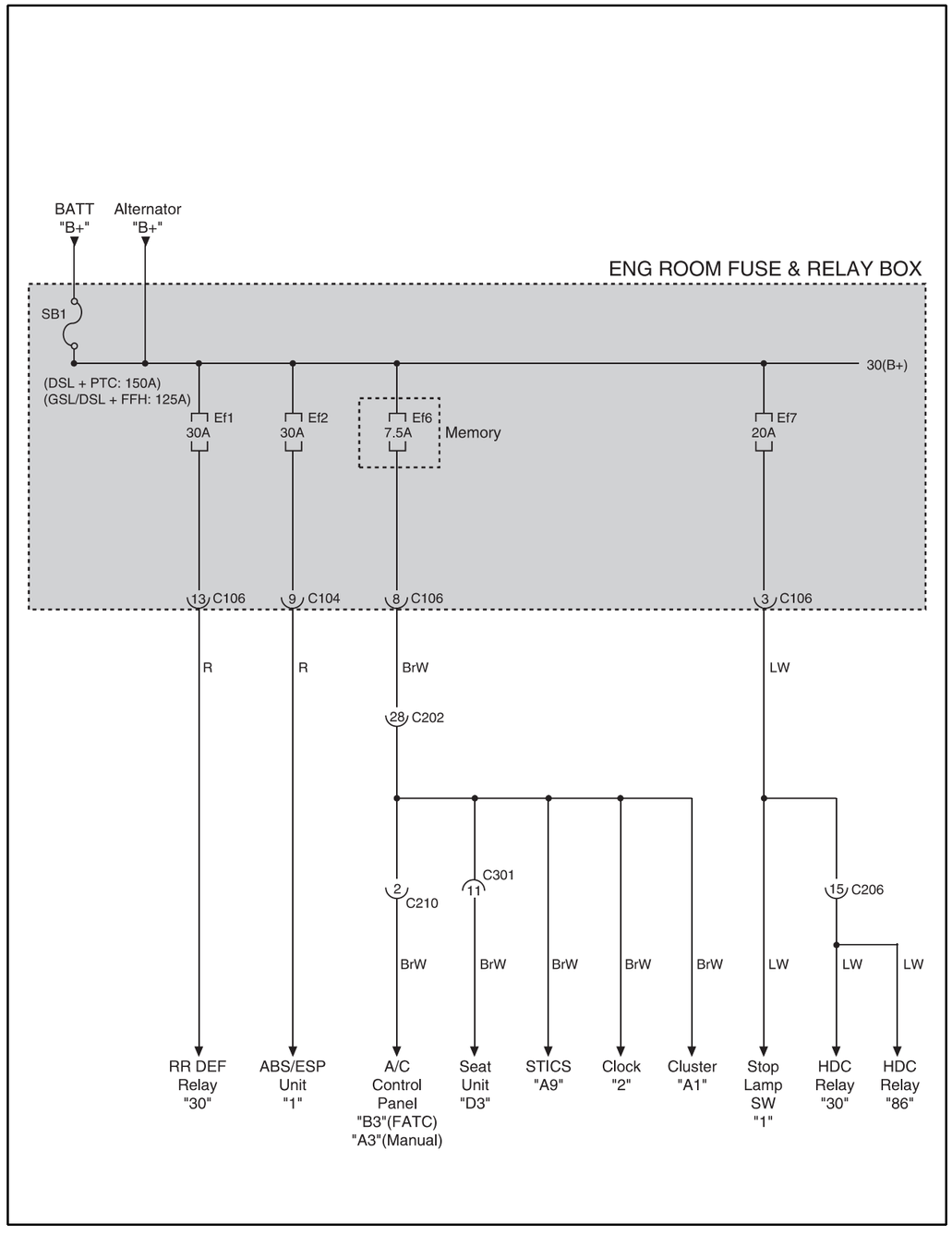


4) SB12 ~ SB16, START RELAY, PTC RELAY

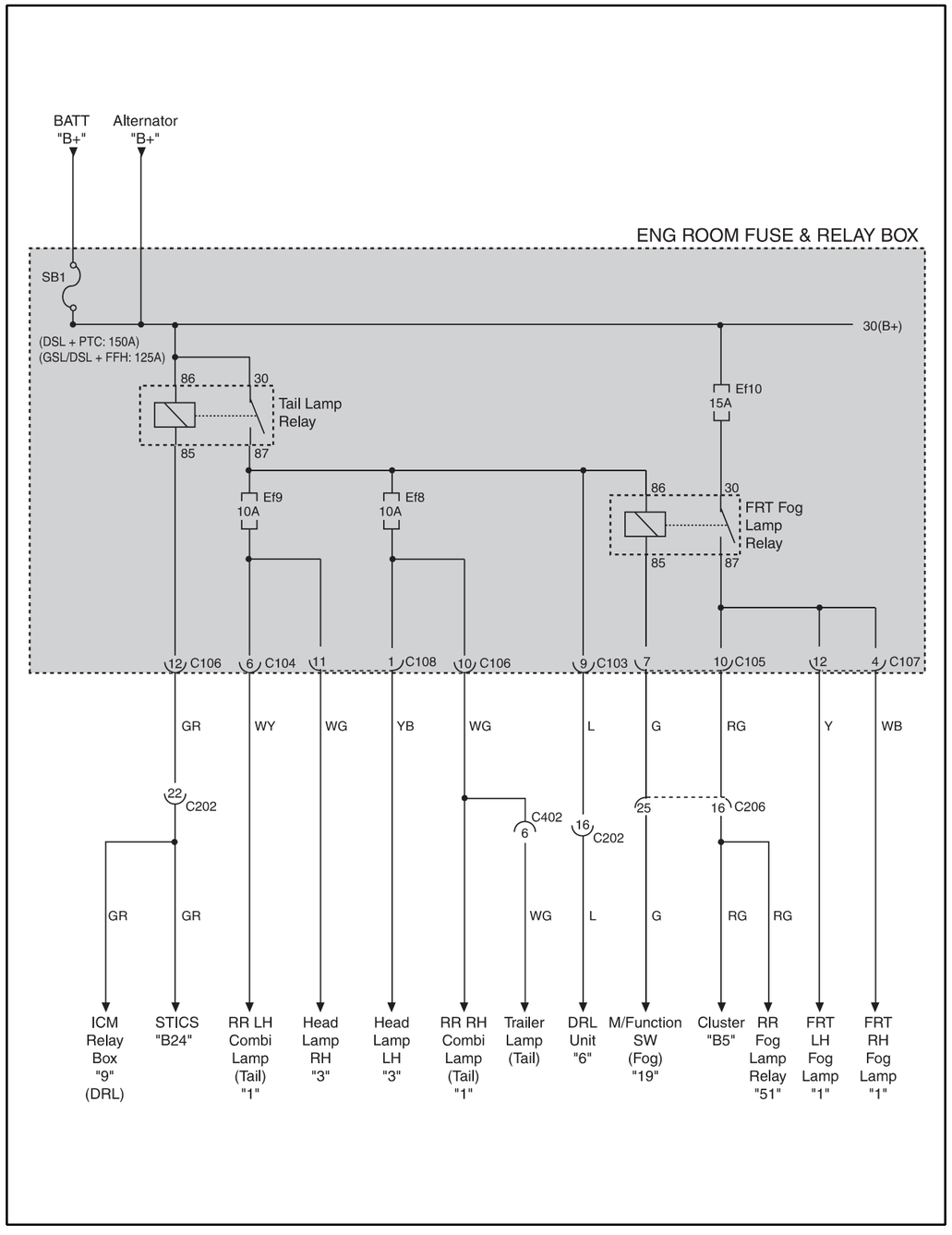


Modification basis	
Application basis	
Affected VIN	

5) Ef1, Ef2, Ef6, Ef7

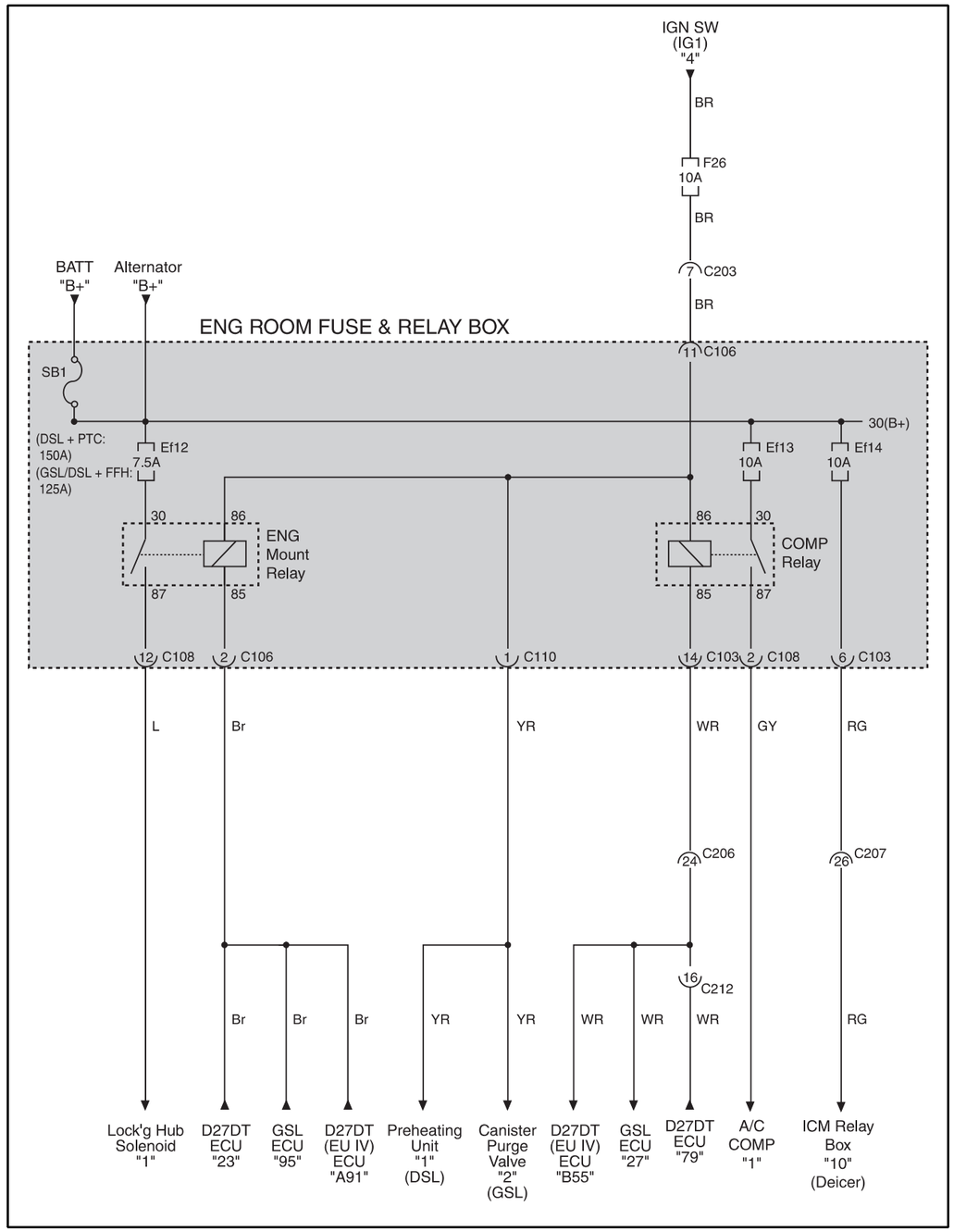


6) Ef8 ~ Ef10, TAIL LAMP RELAY, FRT FOG LAMP RELAY

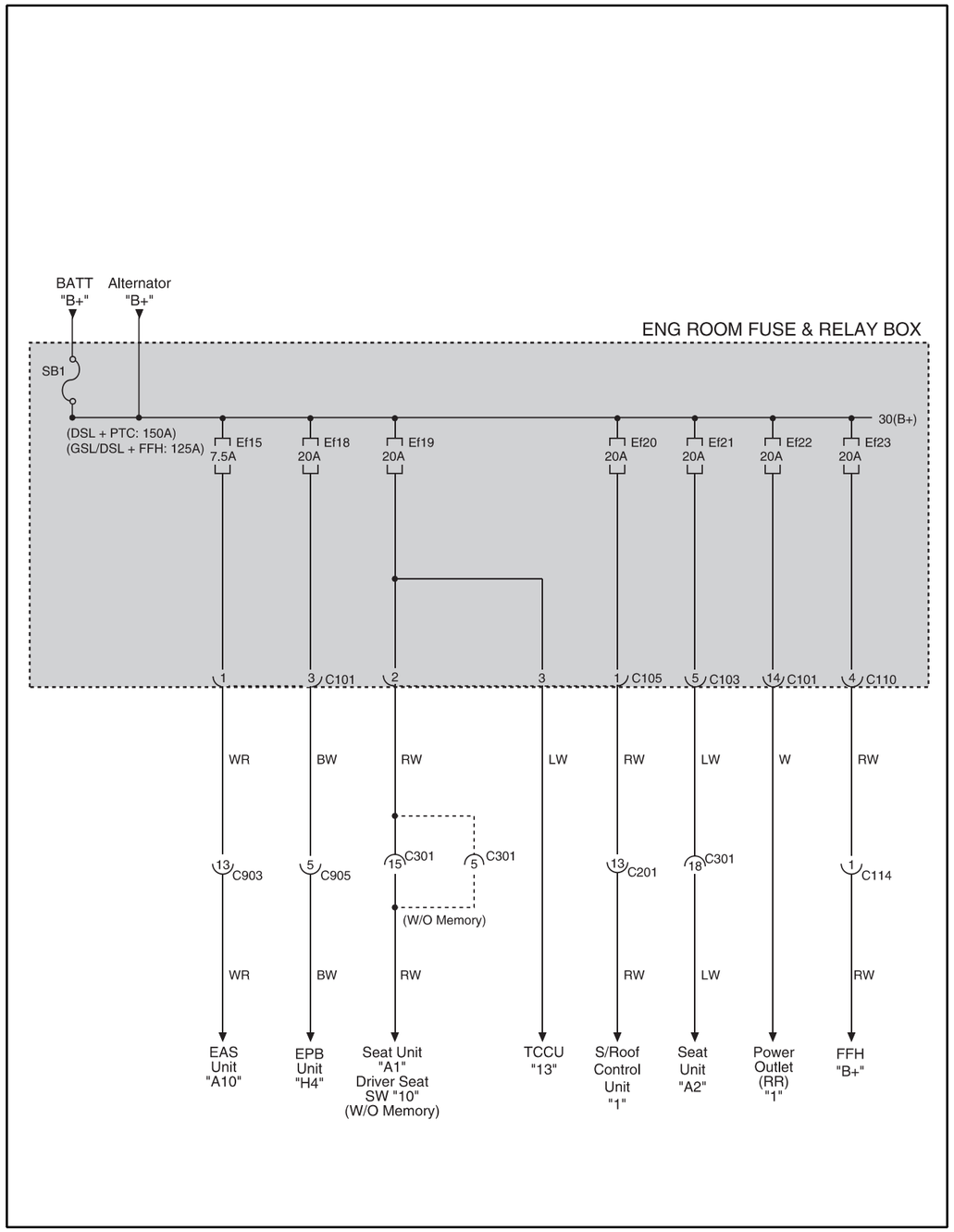


Modification basis	
Application basis	
Affected VIN	

7) Ef12 ~ Ef14, ENG MOUNT RELAY, COMPRESSOR RELAY

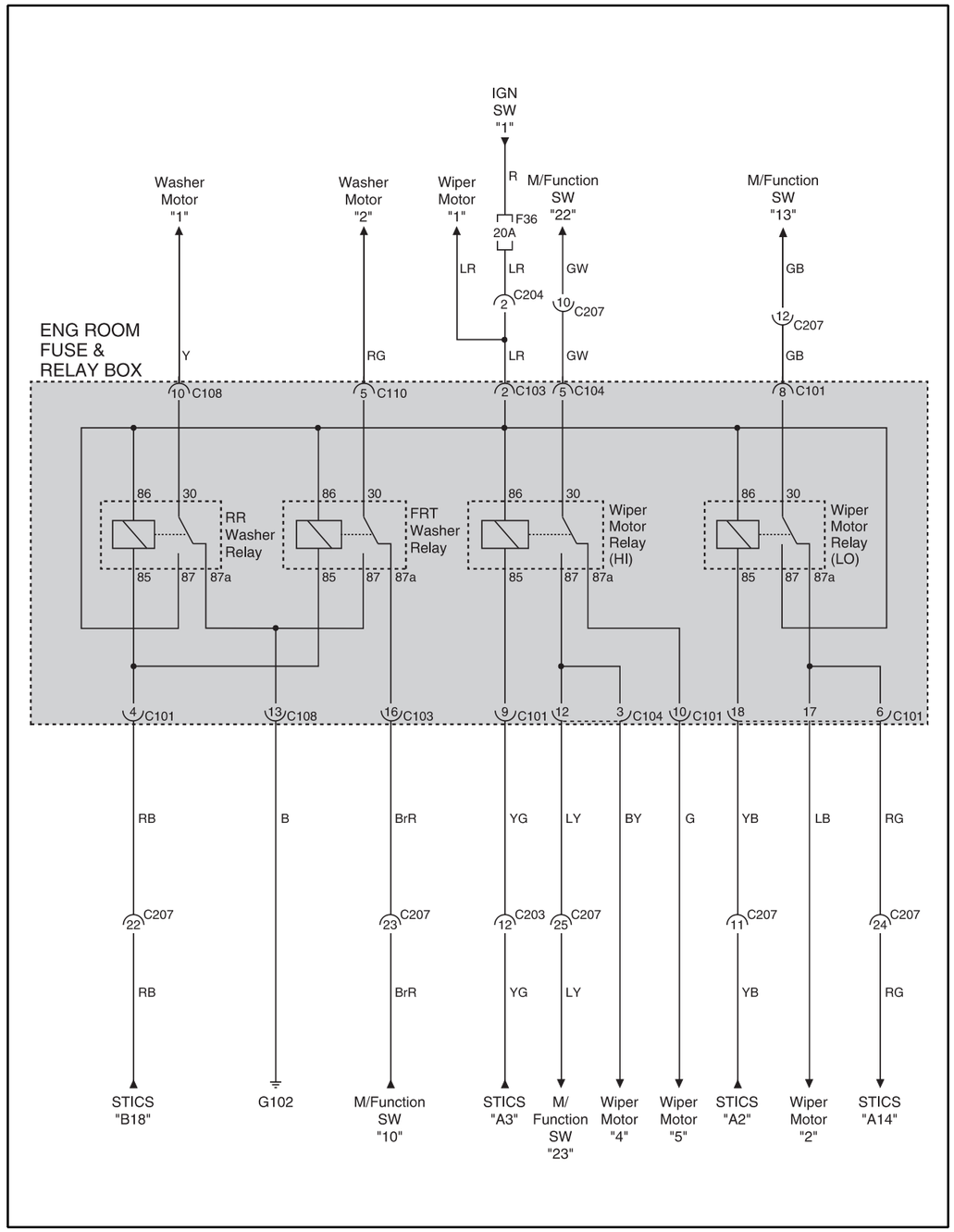


8) Ef15 ~ Ef23



Modification basis	
Application basis	
Affected VIN	

9) WIPER MOTOR RELAY (HI, LO), WASHER RELAY (FRT, RR)

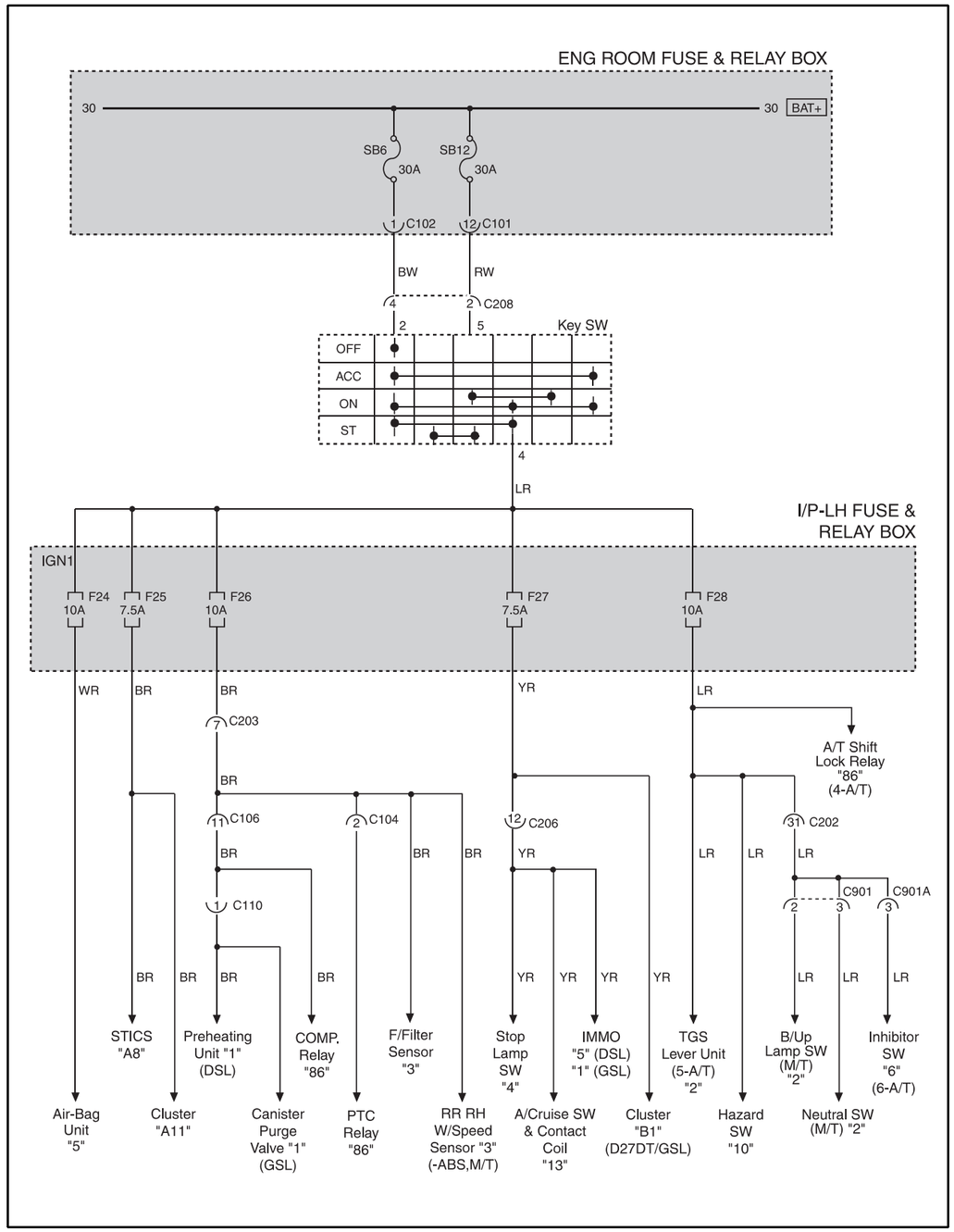


Modification basis	
Application basis	
Affected VIN	

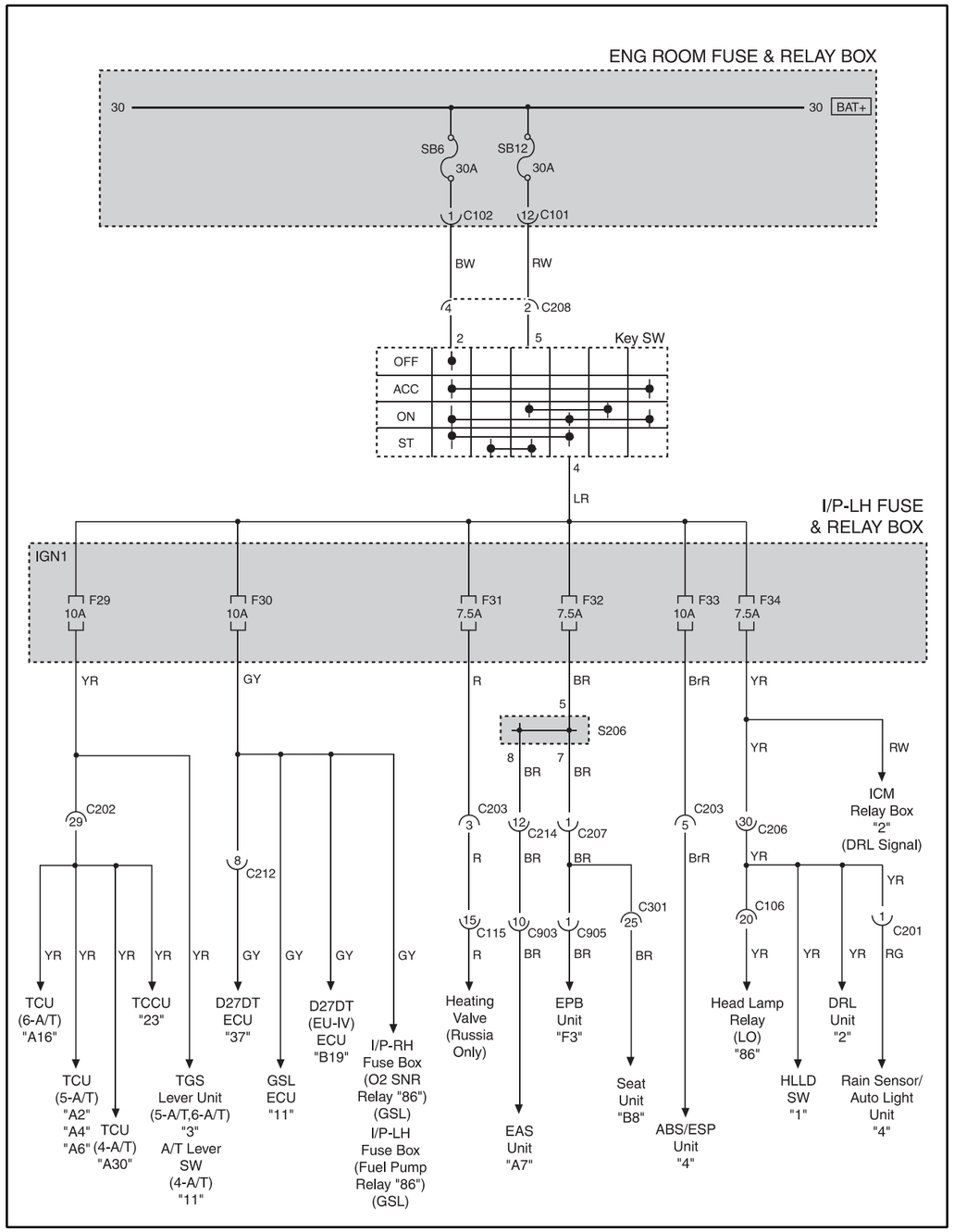
S.G.N. 8410-00

I/P - LH FUSE / RELAY BOX CIRCUIT

1) F24 ~ F28

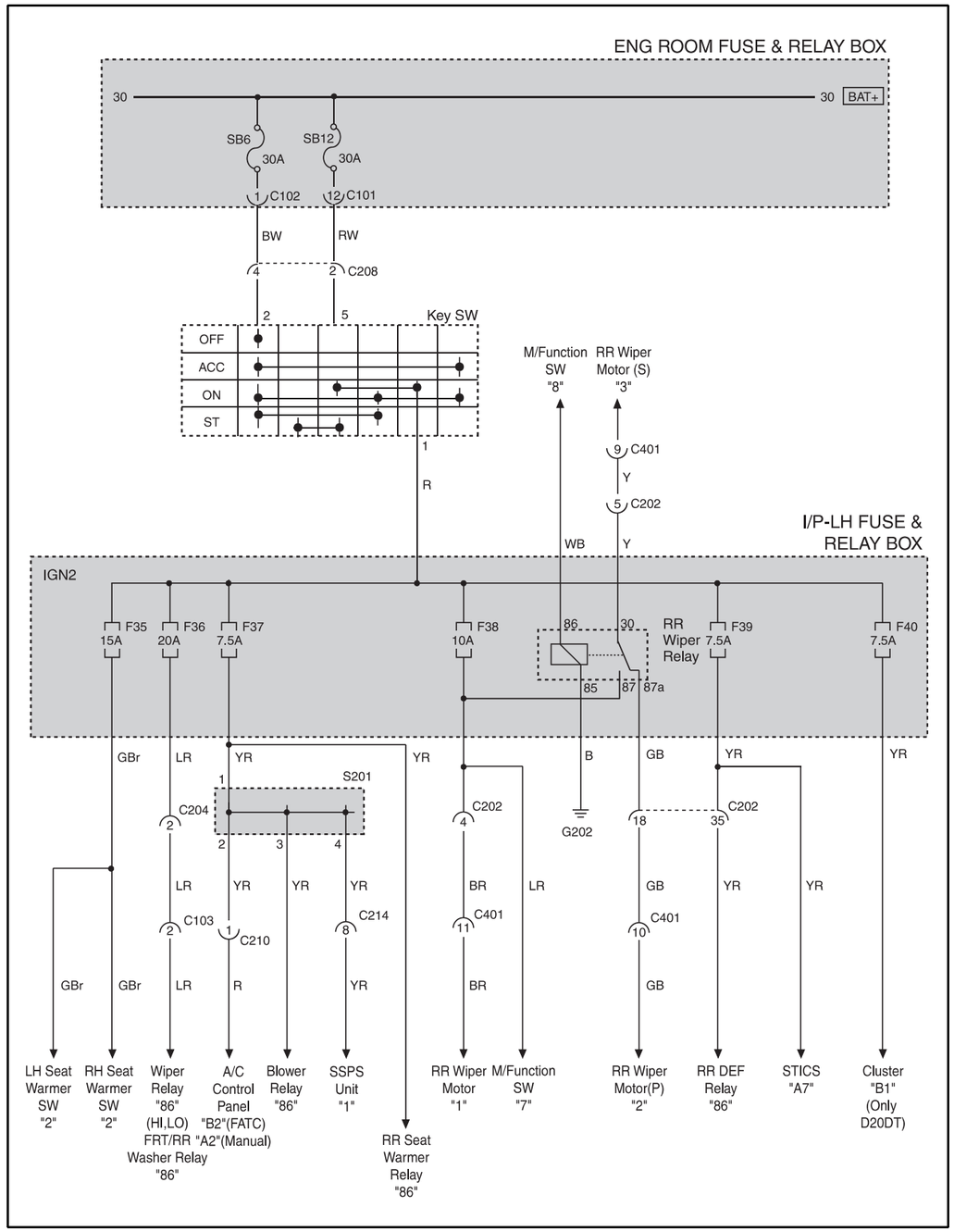


2) F29 ~ F34

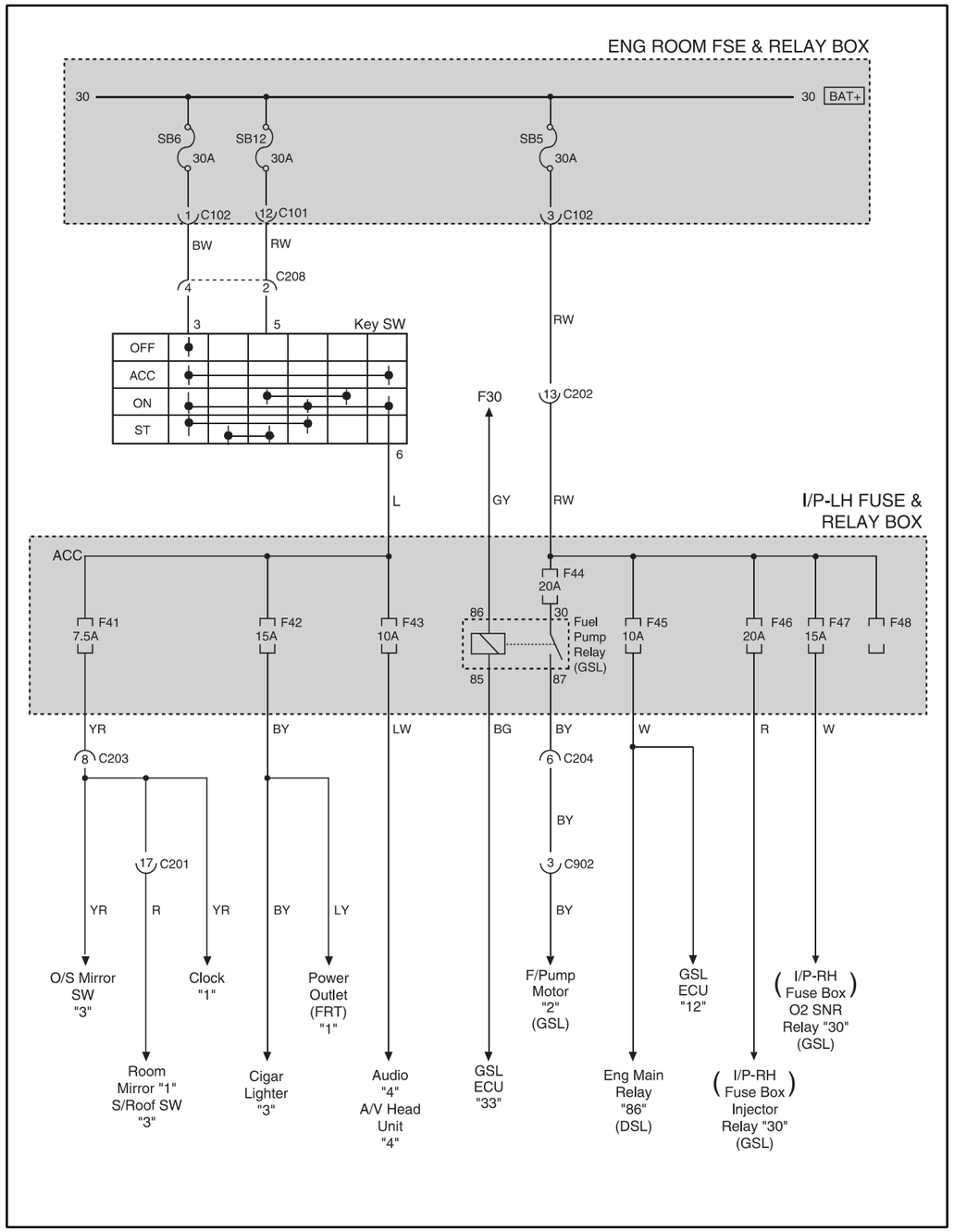


Modification basis	
Application basis	
Affected VIN	

3) F35 ~ F40, RR WIPER RELAY

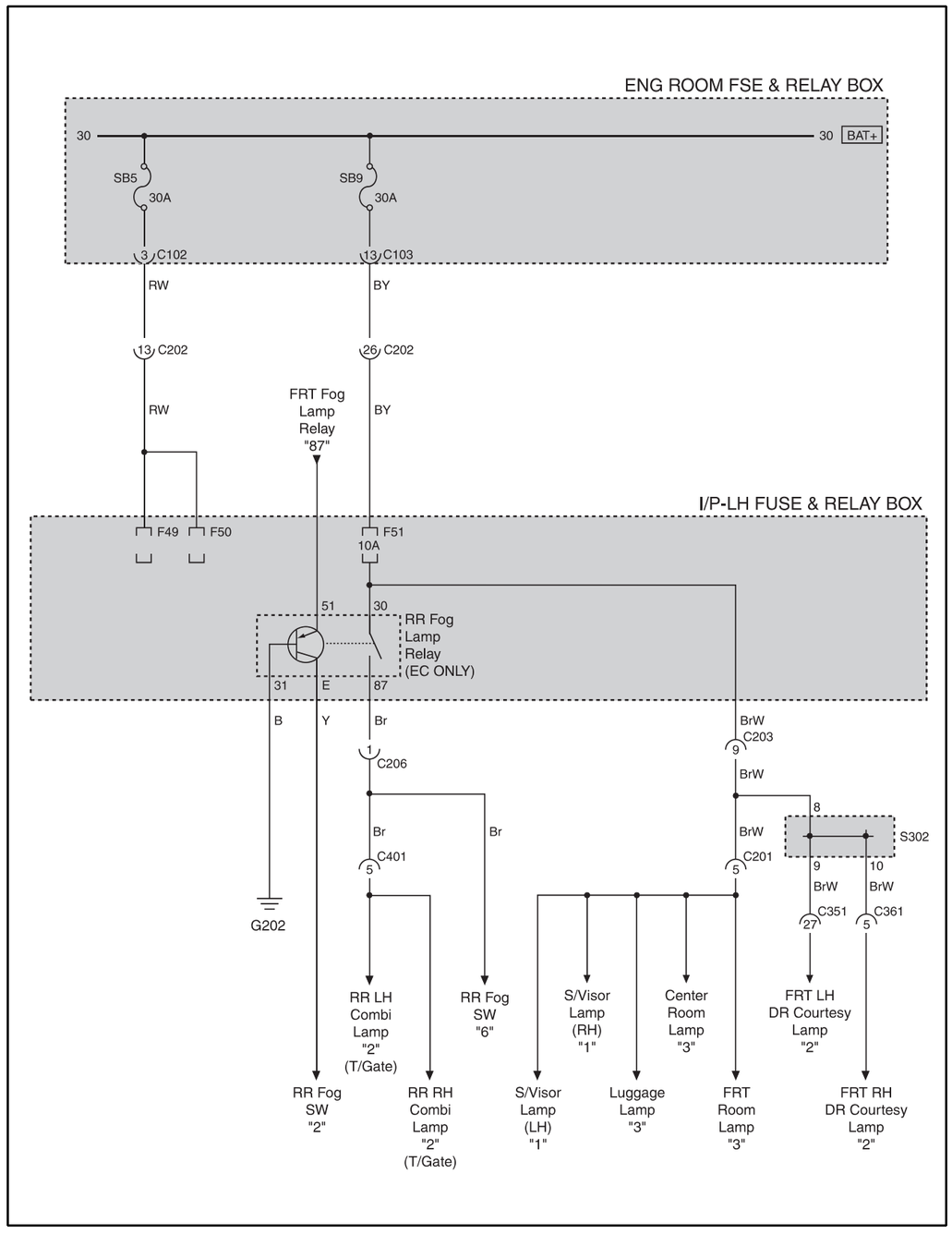


4) F41 ~ F48

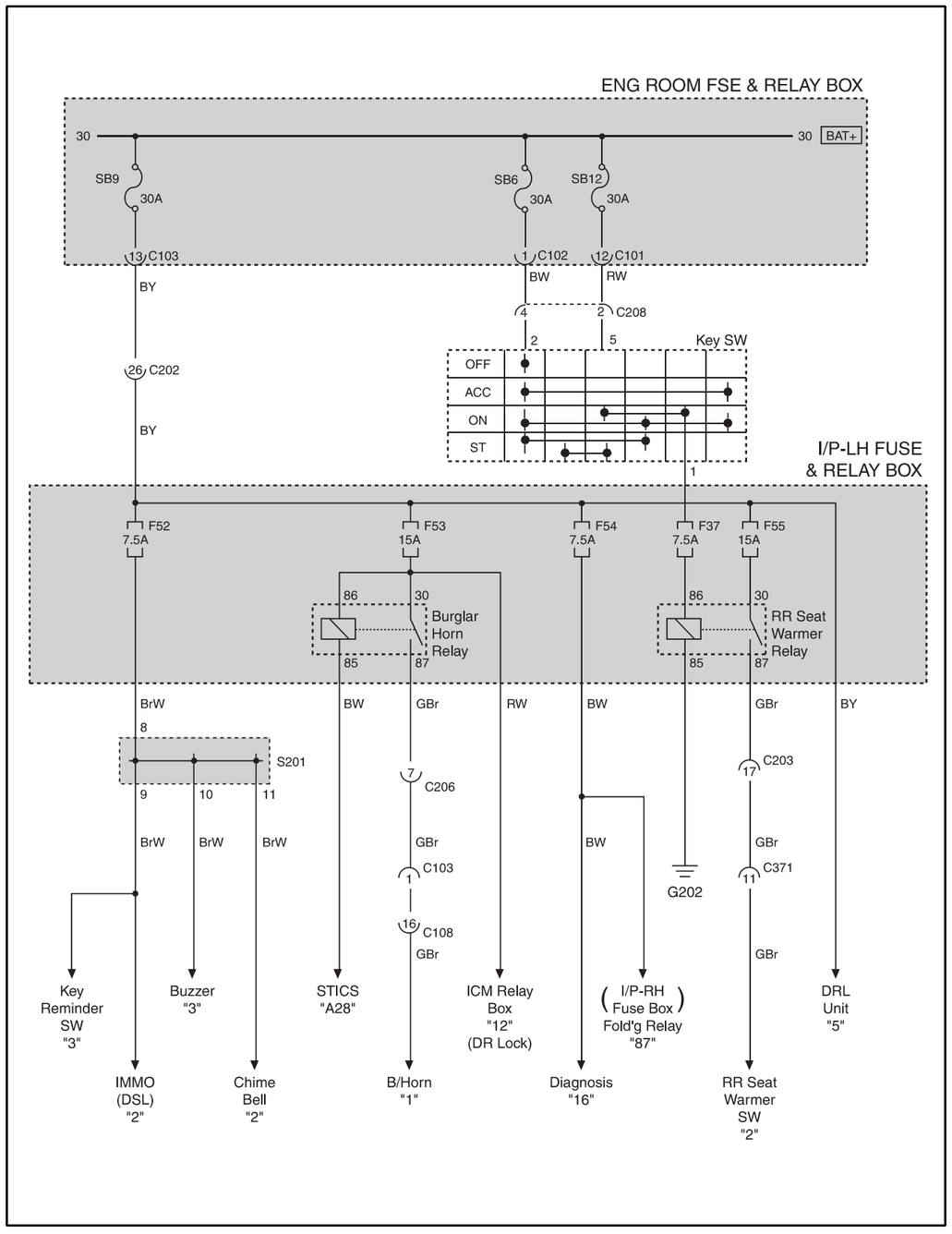


Modification basis	
Application basis	
Affected VIN	

5) F49 ~ F51, RR FOG LAMP RELAY

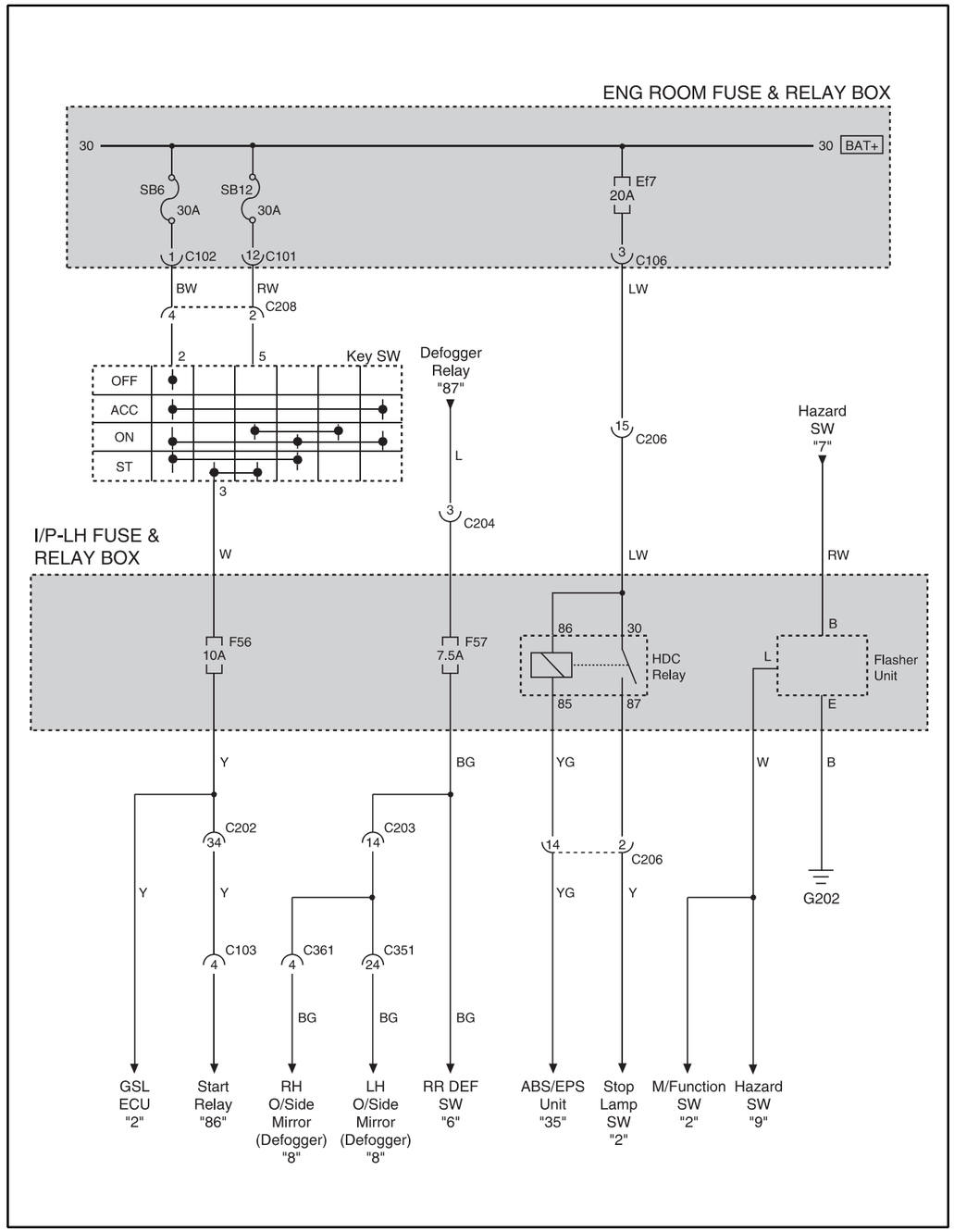


6) F52 ~ F55, BURGLAR HORN RELAY, RR SEAT WARMER RELAY



Modification basis	
Application basis	
Affected VIN	

7) F56 ~ F57, HDC RELAY, FLASHER UNIT

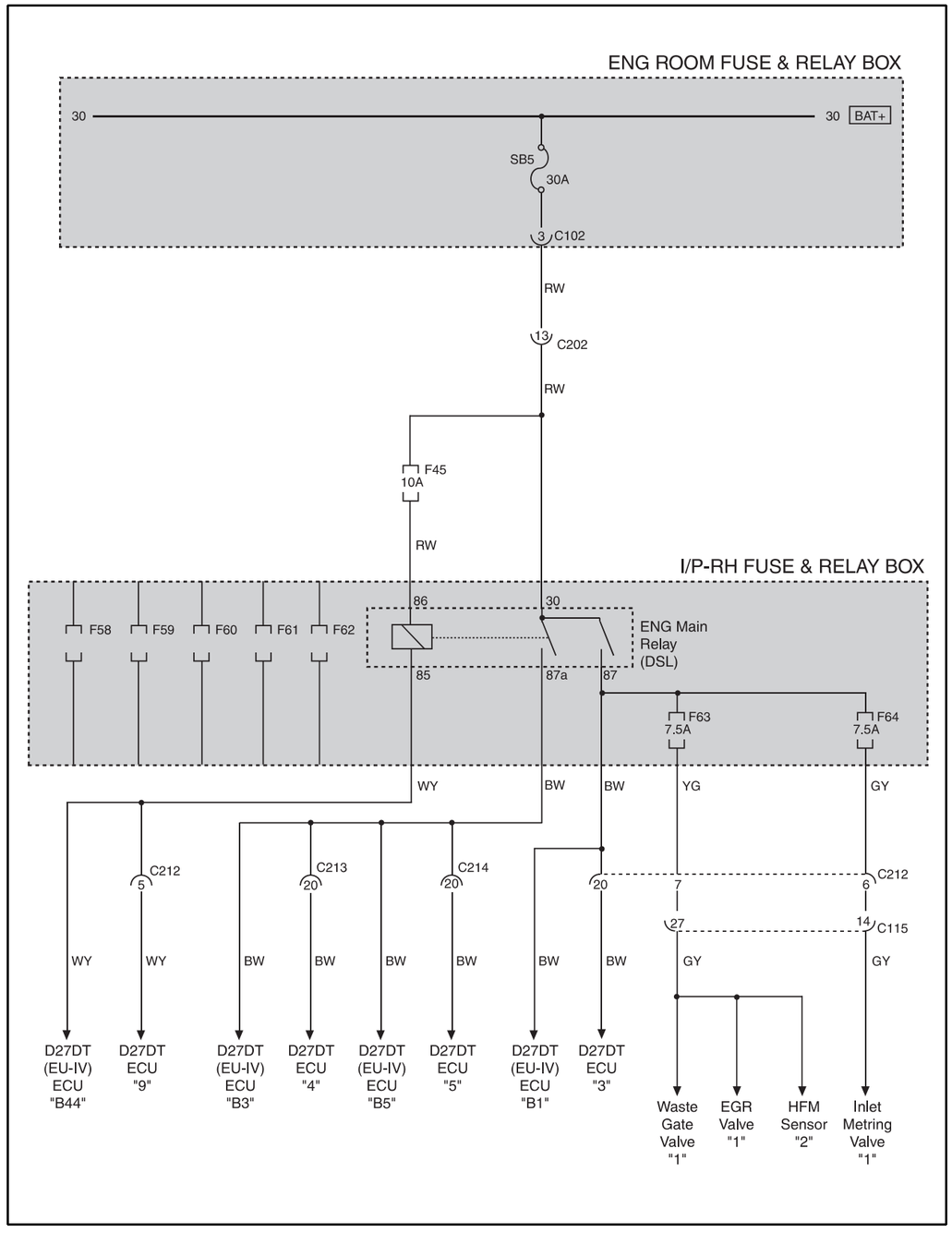


Modification basis	
Application basis	
Affected VIN	

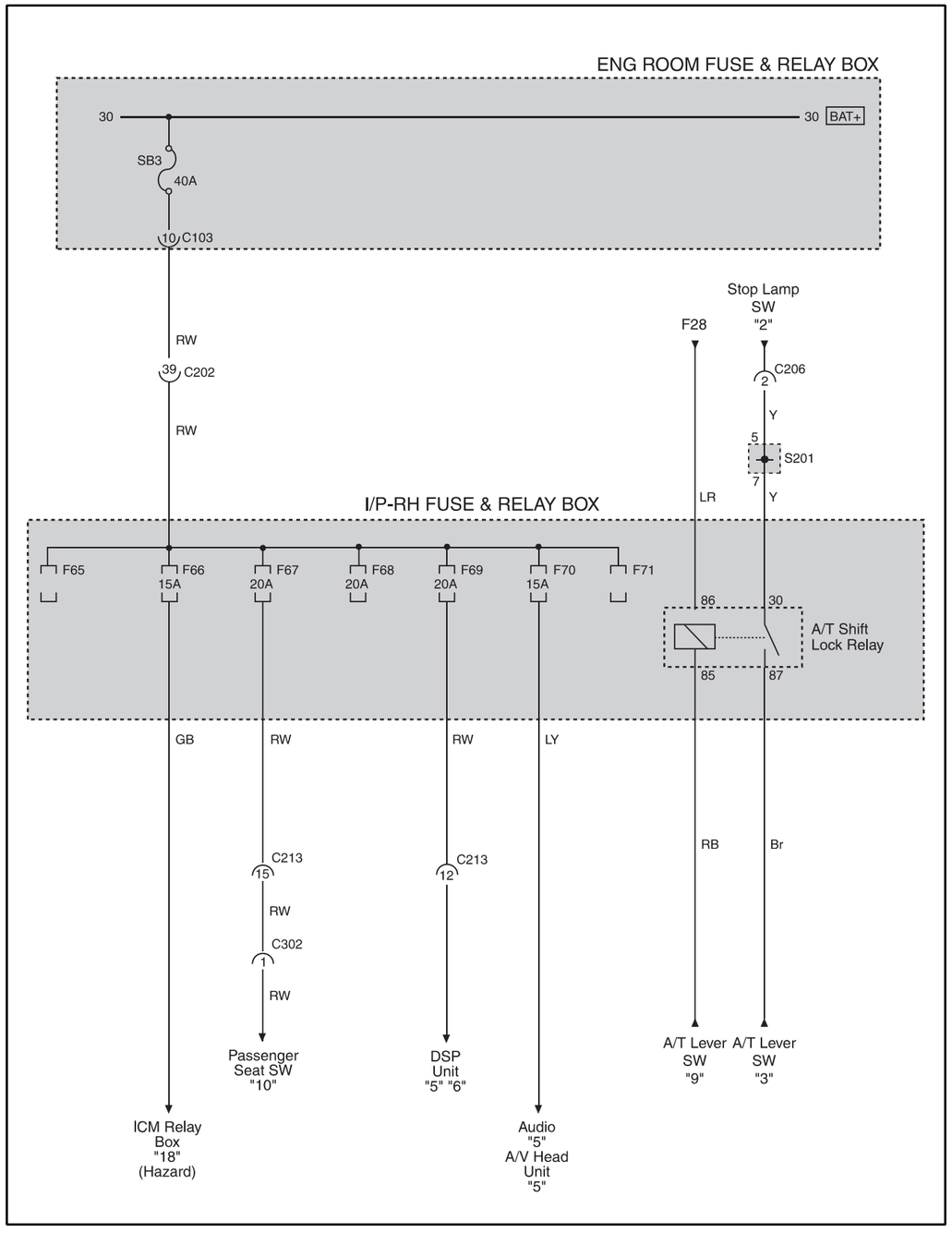
S.G.N. 8410-00

I/P - RH FUSE / RELAY BOX CIRCUIT

1) F58 ~ F64, ENG MAIN RELAY

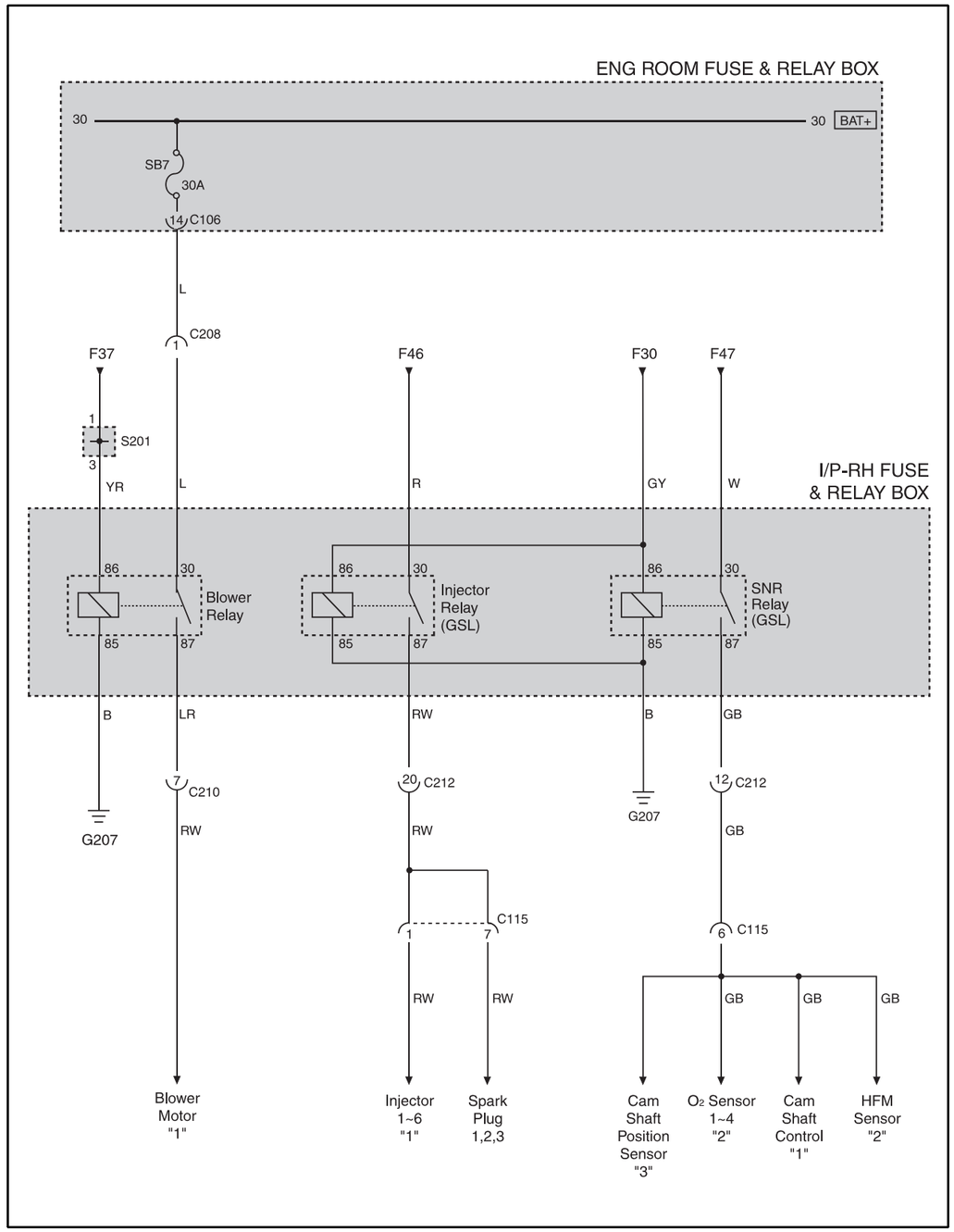


2) F65 ~ F71, SHIFT RELAY (4-A/T)

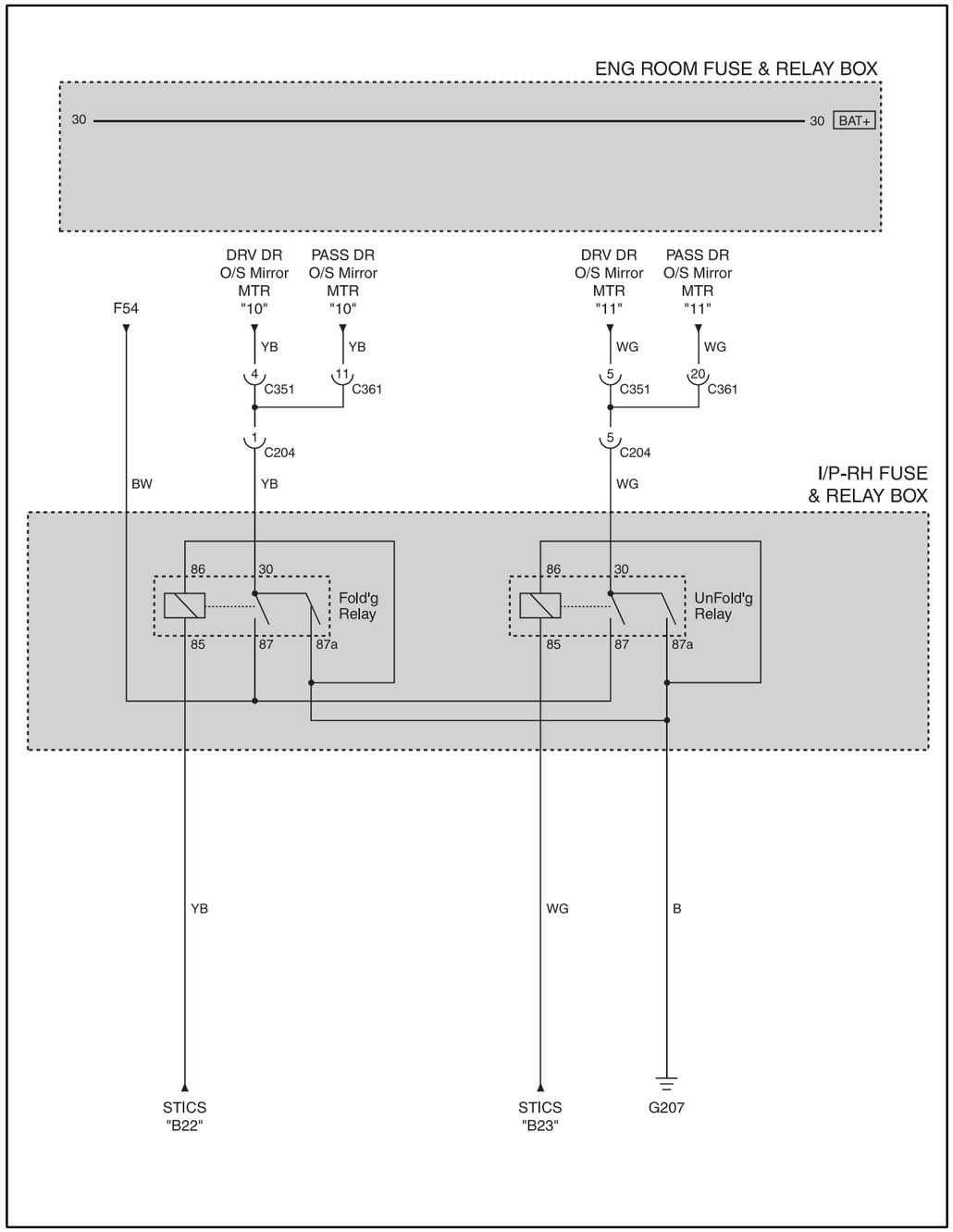


Modification basis	
Application basis	
Affected VIN	

3) BLOWER RELAY, INJECTOR RELAY, SNR RELAY



4) FOLD'G RELAY, UNFOLD'G RELAY

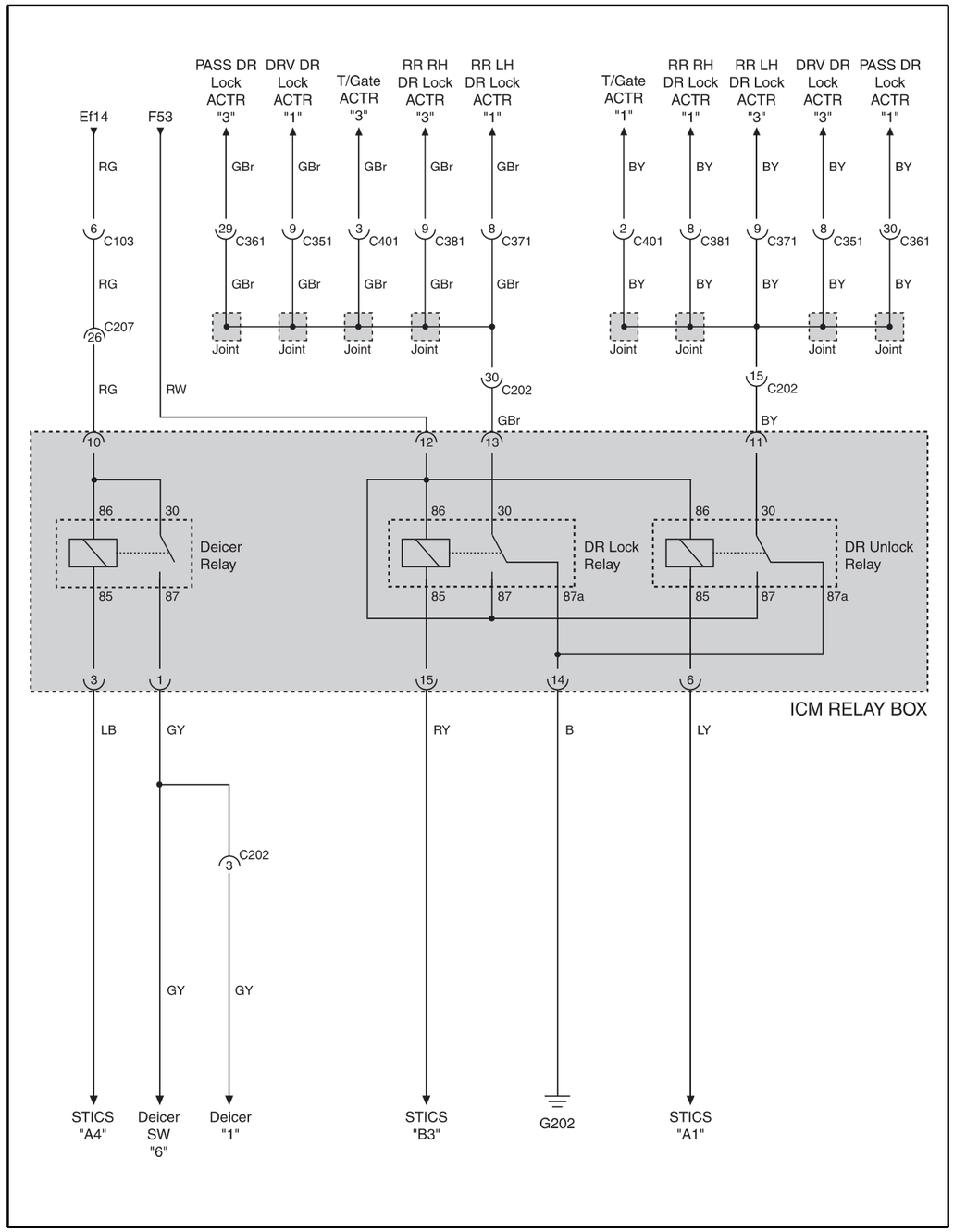


Modification basis	
Application basis	
Affected VIN	

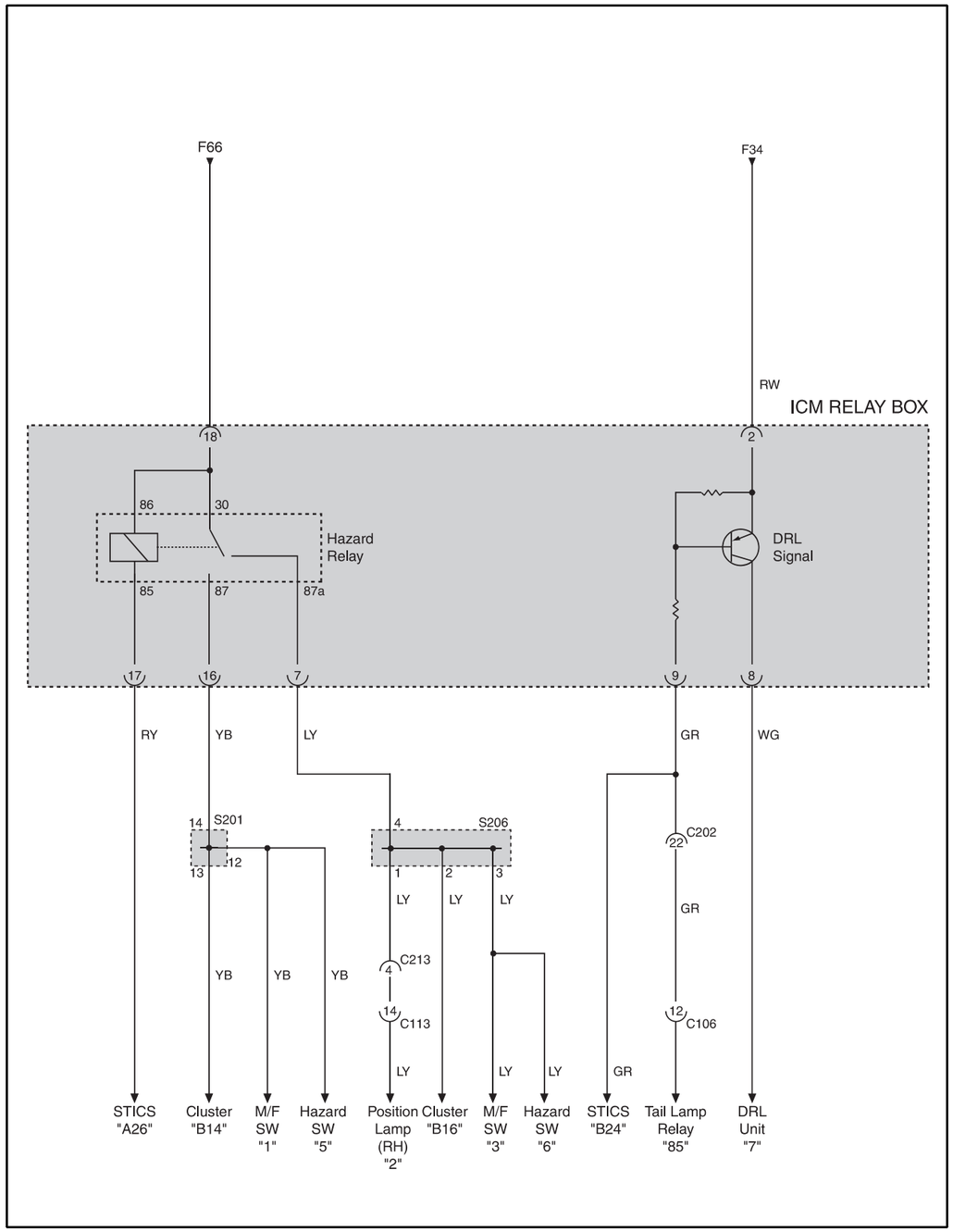
S.G.N. 8410-00

ICM RELAY BOX CIRCUIT

1) DEICER RELAY, DR LOCK/UNLOCK RELAY



2) HAZARD RELAY, DRL SIGNAL



Modification basis	
Application basis	
Affected VIN	

Memo

Memo

1461-01/2820-01/1491-01/1491-01/8210-01/3110-01/3410-01/4892-01/4620-12/8810-01/8010-01/7410-13/7410-02/7410-04/8510-52/8510-48/8710-02/7830-03/8510-05/8610-06/7632-16/7340-03/8310-01/8510-00/8320-01/8410-01/8210-01/8310-10/4810-01/7770-02/7770-10/8910-01/8930-01/8790-01/6810-15/6910-01/6810-

ENGINE

1461-00 STARTING / CHARGING..... 3
2820-00 PREHEATING CIRCUIT..... 5
1491-00 ECU (ENGINE CONTROL UNIT - D20/D27DT EU-IV)..... 6
1491-00 ECU (ENGINE CONTROL UNIT - D20/D27DT)..... 9
1490-00 ECU (ENGINE CONTROL UNIT - GSL G32)..... 12
1490-00 ECU (ENGINE CONTROL UNIT - GSL G23)..... 15
8210-00 DIAGNOSIS CIRCUIT..... 18

CHASSIS

3110-00 TCU (6-A/T)..... 19
3110-00 TCU (5-A/T)..... 21
3110-00 TCU (4-A/T)..... 23
3740-00 A/T SHIFT LOCK (4-A/T)..... 24
3410-00 TCCU..... 25
4480-00 EAS..... 26
4920-00 EPB..... 27
4892-00 ABS/ESP (TPMS)..... 28
4620-00 S.S.P.S (SPEED SENSITIVE POWER STEERING)..... 30

ELECTRIC

8810-00 AIR-BAG (CURTAIN AIR-BAG)..... 31
8010-00 CLUSTER..... 32
7410-00 POWER SEAT - DRIVER (W/ MEMORY)..... 35
7410-00 POWER SEAT - DRIVER (W/O MEMORY)..... 37
7410-00 POWER SEAT - PASSENGER..... 38
8510-00 ELECTRIC OUTSIDE MIRROR (W/O MEMORY)..... 39
8510-00 FRT SEAT WARMER..... 40
8610-00 RR SEAT WARMER..... 41
8710-00 STICS..... 42
7830-00 RR WIPER CIRCUIT..... 49
8510-00 POWER WINDOW CIRCUIT..... 50
8610-00 HORN..... 51
7632-00 CIGAR LIGHTER / POWER OUTLET CIRCUIT..... 52
7340-00 SUN ROOF CIRCUIT..... 53
8310-00 HEAD LAMP / DRL (DAY TIME RUNNING LIGHT) UNIT CIRCUIT..... 54
8510-00 HLLD (HEAD LAMP LEVEL G DEVICE) CIRCUIT..... 55
8320-00 TAIL LAMP CIRCUIT..... 56
8410-00 TURN SIGNAL / HAZARD LAMP CIRCUIT..... 57
8210-00 TRAILER LAMP CIRCUIT..... 58
8310-00 FOG LAMP CIRCUIT..... 59
4810-00 STOP / BACK-UP LAMP CIRCUIT..... 60
7770-00INTERIOR LAMP CIRCUIT..... 61
7770-0 AUTO DIMMING ROOM MIRROR CIRCUIT..... 62
8910-00AUDIO / CLOCK CIRCUIT..... 63
8930-00A/V SYSTEM..... 64
8790-00PARKING AID CIRCUIT..... 66
6810-00PTC HEATER (POSITIVE TEMPERATURE COEFFICIENT).. 67
6910-00FFH (FUEL FIRED HEATER)..... 68
6810-00FATC (FULL AUTO TEMP. CONTROL) CIRCUIT..... 69
6810-00AIR-CON (MANUAL) CIRCUIT..... 75

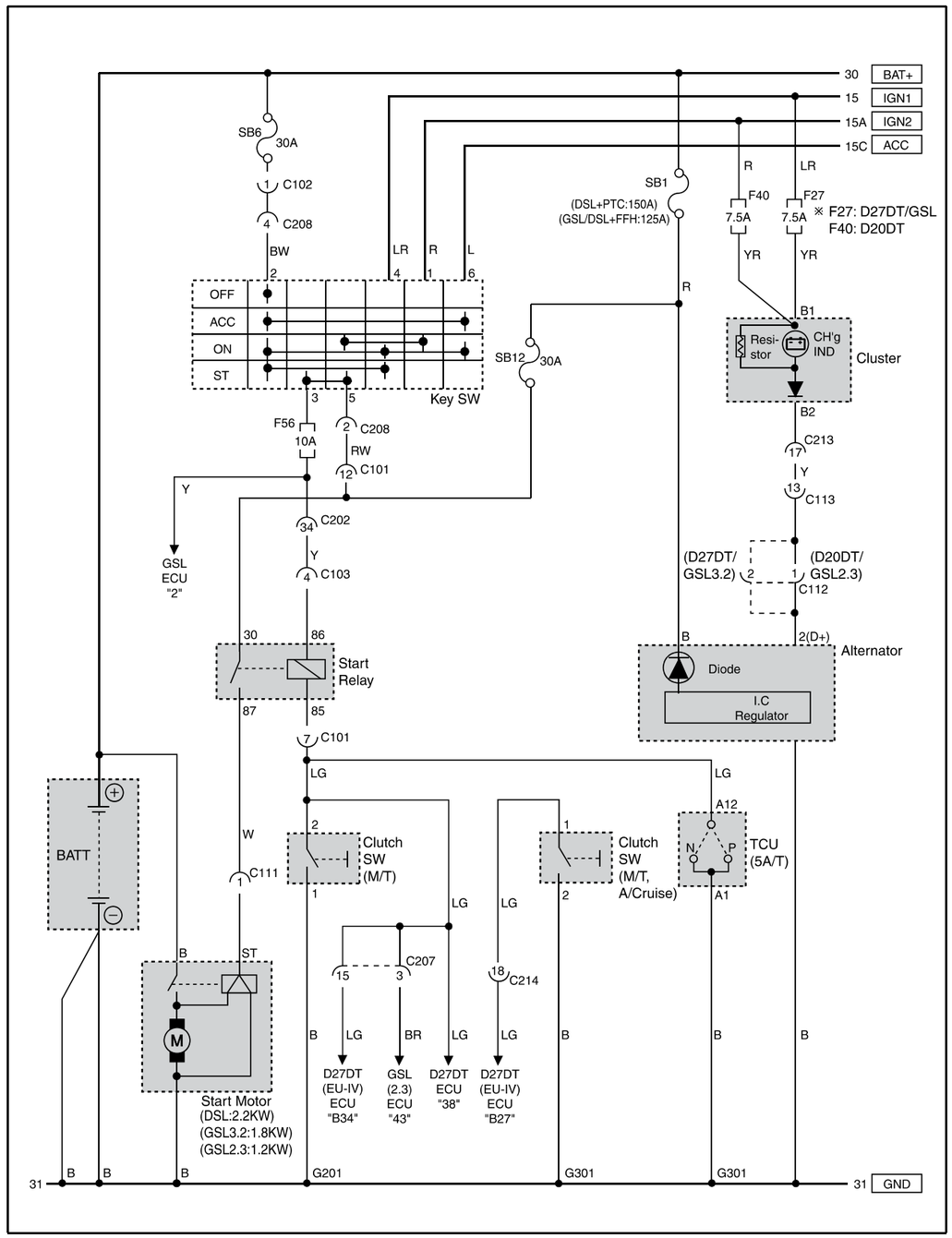
Memo

Memo

S.G.N. 1461-00

STARTING / CHARGING

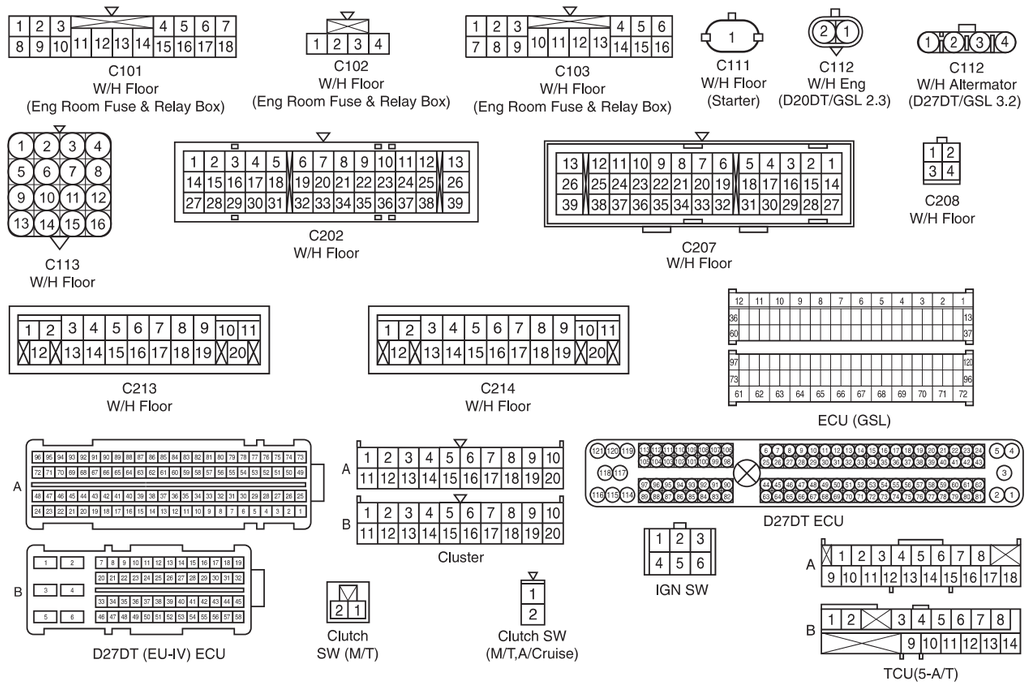
1) 5-AT, M/T



(1) CONNECTOR INFORMATION

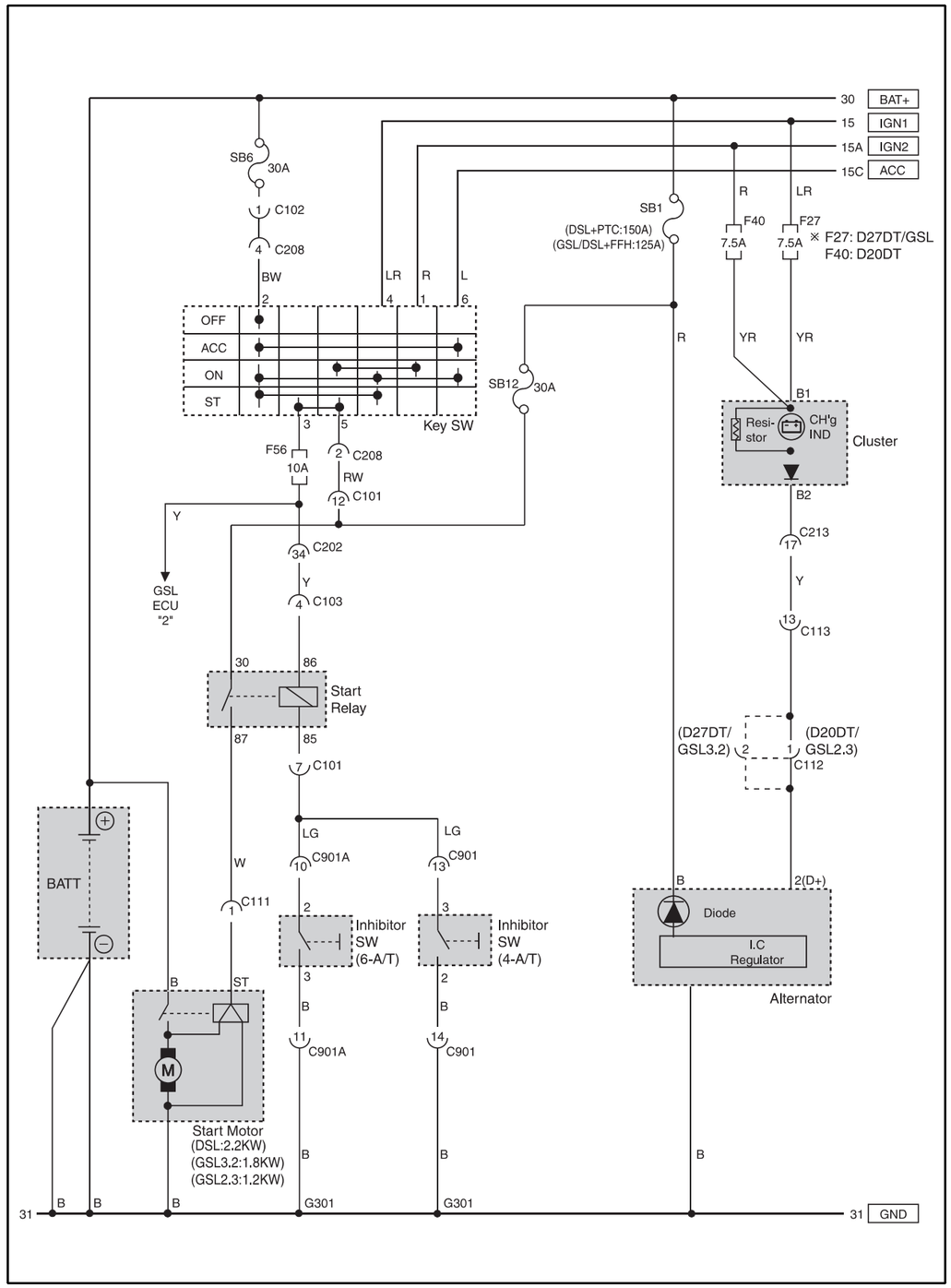
Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C111 (1Pin, Gray)		W/H Floor - Starter Motor	Under the Preheating Time Relay	Solenoid
C112	(2Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D20DT, GSL 2.3
	(4Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D27DT, GSL 3.2
C113 (16Pin, Black)		W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)		W/H Eng - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C208 (4Pin, Colorless)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G201		W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G301		W/H Floor	Under the Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

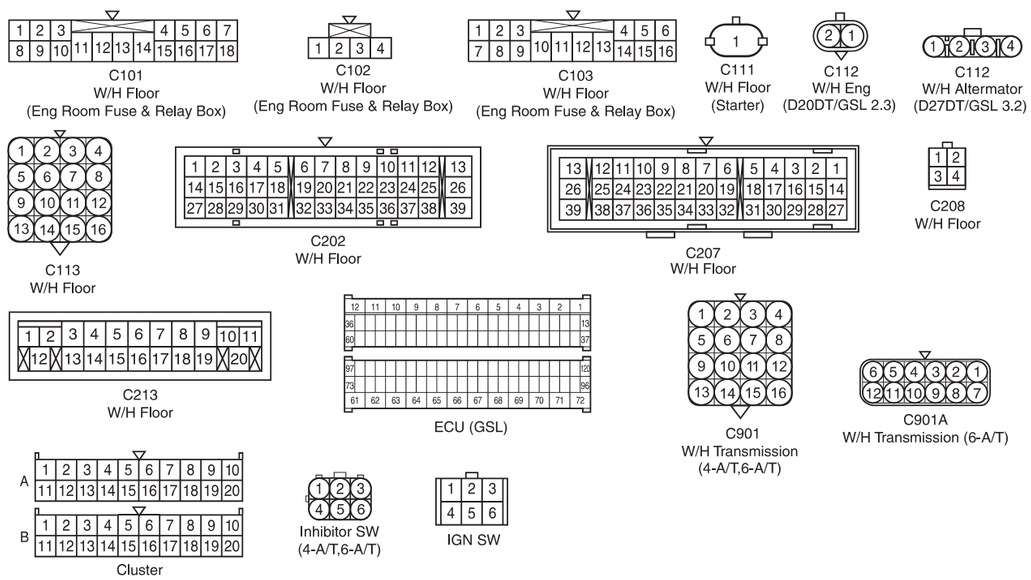
2) 6-A/T, 4-A/T



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C111 (1Pin, Gray)		W/H Floor - Starter Motor	Under the Preheating Time Relay	Solenoid
C112	(2Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D20DT, GSL 2.3
	(4Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D27DT, GSL 3.2
C113 (16Pin, Black)		W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)		W/H Eng - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C208 (4Pin, Colorless)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C901 (16Pin, Black)		W/H Floor - W/H T/M	Upper the T/M	4-A/T, 6-A/T
C901A (12Pin, Black)		W/H Floor - W/H T/M	Upper the T/M	6-A/T
G301		W/H Floor	Under the Driver Seat	

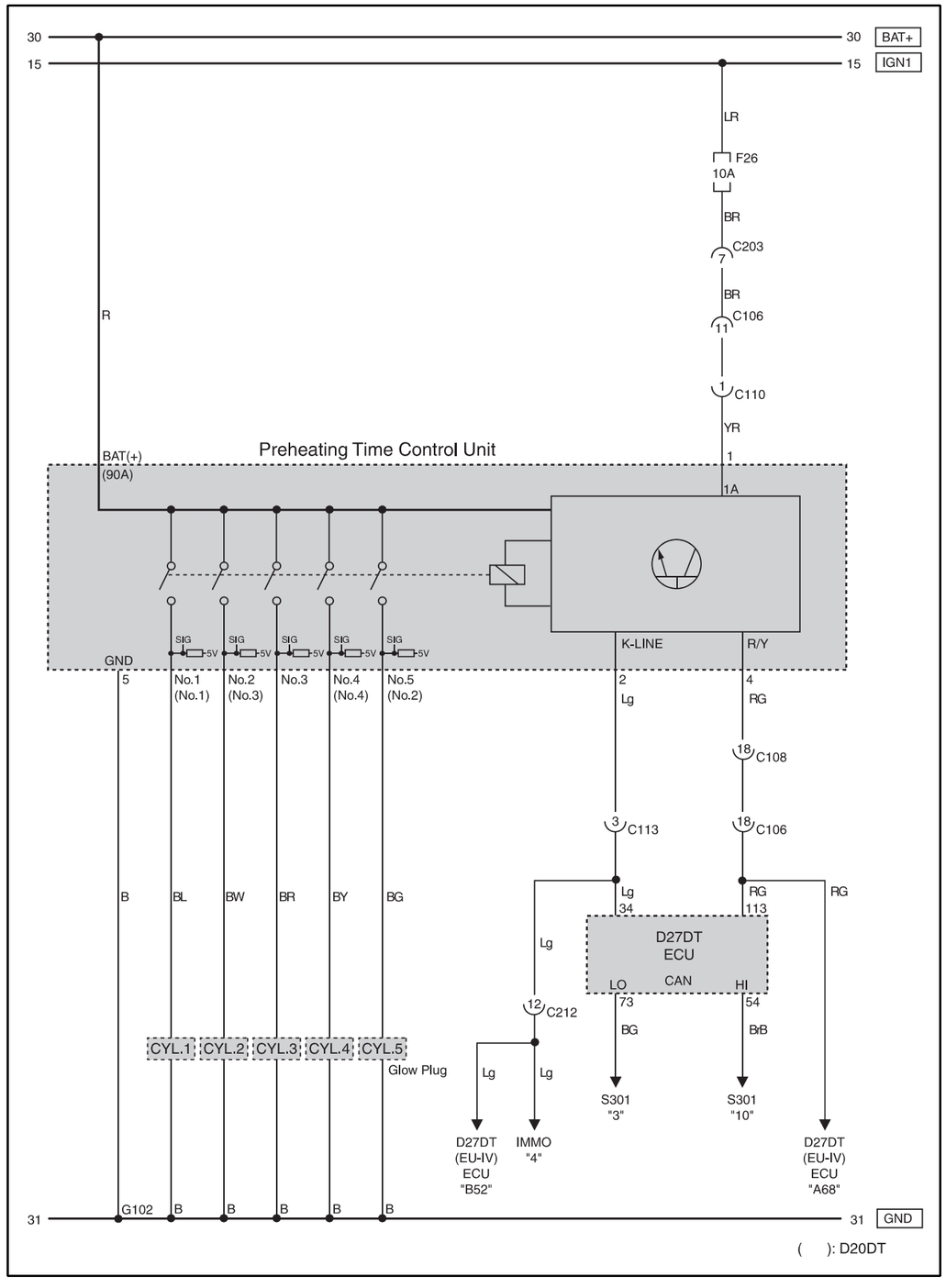
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 2820-00

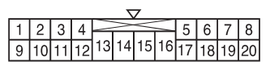
PREHEATING CIRCUIT



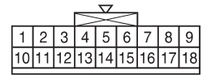
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (10Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

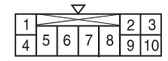
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



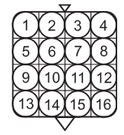
C106
W/H Floor
(Eng Room Fuse & Relay Box)



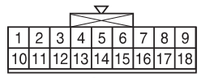
C108
W/H Floor
(Eng Room Fuse & Relay Box)



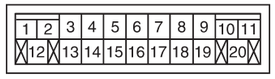
C110
W/H ENG
(Eng Room Fuse & Relay Box)



C113
W/H Floor



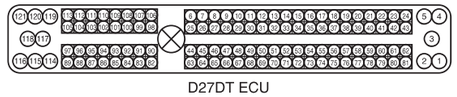
C203
W/H Floor



C212
W/H Floor

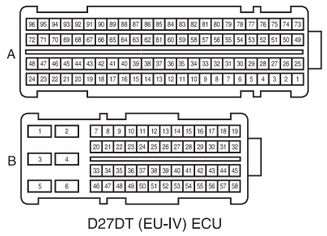


Preheating Unit


D27DT ECU



IMMO (DSL)



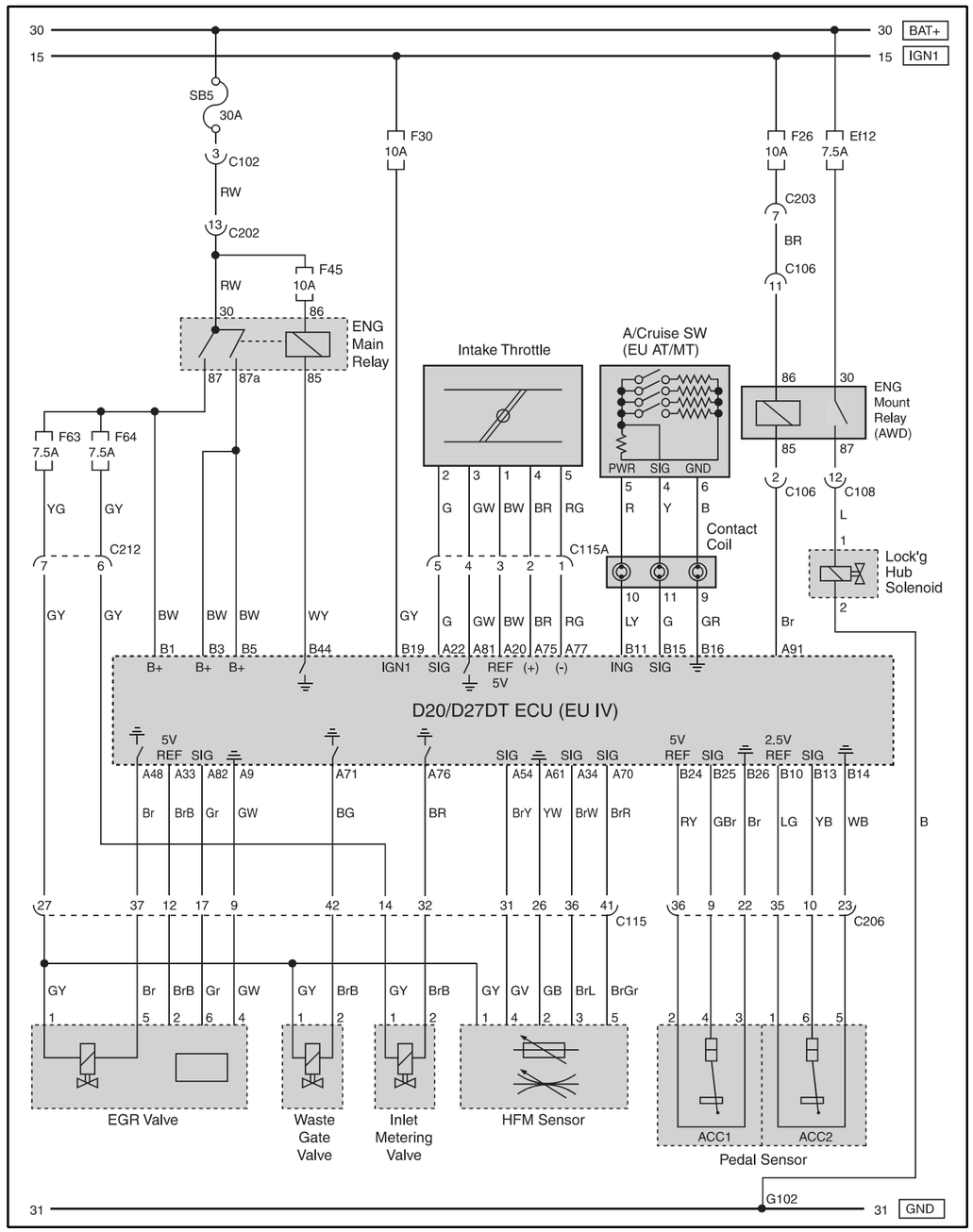
D27DT (EU-IV) ECU

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1491-00

ECU (ENGINE CONTROL UNIT - D20/D27DT EU-IV)

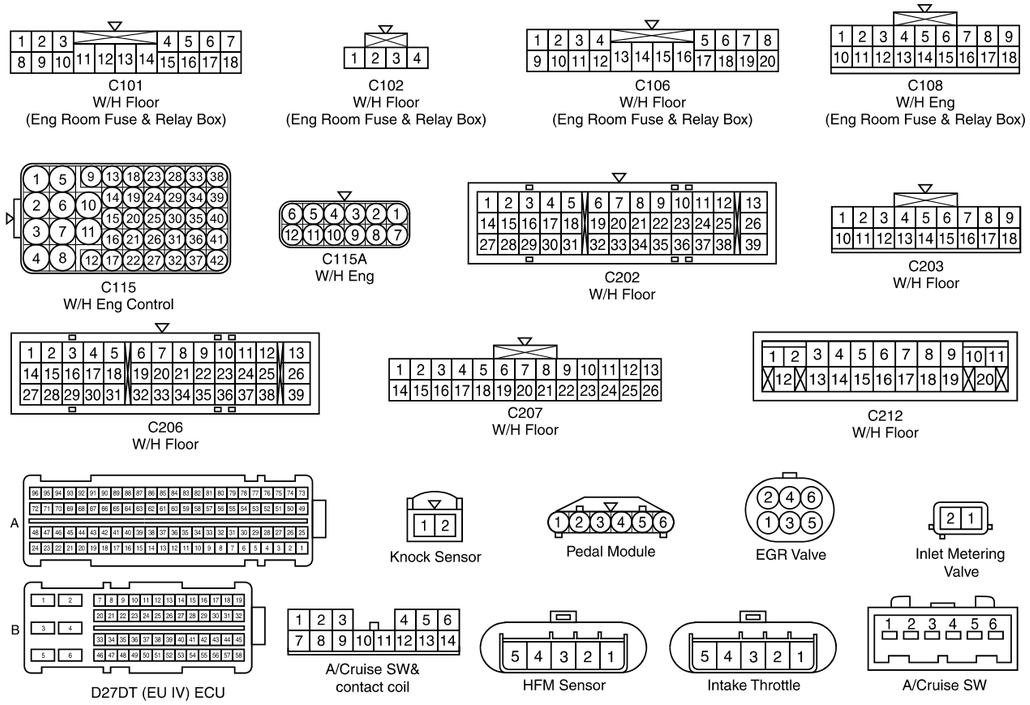
1) ENG MAIN RELAY, INTAKE THROTTLE, A/CRUISE SW, VALVE (EGR, WASTE GATE, INLET METERING), SENSOR (HFM, PEDAL)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C115A (12Pin, White)	W/H Eng - W/H Floor	Beside ABS/ESP Unit	D20/D27DT(EU IV)
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	

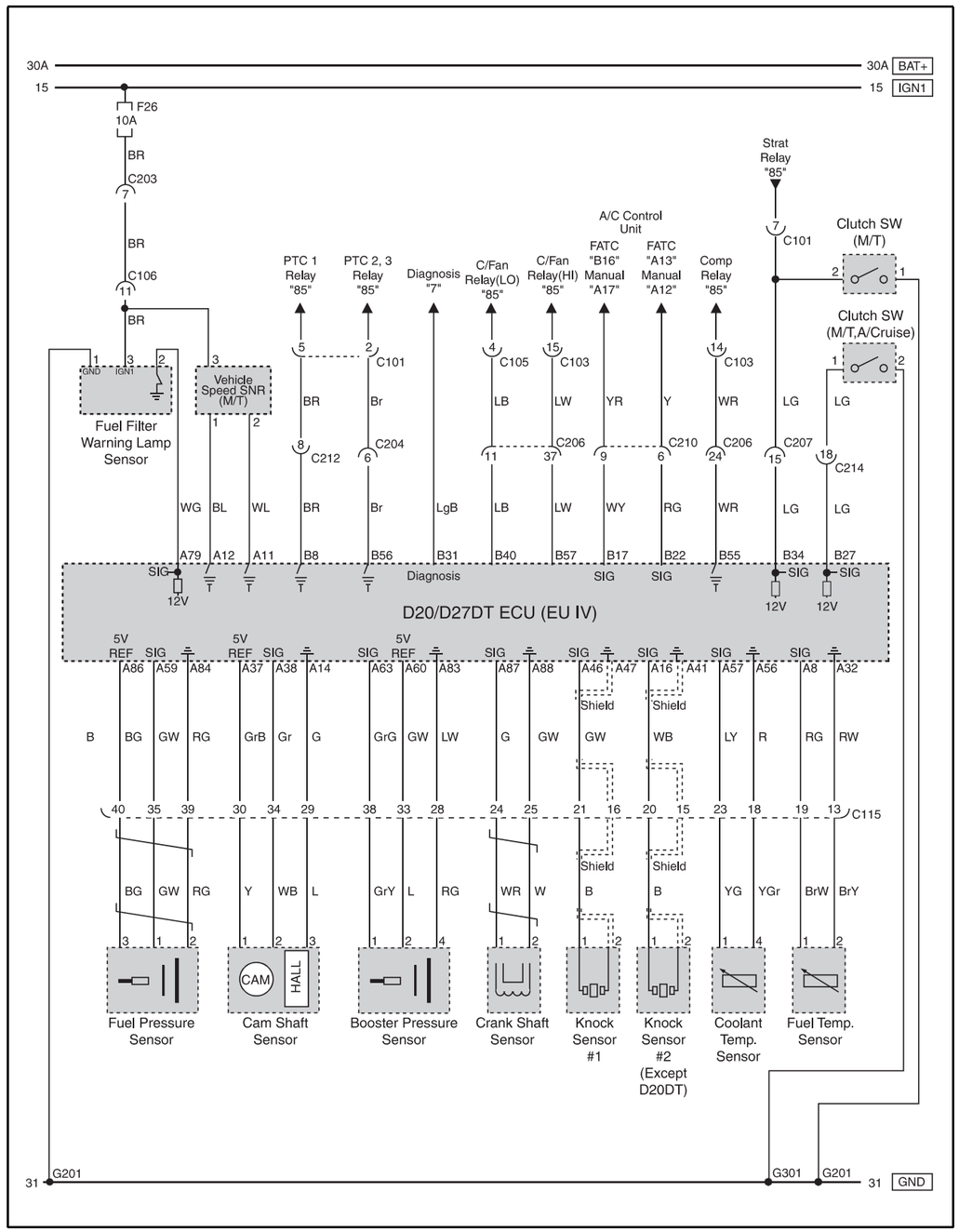
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



ENGINE	REFERENCE VOLTAGE	SENSOR
EURO IV	REF1	Cam Shaft Sensor, Fuel Pressure Sensor, Pedal Sensor1
	REF2	Pedal Sensor2, Cruise Control S/W, Intake Throttle, Booster Pressure Sensor
	REF3	Δ Sensor, E-EGR, A/Con Pressure Sensor

Modification basis	
Application basis	
Affected VIN	

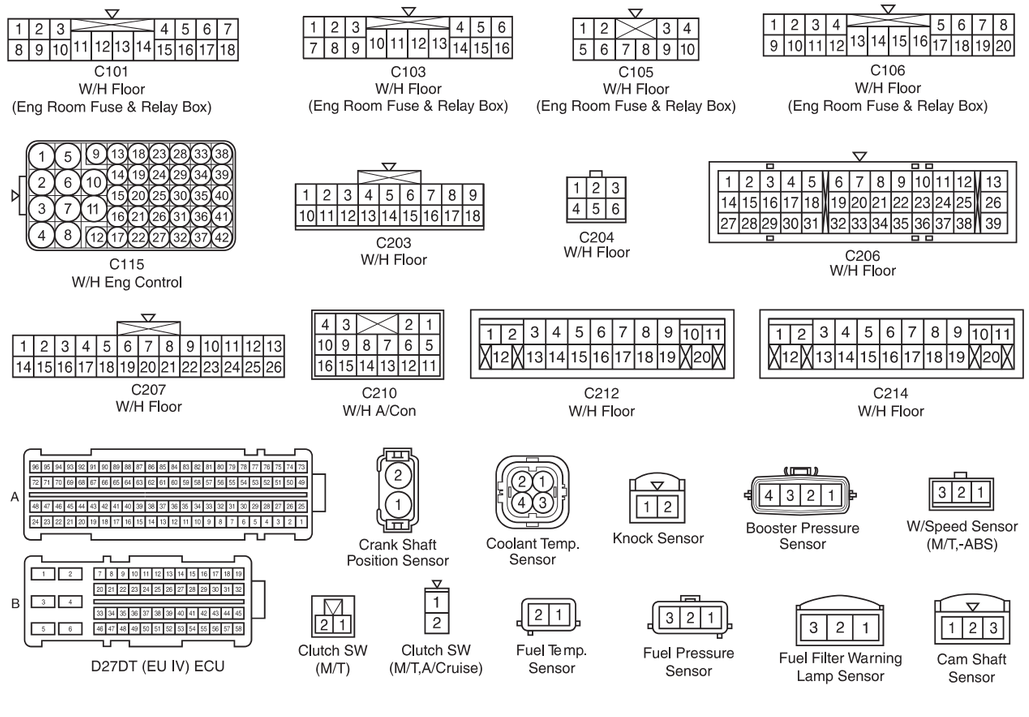
2) SENSOR (FUEL PRESSURE, CAM SHAFT, BOOSTER PRESSURE, CRANK SHAFT, KNOCK, FUEL TEMP, FUEL FILTER WARNING), PTC RELAY



(1) CONNECTOR INFORMATION

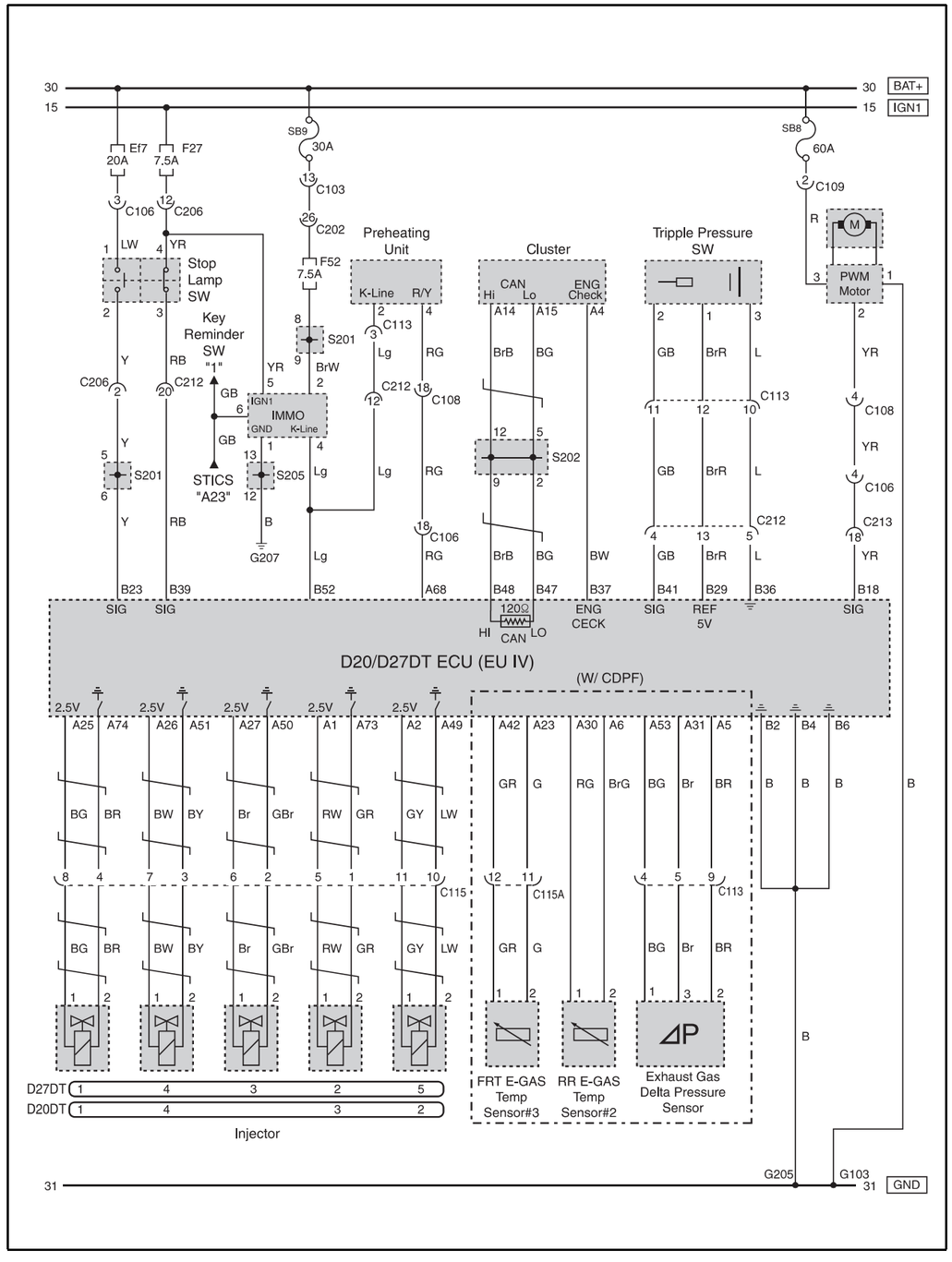
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214(20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G301	W/H Floor	Under the Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

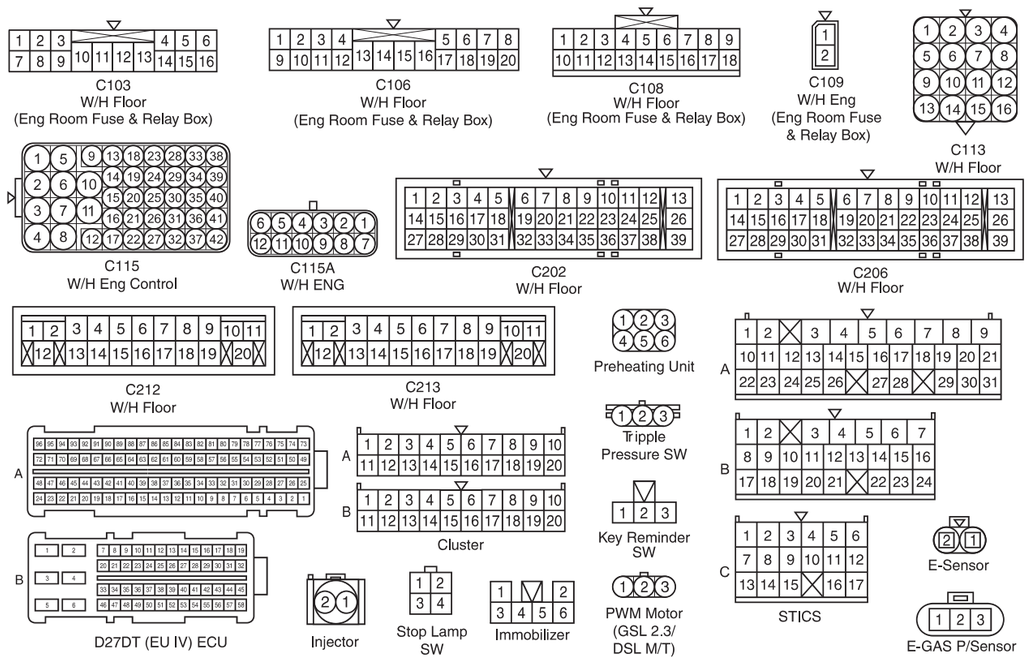
3) INJECTOR, STOP LAMP, IMMOBILIZER, CLUSTER, PREHEATING UNIT, SENSOR (EXHAUST GAS TEMP), TRIPPLE PRESSURE SW



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109 (2Pin, Black)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C115A (12Pin, White)	W/H Eng - W/H Floor	Beside ABS/ESP Unit	D20/27DT(EU IV)
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	GSL 2.3, DSL M/T
G205	W/H Main	RH Eng ECU	ECU
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S205 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

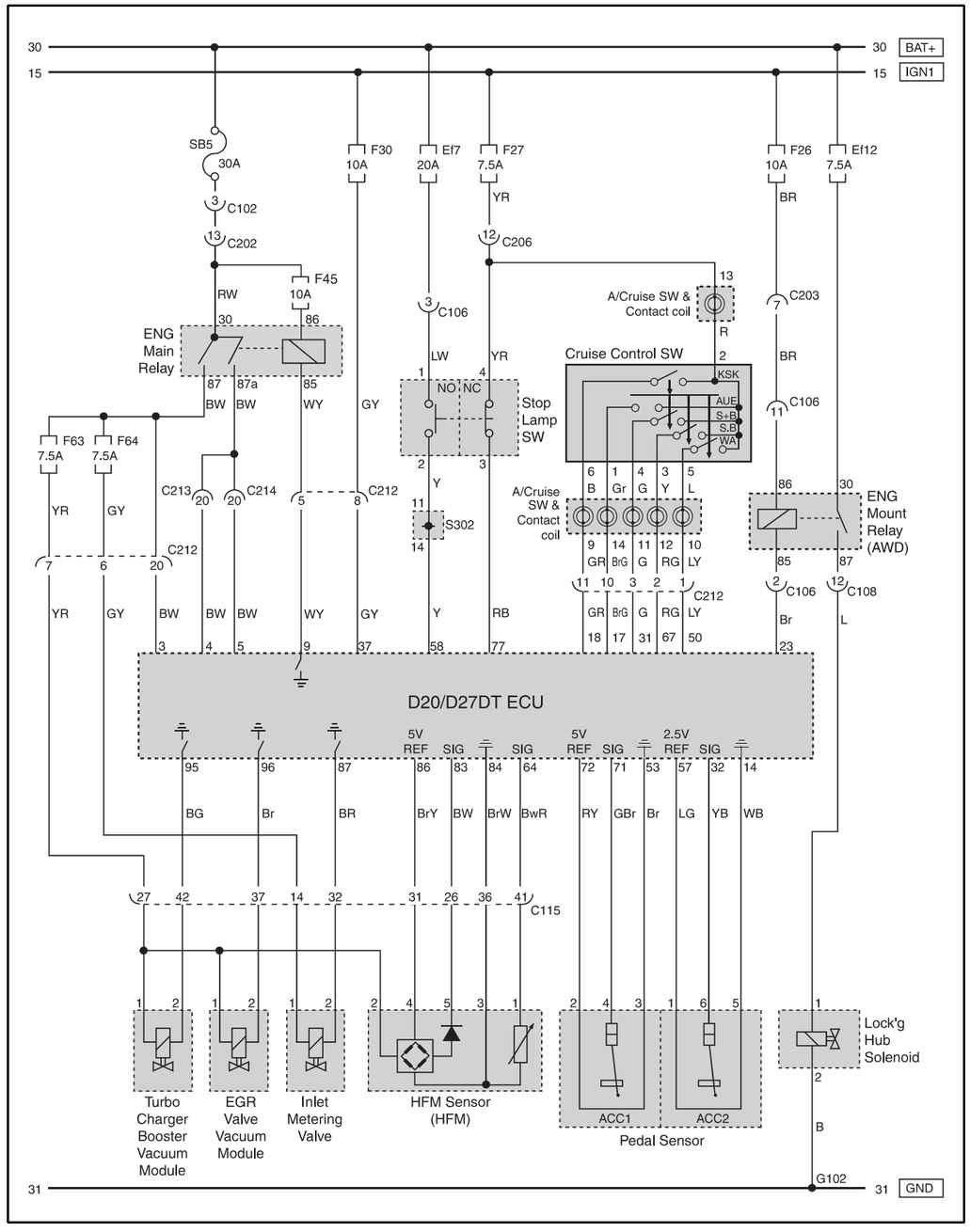


Modification basis	
Application basis	
Affected VIN	

S.G.N. 1491-00

ECU (ENGINE CONTROL UNIT - D20/D27DT)

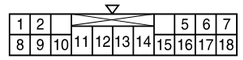
1) ENG MAIN RELAY, PEDAL SENSOR, HFM SENSOR, VALVE, CRUISE CONTROL SW, ENG MOUNT RELAY

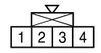


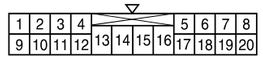
(1) CONNECTOR INFORMATION

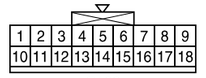
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

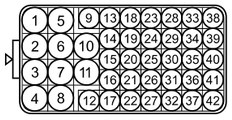
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

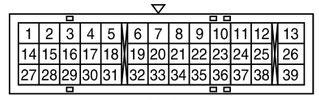

C101
W/H Floor
(Eng Room Fuse & Relay Box)

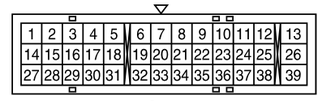

C102
W/H Floor
(Eng Room Fuse & Relay Box)

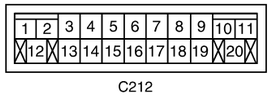

C106
W/H Floor
(Eng Room Fuse & Relay Box)

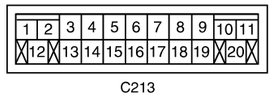

C108
W/H Eng
(Eng Room Fuse & Relay Box)

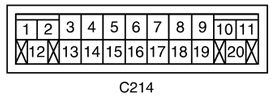

C115
W/H Eng Control

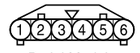

C202
W/H Floor

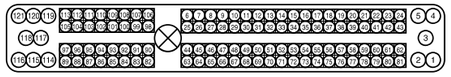

C206
W/H Floor

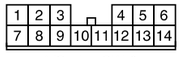

C212
W/H Floor


C213
W/H Floor


C214
W/H Floor


Pedal Module


D27DT ECU

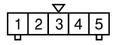

A/Cruise SW & Contact Coil


EGR Valve Vacuum Module

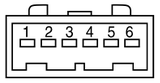

Inlet Metering Valve


Turbo Charger Booster Vacuum Module


Lock'g Hub Solenoid


HFM Sensor

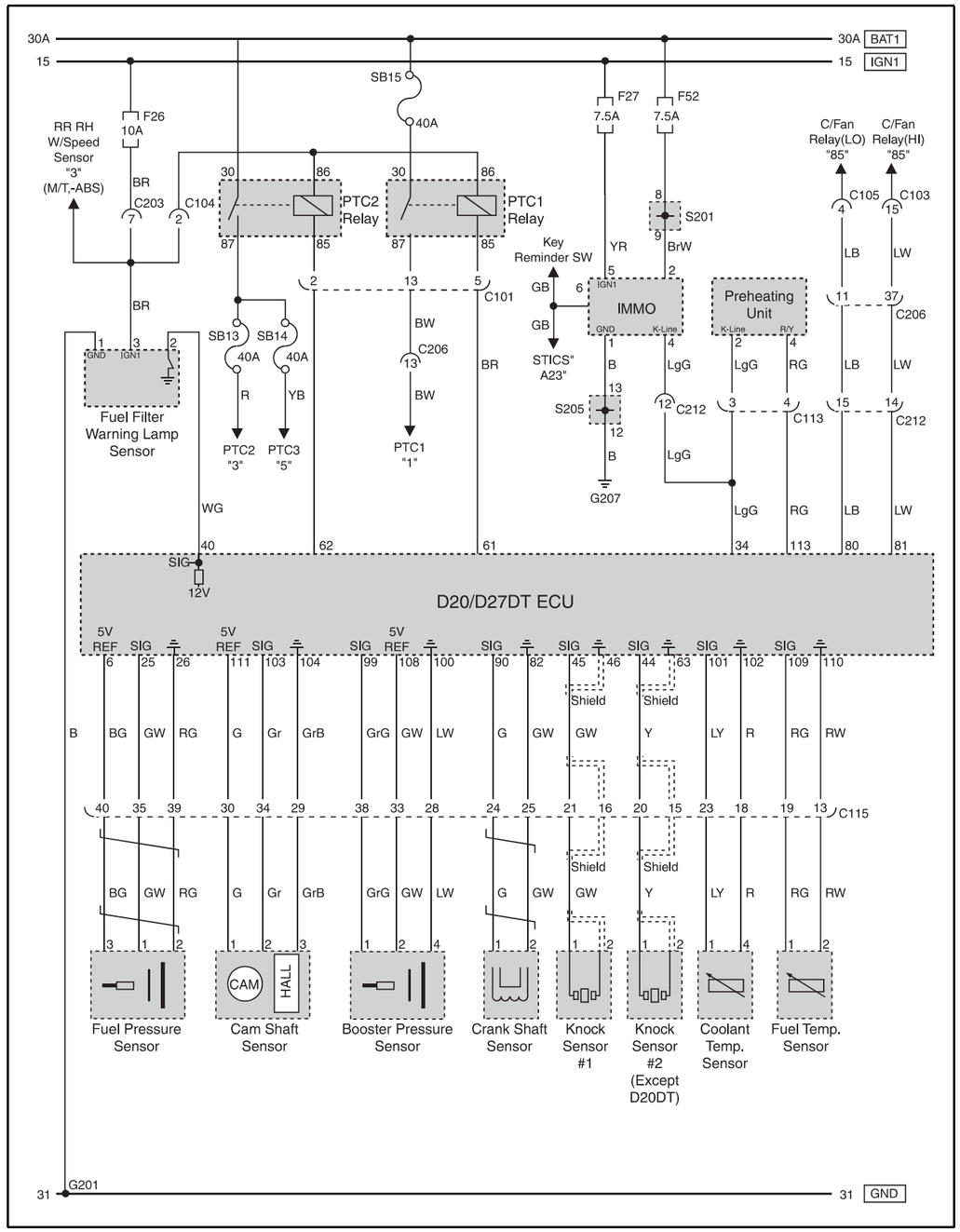

Stop Lamp SW


A/Cruise SW

ENGINE	REFERENCE VOLTAGE	SENSOR
EURO III	REF1	Pedal Sensor1
	REF2	HFM Sensor, Cam Shaft Sensor, Fuel Pressure Sensor, Booster Pressure Sensor
	REF3	Pedal Sensor2

Modification basis	
Application basis	
Affected VIN	

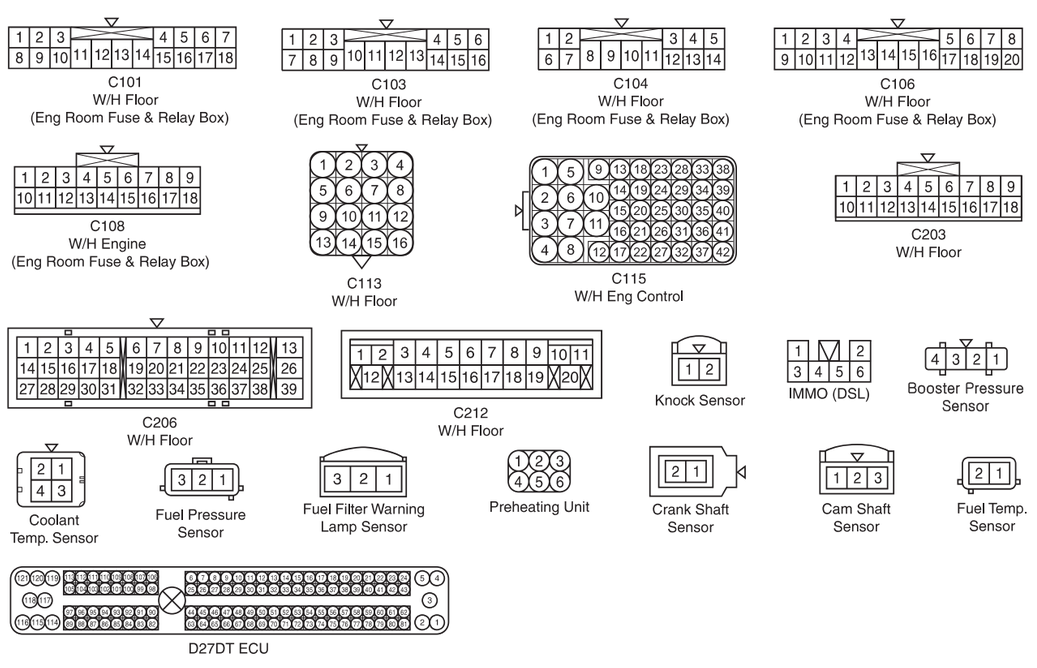
2) FUEL FILTER WARNING LAMP, IMMOBILIZER, SENSOR (FUEL PRESSURE, CAM SHAFT, BOOSTER PRESSURE, CRANK SHAFT, KNOCK, COOLANT TEMP., FUEL TEMP.)



(1) CONNECTOR INFORMATION

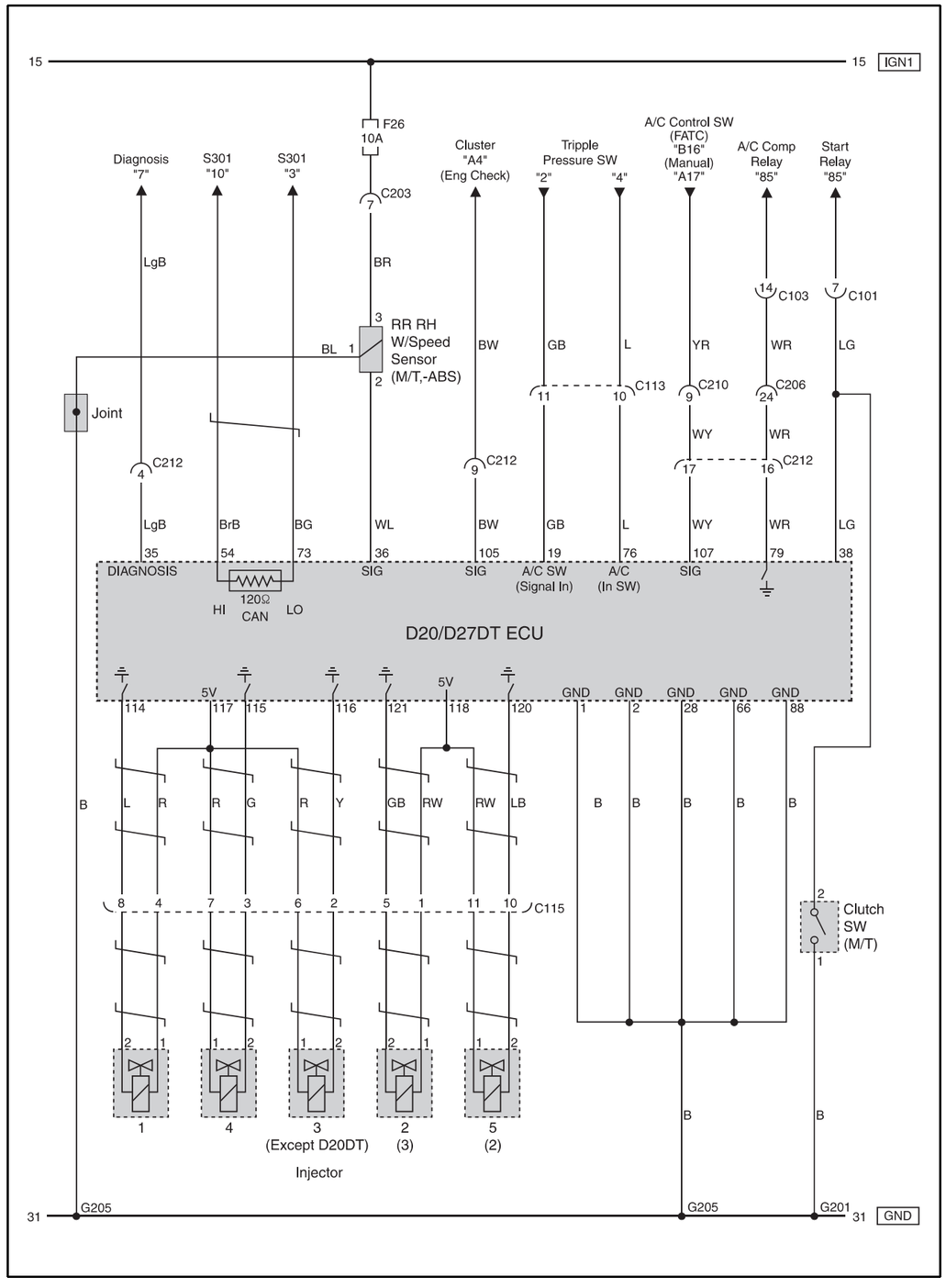
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	GSL 2.3, DSL M/T
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

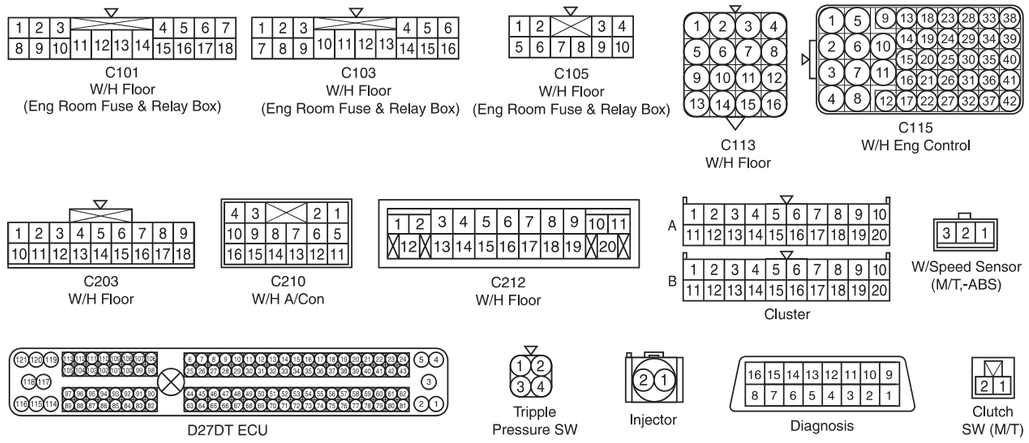
3) INJECTOR, CAN LINE



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G205	W/H Main	RH Eng ECU	ECU
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

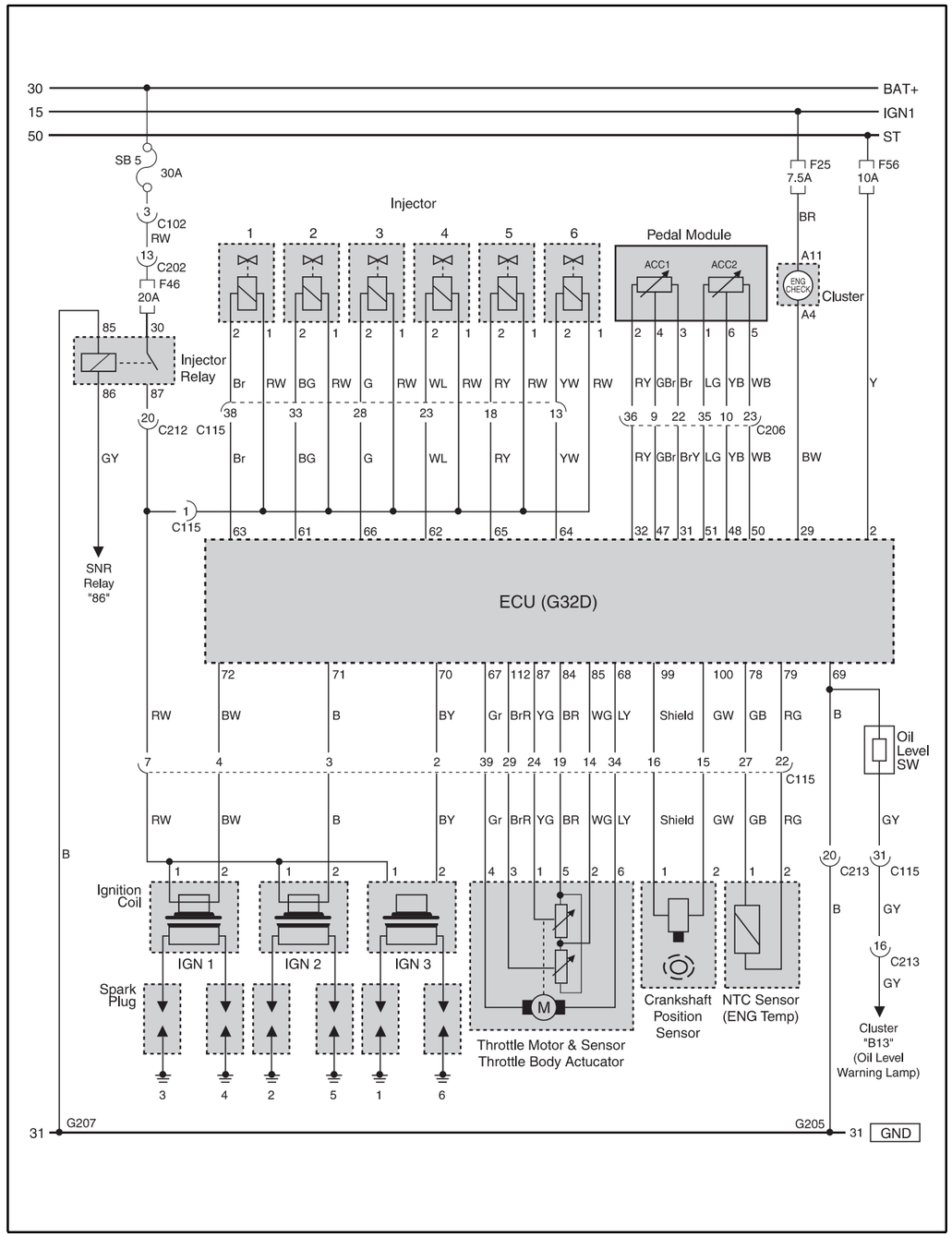
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



S.G.N. 1490-00

ECU (ENGINE CONTROL UNIT - GSL G32)

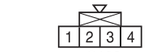
1) IGN COIL, INJECTOR, PEDAL MODULE, THROTTLE SENSOR

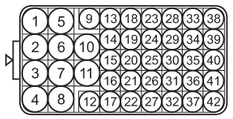


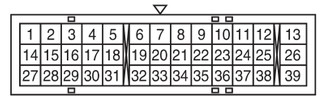
(1) CONNECTOR INFORMATION

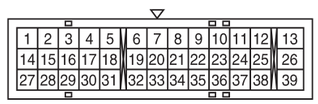
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G205	W/H Main	RH Eng ECU	ECU
G207	W/H Main	Inner the Passengaar Cowl Side PNL	

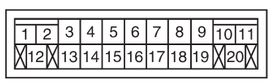
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

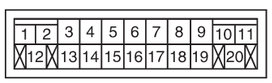

C102
W/H Floor
(Eng Room Fuse & Relay Box)

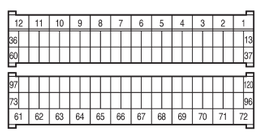

C115
W/H Eng Control

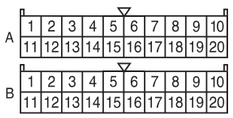

C202
W/H Floor

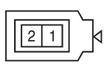

C206
W/H Floor


C212
W/H Floor


C213
W/H Floor


ECU (GSL)

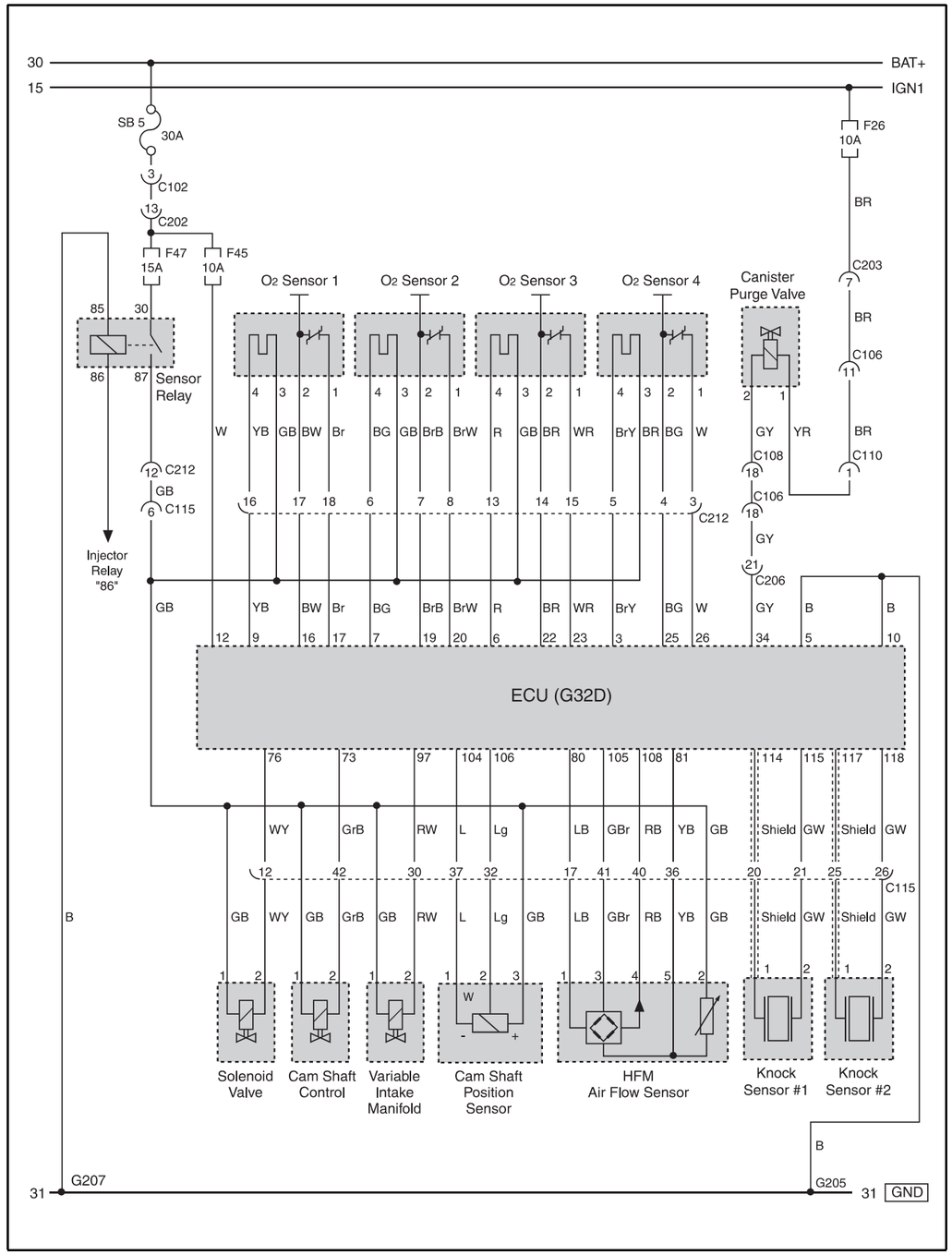

Cluster


Crank Shaft Position Sensor


Pedal Module

Modification basis	
Application basis	
Affected VIN	

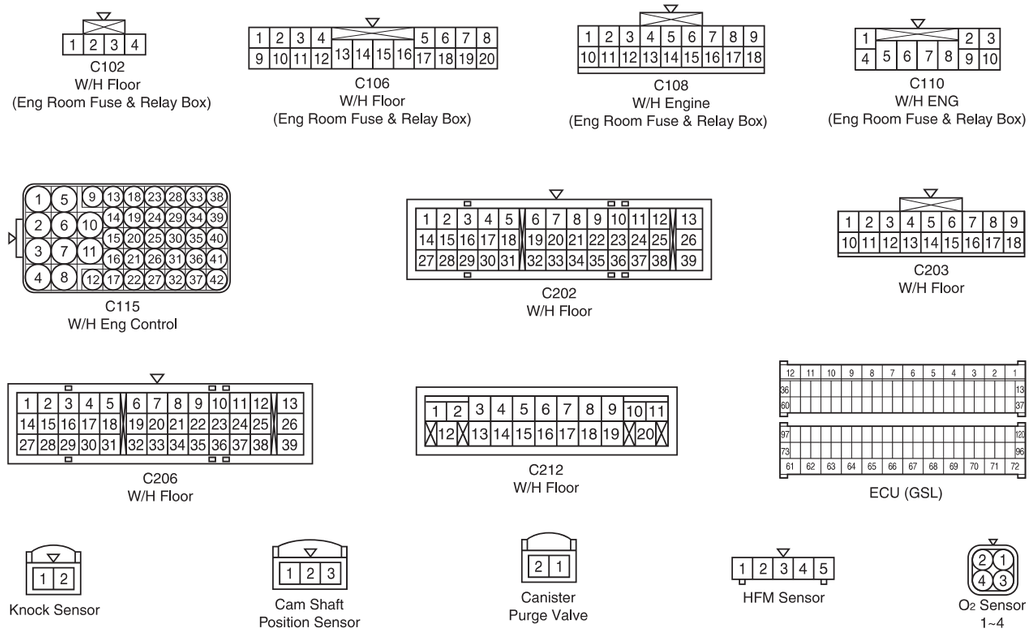
2) O_2 SENSOR, CPS, KNOCK SENSOR, HFM SENSOR, CANISTER PURGE VALVE



(1) CONNECTOR INFORMATION

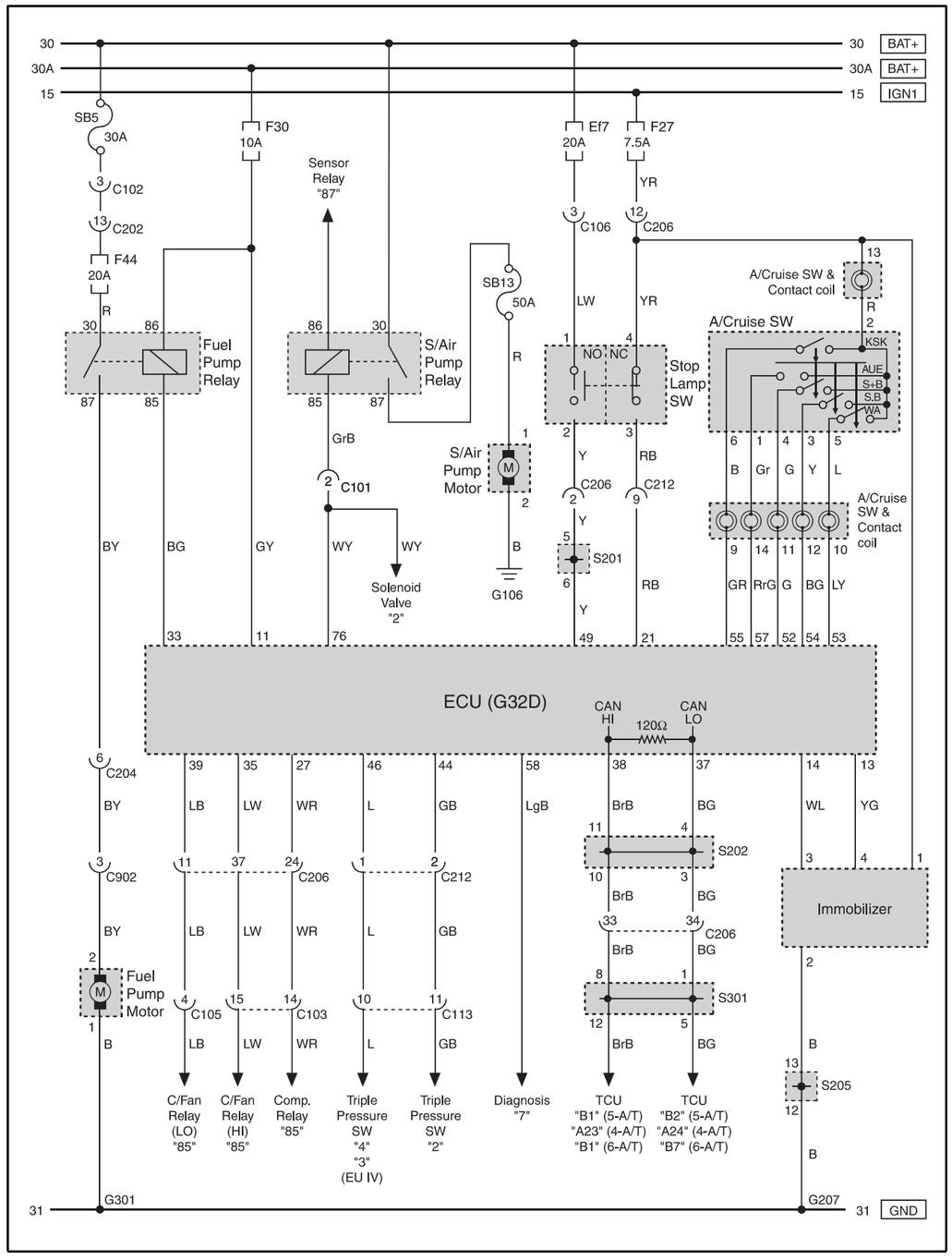
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G205	W/H Main	RH Eng ECU	ECU
G207	W/H Main	Inner the Passengaar Cowl Side PNL	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

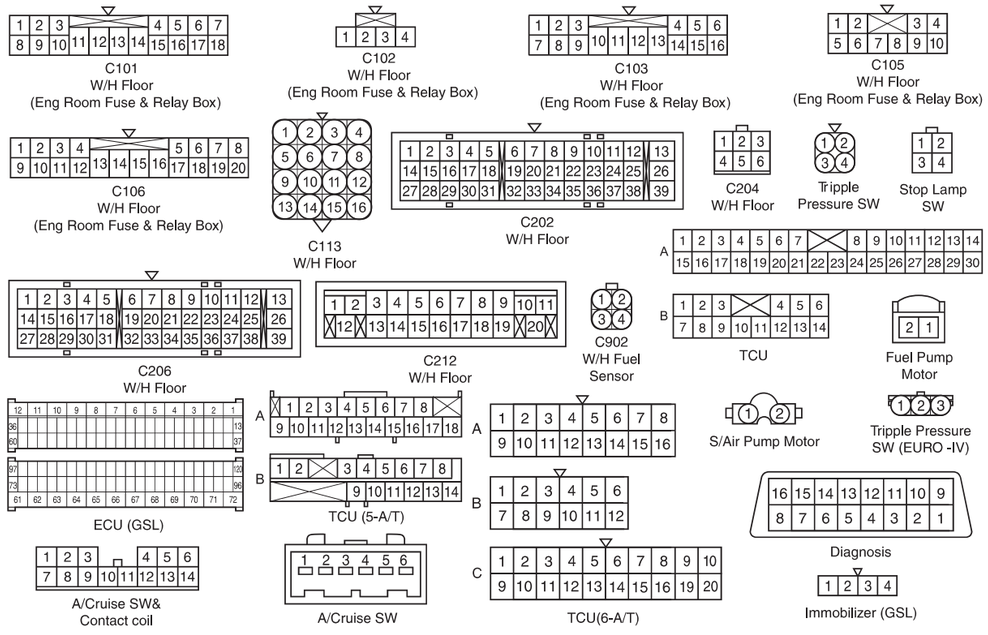
3) S/AIR PUMP, STOP LAMP, CRUISE CONTROL SW, FUEL PUMP, IMMOBILIZER



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C902 (4Pin, Black)	W/H Floor - W/H Fuel Sender	Upper the T/M	
G106	W/H Eng Room	RH Fender PNL (Beside C113)	GSL
G207	W/H Main	Inner the Passengaar Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

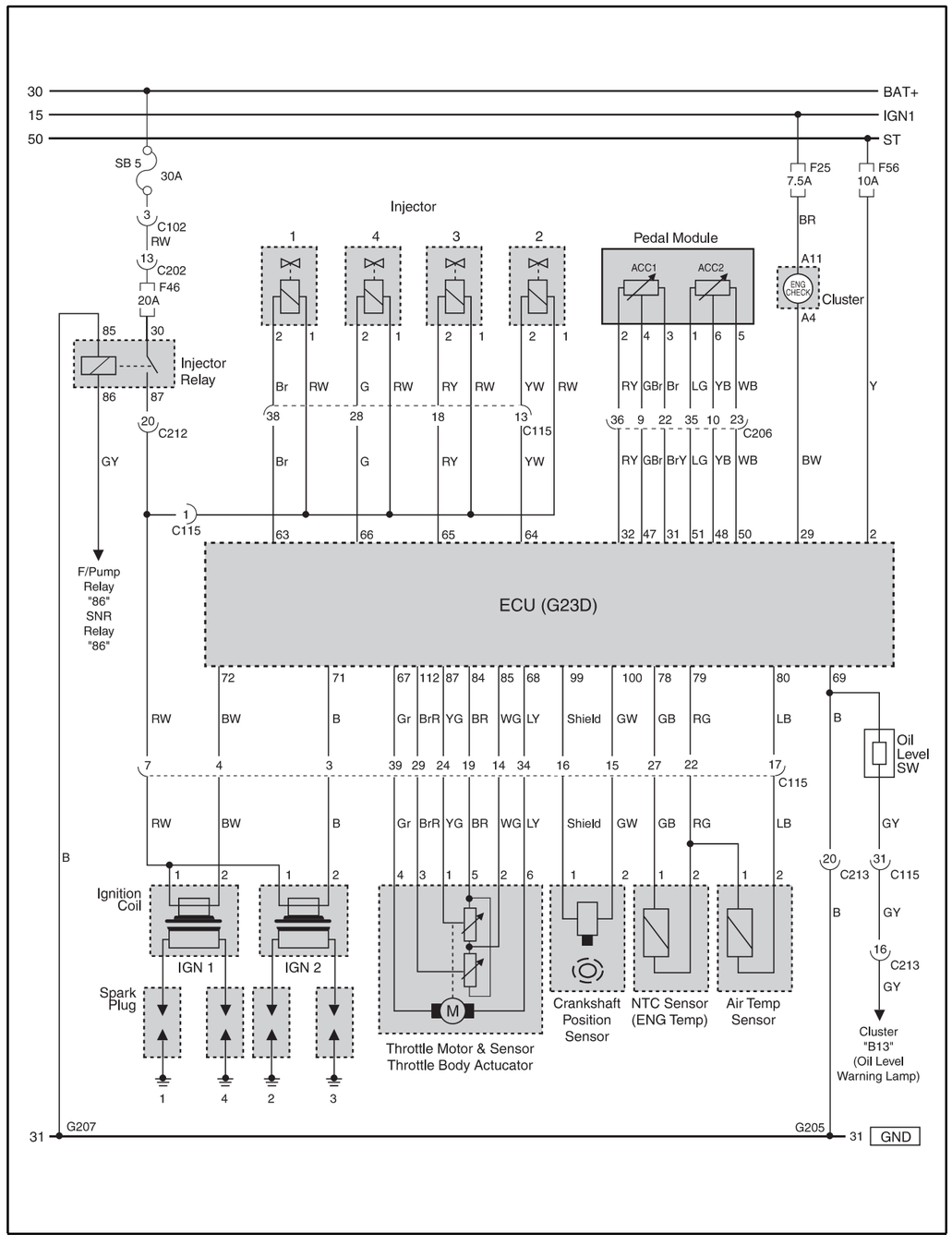


Modification basis	
Application basis	
Affected VIN	

S.G.N. 1490-00

ECU (ENGINE CONTROL UNIT - GSL G23)

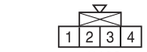
1) IGN COIL, INJECTOR, PEDAL MODULE, THROTTLE SENSOR

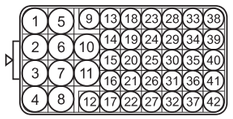


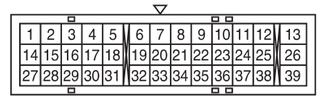
(1) CONNECTOR INFORMATION

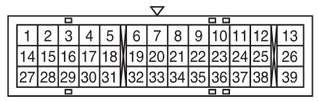
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G205	W/H Main	RH Eng ECU	ECU
G207	W/H Main	Inner the Passenger Cowl Side PNL	

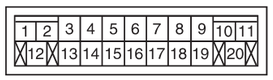
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

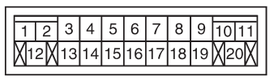

C102
W/H Floor
(Eng Room Fuse & Relay Box)

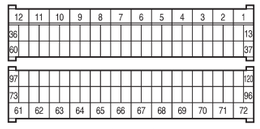

C115
W/H Eng Control

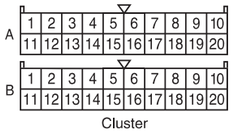

C202
W/H Floor


C206
W/H Floor

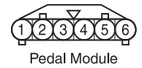

C212
W/H Floor


C213
W/H Floor

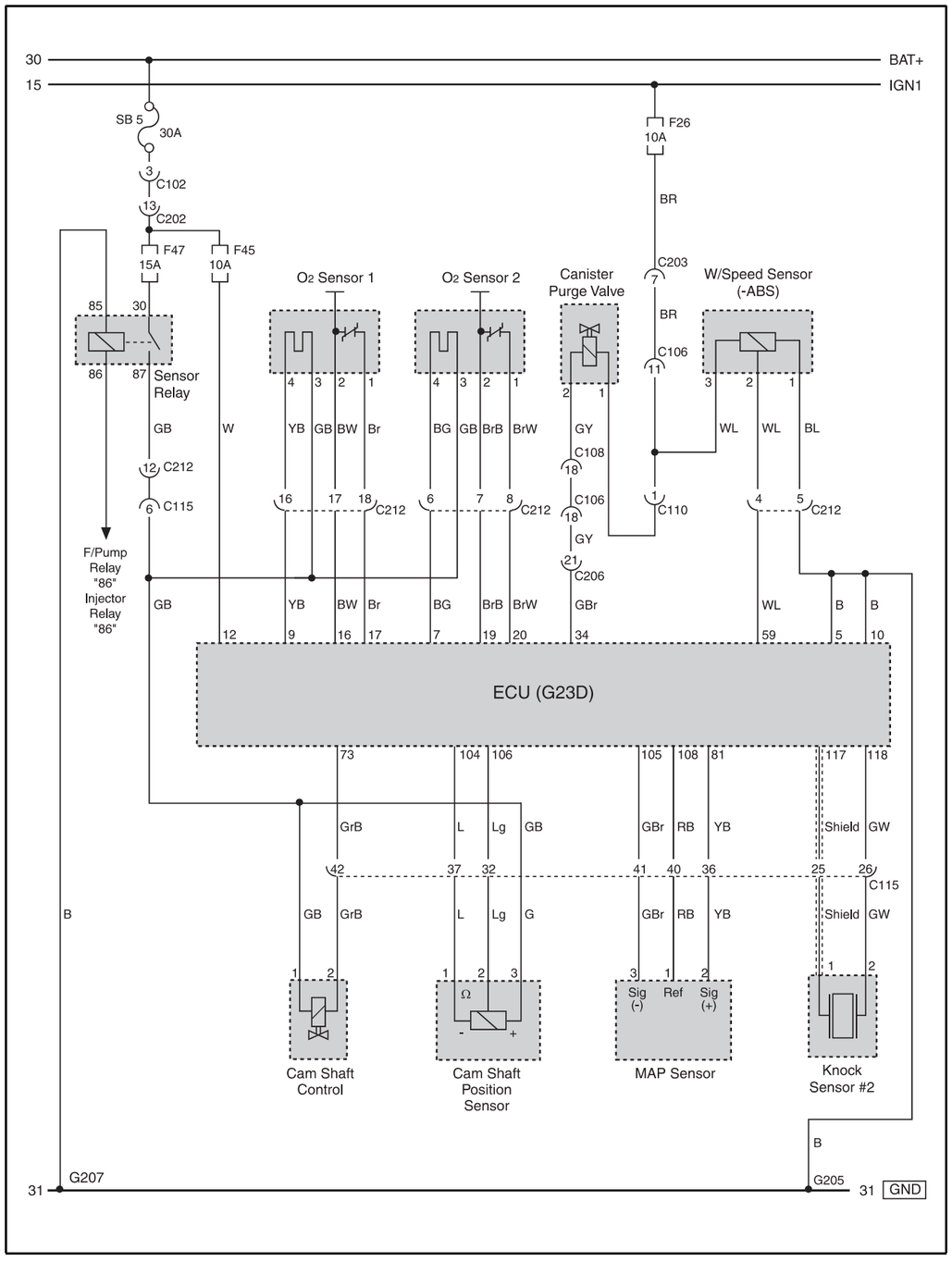

ECU (GSL)


Cluster


Crank Shaft
Position Sensor


Pedal Module

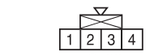
2) O_2 SENSOR, CPS, KNOCK SENSOR, MAP SENSOR, CANISTER PURGE VALVE

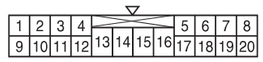


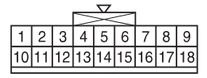
(1) CONNECTOR INFORMATION

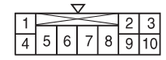
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (10Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G205	W/H Main	RH Eng ECU	ECU
G207	W/H Main	Inner the Passenger Cowl Side PNL	

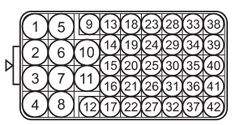
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

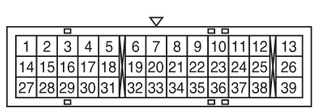

C102
W/H Floor
(Eng Room Fuse & Relay Box)

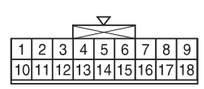

C106
W/H Floor
(Eng Room Fuse & Relay Box)

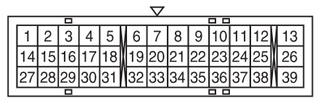

C108
W/H Engine
(Eng Room Fuse & Relay Box)

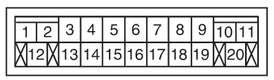

C110
W/H ENG
(Eng Room Fuse & Relay Box)

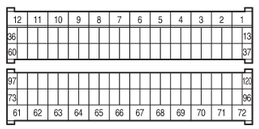

C115
W/H Eng Control


C202
W/H Floor


C203
W/H Floor


C206
W/H Floor


C212
W/H Floor


ECU (GSL)


Knock Sensor


Cam Shaft Position Sensor

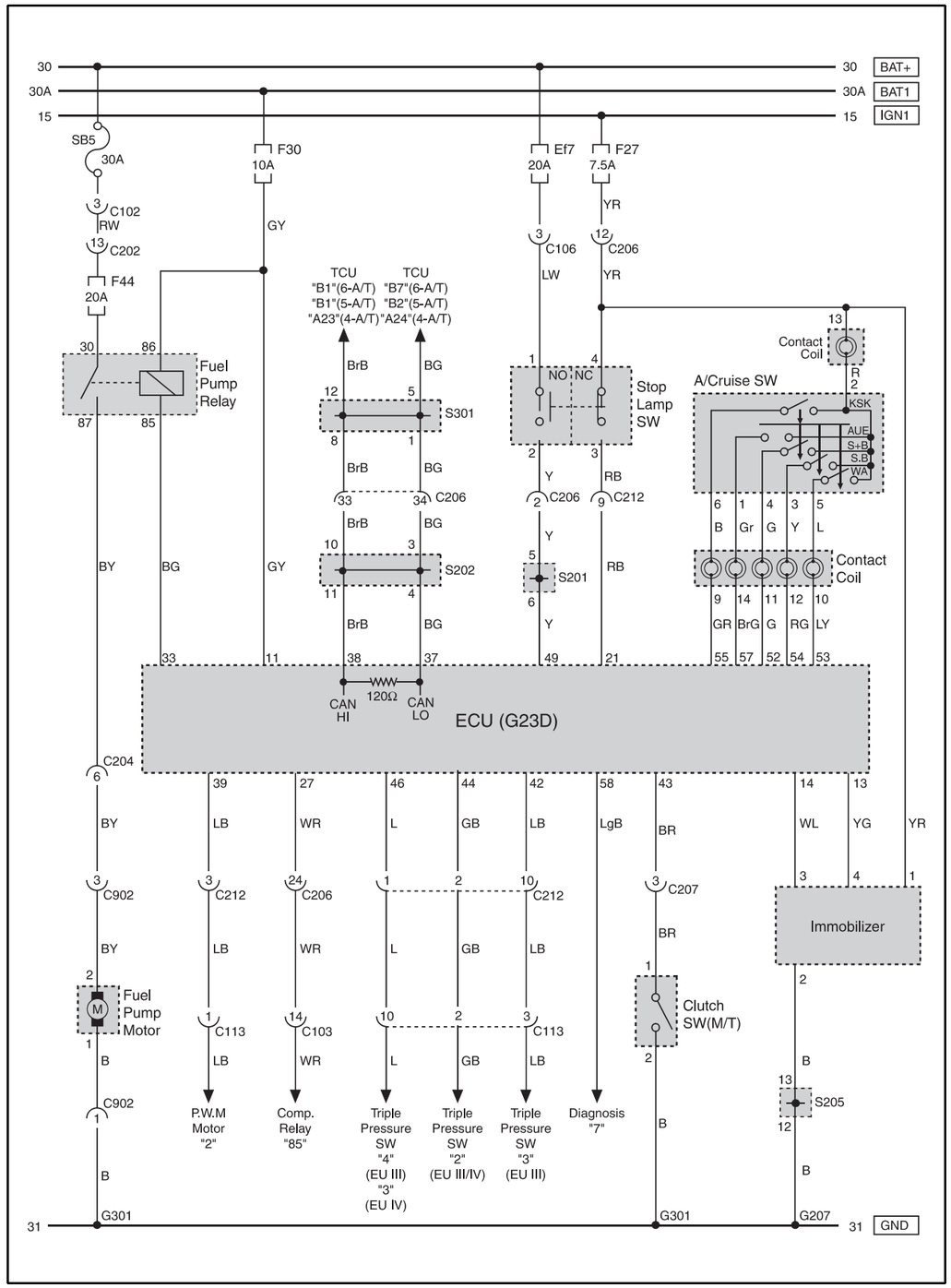

Canister Purge Valve


W/Speed Sensor (-ABS)


O_2 Sensor 1, 2

Modification basis	
Application basis	
Affected VIN	

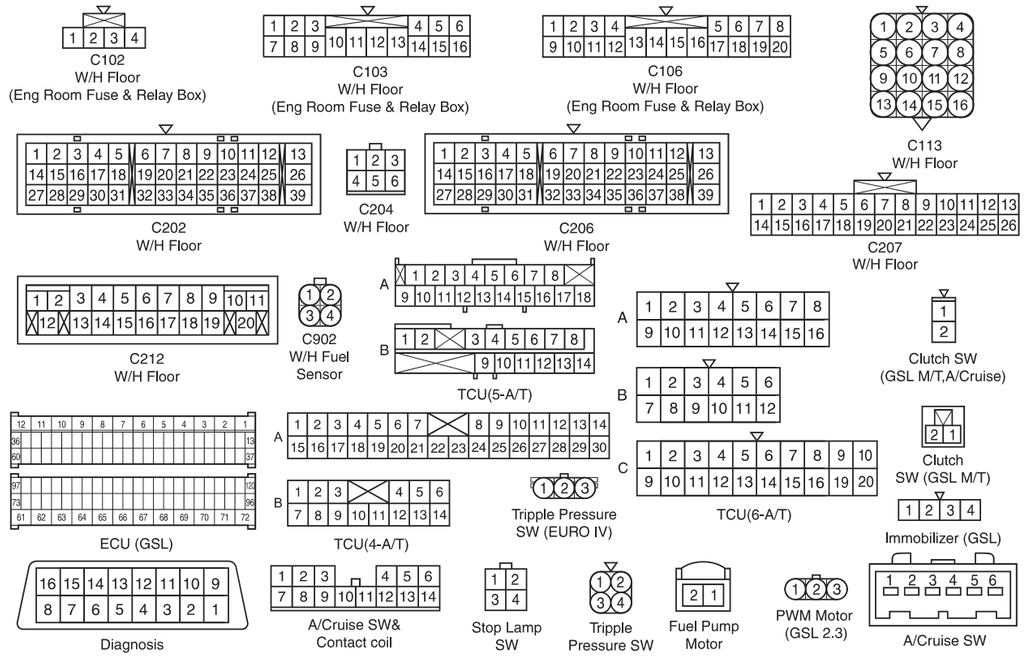
3) STOP LAMP, CRUISE CONTROL SW, FUEL PUMP, IMMOBILIZER



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C902 (4Pin, Black)	W/H Floor - W/H Fuel Sender	Upper the T/M	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S301 (14Pin, Black)	W/H Floor	Beside Driver Seat W/H Protector	CAN

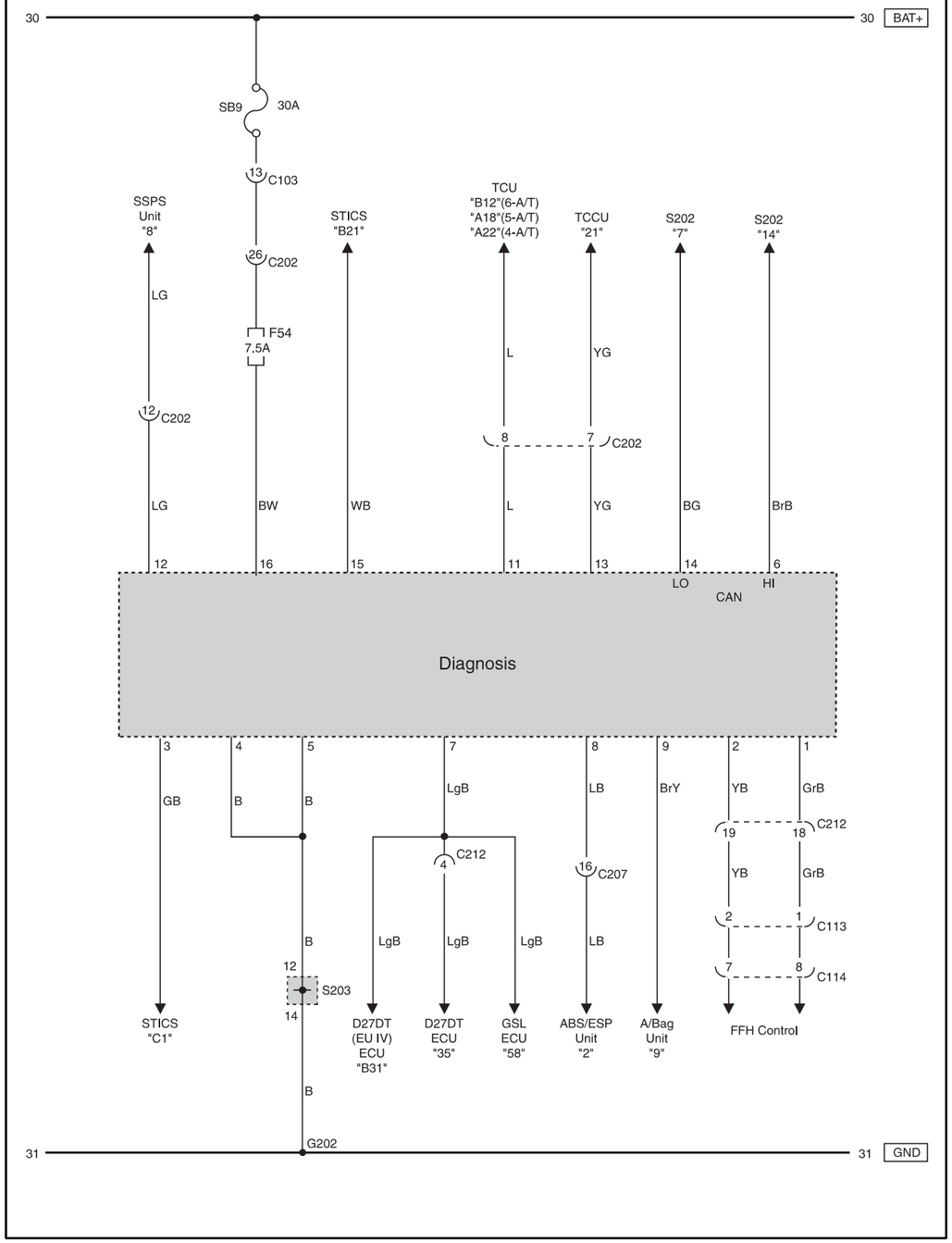
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 8210-00

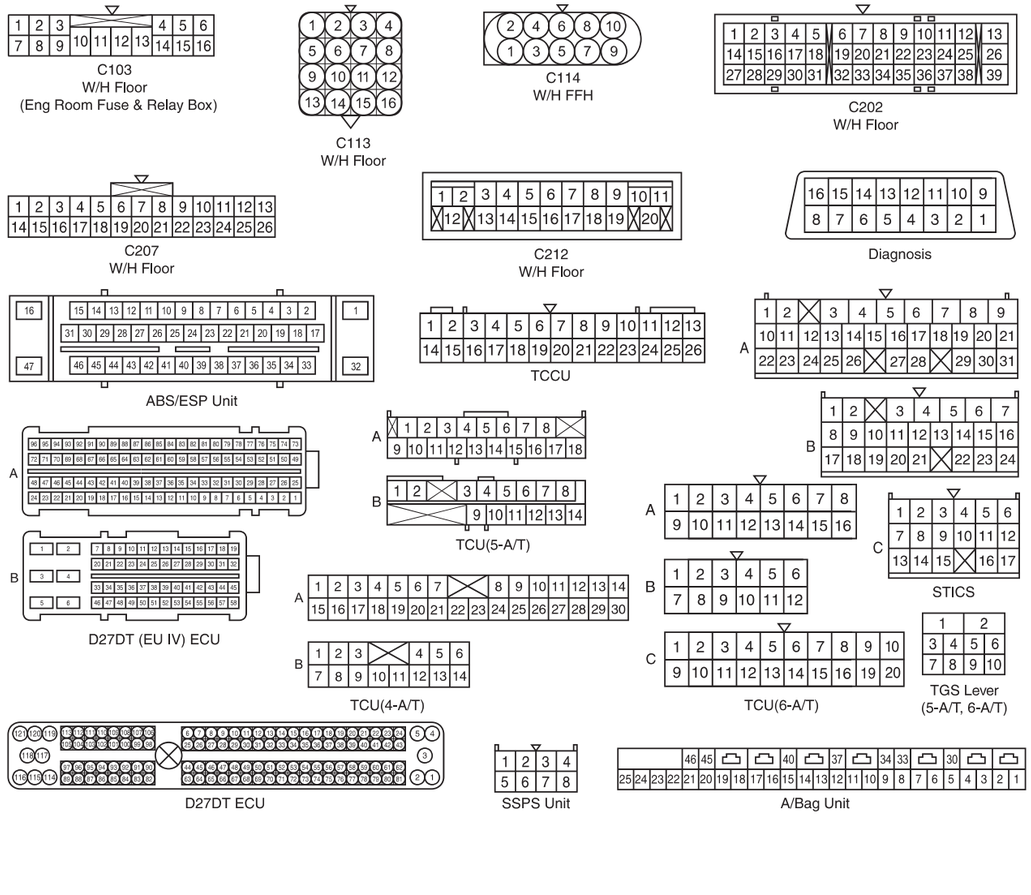
DIAGNOSIS CIRCUIT



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C114 (10Pin, Black)	W/H Eng - W/H FFH	Right Eng Room Dash PNL	FFH
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G202	W/H Main	Under the Driver “A” Pillar	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



CIRCUIT

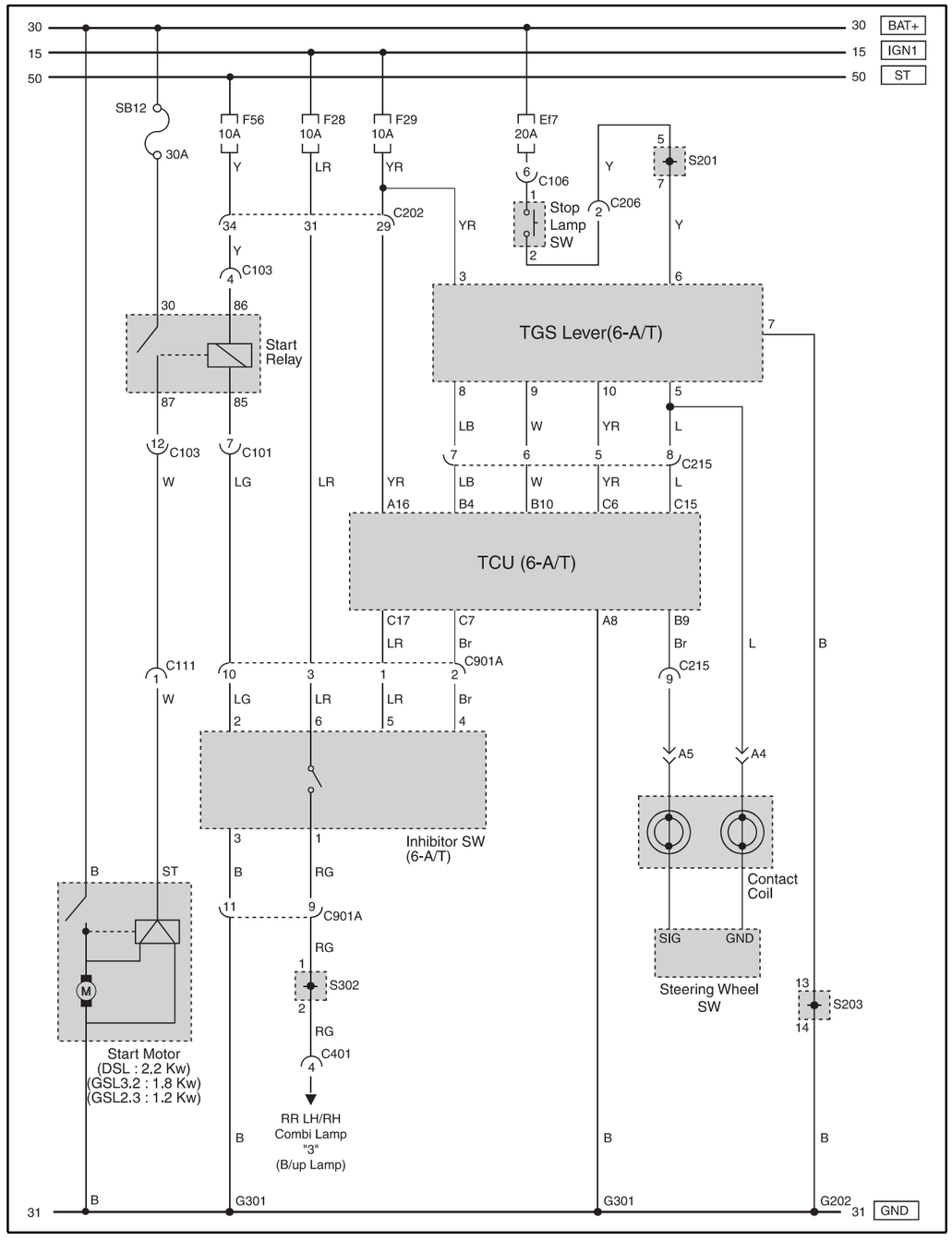
KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 3110-00

TCU (6-A/T)

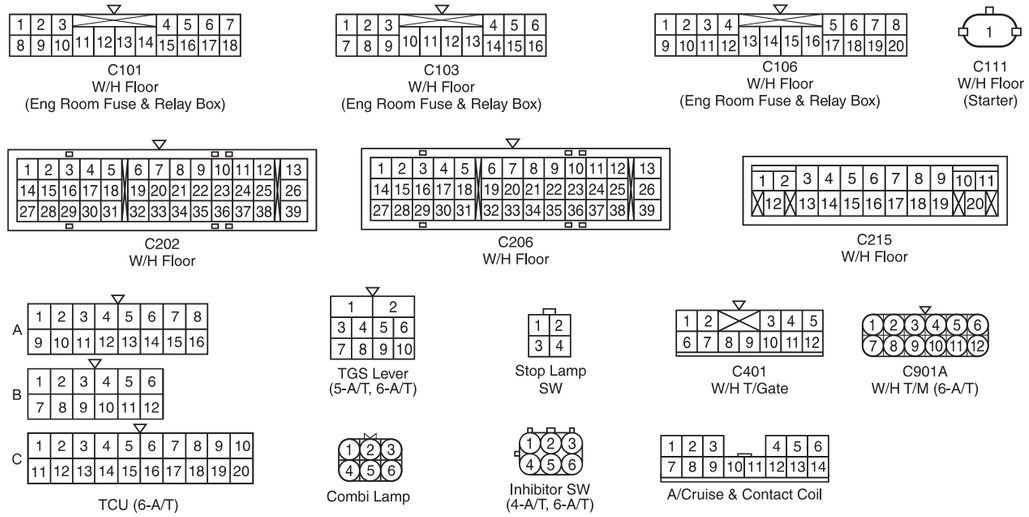
1) START MOTOR, TGS LEVER, INHIBITOR SW



(1) CONNECTOR INFORMATION

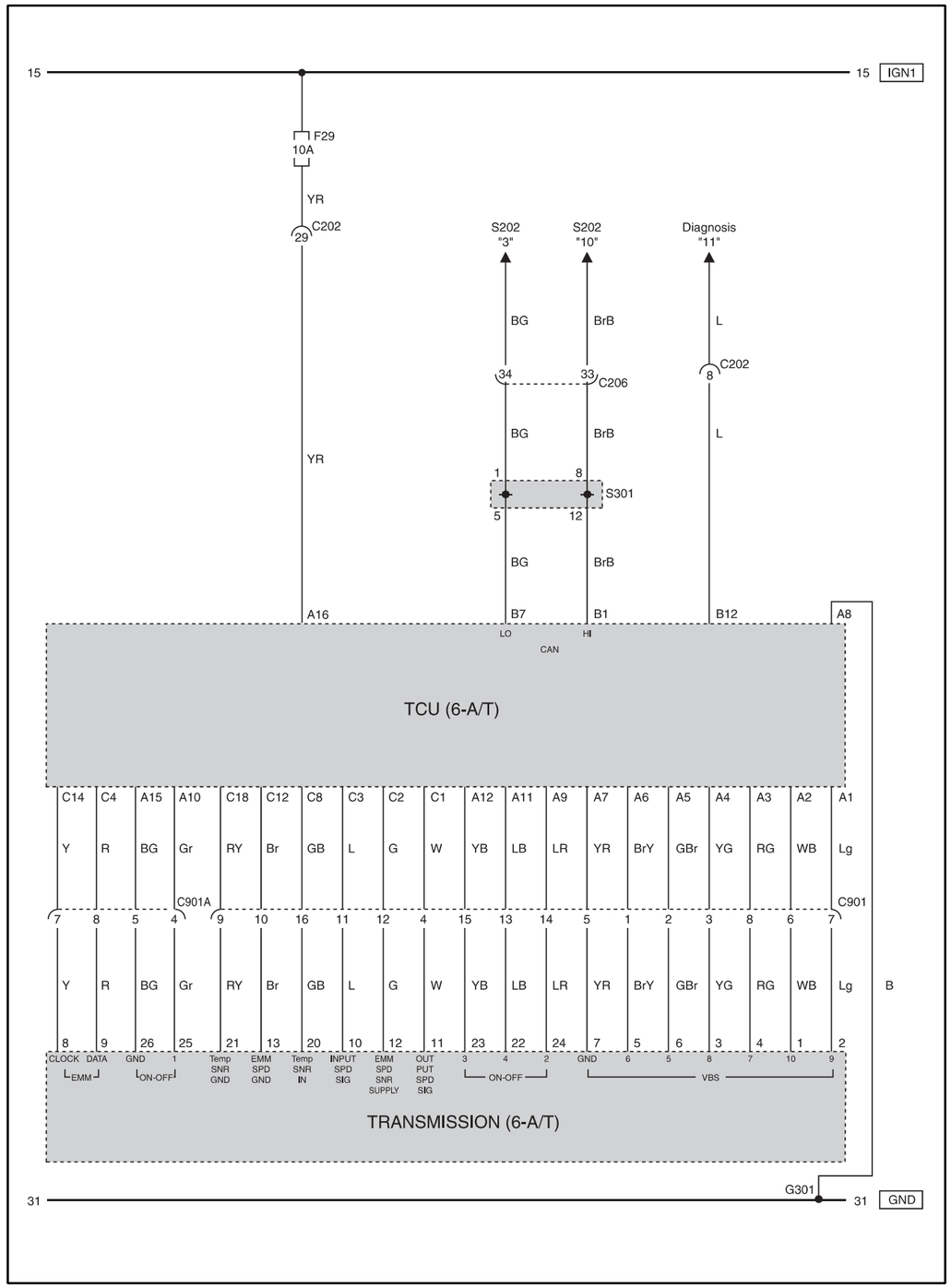
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C111 (1Pin, Gray)	W/H Floor - Starter Motor	Under the Preheating Time Relay	Solenoid
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C215 (20Pin, Brown)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
C901A (12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	6-A/T
G202	W/H Main	Under the Driver “A” Pillar	
G301	W/H Floor	Under the Driver Seat	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S302 (14Pin, Black)	W/H Floor	Beside RR LH Seat W/H Protector	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

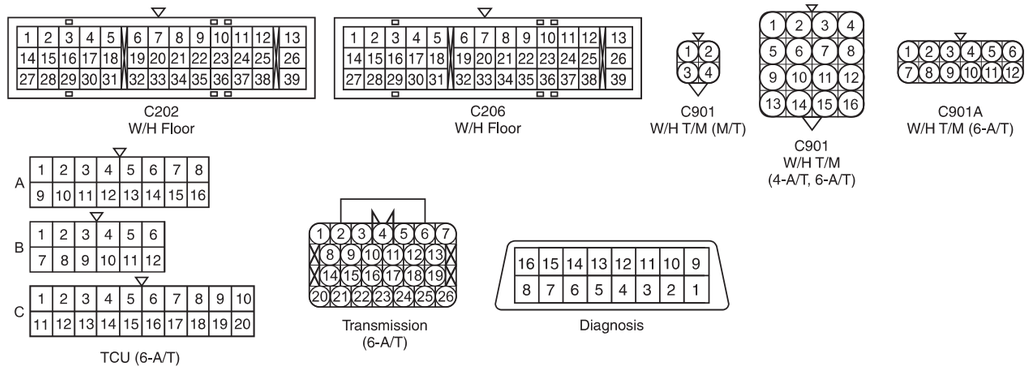
2) SOLENOID, OIL TEMP SENSOR, SPEED SENSOR (N2, N3)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C901	(16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	4-A/T, 6-A/T
	(12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	5-A/T
	(4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C901A (12Pin, Black)		W/H Floor - W/H T/M	Upper the T/M	6-A/T
G301		W/H Floor	Under the Driver Seat	
S202 (14Pin, Black)		W/H Main	RH Protector of the Driver Legroom	CAN
S301 (14Pin, Black)		W/H Floor	Beside Driver Seat W/H Protector	CAN

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

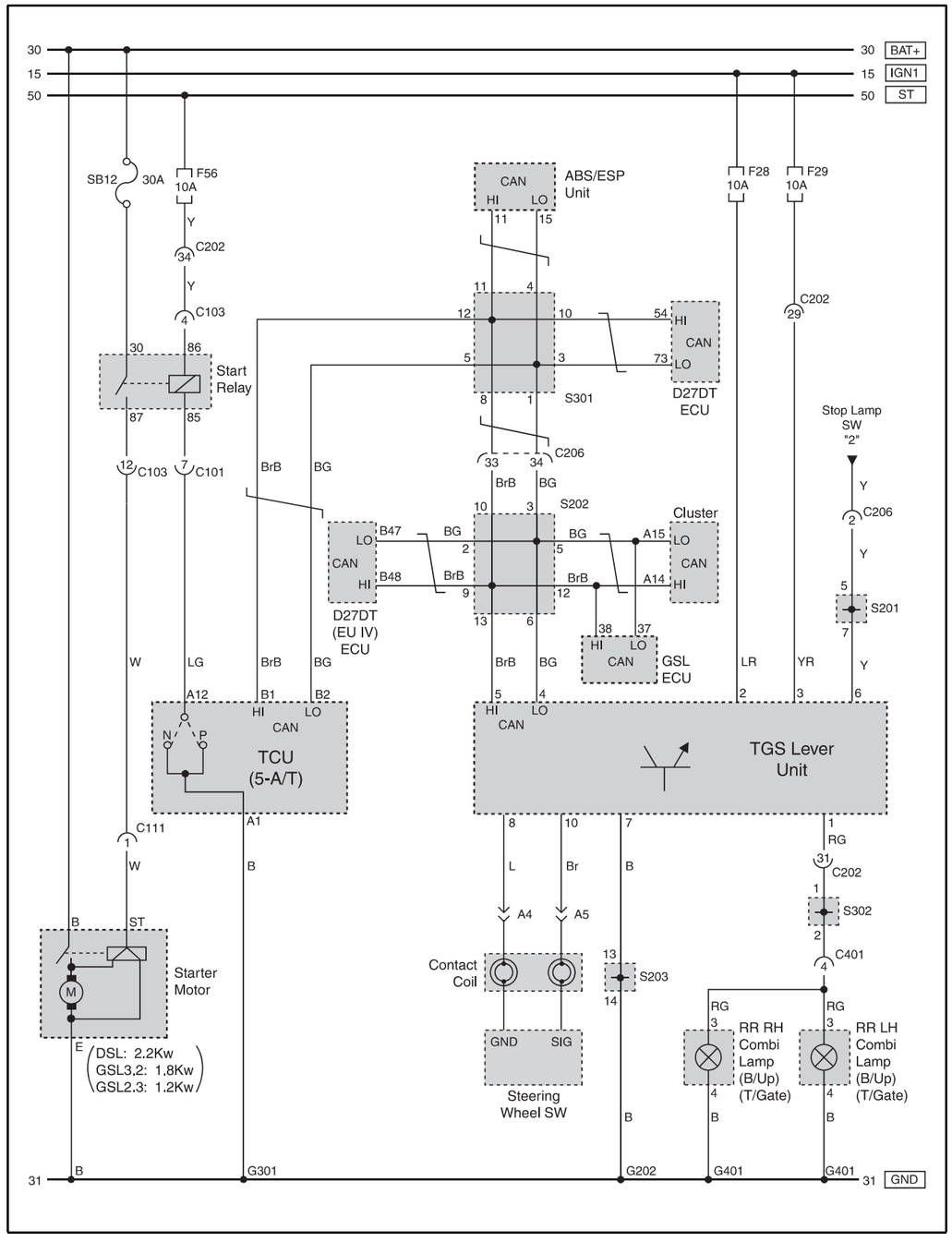


Modification basis	
Application basis	
Affected VIN	

S.G.N. 3110-00

TCU (5-A/T)

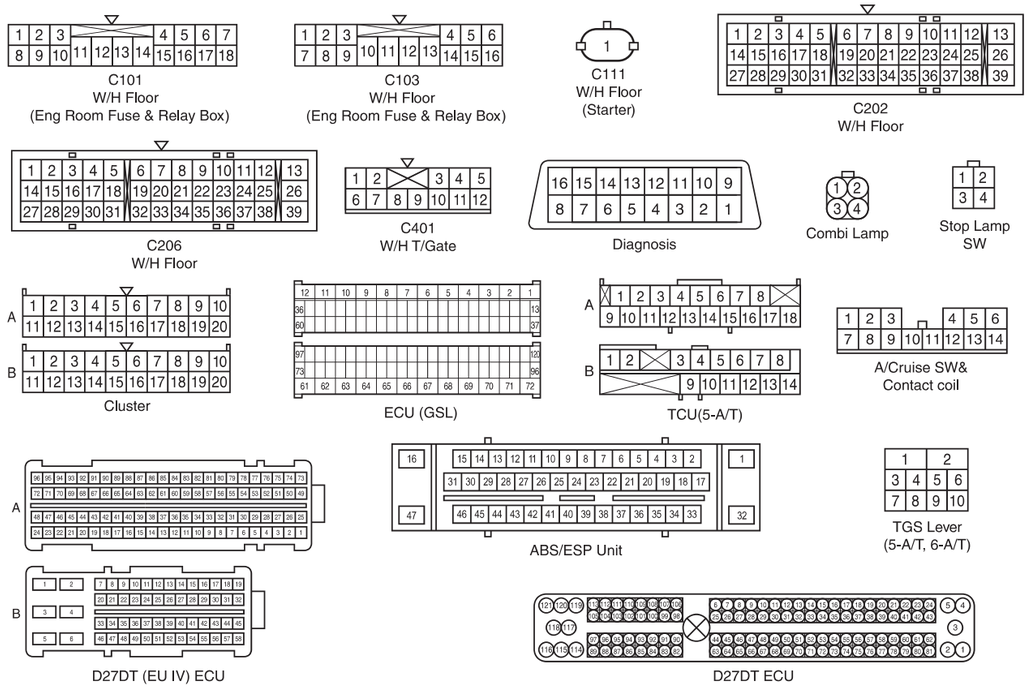
1) START MOTOR, TGS LEVER, CAN LINE



(1) CONNECTOR INFORMATION

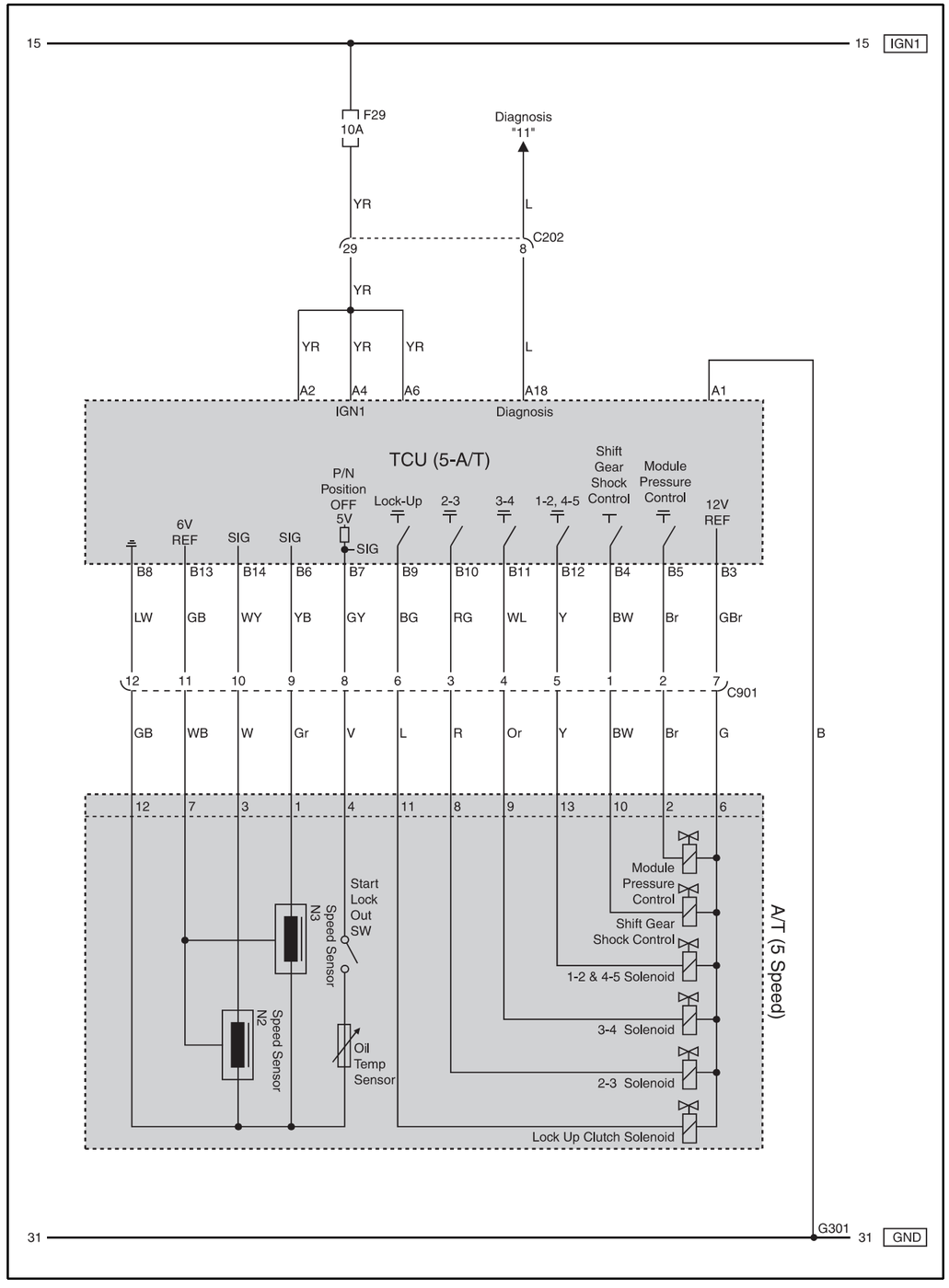
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C111 (1Pin, Gray)	W/H Floor - Starter Motor	Under the Preheating Time Relay	Solenoid
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
G202	W/H Main	Under the Driver “A” Pillar	
G301	W/H Floor	Under the Driver Seat	
G401	W/H T/Gate	Center the T/Gate	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

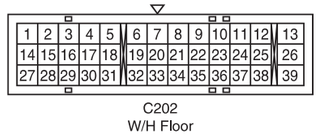
2) SOLENOID, OIL TEMP SENSOR, SPEED SENSOR (N2, N3)



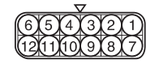
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C901 (12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	5-A/T
G301	W/H Floor	Under the Driver Seat	

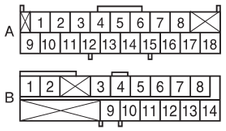
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



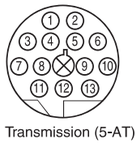
C202
W/H Floor



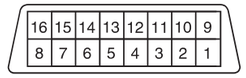
C901
W/H Transmission (5-A/T)



TCU(5-A/T)



Transmission (5-AT)

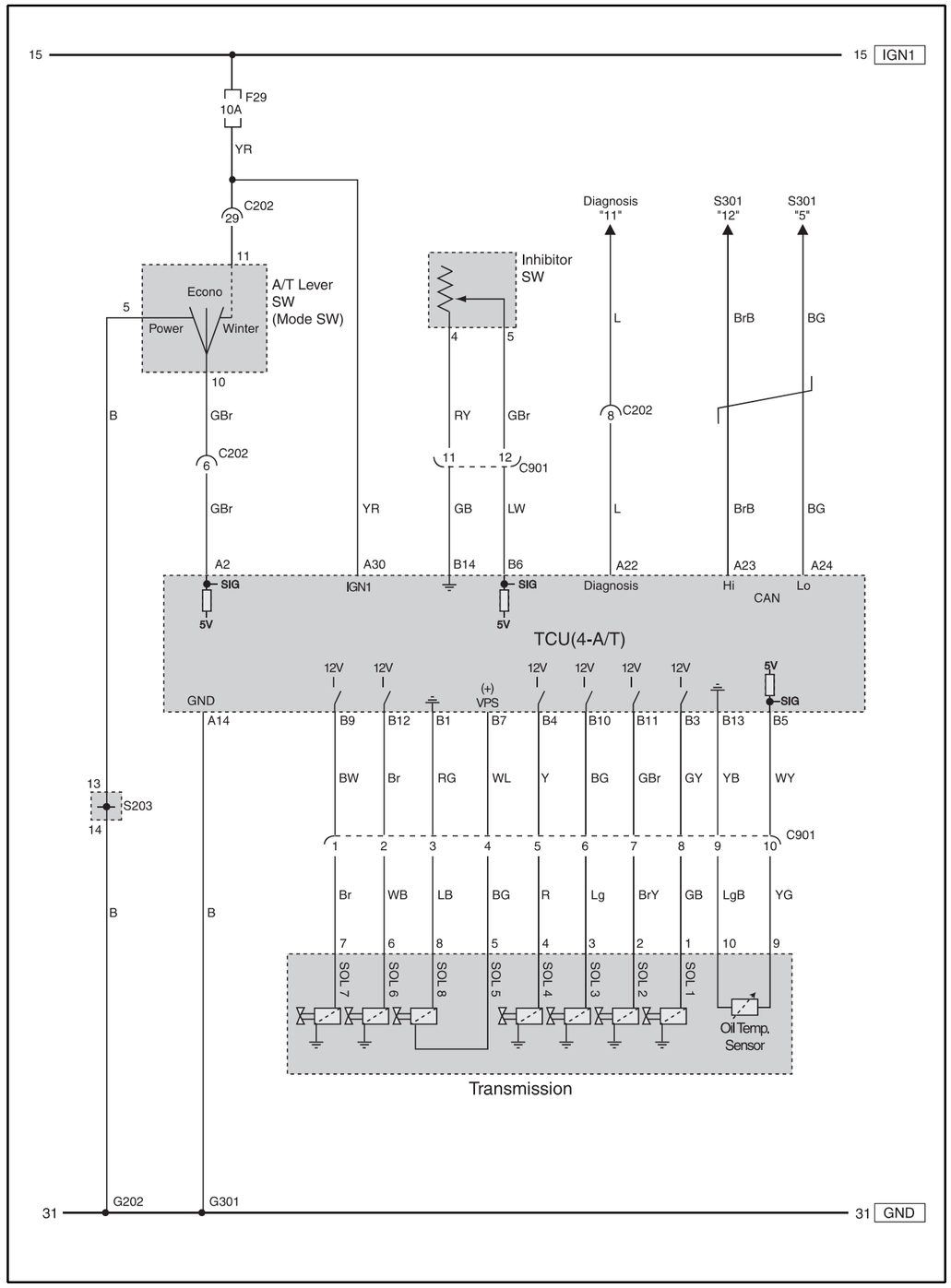


Diagnosis

Modification basis	
Application basis	
Affected VIN	

S.G.N. 3110-00

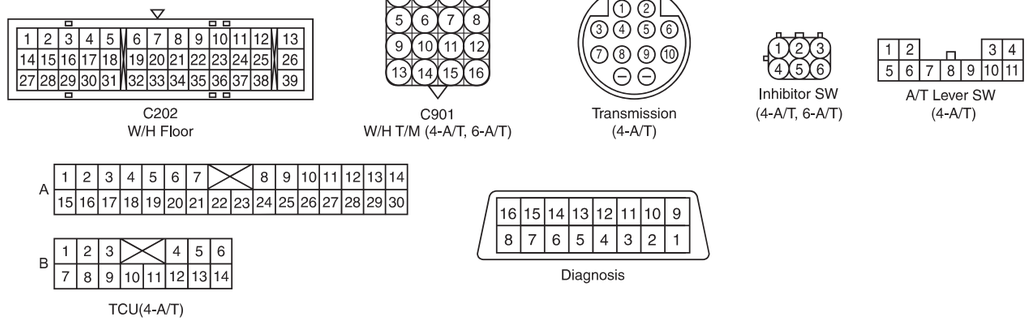
TCU (4-A/T)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C901 (16Pin, Black)	W/H Main - W/H T/M	Upper the T/M	4-A/T, 6-A/T
G202	W/H Main	Under the Driver “A” Pillar	
G301	W/H Floor	Under the Driver Seat	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

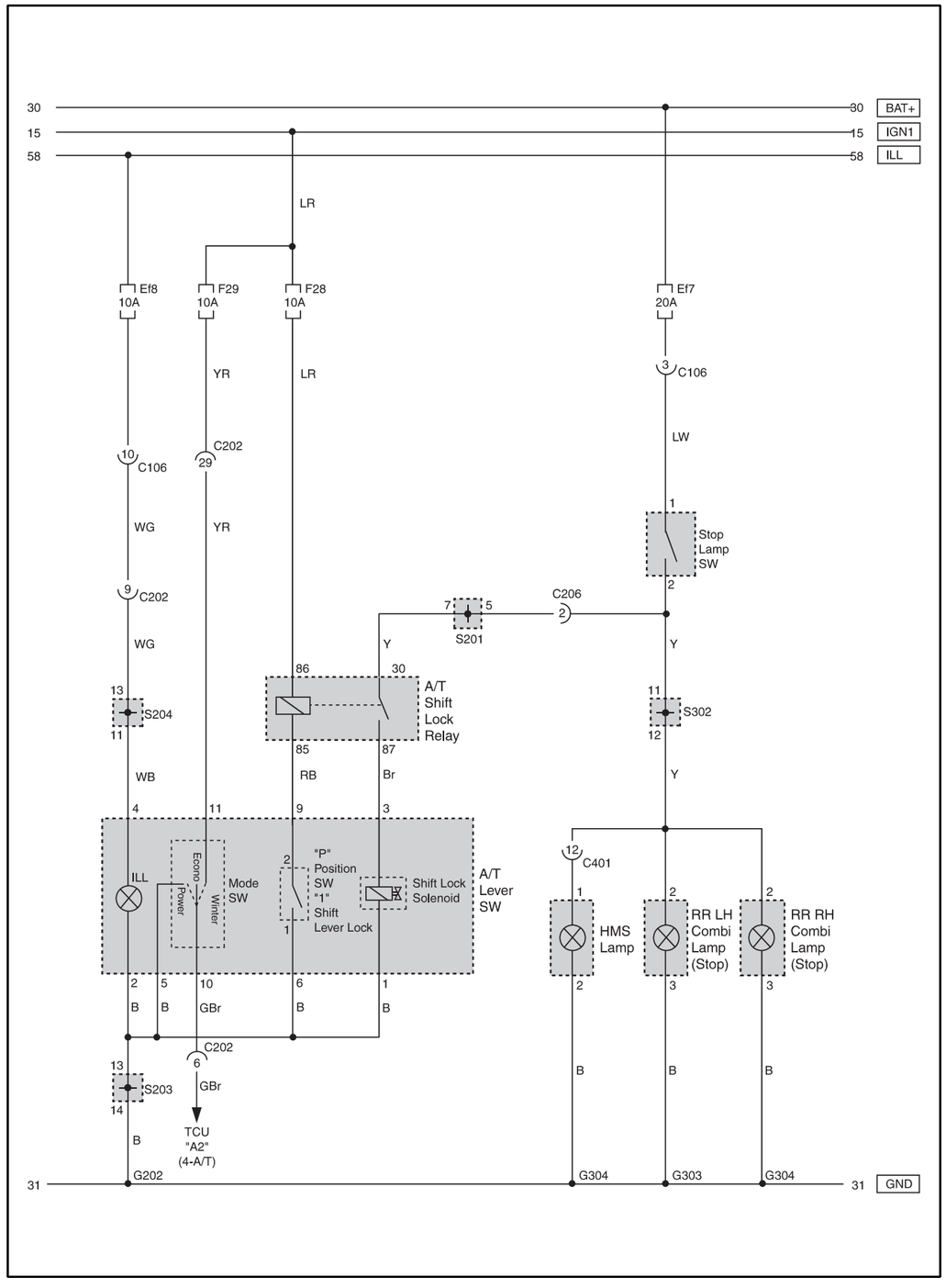
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 3740-00

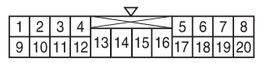
A/T SHIFT LOCK (4-A/T)



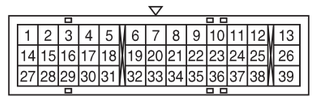
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
G202	W/H Main	Under the Driver “A” Pillar	
G303	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G304	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S302 (14Pin, Black)	W/H Floor	Beside RR LH Seat W/H Protector	

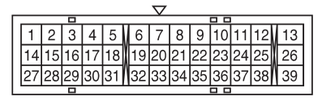
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



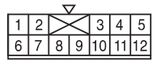
C106
W/H Floor
(Eng Room Fuse & Relay Box)



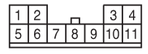
C202
W/H Floor



C206
W/H Floor



C401
W/H T/Gate



A/T Lever SW
(4-A/T)



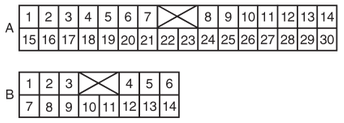
Stop Lamp SW



Combi Lamp
(T/Gate)



HMS Lamp



TCU(4-A/T)

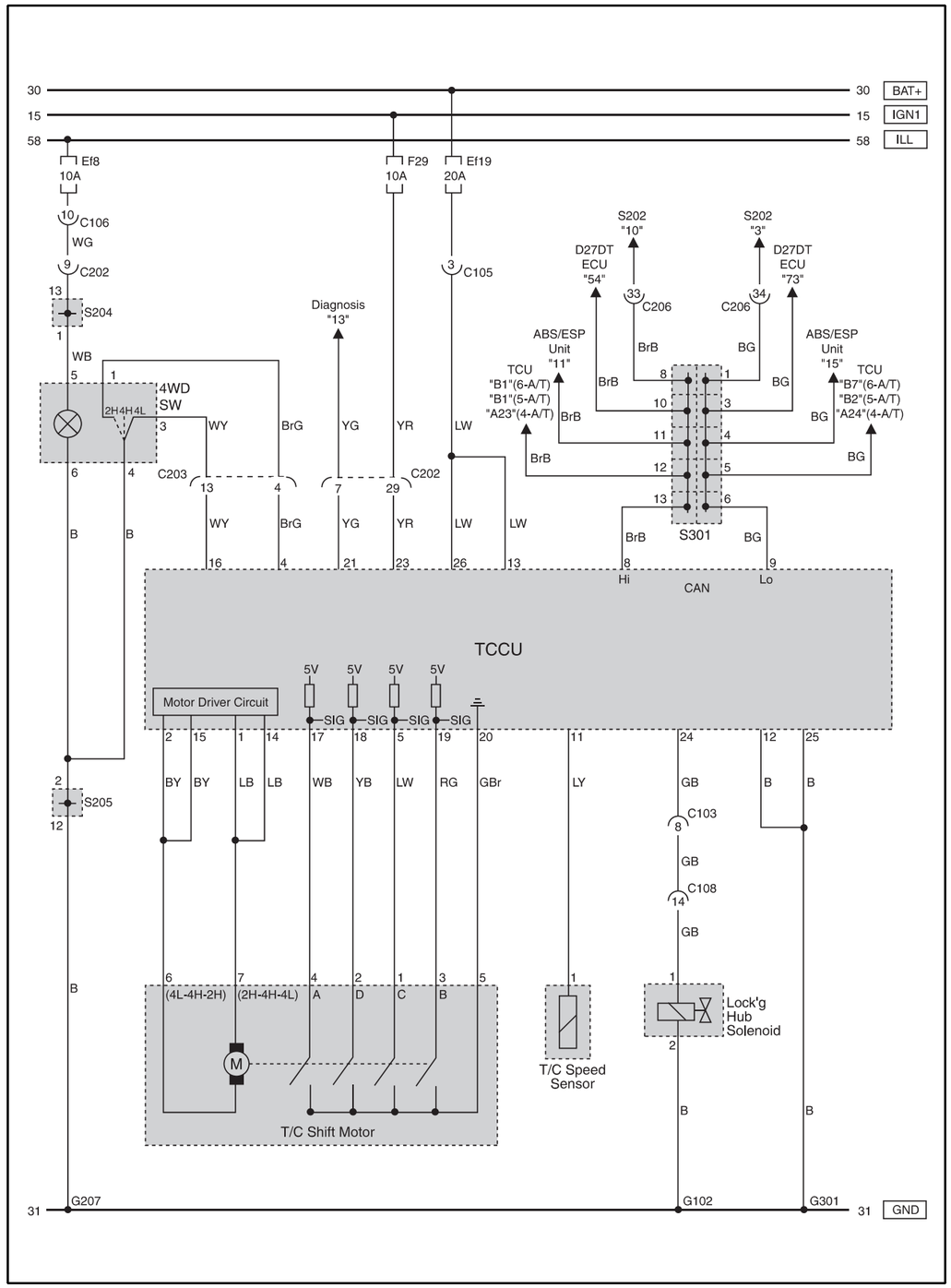
CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 3410-00

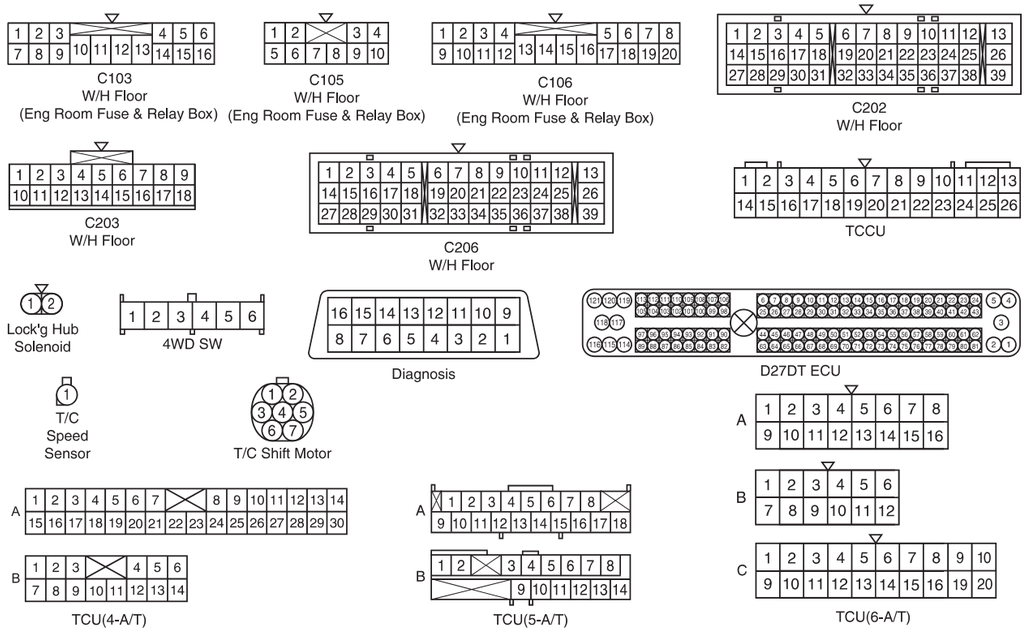
TCCU



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G102	W/H Eng Room	Behind LH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

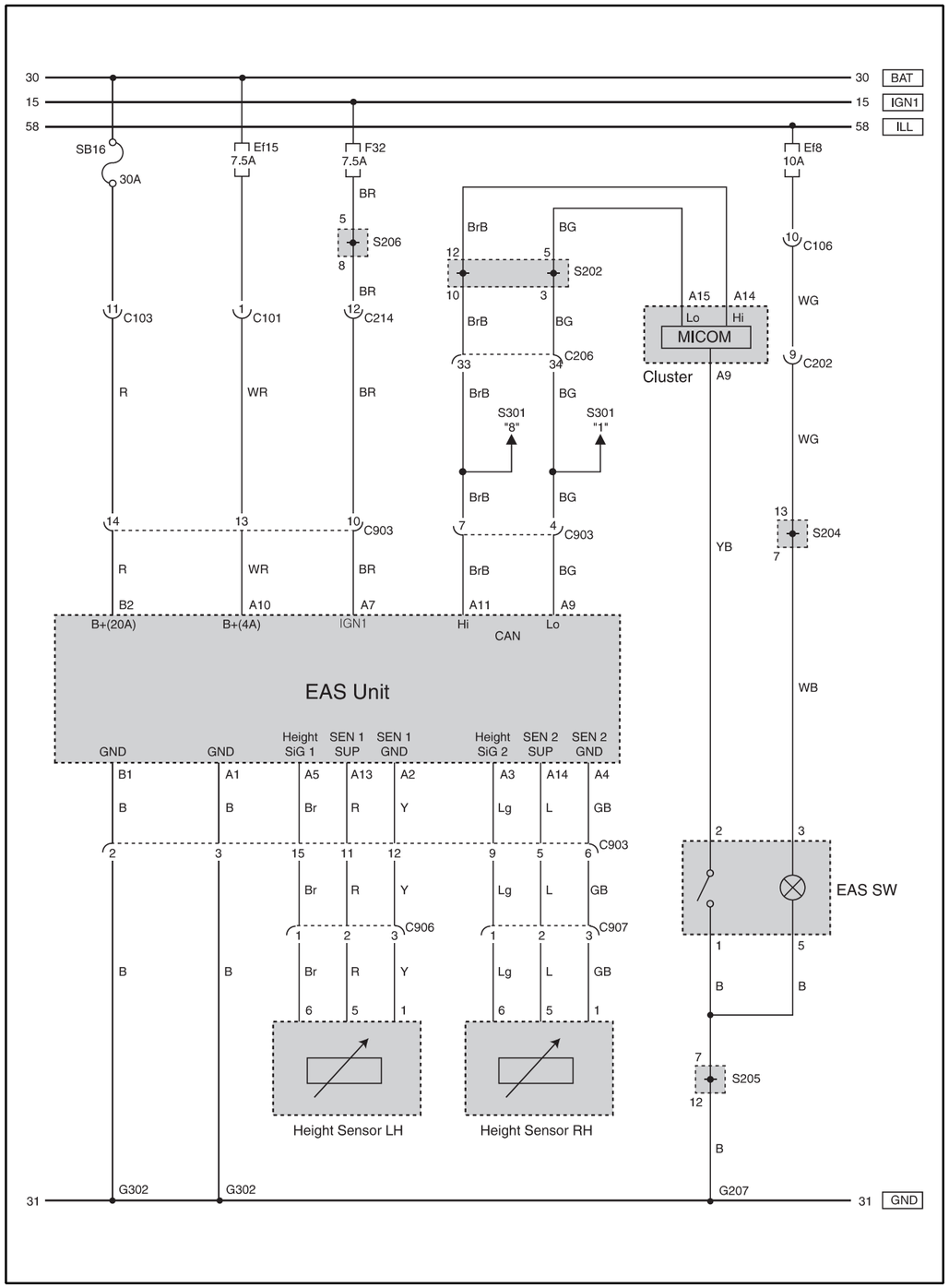
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 4480-00

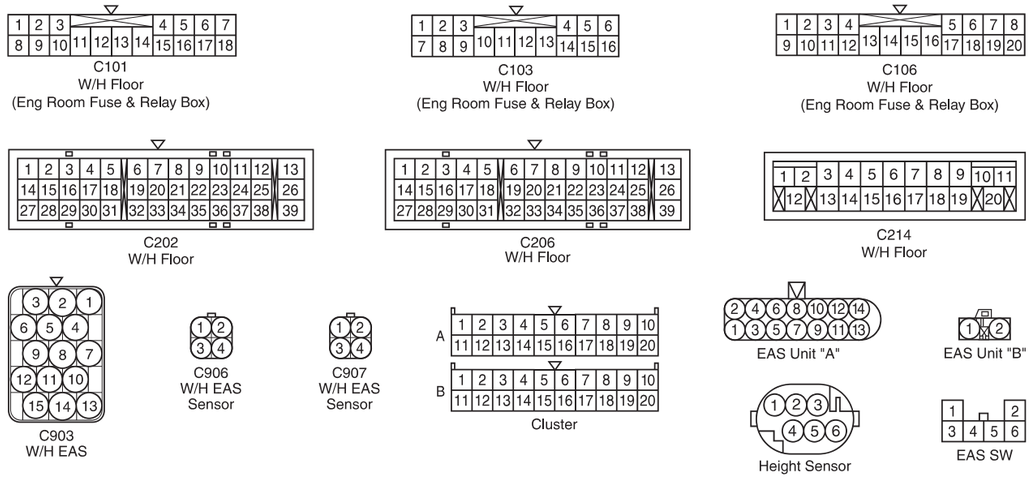
EAS



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C903 (15Pin, Black)	W/H Floor - W/H EAS	Lower the Passenger	
C906 (4Pin, Black)	W/H Floor - W/H EAS Sensor	Under LH Bumper	
C907 (4Pin, Black)	W/H Floor - W/H EAS Sensor	Under RH Bumper	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G302	W/H Floor	Under the Passenger Seat	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



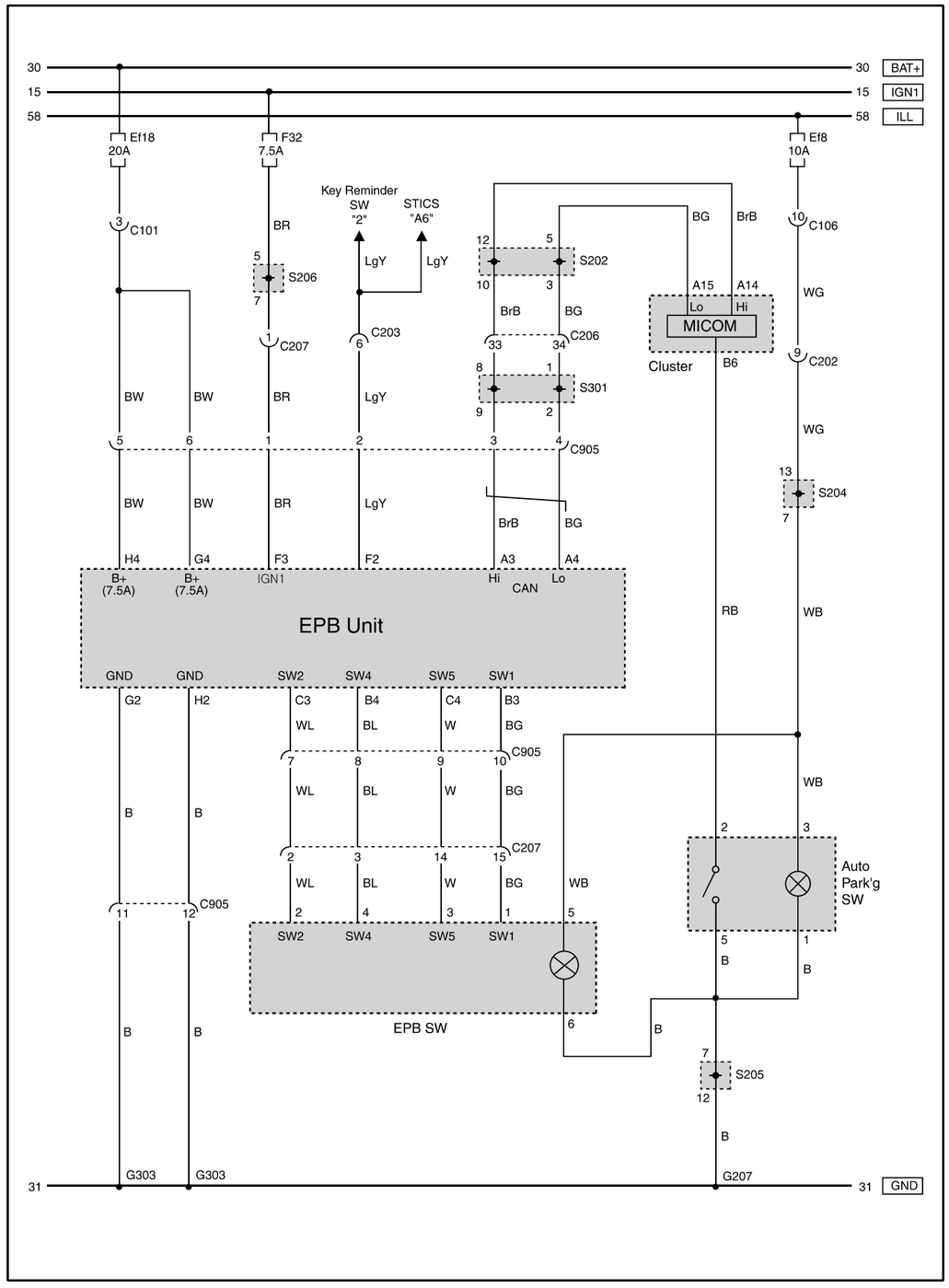
CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 4920-00

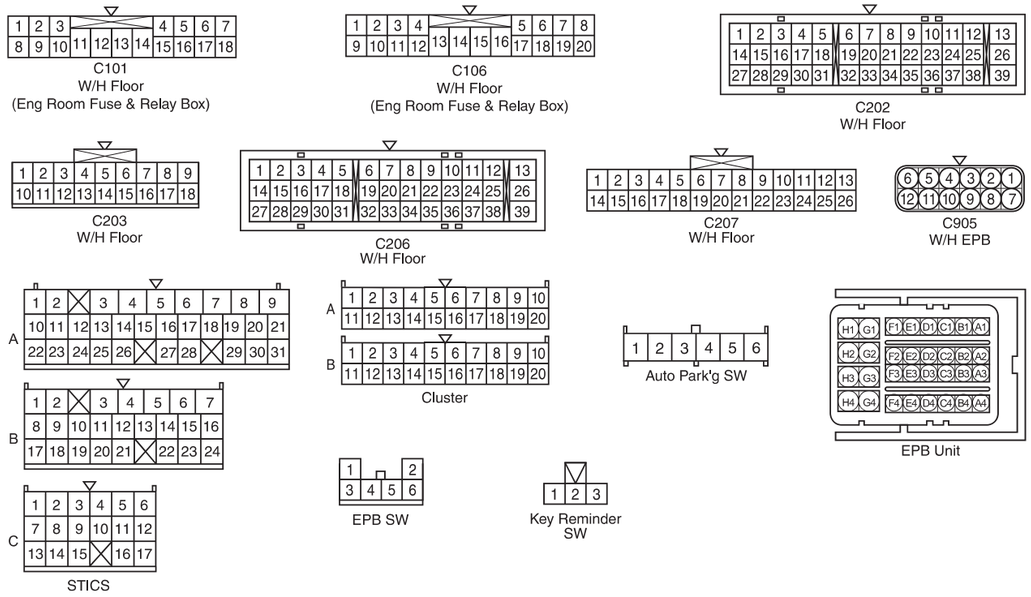
EPB



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C905 (12Pin, Black)	W/H Floor - W/H EPB	Under LH Bumper	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G303	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

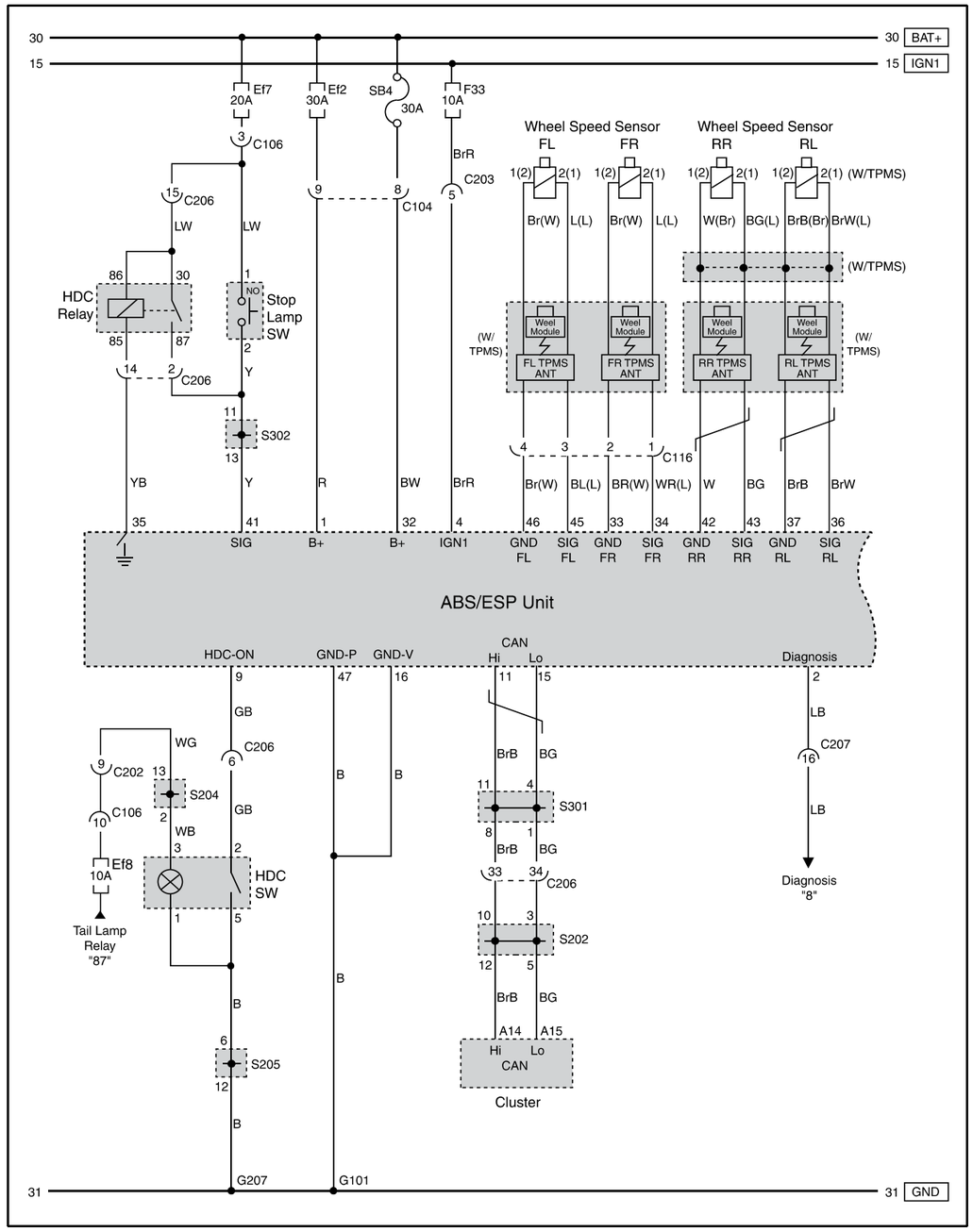


Modification basis	
Application basis	
Affected VIN	

S.G.N. 4892-00

ABS/ESP (TPMS)

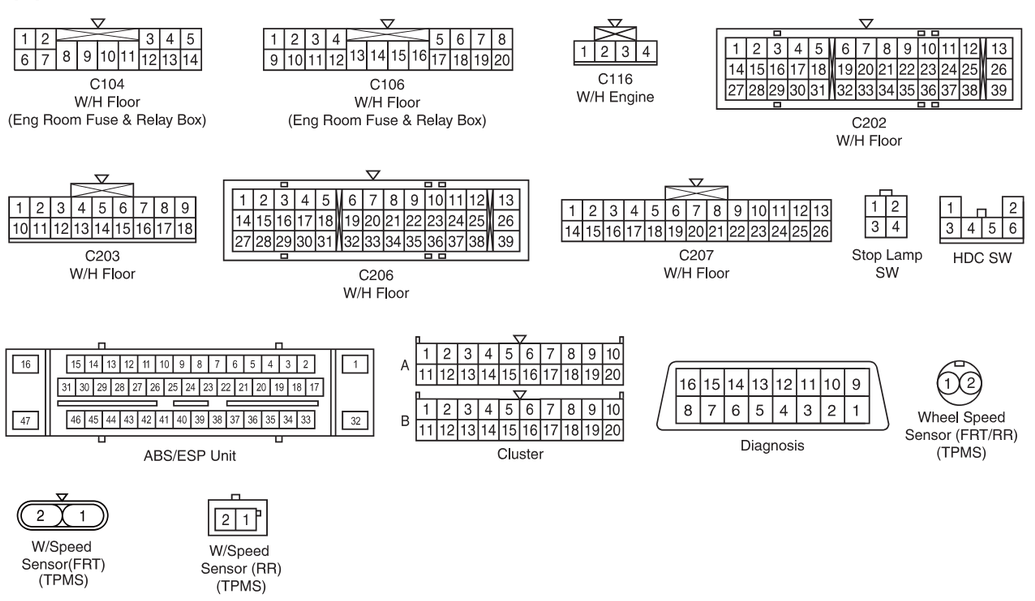
1) W/SPEED SENSOR, STOP LAMP SW, DIAGNOSIS, WARNING LAMP (ABS/ESP), HDC



(1) CONNECTOR INFORMATION

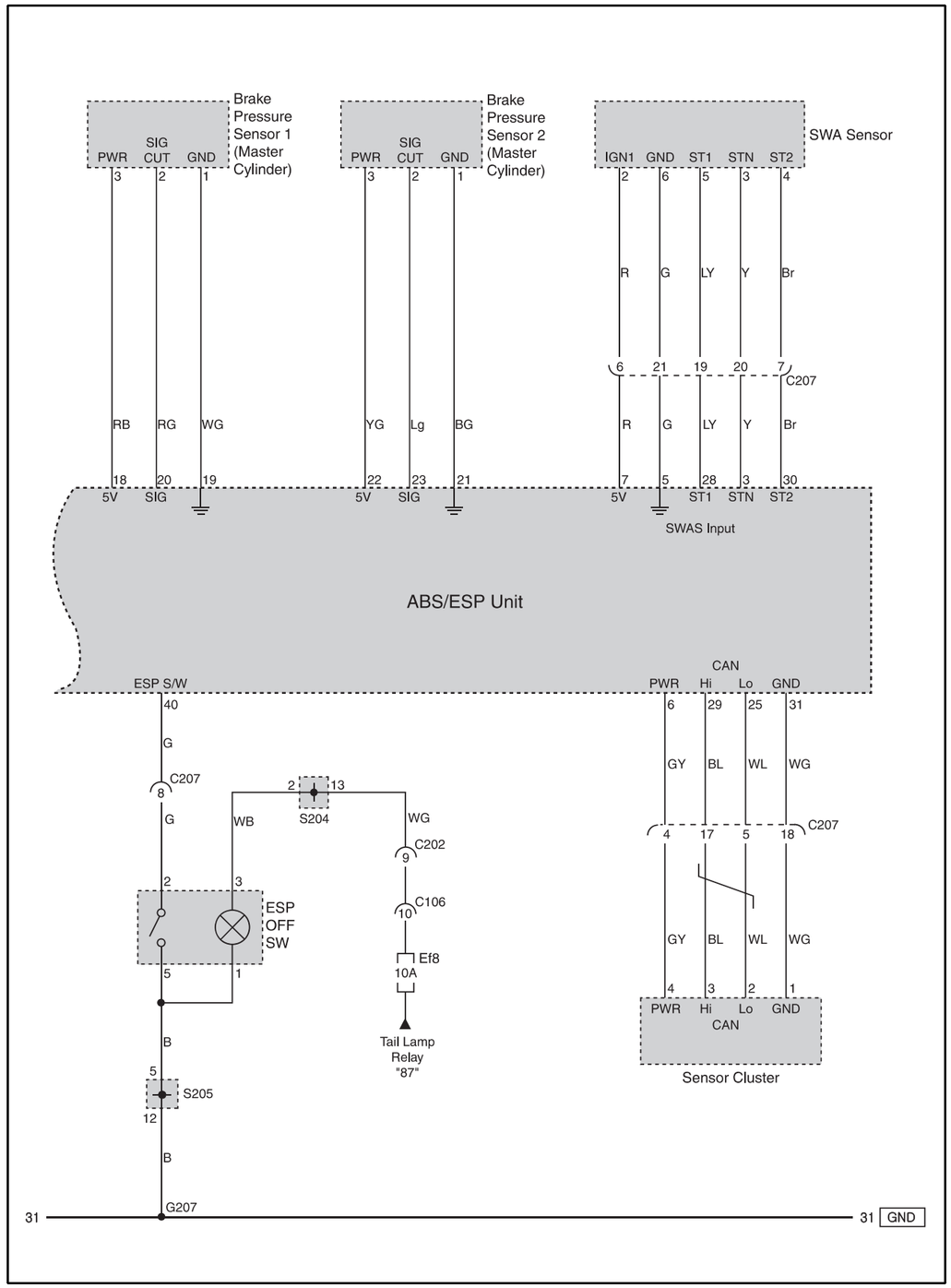
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C116 (4Pin, White)	W/H Eng - W/H Floor	Inside Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G101	W/H Floor	ABS/ESP Modulator	ABS/ESP
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Ptotector	GND
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

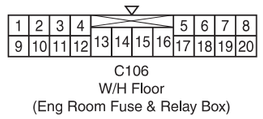
2) PRESSURE SENSOR, S.W.A SENSOR, SENSOR CLUSTER, ESP OFF SW



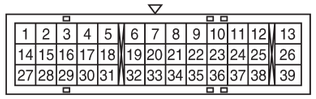
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



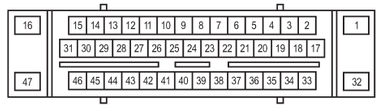
C106
W/H Floor
(Eng Room Fuse & Relay Box)



C202
W/H Floor



C207
W/H Floor



ABS/ESP Unit



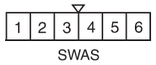
Sensor Cluster



Pressure Sensor



ESP OFF SW

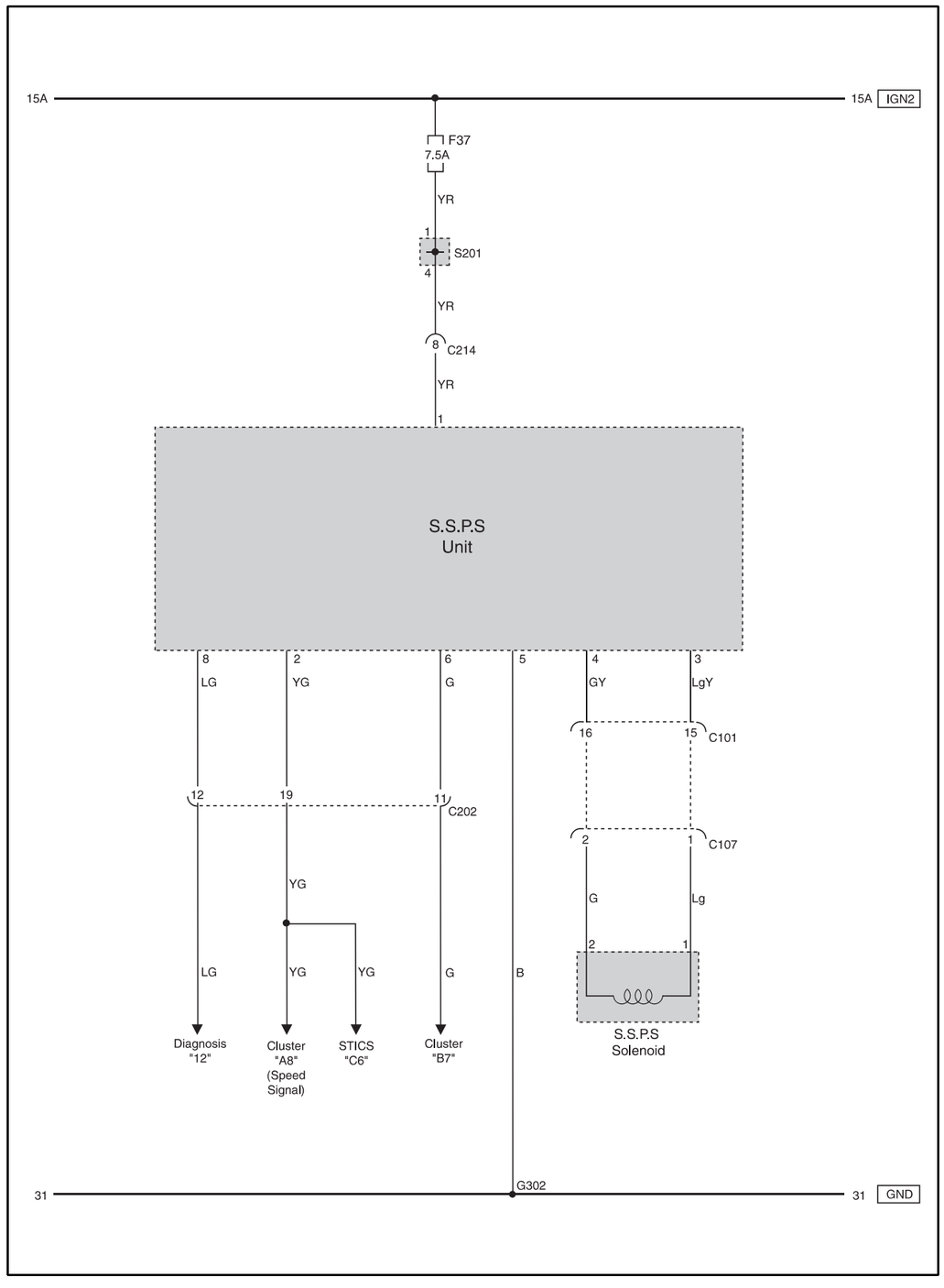


SWAS

Modification basis	
Application basis	
Affected VIN	

S.G.N. 4620-00

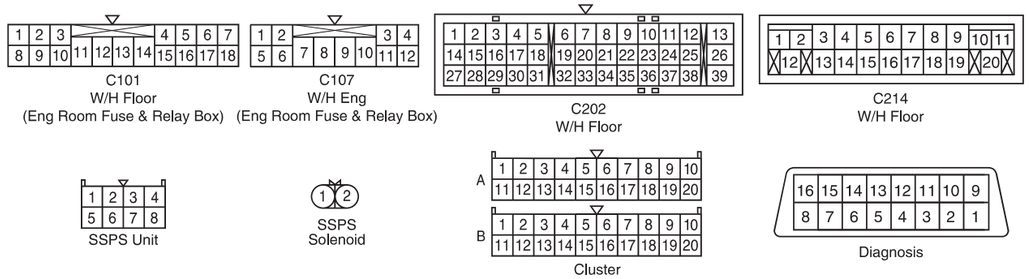
S.S.P.S (SPEED SENSITIVE POWER STEERING



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G302	W/H Floor	Under the Driver Seat	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

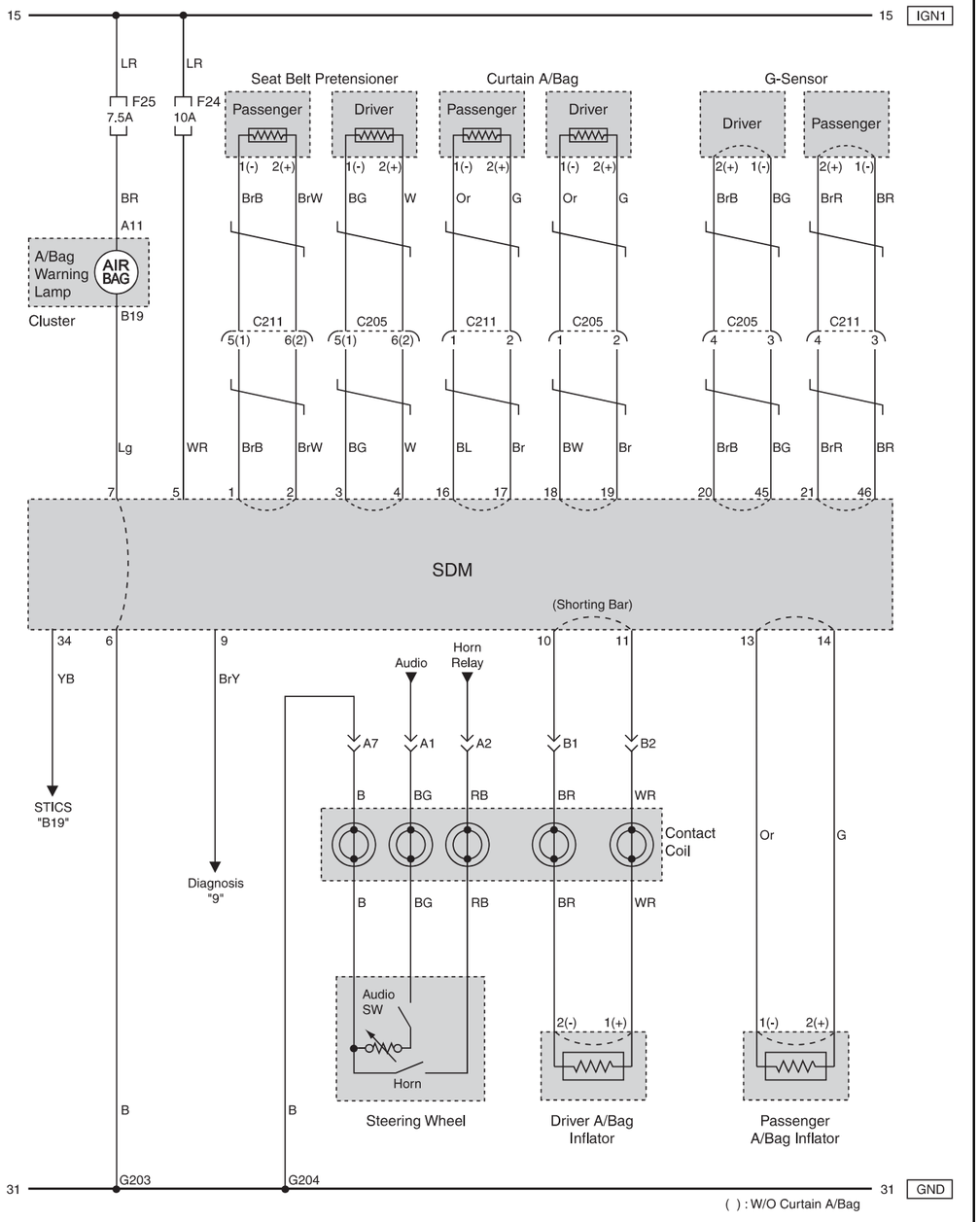
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 8810-00

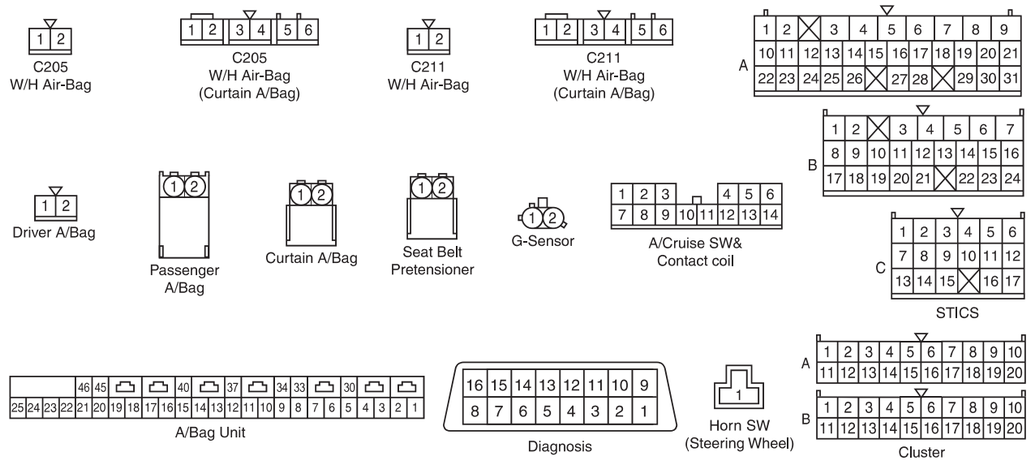
AIR-BAG (CURTAIN AIR-BAG)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C205	(2Pin, Yellow)	W/H Main - W/H A/Bag	Driver Cowl Side C/Holder	
	(6Pin, Yellow)	W/H Main - W/H A/Bag	Driver Cowl Side C/Holder	Curtain A/Bag
C211	(2Pin, Yellow)	W/H Main - W/H A/Bag	Passenger Cowl Side C/Holder	
	(6Pin, Yellow)	W/H Main - W/H A/Bag	Passenger Cowl Side C/Holder	Curtain A/Bag
G203		W/H Main	Backside A/Bag Unit	A/Bag
G204		W/H Main	Backside TGS Lever Unit	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

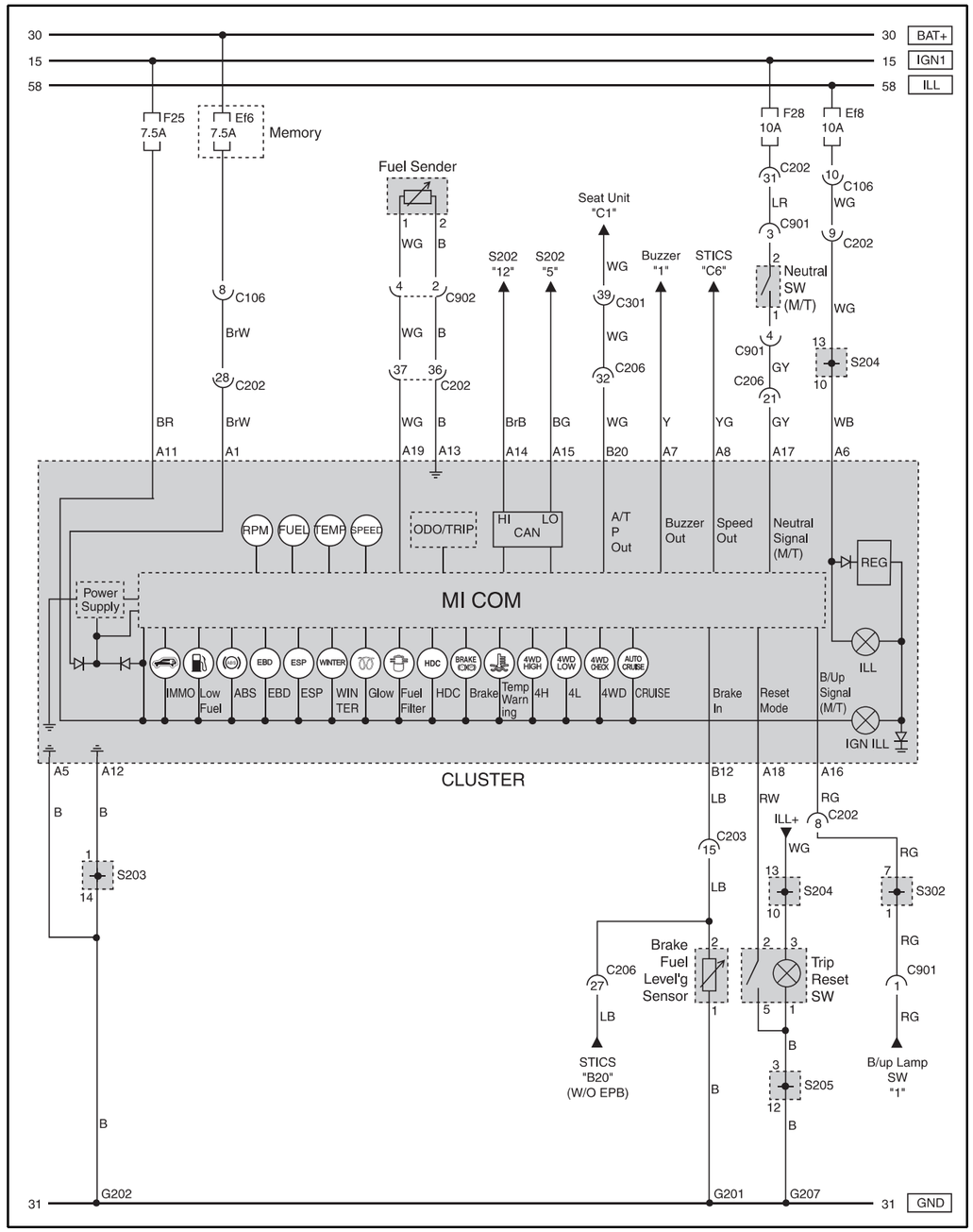


Modification basis	
Application basis	
Affected VIN	

S.G.N. 8010-00

CLUSTER

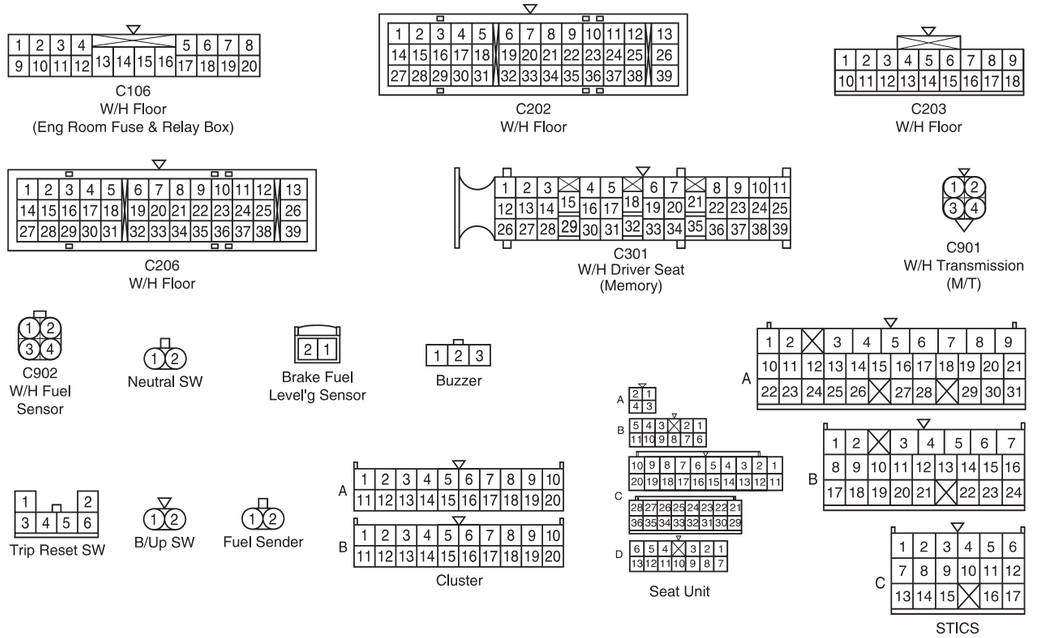
1) GAUGE (SPEED, RPM, FUEL, TEMP), WARNING LAMP (FUEL, FUEL FILTER, ABS/ESP, BRAKE, HDC, 4WD, EPB, EAS, TPMS)



(1) CONNECTOR INFORMATION

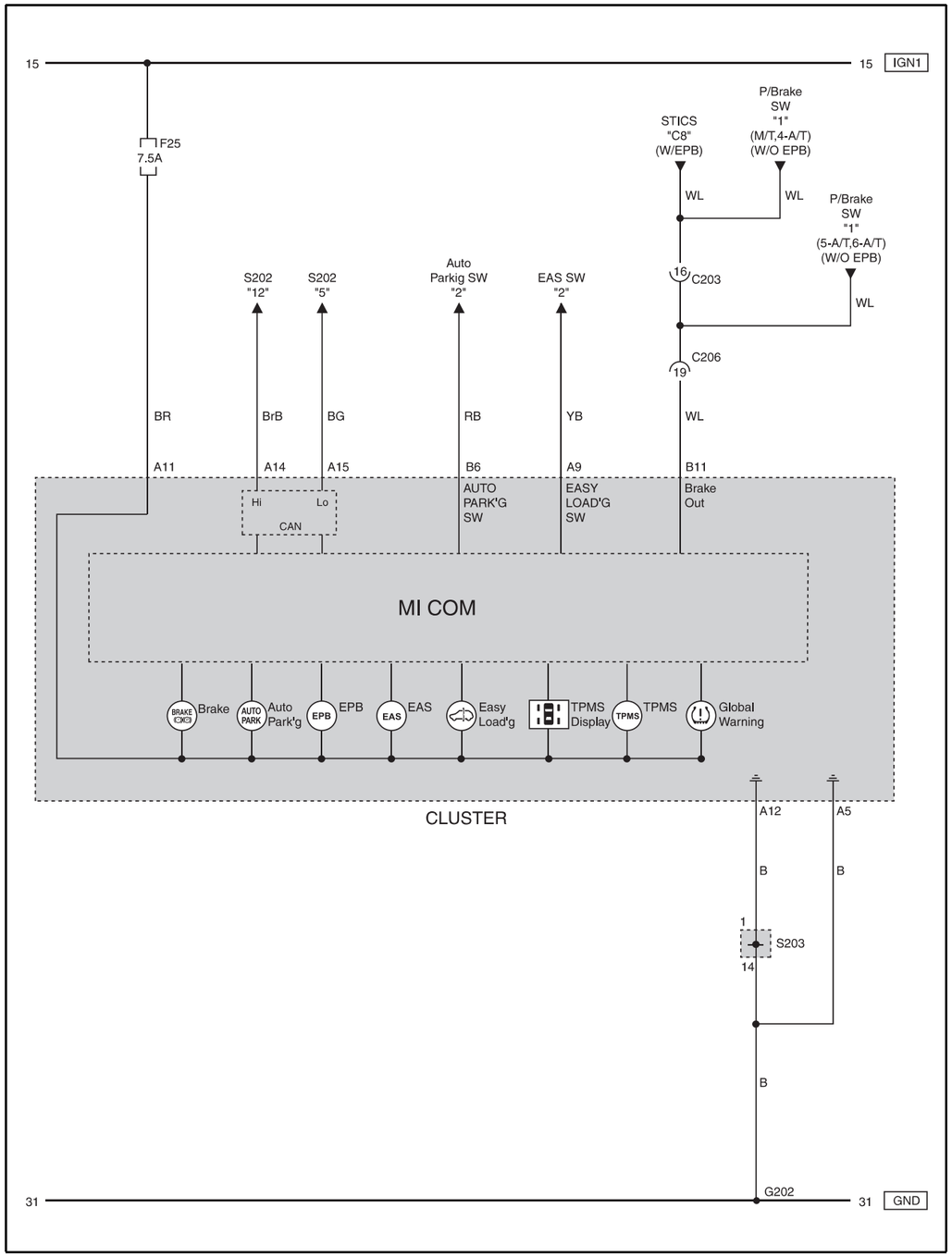
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C301 (39Pin, Black)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/ Memory
C901 (4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C902 (4Pin, Black)	W/H Floor - W/H Fuel Sender	Upper the T/M	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G202	W/H Main	Under the Driver “A” Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

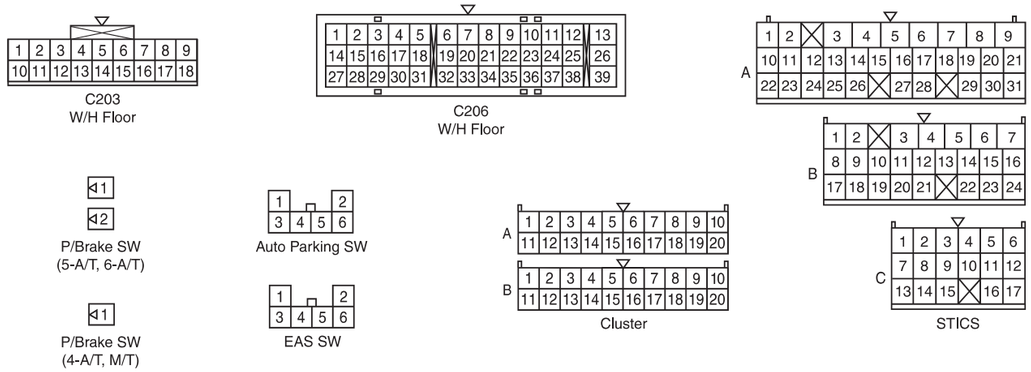
2) WARNING LAMP (EAS, EPB, AUTO PARK'G, TPMS, GROBAL), EASY LOAD'G, TPMS DISPLAY



(1) CONNECTOR INFORMATION

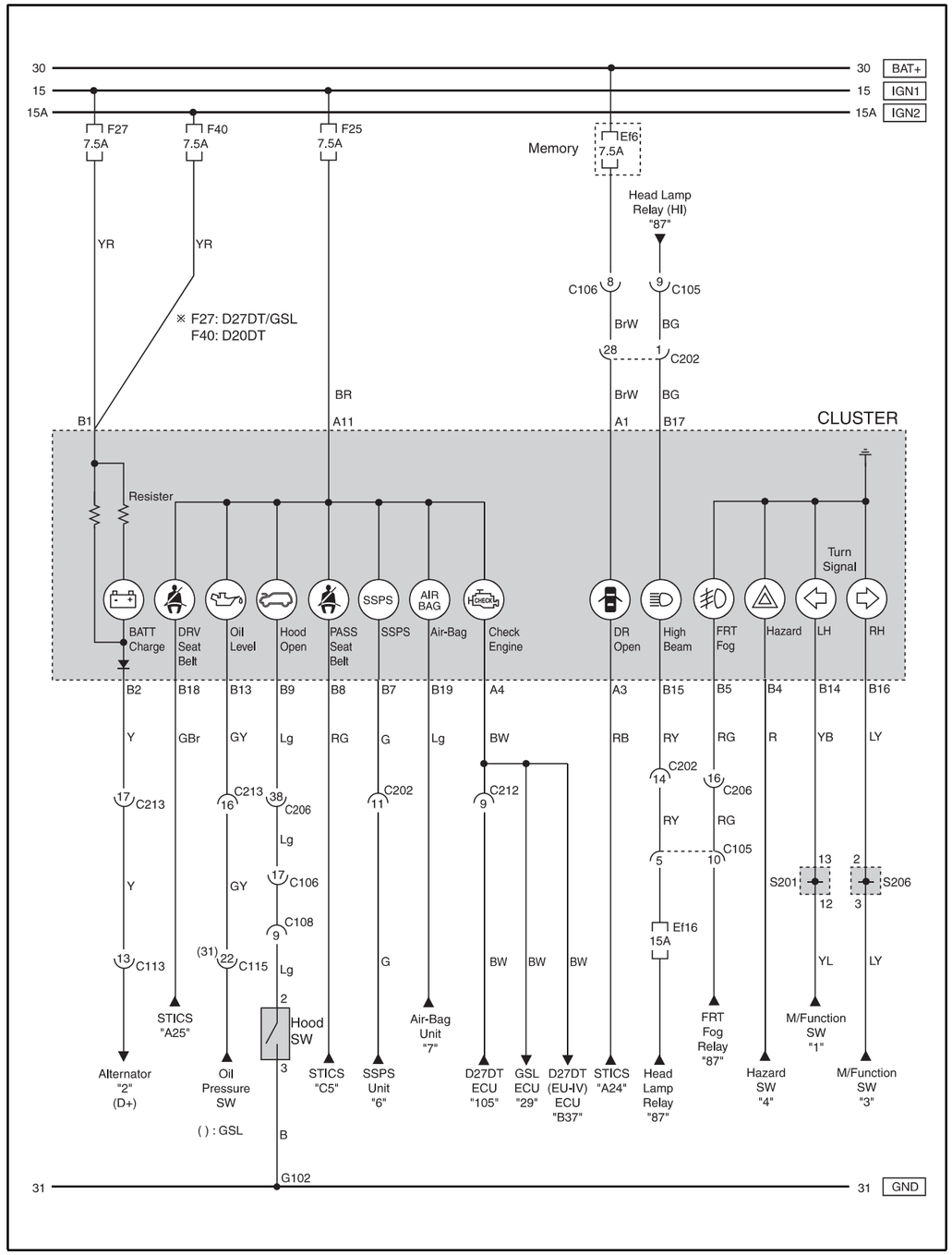
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G202	W/H Main	Under the Driver "A" Pillar	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

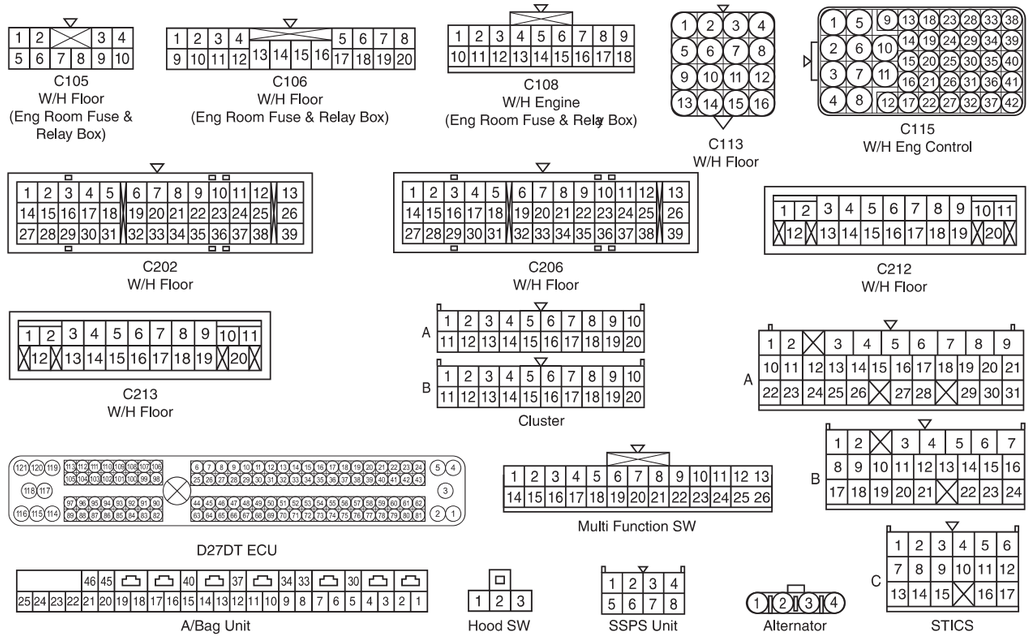
3) WARNING LAMP (BATT CHARGE, OIL, HOOD, DOOR, ENG CHECK, AIR BAG, SSPS, SEAT BELT), TURN SIGNAL, FRT FOG, HAZARD LAMP



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C115 (42Pin, Black)	W/H Floor - W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



CIRCUIT

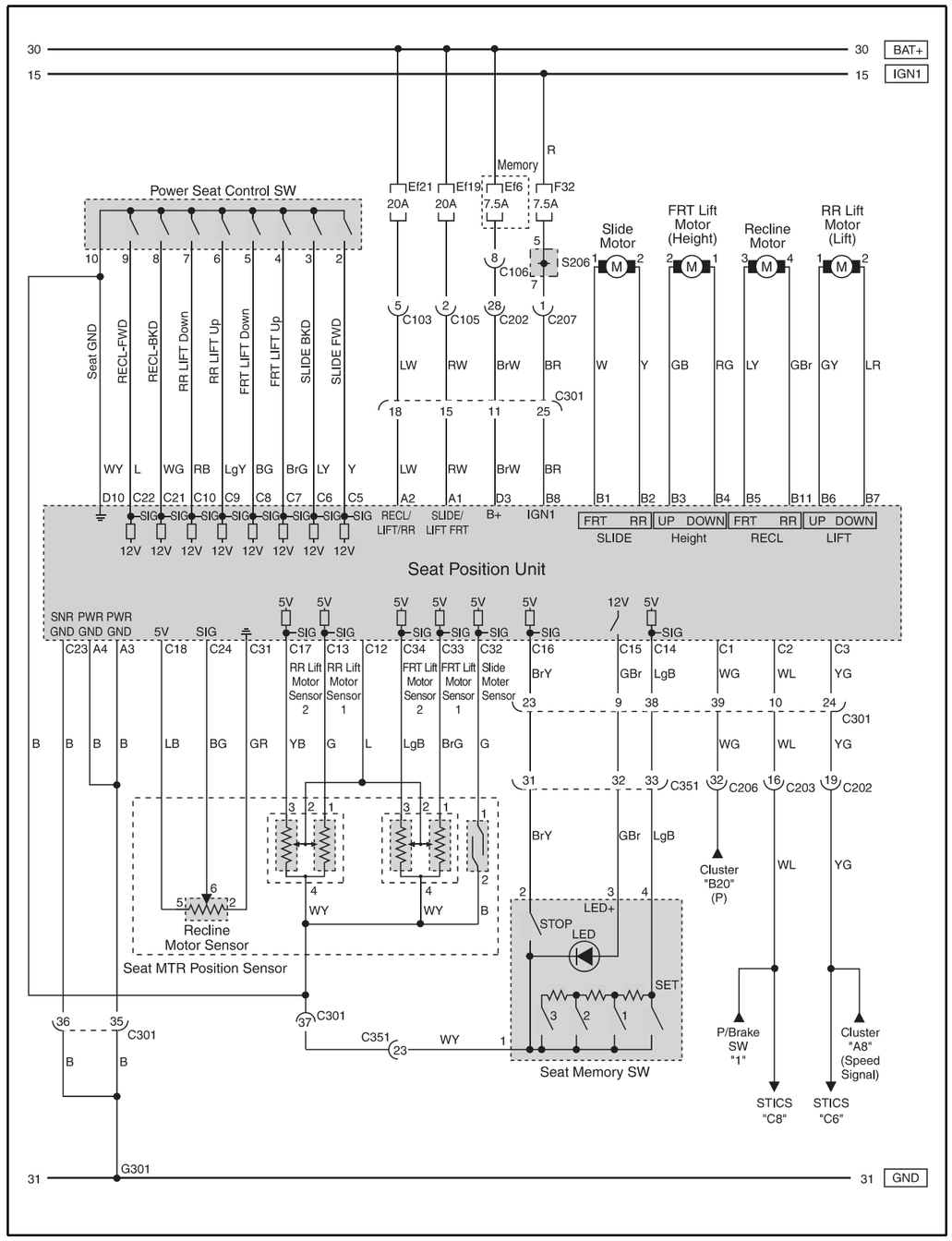
KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 7410-00

POWER SEAT - DRIVER (W/ MEMORY)

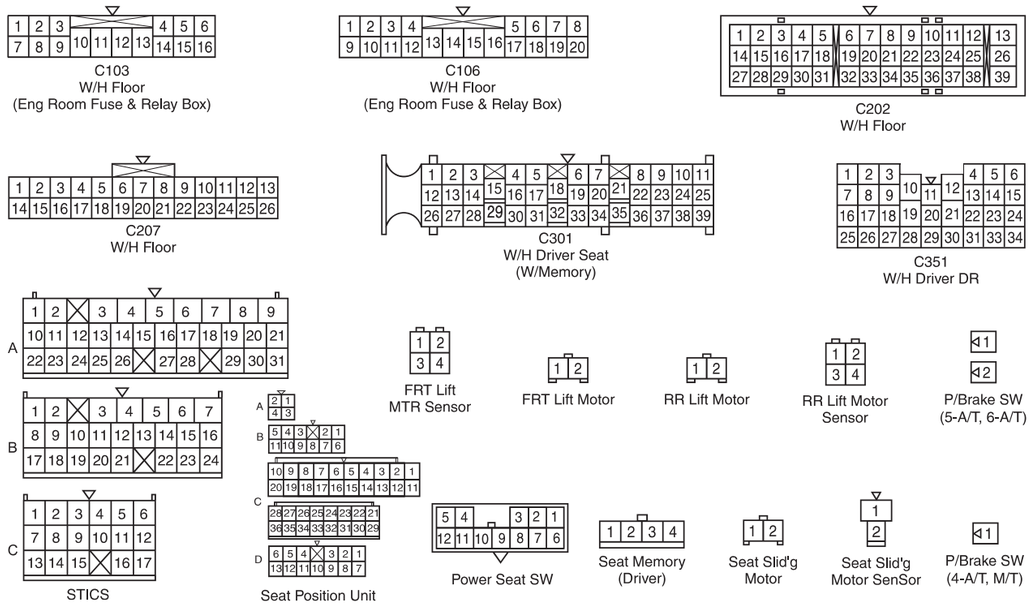
1) DRIVER POWER SEAT / SEAT MEMORY



(1) CONNECTOR INFORMATION

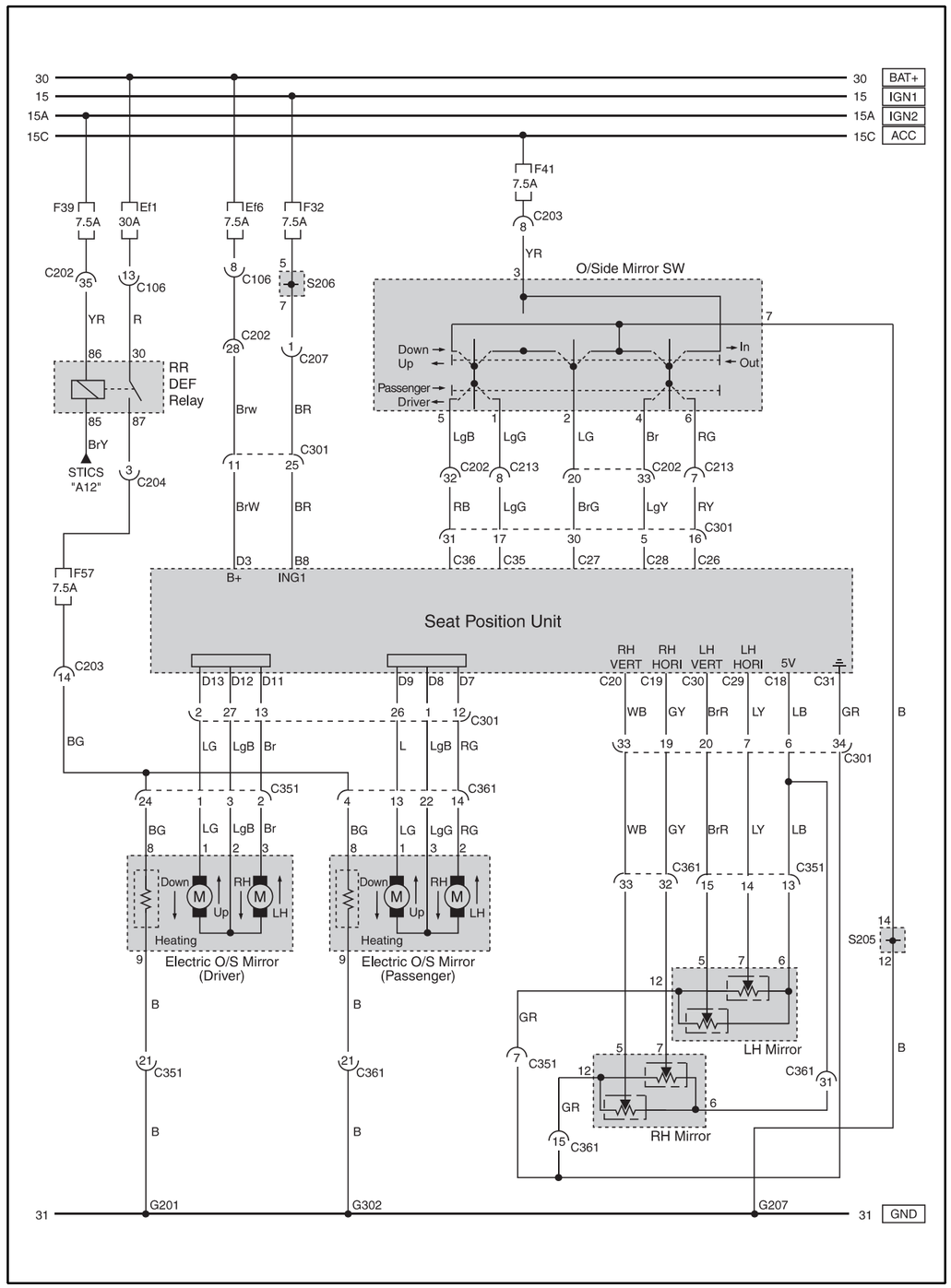
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C301 (39Pin, Black)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/Memory
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
G301	W/H Floor	Under the Driver Seat	
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

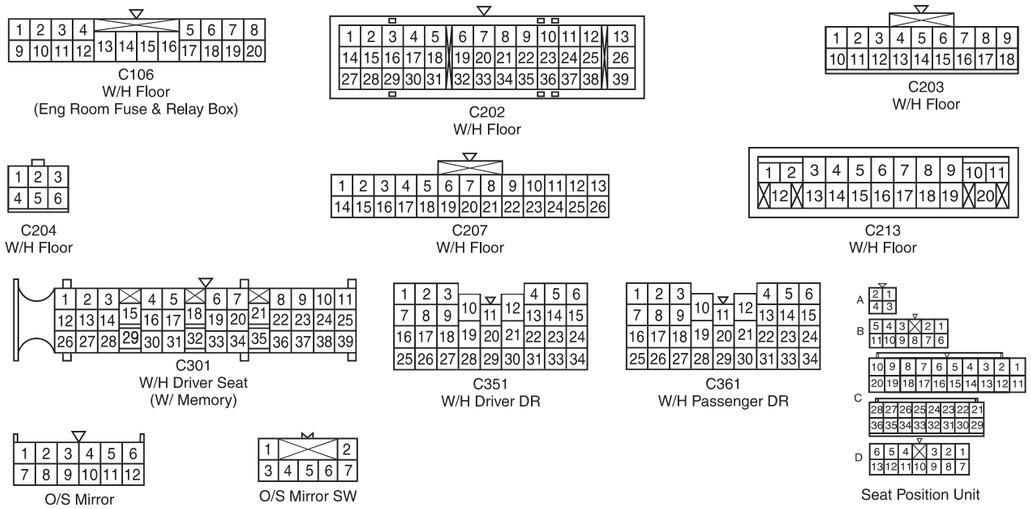
2) ELECTRIC OUTSIDE MIRROR



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Hoder	
C301 (39Pin, Black)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/Memory
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the LH “A” Pillar	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G202	W/H Main	Under the Driver “A” Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G302	W/H Floor	Under the Passenger Seat	
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal

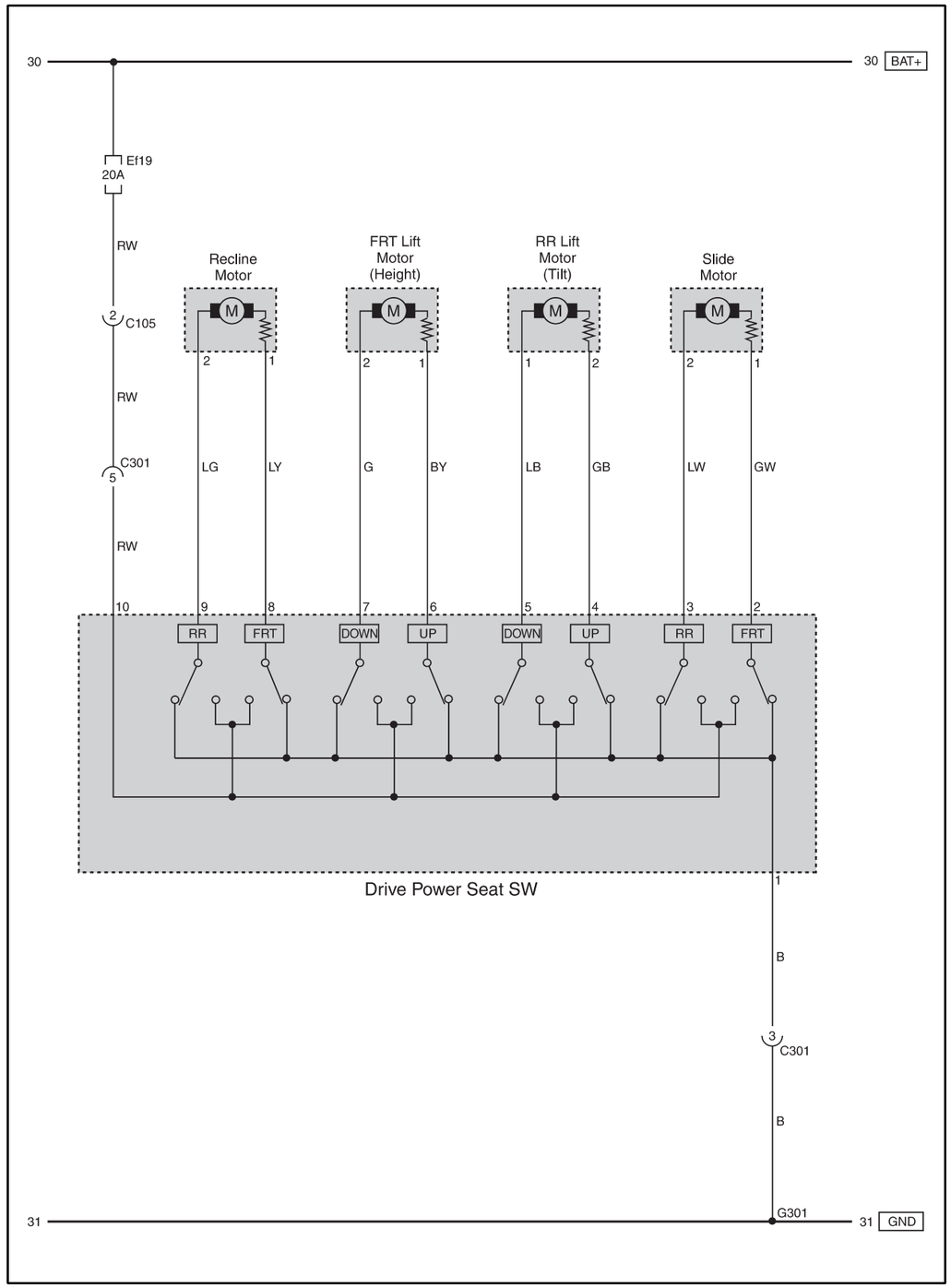
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 7410-00

POWER SEAT - DRIVER (W/O MEMORY)



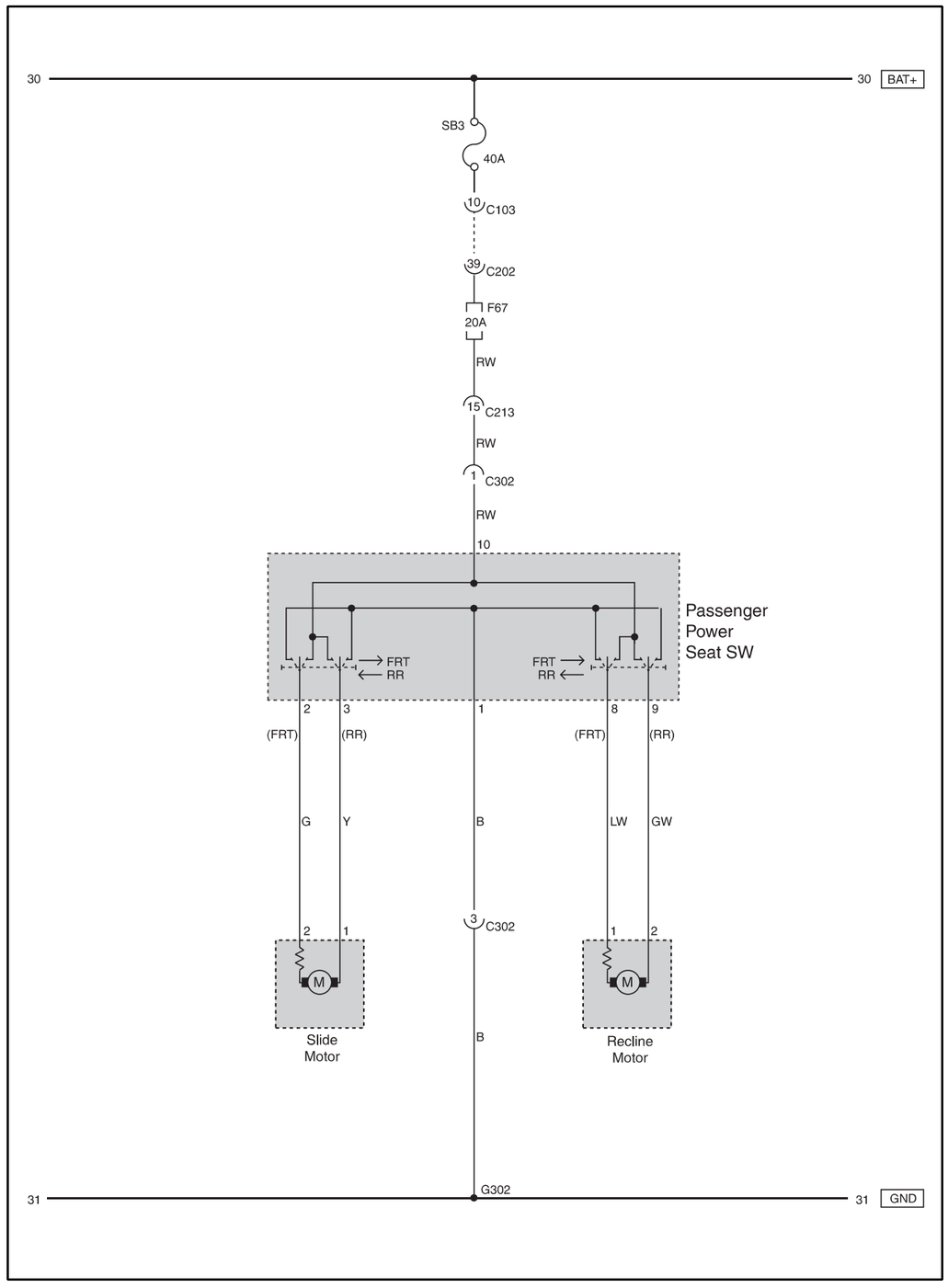
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C105 (10Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C301	(39Pin, Black)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/ Memory
	(6Pin, White)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/O Memory
G301		W/H Floor	Under the Driver Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

S.G.N. 7410-00

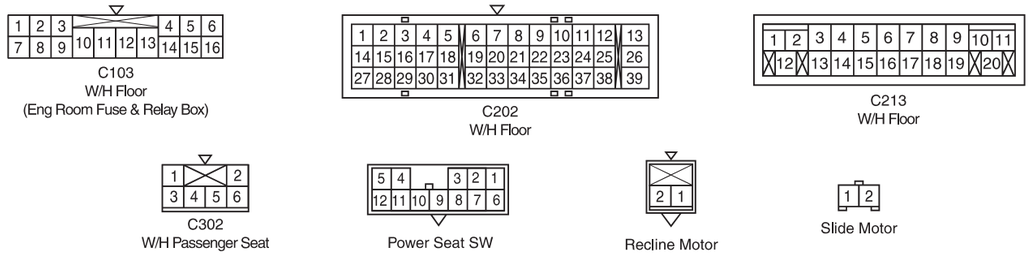
POWER SEAT - PASSENGER



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C302 (6Pin, White)	W/H Floor - W/H Passenger Seat	Under the Passenger Seat	
G302	W/H Floor	Under the Passenger Seat	

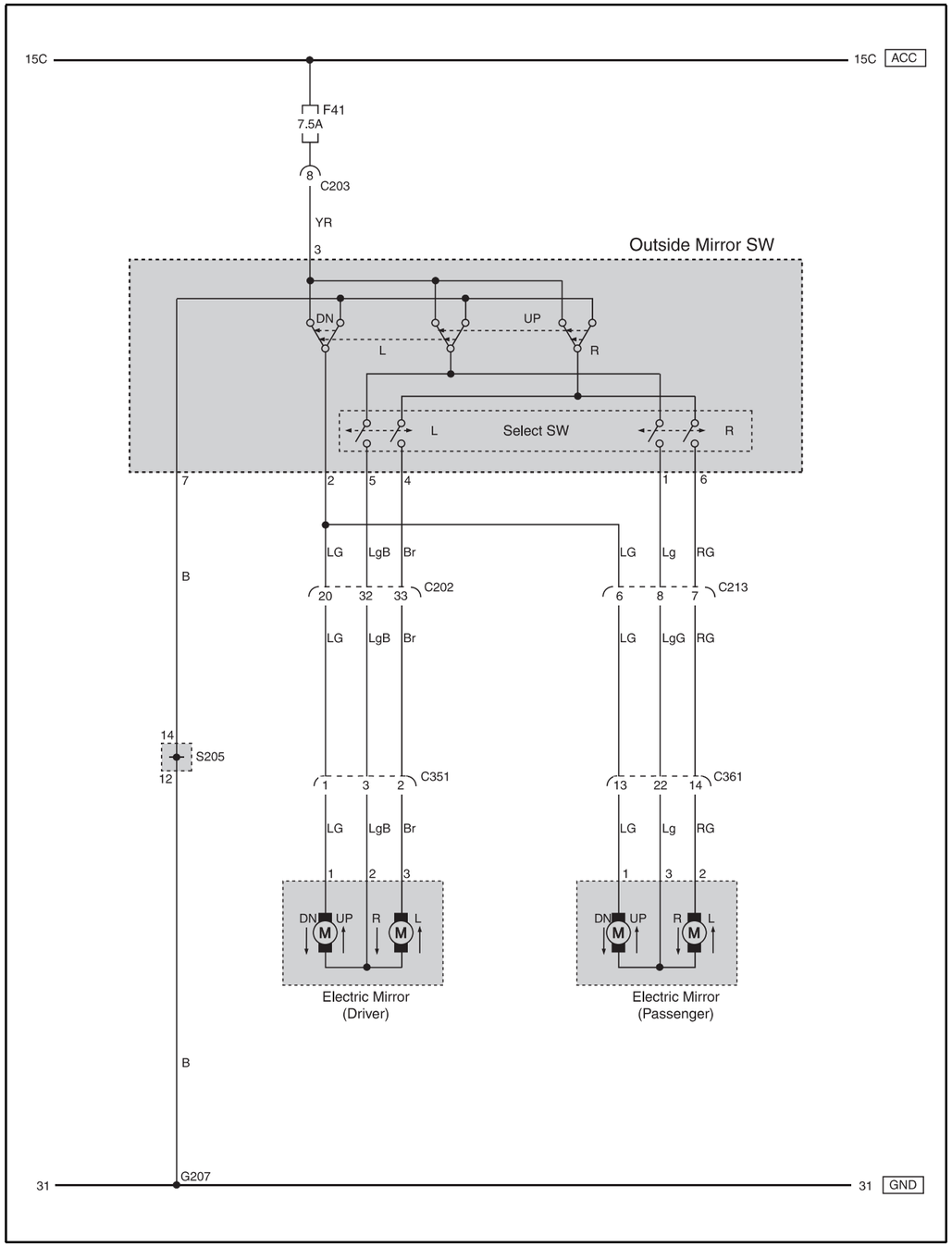
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 8510-00

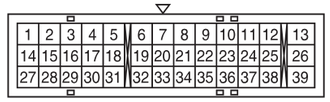
ELECTRIC OUTSIDE MIRROR / FOLDING (W/O MEMORY)



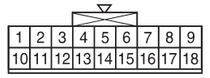
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Hoder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the LH “A” Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

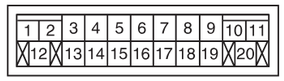
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



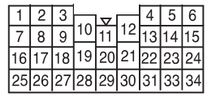
C202
W/H Floor



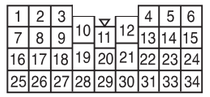
C203
W/H Floor



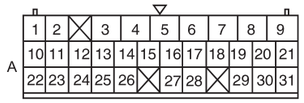
C213
W/H Floor

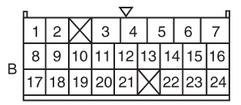


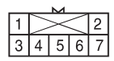
C351
W/H Driver DR



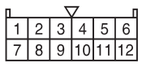
C361
W/H Passenger DR



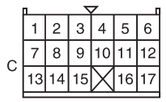




O/S Mirror SW



O/S Mirror

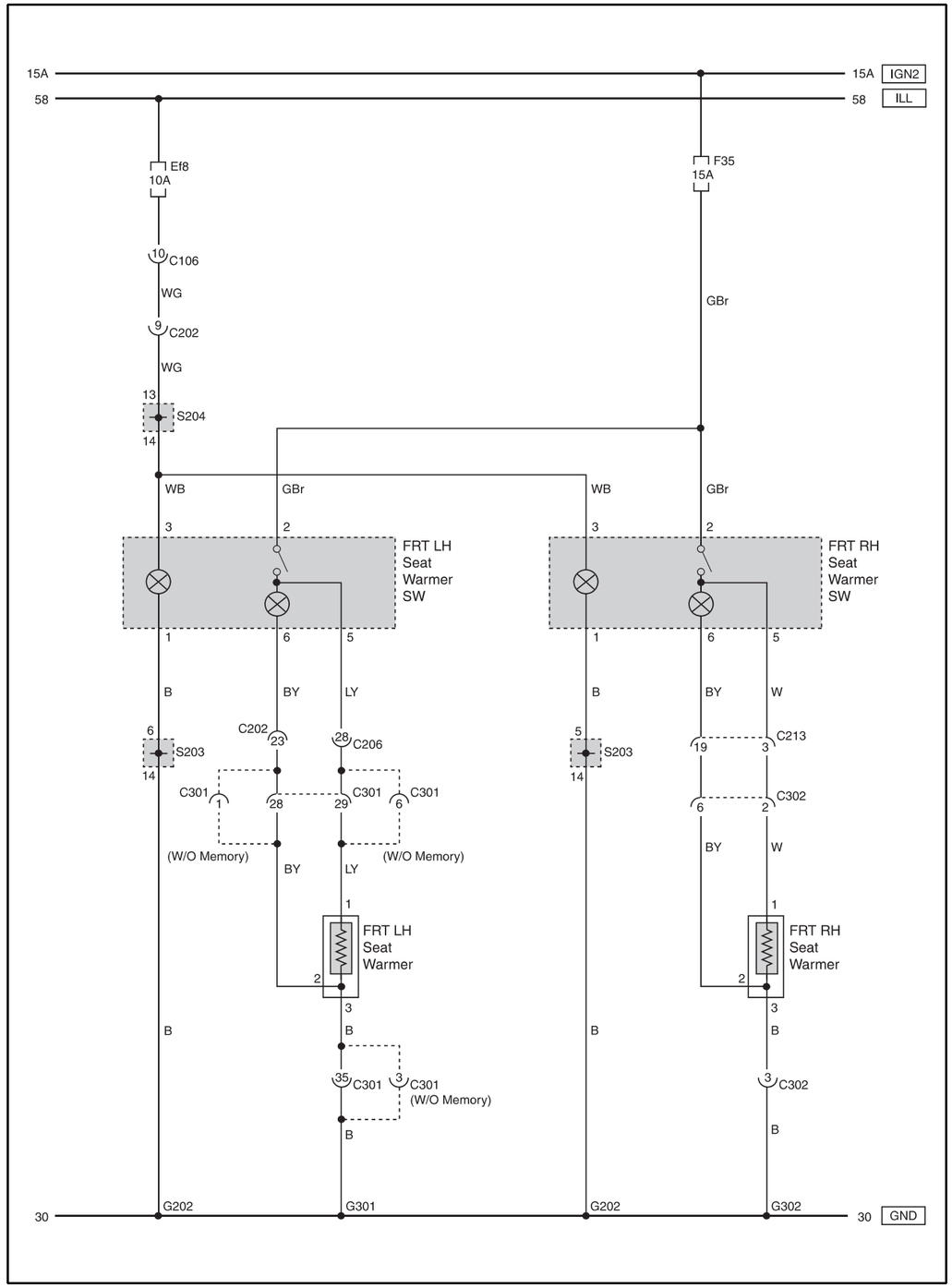


STICS

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8510-00

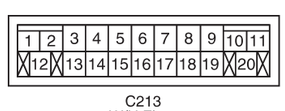
FRT SEAT WARMER



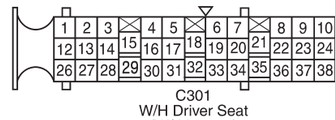
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C301	(39Pin, Black)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/Memory
	(6Pin, White)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/O Memory
C302 (6Pin, White)		W/H Floor - W/H Passenger Seat	Under the Passenger Seat	
G202		W/H Main	Under the Driver “A” Pillar	
G301		W/H Floor	Under the Driver Seat	
G302		W/H Floor	Under the Passenger Seat	
S203 (14Pin, Black)		W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)		W/H Main	RH Protector of the Driver Legroom	ILL

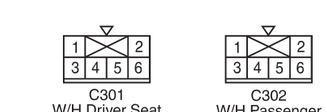
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



C106
W/H Floor
(Eng Room Fuse & Relay Box)



C202
W/H Floor



C206
W/H Floor

C213
W/H Floor

C301
W/H Driver Seat
(W/ Memory)

C301
W/H Driver Seat
(W/O Memory)

C302
W/H Passenger



Seat Warmer



Seat Warmer
SW

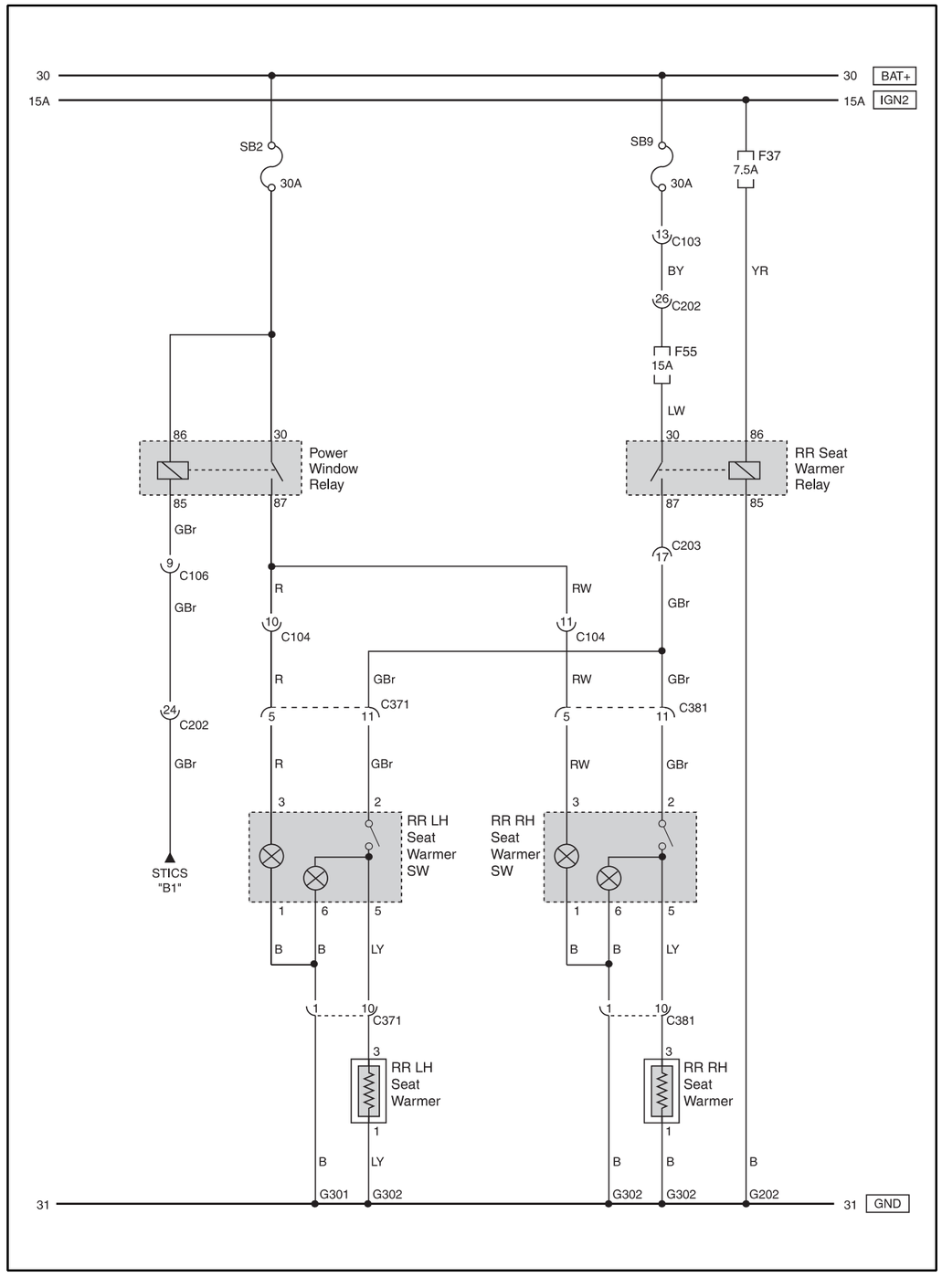
CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8610-00

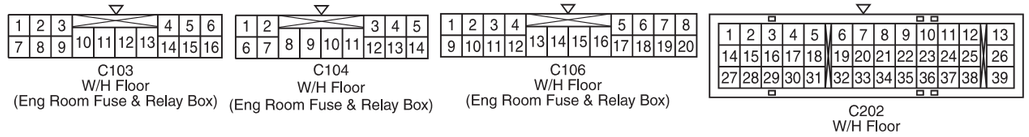
RR SEAT WARMER

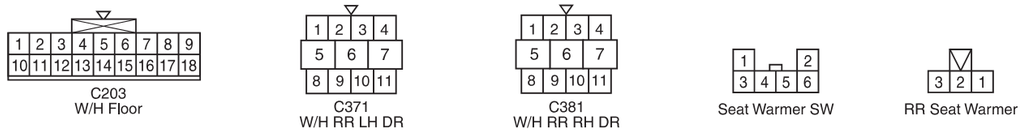


(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C371 (11Pin, White)	W/H Floor - W/H RR LH DR	Under the LH “B” Pillar	
C381 (11Pin, White)	W/H Floor - W/H RR RH DR	Under the RH “B” Pillar	
G202	W/H Main	Under the Driver “A” Pillar	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Passenger Seat	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



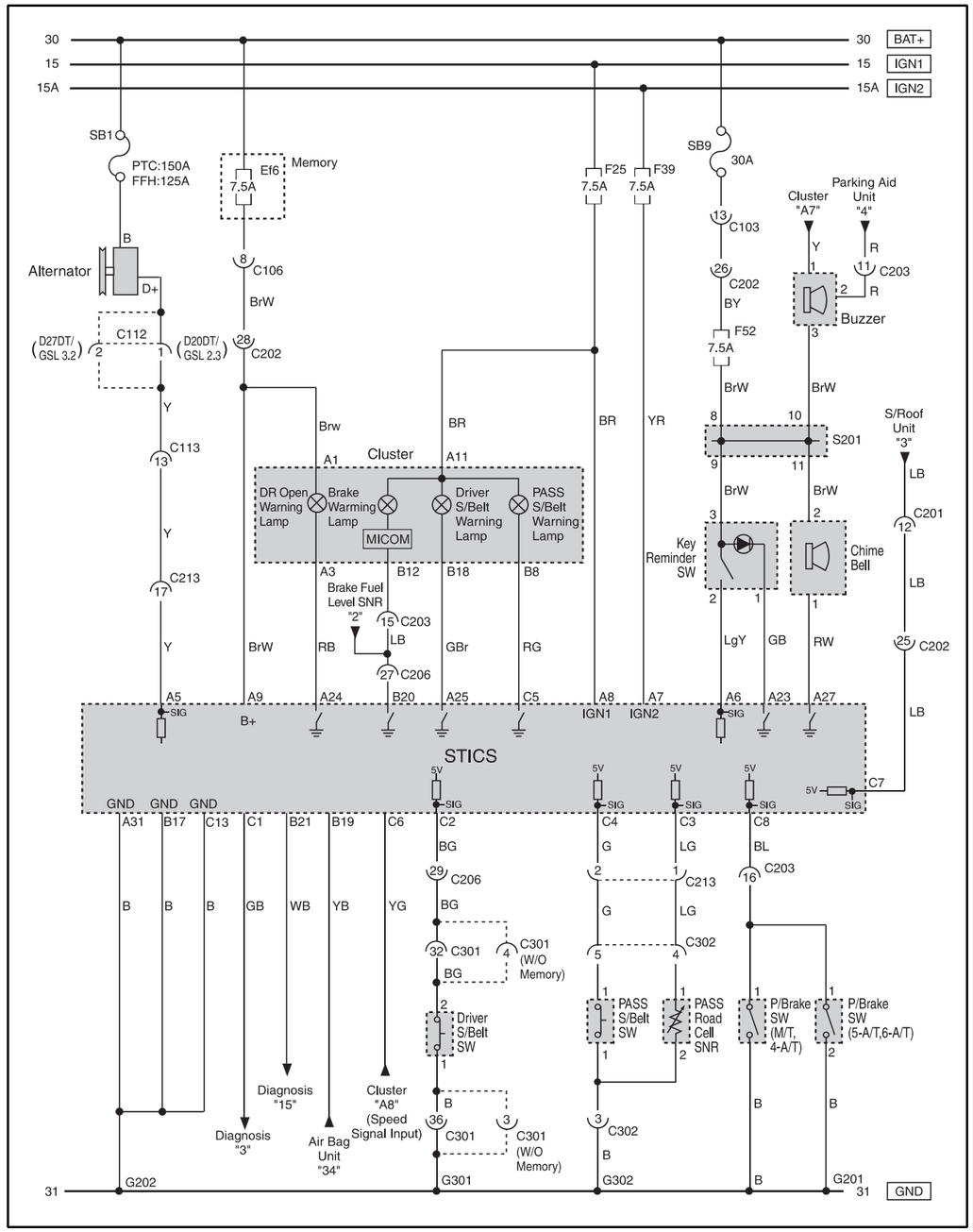


Modification basis	
Application basis	
Affected VIN	

S.G.N. 8710-00

STICS

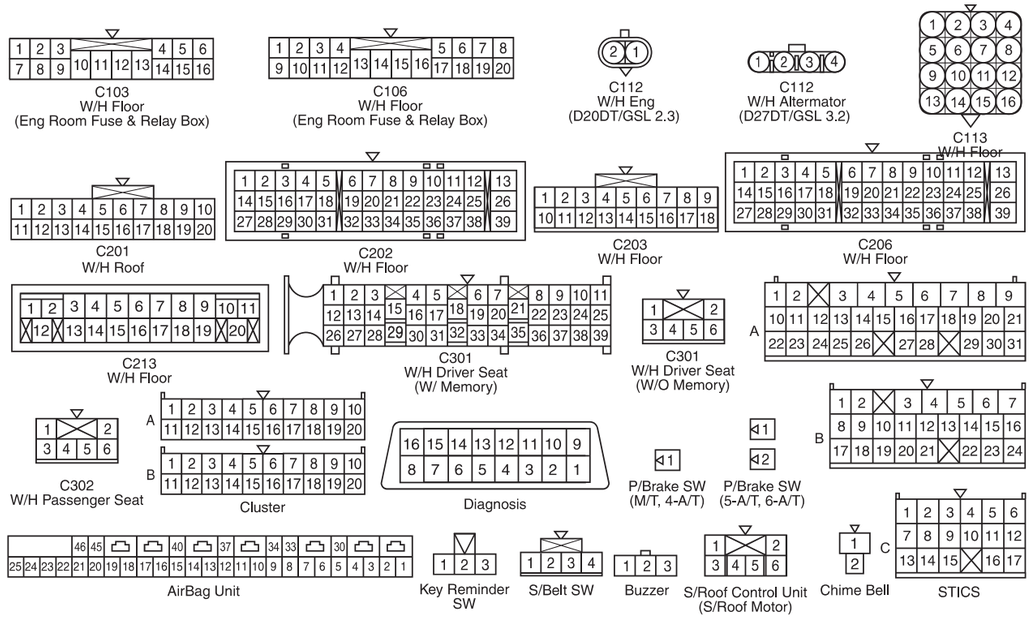
1) POWER/GROUND, CHIME BELL, BUZZER, WARNING LAMP (BRAKE, S/BELT, DR OPEN)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C112	(2Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D20DT/GSL 2.3
	(4Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D27DT/GSL 3.2
C113 (16Pin, Black)		W/H Main - W/H Floor	Inside RH Fender PNL	
C201 (20Pin, White)		W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C301	(39Pin, Black)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/Memory
	(6Pin, White)	W/H Floor - W/H Driver Seat	Under the Driver Seat	W/O Memory
C302 (6Pin, White)		W/H Floor - W/H Passenger Seat	Under the Passenger Seat	
G201		W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G202		W/H Main	Under the Driver “A” Pillar	
G301		W/H Floor	Under the Driver Seat	
G302		W/H Floor	Under the Passenger Seat	
S201 (14Pin, Black)		W/H Main	RH Protector of the Driver Legroom	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

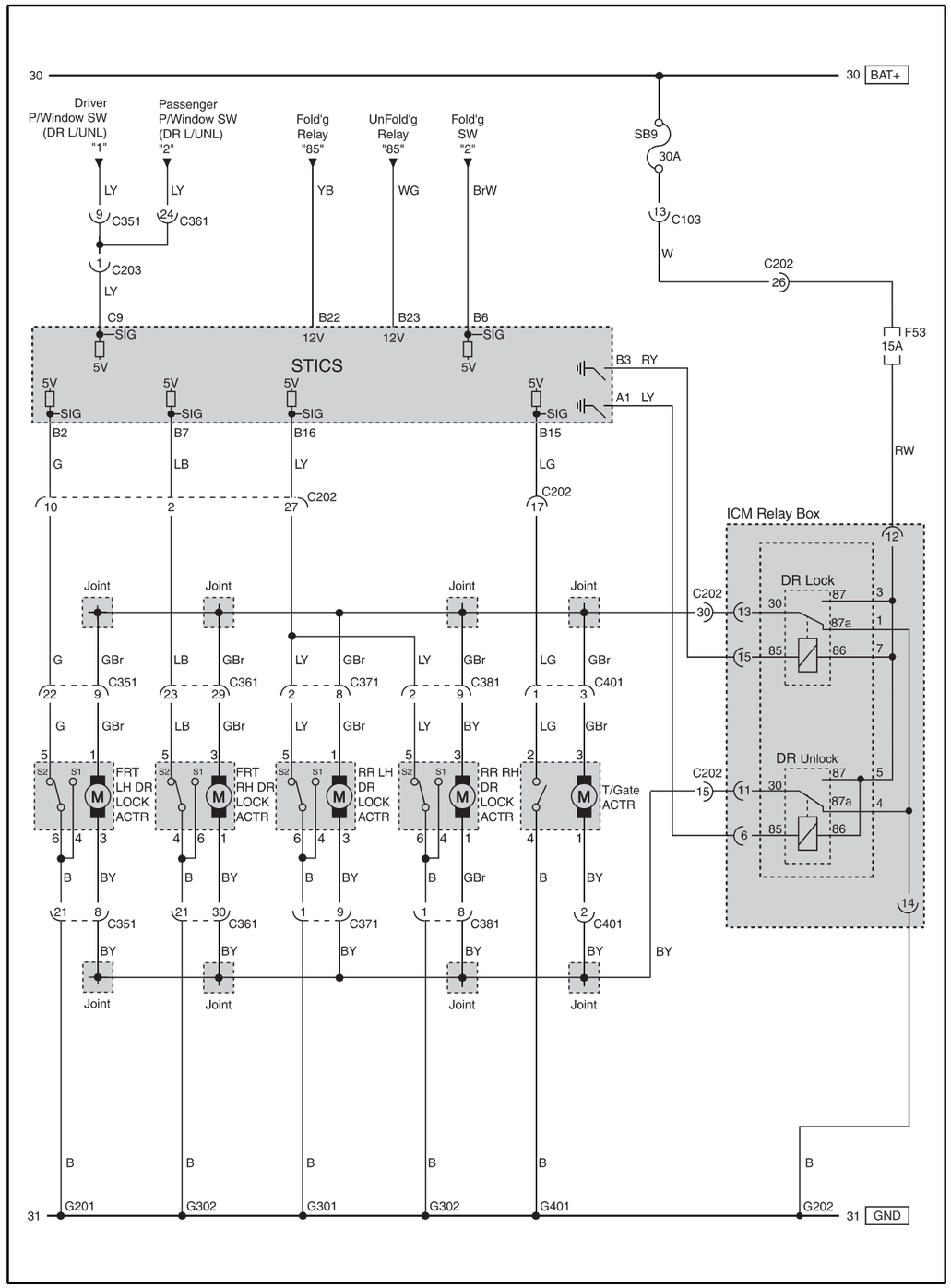


CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

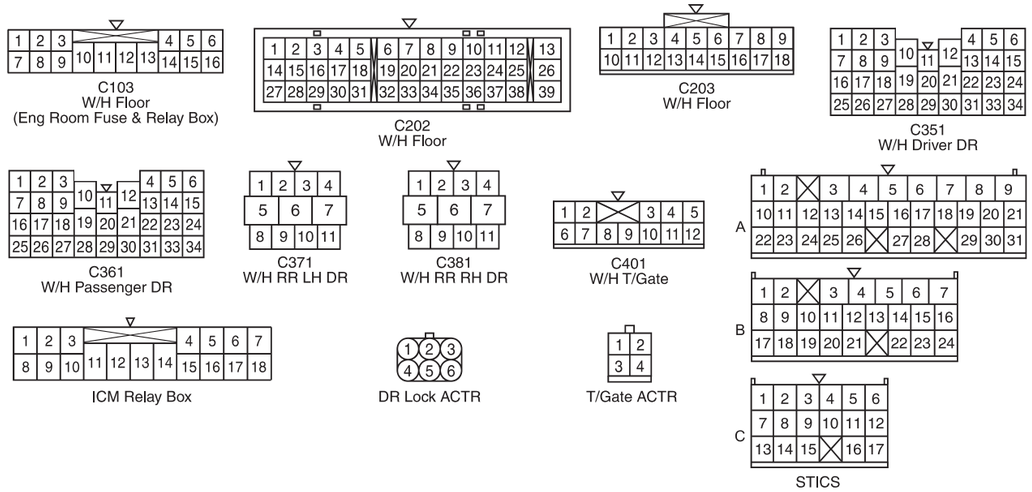
2) CENTRAL DOOR LOCK CIRCUIT



(1) CONNECTOR INFORMATION

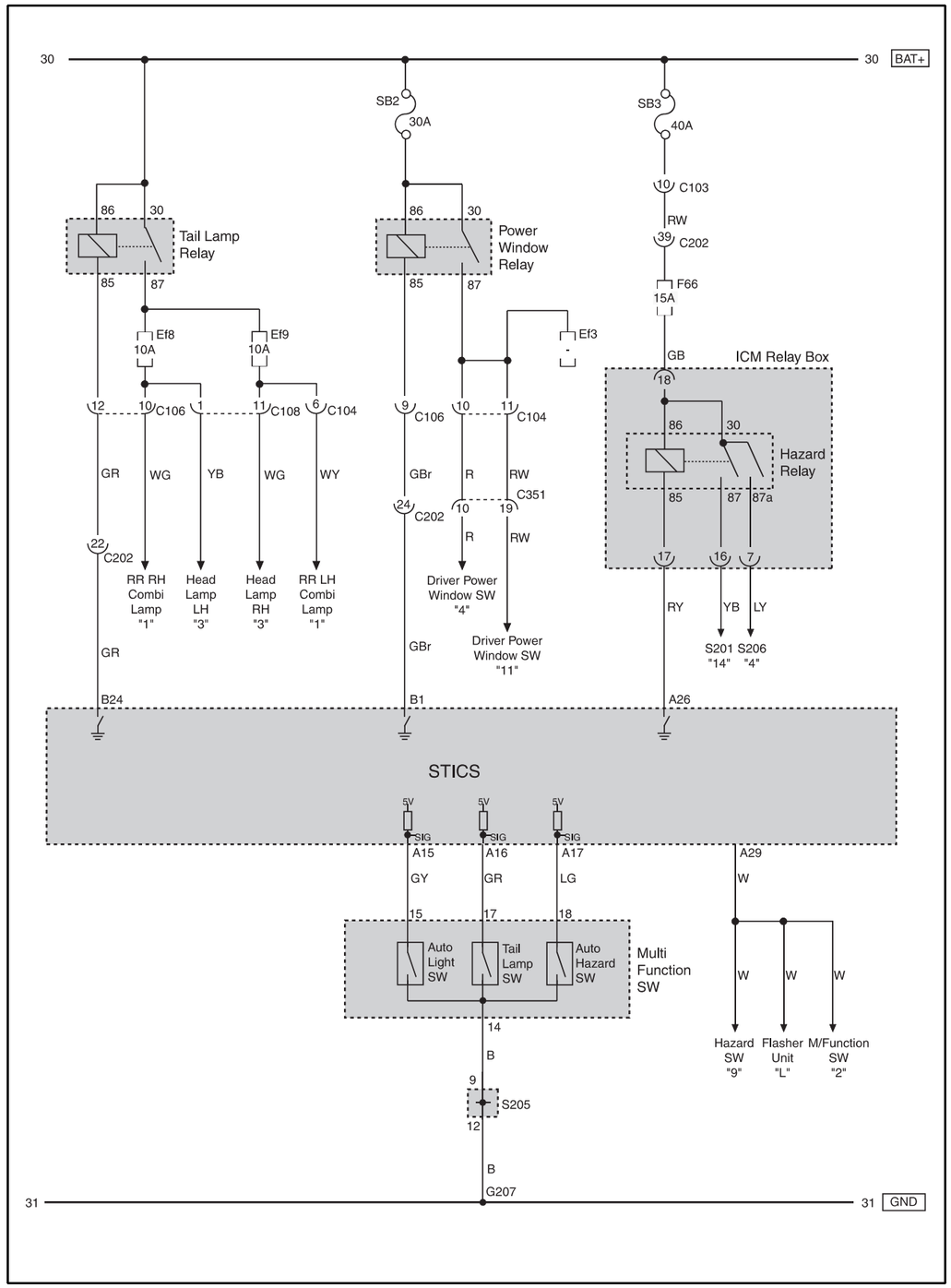
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” Pillar	
C371 (11Pin, White)	W/H Floor - W/H RR LH DR	Under the LH “B” Pillar	
C381 (11Pin, White)	W/H Floor - W/H RR RH DR	Under the RH “B” Pillar	
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Passenger Seat	
G401	W/H T/Gate	Center the T/Gate	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

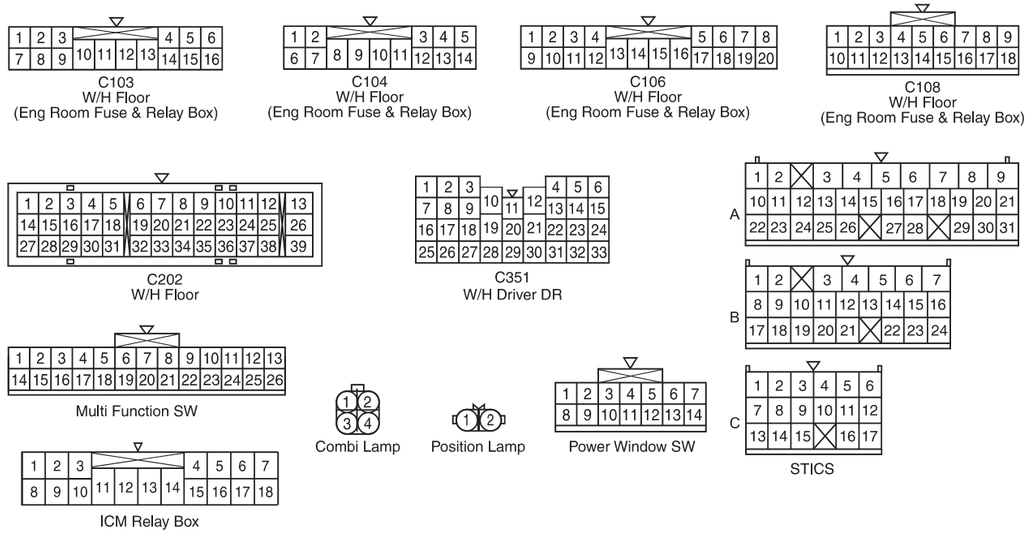
3) TAIL LAMP, HAZARD, POWER WINDOW



(1) CONNECTOR INFORMATION

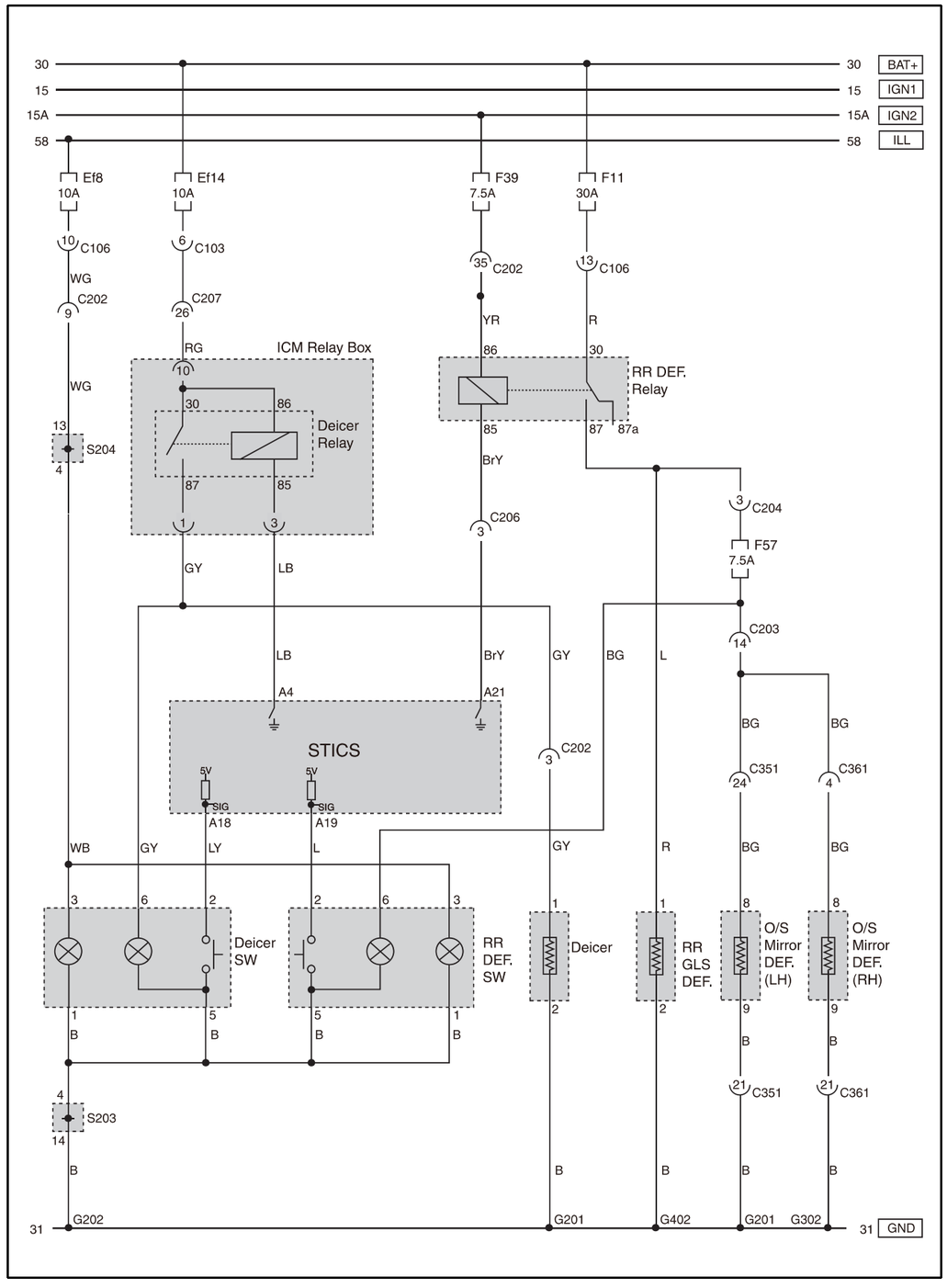
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

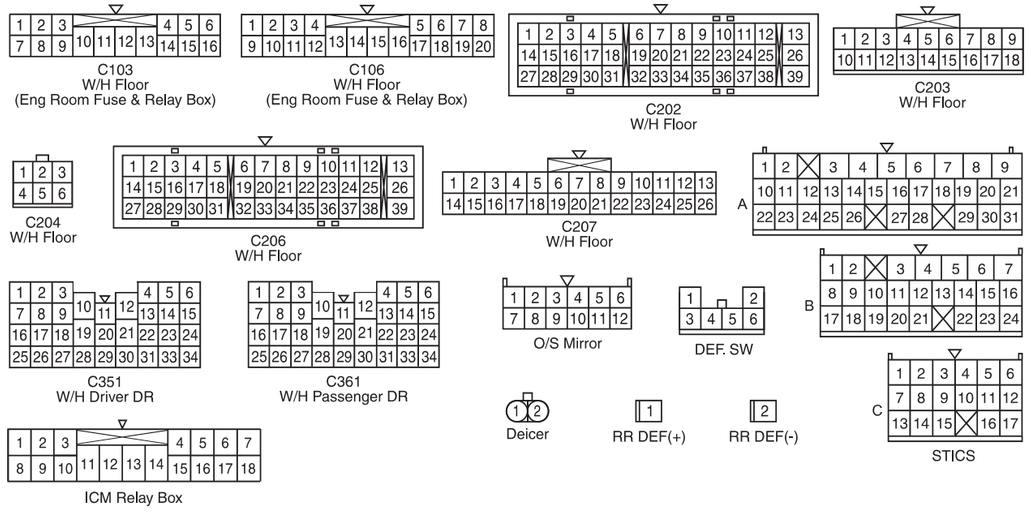
4) DEFOGGER



(1) CONNECTOR INFORMATION

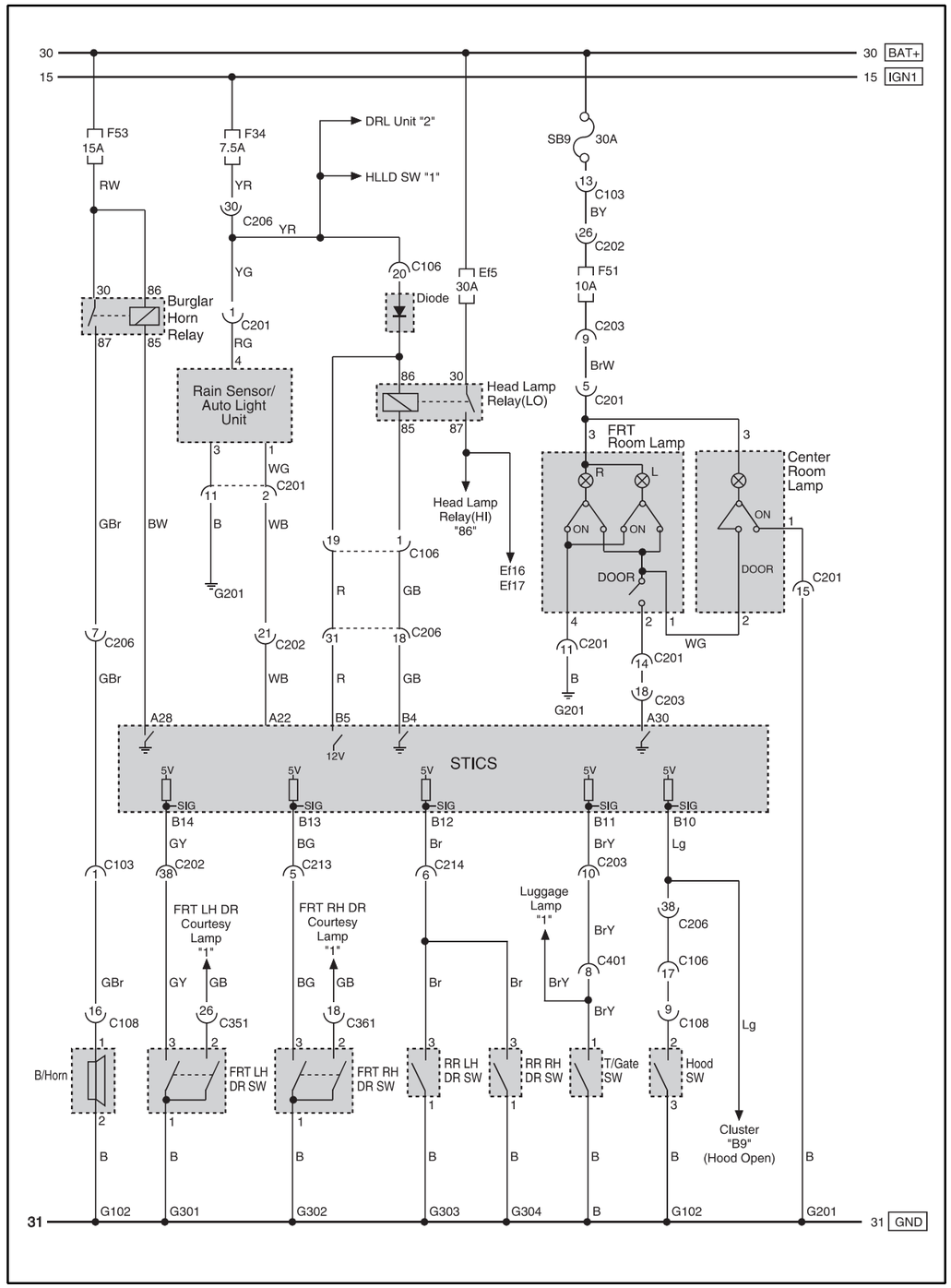
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” Pillar	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G202	W/H Main	Under the Driver “A” Pillar	
G302	W/H Floor	Under the Passenger Seat	
G402	W/H Floor	Upper the RH T/Gate	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

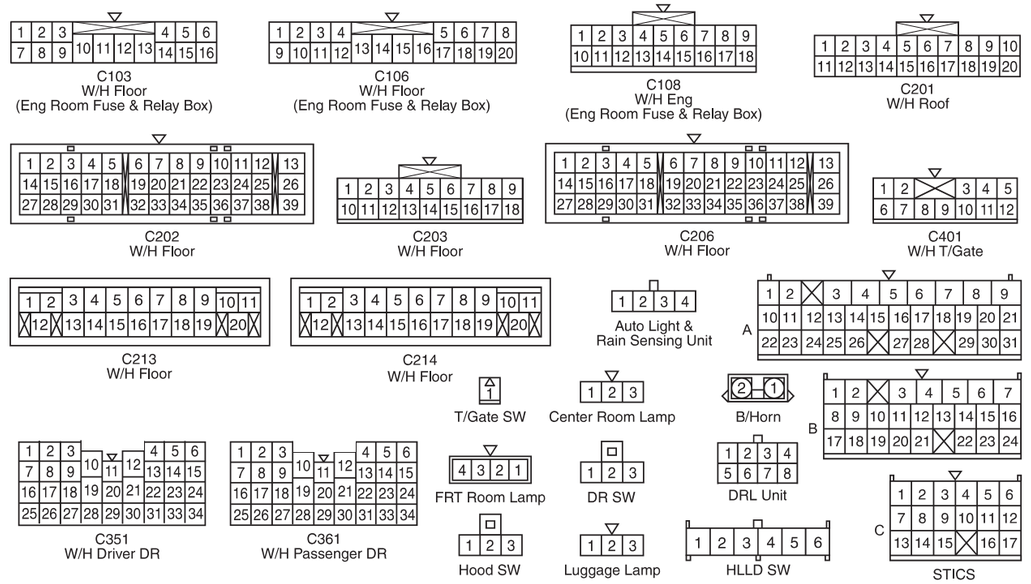
5) PANIC, AUTO LIGHT / RAIN SENSING, ROOM LAMP



(1) CONNECTOR INFORMATION

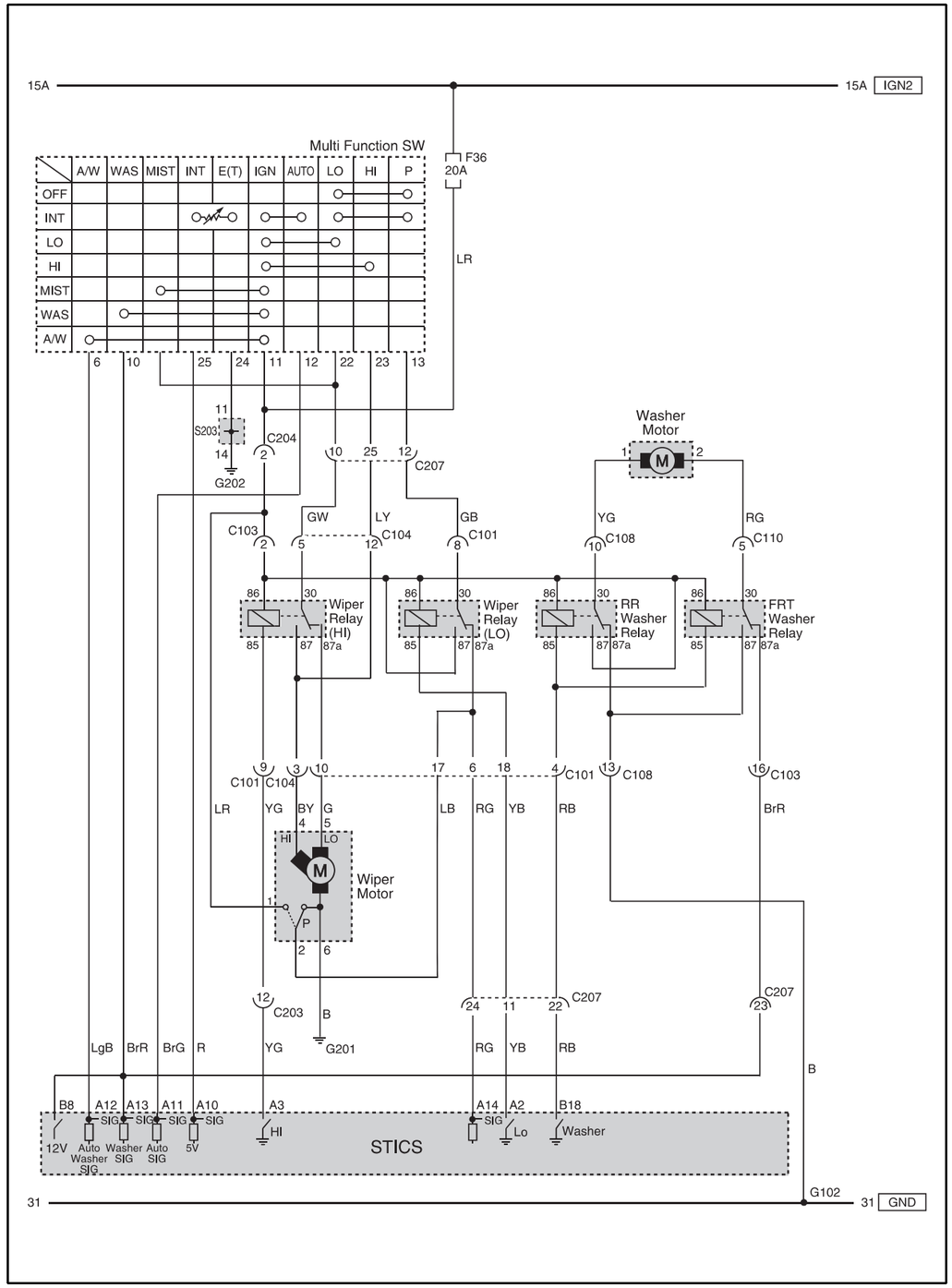
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (20Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” Pillar	
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
G102	W/H Eng Room	Behind LH Head Lamp	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Passenger Seat	
G303	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G304	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

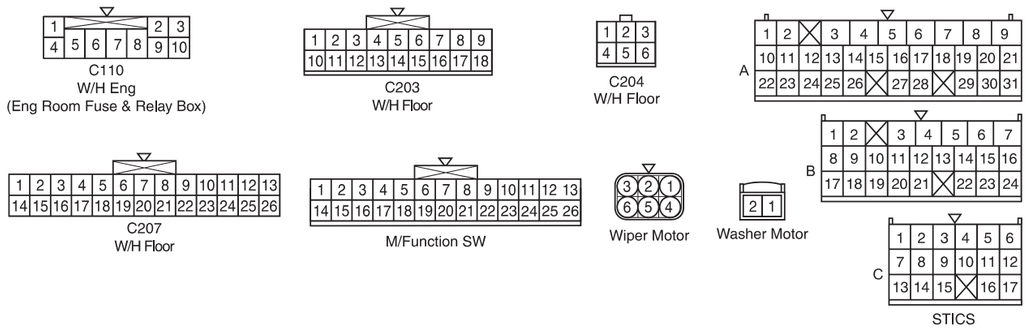
6) FRT WIPER/WASHER / RR WASHER



(1) CONNECTOR INFORMATION

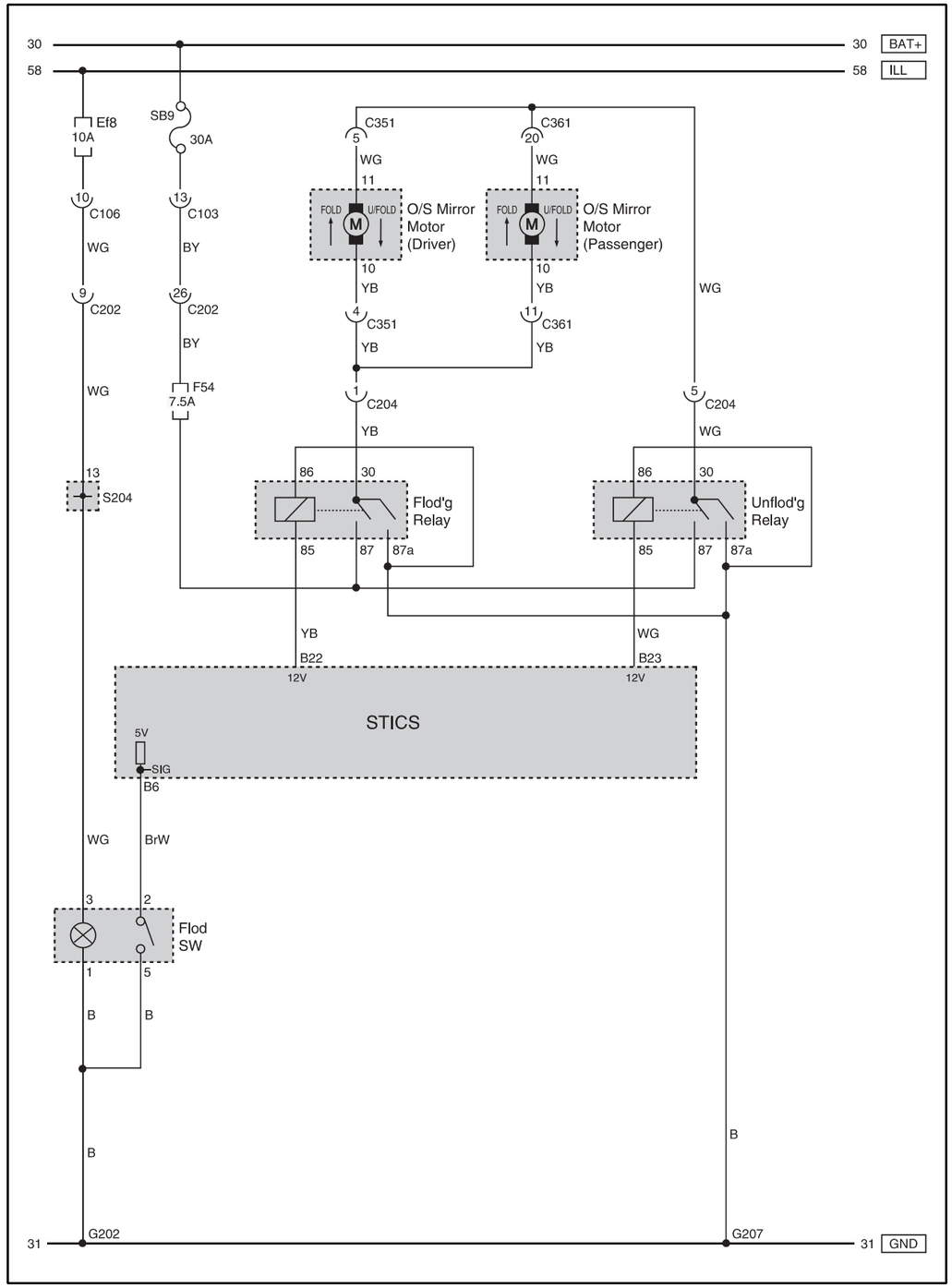
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G102	W/H Eng Room	Behind LH Head Lamp	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G202	W/H Main	Under the Driver “A” Pillar	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

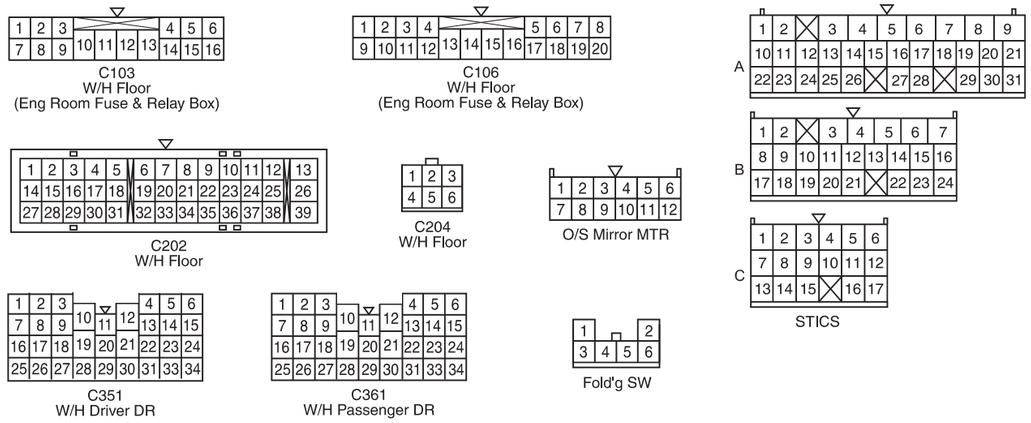
7) MIRROR FOLD'G / UNFOLD'G, FOLD SW



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH "A" Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH "A" Pillar	
G202	W/H Main	Under the Driver "A" Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

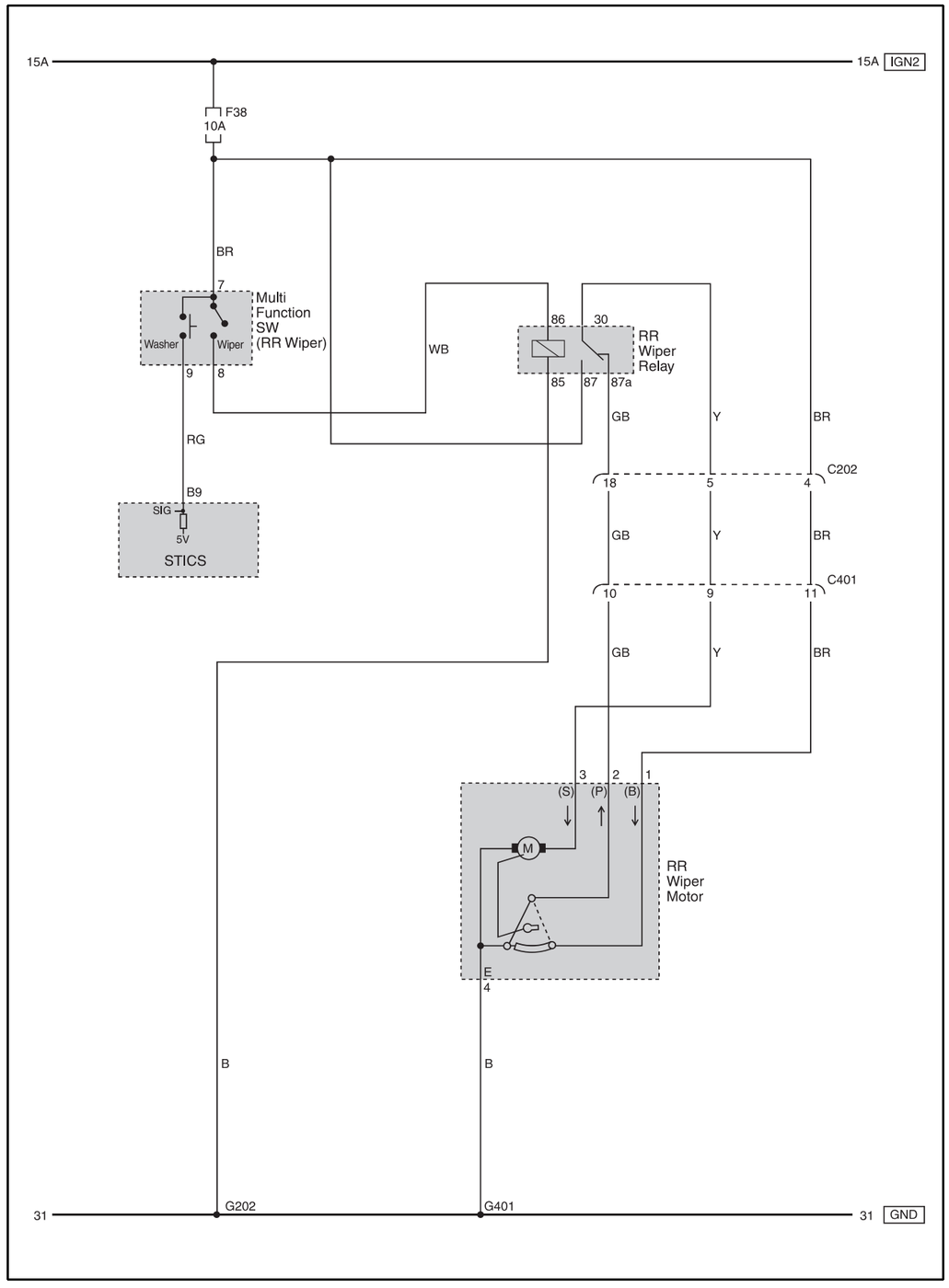
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 7830-00

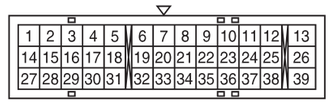
RR WIPER CIRCUIT



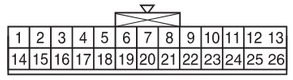
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
G202	W/H Main	Under the Driver “A” Pillar	
G401	W/H T/Gate	Center the T/Gate	

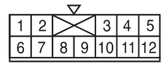
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



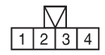
C202
W/H Floor



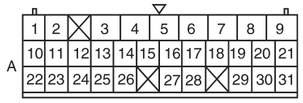
M/Function SW

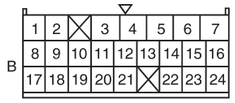


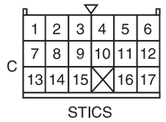
C401
W/H T/Gate



RR Wiper Motor





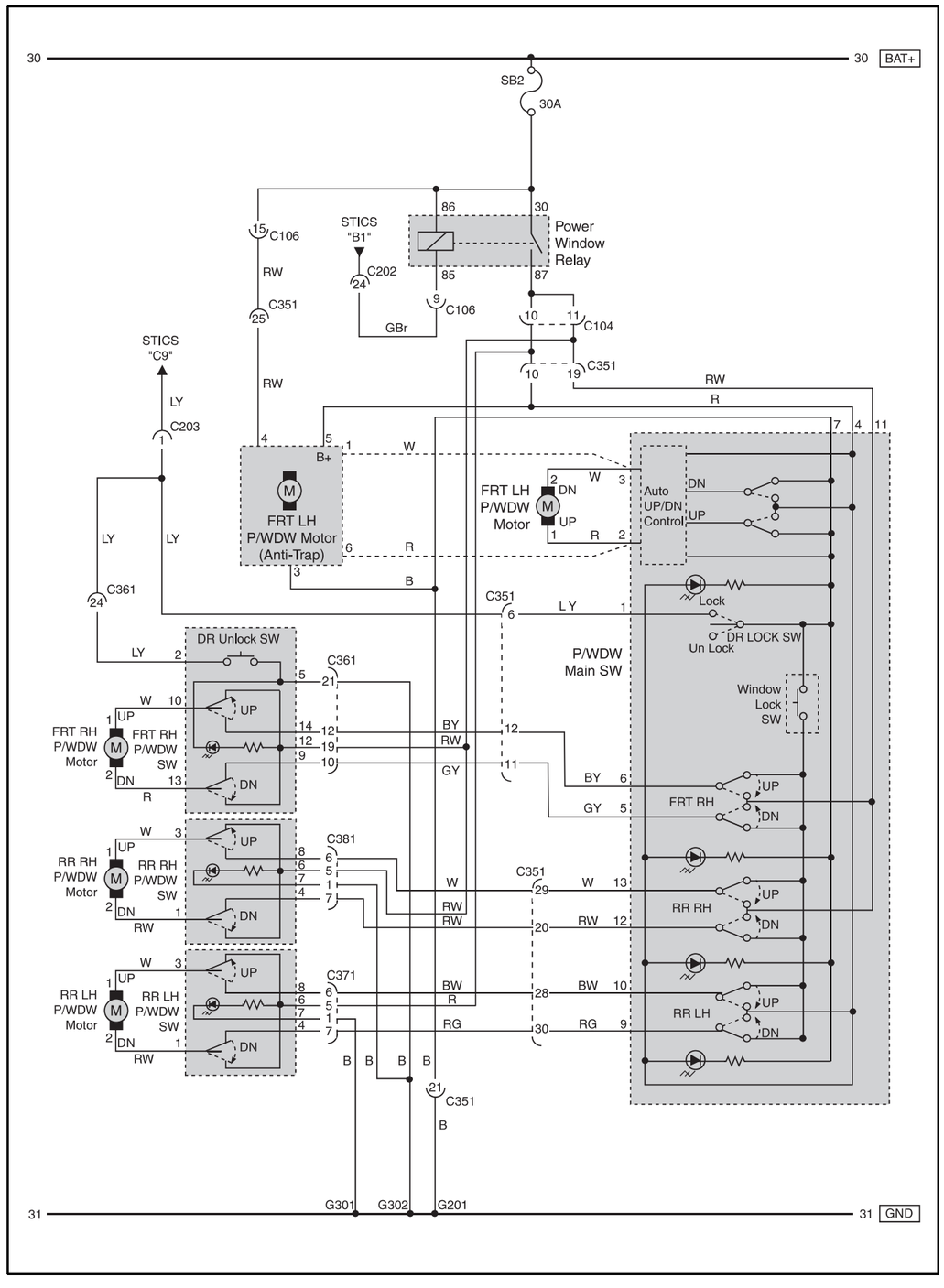


STICS

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8510-00

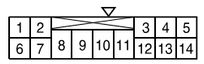
POWER WINDOW CIRCUIT

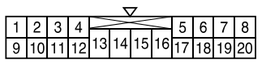


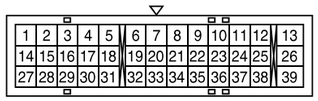
(1) CONNECTOR INFORMATION

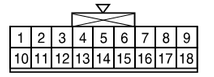
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” Pillar	
C371 (11Pin, White)	W/H Floor - W/H RR LH DR	Under the LH “B” Pillar	
C381 (11Pin, White)	W/H Floor - W/H RR RH DR	Under the RH “B” Pillar	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Passenger Seat	

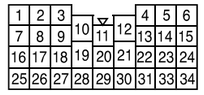
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

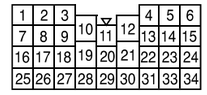

C104
W/H Floor
(Eng Room Fuse & Relay Box)

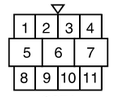

C106
W/H Floor
(Eng Room Fuse & Relay Box)

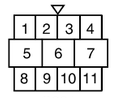

C202
W/H Floor

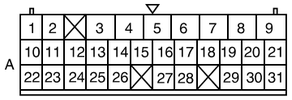

C203
W/H Floor

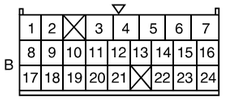

C351
W/H Driver DR

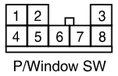

C361
W/H Passenger DR


C371
W/H RR LH DR

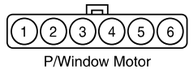

C381
W/H RR RH DR

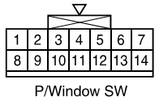

A

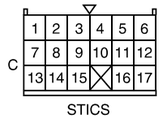

B


P/Window SW
(RR)


P/Window Motor


P/Window Motor
(Anti-Trap)

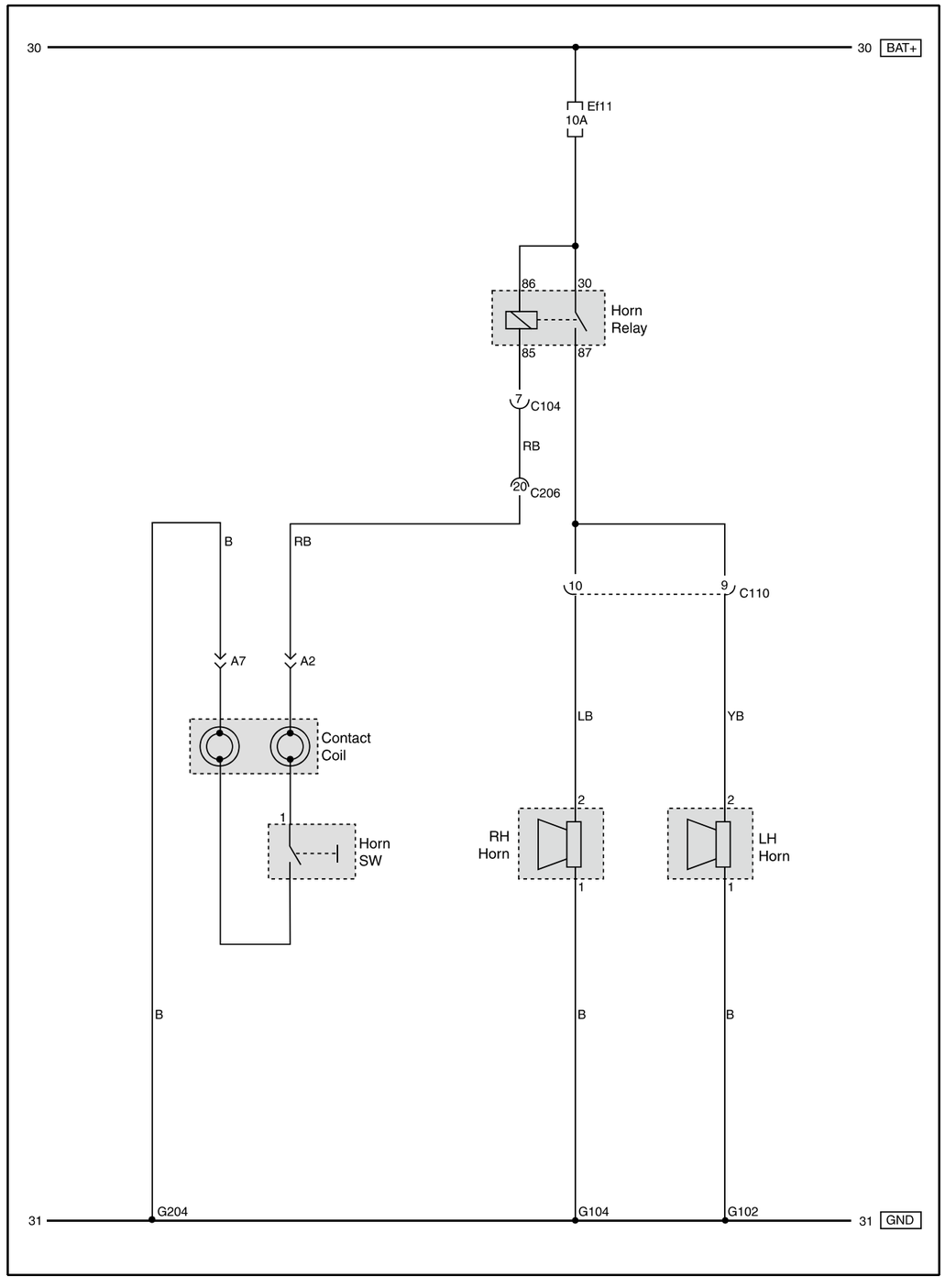

P/Window SW
(FRT LH/RH)


C
STICS

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8610-00

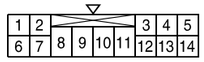
HORN



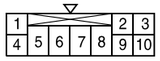
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G204	W/H Main	Backside TGS Lever Unit	

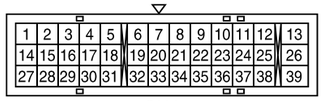
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



C104
W/H Floor
(Eng Room Fuse
& Relay Box)



C110
W/H Eng
(Eng Room Fuse
& Relay Box)



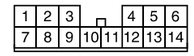
C206
W/H Floor



Horn



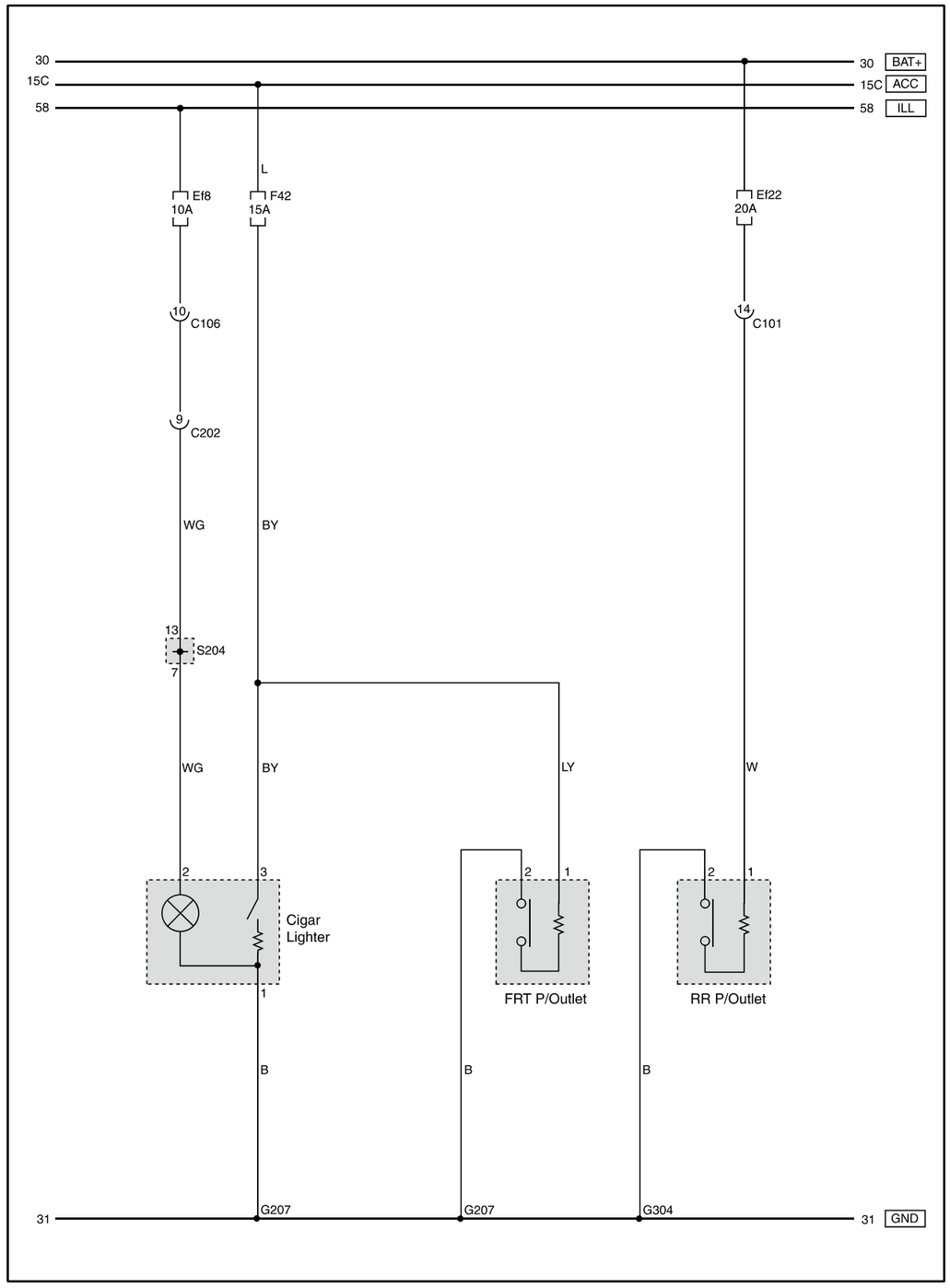
Horn SW
(Steering Wheel)



A/Cruise SW &
Contact Coil

Modification basis	
Application basis	
Affected VIN	

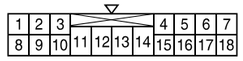
S.G.N. 7632-00 CIGAR LIGHTER / POWER OUTLET CIRCUIT



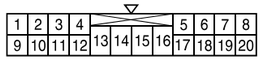
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G304	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

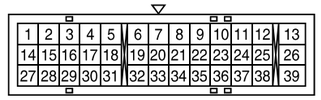
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



C101
W/H Floor
(Eng Room Fuse & Relay Box)



C106
W/H Floor
(Eng Room Fuse & Relay Box)



C202
W/H Floor



Cigar Lighter

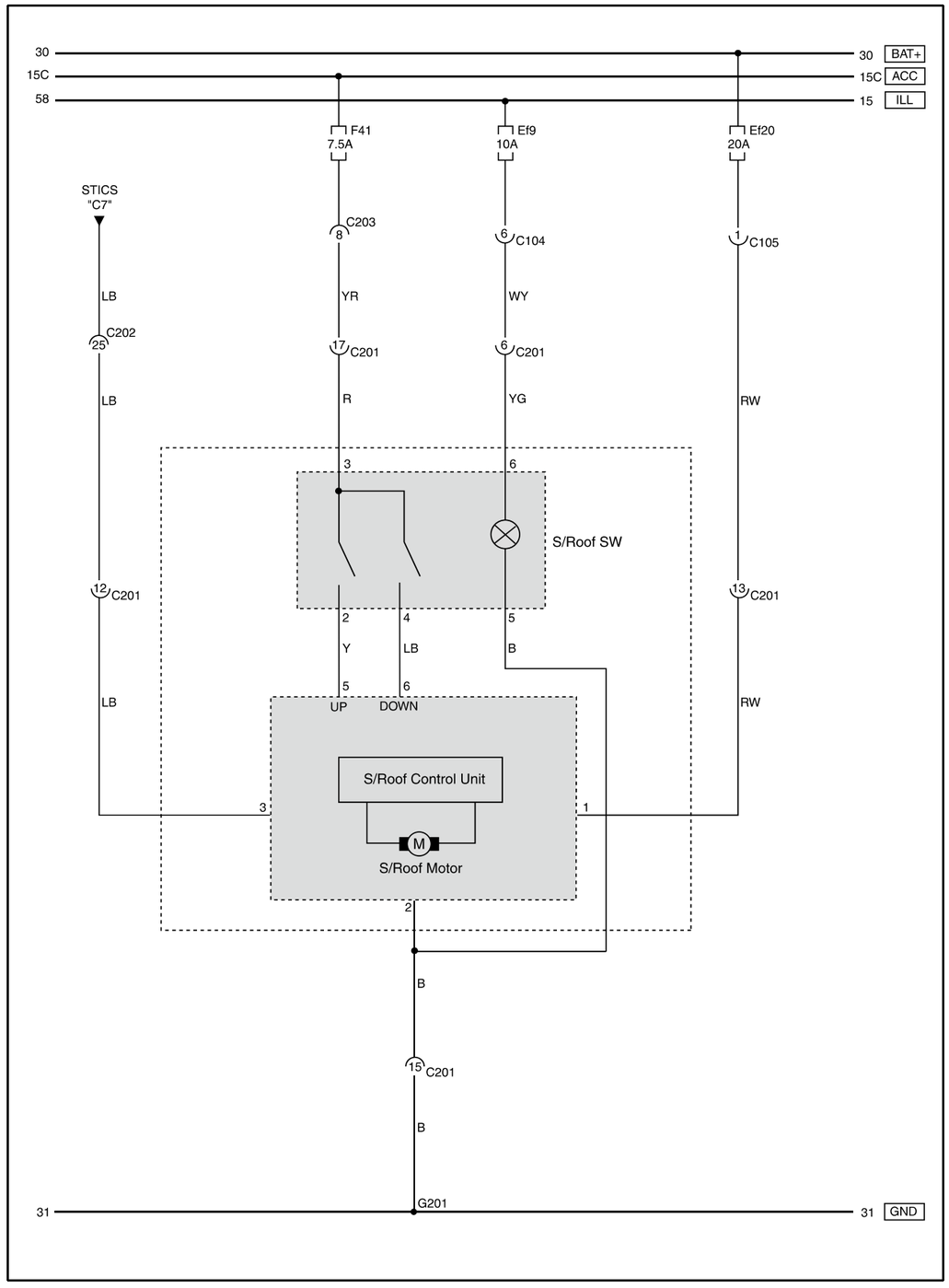


Power Outlet

Modification basis	
Application basis	
Affected VIN	

S.G.N. 7340-00

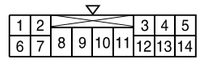
SUN ROOF CIRCUIT



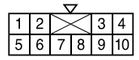
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (20Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder

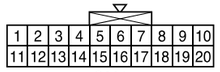
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



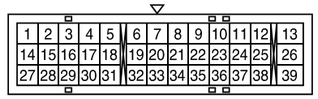
C104
W/H Floor
(Eng Room Fuse & Relay Box)



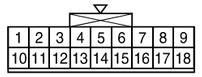
C105
W/H Floor
(Eng Room Fuse & Relay Box)



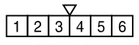
C201
W/H Roof



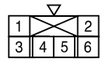
C202
W/H Floor



C203
W/H Floor



S/Roof SW

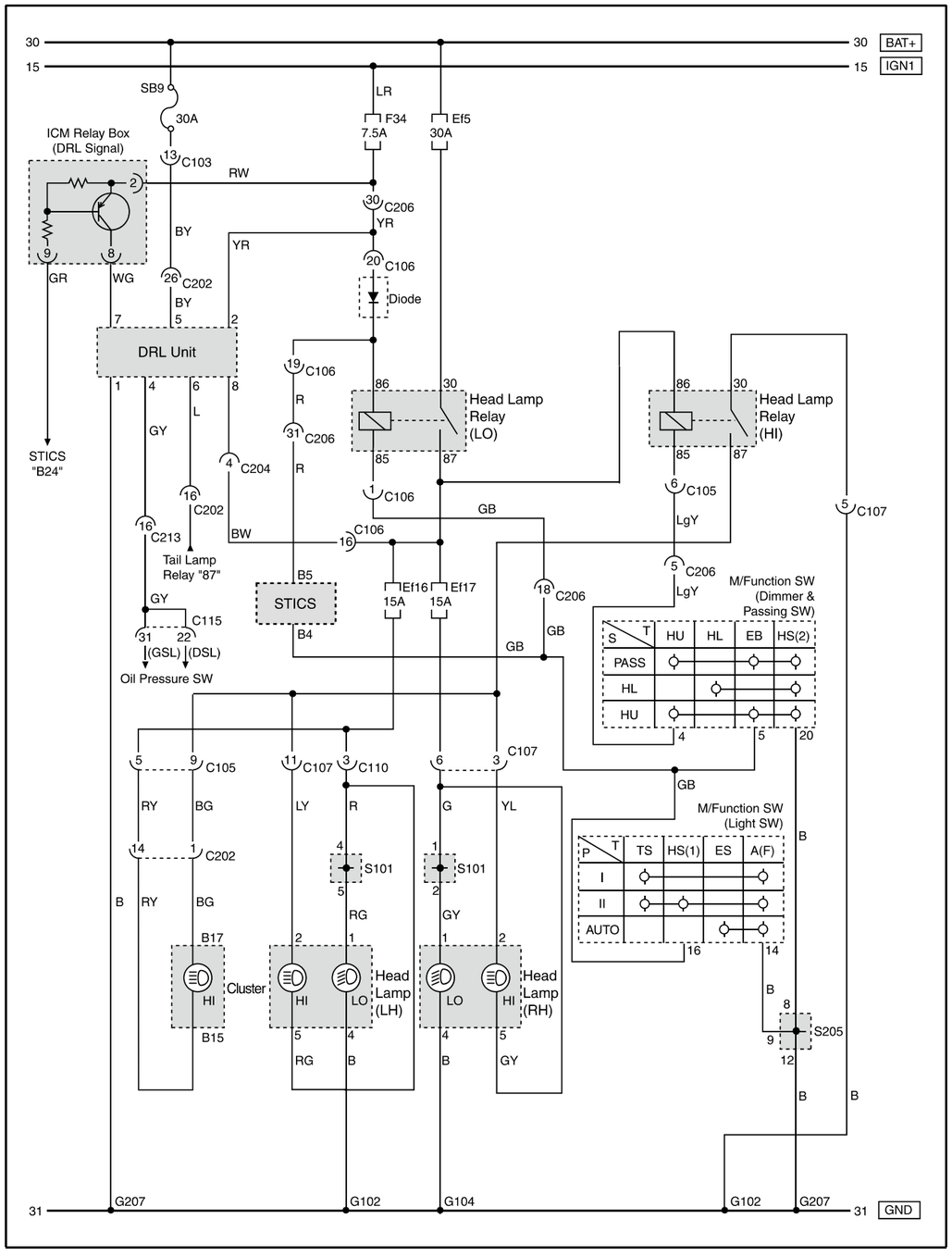


S/Roof Control Unit
(S/Roof Motor)

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8310-00

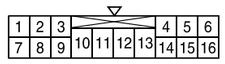
HEAD LAMP / DRL (DAY TIME RUNNING LIGHT) UNIT CIRCUIT

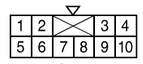


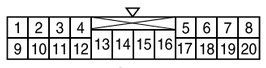
(1) CONNECTOR INFORMATION

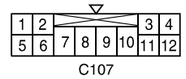
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S101 (6Pin, Black)	W/H Eng	Inside the Eng Room Fuse & Relay Box	Head Lamp
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

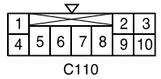
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

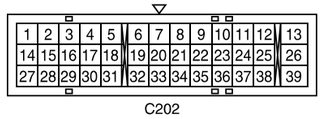

C103
W/H Floor
(Eng Room Fuse & Relay Box)


C105
W/H Floor
(Eng Room Fuse Relay Box)

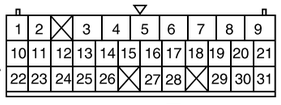

C106
W/H Floor
(Eng Room Fuse Relay Box)

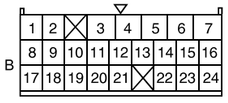

C107
W/H Eng
(Eng Room Fuse Relay Box)

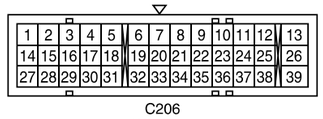

C110
W/H Eng
(Eng Room Fuse Relay Box)

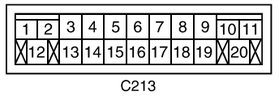

C202
W/H Floor

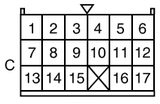

C204
W/H Floor

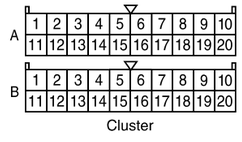

A


B

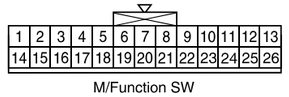

C206
W/H Floor

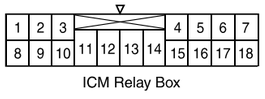

C213
W/H Floor


C
STICS


A
B
Cluster


Head Lamp (LH/RH)

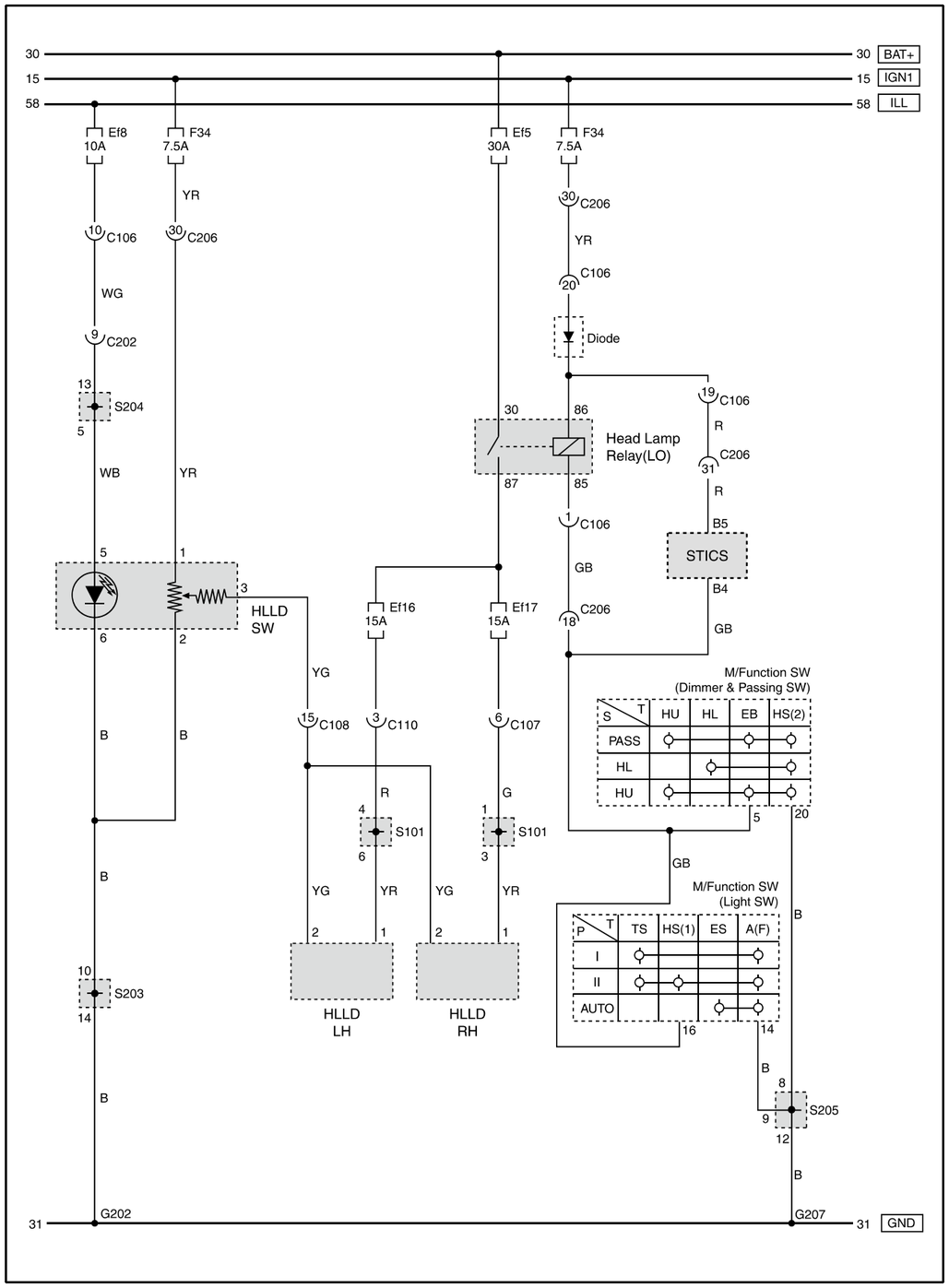

M/Function SW


ICM Relay Box

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8510-00

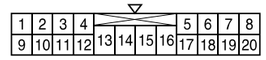
HLLD (HEAD LAMP LEVEL'G DEVICE) CIRCUIT



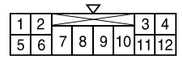
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
G202	W/H Main	Under the Driver "A" Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S101 (6Pin, Black)	W/H Eng	Inside the Eng Room Fuse & Relay Box	Head Lamp
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

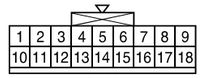
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



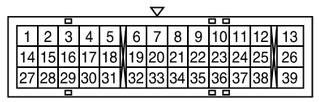
C106
W/H Floor
(Eng Room Fuse Relay Box)



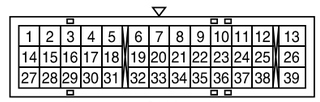
C107
W/H Eng
(Eng Room Fuse & Relay Box)



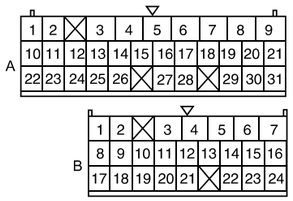
C108
W/H Eng
(Eng Room Fuse Relay Box)



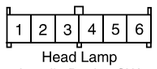
C202
W/H Floor



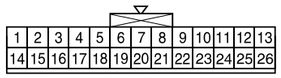
C206
W/H Floor



STICS



Head Lamp
Level'g Device SW



M/Function SW

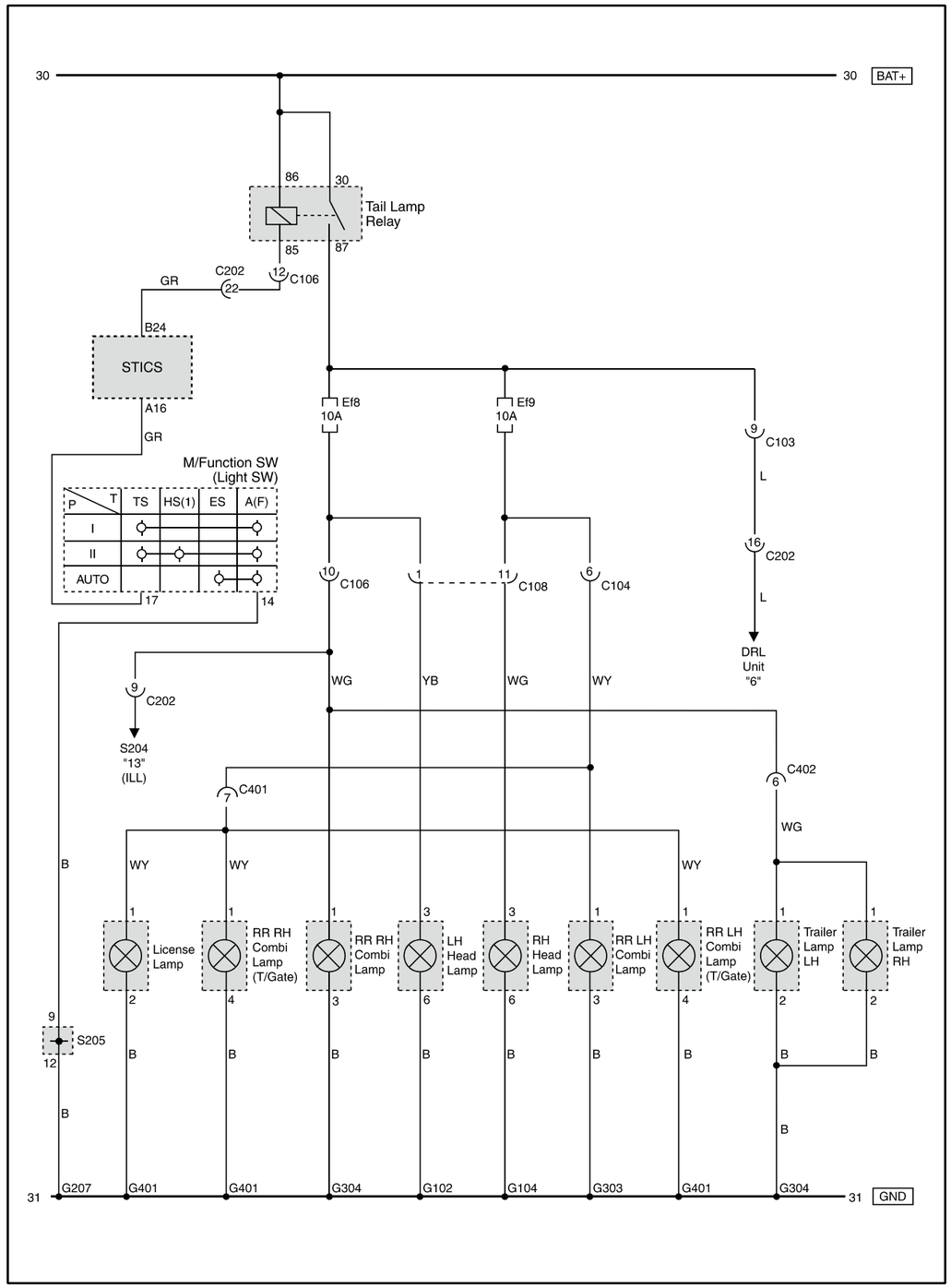


Head Lamp
Level'g Device

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8320-00

TAIL LAMP CIRCUIT



(1) CONNECTOR INFORMATION

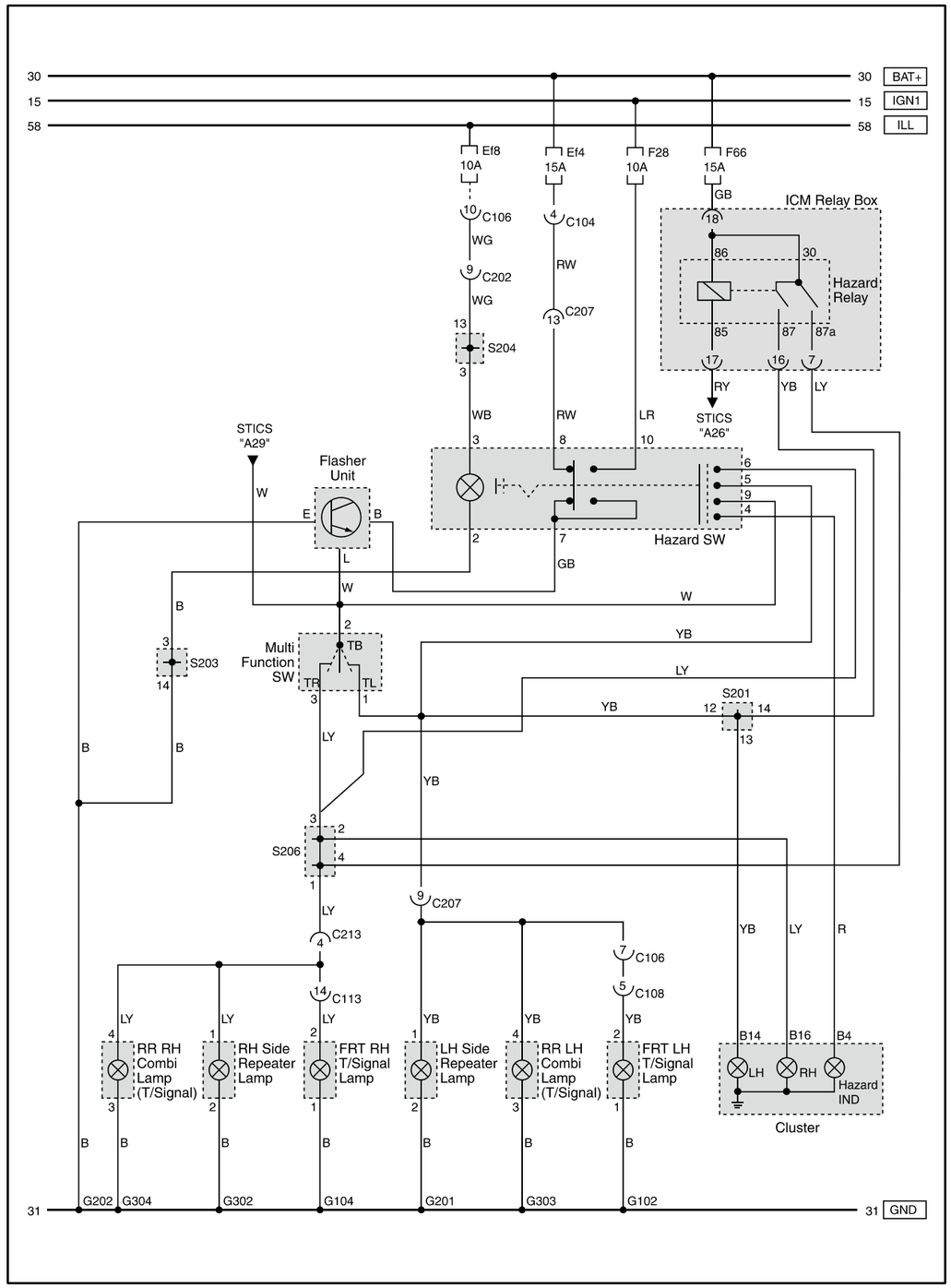
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Inner the LH T/Gate	
C402 (6Pin, Black)	W/H Floor - W/H Trailer	Under RH Bumper	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G303	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G304	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
G401	W/H T/Gate	Center the T/Gate	
S204 (14Pin, Black)	W/H Main	RH Protector of the Drvier Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8410-00

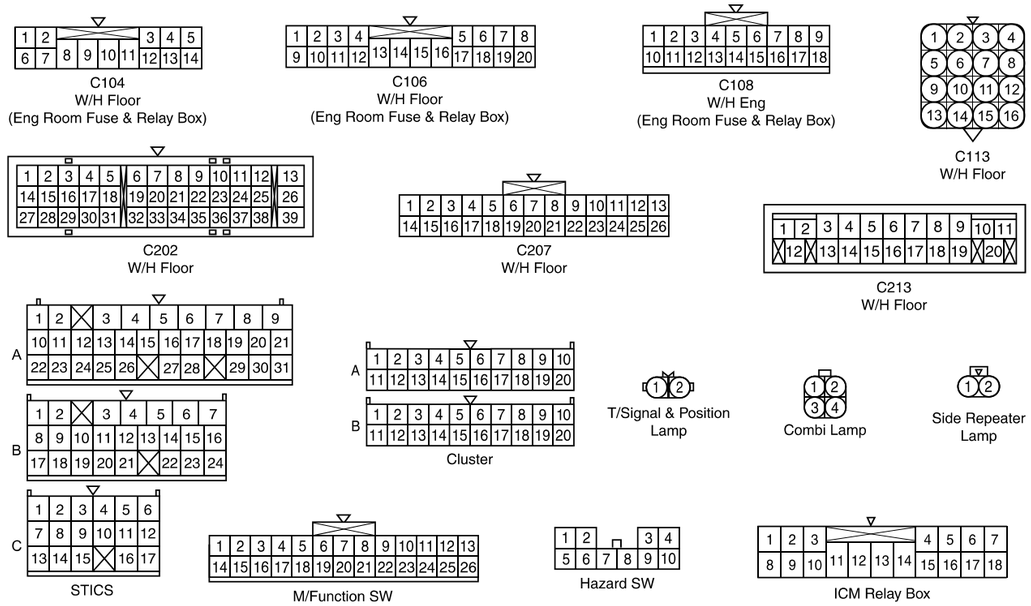
TURN SIGNAL / HAZARD LAMP CIRCUIT



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G202	W/H Main	Under the Driver “A” Pillar	
G302	W/H Floor	Under the Passenger Seat	
G303	W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G304	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Drvier Legroom	ILL
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN1, T/Signal

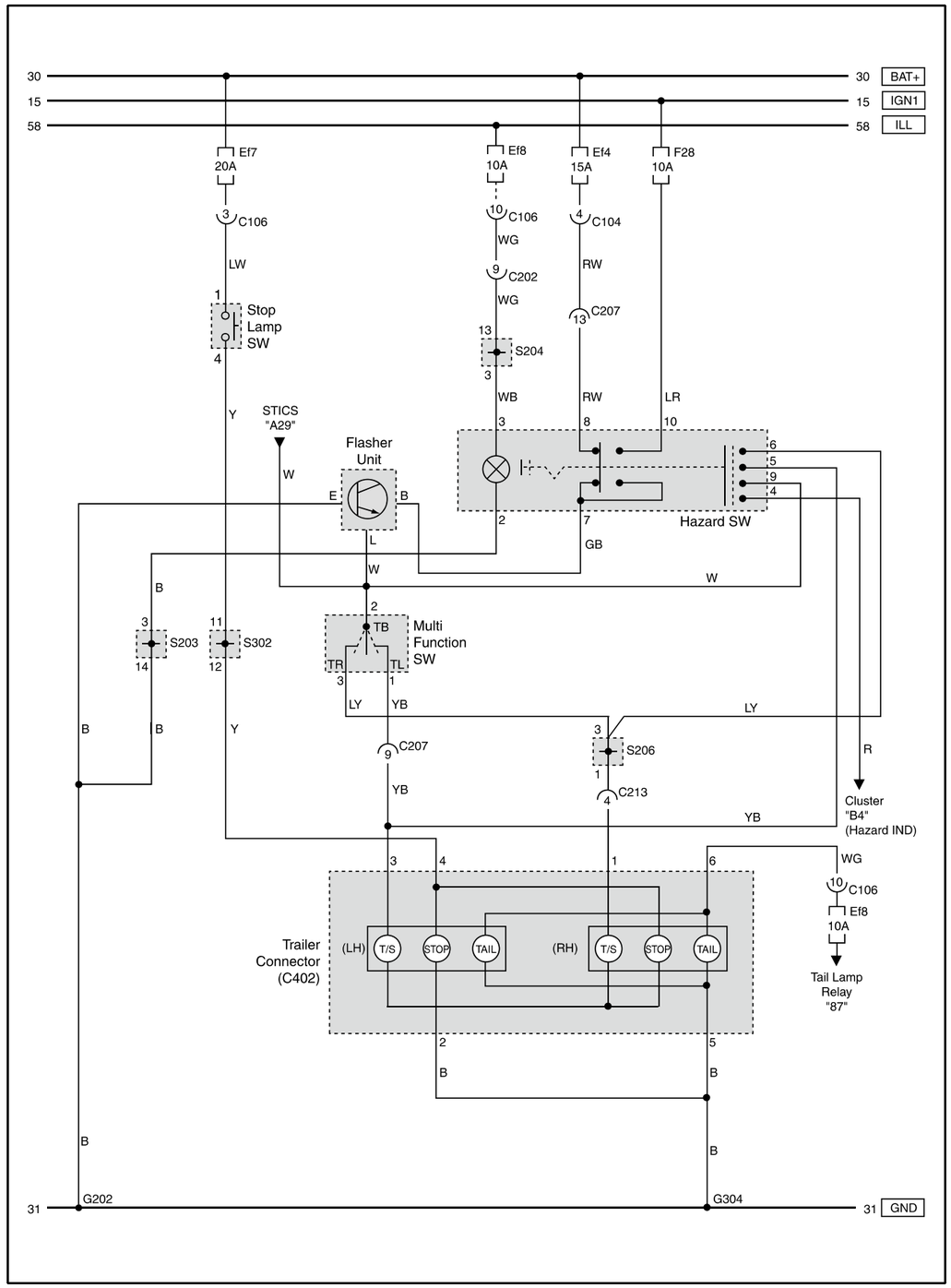
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 8210-00

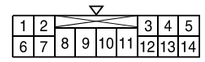
TRAILER LAMP CIRCUIT

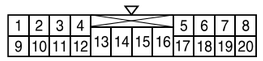


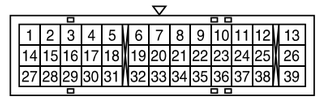
(1) CONNECTOR INFORMATION

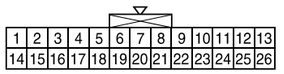
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C207 (26Pin, White)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C402 (6Pin, Black)	W/H Floor - W/H Trailer	Under RH Bumper	
G202	W/H Main	Under the Driver “A” Pillar	
G304	W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Drvier Legroom	ILL
S206 (8Pin, Black)	W/H Main	Upper the PTC Protector	IGN 1, T/Signal
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

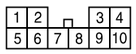

C104
W/H Floor
(Eng Room Fuse & Relay Box)

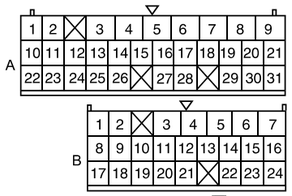

C106
W/H Floor
(Eng Room Fuse & Relay Box)

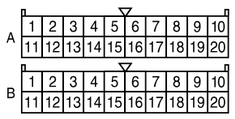

C202
W/H Floor

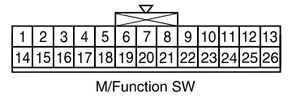

C207
W/H Floor


C402
W/H Trailer

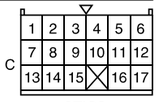

Hazard SW




Cluster


M/Function SW


Stop Lamp SW


STICS

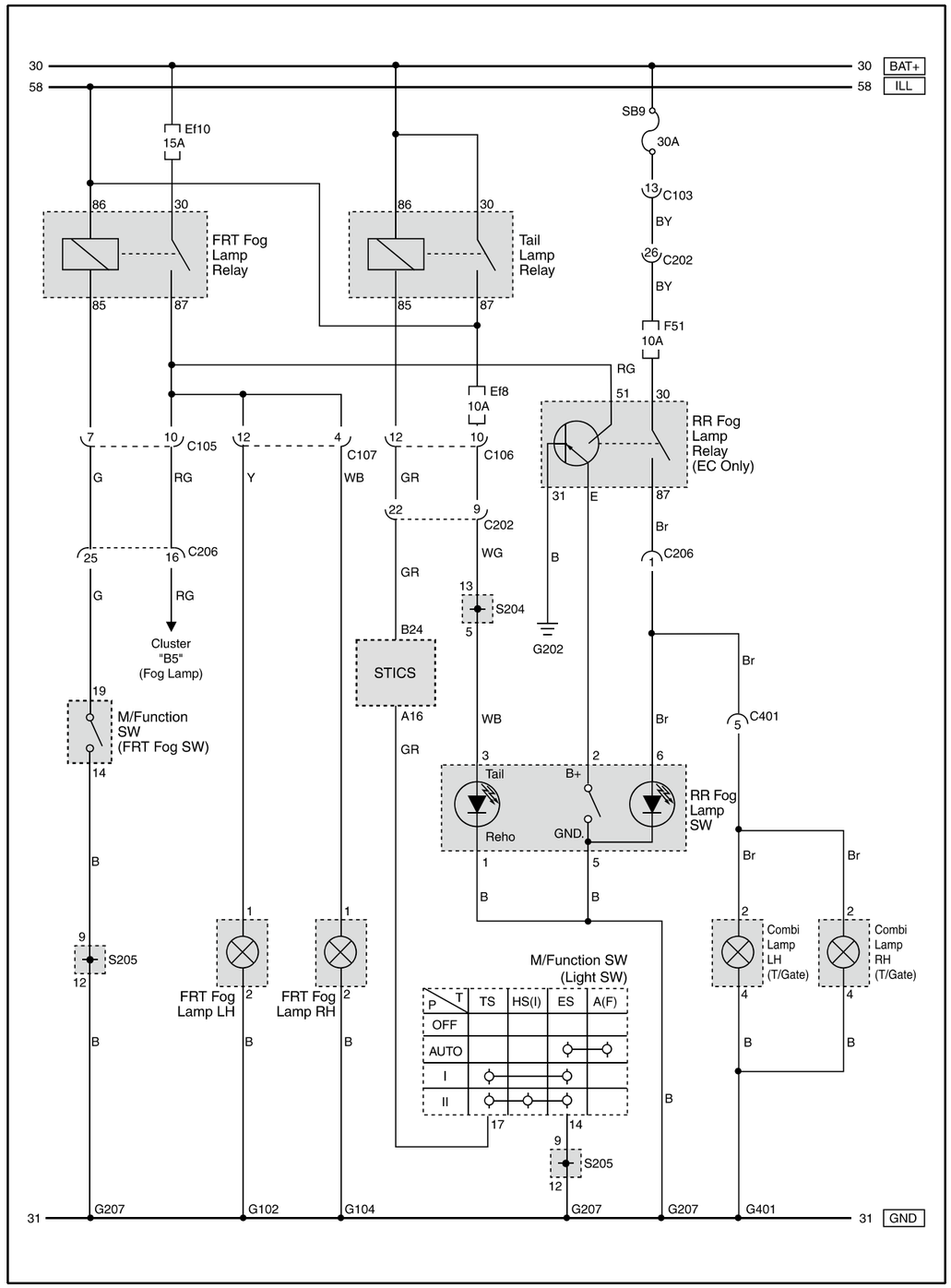
CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8310-00

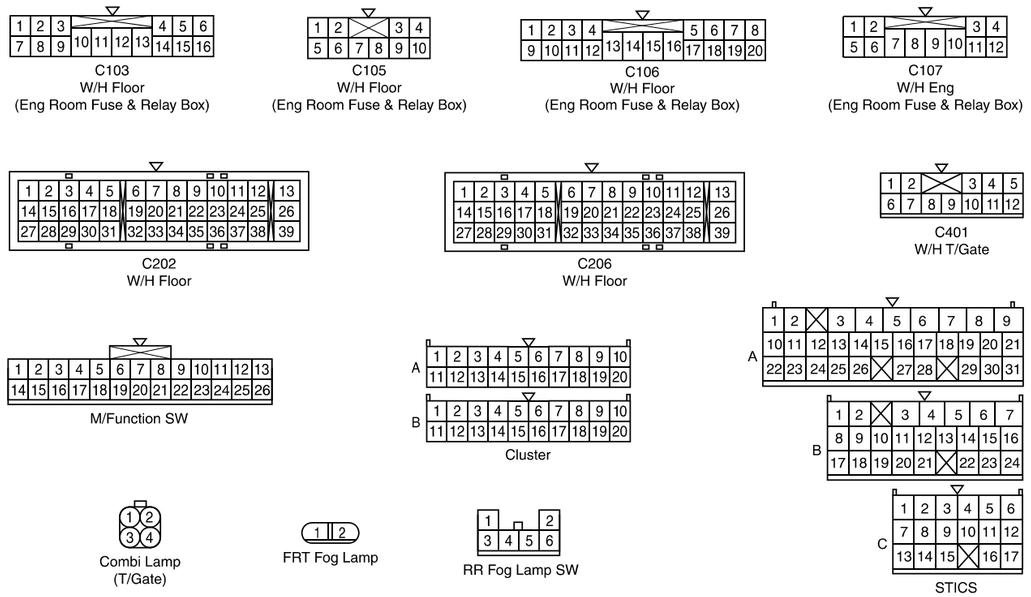
FOG LAMP CIRCUIT



(1) CONNECTOR INFORMATION

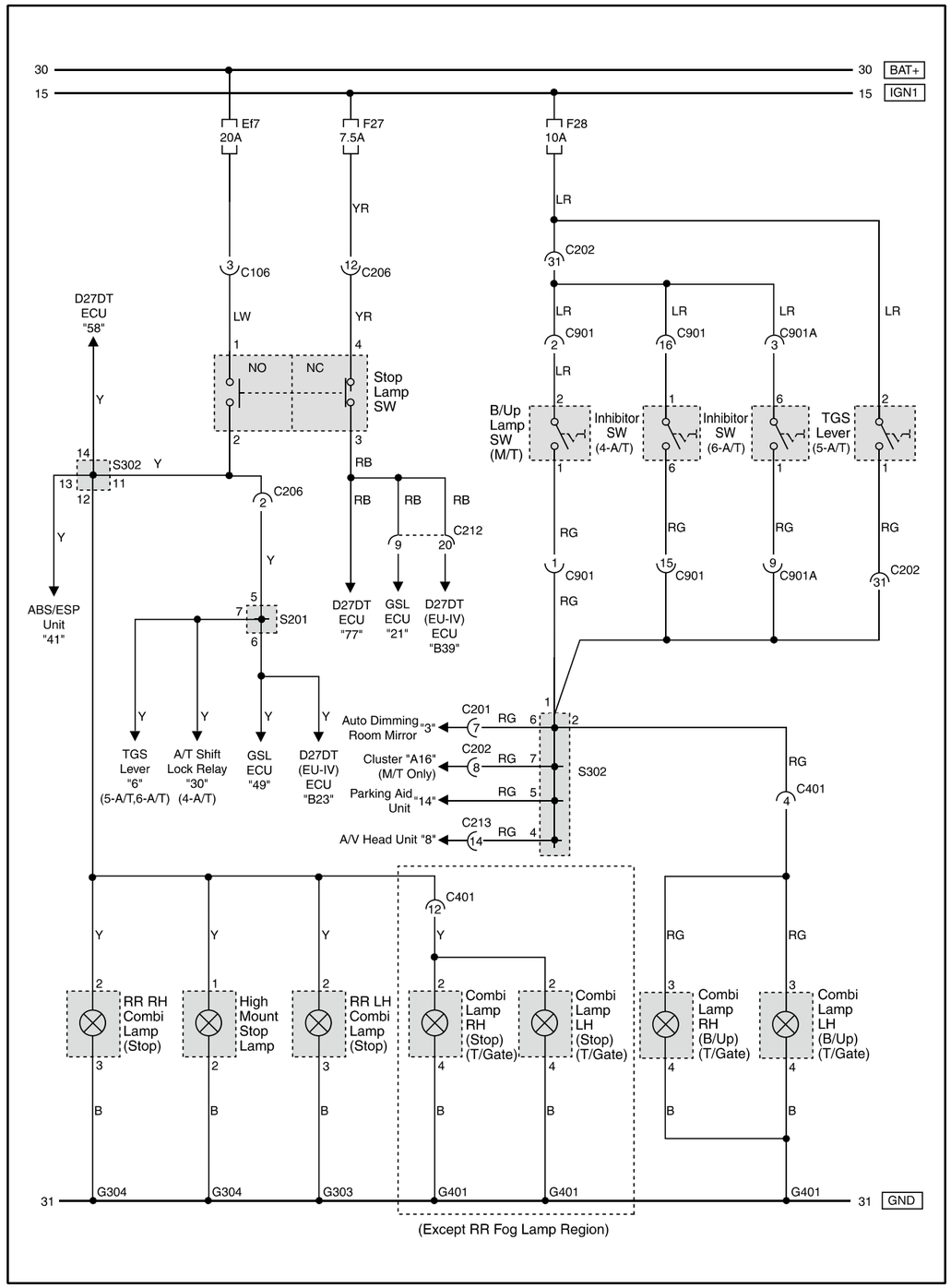
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Upper the RH T/Gate	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G202	W/H Main	Under the Driver “A” Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G401	W/H T/Gate	Center the T/Gate	
S204 (14Pin, Black)	W/H Main	RH Protector of the Drvier Legroom	ILL
S205 (14Pin, Black)	W/H Main	Upper the PTC Protector	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



S.G.N. 4810-00

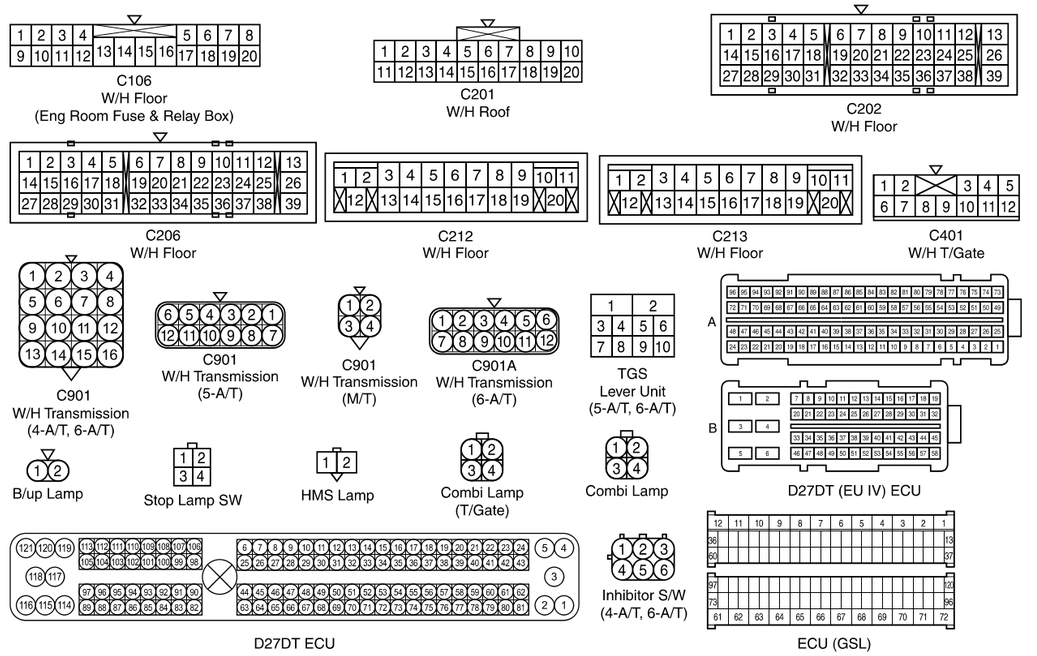
STOP / BACK-UP LAMP CIRCUIT



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (20Pin, White)		W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)		W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C212 (20Pin, L/Green)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C401 (12Pin, White)		W/H Floor - W/H T/Gate	Upper the RH T/Gate	
C901	(16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	4-A/T
	(12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	5-A/T
	(4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C901A (12Pin, Black)		W/H Floor - W/H T/M	Upper the T/M	6-A/T
G303		W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G304		W/H Floor	Passenger QTR PNL (Under the QTR Glass)	
G401		W/H T/Gate	Center the T/Gate	
S201 (14Pin, Black)		W/H Main	RH Protector of the Driver Legroom	
S302 (14Pin, Black)		W/H Main	Beside RR LH Seat W/H Protector	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



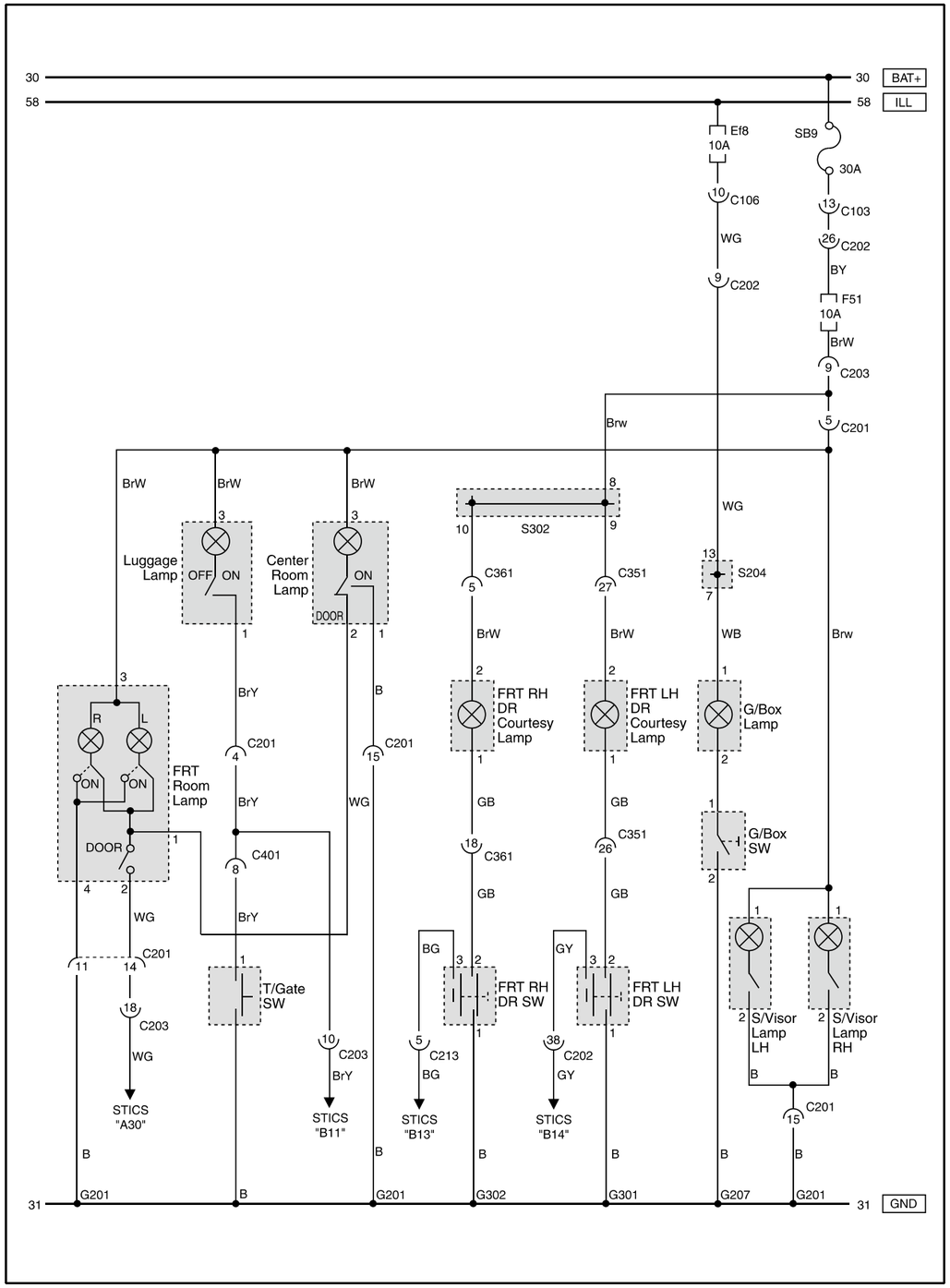
CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 7770-00

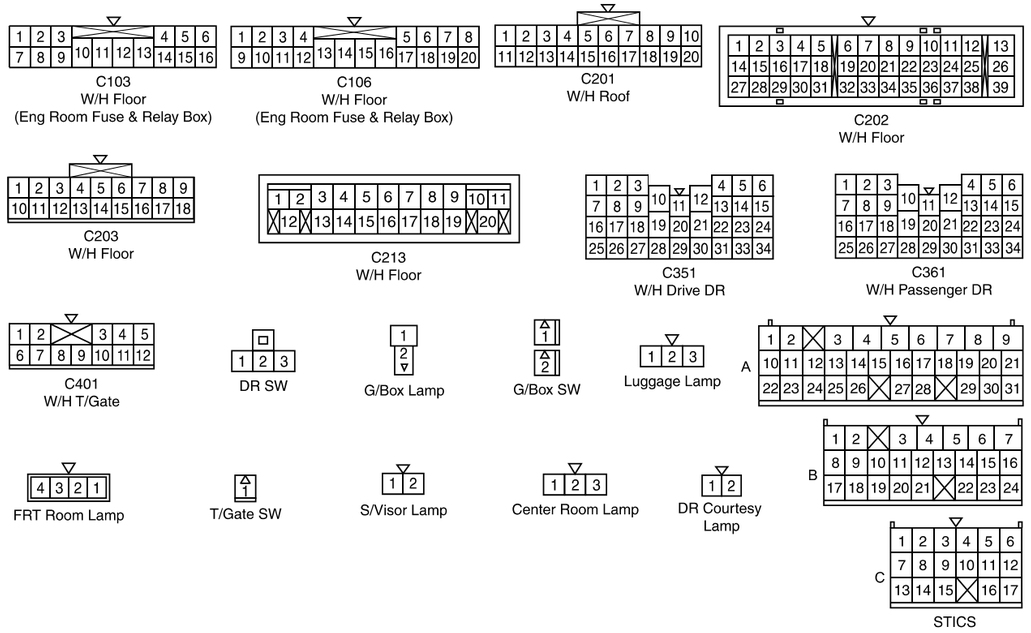
INTERIOR LAMP CIRCUIT



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (20Pin, White)	W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” PIllar	
C401 (12Pin, White)	W/H Floor - W/H T/Gate	Upper the RH T/Gate	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G207	W/H Main	Inner the Passenger Cowl Side PNL	
G301	W/H Floor	Under the Driver Seat	
G302	W/H Floor	Under the Passenger Seat	
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

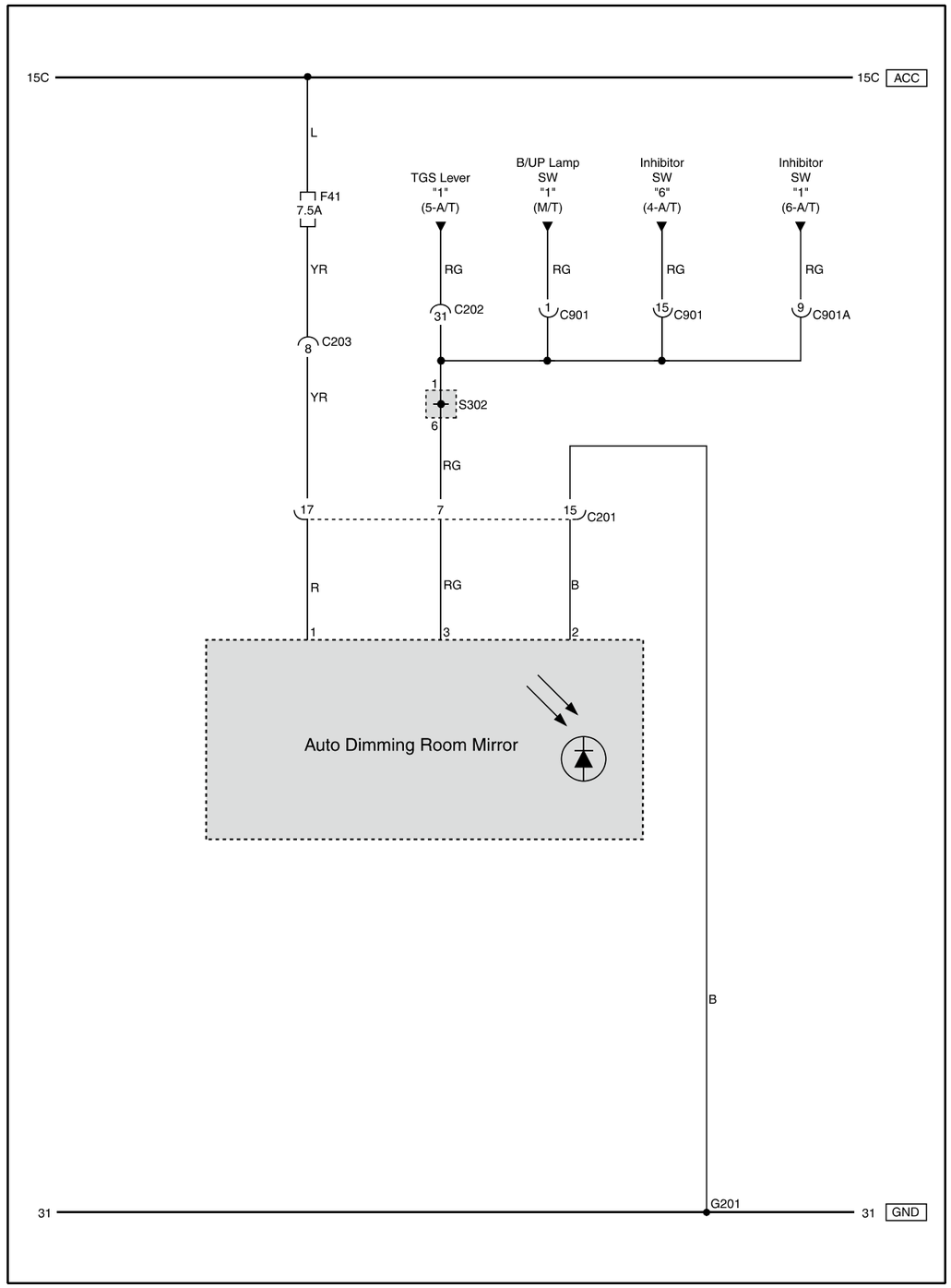
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 7770-00

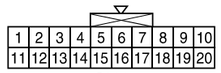
AUTO DIMMING ROOM MIRROR CIRCUIT



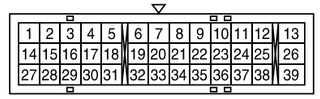
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C201 (20Pin, White)		W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C901	(16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	4-A/T, 6-A/T
	(12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	5-A/T
	(4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C901A (12Pin, Black)		W/H Floor - W/H T/M	Upper the T/M	6-A/T
G201		W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
S302 (14Pin, Black)		W/H Main	Beside RR LH Seat W/H Protector	

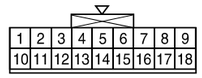
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



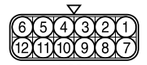
C201
W/H Roof



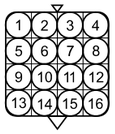
C202
W/H Floor



C203
W/H Floor



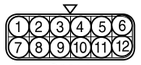
C901
W/H Transmission
(5-A/T)



C901
W/H Transmission
(4-A/T,6-A/T)



C901
W/H Transmission
(M/T)



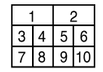
C901A
W/H Transmission
(6-A/T)



Auto Dimming
Room Mirror



B/UP Lamp SW (M/T)

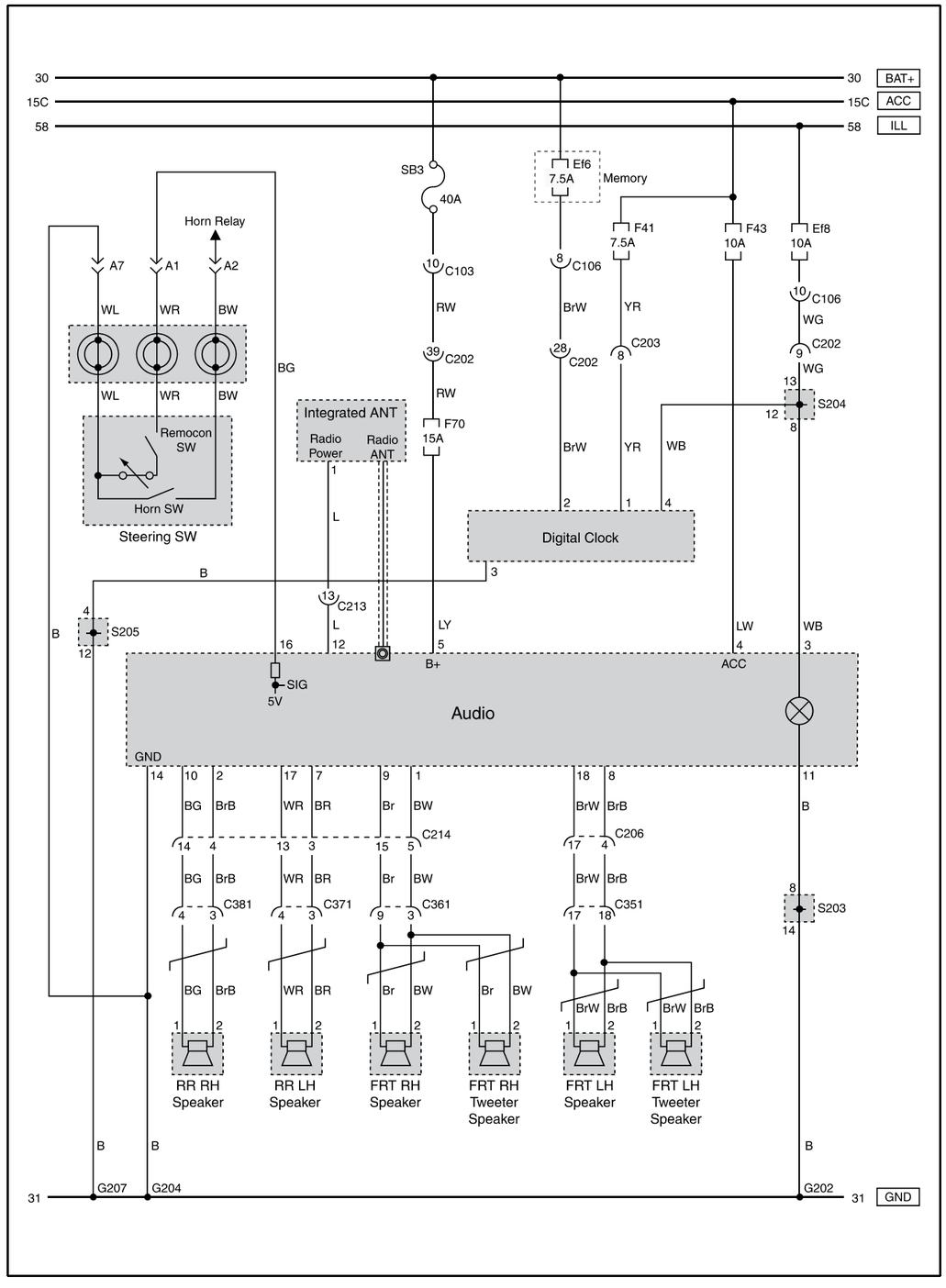


TGS
Lever Unit
(5-A/T, 6-A/T)

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8910-00

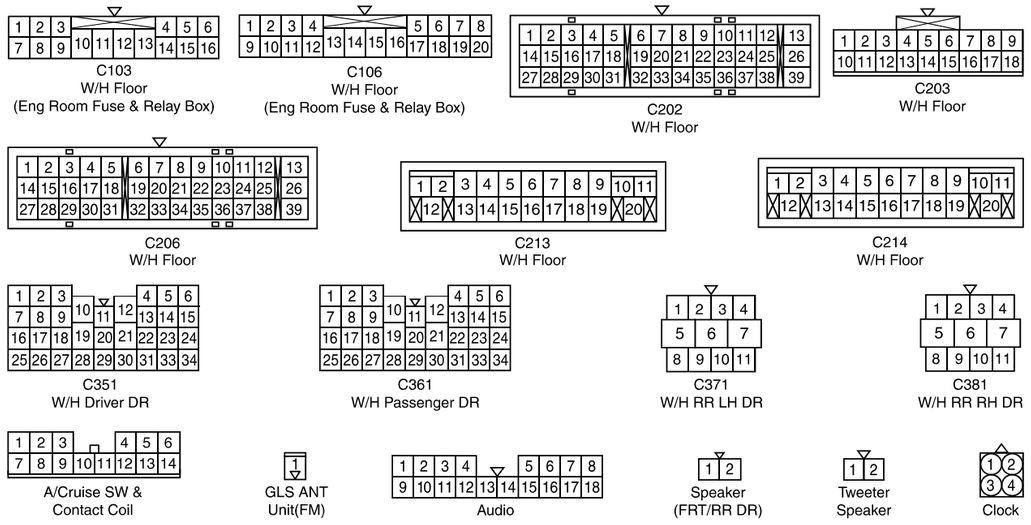
AUDIO / CLOCK CIRCUIT



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” PIllar	
C371 (11Pin, White)	W/H Floor - W/H RR LH DR	Under the LH “B” Pillar	
C381 (11Pin, White)	W/H Floor - W/H RR RH DR	Under the RH “B” Pillar	
G202	W/H Main	Under the Driver “A” Pillar	
G204	W/H Main	Backside TGS Lever Unit	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Under the PTC Protector	GND

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

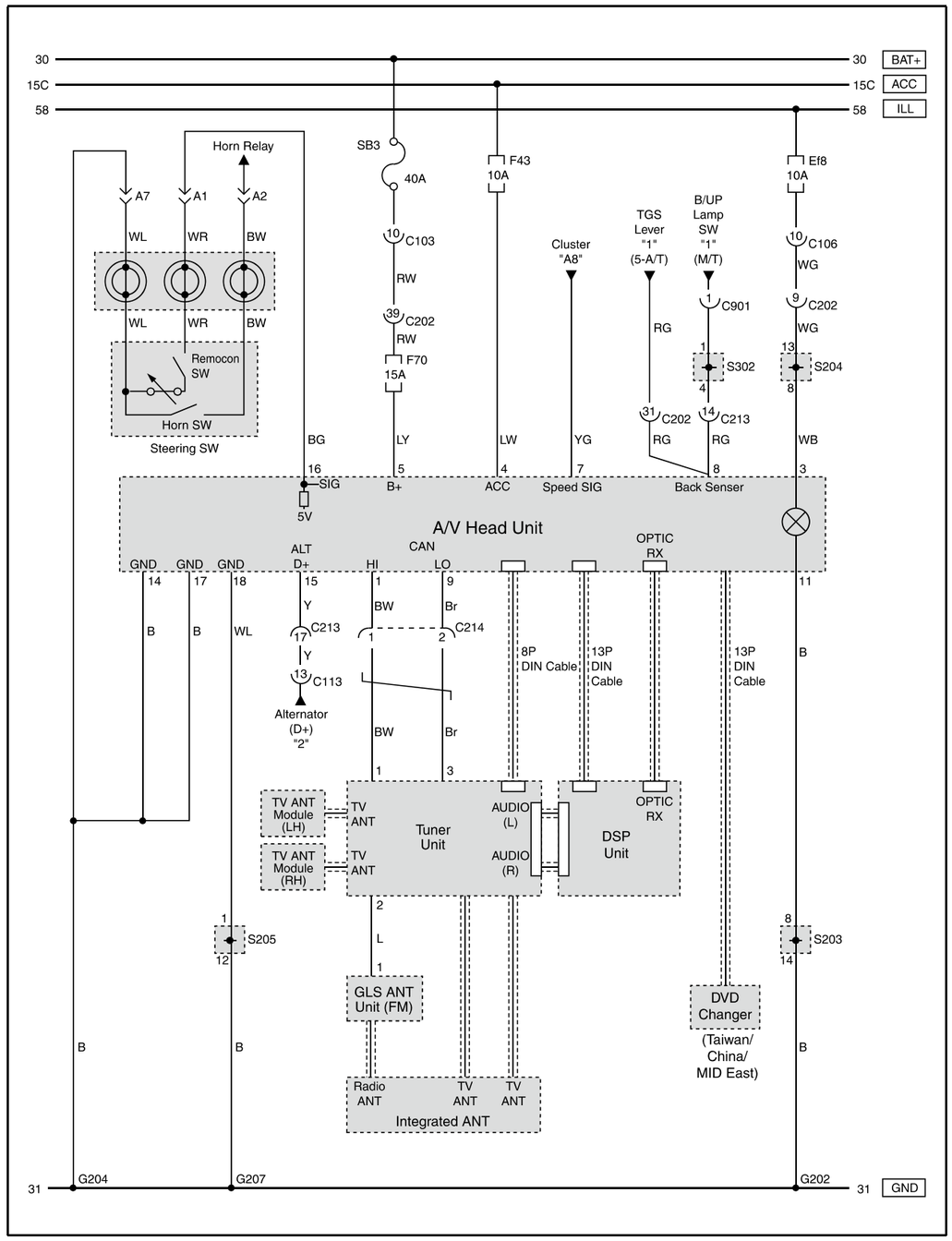


Modification basis	
Application basis	
Affected VIN	

S.G.N. 8930-00

A/V SYSTEM

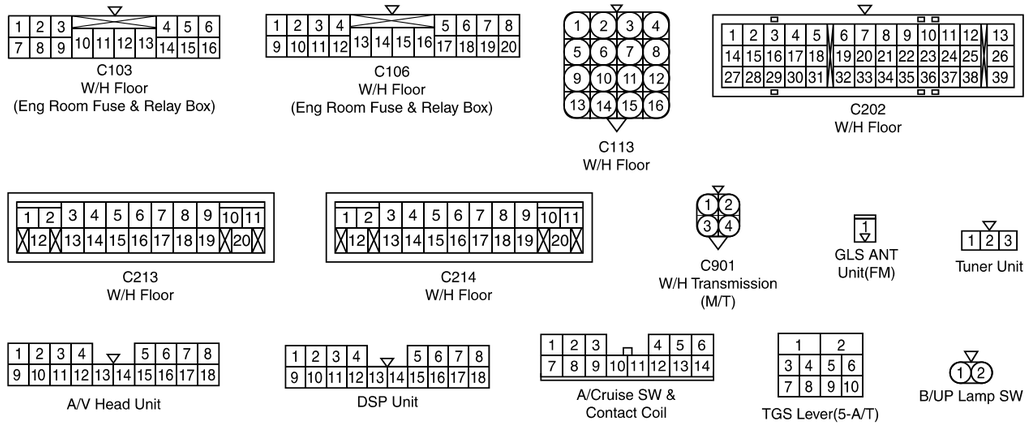
1) A/V HEAD UNIT, TUNER UNIT, DSP UNIT, DVD CHANGER



(1) CONNECTOR INFORMATION

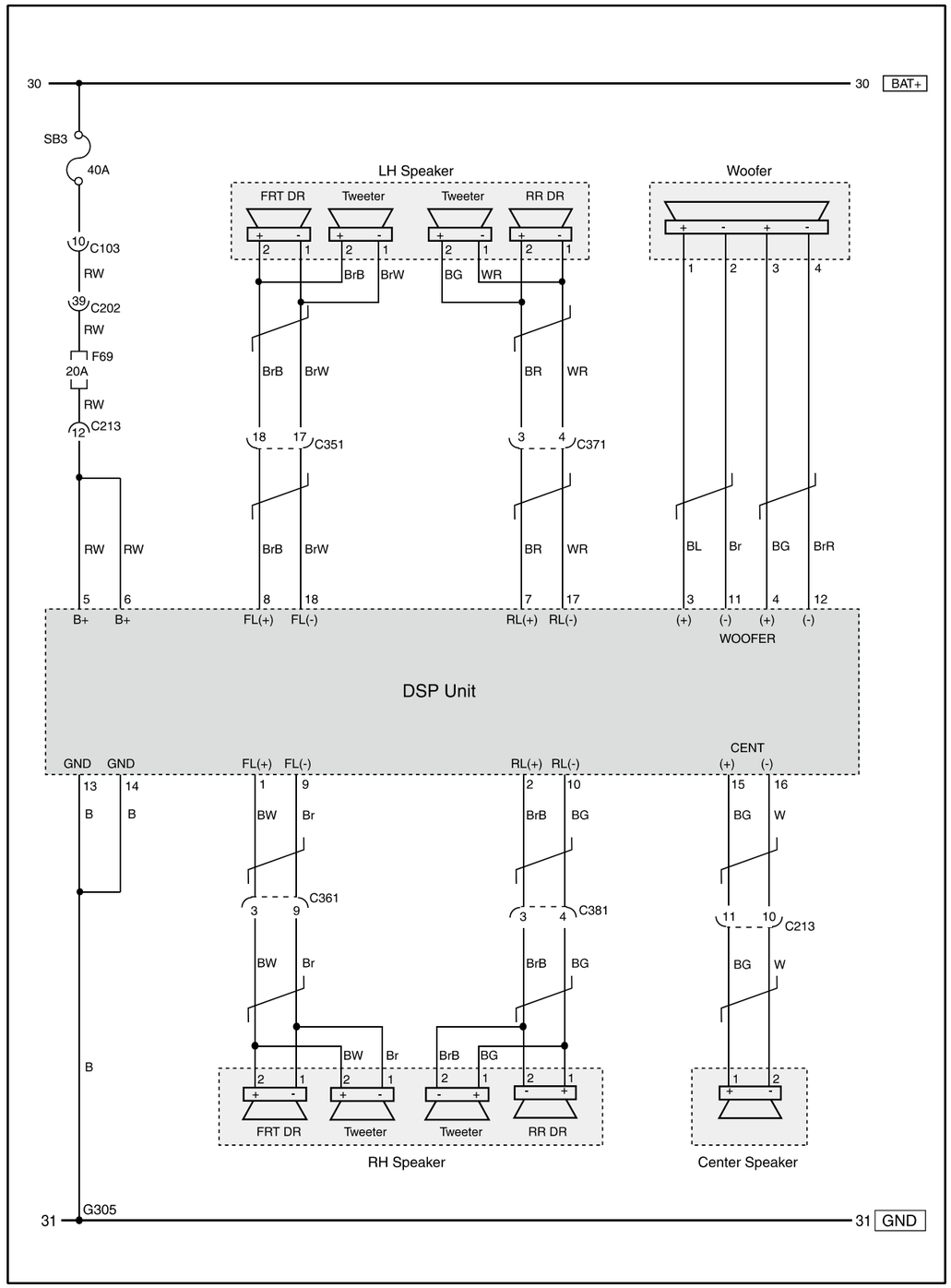
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C901 (4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
G202	W/H Main	Under the Driver “A” Pillar	
G204	W/H Main	Backside TGS Lever Unit	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
S205 (14Pin, Black)	W/H Main	Under the PTC Protector	GND
S302 (14Pin, Black)	W/H Main	Beside RR LH Seat W/H Protector	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

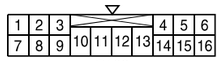
2) DSP UNIT, SPEAKER

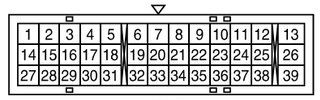


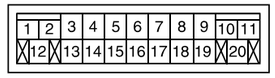
(1) CONNECTOR INFORMATION

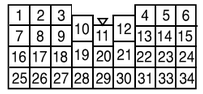
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C351 (33Pin, White)	W/H Floor - W/H Driver DR	Under the LH “A” Pillar	
C361 (33Pin, White)	W/H Floor - W/H Passenger DR	Under the RH “A” Pillar	
C371 (11Pin, White)	W/H Floor - W/H RR LH DR	Under the LH “B” Pillar	
C381 (11Pin, White)	W/H Floor - W/H RR RH DR	Under the RH “B” Pillar	
G305	W/H Floor	Passenger QTR PNL	Audio

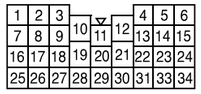
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

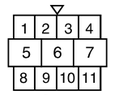

C103
W/H Floor
(Eng Room Fuse & Relay Box)

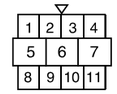

C202
W/H Floor

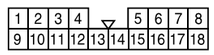

C213
W/H Floor


C351
W/H Driver DR


C361
W/H Passenger DR


C371
W/H RR LH DR


C381
W/H RR RH DR


DSP Unit


Speaker
(FRT/RR DR)


Tweeter Speaker

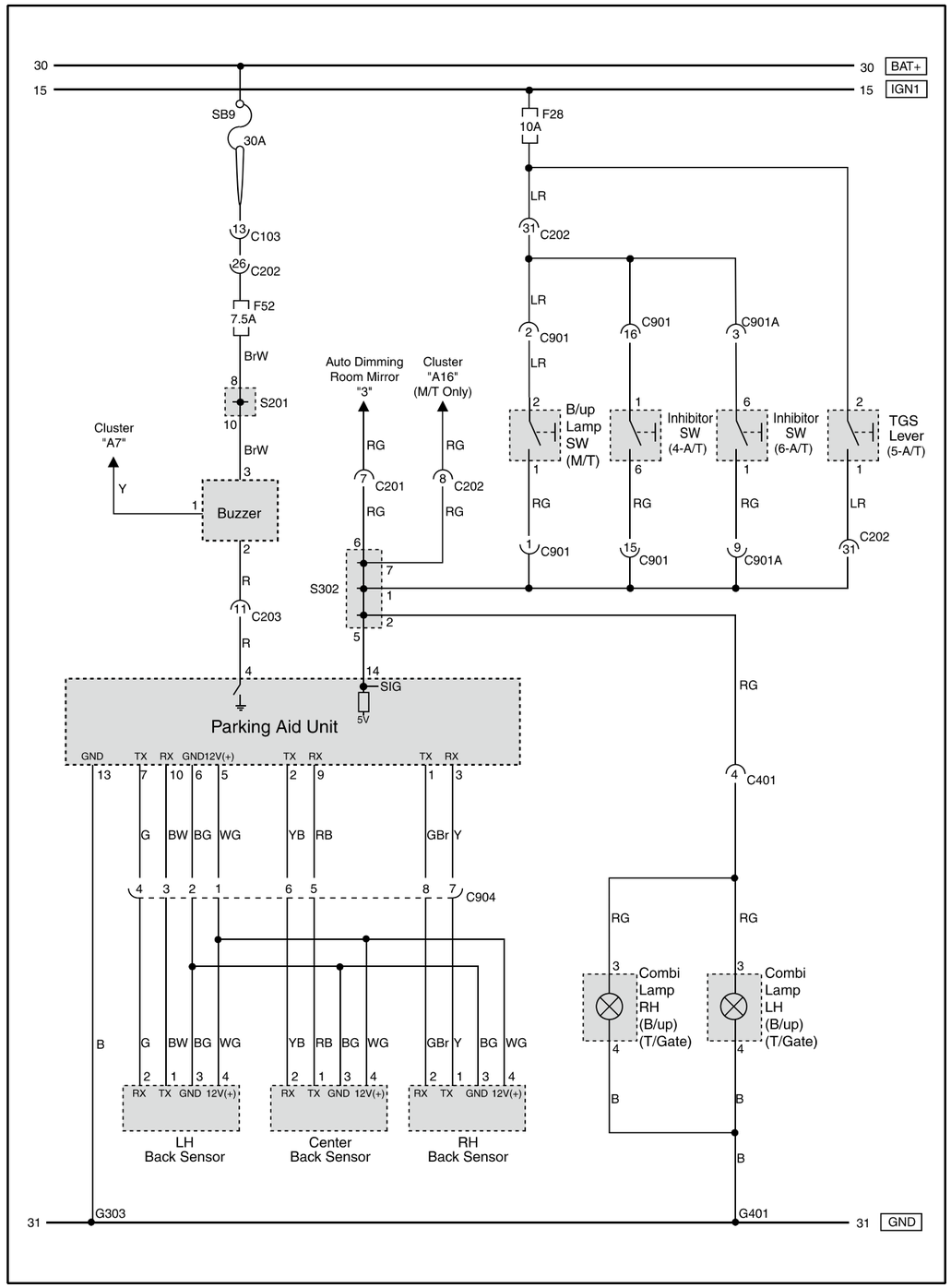

Woofer


Center Speaker

Modification basis	
Application basis	
Affected VIN	

S.G.N. 8790-00

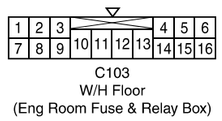
PARKING AID CIRCUIT



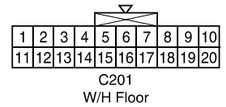
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)		W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C201 (20Pin, White)		W/H Floor - W/H Roof	Inside Driver Cowl Side PNL	
C202 (39Pin, Black)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)		W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C401 (12Pin, White)		W/H Floor - W/H T/Gate	Inner the LH T/Gate	
C901	(16Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	4-A/T, 6-A/T
	(4Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	M/T
C901A (12Pin, Black)		W/H Floor - W/H T/M	Upper the T/M	6-A/T
C904 (8Pin, Black)		W/H Floor - W/H PAS	Under LH Bumper	
G303		W/H Floor	Driver QTR PNL (Under the QTR Glass)	
G401		W/H T/Gate	Center the T/Gate	
S201 (14Pin, Black)		W/H Main	RH Protector of the Driver Legroom	
S302 (14Pin, Black)		W/H Main	Beside RR LH Seat W/H Protector	

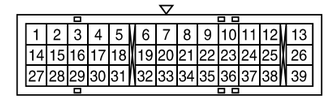
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



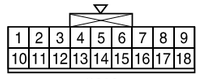
C103
W/H Floor
(Eng Room Fuse & Relay Box)



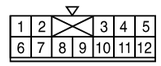
C201
W/H Floor



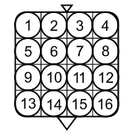
C202
W/H Floor



C203
W/H Floor



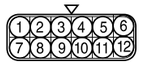
C401
W/H T/Gate



C901
W/H Transmission
(4-A/T,6-A/T)



C901
W/H Transmission(M/T)



C901A
W/H Transmission
(6-A/T)



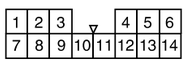
C904
W/H Parking Aid



B/up Lamp SW(M/T)



Buzzer



Parking Aid Unit



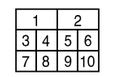
Inhibitor S/W
(6-A/T)



Back Sensor



Combi Lamp(T/Gate)



TGS Lever(5-A/T)

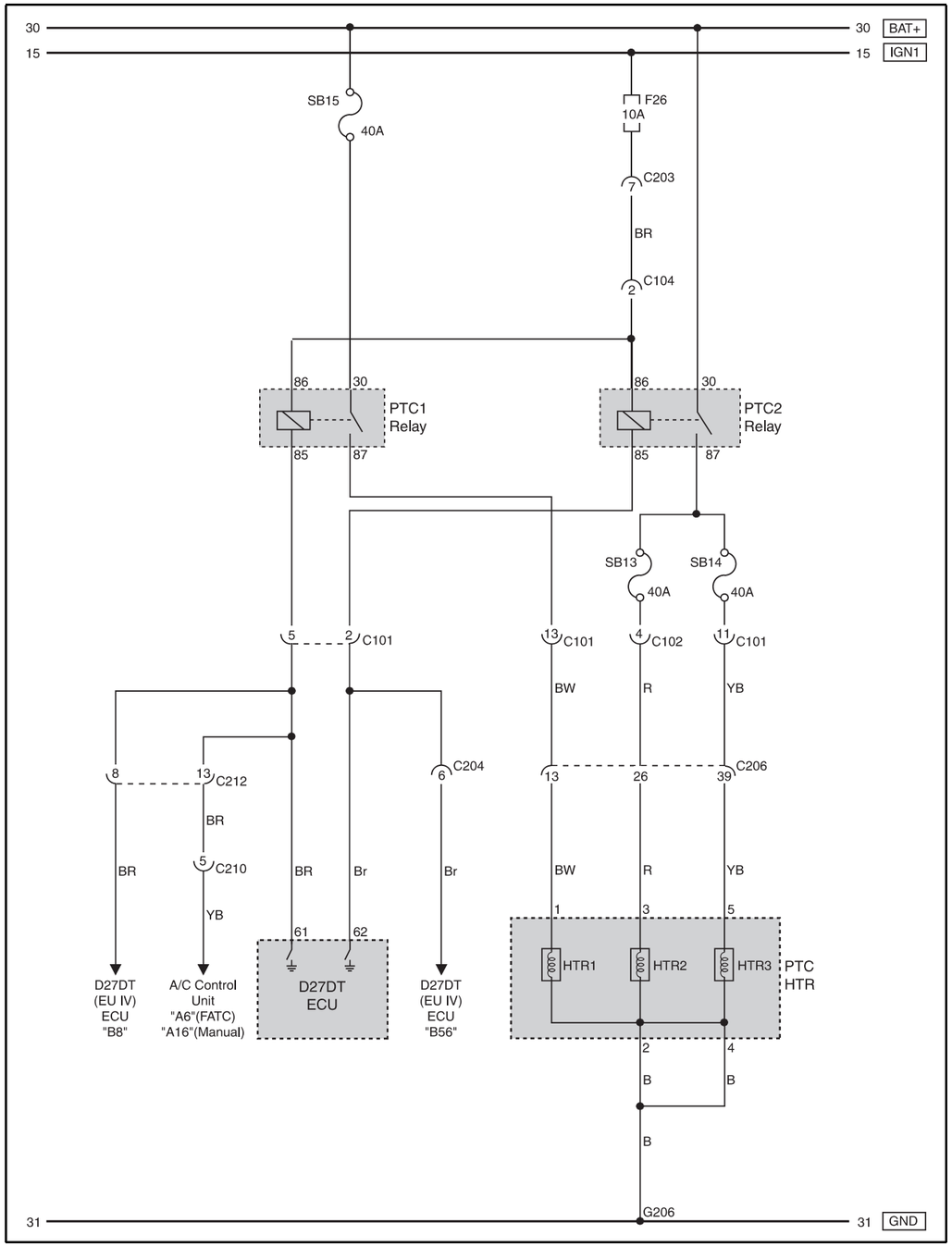
CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

S.G.N. 6810-00

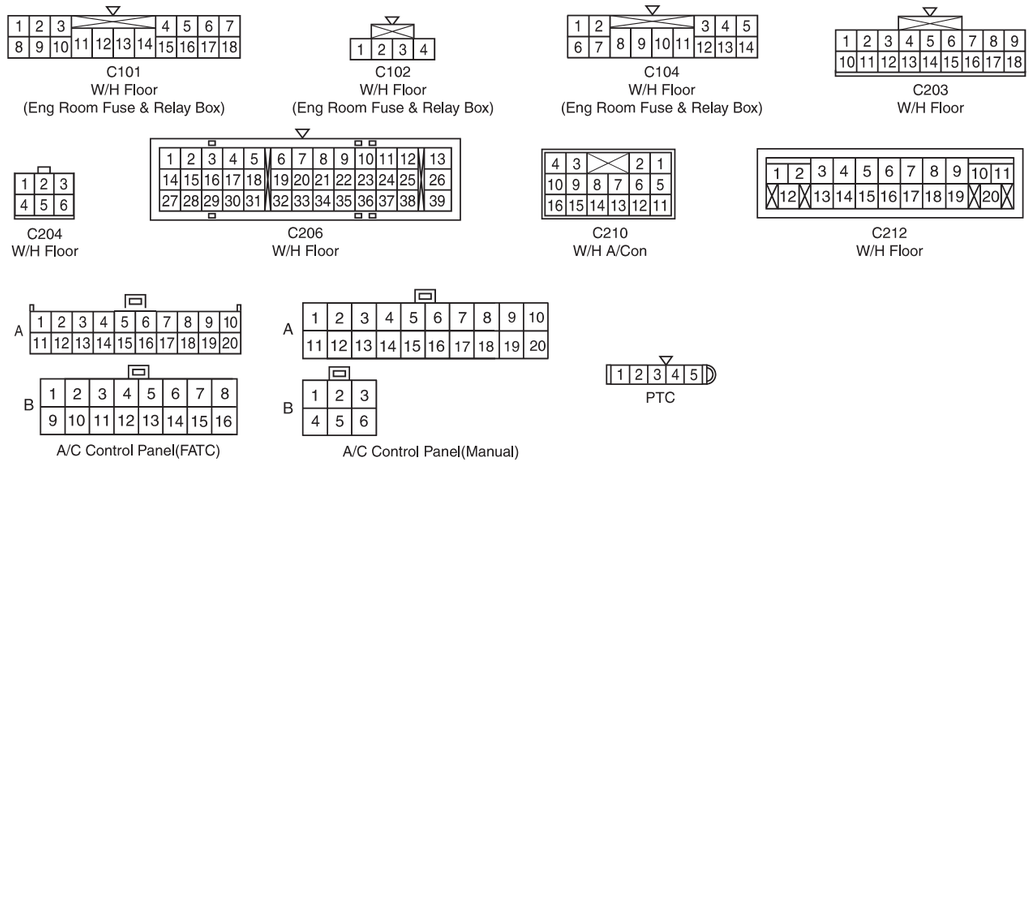
PTC HEATER (POSITIVE TEMPERATURE COEFFICIENT)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C204 (6Pin, Colorless)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G206	W/H Main	LH Eng ECU	PTC

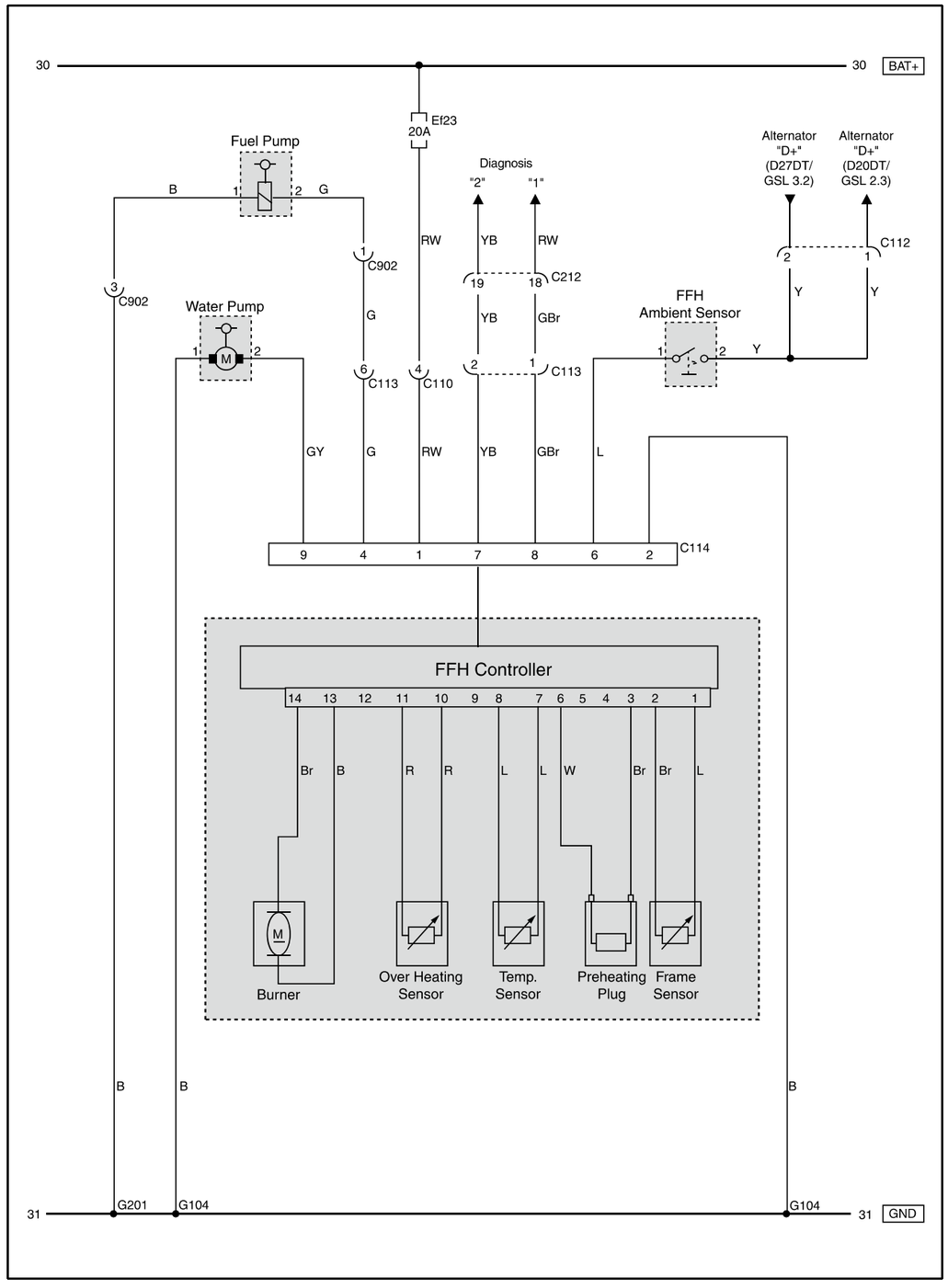
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 6910-00

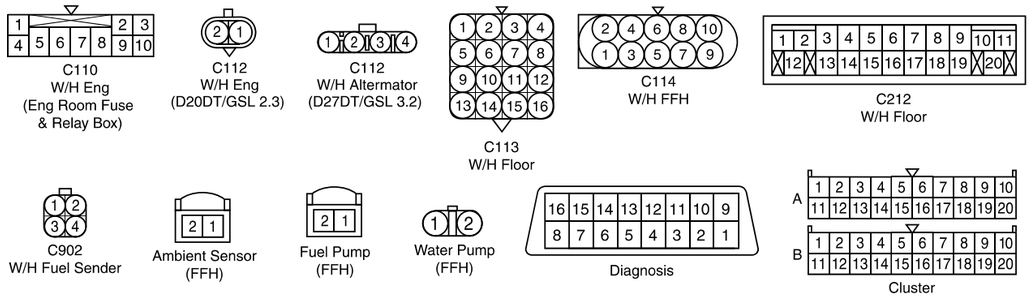
FFH (FUEL FIRED HEATER)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)		Connecting Wiring Harness	Connector Position	Remark
C110 (18Pin, White)		W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C112	(2Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D20DT/GSL 2.3
	(4Pin, Black)	W/H Eng - W/H Alternator	Behind RH Head Lamp	D27DT/GSL 3.2
C113 (16Pin, Black)		W/H Eng - W/H Floor	Inside RH Fender PNL	
C114 (10Pin, Black)		W/H Eng - W/H FFH	Right Eng Room Dash PNL	FFH
C212 (20Pin, L/Green)		W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C902 (4Pin, Black)		W/H Floor - W/H Fuel Sender	Upper the T/M	
G104		W/H Eng Room	Behind RH Head Lamp	
G201		W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

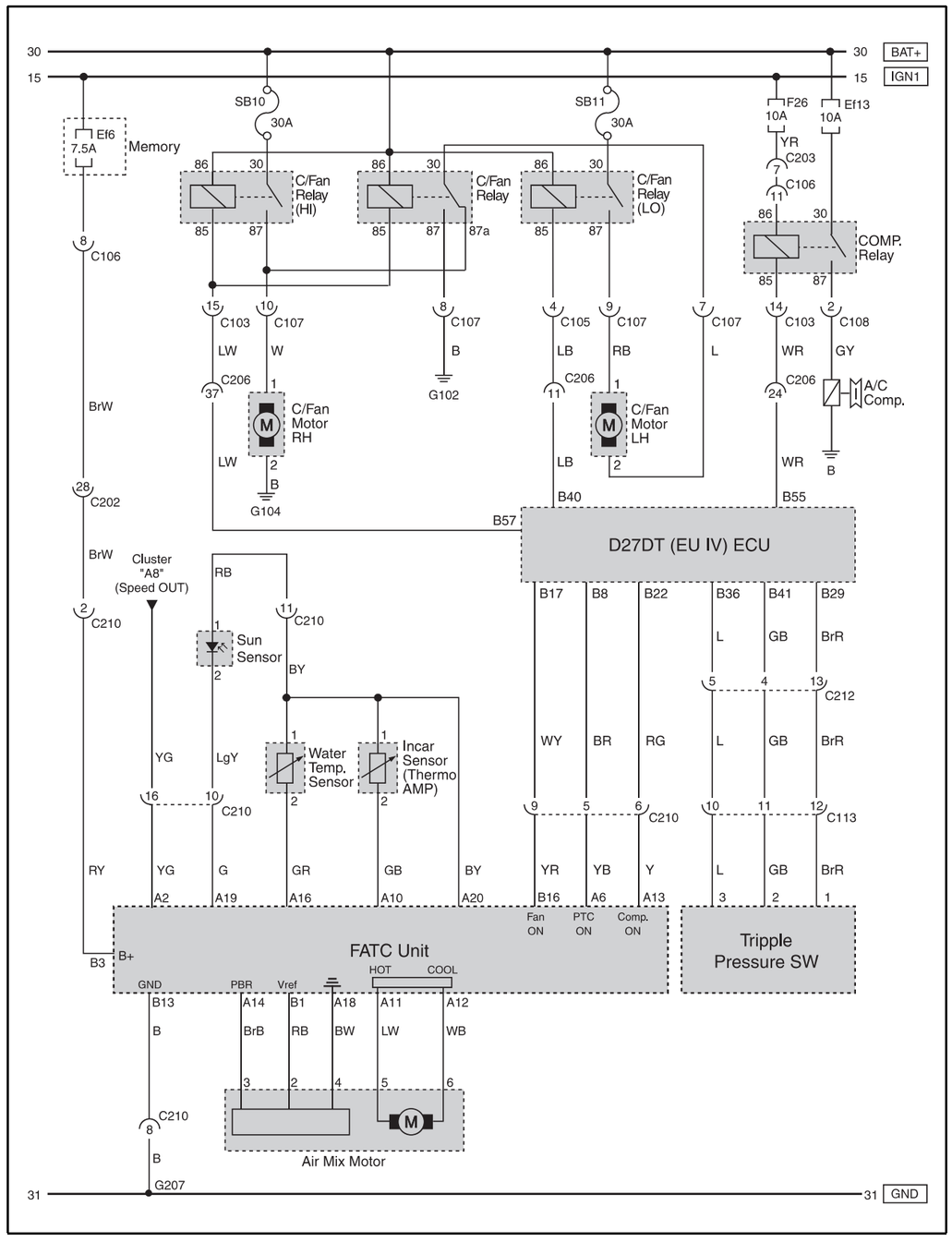


Modification basis	
Application basis	
Affected VIN	

S.G.N. 6810-00

FATC (FULL AUTO TEMP. CONTROL) CIRCUIT

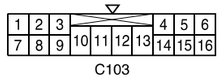
1) C/FAN, SENSOR, AIR MIX MOTOR (D27DT EU IV - A/T)

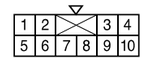


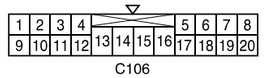
(1) CONNECTOR INFORMATION

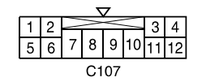
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Drvier Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	

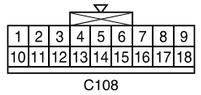
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

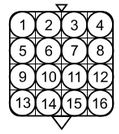

C103
W/H Floor
(Eng Room Fuse & Relay Box)

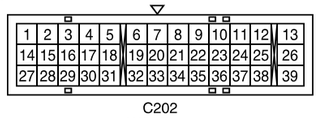

C105
W/H Floor
(Eg Room Fuse & Relay Box)

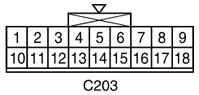

C106
W/H Floor
(Eng Room Fuse & Relay Box)

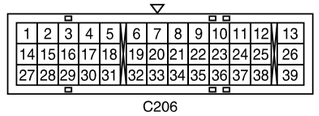

C107
W/H Eng
(Eg Room Fuse & Relay Box)

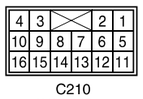

C108
W/H Eng
(Eng Room Fuse & Relay Box)

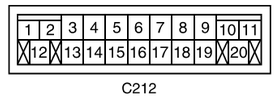

C113
W/H Floor

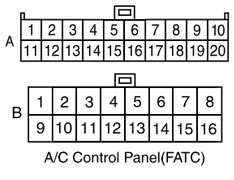

C202
W/H Floor

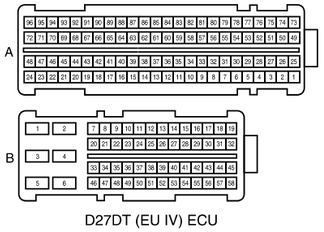

C203
W/H Floor


C206
W/H Floor


C210
W/H A/Con


C212
W/H Floor


A/C Control Panel(FATC)

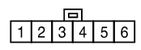

D27DT (EU IV) ECU


Tripple Pressure SW (EURO -IV)


Water Temp. Sensor


Comp.


Condensor Fan Motor

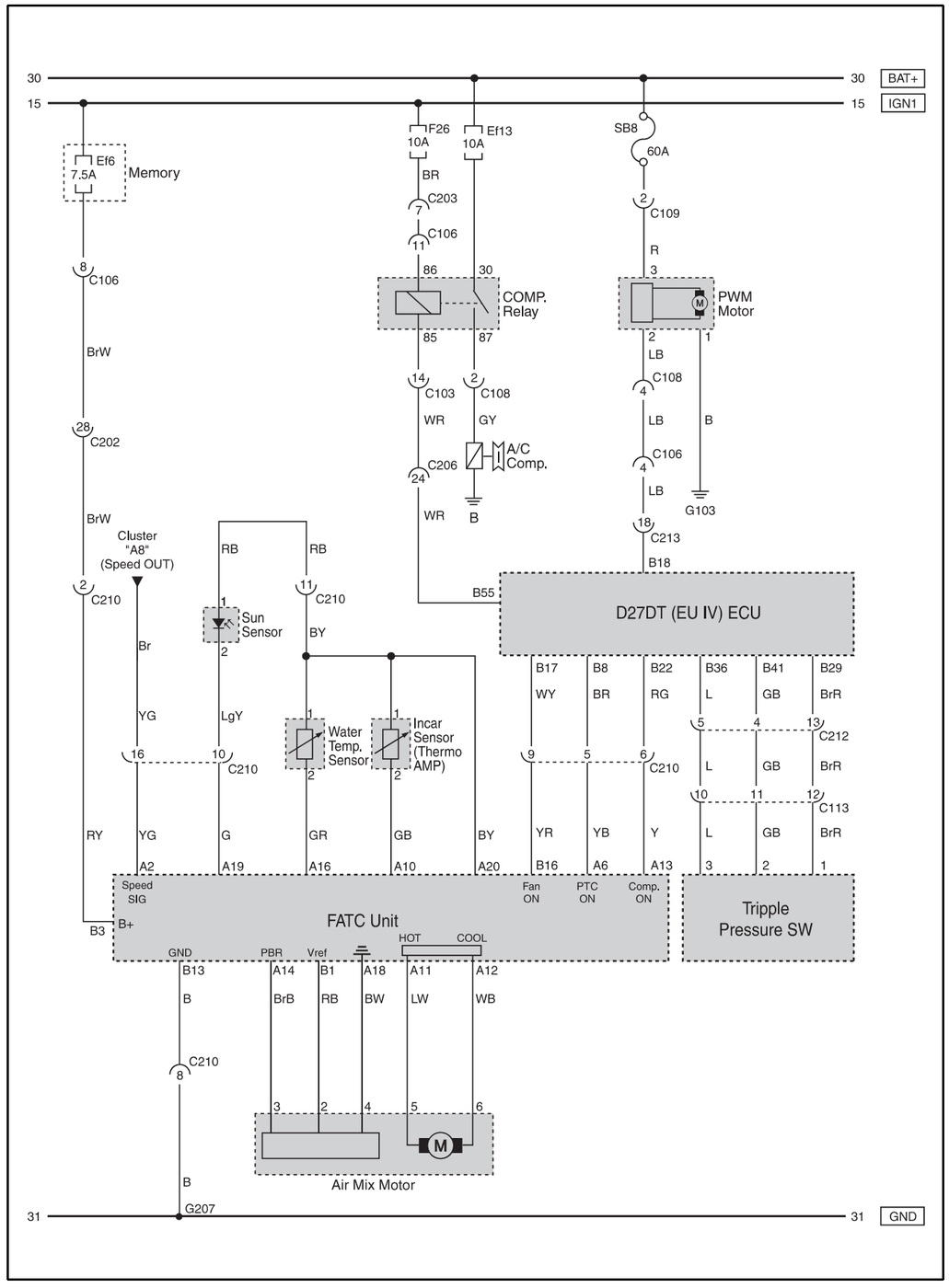

Air Mix Motor
(FATC)


Sun Sensor


Incar Sensor

Modification basis	
Application basis	
Affected VIN	

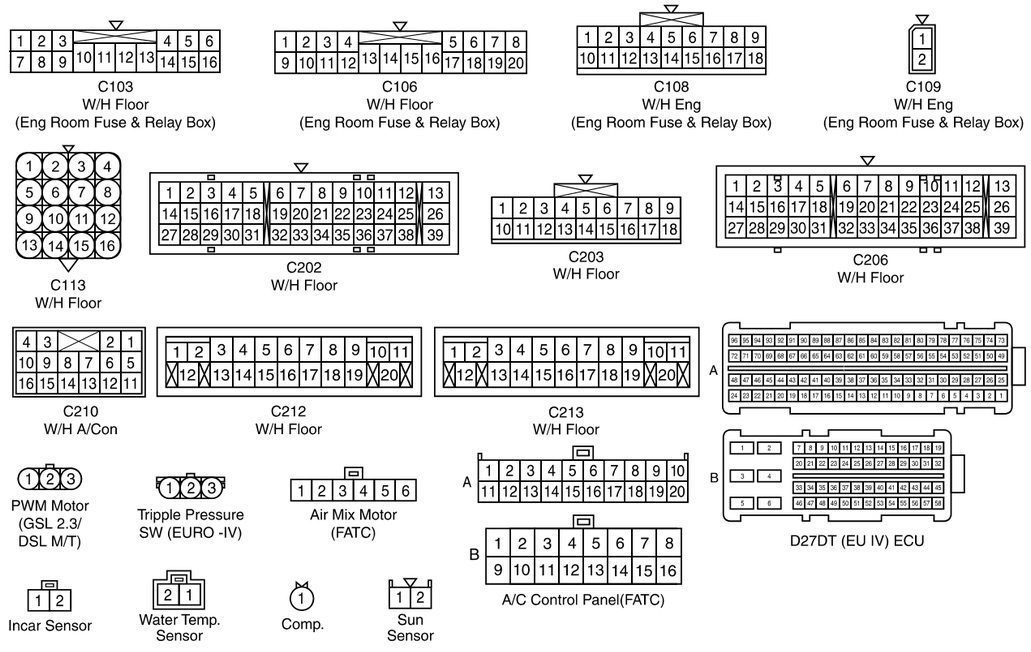
2) PWM MOTOR, AIR MIX MOTOR (D27DT EU IV - M/T)



(1) CONNECTOR INFORMATION

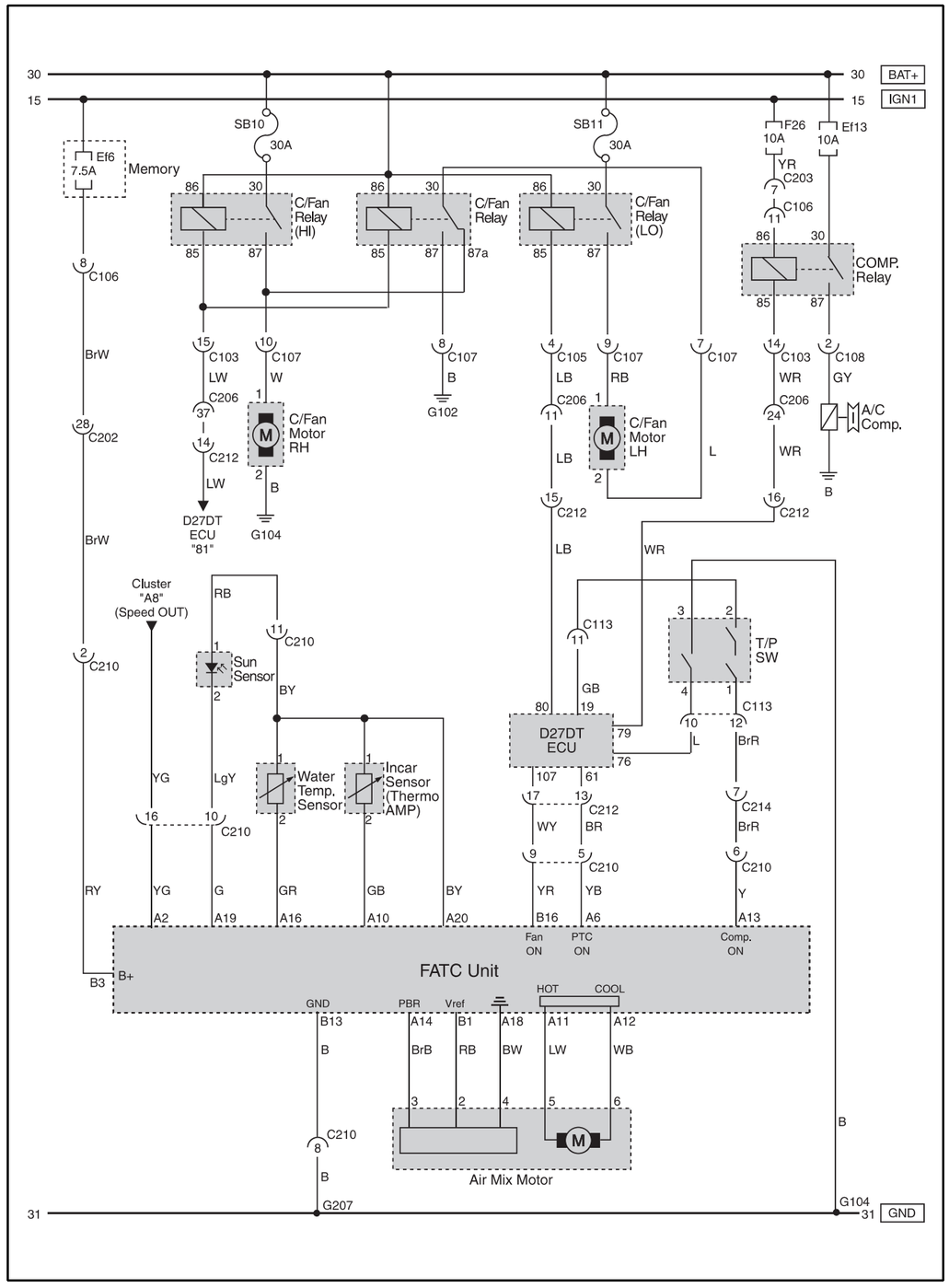
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109 (2Pin, Black)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Drvier Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	GSL 2.3, DSL M/T
G207	W/H Main	Inner the Passenger Cowl Side PNL	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

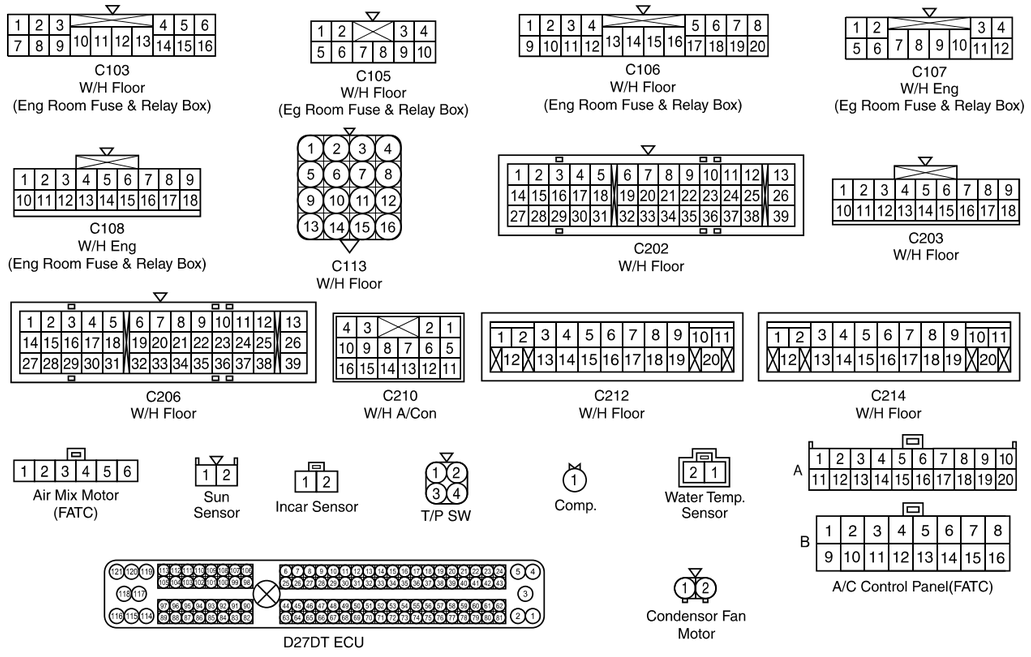
3) C/FAN, SENSOR, AIR MIX MOTOR (D27DT EU III)



(1) CONNECTOR INFORMATION

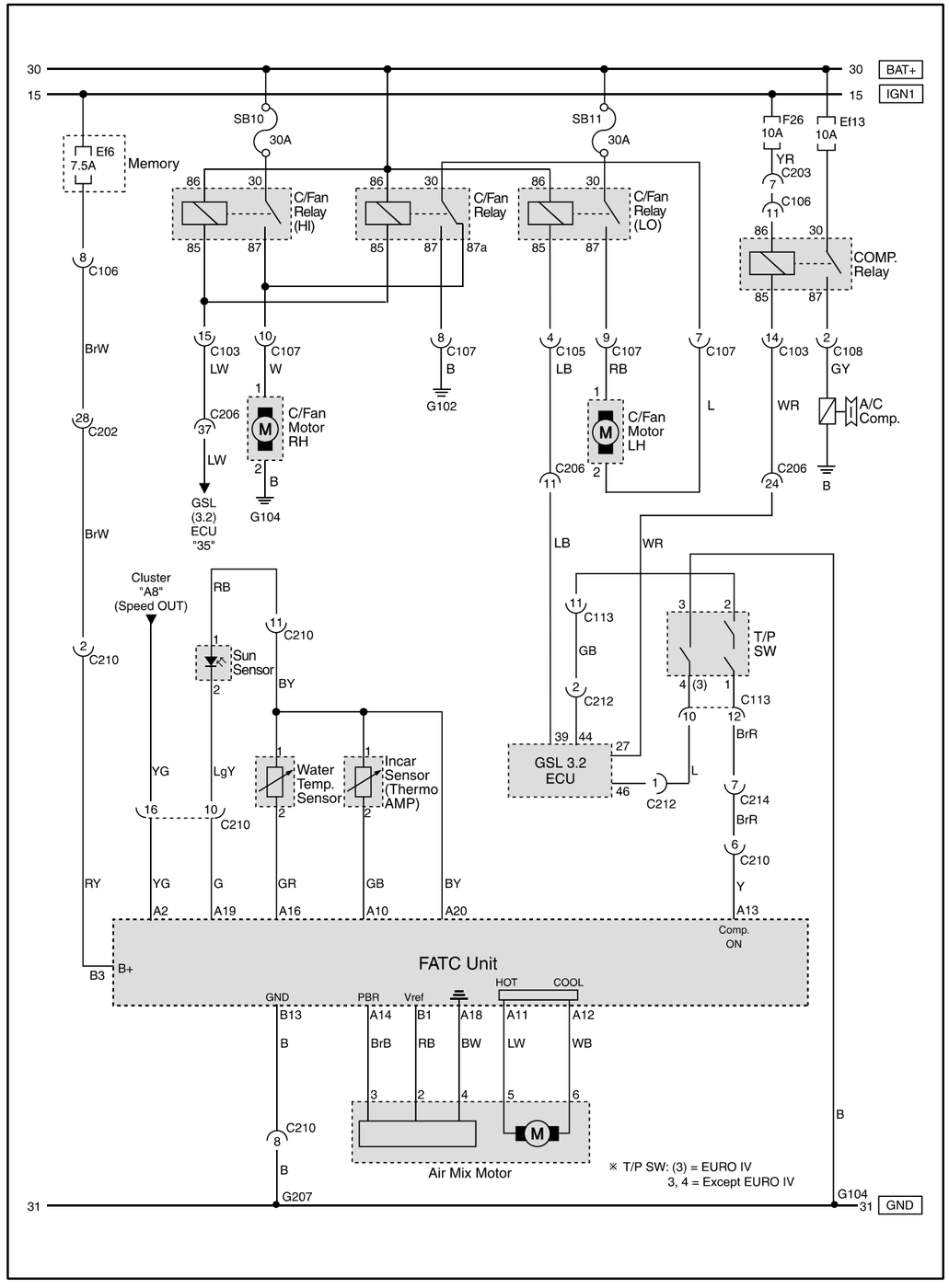
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	PWM
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

4) C/FAN, SENSOR, AIR MIX MOTOR (GSL 3.2)



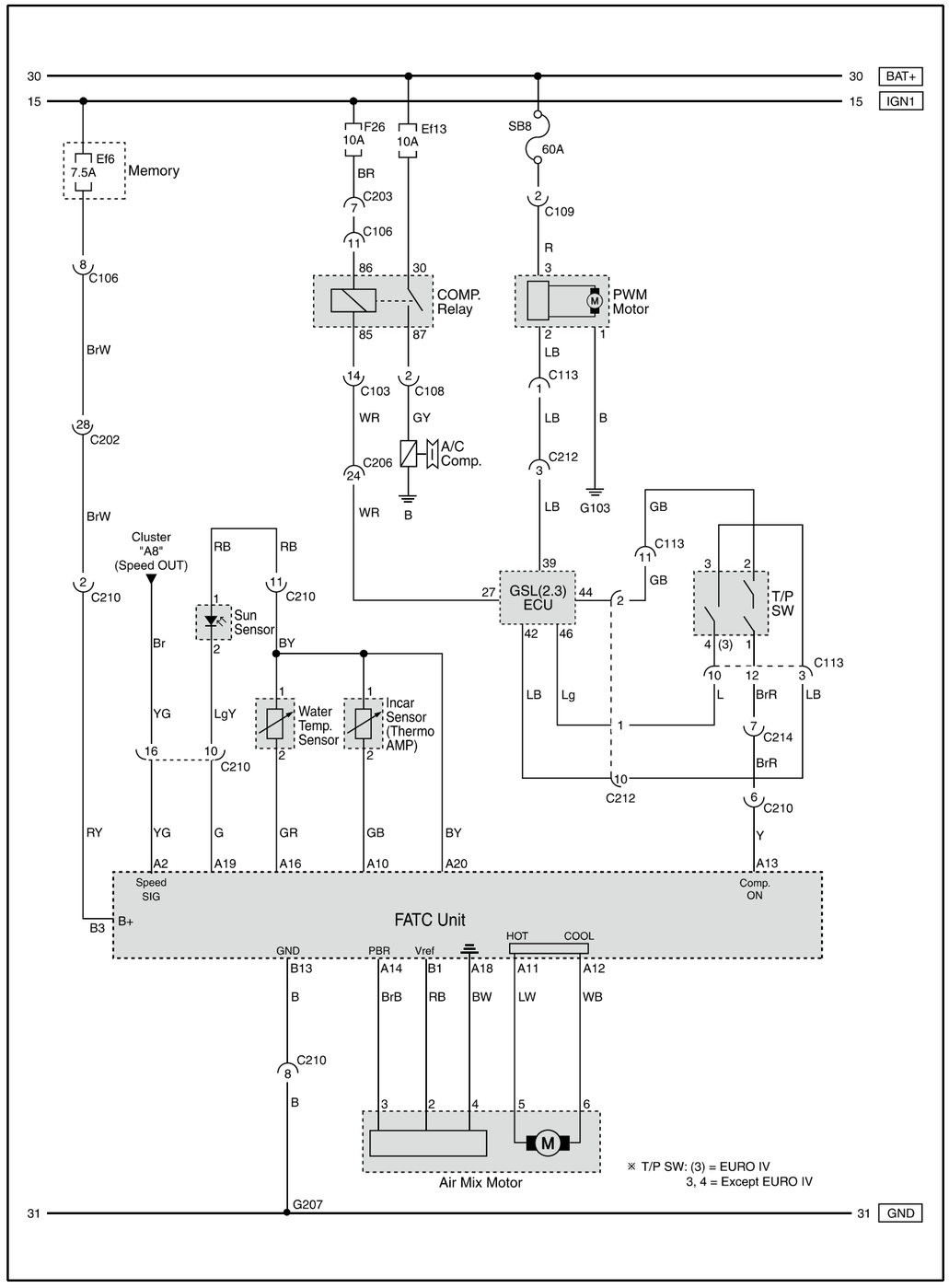
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	PWM
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

Modification basis	
Application basis	
Affected VIN	

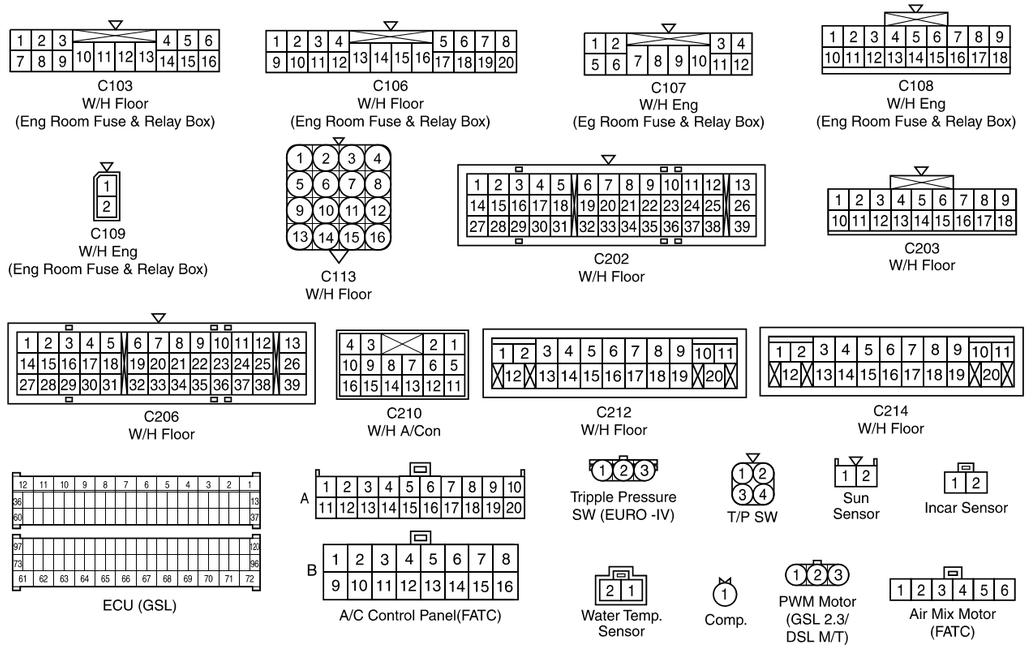
5) PWM MOTOR, AIR MIX MOTOR (GSL 2.3)



(1) CONNECTOR INFORMATION

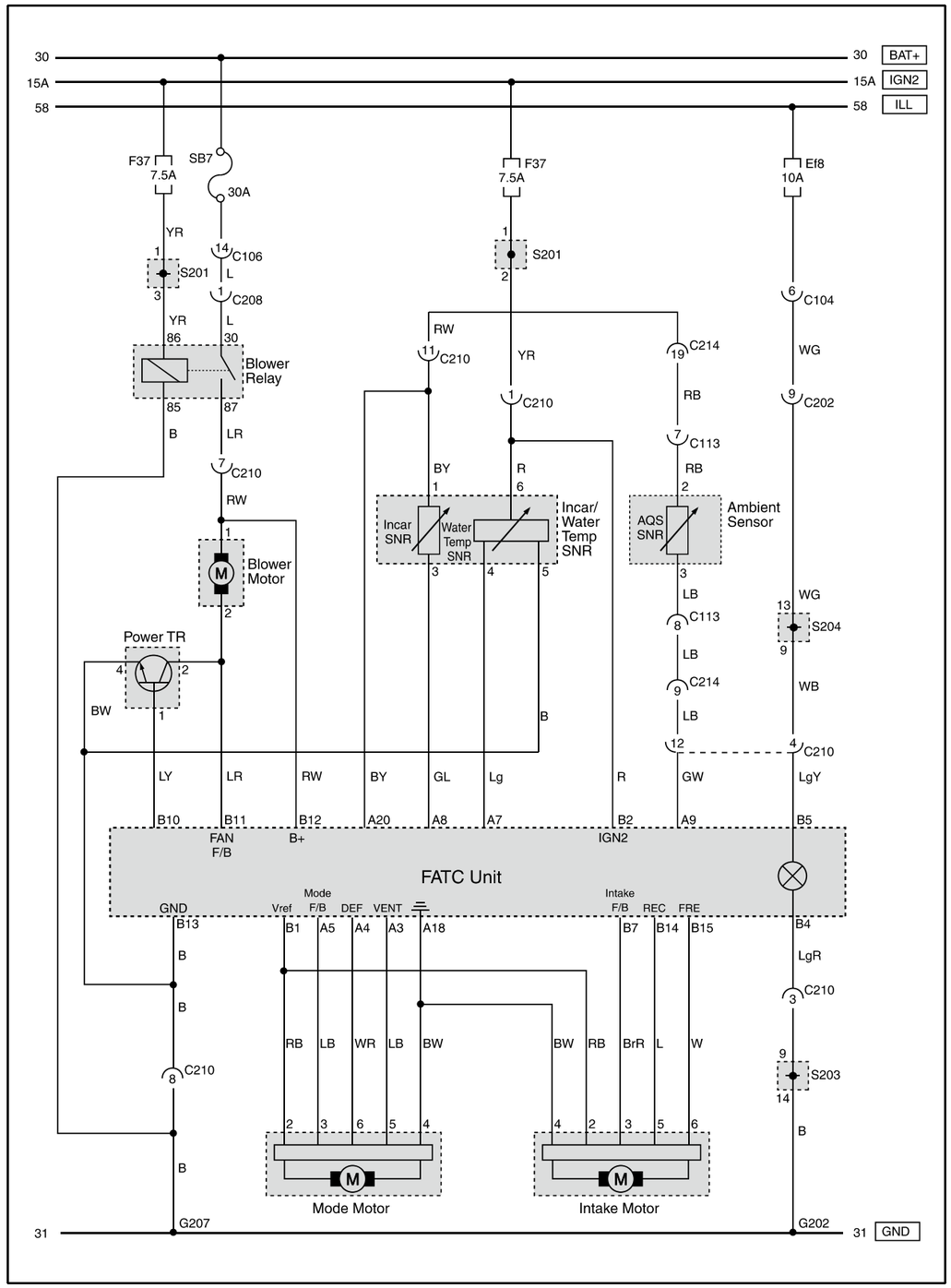
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109 (2Pin, Black)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Drvier Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	GSL 2.3, DSL M/T
G207	W/H Main	Inner the Passenger Cowl Side PNL	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

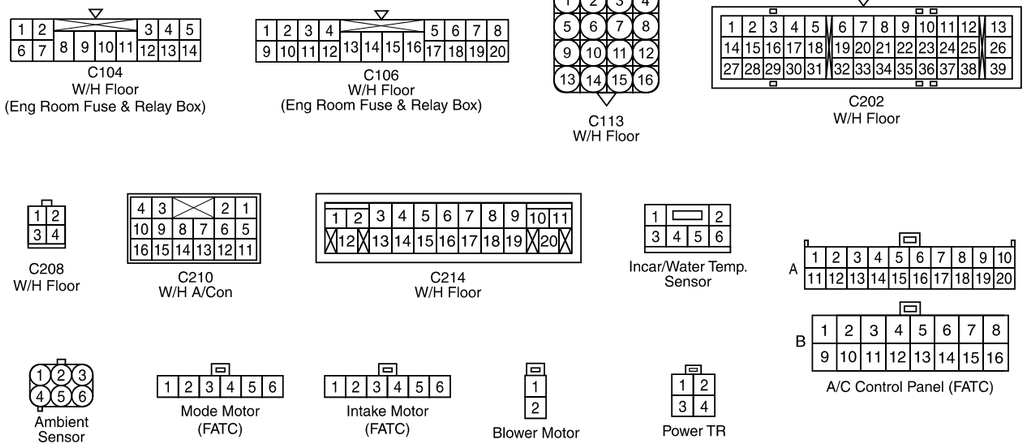
6) BLOWER, ACTUATOR (MODE, INTAKE), AMBI SENSOR



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C208 (4Pin, Colorless)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G202	W/H Main	Under the Driver “A” Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

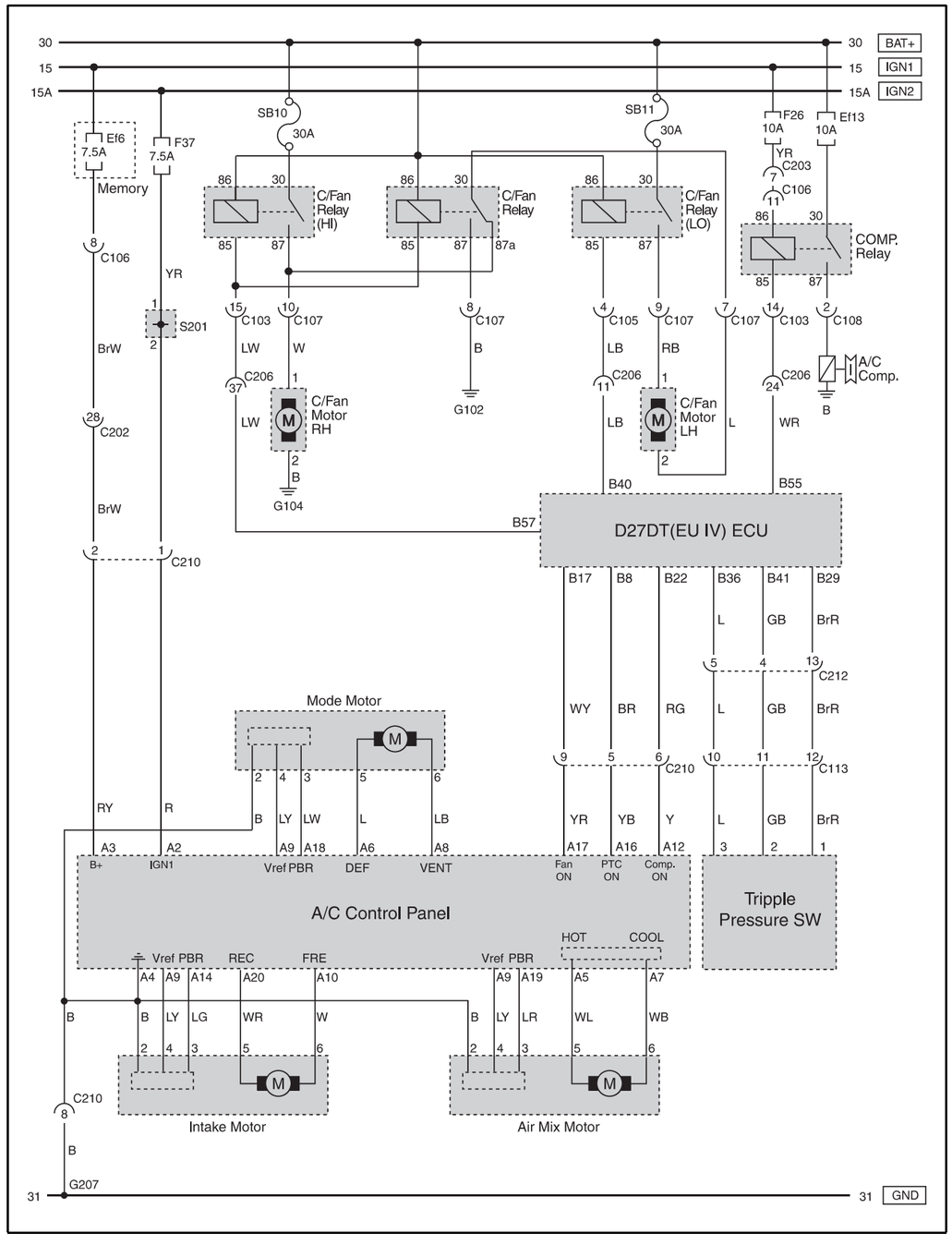


Modification basis	
Application basis	
Affected VIN	

S.G.N. 6810-00

AIR-CON (MANUAL) CIRCUIT

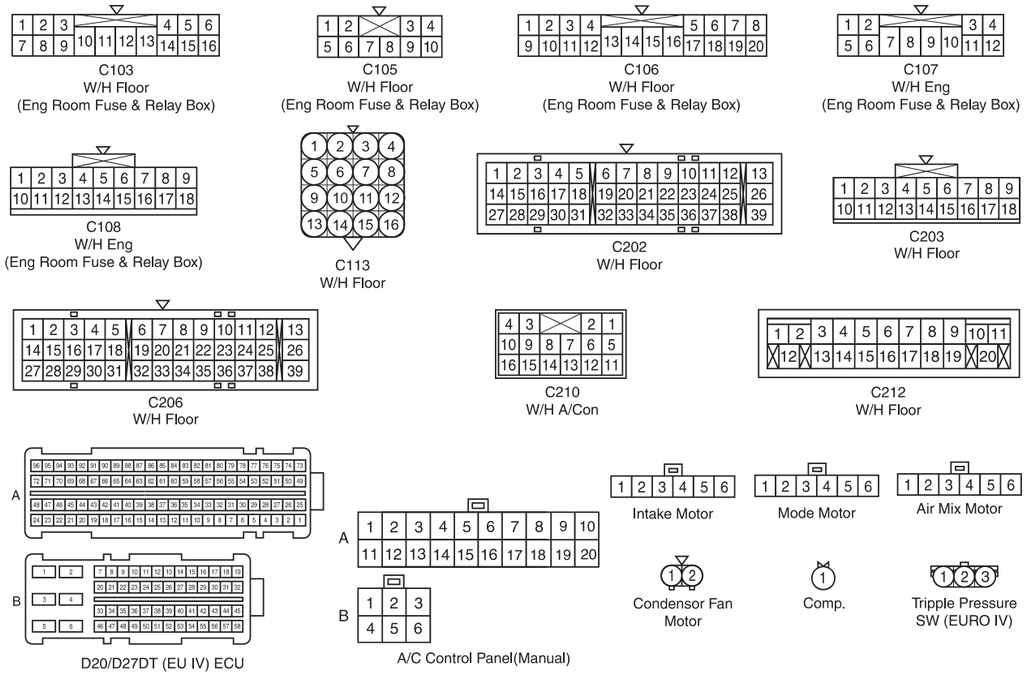
1) COMPRESSOR, MOTOR (D27DT EU IV - A/T)



(1) CONNECTOR INFORMATION

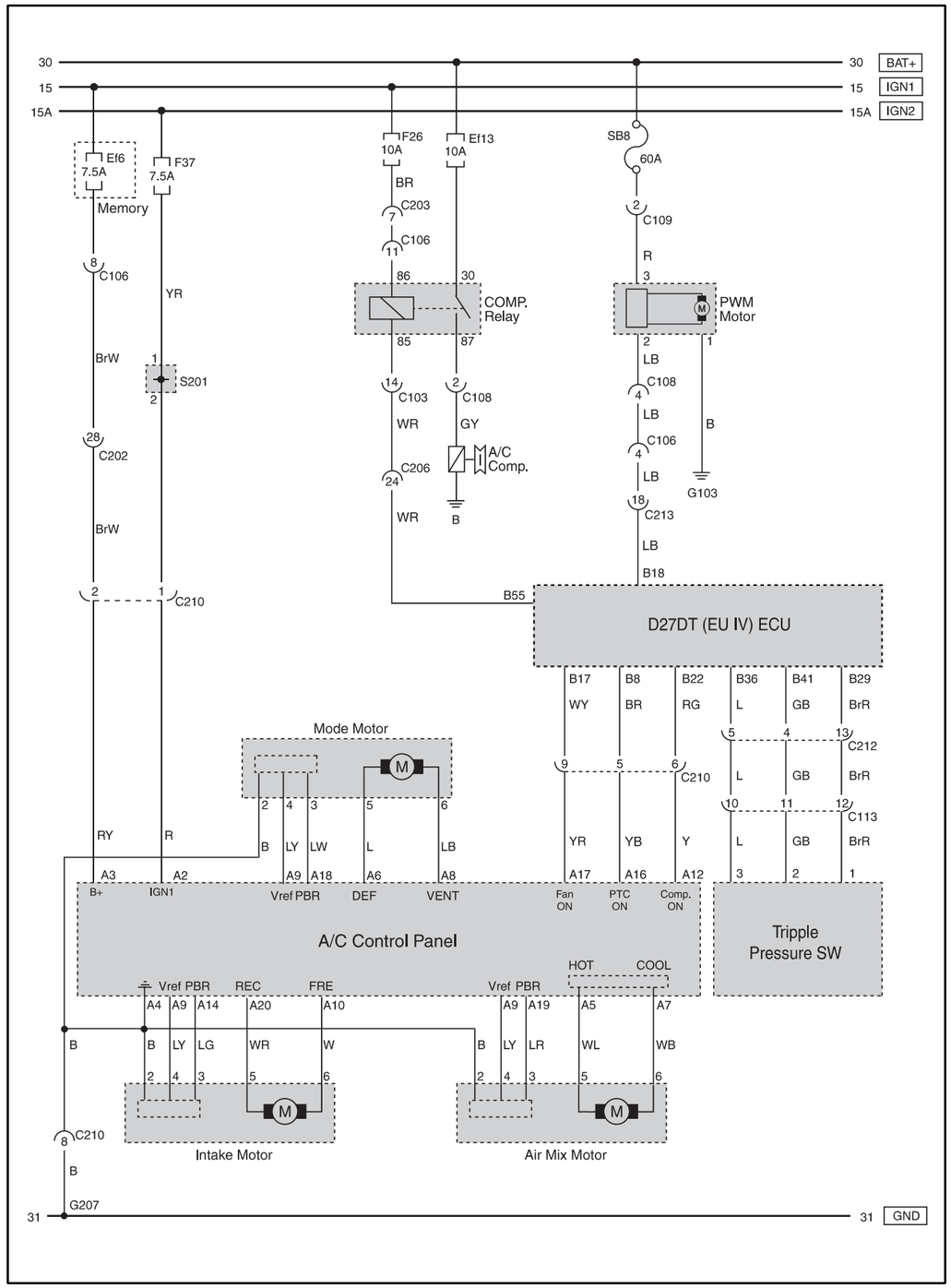
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

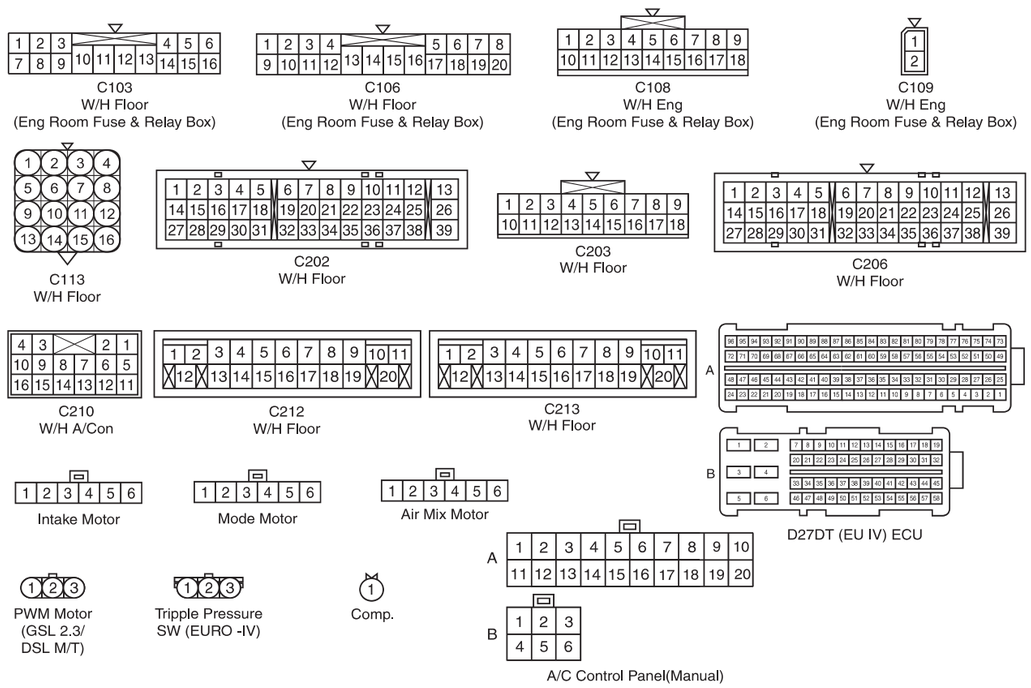
2) PWM MOTOR, MOTOR (D27DT EU IV - M/T)



(1) CONNECTOR INFORMATION

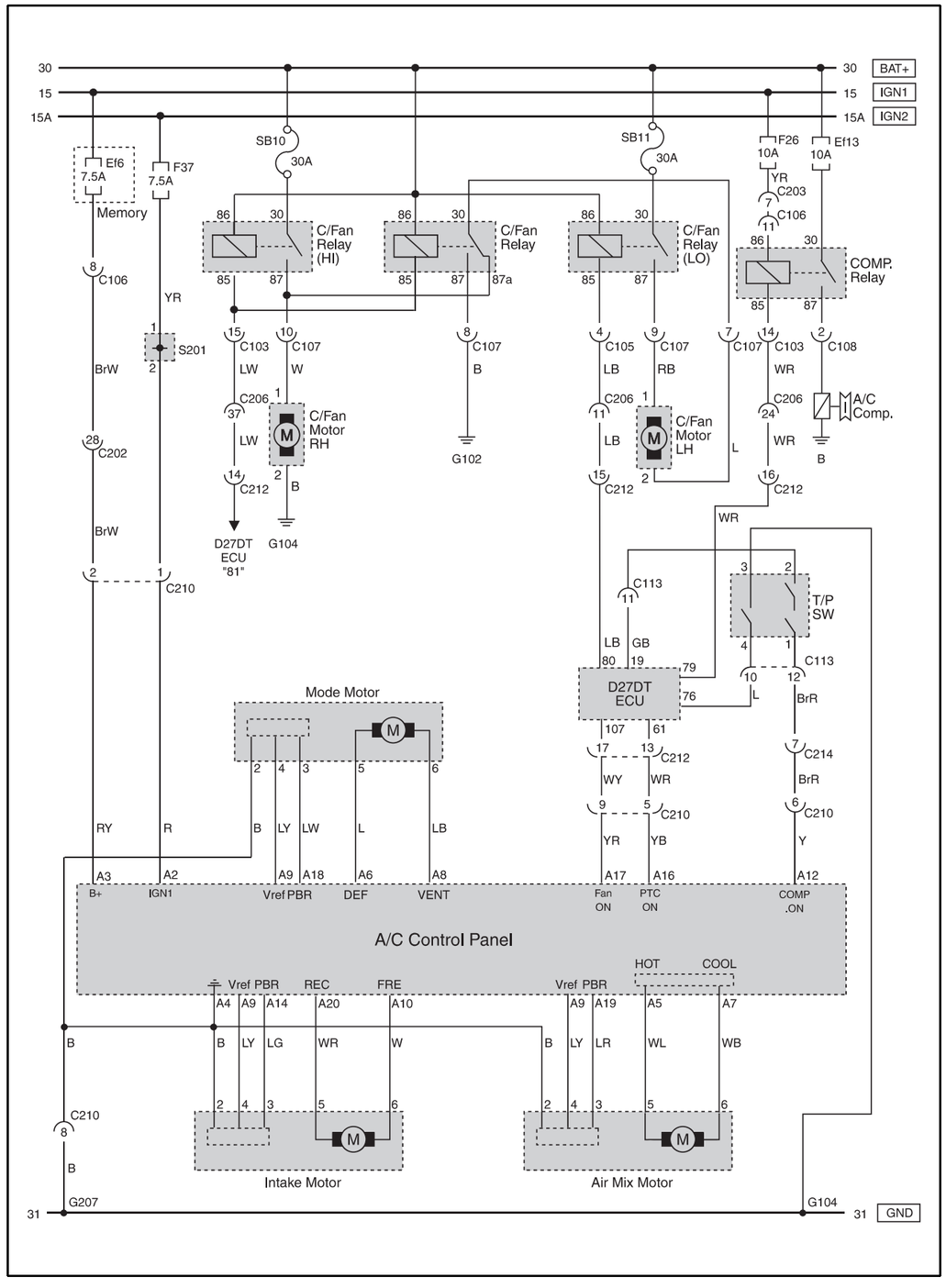
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109 (2Pin, Black)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Drvier Legroom	
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C213 (20Pin, Red)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	GSL 2.3, DSL M/T
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

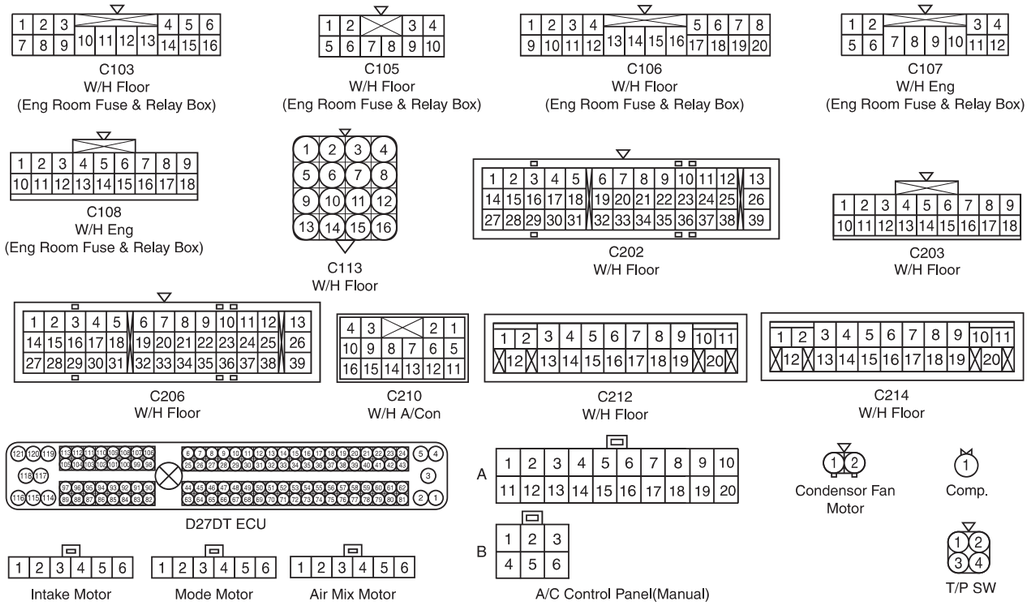
3) COMPRESSOR, MOTOR (D27DT EU III)



(1) CONNECTOR INFORMATION

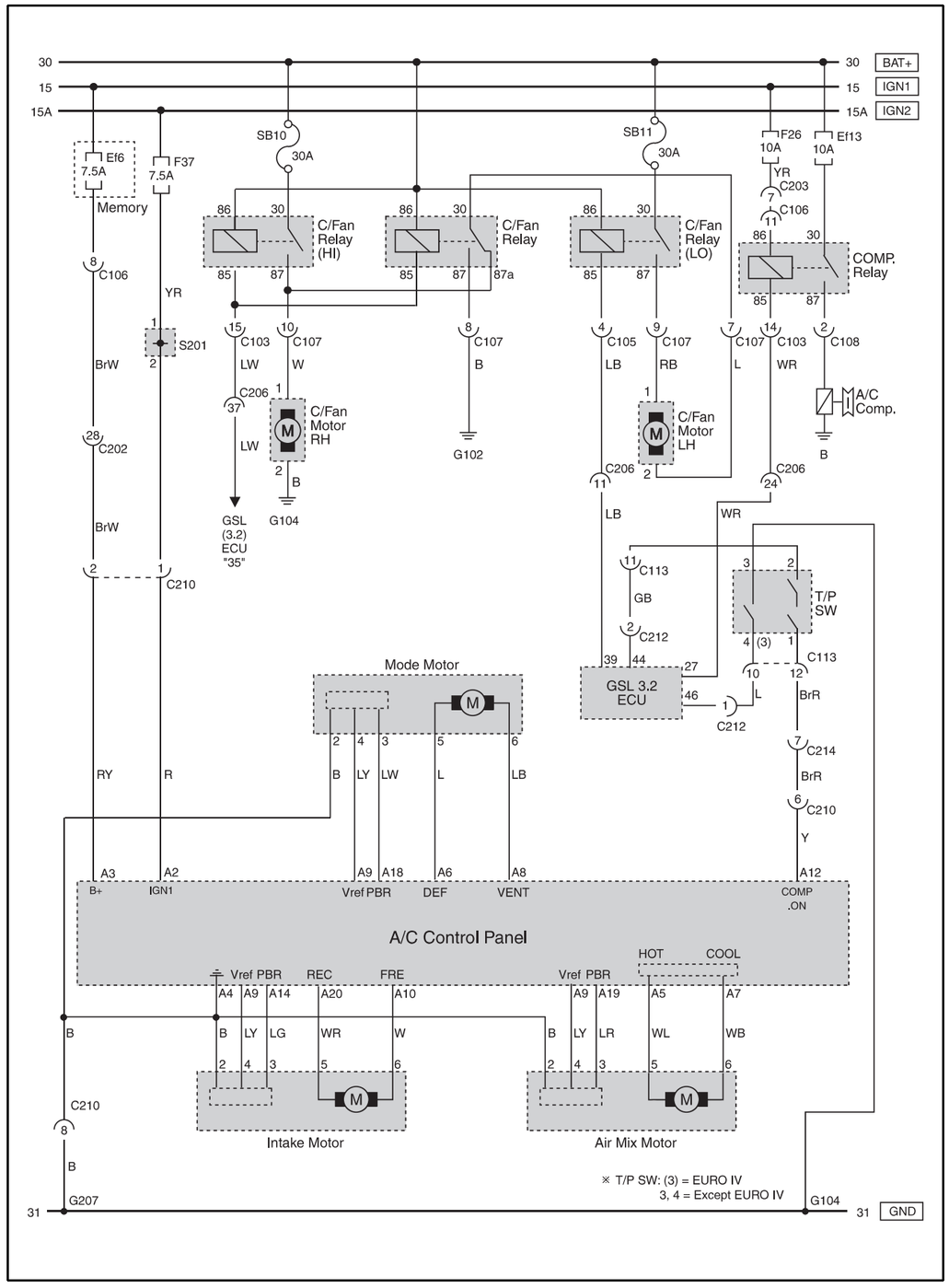
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	PWM
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

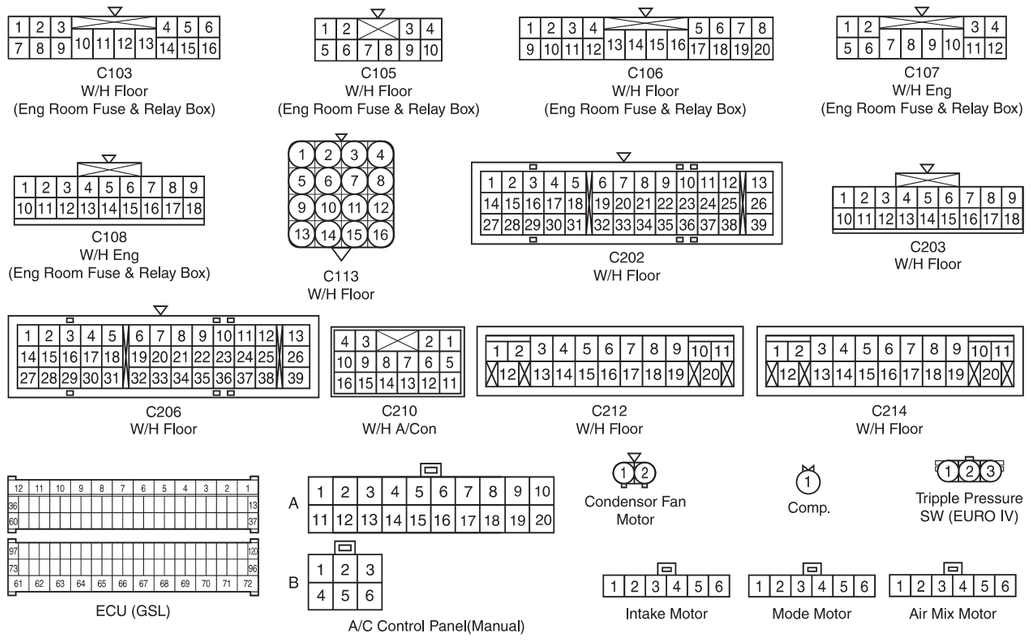
4) COMPRESSOR, MOTOR (GSL 3.2)



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	PWM
C105 (10Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C107 (12Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G102	W/H Eng Room	Behind LH Head Lamp	
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

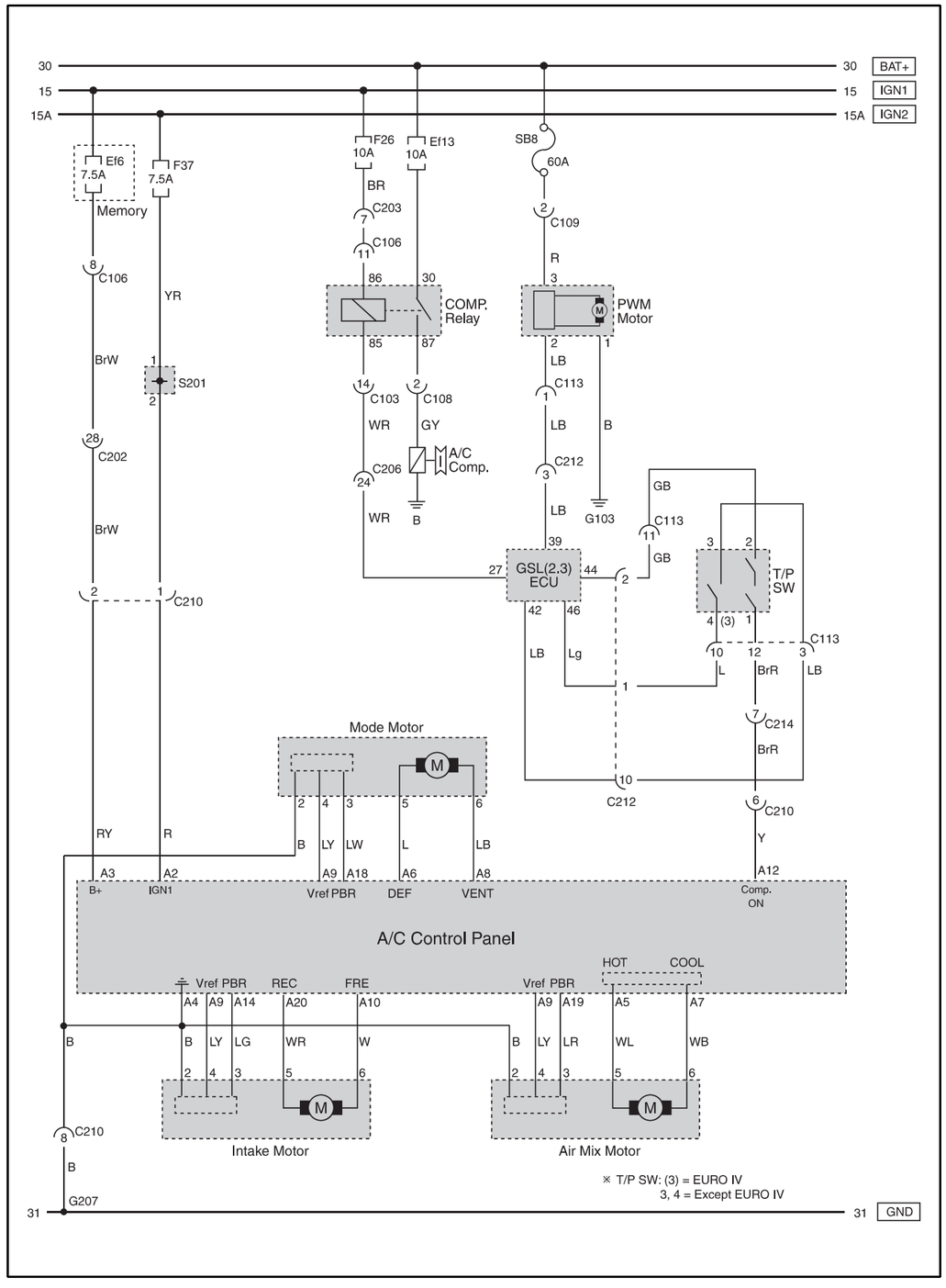


CIRCUIT

KYRON 2008.07

Modification basis	
Application basis	
Affected VIN	

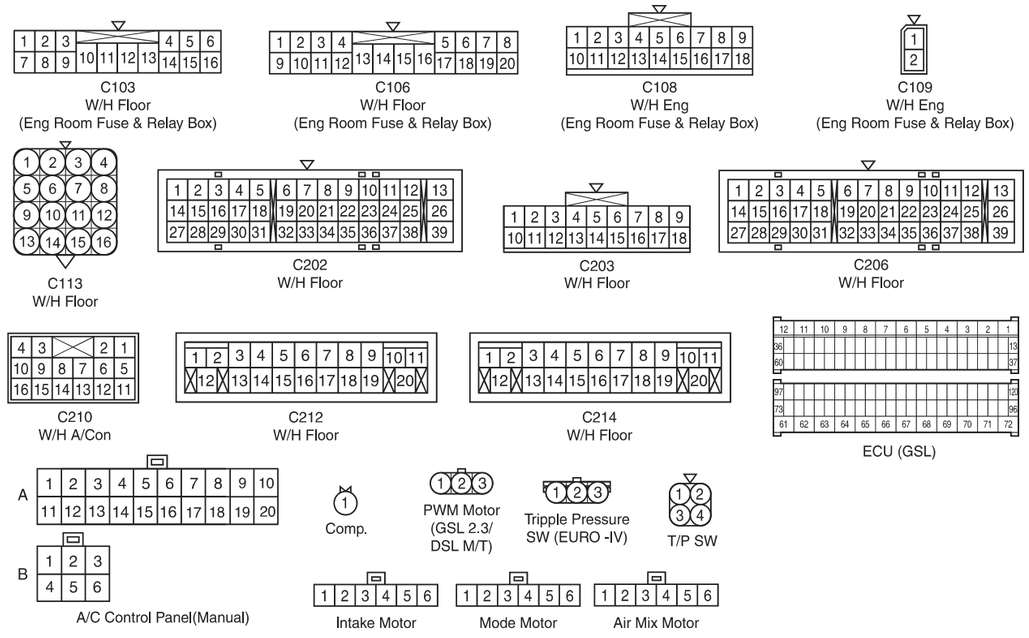
5) PWM MOTOR, MOTOR (GSL 2.3)



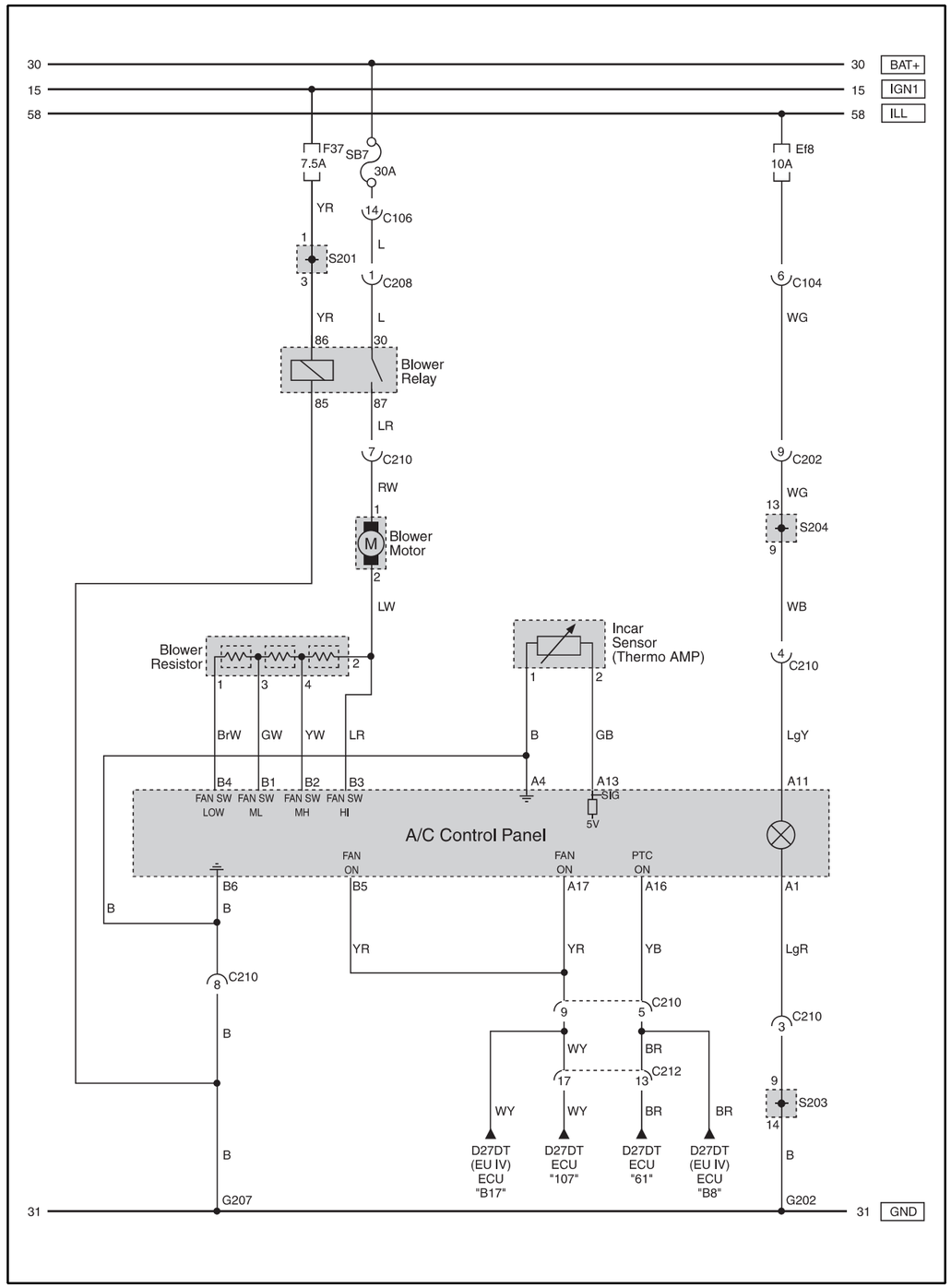
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C103 (16Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C108 (18Pin, White)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C109 (2Pin, Black)	W/H Eng - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng - W/H Floor	Inside RH Fender PNL	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C203 (18Pin, White)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C206 (39Pin, Black)	W/H Main - W/H Floor	Upper the Drvier Legroom	
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	C/Holder
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
C214 (20Pin, Yellow)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	GSL 2.3, DSL M/T
G104	W/H Eng Room	Behind RH Head Lamp	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	

(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



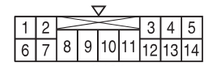
6) BLOWER



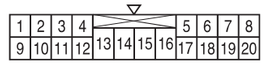
(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor - Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C202 (39Pin, Black)	W/H Main - W/H Floor	Driver Cowl Side C/Holder	
C208 (4Pin, Colorless)	W/H Main - W/H Floor	Upper the Driver Legroom	C/Holder
C210 (16Pin, White)	W/H Main - W/H A/Con	Inside the Middle I/P (Right PTC)	
C212 (20Pin, L/Green)	W/H Main - W/H Floor	Passenger Cowl Side C/Holder	
G202	W/H Main	Under the Driver “A” Pillar	
G207	W/H Main	Inner the Passenger Cowl Side PNL	
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S203 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	GND
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL

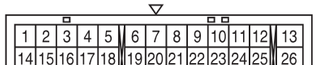
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



C104
W/H Floor
(Eng Room Fuse & Relay Box)



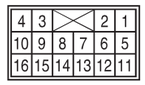
C106
W/H Floor
(Eng Room Fuse & Relay Box)



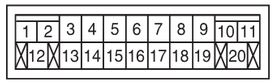
C202
W/H Floor



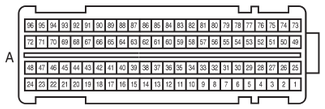
C208
W/H Floor

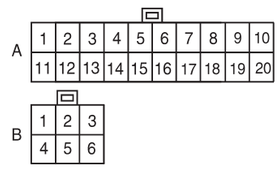


C210
W/H A/Con



C212
W/H Floor





A/C Control Panel(Manual)



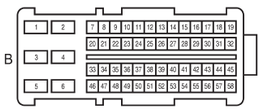
Incar Sensor



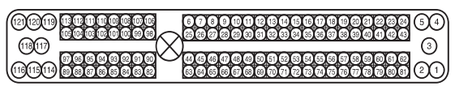
Blower Motor



Blower Resistor



D20/D27DT (EU IV) ECU


D27DT ECU

Modification basis	
Application basis	
Affected VIN	

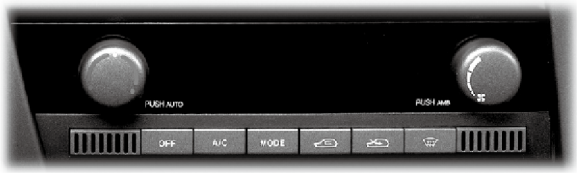
Memo

Memo

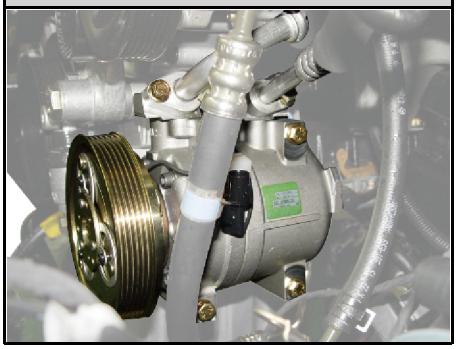
AIR CONDITIONER 6810-15

OVERVIEW AND OPERATION PROCESS

1. SYSTEM LAYOUT AND COMPONENTS

Type	Air Conditioner Controller
FATC	
Manual air conditioner	

Compressor



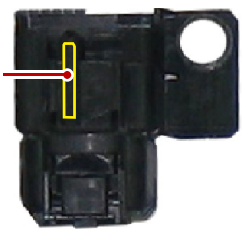


Sun Sensor - Instrument Panel Upper Left



It changes sun load coming through front windshield into current to input to FATC controller.

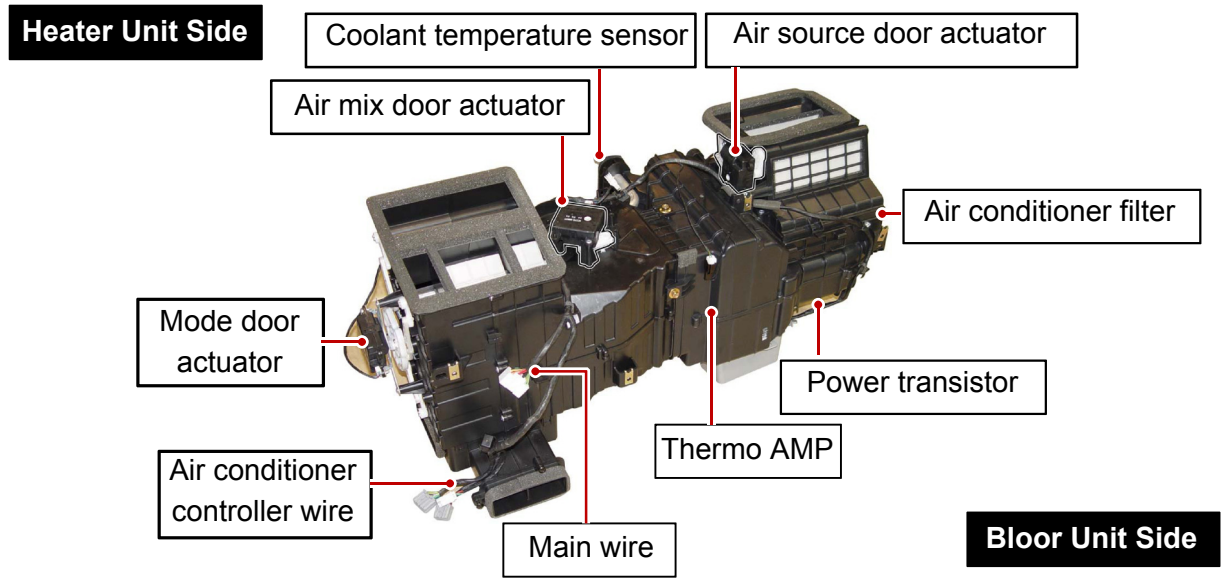
Ambient Temperature Sensor

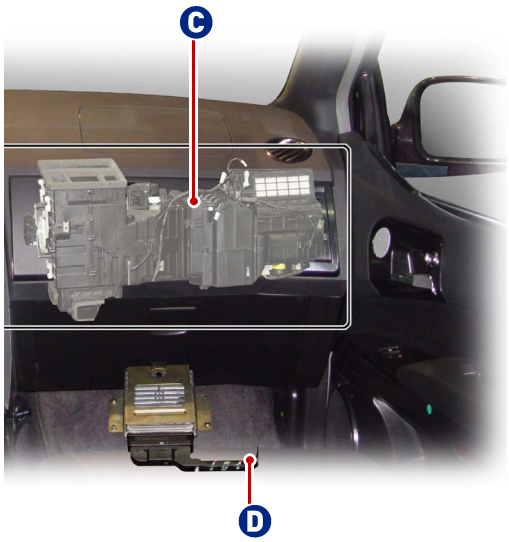


This sensor is installed at the front bottom of engine compartment.
This changes the air source mode by detecting the air pollution and the ambient temperature.

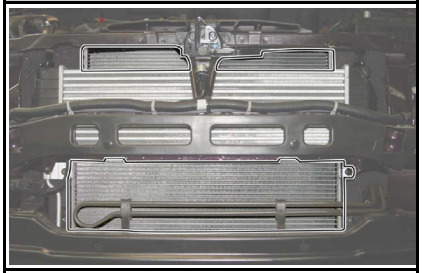
Modification basis	
Application basis	
Affected VIN	

C Front AirConditioner Module Assembly - Inside of Instrume

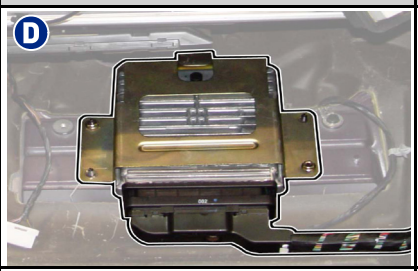
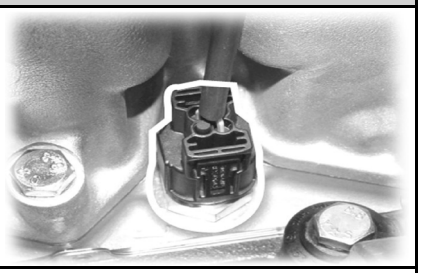




Condenser

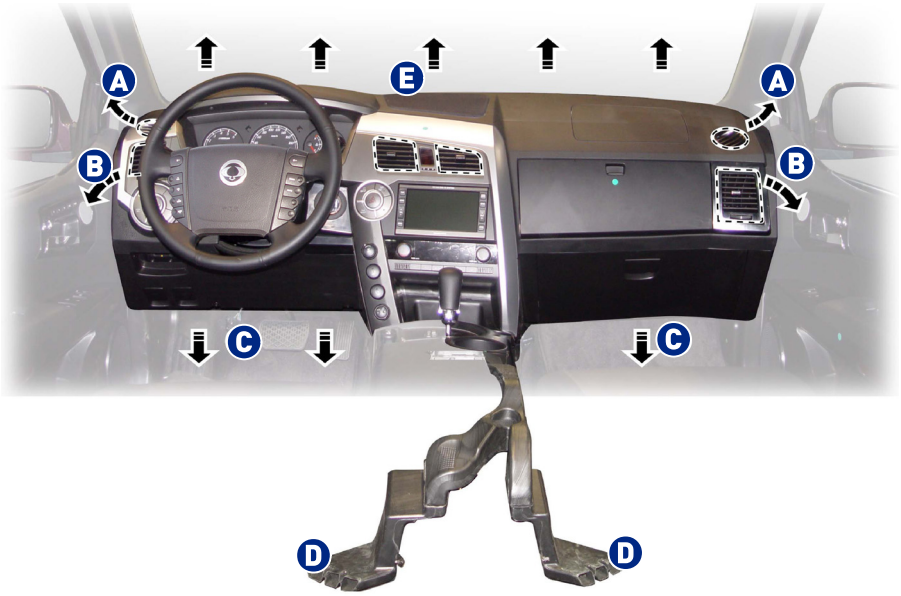


Installed in front of vehicle and condenses vapor refrigerant into low temperature and high pressure liquid refrigerant..

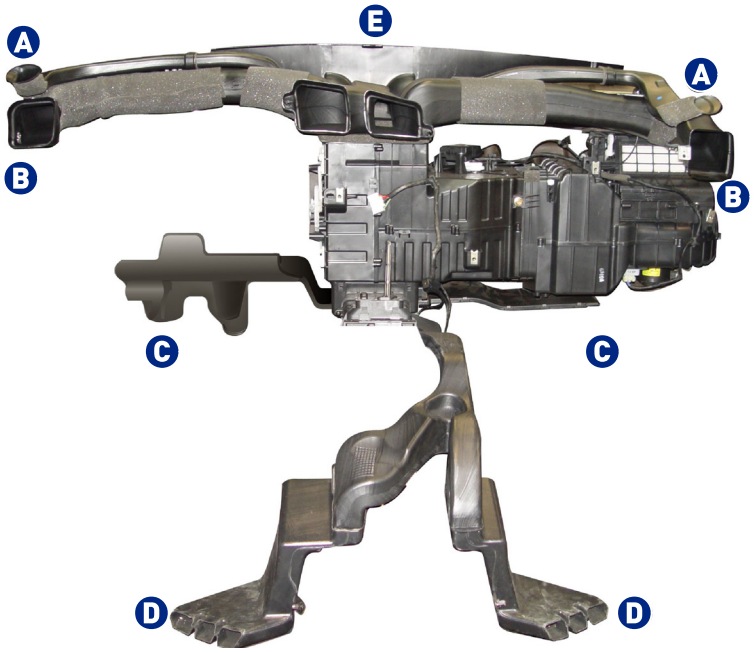
Receiver Drier (LH)	Engine ECU (Passenger Footstep)	Coolant Temperature Sensor (On Engine)
		
Absorbs moisture in the refrigerant and reserves refrigerant to supply smoothly.	Detects A/C switch position, coolant temperature, engine condition and driving condition to control the air conditioner.	A sensor that detects coolant temperature and transmits to engine ECU.

2. VENTILATION SYSTEM COMPONENTS

▶ Locations of Vents



▶ Air Duct



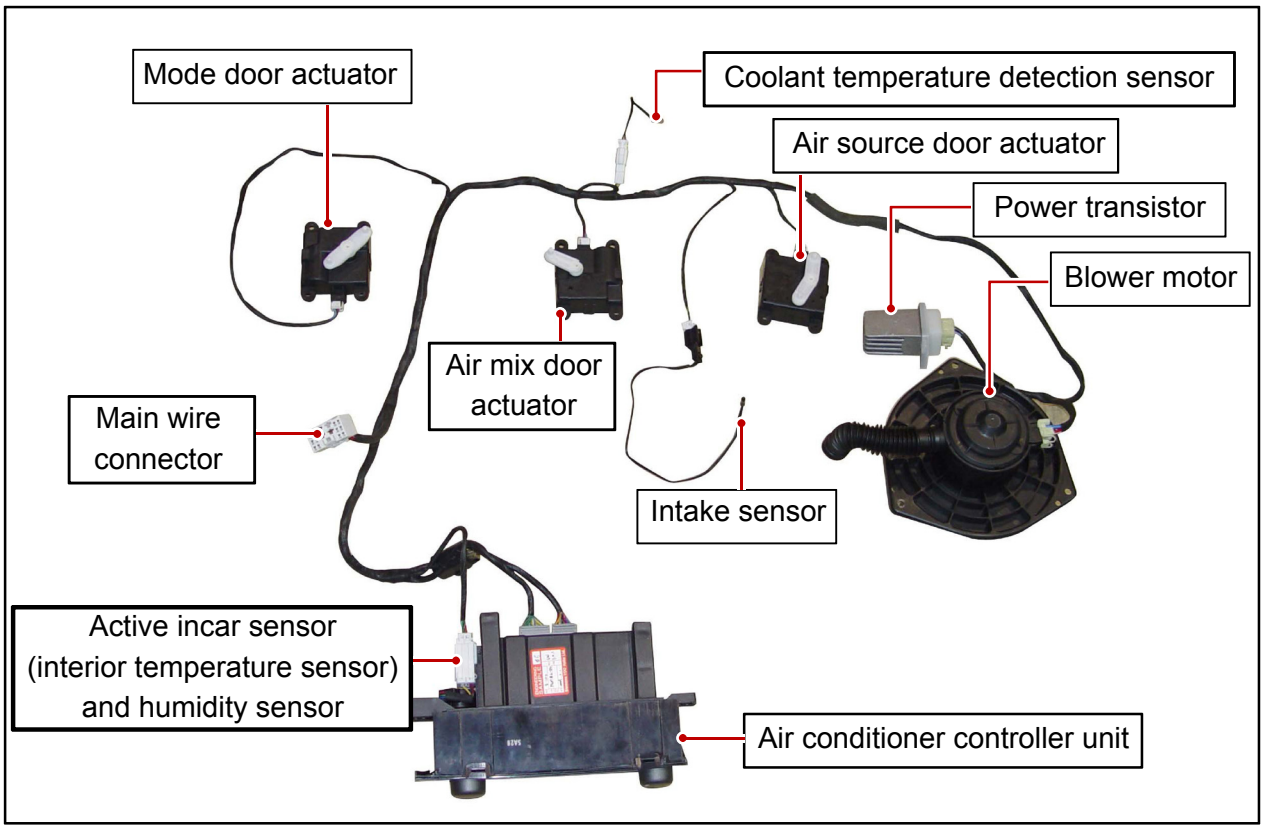
Modification basis	
Application basis	
Affected VIN	

▶ **Air Duct Layout**

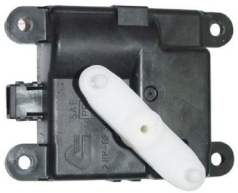


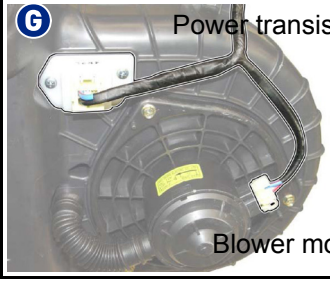
3. AIR CONDITIONER MODULE WIRING AND LAYOUT

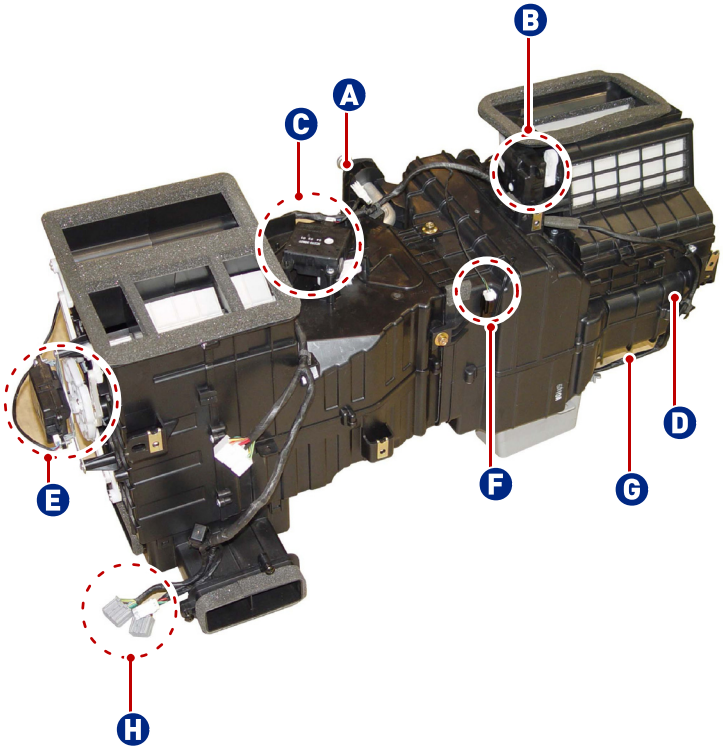
1) FRONT AIR CONDITIONER MODULE WIRING LAYOUT



2) LOCATIONS

Coolant Temperature Sensor
A 
Air Source Door Actuator
B 
C 
Air Conditioner Filter
D 
Mode Door Actuator
E 

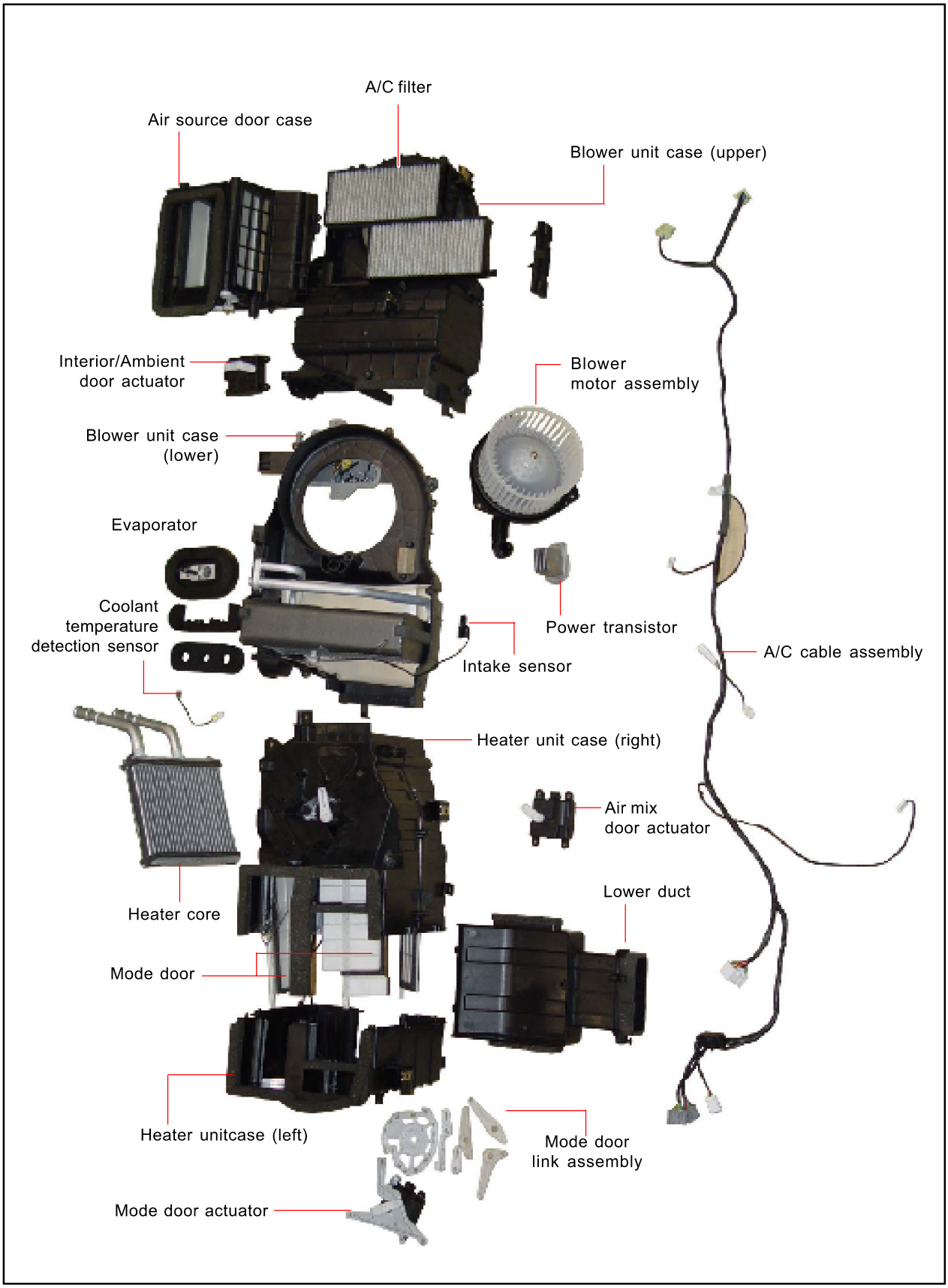
Intake Sensor	Power Transistor/Blower Motor
F 	G 



A/C Controller Unit	Interior Temperature Sensor (Interior Humidity Sensor)
H 	H 

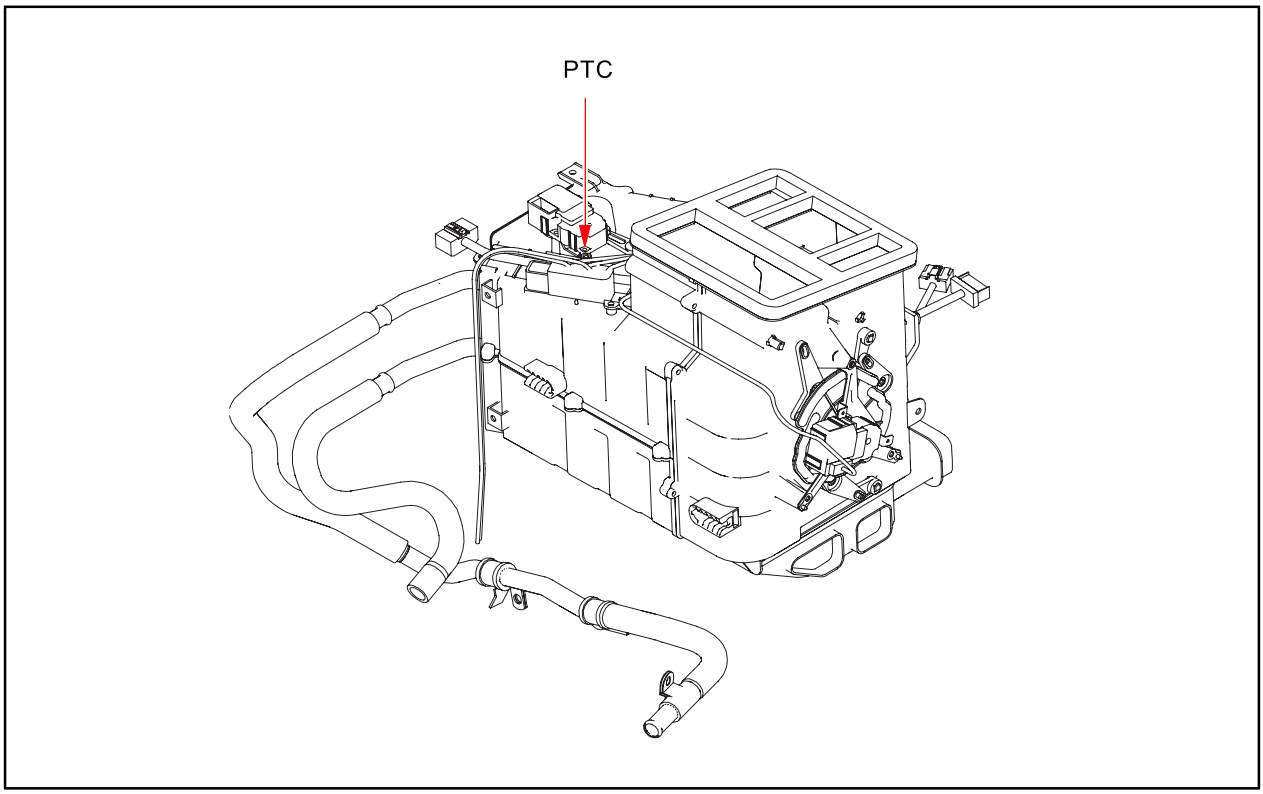
Modification basis	
Application basis	
Affected VIN	

3) Components

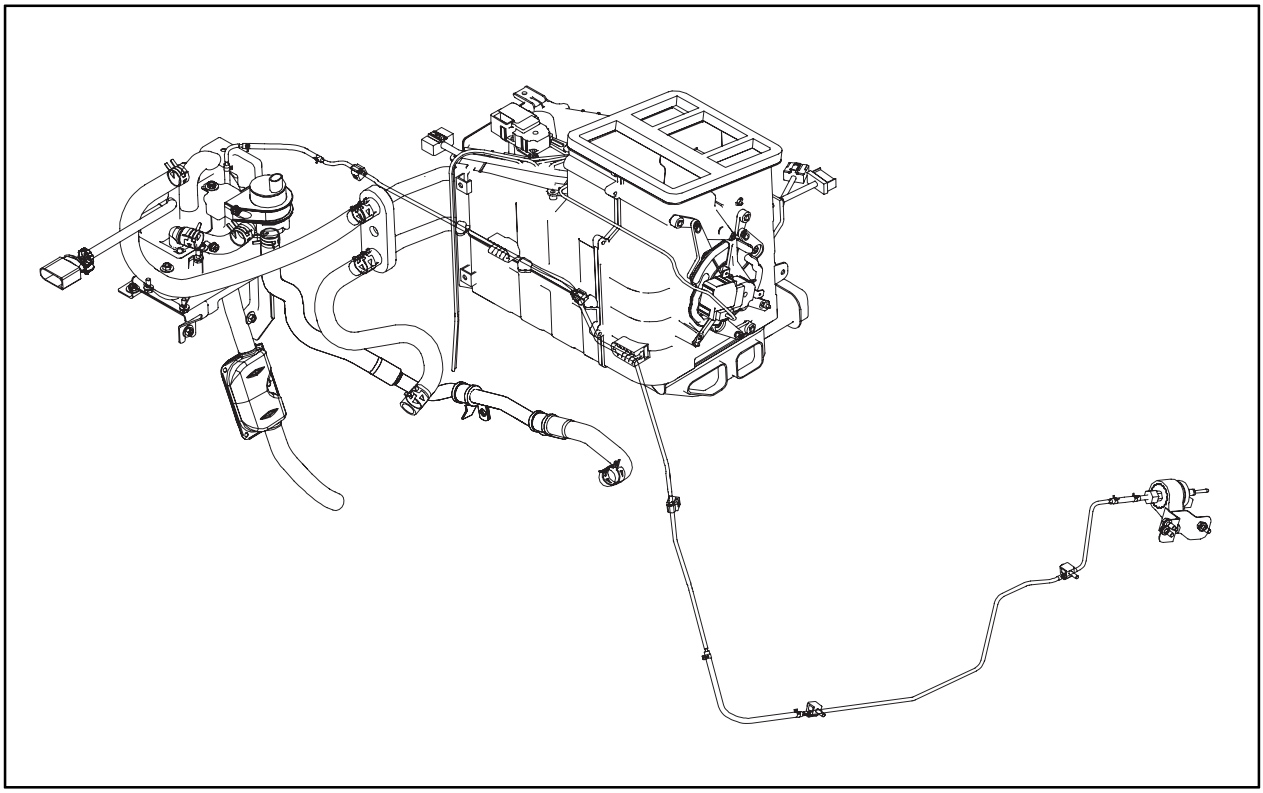


4. PTC HEATER AND FFH HEATER LAYOUT

1) PTC HEATER ASSEMBLY LAYOUT



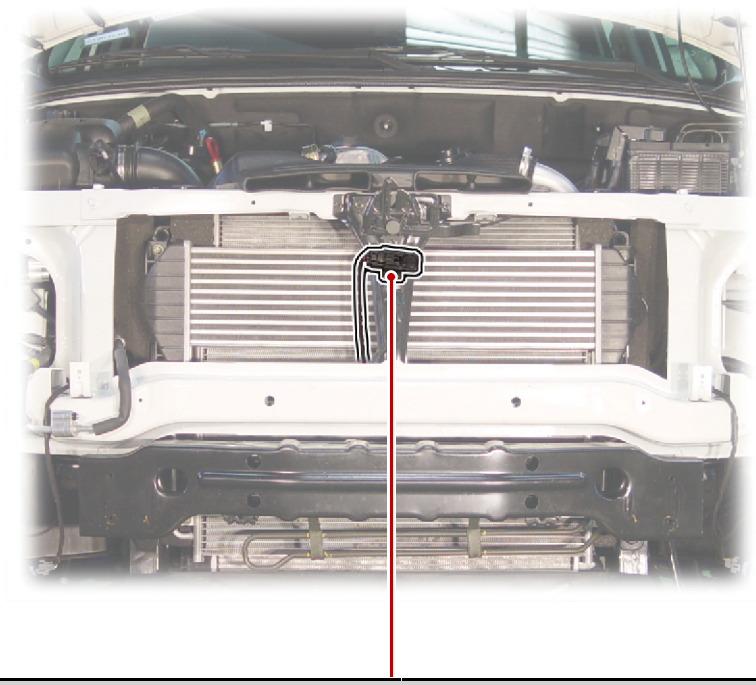
2) FFH HEATER ASSEMBLY LAYOUT



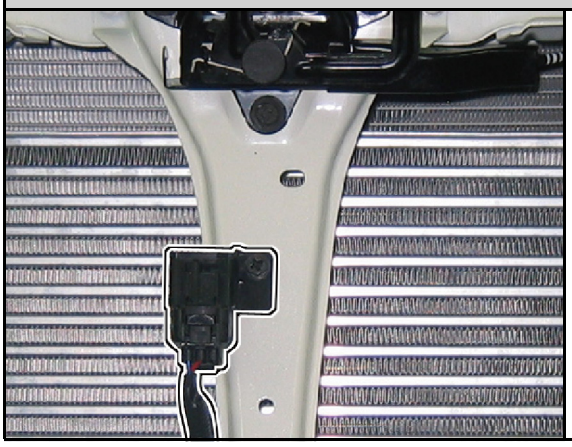
Modification basis	
Application basis	
Affected VIN	

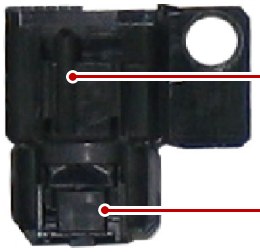
5. AMBIENT TEMPERATURE SENSOR

The ambient temperature sensor is installed in the front area of the engine compartment to detect the ambient temperature.



Ambient temperature sensor





Ambient temperature sensor

Connector

6. SENSORS AND ACTUATORS

1) Sun Sensor

It is installed on the upper left end of instrument panel. It is using characteristics that the amount of current changes according to amount of light on the photosensitive surface. Photo diode, converts the changes in light intensity into electrical changes, detects the amount of light coming through windshield and changes it into current and then sends the signal to FATC controller.



▶ **Inspection**

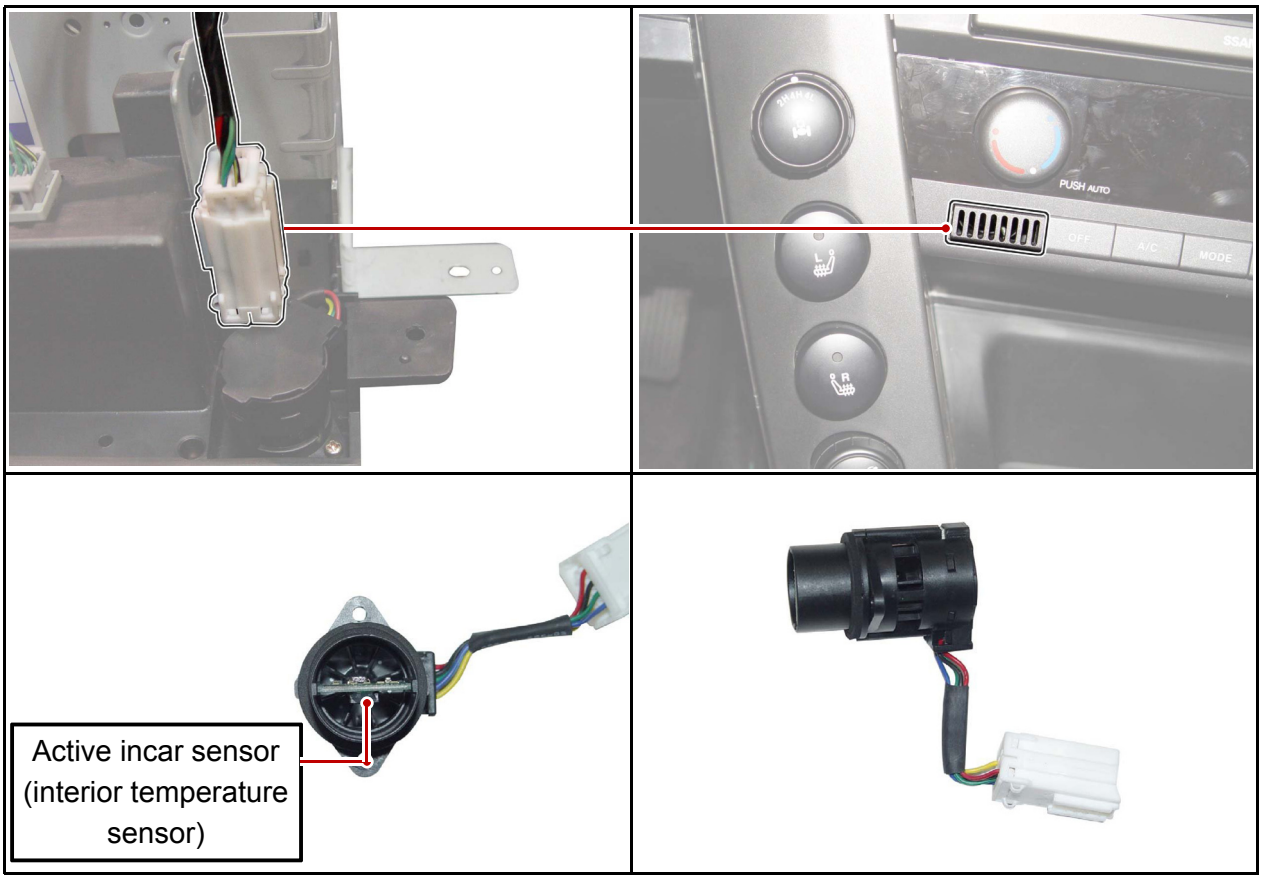
- Remove the sun sensor and measure the current between terminals under sunlight.
- Measure the current again under shade. It is in normal conditions if the measured value is less than the measured value under sunlight.
- Turn the ignition switch to "ON" position.
- Measure the voltage to the sun sensor from FATC connector. (approx. 2.5 V under sunlight and 4.8 V under shade.)
- If the voltage value cannot be measured, check the circuit for open. If the measured value is within the specified range, replace the FATC controller.

Modification basis	
Application basis	
Affected VIN	

2) Active Incar Sensor: AI Sensor

The AI sensor is installed at the driver side instrument panel undercover. It is a sensor that detects interior temperature.

(1) Location



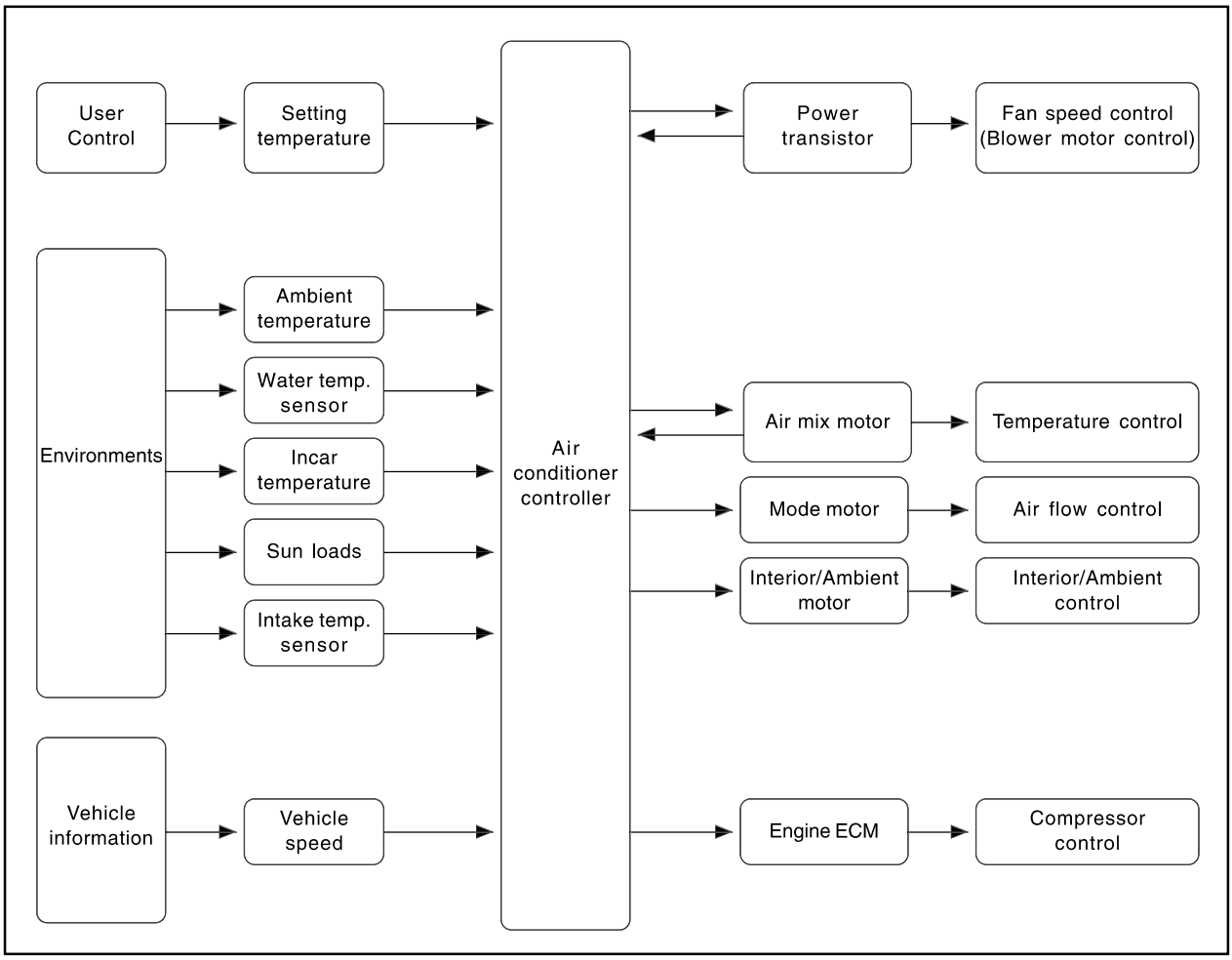
(2) Functions

▶ **Incar temperature sensor**

This sensor is a negative temperature coefficient (NTC) thermistor and detects the interior temperature with air coming from sensor hole and then sends the voltage value according to the changed resistance to FATC controller.

7. AIR CONDITIONER SYSTEM DIAGRAM

This figure shows the input and output system between FACT A/C components and A/C controller.



1) Air Conditioner Compressor Control by Engine ECU

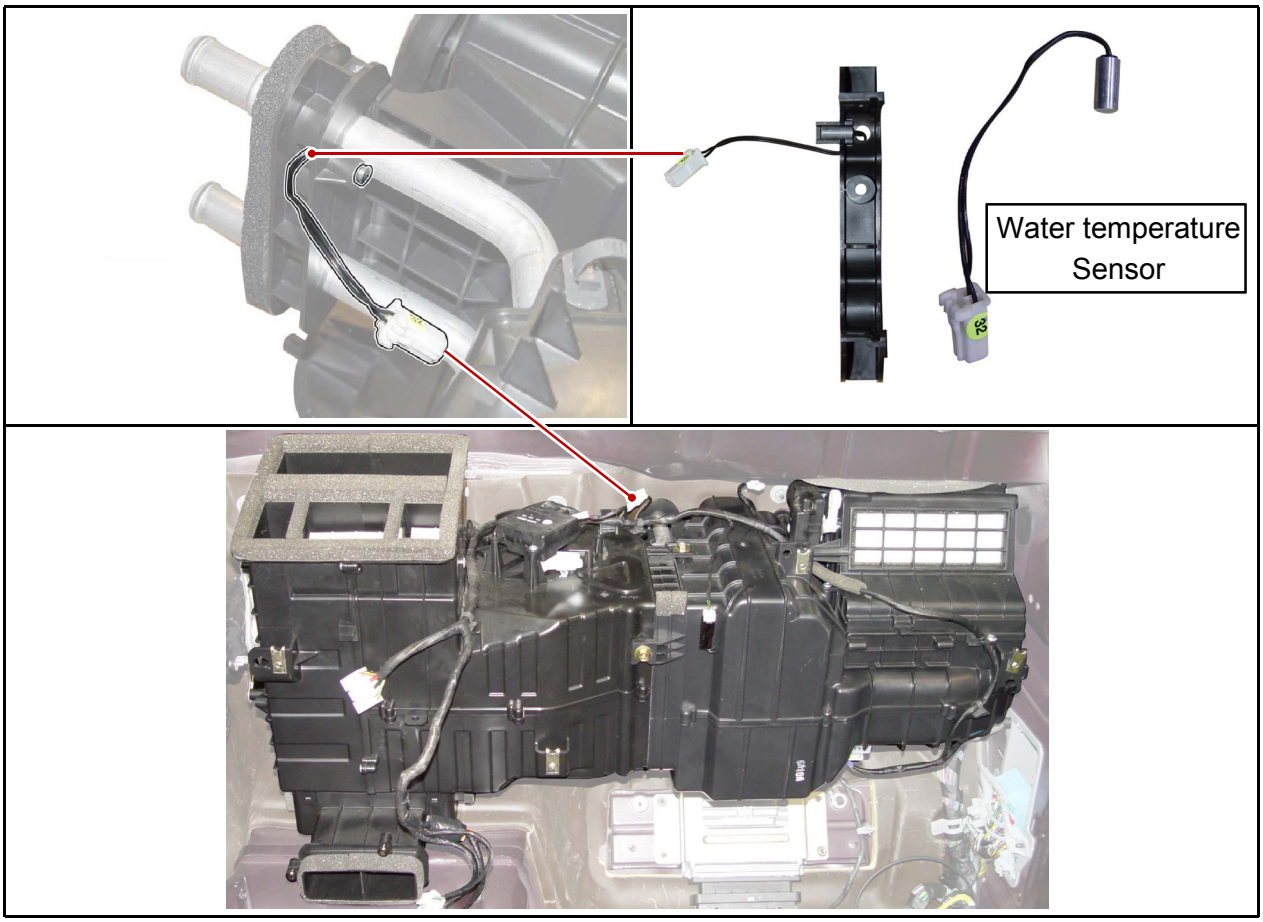
In case of conventional vehicle models, the system turns ON/OFF the compressor switch according to refrigerant pressure, ambient temperature and condenser temperature to protect air conditioner circuits. However, for the vehicle equipped with DI engine, the engine ECU turns off air conditioner compressor as below in addition to above conditions.

1. Coolant temperature: below −20°C
2. Coolant temperature: over 115°C
3. For approx. 4 seconds after starting the engine
4. When engine speed is below 650 rpm
5. When engine speed is over 4,500 rpm
6. During abrupt acceleration for the vehicle equipped with manual transmission

Modification basis	
Application basis	
Affected VIN	

8. AIR CONDITIONER MODULE SENSORS AND ACTUATORS

1) Water Temperature Sensor



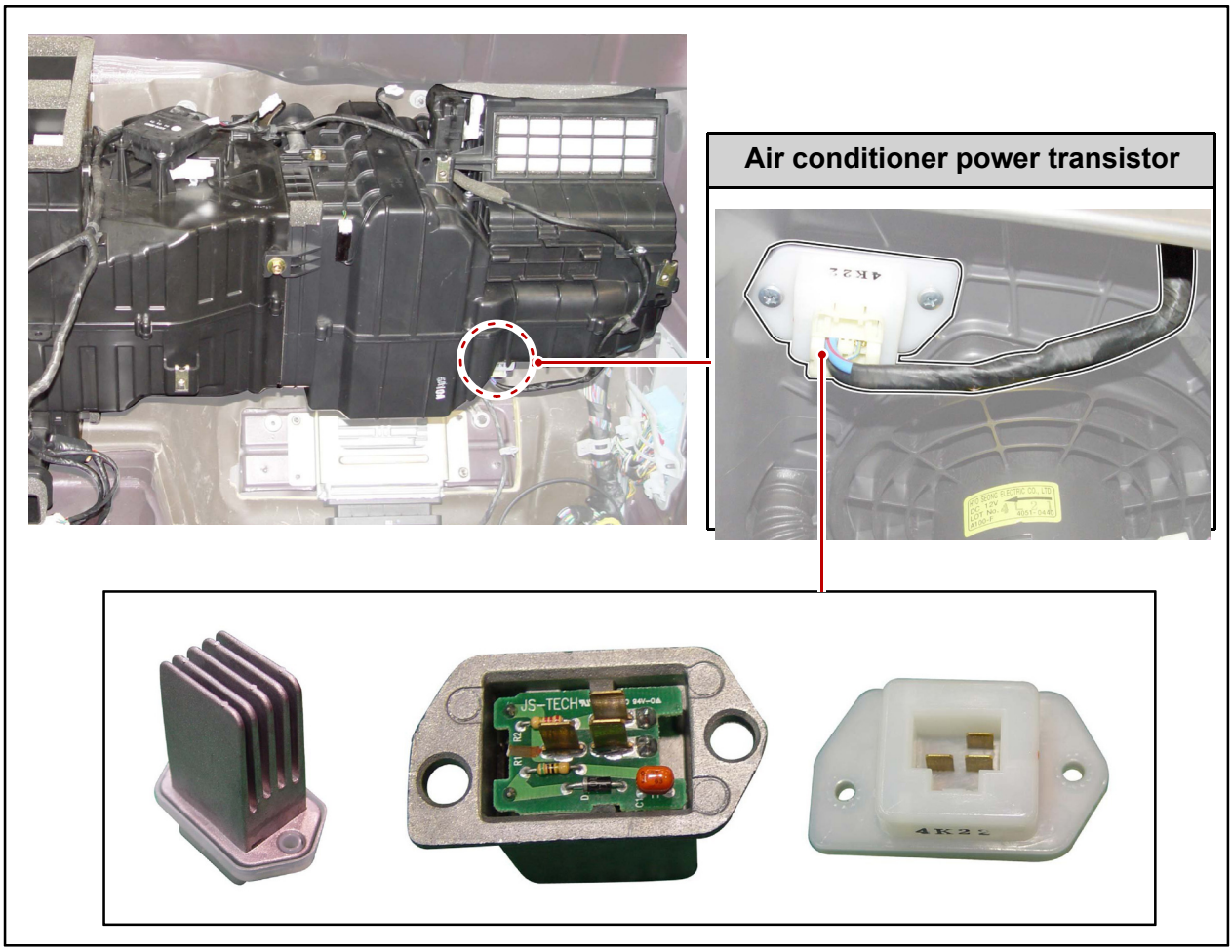
(1) Inspection

If the water temperature sensor defect code (DTC 3) is set, check as below.

- Remove the water temperature sensor and measure the resistance between terminals on the sensor connector.
  (standard: approx. 25°C, 2.2 kΩ)
  In addition, if the resistance is extremely high or low, replace the sensor.
- If the measured value is out of the specified range, replace the water temperature sensor. If the measured value is within the specified range, check as below.
- Turn the ignition switch to ON position and measure the voltage to water temperature sensor from the FATC controller connector. (standard: approx. 2 V at 25°C)
- If the voltage value cannot be measured, check the circuit for open. If the measured value is within the specified range, replace the FATC controller.

2) Power Transistor

The power transistor controls the fan speed. It controls the blower motor operating speed without stages by changing the current value to the base of power transistor when receiving the fan control signal from FATC.



(1) Inspection

If the power transistor defect code (DTC 6) appears, check as below.

- Turn the ignition switch to ON position.
- Measure the voltage between terminals while changing the fan speed from stage 1 to stage 6.
- The specified voltage value in each stage:

Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Blower (V)	4.5	6.0	7.5	9.0	11	Max HI

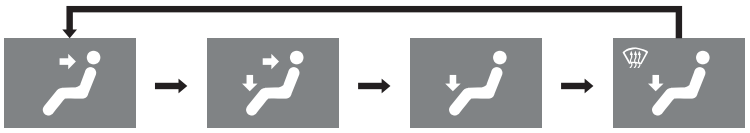
- If the voltage is out of specified value, check the circuit for open. If the circuit is in normal condition, replace the power transistor.

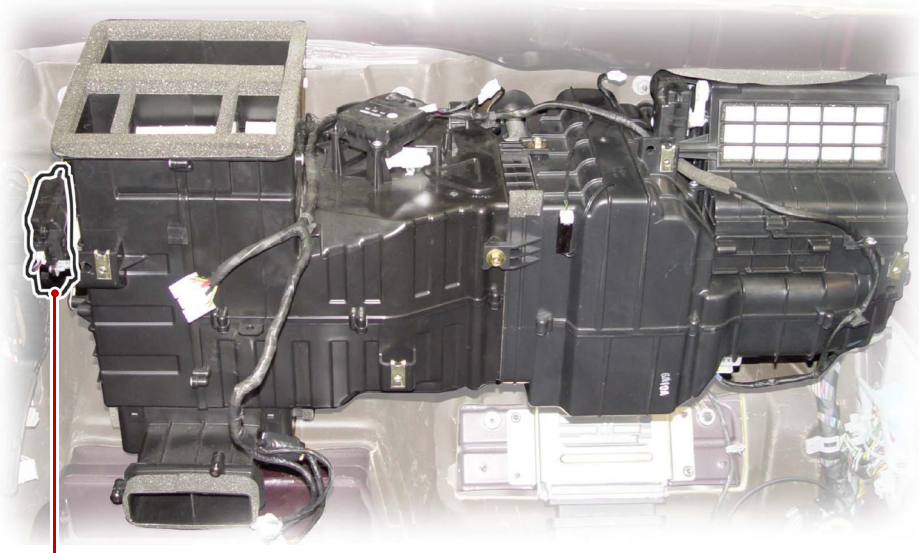
Modification basis	
Application basis	
Affected VIN	

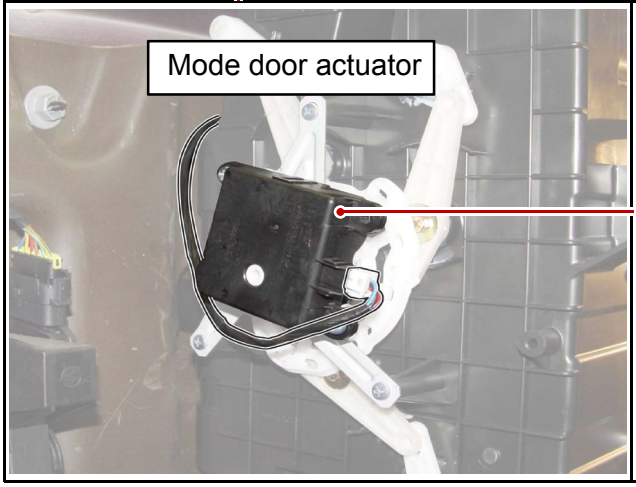
3) Mode Door Actuator

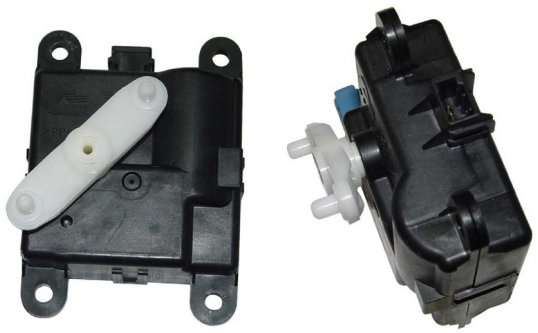
The mode door actuator is an actuator that closes, opens and adjusts the mode door for VENT, FOOT and DEF mode to change the air flow directions according to FATC controller. Under the FATC controller AUTO mode, it stays on DEF mode until the engine coolant temperature reaches at normal operating level and the mode is changed as below when the MODE switch is pressed.







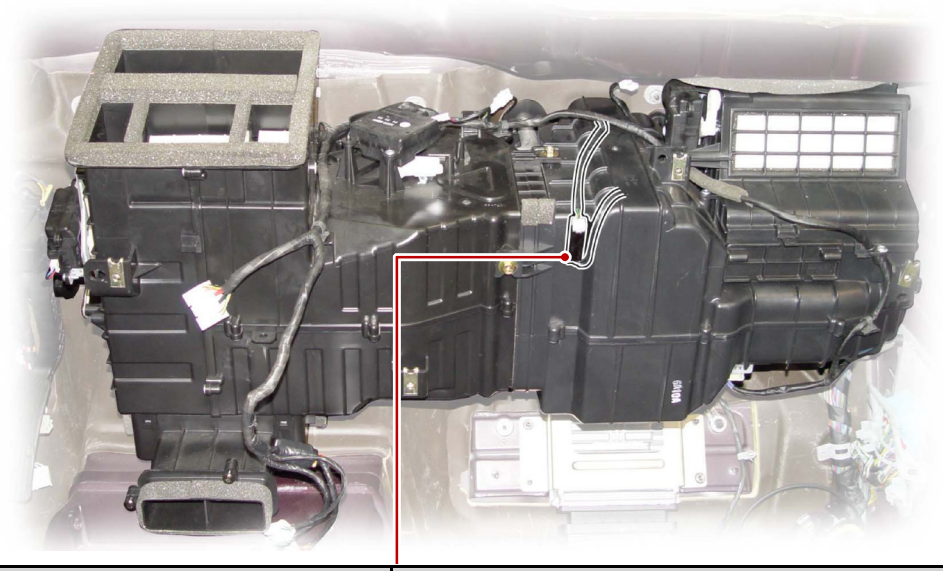


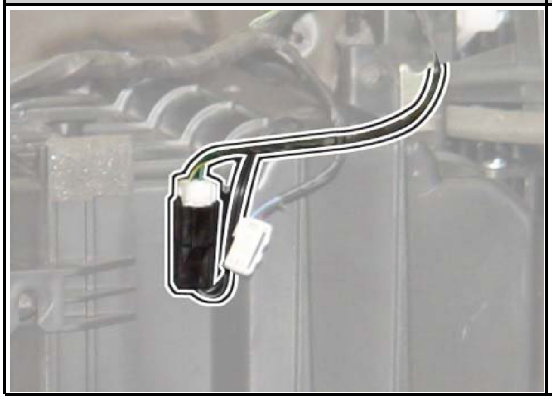


Modification basis	
Application basis	
Affected VIN	

4) Intake Temperature Sensor

The Intake Sensor outputs the compressor ON or OFF signal to ECU to prevent evaporator from freezing. The sensing part of the thermistor is the evaporator fin contact type.



Intake Sensor location	Intake Sensor
	

If the air conditioner does not turn on, check as below.

1. Remove the Intake Sensor and measure the voltage between terminal No. 1 and 2 on the connector.
2. Check whether the output voltages (ON: approx. 12 V, off: 0 V).
3. If the voltage value is out of the specified value, replace the Intake Sensor. If the circuit is in normal condition, check as below.
4. Turn the ignition switch to ON position and turn on the air conditioner by pressing the A/C button. And measure the voltage between terminal A12 and A11 on the FATC controller connector. (standard: approx. 12 V)
5. If the voltage value cannot be measured, check the circuit for open. If the measured value is within the specified range, replace the FATC controller.

Modification basis	
Application basis	
Affected VIN	

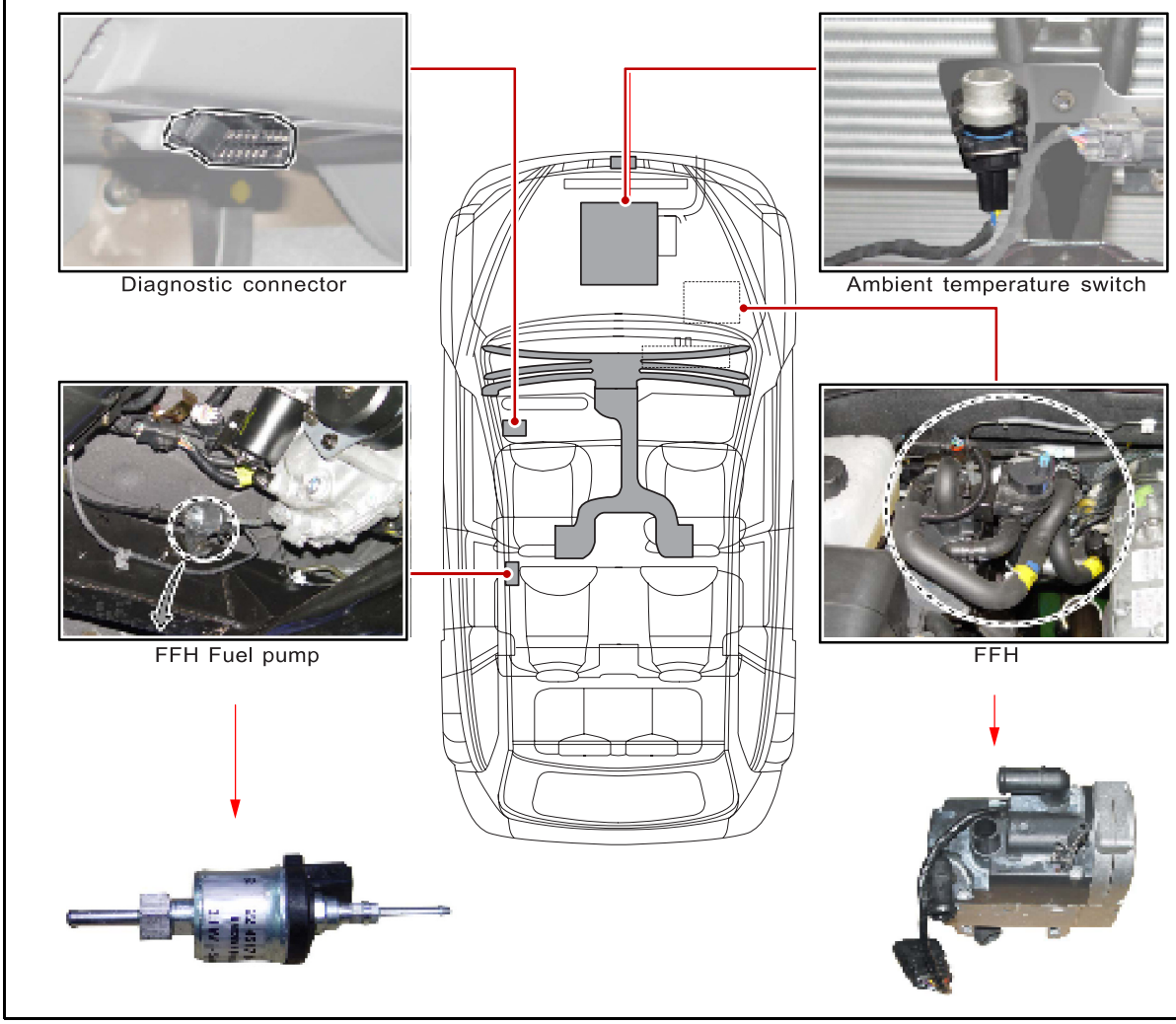
9. FFH (FUEL FIRED HEATER) SYSTEM COMPONENTS

1) OVERVIEW

The system is to increase the coolant temperature quickly by firing diesel fuel in the burner that is installed in engine cooling system when in winter time the ambient temperature and engine coolant temperature is low. (Option) The DI engine equipped vehicle has the Positive Temperature Coefficient (PTC) system as a basic equipment. FFH is operated by the coolant temperature and ambient temperature while PTC is operated by the coolant temperature intake air temperature.

FFH system consists of independent fuel lines and fuel pump, coolant circuit and coolant circulation pump, electrical glow plug and exhaust system. It also provides the diagnostic function. FFH system cannot be operated or stopped by driver's intention. The FFH system is automatically operated by the coolant temperature and the ambient temperature. The FFH system operates up to more 2 minutes to burn the residual fuel inside the system when stopping the engine during its operation. Therefore, a certain period of FFH operation after stopping the engine is not a malfunction.

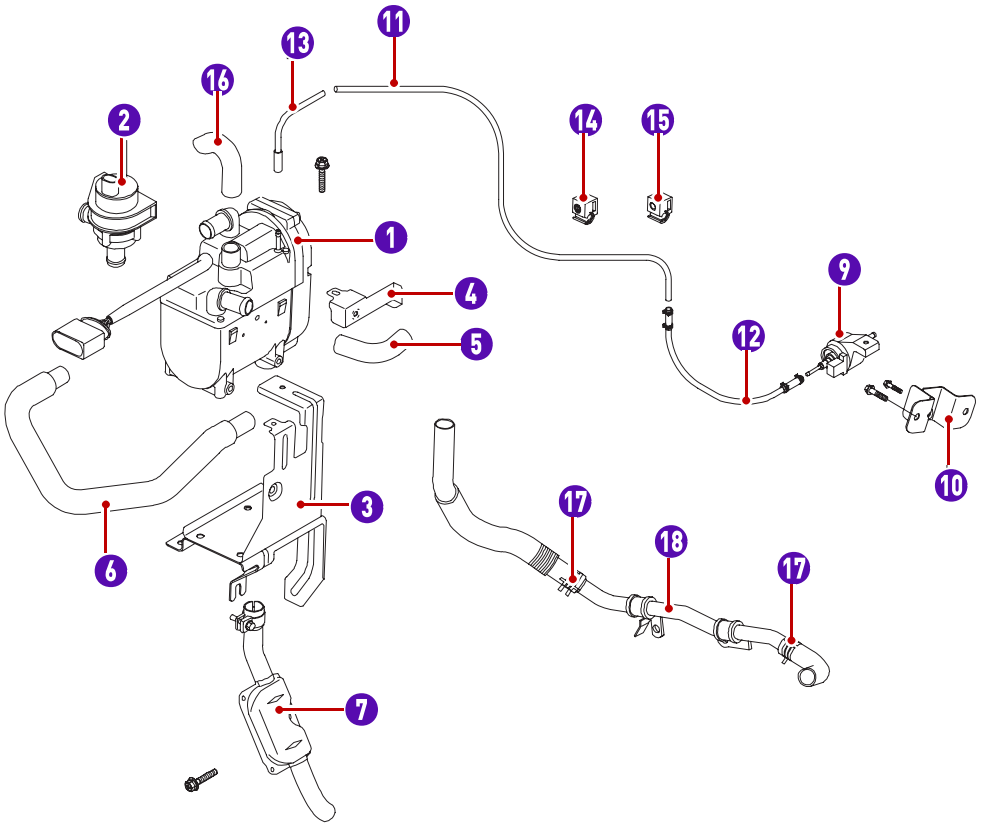
Components Locator



2) FFH LAYOUT

(1) Components

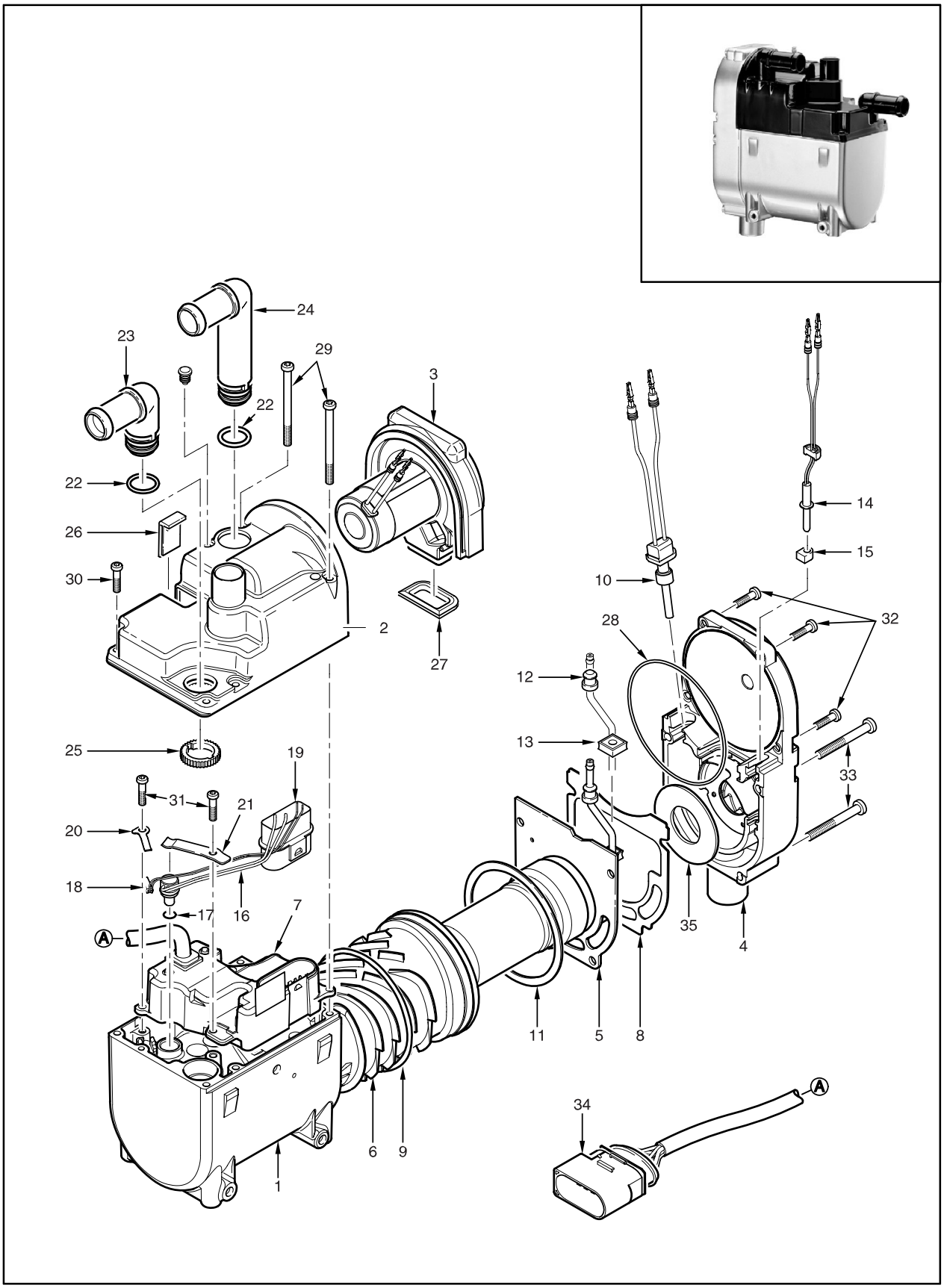




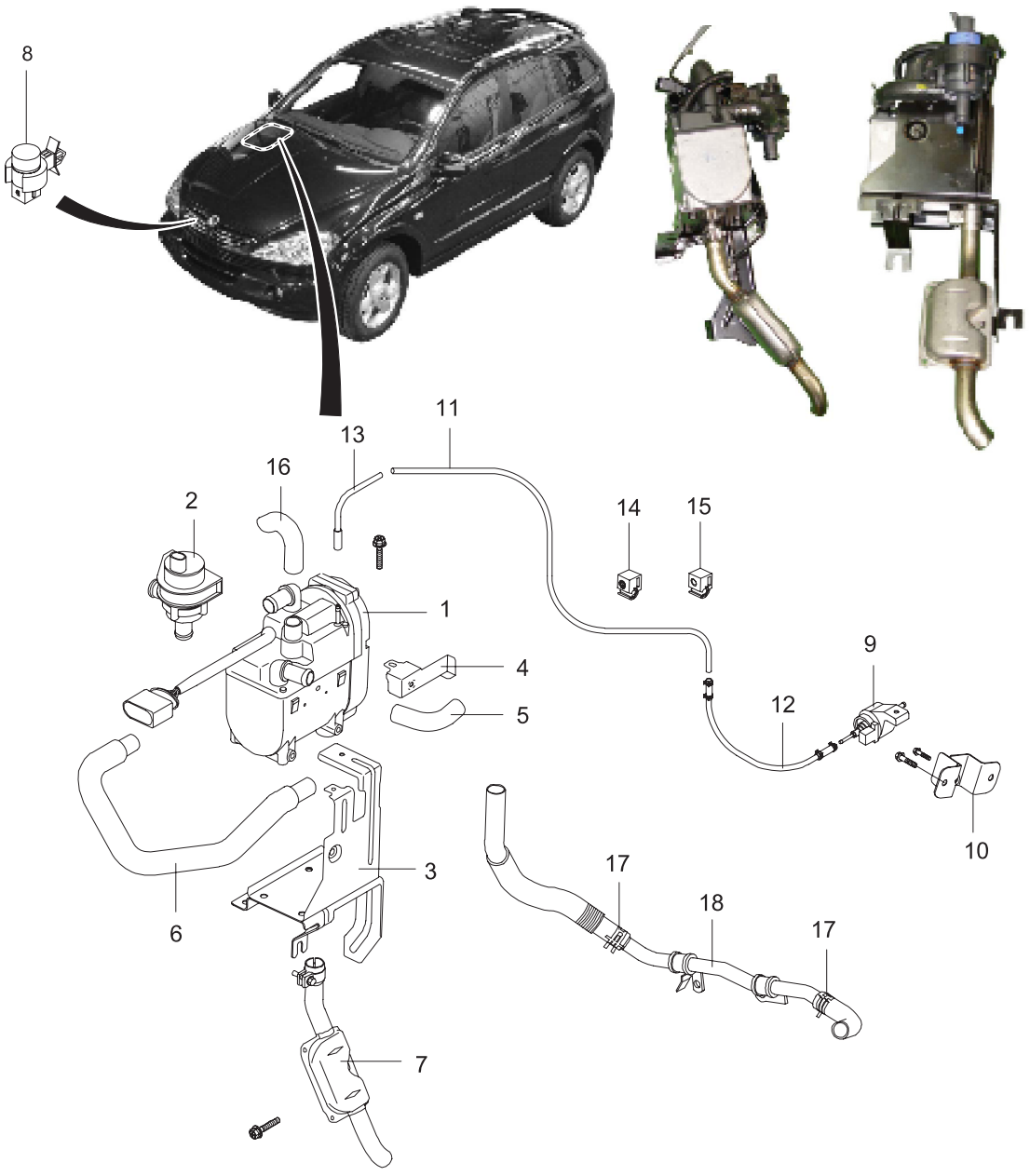
1. FFH assembly	7. FFH pipe assembly & silencer	13. Fuel pipe NO.3
2. Water pump and bracket assembly	8. Ambient temperature switch	14. Tube clip mounting
3. FFH bracket assembly	9. FFH fuel pump	15. Tube clip mounting
4. FFH water pump bracket	10. Fuel pump bracket	16. Intake hose
5. FFH NO.3 inlet hose	11. Fuel pipe NO.1	17. Clamp
6. FFH NO.2 inlet hose	12. Fuel pipe NO.2	18. FFH NO.1 inlet hose

Modification basis	
Application basis	
Affected VIN	

(2) Exploded View



Modification basis	
Application basis	
Affected VIN	



1. FFH assembly
2. Water pump and bracket assembly
3. FFH bracket assembly
4. FFH water pump bracket
5. FFH NO.3 inlet hose
6. FFH NO.2 inlet hose
7. FFH pipe assembly & silencer
8. Ambient temperature switch
9. FFH fuel pump
10. Fuel pump bracket
11. Fuel pipe NO.1
12. Fuel pipe NO.2
13. Fuel pipe NO.3
14. Tube clip mounting
15. Tube clip mounting
16. Intake hose
17. Clamp
18. FFH NO.1 inlet hose

Modification basis	
Application basis	
Affected VIN	

1. Jacket
2. Jacket cover
3. Combustion air fan
4. Combustion chamber
5. Combustion chamber with flame tube
6. Heat exchanger
7. Controller
8. Seal (between combustion chamber and combustion air fan)
9. O-ring
10. Glow plug with cable
11. Seal (between combustion chamber and heat exchanger)
12. Upper bush for fuel pipe
13. Lower bush for fuel pipe
14. Flame sensor
15. Bush for flame sensor (graphite)
16. Control and overheating sensor with cable
17. O-ring
18. Surface sensor with cable
19. Controller connector
    - 14-pin connector (waterproof)
20. Pressure spring for surface sensor
21. Pressure spring for control and overheating sensor
22. O-ring
23. Coolant hose (inlet)
24. Coolant hose (outlet)
25. Tooth ring (2x)
26. Cable harness cover
27. Rubber seal
28. O-ring
29. Screw (M4 x 55 TORX / 2x)
30. Screw (M4 x 16 TORX / 2x)
31. Screw (M4 x 12 TORX / 2x)
32. Screw (M4 x 16 TORX / 4x)
33. Screw (M4 x 44 TORX / 4x)
34. Controller cable harness
35. Insulation washer

(3) SPECIFICATIONS

Heater		D 5 S - H	
Heating medium		Coolant	
Control of the heat flow		Large (full load)	Small
Heat flow		5,000 W	2,300 W
Fuel consumption per hour		approx. 0.63 Liter	approx. 0.28 Liter
Mean electric power consumption	In operation	35 W	11 W
	At start	100 W	
	After-running	12 W	
Rated voltage		12 V	
* Lower voltage limit: An undervoltage protection device in the controller switches the heaters off at approx. 10 volt.		10 V	
* Upper voltage limit: An overvoltage protection device in the controller switches the heaters off at approx. 15 volt.		15 V	
Tolerable operating pressure		up to 2.5 bar overpressure	
Minimum water flow through the heater		300 L/H	
Fuel		In the main fuel tank (fuel)	
Tolerable ambient temperature	Operation	- 40°C ~ 80°C	
	Storage	-40°C ~ 125°C	
Weight (without coolant and water pump & bracket)		approx. 2.3 kg	

Modification basis	
Application basis	
Affected VIN	

10. FFH OPERATING PROCESS

1) Operating Condition

FFH is operated according to the ambient temperature and coolant tempreature.

(1) Initial Operating Conditions of FFH

▶ **Initial Operating Conditions of FFH**

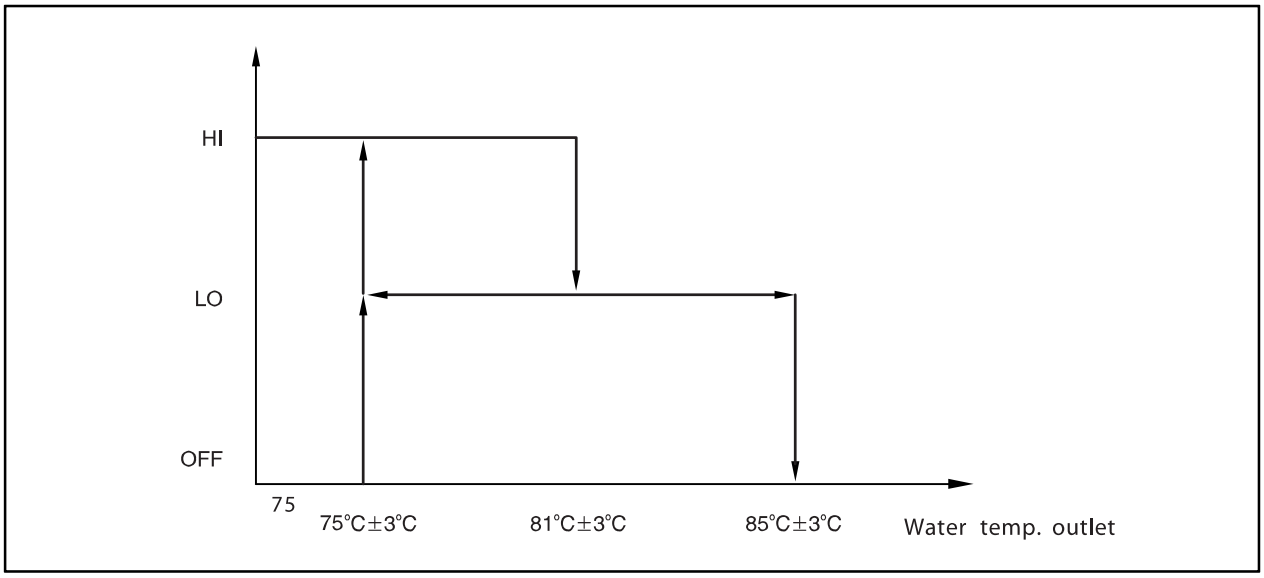
- Ambient temperature: below 5°C
- Coolant temperature: below 75°C

▶ **Repeated Operating Conditions of FFH**

- Coolant temperature: below 75°C
- When the difference between the ambient temperature at initial operation and current ambient temperature is over 3°C (to reduce the hysteresis with the temperature difference when operating FFH), FFH is operated again.

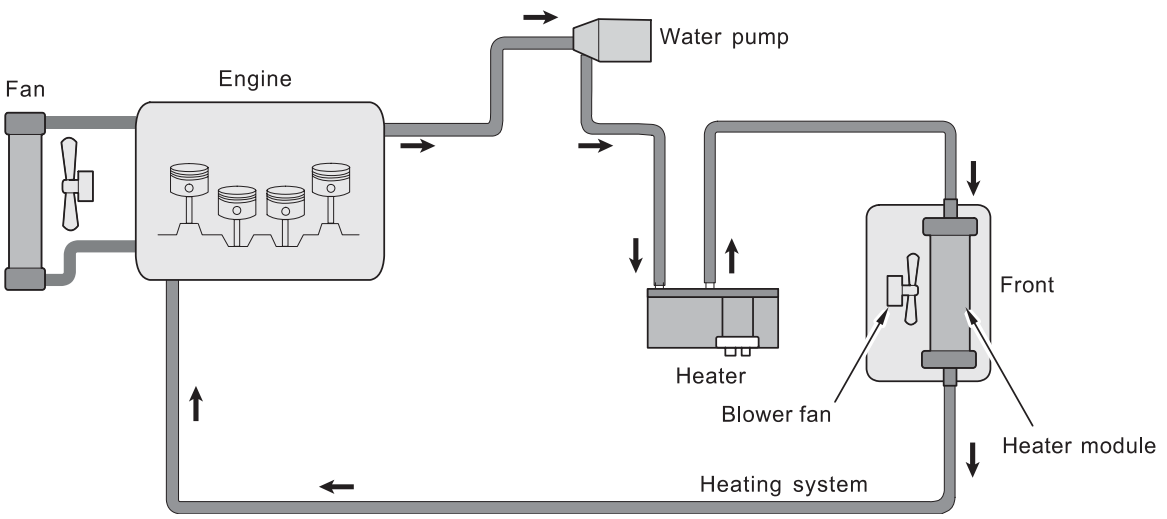
For example, if the initial operating temperature was 4°C, the ambient temperature at repeat operation should be below 1°C and the coolant temperature should be below 75°C.

(2) FFH Operations According To the Changes of Coolant Temperature



Above graph shows the FFH control process while the FFH is operating.
The control element is coolant temperature as shown in the graph.
The FFH is operated in HI mode (high output: approx. 5,000 W) until the coolant temperature reaches at 80°C and starts to be operated in LO mode (low output: approx. 2,300 W) from 81°C.
When the coolant temperature reaches at approx. 85°C, FFH stops its operation until the operating conditions will be met again.

2) Coolant Circulating Route



3) Connecting the Coolant Circuit

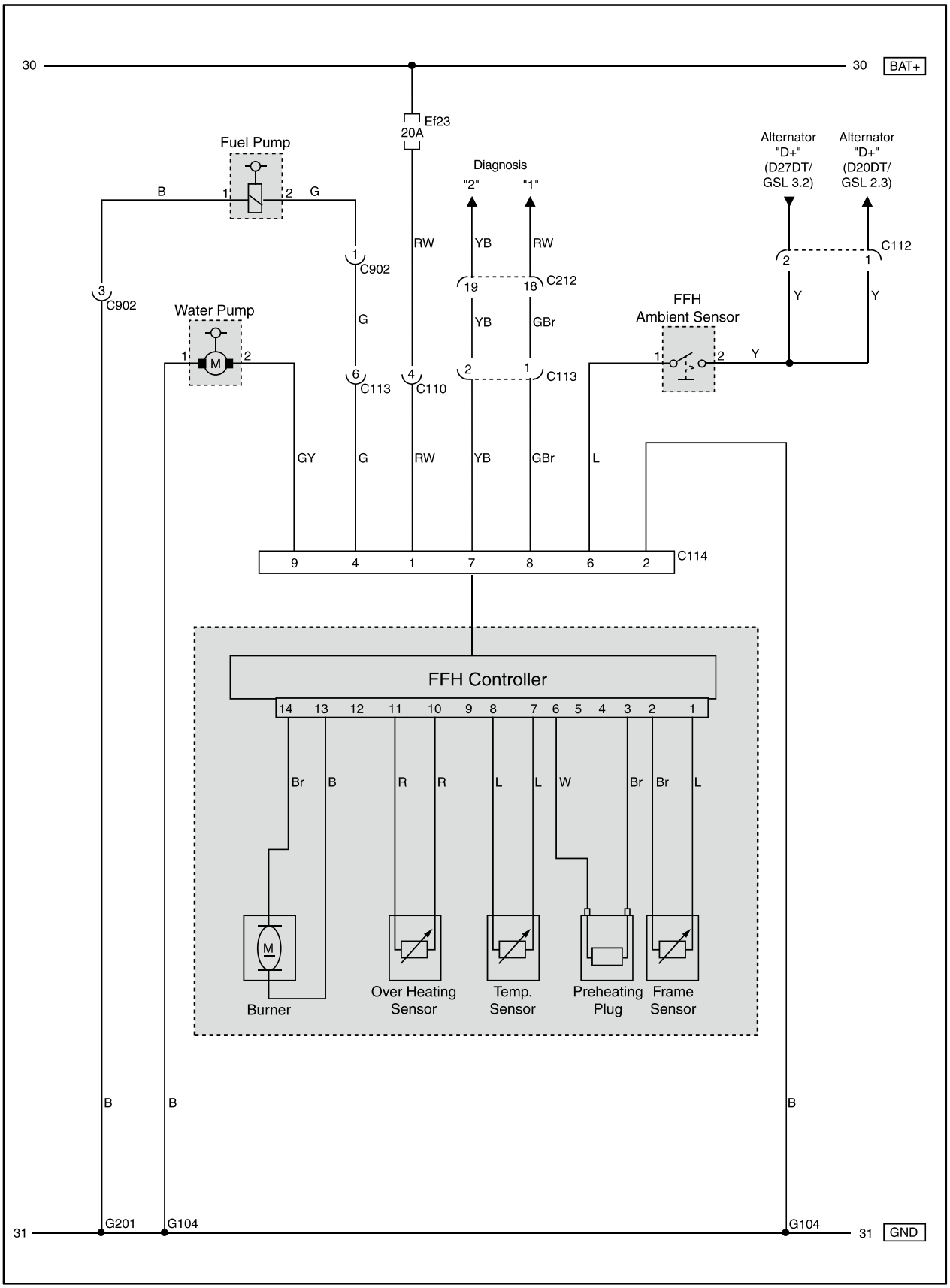
The heater is connected to the coolant circuit in the coolant feed pipe from the vehicle engine to the heat exchanger.

CAUTION

- Parts conveying coolant must be routed and fastened in such a way that they pose no temperature risk to
  person or material sensitive to temperature from radiation and direct contact.
- Before working on the coolant circuit, disconnect the negative battery cable and wait until all components have cooled down completely.
- When installing the heater and the water pump, note the direction of flow of the coolant circuit.
- Fill the heater and water hoses with coolant before connecting to the coolant circuit.
- When routing the coolant pipes, observe a sufficient clearance to hot vehicle parts.
- Protect all coolant hoses/coolant pipes from chafing and from extreme temperatures.
- Secure all hose connections with hose clamps.

Modification basis	
Application basis	
Affected VIN	

4) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	

5) Control and Safety Mode

▶ Heater Operations and Safety Mode

- If the fuel pump fails to ignite within 90 seconds after fuel pumping starts, the start procedure is repeated as described. If after a further 90 seconds fuel pumping the fuel pump still fails to ignite, the heater is switched off in fault mode. The controller is locked after a certain number of failed starts.
- If the flame does out by itself during operation, firstly a new start is activated. If the fuel pump fails to ignite within 90 seconds after fuel pumping has started again, the heater is switched off.
- If the heater is overheated (lack of water, poorly vented cooling circuit), the overheating sensor triggers, the fuel supply is interrupted and the heater is switched off.
- The heater is switched off if the lower or upper voltage limit is reached.
- The fuel pump does not start when the glow plug is defect or electrical lead to the dosing pump is interrupted.
- The fan motor speed is monitored continuously. If the fan motor does not start up, is blocked or if the speed falls below 40% of the nominal speed, the heater is switched off in fault mode after 120 seconds.
- It is possible to diagnose the system by connecting the diagnostic device to controller. For details, refer to the "Diagnosis Procedures" section.

CAUTION

If an emergency shutdown -EMERGENCY OFF- is necessary during operation, proceed as follows;

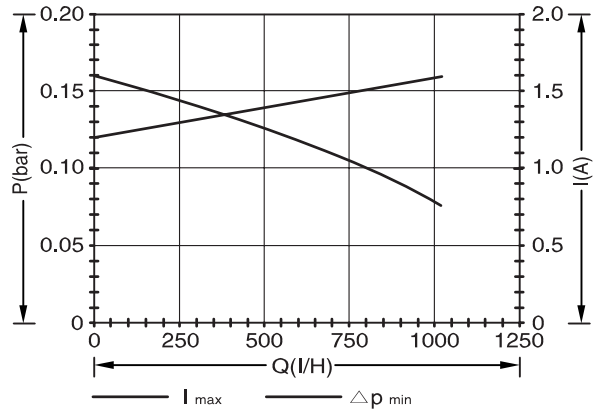
- Pull the fuse (Ef6: 20A) out.
- Disconnect the heater from the battery.

Modification basis	
Application basis	
Affected VIN	

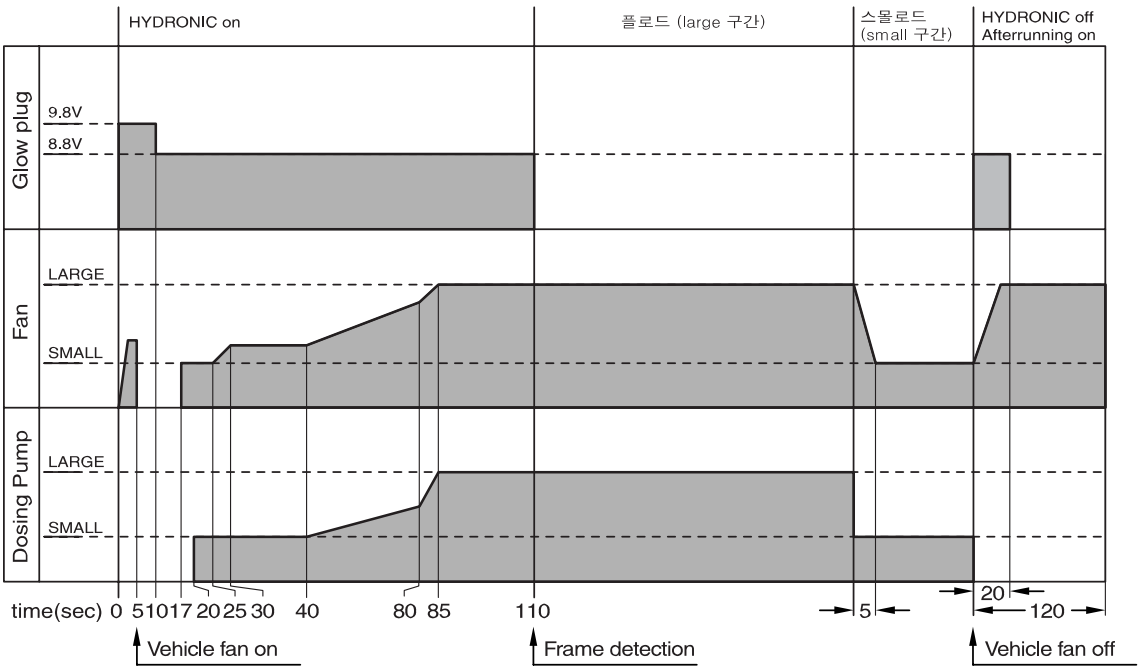
6) Specification - Water Pump

Rated voltage	12 V
Operating voltage	9 V ~ 15 V
Power consumption	16 W
Pumping capacity (0.1 bar)	800 l/h
Operating temperature	- 40°C ~ 135°C
Weight	0.28 kg

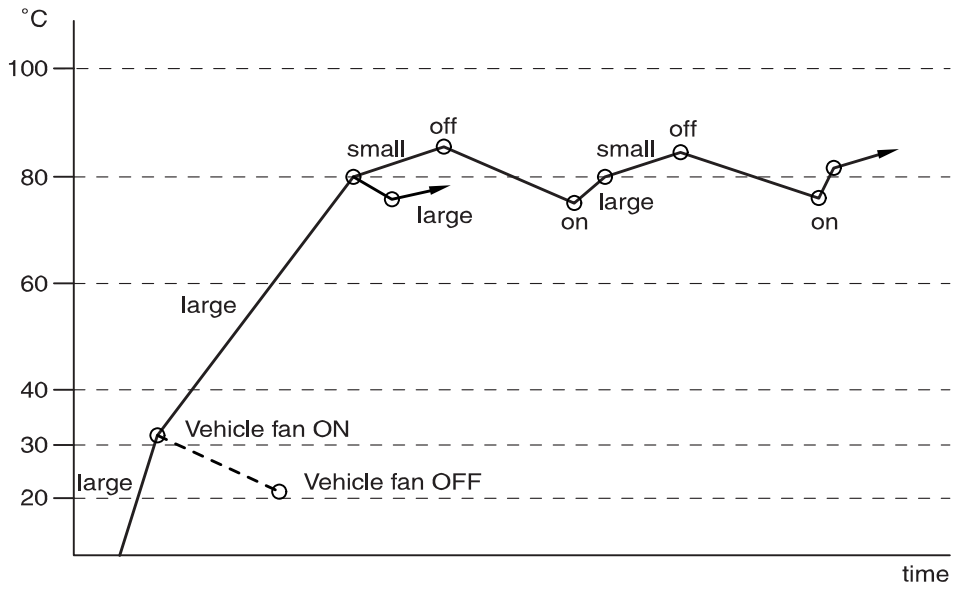
7) Characteristic Curve of Water Pump (12 V)



8) Function Diagram



9) Switching Diagram According to Temperature Changes



Modification basis	
Application basis	
Affected VIN	

AIR BAG SYSTEM 8810-03

GENERAL

1. REMINDER FOR AIR BAG RELATED COMPONENT REPLACEMENT

CAUTION

- When an air bag deploys (curtain air bags and seat belt pretensioners included), the air bag unit must be replaced. Please do not attempt to delete the failure code with scan-100 because some data about the deployment situation are stored in the unit.
- The air bag related components, especially the air bag unit, must be stored in a sealed case to prevent any damage.
- Please do not connect a tester to any air bag connector or single item to measure the supplied power or resistance.
  The detonator may explode due to a sudden extra power supplied by the tester.
- Before removing or installing any air bag related components, disconnect the negative battery cable.

Collision sensors, a kind of impact G (acceleration) sensor, detect the front and longitudinal collisions and determine whether or not the air bags are deployed. The roles of each collision sensor are as below :

▶ **Front G sensors (inside the air bag unit)**

- Send signals to the front air bags and the driver's and front passenger's seat belt pretensioners.
- By the signal from this sensor, front air bags (driver's and passenger's air bags) deploy and the seat belt pretensioners of the driver's and passenger's seat belts retract seat belts.

▶ **Curtain air bag G sensors**

- These are located inside the left and right B-pillar panel bottoms. When collision occurs, the air bag at the side of collision deploys accordingly. Please pay attention to that, in the case of the curtain air bag, only the air bag at the side of collision deploys, not both.

Once an air bag deploys, its repair parts vary according to the deployment situation and damage to the vehicle from collision. Needed repairs also slightly vary between the front air bags and the curtain air bags. The following are the differences :

▶ Replacement parts when the front air bags deploy

The air bag units and their connection wires (connectors included), the seat belt pretensioners and their connection wires (connectors included), the entire front air bags, and the instrument panel (IP).

▶ Replacement parts when a curtain air bag deploys

The new curtain air bag for the deployed side, the air bag unit and its connection wires (connectors included), the collision G sensor assembly for the curtain air bag, and the trims and roof headlining for the broken parts.

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. AIR BAG SYSTEMS (INCLUDING CURTAIN AIR BAGS) OVERVIEW



The air bag systems for this vehicle are not much different from the previous air bag system installed in REXTON.
The curtain air bags are installed at the bottom of the roof trim and they enhance the passenger's safety.
The driver's and passenger's curtain air bags individually deploy.
When the front air bags deploy, the seat belt pretensioners retract the seat belts too.
Collision sensors, a kind of impact G (acceleration) sensor, detect the front and longitudinal collisions and determine whether or not the air bags are deployed. The roles of each collision sensor are
as below:

▶ **Front G sensors (inside the air bag unit)**

- Send signals to the front air bags and the driver's and front passenger's seat belt pretensioners.
- By the signal from this sensor, front air bags(driver's and passenger's air bags) deploy and the seat belt pretensioners of the driver's and passenger's seat belts retract seat belts.

▶ **Curtain air bag G sensors**

- These are located inside the left and right B-pillar panel bottoms. When a collision occurs, the air bag at the side of collision deploys accordingly. Please pay attention to that, in the case of the curtain air bag, only the air bag at the side of collision deploys, not both.

Once an air bag deploys, its repair parts vary according to the deployment situation and damage to the vehicle from collision. Needed repairs also slightly vary between the front air bags and the curtain air bags. The following are the differences:

▶ **Replacement parts when the front air bags deploy**

- The air bag units and their connection wires (connectors included), the seat belt pretensioners and their connection wires (connectors included), the entire front air bags, and the instrument panel (IP).

▶ **Replacement parts when a curtain air bag deploys**

- The new curtain air bag for the deployed side, the air bag unit and its connection wires (connectors included), the collision G sensor assembly for the curtain air bag, and the trims and roof headlining for the broken parts.

CAUTION

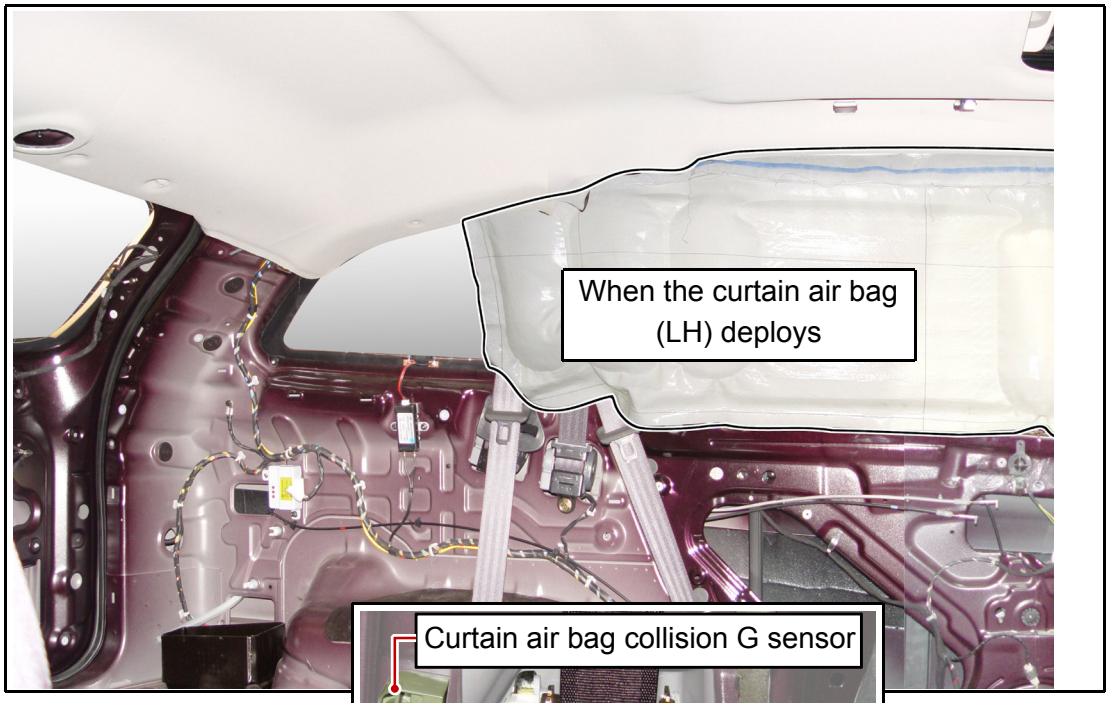
- When an air bag deploys (curtain air bags and seat belt pretensioners included), the air bag unit must be replaced. Please do not attempt to delete the failure code with SCAN-100 because some data about the deployment situation are stored in the unit.
- The air bag related components, especially the air bag unit, must be stored in a sealed case to prevent any damage.
- Please do not connect a tester to any air bag connector or single item to measure the supplied power or resistance. The detonator may explode due to a sudden extra power supplied by the tester.
- Before removing or installing any air bag related components, disconnect the negative battery cable.

Modification basis	
Application basis	
Affected VIN	

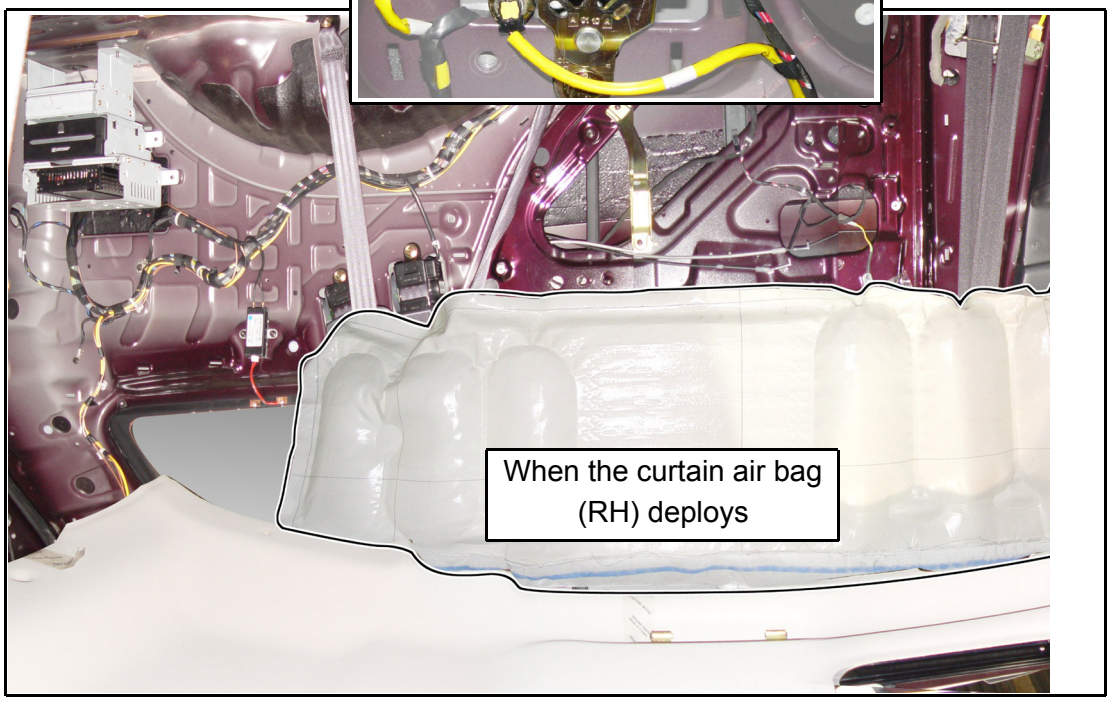
Memo

2. AIR BAG SYSTEM LOCATIONS AND RELATED COMPONENTS

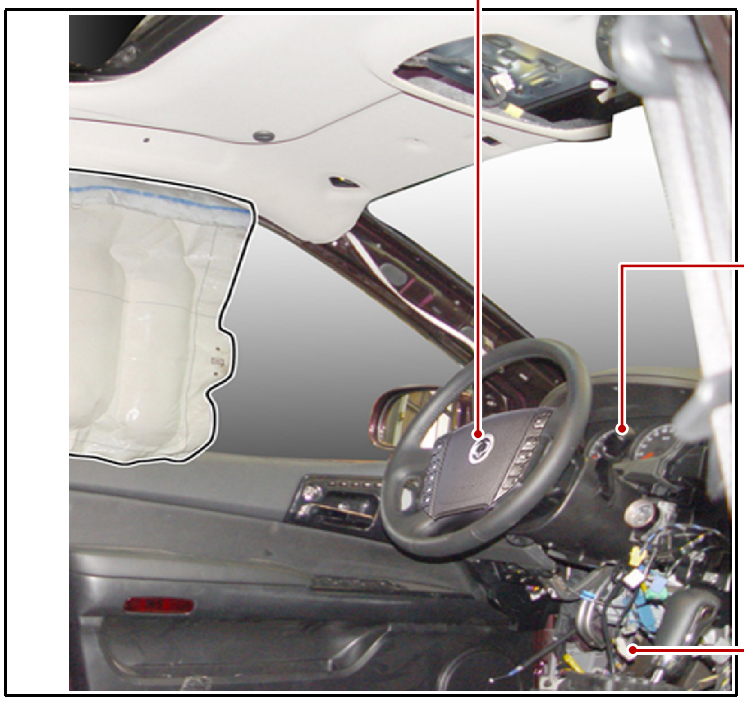
▶ LH

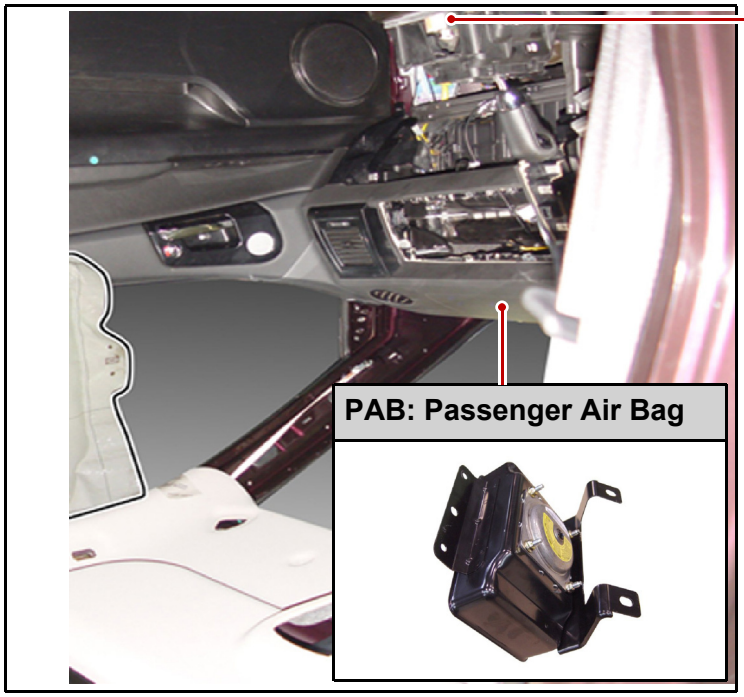


▶ RH



Modification basis	
Application basis	
Affected VIN	





DAB: Driver Air Bag



Air bag warning lamp



STICS



40 ms after receiving the air bag deployment signal at the vehicle speed 3 or higher km/h, it sends out the door
UNLOCK signal for 5 seconds.

Air Bag Unit (SDM)



The collision G sensor is installed nside this. And it sends out signals to deploy the front air bags (driver's and passenger's air bags) and (or) the driver's and passenger's seat belt pretensioners or the driver's and passenger's curtain air bag. When the front collision G sensor sends out only the air bag deployment signal, the signal deploys the two front air bags and activates their seat belt pretensioners.

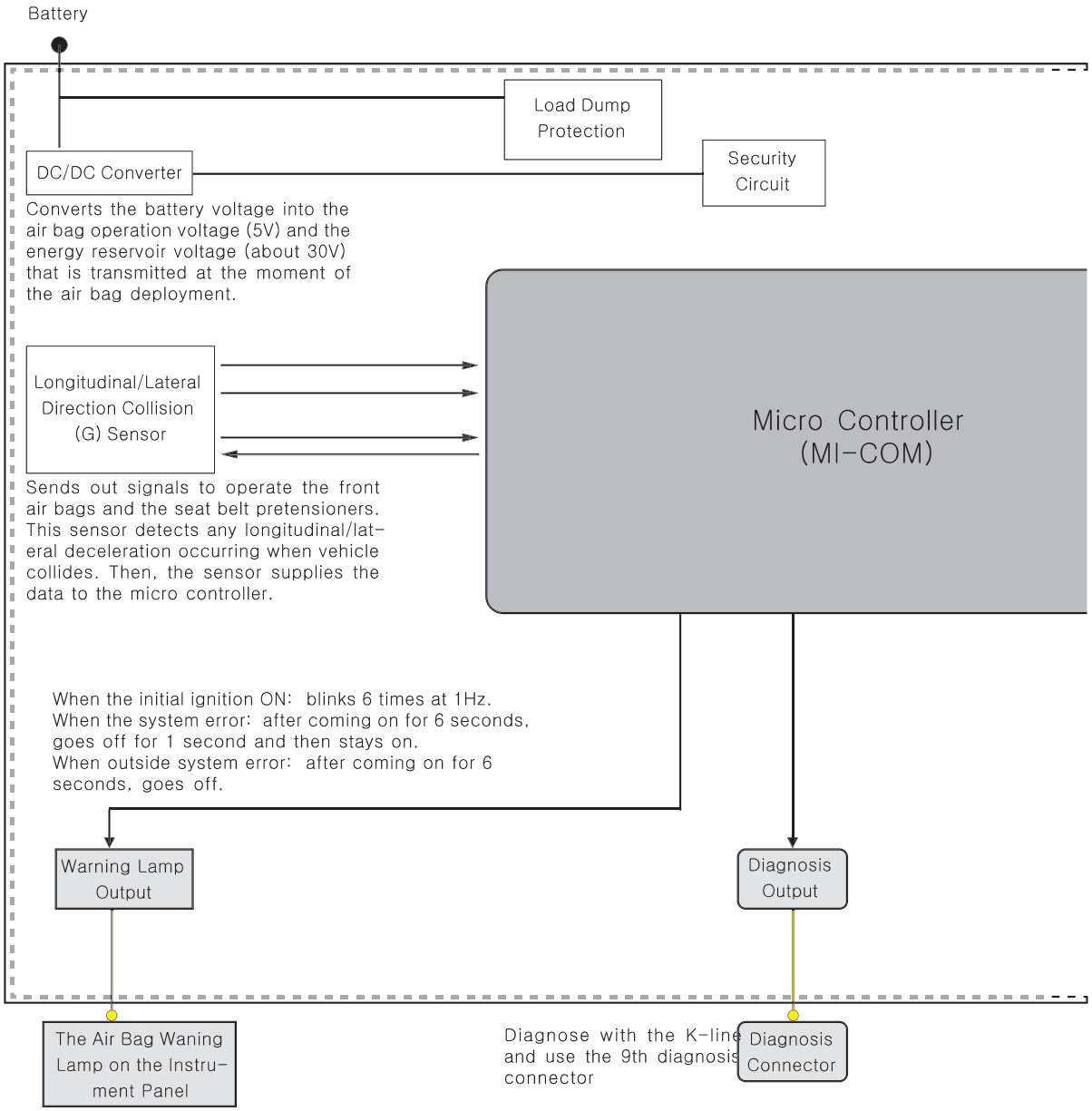
PAB: Passenger Air Bag

Modification basis	
Application basis	
Affected VIN	

3. AIR BAG SYSTEM OPERATION PROCESS

The overall air bag operation process and its functions and roles are broadly explained in this block diagram.
This diagram summarizes and highlights the functions adopted by Ssangyoung Motors.

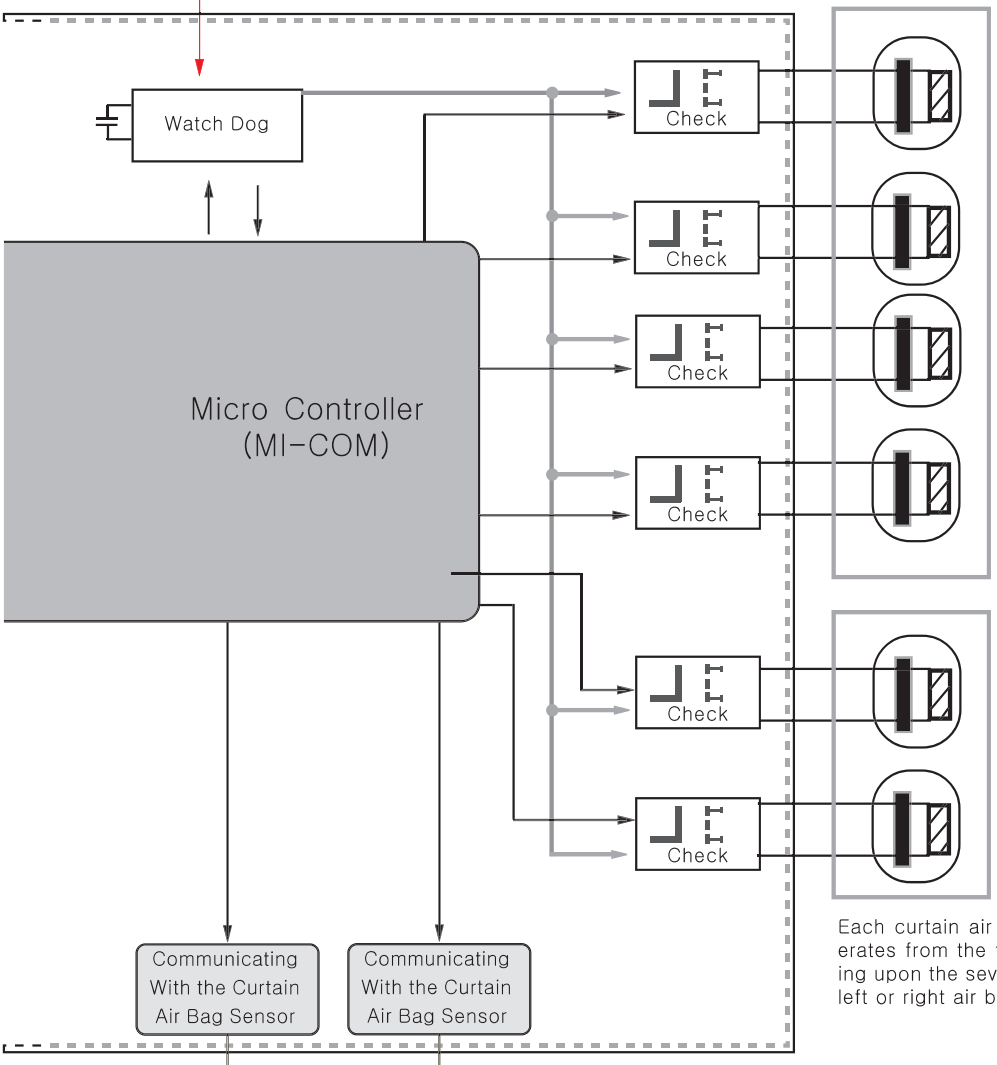
▶ **Air Bag System Block Diagram (Functions and Roles Included)**



Modification basis	
Application basis	
Affected VIN	

The watchdog monitors the micro controller, the air bags, and the seat belt pretensioners. When any error occurs, it turns on the air bag warning lamp.

When the front air bags deploy, the driver's air bag and the front passenger's air bag deploy simultaneously and their seat belt pretensioners also simultaneously retract their seat belts.
The air bag unit monitors conditions of the air bags and the seat belt pretensioners. When any error occurs, it stores the failure diagnostic code or turns on the air bag warning lamp on the instrument panel.



Each curtain air bag independently operates from the front air bags. Depending upon the severity of impact, only the left or right air bag may deploy.

The collision G sensors for the curtain air bags are installed at the bottom of left and right B-pillars. Each measures deceleration rate at time of collision and supplies information about the collision to the air bag unit. Each sensor measures the G value from its side and transmits the decesion to its air bag unit.

Modification basis	
Application basis	
Affected VIN	

4. AIR BAG MODULE AND OTHER COMPONENTS

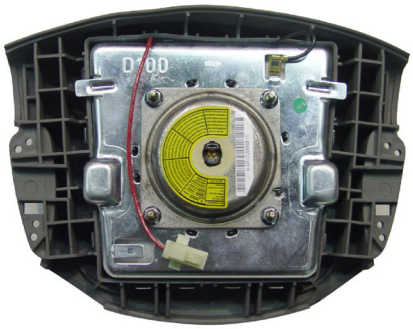
This section describes the air bag module installed in Kyron.
The module consists of the inflator, the cushion, and the mounting cover.

1) DAB: Driver Air Bag

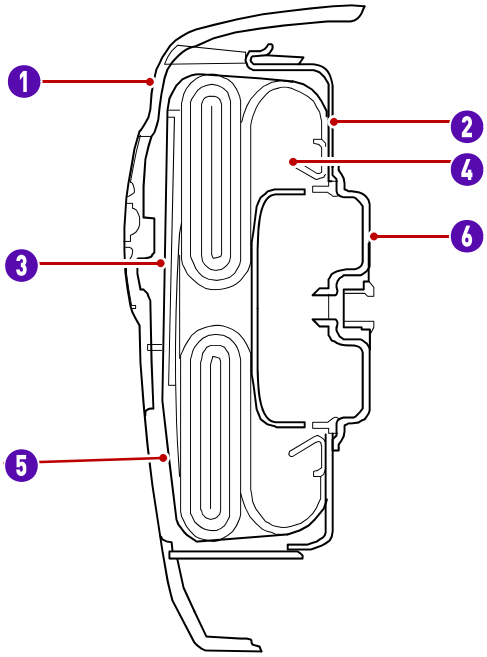
The driver's air bag is installed inside the steering wheel.
If the acceleration sensor (inside the air bag unit) is activated by the deceleration from vehicle collision, the detonation is fired by the electrical signal of the air bag unit.
Then, the detonation sets off explosives and nitrogen gas is generated.

At this point, the air bag very quickly deploys and the gas is emitted from the relieving hole to absorb impact upon the driver.





(1) Components



1. Air bag cover
2. Air bag housing
3. Horn switch
4. Retainer ring
5. Air bag cushion (approx. 50 liters)
6. Inflator* (approx. 190 Kpa)

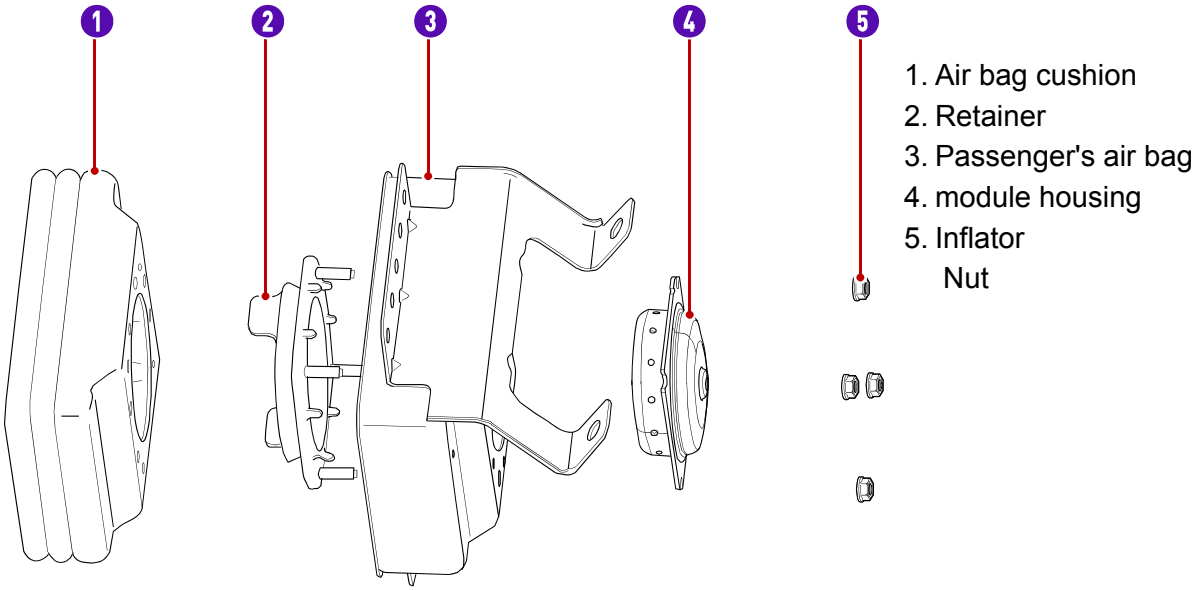
Modification basis	
Application basis	
Affected VIN	

2) PAB: Passenger Air Bag

The passenger's air bag is installed inside the instrument panel above the glove box.
Its operation process is the same as the driver's one.
The driver's air bag, the passenger's air bag, and the seat belt pretensioners on both seats are made to operate together.
When the collision G sensor inside the air bag unit sends a collision signal, the air bag unit instantaneously applies a high current to the driver's and passenger's air bags and the seat belt pretensioners on both seats, fires the detonator in the inflator, and inflates the air bag cushions (curtain air bags independently operate in case of the side collisions).

Front View	Rear View
	

(1) Components



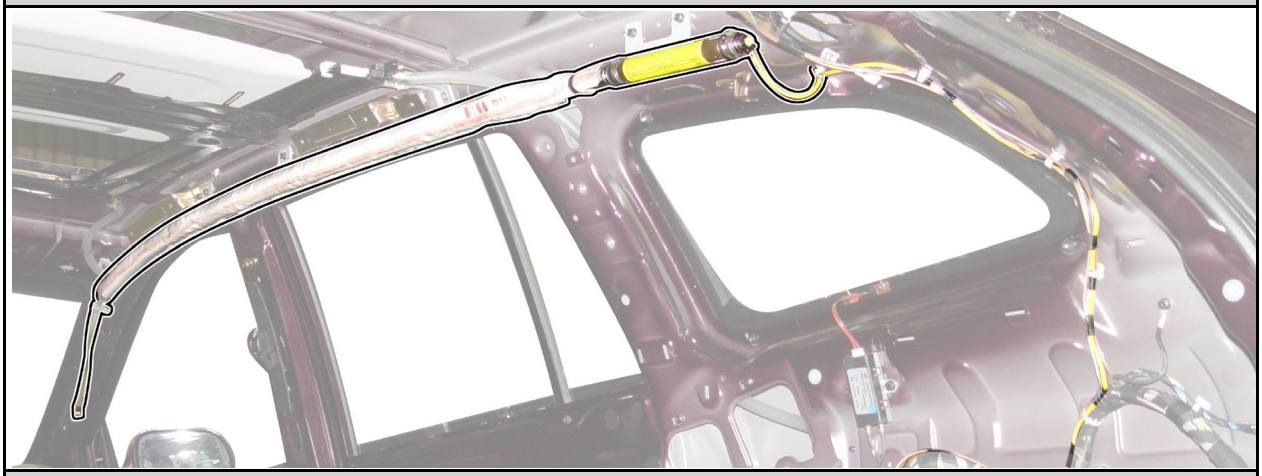
1. Air bag cushion
2. Retainer
3. Passenger's air bag
4. module housing
5. Inflator
   Nut

3) Curtain Air Bag (CAB)

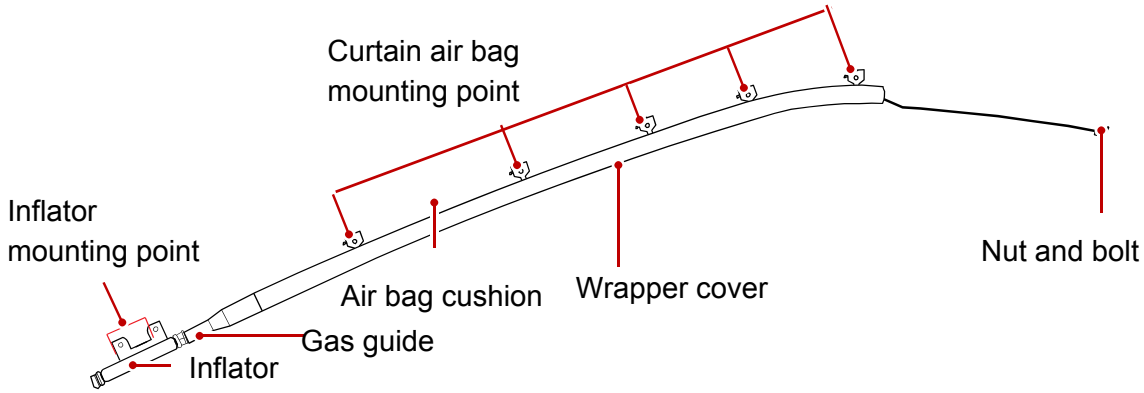
The curtain air bags are installed on both sides of the roof side rails and inside the headlinings. Each curtain air bag is also composed of the air bag cushion and the inflator that has the detonator, explosives, and the gas generator.

A collision situation is detected by the curtain air bag collision G sensor installed at the lower side of the B-pillar.
The signal is transmitted to the air bag unit. The air bag unit instantly inflates the necessary air bag necessary by sending a high current.

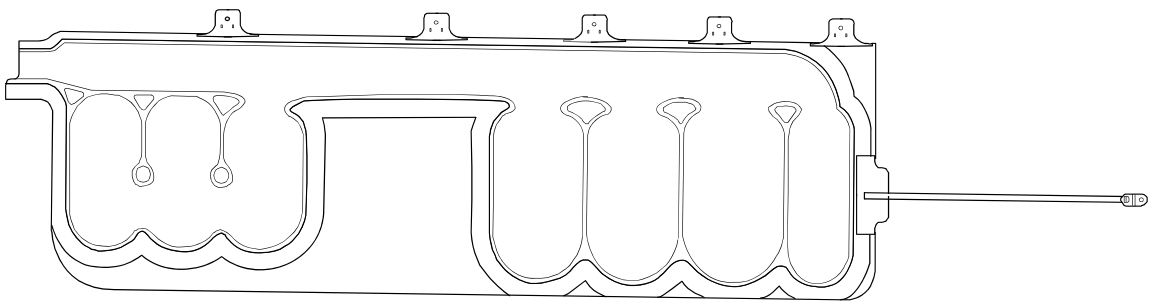
When the Curtain Air Bag is Installed



Terms of the Curtain Air Bag



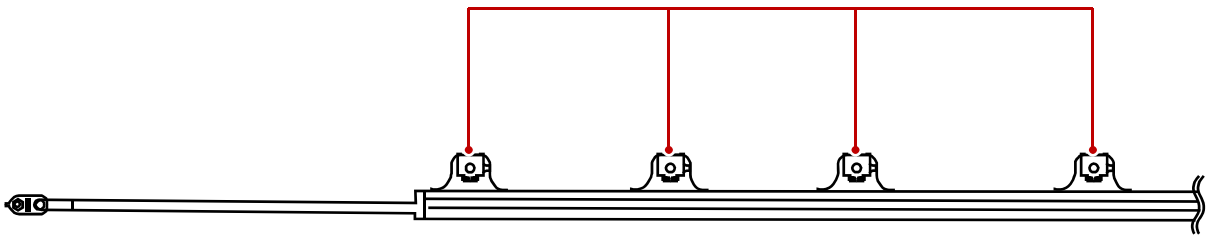
When the Curtain Air Bag Deploys



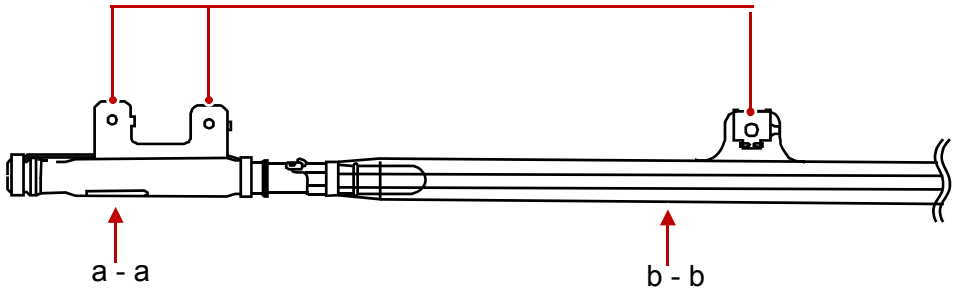
Modification basis	
Application basis	
Affected VIN	

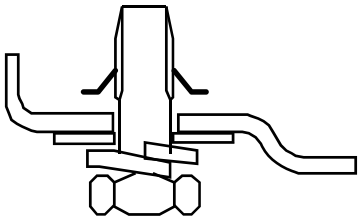
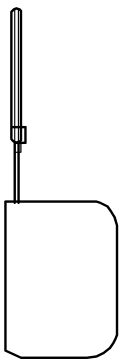
(1) Components

Tightening torque: 8 ~ 10 Nm



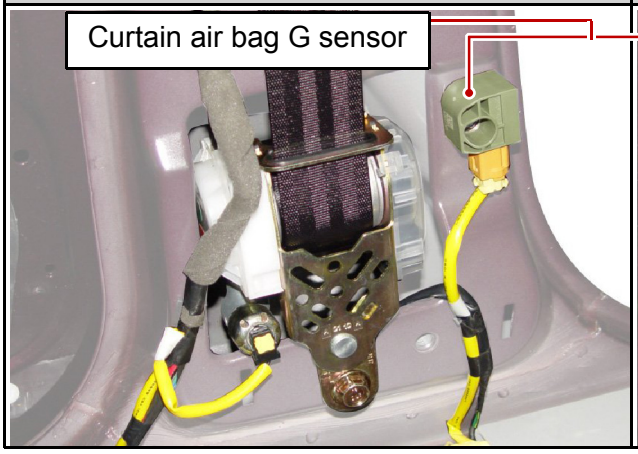
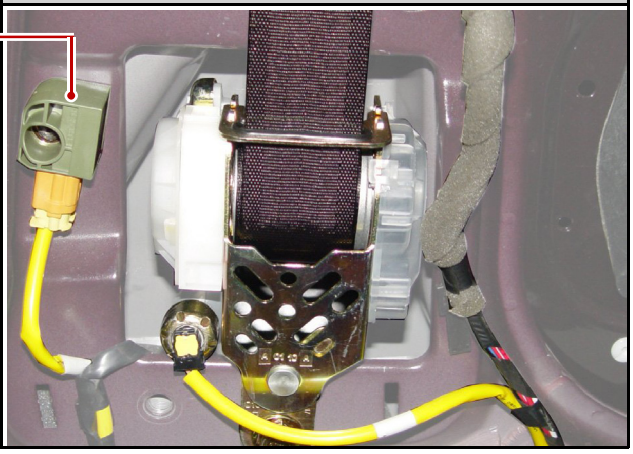
Tightening torque: 8 ~ 10 Nm



Sectimal view a-a	Sectimal view b-b
	

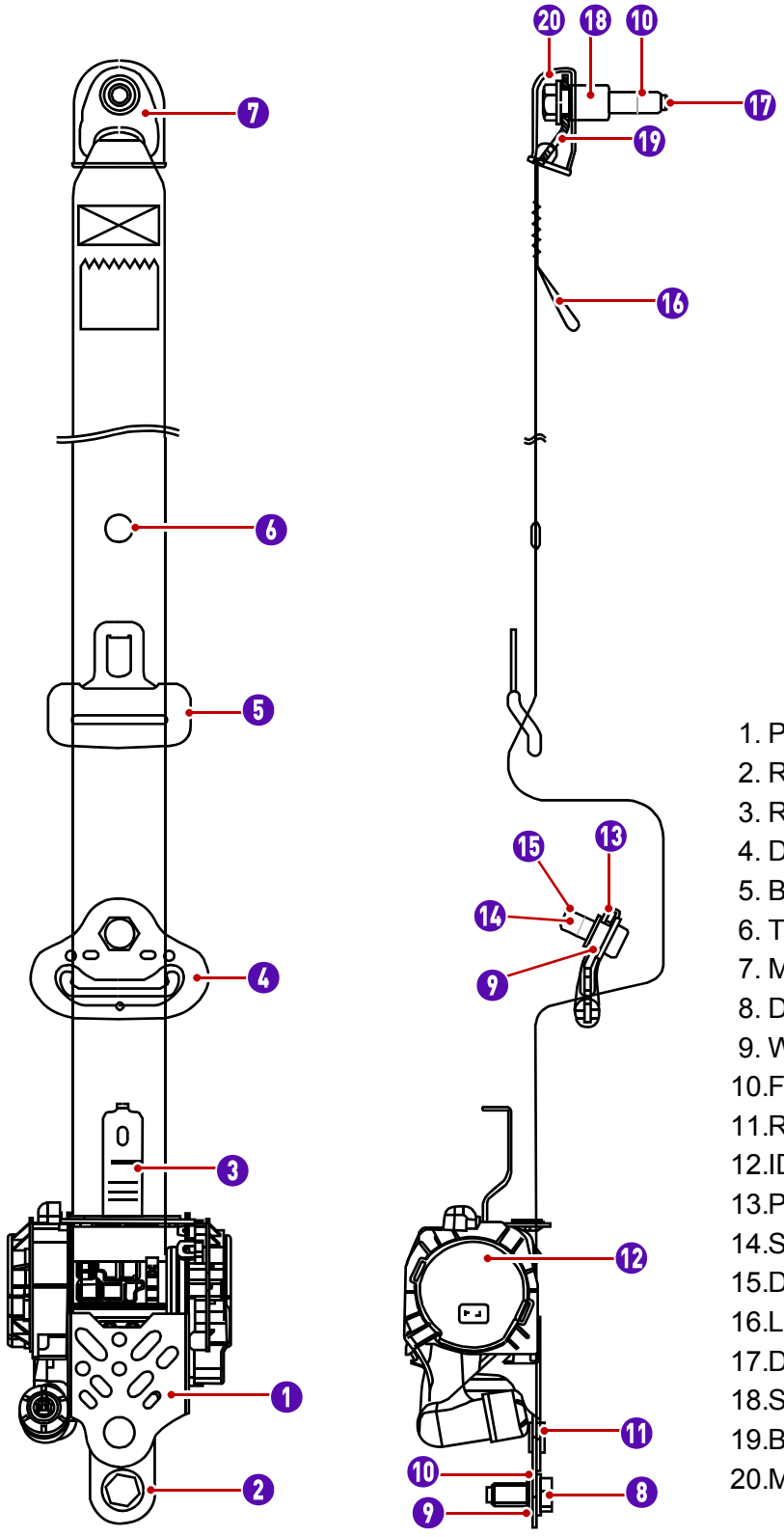
4) Driver and Passenger BPT (Belt Pre-Tensioner)

The belt pretensioner retracts the seat belt to tighten or take up slack in the wearer's belt.
When a collision occurs or when brakes are applied, a seat belt with a pretensioner detects the stopping action and tightens the belt before the wearer is propelled forward.
This holds the occupant more securely in the seat.

Belt Pretensioner (Driver Side)	Belt Pretensioner (Passenger Side)
Tightening torque 35 ~ 55 Nm	Tightening torque 35 ~ 55 Nm
	
Belt pretensioner (LH)	**Belt pretensioner (RH)**
	

Modification basis	
Application basis	
Affected VIN	

(1) Components



1. Pretensioner reel assembly
2. Reel bracket
3. Ring upper stay
4. D-ring
5. Bending tongue
6. Tongue stopper
7. Mini anchor
8. D-bolt
9. Washer
10. Fiber washer
11. Rivet
12. ID label
13. Plastic washer
14. Steel washer
15. D-bolt
16. Label
17. D-bolt
18. Spacer
19. Bush
20. Mini anchor cover

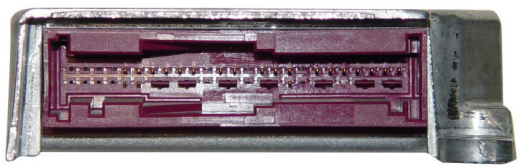
Modification basis	
Application basis	
Affected VIN	

5)Air Bag Unit

Air bag unit is installed under the AV head unit in center fascia panel.



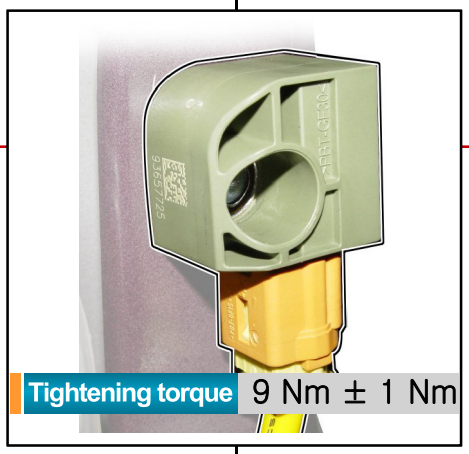
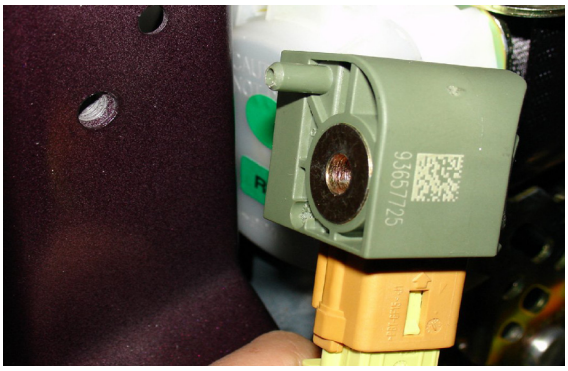
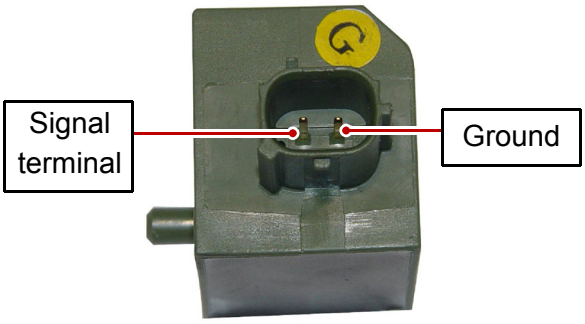
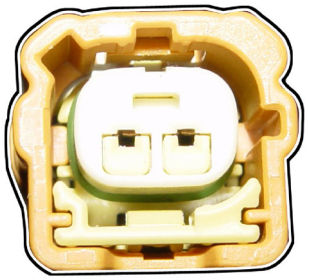
Location of Air Bag

Modification basis	
Application basis	
Affected VIN	

6) Curtain Air Bag Sensor

The curtain air bag sensor is installed inside each B-pillar of the driver's and passenger's seats (that is, around the pretensioner reel).
The body panel has guiding holes to ensure its correct installation.
But incorrect tightening torque may break the sensor or make it insecure.
As a result, the sensor may have inaccurate judgment and have the air bag deployed inaccurately.

Driver's Side	Passenger's Side
 	
	
	Connector 

5. AIR BAG SYSTEM DEPLOY (FIRING LOOP)

According to the collision deceleration rate that each collision G sensor reads, the air bag unit sends out about 2~4 or higher Amp current.
This current generates some heat, which fires the detonator in the inflator.
This table shows the basic inner resistance of the air bag related module and the basic instant current necessary for a firing.

Air bag module	Driver/passenger air bag (DAB / PAB)	Belt pretensioner (BPT)	Curtain air bag (CAB)
Resistance (at -30 ~ 85°C)	2 ± 0.3 W	2.15 ± 0.35 W	2 ± 0.3 W
Firing current for 2msec (at -35°C)	1.2 Amp	0.8 Amp	1.0 Amp

CAUTION

- Please do not connect a tester to any air bag connector or single item to measure the supplied power or resistance. The detonator may explode due to a sudden extra power supplied by the tester.
- Before removing or installing any air bag related components, disconnect the negative battery cable.

Modification basis	
Application basis	
Affected VIN	

6. AIR BAG DEPLOYMENT SIGNAL OUTPUT (CRASH OUT)

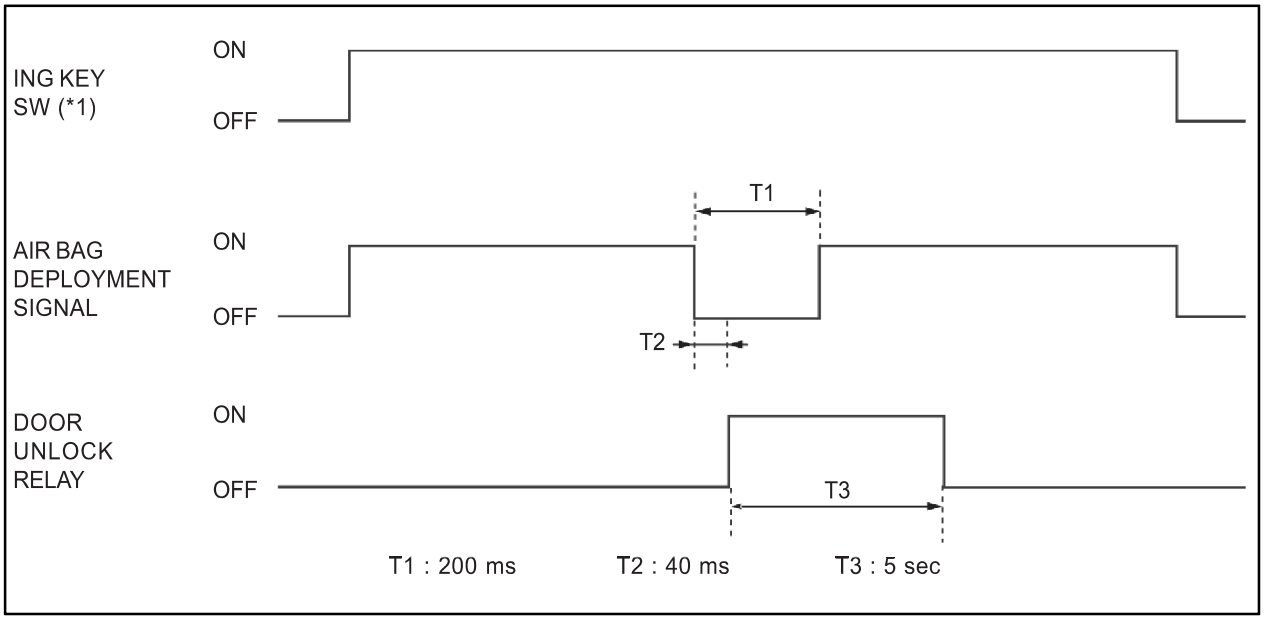
When any air bag deploys, another signal is sent to the sticks to do two basic security operations.

One operation is the automatic door unlock function that cancels the automatic door lock mode.



1) Automatic Door Unlock (Crash unlock: unlock when colliding)

1. When the ignition key is the ON position, the air bag signal is not accepted for the first 7 seconds.
2. When the ignition key is the ON position and the vehicle speed is 3 km/h or higher, 40 ms after receiving the air bag deployment signal, the sticks sends out the door UNLOCK signal for 5 seconds.
3. Even though the ignition switch is turned off in the middle of the unlock signal being sent out, the unlock signal continues for the remaining time.
4. This function cancels when the ignition key is withdrawn.



CAUTION

Reminder for door lock/unlock control

- The unlock function by the air bag signal takes priority over any other lock/unlock
- operations. While or after the automatic unlock is made by the air bag system, any lock or unlock request by other functions is ignored unless the ignition key switch is turned off.
- When another lock or unlock output is requested while the door is being either locked or unlock, the new request will be ignored.
  But, if an unlock request is made by the air bag signal or the remote control key, the request will be accepted.
- When the lock and unlock functions are simultaneously requested, the lock will be performed and the unlock will be ignored.

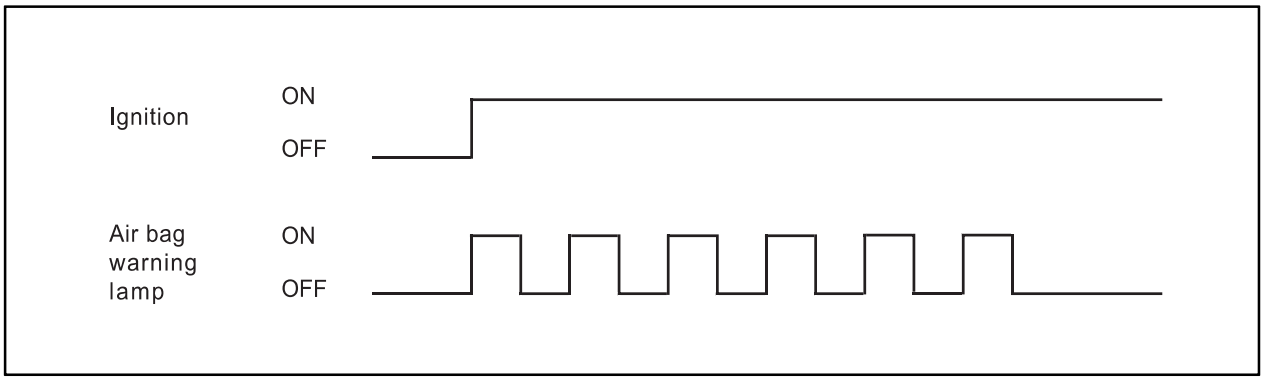
Modification basis	
Application basis	
Affected VIN	

7. AIR BAG WARNING LAMP OPERATIONAL CONDITIONS

The air bag warning lamp on the instrument panel has a few operational conditions.
The following are the conditions.

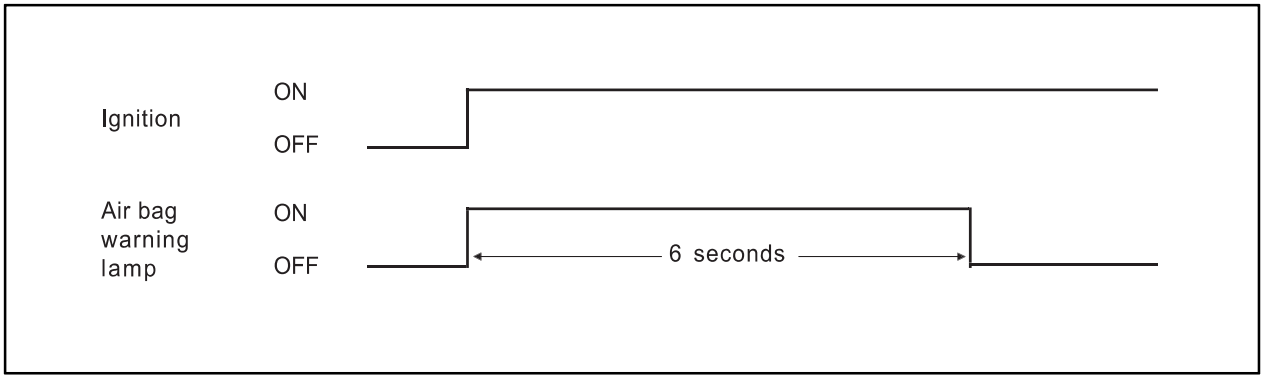
1) When Turning the Ignition Switch to ON Position

The air bag unit performs a turn-on test when the ignition is turned on. The air bag unit flashes the air bag warning lamp six times by supplying an intermittent ground to the warning lamp circuit. After flashing six times, the air bag warning lamp will turn off if no more malfunctions have been detected.



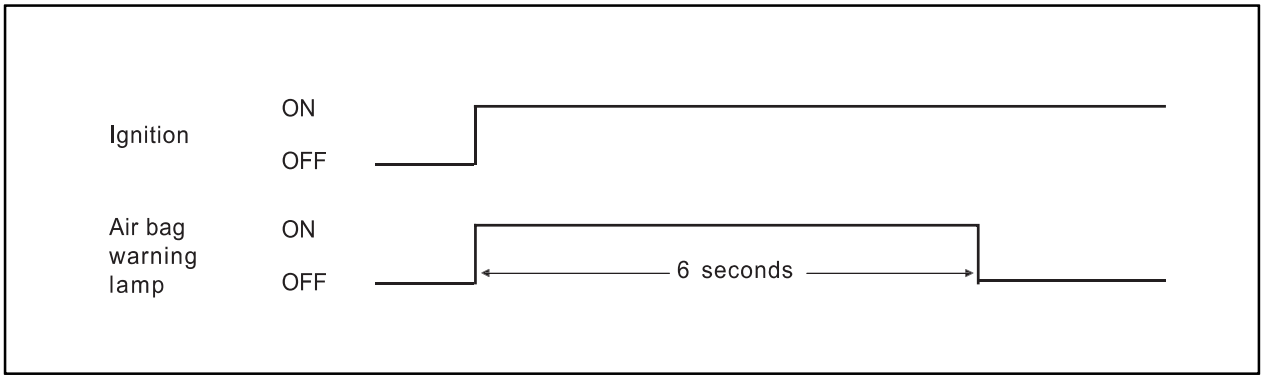
2) When Turning the Ignition Switch to the ON Position

When the air bag unit detects any malfunctions in its unit
When it is recorded as a system failure in the air bag unit, the air bag warning lamp on the instrument panel comes on for about 6 seconds and goes off for 1 second. Then the waning lamp stays on.



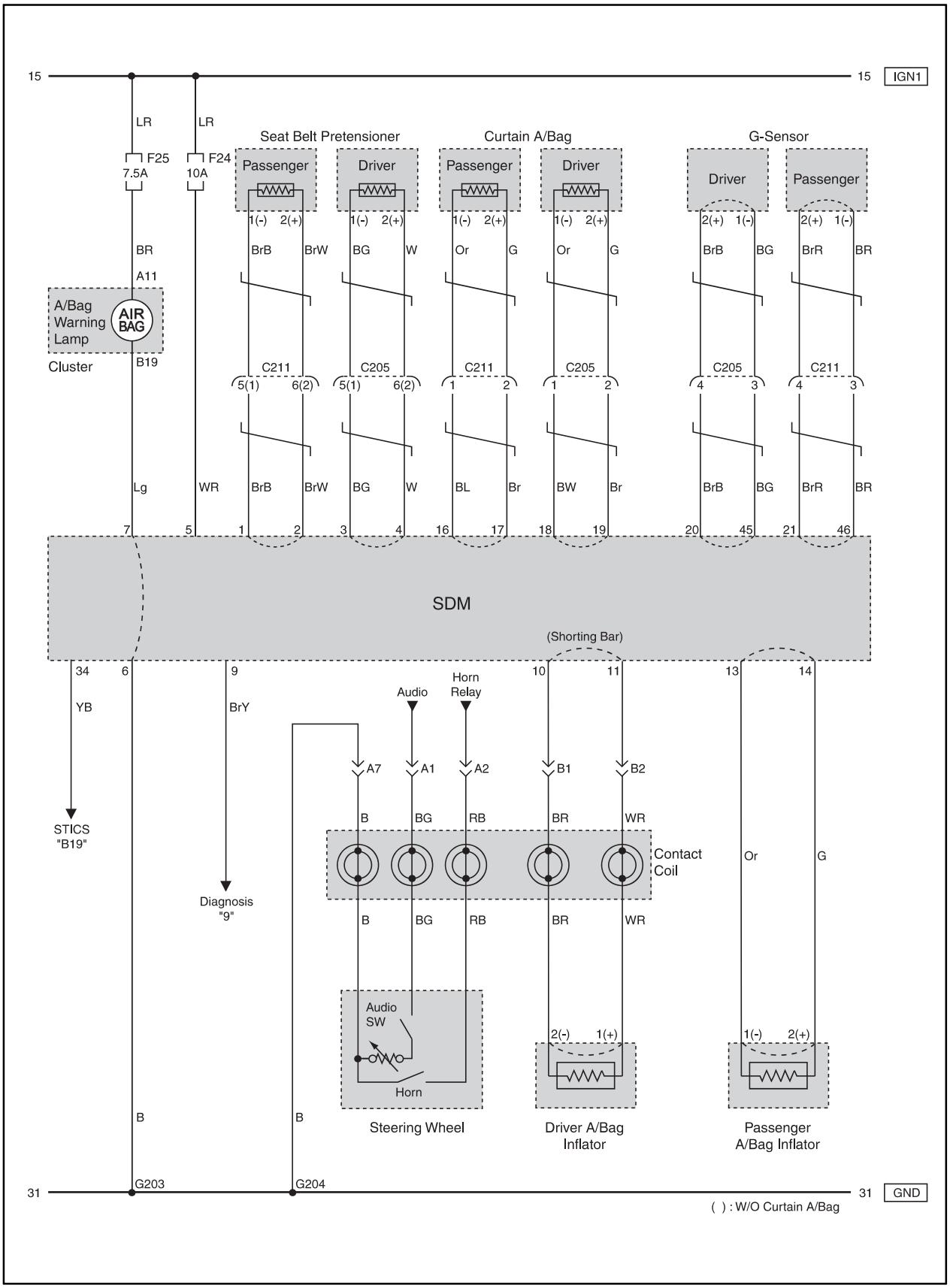
3) When the Air Bag Unit Receives Any Malfunction Signals from the Other Systems

When, due to an error from outside the system, the intermittent failure signal is received 5 times or less, the air bag warning lamp comes on for about 6 seconds and then, goes off.



Modification basis	
Application basis	
Affected VIN	

8. AIR BAG ELECTRICAL WIRING DIAGRAM



Modification basis	
Application basis	
Affected VIN	

SEAT AND SEAT BELT 7410 -01

GENERAL

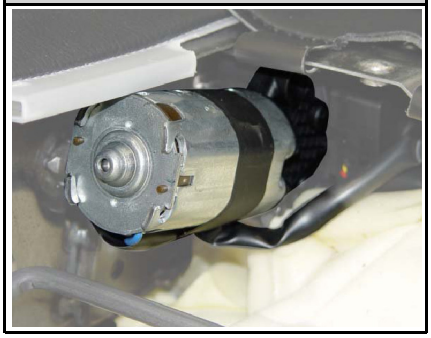
1. SEAT OVERVIEW

1)FRONT SEAT (DRIVER'S SEAT)



Lumbar support lever

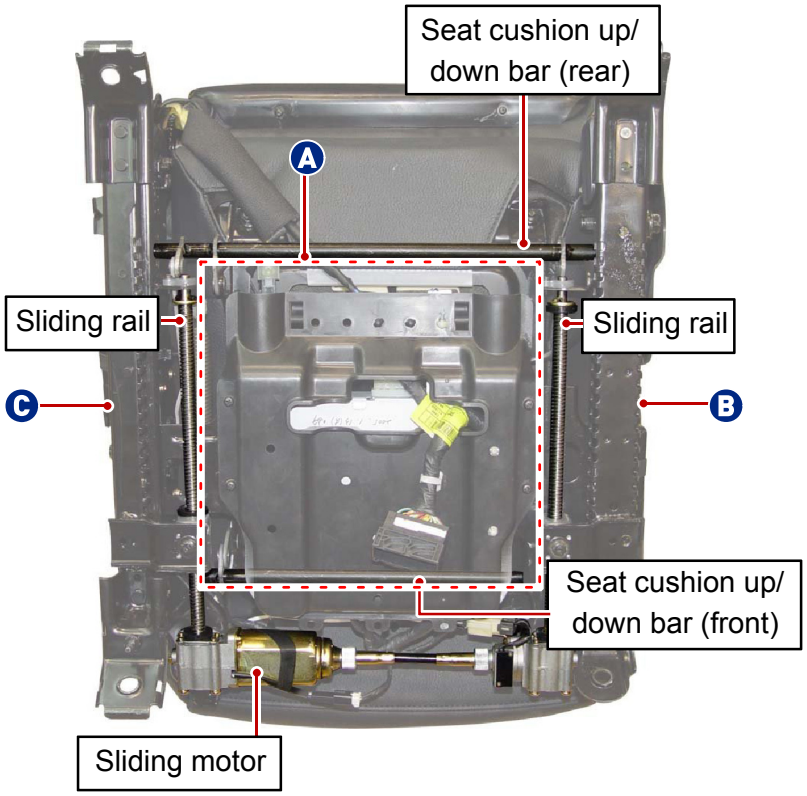
Reclining Motor

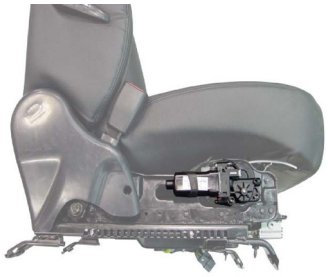


OVERVIEW AND OPERATION PROCESS

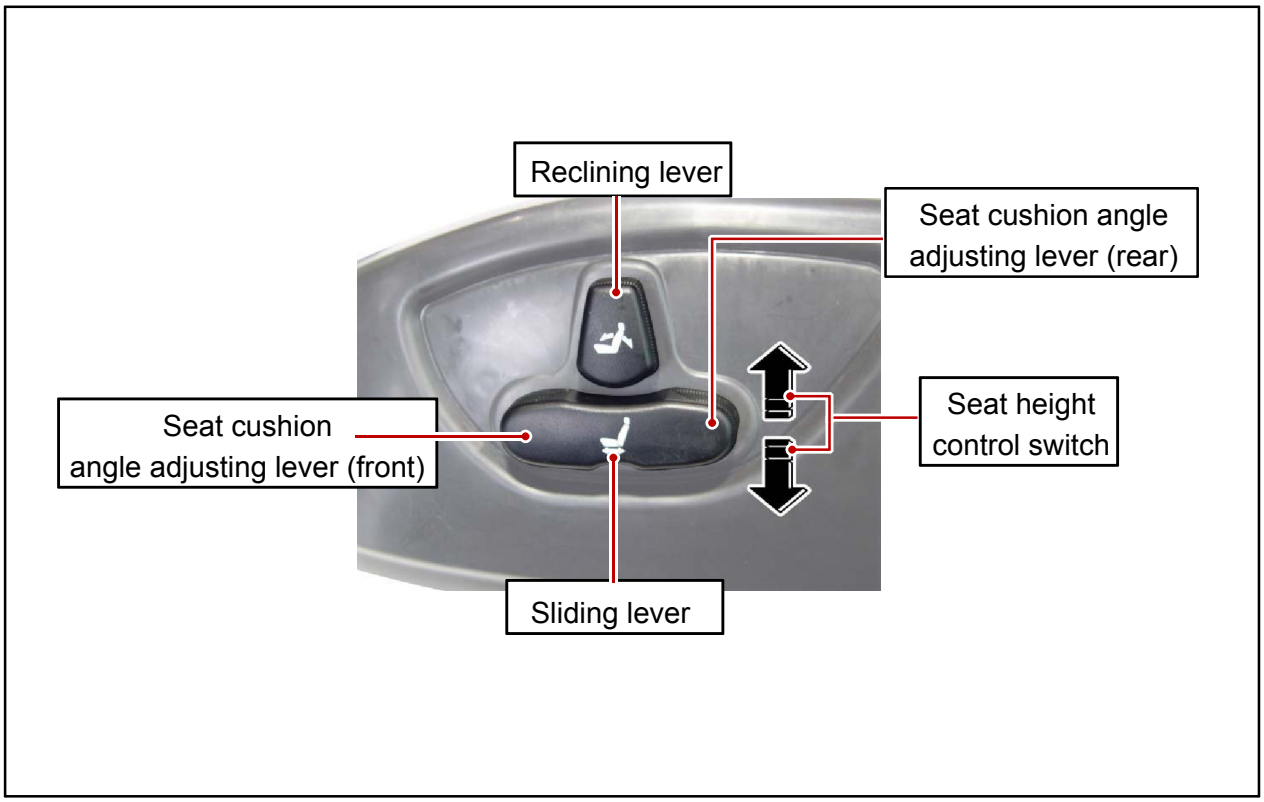
1. SEAT OVERVIEW

1) Front Seat (Driver's Seat)

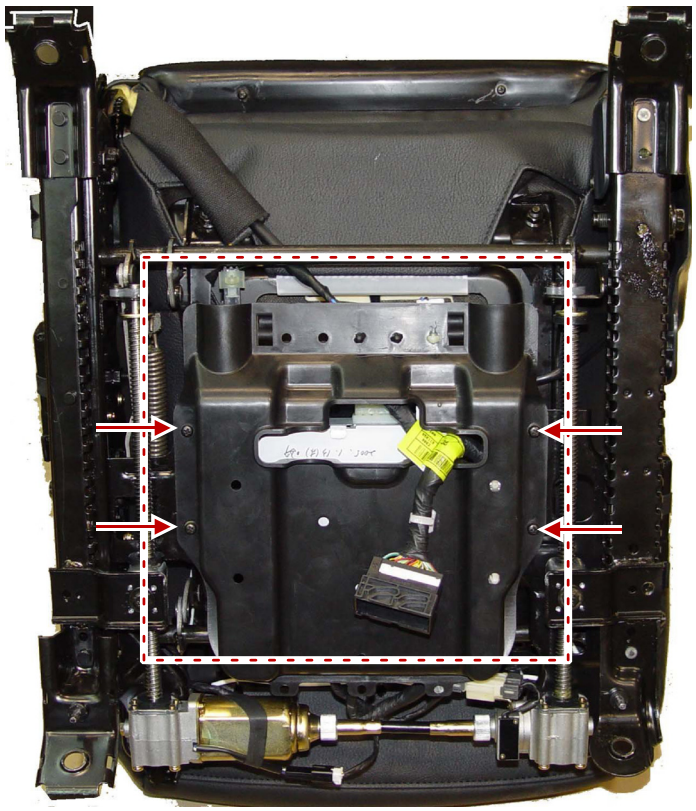


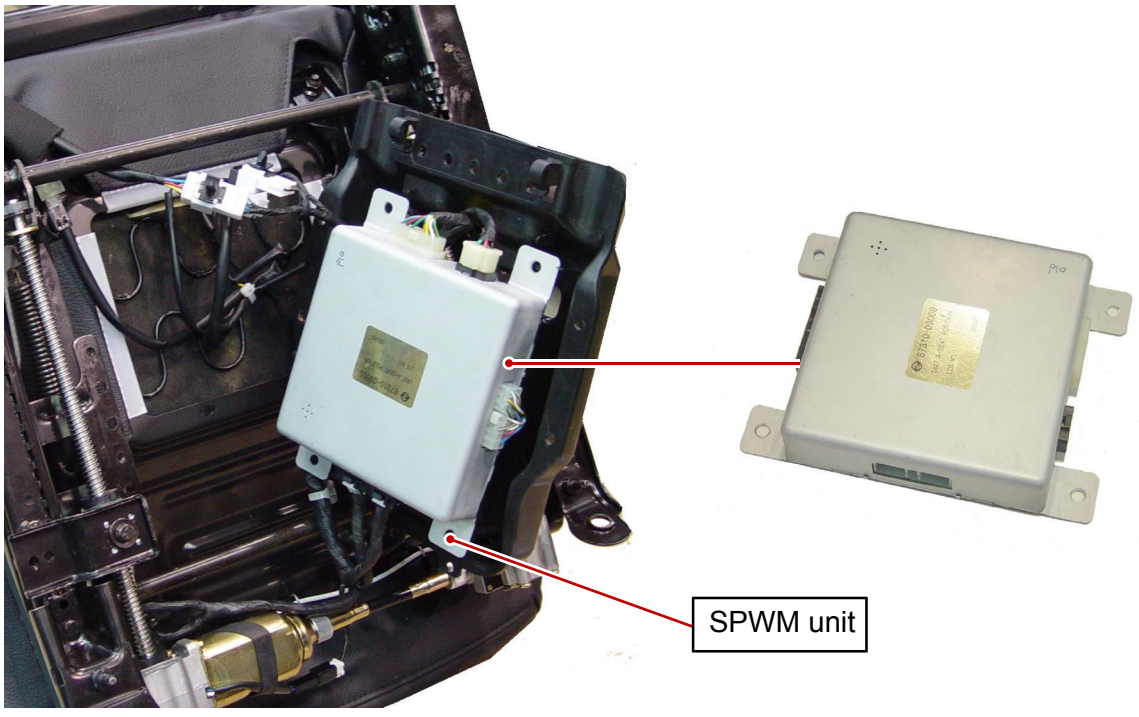
SPWM (Seat Position With Memory) Unit	Seat Cushion Motor (Front)	Seat Cushion Motor (Rear)
A 	B 	C 

Modification basis	
Application basis	
Affected VIN	


Reclining lever
Seat cushion angle adjusting lever (rear)
Seat height control switch
Seat cushion angle adjusting lever (front)
Sliding lever

▶ Location of Seat Position With Memory Unit (Bottom of Driver Seat)





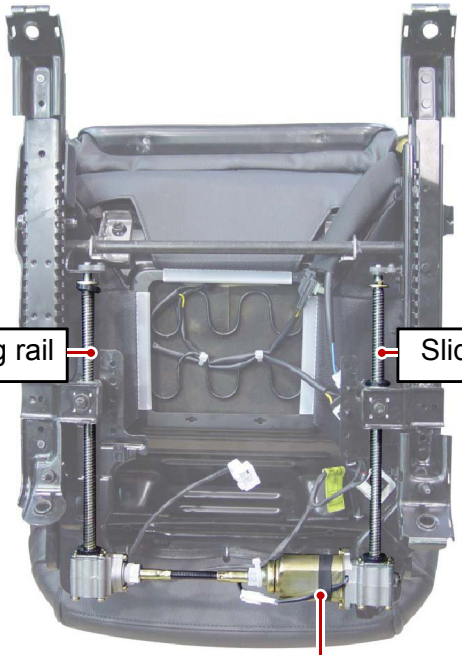
Modification basis	
Application basis	
Affected VIN	

2) Front Seat (Passenger Seat)



Reclining Motor



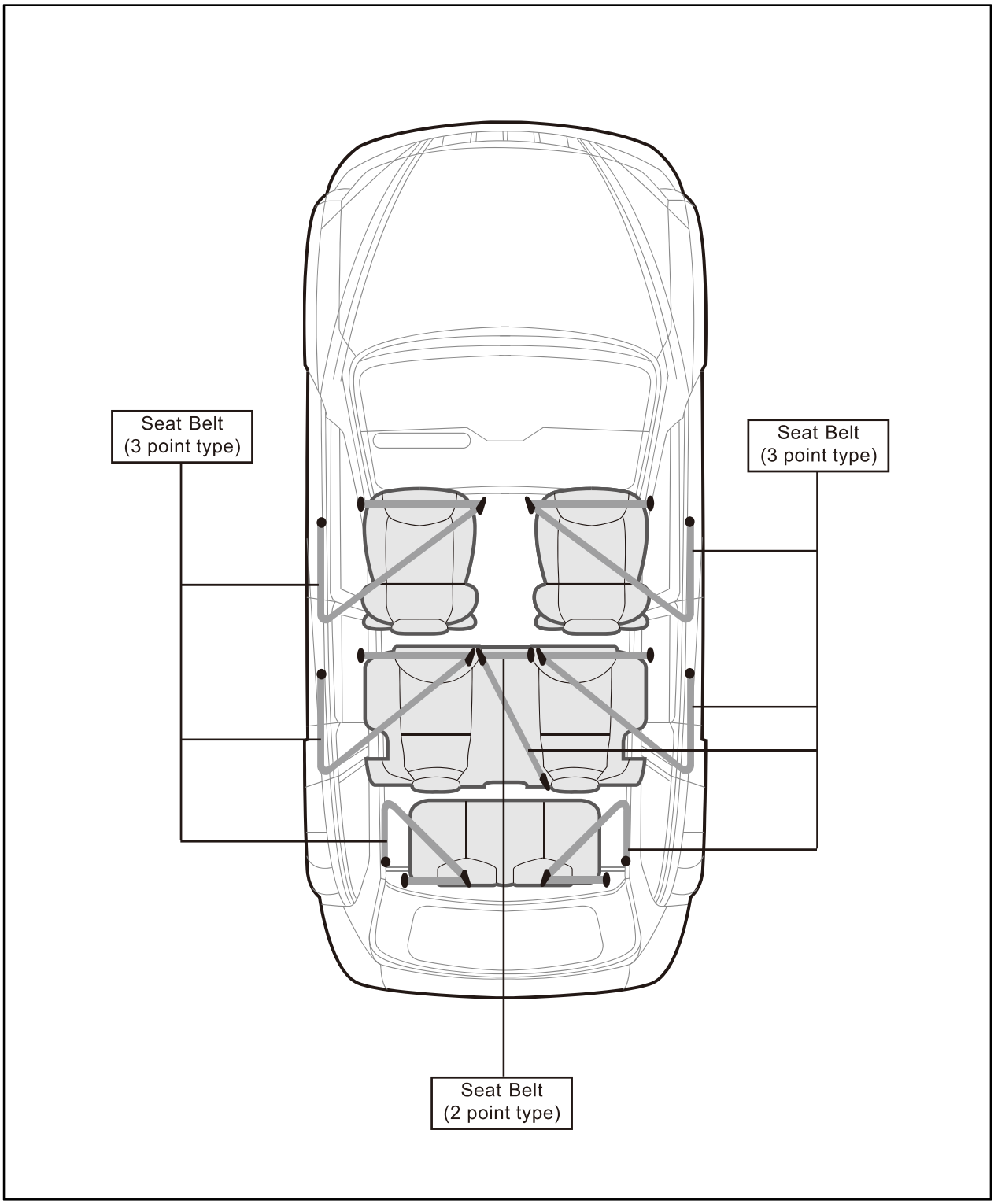




Modification basis	
Application basis	
Affected VIN	

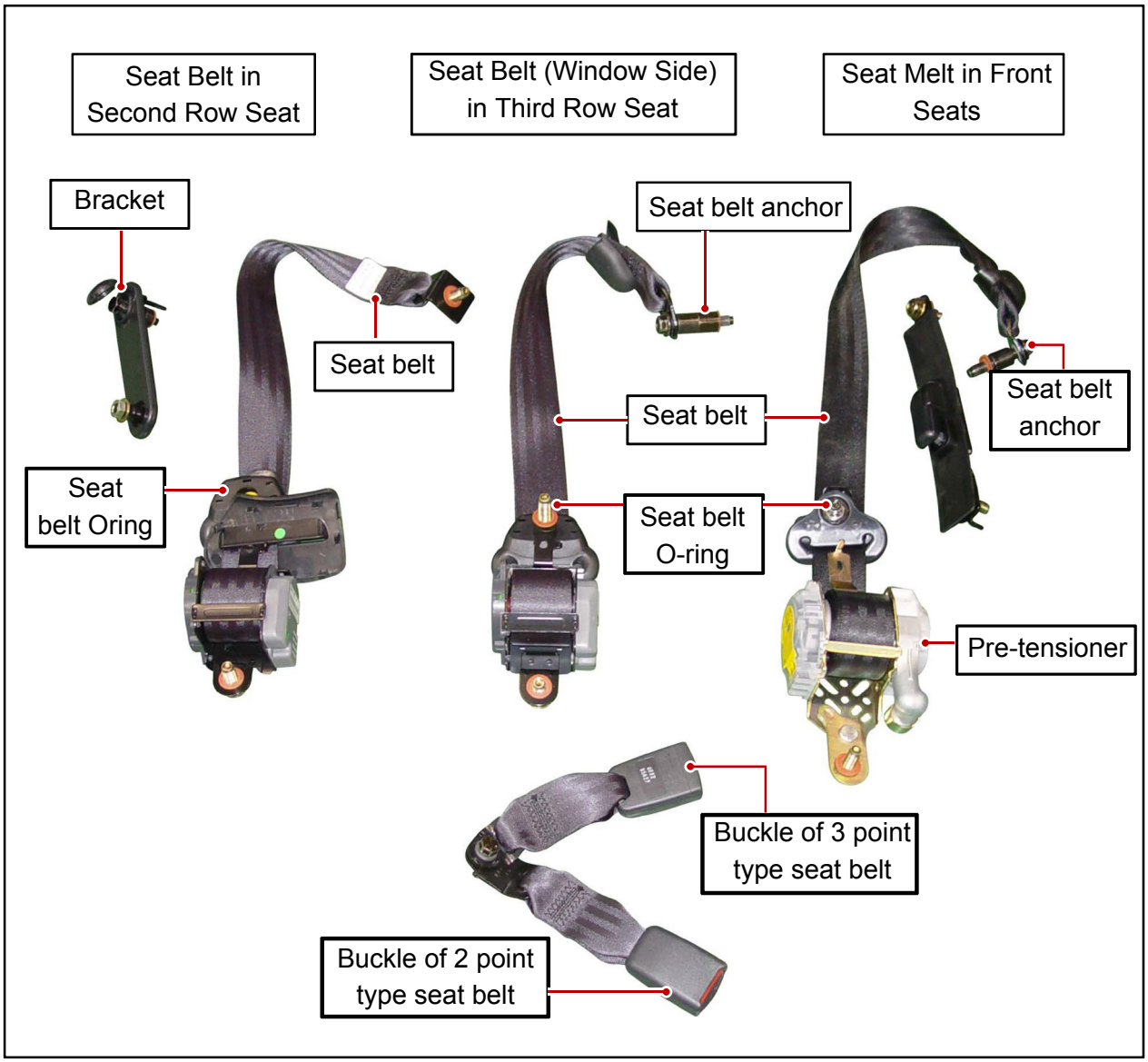
2. SEAT BELT OVERVIEW

3 Point type seat belt: driver's seat, passenger's seat, window side seats of second row seat, third row seat 2 Point type seat belt: center seat of second row seat.
Pretensioner: Installed at front seats. The seat belt pretensioner rewinds the seat belt immediately to protect occupant's face and chest when a strong frontal collision occurs.



Modification basis	
Application basis	
Affected VIN	

1) Seat Belt (3 Point Type)



2) Seat Belt (2 Point Type)



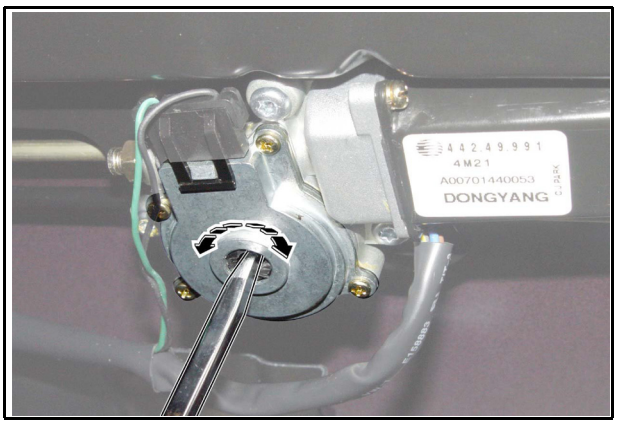
2. point type seat belt is installed only in the center seat of second row seat.

SUNROOF SYSTEM

7340-01

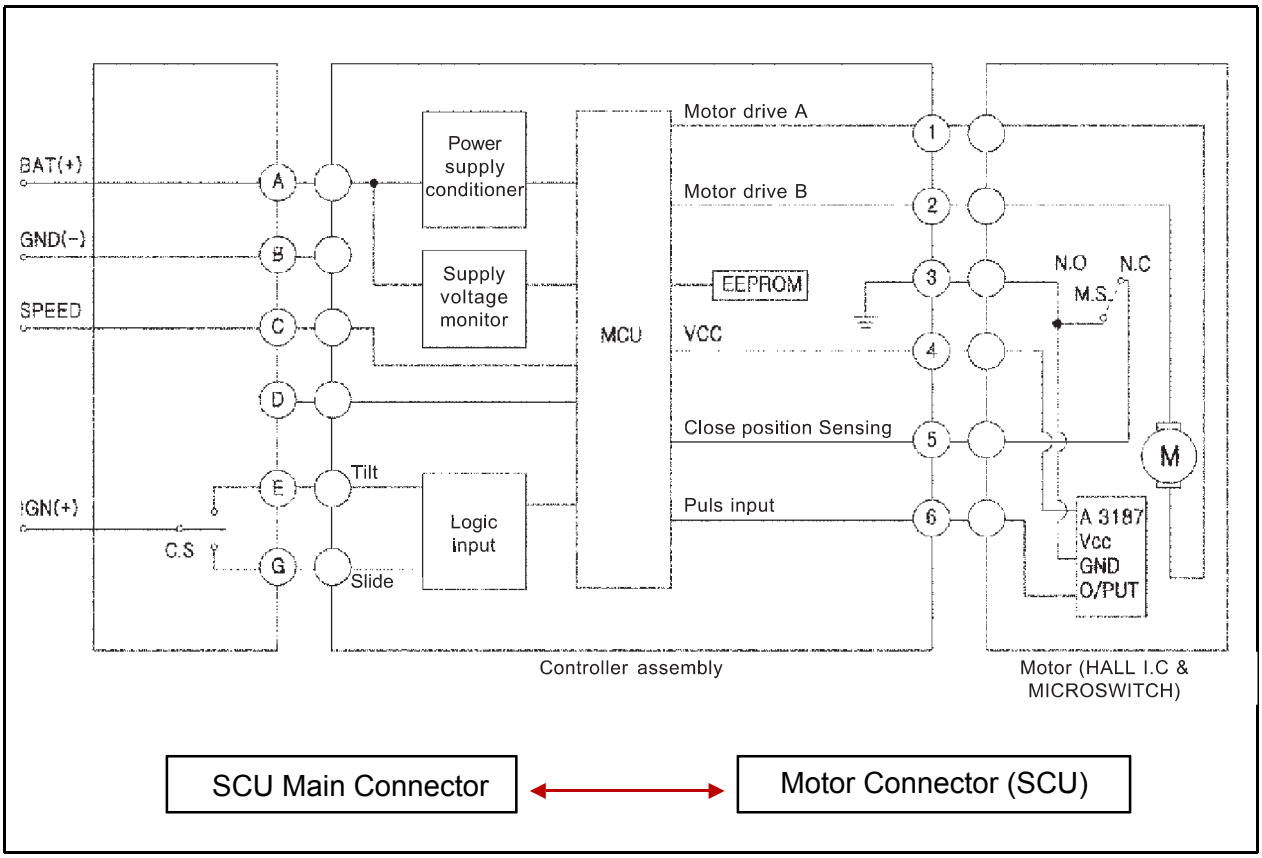
GENERAL

1. HAZARD (MANUAL) OPERATION



The sunroof can be operated by rotating the motor operating hole on the sunroof motor with a proper tool.

1) Circuit Diagram



SCU Main Connector ⟷ Motor Connector (SCU)

Modification basis	
Application basis	
Affected VIN	

2. RESETTING OF SUNROOF CONTROL UNIT

CAUTION

- If the sunroof does not operate properly, check and reset the sunroof control unit.

1. To prevent any parts damage and personal injury, the sunroof setting is canceled
   1) When the battery voltage is disconnected, the fuse is blown, or the abrupt voltage drop occurs due to old battery while operating the sunroof.
   2) When an undesired cancellation occurs due to mistake by a technician.
   3) When parts damage, shorted circuit, or electric leakage occurs.
   4) When keeping the sunroof switch at "OPEN" position.

2. Symptoms when the sunroof setting is canceled
   1) The one-touch operation cannot be activated.
   2) The sunroof is tilted even after completion of closing operation when closing it.
   3) The sunroof opening and tilting level is significantly low.
   4) The sunroof does not operate properly when operating the sunroof switch.

3. [0] point reset of sunroof
   1) Close the sunroof with the sunroof switch and keep the position for approx. 10 seconds. If the [0] point setting is successfully completed, the sunroof should be properly opened from this position.
   2) Check if the sunroof is fully closed. Tilt the sunroof with the sunroof switch and keep it at the position for 10 seconds ([0] point setting).
   3) Close the sunroof with the sunroof switch.

4. Checking after reset
   1) If the sunroof does not operate properly, check the power supply system.
   2) If the sunroof does not operate or operates only during the switch operation even the power supply system is in normal conditions, check if the ground circuit of switch is securely tightened and reset the sunroof system again.

CAUTION

- If the power supply system is in normal conditions, replace the sunroof motor or the sunroof control unit.
- Replace the sunroof control unit with new one and check if the sunroof operates properly before replacing the sunroof motor.

Modification basis	
Application basis	
Affected VIN	

3. TROUBLE DIAGNOSIS

Symptom	Cause	Actio n
Leakage	Clogged or bent drain hose	Check and correct drain hose condition.
	Gap and clearance between panel and glass	Readjust glass location.
Wind noise	Gap and clearance between panel and glass	Readjust glass location.
Improper operations	Malfunction of wire, fuse and ground	Check and replace/repair.
	Malfunction of relay, motor and unit	Replace it.
	Damaged side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace damaged parts.)
	Foreign material in rail	Remove foreign material.
Malfunction	Caught side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace damaged parts.)
	Improper operation of anti-trap function	Check interference of body and wind deflector. (Relieve spring tension.)
	Improper operation of motor	Replace it.
Operation noise	Caught side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace damaged parts.)
	Interference between drain hose and vehicle body	Install sponge to drain hose.
	Interference between vehicle body and roof panel	Apply sealant between vehicle body and roof panel.
	Gap and clearance between roof panel and glass	Readjust glass location.

OVERVIEW AND OPERATION PROCESS

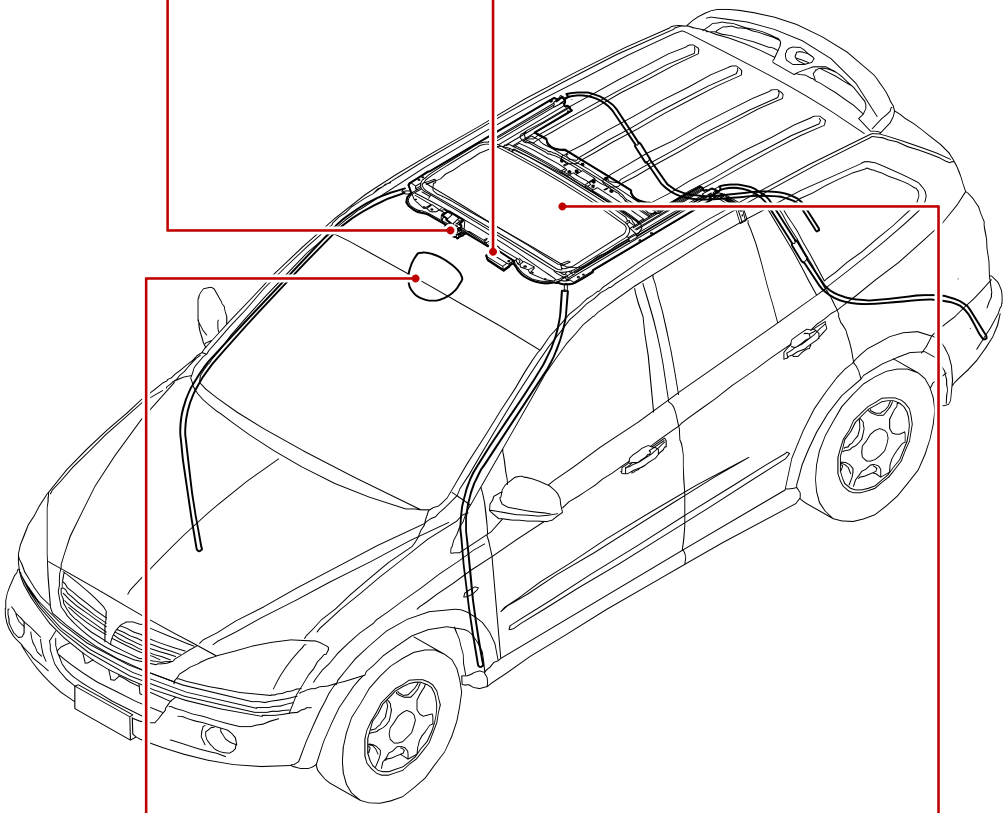
1. SUNROOF COMPONENTS AND LOCATIONS

Sunroof Motor



Sunroof Control Unit (SCU)





Sunroof Switch

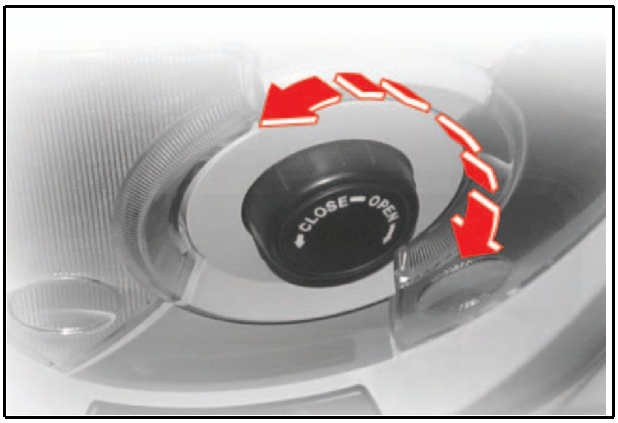


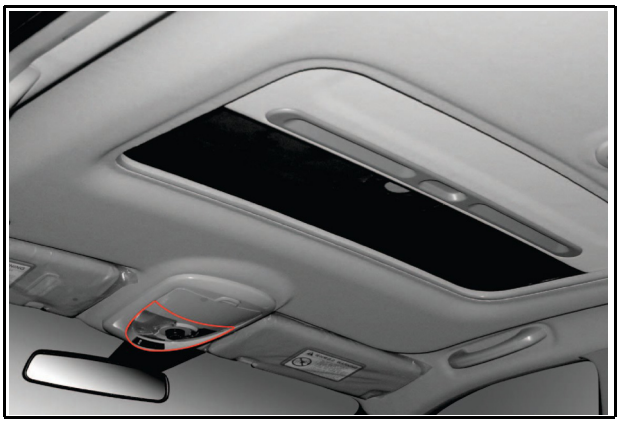
Sunroof Assembly



Modification basis	
Application basis	
Affected VIN	

2. SUNROOF OPERATION AND FUNCTION





▶ Sunroof Sliding Operation

Open
To fully open the sunroof, briefly rotate the sunroof switch clockwise (OPEN direction) with the sunroof closed. To partially open the sunroof, rotate and hold the sunroof switch until it reaches at the desired position.

Close
To fully close the sunroof, briefly rotate the sunroof switch counterclockwise (CLOSE direction) with the sunroof open. To partially close the sunroof, rotate and hold the sunroof switch until it reaches at the desired position.



Anti-trap function is built in SCU

▶ Sunroof Tilting Operation

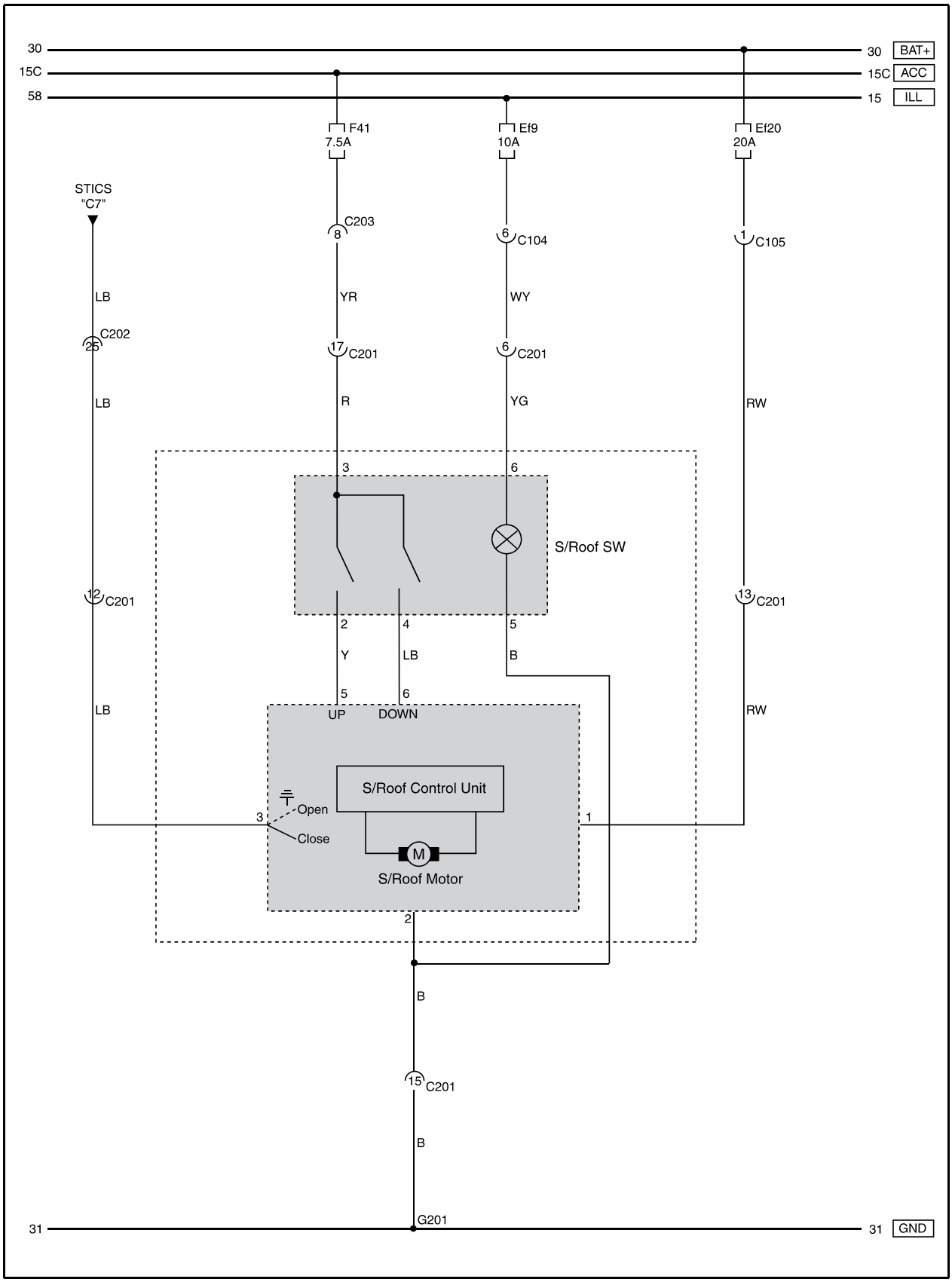
Tilt-up
To tilt-up the sunroof, rotate the sunroof switch counterclockwise (CLOSE direction) with the sunroof fully closed.

Tilt-down
To tilt-down the sunroof, rotate the sunroof switch clockwise (OPEN direction) with the sunroof tilted-up.

▶ Anti-trap Function

To prevent any body parts from being trapped by the sliding sunroof, an Anti-Trap function automatically opens the sunroof when an object is trapped. However, if the force against the sunroof is less than the specified value, the Anti-Trap function doesn't operate.

3.SUNROOF CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

NO DATA

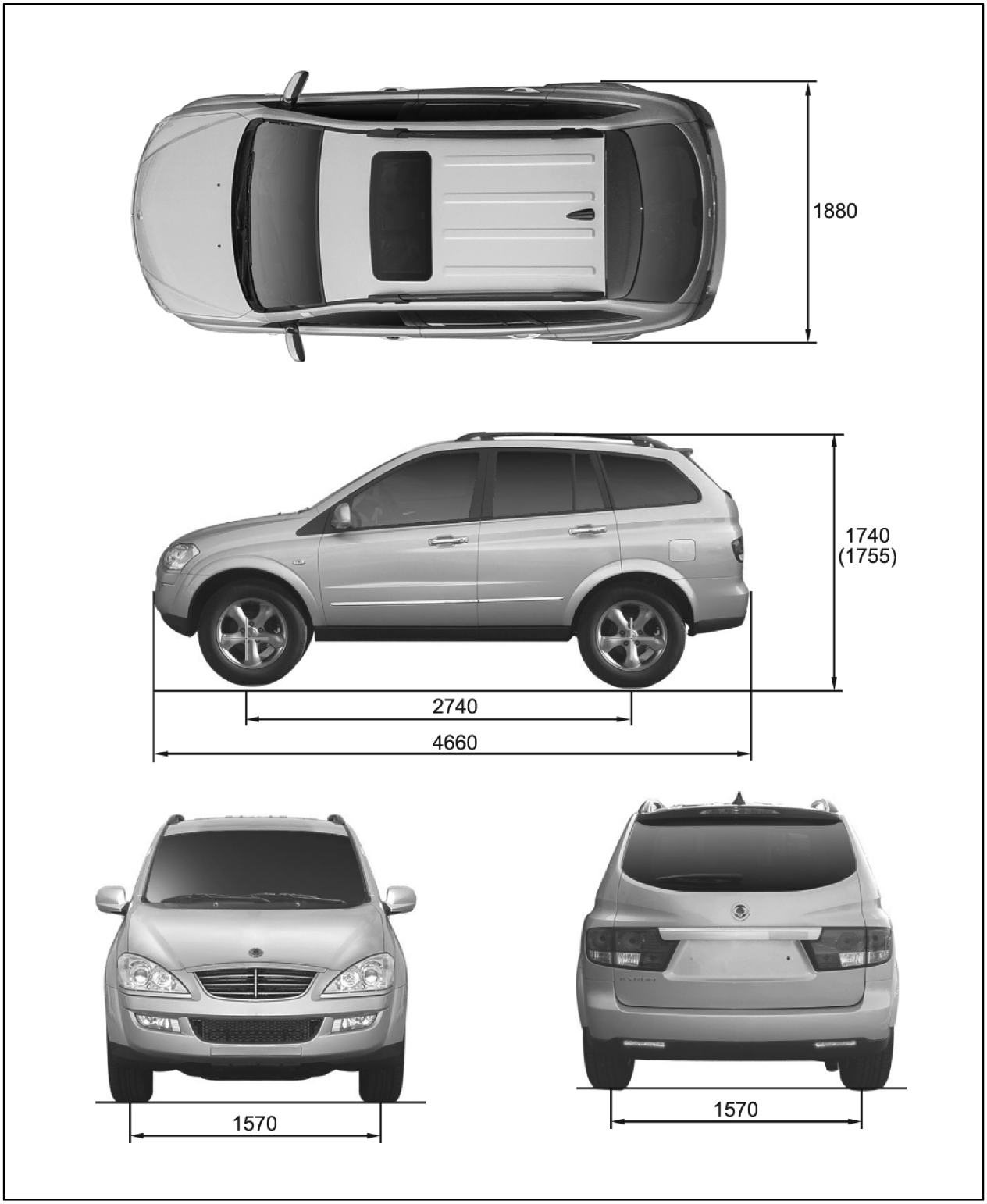
NO DATA

BODY REPAIR

4110-01

GENERAL

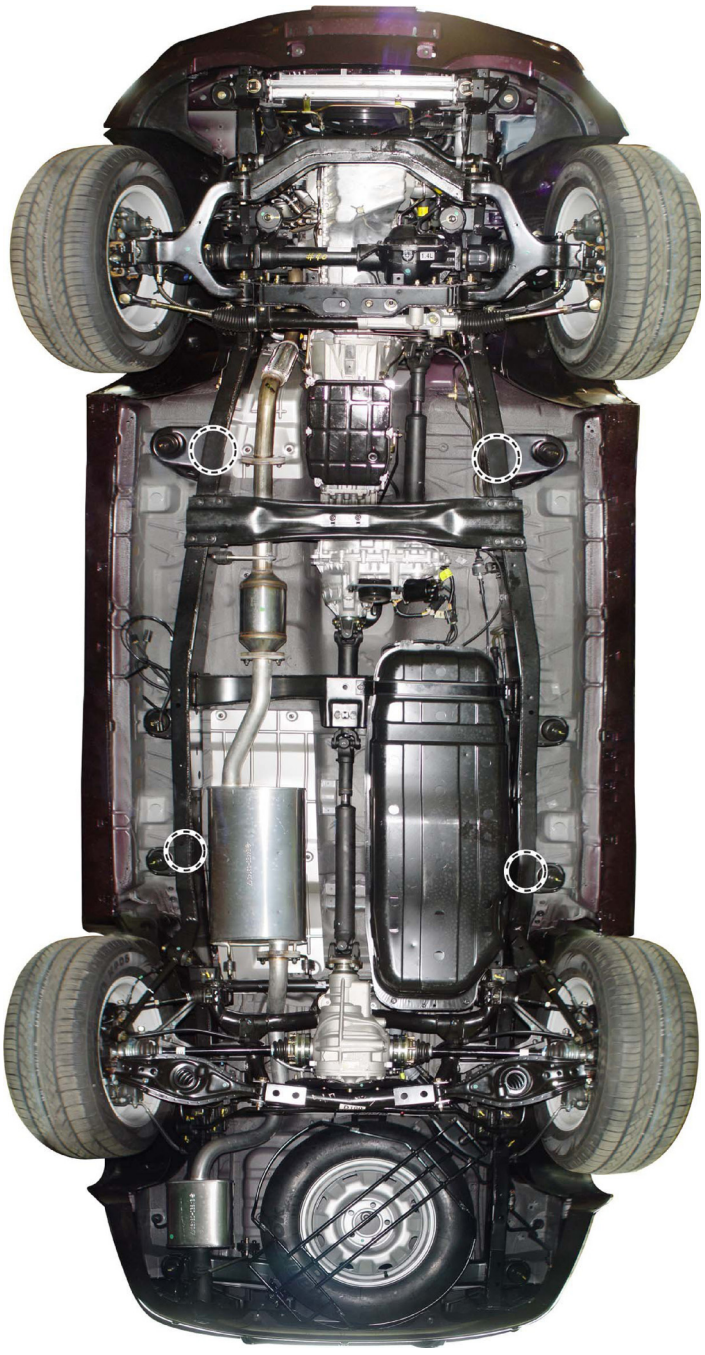
1. DIMENSIONS



Modification basis	
Application basis	
Affected VIN	

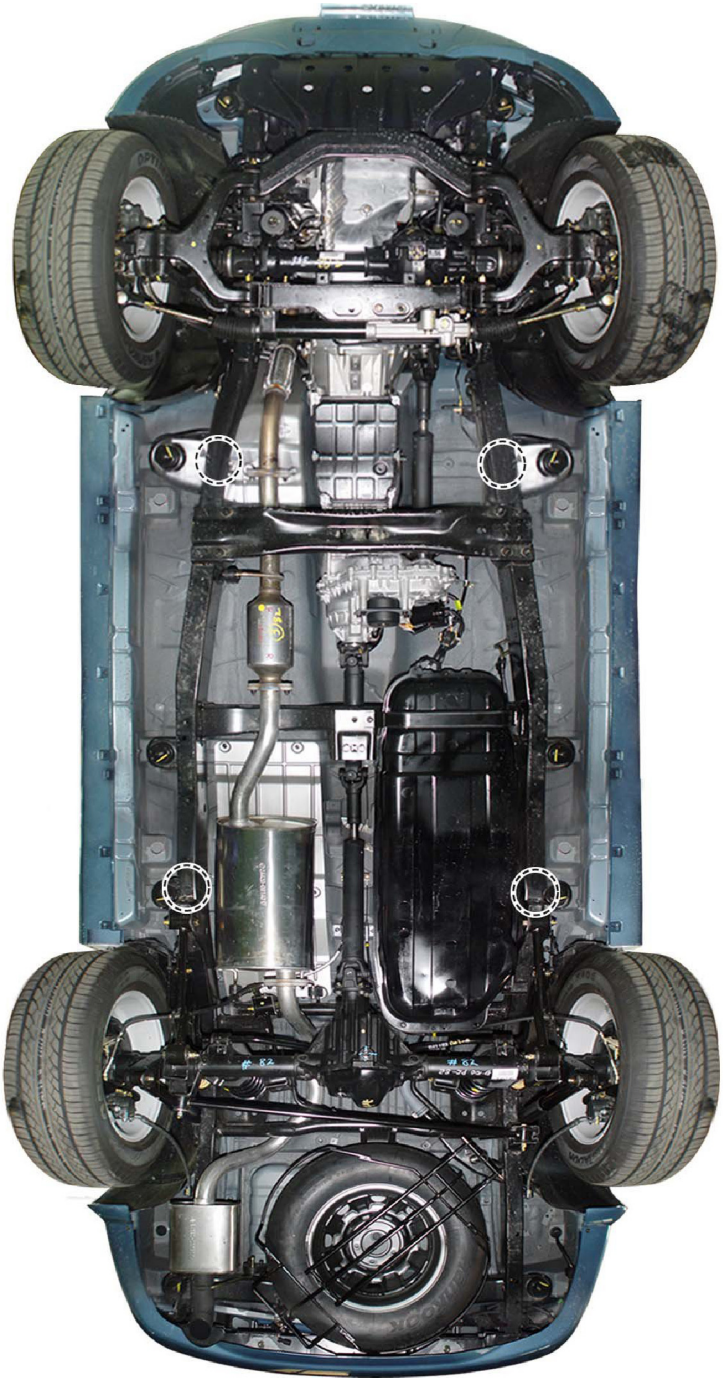
2. JACK-UP POINTS

1) IRS - Lifting Point (Dotted Circles)



Modification basis	
Application basis	
Affected VIN	

2) 5 Link System - Lifting Point (Dotted Circles)

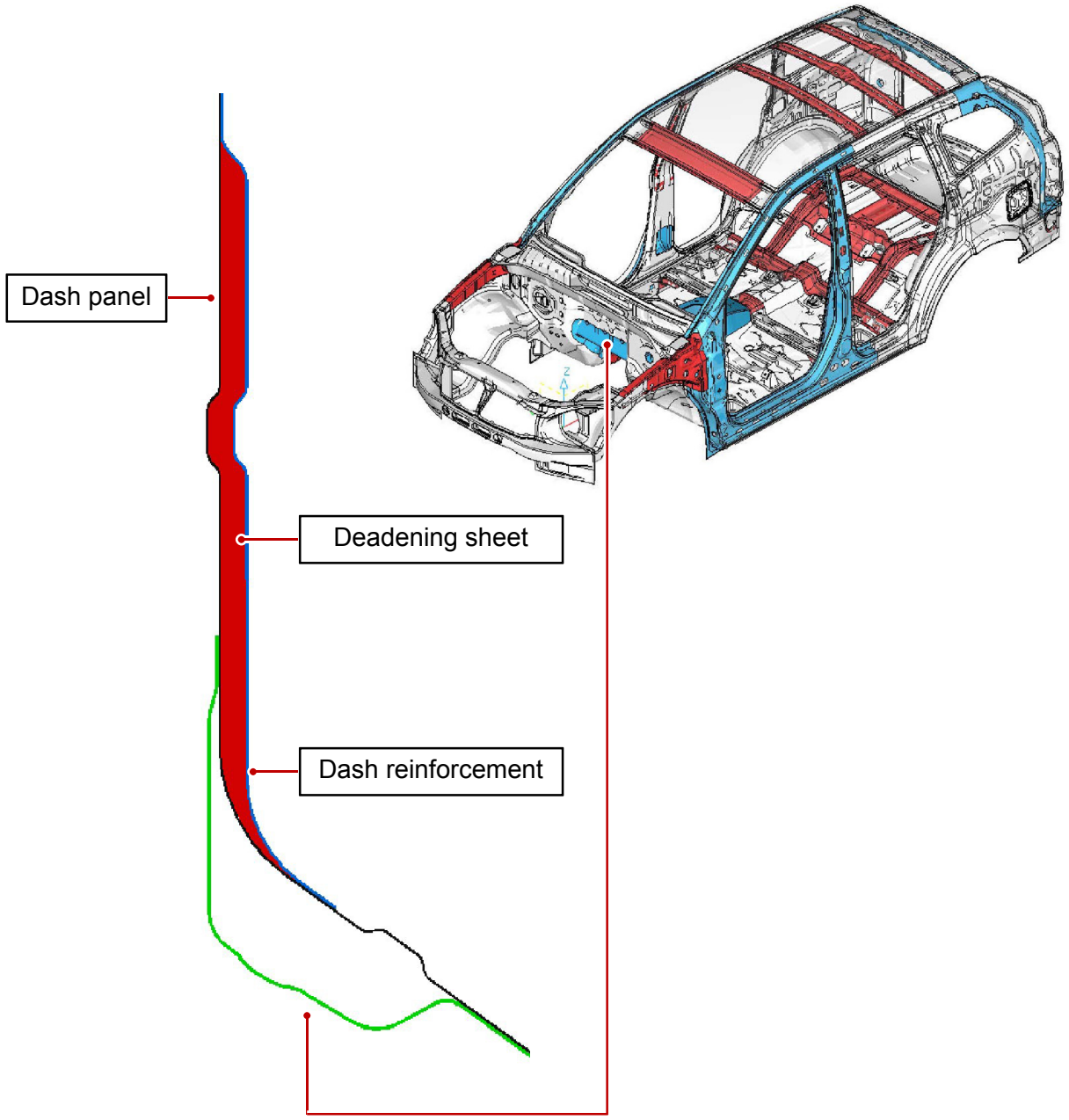


Modification basis	
Application basis	
Affected VIN	

3. DESIGN CHANGES FOR IMPROVING NVH PERFORMANCE

1) Dual Type Dash Panel and Engine Tunnel with Foaming Pad

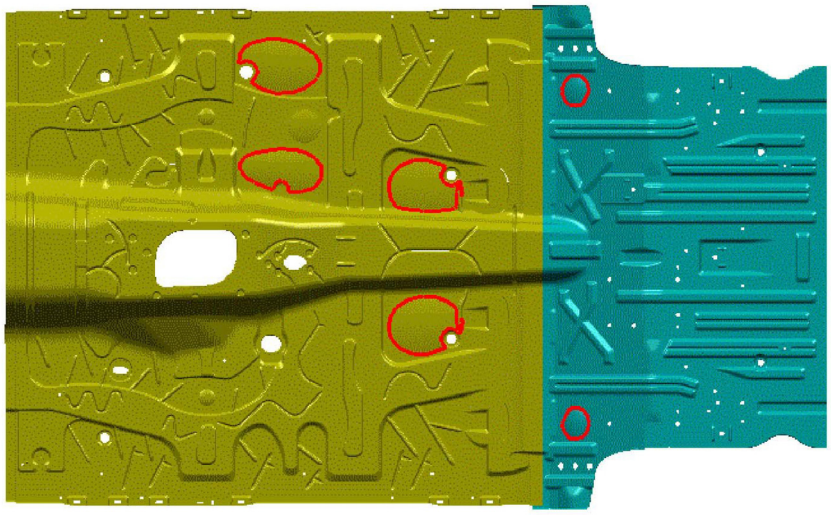
Blocks the noise from engine and transmission and improves the reinforcement of vehicle body.



Added an additional member to the bottom of dash panel to minimize the possibility of engine retreat when collision.

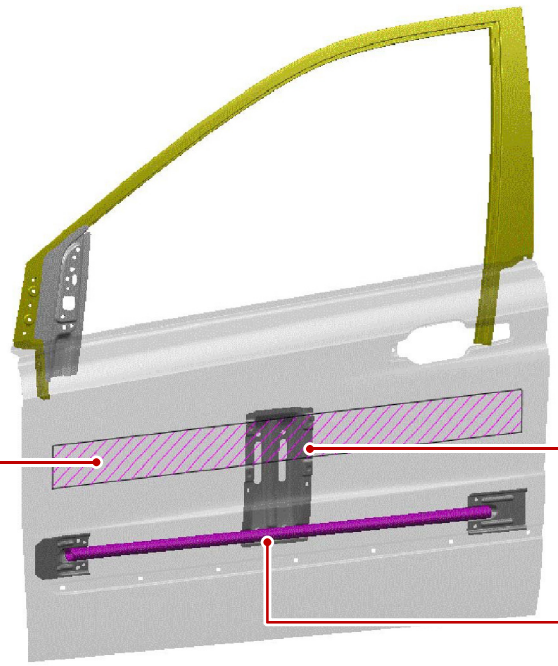
Modification basis	
Application basis	
Affected VIN	

2) Improved Reinforcement and NVH According to the Introducing of Front Floor and Rear Floor



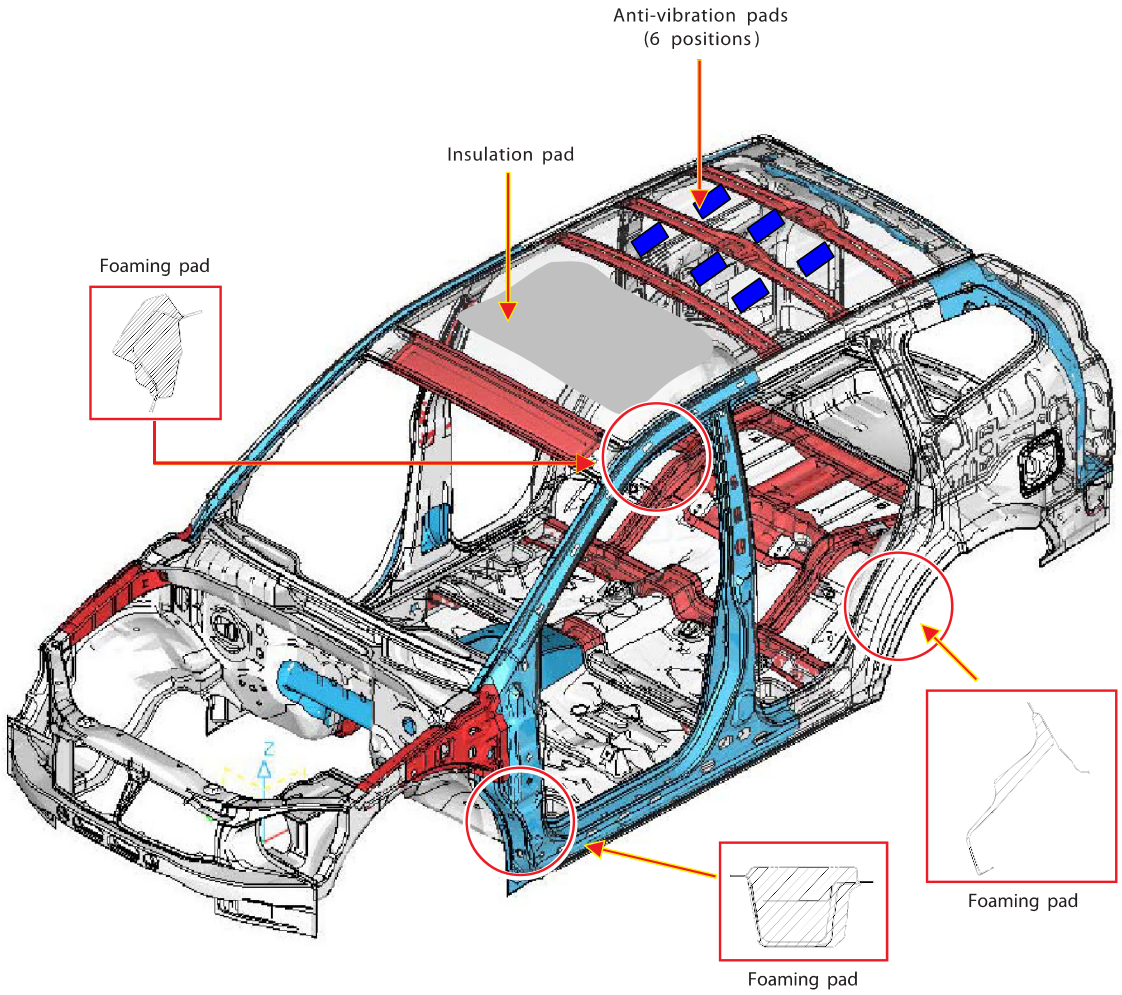
3) Applied BPR (Body Panel Reinforcement) Sealer to the Door Outer Panel

BPR sealer is sprayed by robot and is designed to reinforce the body panel and reduce the noise.



4) Applied BPR (Body Panel Reinforcement) Sealer to the Body Panel

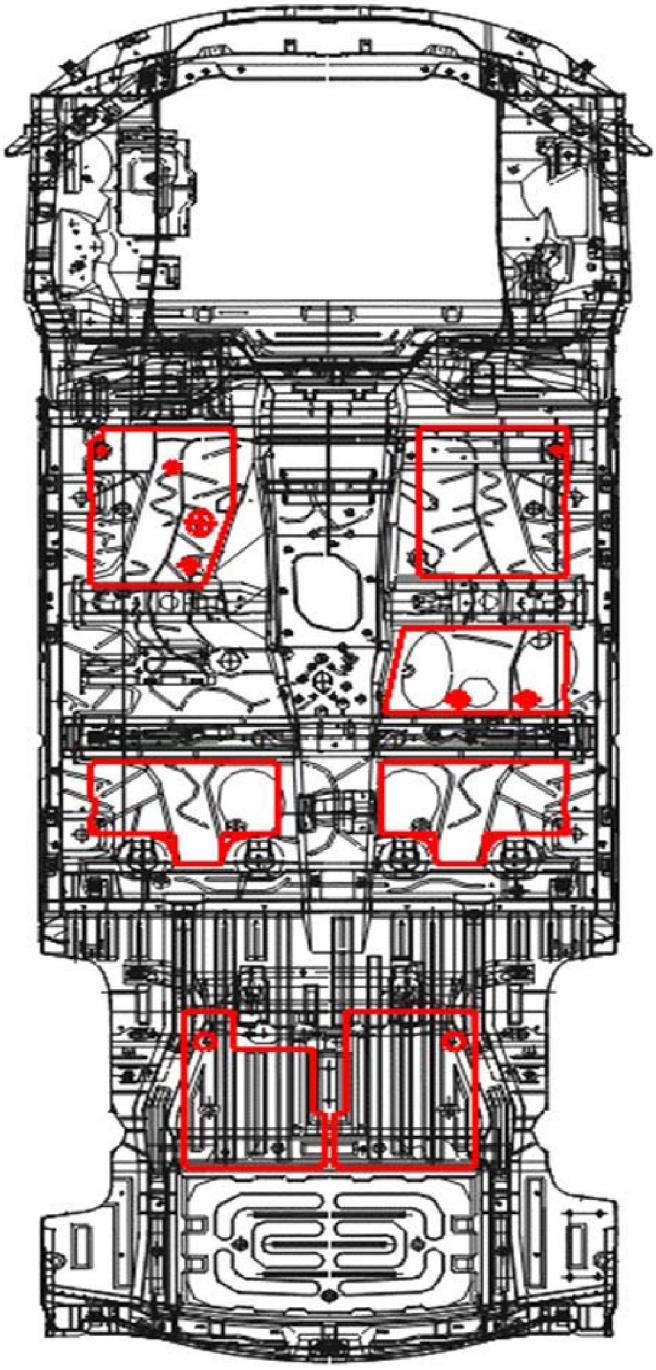
BPR sealer is sprayed by robot and is designed to reinforce the body panel and reduce the noise.



The foaming pads are applied to the symmetry surface of the vehicle.
Thus, totally 6 foaming pad are applied to the vehicle body.

Modification basis	
Application basis	
Affected VIN	

5) Applied the Asphalt to the Body Panel (Improved Anti-Vibration)



Modification basis	
Application basis	
Affected VIN	

INDEX

GENERAL

1. DIMENSIONS..... 3
2. SPECIFICATIONS..... 4
3. VEHICLE IDENTIFICATION..... 6
4. MAINTENANCE INTERVAL..... 7
5. RECOMMENDED FLUIDS AND LUBRICANTS..... 13
6. JACK-UP POINTS 14
7. PIN ARRANGEMENT OF DIAGNOSTIC CONNECTOR..... 16
8. ELECTRIC COMPONENTS AND LAYOUT..... 17
9. STANDARD BOLTS SPECIFICATIONS. 19

Modification basis	
Application basis	
Affected VIN	

GENERAL

1. DIMENSIONS

Unit: mm



* ( ) : Optional

Modification basis	
Application basis	
Affected VIN	

2. SPECIFICATIONS

* ( ) Optional

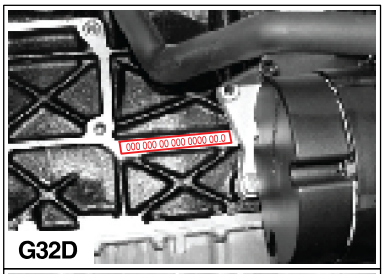
Descriptions			D20DT	D27DT	G23D	G32D
General	Overall length (mm)		4,660	←	←	←
	Overall width (mm)		1,880	←	←	←
	Overall height (mm)		1,740 (1,755: with roof rack)	←	←	←
	Gross vehicle weight (kg)	A/T	2,530	←	←	←
		M/T	2,530	←	2,530	–
	Curb vehicle weight (kg)	A/T	2WD: 1,902 / 4WD: 2,010	2,071 (AWD: 2,053)	2WD: 1,885, 4WD: 1,994	2,046
		M/T	2WD: 1,875/ 4WD: 1,983	2030	2WD: 1,862, 4WD: 1,971	–
	Fuel		Diesel	←	Gasoline	←
	Fuel tank capacity (ℓ)		75	←	←	←
Engine	Numbers of cylinders/ Compression ratio		4 / 17.5:1	5 / 18:1 (EURO IV:17.5:1)	4 / 10.4 : 1	6 / 10 : 1
	Total displacement (cc)		1,998	2,696	2,295	3,199
	Camshaft arrangement		DOHC	←	←	←
	Max. power		141 PS / 4,000 rpm <138 PS / 4,000 rpm>	165 PS / 4,000 rpm <161 PS / 4,000 rpm>	150 PS/5,500 rpm	220 PS / 6,100 rpm
	Max. torque		310 Nm / 1,800 ~ 2,750 rpm	340 Nm / 1,800 ~ 3,250 rpm	214 Nm / 3,500 ~ 4,000 rpm	312 Nm / 4,600 rpm
	Idle speed		780 ± 50 rpm	750 ± 20 rpm	750 ± 50 rpm	700 ± 50 rpm
	Cooling system		Water- cooled / forced circulation	←	←	←
	Coolant capacity (ℓ)		10.5 ~ 11.0	11.0 ~ 11.5	10.5 ~ 11.0	11.5 ~ 12.0
	Max. oil capacity (ℓ) **(when shipping)**		8.2	9.2	7.9	9.8
	Lubrication type		Gear pump, forced circulation	←	←	←
	Turbocharger and cooling type		Turbocharger, air-cooled	←	–	–
Manual Transmis-sion	Operating type		Semi-Remote control, floor change type	←	←	–
	Gear ratio	1st	4.315	←	←	–
		2nd	2.475	←	←	–
		3rd	1.536	←	←	–
		4th	1.000	←	←	–
		5th	0.807	←	←	–
		Reverse	3.919	←	←	–
Automatic Transmis-sion	Model		Electronic, 6-speed	Electronic, 5-speed	Electronic, 6-speed	Electronic, 5-speed
	Operating type		Floor change type	←	←	←
	Gear ratio	1st	3.536	3.595	3.536	3.951
		2nd	2.143	2.186	2.143	2.423
		3rd	1.478	1.405	1.478	1.486
		4th	1.156	1.000	1.156	1.000
		5th	0.866	0.831	0.866	0.833
		6th	0.677		0.677	
		Reverse 1st	3.094	3.167	3.094	3.147
		Reverse 2nd		1.926		1.930

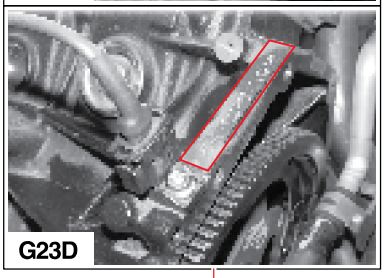
* ( ) Optional

Descriptions			D20DT	D27DT	G23D	G32D
Transfer Case	Model		Part-time	Part-time (AWD)	Part-time	AWD
	Type		Planetary gear type	←	←	←
	Gear ratio	High (4H)	1.000 : 1	←	←	←
		Low (4L)	2.483 : 1	← (AWD: –)	2.483 : 1	–
Clutch (M/T)	Operating type		Hydraulic type	←	←	–
	Disc type		Dry single diaphragm type	←	←	–
Power Steering	Type		Rack and pinion	←	←	←
	Steering angle	Inner	35.72°	←	←	←
		Outer	32.11°	←	←	←
Front Axle	Drive shaft type		Ball joint type	←	←	←
	Axle housing type		Build-up type	Build-up type (IOP type)	Build-up type	IOP type
Rear Axle	Drive shaft type		Semi-floating type	Semi-floating type (Ball joint type)	Semi-floating type	Ball joint type
	Axle housing type		Build-up type	Build-up type (IRS type)	Build-up type	IRS type
Brake	Master cylinder type		Tandem type	←	←	←
	Booster type		Vacuum assisted booster type	←	←	←
	Brake type	Front wheels	Disc type	←	←	←
		Rear wheels	Drum (disc)	←	←	Disc type
	Parking brake		Cable type: internal expansion	Cable type: internal expansion (EPB type)	Cable type: internal expansion	Cable type: internal expansion (EPB type)
Suspension	Front suspension		Wishbone + coil spring	←	←	←
	Rear suspension		5-link + coil spring	5-link + coil spring (Multi link + coil spring) (EAS)	5-link + coil spring	Multi link + coil spring (EAS)
Air Conditioner	Refrigerant (capacity)		R-134a (650 ± 30g)	←	←	←
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	←	←	←
	Starter capacity (V-kW)		12 - 2.2	←	12 - 1.2	12 - 1.8
	Alternator capacity (V-A)		12 - 140 (12 - 115)	←	12 - 115	←

3. VEHICLE IDENTIFICATION

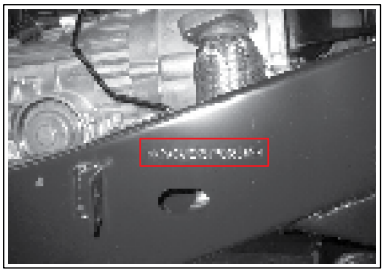
1. Engine Number



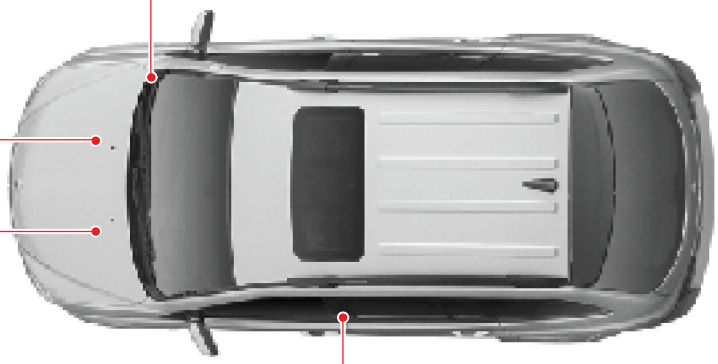


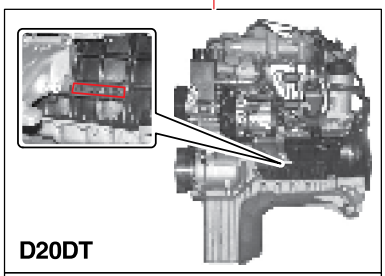
Gasoline Engine:
The engine number is stamped on the lower area of cylinder block in exhaust manifold side.

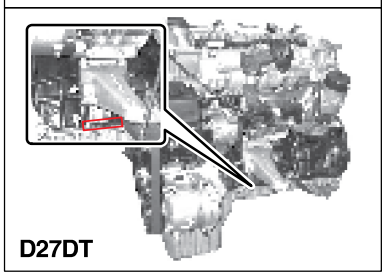
2. Chassis Number



The chassis number is stamped on the frame behind the front right tire.

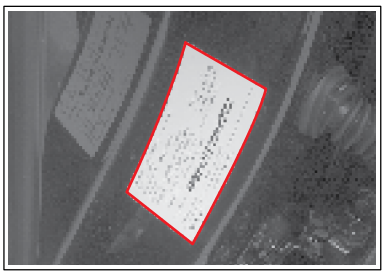






Diesel Engine:
The engine number is stamped on the lower area of cylinder block behind the Intake manifold.

3. Certification Label



The certification label is located on the driver's door sill.

Modification basis	
Application basis	
Affected VIN	

4. MAINTENANCE INTERVAL

1) Diesel Engine

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE ITEM / MAINTENANCE INTERVAL		Kilometers (miles) or time in months, whichever comes first							
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM									
Drive belt		I	I	I	I	I	I	I	I
* Engine oil & filter (1)* (3)* (4)*	EU	Initial check: 5,000 km, and replenish if necessary, change every 15,000 km or 12 months							
	General	Initial change: 5,000 km, change every 10,000 km or 12 months							
Cooling system hose & connections		I	I	I	I	I	I	I	I
Engine coolant (3)* (4)*		Change every 200,000 km or 5 years. And, inspect and replenish if necessary.							
* Fuel filter	Direct Injection (Diesel Engine) EU	I	R*	I	R*	I	R*	I	R*
	General	Replace every 25,000 km (Draining water from fuel filter: whenever replacing the engine oil)							
Additional Water Separator (if equipped)		Replace every 150,000 km or 5 years (Drain the water whenever replacing the engine oil)							
Fuel line & connections		I	I	I	I	I	I	I	I
Air cleaner (2)*	EU	Initial clean: 5,000 km, clean every 15,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)							
	General	Initial clean: 5,000 km, clean every 10,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)							
Injection timing (See NOTE1)		I	I	I	I	I	I	I	I

NOTE 1: Adjust as required;
- When excessive smoke is visible (black or white)
- Poor performance/economy

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R -Replace or change.

(1)* If vehicle is operated under severe condition:
- Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
- Driving in a hilly or mountainous terrain, sandy, or dusty area
- High load driving such as trailer towing
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Shorten the service interval. Inspect the engine oil at any time, occasionally, if necessary refill the engine oil.

(2)* If vehicle is operated under severe condition, driving in dusty condition or sandy condition, pollutant area or off-road driving, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)* More frequent maintenance is required if under dusty driving condition.

(4)* Refer to 밙ecommended fluids, coolant and lubricants?

* Water separator: When replace the engine oil, also drain the water from the fuel filter.

* Use only approved Ssangyong genuine parts.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM		Kilometers (miles) or time in months, whichever comes first							
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

CHASSIS AND BODY

Exhaust pipes & mountings				I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*				Change every: 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*			EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
			General	Periodic check: every 10,000 km, adjust or replace if necessary.							
Brake line & connections (including booster)				Inspect every 15,000 km or 1 years, adjust or replace if necessary							
Manual transmission oil (5)*				I	I	I	R	I	I	I	R
Clutch & brake pedal free play				I	I	I	I	I	I	I	I
Front & Rear differential fluid (3)*	Front	Non IOP		Inspect frequently, change every 30,000 km							
		IOP	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
			General	Periodic check: every 10,000 km, adjust or replace if necessary.							
	Rear	Rigid		Inspect frequently, change every 30,000 km							
		IRDA	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
			General	Periodic check: every 10,000 km, adjust or replace if necessary.							
Transfer case fluid (3)*				Inspect every 15,000 km, change every 60,000 km (Frequnt check of oil leak)							
Automatic transmission fluid (6)*				Inspect every 30,000 km or 12 month (But change every 60,000 km under severe condition)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R -Replace or change.

(3)* Refer to "Recommended fluids and lubricants".

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect manual transmission fluid every 15,000 km (Inspect the leak of fluid at any time, occasionally), then change every 60,000 km

(6)* Change automatic transmission fluid and every 60,000 km if the vehicle is mainly driven under severe conditions: Towing a trailer or off-road driving (Inspect the leak of fluid at any time, occasionlly)

Modification basis	
Application basis	
Affected VIN	

* Use only approved Ssangyong genuine parts.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM		Kilometers (miles) or time in months, whichever comes first							
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

CHASSIS AND BODY

Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequntly and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequntly and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots (8)*		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequntly and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (9)*	EU	I	I	I	I	I	I	I	I
	General	Inspect every 10,000 km							
Air conditioner filter		Change every 10,000 km (But, shorten the service interval under severe conditions)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.
R -Replace or change.

(3)* Refer to Recommended fluids and lubricants.
(6)* After completion of off-road operation, the underbody of the vehicle should be throughly inspected. Examine threaded fasteners for looseness.
(7)* If necessary, rotate and balance wheels.
(8)* After completion of off-road operation, the drive shaft boots should be inspected.
(9)* Inspect propeller shaft grease every 5,000 km or 3 months if the vehicle is mainly driven under severe condition.
- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

Severe Conditions in Air Conditioner Filter
- Pollutant area or off-road driving, extended air conditioner or heater operation

2) Gasoline Engine

* Use only approved Ssangyong genuine parts.

Maintenance service and record retention are the owner's responsibility. You should retain evidence that proper maintenance has been performed on your vehicle in accordance with the scheduled maintenance service chart.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first							
x1,000 km	15	30	45	60	75	90	105	120
x1,000 miles	10	20	30	40	50	60	70	80
Months	12	24	36	48	60	72	84	96
ENGINE CONTROL SYSTEM								
Drive belt	I	I	I	I	I	I	I	I
Engine oil & engine oil filter (1)* (3)* (Initial change: 10,000 km)	R**	R	R	R	R	R	R	R
Cooling system hose & connections	I	I	I	I	I	I	I	I
Engine coolant (3)*	Change every 200,000 km or 5 years. And, inspect replenish if necessary.							
Fuel filter (2)*	Replace every 100,000 km (if using poor quality of fuel, replace every 30,000 km)							
Fuel line & connections	I	I	I	I	I	I	I	I
Air cleaner (2)*	I	I	I	R	I	I	I	R
Ignition timing	I	I	I	I	I	I	I	I
Spark plugs (G32D)	-	-	-	R	-	-	-	R
Spark plugs (G23D)	-	R	-	R	-	R	-	R
Charcoal canister & vapor lines	-	-	I	-	-	I	-	-

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R -Replace or change.

**- In order to secure engine long life and effective break-in, first oil (factory filled) would be recommended to drain with in 10,000 km.

(1)*If vehicle is operated under severe condition: short distance driving, extensive idling or driving in dusty condition, shorten the service interval.

(2)*If vehicle is operated under severe condition, pollutant area or off-road driving, driving in dusty condition or sandy condition, frequently inspect the air cleaner, if necessary, change the air cleaner.

(3)*Refer to "Recommended fluids and lubricants".

Modification basis	
Application basis	
Affected VIN	

* Use only approved Ssangyong genuine parts.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM			Kilometers (miles) or time in months, whichever comes first							
		x1,000 km	15	30	45	60	75	90	105	120
		x1,000 miles	10	20	30	40	50	60	70	80
		Months	12	24	36	48	60	72	84	96
CHASSIS AND BODY										
Exhaust pipes & mountings			I	I	I	I	I	I	I	I
Brake / Clutch fluid (3)*			Change every: 2 years (inspect frequently)							
Parking brake / Brake pads (Front & Rear) (4)*		EU	Periodic check: every 15,000 km, adjust or replace as necessary.							
		General	Periodic check: every 10,000 km, adjust or replace as necessary.							
Brake line & connections (including booster)			Inspect every 15,000 km or 1 years, adjust or replace if necessary							
Manual transmission oil (5)*			I	I	I	R	I	I	I	R
Clutch & brake pedal free play			I	I	I	I	I	I	I	I
Front & Rear differential fluid (3)*	Front	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
		General	Periodic check: every 10,000 km, adjust or replace if necessary.							
	Rear	EU	Periodic check: every 15,000 km, adjust or replace if necessary.							
		General	Periodic check: every 10,000 km, adjust or replace if necessary.							
Transfer case fluid (3)*			Inspect every 15,000 km, change every 60,000 km (Frequnt check of oil leak)							
Automatic transmission fluid (6)*			Inspect every 30,000 km or 12 month (But change every 60,000 km under severe condition)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R -Replace or change.

(3)* Refer to Recommended fluids and lubricants.

(4)* More frequent maintenance is required if the vehicle is operated under any of the following conditions:

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(5)* Inspect manual transmission fluid every 15,000 km (Inspect the leak of fluid at any time,occasionally), then change every 60,000 km

(6)* Change automatic transmission fluid and every 60,000 km if the vehicle is mainly driven under severe conditions. (Inspect the leak of fluid at any time, occasionlly)

* Use only approved Ssangyong genuine parts.

* EU Countries: Only countries that belong to EU. (It does not apply to all countries in EU.)

MAINTENANCE INTERVAL / MAINTENANCE ITEM	Kilometers (miles) or time in months, whichever comes first								
	x1,000 km	15	30	45	60	75	90	105	120
	x1,000 miles	10	20	30	40	50	60	70	80
	Months	12	24	36	48	60	72	84	96

CHASSIS AND BODY

Chassis & underbody bolts & nuts tight / Secure (6)*		Check frequntly and adjust or replace if necessary							
Tire condition & inflation pressure		Check frequntly and adjust or replace if necessary							
Wheel alignment (7)*		Inspect when abnormal condition is noted							
Steering wheel & linkage		I	I	I	I	I	I	I	I
Power steering fluid & lines (3)*		I	I	I	I	I	I	I	I
Drive shaft boots		I	I	I	I	I	I	I	I
Seat belts, buckles & anchors		I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch		Check frequntly and adjust or replace if necessary							
Wheel bearing grease		I	I	I	I	I	I	I	I
Propeller shaft grease - Front / Rear (8)*	EU	I	I	I	I	I	I	I	I
	General	Inspect every 10,000 km							
Air conditioner filter		Change every 10,000 km (But, shorten the service interval under severe conditions)							

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R -Replace or change.

(3)* Refer to Recommended fluids and lubricants.

(6)* After completion of off-road operation, the underbody of the vehicle should be throughly inspected. Examine threaded fasteners for looseness.

(7)* If necessary, rotate and balance wheels.

(8)* Inspect propeller shaft grease every 5,000 km or 3 months if the vehicle is mainly driven under severe condition.

- In off-road or dusty road, or
- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or moutainous terrain.

Severe Conditions in Air Conditioner Filter

- Pollutant area or off-road driving, extended air conditioner or heater operation

Modification basis	
Application basis	
Affected VIN	

5. RECOMMENDED FLUIDS AND LUBRICANTS

Descriptions				Capacity	Specifications
Engine Oil	Diesel Engine		D20DT	≒ 7.5 ℓ	Quality class: Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3 or 229.31 for DSL/GSL ENG without CDPF) (Approved by MB Sheet 229.31 for DSL ENG with CDPF) Viscosity: MB sheet No. 224.1
			D27DT	≒ 8.5 ℓ	
	Gasoline Engine		G23D	≒ 7.5 ℓ	
			G32D	≒ 9.0 ℓ	
Engine Coolant	Diesel Engine		D20DT	10.5 ~ 11.0 ℓ	Ssangyong genuine coolant Anti-Freeze:SYC-1025, Anti-Freeze:Water = 50:50
			D27DT	11.0 ~ 11.5 ℓ	
	Gasoline Engine		G23D	10.5 ~ 11.0 ℓ	
			G32D	11.5 ~ 12.0 ℓ	
Automatic Transmission Fluid			DC5	≒ 8.0 ℓ	Ssangyong genuine oil (Shell ATF 134 or Fuchs ATF 134)
			6A/T	≒ 9.5 ℓ	Ssangyong genuine oil (CAㅁEX PED 1712)
Manual Transmission Fluid				4WD: ≒ 3.6 ℓ, 2WD: ≒ 3.4 ℓ	Ssangyong genuine oil (ATF DEXRON II)
Transfer Case Fluid		Part Time		≒ 1.4 ℓ	Ssangyong genuine oil (ATF DEXRON II or III)
		AWD		≒ 1.1 ℓ	
Axle Oil	Front	Non IOP	D20DT	≒ 1.4 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
			D27DT	≒ 1.4 ℓ , ≒ 1.5 ℓ	
			G23D	≒ 1.4 ℓ	
		IOP		≒ 0.78 ℓ	Ssangyong genuine oil (Shell synthetic fuel efficient GL75W/90)
	Rear	Rigid		M/T (D20DT, G23D) ≒ 1.9 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
				D27DT ALL, D20DT A/T, G23D A/T ≒ 2.0 ℓ	
		LD		≒ 1.8 ℓ	
		IRDA		≒ 1.5 ℓ	Ssangyong genuine oil (Shell synthetic fuel efficient GL75W/90)
Brake / Clutch Fluid				As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid				≒ 1.0 ℓ	Ssangyong genuine oil (ATF DEXRON II or III)

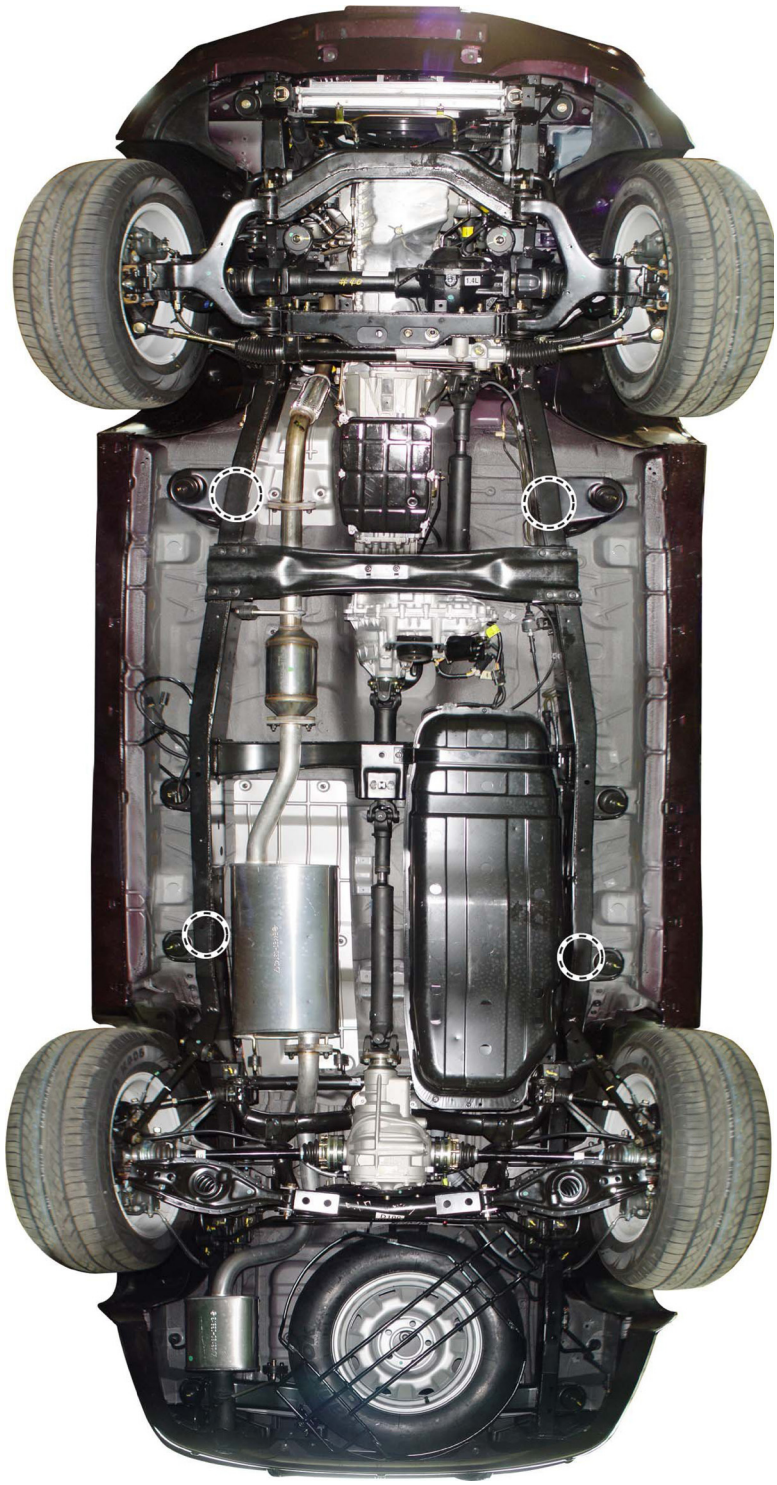
* IOP: Integrated Oil Pan
* IRDA: Independent Rear Drive Axle

CAUTION

- Use only Ssangyong recommended fluids and lubricants.
- Keep the specified levels when adding or replacing the fluids.
- Do not mix any different types or brands of oils or fluids. This may cause damages.

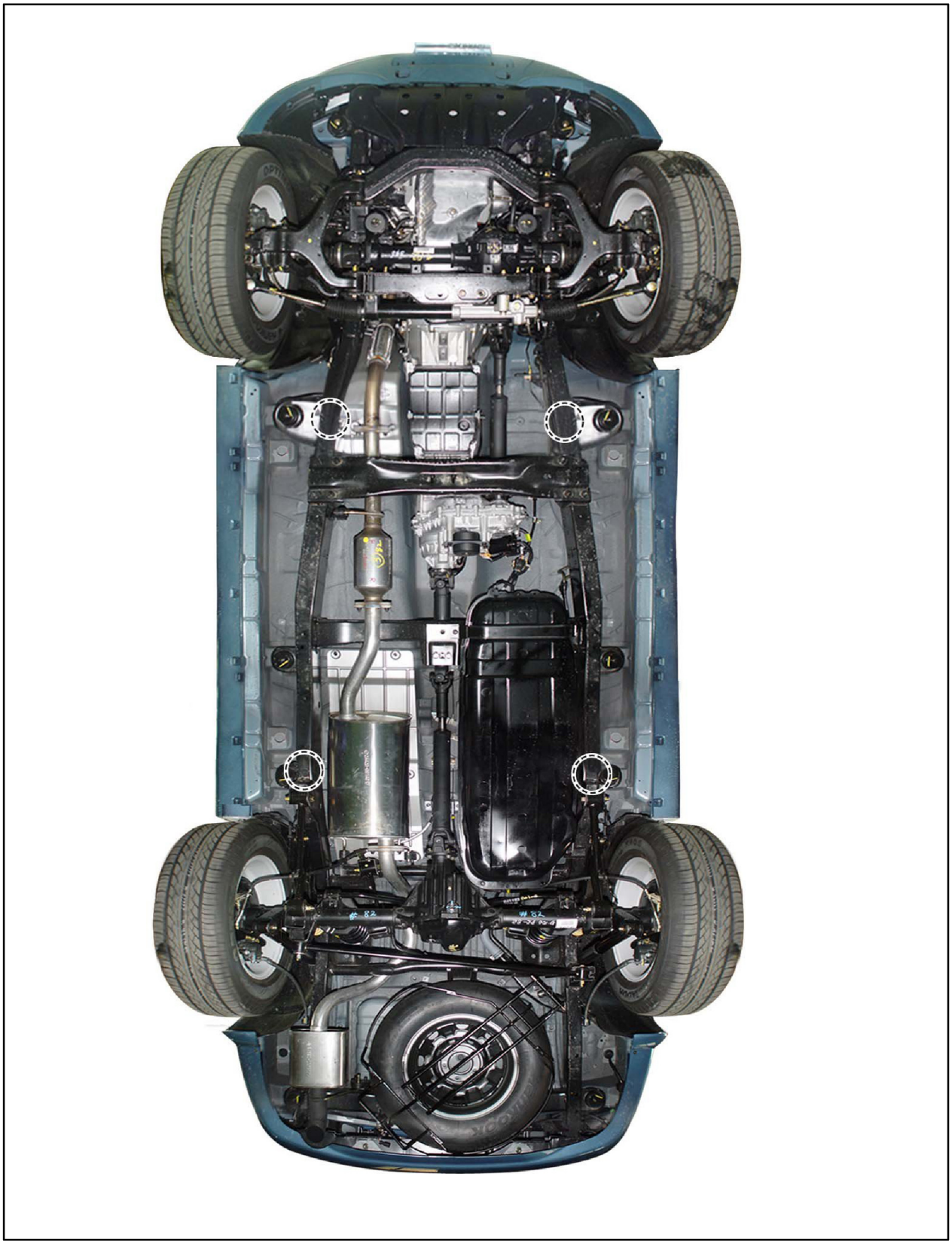
6. JACK-UP POINTS

1) IRS - Lifting Point (Dotted Circles)



Modification basis	
Application basis	
Affected VIN	

2) 5 Link System - Lifting Point (Dotted Circles)

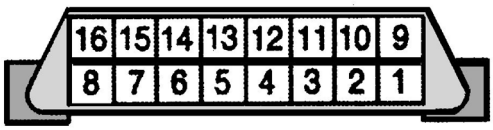


7. PIN ARRANGEMENT OF DIAGNOSTIC CONNECTOR

It is installed under the instrument panel and consists of 16 pins.







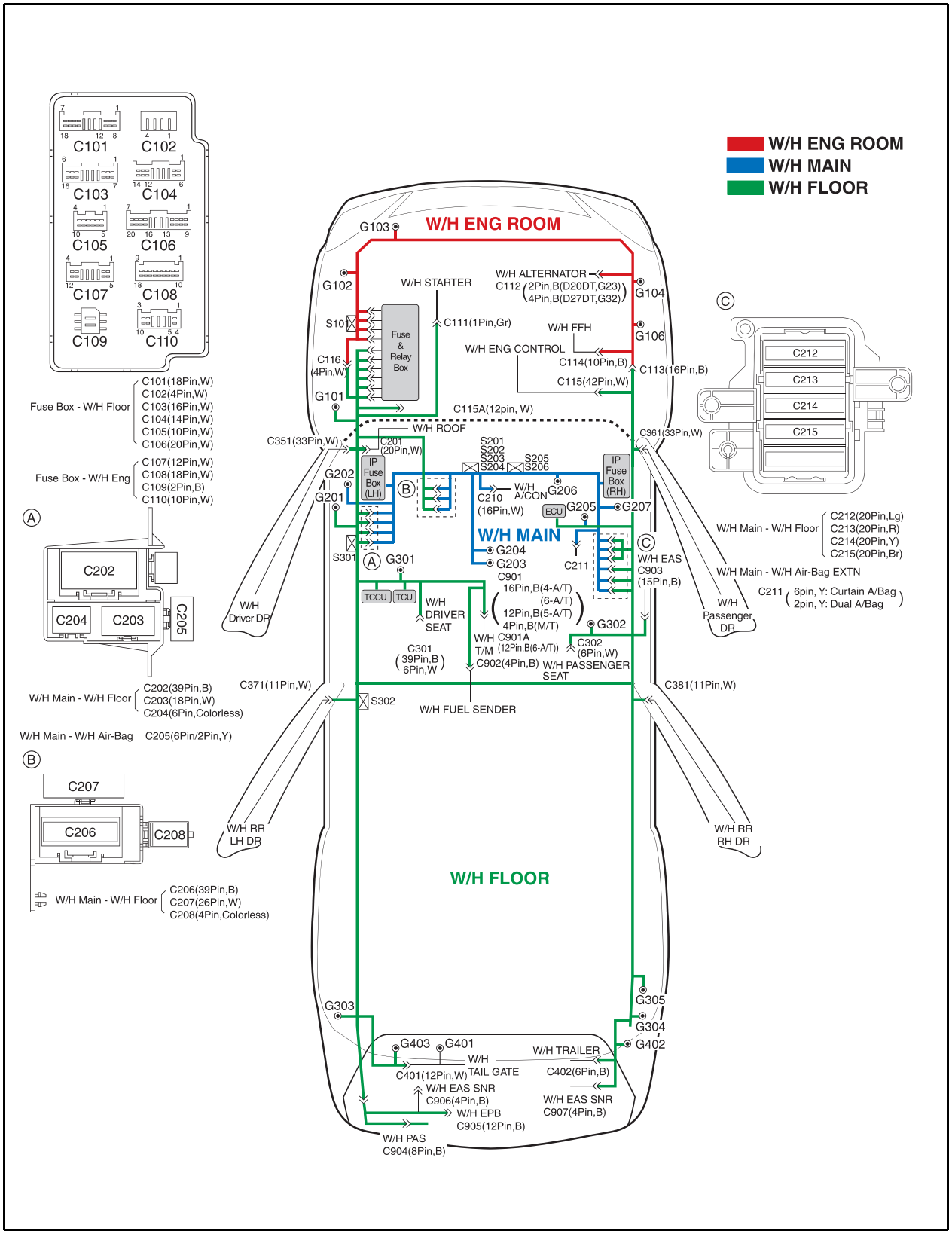
1) Functions of Terminal

Pin no. 1	FFH diagnosis
Pin no. 2	FFH forced driving
Pin no. 3	-
Pin no. 4	Ground
Pin no. 5	Signal ground
Pin no. 6	CAN - HIGH
Pin no. 7	Engine ECU
Pin no. 8	ABS / ESP
Pin no. 9	Air bag
Pin no. 10	TGS lever position unit
Pin no. 11	TCU
Pin no. 12	SSPS
Pin no. 13	TCCU
Pin no. 14	CAN - LOW
Pin no. 15	REKES coding
Pin no. 16	Battery +

Modification basis	
Application basis	
Affected VIN	

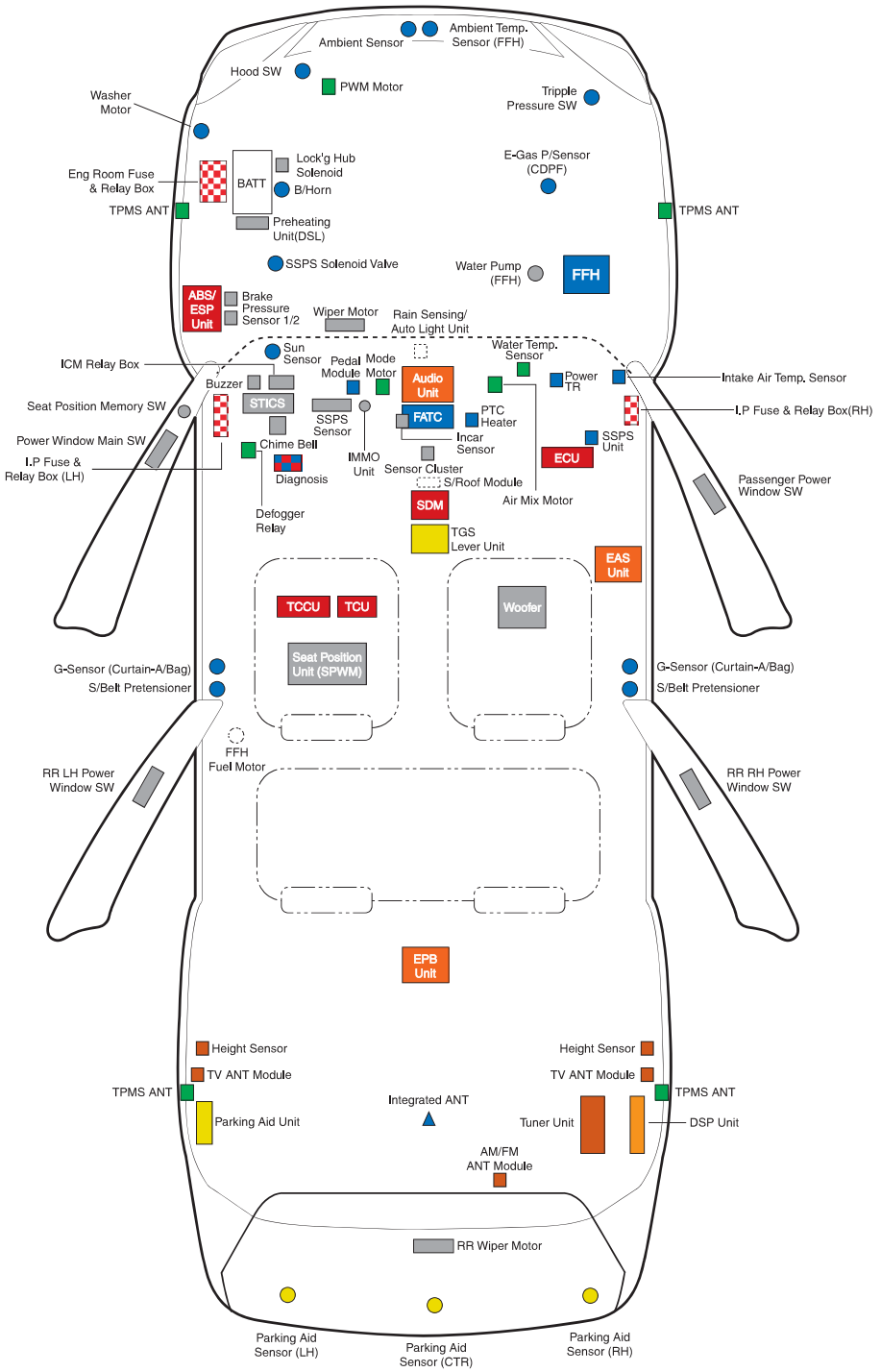
8. ELECTRIC COMPONENTS AND LAYOUT

1) Wiring Harness Arrangement



Modification basis	
Application basis	
Affected VIN	

2) Components Locator

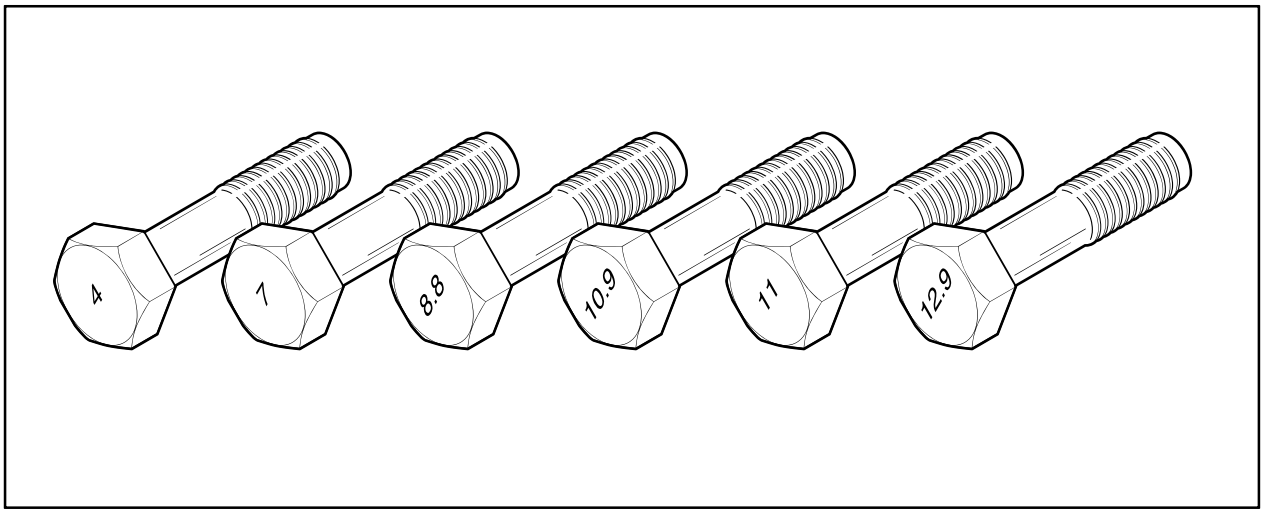


Modification basis	
Application basis	
Affected VIN	

9. STANDARD BOLTS SPECIFICATIONS

Bolt*	Torque (Nm / lb-in)					
	Standard			Limit		
	4T	7T	9T	4T	7T	9T
M3 ×0.5	0.5 Nm (4.5 lb-in)	0.9 Nm (8 lb-in)	1.3 Nm (12 lb-in)	0.7 Nm (6.3 lb-in)	1.2 Nm (11 lb-in)	17 Nm (15 lb-in)
M4 ×0.7	1.2 Nm (11 lb-in)	2.0 Nm (18 lb-in)	3.0 Nm (27 lb-in)	1.6 Nm (14 lb-in)	2.6 Nm (23 lb-in)	4.0 Nm (36 lb-in)
M5 ×0.8	2.4 Nm (22 lb-in)	4.0 Nm (36 lb-in)	5.6 Nm (50 lb-in)	3.1 Nm (28 lb-in)	5.2 Nm (47 lb-in)	7.6 Nm (68 lb-in)
M6 ×1.0	4.0 Nm (36 lb-in)	6.7 Nm (60 lb-in)	9.7 Nm (87 lb-in)	5.4 Nm (49 lb-in)	9.0 Nm (81 lb-in)	12.7 Nm (114 lb-in)
M8 ×1.25	8.6 Nm (77 lb-in)	15.7 Nm (12 lb-in)	22.5 Nm (17 lb-in)	12.7 Nm (9 lb-in)	20.6 Nm (15.2 lb-in)	30.4 Nm (22 lb-in)
M10 ×1.25	18.6 Nm (14 lb-in)	32.3 Nm (24 lb-in)	46.0 Nm (34 lb-in)	25.5 Nm (19 lb-in)	42.1 Nm (31 lb-in)	60.8 Nm (31 lb-in)
M10 ×1.5	18.6 Nm (14 lb-in)	30.4 Nm (22 lb-in)	44.1 Nm (33 lb-in)	24.5 Nm (18 lb-in)	41.2 Nm (30 lb-in)	58.8 Nm (44 lb-in)
M12 ×1.25	34.3 Nm (25 lb-in)	56.8 Nm (42 lb-in)	82.3 Nm (61 lb-in)	45.0 Nm (33 lb-in)	75.5 Nm (56 lb-in)	107.8 Nm (80 lb-in)
M12 ×1.75	32.3 Nm (24 lb-in)	53.9 Nm (40 lb-in)	77.4 Nm (57 lb-in)	43.1 Nm (32 lb-in)	71.5 Nm (53 lb-in)	98.0 Nm (73 lb-in)
M14 ×1.5	54.0 Nm (40 lb-in)	89.2 Nm (66 lb-in)	127.4 Nm (94 lb-in)	71.6 Nm (53 lb-in)	117.6 Nm (87 lb-in)	166.6 Nm (123 lb-in)
M16 ×1.5	81.3 Nm (60 lb-in)	107.8 Nm (80 lb-in)	196.0 Nm (145 lb-in)	107.8 Nm (80 lb-in)	186.2 Nm (138 lb-in)	264.6 Nm (196 lb-in)
M18 ×1.5	117.6 Nm (87 lb-in)	196.0 Nm (145 lb-in)	284.2 Nm (210 lb-in)	156.8 Nm (116 lb-in)	264.6 Nm (196 lb-in)	372.4 Nm (276 lb-in)
M20 ×1.5	166.6Nm (123 lb-in)	274.4 Nm (203 lb-in)	392.0 Nm (290 lb-in)	215.6 Nm (160 lb-in)	362.6 Nm (268 lb-in)	519.4 Nm (384 lb-in)
M22 ×0.5	225.4Nm (167 lb-in)	372.4 Nm (276 lb-in)	529.2 Nm (392 lb-in)	294.0 Nm (218 lb-in)	490.0 Nm (362 lb-in)	705.6 Nm (522 lb-in)
M24 ×1.5	284.2 Nm (210 lb-in)	480.2 Nm (355 lb-in)	686.0 Nm (508 lb-in)	382.2 Nm (283 lb-in)	637.0 Nm (471 lb-in)	921.2 Nm (682 lb-in)
M24 ×2.0	274.4 Nm (203 lb-in)	460.6 Nm (341 lb-in)	666.4 Nm (493 lb-in)	372.4 Nm (276 lb-in)	617.4 Nm (457 lb-in)	891.8 Nm (660 lb-in)

*Diameter X pitch in millimeters



1. Metric bolt strength is embossed on the head of each bolt. The strength of bolt can be classified as 4T, 7T, 8.8T, 10.9T, 11T and 12.9T in general.
2. Observe standard tightening torque during bolt tightening works and can adjust torque to be proper within 15 % if necessary. Try not to over max.
   allowable tightening torque if not required to do so.
3. Determine extra proper tightening torque if tightens with washer or packing.
4. If tightens bolts on the below materials, be sure to determine the proper torque.
   1) Aluminum alloy: Tighten to 80 % of above torque table.
   2) Plastics: Tighten to 20 % of above torque table.

Modification basis	
Application basis	
Affected VIN	

INDEX

1. ECU-GASOLINE..... 3

ECU-GASOLINE

0000-00

DIAGNOSIS

1. ECU-GASOLINE

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Variable Valve Timing System	P0010	Cam Actuator - Short circuit to B+	• **Condition** - Variable valve timing system circuit: short circuit to battery • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	o
		Cam Actuator - Short or Open circuit to Ground	• **Condition** - Variable valve timing system circuit: short or open circuit to ground • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	o
	P0011	Cam Actuator - Fixed to Advance Position	• **Condition** - The noise occurred by valve timing (advance/retard) in each range is over than the specified value. • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	o
	P0012	Cam Actuator - Fixed to Retard Position	• **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 73. 3. Check the cam actuator's power circuit for short and open. 4. Check the magnet and hardware. 5. Check the ECU.	o
HFM Sensor	P0101	Faulty HFM Sensor Signal	• **Condition** - Improper air volume is detected. • **Specification** - 20 kg/h - 0.47 V 0 kg/h - 0.99 V 10 kg/h - 1.2226 ~ 1.2398 V 15 kg/h - 1.3552 ~ 1.3778 V 30 kg/h - 1.6783 ~ 1.7146 V 60 kg/h - 2.1619 ~ 2.2057 V 120 kg/h - 2.7215 ~ 2.7762 V 250 kg/h - 3.4388 ~ 3.5037 V 370 kg/h - 3.8796 ~ 3.9511 V 480 kg/h - 4.1945 ~ 4.2683 V 640 kg/h - 4.5667 ~ 4.6469 V • **Actions** 1. Measure the actual air volume using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 92 and 116. 3. Inspect HFM sensor. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
HFM Sensor	P0102	Low HFM Sensor Signal	• **Condition** - The signal is below the minimum engine load (0.02). - Related circuit: open circuit • **Specification** - 20 kg/h - 0.47 V 0 kg/h - 0.99 V 10 kg/h - 1.2226 ~ 1.2398 V 15 kg/h - 1.3552 ~ 1.3778 V 30 kg/h - 1.6783 ~ 1.7146 V 60 kg/h - 2.1619 ~ 2.2057 V 120 kg/h - 2.7215 ~ 2.7762 V 250 kg/h - 3.4388 ~ 3.5037 V 370 kg/h - 3.8796 ~ 3.9511 V 480 kg/h - 4.1945 ~ 4.2683 V 640 kg/h - 4.5667 ~ 4.6469 V • **Actions** 1. Measure the actual air volume using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 92 and 116. 3. Inspect HFM sensor. 4. Check the ECU.	o
	P0103	High HFM Sensor Signal	• **Condition** - The signal is over the maximum engine load (0.02). - Related circuit: short circuit • **Specification** - 20 kg/h - 0.47 V 0 kg/h - 0.99 V 10 kg/h - 1.2226 ~ 1.2398 V 15 kg/h - 1.3552 ~ 1.3778 V 30 kg/h - 1.6783 ~ 1.7146 V 60 kg/h - 2.1619 ~ 2.2057 V 120 kg/h - 2.7215 ~ 2.7762 V 250 kg/h - 3.4388 ~ 3.5037 V 370 kg/h - 3.8796 ~ 3.9511 V 480 kg/h - 4.1945 ~ 4.2683 V 640 kg/h - 4.5667 ~ 4.6469 V • **Actions** 1. Measure the actual air volume using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 92 and 116. 3. Inspect HFM sensor.	o
MAP Sensor (G23 only)	P0105	Defective Intake Manifold Pressure Sensor Signal		

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Intake Air Temperature Sensor	P0111	Faulty Intake Air Temperature Sensor Signal	• **Condition** - The temperature change of over 20 °C is occurred more than 5 times. • **Specification** 20°C - 2420 Ω - 2.65 V 30°C - 1662 Ω - 2.18 V 50°C - 853 Ω - 1.40 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 80 and 116. 3. Inspect intake air temperature sensor (ATS-HFM6.0 integrated). 4. Check the ECU.	o
	P0112	Intake Air Temperature Sensor Malfunction - Open circuit	• **Condition** - The sensor value is less than minimum specified value (0.1 V). - Related circuit: open circuit • **Specification** 20°C - 2420 Ω - 2.65 V 30°C - 1662 Ω - 2.18 V 50°C - 853 Ω - 1.40 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 80 and 116. 3. Inspect intake air temperature sensor (ATS-HFM6.0 integrated). 4. Check the ECU.	o
	P0113	Intake Air Temperature Sensor Malfunction - Short circuit	• **Condition** - The sensor value is over the maximum specified value (4.9 V). - Related circuit: short circuit • **Specification** 20°C - 2420 Ω - 2.65 V 30°C - 1662 Ω - 2.18 V 50°C - 853 Ω - 1.40 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 80 and 116. 3. Inspect intake air temperature sensor (ATS-HFM6.0 integrated). 4. Check the ECU.	o
Coolant Temperature Sensor	P0116	Faulty Coolant Temperature Sensor Signal	• **Condition** - The coolant temperature is below 50 °C after engine warmed up. • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Coolant Temperature Sensor	P0117	Coolant Temperature Sensor Malfunction - Open circuit	• **Condition** - The sensor value is less than minimum specified value (0.11 V). - Related circuit: open circuit • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	o
	P0118	Coolant Temperature Sensor Malfunction - Short circuit	• **Condition** - The sensor value is over the maximum specified value (4.96 V). - Related circuit: short circuit • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits of ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	o
Throttle Body Control	P0120	No.1 Throttle Position Sensor - Low Voltage	• **Condition** - No.1 throttle position sensor circuit: short or open circuit to ground. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0120	No.1 Throttle Position Sensor - High Voltage	• **Condition** - No.1 throttle position sensor's main power is grounded. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
		No.2 Throttle Position Sensor - Low Voltage	• **Condition** - No.2 throttle position sensor circuit: short or open circuit to ground. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
		No.2 Throttle Position Sensor - High Voltage	• **Condition** - No.2 throttle position sensor's main power is grounded. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0120	Throttle Actuator - Insuffcient Supply Power	• **Condition** - Actuator circuit: short circuit • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		TPS Valve Inconsistent with HFM Sensor Value	• **Condition** - The potentiometer is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O
		Both Throttle Position Sensors Malfunction	• **Condition** - The potentiometer is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	O

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0120	Inconsistent Signals of No.1 and No.2 Throttle Position Sensors	• **Condition** - The difference in amount of 1/2 is occurred in potentiometer. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
		Throttle Actuator Control Malfunction	• **Condition** - The wiring or actuator is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
		Intake Air Flow Sensor and Throttle Sensor Malfunction	• **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Accelerator Pedal Sensor	P0120	Accelerator Pedal Sensor Malfunction - Supply Voltage Fault	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	o
		Accelerator Pedal Sensor #1 Malfunction - Low Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	o
		Accelerator Pedal Sensor #1 Malfunction - High Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	o
		Accelerator Pedal Sensor #2 Malfunction - Low Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	o
		Accelerator Pedal Sensor #2 Malfunction - High Voltage	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	o
		Accelerator Pedal Sensor #1 & #2 - Defective Signal	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	o
		Accelerator Pedal Sensor #1 & #2 Malfunction	• **Specification** - SPS 1/2 pull-down resistance: 464 kΩ - Potentiometer 1/2 voltage: 5 / 2.5 V • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 31, 32, 47, 48, 50 and 51. 3. Check the electric throttle controller.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Control	P0121	Throttle Position Sensor Actuator's Learning Control Malfunction	• **Condition** - The actuator is not properly adjusted and the conditions are not satisfied. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
		Faulty Throttle Body Return Spring	• **Condition** - The return spring of actuator is defective. • **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
Coolant Temperature Sensor	P0125	Low coolant temperature while controlling air/fuel ratio	• **Condition** - The coolant temperature is below the specified temperature for controlling air/fuel ratio after engine warmed up. • **Specification** 20°C - 2.50 kΩ - 3.57 V 80°C - 0.32 kΩ - 1.22 V 100°C - 0.18 kΩ - 0.78 V • **Actions** 1. Measure the actual temperature using SCAN-100. 2. Inspect the circuits for ECU pin No. 78 and 79. 3. Check the coolant temperature sensor. 4. Check the ECU.	o
Thermostat	P0128	Thermostat Fully Open	• **Condition** 1. The actual coolant temperature is lower than the coolant temperature calculated by ECU due to the slow preheat. • **Actions** 1. Check the thermostat.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0131	No.1 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds (refer to P0133) • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
	P0132	No.1 Oxygen Sensor - Overvoltage	• **Condition** - No.1 oxygen sensor is defective. Output voltage > 1.05 V The sensing voltage is not in the specified range. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0133	No.1 Oxygen Sensor - Poor Performance	• **Condition** - No.1 oxygen sensor is defective. The response to the sensor signal is delayed. Closed loop interval of air/fuel ratio control > 1500 ms • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0134	No.1 Oxygen Sensor - Malfunction	• **Condition** - No.1 oxygen sensor is defective. The sensor does not operate. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
		No.1 Oxygen Sensor - Lean Indication (When Decelerating)	• **Condition** - No.1 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0135	No.1 Oxygen Sensor - Faulty Heating Current, Heater Circuit is Open or Short circuit or Short circuit to Ground	• **Condition** - No.1 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0135	No.1 Oxygen Sensor Heater - Short circuit to B+	• **Condition** - No.1 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
		No.1 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Condition** - No.1 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 9. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0137	No.2 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Condition** - No.2 oxygen sensor is defective. The sensor does not operate. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0138	No.2 Oxygen Sensor - Overvoltage	• **Condition** - No.2 oxygen sensor is defective. The output value is not within the specified range. The sensing voltage is not in the specified range. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0140	No.2 Oxygen Sensor - Lean Indication (When Decelerating)	• **Condition** - No.2 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0141	No.2 Oxygen Sensor Heater - Short circuit to B+	• **Condition** - No.2 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 7. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0141	No.2 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Condition** - No.2 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 7. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
		No.2 Oxygen Sensor - Poor Heating	• **Condition** - No.2 oxygen sensor is defective. The response to the sensor signal is delayed. • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 7. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	O
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0151	No.3 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	O

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0152	No.3 Oxygen Sensor - Overvoltage	• **Condition** - No.3 oxygen sensor is defective. The output value is not within the specified range. The sensing voltage is not in the specified range. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0153	No.3 Oxygen Sensor - Poor Performance	• **Condition** - No.3 oxygen sensor is defective. The response to the sensor signal is delayed. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0154	No.3 Oxygen Sensor - Malfunction	• **Condition** - No.3 oxygen sensor is defective. The sensor does not operate. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0154	No.3 Oxygen Sensor - Lean Indication (When Decelerating)	• **Condition** - No.3 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. • **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0155	No.3 Oxygen Sensor - Faulty Heating Current	• **Condition** - No.3 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 6. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
		No.3 Oxygen Sensor Heater - Short circuit to B+	• **Condition** - No.3 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 6. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
		No.3 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Condition** - No.3 oxygen sensor is improperly heated. The heating current is below or over the specified range (below 0.2 A or over 2 A). • **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 6. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.4 Oxygen Sensor (Installed After Catalytic Converter)	P0157	No.4 Oxygen Sensor - Below the Minimum Permissible Voltage	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850 °C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0158	No.4 Oxygen Sensor - Overvoltage	• **Condition** - No.4 oxygen sensor is defective. The output value is not within the specified range. The sensing voltage is not in the specified range. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip -Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
	P0160	No.4 Oxygen Sensor - Lean Indication (When Decelerating)	• **Condition** - No.4 oxygen sensor is defective. There is no "LEAN" signal after shutting off the fuel. • **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850 °C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.4 Oxygen Sensor (Installed After Catalytic Converter)	P0161	No.4 Oxygen Sensor - Poor Heating	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 3. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
		No.4 Oxygen Sensor Heater - Short circuit to B+	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 3. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
		No.4 Oxygen Sensor Heater - Open or Short circuit to Ground	• **Specification** - Operating current: below 1.6 A - Initial current: below 6.0 A for 2 seconds • **Actions** 1. Check the heating condition using SCAN-100. 2. Inspect the circuit and terminal of the ECU pin No. 3. 3. Inspect the heating power supply. 4. Inspect the heating circuit of oxygen sensor. 5. Check the ECU.	o
No.1 Oxygen Sensor (Installed Before Catalytic Converter)	P0171	Short-term Learning Control of Air/Fuel Ratio: Fuel Rich	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) - Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 16 and 17. 3. Inspect the oxygen sensor. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Correction	P0171	Air/Fuel Ratio Control Malfunction - Fuel Rich	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•
		Learning Control Malfunction - Rich at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•
		Learning Control Malfunction - Rich under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•
		Learning Control Malfunction - Rich under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•
	P0172	Air/Fuel Ratio Control Malfunction - Fuel Lean	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•
		Learning Control Malfunction - Lean at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•
		Learning Control Malfunction - Lean under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•
		Learning Control Malfunction - Lean under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	•

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
No.2 Oxygen Sensor (Installed After Catalytic Converter)	P0172	Short-term Learning Control of Air/Fuel Ratio: Fuel Lean	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 19 and 20. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
Fuel Correction	P0174	Air/Fuel Ratio Control Malfunction - Fuel Rich	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
		Fuel Rich at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
		Fuel Rich under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
		Fuel Rich under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
No.3 Oxygen Sensor (Installed Before Catalytic Converter)	P0174	Short-term Learning Control of Air/Fuel Ratio: Fuel Rich	• **Specification** - Specified voltage: Below 100 ~ 900 mV - Insulating resistance: ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 kΩ (850°C) Between sensor circuit and housing - Operating temperature: 850 °C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 22 and 23. 3. Inspect the oxygen sensor. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Correction	P0175	Air/Fuel Ratio Control Malfunction - Fuel Lean	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
		Fuel Lean at Idling	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
		Fuel Lean under Low Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
		Fuel Lean under High Load	• **Actions** 1. Check the oxygen sensor signal and heating line. 2. Check the purge valve unit and circuit. 3. Check the coolant temperature sensor. 4. Check the ignition coil and spark plug. 5. Check the HFM sensor's intake air temperature.	o
No.4 Oxygen Sensor (Installed After Catalytic Converter)	P0175	Short-term Learning Control of Air/Fuel Ratio: Fuel Lean	• **Specification** - Specified voltage: 100 ~ 900 mV - Insulating resistance : ≥ 10 MΩ (350°C) ≥ 300 kΩ (850°C) Resistance between heater and sensor: ≥ 10 MΩ (850°C) Between sensor circuit and housing - Operating temperature: 850°C Gas temperature at ceramic tip - Internal resistance: ≥ 1 kΩ • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of the ECU pin No. 25 and 26. 3. Inspect the oxygen sensor. 4. Check the ECU.	o
Throttle Body Safety Function	P0221	Deceleration Over Limit (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Acceleration Over Limit (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Safety Function	P0221	Control Lever Double Action (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Control Lever Safety Terminal Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Pedal Position Change Fault (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Throttle Position Change Fault (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Defective Constant Speed Driving Control Data (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Faulty Pedal Position Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Faulty Throttle Position Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Faulty CAN Communi-cation Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Faulty Configuration Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		Faulty A/D Converter Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		CPU #1 and #2 - Pedal Position Signal Fault	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Throttle Body Safety Function	P0221	CPU #1 and #2 - TP Valve Position Signal Fault	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		CPU #1 and #2 - MSR Signal Fault	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		CPU #1 and #2 - Idle Control	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		AD Converter Overflow Detected (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		ROM Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		RAM Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
		CPU Recognition Malfunction (CPU2)	• **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the electric throttle controller. 3. Check the ECU.	o
Fuel Pump Relay	P0231	Fuel Pump Relay - Open circuit to Ground	• **Condition** - Fuel pump circuit: short or open circuit to ground • **Specification** - The voltage drop of pin No. 33 and ground: Below 1 V (current = 150 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 33. 2. Inspect the fuel pump relay. 3. Check the ECU.	o
	P0232	Fuel Pump Relay - Short circuit to B+	• **Condition** - Fuel pump: short circuit to battery • **Specification** - The voltage drop of pin No. 33 and ground: Below 1 V (current = 150 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 33. 2. Inspect the fuel pump relay. 3. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Injection System	P0261	No.1 Injector - Short or Open circuit to Ground	• **Condition** - No.1 injector is defective. No.1 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 63. 2. Inspect the injector. 3. Check the ECU.	o
	P0262	No.1 Injector - Short circuit to B+	• **Condition** - No.1 injector is defective. No.1 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.1 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	o
	P0264	No.2 Injector - Short or Open circuit to Ground	• **Condition** - No.2 injector is defective. No.2 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 61. 2. Inspect the injector. 3. Check the ECU.	o
	P0265	No.2 Injector - Short circuit to B+	• **Condition** - No.2 injector is defective. No.2 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.2 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Injection System	P0267	No.3 Injector - Short or Open circuit to Ground	• **Condition** - No.3 injector is defective. No.3 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 66. 2. Inspect the injector. 3. Check the ECU.	o
	P0268	No.3 Injector - Short circuit to B+	• **Condition** - No.3 injector is defective. No.3 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.3 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	o
	P0270	No.4 Injector - Short or Open circuit to Ground	• **Condition** - No.4 injector is defective. No.4 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 62. 2. Inspect the injector. 3. Check the ECU.	o
	P0271	No.4 Injector - Short circuit to B+	• **Condition** - No.4 injector is defective. No.4 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.4 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Injection System	P0273	No.5 Injector - Short or Open circuit to Ground	• **Condition** - No.5 injector is defective. No.5 injector circuit: short circuit to ground • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 65. 2. Inspect the injector. 3. Check the ECU.	o
	P0274	No.5 Injector - Short circuit to B+	• **Condition** - No.5 injector is defective. No.5 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.5 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	o
	P0276	No.6 Injector - Short or Open circuit to Ground	• **Condition** - No.6 injector is defective. No.6 injector has a short circuit to ground. • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 64. 2. Inspect the injector. 3. Check the ECU.	o
	P0277	No.6 Injector - Short circuit to B+	• **Condition** - No.6 injector is defective. No.6 injector circuit: short circuit to battery • **Specification** - Electric resistance: 14.5 Ω ± 0.7 Ω at 20°C - Operating pressure: 380 Kpa - Supply voltage: 6 ~ 16 V • **Actions** 1. Check the No.6 injector's power supply and terminal. 2. Inspect the injector. 3. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Poor Ignition (Misfire)	P0300	Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in more than one cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9.Check the ECU.	•
	P0301	No.1 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.1 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	•
	P0302	No.2 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.2 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	•

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Poor Ignition (Misfire)	P0303	No.3 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.3 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	•
	P0304	No.4 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.4 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	•
	P0305	No.5 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.5 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	•

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Poor Ignition (Misfire)	P0306	No.6 Cylinder - Poor Ignition	• **Condition** - Misfire is occurred in No.6 cylinder causing excessive exhaust gas and catalyst deterioration. • **Actions** 1. Check the ignition system. 2. Check the fuel injection system. 3. Check the fuel pressure. 4. Check the compression pressure. 5. Check the valve timing and clearance. 6. Check the intake air flow sensor. 7. Check the crank angle sensor and air cap. 8. Check the engine wiring harness. 9. Check the ECU.	•
Knock Sensor	P0325	#1 Knock Sensor Malfunction (1, 2, 3 CYL)	• **Condition** - No.1 knock sensor is defective. The value is not within the specified range when the engine temperature is over 75°C, the engine speed is over 3000 rpm and other units are properly operated (for cylinder No. 1, 2 and 3). • **Specification** - Sensitivity: approx. 26 ± 8 mV/g Resistance > 10 MΩ • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 117 and 118. 2. Inspect the No.1 knock sensor. 3. Check the ECU.	o
	P0330	#2 Knock Sensor Malfunction (4, 5, 6 CYL)	• **Condition** - No.2 knock sensor is defective. The value is not within the specified range when the engine temperature is over 75°C, the engine speed is over 3000 rpm and other units are properly operated (for cylinder No. 4, 5 and 6). • **Specification** - Sensitivity: approx. 26 ± 8 mV/g Resistance > 10 MΩ • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 114 and 115. 2. Inspect the No.2 knock sensor. 3. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Crank Position Sensor	P0335	Faulty Crank Position Sensor Signal - No Engine RPM	• **Condition** - The crank angle signals cannot be detected even the cam position is properly detected. • **Specification** - Sensor's internal resistance : 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	o
		Faulty Crank Position Sensor Signal - Faulty Recognition of Gap	• **Condition** - The cam and crank angle signal is improperly recognized or not recognized. • **Specification** - Sensor internal resistance: 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	o
		Crank Position Sensor Adaptation Malfunction - Poor Initialization	• **Condition** - The crank angle sensor is faulty initialized. • **Specification** - Sensor internal resistance: 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	o
	P0336	Crank Position Sensor - Excessive Engine RPM	• **Condition** - The engine rpm is over the proper amount or improper. • **Specification** - Sensor internal resistance: 700 ~ 1050 Ω • **Actions** 1. Measure the crankshaft rpm using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 100 and 99. 3. Inspect the crank angle sensor. 4. Inspect air gap between sensor and drive plate. 5. Check the drive plate's teeth. 6. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Cam Position Sensor	P0340	#1 Cylinder Synchronization Malfunction	• **Condition** - The cam position sensor is defective. The No.1 cylinder is poorly synchronized. • **Specification** - Sensor supply voltage: 4.5 V - 24 V • **Actions** 1. Measure the set voltage of cam position sensor. 2. Inspect the circuits and terminals of ECU pin No. 106 and 104. 3. Inspect the cam position sensor. 4. Check the cam sensor and sprocket for damage. 5. Check the ECU.	O
	P0341	#1 Cylinder Recognition Malfunction	• **Condition** - There is no cam recognition signal. • **Specification** - Sensor supply voltage: 4.5 V - 24 V • **Actions** 1. Measure the set voltage of cam position sensor. 2. Inspect the circuits and terminals of ECU pin No. 106 and 104. 3. Inspect the cam position sensor. 4. Check the cam sensor and sprocket for damage. 5. Check the ECU.	O
Ignition Coil	P0351	#1 Ignition Coil - Faulty Output Voltage	• **Condition** - The ignition unit is defective (for No. 2 and 5 cylinders). Ignition circuit: short circuit to primary and secondary current • **Specification** - Primary resistance: 0.36 Ω Secondary resistance: 5.9 kΩ - Secondary voltage: 38 KV - Ignition output Primary current: 7.0 A Primary voltage: 380 V • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 70, 71 and 72. 2. Inspect the power supply of ignition coil. 3. Inspect the ignition coil and high-voltage cable. 4. Inspect the spark plug for moisture, crack, wear, improper cap and excessive burnt electrode residue. 5. Check the ECU.	O

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Ignition Coil	P0352	#2 Ignition Coil - Faulty Output Voltage	• **Condition** - The ignition unit is defective (for No. 3 and 4 cylinders). Ignition circuit: short circuit to primary and secondary current • **Specification** - Primary resistance: 0.36 Ω Secondary resistance: 5.9 kΩ - Secondary voltage: 38 KV - Ignition output Primary current: 7.0 A Primary voltage: 380 V • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 70, 71 and 72. 2. Inspect the power supply of ignition coil. 3. Inspect the ignition coil and high-voltage cable. 4. Inspect the spark plug for moisture, crack, wear, improper cap and excessive burnt electrode residue. 5. Check the ECU.	o
	P0353	#3 Ignition Coil - Faulty Output Voltage	• **Condition** - The ignition unit is defective (for No. 1 and 6 cylinders). Ignition circuit: short circuit to primary and secondary current • **Specification** - Primary resistance: 0.36 Ω Secondary resistance: 5.9 kΩ - Secondary voltage: 38 KV - Ignition output Primary current: 7.0 A Primary voltage: 380 V • **Actions** 1. Inspect the circuits and terminals of the ECU pin No. 70, 71 and 72. 2. Inspect the power supply of ignition coil. 3. Inspect the ignition coil and high-voltage cable. 4. Inspect the spark plug for moisture, crack, wear, improper cap and excessive burnt electrode residue. 5. Check the ECU.	o
Secondary Air Supply System	P0411	Defective Secondary Air Pump - Insufficient Air Volume	• **Condition** - The secondary air injection pump relay and air pump valve/ hose are defective. • **Specification** - The voltage drop of pin No. 76 and ground: Below 1 V (current = 1000 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 76. 2. Inspect the secondary air pump relay. 3. Inspect the arrange ment of secondary air pump's valve and hose. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Secondary Air Supply System	P0413	Secondary Air Pump - Open circuit to Ground	• **Condition** - Secondary air injection pump relay circuit: short or open circuit to ground • **Specification** - The voltage drop of pin No. 76 and ground: Below 1 V (current = 1000 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 76. 2. Inspect the secondary air pump relay. 3. Check the ECU.	o
	P0414	Secondary Air Pump - Short circuit to B+	• **Condition** - Secondary air injection pump relay circuit: short circuit to battery • **Specification** - The voltage drop of pin No. 76 and ground: Below 1 V (current = 1000 mA) • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 76. 2. Inspect the secondary air pump relay. 3. Check the ECU.	o
Catalytic Monitoring Device	P0420	Faulty Catalyst 1 Purification Rate (1, 2, 3 Cylinder lines)	• **Condition** - The calculated purification rate for bank 1 is below the specified range. (Bank 1 - Cylinder 1/2/3) • **Actions** 1. Inspect the exhaust gas for leaks. 2. Inspect the oxygen sensor and its signal. 3. Inspect the actual effciency of exhaust gas through the exhaust gas test. 4. Inspect the catalyst. 5. Check the ECU.	o
	P0430	Faulty Catalyst 2 Purification Rate (4, 5, 6 Cylinder lines)	• **Condition** - The calculated purification rate for bank 2 is below the specified range. (Bank 2 - Cylinder 4/5/6) • **Actions** 1. Inspect the exhaust gas for leaks. 2. Inspect the oxygen sensor and its signal. 3. Inspect the actual effciency of exhaust gas through the exhaust gas test. 4. Inspect the catalyst. 5. Check the ECU.	o
Evaporated Gas Control System	P0442	Fuel Tank: Oil Leakage	• **Condition** - Minute leak of evaporated gas is occurred (below 1 mm). • **Actions** 1. Inspect the fuel tank and connecting route for the followings: - Fuel tank cap for crack or damage - Vacuum hose for crack, puncture and clogging - Fuel tank for crack, puncture and damage - Canister for crack, puncture and damage - Fuel tank pressure sensor - Canister shut-off valve 2. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Purge Control Solenoid Valve	P0443	Purge Control Solenoid Valve Malfunction - Faulty closing	• **Condition** - The purge control circuit is defective. The purge control is not available. • **Specification** - Duty ratio: 0 ~ 100 % Below 20 % - 7.5 Hz 20 ~ 30 % - 15 Hz 30 ~ 75 % - 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 34. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	o
	P0444	Purge Control Solenoid Valve Malfunction - Short or Open circuit to Ground	• **Condition** - Power supply circuit: short or open circuit to ground • **Specification** - Duty ratio: 0 ~ 100 % below 20 % - 7.5 Hz 20 ~ 30 % - 15 Hz 30 ~ 75 % - 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 34. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	o
	P0445	Purge Control Solenoid Valve Malfunction - Short circuit to B+	• **Condition** - Power supply circuit: short circuit to battery • **Specification** - Duty ratio: 0 ~ 100 % below 20 % - 7.5 Hz 20 ~ 30 % - 15 Hz 30 ~ 75 % - 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 34. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Canister Shut-off Valve	P0447	Canister Shut-off Valve Malfunction - Short or Open circuit to Ground	• **Condition** - Fuel system shut-off valve circuit: short or open circuit to ground • **Specification** - Duty ratio: 0 ~ 100 % below 20 % → 7.5 Hz 20 ~ 30 % → 15 Hz 30 ~ 75 % → 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 36. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	o
	P0448	Canister Shut-off Valve: Short circuit to B+	• **Condition** - Fuel system shut-off valve circuit: short circuit to battery • **Specification** - Duty ratio: 0 ~ 100 % below 20 % → 7.5 Hz 20 ~ 30 % → 15 Hz 30 ~ 75 % → 30 Hz - Internal resistance ≥ 26 Ω • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 36. 2. Inspect the power of the solenoid valve. 3. Inspect the purge control solenoid valve. 4. Check the ECU.	o
Fuel tank pressure sensor	P0450	Fuel Tank Pressure Sensor Malfunction	• **Condition** - Improper fuel tank pressure is detected. • **Specification** 37.5 mbar → 4.51 V 30.0 mbar → 3.90 V 20.0 mbar → 3.10 V 10.0 mbar → 2.30 V 0 mbar → 1.50 V 10.0 mbar → 0.60 V 12.5 mbar → 0.49 V • **Actions** 1. Measure the actual fuel tank pressure using SCAN-100. 2. Inspect the circuits of ECU pin No. 18 and 41 and check pin No. 42. 3. Check the fuel tank pressure sensor. 4. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel tank pressure sensor	P0452	Low Fuel Tank Pressure Sensor Signal	• **Condition** - The fuel tank pressure signal is below the minimum fuel tank pressure (0.1V). - Related circuit: open circuit • **Specification** 37.5 mbar → 4.51 V 30.0 mbar → 3.90 V 20.0 mbar → 3.10 V 10.0 mbar → 2.30 V 0 mbar → 1.50 V 10.0 mbar → 0.60 V 12.5 mbar → 0.49 V • **Actions** 1. Measure the actual fuel tank pressure using SCAN-100. 2. Inspect the circuits of ECU pin No. 18 and 41 and check pin No. 42. 3. Check the fuel tank pressure sensor. 4. Check the ECU.	o
	P0453	High Fuel Tank Pressure Sensor Signal	• **Condition** - The fuel tank pressure signal is over the maximum fuel tank pressure (4.9 V). - Related circuit: open circuit • **Specification** 37.5 mbar → 4.51 V 30.0 mbar → 3.90 V 20.0 mbar → 3.10 V 10.0 mbar → 2.30 V 0 mbar → 1.50 V 10.0 mbar → 0.60 V 12.5 mbar → 0.49 V • **Actions** 1. Measure the actual fuel tank pressuring using SCAN-100. 2. Inspect the circuits of ECU pin No. 18 and 41 and check pin No. 42. 3. Check the fuel tank pressure sensor. 4. Check the ECU.	o
Evaporated Gas Control System	P0455	Fuel Tank: Large Oil Leakage	• **Condition** - The evaporated gas in the fuel tank is leaked. Diagnosis for large leaks • **Actions** 1. Inspect the fuel tank and connecting route for the followings: - Fuel tank cap for crack or damage - Vacuum hose for crack, puncture and clogging - Fuel tank for crack, puncture and damage - Canister for crack, puncture and damage - Fuel tank pressure sensor - Canister shut-off valve 2. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Fuel Level Detection Sensor	P0460	Faulty Fuel Pump Fuel Level Sensor Indication	• **Condition** - The fuel level or the changed amount of fuel after driving for certain distance is improper. • **Specification** 67.29 liters - 38.0 Ω 62.48 liters - 48.2 Ω 58.28 liters - 56.8 Ω 52.23 liters - 67.0 Ω 45.34 liters - 83.3 Ω 37.41 liters - 99.5 Ω 30.10 liters - 122.5 Ω 21.36 liters - 150.0 Ω 6.45 liters - 268.2 Ω • **Actions** 1. Measure the actual fuel level using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 102 and 75. 3. Check the external resistance (200 Ω). 4. Inspect the fuel sender unit. 5. Check the ECU.	o
	P0462	Faulty Fuel Pump Fuel Level Transmission	• **Condition** - The FF (hexadecimal) is inputted to ECU from cluster. • **Specification** 67.29 liters - 38.0 Ω 62.48 liters - 48.2 Ω 58.28 liters - 56.8 Ω 52.23 liters - 67.0 Ω 45.34 liters - 83.3 Ω 37.41 liters - 99.5 Ω 30.10 liters - 122.5 Ω 21.36 liters - 150.0 Ω 6.45 liters - 268.2 Ω • **Actions** 1. Measure the actual fuel level using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 102 and 75. 3. Check the external resistance (200 Ω). 4. Inspect the fuel sender unit. 5. Check the ECU.	o
Cooling fan system (PWM electric fan)	P0480	PWM electric fan - Short circuit to power supply	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Cooling fan system (PWM electric fan)	P0480	PWM electric fan - Open/Short circuit to ground	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
Condenser Fan Unit	P0481	Condenser Fan (Low) Relay - Short circuit to B+	• **Condition** - Power supply wiring: short circuit • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 35. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
		Condenser Fan (Low) Relay - Open circuit to Ground	• **Condition** - Short or open circuit to ground • **Actions** 1. Inspect the circuit and terminal of ECU pin No. 35. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
Cooling fan system (PWM electric fan)	P0483	PWM electric fan - Motor overloaded	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
	P0484	PWM electric fan - Motor stalled	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	
	P0485	PWM electric fan - Short circuit	• **Condition** - The cooling fan's output wiring has a short circuit to power supply. • **Actions** 1. Inspect the circuit and the terminal of No. 39 ECU pin. 2. Inspect the power supply. 3. Inspect the cooling fan. 4. Check the ECU.	

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Auto Cruise Control	P0500	CAN signal Fault: Auto Cruise Malfunction	• **Condition** - The auto cruise is defective.	o
		Auto Cruise Acceleration Function Fault	• **Condition** - The acceleration signal is faulty.	o
		Auto Cruise Deceleration Function Fault	• **Condition** - The deceleration signal is faulty.	o
	P0501	Defective Vehicle Speed Sensor Signal	• **Condition** - The vehicle speed signal is faulty.	o
		Defective Vehicle Speed Sensor Signal	• **Condition** - The vehicle speed signal is faulty.	o
Battery Voltage	P0562	Low Battery Voltage	• **Condition** - The voltage of ECU is faulty. * Less than minimum 8 Volts in 2000 rpm below * Less than 10 Volts in 2000 rpm above • **Specification** Over 8 V • **Actions** 1. Measure the actual battery voltage using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 12, 11, 10 and 5. 3. Check the power supply relay. 4. Check the battery and the ECU.	o
Auto Cruise Control	P0564	Defective Auto Cruise Control Lever	• **Condition** - The auto cruise lever is defective.	o
CAN Communication	P0600	CAN Communication Malfunction: ASR	• **Condition** - The CAN communication with ASR is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	o
		CAN Communication Malfunction: ABS	• **Condition** - The CAN communication with ABS is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	o
		Defective Immobilizer System	• **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
CAN Communication	P0600	CAN Communication Malfunction: TCU	• **Condition** - The CAN communication with TCU is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: TOD (Not used)	• **Condition** - The CAN communication with TOD is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: Shift Lever	• **Condition** - The CAN communication with TGS lever is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: ABS Speed Sensor (FR)	• **Condition** - The ABS front speed sensor's signal is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O
		CAN Communication Malfunction: ABS Speed Sensor (RR)	• **Condition** - The ABS rear speed sensor's signal is defective. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	O

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
CAN Communication	P0600	CAN Communication Malfunction: Faulty Initialization	• **Condition** - The communication network data is not initialized. • **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	o
		CAN Communication Malfunction: MSR Transmission Signal	• **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	o
		CAN Communication Malfunction: ASR Transmission Signal	• **Specification** - Transfer rate: 500 K Baud • **Actions** 1. Check the CAN communication line of relevant unit. 2. Inspect the circuits and terminals of ECU pin No. 37 and 38. 3. Check the ECU.	o
Throttle Body Control	P0601	Throttle Position Sensor - Faulty Learning Signal	– **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
ECU	P0601	Auto Cruise Shutdown Memory Malfunction	• **Condition** - The ECU's internal circuit is defective. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		ECU Malfunction (Call Monitor)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
ECU	P0601	Servo Motor's Voltage Output Stopped	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		Servo Motor - Short or Open circuit	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		ECU Malfunction (CPU not compatible)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		ECU Malfunction (Faulty CPU Communication)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		ECU Malfunction (Faulty CPU (2) Environment)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		ECU Malfunction (CPU (2) Malfunction)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		ECU Malfunction (Faulty CPU run-time)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
		Communication Malfunction (CPU2)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
	P0602	ECU Not Coded	• **Condition** - The ECU coding is incorrect. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o
Incorrect Coding	P0602	Incorrect Transmission Coding	• **Condition** - TCU (Variant) coding is faulty. • **Actions** 1. Check the current coding using SCAN-100. 2. Check ECU and TCU. 3. Check the CAN line.	o
Incorrect Coding	P0603	Incorrect VIN ECU Coding	• **Actions** 1. Check the current coding using SCAN-100. 2. Check ECU and TCU. 3. Check the CAN line.	o
ECU	P0604	ECU Fault (RAM)	• **Condition** - The memory function of ECU RAM is defective. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
ECU	P0605	ECU Fault (EPROM)	• **Condition** - The memory function of ECU is defective. • **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty NVRAM Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty Coding ID Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty Coding Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
		ECU Fault (Faulty Programming Checksum)	• **Actions** 1. Check the ECU connector for contact. 2. Check the ECU.	O
Engine CHECK Warning Lamp	P0650	Engine CHECK Warning Lamp - Short circuit to B+	• **Condition** - Lamp circuit: short circuit to battery • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 29.	O
		Engine CHECK Warning Lamp - Open or Short circuit to Ground	• **Condition** - Lamp circuit: short or open circuit to ground • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 29.	O
Variable Air Intake System	P0661	Variable Air Intake Valve - Open or Short circuit to Ground	• **Condition** - Variable air intake valve circuit: short or open circuit to ground • **Specification** - ON/OFF flip range: approx. 3500 rpm - Operating current: 0.4 - 0.6 A - Solenoid internal resistance: 25 ± 5 Ω (20°C) • **Actions** 1. Check the actual operation condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 97. 3. Check the resonance flap's power supply. 4. Check the resonance flap solenoid and unit for damage. 5. Check the ECU.	O

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Variable Air Intake System	P0662	Variable Air Intake Valve - Short circuit to B+	• **Condition** - Variable air intake valve circuit: short circuit to battery • **Specification** - ON/OFF flip range: approx. 3500 rpm - Operating current: 0.4 - 0.6 A - Solenoid internal resistance: 25 ± 5 Ω (20°C) • **Actions** 1. Check the actual operating condition using SCAN-100. 2. Inspect the circuit and terminal of ECU pin No. 97. 3. Check the resonance flap's power supply. 4. Check the resonance flap solenoid and unit for damage. 5. Check the ECU.	o
TCU	P0702	TCU Fault	• **Actions** - Check DTC codes for TCU.	o
		Transmission Malfunction: Solenoid Valve Voltage	• **Actions** - Check DTC codes for TCU.	o
Auto Cruise Control	P0703	CAN Communication Fault: Stop Lamp Switch	• **Condition** - The brake switch is defective.	o
TCU	P0705	Transmission Malfunction: Shift Lever	• **Actions** - Check DTC codes for TCU.	o
	P0715	Transmission Malfunction: Vehicle Speed Sensor	• **Actions** - Check DTC codes for TCU.	o
	P0720	Transmission Malfunction: Faulty Speed to Output	• **Actions** - Check DTC codes for TCU.	o
	P0730	Transmission Malfunction: Hydraulic System	• **Actions** - Check DTC codes for TCU.	o
		Transmission Malfunction: Faulty Gear Recognition	• **Actions** - Check DTC codes for TCU.	o
	P0734	A/T Control Malfunction	• **Actions** - Check DTC codes for TCU.	o
	P0740	Transmission Malfunction: TCC Head Control	• **Actions** - Check DTC codes for TCU.	o
	P0743	Transmission Malfunction: Lockup Converter Clutch	• **Actions** - Check DTC codes for TCU.	o
	P0748	Transmission Malfunction: Modulator Pressure	• **Actions** - Check DTC codes for TCU.	o
	P0753	Transmission Malfunction: Solenoid Valve 1-2/4-5	• **Actions** - Check DTC codes for TCU.	o
	P0758	Transmission Malfunction: Solenoid Valve 2-3	• **Actions** - Check DTC codes for TCU.	o
	P0763	Transmission Malfunction: Solenoid Valve 3-4	• **Actions** - Check DTC codes for TCU.	o
	P0778	Transmission Malfunction: Transmission Pressure	• **Actions** - Check DTC codes for TCU.	o
	P0836	Transmission Malfunction: Transfer Case	• **Actions** - Check DTC codes for TCU.	o

Modification basis	
Application basis	
Affected VIN	

Related Item	DTC	Trouble	Help	Engine CHECK warning lamp
Incorrect Coding	P1570	Immobilizer Not Coded	• **Actions** 1. Check the current coding using SCAN-100. 2. Check ECU and TCU. 3. Check the CAN line.	o
Throttle Body Control	P1590	Safety Fuel Shut-off Time Expired	• **Specification** - Connection between No.1 throttle position sensor and No.2 throttle position sensor No.1 TPS's pull-down resistance: 464 kΩ No.2 TPS's pull-up resistance: 464 kΩ - Potentiometer voltage: 5 V - Potentiometer resistance: 1 kΩ ± 20 % - Permissible current for wiper arms: below 15 μA - Protective resistance for wiper arms: 320 Ω ± 20 % - Motor voltage/max. current : 12 V / below 1.7 A • **Actions** 1. Measure the actual output value using SCAN-100. 2. Inspect the circuits and terminals of ECU pin No. 67, 68, 84, 85, 87 and 112. 3. Inspect the electric throttle controller. 4. Check the ECU.	o
Starter Signal	P1609	Starter Signal Recognition Malfunction	• **Condition** - The starter signal is improperly recognized. • **Specification** - Over 9.6 V (for 1 seconds) • **Actions** 1. Inspect the circuit and terminal of the ECU pin No. 2. 2. Check the ECU.	o

Memo

INDEX

DIAGNOSIS

1. ECU-DIESEL..... 3

ECU-DIESEL

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DIAGNOSIS

1. ECU-DIESEL

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0100	Air Mass Flow (HFM) Malfunction	- The external power supply is faulty. • Check the external power supply. • Check the sensor wiring harness (open, short, poor contact). - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						
P0102	Low HFM Sensor Signal (Circuit Open)	- HFM sensing values are lower than minimum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0103	High HFM Sensor Signal (Circuit Short)	- HFM sensing values are higher than maximum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). - Actual air mass flow vs. Output voltages. • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						
P0105	Supply Voltage Fault to Booster Pressure Sensor	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction		o				o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0106	High Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						o
P0107	Booster Pressure Sensor Open/GND Short	- Out of signal range about boost pressure sensor at Engine running condition (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction		o				o

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0108	Booster Pressure Sensor Short	- Out of signal range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545~2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction		o				o
P0109	Low Booster Pressure Sensor Signal	- Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0110	Intake Air Temperature Circuit Malfunction - Source Power Problem	- The intake air temperature sensing value is lower than minimum value or higher than maximum value, or the external power to HFM sensor is faulty. - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. - Replace the ECU if required.		o				

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0112	Intake Air Temperature Circuit Malfunction - Open	- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. - Replace the ECU if required.		o				

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0113	Intake Air Temperature Circuit Malfunction - Short	- The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. • Check the source power circuit for short to ground. - Check the sensor resistance. • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. - Replace the ECU if required.		o				
P0115	Supply Voltage Fault to Coolant Temperature Sensor	- Check if the supply voltage of approx. 12 V is applied.						
P0117	Coolant Temperature Sensor Malfunction - Open	- Malfunction in recognition of coolant temperature • Less than minimum values (Circuit Open) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open and poor contact). • ECU pin #A01, A02 - Visually check the sensor and replace if required. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0118	Coolant Temperature Sensor Malfunction - Short	- Malfunction in recognition of coolant temperature • More than maximum values (Circuit Short) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (short and poor contact). • ECU pin #A01, A02 - Visually check the sensor and replace if required. - Replace the ECU if required.						
P0120	Accelerator Pedal Sensor #1 Malfunction - Supply Voltage Fault	- The supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	o					o
P0122	Accelerator Pedal Sensor #1 Malfunction - Open	- Out of range about potentiometer 1 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	o					o
P0123	Accelerator Pedal Sensor #1 Malfunction - Short	- Out of range about potentiometer 1 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	o					o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0147	Impossible to Learn Idle MDP	- Causes (Idle range MDP learning) • The MDP is not learned again until driving over 50,000 km after the MDP is learned. - Conditions for MDP learning (Idle) • Leaning twice for each cylinder (attempt every 5 sec.) • Initial MDP learning: coolant temperature > 60°C • Fuel temperature: 0 ~ 80°C • Vehicle speed: Idle. • The tachometer's needle vibrates while learning idle MDP. • Replace ECU after learning.						
P0148	Impossible to Learn Drive MDP	- Causes • It occurs twice for each cylilnder if MDP is not learned again until driving over 50,000 km after the MDP is learned. - Actions • Check knock sensor and wiring. • Check injector specification. • Check C3I/C2I.						
P0171	Insufficient MDP of Injector #1	- MDP learning value is decreased due to aged injector #1.						
P0172	Insufficient MDP of Injector #2	- MDP learning value is decreased due to aged injector #2.						
P0173	Insufficient MDP of Injector #3	- MDP learning value is decreased due to aged injector #3.						
P0174	Insufficient MDP of Injector #4	- MDP learning value is decreased due to aged injector #4.						
P0175	Insufficient MDP of Injector #5	- MDP learning value is decreased due to aged injector #5.						
P0180	Fuel Temperature Sensor - Malfunction	- The power source circuit is faulty for fuel temperature sensor. (Fuel temperature sensor is mounted in high pressure pump) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin #A09, A10 - Check the ECU wiring and replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0182	Fuel Temperature Sensor - Short to Ground	- The sensing values are higher than specified values for fuel temperature sensor. (More than maximum sensing values 140°C - Circuit Short) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. • ECU pin #A09, A10 - Check the ECU wiring and replace the ECU if required.						
P0183	Fuel Temperature Sensor - Short to B+	- The sensing values are lower than specified values for fuel temperature sensor. (Less than maximum sensing values - 40°C - Circuit Open) - Actual fuel temp. vs. Resistance • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. - Check the ECU wiring and replace the ECU if required.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0190	Supply Voltage Fault to Fuel Rail Pressure Sensor	- The supply voltage to fuel rail pressure sensor is faulty. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					O
P0191	Fuel Rail Pressure Sensor Signal Fault	- The rail pressure drop is too high. - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					O
P0192	Fuel Rail Pressure Sensor Malfunction - Open	- The fuel rail pressure sensing values are lower than specified values. • Minimum sensing values: - 112 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0193	Fuel Rail Pressure Sensor Malfunction - Short	- The fuel rail pressure sensing values are higher than specified values. • Maximum sensing values: 1,600 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	O					O
P0201	Injector #1 Circuit Open	- Injector #1 circuit malfunction: Open. • If the injector pin is defective, perform C2I/C3I coding and check again. • If the injector pin is normal, check the ECU wiring harness . - Replace the ECU if required.						O
P0202	Injector #2 Circuit Open	- Injector #2 circuit malfunction: Open. • If the injector pin is defective, perform C2I/C3I coding and check again. • If the injector pin is normal, check the ECU wiring harness. - Replace the ECU if required.						O
P0203	Injector #3 Circuit Open	- Injector #3 circuit malfunction: Open. • If the injector pin is defective, perform C2I/C3I coding and check again. • If the injector pin is normal, check the ECU wiring harness. - Replace the ECU if required.						O
P0204	Injector #4 Circuit Open	- Injector #4 circuit malfunction: Open. • If the injector pin is defective, perform C2I/C3I coding and check again. • If the injector pin is normal, check the ECU wiring harness. - Replace the ECU if required.						O
P0205	Injector #5 Circuit Open	- Injector #5 circuit malfunction: Open. • If the injector pin is defective, perform C2I/C3I coding and check again. • If the injector pin is normal, check the ECU wiring harness. - Replace the ECU if required.						O

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0215	Main Relay Fault - Stuck	- The main relay is stuck ; Shut down. - Resistance of main relay: 92 Ω ± 9 Ω (at 20°C) - Check the main relay wiring harness. - Check the ECU wiring harness. - If the forced operation is not available, replace the ECU. - Check the fuse for main relay						
P0219	Too Small Clearance of Crank Angle Sensor	- Crank angle signal faults or clearance too close. - Check the sensor wiring harness (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.						o
P0220	Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault	- The supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	o					o
P0222	Accelerator Pedal Sensor #2 Malfunction - Open	- Out of range about potentiometer 2 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	o					o
P0223	Accelerator Pedal Sensor #2 Malfunction - Short	- Out of range about potentiometer 2 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. • Check the circuit for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required.	o					o

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0243	VGT Turbocharger Actuator Circuit Short	- Causes • There is electric problem in the vacuum modulator drive module of turbocharger. - Check pin for the followings (Vacuum Modulator): • Power (Main Relay) • GND - Actions • Check the unit's resistance (15.4 +/- 0.7 Ω) and wiring. • Check the input voltage (12V). • Visually check the unit and replace if necessary.						
P0245	Turbo Charger Actuator Circuit Fault - Short	- The waste gate driver circuit is short to ground or open - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness. - Replace the ECU if required.	O					O
P0246	Turbo Charger Actuator Circuit Fault - Short to B+	- The turbo charger actuator power source circuit is short. - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness for short and poor contact. - Replace the ECU if required.	O					O
P0251	IMV Driver Circuit Malfunction - Short	- IMV driver circuit malfunction: Short - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O	O
P0253	IMV Driver Circuit Malfunction - Short to Ground	- IMV driver circuit malfunction: Short to ground - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O	O
P0255	IMV Driver Circuit Malfunction - Open	- IMV driver circuit malfunction: Open - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the IMV resistance. • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.			O		O	O

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0263	Injector #1 Balancing Fault	- Injector #1 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I/C3I coding after replacement).						
P0266	Injector #2 Balancing Fault	- Injector #2 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I/C3I coding after replacement).						
P0269	Injector #3 Balancing Fault	- Injector #3 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I/C3I coding after replacement).						
P0272	Injector #4 Balancing Fault	- Injector #4 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I/C3I coding after replacement).						
P0275	Injector #5 Balancing Fault	- Injector #5 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I/C3I coding after replacement).						
P0325	Accelerometer #1 (Knock Sensor) Malfunction	- The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. - If the trouble still exists even after replacing the accelerometer, replace the ECU.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0325	Accelerometer #1 (Knock Sensor) Malfunction	- The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. - If the trouble still exists even after replacing the accelerometer, replace the ECU.						
P0335	No Crank Signals	- Refer to P0372.						O
P0336	Too Large Clearance of Crank Angle Sensor	- Air gap of crank angle sensor is abnormal. - Check the sensor wiring harness (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.						O
P0341	Cam Position Sensor Malfunction (Poor Synchronization)	- Not synchronized with Crank angle signal. - Check the source voltage of cam position sensor (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.						O
P0344	Cam Position Sensor Malfunction	- No cam recognition signal (missing events). - Check the source voltage of cam position sensor (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required.						O

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0372	Crank Angle Sensor Malfunction	- Even though cam position recognition is normal, no crank angle signal recognition (missing tooth). - Check the sensor wiring harness (open, short, poor contact). - Check the resistance of crank angle sensor: 1090 Ω ± 15 %. - Measure the air gap: 0.3 ~ 1.3 mm • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. • Drive plate (A/T), DMF (M/T) - Replace the ECU if required.						o
P0400	EGR Control Valve Fault	- When the EGR emission is more than specified value. • The EGR controller circuit is open or short to ground. • The EGR controller is short to battery. - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check if the EGR valve is stuck. - Check the resistance of EGR valve: 15.4 Ω. - Check the ECU wiring harness.						
P0401	EGR Control Valve Fault (Low)	- When the EGR emission is more than specified value. • The EGR controller circuit is open or short to ground. • The EGR controller is short to battery. - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check if the EGR valve is stuck. - Check the resistance of EGR valve: 15.4 Ω. - Check the ECU wiring harness.						
P0402	EGR Valve Stuck in Open Position	- Causes • The E-EGR valve is stuck with it open. - Check pin (refer to the page 1407) - Actions • Check E-EGR valve and sensor wiring. • Visually check the unit and replace if necessary. • Replace the ECU if required. • Refer to DTCs (P0407 and P0408).						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0405	High EGR Open Position Deviation	- Causes • The difference between E-EGR position demand (MAP) value and E-EGR position feedback signal value is over 15% (the sensor output indicates E-EGR is open over 15% in the close status). - Actions • Measure the resistance of E-EGR valve sensor. • Check the sensor and actuator wiring harness. • Check the unit.						o
P0406	High EGR Close Position Deviation	- Causes • The difference between E-EGR position demand (MAP) value and E-EGR position feedback signal value is over 15% (the sensor output indicates EEGR is closed over 15% in the open status). - Actions • Measure the resistance of E-EGR valve sensor. • Check the sensor and actuator wiring harness. • Check the unit.		o				
P0407	Low EGR Position Signal	- Diagnosis of E-EGR signal for the followings: • Sensor signal is high or low. • Total resistance value: 4Ω +/-40% • Sensor output range: 1.2 ~ 4.0 V • Total sensor resistance: 4 kΩ ± 40% • Total motor resistance: 8.0Ω ± 0.5Ω - Check pin for the followings: • Check sensor reference voltage (5V) - ECU Pin #A33 • Sensor signal - ECU Pin #A82 • Sensor GND - ECU Pin #A09 - Actions • Measure the resistance of E-EGR valve sensor. • Check the sensor and actuator wiring harness. • Check the unit.						

Modification basis	
Application basis	
Affected VIN	

<table>
<tr><th>DTC</th><th>Trouble</th><th>Help</th><th>Torque Reduction (max.50%)</th><th>Torque Reduction (max.20%)</th><th>Delayed Engine Stop</th><th>Immediately Engine Stop</th><th>Limp Home Mode</th><th>Engine Check Warning Lamp</th></tr>
<tr><td>P0408</td><td>High EGR Position Signal</td><td>- Diagnosis of E-EGR signal for the followings:
• Sensor signal is high or low.
• Total resistance value: 4Ω +/-40%
• Sensor output range: 1.2 ~ 4.0 V
• Total sensor resistance: 4 kΩ ± 40%
• Total motor resistance: 8.0Ω ± 0.5Ω
- Check pin for the followings:
• Check sensor reference voltage (5V)
• Sensor signal - ECU pin #A82
• Sensor GND - ECU pin #A09
- Actions
• Measure the resistance of E-EGR valve sensor.
• Check the sensor and actuator wiring harness.
• Check the unit.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>P0430</td><td>Front and Rear Exhaust Gas Temperature Sensors - Excessive Temperature Value Difference</td><td>- The value difference between the front exhaust gas temperature sensor on the exhaust manifold and the rear exhaust gas temperature sensor on the CDPF is out of the specified range.
- Measure the resistance of the exhaust gas temperature sensors by temperature and the supplied voltage.
- Check the ECU terminal No. A06 and A30 for connecting the front exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.
- Check the ECU terminal No. A23 and A42 for connecting the rear exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.
<table>
<tr><th>CDPF temperature (°C)</th><th>Resistance (Ω)</th></tr>
<tr><td>-40</td><td>169.18</td></tr>
<tr><td>-20</td><td>184.64</td></tr>
<tr><td>0</td><td>200.0</td></tr>
<tr><td>25</td><td>219.07</td></tr>
<tr><td>50</td><td>237.99</td></tr>
<tr><td>100</td><td>275.4</td></tr>
<tr><td>150</td><td>312.2</td></tr>
<tr><td>200</td><td>348.5</td></tr>
<tr><td>250</td><td>384.1</td></tr>
<tr><td>300</td><td>419.2</td></tr>
<tr><td>350</td><td>453.7</td></tr>
<tr><td>400</td><td>487.6</td></tr>
<tr><td>450</td><td>520.9</td></tr>
<tr><td>500</td><td>553.6</td></tr>
<tr><td>600</td><td>617.3</td></tr>
<tr><td>700</td><td>678.7</td></tr>
<tr><td>800</td><td>737.7</td></tr>
<tr><td>830</td><td>754.9</td></tr>
<tr><td>850</td><td>766.3</td></tr>
</table></td><td></td><td></td><td></td><td></td><td></td><td>o</td></tr>
</table>

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<tr><td>P0431</td><td>DOC malfunction</td><td>- The measured DOC temperature is below the limit for recycling (below 0.5 times).
- Cause: Old/worn DOC
- The recycling mode cannot be activated.
- Check and clear the DTC using SCAN-100.
- Replace the CDPF.</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P0432</td><td>CDPF - Excessive Soot Accumulated</td><td>- The pressure is over 23 Kpa for over 960 seconds due to the resistance by soot.
- If P0432 is generated without error in pressure sensor, the torque is reduced.
- Remove CDPF and clean it by blowing it from the opposite side of discharged side. Then, install it again and check it for soot.</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P0436</td><td>Rear exhaust gas temperature sensor - faulty signal</td><td>- The signal value from the rear exhaust gas temperature sensor is over the specified range.
- See P0437 and P0438 for more information and inspection.</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P0437</td><td>Rear exhaust gas temperature sensor - low signal</td><td>- The signal value from the rear exhaust gas temperature sensor is below the specified range.
- Check the ECU terminal No. A23 and A42 for connecting the rear exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.
<table>
<tr><th>CDPF temperature (°C)</th><th>Resistance (Ω)</th></tr>
<tr><td>-40</td><td>169.18</td></tr>
<tr><td>-20</td><td>184.64</td></tr>
<tr><td>0</td><td>200.0</td></tr>
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Modification basis	
Application basis	
Affected VIN	

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<tr><td>P0438</td><td>Rear exhaust gas temperature sensor - high signal</td><td>- The signal value from the rear exhaust gas temperature sensor is over the specified range.
- Check the ECU terminal No. A23 and A42 for connecting the rear exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.
<table><tr><th>CDPF temperature (°C)</th><th>Resistance (Ω)</th></tr><tr><td>-40</td><td>169.18</td></tr><tr><td>-20</td><td>184.64</td></tr><tr><td>0</td><td>200.0</td></tr><tr><td>25</td><td>219.07</td></tr><tr><td>50</td><td>237.99</td></tr><tr><td>100</td><td>275.4</td></tr><tr><td>150</td><td>312.2</td></tr><tr><td>200</td><td>348.5</td></tr><tr><td>250</td><td>384.1</td></tr><tr><td>300</td><td>419.2</td></tr><tr><td>350</td><td>453.7</td></tr><tr><td>400</td><td>487.6</td></tr><tr><td>450</td><td>520.9</td></tr><tr><td>500</td><td>553.6</td></tr><tr><td>600</td><td>617.3</td></tr><tr><td>700</td><td>678.7</td></tr><tr><td>800</td><td>737.7</td></tr><tr><td>830</td><td>754.9</td></tr><tr><td>850</td><td>766.3</td></tr></table></td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P043A</td><td>Rear exhaust gas temperature sensor - faulty voltage supply</td><td>- The supplied voltage of the rear exhaust gas temperature sensor is out of the specified range.
- Check the ECU terminal No. A42 for connecting the rear exhaust gas temperature sensor as well as the sensor terminal No. 1.</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P0470</td><td>Differential Pressure Sensor - Max./Min. Output</td><td>- Specification for output value of pressure sensor : 0.5 ~4.5V
- The output value of sensor is over 4.5 V or below 0.5 V.
- Check the pressure sensor wiring for open or short circuit.</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P0471</td><td>Differential Pressure Sensor - Abnormal Differential Pressure</td><td>- The actual (measured) pressure difference (actual pressure) is different from the calculated pressure difference (pressure difference between front and rear side of CDPF).
(Possible cause : malfunctioning pressure sensor, leakage in pressure tube, parts removed)</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P0480</td><td>PWM Electric Fan Malfunction (Open circuit)
(Only for D27DTP (POWER UP) model)</td><td>- The communication line between PWM electric fan and ECU is open.
- The PWM electric fan's own malfunction cannot be identified.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0481	PWM Electric Fan Malfunction(Short to B+) (Only for D27DTP (POWER UP) model)	- The communication line between PWM electric fan and ECU has a short to battery. - The PWM electric fan's own malfunction cannot be identified.						
P0482	PWM Electric Fan Malfunction (Short to GND) (Only for D27DTP (POWER UP) model)	- The communication line between PWM electric fan and ECU has a short to ground. - The PWM electric fan's own malfunction cannot be identified.						
P0483	Fan PWM motor out have short to GND	- Motor out have short to GND						
P0484	Fan PWM Stall motor	- Stall motor						
P0485	Fan PWM motor have over load	- Motor have over load						
P0487	Faulty Maximum Throttle Closing Value	- Causes • The throttle is not fully closed when learning the full open value after stopping the engine. - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.						
P0488	Throttle Valve - Seized	- The vacuum modulator of throttle valve has an open circuit. - The throttle valve is seized (mechanically). - Check condition for seizing: * No error in HFM and EGR * Engine running						o
P0488	Faulty Maximum Throttle Opening Value	- Causes • The throttle is not fully open when learning the full open value after initial ignition on. - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0530	Air Conditioner Refrigerant Sensor Supply Power Fault	- Causes • There is electric problem in the air conditioner's pressure sensor. - Check the sensor's specifications and ECU pin. • Power: 5V ..... ECU Pin #B29 • Sensor signal ..... ECU Pin #B41 • Sensor GND ..... ECU Pin #B36 • Actual range: 2.0 kgf/cm^2 (0.75V) ~ 32 kgf/cm^2 (4.5V) • Resistance: 51KΩ (signal terminal and ground) • Output signal 0.5V ..... 0.0 kgf/cm^2 4.5V ..... 32.0 kgf/cm^2 - Actions • Check the sensor's resistance and wiring. • Visually check the unit and replace if necessary.						
P0532	Air Conditioner Refrigerant Pressure Signal Circuit Short	- Causes • There is electric problem in the air conditioner's pressure sensor. - Check the sensor's specifications and ECU pin. • Power: 5V ..... ECU Pin #B29 • Sensor signal ..... ECU Pin #B41 • Sensor GND ..... ECU Pin #B36 • Actual range: 2.0 kgf/cm^2 (0.75V) ~ 32 kgf/cm^2 (4.5V) • Resistance: 51KΩ (signal terminal and ground) • Output signal 0.5V ..... 0.0 kgf/cm^2 4.5V ..... 32.0 kgf/cm^2 - Actions • Check the sensor's resistance and wiring. • Visually check the unit and replace if necessary.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0533	Excessive Air Conditioner Refrigerant Pressure	- Causes • There is electric problem in the air conditioner's pressure sensor. - Check the sensor's specifications and ECU pin. • Power: 5V ..... ECU Pin #B29 • Sensor signal ..... ECU Pin #B41 • Sensor GND ..... ECU Pin #B36 • Actual range: 2.0 kgf/cm^2 (0.75V) ~ 32 kgf/cm^2 (4.5V) • Resistance: 51KΩ (signal terminal and ground) • Output signal 0.5V ..... 0.0 kgf/cm^2 4.5V ..... 32.0 kgf/cm^2 - Actions • Check the sensor's resistance and wiring. • Visually check the unit and replace if necessary.						
P0560	Battery Voltage Malfunction	- Malfunction in recognition of system source voltage (A/D converter faults). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O					O
P0562	Low Battery Voltage	- Malfunction in recognition of system source voltage (Lower than threshold). • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O					O

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0563	High Battery Voltage	- Malfunction in recognition of system source voltage (Higher than threshold). • More than minimum 16 Volts in 2000 rpm below - Check the battery wiring harness (open, short, poor contact). - Check the alternator. - Check the body ground. - Measure the resistance between body ground and ECU ground. • Repair the ECU ground if the resistance is high. - Replace the ECU if required.	O					O
P0571	Brake Pedal Switch Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake and light switch wiring harness. - Check the supply voltage to brake and light switch (12 V). - Check the brake and light switch for contact. - Check the ECU wiring harness (short, poor contact). - Replace the ECU if required.						
P0602	Faulty Vehicle Speed Sensor Coding	- The vehicle signal is inputted via CAN communication without ESP or TCCU. - The CAN communication between units is malfunctioning.						
P0606	ECU Watchdog Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0608	Faulty ABS/ESP Coding	- The ABS/ESP variant coding is faulty. - The CAN communication is malfunctioning.						
P0611	No Data for C3I	- C3I • There is no C3I data in ECU or the checksum is faulty.						O
P0612	Internal Error in C3I Data	- C3I • The error is occurred while sending C3I data in ECU to RAM.						
P0613	Faulty TCU Coding	- The TCU variant coding is faulty. - The CAN communication between units is malfunctioning.						
P0614	TCCU Coding Failt	- Occurred if TCCU variant coding is faulty. - Occurred when there is CAN communication error between units.						
P0618	Multi calibration not performed	- Perform multi calibration again.						
P0619	Multi calibration performing error	- Perform multi calibration again.						
P062D (former P1611)	Injector Bank #1 Malfunction - Low Voltage 4-cylinder engine : 1nd and 4rd cylinders 5-cylinder engine : 1nd, 4rd and 3rdcylinders	- Malfunction of injector (#1, #4, #3) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I/C3I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						O
P062E (former P1618)	Injector Bank #2 Malfunction - Low Voltage 4-cylinder engine : 2nd and 3rd cylinders 5-cylinder engine : 2nd and 5rd cylinders	- Malfunction of injector (#2, #5) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key “OFF”. • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key “ON”. • If recurred, replace the injector (perform C2I/C3I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						O

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P062F	Multi calibration memory error	- Perform multi calibration again.						
P0630	Variant Coding is not done	- Variant coding is not done						O
P0631	Variant Coding writing error	- Variant coding writing error						O
P0633	Immobilizer Fault (refer to immobilizer section)	- Key memory is not available (permissible - 5). - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P0641	ECU Supply Voltage 1 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.						
P0642	ECU Supply Voltage 1 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.						
P0643	ECU Supply Voltage 1 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.						
P0649	Diag Lamp Drive Open Circuit	Open circuit						
P0650	Diag Lamp Drive Short to BATT	Short to batt						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0651	ECU Supply Voltage 2 Fault (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			o		o	o
P0652	ECU Supply Voltage 2 Fault - Low (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			o		o	o
P0653	ECU Supply Voltage 2 Fault - High (5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 5 V - Check the supply voltage to each sensor • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required.			o		o	o
P066A	Internal malfunction in #1 glow plug controller	- Cylinder #1 (Glow Plug #1) - Details: refer to P2673.						
P066B	Internal short in #1 glow plug controller	- Cylinder #1 (Glow Plug #1) - Details: refer to P2673.						
P066C	Internal malfunction in #2 glow plug controller	- Cylinder #2 (Glow Plug #2) - Details: refer to P2673.						
P066D	Internal short in #2 glow plug controller	- Cylinder #2 (Glow Plug #2) - Details: refer to P2673.						
P066E	Internal malfunction in #3 glow plug controller	- Cylinder #3 (Glow Plug #3) - Details: refer to P2673.						
P066F	Internal short in #3 glow plug controller	- Cylinder #3 (Glow Plug #3) - Details: refer to P2673.						
P0670	Defective power supply of glow plug controller	- Details: refer to P2673.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0671	#3 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P0671	#3 Glow Plug - Open Circuit (applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an open circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0672	#4 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P0672	#4 Glow Plug - Open Circuit (applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an open circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0673	#5 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P0673	#5 Glow Plug - Open Circuit (applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an open circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0674	#1 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P0674	#1 Glow Plug - Open Circuit	D27DT: Preheat control relay - The glow plug has an open circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0675	#2 Glow Plug Fault - Open	- The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P0675	#2 Glow Plug - Open Circuit (applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an open circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P067A	Internal malfunction in #4 glow plug controller	- Cylinder #4 (Glow Plug #4) - Details: refer to P2673.						
P067B	Internal short in #4 glow plug controller	- Cylinder #4 (Glow Plug #4) - Details: refer to P2673.						
P067C	Internal malfunction in #5 glow plug controller	- Cylinder #5 (Glow Plug #5) - Details: refer to P2673.						
P067D	Internal short in #5 glow plug controller	- Cylinder #5 (Glow Plug #5) - Details: refer to P2673.						
P0683	Defective CAN communiction of glow plug controller	- GCU's CAN signal is intermittently defective.						
P0685	Main Relay Malfunction	- The the main relay is unexpectedly high/low state (ECU is supplied after 3 seconds). - Relay resistance: 92 ± 9 Ω (at 20°C) - Check the relay wiring harness (open, short and poor contact). - If the forced operation is not available, replace the ECU.						
P0697	ECU Supply Voltage Fault (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.						
P0698	ECU Supply Voltage Fault - Low (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.5 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.						
P0699	ECU Supply Voltage Fault - High (2.5 V)	- Malfunction reference supply voltage from ECU • Supply voltage: 2.5 V - Check the supply voltage to each sensor • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required.						
P0700	TCU Signal Fault	- The communication between ECU and TCU is faulty. - Check the communication line between ECU and TCU. - Replace the ECU if required.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P0704	Clutch switch malfunction	- The clutch switch is faulty (Manual Transmission Only). - Check the switch wiring harness. - Check the switch supply voltage and operations. - Replace the ECU if required.						
P0805	Neutral Signal Input Malfunction (Only for D27DT M/T model)	- The neutral signal of M/T is sent to CAN cluster which is then sent to ECU via CAN communication. - The ECU cannot detect whether signal is missing due to the malfunction in neutral signal and wiring or due to the line malfunction. - Check the wiring related to neutral switch.						
P1102	HFM Sensor - High Characteristic Value (Only for D27DT model)	- The characteristic value of HFM sensor is over the specified value (not wiring malfunction).						
P1103	HFM Sensor - Low Characteristic Value (Only for D27DT model)	- The characteristic value of HFM sensor is below the specified value (not wiring malfunction).						
P1105	Barometric Sensor Circuit Short	- Out of range about barometric sensor (over voltage). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.						o
P1106	Booster Pressure Sensor Malfunction	- Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction		o				

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1107	Barometric Sensor Circuit Short/GND Short	- Out of range about barometric sensor (short to ground). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.						
P1108	Barometric Sensor Circuit Short	- Out of range about barometric sensor (short to B+). - Actual barometric pressure vs. Output voltages. • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU.						
P1109	Booster Pressure Sensor Initial Check Fault	- Implausible signal values or range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P110A	High HFM OBD diagnosis signal	- Air mass flow value from HFM is higher than air mass temperature and other control values. - Check the ECU wiring harness (open and poor contact). - Actual air mass flow vs. output voltages • -20 kg/h: 0.47 V • 0 kg/h: 0.99 V • 10 kg/h: 1.2226 ~ 1.2398 V • 15 kg/h: 1.3552 ~ 1.3778 V • 30 kg/h: 1.6783 ~ 1.7146 V • 60 kg/h: 2.1619 ~ 2.2057 V • 120 kg/h: 2.7215 ~ 2.7762 V • 250 kg/h: 3.4388 ~ 3.5037 V • 370 kg/h: 3.8796 ~ 3.9511 V • 480 kg/h: 4.1945 ~ 4.2683 V • 640 kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						o
P110B	Low HFM OBD diagnosis signal	- Air mass flow value from HFM is lower than air mass temperature and other control values. - Check the air cleaner condition and intake air leakage. - Check the ECU wiring harness (open and poor contact). - Actual air mass flow vs. output voltages • -20 kg/h: 0.47 V • 0 kg/h: 0.99 V • 10 kg/h: 1.2226 ~ 1.2398 V • 15 kg/h: 1.3552 ~ 1.3778 V • 30 kg/h: 1.6783 ~ 1.7146 V • 60 kg/h: 2.1619 ~ 2.2057 V • 120 kg/h: 2.7215 ~ 2.7762 V • 250 kg/h: 3.4388 ~ 3.5037 V • 370 kg/h: 3.8796 ~ 3.9511 V • 480 kg/h: 4.1945 ~ 4.2683 V • 640 kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required.						o

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1115	Coolant Temperature Sensor Malfunction	- Implausible values of coolant temperature (If the temperature is below the limits values after warm up). - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual air temp. vs. Resistance • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open, short and poor contact). - Visually check the sensor and replace if required. - Check the thermostat, water pump radiator related coolant route (thermostat stuck). - Replace the ECU if required.						
P1120	Accelerator Pedal Sensor #1 Malfunction	- The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	o					o
P1121	Accelerator Pedal Sensor #2 Malfunction	- The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.	o					o
P1122	Accelerator Pedal Sensor Malfunction (Limp Home Mode)	- When triggering limp home mode. - Check the supply voltage to sensor. - Check the wiring harness. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					o	o
P1123	Accelerator Pedal Sensor Malfunction (Torque Mode)	- When triggering reduced torque mode. - Check the supply voltage to sensor. - Check the wiring harness. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required	o					o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1124	Accelerator Pedal Sensor Malfunction - Stuck	- The accelerator pedal sensor is stuck. - Check the brake switch wiring harness and operations. - Check the accelerator pedal operations. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required.					o	o
P1148	Accelerometer (Knock Sensor) Learning Fault	- Check if the MDP is successful. - Check the accelerometer (knock sensor) sensor and wiring harness. - Replace the ECU if required.		o				
P1149	Too High Water Level in Fuel Filter	- Drain the water from fuel filter.		o				
P1149	Excessive water in fuel filter	- Drain water from the fuel filter.		o	Fuel warning lamp: OFF Water separator warning lamp ON			
P1170	Torque Trim Fault - High	- Refer to P0372.						
P1171	#1 Injector MDP Malfunction	- The #1 injector MDP is faulty. - Replace the injector and perform C2I/C3I coding again.						
P1172	#2 Injector MDP Malfunction	- The #2 injector MDP is faulty. - Replace the injector and perform C2I/C3I coding again.						
P1173	#3 Injector MDP Malfunction	- The #3 injector MDP is faulty. - Replace the injector and perform C2I/C3I coding again.						
P1174	#4 Injector MDP Malfunction	- The #4 injector MDP is faulty. - Replace the injector and perform C2I/C3I coding again.						
P1175	#5 Injector MDP Malfunction	- The #5 injector MDP is faulty. - Replace the injector and perform C2I/C3I coding again.						
P1190	Fuel Rail Pressure Sensor Initial Signal Fault	- The rail pressure sensor initial values are higher or lower than specified values with the ignition “ON”. • Maximum sensing values: 90 bar (Short) • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	o					o

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1191	Pressure Build Up - Too Slow	- The pressure build up during cranking is too slow. - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. • Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						o
P1192	Fuel Rail Pressure Sensor Initial Signal Fault - Low	- The rail pressure sensor initial values are lower than specified values with the ignition “ON”. • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	o					o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1193	Fuel Rail Pressure Sensor Initial Signal Fault - High	- The rail pressure sensor initial values are higher than specified values with the ignition "ON". • Maximum sensing values: 90 bar (Short) - Check the supply voltage to sensor. • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required.	o					o
P1201	Injector #1 Circuit Short	- Injector #1 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I/C3I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU. - Replace the ECU if required.						
P1202	Injector #2 Circuit Short	- Injector #2 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I/C3I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU. - Replace the ECU if required.						
P1203	Injector #3 Circuit Short	- Injector #3 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I/C3I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1204	Injector #4 Circuit Short	- Injector #4 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I/C3I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU. - Replace the ECU if required.						
P1205	Injector #5 Circuit Short	- Injector #5 circuit malfunction: Short. • If the trouble recurs with the injector removed, replace the injector. Perform C2I/C3I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU. - Replace the ECU if required.						
P1234	VGT Operation Fault (High)	- The boost pressure control is faulty. - Check the air intake system. - Check the supply voltage to sensor. - Check the wiring harness and the ECU wiring harness. - Replace the ECU if required.	o					
P1235	VGT Operation Fault	- The boost pressure control is faulty. - Check the air intake system. - Check the supply voltage to sensor. - Check the wiring harness and the ECU wiring harness. - Replace the ECU if required.	o					o
P1252	Too High IMV Pressure	- The rail pressure is excessively high. - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1253	Minimum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too low - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						o
P1254	Maximum Rail Pressure Control Malfunction (IMV Fault)	- Rail pressure faults: Too high - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						o

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1256	Too Small Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						o
P1257	Too Large Transfer Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1258	Too Small High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						o
P1259	Too Large High Pressure Fuel in Rail Pressure System	- Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. - Check the rail pressure sensor. • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required.						o

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1260	Too high IMV Driving Current	- Abnormal rail pressure, IMV CURRENT TRIM TOO HIGH, DRIFT - Check the IMV wiring harnesses. - Check the ECU wiring harnesses. • Check ECU's pin A76 for open and short. - Check the Rail pressure sensor. • Supply voltage: 5 ± 0.1V • Output voltage at 1600 bar: 4.055 ± 0.125V • Output voltage at atmospheric pressure: 0.5 ± 0.04V - Check low-pressure fuel system. • Check fuel in fuel reservoir and air penetration. • Check fuel filter's specification. - Check high-pressure fuel system. • Check fuel rail and high-pressure pipe for leaks. - Check IMV's resistance (5.44 Ω). • If the resistance is out of specification, replace the high-pressure pump and IMV.						o
P1286	Low Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for open circuit. • If the pin in injector #1 is defective, replace injector #1 and perform C2I/C3I coding, then check again. • If the pin in injector #1 is not defective, check the ECU wiring harness. - Replace the ECU if required.						
P1287	High Resistance for Injector #1 wiring harness	- Out of range about wiring harness resistance for Injector #1. • High: More than 0.573 Ω (injector circuit short) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #1 and perform C2I/C3I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1288	Low Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for open circuit. • If the pin in injector #2 is defective, replace injector #2 and perform C2I/C3I coding, then check again. • If the pin in injector #2 is not defective, check the ECU wiring harness. - Replace the ECU if required.						
P1289	High Resistance for Injector #2 wiring harness	- Out of range about wiring harness resistance for Injector #2. • High: More than 0.573 Ω (injector circuit short) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #2 and perform C2I/C3I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						
P1290	Low Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for open circuit. • If the pin in injector #3 is defective, replace injector #3 and perform C2I/C3I coding, then check again. • If the pin in injector #3 is not defective, check the ECU wiring harness. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1291	High Resistance for Injector #3 wiring harness	- Out of range about wiring harness resistance for Injector #3. • High: More than 0.573 Ω (injector circuit short) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #3 and perform C2I/C3I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						
P1292	Low Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for open circuit. • If the pin in injector #4 is defective, replace injector #4 and perform C2I/C3I coding, then check again. • If the pin in injector #4 is not defective, check the ECU wiring harness. - Replace the ECU if required.						
P1293	High Resistance for Injector #4 wiring harness	- Out of range about wiring harness resistance for Injector #4. • High: More than 0.573 Ω (injector circuit short) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #4 and perform C2I/C3I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1294	Low Resistance for Injector #5 wiring harness	- Out of range about wiring harness resistance for Injector #5. • Low: Less than 0.150 Ω (injector circuit open) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for open circuit. • If the pin in injector #5 is defective, replace injector #5 and perform C2I/C3I coding, then check again. • If the pin in injector #5 is not defective, check the ECU wiring harness. - Replace the ECU if required.						
P1295	High Resistance for Injector #5 wiring harness	- Out of range about wiring harness resistance for Injector #5. • High: More than 0.573 Ω (injector circuit short) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for short circuit. • If the trouble still exists after removing the injector connector, replace injector #5 and perform C2I/C3I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required.						
P1405	EGR Solenoid Valve Malfunction - Short to ground	- Out of range about EGR gas: High. • EGR controller circuit: Open or short to ground - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω. - Check the ECU wiring harness for open and short.		o				
P1406	EGR Solenoid Valve Malfunction - Short to +Batt	- Out of range about EGR gas: Low. • EGR controller circuit: Short to battery - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω - Check the ECU wiring harness for open and short.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1407	Faulty EGR Close Position	- Causes • The EGR position is not closed when EGR is not operated within 50 seconds with the engine idling. - Check pin for the followings: • EEGR #1: Valve power (Main relay) • EEGR #2: Sensor (Reference voltage) ..... ECU #A33 • EEGR #4: Sensor (Ground) ..... ECU #A09 • EEGR #5: Valve drive (PWM) ..... ECU #A48 • EEGR #6: Sensor (Signal) ..... ECU #A82 - Actions • Check EEGR valve and sensor wiring. • Visually check the unit and replace if necessary. • Refer to DTCs (P0407 and P0408).						o
P1407	Throttle Valve Vacuum Modulator - Open/Short	- The vacuum modulator of throttle valve has an electrical problem. - The electric circuit has an open circuit. - The electric circuit has a short circuit to ground. - The electric circuit has a short circuit to battery.						
P1408	Poor EGR valve closing position (learn value not agreed)	- See P1407.						
P1409	EGR Valve Circuit Short	- Check pin for the followings: • The EEGR valve wiring is open. • EEGR Pin #1: Power(Main Relay) • EEGR Pin #5: ECU Pin #A48 - Actions • Check EEGR valve wiring. • Visually check the unit and replace if necessary. • Refer to DTCs (P0407 and P0408).						
P1430	CDPF - Soot Accumulated Over the Limit	- The recycling mode cannot be activated. - The pressure is over 23 Kpa for over 960 seconds due to the resistance by soot. - When the engine CHECK warning lamp flashes, drive the vehicle at over 50 km/h for 20 minutes so that the soot in CDPF is combusted.						Flashing

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1432	Torque Reduction Mode	- Operating condition : When the amount of soot is over the specified range (P1430 error stored) and the recycling mode cannot be operated (related error occurred), the torque reduction mode is activated so that the driver let the system inspected as soon as possible. - In operation: torque reduction, engine CHECK warning lamp ON						o
P1480	Condenser Fan #1 Circuit Malfunction - Open	- Condenser fan #1: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. - If the forced operation is not available after replacing the relay, replace the ECU.						
P1481	Condenser Fan #1 Circuit Malfunction - Short	- Condenser fan #1: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. - If the forced operation is not available after replacing the relay, replace the ECU.						
P1482	Condenser Fan #1 Circuit Malfunction - Short to Ground	- Condenser fan #1: Short to ground. - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. - If the forced operation is not available after replacing the relay, replace the ECU.						
P1500	Vehicle Speed Fault	- The vehicle speed signal through CAN communication is faulty. - Check the CAN communication line for open and short. - Check the ABS/ESP and TCU communication lines. - Check the ECU wiring harness. - Replace the ECU if required.						
P1501	Faulty Variant Coding (Vehicle Speed)	- If the vehicle sensor coding is set to YES (for vehicle with ABS), the vehicle speed input is faulty when the vehicle speed is below 15 km/h with the engine running at 1,600 rpm. - If the vehicle sensor coding is set to NO (for vehicle with CAN and ABS/ESP), the corresponding DTC is not shown. - Check the vehicle speed sensor coding.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1503	Faulty Vehicle Speed Sensor Input	- If the vehicle sensor coding is set to YES (for vehicle with ABS), the amount of pulses of the speed pulse ring for vehicle speed detection is more than the specified value. - Specified pulse: 52 pulses/rev. - Check the vehicle speed sensor coding.						
P1526	Condenser Fan #2 Circuit Malfunction - Open	- Condenser fan #2: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. - If the forced operation is not available after replacing the relay, replace the ECU.						
P1527	Condenser Fan #2 Circuit Malfunction - Short	- Condenser fan #2: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. - If the forced operation is not available after replacing the relay, replace the ECU.						
P1528	Condenser Fan #2 Circuit Malfunction - Short to Ground	- Condenser fan #2: Short to ground - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. - If the forced operation is not available after replacing the relay, replace the ECU.						
P1530	#1 Heater Operating Circuit - Open	- #1 heater circuit malfunction: Open. - Check the wiring harness for open. - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1531	#1 Heater Operating Circuit - Short	- #1 heater circuit malfunction: Short. - Check the wiring harness for short. - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1532	#1 Heater operating circuit - Short to Ground	- #1 heater circuit malfunction: Short to ground. - Check the wiring harness for short. - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1534	#2 Heater Operating Circuit - Open	- #2 heater circuit malfunction: Open. - Check the wiring harness for open. - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1535	#2 Heater Operating Circuit - Short	- #2 heater circuit malfunction: Short. - Check the wiring harness for short. - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1536	#2 Heater Operating Circuit - Short to Ground	- #2 heater circuit malfunction: Short to ground. - Check the wiring harness for short. - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required.						
P1540	Air Conditioner Operating Circuit Fault - Open	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.						
P1541	Air Conditioner Operating Circuit Fault - Short	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.						
P1542	Air Conditioner Operating Circuit Fault - Short to Ground	- Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1564	Auto Cruise Switch Fault (power)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%						
P1565	Auto Cruise Switch Malfunction (Acceleration)	- The auto cruise accelerator switch or related wiring is malfunctioning.						
P1566	Auto Cruise Switch Malfunction (OFF)	- The auto cruise OFF switch or related wiring is malfunctioning.						
P1567	Auto Cruise Switch Malfunction (Return)	- The auto cruise switch or related wiring is malfunctioning.						
P1568	Auto Cruise Switch Fault (when accelerating)	- Auto cruise switch fault (accelerating)						
P1568	Auto Cruise Switch Malfunction (Deceleration)	- The auto cruise decelerator switch or related wiring is malfunctioning.						
P1569	Auto Cruise Switch Fault (when decelerating)	- Auto cruise switch fault (decelerating)						
P1569	Auto Cruise Switch Malfunction (Safety)	- The auto cruise safety switch or related wiring is malfunctioning.						
P1570	Auto Cruise Switch Fault (Signal)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1571	Brake Lamp Signal Fault	- The brake pedal switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal switch wiring harness. - Check the supply voltage to brake pedal switch (12 V). - Check the brake pedal switch for contact. - Check the ECU wiring harness (open, short, poor contact). - Replace the ECU if required.						
P1572	Brake Lamp Signal Fault	- The brake pedal switch or light switch is faulty. • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal and light switch wiring harness. - Check the supply voltage to brake pedal and light switch (12 V). - Check the brake pedal and light switch for contact. - Check the ECU wiring harness (open, short, poor contact). - Replace the ECU if required.						
P1573	Auto Cruise Switch Fault (short)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1578	Auto Cruise Switch Fault (Circuit Short)	- Applied to vehicle with auto cruise, occurred due to coding error for vehicle without auto cruise - Auto cruise switch SPEC • Reference voltage: 5V (ECU Pin #B11) • Switch signal: ECU Pin #B15 • Switch GND: ECU Pin #B16 • Switch signal voltage level * Resistance when accelerating: 220Ω ± 1% * Resistance when decelerating: 560Ω ± 1% * Resumed resistance: 1200Ω ± 1% * Resistance with switch OFF: 75Ω ± 1%						
P1600	ECU Shut Down Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						o
P1601	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						o
P1602	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						o
P1603	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						
P1604	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						
P1605	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						
P1606	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					o	o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1607	ECU Injector Cut Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O
P1608	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.						O
P1614	ECU C2I/C3I/MDP Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1615	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1616	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1620	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1621	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O
P1622	ECU Fault	- The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required.					O	O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P162D (former P1612)	Injector Bank #1 Malfunction - High Voltage 4-cylinder engine : 1nd and 4rd cylinders 5-cylinder engine : 1nd, 4rd and 3rd cylinders	- Malfunction of injector (#1, #4, #3) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key "OFF". • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key "ON". • If recurred, replace the injector (perform C2I/C3I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						o
P162E (former P1619)	Injector Bank #2 Malfunction - High Voltage 4-cylinder engine : 2nd and 3rd cylinders 5-cylinder engine : 2nd and 5rd cylinders	- Malfunction of injector (#2, #5) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key "OFF". • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key "ON". • If recurred, replace the injector (perform C2I/C3I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required.						o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1630	Wrong response from Immobilizer (refer to immobilizer section)	- The invalid key is inserted or no communication between transponder and immobilizer (no response from transponder). - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1631	Immobilizer Fault (refer to immobilizer section)	- The immobilizer is not operating. - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1632	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1633	Immobilizer Fault (refer to immobilizer section)	- No key coding. - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1634	Immobilizer Fault (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required.						
P1635	No response from Immobilizer (refer to immobilizer section)	- No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required.						
P1636	Immobilizer Fault (refer to immobilizer section)	- Severe trouble is not defined. - Perform the immobilizer coding again. - Check the ECU wiring harness. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required.						
P1650	AMF OBD Short to GND	- Short to GND						
P1657	Engine Mount Control Malfunction (Open)	- The wiring for engine mount level control is malfunctioning. - Standard level: - Operating condition:						
P1658	Engine Mount Control Malfunction (Short to B+)	- The wiring for engine mount level control is short to battery. - ECU pin No. 23, relay control - Engine speed : Over 1,200 rpm (30 km/h for vehicle speed)						
P1659	Engine Mount Control Malfunction (Short to GND)	- The wiring for engine mount level control is short to ground. - ECU pin No. 23, relay control - Engine speed : Over 1,200 rpm (30 km/h for vehicle speed)						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1671	#3 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P1671	#3 Glow Plug - Short Circuit (Applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an short circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1672	#4 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P1672	#4 Glow Plug - Short Circuit (Applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an short circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1673	#5 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P1673	#5 Glow Plug - Short Circuit (Applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an short circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS • Plug short circuit: voltage > 6V, current = 0A • Plug short circuit (GND): voltage = 0V • Plug short circuit (batt.): voltage = battery voltage • FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A • Input voltage fault: 6V < input voltage < 16V • Communication fault: Abnormal data for over 1 second - Actions • Check the glow plug for malfunction (measuring its resistance). • Check the connector and wiring. • Visually check the glow plug. • Replace the glow plug if required. • Check the CAN line. • Check the IG1 power. • Check the battery power.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1674	#1 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω. - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P1674	#1 Glow Plug - Short Circuit (Applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an short circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS –Plug short circuit: voltage > 6V, current = 0A –Plug short circuit (GND): voltage = 0V –Plug short circuit (batt.): voltage = battery voltage –FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A –Input voltage fault: 6V < input voltage < 16V –Communication fault: Abnormal data for over 1 second - Actions –Check the glow plug for malfunction (measuring its resistance). –Check the connector and wiring. –Visually check the glow plug. –Replace the glow plug if required. –Check the CAN line. –Check the IG1 power. –Check the battery power.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1675	#2 Glow Plug Fault - Short	- The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check each glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P1675	#2 Glow Plug - Short Circuit (Applied for D27DT engine, Not applied for AQGS model)	D27DT: Preheat control relay - The glow plug has an short circuit. - Check the communication line between ECU and glow plug. - Check the glow plug wiring. - Check the resistance of glow plug. - Check the relay of glow plug. - Check the ECU wiring harness. - Replace the ECU if required. D27DTP: AQGS unit - NGK glow module (AQGS: Advanced Quick Glowing System) - Its condition is sent to ECU through CAN after detected by AQGS. - The AQGS has an electrical problem. - Diagnosis criteria of AQGS –Plug short circuit: voltage > 6V, current = 0A –Plug short circuit (GND): voltage = 0V –Plug short circuit (batt.): voltage = battery voltage –FET malfunction, FET short circuit (GND): voltage = 0V, current = 0A –Input voltage fault: 6V < input voltage < 16V –Communication fault: Abnormal data for over 1 second - Actions –Check the glow plug for malfunction (measuring its resistance). –Check the connector and wiring. –Visually check the glow plug. –Replace the glow plug if required. –Check the CAN line. –Check the IG1 power. –Check the battery power.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1676	Glow Plug Communication Fault	- The communication between ECU and glow plug is faulty. - Check the communication line between ECU and glow plug. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1 Ω. - Check the glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P1677	Glow Plug Controller Fault	- The communication between ECU and glow plug is faulty. - Check the communication line between ECU and glow plug. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1Ω. - Check the glow plug relay. - Check the ECU wiring harness. - Replace the ECU if required.						
P1678	Glow Plug Malfunction - Open	- Glow plug circuit malfunction: Open. - Check the glow plug wiring harness for open. - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.						
P1679	Glow Plug Malfunction - Short	- Glow plug circuit malfunction: Short. - Check the glow plug wiring harness for open. - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.						
P1680	Glow Plug Malfunction - Short to Ground	- Glow plug circuit malfunction: Short to ground. - Check the glow plug wiring harness for open. - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P1683	Defective CAN communiction of glow plug controller	- No GCU CAN signal - Details: refer to P2673.						
P2031	Front exhaust gas temperature sensor - faulty voltage supply	- The supplied voltage of the front exhaust gas temperature sensor is out of the specified range. - Check the ECU terminal No. A30 for connecting the front exhaust gas temperature sensor as well as the sensor terminal No. 1.						o
P2032	Front exhaust gas temperature sensor - low signal	- The signal value from the front exhaust gas temperature sensor is below the specified range. - Check the ECU terminal No. A06 and A30 for connecting the front exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.						o

CDPF temperature (°C)	Resistance (Ω)
-40	169.18
-20	184.64
0	200.0
25	219.07
50	237.99
100	275.4
150	312.2
200	348.5
250	384.1
300	419.2
350	453.7
400	487.6
450	520.9
500	553.6
600	617.3
700	678.7
800	737.7
830	754.9
	766.3

<table>
<tr><th>DTC</th><th>Trouble</th><th>Help</th><th>Torque Reduction (max.50%)</th><th>Torque Reduction (max.20%)</th><th>Delayed Engine Stop</th><th>Immediately Engine Stop</th><th>Limp Home Mode</th><th>Engine Check Warning Lamp</th></tr>
<tr><td>P2033</td><td>Front exhaust gas temperature sensor - high signal</td><td>- The signal value from the front exhaust gas temperature sensor is over the specified range.
- Check the ECU terminal No. A06 and A30 for connecting the front exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.
<table>
<tr><th>CDPF temperature (°C)</th><th>Resistance (Ω)</th></tr>
<tr><td>-40</td><td>169.18</td></tr>
<tr><td>-20</td><td>184.64</td></tr>
<tr><td>0</td><td>200.0</td></tr>
<tr><td>25</td><td>219.07</td></tr>
<tr><td>50</td><td>237.99</td></tr>
<tr><td>100</td><td>275.4</td></tr>
<tr><td>150</td><td>312.2</td></tr>
<tr><td>200</td><td>348.5</td></tr>
<tr><td>250</td><td>384.1</td></tr>
<tr><td>300</td><td>419.2</td></tr>
<tr><td>350</td><td>453.7</td></tr>
<tr><td>400</td><td>487.6</td></tr>
<tr><td>450</td><td>520.9</td></tr>
<tr><td>500</td><td>553.6</td></tr>
<tr><td>600</td><td>617.3</td></tr>
<tr><td>700</td><td>678.7</td></tr>
<tr><td>800</td><td>737.7</td></tr>
<tr><td>830</td><td>754.9</td></tr>
<tr><td>850</td><td>766.3</td></tr>
</table></td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P2080</td><td>Front exhaust gas temperature sensor - faulty signal</td><td>- The signal value from the front exhaust gas temperature sensor is over the specified range.
- See P2032 and P2033 for more information and inspection.</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
</table>

Modification basis	
Application basis	
Affected VIN	

<table>
<tr><th>DTC</th><th>Trouble</th><th>Help</th><th>Torque Reduction (max.50%)</th><th>Torque Reduction (max.20%)</th><th>Delayed Engine Stop</th><th>Immediately Engine Stop</th><th>Limp Home Mode</th><th>Engine Check Warning Lamp</th></tr>
<tr><td>P2081</td><td>Front exhaust gas temperature sensor - Abnormal response</td><td>- The value difference between the front exhaust gas temperature sensor on the exhaust manifold and the rear exhaust gas temperature sensor on the CDPF is out of the specified range.
- Measure the resistance of the exhaust gas temperature sensors by temperature and the supplied voltage.
- Check the ECU terminal No. A06 and A30 for connecting the front exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.
- Check the ECU terminal No. A23 and A42 for connecting the rear exhaust gas temperature sensor as well as the sensor terminal No. 1 and 2.
<table>
<tr><th>CDPF temperature (°C)</th><th>Resistance (Ω)</th></tr>
<tr><td>-40</td><td>169.18</td></tr>
<tr><td>-20</td><td>184.64</td></tr>
<tr><td>0</td><td>200.0</td></tr>
<tr><td>25</td><td>219.07</td></tr>
<tr><td>50</td><td>237.99</td></tr>
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</table></td><td></td><td></td><td></td><td></td><td></td><td>o</td></tr>
<tr><td>P2100</td><td>Throttle Drive Circuit Short</td><td>- Perform the diagnosis when the ignition is turned on.
- Defective intake throttle drive circuit (ECU pin #A75, A77)
- Check pin (refer to P213C).
- Sensor specification: Refer to P213C.
- Actions
• Check the throttle valve and sensor wiring harnesses.
• Visually check the unit and replace if necessary.</td><td></td><td>o</td><td></td><td></td><td></td><td></td></tr>
</table>

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P2101	Throttle Drive Ground Short	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.		O				
P2102	Throttle Drive Short	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.		O				
P2103	Throttle Drive Battery Short	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.		O				
P2104	Throttle Drive Overheat	- Perform the diagnosis when the ignition is turned on. - Defective intake throttle drive circuit (ECU pin #A75, A77) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.		O				

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P213B	Abnormal Throttle Control	- Causes • The difference between throttle position demand (MAP) and throttle position feedback signal is out of +5% or -13%. - Defective throttle control (P213B) - Defective throttle signal (P213C, P213D) - Defective throttle drive (P2103, P2101, P2102, P2104, P2100) - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.		o				
P213C	Low Throttle Signal	- Causes • The throttle valve position sensor signal is stuck low. - Check pin for the followings: • Throttle valve #1: sensor (Power) ..... ECU #A20 • Throttle valve #2: sensor (Signal) ..... ECU #A22 • Throttle valve #3: sensor (GND) ..... ECU #A81 • Throttle valve #4: valve (Positive) ..... ECU #A75 • Throttle valve #5: valve (Positive) ..... ECU #A77 - Sensor & Motor SPEC • Motor * Power: 12 V * Max. current : 6.8A (Normal: 3.6 ~ 0.2) * Motor resistance: 4.3Ω • Sensor * Power: 5 V - Actions • Check the throttle valve and sensor wiring harnesses. (The signal output of throttle valve is below than 0.24 V.) • Visually check the unit and replace if necessary.		o				
P213D	High Throttle Signal	- Causes • The throttle valve position sensor signal is stuck high. - Check pin (refer to P213C). - Sensor specification: Refer to P213C. - Actions • Check the throttle valve and sensor wiring harnesses. • Visually check the unit and replace if necessary.		o				

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P213E	Abnormal power to throttle position sensor * Torque reduced by 30 % for K2006 engine	See P213C.		o				
P213F	Throttle position sensor malfunction * Torque reduced by 30 % for K2006 engine	See P213C.		o				
P2428	Exhaust gas temperature sensor (T3) - high value (over 830°C for over 10 sec.)	- If the value of the exhaust gas temperature sensor on CDPF is over 830°C for over 10 seconds, the corresponding DTC is generated to protect the CDPF system. - Check the front exhaust gas temperature sensor.		- Perform the forced regeneration with SCAN-100. - Replace the T3 sensor. - Check the muffler (in case of power drop).				o
P2429	Exhaust gas temperature sensor (T3) (over 850°C for over 2 sec.)	- If the value of the exhaust gas temperature sensor on CDPF is over 850°C for 2 seconds, the corresponding DTC is generated to protect the CDPF system. - Check the front exhaust gas temperature sensor.		- Perform the forced regeneration with SCAN-100. - Replace the T3 sensor. - Check the muffler (in case of power drop).				o
P242F	Change Interval for CDPF Filter - Warning	- The vehicle is driven for approx. 500,000 km (CDPF change interval).						o
P2452	Differential pressure sensor - faulty voltage supply	- The power supplied to the differential pressure sensor is abnormal. - Check the ECU wiring harness (open circuit and poor contact). • Check the output voltage at ECU pin No. A05. • Check the supplied power between the ECU pin No. A05 and sensor terminal No. 3.						o
P2453	Differential pressure sensor - input signal fault (front and rear input ports installed reversely)	- The hose for the differential pressure sensor and the pipe for CDPF are reversely connected.						o
P2454	Differential pressure sensor - low output value	- The ECU detects that the pressure difference between the front and rear input ports of differential pressure sensor is lower than the ECU mapping value.		- Check the differential pressure sensor connector.				o
P2455	Differential pressure sensor - high output value	- The ECU detects that the pressure difference between the front and rear input ports of differential pressure sensor is higher than the ECU mapping value.		- Check the differential pressure sensor connector.				o

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P2456	Differential pressure sensor - input signal fault (clogging)	- Damaged or clogged differential pressure sensor input port and hoses - The differential pressure sensor assembly is integrated with the hose and pipe and is connected to the CDPF connecting pipe. Therefore, check if these hoses and pipes are clogged or damaged.						
P2458	CDPF - Pressure Leakage	- There is pressure leakage at front or rear side of CDPF. - The pressure is dropped below -15 Kpa for over 10 seconds due to soot.						O
P2459	Regeneration mode - overtime	- When CDPF regeneration process is performed due to the pressure difference between the front and rear of the differential pressure sensor, the post injection period is increased if the temperature value from the rear exhaust gas temperature sensor is low. On the other hand, if the the temperature value from the rear exhaust gas temperature sensor is high, the post injection period is shortened. If the exhaust gas temperature is low due to slow driving, etc. during CDPF regeneration, the regeneration process cannot be completed (if the initial 5 regeneration processes took over 1200 seconds at vehicle speed below 100 km). - If this occurs repeatedly and the exhaust gas is not regenerated, an excessive amount of soot may be accumulated. - If a DTC related to this problem is generated, clear it and drive the vehicle at 50-60 km/h for approx. 15-20 minutes to complete the regeneration process. - If the same DTC is still present, check the rear exhaust gas temperature sensor electrically.			- Check the differential pressure sensor. - Replace the DPF.			O

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P2671	#3 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.						
P2672	#4 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.						

Modification basis	
Application basis	
Affected VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P2673	#5 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.						
P2674	#1 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.						

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	Engine Check Warning Lamp
P2675	#2 Glow Plug Short (Battery)	- NGK glow module (AQGS: Advanced Quick Glowing System) - It is detected by AQGS which then sends the message to ECU through CAN. - The electrical problem is occurred in AQGS. - Diagnosis criteria in AQGS • Plug short: voltage > 6V, current = 0A • Plug short (GND): voltage = 0V • Plug short (battery): voltage = Battery voltage • FET defective, FET short (GND): voltage = 0V, current = 0A • Abnormal input voltage: 6V < input voltage < 16V • Abnormal communication: Communication error for over 1 sec., abnormal data - Actions • Check glow plug for defect (measure the resistance of unit). • Check the connector and wiring harnesses. • Visually check the unit. • Replace the unit if necessary. • Check the CAN line. • Check the IG1 voltage. • Check the battery voltage.						
P3040	ECU Internal Malfunction	- The internal sector of ECU is malfunctioning.						
P3041	ECU Internal Malfunction	- The internal sector of ECU is malfunctioning.						

Modification basis	
Application basis	
Affected VIN	

BRAKE

0000-00

DIAGNOSIS

1. BRAKE..... 3

BRAKE

0000-00

DIAGNOSIS

1. BRAKE

Fault code	Defects	Application			Service hint
		ABS	ABD	ASR	
01	No defects	0	0	0	-
02	ECU	0	0	0	Internal fault of ECU. Replace the ECU.
03	Front/left speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
04	Front/right speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
05	Rear/left speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
06	Rear/right speed sensor (defective wiring)	0	0	0	1. Check resistance between wiring harness and wheel speed sensor : 1.280KW - 1.920KW. 2. Check for wire ground and B+ OPEN. 3. If there is no defect on above, replace sensor.
07	Front/left speed sensor (defective wiring)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.377 - 1.229 mm. 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.
08	Front/right speed sensor (abnormal signal)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.377 - 1.229 mm. 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.
09	Rear/left speed sensor (abnormal signal)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.369 - 1.213 mm. 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.

Modification basis	
Application basis	
Affected VIN	

Fault code	Defects	Application			Service hint
		ABS	ABD	ASR	
10	Rear/right speed sensor (abnormal signal)	0	0	0	1. Check that connector pin arrangement on the relevant wire is correct. 2. Check for wire ground and B+ open. 3. Check air gap between wheel rotor and wheel speed sensor : 0.369 - 1.213mm 4. Check proper contact of wheel speed sensor connector and ECU connector. 5. Check sensor output voltage while shaking wiring harness by turning wheel 1/2 to 1 revolution per second (Voltage should be over 70mV when checked by multimeter and over 120mV/P-P when checked by oscilloscope). 6. If there is no defect on above, replace sensor.
11	Wheel rotor teeth	0	0	0	1. This code will appear if a wheel rotor teeth of four wheels is defective. 2. Check the teeth number of wheel rotor and condition.
13	Front/left inlet valve	0	0	0	1. If this code appear together with the items related with valve relay failure, check the items related with valve failure first and repair defective causes. 2. Check each valve using a over-riding function of tester on sole noid valve diagnosis function. 3. Replace hydraulic modulator.
14	Front/left outlet valve	0	0	0	↑
15	Front/right inlet valve	0	0	0	↑
16	Front/right outlet valve	0	0	0	↑
17	Rear/left inlet valve	-	0	0	↑
18	Rear/left outlet valve	-	0	0	↑
19	Rear/right inlet valve	-	0	0	↑
20	Rear/right outlet valve	-	0	0	↑
17	Rear axle inlet valve	0	-	-	↑
18	Rear axle outlet valve	0	-	-	↑
21	Switching valve	-	0	0	1. If this code appear together with the items related with valve relay failure, check the items related with valve failure first and repair defective causes. 2. Check each valve using a over-riding function of tester on sole noid valve diagnosis function. 3. Check contact of ECU and hydraulic modulator connectors and terminals. 4. Check terminals for open or short (When connector is removed). 5. Replace hydraulic modulator if there is no defect on above.

Modification basis	
Application basis	
Affected VIN	

Fault code	Defects	Application			Service hint
		ABS	ABD	ASR	
22	Shut-off valve	-	0	0	1. If this code appear together with the items related with valve relay failure, check the items related with valve failure first and repair defective causes. 2. Check each valve using a over-riding function of tester on solenoid valve diagnosis function. 3. Check contact of ECU and hydraulic modulator connectors and terminals. 4. Check terminals for open or short (When connector is removed). 5. Replace hydraulic modulator if there is no defect on above.
24	Motor relay/ return pump	0	0	0	1. Check using a over-riding function of tester on pump motor diagnosis function 2. Check resistance between pump motor ground terminal and battery negative terminal : less than 15mW. 3. Check body ground point. 4. Check relay coil internal resistance:40-80W. 5. Replace hydraulic modulator if there is no defect on above.
27	Stop lamp switch	0	0	0	1. Check using stop lamp switch diagnosis function from sensor value output function of tester. 2. Check contact of stop lamp switch terminals on ECU connector. 3. Check other wires for open and short (more than 80% of ECU supply voltage). 4. Check stop lamp switch function and replace if defective (when switch knob (plunger) is pressed by 3mm, resistance between each switch end will be infinite and if not pressed, it will be less than 200mW). 5. Voltage on No.11 when brake pedal is depressed : 11-14V Voltage on No.4 when brake pedal is released : 11-14V
28	Battery voltage low	0	0	0	1. Check battery voltage. 2. Check resistance between relevant voltage terminal of connector and each battery terminal (positive & negative). 3. Check that normal voltage is applied on each pin on connector when ignition switch is turned 'ON' or 'OFF'. 4. Check 10A and 60A fuses for ABS. 5. Replace hydraulic modulator if there is no defect on above.
30	CAN signal (TCU)	-	-	0	1. Check related CAN line for open, short. 2. Check poor contact of related CAN connector. 3. ECU is defective, replace ECU .
31	EMS (Engine)	-	-	0	1. Check related CAN line for open, short. 2. Check poor contact of related CAN connector. 3. ECU is defective, replace ECU . 4. Check EMS using special tool of self-diagnosing.
33	CAN communication	-	-	0	1. Check related CAN line for open, short. 2. Check poor contact of related CAN connector. 3. ECU is defective, replace ECU .
34	Brake over heating	0	0	0	

Modification basis	
Application basis	
Affected VIN	

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="4">Sensor Monitoring</td><td>Front LH
Wheel speed sensor</td><td>C1011 (5011)
C1012 (5012)</td><td>Wheel speed sensor front left-electrical
Wheel speed sensor front left-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1011 (5011)
<u>Cause</u>
- Defective front LH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check HECU connector
- Check the harness connection
2. C1012 (5012)
<u>Cause</u>
- Defective front LH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector
- Check HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.335 ~ 0.945 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
<tr><td>Front RH
Wheel speed sensor</td><td>C1021 (5021)
C1022 (5022)</td><td>Wheel speed sensor front right-electrical
Wheel speed sensor front right-other</td><td></td><td></td></tr>
<tr><td colspan="3">1.C1021 (5021)
<u>Cause</u>
- Defective front RH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check HECU connector
- Check the harness connection
2.C1022 (5022)
<u>Cause</u>
- Defective front RH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector and HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.335 ~ 0.945 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
</table>

Modification basis	
Application basis	
Affected VIN	

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="4">Sensor Monitoring</td><td>Rear RH
Wheel speed sensor</td><td>C1031 (5031)
C1032 (5032)</td><td>Wheel speed sensor rear left-electrical
Wheel speed sensor rear left-other</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3">1. C1031 (5031)
<u>Cause</u>
- Defective rear RH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check the HECU connector
- Check the harness connection

2. C1032 (5032)
<u>Cause</u>
- Defective rear RH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector
- Check the HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.309 ~ 0.958 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
<tr><td>Rear LH
Wheel speed sensor</td><td>C1041 (5041)
C1042 (5042)</td><td>Wheel speed sensor rear left-electrical
Wheel speed sensor rear left-other</td><td></td><td></td></tr>
<tr><td colspan="3">1. C1041 (5041)
<u>Cause</u>
- Defective rear LH wheel speed sensor
- Short or poor contact wire to sensor
<u>Action</u>
- Check the wheel speed sensor connector
- Check the HECU connector
- Check the harness connection

2. C1042 (5042)
<u>Cause</u>
- Defective rear LH wheel speed sensor
- No signals from wheel speed sensor and tooth wheel
- Too large air gap between wheel speed sensor and tooth wheel
- Different number of teeth in tooth wheel
<u>Action</u>
- Check the wheel speed sensor connector and HECU connector
- Check air gap and tooth wheel mounting (Specified air gap: 0.309 ~ 0.958 mm)
- Check the number of teeth (48) in tooth wheel</td><td>O</td><td>O</td></tr>
</table>

<table>
<tr><th>Function</th><th>Defective Components</th><th>Trouble Code</th><th>Descriptions</th><th colspan="2">System</th></tr>
<tr><td rowspan="6">Sensor Monitoring</td><td>Pressure sensor</td><td>C1051 (5051)</td><td>Defective input sensor</td><td>ABS</td><td>ESP</td></tr>
<tr><td colspan="3"><u>Cause</u>
- Abnormal signals from pressure sensor
- Defective pressure sensor or harness
<u>Action</u>
- Check the pressure sensor connector</td><td>X</td><td>O</td></tr>
<tr><td>Steering wheel angle sensor</td><td>C1061 (5061)</td><td>Defective steering wheel angle sensor</td><td></td><td></td></tr>
<tr><td colspan="3"><u>Cause</u>
- Internally defective steering wheel angle sensor
- Abnormal signals from steering wheel angle sensor
- Short circuit between supplying voltage output and ground
- Abnormal signal voltage from steering wheel angle sensor
- Poor installation of steering wheel angle sensor and abnormal signal
<u>Action</u>
- Check the supplying voltage: (Specified voltage: 9 ~ 16 V)
- Check the output voltage: Check voltage between ESP unit terminals with ignition ON
• ST1 voltage check: between ESP unit terminal No. 5 and ground (Specified voltage: 1.3 ~ 4.1V)
• ST2 voltage check: between ESP unit terminal No. 2 and ground (Specified voltage: 1.3 ~ 4.1V)
• STN voltage check: between ESP unit terminal No.12 and ground (Specified voltage: 1.3 ~ 4.1V)</td><td>X</td><td>O</td></tr>
<tr><td>Sensor cluster</td><td>C1073 (5073)
C1074 (5074)</td><td>Sensor cluster -electrical
Sensor cluster-internal</td><td></td><td></td></tr>
<tr><td colspan="3">1. C1073 (5073)
<u>Cause</u>
- Operating voltage exceeds specified range (Hi: 18.0 ± 1.0 V / Lo: 6.5 ± 0.5 V)
- Poor contact or installation of harness
<u>Action</u>
- Check the sensor cluster connector
- Replace the sensor cluster
2. C1074 (5074)
<u>Cause</u>
- Internally defective HECU
- Abnormal A/D converter voltage: 5.0 ± 3 %
- Abnormal supplying voltage (4.580 ~ 4.960 V) to sensor cluster
→ Short circuit between supplying voltage output of sensor cluster and ground
- Poor ground of sensor cluster (0.0 ~ 0.5 V)
→ Short to ground on sensor cluster
- Abnormal signals from lateral acceleration sensor
- Abnormal signals from yawing sensor
- Poor installation of sensor
- Defective sensor cluster
- Defective or short circuit of CAN communication line
<u>Action</u>
- Replace the sensor</td><td>X</td><td>O</td></tr>
</table>

Modification basis	
Application basis	
Affected VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
Battery Voltage Monitoring	**Battery**	C1101 (5101) C1102 (5102)	Battery under voltage Battery over voltage	**ABS**	**ESP**
	1. C1101 (5101) **Cause** - Low voltage out of specified range (9.7 ± 0.3 V) **Action** - Check the supplying voltage **2. C1102 (5102)** **Cause** - Over voltage out of specified range (18.0 ± 1.0 V) **Action** - Check the supplying voltage			O	O
Brake Monitoring	**Brake disc**	C1111 (5111)	Disk temperature is high		
	Cause - Overheated brake disk due to braking force: over 500°C **Action** - Stop driving for a period of time after turning off the ESP			X	O
	Brake lamp switch **ESP OFF switch**	C1201 (5201) C1202 (5202)	Defective brake lamp switch Defective ESP OFF switch		
	1. C1201 (5201) **Cause** - Mechanical defective in brake switch - Defective brake switch harness **Action** - Check the harness and connector **2. C1202 (5202)** **Cause** - Mechanical defective in ESP OFF switch - Defective ESP OFF switch harness (short to ground) **Action** - Check the harness and connector for ESP OFF switch			X	O
Valve Monitoring	**Valve, valve relay**	C1301 (5301)	Defective valve, valve relay in HECU		
	Cause - Abnormal supplying voltage to valve solenoid - Internally defective HECU **Action** - Replace the HECU - Check the battery voltage - Check the HECU connector			O	O

Function	Defective Components	Trouble Code	Descriptions	System	
Pump Monitoring	**Motor pump**	C1302 (5302)	Defective motor pump	**ABS**	**ESP**
	Cause - Too low (below 6.0 V) or no supplying voltage to pump motor - Over 0.93 V from pump motor voltage - Poor contact in pump motor connector - Poor ground **Action** - Check the supplying voltage - Check the HECU connector - Replace the HECU			**O**	**O**
HECU and Sensor Monitoring	**HECU**	C1401 (5401)	HECU hardware		
	Cause - Internally defective HECU - Defective A/D converter, internal voltage regulator, and controller - Defective sensor and short to supplying voltage line - Abnormal temperature sensor signal **Action** - Replace the HECU			**O**	**O**
	Sensor initialization	C1501 (5501)	Abnormal sensor initialization		
	Cause - Abnormal signals from sensors - Abnormal sensor data **Action** - Check the sensors - Initialize the sensors			**O**	**O**
	Vehicle coding	C1170 (5170)	Variant coding error, or misinstallation HECU		
	Cause - Discrepancy between HECU coding and vehicle coding - Defective CAN communication line - Misinstallation HECU **Action** - Check the HECU coding and vehicle coding - Perform vehicle coding - Replace the exact HECU - Check engine ECU variant coding			**(O)**	**O**

Modification basis	
Application basis	
Affected VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
	CAN communication	C1601 (5601)	CAN communication error	**ABS**	**ESP**
	Cause - Short or open to CAN communication line - Poor connection of CAN communication line **Action** - Check the CAN communication line - Check the HECU connector			**(O)**	**O**
	CAN communication	C1602 (5602) C1603 (5603) C1604 (5604) C1605 (5605)	Communication error between engine ECU and HECU Communication error between TCU and HECU Communication error between TCCU (4WD) and HECU Communication error between cluster (Meter) and HECU		
	1. C1602 (5602) **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the engine ECU - Check the CAN communication line - Check the engine ECU connector **2. C1603 (5603)** **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the TCU - Check the CAN communication line - Check the TCU connector **3. C1604 (5604)** **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the TCCU - Check the CAN communication line - Check the TCCU connector **4. C1605 (5605)** **Cause** - Short to CAN communication line - Overload to CAN communication Action **Action** - Check the cluster (meter) - Check the CAN communication line - Check the cluster (meter) connector			**X**	**O**

Function	Defective Components	Trouble Code	Descriptions	System	
CAN Communication Monitoring	**CAN signal error EMS**	C1612 (5612)	Signal from engine ECU is abnormal	**ABS**	**ESP**
	Cause - Engine ECU is defective - Signal from engine ECU error **Action** - Check engine ECU - Check ECU S/W version			**X**	**O**

Modification basis	
Application basis	
Affected VIN	

INDEX

DIAGNOSIS

1. AIR-BAG..... 3

AIR-BAG

0000-00

DIAGNOSIS

1. AIR-BAG

Possible Cause		Action	
Ignition "ON" Check warning lamp on I/P	Does the warning lamp blink at seven times for 7 seconds and then turn off?	Yes	System OK
		No	Connect the scan tool to diagnostic connector (ALDL). Select the fault code display menu and clear code menu.
	Does the fault code display on the scan tool display?	Yes	Perform "Diagnostic System Check".
		No	Check any fuse open. Replace fuse.
	Is there any open in fuse?	Yes	Disconnect wiring connector.
		No	Check any wiring short between fuse and wiring connector.
	Is there any short in fuse?	Yes	Repair wiring.
		No	Disconnect SDM wiring connector. Check wiring short between connector terminal and SDM connector terminal.
	Is there any short in wiring?	Yes	Replace airbag wiring.
		No	Check any open between ALDL connector No.4, No. 5 terminal and ground.
	Is there any open in wiring?	Yes	Repair wiring
		No	Ignition "ON" Measure voltage at the cigar lighter socket.
	Does the voltage indicate 11 ~ 14 V?	Yes	Check any open or short between ALDL connector terminal and wiring connector terminal.
		No	Repair the wiring of the cigar lighter socket.
	Is there any open or short in wiring?	Yes	Repair wiring
		No	Check any open or short between SDM connector terminal and wiring connector terminal.
	Is there any open or short in wiring?	Yes	Replace the airbag wiring.
		No	Replace the SDM.

Code	Fault Contents	Check
01h	Driver airbag circuit, resistance too high	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
02h	Driver airbag circuit, resistance too low	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
03h	Driver airbag circuit, short to ground	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
04h	Driver airbag circuit, short to battery voltage	Check the connection of the driver airbag connector. Check the wiring condition of the driver airbag. (including clock spring) Check the bending of the airbag terminal.
05h	Passenger airbag circuit, resistance too high	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
06h	Passenger airbag circuit, resistance too low	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
07h	Passenger airbag circuit, short to ground	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
08h	Passenger airbag circuit, short to battery voltage	Check the connection of the passenger airbag connector. Check the wiring condition of the passenger airbag. Check the bending of the airbag terminal.
09h	Driver pretensioner circuit, resistance too high	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ah	Driver pretensioner circuit, resistance too low	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Bh	Driver pretensioner circuit, short to ground	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.
0Ch	Driver pretensioner circuit, short to battery voltage	Check the connection of the driver pretensioner connector. Check the wiring condition of the driver pretensioner. Check the bending of the airbag terminal.

Modification basis	
Application basis	
Affected VIN	

Code	Fault Contents	Check
0Dh	Passenger pretensioner circuit, resistance too high	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Eh	Passenger pretensioner circuit, resistance too low	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
0Fh	Passenger pretensioner circuit, short to ground	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
10h	Passenger pretensioner circuit, short to battery voltage	Check the connection of the passenger pretensioner connector. Check the wiring condition of the passenger pretensioner. Check the bending of the airbag terminal.
34h	Driver side airbag circuit, resistance too high	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
35h	Driver side airbag circuit, resistance too low	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
36h	Driver side airbag circuit, short to ground	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
37h	Driver side airbag circuit, short to battery voltage	Check the connection of the driver side airbag connector. Check the wiring condition of the driver side airbag. Check the bending of the airbag terminal.
38h	Passenger side airbag circuit, resistance too high	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
39h	Passenger side airbag circuit, resistance too low	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Ah	Passenger side airbag circuit, short to ground	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
3Bh	Passenger side airbag circuit, short to battery voltage	Check the connection of the passenger side airbag connector. Check the wiring condition of the passenger side airbag. Check the bending of the airbag terminal.
50h	Driver side airbag sensor, open/short to battery voltage	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
51h	Passenger side airbag circuit, short to ground	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.

Code	Fault Contents	Check
52h	Communication malfunction of the driver side airbag	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
53h	Internal fault of the driver side airbag sensor	Check the connection of the driver side airbag sensor connector. Check the wiring condition of the driver side airbag sensor. Check the bending of the airbag terminal.
54h	Passenger side airbag sensor, open/short to battery voltage	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
55h	Passenger side airbag sensor, short to ground	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
56h	Communication malfunction of the passenger side airbag	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
57h	Internal fault of the passenger side airbag sensor	Check the connection of the passenger side airbag sensor connector. Check the wiring condition of the passenger side airbag sensor. Check the bending of the airbag terminal.
17h	Battery voltage too high	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
18h	Battery voltage too low	Check generator output voltage. Check the battery voltage. Check the bending of the airbag terminal.
1Eh	SDM internal fault (Initialization fault)	Replace the SDM.
1Fh	SDM internal fault	Replace the SDM.

Modification basis	
Application basis	
Affected VIN	

Trouble Code	Defections	Action
1101	High battery voltage	• Check alternator output voltage. • Check battery condition (over 21.4 V for 16 seconds). • Check air bag unit terminals for damage.
1102	Low battery voltage	• Check alternator output voltage. • Check battery condition (below 7.2 V for 16 seconds, resumes when the voltage is normal level for 9.6 seconds) • Check air bag unit terminals for damage.
1103	Low communication voltage for curtain air bag sensor	• Check curtain air bag sensor connector. • Check curtain air bag sensor wiring. • Check air bag unit terminals for damage. • Check if curtain air bag sensor is short to battery voltage or ground. • Check if curtain air bag sensor is defective. • Check battery condition (below 10.6 V for 16 seconds, resumes when the voltage is normal level for 9.6 seconds).
1346	Driver's air bag circuit resistance is too high	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: over 6.1 Ω
1347	Driver's air bag circuit resistance is too low	• Check driver air bag connector. • Check driver air bag connector (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: below 1.1 Ω
1348	Driver's air bag circuit is short to ground	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1349	Drivers air bag circuit is short to battery voltage	• Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1352	Passengers air bag circuit resistance is too low	• Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1353	Passengers air bag circuit resistance is too high	• Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.0 Ω
1354	Passengers air bag circuit is short to ground	• Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ

Trouble Code	Defections	Action
1355	Passenger's air bag circuit is short to battery voltage	• Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1361	Driver's pretensioner circuit resistance is too high	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 Ω
1362	Driver's pretensioner circuit resistance is too low	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1363	Driver's pretensioner circuit is short to ground	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1364	Driver's pretensioner circuit is short to battery voltage	• Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1367	Passenger's pretensioner circuit resistance is too high	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 W
1368	Passenger's pretensioner circuit resistance is too low	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1369	Passenger's pretensioner circuit is short to ground	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1370	Passenger's pretensioner circuit is short to battery voltage	• Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1378	Driver's curtain air bag circuit resistance is too high	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1379	Driver's curtain air bag circuit resistance is too low	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω

Modification basis	
Application basis	
Affected VIN	

Trouble Code	Defections	Action
1380	Driver's curtain air bag is short to ground	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1381	Driver's curtain air bag is short to battery voltage	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1382	Passenger's curtain air bag circuit resistance is too high	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1383	Passenger's curtain air bag circuit resistance is too low	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω
1384	Passenger's curtain air bag is short to ground	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1385	Passenger's curtain air bag is short to battery voltage	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1395	Air bag connector problem	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1400	Driver's curtain air bag sensor problem	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage.
1401	Driver's curtain air bag sensor circuit is short to ground	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance: below 250 Ω
1402	Driver's curtain air bag sensor circuit is short to battery voltage	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1409	Communication error in driver's curtain air bag	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 400, B1 401, B1 402, B1 414.

Trouble Code	Defections	Action
1414	Wrong driver's curtain air bag sensor	• Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage.
1403	Passenger's curtain air bag sensor	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1404	Passenger's curtain air bag sensor circuit is short to ground	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 250 Ω
1405	Passenger's curtain air bag sensor circuit is short to battery voltage	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1410	Communication error in passenger's curtain air bag	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check the air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 403, B1 404, B1 405, B1 415.
1415	Wrong driver's curtain air bag sensor	• Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1620	SDM internal fault	• Replace SDM.
1650	Frontal impact record	• Replace SDM.
1651	Driver's curtain air bag impact record	• Replace SDM.
1652	Passenger's curtain air bag impact record	• Replace SDM.
1657	Belt pretensioner operation record	• Replace SDM.
2500	Warning lamp error	• Check wiring to warning lamp. • Check warning lamp bulb. • Check SDM unit terminal.

INDEX

DIAGNOSIS

1. CCCS..... 3

CCCS

0000-00

DIAGNOSIS

1. CCCS

Code	Malfunction	Help
0 X 01	Driver door lock knob does not lock	- Check the driver side door actuator - Check the sensor values • Driver side door open switch (STICS sensor value: No. 5) • Door lock switch (STICS sensor value: No. 21) • Driver door lock switch (STICS sensor value: No. 37) • Door lock switches other than the driver side door (STICS sensor value: No. 38) • Door lock (DICS-Main: No. 30) • Key lock (DICS-Main: No. 32) - Check the driver side door wires and connectors
0 X 02	Passenger door lock knob does not lock	- Check the passenger side door actuator - Check the sensor values • Passenger side door open switch (STICS sensor value: No. 6) • Door lock switch (STICS sensor value: No. 21) • Door lock switches other than the driver side door (STICS sensor value: No. 38) • Door lock (DICS-Sub: No. 3) • Key lock (DICS-Sub: No. 5) - Check the passenger side door wires and connectors
0 X 03	Rear door lock knob does not lock	- When one of the two rear seat door knobs is defective - Check the rear seat door actuator - Check the sensor values • Rear door knob switch (STICS sensor value: No. 7) • Rear right door open switch (STICS sensor value: No. 8) • Door lock switch (STICS sensor value: No. 21) • Rear door open switch (STICS sensor value: No. 23) • Door lock switches other than the driver side door (STICS sensor value: No. 38) • Door lock switch (DICS-Main sensor value: No. 32) • Key lock (DICS-Main sensor value: No. 32) • Door lock (DICS-Sub sensor value: No. 3) • Key lock (DICS-Sub sensor value: No. 5) - Check the rear door wires and connectors
0 X 04	Defective tail lamp auto off function (Battery save function)	- Check the tail lamp relay connector - Check the sensor values • Tail lamp switch (STICS sensor value: No. 3) • Tail lamp signal input status (STICS sensor value: No. 20) • Tail lamp relay (STICS sensor value: No. 47) - Check the tail lamp wires and connectors - The defective code of signals coming from ABS/ESP which senses the vehicle speed incorrectly due to the exterior noises - Current vehicle speed (STICS sensor value: No. 58)
0 X 05	Incorrect indication of the vehicle speed (Detects as over 300 km/h)	- Check the speed sensor connector - Check the other units (ABS) that use speed signal - Does not receive the vehicle speed signal from STICS when the ignition switch is turned off

Code	Malfunction	Help
0 X 06	Vehicle speed indicates over 0 km/h when the ignition switch is turned off	- Current vehicle speed (STICS sensor value: No. 58) - Check the speed sensor connector - Check the other units (ABS) that use speed signal
0 X 07	Tail lamp turns OFF without any signals when the tail lamp switch is turned on	- Check the tail lamp relay connector - Check the sensor values • Tail lamp switch (STICS sensor value: No. 3) • Tail lamp signal input status (STICS sensor value: No. 20) • Tail lamp relay (STICS sensor value: No. 47)
0 X 08	IGN 2 SW is detected as OFF when IGN 1 SW is ON	- Check the tail lamp wires and connectors - Check the sensor values • Key reminder switch (STICS sensor value: No. 13) • Ignition 1 switch (STICS sensor value: No. 17) • Ignition 2 switch (STICS sensor value: No. 18) • Ignition 1 switch (DICS-Main sensor value: No. 60) • Ignition 2 switch (DICS-Main sensor value: No. 59) • Key reminder (DICS-Main sensor value: No. 62)
0 X 09	Driver side door lock knob does not unlock	- Check the driver side door actuator - Check the sensor values • Door open switch (STICS sensor value: No. 5) • Door unlock switch (STICS sensor value: No. 22) • All door unlock switches (STICS sensor value: No. 39) • Key unlock (Main-DICS: No. 31) - Check the driver side door wires and connectors
0 X 0A	Passenger side door lock knob does not unlock	- Check the passenger side door actuator - Check the sensor values • Passenger side door open switch (STICS sensor value: No. 6) • Door unlock switch (STICS sensor value: No.22) • All door unlock switches (STICS sensor value: No. 39) • Key unlock (DICS-Main: No. 31) • Key unlock (Main-DICS: No. 04) - Check the driver side door wires and connectors
0 X 0B	Rear door lock knob does not unlock	- When one of the two rear seat door knobs is defective - Check the rear seat door actuator - Check the sensor values • Rear door knob switch (STICS sensor value: No. 7) • Rear right door open switch (STICS sensor value: No. 8) • Door unlock switch (STICS sensor value: No. 22) • Rear door open switch (STICS sensor value: No. 23) • All door unlock switches (STICS sensor value: No. 39) • Key unlock (DICS-Main sensor value: No. 31) • Key unlock (DICS-Sub sensor value: No. 4) - Check the rear seat door wires and connectors

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Reverse lever detection	Not detected	GND	Detected	12 V	1. Sensor signal detects when the reverse gear signal in A/T equipped vehicle 2. Ground level when not operating 3. Battery level when operating 4. This signal is used when outside rearview mirror in DICS Main/Sub is linked with 5°C. It is linked only when the outside rearview mirror selection switch in DICS Main is not in center position.
2	Input	Driver side seatbelt switch	Unfasten	GND	Fastened	12 V	1. Switch signal checks the driver side seatbelt has been fastened 2. Ground level when unfastened 3. Battery level when fastened
3	Input	Tail lamp switch	OFF	12 V	ON	GND	1. Switch that turns ON or OFF tail lamp switch 2. Battery level when tail lamp switch is OFF 3. Ground level when tail lamp switch is ON
4	Input	Trunk lid open switch	Close	GND	Open	12 V	1. When equipped with PTL, no input data is transmitted from trunk lid open switch to STICS 2. Battery level when open 3. Ground level when close
5	Input	Front left door open switch	Close	12 V	Open	GND	1. Ground level when door is open 2. Battery level when door is close
6	Input	Front right door open switch	Close	12 V	Open	GND	1. Ground level when door is open 2. Battery level when door is close
7	Input	Rear door knob switch	Open	GND	Close	12 V	1. Operating conditions • When the central door lock and unlock function is in operation • When the doors are locked by the driver's door lock knob • When receiving signal from DICS via CAN communication in auto door lock/unlock operation at vehicle speed of 50 km/h. 2. Ground level when rear door knob is open 3. Battery level when rear door knob is close
8	Input	Rear right door open switch	Close	12 V	Open	GND	1. Ground level when door is open 2. Battery level when door is close
9	Input	Parking brake switch	Not operating	12 V	Operating	GND	1. Switch detects the parking brake engagement 2. Ground level when parking brake is engaged 3. Battery level when not operating
10	Input	Auto windshield wiper switch	OFF	12 V	ON	GND	1. Auto windshields wiper switch. No inputs to STICS when the vehicle is equipped with the rain sensor 2. Ground level when ON 3. Battery level when OFF
11	Input	Hood open switch	Close	12 V	Open	GND	1. Hood open detection switch 2. Ground level when open 3. Battery level when close

No.	Input/ Output	Sensor value item	Information				Help
12	Input	Trunk unlock switch	Not operating	GND	Operating	12 V	1. Switch detects the trunk lid unlock from the glove compartment • With the power trunk: Communication between PTL and CAN • Without the power trunk: Controlled by STICS 2. OFF: GND 3. ON: 12 V
13	Input	Key reminder switch	Not detected	GND	Detected	12 V	1. Key reminder detection switch 2. Battery level when operating 3. Ground level when not operating
14	Input	KEY ACC switch	Not detected	GND	Detected	12 V	1. Key accessory detection switch 2. Battery level when operating 3. Ground level when not operating
15	Input	Alternator switch	Not detected	GND	Detected	12 V	1. Alternator charging detection switch 2. Battery level when operating 3. Ground level when not operating
16	Input	P/N switch	Not detected	GND	Detected	12 V	1. Parking (P) or neutral (N) position of A/T detection switch 2. Battery level when operating 3. Ground level when not operating
17	Input	IGN1 switch	Not detected	GND	Detected	12 V	1. Ignition 1 detection switch 2. Battery level when operating 3. Ground level when not operating
18	Input	IGN2 switch	Not detected	GND	Detected	12 V	1. Ignition 2 detection switch 2. Battery level when operating 3. Ground level when not operating
19	Input	Windshield Wiper position switch	Not detected	12 V	Detected	GND	1. Windshield wiper position switch detects the wiper position when the operation stops. With the rain sensor equipped vehicle, no inputs are transmitted to STICS 2. Ground level when in the original position (operating) 3. Battery level when not operating 4. Cannot detect when equipped with the rain sensor
20	Input	Tail lamp operation signal	No input	12 V	Input	GND	1. Tail lamp operation signal (monitoring) is the function that detects the auto light operation of the tail lamp 2. With signal input 3. Without signal input
21	Input	Central door lock switch	Not detected	12 V	Detected	GND	1. Locking door knob switch (Can be detected when the lock switch is in operation) 2. Battery level during door unlock 3. Ground level during door lock
22	Input	Central door unlock switch	Not detected	12 V	Detected	GND	1. Unlocking door knob switch (Can be detected when the unlock switch is in operation) 2. Battery level during door lock 3. Ground level during door unlock

Modification basis	
Application basis	
Affected VIN	

No.	Input/ Output	Sensor value item	Information				Help
23	Input	Rear left door open switch	Close	12 V	Open	GND	1. Rear left door open switch 2. Ground level when door is open 3. Battery level when door is close
24	Input	Heating grid switch	Not detected	12 V	Detected	GND	1. Heating grid operation switch (Blink once when the switch is operated) 2. Battery level when not operating (OFF) 3. Ground level when operating (ON)
25	-	-	-	-	-	-	-
26	Input	Washer switch	OFF	GND	ON	12 V	1. Windshield washer operating switch When equipped with the rain sensor,no inputs are transmitted to STICS 2. Battery level when operating (ON) 3. Ground level when not operating (OFF)
27	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-
32		Armed mode operation	Operating	GND	Not operating	12 V	1. Informs on armed mode 2. Electrical signals cannot be found 3. Battery level when operating 4. Ground level when not operating
33	Output	Rear left P/WDW UP relay	Not operating	12 V	Operating	GND	1. Relay for raising the rear left power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
34	Output	Rear left P/WDW DN relay	Not operating	12 V	Operating	GND	1. Relay for lowering the rear left power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
35	Output	Rear right P/WDW UP relay	Not operating	12 V	Operating	GND	1. Relay for raising the rear right power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
36	Output	Rear right P/WDW DN relay	Not operating	12 V	Operating	GND	1. Relay for lowering the rear right power window (The value changes when it operates within DICS-Main) 2. Ground level when operating 3. Battery level when not operating
37	Output	Driver side door lock relay	Not operating	12 V	Operating	GND	1. Driver side door knob lock relay (Locks all doors) The value appears only when the relay is connected 2. Ground level when operating 3. Battery level when not operating

No.	Input/ Output	Sensor value item	Information				Help
38	Output	All door lock other than driver side	Not operating	12 V	Operating	GND	1. All door knob lock relays other than the driver side The value appears only when the relay is connected 2. Ground level when operating 3. Battery level during normal
39	Output	Driver side door unlock relay	Not operating	12 V	Operating	GND	1. All door knob unlock relays (Cannot operate with driver side lock knob) The value appears only when the relay is connected 2. Ground level when operating 3. Battery level when not operating
40	Output	Windshield wiper relay	Not operating	GND	Operating	12 V	1. Windshield wiper operation switch When equipped with the rain sensor, no inputs are transmitted to STICS 2. Battery level when operating 3. Ground level when not operating
41	Output	Siren operation	Not operating	12 V	Operating	GND	1. Siren operation signal 2. Ground level when operating 3. Battery level when not operating
42	Output	Parking brake headlamp	Not operating	12 V	Operating	GND	1. Parking brake headlamp 2. Ground level when operating 3. Battery level when not operating
43	Output	Buzzer operation	Not operating	12 V	Operating	GND	1. Buzzer operation 2. Ground level when operating 3. Battery level when not operating
44	Output	Door open headlamp	Not operating	12 V	Operating	GND	1. Door open and driving warning 2. Ground level when operating 3. Battery level when not operating
45	Output	Heating grid relay	Not operating	12 V	Operating	GND	1. Heating grid operation relay drive output 2. Ground level when operating 3. Battery level when not operating
46	Output	Hazard warning relay	Operating	GND	Not operating	12 V	1. Heating grid operation relay drive output (Operates when in armed mode) 2. Ground level when operating 3. Battery level when not operating
47	Output	Tail lamp relay	Not operating	12 V	Operating	GND	1. Tail lamp relay drive output (Blink once when operating the tail lamp switch) 2. Ground level when operating 3. Battery level when not operating
48	-	-	-	-	-	-	-
49	Output	Front left foot lamp	Not operating		Operating		1.Driver side foot lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications

Modification basis	
Application basis	
Affected VIN	

No.	Input/ Output	Sensor value item	Information				Help
50	Output	Front right foot lamp	Not operating		Operating		1. Passenger side foot lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications
51	Output	Rear foot lamp	Not operating		Operating		1. Rear door foot lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications
52	Output	Room lamp	Not operating		Operating		1. Room lamp (Operating value delays as per dimming time) 2. Pulse signal between the battery and ground when operating. → Refer to operation signal STICS specifications
53	Output	Rheostat lamp	Not operating		Operating		1. Brightness changes according to the rheostat volume when the tail lamp is turned on 2. Pulse signal between the battery and ground when operating. Pulse width may change by 20% ~ 100% (based on GND). → Refer to operation signal STICS specifications
54	Output	Fixed rate dimming control	Not operating		Operating		1. Fixed rate dimming light (Operating value changes periodically) 2. Pulse signal between the battery and ground when operating. Pulse width maintains 50% of the duty rate. → Refer to operation signal STICS specifications
55	-	-	-	-	-	-	-
56	-	-	-	-	-	-	-
57	-	-	-	-	-	-	-
58	Output	Current vehicle speed	A km/h				
59	Output	Dimming control	A%				Controls the dimming by 20 ~ 100%
60	Output	Windshield wiper operating resistance stages	A kohn				1. Windshield wiper volume value: 0 ~ 10 kΩ → Value between 0 ~ Vcc For the rain sensor equipped vehicle, no inputs are transmitted to STICS
61	Output	Intermittent time	A · 10 ms				1. The unit time of the windshield wiper intermittent intervals For the rain sensor equipped vehicle, no inputs are transmitted to STICS

Code	Malfunction	Help
0 X 21	Power window limiter switch open	- The inputs have more than 30 edge hall pulses under the limiter switch off recognized as the upper position condition during the power window up or down outputs - Check the limiter switch - Check the sensor values • Power window anti-trap (DICS-Main: No. 50) • Power window limiter switch (DICS-Main: No. 56)
0 X 22	Defective power window motor hall sensor	- When the power window motor is under load, the auto-stop orders the power window to disengage auto-up function regardless ON or OFF inputs (no pulse signals) - No inputs of hall pulse exceeding 700 milliseconds during the power window motor down outputs under the limiter switch OFF (the upper position of the window) conditions or no inputs of pulse exceeding 100 milliseconds during the up outputs under the limit switch ON (the lowest position of the window) conditions. - Replace the power window motor
0 X 23	Inactive key door lock actuator	- Check the driver side door actuator - Check the sensor value • Key lock (DICS-Main: No. 32)
0 X 24	Inactive key door unlock actuator	- Check the driver side door actuator • Check the method of the actuator operation - Check the sensor value • Key unlock (DICS-Main: No. 31)
0 X 25	Memory switch input during no mirror UP or DN input	- When the outside rearview mirror has no UP or DOWN sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror UP or DOWN sensor wires - Measure sensor values and check the accordance position • Internal DOWN switch of the outside rearview mirror (DICS-Main: No. 21) • Internal UP switch of the outside rearview mirror (DICSMain:No. 22) • Internal DOWN motor of the outside rearview mirror (DICS-Main: No. 37) • Internal UP motor of the outside rearview mirror (DICSMain:No. 38) • Internal sensor of the outside rearview mirror (DICS-Main: No. 49) • Internal operation of the outside rearview mirror (DICSMain:No. 53)
0 X 26	Memory switch input during no mirror LT or RT input	- When the outside rearview mirror has no LEFT or RIGHT sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror LEFT or RIGHT sensor wires. - Measure the sensor values and check the relevant position • Internal RIGHT switch of the outside rearview mirror (DICS-Main: No. 19) • Internal LEFT switch of the outside rearview mirror (DICSMain: No. 20) • Internal RIGHT motor of the outside rearview mirror (DICSMain: No. 35) • nternal LEFT motor of the outside rearview mirror (DICSMain: No. 36) • Internal sensor of the outside rearview mirror (DICS-Main: No. 49) • Internal operation of the outside rearview mirror (DICSMain: No. 53)
0 X 27	Defective auto-stop	- The window does not lower to the certain range when autostop is detected during the driver side window auto-up operation. - Check the power window motor wires - Measure the sensor values and check the relevant position • Power window anti-trap (DICS-Main: No. 50) • Replace the power window motor

Modification basis	
Application basis	
Affected VIN	

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Rear left P/WDW UP S/W	Not operating		Operating		1. Switch the input signal to raise the rear left window 2. Internal input 3. Input signal transmits to STICS through CAN
2	Input	Front right P/WDW DN S/W	Not operating		Operating		1. Switch the input signal to lower the passenger's window 2. Internal input 3. Input signal transmits to DICS-Sub through CAN
3	Input	Front right P/WDW AUTO DN S/W	Not detected		Detected		1. Switch the input signal to lower the passenger's window automatically 2. Internal input 3. Input signal transmits to DICS-Sub through CAN
4	Input	Front right P/WDW UP S/W	Not operating		Operating		1. Switch the input signal to raise the passenger's window 2. Internal input 3. Input signal transmits to DICS-Sub through CAN
5	Input	Front left P/WDW DN S/W	Not operating		Operating		1. Switch the input signal to lower the driver side window 2. Internal input 3. DICS-Main has direct drive circuit
6	Input	Front left P/WDW AUTO DN S/W	Not detected		Detected		1. Switch the input signal to lower the driver side window automatically 2. Internal input 3. MICOM drives based on the signal
7	Input	Front left P/WDW UP S/W	Not operating		Operating		1. Switch input signal to raise the driver side window 2. Internal input 3. DICS-Main has direct drive circuit
8	Input	Front left P/WDW AUTO UP S/W	Not operating		Operating		1. Switch input signal to raise the driver side window automatically (operates only when the engine is running) 2. Internal input 3. MICOM drives based on the signal 4. When the obstruction is found (detects as hall pulse signal), the auto-stop engages the window to be lowered by 150 mm from its position
9	Input	Detecting driver's P/WDW detention	Not detected		Detected		1. Input signal of the motor protection is engaged by cutting the motor output when detects the increasing in currency when the motor is stopped at the lowest position of the driver side's window 2. Internal input
10	Input	Detecting 3 km/h of vehicle speed	Not detected		Detected		1. Input signal coming from STICS 2. Outside rearview mirrors will not fold when the signal comes on while outside rearview mirror is folding.

No.	Input/ Output	Sensor value item	Information				Help
11	Input	The driver side window status (limit switch)	Closed		Open		1. A signal that informs when the driver side window is opened. 2. When the window is at upper position, it is OFF (close) and when it's not in upper position by lowering, it is ON (open). 3. VCC 5 V level when window is opened: Operating 4. Ground level when window is closed: Not operating
12	Input	Easy access switch	Not operating		Operating		1. The steering column and electrical seat moves automatically during riding ON or OFF when this signal is ON. 2. Internal input 3. Input signal transmits to ESIMS and MSDOS through CAN
13	Input	P/WDW lock switch	Not operating		Operating		1. Only the driver side window is operational when this signal is ON. 2. Internal input 3. Input signal transmits to STICS and DICS Sub through CAN
14	Input	Rear right P/WDW DN S/W	Not operating		Operating		1. Switch input signal to lower the rear right window 2. Internal input 3. Input signal transmits to STICS through CAN
15	Input	Rear right P/WDW UP S/W	Not operating		Operating		1. Switch input signal to raise the rear right window 2. Internal input 3. Input signal transmits to STICS through CAN
16	Input	Rear left P/WDW DN S/W	Not operating		Operating		1. Switch input signal to lower the rear left window 2. Internal input 3. Input signal transmits to STICS through CAN
17	Input	Passenger side outside rearview mirror selection switch	Not detected		Detected		1. Signal that operates the driver side mirror, passenger side mirror and inside rearview mirror has selected the passenger side outside rearview mirror 2. Internal input 3. The signal transmits to DICS SUB and ESIMS through CAN
18	Input	Driver side outside rearview mirror selection switch	Not detected		Detected		1. Signal that operates the driver side mirror, passenger side mirror and inside rearview mirror has selected the passenger side outside rearview mirror 2. Internal input 3. When both left and right mirror selection signals are OFF, the signal selects inside rearview mirror and then ESIMS controls the inside rearview mirror 4. The signal transmits to DICS SUB and ESIMS through CAN

Modification basis	
Application basis	
Affected VIN	

No.	Input/ Output	Sensor value item	Information				Help
19	Input	Driver side outside rearview mirror right-turn switch	Not operating		Operating		1. Switch input to raise the mirror toward right 2. Internal input 3. This signal transmits to DICS SUB and ESIMS through CAN
20	Input	Driver side outside rearview mirror left-turn switch	Not operating		Operating		1. Switch input to move the mirror toward left 2. Internal input 3. This signal transmits to DICS SUB and ESIMS through CAN
21	Input	Driver side outside rearview mirror down switch	Not operating		Operating		1. Switch input to lower the mirror 2. Internal input 3. This signal transmits to DICS SUB through CAN
22	Input	Driver side outside rearview mirror up switch	Not operating		Operating		1. Switch input to raise the mirror upward 2. Internal input 3. This signal transmits to DICS SUB through CAN
23	Input	Driver side outside rearview mirror unfolding switch	Not operating		Operating		1. Switch input to unfold the mirror 2. Internal input 3. This signal transmits to DICS SUB through CAN
24	Input	Driver side outside rearview mirror folding switch	Not operating		Operating		1. Switch input to fold the mirror 2. Internal input 3. This signal transmits to DICS SUB through CAN
25	Input	Memory switch 3	Not detected		Detected		1. Signal that selects No. 3 memory position 2. When the memory switch is pressed for more than 2 seconds under P/N signal ON condition, MSDOS receives memorized position of the mirror through CAN and then moves the mirror to memorized position. 3. When the memory position switch is pressed after memory set switch input under the P/N signal ON condition, the current position value of the mirror (sensor value) transmits to MSDOS 4. Analog input when operating (about 3.8V) 5. VCC 5V when not operating
26	Input	Memory switch 2	Not detected		Detected		1. Signal that selects number 2 memory position 2. Analog input when operating (about 2.4V) 3. VCC 5V level when not operating
27	Input	Memory switch 1	Not detected		Detected		1. Signal that selects number 1 memory position 2. Analog input when operating (about 1.3V) 3. VCC 5 V level when not operating
28	Input	Memory stop switch	Not detected		Detected		1. Switch signal to stop the memory return 2. Ground level when operating 3. VCC 5 V level when not operating
29	Input	Memory SET switch	Not detected		Detected		1. Switch input to store the positions of the memory related mechanisms. When one of the memory switch among 3 is pressed after this signal, position value of the outside rearview mirrors will be transmitted to MSDOS through CAN 2. Analog input when operating (about 0V) 3. VCC 5 V level when not operating

No.	Input/ Output	Sensor value item	Information				Help
31	Input	Driver side door key unlock	Not operating		Operating		1. ON when the driver side door key fob is unlocked 2. Ground level when operating 3. VCC 5 V level when not operating
32	Input	Driver side door key lock	Not operating		Operating		1. ON when the driver side door key fob is locked 2. Ground level when operating 3. VCC 5 V level when not operating
33	Output	Driver side outside rearview mirror unfolding motor	Not operating		Operating		1. Unfolding operation of the driver side outside rearview mirror mottor 2. Battery level when operating 3. Ground level when not operating
34	Output	Driver side outside rearview mirror folding motor	Not operating		Operating		1. Folding operation of the driver side outside rearview mirror motor 2. Battery level when operating 3. Ground level when not operating
35	Output	Driver side outside rearview mirror right-turn motor	Not operating		Operating		Operates the driver side outside rearview mirror motor toward right
36	Output	Driver side outside rearview mirror left-turn motor	Not operating		Operating		Operates the driver side outside rearview mirror motor toward left
37	Output	Driver side outside rearview mirror down motor	Not operating		Operating		Operates the driver side outside rearview mirror motor down
38	Output	Driver side outside rearview mirror up motor	Not operating		Operating		Operates the driver side outside rearview mirror motor up
39	Output	Driver side P/WDW DN MTR	Not operating		Operating		1. Driver side power window motor down 2. Battery level when operating 3. Ground level when not operating
40	Output	Driver side P/WDW UP MTR	Not operating		Operating		1. Driver side power window motor up 2. Battery level when operating 3. Ground level when not operating
41	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-
43	Output	Memory LED	Not operating		Operating		1. Indicates when the LED lamp blinks during the memory set or when the return operation is ON 2. 2 V level when operating 3. Ground level when not operating
44	Output	Output power (5V)	Not operating		Operating		1. 5 V of power supplies each of the power window switch, outside rearview mirror sensor and power window motor hall sensor 2. 5 V level when operating 3. Ground level when not operating
45	Output	Driver side outside rearview mirror operating power	Not operating		Operating		1. Supplying power for the mirror LED lamp 2. 5 V level when operating 3. Ground level when not operating
46	Output	Easy access LED	Not operating		Operating		1. LED lamp turns on when easy access switch is pressed and turns off when pressed again.

No.	Input/ Output	Sensor value item	Information				Help
47	Output	Driver side P/WDW S/W LED					1. LED lamp for power window switch illumination
48	Output	Driver side P/WDW LOCK S/W LED					1. LED lamp turns on when the window lock button is pressed and turns off when pressed again.
49	Status	Yes or No of the driver side outside rearview mirror sensor					1. ON when the driver side outside rearview mirror has no sensor detected or sensor is open-circuited
50	Status	Anti-trap operation status					1. Anti-trap activates when the obstruction is found during auto-up operation of the driver side power window with ignition ON.
51	Status	Side rearview mirror time lag					1. Indicates the outside rearview mirror can be controlled for a certain period of time after ignition key has been removed.
52	Status	Power window time lag					1. Indicates the power window can be controlled for a certain period of time after ignition key has been removed.
53	Status	Possibility of the side rearview mirror operation					1. Indicates the mirror can be controlled when ignition key is in ACC or IGN 1 or when mirror is in time lag
54	Status	Possibility of the power window operation					1. Indicates the power windows can be controlled when ignition key is in IGN 1 or when power windows is in time lag
55	Status	Hall sensor malfunction					1. When the signal coming from a hall sensor in the power window is abnormal
56	Status	Limit switch malfunction					1. When the signal coming from a limit switch in the power window regulator is abnormal
57	Input (CAN)	Armed mode operation state					1. Receives the signal from STICS when the vehicle enters the armed mode by REKES by locking the door. REKES linked power window and outside rearview mirror operation is possible only under the armed status.
58	Input (CAN)	Key ACC power					1. Ignition key ACC status receives from STICS
59	Input (CAN))	IGN 2 power					1. Ignition key IGN 2 status receives from STICS
60	Input	IGN 1 power					1. Ignition key IGN 1 status receives from STICS or DICS receives directly
61	Input (CAN)	Alternator operation status					1. Status of the engine under starting receives from STICS
62	Input (CAN)	Key reminder switch					1. Receives from STICS and indicates when the ignition key is inserted
63	Input (CAN)	Input status of the P/N signals					1. Receives from STICS and indicates the P/N status of transmission
64	Input (CAN)	Input status of the reverse signal					1. Receives from STICS and indicates the reverse status of transmission
65	Input	Lateral sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)				1. Vertical sensor upper value of the outside rearview mirror 2. Sensor value when turned right: Increase 3. Sensor value when turned left: Decrease

No.	Input/ Output	Sensor value item	Information	Help
66	Input	Lateral sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]	1. Vertical sensor upper value of the outside rearview mirror 2. Sensor value when turned right: Increase 3. Sensor value when turned left: Decrease * HI value increases or decreases by 1 if exceeded 8 bit (1~255)
67	Input	Vertical sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)	1. Lateral sensor upper value of the outside rearview mirror 2. Sensor value when moved up: Increase 3. Sensor value when moved down: Decrease
68	Input	Vertical sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]	1. Lateral sensor upper value of the outside rearview mirror 2. Sensor value when moved up: Increase 3. Sensor value when moved down: Decrease * HI value increases or decreases by 1 when exceeds 8 bit (1~255)
69	Input	Software version		Indicates current software version

Modification basis	
Application basis	
Affected VIN	

Code	Malfunction	Help
0 X 07	Operates when power window is locked	- When the power window is locked, the window can be operated from the passenger side. (Passenger switch input during the control by DICS-Main while power window is locking) - Defective CAN communication
0 X 08	Door lock key actuator does not operate	- Check the passenger side door actuator • Check the method of actuator operation status - Check the sensor value • Key lock (DICS-Sub: No. 5)
0 X 09	Door unlock key actuator does not operate	- Check the passenger side door actuator • Checking the method of actuator operation status - Check the sensor value • Key unlock (DICS-Sub: No. 4)
0 X 0A	No mirror UP or DN inputs correspondence to the memory switch inputs	- When the outside rearview mirror has no UP or DOWN sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror UP or DOWN sensor wires - Measure the sensor values and check the relevant position • Internal DOWN motor of the outside rearview mirror (DICS-Sub: No. 13) • Internal UP motor of the outside rearview mirror (DICSSub: No. 14) • Internal sensor of the outside rearview mirror (DICS-Sub: No. 44)
0 X 0B	No mirror LEFT or RIGHT inputs correspondence to the memory switch inputs	- When the outside rearview mirror has no LEFT or RIGHT sensor values, DICS-Main recognizes and disables the vehicle memory function. However, when the memory input has detected, it means the sensor is open-circuited or has different mirror has been installed. - Check the outside rearview mirror LEFT or RIGHT sensor wires - Measure the sensor values and check the relevant position • Internal RIGHT motor of the outside rearview mirror (DICSSub: No. 11) • Internal LEFT motor of the outside rearview mirror (DICSSub: No. 12) • Internal sensor of the outside rearview mirror (DICS-Sub: No. 17)

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Detecting passenger side P/WDW detention	Not operating		Operating		1. Input signal for the motor protection is transmitted. The motor output detects increasing current when the motor is stopped at the lowest position of the passenger side window. 2. Internal input
2	-	-	-	-	-	-	-
3	Input	Passenger side door lock knob	Not operating		Operating		1. Status of the door lock actuator monitors ring switch on(passenger side) door trim 2. Ground level when the lock is detected 3. VCC 5V level when the unlock is detected
4	Input	Passenger side door key unlock	Not operating		Operating		1. ON when the passenger side door key fob is unlocked 2. Ground level when operating (unlock) 3. VCC 5V level when not operating (lock)
5	Input	Passenger side door key lock	Not operating		Operating		1. ON when the passenger side door key fob is locked 2. Ground level when operating 3. VCC 5V level when not operating
6	Input	Front left P/WDW DN S/W	Not detected		Detected		1. Switch input signal to lower the passenger side window 2. DICS SUB drives directly with the circuit
7	Input	Front right P/WDW auto DN S/W	Not detected		Detected		1. Switch input signal to lower the passenger side window automatically 2. MICOM drives directly according to the above signal
8	Input	Front right P/WDW UP S/W	Not detected		Detected		1. Switch input signal to raise the passenger side window 2. DICS SUB drives directly with the circuit
9	Output	Passenger side outside rearview mirror unfolding MTR	Not detected		Detected		1. Motor operates the passenger side's outside rearview mirror to unfold
10	Output	Passenger side outside rearview mirror folding MTR	Close		Open		1. Motor operates the passenger side's outside rearview mirror to fold
11	Output	Passenger side outside rearview mirror left-turn MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror towards right
12	Output	Passenger side outside rearview mirror right-turn MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror towards left
13	Output	Passenger side outside rearview mirror down MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror down
14	Output	Passenger side outside rearview mirror up MTR	Not operating		Operating		1. Motor operates the passenger side's outside rearview mirror up
15	Output	Passenger side P/WDW down MTR	Not operating		Operating		1. Passenger side's power window motor down 2. Battery level when operating 3. Ground level when not operating

Modification basis	
Application basis	
Affected VIN	

No.	Input/ Output	Sensor value item	Information				Help
16	Output	Passenger side P/ WDW up MTR	Not operating		Operating		1. Passenger side's power window motor up 2. Battery level when operating 3. Ground level when not operating
17	State	Yes or No of the passenger side outside rearview mirror sensor	Yes		No		1. ON when the passenger side's outside rearview mirror has no sensor or sensor is open-circuited
18	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-
20	Output	Output power (5V) VDD	Not operating		Operating		1. 5 V is supplied to the power window switch and outside rearview mirror sensor 2. 5 V of level when operating 3. Ground level when not operating
21	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-
23	Output	Passenger side P/ WDW SW LED Lamp	Not operating		Operating		1. LED lamp for the power window switch illumination (Value changes when the window is locked)
24	-	-	-	-	-	-	-
25	Input	Lateral sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)				1. Lateral sensor upper value of the outside rearview mirror Sensor value when moves up: Increase Sensor value when moves down: Decrease
26	Input	Lateral sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]				1. Lateral sensor lowers value of the outside rearview mirror Sensor value when moves up: Increase Sensor value when moves down: Decrease
27	Input	Vertical sensor value of the driver side outside rearview mirror (HI)	Sensor value (increase or decrease by 1)				1. Vertical sensor raises value of the outside rearview mirror Sensor value when turns right: Increase Sensor value when turns left: Decrease
28	Input	Vertical sensor value of the driver side outside rearview mirror (LOW)	Sensor value [value changes within 8 bit (1~255)]				1. Vertical sensor raises value of the outside rearview mirror Sensor value when turns right: Increase Sensor value when turns left: Decrease
29	Input	Software version					Indicates the current software version

Code	Malfunction	Help
0 X 61	Defective driver side seat sliding	• MSDOS continuously monitors the sensor values when the driver operates the seat sliding switch or when the memory return is in action. When the seat sliding operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. • Measure the sensor values and check the relevant position Driver side seat slides-backward (MSDOS sensor value: No. 7) Driver side seat slides-forward (MSDOS sensor value: No. 8) Driver side seat backward slide motor (MSDOS sensor value: No. 15) Driver side seat forward slide motor (MSDOS sensor value: No. 16)
0 X 62	Defective driver side seat tilting	• MSDOS continuously monitors the sensor values when the driver operates the seat tilting or the memory return is in motion. When the seat tilting operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. • Measure the sensor values and check the relevant position Driver side seat tilt-down (MSDOS sensor value: No. 5) Driver side seat tilt-up (MSDOS sensor value: No. 6) Driver side seat tilt-down motor (MSDOS sensor value: No. 13) Driver side seat tilt-up motor (MSDOS sensor value: No. 14)
0 X 63	Defective driver side seat height adjustment	• MSDOS continuously monitors the sensor values when the driver operates the seat height adjustment or the memory return is in motion. When the seat height adjustment operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. • Measure the sensor values and check the relevant position Driver side seat height-lowers (MSDOS sensor value: No. 3) Driver side seat height-raises (MSDOS sensor value: No. 4) Driver side seat height-lowering motor (MSDOS sensor value: No. 11) Driver side seat height-raising motor (MSDOS sensor value: No. 12)

Modification basis	
Application basis	
Affected VIN	

Code	Malfunction	Help
0 X 64	Defective driver side seatback angle adjustment	• MSDOS continuously monitors the sensor values when the driver operates the seat reclining or the memory return is in motion. When the seat recline operation is engaged but the sensor value remains unchanged, the seat motor sensor may be malfunction. • Measure the sensor values and check the relevant position Driver side seatback angle-declination (MSDOS sensor value: No. 1) Driver side seatback angle-inclination (MSDOS sensor value: No. 2) Driver side seatback angle-declination motor (MSDOS sensor value: No. 10) Driver side seatback angle-inclination motor (MSDOS sensor value: No. 11)
0 X 65	No position data input from DICSMain	• When MSDOS sends memory setting order, all DICS_MAIN, DICS-SUB and ESIMS send the position data to MSDOS. If no position data has received from DICS_MAIN, then it will be recognized as an error. • Input data from a respective unit when resetting the memory switch • Check CAN communication between DICS_MAIN and MSDOS
0 X 66	No position data input from DICSSub	• When MSDOS sends memory setting order, all DICS_MAIN, DICS-SUB and ESIMS send the position data to MSDOS. If no position data has received from DICS_MAIN, then it will be recognized as an error. • Input data from a respective unit when resetting the memory switch • Check CAN communication between DICS_SUB and MSDOS
0 X 67	No position data input from ESIMS	• When MSDOS sends memory setting order, all DICS_MAIN, DICS-SUB and ESIMS send the position data to MSDOS. If no position data has received from DICS_MAIN, then it will be recognized as an error. • Input data from a respective unit when resetting the memory switch • Check CAN communication between ESIMS and MSDOS
0 X 68	No return data input from DICS-Main	• During the memory return, DICS_MAIN, DICS-SUB and ESIMS send the memory return operation signals continuously through CAN communication. MSDOS recognizes malfunction and then determines as an error when no data has been received from DICS_MAIN during the memory return. • Input data from a respective unit when operating the memory switch • Check CAN communication between DICS_MAIN and MSDOS • During the memory return, DICS_MAIN, DICS-SUB and ESIMS send the memory return operation signals continuously through CAN communication. MSDOS recognizes malfunction and then determines as an error when no data has been received from DICS_MAIN during the memory return.
0 X 69	No return data input from DICS-Sub	• Input data from a respective unit when operating the memory switch • Check CAN communication between DICS_SUB and MSDOS • During the memory return, DICS_MAIN, DICS-SUB and ESIMS send the memory return operation signals continuously through CAN communication. MSDOS recognizes malfunction and then determines as an error when no data has been received from ESIMS during the memory return.
0 X 70	No return data input from ESIMS	• Input data from a respective unit when operating the memory switch • Check CAN communication between ESIMS and MSDOS

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Driver side seatback reverse switch	Not operating	Vcc	Operating	GND	• A driver operates the seat recliner (seatback angle adjustment) switch backward • Ground level when operating • Vcc level when not operating
2	Input	Driver side seatback forward switch	Not operating	Vcc	Operating	GND	• A driver operates the seat recliner (seatback angle adjustment) switch forward • Ground level when operating • Vcc level when not operating
3	Input	Driver side seat height down switch	Not operating	Vcc	Operating	GND	• A driver operates the seat height (rear part of the seat bottom) adjustment switch downward • Ground level when operating • Vcc level when not operating
4	Input	Driver side seat height up switch	Not operating	Vcc	Operating	GND	• A driver operates the seat height (rear part of the seat bottom) adjustment switch upward • Ground level when operating • Vcc level when not operating
5	Input	Driver side seat tilt-down switch	Not operating	Vcc	Operating	GND	• A driver operates the seat tilting (front part of the seat bottom) switch downward • Ground level when operating • Vcc level when not operating
6	Input	Driver side seat tilt-up switch	Not operating	Vcc	Operating	GND	• A driver operates the seat tilting (front part of the seat bottom) switch upward • Ground level when operating • Vcc level when not operating
7	Input	Driver side seat slide-backward switch	Not operating	Vcc	Operating	GND	• A driver operates the seat slide switch backward • Ground level when operating • Vcc level when not operating
8	Input	Driver side seat slide-forward switch	Not operating	Vcc	Operating	GND	• A driver operates the seat slide switch forward • Ground level when operating • Vcc level when not operating
9	Input	Driver side seatback declining MTR	Not operating	GND	Operating	12 V	• When the recliner (seatback) is moving backward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.

Modification basis	
Application basis	
Affected VIN	

No.	Input/ Output	Sensor value item	Information				Help
10	Output	Driver side seatback inclining MTR	Not operating	GND	Operating	12 V	• When the recliner (seatback) is moving forward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
11	Output	Driver side seat height down MTR	Not operating	GND	Operating	12 V	• When the seat height adjustment (rear part of the seat bottom) is moving downward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
12	Output	Driver side seat height up MTR	Not operating	GND	Operating	12 V	• When the seat height adjustment (rear part of the seat bottom) is moving upward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
13	Output	Driver side seat tilt-down MTR	Not operating	GND	Operating	12 V	• When the seat tilts (front part of the seat bottom) downward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.

No.	Input/ Output	Sensor value item	Information				Help
14	Output	Driver side seat tilt-up MTR	Not operating	GND	Operating	12 V	• When the seat tilts (front part of the seat bottom)upward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
15	Output	Driver side seat slide-backward MTR	Not operating	GND	Operating	12 V	• When the seat (forward/backward movement of seat) slides backward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
16	Output	Driver side seat slide-forward MTR	Not operating	GND	Operating	12 V	• When the seat (forward/backward movement of seat) slides forward • Battery level when operating • Ground level when not operating However, when the recliner motor is operated by the driver side switch operation, this information does not appear on the ECU. It is because the switch drives the motor directly. For more information, go to "Easy access and memory switch operation" where ECU internal software drives the motor directly.
17	Output	Driver side seat slide sensor value	Sensor value				• Sensor value when seat slides (forward or backward movement of the seat) is moving • Sensor value when moving forward: Increase • Sensor value when moving backward: Decrease
18	Input	Driver side seat tilting sensor value	Sensor value				• Sensor value when seat tilting (front part of the seat bottom) is moving • Sensor value when moving upward: Increase • Sensor value when moving downward: Decrease
19	Input	Driver side seat height sensor value	Sensor value				• Sensor value when seat height (rear part of the seat bottom) is moving • Sensor value when moving upward: Increase • Sensor value when moving downward: Decrease
20	Input	Driver side seatback sensor value	Sensor value				• Sensor value when seat recliner (seatback) is moving • Sensor value when moving forward: Increase • Sensor value when moving backward: Decrease

Modification basis	
Application basis	
Affected VIN	

Code	Malfunction	Help
0 X 81	Defective steering column tilt	- ESIMS continuously monitors the sensor values when the driver operates the steering column or the steering column is in motion. When the teering wheel column operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. - Measure the sensor values and check the relevant position • Steering column tilt-up (ESIMS sensor value: No. 1) • Steering column tilt-down (ESIMS sensor value: No. 2) • Steering column tilt-up motor (ESIMS sensor value: No. 13) • Steering column tilt-down motor (ESIMS sensor value: No. 14)
0 X 82	Defective steering column telescope	- ESIMS continuously monitors the sensor values when the driver operates the steering column or the steering column is in motion. When the steering wheel column operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. - Measure the sensor values and check the relevant position • Steering column tilt-up (ESIMS sensor value: No. 3) • Steering column tilt-down (ESIMS sensor value: No. 4) • Steering column tilt-up motor (ESIMS sensor value: No. 15) • Steering column tilt-down motor (ESIMS sensor value: No. 16)
0 X 83	Defective inside rearview mirror left or right movement	- ESIMS continuously monitors the sensor values when the driver adjusts the inside rearview mirror horizontally or the inside rearview mirror is in motion. When the inside rearview mirror horizontal operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. - Measure the sensor values and check the relevant position • Inside rearview mirror moves right (ESIMS sensor value: No. 5) • Inside rearview mirror moves left (ESIMS sensor value: No. 6) • Inside rearview mirror left movement motor (ESIMS sensor value: No. 11) • Inside rearview mirror right movement motor (ESIMS sensor value: No. 12)
0 X 84	Defective inside rearview mirror up or down functions	- ESIMS continuously monitors the sensor values when the driver adjusts the inside rearview mirror vertically or the inside rearview mirror is in motion. When the inside rearview mirror vertical operation is engaged but the sensor value remains unchanged, the motor or the sensor may be malfunction. - Measure the sensor values and check the relevant position • Inside rearview mirror moves down (ESIMS sensor value: No. 7) • Inside rearview mirror moves up (ESIMS sensor value: No. 8) • Inside rearview mirror down movement motor (ESIMS sensor value: No. 10) • Inside rearview mirror up movement motor (ESIMS sensor value: No. 9)

No.	Input/ Output	Sensor value item	Information				Help
1	Input	Steering wheel tilt-up switch	Not operating	Vcc	Operating	GND	1. A driver operates the tilt switch at the steering column upward 2. Ground level when operating 3. Vcc level when not operating
2	Input	Steering wheel tilt-down switch	Not operating	Vcc	Operating	GND	1. A driver operates the tilt switch at the steering column downward 2. Ground level when operating 3. Vcc level when not operating
3	Input	Steering wheel telescope up switch	Not operating	Vcc	Detected	GND	1. A driver operates the telescopic switch on the steering column toward extract 2. Ground level when operating 3. Vcc level when not operating
4	Input	Steering wheel telescope down switch	Not operating	Vcc	Operating	GND	1. A driver operates the telescopic switch on the steering column toward retract 2. Ground level when operating 3. Vcc level when not operating
5	Input	Inside rearview mirror right moving switch	Not operating	Vcc	Operating	GND	1. A driver presses the right side of the mirror operation switch when the mirror selector switch is in the neutral position (center) (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror moves right (*Note: The mirror operates when the ignition switch is in ACC or other position) 5. Receives CAN data from DICS-Main
6	Input	Inside rearview mirror left moving switch	Not operating	Vcc	Detected	GND	1. A driver presses the left part of the mirror operation switch when the mirror selector switch is in center position (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror moves left (*Note: The mirror operates when the ignition switch is in ACC or other position) 5. Receives CAN data from DICS-Main
7	Input	Inside rearview mirror down moving switch	Not operating	Vcc	Operating	GND	1. A driver presses the lower part of the mirror operation switch when the mirror selector switch is in center position (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror tilts down (*Note: The mirror operates if ignition switch is in ACC or more) 5. Receives CAN data from DICS-Main
8	Input	Inside rearview mirror up moving switch	Not operating	Vcc	Operating	GND	1. A driver presses the upper part of the mirror operation switch when the mirror selector switch is in center position (at this moment, the mirror can be adjusted) 2. Ground level when operating 3. Vcc level when not operating 4. When this switch is detected, the mirror tilts up (*Note: The mirror operates if ignition switch is in ACC or more) 5. Receives CAN data from DICS-Main

Modification basis	
Application basis	
Affected VIN	

No.	Input/ Output	Sensor value item	Information				Help
9	Output	Inside rearview mirror up motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for vertical movement) is moving upward 2. Battery level when operating 3. Ground level when not operating
10	Output	Inside rearview mirror down motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for vertical movement) is moving downward 2. Battery level when operating 3. Ground level when not operating
11	Output	Inside rearview mirror left moving motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for vertical movement) is moving downward 2. Battery level when operating 3. Ground level when not operating
12	Output	Inside rearview mirror right moving motor	Not operating	GND	Operating	12 V	1. When the mirror (motor for horizontal movement) is moving right side 2. Battery level when operating 3. Ground level when not operating
13	Output	Steering wheel tilt-up motor	Not operating	GND	Operating	12 V	1. When the tilt motor on the steering column is moving upward 2. Battery level when operating 3. Ground level when not operating
14	Output	Steering wheel tilt-down motor	Not operating	GND	Operating	12 V	1. When the tilt motor on the steering column is moving downward 2. Battery level when operating 3. Ground level when not operating
15	Output	Steering wheel telescope up MTR	Not operating	GND	Operating	12 V	1. When the telescopic motor on the steering column is moving towards the driver 2. Battery level when operating 3. Ground level when not operating
16	Output	Steering wheel telescope down MTR	Not operating	GND	Operating	12 V	1. When the telescopic motor on the steering column is moving away from the driver 2. Battery level when operating 3. Ground level when not operating
17	Input	Steering wheel column tilting sensor	Sensor value				1. Sensor value when the tilt motor on the steering column is moving up/down 2. Sensor value when moving up: Decrease 3. Sensor value when moving down: Increase
18	Input	Steering wheel column telescope sensor	Sensor value				1. Sensor value when the telescopic motor on the steering column is moving up/down 2. Sensor value when moving long extraction : Decrease 3. Sensor value when moving short retraction : Increase
19	Input	Inside rearview mirror left and right movement sensor	Sensor value				1. Sensor value when the longitudinal motor in the mirror moves left or right 2. Sensor value when moving toward right: Increase 3. Sensor value when moving toward left: Decrease
20	Input	Inside rearview mirror up and down movement sensor	Sensor value				1. Sensor value when the vertical motor in the mirror moves up or down 2. Sensor value when moving upward: Increase 3. Sensor value when moving downward: Decrease

Memo

INDEX

DIAGNOSIS

1. SELF DIAGNOSIS..... 3

FATC

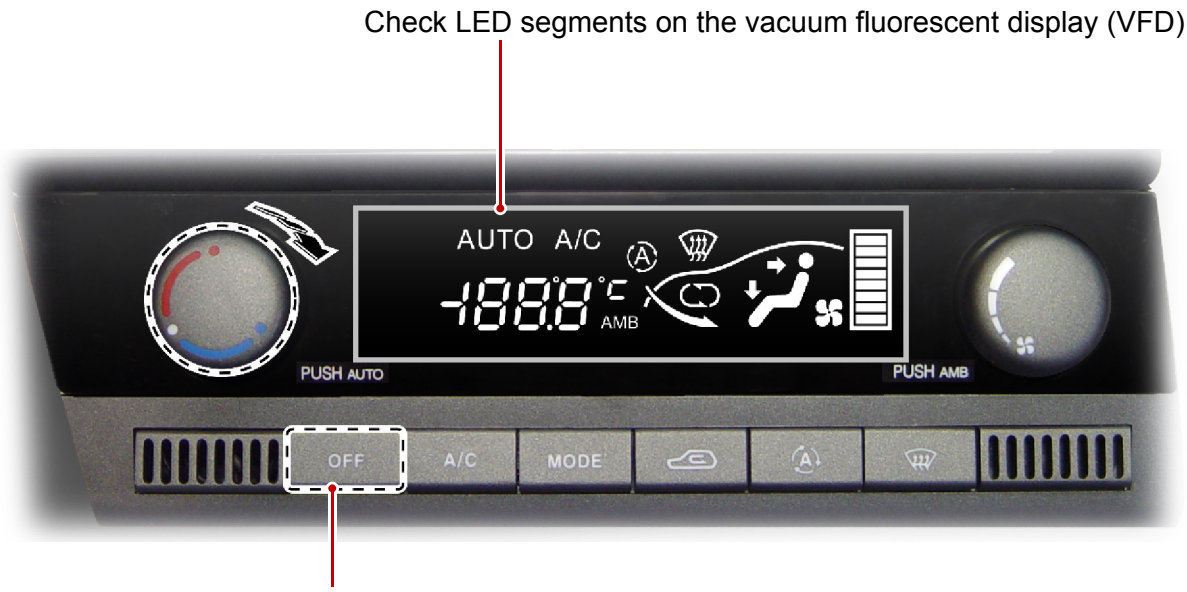
0000-00

DIAGNOSIS

1. SELF DIAGNOSIS

1) Starting Self Diagnosis

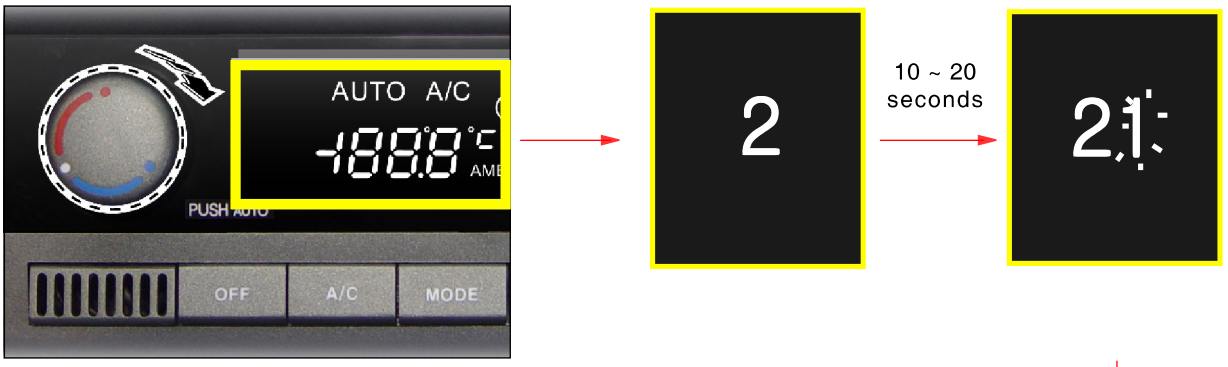
Turn the ignition switch to ON position and press OFF switch for more than 5 seconds within 10 seconds.



2) Set in Trouble Diagnosis Step 2

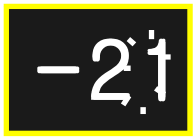
In this step, check the air mix door and sensors for defect.

Once the system starts diagnosis step 2, the digit "2" is displayed, implying step 2, on the display window and the trouble diagnosis for sensors is executed. If no failure exists, "20" is displayed. If any failure exists, the appropriate trouble code is displayed as below.



CAUTION

- The symbol "-" in front of step number "2" means a short circuit of the blinking sensor.



Short-circuit in the ambient air temperature sensor

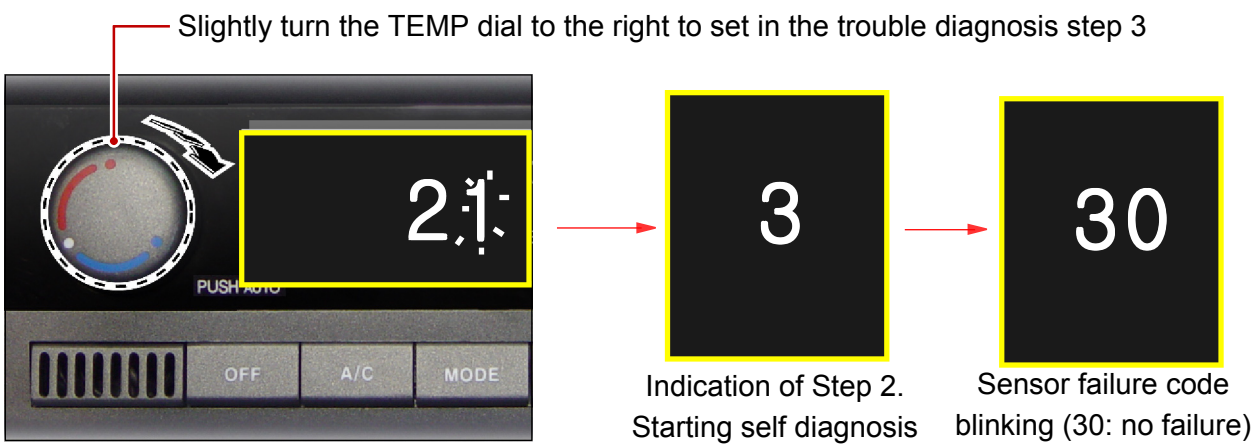
Trouble Code

Code	Malfunction	Remark	Code	Malfunction	Remark
0	VDF segments are OK		5	Defective sun sensor	
1	Defective ambient temperature sensor		6	Check Air mix door	
2	Defective interior temperature sensor		7	Defective humidity sensor	
3	Defective duct temperature sensor		8	-	
4	Defective intake sensor		9	-	

Modification basis	
Application basis	
Affected VIN	

3) Set in Trouble Diagnosis Step 3

In this step, check the position and conditions of recirculation air door and mode door.
Slightly turn the TEMP switch until "3" is displayed on the display window.
If no failure exists, "30" is displayed. If any failure exists, the appropriate trouble code is displayed.

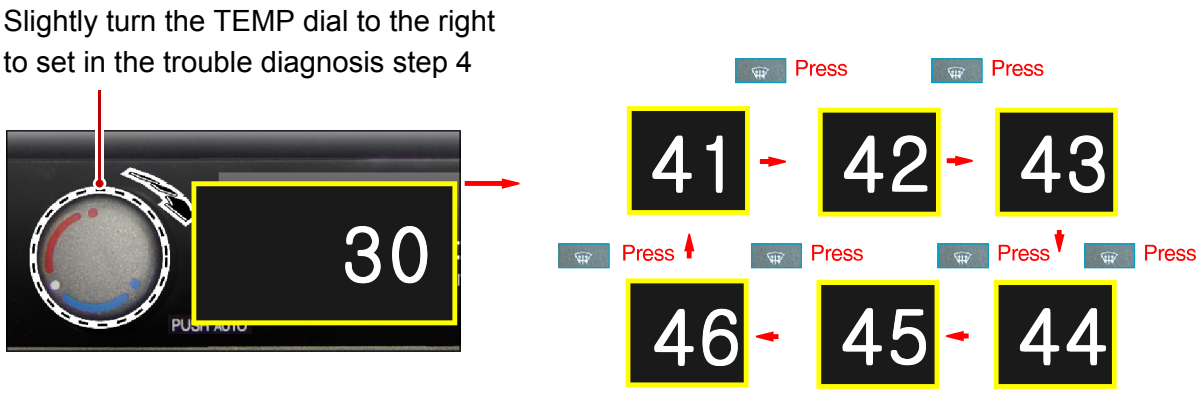


Trouble Code

Code	Malfunction	Remark	Code	Malfunction	Remark
1	Defective VENT		6	DEF	
2	Defective B/L		7	FRE	
3	-		8	20% FRE	
4	FOOT		9	REC	
5	D/F		0	All door OK	

4) Set in Trouble Diagnosis Step 4

In this step, check the position of actuator door, check the fan speed, and check the compressor operation.
Slightly turn the TEMP switch in step 3 until "41" is displayed on the display window. When pressing DEF switch , mode changes as shown below in turns to check each function.

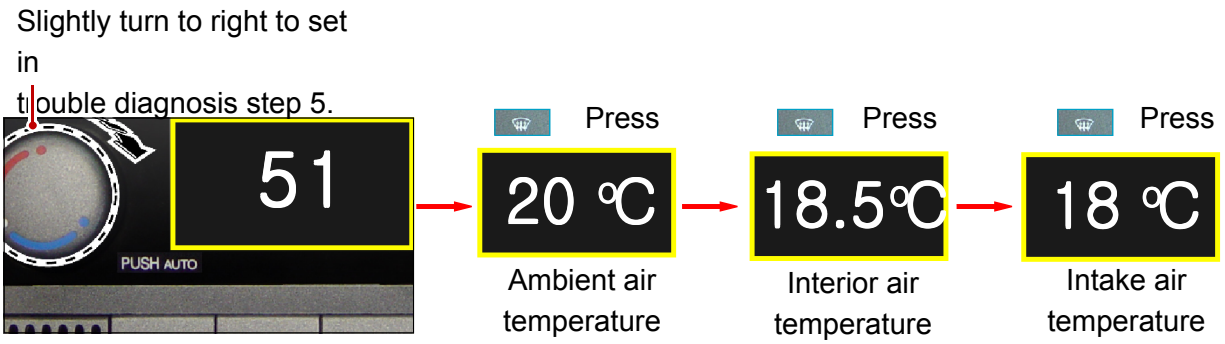


Function Check

Displayed Number	41	42	43	44	45	46
Mode door	VENT	B/L	B/L	FOOT	D/F	DEF
Interior/Ambient door	REC	REC	20%FRE	FRE	FRE	FRE
Air mix door	F/COOL	F/COOL	F/HOT	F/HOT	F/HOT	F/HOT
Blower	4.5 V	10.5 V	8.5 V	8.5 V	8.5 V	MAX
Compressor	ON	ON	OFF	OFF	ON	ON

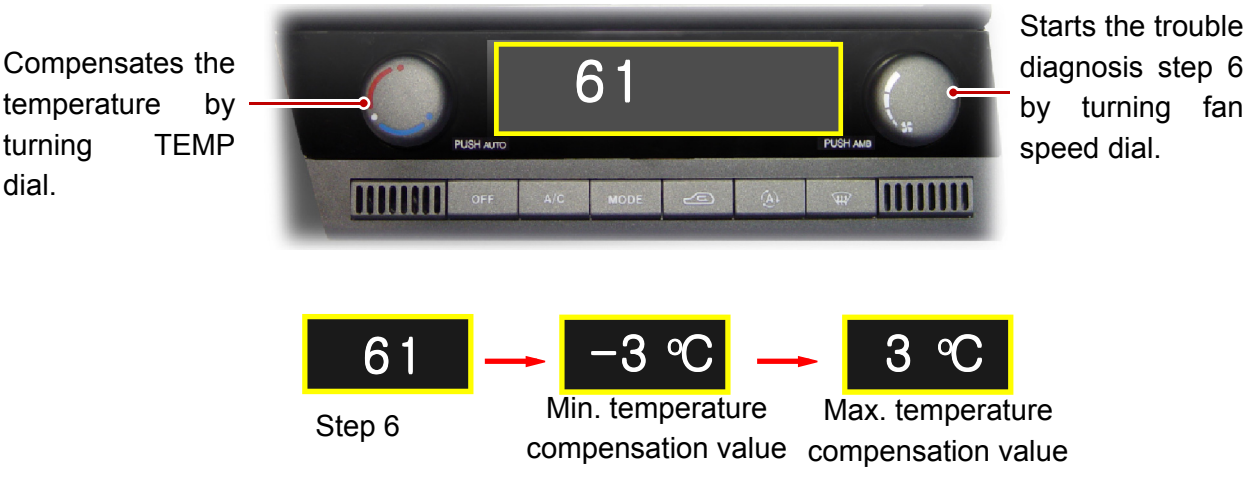
5) Set in Trouble Diagnosis Step 5

In this step, check the conditions of temperature related sensors.
Slightly turn the TEMP switch in step 4 until "51" is displayed on the display window. When pressing DEF switch , displayed temperature changes as shown below in turns.



6) Set in Trouble Diagnosis Step 6

In this step, the temperature can be compensated within the range of −3°C to 3°C in the control process according to the temperature to air conditioner controller. The step 6 initiates when slightly rotating the fan speed switch (other than TEMP switch) in step 5.



Modification basis	
Application basis	
Affected VIN	

INDEX

DIAGNOSIS

1. FFH..... 3

FFH

0000-00

DIAGNOSIS

1. FFH

Trouble Code	Trouble Description	Remedies
0	No faults	-
10	Shutdown for overvoltage	Measure battery voltage (must be < 15.9V). Check alternator and overvoltage.
11	Shutdown for undervoltage	Measure battery voltage (must be > 10.2V under load). Check alternator, wiring and undervoltage.
12	Overheating (abnormal reference value)	Temperature at overheating sensor > 125°C: check cooling system. Check temperature sensor and overheating sensor, replace if necessary.
14	Overheating (difference evaluation-1)	Difference in temperature values between surface sensor and control overheating sensor is too large. (Prerequisite for this trouble code display is that the heater is in operation and the water temperature at the overheating sensor has reached min. 80°C): check cooling system. Check temperature sensor and overheating sensor, replace if necessary
15	Overheating (abnormal heater operation)	Heater does not operate (The controller is locked.) Delete trouble code to release controller lock: check cooling system. Check temperature sensor and overheating sensor, replace if necessary
16	Overheating (difference evaluation-2)	If the surface sensor has a far higher temperature value than the control overheating sensor, then the system proceeds with a fault shutdown.
17	Overheating (defective hardware-2)	Temperature at control overheating sensor > 130°C: check cooling system. Check temperature sensor and overheating sensor, replace if necessary.
20	Open glow plug circuit	Check plug cable for damage, replace if necessary
21	Overload or short circuit of glow plug	Check plug cable for damage, replace if necessary
22	Short circuit of glow plug	Check plug cable for damage, replace if necessary
23	-	-
24	-	-
25	Short circuit of communication line	Check the communication line.
30	Abnormal speed of combustion fan motor	Defective fan wheel or combustion air fan motor (frozen, contaminated, stiff, damaged cable)
31	Defective combustion fan motor	Check cable harness for damage, replace if necessary.
32	Overload or short circuit of combustion fan motor	Defective fan wheel or combustion air fan motor (contaminated, stiff) Check cable harness for damage, replace if necessary.
34	Abnormal output of combustion fan motor	Check the ground and short of combustion air fan motor circuit, replace if necessary.
36	-	-
38	-	-
39	-	-
41	Abnormal water pump operation	Check connector.
42	Overload or short circuit of water pump	Check connector.

Trouble Code	Trouble Description	Remedies
43	Abnormal output of water pump	-
47	Overload or short circuit of fuel pump	Check cable harness for damage, replace if necessary.
48	Abnormal fuel pump operation	Check cable harness for damage, replace if necessary. Check plug-in connection, replace if necessary.
49	Short circuit of fuel pump (B+)	Check cable harness for open to battery voltage, replace if necessary.
50	Improper operation	The controller is locked due to excessive starting problem.
51	Delayed heating time	During start (no flame formed yet), the flame sensor reports temperature value too high for too long, check exhaust gas, combustion air and flame sensor.
52	Time exceeded for cold blowing	Check exhaust gas and combustion air. Check fuel quantity and fuel supply. Clean or replace filter in fuel pump.
53	Flame aborted from “large” stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
54	Flame aborted from “small” stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
60	Abnormal overheating sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
61	Short circuit or ground of overheating sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
64	Abnormal flame sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
65	Short circuit of flame sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
71	Defective surface sensor	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
72	Short circuit of surface sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
74	Defective overheating prevention device	-
87	-	-
88	-	-
89	-	-
90	Watchdog reset	Replace controller.
91	Abnormal reset function	If too many resets occurs, replace controller
92	ROM error	Replace controller.
93	RAM error	Replace controller.
94	Defective transistor	Replace controller.

Modification basis	
Application basis	
Affected VIN	

Trouble Code	Trouble Description	Remedies
95	Software error	Check cable harness for open to battery voltage, replace if necessary. Replace controller.
96	Abnormal process operation	Replace controller.
97	Wrong processor cycle	Replace controller.
98	Defective main relay	Replace controller.
99	EEPROM error	Replace controller.

Causes		Remedies
Low coolant level	• Leakage in radiator • Leakage in coolant auxiliary tank • Leakage in heater core	• Change radiator. • Change coolant auxiliary tank • Change heater core.
	• Leakage in joint junction of coolant hose • Leakage in defective coolant hose	• Check hose or replace clamp. • Change hose.
	• Leakage in water pump gasket • Leakage in water pump sealing	• Change gasket. • Change water pump.
	• Leakage in water inlet cap • Leakage in thermostat housing	• Change water inlet cap gasket. • Change thermostat sealing.
	• Insufficient tightening torque of cylinder head bolt • Damaged cylinder head gasket	• Tighten bolt to specified torque. • Change cylinder head gasket.
Abnormally high coolant temperature	• The coolant leakage (Check the coolant level) • Excessive anti-freezer • Poor coolant hose condition	• Add coolant • Check density of coolant (Anti-freezer). • Check bent of hose, replace if necessary.
	• Defective thermostat • Defective water pump • Defective radiator • Defective coolant auxiliary tank or tank cap	• Change thermostat • Change water pump. • Change radiator. • Change coolant auxiliary tank or tank cap.
	• Crack in cylinder head or in cylinder block • Clogged water flow in cylinder head or block	• Change cylinder head or cylinder block. • Clean coolant flow line.
	• Clogged water flow in radiator core	• Clean radiator core.
	• Defective cooling fan	• Change or check cooling fan.
	• Defective temp. sensor, wiring, and lamp cluster	• Change sensor or check relevant wiring.
Abnormally low coolant temperature	• Defective thermostat	• Change thermostat.
	• Defective cooling fan	• Change or check cooling fan.
	• Defective temp. sensor, wiring, and lamp cluster	• Change sensor or check relevant wiring.

INDEX

DIAGNOSIS

1. P/TRUNK..... 3

P/TRUNK

0000-00

DIAGNOSIS

1. P/TRUNK

Function	System component	DTC	Description
Power Trunk Monitoring	Power striker	0	Faulty power striker
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The micro switch is malfunctioning. - The power striker'motor is malfunctioning. **Actions** - Check the related wiring and connector for proper connection. - Replace the power striker.		
	Power latch	1	Faulty power latch
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The micro switch is malfunctioning. - The power latch motor is malfunctioning. **Actions** - Check the related wiring and connector for proper connection. - Replace the power latch.		
	DC-Gear motor	2	Faulty DC-gear motor
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The hall sensor is malfunctioning. - The DC-gear motor is malfunctioning. **Actions** - Check the related wiring and connector for proper connection. - Replace the DC-gear motor.		
	Power trunk lid	3	Faulty power trunk lid
	Causes - The related wiring is damaged. - The connector is poorly connected or damaged. - The PTL ECU is malfunctioning. **Actions** - Check the related wiring for proper connection. - Replace the PTL ECU.		

<table>
<tr><th>Function</th><th>System component</th><th>DTC</th><th>Description</th></tr>
<tr><td rowspan="10">Power Trunk Monitoring</td><td>Battery</td><td>4</td><td>Low battery voltage</td></tr>
<tr><td colspan="3"><u>Causes</u>
- The related wiring is damaged.
- The connector is poorly connected or damaged.
- The battery is defective.
<u>Actions</u>
- Check the related wiring for proper connection.
- Check the battery and replace it if necessary.</td></tr>
<tr><td>CAN communication</td><td>5</td><td>Faulty CAN communication</td></tr>
<tr><td colspan="3"><u>Causes</u>
- The related wiring is damaged.
- The connector is poorly connected or damaged.
- The CAN communication is malfunctioning.
- The PTL ECU is malfunctioning.
<u>Actions</u>
- Check the related wiring for proper connection.
- Replace the PTL ECU.</td></tr>
<tr><td>Power trunk</td><td>6</td><td>Faulty usage</td></tr>
<tr><td colspan="3"><u>Cause</u>
- If the DC-gear motor is operated 7 times within 2 minutes, it is considered as misusage and overheated DC-gear motor.
<u>Action</u>
- The system resumes its operation in 90 seconds.</td></tr>
<tr><td>PTL ECU</td><td>7</td><td>Faulty temperature detection of unit</td></tr>
<tr><td colspan="3"><u>Causes</u>
- The related wiring is damaged.
- The connector is poorly connected or damaged.
- The internal temperature sensor in the PTL ECU is malfunctioning.
- The PTL ECU is malfunctioning.
<u>Actions</u>
- Check the related wiring for proper connection.
- Replace the PTL ECU.</td></tr>
<tr><td>PTL ECU</td><td>8</td><td>Faulty temperature detection of unit</td></tr>
<tr><td colspan="3"><u>Causes</u>
- The related wiring is damaged.
- The connector is poorly connected or damaged.
- The power trunk lamp is malfunctioning.
- The PTL ECU is malfunctioning.
<u>Actions</u>
- Check the related wiring for proper connection.
- Replace the power trunk lamp.
- Replace the PTL ECU.</td></tr>
</table>

Modification basis	
Application basis	
Affected VIN	

RAIN SENSOR

0000-00

DIAGNOSIS

1. TROUBLE SHOOTING..... 3

RAIN SENSOR

0000-00

DIAGNOSIS

1. TROUBLE SHOOTING

Symptom 1. The wiper does not operate one cycle when turning the multifunction wiper switch to the "AUTO" from the "OFF" position or starting the engine while the wiper switch is in the "AUTO" position.

1. When starting the engine with the multifunction wiper switch in the "AUTO" position, the wiper operates one cycle to remind a driver that the wiper switch is in the "AUTO" position.
2. When the wiper switch is turned to "AUTO" from "OFF", the wiper operates one cycle. It always operates one cycle for the initial operation, however, the wiper does not operate afterwards to prevent the wiper blade wear if not raining when turning the wiper switch to "AUTO" from "OFF". However, the wiper operates up to 5 minutes after rain stops. If this function does not occur, check No. 8 pin. If the pin is normal, check the wiper relay related terminals in the ICM box.

Symptom 2. It rains but the system does not work in the "AUTO" position.

1. Check whether the multifunction wiper switch is in the "AUTO" position.
2. Check the power to the sensor. Check the conditions of the pin 3 (Ground) and the pin 4 (IGN).
3. Check the wiper relay for defective.

Symptom 3. The wiper operates 3 or 4 times at high speed abruptly.

Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the sensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 4. The wiper operates continuously even on the dry glass.

1. Check the wiper blade for wear. If the wiper blade cannot wipe the glass uniformly and clearly, this problem could be occurred. In this case, replace the wiper blade with a new one.
2. Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the ensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 5. The wiper does not operate at high speed even in heavy rain.

Check if the wiper operates at high speed when grounding pin 1 and pin 2.

Symptom 6. The wiper responses are too fast or slow.

Check whether the variable resistance knob on the wiper switch is set in "FAST" or "SLOW". Notify that the customer can select the sensitivity by selecting the variable resistance value. And, select a proper stage.

Modification basis	
Application basis	
Affected VIN	

INDEX

DIAGNOSIS

1. STICS..... 3

STICS

0000-00

DIAGNOSIS

1. STICS

Fault Code	Malfunction	Descriptions
01	Dr Door Lock Knob	Driver's door lock knob is not operated when locking/unlocking doors.
02	Ps Door Lock Knob	Passenger's door lock knob is not operated when locking/unlocking doors.
03	Rr Door Lock Knob	Rear door lock knob is not operated when locking/unlocking doors.
04	T/Gate Lock Knob	Tailgate lock knob is not operated when locking/unlocking doors.
05	Door Lock Output	All door lock knob are not moved to lock position even when the door lock relay is activated.
06	Door Unlock Output	All door lock knob are not moved to unlock position even when the door unlock relay is activated.
07	C/DR Lock Output	Doors are locked by central door lock switch while the engine is running.
08	DR Lock Output	Doors are locked by driver's door lock switch while the engine is running.
09	PS Lock Output	Doors are locked by passenger's door lock switch while the engine is running.
10	Auto Door Lock Output	Door lock knob is not moved to lock position when the system outputs auto door lock signal while the ignition switch is in ON position and the vehicle speed is over 50 km/h.
11	Auto Door Unlock Output	Door lock knob is not moved to unlock position after receiving the output from collision sensor.
12	Wiper Output	The WIPER P-POS signal is not detected when the wiper relay is activated.
13	SPEED SIGNAL	The vehicle speed over 3 km/h is detected at the speed signal area while the ignition switch is in ON position and the alternator signal is "D" LOW.
14	INT WIPER Volume	The circuit is open (over 4.5 V) when changing the INT volume in the speed sensitive INT wiper (saved as history error).
15	SPEED SENSOR	The vehicle speed over 200 km/h is detected (saved as history error).
16	A/BAG COLLISION SENSOR INPUT	A signal is sent to the collision sensor input area while the ignition switch is in OFF position (saved as history error unconditionally).
17	A/BAG COLLISION SENSOR OUTPUT	The RKSTICS outputs UNLOCK signal after receiving collision sensor input while the ignition switch is in ON position (saved as history error).
18	A/BAG COLLISION MONITOR	The STICS outputs the Door Unlock signal due to the collision sensor and the feedback value is in proper range (saved as history error).
19	Door Ajar Warning IND	The door warning indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
20	PARKING BRAKE IND	The parking brake indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
21	Auto Washer Out	The auto washer output is not sent to the front washer (saved as history error).
22	WASHER RELAY	The front washer switch receives the input signal for more than 10 seconds (saved as history error).

Fault Code	Malfunction	Descriptions
23	REMOCON VOLTAGE CHECK	The voltage from remote control key is saved as history error.
24	SBR S/BELT SW (Only EU)	When the seat belt switch circuit is OPEN (HIGH) in KEY OUT & ARMED MODE, the system recognizes it as FAIL and saves it as History error (Normal Close (GND)).
25	SBR SENSOR (Only EU)	When the sensor value is recognized in KEY OUT & ARMED MODE, the system saves it as History error.
26	SBR CONNECTION (Only EU)	When the seat belt switch circuit maintains OPEN (HIGH) in KEY OUT & ARMED MODE while the vehicle speed is over 50 km/h, the system saves it as History error.

Modification basis	
Application basis	
Affected VIN	

INDEX

DIAGNOSIS

1. TC..... 3

TC

0000-00

DIAGNOSIS

1. TC

Symptoms	Check	Action
Electric shift problems	• Faulty or damaged TCCU, speed sensor, motor, clutch or internal wirings	• Overhaul and check, replace if necessary
	• Damaged or worn shift cam, hub, fork and rail shift	• Overhaul and check for wear and damage.
	• Binding shift fork, hub collar or gear	• Check sliding parts, replace if necessary.
Cannot drive front wheel when shifting to 4H, 4L	• Broken drive chain	• Check internal parts and replace drive chain.
Noise in 4WD operation	• Improper or low oil	• Drain and replace with specified oil.
	• Loosened bolts or mounted parts	• Retighten as specified.
	• Noisy T/C bearing	• Disassemble bearings and parts and check for wear or damage. Replace if necessary.
	• Gear abnormal noise	• Check for wear and damage including speedometer gear. Replace if necessary.
Noise in 4H or 4L	• Worn or damaged sprockets or drive chain	• Disassemble and check for wear and damage. Replace if necessary.
	• Incorrect tire pressure	• Adjust tire pressure.
Transfer case oil leakage	• Cracked transfer case	• Replace the case.
	• Leakage from other parts	• Clean case and parts and check for leakage.
	• Breather clogging	• Remove breather hose and clean. Replace if necessary.
	• Improper or too much oil	• Use specified oil and adjust oil level.
	• Loosened sealing bolts	• Retighten.
	• Improperly applied sealant	• Use specified sealant and retighten.
	• Worn or damaged oil seal	• Replace oil seal.

Code	Description	Action
P1806	Detective CAN commuication	• Check communication line. • Replace TCCU if necessary.
P1805	Defective mode switch	• When the mode switch is defective • Check TCCU pin No.4 and 16. • Mode change - 2H (Pin No. 4: Ground) - 4H (No contact: Open) - 4L (Pin No.16: Ground)
P1821	Open or short to ground in magnetic clutch coil circuit	• Voltage at TCCU pin No.11: 11 ~ 15 V • EMC resistance: 2.5 Ω • Check the relevant connectors for contact. • Replace TCCU if necessary.
P1822	Open or short to ground in hub control circuit	• When the hub control circuit is open or short to ground over 0.2 second • Replace TCCU if necessary.
P1841	Open to ground in shift motor circuit	• When TCCU detects the motor failure for 1 second • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1842	Short to ground in shift motor output circuit	• When TCCU detects the motor failure for 1 second • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1843	Defective position sensor in motor	• 2H-4H: after 1.5 seconds • 4H-4L: after 3 seconds • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1844	Stuck in 4L mode	• When no shifting operation from 4L to 4H, even though the shift conditions are satisfied and no error. • Replace TCCU if necessary.

Modification basis	
Application basis	
Affected VIN	

Code	Description	Action
P1850	Defective position encoder	• When the position encoder is defective • Check the relevant harnesses. • Check the relevant connectors for contact. • Check the shift motor.
P1851	Short to ground for position encoder 1	• Short to ground for position encoder 1 in shift motor • Check the relevant harnesses for short. - TCCU pin No.18 • Check the relevant connectors for contact. • Check the shift motor.
P1852	Short to ground for position encoder 2	• Short to ground for position encoder 2 in shift motor • Check the relevant harnesses for short. - TCCU pin No.5 • Check the relevant connectors for contact. • Check the shift motor.
P1853	Short to ground for position encoder 3	• Short to ground for position encoder 2 in shift motor • Check the relevant harnesses for short. - TCCU pin No.19 • Check the relevant connectors for contact. • Check the shift motor.
P1854	Short to ground for position encoder 4	• Short to ground for position encoder 4 in shift motor • Check the relevant harnesses for short. - TCCU pin No.17 • Check the relevant connectors for contact. • Check the shift motor.
P1815	Abnormal CAN neutral signal	• No neutral signal from automatic transmission over 1 second through CAN. • Check CAN communication line. • Check TCU.

Symptoms		Cause	Action
Noise	Noise in all ranges	- Low oil level	- Check major components (bearing surface) for excessive wear
			- Replenish oil
		- Improper oil	- Drain oil and replenish the specified oil
		- Worn or broken chain	- Replace chain or sprocket
	Growling	- Broken bearing	- Replace transfer case housing
		- Low oil level	- Check major components (bearing surface) for excessive wear
			- Replenish oil
	Noise when cornering	- Worn pinion gear teeth	- Replace differential carrier assembly
	Low frequency noise and vibration	- Missing shaft support snap ring	- Visually check the relevant parts for wear and replace if necessary
	Howling	- Abnormal friction in drive system	- Disassemble drive system, check rotating parts for wear and replace the worn parts.
Clunking	Clunking (when starting and stopping)	- Excessive backlash in T/C (over 3°)	- Check backlash and replace if necessary
		- Improper mounting	- Excessive backlash in drive system
			- Check drive system
		- Excessive backlash in other parts	- Excessive backlash in drive system
			- Check drive system
Undrivable	Cannot deliver forward/reverse driving force	- Worn or broken chain	- Replace chain or sprocket
		- Broken sprocket	- Replace chain or sprocket
		- Broken differential carrier	- Replace differential carrier assembly
		- Broken shaft	- Replace shaft
Binding	Dragging in front wheels or rear wheels	- Differential carrier stuck	- Replace differential carrier
Leakage	Leakage at transmission connection	- Damaged oil seal in T/C	- Replace oil seal
		- Clogged breather	- Check breather for clogging
			- Replace connecting hose
	Leakage at front and rear shafts	- Foreign material in oil seal	- Remove any foreign material, check oil seal for damage and replace oil seal
		- Broken oil seal	- Replace oil seal
		- Clogged breather	- Check breather for clogging
			- Replace connecting hose
	Leakage at case or cover body	- Cracked case or cover	- Replace transfer case
		- Air bubbles inside	
	Leakage at drain plug	- Bubbles no mounting bolt	- Replace drain plug
		- Uneven or missing plug coating	
	Leakage at filler plug	- Bubbles no mounting bolt	- Replace filler plug
		- Uneven or missing plug coating	
	Leakage at body connection	- Improperly applied sealant	- Disassembe T/C, apply sealant and reassemble it
		- Loose bolt around the leaking area	- Tighten to the specified torque

Modification basis	
Application basis	
Affected VIN	

INDEX

DIAGNOSIS

1. TCU..... 3

TCU

0000-00

DIAGNOSIS

1. TCU

DTC Code	Defective	Cause and Action
P0742	Torque converter clutch engaged	Cause: - Torque conver clutch is engaged when solenoid valve (S7) is not operated. - The rpm of engine and output shaft is not consistent with the characteristic under the condition with torque converter not engaged. • Allowable slip rpm of torque converter < 50 rpm Symptom: - Torque converter clutch is locked. Action: - Check solenoid valve (S7) wiring for short to B+. - Replace solenoicd valve (S7) if necessary. - Check T/M connector TCU connector for their proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0710	Defective T/M oil temperature sensor	Cause: - Oil temperature of T/M exceeds the specified value. • Oil temperature sensor voltage > 4.88 V • Oil temperature sensor voltage < 0.21 V Symptom: - Oil temperature is fixed to 120°C - Shifting impression is poor. Action: - Check T/M oil temperature sensor for short or open circuit. - Check T/M connector and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.
P0790	Defective W/N/P mode switch	Cause: - The W/N/P mode switch's connection is intermittently disconnected (the input of the mode switch changes rapidly). Symptom: - The switch is fixed to normal mode. Action: - Check W/N/P mode switch input circuit for short or open circuit. - Check W/N/P mode switch wiring. - Replace W/N/P mode switch if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.

DTC Code	Defective	Cause and Action
P0742	Torque converter clutch engaged	Cause: - Torque conver clutch is engaged when solenoid valve (S7) is not operated. - The rpm of engine and output shaft is not consistent with the characteristic under the condition with torque converter not engaged. • Allowable slip rpm of torque converter < 50 rpm Symptom: - Torque converter clutch is locked. Action: - Check solenoid valve (S7) wiring for short to B+. - Replace solenoicd valve (S7) if necessary. - Check T/M connector TCU connector for their proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P0710	Defective T/M oil temperature sensor	Cause: - Oil temperature of T/M exceeds the specified value. • Oil temperature sensor voltage > 4.88 V • Oil temperature sensor voltage < 0.21 V Symptom: - Oil temperature is fixed to 120°C - Shifting impression is poor. Action: - Check T/M oil temperature sensor for short or open circuit. - Check T/M connector and TCU connector for proper connection. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.
P0790	Defective W/N/P mode switch	Cause: - The W/N/P mode switch's connection is intermittently disconnected (the input of the mode switch changes rapidly). Symptom: - The switch is fixed to normal mode. Action: - Check W/N/P mode switch input circuit for short or open circuit. - Check W/N/P mode switch wiring. - Replace W/N/P mode switch if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.

Modification basis	
Application basis	
Affected VIN	

DTC Code	Defective	Cause and Action
P1703	Abnormal engine rpm (CAN)	Cause: - The engine rpm signal (CAN) is out of specified value or there is no engine rpm signal. • Engine rpm < 0 rpm • Engine rpm > 7000 rpm Symptom: - The engine rpm corresponding to the max. engine torque is applyed to the shifting condition. Action: - Check ECU and TCU connectors for poor contact. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds.
P1704	Abnormal output shaft rpm (CAN)	Cause: - The output shaft signal (CAN) is out of specified value or there is no output shaft signal. • Output shaft rpm < 0 rpm • Output shaft rpm > 9000 rpm - The actual vehicle speed is 0 while other signals indicate that vehicle is moving. Symptom: - Cannot shift down by limiting the engine rpm to prevent the engine from overrunning. Action: - Check ECU and TCU connectors for poor contact. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 3 seconds and the rpm is over 0.
P1708	Low TCU supply voltage	Cause: - The TCU supply voltage is low or there is no measured voltage value. Symptom: - Cannot shift to 1st gear position. - Cannot shift to other gear positions due to the low supply voltage. - No. 6 solenoid valve (S6) stops from its operation. Action: - Check TCU terminal for poor contact, bending or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1709	High TCU supply voltage	Cause: - The TCU supply voltage is high. • TCU supply voltage > 16.5 V Symptom: - All solenoid valves stop from their operation when high battery voltage is detected. - Enters into the emergency mode. Action: - Check TCU terminal for short to B+ or short to ground. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.

DTC Code	Defective	Cause and Action
P1713	Defective accelerator pedal signal (CAN)	Cause: - The accelerator pedal signal (CAN) is out of the specified value. • Accelerator pedal signal < 0 % • Accelerator pedal signal > 100 % Symptom: - Cannot shift to 4th gear position. - Torque converter clucth stops from its operation. - The interior default value is applied for shift determination (if the accelerator pedal signal is defective, ECU selects the default value and sends it and error message to TCU via CAN line). - The accelerator pedal signal is not used for P, R, N B2. Action: - Check ECU and TCU connectors for poor contact and their terminals for bend or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1714	Defective vehicle coding	Cause: - The vehicle coding stored in EEPROM is defective (self-test when IGN ON). Symptom: - Determines the vehicle coding value via CAN communication or selects 0 for the coding value. - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1715	Abnormal VPS offset	Cause: - VPS (Variable pressure solenoid valve) is used for controlling clutch and band pressure while shifting. - The VPS offset stored in EEPROM is incorrect (self-test when IGN ON). • VPS offset > 120 mA Symptom: - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1717	Defective RAM	Cause: - RAM operates abnormally. (self-test when IGN ON) Symptom: - No output signal. - Enters into the emergency mode. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1718	Defective ROM	Cause: - The program memory is defective (self-test when IGN ON). - The calculated checksum value is not consistent with the stored checksum value. Symptom: - No output signal. - Enters into the emergency mode. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

Modification basis	
Application basis	
Affected VIN	

DTC Code	Defective	Cause and Action
P1719	Abnormal CAN communication	Cause: - Cannot use information necessary for TCU via CAN communication. Symptom: - The default value is used for all CAN signals. - Enters into the emergency mode. Action: - Check ECU and TCU connectors wiring for poor contact. - Check ECU and TCU connectors' terminals for bend or deformation. - Replace TCU if necessary. - Returns to the normal operation if the failure does not occur within 30 seconds.
P1720	Defective EEPROM	Cause: - EEPROM memory is defective. - The calculated checksum value is not consistent with the stored checksum value or the error occurs in EEPROM communication. (self-test when IGN ON) Symptom: - Determines the vehicle coding value via CAN communication or selects 0 for the coding value. - Shifting impression is poor. Action: - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1722	Incorrect vehicle model	Cause: - Cannot detect the vehicle coding through EEPROM or CAN communication. Symptom: - Selects 0 for the coding value. - Enters into the emergency mode. Action: - Check TCU connector and terminals for poor contact. - DTC disappears after turning ignition from OFF to ON.
P1733	No. 1 solenoid valve open	Cause: - The No. 1 solenoid valve operates with the No. 2 solenoid valve to control the oil flow for the 1-2 shift valve. - The No.1 solenoid valve internal circuit or solenoid valve wiring is open. - The solenoid valve connection is short to B+. Symptom: - The No. 1 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 1 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.1 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1734	No. 2 solenoid valve open	Cause: - The No. 2 solenoid valve operates with the No. 1 solenoid valve to control the oil flow for the 2-3 shift valve. - The No. 2 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 2 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 2 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.2 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1735	No. 3 solenoid valve open	Cause: - The No. 3 solenoid valve operates with the No. 4 solenoid valve to shift smoothly and control the shifting order. - The No. 3 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 3 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 3 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 3 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.3 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

Modification basis	
Application basis	
Affected VIN	

DTC Code	Defective	Cause and Action
P1736	No. 4 solenoid valve open	Cause: - The No. 4 solenoid valve operates with the No. 3 solenoid valve to shift smoothly and control the shifting order. - The No. 4 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 4 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 4 solenoid valve is OFF or ON. - Shifting impression is poor. Action: - Check No. 4 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.4 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1737	No. 5 solenoid valve open	Cause: - The No. 5 solenoid valve is a variable solenoid valve to change the pressure for shifting. - The No. 5 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 4 solenoid valve is always OFF. - Shifting impression is poor. Action: - Check No. 5 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 3.6 ~ 5.5Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.5 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1738	No. 6 solenoid valve open	Cause: - The No. 6 solenoid valve is used to set the hydraulic line pressure to HIGH/LOW level. - The No. 6 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The hydraulic line pressure is high. (No. 6 solenoid valve stops its operation) - Cannot to shift to 1st gear position. Action: - Check No. 6 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 6 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1739	No. 7 solenoid valve open	Cause: - The No. 7 solenoid valve controls the operation of the torque converter clutch. - The No. 7 solenoid valve circuit is open. - The solenoid valve connection is short to B+. Symptom: - The No. 7 solenoid valve stops its operation (OFF). - The torque converter clutch cannot be locked. Action: - Check No. 7 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 7 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1741	No. 1 solenoid valve short	Cause: - The No. 1 solenoid valve operates with the No. 2 solenoid valve to control the oil flow for the 1-2 shift valve. - The No. 1 solenoid valve circuit is short to ground. Symptom: - The No. 1 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 1 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.1 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1742	No. 2 solenoid valve short	Cause: - The No. 2 solenoid valve operates with the No. 1 solenoid valve to control the oil flow for the 2-3 shift valve. - The No. 2 solenoid valve circuit is short to ground. Symptom: - The No. 2 solenoid valve is OFF. - Enters into the emergency mode. Action: - Check No. 2 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 2 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

Modification basis	
Application basis	
Affected VIN	

DTC Code	Defective	Cause and Action
P1743	No. 3 solenoid valve short	Cause: - The No. 3 solenoid valve operates with the No. 4 solenoid valve to shift smoothly and control the shifting order. - The No. 3 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 3 solenoid valve circuit is short to ground. Symptom: - The No. 3 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 3 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 3 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1744	No. 4 solenoid valve short	Cause: - The No. 4 solenoid valve operates with the No. 3 solenoid valve to shift smoothly and control the shifting order. - The No. 4 solenoid valve turns the clutch regulator valve ON and OFF. - The No. 4 solenoid valve circuit is short to ground. Symptom: - The No. 4 solenoid valve is OFF. - Shifting impression is poor. Action: - Check No. 4 solenoid valve wiring and connector (especially its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 4 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1745	No. 5 solenoid valve short	Cause: - The No. 5 solenoid valve is a variable solenoid valve to change the pressure for shifting. - The No. 5 solenoid valve circuit is short to ground. Symptom: - The No. 4 solenoid valve is always OFF. - Shifting impression is poor. Action: - Check No. 5 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 3.6 ~ 5.5Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No.5 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

DTC Code	Defective	Cause and Action
P1746	No. 6 solenoid valve short	Cause: - The No. 6 solenoid valve is used to set the hydraulic line pressure to HIGH/LOW level. - The No. 6 solenoid valve circuit is short to ground. Symptom: - The hydraulic line pressure is high. (No. 6 solenoid valve stops its operation) - Cannot to shift to 1st gear position. Action: - Check No. 6 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value : 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 6 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.
P1747	No. 7 solenoid valve short	Cause: - The No. 7 solenoid valve controls the operation of the torque converter clutch. - The No. 7 solenoid valve circuit is short to ground. Symptom: - The No. 7 solenoid valve stops its operation (OFF). - The torque converter clutch cannot be locked. Action: - Check No. 7 solenoid valve wiring and connector (especially, its ground condition). - Specified resistance value: 22 ~ 30Ω - Check TCU connector for proper connection and its terminal for bend or deformation. - Replace No. 7 solenoid valve if necessary. - Replace TCU if necessary. - DTC disappears after turning ignition from OFF to ON.

Modification basis	
Application basis	
Affected VIN	

Trouble Code	Defectives	Action
P2000	Faulty TCU internal watchdog test	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2001	Faulty TCU internal watchdog function	• Self-diagnosis. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2002	Faulty TCU external watchdog test	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2003	Faulty TCU external watchdog function	• Self-diagnosis. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2004	Faulty TCU Clock	• Self-diagnosis. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2005	Faulty TCU RAM	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2006	Faulty TCU RAM CAN-Controller 1	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2007	Faulty TCU RAM CAN-Controller 2	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2008	Faulty TCU ROM	• Self-diagnosis with IGN ON. • When the TCU internal checksum is different from scanner checksum. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200A	Faulty TCU EEPROM	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200B	Faulty TCU CPU (internal)	• Self-diagnosis. • Check harness contact.
P200C	Faulty TCU program control	• Self-diagnosis. • Check harness contact.
P2010	No TCU variant coding	• Self-diagnosis with IGN ON. • When the TCU coding is not exist. • Check again after TCU coding.

Trouble Code	Defectives	Action
P2011	Faulty TCU variant coding	• Self-diagnosis with IGN ON. • When the TCU coding is faulty. • Check again after TCU coding.
P2012	Faulty TCU checksum	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2013	Faulty TCU (internally)	• Self-diagnosis with IGN ON. • Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2100	Defective 1-2, 4-5 shift solenoid valve	• When 1-2 or 4-5 shift solenoid valve is defective. • Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then and disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2101	1-2, 4-5 shift solenoid valve - short	• When 1-2 or 4-5 shift solenoid valve is defective. • Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2102	Defective 2-3 shift solenoid valve	• When 2-3 shift solenoid valve is defective. • Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2103	2-3 shift solenoid valve - short	• When 2-3 shift solenoid valve is defective. • Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B12 (14), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered mechanical emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.

Modification basis	
Application basis	
Affected VIN	

Trouble Code	Defectives	Action
P2104	Defective 3-4 shift solenoid valve	• When 3-4 shift solenoid valve is defective. • Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B11 (15), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered mechanical emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2105	3-4 shift solenoid valve - short	• When 3-4 shift solenoid valve is defective. • Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B11 (15), B3 (38) - Specified value: 3.8 ± 0.2 Ω • Triggered mechanical emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2106	Defective lockup clutch solenoid valve	• Measure the resistance of lockup clutch solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B9 (17), B3 (38) - Specified value: 2.5 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2107	Defective modulator pressure solenoid valve	• Measure the resistance of modulator pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B5 (36), B3 (38) - Specified value: 5.0 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2108	Defective shift pressure solenoid valve	• Measure the resistance of shift pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals: B4 (37), B3 (38) - Specified value: 5.0 ± 0.2 Ω • Triggered emergency mode when the defective is detected. - Electrical error: Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2200	Faulty speed sensor N2 signal	• When the speed sensor N2 detects 0 rpm of front sun gear speed. • Check the related harness for open, short and contact. - TCU connector terminal B14: rectangular wave signal B8: signal ground B13: 6V
P2203	Faulty speed sensor N3 signal	• When the speed sensor N3 detects 0 rpm of planetary gear carrier speed. • Check the related harness for open, short and contact. - TCU connector terminal B6: rectangular wave signal B8: signal ground B13: 6V
P220A	Abnormal speed sensor output signal (N2, N3)	• When the rpm difference between speed sensor N2 and N3 is over 150 rpm. • Check the related harness for open, short and contact.
P2220	T/M Oil temperature sensor - short	• Turn the IGN OFF, then disconnect TCU connector. • Selector lever position: R or D • T/M Measure the resistance of oil temperature sensor. • TCU connector terminals B7, B8 • Check the related harness for open, short and contact.
P2221	Abnormal T/M oil temperature sensor signal	• Turn the IGN OFF, then disconnect TCU connector. • Selector lever position: R or D • Measure the resistance of T/M oil temperature sensor. • TCU connector terminals: B7, B8 • Check the related harness for open, short and contact.
P2222	Abnormal T/M oil temperature sensor signal	• Turn the IGN OFF, then disconnect TCU connector. • Selector lever position : R or D • Measure the resistance of T/M oil temperature sensor. • TCU connector terminals: B7, B8 • Check the related harness for open, short and contact.
P2300	Faulty CAN communication	• Turn the IGN OFF, then disconnect TCU connector. • Check the communication line for open, short and contact. • Measure the resistance of CAN line: B1, B2 • Specified value : approx. 120 W
P2301	Faulty CAN communication	• Turn the IGN OFF, then disconnect TCU connector. • Check the communication line for open, short and contact. • Measure the resistance of CAN line: B1, B2 • Specified value : approx. 120 W
P2310	CAN: Faulty brake system communication	• Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.

Modification basis	
Application basis	
Affected VIN	

Trouble Code	Defectives	Action
P2311	CAN: Faulty ECU communication	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2312	CAN: Faulty ECU communication	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2313	CAN: Faulty selector lever control communication	• Check CAN communication line H and L. • Check selector lever. • Check the related harness for open, short and contact.
P2315	CAN: Faulty instrument panel communication	• Check CAN communication line H and L. • Check instrument cluster. • Check the related harness for open, short and contact.
P2317	CAN: Faulty communication between TCCU/TOD and CAN (For 4WD only)	• Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2330	CAN: Faulty brake system signal	• Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.
P2331	CAN: Faulty ECU message	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2332	CAN: Faulty ECU message	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2333	CAN: Faulty selector lever signal	• Check CAN communication line H and L. • Check selector lever. Check selector lever. • Check the related harness for open, short and contact.
P2335	CAN: Faulty instrument cluster signal	• Check CAN communication line H and L. • Check instrument cluster. • Check the related harness for open, short and contact.
P2337	CAN: Faulty TCCU/TOD (For 4WD only)	• Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2400	CAN: Faulty rear RH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.309 ~ 0.958 mm) - Check the numbers of tooth wheel: 48 • Check the related harness for open, short and contact.

Trouble Code	Defectives	Action
P2401	CAN: Faulty rear LH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.309 ~ 0.958 mm) - Check the numbers of tooth wheel: 48 • Check the related harness for open, short and contact.
P2402	CAN: Faulty front RH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.335 ~ 0.945 mm) - Check the numbers of tooth wheel: 48
P2403	CAN: Faulty front LH wheel speed sensor signal	• Check CAN communication line H and L. • Check ABS/ESP unit. - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.335 ~ 0.945 mm) - Check the numbers of tooth wheel: 48
P2404	CAN: No brake signal	• Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.
P2405	CAN: No accelerator pedal signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2406	CAN: No engine torque signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2407	CAN: No ESP signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2408	CAN: No minimum engine torque signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2409	CAN: No maximum engine torque signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P240A	CAN: No engine rpm signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.

Modification basis	
Application basis	
Affected VIN	

Trouble Code	Defectives	Action
P240B	CAN: No engine coolant temperature signal	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P240C	CAN: No selector lever position signal	• Check CAN communication line H and L. • Check selector lever. • Check the related harness for open, short and contact.
P240D	CAN: No transfer case position signal (For 4WD only)	• Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2500	Invalid transmission gear ratio	• Cycle the IGN switch from OFF to ON. Check A/T system again after a certain period of driving. • If the trouble still exists, replace A/T assembly. • To protect transmission, any shift is not available.
P2501	Excessive engine rpm	• Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2503	Faulty recognition of currently selected gear	• Check selector lever. • Check the related harness for open, short and contact.
P220B	Excessive N2, N3 rpm	• Check speed sensor N2 and N3.
P2510	Torque converter lockup clutch stuck	• Check the hydraulic lines for leaks (valve No.22 in valve body). • Check the resistance of lockup clutch solenoid valve (Turn the IGN OFF, then disconnect TCU connector). - TCU connector terminals B9 (17), B3 (18) - Specified value : 2.5 ± 0.2 W • Triggered emergency mode when the defective is detected. - Fixed at 2nd gear in “D” range. • Check the related harness for open, short and contact.
P2511	Faulty torque converter lockup heat control	• Check the hydraulic lines for leaks.
P2520	Faulty recognition of torque reduction	• Check ECU.
P2502	Poor gear mesh, transmission slip	• Check the hydraulic lines for leaks. • Check oil filter.
P2600	Too low TCU supply voltage	• Check TCU supply voltage.
P2601	Too high TCU supply voltage	• Check TCU supply voltage.
P2602	Abnormal solenoid valve supply voltage	• Check solenoid supply voltage.
P2603	Abnormal speed sensor supply voltage	• Check speed sensor supply voltage. - TCU connector terminals B13 (13) : 6V

Memo

TGS LEVER

0000-00

DIAGNOSIS

1. TGS LEVER..... 3

TGS LEVER

0000-00

DIAGNOSIS

1. TGS LEVER

DTC	Malfunction	Help tips
P1000-1	Defective program memory	Cause: The calculated checksum value is not consistent with the stored checksum value. Symptom: - Solenoid valve is inoperative. - Backup lamp is OFF. - CAN bus is OFF. - All shift lever position indicators are OFF. Action: - Reset the unit by cyling the ignition switch (OFF → ON) several times.
P1000-2	Defective data memory	Cause: The malfunction is occurred during the RAM memory test with the ignition ON. Symptom: - Solenoid valve is inoperative. - Backup lamp: OFF - CAN bus: OFF - All shift lever position indicators: OFF Action: - If the malfunction stays after turning the ignition switch from OFF to ON, replace the TGS lever.
P1000-3	Faulty MCU reset	Cause: The malfunction is occurred during the microprocessor test with the ignition ON. Symptom: - Solenoid valve is inoperative. - Backup lamp is OFF. - CAN bus is OFF. - All shift lever position indicators are OFF. Action: - Reset the unit by cyling the ignition switch (OFF → ON) several times.
P1000-4	Faulty MCU data process	
P1000-5	Faulty MCU watchdog function	
P1000-6	Too long MCU data throughput time	
P1750-2	Low battery voltage	Cause: The battery voltage is low. (Specified value: less than 8.0 ± 0.3 V for 50 ms) Symptom: - All shift lever position indicators are OFF. Action: - The operation is automatically resumed if the battery voltage is over 8.7 ± 0.3 V for 50 ms. - Check the shift lever connector and power line for contact.
P1817-1	Faulty backup lamp operating current	Cause: The operating current is over 14 ~ 36 A for 50 ms when the backup lamp is in ON condition. Symptom: - Backup lamp is OFF. - Current shift lever indicator is flashing. - Indicator “R” is flashing in “R” position. Action: - Check the input and output wirings of backup lamp for open and short.
P1832-1	Faulty solenoid operating current	Cause: The solenoid valve operating current is over 3 ~ 5 A when the solenoid is operating. Symptom: - Solenoid valve is OFF. - Current shift lever indicator is flashing. Action: - The operation is automatically resumed since the interior temperature is normally within the solenoid operating temperature range. If the problem stays, check the power to the shift lever.

DTC	Malfunction	Help tips
P1833-2	Open solenoid valve circuit	Cause: The solenoid valve circuit is open or short to battery for 50 ms when the solenoid valve is OFF. Symptom: - Solenoid valve is OFF. - Current shift lever indicator is flashing. Action: - Check the power terminal to the shift lever.
P1856-1	Short shift lever position signal (to B+)	Cause: The shift lever position sensor or the power supply is malfunctioning. Symptom: - All shift lever position indicators are flashing.. - The incorrect lever position signal is transmitted through the CAN line. Action: - The operation is automatically resumed if the fault is not detected for 100 ms. - Check the power supply terminal to the shift lever.
P1856-2	Open or short shift lever position signal (to GND)	Cause: The shift lever position sensor is open or short to ground. Symptom: - All shift lever position indicators: flashing. - The incorrect lever position signal is transmitted through the CAN line. Action: - The operation is automatically resumed if the fault is not detected for 100 ms. - Check the power supply terminal to the shift lever.
P1856-3	Abnormal shift lever position signal	Cause: The shift lever position sensor signal is incorrect. Symptom: - All shift lever position indicators are flashing. - The incorrect lever position signal is transmitted through the CAN line. Action: - The operation is automatically resumed if the fault is not detected for 100 ms. - Check the power supply terminal to the shift lever.
P1856-4	Incorrect shift lever position sensor coding	Cause: The calibration value of shift lever position sensor is not stored or not consistent with the stored value. Symptom: - All shift lever position indicators are flashing. - The incorrect lever position signal is transmitted through the CAN line. Action: - Reset the unit by cyling the ignition switch (OFF → ON) several times. - Check the shift lever and replace it if necessary.
P1860-2	Faulty vehicle speed signal	Cause: The vehicle speed is detected as 300 km/h. Symptom: - The gear is shifted as for the vehicle speed is 0 km/h. - Current shift lever position indicator is flashing. Action: - The operation is automatically resumed if the fault is not detected. * For the shift lever, the vehicle speed data is needed to the solenoid valve operation for R/P lock and N lock function.
P1875-3	Faulty CAN bus OFF signal	Cause: The CAN bus OFF condition of the CAN controller is detected for 3 times in the unit. Symptom: - Cannot send the CAN message. - Current shift lever position indicator is flashing. Action: - Check the CAN communication line for open or short. - Check the shift lever and replace it if necessary. * CAN Bus OFF: The status that the CAN communication is totally interrupted if there is an error in the sent/received data through the CAN communication in the unit.

Modification basis	
Application basis	
Affected VIN	

DTC	Malfunction	Help tips
P1876-1	Abnormal CAN communication (vehicle speed)	Cause: There is no vehicle speed signal via CAN communication for 500 ms. Symptom: - The gear is shifted as for the vehicle speed is 0 km/h. - Current shift lever position indicator is flashing. Action: - Check the CAN communication line.
P1910-1	High battery voltage	Cause: The battery voltage is too high. (Specified value: Over 16.3 ± 0.3 V for 50 ms) Symptom: - All shift lever position indicators: OFF Action: - The operation is automatically resumed if the battery voltage is over 16.3 ± 0.3 V for 50 ms. - Check the shift lever power supply line.
P1912-1	Open/Short shift lever tip switch signal (to B+)	Cause: The shift lever tip switch signal is open or short to B+. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the shift lever tip switch.
P1912-2	Short shift lever tip switch signal s(to GND)	Cause: The shift lever tip switch signal is open or short to ground. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M”, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the shift lever tip switch.
P1912-3	Abnormal shift lever tip switch signal	Cause: The shift lever tip switch signal is faulty. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the shift lever tip switch.
P1912-4	Open/Short steering wheel tip switch signal (to B+)	Cause: The steering wheel tip switch signal is open or short to B+. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the steering wheel's tip switch.
P1912-5	Open/Short steering wheel tip switch signal (to GND)	Cause: The steering wheel tip switch signal is open or short to ground. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the steering wheel tip switch.

DTC	Malfunction	Help tips
P1912-6	Abnormal steering wheel tip switch signal	Cause: The steering wheel tip switch signal is faulty. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - The operation is automatically resumed if the fault is not detected for 50 ms. - Check the steering wheel tip switch.
P1912-7	Defective tip switch	Cause: The manual mode switch operates for 50 ms when the shift lever is P, R or N positions. Symptom: - Indicator “M” flashes if the shift lever is in D. - The mode is recognized as the manual mode even if the shift lever is in “D” position. Action: - The operation is automatically resumed if the fault is not detected for 50 ms and the shift lever is in P, R or N positions.
P1927-8	Faulty TCU shift	Check the TCU if there is errors related to the A/T shift.
P1928-4	Defective TCU CAN communication	Cause: The up/down shift command in not delivered to the TCU (faulty tip switch). - There is no CAN signal for 500 ms. Symptom: - Indicator “M” is flashing due to malfunction when the shift lever is in the manual mode position. - If the shift lever is not in “M” position, the malfunction is overridden. Action: - Check the CAN communication line.

Modification basis	
Application basis	
Affected VIN	

ENGINE GENERAL

0000-00

INDEX

GENERAL

1. ENGINE ASSEMBLY LAYOUT..... 3
2. ENGINE CONTROLS LAYOUT..... 5
3. ELECTRICAL COMPONENTS AND PREHEATING SYSTEM..... 10
4. INTAKE SYSTEM LAYOUT..... 12
5. EXHAUST SYSTEM LAYOUT..... 14
6. LUBRICATION SYSTEM LAYOUT..... 16
7. COOLING SYSTEM LAYOUT..... 18
8. FUEL SYSTEM LAYOUT..... 20
9. FUEL SUPPLY SYSTEM..... 22
10. CLEANNESS..... 23
11. MAINTENANCE AND REPAIR..... 28
12. GUIDELINES FOR SERVICE WORK SAFETY..... 30
13. DURING SERVICE WORK FOR INSPECTION..... 34
14. DURING SERVICE WORK FOR ELECTRIC DEVICES..... 36
15. OWNER INSPECTIONS AND SERVICES..... 37
16. STANDARD BOLTS SPECIFICATIONS 41

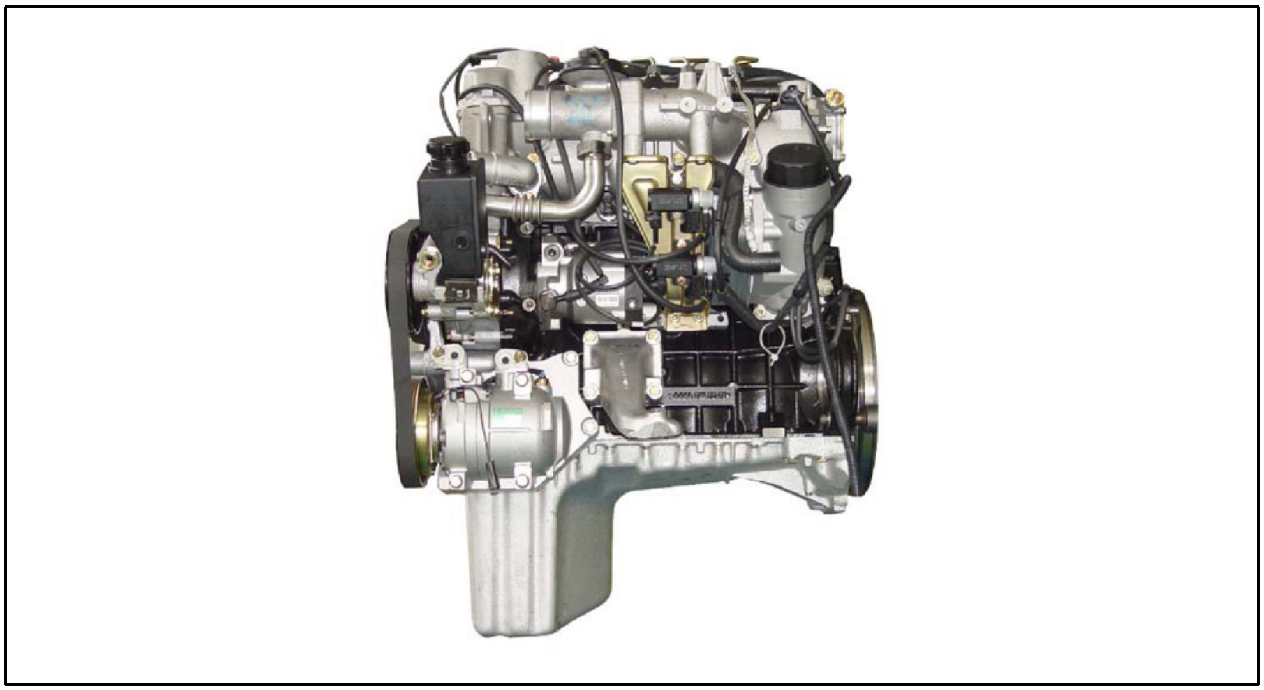
ENGINE GENERAL

0000-00

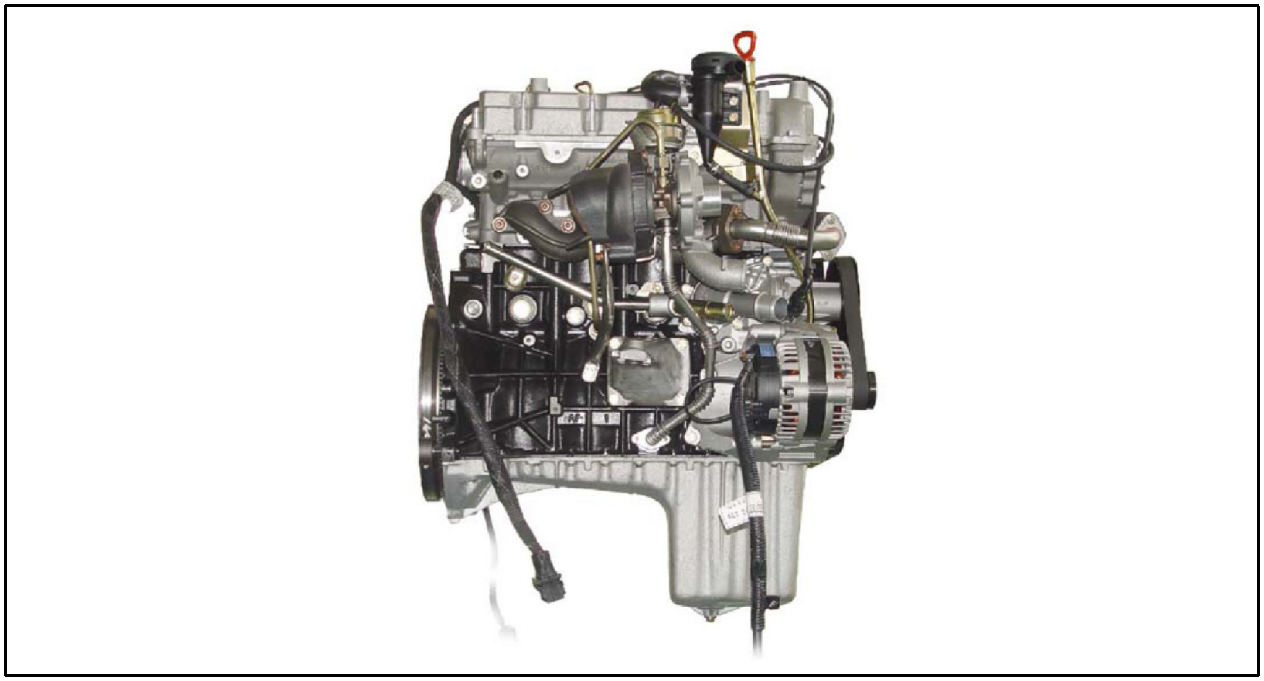
GENERAL

1. ENGINE ASSEMBLY LAYOUT

1) LH SIDE VIEW



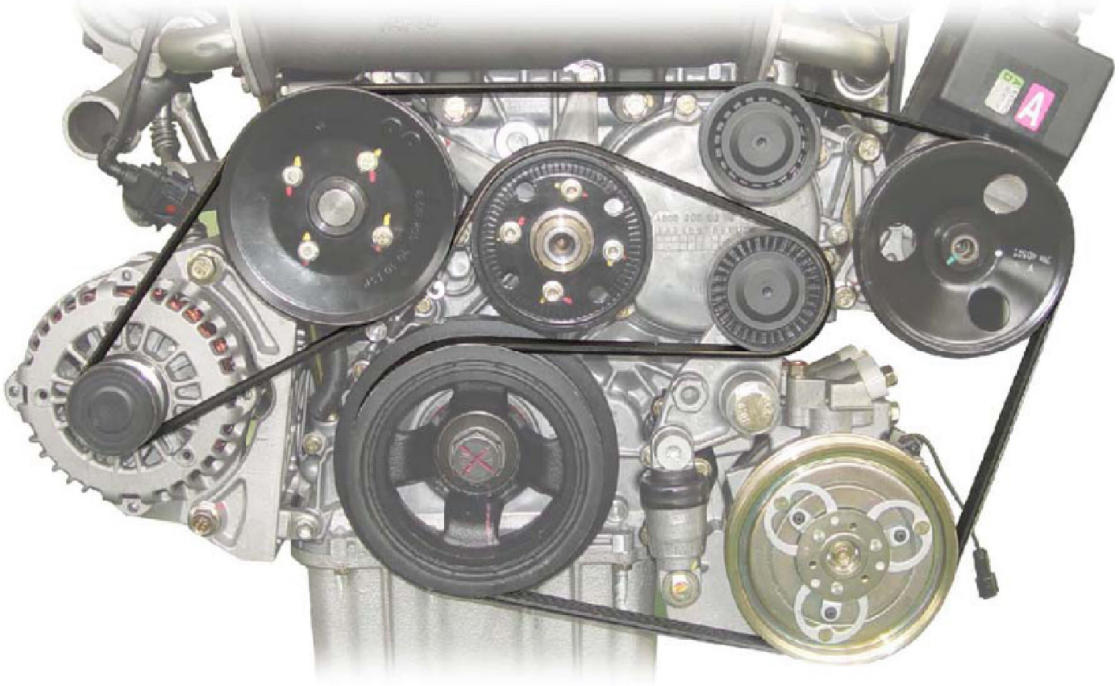
2) RH SIDE VIEW



3) FRONT VIEW



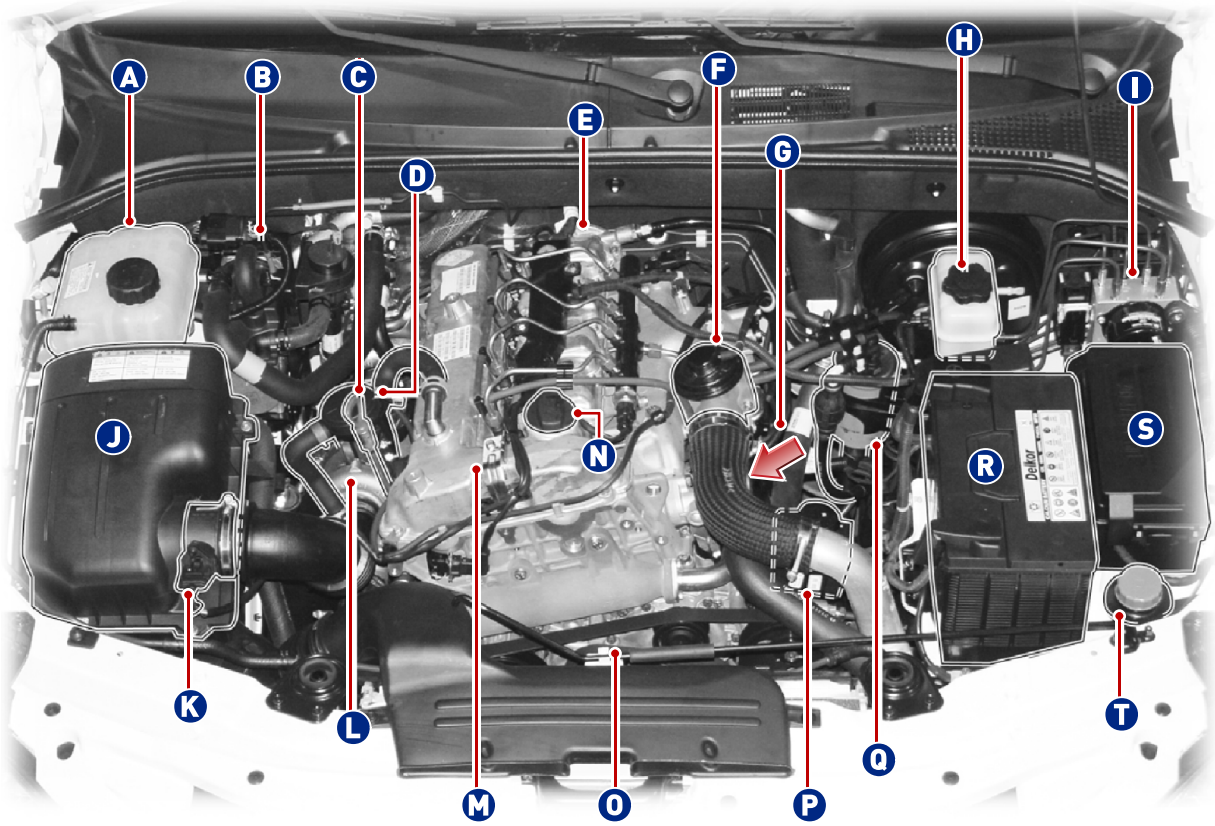
4) FAN BELT



Modification basis	
Application basis	
Affected VIN	

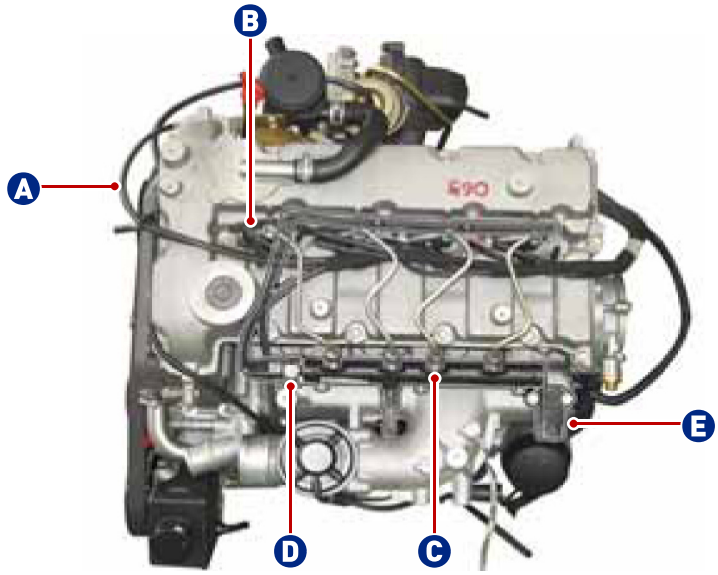
2. ENGINE CONTROLS LAYOUT

1) ECU Related Componets



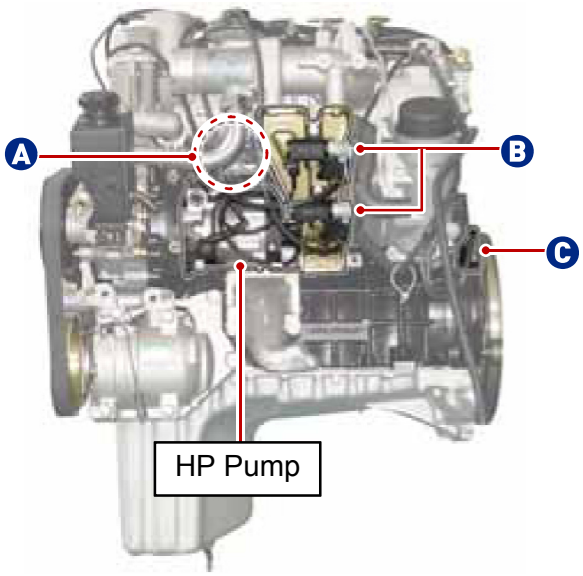
NO.	FUNCTION	NO.	FUNCTION
A	Coolant reservoir	K	HFM sensor
B	FFH	L	VGT turbo charger
C	Engine oil dipstick	M	Engine
D	Oil separator(PCV valve)	N	Engine oil filler cap
E	Vacuum pump	O	PWM electric fan & fan shroud
F	EGR valve	P	Power steering oil reservoir
G	Vacuum modulator	Q	Fuel filter & priming pump
H	Brake fluid reservoir	R	Battery
I	ABS/ESP modulator	S	Fuse box
J	Air cleaner assembly	T	Washer fluid reservoir

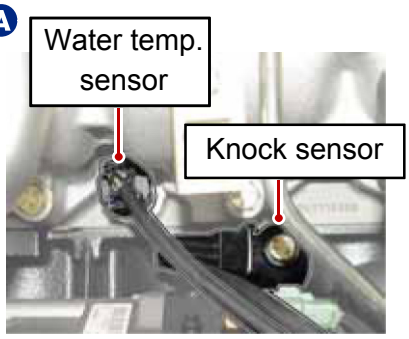
2) Engine And Sensors



Camshaft Position Sensor	Injector	Glow Plug
A 	B 	B 
Common Rail	**Fuel Pressure Sensor (Common Rail)**	**Booster Pressure Sensor**
C 	D 	E 

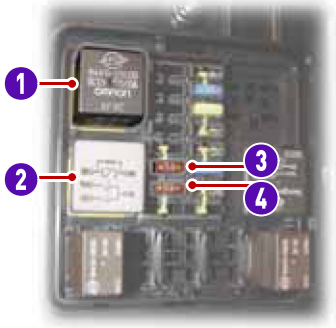
Modification basis	
Application basis	
Affected VIN	



Knock Sensor (1 EA) & Water Temperature Sensor	Vacuum Modulator	Crankshaft Position Sensor
A 	B 	C 

3) Engine Accessories Related to ECU



A IP Interior Fuse Box (Passenger Side)	
 1. Engine ECU main relay 2. Hazard warning lamp 3. VGT & EGR vacuum modulators, HFM 4. HP pumpIMV	Installed 

B Engine ECU	B Mounting Location
	

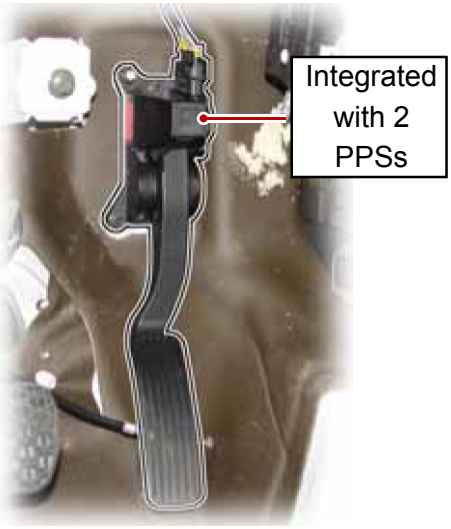
Modification basis	
Application basis	
Affected VIN	

C HFM Sensor

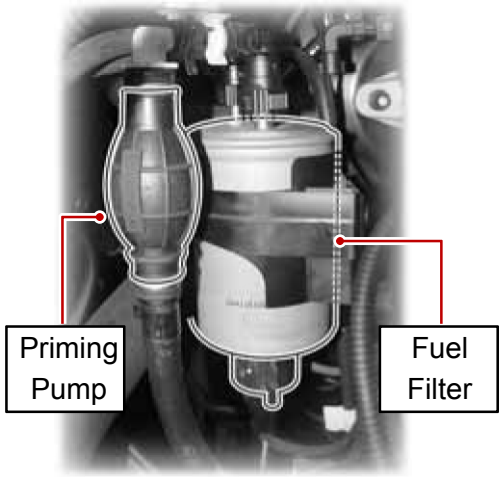




D Accelerator Pedal Module

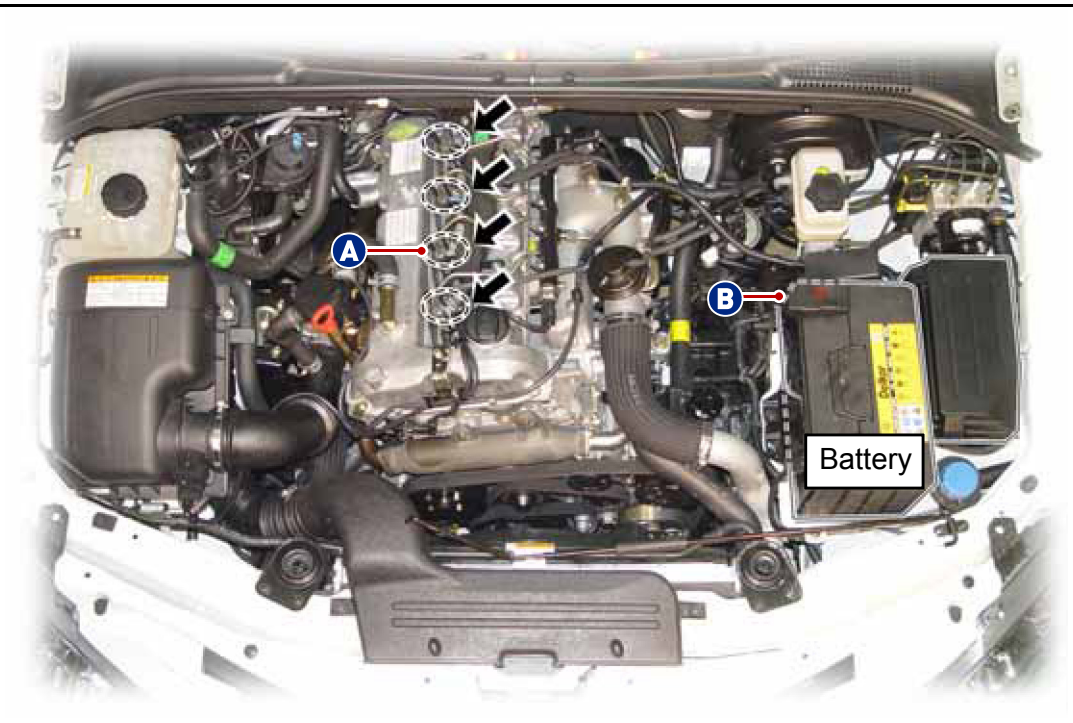


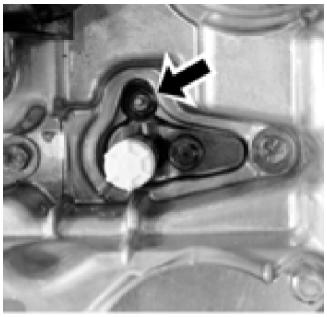
E Fuel Filter Sensor

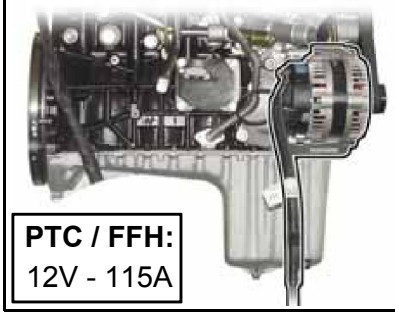
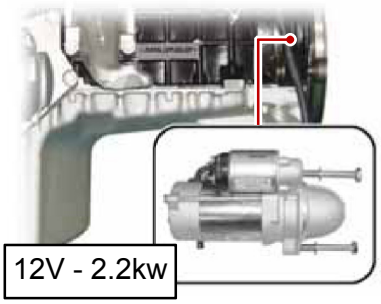


Service Interval (Fuel Filter)	
EU Only	Replace every 30,000 km (Draining water from fuel filter: whenever replacing the engine oil)
General	Replace every 25,000 km (Draining water from fuel filter: whenever replacing the engine oil)

3. ELECTRICAL COMPONENTS AND PREHEATING SYSTEM



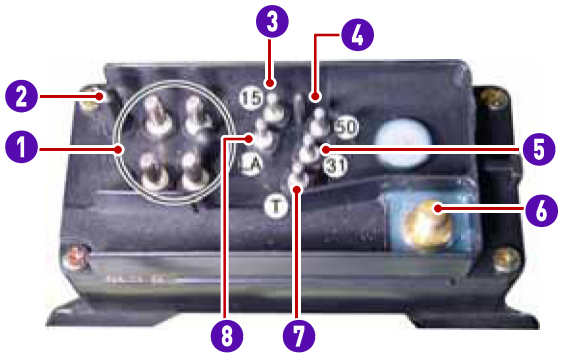
A Glow Plug		Preheat Warning Lamp (Cluster)
		

Alternator	Starter motor	Engine compartment fuse box
 PTC / FFH: 12V - 115A	 12V - 2.2kw	

Modification basis	
Application basis	
Affected VIN	

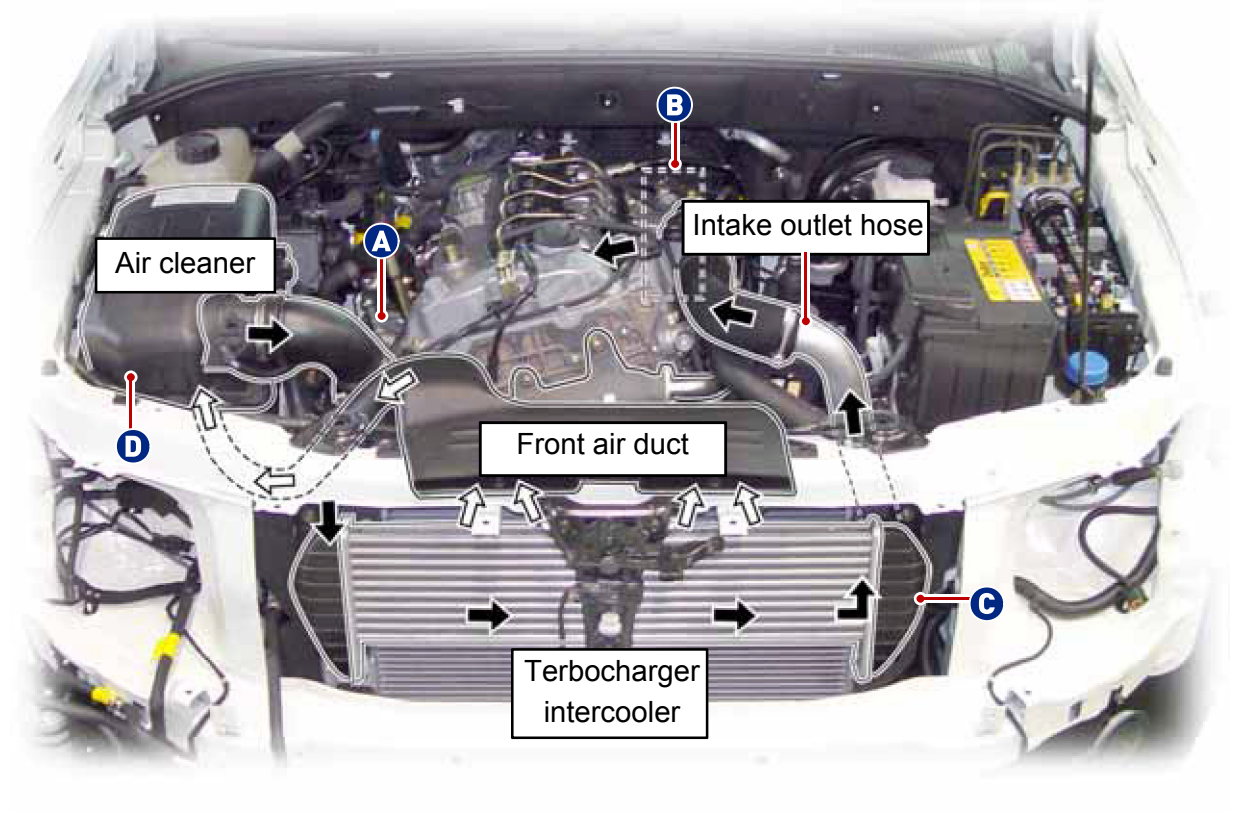
B Preheat Control Unit

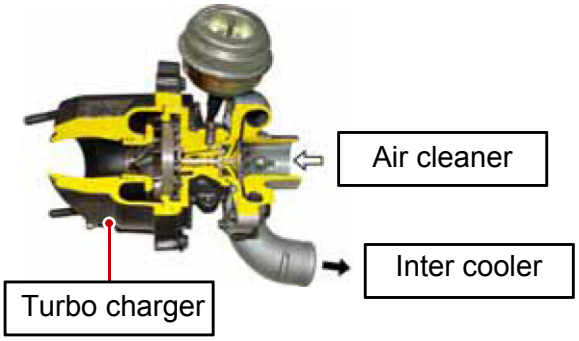
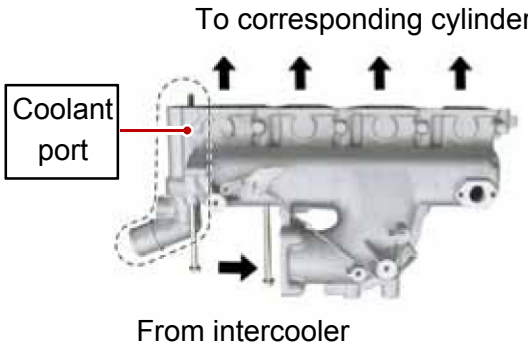




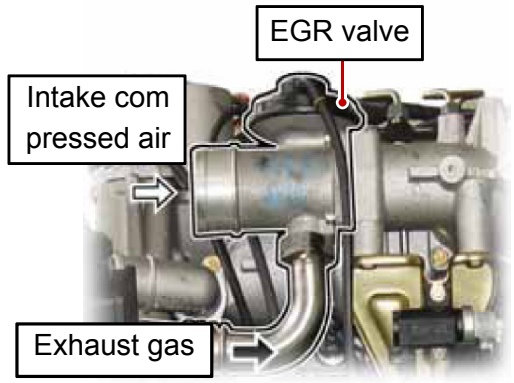
NO.	FUNCTION
1	Glow plug terminal (#1 ~ #4)
2	No G5 for 4 cylinders (Without D20DT)
3	IG1 power supply terminal
4	Glow plug control signal (ECU113)
5	Ground terminal
6	Battery main wire
7	Preheat completion transmit terminal : No use for vehicle without remote engine start
8	K-line (ECU 34)

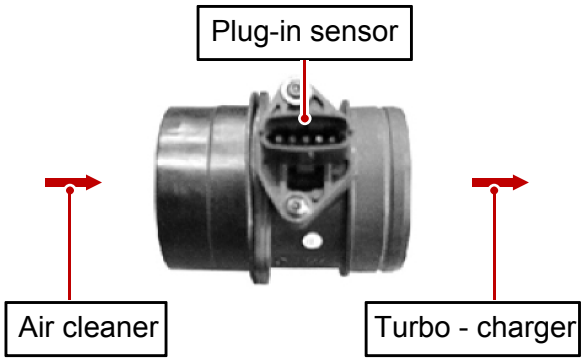
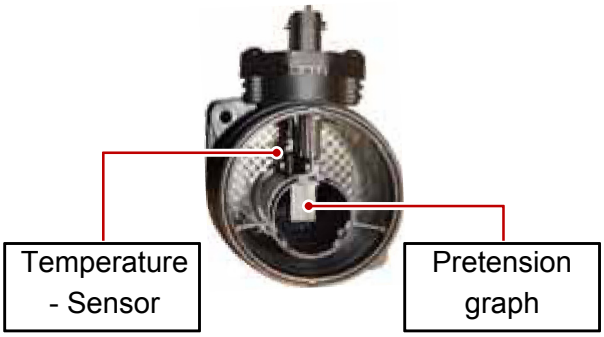
4. INTAKE SYSTEM LAYOUT



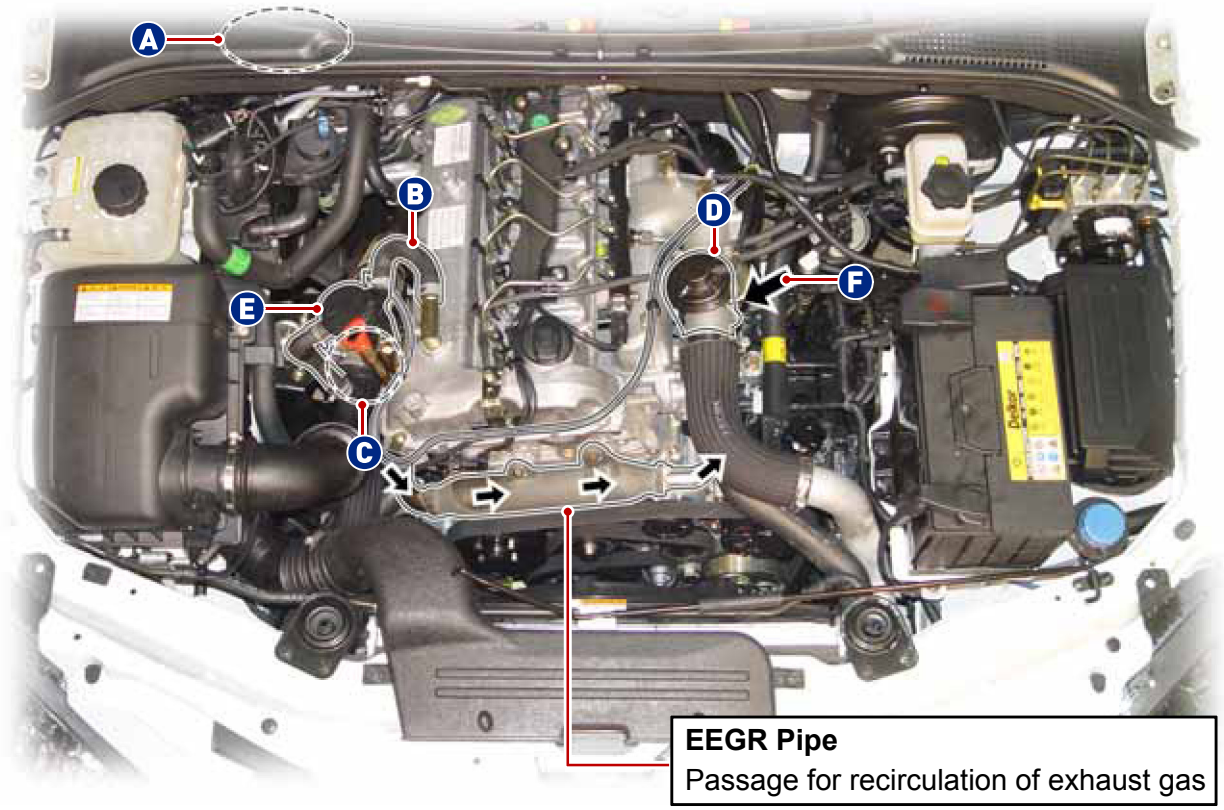
A Supplying Compressed Air with Turbocharger's Operation	B Intake Manifold
	

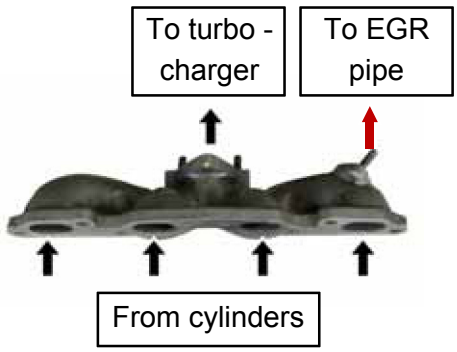
Modification basis	
Application basis	
Affected VIN	

Recirculation of Exhaust Gas when EGR Valve Operates	C Turbocharger Intercooler
	

D HFM Sensor	
	

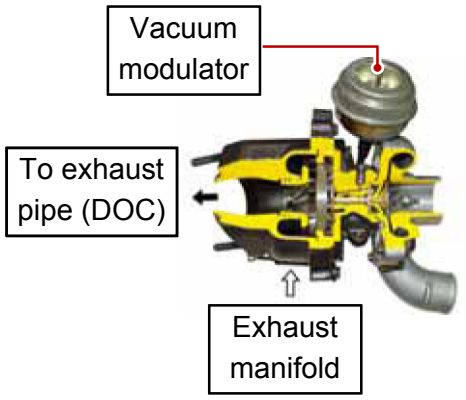
5. EXHAUST SYSTEM LAYOUT



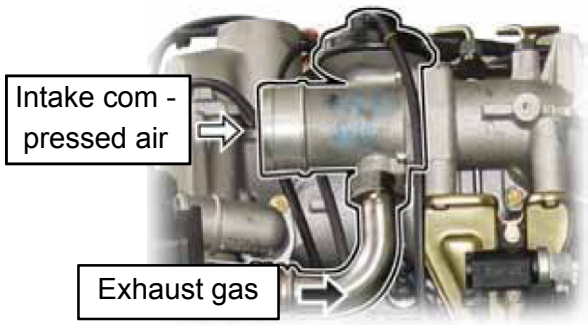
A DOC (Diesel Catalytic Converter)	B Exhaust Manifold
	

Modification basis	
Application basis	
Affected VIN	

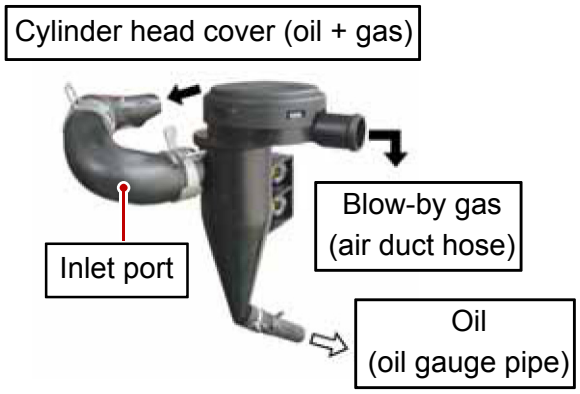
C VGT Turbocharger



D EGR Valved

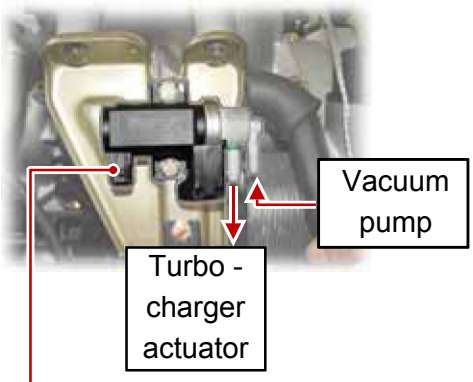


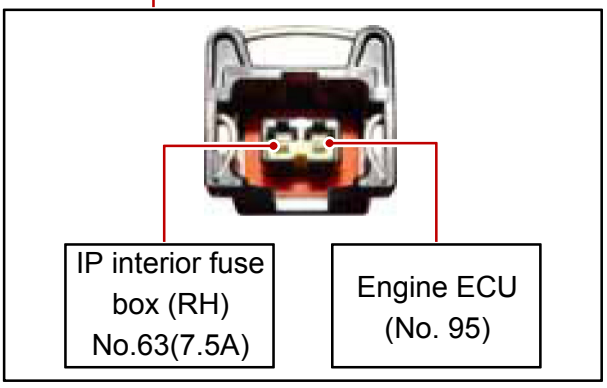
E PCV Oil Separator



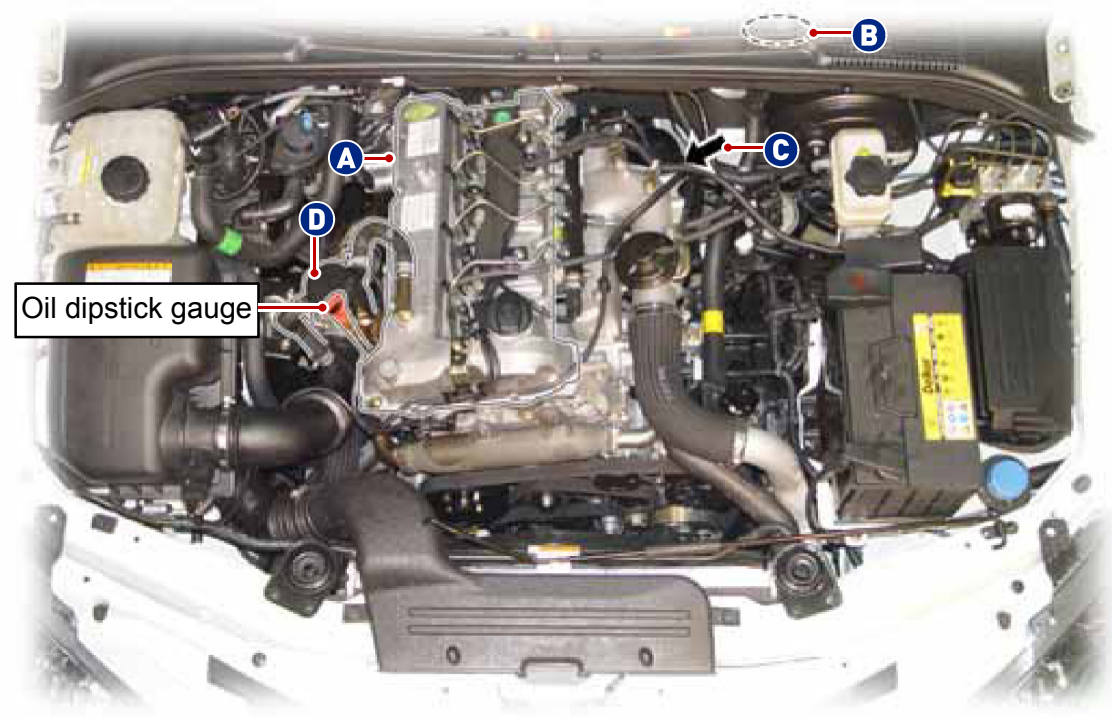
The first separation will happen when blow-by gas passes through baffle plates in cylinder head cover. Then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port.
Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering the combustion chamber through air duct hose via PCV valve that opens/closes due to pressure differences between the intake side and crankcase.

F Turbocharger Vacuum Modulator





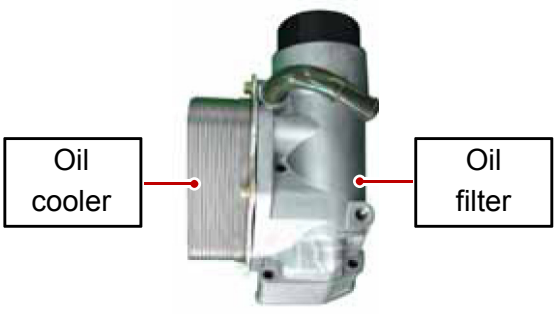
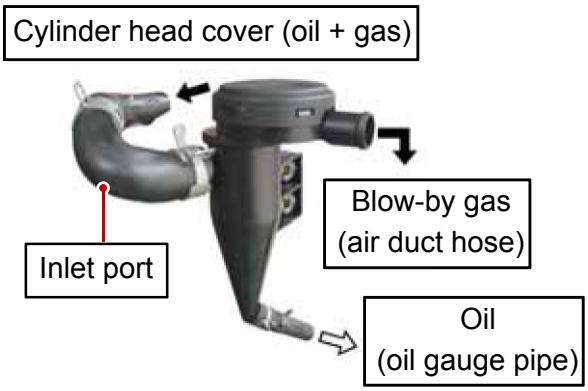
6. LUBRICATION SYSTEM LAYOUT



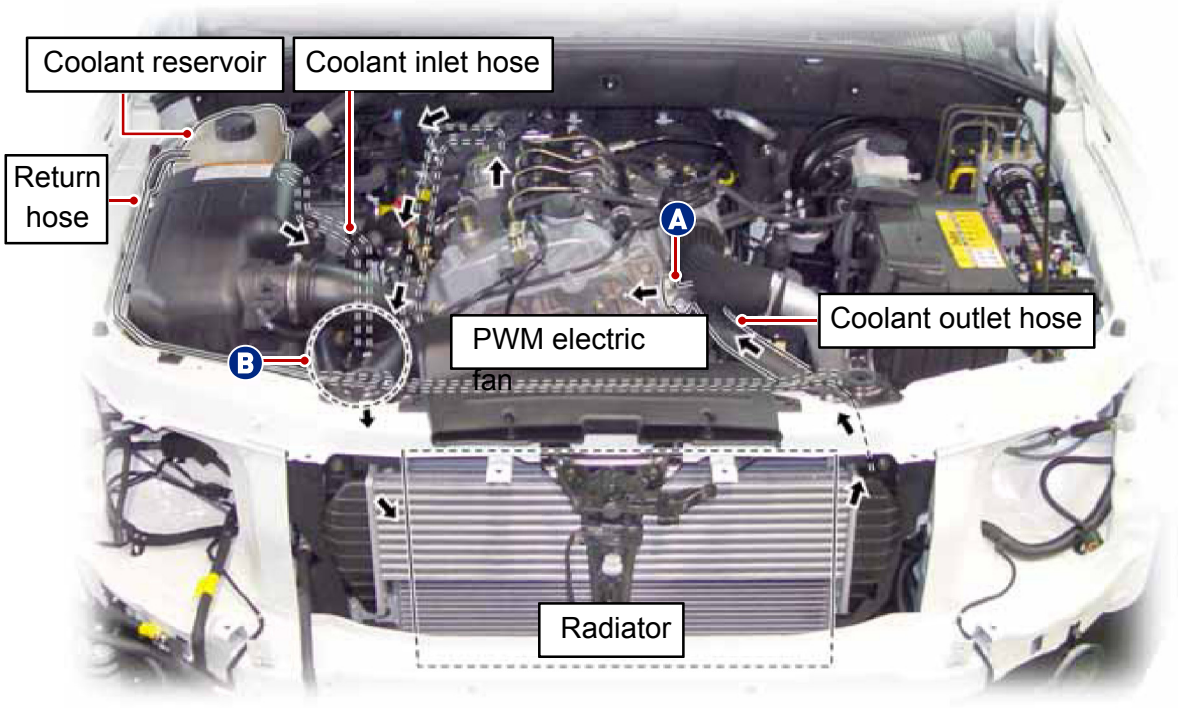
Cylinder Head Cover A	Oil Pressure Warning Lamp (Cluster) B
	

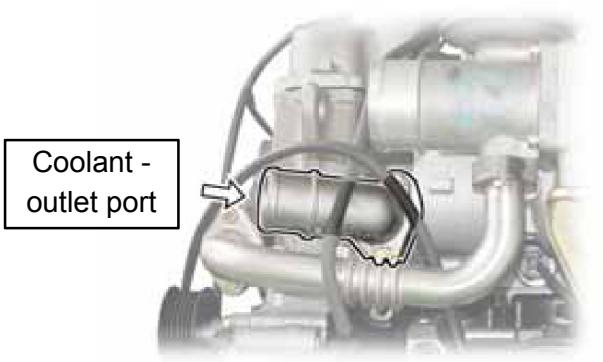
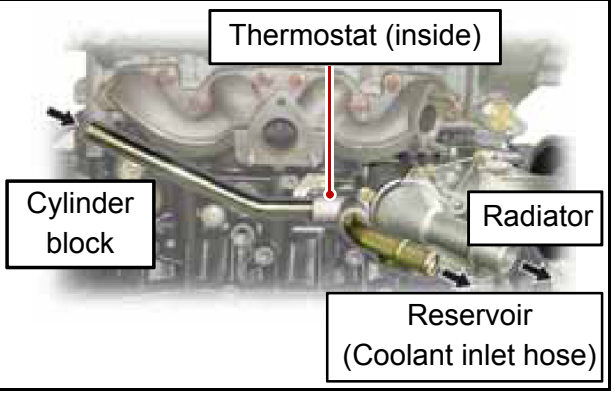
Oil Pan and Baffle Plate (Integrated Type)	Oil Strainer
	

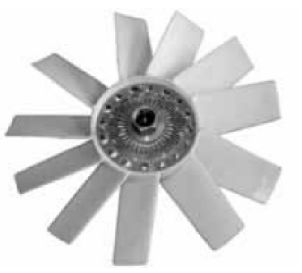
Modification basis	
Application basis	
Affected VIN	

C Oil Filter & Oil Cooler	D PCV Oil Separator
	 The first separation will happen when blow-by gas passes through baffle plates in cylinder head cover. Then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port. Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering the combustion chamber through air duct hose via PCV valve that opens/closes due to pressure differences between the intake side and crankcase.

7. COOLING SYSTEM LAYOUT

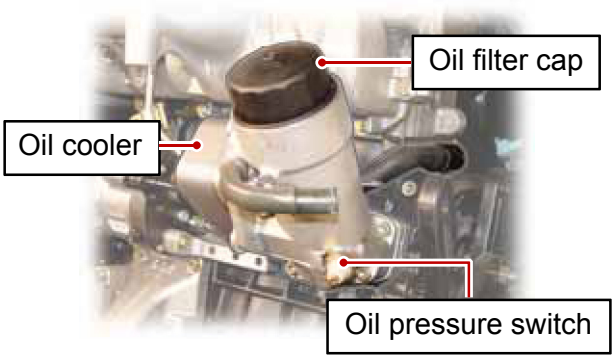


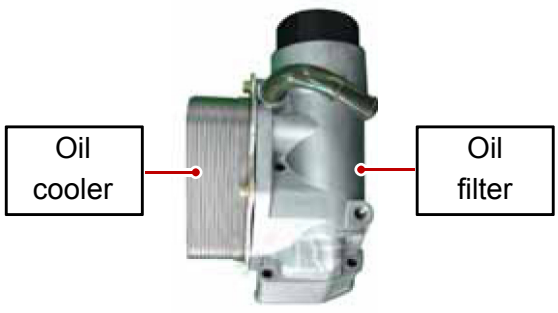
A Coolant Port	B Water Pump & Pipe
	

Radiator Assembly	Cooling Fan and Fan Clutch
	

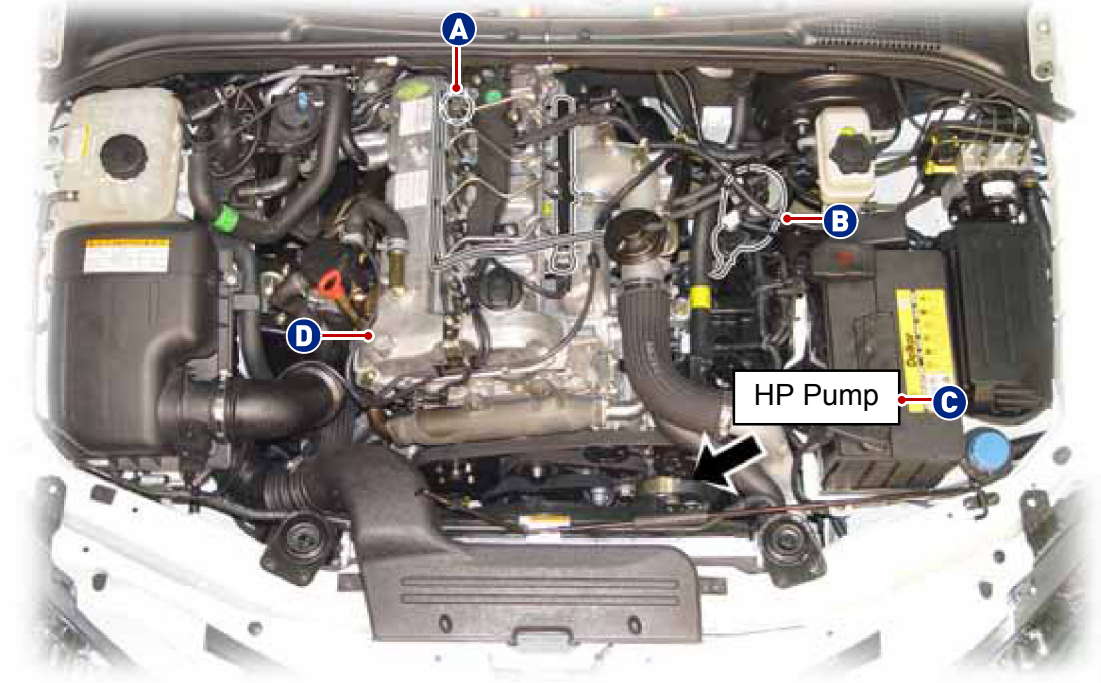
Modification basis	
Application basis	
Affected VIN	

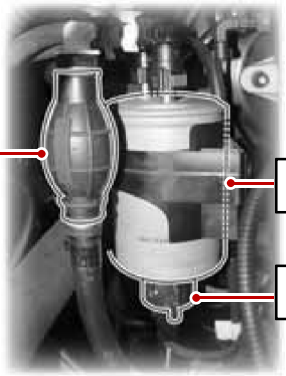
Engine Oil Filter & Cooler



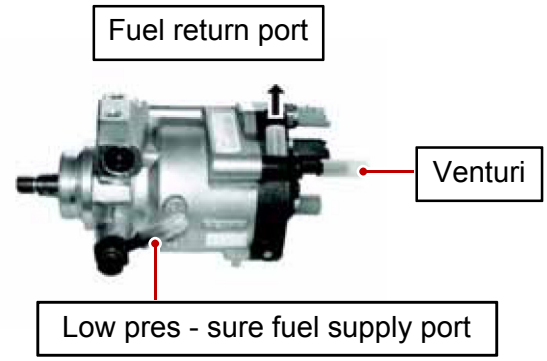


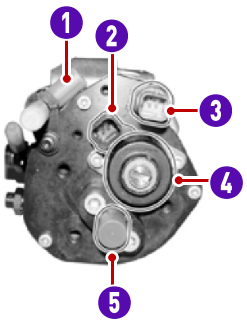
8. FUEL SYSTEM LAYOUT



A Injector		B Fuel Filter & Priming Pump
		 Priming pump, Fuel filter, Connector

C HP Pump

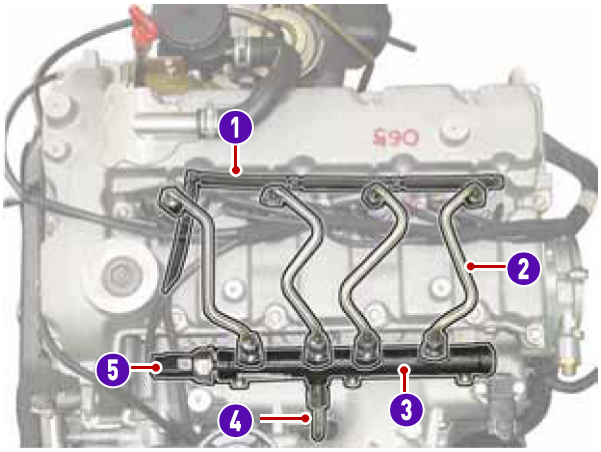




1. Fuel return port
2. Fuel tempera - ture sensor
3. IMV connector
4. IMV valve
5. High pres - sure fuel supply port

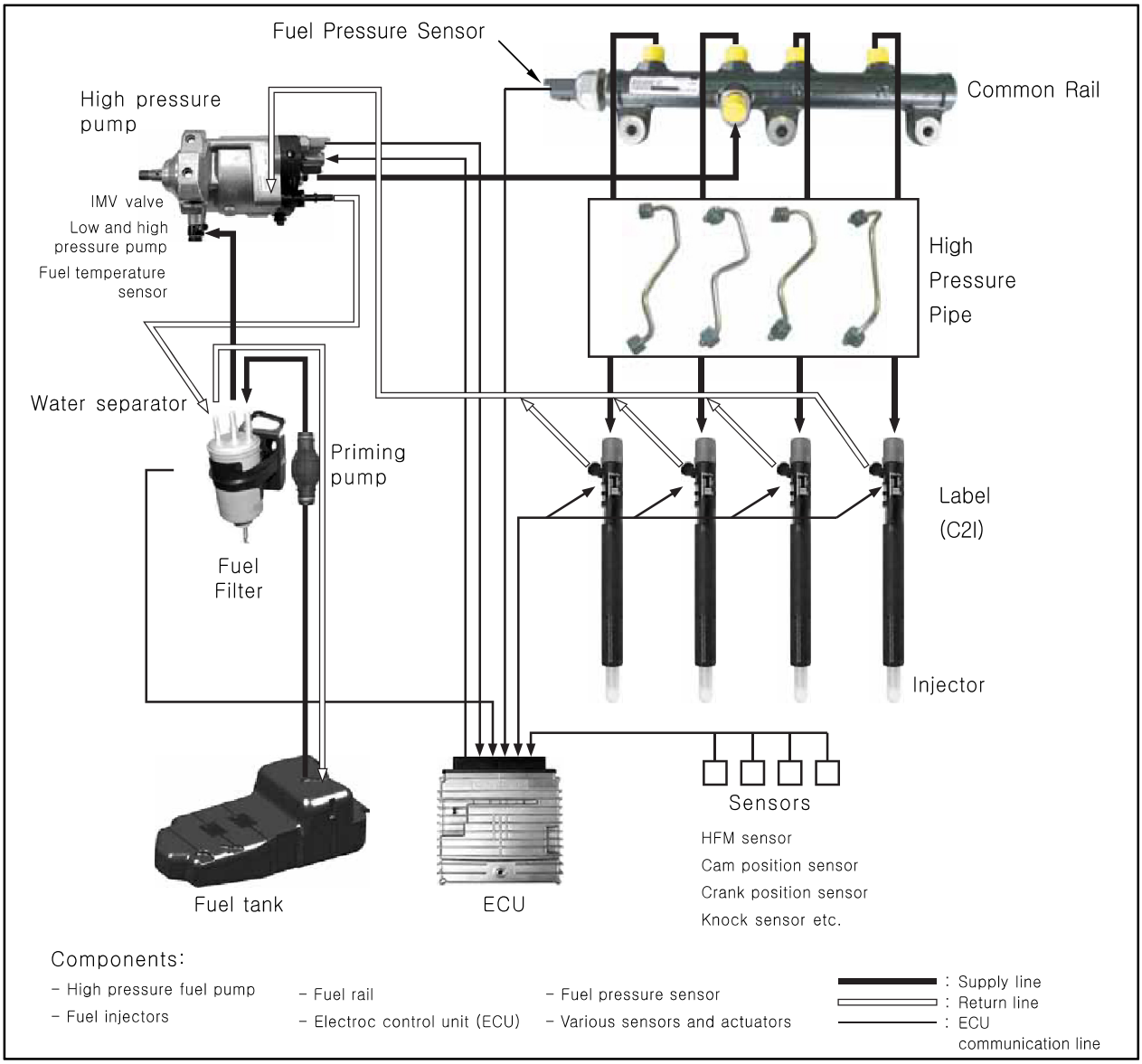
Modification basis	
Application basis	
Affected VIN	

D Cylinder Head



1. Fuel return hose
2. Fuel pipe
3. Common rail
4. High pressure fuel pipe
5. Fuel rail pressure sensor

9. FUEL SUPPLY SYSTEM



According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and barometric sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

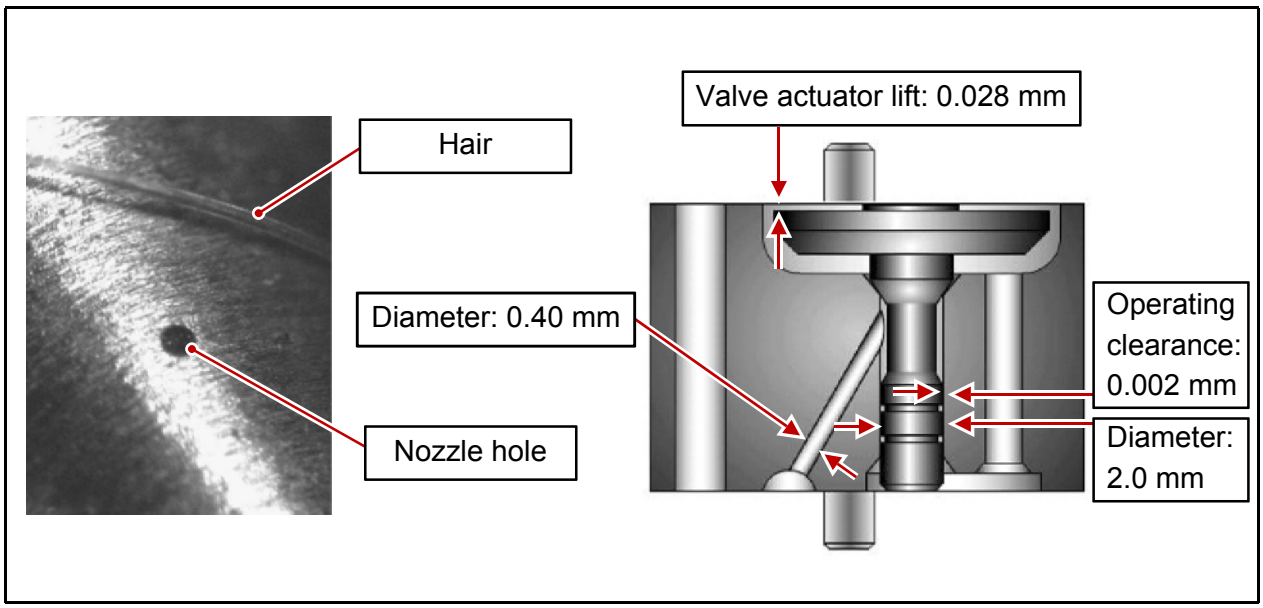
Modification basis	
Application basis	
Affected VIN	

10. CLEANNESS

1) CLEANNESS OF DI ENGINE FUEL SYSTEM AND SERVICE PROCEDURES

The fuel system for DI engine consists of transfer (low pressure) line and high pressure line. Its highest pressure reaches over 1600 bar. Some components in injector and HP pump are machined at the micrometer 100 μm of preciseness. The pressure regulation and injector operation are done by electric source from engine ECU. Accordingly, if the internal valve is stucked due to foreign materials, injector remains open. Even in this case, the HP pump still operates to supply high pressurized fuel. This increases the pressure to combustion chamber (over 250 bar) and may cause fatal damage to engine.

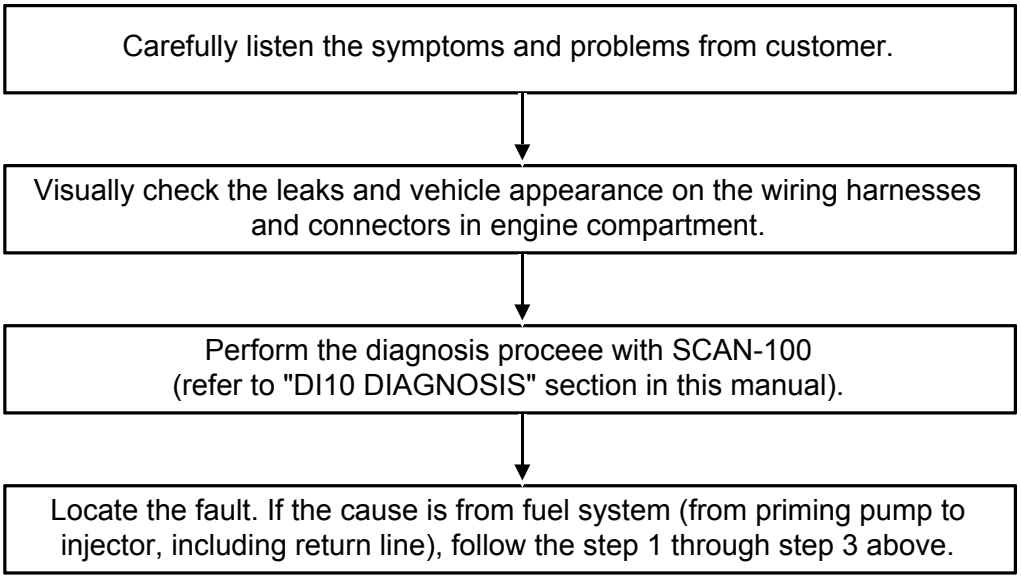
You can compare the thickness of injector nozzle hole and hair as shown in below figure (left side). The right side figure shows the clearance between internal operating elements.



The core elements of fuel system has very high preciseness that is easily affected by dust or very small foreign material. Therefore, make sure to keep the preliminary works and job procedures in next pages. If not, lots of system problems and claims may arise.

2) Job Procedures

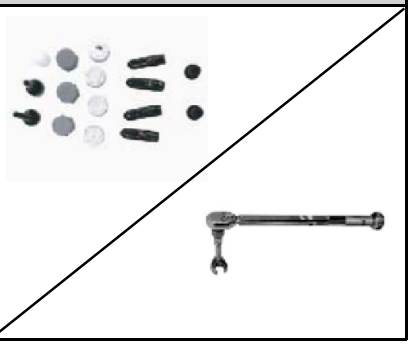
1. Always keep the workshop and lift clean (especially, from dust).
2. Always keep the tools clean (from oil or foreign materials).
3. Wear a clean vinyl apron to prevent the fuzz, dust and foreign materials from getting into fuel system.
   Wash your hands and do not wear working gloves.
4. Follow the below procedures before starting service works for fuel system.



5. If the problem is from HP pump, fuel supply line or injector, prepare the clean special tools and sealing caps to perform the diagnosis for DI engine fuel system in "DIAGNOSIS" section in this manual. At this point, thoroughly clean the related area in engine compartment.

CAUTION

- Clean the engine compartment before starting service works.

Tool kit for high pressure line	Took kit for low pressure line	Removal tool box and cap kits
		

Modification basis	
Application basis	
Affected VIN	

6. Follow the job procedures. If you find a defective component, replace it with new one.

Disconnect the negative battery cable.

↓

For safety reasons: check pressure is low before opening the HP systems (pipes)

↓

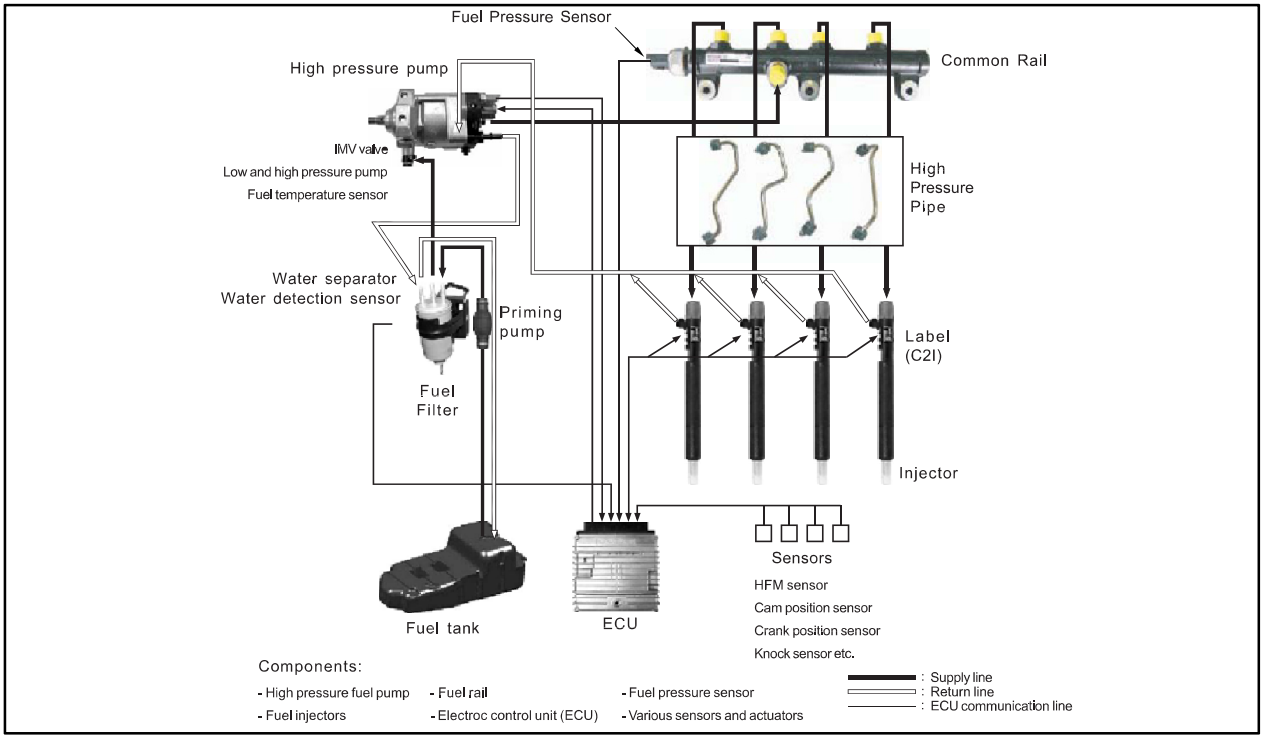
Use special tools and torque wrench to perform the correct works.

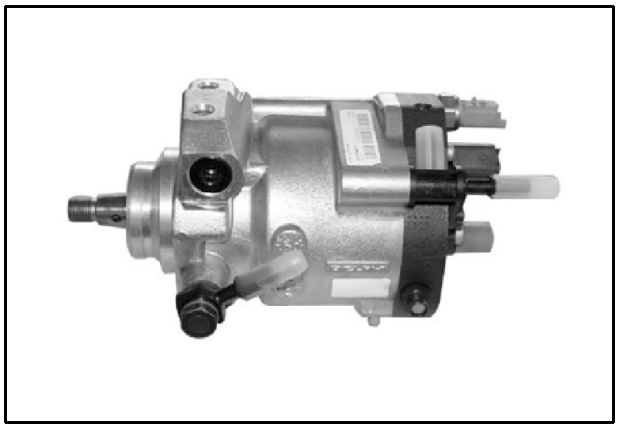
Once disconnected, the fuel pipes between HP pump and fuel rail and between fuel rail and each injector should be replaced with new ones. The pipes should be tightened tospecified tightening torques during installation. Over or under torques out of specified range may cause damages and leaks at connections. Once installed, the pipes have been deformed according to the force during installtion, therefore they are not reusable.

The copper washer on injector should be replaced with new one. The injector holder bolt should be tightened to specified tightening torque as well. If not, the injection point may be deviated from correct position, and it may cause engine disorder.

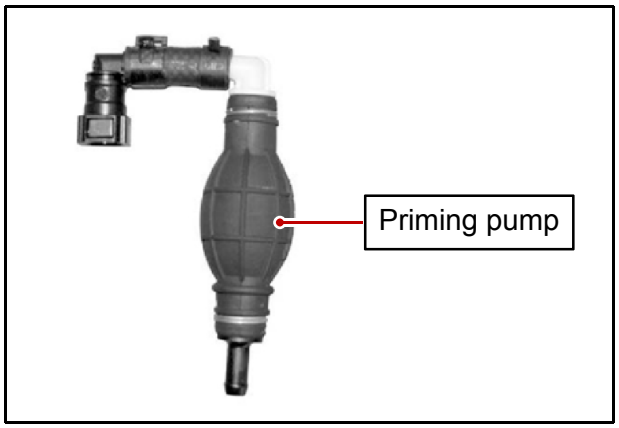
↓

Plug the disconnected parts with sealing caps, and remove the caps immediately before replacing the components.





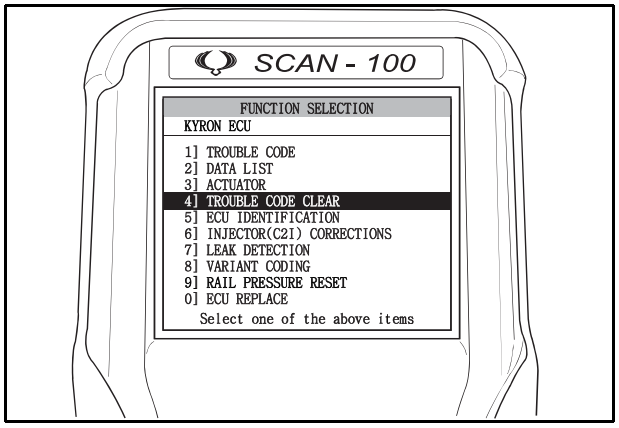
7. Plug the removed components with clean and undamaged sealing caps and store it into the box to keep the conditions when it was installed.
8. Clear the high pressure offset value by SCAN-100 after replacing the high pressure pump.



9. To supply the fuel to transfer line of HP pump press the priming pump until it becomes hard.

CAUTION

- Do not crank engine before having filled pump.



10. Check the installed components again and connect the negative battery cable. Start the engine and check the operating status.
11. With SCAN-100, check if there are current faults and erase the history faults.

Modification basis	
Application basis	
Affected VIN	

3) DI Engine and Its Expected Problems and Remedies Can be Caused by Water in Fuel

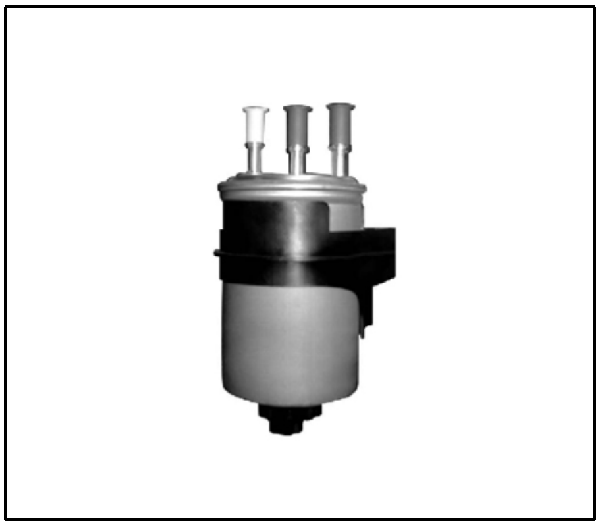
▶ System Supplement Against Paraffin Separation.

In case of Diesel fuel, paraffin, one of the elements, can be separated from fuel during winter and then can stick on the fuel filter blocking fuel flow and causing difficult starting finally. Oil companies supply summer fuel and winter fuel by differentiating mixing ratio of kerosene and other elements by region and season. However, above phenomenon can be happened if stations have poor facilities or sell improper fuel for the season.

In case of DI engine, purity of fuel is very important factor to keep internal preciseness of HP pump and injector.

Accordingly, more dense mesh than conventional fuel filter is used. To prevent fuel filter internal clogging due to paraffin separation, SYMC is using fuel line that high pressure and temperature fuel injected by injector returns through fuel filter to have an effect of built-in heater (see fuel system).

▶ System Supplement And Remedy Against Water In Fuel



As mentioned above, some gas stations supply fuel with excessive than specified water. In the conventional IDI engine, excessive water in the fuel only causes dropping engine power or engine hunting. However, fuel system in the DI engine consists of precise components so water in the fuel can cause malfunctions of HP pump due to poor lubrication of pump caused by poor coating film during high speed pumping and bacterization (under long period parking). To prevent problems can be caused by excessive water in fuel, water separator is installed inside of fuel filter. When fuel is passing filter, water that has relatively bigger specific gravity is accumulated on the bottom of the filter.

If water in the separator on the fuel filter exceeds a certain level, it will be supplied to HP pump with fuel, so the engine ECU turns on warning light on the meter cluster and buzzer if water level is higher than a certain level.

Due to engine layout, a customer cannot easily drain water from fuel filter directly, so if a customer checks in to change engine oil, be sure to perform water drain from fuel filter.

(See fuel system for details.)

11. MAINTENANCE AND REPAIR

1) Maintenance And Lubrication

▶ Normal Vehicle Use

The maintenance instructions contained in the maintenance schedule are based on the assumption that the vehicle will be used for the following reasons:

1. To carry passengers and cargo within the limitation of the tire inflation prassure. Refer to "Wheels and Tire" in section 4H.
2. To be driven on reasonable road surfaces and within legal operating limits.

▶ Explanation of Scheduled Maintenance Services

The services listed in the maintenance schedule are further explained below. When the following maintenance services are performed, make sure all the parts are replaced
and all the necessary repairs are done before driving the vehicle. Always use the proper fluid and lubricants.

▷ Engine Oil and Oil Filter Change

Always use above the API SH grade or recommended engine oil.

▷ Engine Oil Viscosity

Engine oil viscosity (thickness) has an effect on fuel economy and cold weather operation. Lower viscosity engine oils can provide better fuel economy and cold weather performance however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Using oils of any viscosity other than those viscosities recommended could result in engine damage.

▷ Cooling System Service

Drain, flush and refill the system with new coolant. Refer to "Recommended Fluids And Lubricants" in this section.

Modification basis	
Application basis	
Affected VIN	

▷ **Spark Plug Wire Replacement**

Clean wires and inspect them for burns, cracks or other damage. Check the wire boot fit at the Distributor and at the spark plugs. Replace the wires as needed.

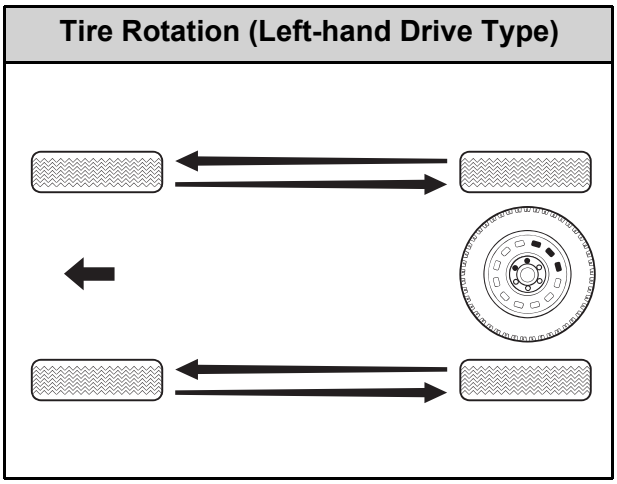
▷ **Brake System Service**

Check the disc brake pads or the drum brake linings.
Check the pad and the lining thickness carefully.

▷ **Tire and Wheel Inspection and Rotation**

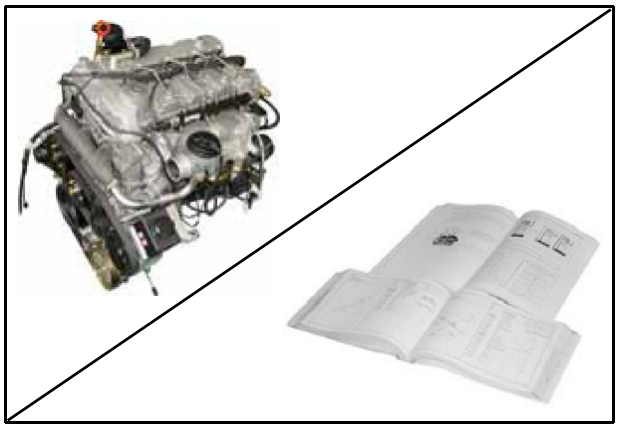
Check the tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate the tires. If irregular or premature wear exists, check the wheel alignment and check for damaged wheels. While the tires and wheels are removed, inspect the brakes.

Tire Rotation (Left-hand Drive Type)



12. GUIDELINES FOR SERVICE WORK SAFETY

1) General



To maintain and operate the vehicle under optimum state by performing safe service works, the service works should be done by following correct methods and procedures.
Accordingly, the purpose of this manual is to prevent differences that can be caused by personal working method, skill, ways and service procedures and to allow prompt/correct service works.

▶ Note, Notice

While using this manual, there are a lot of Note or Notice having below meaning.

CAUTION

- Note means detailed description of supplementary information on work procedure or skill.

CAUTION

- Notice means precautions on tool/device or part damages or personal injuries that can occur during service works.

However, above references and cautions cannot be inclusive measures, so should have habits of taking concerns and cautions based on common senses.

Modification basis	
Application basis	
Affected VIN	

2) Cautions on Inspection/Service

CAUTION

- During service works, be sure to observe below general items for your safety.
  - · For service works, be sure to disconnect battery negative (-) terminal if not starting and inspection.
  - · While inspecting vehicle and replacing various consumable parts, be sure to take caution not to damage vehicle and injure people.
  - · Engine and transmission may be hot enough to burn you. So inspect related locations when they cooled down enough.
  - · If engine is running, keep your clothing, tools, hair and hands away from moving parts.
  - · Even when the ignition key is turned off and positioned to LOCK, electrical fan can be operated while working on near around electrical fan or radiator grille if air conditioner or coolant temperature rises.
  - · Every oil can cause skin trouble. Immediately wash out with soap if contacted.
  - · Painted surface of the body can be damaged if spilled over with oil or anti-freeze.
  - · Never go under vehicle if supported only with jack.
  - · Never near the battery and fuel related system to flames that can cause fire like cigarette.
  - · Never disconnect or connect battery terminal or other electrical equipment if ignition key is turned on.
  - · While connecting the battery terminals, be cautious of polarities (+, -) not to be confused.
  - · There are high voltage and currency on the battery and vehicle wires. So there can be fire if short-circuited.
  - · Do not park while running the engine in an enclosed area like garage. There can be toxication with CO, so make sufficient ventilation.
  - · The electrical fan works electrically. So the fan can be operated unexpectedly during working causing injuries if the ignition key is not in LOCK position. Be sure to check whether ignition key is in LOCK position before work.
  - · Be careful not to touch hot components like catalytic converter, muffler and exhaust pipe when the engine is running or just stopped. They may burn you badly.

3) Guidelines on Engine Service

To prevent personal injuries and vehicle damages that can be caused by mistakes during engine and unit inspection/repair and to secure optimum engine performance and safety after service works, basic cautions and service work guidelines that can be easily forgotten during engine service works are described in.

▶ Cautions before service works

1. Before work on engine and each electrical equipment, be sure to disconnect battery negative (-) terminal.
2. Before service works, be sure to prepare the works by cleaning and aligning work areas.
3. Always position the ignition switch to OFF if not required. If not, there can be electrical equipment damages or personal injuries due to short-circuit or ground by mistake.
4. There should be no leak from fuel injection system (HP pump, fuel hose, high pressure pipe) of the D20DT & D27DT engine. So they should be protected from foreign materials. While removing the engine, do not position the jack and others under the oil pan or
5. engine. To secure the safety, use only safety hook on the engine.

▶ Engine and accessories

Engine has a lot of precise portions so tightening torque should be correct during disassembly/assembly and removal/installation and service work should be done in clean ways during disassembly/assembly.
Maintaining working area clean and cautious service administration is essential element of service works while working on the engine and each section of the vehicle.
So the mechanics should well aware of it.

1. While removing the engine, related parts (bolts, gaskets, etc.) should be aligned as a group.
2. While disassembling/assembling internal components of the engine, well aware of disassembly/assembly section in this manual and clean each component with engine oil and then coat with oil before installation.
3. While removing engine, drain engine oil, coolant and fuel in fuel system to prevent leakage.
4. During service work of removal/installation, be sure to check each connected portions to engine not to make interference.

Modification basis	
Application basis	
Affected VIN	

▶ Fuel and lubrication system

Painted surface of the body can be damaged or rubber products (hoes) can be corroded if engine oil and fuel are spilled over. If spilled over engine, foreign materials in air can be accumulated on the engine damaging fuel system.

1. If work on the fluid system such as fuel and oil, working area should be well ventilated and mechanic should not smoke.
2. Gasket or seal on the fuel/lubrication system should be replaced with new and bolts and nuts should be tightened as specified.
3. After removal/installation works, be sure to check whether there is leak on the connecting section.

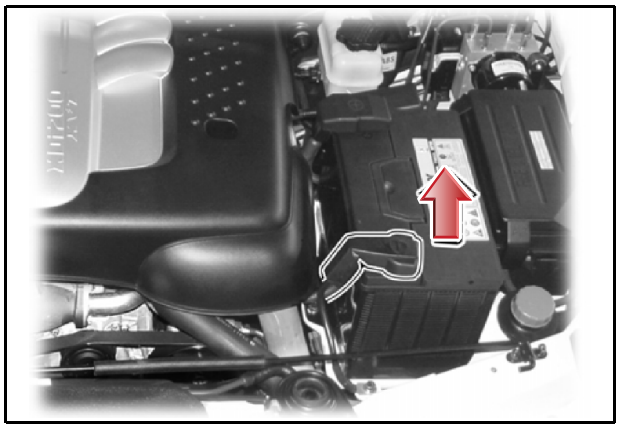
If fine dust or foreign material enters into DI engine's fuel system, there can be serious damages between HP pump and injectors. So, be sure to cover removed fuel system components with cap and protect removed parts not to be contaminated with dirt. (Refer to cleanness in this manual while working on DI engine fuel system)

▶ Electrical equipment

Electrical equipment should be handled more carefully.
Currently, the engine is equipped with a lot of electrical equipments so there can be engine performance drops, incomplete combustion and other abnormals due to short and poor contact. Mechanics should well aware of vehicle's electrical equipment.

1. If have to work on the electrical equipment, be sure to disconnect battery negative (-) terminal and position the ignition switch to off if not required.
2. When replacing electrical equipment, use the same genuine part and be sure to check whether ground or connecting portions are correctly connected during installation.
   If ground or connecting portion is loosened, there can be vehicle fire or personal injury.

13. DURING SERVICE WORK FOR INSPECTION



1. Before lifting up the vehicle with lift, correctly support the lifting points and lift up.
2. When using a jack, park the vehicle on the level ground and block front and rear wheels. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
3. Before service work, be sure to disconnect battery negative (-) terminal to prevent damages by bad wire and short.



4. If service from interior of the vehicle, use protection cover to prevent damage and contamination of seat and floor.
5. Brake fluid and anti-freeze can damage painted surface of body. So carefully handle them during service work.



6. Use recommended and specified tools to increase efficiency of service work.
7. Use only genuine spare parts.

Modification basis	
Application basis	
Affected VIN	





8. Never reuse cotter pin, gasket, O-ring, oil seal, lock washer and self-locking nut. Replace them with new.
   If reused, normal functions cannot be maintained.
9. Align the disassembled parts in clean according to disassembling order and group for easy assembling.
10. According to installing positions, the bolts and nuts have different hardness and design. So be careful not to mix removed bolts and nuts each other and align them according installing positions.
11. To inspect and assemble, clean the parts.
12. Securely clean the parts that related with oil not to be affected by viscosity of oil.
13. Coat oil or grease on the driving and sliding surfaces before installing parts.
14. Use sealer or gasket to prevent leakage if necessary.
15. Damaged or not, never reuse removed gasket.
    Replace with new and cautious on installing directions.
16. Tighten every bolt and nut with specified torque.
17. When service work is completed, check finally whether the work is performed properly or the problem is solved.
18. If work on the fuel line between priming pump and injector (including return line), be sure to cover the removed parts with cap and be careful not to expose the connecting passage and removed parts to external foreign materials or dust. (Refer to cleanness.)
19. If remove high pressure fuel supply pipe between HP pump and fuel rail and high pressure fuel pipe between fuel rail and each injector, be sure to replace them with new.

14. DURING SERVICE WORK FOR ELECTRIC DEVICES

CAUTION
- Be careful not to modify or alter electrical system and electrical device.
  Or there can be vehicle fire or serious damage.

1. Be sure to disconnect battery negative (-) terminal during every service work. Before disconnecting battery negative (-) terminal, turn off ignition key.
2. Replace with specified capacity of fuse if there is bad, blown or short circuited fuse. If use electrical wire or steel wire other than fuse, there can be damages on the various electrical systems. If replaced with over-capacity fuse, there can be damages on the related electrical device and fire.
3. Every wire on the vehicle should be fastened securely not to be loosened with fixing clip.
4. If wires go through edges, protect them with tape or other materials not to be damaged.
5. Carefully install the wires not to be damaged during installation/removal of parts due to interference.
6. Be careful not to throw or drop each sensor or relay.
7. Securely connect each connector until hear a "click" sound.

1) Lifting Positions

▶ 4-post lift

As illustrated, position the vehicle on the 4-post lift securely and block the front and rear of each tire not to move during working.

CAUTION
- During lifting, be sure to check whether vehicle is empty.
  · Board-on lift connection device installed in front of vehicle should be positioned in front of sill locating under the front door.
  · Install lift connecting device on the edge of front and rear of board-on lift.

WARNING
· Be sure to use attachment during lifting to prevent the lift from contacting with body floor.
· While lifting the vehicle, widen the lift floor as far as possible to stabilize between vehicle front and rear.
When fixing the lift floor, be careful not to contact with brake tube and fuel lines.

▶ Safety jack and safety stand

If lift up the vehicle with safety jack and stand, should be more careful during works.

WARNING
· Never be under the vehicle if supported with only jack. If have to be under the vehicle, be sure to use safety block.
· Use wheel block in front and rear of every wheel.

Modification basis	
Application basis	
Affected VIN	

15. OWNER INSPECTIONS AND SERVICES

1) While Operating The Vehicle

▶ Horn Operation

Blow the horn occasionally to make sure it works. Check all the button locations.

▶ Brake System Operation

Be alert for abnormal sounds, increased brake pedal travel or repeated puling to one side when braking. Also, if the brake warning light goes on, or flashes, something may be wrong with part of the brake system.

▶ Exhaust System Operation

Be alert to any changes in the sound of the system or the smell of the fumes. These are signs that the system may be leaking or overheating. Have the system inspected and repaired immediately.

▶ Tires, Wheels and Alignment Operation

Be alert to any vibration of the steering wheel or the seats at normal highway speeds. This may mean a wheel needs to be balanced. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or a wheel alignment.

▶ Steering System Operation

Be alert to changes in the steering action. An inspection is needed when the steering wheel is hard to turn or has too much free play, or is unusual sounds are noticed when turning or parking.s.

▶ Headlamp Aim

Take note of the light pattern occasionally. Adjust the headlights if the beams seem improperly aimed.

2) At Each Fuel Fill

A fluid loss in any (except windshield washer) system may indicate a problem. Have the system inspected and repaired immediately.

▶ **Engine Oil Level**

Check the oil level and add oil if necessary. The best time to check the engine oil level is when the oil is warm.

1. After stopping the engine, wait a few minutes for the oil to drain back to the oil pan.
2. Pull out the oil level indicator (dip stick).
3. Wipe it clean, and push the oil level indicator back down all the way.
4. Pull out the oil level indicator and look at the oil level on it.
   Add oil, if needed, to keep the oil level above the lower mark. Avoid overfilling the engine, since this may cause engine damage.
5. Add oil, if needed, to keep the oil level above the lower mark. Avoid overfilling the engine, since this may cause engine damage.
6. Push the indicator all the way back down into the engine after taking the reading.

If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level reading.

▶ **Engine Coolant Level and Condition**

Check the coolant level in the coolant reservoir tank and add coolant if necessary. Inspect the coolant. Replace dirty or rusty coolant.

▶ **Windshield Washer Fluid Level**

Check the washer fluid level in the reservoir. Add fluid if necessary.

3) At Least Twice A Month

Tire And Wheel Inspection and Pressure Check Check the tire for abnormal wear or damage. Also check for damaged wheels. Check the tire pressure when the tires are cold (check the spare also, unless it is a stowaway).
Maintain the recommended pressures. Refer to "Wheels and Tire" is in section 4H.

4) At Least Monthly

▶ **Lamp Operation**

Check the operation of the license plate lamp, the headlamps (including the high beams), the parking lamps, the fog lamps, the taillamp, the brake lamps, the turn signals, the backup lamps and the hazard warning flasher.

▶ **Fluid Leak Check**

Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids, after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, find the cause and correct it at once.

Modification basis	
Application basis	
Affected VIN	

5) At Least Twice A Year

▶ Power Steering System Reservoir Level

Check the power steering fluid level. Keep the power steering fluid at the proper level. Refer to Section 4G, Power Steering System.

▶ Brake Master Cylinder Reservoir Level

Check the fluid and keep it at the proper level. A low fluid level can indicate worn disc brake pads which may need to be serviced. Check the breather hole in the reservoir cover to be free from dirt and check for an open passage.

▶ Weather-Strip Lubrication

Apply a thin film silicone grease using a clean cloth..

6) Each Time The Oil Is Changed

▶ Brake System Inspection

This inspection should be done when the wheels are removed for rotation. Inspect the lines and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect the disc brake pads for wear. Inspect the rotors for surface condition. Inspect other brake parts, the parking brake, etc., at the same time. Inspect the brakes more often if habit or conditions result in frequent braking.

▶ Steering, Suspension and Front Drive Axle Boot And Seal Inspection

Inspect the front and rear suspension and the steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Clean and inspect the drive axle boot and seals for damage, tears or leakage. Replace the seals if necessary.

▶ Exhaust System Inspection

Inspect the complete system (including the catalytic converter if equipped). Inspect the body near the exhaust system. Look for broken, damaged, missing, or out-ofposition parts as well as open seams, holes, loose connections, or other conditions which could cause heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

▶ Drain the Water from Fuel Filter

When the water level inside water separator in fuel filter exceeds a certain level, water separator warning light comes on and buzzer sounds. Also, the driving force of the vehicle decreases.
If these conditions occur, immediately drain the water from fuel filter & water separator.

▶ Hood Latch Operation

When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. The hood must close firmly.

7) At Least Annually

▶ **Lap and Shoulder Belts Condition and Operation**

Inspect the belt system including: the webbing, the buckles, the latch plates, the retractor, the guide loops and the anchors.

▶ **Movable Head Restraint Operation**

On vehicles with movable head restraints, the restraints must stay in the desired position.

▶ **Spare Tire and Jack Storage**

Be alert to rattles in the rear of the vehicle. The spare tire, all the jacking equipment, and the tools must be securely stowed at all times. Oil the jack ratchet or the screw mechanism after each use.

▶ **Key Lock Service**

Lubricate the key lock cylinder.

▶ **Body Lubrication Service**

Lubricate all the body door hinges including the hood, the fuel door, the rear compartment hinges and the latches, the glove box and the console doors, and any folding seat hardware.

▶ **Underbody Flushing**

Flushing the underbody will remove any corrosive materials used for ice and snow removal and dust control. At least every spring clean the underbody. First, loosen the sediment packed in closed areas of the vehicle. Then flush the underbody with plain water.

▶ **Engine Cooling System**

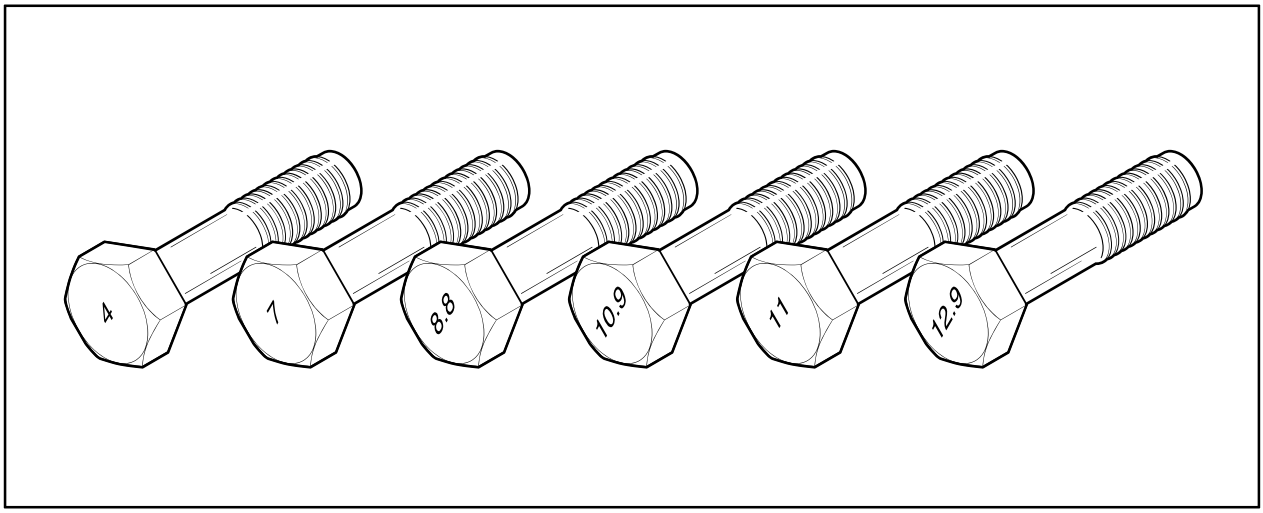
Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. Replace the cracked, swollen, or deteriorated hoses. Tighten the clamps.
Clean the outside of the radiator and the air conditioning condenser. Wash the filler cap and the neck. Pressure test the cooling system and the cap in order to help ensure proper operation.

Modification basis	
Application basis	
Affected VIN	

16. STANDARD BOLTS SPECIFICATIONS

Bolt*	Torque (Nm / lb-in)					
	Standard			Limit		
	4T	7T	9T	4T	7T	9T
M3 ×0.5	0.5 Nm (4.5 lb-in)	0.9 Nm (8 lb-in)	1.3 Nm (12 lb-in)	0.7 Nm (6.3 lb-in)	1.2 Nm (11 lb-in)	17 Nm (15 lb-in)
M4 ×0.7	1.2 Nm (11 lb-in)	2.0 Nm (18 lb-in)	3.0 Nm (27 lb-in)	1.6 Nm (14 lb-in)	2.6 Nm (23 lb-in)	4.0 Nm (36 lb-in)
M5 ×0.8	2.4 Nm (22 lb-in)	4.0 Nm (36 lb-in)	5.6 Nm (50 lb-in)	3.1 Nm (28 lb-in)	5.2 Nm (47 lb-in)	7.6 Nm (68 lb-in)
M6 ×1.0	4.0 Nm (36 lb-in)	6.7 Nm (60 lb-in)	9.7 Nm (87 lb-in)	5.4 Nm (49 lb-in)	9.0 Nm (81 lb-in)	12.7 Nm (114 lb-in)
M8 ×1.25	8.6 Nm (77 lb-in)	15.7 Nm (12 lb-in)	22.5 Nm (17 lb-in)	12.7 Nm (9 lb-in)	20.6 Nm (15.2 lb-in)	30.4 Nm (22 lb-in)
M10 ×1.25	18.6 Nm (14 lb-in)	32.3 Nm (24 lb-in)	46.0 Nm (34 lb-in)	25.5 Nm (19 lb-in)	42.1 Nm (31 lb-in)	60.8 Nm (31 lb-in)
M10 ×1.5	18.6 Nm (14 lb-in)	30.4 Nm (22 lb-in)	44.1 Nm (33 lb-in)	24.5 Nm (18 lb-in)	41.2 Nm (30 lb-in)	58.8 Nm (44 lb-in)
M12 ×1.25	34.3 Nm (25 lb-in)	56.8 Nm (42 lb-in)	82.3 Nm (61 lb-in)	45.0 Nm (33 lb-in)	75.5 Nm (56 lb-in)	107.8 Nm (80 lb-in)
M12 ×1.75	32.3 Nm (24 lb-in)	53.9 Nm (40 lb-in)	77.4 Nm (57 lb-in)	43.1 Nm (32 lb-in)	71.5 Nm (53 lb-in)	98.0 Nm (73 lb-in)
M14 ×1.5	54.0 Nm (40 lb-in)	89.2 Nm (66 lb-in)	127.4 Nm (94 lb-in)	71.6 Nm (53 lb-in)	117.6 Nm (87 lb-in)	166.6 Nm (123 lb-in)
M16 ×1.5	81.3 Nm (60 lb-in)	107.8 Nm (80 lb-in)	196.0 Nm (145 lb-in)	107.8 Nm (80 lb-in)	186.2 Nm (138 lb-in)	264.6 Nm (196 lb-in)
M18 ×1.5	117.6 Nm (87 lb-in)	196.0 Nm (145 lb-in)	284.2 Nm (210 lb-in)	156.8 Nm (116 lb-in)	264.6 Nm (196 lb-in)	372.4 Nm (276 lb-in)
M20 ×1.5	166.6Nm (123 lb-in)	274.4 Nm (203 lb-in)	392.0 Nm (290 lb-in)	215.6 Nm (160 lb-in)	362.6 Nm (268 lb-in)	519.4 Nm (384 lb-in)
M22 ×0.5	225.4Nm (167 lb-in)	372.4 Nm (276 lb-in)	529.2 Nm (392 lb-in)	294.0 Nm (218 lb-in)	490.0 Nm (362 lb-in)	705.6 Nm (522 lb-in)
M24 ×1.5	284.2 Nm (210 lb-in)	480.2 Nm (355 lb-in)	686.0 Nm (508 lb-in)	382.2 Nm (283 lb-in)	637.0 Nm (471 lb-in)	921.2 Nm (682 lb-in)
M24 ×2.0	274.4 Nm (203 lb-in)	460.6 Nm (341 lb-in)	666.4 Nm (493 lb-in)	372.4 Nm (276 lb-in)	617.4 Nm (457 lb-in)	891.8 Nm (660 lb-in)

*Diameter X pitch in millimeters



1. Metric bolt strength is embossed on the head of each bolt. The strength of bolt can be classified as 4T, 7T, 8.8T, 10.9T, 11T and 12.9T in general.
2. Observe standard tightening torque during bolt tightening works and can adjust torque to be proper within 15 % if necessary. Try not to over max.
   allowable tightening torque if not required to do so.
3. Determine extra proper tightening torque if tightens with washer or packing.
4. If tightens bolts on the below materials, be sure to determine the proper torque.
   1) Aluminum alloy: Tighten to 80 % of above torque table.
   2) Plastics: Tighten to 20 % of above torque table.

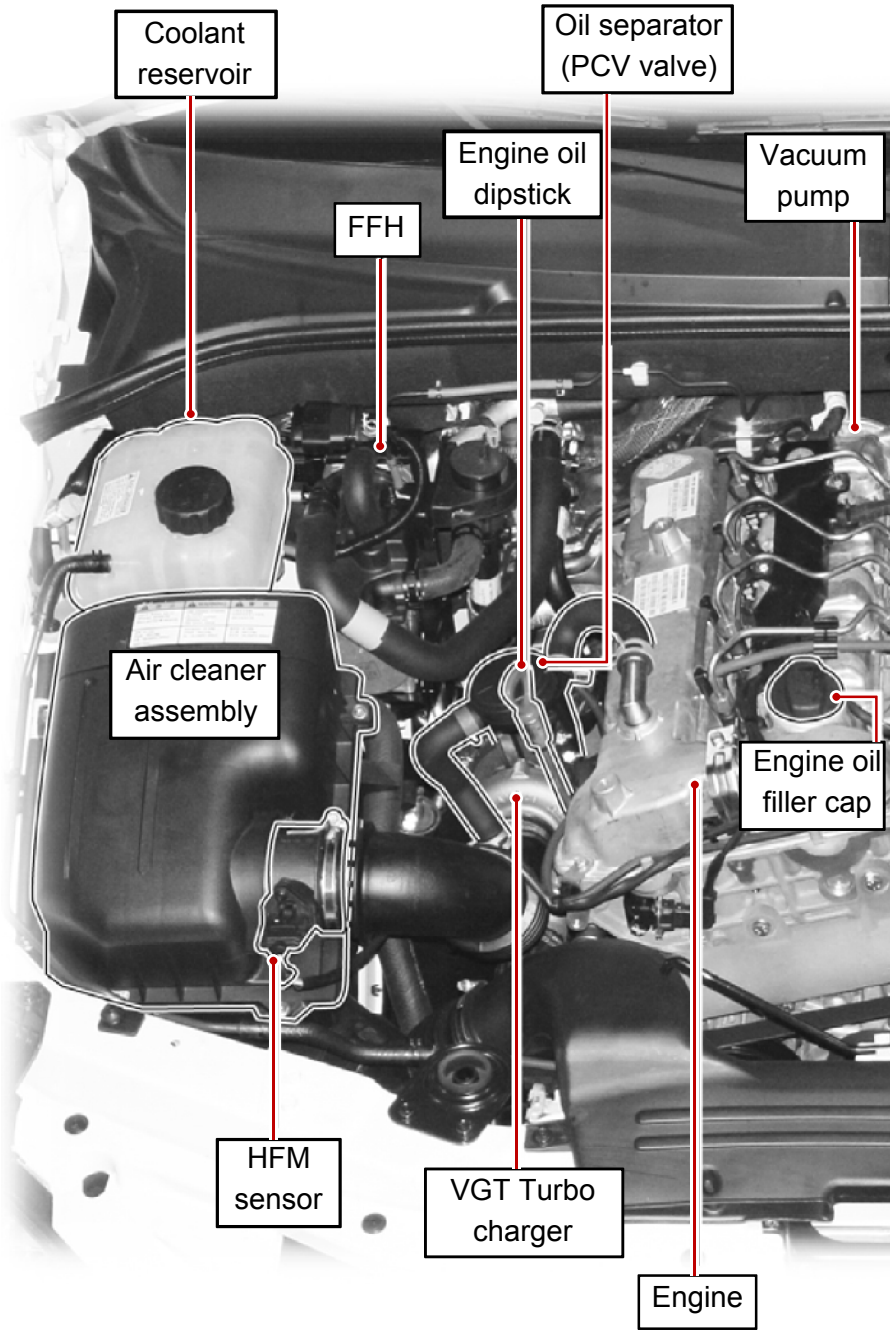
Modification basis	
Application basis	
Affected VIN	

ENGINE ASSEMBLY 1212-01

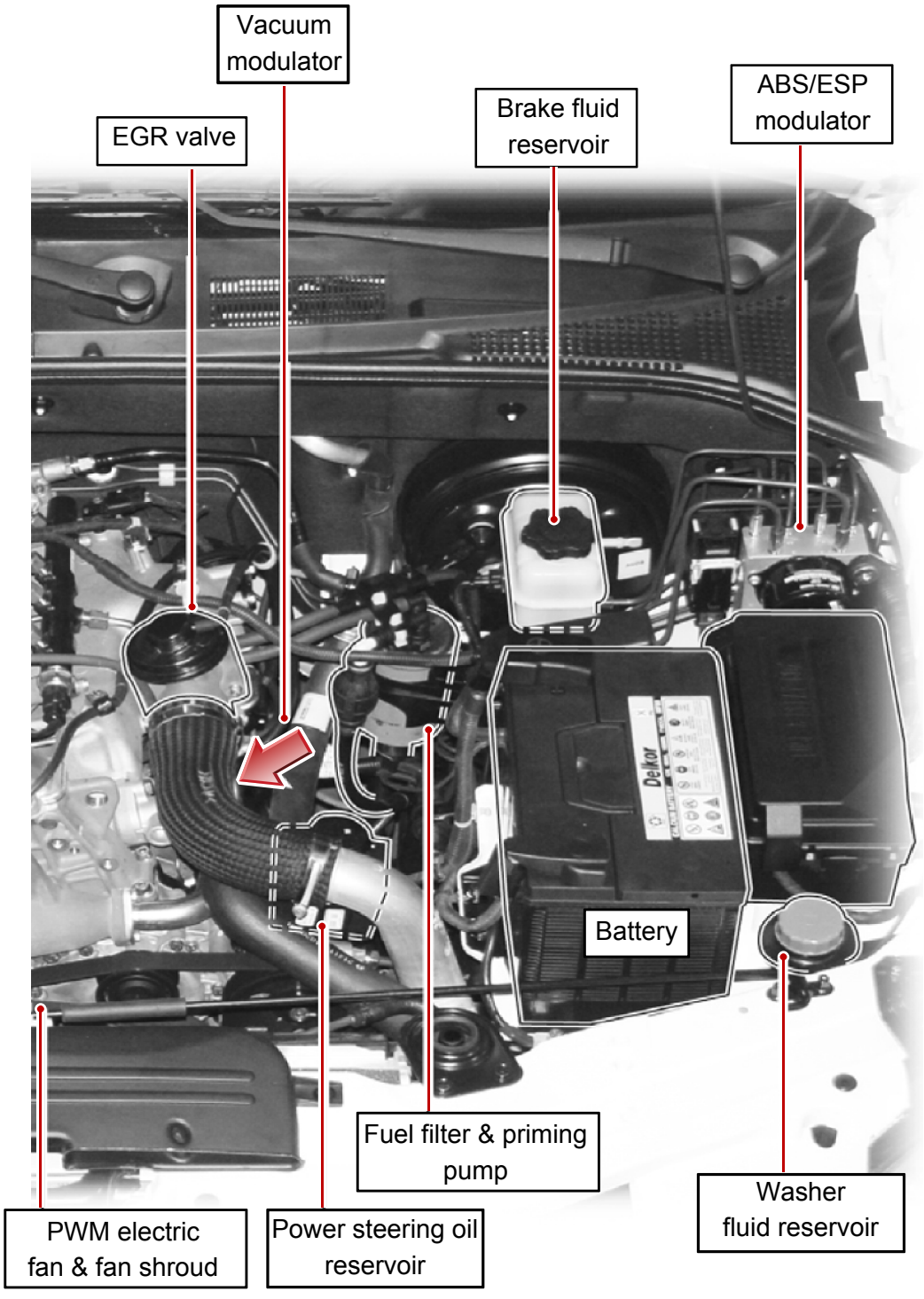
GENERAL

1. MAJOR COMPONENTS IN ENGINE AND ENGINE COMPARTMENT

The advanced electronically controlled D20DT engine that has high pressure fuel system has been introduced to this vehicle. It satisfies the strict emission regulation and provides improved output and maximum torque.



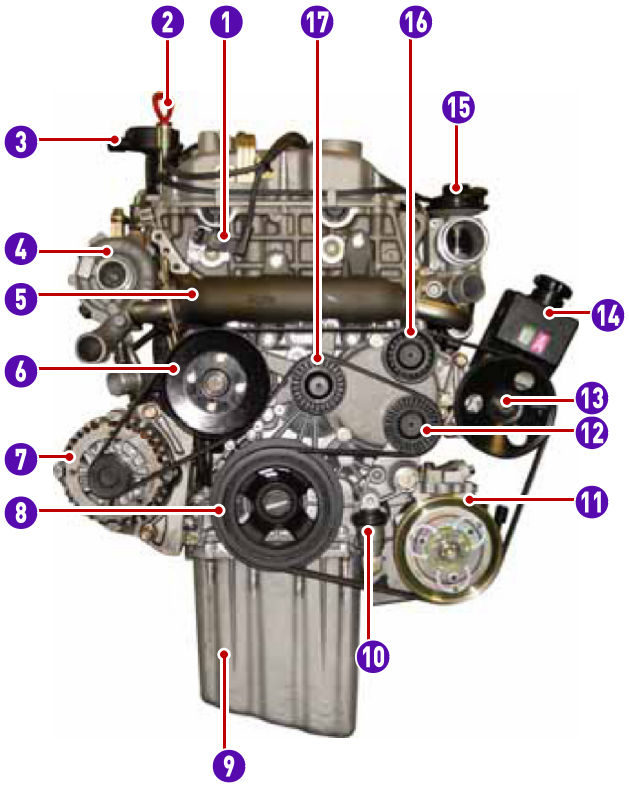
Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

1) Engine Structure

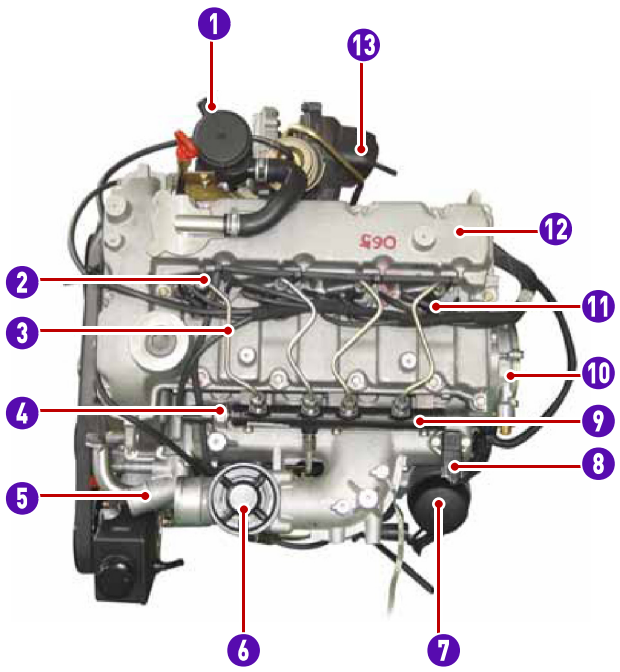
Front View



1	Cam position sensor Tightening torque 12 ± 1.7 Nm
2	Oil dipstick gauge
3	Oil separator (with PCV)
4	VGT Turbo charger
5	EGR pipe
6	Water pump pulley
7	Alternator
8	Crankshaft pulley
9	Oil pan
10	Auto tensioner
11	Air conditioner compressor
12	Auto tensioner pulley
13	Power steering pump pulley
14	Power steering pump
15	EGR valve
16	Idle pulley
17	Viscos clutch pulley

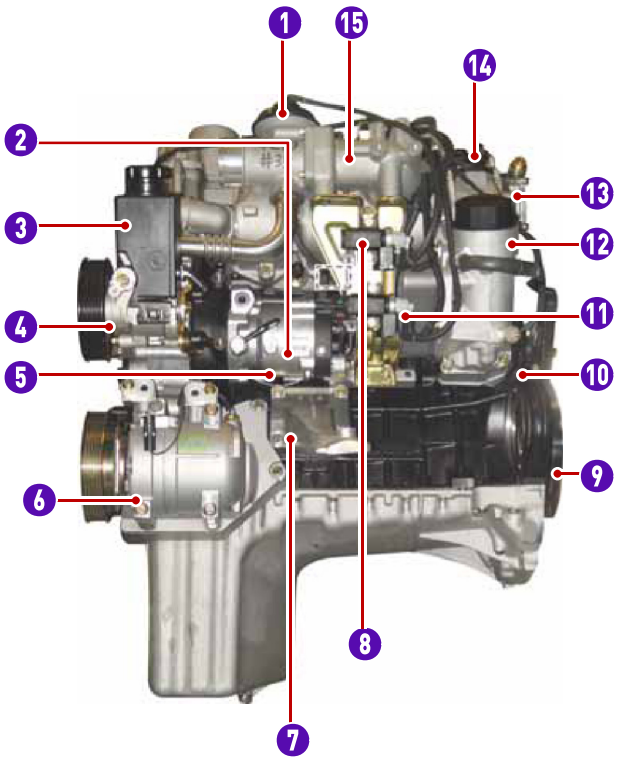
Modification basis	
Application basis	
Affected VIN	

Top View



1	Oil separator
2	Injector cover (10 ± 1.0 Nm → 180 + 20°)
3	Oil pipe (40 ± 4.0 Nm)
4	Fuel pressure sensor
5	Water outlet port
6	EGR valve
7	Oil filler
8	Booster pressure sensor Tightening torque 10 ± 1.0 Nm
9	Common rail (25 ± 2.5 Nm)
10	Vacuum pump (10 ± 1.0 Nm)
11	Glow plug (15 ± 3 Nm)
12	Cylinder head cover
13	VGT Turbo charger

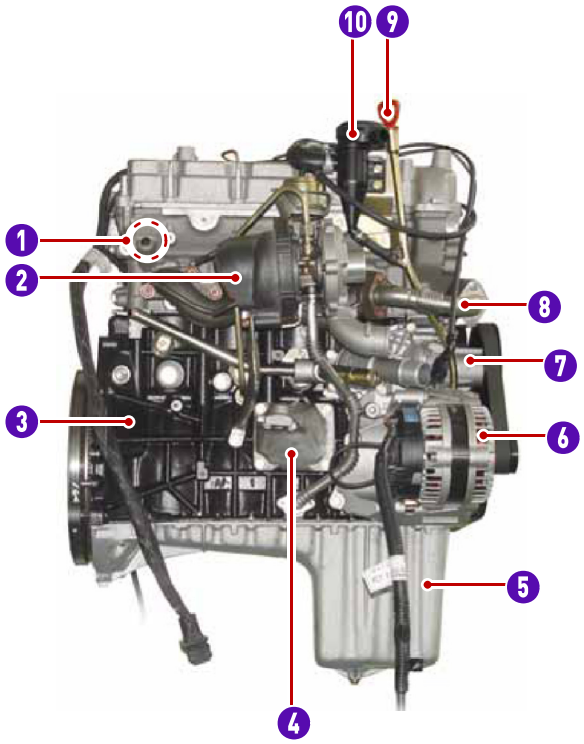
Right Side View



1	EGR valve
2	Knock sensor 20 ± 2.6 Nm
3	Power steering pump oil reservoir
4	Power steering pump
5	HP pump assembly
6	Air conditioner compressor
7	Engine mounting bracket
8	Vacuum modulator for VGT turbocharger actuator
9	Flywheel
10	Crank position sensor Tightening torque 0.8 ± 0.4 Nm Gap: 0.7 ~ 1.5 mm
11	Vacuum modulator for EGR valve
12	Oil filter & oil cooler
13	Vacuum pump
14	Booster pressure sensor
15	Intake manifold

Modification basis	
Application basis	
Affected VIN	

Left Side View



1	Cylinder head jack valve screw
2	VGT Turbo charger assembly
3	Cylinder block assembly
4	Engine mounting bracket
5	Oil pan
6	Alternator
7	Water pump
8	EGR pipe
9	Oil dipstick gauge
10	Oil separator (with PCV)

2. SPECIFICATIONS AND PERFORMANCE CURVE

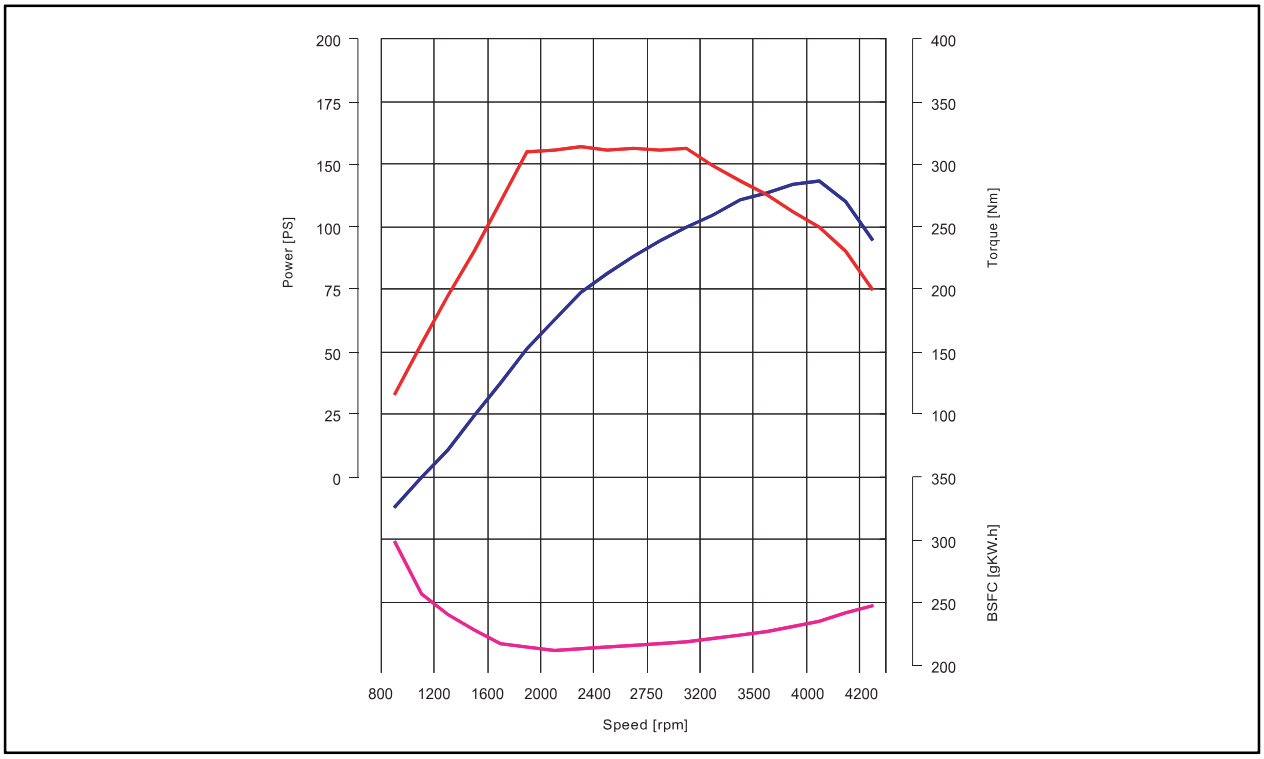
1) Specifications

Description			D20DT
Engine	Type/Number of cylinders		D20DT/4-cylinder
Cylinder	Inner diameter (mm)		86.2
	Stroke (mm)		85.6
Displacement (cc)			1998
Compression ratio			17.5: 1
Maximum output (ps/rpm)			141/4,000
Maximum torque (Nm/rpm)			310/1,800 ~ 2,750
Idle speed	For Manual Transmission		780 ± 50 rpm
	For Automatic Transmission		780 ± 50 rpm
Valve	Intake	Opens (BTDC)	9°
		Closes (ABDC)	26°
	Exhaust	Opens (BBDC)	38°
		Closes (ATDC)	16°
Camshaft	Type		DOHC
Fuel system	Fuel type		Low sulfur diesel
	Fuel pump type		Vane pump in HP pump
	Fuel supply pressure		HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar
	Water separation in fuel filter		at every 10,000 km
	Fuel tank capacity (ℓ)		75
Lubrication system	Oil specification		SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)
	Lubrication type		Forced delivery
	Oil filter type		Full flow, filter element type
	Oil capacity (ℓ)		≒ 7.5
Cooling system	Cooling type		Water cooling type
	Cooling fan operation type		Belt operated type
	Thermostat (Fully Open: 100°C)	Opening temperature (°C)	85
		Type	WAX pellet type
	Coolant capacity (ℓ)		≒ 11.5

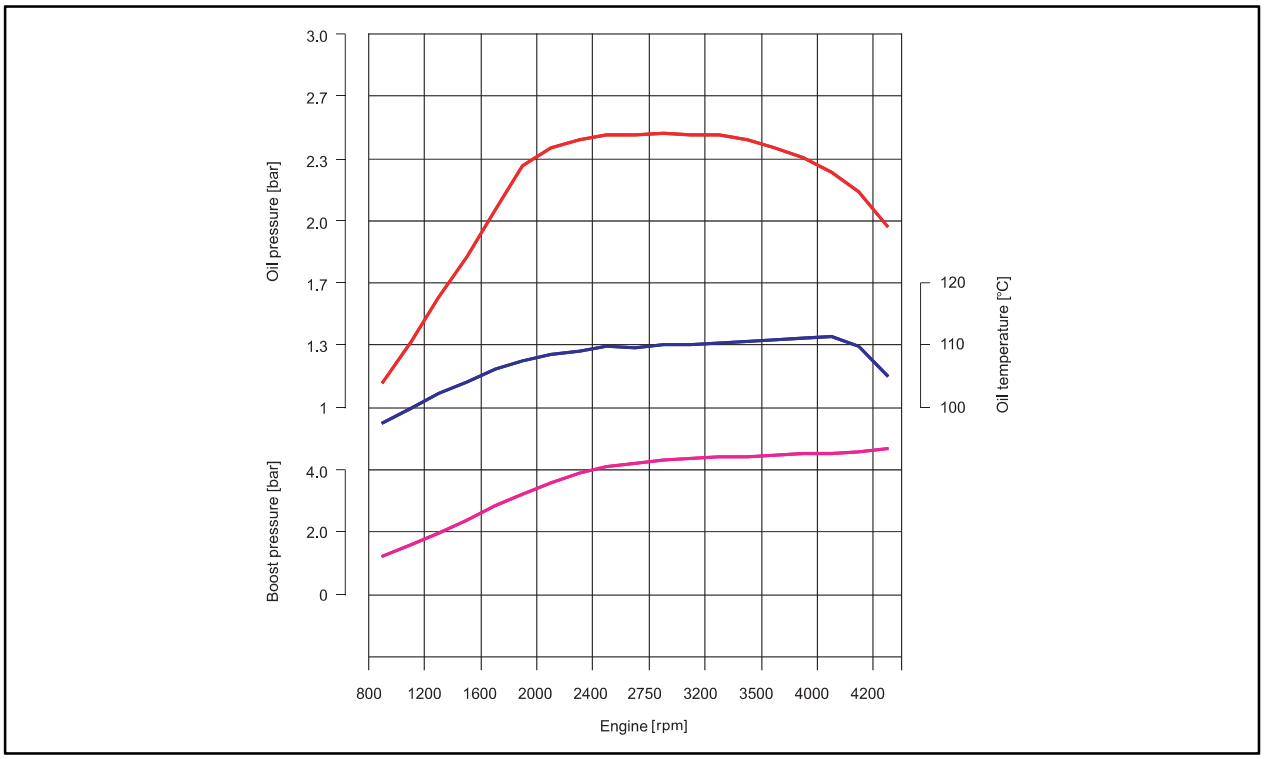
Modification basis	
Application basis	
Affected VIN	

2) Engine Performance Curve

(1) Output and Torque



(2) Oil Temperature/Pressure and Boost Pressure



3. TIGHTENING TORQUE

NO.	Name	Size	Quantity	Tightening Torque (Nm)
1	Main bearing cap	M11 x 67	10	55 ± 5 120° ± 10°
2	Connecting rod cap	M9 x 51	8	40 ± 5 90° ± 10°
3	Rear cover	M6 x 20	6	10 ± 1
4	Oil pump	M8 x 35SOC	3	25 ± 2.5
5	T.G.C. C	M6 x 40	6	10 ± 1
		M6 x 60	3	10 ± 1
		M6 x 70	2	10 ± 1
6	Flywheel	M10 x 22	8	45 ± 5 90° ± 10°
7	Crankshaft hub	M20 x 85	1	200 180° ± 10°
8	Oil pan	M6 x 20	20	10 ± 1
		M6 x 35	3	10 ± 1
		M6 x 85	3	10 ± 1
		M8 x 40	4	25 ± 2.5
9	High pressure pump mounting bolt	M8 x 55	3	25 ± 2.5
10	High pressure pump main nut (intershaft)	M14 x 1.5	1	65 ± 5
11	Cylinder head	M8 x 25	2	25 ± 2.5
		M8 x 50	2	
		M10 x 158	1	85 ± 5
		M10 x 177	9	270° + 10°
12	Camshaft sprocket (Intake)	M11 x 40	1	25 ± 2.5
13	Camshaft sprocket (Exhaust)			90° ± 10°
14	Chain tensioner	M24	1	65 ± 5
15	Auto tensioner	M12 x 90 (UP)	1	82 ± 6
		M8 x 45 (LOWER)	1	32 ± 3
16	Water pump assembly	M6 x 50	7	10 ± 1
17	Water pump pulley	M6 x 10	4	10 ± 1
18	Hot water inlet pipe assembly	M6 x 12	2	10 ± 1
19	Alternator bracket	M8 x 80	1	25 ± 2.5
		M8 x 34	2	25 ± 2.5
		M8 x 30	2	25 ± 2.5
20	Alternator	M10 x 90	1	46 ± 4.6
		M10 x 116	1	46 ± 4.6

NO.	Name	Size	Quantity	Tightening Torque (Nm)
20	Air conditioner compresso r bracket assembly	M8 x 25	1	25 ± 2.5
		M8 x 60	3	25 ± 2.5
22	Air conditioner compresso r sub bracket assembly	M6 x 16	1	10 ± 1.0
		M8 x 20	1	25 ± 2.5
23	Intake manifold	M8 x 50	5	25 ± 2.5
		M8 x 133	5	25 ± 2.5
24	Acoustic cover bracke t	M6 x 16	2	25 ± 2.5
		M8 x 105	1	25 ± 2.5
25	Knock sensor	M8 x 28	1	20 ± 2.6
26	Camshaft position sensor	M8 x 14	1	12 ± 1.7
27	Booster pressure sensor	M6 x 20	2	10 ± 1.0
28	Exhaust manifold stud bolt	M8 x 46	8	15 ± 1.5
		M8 x 35	2	15 ± 1.5
29	Exhauster manifold nut	M8	8	40 ± 4.0
30	Turbo charger assembly	M8	3	25 ± 2.5
31	Turbocharger hollow bolt	M10 x 1.0	1	18 ± 1.8
32	Turbocharger oil feed pipe	M16 (Cylinder block side)	1	25 ± 2.5
33	Turbocharger support bar (nut)	M8	1	23 ± 2.3
34	Turbocharger support bar (bolt)	M8 x 20	1	25 ± 2.5
35	Turbocharger return pipe	M6 x 16 (T/C side)	2	10 ± 1.0
		M6 x 16 (Cylinder block side)	2	10 ± 1.0
36	EGR valve assembly	M6 x 25	4	10 ± 1.0
37	EGR-LH pipe nut	M8	2	35 ± 3.5
38	EGR-RH pipe nut	M6 x 16	2	10 ± 1.0
39	EGR center bolt	M6 x 16	4	10 ± 1.0
40	EGR center pipe	M8 x 25	2	25 ± 2.5
		M8 x 30	2	25 ± 2.5
41	Glow plug	M5	5	15 ± 3.0
42	Va cuum pump	M6 x 20	3	10 ± 1.0
		M6 x 25	5	10 ± 1.0
43	Cooling fan bracket assembly	M6 x 55	1	10 ± 1.0
		M6 x 85	3	10 ± 1.0
44	Cylinder head cover	M6 x 35	18	10 ± 1.0
45	Va cuum modulator	M6 x 16	4	10 ± 1.0
46	Oil dipstick tube	M6 x 16	1	10 ± 1.0
47	Oil filter assembly	M8 x 35	1	25 ± 2.5
		M8 x 55	2	25 ± 2.5
		M8 x 125	1	25 ± 2.5

NO.	Name	S ize	Quantity	Ti ghtening To rque (Nm)
48	Fuel rail assembly	M8 x 35	2	25 ± 2.5
49	Injector	M6 x 60	4	10 ± 1.0 180° + 20°
50	Fuel pipe clip (H-C)	M14	2	40 ± 4.0
51	Fuel pipe clip (C-I)	M14	8	40 ± 4.0
52	Crankshaft position sensor	M6 x 14	1	0.8 ± 0.4
		GA P	-	0.7 ± 1.5 mm
53	Power steering pump	M8 x 100	2	25 ± 2.5
54	Head screw plug	-	1	25 ± 2.5
55	Cam shaft cap bolt	M8 x 60	20	25 ± 2.5
56	Piston topping	-	-	0.765 ~ 1.055 mm
57	Connecting rod end play	-	-	0.500 ~ 1.500 mm
58	Cam shaft end play	-	-	0.100 ~ 0.350 mm
59	Crank shaft end play	-	-	0.100 ~ 0.254 mm

Modification basis	
Application basis	
Affected VIN	

ENGINE FUEL SYSTEM

1881-01

GENERAL

1. CAUTIONS FOR DI ENGINE

This chapter describes the cautions for DI engine equipped vehicle. This includes the water separation from engine, warning lights, symptoms when engine malfunctioning, causes and actions.

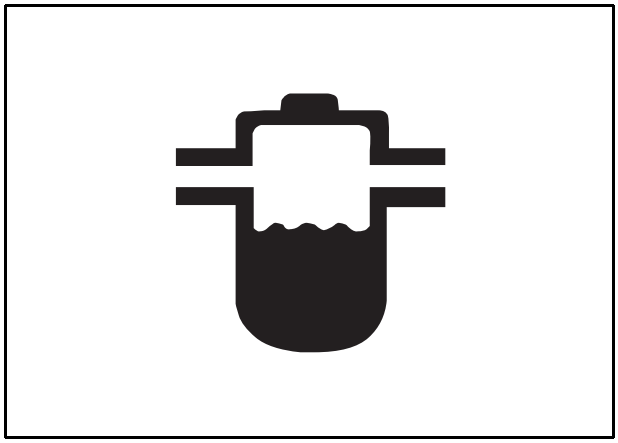
1) DI Engine

Comparatively conventional diesel engines, DI engine controls the fuel injection and timing electrically, delivers high power and reduces less emission.

2) System Safety Mode

When a severe failure has been occurred in a vehicle, the system safety mode is activated to protect the system. It reduces the driving force, restricts the engine speed (rpm) and stops engine operation. Refer to "Diagnosis" section in this manual.

3) Water Separator Warning Light



When the water level inside water separator in fuel filter exceeds a certain level (approx. 39 cc), this warning light comes on and buzzer sounds.
Also, the driving force of the vehicle decreases (torque reduction). If these conditions occur, immediately drain the water from fuel filter.
For the draining procedures, please refer to "How to drain the water from fuel filter" section.

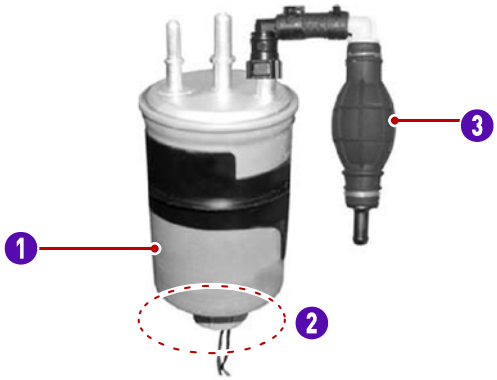
4) Priming Pump

The priming pump installed in fuel pump is the device to fill the fuel into the fuel filter. When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

5) Conditions for Using Priming Pump

- After run out of fuel
- After draining the water from fuel separator
- After replacing the fuel filter

Fuel Filter and Water Separator





1. Fuel filter
2. Water drain plug(water separating operation:every 10,000km)
3. Priming pump

CAUTION

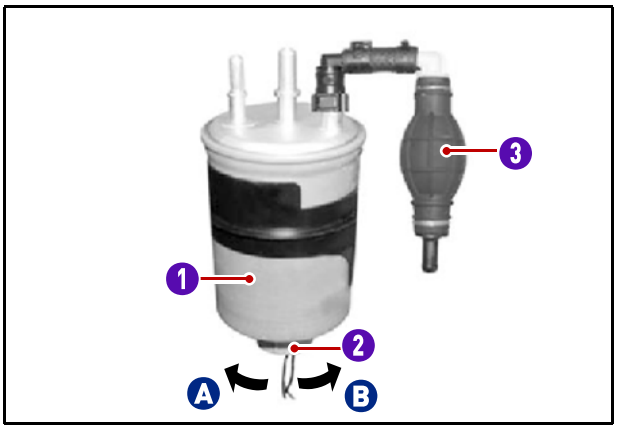
- When replaced the fuel filter or drained the water from fuel filter, press the priming pump until it becomes rigid before starting the engine.
- The water drain from fuel filter should be performed whenever changing the engine oil.

Modification basis	
Application basis	
Affected VIN	

6) Draining the Water From Fuel Filter



1. Place the water container under the fuel filter.



2. Turn the drain plug (2) to "A" direction to drain the water.
3. Wait until a certain amount of fuel gets out from the port, then turn the drain plug to "B" direction to tighten it.

CAUTION
- Be careful not to be injured by surrounding equipment during the working procedures.

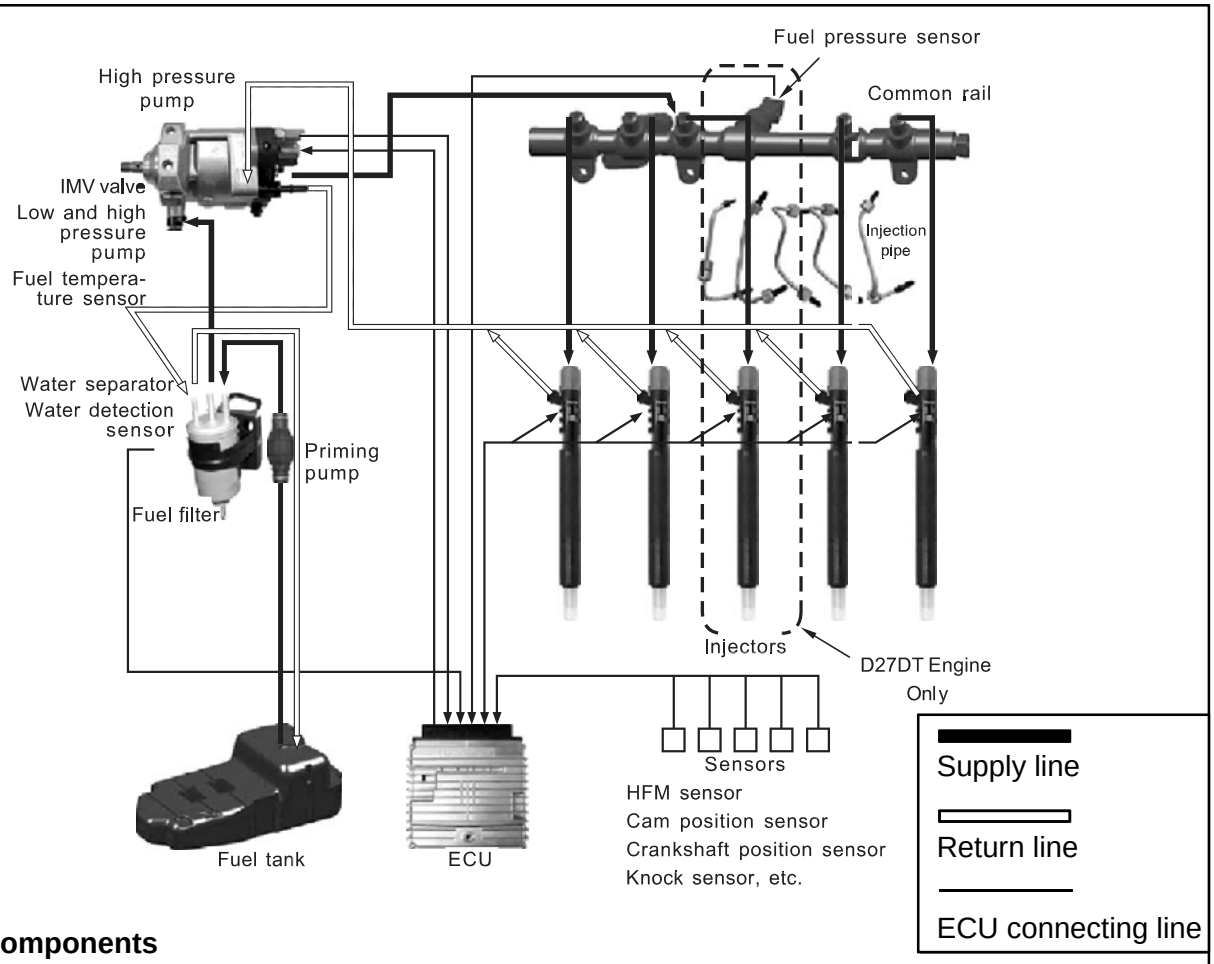


4. Press the priming pump until it becomes rigid.
5. Start the engine and check the conditions.

CAUTION
- If the priming pump is not properly operated, air may get into the fuel line. It may cause starting problem or fuel system problem. Make sure to perform the job in step 4.

OVERVIEW AND OPERATION PROCESS

1. ELECTRONIC CONTROL OF FUEL SYSTEM



Components

- High pressure fuel pump
- Fuel rail
- Fuel pressure sensor
- Fuel injectors
- Electronic control unit(ECU)
- Various sensors and actuators

According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

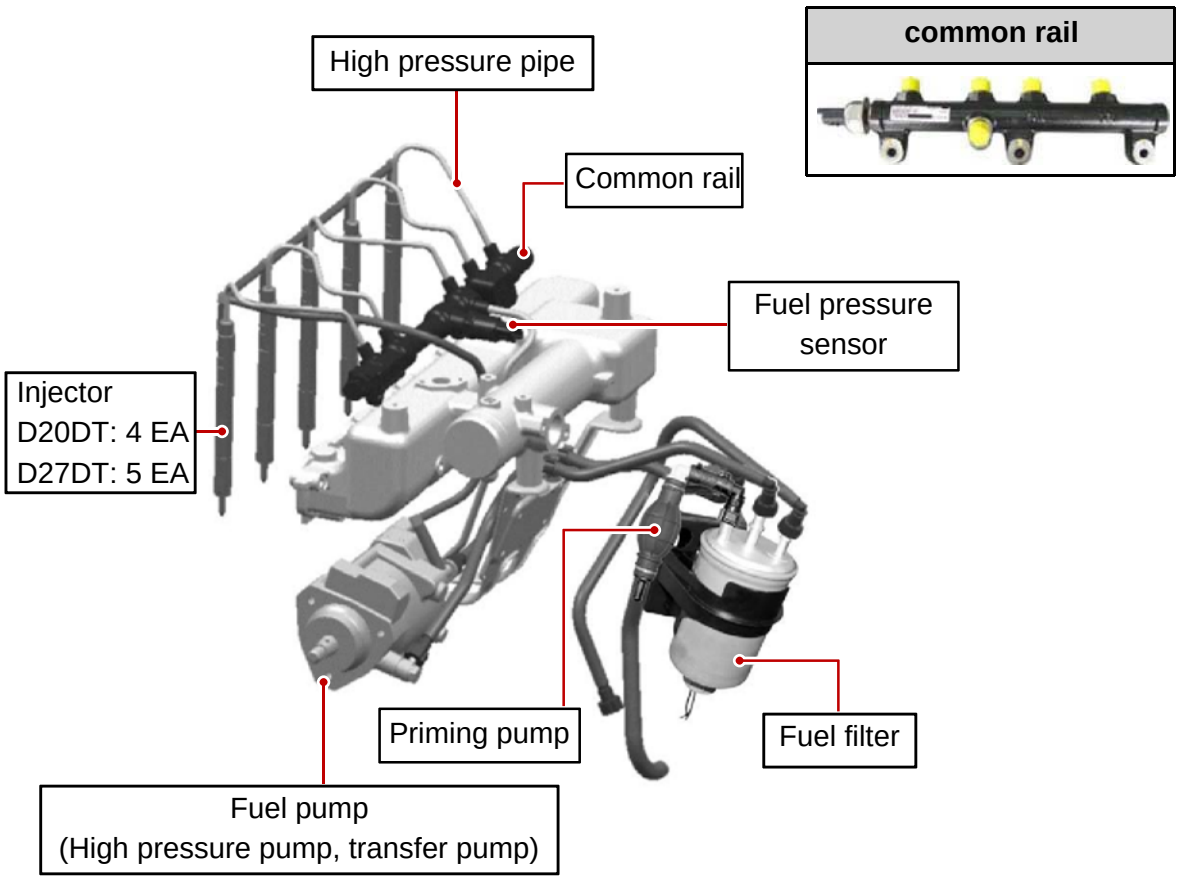
ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and atmospheric pressure sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

Modification basis	
Application basis	
Affected VIN	

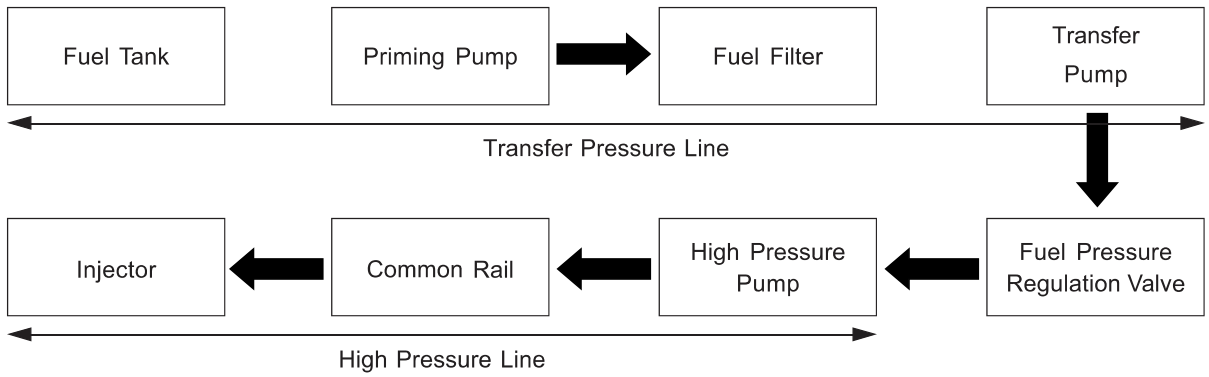
2. COMPOSITION OF FUEL SYSTEM

Components in fuel system are designed to generate and distribute high pressure, and they are controlled electronically by engine ECU. Accordingly, fuel system is completely different from injection pump type fuel supply system on the conventional Diesel engine. The fuel injection system in common rail engine is composed of transfer pressure section that transfers fuel in low pressure, high pressure section that transfers fuel in high pressure and ECU control section.

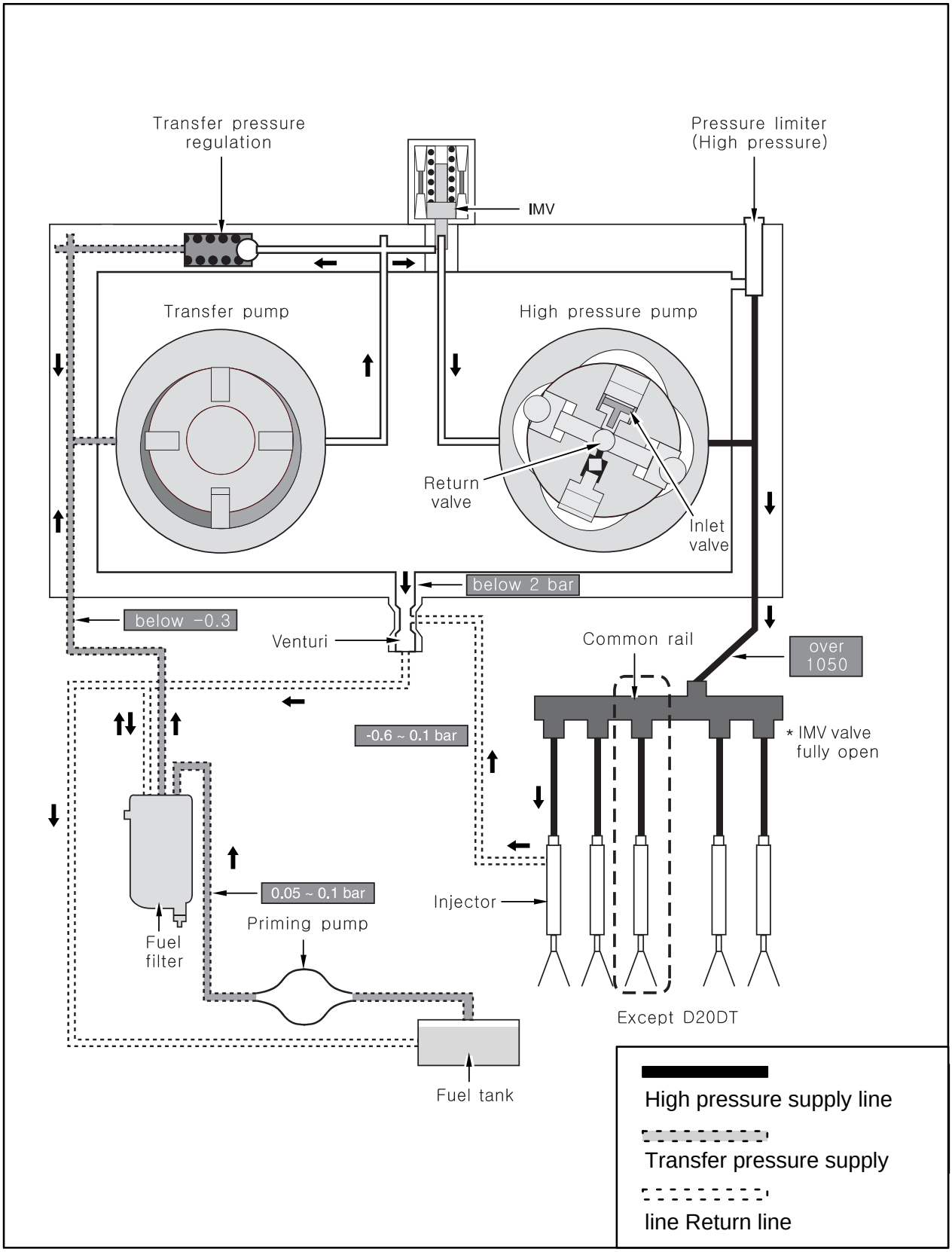
Fuel Line System



Fuel route



3. HYDRAULIC CYCLE IN FUEL LINE (TRANSFER AND HIGH PRESSURE LINE)



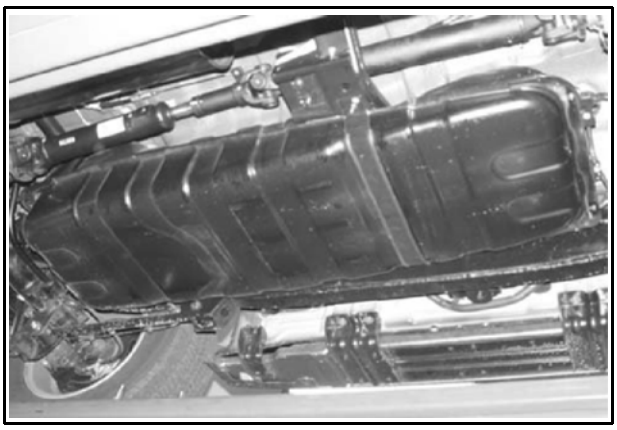
Modification basis	
Application basis	
Affected VIN	

4. COMPONENTS OF LOW PRESSURE TRANSFER LINE

Low pressure stage is to supply sufficient fuel to high pressure section and components are as below.

- Fuel tank (including strainer)
- Hand priming pump
- Fuel filter
- Transfer pump
- Other low pressure fuel hoses

1) Fuel Tank



Fuel tank is made of anti-corrosion material and its allowable pressure is 2 times of operating pressure (more than min. 0.3 bar).
It has protective cap and safety valve to prevent excessive pressure building. Also, to supply fuel smoothly, it has structure to prevent fuel from leaking in shocks, slopes and corners and.

2) Priming Pump



If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to bleed air from transfer line.
When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

- After run out of fuel
- After draining the water from fuel separator
- After replacing the fuel filter

Press the priming pump until it becomes rigid before starting the engine.

3) Fuel Filter



It requires more purified fuel supply than conventional diesel engine. If there are foreign materials in the fuel, fuel system including pump components, delivery valve and injector nozzles may be damaged.
Fuel filter purifies fuel before it reaches to high pressure pump to help proper operations in high pressure pump.
And more, it separates water from fuel to prevent water from getting into FIE system (high pressure line).

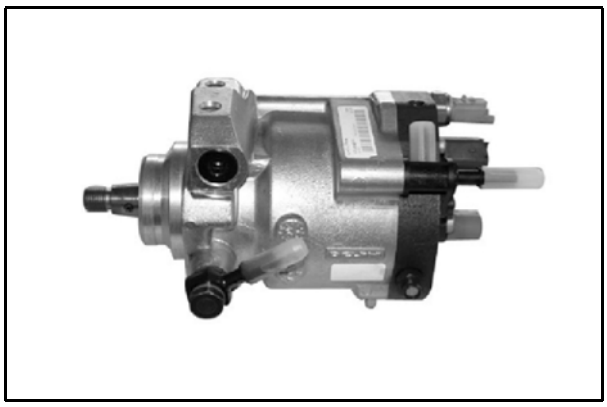
Modification basis	
Application basis	
Affected VIN	

5. COMPONENTS OF HIGH PRESSURE TRANSFER LINE

In the high pressure section, sufficient fuel pressure that injectors requires will be generated and stored. The components are as below:

- High pressure pump
- Rail pressure sensor
- Pressure limit valve
- Common rail
- High pressure pipe
- Injector
- Fuel pressure regulating valve (IMV)

1) High Pressure Pump



This is plunger pump that generates high pressure and driven by crankshaft with timing chain. The high pressure pump increases system pressure of fuel to approx. 1,600 bar and this compressed fuel is transferred to high pressure accumulator (common rail) in tube through high pressure line.

2) Common Rail



It stores fuel transferred from high pressure pump and also stores actual high pressure of fuel. Even though the injectors inject fuel from the rail, the fuel pressure in the rail is maintained to a specific value. It is because the effect of accumulator is increased by unique elasticity of fuel. Fuel pressure is measured by rail pressure sensor.
And the fuel pressure regulating valve (IMV, Inlet Metering Valve) included in high pressure pump housing keeps pressure to a desired level.

3) High Pressure Pipe (Fuel Pipe)



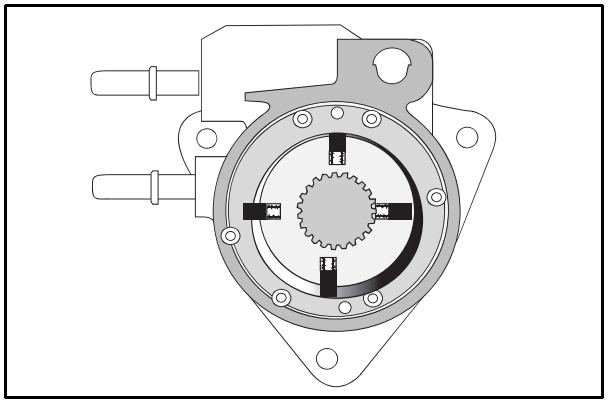
Fuel line transfers high pressure fuel. Accordingly, it is made of steel to endure intermittent high frequency pressure changes that occur under maximum system pressure and injection stops. Injection lines between rail and injectors are all in the same length; it means the lengths between the rail and each injector are the same and the differences in length are compensated by each bending.

4) Injectors



The fuel injection device is composed of electrical solenoid valve, needle and nozzle and controlled by engine ECU. The injector nozzle opens when solenoid valve is activated to directly inject the fuel into combustion chamber in engine. When injector nozzle is open, remaining fuel after injection returns to fuel tank through return line.
Pressure limit valve, fuel returned by low pressure and fuel used for high pressure pump lubrication also return to fuel tank through return line.

5) Transfer Pump



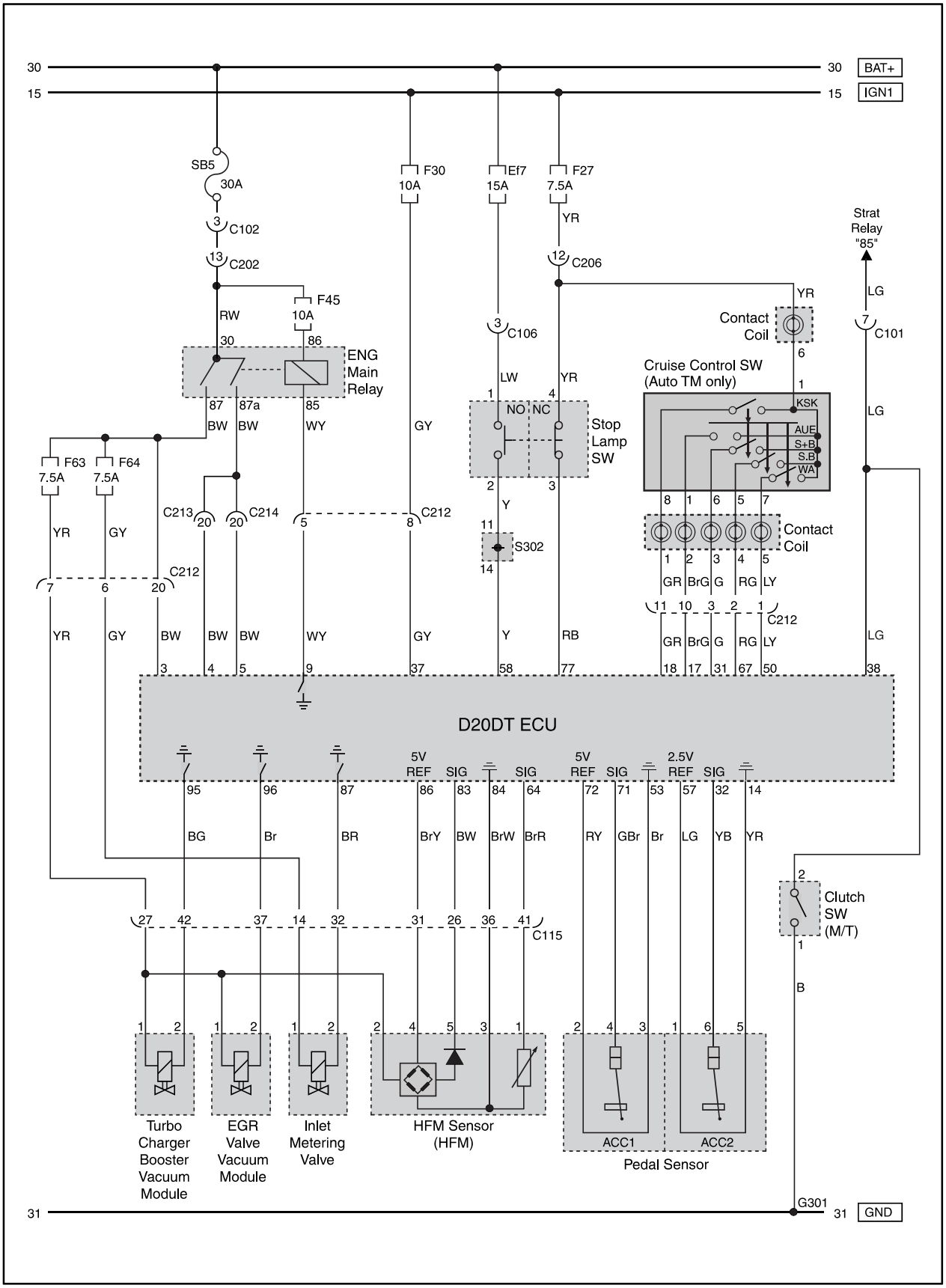
The transfer pump is included in the housing of the high pressure pump. The transfer pump is the volumetric blade type pump. To deliver the continuously required fuel volume, the pump transfers fuel from the fuel tank to high pressure pump.

6) Fuel Filter Replacement

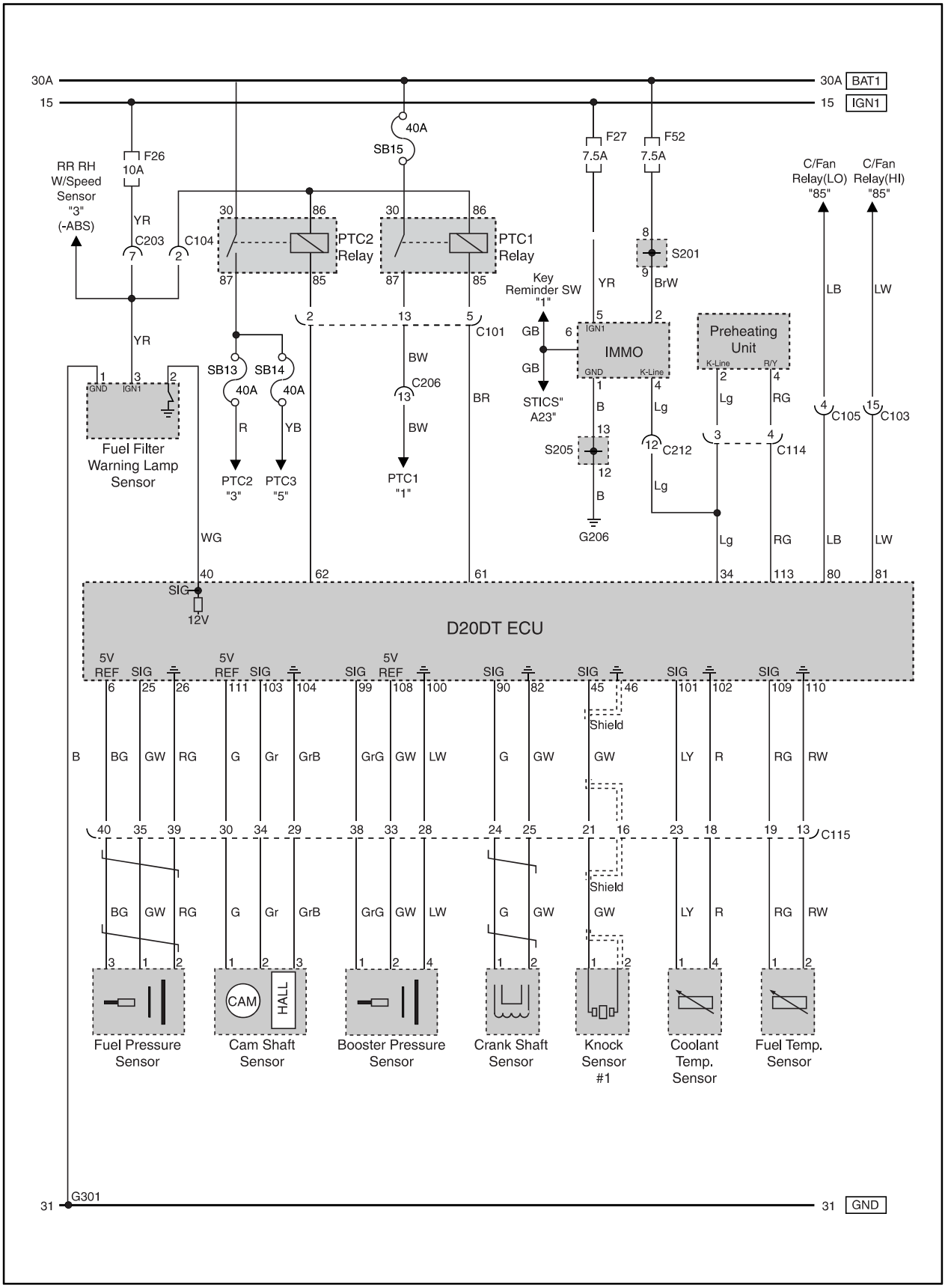
- Fuel filter change interval: every 30,000 km
- Water separation interval: every 10,000 km (same with engine oil change interval)
- Never reuse the removed fuel filter

Modification basis	
Application basis	
Affected VIN	

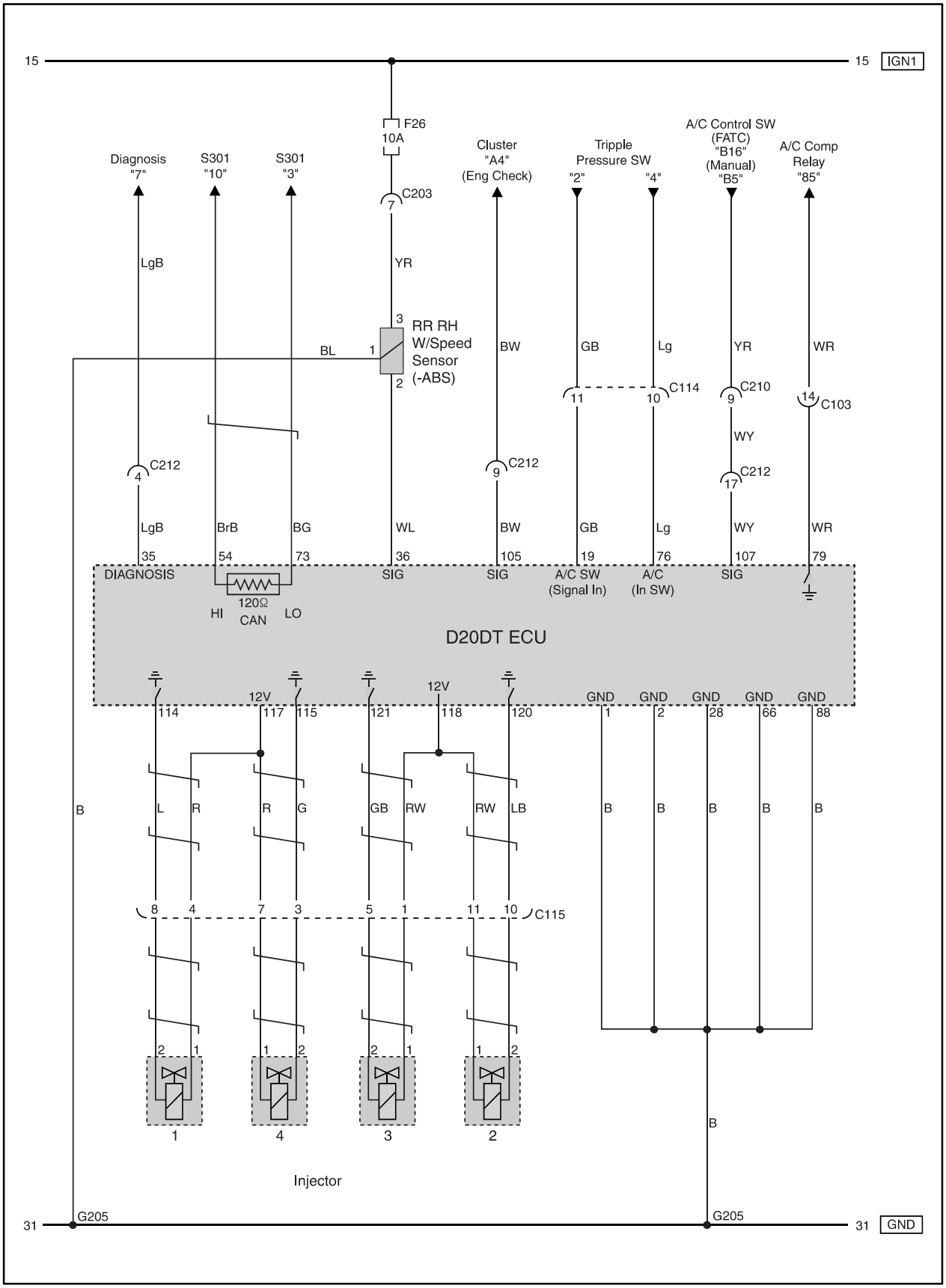
6. CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

Memo

ENGINE INTAKE SYSTEM

2321-01

GENERAL

1. ENGINE INTAKE SPECIFICATIONS

1) Specifications

Element Type	Dry-Element Type
Service Interval	- Initial cleaning: 5,000 km, Clean or change every 10,000 km as required. However, change every 30,000 km. - If the vehicle is operated under severe condition (short distance driving, extensive ldling or driving in dusty condition): More frequent maintenance is required.

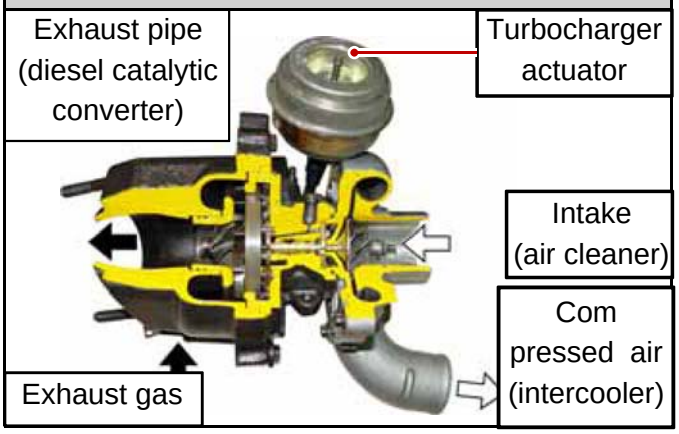
OVERVIEW AND OPERATION PROCESS

1. INTAKE SYSTEM LAYOUT

1) Work Flow of Intake System

Air Cleaner → HFM Sensor → VGT Turbo-charger → Inter-cooler → Intake Manifold → Combus-tion Chamber in Engine

VGT Turbocharger



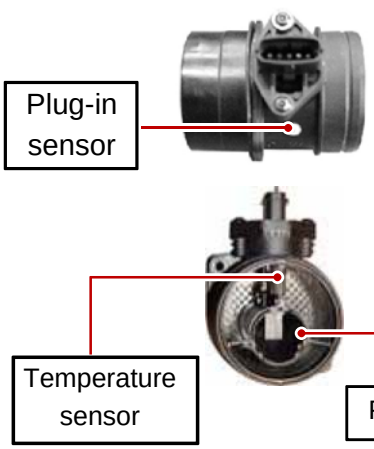
HFM Sensor

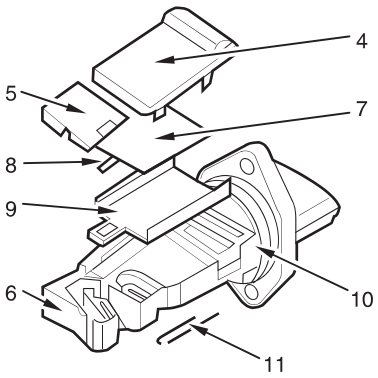
The HFM sensor is installed in the air intake passage between the air cleaner and the intake manifold. It measures the air volume supplied to the combustion chamber and the air temperature.

Major Functions

- It controls the EGR feedback.
- It controls the pressure control valve for the turbocharger booster.



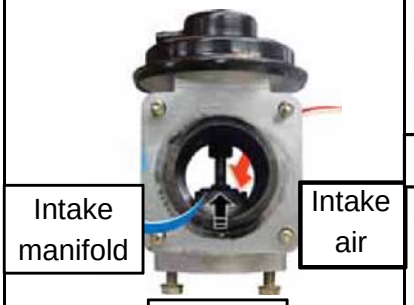


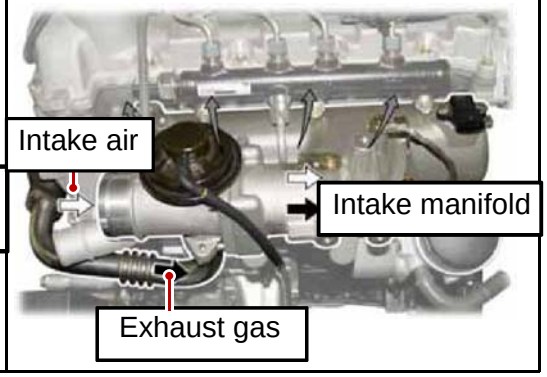


1. Plug-in sensor
2. Cylinder housing
3. Protection grid
4. Hybrid cover
5. Measuring duct cover
6. Housing
7. Hybrid
8. Sensor
9. Mounting plate
10. O-ring
11. Temperature sensor

Modification basis	
Application basis	
Affected VIN	

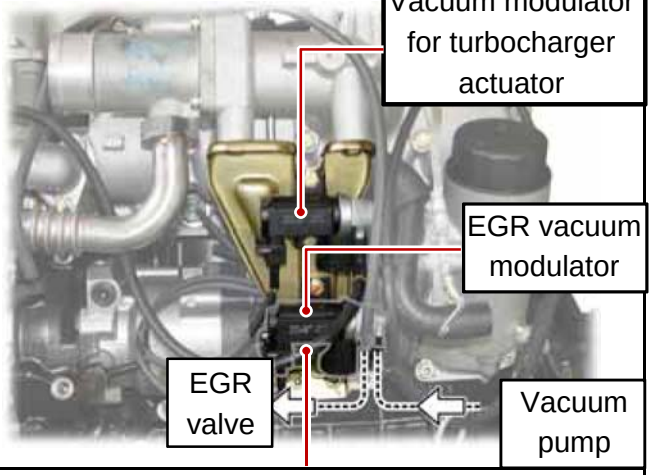
EGR Valve and Its Location
(* For details, refer to "EGR" section.)

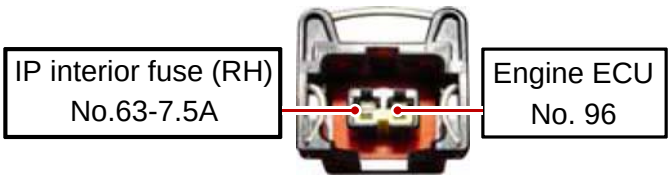






Vacuum Modulator



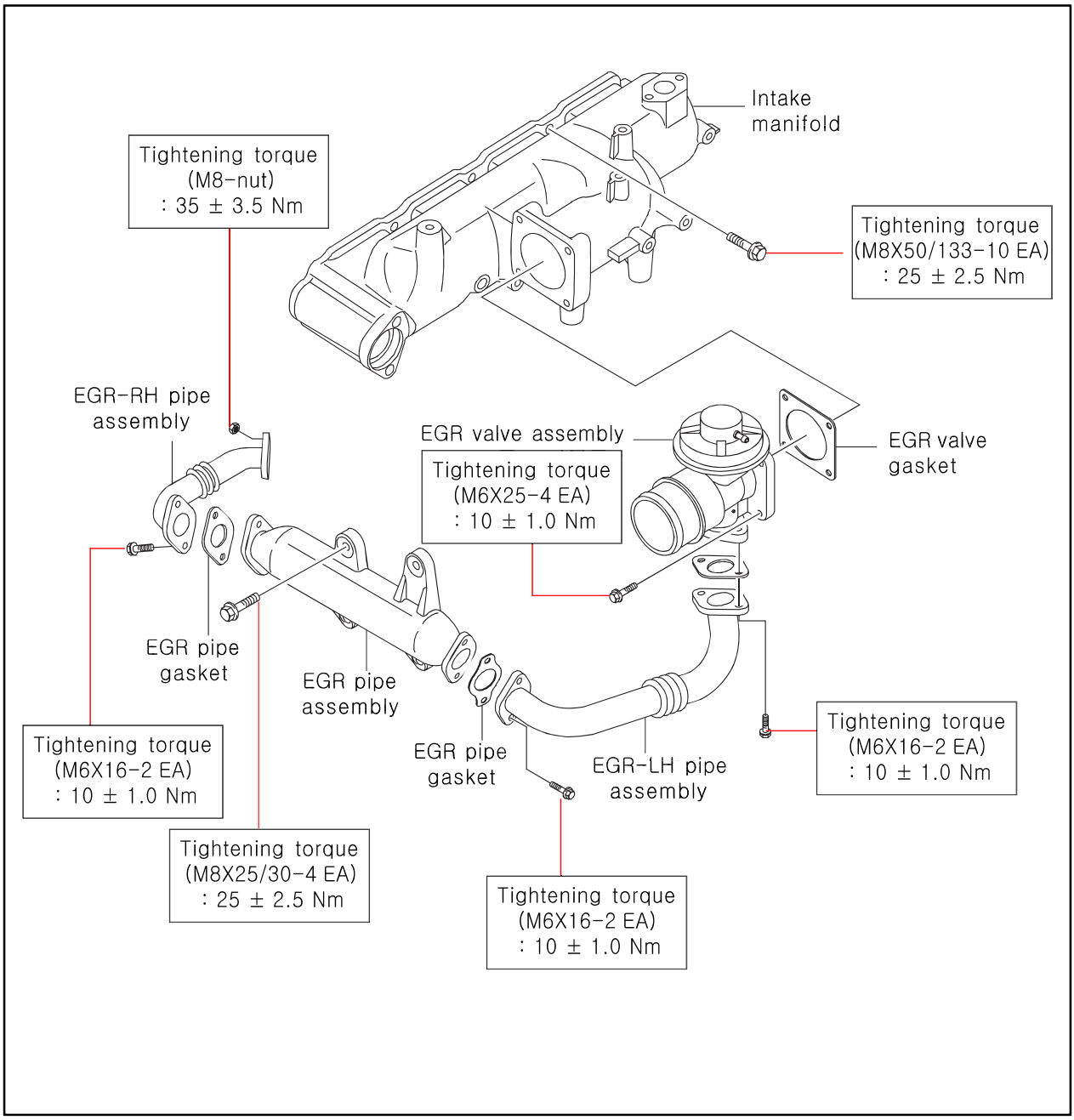


Turbocharger Intercooler

The charging efficiency may be lowered or the knocking may happen as the intake air is heated and the density of air is lowered. The intercooler is the device which cools the supercharged air.



2) Layout



Modification basis	
Application basis	
Affected VIN	

3) Components

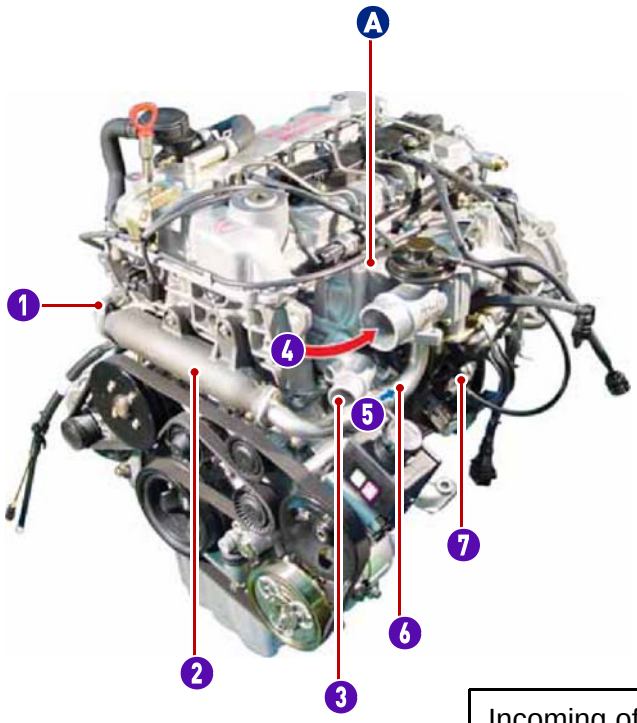
(1) Intake Manifold Assembly

The intake manifold assembly is built for the optimized mixture of the EGR gas in the intake chamber when the compressed air in the turbocharger is sent to the intake port. The intake port is composed of the dual port (tangential and helical port) which increases the swirl ratio in mid/low operating range, improves acceleration/fuel consumption and decreases particle materials. However, there are some differences in the form of the EGR valve and 4-cylinder engine.

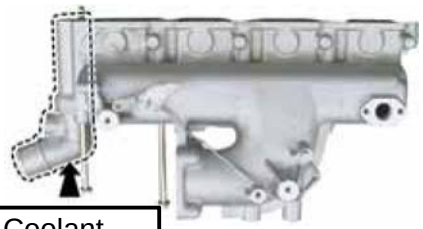
CAUTION

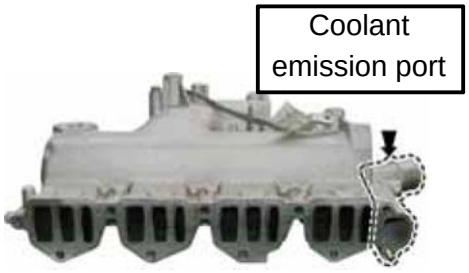
- The inlet port and coolant outlet port is integrated together. Therefore, be careful not to let the residual coolant in the manifold enter the inlet port when removing the intake manifold. Also, replace the gasket with a new one and tighten it to the specified torque (25 ± 2.5 Nm).

The SUS + Rubber coating is applied to the intake manifold gasket to prevent the air leakage and optimize the sealing effect.



A Intake Manifold

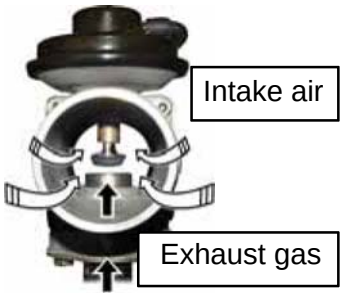




Incoming of intake air (No operation of EGR valve)



Incoming of intake air and exhaust gas (Operation of EGR valve)



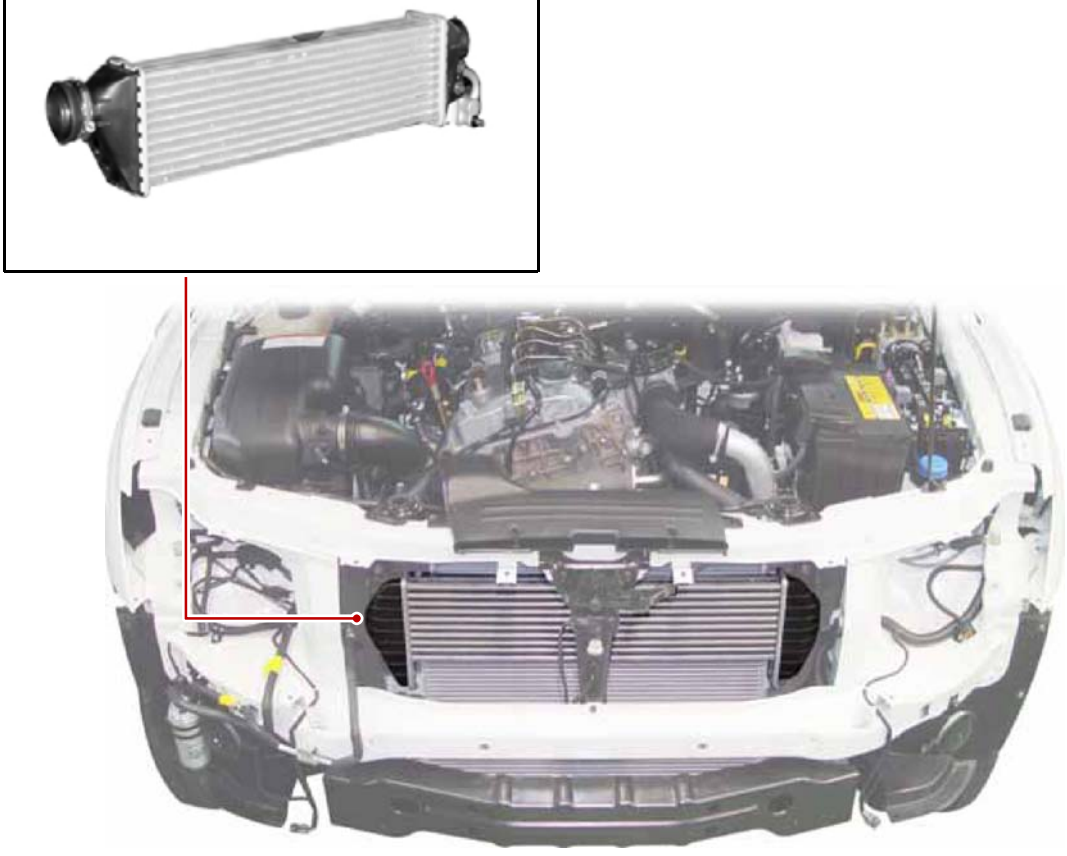
1. EGR pipe (RH)	5. Exhaust gas
2. EGR pipe (center)	6. EGR pipe (LH)
3. Coolant emission port	7. Vacuum modulator to the EGR valve
4. Intake air (intercooler)	

Modification basis	
Application basis	
Affected VIN	

(2) Turbocharger Intercooler Assembly

The turbocharger is designed to improve the engine power by introducing more air (oxygen) into the engine.
However, the intake air is heated during the compression process in the turbocharger compressor and the density is lowered.
The intercooler is the device which cools (50 ~ 60°C) the air entering the engine from high temperature (100 ~ 110°C) to maintain the turbocharging efficiency.
Thus, more air is entered the cylinder than the engine only with the turbocharger to give more power.

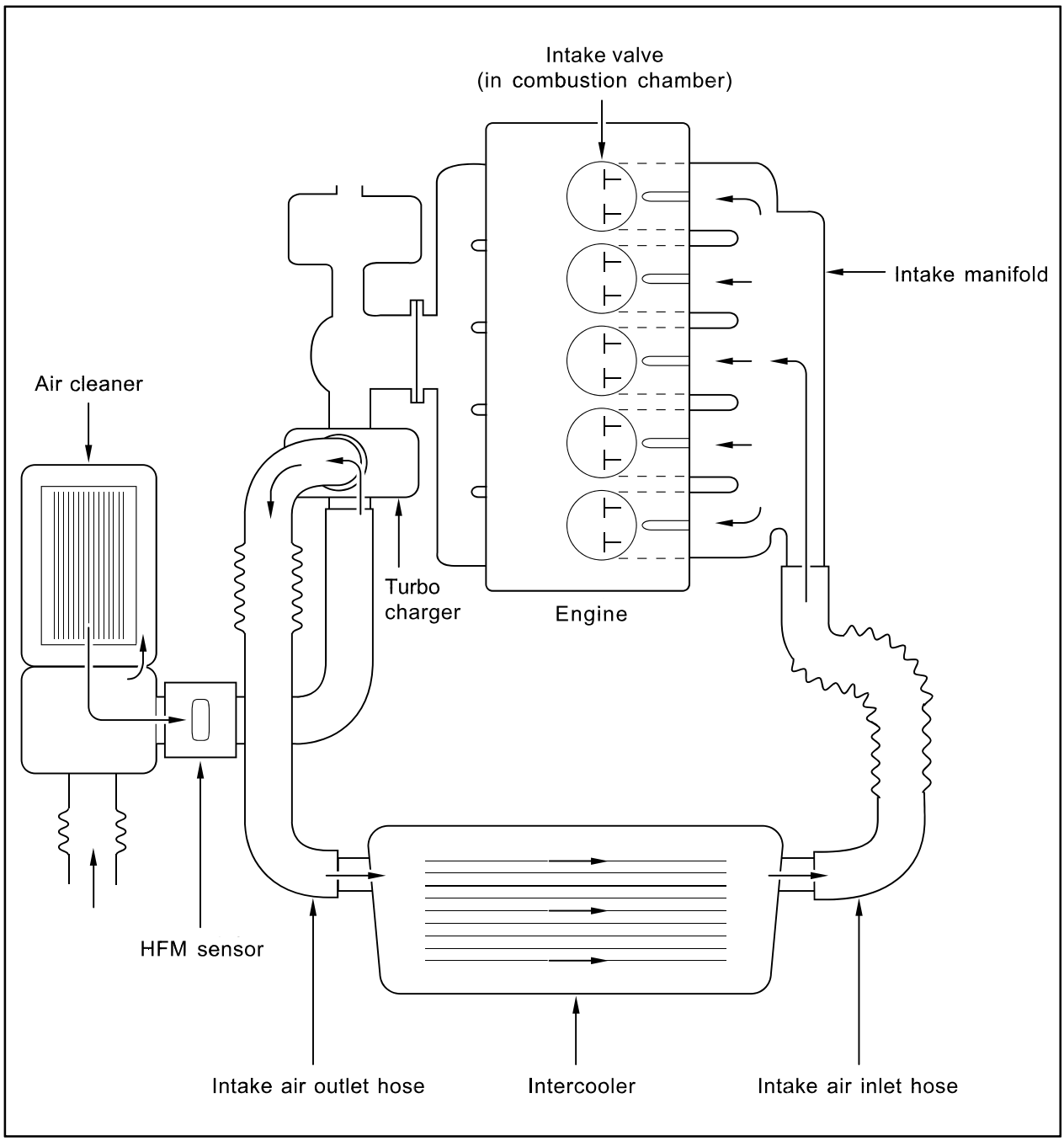
Intercooler



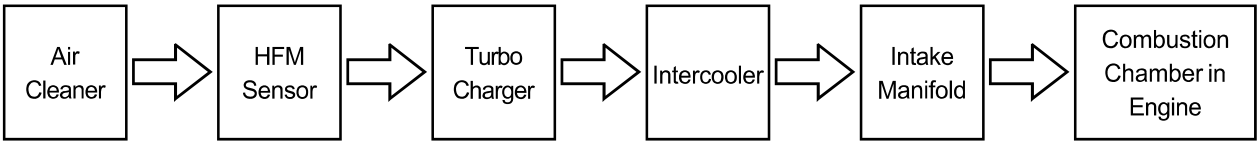
CAUTION

- For removal and installation procedures, refer to the "Cooling system" section in DI engine service manual.

2. AIR FLOWS



1) Work Flow of Intake System



Modification basis	
Application basis	
Affected VIN	

ENGINE EXHAUST SYSTEM

1913-01

GENERAL

1. INSPECTION BEFORE DIAGNOSIS

The base of making diagnosis on the EGR related system is the inspection on the connections of the vacuum hoses in related system as the first priority.When abnormal condition occurs with the EGR system, the basic approach is, as described in prior sentence, making detail inspections of vacuum circuits of each system before connecting the scan tool or vacuum tester. It is necessary to manually check on the connections if there are any slacks or loose circuits even if the visual inspection shows vacuum hose as being connected. If there are not any problems then the next inspection area is the connections of the system connectors. Most problems with the occurrence of system malfunction are from conditions of vacuum line and connector connections and the causes from the malfunction of mechanical mechanism is actually very few.

For example, when there are no problems with basic components, let's assume that there is a vehicle having vacuum leak from connection slack in the vacuum line between EGR vacuum modulator and EGR valve. This vehicle, due to the driving condition or, according to the circumstances, smog or other conditions, could create customer's complaint and by connecting the scanning device could display as the malfunction of the EGR valve's potentiometer.

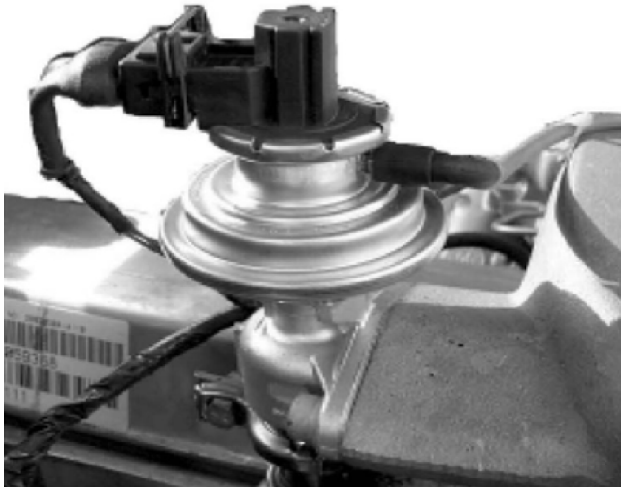
As previously explained, this car has a separate controller to control the HUBER EGR and, in accordance with various input element, the controller controls EGR valve by regulating the force of vacuum being applied to the EGR valve through PWM control. At this time, the controller has to receive feedback whether the EGR valve operates correctly according to the value sent to the EGR modulator and this role is performed by the EGR potentiometer located at top section of the EGR valve.

In other word, the controller sent correct output value to the EGR vacuum modulator but, due to the leakage of vacuum, signal of required value can not be received from the EGR potentiometer causing to display as malfunction of related parts.

As a reference, the EGR valve of diesel vehicle (DI Engine) controlling from the engine ECU to EGR system has different shape than the HUBER EGR valve because the EGR valve's operation signal in the DI engine is performed by the HFM sensor instead of the EGR potentiometer.

This principle is that when the EGR valve opens up to flow exhaust gas into the intake unit the amount of fresh air, comparatively, will be reduced. The DI engine ECU receives feedback signal of change in amount of air being passed through the HFM sensor according to the opening amount of the EGR valve.

▶ HUBER EGR System for IDI Engine (Including the EGR Valve Potentiometer)



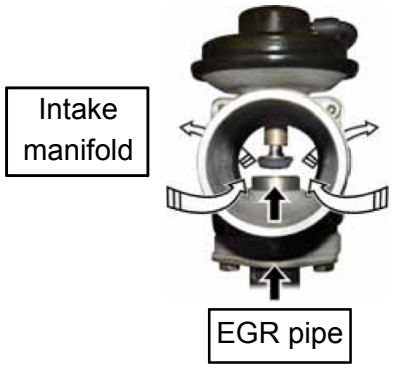
The other big difference between the HUBER EGR and EGR controller for DI engine is that from two vacuum modulator, one is same as being the modulator for EGR valve whereas the HUBER EGR system's the other modulator controls ALDA of injection pump and the DI engine's the other modulator controls waist gate of the turbo charger.
This difference is in accordance with the difference in fuel injection method where the IDI engine has mechanical injection system and DI engine is capable of making electronically controlled fuel injection.
In other word, to reduce the amount of the fuel injection in no-load rapid acceleration mode, the IDI engine's HUBER EGR utilizes solenoid valve to disconnect the connection circuit between intake manifold and ALDA causing negative pressure to occur in the vacuum modulator to reduce the amount of fuel injection. When DI engine, basing input signal from the related sensors such as acceleration pedal sensor and engine RPM, recognizes that current mode is the no-load rapid acceleration mode it reduces the amount of fuel injection by sending short electrical signal to the injector. Therefore, disregarding the modulator for the EGR valve in DI engine, one must keep in mind that the other modulator is used to control the booster pressure valve in turbo charger.

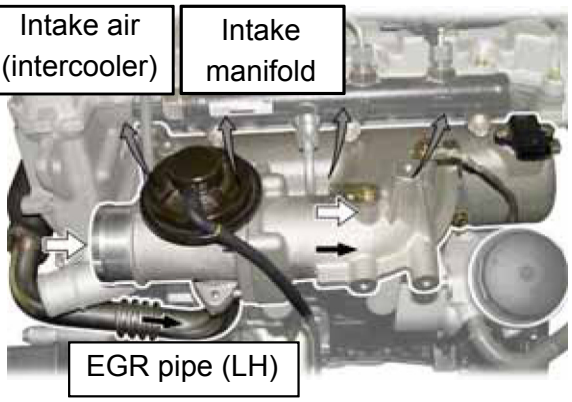
Modification basis	
Application basis	
Affected VIN	

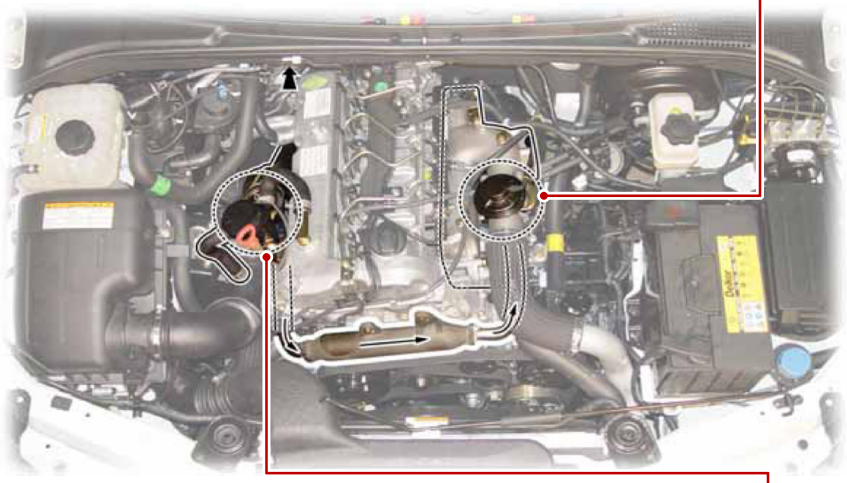
OVERVIEW AND OPERATION PROCESS

1. EXHAUST SYSTEM LAYOUT

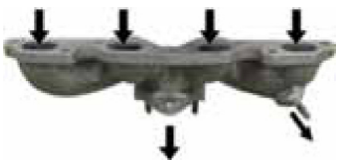
EGR Valve and Installation Location

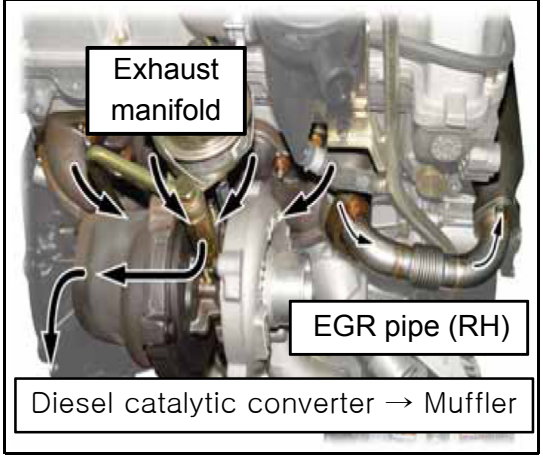




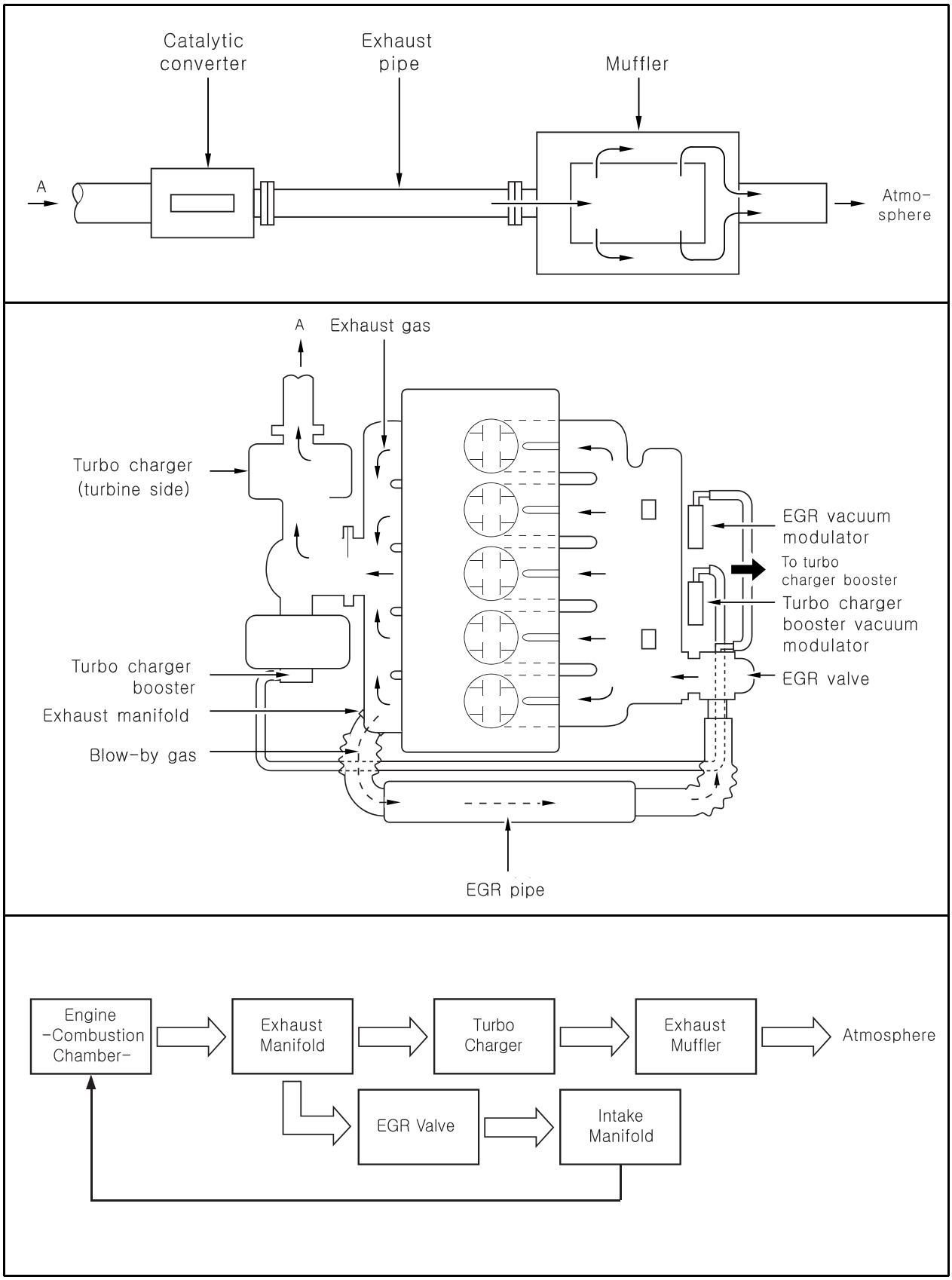


Exhaust Manifold





2) Exhaust Gas Flows



Modification basis	
Application basis	
Affected VIN	

LUBRICATION SYSTEM

1533-01

GENERAL

1. SPECIFICATIONS

Engine oil	Specification	Approved by MB Sheet 229.1 or 229.3 Viscosity: See MB Sheet 224.1
	Capacity	6.8 ~ 8.3 liter
	Service interval	Initial change: 5,000 km, Change every 10,000 km or 12 months (Frequently check the oil level and add if needed. And, every 5,000 km or 6 months under severe conditions)
Engine oil filter		Same interval with engine oil
Oil relief valve opening pressure		5.8 ± 0.3 bar

▶ **Severe Condition:**

- When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.
- When most trips are less than 6 km (Operating when outside temperatures remain below freezing and whenmost trips are less than 16 km)
- When operating in dusty, sandy and salty areas
- In hilly or moutainous terrain
- When doing frequent trailer towing

2. OIL PRESSURE SWITCH

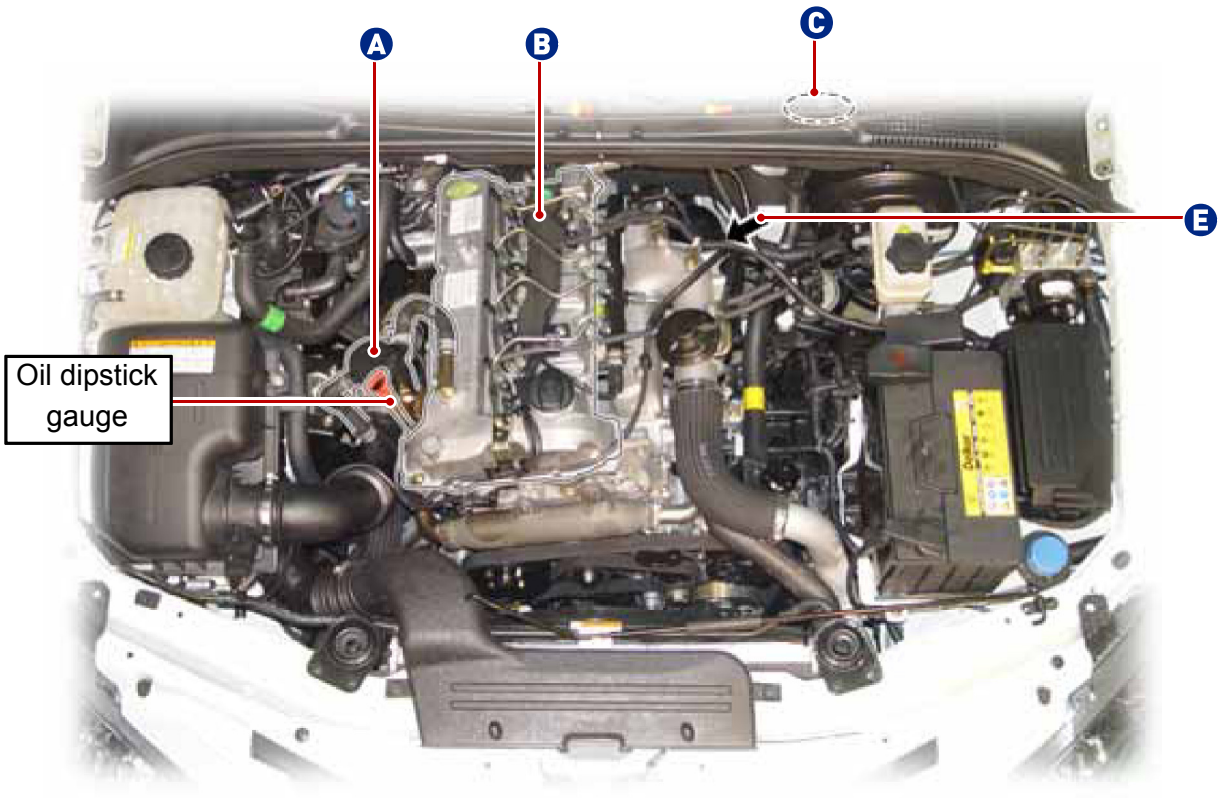


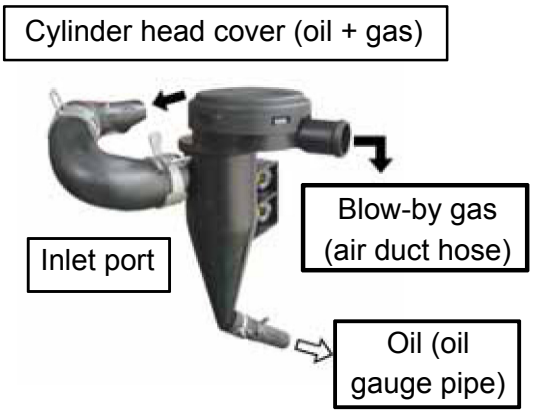
- Operating temperature: −40 ~ 140°C
- Operating pressure: 0.3 ~ 0.55 bar
- Permissible pressure: 10 bar

OVERVIEW AND PERATION PROCESS

1. LAYOUT AND OVERVIEW

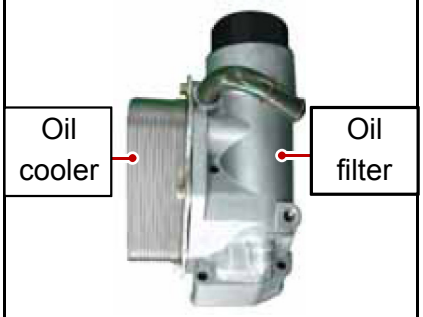
1) Lubrication System



A	PCV Oil Separator
The first separation will happen when blowby gas passes through baffle plates in cylinder head cover. Then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port. Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering the combustion chamber through air duct hose via PCV valve that opens/closes due to pressure differences between the intake side and crankcase.	

Modification basis	
Application basis	
Affected VIN	

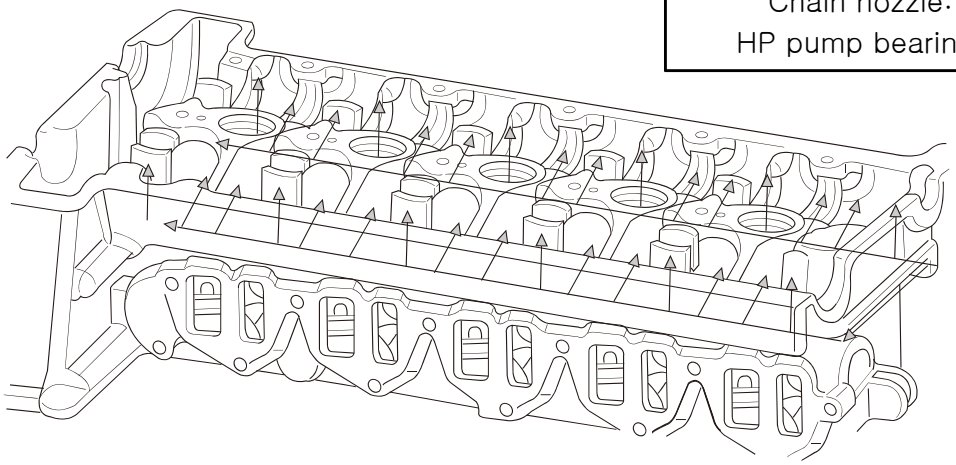
Cylinder Head Cover (B)	Oil pressure Warning Lamp (Cluster) (C)
	

Oil Pan and Baffle Plate (Integrated Type)	Oil Strainer	Oil Filter & Oil Cooler (E)
		

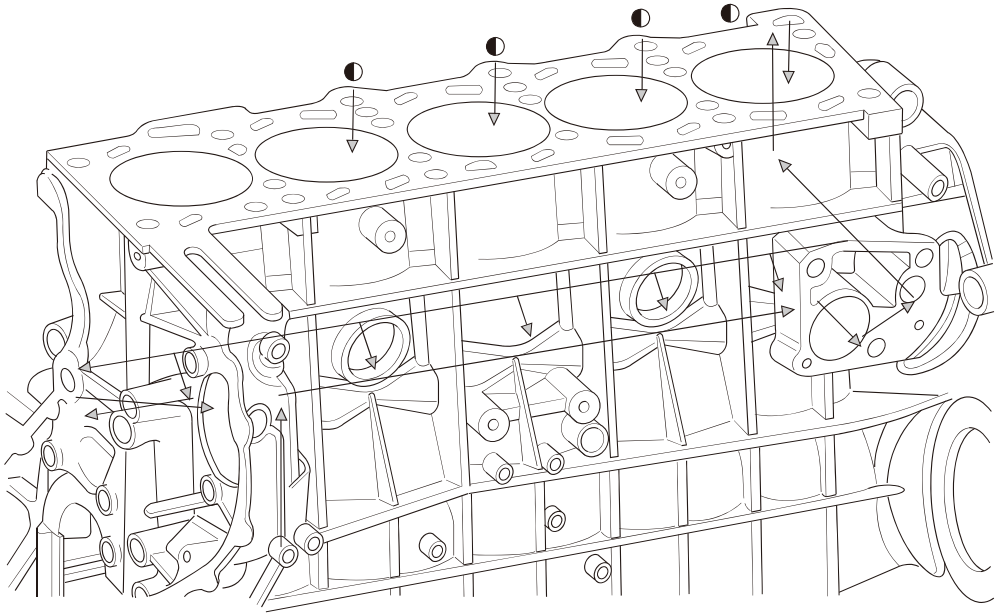
2) Lubrication System Layout

Cylinder Head

Main oil gallery: ϕ 16
Hole to cylinder head: ϕ 9
Main bearing hole: ϕ 7
Chain and injection pump: ϕ 7
Return hole: ϕ 14
Chain nozzle: ϕ 1
HP pump bearing: ϕ 6

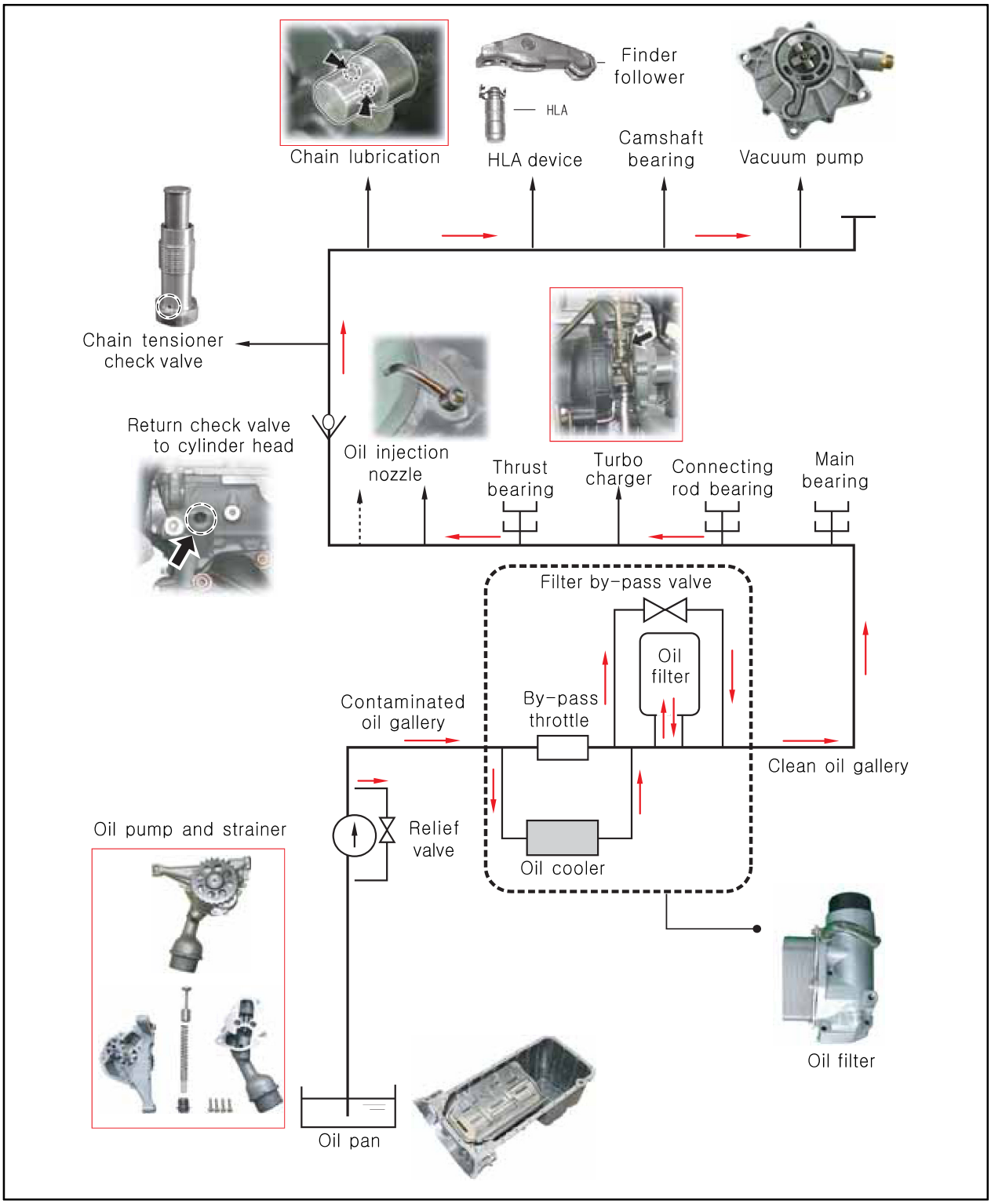


Cylinder Block



Modification basis	
Application basis	
Affected VIN	

2. LUBRICATION DIAGRAM



- Opening pressure of by-pass valve in oil filter: 3 ± 0.4 bar
- To prevent instant oil shortage after stopping the engine, the return check valve is installed in oil supply line of cylinder head

ENGINE COOLING SYSTEM

9210-05

GENERAL

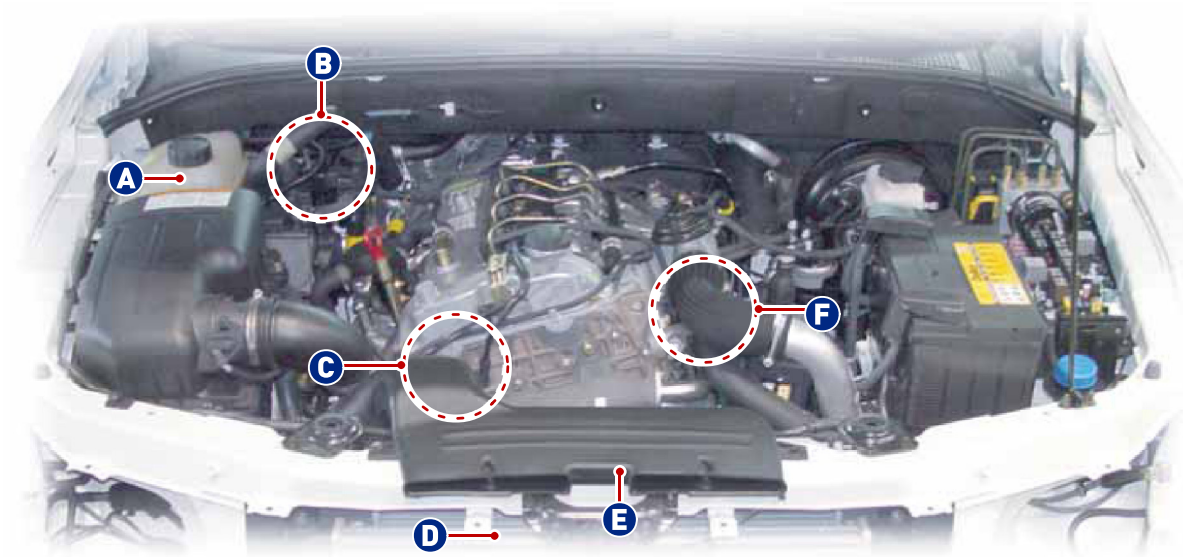
1. ENGINE COOLING SPECIFICATIONS

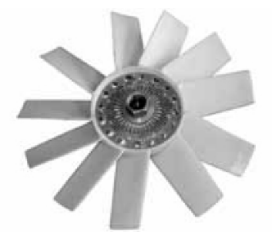
Descriptio n		Unit	Specificatio n
Cooling system	Type	-	Water cooling forced circulation
Coolant	Capacity	ℓ	11.3
Thermostat	Type	-	Wax pellet type
	Initial opening temperature	℃	85
	Fully opening temperature	℃	100
	Fully closing temperature	℃	83
	Stroke	mm	min. 8
Cooling fan	Blades		5
	Diameter	mm	320 (2)
	Low speed ON temp	℃	91
	Low speed OFF temp	℃	88
	High speed ON temp	℃	95
	High speed OFF temp	℃	92
	High speed ON temp. (By A/C pressure)	psi	270
Coolant reservoir	Pressure valve opening pressure	Kg/cm^2	1.2 ~ 1.5
	Vacuum valve opening pressure	Kg/cm^2	0.1
Water pump	Type	-	Centrifugal
	Impeller diameter	mm	72.3
	Impeller blades		10
Radiator	Type	-	Down-flow
	Core width	mm	701
	Core height	mm	372
	Core thickness	mm	18
	Minimum radiation capability	Kcal/h	45,000
Coolant temperature sensor	Resistance (at 20°C)	KΩ	3.33 ~ 3.78
	Resistance (at 80°C)	KΩ	0.32 ~ 0.35
Anti-freeze agent	Type	–	ALUTEC-P78
	Mixture ratio (water and anti-freeze)	–	50 : 50

OVERVIEW AND OPERATION PROCESS

1. COMPONENTS ENGINE COOLING

Coolant Reservoir	FFH	Water Pump
A 	B 	C 

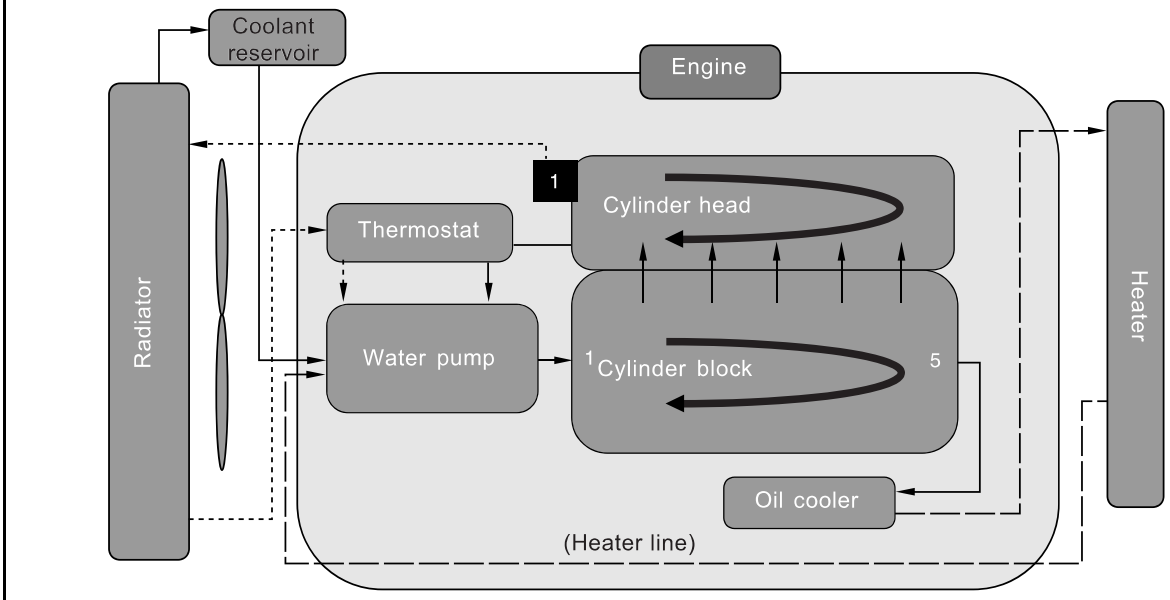


Radiator Assembly	Cooling Fan and Fan Clutch	Coolant Temperature Sensor
D 	E 	F 

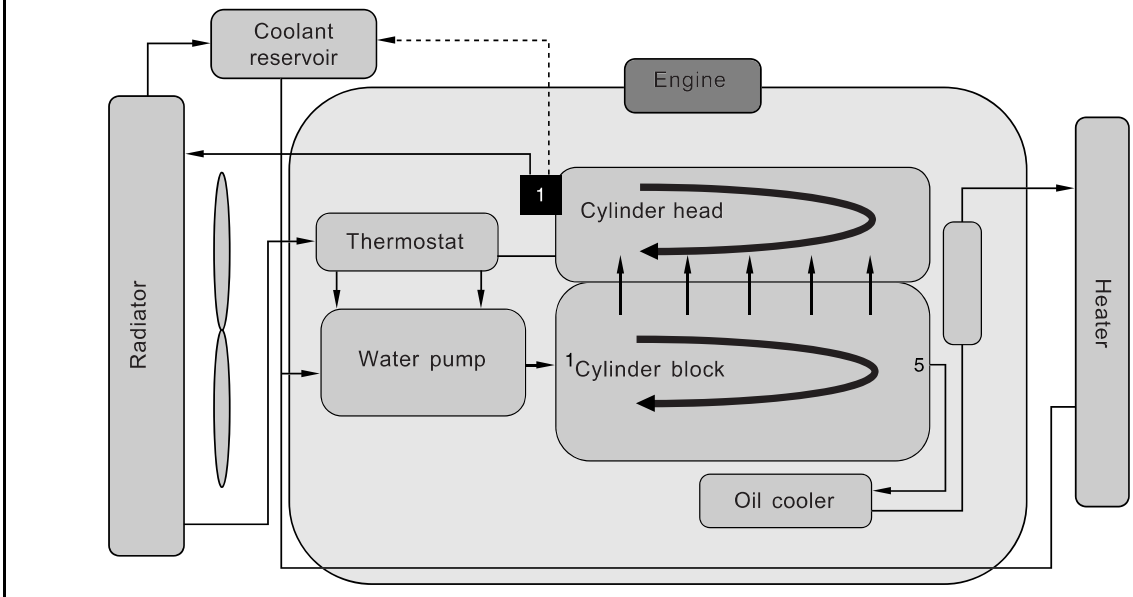
Modification basis	
Application basis	
Affected VIN	

2. COOLING SYSTEM FLOW

PTC Engine Coolant Flows

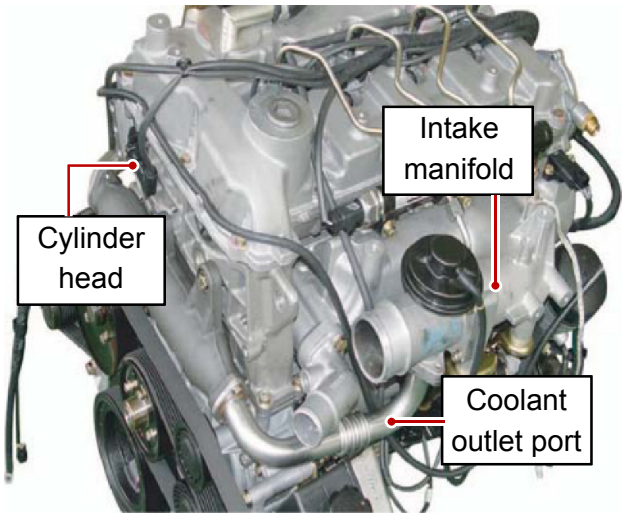


FFH Engine Coolant Flows



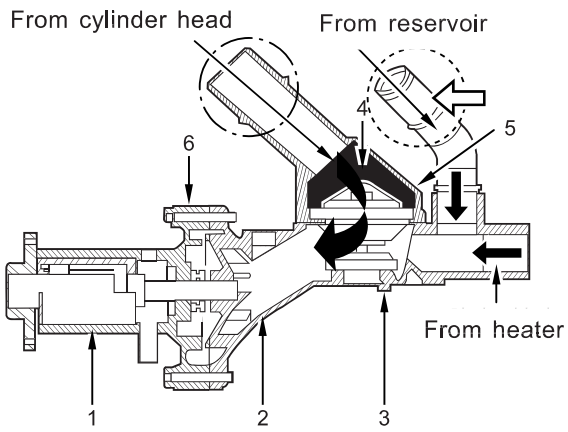
- Cylinder block side
  · Block #5 → Oil cooler → Heater → Heater water pump inlet pipe → Water pump
- Cylinder head side
  · Cylinder head → Coolant outlet port (intake #1) → Radiator → Water pump

3. FUNCTION DESCRIPTION OF COOLING SYSTEM



- Cylinder head coolant outlet port is integrated into intake manifold. (in front of cylinder #1)
  · Improved shape and gasket material to prevent coolant from leaking





- In OM 600 engine, coolant inflows through the heater line rear section (cylinder #4 and #5) of cylinder head.
  However, in D27DT engine, coolant inflows from cylinder block through oil cooler (refer to coolant flows layout in previous page).
  · It prevents cooling efficiency from decreasing due to coolant separation between cylinder #4 and #5.
- In OM 600 engine, the cooling fan is installed with water pump, however, in case of D27DT engine, it is connected to water pump with an additional pulley.

Modification basis	
Application basis	
Affected VIN	

ENGINE ELECTRICAL SYSTEM

1461-01

GENERAL

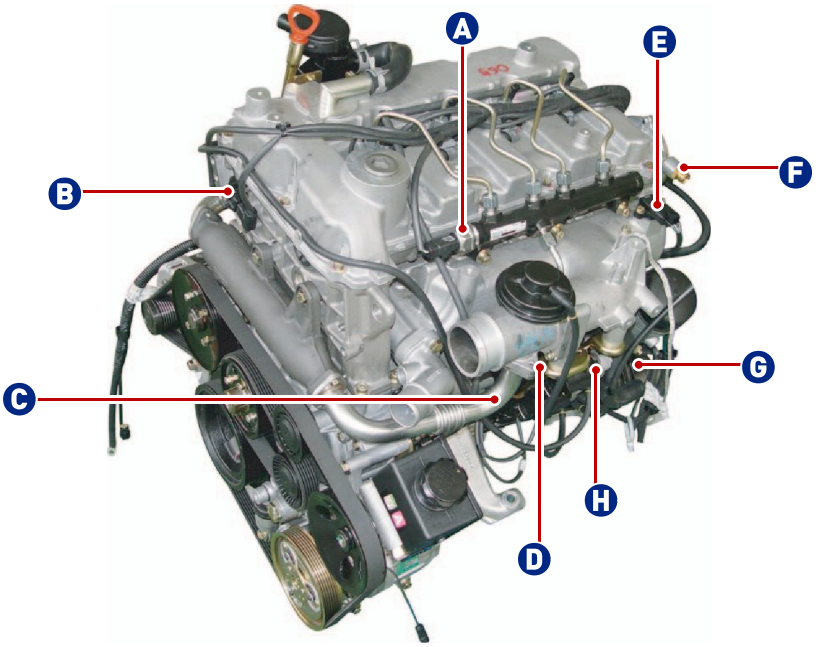
1.SPECIFICATIONS OF ENGINE ELECTRIC

Descriptio			Unit	pecificatio n
Starter	Type		-	WP220
	Output power		Kw	2.2
	No load test □ 12 volts		A	160
	Drive pinion speed at no load		rpm	4500
	Drive pinion speed at load		rpm/A	1700/430
	Brush length		mm	18
	Armature diameter		mm	55
	Armature run-out		mm	0.1
	Segment groove depth		mm	21.7
Alternator	Type		-	CS128D
	Output voltage / current		V/A	PTC equipped vehicle: 12V-140A FFH equipped vehicle: 12V-115A
	Regulator type		-	←
	Regulating voltage		V	14.6
	Brush	Length	mm	12.5
		Quantity	-	2
		Wear limit	mm	7
Battery	Type		-	M F
	Capacity		AH	12V - 90AH
Glow plug	Reserved capatity		RC	160
	Type		-	Seized type
	Rated voltage		-	11.5
	Circuit connection		-	Parallel
	Preheating time		sec	Max. 60 (at -35°C)

OVERVIEW AND OPERATION PROCESS

1. COMPONENTS OF ELECTRIC IN ENGINE

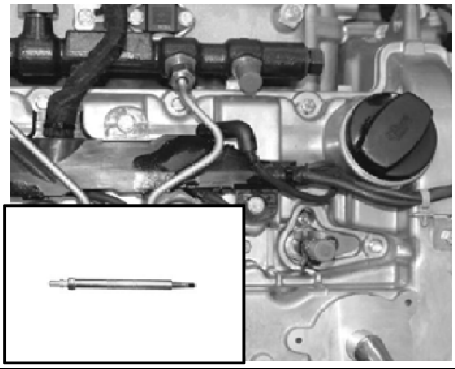
Fuel Pressure Sensor	Camshaft Position Sensor	Coolant Temperature Sensor	Fuel Temperature Sensor
A 	B 	C 	D 

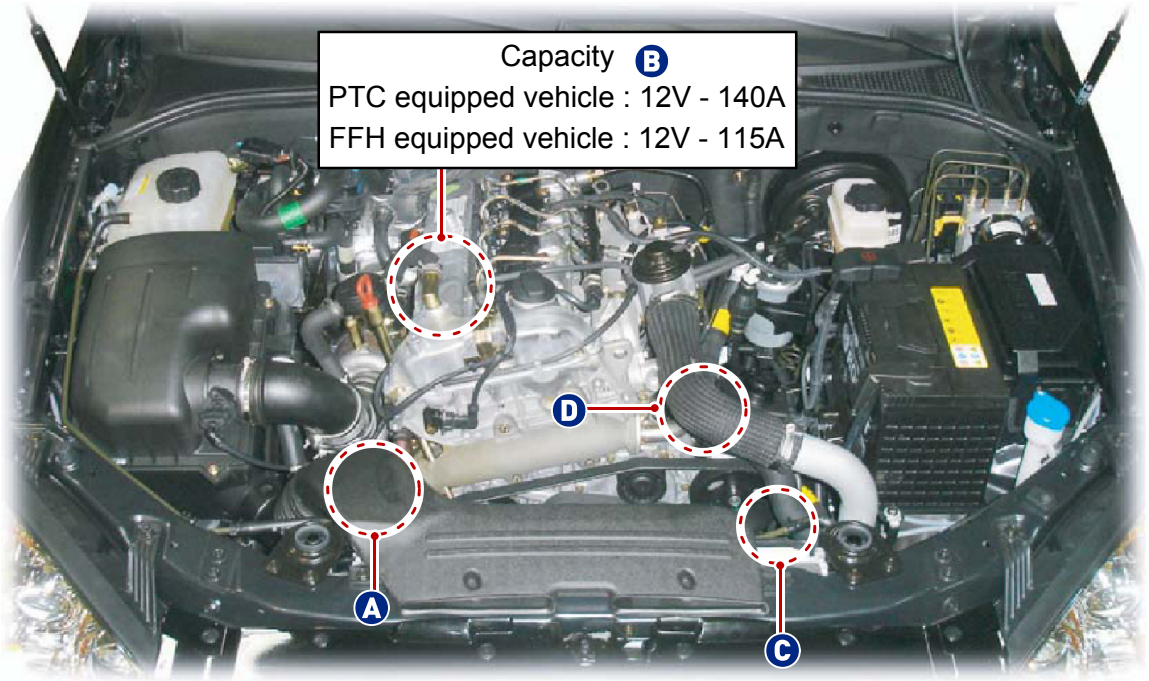


Booster Pressure Sensor	Oil Pressure Switch	Crankshaft Position Sensor	Knock Sensor (1 EA)
E 	F 	G 	H 

Modification basis	
Application basis	
Affected VIN	

2. COMPONENTS OF ELECTRIC DEVICES IN ENGIN

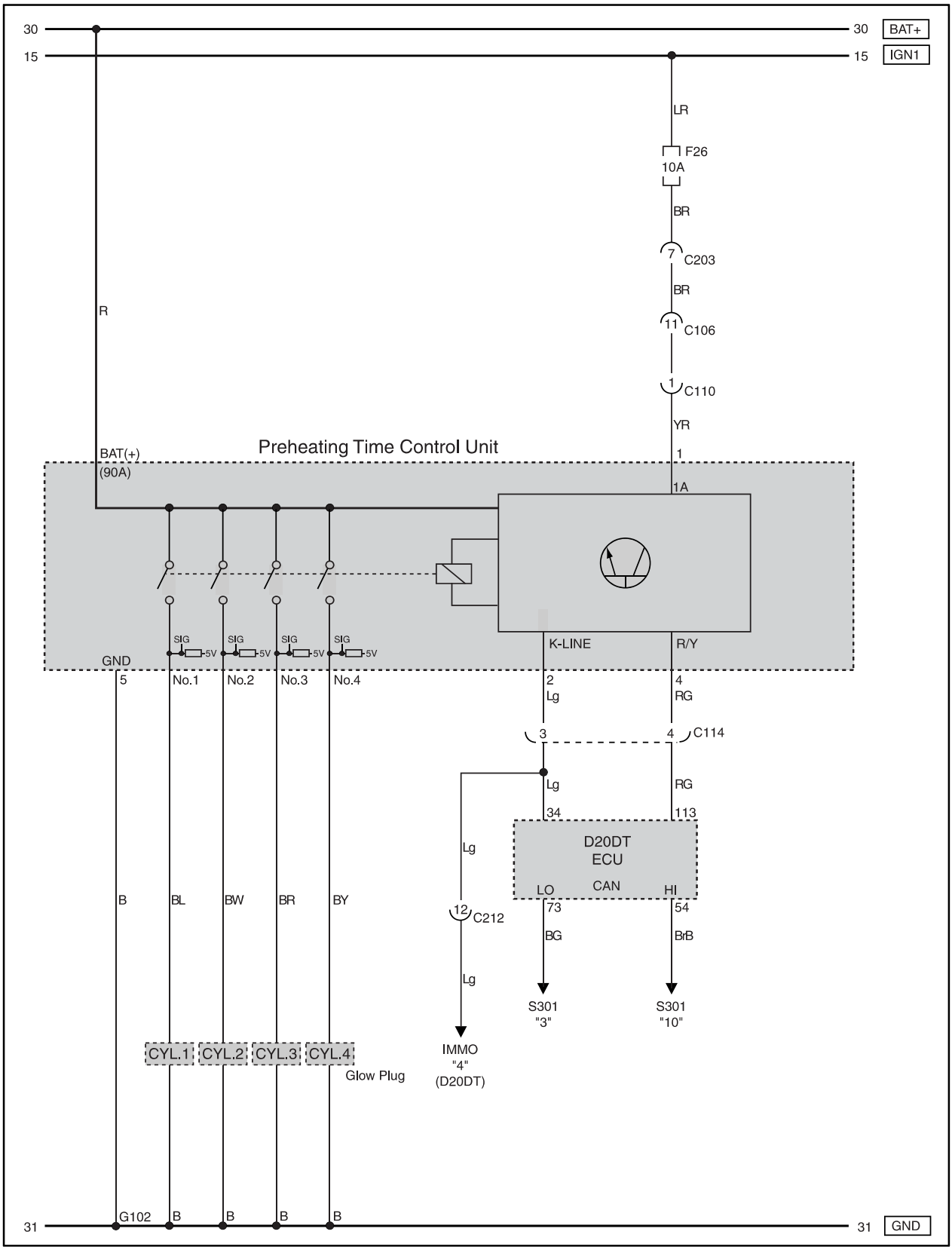
Alternator	Glow Plug
A 	B 



Air Conditioner Compressor	Starter
C 	D 

3. CIRCUIT DIAGRAM OF PREHEATING SYSTEM

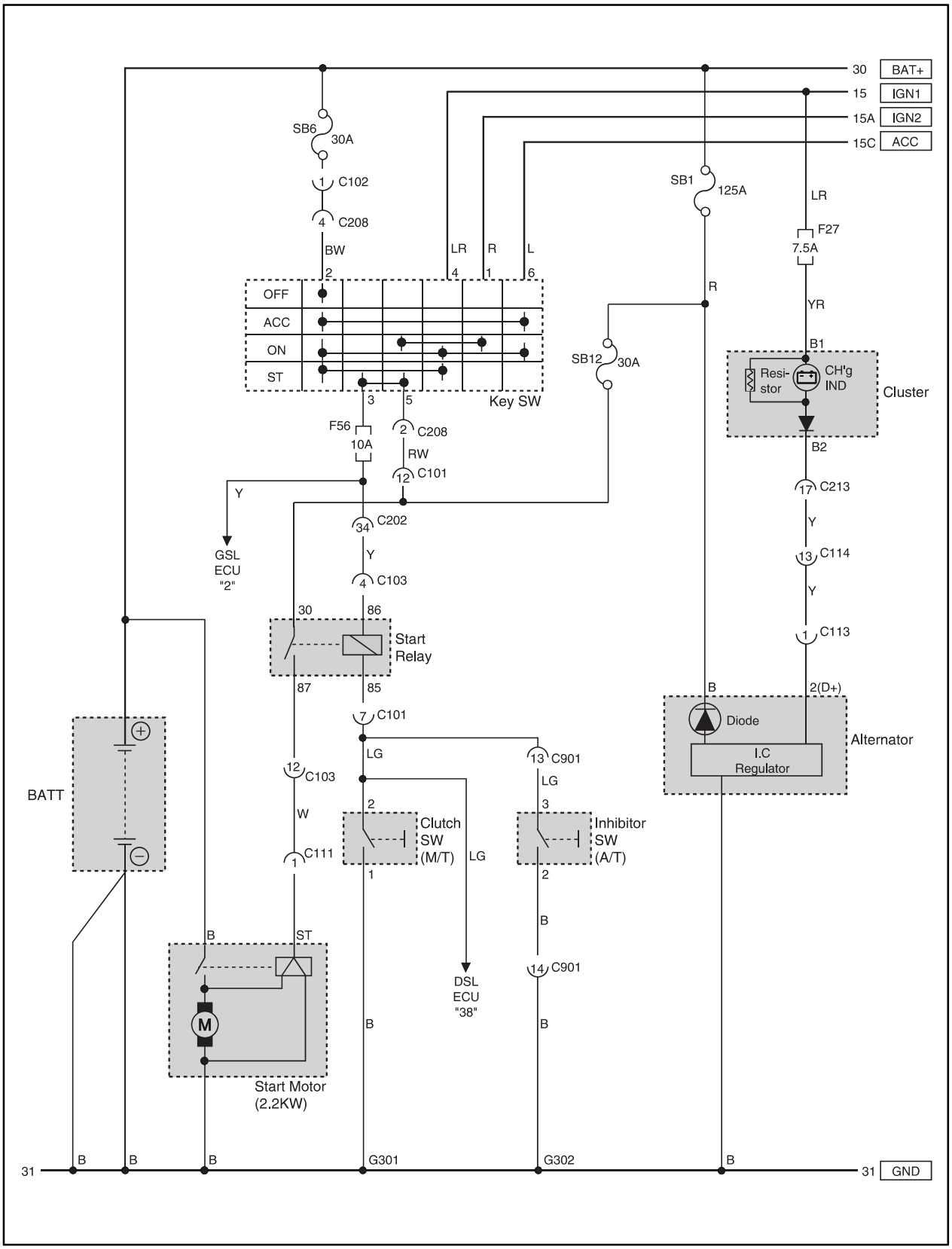
1) Preheating



Modification basis	
Application basis	
Affected VIN	

4. CIRCUIT DIAGRAM OF STARTING AND ALTERNATOR

1) Starting & Charging



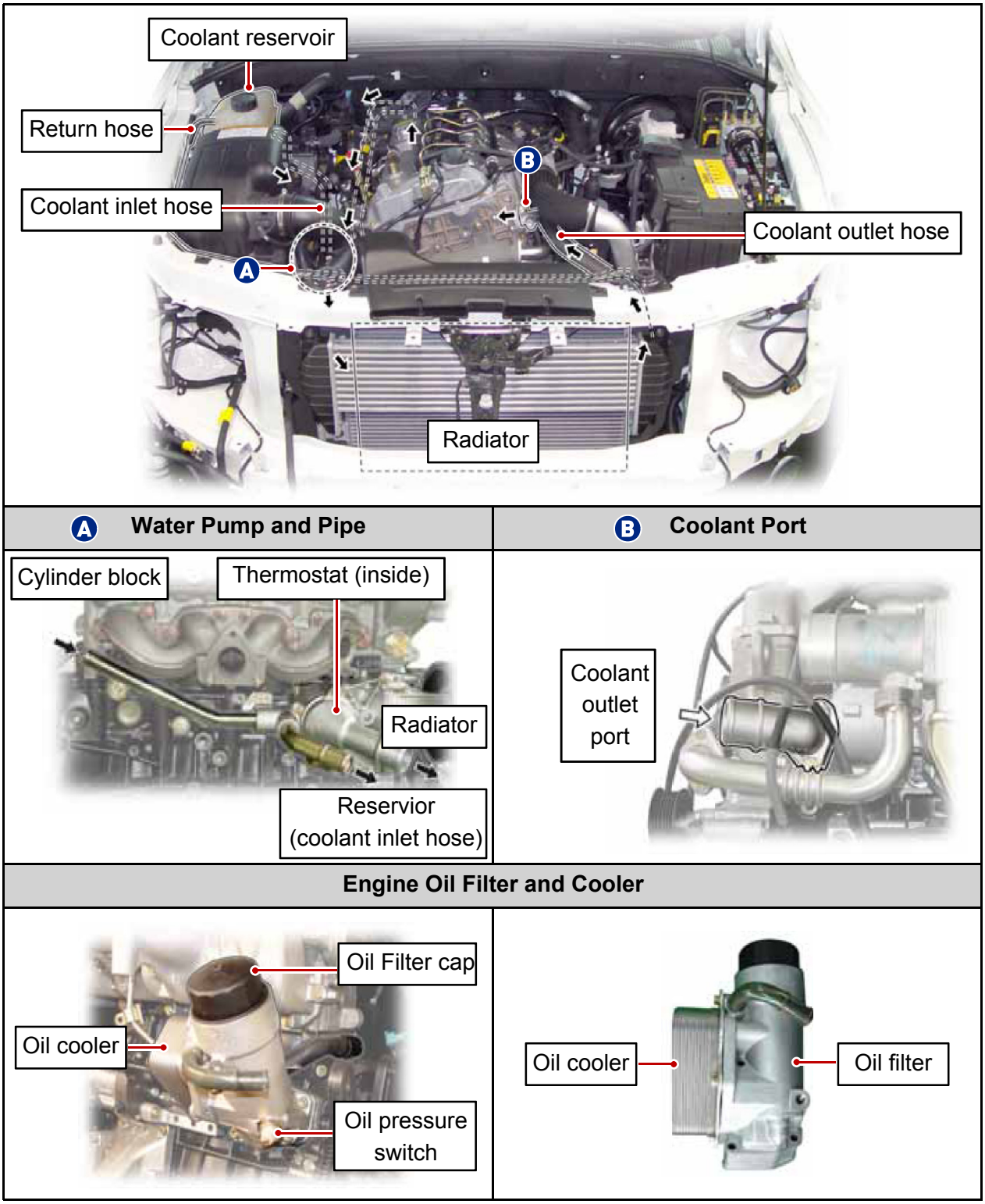
Modification basis	
Application basis	
Affected VIN	

EGINE CONTROL SYSTEM

1491-01

GENERAL

1. ENGINE ECU AND OTHER COMPONENTS



A Water Pump and Pipe

B Coolant Port

Engine Oil Filter and Cooler

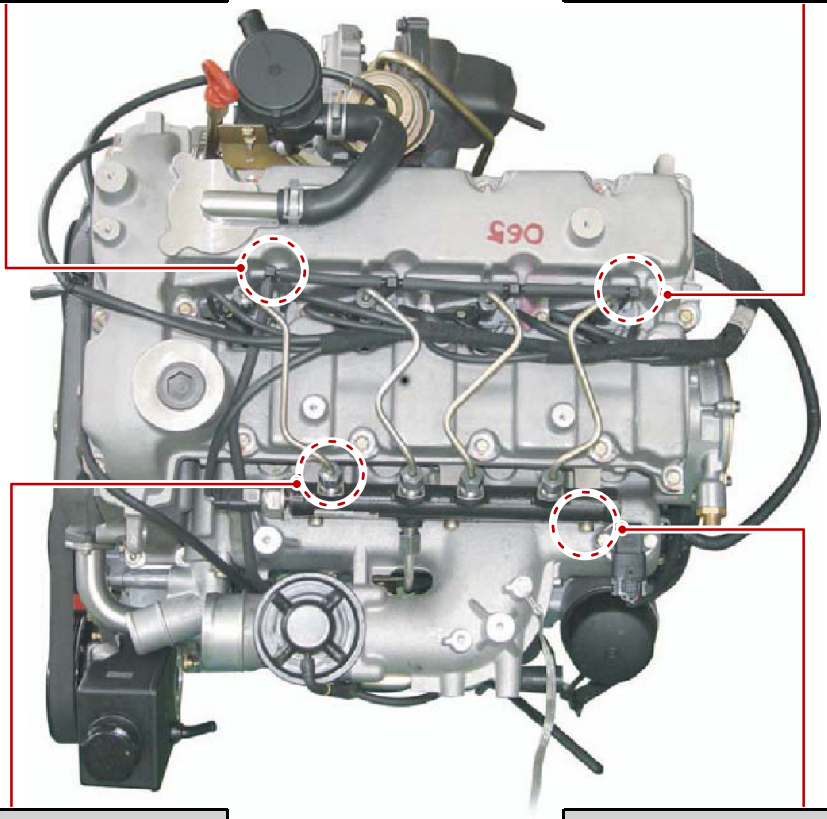
2. TOP VIEW

Fuel Pressure Sensor

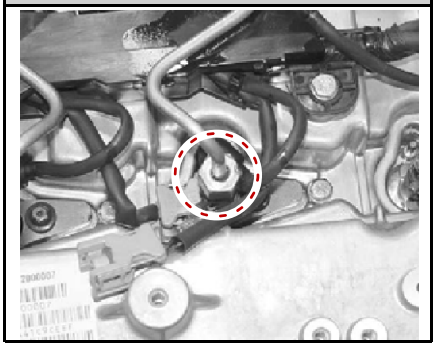


Booster Pressure Sensor

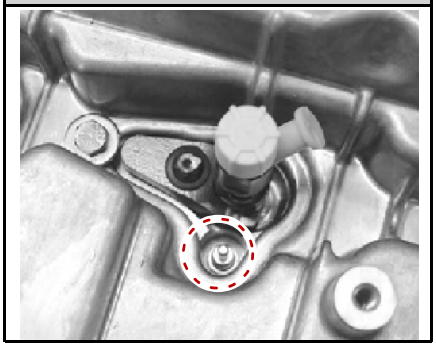




Injectors (4 EA)



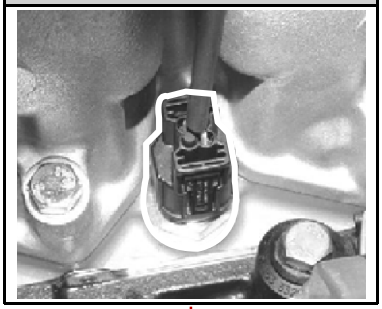
Glow Plugs (4 EA)



Modification basis	
Application basis	
Affected VIN	

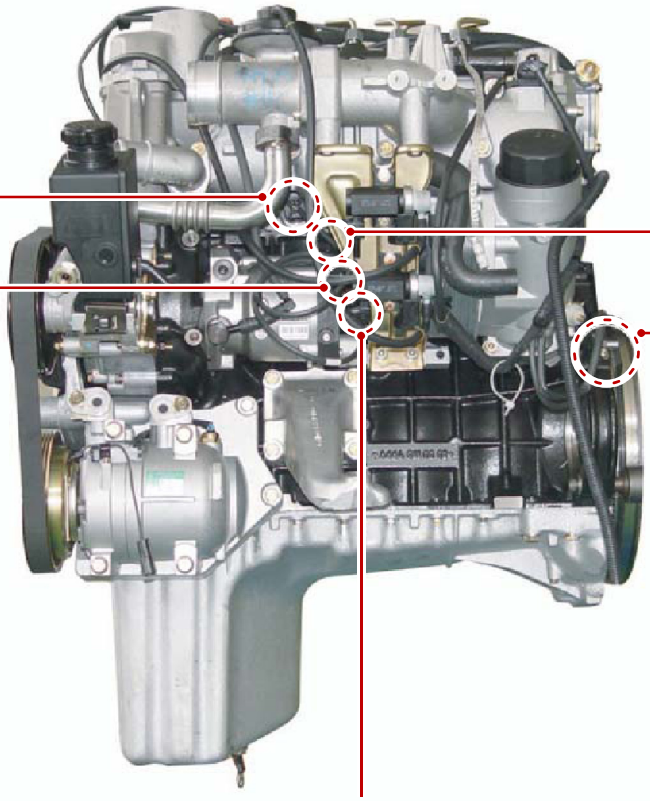
3. SIDE VIEW

Coolant Temperature Sensor

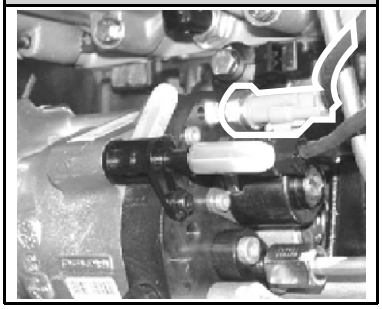


Knock Sensors (1 EA)





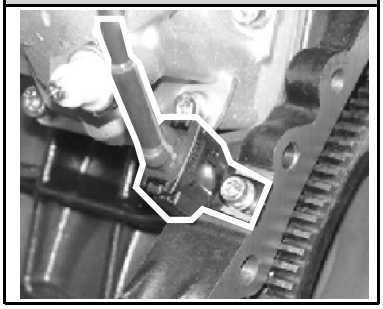
Fuel Temperature Sensor



Fuel Pressure Regulating Valve



Crankshaft Position Sensor



OVERVIEW AND OPERATION PROCESS

1. ECU INPUTS/OUTPUTS

Inputs		Control		Output
Booster pressure sensor Atmospheric pressure sensor (Built-in ECU) Air flow sensor (HFM) Coolant temperature sensor Fuel temperature sensor Fuel pressure sensor Fuel filter water sensor Knock sensor crankshaft position sensor camshaft position sensor Accelerator sensor Vehicle speed sensor Switch input signal (IG, brake, clutch, A/C signal, A/C compressor)	⇒	E C U	⇒	Injector EGR system Fuel pressure regulating valve (IMV) Electrical fan control (Low/High-speed) A/C compressor relay Glow plug relay Immobilizer Warning lights (Water warning light, glow plug indicator light, engine warning light) Preheater (auxiliary heater) K - line CAN communication Self-diagnosis

Modification basis	
Application basis	
Affected VIN	

2. STRUCTURE AND FUNCTION OF ECU

1) Function of ECU

ECU receives and analyzes signals from various sensors and then modifies those signals into permissible voltage levels and analyzes to control respective actuators.
ECU microprocessor calculates injection period and injection timing proper for engine piston speed and crankshaft angle based on input data and stored specific map to control the engine power and emission gas.
Output signal of the ECU microprocessor drives pressure control valve to control the rail pressure and activates injector solenoid valve to control the fuel injection period and injection timing; so controls various actuators in response to engine changes. Auxiliary function of ECU has adopted to reduce emission gas, improve fuel economy and enhance safety, comforts and conveniences. For example, there are EGR, booster pressure control, autocruise (export only) and immobilizer and adopted CAN communication to exchange data among electrical systems (automatic T/M and brake system) in the vehicle fluently. And Scanner can be used to diagnose vehicle status and defectives.
Operating temperature range of ECU is normally -40 ~ +85°C and protected from factors like oil, water and electromagnetism and there should be no mechanical shocks.
To control the fuel volume precisely under repeated injections, high current should be applied instantly so there is injector drive circuit in the ECU to generate necessary current during injector drive stages.
Current control circuit divides current applying time (injection time) into full-in-current-phase and hold-current-phase and then the injectors should work very correctly under every working condition.

3. CONTROL FUNCTION OF ECU

▶ **Controls by operating stages**

- To make optimum combustion under every operating stage, ECU should calculate proper injection volume in each stage by considering various factors.

▶ **Starting injection volume control**

- During initial starting, injecting fuel volume will be calculated by function of temperature and engine cranking speed.
  Starting injection continues from when the ignition switch is turned to ignition position to till the engine reaches to allowable minimum speed.

▶ **Driving mode control**

- If the vehicle runs normally, fuel injection volume will be calculated by accelerator pedal travel and engine rpm and the drive map will be used to match the drivers inputs with optimum engine power.

4. FUEL PRESSURE CONTROL

1) Fuel Pressure Control Elements

Pressure control consists of 2 principle modules.

- Determines rail pressure according to engine operating conditions.
- Controls IMV to make the rail pressure to reach to the required value.

Pressure in the fuel rail is determined according to engine speed and load on the engine. The aim is to adapt the injection pressure to the engine's requirements.

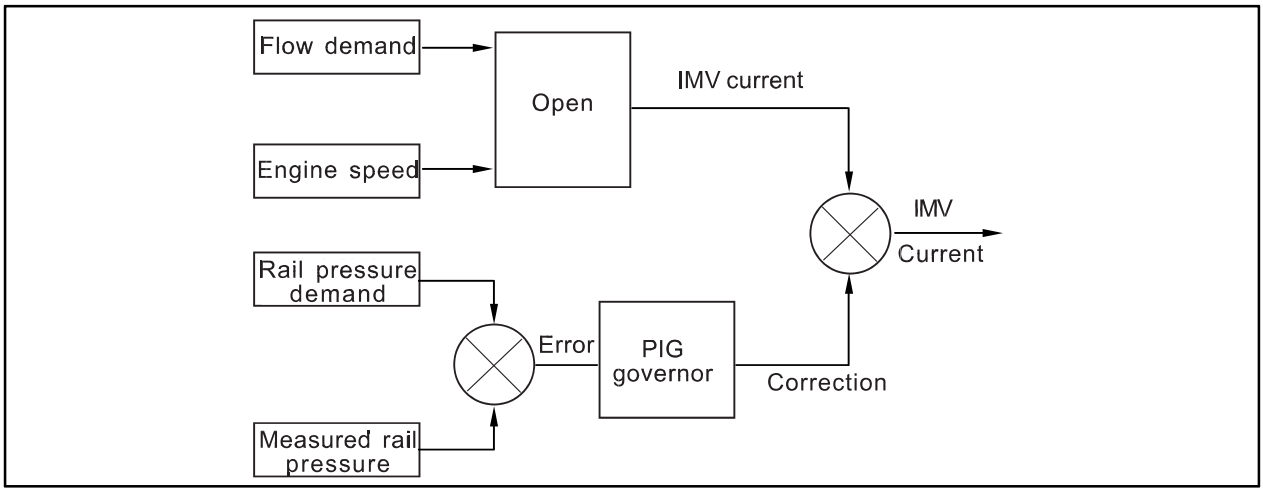
- When engine speed and load are high
  - The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.
- When engine speed and load are low
  - The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will be excessive and part of the fuel will be sprayed directly onto the sides of the cylinder, causing incomplete combustion. So there occurs smoke and damages engine durability.

Fuel pressure is corrected according to air temperature, coolant temperature and atmospheric pressure and to take account of the added ignition time caused by cold running or by high altitude driving. A special pressure demand is necessary in order to obtain the additional flow required during starts. This demand is determined according to injected fuel and coolant temperature.

2) Fuel Pressure Control

Rail pressure is controlled by closed loop regulation of IMV. A mapping system - open loop - determines the current which needs to be sent to the actuator in order to obtain the flow demanded by the ECU. The closed loop will correct the current value depending on the difference between the pressure demand and the pressure measured.

- If the pressure is lower than the demand, current is reduced so that the fuel sent to the high pressure pump is increased.
- If the pressure is higher than the demand, current is increased so that the fuel sent to the high pressure pump is reduced.



Modification basis	
Application basis	
Affected VIN	

5. FUEL INJECTION CONTROL

1) Fuel Injection Control

Injection control is used in order to determine the characteristics of the pulse which is sent to the injectors.

Injection control consists as below.

- Injection timing
- Injection volume
- Translating fuel injection timing and injection volume into values which can be interpreted by the injector driver.
  - a reference tooth (CTP)
  - the delay between this tooth and the start of the pulse (Toff)
  - the pulse time (Ton)

▶ Main injection timing control

The pulse necessary for the main injection is determined as a function of the engine speed and of the injected flow.

The elements are:

- A first correction is made according to the air and coolant temperatures.
  This correction makes it possible to adapt the timing to the operating temperature of the engine. When the engine is warm, the timing can be retarded to reduce the combustion temperature and polluting emissions (NOx). When the engine is cold, the timing advance must be sufficient to allow the combustion to begin correctly.
- A second correction is made according to the atmospheric pressure.
  This correction is used to adapt the timing advance as a function of the atmospheric pressure and therefore the altitude.
- A third correction is made according to the coolant temperature and the time which has passed since starting.
  This correction allows the injection timing advance to be increased while the engine is warming up (initial 30 seconds). The purpose of this correction is to reduce the misfiring and instabilities which are liable to occur after a cold start.
- A fourth correction is made according to the pressure error.
  This correction is used to reduce the injection timing advance when the pressure in the rail is higher than the pressure demand.
- A fifth correction is made according to the rate of EGR.
  This correction is used to correct the injection timing advance as a function of the rate of exhaust gas recirculation.
  When the EGR rate increases, the injection timing advance must in fact be increased in order to compensate for the fall in termperature in the cylinder.

During starting, the injection timing must be retarded in order to position the start of combustion close to the TDC.

To do this, special mapping is used to determine the injection timing advance as a function of the engine speed and of the water temperature. This requirement only concerns the starting phase, since once the engine has started the system must re-use the mapping and the corrections described previously.

▶ Pilot injection timing control

The pilot injection timing is determined as a function of the engine speed and of the total flow.
The elements are:

- A first correction is made according to the air and coolant temperatures.
  This correction allows the pilot injection timing to be adapted to the operating temperature of the engine.
- A second correction is made according to the atmospheric pressure.
  This correction is used to adapt the pilot injection timing as a function of the atmospheric pressure and therefore the altitude.

During the starting phase, the pilot injection timing is determined as a function of the engine speed and of the coolant temperature.

6. FUEL FLOW CONTROL

1) Main Flow Control

The main flow represents the amount of fuel injected into the cylinder during the main injection. The pilot flow represents the amount of fuel injected during the pilot injection.
The total fuel injected during 1 cycle (main flow + pilot flow) is determined in the following manner.
: The driver's demand is compared with the value of the minimum flow determined by the idle speed controller.

- When the driver depress the pedal, it is his demand which is taken into account by the system in order to determine the fuel injected.
- When the driver release the pedal, the idle speed controller takes over to determine the minimum fuel which must be injected into the cylinder to prevent the enigne from stalling.

It is therefore the greater of these 2 values which is retained by the system. This value is then compared with the lower flow limit determined by the ASR trajectory control system. As soon as the injected fuel becomes lower than the flow limit determined by the ASR trajectory control system, the antagonistic torque (engine brake) transmitted to the drive wheels exceeds the adherence capacity of the vehicle and there is therefore a risk of the drive wheels locking. The system thus chooses the greater of these 2 values (main flow & pilot flow) in order to prevent any loss of control of the vehicle during a sharp deceleration.
This value is then compared with the flow limit determined by the cruise control. As soon as the injected fuel becomes lower than the flow limit determined by the cruise control, the vehicle's speed falls below the value required by the driver. The system therefore chooses the greater of these 2 values in order to maintain the speed at the required level.
This valve is then compared with the flow limit determined by the flow limitation strategy. This strategy allows the flow to be limited as a function of the operating conditions of the engine. The system therefore chooses the smaller of these 2 values in order to protect the engine. This value is then compared with the fuel limit determined by the ASR trajectory control system.
As soon as the injected fuel becomes higher than the fuel limit determined by the ASR trajectory control system, the engine torque transmitted to the wheels exceeds the adhesion capacity of the vehicle and there is a risk of the drive wheels skidding. The system therefore chooses the smaller of the two values in order to avoid any loss of control of the vehicle during accelerations.

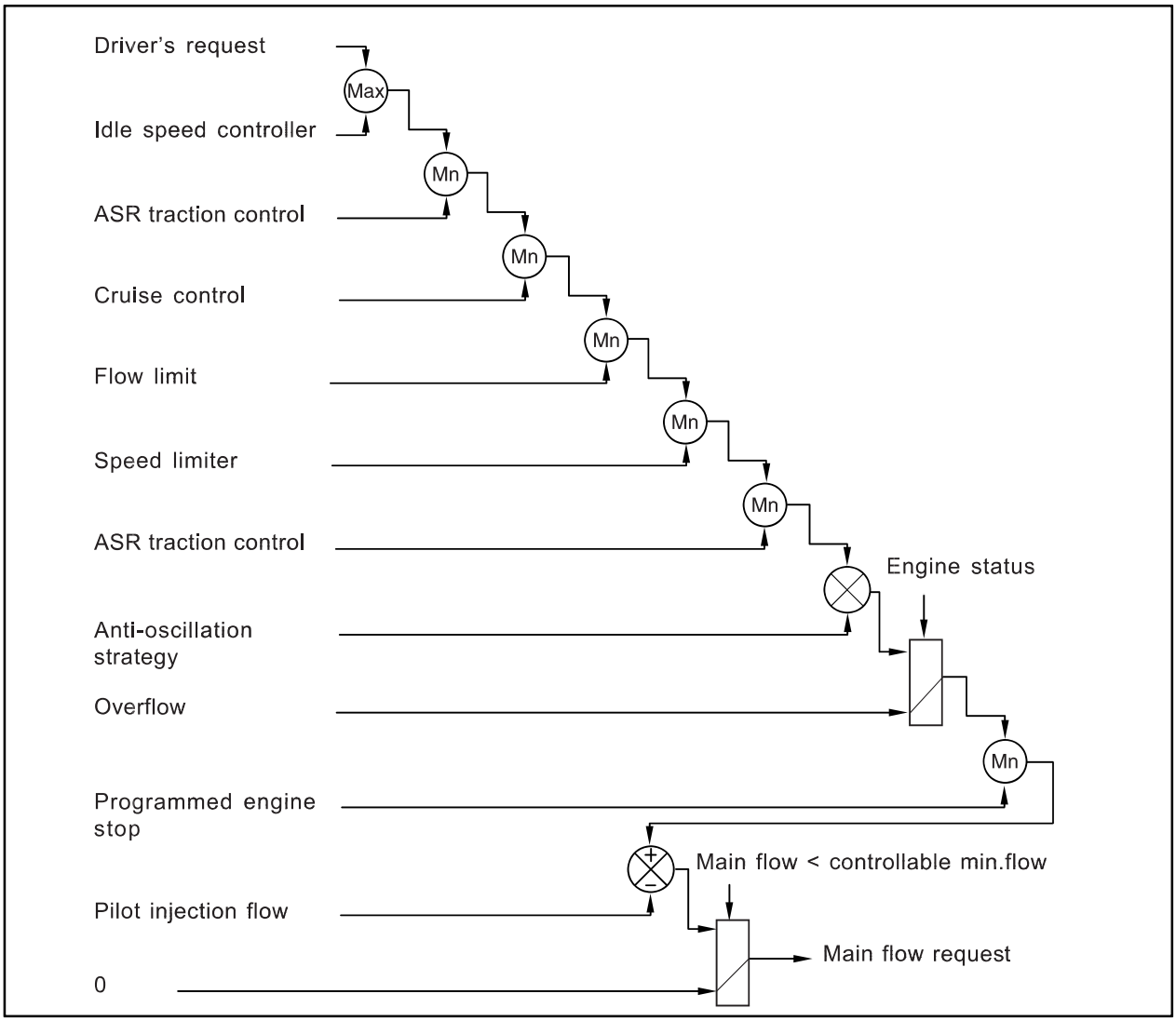
The anti-oscillation strategy makes it possible to compensate for fluctuations in engine speed during transient conditions. This strategy leads to a fuel correction which is added to the total fuel of each cylinder. The correction is determined before each injection as a function of the instantaneous engine speed.

A switch makes it possible to change over from the supercharge fuel to the total fuel according to the state of the engine.

- Until the stating phase has finished, the system uses the supercharged fuel.
- Once the engine changes to normal operation, the system uses the total fuel.

The main fuel is obtained by subtracting the pilot injection fuel from the total fuel.
A mapping determines the minimum fuel which can control an injector as a function of the rail pressure. As soon as the main fuel falls below this value, the fuel demand changes to 0 because in any case the injector is not capable of injecting the quantity demand.

2) Driver Demand



The driver demand is the translation of the pedal position into the fuel demand. It is calculated as a function of the pedal position and of the engine speed. The driver demand is filtered in order to limit the hesitations caused by rapid changes of the pedal position. A mapping determines the maximum fuel which can be injected as a function of the driver demand and the rail pressure. Since the flow is proportional to the injection time and to the square root of the injection pressure, it is necessary to limit the flow according to the pressure in order to avoid extending the injection for too long into the engine cycle. The system compares the driver demand with this limit and chooses the smaller of the 2 values. The driver demand is then corrected according to the coolant temperature. This correction is added to the driver demand.

3) Idle Speed Controller

The idle speed controller consists of 2 principal modules:

- The first module determines the required idle speed according to:
  - · The operating conditions of the engine (coolant temperature, gear engaged)
  - · Any activation of the electrical consumers (power steering, air conditioning, others)
  - · The battery voltage
  - · The presence of any faults liable to interface with the rail pressure control or the injection control. In this case, the accelerated idle speed is activated to prevent the engine from stalling when operating in degraded mode.
  - · It is possible to increase or to reduce the required idle speed with the aid of the diagnostic tool.
- The second module is responsible for providing closed loop control of the engine's idle speed by adapting the minimum fuel according to the difference between the required idle speed and the engine speed.

4) Flow Limitation

The flow limitation strategy is based on the following strategies:

- The flow limitation depending on the filling of the engine with air is determined according to the engine speed and the air flow. This limitation allows smoke emissions to be reduced during stabilized running.
- The flow limitation depending on the atmospheric pressure is determined according to the engine speed and the atmospheric pressure. It allows smoke emissions to be reduced when driving at altitude.
- The full load flow curve is determined according to the gear engaged and the engine speed. It allows the maximum torque delivered by the engine to be limited.
- A performance limitation is introduced if faults liable to upset the rail pressure control or the injection control are detected by the system. In this case, and depending on the gravity of the fault, the system activates:
  - · Reduced fuel logic 1: Guarantees 75 % of the performance without limiting the engine speed.
  - · Reduced fuel logic 2: Guarantees 50 % of the performance with the engine speed limited to 3,000 rpm.
  - · Reduce fuel logic 3: Limits the engine speed to 2,000 rpm.

The system chooses the lowest of all these values.

A correction depending on the coolant temperature is added to the flow limitation. This correction makes it possible to reduce the mechanical stresses while the engine is warming up. The correction is determined according to the coolant temperature, the engine speed and the time which has passed since starting.

▶ **Superchager Flow Demand**

The supercharge flow is calculated according to the engine speed and the coolant temperature. A correction depending on the air temperature and the atmospheric pressure is made in order to increase the supercharge flow during cold starts. It is possible to alter the supercharge flow value by adding a flow offset with the aid of the diagnostic tool.

Modification basis	
Application basis	
Affected VIN	

5) Pilot Flow Control

The pilot flow represents the amount of fuel injected into the cylinder during the pilot injection.
This amount is determined according to the engine speed and the total flow.

- A first correction is made according to the air and water temperature.
  This correction allows the pilot flow to be adapted to the operating temperature of the engine. When the engine is warm, the ignition time decreases because the end-of-compression temperature is higher. The pilot flow can therefore be reduced because there is obviously less combustion noise when the engine is warm.
- A second correction is made according to the atmospheric pressure.

This correction is used to adapt the pilot flow according to the atmospheric pressure and therefore the altitude.
During starting, the pilot flow is determined on the basis of the engine speed and the coolant temperature.

6) Cylinder Balancing Strategy

▶ **Balancing of the point to point flows**

The pulse of each injector is corrected according to the difference in instantaneous speed measured between 2 successive injectors.

- The instantaneous speeds on two successive injections are first calculated.
- The difference between these two instantaneous speeds is then calculated.
- Finally, the time to be added to the main injection pulse for the different injectors is determined. For each injector, this time is calculated according to the initial offset of the injector and the instantaneous speed difference.

▶ **Detection of an injector which has stuck closed**

The cylinder balancing strategy also allows the detection of an injector which has stuck closed. The difference in instantaneous speed between 2 successive injections then exceeds a predefined threshold. In this case, a fault is signaled by the system.

7) Accelerometer Strategy

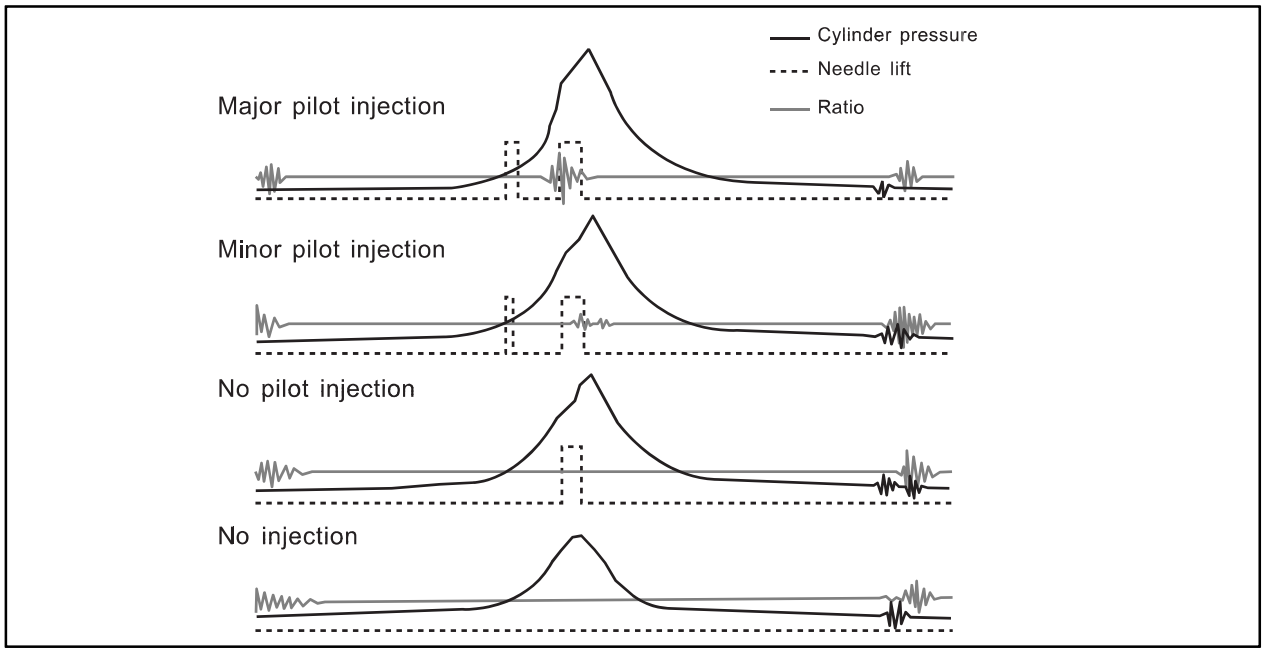
▶ Resetting the pilot injection

The accelerometer is used to reset the pilot injection flow in closed loop for each injector. This method allows the correction of any injector deviations over a period of time. The principle of use of the accelerometer is based on the detection of the combustion noises.

The sensor is positioned in such a way as to receive the maximum signal for all the cylinders. The raw signals from the accelerometer are processed to obtain a variable which quantifies the intensity of the combustion. This variable, known as the ratio, consists of the ratio between the intensity of the background noise and the combustion noise.

- A first window is used to establish the background noise level of the accelerometer signal for each cylinder. This window must therefore be positioned at a moment when there cannot be any combustion.
- The second window is used to measure the intensity of the pilot combustion. Its position is such that only the combustion noises produced by the pilot injection are measured . It is therefore placed just before the main injection.

The accelerometer does not allow any evaluation of the quantity injected. However, the pulse value will be measured when the injector starts injection and this pulse value is called the MDP (Minimum Drive Pulse). On the basis of this information, it is possible to efficiently correct the pilot flows. The pilot injection resetting principle therefore consists of determining the MDP, in other words the pulse corresponding to the start of the increase in value of the ratio (increase of vibration due to fuel combustion).



This is done periodically under certain operating conditions. When the resetting is finished, the new minimum pulse value replaces the value obtained during the previous resetting. The first MDP value is provided by the C2I. Each resetting then allows the closed loop of the MDP to be updated according to the deviation of the injector.

Modification basis	
Application basis	
Affected VIN	

▶ Detection of leaks in the cylinders

The accelerometer is also used to detect any injector which may have stuck open. The detection principle is based on monitoring the ratio. If there is a leak in the cylinder, the accumulated fuel self-ignites as soon as the temperature and pressure conditions are favorable (high engine speed, high load and small leak).

This combustion is set off at about 20 degrees before TDC and before main injection.

The ratio therefore increases considerably in the detection window. It is this increase which allows the leaks to be detected. The threshold beyond which a fault is signaled is a percentage of the maximum possible value of the ratio.

Because of the severity of the recovery process (engine shut-down), the etection must be extremely robust.

An increase in the ratio can be the consequence of various causes:

- Pilot injection too strong
- Main combustion offset
- Fuel leak in the cylinder

If the ratio becomes too high, the strategy initially restricts the pilot injection flow and retards the main injection. If the ratio remains high despite these interventions, this shows that a real leak is present, a fault is signaled and the engine is shut down.

▶ Detection of an accelerometer fault

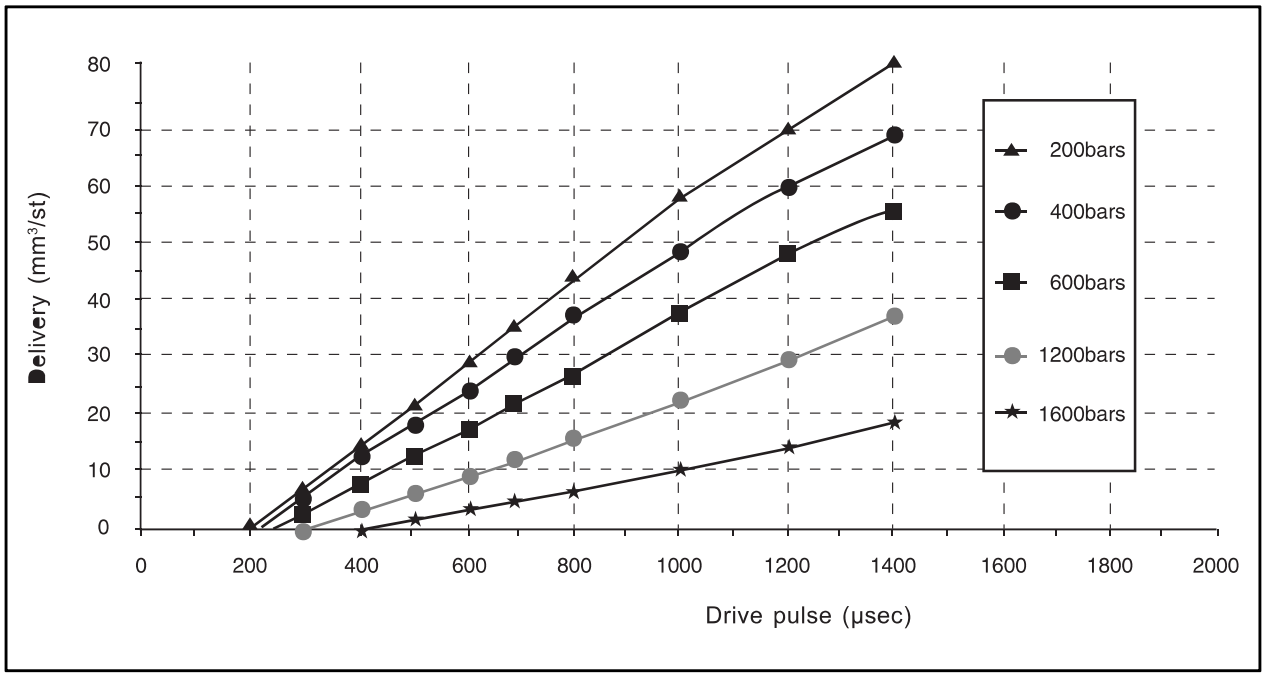
This strategy permits the detection of a fault in the sensor or in the wiring loom connecting the sensor to the ECU.

It is based on detection of the combustion. When the engine is idling, the detection window is set too low for the combustion caused by the main injection. If the ratio increases, this shows that the accelerometer is working properly, but otherwise a fault is signaled to indicate a sensor failure. The recovery modes associated with this fault consist of inhibition of the pilot injection and discharge through the injectors.

7. INDIVIDUAL INJECTOR CALIBRATION (C2I)

Injected fuel is proportional to square root of injection time and rail pressure.

It is function between pulse and rail pressure and fuel injection curve is called injector characteristics curve having the following shape.



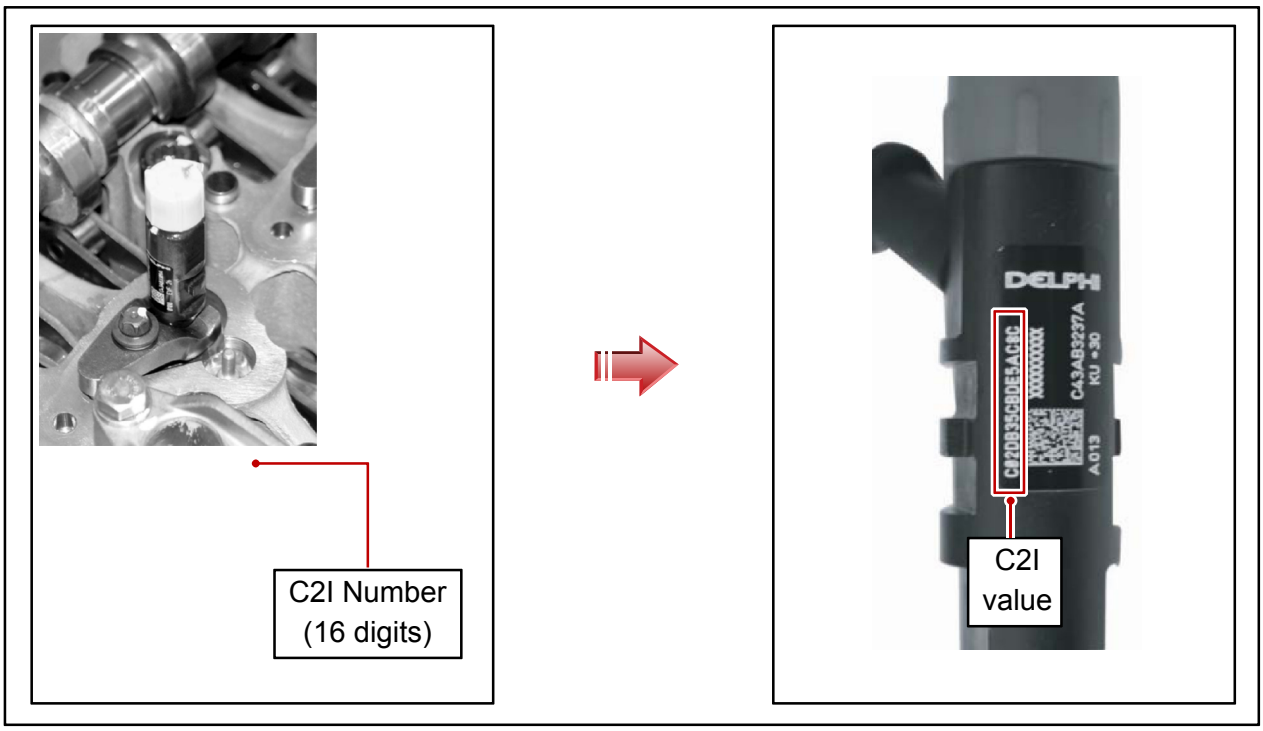
Common rail injectors are very accurate components. They are able to inject fuel delivery between 0.5 to 100 mg/str under pressure varying from 150 to 1600 bar.

This high level of accuracy requires very low machining tolerances (few ㎛).

Nevertheless, due to the machining dispersion, the loss of charge through the functional orifices, the friction between moving parts and electromagnetic field level are different from one injector to the other. So, the difference of fuel delivery for the same pressure and the same pulse can reach 5 mg/str from one injector to the other. It is impossible to control efficiently the engine with such a dispersion between the different injectors. It is necessary to add a correction that allows injecting the demanded fuel delivery whatever the initial hydraulic characteristics of the injector is. The method consists in correcting the pulse that is applied to the injector with an offset that depends on the initial hydraulic map of the injector. So, the pulse should be corrected according to characteristics of each injector.

C2I is composed of models on these characteristics of injectors.
C2I consists of 16-digit composed of numbers from 1 to 9 and alphabets from A to F. ECU remembers C2I, characteristics of each injector, to make the most optimal fuel injection.

- When replacing the injector, C2I code on the top of new injector should be input into ECU because the ECU is remembering the injector's C2I value. If C2I is not input, engine power drops and occurs irregular combustion.
- When ECU is replaced, C2I code of every injector should be input. If not, cannot accelerate the vehicle even when the accelerator pedal is depressed.



※ For coding of C2I, refer to "Diagnosis" section

8. MINIMUM DRIVE PULSE (MDP) LEARNING

When the pulse value that the injector starts injection is measured, it is called mininum drive pulse (MDP). Through MDP controls, can correct pilot injections effectively. Pilot injection volume is very small, 1 ~ 2 mm/str, so precise control of the injector can be difficult if it gets old. So there needs MDP learning to control the very small volume precisely through learning according to getting older injectors.

1) Learning Conditions

Coolant temperature	> 75°C
Vehicle speed	> 50 Km/h (over 5 seconds)
Intake manifold pressure	> 0.7 bar
Engine speed	> 2,500 rpm
Battery voltage	10 V < MDP < 16 V
Fuel temperature	0 < fuel temperature < 80 °C
Initial MDP learning on each injector	5 seconds

2) Trouble Codes

Trouble code	Descriptio n	Diagnosis
P1171	Fault MDP learning on injector No. 1	• Check each injector
P1172	Fault MDP learning on injector No. 2	
P1173	Fault MDP learning on injector No. 3	
P1174	Fault MDP learning on injector No. 4	
P1175	Fault MDP learning on injector No. 5	

Modification basis	
Application basis	
Affected VIN	

CRUISE CONTROL SYSTEM

8510-23

OVERVIEW AND OPERATION PROCESS

1. CRUISE CONTROL SWITCH



The purpose of the cruise control system is to automatically maintain a vehicle speed set by the driver, without depressing the accelerator pedal. The cruise control switch is located under the right side of the steering wheel, and when this switch is operating "AUTO CRUISE" lamp comes on.

The minimum speed for setting the cruise control system is 36 km/h (22.37 mph). Pay constant attention to the distance between the vehicles and the traffic conditions when using the cruise control system.

CAUTION

The cruise control system is a supplementary system, which helps the driver to drive the vehicle at a desired speed without using the accelerator pedal under the traffic condition where the vehicle-to-vehicle distance meets the legal requirement.

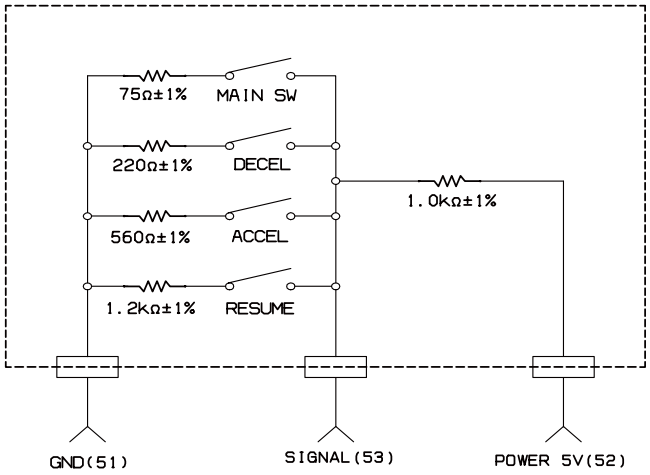
1) When To Use

Use the cruise control system only when (a) the traffic is not jammed, (b) driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

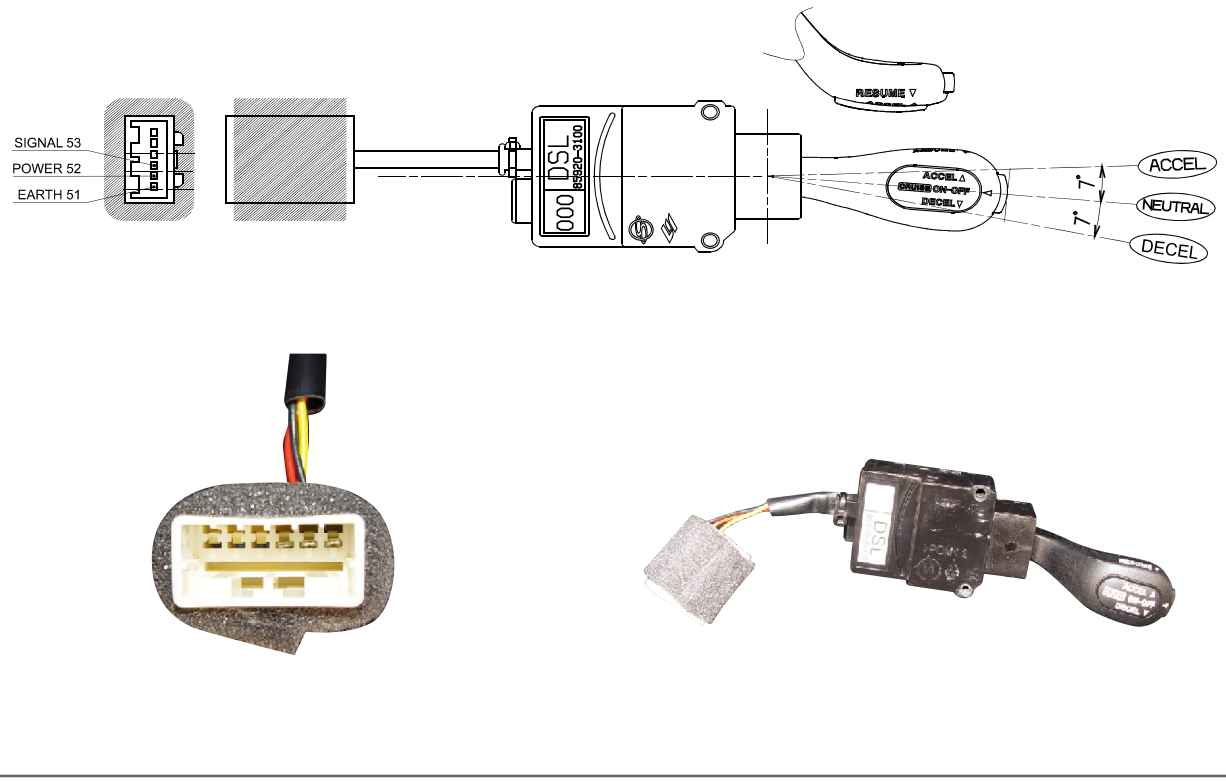
WARNING

Use the cruise control system only when driving on motorways or highways. Do not use the cruise control system where the road conditions are as follows:
- When there is strong wind or cross wind.
- Heavy traffic.
- Slippery roads or steep decline.

2. CIRCUIT DIAGRAM



1) Configuration



3. HOW TO OPERATE CRUISE CONTROL SWITCH

1) How To Set Speed



1. To operate the cruise control system, accelerate the vehicle to the speed within the specified range below with depressing the accelerator pedal.
   - Cruise control operating range: between 36 km/h (22.37 mph) and 150 km/h (93.207 mph)
2. When the desired speed is reached, which should be within the above range, push up the cruise control switch lever to ACCEL side (upwards arrow), or push down the switch lever to DECEL side (downwards arrow).
   And then release the accelerator pedal slowly.
3. Now the vehicle is cruised by this system with the set speed. You don't need to use the accelerator pedal.
4. Refer to the following pages for details of operation.

CAUTION

Never use the cruise control system until you get used to it.
Improper use or not fully aware of this function could result in collision and/or personal injuries.

Modification basis	
Application basis	
Affected VIN	

2) Accelerating with the Cruise Control System



(1) While the cruise control system is running

1. To increase the set speed, push up the cruise control switch lever to ACCEL side and hold it until the desired speed is reached without depressing the accelerator pedal.
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To increase the speed with the cruise control system while the system is not running, follow the procedures below.

1. Accelerate the vehicle to more than 36 km/h (22.37 mph) using the accelerator pedal. Push up the cruise control switch lever to ACCEL side and hold it.
2. When the desired speed is reached, release the accelerator pedal and the switch lever.

(3) Tap-up while the cruise control system is running

To increase the vehicle speed in stages while the cruise control system is running, follow the procedures below.

1. Push up the cruise control switch lever to ACCEL side for less than 0.5 second per one switching while the cruise control system is running; the speed increases each time by 1.3 km/h (0.81 mph).
2. For example, if you want to increase the speed 13 km/h (81 mph) more than the previous set speed, tap up the switch lever to ACCEL side ten times without using the accelerator pedal.

3) Decelerating with the Cruise Control System



(1) While the cruise control system is running

1. To decrease the set speed, push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached without depressing the brake pedal.
   But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To decrease the speed with the cruise control system while the system is not running, follow the procedures below.

1. Push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached while the vehicle speed is over 36 km/h (22.37 mph).
2. When the desired speed is reached, release the switch lever.
3. But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).

(3) Tap-down while the cruise control system is running

To decrease the vehicle speed in stages while the cruise control system is running, follow the below procedures.

1. Push down the cruise control switch lever to DECEL side for less than 0.5 second per one switching while the cruise control system is running; the speed decreases each time by 1.0 km/h (0.62 mph).
2. For example, if you want to decrease the speed 10 km/h (62 mph) lower than the previous set speed, tap down the switch lever to DECEL side ten times without using the brake pedal.

Modification basis	
Application basis	
Affected VIN	

4) Recovery of Set Speed (RESUME)



Even if the cruise control is cancelled, the previous set cruise speed can be recovered by operating the cruise control switch lever like below:
- Pull the switch lever in the arrow direction shown in the illustration.
This RESUME function works only when the vehicle speed is more than 36 km/h (22.37 mph) without using the accelerator or brake pedal.

CAUTION
But the driver should know the previous set speed to react to the changed vehicle speed properly. If the vehicle speed increases abruptly, depress the brake pedal to adjust the vehicle speed properly.

5) Normal Cancellation of the Cruise Control (OFF ↔ ON)



The cruise control system will be cancelled when the button on the side of the switch is pressed, or when one of the following conditions is met:

1. When the brake pedal is depressed or ESP is activated.
2. When the vehicle speed is less than 34 km/h (21.13 mph).
3. When the parking brake is applied while driving.
4. When the clutch pedal is depressed for shifting (M/T only).

CAUTION

Put the cruise control switch lever in the neutral position when not using the cruise control system.

(1) Abnormal Cancellation of the Cruise Control

1. When the rapid deceleration or acceleration occurs.
2. When the cruise control lever is faulty.
3. When the brake switch is malfunctioning or has an open circuit.

When the cruise control function is cancelled abnormally or intermittent problems occur, stop the vehicle and turn off the ignition switch and remove the key to reset the system. After a while, turn on the ignition switch again to operate the cruise control system.

CAUTION

- Do not move the shift lever to Neutral position while driving with the cruise control turned on. Otherwise, it may result in system malfunction or accidents.
- Always be prepared to use the brake or accelerator pedal for safe driving while the cruise control system is running.
- The actual speed can be different from the set speed momentarily when driving on a uphill or downhill. So, it is recommended to disable the cruise control function on a uphill or downhill. hen driving on a steep hill use the engine brake and foot brake properly to protect the vehicle system and for a safe driving.
- Ensure that the braking distance is maintained and use the brake pedal if needed.

Modification basis	
Application basis	
Affected VIN	

ENGINE ASSEMBLY

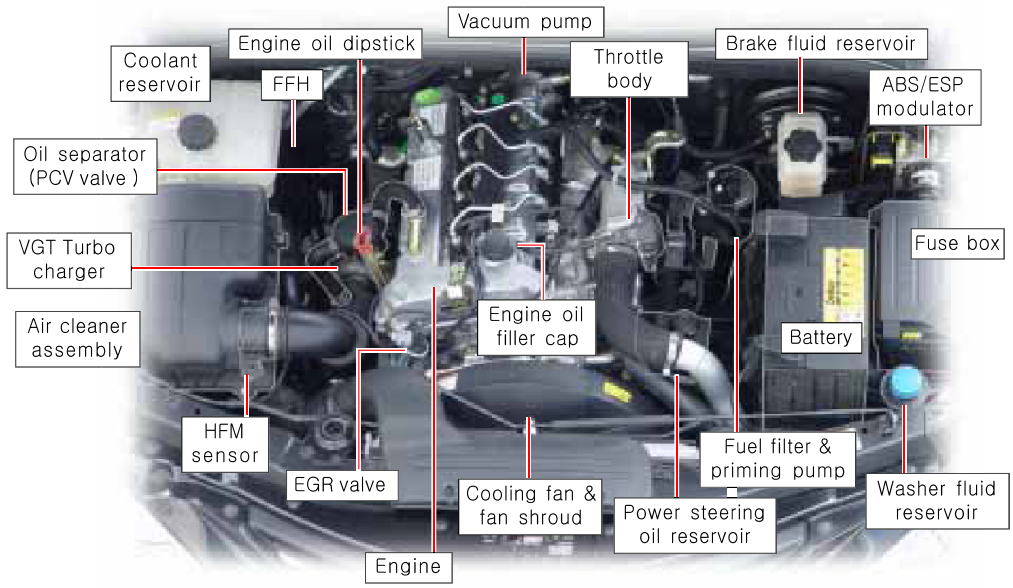
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GENERAL

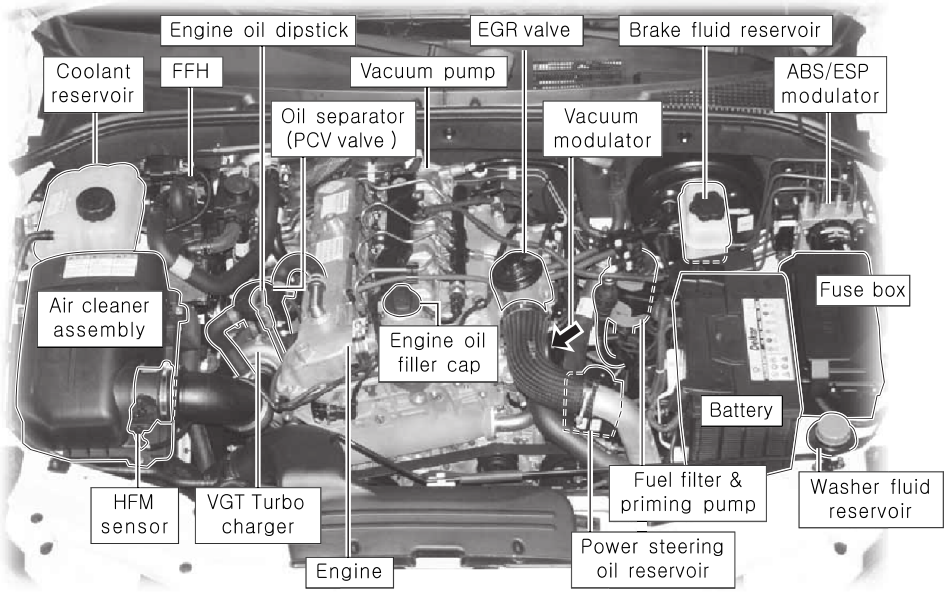
1. MAJOR COMPONENTS IN ENGINE AND ENGINE COMPARTMENT

The electronically controlled advanced D20DT engine that has high pressure fuel system has been introduced to this vehicle. It satisfies the strict emission regulation and provides improved output and maximum torque.

D20DT (EURO)

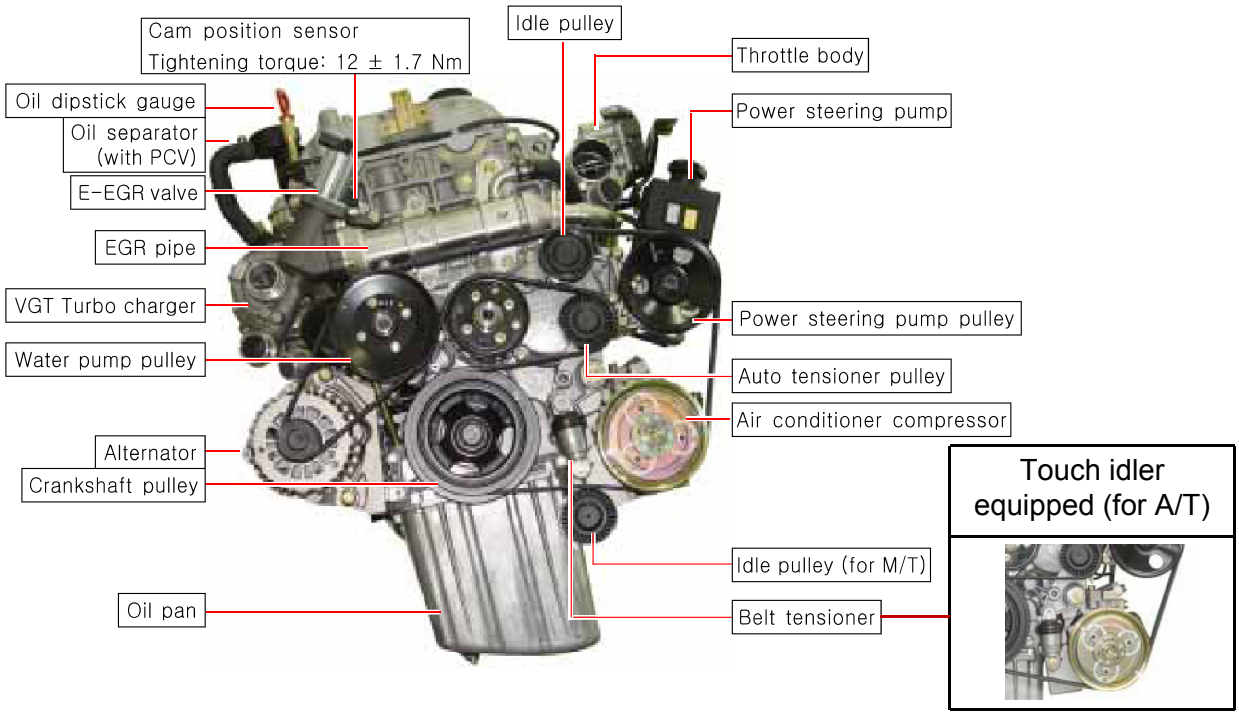


D20DT

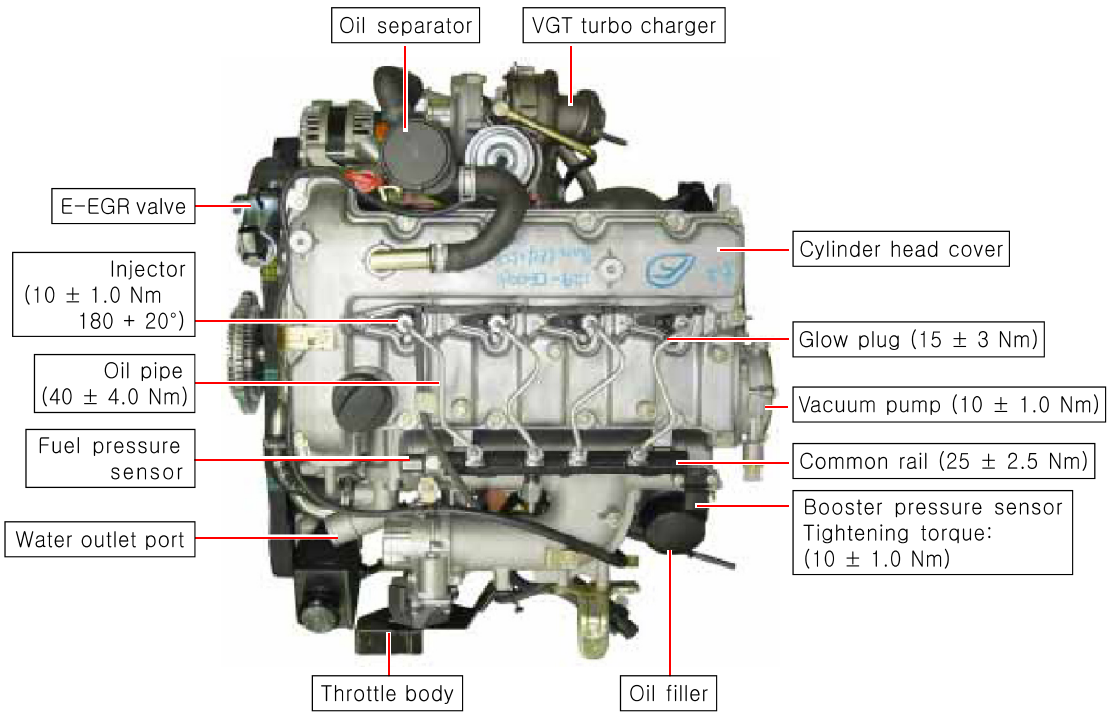


1) Engine Assembly Structure

Front View

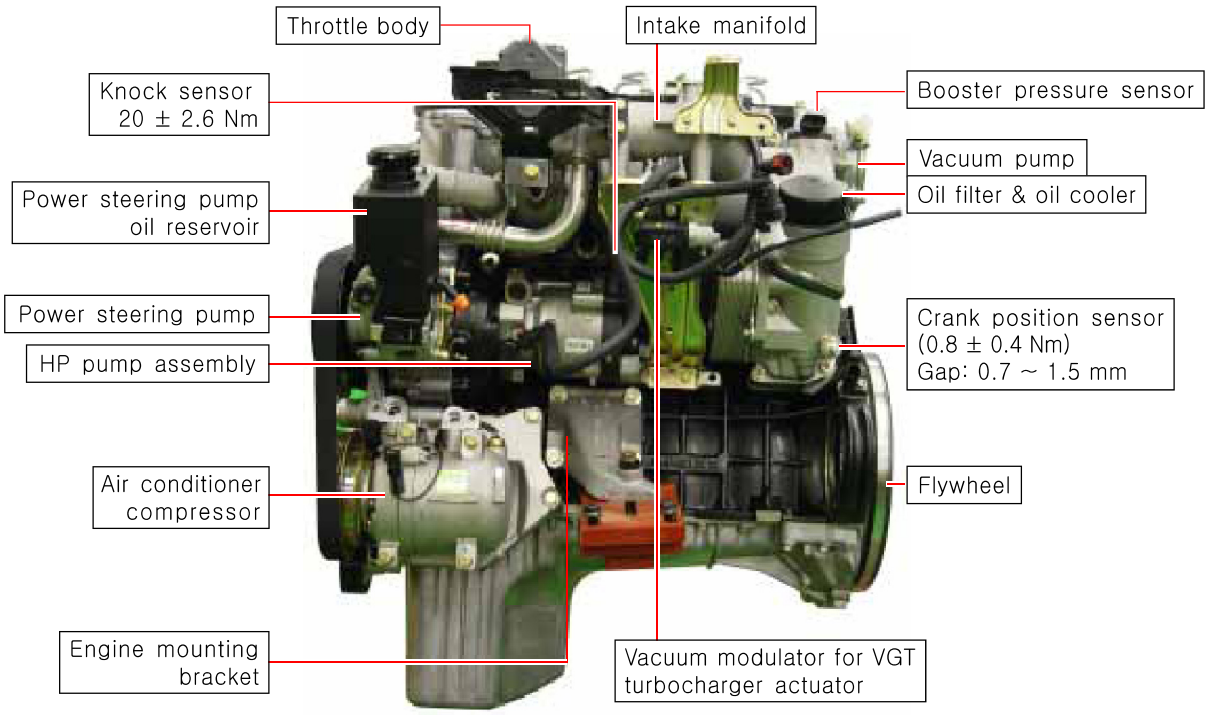


Top View

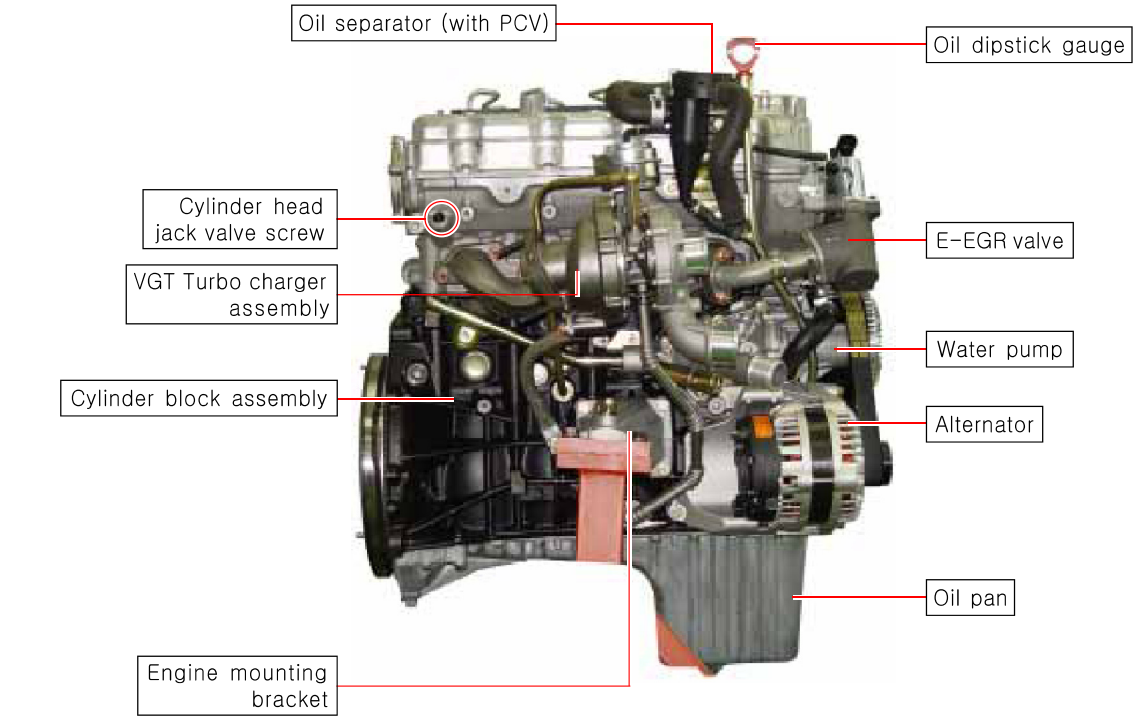


Modification basis	
Application basis	
Affected VIN	

Right Side View



Left Side View



Modification basis	
Application basis	
Affected VIN	

2. SPECIFICATIONS AND PERFORMANCE CURVE

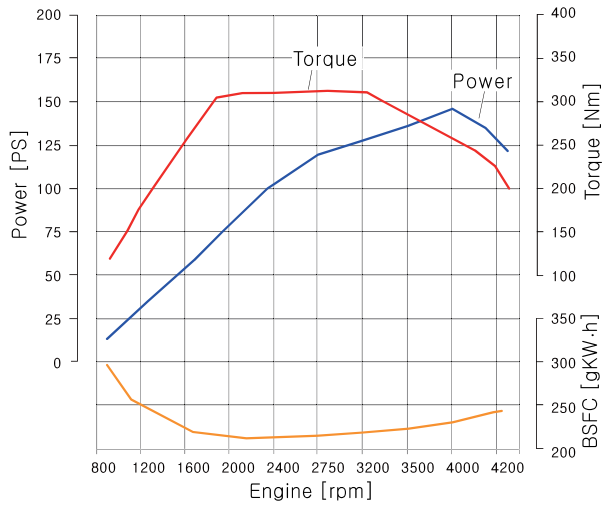
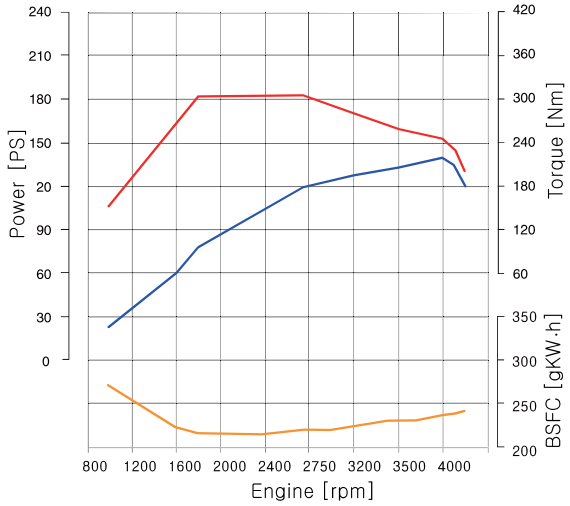
1) Specifications

Description			D20DT (EURO 4)	D20DT
Engine	Type/Number of cylinders		D20DT/4-cylinder	←
Cylinder	Inner diameter		86.2 mm	←
	Stroke		85.6 mm	←
Displacement			1998 cc	←
Compression ratio			17.5:1	←
Maximum output			141 ps / 4,000 rpm	←
Maximum torque			310 Nm / 1,800 ~ 2,750 rpm	←
Idle speed	For Manual Transmission		780 ± 50 rpm	←
	For Automatic Transmission		780 ± 50 rpm	←
Valve	Intake	Opens (BTDC)	9°	←
		Closes (ABDC)	26°	←
	Exhaust	Opens (BBDC)	38°	←
		Closes (ATDC)	16°	←
Camshaft	Type		DOHC	←
Fuel system	Fuel type		Low sulfur diesel	←
	Fuel pump type		Vane pump in HP pump	←
	Fuel supply pressure		HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar	←
	Water separation in fuel filter		at every 10,000 km	←
	Fuel tank capacity		75 ℓ	←
Lubrication system	Oil specification		Quality class: Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3) Viscosity: MB sheet No. 224.1	←
	Lubrication type		Forced delivery	←
	Oil filter type		Full flow, filter element type	←
	Oil capacity		≒7.5 ℓ	←
Cooling system	Cooling type		Water cooling type	←
	Cooling fan operation type		Belt operated type	←
	Thermostat (Fully Open: 100°C)	Opening temperature	85 °C	←
		Type	WAX pellet type	←
	Coolant capacity		≒11.5 ℓ	←

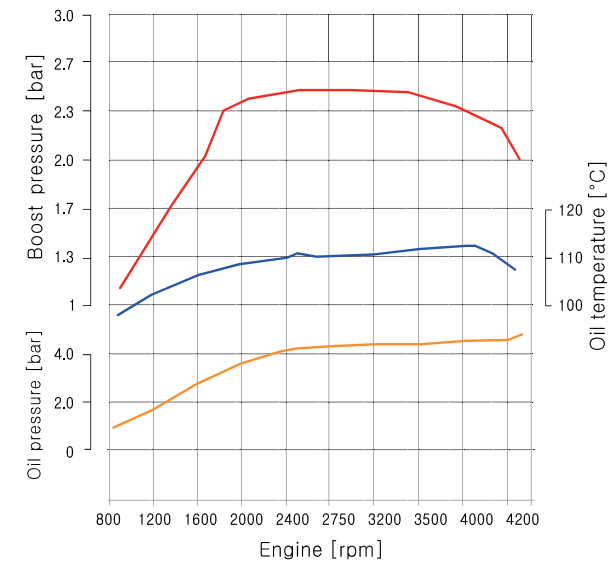
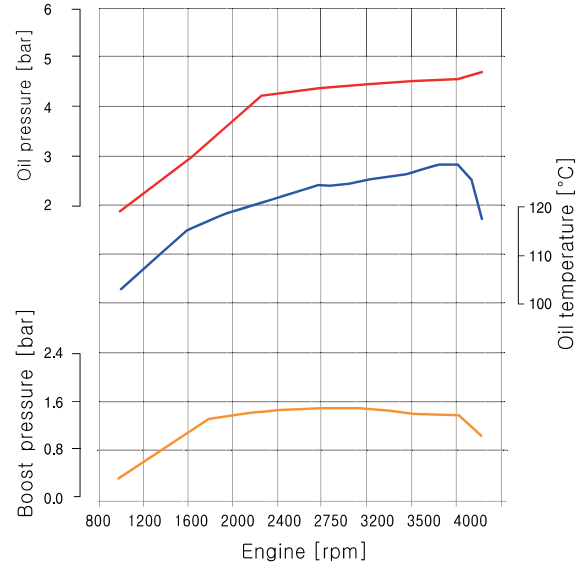
Modification basis	
Application basis	
Affected VIN	

2) Engine Performance Curve

(1) Output and Torque

General	EU4
	

(2) Oil Temperature/Pressure and Boost Pressure

General	EU4
	

3. TIGHTENING TORQUE

Name	Bolt Size	Quantity	Tightening Torque (Nm)	
			D20DT (EURO 4)	D20DT
Main bearing cap	M11 x 67	10	55 ± 5 120° ± 10°	55 ± 5 120° ± 10°
Connecting rod cap	M9 x 51	8	40 ± 5 90° ± 10°	40 ± 5 90° ± 10°
Rear cover	M6 x 20	6	10 ± 1	10 ± 1
Oil pump	M8 x 35SOC	3	25 ± 2.5	25 ± 2.5
T.G.C.C	M6 x 40	6	10 ± 1	10 ± 1
	M6 x 60	3	10 ± 1	10 ± 1
	M6 x 70	2	10 ± 1	10 ± 1
Flywheel	M10 x 22	8	45 ± 5 90° ± 10°	45 ± 5 90° ± 10°
Crankshaft hub	M20 x 85	1	200 180° ± 10°	200 180° ± 10°
Oil pan	M6 x 20	20	10 ± 1	10 ± 1
	M6 x 35	3	10 ± 1	10 ± 1
	M6 x 85	3	10 ± 1	10 ± 1
	M8 x 40	4	25 ± 2.5	25 ± 2.5
High pressure pump mounting bolt	M8 x 55	3	25 ± 2.5	25 ± 2.5
High pressure pump main nut (intershaft)	M14 x 1.5	1	65 ± 5	65 ± 5
Cylinder head	M8 x 25	2	25 ± 2.5	25 ± 2.5
	M8 x 50	2		
	M10 x 158	1	85 ± 5 270° + 10°	85 ± 5 270° + 10°
	M10 x 177	9		
Camshaft sprocket (Intake)	M11 x 40	1	25 ± 2.5 90° ± 10°	25 ± 2.5 90° ± 10°
Camshaft sprocket (Exhaust)				
Chain tensioner	M24	1	65 ± 5	65 ± 5
Auto tensioner	M12 x 90 (UP)	1	82 ± 6	82 ± 6
	M8 x 45 (LOWER)	1	32 ± 3	32 ± 3
Water pump assembly	M6 x 50	7	10 ± 1	10 ± 1
Water pump pulley	M6 x 10	4	10 ± 1	10 ± 1
Hot water inlet pipe assembly	M6 x 12	2	10 ± 1	10 ± 1
Alternator bracket	M8 x 80	1	25 ± 2.5	25 ± 2.5
	M8 x 34	2	25 ± 2.5	25 ± 2.5
	M8 x 30	2	25 ± 2.5	25 ± 2.5
Alternator	M10 x 90	1	46 ± 4.6	46 ± 4.6
	M10 x 116	1	46 ± 4.6	46 ± 4.6

Modification basis	
Application basis	
Affected VIN	

Name	Bolt Size	Quantity	Tightening Torque (Nm)	
			D20DT (EURO 4)	D20DT
Air conditioner compressor bracket assembly	M8 x 25	1	25 ± 2.5	25 ± 2.5
	M8 x 60	3	25 ± 2.5	25 ± 2.5
Air conditioner compressor sub bracket assembly	M6 x 16	1	10 ± 1.0	10 ± 1.0
	M8 x 20	1	25 ± 2.5	25 ± 2.5
Intake manifold	M8 x 50	5	25 ± 2.5	25 ± 2.5
	M8 x 133	5	25 ± 2.5	25 ± 2.5
Acoustic cover bracket	M6 x 16	2	25 ± 2.5	25 ± 2.5
	M8 x 105	1	25 ± 2.5	25 ± 2.5
Knock sensor	M8 x 28	1	20 ± 2.6	20 ± 2.6
Camshaft position sensor	M8 x 14	1	12 ± 1.7	12 ± 1.7
Booster pressure sensor	M6 x 20	2	10 ± 1.0	10 ± 1.0
Exhaust manifold stud bolt	M8 x 46	8	15 ± 1.5	15 ± 1.5
	M8 x 35	2	15 ± 1.5	15 ± 1.5
Exhauster manifold nut	M8	8	40 ± 4.0	40 ± 4.0
Turbo charger assembly	M8	3	25 ± 2.5	25 ± 2.5
Turbocharger hollow bolt	M10 x 1.0	1	18 ± 1.8	18 ± 1.8
Turbocharger oil feed pipe	M16 (Cylinder block side)	1	25 ± 2.5	25 ± 2.5
Turbocharger support bar (nut)	M8	1	23 ± 2.3	23 ± 2.3
Turbocharger support bar (bolt)	M8 x 20	1	25 ± 2.5	25 ± 2.5
Turbocharger return pipe	M6 x 16 (T/C side)	2	10 ± 1.0	10 ± 1.0
	M6 x 16 (Cylinder block side)	2	10 ± 1.0	10 ± 1.0
EGR valve assembly	M6 x 25	4	10 ± 1.0	10 ± 1.0
EGR-LH pipe nut	M8	2	35 ± 3.5	35 ± 3.5
EGR-RH pipe nut	M6 x 16	2	10 ± 1.0	10 ± 1.0
EGR center bolt	M6 x 16	4	10 ± 1.0	10 ± 1.0
EGR center pipe	M8 x 25	2	25 ± 2.5	25 ± 2.5
	M8 x 30	2	25 ± 2.5	25 ± 2.5
Glow plug	M5	5	15 ± 3.0	15 ± 3.0
Vacuum pump	M6 x 20	3	10 ± 1.0	10 ± 1.0
	M6 x 25	5	10 ± 1.0	10 ± 1.0
Cooling fan bracket assembly	M6 x 55	1	10 ± 1.0	10 ± 1.0
	M6 x 85	3	10 ± 1.0	10 ± 1.0
Cylinder head cover	M6 x 35	18	10 ± 1.0	10 ± 1.0
Vacuum modulator	M6 x 16	4	10 ± 1.0	10 ± 1.0

Name	Bolt Size	Quantity	Tightening Torque (Nm)	
			D20DT (EURO 4)	D20DT
Oil dipstick tube	M6 x 16	1	10 ± 1.0	10 ± 1.0
	M8 x 35	1	25 ± 2.5	25 ± 2.5
Oil filter assembly	M8 x 55	2	25 ± 2.5	25 ± 2.5
	M8 x 125	1	25 ± 2.5	25 ± 2.5
Fuel rail assembly	M8 x 35	2	25 ± 2.5	25 ± 2.5
Injector	M6 x 60	4	10 ± 1.0 180° + 20°	10 ± 1.0 180° + 20°
Fuel pipe clip (H-C)	M14	2	40 ± 4.0	40 ± 4.0
Fuel pipe clip (C-I)	M14	8	40 ± 4.0	40 ± 4.0
Crankshaft position sensor	M6 x 14	1	0.8 ± 0.4	0.8 ± 0.4
	GAP	-	0.7 ± 1.5 mm	0.7 ± 1.5 mm
Power steering pump	M8 x 100	2	25 ± 2.5	25 ± 2.5
Head screw plug	-	1	25 ± 2.5	25 ± 2.5
Cam shaft cap bolt	M8 x 60	20	25 ± 2.5	25 ± 2.5
Piston topping	-	-	0.765 ~ 1.055 mm	0.765 ~ 1.055 mm
Connecting rod end play	-	-	0.500 ~ 1.500 mm	0.500 ~ 1.500 mm
Cam shaft end play	-	-	0.100 ~ 0.350 mm	0.100 ~ 0.350 mm
Crank shaft end play	-	-	0.100 ~ 0.254 mm	0.100 ~ 0.254 mm

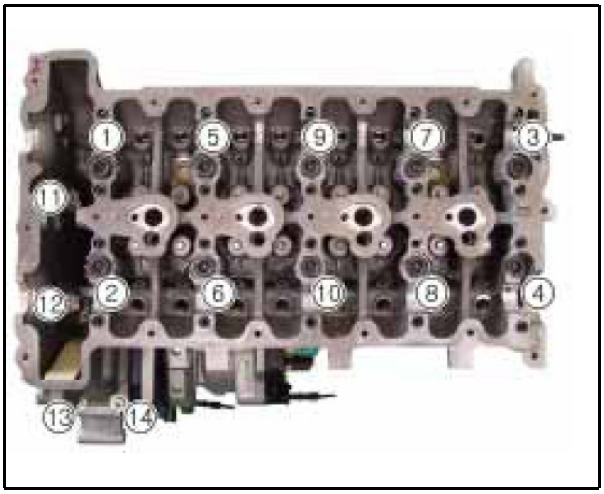
Modification basis	
Application basis	
Affected VIN	

1) Engine Head Bolt Tightening Torque

Head bolt wrench and tightening torque according to the cylinder head bolt changes of the DI engine (D20DT)



Cylinder head bolt wrench
 **W9912 003 0B**
I.D. of head bolt head: 14.5 mm O.D. of head bolt wrench: 13.3 mm



Tightening Torque

A. Removal order
: Remove the bolts in the order as shown in the figure.

B. Installation order (Based on the number in the picture)
: 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1 → 14 → 13 → 12 → 11 (Reverse order of removal)

Size	Tightening torque	Bolt No. (Quantity)
M8 x 25	25 ± 2.5 Nm	11, 12 (2)
M8 x 50	25 ± 2.5 Nm	13, 14 (2)
M10 x 158	85 ± 5 Nm	4 (1)
M10 x 127	270° ± 10°	1 ~ 10 (9)

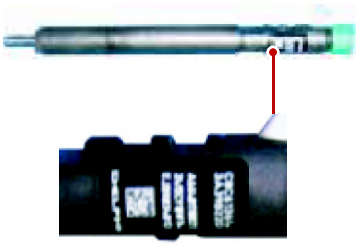
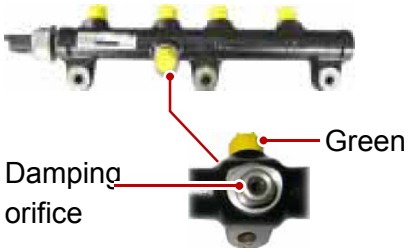
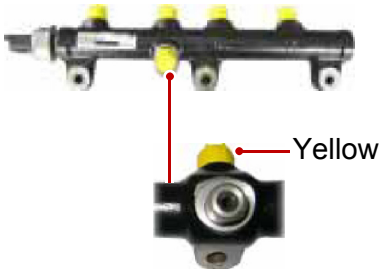
4. MAJOR CHANGES IN D20DT (EU-IV) ENGINE (COMPARED TO D20DT)

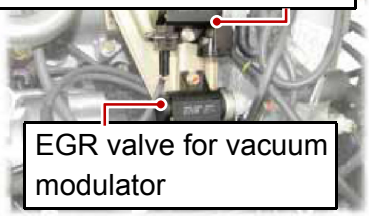
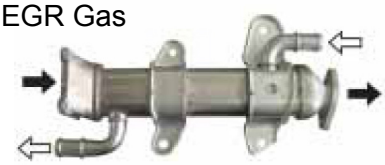
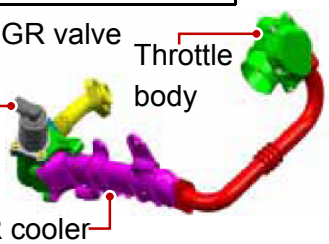
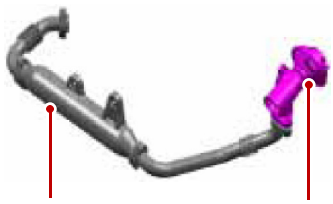
1) Engine Assembly

D20DT (EURO 4) Engine	D20DT Engine
Front Side View  **Touch idler equipped (for A/T)** 	
Top Side View 	
Right Side View 	
Left Side View 	

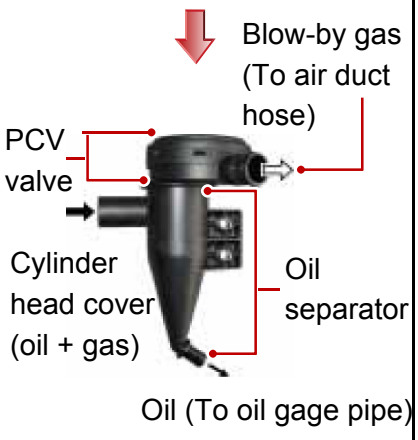
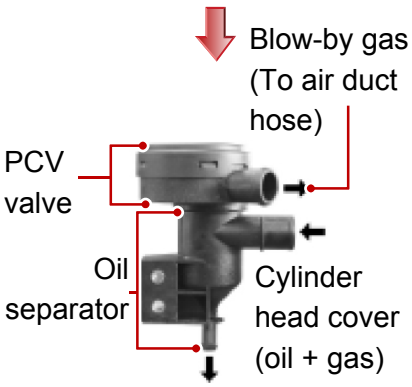
Modification basis	
Application basis	
Affected VIN	

2) Major Changes and Summary

D20DT (EURO 4) Engine	D20DT Engine	Remarks
Injector  C3I Label	 C2I Label	* Injector label - D20DT: Green (Cap) (16 digits: C2I value) - D20DT (EURO 4): Red (Cap) (20 digits: C3I value)
Fuel pipe 		* Diameter increased - D20DT: ID (2.4 mm), OD (6.0 mm) - D27DT (EURO 4): ID (3 mm), OD (6.35 mm)
Fuel high pressure pipe 		Diameter expanded due to the increased capacity.
Common rail 		* D20DT (EURO4): Added damping orifice. (Orifice is added to fuel inlet/ outlet ports in order to dampen the pulsation in fuel flow caused by multi-injections.)
Electric controlled E-EGR valve 	EGR valve 	* E-EGR valve: ECU controls the EGR valve directly without any media. It provide more precise EGR control by transmitting the electric signal of EGR valve operating position.

D20DT (EURO 4) Engine	D20DT Engine	Remarks
HFM 6.0 	HFM 5.0 	* Version up - D27DT: HFM5-CI (Analog signal) - D27DTP: HFM6-ID (Digital signal added)
Vacuum modulator  VGT turbo charger control	Vacuum modulator for controlling turbo charger actuator  EGR valve for vacuum modulator	* D20DT (EURO4) engine uses electric ally controlled E-EGR valve. Thus, the vacuum modulator for controlling EGR valve has been deleted.
Throttle body 	**N/A**	* Throttle body is for future regulation requiring emission reductions. Currently, it is used to prevent the engine from turning off with fluttering noise at the moment the air to intake manifold is blocked by closed flap when the engine is switched off.
EGR cooler EGR Gas  Coolant	EGR center pipe  EGR Gas	* To enhance EGR function, coolant EGR cooler is adopted to reduce the temperature of exhaust gas into the intake manifold.
E-EGR system layout E-EGR valve Throttle body  EGR cooler	EGR system layout  EGR center pipe EGR valve	* Reason of changes - To satisfy the emission regulation, E-EGR valve and EGR cooler are adopted. And the layout also has a great difference from D27DT.

Modification basis	
Application basis	
Affected VIN	

D20DT (EURO 4) Engine	D20DT Engine	Remarks
PCV oil separator  	 	* Increase of Oil separator capacity (approx. 10%) - D20DT (EURO 4): 160 /min - D20DT: 120 /min
Intake manifold 		* The appearance of intake manifold is changed to the round type due to the throttle body. Also, the mounting location of booster pressure sensor is changed.
Water pump 		* For D20DT (EURO4) engine: Additional connecting port for EGR cooler hose
Coolant outlet port 		* For D20DT (EURO4) engine: Additional port for coolant of EGR cooler

ENGINE FUEL SYSTEM

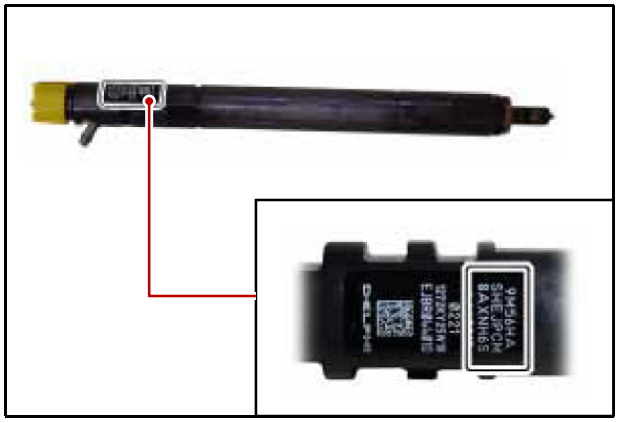
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GENERAL

1. MAJOR CHANGES IN FUEL SYSTEM OF ENGINE

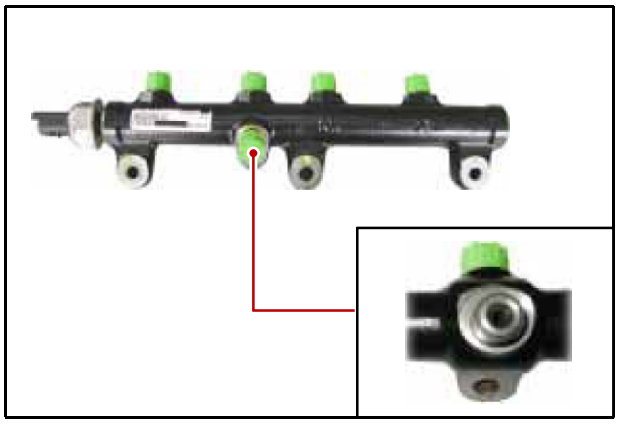
There are some changes in the parts related to the fuel system due to the newly adopted D20DT (EURO 4) engine.
The major changes are as follows. Refer to the next pages for further details.

1) Injector



- Two nozzle holes are added (currently 7) to the tip of the injector to increase the amount of fuel injection and to improve injection efficiency according to the increased engine power.
- The existing C2I coding (16 digits) is changed to C3I coding (20 digits) to monitor fuel injection and follow the target value.
- For the D20DT engine, the injector MDP (minimum current for the solenoid in the injector to lift the nozzle) is leaned only when the engine is running.
  However, for the D20DT (EURO 4) engine, it is learned when the vehicle is in motion and the engine is at idle speed.

2) Common Rail



- The orifice is added to the connection to the fuel pipe of the HP pump to prevent the fuel pulsation by the fuel supply and fuel cut according to the increase of injected fuel volume. (It is also installed on the connection of the high pressure fuel supply line of the HP pump.)

3) Fuel Rail - Chrome Color

Fuel pipe (Common rail → Injector) 
Fuel high pressure pipe (HP pump → Common rail) 

- The I.D and O.D of the fuel rail between HP pump and common rail are increased according to the increased amount of fuel injection.
  Also, the engine ECU, HFM sensor and EGR system are changed to control the fuel injection volume and engine more precisely.

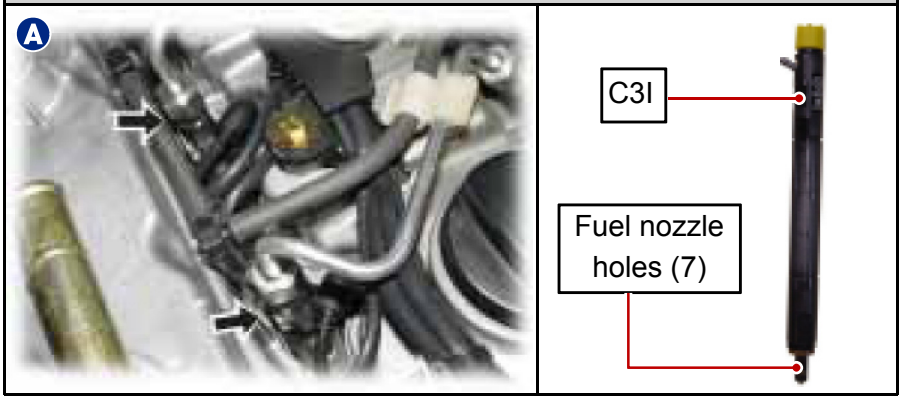
Modification basis	
Application basis	
Affected VIN	

Memo

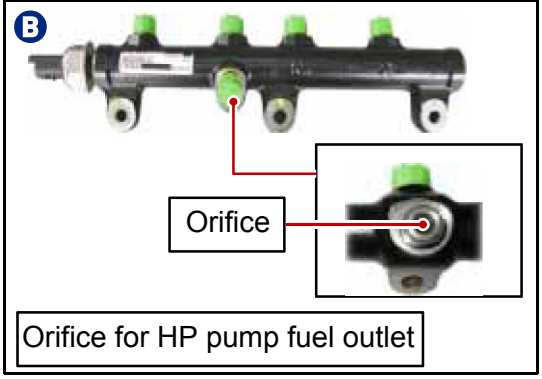
OVERVIEW AND OPERATION PROCESS

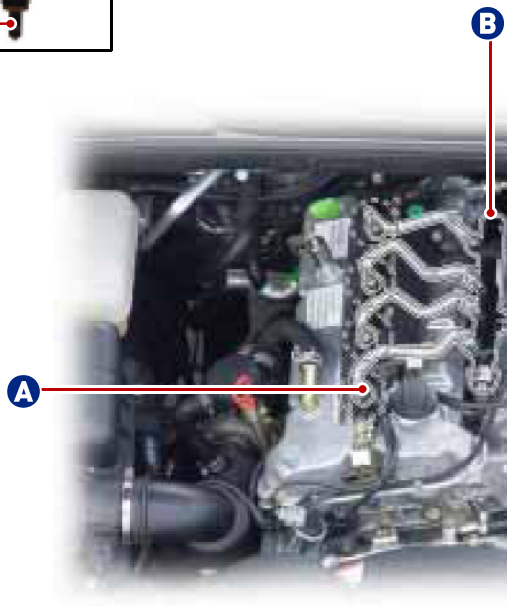
1. COMPONENTS OF FUEL SYSTEM

Injector (7-way Injection and C3I Coding)

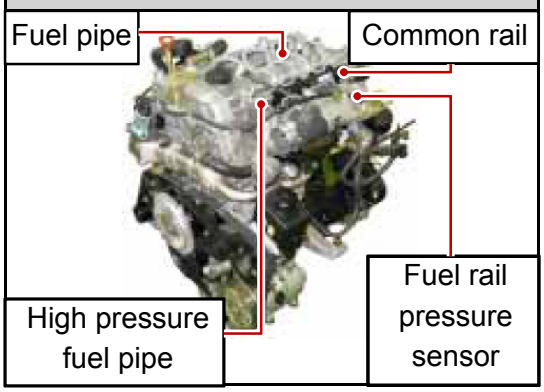


Common Rail (Orifice for Preventing Fuel Pulsation Added)

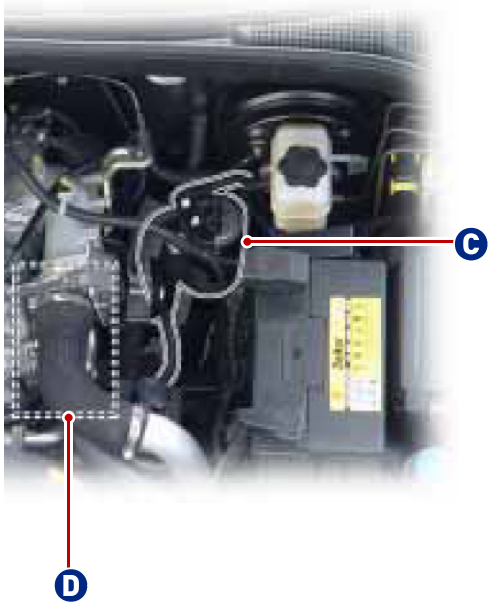




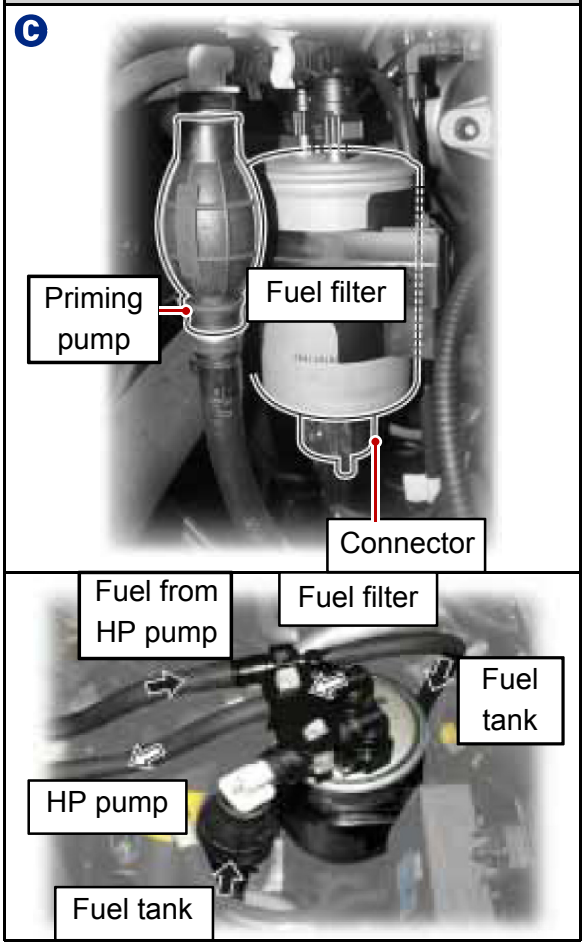
Fuel Supply Rail (Increase in I.D)



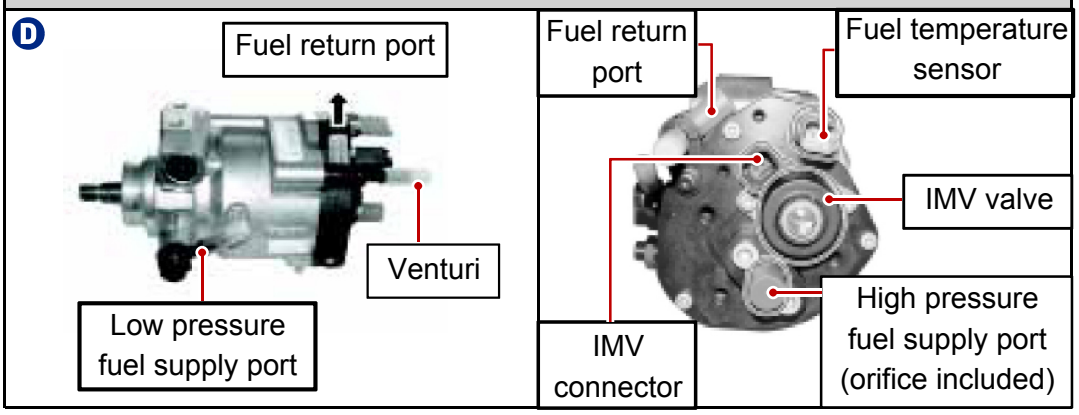
Modification basis	
Application basis	
Affected VIN	



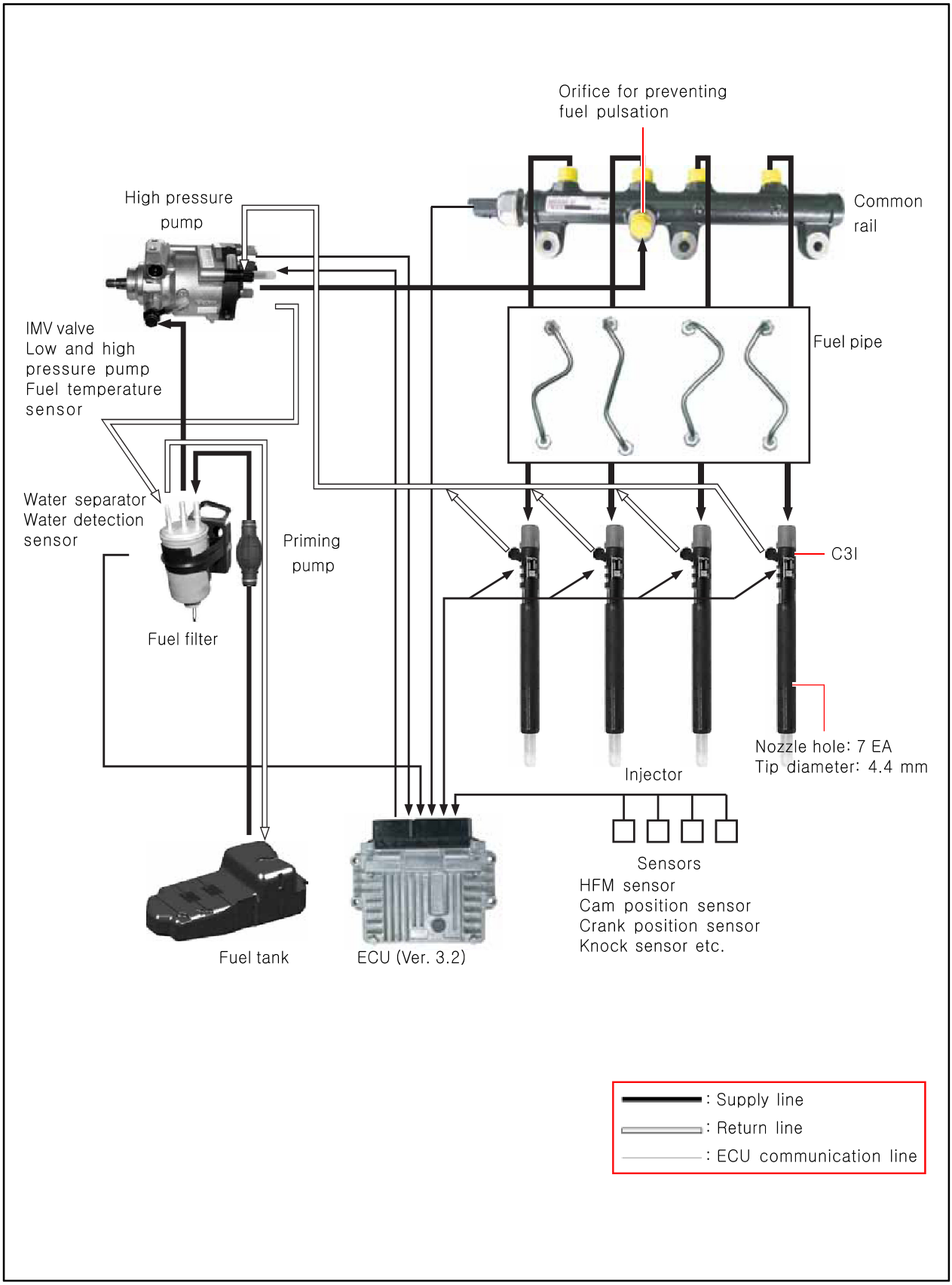
Fuel filter Priming Pump



HP Pump



2. FUEL FLOW OF D20DT (EU-IV) ENGINE



Modification basis	
Application basis	
Affected VIN	

ENGINE INTAKE SYSTEM

2321-01

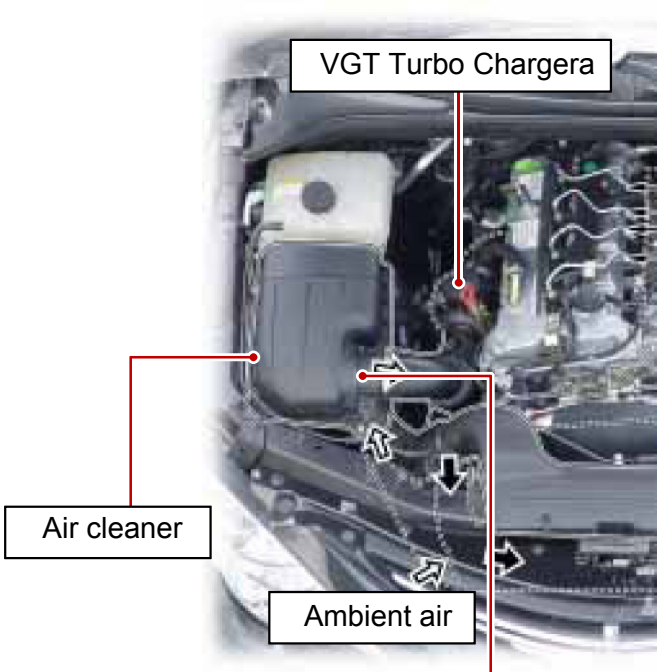
OVERVIEW AND OPERATION PROCESS

1. OVERVIEW

The intake system for the D20DT (EURO 4) engine is equipped with the throttle body that has a flap to block the air coming to the engine when the engine is switched off. Therefore, the structure of the intake manifold has been changed. Also, the improved HFM sensor (from HFM5.0 to HFM6.0) has been installed to control the intake air precisely so that the NOx in the exhaust gas can be decreased.

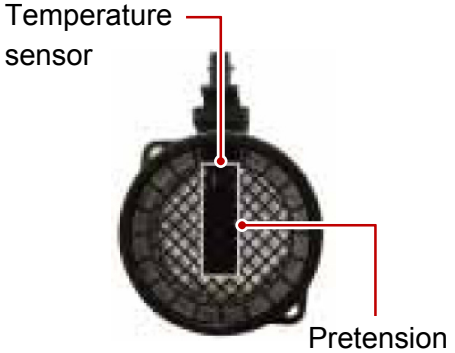
2. INTAKE SYSTEM LAYOUT

⇨ Uncompressed air
➡ Compressed air



HFM Sensor (ver. 6.0)

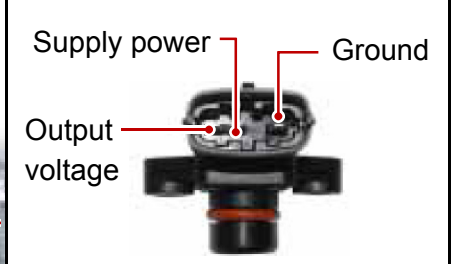




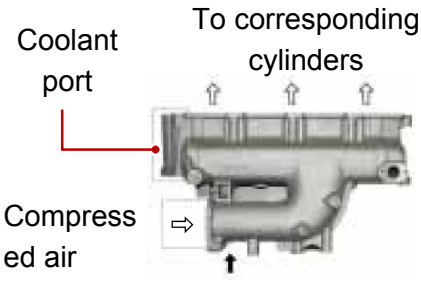
Modification basis	
Application basis	
Affected VIN	



Booster Pressure Sensor

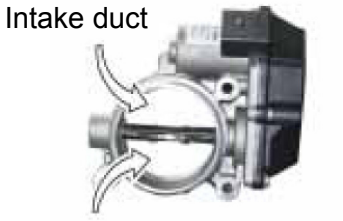


Intake Manifold



Throttle body

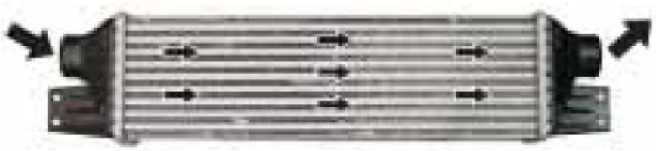
Normal: flap open



Engine stopped: flap closed



Intercooler



ENGINE EXHAUST SYSTEM

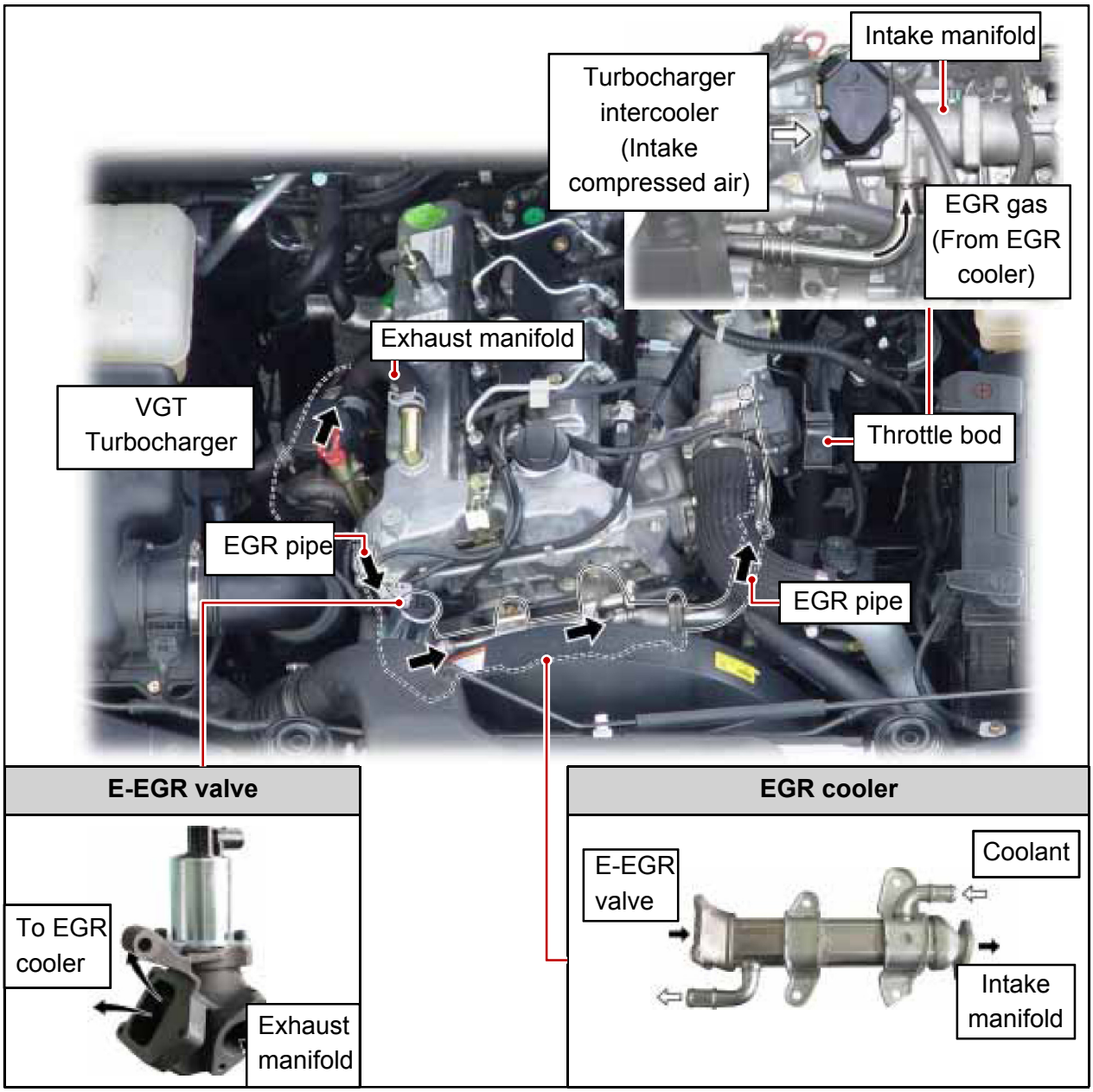
1792-01

OVERVIEW AND OPERATION PROCESS

1. COMPONENTS

The components of the exhaust system for the D20DT (EURO4) engine have been changed as follows:

- ▶ E-EGR valve - Controlling the EGR valve electrically and sends the valve location signal to ECU (vacuum modulator control has been deleted)
- ▶ EGR cooler - Decreasing EGR gas (NOx) efficiently by cooling the EGR gas and let it flow to the intake pipe



CDF (EURO IV)

1881-09

GENERAL INFORMATION

1. OVERVIEW FOR CDPF (EU-IV)

1) General Description

The CDPF (Catalyst & Diesel Particulate Filter) was installed to the Rexton II D27DTP engine previously. However, it is now installed to the all 2009 DI engine models, except the Actyon Sports. The DI engine type sinstalled to Rexton are D27DTP, D27DT and D20DT, and their CDPF, related sensor and operation logic are the same.This section describes the CDPF system (based on Euro IV) which is installed to the Rexton II D27DTPengine (older model).

2) Compatibility of CDPF System by Vehicle Model

Rexton II: Same CDPF system for D27DTP and D27DT engines (including its components)
Kyron & Actyon: Same CDPF system for D27DT and D20DT engines (including its components)

NOTE

- **The CDPF assemblies installed to the Euro IV D27DTP Rexton II and 2009 Rexton II are different in their mounting layout, but their front/rear exhaust temperature sensors and differential pressure sensors are same.**

3) System Met with EURO IV Regulations

The Ssangyong vehicles installed with the D27DT engine manufactured from July 2007 to December 2007 comply with the EURO IV regulations. Modified components from the old engine model are as follow:

- E-EGR valve
- EGR cooler
- Engine ECU (Ver. 3.2)
- HFM senso
- C3I injector
- Electronic throttle valve (body)
- Other engine mounting components

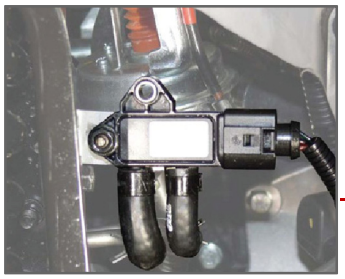
For details about the modified components and system related to the EURO IV regulations, refer to the 2008 Rodius engine service manual.

2. CDPF (EU-IV) SYSTEM

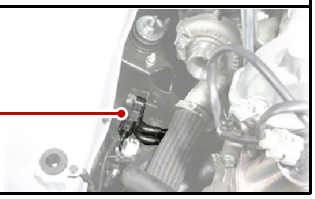
The CDPF system is only installed to the D27DT engine, and the major changes comparing to the previous D27DT engine is as follows:

CDPF (Catalyst & Diesel Particulate Filter) and Sensors

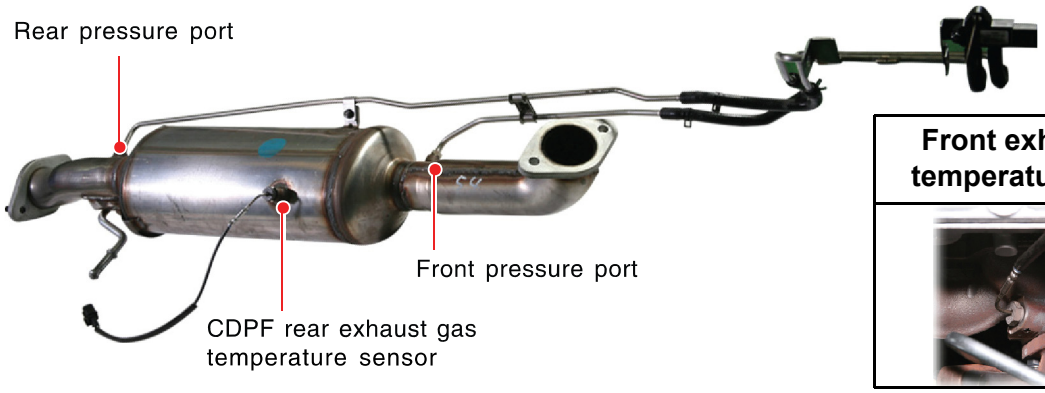
Differential Pressure Sensor (ΔP sensor)



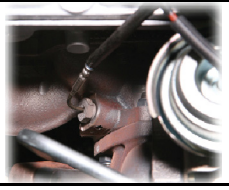
Under air cleaner in right side of engine compartment



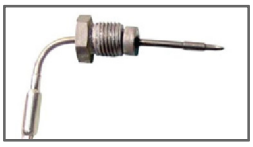
As the soot is filtered in the CDPF, the pressure between the front side and the rear side of the filter is different from each other. If the amount of soot is over 28 g, the soot is burnt in the CDPF. The combustion is determined depending on the pressure difference, temperature of exhaust gas and EGR ratio. According to these, the soot filtered by post injection of injector is burnt at 600°C.



Front exhaust gas temperature sensor



CDPF Exhaust Gas Temperature Sensor



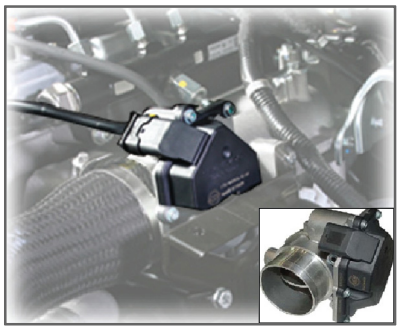
The two temperature sensors in-side the CDPF are installed inexhaust manifold (front exhaustgas temperature sensor) and inDOC (rear exhaust gas tempera-ture sensor), and perform the fol-lowing functions.

Front Exhaust Gas Tempera-ture Sensor:
Measures the exhaust gas tem-perature of the exhaust manifold. As it is installed in front of the VGT turbocharger, it also monitors the exhaust gas tempera-ture coming to the turbocharger. If the temperature of the exhaust gas flowing to the turbocharger is higher than the specification, the engine lowers the exhaust gas temperature.

Rear Exhaust Gas Tempera-ture Sensor:
Measures the increased ex-haust gas temperature after the oxidation process of DOC. If the temperature is below 600°C, the post injection amount is increased to increase the temperature.

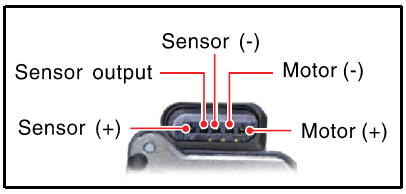
Modification basis	
Application basis	
Affected VIN	

Throttle Body



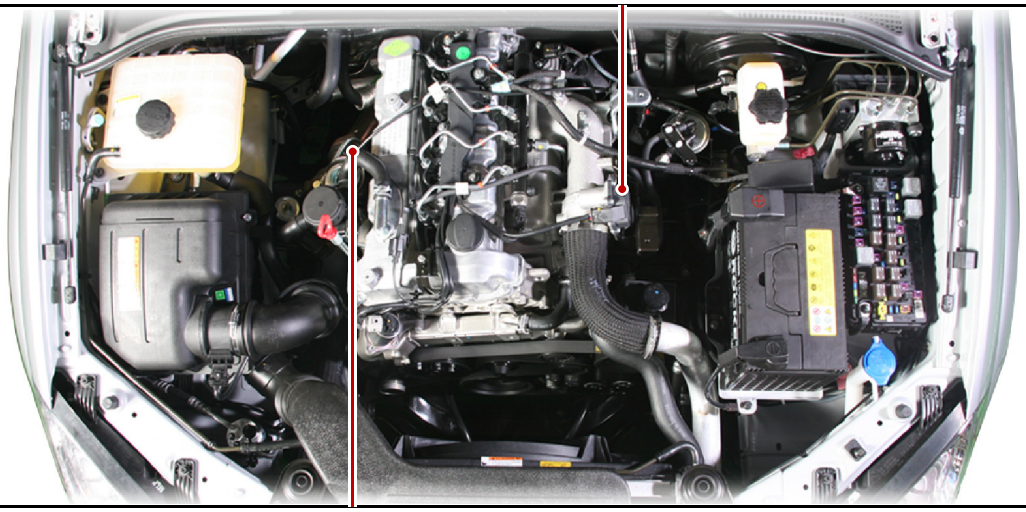
CDPF system controls the amount of intake air by controlling the electronic throttle body. The electronic throttle body has the following main functions.

CDPF control - added a function that increases the exhaust gas temperature by closing the throttle valve flap to minimize the intake air amount by the fuel injection amount during the CDPF regeneration range with the low engine load range.



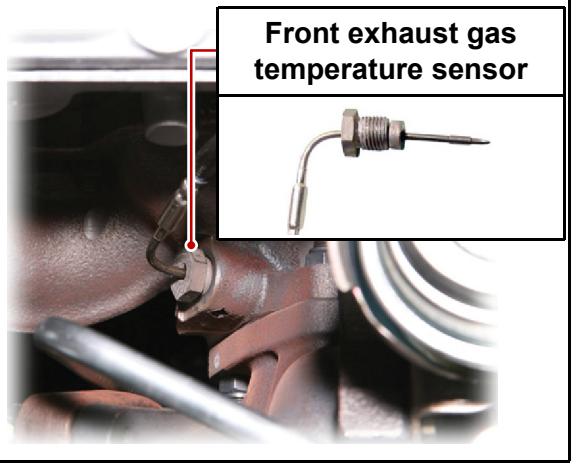
ON/OFF control - prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped.

Duty control - controls the valve inside the throttle body to burn more EGR gas in the EGR valve operating range.



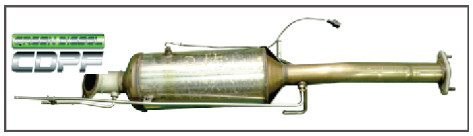
VGT Turbocharger and Front Exhaust Gas Temperature Sensor

Turbocharger may become weaker if high temperature exhaust gas passes through the turbocharger for DPF regeneration process.
The front exhaust gas temperature sensor monitors the temperature of the exhaust gas that flows into the turbocharger.
If the temperature of the exhaust gas that passes through the exhaust manifold is higher than the specification, the ECU decreases the fuel injection amount and increases the EGR gas intake amount to decrease the exhaust gas temperature.



OVERVIEW AND OPERATION PROCESS

1. OVERVIEW



As the solution for environmental regulations and PM (Particla Material) of diesel engine, the low emission vehicle is getting popular. This vehicle is equipped with an extra filter to collect the soot and burn it again so that the amount of PM in the exhaust gas passed through the DOC (Diesel Oxydation Catalyst) is reduced. The CDPF (**C**atalyst & **D**iesel **P**articulate **F**ilter) is anintegrated filter including DOC (Diesel Oxydation Catalyst) and DPF (Diesel Particulate Filter).

▶ Comparison of throttle body functions based on exhaust emission regulation

Regulated parts are carbon monoxide (CO), nitrogen oxide (NOx), particular matter (PM) and soot in the exhaust emission, and the particulars of the regulations are prescribed in the following table.

Engine	Control method	Function
D27DTP + CDPF **D27DT + CDPF** **D20DT + CDPF**	ECU's electric signal (Duty and On/Off control) + Throttle flap control during CDPF operation	**ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped **Duty control -** controls the valve inside the throttle body to burn more EGR gas in the EGR valve operating range. **CDPF control -** added a function that increases the exhaust gas temperature by closing the throttle valve flap to minimize the intake air amount by the fuel injection amount during the CDPF regeneration range with the low engine load range.
D27DT engine (EU IV)	ECU's electric signal (Duty and On/Off control)	**ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped **Duty control -** controls the valve inside the throttle body to burn more EGR gas in the EGR valve operating range.

Modification basis	
Application basis	
Affected VIN	

2.CDPF (EU-IV) SYSTEM CONTROL

1) General Description

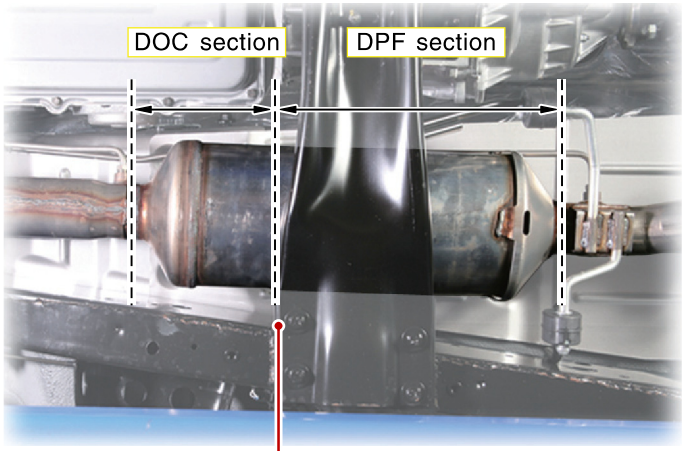
As the soot is filtered in the CDPF, it is burnt and removed, and the CDPF is returned to the initial state to collect the soot. Therefore, the burning procedures in the CDPF can be called as regeneration.

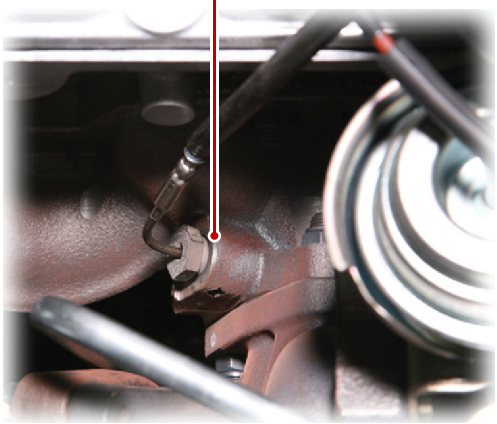
The CDPF assembly is integrated with DOC (at front side) and DPF (at rear side).

The DPF burns the soot with high-temperature exhaust gas (over 600°C). The rear exhaust gas temperature sensor monitors the temperature of DPF section. If this temperature is below the regeneration temperature, the ECU increases the post injection period to increase the fuel injection amount, and consequently to increase the exhaust gas temperature.



Front exhaust gas temperature sensor
(Measuring temperature of exhaust gas in exhaust manifold)





Rear exhaust gas temperature sensor
(Measuring temperature of exhaust gas escaping DOC)

CAUTION

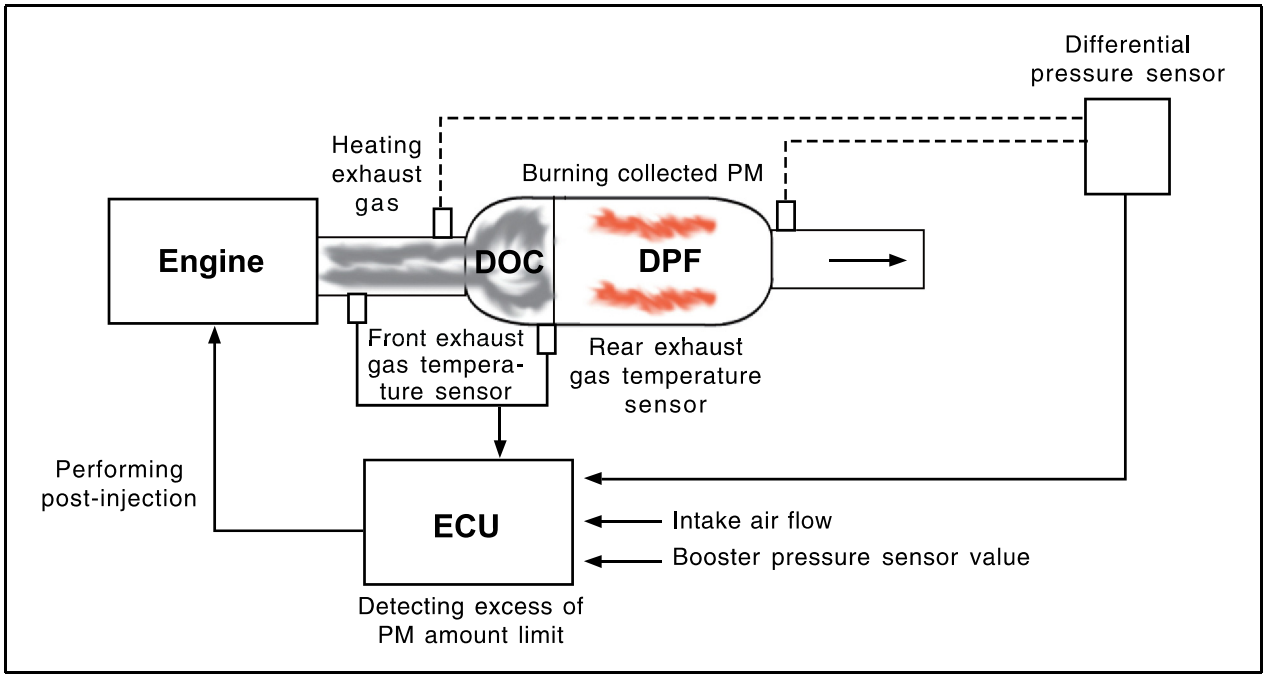
- Normally, when the vehicle is driven for 600 ~ 1,200 km, the enough amount of soot to be burnt is filtered and accumulated in the CDPF. The ECU increase the amount of post injection to increase the tempeature of exhaust gas up to 600°C so that the soot is burnt. The soot is burnt for 15 ~ 20 minutes.

2) System Composition for Soot Combustion

When the engine is running in low load range, the temperature of exhaust gas is decreased as the amount of fuel supplied is decreased. To burn the soot filtered in the CDPF, the control system should be installed to check the operating range and increase the temperature of exhaust gas by controlling the amount of fuel supplied and intake air.
Two temperature sensors and one differential pressure sensor monitor the CDPF's operating range. According to these sensors' information, the throttle flap decreases the intake air entered to the throttle body. Also, the fuel injection pattern is added to increase the temperature of exhaust gas for soot combustion.
There are three fuel injection patterns (pilot injection, pre-injection and main injection). As the CDPF is installed, the post injection pattern is added.

3) Post Injection and Air Mass Control

When the differential pressure sensor detects the pressure difference between the front and the rear side of CDPF, the sensor sends signal indicating the soot is acumulated and the post injection is performed to raise the temperature of exhaust gas. The amount of fuel injected is determined according to the temperature of exhaust gas detected by the rear temperature sensor. If the temperature is below 600°C, the amount of fuel injected is increased to raise the temperature. If the temperature is over 600°C, the amount of fuel injected is decreased or not controlled.
When the engine is running in low load range, the amount of post injection and the amount of intake air are controlled. It is to raise the temperature by increasing the amount of fuel while decreasing the amount of intake air.



Modification basis	
Application basis	
Affected VIN	

NOTE

Throttle bodies by engine type

- The throttle valve is controlled by electric signals sent from the engine ECU for optimal fuel injection volume, engine load and effective combustion of EGR gas according to the Euro 4 regulations. It has following functions by the engine type.

Engine	Control Method	Function
D27DTP + CDPF **D27DT + CDPF** **D20DT + CDPF**	ECU's electric signal (Duty and On/Off control) + Throttle flap control during CDPF operation	**CDPF control -** added a function that increases the exhaust gas temperature by closing the throttle valve flap to minimize the intake air amount by the fuel injection amount during the CDPF regeneration range with the low engine load range. **ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped. **EGR gas amount control -** Close the valve to decrease the intake air amount and lets more EGR gas flows to burn more EGR gas at EGR valve operating range.
D27DT engine (EU IV)	ECU's electric signal (Duty and On/Off control)	**ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped. **EGR gas amount control -** Close the valve to decrease the intake air amount and lets more EGR gas flows to burn more EGR gas at EGR valve operating range.
D27DT engine	No throttle body installed	

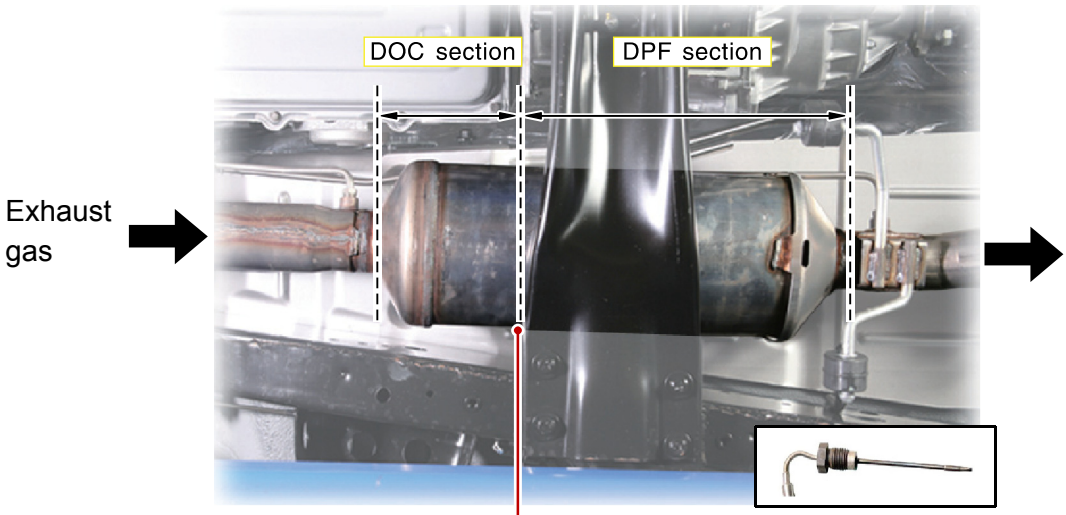
3. SOOT FILTERING AND BURNING PROCEDURES

1) Operating Procedures of CDPF

The most efficient and practical technology for now is adopted to the diesel particulate filter (DPF).
This system collects the soot from the diesel engine to the filter and burns the soot so that over than 95% of soot can be removed from the exhaust gas. However, the durability and the cost of additional system remainas problems.

Firstly, the exhaust gas is passed through the DOC and its temperature is increased as it is oxidized. The ECU detects the temperature change with two temperature sensors. The CO, HC and partial particulate material are removed from the exhaust gas (this procedures are the sames as the ones for the conventional DOC and no sensor is required).

After the exhaust gas is passed through the DOC and oxidized, most of the harmful material is removed from the exhaust gas. However, to meet the environmental regulations in the future, the soot is filtered and burnt again in DPF to decrease the particulate material further.



Rear exhaust gas temperature sensor(Measuring temperature of exhaust gas escaping DOC)

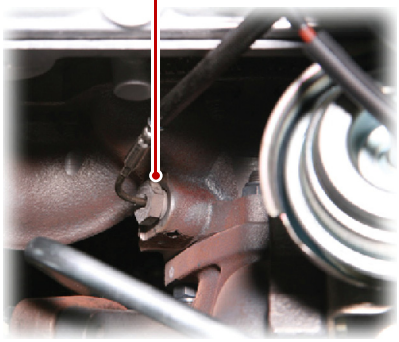
CAUTION

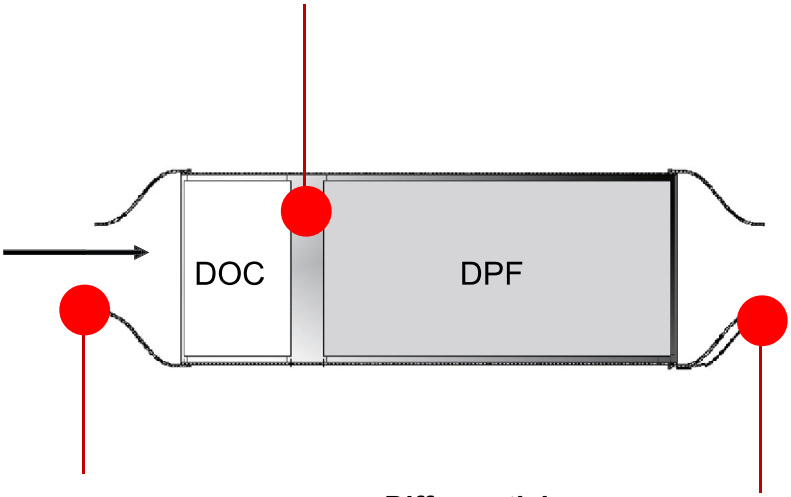
- The filtered soot is burned whenever the vehicle is driven for 600 ~ 1200 km. The driving distance can be differed depending on the vehicle's driving conditions. The soot is burnt for 15 ~ 20 minutes.

Modification basis	
Application basis	
Affected VIN	

Front temperature sensor
(Measuring the temperature of exhaust gas passedthrough exhaust manifold)

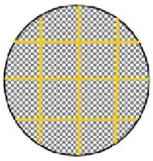
Rear temperature sensor
(Measuring the temperature of exhaust gas passed through DOC)



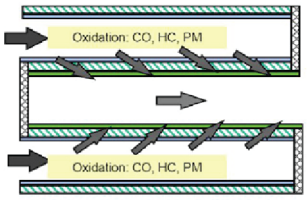


Differential pressure sensor
(Front pressure port)

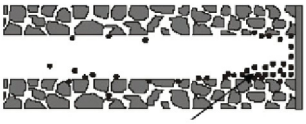
Differential pressure sensor
(Rear pressure port)



The exhaust gas enters intoCDPF assembly after passing through the exhaust manifold. (Normal temperature of ex-haust gas: approx. 250°C)

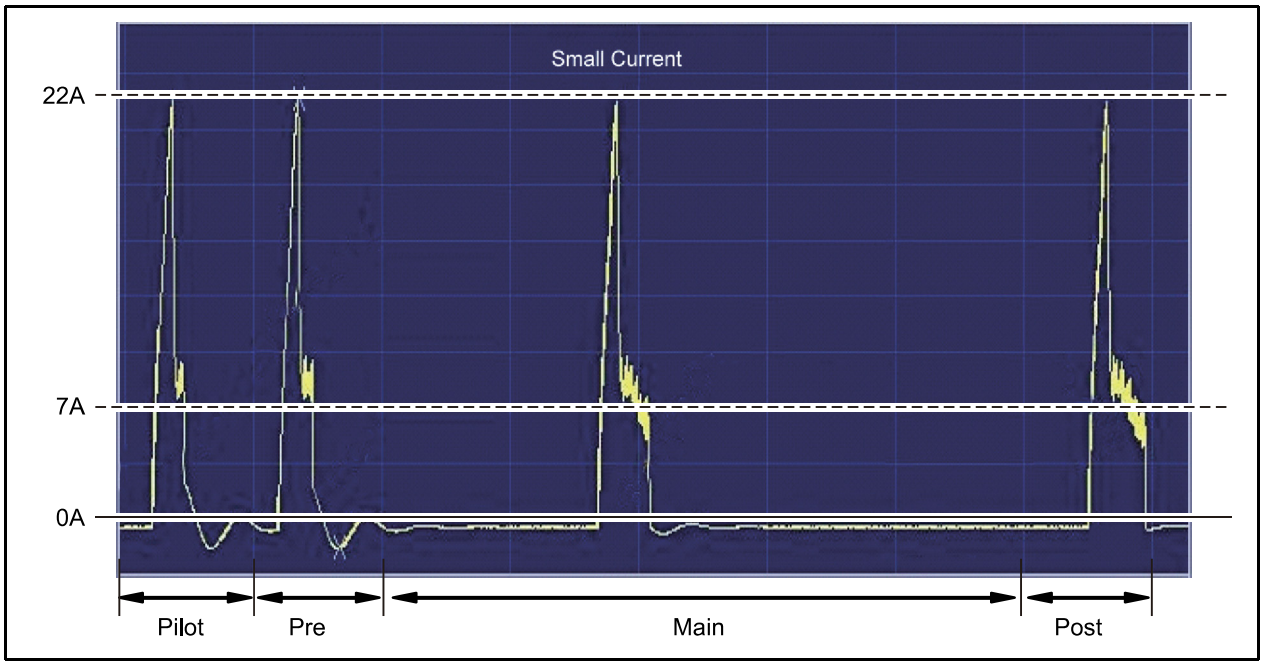


When the exhaust gas enters into the CDPF assembly, its CO, HC and particulate mate-rial are reduced as it is oxi-dized in DOC. The remaining particulate material is filtered and collected in DPF and the temperature of exhaust gas is increased to approx. 450 ~500°C.



The engine ECU detects the amount of particulate material colected by the information from temperature sensors and differential pressure snesor. When the soot is accumulated, the pressure difference be-tween the front and the rear side occurs. Then, the engineECU performs the post injec-tion to raise the exhaust gas temperature and burn the collected soot at approx. 600°C.

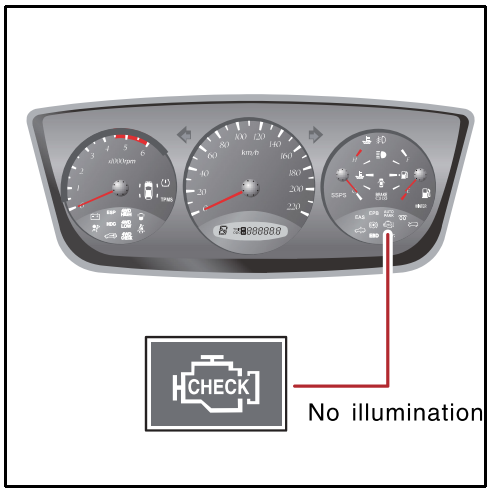
2) Fuel Injection During CDPF Regeneration



Injection	Effect
Pilot injection	Decrease of PM by fuel mixture Decrease of noise from engine combustion
Pre-injection	Decrease of NOx by shortening main injection delay due to flammability Decrease of noise from engine combustion
Main injection	Main power source
Post-injection	Activation of CDPF by increasing exhaust gas temperature and supply-ing reduction material

3) Warning Lamp Related To CDPF

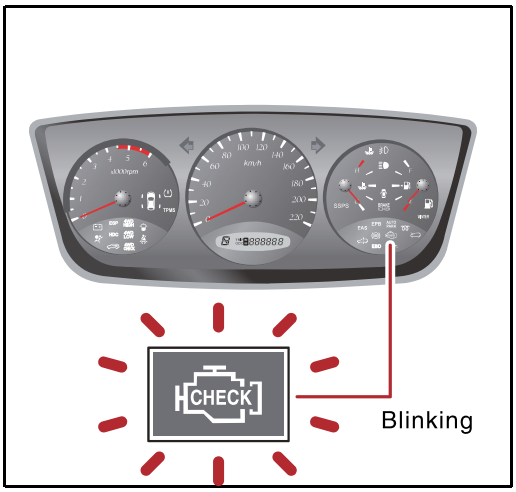
▶ **CDPF regeneration process (warning lamp NOT illuminated)**



The CDPF system enters the regeneration mode when the driving distance becomes approx. 600 to 1,200 km (may differ by the driving condition and driving style). Then, the engine ECU performs the CDPF regeneration operation. However, the driver is not in-formed with this operation by any engine warning lamp or vehicle signal, so he/she may not detect this operation. The control logic at the post-injection dur-ing the regeneration process is to increase the fuel injection volume and control the intake air volume (by the throttle body) in order to increase the tem-perature of the exhaust gas. The driver may not feel any particular difference from the vehicle.

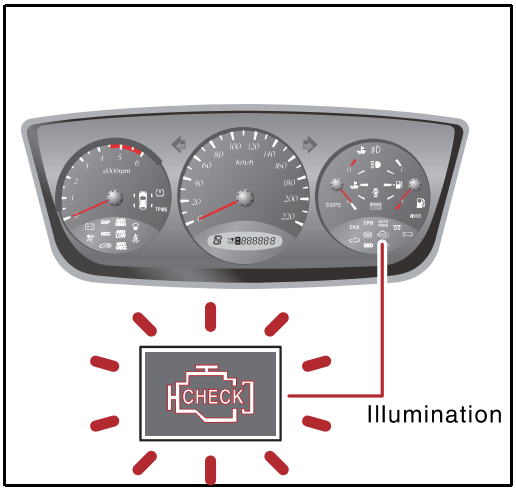
Modification basis	
Application basis	
Affected VIN	

▶ Overload of CDPF (warning lamp blinking)



1. If the CDPF cannot reach the regeneration tem-perature due to low speed driving or other reason during the regeneration process, the soot is con-tinuously accumulated in the CDPF. When this condition continues and the CDPF is overloaded with soot, the engine warning lamp blinks to in-form this situation to the driver.
2. In order to solve this problem, drive the vehicle at a speed of approx. 80 km/h for 15 to 20 minutes to perform the CDPF regeneration process.
3. If the engine warning lamp on the instrument clus-ter blinks, the CDPF is overloaded. In this case, perform the step 2.

▶ Excessive overload of CDPF (warning lamp illuminated)



1. If the vehicle is driven at a speed of 5 to 10 km/h for an extended period of time, the soot accumu-lated in the CDPF cannot be burnt as the CDPF cannot reach the regeneration temperature. Then, an excessive amount of soot can be accumulated in the CDPF.
2. This case is much worse than the simple over-load of the CDPF. To inform this to the driver, the engine warning lamp comes on and the engine power is decreased to protect the system.
3. To solve this problem, blow soot between the en-gine and exhaust system several times and erase the related DTC. Then, check if the same DTC is regenerated again. If so, check the DTC related to the differential pressure sensor.

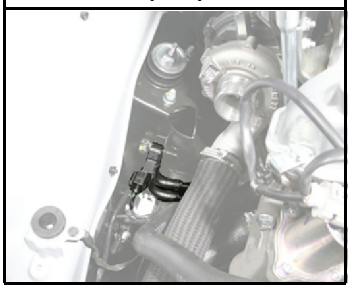
Actually, the DTC for the CDPF is generated more often by the component related to the CDPF system, such as the differential pressure sensor, than by excessive soot in the CDPF.

4. COMPONENTS OF CDPF SYSTEM

1) Mounting Condition and Location

Differential Pressure Sensor

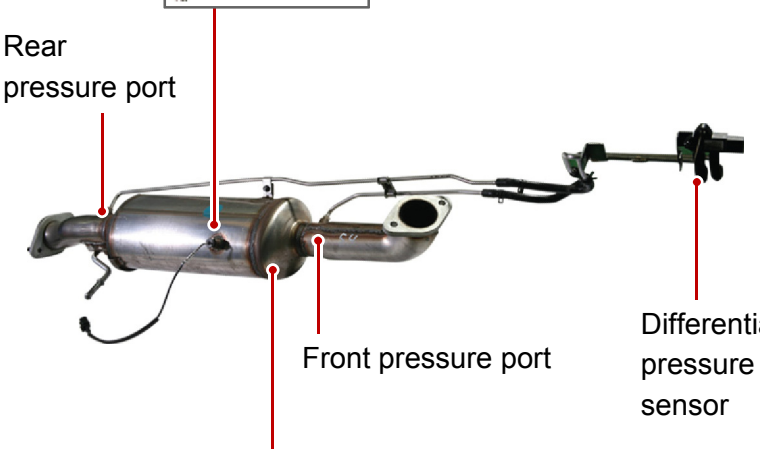
Engine compartment (RH)



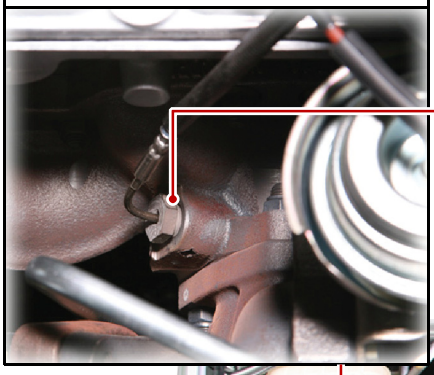


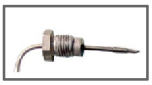
Rear exhaust gas temperature sensor





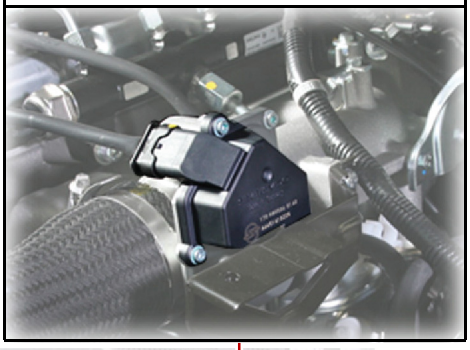
Front Exhaust Gas Temperature Sensor

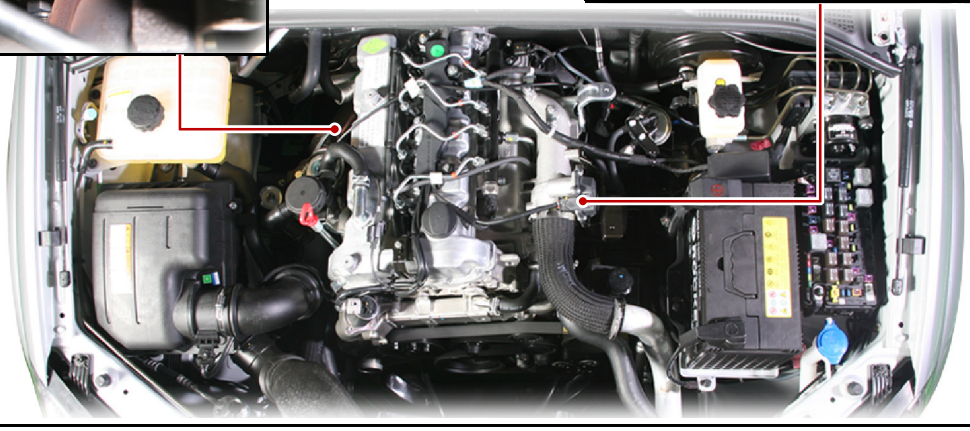




Front exhaust gas temperature sensor

Throttle Body





Modification basis	
Application basis	
Affected VIN	

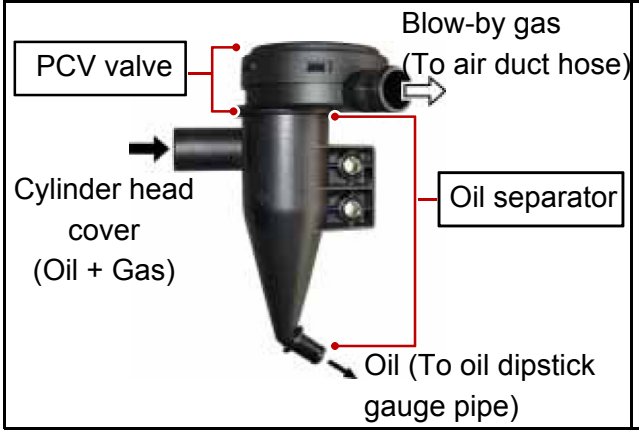
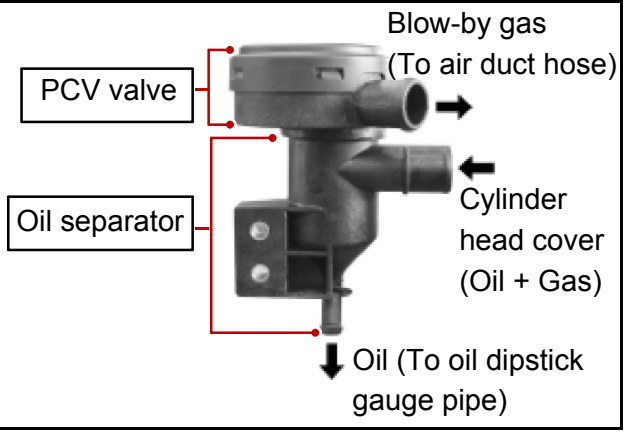
LUBRICATION SYSTEM

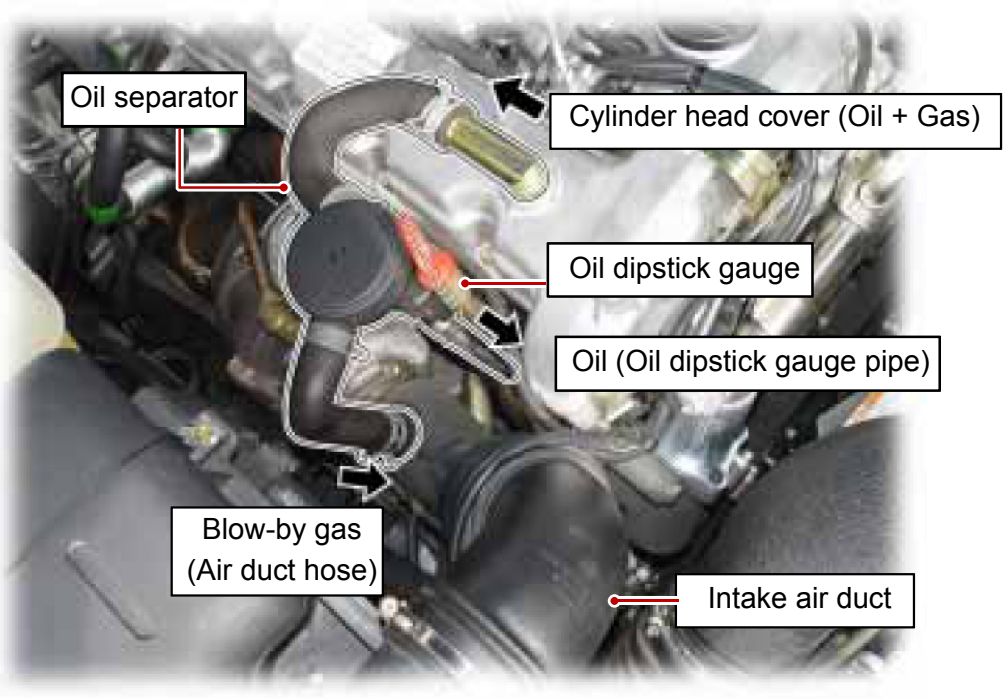
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OVERVIEW AND OPERATION PROCESS

1. OVERVIEW OIL SEPARATORS

For the D20DT (EURO4) engine, the PCV oil separator's capacity has been increased by 10% compared to the conventional PCV oil separator for D20DT engine to separate the oil and the gas more efficiently.

PCV Oil Separator (High Capacity Type)	PCV Oil Separator
	



The first separation will happen when blowby gas passes through baffle plates in cylinder head cover. Then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port. Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering the combustion chamber through air duct hose via PCV valve that opens/closes due to pressure differences between the intake side and crankcase.

CAUTION

Performance of PCV Separator and Oil/Carbon Accumulation in Intake Manifold

It is not possible to separate the blowby gas (oil and unburned gas) completely from the crankcase.
This problem is related to the engine control and the PCV oil separator is designed to recirculate approx. 70% of blowby gas.

When servicing the intake system, you can find that oil and carbon is accumulated in the intake pipe.
It is normal for the vehicle that is normally used in city. Because of the engine control problem, the 100% of blowby gas cannot be recirculated and EGR and PCV oil separator's operating ranges are overlapped in normal driving mode. These are the cause of oil and carbon accumulated in the intake pipe.

When the EGR system is operated, the particulate material in the exhaust gas is drawn into the intake pipe and the oil not filtered in the PCV oil separator is also drawn into the intake pipe.

However, unless the particulate material or oil are accumulated excessively in the pipe, they do not affect the intake/exhaust valve or related components.

On the contrary, if they are removed using carbon cleaner or chemicals, the engine system may not function properly.

If too much oil or particulate material is accumulated, check the followings:

1. Engine oil level
2. EGR valve (exhaust gas leak and operating condition)
3. Turbocharger (oil/gas leak and operating condition)
4. PCV oil separator (installation condition and leak)
5. PCV oil separator (some functions)

Modification basis	
Application basis	
Affected VIN	

ENGINE COOLING SYSTEM

2112-00/1520-00

COOLING SYSTEM

1. COMPARISON IN COOLING SYSTEM FOR EACH ENGINE..... 3

WATER PUMP

1. OVERVIEW..... 4

Modification basis	
Application basis	
Affected VIN	

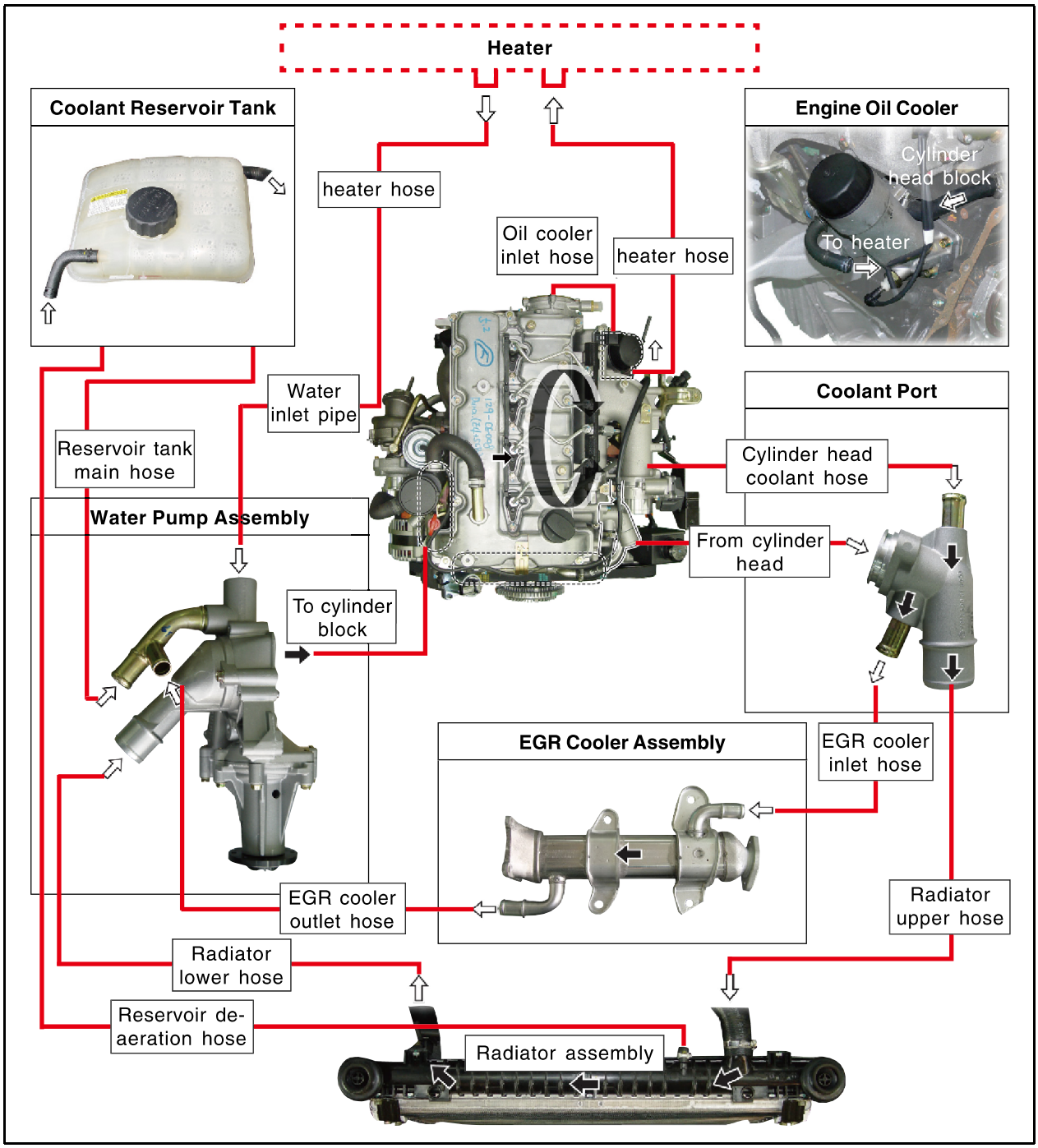
COOLING SYSTEM

2112-00

1. COMPARISON IN COOLING SYSTEM FOR EACH ENGINE

For the D20DT (EURO4) engine, the cooling system is equipped with E-EGR cooler and the water pump which its capacity is improved according to the additional coolant line in the cylinder block.

1) Cooling System for Engine



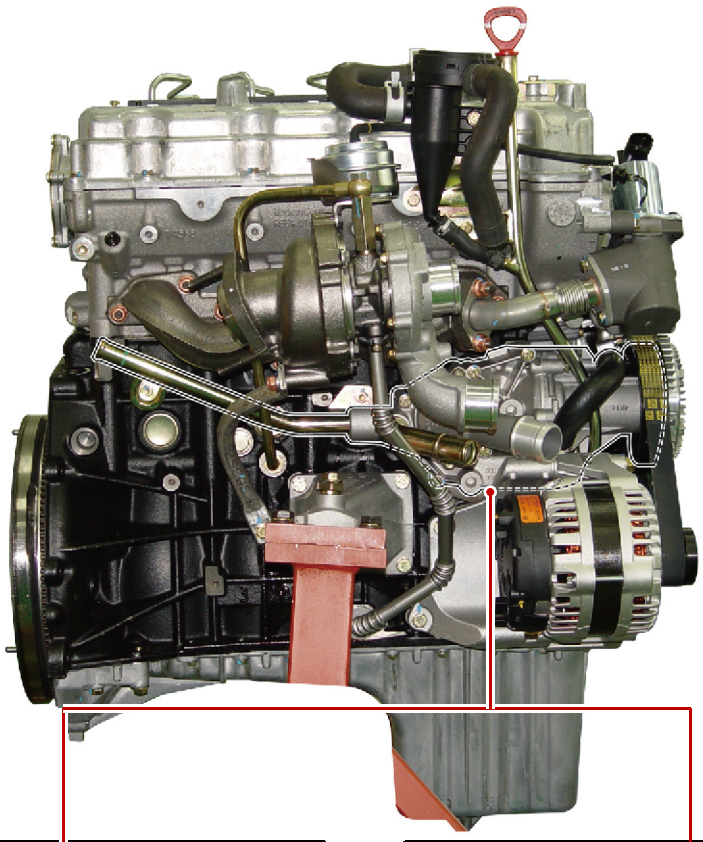
Modification basis	
Application basis	
Affected VIN	

WATER PUMP

1520-00

1. OVERVIEW

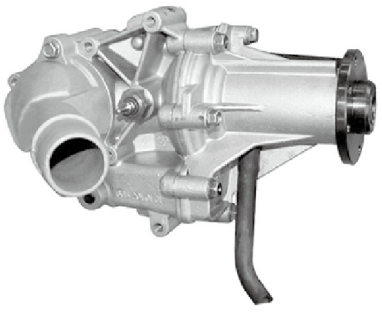
The belt-driven centrifugal water pump consists of an impeller, a drive shaft, and a belt pulley. The impeller is supported by a completely sealed bearing. The water pump is serviced as an assembly and, therefore, cannot be disassembled.
The capacity of water pump has been increased due to the EGR cooler, increased engine power and additional coolant port in the cylinder block.



For D20DT (EURO4) engine

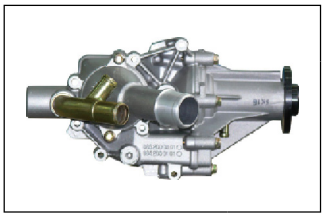


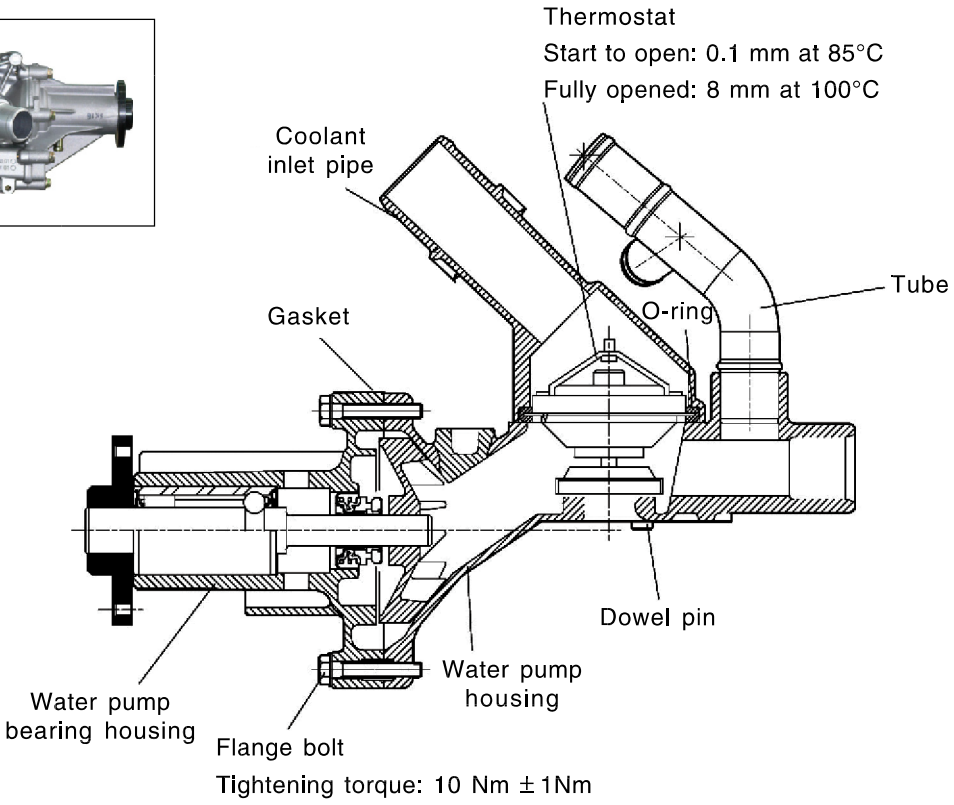
For D20DT engine

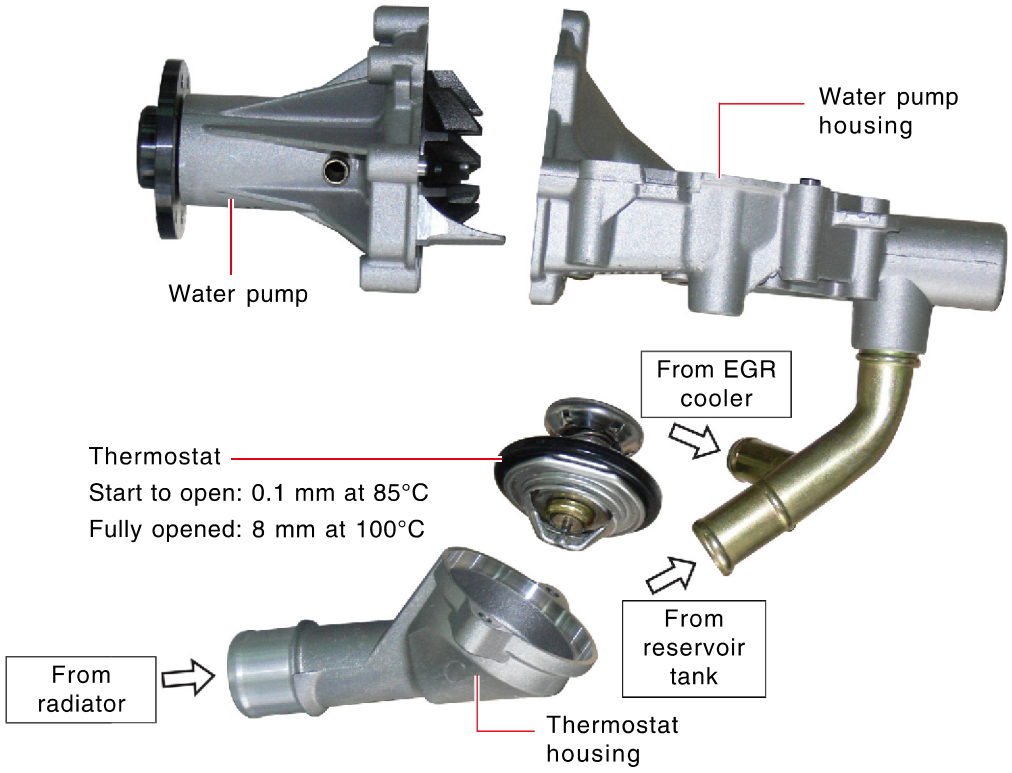


Modification basis	
Application basis	
Affected VIN	

1) Structure of Water Pump for D20DT Engine







Memo

ENGINE ELECTRIC DEVICES

1491-01

OVERVIEW AND OPERATION PROCESS

1. OVERVIEW OF ENGINE ECU

The engine ECUs are various according to the engine model (D20DT engine, D20DT (EURO4) engine). For the D20DT (EURO4) engine, one connector is added to the engine ECU (2 connectors total) to control the additional sensor, actuator and exhaust gas control function.



D20DT (EURO4) Engine ECU - Ver. 3.2	D20DT Engine ECU - Ver. 3.1
Connector A Connector B 	
	

For the D20DT (EURO4) engine, the connector pin is added and DTC is changed as the following components are added. the functions of engine ECU pin for D20DT (EURO4) engine and D20DT engine are not same. For more details, refer to the respective section.

▶ **E-EGR (Electric-Exhaust Gas Recirculation) Valve**

It is electrically controlled by the ECU for precise control. Old version was controlled by the vacuum modulator.

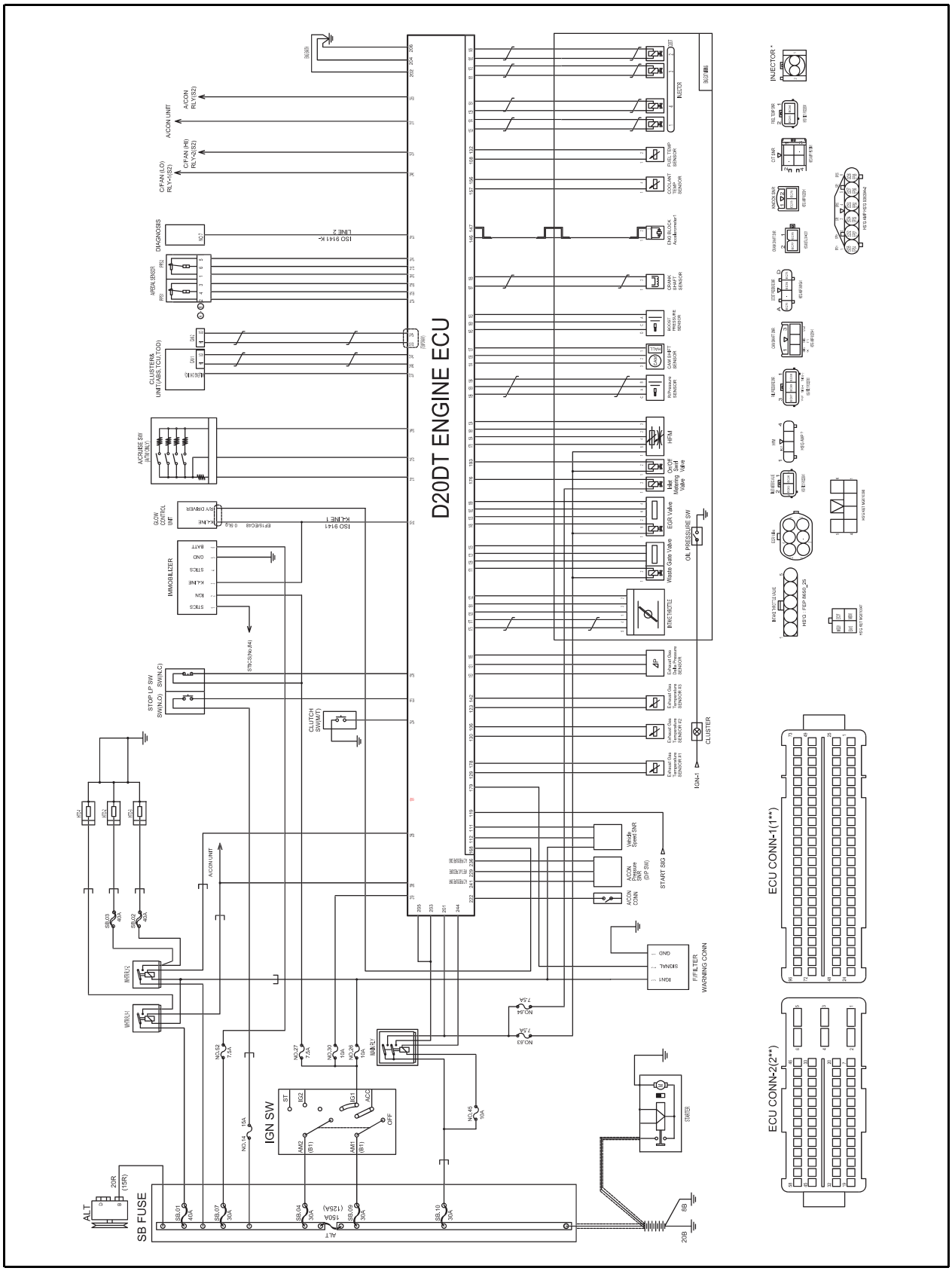
▶ **Throttle Body**

It is electrically controlled by ECU as E-EGR valve.

▶ **AQGS (Advanced Quick Glow System) Unit**

The glow control relay (K-line communication with engine ECU) is deleted. The unit communicates via CAN communication with engine ECU. Also, the number of pins is increased as glow plug's performance has been improved (1000˚C increase in approx. 2 seconds).

2. D20DT (EU-IV) ENGINE'S ECU CIRCUIT



Modification basis	
Application basis	
Affected VIN	

CRUISE CONTROL SYSTEM

8510-23

OVERVIEW AND OPERATION PROCESS

1. CRUISE CONTROL SWITCH



The purpose of the cruise control system is to automatically maintain a vehicle speed set by the driver, without depressing the accelerator pedal. The cruise control switch is located under the right side of the steering wheel, and when this switch is operating "AUTO CRUISE" lamp comes on.

The minimum speed for setting the cruise control system is 36 km/h (22.37 mph). Pay constant attention to the distance between the vehicles and the traffic conditions when using the cruise control system.

CAUTION

The cruise control system is a supplementary system, which helps the driver to drive the vehicle at a desired speed without using the accelerator pedal under the traffic condition where the vehicle-to-vehicle distance meets the legal requirement.

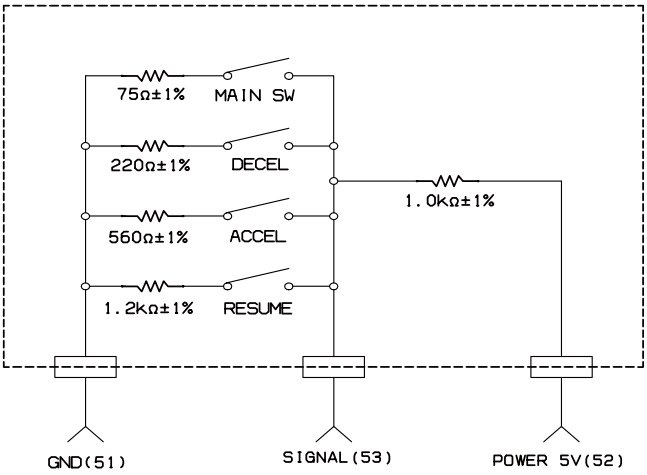
1) When To Use

Use the cruise control system only when (a) the traffic is not jammed, (b) driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

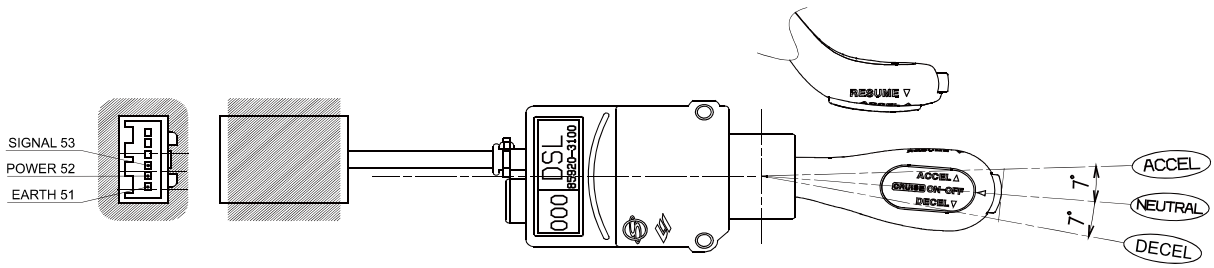
WARNING

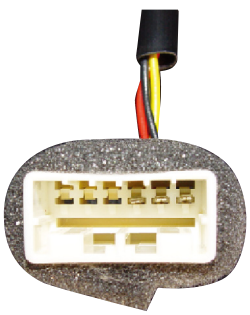
Use the cruise control system only when driving on motorways or highways. Do not use the cruise control system where the road conditions are as follows:
- When there is strong wind or cross wind.
- Heavy traffic.
- Slippery roads or steep decline.

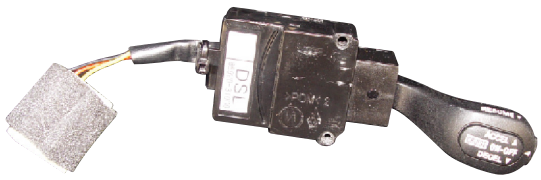
2. CIRCUIT DIAGRAM



1) Configuration







Modification basis	
Application basis	
Affected VIN	

3. HOW TO OPERATE CRUISE CONTROL SWITCH

1) How To Set Speed



1. To operate the cruise control system, accelerate the vehicle to the speed within the specified range below with depressing the accelerator pedal.
   - Cruise control operating range: between 36 km/h (22.37 mph) and 150 km/h (93.207 mph)
2. When the desired speed is reached, which should be within the above range, push up the cruise control switch lever to ACCEL side (upwards arrow), or push down the switch lever to DECEL side (downwards arrow).
   And then release the accelerator pedal slowly.
3. Now the vehicle is cruised by this system with the set speed. You don't need to use the accelerator pedal.
4. Refer to the following pages for details of operation.

CAUTION

Never use the cruise control system until you get used to it.
Improper use or not fully aware of this function could result in collision and/or personal injuries.

Modification basis	
Application basis	
Affected VIN	

2) Accelerating with the Cruise Control System



(1) While the cruise control system is running

1. To increase the set speed, push up the cruise control switch lever to ACCEL side and hold it until the desired speed is reached without depressing the accelerator pedal.
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To increase the speed with the cruise control system while the system is not running, follow the procedures below.

1. Accelerate the vehicle to more than 36 km/h (22.37 mph) using the accelerator pedal. Push up the cruise control switch lever to ACCEL side and hold it.
2. When the desired speed is reached, release the accelerator pedal and the switch lever.

(3) Tap-up while the cruise control system is running

To increase the vehicle speed in stages while the cruise control system is running, follow the procedures below.

1. Push up the cruise control switch lever to ACCEL side for less than 0.5 second per one switching while the cruise control system is running; the speed increases each time by 1.3 km/h (0.81 mph).
2. For example, if you want to increase the speed 13 km/h (81 mph) more than the previous set speed, tap up the switch lever to ACCEL side ten times without using the accelerator pedal.

3) Decelerating with the Cruise Control System



(1) While the cruise control system is running

1. To decrease the set speed, push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached without depressing the brake pedal.
   But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To decrease the speed with the cruise control system while the system is not running, follow the procedures below.

1. Push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached while the vehicle speed is over 36 km/h (22.37 mph).
2. When the desired speed is reached, release the switch lever.
3. But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).

(3) Tap-down while the cruise control system is running

To decrease the vehicle speed in stages while the cruise control system is running, follow the below procedures.

1. Push down the cruise control switch lever to DECEL side for less than 0.5 second per one switching while the cruise control system is running; the speed decreases each time by 1.0 km/h (0.62 mph).
2. For example, if you want to decrease the speed 10 km/h (62 mph) lower than the previous set speed, tap down the switch lever to DECEL side ten times without using the brake pedal.

Modification basis	
Application basis	
Affected VIN	

4) Recovery of Set Speed (RESUME)



Even if the cruise control is cancelled, the previous set cruise speed can be recovered by operating the cruise control switch lever like below:
- Pull the switch lever in the arrow direction shown in the illustration.
This RESUME function works only when the vehicle speed is more than 36 km/h (22.37 mph) without using the accelerator or brake pedal.

CAUTION
But the driver should know the previous set speed to react to the changed vehicle speed properly. If the vehicle speed increases abruptly, depress the brake pedal to adjust the vehicle speed properly.

5) Normal Cancellation of the Cruise Control (OFF ↔ ON)



The cruise control system will be cancelled when the button on the side of the switch is pressed, or when one of the following conditions is met:

1. When the brake pedal is depressed or ESP is activated.
2. When the vehicle speed is less than 34 km/h (21.13 mph).
3. When the parking brake is applied while driving.
4. When the clutch pedal is depressed for shifting (M/T only).

CAUTION

Put the cruise control switch lever in the neutral position when not using the cruise control system.

(1) Abnormal Cancellation of the Cruise Control

1. When the rapid deceleration or acceleration occurs.
2. When the cruise control lever is faulty.
3. When the brake switch is malfunctioning or has an open circuit.

When the cruise control function is cancelled abnormally or intermittent problems occur, stop the vehicle and turn off the ignition switch and remove the key to reset the system. After a while, turn on the ignition switch again to operate the cruise control system.

CAUTION

- Do not move the shift lever to Neutral position while driving with the cruise control turned on. Otherwise, it may result in system malfunction or accidents.
- Always be prepared to use the brake or accelerator pedal for safe driving while the cruise control system is running.
- The actual speed can be different from the set speed momentarily when driving on a uphill or downhill. So, it is recommended to disable the cruise control function on a uphill or downhill. hen driving on a steep hill use the engine brake and foot brake properly to protect the vehicle system and for a safe driving.
- Ensure that the braking distance is maintained and use the brake pedal if needed.

Modification basis	
Application basis	
Affected VIN	

NO DATA

INDEX

GENERAL

1. ENGINE ASSEMBLY LAYOUT..... 3
2. COMPONENTS IN D20DT ENGINE AND D27DT ENGINE..... 7
3. ENGINE CONTROLS LAYOUT..... 11
4. ELECTRICAL COMPONENTS AND PREHEATING SYSTEM..... 15
5. INTAKE SYSTEM LAYOUT..... 17
6. EXHAUST SYSTEM LAYOUT..... 19
7. LUBRICATION SYSTEM LAYOUT..... 21
8. COOLING SYSTEM LAYOUT..... 23
9. FUEL SYSTEM LAYOUT..... 25
10. FUEL SUPPLY SYSTEM..... 27
11. CLEANNESS..... 29
12. MAINTENANCE AND REPAIR..... 35
13. GUIDELINES FOR SERVICE WORK SAFETY..... 37
14. DURING SERVICE WORK FOR INSPECTION..... 41
15. DURING SERVICE WORK FOR ELECTRIC DEVICES..... 43
16. OWNER INSPECTIONS AND SERVICES..... 44
17. STANDARD BOLTS SPECIFICATIONS 48

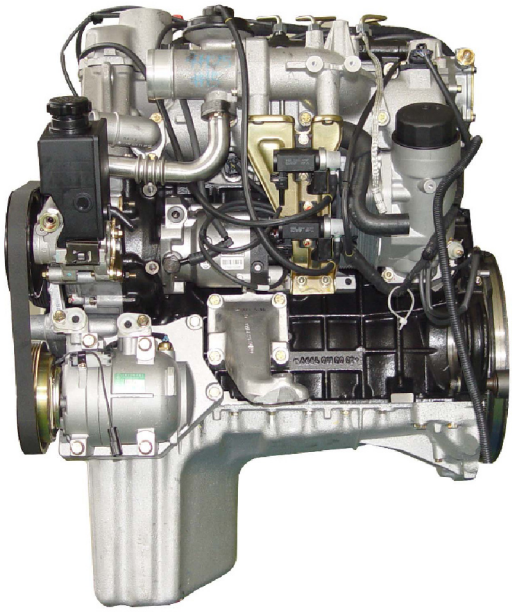
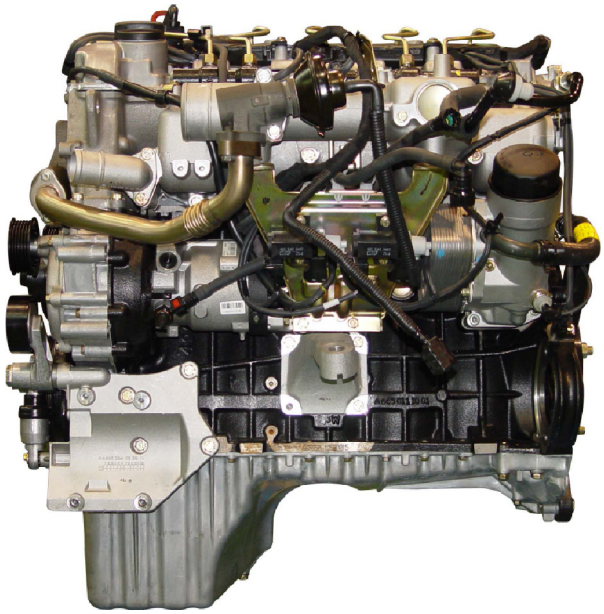
ENGINE GENERAL

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GENERAL

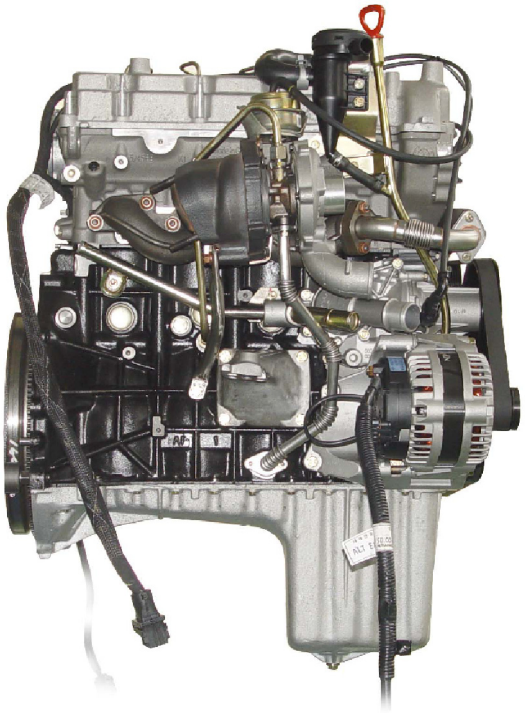
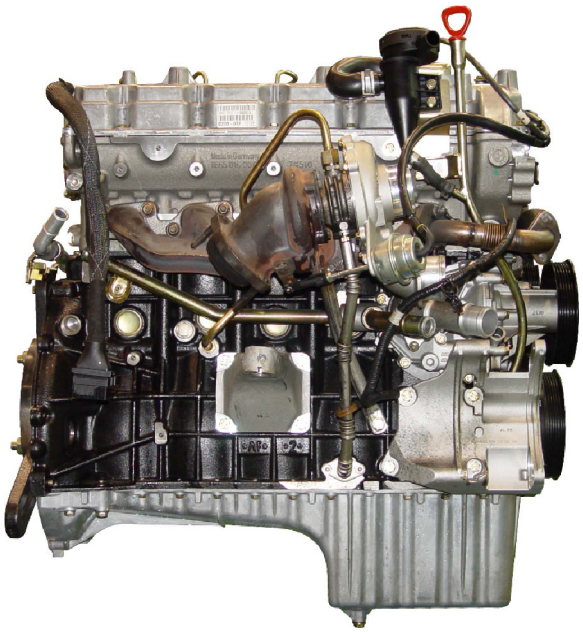
1. ENGINE ASSEMBLY LAYOUT

1) LH Side View

D20DT

D27DT


Modification basis	
Application basis	
Affected VIN	

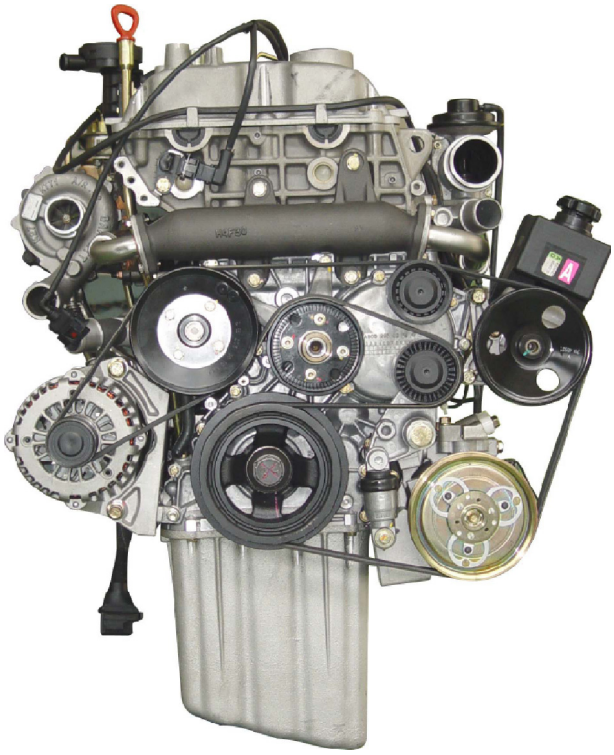
2) RH side view

D20DT

D27DT


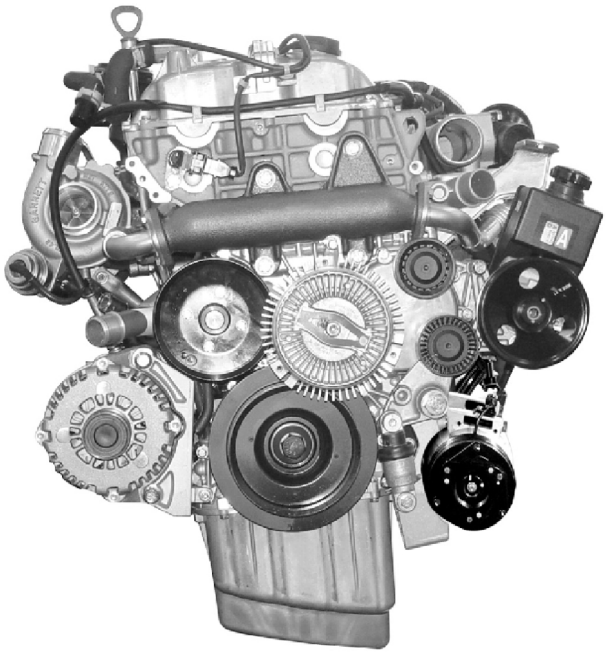
Modification basis	
Application basis	
Affected VIN	

3) Front view

D20DT

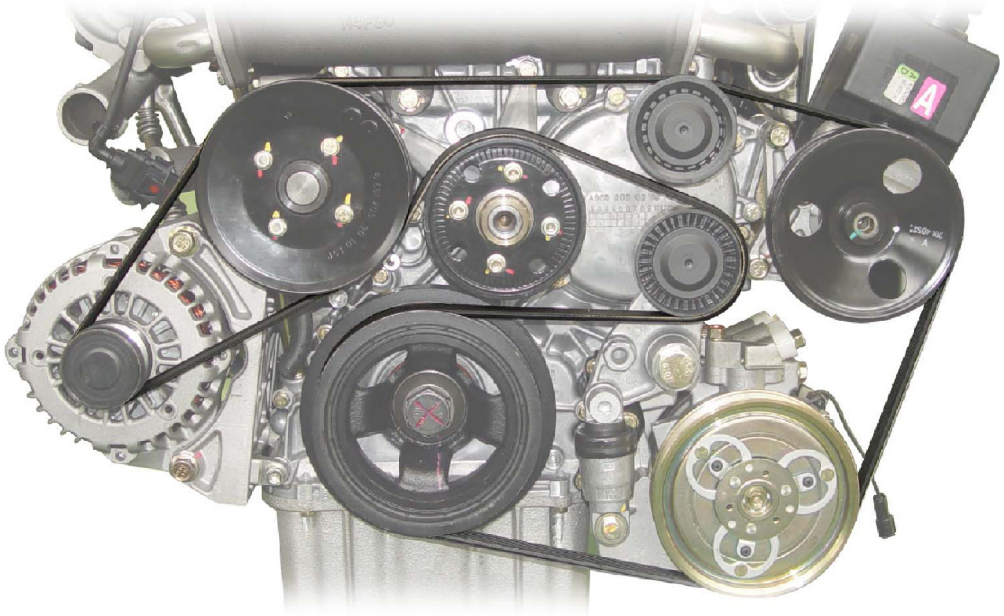


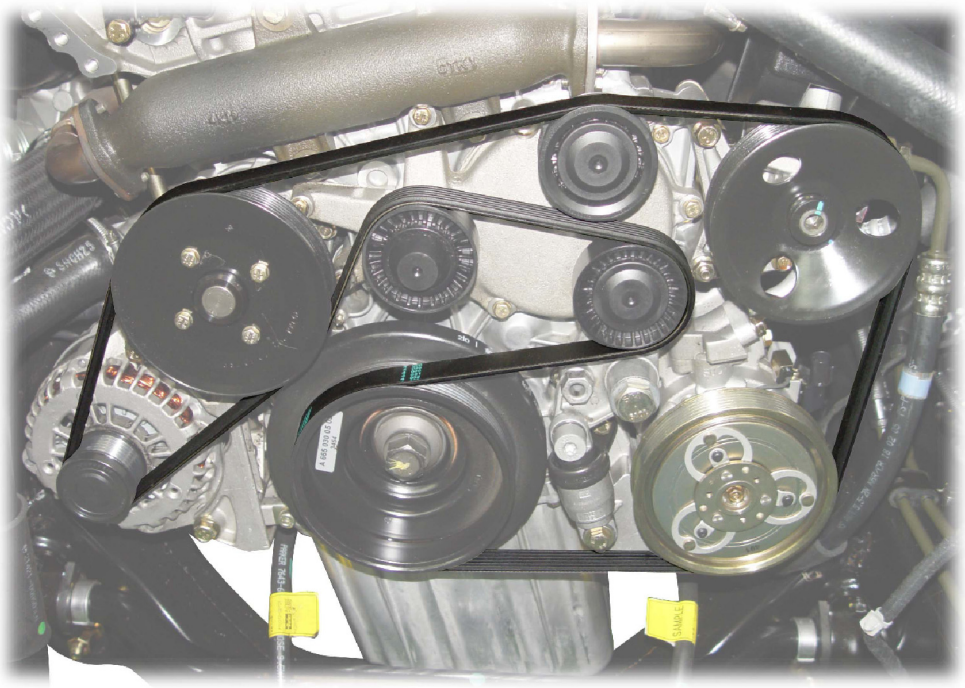
D27DT



Modification basis	
Application basis	
Affected VIN	

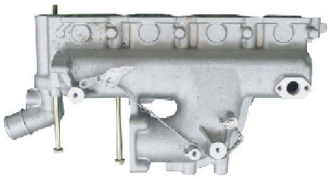
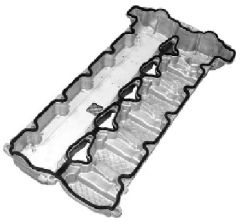
4) Fan belt

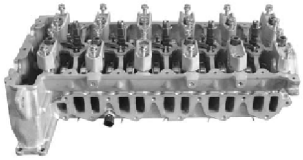
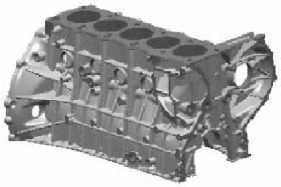
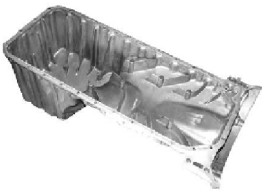
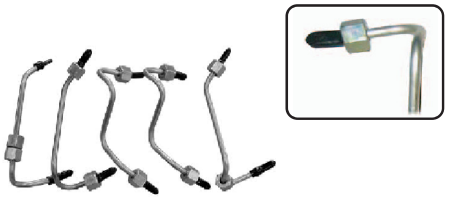
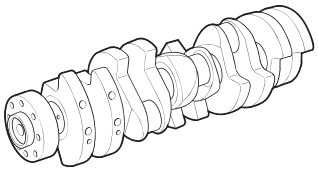
D20DT


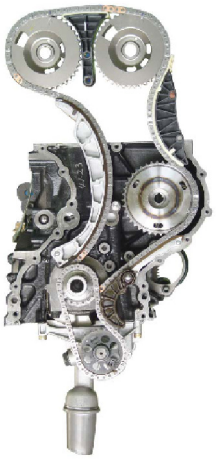
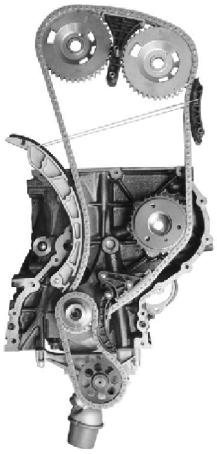
D27DT


Modification basis	
Application basis	
Affected VIN	

2. COMPONENTS IN D20DT ENGINE AND D27DT ENGINE

Components	D20DT	D27DT
Turbocharger		
Common rail		
EGR valve		
Exhaust manifold		
Intake manifold		
Cylinder head cover		

Components	D20DT	D27DT
Cylinder head		
Cylinder block		
Oil pan		
High pressure pipe		
Intake camshaft and exhaust camshaft		
Crankshaft		

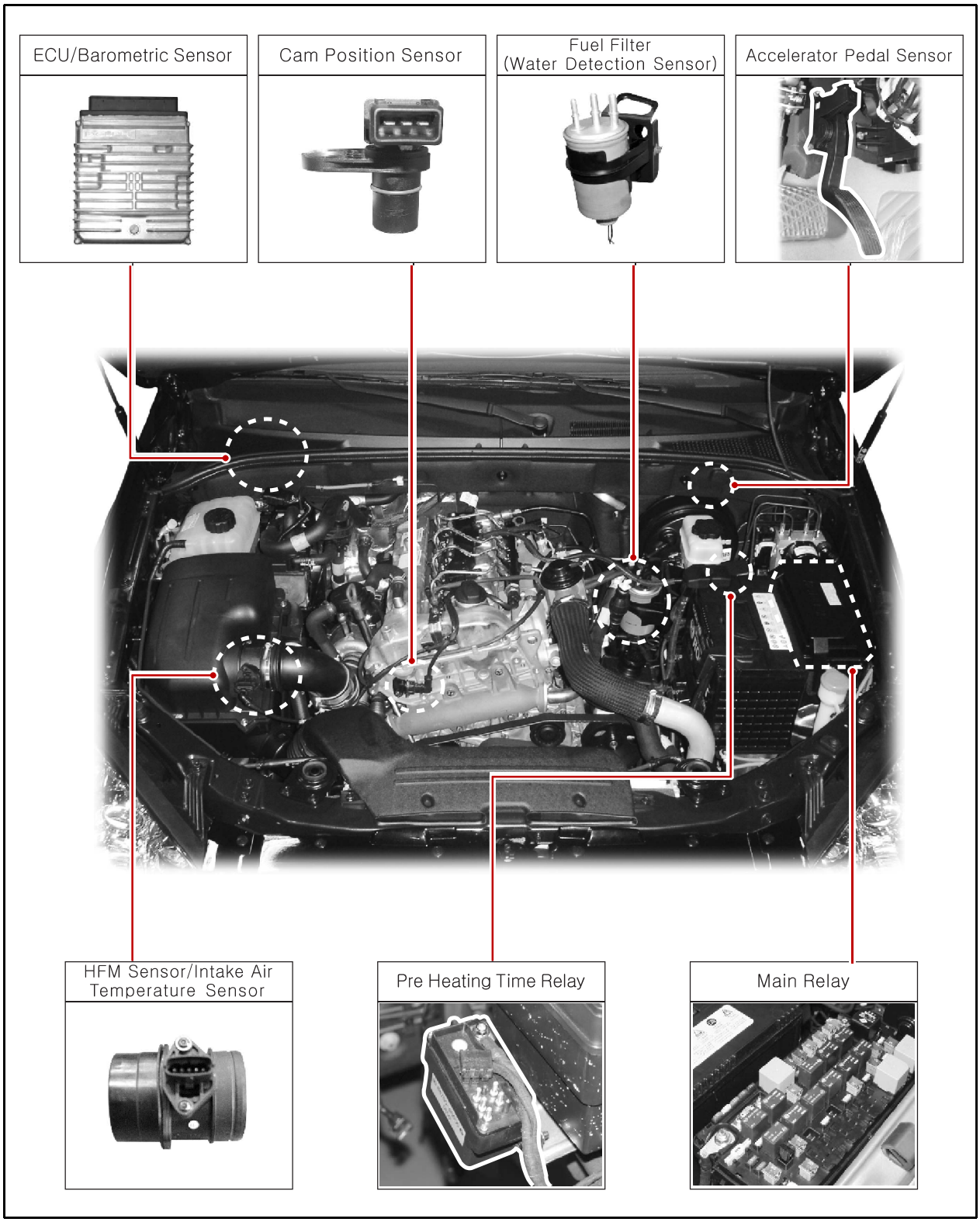
Components	D20DT	D27DT
Sprocket - HP pump		
Timing chain devices		
Chain double bush	D20DT  D27DT 	
Tensioner rail		
Oil pump assy		

Components	D20DT	D27DT
Clamping rail comp		
Guid rail LWR		
EGR pipe - LH		
Fuel injector		

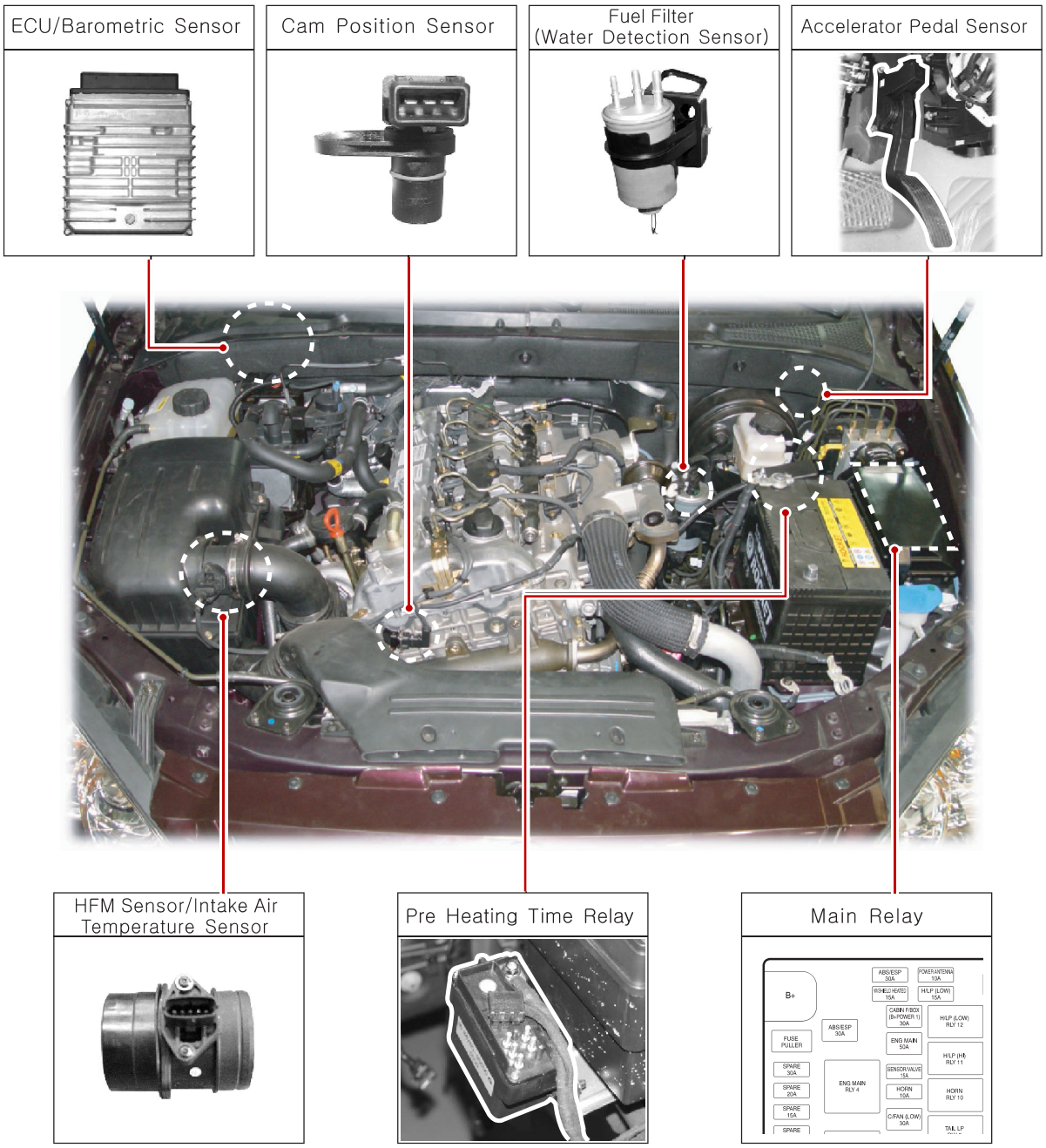
3. ENGINE CONTROLS LAYOUT

1) Ecu related componets

(1) D20DT Engine



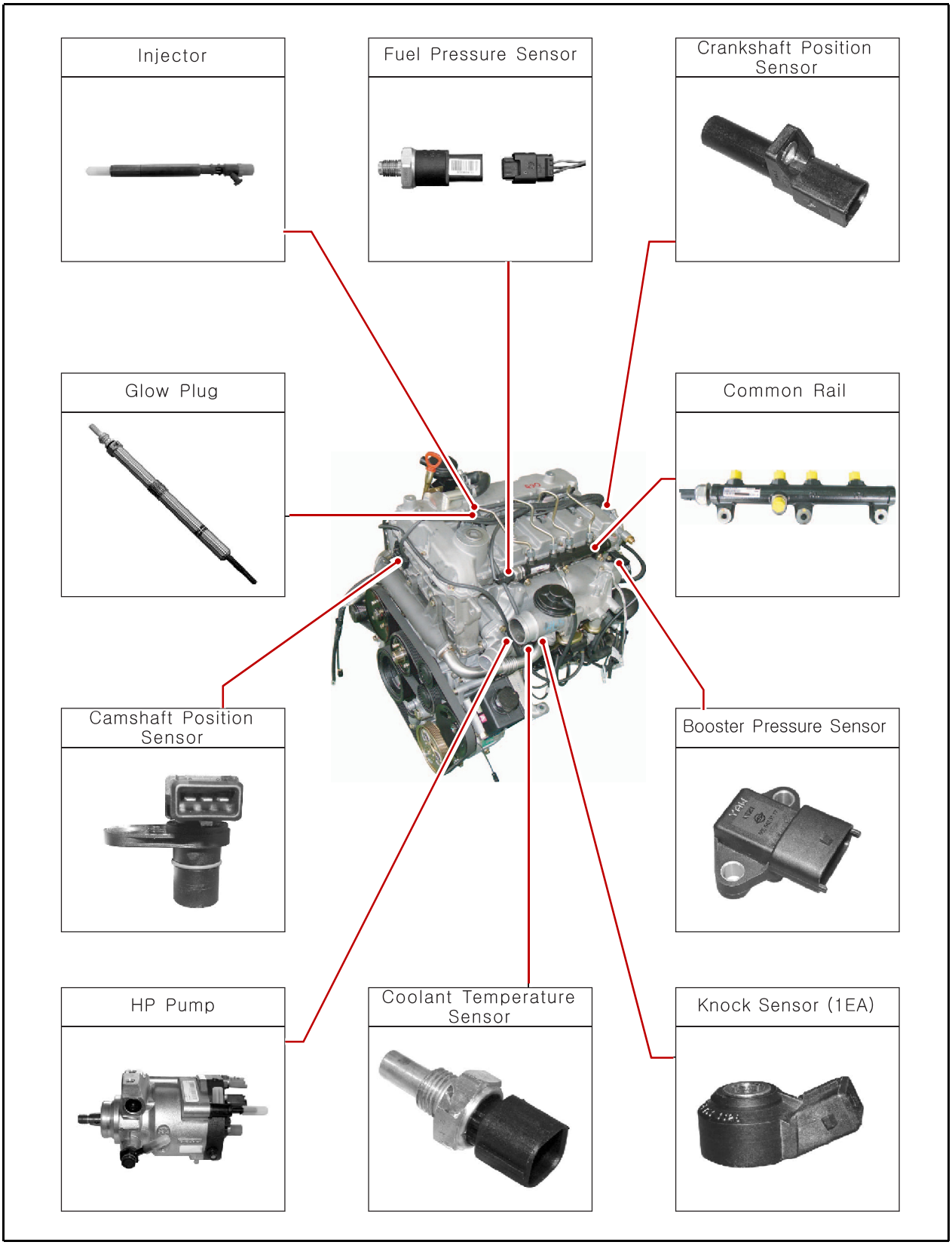
(2) D27DT Engine



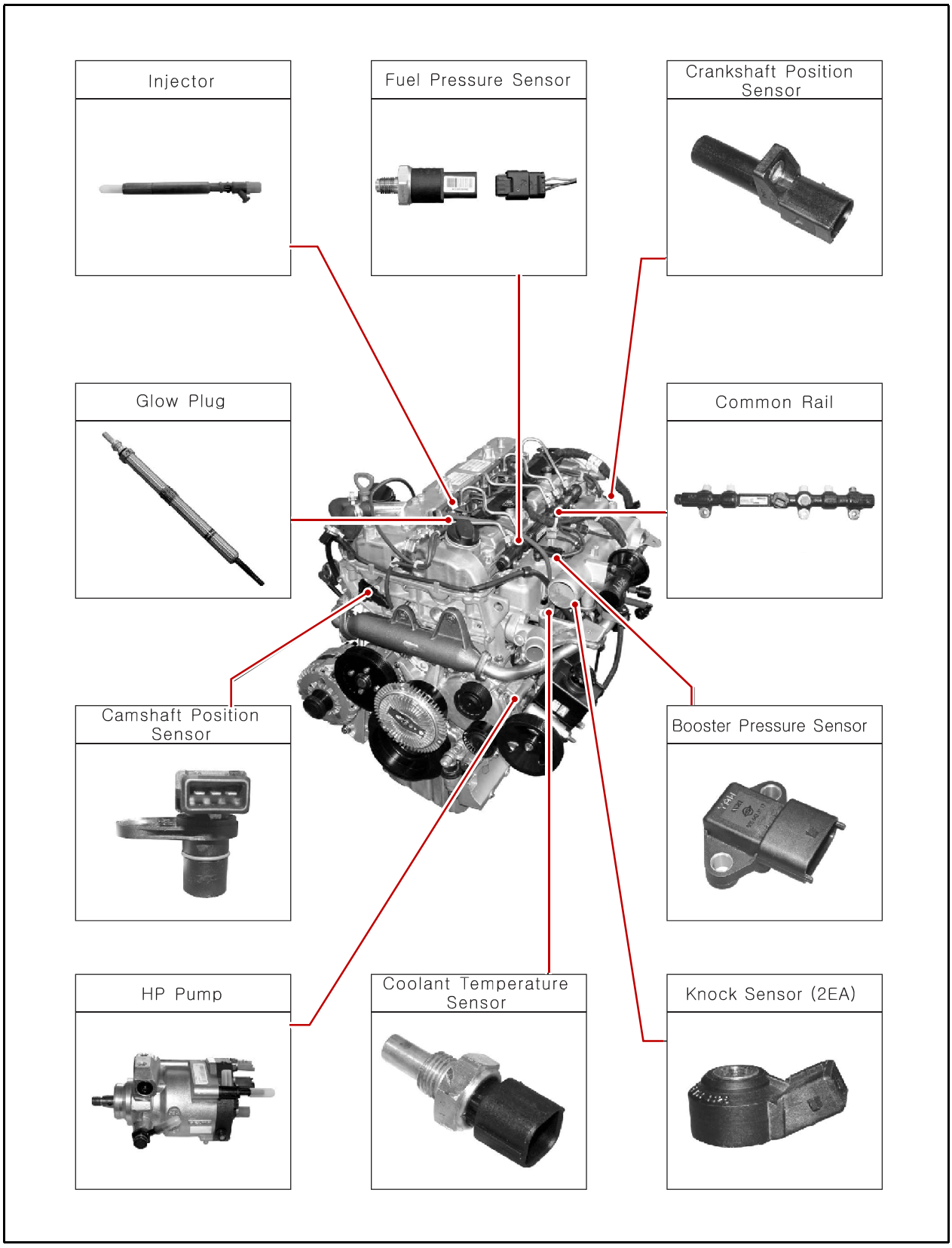
Modification basis	
Application basis	
Affected VIN	

2) ENGINE AND SENSORS

(1) D20DT Engine



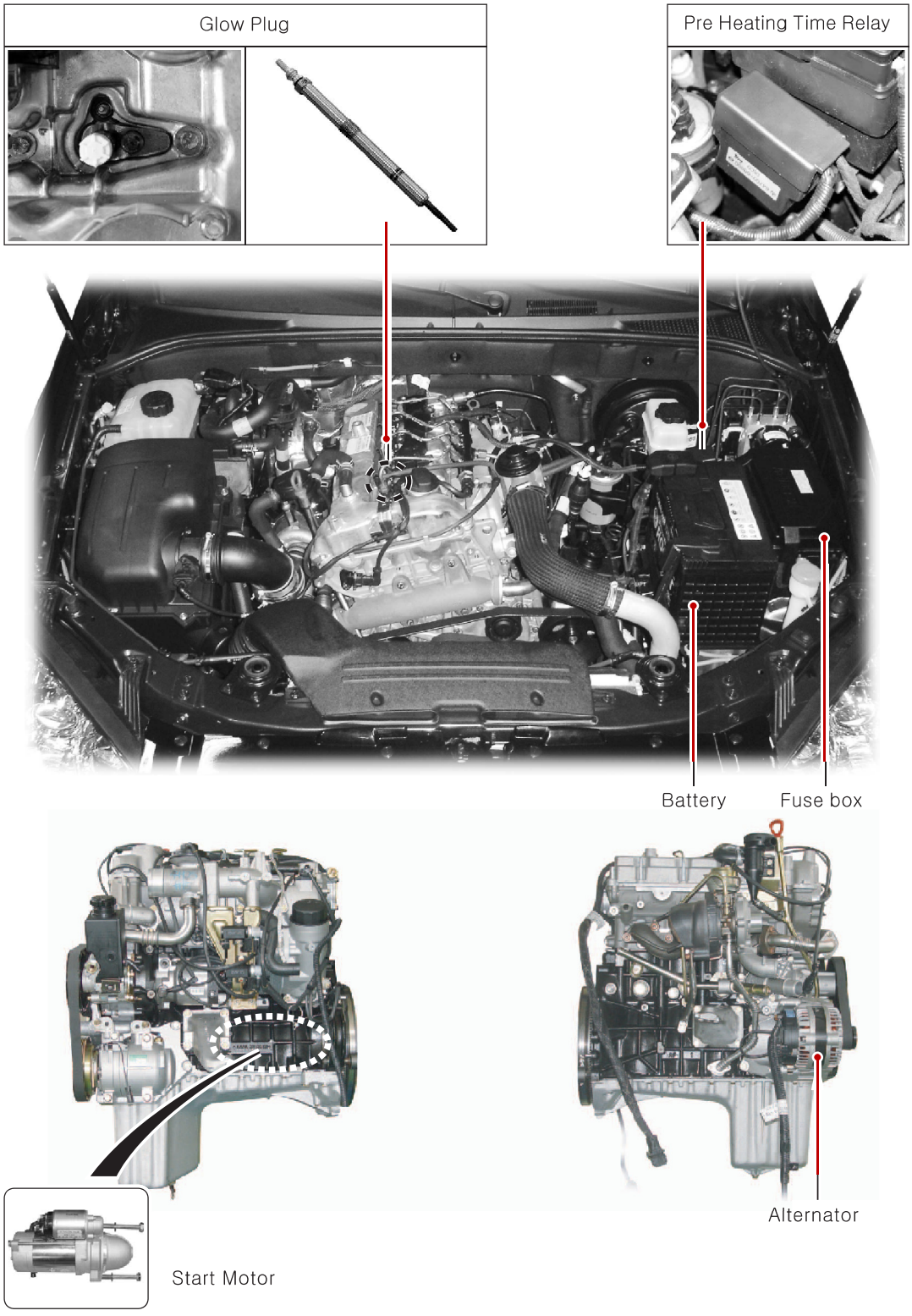
(2) D27DT Engine



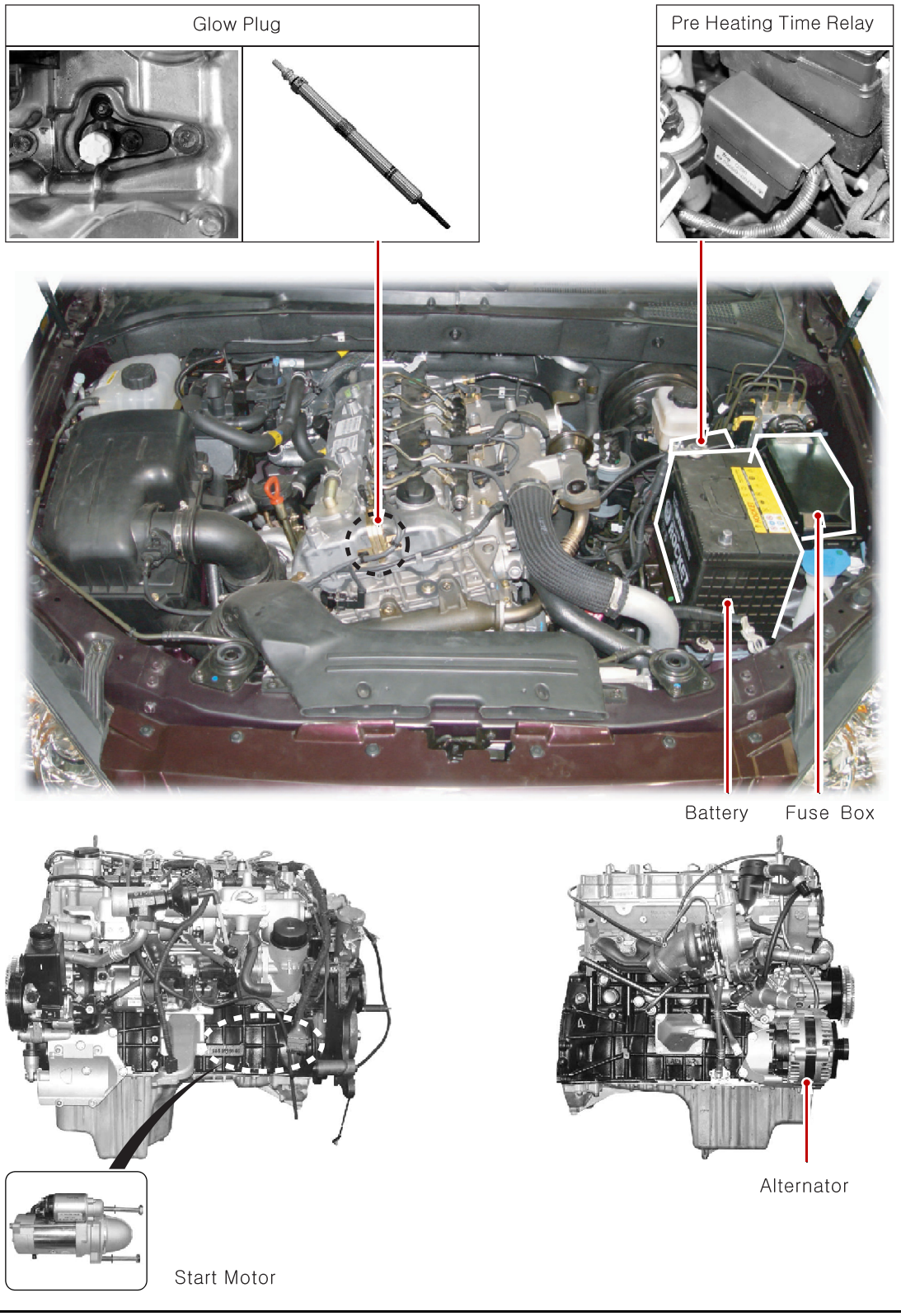
Modification basis	
Application basis	
Affected VIN	

4. ELECTRICAL COMPONENTS AND PREHEATING SYSTEM

1) D20DT Engine



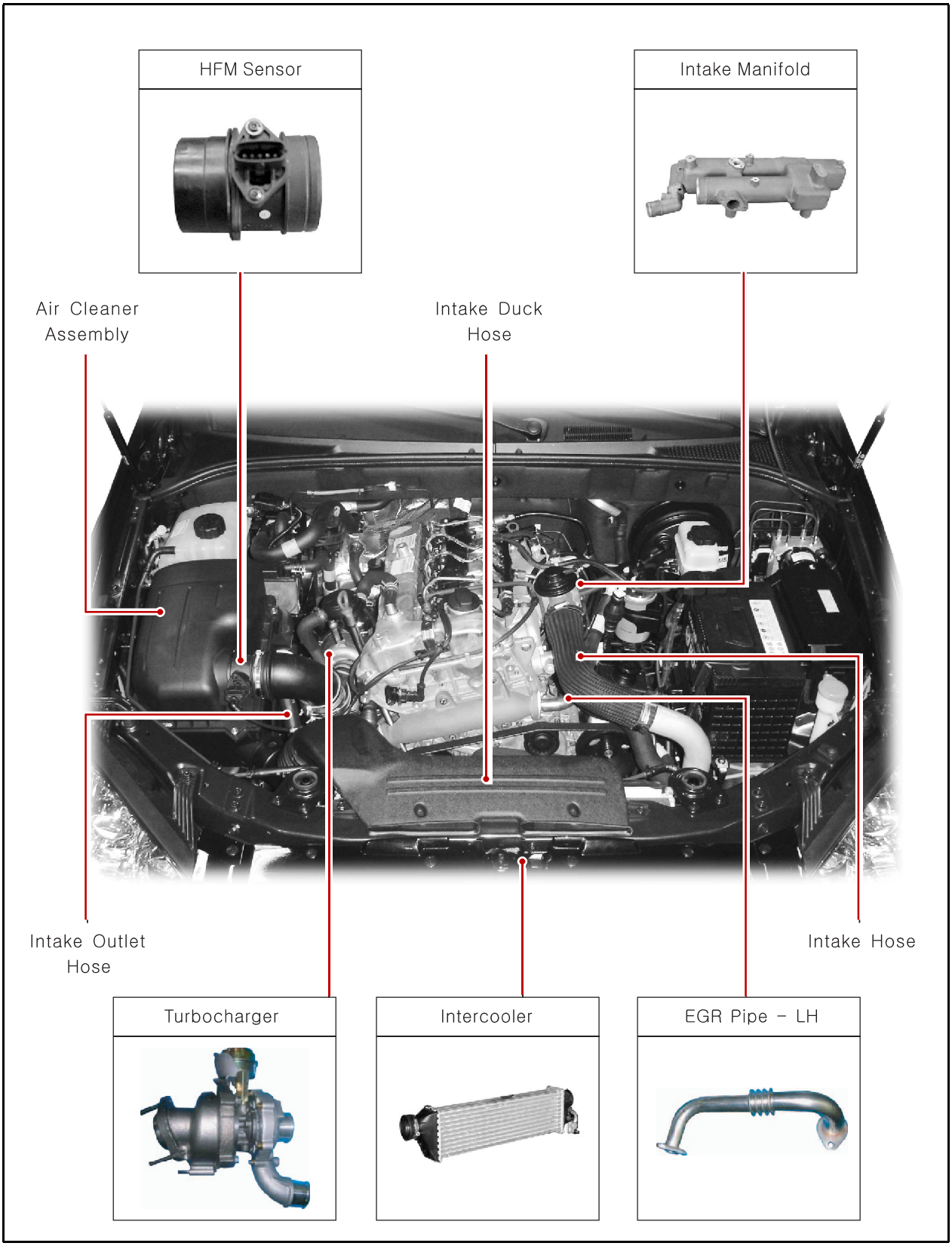
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

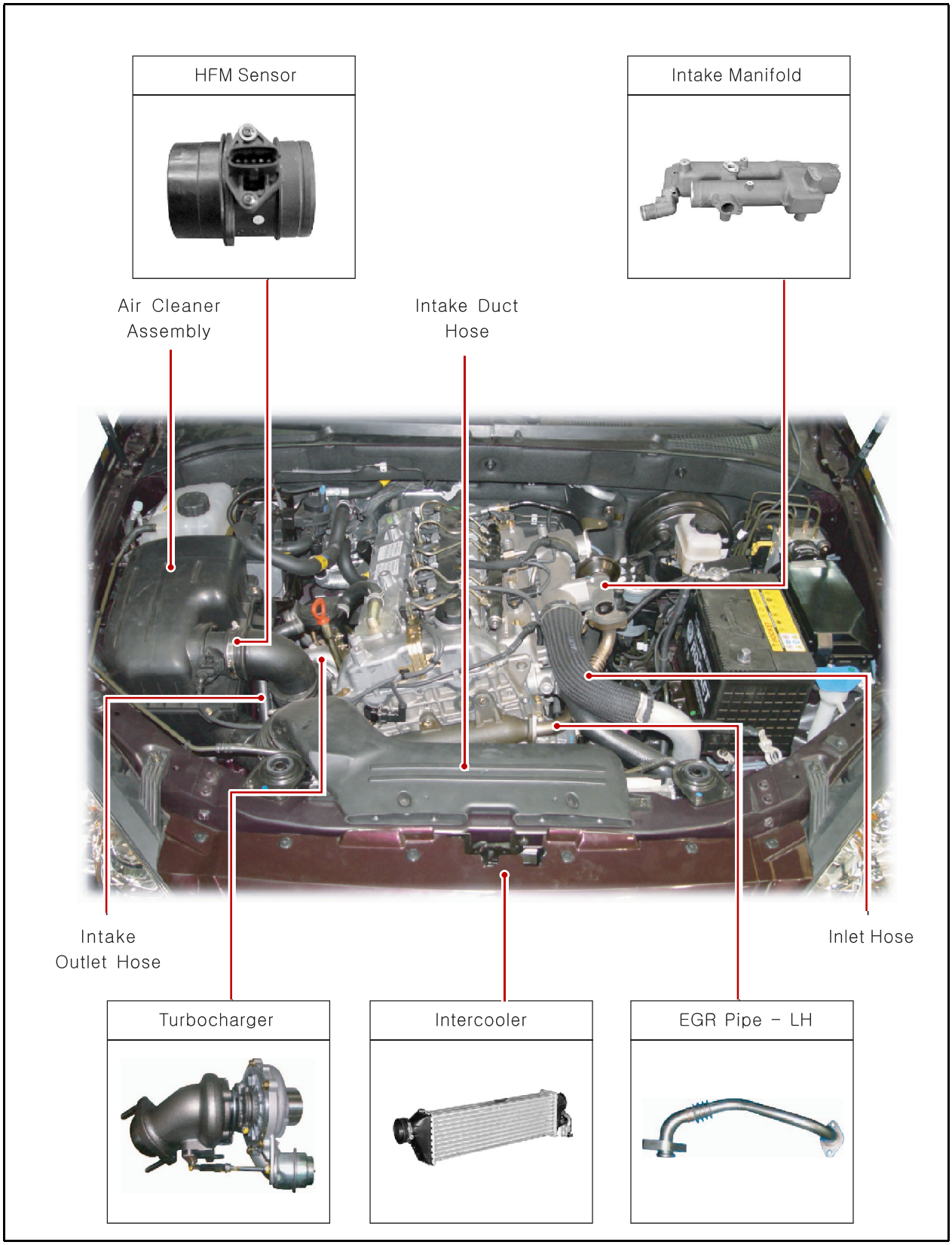
5. INTAKE SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

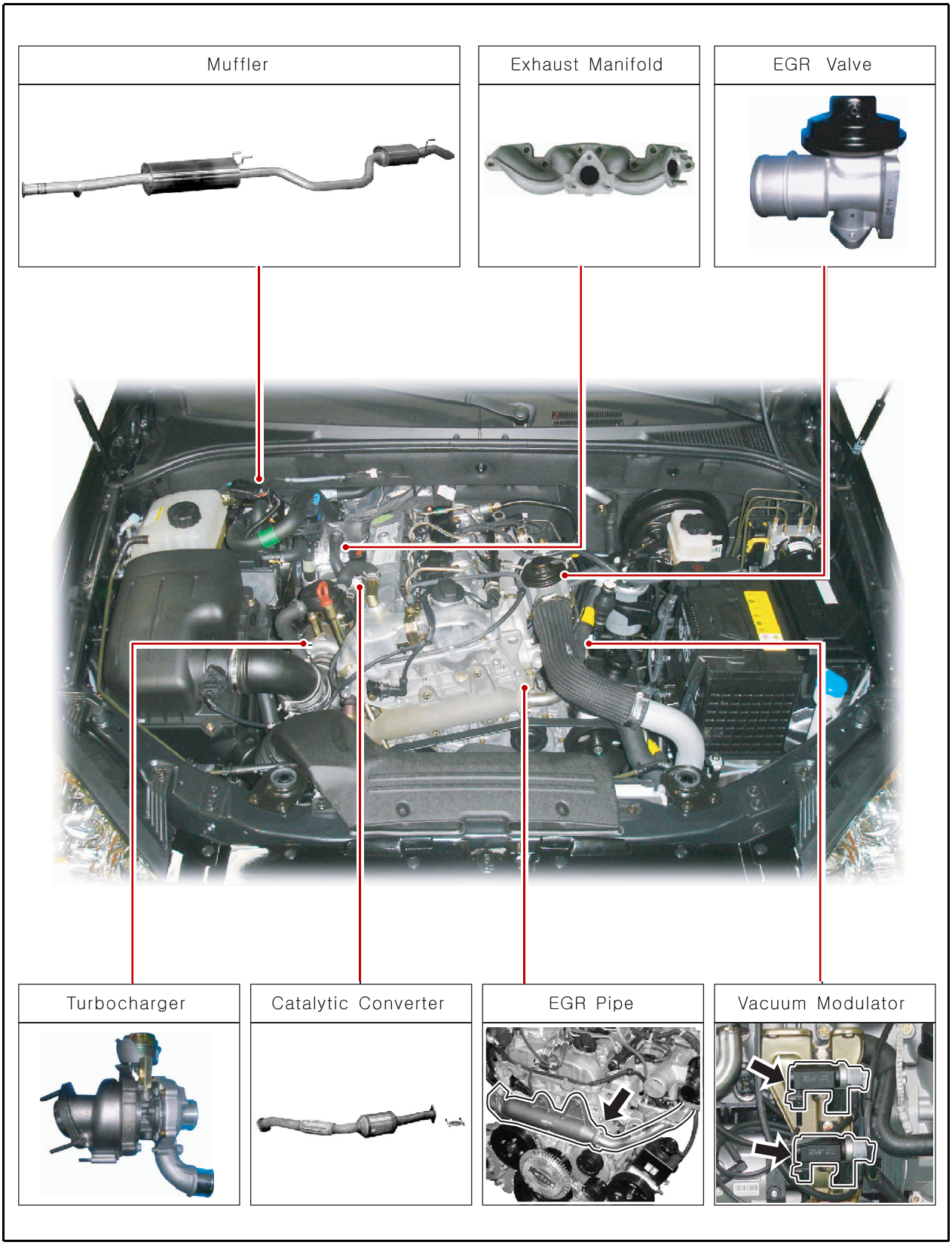
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

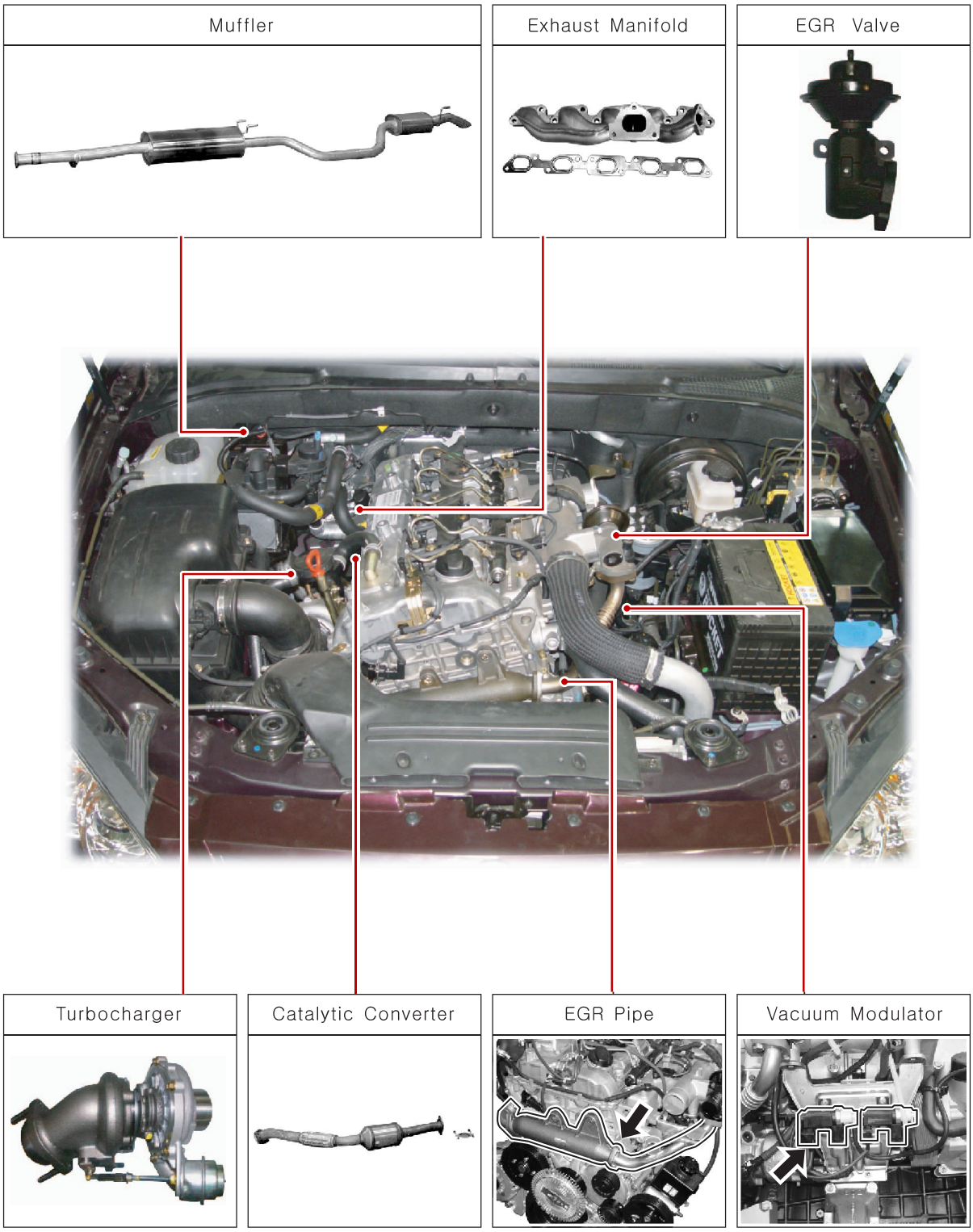
6. EXHAUST SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

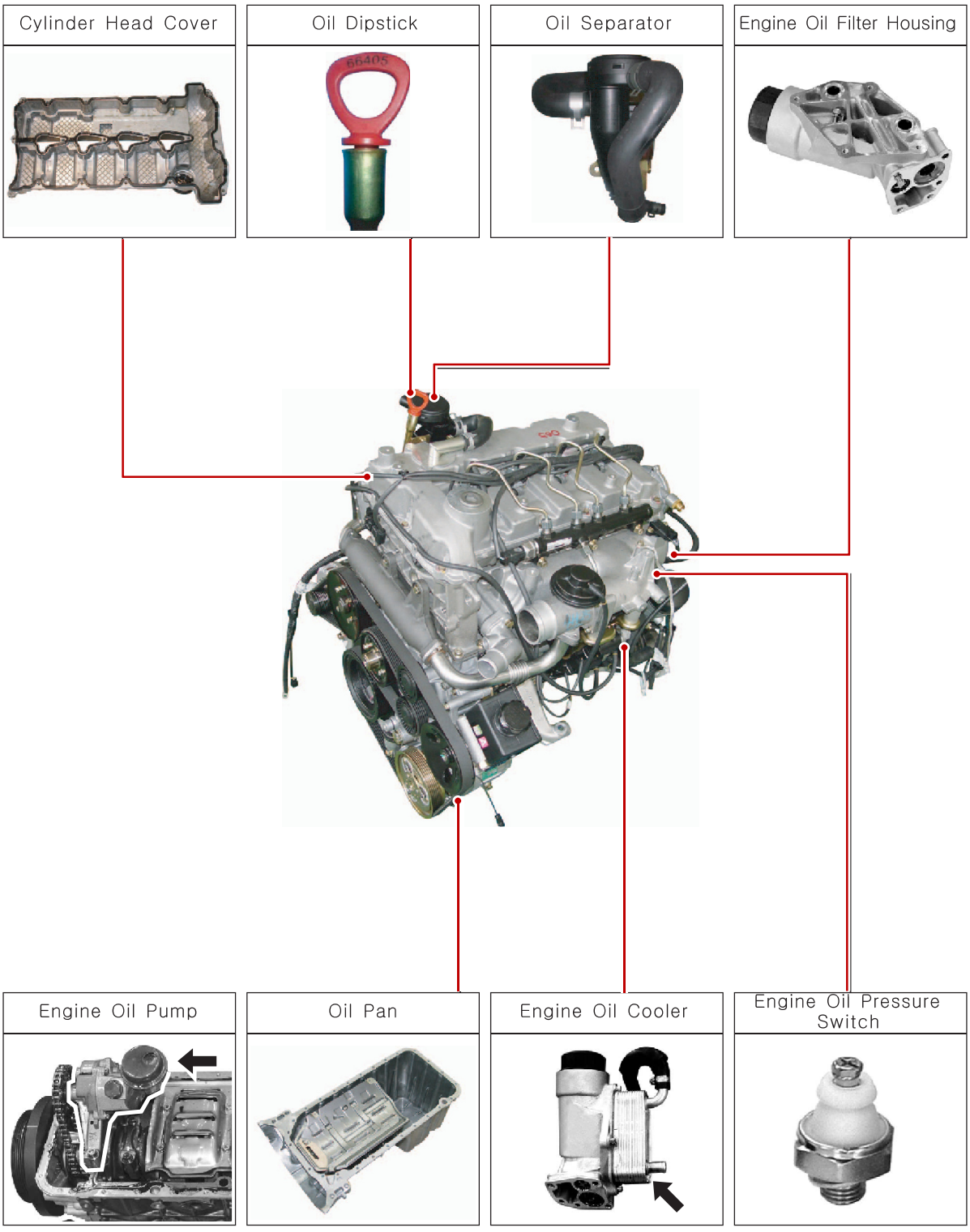
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

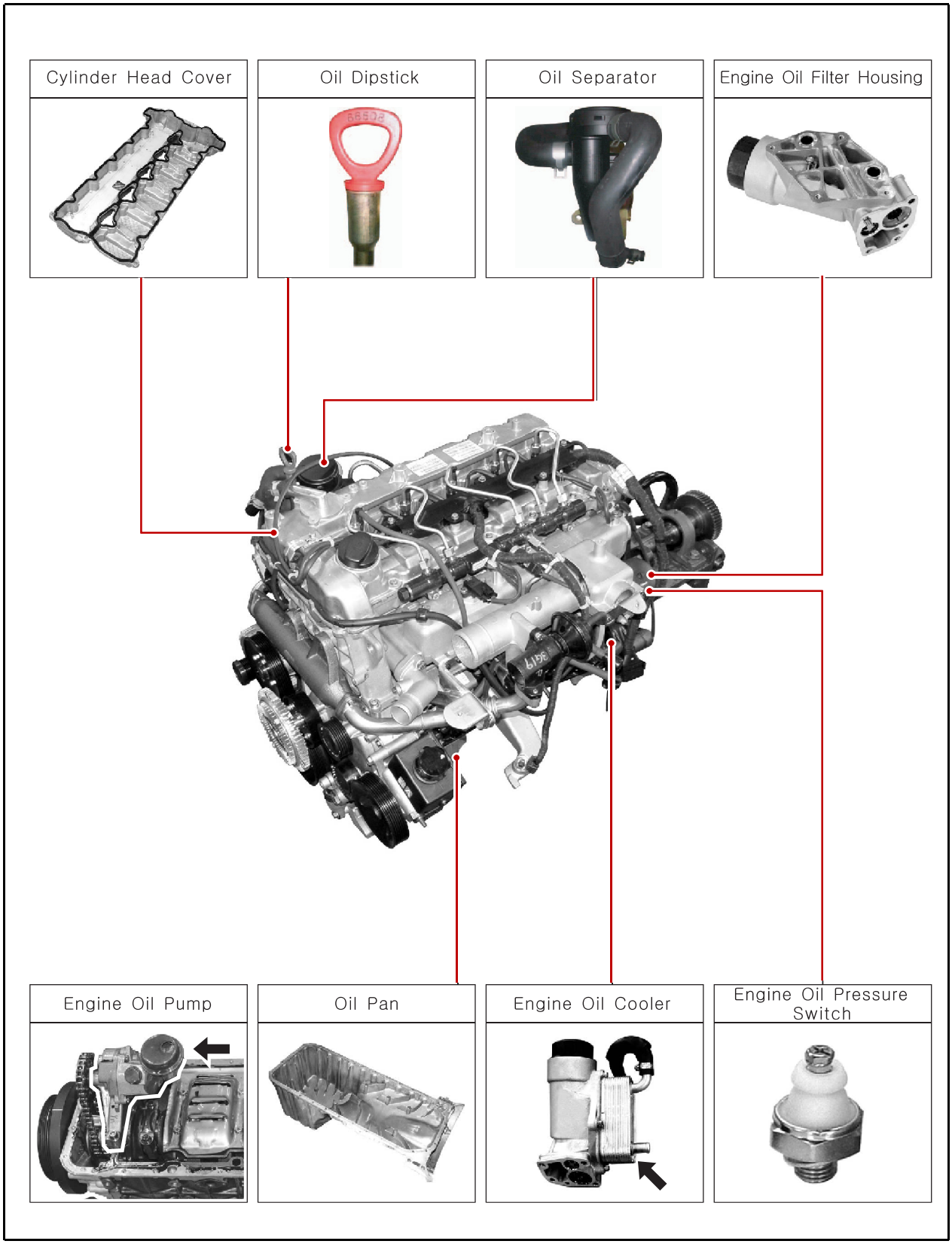
7. LUBRICATION SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

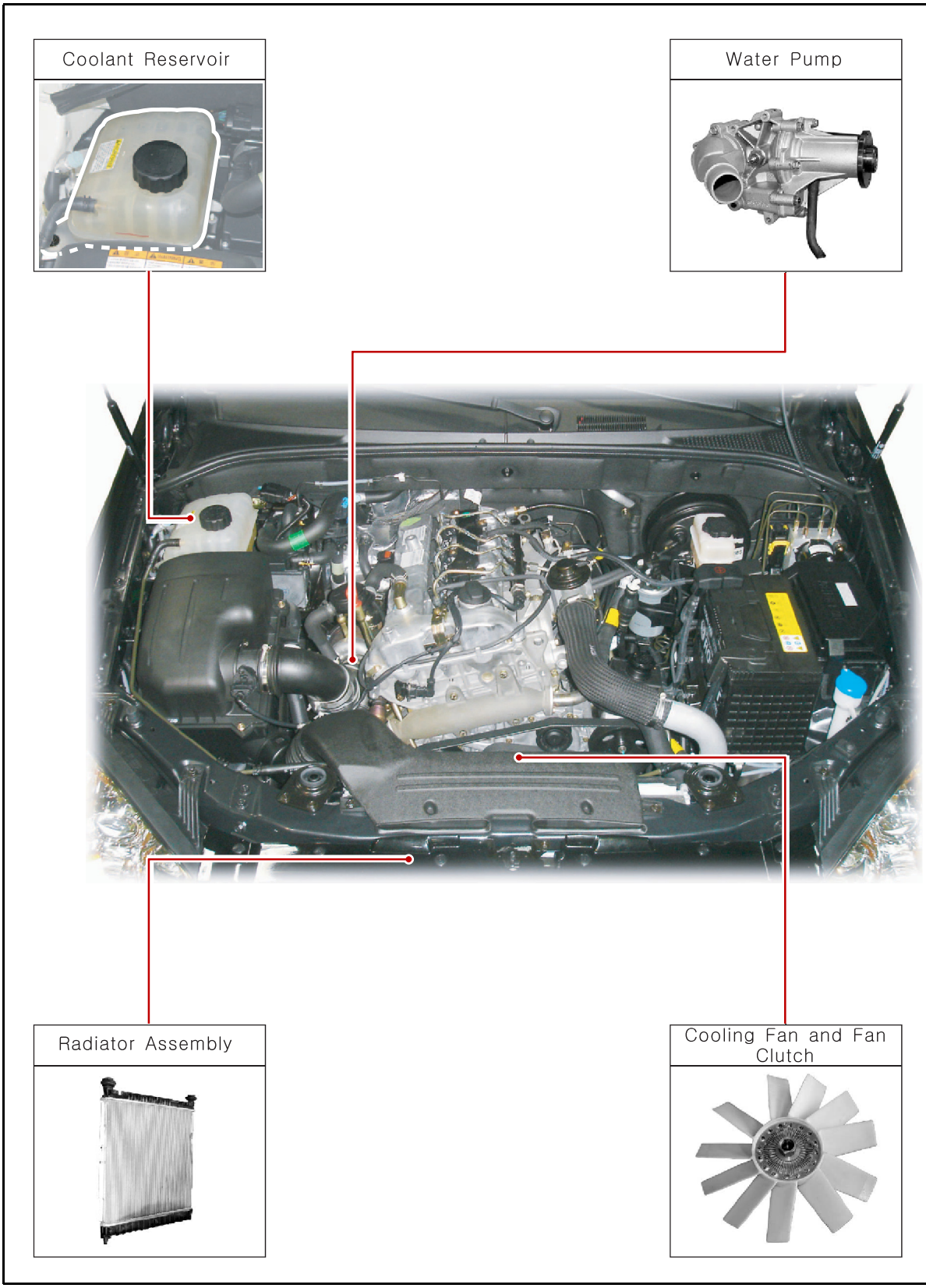
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

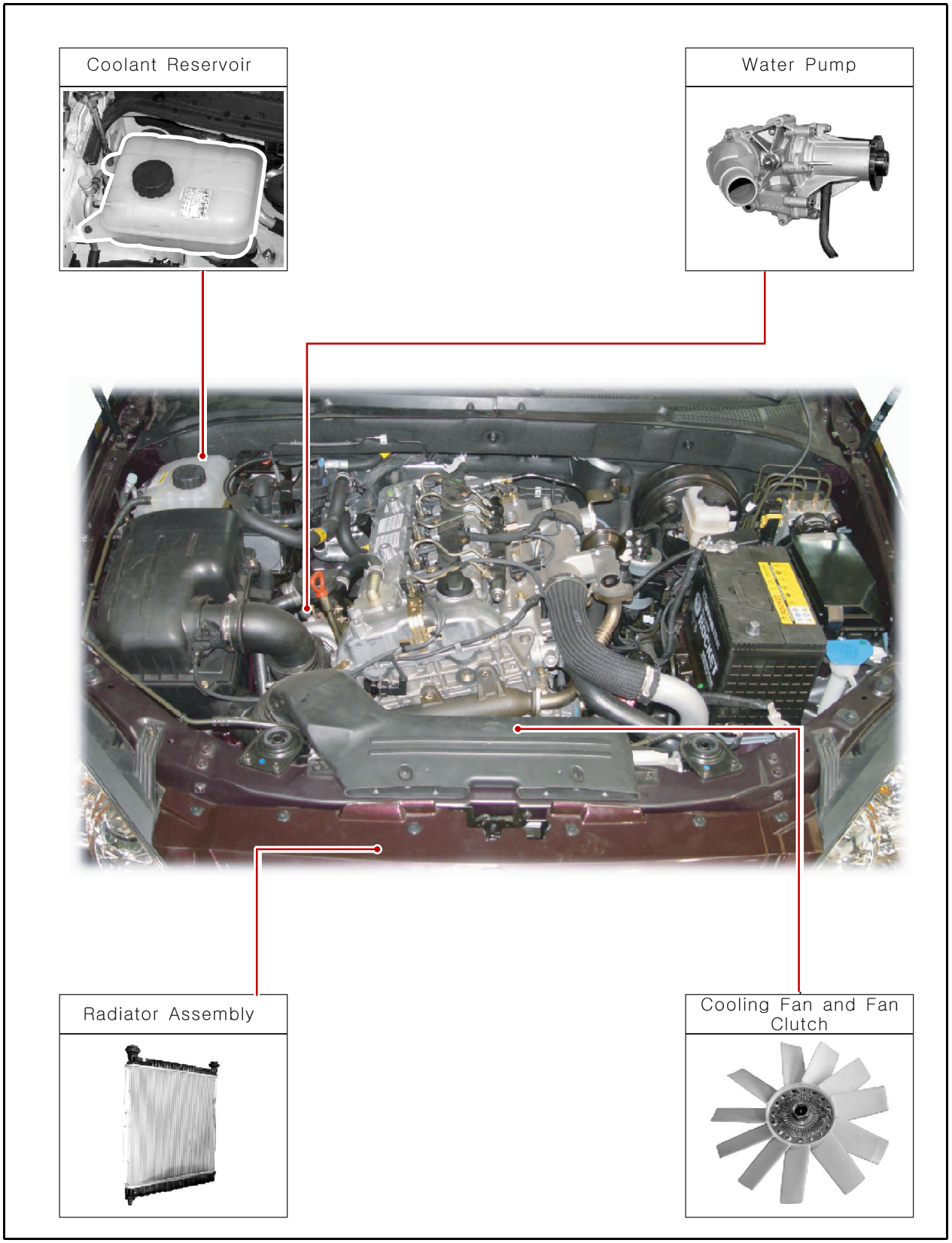
8. COOLING SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

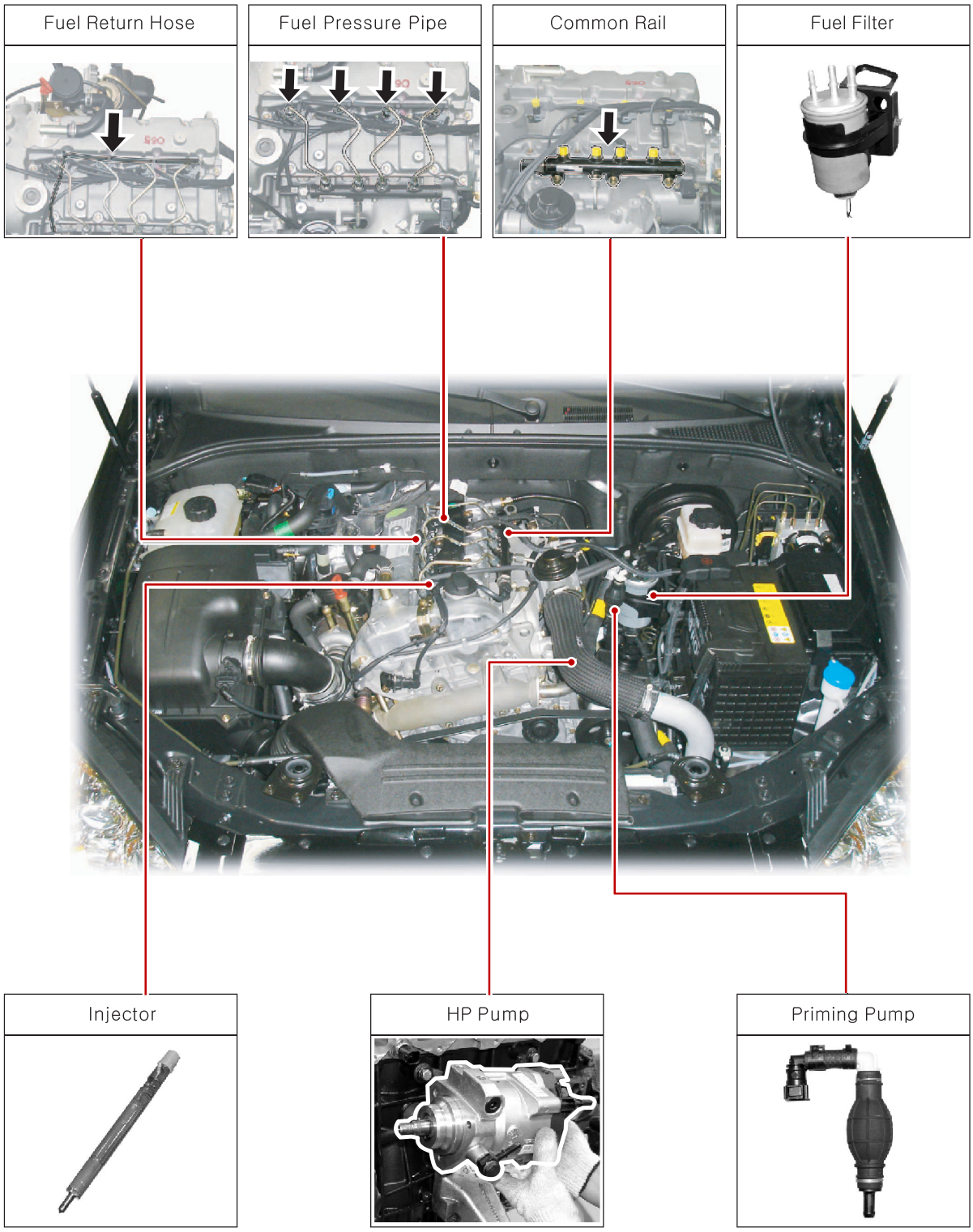
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

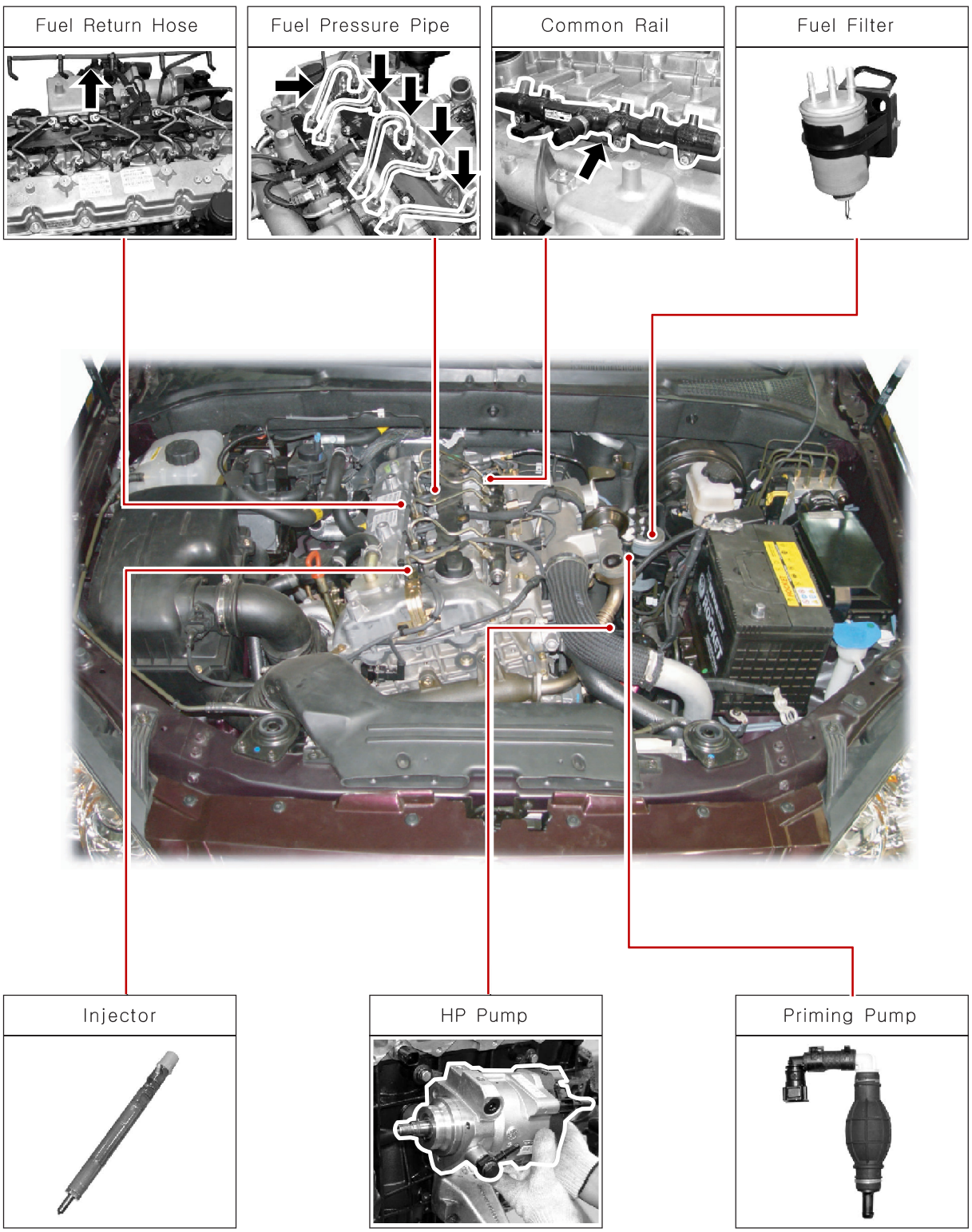
9. FUEL SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

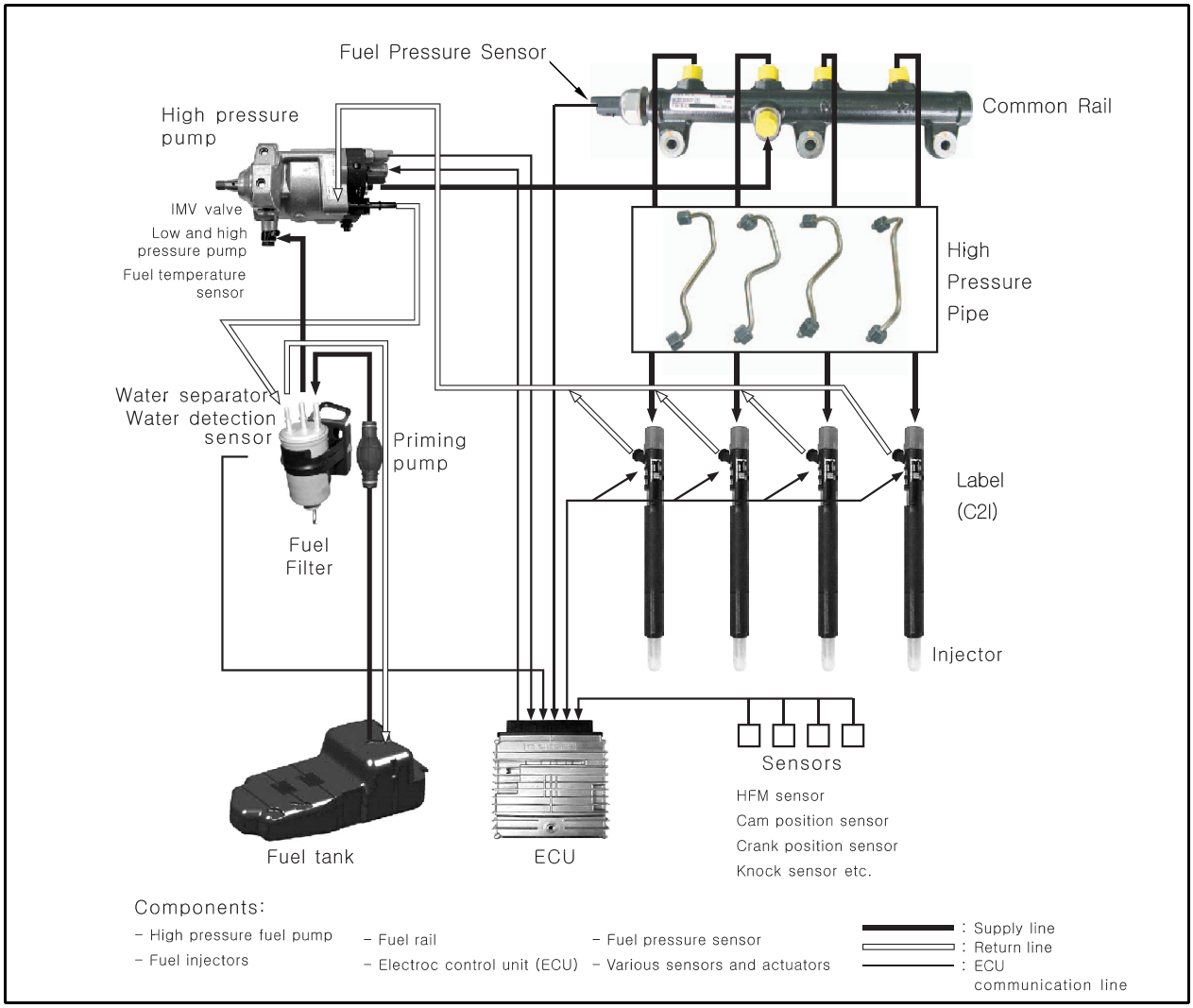
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

10. FUEL SUPPLY SYSTEM

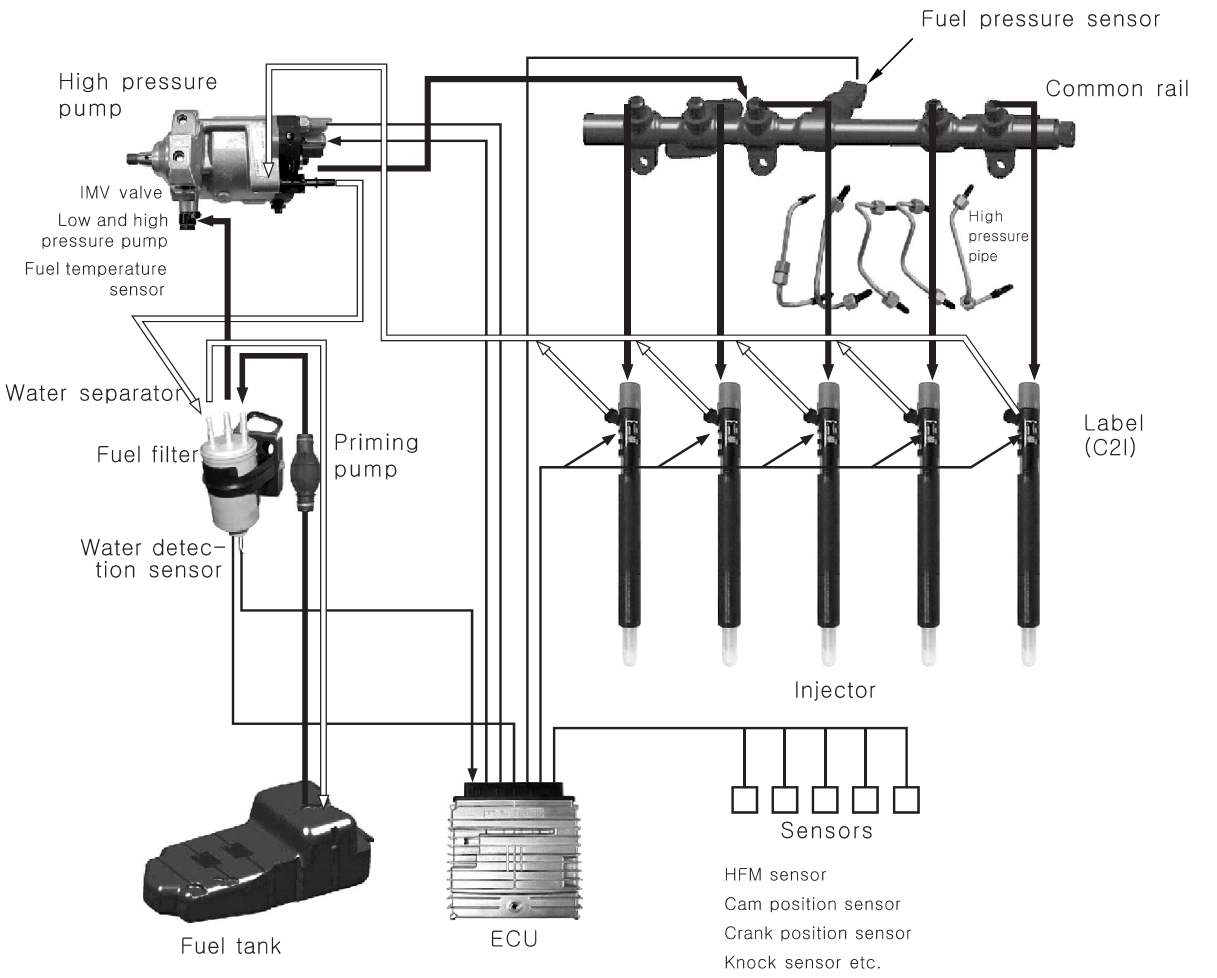
1) D20DT Engine



According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and barometric sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

11. CLEANNESS

1) Cleanness of di engine fuel system and service procedures

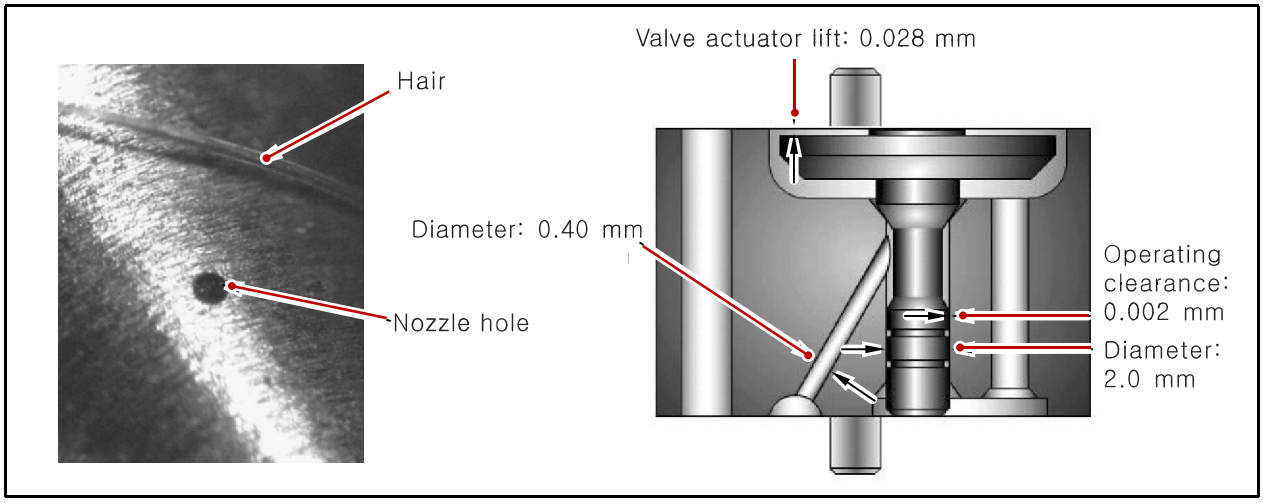
The fuel system for DI engine consists of transfer (low pressure) line and high pressure line. Its highest pressure reaches over 1600 bar.

Some components in injector and HP pump are machined at the micrometer 100 μm of preciseness.

The pressure regulation and injector operation are done by electric source from engine ECU. Accordingly, if the internal valve is stucked due to foreign materials, injector remains open. Even in this case, the HP pump still operates to supply high pressurized fuel. This increases the pressure to combustion chamber (over 250 bar) and may cause fatal damage to engine.

You can compare the thickness of injector nozzle hole and hair as shown in below figure (left side).

The right side figure shows the clearance between internal operating elements.



The core elements of fuel system has very high preciseness that is easily affected by dust or very small foreign material. Therefore, make sure to keep the preliminary works and job procedures in next pages. If not, lots of system problems and claims may arise.

2) Job procedures

1. Always keep the workshop and lift clean (especially, from dust).
2. Always keep the tools clean (from oil or foreign materials).
3. Wear a clean vinyl apron to prevent the fuzz, dust and foreign materials from getting into fuel system.
   Wash your hands and do not wear working gloves.
4. Follow the below procedures before starting service works for fuel system.

Carefully listen the symptoms and problems from customer.

↓

Visually check the leaks and vehicle appearance on the wiring harnesses and connectors in engine compartment.

↓

Perform the diagnosis proceee with SCAN-100
(refer to “DI10 DIAGNOSIS” section in this manual).

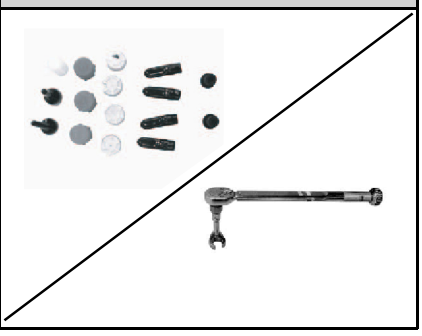
↓

Locate the fault. If the cause is from fuel system (from priming pump to injector, including return line), follow the step 1 through step 3 above.

5. If the problem is from HP pump, fuel supply line or injector, prepare the clean special tools and sealing caps to perform the diagnosis for DI engine fuel system in "DIAGNOSIS" section in this manual.
   At this point, thoroughly clean the related area in engine compartment.

CAUTION

- Clean the engine compartment before starting service works.

Tool kit for high pressure line	Took kit for low pressure line	Removal tool box and cap kits
		

Modification basis	
Application basis	
Affected VIN	

6. Follow the job procedures. If you find a defective component, replace it with new one.

Disconnect the negative battery cable.

↓

For safety reasons: check pressure is low before opening the HP systems (pipes)

↓

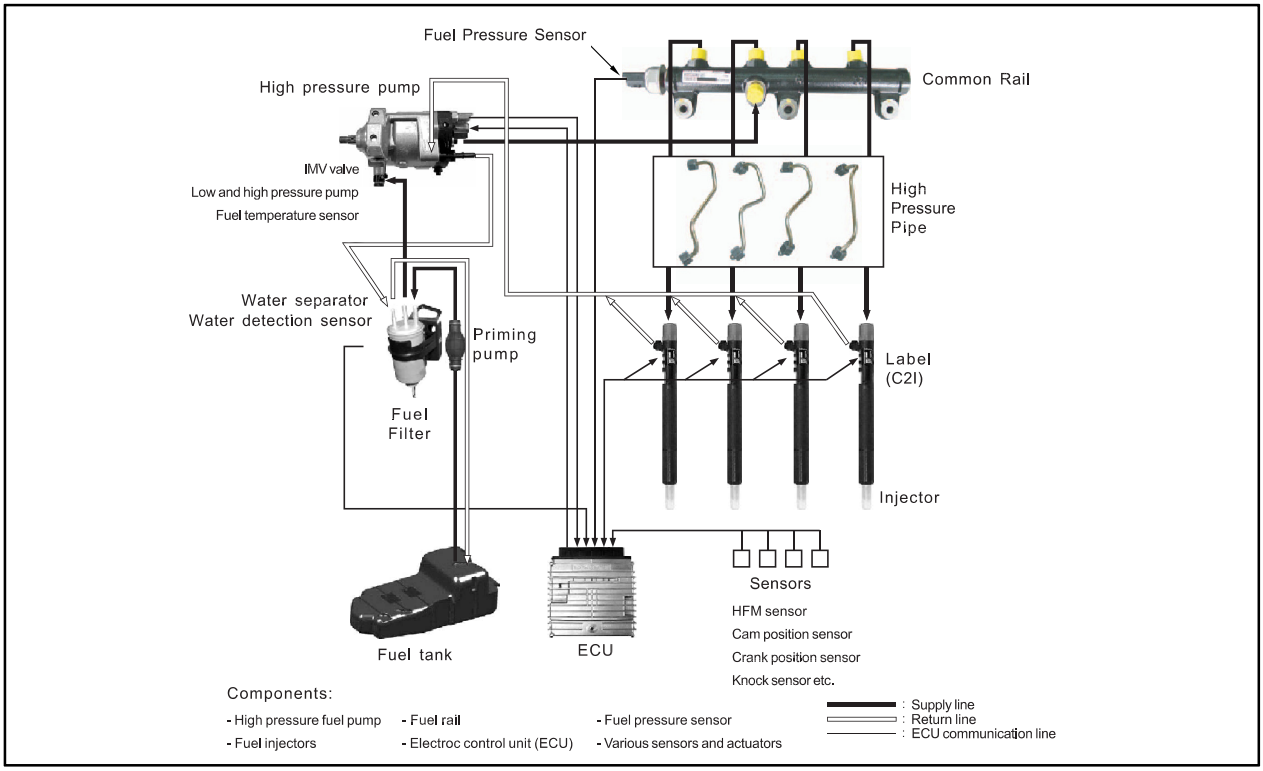
Use special tools and torque wrench to perform the correct works.

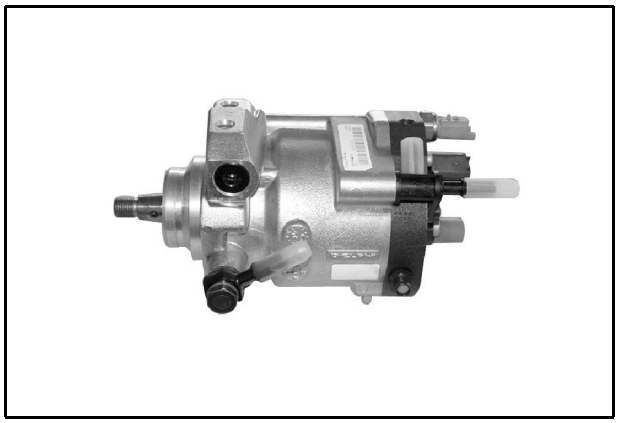
Once disconnected, the fuel pipes between HP pump and fuel rail and between fuel rail and each injector should be replaced with new ones. The pipes should be tightened to specified tightening torques during installation. Over or under torques out of specified range may cause damages and leaks at connections. Once installed, the pipes have been deformed according to the force during installtion, therefore they are not reusable.

The copper washer on injector should be replaced with new one. The injector holder bolt should be tightened to specified tightening torque as well. If not, the injection point may be deviated from correct position, and it may cause engine disorder.

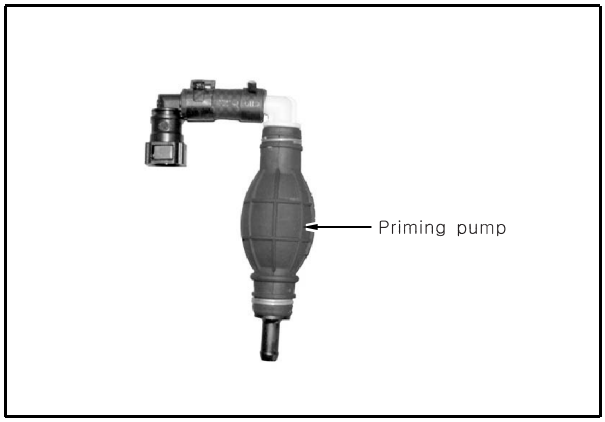
↓

Plug the disconnected parts with sealing caps, and remove the caps immediately before replacing the components.





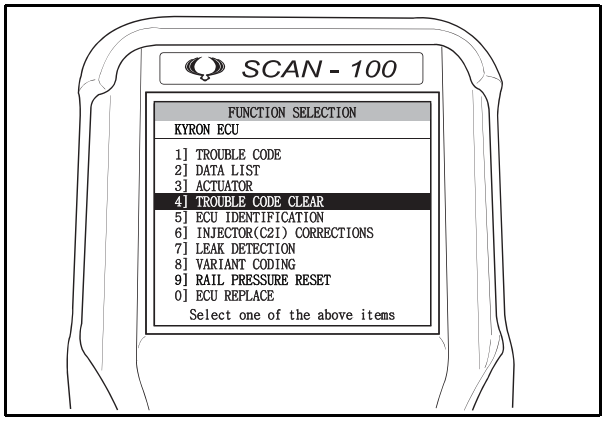
7. Plug the removed components with clean and undamaged sealing caps and store it into the box to keep the conditions when it was installed.
8. Clear the high pressure offset value by SCAN- 100 after replacing the high pressure pump.



9. To supply the fuel to transfer line of HP pump press the priming pump until it becomes hard.

CAUTION

- Do not crank engine before having filled pump.



10. Check the installed components again and connect the negative battery cable. Start the engine and check the operating status. With SCAN-100, check if there are current
11. faults and erase the history faults.

Modification basis	
Application basis	
Affected VIN	

3) Di engine and its expected problems and remedies can be caused by water in fuel

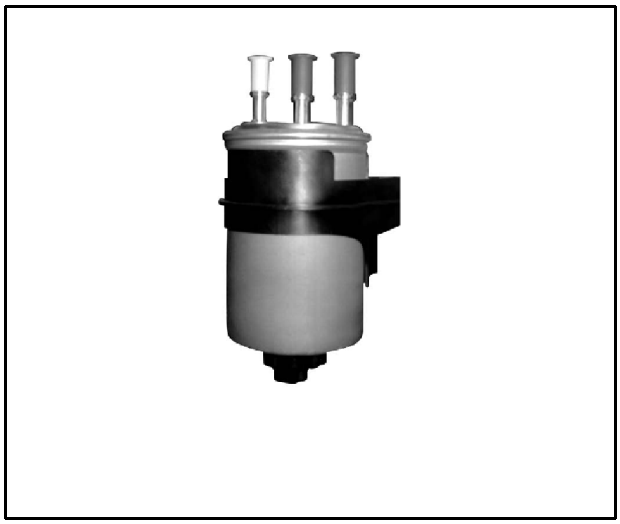
▶ SYSTEM SUPPLEMENT AGAINST PARAFFIN SEPARATION.

In case of Diesel fuel, paraffin, one of the elements, can be separated from fuel during winter and then can stick on the fuel filter blocking fuel flow and causing difficult starting finally. Oil companies supply summer fuel and winter fuel by differentiating mixing ratio of kerosene and other elements by region and season. However, above phenomenon can be happened if stations have poor facilities or sell improper fuel for the season.

In case of DI engine, purity of fuel is very important factor to keep internal preciseness of HP pump and injector.

Accordingly, more dense mesh than conventional fuel filter is used. To prevent fuel filter internal clogging due to paraffin separation, SYMC is using fuel line that high pressure and temperature fuel injected by injector returns through fuel filter to have an effect of built-in heater (see fuel system).

▶ SYSTEM SUPPLEMENT AND REMEDY AGAINST WATER IN FUEL



As mentioned above, some gas stations supply fuel with excessive than specified water. In the conventional IDI engine, excessive water in the fuel only causes dropping engine power or engine hunting. However, fuel system in the DI engine consists of precise components so water in the fuel can cause malfunctions of HP pump due to poor lubrication of pump caused by poor coating film during high speed pumping and bacterization (under long period parking). To prevent problems can be caused by excessive water in fuel, water separator is installed inside of fuel filter. When fuel is passing filter, water that has relatively bigger specific gravity is accumulated on the bottom of the filter.

If water in the separator on the fuel filter exceeds a certain level, it will be supplied to HP pump with fuel, so the engine ECU turns on warning light ( ) on the meter cluster and buzzer if water level is higher than a certain level.

Due to engine layout, a customer cannot easily drain water from fuel filter directly, so if a customer checks in to change engine oil, be sure to perform water drain from fuel filter. (See fuel system for details.)

Memo

12. MAINTENANCE AND REPAIR

1) Maintenance and lubrication

▶ Normal Vehicle Use

The maintenance instructions contained in the maintenance schedule are based on the assumption that the vehicle will be used for the following reasons:

1. To carry passengers and cargo within the limitation of the tire inflation prassure. Refer to "Wheels and Tire" in section 4H.
2. To be driven on reasonable road surfaces and within legal operating limits.

▶ Explanation of Scheduled Maintenance Services

The services listed in the maintenance schedule are further explained below.
When the following maintenance services are performed, make sure all the parts are replaced and all the necessary repairs are done before driving the vehicle. Always use the proper fluid and lubricants.

▷ **Engine Oil and Oil Filter Change**

Always use above the API SH grade or recommended engine oil.

▷ **Engine Oil Viscosity**

Engine oil viscosity (thickness) has an effect on fuel economy and cold weather operation. Lower viscosity engine oils can provide better fuel economy and cold weather performance; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Using oils of any viscosity other than those viscosities recommended could result in engine damage.

▷ **Cooling System Service**

Drain, flush and refill the system with new coolant. Refer to "Recommended Fluids And Lubricants" in this section.

▷ **Spark Plug Wire Replacement**

Clean wires and inspect them for burns, cracks or other damage. Check the wire boot fit at the Distributor and at the spark plugs. Replace the wires as needed.

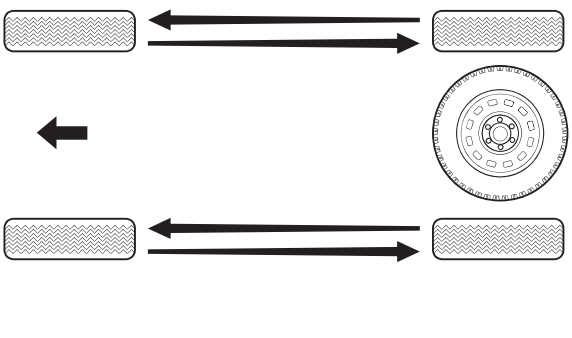
▷ **Brake System Service**

Check the disc brake pads or the drum brake linings.
Check the pad and the lining thickness carefully.

▷ **Tire and Wheel Inspection and Rotation**

Check the tires for abnormal wear or damage.
To equalize wear and obtain maximum tire life, rotate the tires. If irregular or premature wear exists, check the wheel alignment and check for damaged wheels. While the tires and wheels are removed, inspect the brakes.

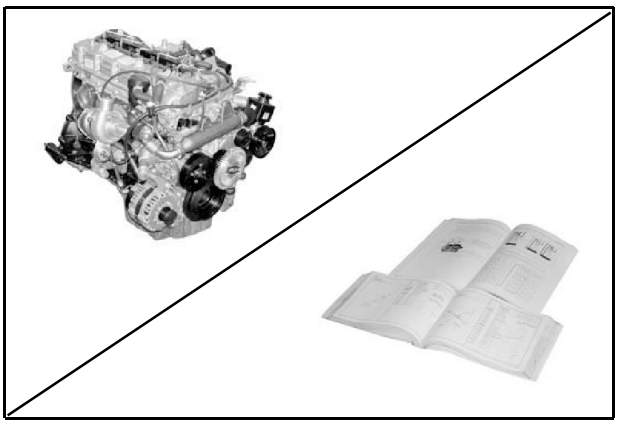
Tire Rotation (Left-hand Drive Type)



Modification basis	
Application basis	
Affected VIN	

13.GUIDELINES FOR SERVICE WORK SAFETY

1) General



To maintain and operate the vehicle under optimum state by performing safe service works, the service works should be done by following correct methods and procedures. Accordingly, the purpose of this manual is to prevent differences that can be caused by personal working method, skill, ways and service procedures and to allow prompt/correct service works.

▶ Note, Notice

While using this manual, there are a lot of Note or Notice having below meaning.

CAUTION

- Note means detailed description of supplementary information on work procedure or skill.

CAUTION

- Notice means precautions on tool/device or part damages or personal injuries that can occur during service works.

However, above references and cautions cannot be inclusive measures, so should have habits of taking concerns and cautions based on common senses.

2) Cautions on Inspection/Service

CAUTION

- During service works, be sure to observe below general items for your safety
  - · For service works, be sure to disconnect battery negative (-) terminal if not starting and inspection.
  - · While inspecting vehicle and replacing various consumable parts, be sure to take caution not to damage vehicle and injure people.
  - · Engine and transmission may be hot enough to burn you. So inspect related locations when they cooled down enough.
  - · If engine is running, keep your clothing, tools, hair and hands away from moving parts.
  - · Even when the ignition key is turned off and positioned to LOCK, electrical fan can be operated while working on near around electrical fan or radiator grille if air conditioner or coolant temperature rises.
  - · Every oil can cause skin trouble. Immediately wash out with soap if contacted.
  - · Painted surface of the body can be damaged if spilled over with oil or anti-freeze.
  - · Never go under vehicle if supported only with jack.
  - · Never near the battery and fuel related system to flames that can cause fire like cigarette.
  - · Never disconnect or connect battery terminal or other electrical equipment if ignition key is turned on.
  - · While connecting the battery terminals, be cautious of polarities (+, ?) not to be confused.
  - · There are high voltage and currency on the battery and vehicle wires. So there can be fire if short-circuited.
  - · Do not park while running the engine in an enclosed area like garage. There can be toxication with CO, so make sufficient ventilation.
  - · The electrical fan works electrically. So the fan can be operated unexpectedly during working causing injuries if the ignition key is not in LOCK position. Be sure to check whether ignition key is in LOCK position before work.
  - · Be careful not to touch hot components like catalytic converter, muffler and exhaust pipe when the engine is running or just stopped. They may burn you badly.

Modification basis	
Application basis	
Affected VIN	

3) Guidelines on engine service

To prevent personal injuries and vehicle damages that can be caused by mistakes during engine and unit inspection/ repair and to secure optimum engine performance and safety after service works, basic cautions and service work guidelines that can be easily forgotten during engine service works are described in.

▶ Cautions before service works

1. Before work on engine and each electrical equipment, be sure to disconnect battery negative (-) terminal.
2. Before service works, be sure to prepare the works by cleaning and aligning work areas.
3. Always position the ignition switch to OFF if not required. If not, there can be electrical equipment damages or personal injuries due to short-circuit or ground by mistake.
4. There should be no leak from fuel injection system (HP pump, fuel hose, high pressure pipe) of the D20DT & D27DT engine. So they should be protected from foreign materials.
5. While removing the engine, do not position the jack and others under the oil pan or engine. To secure the safety, use only safety hook on the engine.

▶ Engine and accessories

Engine has a lot of precise portions so tightening torque should be correct during disassembly / assembly and removal/installation and service work should be done in clean ways during disassembly / assembly.

Maintaining working area clean and cautious service administration is essential element of service works while working on the engine and each section of the vehicle.
So the mechanics should well aware of it.

1. While removing the engine, related parts (bolts, gaskets, etc.) should be aligned as a group.
2. While disassembling/assembling internal components of the engine, well aware of disassembly/assembly section in this manual and clean each component with engine oil and then coat with oil before installation.
3. While removing engine, drain engine oil, coolant and fuel in fuel system to prevent leakage.
4. During service work of removal/installation, be sure to check each connected portions to engine not to make interference.

▶ Fuel and lubrication system

Painted surface of the body can be damaged or rubber products (hoes) can be corroded if engine oil and fuel are spilled over. If spilled over engine, foreign materials in air can be accumulated on the engine damaging fuel system.

1. If work on the fluid system such as fuel and oil, working area should be well ventilated and mechanic should not smoke.
2. Gasket or seal on the fuel/lubrication system should be replaced with new and bolts and nuts should be tightened as specified.
3. After removal/installation works, be sure to check whether there is leak on the connecting section.

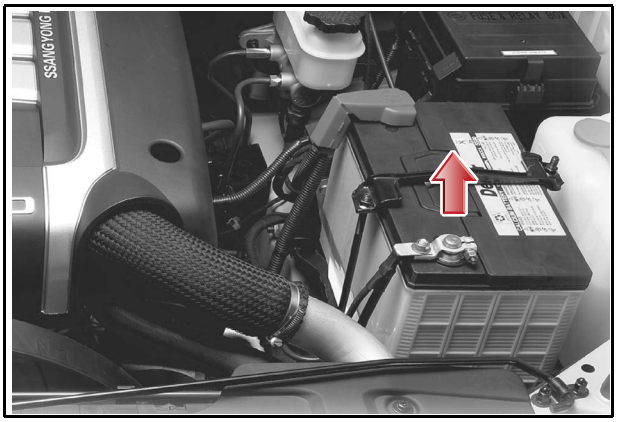
If fine dust or foreign material enters into DI engine's fuel system, there can be serious damages between HP pump and injectors. So, be sure to cover removed fuel system components with cap and protect removed parts not to be contaminated with dirt. (Refer to cleanness in this manual while working on DI engine fuel system)

▶ Electrical equipment

Electrical equipment should be handled more carefully.
Currently, the engine is equipped with a lot of electrical equipments so there can be engine performance drops, incomplete combustion and other abnormals due to short and poor contact. Mechanics should well aware of vehicle's electrical equipment.

1. If have to work on the electrical equipment, be sure to disconnect battery negative (-) terminal and position the ignition switch to off if not required.
2. When replacing electrical equipment, use the same genuine part and be sure to check whether ground or connecting portions are correctly connected during installation. If ground or connecting portion is loosened, there can be vehicle fire or personal injury.

14. DURING SERVICE WORK FOR INSPECTION



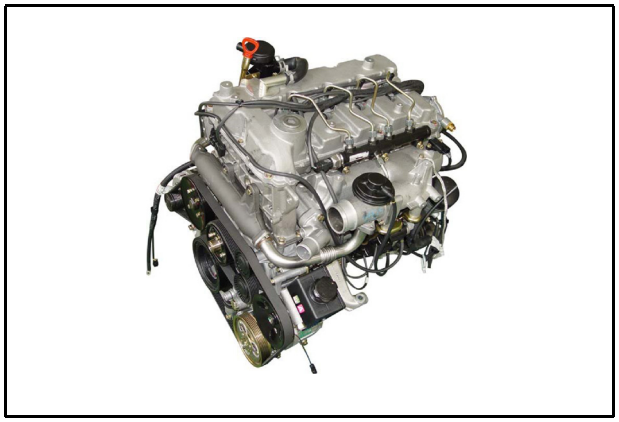
1. Before lifting up the vehicle with lift, correctly support the lifting points and lift up.
2. When using a jack, park the vehicle on the level ground and block front and rear wheels. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
3. Before service work, be sure to isconnect battery negative (-) terminal to prevent damages by bad wire and short.



4. If service from interior of the vehicle, use protection cover to prevent damage and contamination of seat and floor.
5. Brake fluid and anti-freeze can damage painted surface of body. So carefully handle them during service work.



6. Use recommended and specified tools to increase efficiency of service work.
7. Use only genuine spare parts.





8. Never reuse cotter pin, gasket, O-ring, oil seal, lock washer and self-locking nut. Replace them with new.
   If reused, normal functions cannot be maintained.
9. Align the disassembled parts in clean according to disassembling order and group for easy assembling.
10. According to installing positions, the bolts and nuts have different hardness and design. So be careful not to mix removed bolts and nuts each other and align them according installing positions.
11. To inspect and assemble, clean the parts.
12. Securely clean the parts that related with oil not to be affected by viscosity of oil.
13. Coat oil or grease on the driving and sliding surfaces before installing parts.
14. Use sealer or gasket to prevent leakage if necessary.
15. Damaged or not, never reuse removed gasket. Replace with new and cautious on installing directions.
16. Tighten every bolt and nut with specified torque.
17. When service work is completed, check finally whether the work is performed properly or the problem is solved.
18. If work on the fuel line between priming pump and injector (including return line), be sure to cover the removed parts with cap and be careful not to expose the connecting passage and removed parts to external foreign materials or dust. (Refer to cleanness.)
19. If remove high pressure fuel supply pipe between HP pump and fuel rail and high pressure fuel pipe between fuel rail and each injector, be sure to replace them with new.

Modification basis	
Application basis	
Affected VIN	

15. DURING SERVICE WORK FOR ELECTRIC DEVICES

CAUTION

- Be careful not to modify or alter electrical system and electrical device. Or there can be vehicle fire or serious damage.

1. Be sure to disconnect battery negative (-) terminal during every service work. Before disconnecting battery negative (-) terminal, turn off ignition key.
2. Replace with specified capacity of fuse if there is bad, blown or short circuited fuse. If use electrical wire or steel wire other than fuse, there can be damages on the various electrical systems. If replaced with over-capacity fuse, there can be damages on the related electrical device and fire.
3. Every wire on the vehicle should be fastened securely not to be loosened with fixing clip.
4. If wires go through edges, protect them with tape or other materials not to be damaged.
5. Carefully install the wires not to be damaged during installation/removal of parts due to interference.
6. Be careful not to throw or drop each sensor or relay.
7. Securely connect each connector until hear a "click" sound.

1) Lifting positions

▶ 4-post lift

As illustrated, position the vehicle on the 4-post lift securely and block the front and rear of each tire not to move during working.

CAUTION

During lifting, be sure to check whether vehicle is empty.

- Board-on lift connection device installed in front of vehicle should be positioned in front of sill locating under the front door.
- Install lift connecting device on the edge of front and rear of board-on lift.

WARNING

- Be sure to use attachment during lifting to prevent the lift from contacting with body floor.
- While lifting the vehicle, widen the lift floor as far as possible to stabilize between vehicle front and rear.
  When fixing the lift floor, be careful not to contact with brake tube and fuel lines.

▶ Safety jack and safety stand

If lift up the vehicle with safety jack and stand, should be more careful during works.

WARNING

- Never be under the vehicle if supported with only jack. If have to be under the vehicle, be sure to use safety block.
- Use wheel block in front and rear of every wheel.

16. OWNER INSPECTIONS AND SERVICES

1) While Operating The Vehicle

▶ Horn Operation

Blow the horn occasionally to make sure it works. Check all the button locations.

▶ Brake System Operation

Be alert for abnormal sounds, increased brake pedal travel or repeated puling to one side when braking. Also, if the brake warning light goes on, or flashes, something may be wrong with part of the brake system.

▶ Exhaust System Operation

Be alert to any changes in the sound of the system or the smell of the fumes.
These are signs that the system may be leaking or overheating. Have the system inspected and repaired immediately.

▶ Tires, Wheels and Alignment Operation

Be alert to any vibration of the steering wheel or the seats at normal highway speeds. This may mean a wheel needs to be balanced. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or a wheel alignment.

▶ Steering System Operation

Be alert to changes in the steering action. An inspection is needed when the steering wheel is hard to turn or has too much free play, or is unusual sounds are noticed when turning or parking.

▶ Headlamp Aim

Take note of the light pattern occasionally. Adjust the headlights if the beams seem improperly aimed.

2) At each fuel fill

A fluid loss in any (except windshield washer) system may indicate a problem. Have the system inspected and repaired immediately.

▶ Engine Oil Level

Check the oil level and add oil if necessary. The best time to check the engine oil level is when the oil is warm.

1. After stopping the engine, wait a few minutes for the oil to drain back to the oil pan.
2. Pull out the oil level indicator (dip stick).
3. Wipe it clean, and push the oil level indicator back down all the way.
4. Pull out the oil level indicator and look at the oil level on it.
5. Add oil, if needed, to keep the oil level above the lower mark. Avoid overfilling the engine, since this may cause engine damage.
6. Push the indicator all the way back down into the engine after taking the reading.

If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level reading.

▶ Engine Coolant Level and Condition

Check the coolant level in the coolant reservoir tank and add coolant if necessary. Inspect the coolant. Replace dirty or rusty coolant.

▶ Windshield Washer Fluid Level

Check the washer fluid level in the reservoir. Add fluid if necessary.

3) At least twice a month

Tire And Wheel Inspection and Pressure Check

Check the tire for abnormal wear or damage. Also check for damaged wheels. Check the tire pressure when the tires are cold (check the spare also, unless it is a stowaway).
Maintain the recommended pressures. Refer to "Wheels and Tire" is in section 4H.

4) At least monthly

▶ Lamp Operation

Check the operation of the license plate lamp, the headlamps (including the high beams), the parking lamps, the fog lamps, the taillamp, the brake lamps, the turn signals, the backup lamps and the hazard warning flasher.

▶ Fluid Leak Check

Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids, after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, find the cause and correct it at once.

5) At least twice a year

▶ Power Steering System Reservoir Level

Check the power steering fluid level. Keep the power steering fluid at the proper level. Refer to Section 4G, Power Steering System.

▶ Brake Master Cylinder Reservoir Level

Check the fluid and keep it at the proper level. A low fluid level can indicate worn disc brake pads which may need to be serviced. Check the breather hole in the reservoir cover to be free from dirt and check for an open passage.

▶ Weather-Strip Lubrication

Apply a thin film silicone grease using a clean cloth.

6) Each time the oil is changed

▶ Brake System Inspection

This inspection should be done when the wheels are removed for rotation. Inspect the lines and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect the disc brake pads for wear. Inspect the rotors for surface condition. Inspect other brake parts, the parking brake, etc., at the same time. Inspect the brakes more often if habit or conditions result in frequent braking.

▶ Steering, Suspension and Front Drive Axle Boot And Seal Inspection

Inspect the front and rear suspension and the steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Clean and inspect the drive axle boot and seals for damage, tears or leakage. Replace the seals if necessary.

▶ Exhaust System Inspection

Inspect the complete system (including the catalytic converter if equipped). Inspect the body near the exhaust system. Look for broken, damaged, missing, or out-ofposition parts as well as open seams, holes, loose connections, or other conditions which could cause heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

▶ Drain the Water from Fuel Filter

When the water level inside water separator in fuel filter exceeds a certain level, water separator warning light comes on and buzzer sounds. Also, the driving force of the vehicle decreases.
If these conditions occur, immediately drain the water from fuel filter & water separator.

▶ Hood Latch Operation

When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. The hood must close firmly.

7) At least annually

▶ Lap and Shoulder Belts Condition and Operation

Inspect the belt system including: the webbing, the buckles, the latch plates, the retractor, the guide loops and the anchors.

▶ Movable Head Restraint Operation

On vehicles with movable head restraints, the restraints must stay in the desired position.

▶ Spare Tire and Jack Storage

Be alert to rattles in the rear of the vehicle. The spare tire, all the jacking equipment, and the tools must be securely stowed at all times. Oil the jack ratchet or the screw mechanism after each use.

▶ Key Lock Service

Lubricate the key lock cylinder.

▶ Body Lubrication Service

Lubricate all the body door hinges including the hood, the fuel door, the rear compartment hinges and the latches, the glove box and the console doors, and any folding seat hardware.

▶ Underbody Flushing

Flushing the underbody will remove any corrosive materials used for ice and snow removal and dust control. At least every spring clean the underbody. First, loosen the sediment packed in closed areas of the vehicle. Then flush the underbody with plain water.

▶ Engine Cooling System

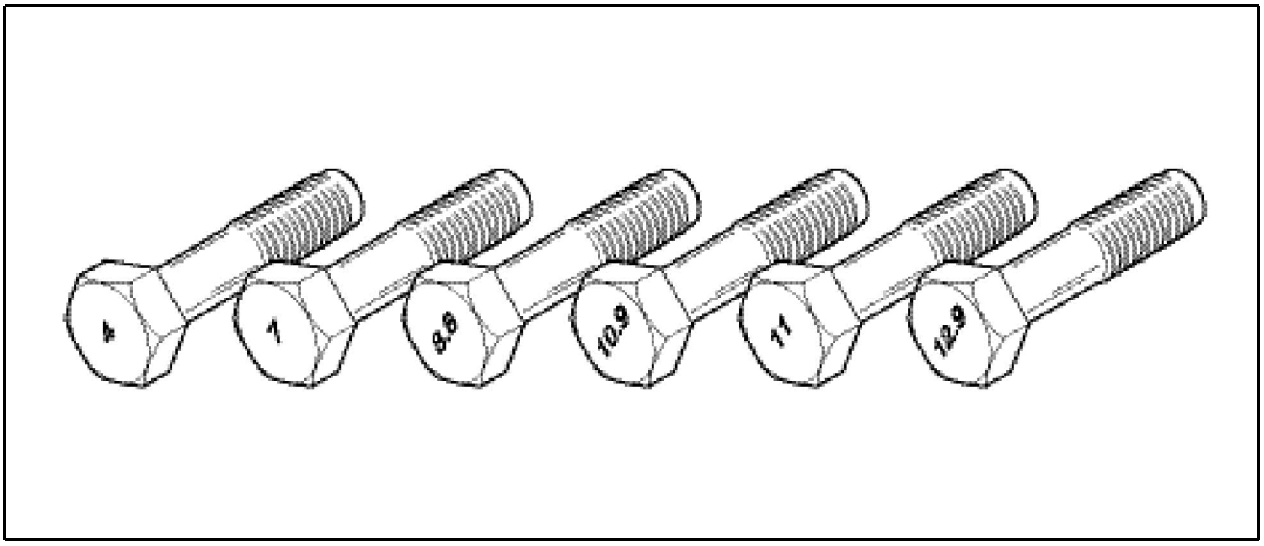
Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. Replace the cracked, swollen, or deteriorated hoses. Tighten the clamps. Clean the outside of the radiator and the air conditioning condenser. Wash the filler cap and the neck. Pressure test the cooling system and the cap in order to help ensure proper operation.

17. STANDARD BOLTS SPECIFICATIONS

Bolt*	Torque (Nm / lb-in)					
	Standard			Limit		
	4T	7T	9T	4T	7T	9T
M3 × 0.5	0.5 Nm (4.5 lb-in)	0.9 Nm (8 lb-in)	1.3 Nm (12 lb-in)	0.7 Nm (6.3 lb-in)	1.2 Nm (11 lb-in)	17 Nm (15 lb-in)
M4 × 0.7	1.2 Nm (11 lb-in)	2.0 Nm (18 lb-in)	3.0 Nm (27 lb-in)	1.6 Nm (14 lb-in)	2.6 Nm (23 lb-in)	4.0 Nm (36 lb-in)
M5 × 0.8	2.4 Nm (22 lb-in)	4.0 Nm (36 lb-in)	5.6 Nm (50 lb-in)	3.1 Nm (28 lb-in)	5.2 Nm (47 lb-in)	7.6 Nm (68 lb-in)
M6 × 1.0	4.0 Nm (36 lb-in)	6.7 Nm (60 lb-in)	9.7 Nm (87 lb-in)	5.4 Nm (49 lb-in)	9.0 Nm (81 lb-in)	12.7 Nm (114 lb-in)
M8 × 1.25	8.6 Nm (77 lb-in)	15.7 Nm (12 lb-in)	22.5 Nm (17 lb-in)	12.7 Nm (9 lb-in)	20.6 Nm (15.2 lb-in)	30.4 Nm (22 lb-in)
M10 × 1.25	18.6 Nm (14 lb-in)	32.3 Nm (24 lb-in)	46.0 Nm (34 lb-in)	25.5 Nm (19 lb-in)	42.1 Nm (31 lb-in)	60.8 Nm (31 lb-in)
M10 × 1.5	18.6 Nm (14 lb-in)	30.4 Nm (22 lb-in)	44.1 Nm (33 lb-in)	24.5 Nm (18 lb-in)	41.2 Nm (30 lb-in)	58.8 Nm (44 lb-in)
M12 × 1.25	34.3 Nm (25 lb-in)	56.8 Nm (42 lb-in)	82.3 Nm (61 lb-in)	45.0 Nm (33 lb-in)	75.5 Nm (56 lb-in)	107.8 Nm (80 lb-in)
M12 × 1.75	32.3 Nm (24 lb-in)	53.9 Nm (40 lb-in)	77.4 Nm (57 lb-in)	43.1 Nm (32 lb-in)	71.5 Nm (53 lb-in)	98.0 Nm (73 lb-in)
M14 × 1.5	54.0 Nm (40 lb-in)	89.2 Nm (66 lb-in)	127.4 Nm (94 lb-in)	71.6 Nm (53 lb-in)	117.6 Nm (87 lb-in)	166.6 Nm (123 lb-in)
M16 × 1.5	81.3 Nm (60 lb-in)	107.8 Nm (80 lb-in)	196.0 Nm (145 lb-in)	107.8 Nm (80 lb-in)	186.2 Nm (138 lb-in)	264.6 Nm (196 lb-in)
M18 × 1.5	117.6 Nm (87 lb-in)	196.0 Nm (145 lb-in)	284.2 Nm (210 lb-in)	156.8 Nm (116 lb-in)	264.6 Nm (196 lb-in)	372.4 Nm (276 lb-in)
M20 × 1.5	166.6Nm (123 lb-in)	274.4 Nm (203 lb-in)	392.0 Nm (290 lb-in)	215.6 Nm (160 lb-in)	362.6 Nm (268 lb-in)	519.4 Nm (384 lb-in)
M22 × 0.5	225.4Nm (167 lb-in)	372.4 Nm (276 lb-in)	529.2 Nm (392 lb-in)	294.0 Nm (218 lb-in)	490.0 Nm (362 lb-in)	705.6 Nm (522 lb-in)
M24 × 1.5	284.2 Nm (210 lb-in)	480.2 Nm (355 lb-in)	686.0 Nm (508 lb-in)	382.2 Nm (283 lb-in)	637.0 Nm (471 lb-in)	921.2 Nm (682 lb-in)
M24 × 2.0	274.4 Nm (203 lb-in)	460.6 Nm (341 lb-in)	666.4 Nm (493 lb-in)	372.4 Nm (276 lb-in)	617.4 Nm (457 lb-in)	891.8 Nm (660 lb-in)

*Diameter X pitch in millimeters

Modification basis	
Application basis	
Affected VIN	



1. Metric bolt strength is embossed on the head of each bolt. The strength of bolt can be classified as 4T, 7T, 8.8T, 10.9T, 11T and 12.9T in general.
2. Observe standard tightening torque during bolt tightening works and can adjust torque to be proper within 15 % if necessary. Try not to over max. allowable tightening torque if not required to do so.
3. Determine extra proper tightening torque if tightens with washer or packing.
4. If tightens bolts on the below materials, be sure to determine the proper torque.
   1) Aluminum alloy: Tighten to 80 % of above torque table.
   2) Plastics: Tighten to 20 % of above torque table.

Memo

ENGINE ASSEMBLY

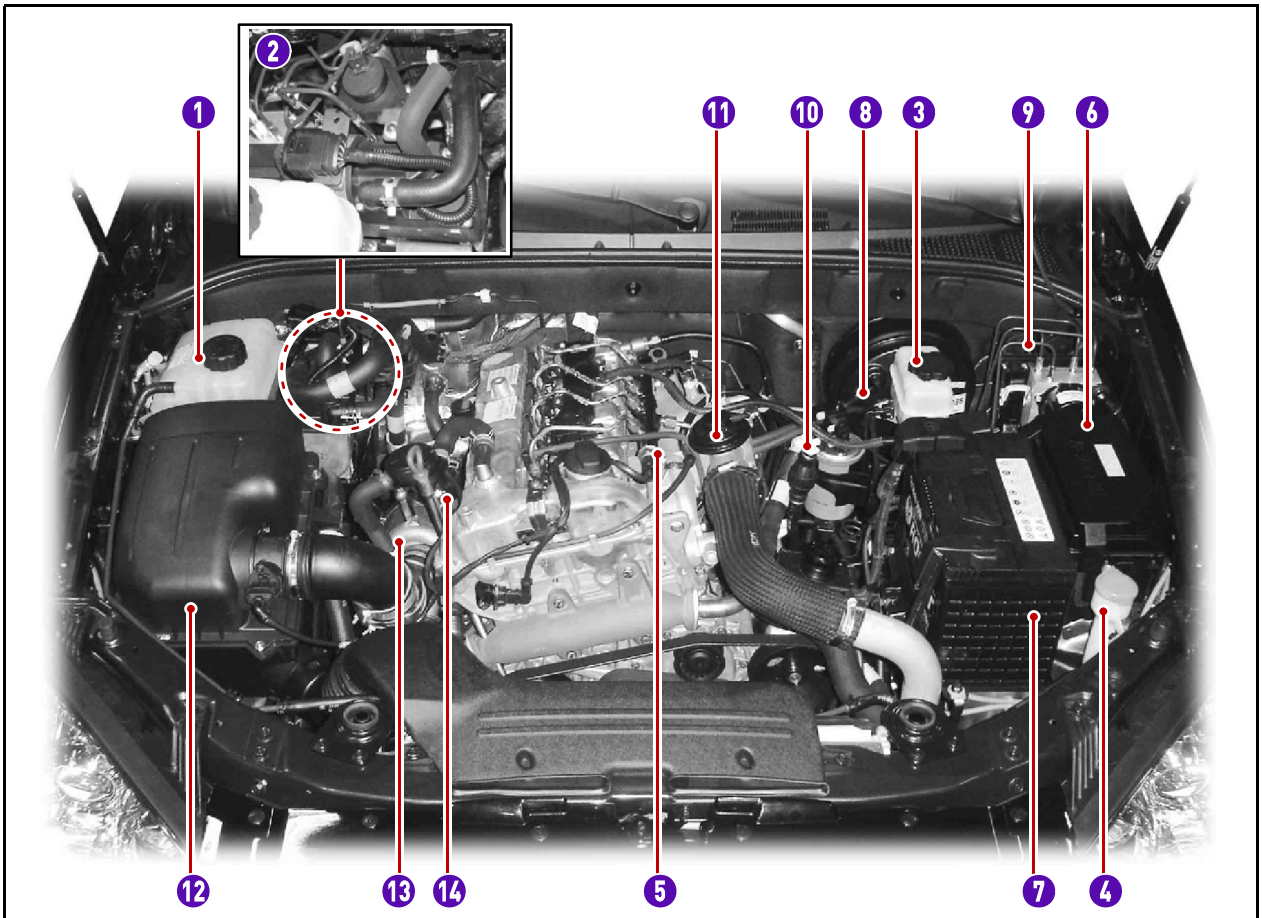
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GENERAL

1. MAJOR COMPONENTS IN ENGINE AND ENGINE COMPARTMENT

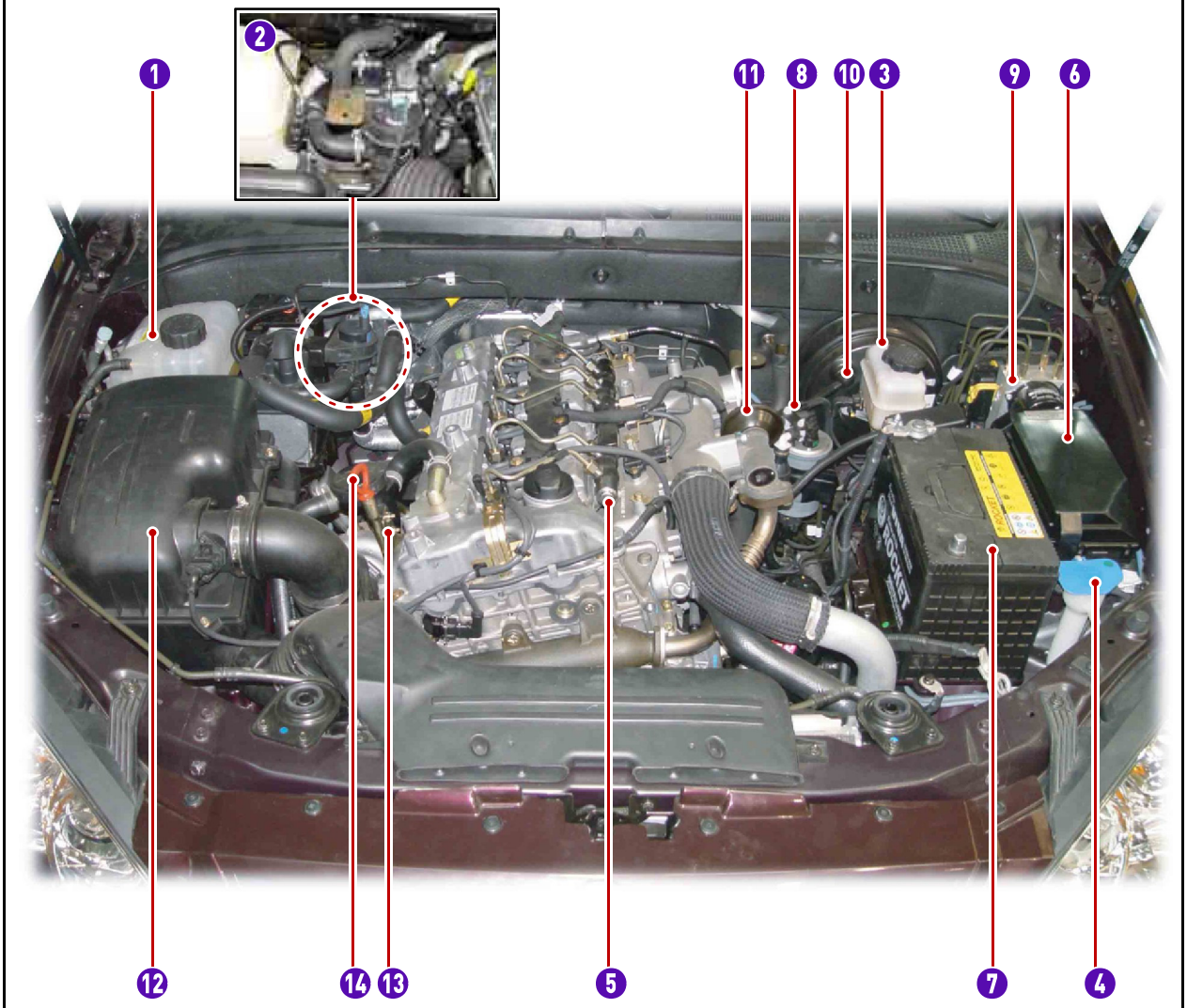
1) D20DT ENGINE

The advanced electronically controlled D20DT engine that has high pressure fuel system has been introduced to this vehicle. It satisfies the strict emission regulation and provides improved output and maximum torque.



1	Coolant reservoir	8	Fuel filter
2	FFH device	9	ABS/ESP unit
3	Brake fluid reservoir	10	Priming pump
4	Washer fluid reservoir	11	EGR valve
5	Common rail	12	Air cleaner assembly
6	Fuse box	13	Turbo charger
7	Battery	14	Oil dipstick

2) D27DT ENGINE



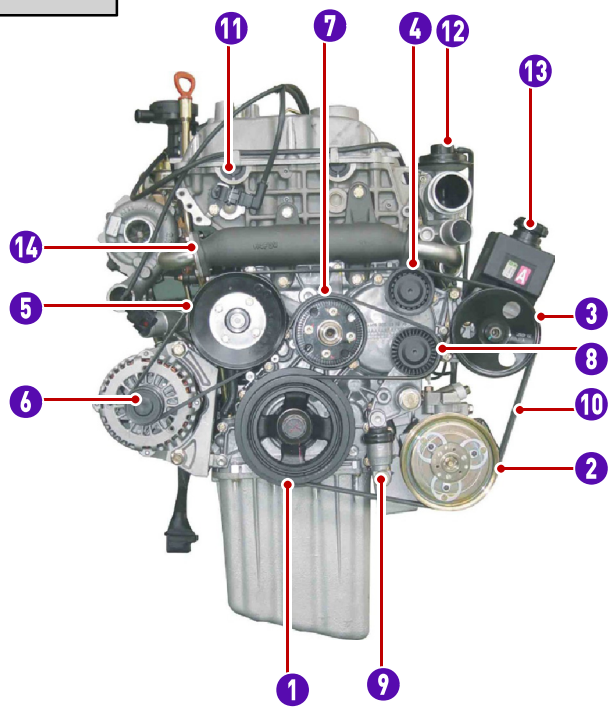
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5	Common rail	12	Air cleaner assembly
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7	Battery	14	Oil dipstick

Modification basis	
Application basis	
Affected VIN	

2. ENGINE STRUCTURE

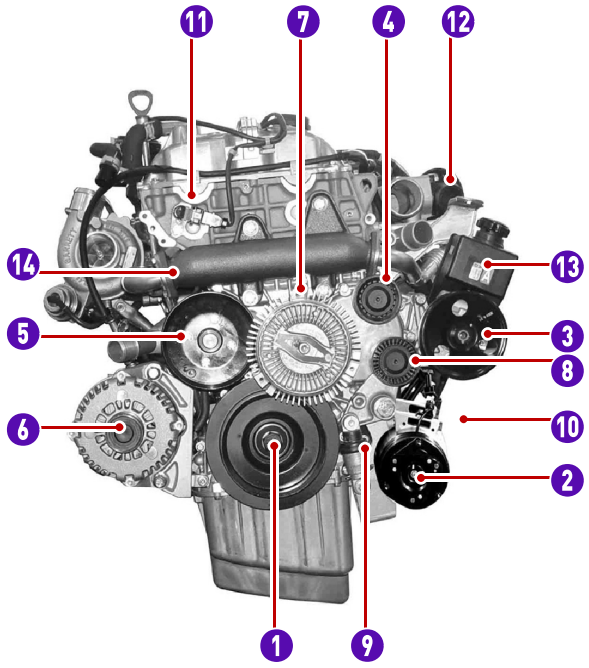
1) Front View

D20DT



1	TVD (Torsional Vibration Damper)
2	Air conditioner compressor
3	Power steering pump pulley
4	Idle pulley
5	Water pump pulley
6	Alternator
7	Viscos clutch pulley
8	Auto tensioner pulley
9	Auto tensioner
10	Poly-grooved belt
11	Cam position sensor
12	EGR valve
13	Power steering pump
14	EGR center pipe

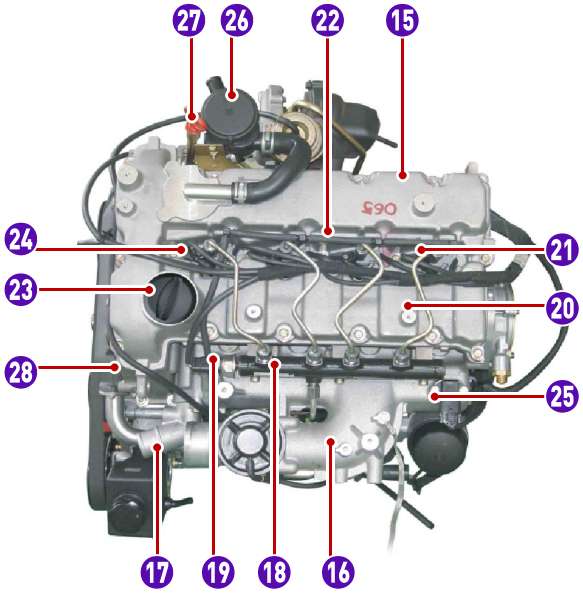
D27DT



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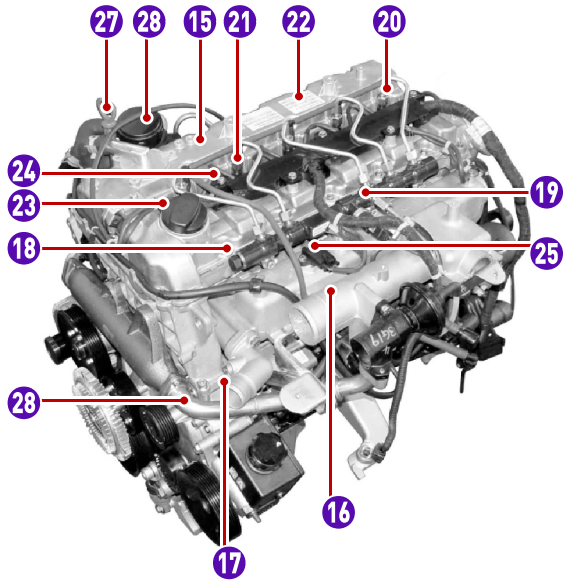
2) Top View

D20DT



15	Cylinder head cover
16	Intake manifold
17	Water outlet port
18	Common rail
19	Fuel pressure sensor
20	Fuel pipe
21	Injector
22	Fuel return line
23	Oil filler cap
24	Glow plug
25	Booster pressure sensor
26	PCV valve and oil separator
27	Oil dipstick
28	EGR-LH pipe

D27DT

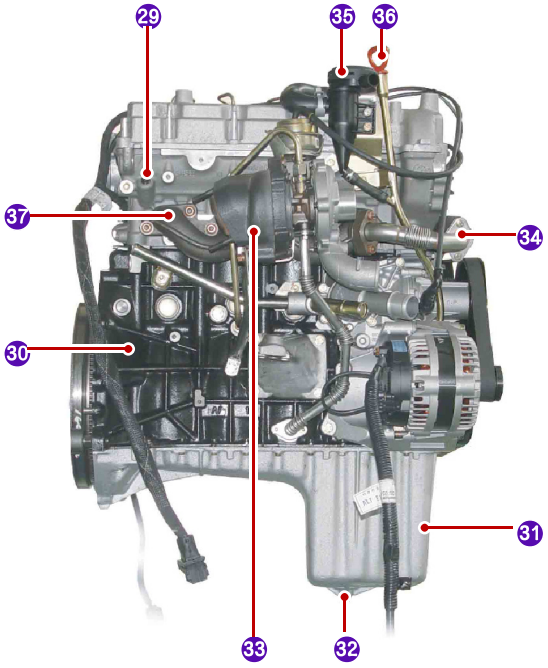


15	Cylinder head cover
16	Intake manifold
17	Water outlet port
18	Common rail
19	Fuel pressure sensor
20	Fuel pipe
21	Injector
22	Fuel return line
23	Oil filler cap
24	Glow plug
25	Booster pressure sensor
26	PCV valve and oil separator
27	Oil dipstick
28	EGR-LH pipe

Modification basis	
Application basis	
Affected VIN	

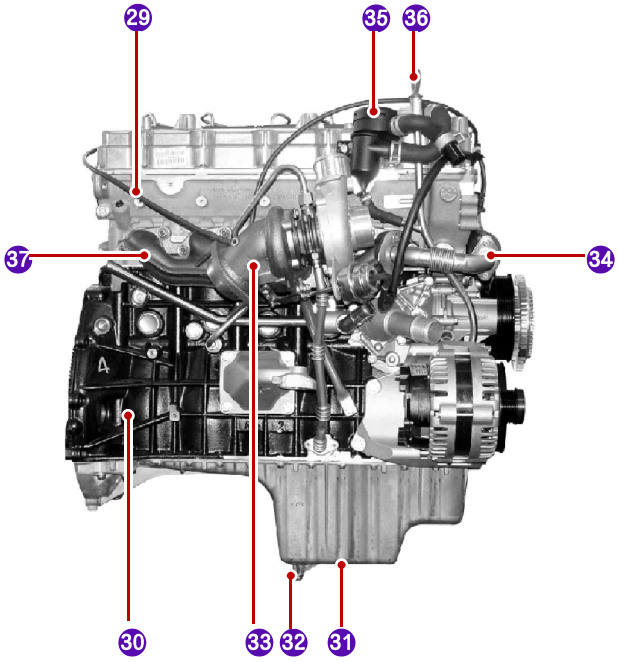
3) Right Side View

D20DT



29. Cylinder head
30. Cylinder block
31. Oil pan
32. Drain plug
33. Turbo charger
34. EGR-RH pipe
35. PCV valve and oil separator
36. Oil dipstick
37. Exhaust manifold

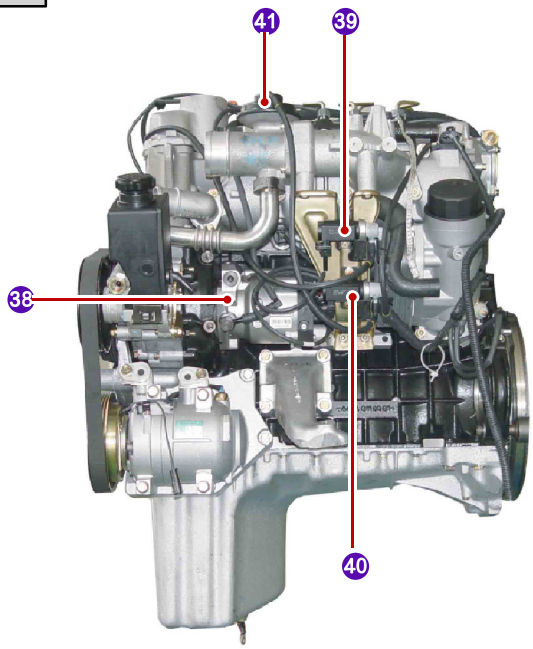
D27DT



29. Cylinder head
30. Cylinder block
31. Oil pan
32. Drain plug
33. Turbo charger
34. EGR-RH pipe
35. PCV valve and oil separator
36. Oil dipstick
37. Exhaust manifold

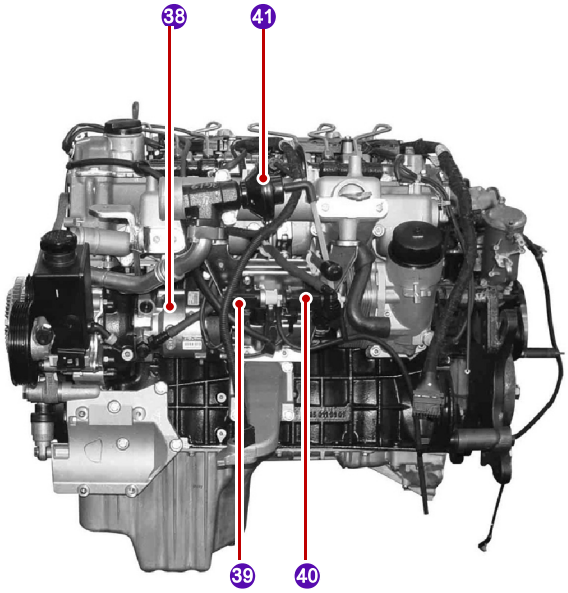
4) Left Side View

D20DT



38. High pressure pump
39. Turbo charger booster vacuum modulator (Gray)
40. EGR valve vacuum modulator
41. EGR valve (Black)

D27DT



38. High pressure pump
39. Turbo charger booster vacuum modulator (Gray)
40. EGR valve vacuum modulator
41. EGR valve (Black)

Modification basis	
Application basis	
Affected VIN	

3. SPECIFICATIONS AND PERFORMANCE CURVE

1) Specifications

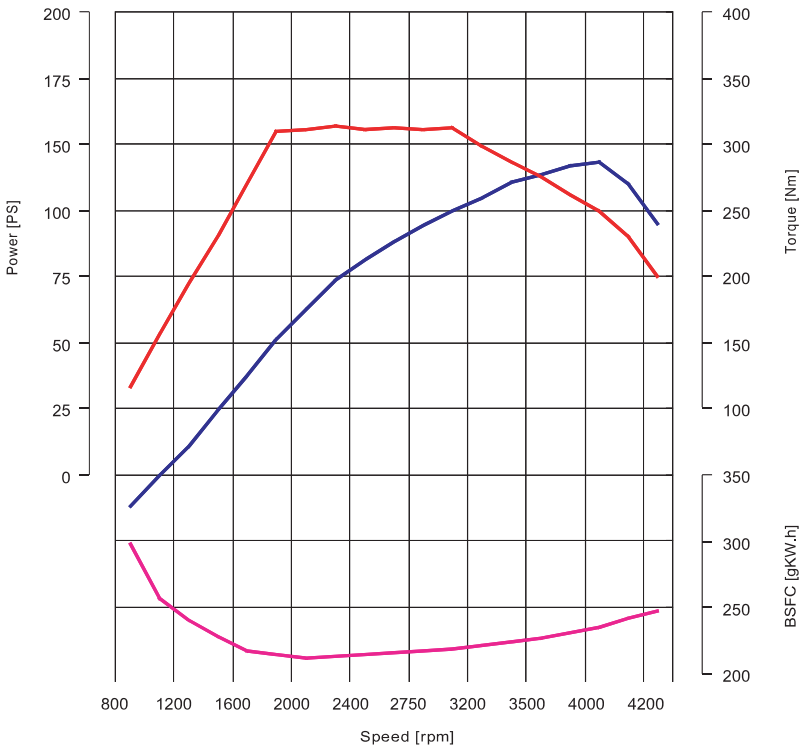
Description			D20DT	D27DT
Engine	Type/Number of cylinders		D20DT/4-cylinder	D27DT/5-cylinder
Cylinder	Inner diameter (mm)		86.2	86.2
	Stroke (mm)		85.6	92.4
Displacement (cc)			1998	2696
Compression ratio			17.5:1	18:1
Maximum output (ps/rpm)			141/4,000	165/4,000
Maximum torque (Nm/rpm)			310/1,800 ~ 2,750	340/1,800 ~ 3,250
Idle speed	For Manual Transmission		750 ± 50 rpm	750 ± 50 rpm
	For Automatic Transmission		750 ± 50 rpm	750 ± 50 rpm
Valve	Intake	Opens (BTDC)	9°	9°
		Closes (ABDC)	26°	26°
	Exhaust	Opens (BBDC)	38°	38°
		Closes (ATDC)	16°	16°
Camshaft	Type		DOHC	DOHC
Fuel system	Fuel type		Low sulfur diesel	Low sulfur diesel
	Fuel pump type		Vane pump in HP pump	Vane pump in HP pump
	Fuel supply pressure		HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar	HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar
	Water separation in fuel filter		at every 10,000 km	at every 10,000 km
	Fuel tank capacity (ℓ)		80	80
Lubrication system	Oil specification		SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)	SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)
	Lubrication type		Forced delivery	Forced delivery
	Oil filter type		Full flow, filter element type	Full flow, filter element type
	Oil capacity (ℓ)		5.0 ~ 7.5	6.0 ~ 8.5
Cooling system	Cooling type		Water cooling type	Water cooling type
	Cooling fan operation type		Belt operated type	Belt operated type
	Thermostat: Fully Open: 100°C)	Opening temperature (°C)	85	85
		Type	WAX pellet type	WAX pellet type
	Coolant capacity (ℓ)		11.5	11.5

2) Engine Performance Curve

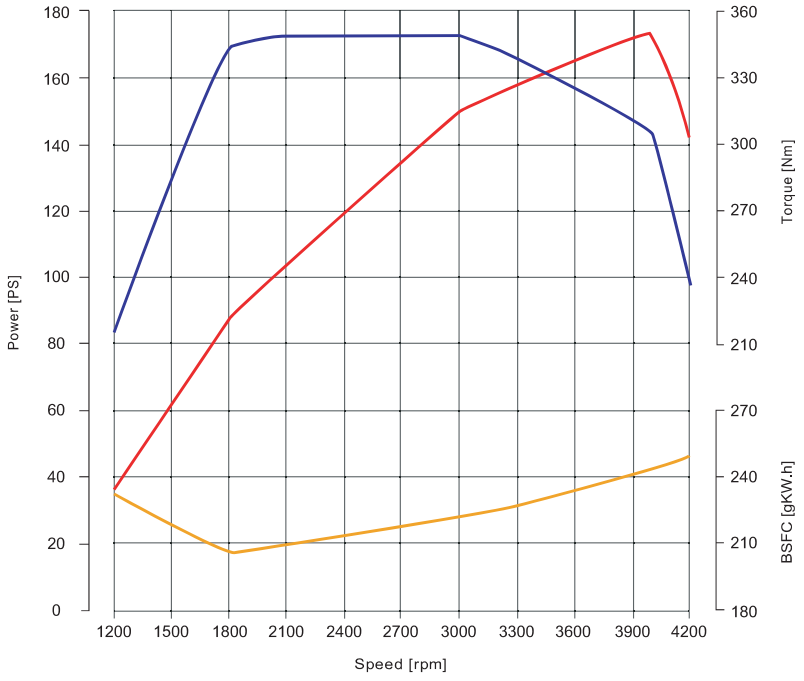
(1) Vehicle with A/T

▶ Output and Torque

D20DT engine



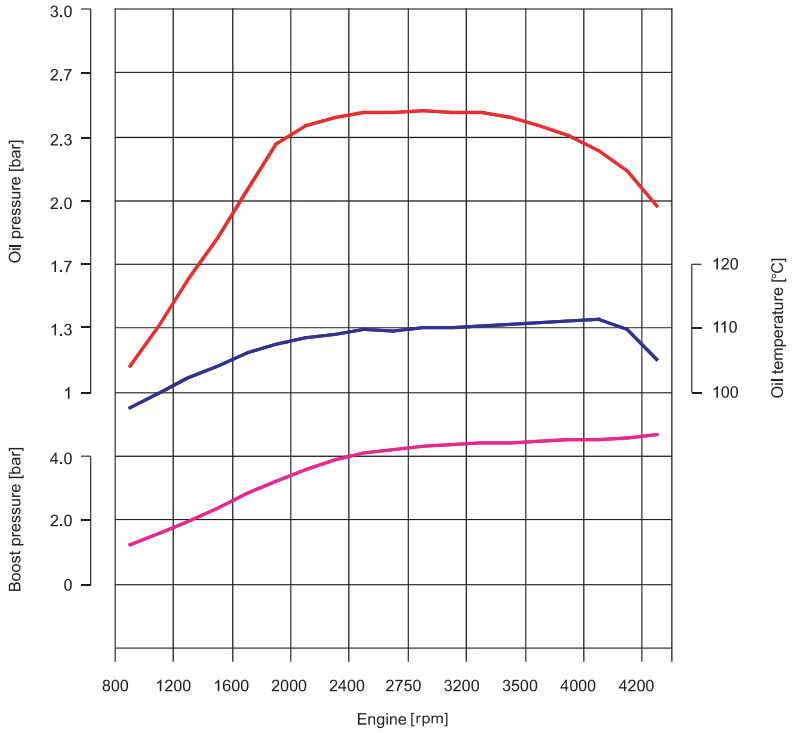
D27DT engine



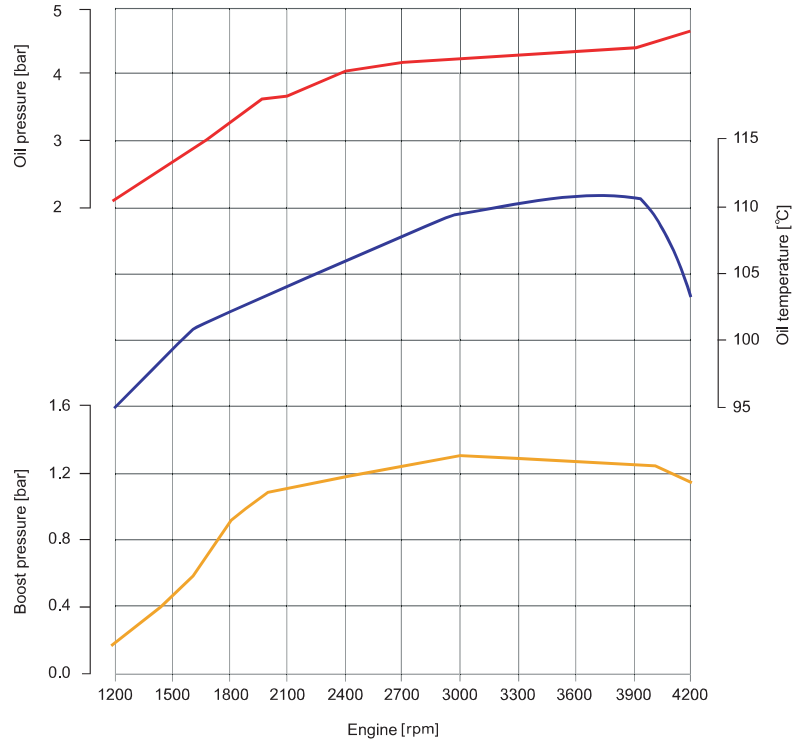
Modification basis	
Application basis	
Affected VIN	

▶ Oil Temperature/Pressure and Boost Pressure

D20DT engine



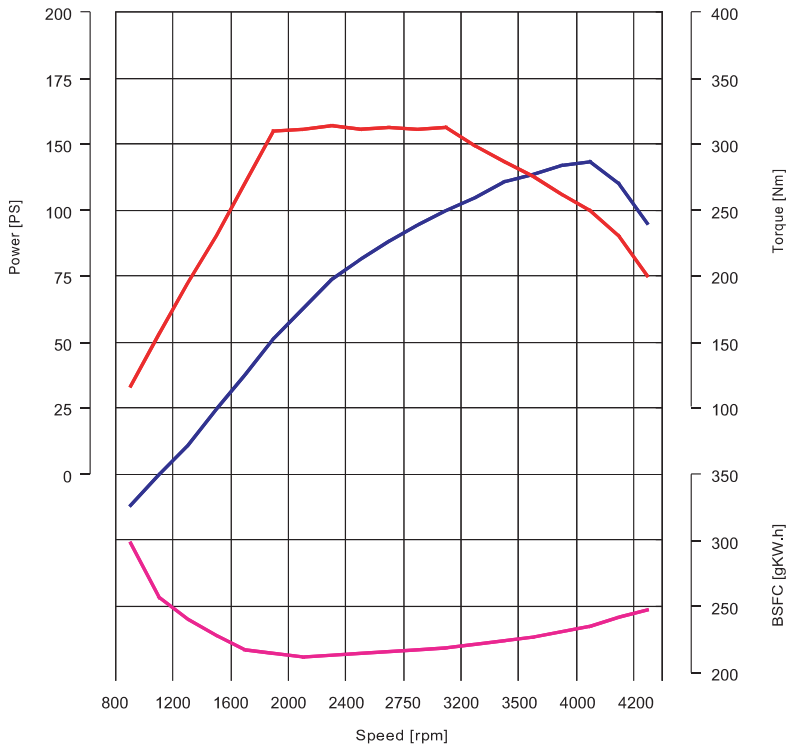
D27DT engine



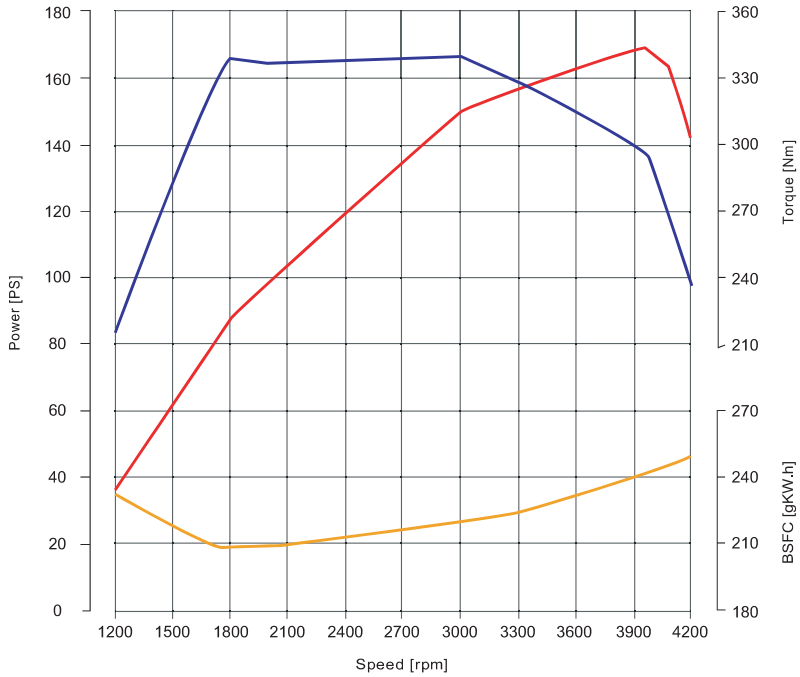
(2) Vehicle with M/T

▶ Output and Torque

D20DT engine



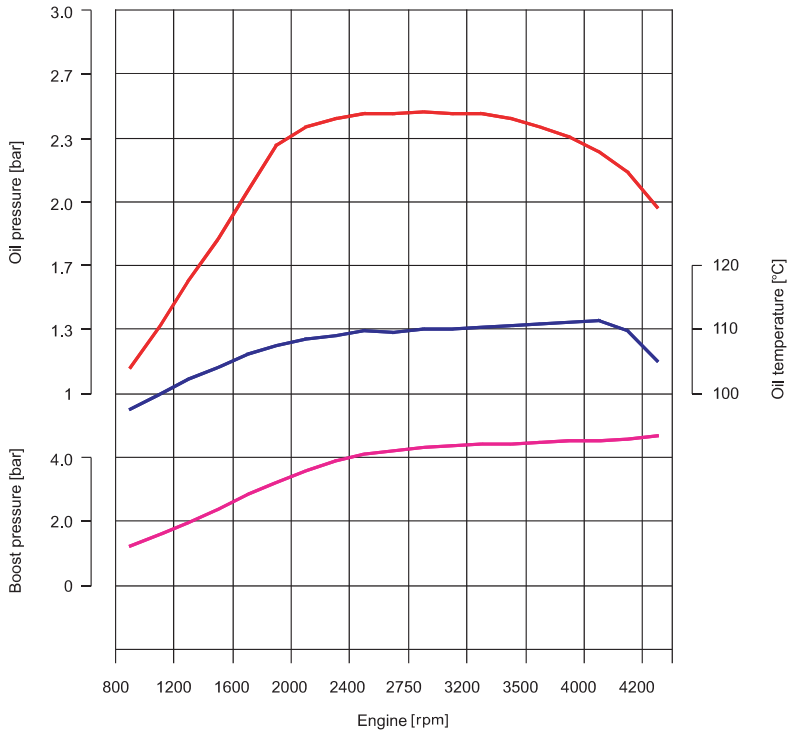
D27DT engine



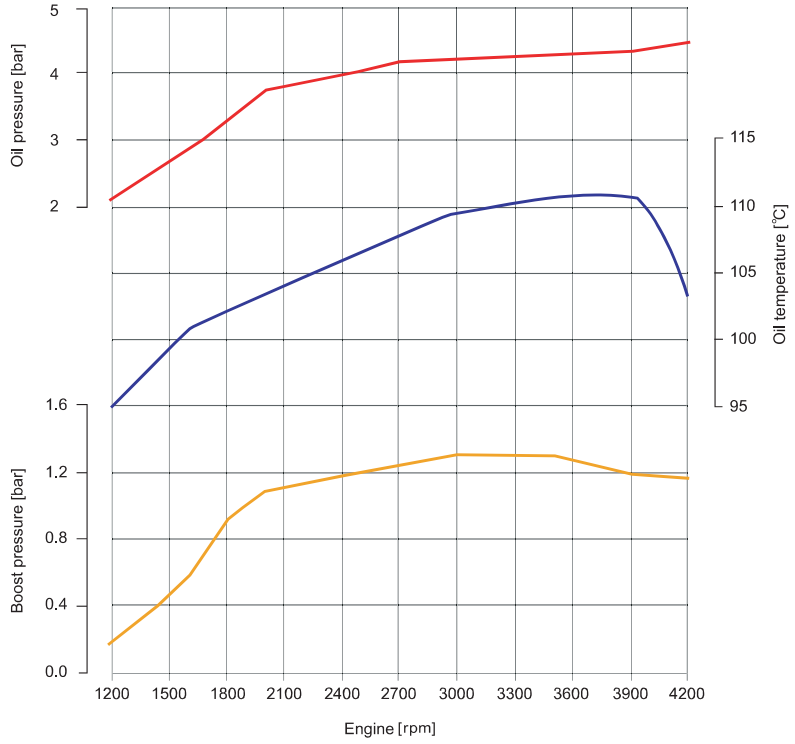
Modification basis	
Application basis	
Affected VIN	

▶ Oil Temperature/Pressure and Boost Pressure

D20DT engine



D27DT engine



Modification basis	
Application basis	
Affected VIN	

4. TIGHTENING TORQUE

NO.	Name	Size	Quantity	Tightening Torque (Nm)
1	Oil nozzle	M6 x 22	5	10 ± 1
2	Main bearing cap	M11 x 62	12	55 ± 5 90° ± 10°
3	Connecting rod cap	M9 x 52	5	40 ± 5 90° ± 10°
4	Rear cover	M6 x 20	6	10 ± 1
5	Oil pump	M8 x 35SOC	3	25 ± 2.5
6	Oil baffle plate assembly	M6 x 20	10	10 ± 1
7	T.G.C.C	M6 x 16	1	10 ± 1
		M6 x 40	6	10 ± 1
		M6 x 60	3	10 ± 1
		M6 x 70	2	10 ± 1
		M8 x 80SOC	1	25 ± 2.5
8	Flywheel	M10 x 28.5	8	45 ± 5 90° ± 10°
9	Crankshaft hub	M20 x 85 Head: M18	1	200 ± 20 180° ± 10°
10	Oil pan	M6 x 20	24	10 ± 1
		M6 x 35	3	10 ± 1
		M6 x 85	3	10 ± 1
		M8 x 40	4	25 ± 2.5
11	High pressure pump assembly	M8 x 40	4	25 ± 2.5
12	High pressure pump sprocket assembly	M14 x 1.5-8-1	1	65 ± 5
13	High pressure pump bracket	M7 x 16	3	20 ± 2 x 90° + 10°
14	Cylinder head assembly	M8 x 25	2	25 ± 2.5
		M8 x 50	2	
		M12 x 177	11	Step1: 20 ± 2 Step2: 85 ± 5
		M12 x 158	1	Step3: 3 x 90° + 10°
15	Camshaft cap	M8 x 60	24	25 ± 2.5
16	Stud bolt	M8	10	15 ± 1.5
17	Camshaft sprocket (Intake)	M11 x 52	1	25 ± 2.5
	Camshaft sprocket (Exhaust)		1	90° ± 10°
18	Chain tensioner	M22	1	65 ± 5
19	Coolant temperature sensor	M14	1	22 ± 2.2

Modification basis	
Application basis	
Affected VIN	

NO.	Name	Size	Quantity	Tightening Torque (Nm)
20	Auto tensioner	M8 x 45(LOWER)	1	32 ± 3
		M12 x 90	1	82 ± 6
21	Water pump assembly	M6 x 50	7	10 ± 1
22	Water pump pulley	M6 x 12	4	10 ± 1
23	Hot water inlet pipe assembly	M6 x 12	2	10 ± 1
24	Alternator bracket	M8 x 32	4	25 ± 2.5
25	Alternator	M10 x 90	2	46 ± 4.6
26	Air conditioner compressor assembly	M8 x 95	4	46 ± 4.6
27	Air conditioner compressor bracket assembly	M8 x 25	1	25 ± 2.5
		M8 x 60	3	25 ± 2.5
28	Air conditioner compressor sub bracket assembly	M6 x 14	1	10 ± 1.0
		M8 x 16	1	25 ± 2.5
29	Intake manifold	M8 x 45	6	25 ± 2.5
		M8 x 130	6	25 ± 2.5
30	Bracket	M6 x 16	1	10 ± 1.0
31	Knock sensor	M8 x 28	2	20 ± 2.6
32	Camshaft position sensor	M8 x 16	1	12 ± 1.7
33	Booster pressure sensor	M6 x 16	2	10 ± 1.0
34	Exhauster manifold	M8	10	40 ± 4
35	Turbo charger assembly	M8	4	25 ± 2.5
36	Turbo charger adaptor piece		1	32 ± 3.2
37	Nut	M8	1	25 ± 2.5
38	Combination bolt	M8 x 22	1	25 ± 2.5
39	T/C oil supply pipe	M6 x 16 (Cylinder block side)	1	25 ± 2.5
		M16 (T/C side)	1	20 ± 2.0
40	T/C oil return pipe	M6 x 16 (T/C side)	2	10 ± 1.0
		M6 x 16 (Cylinder block side)	2	10 ± 1.0
41	EGR valve assembly	M8 x 22	2	25 ± 2.5
42	EGR-LH pipe bolt	M6 x 16	2	10 ± 1.0
		M8 x 22	2	35 ± 2.0
43	EGR combination bolt	M6 x 16	4	10 ± 1.0
		M8 x 16	4	25 ± 2.5
	EGR-RH pipe nut	M8	2	35 ± 2.0
44	Glow plug cable nut	M5	5	15 ± 3
45	Vacuum pump	M6 x 20	3	10 ± 1.0
46	Cooling fan bracket assembly	M6 x 25	5	10 ± 1.0
		M6 x 65	1	10 ± 1.0
		M6 x 85	3	10 ± 1.0
47	Cylinder head cover	M6 x 35	21	23 ± 2.3

NO.	Name	Size	Quantity	Tightening Torque (Nm)
48	Vacuum modulator	M6 x 16SOC	4	10 ± 1.0
49	WDT combination bolt	M6 x 16	3	10 ± 1.0
50	Oil dipstick tube	M6 x 16	1	10 ± 1.0
51	Oil filter assembly	M8 x 35SOC	1	25 ± 2.5
		M8 x 50SOC	2	25 ± 2.5
		M8 x 55SOC	1	25 ± 2.5
52	Fuel rail assembly	M8 x 35SOC	3	25 ± 2.5
53	Injector clamp washer	M6 x 60	5	10 ± 1.0 180 + 20°
54	Fuel pipe clip (H-C)	M6 x 19	1	10 ± 1.0
55	Fuel pipe clip (C-I)	M6 x 16	5	10 ± 1.0
56	Crankshaft position sensor	M5 x 17	1	0.8 ± 0.4
57	Crankshaft position sensor	GAP	-	0.7 ~ 1.5 mm
58	Wiring	M6 x 16	5	10 ± 1.0
59	Intake manifold bracket	M8 x 16	2	25 ± 2.5
		M8 x 40	2	25 ± 2.5
60	Power steering pump	M8 x 100	2	25 ± 2.5
		NUT	2	25 ± 2.5
61	Piston protrusion	-	-	0.765 ~ 1.055 mm
62	Clearance between connecting rod and pin boss	-	-	0.05 ~ 0.31 mm
63	End play of crankshaft	NEW: 0.100 ~ 0.245 mm // USED: 0.300 mm		

Modification basis	
Application basis	
Affected VIN	

ENGINE FUEL SYSTEM

1881-01

GENERAL

1. CAUTIONS FOR DI ENGINE

This chapter describes the cautions for DI engine equipped vehicle. This includes the water separation from engine, warning lights, symptoms when engine malfunctioning, causes and actions.

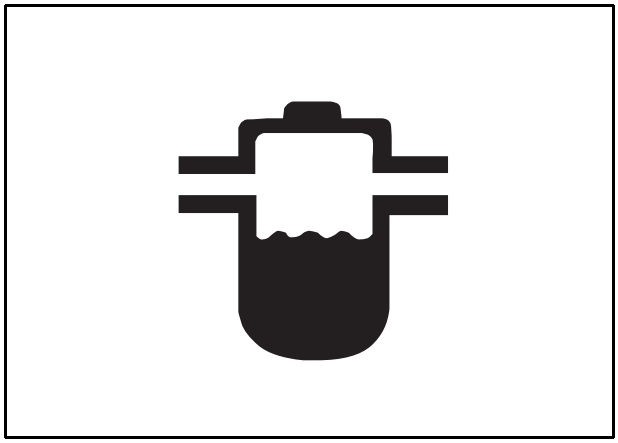
1) DI Engine

Comparatively conventional diesel engines, DI engine controls the fuel injection and timing electrically, delivers high power and reduces less emission.

2) System Safety Mode

When a severe failure has been occurred in a vehicle, the system safety mode is activated to protect the system. It reduces the driving force, restricts the engine speed (rpm) and stops engine operation. Refer to "Diagnosis" section in this manual.

3) Water Separator Warning Light



When the water level inside water separator in fuel filter exceeds a certain level (approx. 39 cc), this warning light comes on and buzzer sounds.
Also, the driving force of the vehicle decreases (torque reduction). If these conditions occur, immediately drain the water from fuel filter.
For the draining procedures, please refer to "How to drain the water from fuel filter" section.

4) Priming Pump

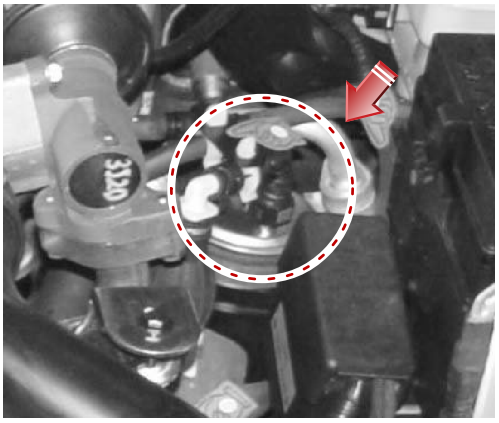
The priming pump installed in fuel pump is the device to fill the fuel into the fuel filter. When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

5) Conditions for Using Priming Pump

- After run out of fuel
- After draining the water from fuel separator
- After replacing the fuel filter

6) Fuel Filter and Water Separator





1. Fuel filter
2. Water drain plug
   (water separating operation: every 10,000 km)
3. Priming pump

CAUTION

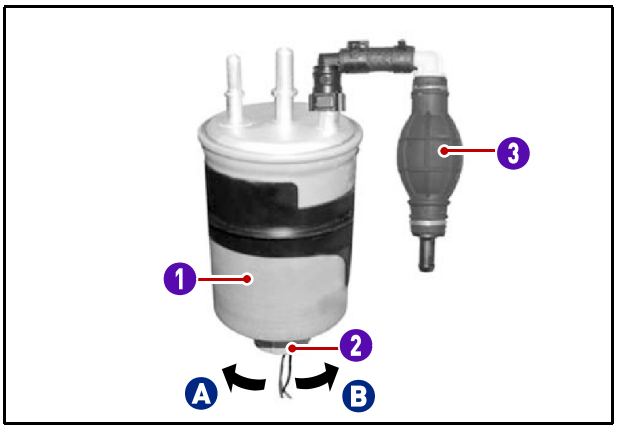
- When replaced the fuel filter or drained the water from fuel filter, press the priming pump until it becomes rigid before starting the engine.
- The water drain from fuel filter should be performed whenever changing the engine oil.

Modification basis	
Application basis	
Affected VIN	

▶ Draining the Water From Fuel Filter



1. Place the water container under the fuel filter.



2. Turn the drain plug (2) to "A" direction to drain the water.
3. Wait until a certain amount of fuel gets out from the port, then turn the drain plug to "B" direction to tighten it.

CAUTION
- Be careful not to be injured by surrounding equipment during the working procedures.

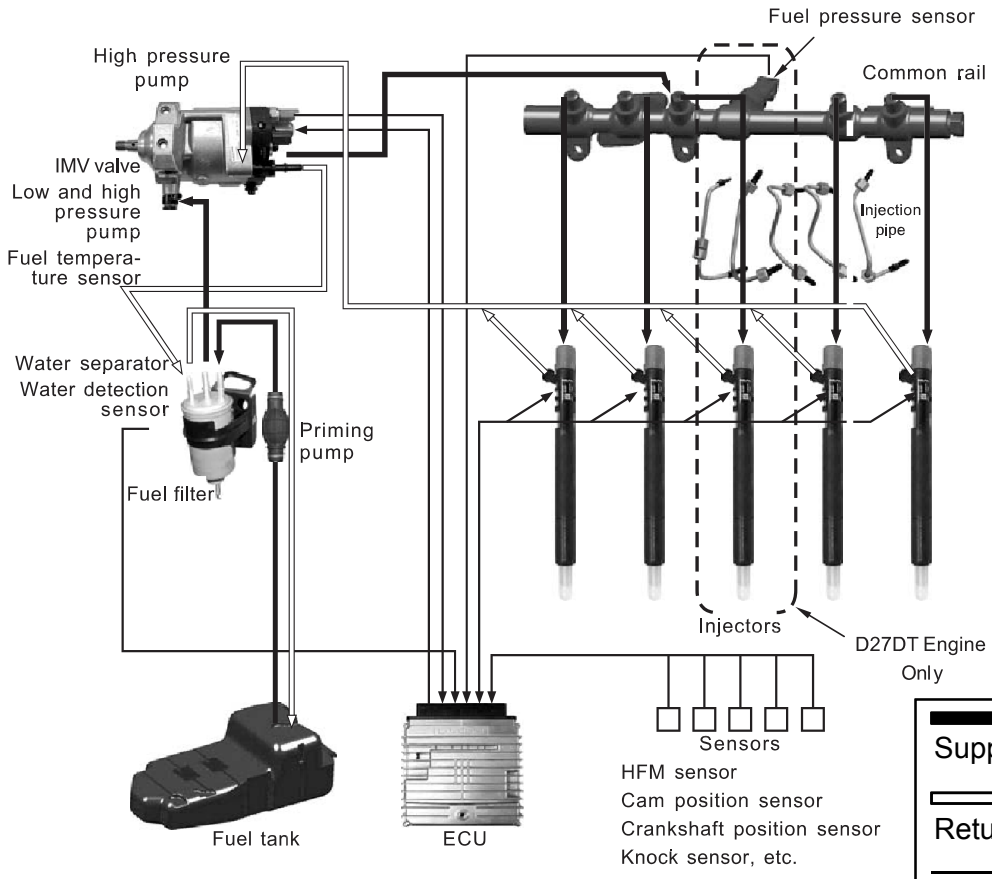


4. Press the priming pump until it becomes rigid.
5. Start the engine and check the conditions.

CAUTION
- If the priming pump is not properly operated, air may get into the fuel line. It may cause starting problem or fuel system problem. Make sure to perform the job in step 4.

OVERVIEW AND OPERATION PROCESS

1. ELECTRONIC CONTROL OF FUEL SYSTEM



System composition

- High pressure fuel pump
- Fuel rail
- Fuel pressure sensor
- Fuel injector
- Electronic control unit(ECU)
- Other sensors and actuators

According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

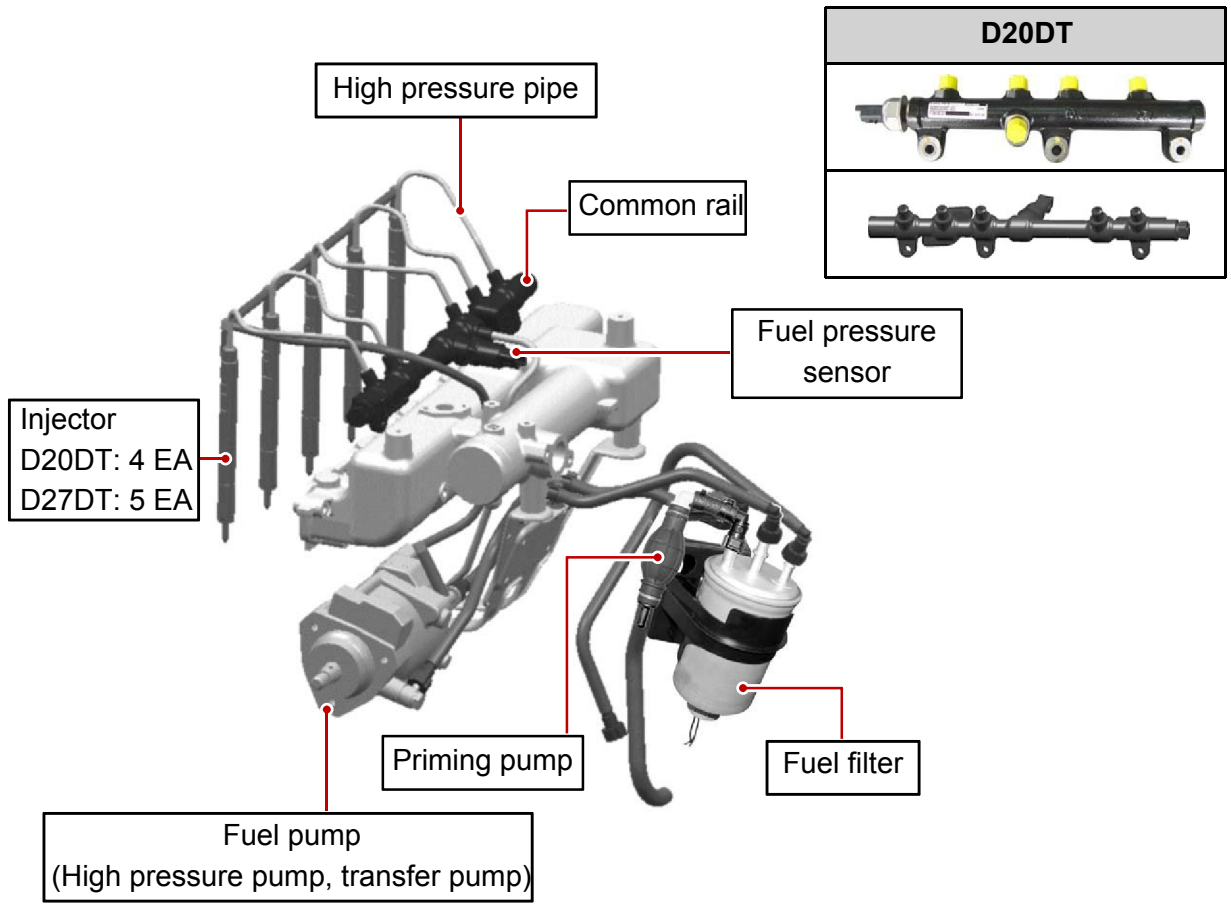
ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and atmospheric pressure sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

Modification basis	
Application basis	
Affected VIN	

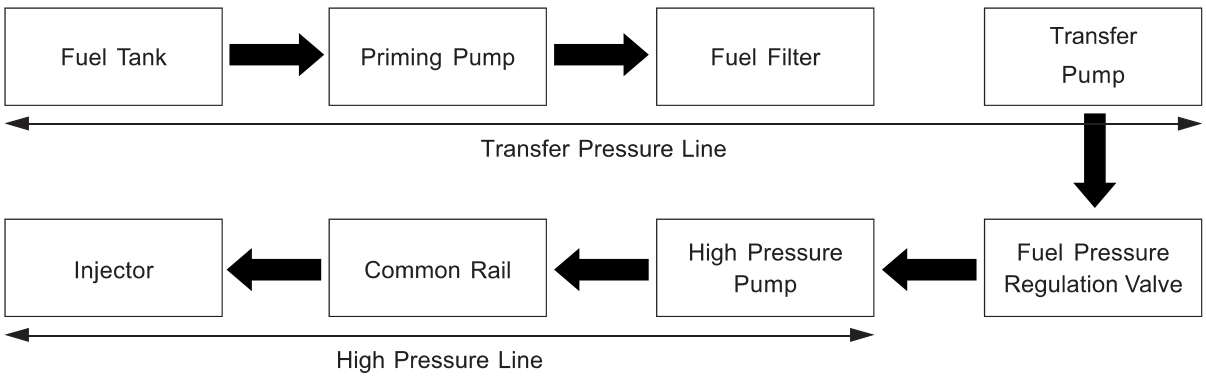
2. COMPOSITION OF FUEL SYSTEM

Components in fuel system are designed to generate and distribute high pressure, and they are controlled electronically by engine ECU. Accordingly, fuel system is completely different from injection pump type fuel supply system on the conventional Diesel engine. The fuel injection system in common rail engine is composed of transfer pressure section that transfers fuel in low pressure, high pressure section that transfers fuel in high pressure and ECU control section.

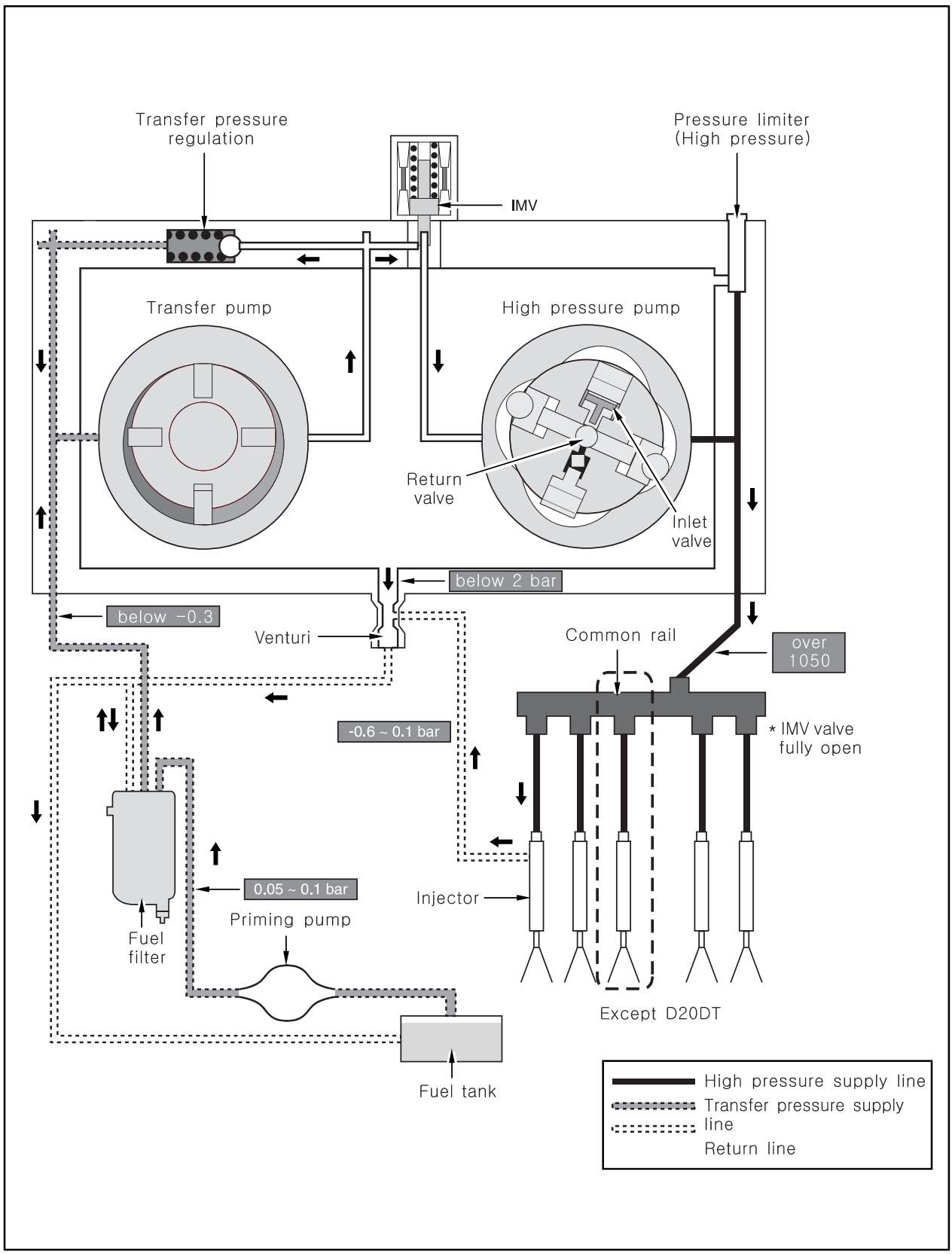
Fuel Line System



Fuel route



3. HYDRAULIC CYCLE IN FUEL LINE (TRANSFER AND HIGH PRESSURE LINE)



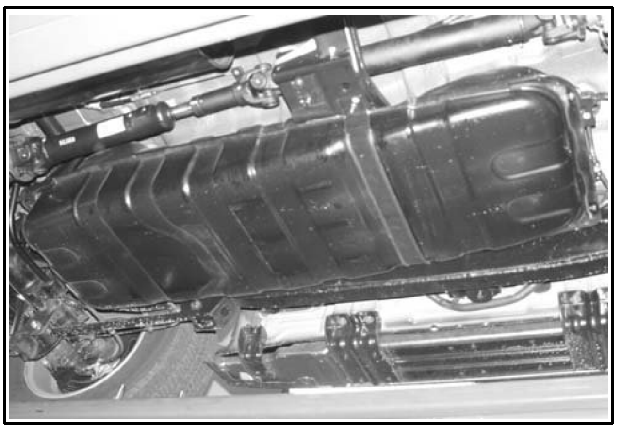
Modification basis	
Application basis	
Affected VIN	

4. COMPONENTS OF LOW PRESSURE TRANSFER LINE

Low pressure stage is to supply sufficient fuel to high pressure section and components are as below.

- Fuel tank (including strainer)
- Hand priming pump
- Fuel filter
- Transfer pump
- Other low pressure fuel hoses

1) Fuel tank



Fuel tank is made of anti-corrosion material and its allowable pressure is 2 times of operating pressure (more than min. 0.3 bar). It has protective cap and safety valve to prevent excessive pressure building. Also, to supply fuel smoothly, it has structure to prevent fuel from leaking in shocks, slopes and corners and.

2) Priming pump



If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to bleed air from transfer line.

When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

- After run out of fuel
- After draining the water from fuel separator
- After replacing the fuel filter

Press the priming pump until it becomes rigid before starting the engine.

3) Fuel filter



It requires more purified fuel supply than conventional diesel engine. If there are foreign materials in the fuel, fuel system including pump components, delivery valve and injector nozzles may be damaged.
Fuel filter purifies fuel before it reaches to high pressure pump to help proper operations in high pressure pump.
And more, it separates water from fuel to prevent water from getting into FIE system (high pressure line).

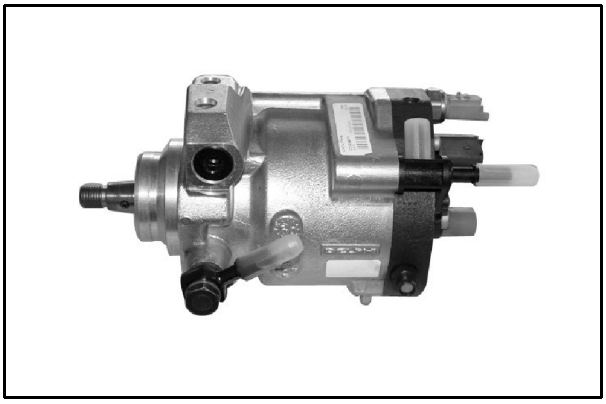
Modification basis	
Application basis	
Affected VIN	

5. COMPONENTS OF HIGH PRESSURE TRANSFER LINE

In the high pressure section, sufficient fuel pressure that injectors requires will be generated and stored. The components are as below:

- High pressure pump
- Rail pressure sensor
- Pressure limit valve
- Common rail
- High pressure pipe
- Injector
- Fuel pressure regulating valve (IMV)

1) High pressure pump



This is plunger pump that generates high pressure and driven by crankshaft with timing chain. The high pressure pump increases system pressure of fuel to approx. 1,600 bar and this compressed fuel is transferred to high pressure accumulator (common rail) in tube through high pressure line.

2) Common rail

D20DT



D27DT



It stores fuel transferred from high pressure pump and also stores actual high pressure of fuel. Even though the injectors inject fuel from the rail, the fuel pressure in the rail is maintained to a specific value. It is because the effect of accumulator is increased by unique elasticity of fuel. Fuel pressure is measured by rail pressure sensor.
And the fuel pressure regulating valve (IMV, Inlet Metering Valve) included in high pressure pump housing keeps pressure to a desired level.

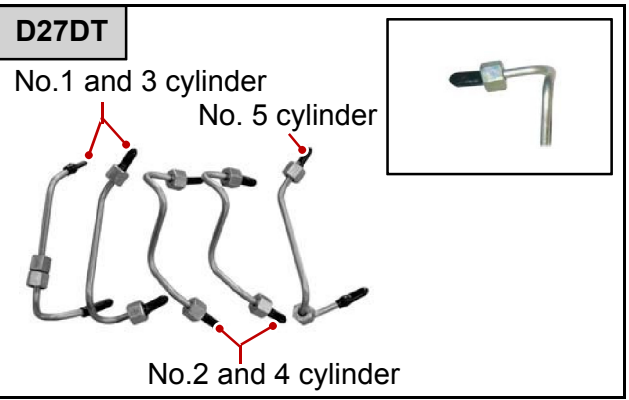
3) High pressure pipe (fuel pipe)

Fuel line transfers high pressure fuel. Accordingly, it is made of steel to endure intermittent high frequency pressure changes that occur under maximum system pressure and injection stops. Injection lines between rail and injectors are all in the same length; it means the lengths between the rail and each injector are the same and the differences in length are compensated by each bending.

D20DT



D27DT



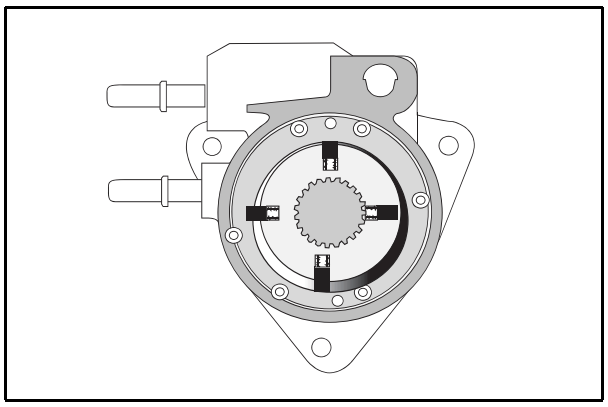
4) Injectors



The fuel injection device is composed of electrical solenoid valve, needle and nozzle and controlled by engine ECU. The injector nozzle opens when solenoid valve is activated to directly inject the fuel into combustion chamber in engine. When injector nozzle is open, remaining fuel after injection returns to fuel tank through return line.

Pressure limit valve, fuel returned by low pressure and fuel used for high pressure pump lubrication also return to fuel tank through return line.

5) Transfer pump



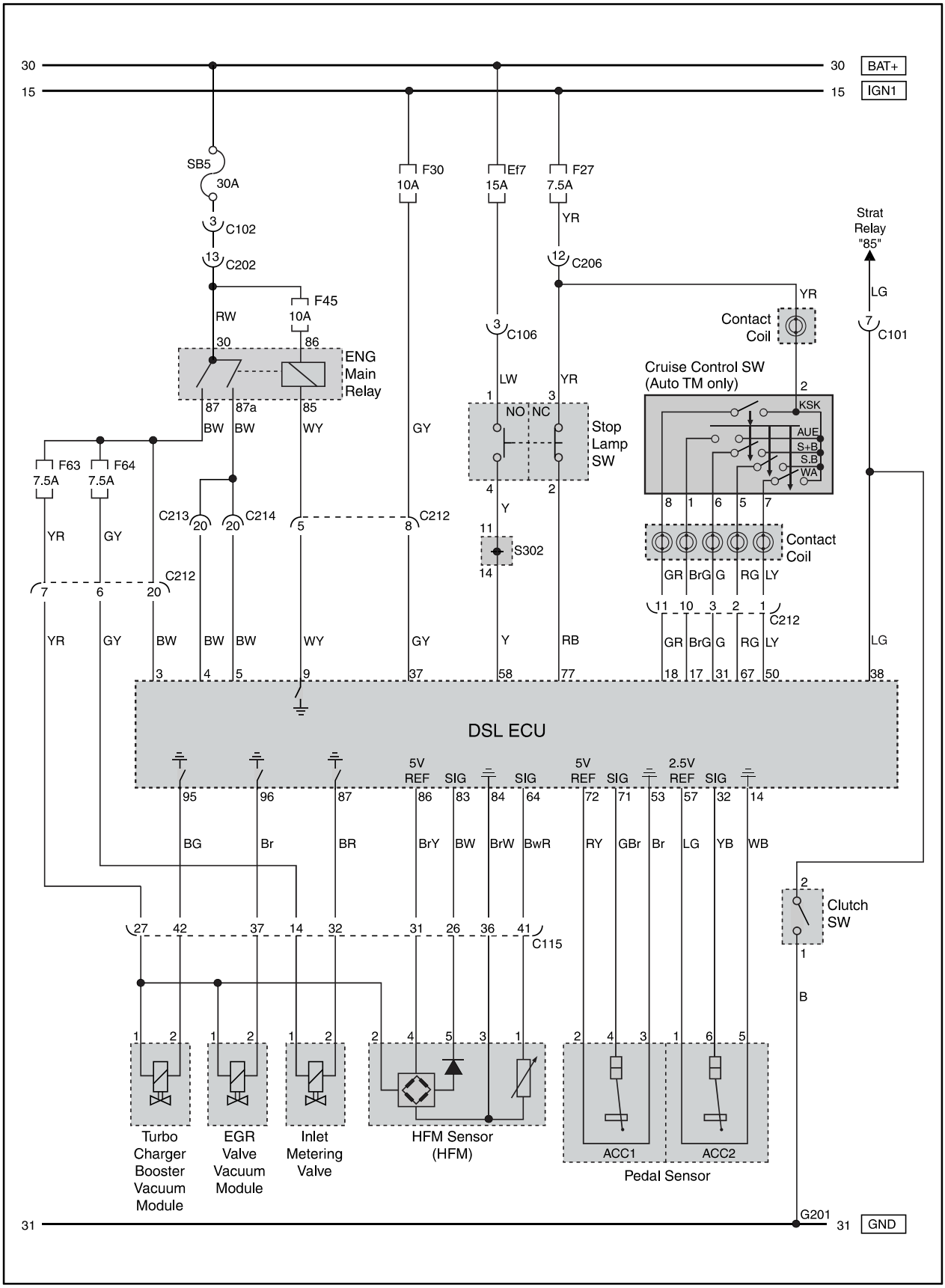
The transfer pump is included in the housing of the high pressure pump. The transfer pump is the volumetric blade type pump. To deliver the continuously required fuel volume, the pump transfers fuel from the fuel tank to high pressure pump.

Modification basis	
Application basis	
Affected VIN	

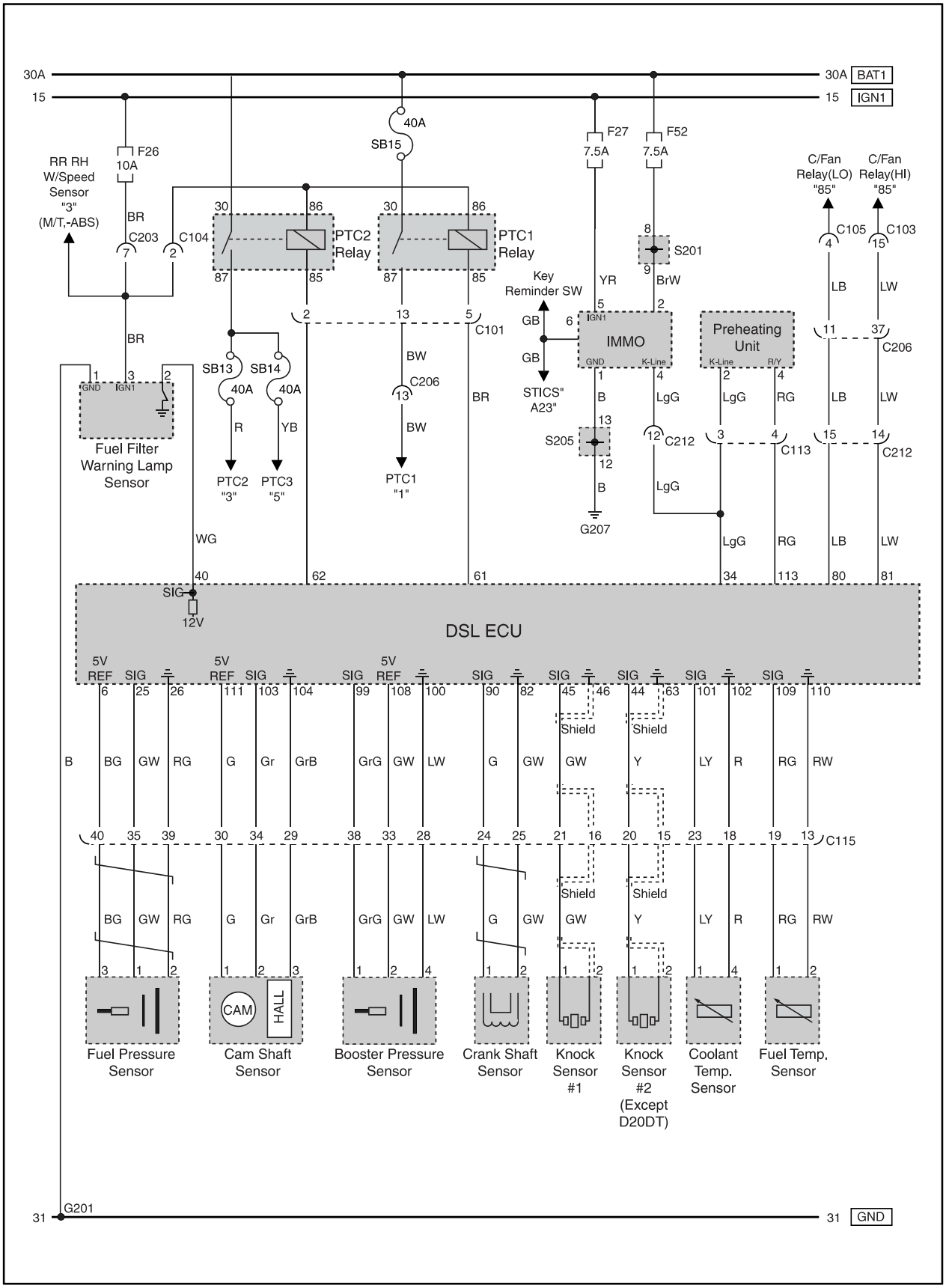
6) Fuel filter replacement

- Fuel filter change interval: every 30,000 km
- Water separation interval: every 10,000 km (same with engine oil change interval)
- Never reuse the removed fuel filter

7) Circuit Diagram



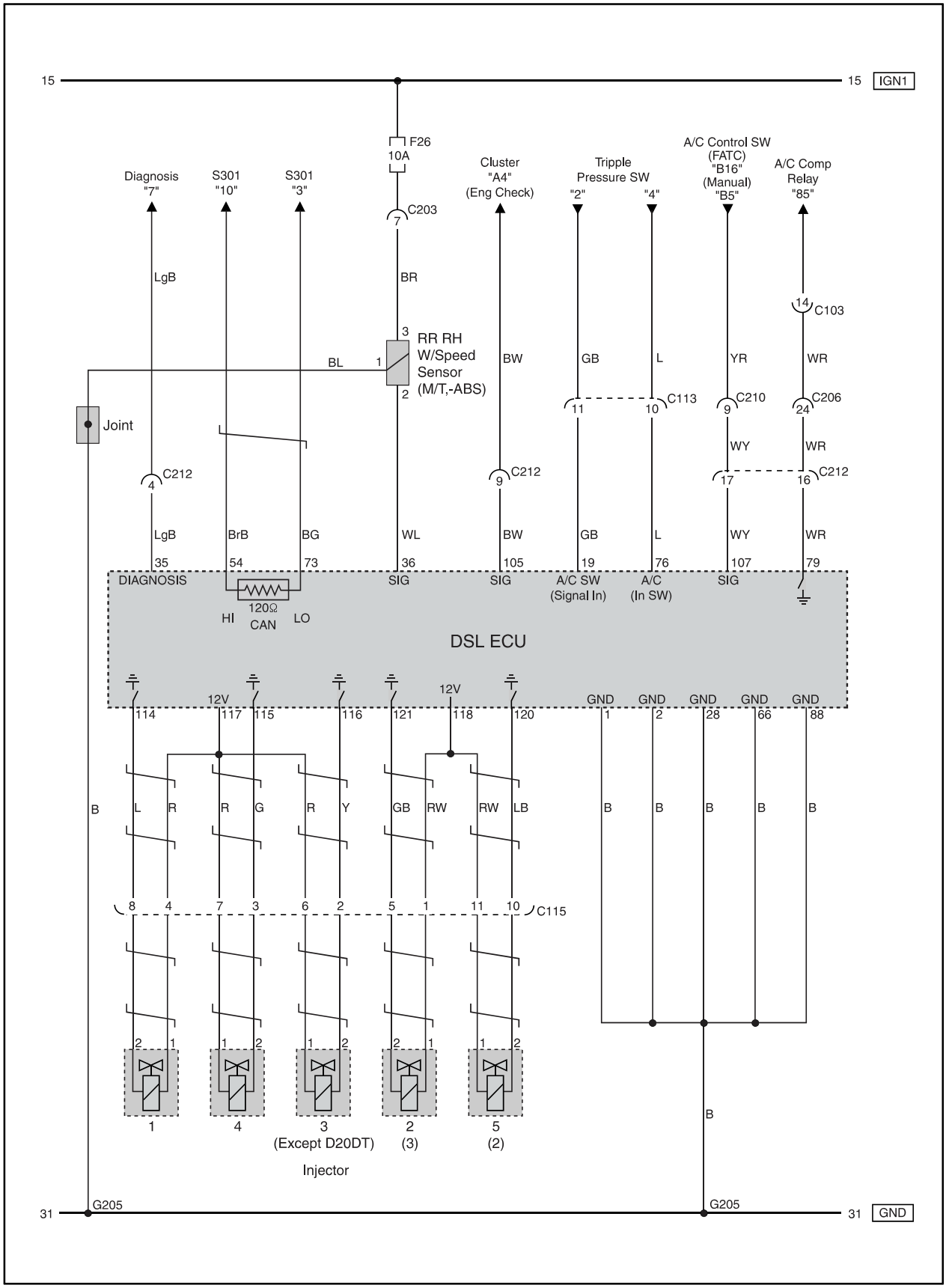
Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

ENGINE D20DT

undefined



Modification basis	
Application basis	
Affected VIN	

EXHAUST SYSTEM

1913-01

GENERAL

1. INSPECTION BEFORE DIAGNOSIS

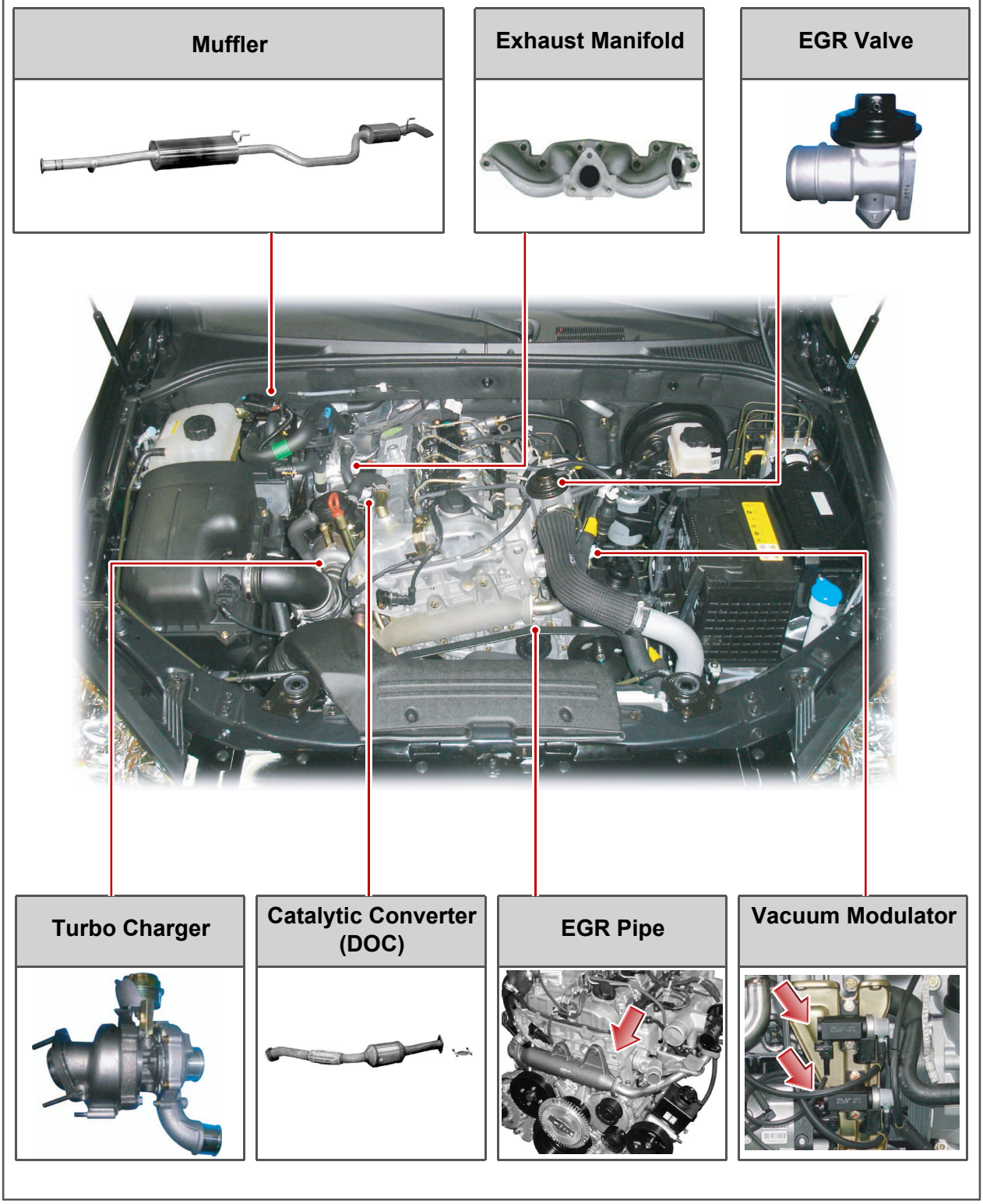
The base of making diagnosis on the EGR related system is the inspection on the connections of the vacuum hoses in related system as the first priority.
When abnormal condition occurs with the EGR system, the basic approach is, as described in prior sentence, making detail inspections of vacuum circuits of each system before connecting the scan tool or vacuum tester.
It is necessary to manually check on the connections if there are any slacks or loose circuits even if the visual inspection shows vacuum hose as being connected.
If there are not any problems then the next inspection area is the connections of the system connectors.
Most problems with the occurrence of system malfunction are from conditions of vacuum line and connector connections and the causes from the malfunction of mechanical mechanism is actually very few.
For example, when there are no problems with basic components, let's assume that there is a vehicle having vacuum leak from connection slack in the vacuum line between EGR vacuum modulator and EGR valve.
This vehicle, due to the driving condition or, according to the circumstances, smog or other conditions, could create customer's complaint and by connecting the scanning device could display as the malfunction of the EGR valve's potentiometer.
As previously explained, this car has a separate controller to control the HUBER EGR and, in accordance with various input element, the controller controls EGR valve by regulating the force of vacuum being applied to the EGR valve through PWM control.
At this time, the controller has to receive feedback whether the EGR valve operates correctly according to the value sent to the EGR modulator and this role is performed by the EGR potentiometer located at top section of the EGR valve. In other word, the controller sent correct output value to the EGR vacuum modulator but, due to the leakage of vacuum, signal of required value can not be received from the EGR potentiometer causing to display as malfunction of related parts.
As a reference, the EGR valve of diesel vehicle (DI Engine) controlling from the engine ECU to EGR system has different shape than the HUBER EGR valve because the EGR valve's operation signal in the DI engine is performed by the HFM sensor instead of the EGR potentiometer.
This principle is that when the EGR valve opens up to flow exhaust gas into the intake unit the amount of fresh air, comparatively, will be reduced.
The DI engine ECU receives feedback signal of change in amount of air being passed through the HFM sensor according to the opening amount of the EGR valve.

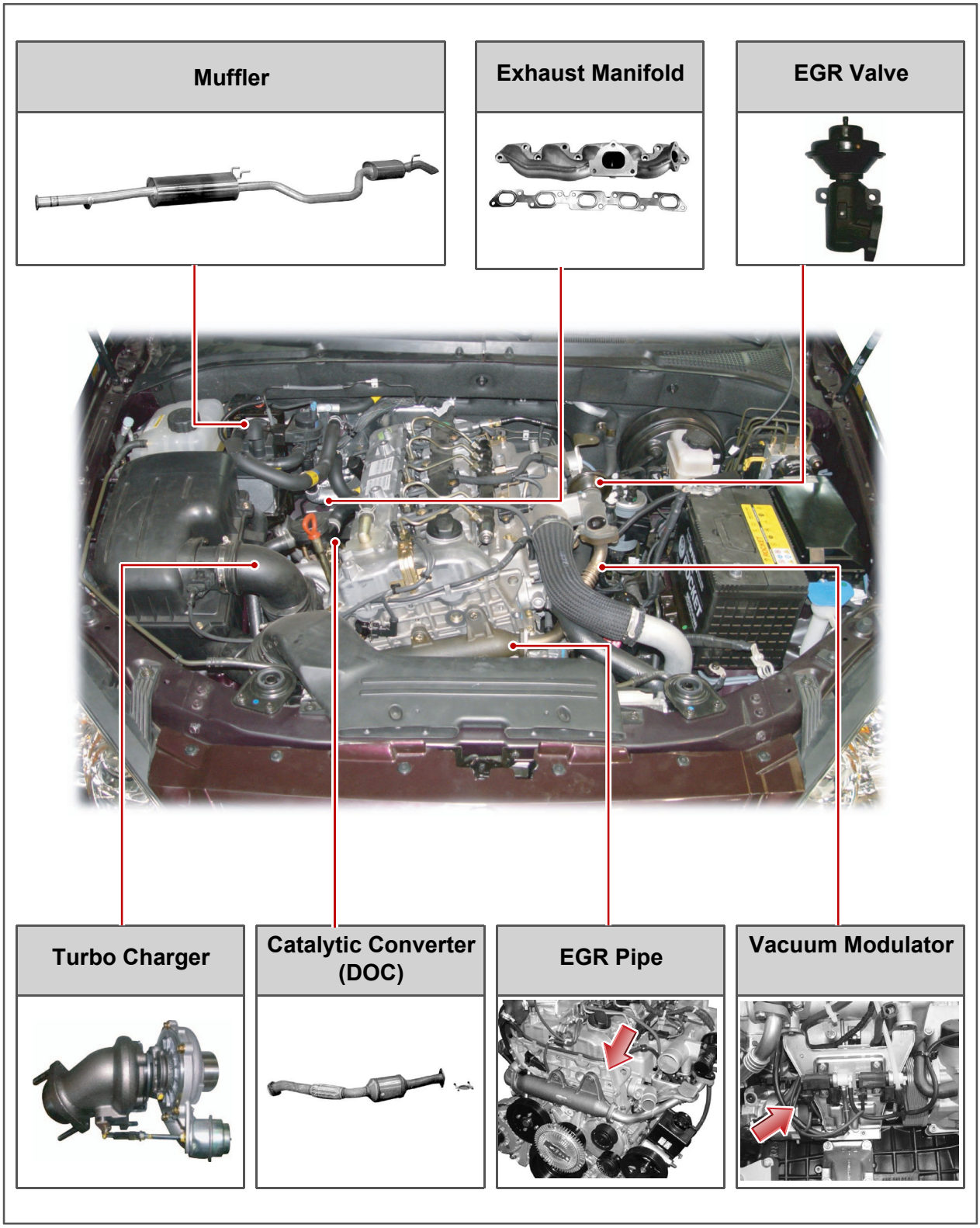
D20DT	D27DT
	
HUBER EGR System for IDI Engine (Including the EGR Valve Potentiometer)	EGR System for DI Engine

OVERVIEW AND OPERATION PROCESS

1. COMPONENTS LOCATOR OF EXHAUST SYSTEM

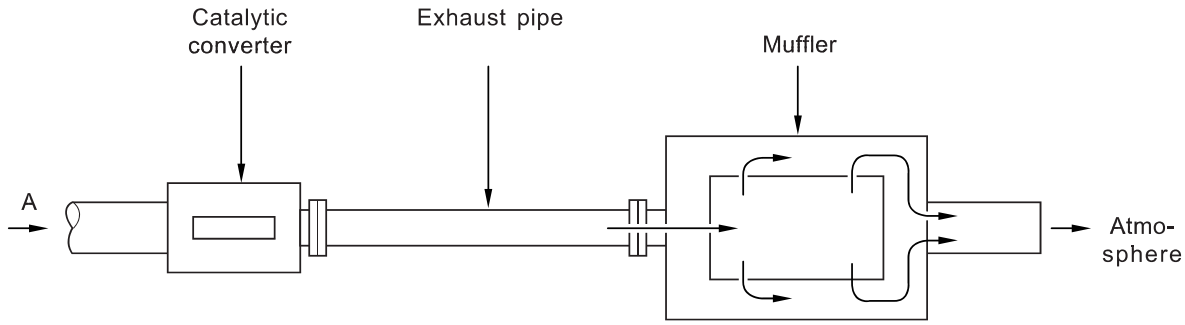
1) D20DT ENGINE

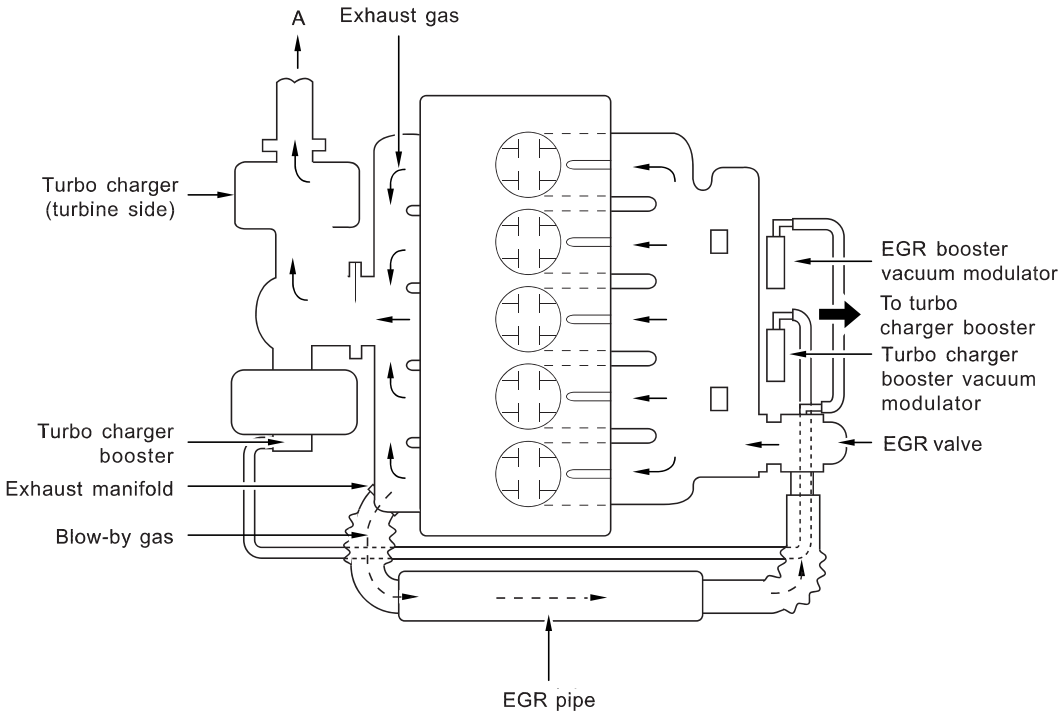


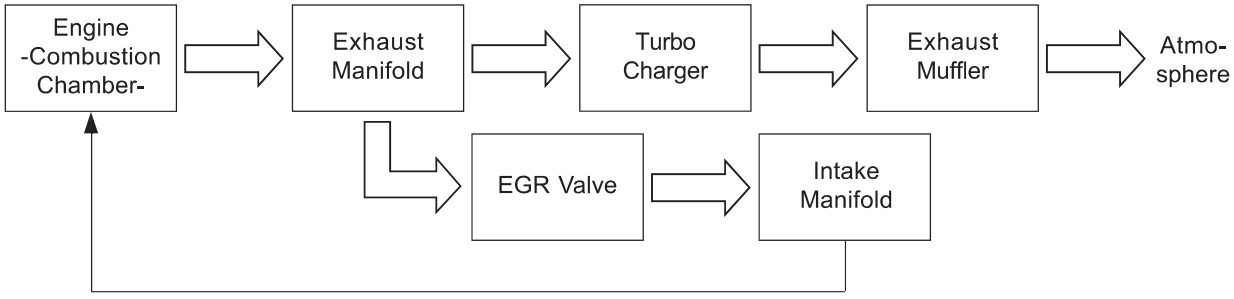


Modification basis	
Application basis	
Affected VIN	

2. EXHAUST GAS FLOWS







ENGINE LUBRICATION SYSTEM 1533-01

GENERAL

1.SPECIFICATIONS OF ENGINE LUBRICATION

Engine oil	Specification	Approved by MB Sheet 229.1 or 229.3 Viscosity: See MB Sheet 224.1
	Capacity	6.8 ~ 8.3 liter
	Service interval	Initial change: 5,000 km, Change every 10,000 km or 12 months (Frequently check the oil level and add if needed. And, every 5,000 km or 6 months under severe conditions)
Engine oil filter		Same interval with engine oil
Oil relief valve opening pressure		5.8 ± 0.3 bar

Severe Condition:

1. When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.
2. When most trips are less than 6 km (Operating when outside temperatures remain below freezing and whenmost trips are less than 16 km)
3. When operating in dusty, sandy and salty areas
4. In hilly or moutainous terrain
5. When doing frequent trailer towing



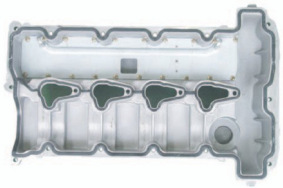
▶Oil Pressure Switch

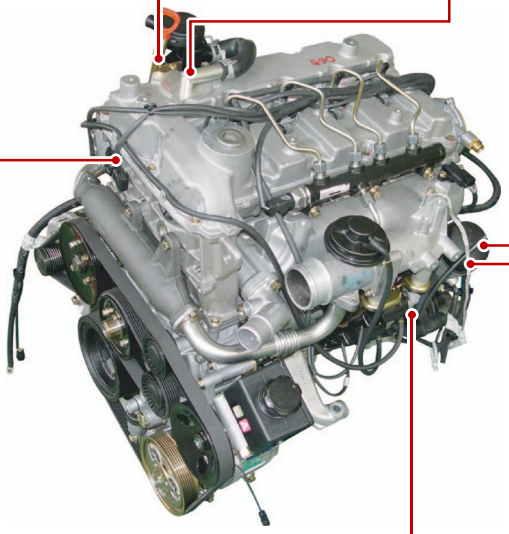
1. Operating temperature: −40 ~ 140°
2. Operating pressure: 0.3 ~ 0.55 bar
3. Permissible pressure: 10 bar

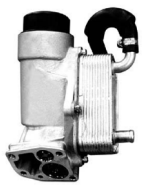
OVERVIEW AND OPERATION PROCESS

1. COMPONENTS OF LUBRICATION SYSTEM

1)D20DT ENGINE

Cylinder Head Cover	Oil Dipstick	Oil Separator	Oil Filter
			

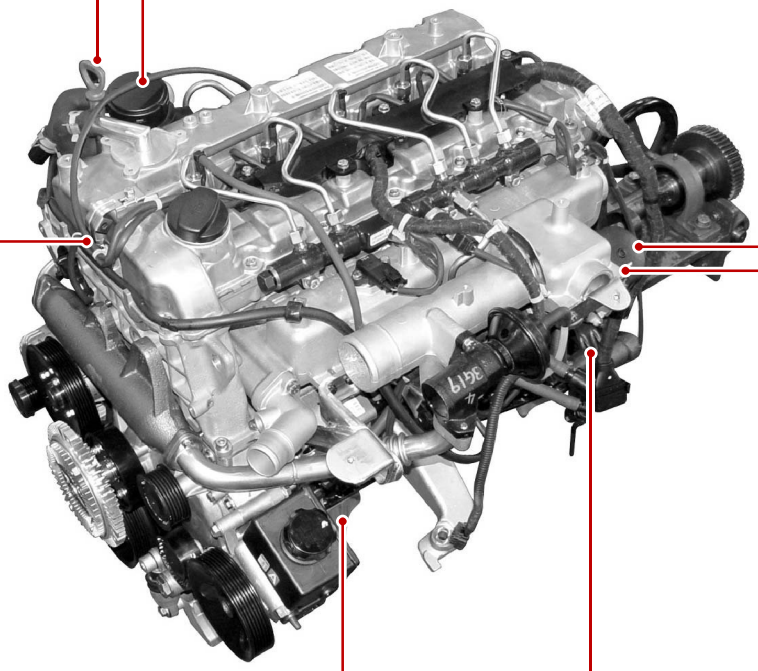


Oil Pump	Oil Pan	Oil Cooler	Oil Pressure Switch
			

Modification basis	
Application basis	
Affected VIN	

2)D27DT Engine

Cylinder Head Cover	Oil Dipstick	Oil Separator	Oil Filter
			



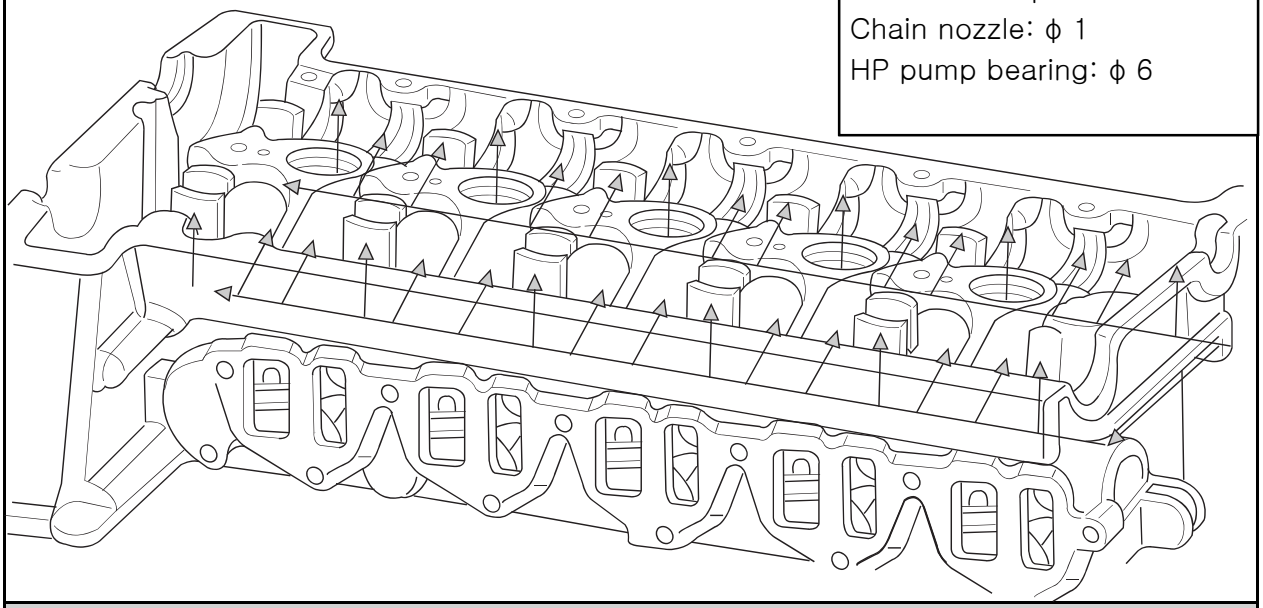
Oil Pump	Oil Pan	Oil Cooler	Oil Pressure Switch
			

Modification basis	
Application basis	
Affected VIN	

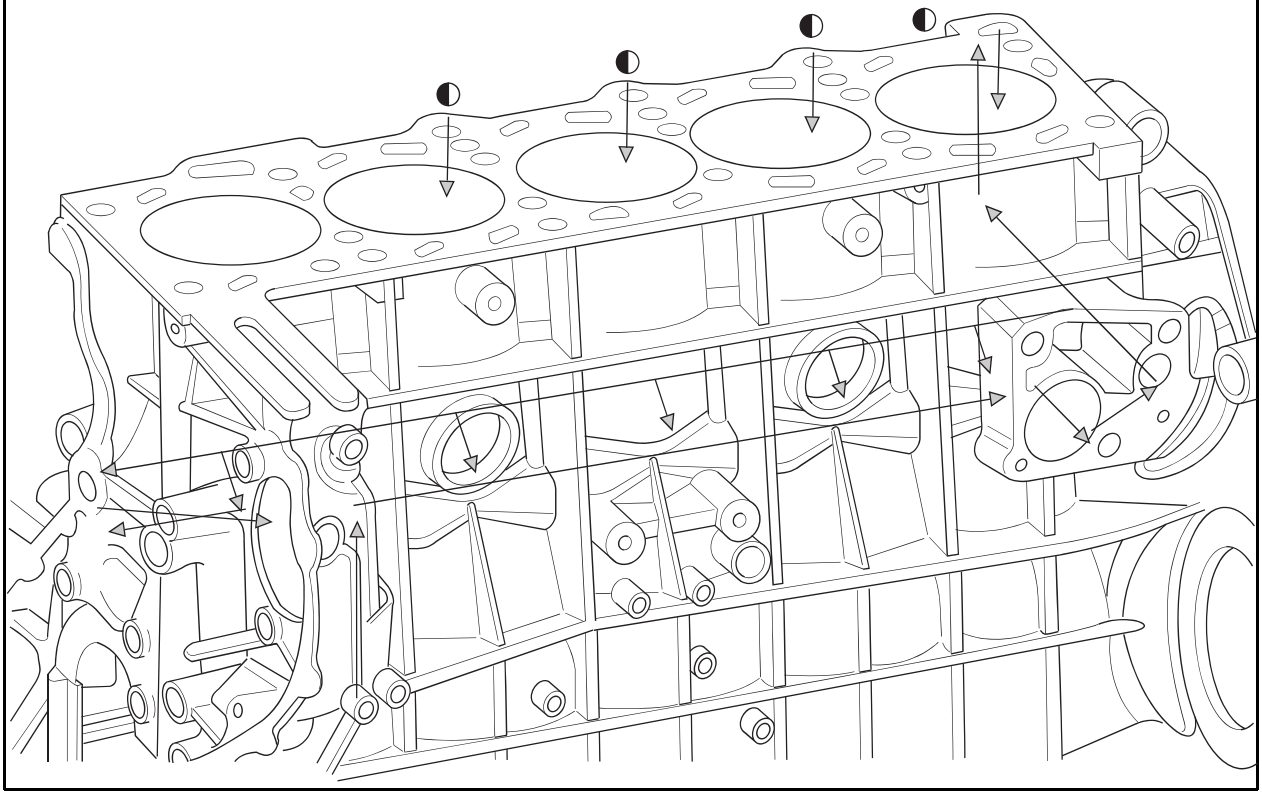
2. LUBRICATION SYSTEM LAYOUT

Cylinder Head

Main oil gallery: ϕ 16
Hole to cylinder head: ϕ 9
Main bearing hole: ϕ 7
Chain and injection pump: ϕ 7
Return hole: ϕ 14
Chain nozzle: ϕ 1
HP pump bearing: ϕ 6

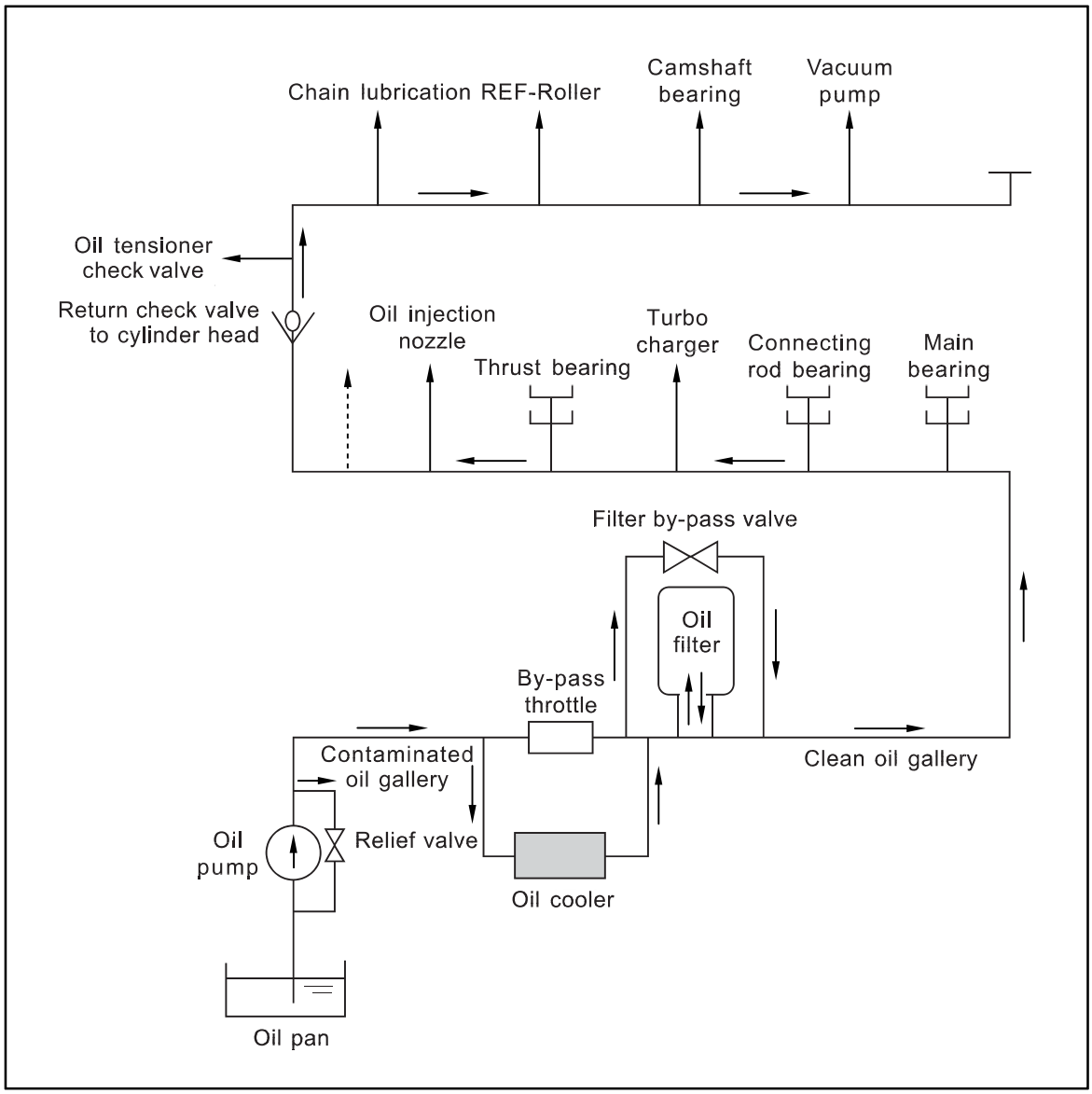


Cylinder Block



Modification basis	
Application basis	
Affected VIN	

3. LUBRICATION DIAGRAM



※ 1. Opening pressure of by-pass valve in oil filter: 3 ± 0.4 bar

2. To prevent instant oil shortage after stopping the engine, the return check valve is installed in oil supply line of cylinder head

ENGINE COOLING SYSTEM

9210-05

GENERAL

1. ENGINE COOLING SPECIFICATIONS

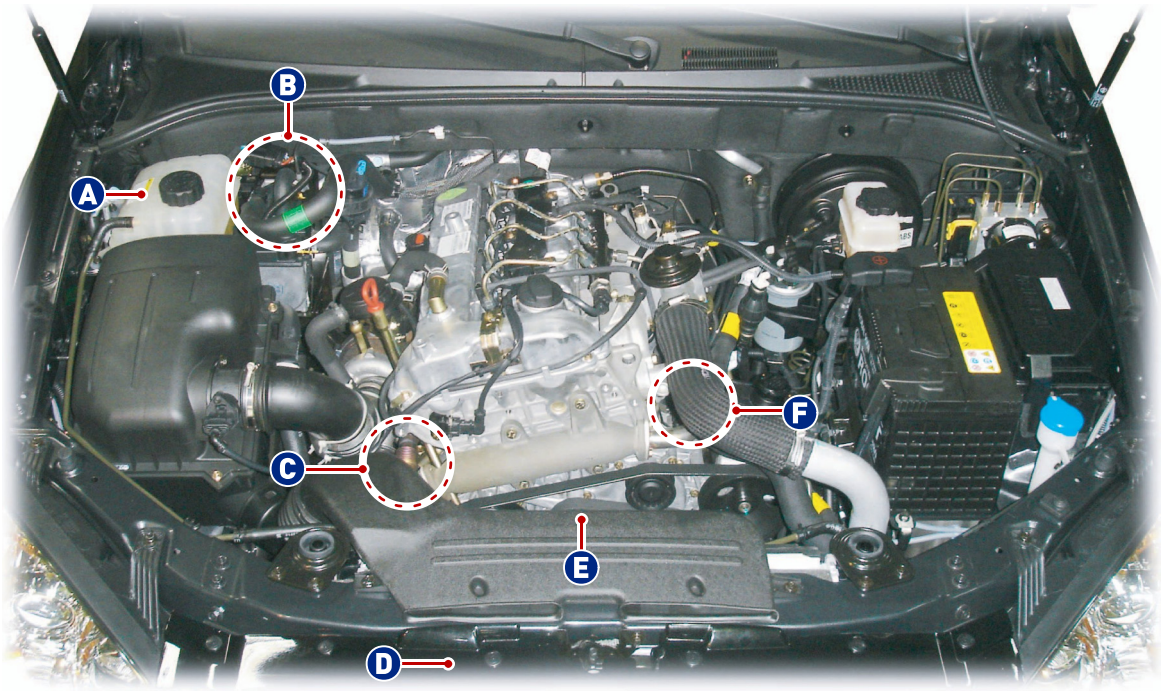
Descriptio n		Unit	Specificatio n
Cooling system	Type	-	Water cooling forced circulation
Coolant	Capacity	ℓ	11.3
Thermostat	Type	-	Wax pellet type
	Initial opening temperature	℃	85
	Fully opening temperature	℃	100
	Fully closing temperature	℃	83
	Stroke	mm	min. 8
Cooling fan	Blades		5
	Diameter	mm	320 (2)
	Low speed ON temp	℃	91
	Low speed OFF temp	℃	88
	High speed ON temp	℃	95
	High speed OFF temp	℃	92
	High speed ON temp. (By A/C pressure)	psi	270
Coolant reservoir	Pressure valve opening pressure	Kg/cm^2	1.2 ~ 1.5
	Vacuum valve opening pressure	Kg/cm^2	0.1
Water pump	Type	-	Centrifugal
	Impeller diameter	mm	72.3
	Impeller blades		10
Radiator	Type	-	Down-flow
	Core width	mm	701
	Core height	mm	372
	Core thickness	mm	18
	Minimum radiation capability	Kcal/h	45,000
Coolant temperature sensor	Resistance (at 20°C)	KΩ	3.33 ~ 3.78
	Resistance (at 80°C)	KΩ	0.32 ~ 0.35
Anti-freeze agent	Type	–	ALUTEC-P78
	Mixture ratio (water and anti-freeze)	–	50 : 50

OVERVIEW AND OPERATION PROCESS

1. COMPONENTS ENGINE COOLING

1) D20DT Engine

Coolant Reservoir	FFH	Water Pump
A 	B 	C 

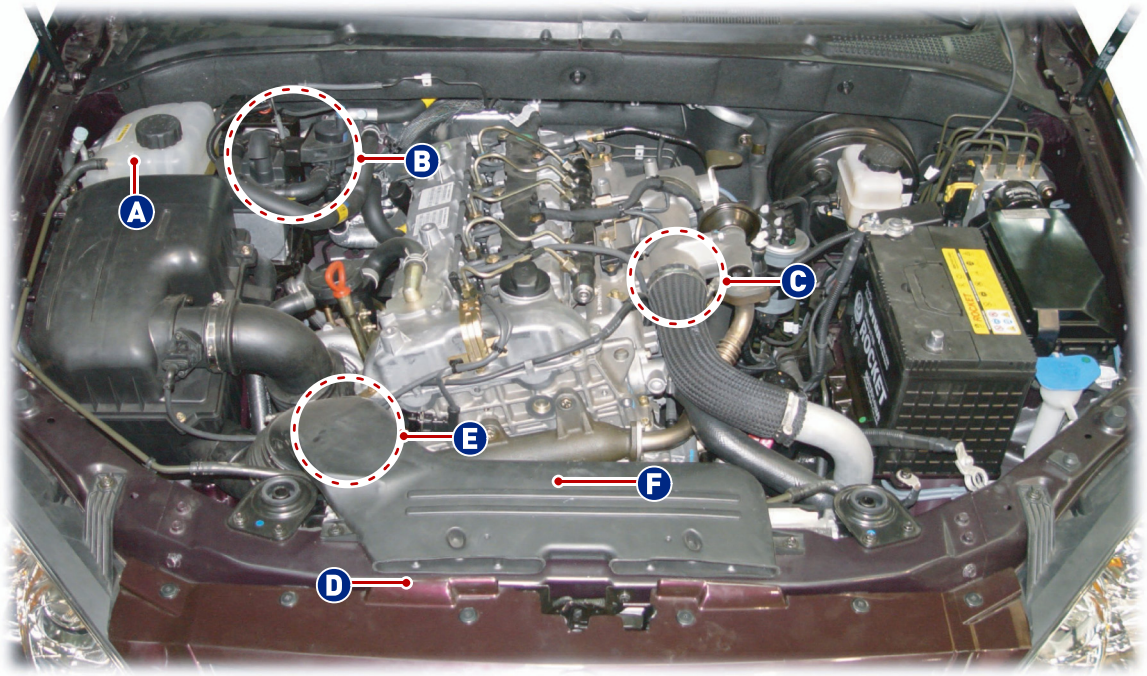


Radiator Assembly	Cooling Fan and Fan Clutch	Coolant Temperature Sensor
D 	E 	F 

Modification basis	
Application basis	
Affected VIN	

2) D27DT Engine

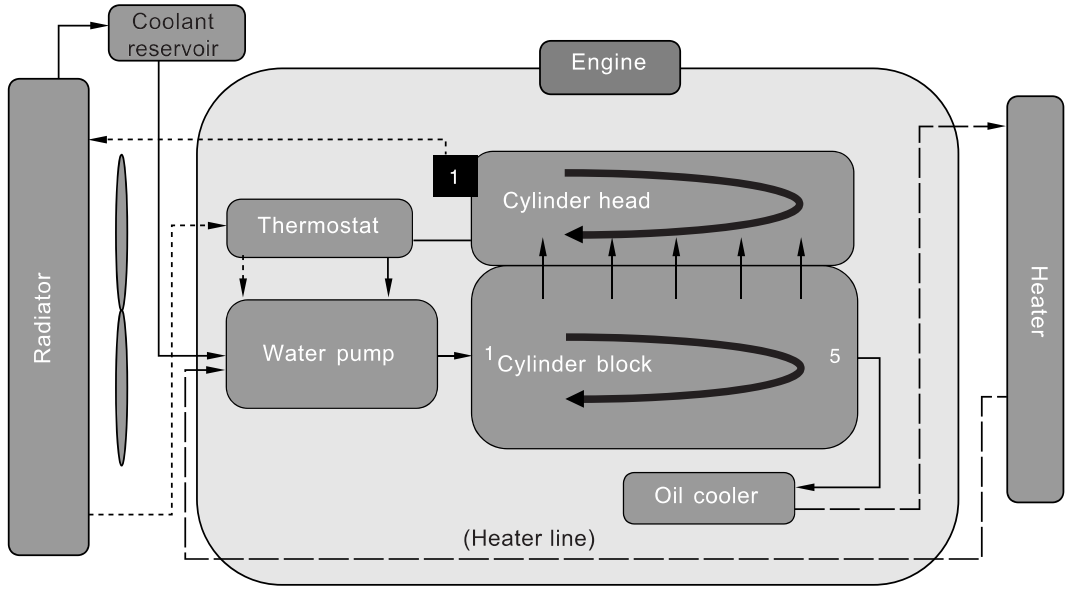
Coolant Reservoir	FFH	Coolant Temperature Sensor
A 	B 	C 



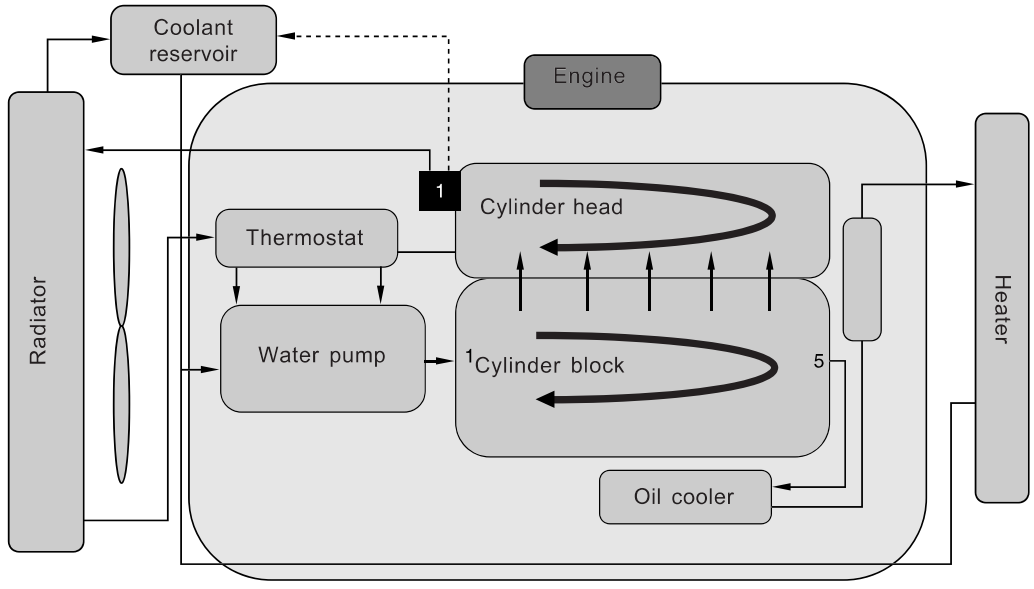
Radiator	Water Pump	Cooling Fan
D 	E 	F 

2. COOLING SYSTEM FLOW

PTC Engine Coolant Flows



FFH Engine Coolant Flows

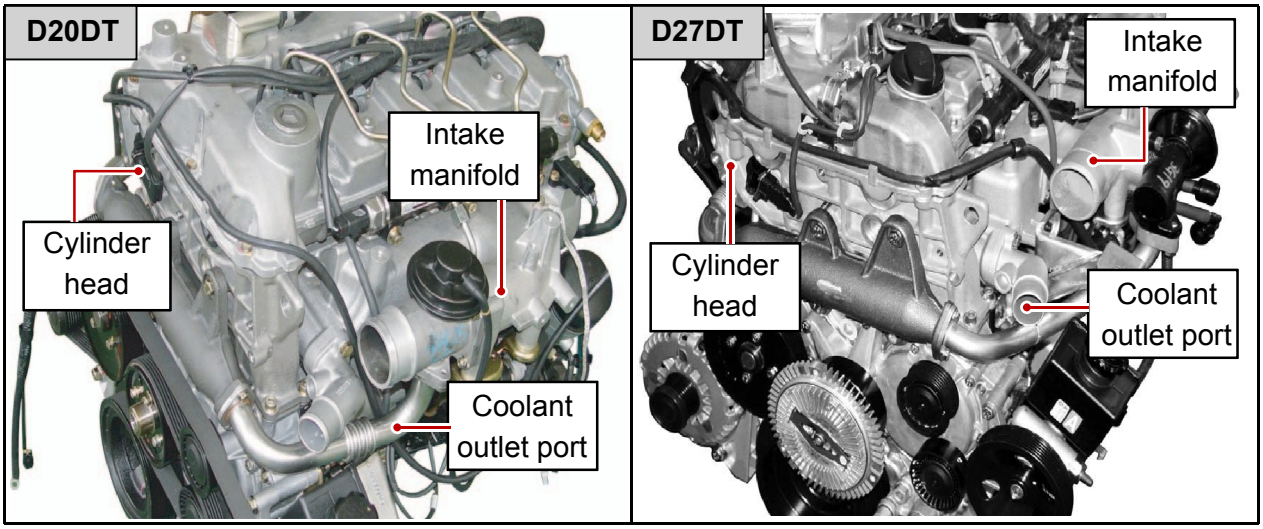


- Cylinder block side
  · Block #5 → Oil cooler → Heater → Heater water pump inlet pipe → Water pump
- Cylinder head side
  · Cylinder head → Coolant outlet port (intake #1) → Radiator → Water pump

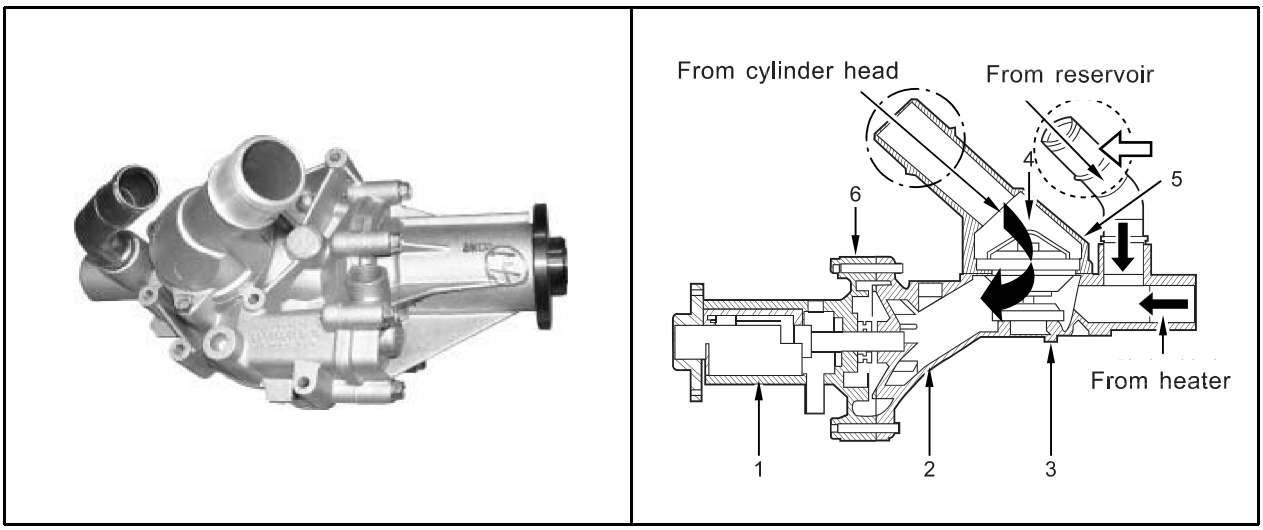
Modification basis	
Application basis	
Affected VIN	

3. FUNCTION DESCRIPTION OF COOLING SYSTEM

- Cylinder head coolant outlet port is integrated into intake manifold. (in front of cylinder #1)
  · Improved shape and gasket material to prevent coolant from leaking



- In OM 600 engine, coolant inflows through the heater line rear section (cylinder #4 and #5) of cylinder head.
  However, in D27DT engine, coolant inflows from cylinder block through oil cooler (refer to coolant flows layout in previous page).
  · It prevents cooling efficiency from decreasing due to coolant separation between cylinder #4 and #5.
- In OM 600 engine, the cooling fan is installed with water pump, however, in case of D27DT engine, it is connected to water pump with an additional pulley.



ENGINE ELECTRIC SYSTEM

1461-01

GENERAL

1.SPECIFICATIONS OF ENGINE ELECTRIC

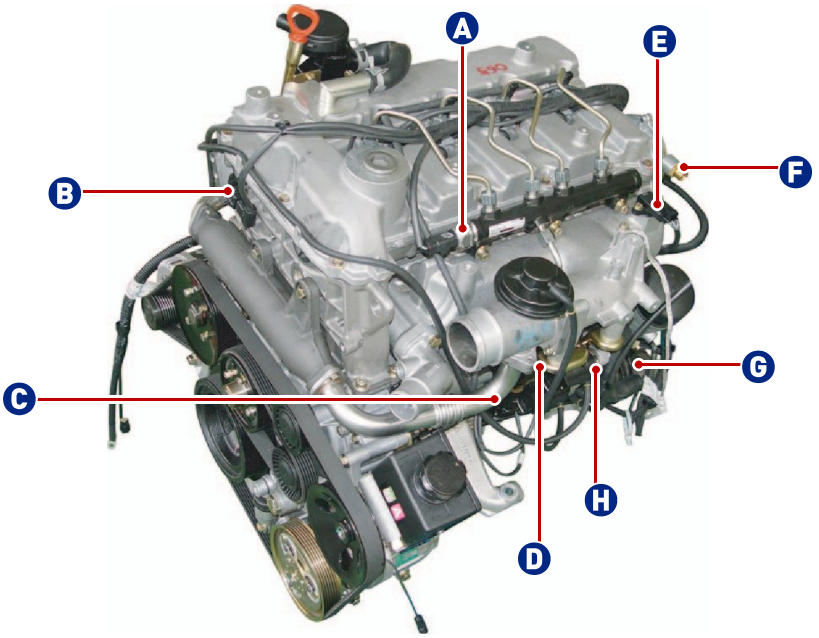
Descriptio			Unit	pecificatio n
Starter	Type		-	WP220
	Output power		Kw	2.2
	No load test □ 12 volts		A	160
	Drive pinion speed at no load		rpm	4500
	Drive pinion speed at load		rpm/A	1700/430
	Brush length		mm	18
	Armature diameter		mm	55
	Armature run-out		mm	0.1
	Segment groove depth		mm	21.7
Alternator	Type		-	CS128D
	Output voltage / current		V/A	PTC equipped vehicle: 12V-140A FFH equipped vehicle: 12V-115A
	Regulator type		-	←
	Regulating voltage		V	14.6
	Brush	Length	mm	12.5
		Quantity	-	2
		Wear limit	mm	7
Battery	Type		-	M F
	Capacity		AH	12V - 90AH
Glow plug	Reserved capatity		RC	160
	Type		-	Seized type
	Rated voltage		-	11.5
	Circuit connection		-	Parallel
	Preheating time		sec	Max. 60 (at -35°C)

OVERVIEW AND OPERATION PROCESS

1. COMPONENTS OF ELECTRIC IN ENGINE

1) D20DT ENGINE

Fuel Pressure Sensor	Camshaft Position Sensor	Coolant Temperature Sensor	Fuel Temperature Sensor
A 	B 	C 	D 

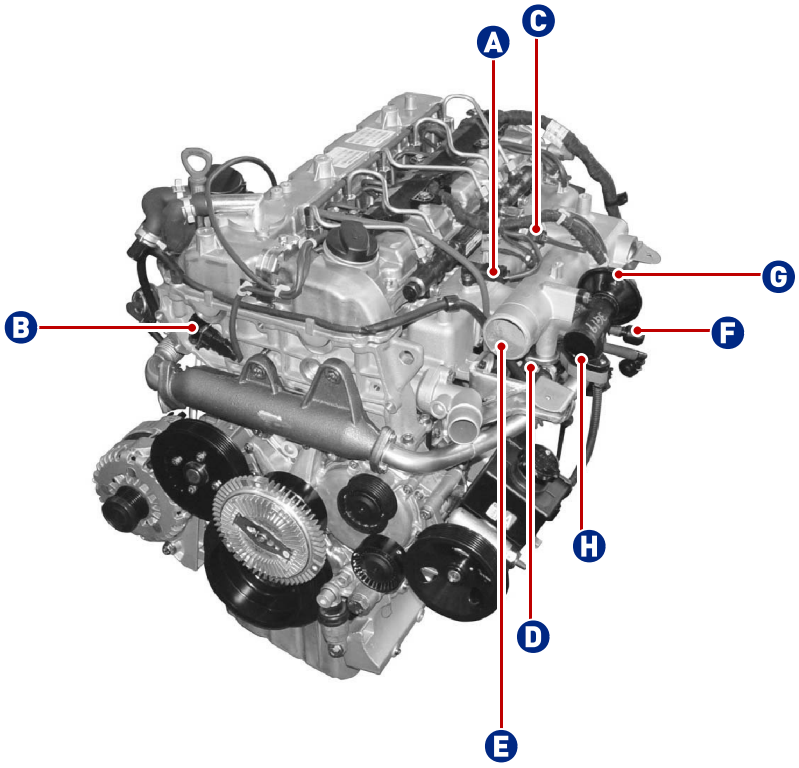


Booster Pressure Sensor	Oil Pressure Switch	Crankshaft Position Sensor	Knock Sensor (1 EA)
E 	F 	G 	H 

Modification basis	
Application basis	
Affected VIN	

2) D27DT ENGINE

Booster Pressure Sensor	Camshaft Position Sensor	Fuel Pressure Sensor	Fuel Temperature Sensor
A 	B 	C 	D 



Coolant Temperature Sensor	Oil Pressure Switch	Crankshaft Position Sensor	Knock Sensor (2 EA)
E 	F 	G 	H 

2. COMPONENTS OF ELECTRIC DEVICES IN ENGINE

1) D20DT ENGINE

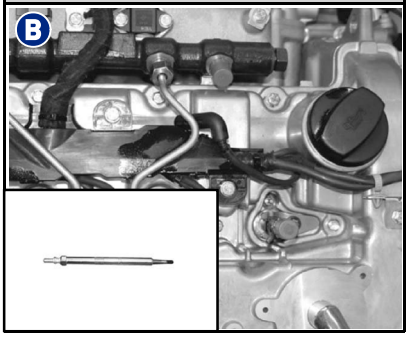
Alternator

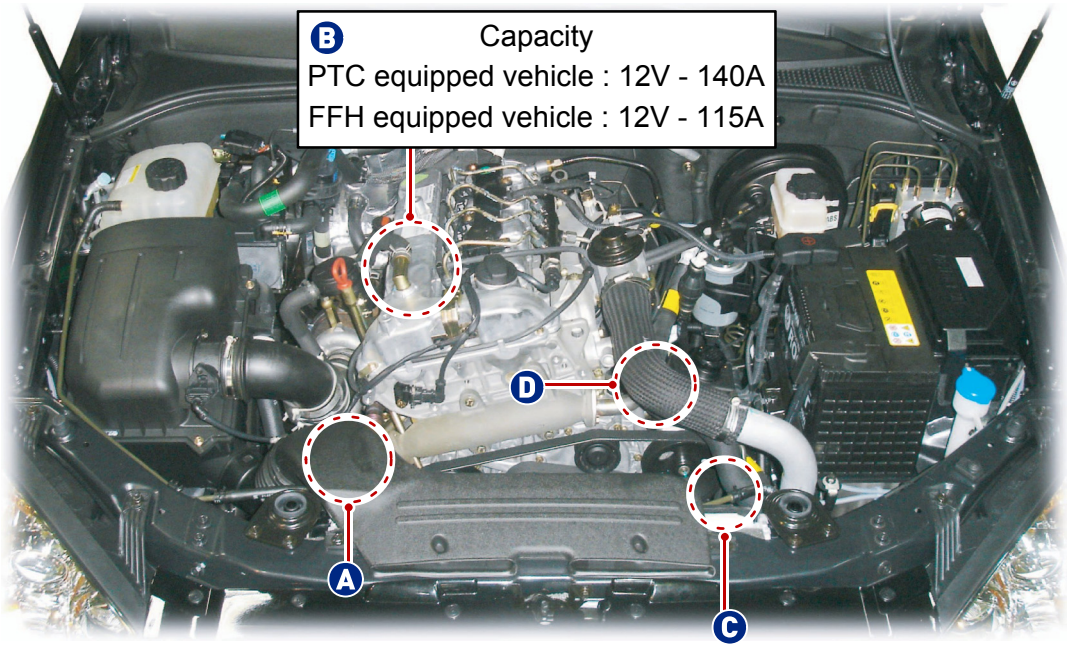
A



Glow Plug

B





Air Conditioner Compressor

C



Starter

D



Modification basis	
Application basis	
Affected VIN	

1) D27DT ENGINE

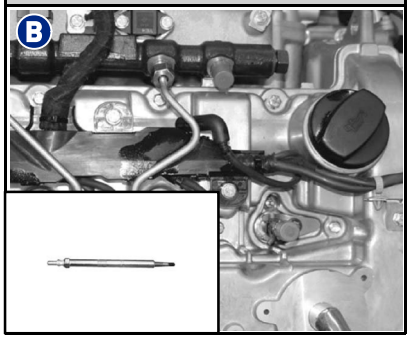
Alternator

A

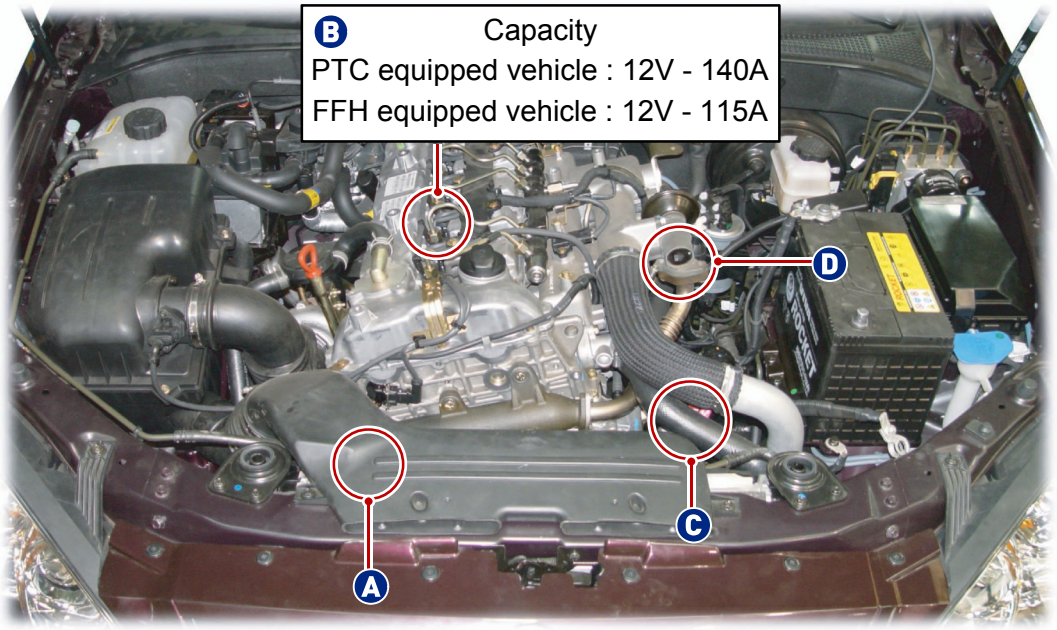


Glow Plug

B



B Capacity
PTC equipped vehicle : 12V - 140A
FFH equipped vehicle : 12V - 115A



Air Conditioner Compressor

C

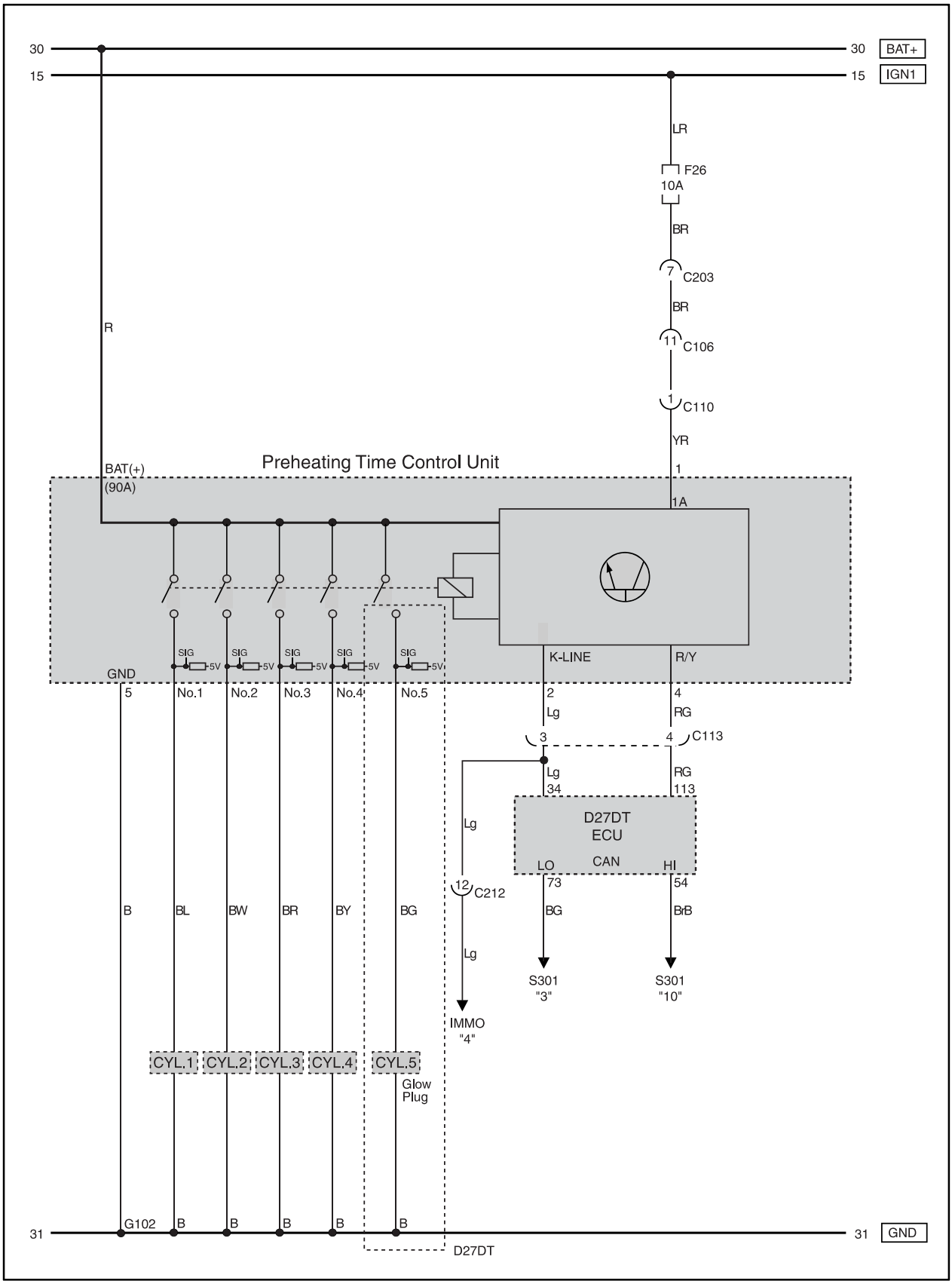


Starter

D

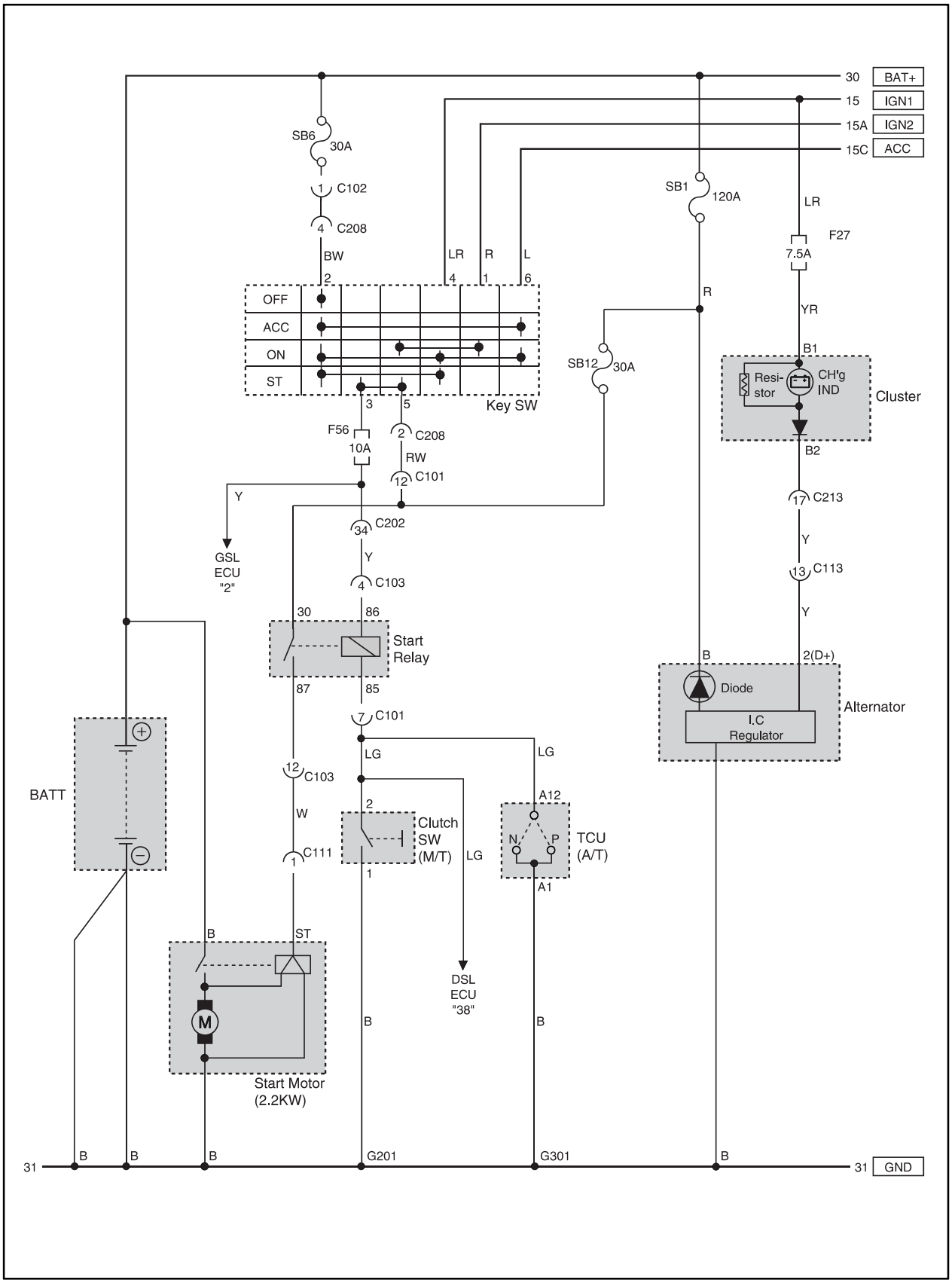


3. CIRCUIT DIAGRAM OF PREHEATING SYSTEM



Modification basis	
Application basis	
Affected VIN	

4. CIRCUIT DIAGRAM OF STARTING AND ALTERNATOR



Modification basis	
Application basis	
Affected VIN	

ENGINE D20DT

undefined

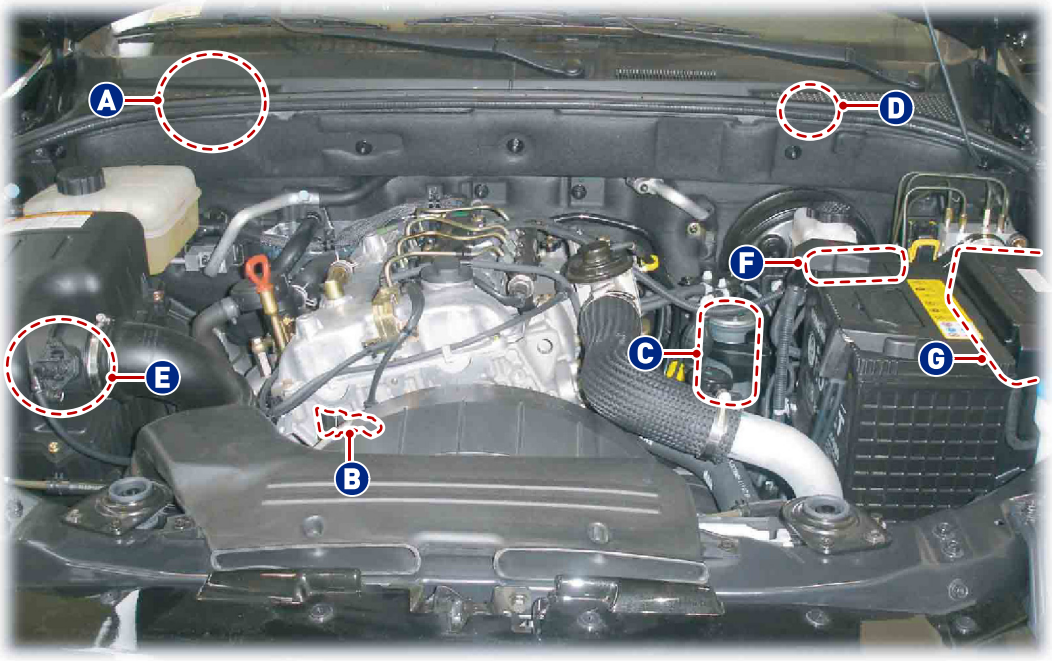
EGINE CONTROL SYSTEM

1491-01

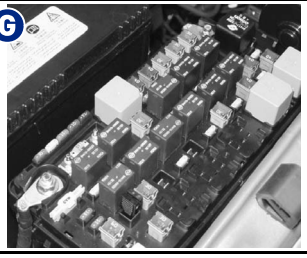
GENERAL

1. ENGINE ECU AND OTHER COMPONENTS

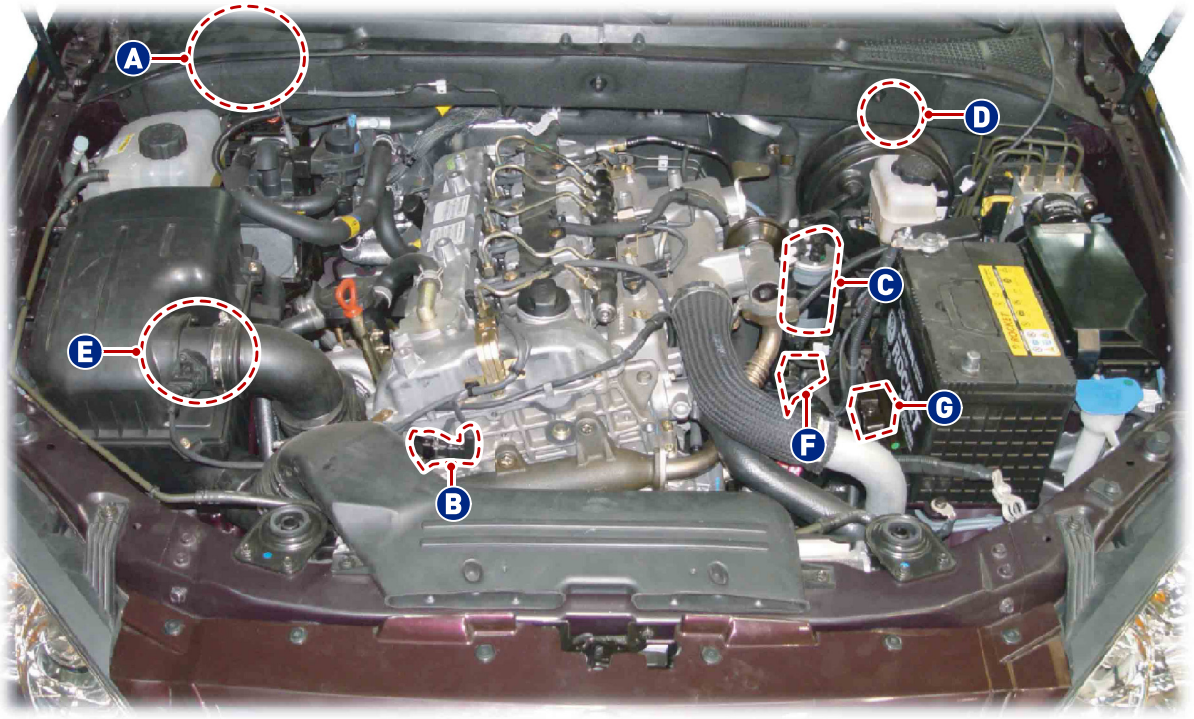
1) D20DT Engine

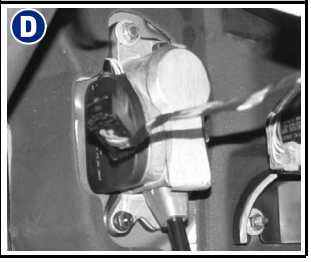


ECU/Barometric Sensor	Camshaft Position Sensor	Fuel Filter (Water Sensor)	Accelerator Pedal Sensor
A 	B 	C 	D 

HFM Sensor / Intake Air Temperature Sensor	Preheating Relay	Main Relay
E 	F 	G 

2) D20DT Engine



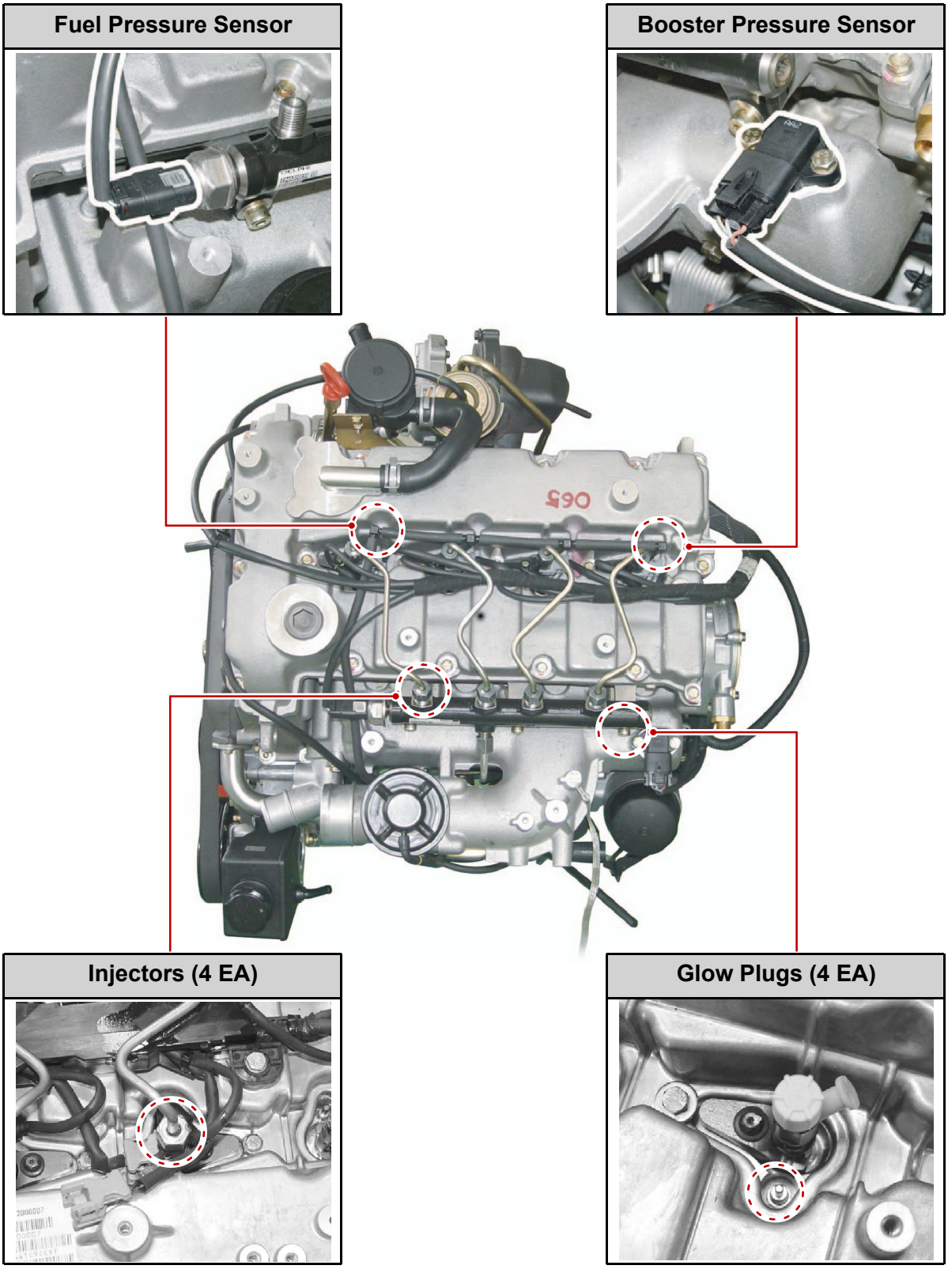
ECU/Barometric Sensor	Camshaft Position Sensor	Fuel Filter (Water Sensor)	Accelerator Pedal Sensor
A 	B 	C 	D 

HFM Sensor / Intake Air Temperature Sensor	Preheating Relay	Main Relay
E 	F 	G 

Modification basis	
Application basis	
Affected VIN	

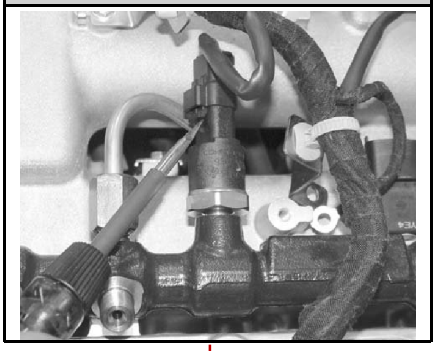
3) TOP VIEW

(1) D20DT Engine



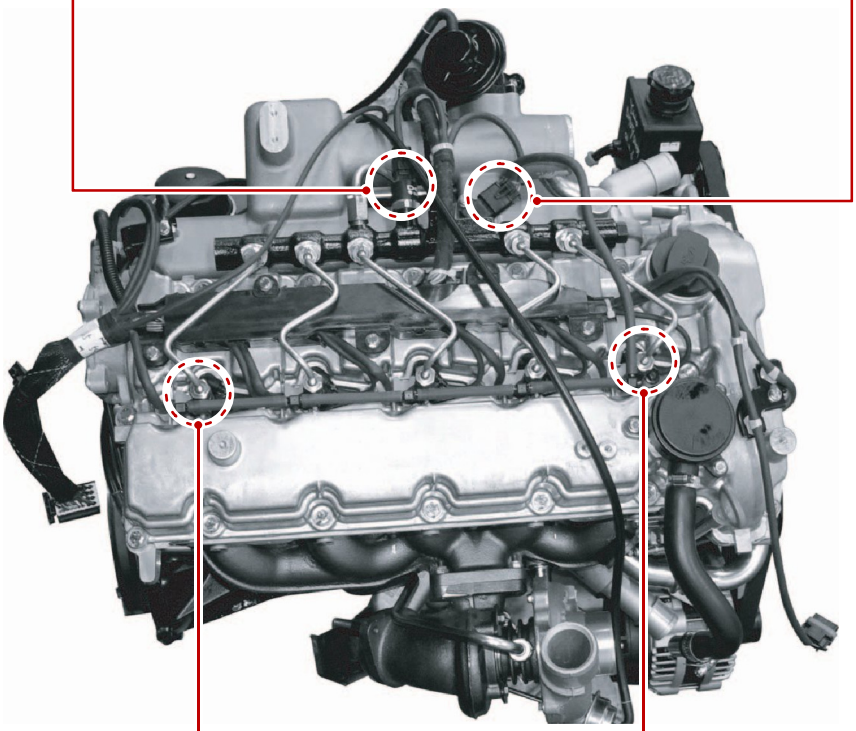
(2) D27DT Engine

Fuel Pressure Sensor

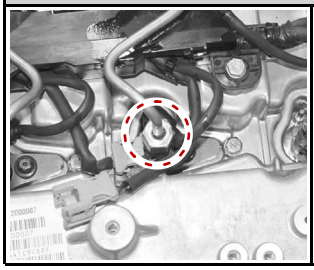


Booster Pressure Sensor



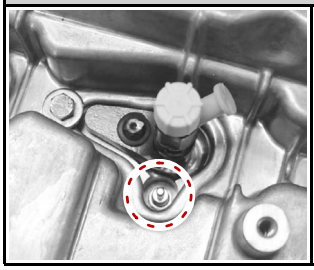


Injectors (5 EA)





Glow Plugs (5)

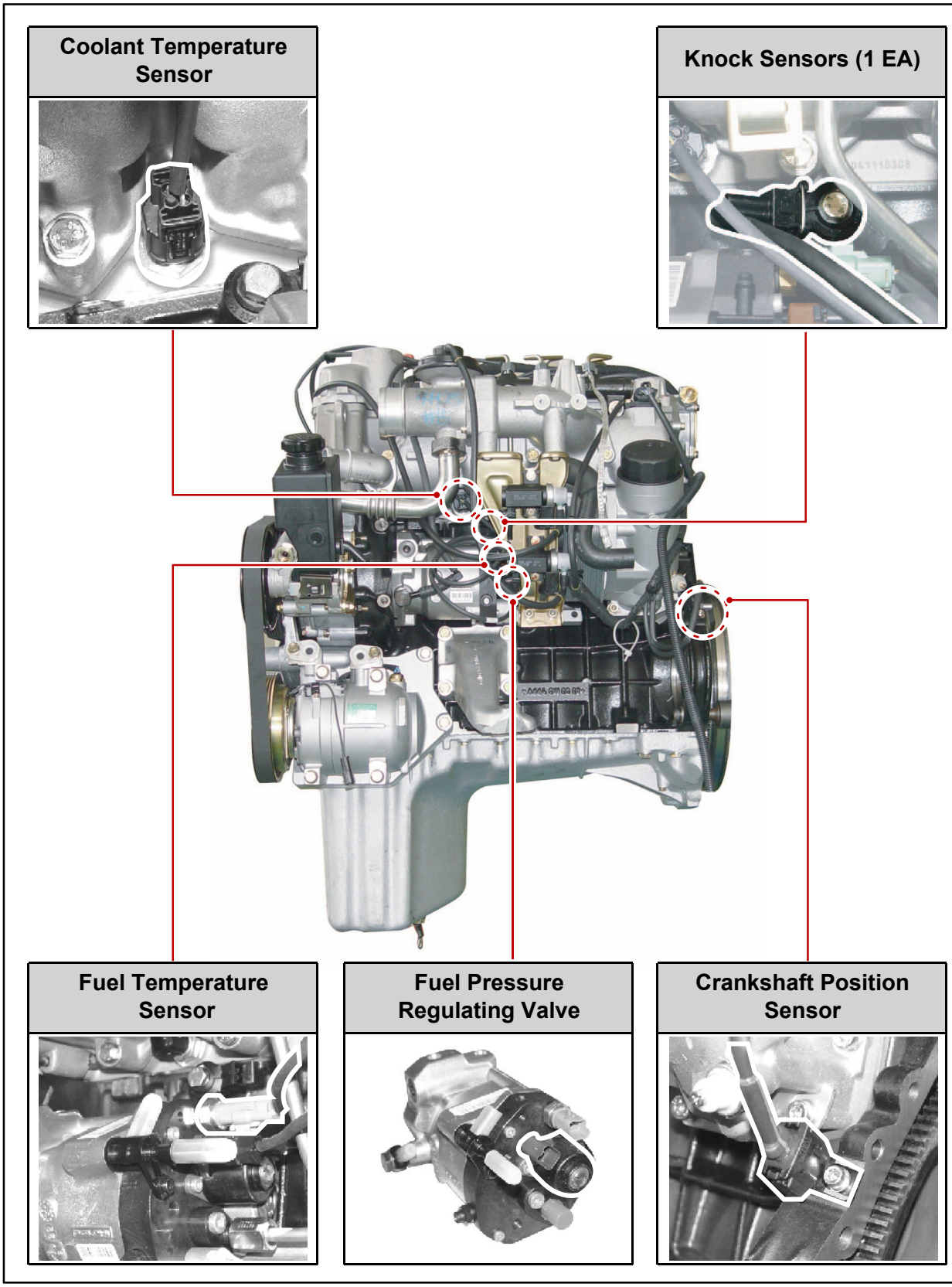




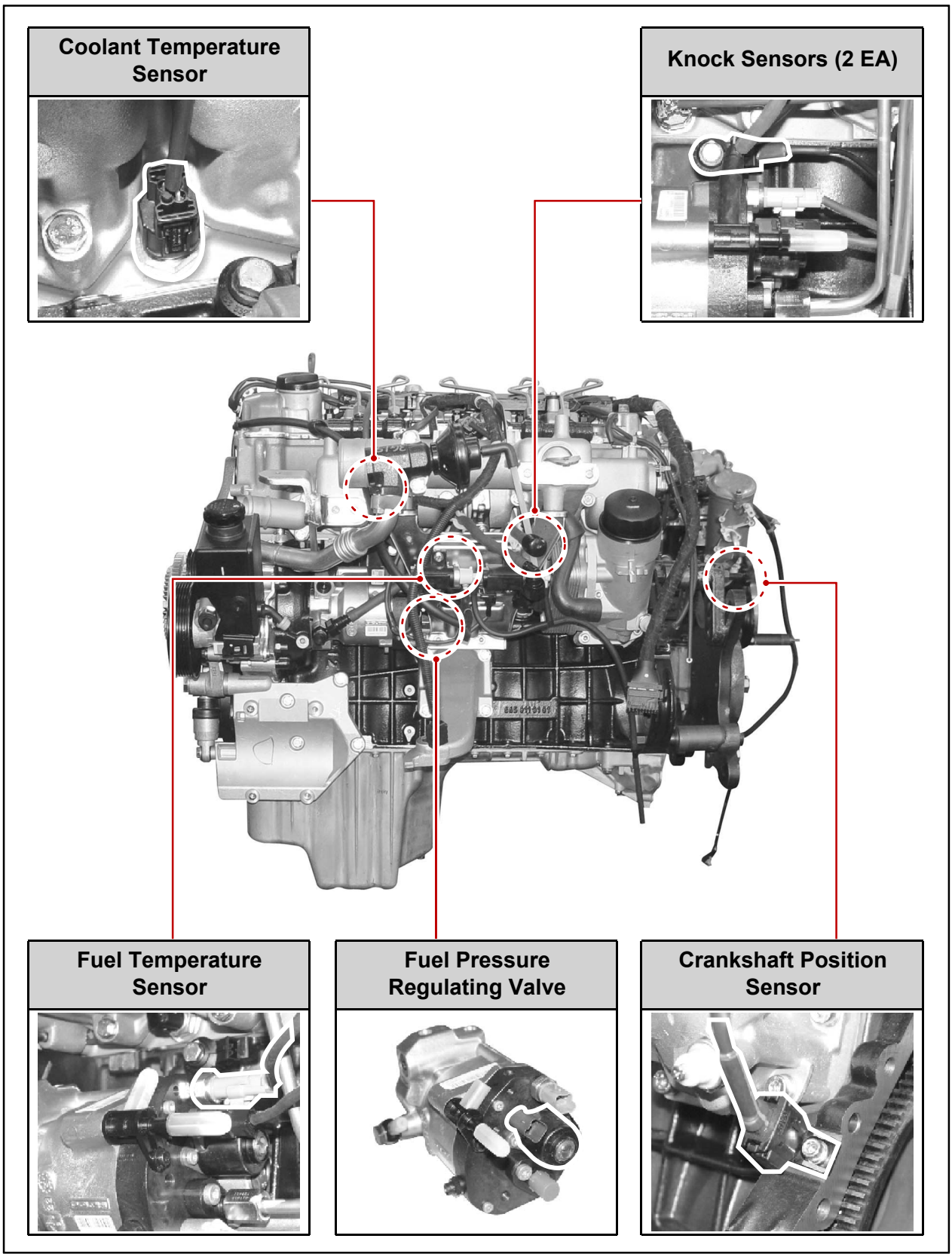
Modification basis	
Application basis	
Affected VIN	

4) SIDE VIEW

(1) D20DT Engine



(2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. ECU INPUTS/OUTPUTS

Inputs	Control	Output
Booster pressure sensor Atmospheric pressure sensor (Built-in ECU) Air flow sensor (HFM) Coolant temperature sensor Fuel temperature sensor Fuel pressure sensor Fuel filter water sensor Knock sensor crankshaft position sensor camshaft position sensor Accelerator sensor Vehicle speed sensor Switch input signal (IG, brake, clutch, A/C signal, A/C compressor)	E C U	Injector EGR system Fuel pressure regulating valve (IMV) Electrical fan control (Low/High-speed) A/C compressor relay Glow plug relay Immobilizer Warning lights (Water warning light, glow plug indicator light, engine warning light) Preheater (auxiliary heater) K - line CAN communication Self-diagnosis

2. STRUCTURE AND FUNCTION OF ECU

1) Function of ECU

ECU receives and analyzes signals from various sensors and then modifies those signals into permissible voltage levels and analyzes to control respective actuators.
ECU microprocessor calculates injection period and injection timing proper for engine piston speed and crankshaft angle based on input data and stored specific map to control the engine power and emission gas.
Output signal of the ECU microprocessor drives pressure control valve to control the rail pressure and activates injector solenoid valve to control the fuel injection period and injection timing; so controls various actuators in response to engine changes. Auxiliary function of ECU has adopted to reduce emission gas, improve fuel economy and enhance safety, comforts and conveniences. For example, there are EGR, booster pressure control, autocruise (export only) and immobilizer and adopted CAN communication to exchange data among electrical systems (automatic T/M and brake system) in the vehicle fluently. And Scanner can be used to diagnose vehicle status and defectives.
Operating temperature range of ECU is normally −40 ~ +85°C and protected from factors like oil, water and electromagnetism and there should be no mechanical shocks.
To control the fuel volume precisely under repeated injections, high current should be applied instantly so there is injector drive circuit in the ECU to generate necessary current during injector drive stages.
Current control circuit divides current applying time (injection time) into full-in-current-phase and hold-current-phase and then the injectors should work very correctly under every working condition.

3. CONTROL FUNCTION OF ECU

▶ **Controls by operating stages**

- To make optimum combustion under every operating stage, ECU should calculate proper injection volume in each stage by considering various factors.

▶ **Starting injection volume control**

- During initial starting, injecting fuel volume will be calculated by function of temperature and engine cranking speed.
  Starting injection continues from when the ignition switch is turned to ignition position to till the engine reaches to allowable minimum speed.

▶ **Driving mode control**

- If the vehicle runs normally, fuel injection volume will be calculated by accelerator pedal travel and engine rpm and the drive map will be used to match the drivers inputs with optimum engine power.

Modification basis	
Application basis	
Affected VIN	

4. FUEL PRESSURE CONTROL

1) Fuel Pressure Control Elements

Pressure control consists of 2 principle modules.

- Determines rail pressure according to engine operating conditions.
- Controls IMV to make the rail pressure to reach to the required value.

Pressure in the fuel rail is determined according to engine speed and load on the engine. The aim is to adapt the injection pressure to the engine's requirements.

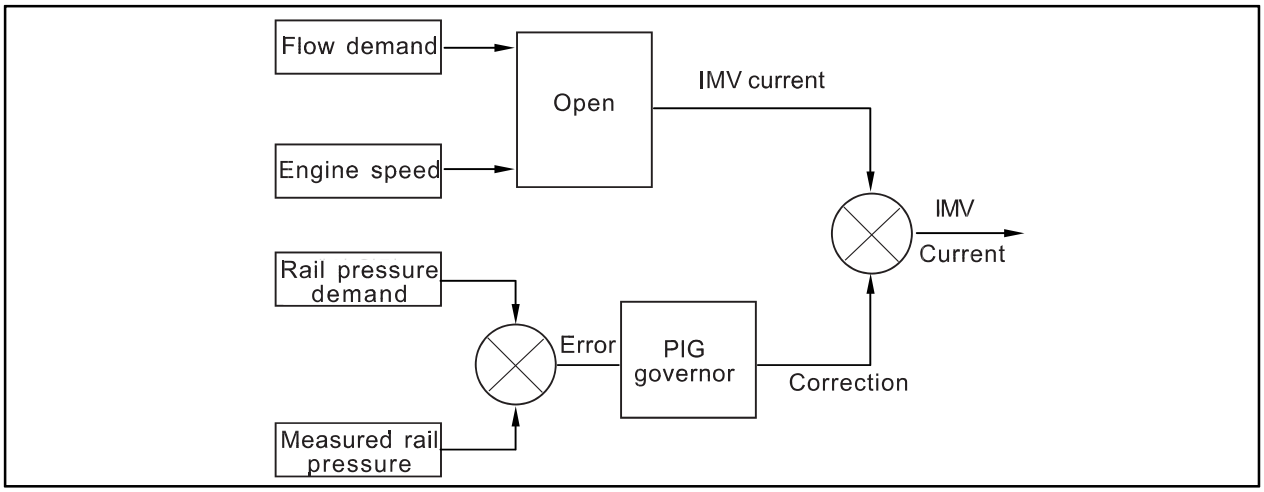
- When engine speed and load are high
  - The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.
- When engine speed and load are low
  - The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will be excessive and part of the fuel will be sprayed directly onto the sides of the cylinder, causing incomplete combustion. So there occurs smoke and damages engine durability.

Fuel pressure is corrected according to air temperature, coolant temperature and atmospheric pressure and to take account of the added ignition time caused by cold running or by high altitude driving. A special pressure demand is necessary in order to obtain the additional flow required during starts. This demand is determined according to injected fuel and coolant temperature.

2) Fuel Pressure Control

Rail pressure is controlled by closed loop regulation of IMV. A mapping system - open loop - determines the current which needs to be sent to the actuator in order to obtain the flow demanded by the ECU. The closed loop will correct the current value depending on the difference between the pressure demand and the pressure measured.

- If the pressure is lower than the demand, current is reduced so that the fuel sent to the high pressure pump is increased.
- If the pressure is higher than the demand, current is increased so that the fuel sent to the high pressure pump is reduced.



5. FUEL INJECTION CONTROL

1) Fuel Injection Control

Injection control is used in order to determine the characteristics of the pulse which is sent to the injectors.

Injection control consists as below.

- Injection timing
- Injection volume
- Translating fuel injection timing and injection volume into values which can be interpreted by the injector driver.
  - a reference tooth (CTP)
  - the delay between this tooth and the start of the pulse (Toff)
  - the pulse time (Ton)

▶ Main injection timing control

The pulse necessary for the main injection is determined as a function of the engine speed and of the injected flow.

The elements are:

- A first correction is made according to the air and coolant temperatures.
  This correction makes it possible to adapt the timing to the operating temperature of the engine. When the engine is warm, the timing can be retarded to reduce the combustion temperature and polluting emissions (NOx). When the engine is cold, the timing advance must be sufficient to allow the combustion to begin correctly.
- A second correction is made according to the atmospheric pressure.
  This correction is used to adapt the timing advance as a function of the atmospheric pressure and therefore the altitude.
- A third correction is made according to the coolant temperature and the time which has passed since starting.
  This correction allows the injection timing advance to be increased while the engine is warming up (initial 30 seconds). The purpose of this correction is to reduce the misfiring and instabilities which are liable to occur after a cold start.
- A fourth correction is made according to the pressure error.
  This correction is used to reduce the injection timing advance when the pressure in the rail is higher than the pressure demand.
- A fifth correction is made according to the rate of EGR.
  This correction is used to correct the injection timing advance as a function of the rate of exhaust gas recirculation.
  When the EGR rate increases, the injection timing advance must in fact be increased in order to compensate for the fall in termperature in the cylinder.

During starting, the injection timing must be retarded in order to position the start of combustion close to the TDC.

To do this, special mapping is used to determine the injection timing advance as a function of the engine speed and of the water temperature. This requirement only concerns the starting phase, since once the engine has started the system must re-use the mapping and the corrections described previously.

Modification basis	
Application basis	
Affected VIN	

▶ Pilot injection timing control

The pilot injection timing is determined as a function of the engine speed and of the total flow.
The elements are:

- A first correction is made according to the air and coolant temperatures.
  This correction allows the pilot injection timing to be adapted to the operating temperature of the engine.
- A second correction is made according to the atmospheric pressure.
  This correction is used to adapt the pilot injection timing as a function of the atmospheric pressure and therefore the altitude.

During the starting phase, the pilot injection timing is determined as a function of the engine speed and of the coolant temperature.

6. FUEL FLOW CONTROL

1) Main Flow Control

The main flow represents the amount of fuel injected into the cylinder during the main injection.
The pilot flow represents the amount of fuel injected during the pilot injection.
The total fuel injected during 1 cycle (main flow + pilot flow) is determined in the following manner.
: The driver's demand is compared with the value of the minimum flow determined by the idle speed controller.

- When the driver depress the pedal, it is his demand which is taken into account by the system in order to determine the fuel injected.
- When the driver release the pedal, the idle speed controller takes over to determine the minimum fuel which must be injected into the cylinder to prevent the enigne from stalling.

It is therefore the greater of these 2 values which is retained by the system. This value is then compared with the lower flow limit determined by the ASR trajectory control system. As soon as the injected fuel becomes lower than the flow limit determined by the ASR trajectory control system, the antagonistic torque (engine brake) transmitted to the drive wheels exceeds the adherence capacity of the vehicle and there is therefore a risk of the drive wheels locking. The system thus chooses the greater of these 2 values (main flow & pilot flow) in order to prevent any loss of control of the vehicle during a sharp deceleration.
This value is then compared with the flow limit determined by the cruise control. As soon as the injected fuel becomes lower than the flow limit determined by the cruise control, the vehicle's speed falls below the value required by the driver. The system therefore chooses the greater of these 2 values in order to maintain the speed at the required level.
This valve is then compared with the flow limit determined by the flow limitation strategy. This strategy allows the flow to be limited as a function of the operating conditions of the engine. The system therefore chooses the smaller of these 2 values in order to protect the engine. This value is then compared with the fuel limit determined by the ASR trajectory control system.
As soon as the injected fuel becomes higher than the fuel limit determined by the ASR trajectory control system, the engine torque transmitted to the wheels exceeds the adhesion capacity of the vehicle and there is a risk of the drive wheels skidding. The system therefore chooses the smaller of the two values in order to avoid any loss of control of the vehicle during accelerations.

The anti-oscillation strategy makes it possible to compensate for fluctuations in engine speed during transient conditions. This strategy leads to a fuel correction which is added to the total fuel of each cylinder. The correction is determined before each injection as a function of the instantaneous engine speed.

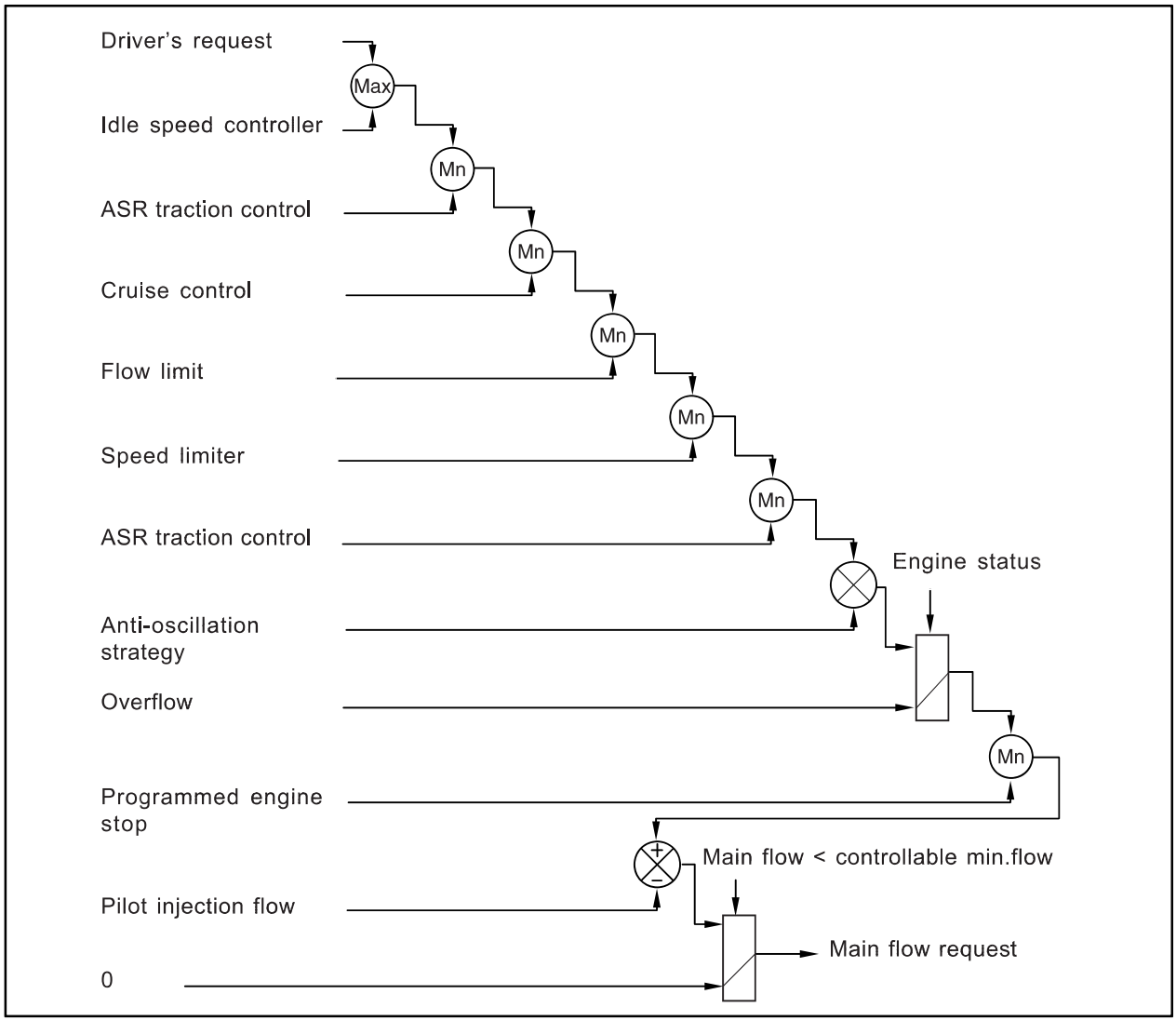
Modification basis	
Application basis	
Affected VIN	

A switch makes it possible to change over from the supercharge fuel to the total fuel according to the state of the engine.

- Until the stating phase has finished, the system uses the supercharged fuel.
- Once the engine changes to normal operation, the system uses the total fuel.

The main fuel is obtained by subtracting the pilot injection fuel from the total fuel.
A mapping determines the minimum fuel which can control an injector as a function of the rail pressure. As soon as the main fuel falls below this value, the fuel demand changes to 0 because in any case the injector is not capable of injecting the quantity demand.

2) Driver Demand



The driver demand is the translation of the pedal position into the fuel demand. It is calculated as a function of the pedal position and of the engine speed. The driver demand is filtered in order to limit the hesitations caused by rapid changes of the pedal position. A mapping determines the maximum fuel which can be injected as a function of the driver demand and the rail pressure. Since the flow is proportional to the injection time and to the square root of the injection pressure, it is necessary to limit the flow according to the pressure in order to avoid extending the injection for too long into the engine cycle. The system compares the driver demand with this limit and chooses the smaller of the 2 values. The driver demand is then corrected according to the coolant temperature. This correction is added to the driver demand.

Modification basis	
Application basis	
Affected VIN	

3) Idle Speed Controller

The idle speed controller consists of 2 principal modules:

- The first module determines the required idle speed according to:
  - The operating conditions of the engine (coolant temperature, gear engaged)
  - Any activation of the electrical consumers (power steering, air conditioning, others)
  - The battery voltage
  - The presence of any faults liable to interface with the rail pressure control or the injection control. In this case, the accelerated idle speed is activated to prevent the engine from stalling when operating in degraded mode.
  - It is possible to increase or to reduce the required idle speed with the aid of the diagnostic tool.
- The second module is responsible for providing closed loop control of the engine's idle speed by adapting the minimum fuel according to the difference between the required idle speed and the engine speed.

4) Flow Limitation

The flow limitation strategy is based on the following strategies:

- The flow limitation depending on the filling of the engine with air is determined according to the engine speed and the air flow. This limitation allows smoke emissions to be reduced during stabilized running.
- The flow limitation depending on the atmospheric pressure is determined according to the engine speed and the atmospheric pressure. It allows smoke emissions to be reduced when driving at altitude.
- The full load flow curve is determined according to the gear engaged and the engine speed. It allows the maximum torque delivered by the engine to be limited.
- A performance limitation is introduced if faults liable to upset the rail pressure control or the injection control are detected by the system. In this case, and depending on the gravity of the fault, the system activates:
  - Reduced fuel logic 1: Guarantees 75 % of the performance without limiting the engine speed.
  - Reduced fuel logic 2: Guarantees 50 % of the performance with the engine speed limited to 3,000 rpm.
  - Reduce fuel logic 3: Limits the engine speed to 2,000 rpm.

The system chooses the lowest of all these values.

A correction depending on the coolant temperature is added to the flow limitation. This correction makes it possible to reduce the mechanical stresses while the engine is warming up. The correction is determined according to the coolant temperature, the engine speed and the time which has passed since starting.

▶ **Superchager Flow Demand**

The supercharge flow is calculated according to the engine speed and the coolant temperature. A correction depending on the air temperature and the atmospheric pressure is made in order to increase the supercharge flow during cold starts. It is possible to alter the supercharge flow value by adding a flow offset with the aid of the diagnostic tool.

5) Pilot Flow Control

The pilot flow represents the amount of fuel injected into the cylinder during the pilot injection. This amount is determined according to the engine speed and the total flow.

- A first correction is made according to the air and water temperature.
  This correction allows the pilot flow to be adapted to the operating temperature of the engine. When the engine is warm, the ignition time decreases because the end-of-compression temperature is higher. The pilot flow can therefore be reduced because there is obviously less combustion noise when the engine is warm.
- A second correction is made according to the atmospheric pressure.

This correction is used to adapt the pilot flow according to the atmospheric pressure and therefore the altitude.

During starting, the pilot flow is determined on the basis of the engine speed and the coolant temperature.

6) Cylinder Balancing Strategy

▶ **Balancing of the point to point flows**

The pulse of each injector is corrected according to the difference in instantaneous speed measured between 2 successive injectors.

- The instantaneous speeds on two successive injections are first calculated.
- The difference between these two instantaneous speeds is then calculated.
- Finally, the time to be added to the main injection pulse for the different injectors is determined. For each injector, this time is calculated according to the initial offset of the injector and the instantaneous speed difference.

▶ **Detection of an injector which has stuck closed**

The cylinder balancing strategy also allows the detection of an injector which has stuck closed. The difference in instantaneous speed between 2 successive injections then exceeds a predefined threshold. In this case, a fault is signaled by the system.

7) Accelerometer Strategy

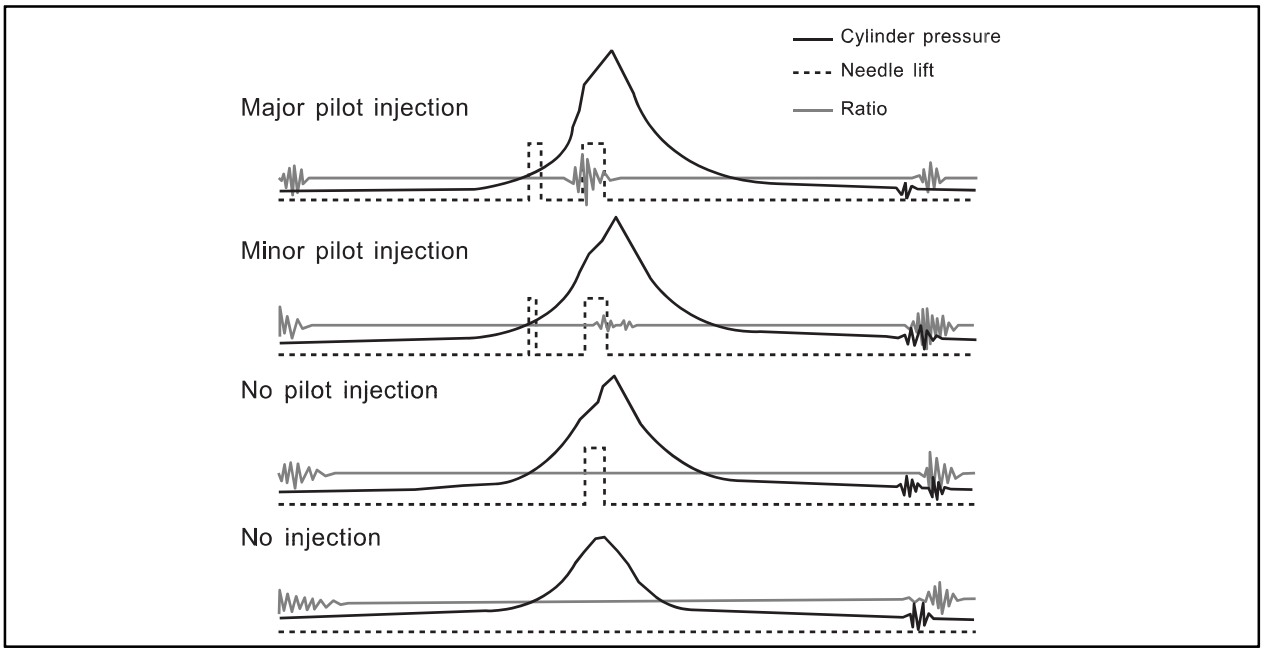
▶ Resetting the pilot injection

The accelerometer is used to reset the pilot injection flow in closed loop for each injector. This method allows the correction of any injector deviations over a period of time. The principle of use of the accelerometer is based on the detection of the combustion noises.

The sensor is positioned in such a way as to receive the maximum signal for all the cylinders. The raw signals from the accelerometer are processed to obtain a variable which quantifies the intensity of the combustion. This variable, known as the ratio, consists of the ratio between the intensity of the background noise and the combustion noise.

- A first window is used to establish the background noise level of the accelerometer signal for each cylinder. This window must therefore be positioned at a moment when there cannot be any combustion.
- The second window is used to measure the intensity of the pilot combustion. Its position is such that only the combustion noises produced by the pilot injection are measured . It is therefore placed just before the main injection.

The accelerometer does not allow any evaluation of the quantity injected. However, the pulse value will be measured when the injector starts injection and this pulse value is called the MDP (Minimum Drive Pulse). On the basis of this information, it is possible to efficiently correct the pilot flows. The pilot injection resetting principle therefore consists of determining the MDP, in other words the pulse corresponding to the start of the increase in value of the ratio (increase of vibration due to fuel combustion).



This is done periodically under certain operating conditions. When the resetting is finished, the new minimum pulse value replaces the value obtained during the previous resetting. The first MDP value is provided by the C2I. Each resetting then allows the closed loop of the MDP to be updated according to the deviation of the injector.

▶ Detection of leaks in the cylinders

The accelerometer is also used to detect any injector which may have stuck open. The detection principle is based on monitoring the ratio. If there is a leak in the cylinder, the accumulated fuel self-ignites as soon as the temperature and pressure conditions are favorable (high engine speed, high load and small leak).
This combustion is set off at about 20 degrees before TDC and before main injection.
The ratio therefore increases considerably in the detection window. It is this increase which allows the leaks to be detected. The threshold beyond which a fault is signaled is a percentage of the maximum possible value of the ratio.
Because of the severity of the recovery process (engine shut-down), the etection must be extremely robust.
An increase in the ratio can be the consequence of various causes:

- Pilot injection too strong
- Main combustion offset
- Fuel leak in the cylinder

If the ratio becomes too high, the strategy initially restricts the pilot injection flow and retards the main injection. If the ratio remains high despite these interventions, this shows that a real leak is present, a fault is signaled and the engine is shut down.

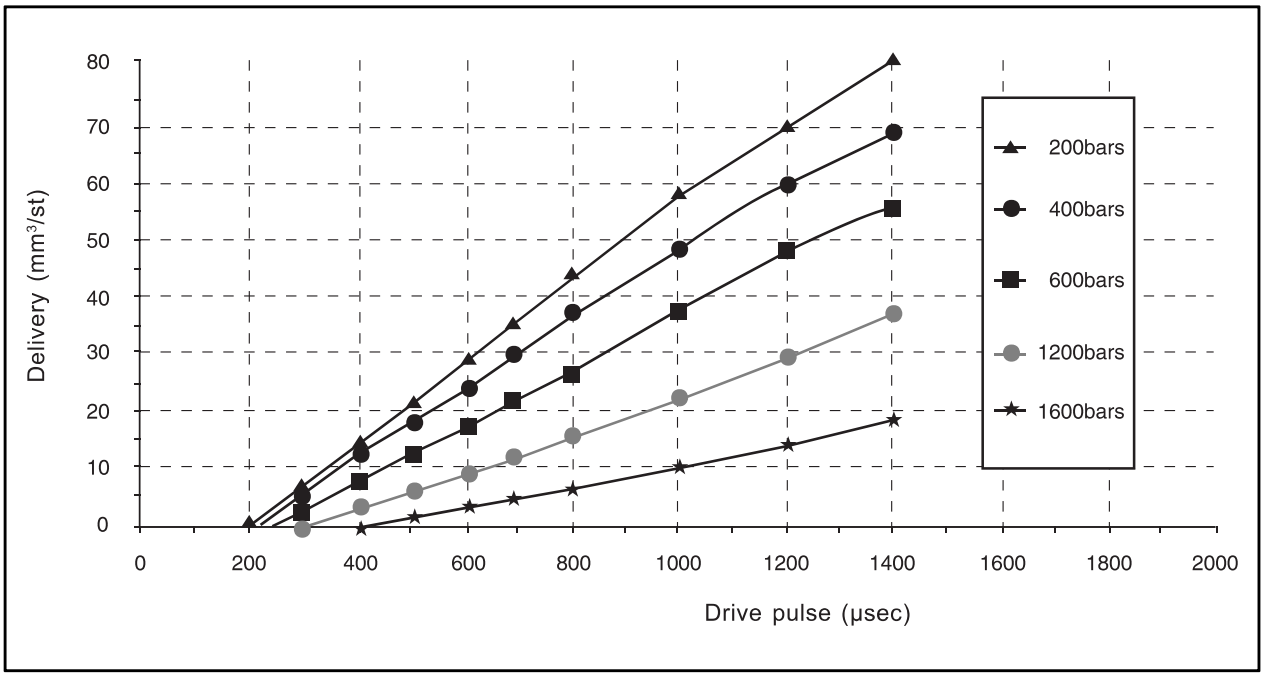
▶ Detection of an accelerometer fault

This strategy permits the detection of a fault in the sensor or in the wiring loom connecting the sensor to the ECU.
It is based on detection of the combustion. When the engine is idling, the detection window is set too low for the combustion caused by the main injection. If the ratio increases, this shows that the accelerometer is working properly, but otherwise a fault is signaled to indicate a sensor failure. The recovery modes associated with this fault consist of inhibition of the pilot injection and discharge through the injectors.

7. INDIVIDUAL INJECTOR CALIBRATION (C2I)

Injected fuel is proportional to square root of injection time and rail pressure.

It is function between pulse and rail pressure and fuel injection curve is called injector characteristics curve having the following shape.



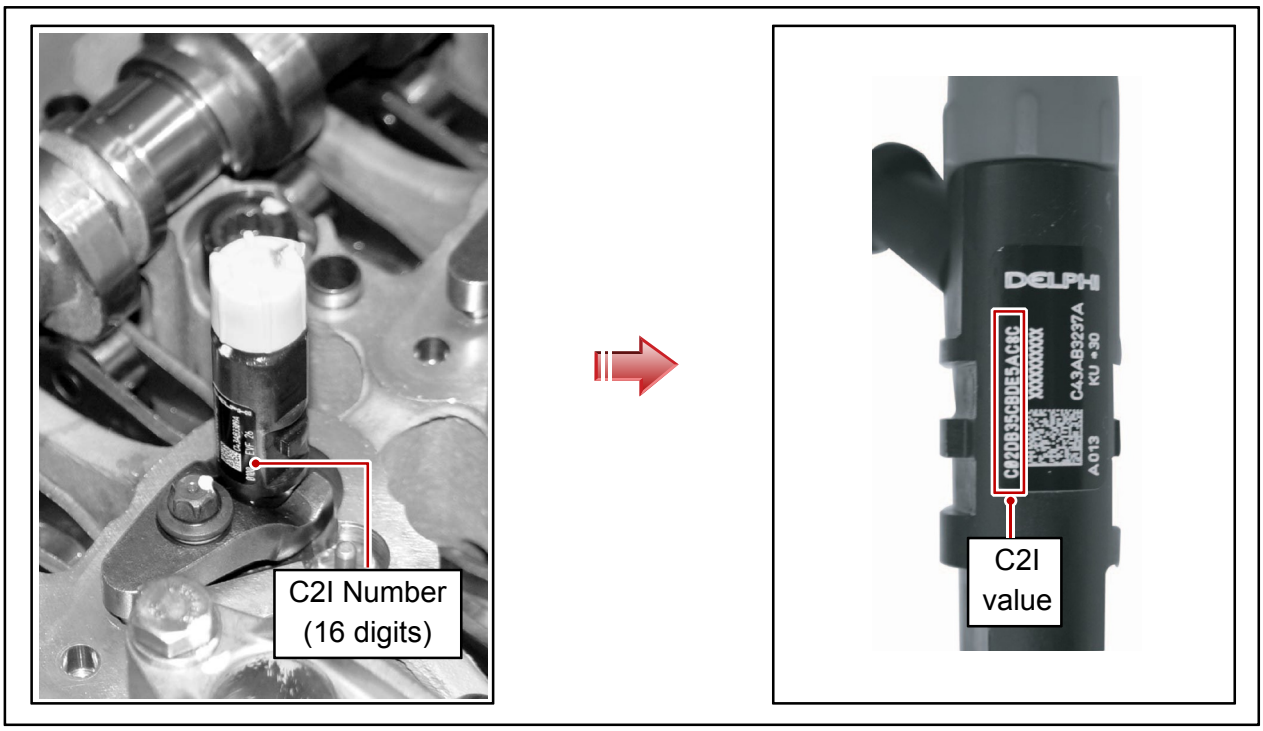
Common rail injectors are very accurate components. They are able to inject fuel delivery between 0.5 to 100 mg/str under pressure varying from 150 to 1600 bar.

This high level of accuracy requires very low machining tolerances (few ㎛).

Nevertheless, due to the machining dispersion, the loss of charge through the functional orifices, the friction between moving parts and electromagnetic field level are different from one injector to the other. So, the difference of fuel delivery for the same pressure and the same pulse can reach 5 mg/str from one injector to the other. It is impossible to control efficiently the engine with such a dispersion between the different injectors. It is necessary to add a correction that allows injecting the demanded fuel delivery whatever the initial hydraulic characteristics of the injector is. The method consists in correcting the pulse that is applied to the injector with an offset that depends on the initial hydraulic map of the injector. So, the pulse should be corrected according to characteristics of each injector.

C2I is composed of models on these characteristics of injectors.
C2I consists of 16-digit composed of numbers from 1 to 9 and alphabets from A to F. ECU remembers C2I, characteristics of each injector, to make the most optimal fuel injection.

- When replacing the injector, C2I code on the top of new injector should be input into ECU because the ECU is remembering the injector's C2I value. If C2I is not input, engine power drops and occurs irregular combustion.
- When ECU is replaced, C2I code of every injector should be input. If not, cannot accelerate the vehicle even when the accelerator pedal is depressed.



※ For coding of C2I, refer to "Diagnosis" section

Modification basis	
Application basis	
Affected VIN	

8. MINIMUM DRIVE PULSE (MDP) LEARNING

When the pulse value that the injector starts injection is measured, it is called mininum drive pulse (MDP). Through MDP controls, can correct pilot injections effectively. Pilot injection volume is very small, 1 ~ 2 mm/str, so precise control of the injector can be difficult if it gets old. So there needs MDP learning to control the very small volume precisely through learning according to getting older injectors.

1) Learning Conditions

Coolant temperature	> 75°C
Vehicle speed	> 50 Km/h (over 5 seconds)
Intake manifold pressure	> 0.7 bar
Engine speed	> 2,500 rpm
Battery voltage	10 V < MDP < 16 V
Fuel temperature	0 < fuel temperature < 80 °C
Initial MDP learning on each injector	5 seconds

2) Trouble Codes

Trouble code	Descriptio n	Diagnosis
P1171	Fault MDP learning on injector No. 1	• Check each injector
P1172	Fault MDP learning on injector No. 2	
P1173	Fault MDP learning on injector No. 3	
P1174	Fault MDP learning on injector No. 4	
P1175	Fault MDP learning on injector No. 5	

Memo

CRUISE CONTROL SYSTEM

8510-23

OVERVIEW AND OPERATION PROCESS

1. CRUISE CONTROL SWITCH



The purpose of the cruise control system is to automatically maintain a vehicle speed set by the driver, without depressing the accelerator pedal. The cruise control switch is located under the right side of the steering wheel, and when this switch is operating "AUTO CRUISE" lamp comes on.

The minimum speed for setting the cruise control system is 36 km/h (22.37 mph). Pay constant attention to the distance between the vehicles and the traffic conditions when using the cruise control system.

CAUTION

The cruise control system is a supplementary system, which helps the driver to drive the vehicle at a desired speed without using the accelerator pedal under the traffic condition where the vehicle-to-vehicle distance meets the legal requirement.

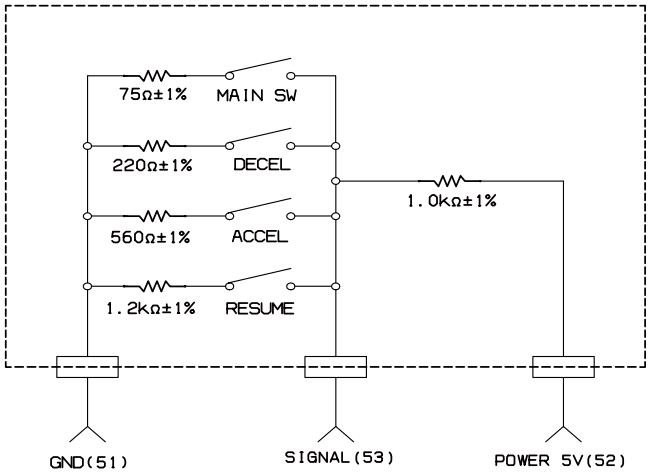
1) When To Use

Use the cruise control system only when (a) the traffic is not jammed, (b) driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

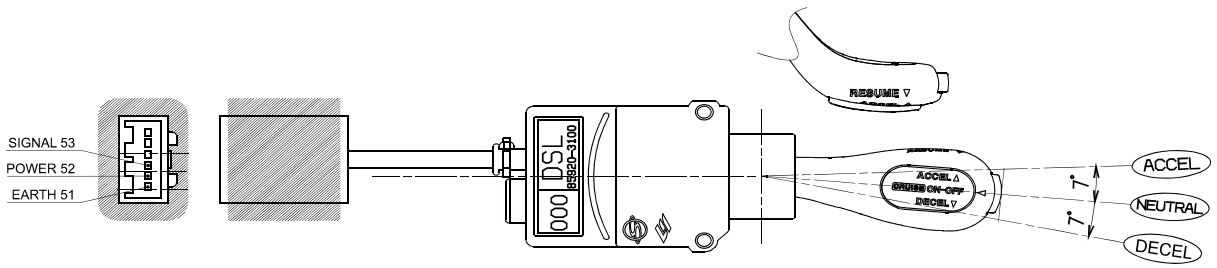
WARNING

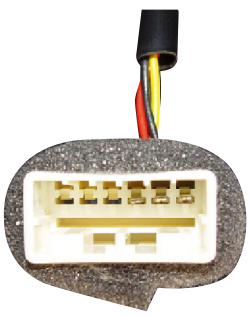
Use the cruise control system only when driving on motorways or highways. Do not use the cruise control system where the road conditions are as follows:
- When there is strong wind or cross wind.
- Heavy traffic.
- Slippery roads or steep decline.

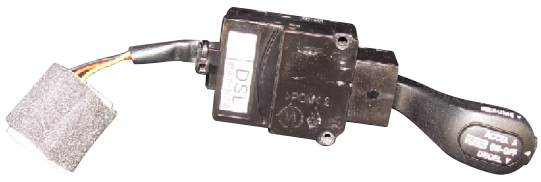
2. CIRCUIT DIAGRAM



1) Configuration







Modification basis	
Application basis	
Affected VIN	

3. HOW TO OPERATE CRUISE CONTROL SWITCH

1) How To Set Speed



1. To operate the cruise control system, accelerate the vehicle to the speed within the specified range below with depressing the accelerator pedal.
   - Cruise control operating range: between 36 km/h (22.37 mph) and 150 km/h (93.207 mph)
2. When the desired speed is reached, which should be within the above range, push up the cruise control switch lever to ACCEL side (upwards arrow), or push down the switch lever to DECEL side (downwards arrow).
   And then release the accelerator pedal slowly.
3. Now the vehicle is cruised by this system with the set speed. You don't need to use the accelerator pedal.
4. Refer to the following pages for details of operation.

CAUTION

Never use the cruise control system until you get used to it.
Improper use or not fully aware of this function could result in collision and/or personal injuries.

2) Accelerating with the Cruise Control System



(1) While the cruise control system is running

1. To increase the set speed, push up the cruise control switch lever to ACCEL side and hold it until the desired speed is reached without depressing the accelerator pedal.
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To increase the speed with the cruise control system while the system is not running, follow the procedures below.

1. Accelerate the vehicle to more than 36 km/h (22.37 mph) using the accelerator pedal. Push up the cruise control switch lever to ACCEL side and hold it.
2. When the desired speed is reached, release the accelerator pedal and the switch lever.

(3) Tap-up while the cruise control system is running

To increase the vehicle speed in stages while the cruise control system is running, follow the procedures below.

1. Push up the cruise control switch lever to ACCEL side for less than 0.5 second per one switching while the cruise control system is running; the speed increases each time by 1.3 km/h (0.81 mph).
2. For example, if you want to increase the speed 13 km/h (81 mph) more than the previous set speed, tap up the switch lever to ACCEL side ten times without using the accelerator pedal.

3) Decelerating with the Cruise Control System



(1) While the cruise control system is running

1. To decrease the set speed, push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached without depressing the brake pedal.
   But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To decrease the speed with the cruise control system while the system is not running, follow the procedures below.

1. Push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached while the vehicle speed is over 36 km/h (22.37 mph).
2. When the desired speed is reached, release the switch lever.
3. But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).

(3) Tap-down while the cruise control system is running

To decrease the vehicle speed in stages while the cruise control system is running, follow the below procedures.

1. Push down the cruise control switch lever to DECEL side for less than 0.5 second per one switching while the cruise control system is running; the speed decreases each time by 1.0 km/h (0.62 mph).
2. For example, if you want to decrease the speed 10 km/h (62 mph) lower than the previous set speed, tap down the switch lever to DECEL side ten times without using the brake pedal.

Modification basis	
Application basis	
Affected VIN	

4) Recovery of Set Speed (RESUME)



Even if the cruise control is cancelled, the previous set cruise speed can be recovered by operating the cruise control switch lever like below:
- Pull the switch lever in the arrow direction shown in the illustration.
This RESUME function works only when the vehicle speed is more than 36 km/h (22.37 mph) without using the accelerator or brake pedal.

CAUTION
But the driver should know the previous set speed to react to the changed vehicle speed properly. If the vehicle speed increases abruptly, depress the brake pedal to adjust the vehicle speed properly.

5) Normal Cancellation of the Cruise Control (OFF ↔ ON)



The cruise control system will be cancelled when the button on the side of the switch is pressed, or when one of the following conditions is met:

1. When the brake pedal is depressed or ESP is activated.
2. When the vehicle speed is less than 34 km/h (21.13 mph).
3. When the parking brake is applied while driving.
4. When the clutch pedal is depressed for shifting (M/T only).

CAUTION

Put the cruise control switch lever in the neutral position when not using the cruise control system.

(1) Abnormal Cancellation of the Cruise Control

1. When the rapid deceleration or acceleration occurs.
2. When the cruise control lever is faulty.
3. When the brake switch is malfunctioning or has an open circuit.

When the cruise control function is cancelled abnormally or intermittent problems occur, stop the vehicle and turn off the ignition switch and remove the key to reset the system. After a while, turn on the ignition switch again to operate the cruise control system.

CAUTION

- Do not move the shift lever to Neutral position while driving with the cruise control turned on. Otherwise, it may result in system malfunction or accidents.
- Always be prepared to use the brake or accelerator pedal for safe driving while the cruise control system is running.
- The actual speed can be different from the set speed momentarily when driving on a uphill or downhill. So, it is recommended to disable the cruise control function on a uphill or downhill. hen driving on a steep hill use the engine brake and foot brake properly to protect the vehicle system and for a safe driving.
- Ensure that the braking distance is maintained and use the brake pedal if needed.

ENGINE GENERAL

0000-00

GENERAL

1. STRUCTURE AND COMPARISON..... 3
2. ENGINE SPECIFICATIONS AND PERFORMANCE CURVE..... 7
3. TIGHTENING TORQUE..... 9
4. MAJOR CHANGES IN D27DTP(POWER UP ENGINE(COMPARED TO D27DT).... 12

OERVIEW AND OPERATION PROCESS

1. ENGINE COMPARTMENT..... 21
2. SYSTEM IN ENGINE COMPARTMENT. 25

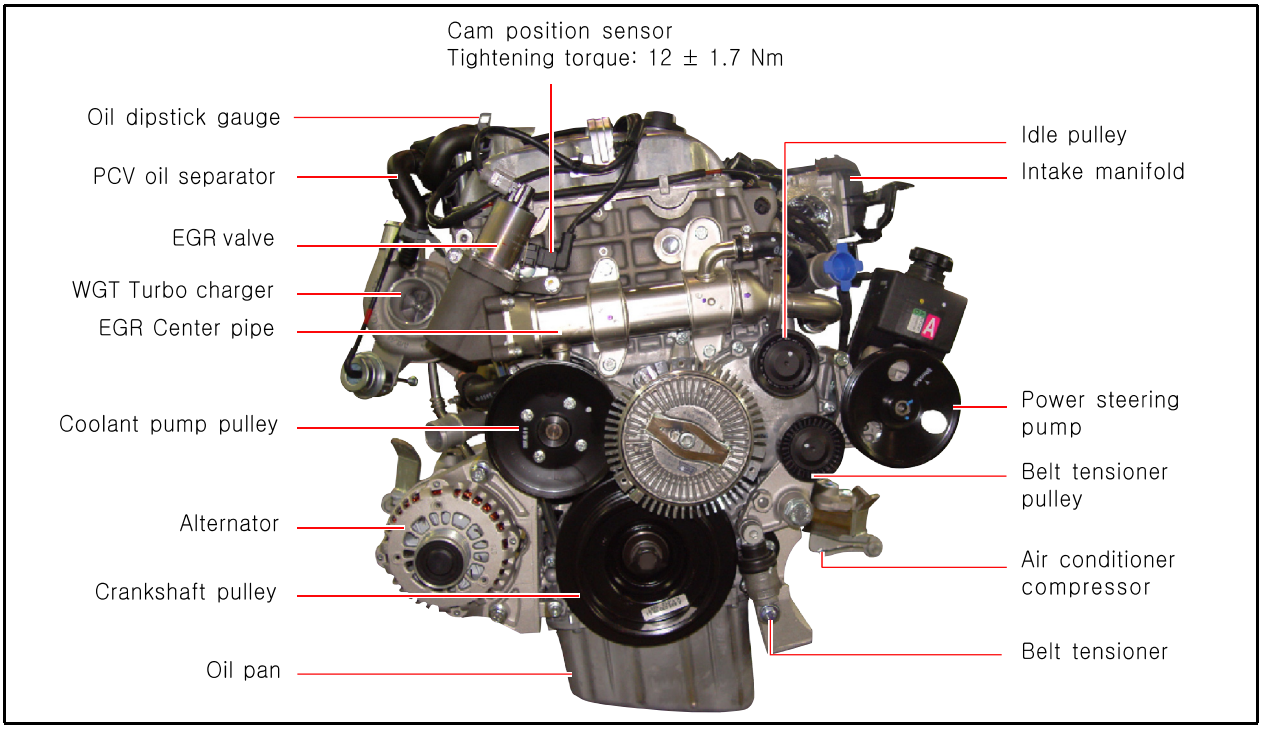
ENGINE GENERAL

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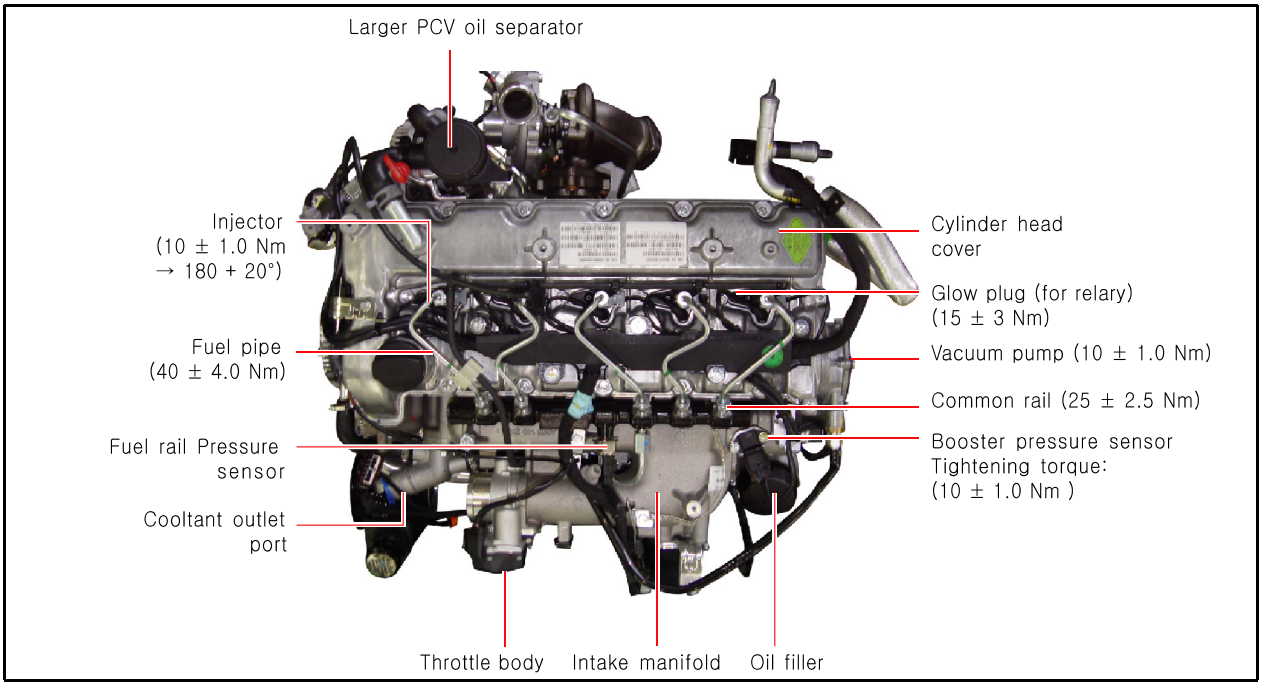
GENERAL

1. STRUCTURE AND COMPARISON

▶D27DT (EU IV) Engine - Front View

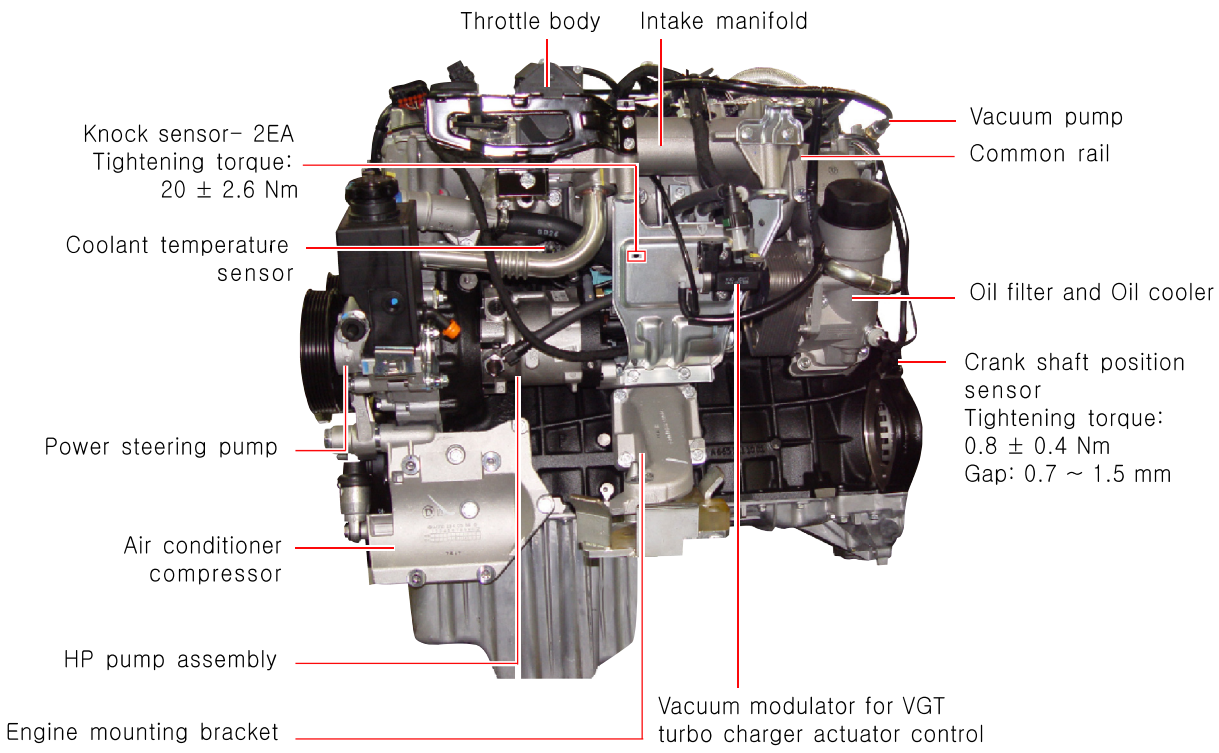


▶D27DT (EU IV) Engine - Front View

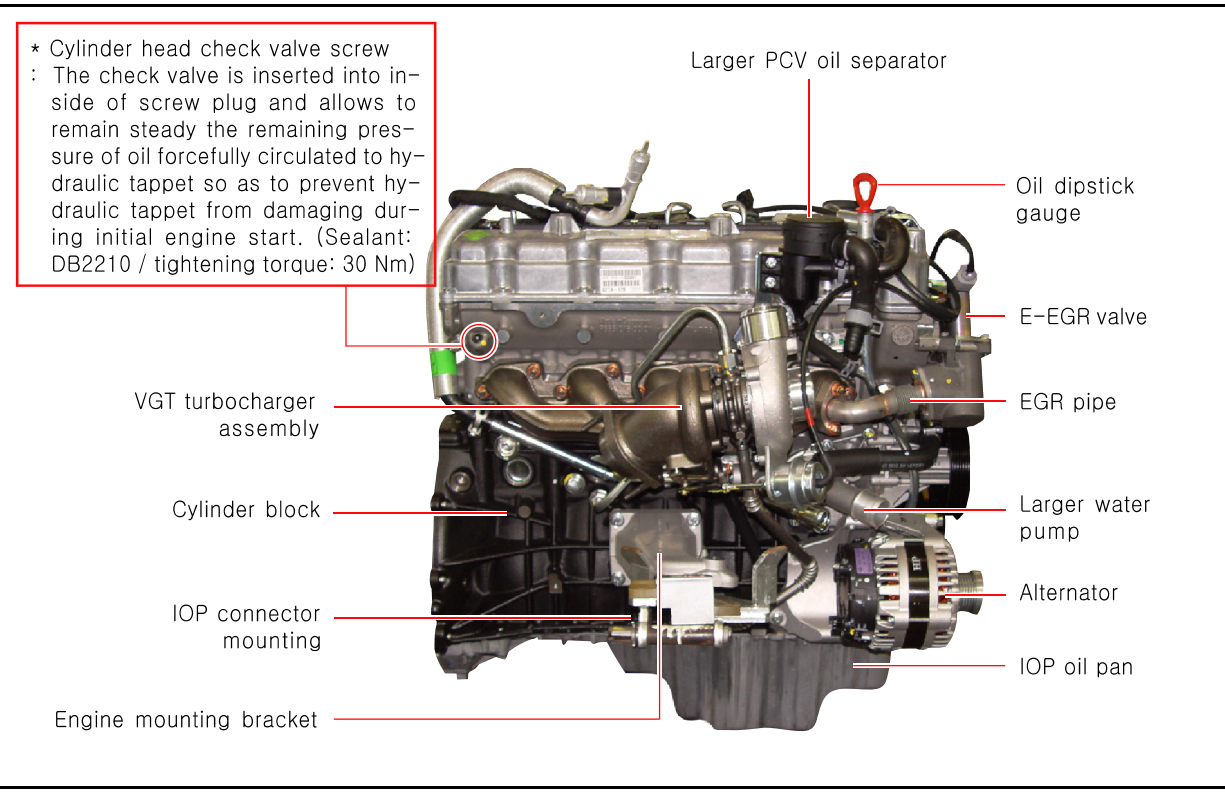


Modification basis	
Application basis	
Affected VIN	

▶D27DT (EU IV) Engine - Side View

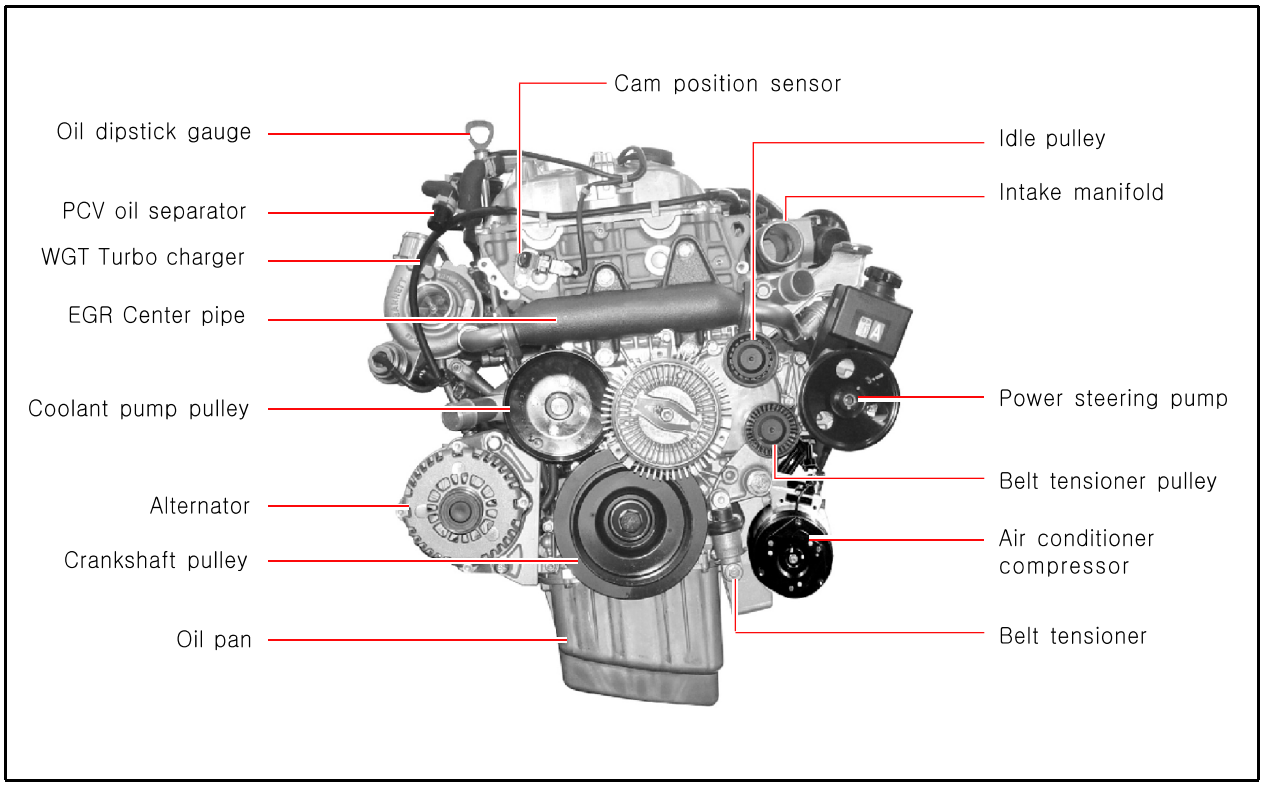


▶D27DT (EU IV) Engine - Left Side View

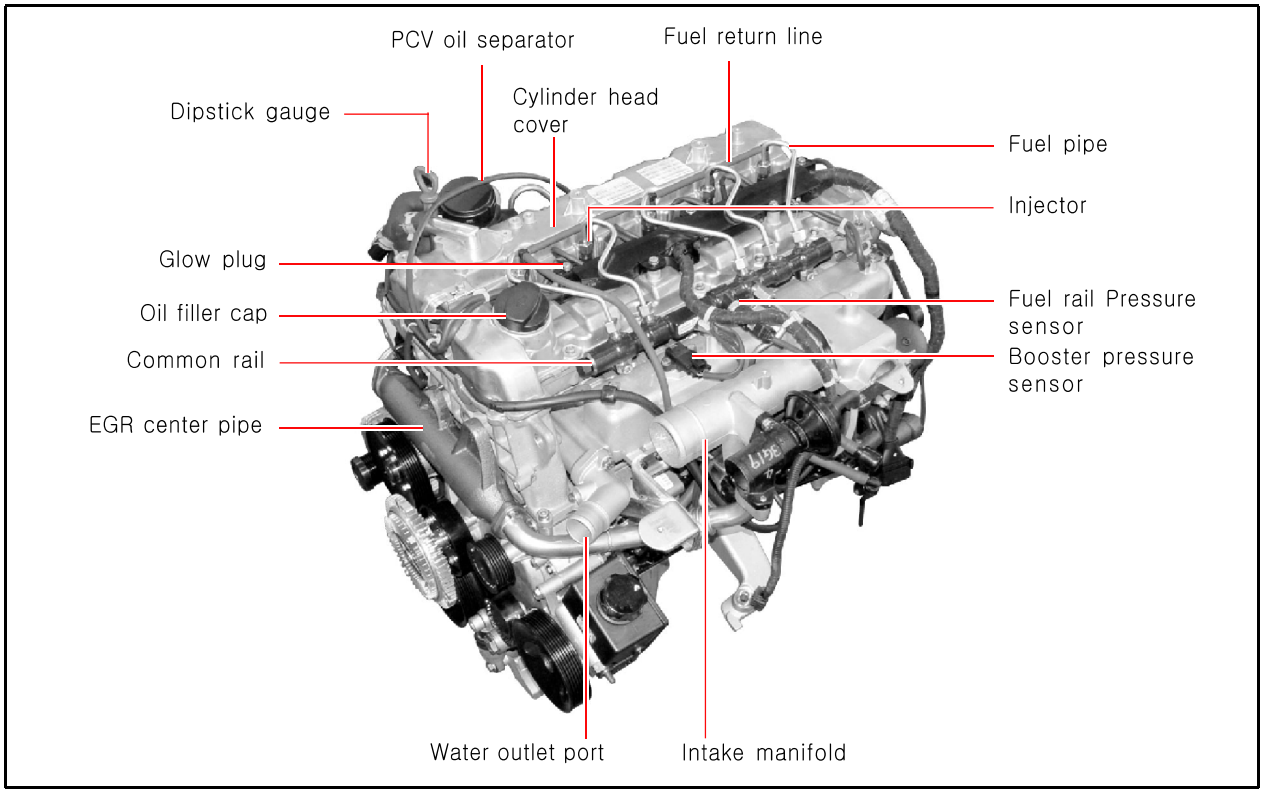


Modification basis	
Application basis	
Affected VIN	

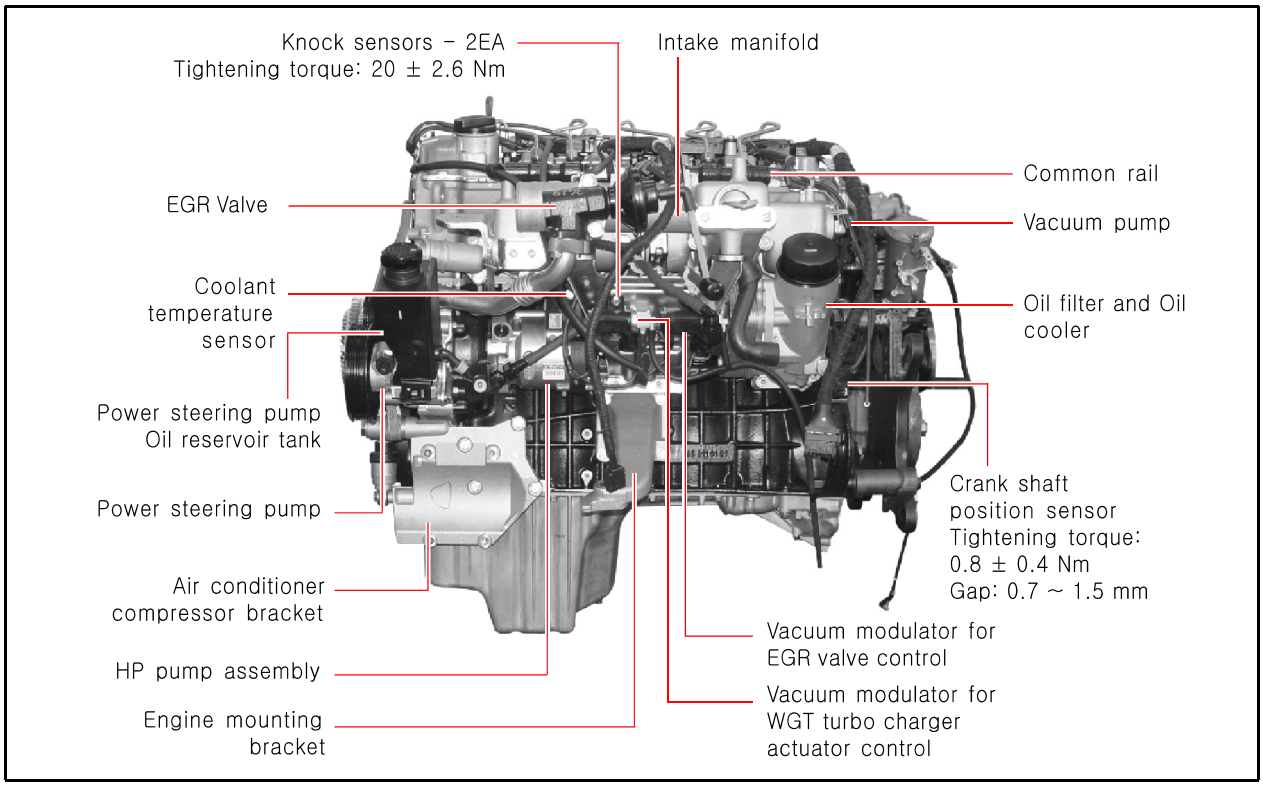
▶D27DT Engine (General) - Front View



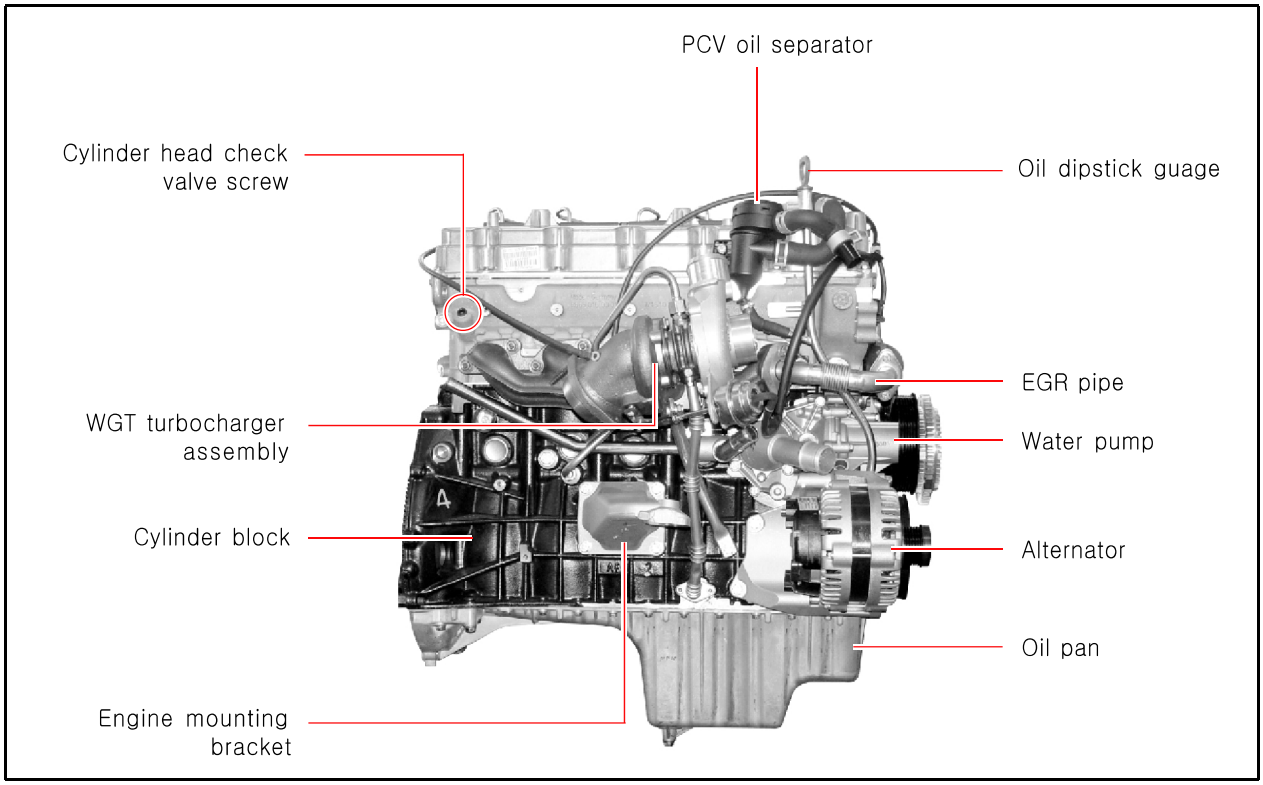
▶D27DT Engine (General) - Top View



▶D27DT Engine (General) - Side View



▶D27DT Engine (General) - Left Side View



Modification basis	
Application basis	
Affected VIN	

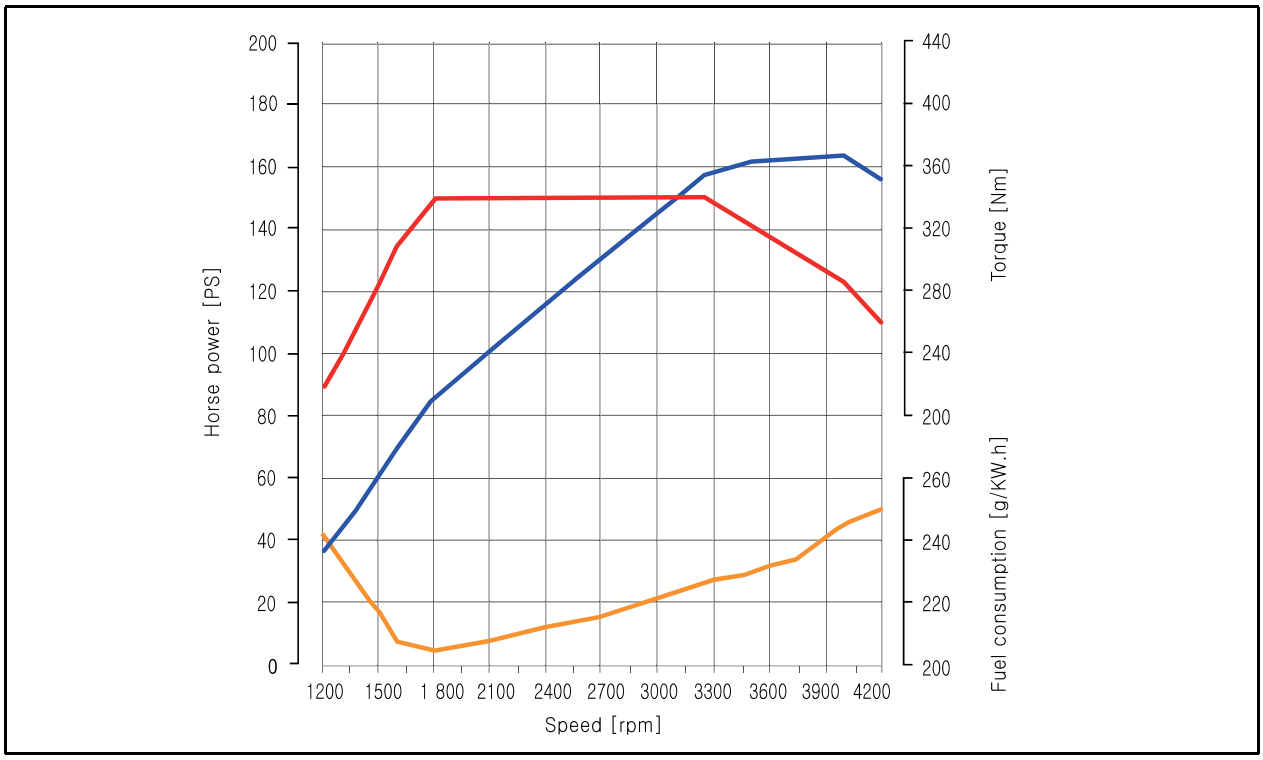
2. ENGINE SPECIFICATIONS AND PERFORMANCE CURVE

1) Specifications

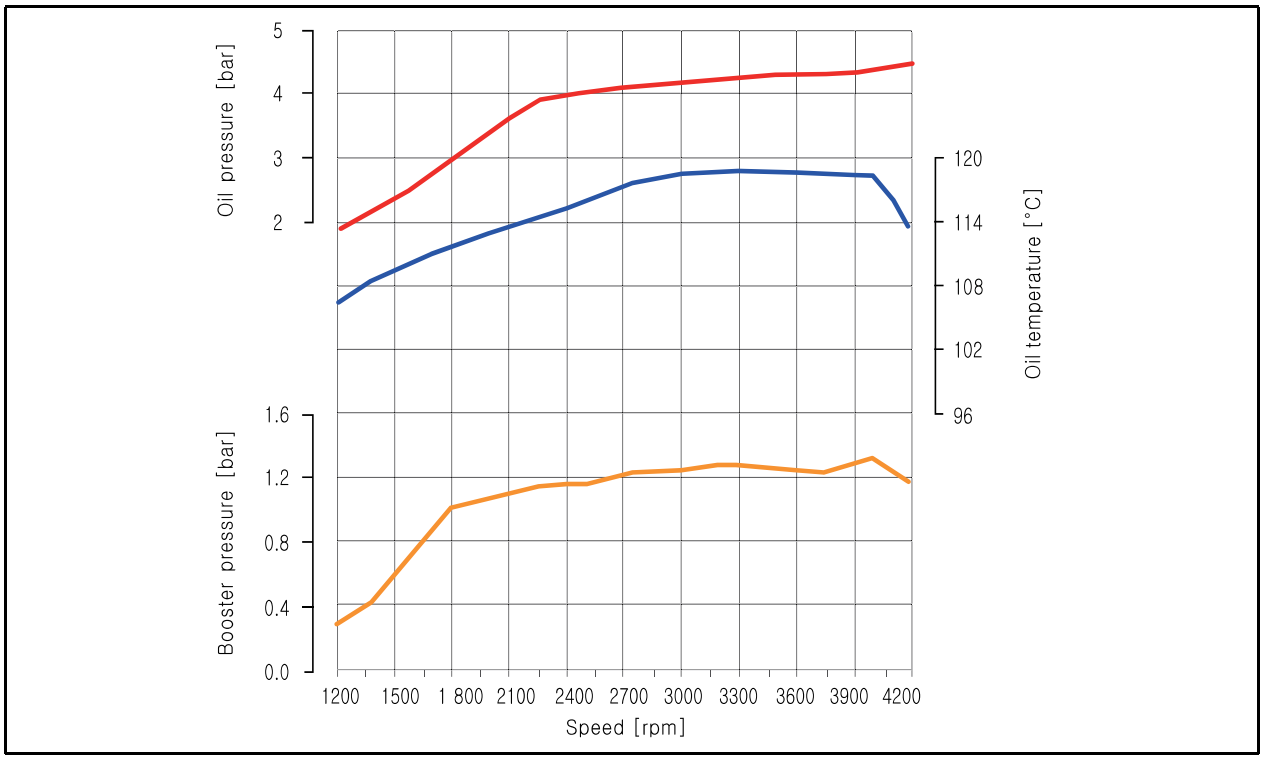
Descriptions			D27DTP (POWER UP) + CDPF Engine * ( ) : CDPF	D27DT (EU IV) Engine	D27DT Engine
Engine	Type/Number of cylinders		D27DT/5-cylinder	←	←
Cylinder	Inner diameter (mm)		86.2	←	←
	Stroke (mm)		92.4	←	←
Displacement (cc)			2696	←	←
Compression ratio			17.5:1	←	←
Maximum output (ps/rpm)		For Automatic	186 (180) / 4,000	165 / 4,000	←
		Transmission	-	165 / 4,000	←
Maximum torque (kg ·m/rpm)		For Manual	41 / 1,600 ~ 3,000	35.7 / 1,800 ~ 3,250	←
		Transmission	-	34.7 / 1,800 ~ 3,250	←
Idle speed	For Manual Transmission		-	750 ± 20 rpm	760 ± 50 rpm
	For Automatic Transmission		750 ± 20 rpm	←	←
Valve	Intake	Opens (btdc)	9°	←	←
		Closes (abdc)	26°	←	←
	Exhaust	Opens (bbdc)	38°	←	←
		Closes (atdc)	16°	←	←
Camshaft	Type		DOHC	←	←
Fuel system	Fuel type		Low sulfur diesel	←	←
	Fuel pump type		Vane pump in HP pump	←	←
	Fuel supply pressure	HP pump Inlet port	-0.4 ~ 0 mbar	Max. 400 mbar	←
		HP pump outlet port (with IMV fully open)	Below 1,600 bar	Above 1,050 bar	←
	Water separation in fuel filter		Every 10,000 km	←	←
	Fuel tank capacity (ℓ)		78	←	←
Lubrication system	Oil specification		SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)	←	←
	Lubrication type		Gear pump Forced circulation	←	←
	Oil filter type		Full flow type, filter element type	←	←
	Oil capacity (ℓ)		≒ 8.5	←	←
Cooling system	Cooling type		Water cooling type/ Forced circulation	←	←
	Cooling fan operation type		Belt operated type	←	←
	Thermostat (* Note: Fully opened at 100°C)	Opening temperature	85 °C	←	←
		Type	WAX Pellet Type	←	←
	Coolant capacity (ℓ)		≒ 11.0 ~ 11.5	←	←

2) D27DT Engine Performance Curve

(1) Output and Torque



(2) Oil Temperature/Pressure and Boost Pressure



Modification basis	
Application basis	
Affected VIN	

3. TIGHTENING TORQUE

This table shows the tightening torques for removal/mounting and disassembly/reassemly of the engine.

Name	Size	Quantity	Tightening Torque (Nm)		
			D20DT	D27DT	D27DTP
Main bearing cap	M11 x 67	10	55 ± 5 120° ± 10°	←	←
Connecting rod cap	M9 x 51	8	40 ± 5 90° ± 10°	←	←
Rear cover	M6 x 20	6	10 ± 1	←	←
Oil pump	M8 x 35SOC	3	25 ± 2.5	←	←
T.G.C.C	M6 x 40	6	10 ± 1	←	←
	M6 x 60	3	10 ± 1	←	←
	M6 x 70	2	10 ± 1	←	←
Flywheel	M10 x 22	8	45 ± 5 90° ± 10°	←	←
Crankshaft hub	M20 x 85	1	200 180° ± 10°	←	←
Oil pan	M6 x 20	24	10 ± 1	←	←
	M6 x 35	3	10 ± 1	←	←
	M6 x 85	3	10 ± 1	←	←
	M8 x 40	4	25 ± 2.5	←	←
High pressure pump mounting bolt	M8 x 55	3	25 ± 2.5	←	←
High pressure pump main nut (Intermediate shaft)	M14 x 1.5	1	65 ± 5	←	←
Cylinder head	M8 x 25	2	25 ± 2.5	←	←
	M8 x 50	2			
	M10 x 158	1	85 ± 5 270° ± 10°	←	←
	M10 x 177	9			
Camshaft sprocket (Intake)	M11 x 40	1	25 ± 2.5 90° ± 10°	←	←
Camshaft sprocket (Exhaust)					
Chain tensioner	M24	1	65 ± 5	←	←
Auto tensioner	M12 x 90(UP)	1	82 ± 6	←	←
	M8 x 45(LOW)	1	32 ± 3	←	←
Water pump	M6 x 50	7	10 ± 1	←	←
Water pump pulley	M6 x 10	4	10 ± 1	←	←
Hot water inner pipe	M6 x 12	2	10 ± 1	←	←
Alternator brackrt	M8 x 80	1	25 ± 2.5	←	←
	M8 x 34	2	25 ± 2.5	←	←
	M8 x 30	2	25 ± 2.5	←	←
Alternator	M10 x 90	1	46 ± 4.6	←	←
	M10 x 116	1	46 ± 4.6	←	←

Name	Size	Quantity	Tightening Torque (Nm)		
			D20DT	D27DT	D27DTP
Air conditioner compressor bracket	M8 x 25	1	25 ± 2.5	←	←
	M8 x 60	3	25 ± 2.5	←	←
Air conditioner compressor sub bracket	M6 x 16	1	10 ± 1.0	←	←
	M8 x 20	1	25 ± 2.5	←	←
Intake manifold	M8 x 50	5	25 ± 2.5	←	←
	M8 x 133	5	25 ± 2.5	←	←
Acoustic cover bracket	M6 x 16	2	25 ± 2.5	←	←
	M8 x 105	1	25 ± 2.5	←	←
Knock sensor	M8 x 28	1	20 ± 2.6	←	←
Camshaft position sensor	M8 x 14	1	12 ± 1.7	←	←
Booster pressure sensor	M6 x 20	2	10 ± 1.0	←	←
Exhauster manifold stud bolt	M8 x 46	10	15 ± 1.5	←	←
	M8 x 35	2	15 ± 1.5	←	←
Exhaust manifold nut	M8	10	40 ± 4.0	←	←
Turbo charger assembly	M8	3	25 ± 2.5	←	←
Turbo charger hollow bolt	M10 x 1.0	1	18 ± 1.8	←	15 ± 1.0
Turbo charger oil supply pipe	M16 (BLOCK side)	1	25 ± 2.5	←	←
Turbo charger support bar (nut)	M8	1	23 ± 2.3	←	←
Turbo charger support bar (bolt)	M8 x 20	1	25 ± 2.5	←	←
Turbo charger return pipe	M6 x 16 (T/C side)	2	10 ± 1.0	←	←
	M6 x 16 (BLOCK side)	2	10 ± 1.0	←	←
EGR Valve	M6 x 16	4	10 ± 1.0	←	-
EGR pipe (RH) nut	M8	2	35 ± 3.5	←	-
EGR pipe (RH) bolt	M6 x 16	2	10 ± 1.0	←	-
EGR cooler bolt	M8 x 16	4	25 ± 1.0	←	-
EGR valve & EGR cooler	M6 x 20	3	25 ± 2.5	←	-
	M6 x 20	2	25 ± 2.5	←	-
Glow plug	M5	5	15 ± 3.0	←	←
Vacuum pump	M6 x 20	3	10 ± 1.0	←	←
Cooling pan bracket	M6 x 25	5	10 ± 1.0	←	←
	M6 x 55	1	10 ± 1.0	←	←
	M6 x 85	3	10 ± 1.0	←	←
Cylinder head cover	M6 x 35	21	10 ± 1.0	←	←
Vacuum modulator	M6 x 16	4	10 ± 1.0	←	←
Oil dipstick gage	M6 x 16	1	10 ± 1.0	←	←
Oil filter	M8 x 35	1	25 ± 2.5	←	←
	M8 x 55	2	25 ± 2.5	←	←
	M8 x 125	1	25 ± 2.5	←	←

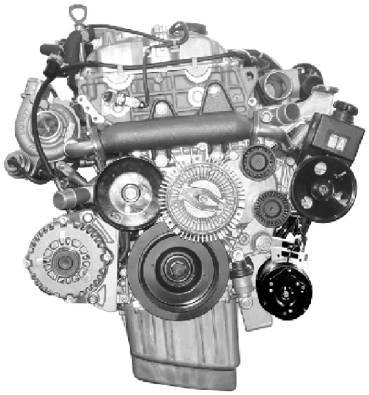
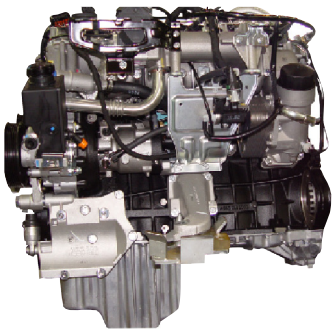
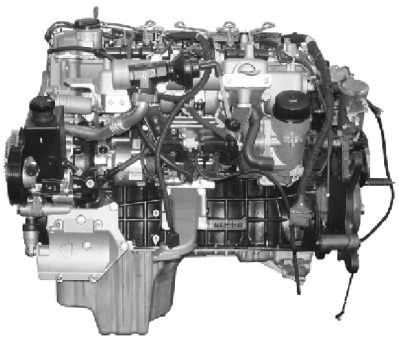
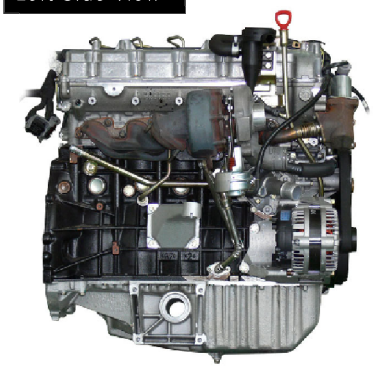
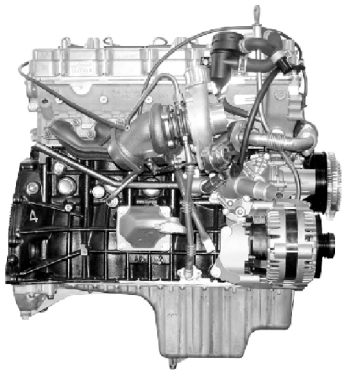
Modification basis	
Application basis	
Affected VIN	

Name	Size	Quantity	Tightening Torque (Nm)		
			D20DT	D27DT	D27DTP
Fuel rail	M8 x 35	2	25 ± 2.5	←	←
Injector	M6 x 60	4	10 ± 1.0 180° ± 20°	←	←
Fuel pipe nut (H -> C)	M14	2	40 ± 4.0	←	←
Fuel pipe nut (C -> I)	M14	8	40 ± 4.0	←	←
Crank position sensor	M6 x 14	1	0.8 ± 0.4	←	←
	Gap	-	0.7 ± 1.5 mm	←	←
Power steering pump	M8 x 100	2	25 ± 2.5	←	←
Head screw plug	-	1	25 ± 2.5	←	←
Camshaft cap bolt	M8 x 60	20	25 ± 2.5	←	←
Piston topping	-	-	0.765 mm ~ 1.055 mm		
Connecting rod end play	-	-	0.500 mm ~ 1.500 mm		
Camshaft end play	-	-	0.100 mm ~ 0.350 mm		
Crank shaft end play	-	-	0.100 mm ~ 0.254 mm		
E-EGR valve assembly	M8 x 60	1	-	25 ± 2.5 (EU IV)	←
	M8 x 35	1	-	25 ± 2.5 (EU IV)	←
	M6 x 20	3	-	10 ± 1.0 (EU IV)	←
E-EGR cooler	M8 x 16	4	-	25 ± 2.5 (EU IV)	←
EGR pipe combination bolt	M6 x 16	6	-	10 ± 1.0 (EU IV)	←
Throttle body	M6 x 45	3	-	10 ± 1.0 (EU IV)	←

4. MAJOR CHANGES IN D27DTP (POWER UP) ENGINE (COMPARED TO D27DT)

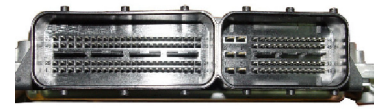
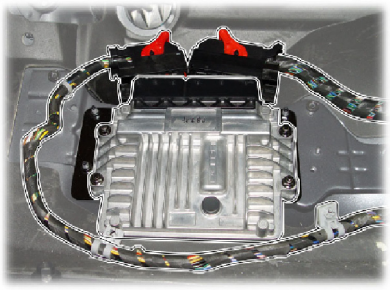
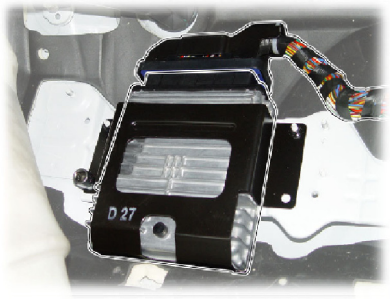
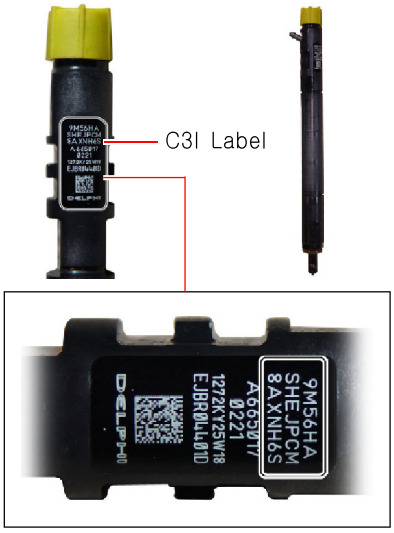
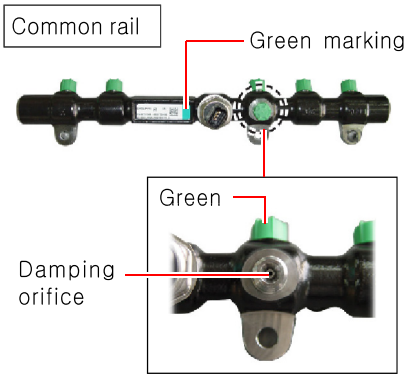
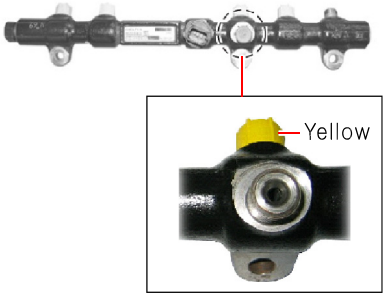
The shape and size of D27DTP (POWER UP) are slightly different from those of D27DT engine but the basic configuration of two systems is almost same.

1) Engine Assembly

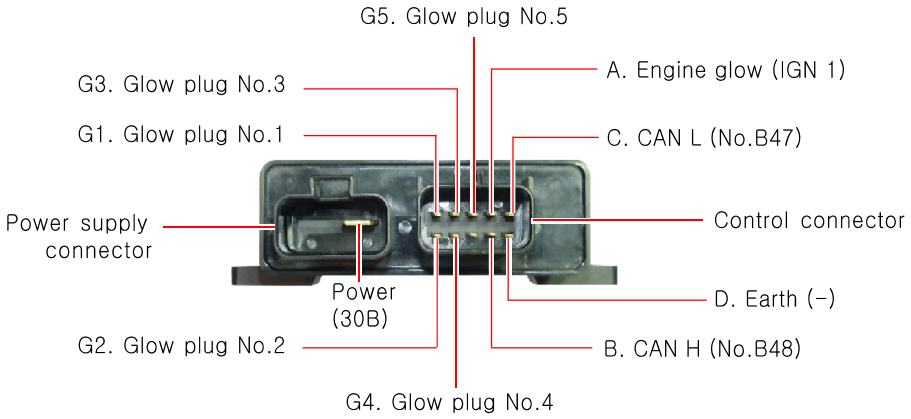
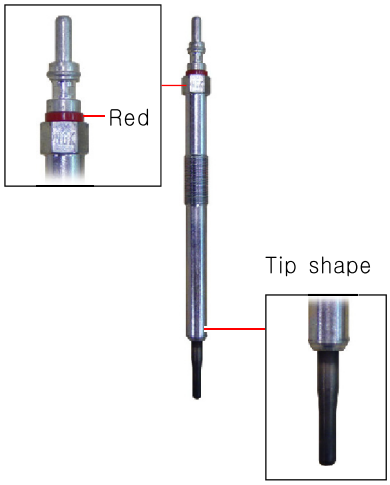
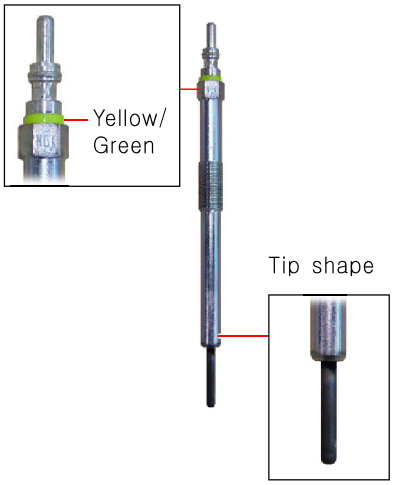
D27DTP (POWER UP) + CDPF Engine	D27DT (EU IV) Engine	D27DT Engine (General)
Front Side View 		
Right Side View 		
Left Side View 		

Modification basis	
Application basis	
Affected VIN	

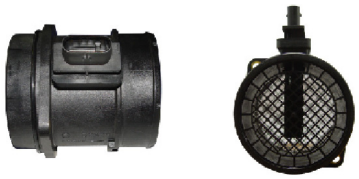
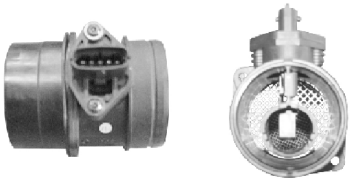
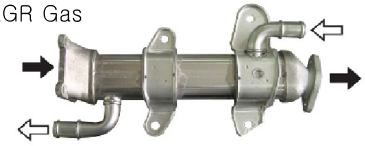
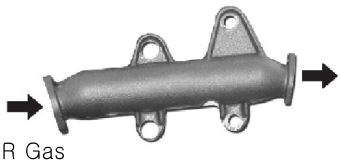
2) Major Changes and Summary

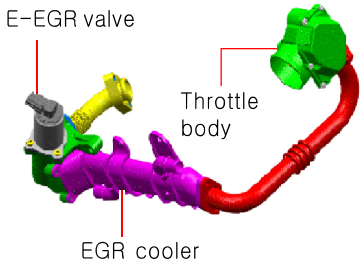
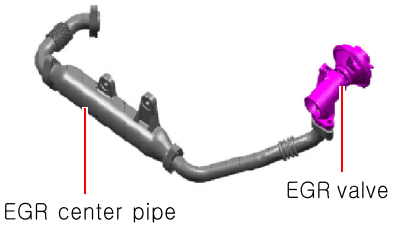
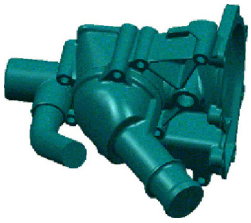
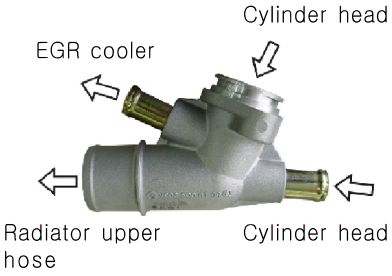
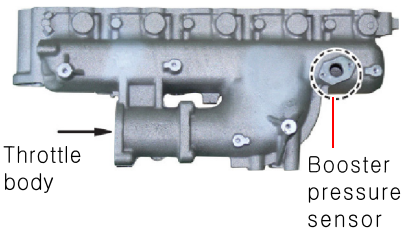
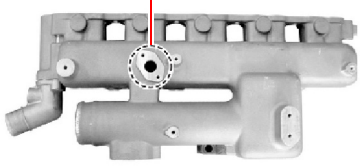
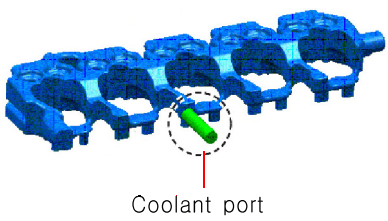
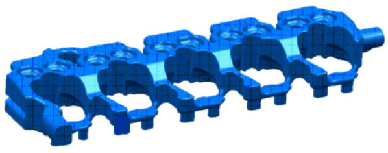
D27DTP (POWER UP) + CDPF Engine D27DT (EU IV) Engine	D27DT Engine (General)	Remarks
ECU D27DTP Engine ECU - Ver. 3.2  	D27DT Engine ECU - Ver. 3.1  	ECU version of D27DTP (POWER UP) & D27DT (EU IV) engine: Changed to 3.2 from 3.1. Number of connectors of D27DTP (POWER UP) & D27DT (EU IV) engine: Changed to 2 from 1. 1.E-EGR valve and related system 2.Throttle body and related system 3.AQGS and related system
Injector 		* Injection nozzle (holes) - D27DT (General) (5) - D27DTP & D27DT (EU IV) (7) * Injector label - D27DT (General) (16 digits: C2I value) - D27DTP & D27DT (EU IV) (20 digits: C3I value)
Common rail 		* D27DTP: Added damping orifice. (Orifice is added to fuel inlet/ outlet ports in order to dampen the pulsation in fuel flow caused by multi-injections.)

Modification basis	
Application basis	
Affected VIN	

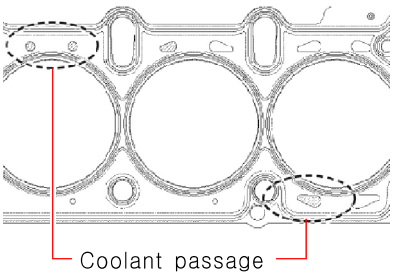
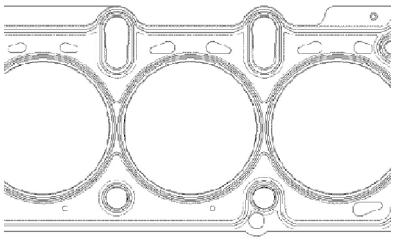
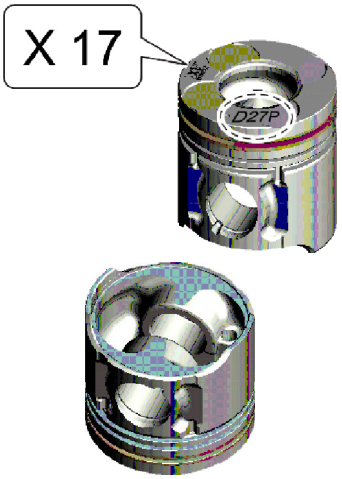
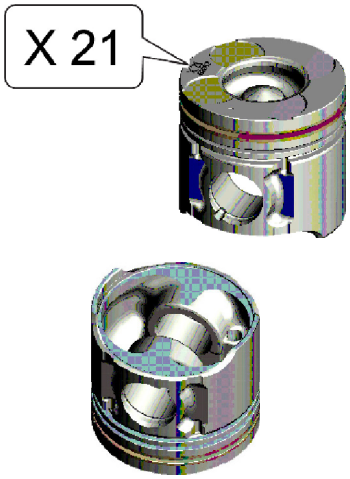
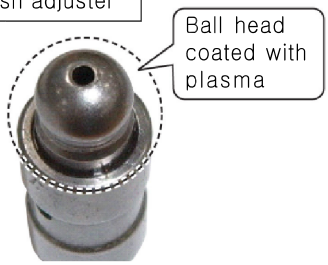
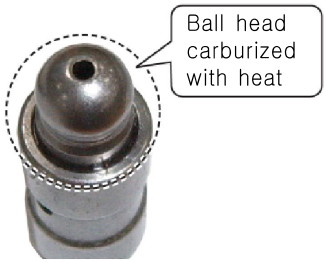
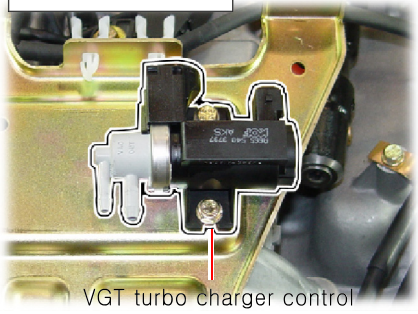
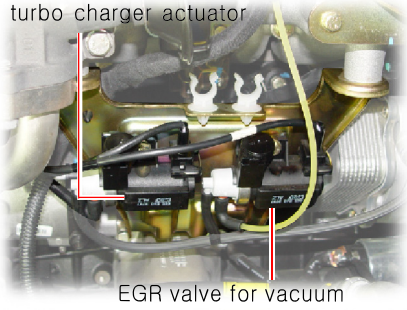
D27DTP (POWER UP) + CDPF Engine D27DT (EU IV) Engine	D27DT Engine (General)	Remarks
Fuel pipe 		* Surface coating color - D27DT: Yellow - D27DTP & D27DT (EU IV): Chrome * Diameter increased - D27DT: ID (2.4 mm), OD (6.0 mm) - D27DTP & D27DT (EU IV): ID (3 mm), OD (6.35 mm)
AQGS unit pin function 		
Glow plug 		* Insulator color - D27DT: Yellow (NGK) or green (BERU) - D27DTP & D27DT (EU IV): Red * Tip diameter and shape changed - D27DT: ϕ 3.5 / 4.0 mm - D27DTP & D27DT (EU IV): ϕ 4.4 mm

Modification basis	
Application basis	
Affected VIN	

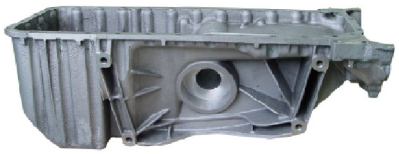
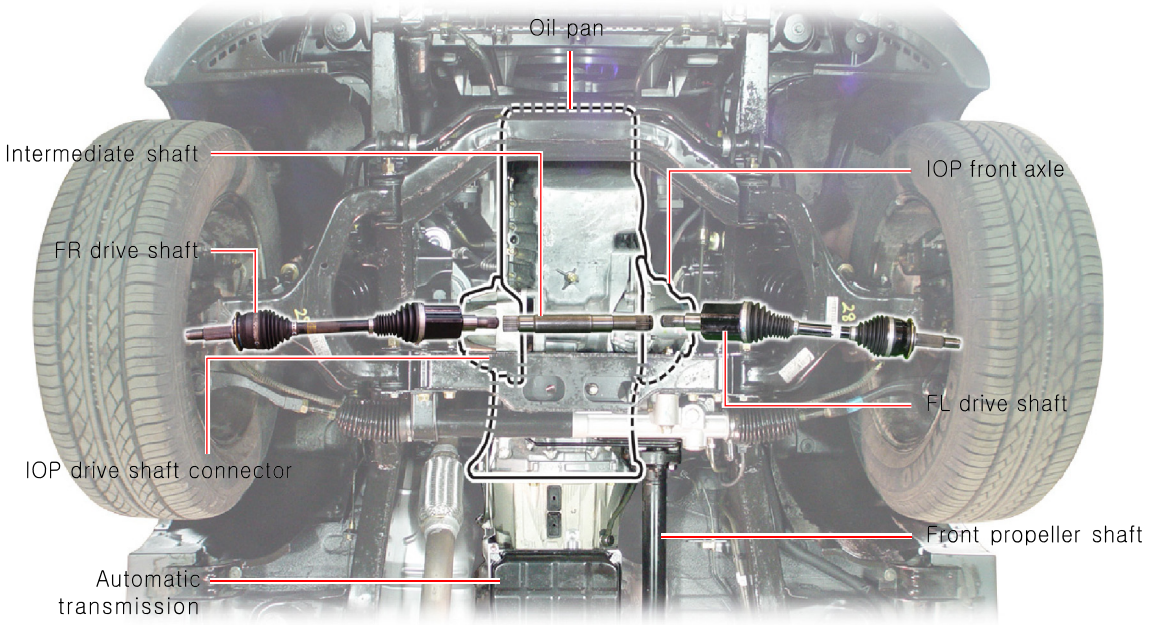
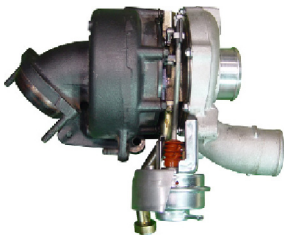
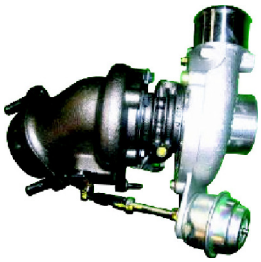
D27DTP (POWER UP) + CDPF Engine D27DT (EU IV) Engine	D27DT Engine (General)	Remarks
HFM 6.0 	HFM 5.0 	* Version up – D27DT (General): HFM5-CI (Analog signal) – D27DTP & D27DT (EU IV): HFM6-ID (Digital signal added)
Electric controlled E-EGR valve 	Vacuum modulator controlled EGR valve 	* E-EGR valve: ECU controls the EGR valve directly without any media. It provide more precise EGR control by transmitting the electric signal of EGR valve operating position.
Throttle body 	N/A	* Throttle body is for future regulation requiring emission reductions. Currently, it is used to prevent the engine from turning off with fluttering noise at the moment the air to intake manifold is blocked by closed flap when the engine is switched off.
EGR cooler EGR Gas  Coolant	EGR center pipe  EGR Gas	* To enhance EGR function, coolant EGR cooler is adopted to reduce the temperature of exhaust gas into the intake manifold.

D27DTP (POWER UP) + CDPF Engine D27DT (EU IV) Engine	D27DT Engine (General)	Remarks
E-EGR system layout  	EGR system layout  	* Reason of changes – To satisfy the emission regulation, E-EGR valve and EGR cooler are adopted. And the layout also has a great difference from D27DT.
Water pump  		* For D27DTP engine: Additional connecting port for EGR cooler hose
Coolant outlet port  		* For D27DTP (POWER UP) engine: Additional port for coolant of EGR cooler
Intake manifold  	Booster pressure sensor 	* The appearance of intake manifold is changed to the round type due to the throttle body. Also, the mounting location of booster pressure sensor is changed.
Cylinder head  		* The cooling port is added to improve cooling performance for D27DTP (POWER UP) & D27DT (EU IV) engine.

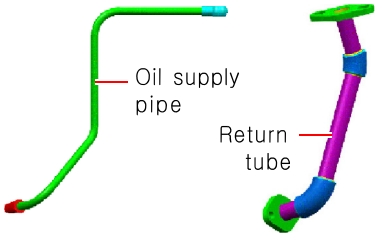
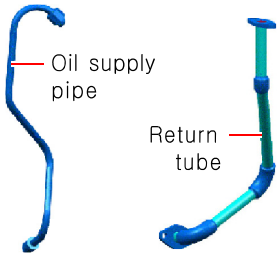
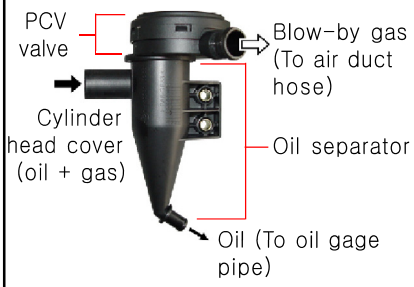
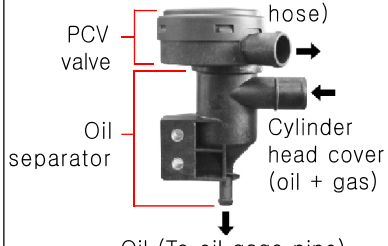
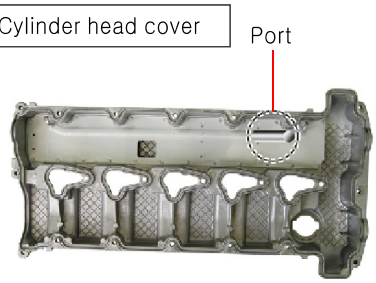
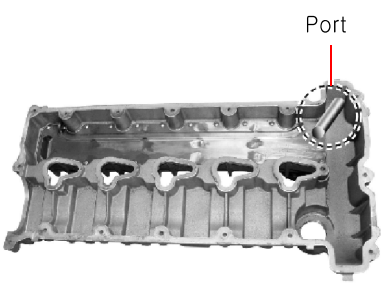
Modification basis	
Application basis	
Affected VIN	

D27DTP (POWER UP) + CDPF Engine D27DT (EU IV) Engine	D27DT Engine (General)	Remarks
Cylinder head gasket  		* The appearance of gasket is changed and the coolant passages are added to improve cooling performance for D27DTP (POWER UP) & D27DT (EU IV) engine.
Piston  	 	* Changed compression ratio – D27DT (General) (18:1) – D27DTP & D27DT (EU IV) (17.5:1) (The appearance of bowl is changed and the color mark is added due to the new compression ratio.) * The appearance fo bowl is changed and the color mark is added due to the new com-pression ratio (18 → 17.5). * The piston pin bending side and the appearance of piston pin hole taper is changed for reinforcement.
Lash adjuster  	 	* The ball head is coated with plasma to prevent the lash adjuster from wearing.
Vacuum modulator  	Vacuum modulator for controlling turbo charger actuator  	* D27DTP (POWER UP) & D27DT (EU IV) engine uses electric ally controlled E-EGR valve. Thus, the vacuum modulator for controlling EGR valve has been deleted.

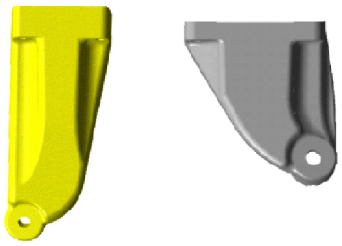
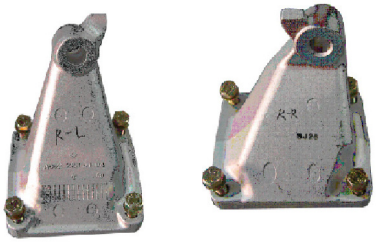
Modification basis	
Application basis	
Affected VIN	

D27DTP (POWER UP) + CDPF Engine	D27DT Engine (General) D27DT (EU IV) Engine	Remarks
IOP oil pan 	Oil pan 	* The vehicle with D27DTP (POWER UP) engine is equipped with IOP axle. Refer to the figure below.
Glow system- AQGS unit 	Glow system - Glow control relay 	* D27DTP (POWER UP) engine adopts AQGS (Advanced Quick Glow System), which controls the quick preheating of glow plugs and CAN communication with engine ECU.
		
VGT turbocharger 	WGT turbocharger 	* D27DTP (POWER UP) engine is equipped with the enhanced VGT turbocharger.

Modification basis	
Application basis	
Affected VIN	

D27DTP (POWER UP) + CDPF Engine	D27DT Engine (General) D27DT (EU IV) Engine	Remarks
1.Support bar of Turbocharger 		* Support bar is changed due to VGT turbocharger mounting.
2.Oil supply pipe and return tube of Turbocharger 		* The shape of oil supply pipe and return tube is changed due to VGT turbocharger mounting.
PCV oil separator  	 	* Increase of Oil separator capacity (approx. 10%) - D27DT & D27DT (EU IV): 120ℓ/min - D27DTP: 160ℓ/min
Cylinder head cover 		* The direction of blow-by outlet port is changed due to the introduction of larger oil separator.

Modification basis	
Application basis	
Affected VIN	

D27DTP (POWER UP) + CDPF Engine	D27DT Engine (General) D27DT (EU IV) Engine	Remarks
Switchable engine mounting 	Engine mounting 	* The switchable engine mounting system (SEM) controls the engine in soft mode or hard mode by dividing the speed to the low speed range and mid-high speed range according to the vehicle speed and the engine rpm. This is only available in D27DTP (POWER UP) engine.
Engine bracket LH RH 	LH RH 	* The bracket is changed due to the mounting location of D27DTP (POWER UP) engine and the switchable engine mounting.

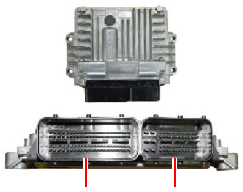
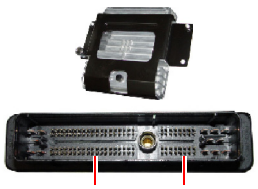
Modification basis	
Application basis	
Affected VIN	

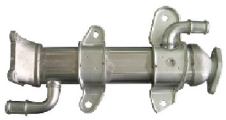
OVERVIEW AND OPERATION PROCESS

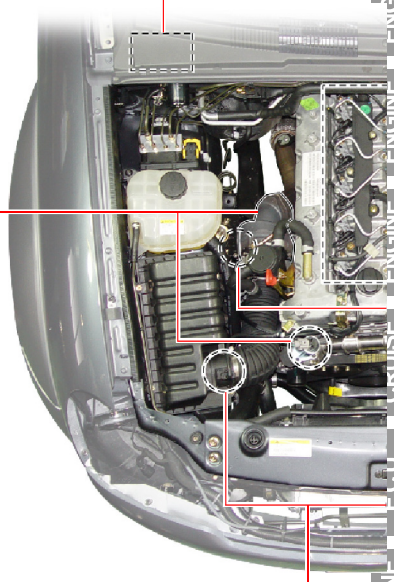
1. ENGINE COMPARTMENT

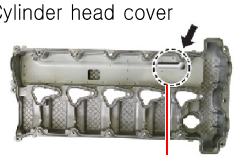
The major changes due to the newly adopted engine compared to D27DT engine are as follows:

Intake System	
D27DTP & D27DT (EU IV)	D27DT
HFM sensor (Ver. 6.0) 	Throttle body 

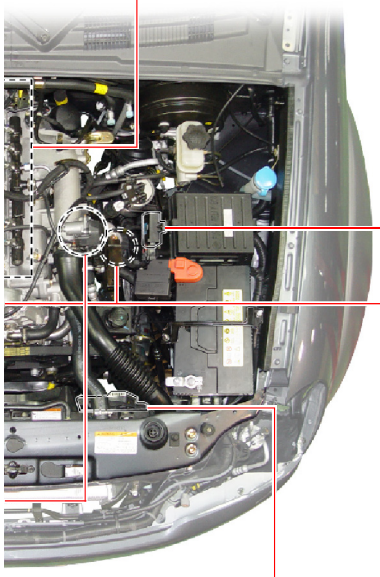
Engine Control (Engine ECU-3.2)	
D27DTP & D27DT (EU IV)	D27DT
 Connector A Connector B	 Connector A Connector B

Exhaust System		
VGT turbo charger	E-EGR valve	EGR cooler
		



Lubrication System		
D27DTP Cylinder head cover  Modification in blow-by gas outlet port	Larger PCV oil separator 	OP oil pan  * Axle integral type
D27DT (EU IV) & D27DT 		

Modification basis	
Application basis	
Affected VIN	



Fuel System

D27DTP & D27DT (EU IV)

Injector



D27DTP & D27DT (EU IV)

Fuel pipe



D27DTP & D27DT (EU IV)

Common rail



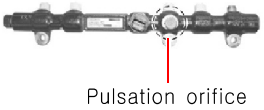
D27DT



D27DT



D27DT



Preheat System

AQGS unit



D27DTP & D27DT (EU IV)

Glow plug



D27DT



Switchable Engine M ounting (SEM)

D27DTP

LH



RH



D27DT (EU IV) & D27DT



Cooling System

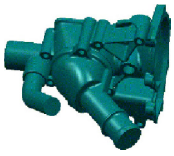
D27DTP & D27DT (EU IV)

Large water pump



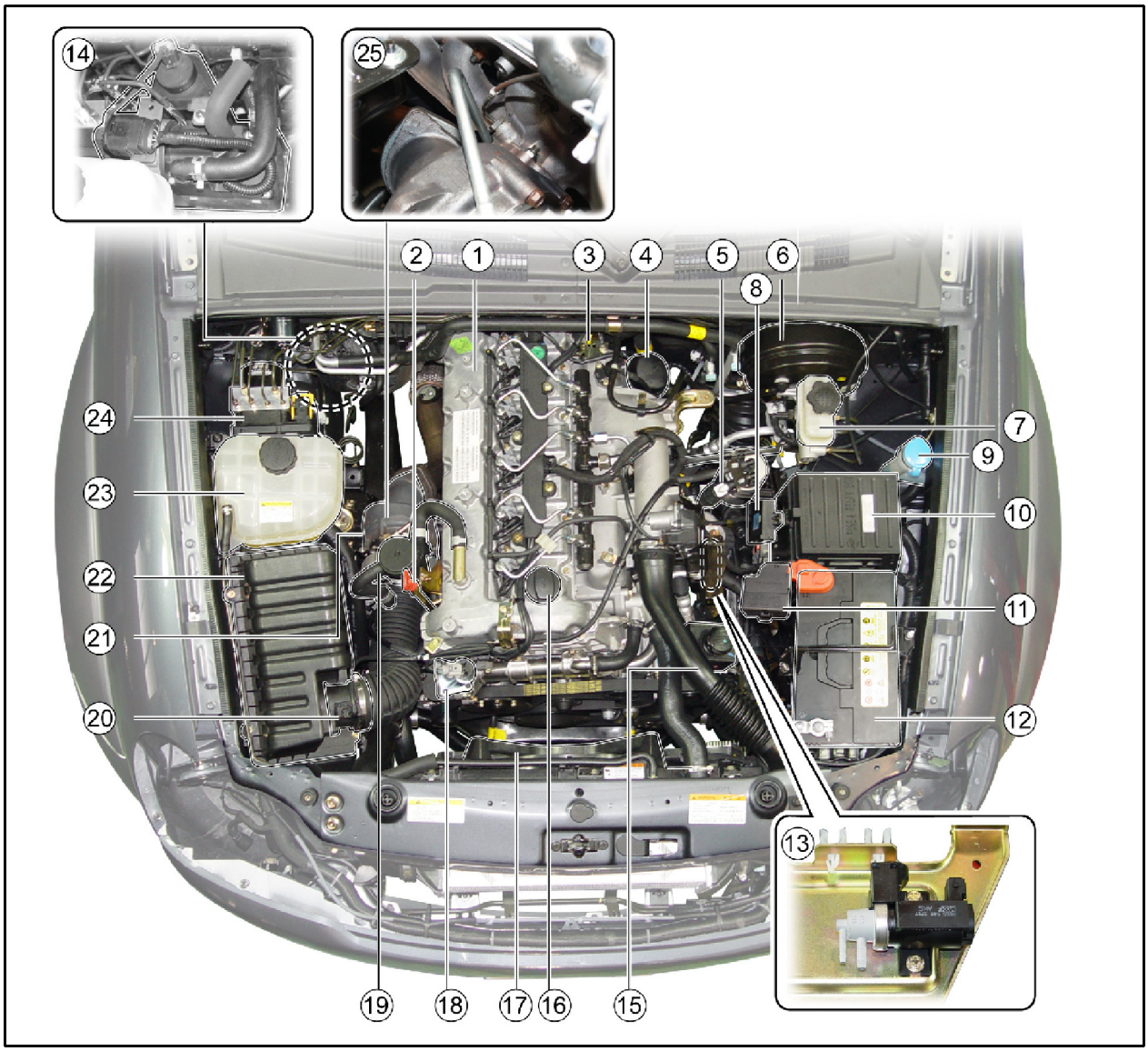
* EGR cooler port included

D27DT



Modification basis	
Application basis	
Affected VIN	

▶Engine Compartment Layout



1. Engine assembly
2. Engine oil dipstick
3. Vacuum pump
4. Oil filter and cooler
5. Fuel filter and priming pump
6. Brake booster
7. Brake oil tank
8. AQGS unit
9. Washer fluid filler cap
10. Engine compartment fuse box
11. PTC relay box
12. Battery
13. Vacuum modulator (for VGT turbo charger)
14. FFH Assembly (Only for vehicle with FFH)
15. Power steering oil tank
16. Engine oil filler cap
17. Fan shroud
18. E-EGR Valve
19. High-capacity PCV oil separator
20. HFM sensor (6.0)
21. VGT turbo charger
22. Air cleaner housing
23. 2Coolant surge tank
24. ABS/ESP HECU (Including TPMS function: optional)
25. Exhaust gas FRT Temp. sensor (T3)

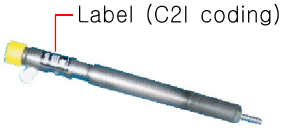
▶Major Sensors and Components

Injector

D27DTP & D27DT (EU IV)

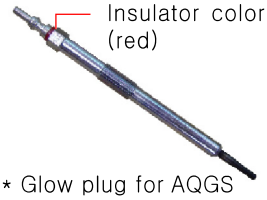


D27DT



Glow Plug

D27DTP & D27DT (EU IV)



D27DT



Common Rail

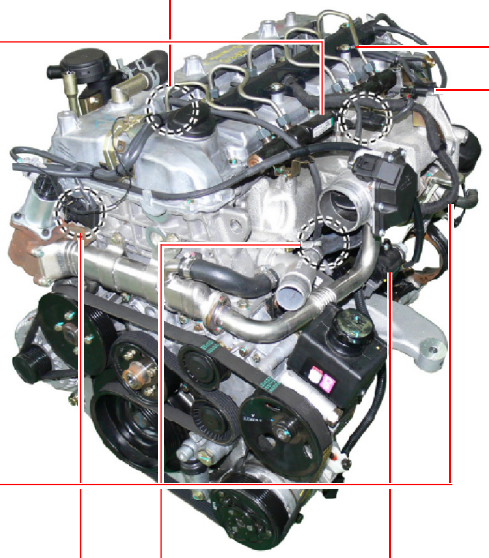
D27DTP & D27DT (EU IV)



* Orifice for preventing fuel pulsation

D27DT





Fuel Pressure Sensor (Common Rail)



Booster Pressure Sensor



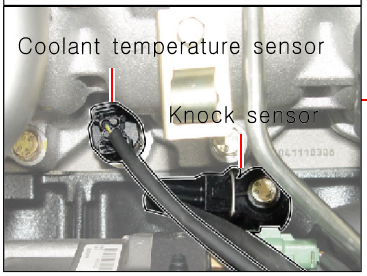
Crankshaft Position Sensor



Camshaft Position Sensor

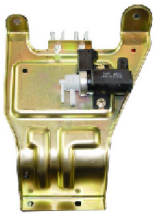


Knock Sensor (2EA) & Coolant Temperature Sensor



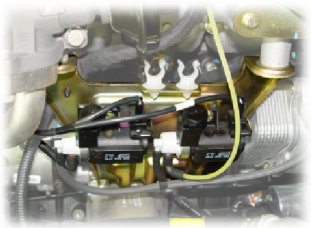
Vacuum Modulator for VGT Turbo Charger

D27DTP & D27DT (EU IV)



* Vacuum modulator for EGR valve deleted

D27DT



D27DTP

VGT Turbo Charger



D27DT (EU IV) & D27DT

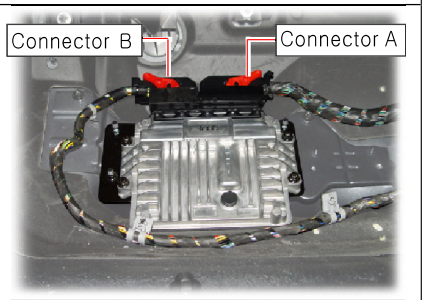
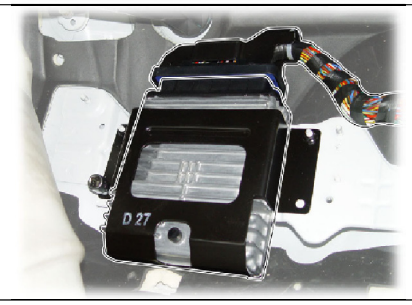
WGT Turbo Charger

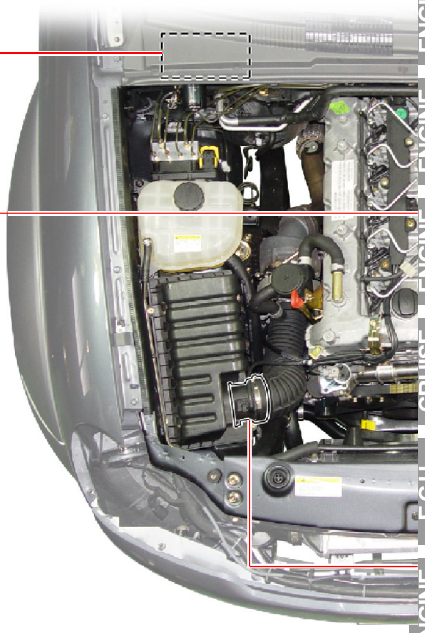


Modification basis	
Application basis	
Affected VIN	

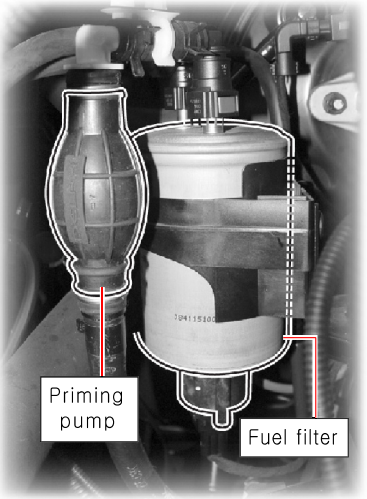
2. SYSTEMS IN ENGINE COMPARTMENT

1) Engine Accessories Related to ECU

Engine ECU – Ver. 3.2	Engine ECU Mounting Location
D27DTP & D27DT (EU IV) 	
D27DT 	

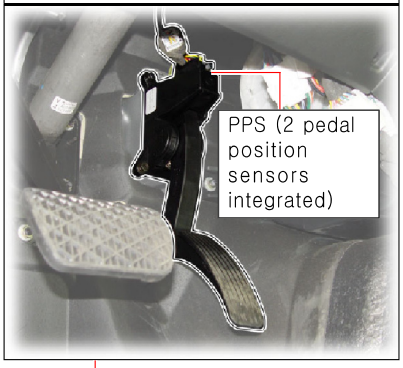


Fuel Filter (Water Detecting) Seneor

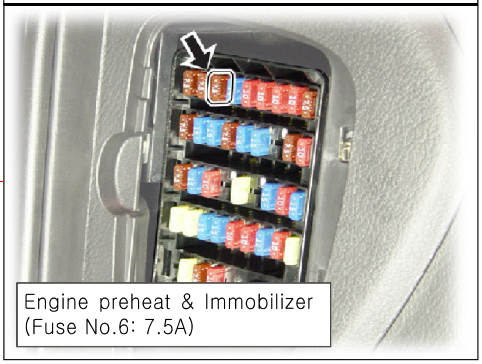


Draining water from fuel filter:
every 10,000 km

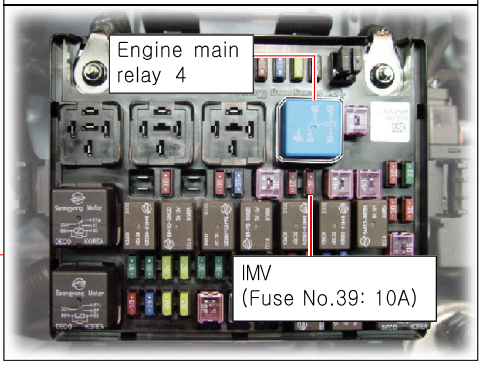
Accelerator Pedal Module

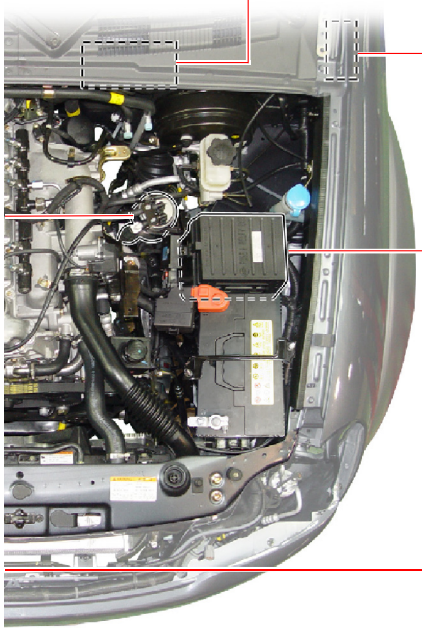


Interior Fuse Box (Driver's Side)



Engine Compartment Fuse Box





HFM Sensor (Ver. 6.0)

D27DTP & D27DT (EU IV)





Additional function: The digital signal about intake air volume is transfered to control the engine precisely.

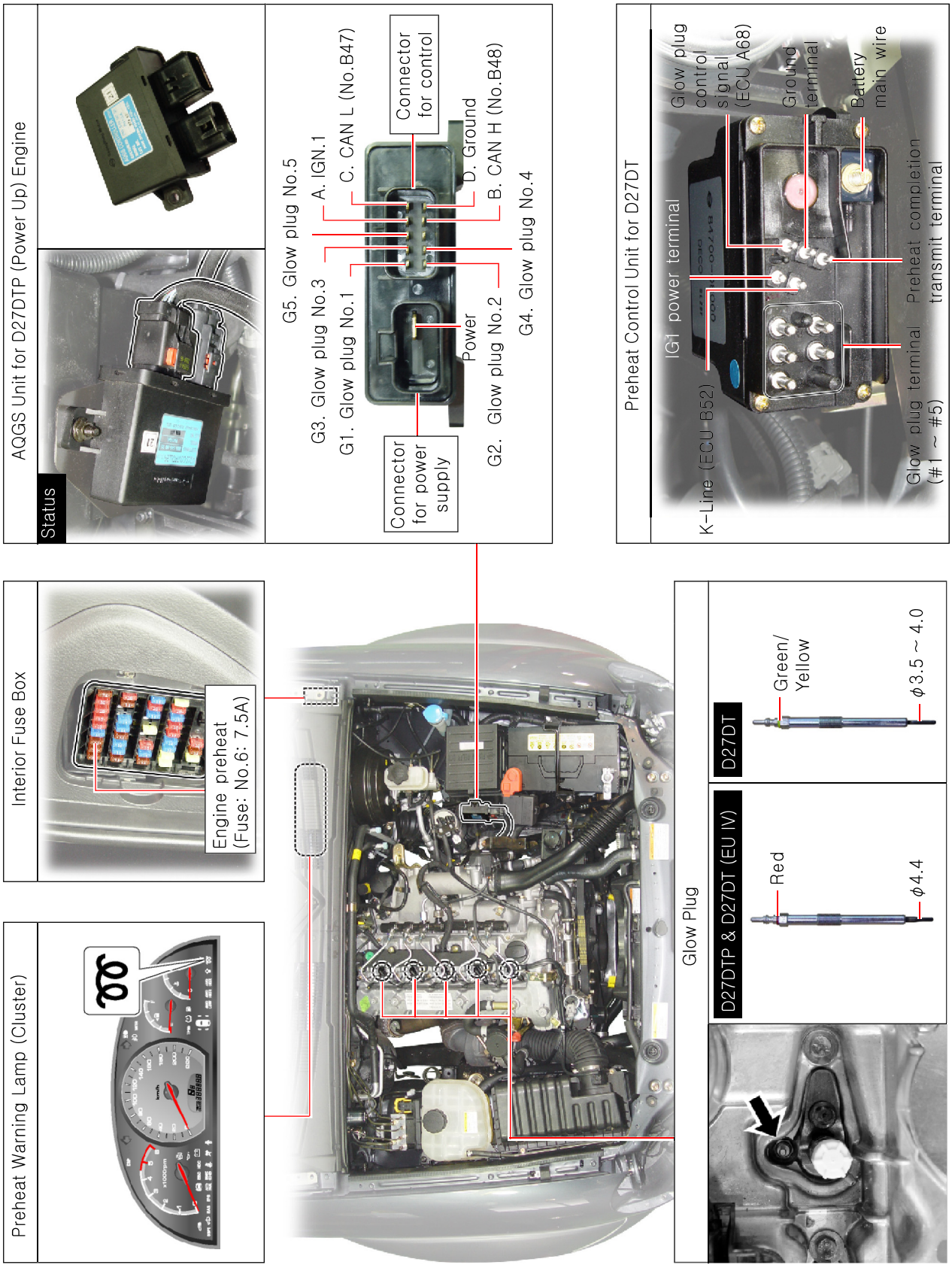
D27DT





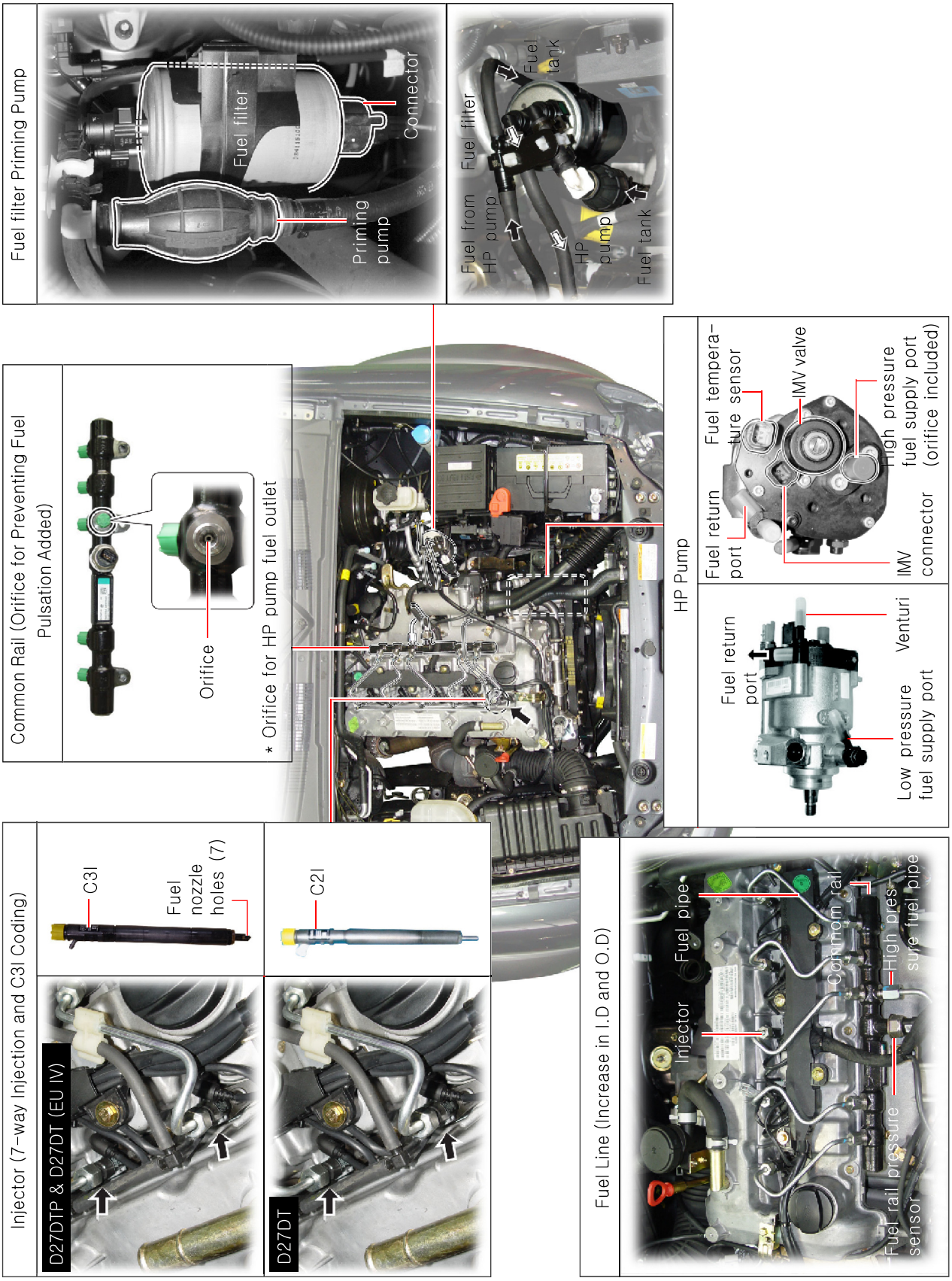
Modification basis	
Application basis	
Affected VIN	

2) Preheat System



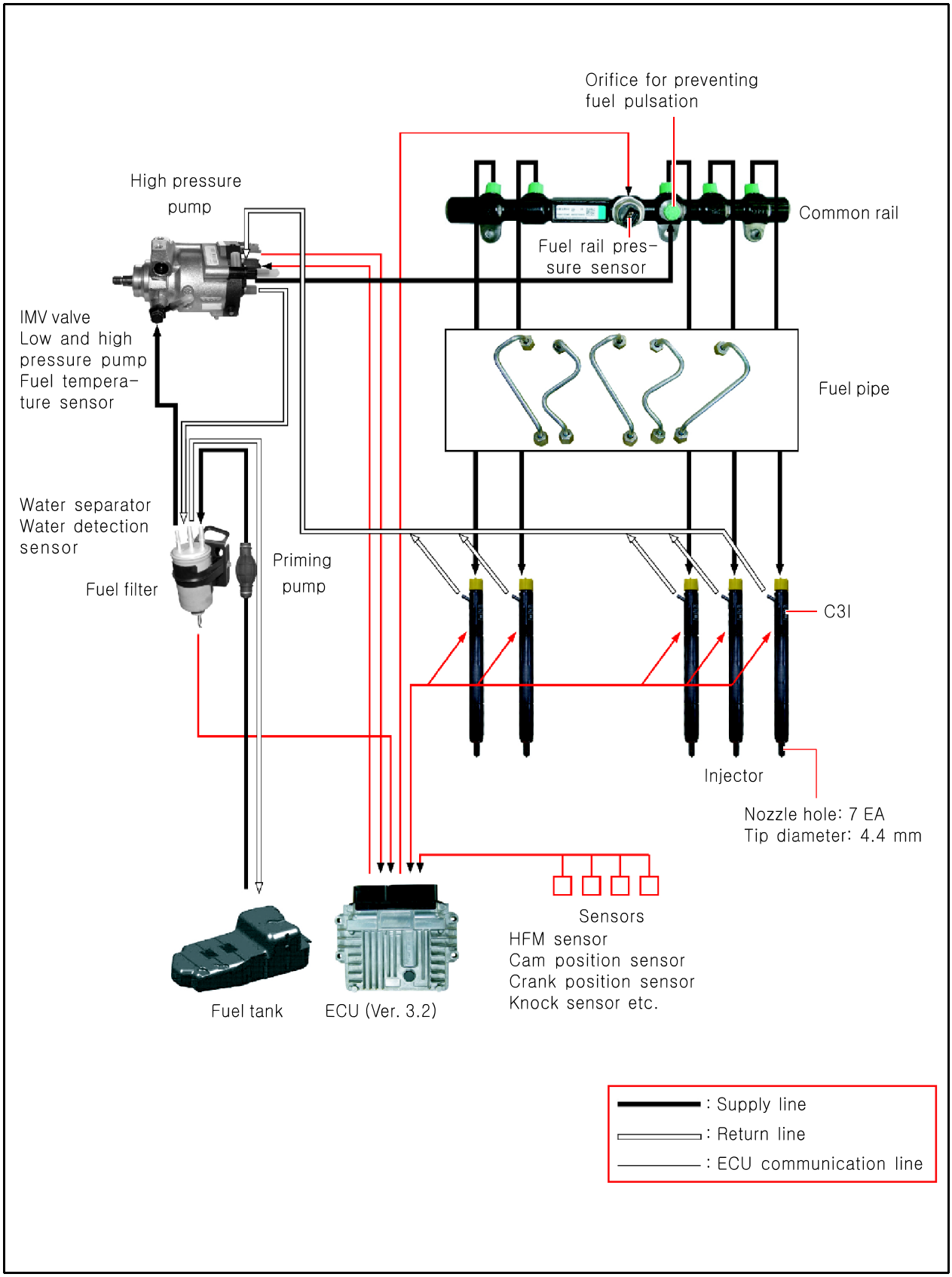
Modification basis	
Application basis	
Affected VIN	

3) Fuel System

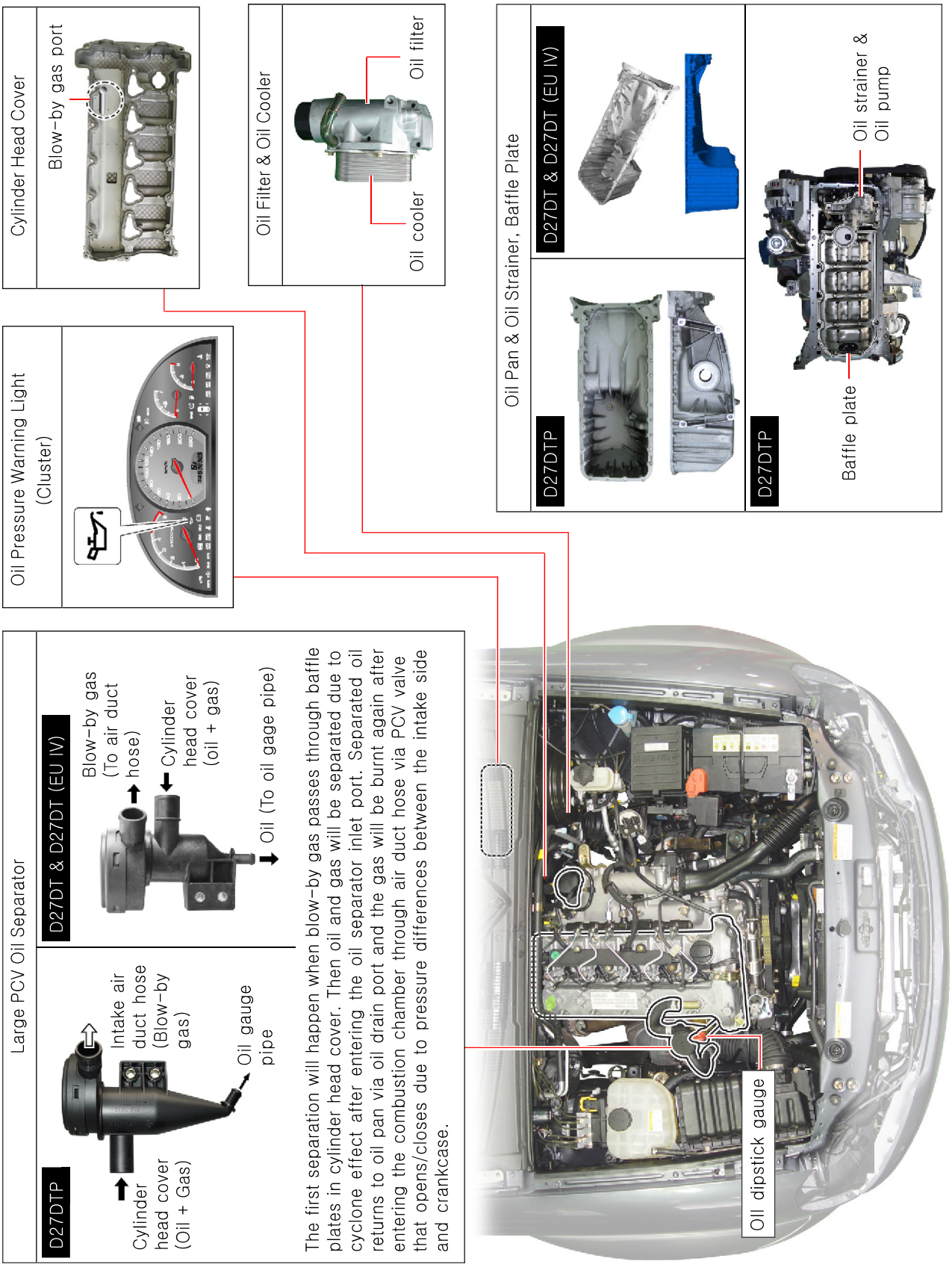


Modification basis	
Application basis	
Affected VIN	

▶Fuel Supply System

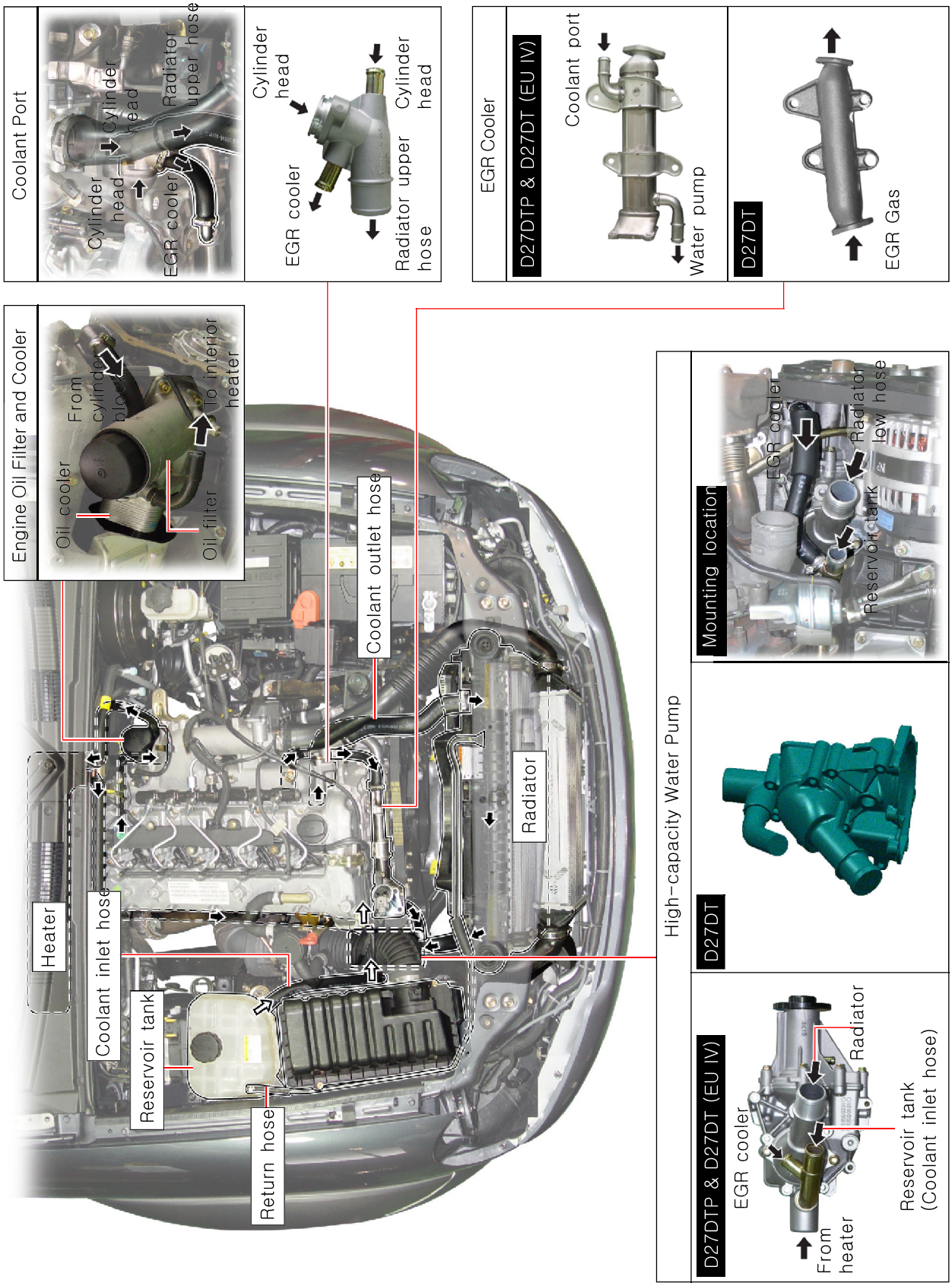


4) Lubrication System



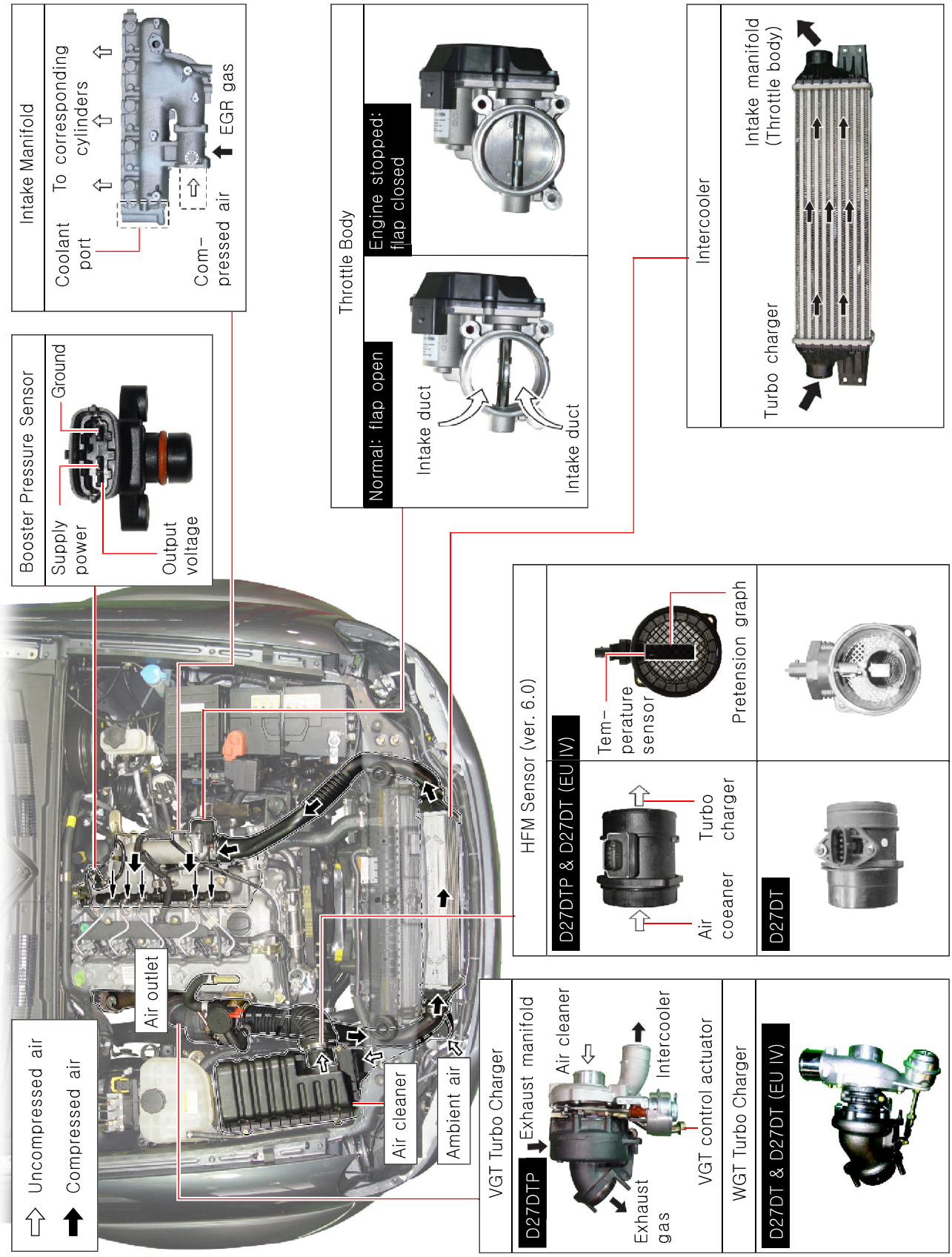
Modification basis	
Application basis	
Affected VIN	

5) Cooling System



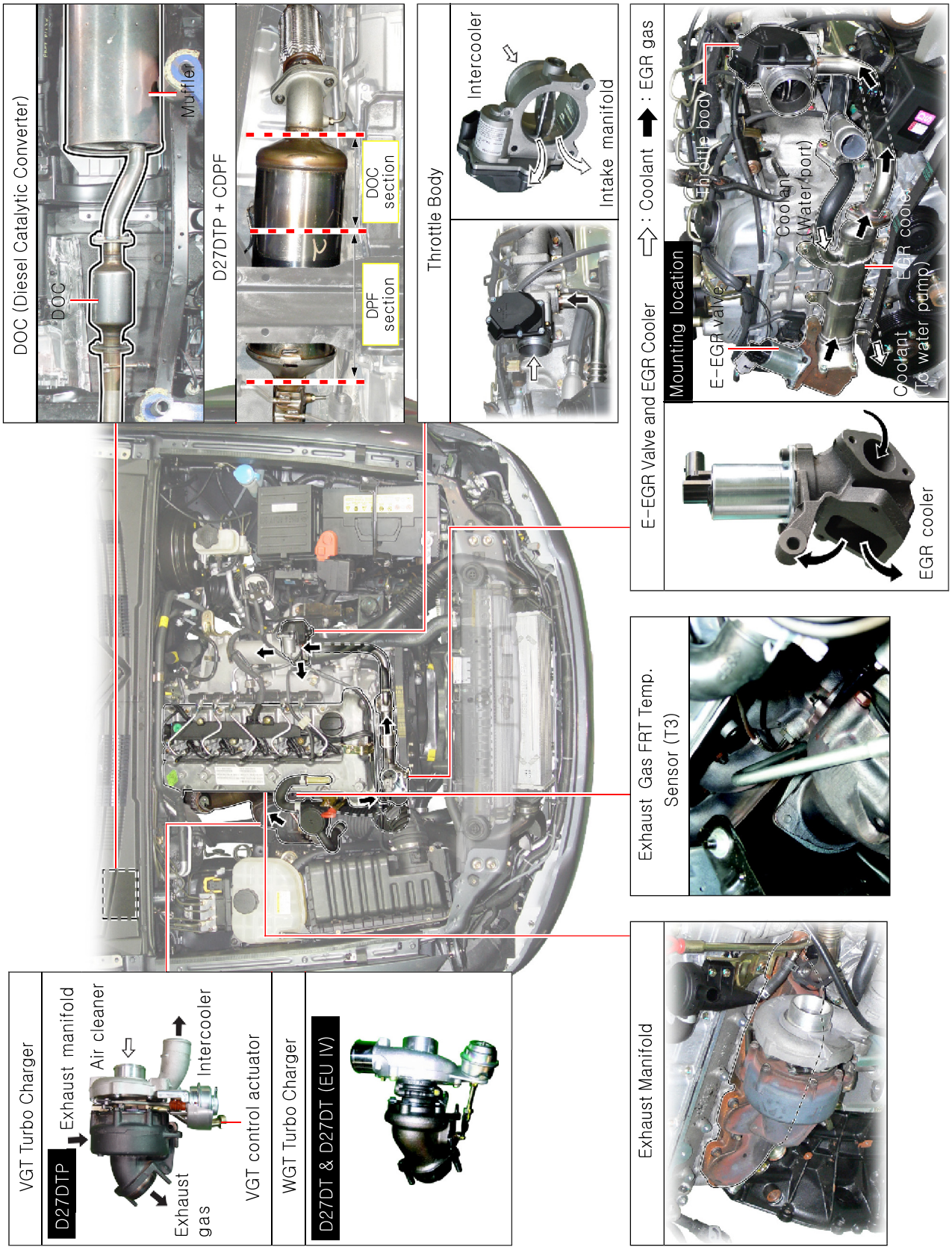
Modification basis	
Application basis	
Affected VIN	

6) Intake System



Modification basis	
Application basis	
Affected VIN	

7) Exhaust System



Modification basis	
Application basis	
Affected VIN	

ENGINE FUEL SYSTEM

1881-09

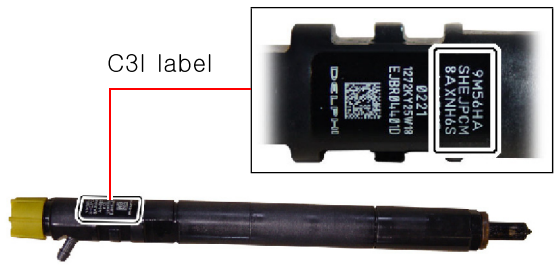
OVERVIEW AND OPERATION PROCESS

1. MAJOR CHANGES IN FUEL SYSTEM OF D27DTP (POWER UP) ENGINE

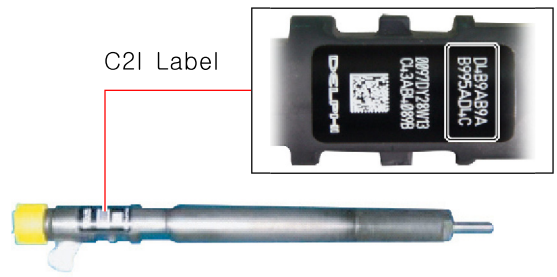
There are some changes in the parts related to the fuel system due to the newly adopted D27DTP (POWER UP) engine. The major changes are as follows. Refer to the next pages for further details.

1) Injector

D27DTP & D27DT (EU IV)



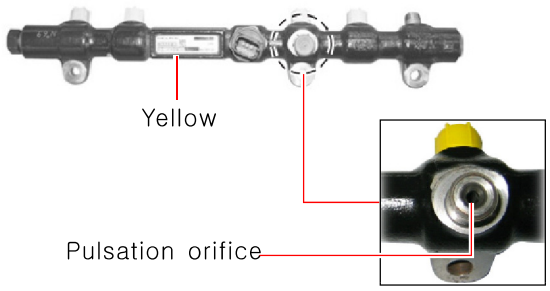
D27DT



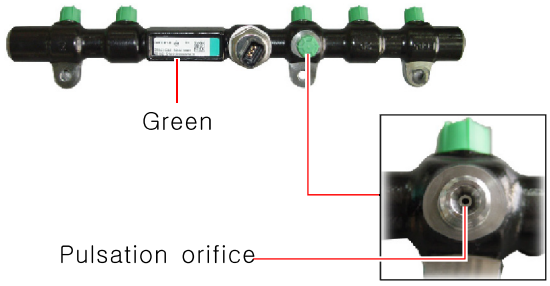
- Two nozzle holes are added (currently 7) to the tip of the injector to increase the amount of fuel injection and to improve injection efficiency according to the increased engine power.
- The existing C2I coding (16 digits) is changed to C3I coding (20 digits) to monitor fuel injection and follow the target value.
- For the D27DT engine, the injector MDP (minumum current for the solenoid in the injector to lift the nozzle) is leaned only when the engine is running. However, for the D27DTP engine, it is learned when the vehicle is in motion and the engine is at idle speed.

2) Common Rail

D27DTP & D27DT (EU IV)



D27DT



· The orifice is added to the connection to the fuel pipe of the HP pump to prevent the fuel pulsation by the fuel supply and fuel cut according to the increase of injected fuel volume. (It is also installed on the connection of the high pressure fuel supply line of the HP pump.)

Modification basis	
Application basis	
Affected VIN	

3) Fuel Rail - Chrome Color

D27DTP & D27DT (EU IV)

* Fuel pipe (Common rail → Injector)



* Fuel high pressure pipe (HP pump → Common rail)



D27DT

* Fuel pipe (Common rail → Injector)



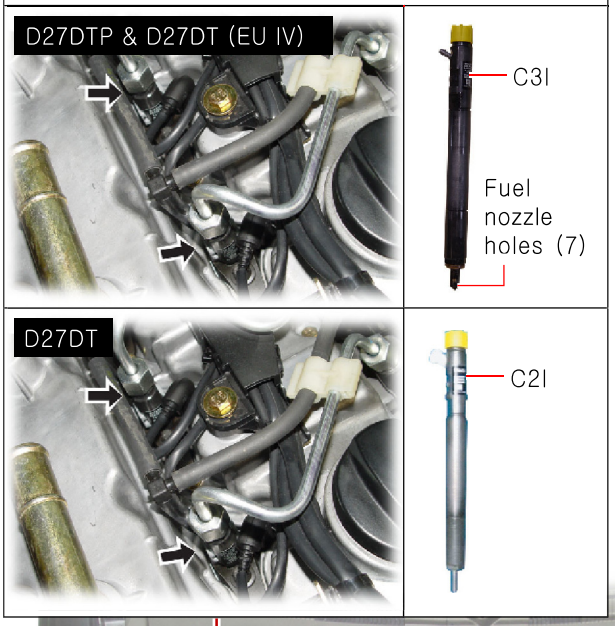
* Fuel high pressure pipe (HP pump → Common rail)



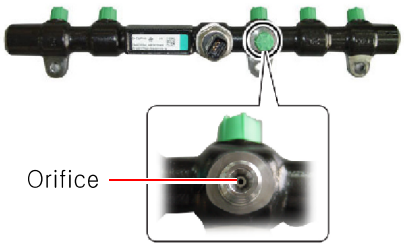
· The I.D and O.D of the fuel rail between HP pump and common rail are increased according to the increased amount of fuel injection.
Also, the engine ECU, HFM sensor and EGR system are changed to control the fuel injection volume and engine more precisely.

2. COMPONENTS OF FUEL SYSTEM

Injector (7-way Injection and C3I Coding)

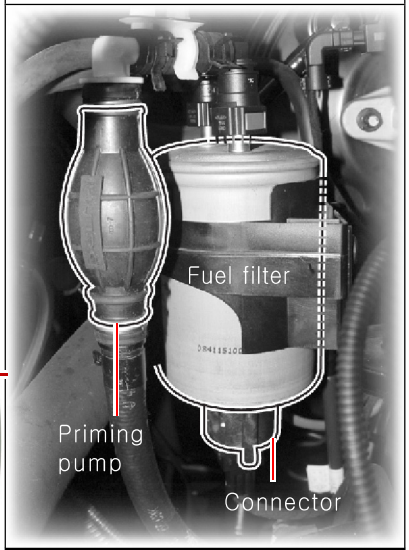


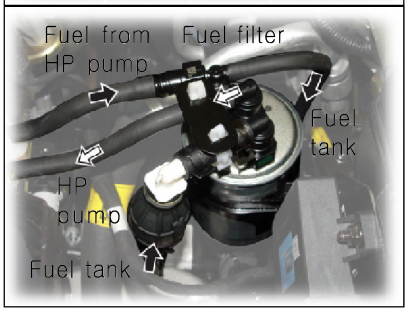
Common Rail (Orifice for Preventing Fuel Pulsation Added)

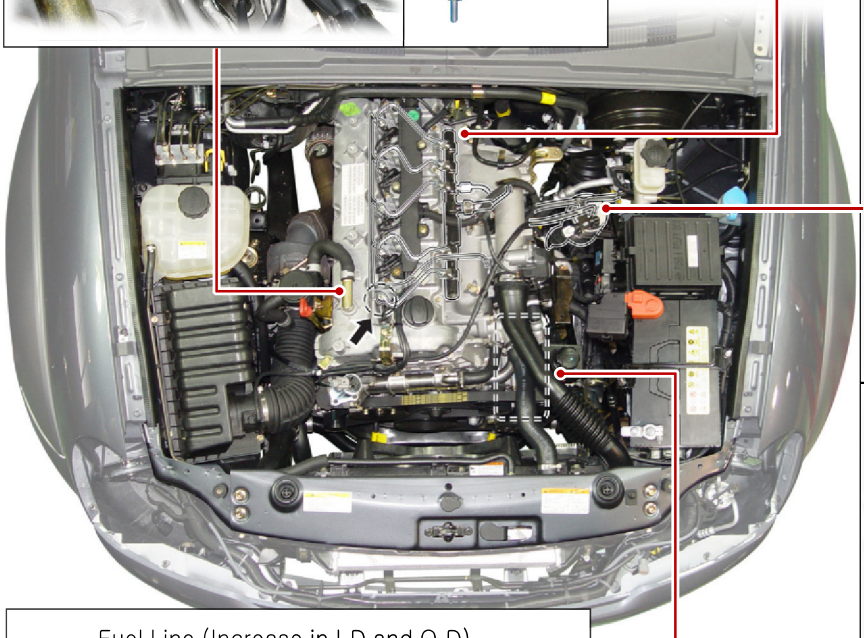


* Orifice for HP pump fuel outlet

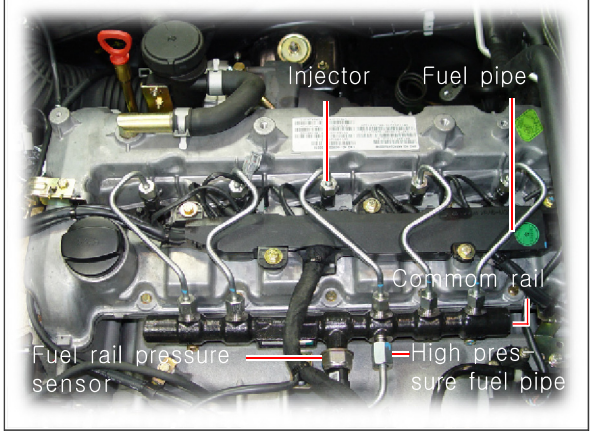
Fuel filter Priming Pump



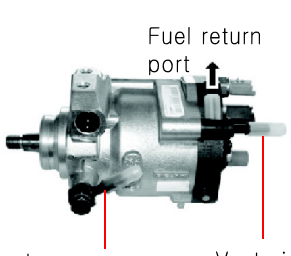


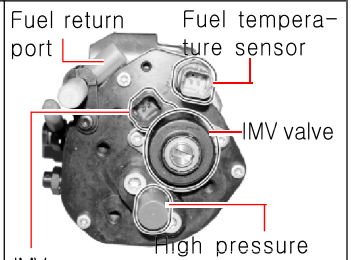


Fuel Line (Increase in I.D and O.D)



HP Pump

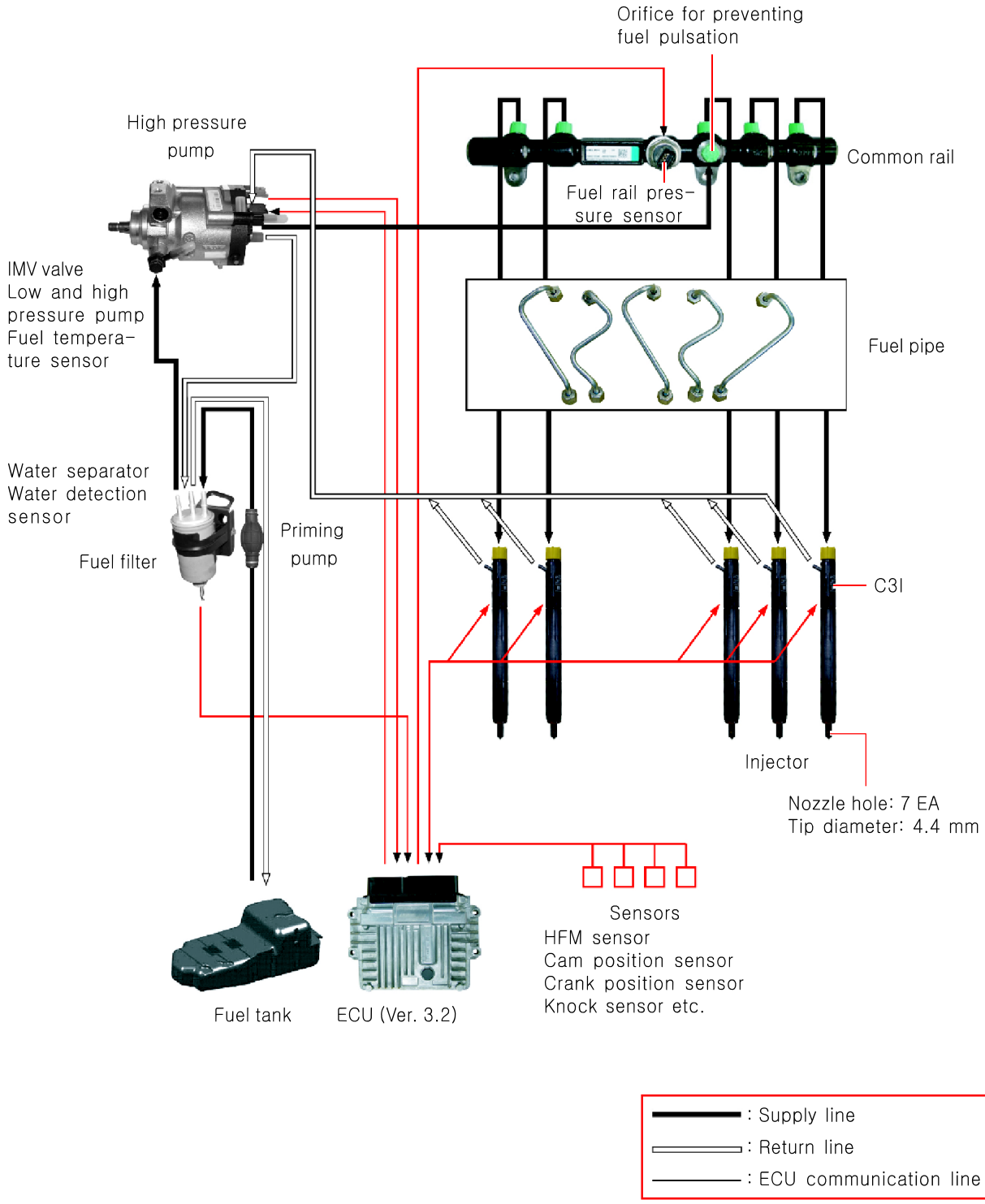




Modification basis	
Application basis	
Affected VIN	

▶Fuel Flow of D27DTP (Power Up) Engine

Fuel Supply System



Modification basis	
Application basis	
Affected VIN	

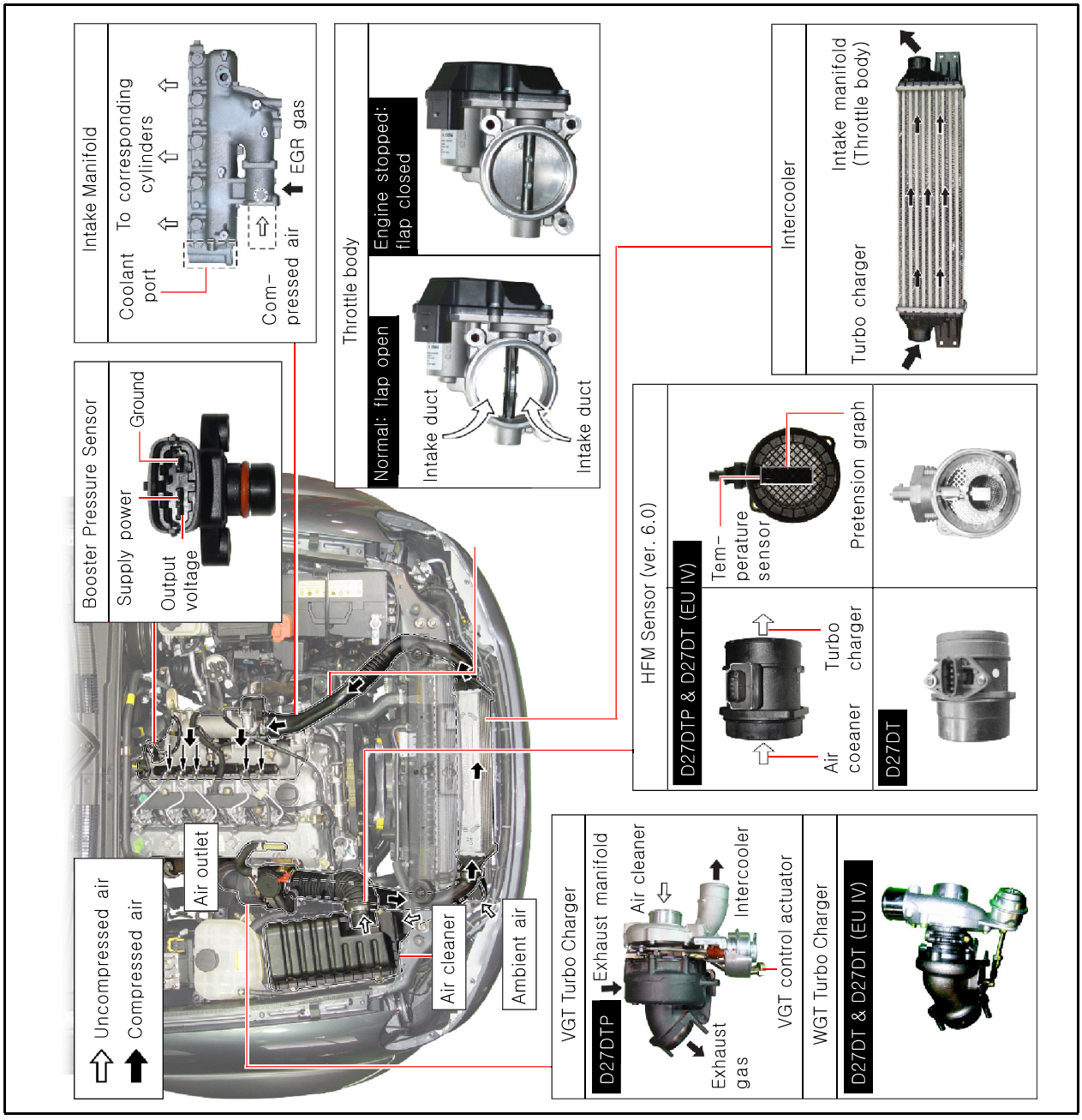
ENGINE INTAKE SYSTEM

2321-01

OVERVIEW AND OPERATION PROCESS

1. INTAKE SYSTEM LAYOUT

The intake system for the D27DTP (POWER UP) engine is equipped with the throttle body that has a flap to block the air coming to the engine when the engine is switched off. Therefore, the structure of the intake manifold has been changed.
Also, the improved HFM sensor (from HFM5.0 to HFM6.0) has been installed to control the intake air precisely so that the NOx in the exhaust gas can be decreased.



Modification basis	
Application basis	
Affected VIN	

ENGINE EXHAUST SYSTEM

1792-01

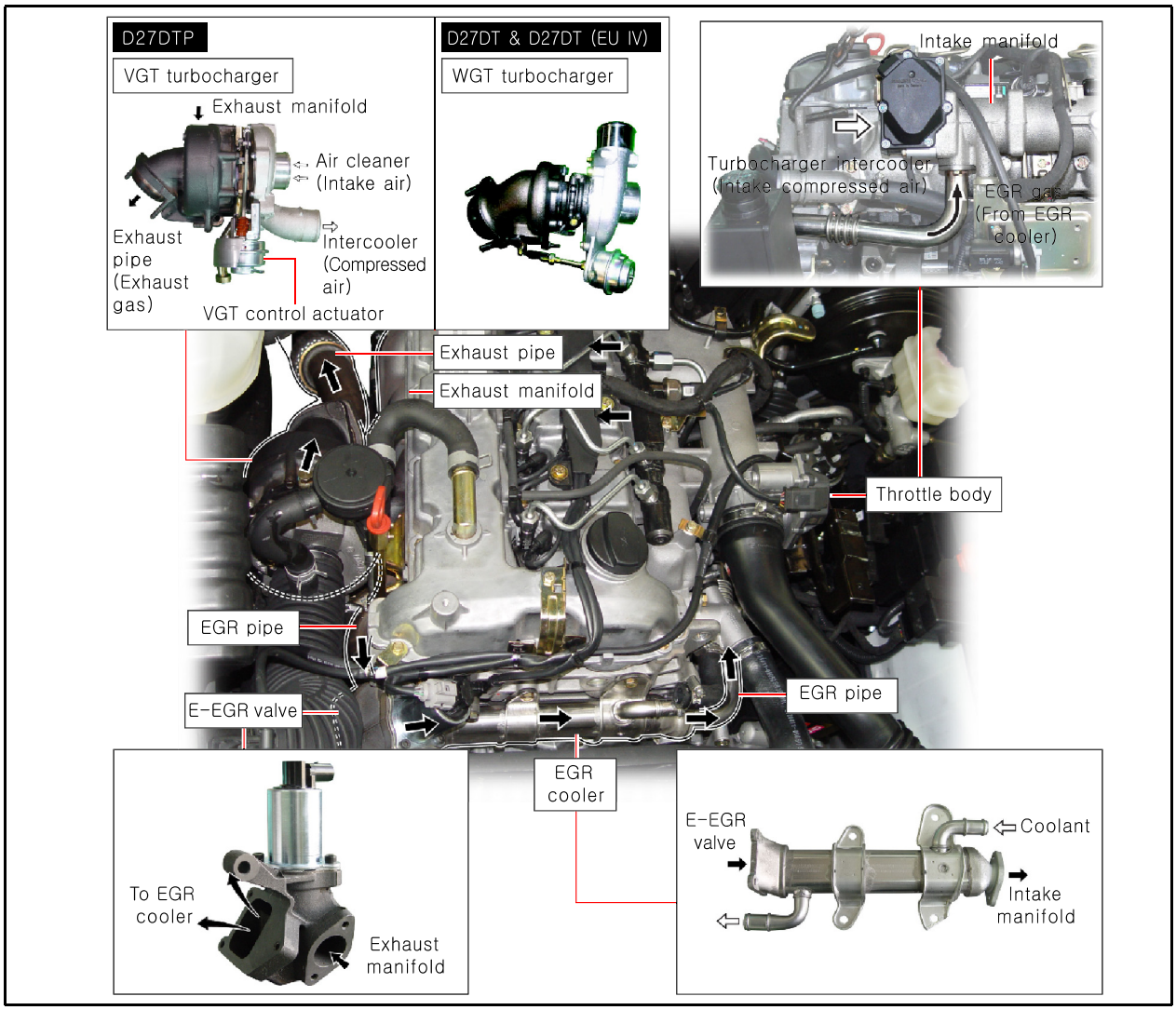
OVERVIE AND OPERATION PROCESS

1. COMPONENTS

The components of the exhaust system for the D27DTP (POWER UP) engine have been changed as follows:

1. E-EGR valve: Controlling the EGR valve electrically and sends the valve location signal to ECU (vacuum modulator control has been deleted)
2. EGR cooler: Decreasing EGR gas (NOx) efficiently by cooling the EGR gas and let it flow to the intake pipe
3. VGT turbocharger: Increase in capacity and performance compared to D27DTP & D20DT engine

The EGR system has been changed to control NOx more efficiently and the VGT turbo charger has been changed to increase the engine power. For more details, refer to the next description. The exhaust system for D27DTP (POWER UP) engine is as follows:



Modification basis	
Application basis	
Affected VIN	

CDPF (EURO IV) 1881-09

GENERAL INFORMATION

1. OVERVIEW FOR CDPF (EU-IV)

1) General Description

The CDPF (Catalyst & Diesel Particulate Filter) was installed to the Rexton II D27DTP engine previously. However, it is now installed to the all 2009 DI engine models, except the Actyon Sports. The DI engine type sinstalled to Rexton are D27DTP, D27DT and D20DT, and their CDPF, related sensor and operation logic are the same.This section describes the CDPF system (based on Euro IV) which is installed to the Rexton II D27DTPengine (older model).

2) Compatibility of CDPF System by Vehicle Model

Rexton II: Same CDPF system for D27DTP and D27DT engines (including its components)
Kyron & Actyon: Same CDPF system for D27DT and D20DT engines (including its components)

NOTE

- **The CDPF assemblies installed to the Euro IV D27DTP Rexton II and 2009 Rexton II are different in their mounting layout, but their front/rear exhaust temperature sensors and differential pressure sensors are same.**

3) System Met with EURO IV Regulations

The Ssangyong vehicles installed with the D27DT engine manufactured from July 2007 to December 2007 comply with the EURO IV regulations. Modified components from the old engine model are as follow:

- E-EGR valve
- EGR cooler
- Engine ECU (Ver. 3.2)
- HFM senso
- C3I injector
- Electronic throttle valve (body)
- Other engine mounting components

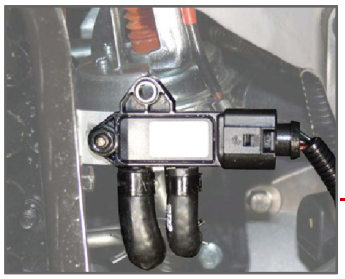
For details about the modified components and system related to the EURO IV regulations, refer to the 2008 Rodius engine service manual.

2. CDPF (EU-IV) SYSTEM

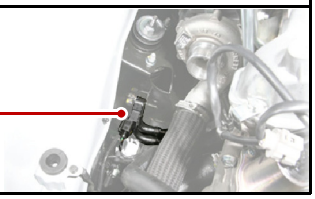
The CDPF system is only installed to the D27DT engine, and the major changes comparing to the previous D27DT engine is as follows:

CDPF (Catalyst & Diesel Particulate Filter) and Sensors

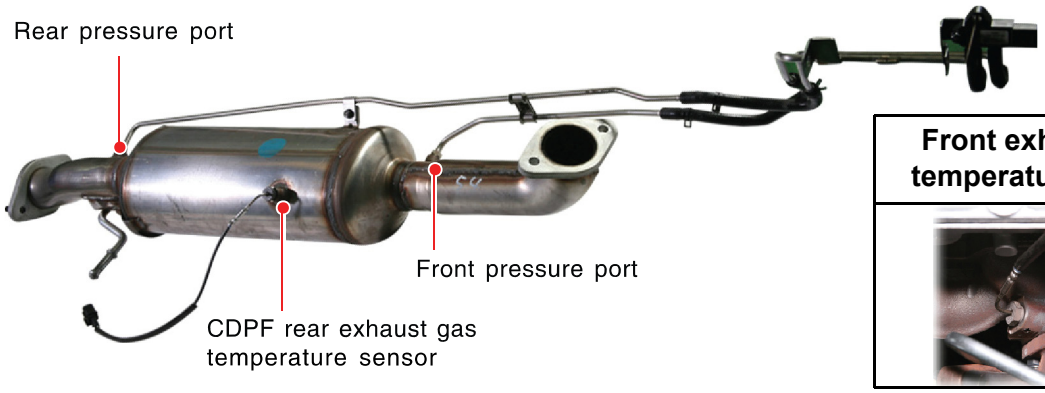
Differential Pressure Sensor (ΔP sensor)



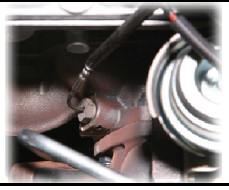
Under air cleaner in right side of engine compartment



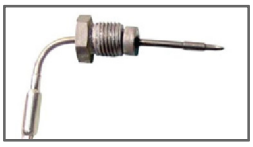
As the soot is filtered in the CDPF, the pressure between the front side and the rear side of the filter is different from each other. If the amount of soot is over 28 g, the soot is burnt in the CDPF. The combustion is determined depending on the pressure difference, temperature of exhaust gas and EGR ratio. According to these, the soot filtered by post injection of injector is burnt at 600°C.



Front exhaust gas temperature sensor



CDPF Exhaust Gas Temperature Sensor



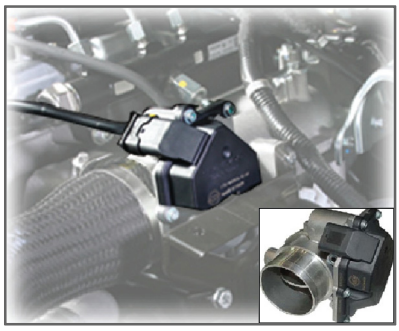
The two temperature sensors in-side the CDPF are installed inexhaust manifold (front exhaustgas temperature sensor) and inDOC (rear exhaust gas tempera-ture sensor), and perform the fol-lowing functions.

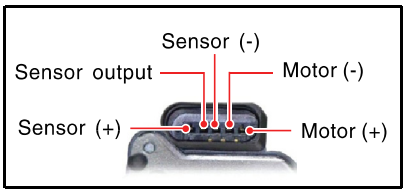
Front Exhaust Gas Tempera-ture Sensor:
Measures the exhaust gas tem-perature of the exhaust manifold. As it is installed in front of the VGT turbocharger, it also monitors the exhaust gas tempera-ture coming to the turbocharger. If the temperature of the exhaust gas flowing to the turbocharger is higher than the specification, the engine lowers the exhaust gas temperature.

Rear Exhaust Gas Tempera-ture Sensor:
Measures the increased ex-haust gas temperature after the oxidation process of DOC. If the temperature is below 600°C, the post injection amount is increased to increase the temperature.

Modification basis	
Application basis	
Affected VIN	

Throttle Body



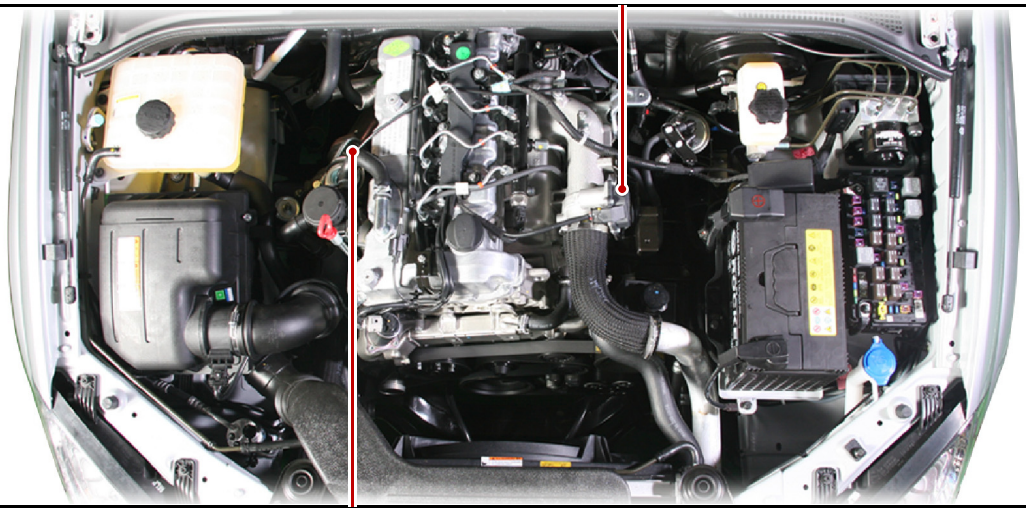


CDPF system controls the amount of intake air by controlling the electronic throttle body. The electronic throttle body has the following main functions.

CDPF control - added a function that increases the exhaust gas temperature by closing the throttle valve flap to minimize the intake air amount by the fuel injection amount during the CDPF regeneration range with the low engine load range.

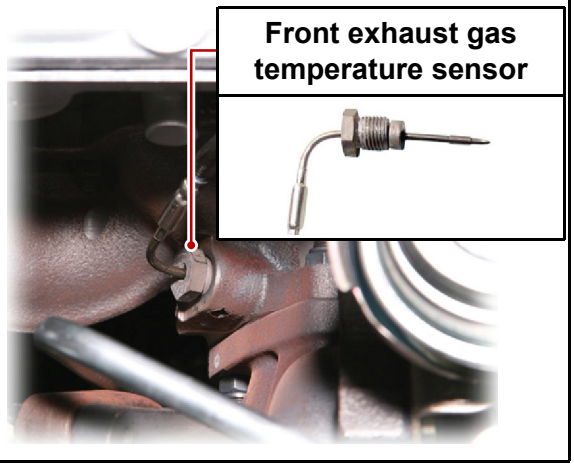
ON/OFF control - prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped.

Duty control - controls the valve inside the throttle body to burn more EGR gas in the EGR valve operating range.



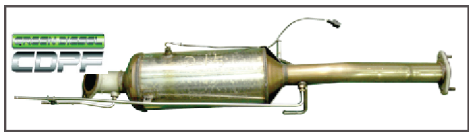
VGT Turbocharger and Front Exhaust Gas Temperature Sensor

Turbocharger may become weaker if high temperature exhaust gas passes through the turbocharger for DPF regeneration process.
The front exhaust gas temperature sensor monitors the temperature of the exhaust gas that flows into the turbocharger.
If the temperature of the exhaust gas that passes through the exhaust manifold is higher than the specification, the ECU decreases the fuel injection amount and increases the EGR gas intake amount to decrease the exhaust gas temperature.



OVERVIEW AND OPERATION PROCESS

1. OVERVIEW



As the solution for environmental regulations and PM (Particla Material) of diesel engine, the low emission vehicle is getting popular. This vehicle is equipped with an extra filter to collect the soot and burn it again so that the amount of PM in the exhaust gas passed through the DOC (Diesel Oxydation Catalyst) is reduced. The CDPF (**C**atalyst & **D**iesel **P**articulate **F**ilter) is anintegrated filter including DOC (Diesel Oxydation Catalyst) and DPF (Diesel Particulate Filter).

▶ Comparison of throttle body functions based on exhaust emission regulation

Regulated parts are carbon monoxide (CO), nitrogen oxide (NOx), particular matter (PM) and soot in the exhaust emission, and the particulars of the regulations are prescribed in the following table.

Engine	Control method	Function
D27DTP + CDPF **D27DT + CDPF** **D20DT + CDPF**	ECU's electric signal (Duty and On/Off control) + Throttle flap control during CDPF operation	**ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped **Duty control -** controls the valve inside the throttle body to burn more EGR gas in the EGR valve operating range. **CDPF control -** added a function that increases the exhaust gas temperature by closing the throttle valve flap to minimize the intake air amount by the fuel injection amount during the CDPF regeneration range with the low engine load range.
D27DT engine (EU IV)	ECU's electric signal (Duty and On/Off control)	**ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped **Duty control -** controls the valve inside the throttle body to burn more EGR gas in the EGR valve operating range.

Modification basis	
Application basis	
Affected VIN	

2.CDPF (EU-IV) SYSTEM CONTROL

1) General Description

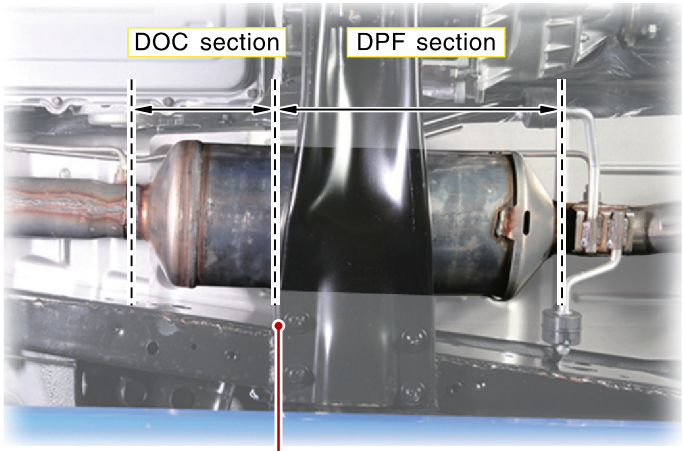
As the soot is filtered in the CDPF, it is burnt and removed, and the CDPF is returned to the initial state to collect the soot. Therefore, the burning procedures in the CDPF can be called as regeneration.

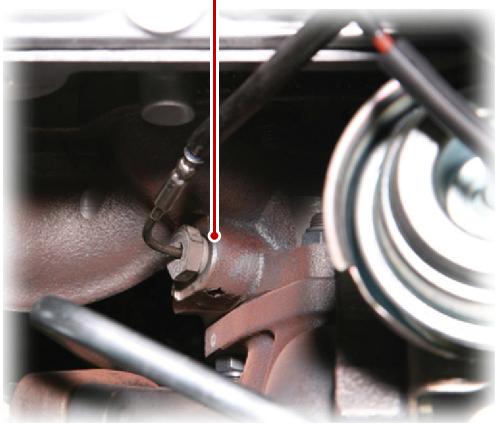
The CDPF assembly is integrated with DOC (at front side) and DPF (at rear side).

The DPF burns the soot with high-temperature exhaust gas (over 600°C). The rear exhaust gas temperature sensor monitors the temperature of DPF section. If this temperature is below the regeneration temperature, the ECU increases the post injection period to increase the fuel injection amount, and consequently to increase the exhaust gas temperature.



Front exhaust gas temperature sensor
(Measuring temperature of exhaust gas in exhaust manifold)





Rear exhaust gas temperature sensor
(Measuring temperature of exhaust gas escaping DOC)

CAUTION

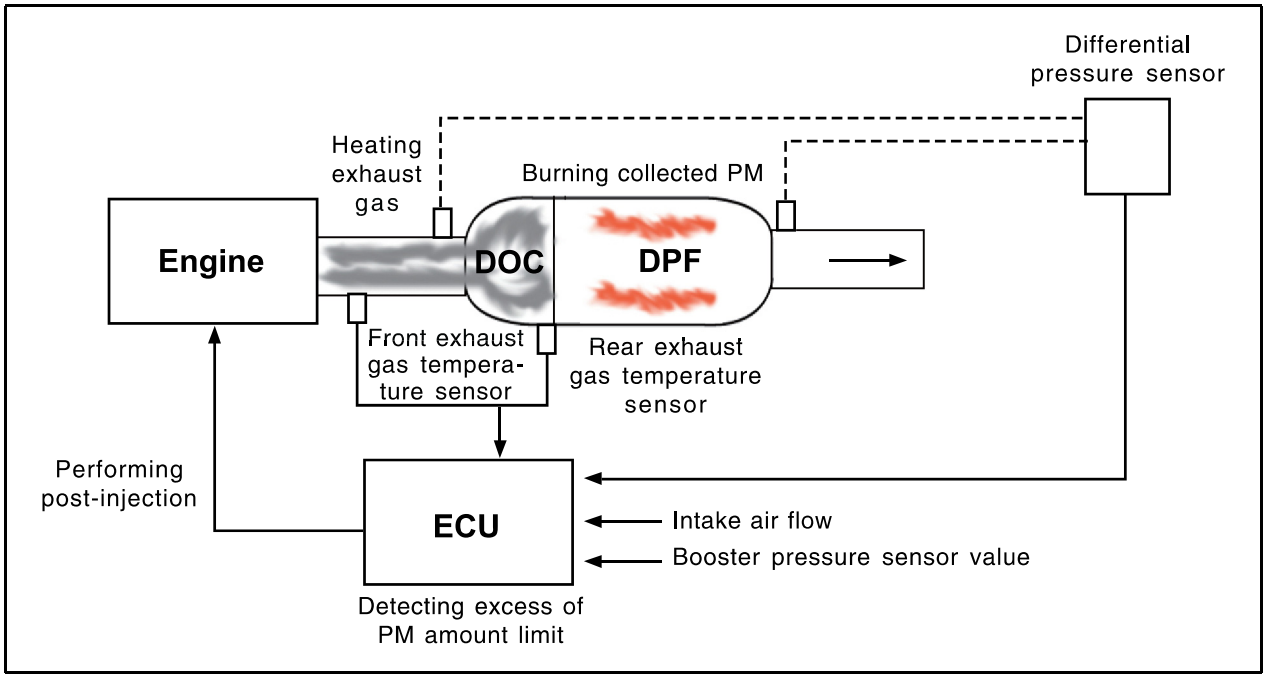
- Normally, when the vehicle is driven for 600 ~ 1,200 km, the enough amount of soot to be burnt is filtered and accumulated in the CDPF. The ECU increase the amount of post injection to increase the tempeature of exhaust gas up to 600°C so that the soot is burnt. The soot is burnt for 15 ~ 20 minutes.

2) System Composition for Soot Combustion

When the engine is running in low load range, the temperature of exhaust gas is decreased as the amount of fuel supplied is decreased. To burn the soot filtered in the CDPF, the control system should be installed to check the operating range and increase the temperature of exhaust gas by controlling the amount of fuel supplied and intake air.
Two temperature sensors and one differential pressure sensor monitor the CDPF's operating range. According to these sensors' information, the throttle flap decreases the intake air entered to the throttle body. Also, the fuel injection pattern is added to increase the temperature of exhaust gas for soot combustion.
There are three fuel injection patterns (pilot injection, pre-injection and main injection). As the CDPF is installed, the post injection pattern is added.

3) Post Injection and Air Mass Control

When the differential pressure sensor detects the pressure difference between the front and the rear side of CDPF, the sensor sends signal indicating the soot is acumulated and the post injection is performed to raise the temperature of exhaust gas. The amount of fuel injected is determined according to the temperature of exhaust gas detected by the rear temperature sensor. If the temperature is below 600°C, the amount of fuel injected is increased to raise the temperature. If the temperature is over 600°C, the amount of fuel injected is decreased or not controlled.
When the engine is running in low load range, the amount of post injection and the amount of intake air are controlled. It is to raise the temperature by increasing the amount of fuel while decreasing the amount of intake air.



Modification basis	
Application basis	
Affected VIN	

NOTE

Throttle bodies by engine type

- The throttle valve is controlled by electric signals sent from the engine ECU for optimal fuel injection volume, engine load and effective combustion of EGR gas according to the Euro 4 regulations. It has following functions by the engine type.

Engine	Control Method	Function
D27DTP + CDPF **D27DT + CDPF** **D20DT + CDPF**	ECU's electric signal (Duty and On/Off control) + Throttle flap control during CDPF operation	**CDPF control -** added a function that increases the exhaust gas temperature by closing the throttle valve flap to minimize the intake air amount by the fuel injection amount during the CDPF regeneration range with the low engine load range. **ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped. **EGR gas amount control -** Close the valve to decrease the intake air amount and lets more EGR gas flows to burn more EGR gas at EGR valve operating range.
D27DT engine (EU IV)	ECU's electric signal (Duty and On/Off control)	**ON/OFF control -** prevents the engine from turning off with vibration and noise by closing the throttle body flap to block the intake air when the engine is stopped. **EGR gas amount control -** Close the valve to decrease the intake air amount and lets more EGR gas flows to burn more EGR gas at EGR valve operating range.
D27DT engine	No throttle body installed	

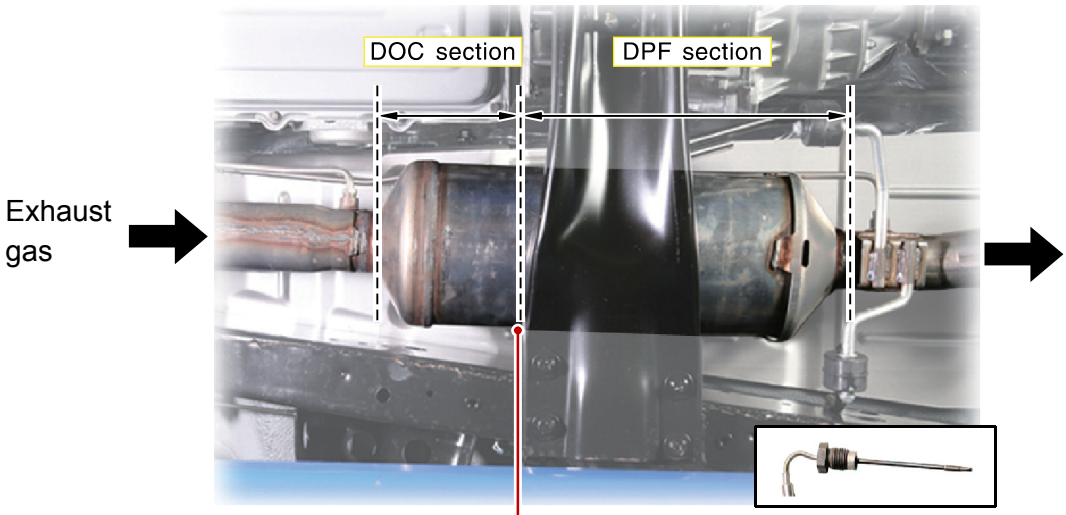
3. SOOT FILTERING AND BURNING PROCEDURES

1) Operating Procedures of CDPF

The most efficient and practical technology for now is adopted to the diesel particulate filter (DPF).
This system collects the soot from the diesel engine to the filter and burns the soot so that over than 95% of soot can be removed from the exhaust gas. However, the durability and the cost of additional system remainas problems.

Firstly, the exhaust gas is passed through the DOC and its temperature is increased as it is oxidized. The ECU detects the temperature change with two temperature sensors. The CO, HC and partial particulate material are removed from the exhaust gas (this procedures are the sames as the ones for the conventional DOC and no sensor is required).

After the exhaust gas is passed through the DOC and oxidized, most of the harmful material is removed from the exhaust gas. However, to meet the environmental regulations in the future, the soot is filtered and burnt again in DPF to decrease the particulate material further.



Rear exhaust gas temperature sensor(Measuring temperature of exhaust gas escaping DOC)

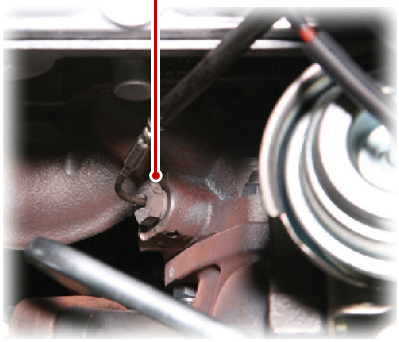
CAUTION

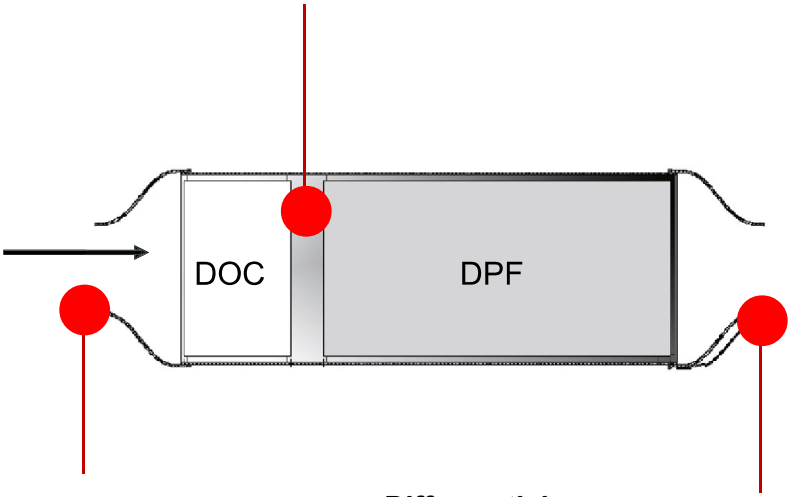
- The filtered soot is burned whenever the vehicle is driven for 600 ~ 1200 km. The driving distance can be differed depending on the vehicle's driving conditions. The soot is burnt for 15 ~ 20 minutes.

Modification basis	
Application basis	
Affected VIN	

Front temperature sensor
(Measuring the temperature of exhaust gas passedthrough exhaust manifold)

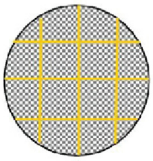
Rear temperature sensor
(Measuring the temperature of exhaust gas passed through DOC)



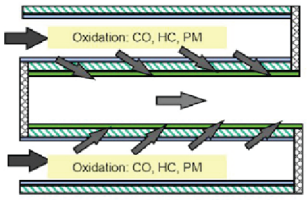


Differrential pressure sensor
(Front pressure port)

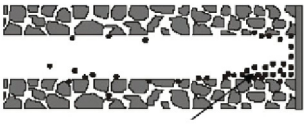
Differrential pressure sensor
(Rear pressure port)



The exhaust gas enters intoCDPF assembly after passing through the exhaust manifold. (Normal temperature of ex-haust gas: approx. 250°C)

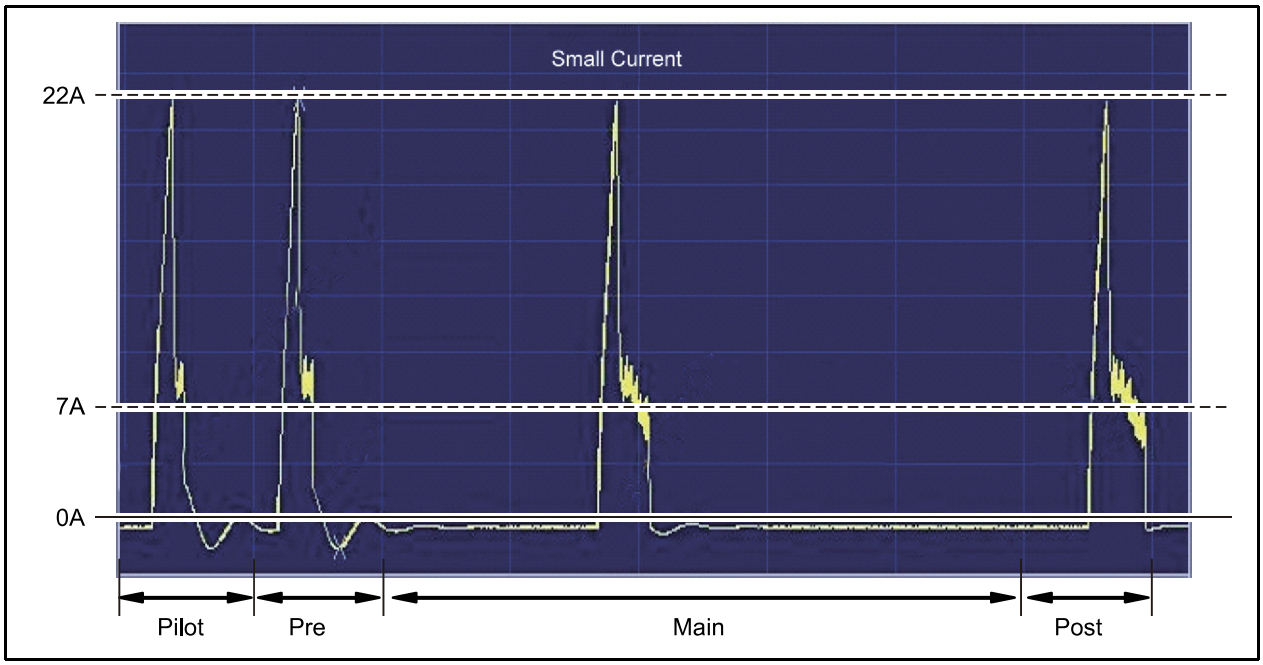


When the exhaust gas enters into the CDPF assembly, its CO, HC and particulate mate-rial are reduced as it is oxi-dized in DOC. The remaining particulate material is filtered and collected in DPF and the temperature of exhaust gas is increased to approx. 450 ~500°C.



The engine ECU detects the amount of particulate material colected by the information from temperature sensors and differential pressure snesor. When the soot is accumulated, the pressure difference be-tween the front and the rear side occurs. Then, the engineECU performs the post injec-tion to raise the exhaust gas temperature and burn the collected soot at approx. 600°C.

2) Fuel Injection During CDPF Regeneration



Injection	Effect
Pilot injection	Decrease of PM by fuel mixture Decrease of noise from engine combustion
Pre-injection	Decrease of NOx by shortening main injection delay due to flammability Decrease of noise from engine combustion
Main injection	Main power source
Post-injection	Activation of CDPF by increasing exhaust gas temperature and supply-ing reduction material

3) Warning Lamp Related To CDPF

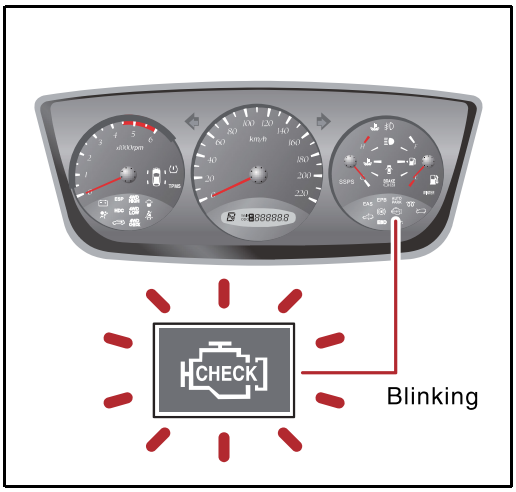
▶ CDPF regeneration process (warning lamp NOT illuminated)



The CDPF system enters the regeneration mode when the driving distance becomes approx. 600 to 1,200 km (may differ by the driving condition and driving style). Then, the engine ECU performs the CDPF regeneration operation. However, the driver is not in-formed with this operation by any engine warning lamp or vehicle signal, so he/she may not detect this operation. The control logic at the post-injection dur-ing the regeneration process is to increase the fuel injection volume and control the intake air volume (by the throttle body) in order to increase the tem-perature of the exhaust gas. The driver may not feel any particular difference from the vehicle.

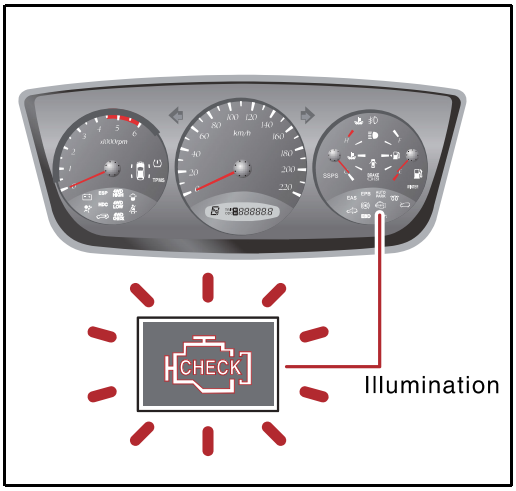
Modification basis	
Application basis	
Affected VIN	

▶ Overload of CDPF (warning lamp blinking)



1. If the CDPF cannot reach the regeneration tem-perature due to low speed driving or other reason during the regeneration process, the soot is con-tinuously accumulated in the CDPF. When this condition continues and the CDPF is overloaded with soot, the engine warning lamp blinks to in-form this situation to the driver.
2. In order to solve this problem, drive the vehicle at a speed of approx. 80 km/h for 15 to 20 minutes to perform the CDPF regeneration process.
3. If the engine warning lamp on the instrument clus-ter blinks, the CDPF is overloaded. In this case, perform the step 2.

▶ Excessive overload of CDPF (warning lamp illuminated)



1. If the vehicle is driven at a speed of 5 to 10 km/h for an extended period of time, the soot accumu-lated in the CDPF cannot be burnt as the CDPF cannot reach the regeneration temperature. Then, an excessive amount of soot can be accumulated in the CDPF.
2. This case is much worse than the simple over-load of the CDPF. To inform this to the driver, the engine warning lamp comes on and the engine power is decreased to protect the system.
3. To solve this problem, blow soot between the en-gine and exhaust system several times and erase the related DTC. Then, check if the same DTC is regenerated again. If so, check the DTC related to the differential pressure sensor.

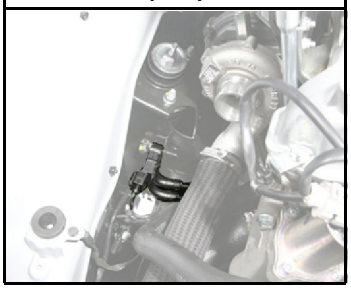
Actually, the DTC for the CDPF is generated more often by the component related to the CDPF system, such as the differential pressure sensor, than by excessive soot in the CDPF.

4. COMPONENTS OF CDPF SYSTEM

1) Mounting Condition and Location

Differential Pressure Sensor

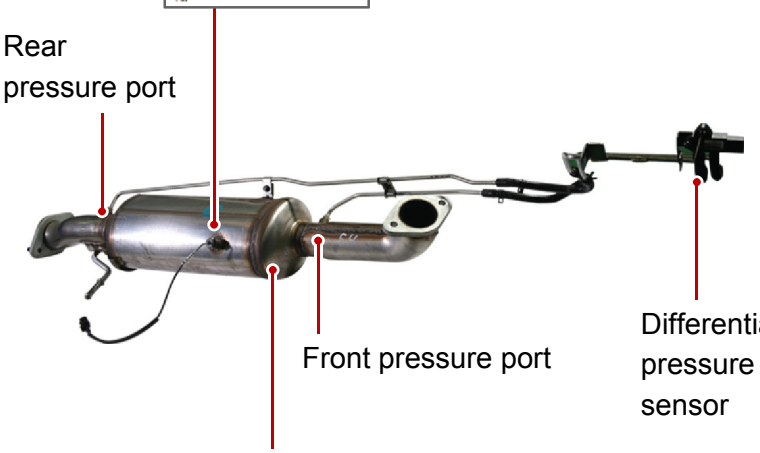
Engine compartment (RH)



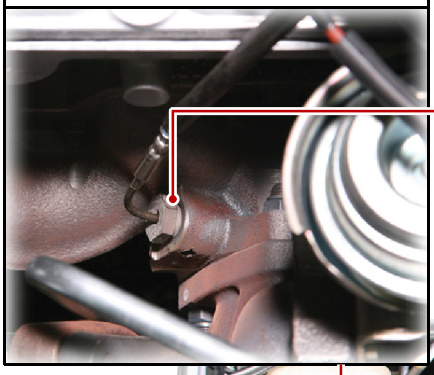


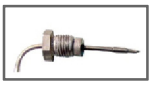
Rear exhaust gas temperature sensor





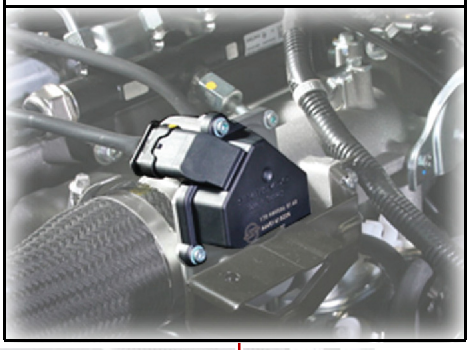
Front Exhaust Gas Temperature Sensor

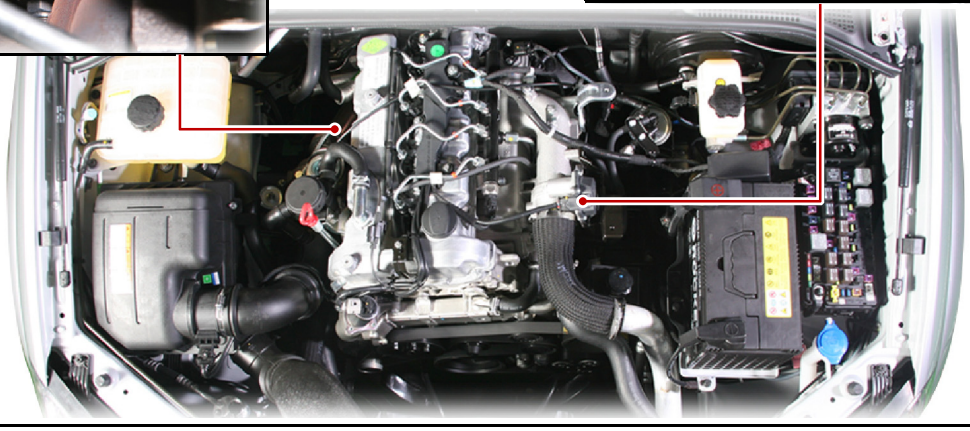




Front exhaust gas temperature sensor

Throttle Body





Modification basis	
Application basis	
Affected VIN	

NO DATA

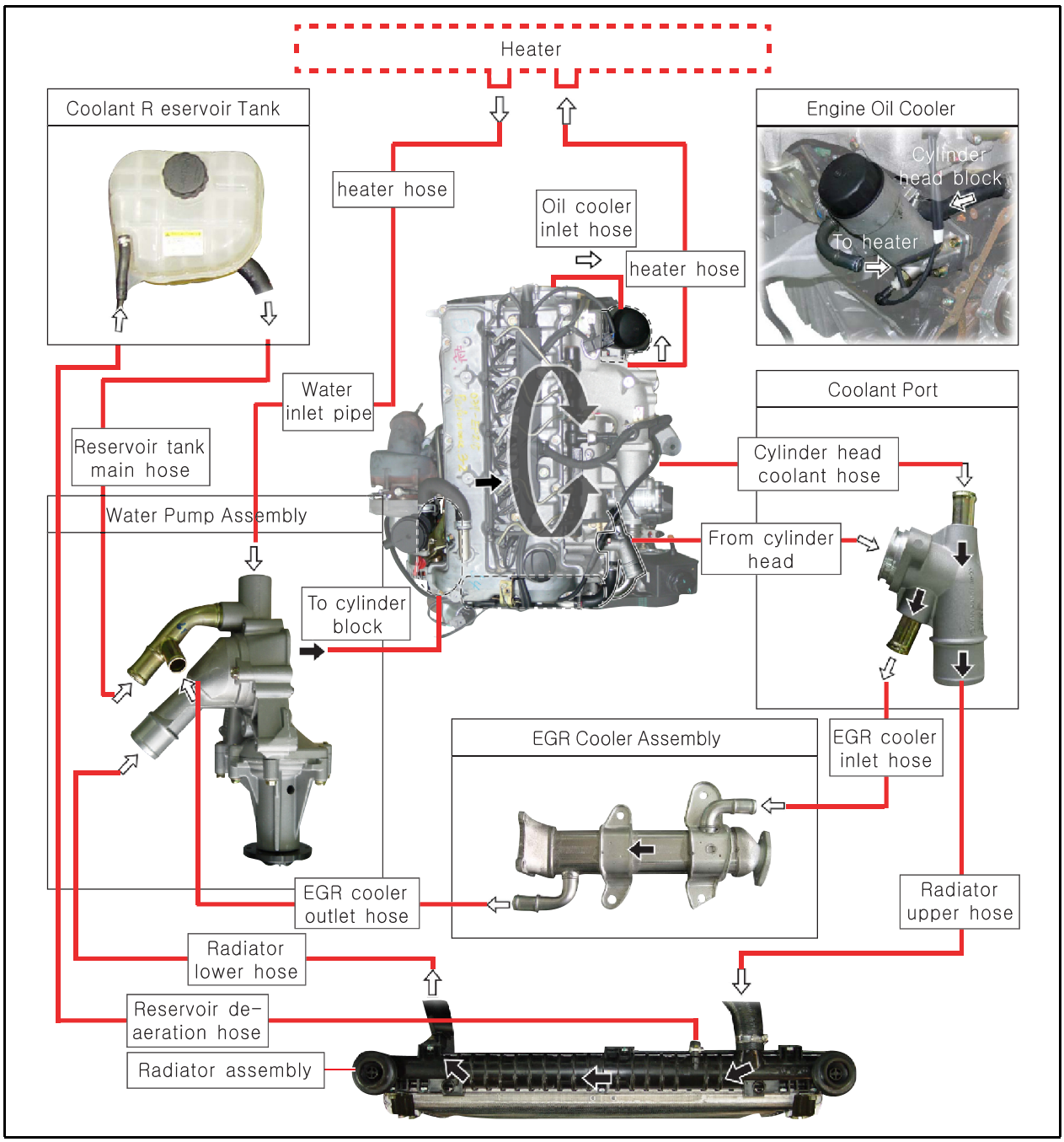
ENGINE COOLING SYSTEM 1520-01

OVERVIEW AND OPERATION PROCESS

1. COMPARISON IN COOLING SYSTEM FOR EACH ENGINE

For the D27DTP (POWER UP) engine, the cooling system is equipped with E-EGR cooler and the water pump which its capacity is improved according to the additional coolant line in the cylinder block. For the D27DT engine, the cooling system uses the fan clutch.

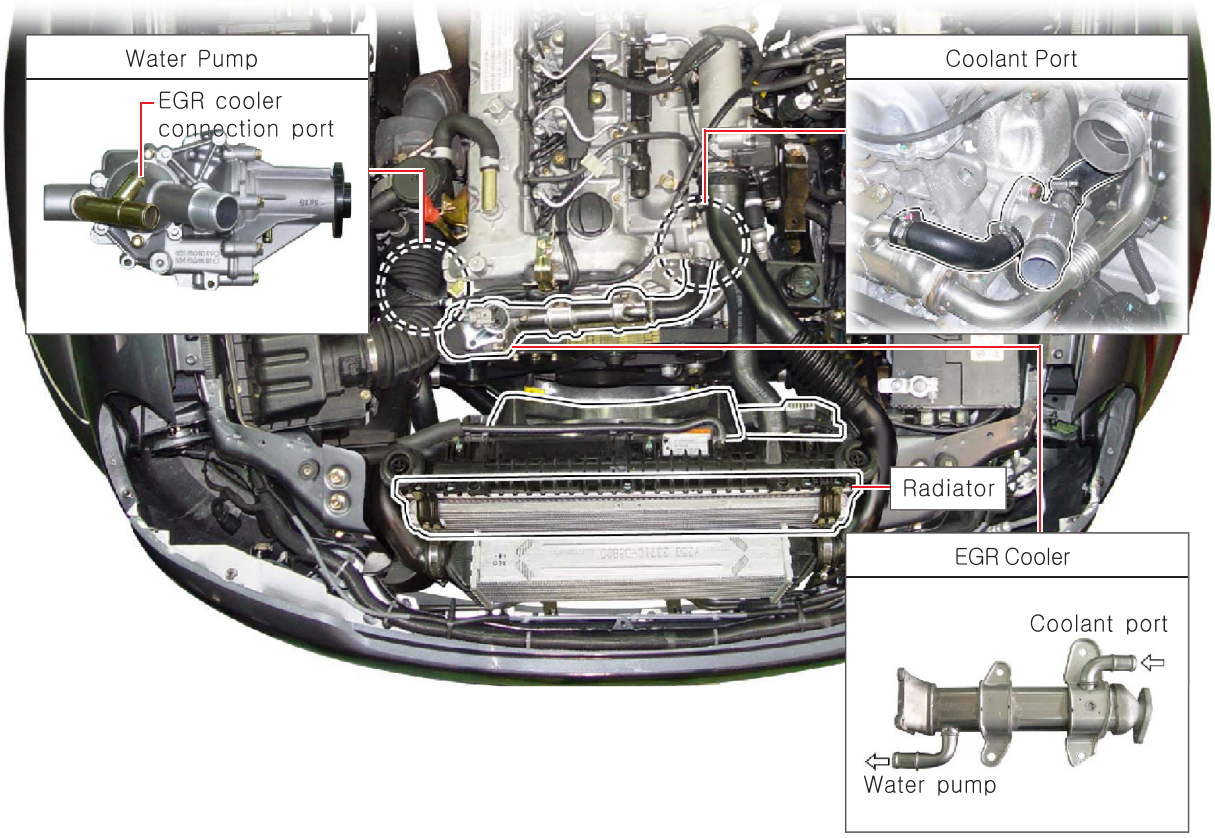
▶Cooling System for D27DTP (POWER UP) Engine



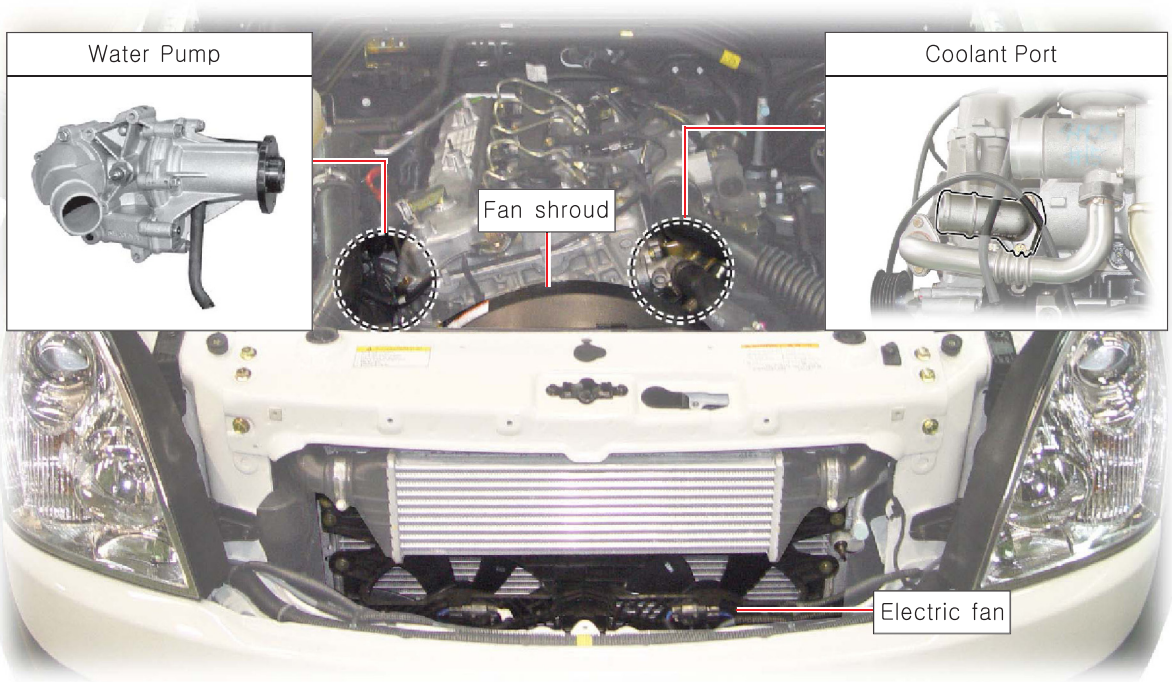
Modification basis	
Application basis	
Affected VIN	

▶Comparison

D27DTP (POWER UP) & D27DT (EU IV) Engine



D27DT Engine



Modification basis	
Application basis	
Affected VIN	

NO DATA

NO DATA

NO DATA

ENGINE INFORMATION

0000-00

GENERAL)

1. COMPONENT LOCATOR..... 4
2. DESCRIPTION AND OPERATION..... 7

Memo

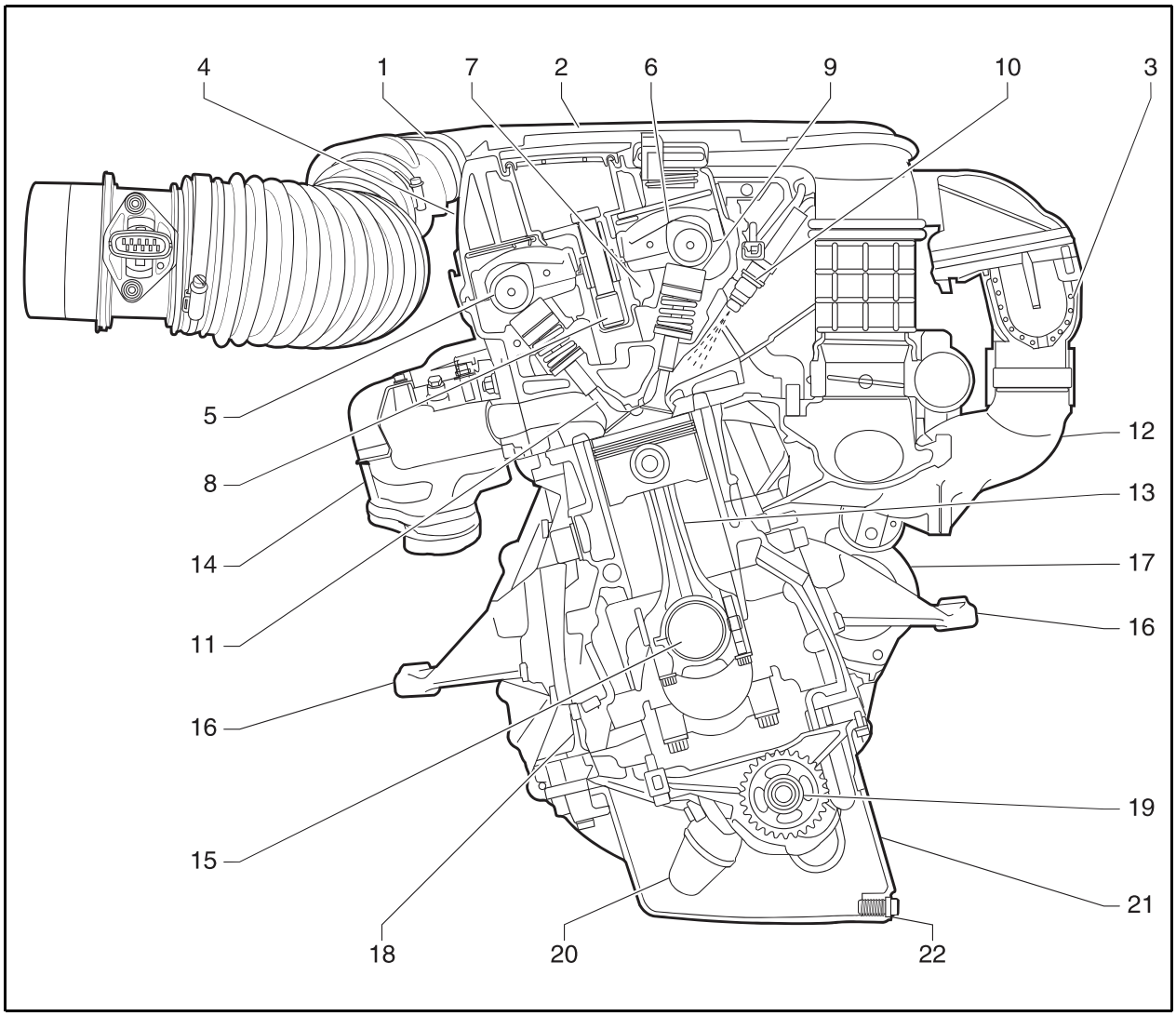
ENGINE GENERAL

0000-00

GENERAL

1. COMPONENT LOCATOR

1) Front View

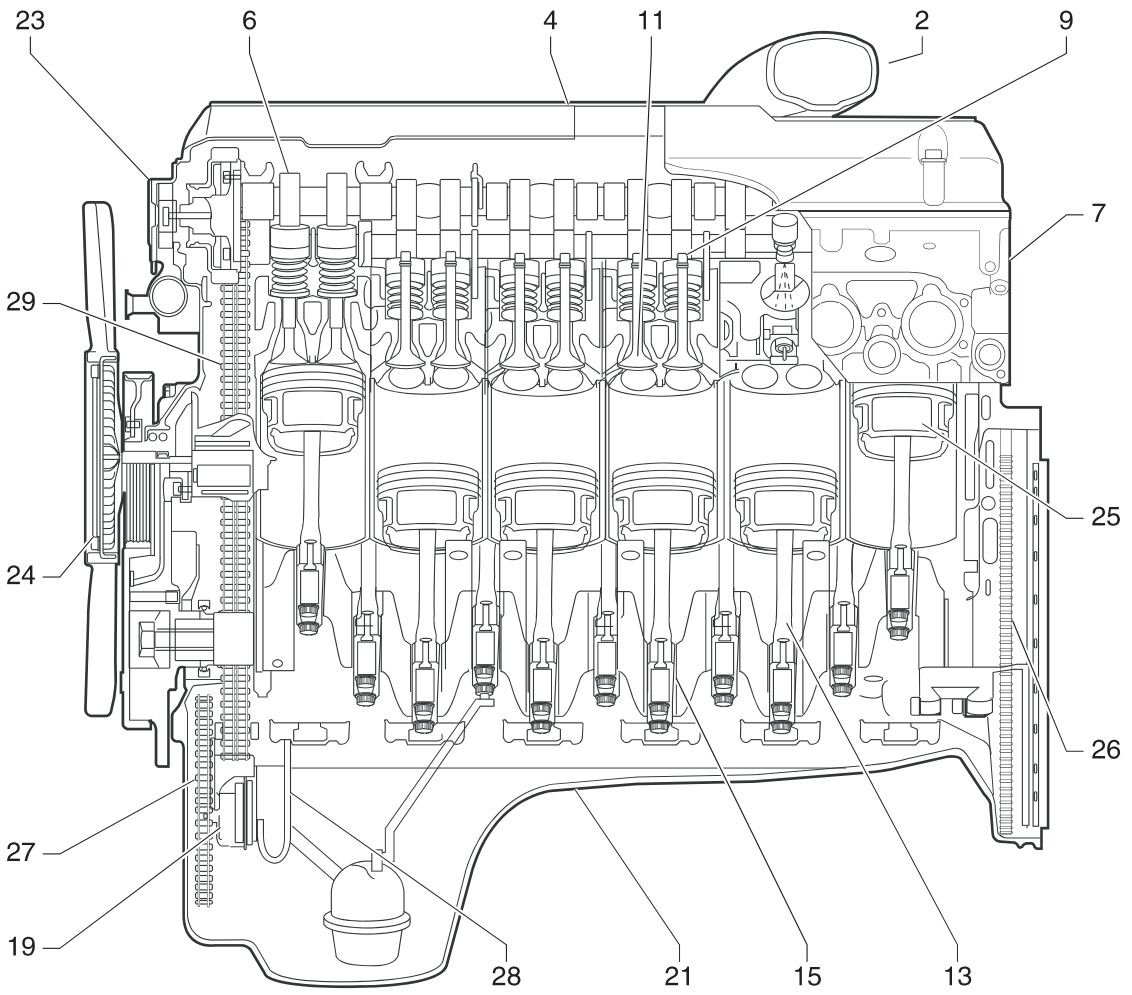


Modification basis	
Application basis	
Affected VIN	

▶ **Front View**

NO.	FUNCTION	NO.	FUNCTION
1	HFM sensor	12	Intake manifold
2	Intake air duct	13	Connecting rod
3	Resonance flap	14	Exhaust manifold
4	Cylinder head cover	15	Crankshaft
5	Exhaust camshaft	16	Engine mounting
6	Intake camshaft	17	Starter
7	Cylinder head	18	Crankcase
8	Spark plug connector	19	Oil pump sprocket
9	Valve tappet	20	Oil strainer
10	Injector	21	Oil pan
11	Exhaust valve	22	Drain plug

2) SIDE VIEW



NO.	FUNCTION	NO.	FUNCTION
23	Camshaft adjuster	27	Oil pump drive chain
24	Cooling fan and viscous clutch	28	Oil return pipe
25	Piston	29	Timing chain
26	Flywheel of drive plate		

Modification basis	
Application basis	
Affected VIN	

2. DESCRIPTION AND OPERATION

1) Cleanliness And Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousanths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation.

Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order.

They should be installed in the same locations, and with the same mating surfaces, as when they were removed. Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

2) On-Engine Service

CAUTION

- Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted. Notice Any time the air cleaner is removed, the intake opening

CAUTION

- Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.g

Memo

ENGINE ASSEMBLY 1113-01

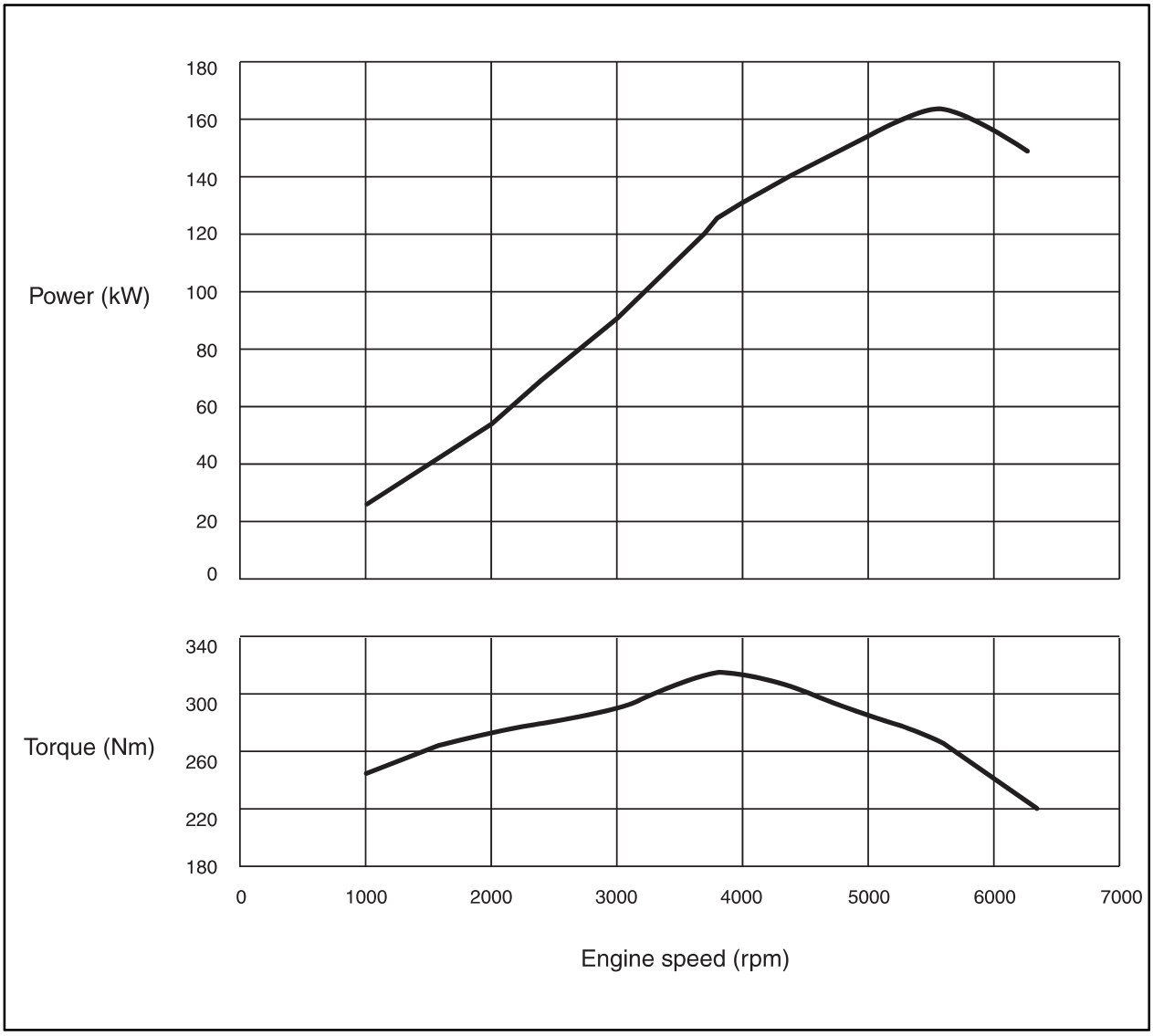
GENERAL

1. SPECIFICATIONS

1) ENGINE SPECIFICATIONS

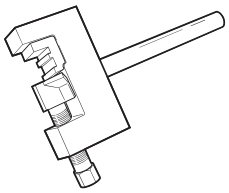
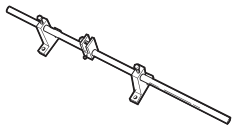
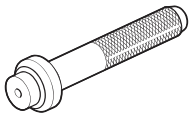
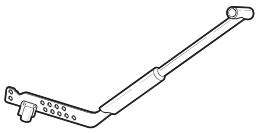
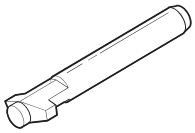
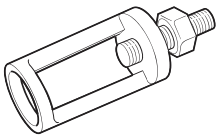
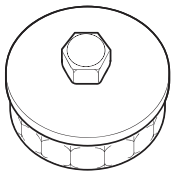
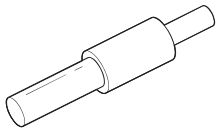
Application			M162 Engine
Engine model			M162.990
Displacement (CC)			3199
Cylinder (Bore x Stroke) (mm)			89.9 x 84.0
Fuel injection / Ignition system			MSE 3.63D
Compression ratio			10 : 1
Number of cylinders			6
Camshaft valve arrangement			DOHC
Camshaft drive type			Chain-Driven
Max. output (ps/rpm)			220 / 6000
Max. torque (kg•m/rpm)			31.6 / 3900
Firing order			1 - 5 - 3 - 6 - 2 - 4
Ignition type			Distributorless double ignition
Ignition timing			BTDC 8°
Va lve timing	Intake	Open/Close	AT DC 11° / ABDC 34°
Valve clearance adjustment			Automatic control
Idle speed (rpm)			700 ± 50
Fuel injection pressure (kg/cm^2)			3 ~ 4
Oil capacity (liter)			9
Lubrication type			Forced by gear pump
Oil filter type			Full flow with paper filter
Fuel			Unleaded gasoline

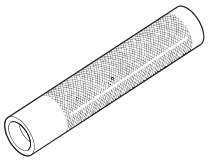
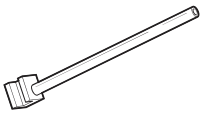
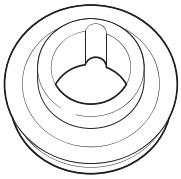
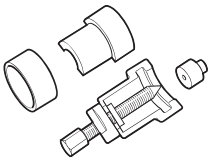
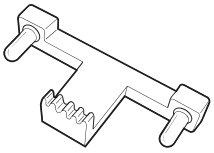
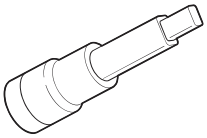
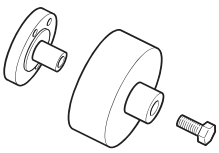
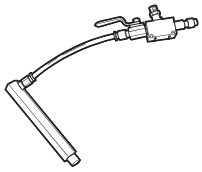
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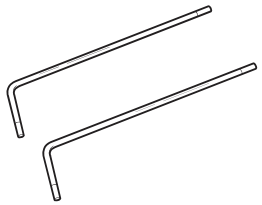
Modification basis	
Application basis	
Affected VIN	

2. SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Name and Part Number
000 589 58 43 00 Chain Assembly 	A9917 0101B (111 589 01 59 00) Supporting Bar 
W991 1 0010B (102 589 00 15 00) Drift 	A9917 0111B (111 589 18 61 00) Lever Pusher 
A991 1 0050B (102 589 12 15 00) Drift 	A9917 0121B (111 589 25 63 00) Thrust Piece 
A9910 0050A (103 589 02 09 00) Oil Filter Remover 	A9913 0061B (116 589 01 34 00) Threaded Pin 

Name and Part Number	Name and Part Number
A9917 0171B (119 589 00 43 00) Drift 	A9910 0150A (603 589 00 40 00) Fan Clutch Holder 
A991 1 0060B (601 589 03 14 00) Crankshaft Front Seal Installer 	W9910 0150A (615 589 01 33 00) Crankshaft Sprocket Puller 
A9910 0150B (602 589 00 40 00) Engine Lock 	A9912 0080B (617 589 00 10 00) Allen Wrench Socket 
W991 1 0020B (601 589 03 43 00) Crankshaft Rear Seal Installer 	A991 1 0012B (DW1 10-090) Connecting Hose 

Modification basis	
Application basis	
Affected VIN	

Name and Part Number
A9917 0012B (DW110-120)Holding Pin 

Modification basis	
Application basis	
Affected VIN	

3. FASTENER TIGHTENING SPECIFICATIONS

Application	Nm	Lb-Ft	Lb-In
A/C bracket bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Armature bolt in camshaft actuator	35	26	-
Belt tensioning pulley nut	40.5 ~ 49.5	29.9 ~ 36.5	-
Camshaft actuator bolt	9 ~ 11	-	80 ~ 97
Camshaft adjuster mounting nut	60 ~ 70	44 ~ 52	-
Camshaft bearing cap bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Chain tensioner assembly	72 ~ 88	53 ~ 65	-
Chain tensioner screw plug	40	30	-
Connecting rod bearing cap bolt	40 + 5 90° + 10°	30 + 3.7 90° + 10°	-
Cooling fan bracket bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Crankshaft bearing cap bolt	50 ~ 60 90° + 5°	37 ~ 44 90° + 5°	-
Crankshaft sealing rear cover mounting bolt	9 - 11	-	80 ~ 97
Cylinder block drain plug	30	22	-
Cylinder head bolt	55 +90° +90°	41 +90° +90°	-
Cylinder head cover bolt	9 ~ 11	-	80 ~ 97
Cylinder head front cover bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Engine mounting bracket nut	70	52	-
Exhaust camshaft sprocker bolt	18 ~ 22 90° ± 5°	13 ~ 16 90° ± 5°	-
Exhaust manifold and pipe	30	22	-
Flywheel mounting bolt	45 + 5 90° + 10°	33 + 3.7 90° + 10°	-
Fuel feed and return hose to fuel rail	21 ~ 25	15 ~ 18	-
Generator carrier bolt	25	18	-
Intake air duct nut	9 ~ 11	-	80 ~ 97
Intake flange shaft bolt	18 ~ 22 90° ± 5°	13 ~ 16 90° ± 5°	-
Lower engine mounting nut	38	28	-
Oil dipstick guide tube bolt	9 ~ 11	-	80 ~ 97
Oil drain plug	22.5 ~ 27.5	16.6 ~ 20.3	-

Modification basis	
Application basis	
Affected VIN	

4. FASTENER TIGHTENING SPECIFICATIONS (CONT'D)

Application		Nm	Lb-Ft	Lb-In
Oil filter bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Oil filter cover		25	18	-
Oil gallery screw plug in cylinder head		15	11	-
Oil pan bolt	M10	40	30	-
	M8	22.5 ~ 27.5	16.6 ~ 20.3	-
	M6	9 ~ 11	-	80 ~ 97
Oil pressure relief valve screw plug		50	37	-
Oil pump drive sprocket bolt		29 ~ 35	21 ~ 26	-
Oil pump mounting bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Oil pump sprocket bolt		29 ~ 35	21 ~ 26	-
Spark plug cover bolt		9 ~ 11	-	80 ~ 97
Steering pump bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Tensioning device bolt		26 ~ 32	19 ~ 24	-
Timing gear case cover bolt	M8	22.5 ~ 27.5	16.6 ~ 20.3	-
	M6	9 ~ 11	-	80 ~ 97
Torque converter mounting bolt		42	31	-
Transmission mounting nut		54 ~ 68	40 ~ 50	-
Under cover		28 ~ 47	21 ~ 35	-
Upper engine mounting nut		70	52	-
Vibration damper center bolt		180 ~ 220 90° + 10°	133 ~ 162 90° + 10°	-
Water pump pulley bolt		22.5 ~ 27.5	16.6 ~ 20.3	-

ENGINE FUEL SYSTEM 2211-22

OVERVEIW AND OPERATION PROCESS

1. FUEL SYSTEM SPECIFICATION

▶ Use Only Unleaded Fuel Rated at 89 Octane or Higher

Fuel quality and additives contained in fuel have a significant effect on power output, drivability, and life of theengine. Fuel with too low an octane number can cause engine knock.

CAUTION
- Use of fuel with an octane number lower than 89 may damage engine and exhaust system.

CAUTION
- To prevent accidental use of leaded fuel, the nozzles for leaded fuel are larger, and will not fit the fuel filler neck of your vehicle.

▶ Do Not Use Methanol

Fuels containing methanol (wood alcohol) should not be used in vehicle.
This type of fuel can reduce vehicle performance and damage components of the fuel system.

CAUTION
- Use of methanol may damage the fuel sys-tem.

▶ Vehicle Fueling from Drums or Storage Containers

For safety reasons (particularly when using noncommercial fueling systems) fuel containers, pumps and hoses must be properly earthed. Static electricity build up can occur under certain atmospheric and fuel flow conditions if unearthed hoses, particularly plastic, are fitted to the fuel-dispensing pump.

It is therefore recommended that earthed pumps with integrally earthed hoses be used, and that storage containers be properly earthed during all noncommercial fueling operations.

▶ temperature vs resistance

℃	℉	ECT Sensor	IAT Sensor
		ohms (Ω)	
Temperature vs Resistance Values (Approximate)			
130	266	88	102
120	248	111.6	127
110	230	143	159
100	212	202	202
90	194	261	261
80	176	340	340
70	158	452	452
60	140	609	609
50	122	835	835
40	113	1166	1166
30	86	1662	1662
20	68	2420	2420
10	50	3604	3604
0	32	5499	5499
-10	14	8609	8609
-20	-4	13850	13850
-30	-22	22960	22960
-40	-40	39260	39260

Modification basis	
Application basis	
Affected VIN	

NO DATA

ENGINE EXHAUST SYSTEM 2420-01

GENERAL

1. OVERVIEW OF EXHAUST SYSTEM

CAUTION

- When you are inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor panel and possible damage to the passenger compartment insulation and trim materials.
  Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit exhaust fumes to seep into the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.

2. OVERVIEW OF MUFFLER

Aside from the exhaust manifold connection, the exhaust system uses a flange and seal joint design rather than a slip joint coupling design with clamp and U-bolts.
If hole, open seams, or any deterioration is discovered upon inspection of the front muffler and pipe assembly, the complete assembly should be replace, the complete assembly should be replaced.
The same procedure is applicable to the rear muffler assembly. Heat shields for the front and rear muffler assembly and catalytic converter protect the vehicle and the environment from the high temperatures that the exhaust system develops.

3. OVERVIEW OF CATALYTIC CONVERTER

CAUTION

- When jacking or lifting the vehicle from the body side rails, be certain that the lift pads do not contact the catalytic converter, as this could damage the catalytic converter.

CAUTION

- Use of anything other than unleaded fuel will damage the catalyst in the catalytic converter.
  · The catalytic converter are emission-control devices added to the exhaust system to reduce pollutants from the exhaust pipes.
  · The oxidation catalyst is coated with a catalytic material containing platinum and palladium, which reduces levels of hydrocarbon (HC) and carbon monoxide (CO) from the exhaust gas. The three-way catalyst has coatings which contain platinum and rhodium, which additionally lower the levels of oxides of nitrogen (NOx).

4. FASTENER TIGHTENING SPECIFICATIONS

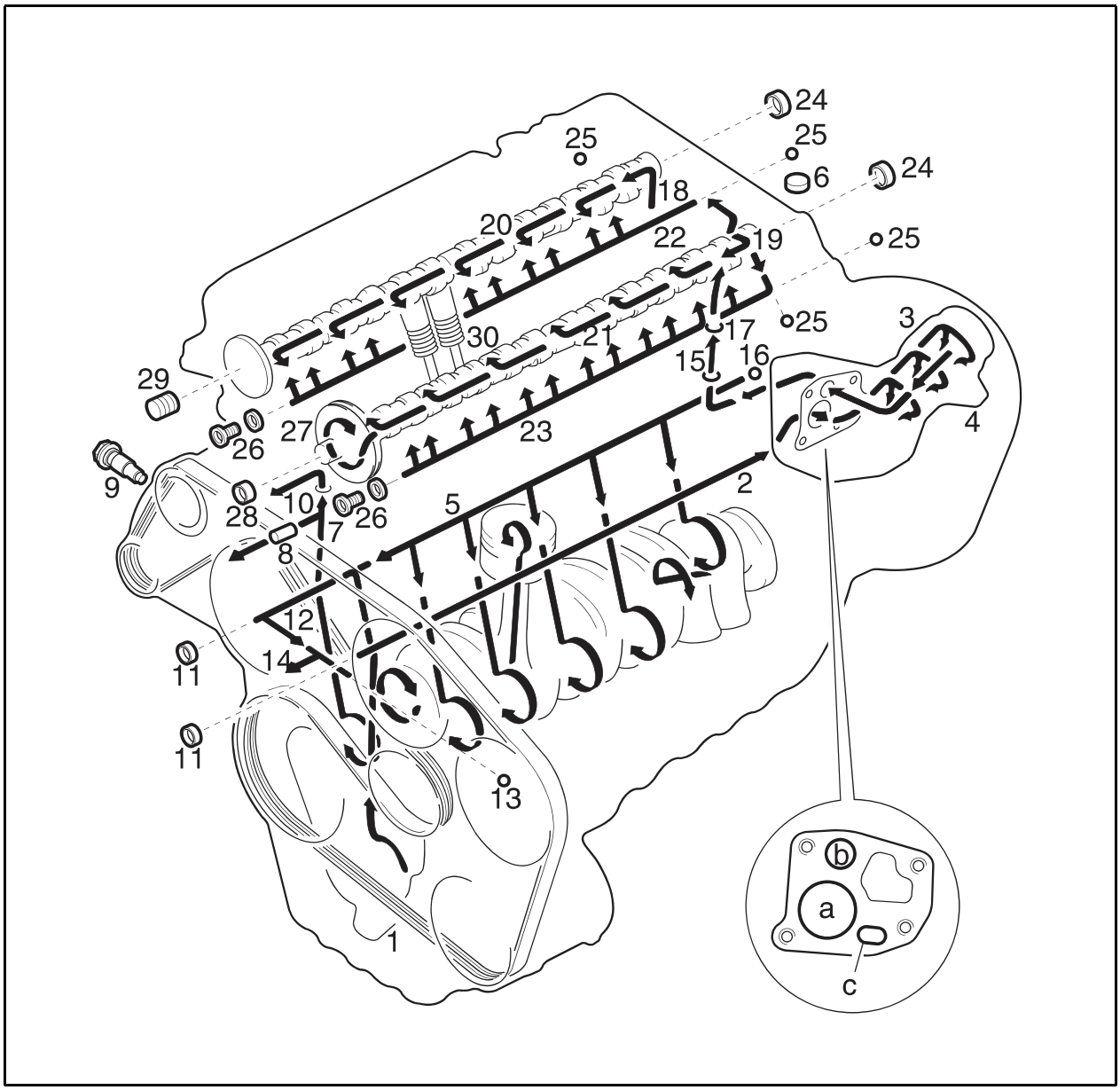
Application	Nm	Lb-Ft	Lb-In
Exhaust manifold to front exhaust pipe nut	15 ~ 28	11 ~ 21	-
Front exhaust pipe to muffler nut	28 ~ 47	21 ~ 35	-
Intake air duct mounting bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Intake manifold mounting bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Muffler to tail exhaust pipe nut	28 ~ 47	21 ~ 35	-
Resonance flap mounting bolt	9 ~ 11	-	80 ~ 97

Modification basis	
Application basis	
Affected VIN	

ENGINE LUBRICATION SYSTEM 9210-01

OVERVIEW AND OPERATION PROCESS

1. OIL CIRCULATION



▶ OIL CIRCULATION

NO.	FUNCTION	NO.	FUNCTION
1	Oil pump	18	Oil supply (to exhaust camshaft)
2	Oil gallery (to oil filter)	19	Oil supply (to intake camshaft)
3	Oil filter	20	Oil supply (to exhaust camshaft bearing)
4	Oil pressure switch	21	Oil supply (to intake camshaft bearing)
5	Main oil gallery	22	Oil gallery (oil supply to exhaust valve tappet)
6	Cylinder head closing cover	23	Oil gallery (oil supply to intake valve tappet)
7	Oil gallery (at chain tensioner)	24	Camshaft closing cover
8	Oil non-return valve	25	Ball (ϕ 8 mm)
9	Chain tensioner	26	Screw plug
10	Vent (chain tensioner)	27	Camshaft adjuster
11	Front closing cover (ϕ 17 mm)	28	Front closing cover (intake camshaft)
12	Oil gallery (perpendicular to the shaft)	29	Front treaded bushing (exhaust camshaft)
13	Ball (ϕ 6 mm)	30	Valve tappet
14	Oil spray nozzle (timing chain)	a	Oil gallery (from oil pump to oil filter)
15	Oil gallery (at cylinder head)	b	Main oil gallery
16	Ball (ϕ 15mm)	c	Oil return line (oil returns to the oil pan when replacing the filter element)
17	Oil restriction inner (ϕ 4mm)		

Modification basis	
Application basis	
Affected VIN	

ENGINE COOLING SYSTEM

2110-01

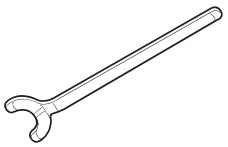
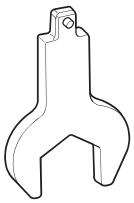
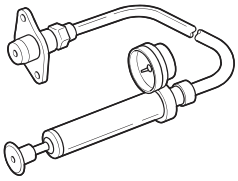
GENERAL

1. GENERAL SPECIFICATIONS

Application		Unit	Gasoline Engine
Cooling system	Type	-	Water cooling forced circulation
Coolant	Capacity	L	11.3
Thermostat	Type	-	Wax pellet type
	Initial opening temp.	°C (°F)	82 (180)
	Fully opening temp.	°C (°F)	95 (203)
	Fully closing temp.	°C (°F)	80 (176)
	Stroke	mm	7
Cooling fan	Type	-	Electric cooling
	Blades	-	5
	Diameter	mm	320
	Low speed ON temp.	°C (°F)	95 (203)
	Low speed OFF temp.	°C (°F)	90 (194)
	High speed ON temp.	°C (°F)	105 (221)
	High speed OFF temp.	°C (°F)	100 (212)
	High speed ON temp. (By A/C pressure)	kPa (psi)	269.8 (1860)
Coolant reservoir	Pressure valve opening pressure	kPa (psi)	118 ~ 147 (17.1 ~ 21.3)
	Vacuum valve opening pressure	kPa (psi)	9.8 (1.4)
Water pump	Type	-	Turbo centrifugal
	Impeller diameter	mm	65
	Impeller blades	-	8
Radiator	Type	-	Cross-flow
	Core width	mm	701
	Core height	mm	372
	Core thickness	mm	18
	Minimum radiation capability	Kcal/h	45,000
Coolant temperature gauge	Resistance (at 50°C (122°F))	Ω	185.2
	Resistance (at 80°C (176°F))	Ω	47.4
	Resistance (at 105°C (221°F))	Ω	28.2
Engine coolant temperature sensor	Resistance (at 20°C (68°F))	K Ω	3.33 ~ 37.8
	Resistance (at 80°C (176°F))	K Ω	0.32 ~ 0.35
Anti-freeze agent	Type	-	ALUTEC-P78
	Mixture of water and good quality ethylene glycol-base anti-freeze	-	50 : 50

Modification basis	
Application basis	
Affected VIN	

2. SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Name and Part Number
A9910 0060A (111 589 00 40 00) Holder 	A9910 0070A (111 589 02 01 00) Open End Wrench 
A9921 0012A (124 589 15 21 00) Leakage Te ster 	A9910 0150A (603 589 00 40 00) Fan Clutch Holder 

Modification basis	
Application basis	
Affected VIN	

3. FASTENER TIGHTENING SPECIFICATIONS

Application	Nm	Lb-Ft	Lb-In
Automatic transmission oil cooler pipe	20	15	-
Automatic transmission oil cooler pipe mounting bolt	3 ~ 7	-	27 ~ 62
Coolant drain plug	30	22	-
Cooling fan bolt	9 ~ 11	-	80 ~ 97
Cooling fan shroud bolt	3 ~ 7	-	27 ~ 62
Engine hanger bracket and coolant outlet port bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Radiator mounting bracket bolt	3 ~ 7	-	27 ~ 62
Thermostat cover bracket bolt	9 ~ 11	-	80 ~ 97
Viscous clutch mounting bolt	40.5 ~ 49.5	29.8 ~ 36.5	-
Water pump mounting bolt	22.5 ~ 27.5	16.6 ~ 20.3	-

OVERVIEW AND OPERATION PROCESS

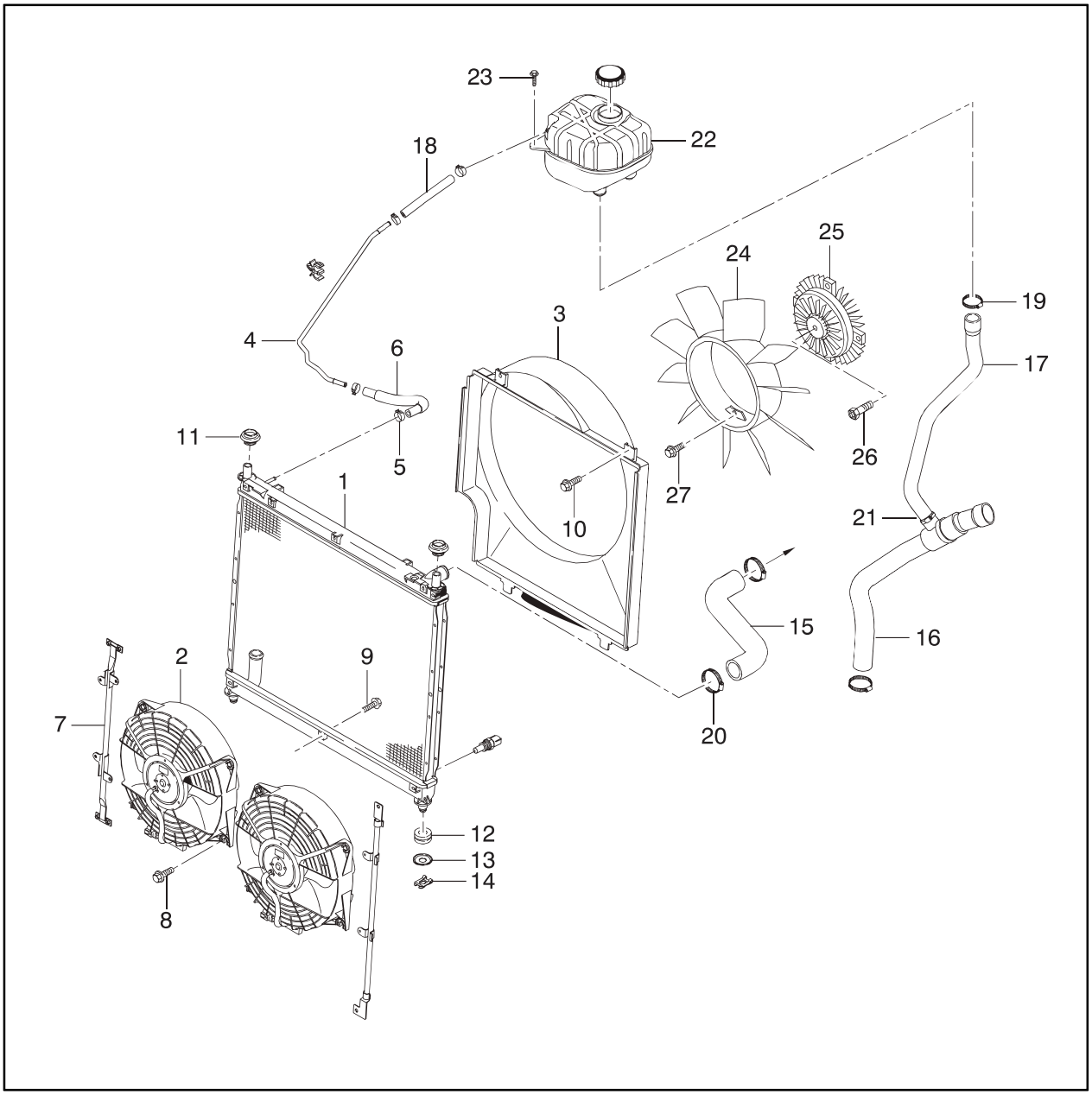
1. GENERAL DESCRIPTION

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions. When the engine is cold, the cooling system cools the engine slowly or not at all. This slow cooling of the engine allows the engine to warm up quickly. The cooling system includes a radiator and recovery subsystem, cooling fans, a thermostat and housing, a water pump, and a water pump drive belt. The timing belt drives the water pump. All components must function properly for the cooling system to operation. The water pump draws the coolant from the radiator.

The coolant then circulates through water jackets in the engine block, the intake manifold, and the cylinder head. When the coolant reaches the operating temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools. This system directs some coolant through the hoses to the heat core. This provides for heating and defrosting. The coolant reservoir is connected to the radiator to recover the coolant displaced by expansion from the high temperatures. The coolant reservoir maintains the correct coolant level. The cooling system for this vehicle has no radiator cap or filler neck. The coolant is added to the cooling system through the coolant reservoir.

Modification basis	
Application basis	
Affected VIN	

2. COMPONENT LOCATOR



1. Radiator
2. Electric fan
3. Shroud
4. Deaeration tube
5. Clamp
6. Deaeration hose (radiator)
7. Electric fan mounting bracket
8. Bolt (M6, 8 pieces)
9. Bolt (M6, 4 pieces)
10. Bolt (M6, 4 pieces)
11. Upper radiator insulator
12. Lower radiator insulator
13. Plate
14. Clip
15. Inlet hose
16. Outlet hose
17. 3 way hose
18. Deaeration hose (reserver tank)
19. Clamp
20. Clamp
21. Make up hose holder
22. Reserver tank
23. Bolt (M6, 2 piece)
24. Cooling fan
25. Viscous clutch
26. Bolt (M6, 1 piece)
27. Bolt (M6, 3 piece)

Modification basis	
Application basis	
Affected VIN	

ENGINE ELECTRIC DEVICES 1452-01

GENERAL

1. GENERAL SPECIFICATIONS

Application			Unit	Gasoline Engine
Starter	Type		-	PG170S
	Output power		Kw	1.8
	No load test @ 12 volts		A	98
	Drive pinion speed at no load		rpm	2,600
	Drive pinion speed at load		rpm/A	1,087/380
	Brush length		mm	16.1
	Armature diameter		mm	54.1
	Armature run-out		mm	0.08
	Segment groove depth		mm	19.6
Alternator	Type		-	SG135
	Output voltage / current		V/A	14/115
	Regulator type		-	HYBRID
	Regulating voltage		V	14.7
	Brush	Length	mm	18.5
		Quantity	-	2
		Abrasion limit	mm	13.5
Battery	Type		-	MF
	Capacity		AH	75
	Reserve capacity		RC	130
Ignition coil	Type		-	DIS
	Primary coil resistance		W	0.3 ~ 0.9
	Secondary coil resistance		KW	6 ~ 8.5
Spark plug	Type		-	WR8DC
	Clearance		-	0.8 ~ 0.9
High tension cable	Resistance		KW/m	1.9

2. FASTENER TIGHTENING SPECIFICATIONS

Application	Nm	Lb-Ft	Lb-In
Batter cable nut	12 ~ 18	9 ~ 13	-
Battery cable nut on starter	12 ~ 15	9 ~ 11	-
Batter mounting bracket nut	12 ~ 18	9 ~ 13	-
Engine electric wire nut on starter	6 ~ 7	-	53 ~ 62
Alternator combination bolt	42 ~ 50	31 ~ 37	-
Alternator terminal b+ nut	14 ~ 18	10 ~ 13	-
Alternator terminal d+ nut	4 ~ 5	-	35 ~ 44
Ignition cable cover bolt	9 ~ 11	-	80 ~ 97
Ignition coil bolt	9 ~ 11	-	80 ~ 97
Spark plug	25 ~ 30	15 ~ 22	-
Starter mounting bolt	35 ~ 48	26 ~ 35	-

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. CHARGING SYSTEM OPERATION

Alternators use a new type of regulator that incorpo-rates a diode trio. A Delta stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier alternators.
A conventional pulley and fan are used. There is no test hole.

1) CHARGING TIME REQUIRED

The time required to charge a battery will vary depending upon the following factors:

▶ Size of Battery
- A Completely discharged large heavy-duty battery required more than twice the recharging time as a completely discharged small passenger car battery.

▶ Temperature
- A longer time will be needed to charge any battery at −18°C (0°F) than at 27°C (80°F). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. The battery will accept a higher current rate as the battery warms.

▶ Charger Capacity
- A charger which can supply only 5 amperes will require a much longer charging period than a charger that can supply 30 amperes or more.

▶ State-of-Charge
- A completely discharged battery requires more than twice as much charge as a onehalf charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

2. STARTING SYSTEM OPERATION

The engine electrical system includes the battery, the ignition, the starter, the alternator, and all the related wiring. Diagnostic tables will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that component section of the service manual. The starting system circuit consists of the battery, the starter motor, the ignition switch, and all the related electrical wiring. All of these components are connected electrically.

3. IGNITION SYSTEM OPERATION

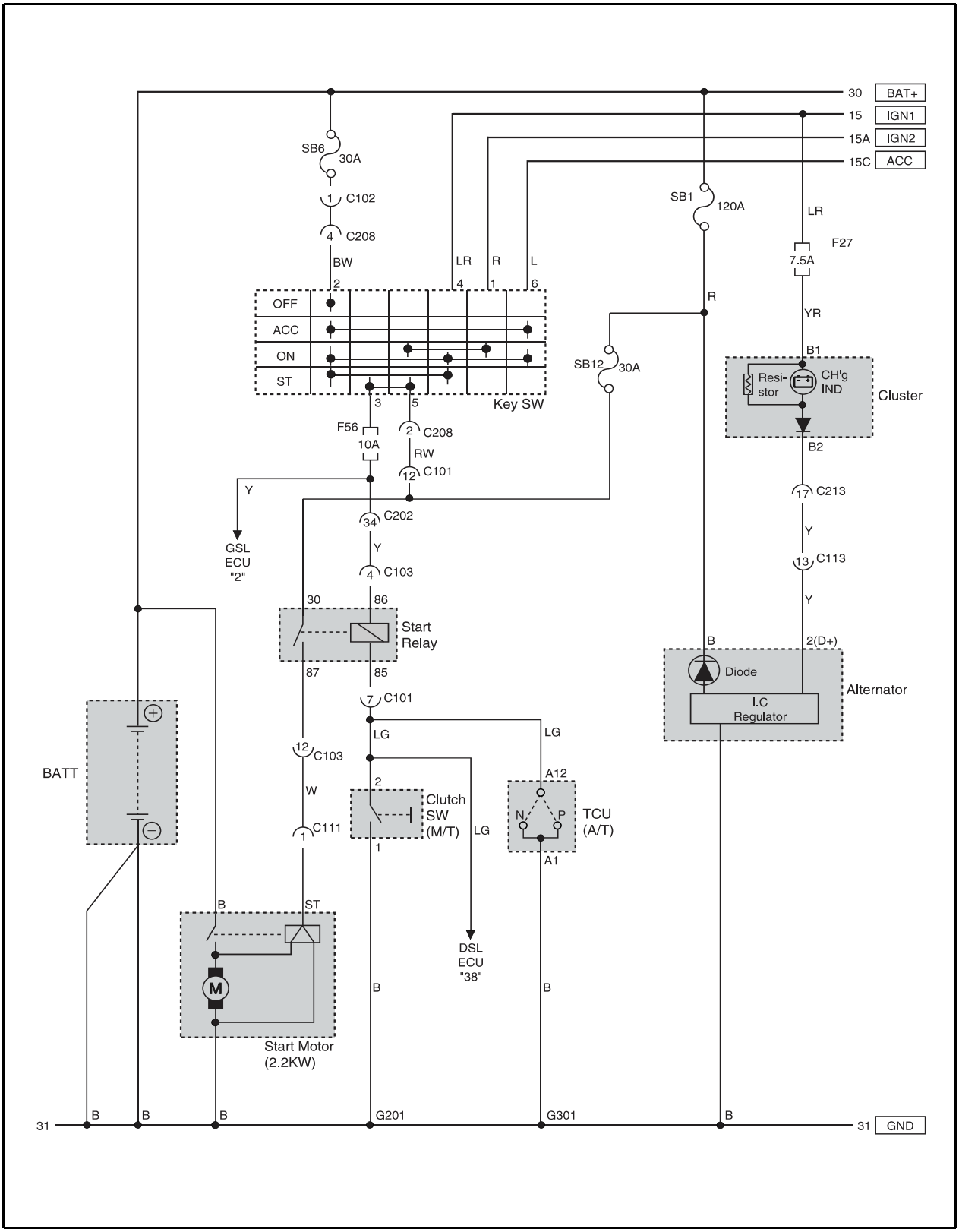
This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor input to the Engine Control Module (ECM).
The ECM then determines Electronic Spark Timing (EST) and triggers the electronic ignition system ignition coil.
This type of distributorless ignition system uses a "waste spark" method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (2.3L DOHC: 2 - 3 or 1 - 4, 3.2L DOHC: 1 - 6 or 2 - 5 or 3 - 4).
The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke.
The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug.
The remaining energy is available to the spark plug in the cylinder on the compression stroke. These systems use the EST signal from the ECM to control the EST.
The ECM uses the following information: Engine load (mass air flow sensor, manifold air pressure sensor).
Engine coolant temperature.
Intake air temperature.
Crankshaft position.
Engine speed (rpm).

1) Electronic Ignition System Ignition Coil

The Electronic Ignition (EI) system ignition coil is located on the cylinder head cover.
The double ended coils re ceive the signal for the ECM which controls the spark advance.
Each EI system ignition coil provides the high voltage to two spark plugs simultaneously;
3.2L DOHC
T1/1: cylinder 2 and 5
T1/2: cylinder 3 and 4
T1/3: cylinder 1 and 6
The EI system ignition coil is not serviceable and must be replaced as an assembly.

Modification basis	
Application basis	
Affected VIN	

4. STARTING AND CHARGING SYSTEM (GASOLINE ENGINE) CIRCUIT



Modification basis	
Application basis	
Affected VIN	

ENGINE CONTROL SYSTEM 1522-16

GENERAL

1. ENGINE DATA DISPLAY TABLE

Parameter	Unit	Value
Engine coolant temp.	℃	greater than 95℃ after warm up
Intake air temp.	℃	-40 ~ 130℃ (varies with ambient temp. or engine mode)
Engine rpm	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Regular rpm	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Engine load	%	18 ~ 25 %
Mass air flow meter	Kg/h	16 ~ 25 Kg/h
Throttle position angle	℃TA	0℃TA (up to 100℃TA at the wide open throttle)
Spark advance	℃CA	℃CA (6 ~ 9℃CA)
Indicated engine torque	Nm	Varies with engine condition
Injection time	ms	3 ~ 5 ms
Battery voltage	V	13.5 ~ 14.1V (engine running)
Front axle speed	Km/h	0 ~ 265 Km/h
Rear axle speed	Km/h	0 ~ 265 Km/h
Accel. Pedal position 1	V	0.4 ~ 4.8 V
Accel. Pedal position 2	V	0.2 ~ 2.4 V
Throttle position 1	V	0.3 ~ 4.6 V
Throttle position 2	V	0.3 ~ 4.6 V
Fuel integrator		0.8 ~ 1.2
Oxygen sensor	mv	100 ~ 900 mv
A/c s/w condition	1=ON/0=OFF	-
Full load state	1=ON/0=OFF	-
Shift gear state (A/T)	1=ON/0=OFF	-
A/c control state	1=ON/0=OFF	-
Clutch switch (M/T)	1=ON/0=OFF	-
Cam actuator state	1=ON/0=OFF	-
Knocking control	1=ON/0=OFF	-
Protect mission	1=ON/0=OFF	-
Purge control valve	1=ON/0=OFF	-
Lambda function	1=ON/0=OFF	-
Catalyst heating	1=ON/0=OFF	-
Overrun fuel cut	1=ON/0=OFF	-
Full fuel cut	1=ON/0=OFF	-
Brake switch	1=ON/0=OFF	-
Cruise control status	1=ON/0=OFF	-

* Condition: Warmed up, idle, P/N or neutral

1) TEMPERATURE VS RESISTANCE

℃	°F	ECT Sensor	IAT Sensor
		ohms (Ω)	
Temperature vs Resistance Values (Approximate)			
130	266	88	102
120	248	111.6	127
110	230	143	159
100	212	202	202
90	194	261	261
80	176	340	340
70	158	452	452
60	140	609	609
50	122	835	835
40	113	1166	1166
30	86	1662	1662
20	68	2420	2420
10	50	3604	3604
0	32	5499	5499
-10	14	8609	8609
-20	-4	13850	13850
-30	-22	22960	22960
-40	-40	39260	39260

2. FASTENER TIGHTENING SPECIFICATIONS

Application	Nm	Lb-Ft	Lb-In
Camshaft position sensor retaining bolts	10	-	89
Canister mounting bolts	6	-	53
Coolant temperature sensor	30	22	-
Crankshaft position sensor retaining bolt	10	-	89
Engine Control Module (ECM) mounting bracket nuts	10	-	89
Fuel filter mounting bracket bolt	6	-	53
Fuel filter lines	28	21	-
Fuel pressure test connector	25	18	-
Fuel rail assembly bolts	25	18	-
Fuel return and supply lines	23	17	-
Fuel tank retaining nuts	38	28	-
Intake air duct mounting bolts	9	-	80
Knock sensor mounting bolt	25	18	-
Oxygen sensor	55	41	-
Pedal position censor mounting bolts and nut	6	-	53
Throttle body bolts	12	-	106

Modification basis	
Application basis	
Affected VIN	

CRUISE CONTROL SYSTEM 8510-23

OVERVIEW AND OPERATION PROCESS

1. CRUISE CONTROL SWITCH



The purpose of the cruise control system is to automatically maintain a vehicle speed set by the driver, without depressing the accelerator pedal. The cruise control switch is located under the right side of the steering wheel, and when this switch is operating "AUTO CRUISE" lamp comes on.

The minimum speed for setting the cruise control system is 36 km/h (22.37 mph). Pay constant attention to the distance between the vehicles and the traffic conditions when using the cruise control system.

CAUTION

The cruise control system is a supplementary system, which helps the driver to drive the vehicle at a desired speed without using the accelerator pedal under the traffic condition where the vehicle-to-vehicle distance meets the legal requirement.

1) When To Use

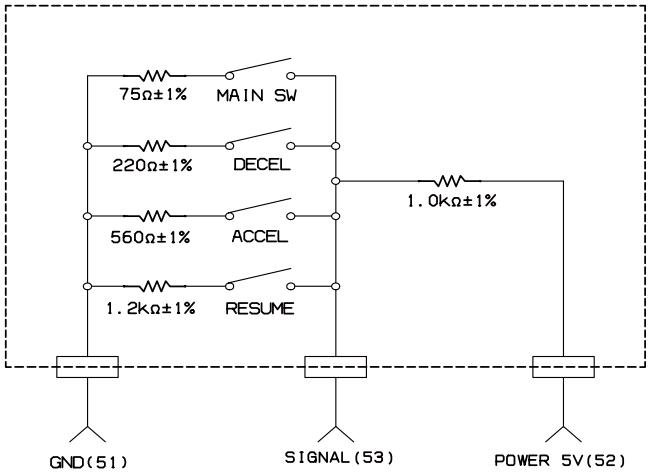
Use the cruise control system only when (a) the traffic is not jammed, (b) driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

WARNING

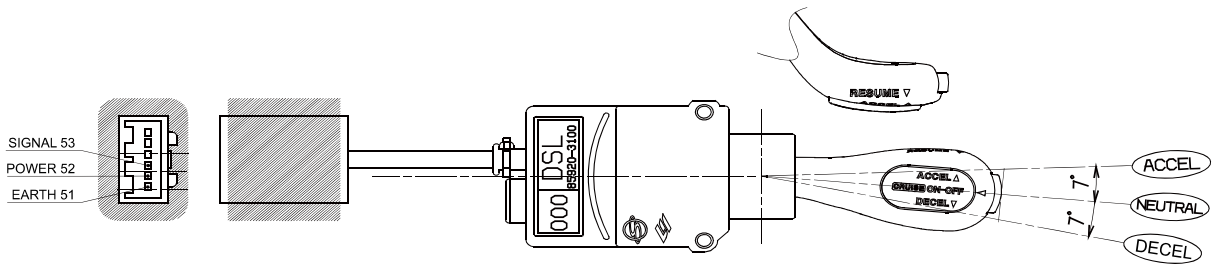
Use the cruise control system only when driving on motorways or highways. Do not use the cruise control system where the road conditions are as follows:
- When there is strong wind or cross wind.
- Heavy traffic.
- Slippery roads or steep decline.

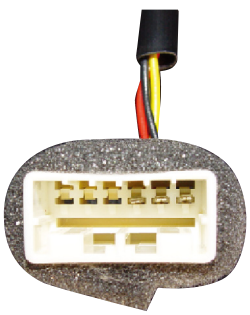
Modification basis	
Application basis	
Affected VIN	

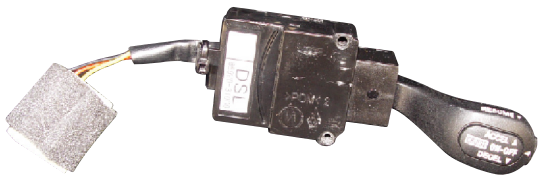
2. CIRCUIT DIAGRAM



1) Configuration







3. HOW TO OPERATE CRUISE CONTROL SWITCH

1) How To Set Speed



1. To operate the cruise control system, accelerate the vehicle to the speed within the specified range below with depressing the accelerator pedal.
   - Cruise control operating range: between 36 km/h (22.37 mph) and 150 km/h (93.207 mph)
2. When the desired speed is reached, which should be within the above range, push up the cruise control switch lever to ACCEL side (upwards arrow), or push down the switch lever to DECEL side (downwards arrow).
   And then release the accelerator pedal slowly.
3. Now the vehicle is cruised by this system with the set speed. You don't need to use the accelerator pedal.
4. Refer to the following pages for details of operation.

CAUTION

Never use the cruise control system until you get used to it.
Improper use or not fully aware of this function could result in collision and/or personal injuries.

Modification basis	
Application basis	
Affected VIN	

2) Accelerating with the Cruise Control System



(1) While the cruise control system is running

1. To increase the set speed, push up the cruise control switch lever to ACCEL side and hold it until the desired speed is reached without depressing the accelerator pedal.
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To increase the speed with the cruise control system while the system is not running, follow the procedures below.

1. Accelerate the vehicle to more than 36 km/h (22.37 mph) using the accelerator pedal. Push up the cruise control switch lever to ACCEL side and hold it.
2. When the desired speed is reached, release the accelerator pedal and the switch lever.

(3) Tap-up while the cruise control system is running

To increase the vehicle speed in stages while the cruise control system is running, follow the procedures below.

1. Push up the cruise control switch lever to ACCEL side for less than 0.5 second per one switching while the cruise control system is running; the speed increases each time by 1.3 km/h (0.81 mph).
2. For example, if you want to increase the speed 13 km/h (81 mph) more than the previous set speed, tap up the switch lever to ACCEL side ten times without using the accelerator pedal.

3) Decelerating with the Cruise Control System



(1) While the cruise control system is running

1. To decrease the set speed, push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached without depressing the brake pedal.
   But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To decrease the speed with the cruise control system while the system is not running, follow the procedures below.

1. Push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached while the vehicle speed is over 36 km/h (22.37 mph).
2. When the desired speed is reached, release the switch lever.
3. But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).

(3) Tap-down while the cruise control system is running

To decrease the vehicle speed in stages while the cruise control system is running, follow the below procedures.

1. Push down the cruise control switch lever to DECEL side for less than 0.5 second per one switching while the cruise control system is running; the speed decreases each time by 1.0 km/h (0.62 mph).
2. For example, if you want to decrease the speed 10 km/h (62 mph) lower than the previous set speed, tap down the switch lever to DECEL side ten times without using the brake pedal.

Modification basis	
Application basis	
Affected VIN	

4) Recovery of Set Speed (RESUME)



Even if the cruise control is cancelled, the previous set cruise speed can be recovered by operating the cruise control switch lever like below:
- Pull the switch lever in the arrow direction shown in the illustration.

This RESUME function works only when the vehicle speed is more than 36 km/h (22.37 mph) without using the accelerator or brake pedal.

CAUTION

But the driver should know the previous set speed to react to the changed vehicle speed properly. If the vehicle speed increases abruptly, depress the brake pedal to adjust the vehicle speed properly.

5) Normal Cancellation of the Cruise Control (OFF ↔ ON)



The cruise control system will be cancelled when the button on the side of the switch is pressed, or when one of the following conditions is met:

1. When the brake pedal is depressed or ESP is activated.
2. When the vehicle speed is less than 34 km/h (21.13 mph).
3. When the parking brake is applied while driving.
4. When the clutch pedal is depressed for shifting (M/T only).

CAUTION

Put the cruise control switch lever in the neutral position when not using the cruise control system.

(1) Abnormal Cancellation of the Cruise Control

1. When the rapid deceleration or acceleration occurs.
2. When the cruise control lever is faulty.
3. When the brake switch is malfunctioning or has an open circuit.

When the cruise control function is cancelled abnormally or intermittent problems occur, stop the vehicle and turn off the ignition switch and remove the key to reset the system. After a while, turn on the ignition switch again to operate the cruise control system.

CAUTION

- Do not move the shift lever to Neutral position while driving with the cruise control turned on. Otherwise, it may result in system malfunction or accidents.
- Always be prepared to use the brake or accelerator pedal for safe driving while the cruise control system is running.
- The actual speed can be different from the set speed momentarily when driving on a uphill or downhill. So, it is recommended to disable the cruise control function on a uphill or downhill. hen driving on a steep hill use the engine brake and foot brake properly to protect the vehicle system and for a safe driving.
- Ensure that the braking distance is maintained and use the brake pedal if needed.

Modification basis	
Application basis	
Affected VIN	

ENGINE ASSEMBLY 1113-01

GENERAL

1. DESCRIPTION AND OPERATION

1) Cleanliness and Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousanths of an inch.
When any internal engine parts are serviced, care and cleanliness are important.
A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure.
This is considered standard shop practice even if not specifically stated.
Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.
Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

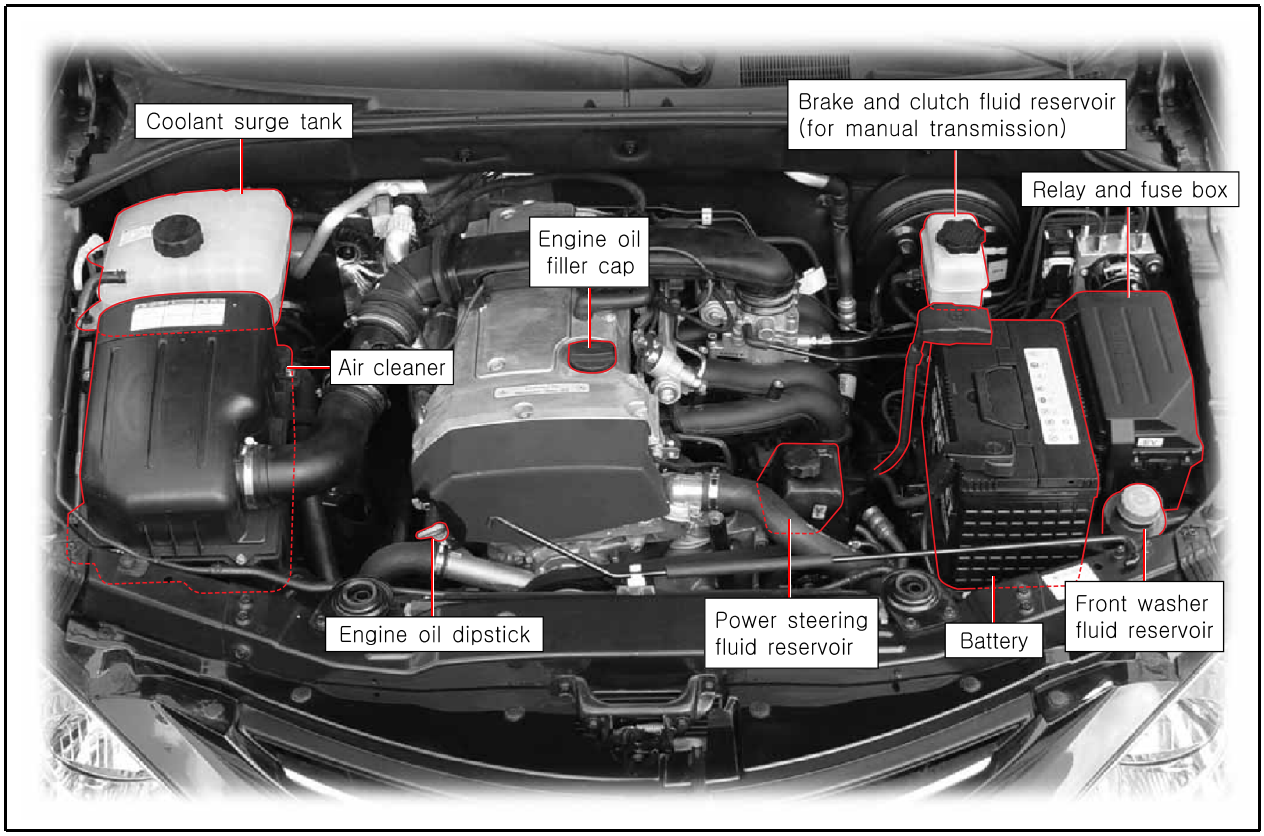
2) On-engine Service

CAUTION

- Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

CAUTION

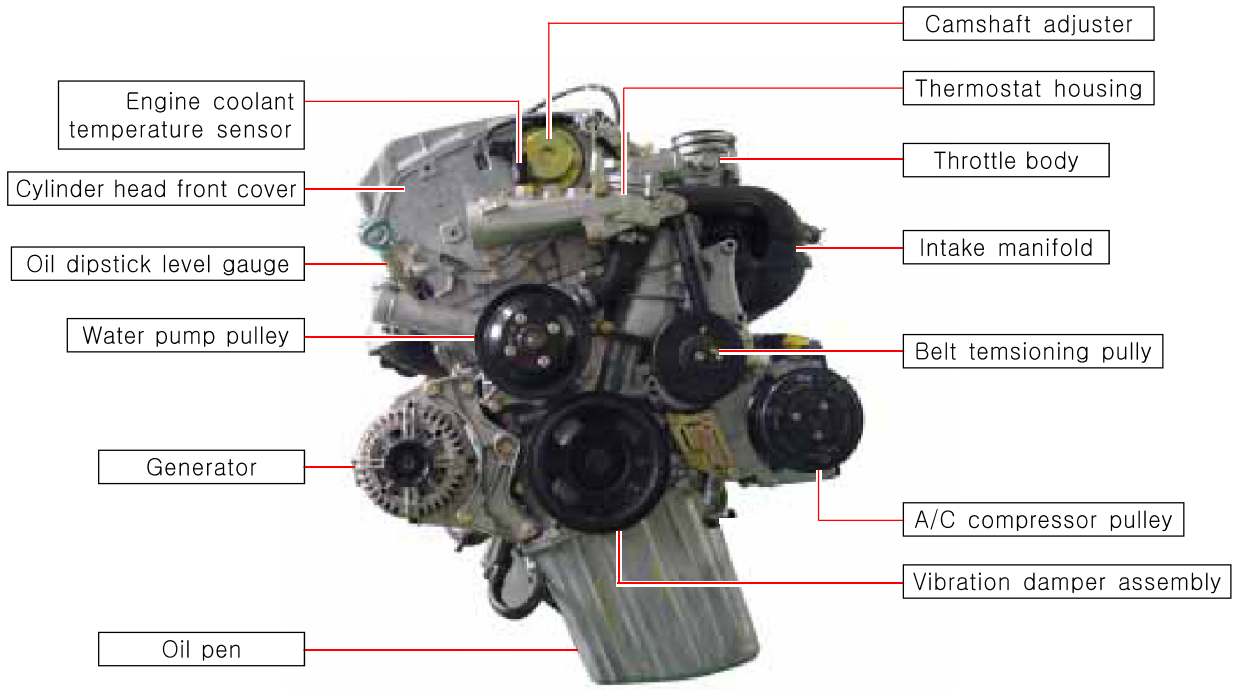
- Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.



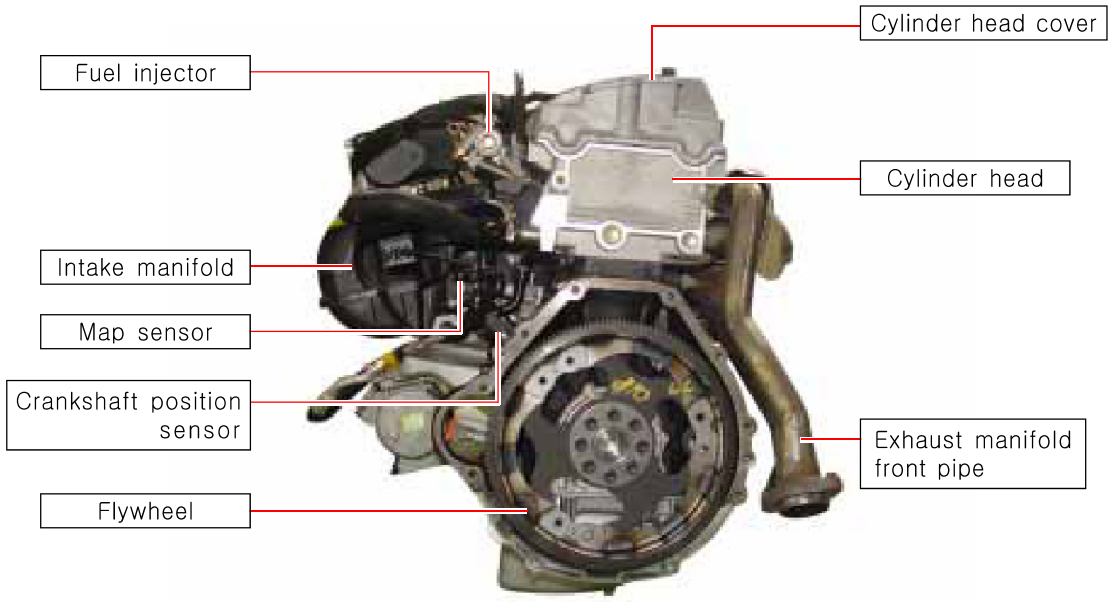
Modification basis	
Application basis	
Affected VIN	

2. G23D ENGINE ASSEMBLY

Front View

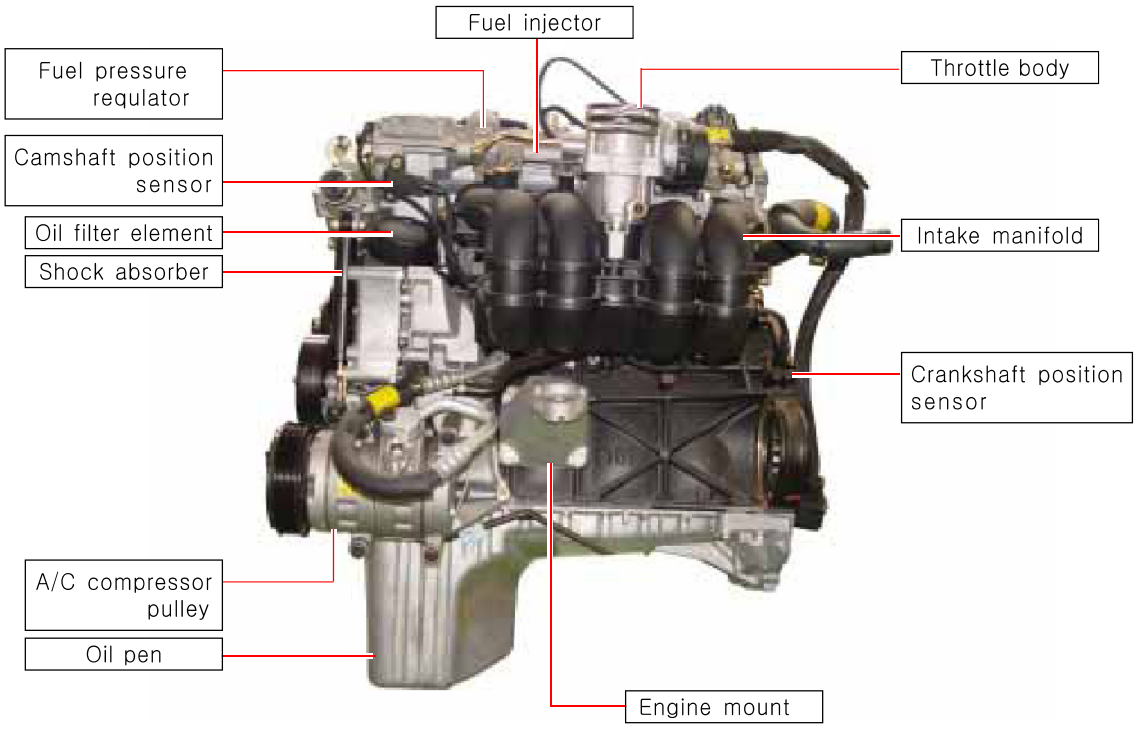


Rear View

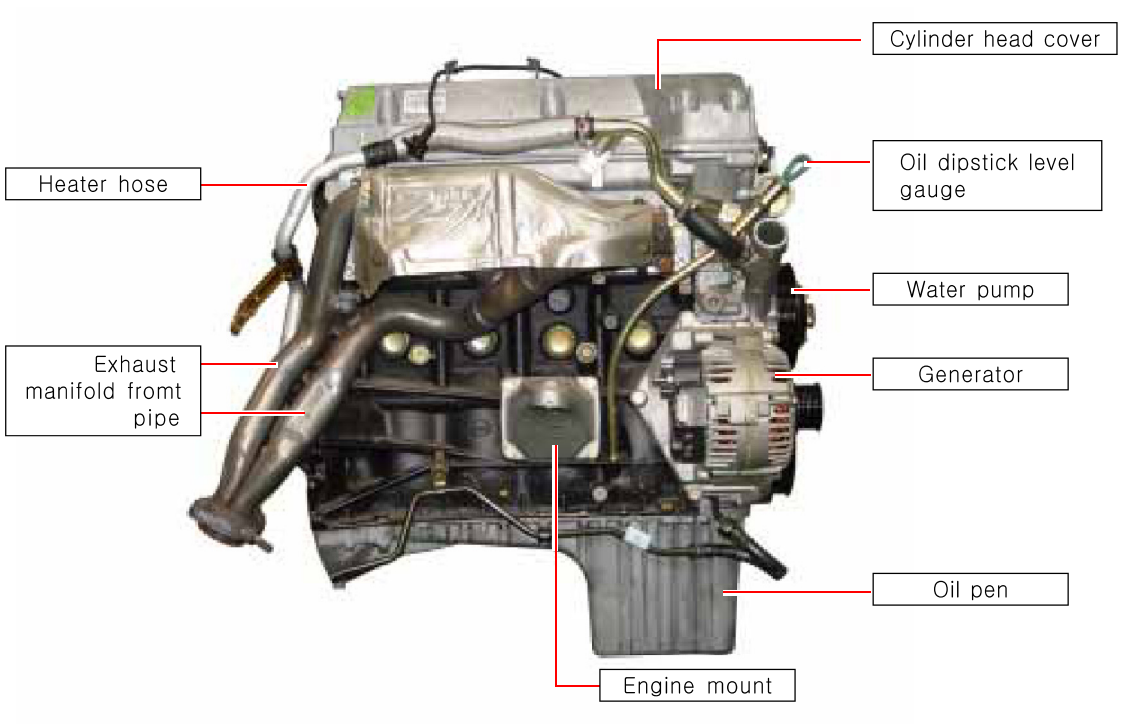


Modification basis	
Application basis	
Affected VIN	

LH Side View



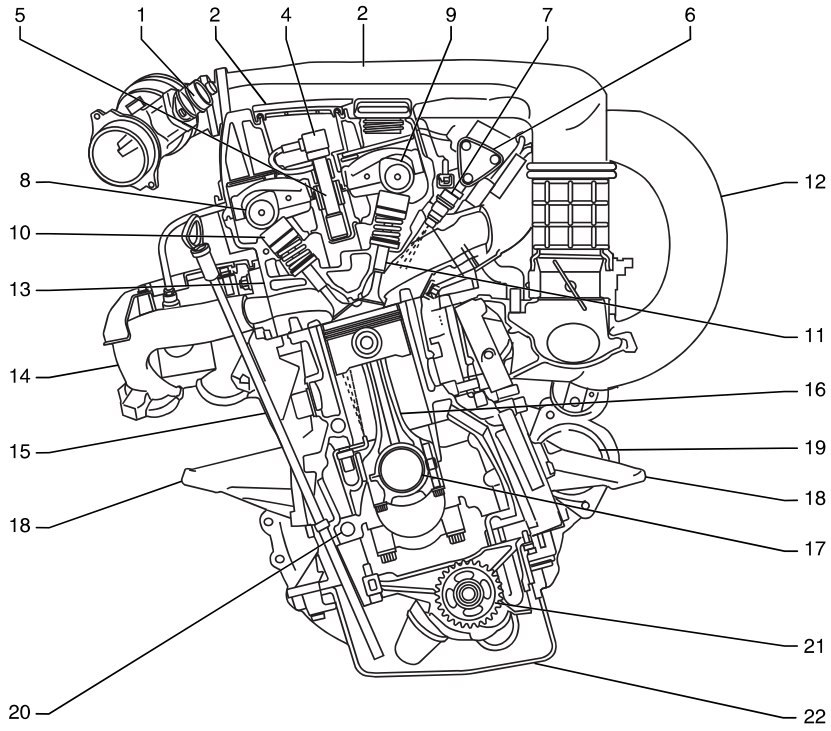
RH Side View



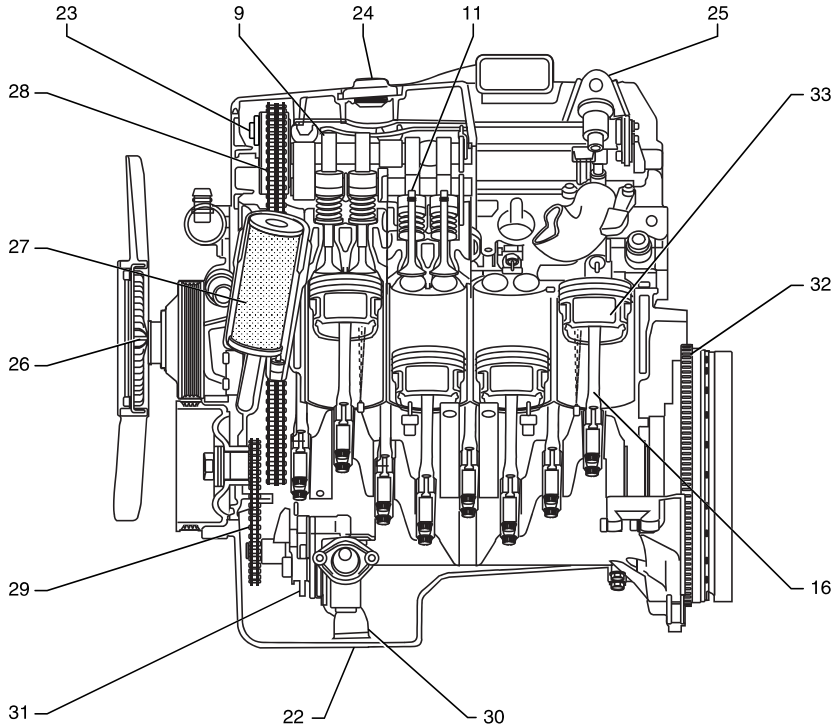
Modification basis	
Application basis	
Affected VIN	

3. G23D ENGINE STRUCTURE

Front View



Side View



▶ **Front View**

NO.	FUNCTION	NO.	FUNCTION
1	HFM Sensor	12	Intake Manifold
2	Intake Air Duct	13	Cylinder Head
3	Cylinder Head Cover	14	Exhaust Manifold
4	Ignition Coi	15	Dipstick Guide Tube and Gauge
5	Spark Plug Connector	16	Connecting Rod
6	Fuel Distributor	17	Crankshaft
7	Injector	18	Engine Mounting Bracket
8	Exhaust Camshaft	19	Starter
9	Intake Camshaft	20	Crankcase
10	Valve Tappet	21	Oil Pump Sprocket
11	Intake Valve	22	Oil Pan

▶ **Side View**

NO.	FUNCTION	NO.	FUNCTION
23	Camshaft Adjuster	29	Oil Pump Drive Chain
24	Oil Filler Cap	30	Oil Strainer
25	Engine Hanger Bracket	31	Oil Pump
26	Cooling Fan and Viscous Clutch	32	Ring Gear and Flywheel of Drive Plate
27	Oil Filter	33	Piston
28	Timing Chain		

Modification basis	
Application basis	
Affected VIN	

4. DIAGNOSTIC INFORMATION AND PROCEDURE

1) Oil Leak Diagnosis

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

▶ Finding the Leak

- Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
- Identify where the fluid is leaking from.
  · After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
  · Wait a few minutes.
  · You should be able to find the approximate location of the leak by the drippings on the paper.
- Visually check around the suspected component.
  Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
- If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
  · Clean the area well.
  · Dry the area.
  · Operate the vehicle for several miles at normal operating temperature and varying speeds.
  · After operating the vehicle, visually check the suspected component.
  · If you still cannot locate the leak, try using the powder or black light and dye method.

▶ Powder Method

- Clean the suspected area.
- Apply an aerosol-type powder (such as foot powder) to the suspected area.
- Operate the vehicle under normal operating conditoins.
- Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

▶ Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

- Pour the specified amount of dye into the engine oil fill tube.
- Operate the vehicle normal operating conditions as directed in the kit.
- Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

▶ Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly.

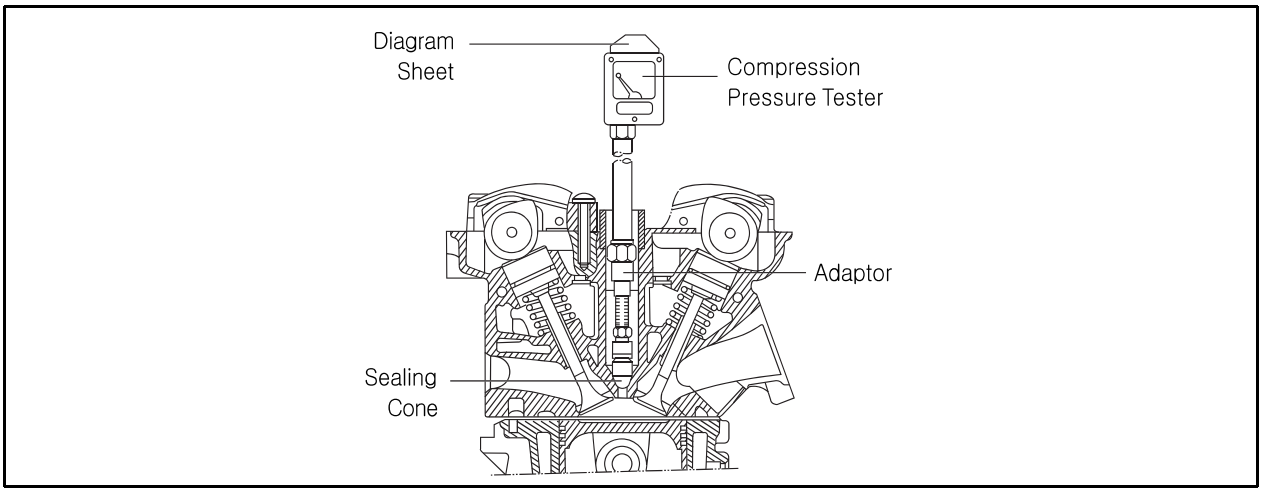
If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

▶ Gaskets

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

Modification basis	
Application basis	
Affected VIN	

2) Compression Pressure Test



▶ Standard Service Data

Application	G23D Engine
Compression Ratio	10.4 : 1
Normal Engine Temperature	←
Normal Compression Pressure	Min. 11 bar, Max. 15 bar
Permissible Pressure Difference Between Individual C ylinders	←

CAUTION

- A9912 0012B (001 589 76 21 00) Compression Pressure Tester

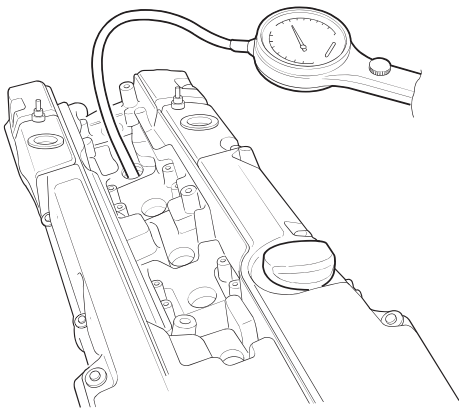
▶ Measuring Procedure

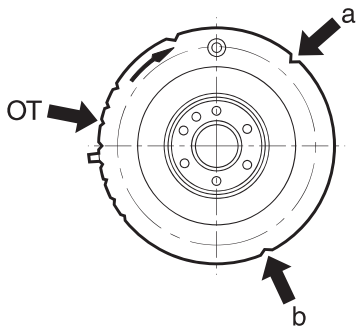
- Warm the engine up to normal operating temperature.
- Remove the spark plugs using the spark plug wrench.
- Place the diagram sheet to compression pressure tester A9912 0012B (001 589 76 21 00).
- Connect the adaptor to compression pressure tester A9912 0012B (001 589 76 21 00) and install it into the spark plug hole.
- Crank the engine approx. eight revolutions by using the start motor.
- Compare the measurements of compression pressure tester A9912 0012B (001 589 76 21 00) with the specifications.
- Measure the compression pressure of the other cylinders in the same way.
- If measured value is not within the specifications, perform the cylinder pressure leakage test.

CAUTION

- Discharge the combustion residues in the cylinders before testing the compression pressure.
- Apply the parking brake before cranking the engine.

3) Cylinder Pressure LeakageTest





▶ **Permissible Pressure Leakage**

At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

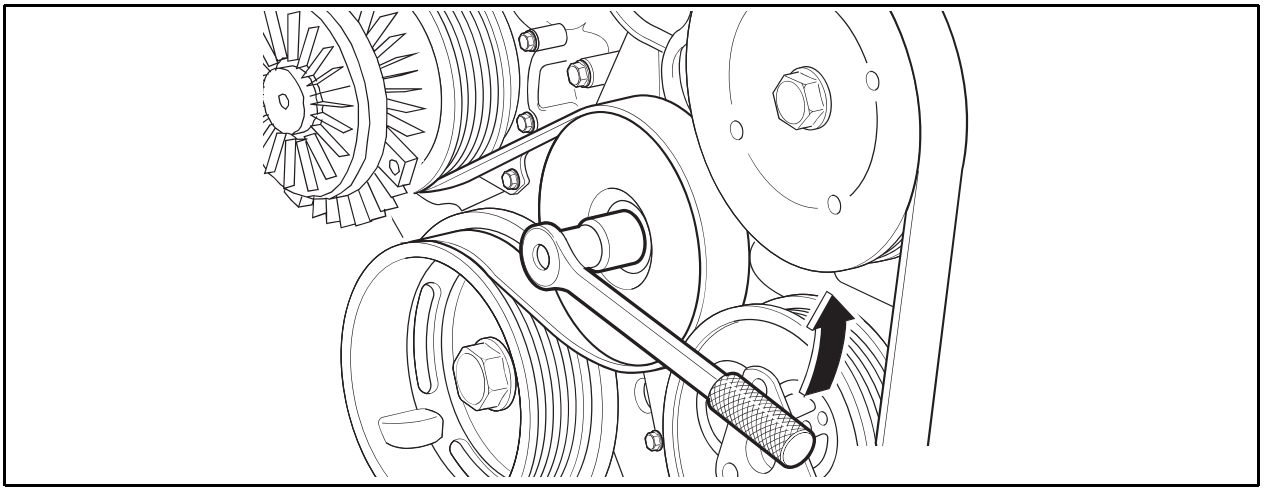
▶ **Cylinder Number**

OT (TDC)	1, 4
UT (BDC 180 °)	2, 3

▶ **Cylinder Number**

Cylinder Pressure Leakage Tester	Bosch, EFAW210A Sun, CLT 228

Modification basis	
Application basis	
Affected VIN	



▶ **Leakage Test**

- Warm the engine up to normal operating temperature.
- Disconnect the negative battery cable.
- Remove the spark plugs.
- Check the coolant level by opening the coolant reservoir cap and replenish if insufficient.
- Open the engine oil filler cap.
- Connect the tester to air pressure line and adjust the scale of tester.
- Install the connecting hose to spark plug hole.
- Position the piston of No.1 cylinder at TDC by rotating the crankshaft.
- Connect the connecting hose to tester and measure the leakage volume after blowing up 5 bar of compressed air.

CAUTION

- Measure the leakage volume in the completely opening condition of throttle valve by pulling the acceleration cable.

- Perform the pressure test according to the firing order.

CAUTION

- Firing Order: 1 - 3 - 4 - 2

- Compare the leakage pressure with the specifications.

5. GENERAL DIAGNOSIS

Condition		Probable Cause	Correction
Hard starting (With normal cranking)	Malfunction of immobilizer system	• Faulty immoblilzer system	• Check (Antenna, Immobilizer transponder) • Replace (Antenna, Immobilizer transponder)
	Malfunction of ignition system	• Faulty fuse	• Replace the fuse.
		• Faulty spark plug.	• Clean, adjust the plug gap or replace.
		• Electric leakage at the high tension cable.	• Replace the cable.
		• Poor connection of the high tension cable or lead wires.	• Replace the cable or wires.
		• Faulty ignition coil.	• Replace the ignition coil.
	Malfunction of fuel system	• Empty of fuel in the fuel tank.	• Feed the fuel.
		• Dirty or clogged fuel filter.	• Replace the filter.
		• Clogged fuel pipe.	• Clean the fuel pipe.
		• Malfunction of the fuel pump.	• Replace the fuel pump.
		• Malfunction of the fuel injector.	• Replace the injector.
		• The foreign material in the fuel tank.	• Clean the fuel tank.
	Decline of compression pressure	• Poor tightening spark plug.	• Tighten to the specified torque. Compression
		• Cracked cylinder head gasket.	• Replace the gasket.
		• Inadequate the valve clearance.	• Adjust the clearance.
		• Leakage of the valve clearance.	• Repair the valve.
		• Interference of the valve stem.	• Replace the valve or the valve guide.
		• Low elasticity or damage of the valve spring.	• Replace the valve spring.
		• Abnormal interference of pistons and cylinders.	• Replace the piston ring.
		• Excessive wear of pistons, rings, or cylinders.	• Replace the ring or the piston and boring or replace the cylinder.
	Others	• Broken timing belt.	• Replace the belt.
		• Loosening, damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
		• Leakage of intake system.	• Replace intake system.
Lack of engine power	Decline of compression pressure	• Refer to above in this page.	• Refer to above in this page.
	Malfunction of ignition system	• Faulty spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.

Modification basis	
Application basis	
Affected VIN	

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Lack of engine power	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
	Others	• Clogged exhaust system.	• Check and repair the system.
		• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Dragging brakes.	• Repair or replace the brakes.
Rough engine idling	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the regulator.
	Malfunction of ignition system	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Malfunction of the ignition coil.	• Replace the ignition coil.
	Others	• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Poor connection or damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Engine hesitate (Upon pressing accelerating pedal, the engine makes delayed response This situation is remarkable when cruising or starting.)	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of ignition system	• Poor spark plug or Poor adjustment of the plug gap.	• Replace the plug or adjust the gap.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Others	• Malfunction of the air cleaner system.	• Clean or replace the air cleaner system.
		• Leak of the intake manifold gasket.	• Replace the gasket.

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Engine surging (Engine power makes fluctuation in a fixed speed and speed changes without operating the accelerating pedal.)	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the fuel pressure regulator.
	Malfunction of ignition system	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
	Others	• Leak of the intake manifold gasket.	• Clean or replace the gasket.
		• Leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Excessive detonation (According to the opening range of Malfunction of metallic is made with abnormal explosion)	Overtheated engine	• Refer to "Overheat" in this page.	• Refer to "Overheat" in this page.
	Malfunction of fuel system	• Abnormal spark plug.	• Replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Malfunction of ignition system	• Clogged or contaminated fuel filter and fuel pipe.	• Clean or replace the fuel filter and the fuel pipe.
	Others	• Leak of the intake manifold gasket.	• Replace the gasket.
		• Excessive carbon deposit due to abnormal combustion.	• Remove the carbon.
Overheat	Malfunction of cooling system	• Lack of coolant.	• Refill coolant.
		• Malfunction of the thermostat.	• Replace the thermostat.
		• Malfunction of the cooling fan.	• Check or replace the cooling fan.
		• Poor water pump performance.	• Replace the pump.
		• Clogged or leaky radiator.	• Clean, repair or replace the radiator.
	Malfunction of lubrication system	• Poor engine oil.	• Replace engine oil with the specified one.
		• Blocking oil filter or strainer.	• Clean or repair the oil filter or the strainer.
		• Lack of engine oil.	• Refill oil.
		• Poor oil pump performance.	• Replace or repair the pump.
	Other	• Leakage of oil	• Repair.
		• Damaged cylinder head gasket.	• Replace the gasket.

Modification basis	
Application basis	
Affected VIN	

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Poor fuel consumption	Decline of compression pressure	• Refer to "Page 1A-7".	• Refer to "Page 1A-7".
	Malfunction of fuel system	• Leakage of the fuel tank or the fuel pipe.	• Repair or replace the fuel tank or the fuel pipe
	Malfunction of ignition system	• Abnormal spark plug (Excessive carbon deposit, inadequate gap, burnt electrode).	• Replace the plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable normally or replace it.
	Malfunction of cooling system	• Malfunction of the thermostat.	• Repair the thermostat.
	Others	• Improperly installed valve.	• Repair or replace the valve.
		• Low pressure of tires.	• Adjust the pressure of tires.
Excessive consumption of engine oil	Leakage of engine oil	• Loosened oil drain plug.	• Tighten the plug.
		• Loosened oil pan bolt.	• Tighten the bolt. Engine Oil
		• Loosened oil filter.	• Tighten the filter.
		• Loosened oil pressure switch.	• Tighten the switch.
		• Leakage of camshaft front oil seal.	• Replace the seal.
		• Leakage of crankshaft front oil seal.	• Replace the seal.
		• Leakage at the cylinder head cover gasket.	• Replace the gasket.
		• Damage of the cylinder head gasket.	• Replace the gasket.
	Oil mixing in combustion chamber	• Stuck piston ring.	• Remove carbon and replace the ring.
		• Worn piston or cylinder.	• Replace the piston or the cylinder.
		• Worn piston ring or ring groove.	• Replace the piston or ring.
		• Inadequate position of the piston ring cutting part.	• Adjust the position.
		• Abrasion or damage of the valve system.	• Replace the valve system.
Low oil pressure	Malfunction of lubrication system	• Inadequate oil viscosity.	• Replace with the specified one.
		• Loosening of the oil pressure switch.	• Tighten the switch.
		• Lack of engine oil.	• Refill oil.
		• Blocking oil strainer.	• Clean the strainer.
		• Lowered function of the oil pump.	• Replace the pump.
		• Abrasion or damage of the oil pump relief valve.	• Replace the valve.

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Engine noise	Valve noise	• Inadequate valve clearance	• Adjust the valve clearance.
		• Abrasion of valve stem or guide.	• Replace the valve stem or the guide.
		• Weak valve spring.	• Replace the spring.
	Piston, ring, cylinder noise	• Abrasion of the piston, the ring or the cylinder.	• Boring the cylinder or replace the piston, the ring or the cylinder.
	Connecting rod noise	• Abrasion of the connecting rod bearing.	• Replace the bearing.
		• Loosened the connecting rod nut.	• Tighten to the specified torque
	Crankshaft noise	• Abrasion of the crankshaft bearing.	• Replace the bearing.
		• Abrasion of the crankshaft journal.	• Grind or replace the crankshaft journal.
		• Loosened bearing cap bolt.	• Tighten to the specified torque.
		• Excessive clearance of the crankshaft thrust bearing.	• Adjust or replace.

Modification basis	
Application basis	
Affected VIN	

6. SPECIFICATIONS

1) Engine Specifications

Application			G23D Engine	Remarks
Engine Model			M161.970	
Displacement			2295 cc	
Cylinder (Bore x Stroke)			90.9 x 88.4 mm	
Fuel Injection / Ignition System			MSE 3.53D	
Compression Ratio			10.4 : 1	
Number of Cylinders			4	
Camshaft Valve Arrangement			DOHC	
Camshaft Drive Type			Chain-Driven	
Max. Output			149 ps / 5500 rpm	
Max. Torque			22.4 kg•m / 4000 rpm	
Firing Order			1 - 3 - 4 - 2	
Ignition Type			Distributor less double ignition	
Ignition Timing			BTDC 6° ± 2°	
Valve Timing	Intake	Open/Close	ATDC 13.15° / ABDC 13.57°	
	Exhaust	Open/Close	BBDC 16.58° / BTDC 17.05°	
Valve Clearance Adjustment			←	
Idle Speed			750 ± 50 rpm	
Fuel Injection Pressure			3.2 - 4.2 kg/cm²	
Oil Capacity			7.5 ℓ	
Lubrication Type			Forced by gear pump	
Oil Filter Type			Full flow with paper filter	
Fuel			Unleaded gasoline	

MSE : Engine Control Module

3.53D : 4 Cylinder Version

2) Fastener Tightening Specifications

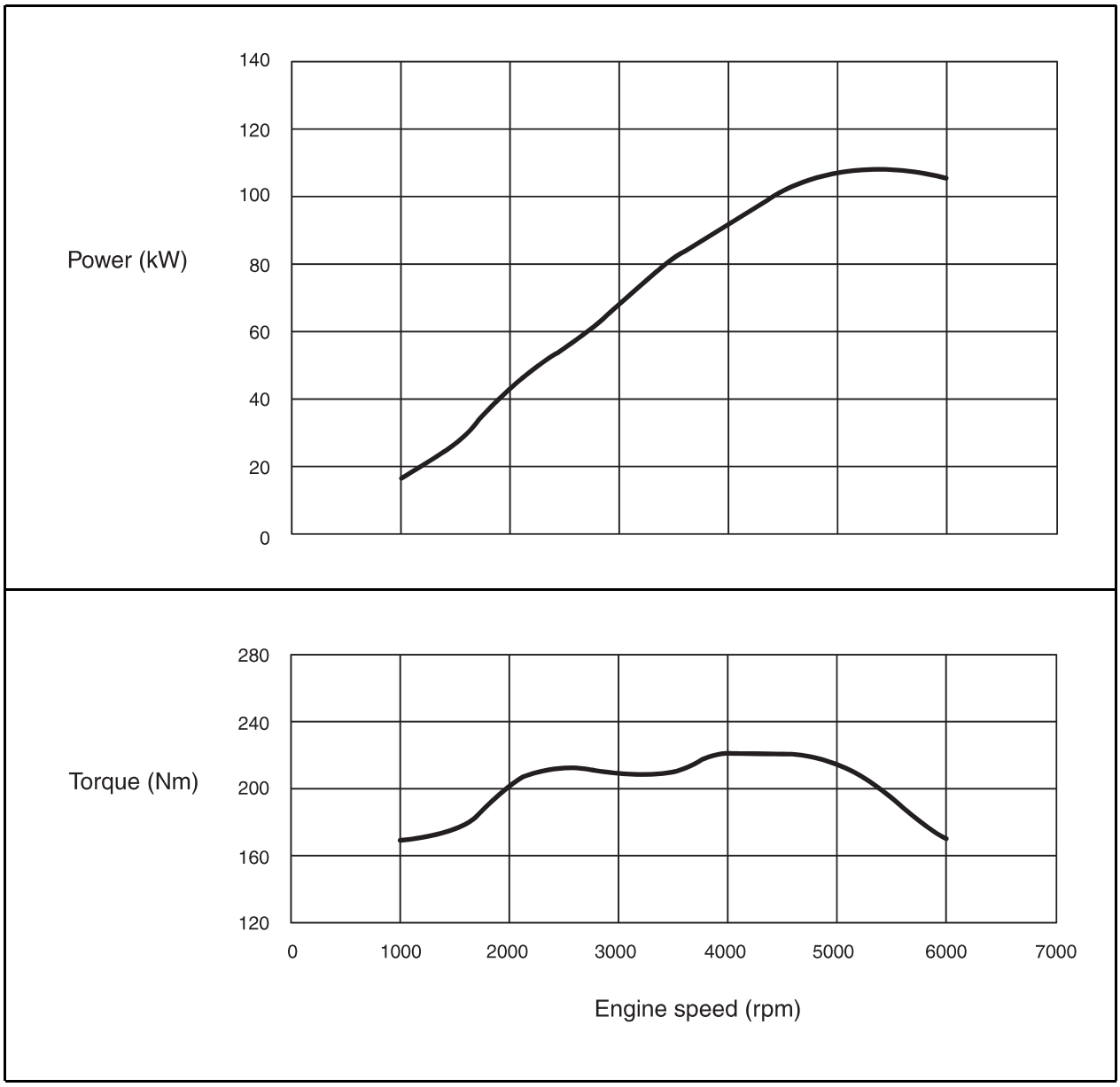
Application		N•m	Lb-Ft	Lb-In
Fuel Feed and Return Line		21 ~ 25	15 ~ 18	-
Exhaust Manifold and Pipe		30	22	-
Engine Mounting Nuts		70	52	-
Generator Carrier Bolts		25	18	-
Tensioning Pulley Bolt		40.5 ~ 49.5	29.9 ~ 36.5	-
Steering Pump Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
A/C Braket Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
Intake Air Duct Mounting Nuts		9 ~ 11	-	80 ~ 97
Spark Plug Cover Bolts		9 ~ 11	-	80 ~ 97
Cylinder Head Cover Bolts		9 ~ 11	-	80 ~ 97
Magnetic Assembly Bolt		9 ~ 11	-	80 ~ 97
Cylinder Head Front Cover Bolts	M8	22.5 ~ 27.5	16.6 ~ 20.3	-
	M6	9 ~ 11	-	80 ~ 97
Cylinder Head Bolts		55 +90° +90°	41 +90° +90°	- - 80 ~ 97
Timing Gear Case Cover Bolts		22.5 - 27.5	16.6 ~ 20.3	-
Crankshaft Sealing Rear Cover Mounting Bolts		9 ~ 11	-	-
Vibration Damper Center Bolts		200 + 20 +90° + 10°	148 + 15 +90° + 10°	- -
Flywheel Mounting Bolt		40 +90°	30 +90°	- -
Amarture Bolt in Flywheel		45 + 5	33 + 3.7	-
Camshaft Adjuster Flange Bolts		+90° + 10° 35	+90° + 10° 26	- -
Intake Flange Shaft Bolts		18 ~ 22 60° ± 5°	13 ~ 16 60° ± 5°	- -
Exhaust Camshaft Sprocket Bolts		18 ~ 22 60° ± 5°	13 ~ 16 60° ± 5°	- -
Intake Flange Shaft Bolts		18 ~ 22	13 ~ 16	-
Exhaust Camshaft Sprocket Bolts		60° ± 5°	60° ± 5°	-
Camshaft Bearing Cap Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
Chain Tensioner Screw Plug		40	30	-
Chain Tension Assembly		72 ~ 88	53 ~ 65	-
Oil Pump Sprocket Bolt		29 ~ 35	21 ~ 26	-
Tensioning Device Bolts		26 ~ 32	19 ~ 24	-
Water Pump Pulley		22.5 ~ 27.5	16.6 ~ 20.3	-
Upper Intake Manifold Bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Lower Intake Mainfold Bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Flange Bolt to Exhaust Mainfold		30	22	-

Modification basis	
Application basis	
Affected VIN	

▶ Fastener Tightening Specifications (Cont'd)

Application	N•m	Lb-Ft	Lb-In
Exhaust Mainfold Nut to Stud Bolt	26 ~ 34	19 ~ 25	-
Oil Drain Plug	25	18	-
Oil Filter Cover	25	18	-
Oil Filter Bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Oil Pump Drive Sprocket Bolt	29 ~ 35	21 ~ 26	-
Oil Pump Mounting Bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Oil Strainer Bracket Bolt	9 ~ 11	-	80 ~ 97
Oil Pressure Relief Valve Screw Plug	50	37	-
Oil Dipstick Guide Tube Bolt	9 ~ 11	-	80 ~ 97
Oil Gallery Screw Plug	15	11	-
Shock Absorber Bolts	22.5 ~ 27.5	16.6 ~ 20.3	-
Crankshaft Bearing Cap Bolts	55/+90°	41/+90°	-
Torque Converter Mounting Bracket Bolts	42	31	-

2) Performance Curve



Modification basis	
Application basis	
Affected VIN	

Memo

ENGINE INTAKE SYSTEM 1713-08

GENERAL

1. SPECIFICATIONS

(1) Fastener Tightening Specifications

Application	N•m	Lb-Ft	Lb-In
DOC to Muffler Nut	28 - 47	21 - 35	-
Exhaust Manifold to Front Exhaust Pipe Nut	15 - 28	11 - 21	-
Front Exhaust Pipe to DOC Nut	28 - 47	21 - 35	-
Front Exhaust Pipe to Muffler Nut	28 - 47	21 - 35	-
Intake Air Duct Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Intake Manifold Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Muffler to Tail Exhaust Pipe Nut	28 - 47	21 - 35	-
Resonance Flap Mounting Bolt	9 - 11	-	80 - 97

ENGINE EXHAUST SYSTEM

2420-01

GENERAL

1. SPECIFICATION

(1) Fastener Tightening Specifications

Application	N•m	Lb-Ft	Lb-In
DOC to Muffler Nut	28 - 47	21 - 35	-
Exhaust Manifold to Front Exhaust Pipe Nut	15 - 28	11 - 21	-
Front Exhaust Pipe to DOC Nut	28 - 47	21 - 35	-
Front Exhaust Pipe to Muffler Nut	28 - 47	21 - 35	-
Intake Air Duct Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Intake Manifold Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Muffler to Tail Exhaust Pipe Nut	28 - 47	21 - 35	-
Resonance Flap Mounting Bolt	9 - 11	-	80 - 97

OVERVIEW AND OPERATION PROCESS

1. DESCRIPTION AND OPERATION

1) Exhaust System

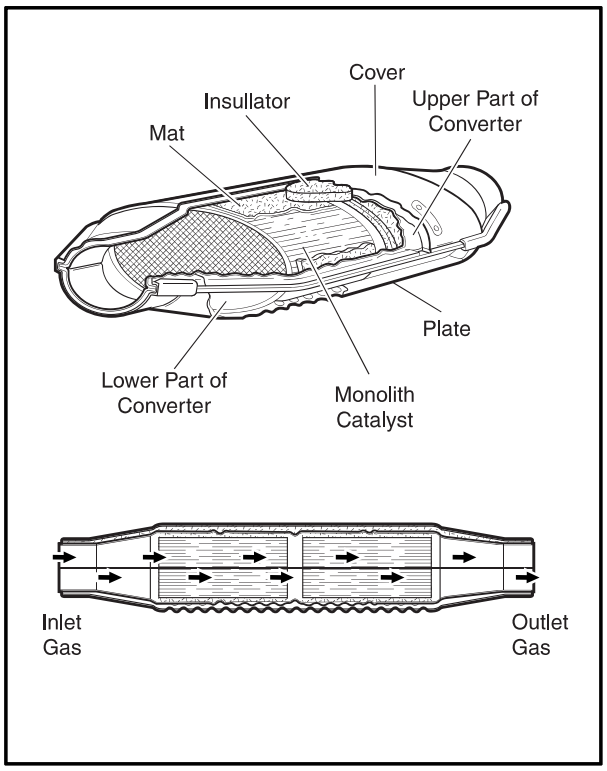
CAUTION

When you are inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible
overheating of the floor panel and possible damage to the passenger compartment insulation and trim materials.
Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit exhaust fumes to seep into the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.

2) Catalytic Converter (Gasoline Engine)

1. When jacking or lifting the vehicle from the body side rails, be certain that the lift pads do not contact the catalytic converter, as this could damage the catalytic converter.
2. Use of anything other than unleaded fuel will damage the catalyst in the catalytic converter.

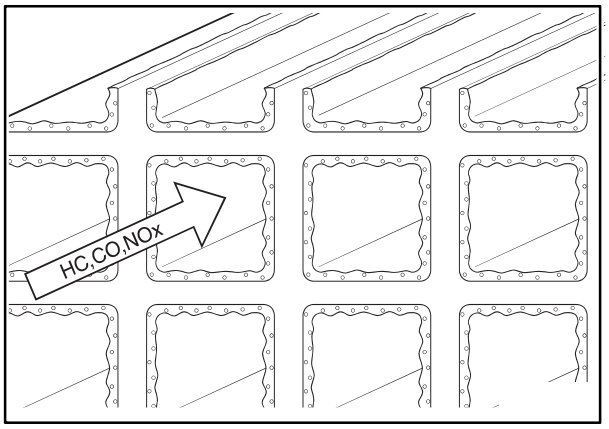
▶ **Catalytic Converter Structure**



The Catalytic converter of monolith type consists of 2 walled metal bodies which is made of Cordierite. The principal element of converter consists of the materials like Alumina or oxidized Serume in order to apply to Ceramic Monolith. Washer coat operates first, and catalytic metal elements (Pt, Pd, Rh) operates to washer coat next.
Monolith type is lighter than other types, easy to manufacture and quickly approaches to proper temperature. Washer coat is used to make a contact surface with exhaust gas bigger by adhering closely to small holes
of inner layer. If a lead compound or phosphorus adheres to the surface and the temperature rises, its surface is decreased. The total area of general monolith converter is about 45, 000~500,000ft3. (10 times of a football field) Generally Alumina (AL2 O3) is used as a raw materialand its 7 phases of gamma, delta, theta have big areas and high stability for the temperature, and nowadays gamma Alumina is used usually.

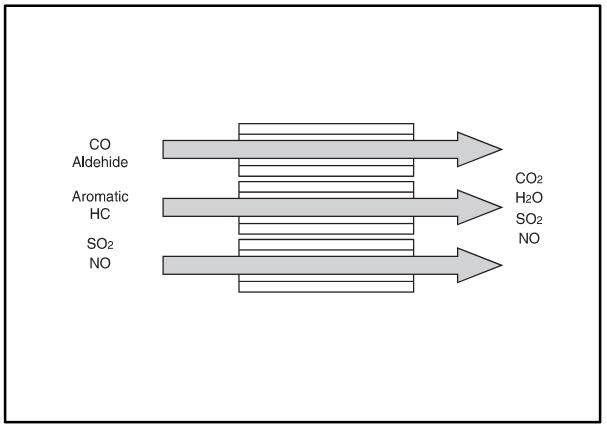
Modification basis	
Application basis	
Affected VIN	

▶ Catalytic Converter and Temperature



Catalytic converter has the normal function of purification at a range of the temperature. Because it has a weak point of decreasing of the purification rate in the condition of continuous high temperature, it should keep the temperature range of 400 to 500°C for normal condition. HC purification rate becomes better according to the increase of temperature in the normal range of temperature. CO purification rate becomes the best near the temperature of 450°C, and NOx does so near the temperature of 400 to 500°C.

▶ Purification of Catalytic Converter



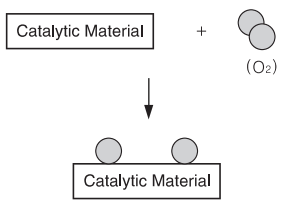
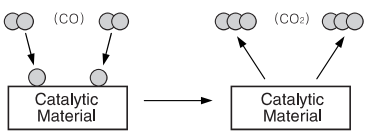
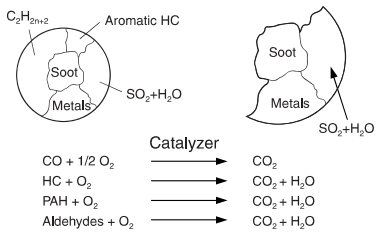
- Adhesion of soluble organic fraction (SOF) below 180°C
- Purification of soluble organic fraction (SOF) over 180°C

  Chemical reaction formula

  SOF(HC)+O2 → CO2+H2O

  2CO+O2 → 2CO2

  2C2H6+7O2 → 4CO2+6H20
- By catalytic action of two primary catalytic converter, oxidation occurs in order to decrease HC and CO.

Oxygen adheres to catalytic material : below 180°C	Catalytic material supplies each CO and HC with O2 for their oxidation : above 180°C	Catalytic material conversion process by DOC
		

Modification basis	
Application basis	
Affected VIN	

▶ **Method for Reduction of NOx**

NOx is generated a great deal in case that combustion temperature and excess air factor are high. EGR valve can decrease NOx (30 to 35% decrease) by making temperature of combustion chamber fall by means of exhaust gas re-circulation.

- EGR valve is installed on the diesel engine of Musso, Korando, Istana and Rexton. And micro switch is installed together to control EGR valve.
- The setting method of micro switch is identical with the existing one.

Modification basis	
Application basis	
Affected VIN	

ENGINE COOLING SYSTEM 2110-01

GENERAL

1. GENERAL SPECIFICATIONS

Application		Unit	Gasoline Engine
Cooling System	Type	-	Water Cooling Forced Circulation
Coolant	Capacity	L	11.3
Thermostat	Type	-	Wax Pellet Type
	Initial Opening Temp.	°C (°F)	82 (180)
	Fully Opening Temp.	°C (°F)	95 (203)
	Fully Closing Temp.	°C (°F)	80 (176)
	Stroke	mm	7
Cooling Fan	Type	-	PWM
	Blades	-	5
	Diameter	mm	320
	Low Speed ON Temp.	°C (°F)	95 (203)
	Low Speed OFF Temp.	°C (°F)	90 (194)
	High Speed ON Temp.	°C (°F)	105 (221)
	High Speed OFF Temp.	°C (°F)	100 (212)
	High Speed ON Temp. (By A/C Pressure)	kPa (psi)	269.8 (1860)
Coolaant Reservoir	Pressure Valve Opening Pressure	kPa (psi)	118 - 147 (17.1 - 21.3)
	Vacuum Valve Opening Pressure	kPa (psi)	9.8 (1.4)
Water Pump	Type	-	Turbo Centrifugal
	Impeller Diameter	mm	65
	Impeller Blades	-	8
Radiator	Type	-	Cross-flow
	Core Width	mm	701
	Core Height	mm	372
	Core Thickness	mm	18
Coolant Tem-perature Gauge	Minimum Radiation Capability	Kcal/h	45,000
	Resistance (at 50 °C (122°F))	Ω	185.2
	Resistance (at 80 °C (176°F))	Ω	47.4
	Resistance (at 105 °C (221°F))	Ω	28.2
Engine Coolant Temperature Sensor	Resistance (at 20 °C (68°F))	K Ω	3.33 - 37.8
	Resistance (at 80 °C (176°F))	K Ω	0.32 - 0.35
Anti-Freeze Agent	Type	-	ALUTEC-P78
	Mixture of Water and Good Quality Eth-ylene Glycol-Base Anti-Freeze	-	50 : 50

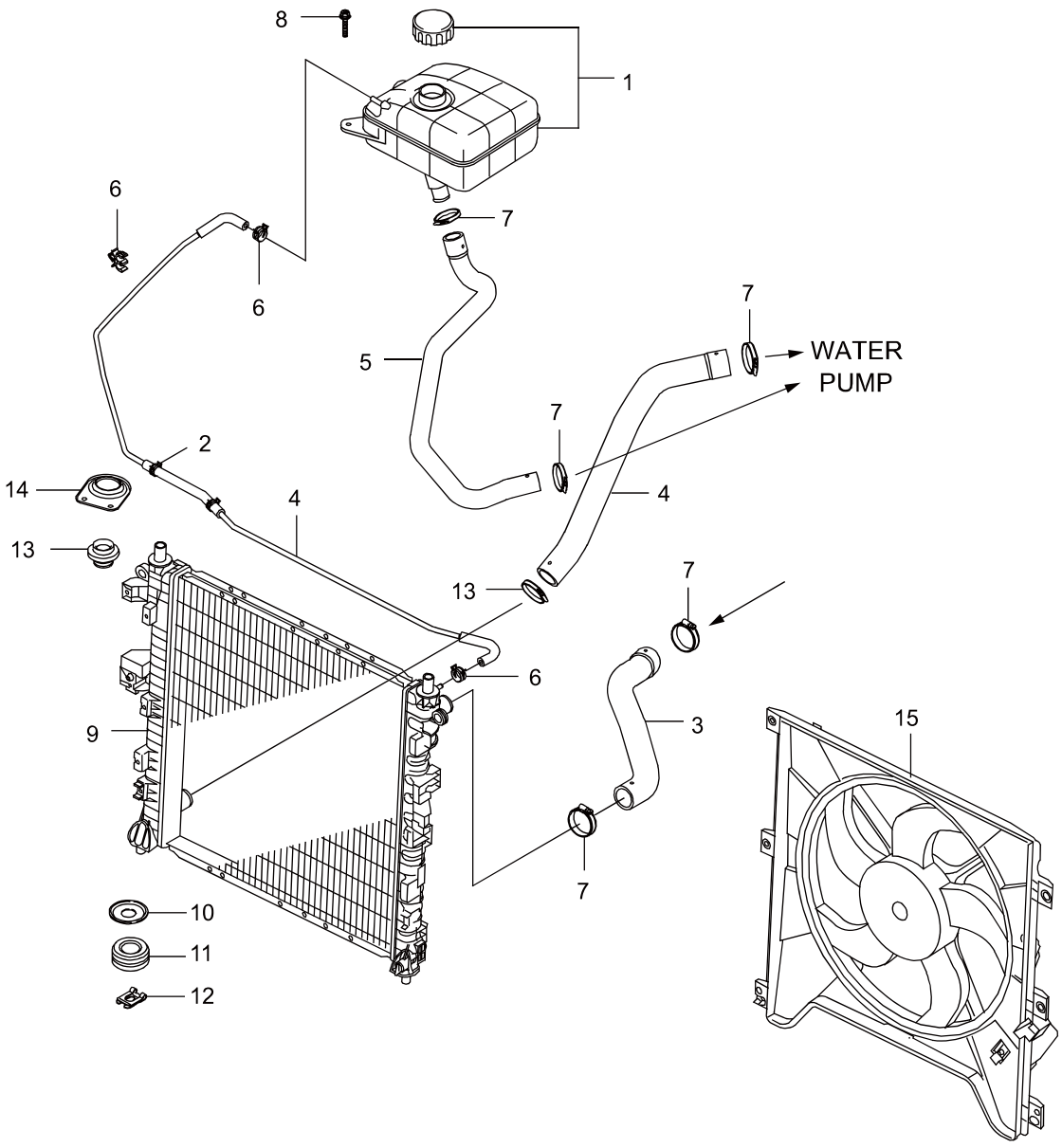
2. FASTENER TIGHTENING SPECIFICATIONS

Application		Nm	Lb-Ft	Lb-In
Automatic Transmission Oil Cooler Pipe		20	15	-
Automatic Transmission Oil Cooler Pipe Mounting Bolt		3 - 7	-	27 - 62
Coolant Drain Plug		30	22	-
Cooling Fan Bolt		9 - 11	-	80 - 97
Cooling Fan Shroud Bolt		3 - 7	-	27 - 62
Oil Cooler Pipe Line Bolt		9 - 11	-	80 - 97
Radiator Mounting Bracket Bolt		3 - 7	-	27 - 62
Tensioning Device Shock Absorber Bolt		22.5 - 27.5	16.6 - 20.3	-
Thermostat Cover Bolt		9 - 11	-	80 - 97
Thermostat Housing Bolt	M6	9 - 11	-	80 - 97
	M8	22.5 - 27.5	16.6 - 20.3	-
Viscous Clutch Mounting Bolt		40.5 - 49.5	29.8 - 36.5	-
Water Pump Housing Bolt	M6	9 - 11	-	80 - 97
	M8	22.5 - 27.5	16.6 - 20.3	-
Water Pump Pulley Bolt		9 - 11	-	80 - 97

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. COMPONENT LOCATOR



1. Reserver Tank
2. Deaeration Tube
3. Inlet Hose
4. Outlet Hose
5. 3 way Hose
6. Clamp
7. Clamp
8. Bolt (M6, 2 piece)
9. Radiator
10. Lower Radiator Insulator
11. Plate
12. Clip
13. Upper Radiator Insulator
14. Bracket
15. PWM Electric Fan

2. DESCRIPTION AND OPERATION

1) General Description

The cooling system maintains the engine temperature at an efficient level during all engine operating conditions.
When the engine is cold, the cooling system cools the engine slowly or not at all. This slow cooling of the engine allows the engine to warm up quickly.
The cooling system includes a radiator and recovery subsystem, cooling fans, a thermostat and housing, a water pump, and a water pump drive belt. The timing belt drives the water pump.
All components must function properly for the cooling system to operation. The water pump draws the coolant from the radiator. The coolant then circulates through water jackets in the engine block, the intake manifold, and the cylinder head. When the coolant reaches the operating
temperature of the thermostat, the thermostat opens. The coolant then goes back to the radiator where it cools.
This system directs some coolant through the hoses to the heat core. This provides for heating and defrosting.
The coolant reservoir is connected to the radiator to recover the coolant displaced by expansion from the high temperatures. The coolant reservoir maintains the correct coolant level.
The cooling system for this vehicle has no radiator cap or filler neck. The coolant is added to the cooling system through the coolant reservoir.

2) Radiator

This vehicle has a lightweight tube-and-fin aluminum radiator. Plastic tanks are mounted on the upper and the lower sides of the radiator core.
On vehicles equipped with automatic transaxles, the transaxle fluid cooler lines run through the radiator tank.
A radiator drain plug is on this radiator.
To drain the cooling system, open the drain plug.

3) Coolant Reservoir

The coolant reservoir is a transparent plastic reservoir, similar to the windshield washer reservoir.
The coolant reservoir is connected to the radiator by a hose and to the engine cooling system by another hose.
As the vehicle is driven, the engine coolant heats and expands. The portion of the engine coolant displaced by this expansion flows from the radiator and the engine into the coolant reservoir. The air trapped in the radiator and the engine is degassed into the coolant reservoir.
When the engine stops, the engine coolant cools and contracts. The displaced engine coolant is then drawn back into the radiator and the engine. This keeps the radiator filled with the coolant to the desired level at all times and increases the cooling efficiency.
Maintain the coolant level between the MIN and MAX marks on the coolant reservoir when the system is cold.

Modification basis	
Application basis	
Affected VIN	

4) Water Pump

The belt-driven centrifugal water pump consists of an impeller, a drive shaft, and a belt pulley.
The impeller is supported by a completely sealed bearing.
The water pump is serviced as an assembly and, therefore, cannot be disassembled.

5) Thermostat

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the thermostat housing to the front of the cylinder head.
The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator. At this point, the engine coolant is allowed to circulate only throughout the heater core to warm it quickly and evenly.
As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator wherethe heat is dissipated. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits.
The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled.
As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine.
As the wax pellet cools, the contraction allows a spring to close the valve.
The thermostat begins to open at 82°C(180 °F) and is fully open at 95°C(203°F). The thermostat closes at 80°C (176°F).

6) Electric Cooling Fan

CAUTION

- Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury.
  This fan is electric and can turn on even when the engine is not running.

CAUTION

- If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new one to prevent possible injury.

The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fins and across the condenser on air conditioned (A/C)-equipped vehicles.
This helps to speed cooling when the vehicle is at idle or moving at low speeds.
All models have two fans. The main fan is 320 mm (12. 6 inches) in diameter with seven blades to aid the airflow through the radiator and the condenser. An electric motor attached to the radiator support drives the fan.
The auxiliary fan is 320 mm (12.6 inches) in diameter.

▶ **A/C Off or Non-AC Model**

- The cooling fans are actuated by the engine control module (ECM) using a low-speed cooling fan relay, a high-speed cooling fan relay and a cooling fan motor relay.
- The ECM will turn the cooling fans on at low speed when the coolant temperature reaches 95°C(203°F) and at high speed when the coolant temperature reaches 105°C(221°F).
- The ECM will change the cooling fans from high peed to low speed at 100°C(212°F) and will turn the cooling fans off at 90°C (194°F).

▶ **A/C On**

- The ECM will turn the cooling fans on at low speed when the A/C system is on. The ECM will change to high speed when the high side A/C pressure reaches 1860 kPa (269.8 psi).
- The cooling fans will return to low speed when the high side A/C pressure reaches 1378 kPa (199.8 psi).

7) Engine Coolant Temperature Sensor

The Engine Coolant Temperature (ECT) sensor uses a temperature to control the signal voltage to the Engine Control Module (ECM).

8) Coolant Temperature Gauge

The coolant temperature gauge controls the instrument panel temperature indicator. The coolant temperature gauge is located with ECT sensor.

Modification basis	
Application basis	
Affected VIN	

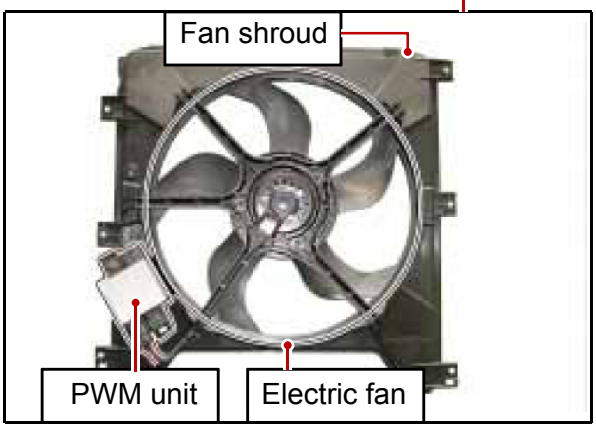
3. PWM (PULSE WIDTH MODULATION) ELECTRIC FAN OPERATION

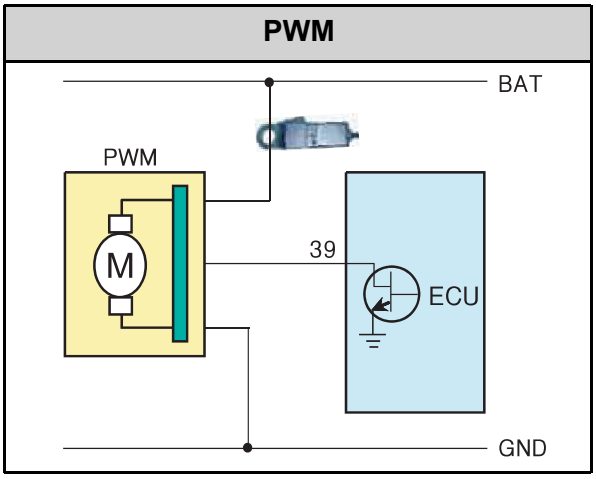
1) Function

The PWM (Pulse Width Modulation) high capacity electric fan is installed instead of electric condenser fan to enhance the durability and controllability and reduce noise.

2) Mounting Location







3) PWM Electric Fan

(1) Advantages and Disadvantages of the PWM Electric Fan



▶ **Advantages**

- Enhanced A/C performance: at low speed, at idling, driving in city
- Reduction of vibration/noise: fan activated by PWM only when necessary
- Reduction of engine consuming power (V/Fan driving force) by 4 Hp - Cost saving

▶ **Disadvantage**

- Poor engine cooling perfomance at low and high rpm

4) PWM (Pulse Width Modulation) Unit



It controls the time of the output voltage to control the fan motor speed independently.

▶ **Internal functions**

- Motor power shutting-off function when overcurrent is applied
- Adverse voltage prevention function
- Detection function for the motor lock
- Temperature detecting function: The electric fan operates at FULL speed to cool down the PWM unit when the interior temperature of PWM unit is over 120~150°C.
- Communication function when failing: The fail signal is transmitted to the ECU when the PWM unit is malfunctioning.
- Soft start function: The motor speed is gradually increased when the motor is initially operated.

Modification basis	
Application basis	
Affected VIN	

5) Shutting-off Condition of the A/C Compressor

▶ **Coolant temperature**

- When coolant temperature is below 20°C or over 115°C, engine speed is below 650 rpm or over 4500 rpm for 4 seconds after engine starting, abrupt acceleration and A/C refrigerant pressure sensor detecting the followings
- A/C compressor is turned off when the refrigerant pressure is below 2.0 kg/cm2 and then is turned on when the refrigerant pressure is over 2.4 kg/cm2.
- A/C compressor is turned off when the refrigerant pressure is over 30 kg/cm2 and then is turned on when the refrigerant pressure is below 21.4 kg/cm2.

ENGINE ELECTRIC DEVICES 1452-01

GENERAL

1. DIAGNOSTIC INFORMATION AND PROCEDURE

1) Ignition System

Condition	Probable Cause	Correction
No Crank	• Low battery voltage.	• Charging the battery or Replace the battery.
	• Battery cable is loose, corroded, or damaged.	• Repair or Replace the battery cable.
	• Faulty starter motor or starter motor circuit is open.	• Repair or Replace the starter motor/starter motor circuit.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Ground short.	• Repair the ground short.
Crank OK, But Too Slow	• Low battery voltage.	• Charging the battery or Replace the battery.
	• Battery. • Battery cables are loose, corroded, or damaged.	• Repair or Replace the battery cable.
	• Faulty starter motor.	• Repair or Replace the starter motor.
Starter Motor Does Not Stop	• Faulty starter motor.	• Repair or Replace the starter motor.
	• Faulty ignition switch.	• Replace the ignition switch.
Starter Motor Running, But Not Cranking	• Broken the clutch pinion gear or faulty starter motor.	• Replace the starter motor.
	• Broken the flywheel ring gear.	• Replace the flywheel.
	• Connected circuit is open.	• Repair the open circuit.
Battery Discharge	• Loosen the generator drive belt.	• Adjust the belt tension or Replace the belt.
	• The circuit is open or a short.	• Repair the open or a short circuit.
	• Battery run down.	• Replace the battery.
	• Open ground circuit.	• Repair the open ground circuit.
Charging Indicator Lamp Does Not Work When the Ignition Switch ON (Engine Does Not Work)	• Charging indicator lamp is blown or fuse is blown.	• Repair or Replace the charging indicator lamp/fuse.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Generator ground circuit is open or a short.	• Repair the circuit.
Charging Indicator Lamp Does Not Put Out Lights After Starting the Engine	• Battery cable is corroded or damaged.	• Repair or Replace the battery cable.
	• Loosen the generator drive belt.	• Adjust the belt tension or Replace the belt.
	• Faulty wiring harness.	• Repair the wiring harness.
Battery Over Charging	• Generator Voltage Regulator Faulty	• Replace Generator
	• Voltage detecfing wiring faulty	• Repair Wiring

2) Ignition System (Cont'd)

Condition	Probable Cause	Correction
Hard Engine Starting	• Ignition coil faulty	• Replace ignition coil
	• Distributor (including optical sensor) faulty	• Replace distribator (or sensor)
	• Spark plug malfuntion	• Replace spark plug or adjust clearance
	• Ignition timing faulty (spark plug light is normal)	• Resetting valve timing
Unstable Engine Idling	• Spark plug malfunction	• Replace spark plug or adjust clearance
	• Ignition coil faulty	• Replace ignition coil
	• Ignition timing faulty	• Resetting valve timing
Enging Acceralation Malfunction	• Ignition timing faulty	• Resetting valve timing

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. DESCRIPTION AND OPERATION

1) Battey

The sealed battery is standard on all cars. There are no vent plugs in the cover.
The battery is completely sealed, except for two small vent holes in the sides.
These vent holes allow the small amount of gas produced in the battery to escape.
The battery has the following advantages over conventional batteries:

- No water addition for the life of the battery.
- Overcharge protection. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery.
  In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing, which causes liquid loss.
- Not as liable to self-discharge as a conventional battery. This is particularly important when a battery is left standing for long periods of time.
- More power available in a lighter, smaller case.

The battery has three major functions in the electrical system.
First, the battery provides a source of energy for cranking the engine.
Second, the battery acts as a voltage stabilizer for the electrical system. Finally, the battery can, for a limited time, provide energy when the electrical demand exceeds the output of the generator.

2) Ratings

▶ A battery has two ratings: (1) a reserve capacity rating designated at 27°C(80°F), which is the time a fully charged battery will provide 25 amperes of current flow at or above 10.5 volts (2) a cold cranking amp rating determined under testing at −18°C(0°F), which indicates the cranking load capacity.

(1)Reserve Capacity

The reserve capacity (RC) is the maximum length of time it is possible to travel at night with the minimum electrical load and no generator output. Expressed in minutes, the RC rating is the time required for a fully charged battery, at a temperature of 27°C(80°F) and being discharged at a current of 25 amperes, to reach a terminal voltage of 10.5 volts.

(2) Cold Cranking Amperage

The cold cranking amperage test is expressed at a battery temperature of −18°C(0°F).
The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts.
This rating is a measure of cold cranking capacity.
The battery is not designed to last indefinitely. However, with proper care, the battery will provide many years of service. If the battery tests well, but fails to perform satisfactorily in service for no apparent reason, the following factors may point to the cause of the trouble:

- Vehicle accessories are left on overnight.
- Slow average driving speeds are used for short periods.
- The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
- Defects in the charging system, such as electrical shorts, a slipping generator belt, a faulty generator, or a faulty voltage regulator.
- Battery abuse, including failure to keep the battery cable terminals clean and tight or a loose battery hold-down clamp.
- Mechanical problems in the electrical system, such as shorted or pinched wires.

3) Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

▶ Size of Battery - A Completely discharged large heavy-duty battery required more than twice the recharging time as a completely discharged small passenger car battery.

▶ Temperature − A longer time will be needed to charge any battery at −18°C(0°F) than at 27°C(80°F).
When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first.
The battery will accept a higher current rate as the battery warms.

▶ Charger Capacity - A charger which can supply only 5 amperes will require a much longer charging period than a charger that can supply 30 amperes or more.

▶ State-of-Charge - A completely discharged battery requires more than twice as much charge as a onehalf charged battery.
Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

Modification basis	
Application basis	
Affected VIN	

4) Charging a Completely Discharged Battery (Off the Vehicle)

Unless this procedure is properly followed, a perfectly good battery may be needlessly replaced.
The following procedure should be used to recharge a completely discharged battery:

1. Measure the voltage at the battery terminals with an accurate voltmeter.
   If the reading is below 10 volts, the charge current will be very low, and it could take some time before the battery accepts the current in excess of a few milliamperes.
   Refer to "Charging Time Required" in this section, which focuses on the factors affecting both the charging time required. Such low current may not be detectable on ammeters available in the field.
2. Set the battery charger on the high setting.

CAUTION

Some chargers feature polarity protection circuitry, which prevents charger unless the charger leads are correctly connected to the battery terminals.
A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly, making it appear that the battery will not accept charging current.
Therefore, follow the specific charger manufacturer's instruction for by passing or overriding the circuitry so that the charger will turn on and charge a low-voltage battery.

3. Continue to charge the battery until the charge current is measurable. Battery chargers vary in the amount of voltage and current provided. The time required for the battery to accept a measurable charger current at various voltages may be as follows:

Voltage	Hours
16.0 or more	Up to 4 hours
14.0 - 15.9	Up to 8 hours
13.9 or less	Up to 16 hours

- If the charge current is not measurable at the end of the above charging times, the battery should be replaced.
- If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

CAUTION

It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore the battery to a usable state.

- If the charge current is still not measurable after using the charging time calculated by the above method, the battery should be replaced.

5) Jump Starting Procedure

1. Position the vehicle with the charged battery so that the jumper cables will reach from the charged battery to the battery that requires charging.
2. Turn off the ignition, all the lights, and all the electrical loads in both vehicles.
3. Leave the hazard flasher on if jump starting where there may be other traffic and any other lights needed for the work area.
4. Apply the parking brake firmly in both vehicles.

CAUTION
In order to avoid damaging the vehicle make sure the cables are not on or near pulleys, fans, or other parts that will move when the engine starts.

5. Shift an automatic transmission to PARK.

CAUTION
In order to avoid injury, do not use cables that have loose or missing insulation.

6. Clamp one end of the first jumper cable to the positive terminal on the booster battery. Make sure it does not touch any other metal parts.
7. Clamp the other end of the same cable to the positive terminal on the discharged battery. Never connect the other end to the negative terminal of the discharged battery.

CAUTION
Do not attach the cable directly to the neg-ative terminal of the discharged battery. Doing so could cause sparks and possible battery explosion.

8. Clamp one end of the second cable to the negative terminal of the booster battery.
9. Make the final connection to a solid engine ground, such as the engine lift bracket at least 450 millimeters (18 inches) from the discharged battery.
10. Start the engine of the vehicle with the good battery.
    Run the engine at a moderate speed for several minutes.
11. Then start the engine of the vehicle with the discharged battery.
12. Remove the jumper cables by reversing the above sequence exactly, removing the negative cable from the vehicle with the discharged battery first.
    While removing each clamp, take care that it does not touch any other metal while the other end remains attached.

Modification basis	
Application basis	
Affected VIN	

6) Alternator

Alternators are equipped with internal regulators.
Unlike three-wire generators, the alternator may be used with only two connections: battery positive and an "D+" terminal to the charge indicator lamp.
As with other charging systems, the charge indicator lamp lights when the ignition switch is turned to RUN, and goes out when the engine is running.
If the charge idicator is on with the engine running, a charging system defect is indicated. This indicator light will glow at full brilliance for several kinds of defects as well as when the system voltage is too high or too low.
The regulator voltage setting varies with temperature and limits the system voltage by controlling rotor field current.
Achieve correct average field current for proper system voltage control by varying the on-off time. At high speeds, the on-time may be 10 percent and the off-time 90 percent.
At low speeds, with high electrical loads, the on-time may be 90 percent and the off-time 10 percent.

7) Charging System

Generators use a new type of regulator that incorporates a diode trio.
A Delta stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators.
A conventional pulley and fan are used.
There is no test hole.

8) Starter

Wound field starter motors have pole pieces, arranged around the armature, which are energized by wound field coils.
Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icy conditions, and splashes.
In the basic circuit, solenoid windings are energized when the switch is closed.
The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear.
The solenoid main contacts close. Cranking then takes place.
When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage.
To prevent excessive overrun, the switch should be released immediately after the engine starts.

9) Starting System

The engine electrical system includes the battery, the ignition, the starter, the generator, and all the related wiring.
Diagnostic tables will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that component section of the service manual.
The starting system circuit consists of the battery, the starter motor, the ignition switch, and all the related electrical wiring.
All of these components are connected electrically.

Modification basis	
Application basis	
Affected VIN	

CRUISE CONTROL SYSTEM 8510-23

OVERVIEW AND OPERATION PROCESS

1. CRUISE CONTROL SWITCH



The purpose of the cruise control system is to automatically maintain a vehicle speed set by the driver, without depressing the accelerator pedal. The cruise control switch is located under the right side of the steering wheel, and when this switch is operating "AUTO CRUISE" lamp comes on.

The minimum speed for setting the cruise control system is 36 km/h (22.37 mph). Pay constant attention to the distance between the vehicles and the traffic conditions when using the cruise control system.

CAUTION

The cruise control system is a supplementary system, which helps the driver to drive the vehicle at a desired speed without using the accelerator pedal under the traffic condition where the vehicle-to-vehicle distance meets the legal requirement.

1) When To Use

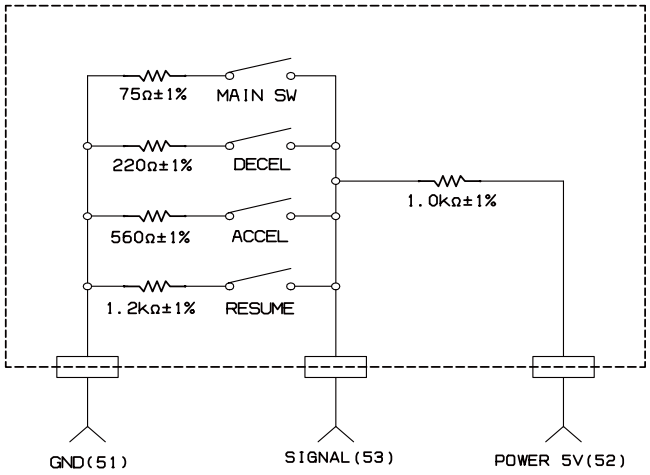
Use the cruise control system only when (a) the traffic is not jammed, (b) driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

WARNING

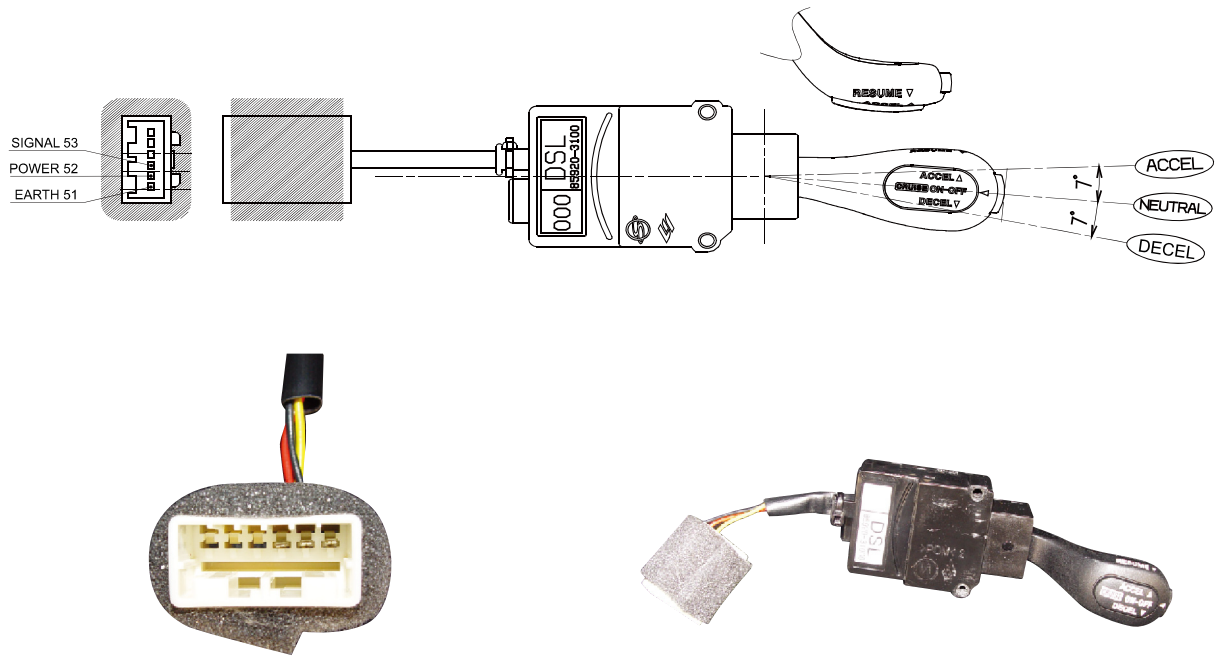
Use the cruise control system only when driving on motorways or highways. Do not use the cruise control system where the road conditions are as follows:
- When there is strong wind or cross wind.
- Heavy traffic.
- Slippery roads or steep decline.

Modification basis	
Application basis	
Affected VIN	

2. CIRCUIT DIAGRAM



1) Configuration



3. HOW TO OPERATE CRUISE CONTROL SWITCH

1) How To Set Speed



1. To operate the cruise control system, accelerate the vehicle to the speed within the specified range below with depressing the accelerator pedal.
   - Cruise control operating range: between 36 km/h (22.37 mph) and 150 km/h (93.207 mph)
2. When the desired speed is reached, which should be within the above range, push up the cruise control switch lever to ACCEL side (upwards arrow), or push down the switch lever to DECEL side (downwards arrow).
   And then release the accelerator pedal slowly.
3. Now the vehicle is cruised by this system with the set speed. You don't need to use the accelerator pedal.
4. Refer to the following pages for details of operation.

CAUTION

Never use the cruise control system until you get used to it.
Improper use or not fully aware of this function could result in collision and/or personal injuries.

Modification basis	
Application basis	
Affected VIN	

2) Accelerating with the Cruise Control System



(1) While the cruise control system is running

1. To increase the set speed, push up the cruise control switch lever to ACCEL side and hold it until the desired speed is reached without depressing the accelerator pedal.
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To increase the speed with the cruise control system while the system is not running, follow the procedures below.

1. Accelerate the vehicle to more than 36 km/h (22.37 mph) using the accelerator pedal. Push up the cruise control switch lever to ACCEL side and hold it.
2. When the desired speed is reached, release the accelerator pedal and the switch lever.

(3) Tap-up while the cruise control system is running

To increase the vehicle speed in stages while the cruise control system is running, follow the procedures below.

1. Push up the cruise control switch lever to ACCEL side for less than 0.5 second per one switching while the cruise control system is running; the speed increases each time by 1.3 km/h (0.81 mph).
2. For example, if you want to increase the speed 13 km/h (81 mph) more than the previous set speed, tap up the switch lever to ACCEL side ten times without using the accelerator pedal.

3) Decelerating with the Cruise Control System



(1) While the cruise control system is running

1. To decrease the set speed, push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached without depressing the brake pedal.
   But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).
2. When the desired speed is set, release the switch lever.

(2) When the cruise control system is not running

To decrease the speed with the cruise control system while the system is not running, follow the procedures below.

1. Push down the cruise control switch lever to DECEL side and hold it until the desired speed is reached while the vehicle speed is over 36 km/h (22.37 mph).
2. When the desired speed is reached, release the switch lever.
3. But the cruise control system cannot maintain the cruise function at less than 34 km/h (21.13 mph).

(3) Tap-down while the cruise control system is running

To decrease the vehicle speed in stages while the cruise control system is running, follow the below procedures.

1. Push down the cruise control switch lever to DECEL side for less than 0.5 second per one switching while the cruise control system is running; the speed decreases each time by 1.0 km/h (0.62 mph).
2. For example, if you want to decrease the speed 10 km/h (62 mph) lower than the previous set speed, tap down the switch lever to DECEL side ten times without using the brake pedal.

Modification basis	
Application basis	
Affected VIN	

4) Recovery of Set Speed (RESUME)



Even if the cruise control is cancelled, the previous set cruise speed can be recovered by operating the cruise control switch lever like below:
- Pull the switch lever in the arrow direction shown in the illustration.

This RESUME function works only when the vehicle speed is more than 36 km/h (22.37 mph) without using the accelerator or brake pedal.

CAUTION

But the driver should know the previous set speed to react to the changed vehicle speed properly. If the vehicle speed increases abruptly, depress the brake pedal to adjust the vehicle speed properly.

5) Normal Cancellation of the Cruise Control (OFF ↔ ON)



The cruise control system will be cancelled when the button on the side of the switch is pressed, or when one of the following conditions is met:

1. When the brake pedal is depressed or ESP is activated.
2. When the vehicle speed is less than 34 km/h (21.13 mph).
3. When the parking brake is applied while driving.
4. When the clutch pedal is depressed for shifting (M/T only).

CAUTION

Put the cruise control switch lever in the neutral position when not using the cruise control system.

(1) Abnormal Cancellation of the Cruise Control

1. When the rapid deceleration or acceleration occurs.
2. When the cruise control lever is faulty.
3. When the brake switch is malfunctioning or has an open circuit.

When the cruise control function is cancelled abnormally or intermittent problems occur, stop the vehicle and turn off the ignition switch and remove the key to reset the system. After a while, turn on the ignition switch again to operate the cruise control system.

CAUTION

- Do not move the shift lever to Neutral position while driving with the cruise control turned on. Otherwise, it may result in system malfunction or accidents.
- Always be prepared to use the brake or accelerator pedal for safe driving while the cruise control system is running.
- The actual speed can be different from the set speed momentarily when driving on a uphill or downhill. So, it is recommended to disable the cruise control function on a uphill or downhill. hen driving on a steep hill use the engine brake and foot brake properly to protect the vehicle system and for a safe driving.
- Ensure that the braking distance is maintained and use the brake pedal if needed.

Modification basis	
Application basis	
Affected VIN	

INDEX

ELECTRIC GENERAL

1. LOCATIONS OF INTERIOR UNITS AND SENSORS 2
2. SWITCHES, UNITS AND SENSORS IN ENGINE COMPARTMENT..... 4
3. INTERIOR SWITCHES..... 6
4. AUDIO / VIDEO SYSTEM..... 8
5. ELECTRIC COMPONENTS AND LAYOUT..... 10

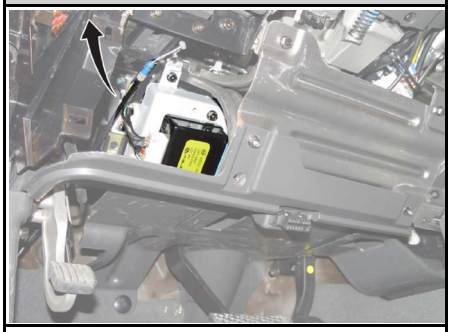
ELECTRIC SYSTEM

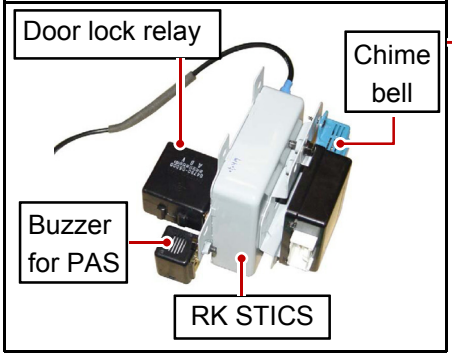
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ELECTRIC GENERAL

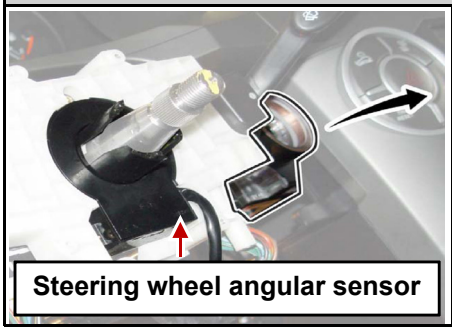
1. LOCATIONS OF INTERIOR UNITS AND SENSORS

Under Instrument Panel

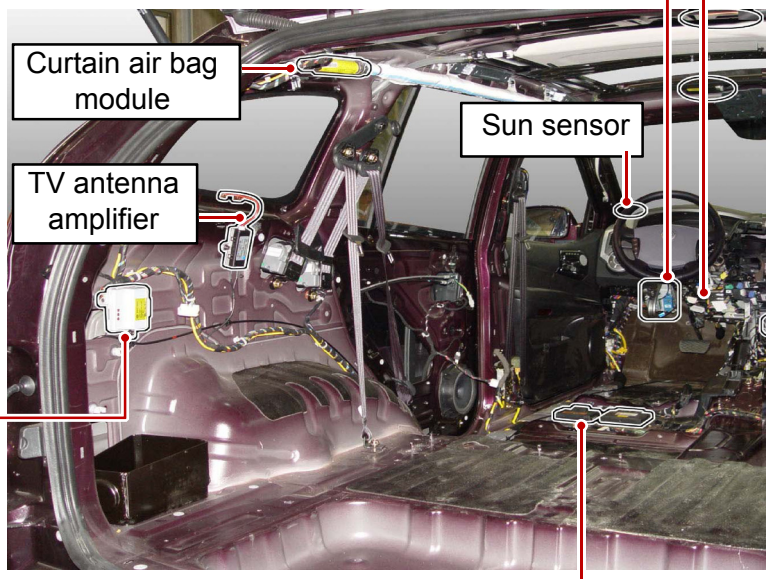




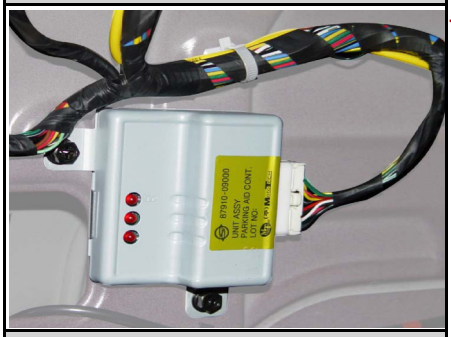
Steering Wheel Angular Sensor / Immobilizer







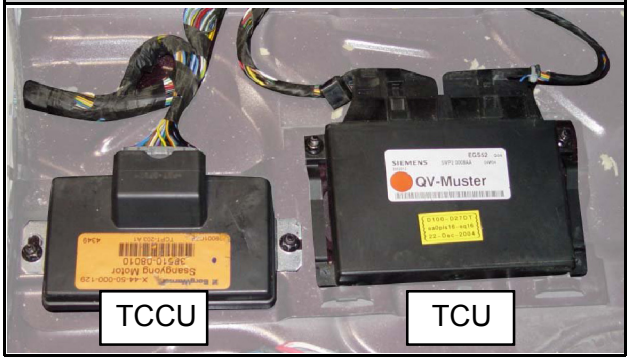
PAS Unit



Driver Seat Memory Switch



TCCU and TCU



Modification basis	
Application basis	
Affected VIN	

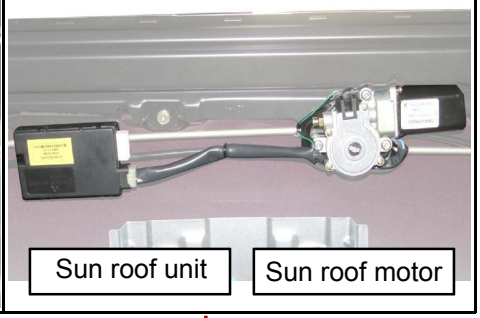
Rain Sensing Unit (Including Auto Lignt) and ECM

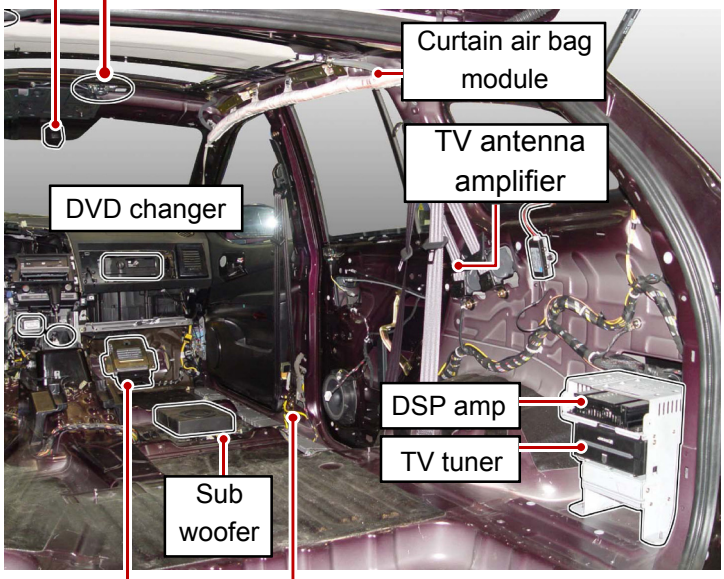


Sensor Cluster

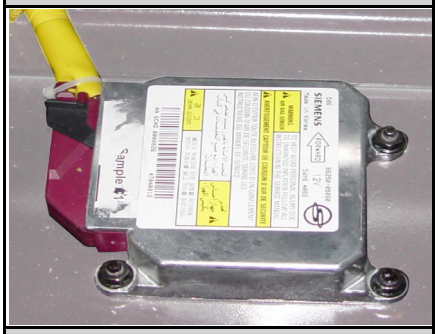


Sun Roof Unit and Motor





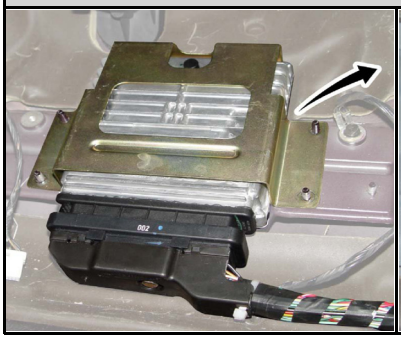
Air Bag ECU

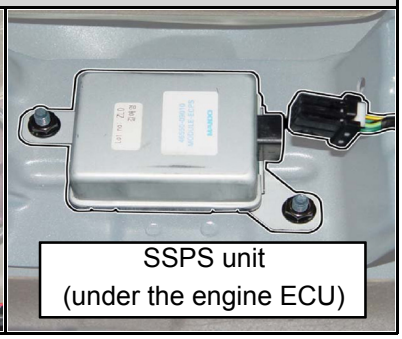


Curtain Air Bag Sensor



Engine ECU and SSPS Unit





Interior Temperature and Humidity Sensor



Modification basis	
Application basis	
Affected VIN	

2. SWITCHES, UNITS AND SENSORS IN ENGINE COMPARTMENT

FFH Assembly



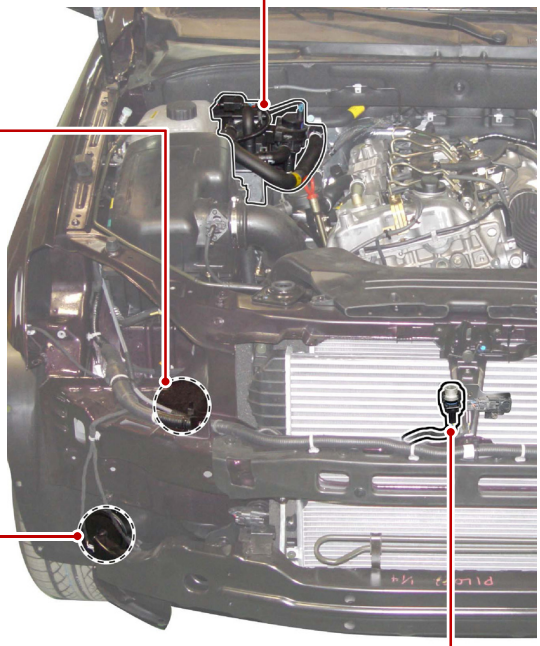


Receiver Drier and Triple Pressure Switch



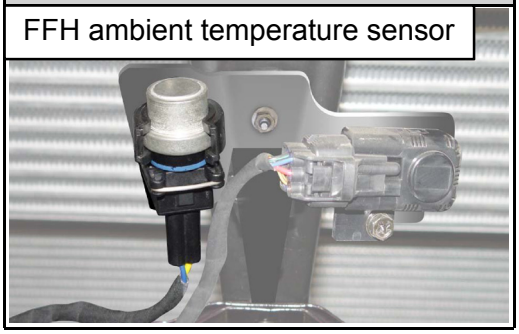
Horn (RH)



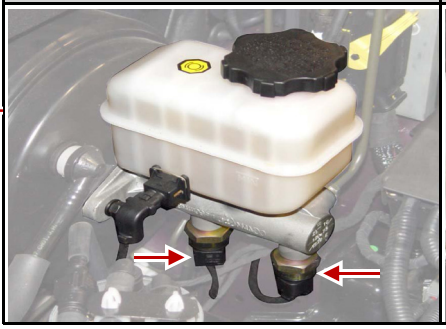


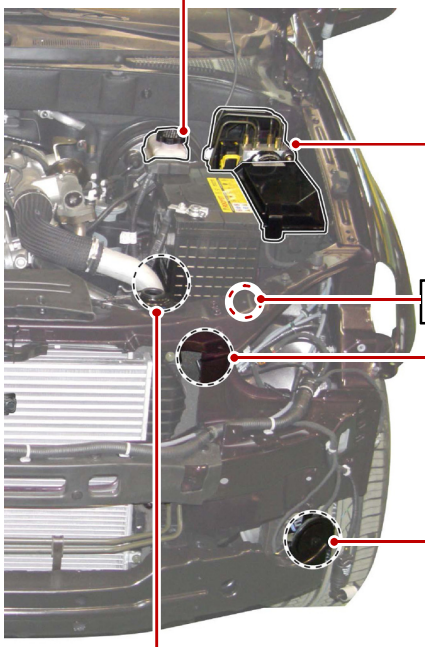
FFH Ambient Temperature Sensor

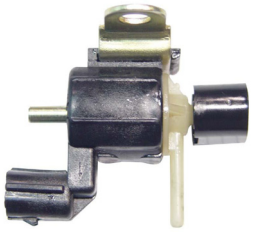
FFH ambient temperature sensor

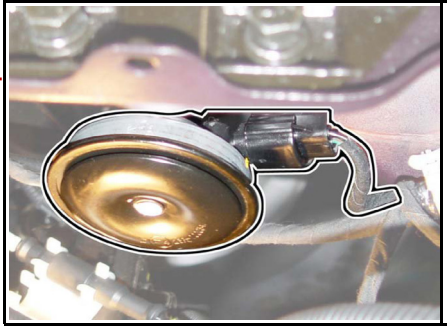


Modification basis	
Application basis	
Affected VIN	

ESP Pressure Sensor / Primary, Secondary	ABS (ESP) HECU
	



IWE Vacuum Solenoid Valve (4WD)


Theft Deterrent Horn (Under the Battery)	Fuse and Relay Box
	

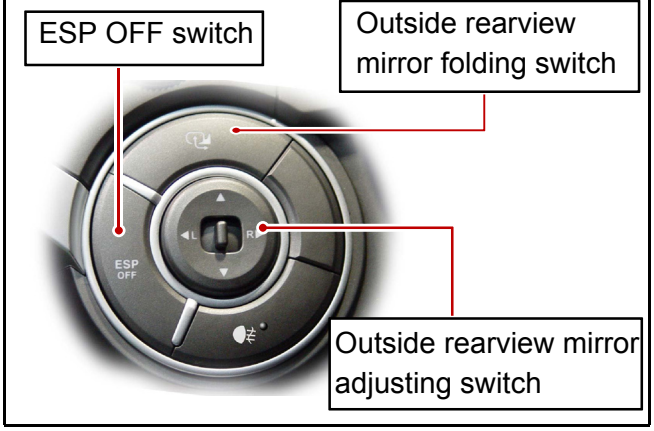
Modification basis	
Application basis	
Affected VIN	

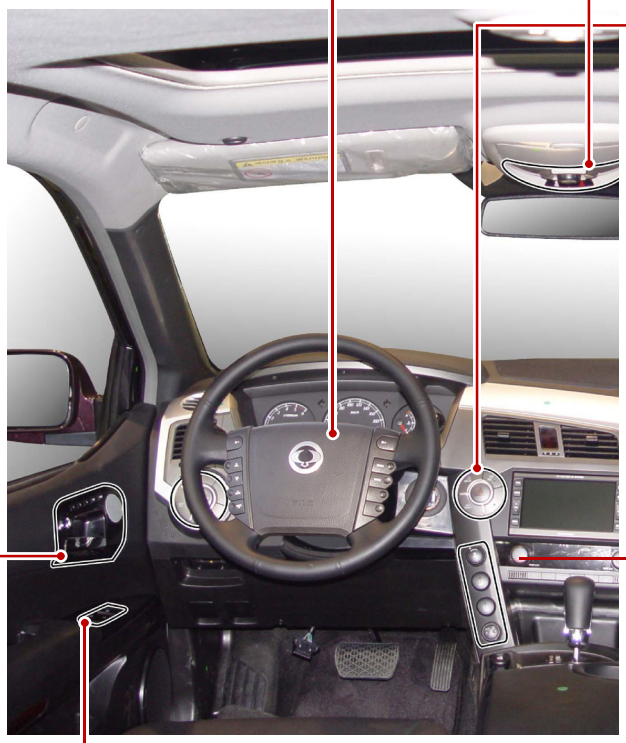
3. INTERIOR SWITCHES

Remote Control Switch on the Steering Wheel

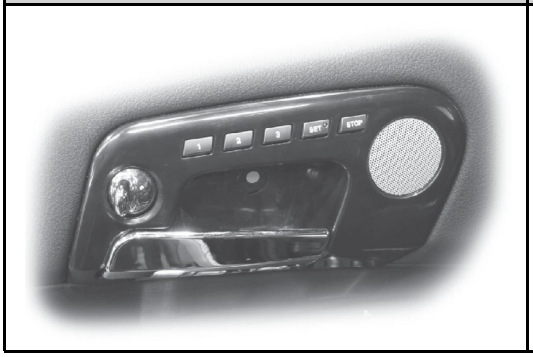


Bezel Assembly on Outside Rearview Mirror Adjusting Switch





Seat Position Memory Switch (Driver's Door)



Driver's Power Window Main Switch



Modification basis	
Application basis	
Affected VIN	

Sun Roof Switch



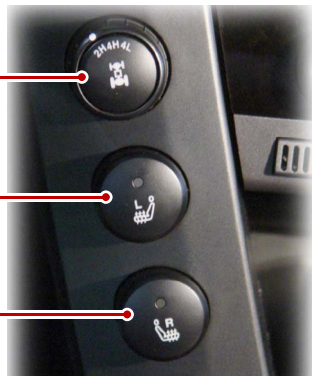


Bezel Assembly on Hazard Switch

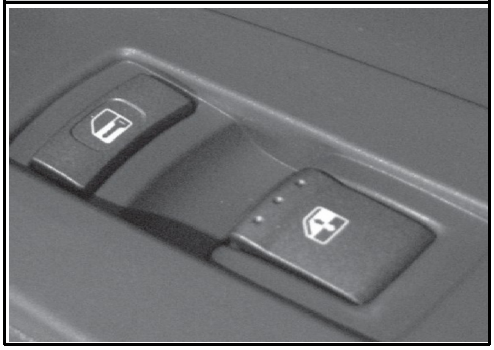


1. HDC switch
2. Outside rearview mirror and rear glass heated switch
3. Hazard switch
4. TRIP switch
5. Front defogger switch

Center Fascia Switch



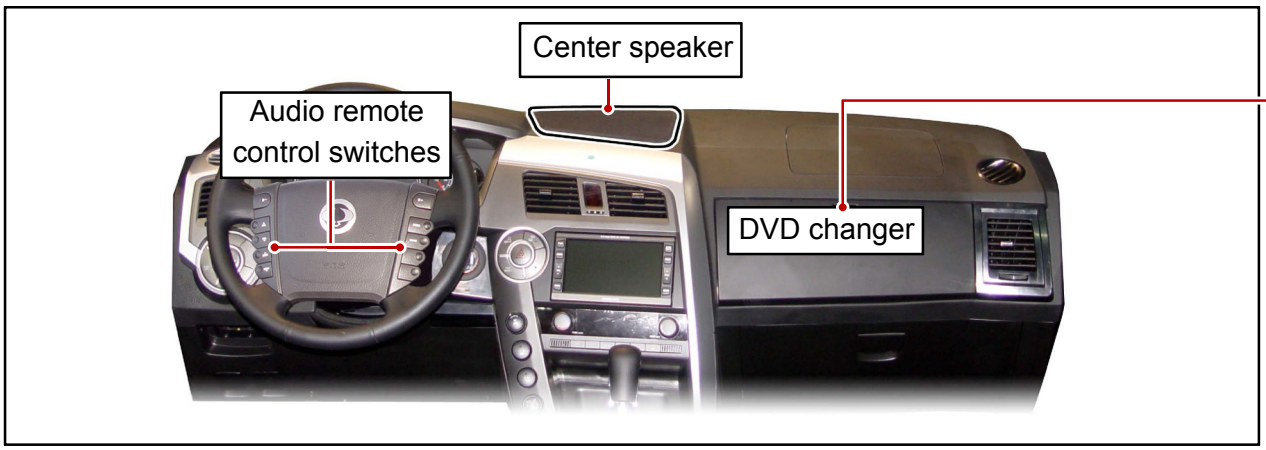
Passenger's Power Window Switch



Modification basis	
Application basis	
Affected VIN	

4. AUDIO / VIDEO SYSTEM

▶ AV System



AV Head Unit

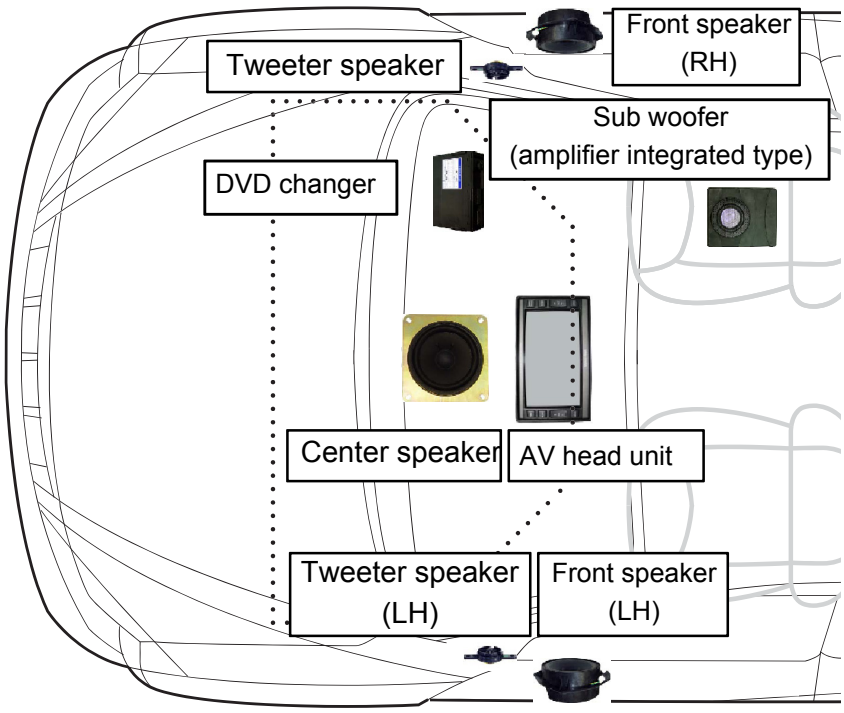


DVD+tape



Sub Woofer



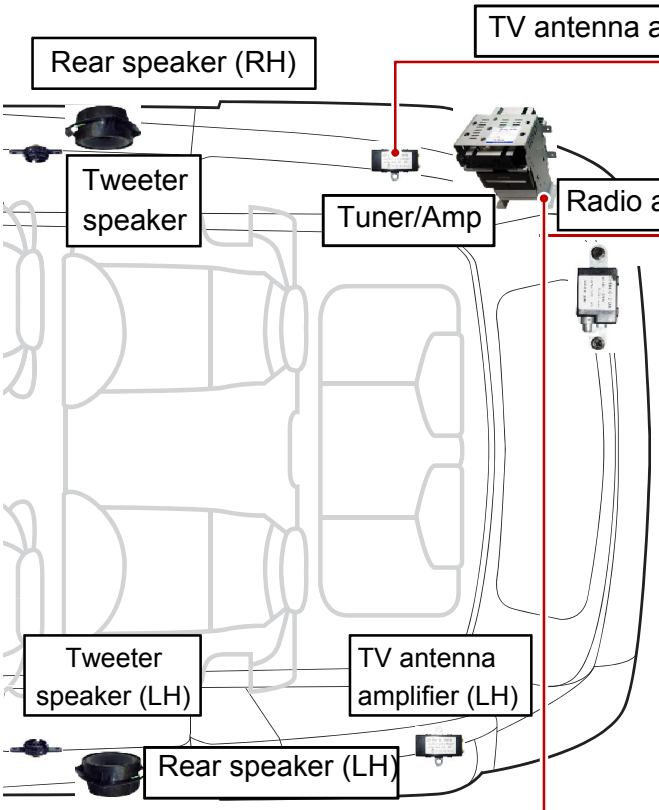


Other Audio Head Unit

6-INDASH CD+TAPE+RADIO	CD+RADIO
	

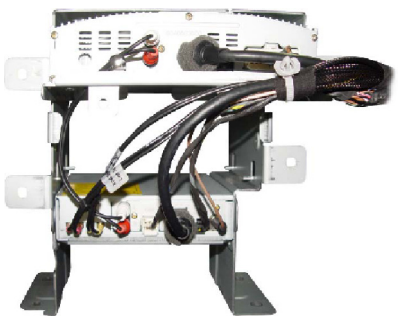
Modification basis	
Application basis	
Affected VIN	

Location: Inside of panel above glove box	6 DVD changer
	



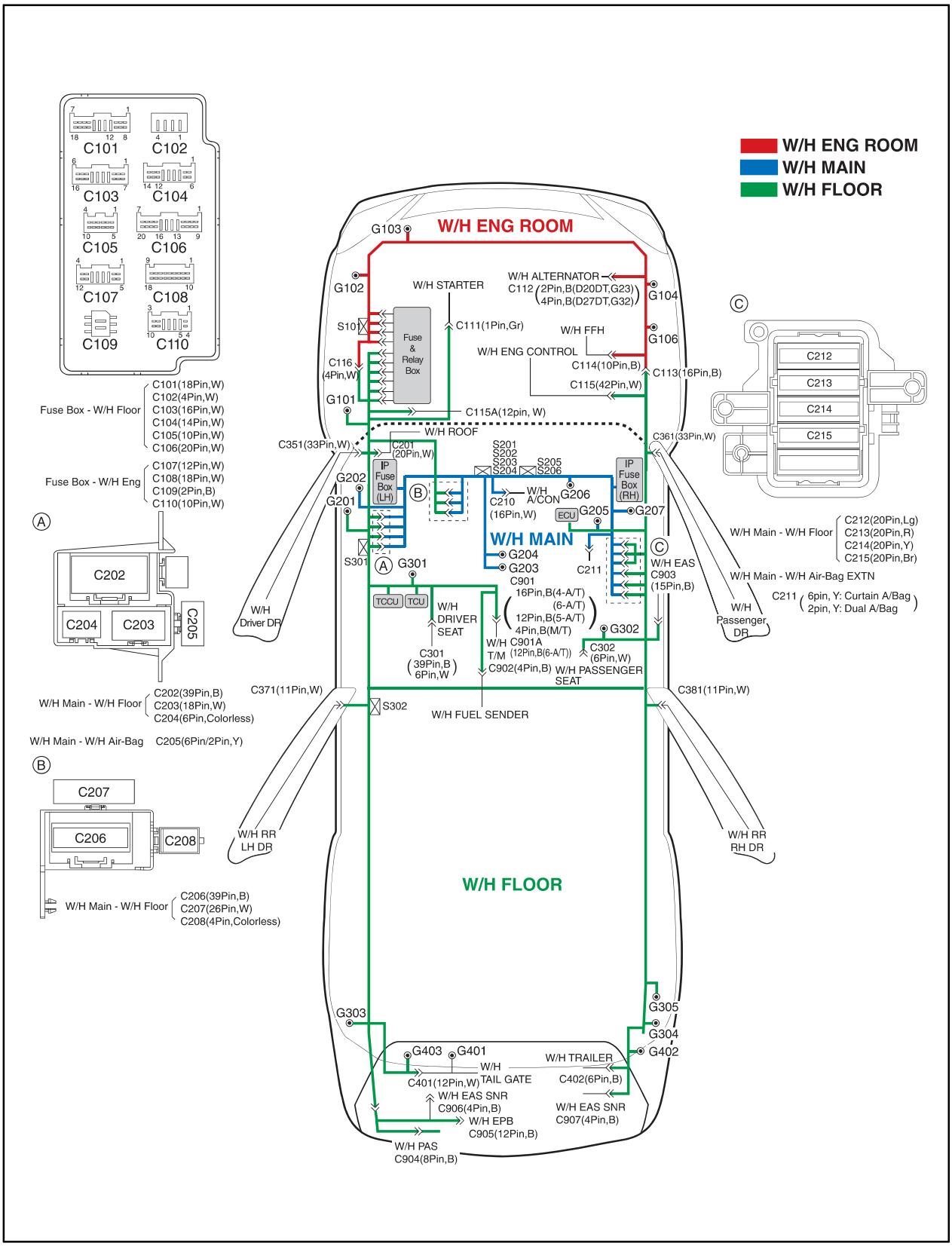




AV System


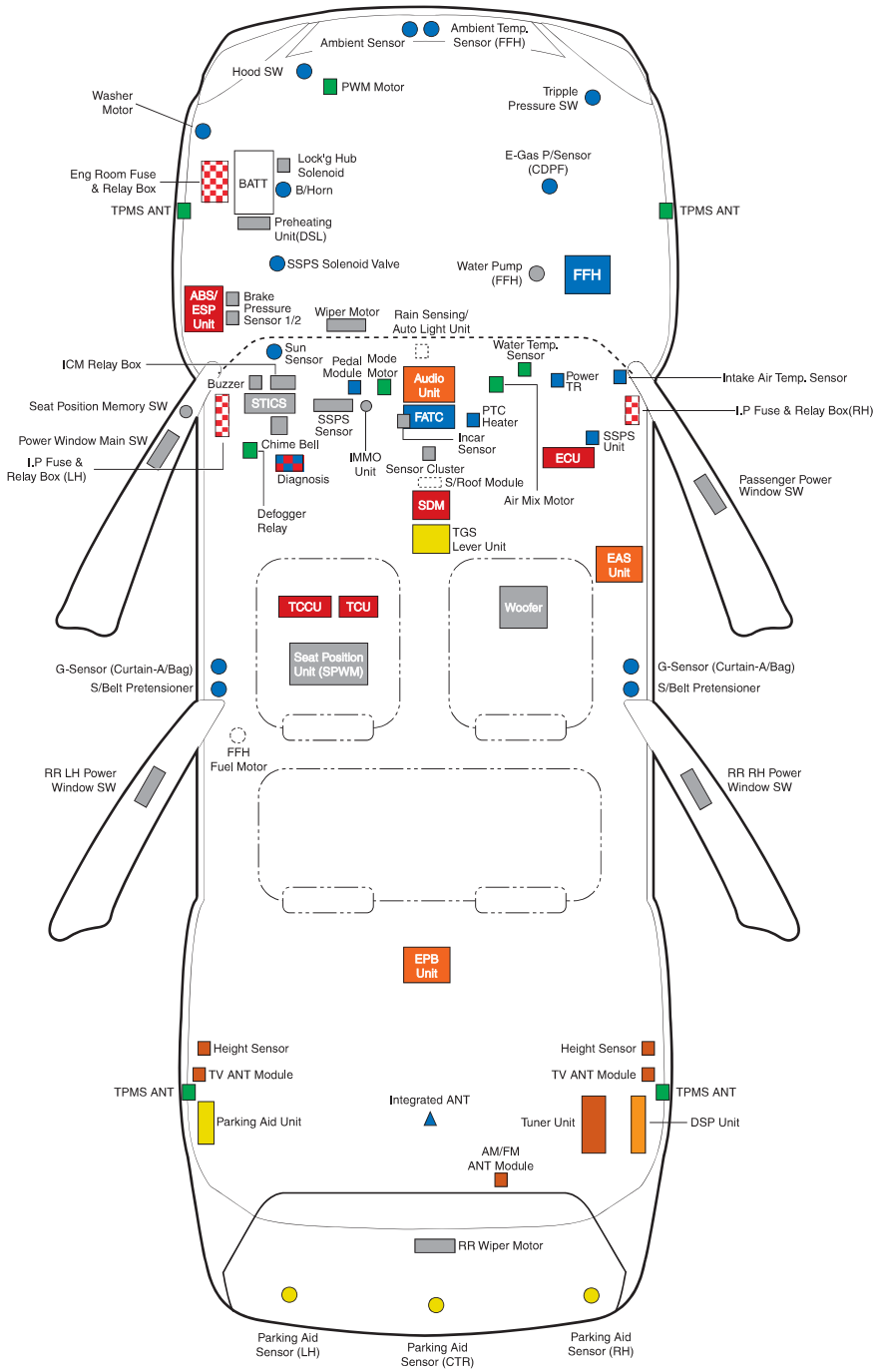
5. ELECTRIC COMPONENTS AND LAYOUT

▶ Wiring Harness Arrangement



Modification basis	
Application basis	
Affected VIN	

▶ Components Locator



Modification basis	
Application basis	
Affected VIN	

Memo

FUSE AND RELAY 8410-02

GENERAL INFORMATION

1. GENERAL INFORMATION

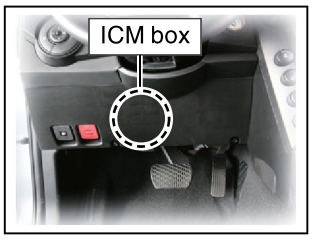
The ICM (Integrated Control Module) box installed to the new Actyon model is integrated with some relays of previous model and is installed to the back of the STICKS.
As the ICM box is newly installed, the following relays are integrated into the ICM box.

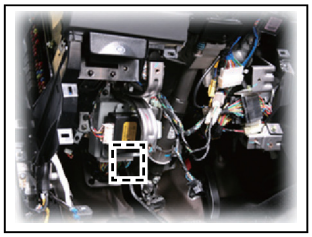
- **Door lock relay (previously installed to STICKS bracket)**
- **Windshield de-icer relay (previously installed next to floor on the driver side)**
- **Turn signal lamp relay (previously installed to passenger side fuse & relay box)**

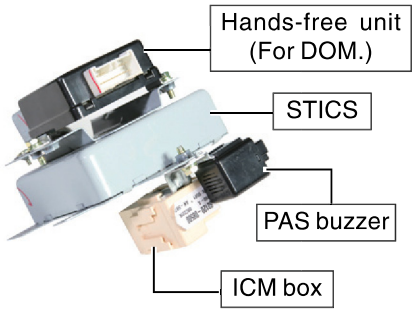
PREVIOUS MODEL

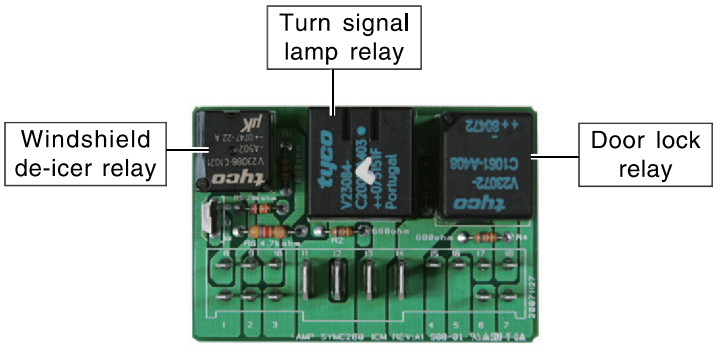


NEW MODEL









Inner view of ICM PCB

* Some relays have been integrated into the ICM box.

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

The ICM (Integrated Control Module) mounted to the back of the STICS is integrated with the door lock relay, windshield de-icer relay and turn signal lamp relay. There are four fuse & relay units.

2. FUSE AND RELAY MOUNTING LOCATION

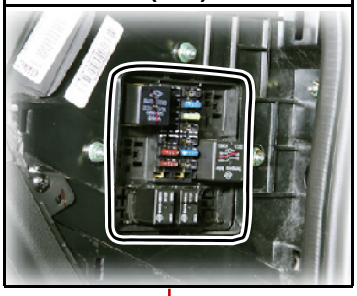
(1) In engine compartment



Fuse & Relay Box InEngine Compartment



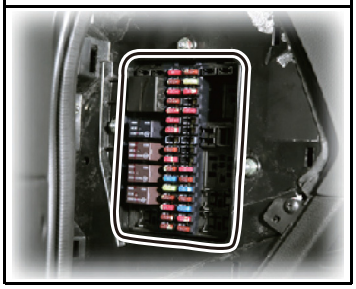
Interior Fuse & Relay Box On The Driver Side (RH)



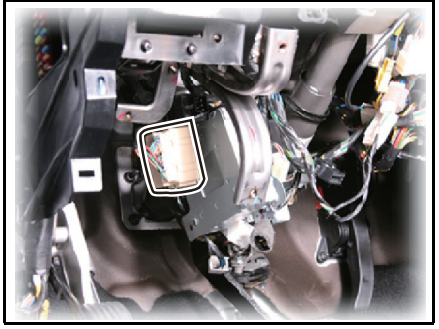
(2) In vehicle



Interior Fuse & Relay Box On The Driver Side (LH)

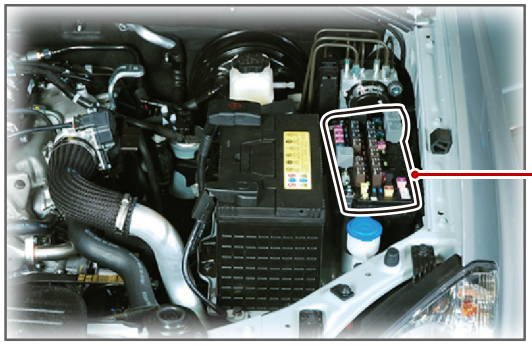


Mounting Location of ICM

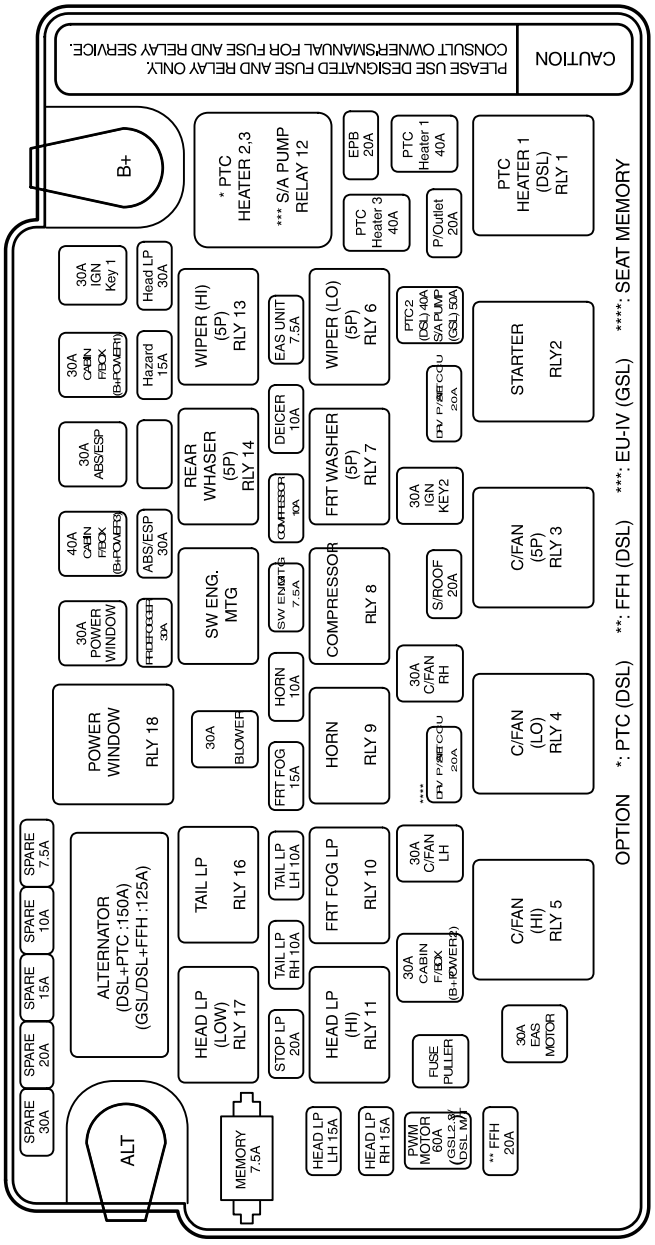


Modification basis	
Application basis	
Affected VIN	

3. CAPACITY AND NAME OF FUSE AND RELAY IN ENGINE COMPARTMENT







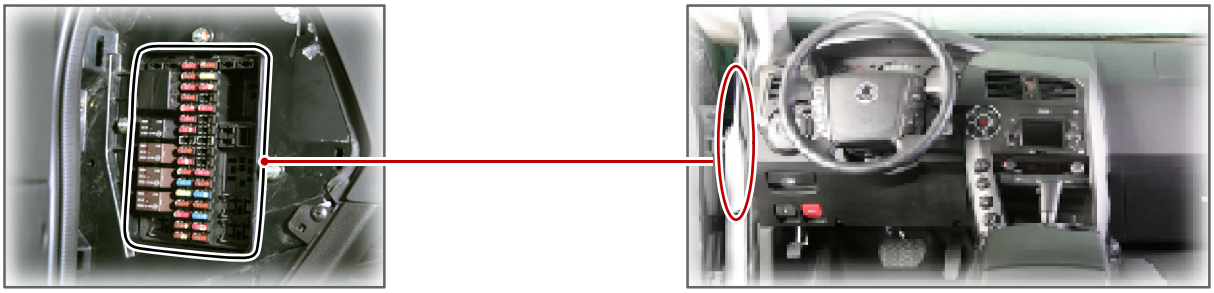
The label attached on each fuse box indicates only major fuses and relays. Therefore, there are more fuses and relays than indicated.

For details about the connection of fuses and relays, refer to the power distribution circuit diagram on the following pages.

Modification basis	
Application basis	
Affected VIN	

4. CAPACITY AND NAME OF INTERIOR FUSE AND RELAY

1) Interior Fuse and Relay Box On the Driver Side



SPARE		SPARE		F24 10A	A/BAG	F41 7.5A	O/SIDE MRR DIGITAL CLOCK ECM MRR, S/ROOF
				F25 7.5A	CLUSTER STICS	F42 20A	C/LIGHTER P/OUTLET
FLASHER UNIT				F26 10A	ENG ROOM FUSE & RLY BOX	F43 10A	AUDIO TUNNER UNIT
				F27 7.5A	ALTERNATOR IMMOBILIZER S/LAMP	F44 20A	*GSL FUEL PUMP
				F28 10A	T/SIGNAL BACK UP LP	F45 10A	ENG ECU
RR WIPER				F29 10A	TCU, TGS TCCU	F46 20A	*GSL INJECTOR
				F30 10A	ENG ECU	F47 15A	*GSL SENSOR
BURGLAR HORN				F31 7.5A	HEATING VALVE (Russia Only)	F48 -	SPARE
				F32 7.5A	SEAT UNIT EAS, EPB	F49 -	SPARE
*HDC H D C				F33 10A	ABS/ESP	F50 -	SPARE
				F34 7.5A	HEAD LP R/SNR& AUTO LIGHT DRL	F51 10A	RR FOG LAMP INTERIOR LAMP
RR SEAT WARMER				F35 15A	FRT S/WARMER	F52 7.5A	IMMOBILIZER BUZZER, CHIME
				F36 20A	FRT WIPER WASHER	F53 15A	DOOR LOCK/UNLOCK B/HORN
				F37 7.5A	RR S/WARMER A/CON	F54 7.5A	SEAT UNIT FOLDING DIAGNOSIS
SPARE				F38 10A	RR WIPER	F55 15A	RR SEAT WARMER
				F39 7.5A	STICS FRT & RR GLASS HEATER	F56 10A	STARTER GSL ECU
				F40 7.5A	ALT D (D20DT)	F57 7.5A	DEF IND O/S MRR DEF

RR FOG LAMP

SPARE

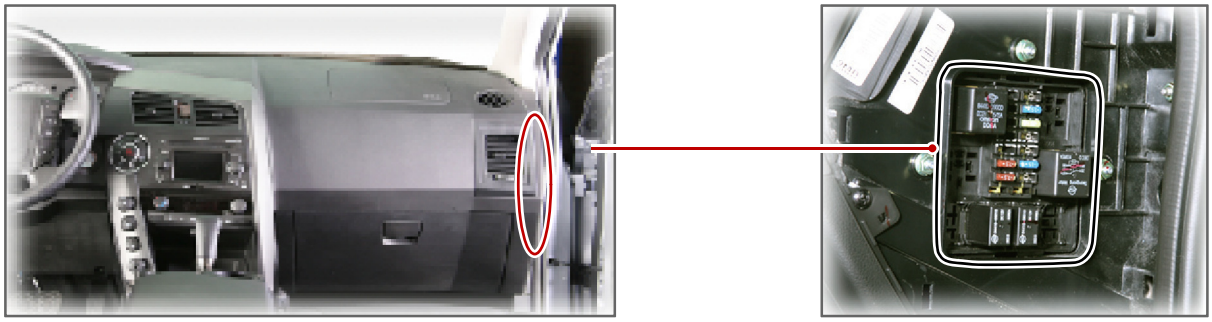
SPARE

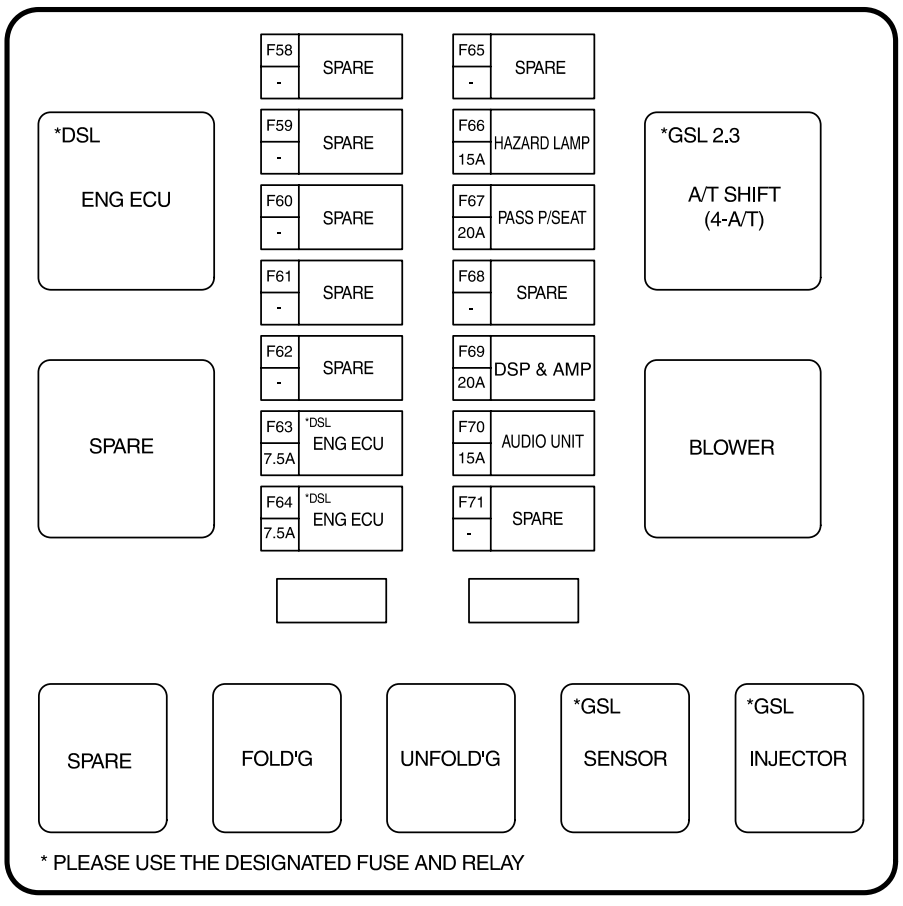
*GSL F/PUMP

* PLEASE USE THE DESIGNATED FUSE AND RELAY

Modification basis	
Application basis	
Affected VIN	

2) Interior Fuse and Relay Box On the Passenger Side





Modification basis	
Application basis	
Affected VIN	

5. OPERATING PROCESS OF ICM BOX

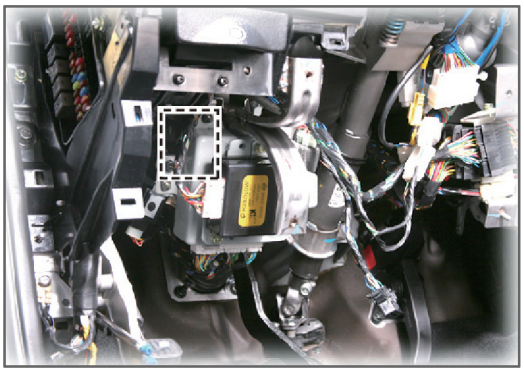
1) Overview

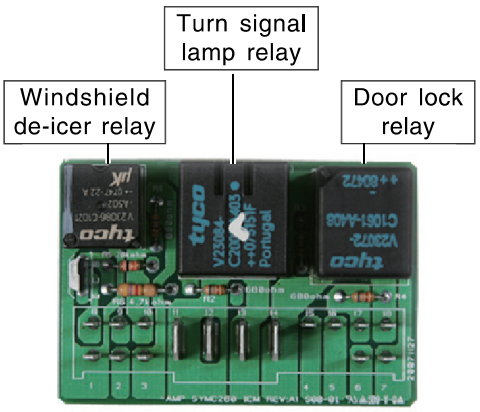
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- **Door lock relay (previously installed to STICKS bracket)**
- **Windshield de-icer relay (previously installed next to floor on the driver side)**
- **Turn signal lamp relay (previously installed to passenger side fuse & relay box)**

2) Mounting Location



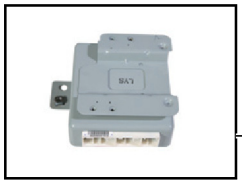




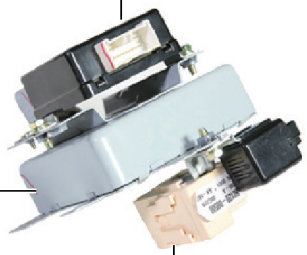
Inner view of ICM PCB

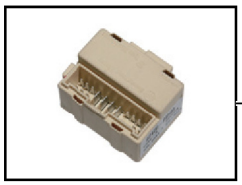


Hands-free unit (For DOM.)



STICS





ICM box

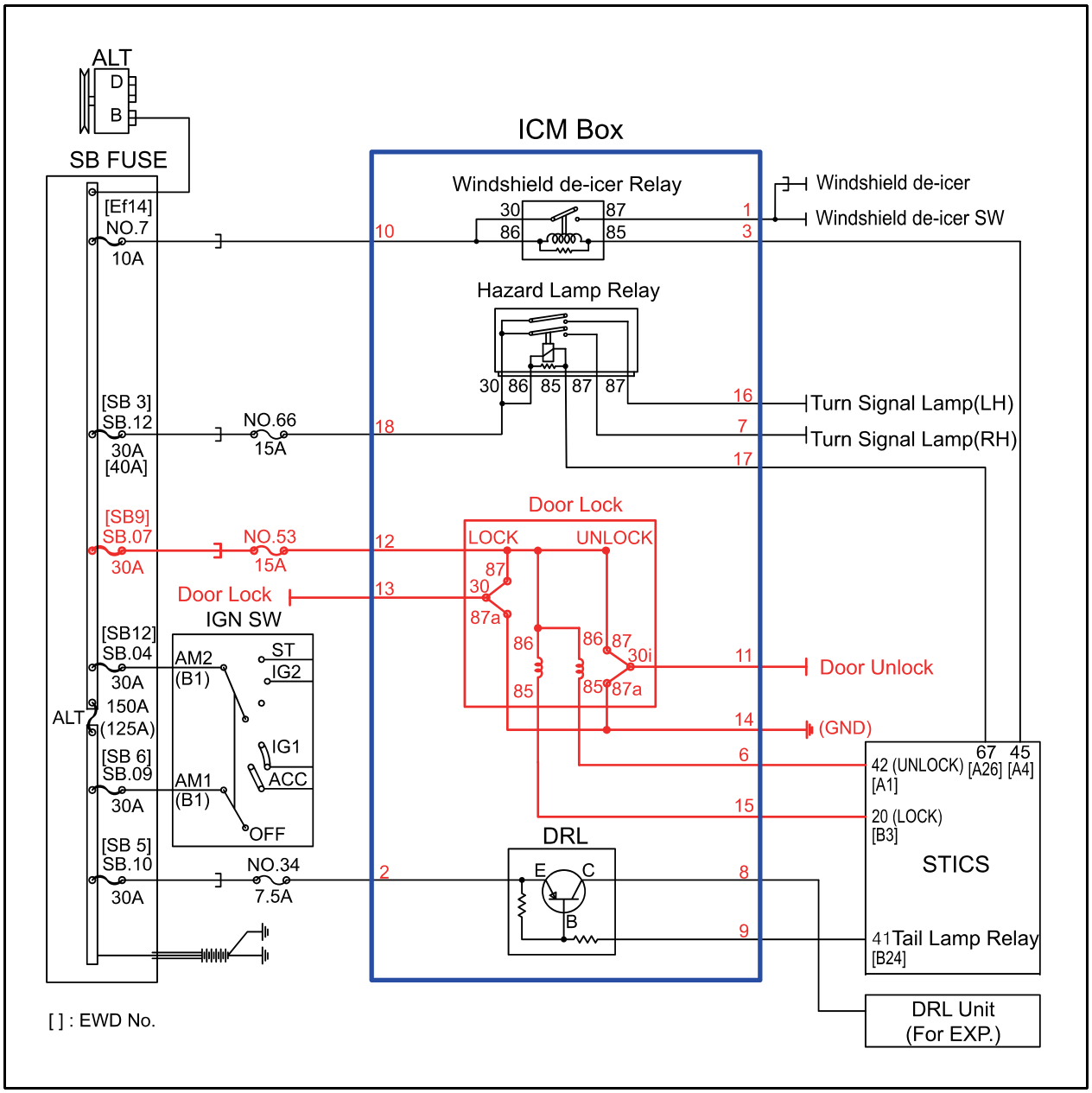
CAUTION

- Relays in the ICM box cannot be replaced respectively; so if the components on the PCB are defective, the ICM box should be replaced as an assembly.

Modification basis	
Application basis	
Affected VIN	

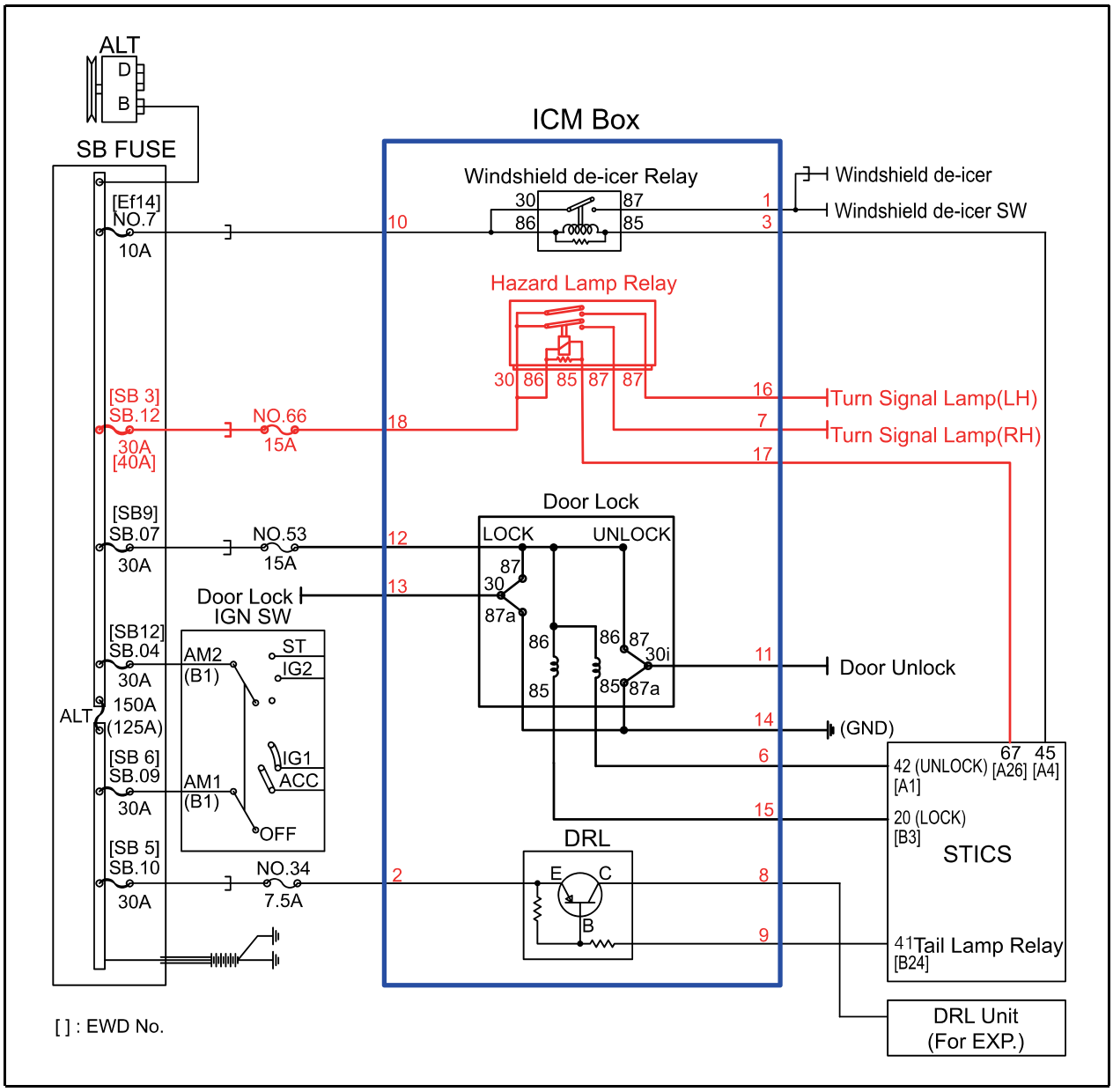
3) Operating Process by Power Supply of ICM Box

(1) Door lock relay



As the ICM box is supplied with power from the fuse (12-pin) and STICS (6-pin, 15-pin), it operates the door actuator (11-pin, 13-pin) through its door lock relay to lock/unlock the door.
In order to check the operation of the relay, measure the voltage at the connector of the ICM box and check the output through the ICM box after operating the corresponding door.
Of course, the components for the corresponding system should be checked in advance.

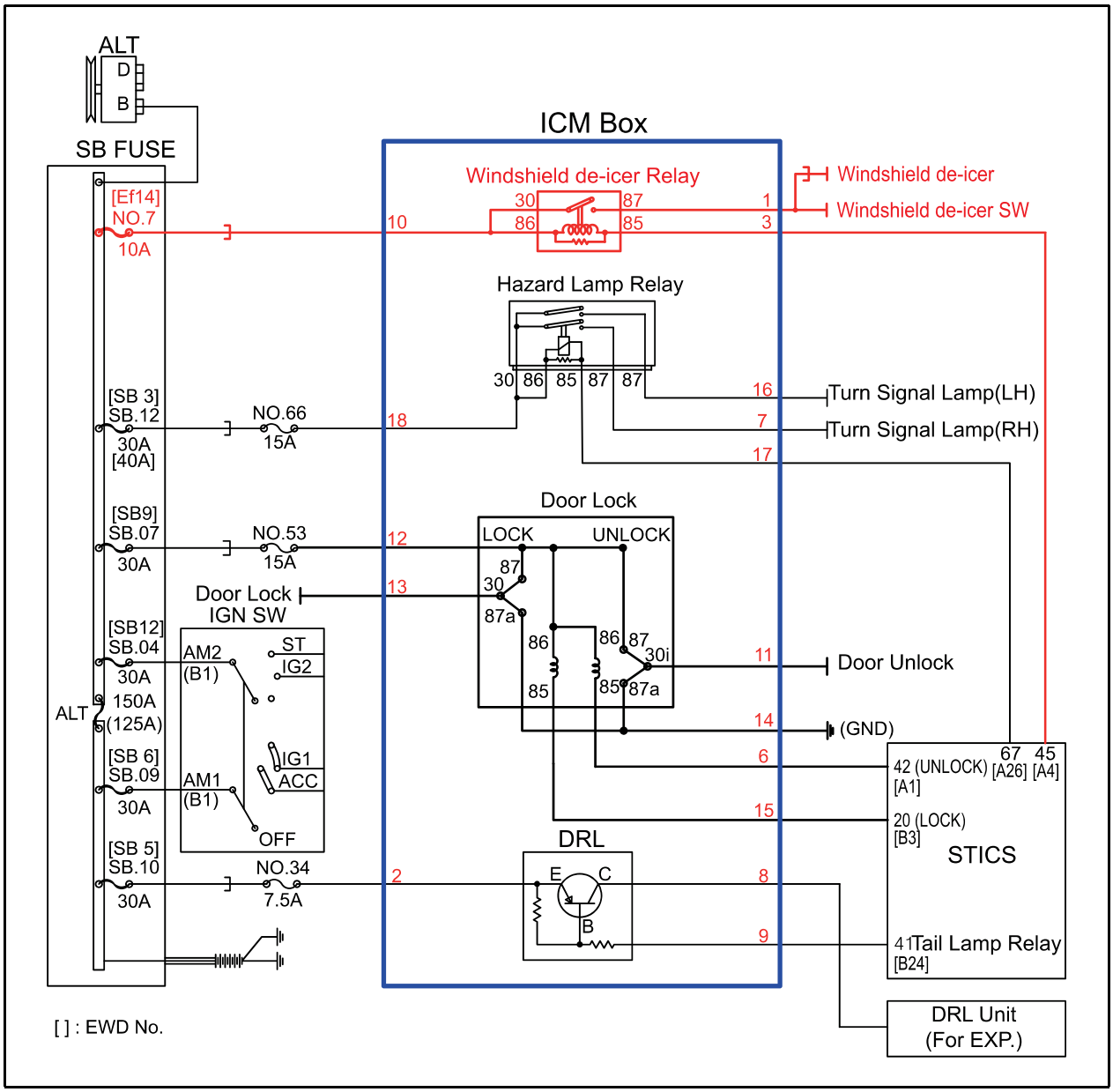
(2) Turn signal lamp (hazard warning lamp operation)



- When the hazard warning lamp switch is pressed for approx. 0.1 to 0.59 seconds, the hazard warning lamp blinks 3 times at an interval of 0.35 seconds.
- When the hazard warning lamp switch is pressed for approx. 0.6 seconds or longer, the hazard warning lamp blinks 10 times at an interval of 0.35 seconds.
- This function is only available when the ignition key is in the "ON" position.
- If the ignition key is turned to the "OFF" position during this function is activated, this function is immediately deactivated.
- If the system receives signals for the turn signal lamp operation during this function is
- activated, this function is immediately deactivated.
- While the turn signal lamp signals are already inputted, pressing the hazard warning lamp switch does not activate the hazard warning lamp function.

Modification basis	
Application basis	
Affected VIN	

(3) Windshield de-icer operation



Pressing the windshield de-icer switch activates the de-icer for 12 minutes and pressing the switch again deactivates the de-icer. At this time, pressing the switch again activates the de-icer for 12 minutes from the time the switch is pressed again.

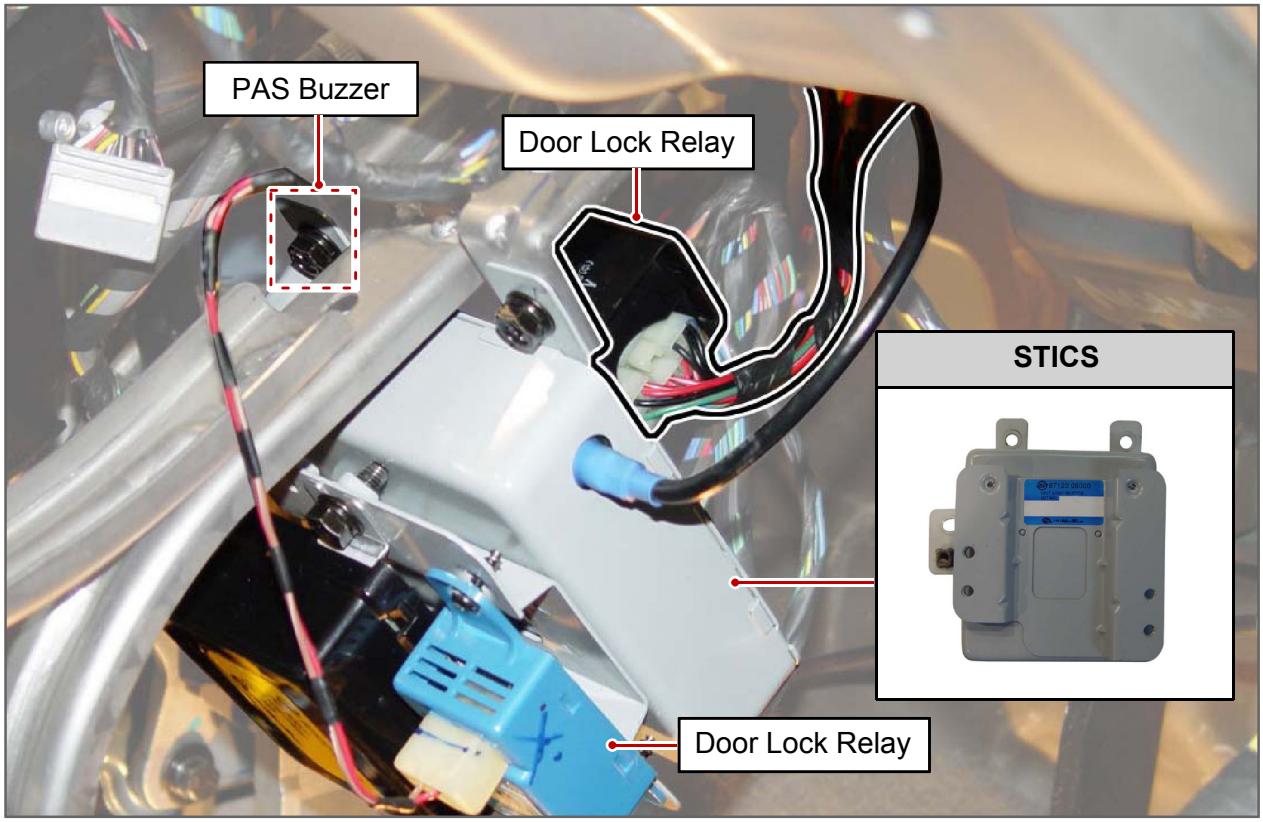
STICS

8710-01

GENERAL

1. STICS OVERVIEW

The RKSTICS (REKES + STICS (Super Time & Integrated Control System)) communicates with the transmitter (remote controller) and other electronic systems to transmit and receive the data. The STICS also includes a diagnosis function that can inspect the error for related devices.



Modification basis	
Application basis	
Affected VIN	

2. SPECIFICATIONS

1) Electrical Performance

▶ Electrical Performance

Item	Requirement	Remark
Rated voltage	DC 12.0 V	
Operating voltage	DC 9.0 V ~ 16.0 V	Should operate normally within this range. (9.5 V ~ 16.0 V only for auto hazard lamp function)
Operating temperature	-30°C ~ +80°C	Should operate normally within this range.
Reserved temperature	-40°C ~ +85°C	
Max. operating humidity	95%	
Resistible voltage	24 V	
Insulating resistance	No heat and fire due to the current leaks.	Confined with PCB, waterproof and coating that requires the insulation.
Parasitic current	below 7.0 mA	When initiating the sleep mode after removing ignition key and locking the doors
Voltage drop	below 1.5 V below 1.8 V	Pin no. 72 and 2, 4, 7, 8, 9, 10, 11, 12, 19, 24, 27, 28, 29, 30, 31, 32, 33, 36, 56, 57, 58, 59, 60, 61, 70, 71 Pin no. 72 and 5, 6, 16, 17, 18, 20, 21, 23, 35, 37, 39, 41, 42, 43, 44, 45, 62, 64, 65, 66, 67, 68, 69

2) Characteristics of Radio Wave

1. Transmitting frequency: 447.800 ± 0.0125 MHz
2. Channel width: below 12.5 KHz
3. Frequency bandwidth: below 8.5 KHz
4. Modulation method: FSK (Frequency Shift Keying)
5. Receiving distance: Approx. 10 ~ 15 m (In case there are not obstacles around the system)

▶ Rated Load

NO.	Description	Rated Load
1	Chime bell / Buzzer	DC 12V 350 mA (Inducted load)
2	Front Room lamp	DC 12V 16W (Lamp load)
3	Rear Room lamp	DC 12V 8W (Lamp load)
4	Key hole illumination	DC 12V 1.2W (Lamp load)
5	Seatbelt warning lamp	DC 12V 1.2W (Lamp load)
6	Parking brake warning lamp	DC 12V 1.2W (Lamp load)
7	Door ajar warning lamp	DC 12V 1.2W (Lamp load)
8	Door lock relay	DC 12V 200 mA (Inducted load)
9	Door unlock relay	DC 12V 200 mA (Inducted load)
10	Horn relay	DC 12V 200 mA (Inducted load)
11	Tail lamp relay	DC 12V 200 mA (Inducted load)
12	Hazard warning relay	DC 12V 200 mA (Inducted load)
13	Power window relay	DC 12V 200 mA (Inducted load)
14	Rear defogger relay	DC 12V 200 mA (Inducted load)
15	Wiper LOW relay	DC 12V 250 mA (Inducted load)
16	Wiper HIGH relay	DC 12V 250 mA (Inducted load)
17	Front washer motor	DC 12V 1.5 A
18	Rear washer motor relay	DC 12V 500 mA (Inducted load)
19	Headlamp relay	DC 12V 750 mA (Inducted load)
20	Front defogger relay	DC 12V 200 mA (Inducted load)
21	Outside Rearview Mirror Folding Relay	DC 12V 200 mA (Inducted load)
22	Outside Rearview Mirror Unfolding Relay	DC 12V 200 mA (Inducted load)

▶ Input Signals

NO.	Input Signal Name	Logic Status
1	IGN1	ON = BAT (IGN "ON" or "START")
2	IGN2	ON = BAT (IGN "ON")
3	ALT_D	ON = BAT (engine running)
4	Key reminder (door ajar warning switch)	IN = BAT (Key in)
5	Driver's door switch	OPEN = GND, CLOSE = OPEN
6	Passenger's door switch	OPEN = GND, CLOSE = OPEN
7	Rear door switch	- OPEN (one of rear seat) = GND - CLOSE (all rear seats) = OPEN
8	Tailgate switch	OPEN = GND, CLOSE = OPEN
9	Hood switch	OPEN = GND, CLOSE = OPEN
10	Driver's door lock/unlock switch	LOCK = OPEN, UNLOCK = GND
11	Passenger's door lock/unlock switch	LOCK = OPEN, UNLOCK = GND
12	Rear door lock/unlock switch	- UNLOCK (one of rear seat) = GND - LOCK (all rear seats) = OPEN
13	Tailgate lock/unlock switch	LOCK = OPEN, UNLOCK = GND
14	Rear defogger switch	ON = GND, OFF = OPEN
15	Seatbelt switch	Unfastened = GND, Fastened = OPEN
16	Sunroof operation switch	ON = GND, OFF = OPEN
17	Parking brake switch	ON = GND, OFF = OPEN
18	Air bag collision sensor	ON = 200 ms output (LOW), OFF = OPEN
19	Wiper motor (parking) switch	STOP = BAT VOLTAGE, ROTATING = GND
20	Washer switch	ON = BAT, OFF = OPEN
21	Intermittent auto switch	ON = BAT, OFF = OPEN
22	Auto washer switch	ON = BAT, OFF = OPEN
23	Intermittent resistance	0 ~ 51kW (for intermittent wiper)
24	Speed sensor	ON = GND (PWM), OFF = OPEN
25	Outside rearview mirror folding/unfolding switch	ON = GND, OFF = OPEN
26	Front defogger switch	ON = GND, OFF = OPEN
27	Auto hazard switch	ON = GND, OFF = OPEN
28	Central door lock switch	ON = GND, OFF = OPEN
29	Rear washer switch	ON = BAT, OFF = OPEN
30	Multifunction auto light switch	ON = GND, OFF = OPEN
31	Indicator lamp switch	ON = BAT/GND, OFF = OPEN (Approx. 5.1V ~ 9.2V)
32	Seat adjustment and switch memory unit	ON = GND (PWM), OFF = OPEN
33	Rain sensor	ON = GND (DATA), OFF = BAT
34	Diagnosis (SCAN-100)	ON = GND (DATA), OFF = BAT (KWP2000)

Modification basis	
Application basis	
Affected VIN	

▶ Chattering of Input Signals

- Vehicle speed input:
  The vehicle speed is the average value of 4 pulses among 6 pulse inputs regardless of the input for 1.0 second after IGI 1 ON. The time indicated in each function does not include the vehicle speed calculating time.
- 20 ms target input:
  Wiper motor A/S (parking) terminal
- 100 ms target input switch
  All switches except wiper motor A/S (parking) terminal

▶ Time Tolerance

- If not indicated, time tolerance will be ± 10%.
  However, if less than 500 ms, time tolerance will be ± 100 ms.
- The time indicated in each function does not include chattering processing time from switch input changing point.

Memo

IMMOBILIZER SYSTEM 7010-06

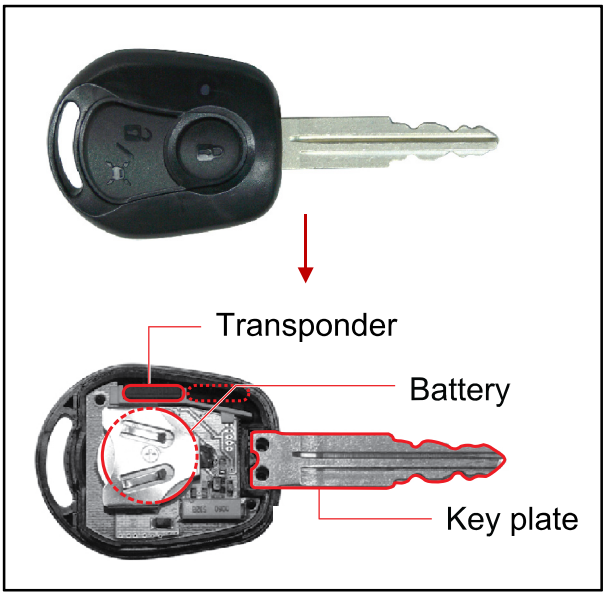
GENERAL

1. IMMOBILIZER OVERVIEW



The immobilizer unit communicates with the enginecontrol unit to enable the engine starting.

1) What is the immobilizer system?



The immobilizer system prevents the vehicle theft byallowing only the authorized key to start the engine. Thetransponder inside the key communicates with the im-mobilizer installed in the key box, and the system per-mits the engine to start after confirming the encryptedcoding from the engine ECU. Refer to the informationthat follows for specific functions and their descriptions.

2. BASIC FUNCTIONS OF IMMOBILIZER KEY (REKES FUNCTION)

1) Remote Control Key

When pressing the switch on the remote control key, the vehicle control message coded by CPU is transmitted to RKSTICS. Then, STICS' CPU controls the vehicle. The key for 2007 Kyron differs from the previous model in appearance and function.

(1) Door Unlock and Panic Function

Briefly press (below 0.5 sec): Door unlock and theft deterrent mode is deactivated Press and hold (over 2 sec): Panic function

▶ **Door unlock (Briefly press)**

- If the unlock button on the remote control is pressed, the door will be opened and the theft deterrent mode will be activated. If the door coupled switch of front room lamp is pressed, the lamp will come on for 30 seconds.
  It will turn off immediately after the lock button of the remote control is pressed.



▶ **Panic function: activated in the theft deterrent mode**

- If you press and hold the door unlock and panic buttons, the buzzer will sound for 27 seconds.
- The function is inactivated if any button of remote control is pressed.

Without REKES key

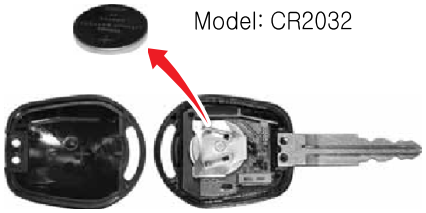


With REKES key



Without REKES key





Model	CR 2032 (Rekes key type)
	V 625U (without Rekes)
Amount	One

Modification basis	
Application basis	
Affected VIN	

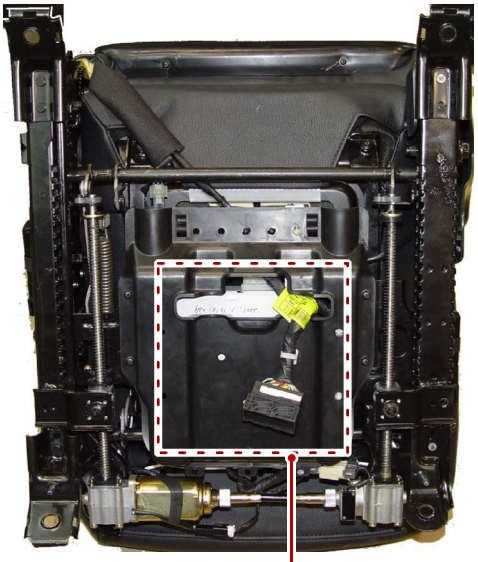
Memo

SPWM (Seat Position With Memory) UNIT

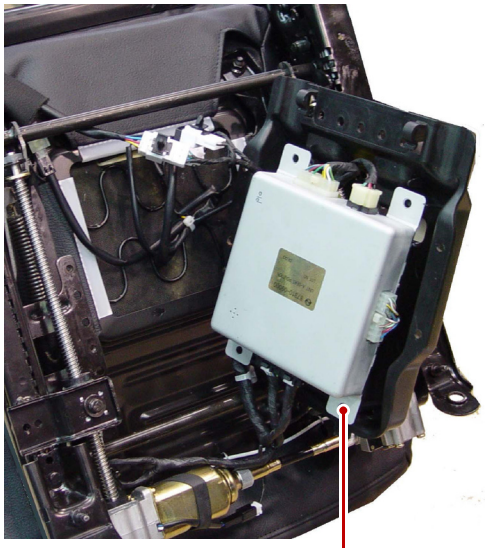
7410-13

GENERAL

1. SEAT POSITION WITH MEMORY OVERVIEW



Location
(Bottom of diver's seat)



SPWM

▶ **Functions of SPWM**

Seat Position With Memory

- **Power seat control**
- **Outside rearview mirror control**
- **Driver's seat and outside mirror position memory**

- Adjusting the power seat's position with the seat adjusting switch
- Adjusting the angle of the outside rearview mirrors (OSRVM)
- Seat memory positions: for 3 persons
- Folding/Unfolding the outside rearview mirrors

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. SEAT POSITION WITH MEMORY COMPONENTS

LH outside rearviewmirror



RH outside rearviewmirror



Seat memory switch



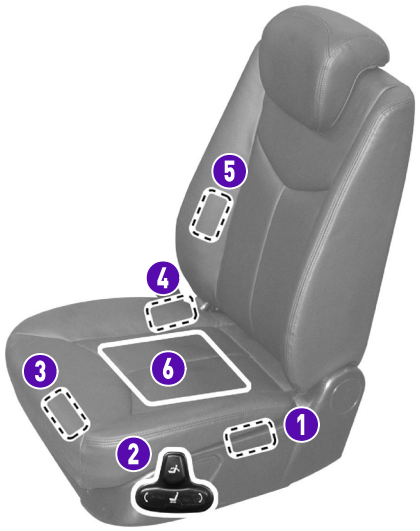
Outside rearview mirror folding switch



SPWM Unit



Seat Position With Memory COMPONENTS

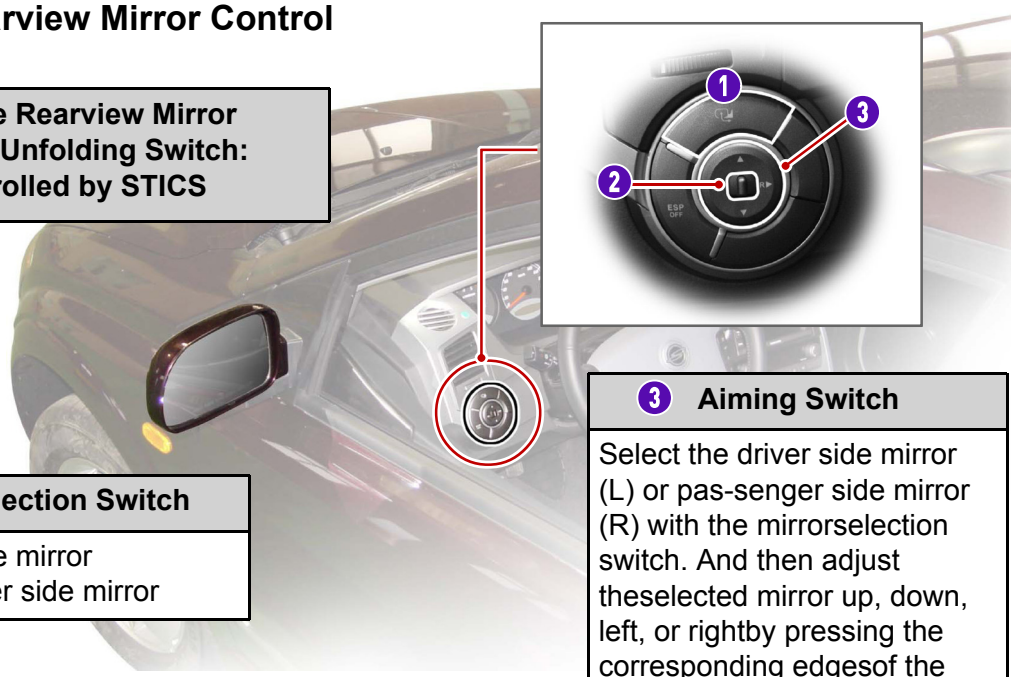


1. Front cushion motor/sensor
2. Seat adjusting switch
3. Sliding motor/sensor
4. Rear cushion motor/sensor
5. Reclining motor/sensor
6. SPWM Unit

Modification basis	
Application basis	
Affected VIN	

2. SEAT POSITION WITH MEMORY OPERATIONS

1) Outside Rearview Mirror Control



1 Outside Rearview Mirror Folding/Unfolding Switch: controlled by STICS

2 Mirror Selection Switch

"L": Driver side mirror
"R": Passenger side mirror

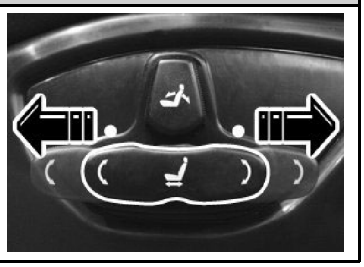
3 Aiming Switch

Select the driver side mirror (L) or pas-senger side mirror (R) with the mirrorselection switch. And then adjust theselected mirror up, down, left, or rightby pressing the corresponding edgesof the switch to get the direct rearview.

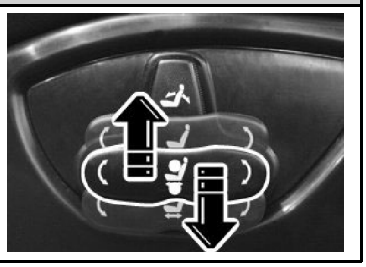
2) Seat Position Control



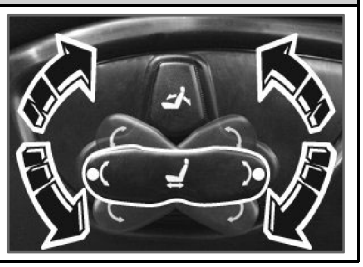
Seat Slide Adjustment



Seat Height Adjustment



Seat Tilt Adjustment



3) DRIVER'S SEAT POSITION MEMORY FUNCTION

The position memory is available for up to three drivers. Each driver can set his/her own driver's seat outside rearviewmirrors and interior rearview mirror positions and they will be separately stored in the integrated computer. If some-body has moved the seat, the memory positions can be recalled automatically by pressing the position button.



▶ **Storing Memory Settings**

1. Position the transmission shift lever to"P"with the ignition switch"ON"(for your safety, do not start the engine).Apply the parking brake if the vehicle is equipped with M/T.
2. Adjust the driver's seat and outside rearview mirrors to the desired positions.
3. Press the "SET"button. The indicator on the button will come on.
4. Within 5 seconds, press the buttons (1), (2) or (3) you want to set. The indicator on the set buttonblinks 3 times.

Modification basis	
Application basis	
Affected VIN	

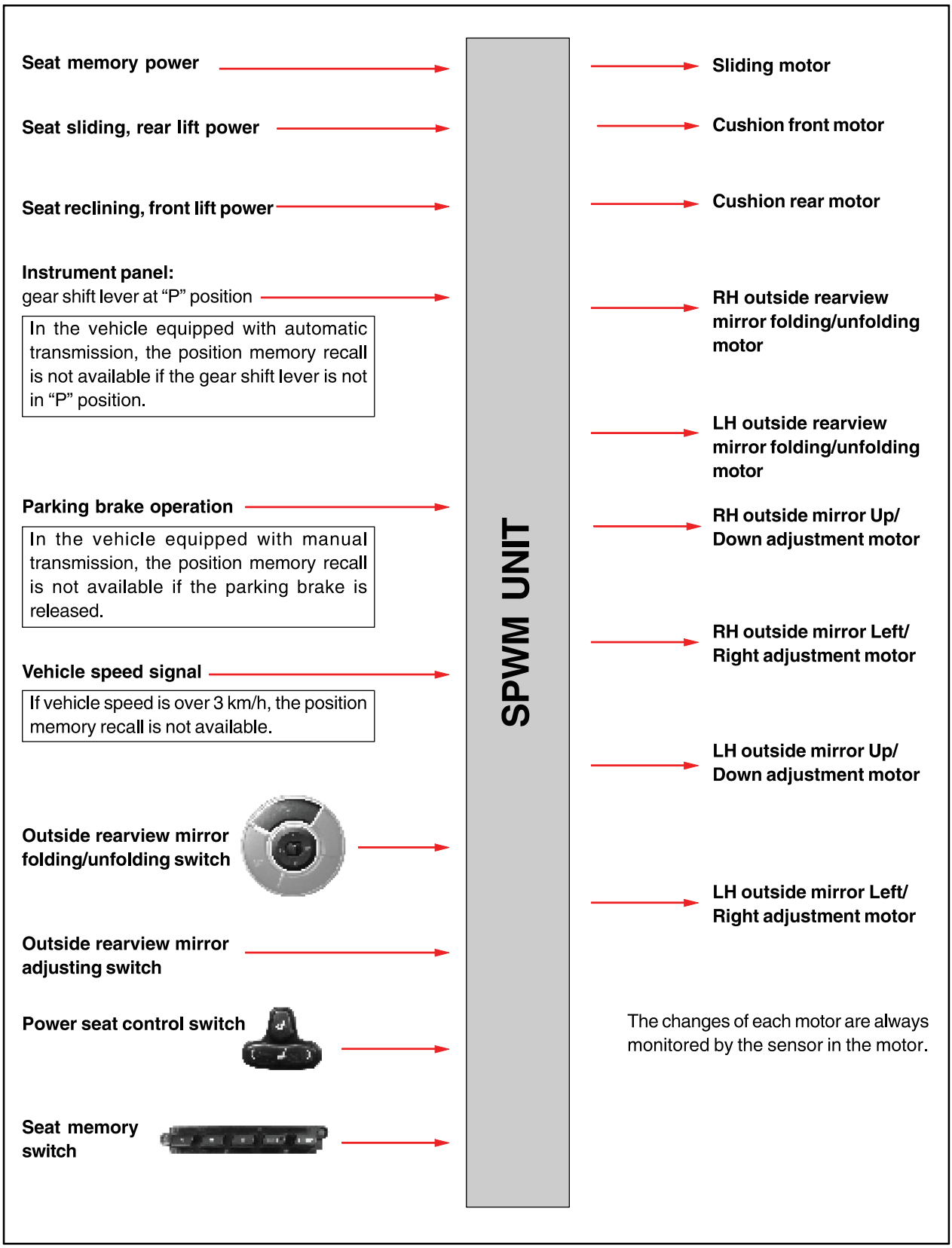
4) OPERATING MEMORY SETTINGS

- Press and hold the desired buttons (1, 2 or 3) for more than 1.5 seconds.
- Driver's seat and outside rearview mirrors start to move. The position memory recall is canceled if moving thevehicle during its operation.
- Wait until they stop moving.
- When the position memory recall is completed, the buzzer sounds twice. (If failed, the buzzer sounds threetimes.)

CAUTION

· The position memory recall is canceled if operating the seat or the outside rearview mirrors during itsoperation.
· In the vehicle equipped with automatic transmission, the position memory recall is not available if the parkingbrake is released and the gear shift lever is not in "P" position.
· In the vehicle equipped with manual transmission, the position memory recall is not available if the parkingbrake is released.
· If the position memory recall is successfully completed the buzzer sounds twice. If it failed, the buzzer soundsthree times.

3. SEAT POSITION WITH MEMORY INPUT/OUTPUT OF SPWM UNIT



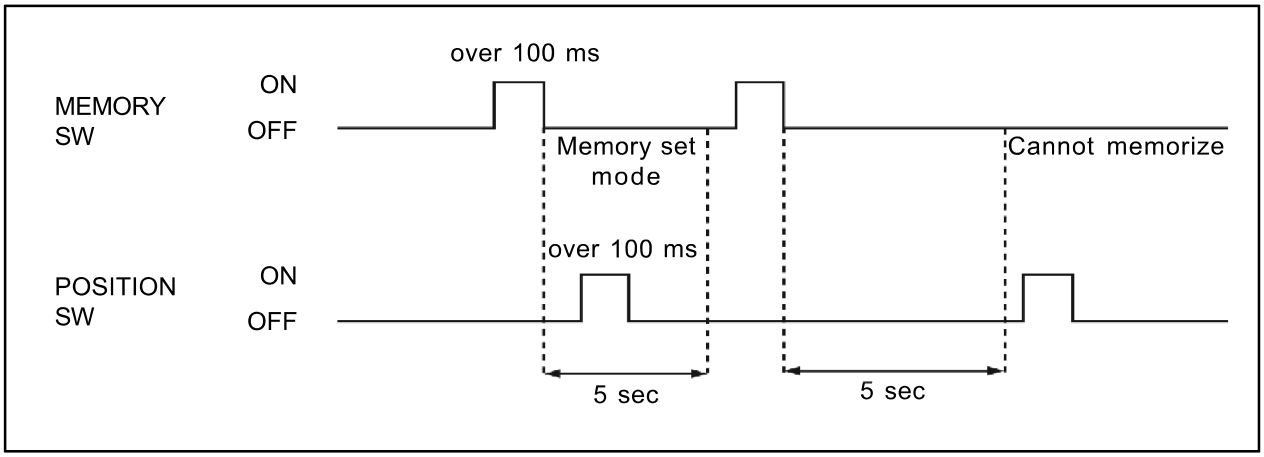
Modification basis	
Application basis	
Affected VIN	

4. CONTROL AND OPERATING CONDITIONS

1) Seat Position Memory

▶ Seat Position Memory Operation

- To store the seat position and the outside rearview mirror position, press the SET button and, within 5 seconds,press one of position switches. The memory setting is available for up to 3 different drivers.
- The memory set mode is only available within 5 seconds after pressing the SET button.

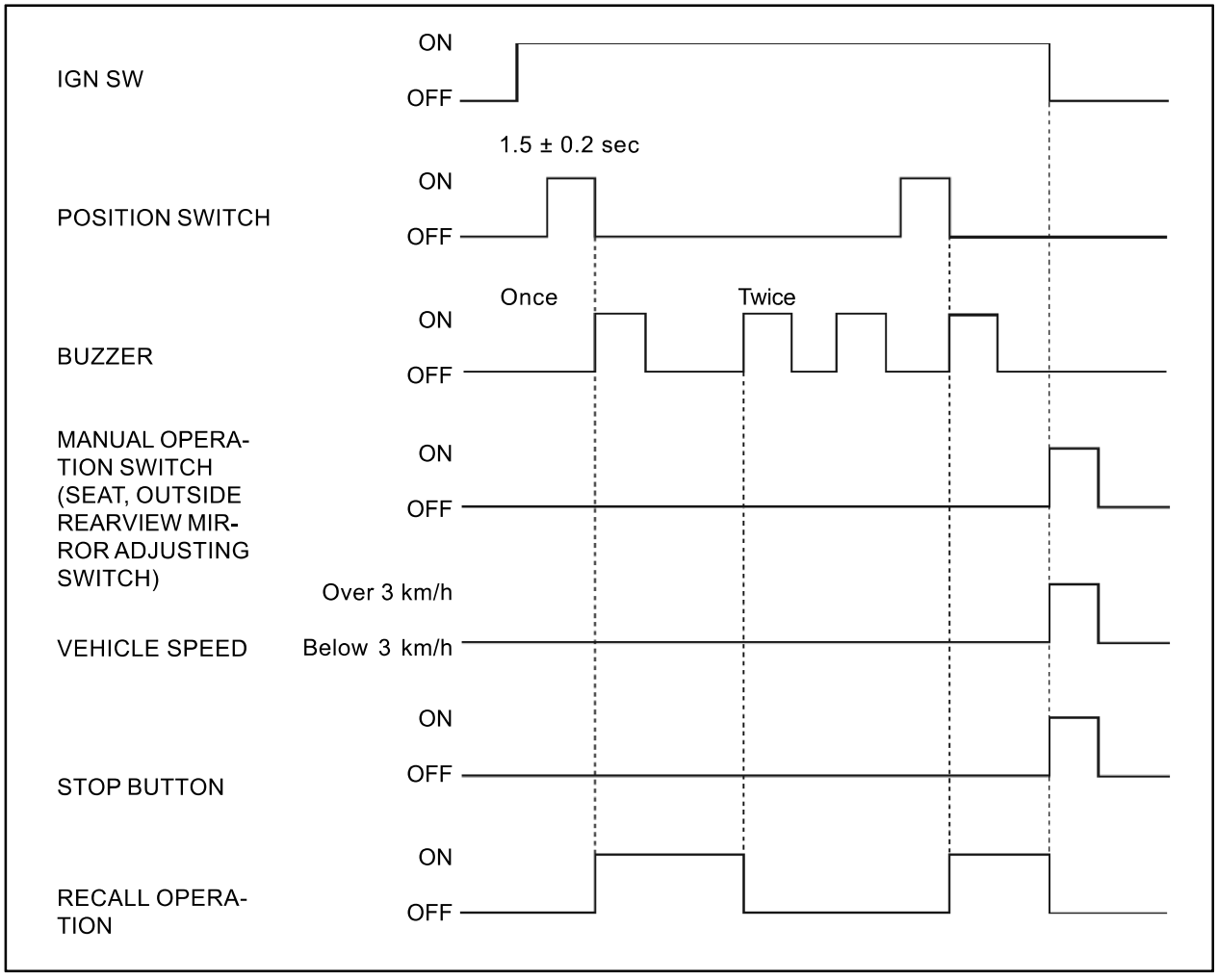


- If any of the following conditions is met, the memory set mode is canceled.
  - · No switch inputs within 5 seconds after pressing SET button.
  - · When adjusting the seat or outside rearview mirror positions during the memory recall operation.
  - · When turning off the ignition switch.
  - · When pressing the STOP button
  - · When the memory setting is completed.
- The memory recall is not available when the vehicle speed is over 3 km/h or the gear shift lever is not in "P"position with the parking brake released.
- The memory set can be unlimitedly renewed.
- The stored positions are erased when disconnecting the battery cables.
- The buzzer sounds once if the memory set mode is activated.
- The buzzer sounds twice if the memory setting/recalling is completed.
- The buzzer sounds three times if an error is found in the sensor during the memory recall operation.

▶ Seat Memory Recall Operation

- When pressing the position switch with the ignition switch ON, the seat and outside rearview mirrors move to thememorized positions.
- When pressing another position switch during previously activated memory recall
- operation, the newly pressedposition switch takes priority and recalls its stored position.
- The buzzer sounds once if a position switch is pressed.
- If any of the following conditions is met, the memory recall function is deactivated.
  - · When turning off the ignition switch.
  - · When the gear shift lever is not in "P"position with the parking brake released.
  - · When the parking brake is released (only for the vehicle equipped with manual transmission)
  - · When the vehicle speed is over 3 km/h.
  - · When pressing the STOP button during the memory recall operation.
  - · When adjusting the seat or outside rearview mirrors during the memory recall operation.
- The seat will not move unless a position switch has a memory setting.

▶ Timing Chart



Modification basis	
Application basis	
Affected VIN	

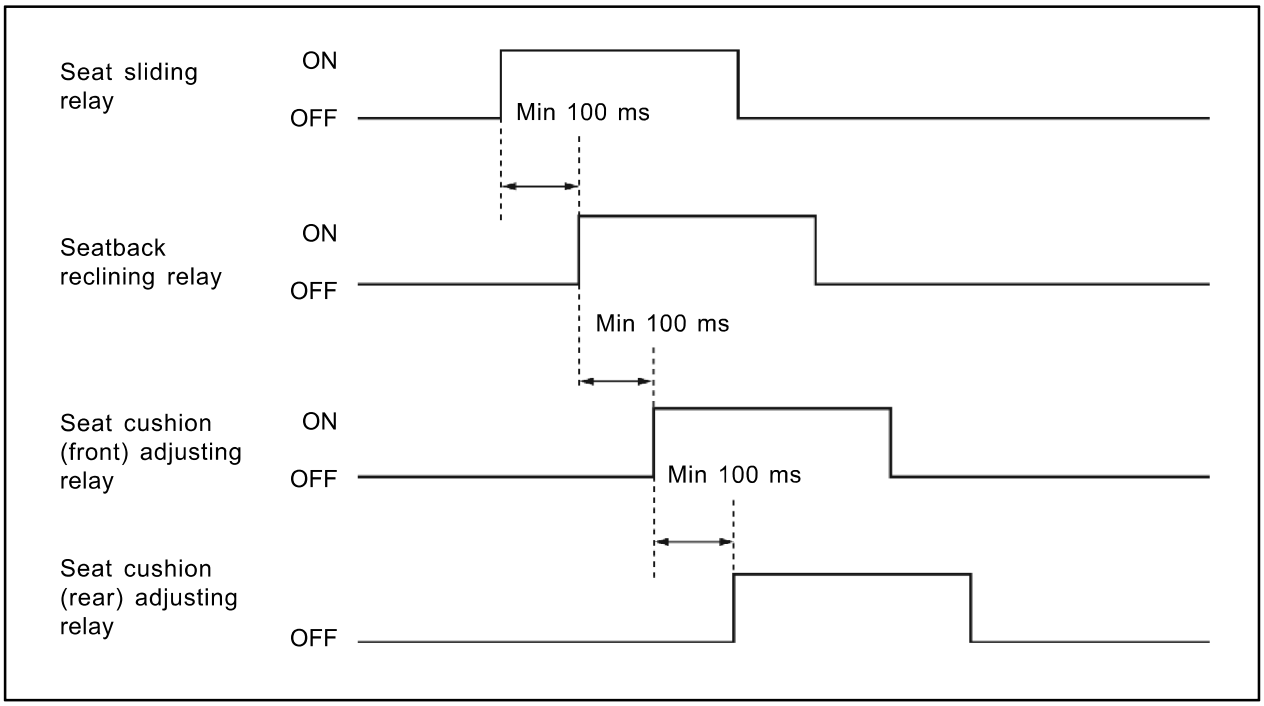
2) POWER SEAT

▶ Seat Position Control

- The position sensor senses the changes of motor in the seat.
- The seat position is stored by the memory order of position switch.
- The stored seat position is recalled by the recall order of position switch.
- The manual adjustment of seat positions takes priority over the memory and recall orders.

▶ Motor Drive Control

- In the case of the automatic control, each motor drive is delayed for 100 msec to prevent the irruptive current frombeing overlapped. The priorities are as follows.
  Seat sliding → Seatback reclining → Seat cushion height adjusting (front) → Seat cushion height adjusting (rear)



- Continuous motor driving timeSeat sliding: 16 seconds, Seatback reclining : 50 seconds, Cushion height adjusting : 6 seconds
- Reverse controlWhen reversing the control motor, the motor starts to rotate in the opposite direction 100 msec after the forwarddriving is completed.
- The motor doesn't operate if the difference between the stored position and the current position is out of thespecified range
  · Sliding : 12 edges (6 pulses)
  · Cushion height : 6 edges (3 pulses)
  · Reclining : 100 mV

▶ **Error Detection**

After the motor starts to drive, if the position sensor value doesn't change for about 3 seconds during the seat slidingor seatback reclining adjustment and for 1.6 seconds during the seat cushion height adjustment, it is determinedthat the harness circuit is open or the sensor failure occurred.

▶ **If an error is detected,**

The memory recall operation stops. However, the seat can be adjusted by manual switches.The memory recall operation can be activated after the failure is corrected. This is determined when the systemdetects the value changes from the position sensor. This is called the Release of automatic control stop

▶ **Relay Protection**

Once the relay is turned on, it will not be turned off within 60 ms.

▶ **Specifications**

- Rated voltage : DC 12 V
- Operating voltage : DC 9 ~ 16 V
- Current consumption : Max. 500 mA (not including the load)
- Operating temperature range : −30°C ~ 75°C
- Reserve temperature range : −40°C ~ 85°C
- Parasitic current : Max. 2 mA

Modification basis	
Application basis	
Affected VIN	

3) Outside Rearview Mirror (OSRVM)

▶ Mirror Position Control

- The position sensor senses the changes of motors in the mirrors.
- The mirror position is stored by the memory order of position switch.
- The mirror position is recalled by the recall order of position switch.
- The manual adjustment of mirror positions takes priority over the memory and recall orders.

▶ Motor Drive Control

- Driving sequenceHorizontal → Vertical
- Control during memory reca
  - · Horizontal direction : 1.5 ~ 3.7 V
  - · Vertical direction : 1.5 ~ 3.7 V

CAUTION

Field of vision :

· The control range of mirror that is notlimited mechanically.

· The control range of that doesn't affectthe sensor characteristics

- LOCK detection
  - · Timer monitors the motor driving time to detect LOCK condition.
- Monitoring the memory recall time
  - · If the memory recall operation cannot be finished within 40 seconds after activating it, the system stop themotor output and terminate the control.

▶ Error Detection

Even though the motor runs, if the drive input change (for 5 seconds) from the position sensor doesn't change, it isdetermined that the harness circuit is open or the motor/sensor failure occurred.When an error is detected, any memory set or recall operations are prohibited, but the manual operation is possible.When the sensor input changes by a manual operation, this error is cleared.

▶ Specification

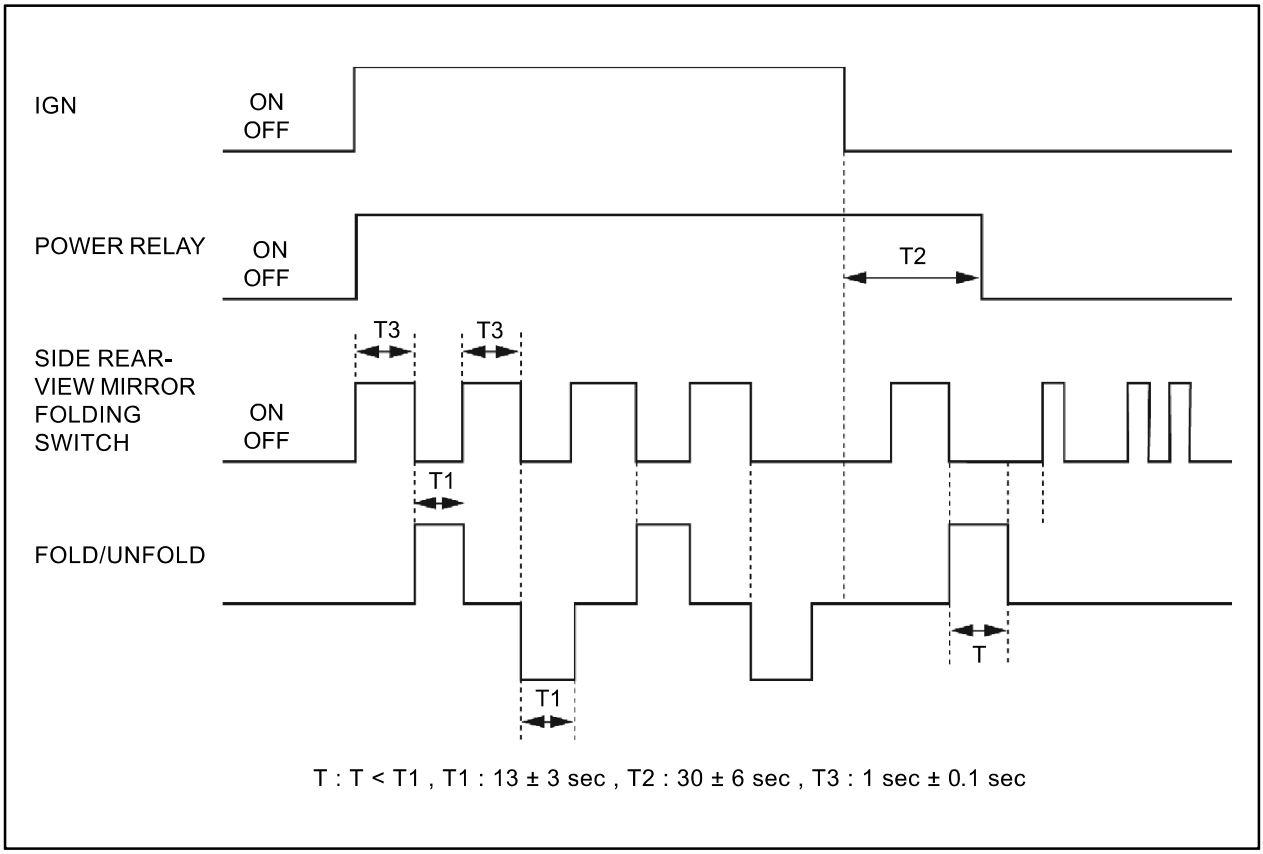
- Rated voltage : DC 12 V
- Operating voltage : DC 9 ~ 16 V
- Current consumption : Max. 300 mA (not including the load)
- Operating temperature range : −30°C ~ 75°C
- Reserve temperature range : −40°C ~ 85°C

4) Folding/Unfolding of Outside Rearview Mirror

▶ Operation Logic

- When pressing the outside rearview mirror folding switch, the outside rearview mirrors are folded.
- Normal operation modeMode changes between Folding and Unfolding
- The outside rearview mirrors can be folded and unfolded within 30 ± 6 seconds even after turning off the ignitionswitch.
- To prevent the outside rearview mirrors from stopping during its operation, the mirror operating time is extended13 seconds when pressing the switch again.

▶ Timing Chart



T : T < T1 , T1 : 13 ± 3 sec , T2 : 30 ± 6 sec , T3 : 1 sec ± 0.1 sec

Modification basis	
Application basis	
Affected VIN	

CLUSTER

8010-01

GENERAL

1. DESCRIPTIONS OF INDICATOR DISPLAY

The instrument cluster sends and receives the data through CAN communication.The HDC warning light and the engine hood open warning light are newly introduced.

D20DT, D27DT



1. Tachometer
2. Speedometer
3. Left turn signal indicator
4. Right turn signal indicator
5. Engine coolant temperature gauge
6. Fuel gauge
7. Engine overheat warning light
8. Fog light indicator
9. High beam indicator
10. Door ajar warning light
11. Seat belt reminder (passenger's seat)
12. Brake warning light
13. Low fuel level warning light
14. Winter mode indicator
15. ESP warning light
16. 4WD HIGH indicator
17. Battery charge warning light
18. Air bag warning light
19. HDC indicator
20. Immobilizer indicator
21. Water separator warning light
22. Seat belt reminder (driver's seat)
23. 4WD LOW indicator
24. 4WD CHECK warning light
25. Auto shift indicator (for automatic transmission)
26. ODOmeter/ Trip odometer
27. ABS warning light
28. EBD warning light
29. Engine hood open warning light
30. Glow indicator
31. Engine check warning light
32. Engine oil pressure warning light
33. Auto cruise indicator
34. SSPS warning light
35. Hazard warning light (Eastern Europe only)

Modification basis	
Application basis	
Affected VIN	

For Gasoline Engine



1. Tachometer
2. Speedometer
3. Left turn signal indicator
4. Right turn signal indicator
5. Engine coolant temperature gauge
6. Fuel gauge
7. Engine overheat warning light
8. Fog light indicator
9. High beam indicator
10. Door ajar warning light
11. Seat belt reminder (passenger's seat)
12. Brake warning light
13. Low fuel level warning light
14. Hazard warning light (Eastern Europe only)
15. ESP warning light
16. 4WD HIGH indicator
17. Battery charge warning light
18. Air bag warning light
19. HDC indicator
20. Immobilizer indicator
21. Seat belt reminder (driver's seat)
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29. Engine check warning light
30. Engine oil pressure warning light
31. Auto cruise indicator
32. SSPS warning light
33. Power mode indicator
34. Winter mode indicator

Modification basis	
Application basis	
Affected VIN	

Memo

2.WARNING / INDICATOR PANE

ESP Warning Light

This warning light comes on when pressing the “ESP OFF” switch or the ESP system is defective. If the ESP function operates while driving, this warning light flickers and the alarm sounds.

HDC Warning Light

Green light on: HDC is ready for use (by pressing the HDC switch).
Green light blinking: HDC is being applied.
Red light on: the HDC system is overheated or malfunctioning.
When HDC is applied, the green HDC indicator blinks.
When the red HDC indicator is on, the HDC system is overheated or malfunctioning.

When the red HDC indicator is on, the HDC function does not work.

Immobilizer Indicator

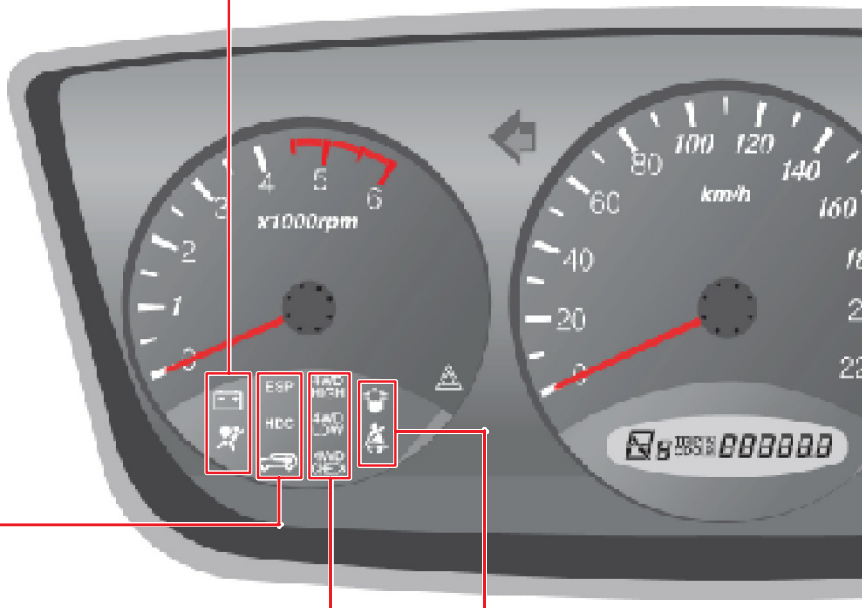
This indicator comes on when the ignition key is communicating with the engine control unit (during engine starting) for approx. 0.5 seconds.

Battery Charge Warning Light

This warning light comes on when the ignition switch is turned on and go off when the engine is started. If this light doesn’t go off after engine starting or comes on while driving, it means there is a malfunction in the system.

Air Bag Warning Light

When the ignition is switched on, this warning light illuminates and then should go out, to confirm that the air bag is operational. If it does not come on, or if it does not go out, or if it flashes or illuminates continuously while driving, it means that there is malfunction in the system.



4WD Indicator

4WD HIGH indicator
When shifting the driving mode from "4L" to "4H", this indicator blinks until the shifting operation is completed. After completion of the mode change to 4H, the indicator comes on.

4WD LOW Indicator
When shifting the driving mode between “4WD LOW” and “4WD HIGH”, this indicator blinks until the shifting operation is completed. After completion of mode change, the indicator goes out.

4WD CHECK Warning Light
If “4WD CHECK” warning light stays on continuously, it may indicate that there is something wrong in the transfer case system.

Water Separator Warning Light

When the water level inside water separator in fuel filter exceeds a certain level, this warning light comes on and buzzer sounds. Also, the driving force of the vehicle decreases. If these conditions occur, immediately drain the water from fuel filter and water separator.

Seat Belt Reminde r

The seat belt warning light comes on and the seat belt warning chime sound for 6 seconds when the ignition switch is turned to “ON” position unless the driver’s seat belt is securely fastened. This reminding operation stops when the driver fastens the seat belt even during its operation period.

Modification basis	
Application basis	
Affected VIN	

Over Temp. Warning Light

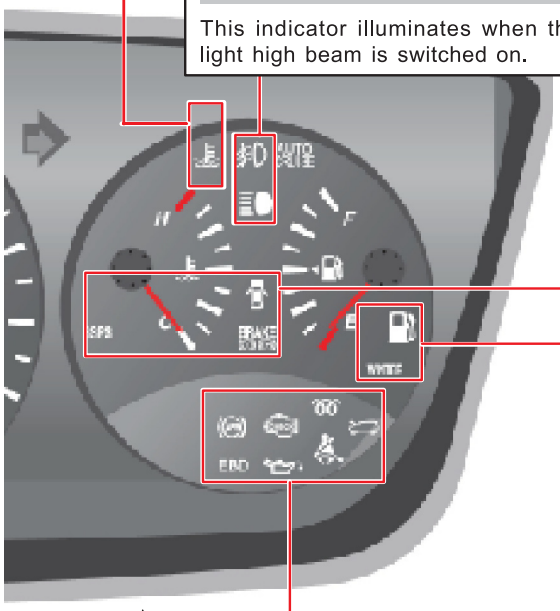
When the engine coolant temperate is abnormally hot (over 120ºC), the engine overheat warning light blinks and a warning buzzer sounds. (check the coolant system)

Fog Lamp Indicator

When the tail or head lights are on, the fog lights come on if the fog light switch is turned to the “ON” position. Then, the fog light indicator comes on the instrument panel.

High Beam Indicator

This indicator illuminates when the headlight high beam is switched on.



SSPS Warning Light

This warning light comes on when the SSPS system is defective. When this warning light comes one, the steerability becomes heavy.

Door Open Warning Light

This light comes on when a door or tailgate is either opened or not closed completely.

Brake Warning Light

This warning light comes on and warning buzzer sounds when the parking brake is applied and/or the brake fluid level is lower than specified level.

Low Fuel Level Warning Light

This warning light indicates that the fuel will soon be exhausted. The time it takes to turn on, however, varies according to the vehicle operating conditions or gradient of the road.

Winter Mode Indicator

The indicator comes on when the Winter mode (W) switch near the gear selector lever is pressed.
Use this mode to drive off smoothly under icy and slippery road.

Glow Indicator

This indicator comes on when the ignition switch is turned on and stays on for a short time or may go off right away. When the glow plugs are sufficiently heated for cold starting, the light will go out. In the vehicle equipped with direct injection type engine, this indicator may come on very shortly or may not come on.

Engine Hood Open Warning Light

When the engine hood is open, this light comes on to inform the driver.

EBD Warning Light

This warning light comes on when the ignition switch is turned to ON and should go out if the system is normal. If the EBD system is abnormal, EBD warning light comes on.

Engine Oil Pressure Warning Light

This warning light comes on when the ignition is switched on and should go out when the engine is started. If the light comes on while driving, it indicates that the oil pressure is dangerously low.

ABS Warning Light

This warning light comes on when the ignition switch is turned to ON and should go out if the system is normal. The vehicle equipped with ABS performs self-diagnosis on the system when the engine is started and drives off. During the diagnosis, brake pedal vibration and noise may be apparent when the driving motors discharges the hydraulic pressure from the internal hydraulic device. This means the ABS is properly functioning.

Engine Check Warning Light

If the light stays on or comes on while driving, some of engine control components including sensors and devices are defective.
When this warning light comes on, the vehicle operates in safety mode to maintain minimum driving conditions and to prevent the system from being damaged. In this mode, the engine driving force may be decreased or the engine may stall.

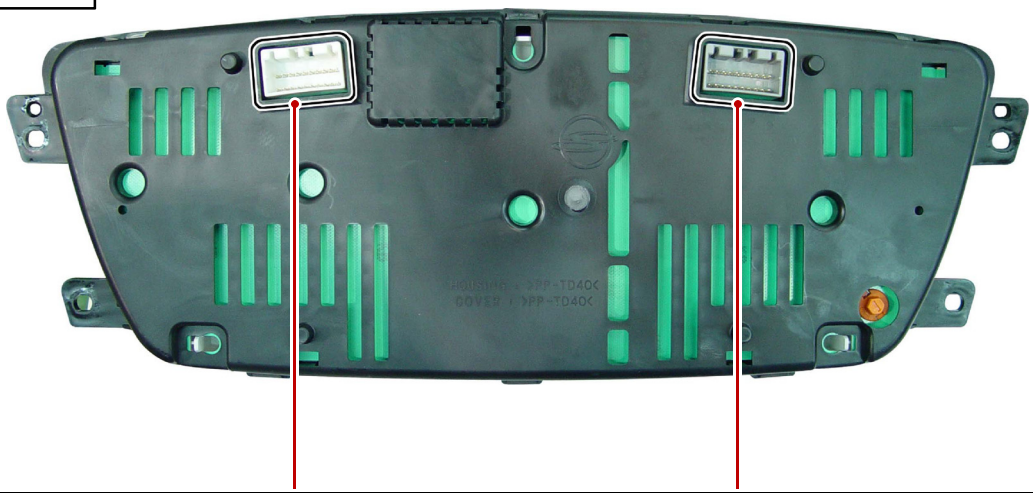
OVERVIEW AND OPERATION PROCESS

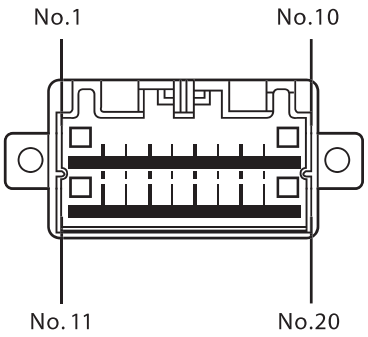
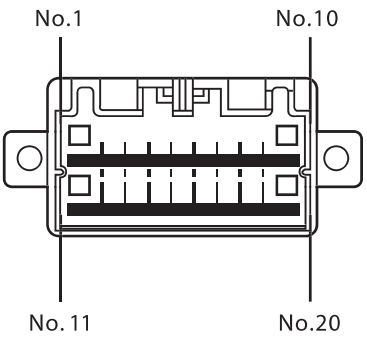
1. CLUSTER CONFIGURATION

Front View



Rear View

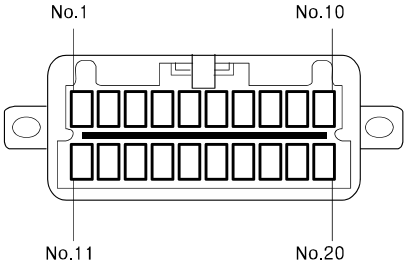


Main Connector	Sub Connector
	

Modification basis	
Application basis	
Affected VIN	

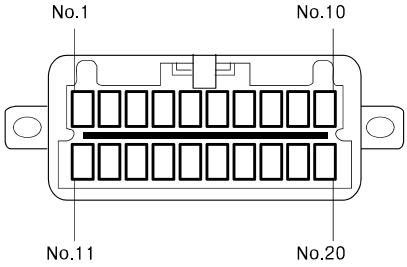
▶ Connector Pin Arrangement

Main Connector - 20 pins



PIN NO.	Function
1	A/T N (Neutral) output
2	Hood open
3	Seat belt (passenger)
4	SSPS
5	-
6	Front fog lamp
7	Hazard warning flasher
8	-
9	Charge
10	IGN (alternator)
11	A/T P (Parking) output
12	Air bag
13	Seat blet (driver)
14	High beam (-)
15	RH indicator lamp (+)
16	High beam (+)
17	LH indicator lamp (+)
18	Oil pressure
19	Parking brake signal input (STICS)
20	-

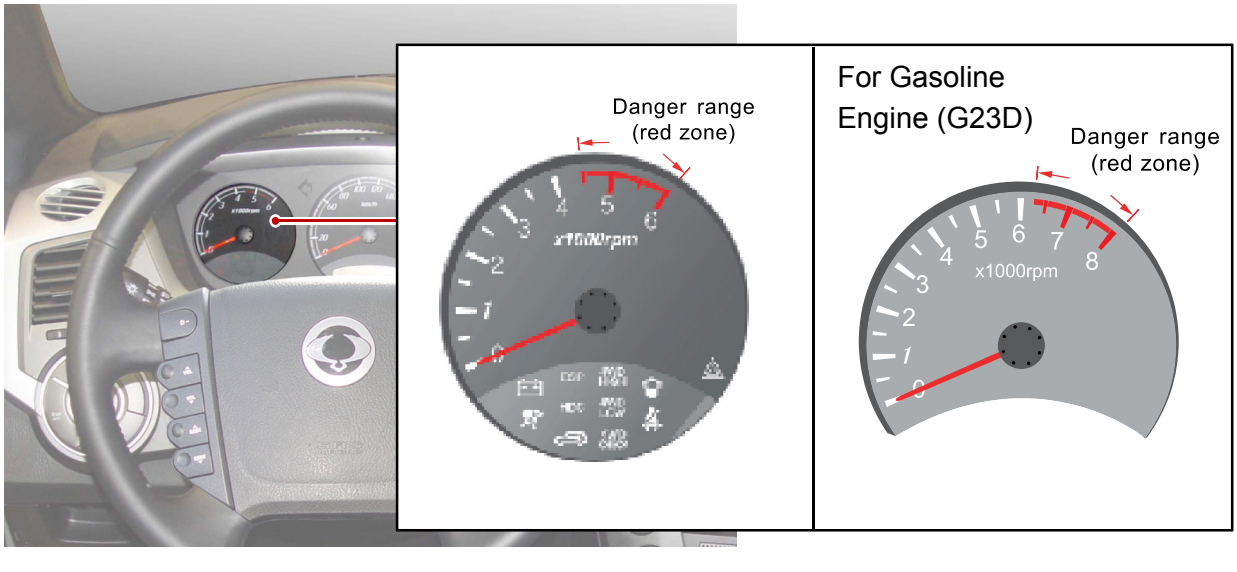
Sub Connector - 20 pins



PIN NO.	Function
1	-
2	-
3	4P output
4	Buzzer output
5	Light (+)
6	PGND (signal -)
7	Engine check
8	Door open
9	-
10	Battery
11	Troubleshooting
12	Fuel input signal
13	RESET / MODE switch
14	M/T N (Neutral) input
15	M/T P (Parking) input
16	CAN Low
17	CAN High
18	AGND (Fuel -)
19	MGND (Micom -)
20	IGN

2. CLUSTER WARNING LIGHTS AND INDICATORS

1) Engine Tachometer



The tachometer indicates engine speed in revolutions per minute. Multiply 1,000 to the current number, then it willbe the current number of engine revolutions.Under the normal engine operating temperature, the proper idling speed is 700 ~ 800 rpm. The red zone (danger rpmrange) starts from 4,500 rpm. (Gasoline Engine: 6,250rpm)

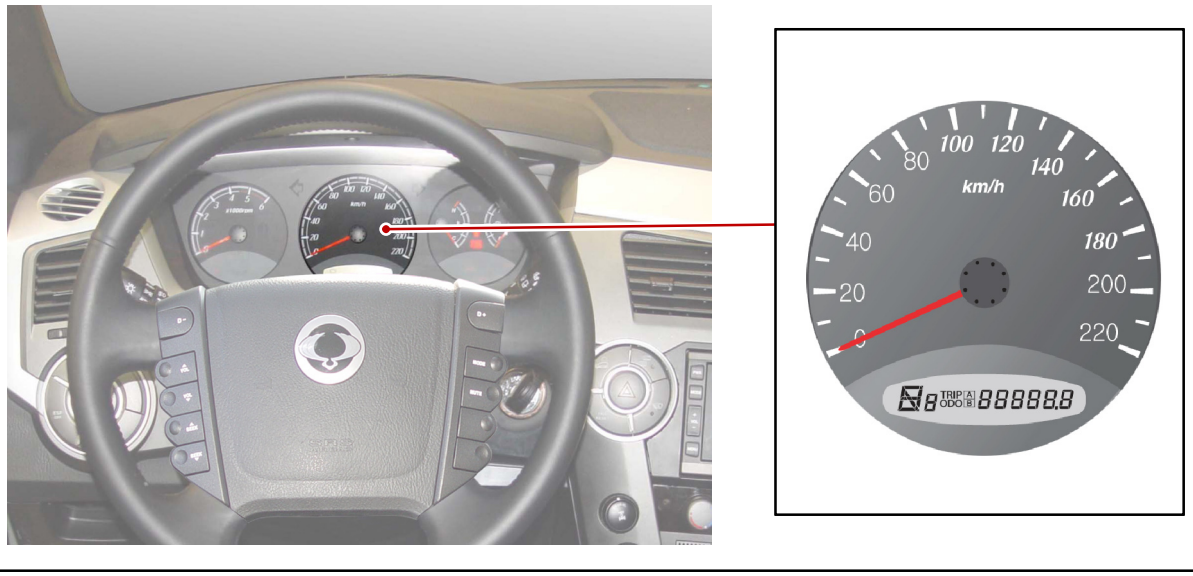
- Connect the tachometer for tune-up test and start the engine.
- Eliminate the hysteresis by tapping the tachometer.
- Compare the values on the tester and tachometer and replace the tachometer if the tolerance is excessive.

Description	Specification (VIN=13 ± 0.1V, Temperature: 25°C)						
Engine speed (rpm)	750	1000	2000	3000	4000	5000	6000
Tolerance (rpm)	-	+100	+100	+100	+100	+100	-
	-	-100	-100	-100	-100	-100	

If the tachometer pointer vibrates, stands at a certain range or sounds abnormal noise, there could be defectivesin tachometer. If there is a difference between actual engine speed (rpm) and reading from tachometer,connect a scanner and then compare the value on tachometer with the reading from scanner.

Modification basis	
Application basis	
Affected VIN	

2) Speedometer



The speedometer indicates the vehicle speed by calculating the signals from the rear (right 8 LEFT) wheel speedsensor through ABS or ESP unit. In this model, the wheel speed sensor is installed at the rear tire area even thoughthe ABS/ESP is not equipped. Its signal is used as a standard vehicle speed that is transmitted to instrument panel,TCU, TCCU, and engine ECU via CAN communication.

- ABS/ESP (equipped): ABS/ESP ECU (208h), RR RH wheel speed sensor
- ABS/ESP (not equipped): ENG ECU (320h), RR RH wheel speed sensor

If the speedometer pointer vibrates, stands at a certain range or sounds abnormal noise, **there could be defectives in speedometer. However, these symptoms also could be appeared when the tire has uneven wear, different tire inflation pressures or different tire specifications.**

Perform the speedometer test regarding the tolerance as described. However, it is not similar simple work in fielddue to lack of measuring conditions such as test equipment and preciseness.

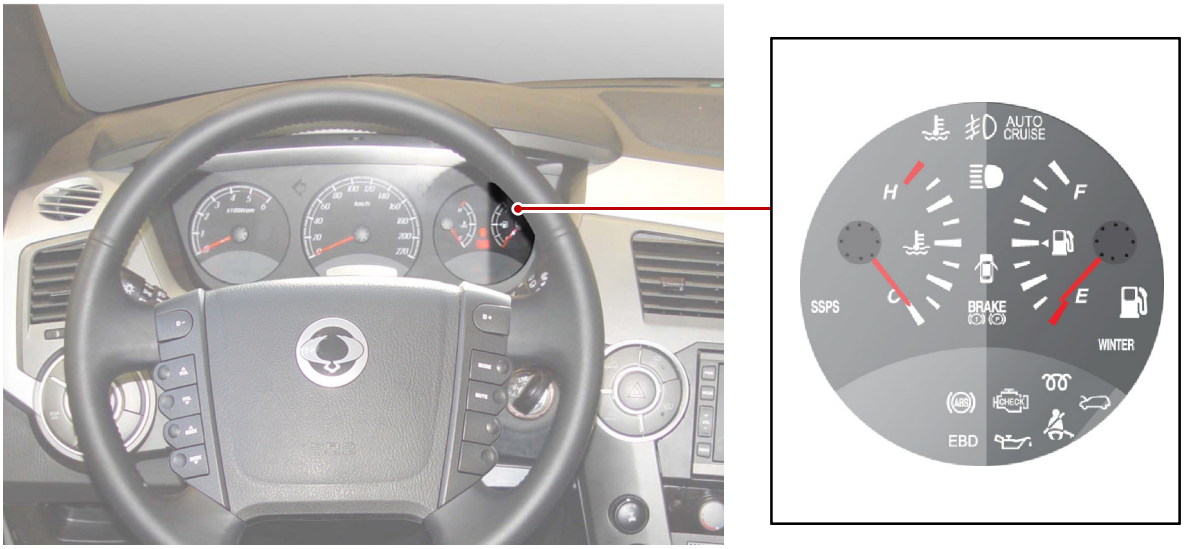
- Check the allowable tolerance of the speedometer and operations of the trip odometer by
- using a tester.
- Check if the speedometer pointer is shaking and the abnormal noise sounds.
  Eliminate the hysteresis by tapping the speedometer.

Description	(VIN = 13 ± 0.1V, Temperature: 25°C)								
Standard speed (Km/h)	20	40	(60)	80	100	120	140	(160)	(180)
Tolerance (Km/h)	+4	+4	+7	+9	+10.5	+12.5	+14.5	+16	+18
	0	0	+2.5	+3.5	+4	+6	+7.5	+8.5	+10

CAUTION

- The allowable tolerance increases when the tires are worn or the tire pressure is out of specified range.

3) Fuel Level Gauge



The fuel level gauge displays the resistance value of the float on the fuel sender in the fuel tank through a pointer.Note that this vehicle doesn't have a service hole for checking the fuel sender connector in the fuel tank.

The fuel sender and its connector can be checked and replaced only when the fuel tank is removed. The powersupply and resistance value should be measured at the connector in front of the fuel sender (refer to wiring diagram).When the power supply and output resistance are normal, the float operation by fuel level may be defective; if so,replace the fuel sender.

Tolerance and resistance value by indicating angle

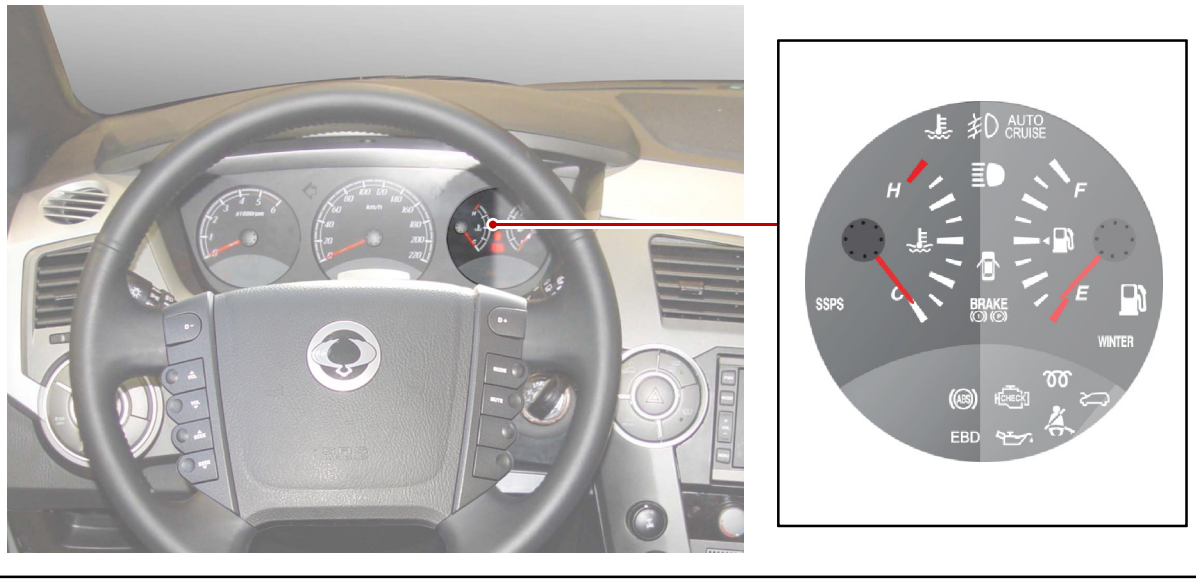
	Tolerance and resistance value by indicating angle (VIN = 13.5 ± 0.1 V, temperature: 25°C)						
Scale	Full	Full (Gauge)	(3/4)	1/2	(1/4)	Empty (Gauge)	Empty
Indicating angle (°)	-	105	78.75	52.5	26.25	0	-
Tolerance (°)	-	+4, 0	-	±5	-	0, -4	-
Resistance (Ω)	38	43	67	99.5	150	276.3	283

CAUTION

- This table shows the tolerance and resistance value changes by fuel level in normal conditions. Therefore, thedifferences that can be occurred by the road conditions and fuel fluctuations are ignored.

Modification basis	
Application basis	
Affected VIN	

4) Coolant Temperature Gauge



The coolant temperature gauge displays the coolant temperature with a pointer. The angle of pointer thatchanges by coolant temperature is as shown below.

		Tolerance and resistance value by indicating angle		
Indicating angle (°)	0	52.5	102	105
Tolerance	+0°C -4°C	+0°C -4°C	-	+4°C +0°C
Coolant temperature	Less than 40°C	70 ~ 110°C	120°C	Over 125°C

Measurement of coolant temperature sensor resistance

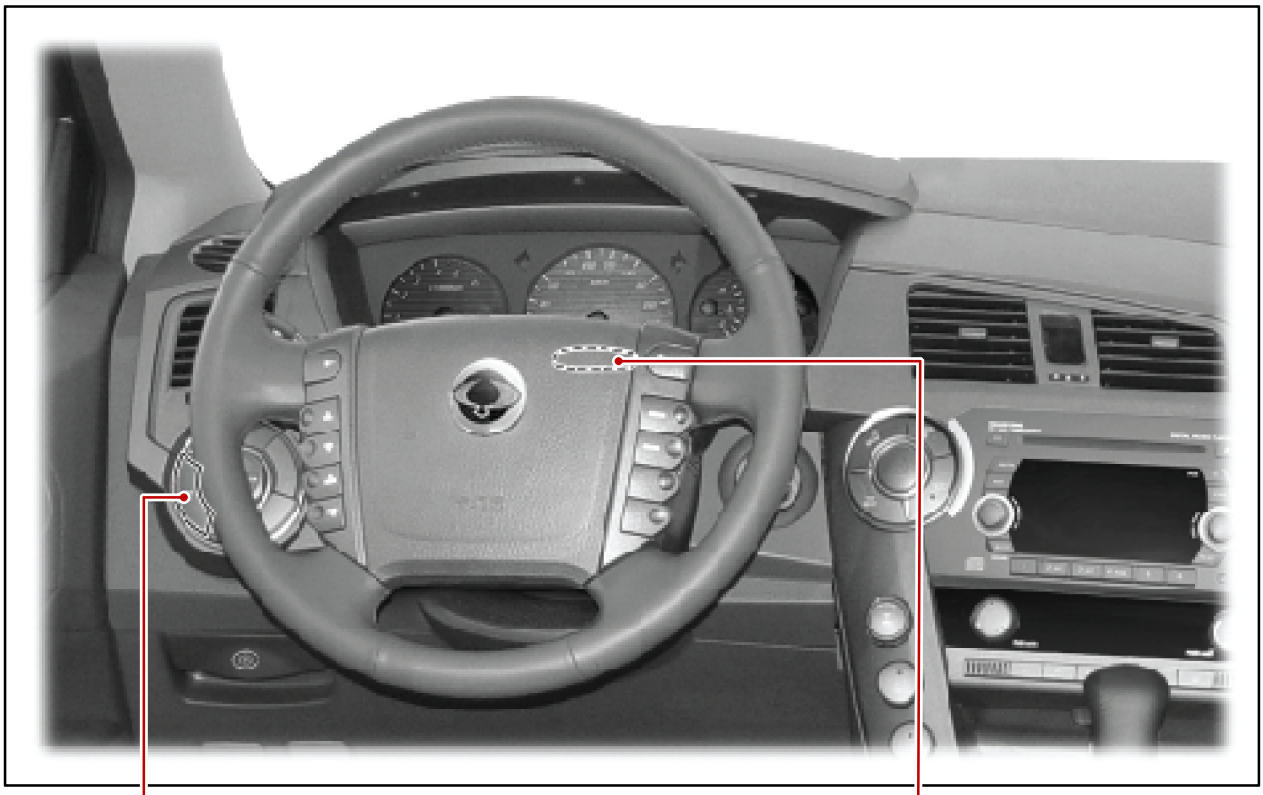
Measure the resistance between the terminal and the ground with an ohmmeter and replace if the resistance is outof specified range.

Resistance value by coolant temperature: 20°C – 2449W±5 %
50°C – 826W±5 %
80°C – 321W±5 %
100°C – 12W±5 %

CAUTION

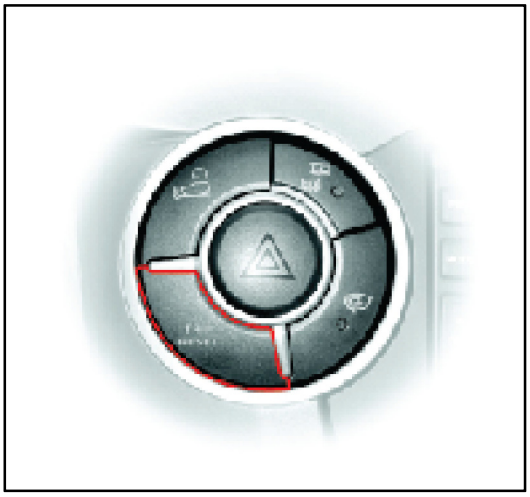
- When the resistance value by coolant temperature is within the specified range, check thermostat, waterpump, radiator related coolant circuit for normal operation. Also, check the wiring harnesses and connectorsfor proper connection.

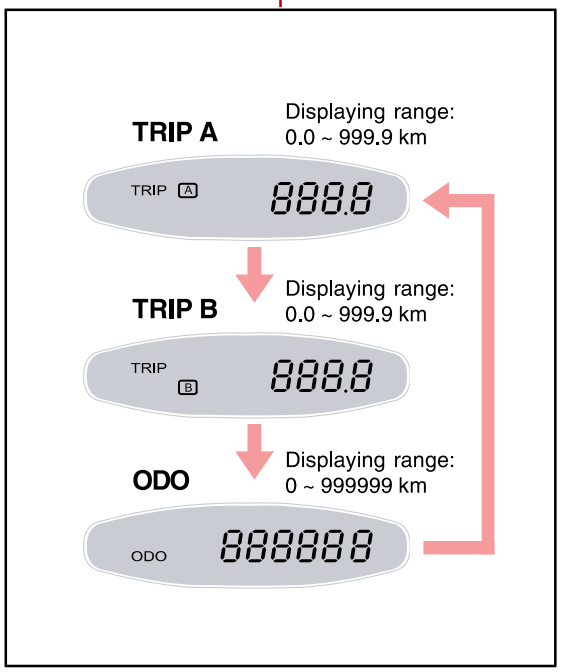
5) TRIP ODOmeter (TRIP A, TRIP B) and ODOmeter



Odometer/Trip Odometer

When pressing the TRIP/RESET switch on the cen-ter panel, the odometer/trip odometer is convertedand the meter resets to 0.0 km in Trip A and Trip B.





Modification basis	
Application basis	
Affected VIN	

3. OPERATION OF HDC INDICATOR CONTROLLER

This table describes the coming-on and blinking mode of HDC indicator according to the HDC switch operation (ON/OFF).

The HDC indicator on the instrument panel has two modes; green (function lamp) and red (warning lamp). The HDCswitch is a push & self return type switch ? when you press it once, it starts to operate and when you press it again,it stops the operation.

<table>
<tr><td colspan="4" rowspan="3">HDC Operation Mode</td><td>HDC indicator</td><td>HDC warning lamp</td></tr>
<tr><td>Green</td><td>Red</td></tr>
<tr><td>HDC</td><td>HDC</td></tr>
<tr><td colspan="4">Initial ignition ON (From hence, this signifies operation mode after the engine starts. Even when HDC switch is ON, if the ignition is OFF, HDC operation stops automatically.)</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="2">Not available</td><td colspan="3">HDC switch OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="3">HDC system error</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="2">Stand-by</td><td colspan="3">HDC switch ON</td><td>ON</td><td>OFF</td></tr>
<tr><td colspan="5">The HDC switch is turned ON, but HDC system is in stand-by mode because the operating requirements are not met.</td></tr>
<tr><td rowspan="2">In operation</td><td colspan="3">HDC system is operating.</td><td>Blinking (0.5 seconds of interval)</td><td>OFF</td></tr>
<tr><td colspan="5">The HDC switch is turned ON, and the operating requirements are met. HDC is operating with operating sound.</td></tr>
<tr><td rowspan="4">System overheat</td><td rowspan="2">High brake system temperature (over 350°C)</td><td>HDC stand-by mode</td><td colspan="2">OFF</td><td>Blinking</td></tr>
<tr><td>HDC is operating</td><td colspan="3">Alternate blinking of green and red lamp (0.5 seconds of interval)</td></tr>
<tr><td colspan="2">Too high brake system temperature (over 450°C)</td><td colspan="2">OFF</td><td>ON</td></tr>
<tr><td colspan="5">There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating numbers and conditions of HDC (HDC cannot be operated).</td></tr>
</table>

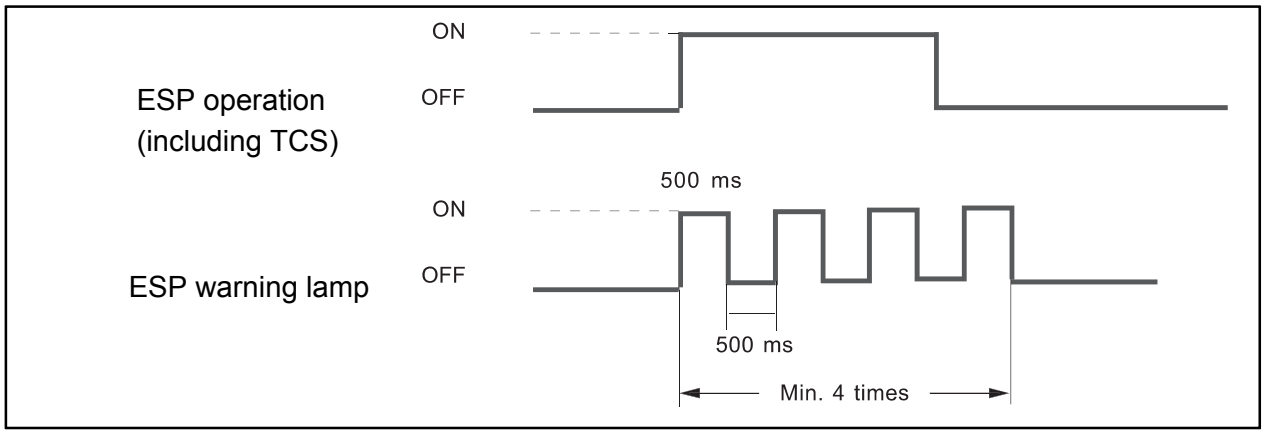
CAUTION

- Basically, the brake system's basic functions can work even when there are problems with the HDC system.As given in the table above, the HDC warning lamp comes on when:
  - · Initial ignition ON
  - · HDC system error occurs
  - · Brake system overheat

4. ESP WARNING LAMP

1) ESP Warning Lamp Blinking in Control

ESP warning lamp blinks when ESP control is activated. If the activation reaches a certain limitation, a beep soundsto warn the driver. The ESP warning lamp goes off when ESP function is deactivated. Even when the ESP isoperated for a very short period of time, the ESP warning lamp blinks minimum of 4 times every 500 milliseconds.



▶ **When receiving CAN data**

- LAMP: (200h, 1.5) ESP - INFO - BL: when receiving data, 500 ms on/off
- BUZZER: (200h, 1.4) ESP - INFO - BUZZ: when receiving data, 100 ms on/off

2) ESP System Cancellation Using the ESP OFF Switch

When the ESP switch is pressed (for over approximately 150 ms), the ESP system will be cancelled and thevehicle will be driven regardless of the output values from the corresponding sensors. Then, the ESPwarning lamp on the instrument panel comes on.

▶ **The detailed operation procedures are as follows:**

- The ESP warning lamp comes on when the ESP OFF switch is pressed for over 150 ms.
- The switch returns to normal position when the OFF switch is released.
- The ESP system will be cancelled after approximately 150 ms.

Based on the above procedures, we can see that the ESP system will be cancelled after a certain period (approx.150 ms) from releasing the switch to the original position. The ESP system does not get canceled immediatelywhen the ESP warning lamp is turned on by pressing the ESP OFF switch.When you turn the ESP system off by pressing the ESP switch for over 150 ms, the TCS system is turned off. And thebasic ABS system will operate.

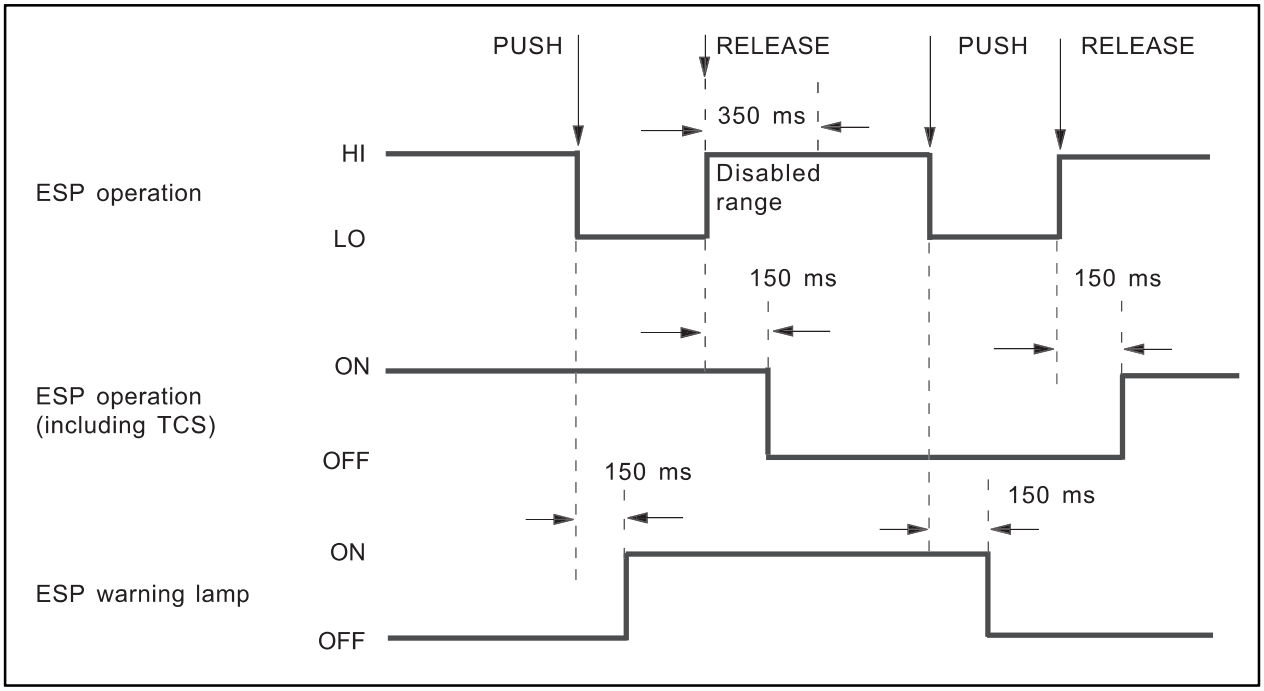
Modification basis	
Application basis	
Affected VIN	

3) Resuming the ESP System by Using the ESP OFF Switch

The ESP system will be resumed and the ESP warning lamp at the instrument panel goes off when the ESP switchat the center switch panel is pushed (for over approximately 150 ms) while the ESP system is not operating.

▶ **The detailed operation procedures are as follows.**

- The ESP warning lamp comes on when the ESP OFF switch is pushed for over 150 ms.
- The switch returns to normal position when the OFF switch is released.
- The ESP system will be resumed after approx. 150 ms.

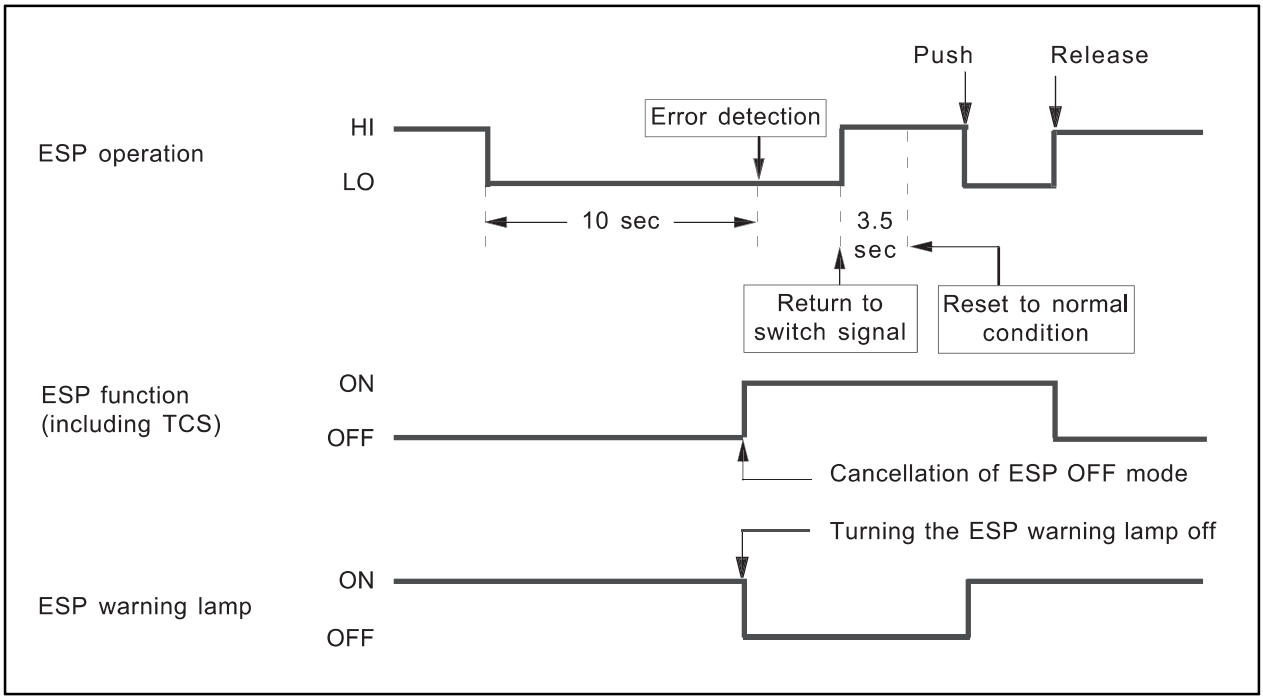


CAUTION

- When turning the ignition switch off while the ESP system is activated, the ESP system will be resumed whenignition switch is turned on again.
- When the vehicle is controlled by ESP system during driving, the ESP OFF switch does not operate.
- The ESP OFF switch operates when it is pushed for over 150 ms. When it is pushed for less than 150 ms, theESP OFF mode and the ESP warning lamp will not be changed.
- When the ESP OFF switch is pushed within 350 ms of being turned off, the ESP warning lamp and ESP systemwill not be turned on.

4) ESP OFF Switch Monitoring

When the ESP unit recognizes that the ESP OFF switch is pushed for over 10 seconds, the ESP unit determinesit as a ESP OFF switch malfunction. When the ESP OFF switch is pushed, the ESP system is resumed after 10seconds. However, the ESP warning lamp comes on when the ESP OFF switch is pushed (for over 150 ms) andthen goes out when the ESP system is resumed. When the ESP OFF switch returns to normal position, the ESPunit resets the ESP OFF switch for approx. 3.5 seconds.



Modification basis	
Application basis	
Affected VIN	

5) ESP Warning Lamp Operation Depending on System Conditions

The table shows ESP warning lamp operations when the ESP system is defective or ESP (including TCS function)is working.

	Warning Lamp		Controls			
	ABS W/L	ESP W/L	ABS	ASR	ABD	Vehicle yaw contro l
Initial start (for 1.8 sec)	ON	ON	NO	NO	NO	NO
Normal mode	OFF	BLINKS WHEN ESP OPERATION	OK	OK	OK	OK
ESP fault	OFF	ON	OK	NO	NO	NO
ABS fault	ON	ON	NO	NO	NO	NO
System fault	ON	ON	NO	NO	NO	NO
Low batt. voltage	ON	ON	NO	NO	NO	NO
High battery voltage	ON	ON	NO	NO	NO	NO
High brake pad temp.	OFF	ON	OK	NO	NO	NO
ESP-OFF mode	OFF	ON	OK	NO	NO	OK Note 1)
Entering diag. mode	ON	ON	NO	NO	NO	NO

CAUTION

· When the driver presses the brake pedal during the ESP OFF mode, the yaw control is performed to compen-sate the vehicle stability (posture) during ESP operation.

6) Reasons why N Switch Signal is Transmitted to Instrument Panel *(1)

▶ HDC operation signal

The HDC function operates when the HDC switch is turned on with gear shift lever is in forward/reverse drivingpositions. Vehicles with the automatic transmission receive the signal from the gear shift lever unit and vehicles withmanual transmission receive the neutral signal from the N (neutral) switch.

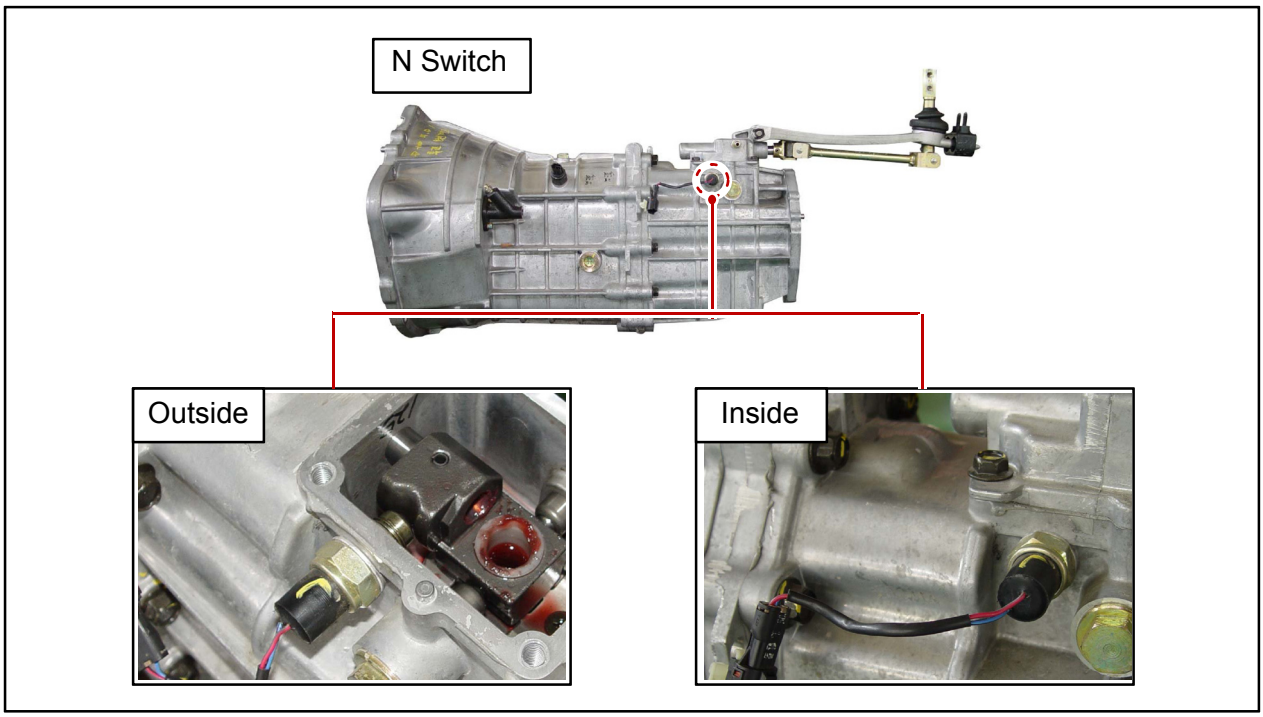
- Manual transmission: operates in the 1st gear or reverse gear position (does not operate in the neutral position).
- Automatic transmission: operates in all hear positions except P (parking) and N (neutral) position.

CAUTION

The vehicle with the manual transmission doesn't have a independent device or switch that detects the 1stgear position. It detects only the forward/reverse direction through the rear light switch and the neutral switch,and cannot solely detect the 1st gear position. The reason for noting the 1st gear above, although the HDC alsooperates at over the 2nd gear, is because the engine may be turned off during the HDC operation.The HDC operates on the very steep road. Thus, it should be used only when the transmission is in the 1st gearposition.

▶ Raising the RPM in vehicles with the manual transmission.

This switch detects whether the gear is in N position or in other positions. The instrument cluster sends the signalto the engine ECU. The engine ECU receives the N switch signal, the vehicle speed, the clutch operating conditions,and the engine coolant temperature and raises the engine speed by 100-200 rpm. This helps the vehicle startsmoothly during gear shifting.

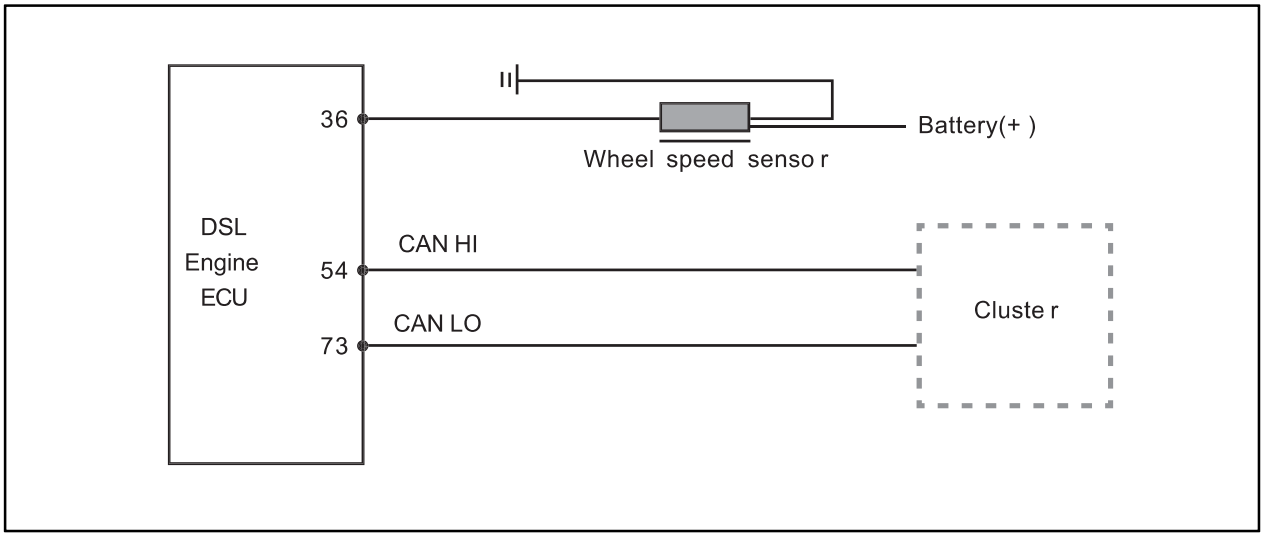


Modification basis	
Application basis	
Affected VIN	

7) Vehicle Speed Input to Non-ABS Equipped Vehicle

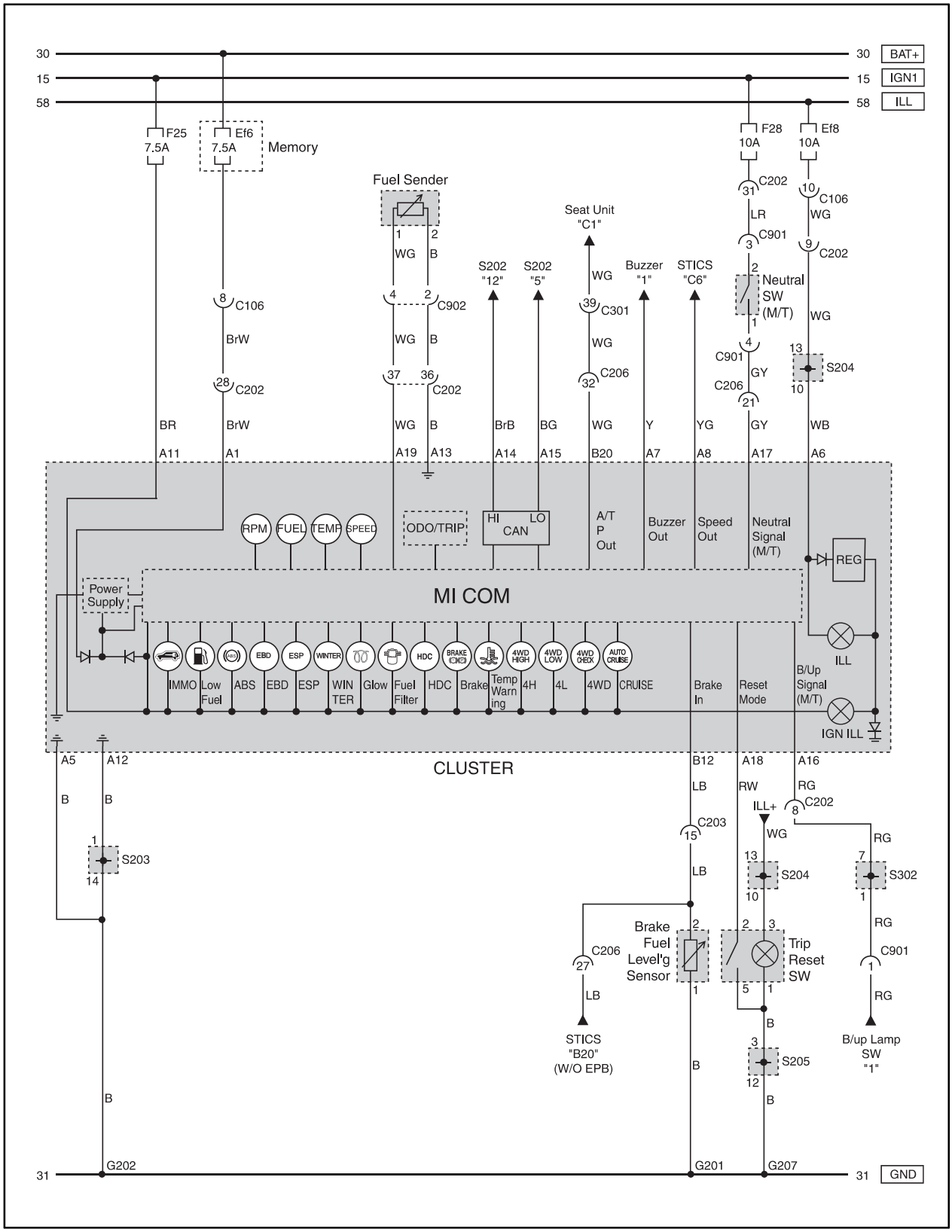
The wheel speed sensor is installed on the rear right wheel regardless of the ABS/ESP installation.

This sensor is to signal the vehicle speed to the engine ECU, TCCU, transmission, and instrument panel. There isno separate unit to process the wheel speed sensor signal. The wheel speed sensor is connected to the engine ECU(terminal 36), where its signal is processed, and is connected to other related systems through CAN communication.



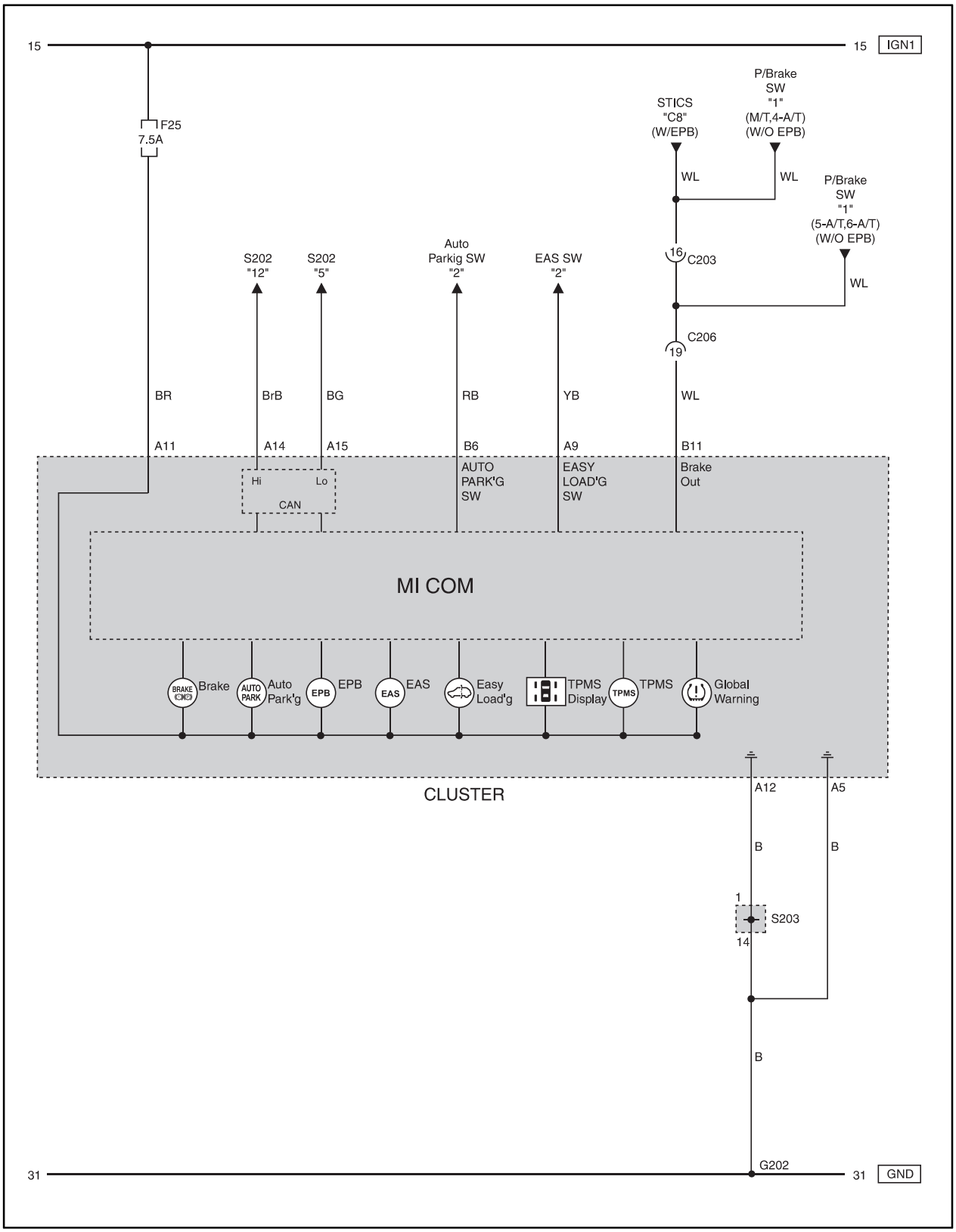
5. CLUSTER ELECTRICAL WIRING DIAGRAMS

▶ **Gauge (Speed, RPM, Fuel, Temp), Warning Lamp (Fuel, Fuel Filter, ABS/ESP, Brake, HDC, 4WD, EPB, EAS, TPMS)**



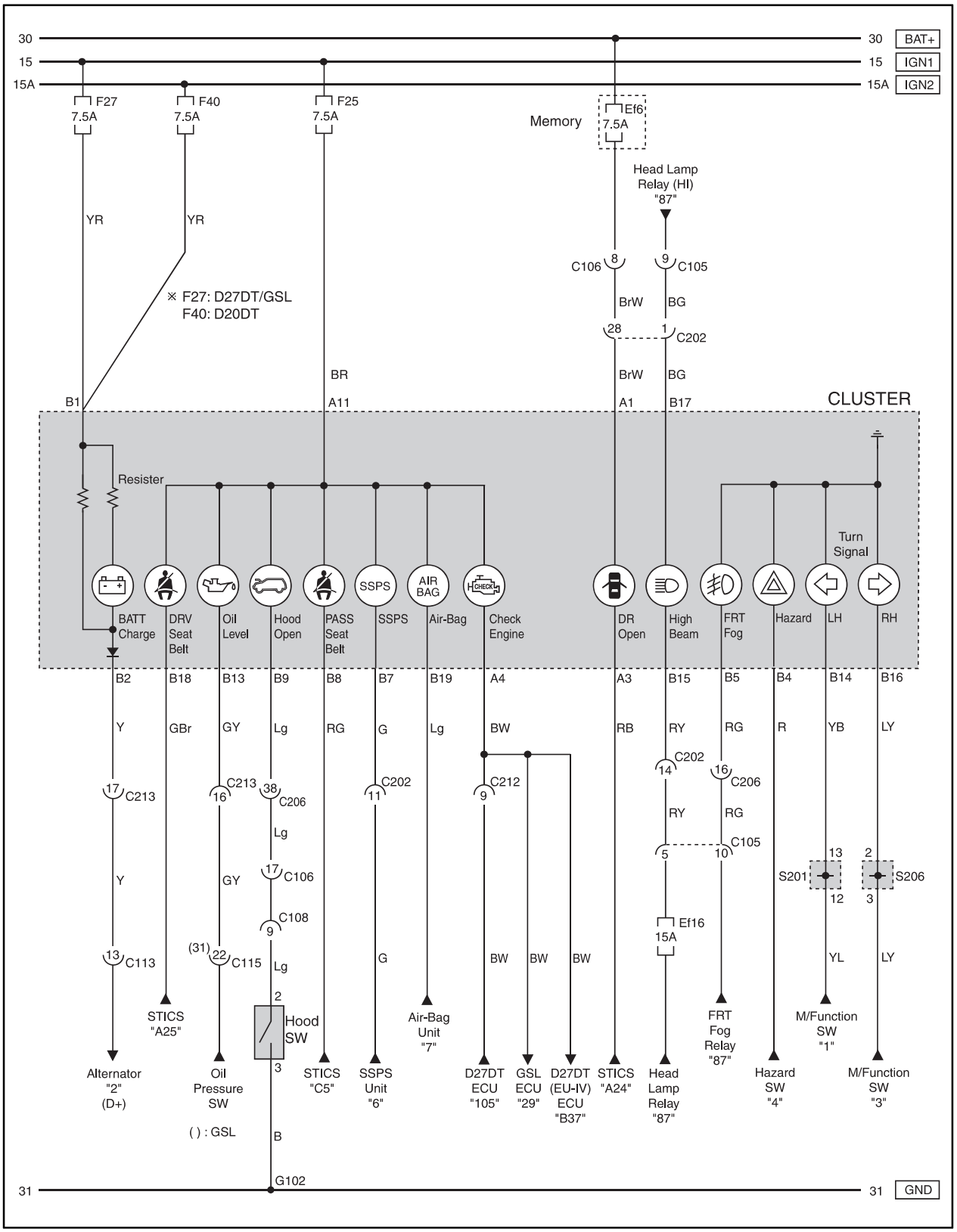
Modification basis	
Application basis	
Affected VIN	

▶ Warning Lamp (EAS, EPB, Auto Park's, TPMS, Grobal), Easy Load'g, TPMS Display



Modification basis	
Application basis	
Affected VIN	

▶ Warning Lamp (BATT Charge, Oil, Hood, Door, Eng Check, Air Bag, SSPS, Seat Belt), Turn Signal, FRT Fog, Hazard Lamp



Modification basis	
Application basis	
Affected VIN	

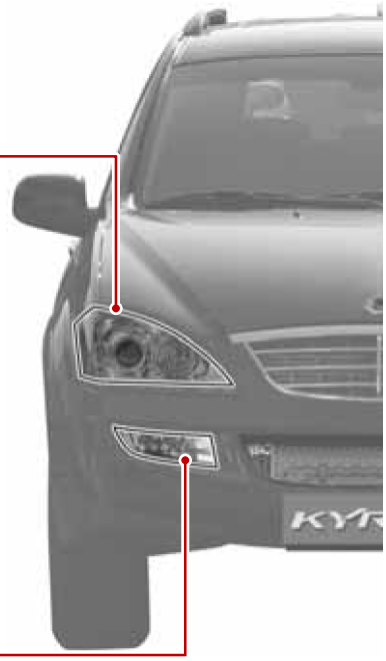
LAMP

8310-01

GENERAL

1. LOCATIONS OF LAMPS AND SPECIFICATIONS

1) EXTERIOR LAMPS



Headlamp Assembly

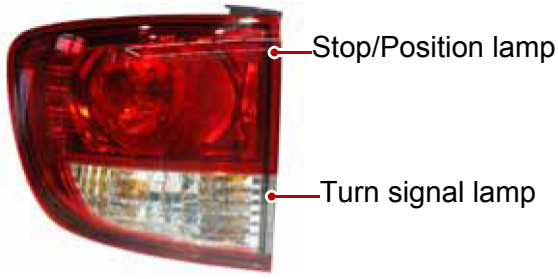


Fog Lamp Assembly

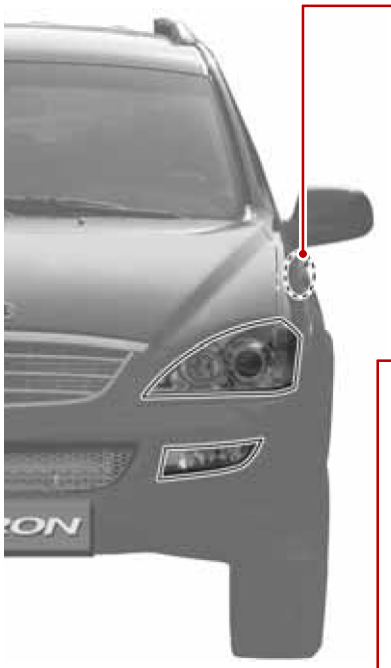


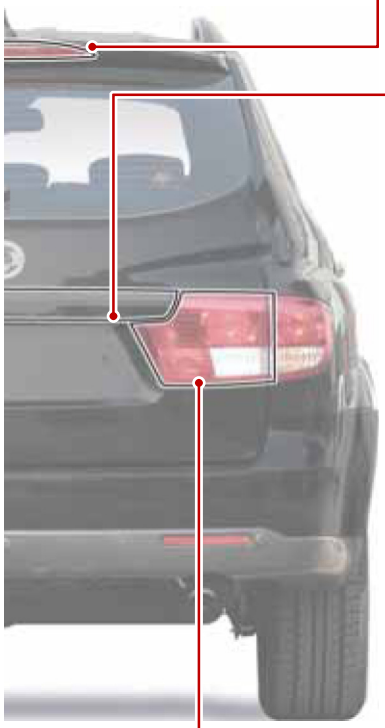


Quarter Combination Lamp Assembly



Modification basis	
Application basis	
Affected VIN	





Side Repeater Assembly



High Mounted Stop Lamp Assembly



License Plate Assembly



Reflector Assembly



Tailgate Combination Lamp Assembly



Tail lamp

Backup lamp

Rear fog lamp or stop lamp (Rear fog lamp: Regulation required only)

Modification basis	
Application basis	
Affected VIN	

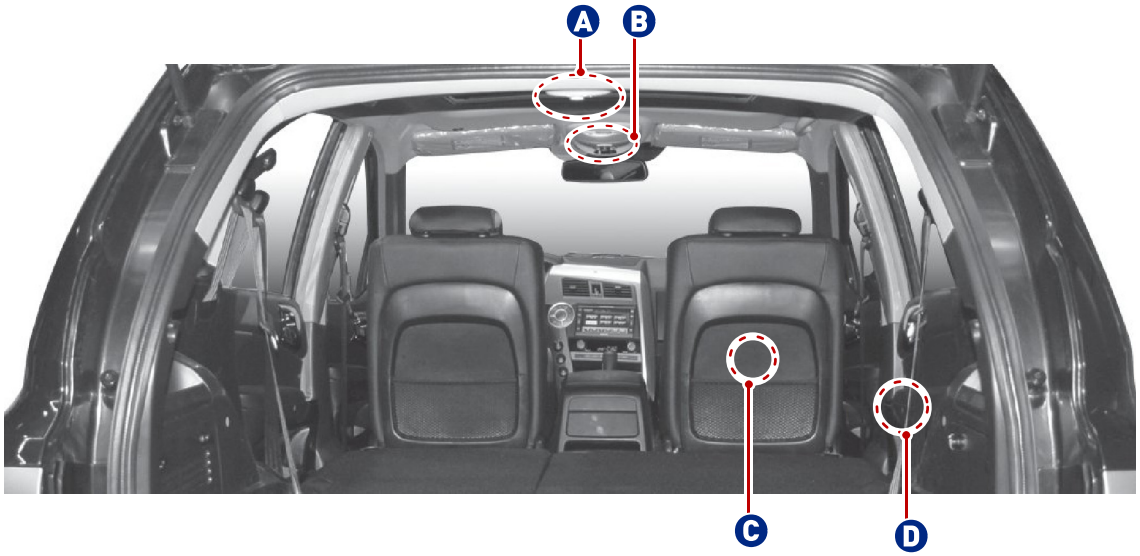
▶ BULB SPECIFICATIONS

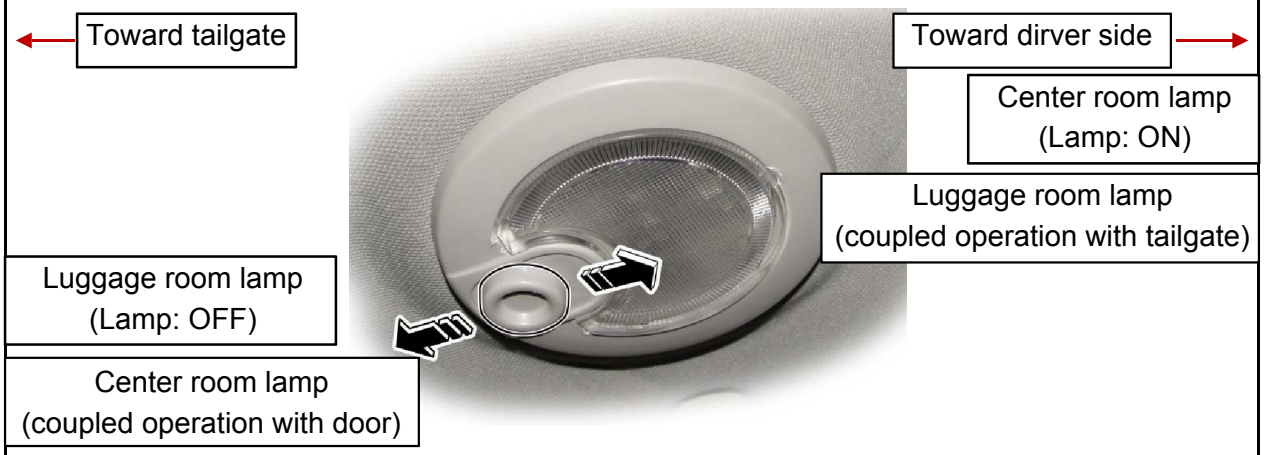
Description			Amount	Specification (EU)	Specification (General)
Exterior lamp	Headlamp	High beam	2	55W	←
		Low beam	2	55W	←
		Turn signal lamp	2	PY21W	28W AMBER
		Position lamp	2	W5W	8W
	Front fog light		2	H27W/2	←
	Side repeater		2	W5W	5W
	Rear combination lamp	Stop (tail) lamp	4	P21W(5W)	27W(8W)
		Turn signal lamp	2	PY21W	27W AMBER
	Back-up lamp	EU	1	16W	-
		General	2	-	16W
	Rear fog light		1	P21W	-
	License plate lamp		2	W5W	5W
	High mounted stop lamp	LED type	-	-	-
		Bulb type	5	W5W	5W
Interior lamp	Front room lamp		2	10W	←
	Glove box lamp		1	10W	←
	Center room lamp		1	10W	←
	Luggage lamp		1	10W	←
	Door courtesy lamp		2	5W	←

Modification basis	
Application basis	
Affected VIN	

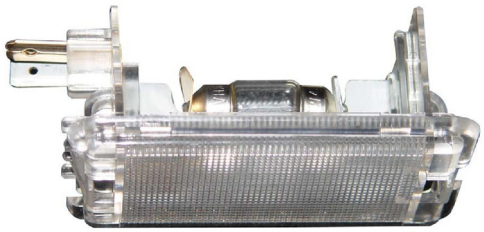
Memo

2) INTERIOR LAMPS



A Center and Luggage Room Lamp	
	
Center Room Lamp	**Luggage Room Lamp**
When this switch is pushed towards the rear of the vehicle, the lamp comes on. If the switch is pushed to the opposite direction, the lamp will go off. But, when any door is open, the lamp comes on and stays for 30 seconds. When the door is closed, the lamp will go off.	When this switch is pushed towards the tailgate, the lamp comes on when the tailgate is open. If the switch is pushed to the opposite direction, the lamp will go off and will not come on even if the tailgate is open.

Modification basis	
Application basis	
Affected VIN	

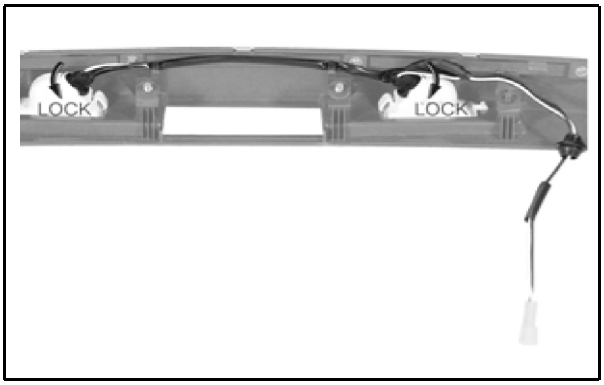
C Glove Box	D Door Courtesy Lamp
	
12V/5W - One at glove box	12V/5W - one at each door

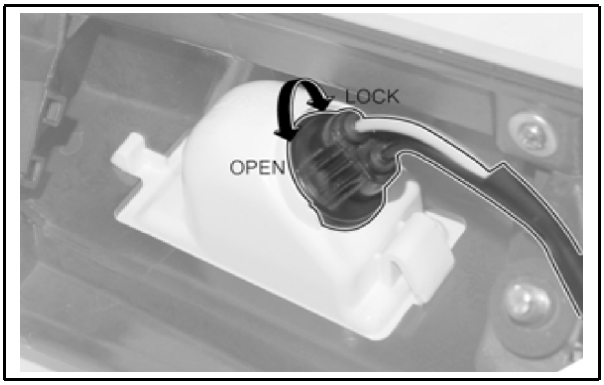
B Front Room Lamp



The driver's room lamp and the passenger's room lamp are separately turned on when pressing the switch (1, 2). However, the front lamps are turned on when opening a door and turned off when closing it. The front room lamps and center are turned on when pressing the room lamp main switch (3).

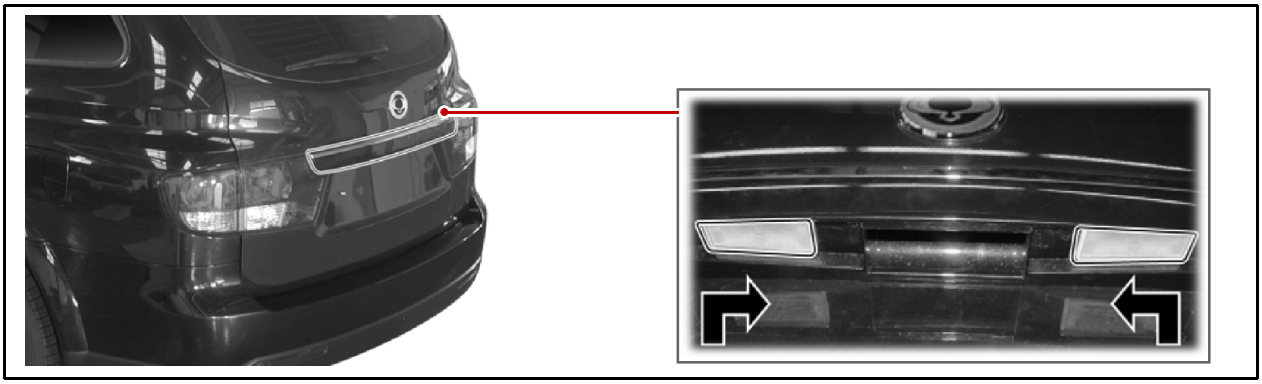
3. Install the bulbs into the license plate lamp. Make sure the location and "LOCK" direction are correct.





1) Bulb Replacement

1. Pry off the side of the license plate lamp from the rear garnish of the tailgate.



2. Remove the bulb from the removed license plate lamp.





CAUTION

- Use only specified bulb for replacement.

WIPER AND WASHER SYSTEM 7810-01

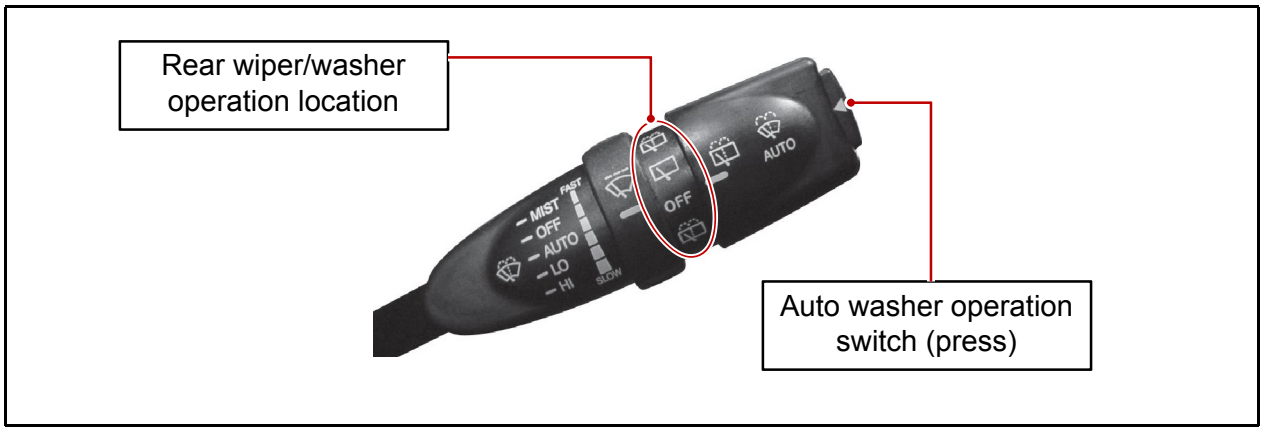
GENERAL

1. WIPER AND WASHER SYSTEM OVERVIEW

The wiper and washer system are controlled by STICS according to driver's wiper switch operation. And the detection of rain drops by rain sensor is transmitted to STICS as the signal for wiper system control.

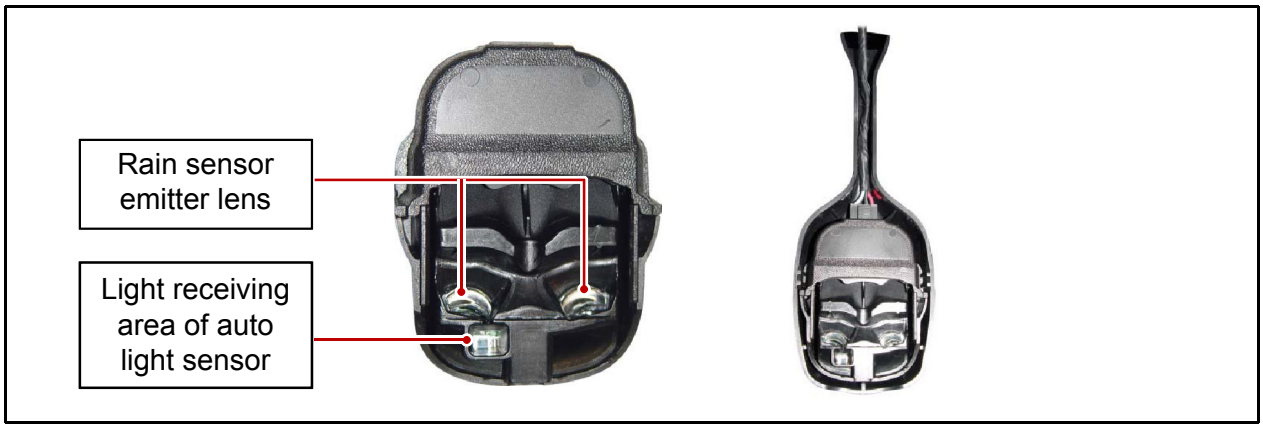
The characteristics of the wiper and washer system including basic functions of manual wiper are as follows.

1) Wiper function coupled auto washer



When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid wil be sprayed again and the wiper will automatically operate 3 times.

2) Integrated auto light sensor in rain sensor unit

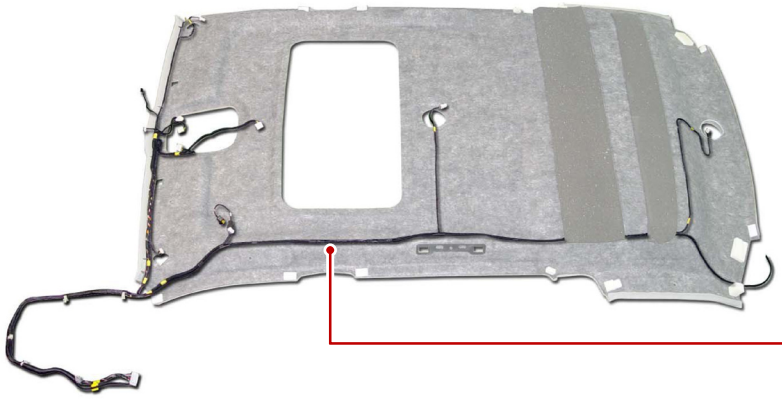


The rain sensor unit is installed on a proper location to detect the rain drops and the illumination intensity.

To control the system, the sensed values of rain sensor and auto light sensor are sent to pin no. 63 in STICS unit.

3) Rear washer fluid supply system

There is no separate washer fluid reservoir for the rear washer system in this vehicle. The rear washer system uses the front washer fluid reservoir.
Because of this, the washer hose is supposed to be long between front reservoir tank and rear washer nozzle.
To avoid being damaged or interfered while in assembling the vehicle, the rear washer hose is fixed on headlining with silicone

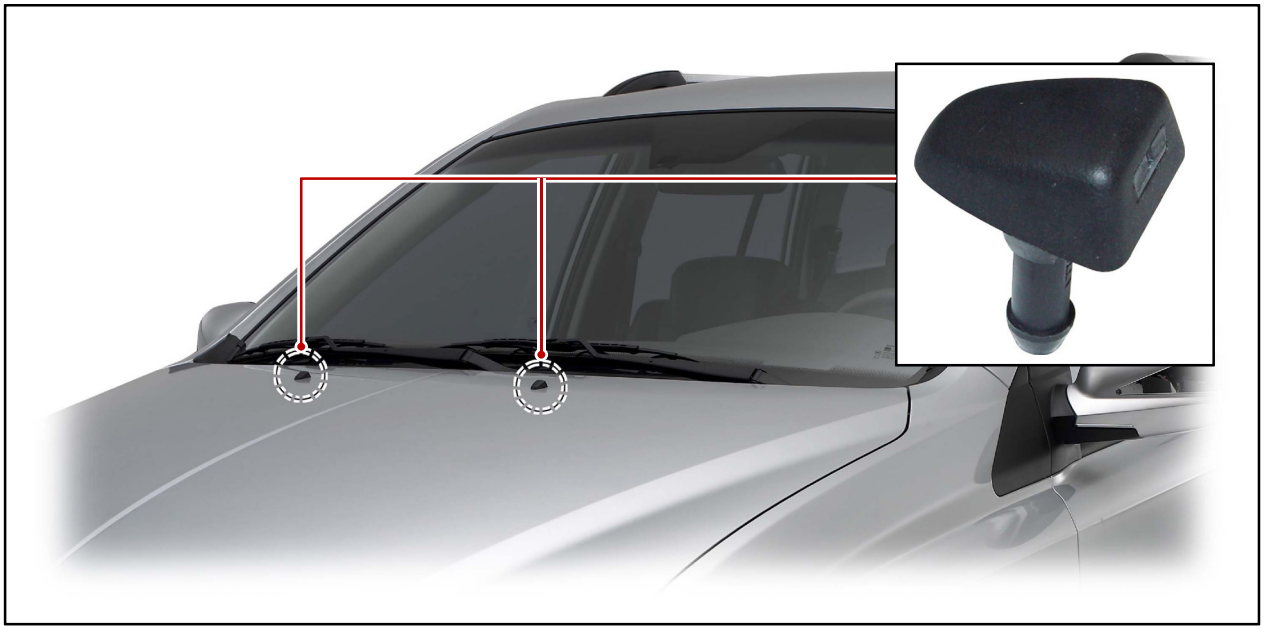


Rear washer hose and roof wiring harness are fixed at the headlining section with silicone.

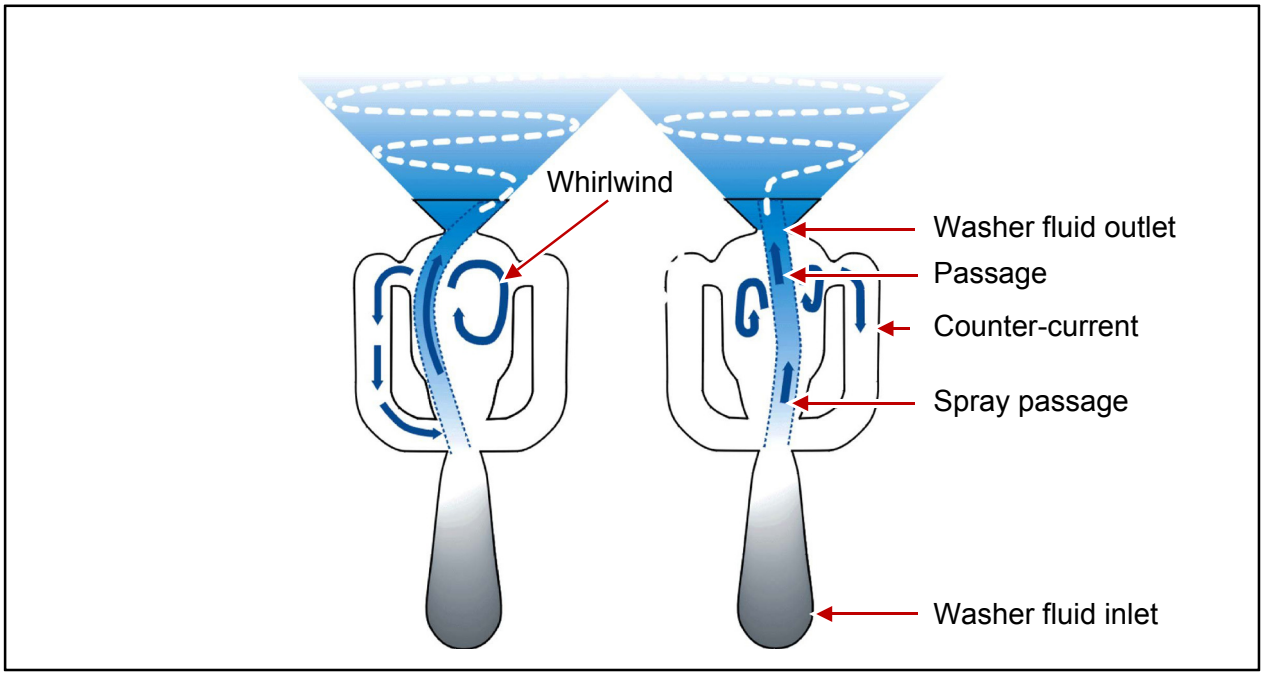
Modification basis	
Application basis	
Affected VIN	

4) Fluidic washer nozzle

Fluidic Washer Nozzle is applied to the front washer spray system in this vehicle.
The inside of nozzle is designed to utilize the fluidic movement.



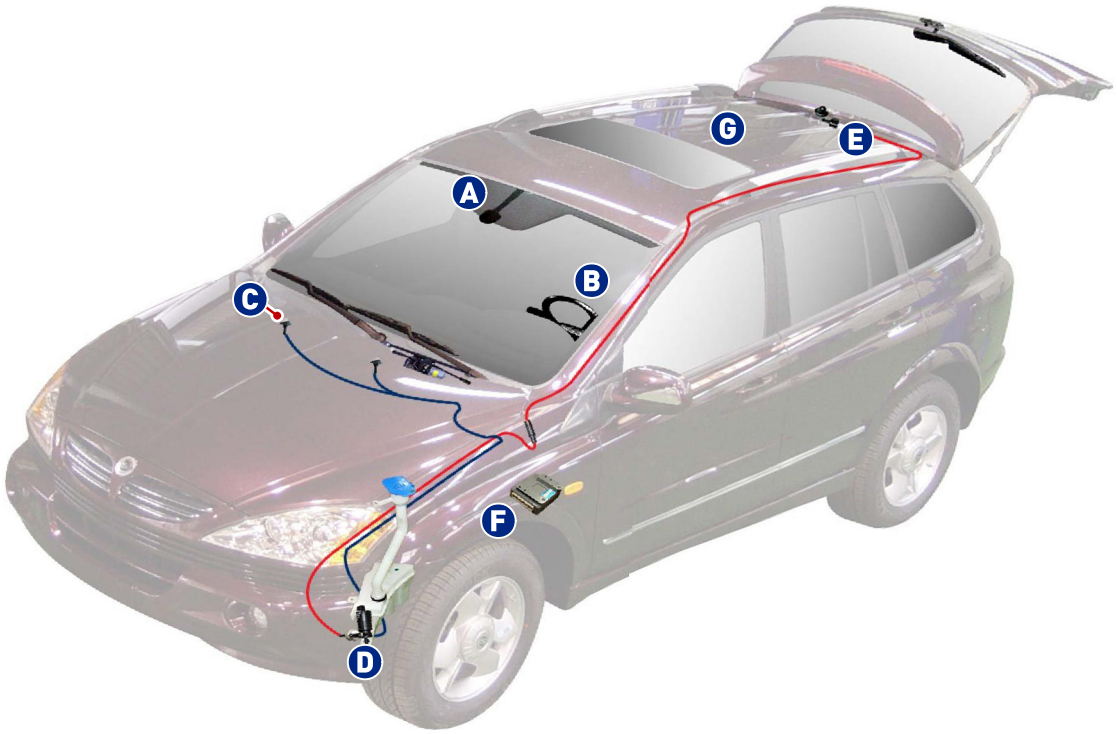
This is a shape of the inside of nozzle.
It is designed to change the spraying direction continuously according to the spraying time. (fan-shape)
The figure below shows the changes of spraying direction according to the spraying time.

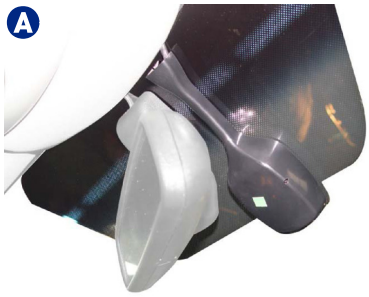


It is designed to be changed spraying direction using the whirlwind and backflow generated in nozzle.

OVERVIEW AND OPERATION PROCESS

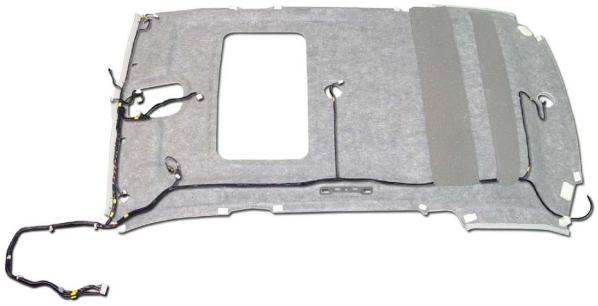
1. SYSTEM LAYOUT OF WIPER AND WASHER (WITH RAIN SENSOR)



Rain Sensor Unit	Multifunction Wiper and Washer Switch	Front Nozzle Assembly
A 	B 	C 

Washer Reservoir Tank Assemblyt	Rear Washer Nozzle and Check Valve
D 	E  1. Rear nozzle assembly 2. Rear nozzle 3. Check valve

Modification basis	
Application basis	
Affected VIN	

STICS	Rear Washer Hose Mounting
F 	G 

▶ **Rain Sensor Unit** A
- The rain sensor unit is integrated into the auto light sensor. It sends the amount of rain drops to STICS.

▶ **Multifunction Wiper and Washer Switch** B
- When the front wiper switch is off and this switch is pressed, washer fluid will be sprayed and the wiper will automatically operate 4 times. Then, the fluid wil be sprayed again and the wiper will automatically operate 3 times.

▶ **Front Nozzle Assembly** C
- The washer nozzles are installed at both sides of engine hood. The spraying pattern is specially designed to improve the spraying performance.

▶ **Washer Reservoir Tank Assemblyt** D
- There is no separate washer reservoir tank for the rear washer fluid.
  The rear washer system uses the front washer fluid reservoir.

▶ **Rear Washer Nozzle and Check Valve** E

▶ **STICS** F
- STICS receives the rain sensing datafrom the rain sensor and controls the wiper and washer systems.

▶ **Rear Washer Hose Mounting** G
- There is no separate washer fluid reservoir for the rear washer system in this vehicle. The rear washer system uses the front washer fluid reservoir. Because of this, the washer hose is supposed to be long between front reservoir tank and rear washer nozzle. To avoid being damaged or interfered while in assembling the vehicle, the rear washer hose is fixed on headlining with silicone

2. WIPER / WASHER RELATED FUNCTION AND SPECIFICATION

1) Wiper and Washer Fluid Switch Operation

MIST

When turning up the switch, the wiper operates once. When releasing the switch, the pointers return back to “OFF” position.

OFF

Wiping stops

AUTO

Wiper speed controls automatically according to the vehicle speed or amount of rain (rain sensing wiper).

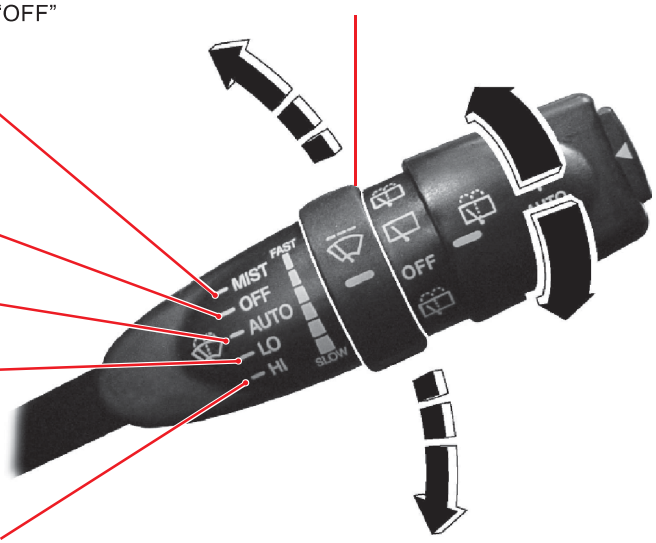
LO

Wiping speed gets slower when placing the pointer at the “LO” positon.

Wiping speed gets faster when placing the pointer at the “HI” positon.

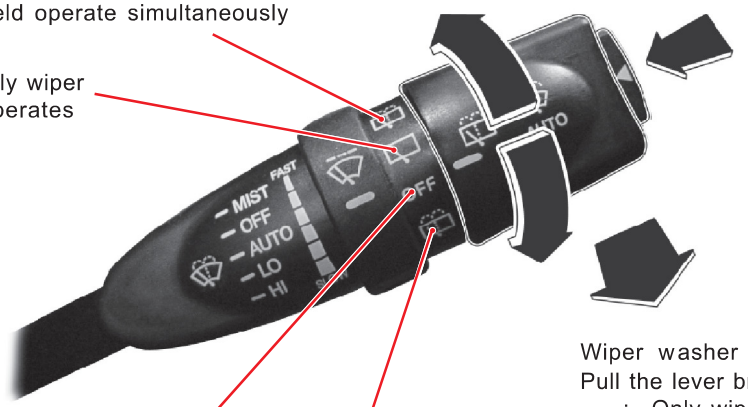
HI

Wiper speed control switch
When turning to FAST, wiping speed gets faster and when turing to SLOW, wiping speed gets slower.



Wiper and washer fluid for rear wind-shield operate simultaneously

Only wiper operates



Wiping stops

Washer fluid for rear windshield operates once.

Auto washer switch
If pressing the switch when the wiper switch turns to the “OFF” position, washer fluid is sprayed once and wiper operates 4 times.
After a while, washer fluid is sprayed one more and the wiper operates 3 times.

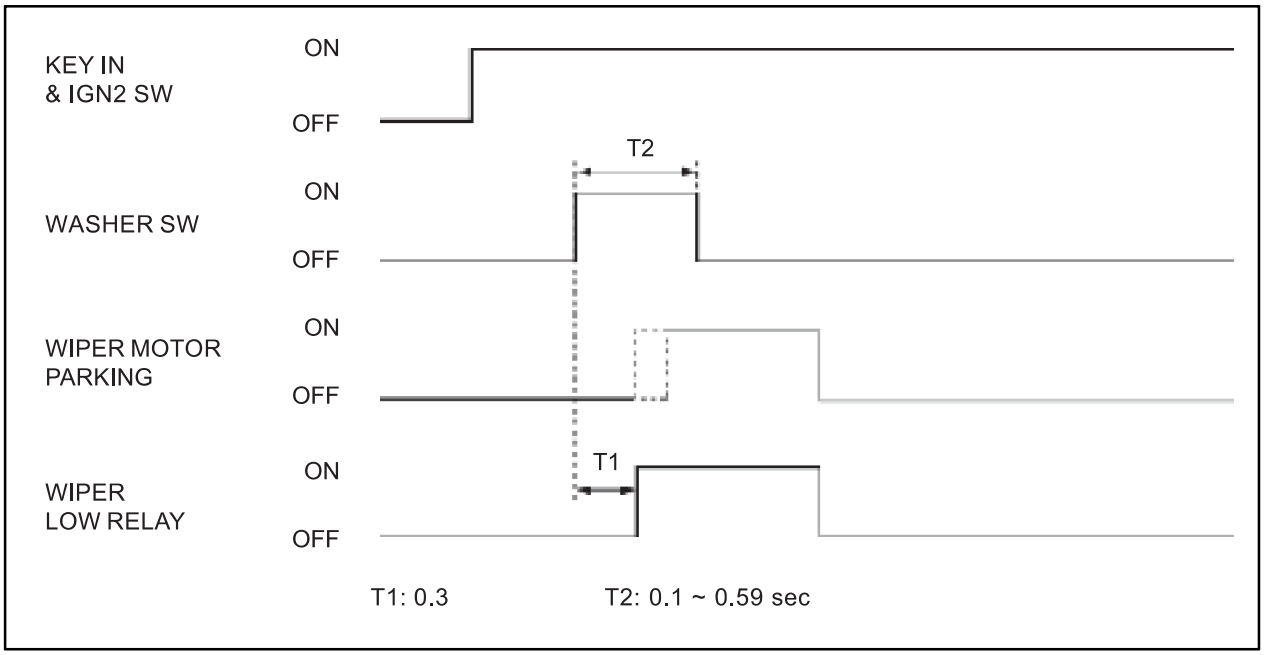
Wiper washer fluid coupled function
Pull the lever briefly (below 0.6 seconds)
: Only wiper operates
Pull and hold the lever for more than 0.6 seconds
: Wiper operates 3 times
Washer fluid coupled operation

Modification basis	
Application basis	
Affected VIN	

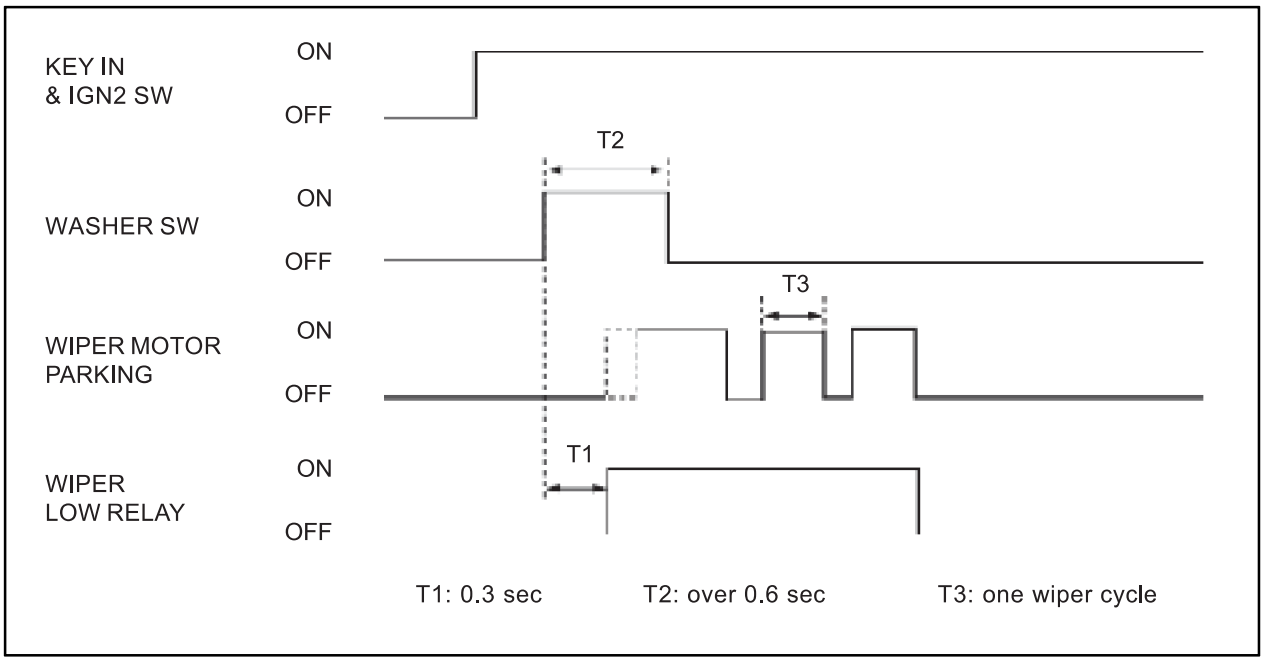
2) STICS Control Logic Related to Wiper and Washer

(1) Wiper MIST and Front Washer Coupled Wiper

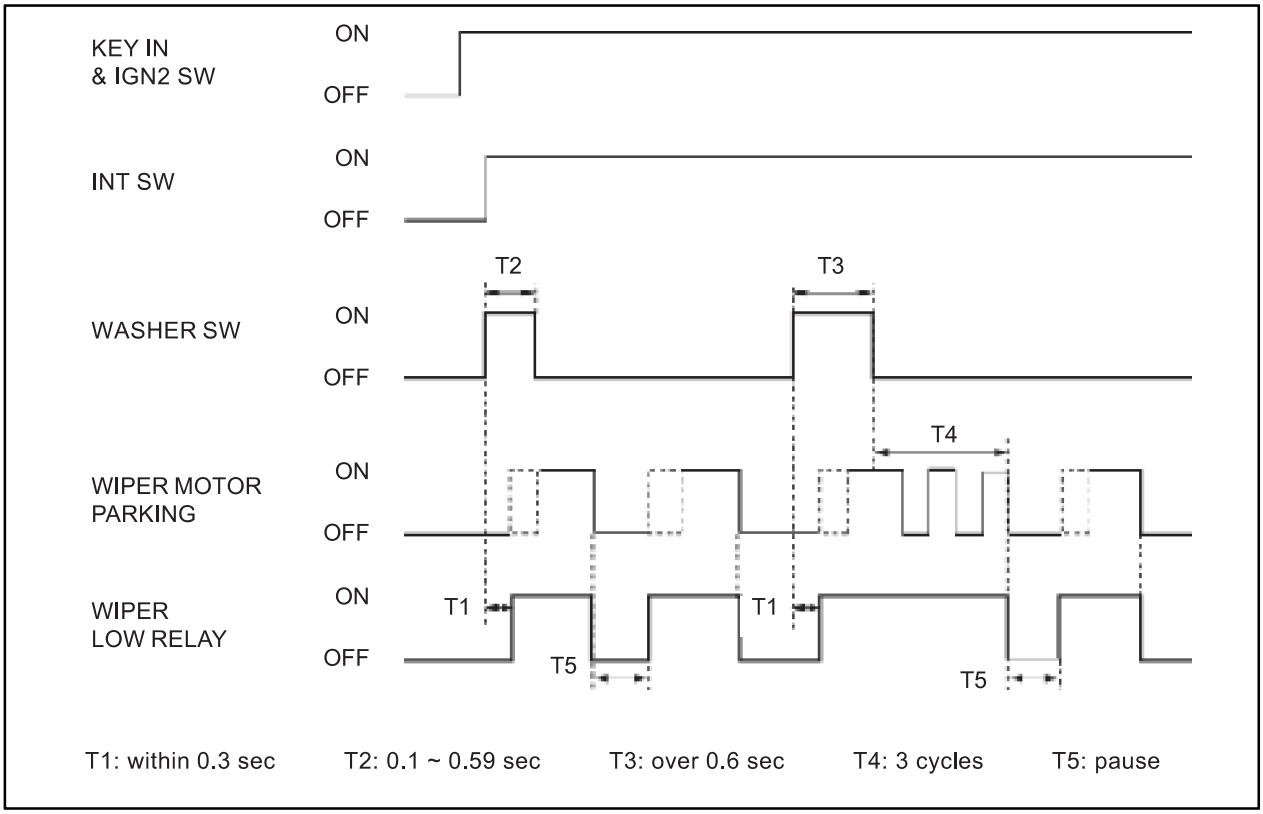
- The wiper relay is turned on 0.3 seconds after turning "ON" the washer switch for 0.1 ~ 0.59 seconds with the ignition key "ON", and it is turned off when the parking terminal is turned off.



- The wiper relay is turned on 0.3 seconds after turning "ON" the washer switch over 0.6 seconds with the ignition key "ON", and it is turned on three times immediately after turning off the washer switch.

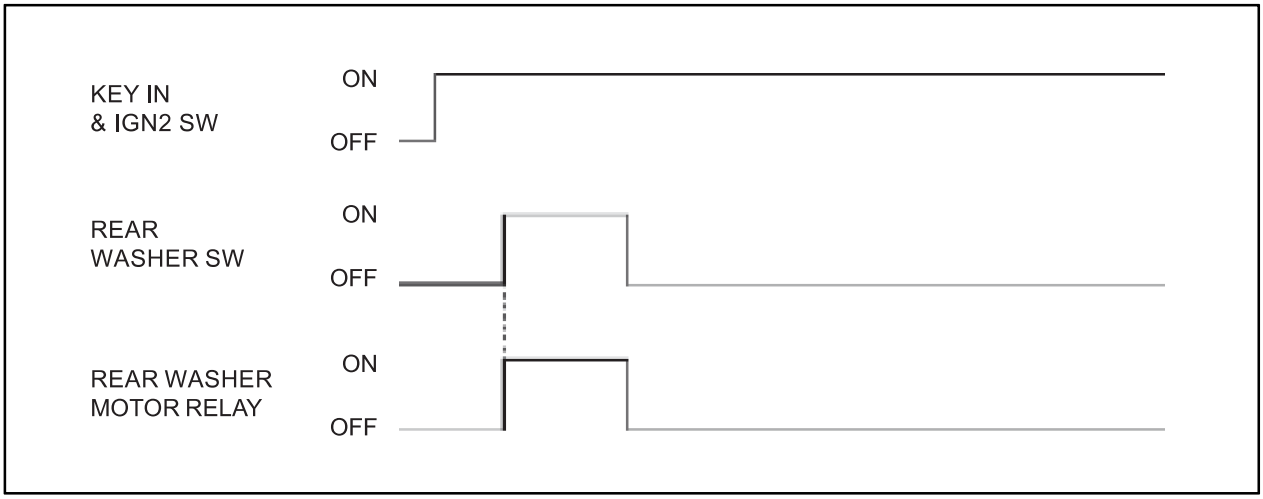


- When the washer switch is ON for more than 0.6 seconds during the wiper operation by the INT switch, the operation in step (2) is performed. When it is ON for a certain period of time (0.1 to 0.59 seconds), the operation in step (1) is performed.



(2) Rear Washer Motor Control

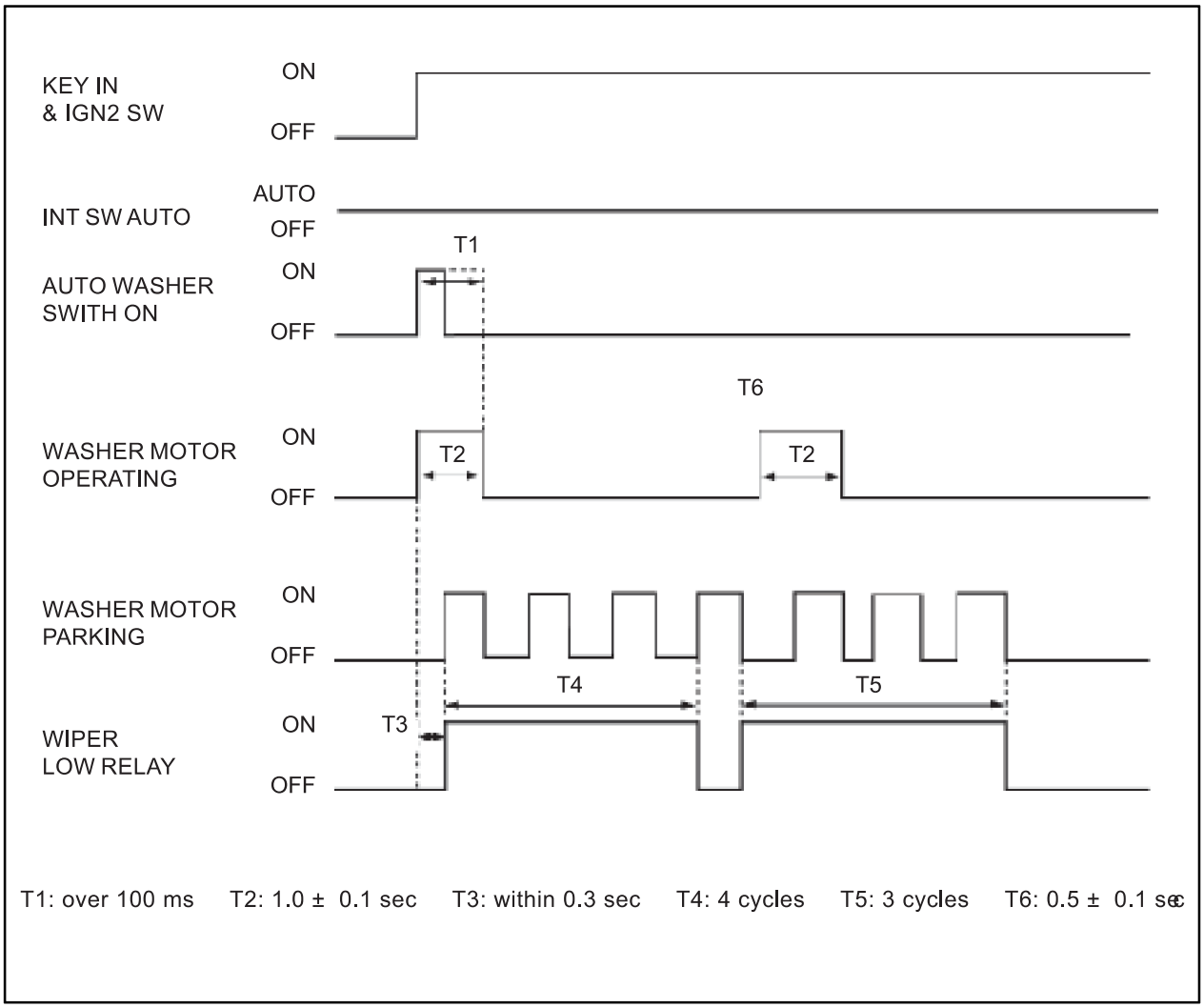
- When the rear washer switch is turn on with the ignition switch "ON", the rear washer motor relay output is activated from the time when the rear washer switch is turned on, and it is deactivated when the rear washer switch is turned off.
- It cannot be activated while the front washer switch or the auto washer and wiper (AFW: Advanced Fast Washer) is in operation.



Modification basis	
Application basis	
Affected VIN	

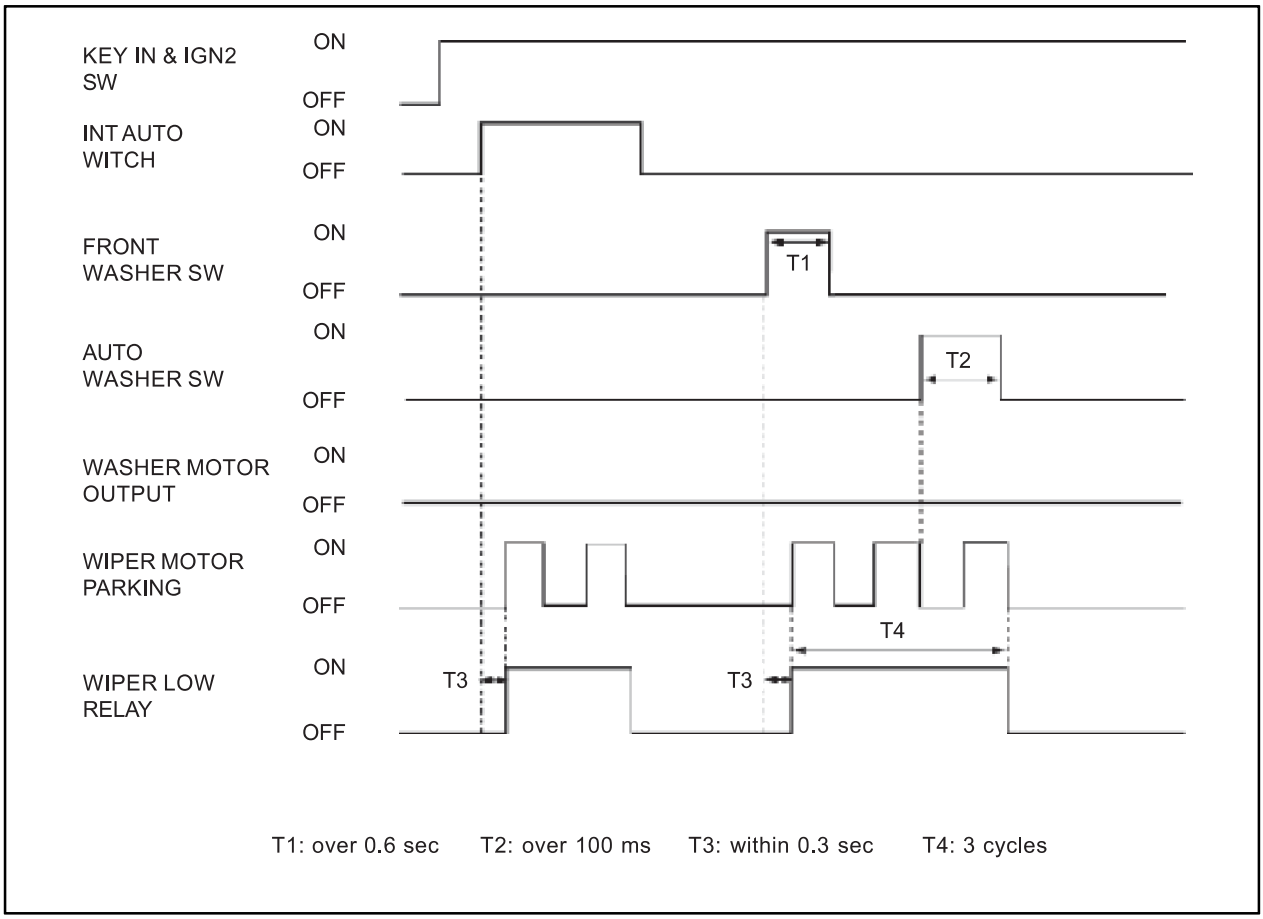
(3) Auto Washer and Wiper Switch (AFW)

- When the auto washer switch is turned on with the ignition switch "ON" and the INT switch "OFF", the washer motor output is activated for 1 second. If the system recognizes this output, the wiper relay output is activated during 4 cycles and the washer motor output is activated for 1 second. Then, the wiper relay output is deactivated after 3 cycles.



(4) FRONT Washer & AUTO Washer and Wiper Switch operation

- The auto washer switch output is overridden during the washer coupled wiper operation.
- The auto washer switch input is overridden during the auto washer coupled wiper operation.
- The auto washer switch input is overridden during the rain sensor coupled wiper or vehicle speed sensitive INT wiper operation.
- When the auto INT switch input is received during the auto washer operation, the auto washer operation stops and the auto INT operation is activated.

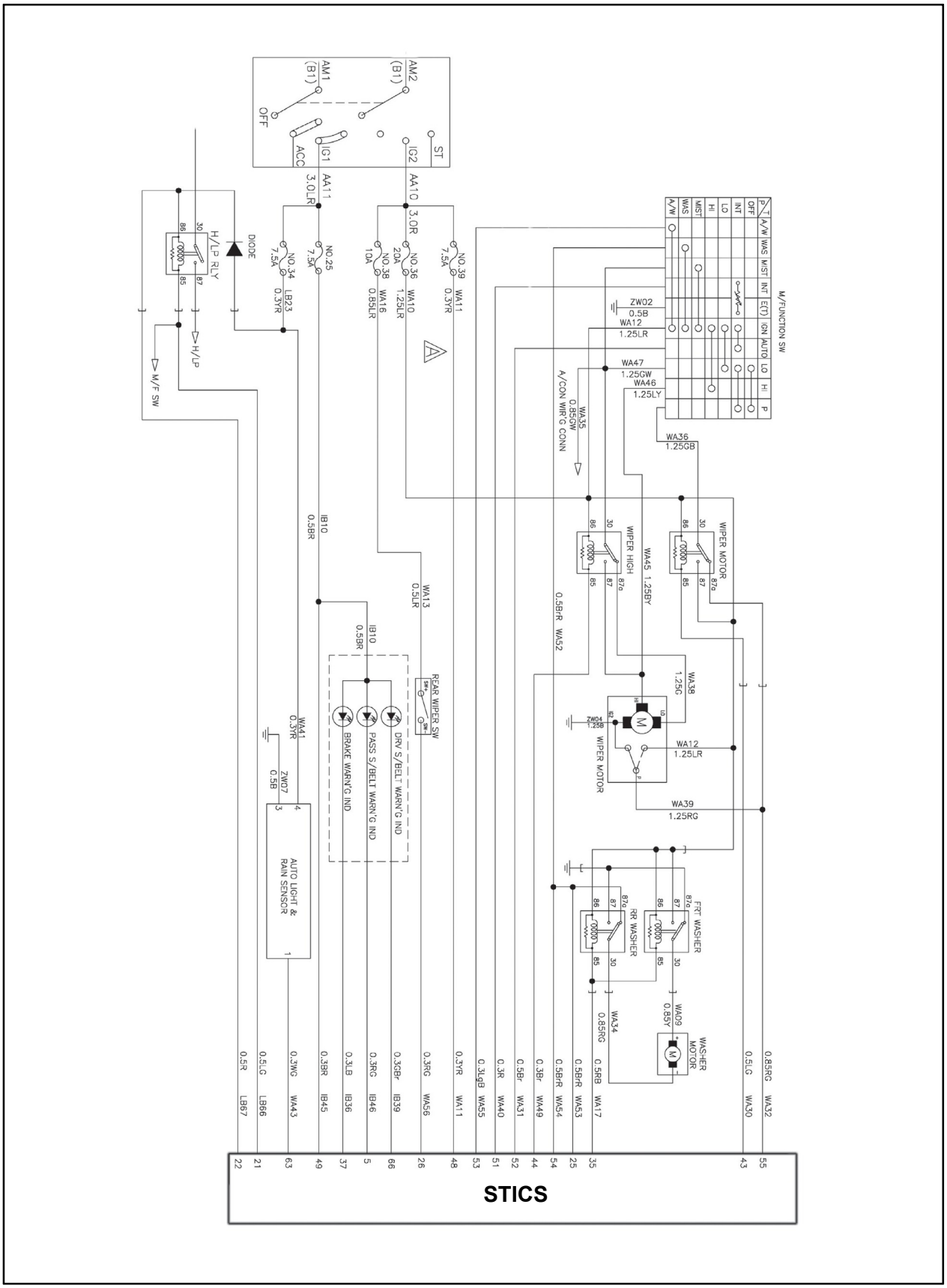


(5) Priorities in Washer Operations

1. The rear washer switch input is overridden during the front washer operation.
2. The rear washer switch input is overridden during the auto washer and wiper (AFW) operation.
3. The front washer switch input is overridden during the rear washer operation.
4. The auto washer switch input is overridden during the rear washer operation.
5. The front washer switch input is overridden during the auto washer and wiper (AFW) operation.
6. The auto washer switch input is overridden during the front washer operation.

Modification basis	
Application basis	
Affected VIN	

3. WIPER AND WASHER SYSTEM RELATED CIRCUIT

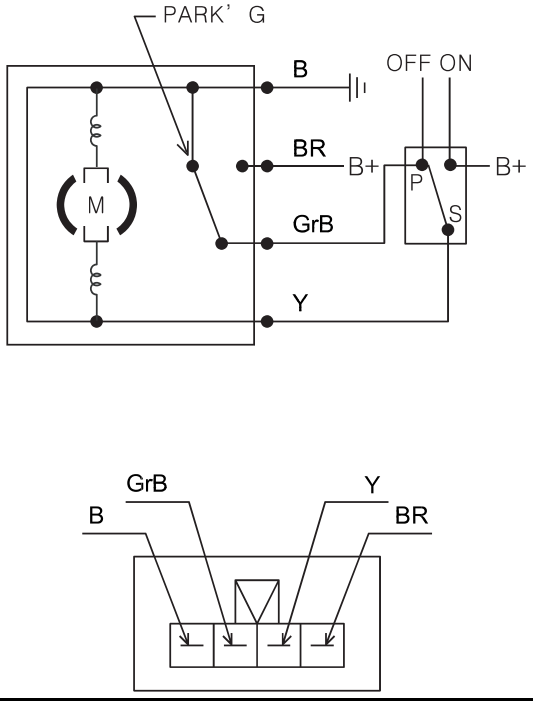
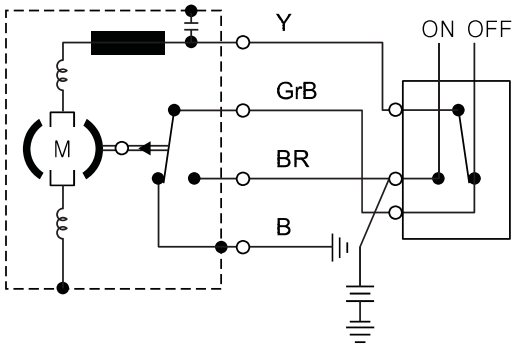
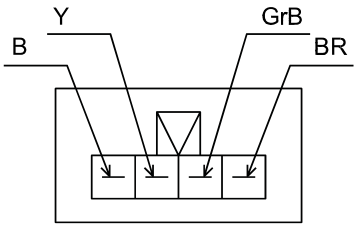


Modification basis	
Application basis	
Affected VIN	

4. REAR WIPER

1) OVERVIEW

The rear wiper system of NEW KYRON has different components compared to previous version of KYRON due to modification of the tailgate.
The followings are comparison of the system equipped in NEW KYRON with the system in previous version of KYRON.

	KYRON (from March '07)	Previous version
Wiper motor	Manufacturer: Kamco 	Manufacturer: Dongyang mechatronics 
Arm / Blade	Blade length: 12 Manufacturer: Kamco 	Blade length: 14 Manufacturer: KCW Corporation 
Circuit diagram		Modification in connector pin arrangement  

Modification basis	
Application basis	
Affected VIN	

RAIN SENSING SYSTEM (WITH AUTO LIGHT SENSOR) 8610-09

GENERAL

1. RAIN SENSING SYSTEM (WITH AUTO LIGHT SENSOR) OVERVIEW

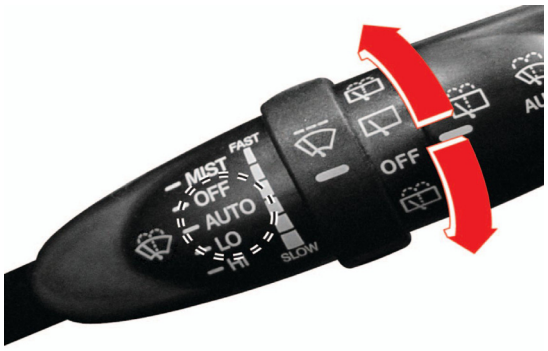
The rain sensing wiper unit in this vehicle doesn't control the wiper directly.
The rain sensing unit detects the amount of rain drops and sends the operating signal to STICS, and STICS drives the wiper directly.

Rain sensing unit (Auto light sensor integrated type)



A sensor that emits infrared rays through LED and then detects the amount of rain drops by receiving reflected rays against sensing section (rain sensor mounting section on the windshield) with photodiode. The auto light sensor is Integrated into the rain sensor. (refer to the below picture)

Multifunction wiper switch: AUTO and sensitivity control



AUTO: Wiper operates automatically by rain sensor
FAST <——> SLOW: Auto delay/Auto speed control.
A position that can control sensitivity against rains on the windshield and transmits wiping demand signal accordingly.



▶ **Emitter lens**
The LED emits the infrared rays is located at bottom and the lens guides the infrared rays to target point.

Enlarged auto light sensor section



Horizon autolight sensor
Auto light sensor
Vertical autolight sensor

Modification basis	
Application basis	
Affected VIN	

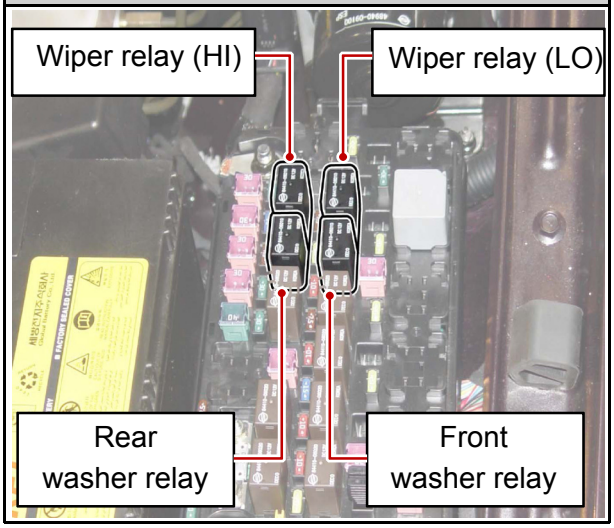
1) STICS

The rain sensing unit detects the amount of rain drops and sends the operating signal to STICS, and STICS drives the wiper directly.
At this moment, STICS determines the wiper operation mode (washer, MIST, AUTO), then sends the information to the rain sensor.

STICS



Engine compartment fuse box



(1) Auto Light Sensor And Rain Sensor Coupled Control

▶ **Rain detected headlamp**

- If it rains heavy which requires the highest INT speed, the headlamps are turned on automatically.

▶ **Night detected wiping**

- When the auto light control turns on the headlamps and the rain sensor detects the rain, the wiper sensitivity is automatically increased by one level.
  (For example, the AUTO wiper switch is at the 3rd level, but the wiper operates at the 4th level.)

Modification basis	
Application basis	
Affected VIN	

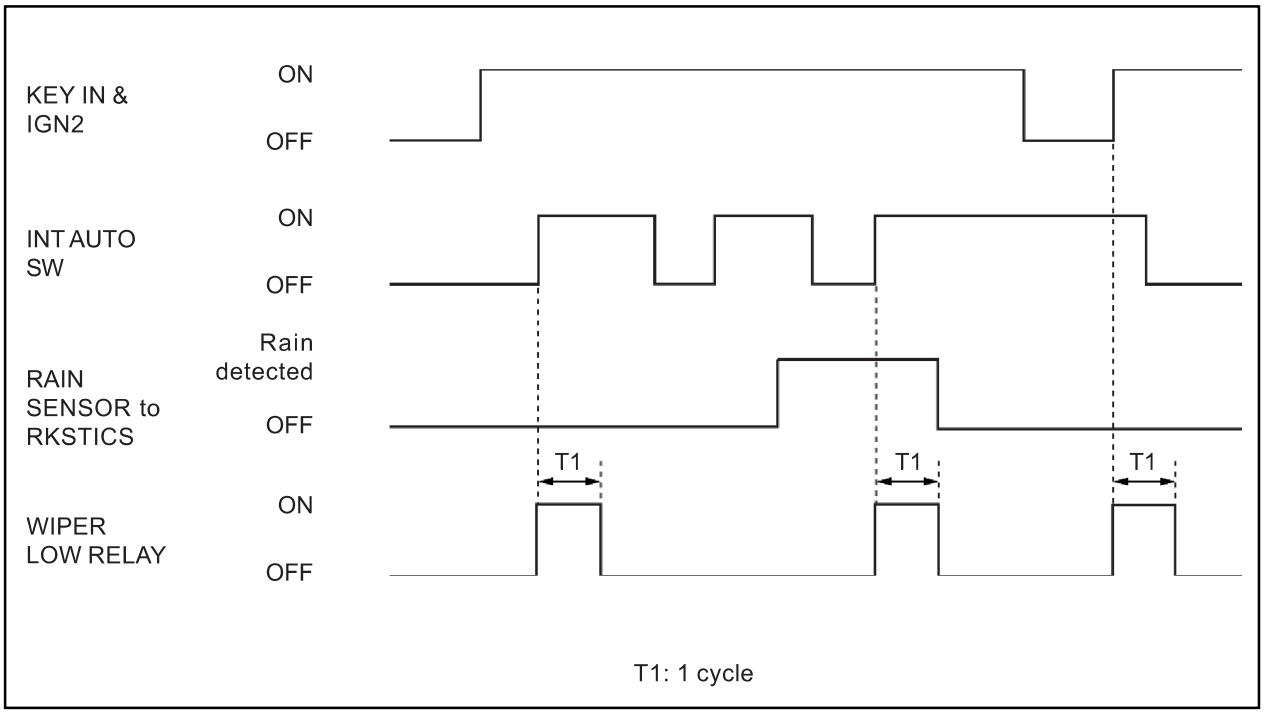
OVERVIEW AND OPERATION PROCESS

1. FUNCTIONS AND SPECIFICATIONS OF RAIN SENSING WIPER

1) Power-up Reminder Wiper

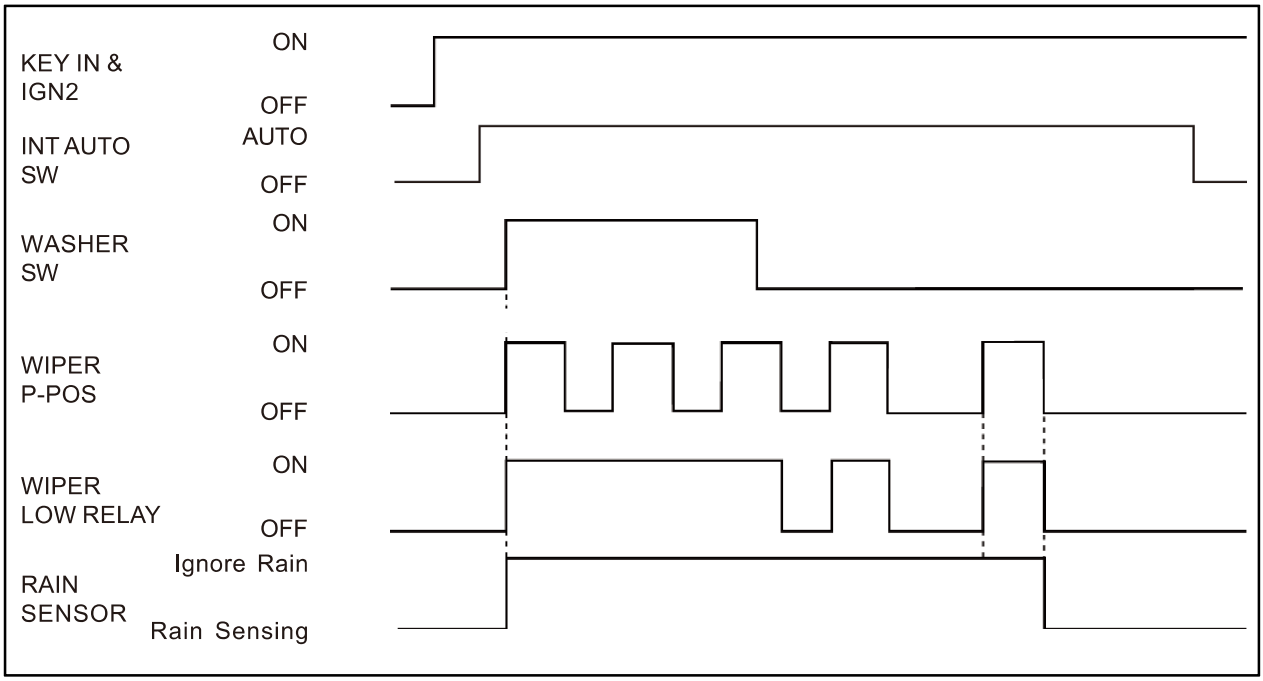
- When turning off and on the auto INT switch, the system drives the wiper motor through LOW relay regardless of communication with rain sensor.
- The wiper relay (LOW) is turned on and the wiper motor runs one cycle when changing the wiper switch to "AUTO" position from any other positions (while the ignition key is in "ON" position).

When the wiper switch is turned to "ON" position again from other positions, the system Drives the wiper motor through LOW relay one cycle only when the rain sensor detects the "Rain Detected" signal.



2) Washer Coupled Wiper in the Rain Sensing Mode

- The washer coupled wiper is operated when receiving the washer switch input with the ignition switch "ON" and the auto INT switch "ON" in rain sensing mode. At this moment, the communication with the rain sensor is overridden. However, the washer switch input is overridden during continuous operation.
- The operation data is sent to the rain sensor even during the washer coupled wiper operation.

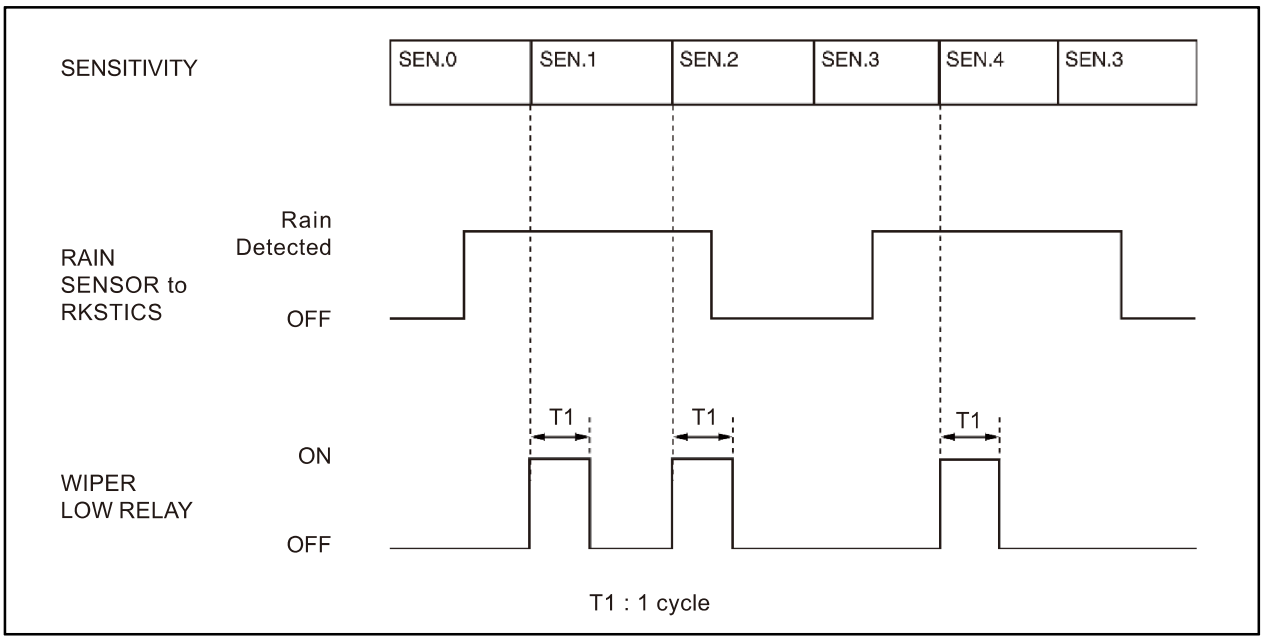


Modification basis	
Application basis	
Affected VIN	

3) Rain Sensing Sensitivity Control

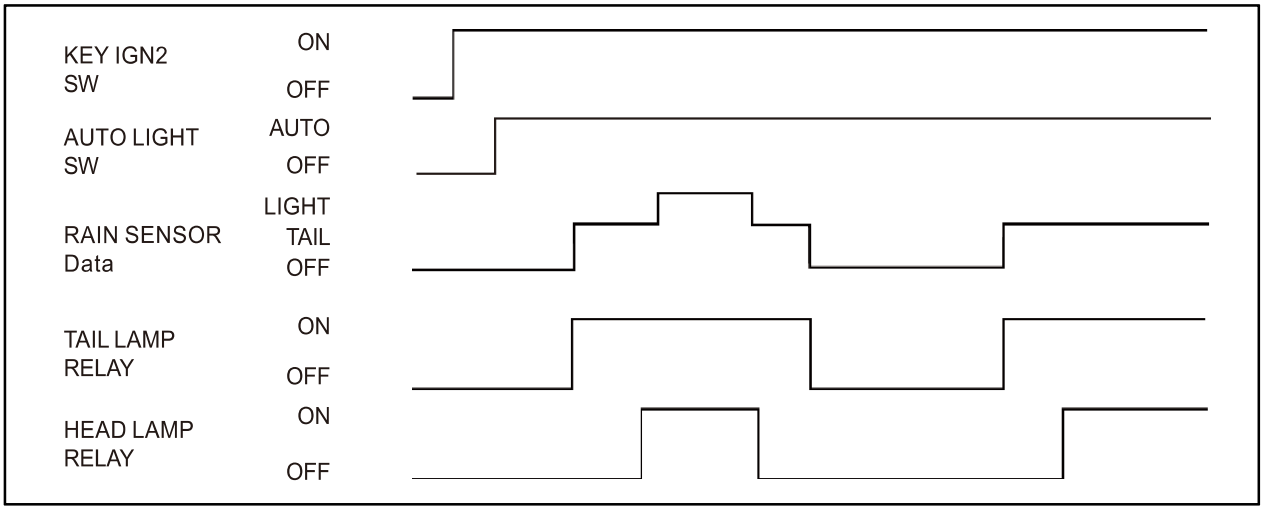
- The wiper relay (LO) is turned on and the wiper motor runs one cycle when the volume sensitivity is increased (ex: from 0 to 1) (while the ignition key is in "ON" position, the wiper switch is in "AUTO" position, and the wiper motor is in "Parked" position). However, the wiper motor can be operated only when the rain sensor detects the "Rain Detected" signal.

- If the volume sensitivity is changed more than 2 stages within 2 seconds, the wiper motor runs only one cycle.



4) Auto Light Control

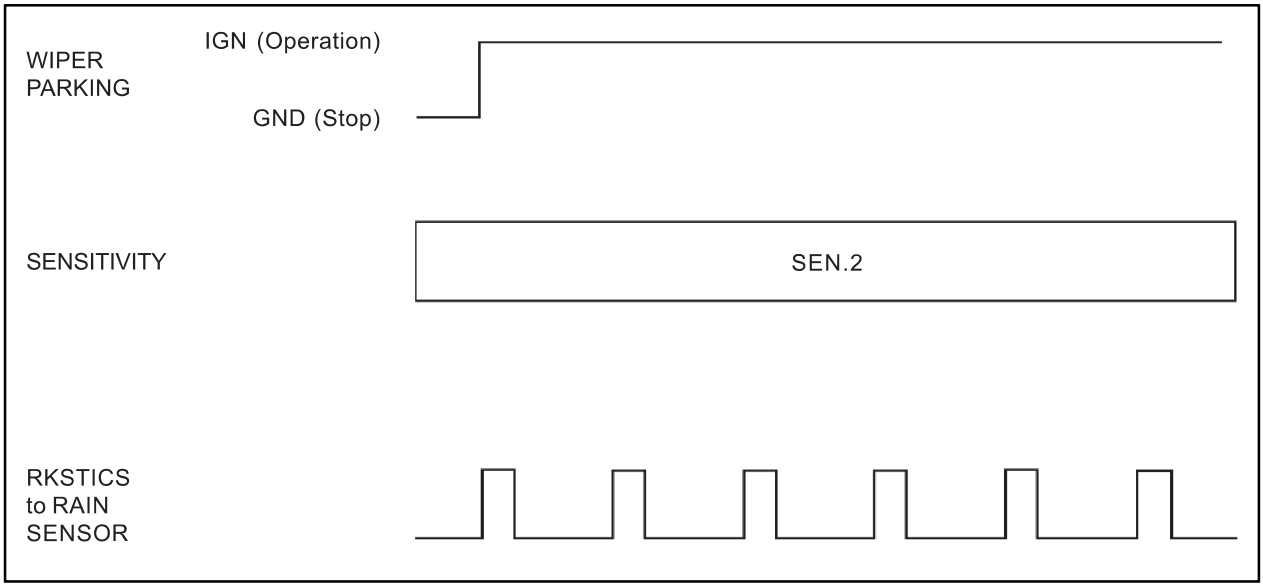
- Only when the auto light switch is in "AUTO" position, control the tail lamp and headlamp by communicating with the rain sensor (while the ignition key is in "ON" position).



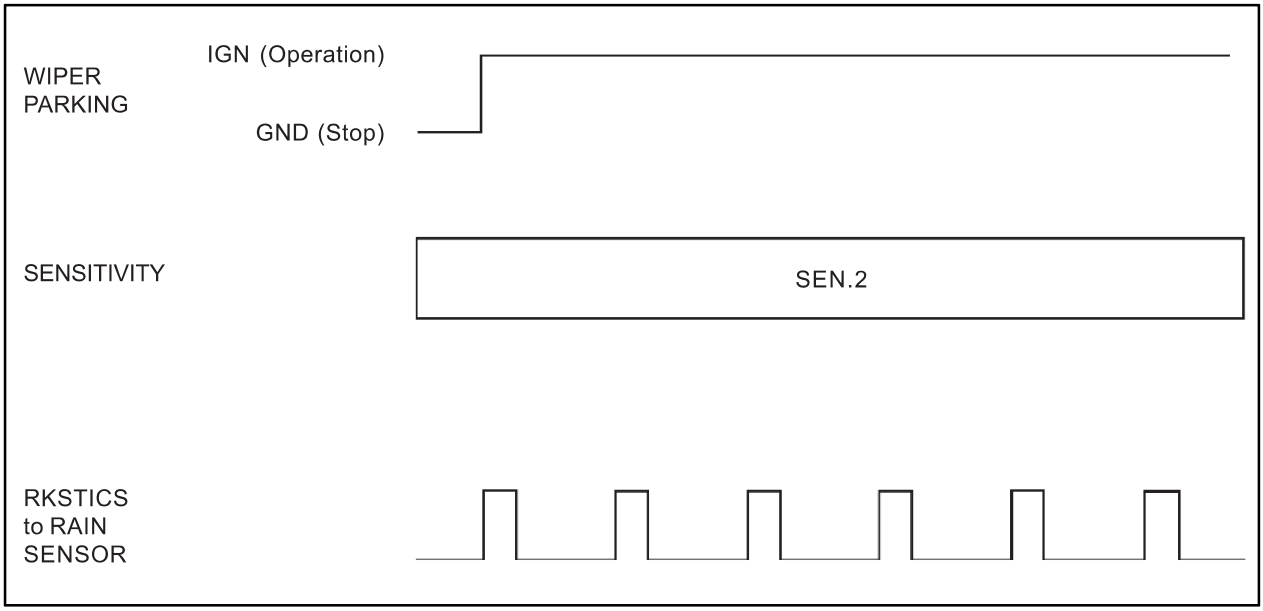
Modification basis	
Application basis	
Affected VIN	

5) Wiper Operation When the Wiper Parking Terminal Is Grounded

- The wiper system continuously outputs the parking signal of current sensitivity when the parking terminal is grounded (while the ignition key is in "ON" position and the INT switch is in "ON" position).
- **The wiper motor runs only when the rain sensor requires.**



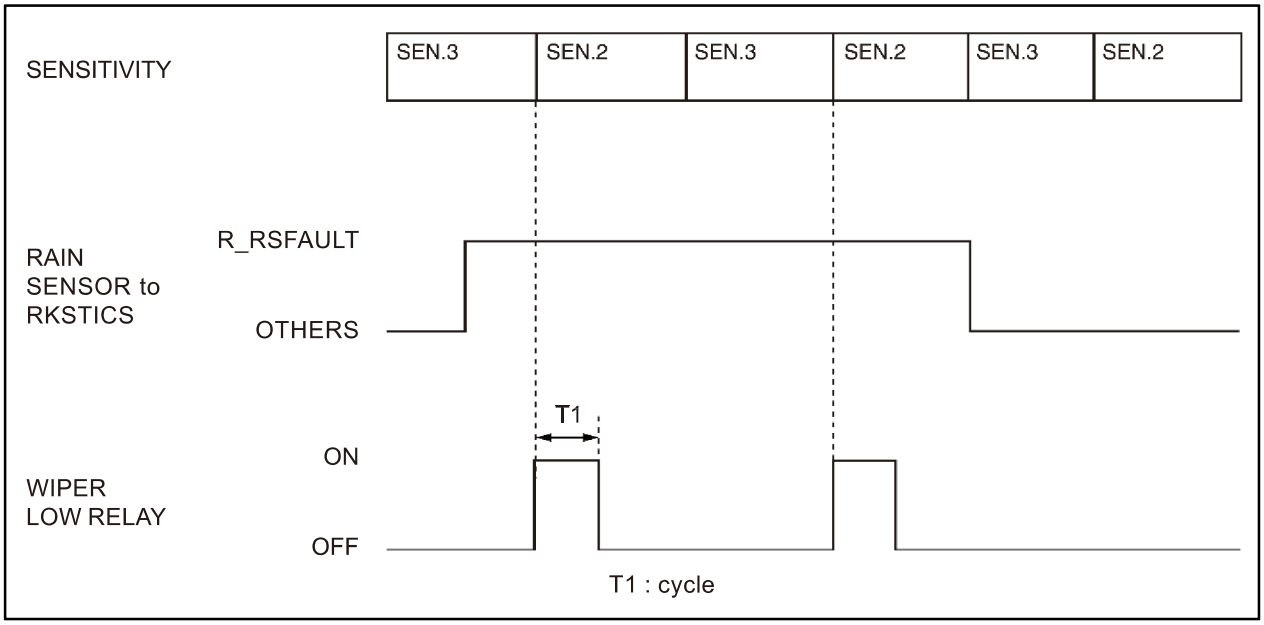
- When the parking terminal is fixed to IGN (HIGH), the wiper system outputs the operating signal of current sensitivity for 2 seconds, then continuously outputs the parking signal of current sensitivity (while the ignition key is in "ON" position and the INT switch is in "ON" position).
- **The wiper motor runs only when the rain sensor requires.**



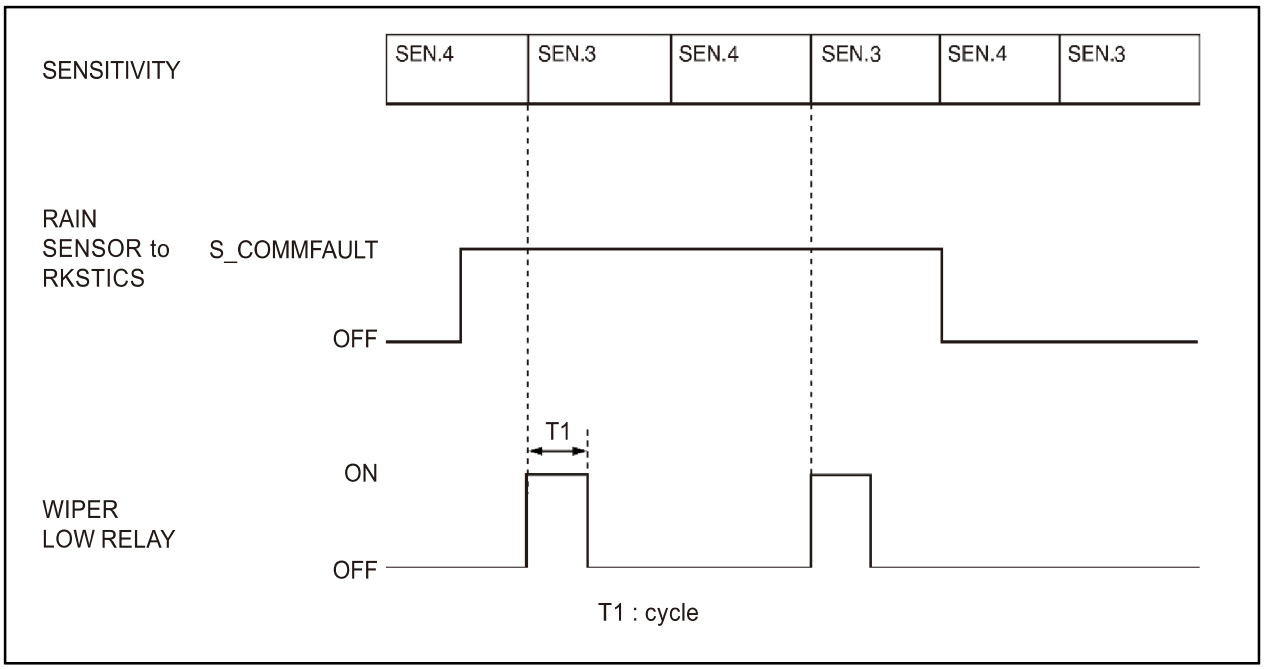
Modification basis	
Application basis	
Affected VIN	

6) Defective Rain Sensor

- The wiper relay (LO) is turned on and the wiper motor runs one cycle when the wiper sensitivity is changed to 2 from 3 during receiving the malfunction signal (1) from the rain sensor (while the ignition key is in "ON" position and the INT switch is in "ON" position).



- The wiper relay (LO) is turned on and the wiper motor runs one cycle when the wiper sensitivity is changed to 3 from 4 during receiving the malfunction signal (2) from the rain sensor (while the ignition key is in "ON" position and the INT switch is in "ON" position).



2. OPERATION MODE OF RAIN SENSING WIPER SYSTEM

Driver Switch Positions		Operation Mode
MIST (Transmits the manual operation mode signal to sensor)		As long as the switch is in MIST position, the wiper motor operates in low speed. The wiper blade returns to parking position if the switch returns to the original position. The rain sensor ignores inputs during parking signal periods.
OFF (Transmits the manual operation mode signal to sensor)		The wiper motor rotates in low speed until it returns to parking position. When the system is in manual mode, the sensitivity of sensor will be set to 2 (AUTO 2) internally. By doing so, immediate wiping with proper intervals is possible when a driver sets the system from OFF to AUTO.
AUTO 1 (low sensitivity)	SLOW ▲	Auto delay/auto speed control. Low sensitivity against rains on windshield. When the switch is in AUTO position, the sensor transmits the wiping request signal to STICS.
AUTO 2 (low/med sensitivity)		Auto delay/auto speed control. Low/medium sensitivity against rains on windshield.
AUTO 3 (medium sensitivity)		Auto delay/auto speed control. Medium sensitivity against rains on windshield.
AUTO 4 (med/hi sensitivity)		Auto delay/auto speed control. Medium/high sensitivity against rains on windshield.
AUTO 5 (high sensitivity)	▼ FAST	Auto delay/auto speed control. High sensitivity against rains on windshield.
LOW SPEED (transmits the manual operation mode signal to sensor)		The wiper motor rotates continuously in low speed of approx. 45 rev./minute at B+=13.5V (in the normal battery voltage). The rain sensor operations are same as in MIST.
HI SPEED (transmits the manual operation mode signal to sensor)		The wiper motor rotates continuously in high speed of approx. 70 rev./minute at B+=13.5V (in the normal battery voltage). The rain sensor operations are same as in MIST.

▶ **Rain detected headlamp**

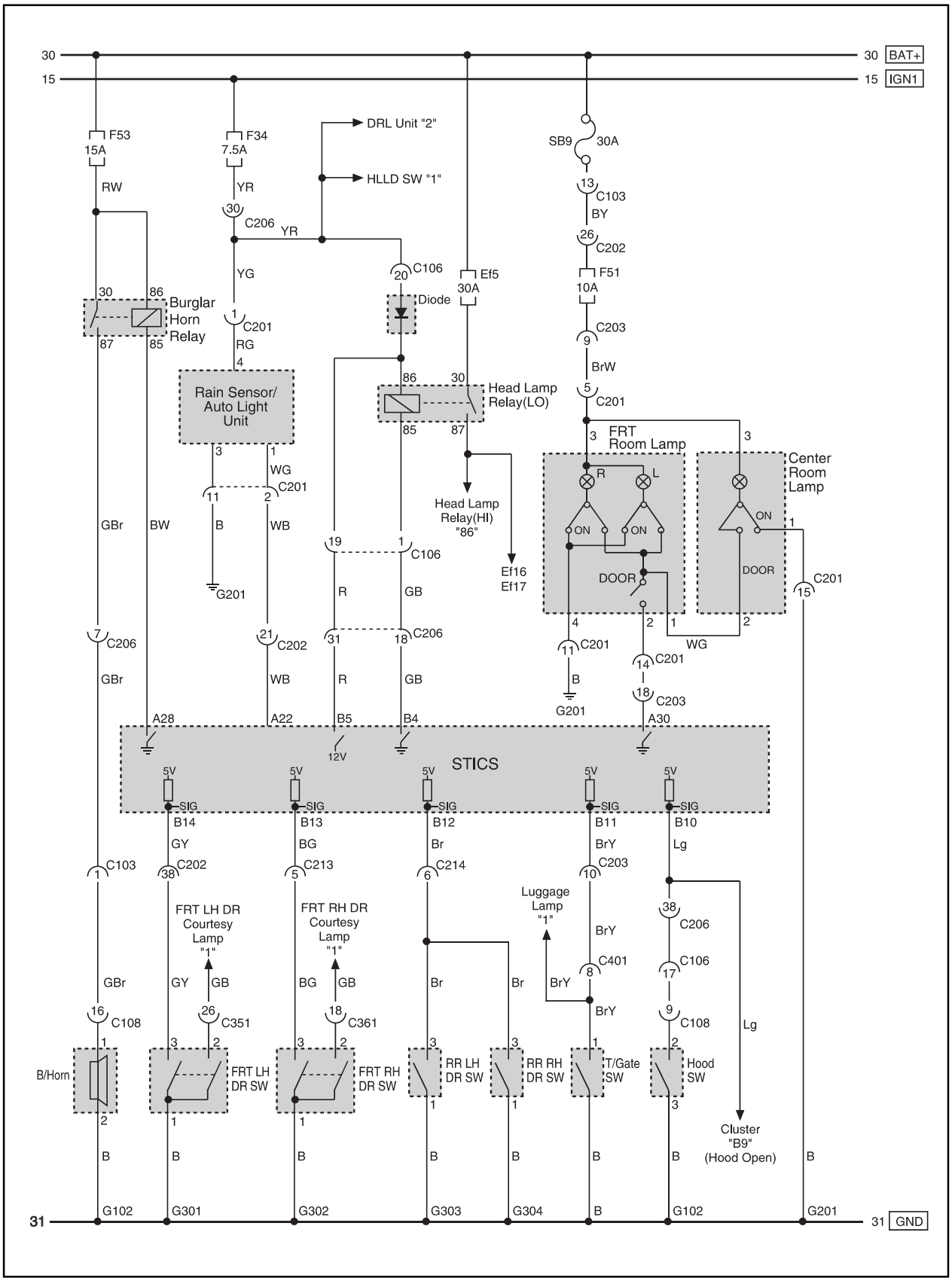
- If it rains heavy which requires the highest INT speed, the headlamps are turned on automatically.

▶ **Night detected wiping**

- When the auto light control turns on the headlamps and the rain sensor detects the rain, the wiper sensitivity is automatically increased by one level. (i.e. the AUTO wiper switch is at the 3rd level, but the wiper operates at the 4th level.)

Modification basis	
Application basis	
Affected VIN	

3. ELECTRICAL WIRING DIAGRAM



Modification basis	
Application basis	
Affected VIN	

PARKING AID SYSTEM 8790-00

GENERAL

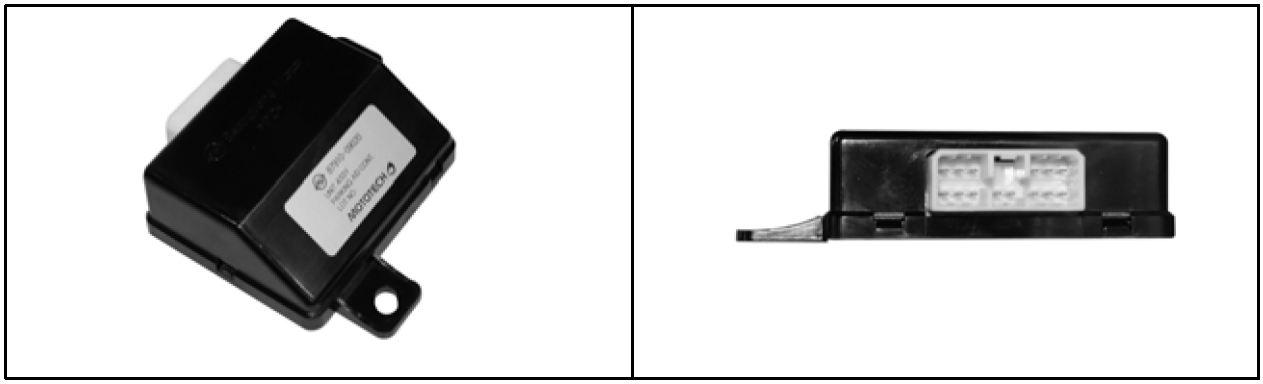
1. COMPONENT SPECIFICATIONS

The parking aid system emits the supersonic wave signals from the sensors on the rear bumper with a specific interval and detects the reflected signals from obstacles while the gear selector lever is in "R" position. The alarm interval becomes faster as the obstacle approaches. This supplementary system is to secure the safety distance for parking.

Items		Value	Items		Value
Rated voltage		DC 12 V	Operating temperature		-30°C ~ +80°C
Operating voltage		UNIT 12 V , SENSOR 8 V	Storage temperature		-40°C ~ +85°C
Allowable max. current	Unit	100 mA (DC 12 V)	Relative humidity		95% (max.)
	Sensor	20 mA (DC 8 V)	Weight	Unit	160g ± 10g (max.)
Sensor insulating resistance		More than 5M Ω		Sensor	50g ± 10g (max.)

1) Parking Aid Unit

Detecting type: Supersonic wave Detecting distance: 25 cm ~ 100 cm (direct distance between sensor and obstacle)



2) Parking Aid Sensor



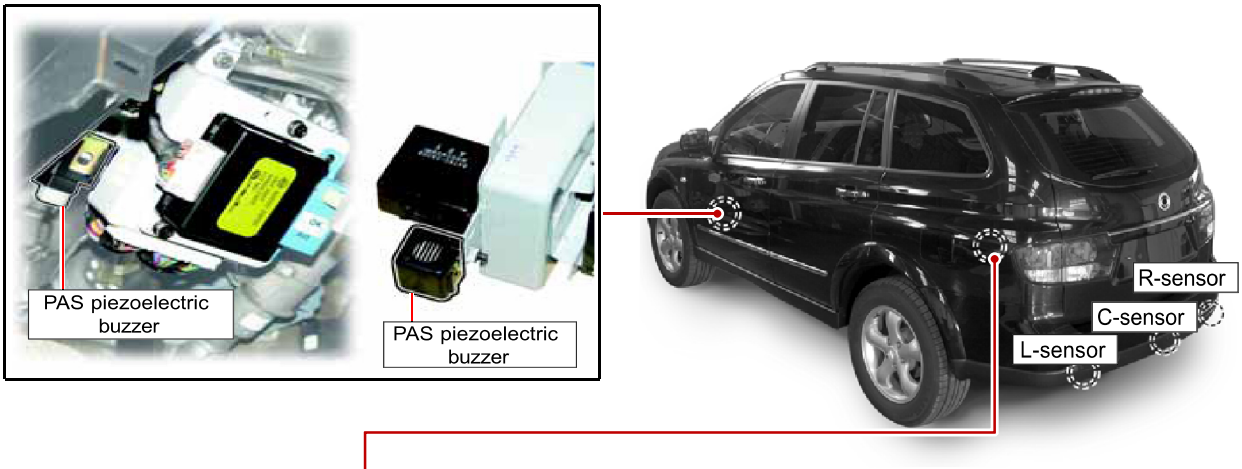
Detecting type: Supersonic wave
(Piezometric ceramic element)
measuring time taken that the emitted
supersonic wave is reflected and returned to the sensor.

OVERVIEW AND OPERATION PROCESS

1. SYSTEM CONFIGURATION

The parking aid device is integrated in the rear bumper and it uses three piezoelectric elements to measure vertical and horizontal distance to obstacles.

If the sensor receives the reverse signal, it calculates the distance between itself and obstacles and sends the calculated value to the PAS unit, which will warn a driver by controlling the activation of the Piezo buzzer in relation to the distance. The PAS unit of KYRON from Mach '07 has been changed for its installed positions and shape due to the shape change of the rear bumper and also its internal elements have been changed due to the setting values of the PAS unit.



Parking Aid Unit



PAS Sensor Components



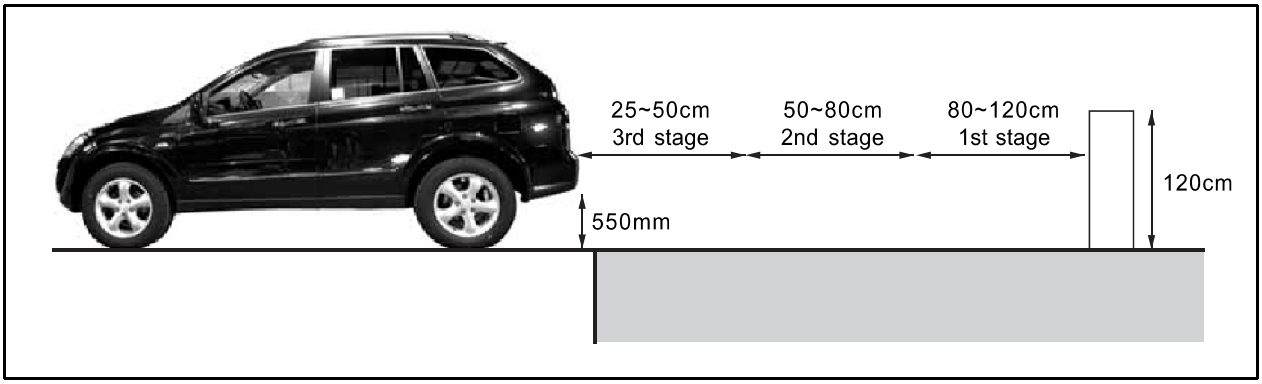
CAUTION

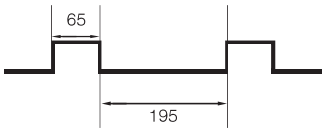
- KYRON from '07 March and earlier KYRON are not compatible with the PAS unit and its sensor parts each other.

Modification basis	
Application basis	
Affected VIN	

2. ALARM INTERVAL AND TROUBLE SHOOTING

1) Detected Distance and Range



Stage	LH & RH sensors	Center sensor	Alarm interval (msec)	Remarks
1	80 ~ 100 cm	80 ~ 120 cm		"Beep----, Beep----"
2	50 ~ 80 cm			"Beep-, Beep-, Beep-"
3	25 ~ 50 cm			"Beep----"
Tolerance	± 10 cm		± 10%	

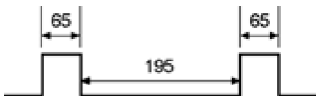
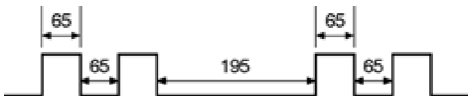
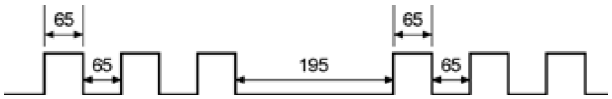
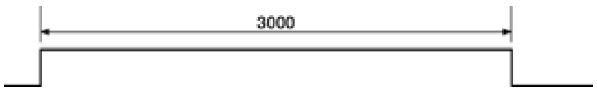
2) Troubleshooting



When the power is applied (gear selector lever is in "R" position), the sensor will be diagnosed once. If normal, the warning buzzer sounds only for 65 ms. If found any failure due to open circuit to sensor or communication error, the data in failed sensor is transmitted to notice its failure by buzzer sound.

If more than one sensor is defective, warning buzzer sounds for 3 seconds.

▶ When failed

Items	Alarm interval (msec)	Diagnosis conditions
LH sensor failed ("Beep----Beep")		1. Ignition key ON 2. Failing condition - Open circuit in line that transmits data from sensor to unit - Open circuit in line that supply power (+, -)
Center sensor failed ("Beep Beep---- Beep Beep")		
RH sensor failed ("Beep Beep Beep---- Beep Beep Beep")		
Sensor failed (over 2EA) ("Beep----")		

Modification basis	
Application basis	
Affected VIN	

3. CAUTIONS ON PARKING AID SYSTEM

CAUTION

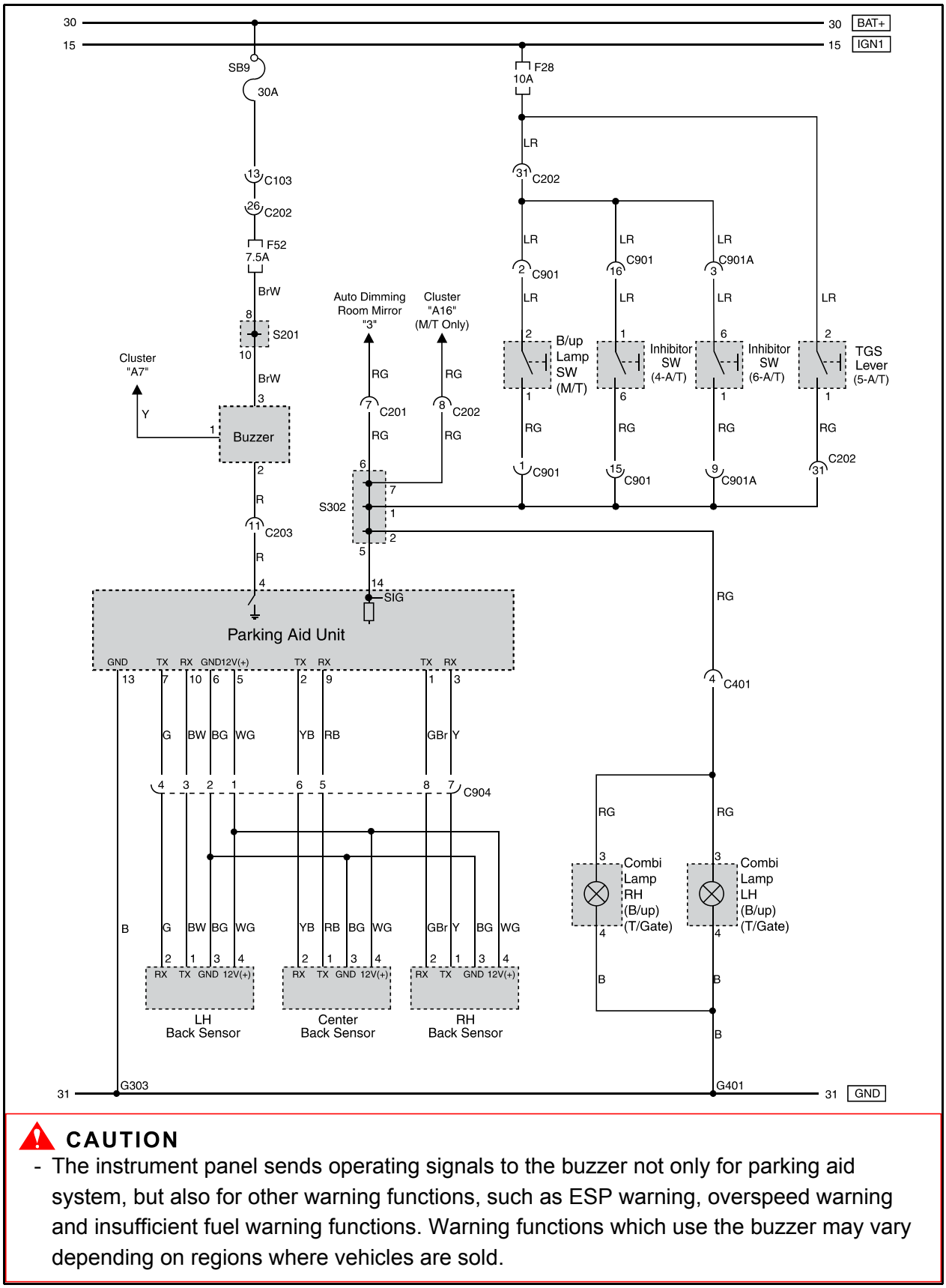
- Note that the display does not show everything in the rear area. Always check nobody, especially animals and children, is behind the vehicle.
- If you can not properly check back, get out of the vehicle and then check it.

1. The parking aid system is just a supplemental device to help your parking operation.
2. Always keep the safety precautions.
3. Do not press or shock the sensors by hitting or high-pressure water gun while washing, or the sensors will be damaged.
4. If the system is in normal operating conditions, a short beep sounds when the gear selector lever is moved into "R" position with the ignition key "ON".

▶ **The parking aid system will not work or improperly work under following cases:**

1. Certain obstacles that sensors can not detect
   - Wires, ropes, chains.
   - Cotton, sponge, clothes, snow that absorb ultrasonic waves.
   - Obstacles lower than the bumper.
2. Not defective but improperly working
   - When the sensing portion is frozen. (operates normally after thawed)
   - When the sensing portion is covered by rain, water drops, snow or mud (operates normally after cleaned).
   - When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles).
   - When a high-power radio is turned on.
3. Narrowed sensing area
   - When the sensing portion is partially covered by snow or mud. (operates normally after cleaned)
   - Surrounding temperature of sensor is too high (approx. over 80 °C) or too low (approx. below -30 °C).
4. Not defective but may occur improper working
   - When driving on the rough roads, gravel road, hill and grass.
   - When the bumper height is changed due to the heavy load.
   - When the sensing portion is frozen.
   - When the sensing portion is covered by rain, water drops, snow or mud.
   - When receiving other ultrasonic signals (metal sound or air braking noises from heavy commercial vehicles).
   - When a high-power radio is turned on.
   - When some accessories are attached in detecting ranges.
   - When the vehicle height is lowered due to operation of EAS.

4. CIRCUIT DIAGRAM



CAUTION

- The instrument panel sends operating signals to the buzzer not only for parking aid system, but also for other warning functions, such as ESP warning, overspeed warning and insufficient fuel warning functions. Warning functions which use the buzzer may vary depending on regions where vehicles are sold.

Modification basis	
Application basis	
Affected VIN	

AV

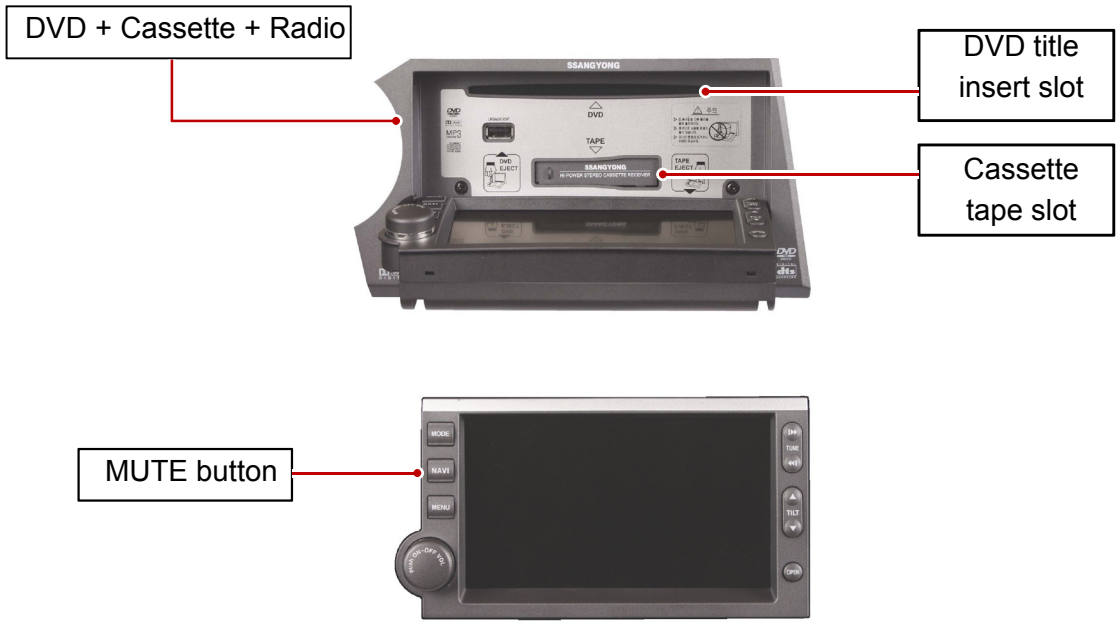
8930-14

GENERAL

1. AV HEAD UNIT OVERVIEW

DVD + Cassette player : 10 speakers (center speaker, woofer speakers, tweeter speakers)

AV head unit



Tuner



DVD 6 DISC changer



DSP amplifier



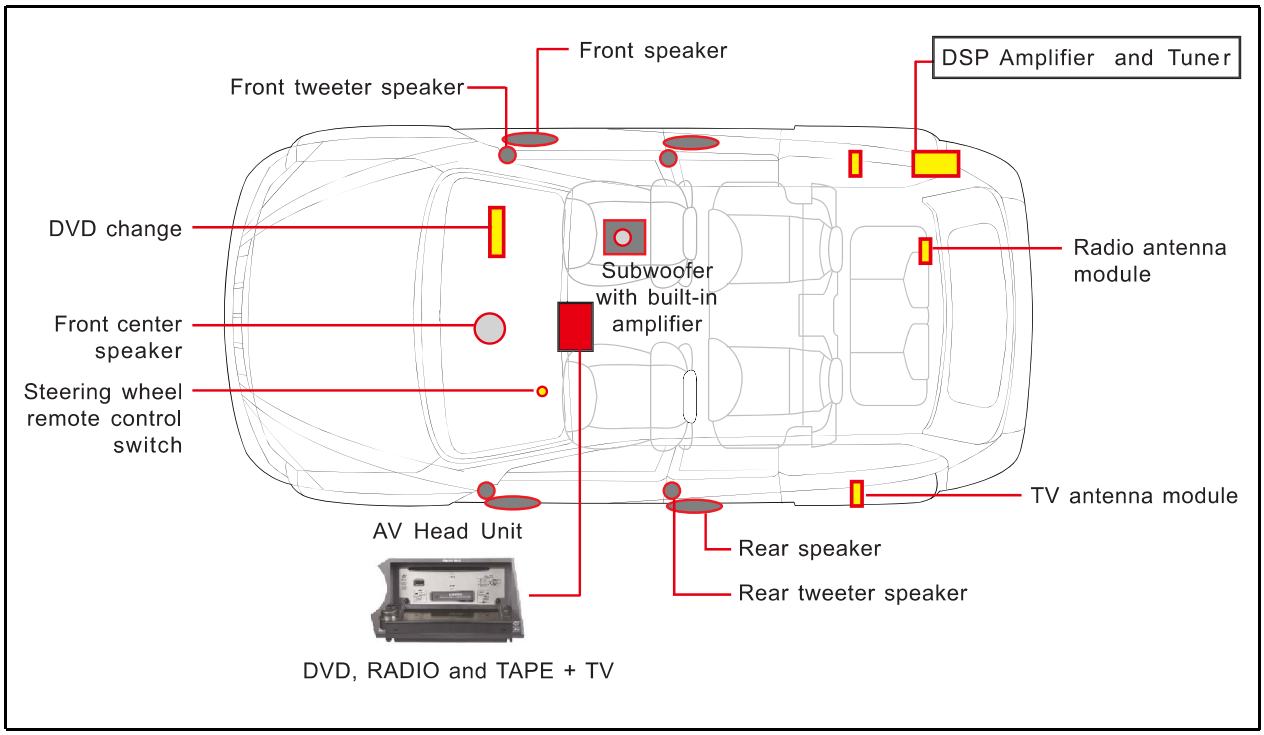
Subwoofer



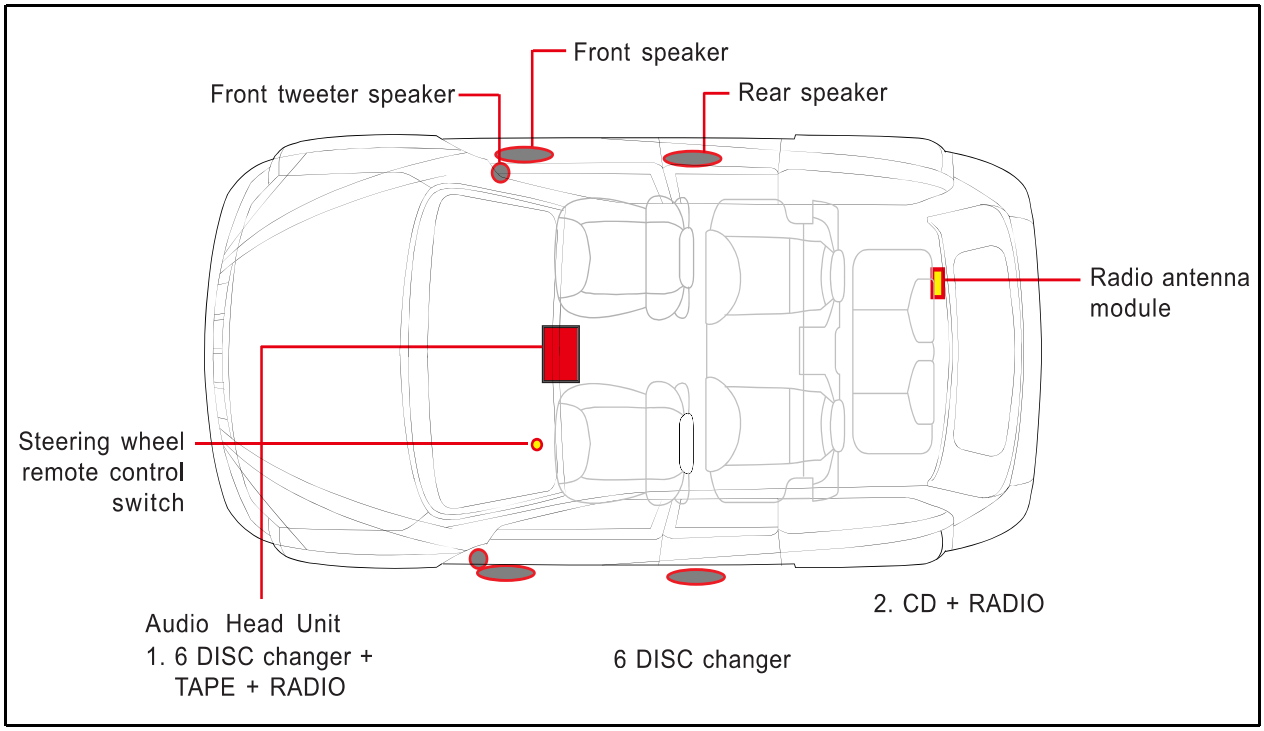
OVERVIEW AND OPERATION PROCESS

1. AV SYSTEM CONFIGURATION

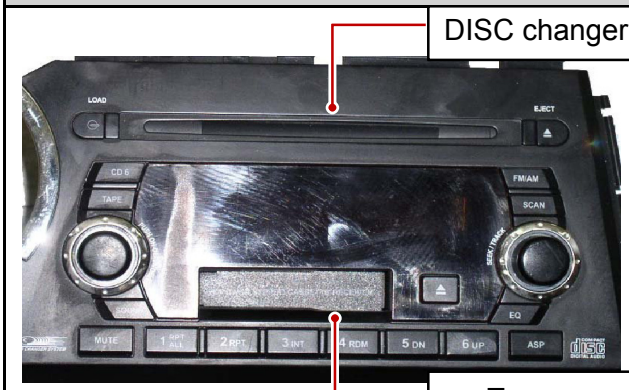
▶ AV System (DVD Head Unit + DVD Changer)



▶ Audio System - 6 Speakers



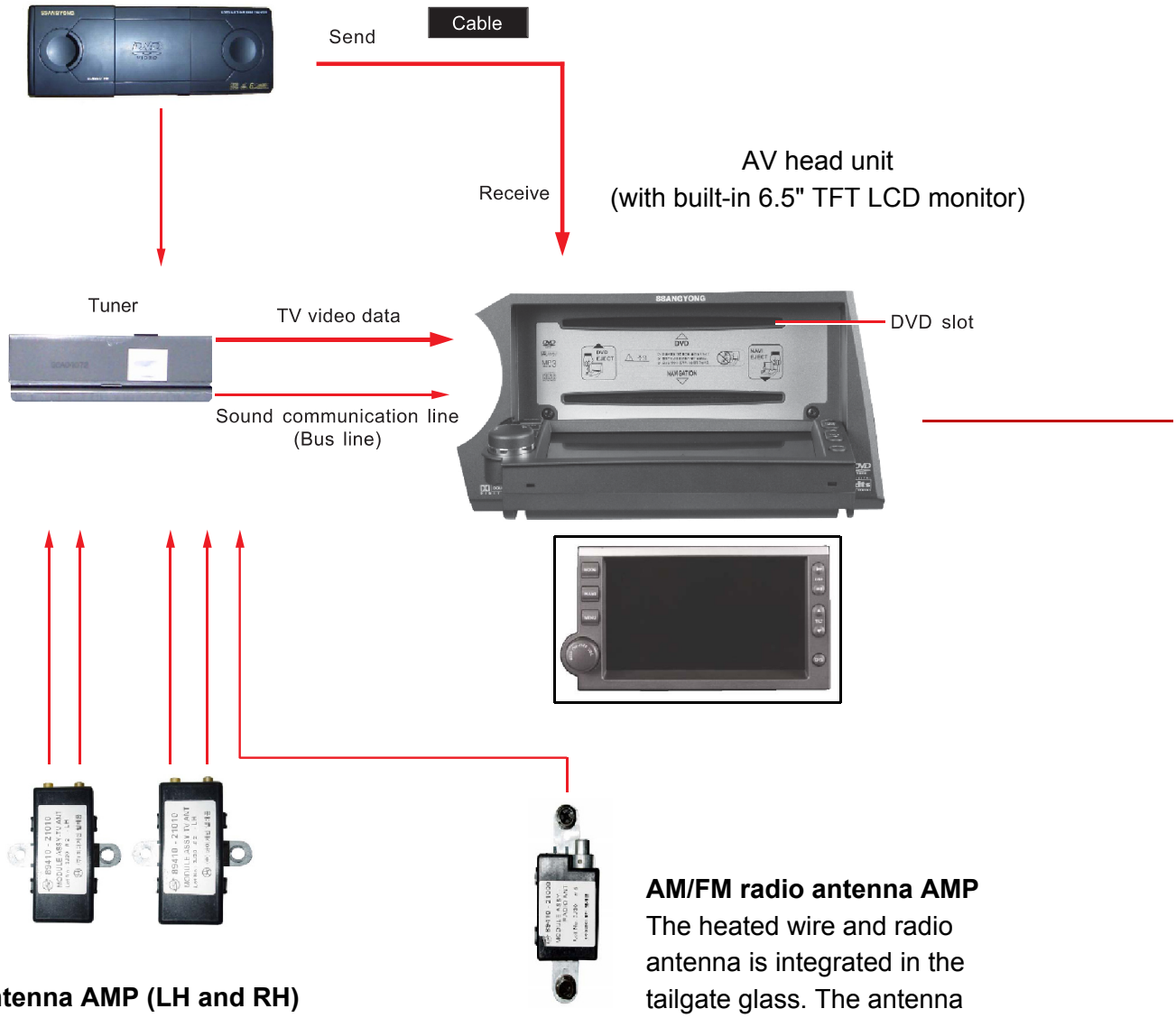
Modification basis	
Application basis	
Affected VIN	

6 DISC changer + TAPE + RADIO	CD + RADIO
	

2. AV HEAD SYSTEM CIRCULATION

DVD changer

It is installed in the center console. Audio signal of DVD changer outputs to corresponding speakers through the cable. Video signal is transmitted to the monitor of AV head unit.



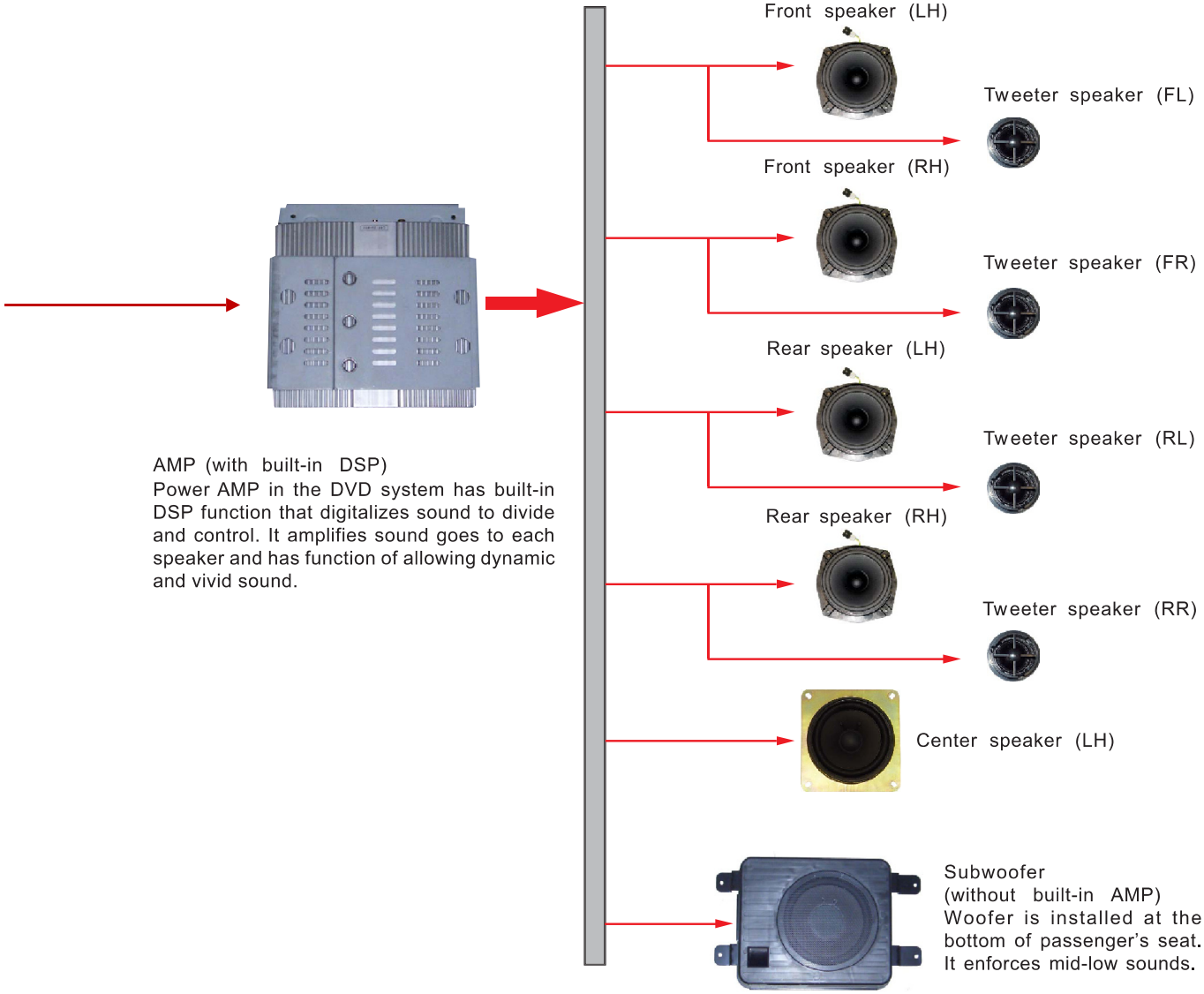
TV antenna AMP (LH and RH)

The glass antennas at both rear quarter glasses are to receive TV and AM radio (quarter RH glass) signals and transmits each 2-channel video and audio signals to tuner. Each AMP amplifies receives TV signals and then transmits to tuner.

AM/FM radio antenna AMP

The heated wire and radio antenna is integrated in the tailgate glass. The antenna transmits AM/ FM audio signals to tuner.

Modification basis	
Application basis	
Affected VIN	



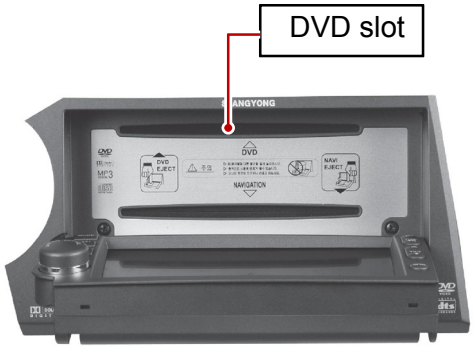
AMP (with built-in DSP)
Power AMP in the DVD system has built-in DSP function that digitalizes sound to divide and control. It amplifies sound goes to each speaker and has function of allowing dynamic and vivid sound.

Subwoofer
(without built-in AMP)
Woofer is installed at the bottom of passenger's seat. It enforces mid-low sounds.

3. AV SYSTEM FUNCTIONS

AV system head unit operates Radio, TV, Audio CD, DVD and Video CD.
The touch screen type 6.5" TFT LCD monitor is installed on the system.





①	Power ON/OFF, Volume control
②	AV replay, AV reset screen
③	Replay mode selection (briefly press), Current replay mode (press and hold)
④	Next channel (radio or TV) or next track (audio or video)
⑤	
⑥	The monitor moves to parking position when turning the ignition switch to OFF position. It moves to the preset position when turning the ignition switch to ON position again.

Display when turning on the monitor



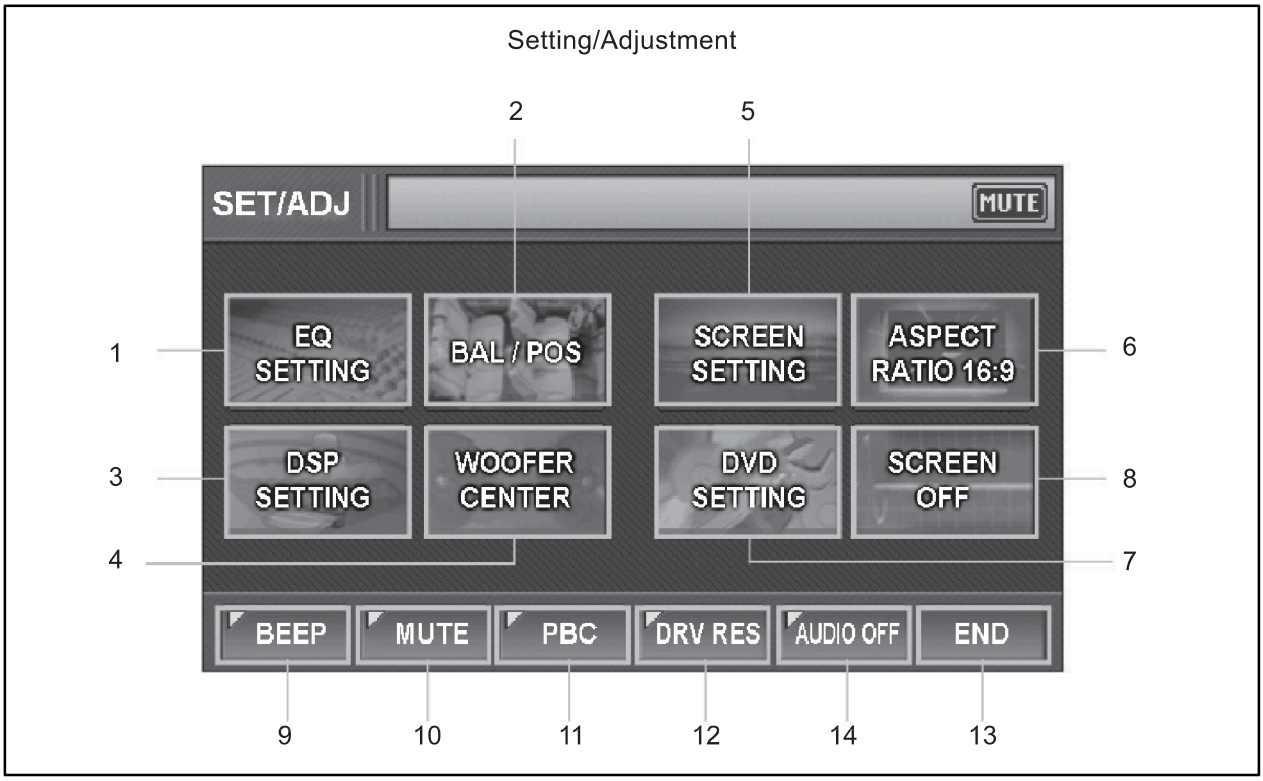
Modification basis	
Application basis	
Affected VIN	

4. AV SYSTEM SPECIFICATIONS AND CONTROL

Display	6.5 Wide TFT LCD Aspect ratio: Full/16x9/4:3 Touch screen key: Full touch
TV	Diversity Antenna with high reception performance Automatic station selection
Radio	Automatic station selection Station memory: 8 channels in each band (AM1, AM2, FM1, FM2)
DVD	Automatic replay: Audio CD, DVD title Playback control supported Sub woofer speakers
DVD Changer (option)	Install 6-discs in the magazine Automatic replay: Audio CD, DVD title
Others	DSP function, Equalizer function



▶ Function Settings on Touch Panel (Example)



1	Equalizer setting: Preset value, Treble/Medium/Bass
2	Balance setting
3	DSP (Digital Signal Process) setting
4	Volume control of sub woofer and center speakers
5	Screen setting: brightness, colors, gamma, contrast
6	Aspect ratio setting: 16:9/4:3/ZOOM1/ZOOM2
7	Initial screen setting of DVD title: sound, caption etc.
8	Turning OFF the screen (however, audio system still operates)
9	Turning OFF/ON the button operating sound (“Beep” sound)
10	Turning OFF/ON the speakers
11	Turning OFF/ON the PBC function
12	Turning OFF/ON the driving restriction
13	Moves to replay mode out from SET/ADJUSTMENT mode
14	Audio OFF

Modification basis	
Application basis	
Affected VIN	

Basic display

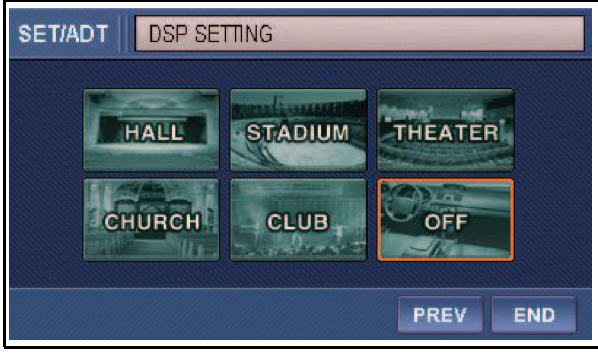


Turn the AV system ON.

Press "MODE" button to select a mode.

When pressing "RADIO" section on the screen, the "RADIO" mode screen is displayed.

DSP control

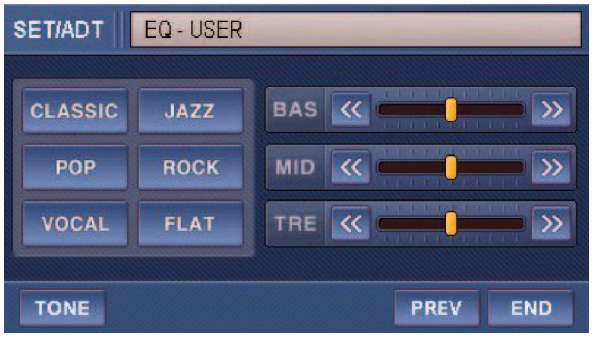


Selecting an acoustic perspective

Press "DSP SETTING" button in "SET/ADJ" screen and select one acoustic perspective (HALL, STADIUM, THEATER, CHURCH, CLUB).

Press "OFF" button to cancel the DSP function.

EQ control

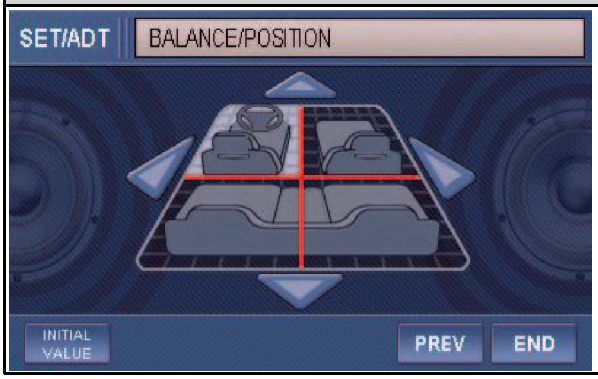


Adjusting the sound according to the music genre Press "EQ SETTING" button in "SET/ADJ" screen and adjust the sound.

To adjust the tone, press "TONE" button.

The tone can be adjusted by BAS/MID/TRE bars on the screen.

BALANCE/POSITION control



Adjusting the sound according to the seated position.

Press "BAL/POS" button in "SET/ADJ" screen and select a seat position (driver's, passenger's, rear seats, all seats) on the screen (Position setting).

To, adjust the balance, use the arrows on the screen.

* BALANCE function and POSITION function cannot be used simultaneously.

ION 4-SPEED

3410-01

GENERAL

1. SPECIFICATIONS

Description		Specifications	Remark
Gear ratios	1st	2.742	
	2nd	1.508	
	3rd	1.000	
	4th	0.708	
	Reverse	2.428	
	Final gear ratio	4.55	
Torque converter	Diamerter	260 (mm)	
	Number of element	3 EA	
	Number of Step	1 EA	
	Number of Phase	2 EA	
Transmission component	Planetary gear set	1 EA	
	One-way clutch	3 EA	
	Multi disc clutch	4 EA	
	Band brake	2 EA	
Weight	Including oil	76 kg	
Oil	Fluid specification	CASTROL TQ 95	
	Fluid capacity	Approx. 9.5 ℓ	
Resistance of oil temperature sensor	-20°C	13,638 ~ 17,287 Ω	
	0°C	5,177 ~ 6,616 Ω	
	20°C	2,278 ~ 2,723 Ω	
	100°C	177 ~ 196 Ω	
	135°C	75 ~ 85 Ω	
Resistance of gear position sensor	1 gear position	1.0 ~ 1.4 kΩ(1.0 V)	
	2 gear position	1.8 ~ 2.2 kΩ(1.5 V)	
	3 gear position	3.0 ~ 3.4 kΩ(2.0 V)	
	D gear position	4.5 ~ 4.9 kΩ(2.5 V)	
	N gear position	6.8 ~ 7.2 kΩ(3.0 V)	
	R gear position	10.8 ~ 11.2 kΩ(3.5 V)	
	P gear position	18.6 ~ 19.0 kΩ(4.0 V)	

Modification basis	
Application basis	
Affected VIN	

2. FASTENER TIGHTENING SPECIFICATIONS

Application	Nm	Lb-Ft	Lb-Ft
Adaptor Housing to Case Bolts	30 ~ 35	22 ~ 26	-
Cam Plate to Case (Parking Pawl) Screws	16 ~ 22	12 ~ 16	-
Centre Support to Case Bolts	20 ~ 27	15 ~ 20	-
Detent Spring Screw	20 ~ 22	15 ~ 16	-
Extension Housing to Case Bolts	54 ~ 68	40 ~ 50	-
Front Propeller Shaft Bolts	70 ~ 80	52 ~ 59	-
Inhibitor Switch to Case Bolts	4 ~ 6	-	35 ~ 53
Oil Cooler Pipes	40 ~ 45	29 ~ 33	-
Oil Pan to Case Bolts	4 ~ 6	-	35 ~ 53
On/Off Solenoid valve Retainer Screws	8 ~ 12	-	71 ~ 106
Output Flange Nuts	35	26	-
Pump Cover Plate to Crescent Screw	13 ~ 16	10 ~ 12	-
Pump Cover Plate to Pump Cover Screws	13 ~ 16	10 ~ 12	-
Pump Cover to Case Bolts	24 ~ 34	18 ~ 25	-
Pump to Pump Cover Bolts	24 ~ 27	18 ~ 20	-
Rear Propeller Shaft Bolts	70 ~ 80	52 ~ 59	-
Rear Servo Cover to Case Bolts	30 ~ 35	22 ~ 26	-
TCM Mounting Bolt	10	-	89
Torque Converter Housing to Case Bolts	54 ~ 68	40 ~ 50	-
Torque Converter Mounting Bolts	42	31	-
Transfer Case to Transmission Housing Bolts	35 ~ 60	26 ~ 44	-
Transmission Filler Plug	30 ~ 35	22 ~ 26	-
Upper Valve Body to Lower Valve Body Screws	11 ~ 16	8 ~ 12	-
Valve Body To Case Bolts	8 ~ 13	-	71 ~ 115
Variable Pressure Solenoid valve (S5) Retainer Screw	8 ~ 12	-	71 ~ 106

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. DESCRIPTION AND OPERATION OF AUTOMATIC TRANSMISSION

The ION (BTR) Four Speed Automatic Transmission is an electronically controlled overdrive four speed unit with a lock-up torque converter. The lock-up torque converter results in lower engine speeds at cruise and eliminates unnecessary slippage. These features benefit the customer through improved fuel economy and noise reduction.

Of primary significance is the Transmission Control Module (TCU) which is a microprocessor based control system.

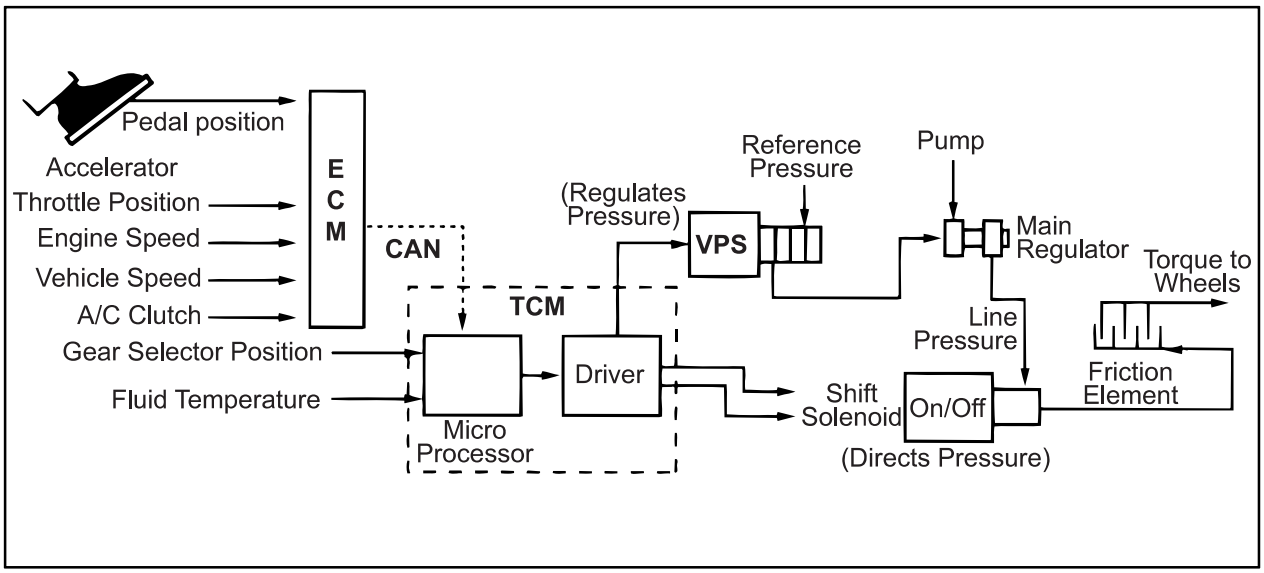
	Max. Power (kW)	Configuration
320	160	260 mm Torque Converter-Wide Ratio Gear Set Splined Output for Transfer Case

The TCU utilizes throttle position, rate of throttle opening, engine speed, vehicle speed, transmission fluid temperature, gear selector position and mode selector inputs, and in some applications a Kickdown Switch to control all shift feel and shift schedule aspects.

The TCU drives a single proportional solenoid multiplexed to three regulator valves to control all shift feel aspects. The output pressure of this solenoid is controlled as a function of transmission fluid temperature to maintain consistent shift feel throughout the operating range.

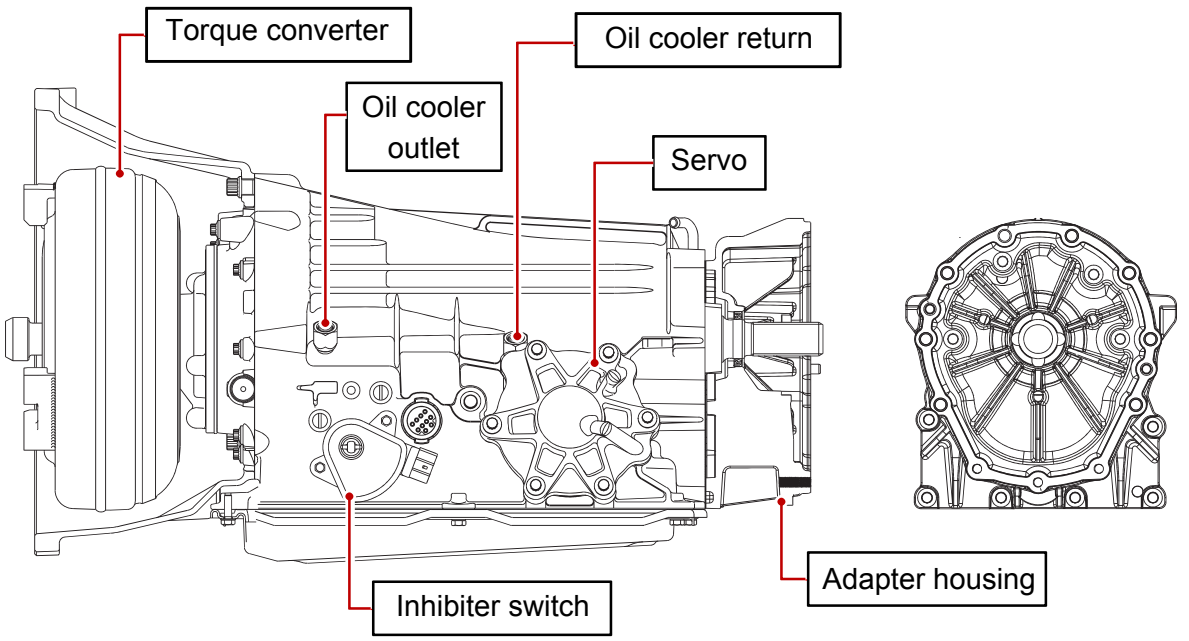
Shift scheduling is highly flexible, and several independent schedules are programmed depending on the vehicle.

Typically the NORMAL schedule is used to maximize fuel economy and driveability, and a POWER schedule is used to maximize performance. WINTER schedule is used to facilitate starting in second gear.

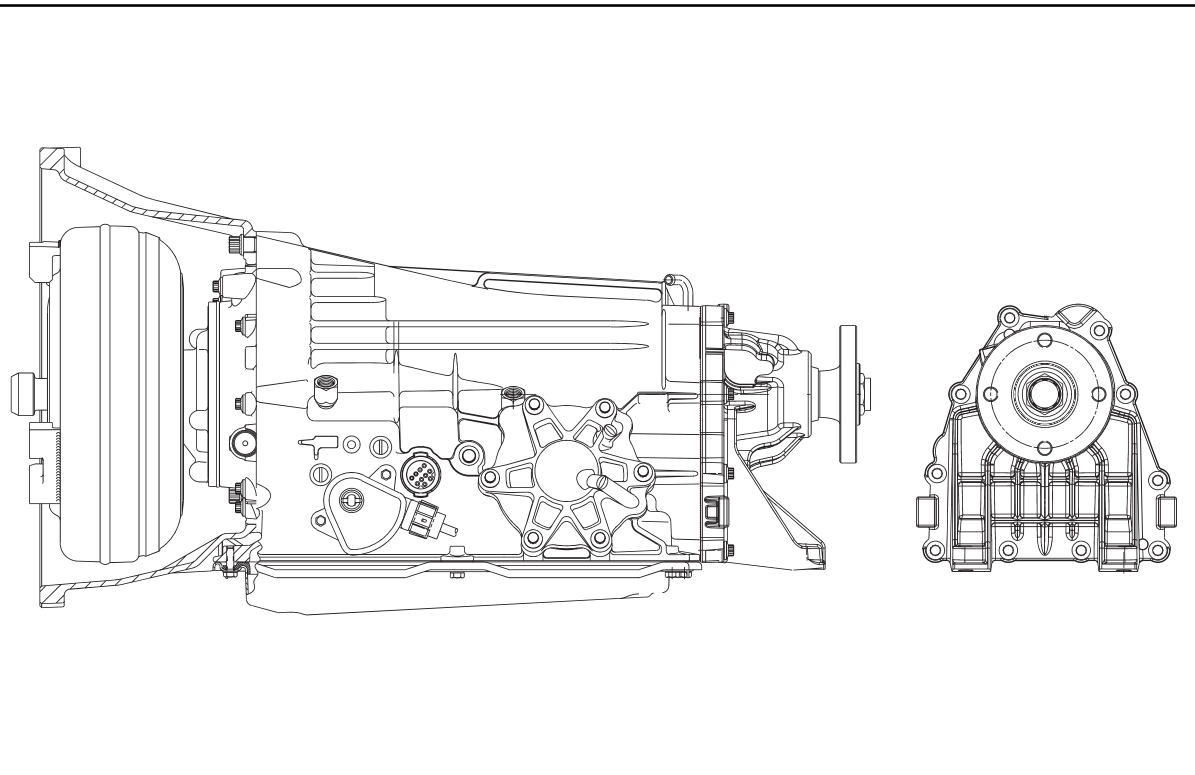


2. APPEARANCE

1) 4WD Automatic Transmission



2) 2WD Automatic Transmission



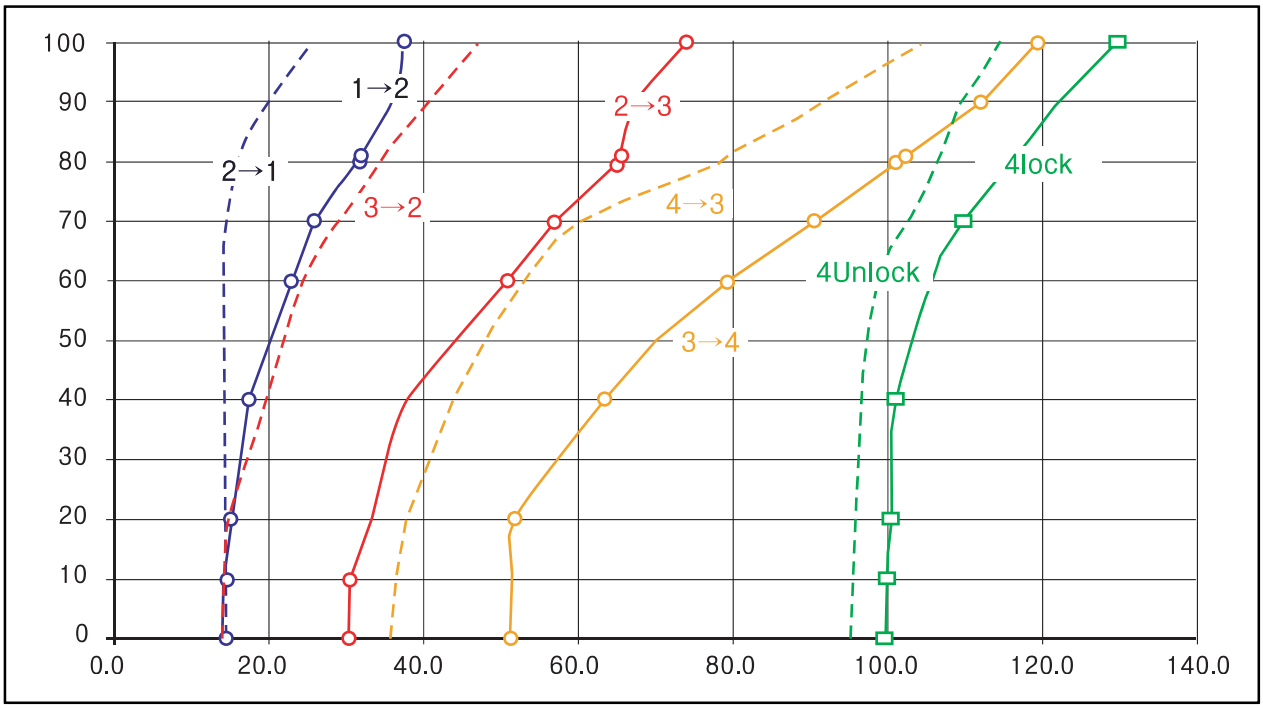
Modification basis	
Application basis	
Affected VIN	

3. SHIFT PATTERN DIAGRAM

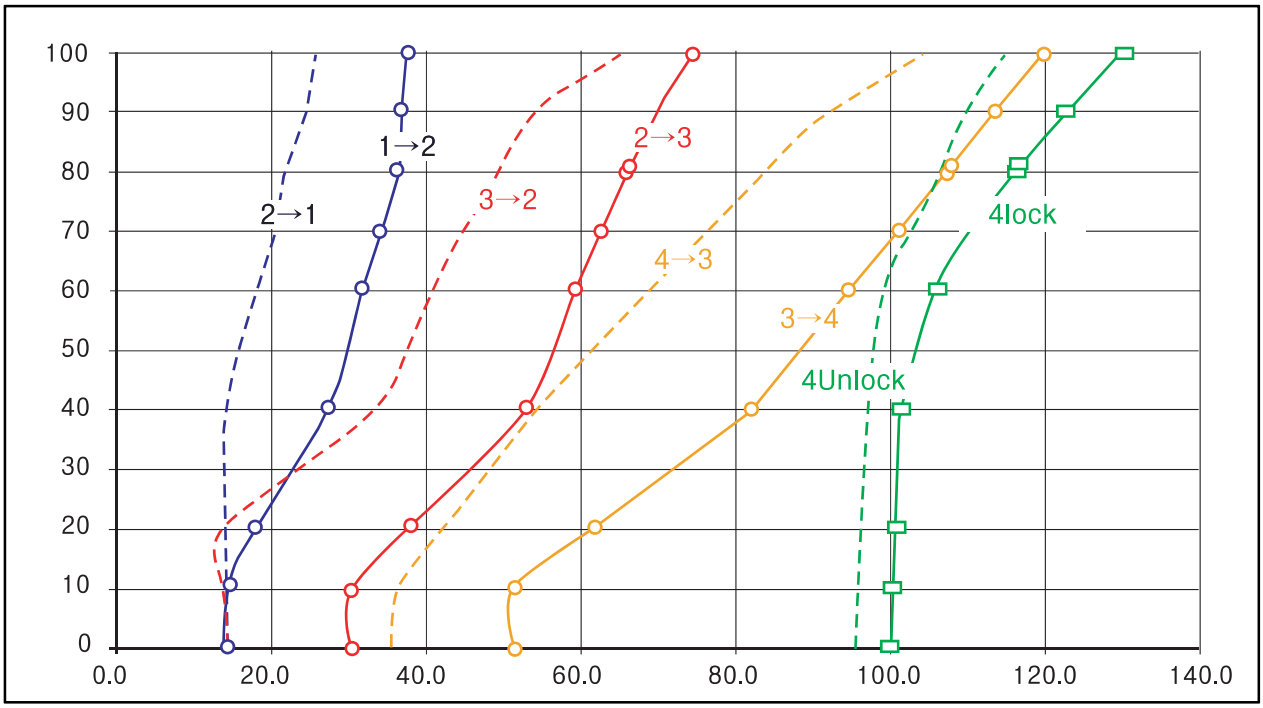
1) Normal Mode

CAUTION

- WINTER mode has same shift pattern with NORMAL mode except 2nd gear drive-off.



2) Power Mode



Modification basis	
Application basis	
Affected VIN	

4. OPERATORS INTERFACES

There are three operator interfaces as the following

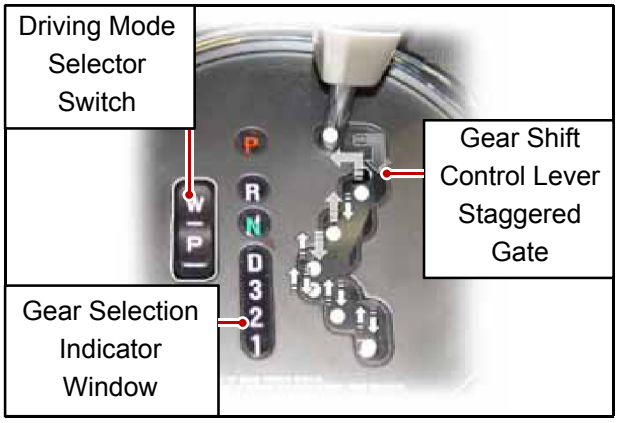
- Gear Shift Control Lever
- Driving Mode Selector
- Indicator Light

1) Gear Shift Control Lever

The transmission uses a conventional shift control lever.
The gear shift control lever can be moved from one position to another within the staggered configuration of the shift control lever gate to positively indicate the gear selection.

- P - Park position prevents the vehicle from rolling either forward or backward by locking the transmission output shaft. The inhibitor switch allows the engine to be started. For safety reasons, the parking should be used in addition to the park position. Do not select the Park position until the vehicle comes to a complete stop because it mechanically locks the output shaft.
- R - Reverse allows the vehicle to be operated in a rearward direction. The inhibitor switch enables reverse lamp operation.
- N - Neutral allows the engine to be started and operated while driving the vehicle. The inhibitor switch allows the engine to be started. There is no power transferred through the transmission in Neutral. But the final drive is not locked by the parking pawl, so thewheels are free to rotate.
- D - Overdrive range is used for all normal driving conditions. 4th gear (overdrive gear) reduces the fuel consumption and the engine noise. Engine braking is applied with reduced throttle.
  First to second (1 → 2), first to third (1 → 3), second to third (2 → 3), second to fourth (2 → 4), third to fourth (3 → 4), fourth to third (4 → 3), fourth to second (4 → 2), third to second (3 → 2), third to first (3 → 1) and second to first (2 → 1) shifts are all available as a function of vehicle speed, throttle position and the time change rate of the throttle position.
  Downshifts are available for safe passing by depressing the accelerator. Lockup clutch may be enabled in 3rd and 4th gears depending on vehicle type.
- 3 - Manual 3 provides three gear ratios (first through third) and prevents the transmission from operating in 4th gear. 3rd gear is used when driving on long hill roads or in heavy city traffic. Downshifts are available by depressing the accelerator.
- 2 - Manual 2 provides two gear ratios (first and second). It is used to provide more power when climbing hills or engine braking when driving down a steep hill or starting off on slippery roads.
- 1 - Manual 1 is used to provide the maximum engine braking when driving down the severe gradients.

Modification basis	
Application basis	
Affected VIN	



2) Driving Mode Selector

The driving mode selector consists of a driving mode selector switch and indicator light. The driving mode selector is located on the center console and allows the driver to select the driving mode.

The driving modes available to be selected vary with vehicle types. Typically the driver should have the option to select among NORMAL, POWER and WINTER modes.

When NORMAL mode is selected upshifts will occur to maximize fuel economy. When POWER mode is selected, upshifts will occur to give maximum performance and the POWER mode indicator light is switched ON.

When WINTER mode is selected, starting in second gear is facilitated, the WINTER mode indicator light is switched ON and the POWER mode indicator light is switched OFF.

3) Indicator Light

The indicator light is located on the instrument panel.

- Auto shift indicator light comes ON when the ignition switch ON and shows the gear shift control lever posi-tion.
- POWER mode indicator light comes ON when the POWER mode is selected and when the kickdown switch is depressed.
- WINTER mode indicator light comes ON when the WINTER mode is selected.

5. CONTROL SYSTEMS

BTRA M74 4WD automatic transmission consists of two control systems. One is the electronic control system that monitors vehicle parameters and adjusts the transmission performance. Another is the hydraulic control system that implements the commands of the electronic control system commands.

6. ELECTRONIC CONTROL SYSTEM

The electronic control system comprises of sensors, a TCU and seven solenoids. The TCU reads the inputs and activates the outputs according to values stored in Read Only Memory (ROM).

The TCU controls the hydraulic control system. This control is via the hydraulic valve body, which contains seven electromagnetic solenoids. Six of the seven solenoids are used to control the line pressure, operate the shift valves and the torque converter lock-up clutch, and to turn ON and OFF the two regulator valves that control the shift feel.

The seventh solenoid is the proportional or Variable Pressure Solenoid (VPS) which works with the two regulator valves to control shift feel.

1) Transmission Control Module (TCU)

The TCU is an in-vehicle micro-processor based transmission management system. It is mounted under the driver's side front seat in the vehicle cabin.

The TCU contains :

- Processing logic circuits which include a central microprocessor controller and a back-up memory system.
- Input circuits.
- Output circuits which control external devices such as the Variable Pressure Solenoid (VPS) driver, On/ Off solenoid drivers, a diagnostics output and the driving mode indicator light.

Modification basis	
Application basis	
Affected VIN	

2) Processing Logic

Shift schedule and calibration information is stored in an Erasable Programmable Read Only Memory (EPROM).

Throttle input calibration constants and the diagnostics information are stored in Electrically Erasable Programmable Read Only Memory (EEPROM) that retains the memory even when power to the TCU is disconnected.

TCU continuously monitors the input values and uses these, via the shift schedule, to determine the required gear state. At the same time it monitors, via the solenoid outputs, the current gear state, whenever the input conditions change such that the required gear state is different to the current gear state, the TCU initiates a gear shift to bring the two states back into line.

Once the TCU has determined the type of gearshift required the TCU accesses the shift logic, estimates the engine torque output, adjusts the variable pressure solenoid ramp pressure then executes the shift.

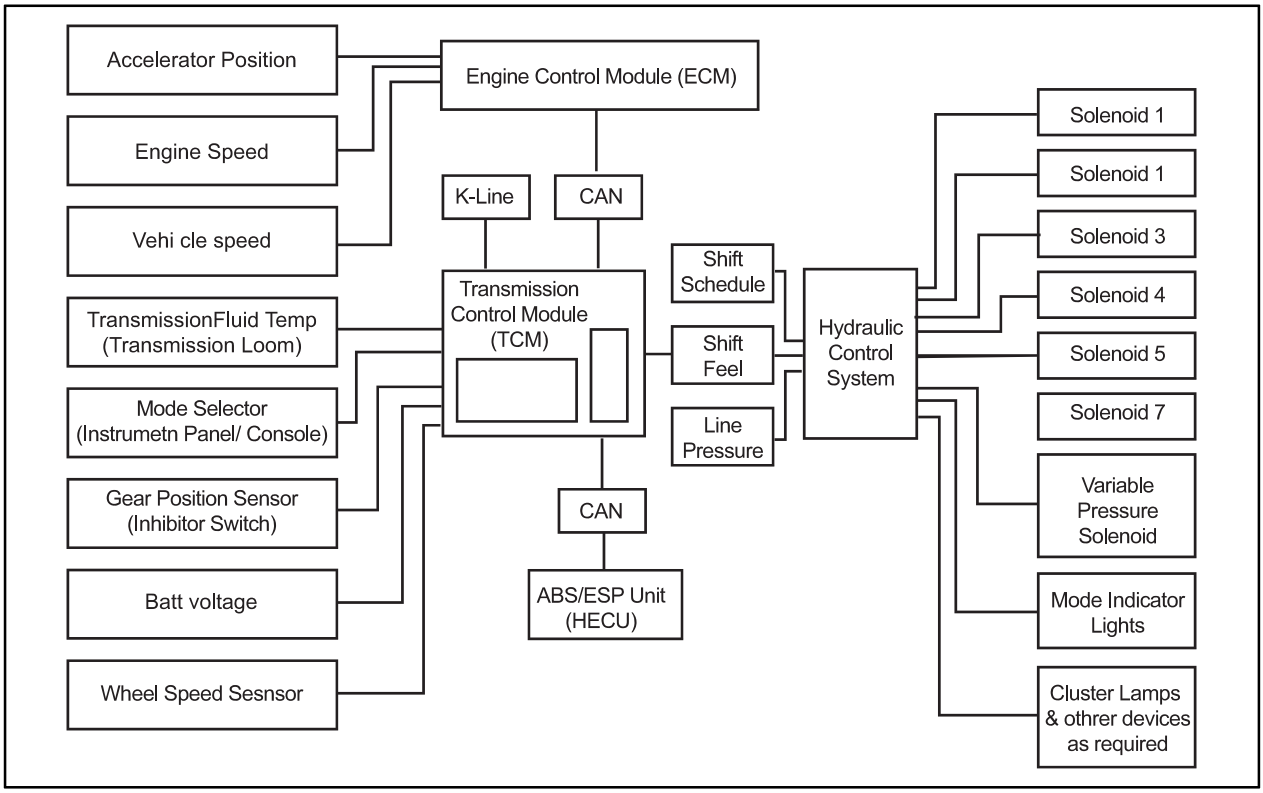
The TCU continuously monitors every input and output circuit for short or open circuits and operating range.

When a failure or abnormal operation is detected the TCU records the condition code in the diagnostics memory and implements a Limp Home Mode (LHM).

The actual limp home mode used depends upon the failure detected with the object to maintain maximum driveability without damaging the transmission. In general input failures are handled by providing a default value.

Output failures, which are capable of damaging the transmission, result in full limp mode giving only third or fourth gear and reverse. For further details of limp modes and memory retention refer to the Diagnostic Trouble Code Diagnosis Section.

The TCU is designed to operate at ambient temperatures between - 40 and 85°C (- 40 and 185°F). It is also protected against electrical noise and voltage spikes, however all the usual precautions should be observed, for example when arc welding or jump starting.



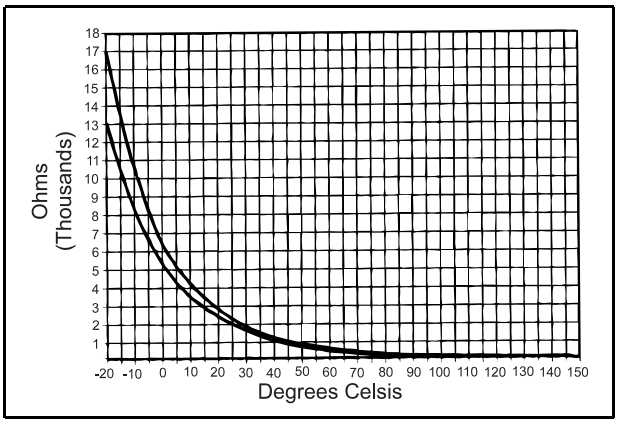
3) TCU Inputs

To function correctly, the TCU requires engine speed, vehicle speed, transmission fluid temperature, throttle position, gear position and Kickdown Switch inputs to determine the variable pressure solenoid current ramp and on/off solenoid states. This ensures the correct gear selection and shift feel for all driving conditions.

The inputs required by the TCU are as follows :

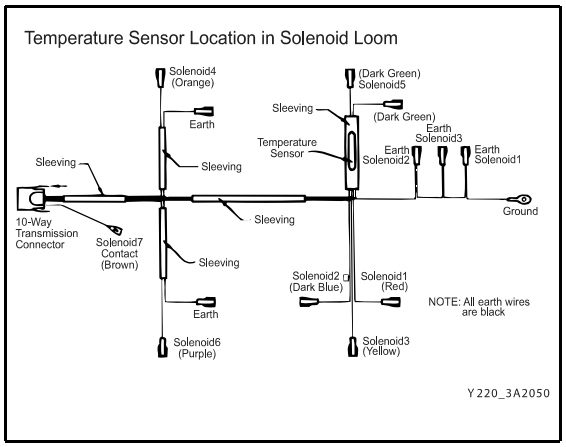
- Engine Speed The engine speed signal is derived from the Controller Area Network (CAN) via Engine Control Module (ECM).
- Vehicle Speed The vehicle speed sensor, which is located in the transfer case, sends the output shaft speed signal to the Engine Control Module (ECM). The information is then transferred to the TCU via the CAN.
- Transmission Fluid Temperature The transmission fluid temperature sensor is a thermistor located in the solenoid wiring loom within the valve body of the transmission. This sensor is a typical Negative Temperature Coefficient (NTC) resistor with low temperatures producing a high resistance and high temperatures producing a low resistance.
  If the transmission fluid temperature exceeds 135°C (275°F), the TCU will impose converter lock-up at lower vehicle speeds and in some vehicles flashes the mode indicator light. This results in maximum oil flow through the external oil cooler and eliminates slippage in the torque converter. Both these actions combine to reduce the oil temperature in the transmission.

Modification basis	
Application basis	
Affected VIN	



Temperature (°C)	Resistance (Ohms)	
	Minimum	Maximum
-20	13,638	17,287
0	5,177	6,616
20	2,278	2, 723
100	117	196
135 (Overheat Mode Threshold)	75	85

▶ **Pin No. Codes and colors in Solenoid Loom**

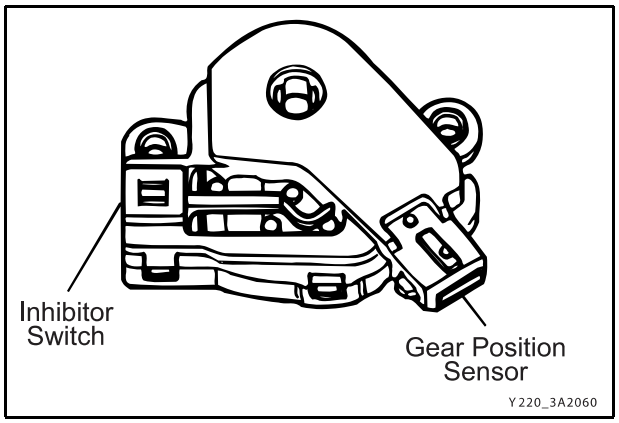


Pin No.	Wire Color	Connects to
1	Red	Solenoid 1
2	Blue	Solenoid 2
3	Yellow	Solenoid 3
4	Orange	Solenoid 4
5	Green	Solenoid 5
6	Violet	Solenoid 6
7	Brown	Solenoid 7
8	Green	Solenoid 5
9	White	Temperature Sensor
10	White	Temperature Sensor

4) Gear Position Sensor

The gear position sensor is incorporated in the inhibitor switch mounted on the side of the transmission case.

The gear position sensor is a multi-function switch providing three functions:



- Inhibit starting of the vehicle when the shift lever is in a position other than Park or Neutral
- Illuminate the reverse lamps when Reverse is selected
- Indicate to the TCU which lever position has been selected by way of a varying resistance.

Modification basis	
Application basis	
Affected VIN	

Readings for Resistance / Shift Lever Positions

Shift Lever Position	Resistance (kΩ)
Manual 1	1 ~ 1.4
Manual 2	21.8 ~ 2.2
Manual 3	3 3 ~ 3.4
Drive	4.5 ~ 4.9
Neutral	6.8 ~ 7.2
Reverse	10.8 ~ 11.2
Park	18.6 ~ 19

5) Diagnostic Inputs

The diagnostic control input or K-line is used to initiatethe outputting of diagnostic data from the TCU to a diagnostic test instrument. This input may also be used to clear the stored fault history data from the TCU's retentive memory. Connection to the diagnostic input of the TCU is via a connector included in the vehicle's wiring harness or computer interface.

6) Battery Voltage Monitoring Input

The battery voltage monitoring input is connected to the positive side of the battery. This signal is taken from the main supply to the TCU.

If the battery voltage at the TCU falls below 11.3 V, the transmission will adopt a low voltage mode of operating in which shifts into first gear are inhibited. All other shifts are allowed but may not occur because of the reduced voltage. This condition normally occurs only when the battery is in poor condition.

If the battery voltage is greater than 16.5 V, the transmission will adopt limp home mode and all solenoids are turned OFF.

When system voltage recovers, the TCU will resume normal operation after a 30 seconds delay period.

7) TCU Outputs

The outputs from the TCU are supplied to the components described below :

- Solenoids
- Mode Indicator Light

8) Solenoids

The TCU controls seven solenoids. Solenoids 1 to 6 (S1 to S6) are mounted in the valve body, while Solenoid 7 (S7) is mounted in the pump cover.

- Solenoid 1 and 2: S1 and S2 are normally open ON/ OFF solenoids that set the selected gear. These solenoids determine static gear position by operating the shift valves. Note that S1 and S2 solenoids also send signal pressure to allow or prohibit rear band engagement.
- Solenoid 3 and 4: S3 and S4 are normally open ON/ OFF solenoids that combine to control shift quality and sequencing. S3 switches the clutch regulator valve OFF or ON. S4 switches the front band regulator valve OFF or ON. S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 5: S5 is a variable pressure solenoid that ramps the pressure during gear changes. This solenoid provides the signal pressure to the clutch and band regulator, thereby controlling the shift pressures.
  S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 6: S6 is a normally open ON/OFF solenoid that sets the high/low level of line pressure. Solenoid OFF gives high pressure.
- Solenoid 7: S7 is a normally open ON/OFF solenoid that controls the application of the converter clutch.
  Solenoid ON activates the clutch.

Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

Modification basis	
Application basis	
Affected VIN	

▶ Solenoid Operation during Gearshifts

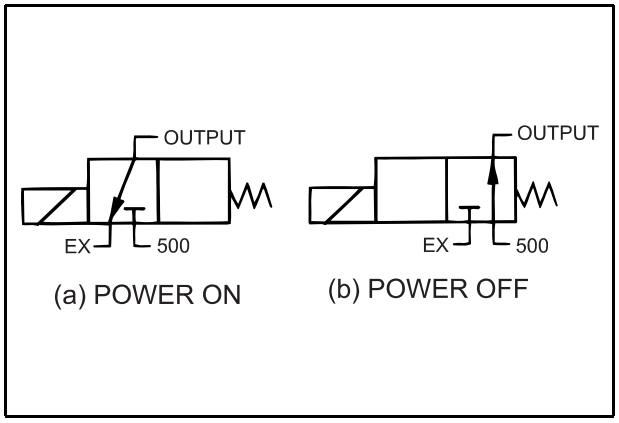
Shift	To Initiate Shift	Typical S5 Current Ramp	To Complete Shift
1-2	S1 OFF S4 ON	750 mA to 600 mA	S4 OFF
1-3	S1 OFF S2 OFF S3 ON S4 ON	850 mA to 750 mA	S3 OFF S4 OFF
1-4	S2 OFF S3 ON S4 ON	850 mA to 750 mA	S3 OFF S4 OFF
2-3	S2 OFF S3 ON S4 ON	700 mA to 500 mA	S3 OFF S4 OFF
3-4	S1 ON S4 ON	750 mA to 600 mA	S4 OFF
4-3	S4 ON	750 mA to 900 mA	S1 OFF S4 OFF
4-2	S3 ON	750 mA to 950 mA	S1 OFF S2 ON S3 OFF
4-1	S3 ON S4 ON	600 mA to 1000 mA	S2 ON S3 OFF S4 OFF
3-2	S2 ON S4 ON	600 mA to 450 mA @ 20 kph. 550 mA to 400 mA @ 60 kph. 800 mA to 650 mA @ 100 kph.	S4 OFF
3-1	S3 ON S4 ON		S1 ON S2 ON S3 OFF
2-1	S4 ON	700 mA to 950 mA 800 mA to 950 mA	S4 OFF S1 ON S4 OFF
Conv. Clutch			
ON	S7 ON	700 mA to 400 mA	S7 OFF
OFF		600 mA to 100 mA	

▶ Solenoid valve symbols (ON/OFF solenoids)

The solenoid symbol shown adjacent to each solenoid on the hydraulic system schematics indicates the state of the oil flow through the solenoid valve with the power ON or OFF.

▶ Normally open (NO) solenoid

POWER ON: Line 500 port is closed. The output port is open to exhaust at the solenoid valve.
POWER OFF: The exhaust port is closed. The output port is open to line 500.



▶ Variable pressure solenoid multiplexing system

Friction element shifting pressures are controlled by the Variable Pressure Solenoid (VPS).
Line pressure is completely independent of shift pressure and is a function of throttle position, gear state and engine speed.
S5 is a proportional or variable pressure solenoid that provides the signal pressure to the clutch and band regulator valves thereby controlling shift pressures.
VPS pressure is multiplexed to the clutch regulator valve, the band regulator valve and the converter clutch regulator valve during automatic gearshifts.
A variable pressure solenoid produces a hydraulic pressure inversely proportional to the current applied. During a gearshift the TCU applies a progressively increasing or decreasing (ramped) current to the solenoid. Current applied will vary between a minimum oaf 200 mA and a maximum of 1000 mA. Increasing current decreases output (S5) pressure. Decreasing current increases output (S5) pressure.
Line 500 pressure, (approximately 440 to 560 kPa), is the reference pressure for the VPS, and the VPS output pressure is always below line 500 pressure.

Modification basis	
Application basis	
Affected VIN	

When the VPS is at standby, that is no gearshift is taking place, the VPS current is set to 200 mA giving maximum output pressure.
Under steady state conditions the band and clutch regulator valve solenoids are switched OFF. This applies full Line 500 pressure to the plunger and because Line 500 pressure is always greater than S5 pressure it squeezes the S5 oil out between the regulator valve and the plunger. The friction elements are then fed oil pressure equal to Line 500 multiplied by the amplification ratio.
When a shift is initiated the required ON/OFF solenoid is switched ON cutting the supply of Line 500 to the plunger.
At the same time the VPS pressure is reduced to the ramp start value and assumes control of the regulator valve by pushing the plunger away from the valve. The VPS then carries out the required pressure ramp and the timed shift is completed by switching OFF the ON/ OFF solenoid and returning the VPS to the standby pressure.
This system enables either the band or clutch or both to be electrically controlled for each gearshift.

▶ **Mode indicator light**

Depending on the application, the mode indicator light may be used to indicate the mode that has been selected or if an overheat condition exists. The mode indicator light is usually located on the instrument cluster.

9) Communication Systems

(1) CAN

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCU obtains the actual engine speed and throttle position, vehicle speed and accelerator position etc. from ECM via CAN without any additional sensors.

(2) K-Line

The K-line is typically used for obtaining diagnostic information from the TCU. A scan tool with a special interface is connected to the TCU via Data Link Connector (DLC) and all current faults, stored faults, runtime parameters are then available. The stored trouble codes can also be cleared by scan tool.
The K-line can be used for vehicle coding at the manufacturer's plant or in the workshop. This allows for one TCU design to be used over different vehicle mod-els.
The particular code is sent to the microprocessor via the K-line and this results in the software selecting the correct shift and VPS ramp parameters.

7. HYDRAULIC CONTROL SYSTEM

The hydraulic controls are located in the valve body, pump body and main case.

The valve body contains the following :

- Manual valve
- Three shift valves
- Sequence valve
- Solenoid supply pressure regulator valve
- Line pressure control valve
- Clutch apply feed regulator valve
- Band apply feed regulator valve
- Solenoid S1 to S6
- Reverse lockout valve

The pump cover contains the following :

- Primary regulator valve for line pressure
- Converter clutch regulator valve
- Converter clutch control valve
- Solenoid S7

The main case contains the following :

- B1R exhaust valve

All upshifts are accomplished by simultaneously switching on a shift valve(s), switching VPS pressure to the band and/or clutch regulator valve, and then sending the VPS a ramped current. The shift is completed by switching the regulators OFF and at the same time causing the VPS to reach maximum pressure.

All downshifts are accomplished by switching VPS pressure to the band and/or clutch regulator valve and sending a ramped current to the VPS. The shift is completed by simultaneously switching the regulators OFF, switching the shift valves and at the same time causing the VPS to return to stand-by pressure.

The primary regulator valve is located in the pump cover and supplies four line pressures; high and low for forward gears, and high and low for reverse. This pressure has no effect on shift quality and merely provides static clutch capacity during steady state operation. Low pressure can be obtained by activating an ON/OFF solenoid with high line pressure being the default mode.

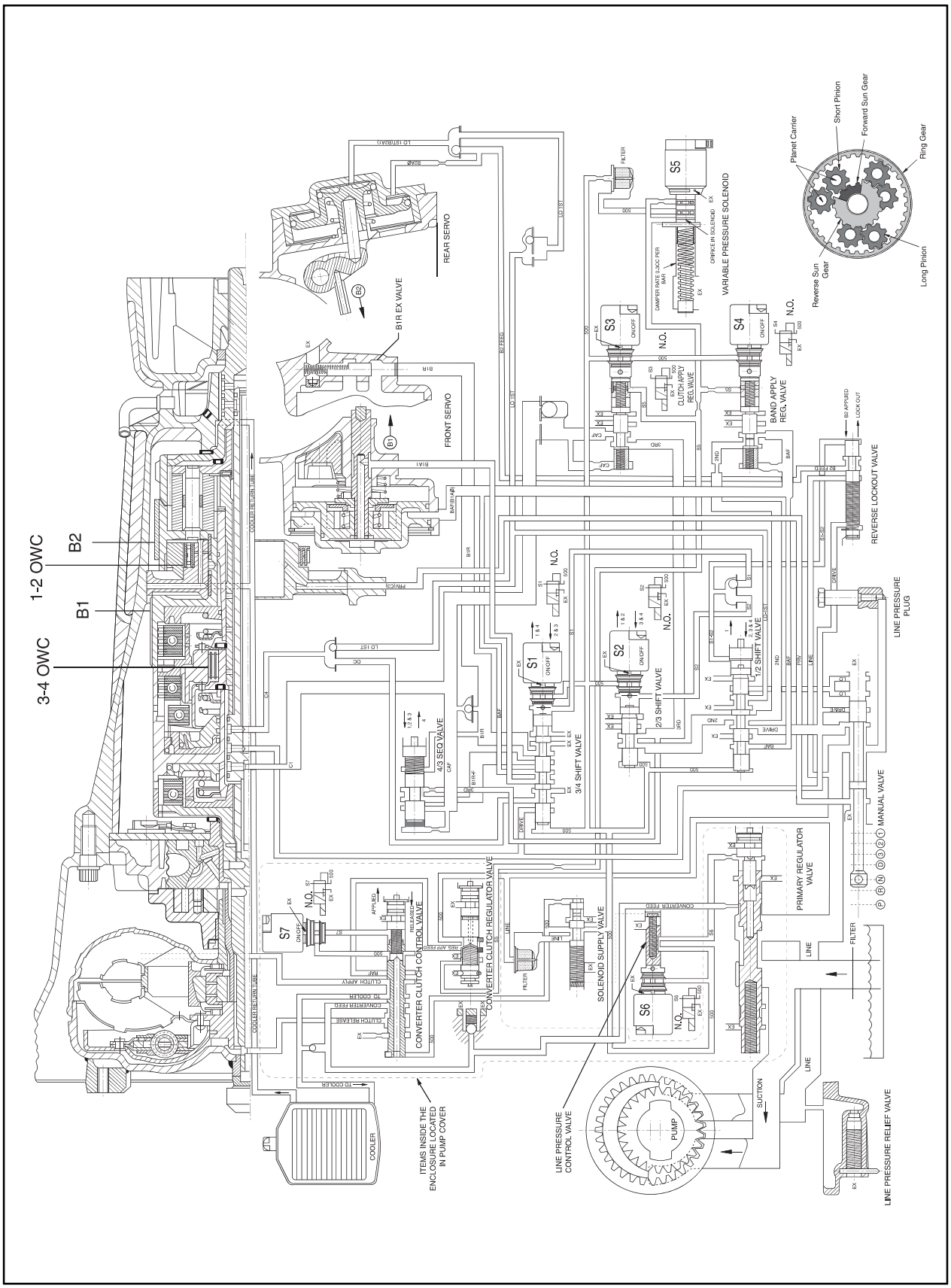
Torque converter lock-up is initiated by toggling the converter clutch control valve with an ON/OFF solenoid.

The actual apply and release of the clutch is regulated by the VPS via the converter clutch regulator valve.

The solenoid supply pressure regulator valve provides reference pressure for all the solenoids.

Modification basis	
Application basis	
Affected VIN	

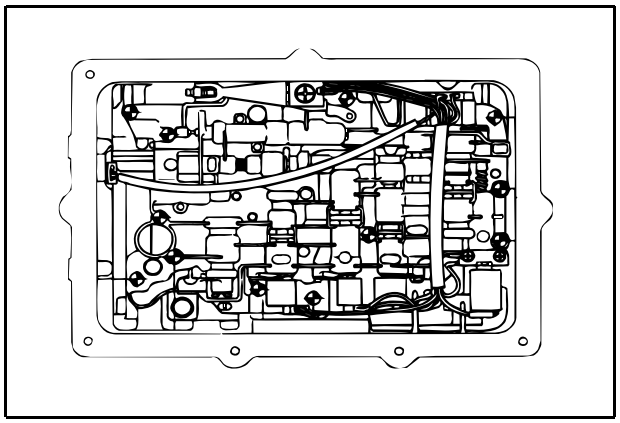
1) Hydraulic Control Circuit

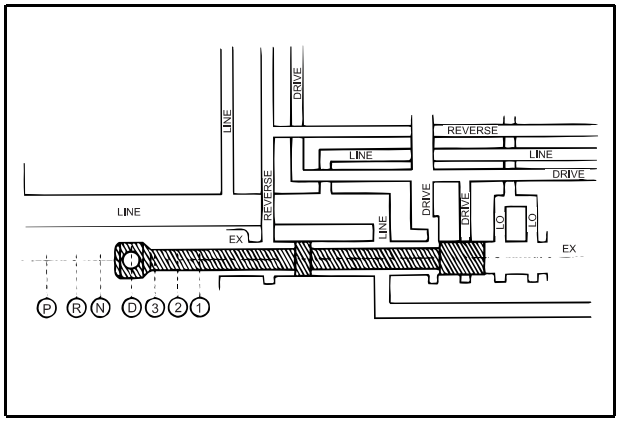


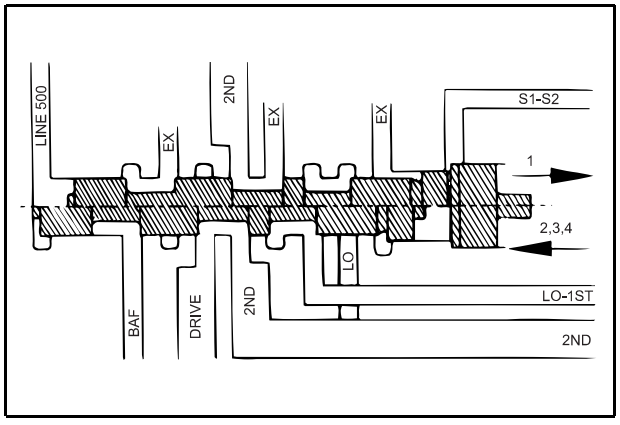
Modification basis	
Application basis	
Affected VIN	

2) Hydraulic Components

(1) Valve Body







▶ Manual valve

The manual valve is connected to the vehicle selector mechanism and controls the flow of oil to the forward and reverse circuits. The manual valve function is identical in all forward gear positions except that in the Manual 1 position an additional supply of oil is directed to the 1- 2 shift valve for application of the rear band and the C4 overrun clutch. The manual valve directs the line pressure into the PRND fluid circuits.

▶ 1-2 shift valve

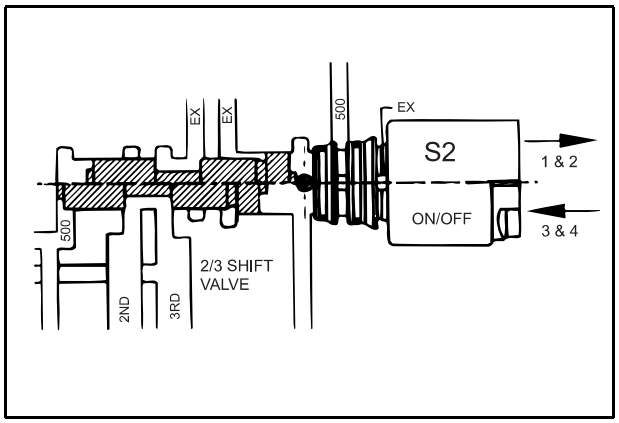
The 1-2 shift valve is a two position valve that must be switched to the 2, 3 and 4 position in order to get any forward gear other than first gear. It is used for all 1-2 and 2-1 gearshifts.

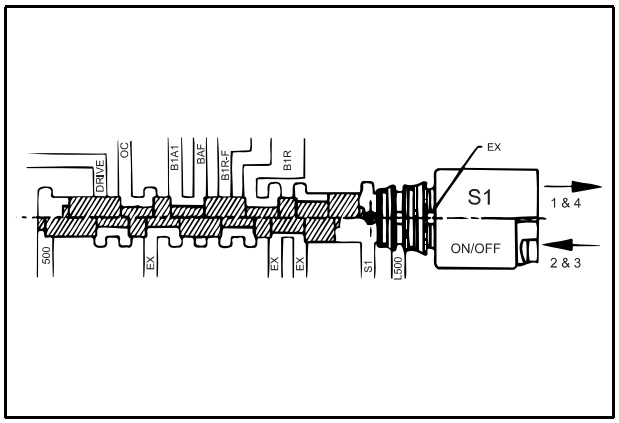
The switching of this valve is achieved by using S1 and/ or S2.

During a 1-2 gearshift drive oil from the manual valve passes through to the second gear circuit. During a 2-1 gearshift the band apply feed oil is allowed to exhaust via the 1-2 shift valve.

The 1-2 shift valve works in conjunction with the 3-4 shift valve to disengage the C4 clutch in first gear, and engage C4 in second gear. When Manual 1 is selected the C4 clutch and rear band (B2) are engaged.

Modification basis	
Application basis	
Affected VIN	





▶ 2-3 shift valve

The 2-3 shift valve is a two position valve. It is used on all 2-3 and 3-2 gearshifts.
The switching of this valve is achieved by S2 which is located at the end of the valve spool.
In the 1, 2 position, second gear oil from the 1-2 shift valve is prevented from entering the third gear circuit.
When the valve is moved to the 3, 4 position, oil from the second gear circuit is routed to the third gear circuit and the transmission is changed to third gear.

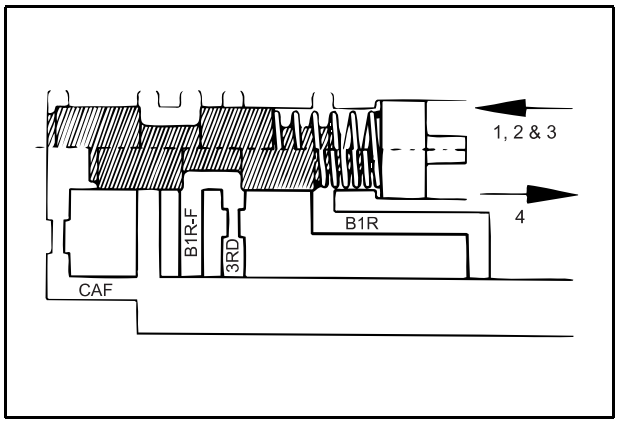
▶ 3-4 shift valve

The 3-4 shift valve is a two position valve. It is used for all 3-4 and 4-3 gearshifts.
The switching of this valve is achieved by S1 which is located at the end of the valve spool.

During a 3-4 gearshift the 3-4 shift valve:

- Exhausts the front band release (B1R) circuit thereby allowing the application of the front band (B1).
- Connects the inner apply area of the front servo (B1AI) to the Band Apply Feed (BAF) circuit thus allowing greater apply forces to the front band.
- Exhausts the Overrun Clutch (OC) circuit which allows the C4 clutch to disengage.

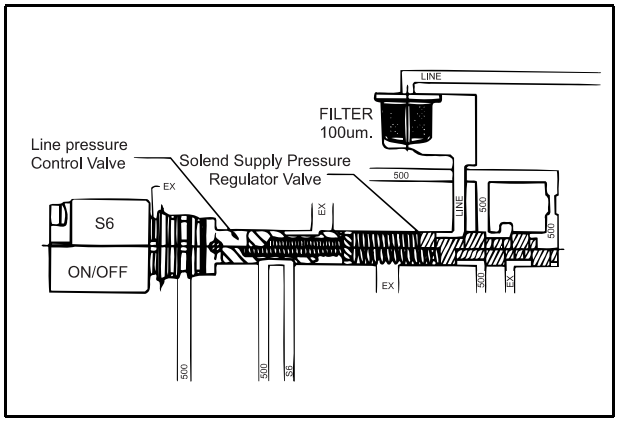
During a 4-3 gearshift, the C4 clutch is engaged and the front band (B1) is released. These actions are sequenced by the 4-3 sequence valve.
The 3-4 shift valve also switches during 1-2 and 2-1 gearshifts where its function is to apply the overrun clutch (C4) in second gear but to release it in first gear.
Note that the C4 clutch is applied in Manual 1 by virtue of the manual valve and the 1-2 hift valve. Refer to "1-2 Shift Valve" in this section.



▶ 4-3 sequence valve

The 4-3 sequence valve is a two position spring loaded valve. It switches during 3-4 and 4-3 gearshifts although it performs no function during the 3-4 shift.

During the 4-3 shift the 4-3 sequence valve delays the connection of the Clutch Apply Feed (CAF) circuit to the B1R circuit until the B1R circuit has been fully pressurized by using the third gear circuit. This prevents objectionable engine flare on completion of the 4-3 gearshift.



▶ Solenoid supply pressure regulator valve

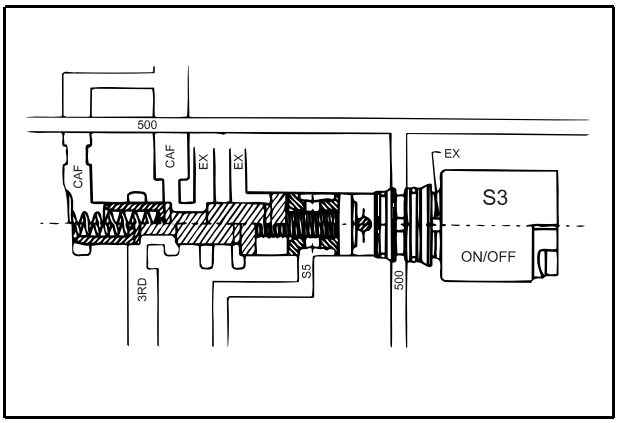
The solenoid supply pressure regulator valve supplies a constant pressure to all solenoids (S1 to S7). Line pressure is used as the feeding oil to this regulator and the output is termed line 500.

▶ Line pressure control valve

Line pressure is controlled by S6, which acts as the line pressure control valve. When S6 pressure is applied to the end of the Primary Regulator Valve (PRV), it is opposed by spring force and causes LOW line pressure for light throttle application and cruising.

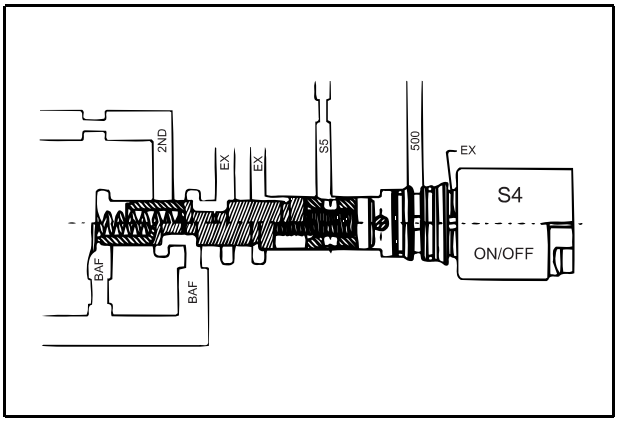
Heavy throttle application causes the normally open S6 to open (switch Off) thus closing line 500 and opening S6 to exhaust. Removal of S6 pressure from the PRV results in HIGH line pressure.

Modification basis	
Application basis	
Affected VIN	



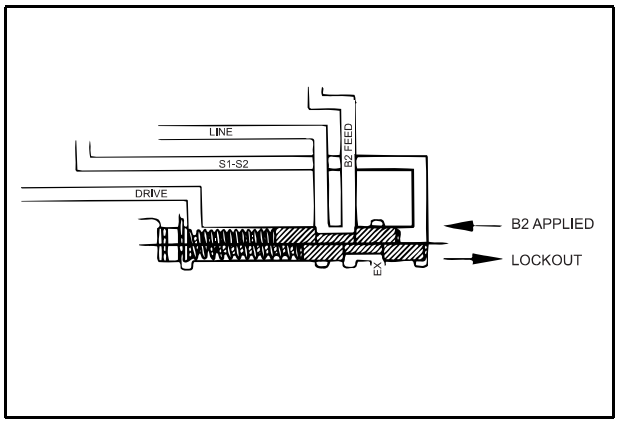
▶ Clutch apply feed regulator valve

The clutch apply feed regulator valve is a fixed ratio (2.25:1) valve. This valve provides a regulated pressure to the C1 clutch and controls the change rate of the clutch state to give the desired shift quality.
Third gear oil supplied to the valve is regulated to provide an output pressure, Clutch Apply Feed (CAF) pressure, of 2.25 times the S5 signal pressure when S3 is ON. When S3 is OFF, the output pressure is 2.25 times the line 500 pressure.



▶ Band apply feed regulator valve

The band apply feed regulator valve is a fixed ratio (1.4:1) valve. It provides a regulated pressure to the front servo, and controls the change rate of the front band (B1) state to give the desired shift quality.
Second gear oil supplied to the valve is regulated to provide an output pressure, Band Apply Feed (BAF) pressure, of 1.4 times the S5 signal pressure when S4 is ON. When S4 is OFF the output pressure is 1.4 times the line 500 pressure.



▶ Reverse lockout valve

The reverse lockout valve is a two position valve contained in the upper valve body. This valve uses S1-S2 pressure as a signal pressure and controls the application of the rear band (B2).

While the manual valve is in D, 3, 2 or 1 positions, drive oil is applied to the spring end of the valve, overriding any signal pressures and holding the valve in the lockout position. This prevents the application of B2 in any of the forward driving gears except M1.

When the manual valve is in P, R or N positions, drive oil is exhausted and the reverse lockout valve may be toggled by S1-S2 pressure.

B2 is applied in P, R, and N if the following conditions are satisfied :

- In P or N, vehicle speed = 3 km/h.
- In R, vehicle speed = 10 km/h.
- Engine speed = 1600 rpm.
- Throttle position = 12 %.

Under these conditions, the TCU switches solenoids S1 and S2 to OFF. The reverse lockout valve toggles under the influence of the S1-S2 pressure, to connect the line pressure to the B2 feed. Oil is fed to both the inner and outer apply areas of the rear servo piston, applying B2.

If any of the above conditions are not satisfied, the TCU switches solenoids S1 and S2 to ON.

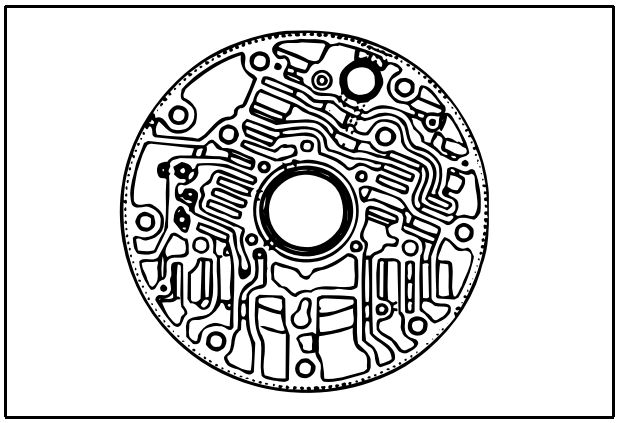
S1- S2 pressure is exhausted and the valve is held in the lockout position by the spring. In this position, engagement of B2 is prohibited.

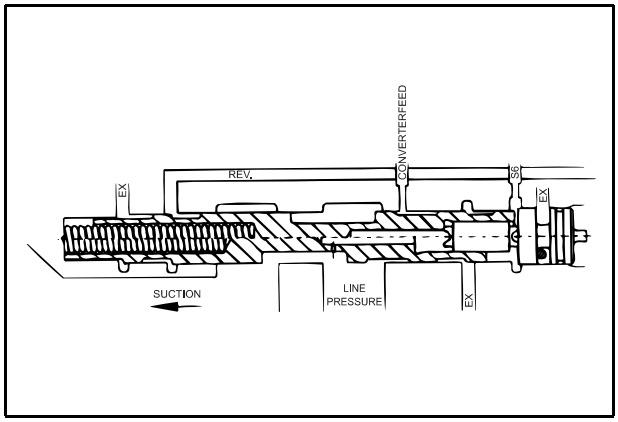
This feature protects the transmission from abuse by preventing the undesirable application of B2 at high speed, and by providing a reverse lockout function.

Note that if the transmission is in failure mode, the rear band will be applied at all times in P, R and N.

Modification basis	
Application basis	
Affected VIN	

(2) Pump cover





▶ Primary regulator valve

The Primary Regulator Valve (PRV) regulates the transmission line pressure (or pump output pressure). This valve gives either high or low line pressure depending on whether S6 is switched OFF or ON. When S6 is switched ON, S6 pressure is applied to the PRV moving it against spring pressure and opening the line pressure circuit to the pump suction port resulting in reduced line pressure.

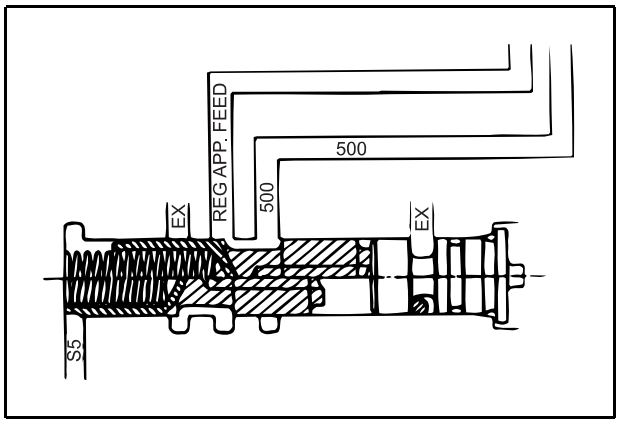
Low line pressure is used during light throttle applications and cruising. Heavy throttle will cause S6 to switch OFF and thereby cause high line pressure.

This stepped line pressure control has no detrimental effect on shift feel because all shifting pressures are controlled by separate band and clutch regulator valves, and the output of S5.

When reverse gear is selected, both the low and high line pressure values are boosted to guard against slippage.

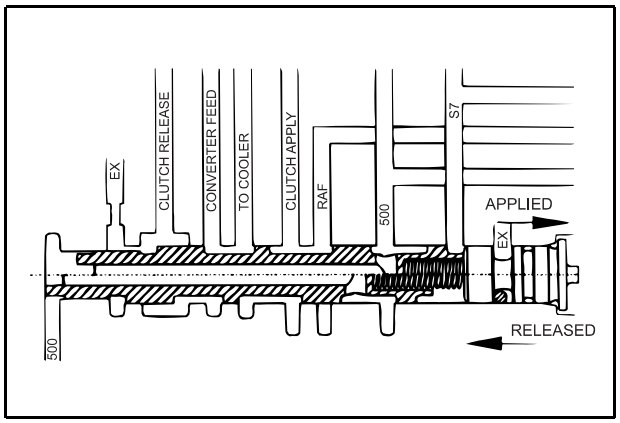
This is achieved by applying reverse oil line pressure to the PRV to assist the spring load. The other end of the valve contains ports for line pressure feedback and S6 pressure.

The PRV also regulates the supply of oil to the converter via the converter feed port. The cascade effect of the PRV ensures the first priority of the valve is to maintain line pressure at very low engine speeds. When the engine speed increases and the pump supplies an excess of oil the PRV moves to uncover the converter feed port thereby pressurizing the converter. If there is an excess of oil for the transmission's needs then the PRV moves further to allow oil to return to the suction port.



▶ Converter clutch regulator valve

The converter clutch regulator valve regulates the pressure of the oil which applies the converter clutch. Input oil from the line 500 circuit is regulated within the valve, with the output pressure being variable according to the signal pressure from the S5 circuit. Converter clutch apply and release application is smoothed by electronically varying the S5 circuit pressure.



▶ Converter clutch control valve

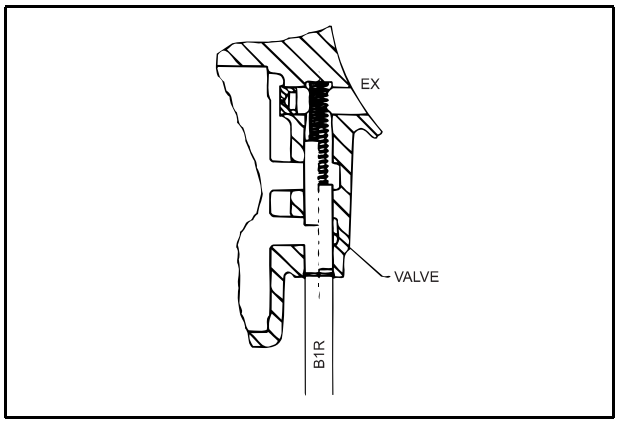
The converter clutch control valve is a two position valve which applies or releases the converter clutch.

The switching of this valve is governed by the signal pressure from S7.

When the valve is in the OFF or released position, converter feed oil from the PRV is directed to the release side of the converter clutch. After flowing through the converter, oil returns to the converter clutch control valve and is then directed to the oil cooler.

When the valve is in the ON or applied position, regulated oil from the converter clutch regulator valve is directed to the apply side of the converter clutch. This oil remains within the converter because the converter clutch piston is sealed against the flat friction surface of the converter cover. To provide oil flow to the cooler the converter clutch control valve directs converter feed oil from the PRV directly to the cooler circuit.

Modification basis	
Application basis	
Affected VIN	



▶ B1R exhaust valve

The B1R exhaust valve is a two position spring loaded valve located in the transmission case directly adjacent to the front servo. It permits the servo release oil to be rapidly exhausted into the transmission case during application of the front band (B1). This prevents the needto force the oil back from the front servo through the valve body and through the 3-4 shift valve. The spring positions the valve to prevent oil entering the release area of the servo until the B1R circuit oil pressure reaches approximately 100 kPa.

(3) Power train system

The Power Train System consists of :

- A torque converter with single face lock-up clutch
- Four multi-plate clutch assemblies
- Two brake bands
- Two one-way clutches
- Planetary gear set
- Parking mechanism

A conventional six pinion Ravigneaux compound planetary gear set is used with overdrive (fourth gear) being obtained by driving the carrier.
The cross-sectional arrangement is very modular in nature.
Four main sub-assemblies are installed within the case to complete the build.

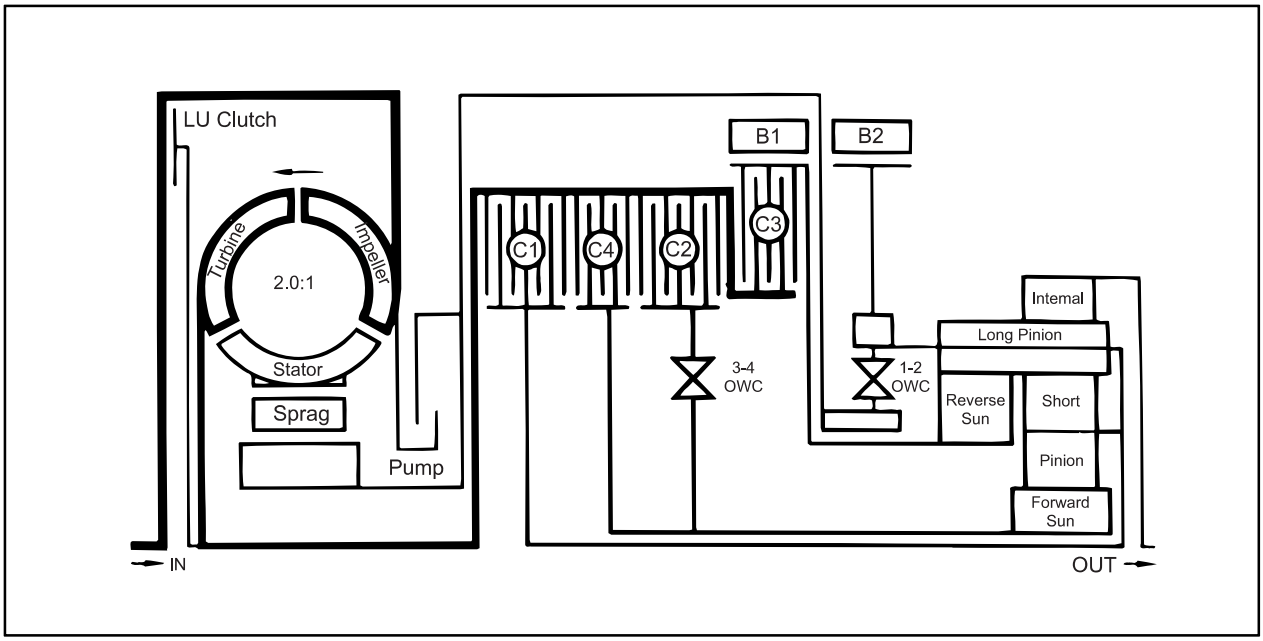
These subassemblies are :

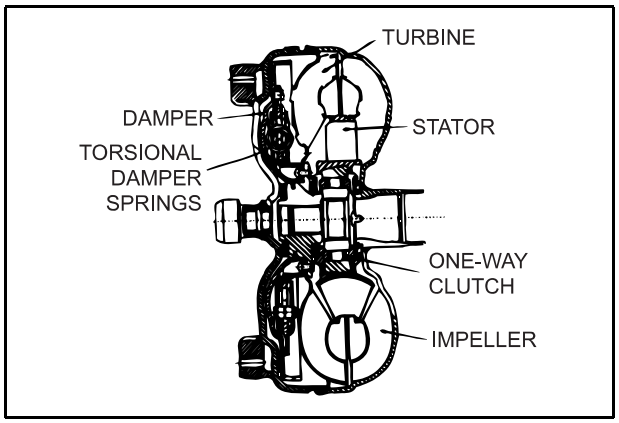
- Gear set-sprag-centre support
- C1 -C2 -C3 -C4 clutch sub-assembly
- Pump assembly
- Valve body assembly

One, or a combination of selective washers are used between the input shaft flange and the number 4 bearing to control the transmission end float. This arrangement allows for extensive subassembly testing and simplistic final assembly during production.
A general description of the operation of the Power Train System is detailed below.
First gear is engaged by applying the C2 clutch and locking the 1-2 One Way Clutch (1-2 OWC). The 1-2 shift is accomplished by applying the B1 band and overrunning the 1-2 OWC. The 2-3 shift is accomplished by applying the C1 clutch and releasing the B1 band. The 3-4 shift is accomplished by re-applying the B1 band and overrunning the 3-4 OWC. Reverse gear is engaged by applying the C3 clutch and the B2 band.
The C4 clutch is applied in the Manual 1, 2 and 3 ranges to provide engine braking. In addition, the C4 clutch is also applied in the Drive range for second and third gears to eliminate objectionable freewheel coasting.
The B2 band is also applied in the Manual 1 range to accomplish the low-overrun shift.
Both the front and rear servos are dual area designs to allow accurate friction element matching without the need for secondary regulator valves. All the friction elements have been designed to provide low shift energies and high static capacities when used with the new low static co-efficient transmission fluids. Non-asbestos friction materials are used throughout.

Modification basis	
Application basis	
Affected VIN	

ELEMENTS ENGAGED										
Gear	Gear Ratio	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
First	2.741		X					X	X	
Second	1.508		X			X			X	
Third	1.000	X	X		X				X	
Fourth	0.708	X	X		X	X				X
Reverse	2.428			X			X			
Manual 1	2.741		X		X		X		X	





▶ Torque converter

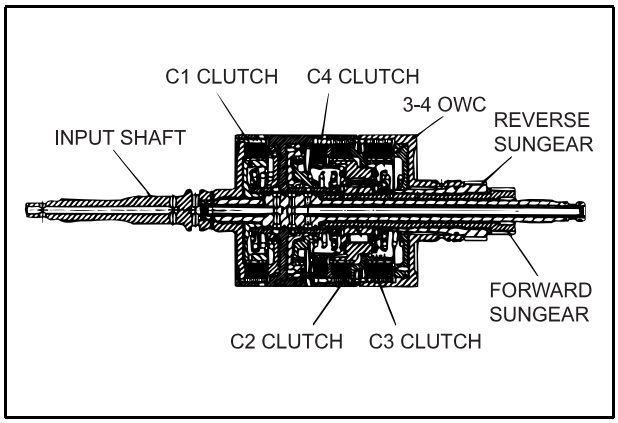
The torque converter consists of a turbine, stator pump, impeller and a lock-up damper and piston assembly. As in conventional torque converters, the impeller is attached to the converter cover, the turbine is splined to the input shaft and the stator is mounted on the pump housing via a one way clutch (sprag).

The addition of the damper and piston assembly en-ables the torque converter to lock-up under favorable conditions.

Lock-up is only permitted to occur in third and fourth gears under specified throttle and vehicle speed conditions.

Lock-up is achieved by applying hydraulic pressure to the damper and piston assembly which couples the turbine to the converter cover, locking-up the converter and eliminating unwanted slippage. Whenever lock-up occurs, improved fuel consumption is achieved. Torsional damper springs are provided in the damper and piston assembly to absorb any engine torque fluctuations during lock-up.

Modification basis	
Application basis	
Affected VIN	



▶ Clutch packs

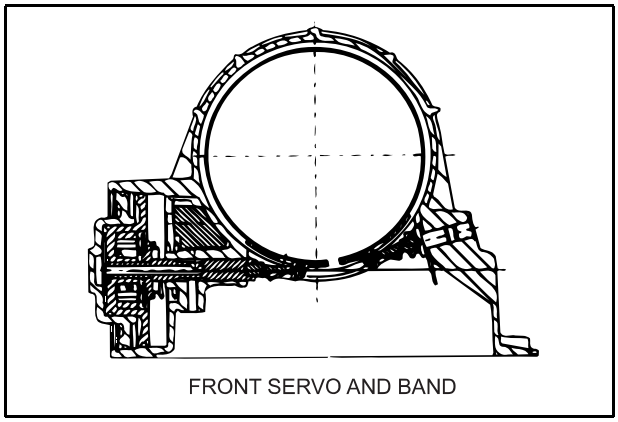
There are four clutch packs. All clutch packs are composed of multiple steel and friction plates.

C1 CLUTCH: When applied, this clutch pack allows the input shaft to drive the planet carrier. This occurs in third and fourth gears.

C2 CLUTCH: When applied this clutch pack allows the input shaft to drive the forward sun gear via the 3-4 OWC.
This occurs in all forward gears.

C3 CLUTCH: When applied this clutch pack allows the input shaft to drive the reverse sun gear. This only occurs in reverse gear.

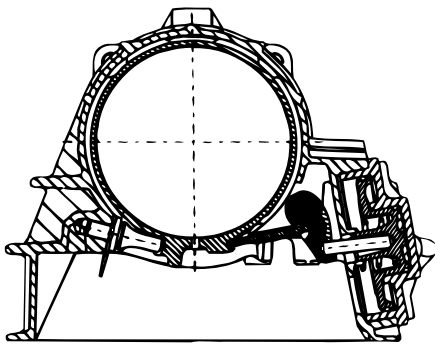
C4 CLUTCH: When applied this clutch provides engine braking on overrun. This occurs in Manual 1, 2 and 3 and also Drive 2 and Drive 3 to prevent objectionable free wheel coasting.


FRONT SERVO AND BAND

▶ Bands

The transmission utilizes two bands, the B1 band (sometimes known as the 2-4 band), and the B2 band (sometimes known as the low-reverse band).

The B1 band is a flexible band which is engaged by the front servo piston. B1 is activated in second and fourth gear. When activated B1 prevents the reverse sun gear from rotating by holding the C3 clutch assembly stationary. In second gear only the outer area of the apply piston is utilized. In fourth gear both areas are utilized for greater clamping force.



REAR SERVO AND BAND

▶ One way clutches

The transmission uses two OWCs, the 1-2 OWC and the 3-4 OWC. (Note that a third OWC is located in the torque converter, also known as a sprag.)

The 1-2 OWC is located between the planetary carrier assembly and the center support. This allows the carrier to rotate around the center support in one direction only. The one way clutch is engaged only in Drive 1.

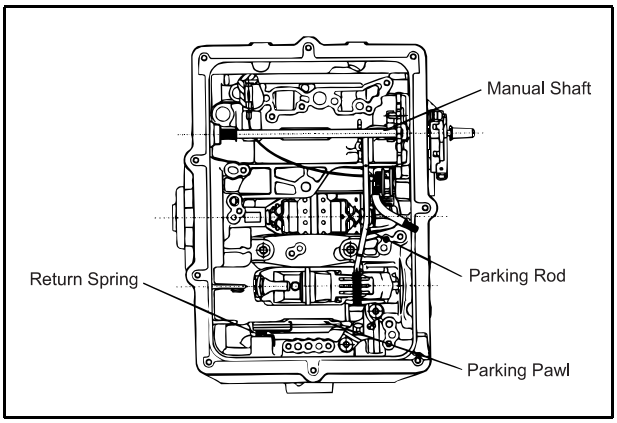
This 3-4 OWC is located between the C4 and the C2 clutch assemblies. This allows the C2 clutch to drive the forward sun gear in first, second and third gears but unlocks in fourth gear and during overrun.

The B2 band is a solid band which is engaged by the rear servo piston. B2 is activated in Park, Reverse, Neutral and Manual 1. When activated B2 prevents the planet carrier assembly from rotating. In Manual 1 only the inner area of the apply piston is utilized. In Park, Reverse and Neutral, both areas are utilized for greater clamping force.

▶ Planetary gear set

The planetary gear set used in the transmission is a conventional six pinion Ravigneaux compound gear set.

Modification basis	
Application basis	
Affected VIN	



▶ Parking mechanism

When Park is selected the manual lever extends the park rod rearwards to engage the parking pawl. The pawl will engage the external teeth on the ring gear thus locking the output shaft to the transmission case. When Park is not selected a return spring holds the parking pawl clear of the output shaft, preventing accidental engagement of Park.

8. POWER FLOWS

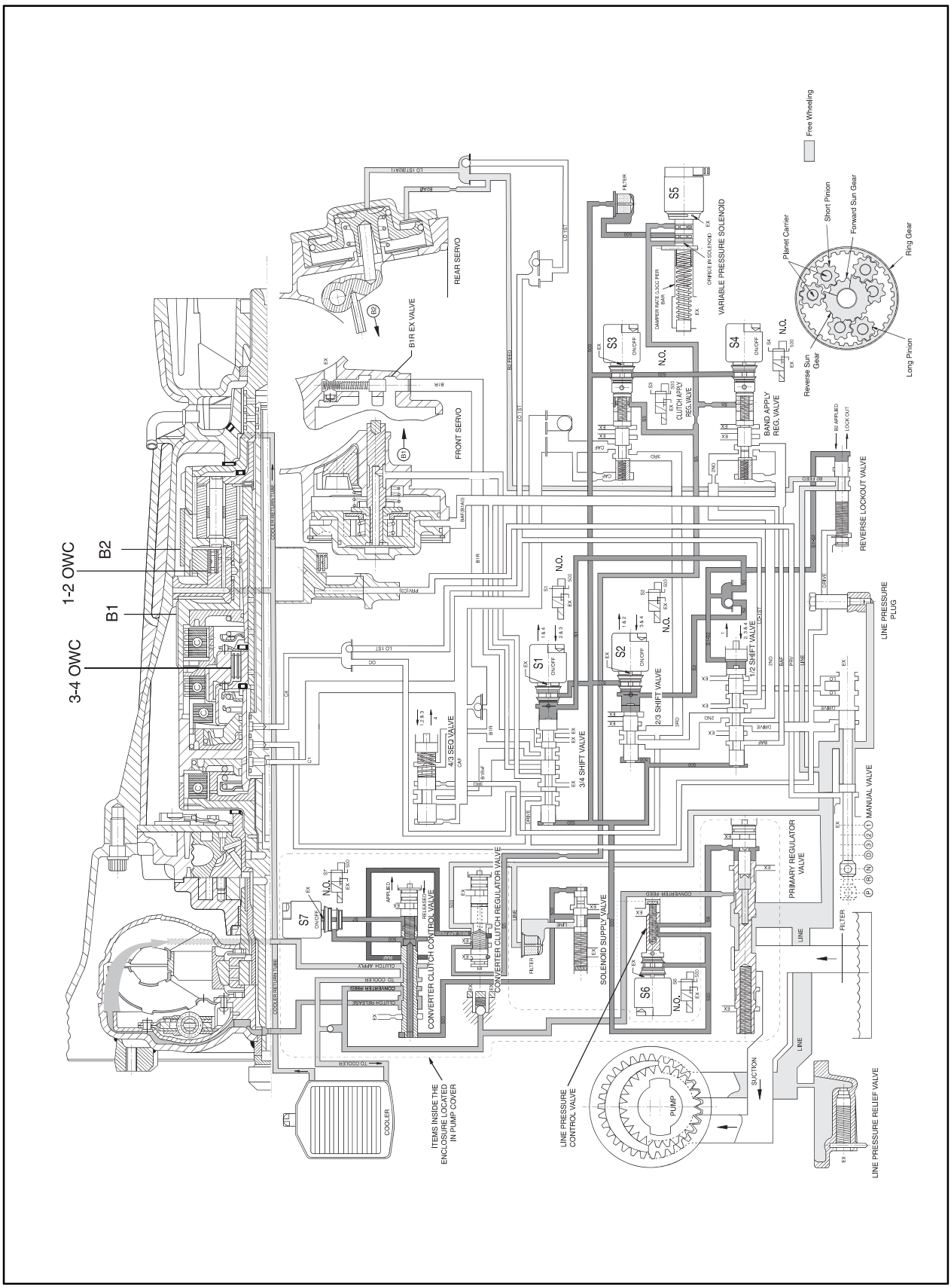
The power flows for the various transmission selections are listed below :

- Power Flow - Neutral and Park
- Power Flow - Reverse
- Power Flow - Manual 1
- Power Flow - Drive 1
- Power Flow - Drive 2
- Power Flow - Drive 3
- Power Flow - Drive 3 Lock Up
- Power Flow - Drive 4 (Overdrive)
- Power Flow - Drive 4 Lock Up

The following table details the engaged elements versus the gear selected for all transmission selections.

ELEMENTS ENGAGED									
Gear State	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Park and Neutral	-	-	-	-	-	X	-	-	-
Reverse	-	-	X	-	-	X	-	-	-
Manual 1	-	X	-	X	-	X	-	X	-
Drive 1	-	X	-	-	-	-	X	X	-
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	-	-	-	-	X	-
Drive 4 Overdrive	X	X	-	-	X	-	-	-	-
Drive 4 Lock Up	X	X	-	-	X	-	-	-	X

1) Park and Neutral



Modification basis	
Application basis	
Affected VIN	

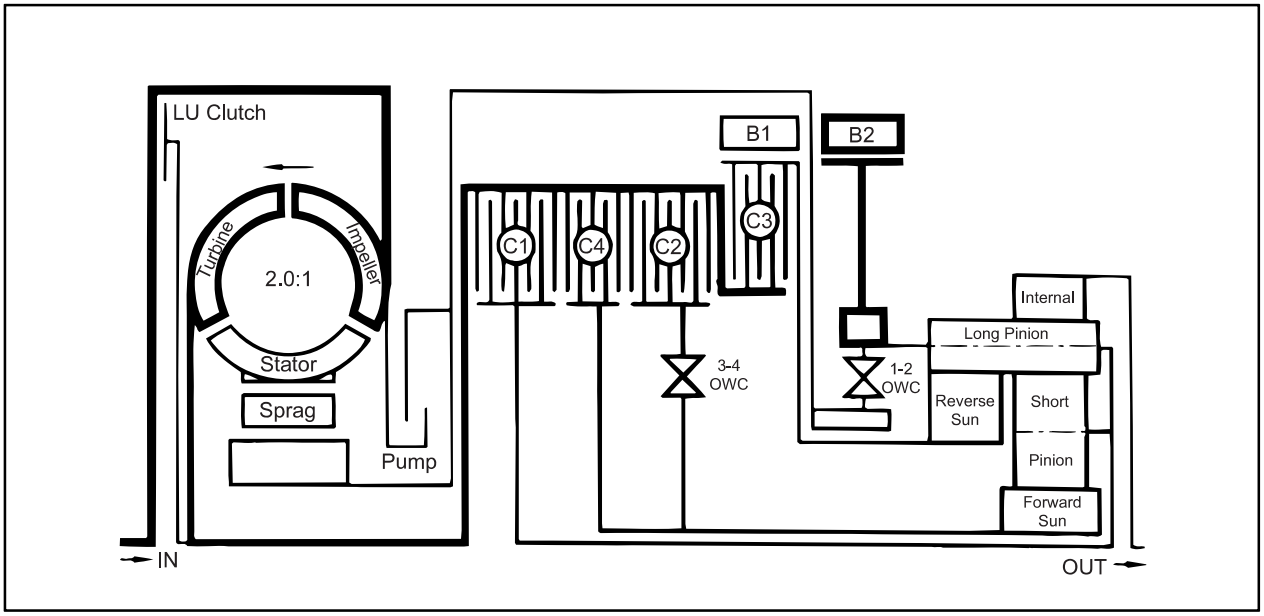
(1) Power flow - Park and neutral

In Park and Neutral, there is no drive to the planetary gear set. The rear band is applied to eliminate 'clunk' on engagement of the reverse gear, and to improve the low range engagement for 4WD applications. No other clutches or bands are applied.
In Park the transmission is mechanically locked by engaging a case mounted pawl with teeth on the output shaft ring gear.

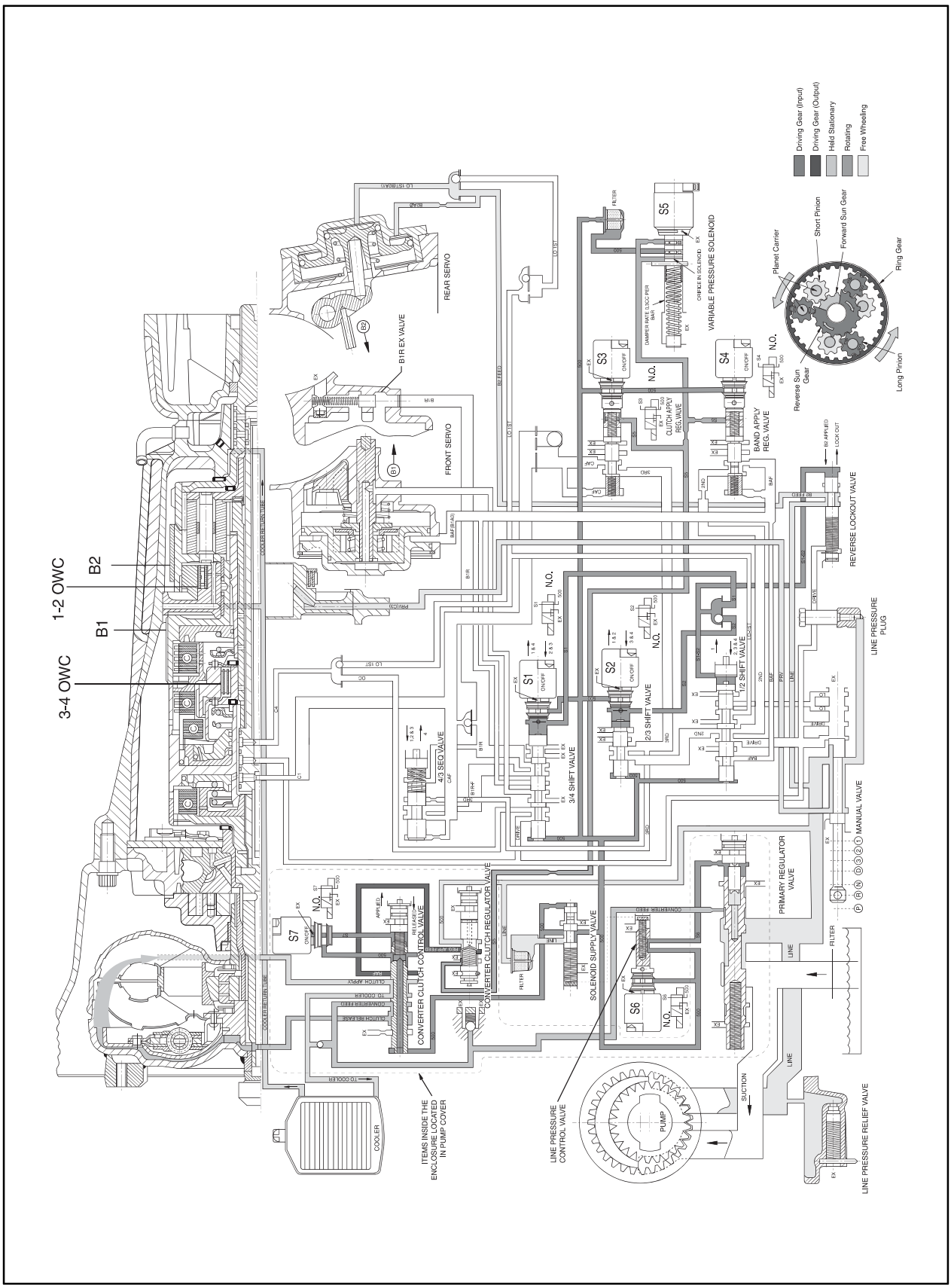
(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched OFF.
- Line (pump) pressure is applied to the Primary Regulator Valve (PRV) and to the solenoid supply pressure regulator valve.
- The converter, oil cooler, and lubrication circuits are charged from the primary regulator valve.
- The line 500 circuit is charged by the solenoid supply pressure regulator valve.
- The S5 circuit is charged by the variable pressure solenoid (S5).
- Line pressure is prevented from entering the drive circuit by the manual valve.
- The B1 circuit and all clutch circuits are open to exhaust.



2) Reverse



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Reverse

In Reverse, transmission drive is via the input shaft and the forward clutch cylinder to the hub of the C3 clutch.

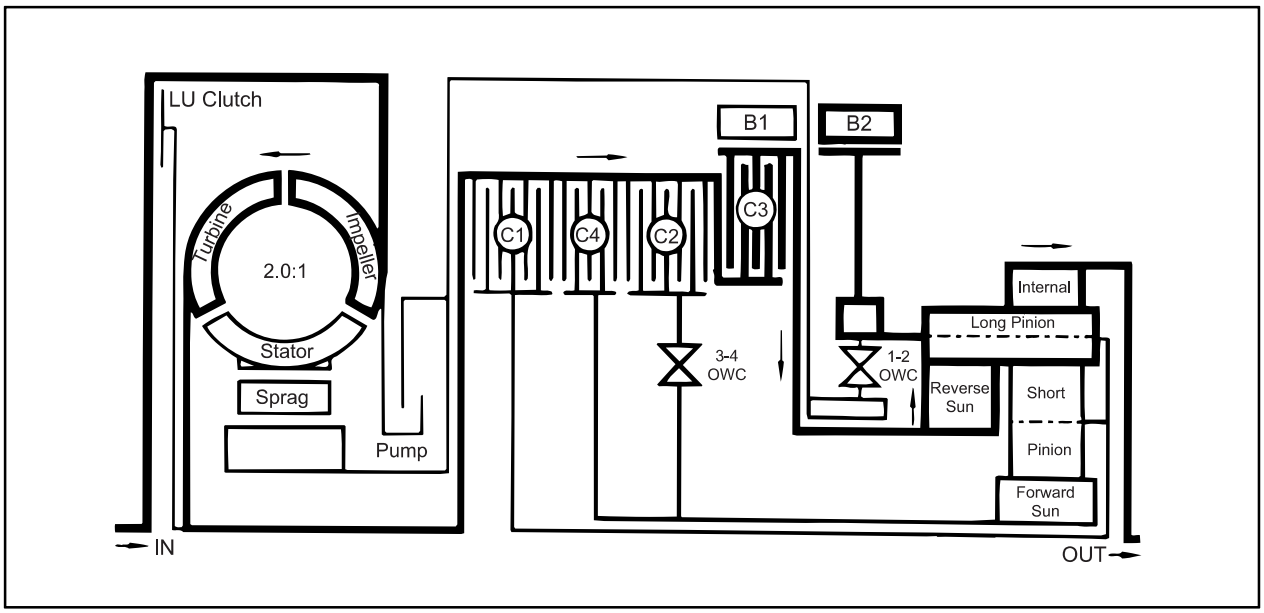
The elements of the transmission function as follows :

- The C3 clutch is engaged and drives the reverse sun gear in a clock-wise direction.
- The B2 band is engaged and holds the planetary gear carrier stationary causing the long pinion to rotate anti-clockwise about its axis on the pinion shaft.
- The long pinion drives the internal ring gear in the same direction.
- The internal ring being splined to the output shaft drives it in an anti-clockwise or reverse direction.

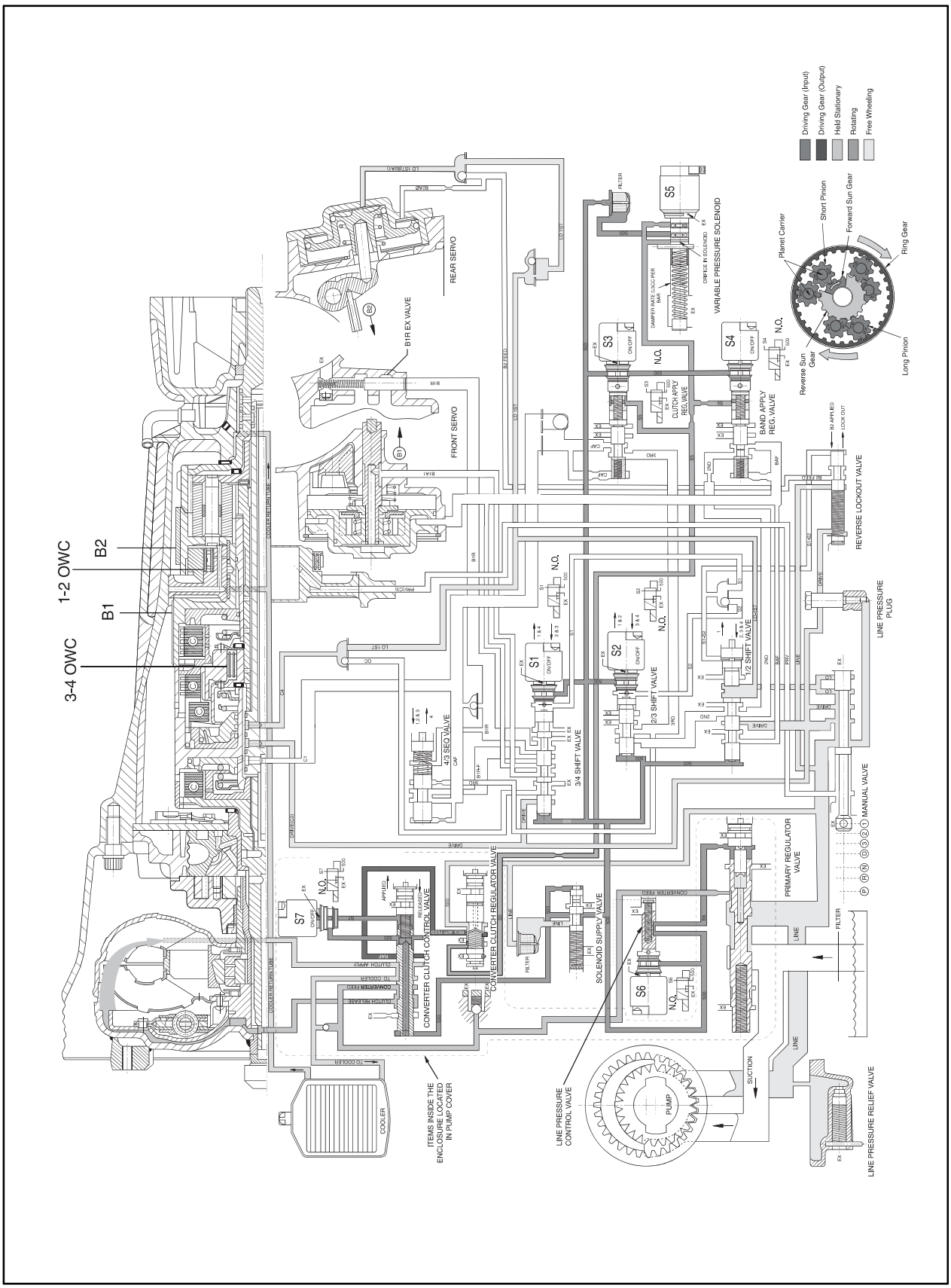
(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows :

- Solenoids S1 and S2 are switched OFF.
- Line pressure is directed through the reverse lockout valve to both the inner and outer apply areas of the rear servo piston for B2 band application.
- Line pressure feeds the reverse oil circuit via the manual valve.
- Reverse oil is routed from the manual valve to the C3 clutch.
- Reverse oil is also applied to the spring end of the primary regulator valve to assist the spring and to boost the line pressure value.
- All other clutch and band apply circuits are open to exhaust.



3) Manual 1



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Manual 1

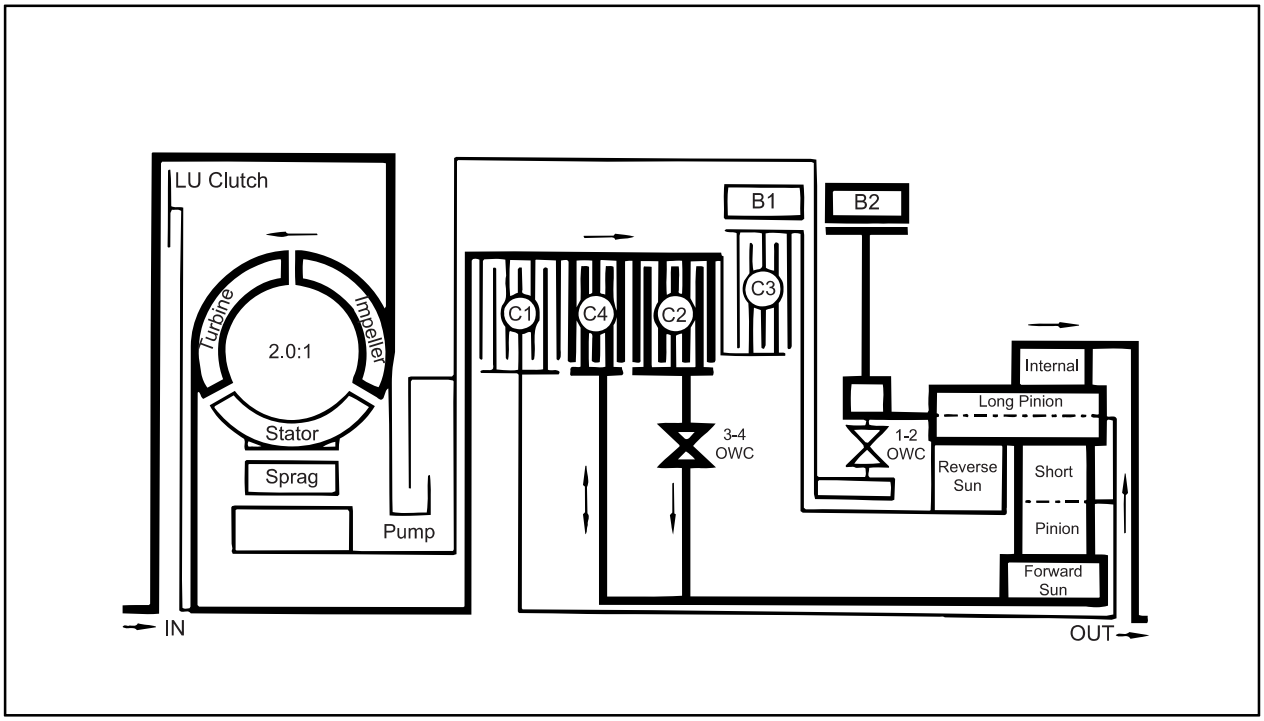
In Manual 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows;

- The C2 clutch is engaged to drive the forward sun gear, via the 3-4 OWC.
- The B2 band is engaged to hold the planetary gear carrier stationary.
- The forward sun gear drives the short pinion anticlockwise.
- The short pinion drives the long pinion clockwise.
- The long pinion rotating about its axis drives the internal ring gear and the output shaft in a clockwise or forward direction.
- The C4 clutch provides engine braking through the 3-4 OWC on overrun.

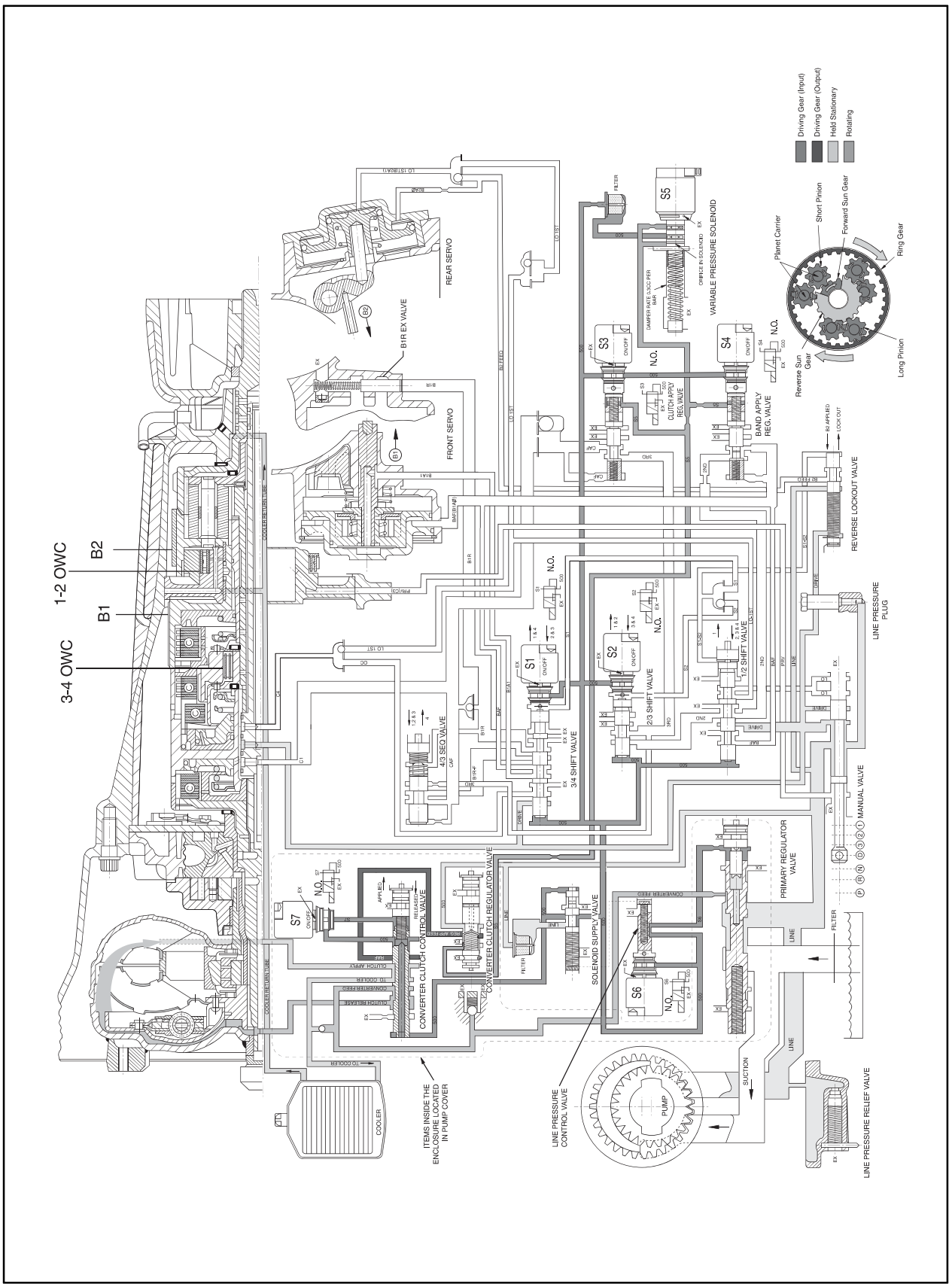
(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows :

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- Lo-1st (line pressure) oil is routed through the 1-2 shift valve to the C4 clutch, and to the inner apply area of the rear servo piston for B2 band application.



4) Drive 1



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Drive 1

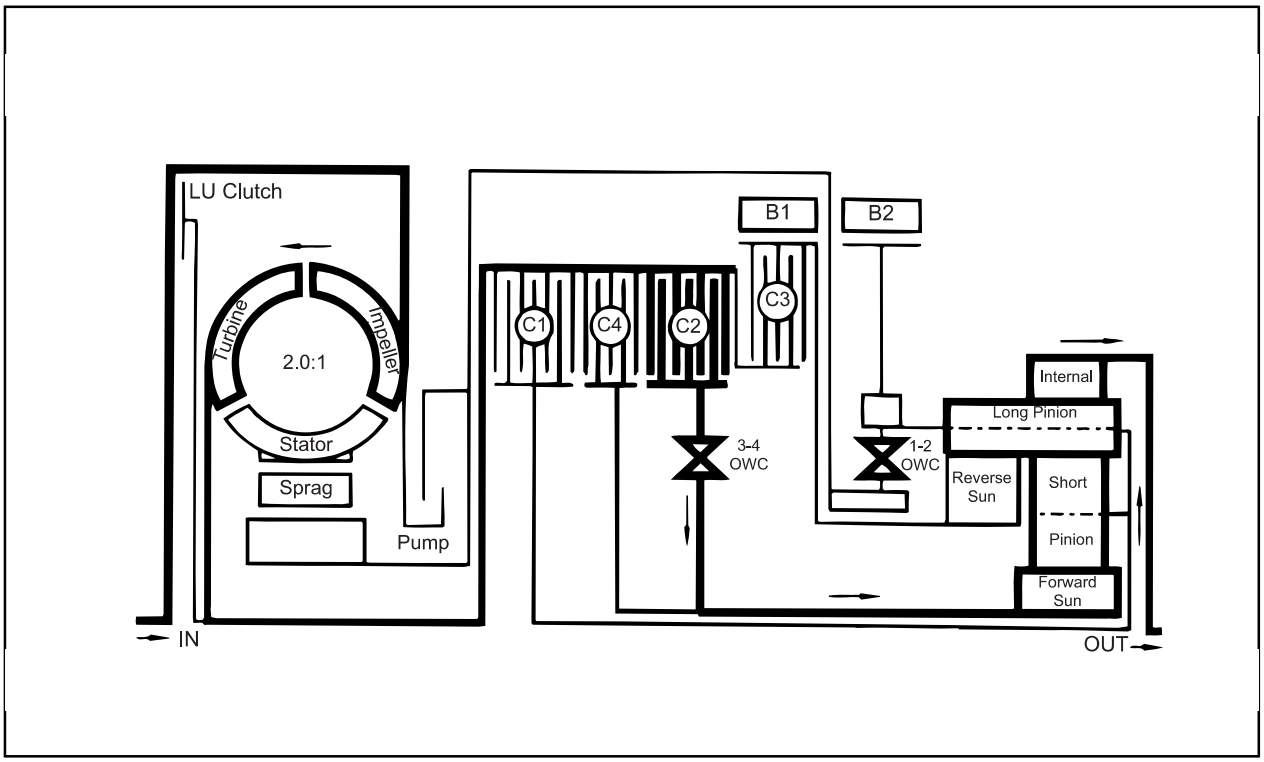
In Drive 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC.
- The forward sun gear drives the short pinion anticlockwise.
- The short pinion drives the long pinion clockwise.
- The 1-2 OWC prevents the planetary gear carrier from rotating under reaction force and the long pinion rotates on its axis driving the internal ring gear and output shaft in a clockwise or forward direction.
- There is no engine braking on overrun.

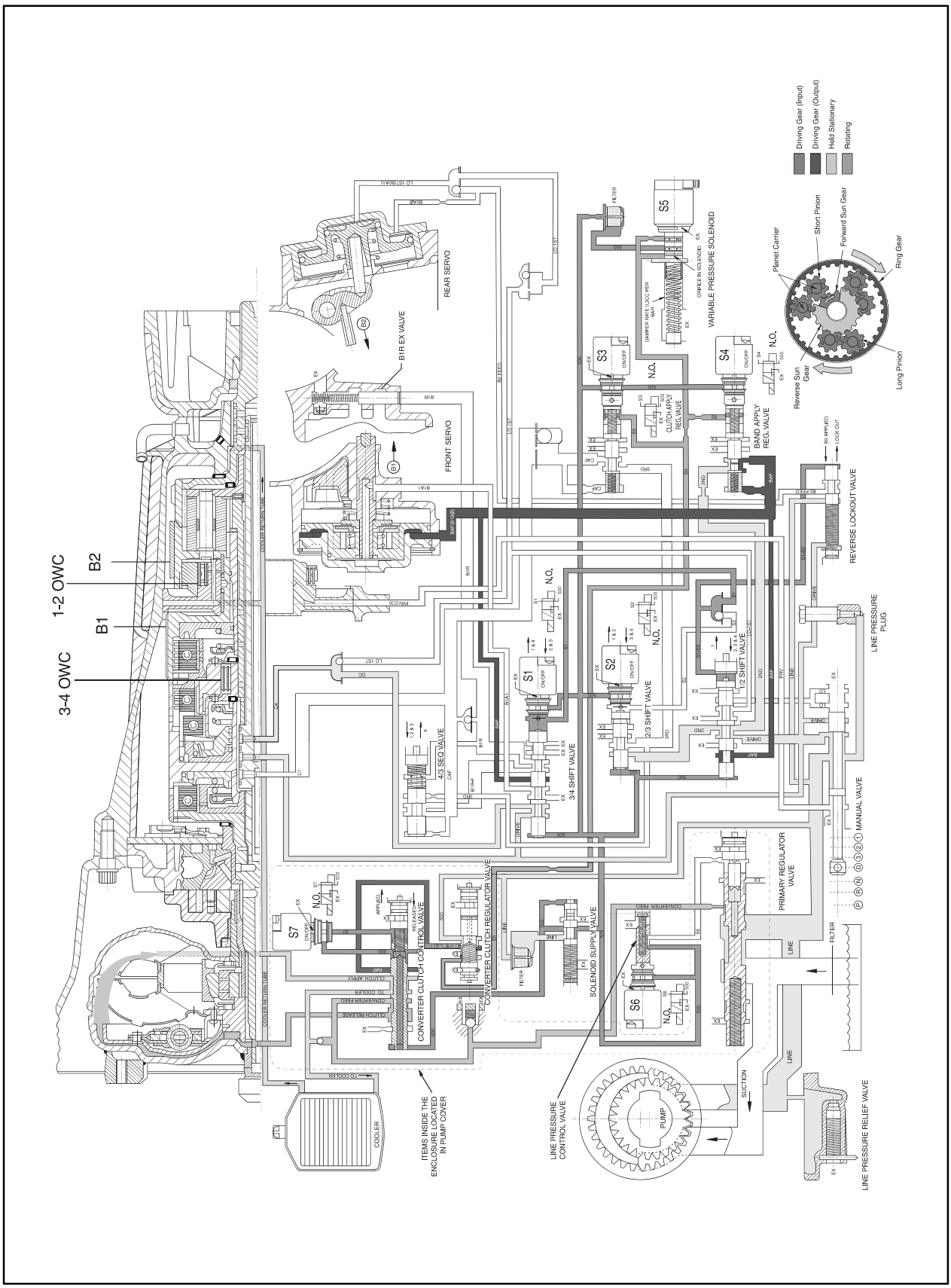
(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows :

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.



5) Drive 2 and Manual 2



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Drive 2 and manual 2

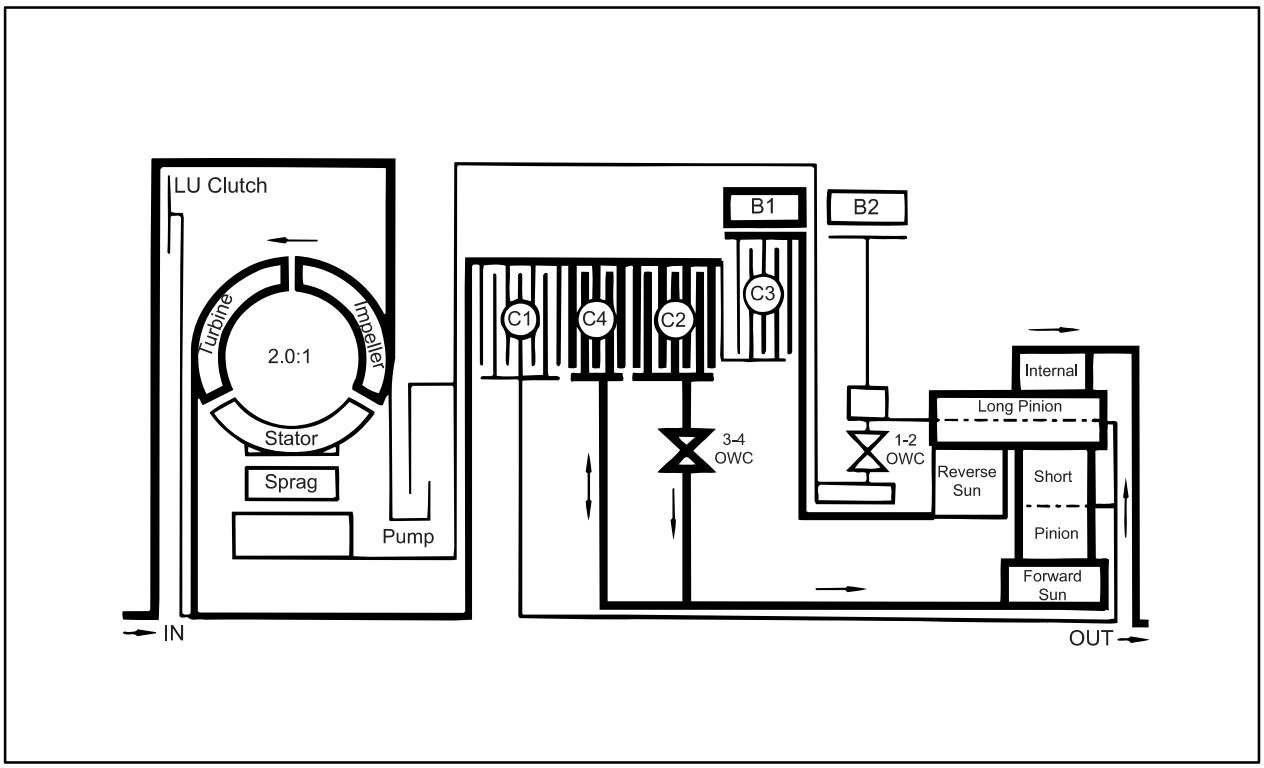
In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC.
- The forward sun gear drives the short pinion anticlockwise.
- The short pinion drives the long pinion clockwise.
- The 1-2 OWC prevents the planetary gear carrier from rotating under reaction force and the long pinion rotates on its axis driving the internal ring gear and output shaft in a clockwise or forward direction.
- There is no engine braking on overrun.

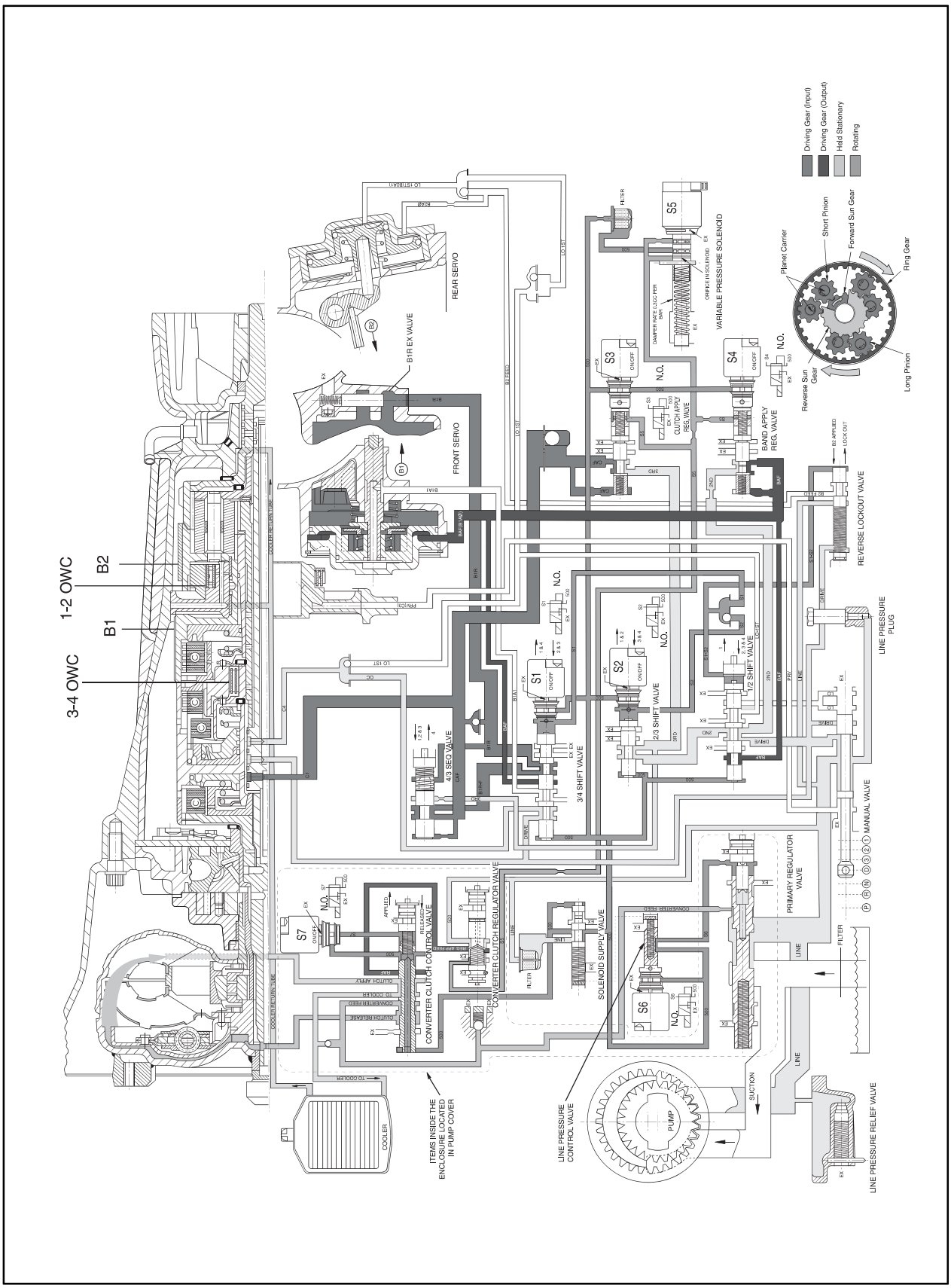
(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows :

- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.



6) Drive 3 and Manual 3



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Drive 3 and manual 3

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is engaged to drive the forward sun gear.
- The C1 clutch is engaged to drive the planet carrier.
- The short pinion drives the long pinion clockwise.
- The forward sun gear and the planet carrier are driven clockwise at the same speed therefore there is no relative motion between the sun gear and the pinions.
- The ring gear and output shaft are driven in a clockwise or forward direction at input shaft speed.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

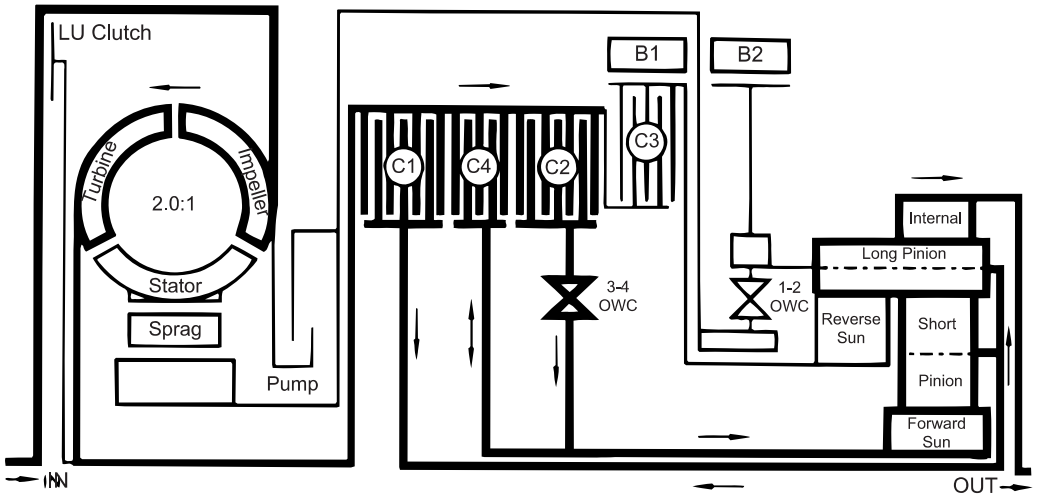
- Solenoid S1 is switched OFF. S2 is switched OFF.
- With S1 and S2 switched OFF, the 2-3 and 3-4 shift valves are held in the third gear position by line 500 pressure.
- The 1-2 shift valve is held in the third gear position by S1-S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valvera-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.

The CAF oil is directed to :

- The C1clutch
- The 4-3 sequence valve

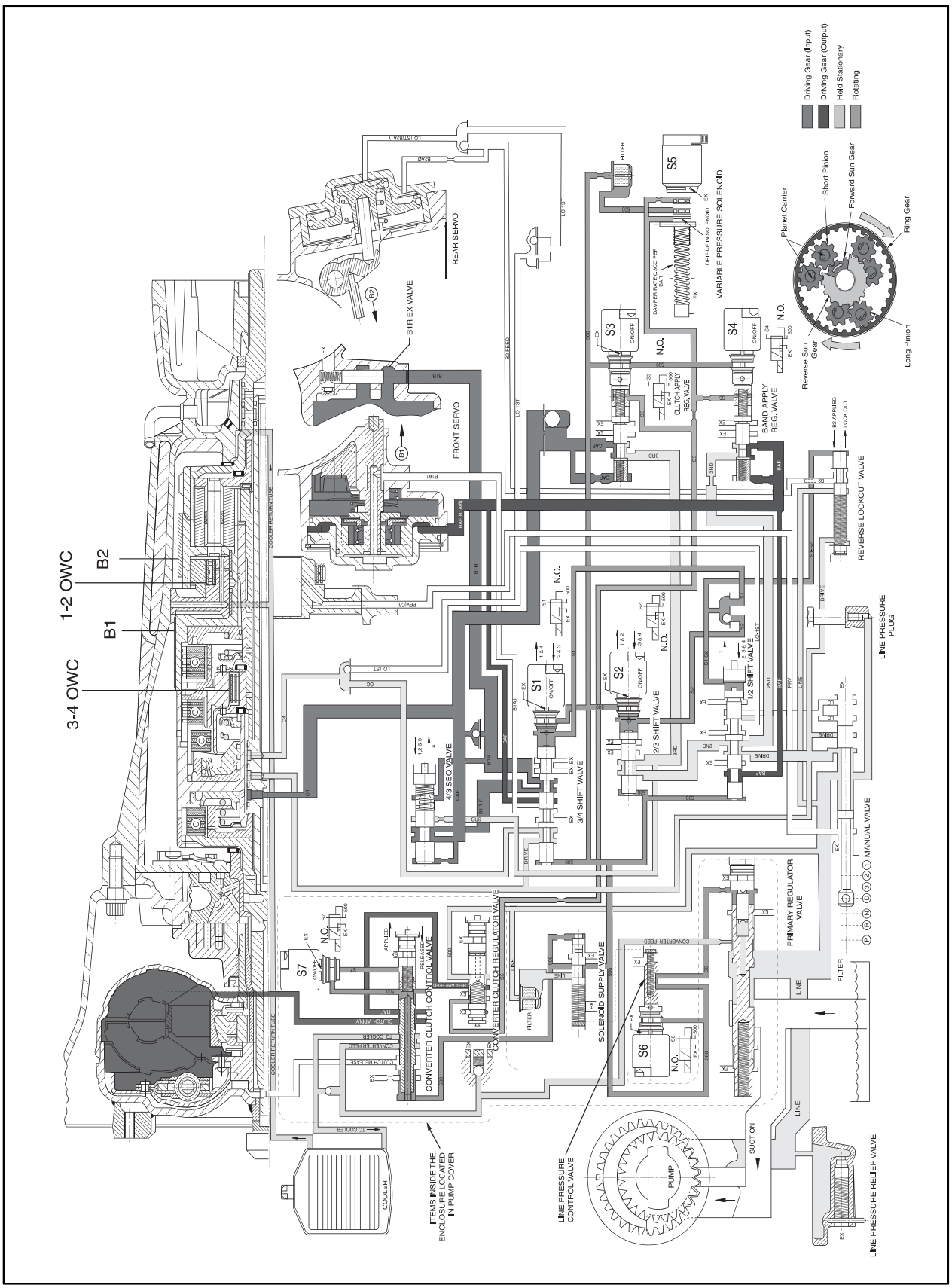
- At the 4-3 sequence valve the CAF oil becomes Band 1 Release Feed (B1R-F) oil, and is directed through the 3-4 shift valve to the spring end of the 4-3 sequence valve, and to the release side of the front servo piston to hold band 1 OFF.
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

	ELEMENTS ENGAGED								
Gear State	C1	C1	C1	C1	B1	B1	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 3 and Manual 3	x	x	-	x	-	-	-	x	-



Modification basis	
Application basis	
Affected VIN	

7) Drive 3 Lock Up and Manual 3 Lock Up



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Drive 3 lock up and manual 3 lock up

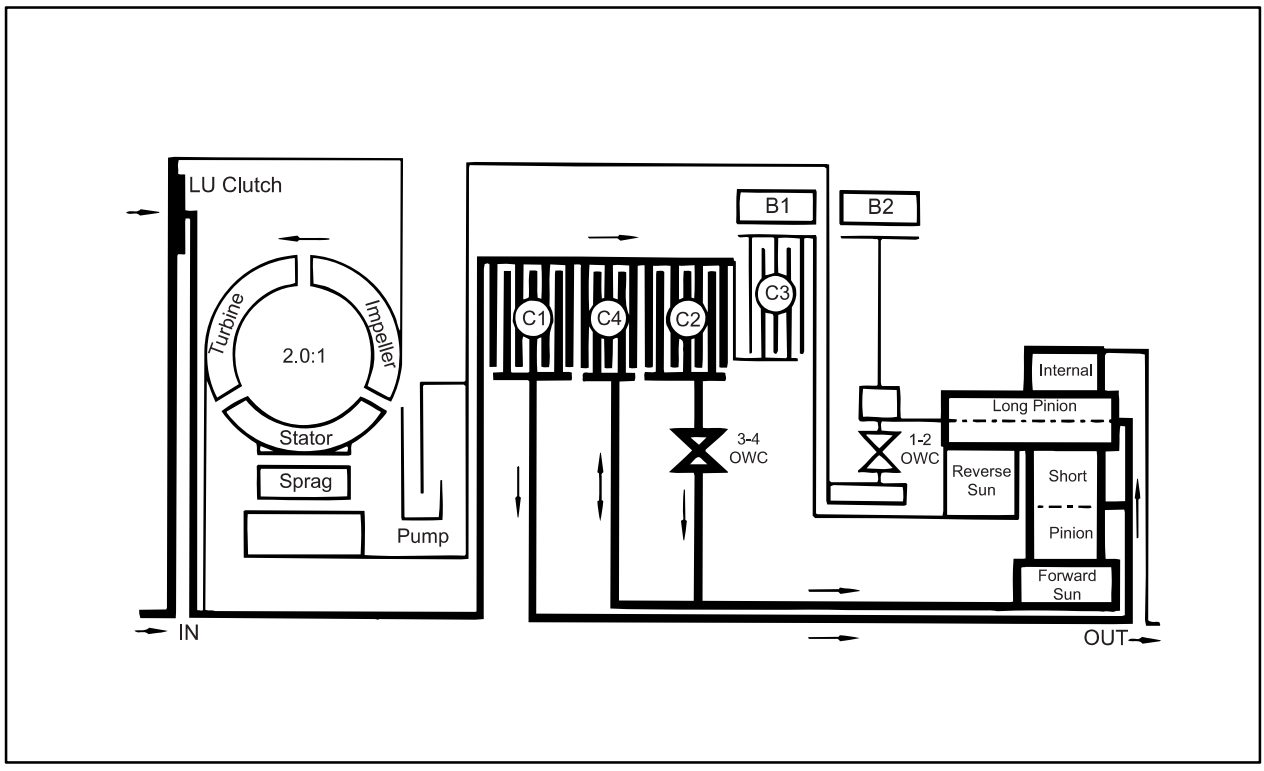
In Drive 3 Lock Up and Manual 3 Lock Up, transmission drive is the same as for Drive 3 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

(2) Control

Control for Drive 3 Lock Up and Manual 3 Lock Up is the same as for Drive 3 with the addition of the converter clutch circuit activated by solenoid S7.

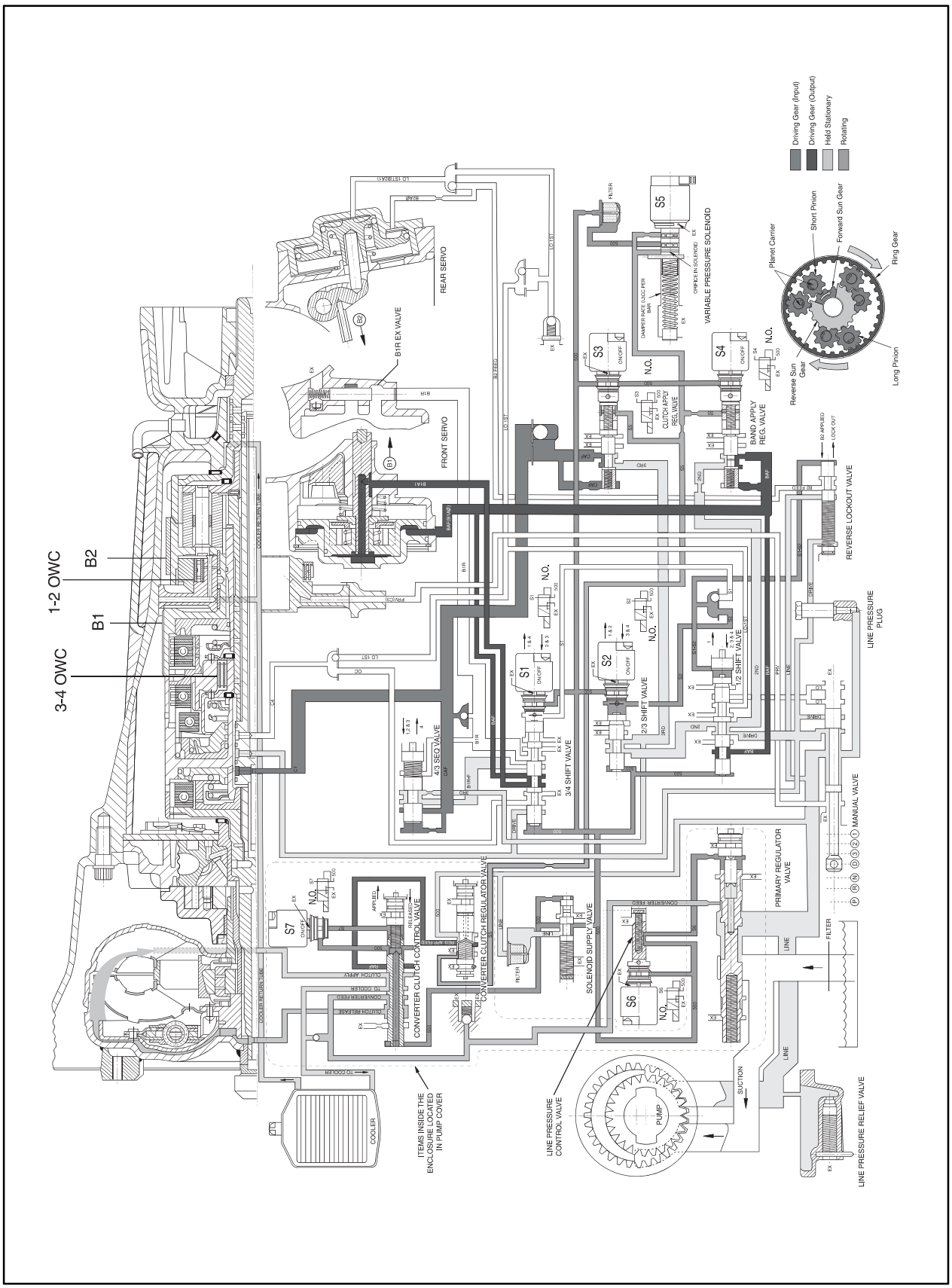
- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

	ELEMENTS ENGAGED								
Gear State	C1	C1	C1	C1	B1	B1	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 3 Lock Up and Manual 3 Lock Up	x	x	-	x	-	-	-	x	x



Modification basis	
Application basis	
Affected VIN	

8) Drive 4 (Overdrive)



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Drive 4 (Overdrive)

In Drive 4 (Overdrive), transmission drive is via the input shaft to the forward clutch cylinder.

The elements of the transmission function as follows :

- The C1 clutch is applied to drive the planet carrier clockwise.
- The B1 band is applied to hold the reverse sun gear stationary.
- As the planet carrier tuns, the long pinion walks around the stationary reverse sun gear and rotates around its axis driving the internal ring gear and output shaft in a clockwise or forward direction at a speed faster than the input shaft i.e. in overdrive ratio.
- The forward sun gear is also driven faster than the input shaft and overruns the 3-4 OWC.
- The C2 clutch is engaged to reduce the speed differential across the 3-4 OWC.

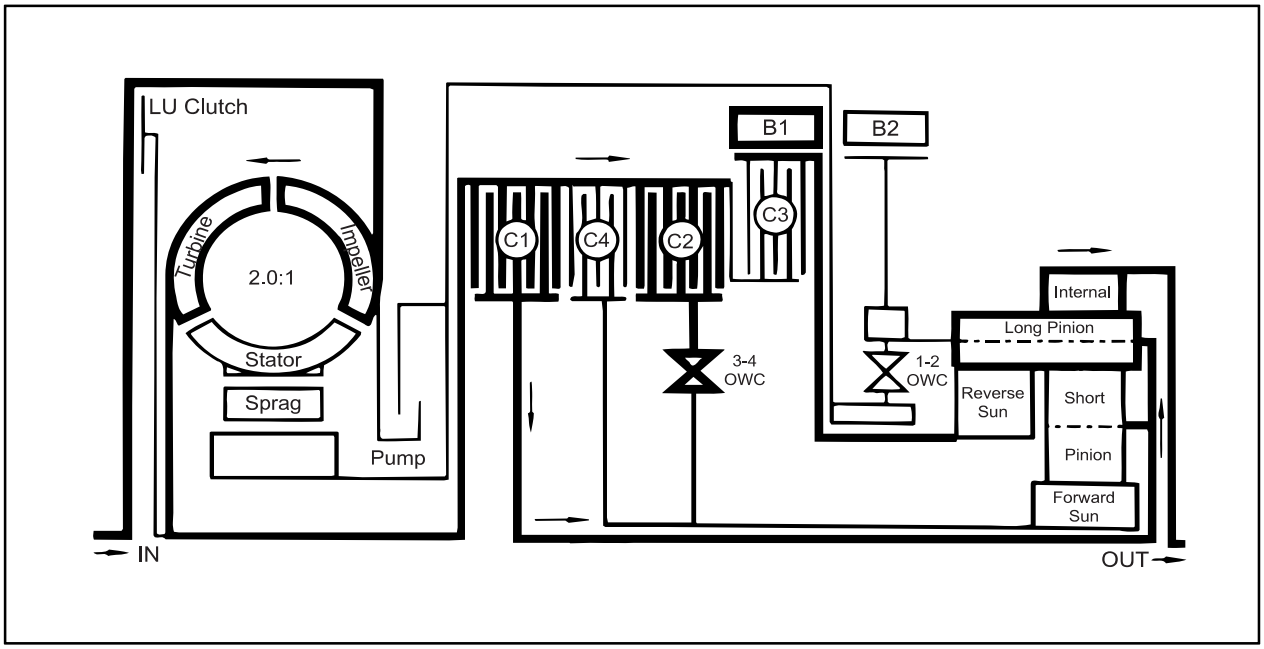
(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows :

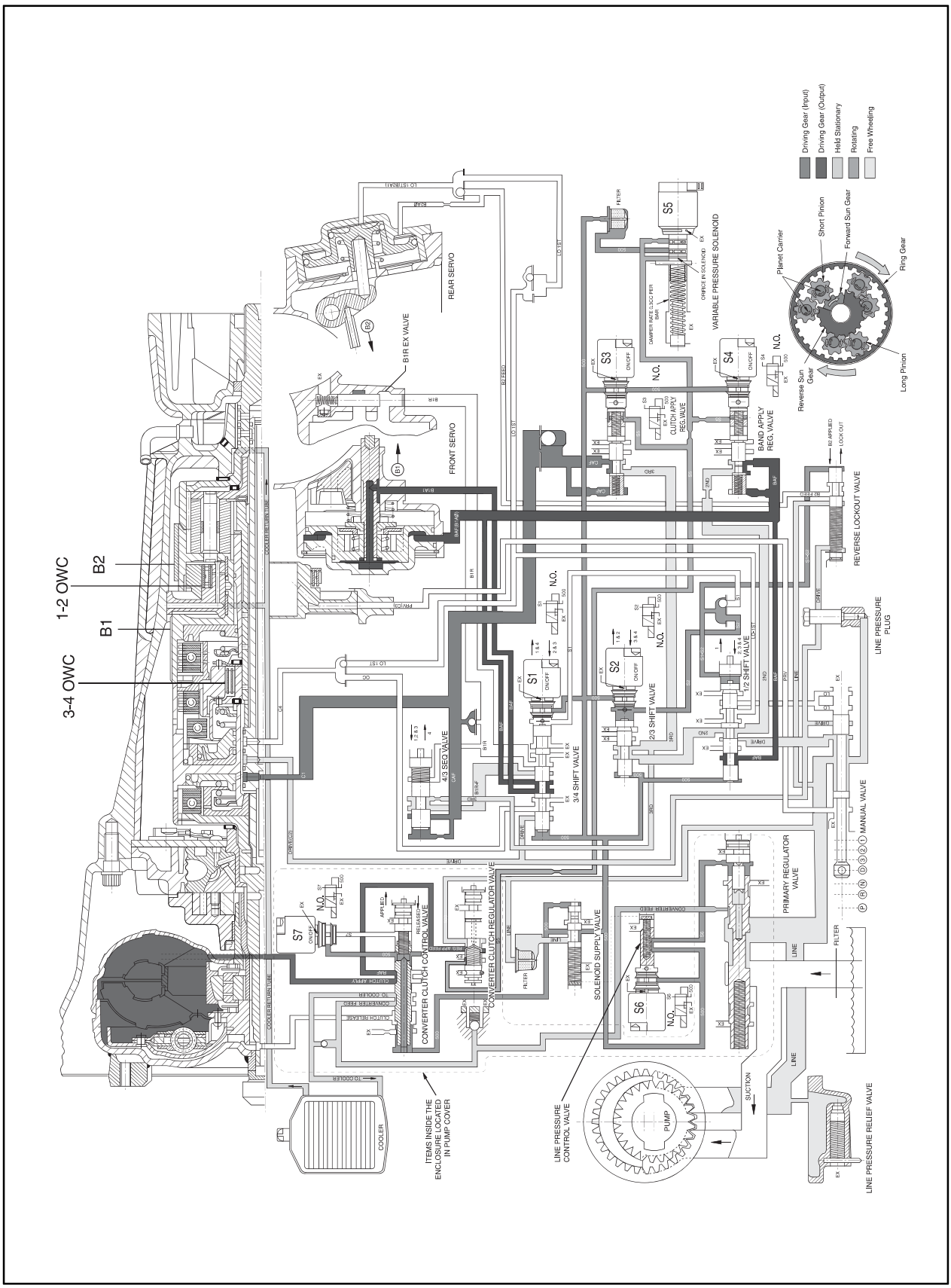
- Solenoid S1 is switched ON. S2 is switched OFF.
- With S1 switched ON, the 3-4 shift valve is held in the fourth gear position by line 500 pressure on the small end of the valve.
- With S2 switched OFF, the 2-3 shift valve is held in the fourth gear position by line 500 pressure on the large end of the valve.
- The 1-2 shift valve is held in the fourth gear position by S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ra-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to
  · the outer apply area of the front servo
  · the inner apply area of the front servo piston via the 3-4 shift valve
  · the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.
- The CAF oil is directed to
  · The C1clutch
  · The 4-3 sequence valve
- Drive oil (line pressure) from the manual valve engages the C2 clutch.

Modification basis	
Application basis	
Affected VIN	

	ELEMENTS ENGAGED								
Gear State	C1	C1	C1	C1	B1	B1	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 4 Overdrive	x	x	-	-	x	-	-	-	-



9) Drive 4 Lock Up



Modification basis	
Application basis	
Affected VIN	

(1) Power flow - Drive 4 lock up

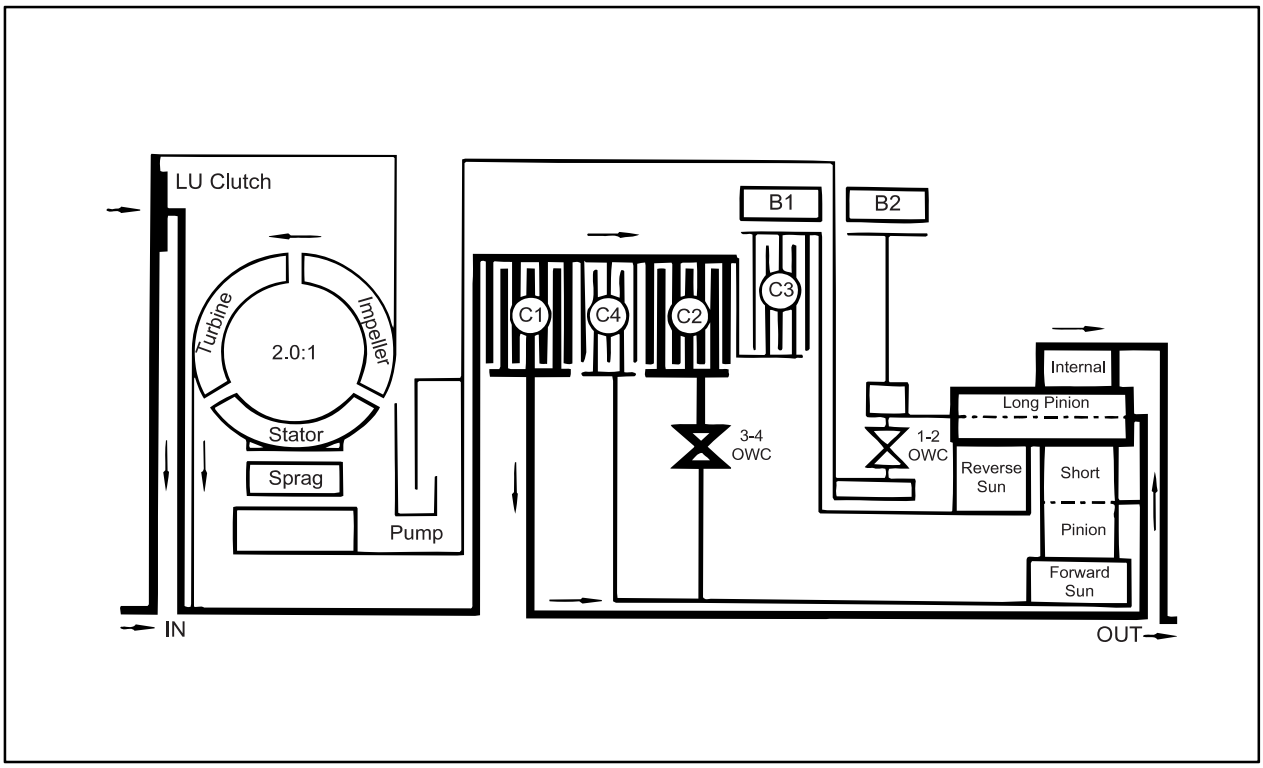
In Drive 4 Lock Up, transmission drive is the same as for Drive 4 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

(2) Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows :

- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drived from drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

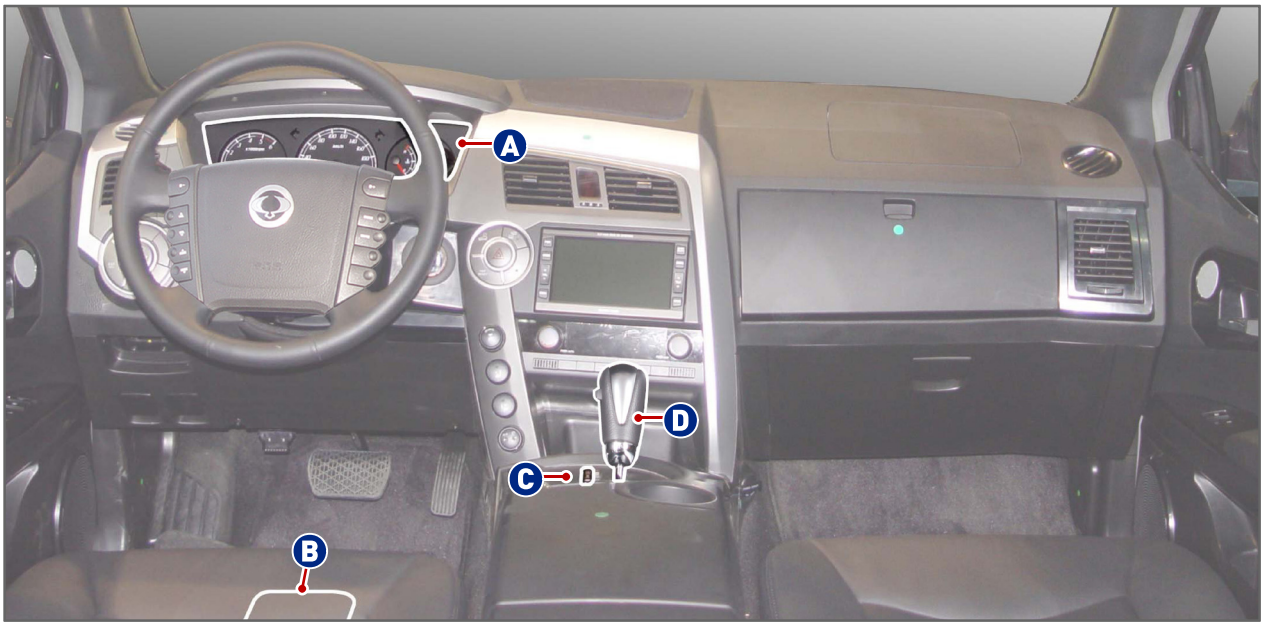
	ELEMENTS ENGAGED								
Gear State	C1	C1	C1	C1	B1	B1	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 4 Overdrive	x	x	-	-	x	-	-	-	x

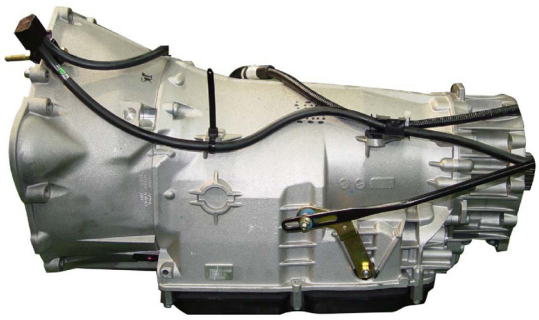


AUTOMATIC TRANSMISSION (DC 5-SPEED) 3650-01

GENERAL

1. AUTOMATIC TRANSMISSION OVERVIEW



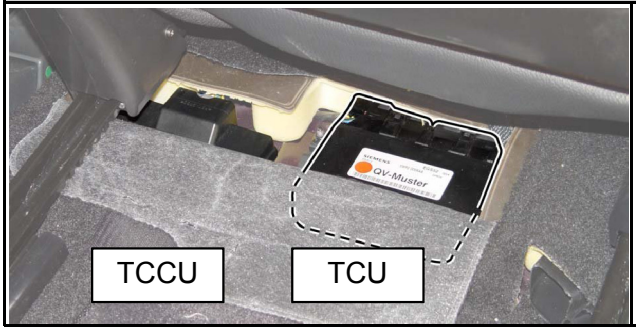
DC 5-speed Automatic Transmission Assembly	
	T-Tronic DC 5-speed automatic transmission is an electronically controlled 5-speed transmission with a lockup clutch in the torque converter. The ratios for the gears are realized by three planetary gear sets. The 5th gear is designed with a step-up ratio of 0.83 as an overdrive. The selector lever is controlled by electronically and mechanically. The gears are shifted by the corresponding combination of three hydraulically actuated multiple-disc brakes, three hydraulically actuated multiple-disc clutches and two mechanical one-way clutches. This electronically controlled automatic transmission adjusts the operating pressure to provide proper shifting in relation to engine power. This function improves shifting quality significantly. And, the driver can select "S" (Standard) mode or "W" (Winter) mode according to the driving conditions.

Modification basis	
Application basis	
Affected VIN	

A Instrument Panel

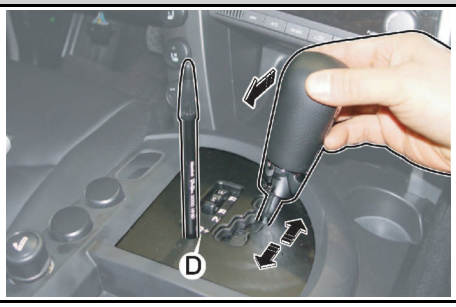


B TCU Assembly





Releasing Lock-up Solenoid Valve



When the gear selector lever cannot be moved from "P" position to other positions, manually release the lock-up function as shown in figure.

C Standard Mode / Winter Mode



"S" mode is used in normal driving.
When "W" mode is selected, the vehicle starts from 2nd gear (forward and reverse) to achieve smooth starting on the slippery road.

D Selector Lever

Downshift (Manual Mode)

1← 2 ← 3 ← 4 ← D

The shiftable gear is down by one step as the lever is moved to left (-) direction.



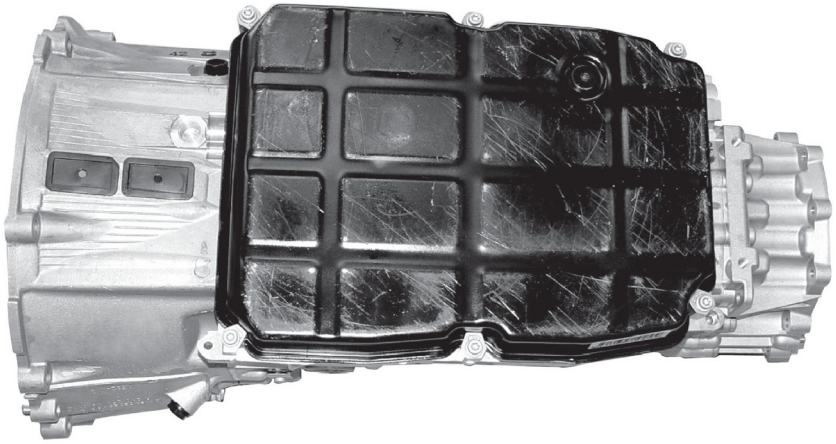
Upshift (Manual Mode)

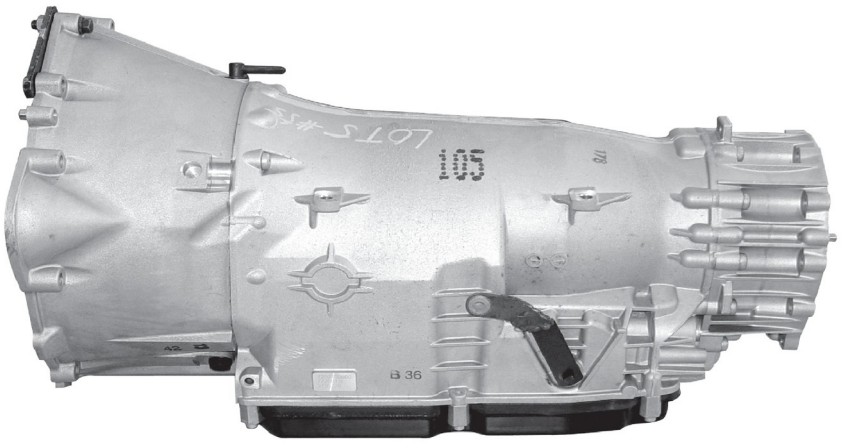
1→ 2 → 3 → 4 → D

The shiftable gear is up by one step as the lever is moved to right (+) direction.

2. AUTOMATIC TRANSMISSION (DC 5-SPEED) APPEARANCE

Left Side

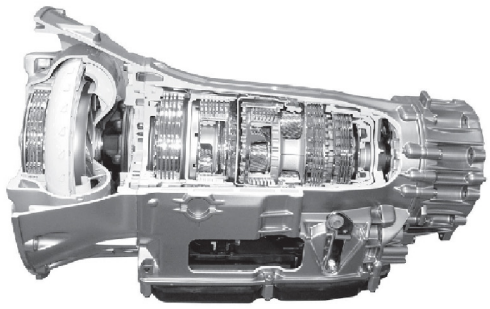


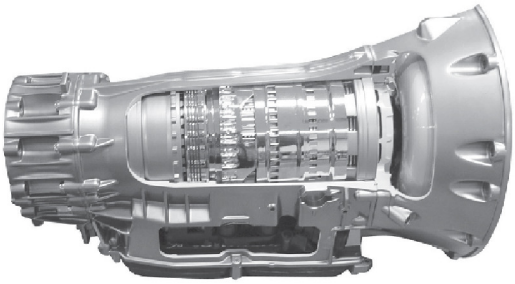


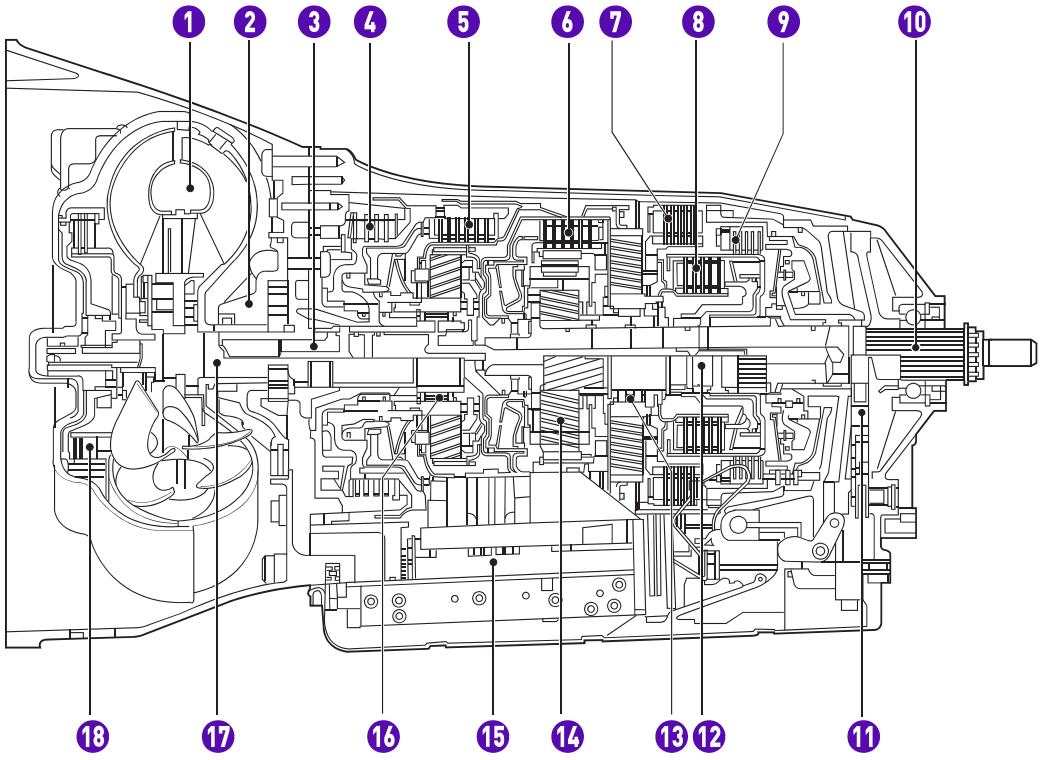
With Torque Converter	Without Torque Converter	Rear View
		

Modification basis	
Application basis	
Affected VIN	

3. AUTOMATIC TRANSMISSION STRUCTURE







※ This sectional drawing is based on DC 5-speed A/T 2WD model. 4WD model has also same structure.

1. Torque converter
2. Oil pump
3. Input shaft
4. Disc brake B1
5. Disc clutch C1
6. Disc clutch C2
7. Disc brake B3
8. Disc clutch C3
9. Disc brake B2
10. Output shaft
11. Parking lock gear
12. Intermediate shaft
13. Freewheel F2
14. Center planetary gear set
15. Electric control unit (valve body)
16. Freewheel F1 (Front planetary gear set)
17. Stator shaft
18. Converter lockup clutch

Modification basis	
Application basis	
Affected VIN	

▶ Specifications

Item		5-Speed Automatic Transmission	
		D20DT	D27DT
Input torque		2WD (580 Nm), 4WD (400 Nm)	
Weight (including ATF)		76 kg (2WD), 78 kg (4WD)	
Diameter (torque converter)		270 mm	
Lockup function		Yes	
Gear ratios	1st	3.951	3.595
	2nd	2.423	2.186
	3rd	1.486	1.405
	4th	1.000	1.000
	5th	0.833	0.831
	Rev. 1st: S / Rev. 2nd: W	3.147/1.93	3.167/1.926
Driving type		2WD/4WD	
Fluid specification		Fuchs ATF 3353 or Shell ATF 3353	
Fluid capacity		Approx. 8 ℓ	
Selector lever position	P.R.N.D	Mechanical	
	D+/D-	Electrical	
Parking lock system		Brake switch (signal) → TGS lever	
Selected lever indication	P.R.N.D	Lever position	
	4, 3, 2, 1	CAN	
Oil temperature sensor	Resistance: R, D	0.5 ~ 2.5 kW	
TCU		EGS 52	
Shift solenoid valve (25°C)	Resistance	3.8 ± 0.2 W	
	Operating distance	0.2 mm	
	Operating current	1.5 ~ 2 A	
M/P, S/P solenoid valve (23°C)	Resistance	5.0 ± 0.2 W	
	Operating distance	0.6 mm	
	Operating current	0 ~ 1.2 A	
Lockup solenoid valve (25°C)	Resistance	2.5 ± 0.2 W	
	Operating distance	0.2 mm	
	Operating current	1.5 ~ 2.0 A	
	Operating range	3rd to 5th gears	
Speed sensor	Type	HALL type	
	Operating voltage	6 V	
Start lockout switch	Switch contact	ON (D, R position)	
	Switch contact	OFF (P, N position)	

Modification basis	
Application basis	
Affected VIN	

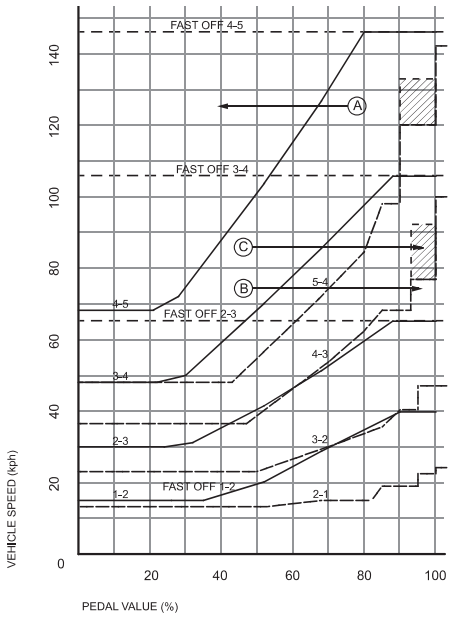
Item		5-Speed Automatic Transmission
Mode switch		W (Winter)
		S (Standard)
One-way clutch		F1, F2
Planetary gear set	Number of planetary gear set pinion (Front, Center, Rear)	4, 4, 4
Disc clutch	C1	Single side friction plate
	C2	Double side friction plate
	C3	Single side friction plate
Disc brake	B1	Single side friction plate
	B2	Double side friction plate
	B3	Double side friction plate

▶ Characteristics of Automatic Transmission

- Performance Curve

D20DT

Standard Mode



Upshift: ——————

Downshift: ——·——·——

Lockup (slipping): – – ———— – –

Unlock (open): ——————

FAST OFF: – – – – – – – – – –

Dynamic shift zone: ▱▱▱▱▱▱▱▱▱▱▱▱

FAST OFF: When abruptly releasing the accelerator pedal, the transmission remains at 4th gear other than 4 → 5 shift (when slowly releasing the accelerator pedal, the transmission is shifted to 5th gear).

Dynamic shift zone:

When operating the accelerator pedal (B), the 4 → 3 shift is completed by kick-down signal after completion of 4 → 3 shift (100% of pedal position). When promptly operating the accelerator pedal (C), the 4 → 3 shift is done in shaded area (93% of pedal position).

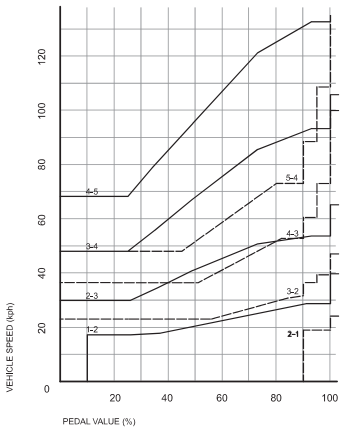
4th gear: 1.000

5th gear: 0.833

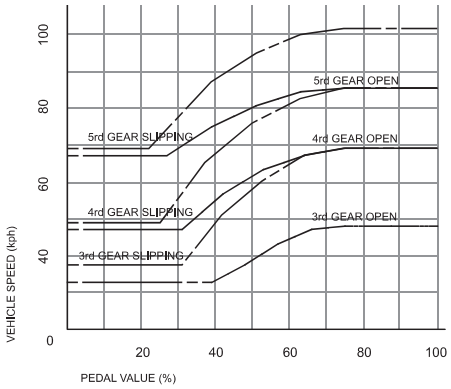
Rev. 1st gear: 3.147

Rev. 2nd gear: 1.93

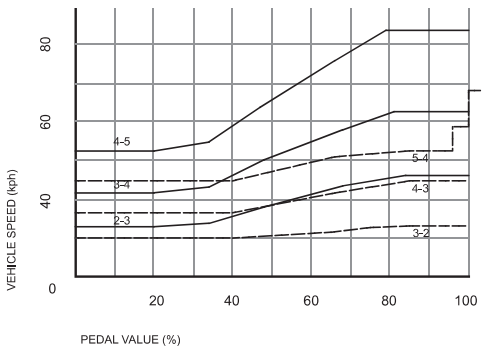
WINTER Mode (2WD)



Lockup Mode (Open/Slipping)



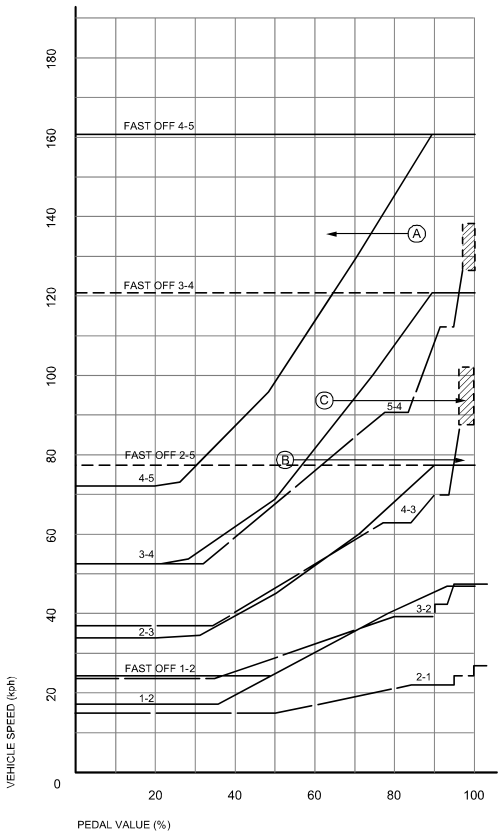
Low Mode (4WD)



Modification basis	
Application basis	
Affected VIN	

D27DT

Standard Mode



Upshift:
Downshift:
Lockup (slipping):
Unlock (open):
FAST OFF:
Dynamic shift zone:

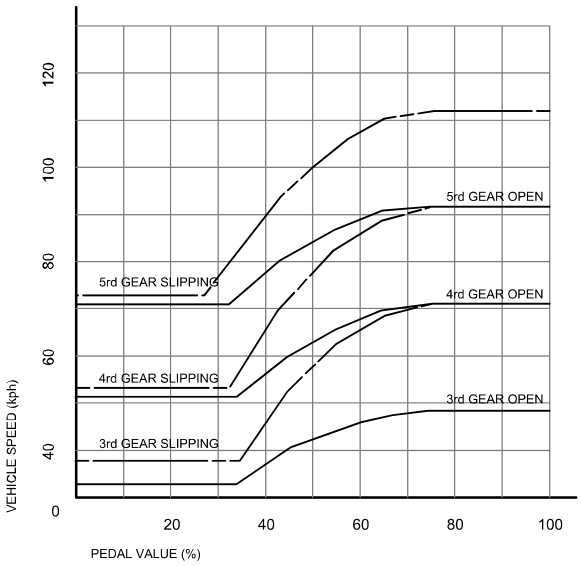
FAST OFF: When abruptly releasing the accelerator pedal, the transmission remains at 4th gear other than 4 → 5 shift (when slowly releasing the accelerator pedal, the transmission is shifted to 5th gear).

Dynamic shift zone:

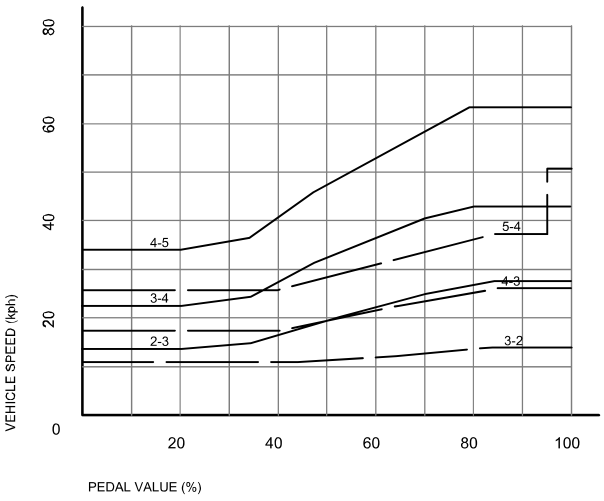
When operating the accelerator pedal (B), the 4 → 3 shift is completed by kick-down signal after completion of 4 → 3 shift (100% of pedal position). When promptly operating the accelerator pedal (C), the 4 → 3 shift is done in shaded area (93% of pedal position).

4th gear: 1.000
5th gear: 0.833
Rev. 1st gear: 3.147
Rev. 2nd gear: 1.93

Lockup Mode (Open/Slipping)



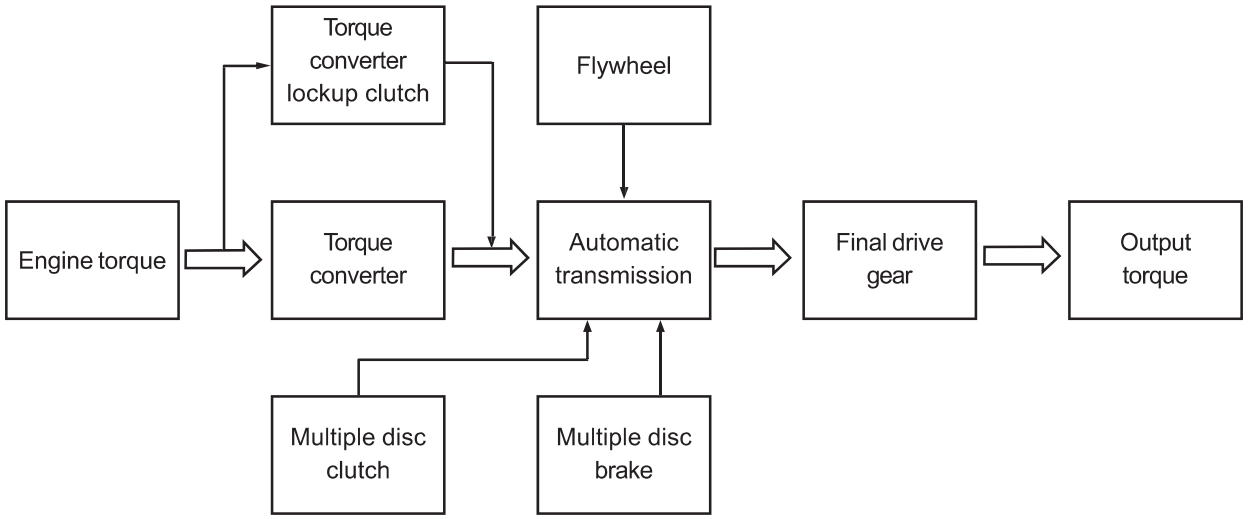
WINTER Mode



Modification basis	
Application basis	
Affected VIN	

▶ General Characteristics

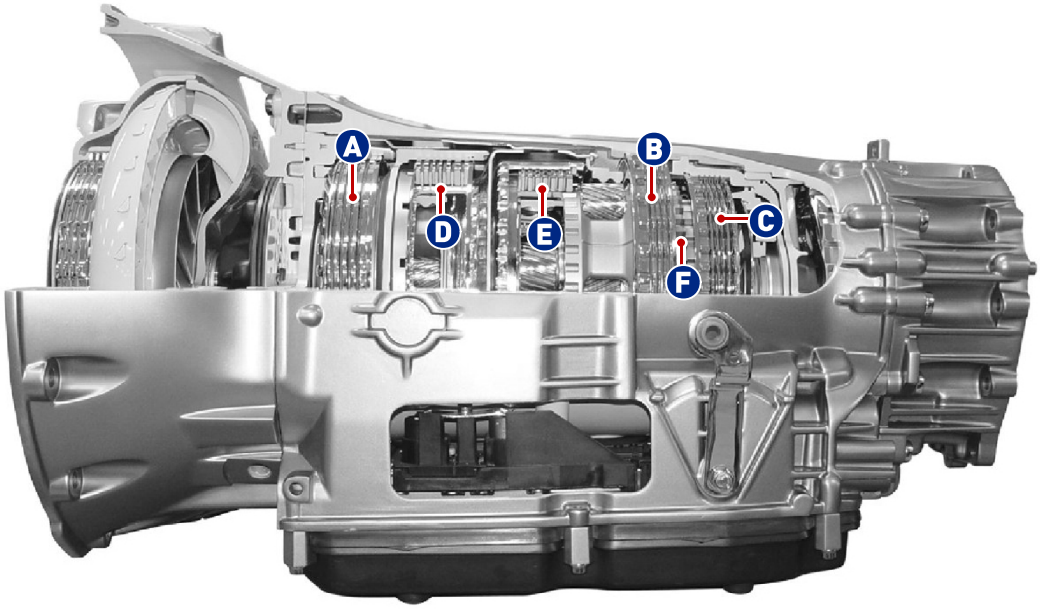
Characteristic	Function and Effect
Slope recognition (down hill, up hill)	Slope is recognized based on engine RPM and accelerator pedal position. → Delays up shift
Engine torque reduction	Ignition timing is delayed to reduce torque at all shifting moments. → Improves shift quality
Engine rpm limitation	Engine rpm is limited until the gears are fully engaged when shifting from “N” to “D”. → Prevents shift shock
ESP Operation	When the ESP is controlling the engine torque, shifting is not available and vehicle starts off with 2nd gear. → Cannot use kick-down function and shift at maximum rpm
ABS Operation	Brake control is not affected.
Fast-off function	It is not shifted up when accelerator pedal is abruptly released. → To get engine brake effect during cornering
Altitude recognition	As altitude increases (atmospheric pressure reduces), engine torque decreases. To compensate this torque reduction, shift up occurs when depressing the accelerator pedal more than usual operation (adjusting shift diagram). → Improves driving performance and increases torque
Oil temperature	If transmission fluid temperature is too low, the shifting point gets delayed in full throttle and kick down. → Improves driving performance
Hydraulic pressure is produced in emergency driving mode	When starting the engine with cycling the ignition switch (“OFF” and “ON”) due to transmission trouble, the selector lever should be placed in “P” position. If starting the engine with selector lever “N” position, the lever should be moved into “P” position. The selector valve changes the path of hydraulic pressure in selector lever “P” position. → The hydraulic pressure flows to direct operation mode via “R” and “D” valve to operate “reverse 2nd” and “forward 2nd” gear.
Adaptation	Function to optimize the shifting quality. → Compensates the shifting quality according to play and wear



Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. POWER FLOW



Brake B1(disk) assembly	Brake B3 (disk) assembly	Brake B2 (disk) assembly
A 	B 	C 
C1 (Disk clutch) assembly	**C2 (Disk clutch) assembly**	**C3 (Disk clutch) assembly**
D 	E 	F 

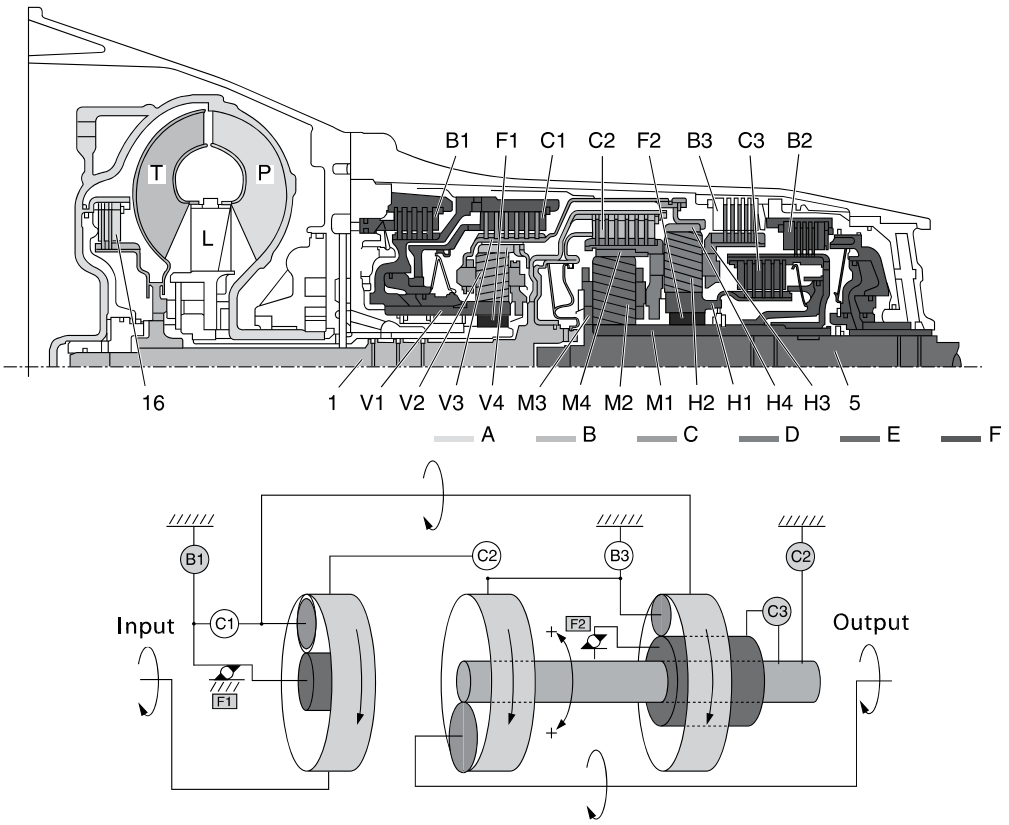
▶ Shifting Elements

Gear	C1	C2	C3	B1	B2	B3	F1	F2
1			● 3)	● 3)	●		●	●
2	●		● 3)		●			●
3	●	●			●			
4	●	●	●					
5		●	●	● 3)			●	
P/N 1)			●	●				
P/N 2)	●		●					
R 1)			●	● 3)		●	●	
R 2)	●		●			●		

※ 1) Selector program switch: S mode 2) Selector program switch: W mode 3) Overrun

Modification basis	
Application basis	
Affected VIN	

1) 1st Gear (D20DT: 3.951, D27DT: 3.595)



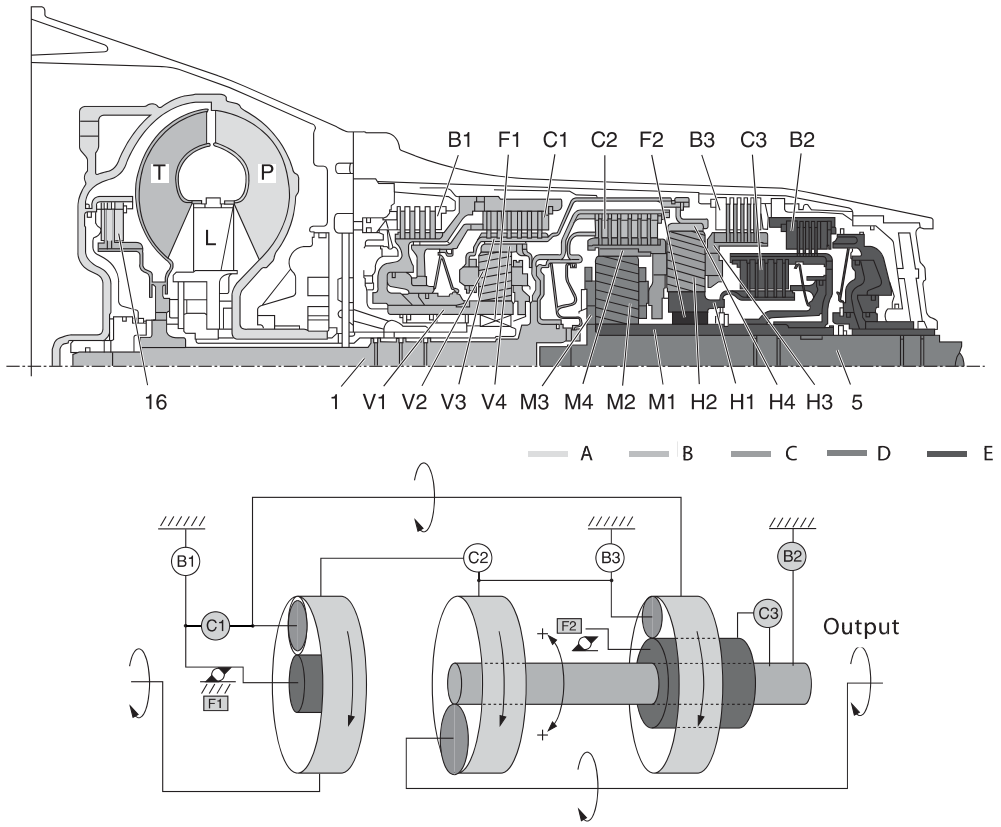
16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. 3rd gear ratio
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front sun gear: Locked by F1 and B1, Planetary gear carrier: Rotation with reduced speed
3. Rear ring gear: clockwise rotation
4. Rear sun gear: Locked by F2 and B2, Planetary gear carrier: Clockwise rotation with reduced speed
5. Center ring gear: Clockwise rotation
6. Center sun gear: Locked by B2, Rotation with reduced speed
7. Output shaft: Clockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2	Lockup clutch
1			● 3)	● 3)	●		●	●	

※ 3) Overrun

2) 2nd Gear (D20DT: 2.423, D27DT: 2.186)



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

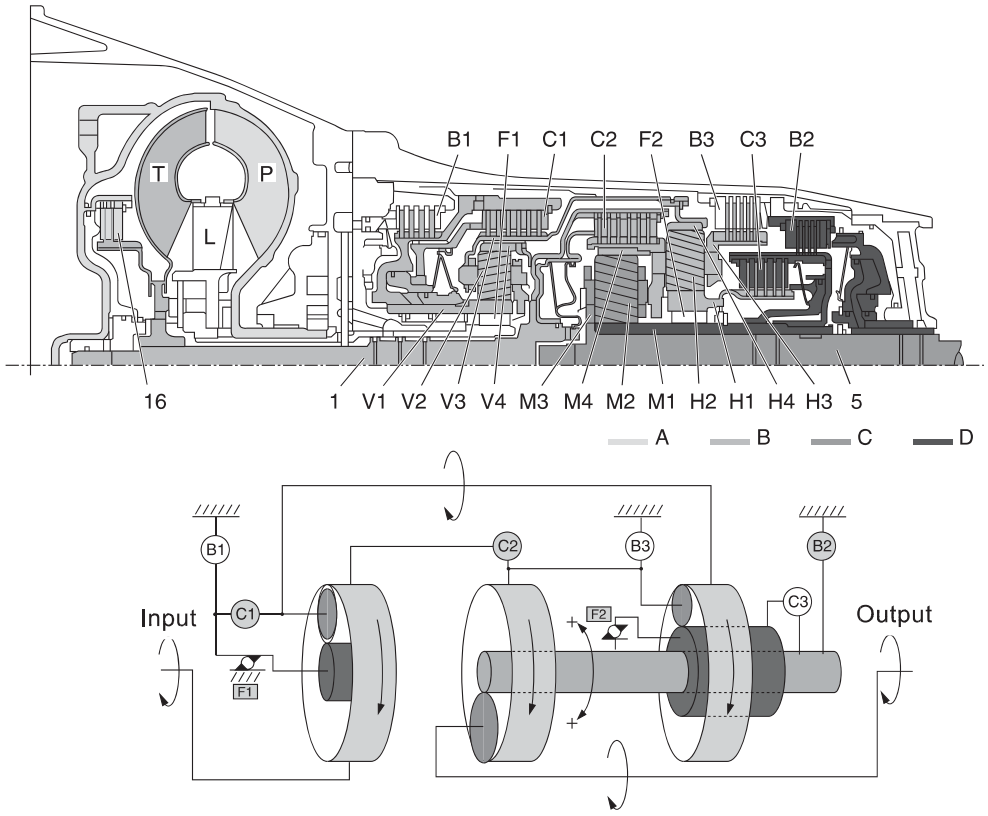
1. Input shaft: Clockwise rotation
2. Sun gear and planetary gear carrier: Clockwise rotation by C1 activation
3. Rear ring gear: Clockwise rotation
4. Rear sun gear: Locked by F2 and B2, Planetary gear carrier: Rotation with reduced speed
5. Center ring gear: Clockwise rotation
6. Sun gear: Locked by B2, Planetary gear carrier: Rotation with reduced speed
7. Output shaft: Clockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
2	●		● 3)		●			●

※ 3) Overrun

Modification basis	
Application basis	
Affected VIN	

3) 3rd Gear (D20DT: 1.486, D27DT: 1.405)

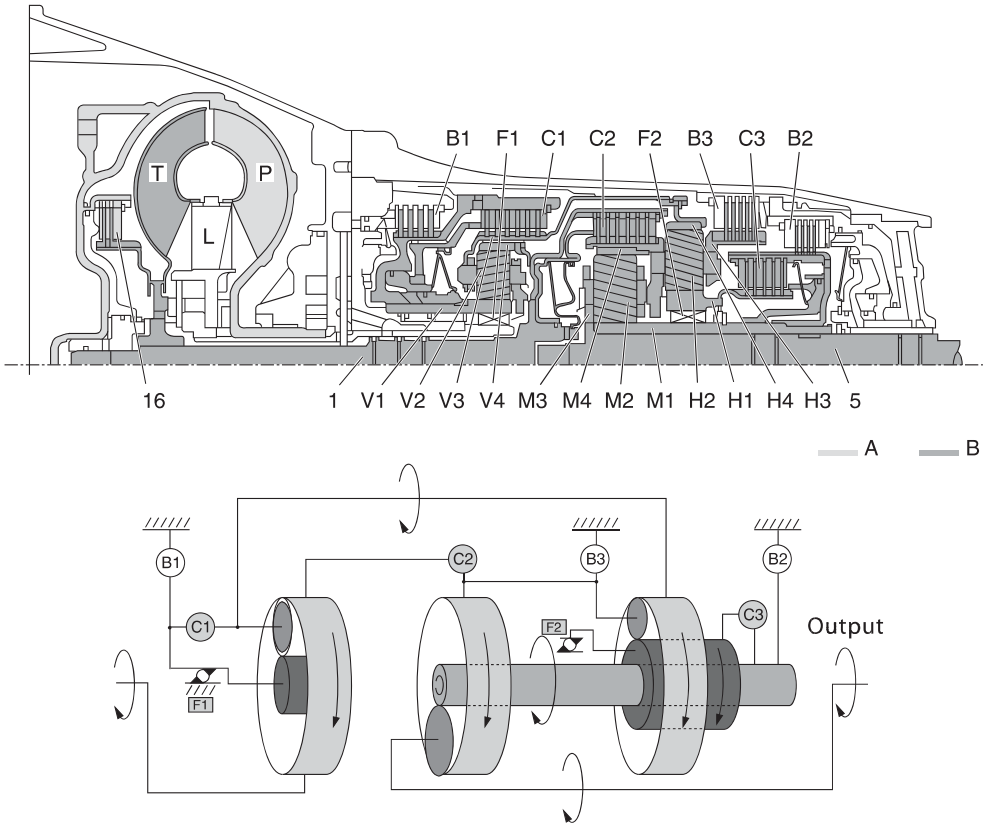


16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Center ring gear: Clockwise rotation by clutch 2 activation (direct connection)
4. Center sun gear: Locked by B2, Planetary gear carrier: Clockwise rotation with reduced speed
5. Output shaft: Clockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
3	●	●			●			

4) 4th Gear (1.000)



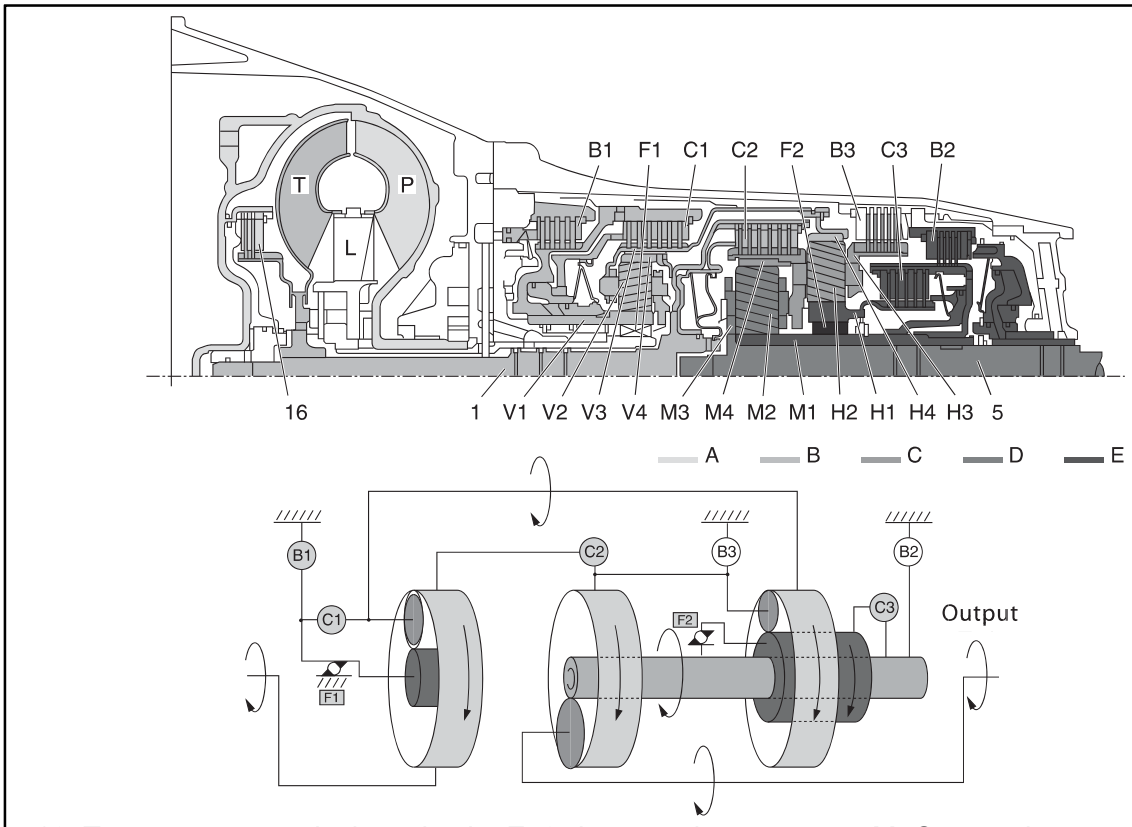
16. Torque converter lockup clutch
L. Stator
T. Turbine wheel
A. Engine speed
M. Center planetary gear set
V. Front planetary gear set
B. Planetary gear set
P. Impeller

1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Center ring gear and rear planetary gear carrier: Clockwise rotation
4. Front sun gear and planetary gear carrier: Clockwise rotation (direct connection)
5. Rear ring gear: Clockwise rotation
6. Rear sun gear: Rotation by ring gear and planetary gear carrier (direct connection)
7. Center sun gear: Clockwise rotation by C3 activation
8. Planetary gear carrier: Clockwise rotation by center sun gear and ring gear (direct connection)
9. Output shaft: Clockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
4	●	●	●					

Modification basis	
Application basis	
Affected VIN	

5) 5th Gear (D20DT: 0.833, D27DT: 0.831)



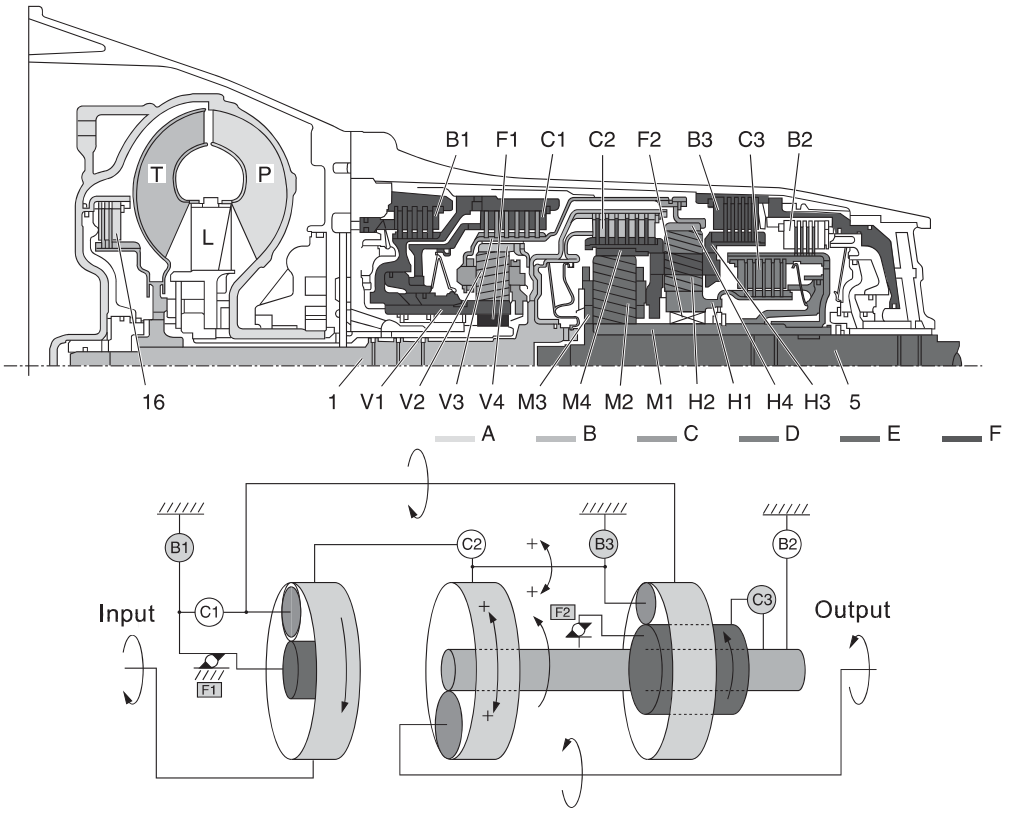
16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. 3rd gear ratio
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front sun gear: Locked by B1, Planetary gear carrier: Rotation with reduced speed
3. Rear planetary gear ring gear: Clockwise rotation with reduced speed
4. Center ring gear and rear planetary gear carrier: Clockwise rotation by clutch C2 activation
5. Rear sun gear: Clockwise rotation because rear planetary gear carrier rotates faster than rear ring gear(increased speed)
6. Center sun gear: Clockwise rotation with increased speed by clutch C3 activation
7. Center planetary gear carrier: Clockwise rotation (increased speed)
8. Output shaft: Clockwise rotation (increased speed)

Gear	C1	C2	C3	B1	B2	B3	F1	F2
5		●	●	● 3)			●	

※ 3) Overrun

6) Reverse 1st Gear (D20DT: 3.147, D27DT: 3.167)
- Standard (S) Mode



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. Locking elements
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

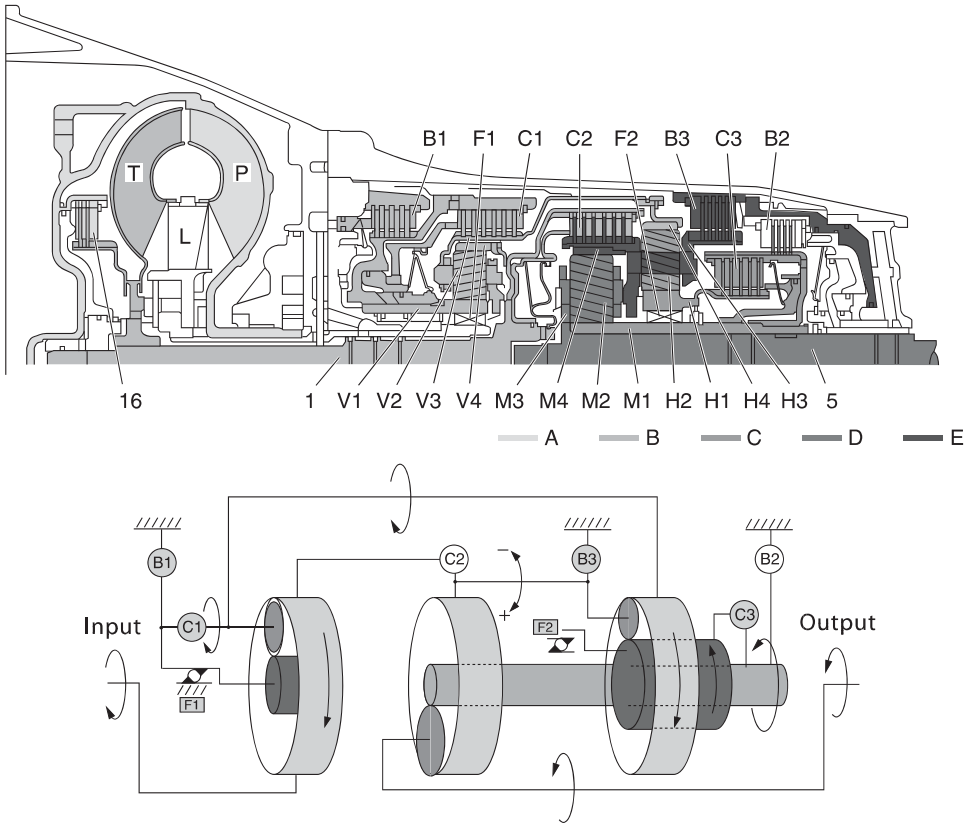
1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Front sun gear: Locked by one-way clutch F1
4. Front planetary gear carrier: Clockwise rotation (reduced speed)
5. Rear planetary gear ring gear: Clockwise rotation
6. Rear planetary gear carrier: Locked by B3
7. Rear sun gear and center sun gear: Counterclockwise rotation (increased speed)
8. Center ring gear: Locked by B3
9. Center planetary gear carrier: Counterclockwise rotation (reduced speed)
10. Output shaft: Counterclockwise rotation

Gear	C1	C2	C3	B1	B2	B3	F1	F2
R (S)			●	● 3)		●	●	

※ 3) Overrun

Modification basis	
Application basis	
Affected VIN	

7) Reverse 2nd Gear (D20DT: 1.93, D27DT: 1.926) - Winter (W) Mode Mode



16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Front planetary gear carrier: Clockwise rotation by clutch C1 activation (direct connection)
4. Rear ring gear: Clockwise rotation
5. Rear planetary gear carrier and center ring gear: Locked by brake B3
6. Rear sun gear and center sun gear: Counterclockwise rotation (increased speed)
7. Center planetary gear carrier: Counterclockwise rotation (reduced speed)
8. Output shaft: Counterclockwise rotation

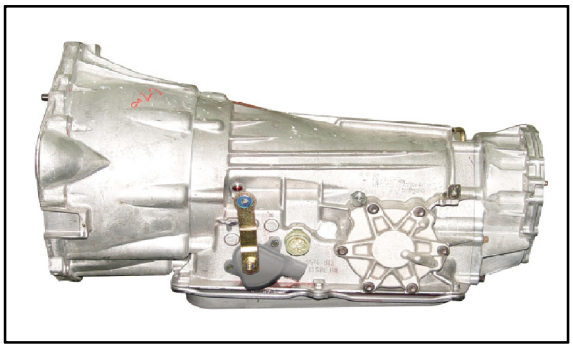
Gear	C1	C2	C3	B1	B2	B3	F1	F2
R (W)	●		●			●		

AUTOMATIC TRANSMISSION 3650-01

GENERALS

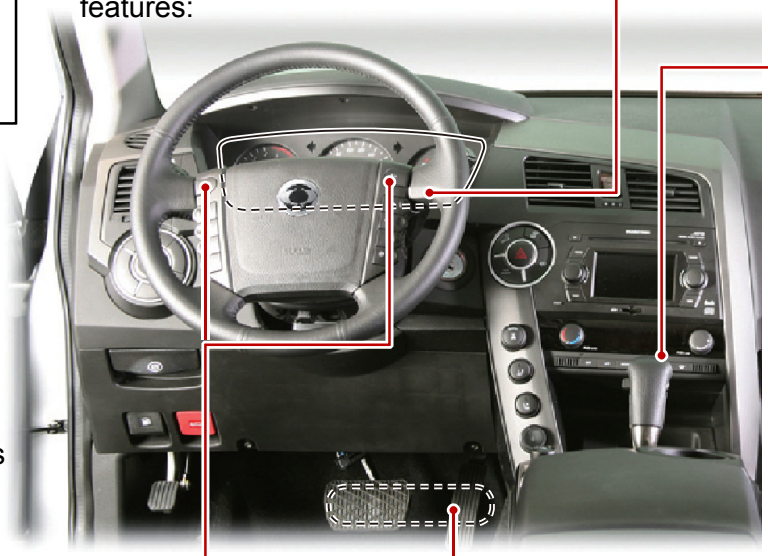
1. DSI M78 6-SPEED AUTOMATIC TRANSMISSION GENERAL

▶ Six Speed Automatic Transmission



The six speed automatic (M78) transmission is available in two variants: four wheel drive and two wheel drive.
The transmission has the following features:

- Six Forward Speeds
- One reverse gear
- A torque converter with an integral converter lock-up clutch
- Electronic shift and pressure controls
- A single planetary gear-set
- A double planetary gear-set
- Two hydraulically controlled brake bands
- Three multi-plate clutches
- All hydraulic functions are directed by electronic solenoids to control:
- Engagement feel
  - Shift feel
  - Shift scheduling
  - Modulated torque converter clutch applications



Tip Switch on Steering Wheel



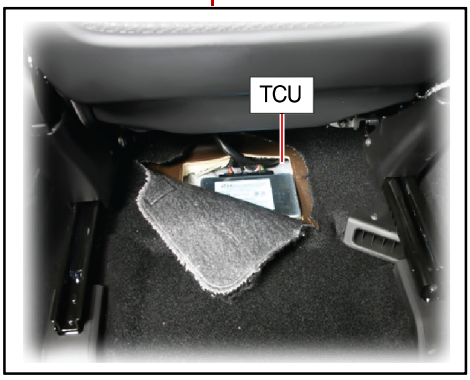
Shift down



Shift up

▶ TCU (Installed under the driver's seat)

The TCU receives input signals from certain transmission-related sensors and switches. The TCU also uses these signals when determining transmission operating strategy.
Using all of these input signals, the TCU can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the pressure needed to optimise shift feel.



Modification basis	
Application basis	
Affected VIN	

▶ Six Speed Automatic Transmission



Gear Position Indicator (for automatic transmission)



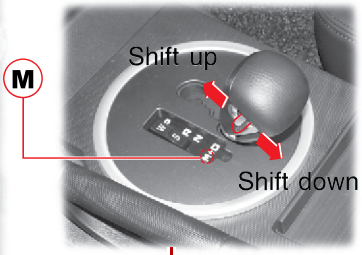
This indicator shows the current position of the gear.

P: Parking
R: Reverse
N: Neutral
D: Driving (1 ~ 6th gear shifting) - 6A/T
6: 1~6th Gear shifting
5: 1~5th Gear shifting
4: 1~4th Gear shifting
3: 1~3rd Gear shifting
2: 1~2nd Gear shifting
1: 1st Gear

▶ TGS Lever



Tip Switch on Gear Selector Lever



Tip Switch (Manual GearAdjustment)

The shiftable gear can be adjusted by this switch when the gear selector lever is in "M" position.

Shift Lock Release Button Hole when Locked in the "P" Position

If you cannot move the selector lever from the "P" position, try to move the lever while pushing down here with a sharp object such as a ballpoint pen. For your safety, turn off the engine and depress the brake pedal before the attempt.



Winter Mode

When winter mode is selected, starting in second gear is facilitated and the WINTER mode indicator light is switched ON. To prevent wheel spin on slippery surfaces, the transmission will not allow first gear unless manually overridden.

Standard Mode

Standard Mode is selected when the lever is in the D position with the mode switch in the standard (S) position and the transmission is within normal temperature ranges. Shift schedule points are optimised for fuel efficiency and general driving conditions.

Shift from the "P" Position

To shift into any other positions from the "P" position after stopping the vehicle, you have to depress the brake pedal with the ignition switch "ON".

2. STRUCTURE CHARACTERISTICS AND SPECIFICATIONS

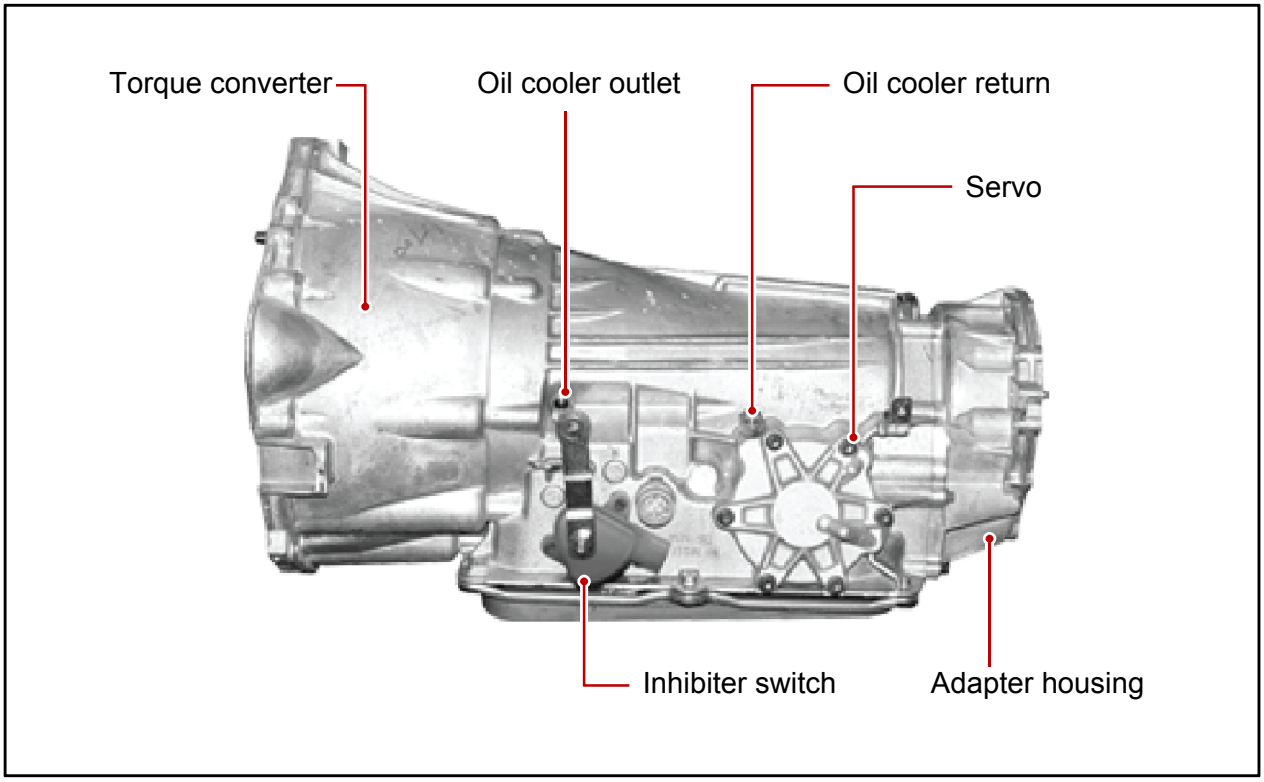
1) Specifications

Description		DSI M78 6A/T	REMARK
Gear ratios	1st	3.536 : 1	
	2nd	2.143 : 1	
	3rd	1.478 : 1	
	4th	1.156 : 1	
	5th	0.866 : 1	
	6th	0.677 : 1	
	Reverse	3.094 : 1	
Torque converter	Diamerter	260 (mm)	
	Number of element	3 EA	
	Number of Step	1 EA	
	Number of Phase	2 EA	
Transmission component	Planetary gear set	2 EA	
	One-way clutch	1 EA	
	Multi disc clutch	3 EA	
	Band brake	2 EA	
Weight	Including oil	79 kg	
Oil	Fluid specification	CALTEX PED 1712 ATF	
	Fluid capacity	Approx. 9.5 ℓ	
	Change interval	At every regular check-up (every 30,000 km or 1 year) Check fluid level, leakage and fluid condition. Change if necessary	
Resistance of oil temperature sensor	-20°C	430.7 ~ 533.9 Ω	
	0°C	146.8 ~ 175.7 Ω	
	20°C	56.74 ~ 65.86 Ω	
	100°C	3.201 ~ 3.399 Ω	
Resistance of gear position sensor	1	-	
	2	-	
	3	-	
	D gear position	2.686 kΩ ± 8%	
	N gear position	5.036 kΩ ± 8%	
	R gear position	8.953 kΩ ± 8%	
	P gear position	16.786 kΩ ± 8%	

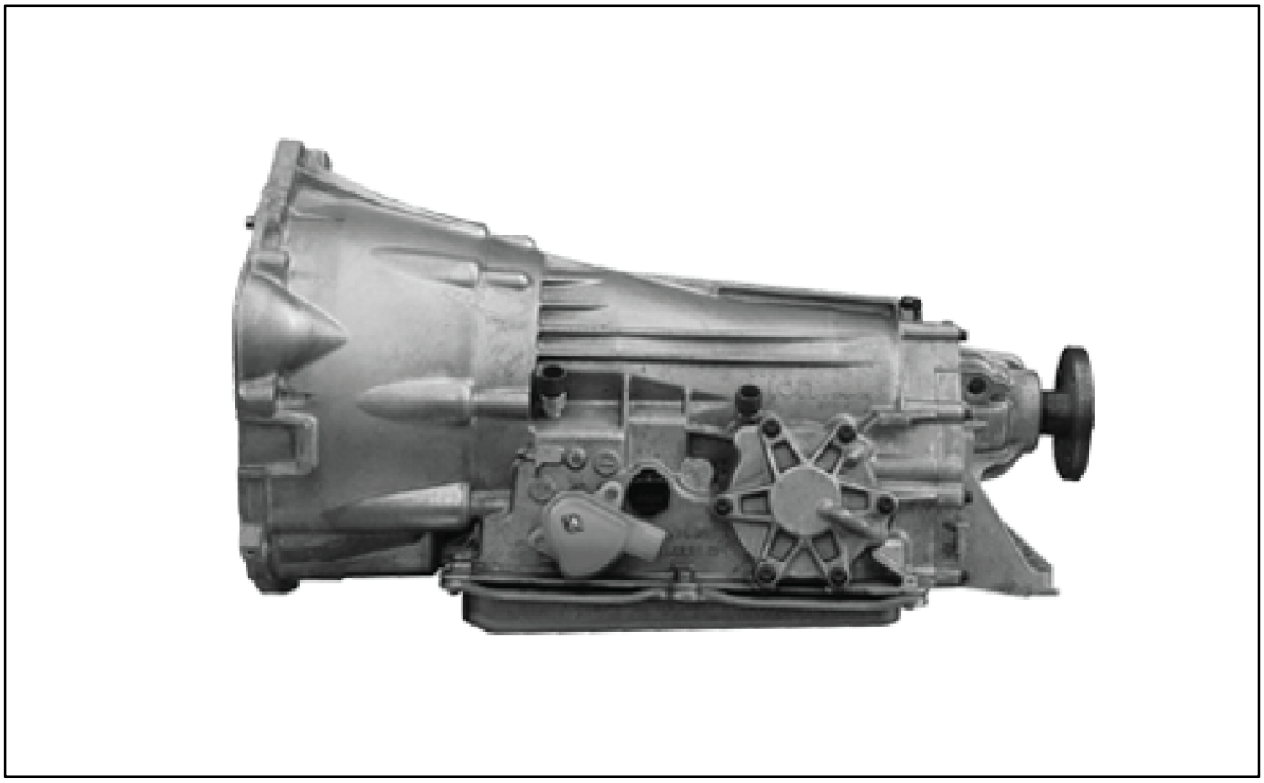
Modification basis	
Application basis	
Affected VIN	

2) Appearance

▶ **4WD Automatic Transmission**

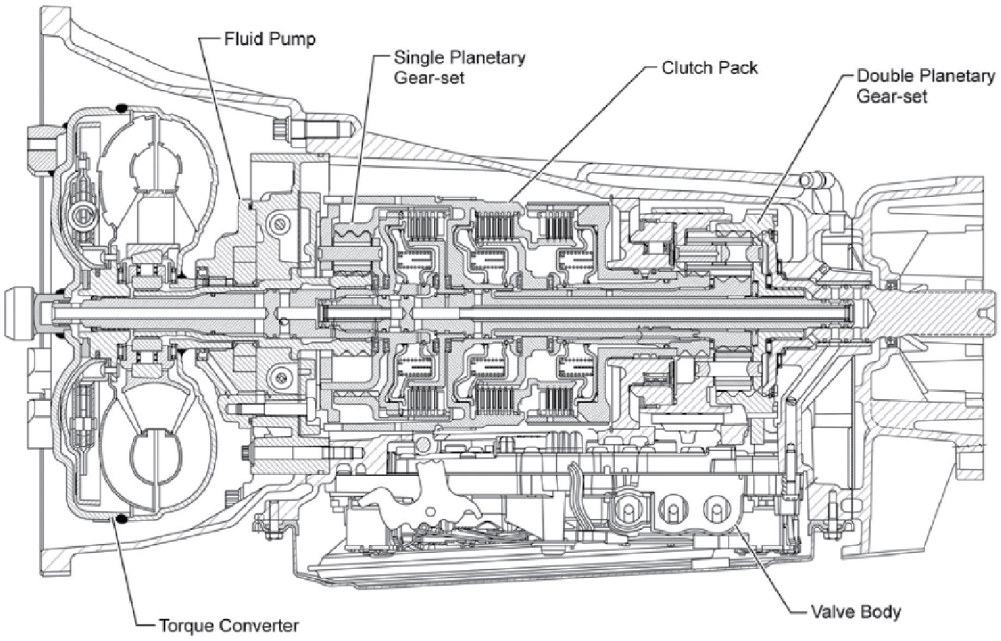


▶ **2WD Automatic Transmission**

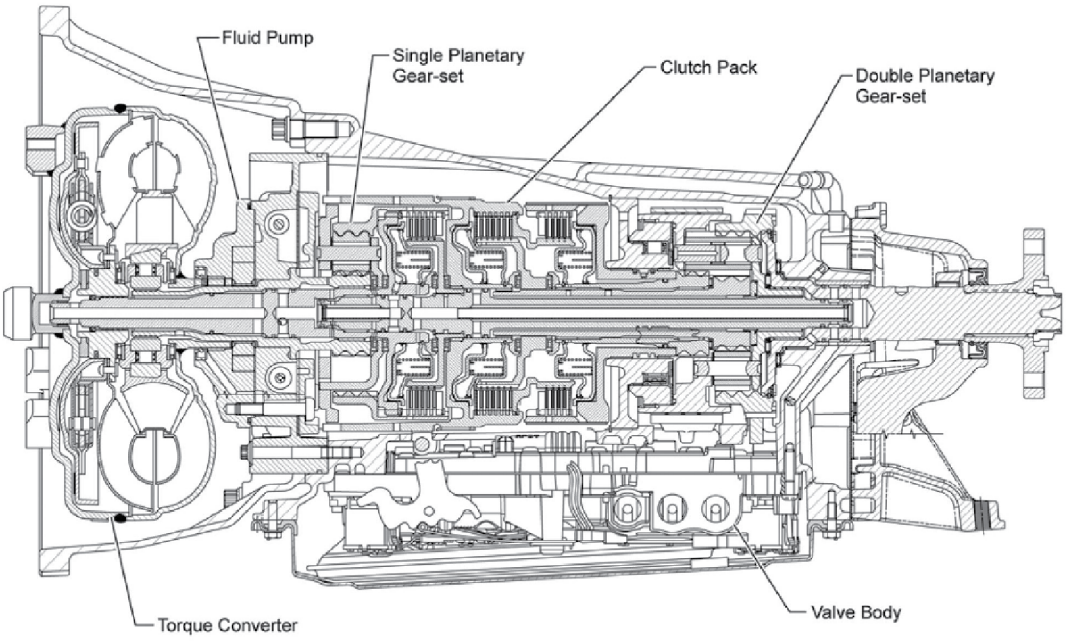


3) Internal Assembly Figure

4WD

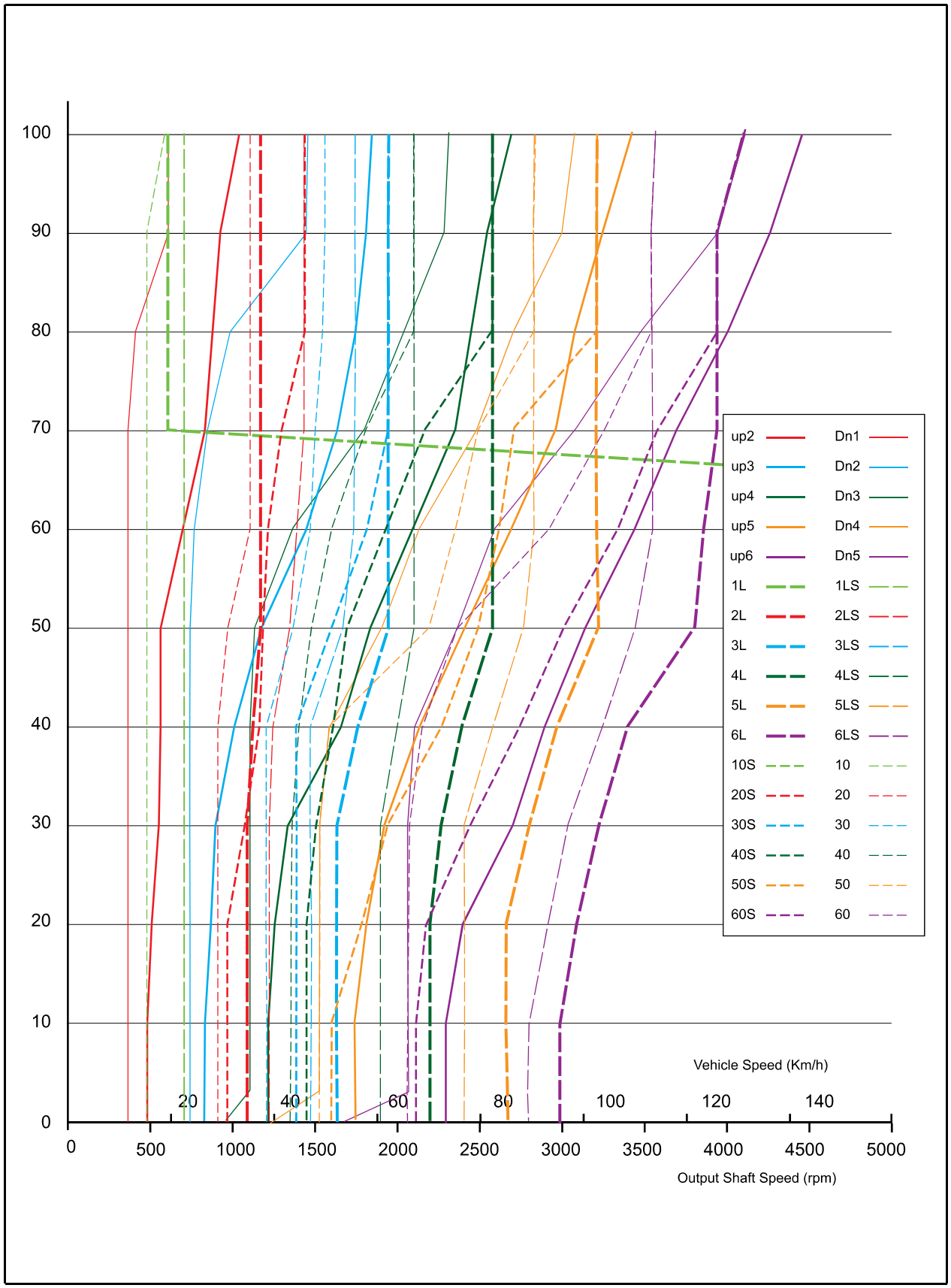


2WD



Modification basis	
Application basis	
Affected VIN	

4) Shift Pattern



Modification basis	
Application basis	
Affected VIN	

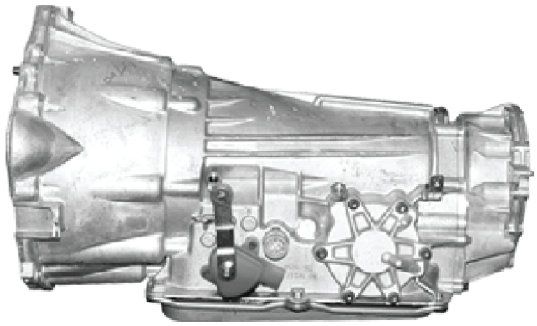
3. TIGHTENING TORQUE

Component	Size	Torque (Nm)
TC housing	M12 x 32	54 ~ 68
Extension housing	M12 x 32	54 ~ 68
Oil pan	M6 x 16	4 ~ 6
Tightening valve body and transmission housing	M6 x 26	8 ~ 13
Tightening valve body and transmission housing	M6 x 45	8 ~ 13
Tightening center support and transmission housing	M10 x 34	20 ~ 27
Output shaft locking nut	M24 x 15	100 ~ 110
Tightening oil pump and pump cover	M8 x 55	24 ~ 27
Tightening pump cover and transmission housing	M8 x 40	24 ~ 34
Tightening pump cover and transmission housing	M8 x 58	24 ~ 34
Tightening upper valve body and lower valve body	M6 x 30	15 ~ 17
Fixing detent spring	M8 x 16	20 ~ 25
Fixing VBS & speed sensor	M4 x 12	2.8 ~ 3.2
Transmission oil level plug		30 ~ 35
Fixing front transmission cooler line and transmission cooler connector		25 ~ 35
Fixing rear transmission cooler line and transmission cooler connector		25 ~ 35
Fixing torque converter and drive plate		40 ~ 42
Tightening transmission selector lever and shaft rod		14 ~ 20

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERTION PROCESS

1. GENERAL DESCRIPTION



4WD

The six speed automatic (M78) transmission is available in two variants: four wheel drive and two wheel drive.
The transmission has the following features:

- Six Forward Speeds
- One reverse gear
- A torque converter with an integral converter lock-up clutch
- Electronic shift and pressure controls
- A single planetary gear-set
- A double planetary gear-set
- Two hydraulically controlled brake bands
- Three multi-plate clutches
- All hydraulic functions are directed by electronic solenoids to control:
  - Engagement feel
  - Shift feel
  - Shift scheduling
  - Modulated torque converter clutch applications

The transmission contains fully synthetic automatic transmission fluid (ATF) and is filled for life; therefore it does not require periodic servicing.
Engine power reaches the transmission via a torque converter with integral converter lock-up clutch.
The six forward gears and one reverse gear are obtained from a single planetary set, followed by a double planetary set. This type of gear-set arrangement is commonly known as Lepelletier type gear-set.
The automatic transmission is electronically controlled. The control system is comprised of the following elements:

- External transmission control unit (TCU)
- Internal embedded memory module (EMM)
- Input and output speed sensors
- Valve body unit comprised of four on/off solenoid valves and six variable bleed solenoids
- Torque converter

2. ADVANCED SIX SPEED FEATURES

1) Characteristics

▶ Early Downshifts with Hard Braking and Skip Shifts

When heavy braking is detected, the transmission downshifts early and skips gears to provide increased engine braking to provide gear selection for tip-in.

▶ Gear Hold Going Uphill/Downhill

If the accelerator pedal is released when travelling uphill, upshifts are prevented to reduce busyness on grades. If the accelerator pedal is released when travelling downhill, upshifts are prevented to enhance engine braking.

▶ Upshift Prevention with Fast-off Accelerator Pedal

Upshifts are prevented when the throttle is backed off very quickly to reduce busyness in sporty driving.

▶ Drive and Reverse Engagement

A soft engagement feature avoids harsh take up of drive when selecting Drive or Reverse. This is achieved by limiting engine speed and engine torque which results in a rapid, but progressive engagement of either Drive or Reverse when moving from the Park or Neutral positions. Drive and Reverse engagements from either Park or Neutral are performed in less than 2.2 seconds.
There is no drive engagement prevention strategy implemented on the transmission system as there is sufficient engine strategy to protect the system. However, reverse engagement is prevented until engine speed is less than 1400 rpm and the accelerator pedal position is less than 12% and vehicle speed is less than 10 km/h.

▶ Converter Clutch Lock-Up In All Gears

The transmission features converter clutch lock-up in all gears. This feature provides improved fuel economy and vehicle performance. It also improves transmission cooling efficiency when towing heavy loads at low speeds, e.g. in city driving or hill terrain.

▶ Converter Clutch Lock-Up In All Gears

The embedded memory module (EMM) is matched to the transmission's valve bodies during transmission assembly to ensure refined shift quality. The EMM is integrated into the input speed sensor which is mounted on the valve body in the transmission. The EMM is used to store data such as valve body calibration data and valve body serial number.
Upon installation, the TCU will download the data from the EMM and utilise this data in the operation of the transmission.

Modification basis	
Application basis	
Affected VIN	

2) Transmission Cooling

The transmission cooling system ensures rapid warm-up and constant operating temperature resulting in reduced fuel consumption and refined shift quality.
It also includes a cooler by-pass within the hydraulic system to allow sufficient cooling and lubrication to the transmission drivetrain in the event of a blockage in the transmission cooler.

3) Shift Strategy

▶ Gear Hold Going Uphill/Downhill

Transmission gear change is controlled by the TCU. The TCU receives inputs from various engine and vehicle sensors to select shift schedules and to control the shift feel and torque converter clutch (TCC) operation at each gear change

▶ Coastdown

Coastdown downshifts occur at 0% pedal when the vehicle is coasting down to a stop.

▶ Torque Demand

Torque demand downshifts occur (automatically) when the driver demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

3. FUNCTION OF EACH MODE

1) Description

(1) Shift Lock Release Button Hole when Locked in the "P" Position

If you cannot move the selector lever from the "P" position, try to move the lever while pushing down here with a sharp object such as a ballpoint pen. For your safety, turn off the engine and depress the brake pedal before the attempt.

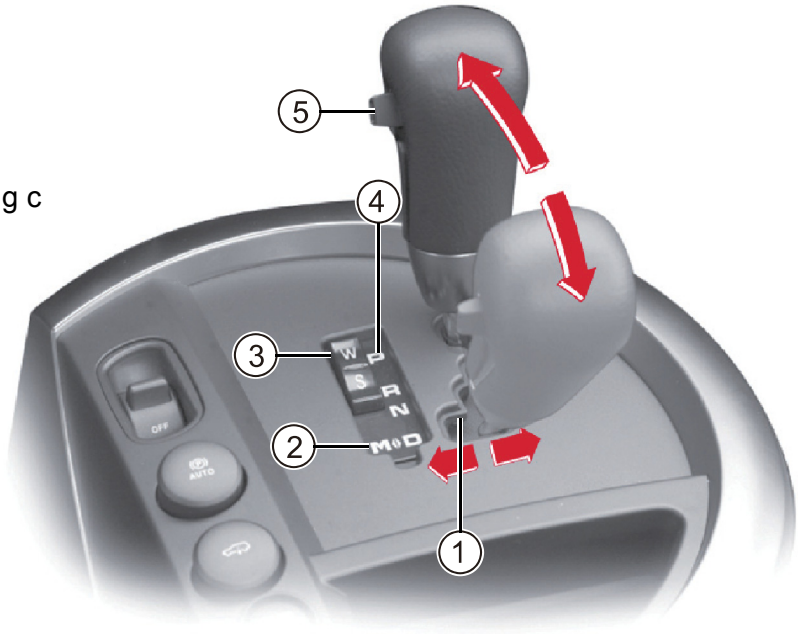
Shift from the "P" Position
To shift into any other positions from the "P" position after stopping the vehicle, you have to depress the brake pedal with the ignition switch "ON".

(2) Selection of Manual / Automatic Shift Function

- **D** : Automatic shift according to the driving condition
- **M** : Manual shift

(3) Mode Switch

- **W** : Winter mode
- **S** : Standard mode
  Use the standard mode in normal driving c



(4) Gear Position

- **P** : Parking
- **R** : Reverse
- **N** : Neutral
- **D** : Driving

(5) Tip Switch (Manual Gear Adjustment)

The shiftable gear can be adjusted by this switch when the gear selector lever is in "M" position.

Modification basis	
Application basis	
Affected VIN	

2) Range Mode (Manual Mode)

This allows the driver to define the highest possible gear by selecting "+" or "-" on the gear selector when the lever is in the "M" position. When the lever is first moved to the manual "M" position the transmission will select the lowest possible gear.
When maximum engine rpm is reached the transmission will upshift automatically regardless of the driver selected limit. 4WD models with low range will not automatically upshift when low range is selected.

NOTE
Kickdown Function
If you need to accelerate rapidly, depress the accelerator pedal completely to the floor.
Then, a one- or two-lever gear will automatically be engaged.
This is called the Kickdown function.

▶ 1st Gear State

The 1st gear state will display on the instrument cluster. Unlike the normal 1st gear, engine braking will be available in this manual 1st state.

▶ 2st Gear State

The 2nd gear state will display on the instrument cluster. 2-1 automatic kick-down shifts are available. 2nd gear has engine braking available.

▶ 3st Gear State

The 3rd gear state will display on the instrument cluster. 3-2 and 3-1 automatic kick-down shifts are available. 3rd gear has engine braking available.

▶ 4st Gear State

The 4th gear state will display on the instrument cluster. 4-3, 4-2 and 4-1 automatic kick-down shifts are available. 4th gear has engine braking available.

▶ 5st Gear State

The 5th gear state will display on the instrument cluster. 5-4, 5-3 automatic kick-down shifts are available. 5th gear has engine braking available.

▶ 6st Gear State

The 6th gear state will display on the instrument cluster. 6-5, 6-4 automatic kick-down shifts are available. 6th gear has engine braking availabl

4. LIMP HOME MODE

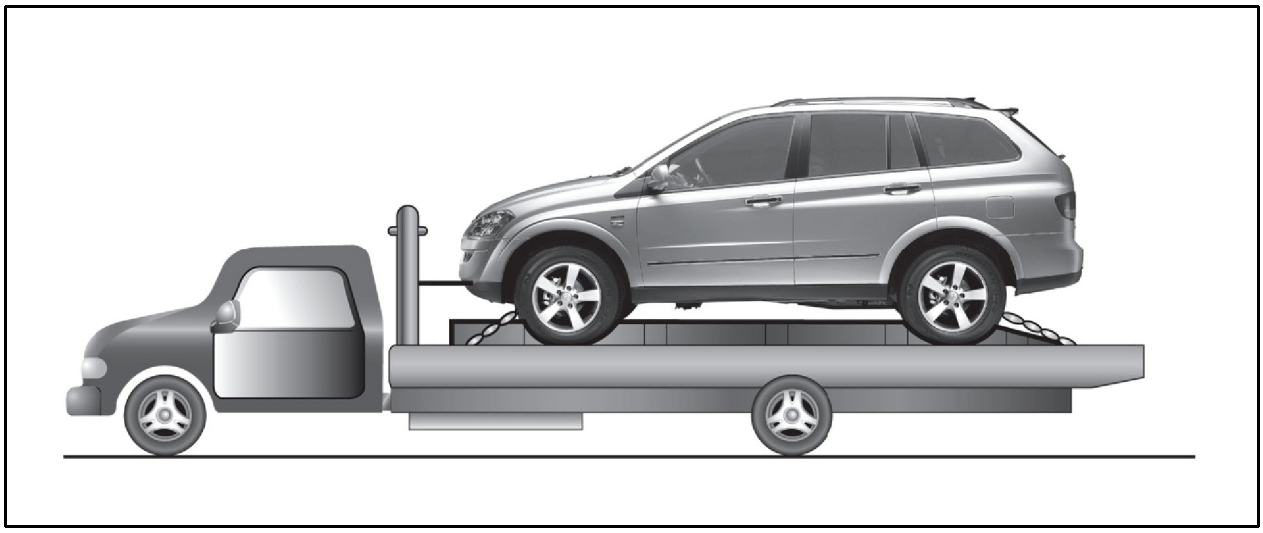
▶ In case of transmission malfunction

1. If a serious fault occurs in the automatic transmission, the TCU enters the limp home mode to secure safe driving and protect the automatic transmission.
2. As power is no longer supplied to the solenoid, the current basic function (P, R, N, D) is maintained and the 4th gear can be maintained only by the operation of the hydraulic system without electrical operation.
3. The ECU communicates with other electric modules with CAN. If a serious fault occurs, the transmission automatically enters the limp home mode for service.
4. The TCU monitors all factors which can af

▶ In case of overheated transmission

1. The TCU enters the limp home mode when the batter voltage drops below 8 V.
2. If the transmission is overheated, the shift pattern is changed to the hot mode to cool the transmission more efficiently.
3. While the transmission is overheated, the selector lever symbol and engine temperature warning lamp on the instrument cluster blink until the transmission is cooled down to the normal operation temperature. If the transmission is excessively overheated, the gear cannot be shifted but remains in the neutral position.

▶ Towing vehicle equipped with A/T



NOTE

The best way to transport the vehicle is to load it to a truck and transport it, especially if the vehicle is 4WD.

- If towing the vehicle with the propeller shaft connected, the transmission or oil pump of transfer case may malfunction, resulting in internal damage due to poor lubrication.

Modification basis	
Application basis	
Affected VIN	

5. TRANSMISSION ELECTRONIC CONTROL SYSTEM

1) General FATCS About TCU

The transmission control unit (TCU) and its input/output network control the following transmission operations:

- Shift timing
- Line pressure
- Clutch pressure (shift feel)
- Torque converter clutch

In addition, the TCU receives input signals from certain transmission-related sensors and switches. The TCU also uses these signals when determining transmission operating strategy.
Using all of these input signals, the TCU can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the pressure needed to optimise shift feel. To accomplish this, the TCU operates six variable bleed control solenoids and four on/off solenoids to control transmission operation.
The following provides a brief description of each of the sensors and actuators used to control transmission operation.

2) Transmission Control Unit

Caution: If the TCU requires reprogramming the handbrake must be firmly applied and the transmission placed in Park (P).
The transmission control unit (TCU) is mounted under the left-hand front seat and controls the operation of the transmission.
The TCU is activated and deactivated by the ignition power supply and is connected to the transmission link harness by a 26 pin connector.
The TCU processes information received from internal sensors and signals received across the CAN bus in analogue and digital forms such as:

- Transmission input speed
- Transmission output speed
- Accelerator pedal position
- Gear selector position
- Engine torque
- Engine speed
- Transmission fluid temperature
- Brake pedal status
- Engine oil temperature
- Engine coolant temperature
- Ambient air temperature
- Barometric pressure

This information is used by the TCU to decide which shift pattern to select and for shift energy management. Electro-hydraulic solenoid valves and variable bleed solenoids control the transmission gear changes.

Six variable bleed solenoids and four on/off solenoids are used to direct transmission fluid flow to control the fluid pressure within the three clutches and two bands. Separate pressure regulators are used exclusively for torque converter clutch control and main transmission line pressure.
The TCU monitors all TCU inputs and outputs to confirm correct system operation. If a fault occurs the TCU is able to perform default action and inform the driver of the problem through the instrument cluster warning lights. Detailed information is available via trouble codes which can be read with the service tool.

3) Transmission Control Monitoring System

The TCU monitors all input and outputs to identify possible failures. If a fault is detected, the TCU takes the appropriate action to ensure the transmission maintains a safe mode of operation, without sacrificing transmission durability or driver safety.

▶ Supply Monitoring

If the battery voltage is either too great or too low, the TCU will detect a fault condition.

▶ Solenoid Supply Monitoring

While the solenoid operating transistors are being activated, checks are run for open circuits, shorts circuits to ground and short circuits to supply. The monitoring function evaluates the voltage characteristics during the switch ON process checking for the above faults.

▶ Gear Ratio Monitoring

The gear ratio diagnostic checks if each gear ratio is correctly engaged. Also, following a gear shift the diagnostic checks if the transmission has engaged the target gear within the allowed time.

▶ Torque Converter Monitoring

The TCU checks if the torque converter can be locked correctly. If torque converter lock-up does not occur correctly the TCU performs the appropriate fail-safe action of opening the torque converter clutch.

4) Shift Energy Management

This function involves reducing or increasing the engine output torque during shifting. The aim when upshifting is to reduce the energy which is dissipated in the friction elements of the transmission. This is done by reducing the engine torque during the ratio change without interrupting the tractive drive. This function is used for:
- Increasing the transmission service life by shortening the slipping time
- Improving the shift comfort by reducing the step change in torque caused by the gearshift

Modification basis	
Application basis	
Affected VIN	

- Transferring a higher engine power, this is allowed by the mechanical in-gear strength of the transmission

Real-time control of engine torque is required to maintain maximum shift quality and transmission durability. The TCU has the ability to control the engine torque during the gearshift to synchronise with the operation of the transmission clutches.

▶ Pressure Modulation

To provide a high level of shift comfort and durability, the hydraulic pressure in the shift related friction elements of the transmission must be matched accurately to the transmission input torque. This hydraulic pressure is composed of a hydraulically pre-set basic pressure and a controlling pressure which is set by one of the variable bleed solenoids.

The transmission input torque can be directly calculated from the following operating parameters: engine torque signals, engine speed or any signals transmitted from the engine management ECU by CAN, and converter slip. Separate pressure characteristics for each gear change make it possible to adapt precisely to the particular shift operation.

High and Low range operation has different parameters to optimise shift quality.

4) Shift Map Selection

The driver can manually select between normal (S) and winter modes (W) via the mode switch. Depending on the transmission temperature, uphill and downhill grades and altitude, shift maps will be selected by the TCU to suit the driving conditions. The following maps are available.

▶ Normal Mode

Normal Mode is selected when the lever is in the D position with the mode switch in the normal (S) position and the transmission is within normal temperature ranges. Shift schedule points are optimised for fuel efficiency and general driving conditions.

▶ Uphill and Downhill Mode

In this mode, depending on the load of the vehicle, adaptive shift maps are selected to progressively adjust the shift points and torque converter lock points.

▶ Altitude Mode

Shift points are automatically adjusted at higher altitudes to compensate for changes in engine torque where the torque produced by the engine is greatly reduced by the effects of reduced barometric pressure and temperature.

▶ Winter Mode

When winter mode is selected, starting in second gear is facilitated and the WINTER mode indicator light is switched ON. To prevent wheel spin on slippery surfaces, the transmission will not allow first gear unless manually overridden.

▶ Low Range Schedule

When the transfer case is in 4L position, the transmission uses a different shift map to optimise low range driving. Similar to winter mode, 1st gear is inhibited. The transmission may skip gears, e.g. 2-4, to optimise engine rpm.

▶ Warm up Schedule

Used typically when transmission fluid temperature is below 20°C.
The torque converter will not lock-up below 20°C to assist in transmission warm-up.

▶ Hot Mode

The hot mode is progressively applied between temperatures of 110°C- 145°C. The torque converter lock-up is increased to prevent heat generation by the torque converter.
As additional assistance to the hot mode, the following are activated:
- Above 110°C - the electrical radiator fans are switch ON
- Above 130°C - the engine torque will be reduced and the WINTER light on the instrument cluster will flash
- Above 145°C - the transmission will neutralise until the fluid temperature falls below 120°C as a final protection.

Activation of the hot mode inhibits other transmission performance features including uphill and downhill compensation and altitude compensation. Some degradation in shift feel may be experienced as the torque converter is not unlocked during shifting. The fluid temperature must be below 105갰 to exit all hot modes.

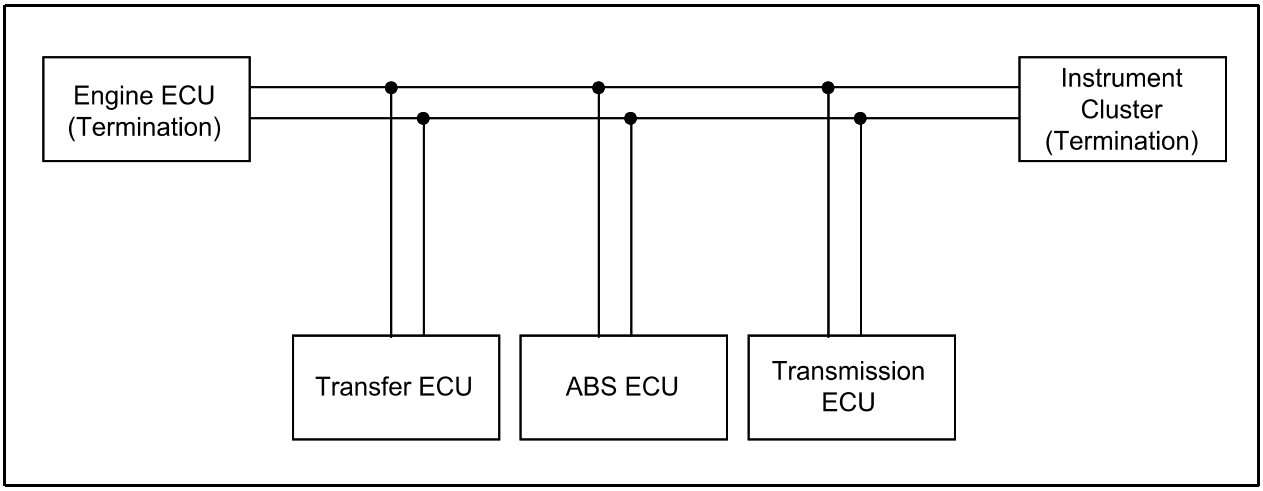
▶ Cruise

When cruise control is activated the engine ECU may request the transmission to downshift under trailing throttle conditions to increase engine braking.

Modification basis	
Application basis	
Affected VIN	

6. CONFIGURATION OF CAN RELATED TO TCU

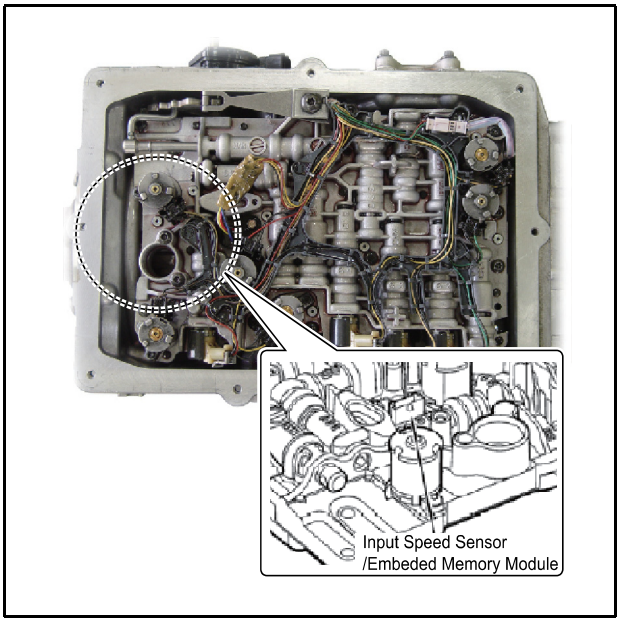
1) Communication Network



The TCU sends signals to be used by other vehicle systems via the CAN bus, such as:

- Selector lever position
- Selected gear state
- Manual mode activation
- Output torque
- Input speed
- Output speed
- Transmission fluid temperature
- Engine torque reduction requests

2) Embedded Memory Module



The embedded memory module (EMM) is matched to the transmission valve body during manufacture.
The EMM is integrated into the input speed sensor which is mounted on the valve body in the transmission.
The EMM data contains transmission specific characterisation information. Upon installation, the TCU will upload the data from the EMM and utilise this data in the operation of the transmission.

7. POWER TRAIN

The various power train of the transmission is as follow:

- Power train - M 1st gear
- Power train - D 1st gear
- Power train - D 2nd gear
- Power train - D 2nd gear - lockup
- Power train - D 3rd gear
- Power train - D 4th gear - D 4th gear - limp home mode
- Power train - D 5th gear
- Power train - D 6th gear

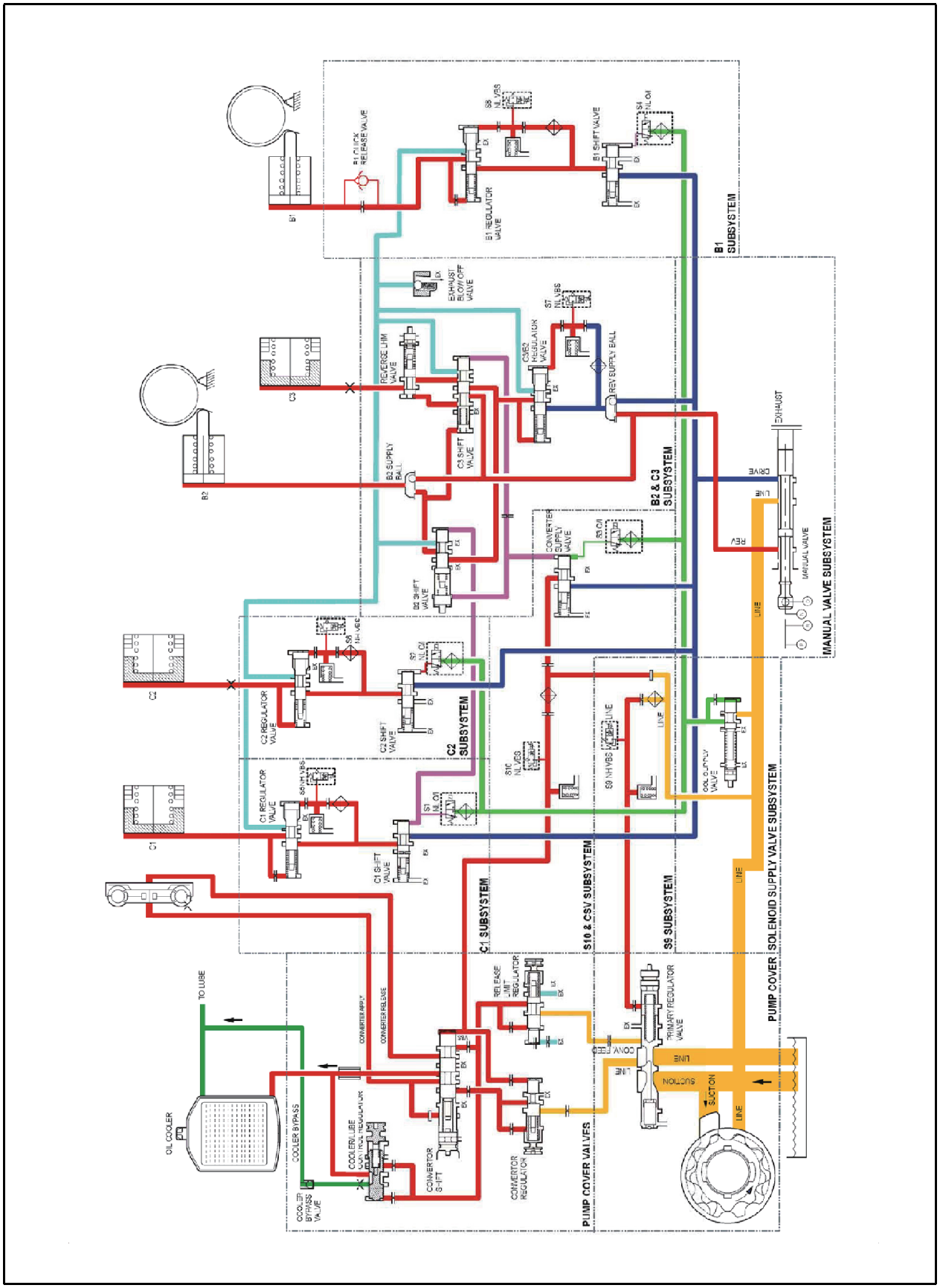
▶ Gear States Summary

Gear	Ratio	Engaged elements (clutches & bands)						Shift ON/OFF solenoids			
		C1	C2	C3	B1	B2	1-2 OWC	S1	S2	S3	S4
M1	3.536		ON			ON		ON			
1st	3.536		ON				ON	ON			
2nd	2.143		ON		ON			ON			ON
3rd	1.478		ON	ON				ON		ON	
4th	1.156	ON	ON								
5th	0.866	ON		ON					ON		
6th	0.677	ON			ON				ON		ON
Reverse	-3.094			ON		ON		ON	ON	ON	

Gear	Ratio	Variable Pressure Solenoid Valve					
		S5(A)	S6(A)	S7(A)	S8A)	S9A)	S10(A)
M1	3.536	1	0	1			
1st	3.536	1	0			0-1	
2nd	2.143	1	0		1	0-1	
3rd	1.478	1	0	1		0-1	
4th	1.156	0	0			0-1	
5th	0.866	0	1	1		0-1	
6th	0.677	0	1		1	0-1	
Reverse	-3.094	1	1	1		0-1	

Modification basis	
Application basis	
Affected VIN	

▶ Overall Hydraulic Circui



Modification basis	
Application basis	
Affected VIN	

▶ Solenoids

- There are in total 10 solenoids used to control the transmission. All solenoids are located in the Valve Body.
- Solenoids **S1, S2, S3 & S4** are ON/OFF solenoids. They determine the static gear position of the transmission by controlling the shift valves.
- Solenoids **S5, S6, S7 & S8** are Variable Bleeding Solenoids (VBS) which ramp pressure via a current change during gear shifting. They direct pressure to the regulator valves and are the primary means of controlling gear shift quality.
- Solenoids **S9** is also a variable bleeding solenoid. It controls Line Pressure.
- Solenoid **S10** is a variable bleeding solenoid as well and is used for controlling the application of the Torque Converter lock-up clutch.
- ON/OFF Solenoids:
  - **S1** controls apply/release of the C1 Clutch.
  - **S2** controls apply/release of the C2 Clutch
  - **S3** controls apply/release of the C3 Clutch & B2 Band
  - **S4** controls apply/release of the B1 Band
- VBS Solenoids are generally used for regulating and ramping pressure to different shift elements (clutch/band) :
  - **S5** regulates pressure supplied to the C1 Clutch
  - **S6** regulates pressure supplied to the C2 Clutch
  - **S7** regulates pressure supplied to the C3 Clutch & B2 Band
  - **S8** regulates pressure supplied to the B1 Band

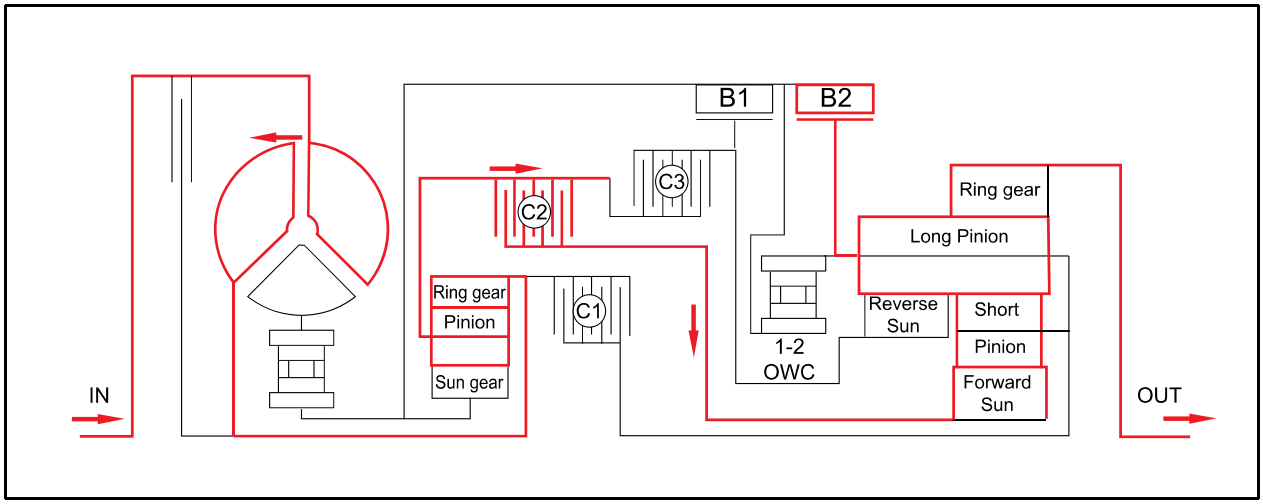
▶ Gear States Summary

Gear	Ratio	Engaged elements (clutches & bands)						Shift ON/OFF solenoids			
		C1	C2	C3	B1	B2	1-2 OWC	S1	S2	S3	S4
M1	3.536		ON			ON		ON			
1st	3.536		ON				ON	ON			
2nd	2.143		ON		ON			ON			ON
3rd	1.478		ON	ON				ON		ON	
4th	1.156	ON	ON								
5th	0.866	ON		ON					ON		
6th	0.677	ON			ON				ON		ON
Reverse	-3.094			ON		ON		ON	ON	ON	

Modification basis	
Application basis	
Affected VIN	

1) Power Train - "M" (Manual) Position

▶ Power flow diagram



▶ Functioning elements

- C2 applied, drives FSG
- B2 applied to hold Rear Planet Carrier held stationary.
- This gear state provides engine breaking.

▶ Control

- S1 is ON, S7 is ON
- S1 ON moves C1 Shift Valve to the left end not allowing an application of the C1 Clutch.
- S1 ON moves B2 Shift Valve to its left-end position allowing an application of the B2 Band. (S7 must be ON as well).
- C2 Shift Valve (S2 OFF) is open allowing drive oil to engage C2 Clutch.
- Drive oil that engages C2 Clutch is regulated by VBS S6.

▶ Connecting Components

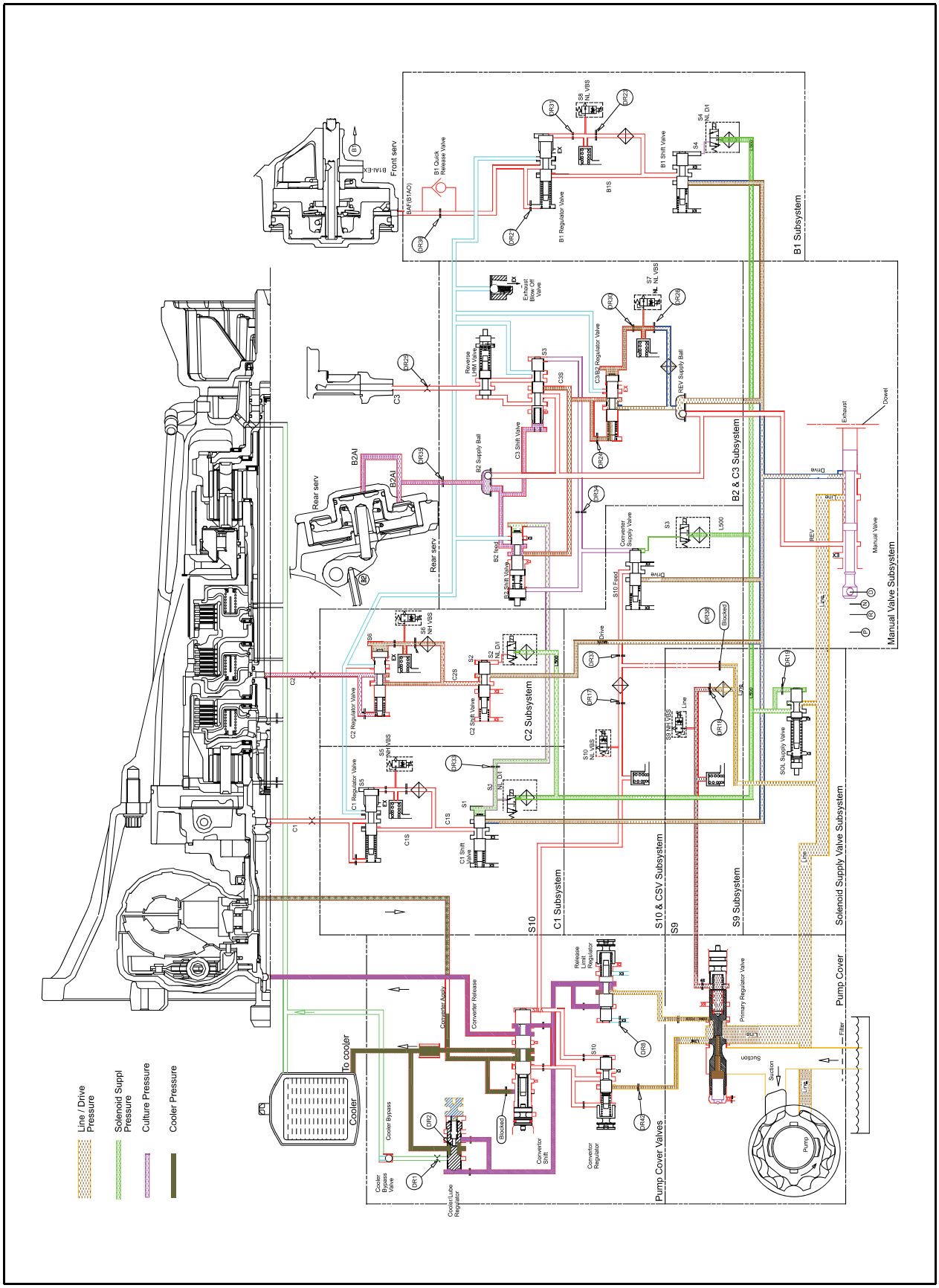
CAUTION

- Manual 1st is not achieved by moving the Manual Valve into a certain position. This gear state is obtained electronically by solenoids S1 & S7.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.536		ON					ON	ON			ON				1	0	1		0-1	

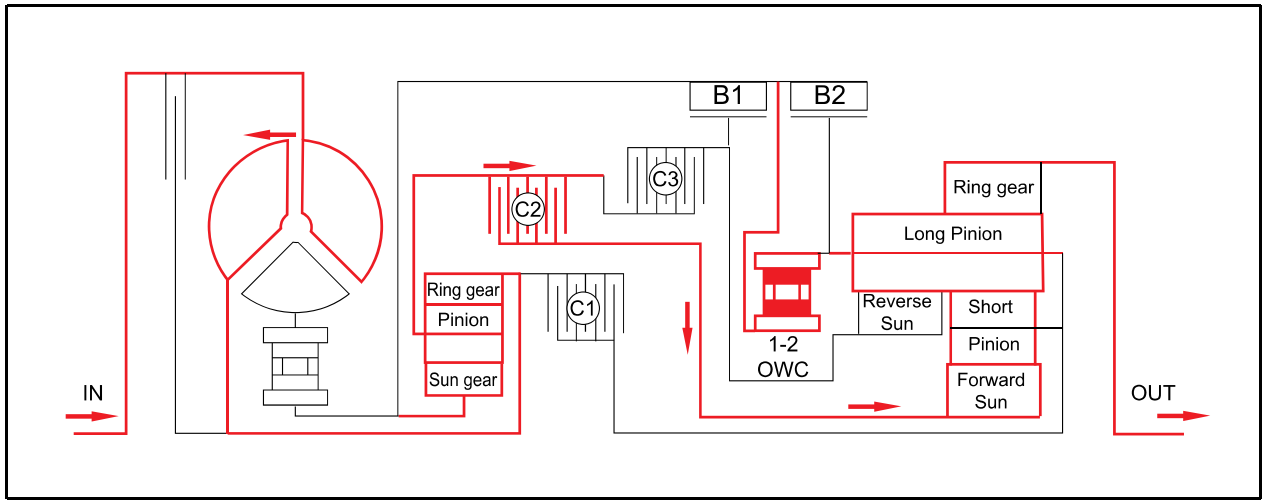
▶ Manual 1st - C2 & B2 ON (3.536)



Modification basis	
Application basis	
Affected VIN	

2) Power Train - "D" (Drive) 1st (Auto)

▶ Power flow diagram



▶ Functioning elements

- C2 applied, drives FSG
- Rear Planet Carrier held via 1-2 OWC

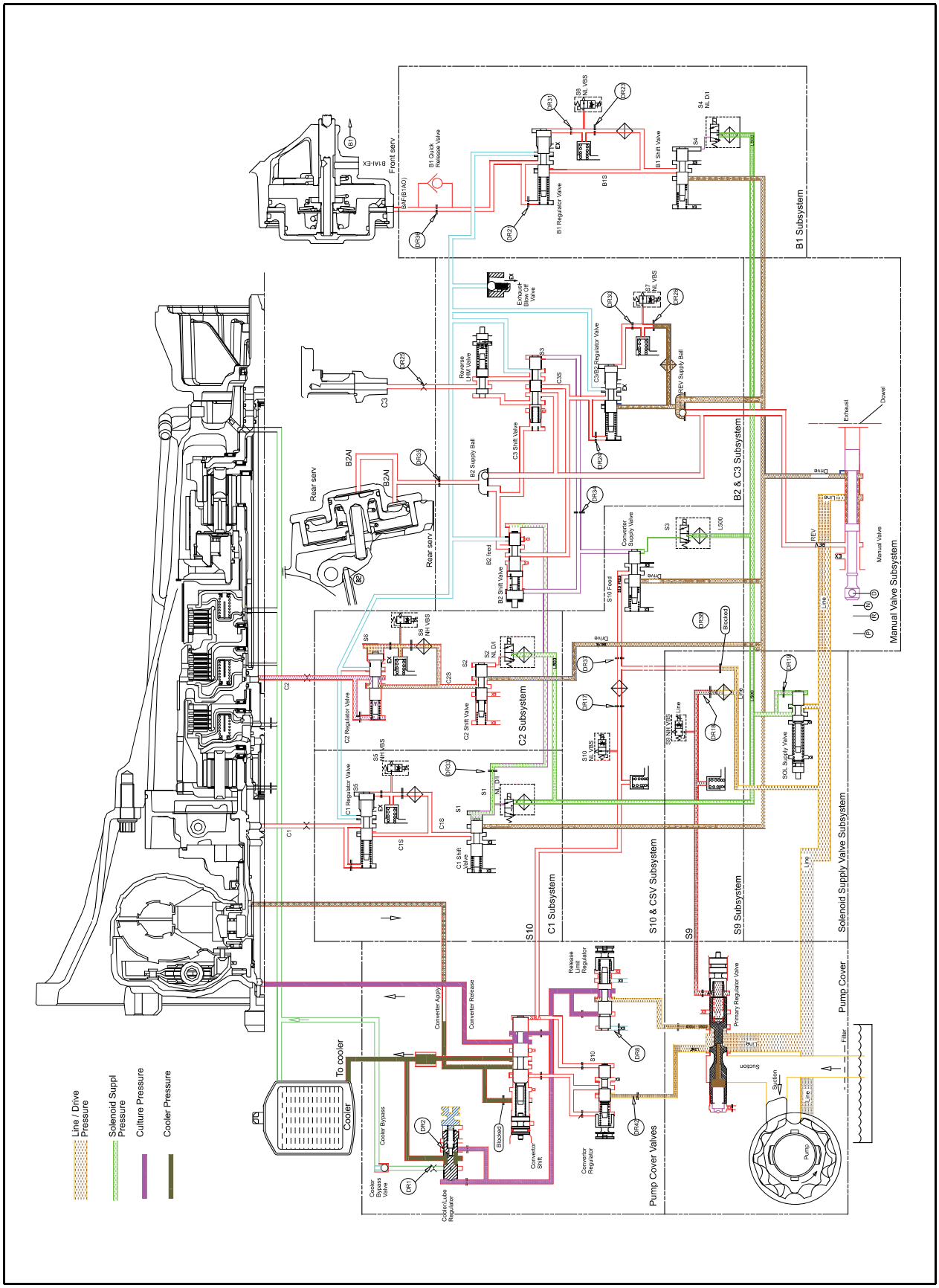
▶ Control

- S1 is ON, S2 is OFF
- S1 ON moves C1 Shift Valve to the left end not allowing an application of the C1 Clutch.
- C2 Shift Valve (S2 OFF) is open allowing drive oil to engage C2 Clutch.
- Drive oil that engages C2 Clutch is regulated by VBS S6.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.536		ON							ON		ON				1	0			0-1	

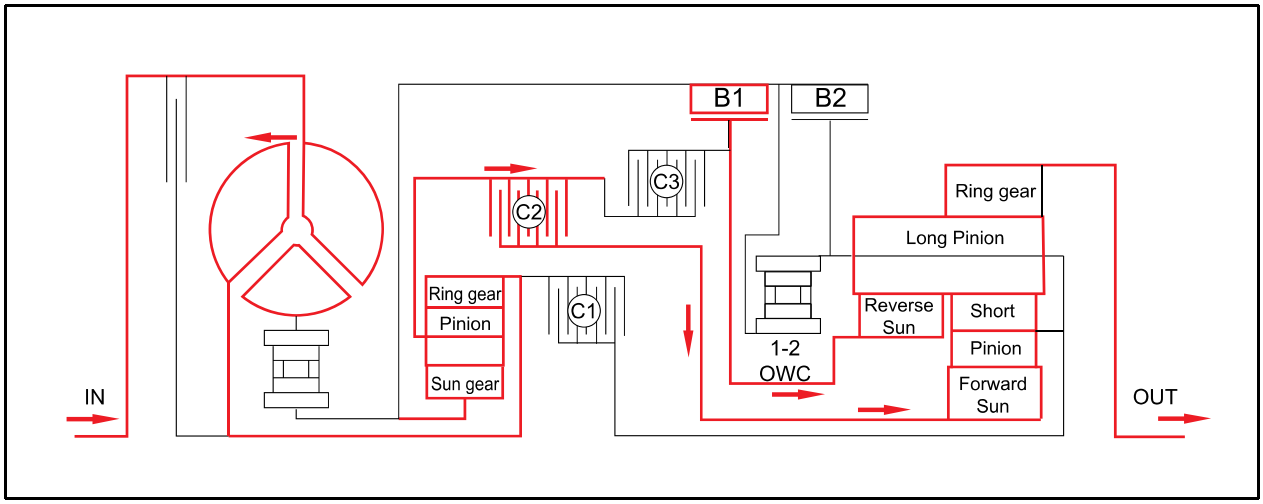
▶ Auto 1st - C2 & OWC ON (3.536)



Modification basis	
Application basis	
Affected VIN	

3) Power Train - "D" (Drive) 2nd

▶ Power flow diagram



▶ Functioning elements

- C2 applied, drives FSG
- B1 applied to hold RSG stationary

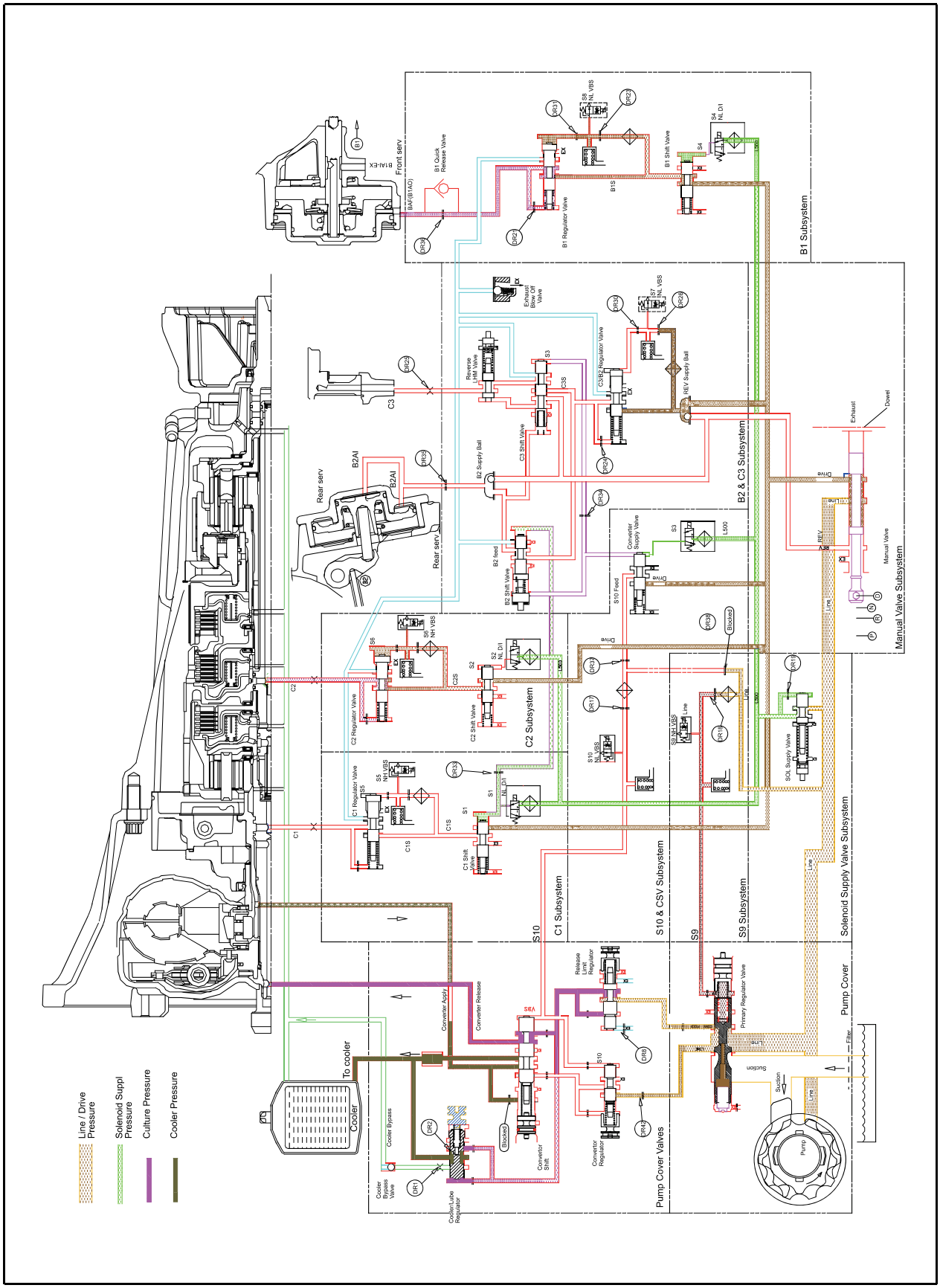
▶ Control

- S1 is ON, S2 is OFF & S4 is ON.
- S1 ON moves C1 Shift Valve to its left-end position not allowing the application of the C1 Clutch.
- C2 Shift Valve is OPEN (S2 OFF) allowing drive oil to engage C2 Clutch.
- Drive oil that engages C2 Clutch is regulated by VBS S6.
- S4 ON moves B1 Shift Valve to its left-end position allowing engagement of B1 Band.
- Drive oil that engages B1 Band is regulated by VBS S8.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
2.143		ON		ON							ON			ON	1	0		1	0-1	

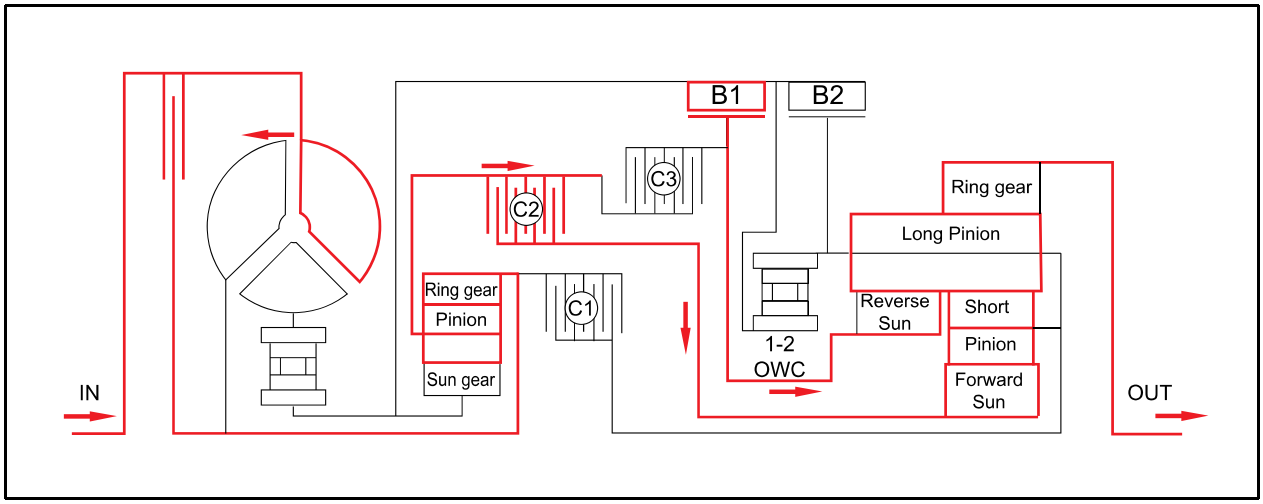
▶ Auto 2nd - C2 & B1 ON (2.143)



Modification basis	
Application basis	
Affected VIN	

4) Power Train - "D" (Drive) 2nd - Lockup

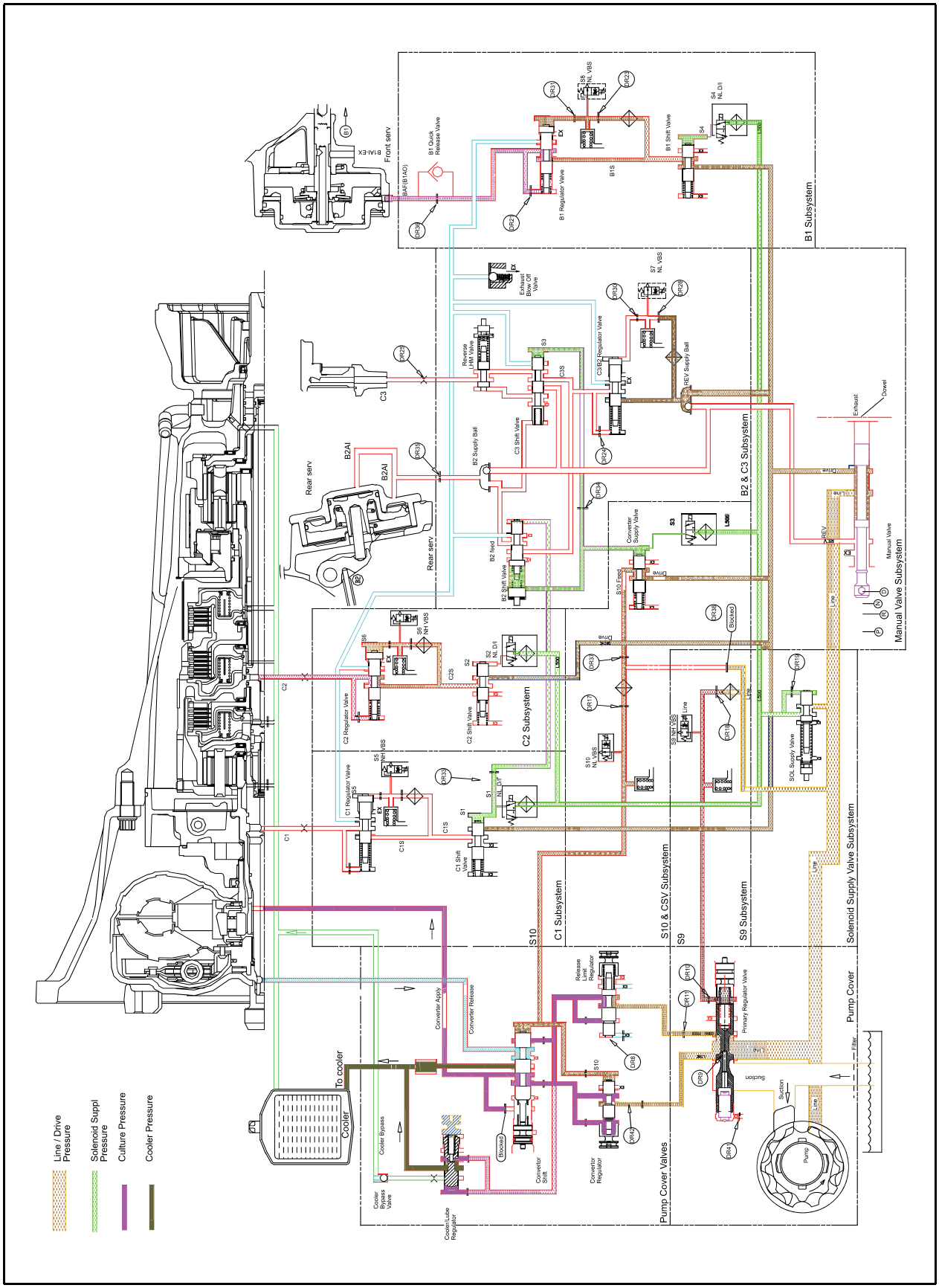
▶ Power flow diagram



▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
2.143		ON		ON							ON		ON	ON	1	0	0	1	0-1	1

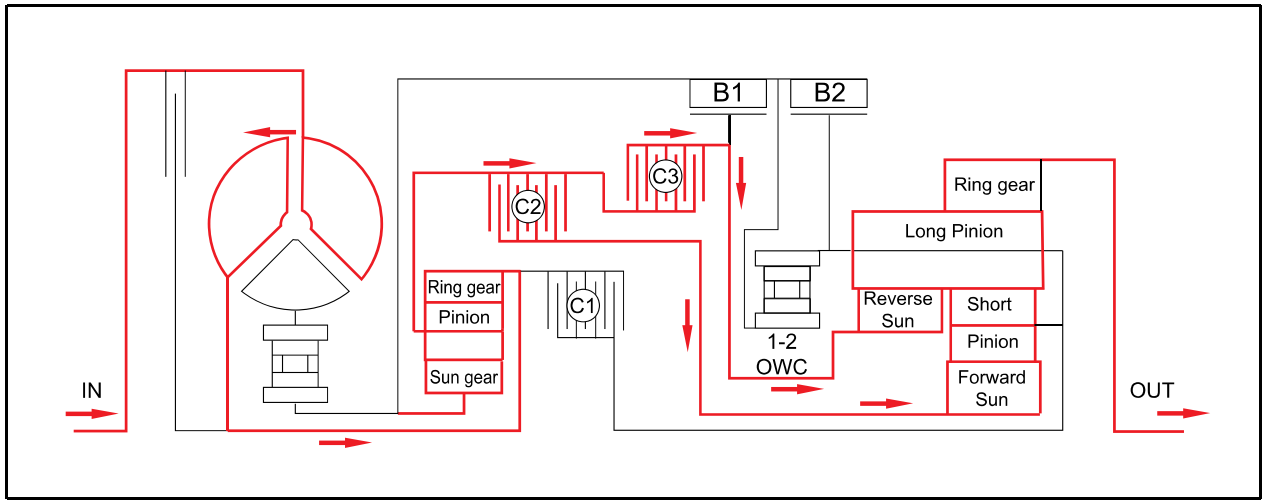
▶ 2nd Lockup - C2, B1 & TCC ON



Modification basis	
Application basis	
Affected VIN	

5) Power Train - "D" (Drive) 3rd

▶ Power flow diagram



▶ Functioning elements

- C2 applied, drives FSG
- C3 applied, drives Rear Planet Carrier
- Rear Planetary Gear Set is locked and the output is equal to the ratio of the Front Gear Set.

▶ Control

- S1 ON moves C1 Shift Valve to the left end not allowing the application of the C1 Clutch.
- C2 Shift Valve is open allowing drive oil to engage C2 Clutch (S2 OFF).
- S3 & S7 ON moves C3 Shift Valve to the left end allowing the application of C3 Clutch.

▶ Connecting Components

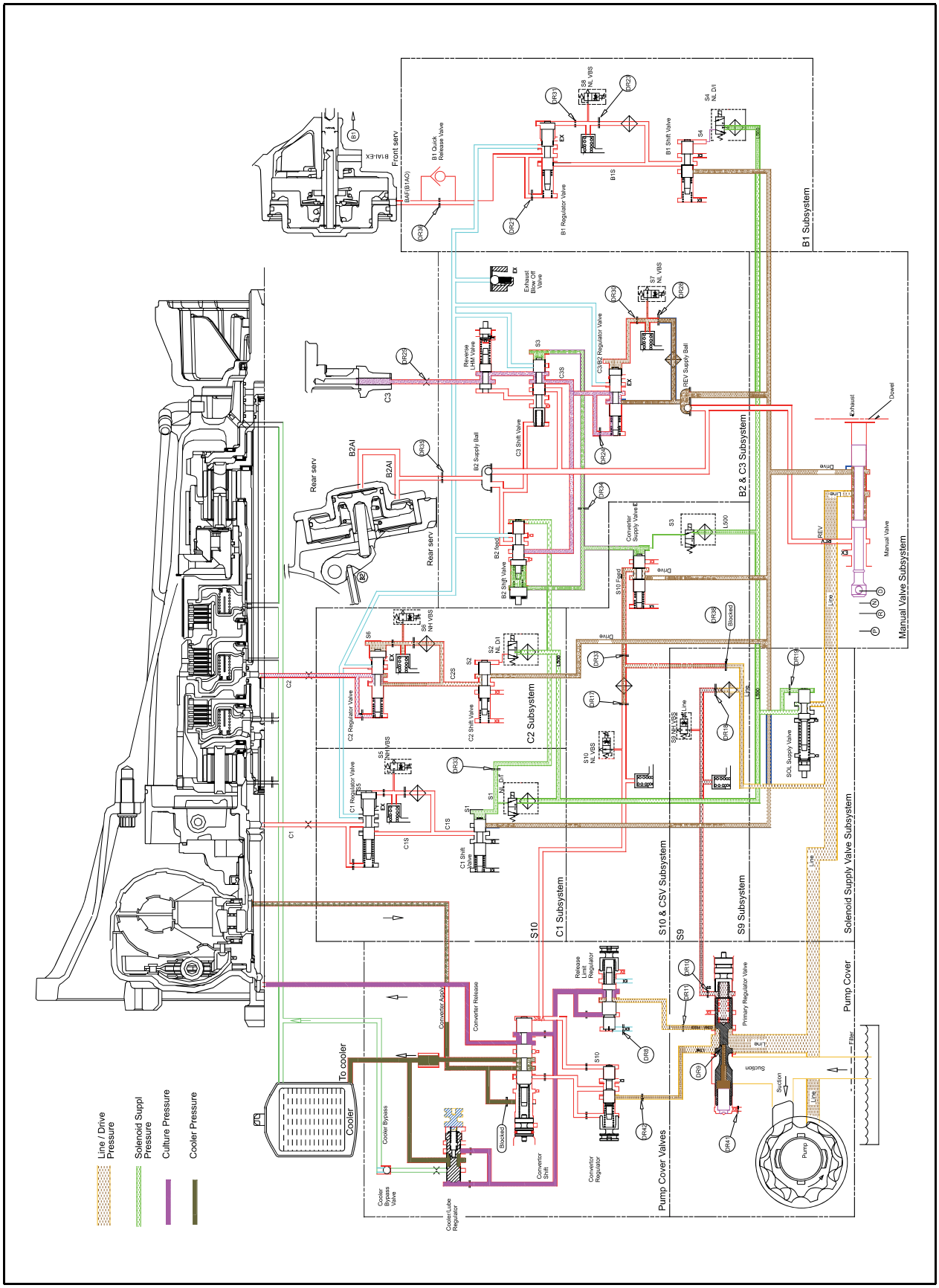
CAUTION

- C3 Clutch cannot be engaged without S7 being ON and supplying pressure to the C3 Regulator Valve.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
1.478		ON	ON								ON		ON		1	0	1		0-1	

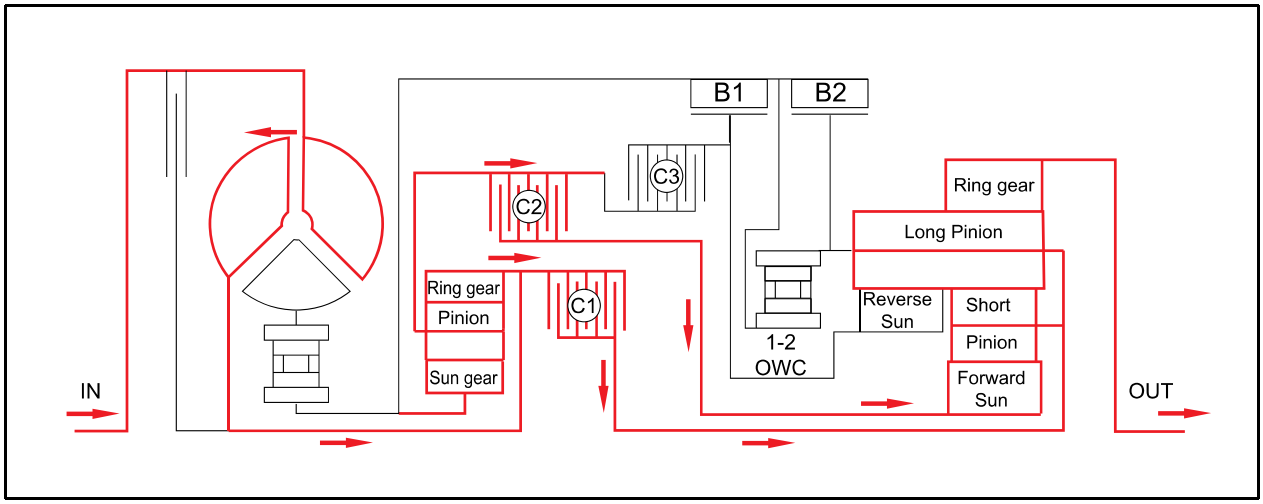
▶ 3rd Gear - C2 & C3 ON (1.478)



Modification basis	
Application basis	
Affected VIN	

6) Power Train - "D" (Drive) 4th - "D" (Drive) 4th Limp Home Mode

▶ Power flow diagram



▶ Functioning elements

- C2 applied, drives FSG
- C1 applied, drives Rear Planet Carrier

▶ Control

- S1 is OFF, S2 is OFF.
- C1 Shift Valve is OPEN (S1 OFF) allowing drive oil to engage C1 Clutch.
- C2 Shift Valve is OPEN (S2 OFF) allowing drive oil to engage C2 Clutch.
- Drive oil that engages C1 & C2 Clutches is regulated by S5 & S6 VBS, respectively for each clutch.

▶ Connecting Components

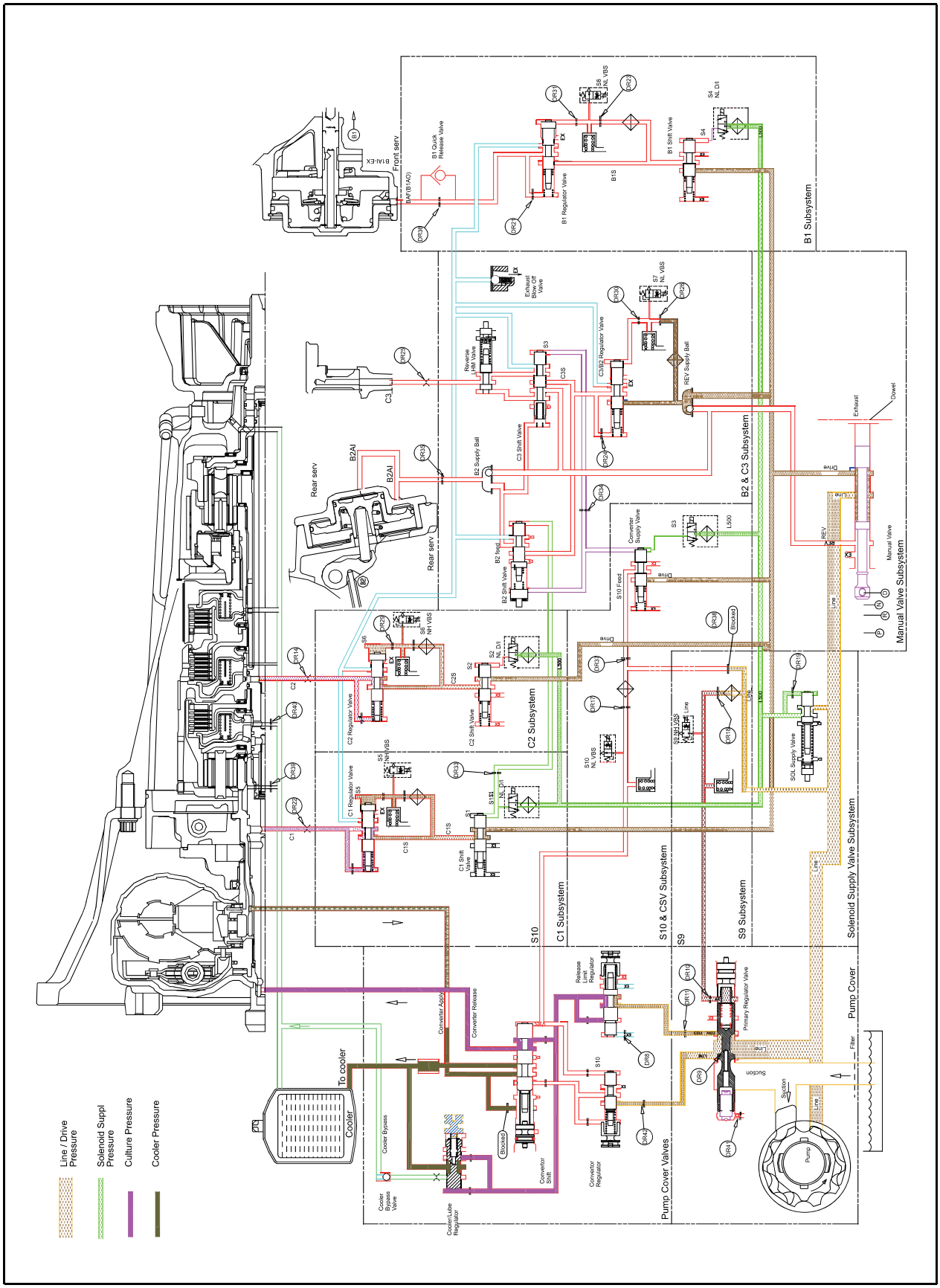
CAUTION

- 4th GEAR is used as a LHM state.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
1.156	ON	ON													0	0			0-1	

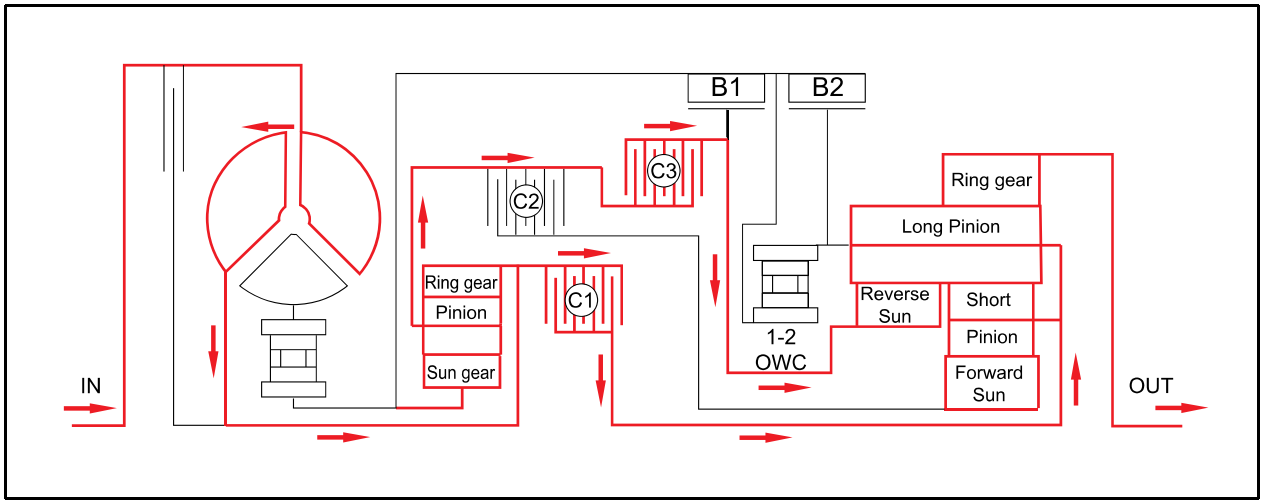
▶ 4th & 4th LHM - C1 & C2 ON (1.156)



Modification basis	
Application basis	
Affected VIN	

7) Power Train - "D" (Drive) 5th

▶ Power flow diagram



▶ Functioning elements

- C1 applied, drives Rear Planet Carrier
- C3 applied, drives RSG

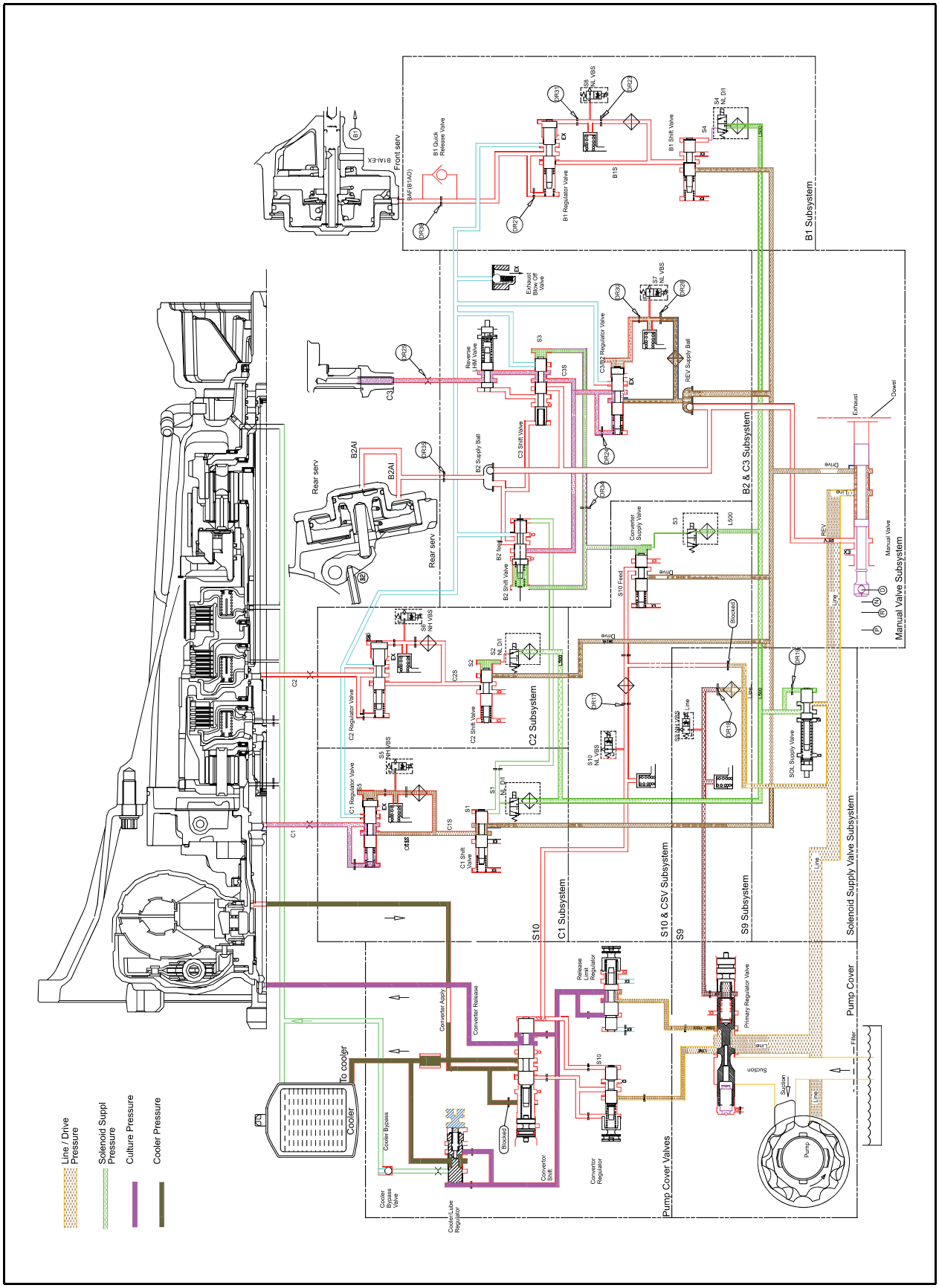
▶ Control

- S1 is OFF,S2 is ON, S3 is ON.
- S2 ON moves C2 Shift Valve to its left-end position not allowing the application of the C2 Clutch.
- C1 Shift Valve is OPEN (S1 OFF) allowing drive oil to engage C1 Clutch
- S3 ON and with S7 ON moves C3 Shift Valve to the left end allowing the application of C3 Clutc.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF sole-				Variable pressure valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
0.866	ON		ON									ON	ON		0	1	1		0-1	

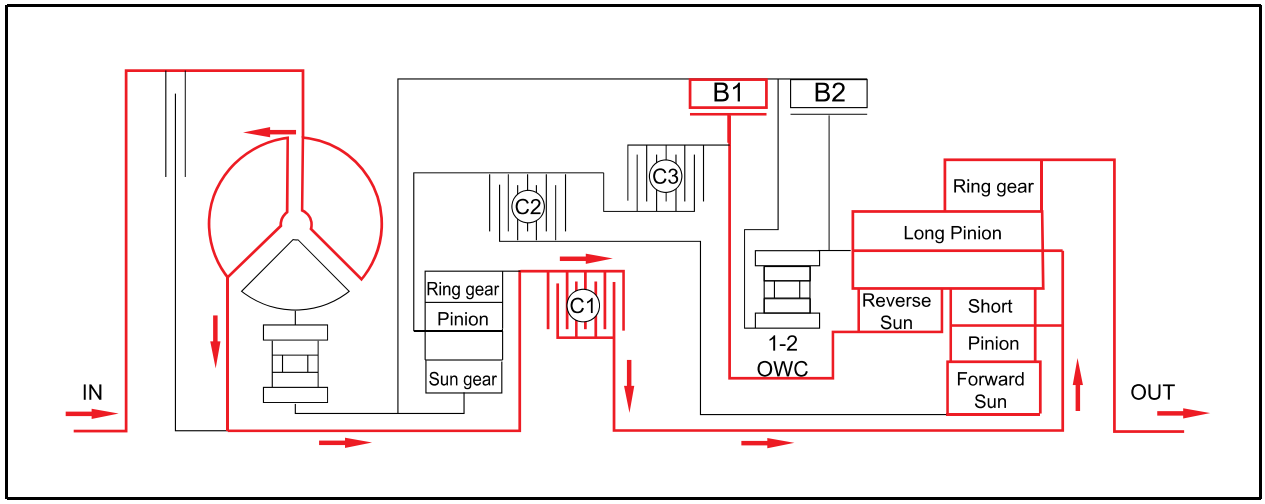
▶ 5th Gear - C1 & C3 ON (0.866)



Modification basis	
Application basis	
Affected VIN	

8) Power Train - "D" (Drive) 6th

▶ Power flow diagram



▶ Functioning elements

- C1 applied, drives Rear Planet Carrier
- B1 applied to hold RSG

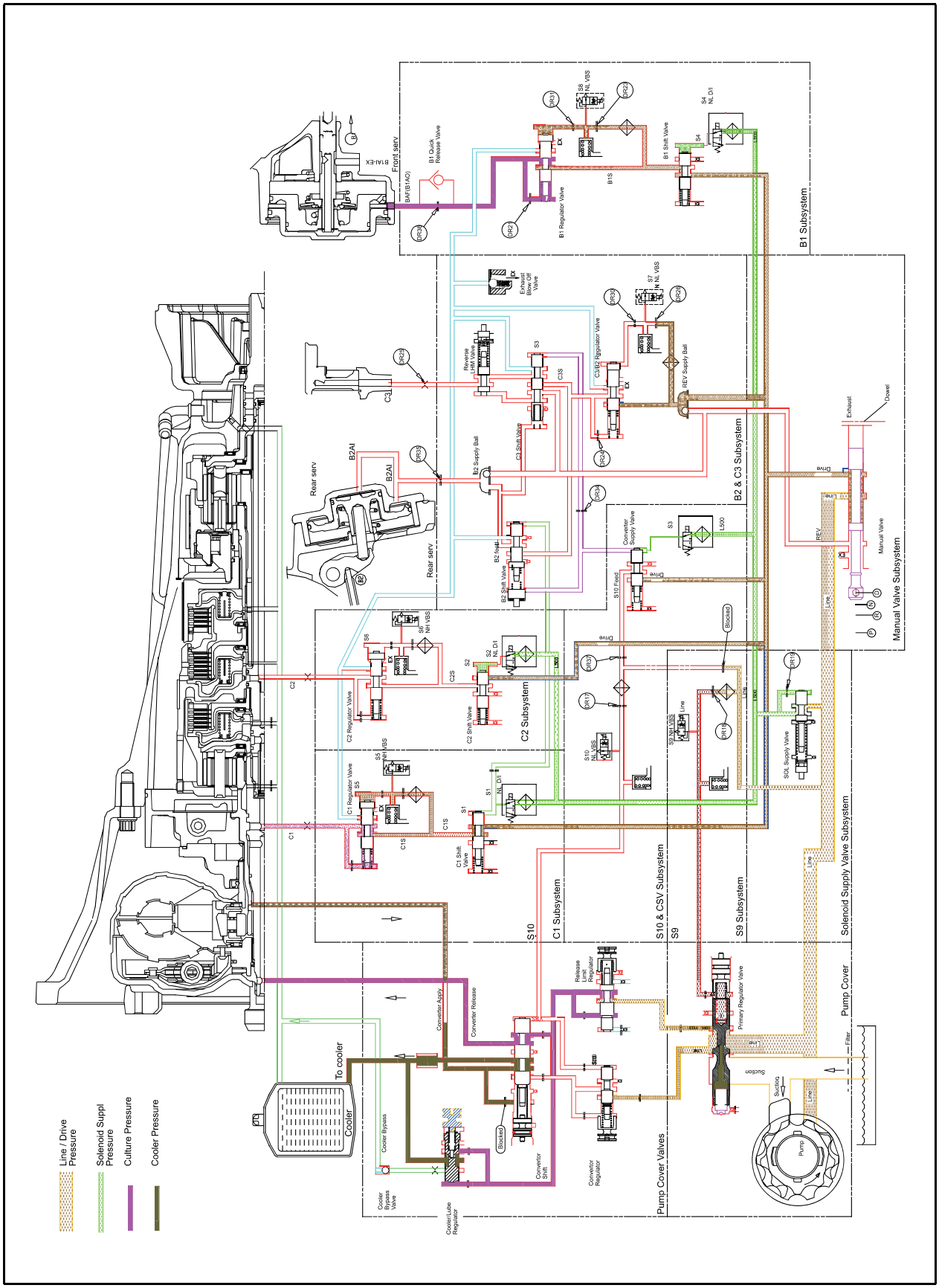
▶ Control

- S1 is OFF, S2 is ON, S4 is ON.
- S2 ON moves C2 Shift Valve to its left-end position not allowing the application of the C2 Clutch.
- C1 Shift Valve is OPEN (S1 OFF) allowing drive oil to engage C1 Clutch
- S4 ON moves B1 Shift Valve to its left-end position allowing the engagement of B1 Band.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
0.677	ON			ON								ON		ON	0	1		1	0-1	

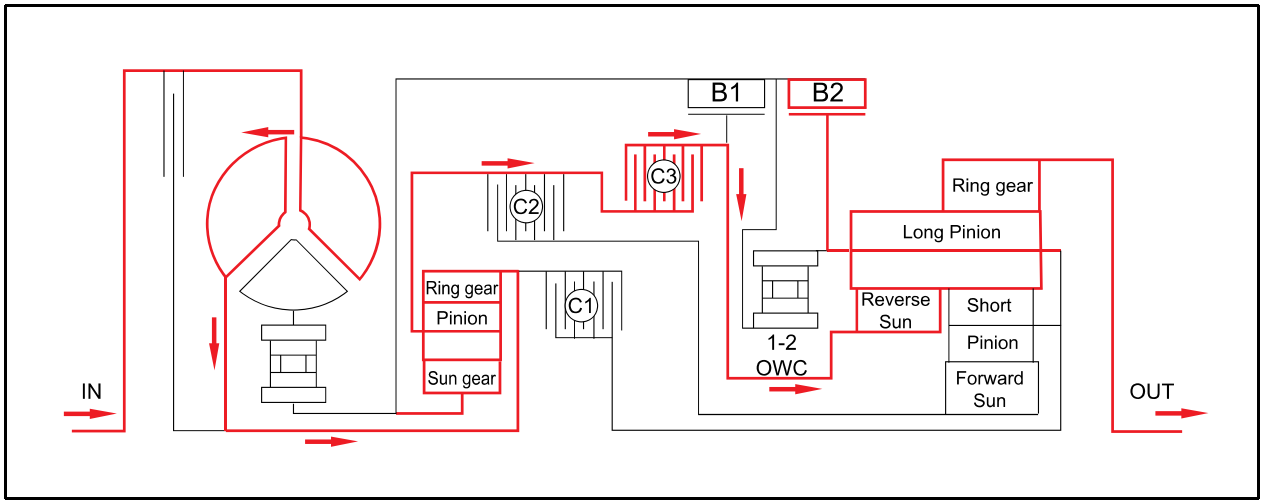
▶ 6th Gear - C1 & B1 ON (0.677)



Modification basis	
Application basis	
Affected VIN	

9) Power Train - Reverse

▶ Power flow diagram



▶ Functioning elements

- C3 applied, drives RSG
- B2 applied, holds Rear Planet Carrier stationary

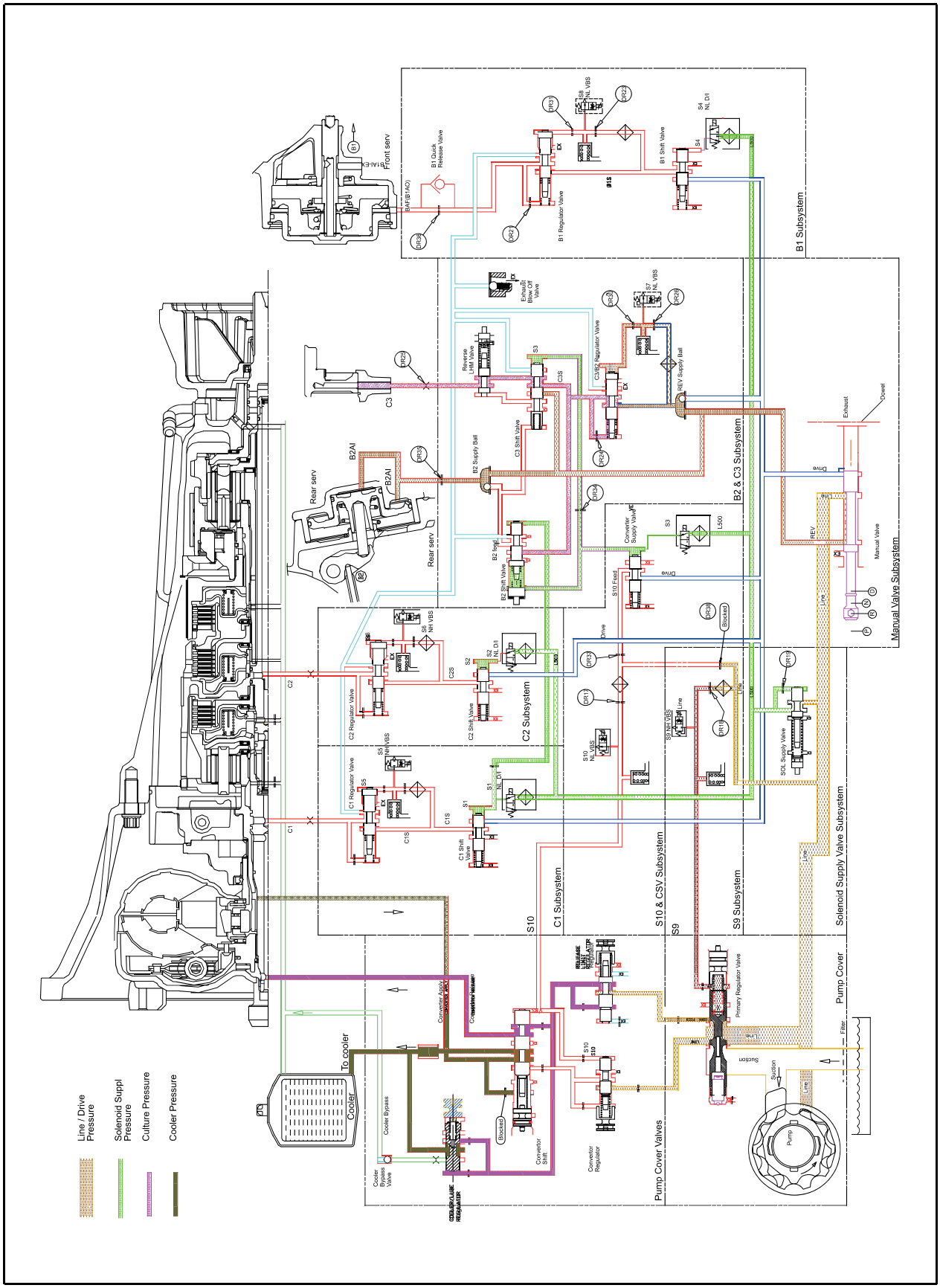
▶ Control

- S1 is ON, S2 is ON, S3 is ON.
- Line pressure is directed via Manual Valve to apply B2 Band directly.
- S3 ON allows ramping and regulating pressure supplied to the C3.
- S1 & S2 are ON not allowing engagement either C1 or C2 Clutch at any circumstances.

▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.094			ON				ON	ON			ON	ON	ON		1	1	1		0-1	

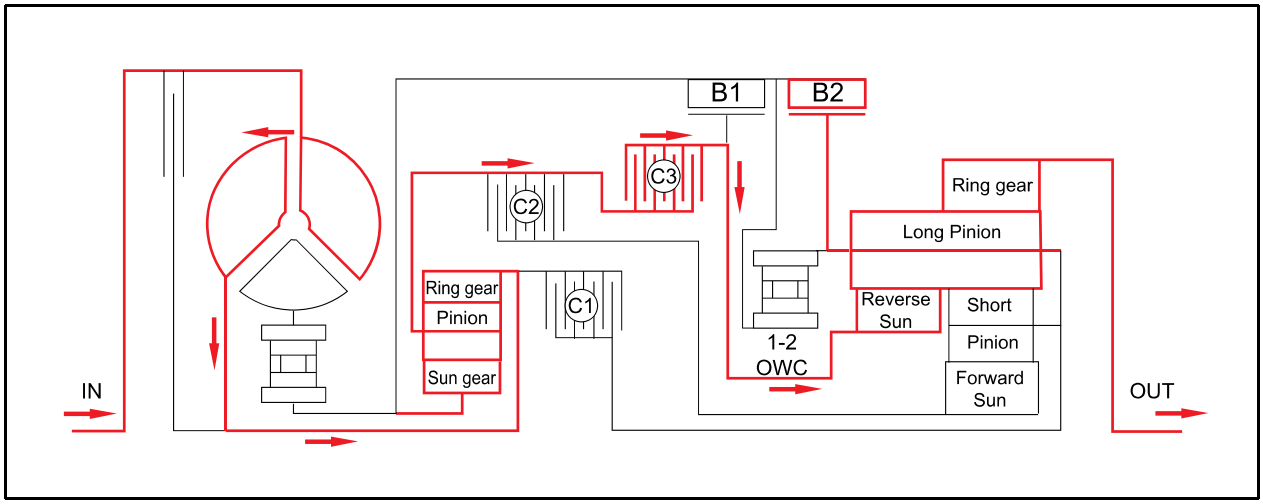
▶ Reverse - C3 & B2 ON (-3.094)



Modification basis	
Application basis	
Affected VIN	

10) Power Train - Reverse (Limp Home Mode)

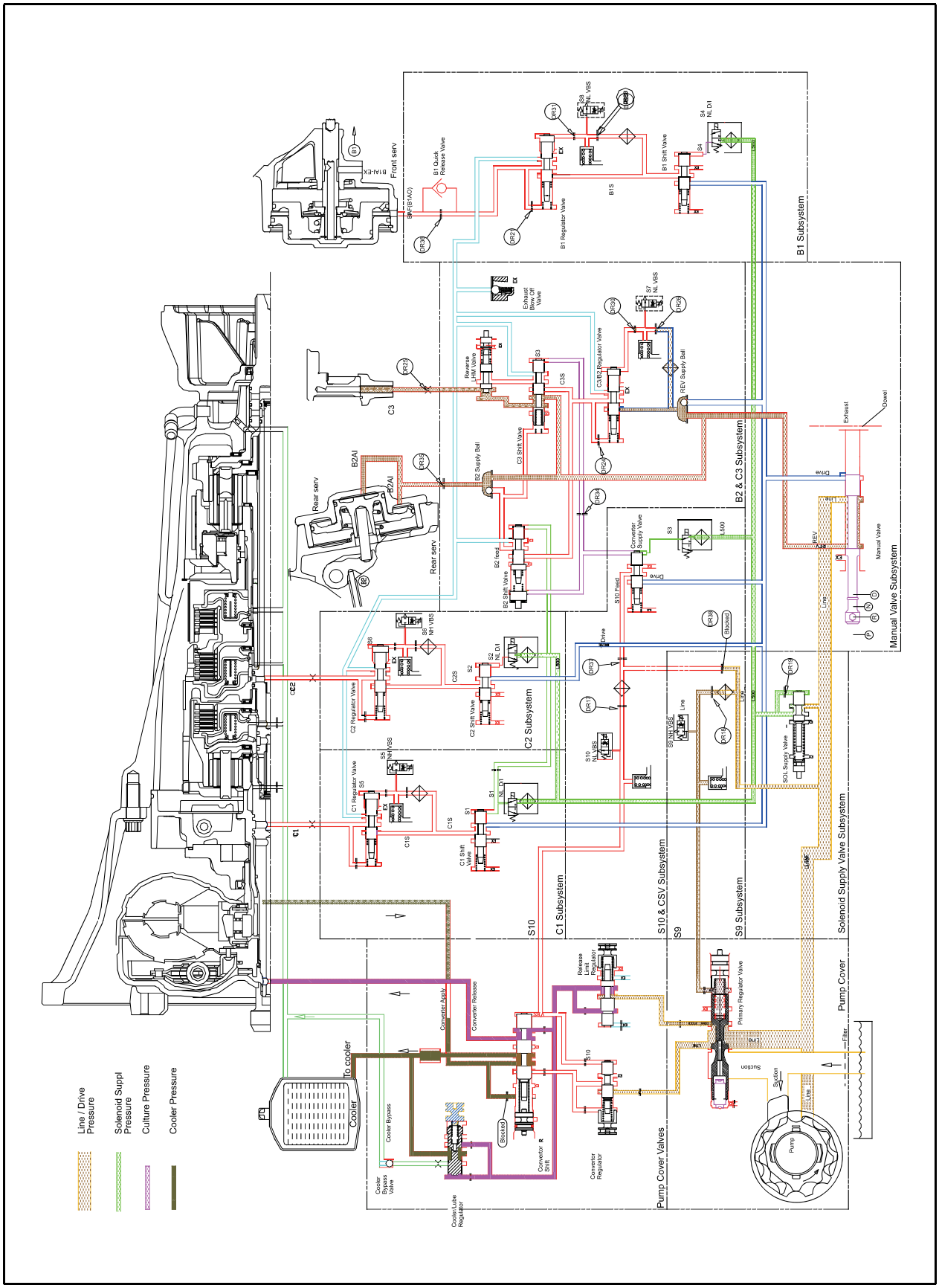
▶ Power flow diagram



▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
3.094			ON				ON	ON							0	0	0	0	0	0

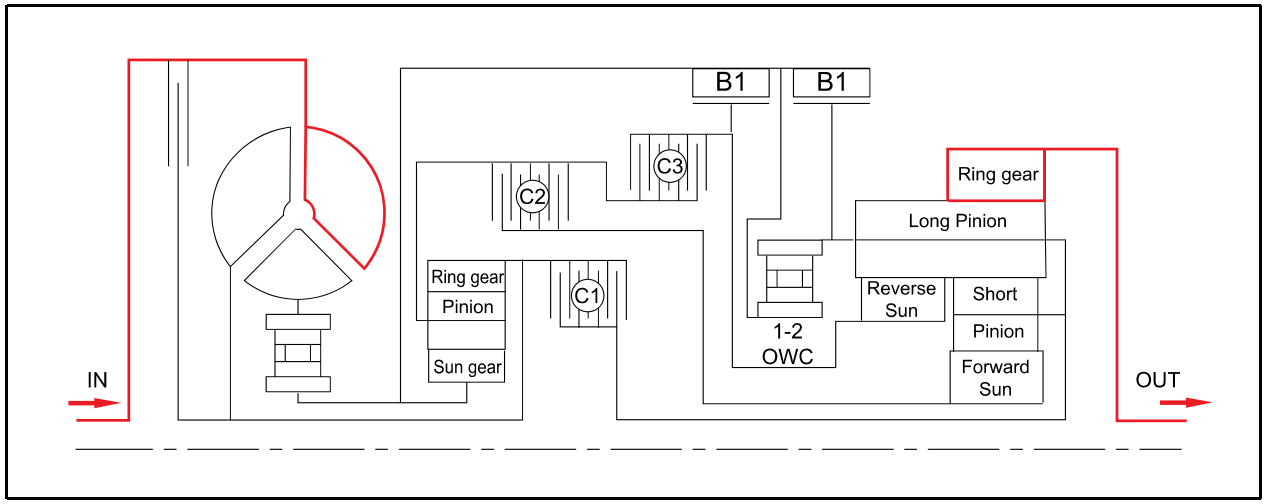
▶ Reverse at LHM - C3 & B2 ON



Modification basis	
Application basis	
Affected VIN	

11) Power Train - Parking

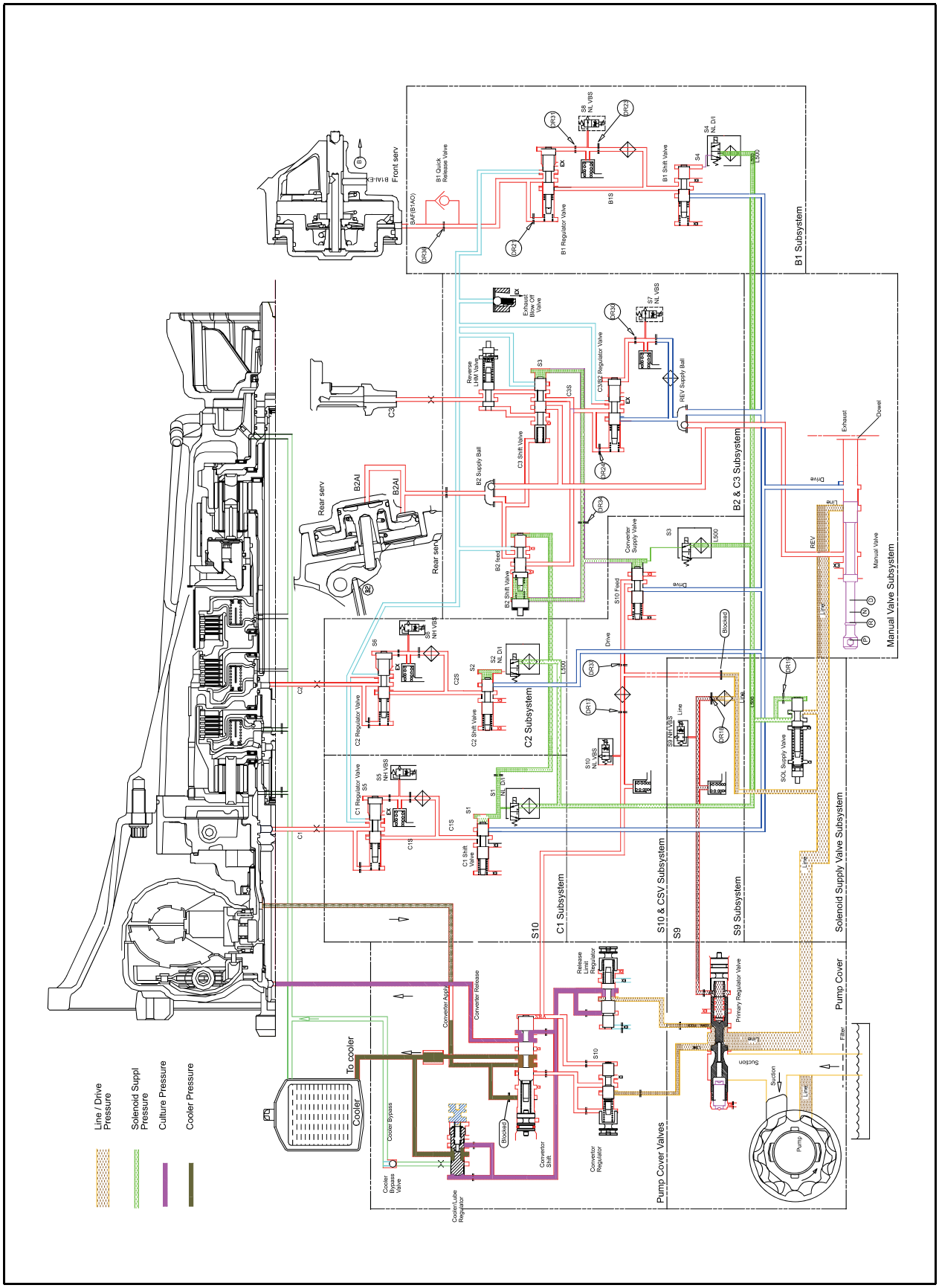
▶ Power flow diagram



▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
N/A											ON	ON	ON						1	

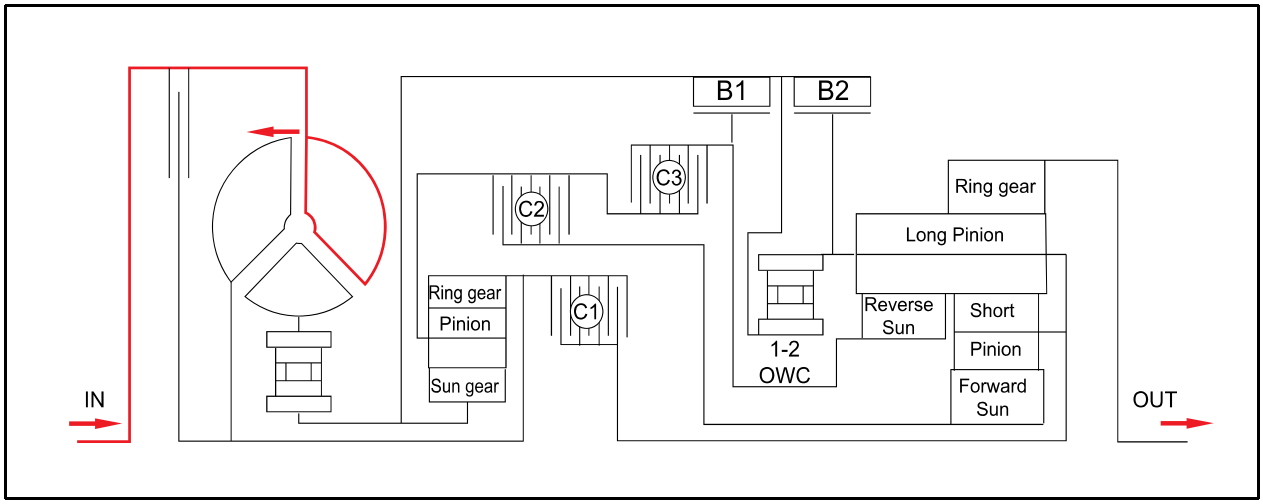
▶ Park



Modification basis	
Application basis	
Affected VIN	

12) Power Train - Neutral

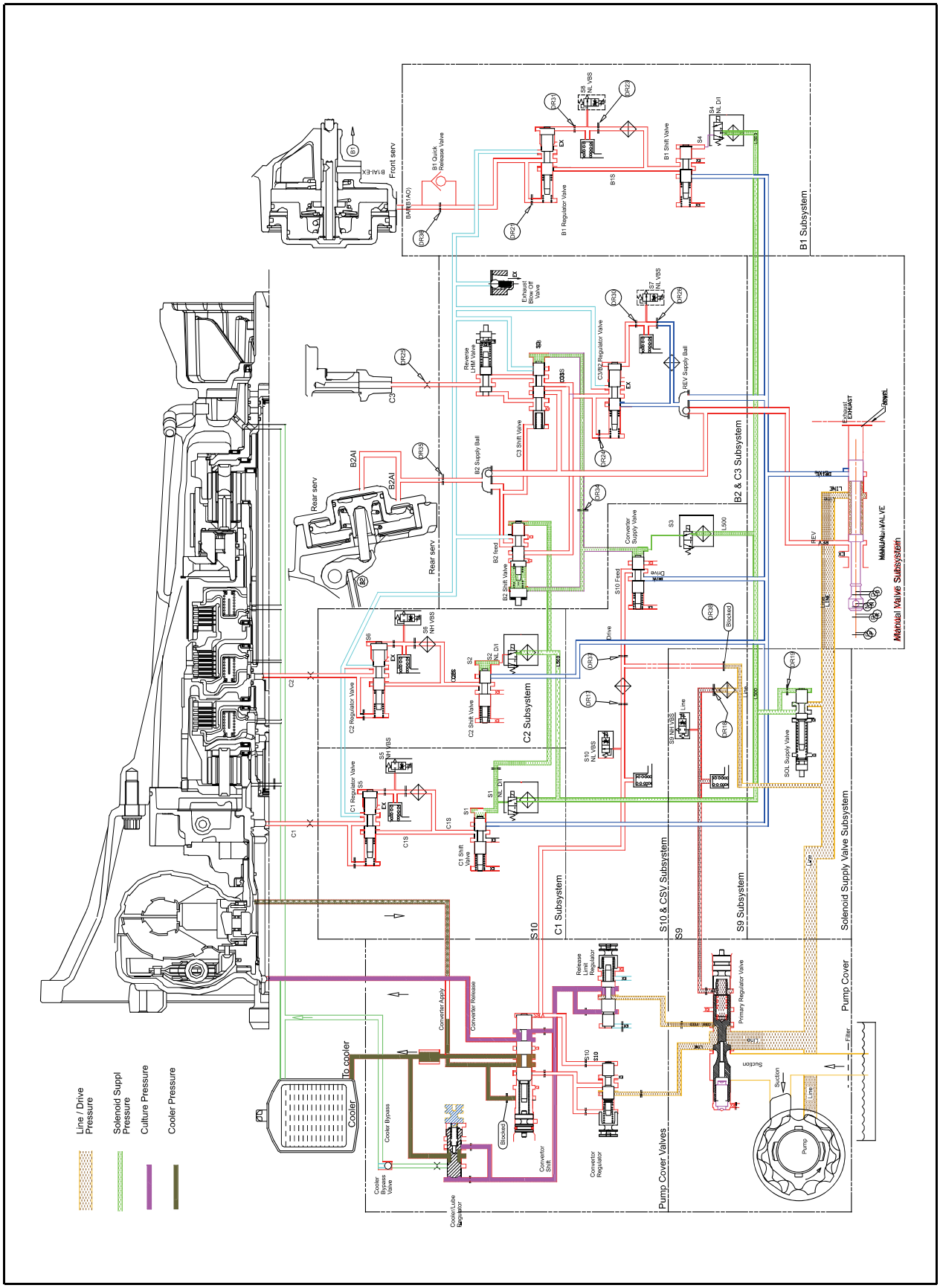
▶ Power flow diagram



▶ Connecting Components

Gear ratio	Elements engaged										ON / OFF solenoids				Variable pressure sol. valve-VBS					
	C1	C2	C3	B1			B2		OWC	CONV CLU	S1	S2	S3	S4	S5 (A)	S6 (A)	S7 (A)	S8 (A)	S9 (A)	S10 (A)
				AO	AI	R	AO	AI												
N/A											ON	ON	ON						0-1	

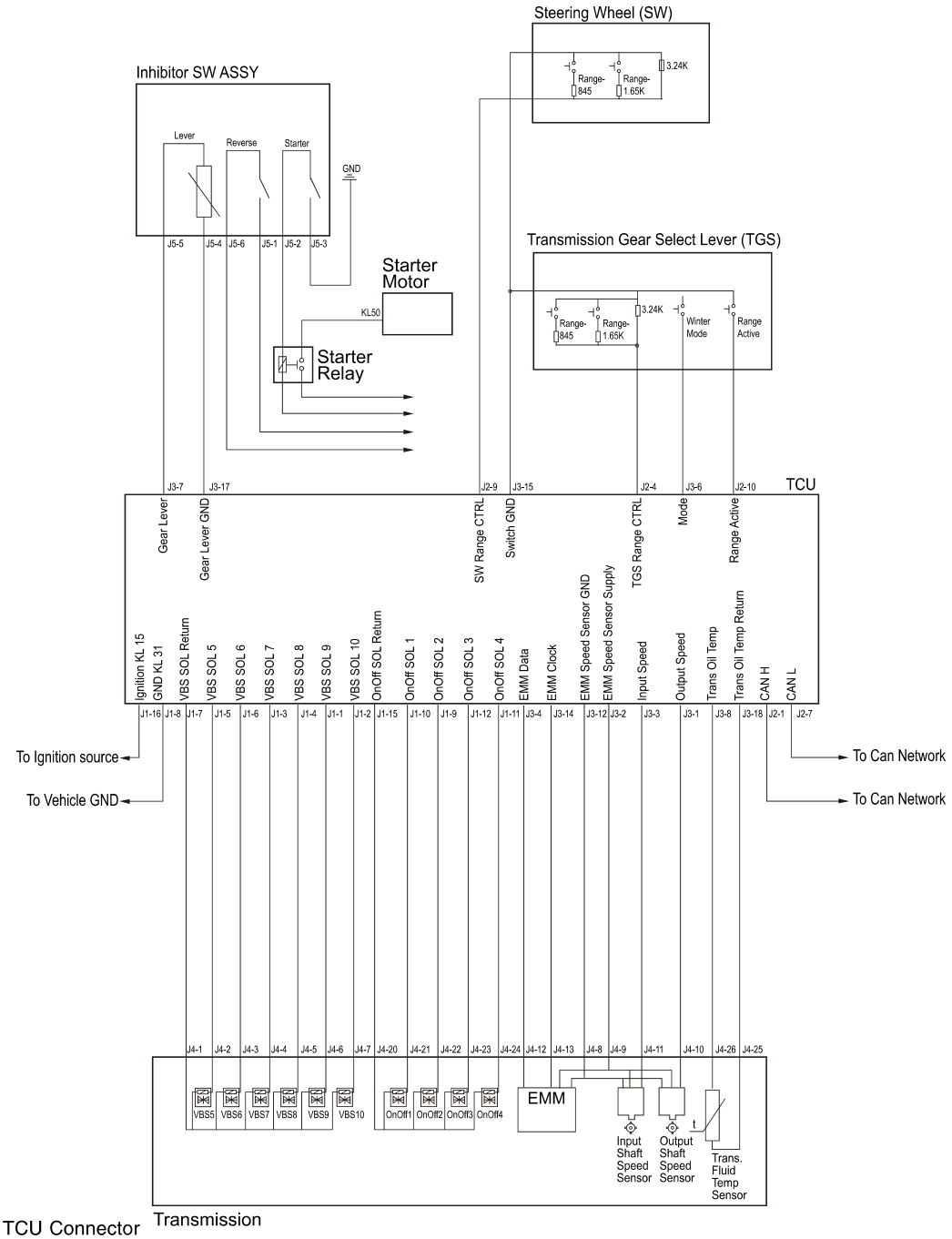
▶ Neutral



Modification basis	
Application basis	
Affected VIN	

DIAGNOSIS AND TESTING

1. WIRING DIAGRAM



* TCU Connector

SM J1 = EWD A

SM J2 = EWD B

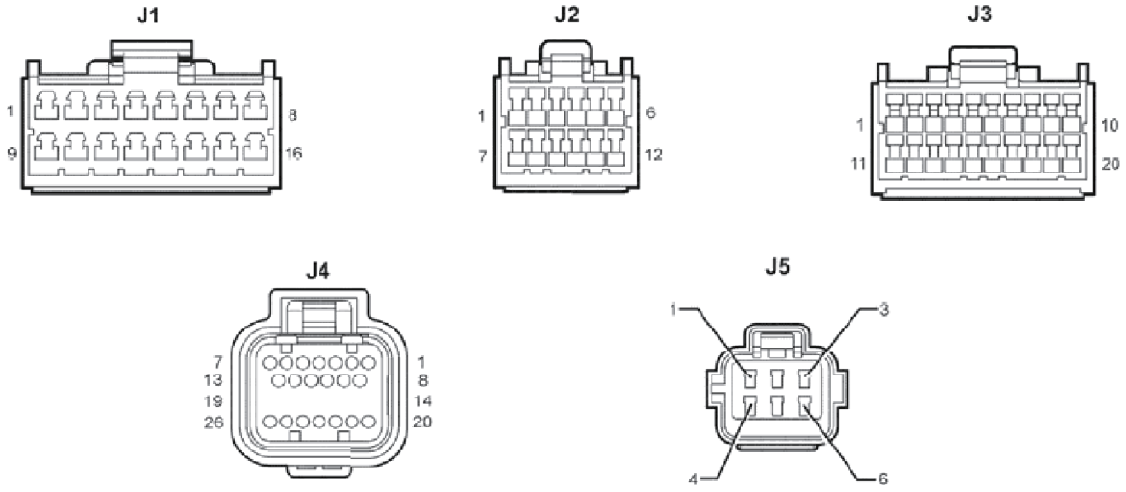
SM J3 = EWD C

(SM: Service Manual, EWD: Electrical Wiring Diagram)

Modification basis	
Application basis	
Affected VIN	

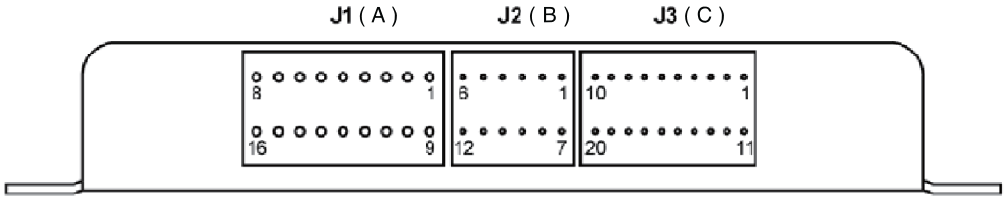
2. WIRE HARNESS CONNECTOR CHART

Connector Front View



3. UNIT CONNECTOR DESCRIPTION

1) Transmission Control Unit



( ) : EWD

▶ **Connector J1 (A)**

Terminal / Pin	Function	Terminal / Pin	Function
J1-1	VBS Solenoid 9	J1-9	On / Off Solenoid 2
J1-2	VBS Solenoid 10	J1-10	On / Off Solenoid 1
J1-3	VBS Solenoid 7	J1-11	On / Off Solenoid 4
J1-4	VBS Solenoid 8	J1-12	On / Off Solenoid 3
J1-5	VBS Solenoid 5	J1-13	-
J1-6	VBS Solenoid 6	J1-14	-
J1-7	VBS Solenoid Return	J1-15	On / Off Solenoid Return
J1-8	Ground	J1-16	Ignition Supply Voltage

▶ Connector J2 (B)

Terminal / Pin	Function	Terminal / Pin	Function
J2-1	CAN High	J2-7	CAN Low
J2-2	-	J2-8	-
J2-3	-	J2-9	Steering Wheel Range Control
J2-4	Transmission Gear Selector Range Control	J2-10	Range Active
J2-5	-	J2-11	-
J2-6	-	J2-12	-

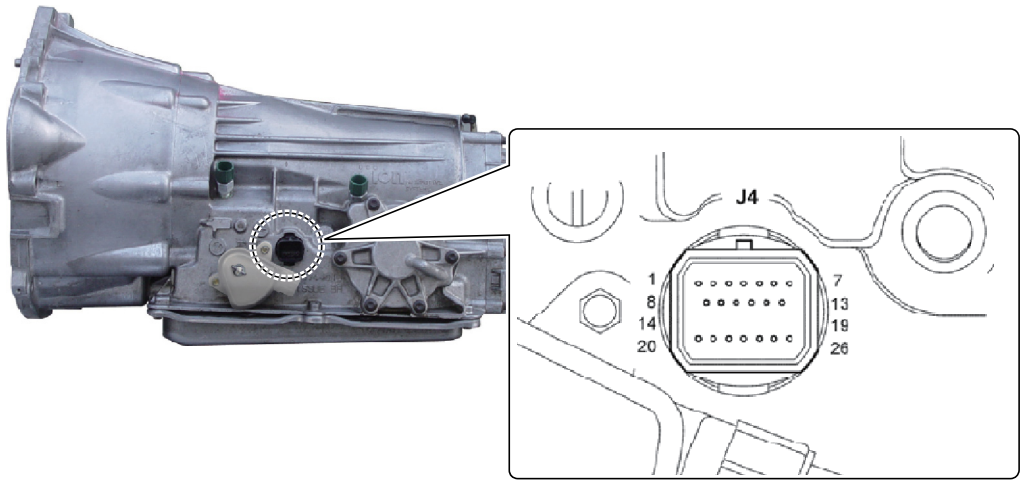
▶ Connector J3 (C)

Terminal / Pin	Function	Terminal / Pin	Function
J3-1	Output Speed	J3-11	-
J3-2	EMM / Speed Sensor Supply Voltage	J3-12	EMM / Speed Sensor Ground
J3-3	Input Speed	J3-13	-
J3-4	Embedded Memory Module Data	J3-14	Embedded Memory Module Clock
J3-5	-	J3-15	Switch Ground
J3-6	Mode	J3-16	-
J3-7	Gear Lever	J3-17	Gear Lever Ground
J3-8	Transmission Fluid Temperature	J3-18	Transmission Fluid Temperature Return
J3-9	-	J3-19	-
J3-10	-	J3-20	-

Modification basis	
Application basis	
Affected VIN	

2) Transmission

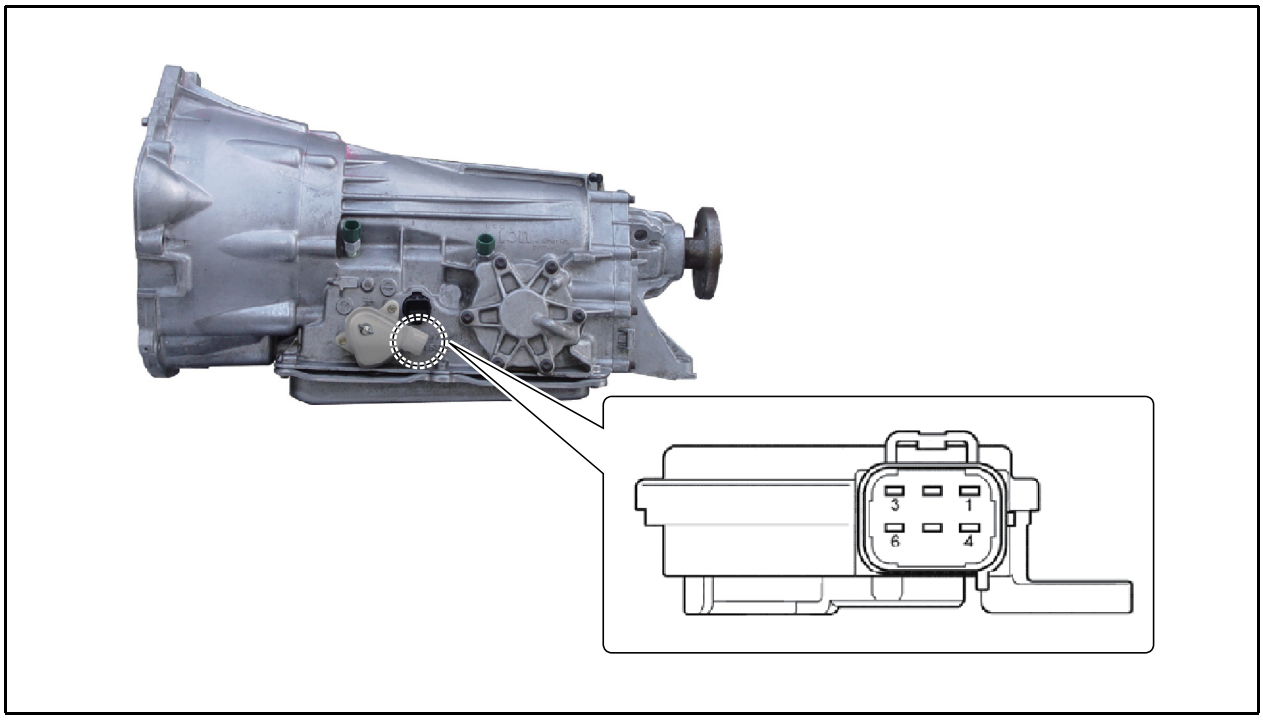
Connector Front View



▶ **Connector J4**

Terminal / Pin	Function	Terminal / Pin	Function
J4-1	VBS Solenoid Return	J4-14	-
J4-2	VBS Solenoid 5	J4-15	-
J4-3	VBS Solenoid 6	J4-16	-
J4-4	VBS Solenoid 7	J4-17	-
J4-5	VBS Solenoid 8	J4-18	-
J4-6	VBS Solenoid 9	J4-19	-
J4-7	VBS Solenoid 10	J4-20	On/Off Solenoid Return
J4-8	EMM Data / Speed Sensor Ground	J4-21	On/Off Solenoid
J4-9	EMM / Speed Sensor Supply Voltage	J4-22	On/Off Solenoid
J4-10	Output Speed	J4-23	On/Off Solenoid
J4-11	Input Speed	J4-24	On/Off Solenoid
J4-12	Embedded Memory Module Data	J4-25	Transmission Fluid Temperature Return
J4-13	Embedded Memory Module Clock	J4-26	Transmission Fluid Temperature Input

3) Inhibitor Switch



▶ **Connector J5**

Terminal / Pin	Function	Terminal / Pin	Function
J5-1	Reverse Circuit	J5-4	Gear Lever Ground
J5-2	Starter Circuit	J5-5	Gear Lever
J5-3	Starter Circuit	J5-6	Reverse Circuit

Modification basis	
Application basis	
Affected VIN	

TROUBLE CODE DIAGNOSIS

1. DIAGNOSTIC TROUBLE CODE LIST

DTC	Description	Sub System
P0603	TCU Adaptive Data Memory Error	TCU (see page 68)
P0604	TCU Adaptive Data Limit Reached	
P0700	Transmission Control System (MIL Request)	
P0707	Gear Lever Position Sensor Error Low	
P0708	Gear Lever Position Sensor Error High	Inhibitor Switch Assembly (see page 71)
P0711	Transmission Oil Temp Over Temp	
P0712	Transmission Oil Temperature Sensor Error Low	Transmission Cooling (see page 74)
P0713	Transmission Oil Temperature Sensor Error High (Open Circuit)	Transmission Oil Temperature Sensor (see page 75)
P0716	Input Shaft/Turbine Speed Value	
P0717	Input Shaft/Turbine Speed Sensor Erratic	Input Speed Sensor (see page 78)
P071D	Manual Shift Control Up/Down (TGS) Switch Stuck	
P071E	Manual Shift Control Up/Down (TGS) Switch Signal Low	Transmission Gear Select (TGS) Lever (see page 82)
P071F	Manual Shift Control Up/Down (TGS) Switch Signal High	
P0721	Output Shaft Speed Sensor Value	
P0722	Output Shaft Speed Sensor Erratic	Output Speed Sensor (see page 85)
P0729	Gear 6 Incorrect Ratio	
P0731	Gear 1 or M1 Incorrect Ratio	Gear Engagement (see page 87)
P0732	Gear 2 Incorrect Ratio	
P0733	Gear 3 Incorrect Ratio	
P0734	Gear 4 Incorrect Ratio	
P0735	Gear 5 Incorrect Ratio	
P0736	Reverse Incorrect Ratio	
P0741	Torque converter clutch circuit stuck off	
P0742	Torque converter clutch circuit stuck on	Torque Converter Control (see page 90)
P0744	Torque converter clutch Slip Error	
P0826	Manual Shift Control Up/Down (Steering Wheel) Switch Stuck	
P0827	Manual Shift Control Up/Down (Steering Wheel) Switch Signal Low	Steering Wheel (see page 92)
P0828	Manual Shift Control Up/Down (Steering Wheel) Switch Signal High	
P0962	Solenoid S9 Over Current	
P0963	Solenoid S9 Low Current	Variable Bleed Solenoids (see page 95)
P0966	Solenoid S10 Over Current	
P0967	Solenoid S10 Low Current	

DTC	Description	Sub System
P0973	Solenoid S1 Over Current	ON / OFF Solenoids (see page 101)
P0974	Solenoid S1 Low Current	
P0976	Solenoid S2 Over Current	
P0977	Solenoid S2 Low Current	
P0979	Solenoid S3 Over Current	
P0980	Solenoid S3 Low Current	
P0982	Solenoid S4 Over Current	
P0983	Solenoid S4 Low Current	
P0985	Solenoid S5 Over Current	Variable Bleed Solenoids (see page 95)
P0986	Solenoid S5 Low Current	
P0998	Solenoid S6 Over Current	
P0999	Solenoid S6 Low Current	
P099B	Solenoid S7 Over Current	
P099C	Solenoid S7 Low Current	
P099E	Solenoid S8 Over Current	
P099F	Solenoid S8 Low Current	
P1604	TCU EMM Data Error	TCU (see page 68)
P1605	EMM Data Mismatch	Input Speed Sensor (see page 82)
P1610	EMM Comms Error	
P1611	EMM Data Error	
P1701	TCU Supply Voltage Low	TCU (see page 68)
P1703	TCU Supply Voltage High	
U0100	Cyclic CAN messages from Engine Management ECU are unavailable	CAN Network (see page 106)
U0102	Cyclic CAN messages from Transfer Case ECU are unavailable	
U0103	Cyclic CAN messages from TGS ECU are unavailable	
U0121	Cyclic CAN messages from Brake System ECU (ABS/ ESP/TCS) are unavailable	
U0401	CAN signals from EMS are out of range or Invalid	
U0403	CAN signals from Transfer Case are out of range or Invalid	
U404	CAN signals from Gear Lever ECU are out of range or Invalid	
U0415	CAN signals from Brake System ECU (ABS/ESP/TCS) are out of range or Invalid	
U1600	ECU Application Software Missing	TCU Calibration (see page 109)
U1601	ECU Application Software Missing or Corrupted	
U1606	TCU Calibration Error - Platform	
U1607	TCU Calibration Error - Active Variant	
U1608	TCU VIN Coding Error	
U1609	TCU Hardware (pcb) Calibration Error	

Modification basis	
Application basis	
Affected VIN	

2. SYSTEM DIAGNOSIS

1) TCU

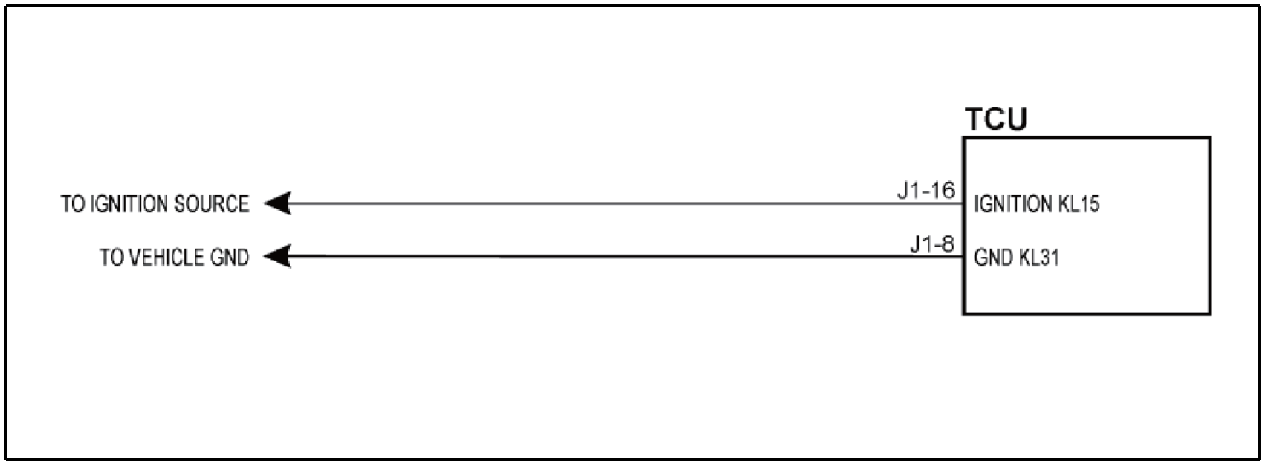
The transmission control unit (TCU) controls transmission gear selection via variable bleed solenoids and On/Off solenoids. The TCU operating voltage is 8-16 V, with current draw typically being less than 4 amps but reaching as high as 10 amps during gear shifts.
As the mechanical components of the transmission change due to wear etc, the TCU adapts its shift data to accommodate these changes and maintain shift quality over the life of the vehicle. If a transmission component degrades to a point whereby the TCU is unable to adapt its shift data to maintain shift quality, the TCU will set a DTC.

DTC	Title	System Action
P0603	TCU Adaptive Data Memory Error	• MIL - OFF • Normal transmission operation with degraded shift quality
P0604	TCU Adaptive Data Limit Reached	• MIL - OFF • Normal transmission operation with degraded shift quality
P0700	Transmission Control System (MIL Request)	• MIL - ON
P1604	TCU EMM Data Error	• MIL - ON • Transmission in LHM
P1701	TCU Supply Voltage Low	• MIL - ON • Transmission in LHM
P1703	TCU Supply Voltage High	• MIL - ON • Transmission in LHM

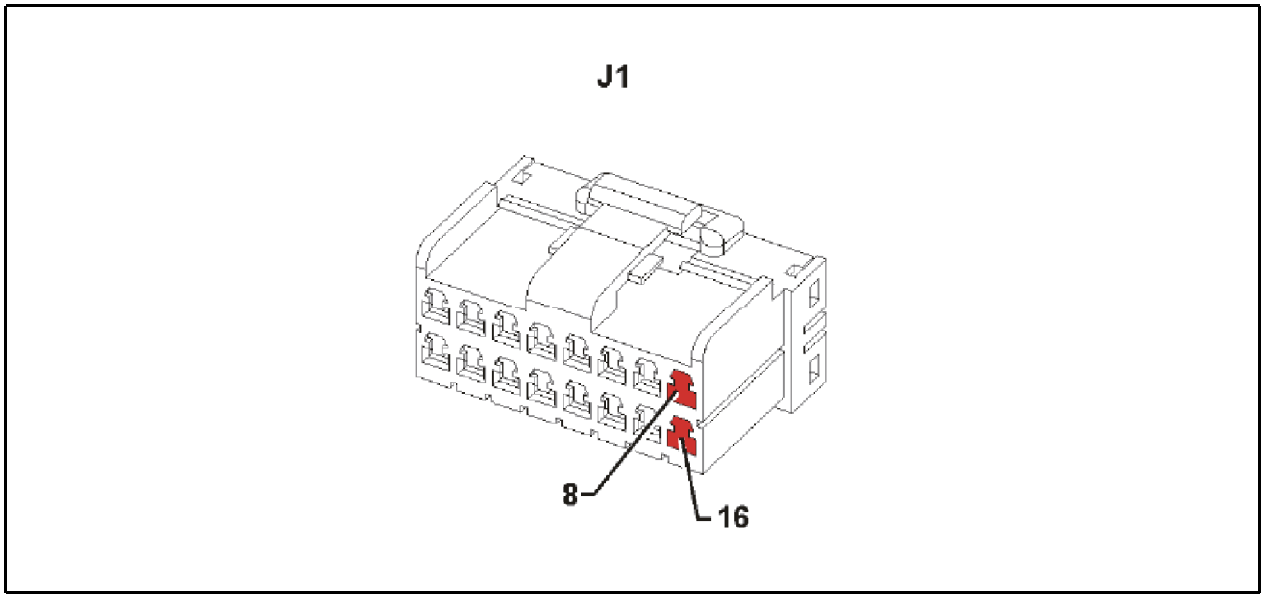
▶ **Connector J5**

DTC	Description
P0603	TCU is not able to store adaptive (learning) data.
P0604	TCU shift adaptation is applying maximum effort. This may be because the transmission operation has degraded significantly.
P0700	The transmission control system has a sufficient number, and DTC type of faults to turn the MIL light ON.
P1604	The EMM Data image stored in the TCU is corrupted or missing.
P1701	The battery voltage sensor is reporting a value too low to operate the solenoids correctly.
P1703	The battery voltage sensor is reporting a value too high for continuous operation of solenoids. The solenoids will be disabled and the transmission in LHM during this condition.

▶ Schematic



▶ Connector Details



Modification basis	
Application basis	
Affected VIN	

▶ DTC Details

DTC	Evaluation Condi-	Possible Causes	Actions
P0603 TCU Adaptive Data Memory Error	Ignition key in ON position	TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Replace TCU
P0604 TCU Adaptive Data Limit Reached	Ignition key in ON position	Transmission	• Clear DTC and check if DTC sets within the evaluation conditions • Service transmission
P0700 TM Control System (MIL Request)	Ignition key in ON position	Other DTC's requiring the MIL to be turned ON are set.	• Clear DTC and check if DTC sets within the evaluation conditions • Check if any DTC's requiring the MIL to be turned ON are set • Replace TCU
P1604 TCU EMM Data Error	Ignition key in ON position	• Embedded Memory Module (EMM). • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Replace TCU
P1701 TCU Supply Voltage Low	• Ignition key in ON position • Engine speed > 300 rpm • TCU supply voltage <8 V for 0.5 seconds	• Vehicle charging system • Vehicle battery • TCU to Transmission harness and/or connector fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check vehicle charging system • Check vehicle battery • Check circuit between terminal J1-8 and vehicle ground • Check circuit between terminal J1-16 and ignition source. Refer to vehicle electrical section for circuit specific information • Check supply voltage at TCU • Replace TCU
P1703 TCU Supply Voltage High	Ignition key in ON position TCU supply voltage >17 V for 60 seconds	• Vehicle charging system • Vehicle battery • TCU to Transmission harness and/or connector fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check vehicle charging system • Check vehicle battery • Check circuit between terminal J1-8 and vehicle ground • Check circuit between terminal J1-16 and ignition source. Refer to vehicle electrical section for circuit specific information • Check supply voltage at TCU • Replace TCU

▶ DTC Clearing

DTC	Conditions
P0603, P0604, P0700, P1604, P1701 & P1703	• Ignition ON • Engine stopped • Scan tool

2) Inhibitor Switch Assembly

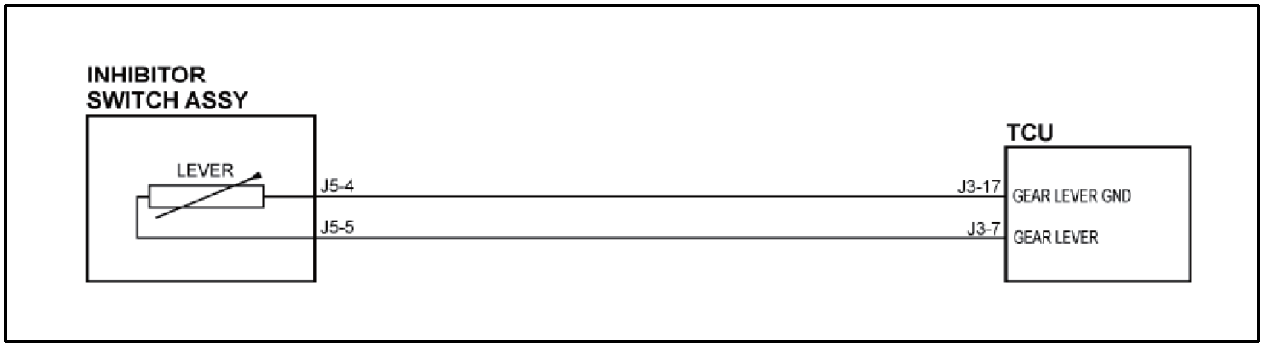
The inhibitor switch assembly provides gear position data to the transmission control unit (TCU), inhibits starter motor operation when the transmission gear select (TGS) lever is not in the neutral or park position, and enables reverse light operation when the TGS lever is in the reverse position. The inhibitor switch has an individual circuit for each of these functions, with only the gear lever position circuit being connected directly to the TCU.
The TCU supplies a 5 V reference signal to the gear lever position circuit (inhibitor switch) and measures the voltage drop in the circuit to determine the gear lever position. There is a different resistance value for each position of the TGS lever.

DTC	Title	System Action
P0707	Gear Lever Position Sensor Error Low	• MIL - ON • Transmission in LHM
P0708	Gear Lever Position Sensor Error High	• MIL - ON • Transmission in LHM

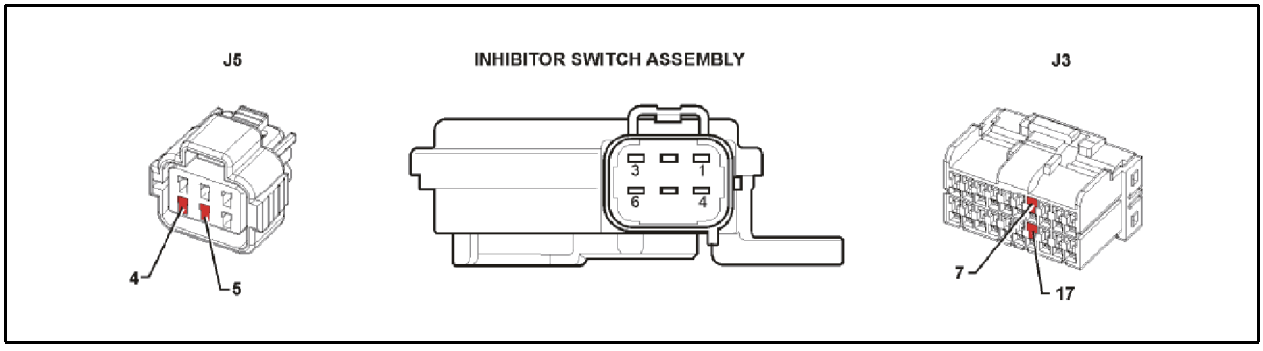
▶ DTC Description

DTC	Description
P0707	The Gear Lever Position sensor (Inhibitor Switch) is giving a value indicative of a short circuit to
P0708	ground

▶ Schematic



▶ Connector Details



Modification basis	
Application basis	
Affected VIN	

▶ Resistance Values

Gear Lever Position Sensor Specifications

Gear Position	Value
P	16.786 kΩ ± 8%
R	8.953 kΩ ± 8%
N	5.036 kΩ ± 8%
D	2.686 kΩ ± 8%

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0707 Gear Lever Position Sensor Error Low	Ignition key in ON position	• TCU to Inhibitor Switch Assy harness and/or connector fault • Inhibitor Switch Assy • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Disconnect connector J5 from the inhibitor switch assembly. Check resistance of inhibitor switch assembly between terminals 4 and 5 for each position of TGS lever. Refer to the resistance table above for specifications. Replace transmission if the resistance values are outside of the specified range. • Check circuit between terminals J5-4 and J3-17 for short or open condition • Check circuit between terminals J5-5 and J3-7 for short or open condition • Disconnect connector J5 from inhibitor switch assembly and measure voltage across J5-4 and J5-5 with the ignition key in the ON position. Voltage reading should be 5 V ± 0.1 V. If voltage reading is outside specifications, replace TCU

DTC	Evaluation Conditions	Possible Causes	Actions
P0708 Gear Lever Position Sensor Error High	Ignition key in ON position	• TCU to Inhibitor Switch Assy harness and/or connector fault • Inhibitor Switch Assy • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Disconnect connector J5 from the inhibitor switch assembly. Check resistance of inhibitor switch assembly between terminals 4 and 5 for each position of TGS. Refer to the resistance table above. Replace transmission assembly if the resistance values are outside of the specified range. • Check circuit between terminals J5-4 and J3-17 for short or open condition • Check circuit between terminals J5-5 and J3-7 for short or open condition • Replace TCU

▶ DTC Clearing

DTC	Conditions
P0707 & P0708	• Ignition ON • Engine stopped • Scan tool

Modification basis	
Application basis	
Affected VIN	

3) Transmission Cooling

The transmission control unit (TCU) monitors the transmission oil temperature. If the vehicle cooling system is unable to maintain a satisfactory transmission oil temperature the TCU will take precautionary measures to prevent damage to the transmission and other vehicle components. The TCU also monitors the rate of temperature change according to current operating conditions (performance). If the temperature sensor performance is outside a pre-determined set of values, DTC P0711 will set.

DTC	Title	System Action
P0711	Transmission Oil Temp Over Temp	• MIL - ON • Normal transmission operation with degraded shift quality and "WINTER" indicator flashing when transmission oil temperature is >130°C. • When the transmission oil temperature is > 145°C the TCU will disable gear engagement until transmission oil temperature is <120°C

▶ DTC Description

DTC	Description
P0711	Transmission Oil Temperature is high enough to cause degraded transmission operation

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0711 Transmission Oil Temp Over Temp	• Ignition key in ON position • Transmission oil temperature is > 130°C	• Transmission cooler blocked • Transmission cooler lines restricted • Engine cooling system fault	• Clear DTC and check if DTC sets within the evaluation conditions • Inspect transmission oil level and oil quality • Inspect transmission cooling system • Inspect engine cooling system

▶ DTC Clearing

DTC	Conditions
P0711	• Ignition ON • Engine stopped • Scan tool

4) Transmission Oil Temperature Sensor

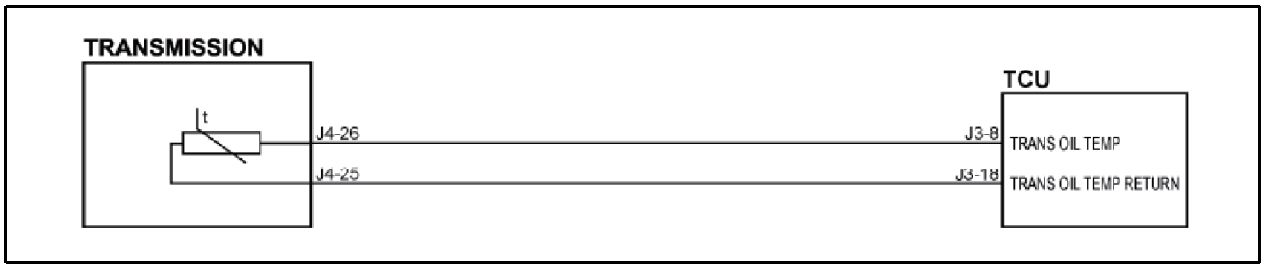
The automatic transmission fluid temperature (TFT) sensor is mounted in the valve body harness tray. The TFT sensor is a negative coefficient thermistor.
The transmission control unit (TCU) supplies a 5 V reference signal to the sensor and measures the voltage drop in the circuit. When the transmission fluid is cold, the sensor resistance is high, with the sensor resistance decreasing as the fluid temperature increases.

DTC	Title	System Action
P0712	Transmission Oil Temperature Sensor Error Low	• MIL - ON
P0713	Transmission Oil Temperature Sensor Error High	• MIL - ON

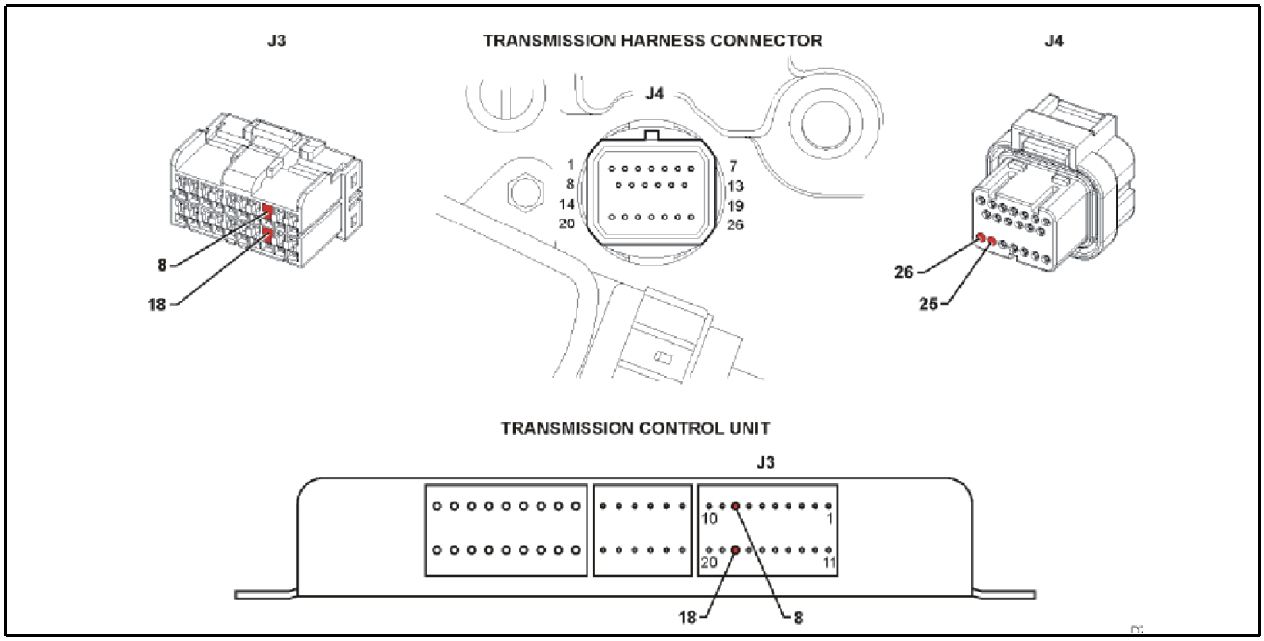
▶ DTC Description

DTC	Description
P0712	Transmission oil temperature sensor is giving a value indicative of a short circuit to ground.
P0713	Transmission oil temperature sensor is giving a value indicative of an open circuit.

▶ Schematic



▶ Connector Details



Modification basis	
Application basis	
Affected VIN	

▶ Resistance Values

Temperature	Minimum Resistance Value	Maximum Resistance Value
-40°C	1.467 MΩ	1.896 MΩ
-30°C	778.4 kΩ	984.2 kΩ
-20°C	430.7 kΩ	533.9 kΩ
-10°C	247.3 kΩ	301.1 kΩ
0°C	146.8 kΩ	175.7 kΩ
10°C	89.95 kΩ	106 kΩ
20°C	56.74 kΩ	65.86 kΩ
30°C	36.76 kΩ	42.10 kΩ
40°C	24.43 kΩ	27.61 kΩ
50°C	16.60 kΩ	18.54 kΩ
60°C	11.53 kΩ	12.73 kΩ
70°C	8.161 kΩ	8.916 kΩ
80°C	5.880 kΩ	6.360 kΩ
90°C	4.306 kΩ	4.614 kΩ
100°C	3.210 kΩ	3.399 kΩ
110°C	2.392 kΩ	2.562 kΩ
120°C	1.811 kΩ	1.955 kΩ
130°C	1.388 kΩ	1.510 kΩ
140°C	1.075 kΩ	1.179 kΩ
150°C	0.843 kΩ	0.930 kΩ

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0712 Transmission Oil Temperature Sensor Error Low	Ignition key in ON position	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Temperature sensor • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminal's J3-8 and J4-26 for short condition • Check circuit between terminal's J3-18 and J4-25 for short condition • Disconnect transmission connector J4. Check resistance of transmission oil temp. sensor between terminals J4-25 and J4-26. Refer to the resistance table above for specifications. Replace transmission assembly if the resistance values are outside of the specified range • Disconnect connector J3 from the TCU and measure voltage across TCU terminals (TCU side) J3-8 and J3-18 with the ignition key in the ON position. Voltage reading should be 5 V ± 0.1 V. If voltage reading is outside specifications, replace TCU
P0713 Transmission Oil Temperature Sensor Error High	Ignition key in ON position	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Temperature sensor • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminal's J3-8 and J4-26 for open condition • Check circuit between terminal's J3-18 and J4-25 for open condition • Disconnect transmission connector J4. Check resistance of transmission oil temp. sensor between terminals J4-25 and J4-26. Refer to the resistance table above for specifications. Replace transmission assembly if the resistance values are outside of the specified range • Disconnect connector J3 from the TCU and measure voltage across TCU terminals (TCU side) J3-8 and J3-18 with the ignition key in the ON position. Voltage reading should be 5 V ± 0.1 V. If voltage reading is outside specifications, replace TCU

▶ DTC Clearing

DTC	Conditions
P0712 & P0713	• Ignition ON • Engine stopped • Scan tool

Modification basis	
Application basis	
Affected VIN	

5) Input Speed Sensor

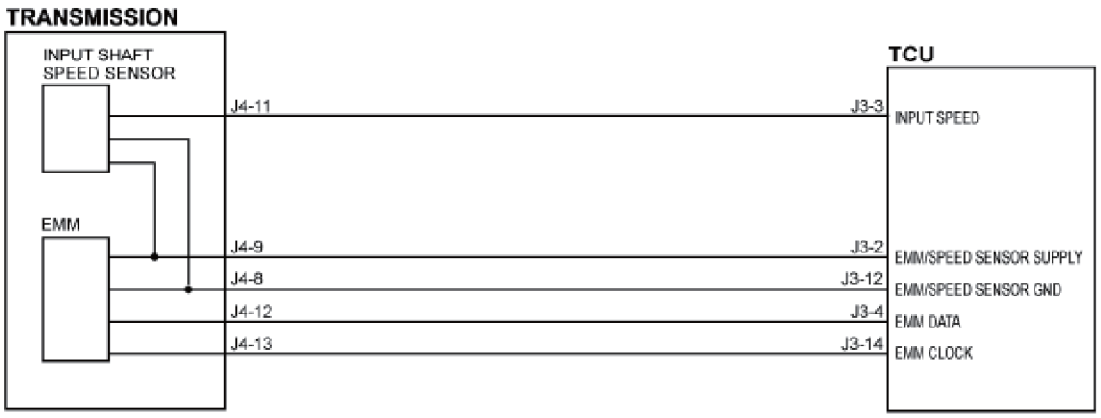
The ISS sensor is a Hall Effect type sensor and is mounted on the valve body in the transmission. The EMM is matched to the transmission valve body during manufacture. The EMM is integrated into the input speed sensor.
The hall effect sensor drives the signal low. The TCU then pulls the signal up to 5 V via a resistor, 36 times per revolution of the C2 cylinder.

DTC	Title	System Action
P0716	Input Shaft/Turbine Speed Value	• MIL - ON • Closed loop torque converter clutch slip control is disabled • Adaptive learning is disabled • Engine speed is used to estimate input shaft speed for gear shifting
P0717	Input Shaft/Turbine Speed Sensor Erratic	• MIL - ON • Closed loop torque converter clutch slip control is disabled • Adaptive learning is disabled • Engine speed is used to estimate input shaft speed for gear shifting
P1605	EMM Data Mismatch	• MIL - OFF • Transmission in LHM
P1610	EMM Comms Error	• MIL - OFF
P1611	EMM Data Error	• MIL - ON • Last known valid EMM data in TCU used • Normal transmission operation

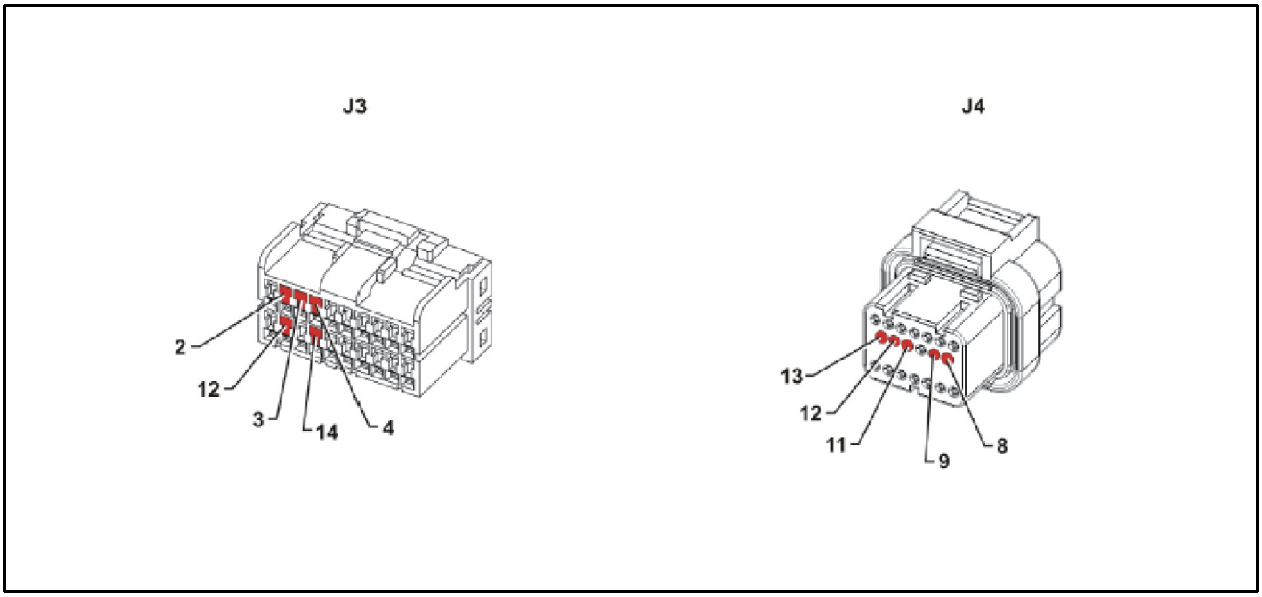
▶ DTC Description

DTC	Description
P0716	The input shaft speed (ISS) is compared to engine speed and validated for plausibility
P0717	The input speed sensor is receiving intermittent or spurious pulses.
P1605	The Embedded Memory Module (EMM) data stored in the TCU does not match the EMM module in the transmission
P1610	The TCU was unable to communicate with EMM
P1611	The data stored in the EMM is corrupted or missing or invalid

▶ Schematic



▶ Connector Details



Modification basis	
Application basis	
Affected VIN	

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0716 Input Shaft/ Turbine Speed Value	• Ignition key in ON position • Engine speed > 3000 rpm	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Input speed sensor • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J3-3 and J4-11 for short or open condition • Check circuit between terminals J3-2 and J4-9 for short or open condition • Check circuit between terminals J3-12 and J4-8 for short or open • Disconnect transmission connector J4. Measure the voltage across terminals J4-8 and J4-9 with ignition key in ON position. Voltage reading should be > 10 V. Replace the TCU if the reading is <10 V • Measure the voltage across terminals J4-8 and J4-11 with ignition key in ON position. Voltage reading should be 5 V ± 0.1 V .Replace the TCU if the reading is not within specification • Reconnect transmission connector J4. Connect an oscilloscope to J3-3 and J3-12 and start the engine. Increase engine rpm and observe the square wave pattern. If the pattern shows switching from 5 V to 0 V, replace the TCU. If the pattern does not show switching, replace the transmission
P0717 Input Shaft/ Turbine Speed Sensor Erratic	• Ignition key in ON position • Engine speed is >3000 rpm	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Input speed sensor • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J3-3 and J4-11 for short or open condition • Check circuit between terminals J3-2 and J4-9 for short or open condition • Check circuit between terminals J3-12 and J4-8 for short or open • Disconnect transmission connector J4. Measure the voltage across terminals J4-8 and J4-9 with ignition key in ON position. Voltage reading should be > 10 V. Replace the TCU if the reading is <10 V • Measure the voltage across terminals J4-8 and J4-11 with ignition key in ON position. Voltage reading should be 5 V ± 0.1 V. Replace the TCU if the reading is not within specification • Reconnect transmission connector J4. Connect an oscilloscope to J3-3 and J3-12 and start the engine. Increase engine rpm and observe the square wave pattern. If the pattern shows switching from 5 V to 0 V, replace the TCU. If the pattern does not show switching, replace the transmission

DTC	Evaluation Conditions	Possible Causes	Actions
P1605 EMM Data Mismatch	Ignition key in ON position	EMM data stored in the TCU does not match the EMM module in the transmission. This indicates that the transmission or TCU has been replaced.	• Clear DTC and check if DTC sets within the evaluation conditions • Replace the transmission
P1610 EMM Comms Error	Ignition key in ON position	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • EMM • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J3-2 and J4-9 for short or open condition • Check circuit between terminals J3-12 and J4-8 for short or open • Check circuit between terminals J3-4 and J4-12 for short or open condition • Check circuit between terminals J3-14 and J4-13 for short or open condition • Replace the transmission
P1611 EMM Data Error	Ignition key in ON position	• EMM	• Clear DTC and check if DTC sets within the evaluation conditions • Replace the transmission

▶ DTC Clearing

DTC	Conditions
P0716, P0717, P1605, P1610 & P1611	• Ignition ON • Engine stopped • Scan tool

6) Transmission Gear Select Lever

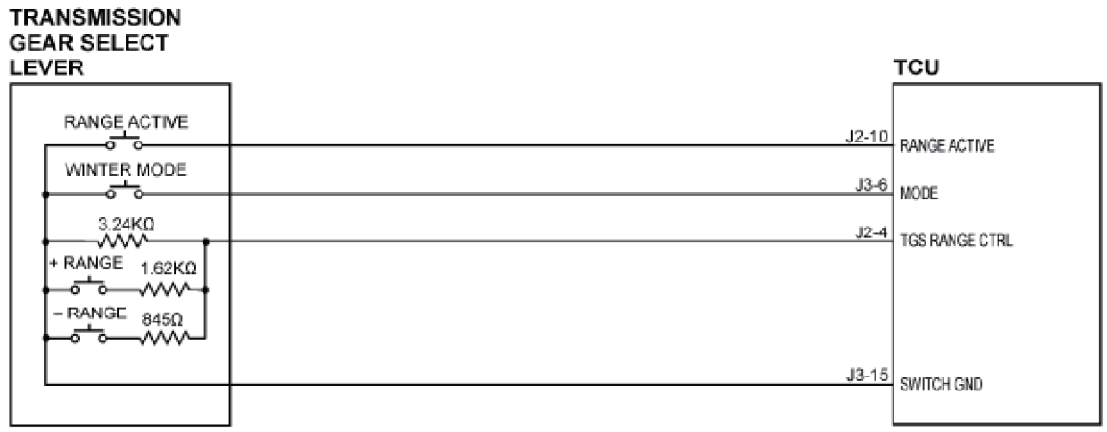
The transmission gear select lever contains the mode switch, manual mode active switch and up/down switches. These switches are connected directly to the TCU.

DTC	Title	System Action
P071D	Manual Shift Control Up/Down (TGS) Switch Stuck	• MIL - OFF • Manual shift control (TGS) switches disabled
P071E	Manual Shift Control Up/Down (TGS) Switch Signal Low	• MIL - OFF • Manual shift control (TGS) switches disabled
P071F	Manual Shift Control Up/Down (TGS) Switch Signal High	• MIL - OFF • Manual shift control (TGS) switches disabled

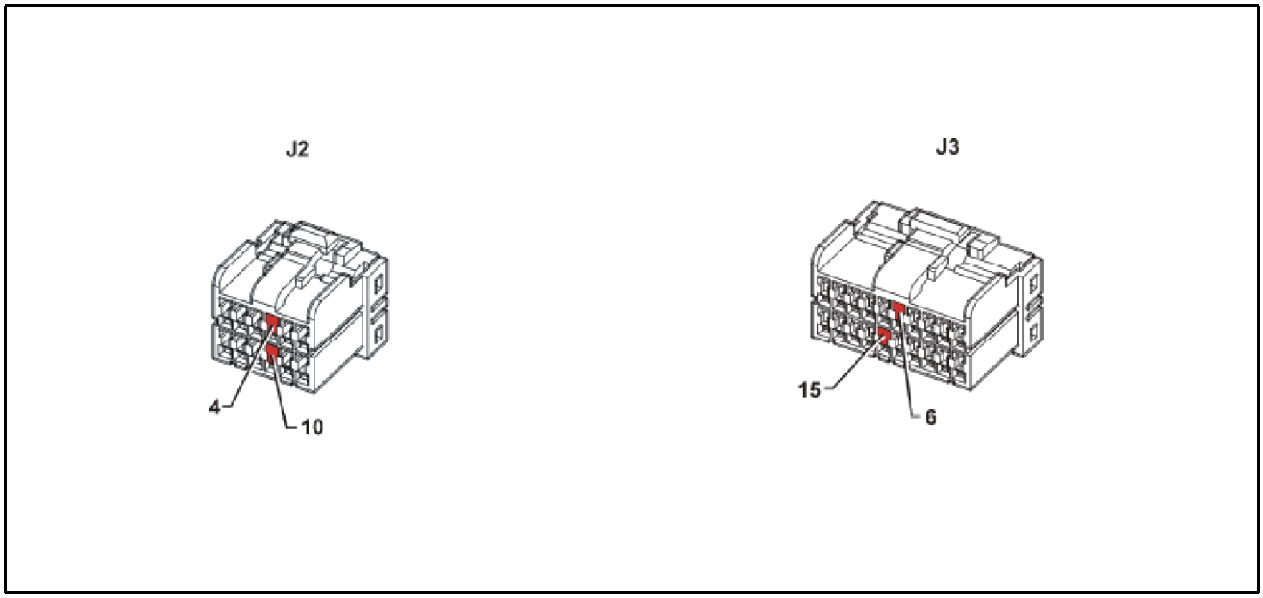
▶ DTC Description

DTC	Description
DTC P071D	The Manual Shift Control Up/Down switch (TGS) has been depressed for more than 120 seconds continuously. This may indicate a faulty switch
DTC P071E	The Manual Shift Control Up/Down (TGS) switch signal is giving a value indicative of a short circuit
DTC P071F	The Manual Shift Control Up/Down (TGS) switch signal is giving a value indicative of an open circuit

▶ Schematic



▶ Connector Details



▶ Resistance Values

Transmission Gear Select Lever

Switch	Value
Range up (press and hold)	1.08 kΩ ± 10%
Range down (press and hold)	555 kΩ ± 10%
Range up / down at rest position	3.24 kΩ ± 10%

▶ Resistance Values

DTC	Evaluation Conditions	Possible Causes	Actions
P071D Manual Shift Control Up/Down (TGS) Switch Stuck	Ignition key in ON position	• Shift Control Up/Down switch (TGS) • TCU to Shift Control Up/Down switch harness and/or connector fault • TCU	

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Condi-	Possible Causes	Actions
P071E Manual Shift Control Up/Down (TGS) Switch Signal Low	Ignition key in ON position	• Shift Control Up/Down switch (TGS) • TCU to Shift Control Up/Down switch harness and/or connector fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check up/down switch (TGS) mechanical operation • Check circuit between terminal J2-4 and Shift Control Up/Down switch (TGS) for short or open condition • Check circuit between terminals J3-15 and TGS Lever for short or open condition • Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-4 and J3-15. Refer to the resistance table above for specifications. Replace TGS lever if the resistance values are outside of the specified range • Replace TCU
P071F Manual Shift Control Up/Down (TGS) Switch Signal High	Ignition key in ON position	• Shift Control Up/Down switch (TGS) • TCU to Shift Control Up/Down switch harness and/or connector fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check up/down switch (TGS) mechanical operation • Check circuit between terminal J2-4 and Shift Control Up/Down switch (TGS) for short or open condition • Check circuit between terminals J3-15 and TGS Lever for short or open condition • Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-4 and J3-15. Refer to the resistance table above for specifications. Replace TGS lever if the resistance values are outside of the specified range • Replace TCU

▶ DTC Clearing

DTC	Conditions
P071D, P071E, P071F	• Ignition ON • Engine stopped • Scan tool

7) Output Speed Sensor

The OSS sensor is a Hall Effect type sensor and is mounted at the rear of the transmission main case.

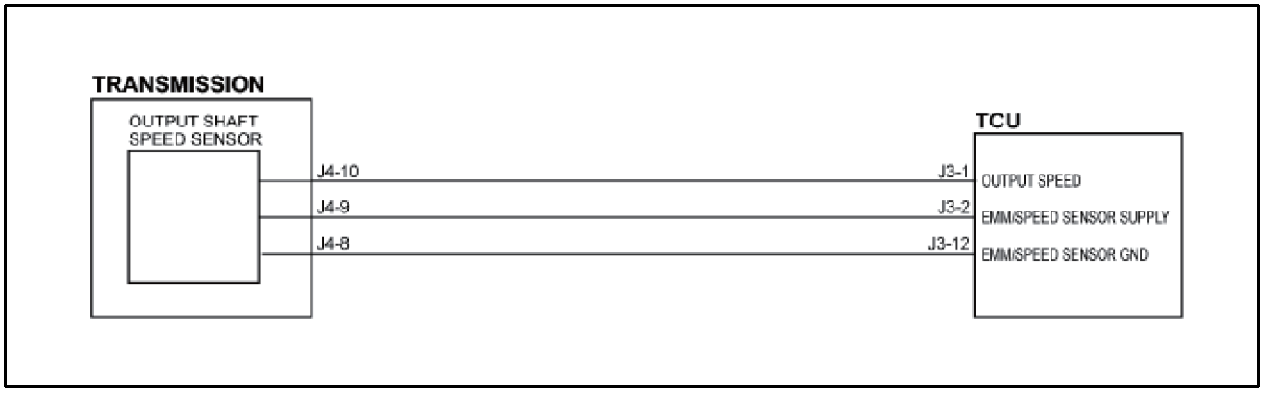
The hall effect sensor drives the signal low. The TCU then pulls the signal up to 5 V via a resistor, 22 times per revolution of the transmission output shaft.

DTC	Title	System Action
P0721	Output Shaft Speed Sensor Value	• MIL - ON • Transmission in LHM
P0722	Output Shaft Speed Sensor Erratic	• MIL - ON • Transmission in LHM

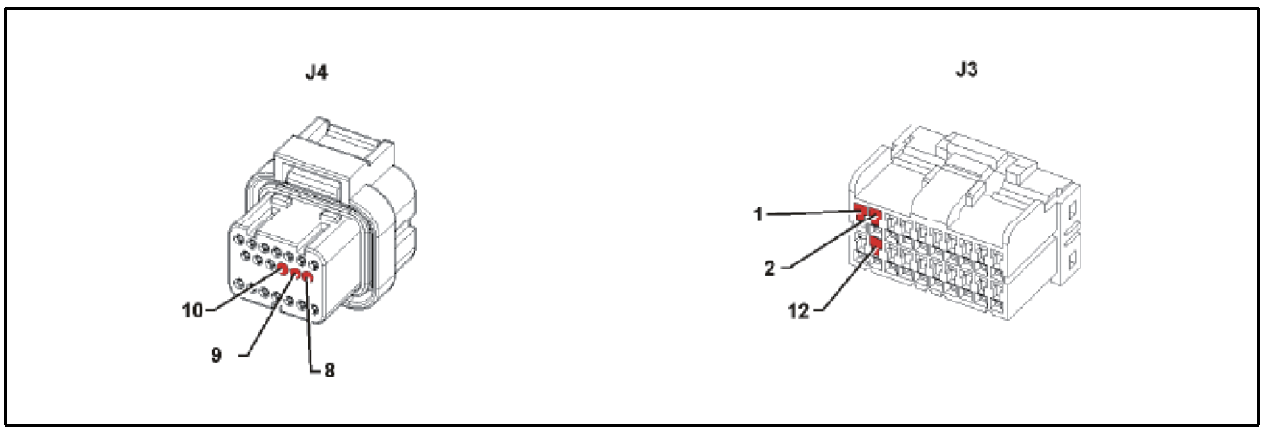
▶ DTC Description

DTC	Description
P0721	The output shaft speed (OSS) sensor is compared to external equivalent speed signals and validated for integrity
P0722	The output speed sensor is receiving intermittent or spurious pulses.

▶ Schematic



▶ Connector Details



Modification basis	
Application basis	
Affected VIN	

▶ DTC Details

DTC	Evaluation Condi-	Possible Causes	Actions
P0721 Output Shaft Speed Sensor Value	Ignition key in ON position	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Output speed sensor • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J3-1 and J4-10 for short or open condition • Check circuit between terminals J3-2 and J4-9 for short or open condition • Check circuit between terminals J3-12 and J4-8 for short or open • Disconnect connector J4 from transmission and measure voltage across terminals J4-8 and J4-9. If reading is not > 10 V, replace TCU • Measure voltage across terminals J4-8 and J4-10. If reading is not 5 V ± 0.1 V, replace TCU • Connect connector J4 to transmission, start engine, and connect oscilloscope to terminal J3-3. Shift TGS to Park position, increase engine speed and observe square wave switching from 5 V to 0 V. If correct, replace TCU. If not, replace transmission
P0722 Output Shaft Speed Sensor Erratic	Ignition key in ON position	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • Output speed	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J3-1 and J4-10 for short or open condition • Check circuit between terminals J3-2 and J4-9 for short or open condition • Check circuit between terminals J3-12 and J4-8 for short or open • Disconnect connector J4 from transmission and measure voltage across terminals J4-8 and J4-9. If reading is not > 10 V, replace TCU • Measure voltage across terminals J4-8 and J4-10. If reading is not 5 V ± 0.1 V, replace TCU • Connect connector J4 to transmission, start engine, and connect oscilloscope to terminal J3-3. Shift TGS to Park position, increase engine speed and observe square wave switching from 5 V to 0 V. If correct, replace TCU. If not,

▶ DTC Details

DTC	Conditions
P0721 & P0722	• Ignition ON • Engine stopped • Scan tool

8) Gear Engagement

Transmission gear change is controlled by the TCU. The TCU receives inputs from various engine and vehicle sensors to select shift schedules and to control the shift feel and torque converter clutch (TCC) operation at each gear change.

DTC	Title	System Action
P0729	Gear 6 Incorrect Ratio	• MIL - ON • Transmission in LHM
P0731	Gear 1 or M1 Incorrect Ratio	• MIL - ON • Transmission in LHM
P0732	Gear 2 Incorrect Ratio	• MIL - ON • Transmission in LHM
P0733	Gear 3 Incorrect Ratio	• MIL - ON • Transmission in LHM
P0734	Gear 4 Incorrect Ratio	• MIL - ON • Transmission in LHM
P0735	Gear 5 Incorrect Ratio	• MIL - ON • Transmission in LHM
P0736	Reverse Incorrect Ratio	• MIL - ON • Transmission in LHM

▶ DTC Description

DTC	Description
P0729	The observed gear ratio in GEAR 6 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0731	The observed gear ratio in GEAR 1 or GEAR MANUAL 1 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0732	The observed gear ratio in GEAR 2 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0733	The observed gear ratio in GEAR 3 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0734	The observed gear ratio in GEAR 4 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0735	The observed gear ratio in GEAR 5 when not shifting is outside nominal values +/-10% for more than 0.5 seconds.
P0736	The observed gear ratio in REVERSE when not shifting is outside nominal values +/-10% for more than 0.5 seconds.

Modification basis	
Application basis	
Affected VIN	

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0729 The observed gear ratio in GEAR 6 is incorrect	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission output shaft speed >300 rpm • Transmission gear select lever NOT in Neutral	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission
P0731 The observed gear ratio in GEAR 1 or GEAR MANUAL 1 is incorrect	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission output shaft speed >300 rpm • Transmission gear select lever NOT in Neutral	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission
P0732 The observed gear ratio in GEAR 2 is incorrect	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission output shaft speed >300 rpm • Transmission gear select lever NOT in Neutral	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission
P0733 The observed gear ratio in GEAR 3 is incorrect	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission output shaft speed >300 rpm • Transmission gear select lever NOT in Neutral	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission
P0734 The observed gear ratio in GEAR 4 is incorrect	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission output shaft speed >300 rpm • Transmission gear select lever NOT in Neutral	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission

DTC	Evaluation Conditions	Possible Causes	Actions
P0735 The observed gear ratio in GEAR 5 is incorrect	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission output shaft speed >300 rpm • Transmission gear select lever NOT in Neutral	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission
P0736 The observed gear ratio in REVERSE is incorrect	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission output shaft speed >300 rpm • Transmission gear select lever NOT in Neutral	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission

▶ DTC Clearing

DTC	Conditions
P0729, P0731, P0732, P0733, P0734, P0735 & P0736	• Ignition ON • Engine stopped • Scan tool

Modification basis	
Application basis	
Affected VIN	

9) Torque Converter Control

The torque converter lock-up clutch is engaged and released via the hydraulic control system. Pressure at the torque converter lock-up clutch piston is determined by an electronic variable bleed solenoid (VBS). During operation, the TCU evaluates torque converter slip speed and compares this against what is expected. If torque converter slip is not within predefined parameters, a DTC will set to indicate a torque converter lock-up problem.

DTC	Title	System Action
P0741	Torque converter clutch circuit stuck OFF	• MIL - ON • Torque converter remains in open state
P0742	Torque converter clutch circuit stuck ON	• MIL - ON • Torque converter remains in open state with Solenoid S3 disabled
P0744	Torque converter clutch Slip Error	• MIL - ON • Torque converter remains in open state

▶ DTC Description

DTC	Description
P0741	Torque converter stuck open when requested to lock. Slip speed is greater than 50 rpm for more than 0.5 seconds while locked state requested.
P0742	Torque converter stuck locked when requested to open. Slip speed is less than 150 rpm and engine torque is greater than 150 Nm for more than 0.5 seconds while open state requested.
P0744	Torque converter slip speed cannot be controlled for more than 0.5 seconds.

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0741 Torque converter clutch circuit stuck OFF	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission NOT shifting • Transmission gear select lever in Drive	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission
P0742 Torque converter clutch circuit stuck ON	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission NOT shifting • Transmission gear select lever in Drive	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission
P0744 Torque converter clutch Slip Error	• Ignition key in ON position • Engine speed >300 rpm • Engine not in LHM • Transmission oil temperature >0°C • Transmission NOT shifting • Transmission gear select lever in Drive	• Low oil level • Contaminated oil • Mechanical damage • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check oil level • Check oil quality • Check for mechanical damage • Replace transmission

▶ DTC Clearing

DTC	Conditions
P0741, P0742 & P0744	• Ignition ON • Engine stopped • Scan tool

Modification basis	
Application basis	
Affected VIN	

10) Steering Wheel

The steering wheel contains transmission gear select (TGS) up/down switches and are directly connected to the TCU. These switches operate in parallel with the TGS lever switches directly to the TCU.

DTC	Title	System Action
P0826	Manual Shift Control Up/Down (Steering Wheel) Switch Stuck	• MIL - OFF • Manual shift control (steering wheel) switches disabled
P0827	Manual Shift Control Up/Down (Steering Wheel) Switch Signal Low	• MIL - OFF • Manual shift control (steering wheel) switches disabled
P0828	Manual Shift Control Up/Down (Steering Wheel) Switch Signal High	• MIL - OFF • Manual shift control (steering wheel) switches disabled

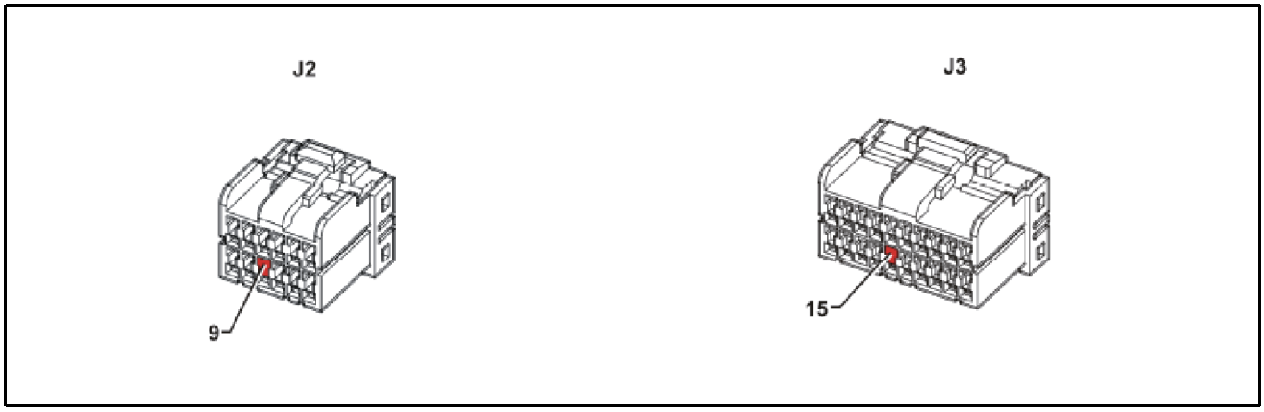
▶ DTC Description

DTC	Description
P0826	The Manual Shift Control Up/Down (Steering Wheel) switch has been depressed for more than 120 seconds continuously. This may indicate a faulty switch
P0827	The Manual Shift Control Up/Down (Steering Wheel) switch signal is giving a value indicative of a short circuit
P0828	The Manual Shift Control Up/Down (Steering Wheel) switch signal is giving a value indicative of an open circuit

▶ Schematic



▶ Connector Details



▶ Resistance Values

Switch	Value
Range up (press and hold)	1.08 kΩ ± 10%
Range down (press and hold)	555 kΩ ± 10%
Range up / down at rest position	3.24 kΩ ± 10%

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0826 Manual Shift Control Up/Down (Steering Wheel) Switch Stuck	Ignition key in ON position	• Shift Control Up/ Down Switch (steering wheel) • TCU to Shift Control Up/Down switch harness and/or connector fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check up/down switch (steering wheel) mechanical operation • Check circuit between terminal J2-9 and Shift Control Up/Down switch (steering wheel) for short or open condition • Check circuit between terminals J3-15 and steering wheel for short or open condition • Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-9 and J3-15. Refer to the resistance table above for specifications. Replace range up/down switch (steering wheel) if the resistance values are outside of the specified range • Replace TCU

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Conditions	Possible Causes	Actions
P0827 Manual Shift Control Up/Down (Steering Wheel) Switch Signal Low	Ignition key in ON position	• Shift Control Up/Down Switch (steering wheel) • TCU to Shift Control Up/Down switch harness and/or connector fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check up/down switch (steering wheel) mechanical operation • Check circuit between terminal J2-9 and Shift Control Up/Down switch (steering wheel) for short or open condition • Check circuit between terminals J3-15 and steering wheel for short or open condition • Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-9 and J3-15. Refer to the resistance table above for specifications. Replace range up/down switch (steering wheel) if the resistance values are outside of the specified range • Replace TCU
P0828 Manual Shift Control Up/Down (Steering Wheel) Switch Signal High	Ignition key in ON position	• Shift Control Up/Down Switch (steering wheel) • TCU to Shift Control Up/Down switch harness and/or connector fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check up/down switch (TGS) mechanical operation • Check circuit between terminal J2-4 and Shift Control Up/Down switch (TGS) for short or open condition • Check circuit between terminals J3-15 and TGS Lever for short or open condition • Disconnect TCU connectors J2 & J3 and measure resistance across terminals J2-9 and J3-15. Refer to the resistance table above for specifications. Replace range up/down switch (steering wheel) if the resistance values are outside of the specified range • Replace TCU

▶ DTC Clearing

DTC	Conditions
P0826, P0827 & P0828	• Ignition ON • Engine stopped • Scan tool

11) Variable Bleed Solenoids

The transmission control unit uses variable bleed solenoids to regulate hydraulic pressure. This hydraulic pressure controls torque flow through clutch elements within the transmission.
The TCU is able to vary the amount of torque applied to the clutch elements by controlling the current to the variable bleed solenoid windings. The clutch element torque transfer is directly related to the current applied to the solenoids.
During operation, the TCU evaluates the actual current delivered to the solenoid and compares this against what is expected. If the current is not within predefined parameters, a DTC will be set to indicate the load on the TCU is abnormal.

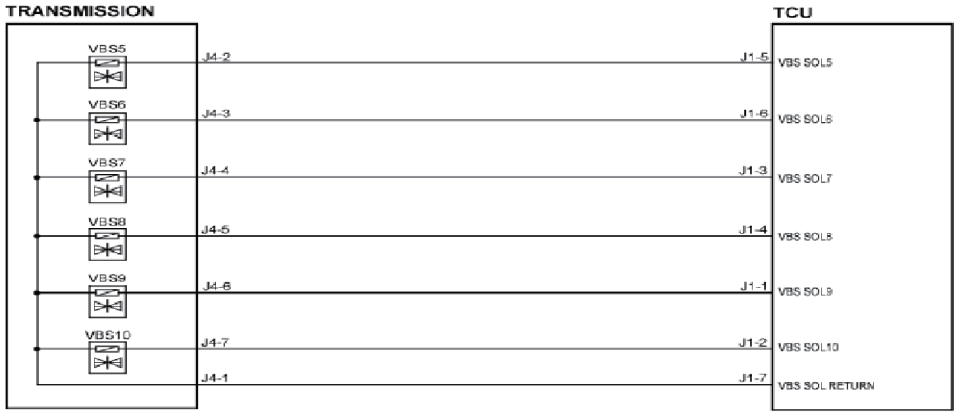
DTC	Title	System Action
P0962	Solenoid S9 Over Current	• MIL - ON • Transmission in LHM
P0963	Solenoid S9 Low Current	• MIL - ON • Transmission in LHM
P0966	Solenoid S10 Over Current	• MIL - ON • Transmission in LHM
P0967	Solenoid S10 Low Current	• MIL - ON • Transmission in LHM
P0985	Solenoid S5 Over Current	• MIL - ON • Transmission in LHM
P0986	Solenoid S5 Low Current	• MIL - ON • Transmission in LHM
P0998	Solenoid S6 Over Current	• MIL - ON • Transmission in LHM
P0999	Solenoid S6 Low Current	• MIL - ON • Transmission in LHM
P099B	Solenoid S7 Over Current	• MIL - ON • Transmission in LHM
P099C	Solenoid S7 Low Current	• MIL - ON • Transmission in LHM
P099E	Solenoid S8 Over Current	• MIL - ON • Transmission in LHM
P099F	Solenoid S8 Low Current	• MIL - ON • Transmission in LHM

Modification basis	
Application basis	
Affected VIN	

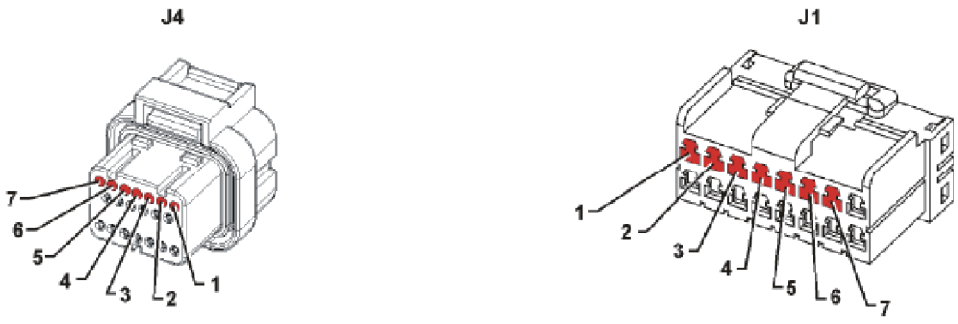
▶ DTC Description

DTC	Description
P0962	The Variable Bleed Solenoid S9 feedback indicates a short circuit.
P0963	The Variable Bleed Solenoid S9 feedback indicates an open circuit
P0966	The Variable Bleed Solenoid S10 feedback indicates a short circuit
P0967	The Variable Bleed Solenoid S10 feedback indicates an open circuit
P0985	The Variable Bleed Solenoid S5 feedback indicates a short circuit
P0986	The Variable Bleed Solenoid S5 feedback indicates an open circuit
P0998	The Variable Bleed Solenoid S6 feedback indicates a short circuit
P0999	The Variable Bleed Solenoid S6 feedback indicates an open circuit
P099B	The Variable Bleed Solenoid S7 feedback indicates a short circuit
P099C	The Variable Bleed Solenoid S7 feedback indicates an open circuit
P099E	The Variable Bleed Solenoid S8 feedback indicates a short circuit
P099F	The Variable Bleed Solenoid S8 feedback indicates an open circuit

▶ Schematic



▶ Connector Details



▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0962 Solenoid S9 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS9 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-6 and J1-1 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-6 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P0963 Solenoid S9 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS9 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-6 and J1-1 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-6 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P0966 Solenoid S10 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS10 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-7 and J1-2 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-7 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P0967 Solenoid S10 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS10 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-7 and J1-2 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-7 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Conditions	Possible Causes	Actions
P0985 Solenoid S5 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS5 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-2 and J1-5 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-2 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P0986 Solenoid S5 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS5 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-2 and J1-5 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-2 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P0998 Solenoid S6 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS6 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-3 and J1-6 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-3 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P0999 Solenoid S6 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS6 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-3 and J1-6 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-3 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU

DTC	Evaluation Conditions	Possible Causes	Actions
P099B Solenoid S7 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS7 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-4 and J1-3 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-4 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P099C Solenoid S7 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS7 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-4 and J1-3 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-4 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P099E Solenoid S8 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS8 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-5 and J1-4 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-5 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU
P099F Solenoid S8 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • VBS8 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-5 and J1-4 for short or open condition • Check circuit between terminals J4-1 and J1-7 for short or open condition • Check between terminals J4-1 and J4-5 for solenoid resistance of 4.14 ± 0.3 Ω. Replace transmission if value is outside of this range. • Replace TCU

Modification basis	
Application basis	
Affected VIN	

▶ DTC Clearing

DTC	Conditions
P0962, P0963, P0966, P0967, P0985, P0986, P0998, P0999, P099B, P099C, P099E & P099F	• Ignition ON • Engine stopped • Scan tool

12) On/Off Solenoids

The TCU uses on/off solenoids to select between different clutch elements within the transmission.
During operation, the TCU evaluates the actual current delivered to the on/off solenoid and compares this against what is expected. If the current is not within predefined parameters, a DTC will be set to indicate the load on the TCU is abnormal.

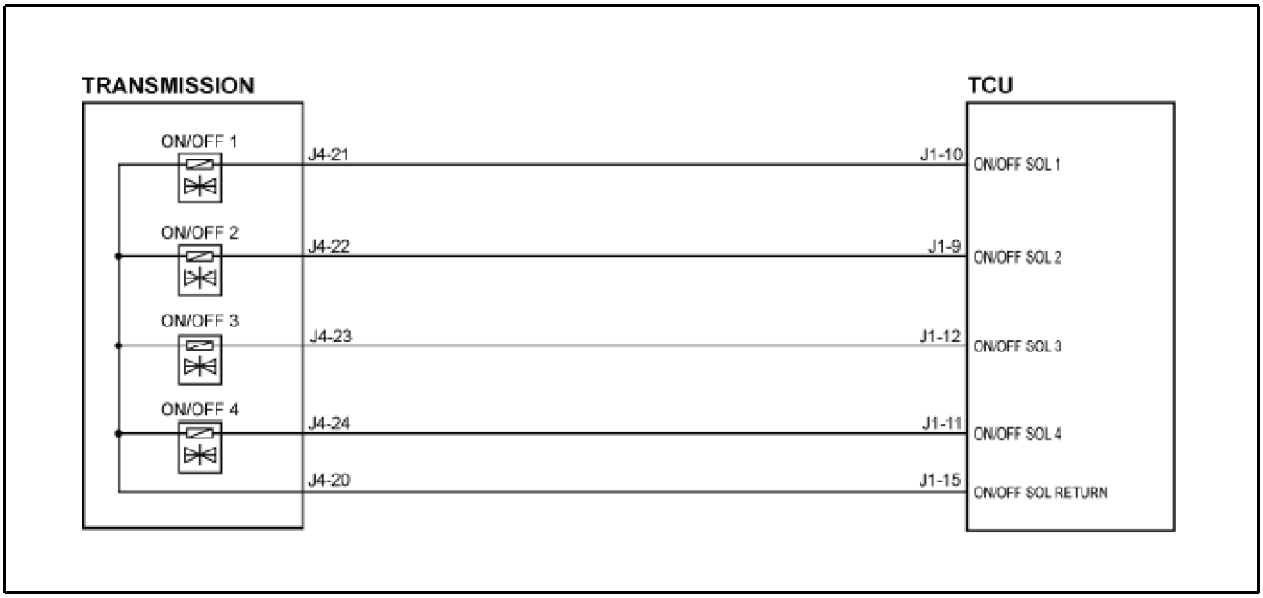
DTC	Title	System Action
P0973	Solenoid S1 Over Current	• MIL - ON • Transmission in LHM
P0974	Solenoid S1 Low Current	• MIL - ON • Transmission in LHM
P0976	Solenoid S2 Over Current	• MIL - ON • Transmission in LHM
P0977	Solenoid S2 Low Current	• MIL - ON • Transmission in LHM
P0979	Solenoid S3 Over Current	• MIL - ON • Transmission in LHM
P0980	Solenoid S3 Low Current	• MIL - ON • Transmission in LHM
P0982	Solenoid S4 Over Current	• MIL - ON • Transmission in LHM
P0983	Solenoid S4 Low Current	• MIL - ON • Transmission in LHM

▶ DTC Description

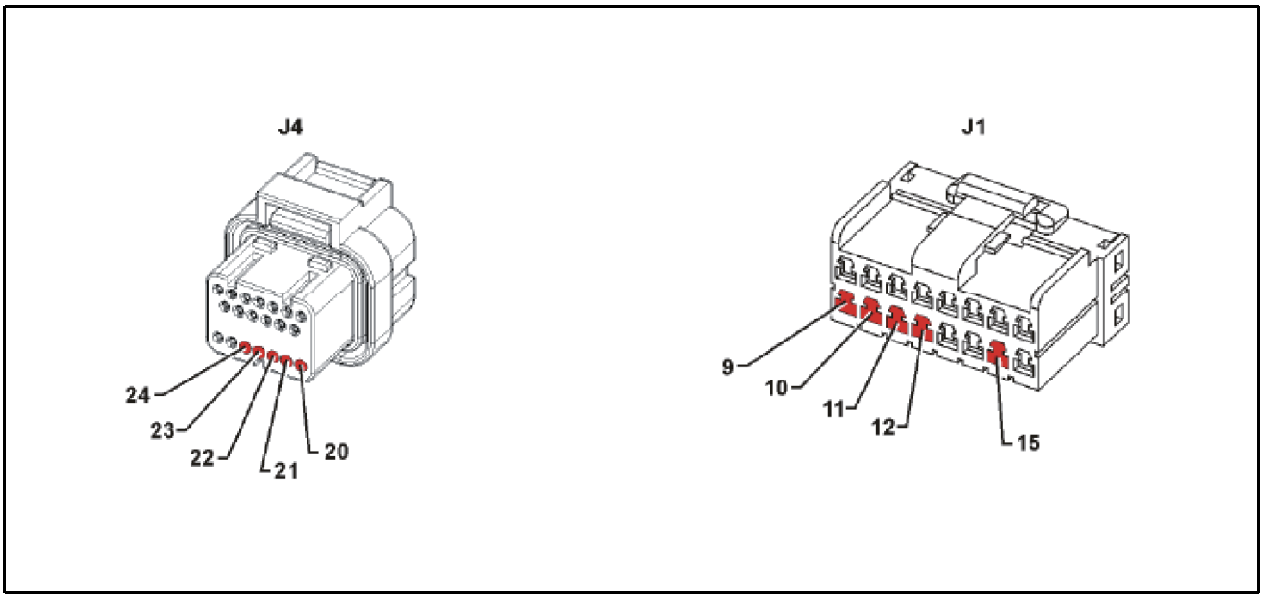
DTC	Description
P0973	The On/Off Solenoid S1 feedback indicates a short circuit
P0974	The On/Off Solenoid S1 feedback indicates an open circuit
P0976	The On/Off Solenoid S2 feedback indicates a short circuit
P0977	The On/Off Solenoid S2 feedback indicates an open circuit
P0979	The On/Off Solenoid S3 feedback indicates a short circuit
P0980	The On/Off Solenoid S3 feedback indicates an open circuit
P0982	The On/Off Solenoid S4 feedback indicates a short circuit
P0983	The On/Off Solenoid S4 feedback indicates an open circuit

Modification basis	
Application basis	
Affected VIN	

▶ Schematic



▶ Connector Details



▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
P0973 Solenoid S1 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 1 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-21 and J1-10 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-21 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU
P0974 Solenoid S1 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 1 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-21 and J1-10 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-21 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU
P0976 Solenoid S2 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 2 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-22 and J1-9 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-22 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU
P0977 Solenoid S2 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 2 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-22 and J1-9 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-22 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU

DTC	Evaluation Conditions	Possible Causes	Actions
P0979 Solenoid S3 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 3 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-23 and J1-12 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-23 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU
P0980 Solenoid S3 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 3 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-23 and J1-12 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-23 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU
P0982 Solenoid S4 Over Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 4 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-24 and J1-11 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-24 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU
P0983 Solenoid S4 Low Current	• Ignition key in ON position • Solenoid energised • TCU supply voltage OK	• TCU to Transmission harness and/or connector fault • Transmission internal harness and/or connector fault • On/Off Solenoid 4 • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check circuit between terminals J4-24 and J1-11 for short or open condition • Check circuit between terminals J4-20 and J1-15 for short or open condition • Check between terminals J4-20 and J4-24 for solenoid resistance of 22.0 ± 1.2 Ω Replace transmission if value is outside of this range. • Replace TCU

▶ DTC Clearing

DTC	Conditions
P0973, P0974, P0976, P0977, P0979, P0980, P0982 & P0983	• Ignition ON • Engine stopped • Scan tool

13) CAN Network

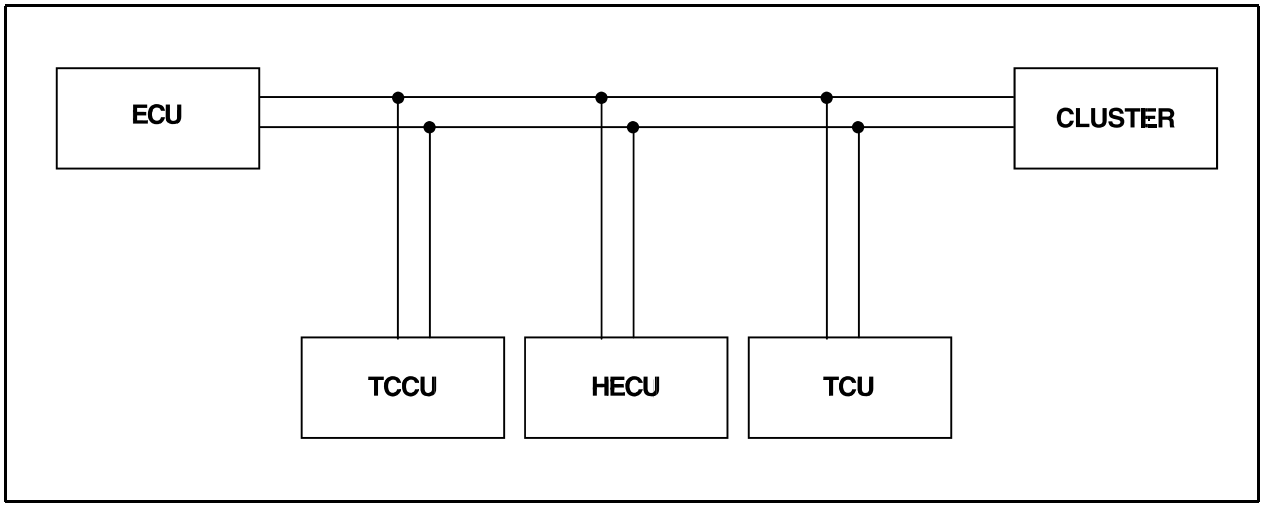
The Controller Area Network (CAN) bus is used to share vehicle system information between the control units connected to the bus. The TCU obtains the majority if its information via this network. If the TCU does not receive information at regular intervals from the electronic control units connected to the bus, the TCU will set a communication DTC.

DTC	Title	System Action
U0100	Cyclic CAN messages from Engine ECU are unavailable	• MIL - OFF • Transmission in LHM
U0102	Cyclic CAN messages from Transfer Case Control Unit are unavailable	• MIL - OFF • Transmission in LHM
U0103	Cyclic CAN messages from TGS ECU are unavailable	• MIL - OFF • Transmission in LHM
U0121	Cyclic CAN messages from Brake System Control Unit (ABS/ESP/TCS) are unavailable	• MIL - OFF • Transmission in LHM
U0401	CAN signals from Engine ECU are out of range or Invalid	• MIL - OFF • Transmission in LHM
U0403	CAN signals from Transfer Case Control Unit are out of range or Invalid	• MIL - OFF • Transmission in LHM
U0404	CAN signals from Gear Lever ECU are out of range or Invalid	• MIL - OFF • Transmission in LHM
U0415	CAN signals from Brake System Control Unit (ABS/ESP/TCS) are out of range or Invalid	• MIL - OFF • Transmission in LHM

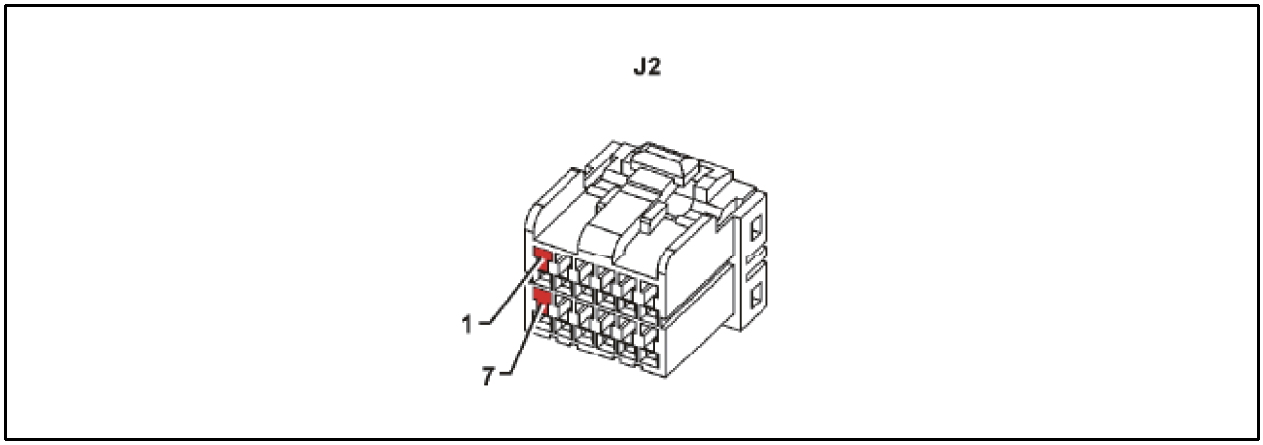
▶ DTC Description

DTC	Description
U0100	CAN Message not available
U0102	CAN Message not available
U0103	CAN Message not available
U0121	CAN Message not available
U0403	CAN Message not available
U0404	CAN Message not available
U0415	CAN Message not available

▶ Schematic



▶ Connector Details



▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
U0100 Cyclic CAN messages from Engine ECU are unavailable U0401 CAN signals from Engine ECU are out of range or Invalid	• Ignition key in ON position for longer than 1 second • CAN Message from Engine ECU not received for five message cycles	• Wiring harness and/or connector fault • Engine ECU system fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check Engine ECU system • Check circuit between terminal J2-1 and Engine ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Check circuit between terminal J2-7 and Engine ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Replace TCU

Modification basis	
Application basis	
Affected VIN	

DTC	Evaluation Conditions	Possible Causes	Actions
U0102 Cyclic CAN messages from Transfer Case Control Unit are unavailable U0403 CAN signals from Transfer Case Control Unit are out of range or Invalid	• Ignition key in ON position for longer than 1 second • CAN Message from Transfer Case Control Unit not received for five message cycles	• Wiring harness and/or connector fault • Transfer Case system fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check Transfer Case Control Unit • Check circuit between terminal J2-1 and Transfer Case Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Check circuit between terminal J2-7 and Transfer Case Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Replace TCU
U0103 Cyclic CAN messages from TGS ECU are unavailable U0404 CAN signals from Gear Lever ECU are out of range or Invalid	• Ignition key in ON position for longer than 1 second • CAN Message from ECU not received for five message cycles	• Wiring harness and/or connector fault • Brake system fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check engine management system • Check circuit between terminal J2-1 and transmission gear select ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Check circuit between terminal J2-7 and transmission gear select ECU for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Replace TCU
U0121 Cyclic CAN messages from Brake System Control Unit (ABS/ESP/TCS) are unavailable U0415 CAN signals from Brake System Control Unit (ABS/ESP/TCS) are out of range or Invalid	• Ignition key in ON position for longer than 1 second • CAN Message from Brake System Control Unit not received for five message cycles	• Wiring harness and/or connector fault • Brake system fault • TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Check Brake System Control Unit DTC's • Check circuit between terminal J2-1 and Brake System Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Check circuit between terminal J2-7 and Brake System Control Unit for short or open condition. Refer to vehicle CAN communication diagnostics for further information • Replace TCU

▶ DTC Clearing

DTC	Conditions
U0100, U0102, U0121, U0401, U0403, & U0415	• Ignition ON • Engine stopped • Scan tool

14) TCU Calibration

TCU software or calibration may be upgraded at service. These DTC뭘 protect the TCU against corrupted files being loaded into the TCU. They also ensure only the correct calibration parameters are used with the software version currently loaded into the TCU.

DTC	Title	System Action
U1600	ECU Application Software Mismatch	• MIL - OFF • Transmission in LHM
U1601	TCU Application Software Missing or Corrupted	• MIL - OFF • Transmission in LHM
U1606	TCU Calibration Error – Platform	• MIL - ON • Transmission in LHM
U1607	TCU Calibration Error - Active Variant	• MIL - ON • Transmission in LHM
U1608	TCU VIN Coding Error	• MIL - ON • Transmission in LHM
U1609	TCU Hardware (pcb) Calibration Error	• MIL - ON • Transmission in LHM

▶ DTC Description

DTC	Description
U1600	The TCU Software and Calibration are not compatible
U1601	During initialisation, the TCU software was found to be missing or corrupted. In this condition the TCU will not operate, and the transmission will be in LHM
U1606	Platform calibration data CRC check failed at initialisation of TCU. This is normal for a development TCU
U1607	Active Variant calibration data CRC check failed at initialisation of TCU. This is normal for a development TCU
U1608	VIN based variant could not be determined. TCU will use default VIN calibration
U1609	Calibration for TCU hardware (pcb) is missing or corrupted. TCU will use default calibration

Modification basis	
Application basis	
Affected VIN	

▶ DTC Details

DTC	Evaluation Conditions	Possible Causes	Actions
U1600 ECU Application Software Mismatch U1601 TCU Calibration Error – Platform	• Ignition key in ON position • Message not received for 5 x cycle time	• TCU calibration	• Clear DTC and check if DTC sets within the evaluation conditions • Update TCU calibration software. Refer to vehicle scan tool documentation for further information • Replace TCU
U1606 TCU Calibration Error – Platform U1607 TCU Calibration Error - Active Variant	• Ignition key in ON position • CRC not Valid	• TCU calibration	• Clear DTC and check if DTC sets within the evaluation conditions • Update TCU calibration software. Refer to vehicle scan tool documentation for further information • Replace TCU
U1608 TCU VIN Coding Error	• Ignition key in ON position • VIN not compatible with calibration	• TCU calibration	• Clear DTC and check if DTC sets within the evaluation conditions • Update TCU calibration software. Refer to vehicle scan tool documentation for further information
U1609 TCU Hardware (pcb) Calibration Error	• Ignition key in ON position • TCU manufacturing information not present	• TCU	• Clear DTC and check if DTC sets within the evaluation conditions • Replace TCU

▶ DTC Clearing

DTC	Conditions
U1600, U1601, U1606, U1607, U1608 & U1609	• Ignition ON • Engine stopped • Scan tool

MAINTENANCE OPERATIONS 3680-01

GENERALS

1. OIL TEST

1) Hydraulic System

If there is a problem in the hydraulic system, perform the following:

- Test transmission oil
- Inspect the manual linkage adjustment
- Check the engine's idling speed
- Perform the stall test
- Perform the driving test

2) Oil Test

▶ Check the Amount of Oil

This check must be performed when the engine is warm. If there is insufficient oil and the vehicle moves, shift loss or delay may happen.
First, check the transmission malfunction code. If there is a problem with the shaft speed, insufficient oil may cause the problem.
When there is an abnormal shift delay or loss of driving power during driving or reversing, perform the driving test. When the level of oil is low and this vehicle is moving on a corner, there will be a brief driving power loss.
When both oil temperature and level are low, there will be loss of driving power. Replenish oil if the engine is completely warmed up and there is no loss of driving power, but there is still a problem with the vehicle speed.

▶ Oil Check and Replenishment

When replenishing or changing transmission oil, a genuine recommended oil must be used.
If non-approved oil is used, it will have fatal impacts on the transmission's performance and life. Never use such oil. Wrong oil can damage the transmission.
When the transmission oil is hot, do not remove the filler plug. Wait for 2 hours to cool down the oil. Then, remove the plug.

1. When the engine is hot, wait for 2 hours before replenishing transmission oil. Then, the transmission's temperature also becomes cooled down to a proper range. When the filler plug is removed while the temperature of oil is hot, oil will flow out and its level in the transmission will go down.
2. Push the selection lever to the "P" position and shut off the engine.
3. Raise up the vehicle with a proper lift.
4. Clean up the surroundings of the filler plug before removing the plug. After removing the plug, clean up the plug thoroughly and inspect the O-ring for any damage.

Modification basis	
Application basis	
Affected VIN	

5. After attaching the filler pump to the transmission, lower the vehicle and replenish oil. Engage the parking brake, start the engine while the selection lever is engaged to "P" and press the foot brake. Then, start shifting the selection lever to all positions. Replenish oil until you can sense moving of the transmission gears.
6. Shut off the engine again and raise up the vehicle. Ensure that the vehicle maintains horizontal balance.
7. Shut off the engine, wait for at least 3 minutes (within 1 hour), and remove the filler pump. If oil reaches to just below the filler inlet, it is appropriate. If not, replenish oil until it reaches this level.
8. Replace the filler plug with a new one. Wipe off oil on the transmission or other parts of the vehicle.
9. Apply the specified torque to tighten up the filler plug (30 ~ 35 Nm).

▶ Oil check/Replenishment when there is an insufficient amount of oil

1. Engage the shift lever to the "P" position and shut off the engine.
2. Raise this vehicle with an appropriate lift.
3. Clean up the surroundings of the filler plug before removing the plug. After removing the plug, clean up the plug thoroughly and inspect the O-ring for any damage. Then, attach the filler pump to the oil inlet.
4. After attaching the filler pump to the transmission, lower this vehicle and replenish oil.
   a. When the transmission torque converter has no oil: 9.5 ℓ
   b. When the transmission torque converter is filled with oil: 4.5 ℓ
5. Engage the parking brake, start the engine while the selection lever is engaged to "P" and depress the foot brake. Then, start shifting the selection lever to all positions. Replenish oil until you can sense moving of the transmission gears.
6. Add a 0.5 ℓ of recommended oil.
7. Shut off the engine and raise this vehicle with an appropriate lifte. Detach the filler pump. Replace the filler plug with a new one (Tightening torque: 30 ~ 35 Nm).
8. When this vehicle travels 3.5 ~ 4.5 kilometers with the engine's RPM below 2500, the temperature of the transmission will reach to 50 ~ 60°C.
9. With the engine idling, press the brake pedal and shift the transmission selector lever to all positions several times.
10. Shut off the engine and raise the vehicle with an appropriate lift. Maintain horizontal balance of the vehicle if possible.
11. Remove the filler plug 3 minutes after shutting off the engine. If oil reaches just below the filler inlet, it is appropriate. If not, replenish oil until it reaches this level.
12. Replace the filler plug with a new one. Wipe off oil on the transmission or other parts of the vehicle. Apply the specified torque to tighten up the filler plug (30 ~ 35 Nm).

2. STALL TEST

Stall testing can be performed on the Model 78 6 speed automatic transmission to determine whether the transmission clutches can hold the full engine torque without slipping.
Stall testing should be performed for a period no longer then 10 seconds.

- Apply Hand Brake
- Start Engine
- Press Brake Pedal
- Shift to "DRIVE"
- Press Accelerator Pedal to 100 % for 6 seconds
- Observe Engine speed
- Release Accelerator Pedal
- Shift To Reverse
- Press Accelerator Pedal to 100 % for 6 seconds
- Observe Engine speed

If engine speed is observed > 3000 rpm; transmission hardware failure

Modification basis	
Application basis	
Affected VIN	

3. TRANSMISSION RESET PROCEDURE (REPLACEMENT TRANSMISSION)

t is necessary to reset the adaptive data stored within the transmission control unit (TCU) when the transmission and or TCU have been replaced.

▶ Green Offset Reset

Carried out when a replacement transmission has been installed in a vehicle.

▶ Adaptive Reset

Carried out when one of the following has occurred:

- Replace transmission
- Replace TCU

▶ Green Offset Reset Procedure

To perform a green offset reset procedure, proceed as follows:

1. Connect the vehicle's diagnostic scan tool to the vehicles diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.
2. With the transmission gear select (TGS) lever in Park, turn the ignition key to the ON position (engine not running).
3. Using the scan tool, set the parameter **Set Km Travelled** to 0Km.
4. Run the task **Activate Adaptive Green Offset.**
5. Turn the ignition key to the OFF position.
6. Start the vehicle and check for normal operation.

▶ Adaptive Reset Procedure

To perform an adaptive reset procedure, proceed as follows:

1. Connect the vehicle's diagnostic scan tool to the vehicles diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.
2. With the transmission gear select (TGS) lever in Park, turn the ignition key to the ON position (engine not running).
3. Set the parameter **Set Km Travelled** to 0 Km.
4. Run the task **Reset Adaptive Data.**
5. Turn the ignition key to the OFF position.
6. Start the vehicle and check for normal operation.

4. FLUID LEVEL INSPECTION

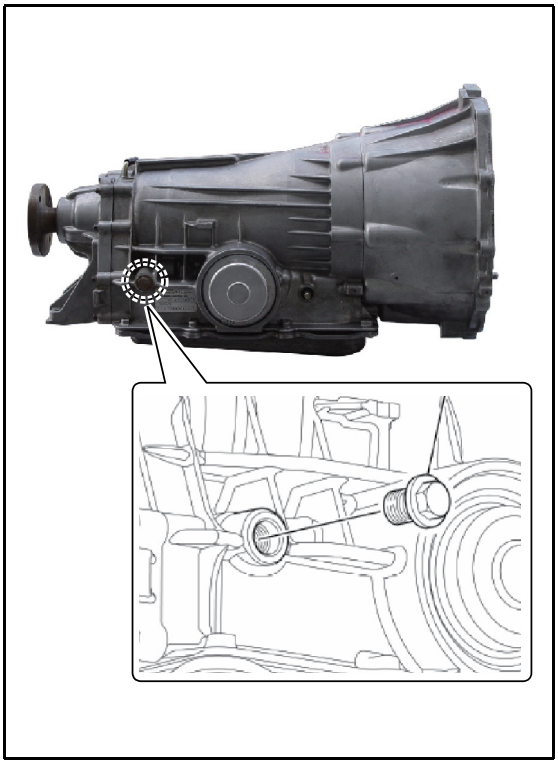
NOTE

- As the temperature of the transmission fluid greatly affects the fluid level, this procedure
- must only be carried out with the transmission fluid temperature below 50°C). If the
- transmission fluid temperature is greater than 50°C and the correct procedure is not followed, the result could be a false reading of the fluid level.

Fluid level inspection must be carried out with the vehicle level.

Caltex PED 1712 ATF must be used.

1. Raise the vehicle on a certified hoist.
2. Place a drain container below the fluid level hole and remove the transmission fluid level plug (1).
3. If fluid starts to drain from the fluid level hole, reinstall the fluid level plug. If no fluid drains from the fluid level hole, fill the transmission until fluid starts to drain from the level hole and reinstall the plug.
4. Drive the vehicle for approximately five minutes.
5. Connect the vehicle's diagnostic scan tool to the vehicles diagnostic connector. Refer to the vehicle repair manual for information on connecting the scan tool.
6. With the gear select lever in the Neutral position, start the engine and allow to run at idle until the transmission fluid temperature reaches 50°C.



NOTE

Use the scan tool to monitor the transmission fluid temperature.

7. Raise the vehicle on a certified hoist.
8. When the transmission fluid temperature reaches 50°C turn off the engine.
9. Place a drain container below the fluid level hole and remove the transmission fluid level plug. Allow transmission fluid to drain from the fluid level hole for 50 seconds.
10. Reinstall the fluid level plug and tighten the plug to the correct torque specification.

Transmission fluid level plug torque specification	30 ~ 35 Nm

11. Lower the vehicle to the ground and road test the vehicle to check vehicle operation and for fluid leaks.

Modification basis	
Application basis	
Affected VIN	

5. TRANSMISSION COOLER AND HYDRAULIC LINE FLUSHING PROCEDURE

NOTE

To prevent transmission damage due to contaminants being present in the transmission cooler and/or hydraulic lines, the cooler and lines must be flushed.

1. Raise the vehicle on a certified hoist.
2. Using compressed air, clear the cooler lines of any residual fluid.
3. Connect the front transmission cooler line to the transmission.

Front transmission cooler line to transmission fitting torque specification	25 ~ 35 Nm

4. Connect one end of a rubber hose to the end of the rear cooler line and place the other end in a suitable container to collect the transmission fluid as it is pumped out.
5. Start the engine and run for approximately 30 seconds at idle. (With ATF at 50°C temperature, a minimum of 2.5litres oil flow after 30 seconds.)
6. Whist the engine is running, have an assistant pump transmission fluid into the transmission fluid level hole.
7. Connect the rear transmission cooler line to the transmission.

Rear transmission cooler line to transmission fitting torque specification	25 ~ 35 Nm

8. Check the transmission fluid level; refer to Fluid Level Inspection on page 69.

6. LUBRICATION

Automatic transmission fluid.....Caltex PED 1712 ATF

7. TRANSMISSION COOLER AND HYDRAULIC LINE FLUSHING PROCEDURE(NEW TRANSMISSION)

Items	Size	Torque (Nm)
TC Housing	M12 x 32	54 ~ 68
Extension Housing	M12 x 32	54 ~ 68
Oil Pan	M6 x 16	4 ~ 6
Valve Body to Case	M6 x 26	8 ~ 13
Valve Body to Case	M6 x 45	8 ~ 13
Center Support to Case	M10 x 34	20 ~ 27
Output Shaft Locking Nut	M24 x 15	100 ~ 110
Pump to Pump Cover	M8 x 55	24 ~ 27
Pump Cover to Case	M8 x 40	24 ~ 34
Pump Cover to Case	M8 x 58	24 ~ 34
Upper Valve Body to Lower	M6 x 30	15 ~ 17
Detent Spring	M8 x 16	20 ~ 25
VBS & Speed Sensor	M4 x 12	2.8 ~ 3.2
Transmission Oil Level Plug		30 ~ 35
Front Transmission Cooler Line to Transmission Connector		25 ~ 35
Rear Transmission Cooler Line to Transmission Cooler Connector		25 ~ 35
Torque Converter to Drive Plate Bolt		40 ~ 42
Transmission Selector Lever to Cross Shaft Nut		14 ~ 20

Modification basis	
Application basis	
Affected VIN	

Memo

TGS LEVER 3721-01

OVERVIEW AND OPERATION PROCESS

1. OVERVIEW

The TGS lever communicates with TCU (Transmission Control Unit), ECU (Engine Control Unit), ESP HECU and instrument panel to let the driver shift to desired gear as well as to keep desired driving conditions. The tip switches installed on the lever knob and the steering wheel is for selecting gears manually with the selector lever in the "M" position. The tip switches on the steering wheel is for driver's convenience especially when driving on bumpy road (during engine braking). Gear shifting with the tip switches is only possible when the selector lever is in the "M" position. For safety reason, it is possible to move the selector lever from the "N", "P" or "R" position to any other positions only when the ignition key is in the "ON" position and the brake pedal is depressed (N, P and R lock functions). The TGS lever of KYRON from March '07 is the same as the one of REXTON II in the aspect of the system, but the knob, the top cover, the lever, the bracket and the rod is newly designed due to differences of the shape of the lever mounting body.

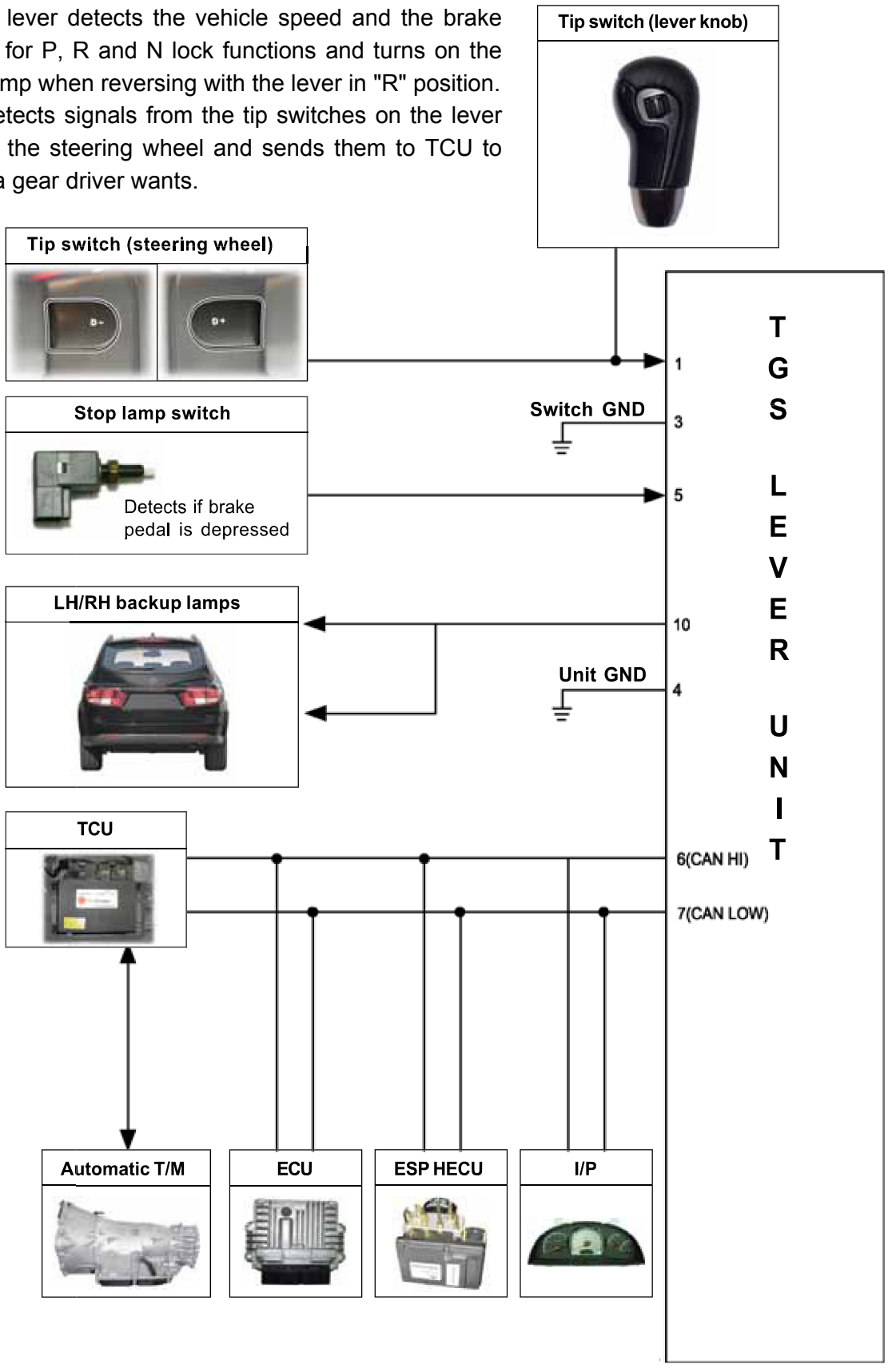
2. LOCATIONS AND COMPONENTS



Modification basis	
Application basis	
Affected VIN	

3. INPUT/OUTPUT OF TGS LEVER

The TGS lever detects the vehicle speed and the brake operation for P, R and N lock functions and turns on the backup lamp when reversing with the lever in "R" position. Also, it detects signals from the tip switches on the lever knob and the steering wheel and sends them to TCU to shift into a gear driver wants.



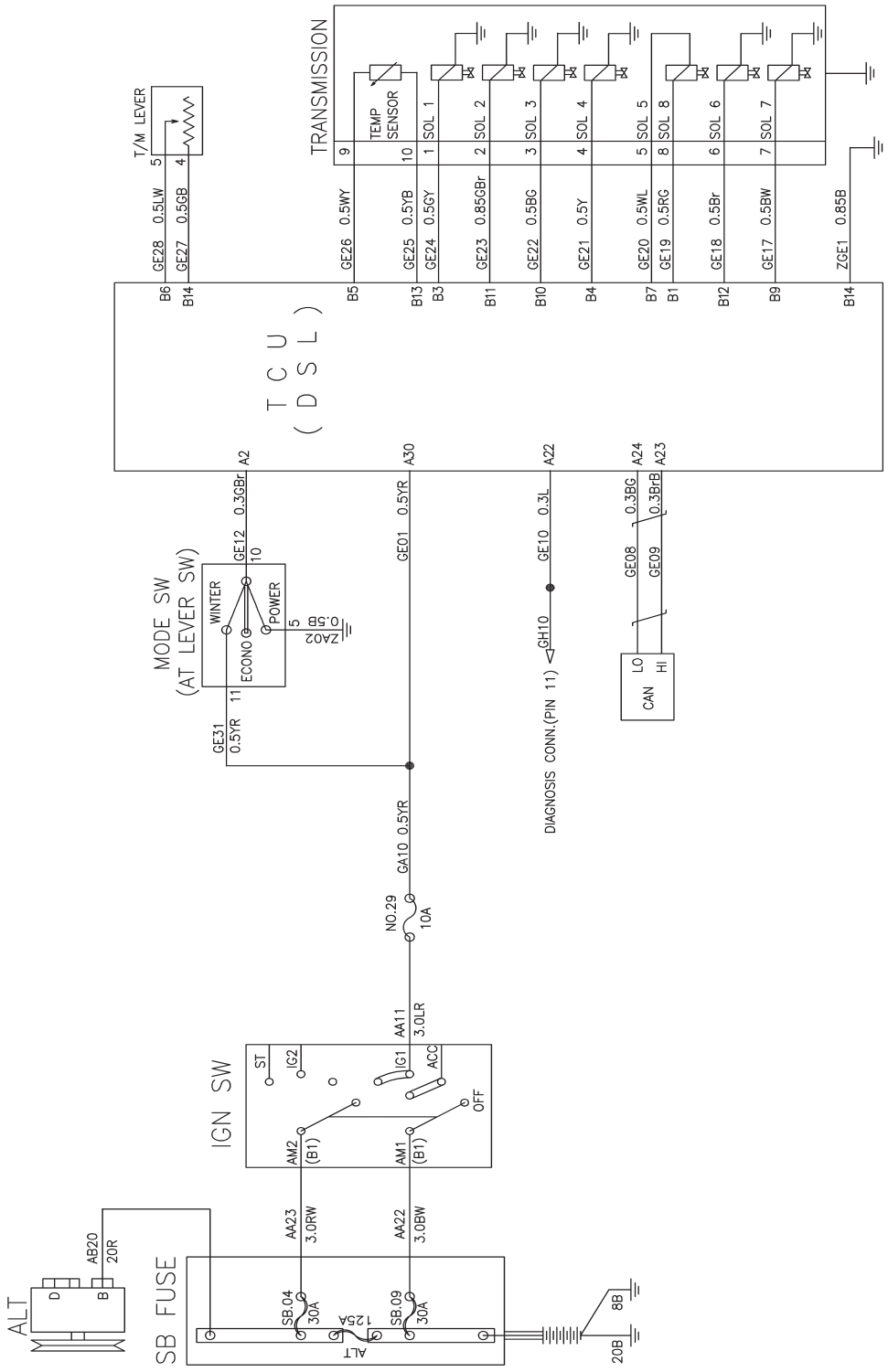
Modification basis	
Application basis	
Affected VIN	

T/M LEVER

3170-01

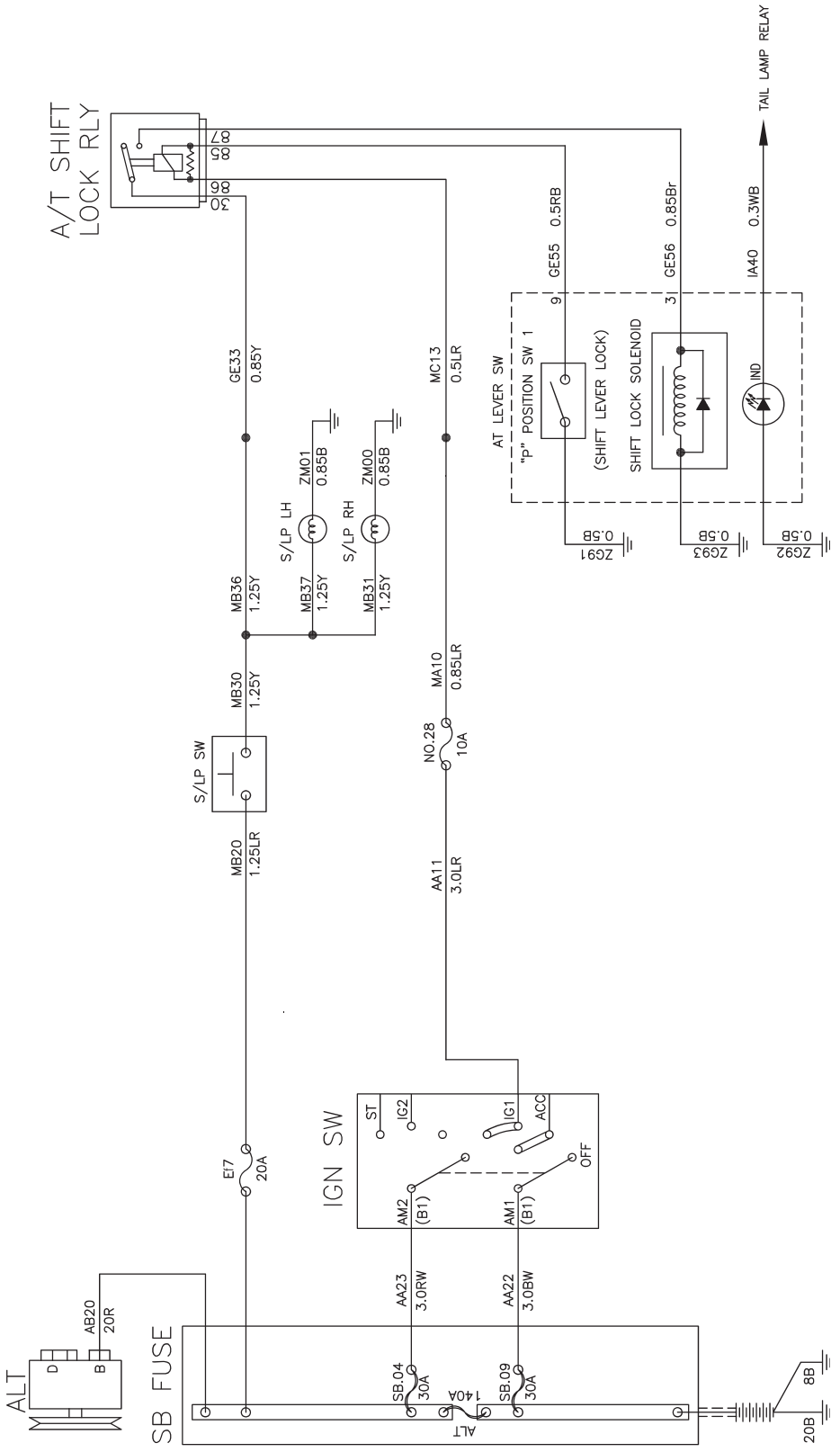
OVERVIEW AND OPERATION PROCESS

1. CIRCUIT OF ION 4-SPEED AUTOMATIC T/M



Modification basis	
Application basis	
Affected VIN	

2. CIRCUIT OF SHIFT INTER LOCK

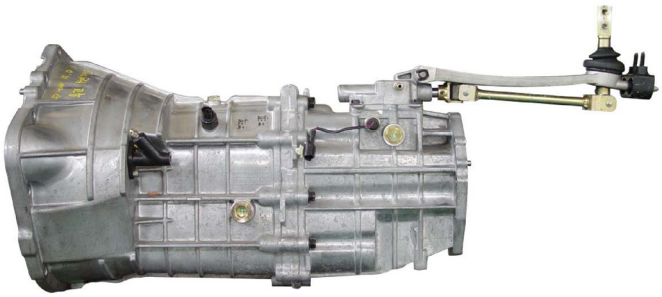


Modification basis	
Application basis	
Affected VIN	

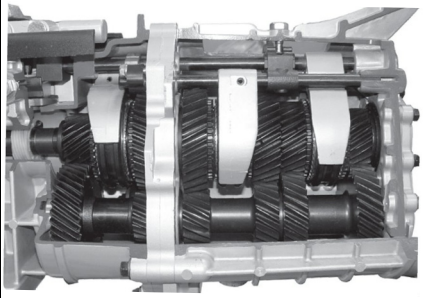
GENERAL

1. OVERVIEW AND CHARACTERISTICS OF MANUAL TRANSMISSION

1) SYSTEM COMPONENTS

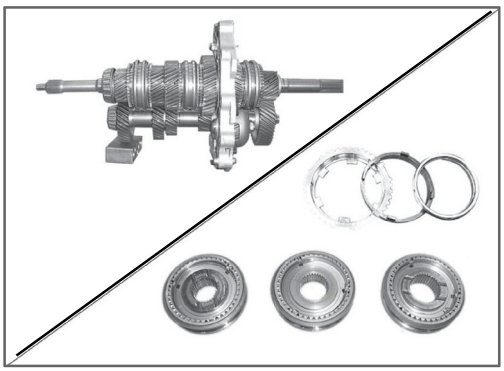


Inside



Front View





(1) Features

1. All gears use the helical type and high strength materials.

CAUTION

- The helical type gear prevents the axial gear missing and provides less noise.

2. The semi-remote control type gear shift mechanism is used to prevent incorrect shifting.
3. To improve the shifting performance, 3-piece double cone is used for 1/2 shift.
4. The synchronizing devices are installed in 1/2, 3/4, 5/R gears. To prevent the double engagement, the independent interlock devices are installed.

CAUTION

- TSM54/52 transmission uses the inertia lock type key to make smooth gear engagement and to provide silent gear engagement.

5. The clutch release system is available to use CSC (Concentric Slave Cylinder) or Fork type according to the vehicle model.

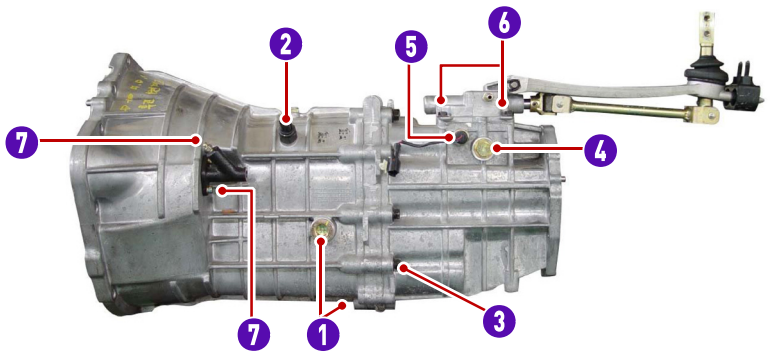
2. SPECIFICATIONS AND TIGHTENING TORQUE OF MANUAL TRANSMISSION

1) Specifications

Descriptio n		Specifications (D20DT, D27DT)
Length (mm)		628.3 mm
Distance between shafts (mm)		81 mm
Input torque (kg-m)		34.7 kg-m (340 Nm)
Transmission control type		Semi-remote
Weight (kg) - not including transmission fluid		44 kgm
Gear ratio/Gear teeth (input gear: main gear)	1st gear	4.315
	2nd gear	2.475
	3rd gear	1.536
	4th gear	1.000
	5th gear	0.807
	Reverse gear	3.919
Transmission fluid	Specification	ATF DEXRON II
	Capacity (ℓ)	3.6 ℓ / 3.4 ℓ (4WD / 2WD)
	Change interval	Inspect at every 10,000 km, replace at every 60,000 km (add or replace if necessary)

2) Tightening Torque

Descriptio n	Tightening Torque
1. Oil drain plug & filler plug	40 ~ 50 Nm
2. Backup lamp switch (24 mm)	30 ~ 40 Nm
3. Extension housing bolt (14 mm)	42 ~ 57 Nm
4. Extension housing spring plug (27 mm)	70 ~ 100 Nm
5. Neutral switch	30 ~ 40 Nm
6. Shift top cover bolt (12 mm)	17 ~ 26 Nm
7. Concentric slave cylinder adapter bolt	10 ~ 16 Nm

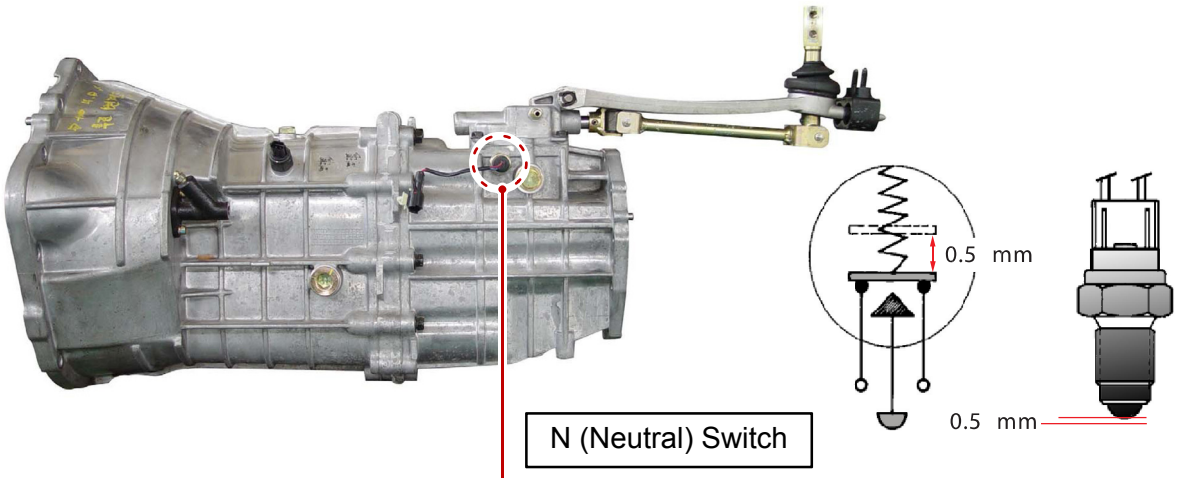


Modification basis	
Application basis	
Affected VIN	

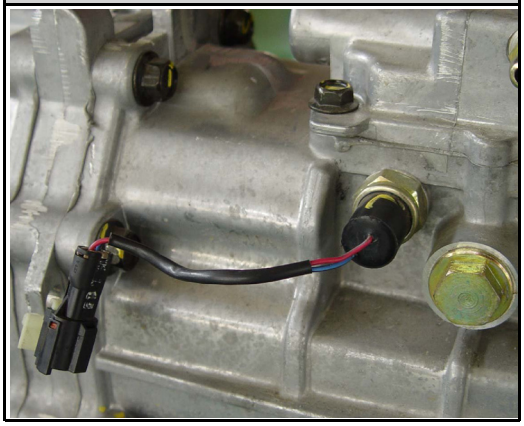
OVERVIEW AND OPERATION PROCESS

1. MANUAL TRANSMISSION SYSTEM

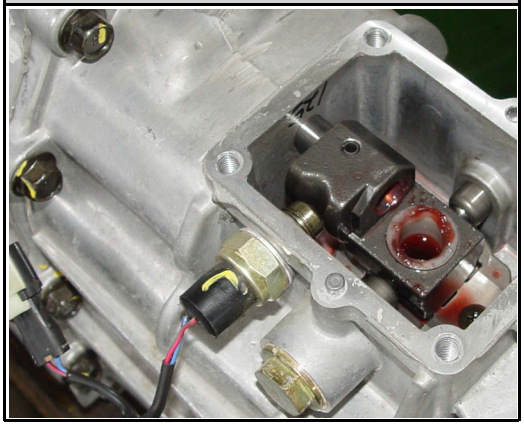
1) Neutral Switch



Outside N Switch



Inside N Switch



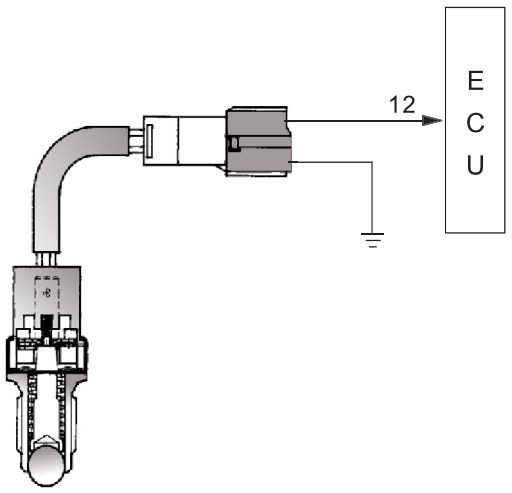
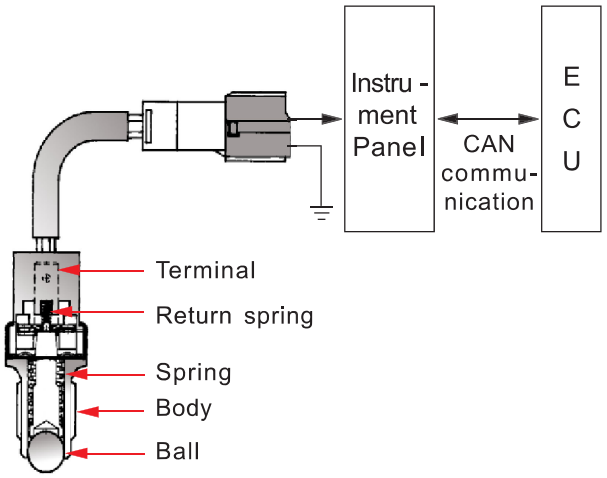
2) Function of N Switch

▶ **Aids a smooth start of the vehicle by raising the RPM during the gear shifting when the engine is cold.**

When the vehicle is trying to start from the stopped state (vehicle speed below 3 km/h), the N switch determines the shifting timing by using the clutch switch and the N switch. It raises the engine RPM (100 ~ 200 rpm). Operation conditions are as follows.

- The vehicle speed is at the stopped state (Vehicle speed below 3km/h detection).
- While depressing the clutch (Clutch switch detection).
- The gear lever is at a position other than neutral (N switch detection).
- Start the vehicle while depressing the clutch pedal (Clutch switch detection).
- The RPM increases in accordance with the temperature of the engine coolant (Engine coolant temperature sensor detection).
  : appx. 100 rpm increase
  : appx. 100 ~ 170 rpm increase
  : appx. 80°C (normal temperature of the engine coolant): around 200 rpm increase
- When the gear has been smoothly shifted and the vehicle speed exceeds 3km/h, it returns to the previous operation interval of the engine RPM.

In case of Kyron, the N switch signal is transmitted to the instrument panel, and then the instrument panel transmits it to the engine ECU through the CAN communication.

Vehicle Made After 04.09.15	Kyron
	

Modification basis	
Application basis	
Affected VIN	

▶ **Detects the position of the shifting lever for the HDC operation among ABS/ESP functions.**

It is used for the second item of the 6 operation conditions of the ABS/ESP's HDC function.
Please refer to the ABS/ESP section for the specific information related to the HDC.

- HDC Operation switch ON **and**
- Forward/Reverse Shifting lever location **and**
  - · Manual transmission: operates in the 1st gear or reverse gear position (does not operate in the neutral position).
  - · Automatic transmission: possibly operates except in the P (parking) or N (neutral) position.

CAUTION

- The vehicle with the manual transmission does not have a separate device or switch that detects the 1st gear. It only detects the forward/reverse direction of the vehicle through the back-up light switch and the neutral switch, and cannot solely detect the 1st gear position. The reason for noting the 1st gear above, though the HDC also operates in the 2nd gear position, is because the engine may turn off during the HDC operation process. You may face a very dangerous situation if the engine turns off at a steep hill.
- The HDC aids the slowdown of the vehicle when driving down a steep hill and cannot sufficiently decelerate only with the engine brake. Thus, a driver must operate the HDC only in the 1st gear when driving a vehicle with the manual transmission.

- When not depressing the accelerator pedal or brake pedal. **and**
- The vehicle speed is above 7 km/h (based on the automatic transmission/4H drive mode). **and**
- The ESP's vehicle position control function and HBA function are not in operation. **and**
  - · The HDC is added to aid drivers when driving down the hill, but when any basic function of the ESP is in operation prior to the HDC system operation, the ESP takes priority over the HDC.
- The inclination of the driving road exceeds 10%.
  - · When the inclination of the driving road exceeds 10%, the HDC operates until the vehicle reaches the speed condition given in step 4).

When the Inclination is 10% ~ 20% During the HDC Operation
When depressing the accelerator pedal or brake pedal, it converts to the stand-by mode, and when depressing the accelerator pedal again, the HDC operates again. Therefore, driver may maintain a desired speed by repeating this depressing and releasing process of the accelerator pedal.
When the Inclination Exceeds 20% During the HDC Operation
When depressing the accelerator pedal, it converts to the HDC operation stand-by mode. When depressing the brake pedal, the HDC operation state is maintained and the braking power is enhanced. In this case, the HECU emits an abnormal noise and the brake pedal may feel very rigid, but this is a normal occurrence resulted from the HDC operation.

Overview of HDC Operation

HDC (Hill Descent Control) System

The HDC system is an automatic descent control device that allows the vehicle to automatically decelerate to about 7 km/h with increment of 0.1G, on steep roads (inclination exceeding 10%) through a separately installed switch operation. When the vehicle speed reaches below 7 km/h (refer to the information below), the HDC automatically terminates the operation.

The HDC does not have a separate sensor for the input signal and detects the inclination of hills by using the G sensor (acceleration sensor) in the sensor cluster.



A HDC Switch



When you see a steep downhill ahead, press the HDC switch and the green HDC indicator comes on. When the G sensor within the sensor cluster detects a inclination exceeding 10%, the ESP's HDC function operates. When this occurs, the green HDC indicator goes off along with a loud operation noise.

B Sensor Cluster



The G Sensor within the sensor cluster detects the inclination of driving roads. When the HDC switch is in operation, if the G sensor detects a downhill inclination exceeding 10%, it transmits the HDC operation signal to the ESP HECU.

Modification basis	
Application basis	
Affected VIN	

Ⓒ HDC Indicator (Instrument panel)	
	When pressing the HDC switch, the green HDC indicator on the instrument panel comes on, and when the HDC operates, the green HDC indictor blinks with 0.5 seconds of interval. HDC (Red Letters) HDC (Green Letters)

CAUTION

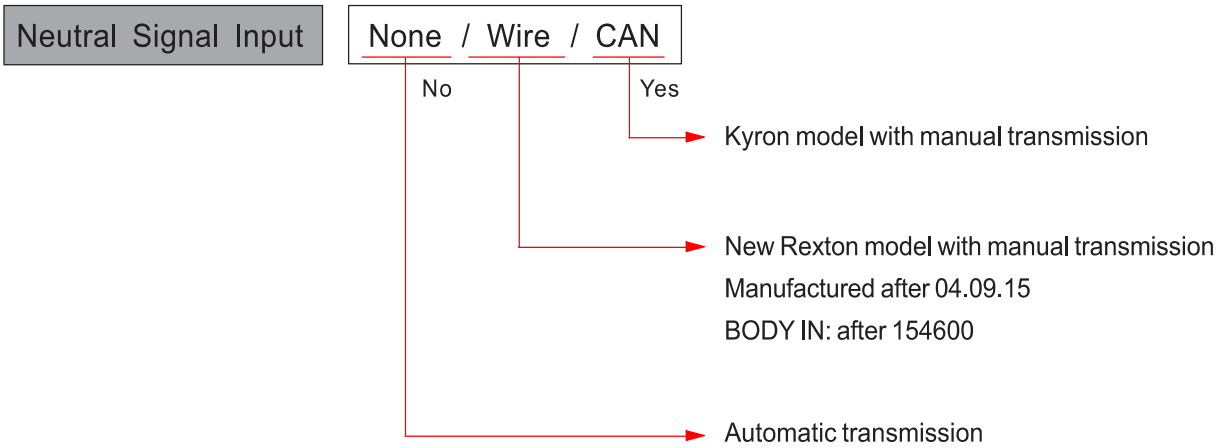
- The G sensor within the sensor cluster measures the actual road inclination. However, it may recognize a sharp turn or rough road as a downhill with a inclination exceeding 10%, and the HDC may operate.

※ For the specific information, please refer to the ABS/ESP section.

3) Variant Coding Related to N Switch

Kyron's N Switch transmits information to the ECU through the CAN communication while New Rexton is connected to the ECU through wires. Thus, if you set the variant coding in the engine ECU, you must do it differently, and you must set the variant coding differently according to the vehicle category and specification as below.

Variant Coding Options



Modification basis	
Application basis	
Affected VIN	

Memo

GENERAL

1. CLUTCH SPECIFICATIONS

Description		Specification
Operating type		Hydraulic
Clutch pedal	Type	Suspended
	Maximum pedal stroke	140 mm
	Pedal free play	5 ~ 15 mm
Clutch disc	Type	Single dry diaphragm
	Dimension of facing	240 × 160 × 3.5 mm / 240 × 155 × 4.0 mm
	Facing size/quantity	251 cm^2 / 2 / 263 cm^2 / 2
	Thickness of disc	Free: 8.4 ~ 9.0 mm / 9.55 ~ 10.5 mm When loaded: 7.7 ~ 8.3 mm / 8.9 ~ 9.5 mm
Clutch cover assembly setting force		Min. 680 kg / 490 ~ 570 kg
Clutch master cylinder	Stroke	30 mm
	Inner diameter	ϕ 17.46 mm
Concentric slave cylinder	Stroke	7.0 mm
	Sectional area	706 mm^2
Clutch fluid		DOT4

2. TIGHTTENING TORQUE

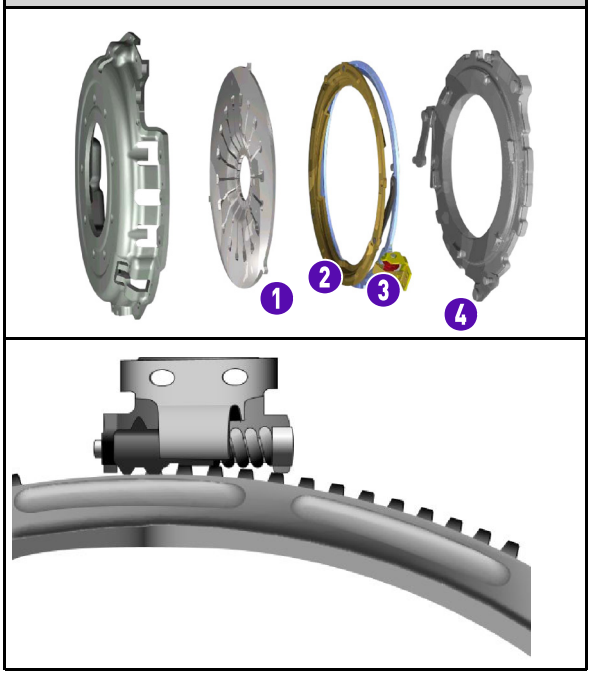
Description	Tightening Torque
Clutch housing bolt (8 locations)	49 ~ 59 Nm
Clutch cover (pressure plate) bolt	21 ~ 27 Nm
Concentric slave cylinder bolt (3 locations)	10 ~ 16 Nm
Concentric slave cylinder flare nut	20 ~ 25 Nm
Adapter flare nut	20 ~ 25 Nm
Clutch oil pipe flange nut	15 ~ 18 Nm
Master cylinder bolt	8 ~ 18 Nm
Fulcrum (clutch pedal bushing) bolt/nut	16 ~ 22 Nm
Clutch pedal bracket mounting bolt	8 ~ 18 Nm
Stopper bolt	16 ~ 22 Nm

OVERVIEW AND OPERATION PROCESS

1. FUNCTION AND OVERVIEW

1) SAT (Self Adjusting Technology) Clutch System

Internal Components of Clutch Cover



(1) Function

SAT is new clutch system which adjusts the clutch freeplay according to the wear of clutch disc.

(2) Operation description

- Diaphragm spring rotates the adjusting equipment as clutch disc is wearing and so, pressure plate is pushed to clutch disc side at the amount of wear.
- Disc wear (Free play) → Diaphragm spring (1) → Adjusting equipment (2 , 3) → Pressure plate (4)

2) Overview

▶ **Driving Elements**

The driving elements consist of two flat surfaces machined to a smooth finish.
One of these is the rear face of the engine flywheel and the other is the clutch pressure plate. The clutch pressure plate is fitted into a clutch steel cover, which is bolted to the flywheel.

▶ **Driven Elements**

The driven element is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the input shaft.
The driving and driven elements are held in contact by spring pressure. This pressure is exerted by a diaphragm spring in the clutch cover pressure plate assembly.

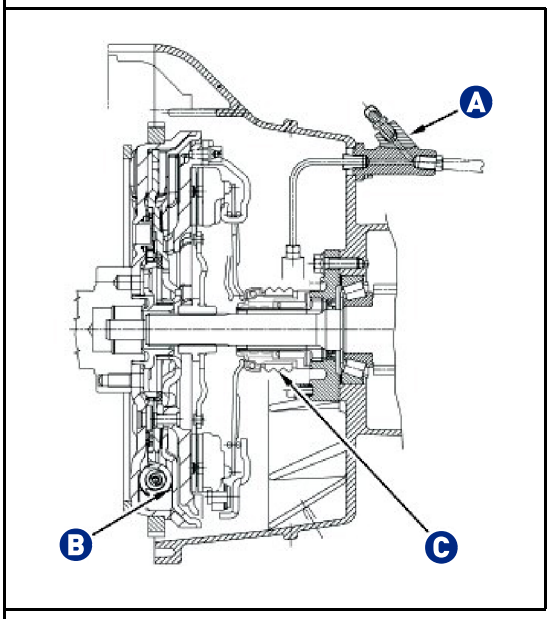
▶ **Operating Elements**

The clutch "release" system consists of the clutch pedal and clutch release cylinder.
This system directly releases the clutch by using hydraulic pressure while the conventional clutch system releases the clutch by using release lever and release fork. This system provides higher efficiency than conventional clutch system, and its durability is superior.
1) Clutch master cylinder (mounted on clutch pedal)
2) Concentric slave cylinder pipe (mounted inside of transmission)

Modification basis	
Application basis	
Affected VIN	

3) Functions

Components of Clutch Assembly



A Adapter/Pipe Assembly



B Clutch Assembly



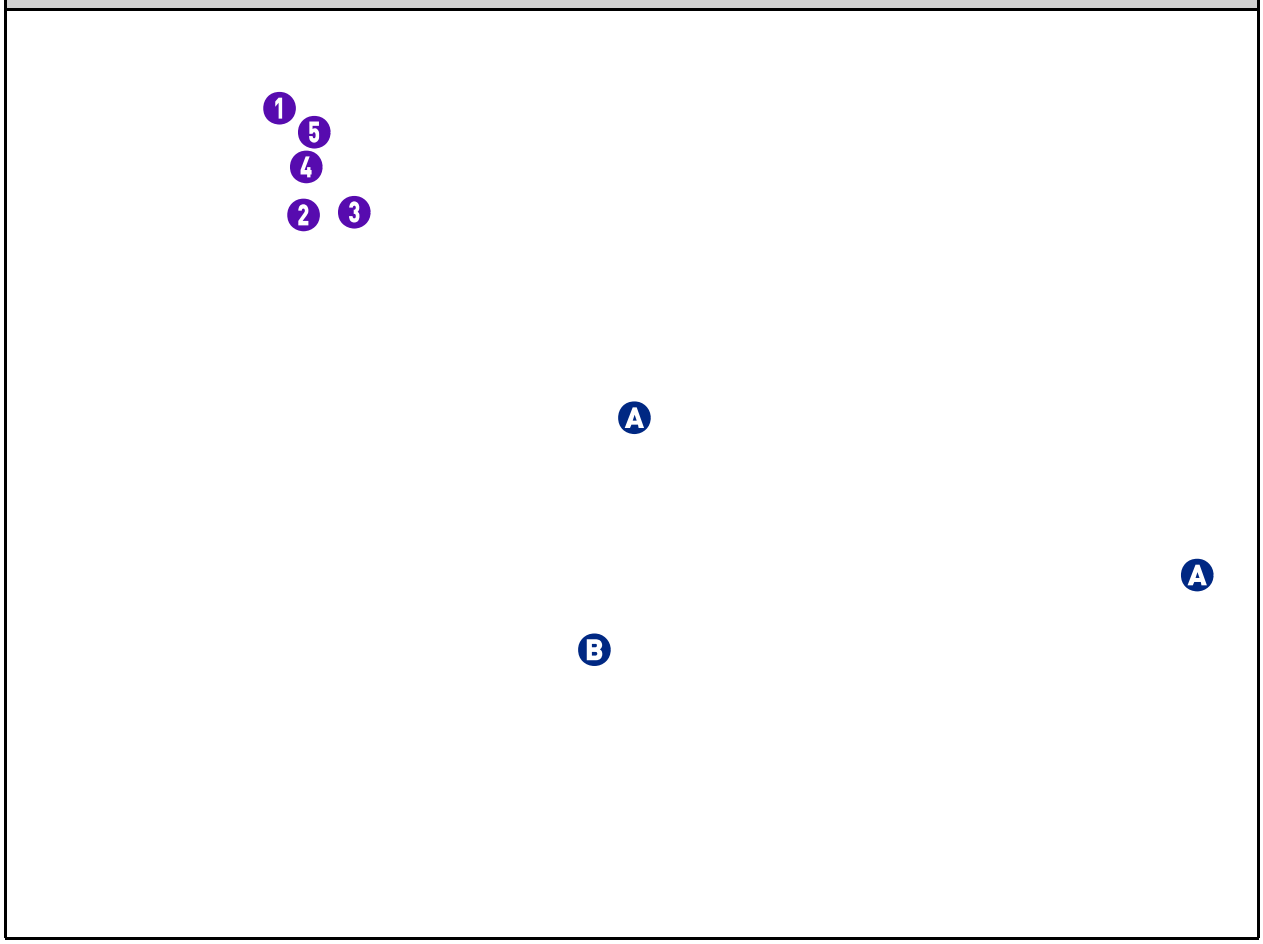


C Concentric Slave Cylinder





Cross Sectional View of Clutch Assembly



1 Transmission housing
2 Clutch disc assembly
3 Clutch disc cover assembly
4 Bolt
5 Washer
6 Bolt

Modification basis	
Application basis	
Affected VIN	

GENERAL

1. AXLE SPECIFICATIONS

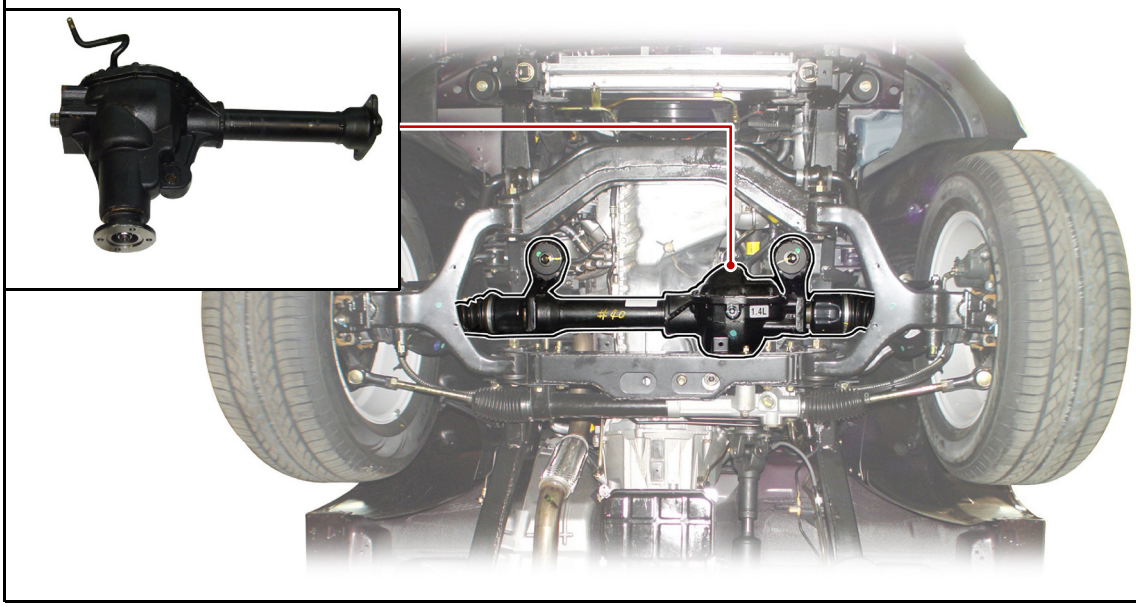
Location		Front axle				Rear axle	
Specification		M/T		A/T		Independent suspension	5-link
Torque		-		-		5,164 Nm	-
Gear ratio		D20DT	D27DT	D20DT	D27DT	←	←
		4.27	3.91	3.54	3.31		
Gear	Type	→		→		Hypoid	←
	Size	f 198.1 mm		←		218 mm (diameter)	f 243.8 mm
	Offset	30 mm		←		Less than 30 mm	-
Housing		Steel casting (steel, aluminum cover)		←		Aluminum die casting	Steel casting (steel, aluminum cover)
Oil	Specification	SAE 80W/90		←		SAE 75W/90 (Synthetic)	SAE 80W/90
	Capacity	1.4 L		1.4 L		1.5 L	1.9 L
Length		448.0 mm		←		412 mm	469.0 mm
Width		681.9 mm		←		292 mm	1717.7 mm
Weight		45 kg		←		30 kg	100 kg

OVERVIEW AND OPERATION PROCESS

1. AXLE OVERVIEW

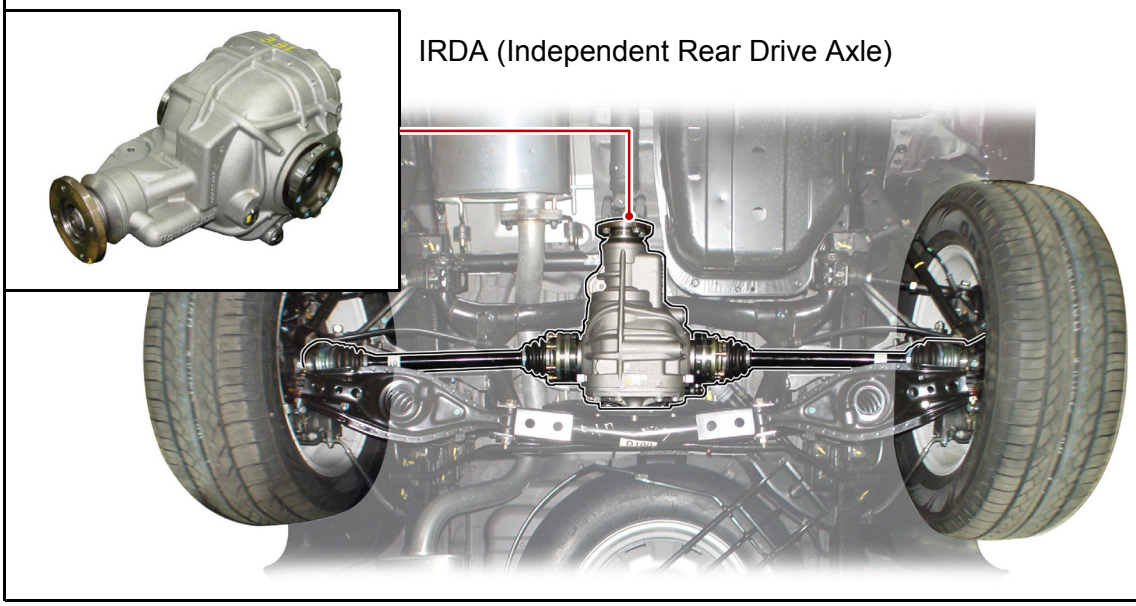
Compared to previous models, in addition to existing 5-link suspension, the IRDA (Independent Rear Drive Axle) is adopted for the independent type suspension in this vehicle.
The below figures for rear axle show the rear axle with the independent type suspension (4WD, A/T).

Front Axle



Rear Axle

IRDA (Independent Rear Drive Axle)



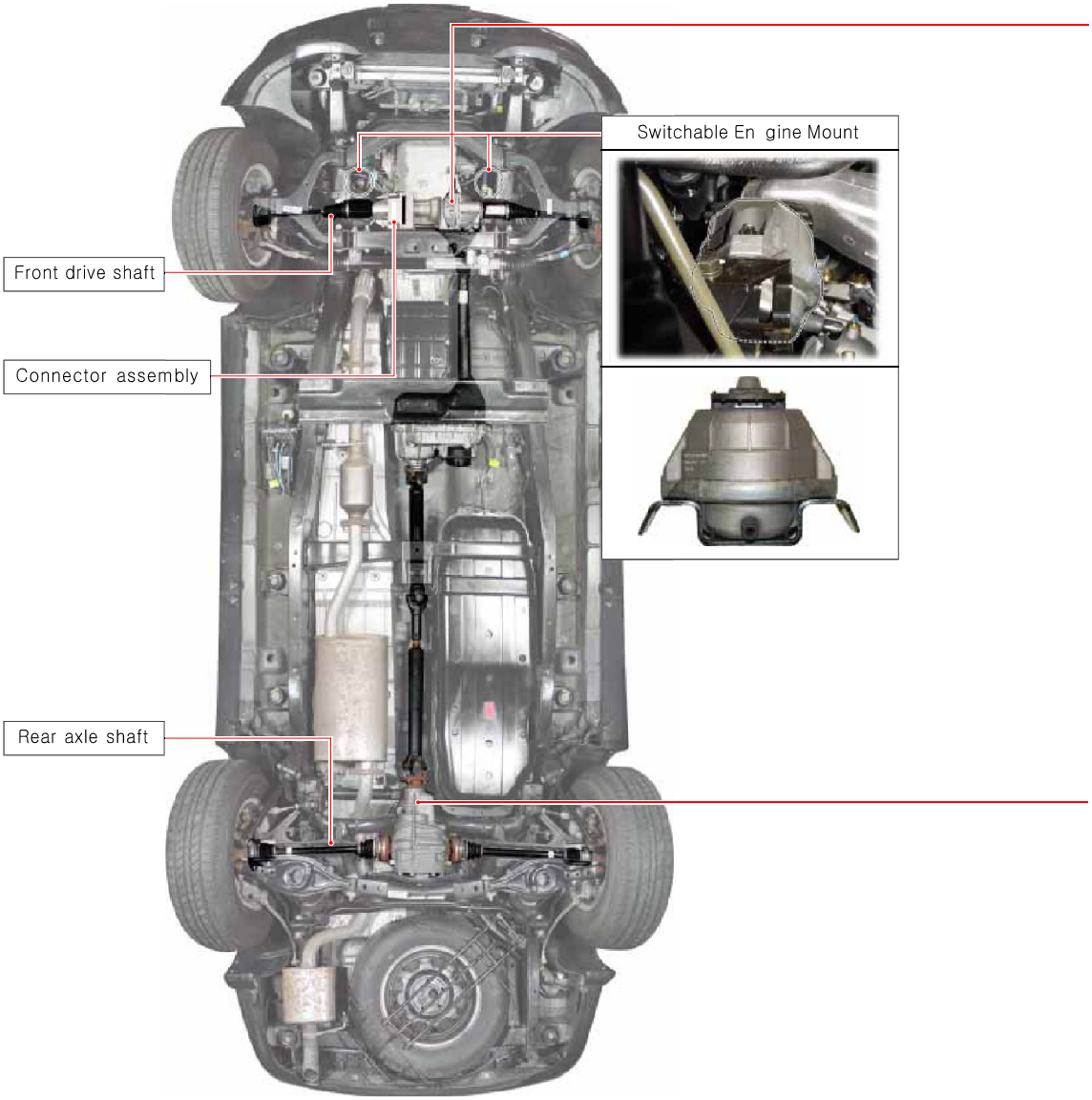
Modification basis	
Application basis	
Affected VIN	

AXLE (IOP) 4210-01

OVERVIEW AND OPERATION PROCESS

1. OVERVIEW

The 2007 Kyron is equipped with different types of front and rear axles.
As the IOP axle is installed, AWD (All Wheel Driver) transfer case and the switchable engine mount are installed.



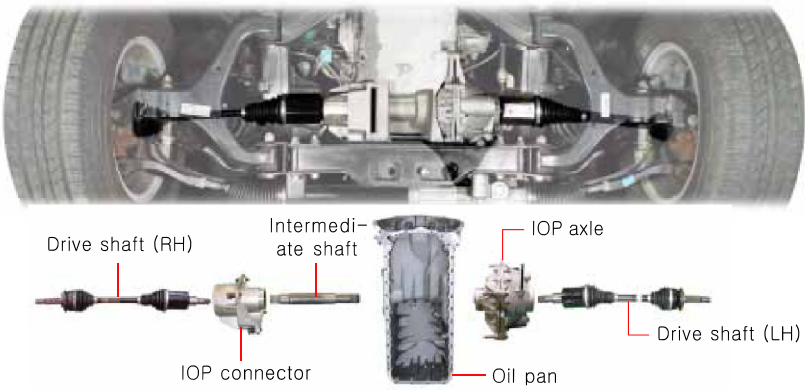
This vehicle is equipped with front IOP axle system and IRDA with new technology.

Modification basis	
Application basis	
Affected VIN	

Front Axle

IOP axle

The IOP front axle is integrated with the engine oil pan so that the engine mounting height is lowered and the engine vibration is reduced.



Conventional axle (Non IOP axle)



Rear Axle

5-link type rear axle (semi floating type: integrated type)



Independent suspension type rear axle (IRDA)

There is not much different in the rear axle system. However, as EAS and EPB with new technology are adopted, suspension specification and rear axle module have been changed.



2. WHEEL ALIGNMENT

Items		Before alignment	After alignment				Remarks
			Kyron		Actyon	Actyon Sports	
Front	Camber	-0.19° ± 0.3°	LH	-0.19° ± 0.25°	←	-0.19° ± 0.3°	The adjustment values for LH and RH side are different for Kyron and Actyon.
			RH	-0.29° ± 0.25°	←		
	Caster	4.4° ± 0.5°	LH	4.4° ± 0.4°	←	4.4° ± 0.5°	
			RH	4.5° ± 0.4°	←		
	Toe-in	22 mm (0 ~ 4 mm)	22mm (0 ~ 4mm)		←	←	-
Rear	Camber	-0.79° ± 0.18°	←		-	-	Applied only to Kyron's IRS type
	Total toe	0.19° ± 0.18° (22 mm)	←		-	-	No specific adjustment value

▶ **Actions**

1. Before performing the wheel alignment, unload all the items from the vehicle.
2. When setting the wheel alignment tools, the above adjustment values should be followed.
3. The difference of the front camber and the caster at both ends should be below 30' (0.5°).

Modification basis	
Application basis	
Affected VIN	

PART TIME TRANSFER CASE & LOCKING HUB SYSTEM 3240-01

GENERAL

1. PART TIME TRANSFER CASE OVERVIEW

By using the planetary gear sets, two-gears shift type part time transfer case achieves direct connection when selecting 4WD "HIGH" and 2.48 of reduction gear ratio when selecting 4WD "LOW". The silent chain in transfer case transfers the output power to front wheels.
The simple operation of switches on instrument panel allows to shift between "2H" and "4H" easily while driving (for 4L: stop vehicle first). The warning lamp warns the driver when the system is defective.

The 4WD system integrated in KYRON does not have big difference in comparison to the conventional part time transfer case, but the changes in comparison to the conventional transfer case are as follows:

- No additional coding is required when replacing TCCU.
- Delete the devices (tone wheel speed sensor, wiring etc.) related to the speed sensor in the transfer case.
  This system receives the speed signals from ABS/ESP HECU or instrument panel (for non-ABS vehicle(Note 1) through the CAN communication.
- The new TCCU is available to install on the vehicle with the conventional DI engine part time TCCU.

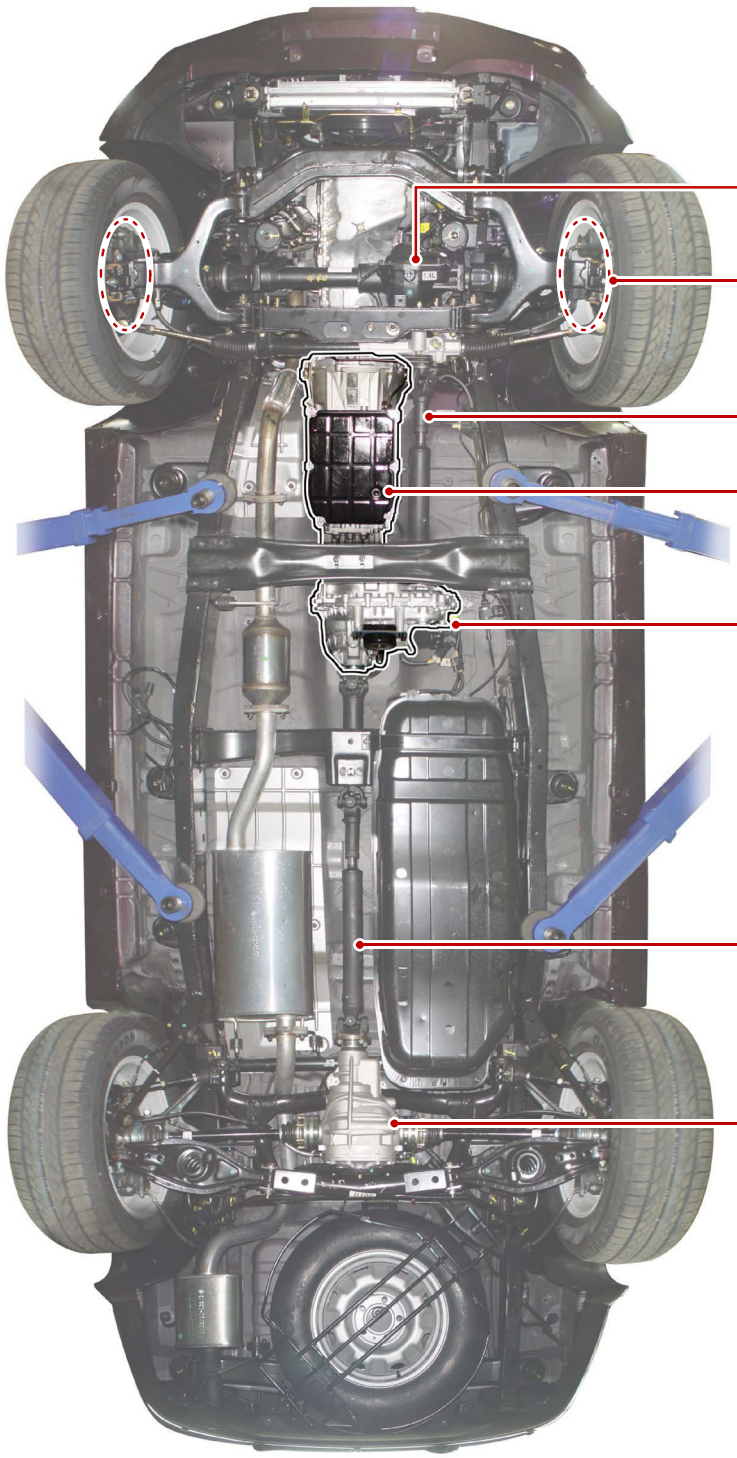
CAUTION
- In non-ABS vehicle, the vehicle speed sensor is installed on the rear drive axle. The engine ECU sends the speed signal to the instrument panel, and then the instrument panel provides the information to TCCU and other devices.

2. PART TIME TRANSFER CASE SPECIFICATIONS

Descriptio n		Part Time T/C
Total length		343 mm
Mating surface of front flange		40 mm
Weight		33.9 Kg (without oil)
Oil capacity		1.4 L
Location		Transfer case
Major elements	Housing	Part time
	Tightening bolt	11EA, M8 x 1.25
	Input shaft	A/T: External spline M/T: Internal spline
	Ring gear	Inserted into housing groove
	Sun gear	Separated input shaft and sun gear

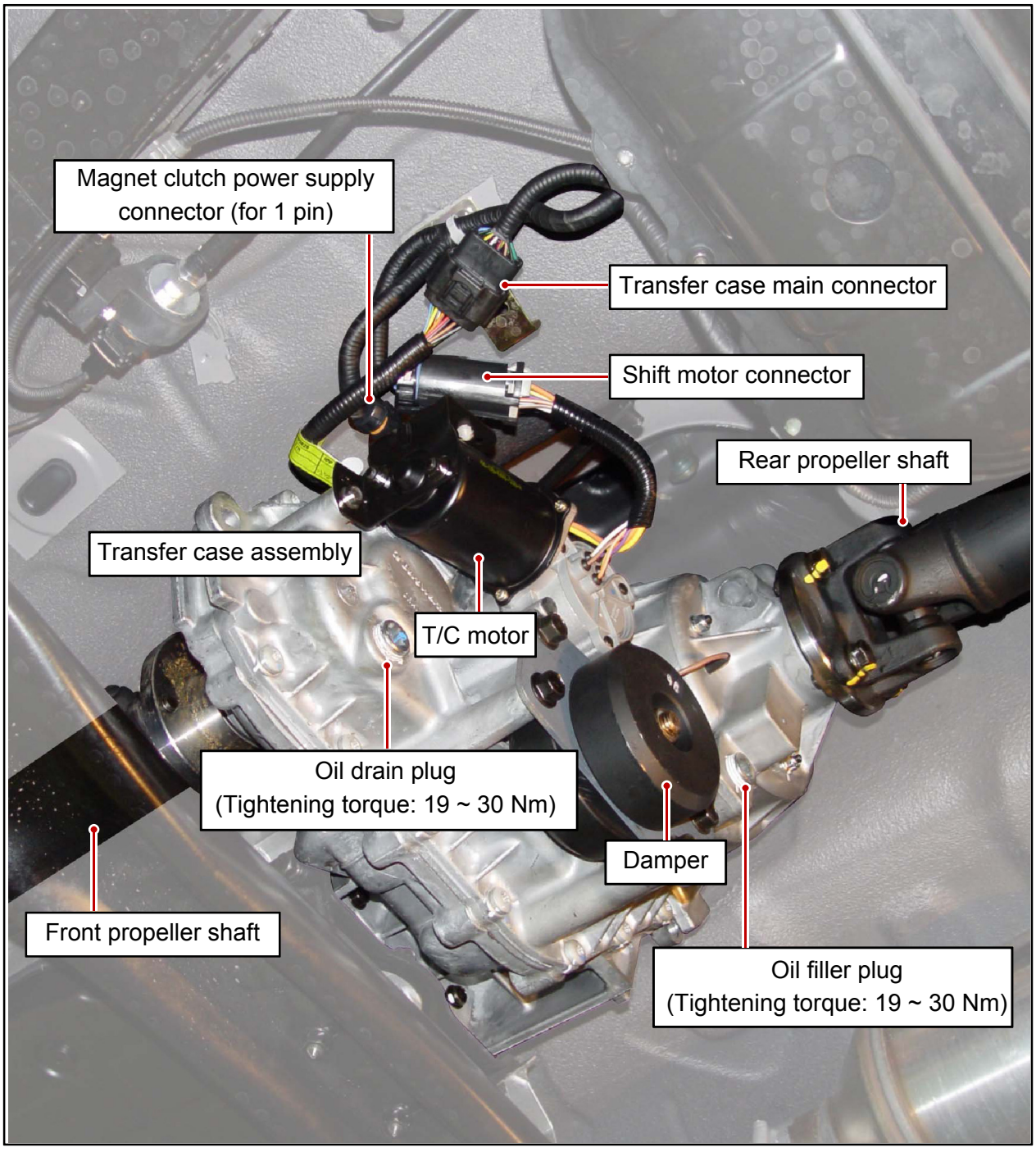
OVERVIEW AND OPERATION PROCESS

1. STRUCTURE



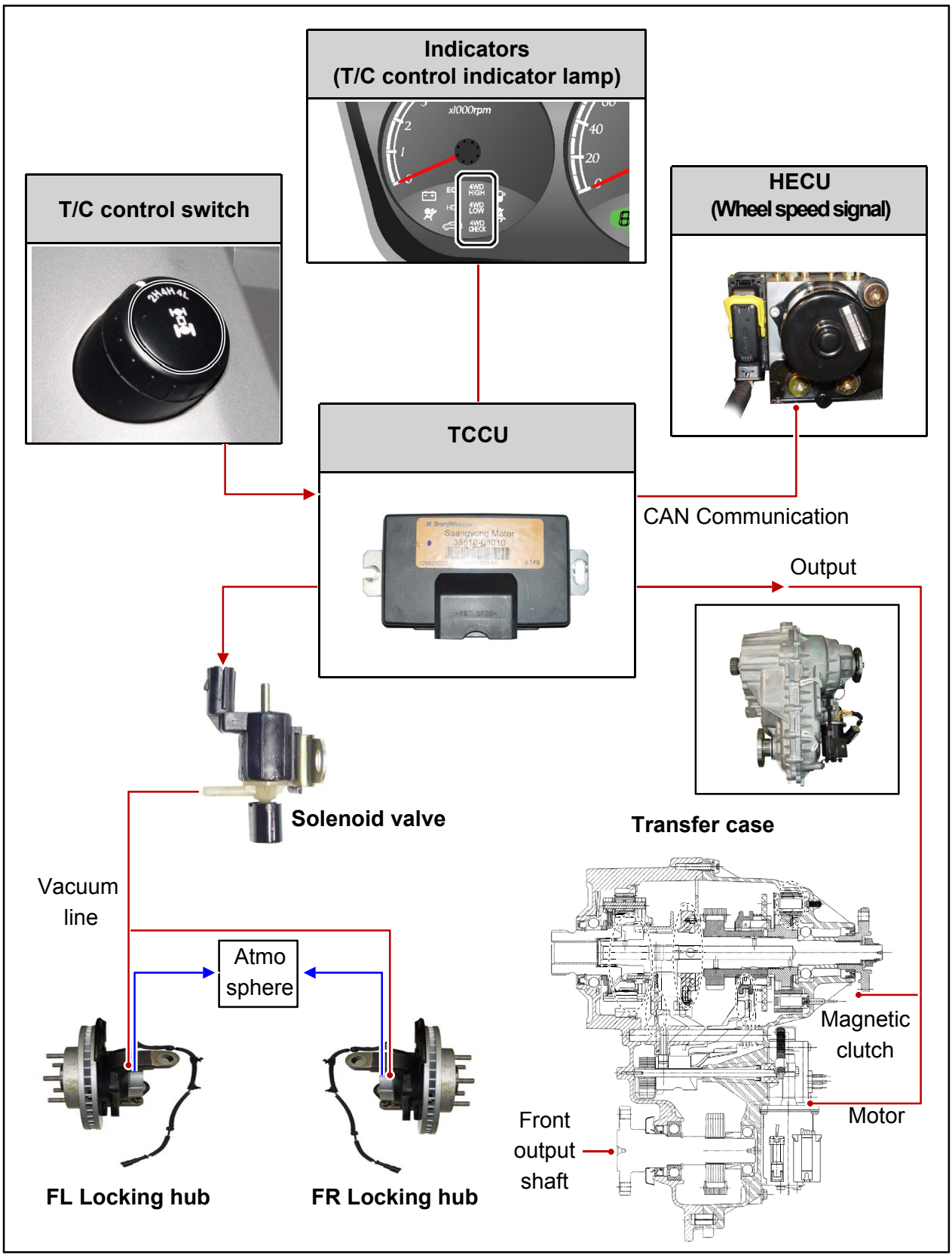
Modification basis	
Application basis	
Affected VIN	

1) Components Location



2. SYSTEM LAYOUT AND FUNCTIONS

1) System Layout



Modification basis	
Application basis	
Affected VIN	

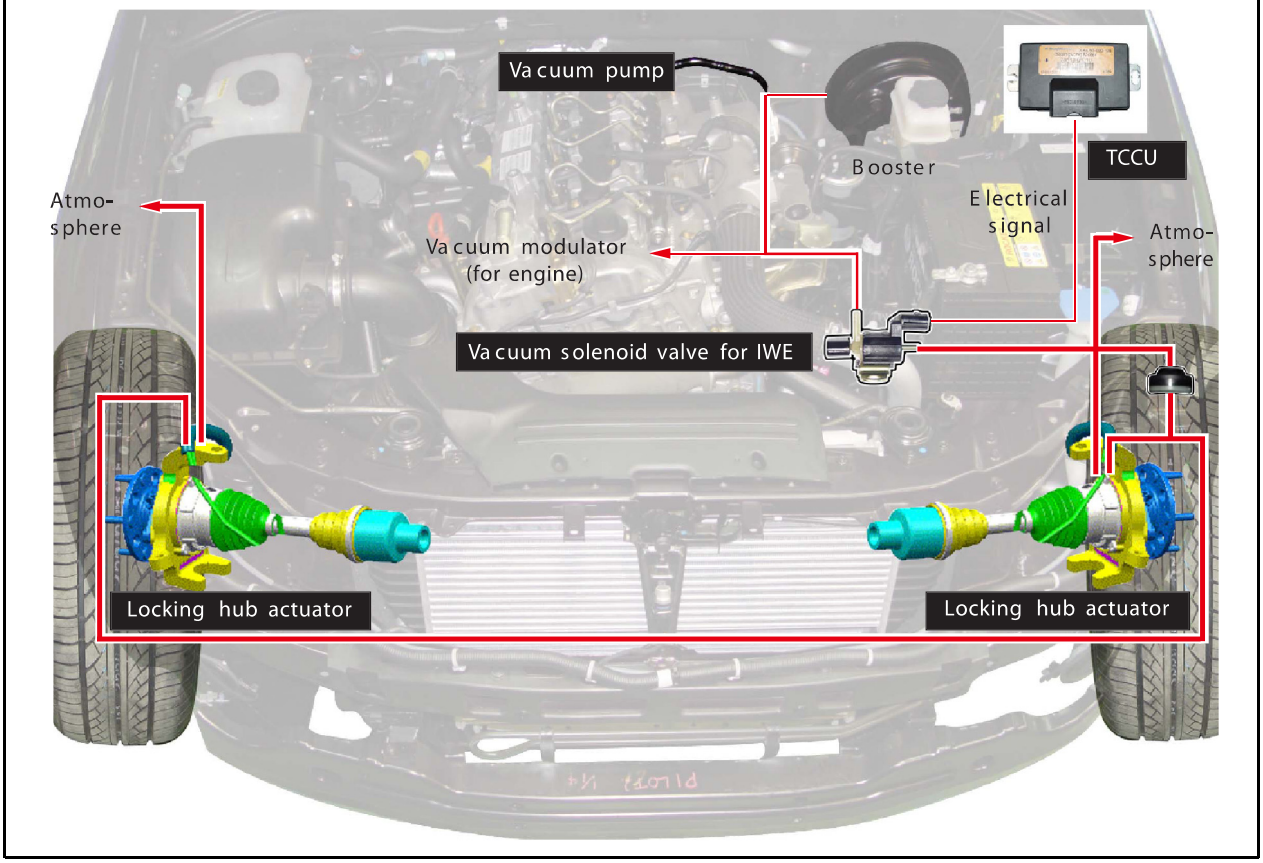
3. LOCKING HUB SYSTEM

The transfer case and the TCCU differ from previous models only in the speed sensor related parts. However, the vacuum locking hub operation system works oppositely from previous models and its components also have changed.

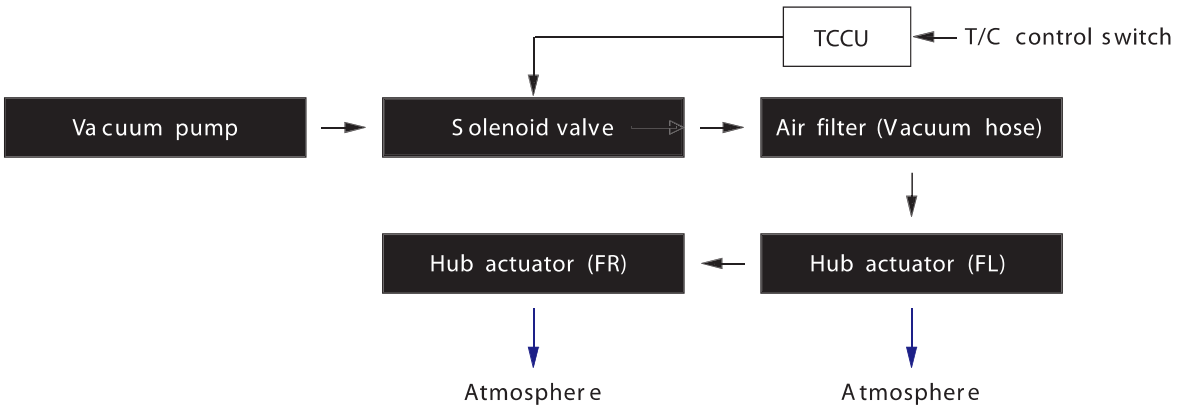
The vacuum locking hub that is applied to Kyron uses the IWE (Integrated Wheel End) system, and in this system, the vacuum is generated only within the hub actuator.

It is structured to transmit power to the front section after the actuator hub is engaged following the release of vacuum from the drive shaft end gear and the hub end gear.

Operating Process



Vacuum generation process in front hub actuator:



Modification basis	
Application basis	
Affected VIN	

1) Vacuum System



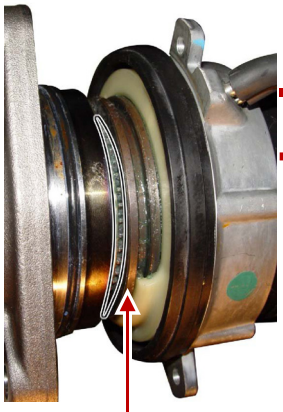
Vacuum operation during 2WD mode

During 2WD mode, the vacuum pressure from vacuum pump is continuously transmitted to the locking hub system. This vacuum pressure pulls in the locking hub actuator so that it will not be engaged with the front end hub gear.

In 4WD mode, the TCCU blocks the transferring of vacuum pressure from vacuum pump to locking hub by supplying the power to solenoid valve.



Air filter



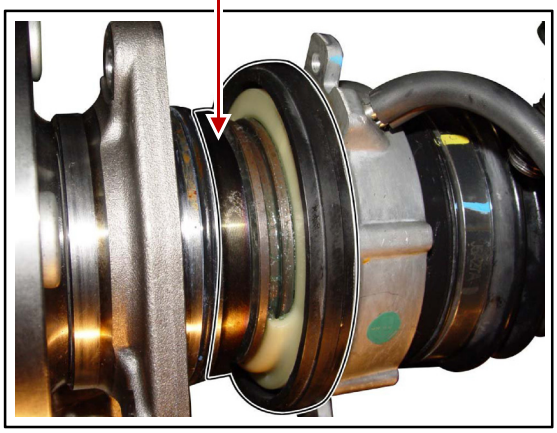
Atmosphere
(in 4WD mode)

2WD (applying vacuum pressure to hub actuator)

The vacuum pressure pulls in the locking hub actuator so that it will not be engaged with the front end hub gear.

4WD (releasing vacuum pressure from hub actuator)

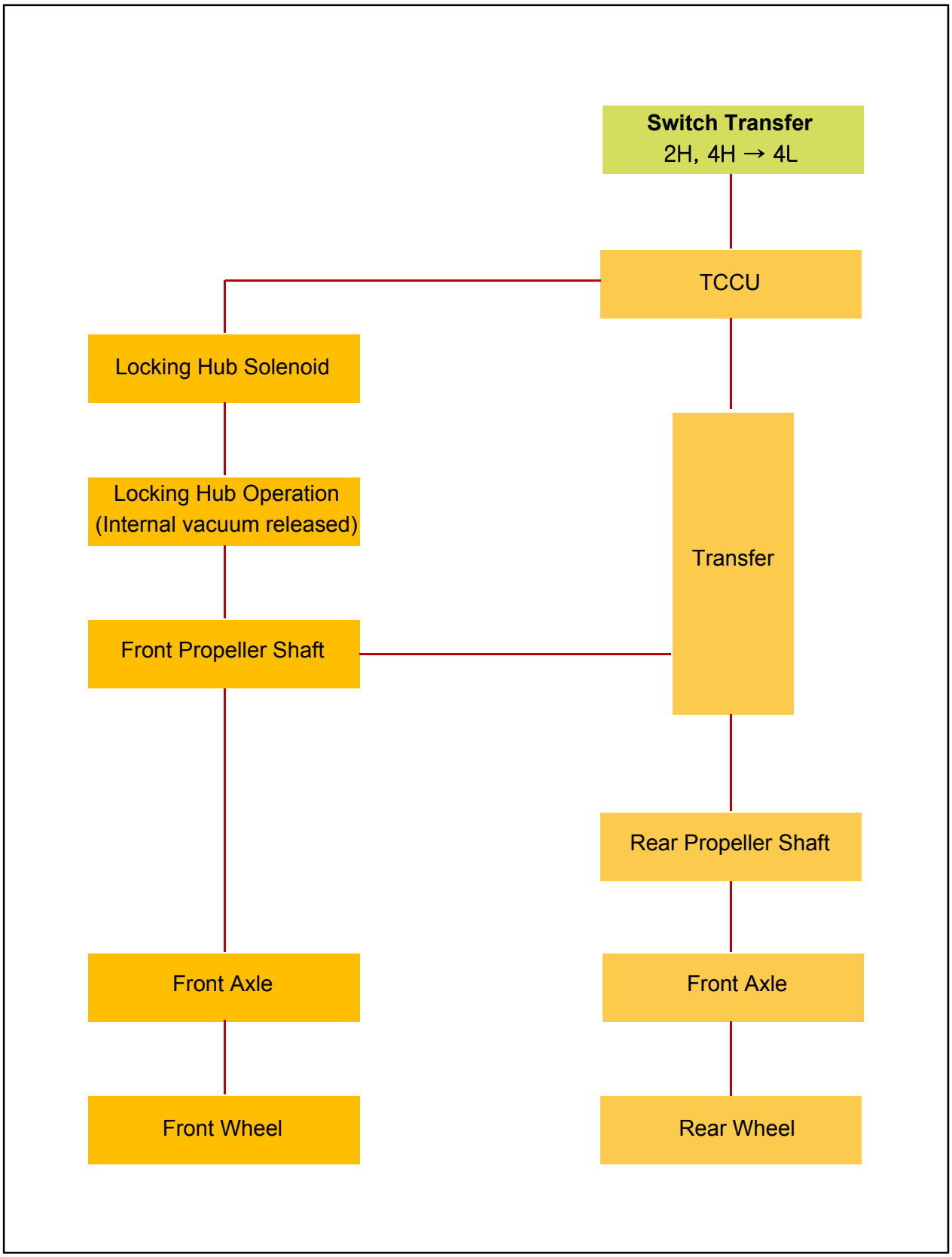
The vacuum pressure is released from the hub actuator. At this time, the front hub end gear is engaged.



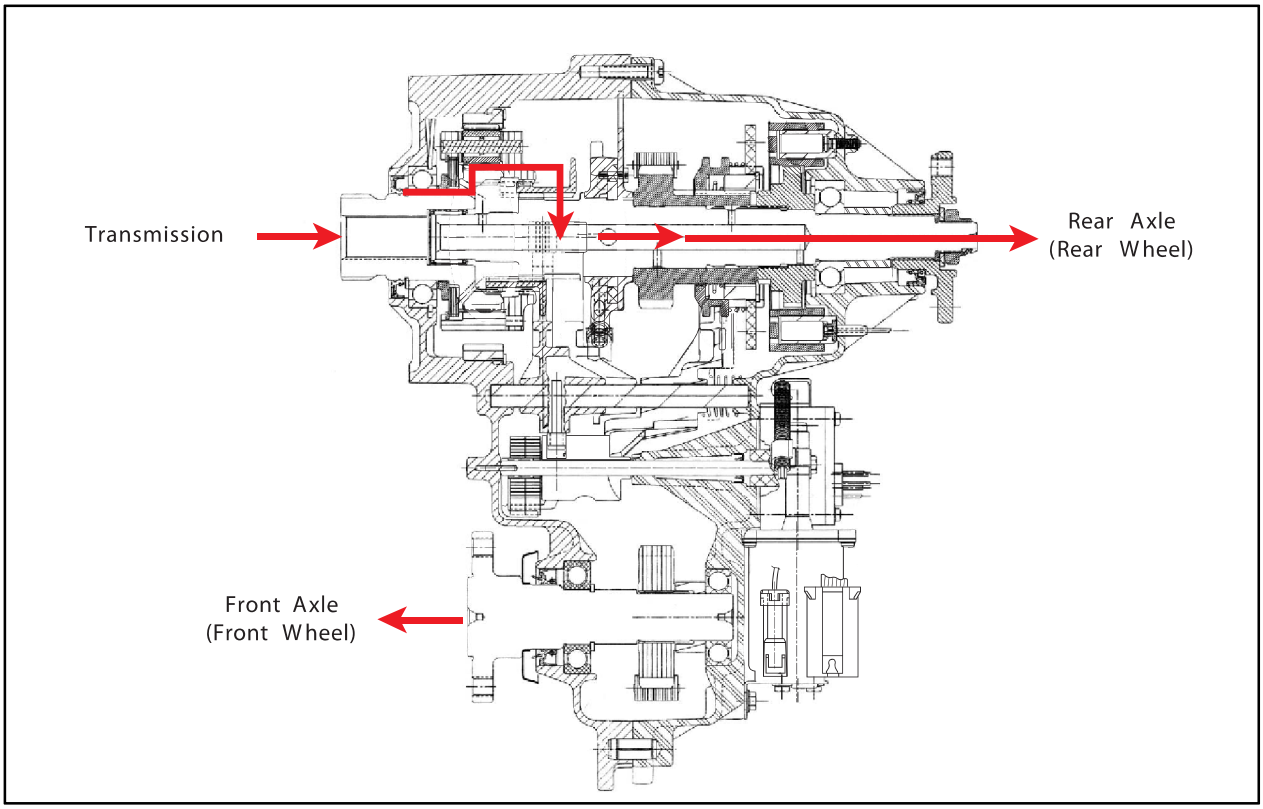
Modification basis	
Application basis	
Affected VIN	

4. POWER FLOW

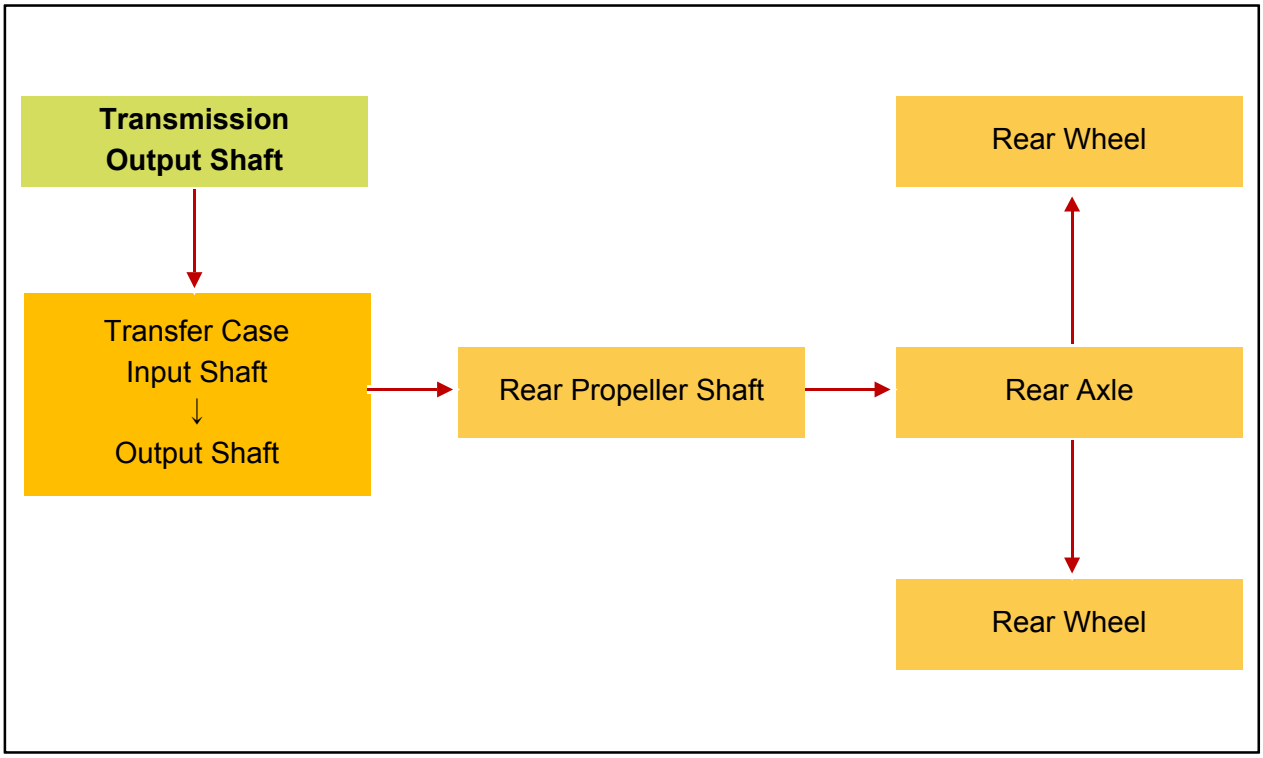
1) POWER FLOW



2) 2H MODE (2WD)

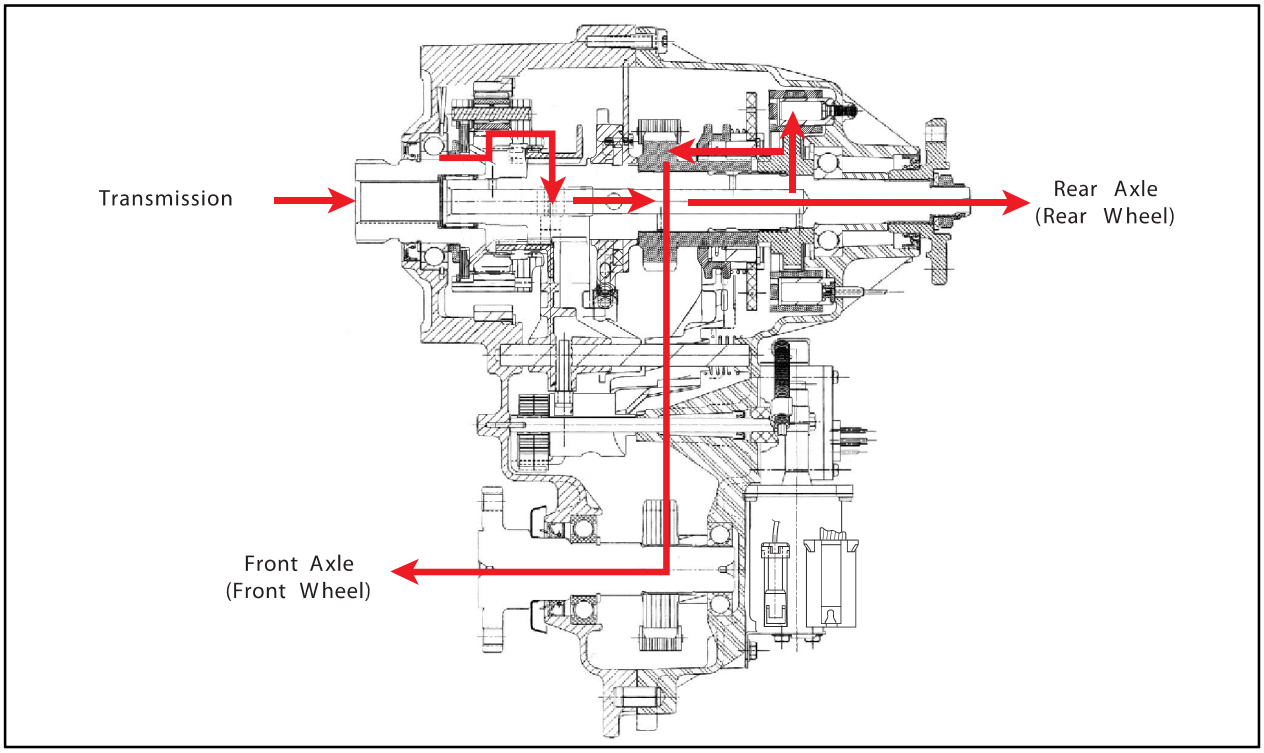


▶ **Power Flow**

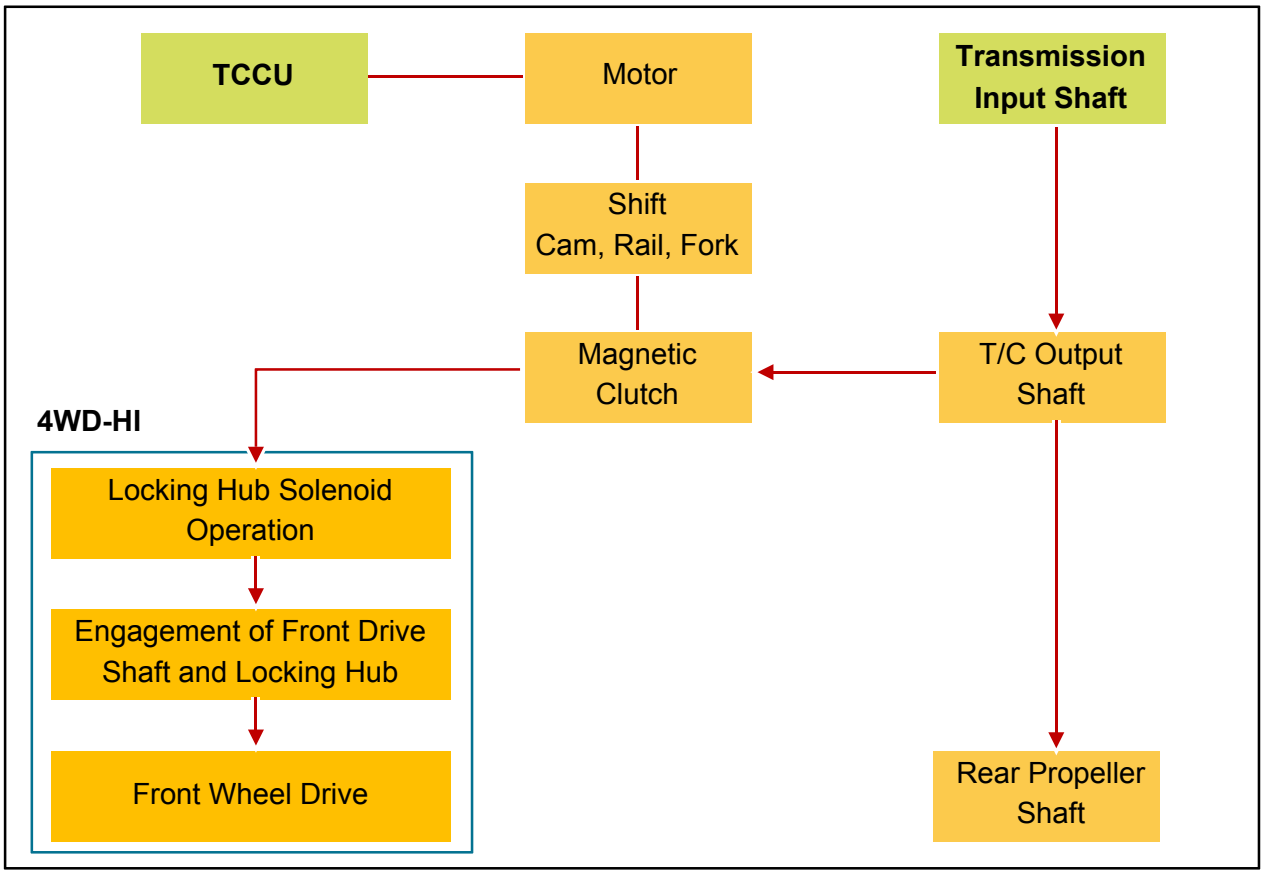


Modification basis	
Application basis	
Affected VIN	

3) 4H MODE (4WD - HIGH SPEED)

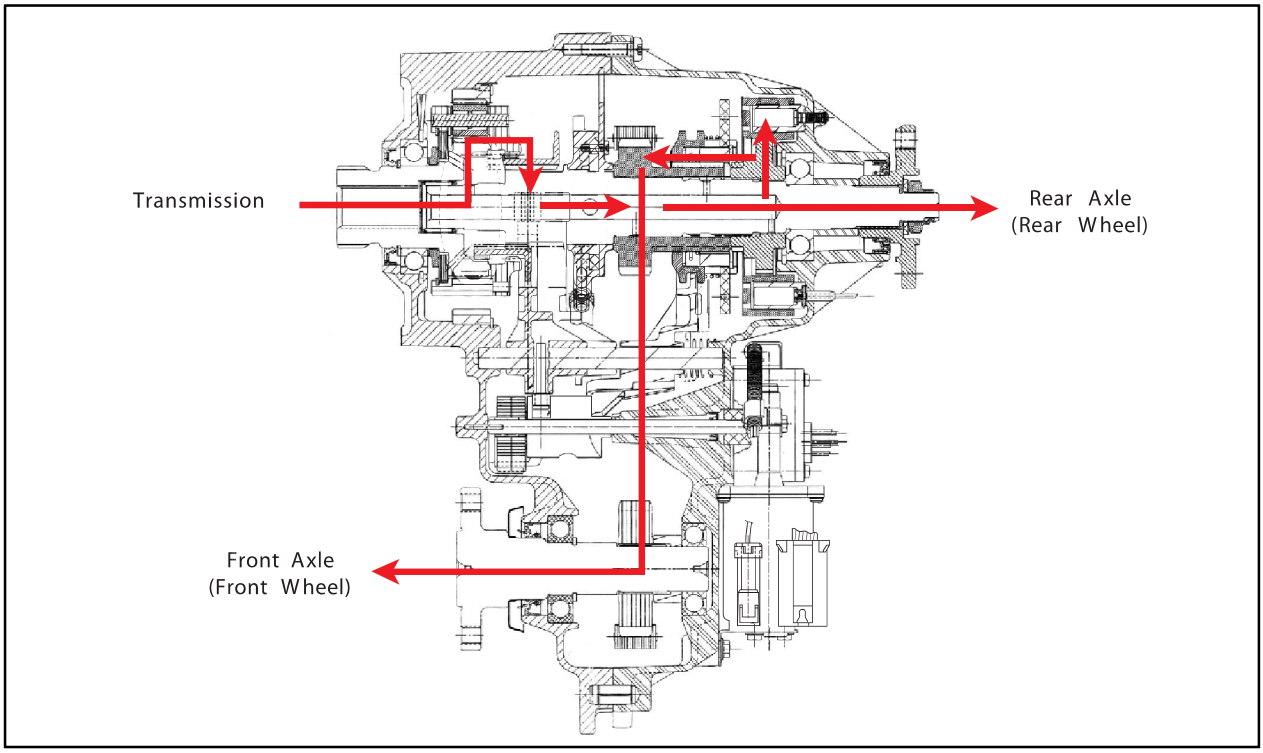


▶ **Power Flow**

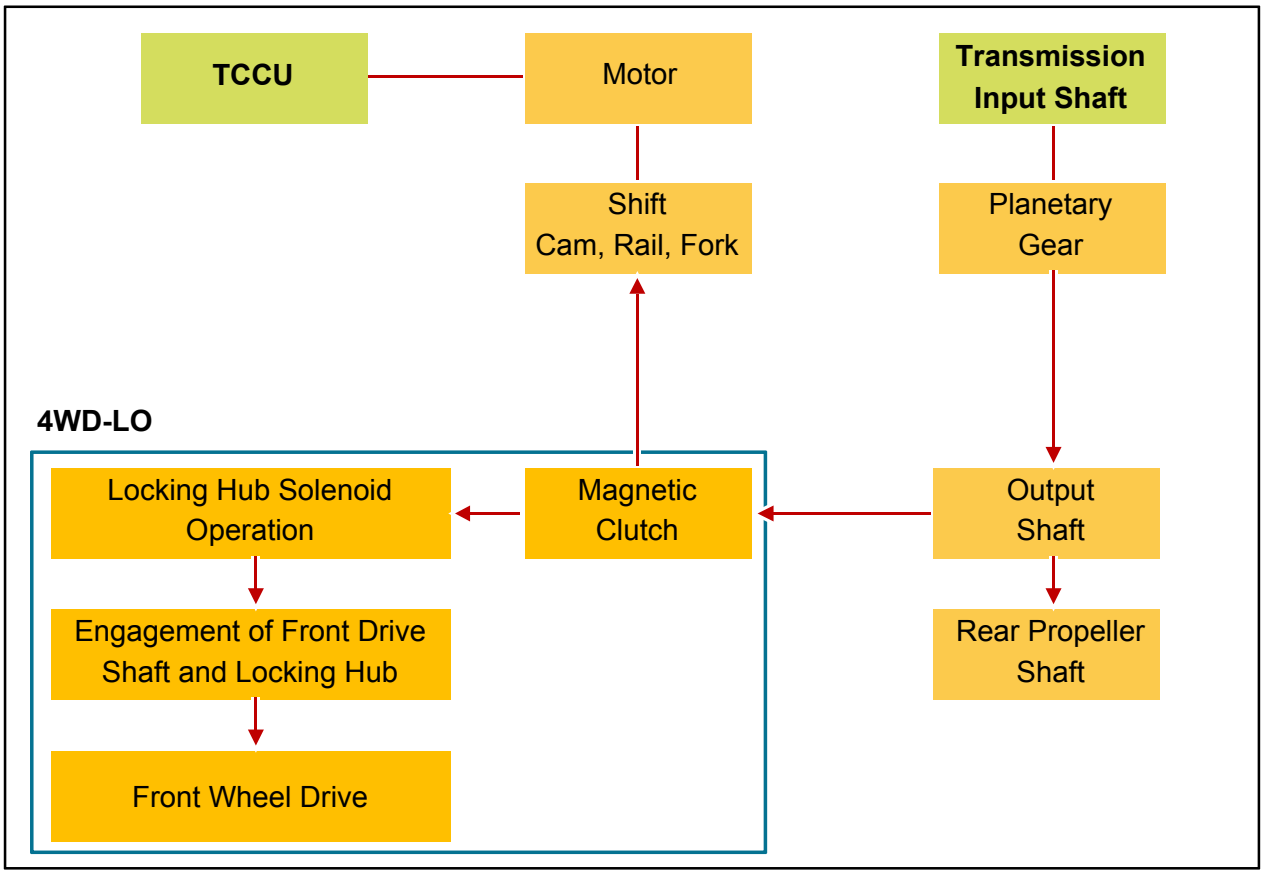


Modification basis	
Application basis	
Affected VIN	

4) 4L MODE (4WD - LOW SPEED)



▶ **Power Flow**



Modification basis	
Application basis	
Affected VIN	

PROPELLER SHAFT

3310-01/3310-00/3310-06

GENERAL

1. SPECIFICATION..... 3

OVERVIEW AND OPERATION PROCESS

1. OVERVIEW..... 4
2. COMPONENT LOCATOR..... 5
3310-01 FRONT PROPELLER SHAFT..... 7
3310-06 REAR PROPELLER SHAFT..... 9
3310-00 DISASSEMBLY AND REASSEMBLY PROPELLER SHAFT..... 11

PROPELLER SHAFT

3310-00

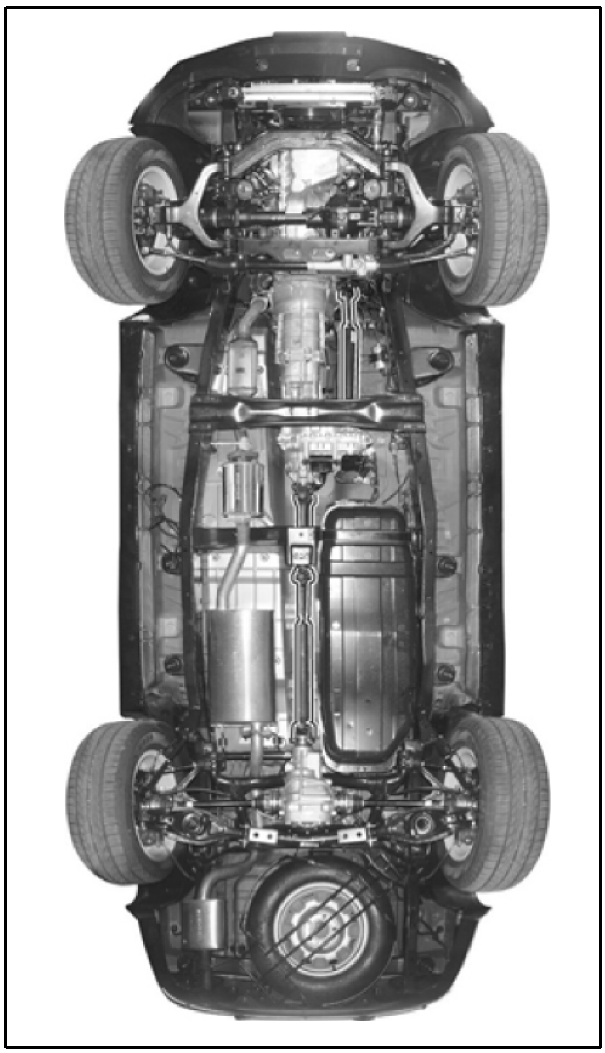
GENERAL

1. SPECIFICATION

Description	Specification		
Structure			Yoke and spider type universal joint
Joint type			Spider (Needle roller bearing)
Number of spiders	Front	Full time T/C	1
		Part time T/C	2
	Rear		3
Outer diameter of spider (mm)			ϕ17.91
Tube run-out (after installation)			below 0.4 mm
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	Diesel + M/T(A/T) + 4408 TC (Part time)		607.1 x ϕ59.5 x ϕ63.5 (compressed)
	Gasoline + M/T(A/T) + 4421 TC (TOD)		577.9 x ϕ44.7 x ϕ50.8 (center position)
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	Diesel + M/T(A/T) + 4408 TC		(585.2 + 567.5) x ϕ59.5 x ϕ63.5 (compressed)
	Gasoline + M/T(A/T) + 4421 TC		(566.1 + 567.5) x ϕ59.5 x ϕ63.5 (compressed)
Unbalance	below 30 g·cm @ 4500 rpm (Front shaft + Part time TC, Rear shaft)		
	below 14.5 g·cm @ 5300 rpm (Front shaft + Full time TC)		
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	DI engine + M/T(A/T) + Part time TC		575.7 x ϕ59.5 x ϕ63.5 (compressed)
	DI engine + M/T(A/T) + Full time TC		560.8 x ϕ44.7 x ϕ50.8 (center position)
Front shaft dimension Length x Inner diameter x Outer diameter (mm)	DI engine + M/T(A/T) + Part time TC		(565.9 + 547.6) x ϕ59.6 x ϕ63.5 (compressed)
	DI engine + M/T(A/T) + Full time TC		

OVERVIEW AND OPERATION PROCESS

1. OVERVIEW



The propeller shaft transfers the power through the transmission and transfer case to the front/rear axle differential carrier (final reduction gear). It is manufactured by a thin rounded steel pipe to have the strong resisting force against the torsion and bending.

Both ends of propeller shaft are connected to the spider and the center of propeller shaft is connected to the spline to accommodate the changes of the height and length. The rubber bushing that covers the intermediate bearing keeps the balance of rear propeller shaft and absorbs its vibration.

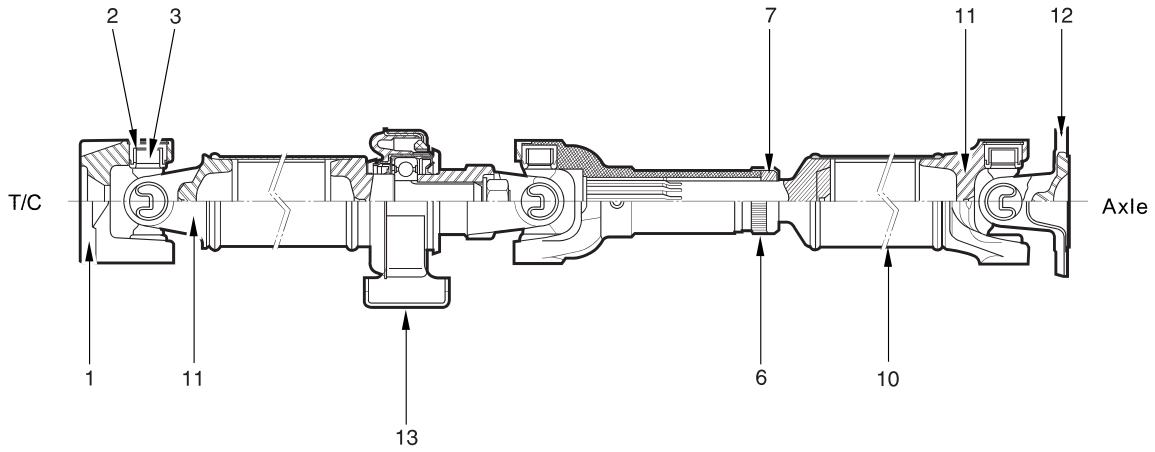
Modification basis	
Application basis	
Affected VIN	

2. COMPONENT LOCATOR

1) Cross Sectional View

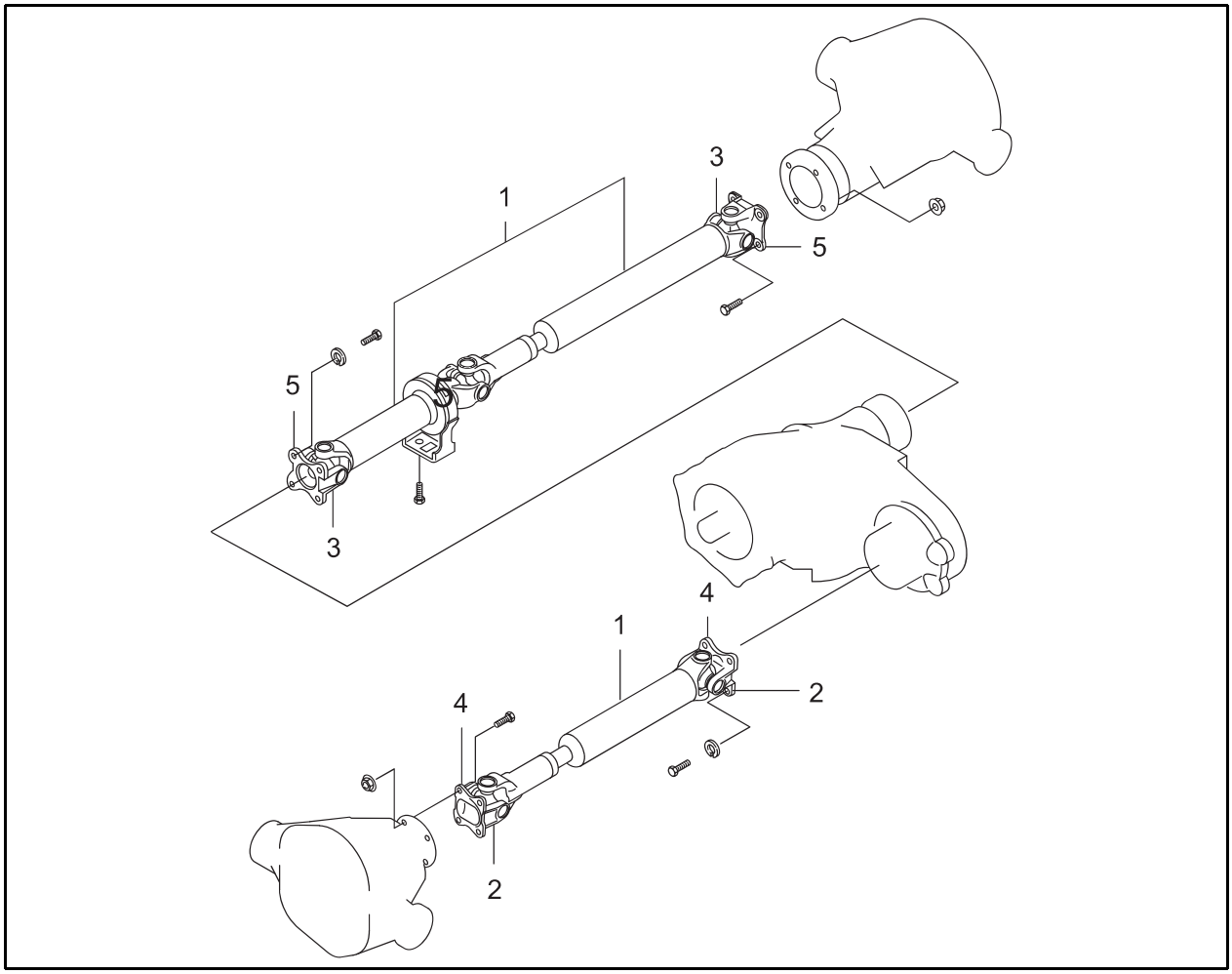
Front propeller shaft

Rear Propeller Shaft



1. Flange yoke
2. Journal bearing cap
3. Spider journal
4. Slip yoke assembly
5. Grease nipple
6. Dust cap
7. Oil seal
8. Split washer
9. Slip tube shaft
10. Tube
11. Tube yoke
12. Flange yoke
13. Center bearing

2) Propeller Shaft Assemble



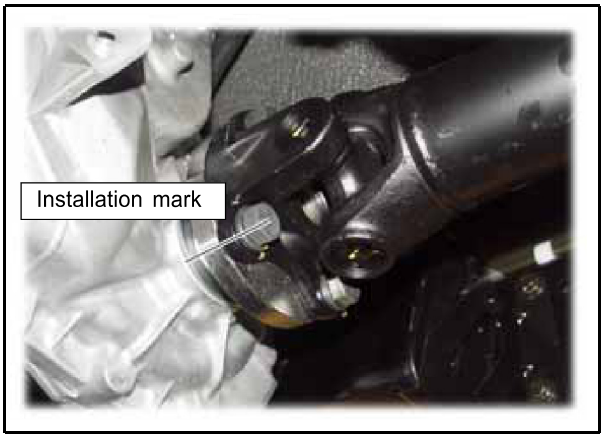
1. Propeller shaft
2. Joint (propeller front)
3. Joint (propeller rear)
4. Yoke (front)
5. Yoke (rear)

Modification basis	
Application basis	
Affected VIN	

S.G.N. 3310-01

FRONT PROPELLER SHAFT

Manual Transmission	Automatic Transmission (For Gasoline Engine)
	

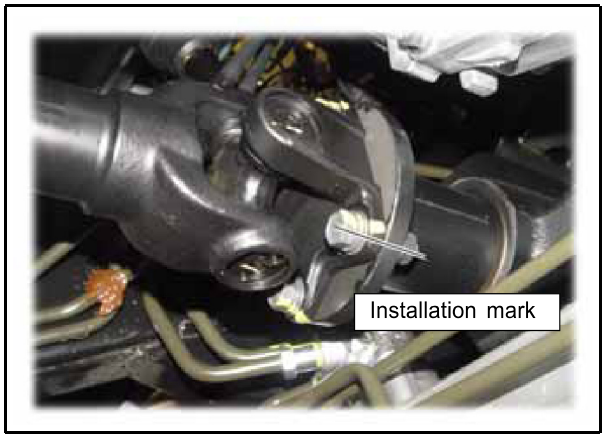


1. Remove the flange yoke mounting bolt on the transfer case side of the front propeller shaft.

CAUTION

- Put installation marks on the yoke to the propeller and the flange to the transfer case.

Modification basis	
Application basis	
Affected VIN	



2. Remove the flange yoke mounting bolt and nut on the front axle side of the front propeller shaft.

CAUTION
- Put installation marks on the yoke to the propeller and the flange to the transfer case.

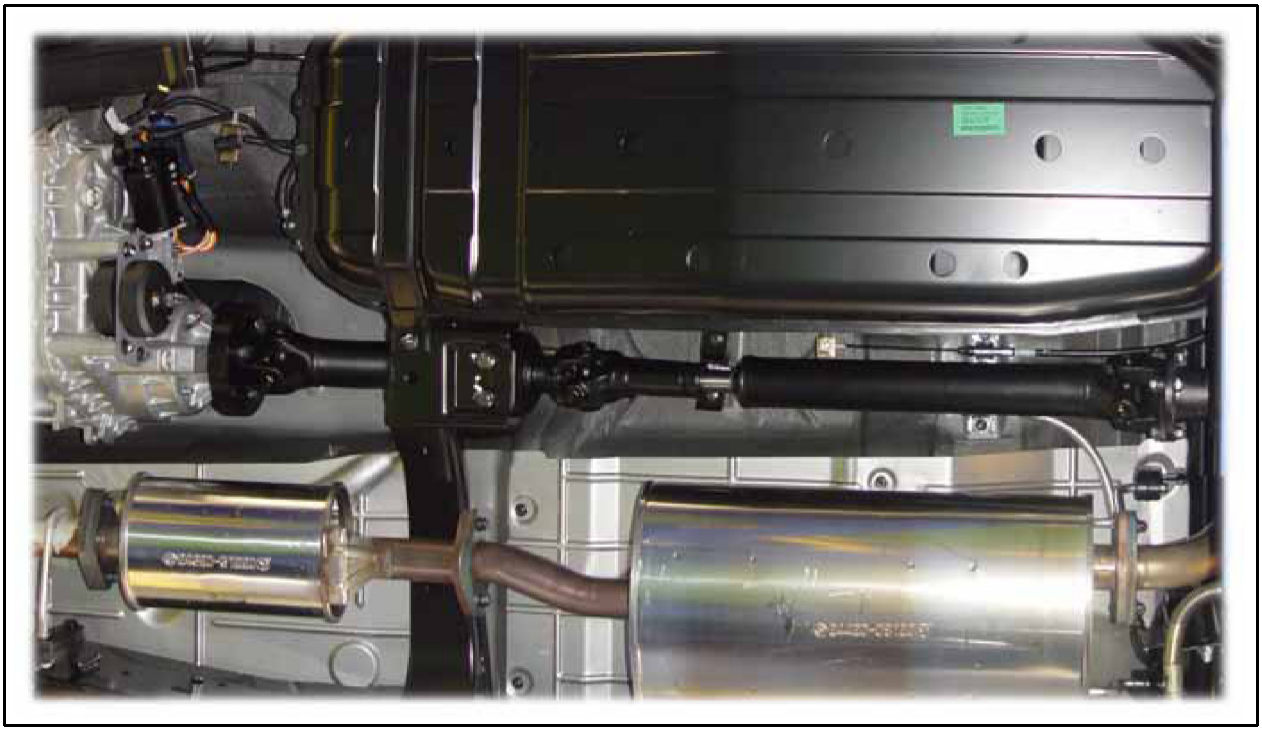


3. Remove the front propeller shaft.

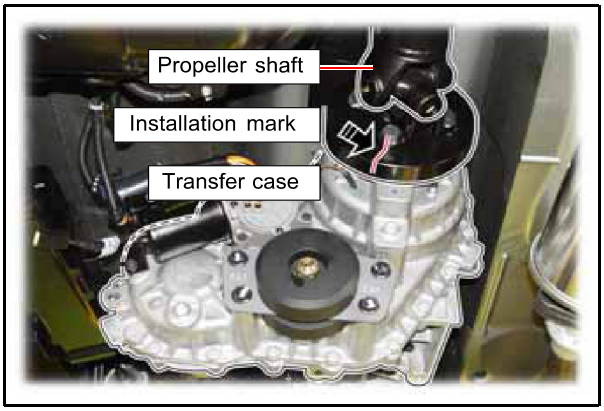
Modification basis	
Application basis	
Affected VIN	

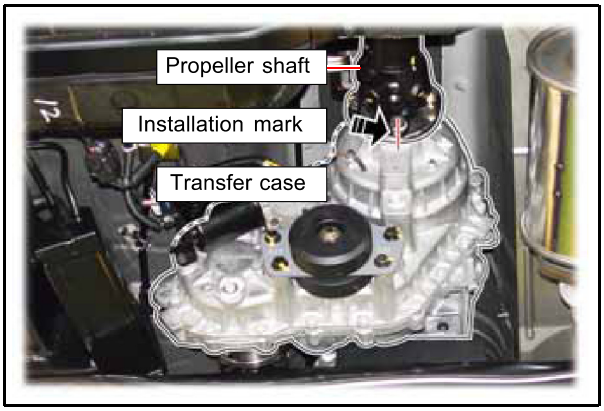
S.G.N. 3310-06

REAR PROPELLER SHAFT



1. Remove the yoke mounting bolt and nut on the transfer case side of the rear propeller shaft.

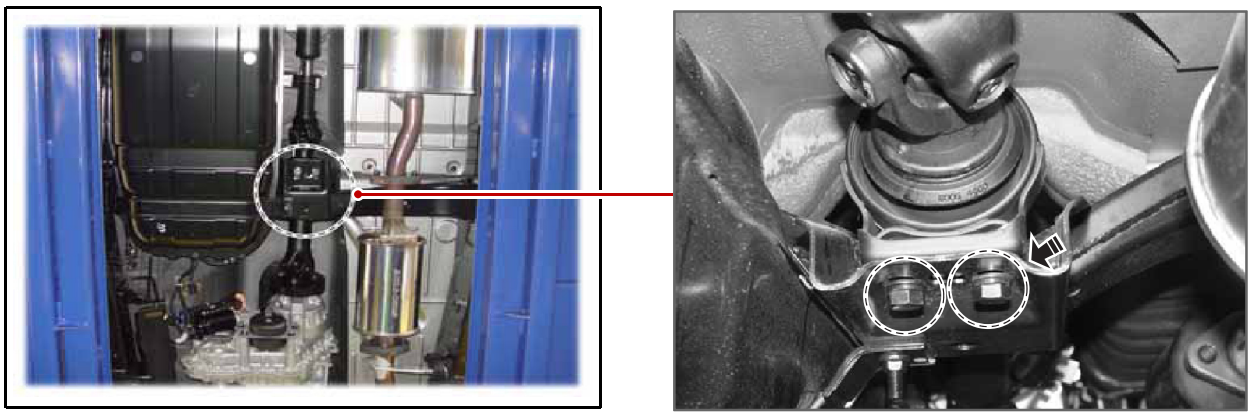




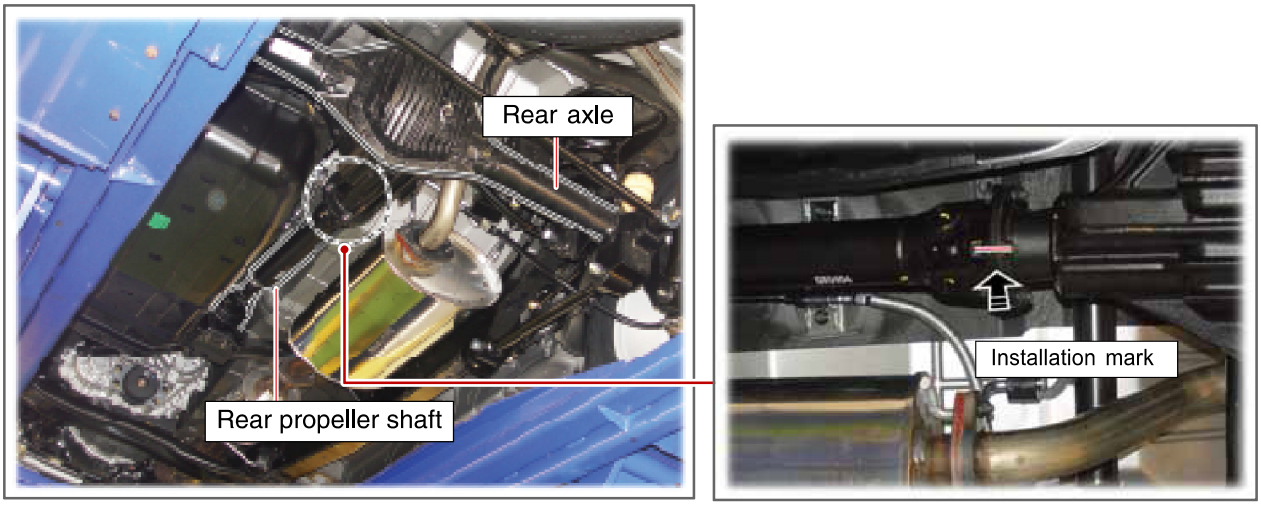
CAUTION

- Put installation marks on the yoke of the rear propeller shaft and the flange of the transfer case.

2. Remove the intermediate bearing(center) bolts.



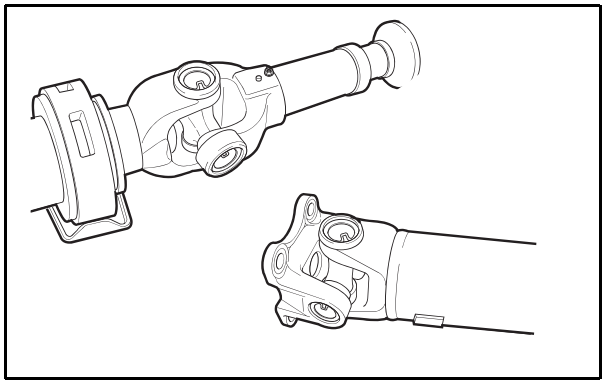
3. Remove the yoke and flage mounting bolts and nuts on the rear axle side of the rear propeller shaft. Then, remove the rear propeller shaft.



Modification basis	
Application basis	
Affected VIN	

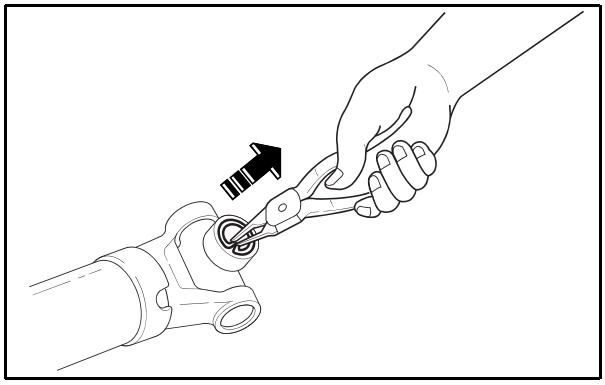
S.G.N. 3310-00

DISASSEMBLY AND REASSEMBLY PROPELLER SHAFT

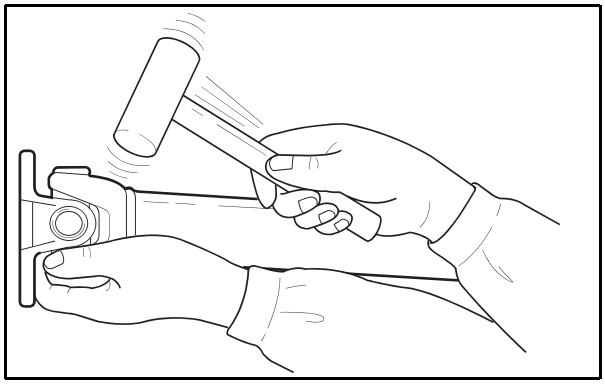


1) Disassembly

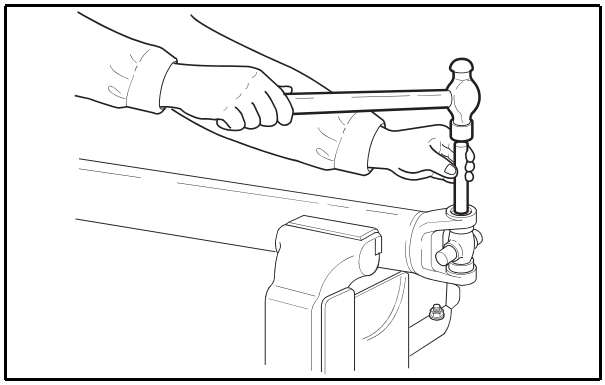
1. Place an alignment mark and remove the propeller shaft.
2. Place an alignment on the spiders before removing.



3. Remove the snap ring with snap ring pliers.

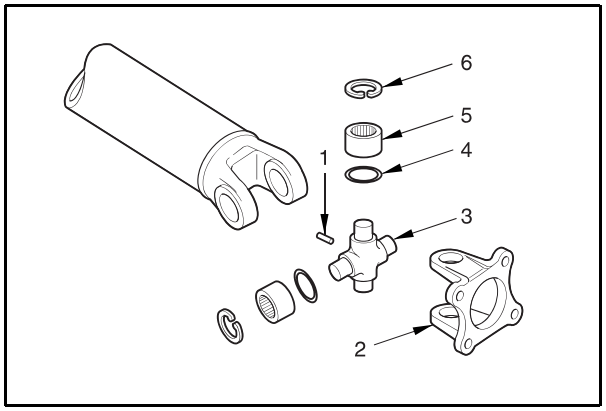


4. Tap the yoke shoulder on shaft with copper hammer to remove the roller bearing. Remove the other bearings with same manner.

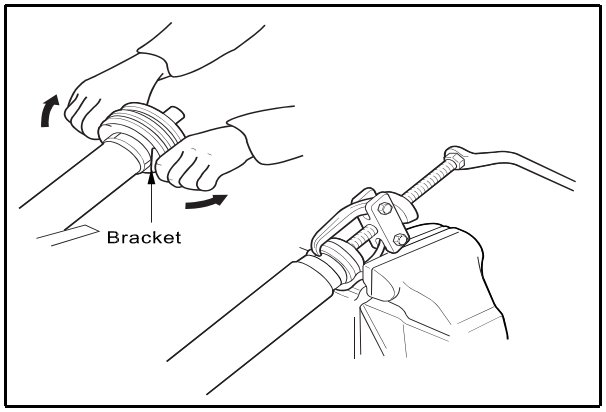


5. If it cannot be removed, hold the welding area with vise and remove the needle bearing by using a suitable drift and hammer.

Modification basis	
Application basis	
Affected VIN	

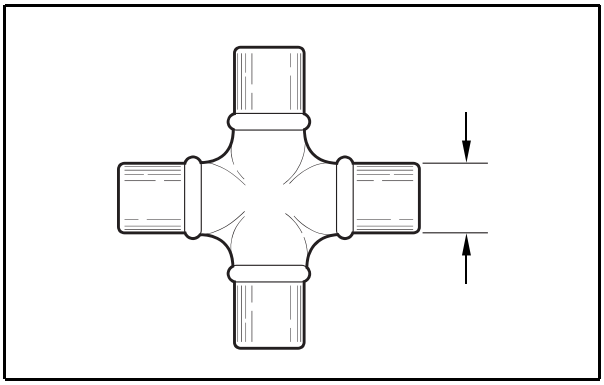


6. Disassemble the universal joint.
   The universal joint compensates the angle changes due to vertical movement of the axle shaft.



7. Remove the intermediate bearing bracket and remove the bearing with special tool.

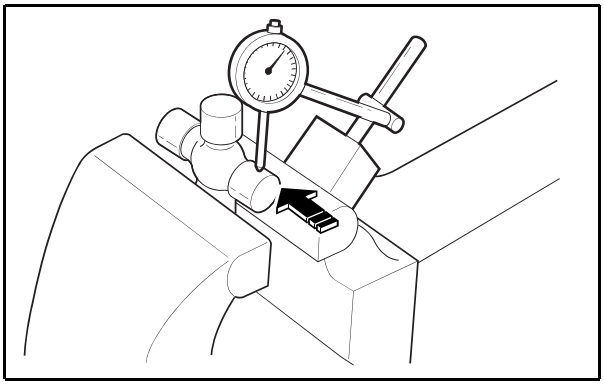
Modification basis	
Application basis	
Affected VIN	



2) Check

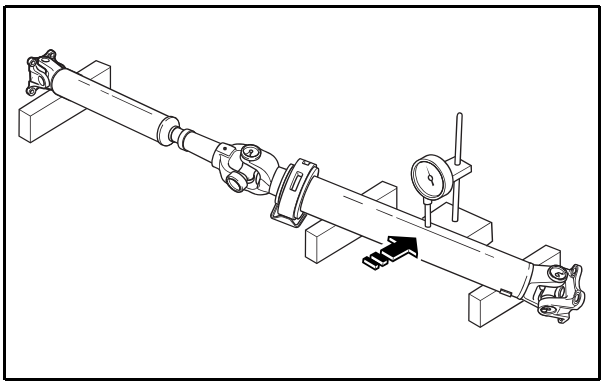
1. Visual Check Check the components for wear and crack and replace if needed.
2. Outer diameter of spider journal.

Specified value	17.893 mm
Limit	17.910 mm



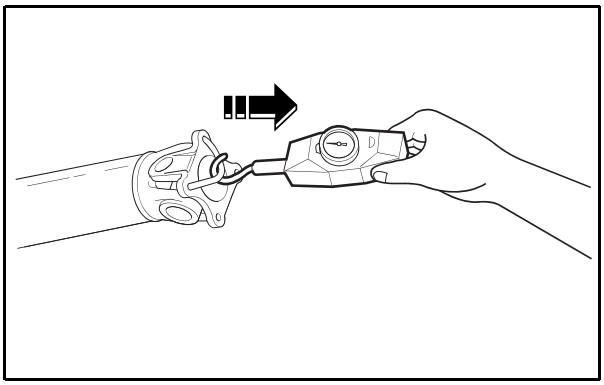
3. Clearance between spider journal and bearing.

Specified value	0.03 ~ 0.098 mm
Limit	0.25 mm



4. Run-out of propeller shaft Set up the dial gauge on the center point of propeller shaft and measure the run-out. If the run-out is out of the specified range, correct it with press or replace it with new one.

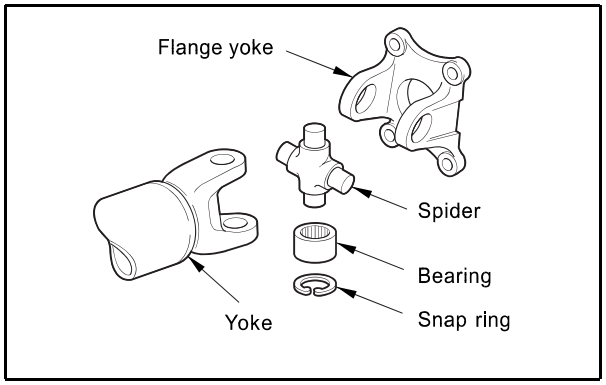
Limit	0.4 mm



5. Starting torque of universal joint.

Specified value	3 ~ 8 kg.cm

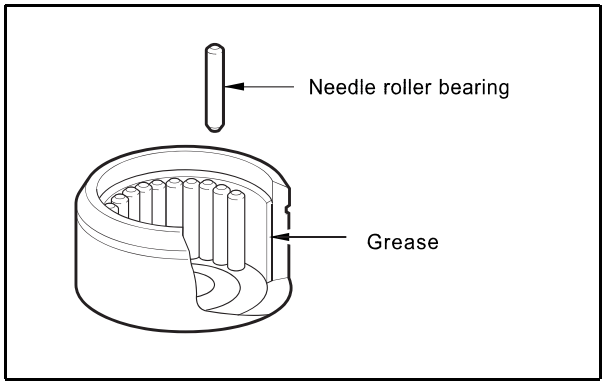
6. Major causes of vibration
   - Balance weights missing
   - Excessive run-out of propeller shaf
   - When using the general bolts
   - Excessive wear of universal joint
   - Stuck in sleeve joint
   - Vibration is mainly caused by the angle changes in front and rear universal joint. It normally occurs when the vehicle speed is 60 ~ 100 km/h.



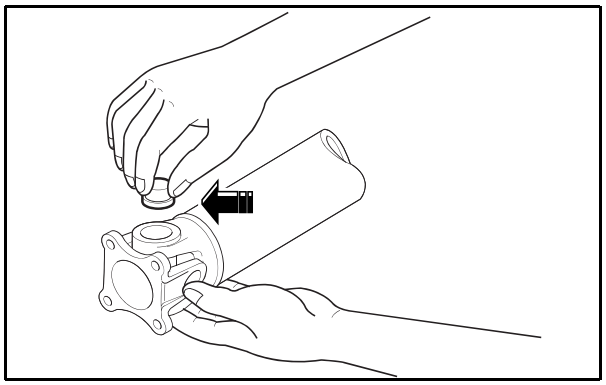
3) Assembly

Clean the components and replace if damaged.

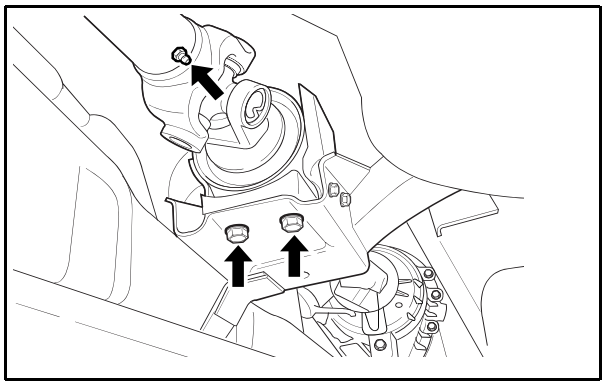
1. Align the alignment marks on the yoke and assemble the spider, bearing and snap ring.



2. Apply the grease to the inner lip of needle roller bearing and assemble the needle roller.



3. Install the yoke bearing shaft on the shaft and insert the spider. Place the cap on the opposite side and tap it with plastic hammer to seat it. Adjust the clearance of spider below 0.1 mm and install the snap ring.



4. Install the intermediate bearing to the rear propeller shaft.
5. Apply the grease on the propeller shaft and install it.

Modification basis	
Application basis	
Affected VIN	

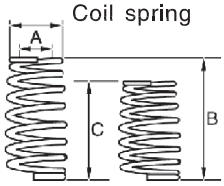
SUSPENSION 4411-01

GENERAL

1. FRONT SUSPENSION SPECIFICATIONS

Description		Specification
Suspension type		Double wishbone
Spring type		Coil spring
Shock absorber type		Cylindrical double tube (gas type)
Stabilizer type		Torsion bar
Wheel alignment	Toe-in	2 ± 2 mm
	Camber	-0.19° ± 0.3° (the difference between both ends is should be below 30')
	Caster	4.4° ± 0.5° (the difference between both ends is should be below 30')
Height “H”		96.5 ± 5 mm

2. REAR SUSPENSION SPECIFICATIONS

Description		Specification
Suspension type		IRS type
Spring type		Coil spring
Stabilizer bar type		Torsion bar
Shock absorber	Type	Cylindrical double tube
	Max. length	463 mm
	Min. length	310 mm
Coil spring 	Coil thickness	14.9 mm
	Inner diameter of coil (A)	ø 70.1 mm
	Free length (B)	344.9 mm
	Length at load (C)	252.1 mm
	Spring rate	8.68 ± 5 %

GENERAL

1. BRAKE SYSTEM GENERAL INFORMATION

Front Disc

Front Ventilated Disc and Caliper (2 internal Cylinders)

1) FRONT BRAKE

For **the front brake system**, the ventilated disc type is applied regardless of the ABS/ESP system installation.
Two 43 mm diameter calipers (non-ABS/ESP equipped vehicles) and two 45 mm diameter calipers (ABS/ESP equipped vehicles) are installed.

Rear Disc

ABS/ESP + 5Link Suspension: solid type disc ABS/ESP + Independent suspension: ventilated disc
Rear Disc and Caliper (1 Internal Cylinder)

2) REAR BRAKE

For the rear brake system, specifications differ between ABS/ESP system equipped vehicles and non-ABS/ESP system equipped vehicles. The drum type brake is installed on non-ABS equipped vehicles.
When ABS/ESP is installed on the 5-link type suspension, the solid disc (disc thickness: approx. 10.4 mm) is installed. When ABS/ESP is installed on the independent suspension, the ventilated disc (disc thickness: approx. 20 mm) is installed.

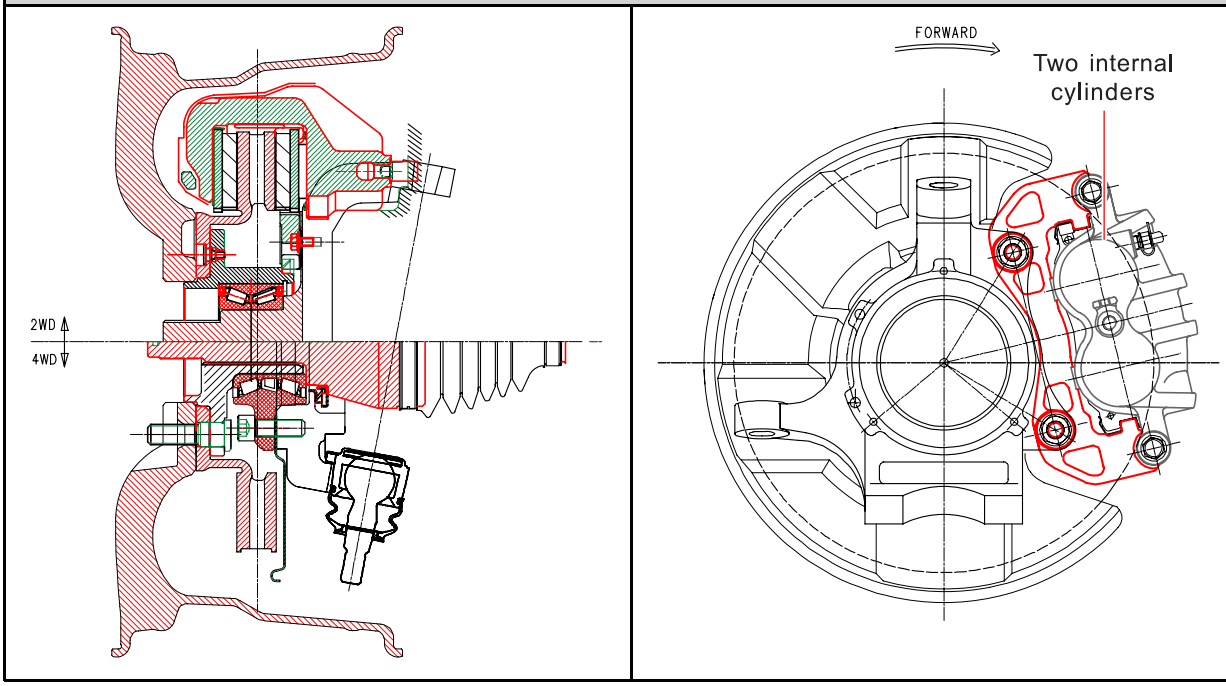
Parking brake system: The hand operated type parking brake is installed on vehicles with the manual transmission and the foot operated type parking brake is installed on vehicles with the automatic transmission.

	
Hand Operated Type (Vehicle with Manual Transmission)	Foot Operated Type (Vehicle with Automatic Transmission)

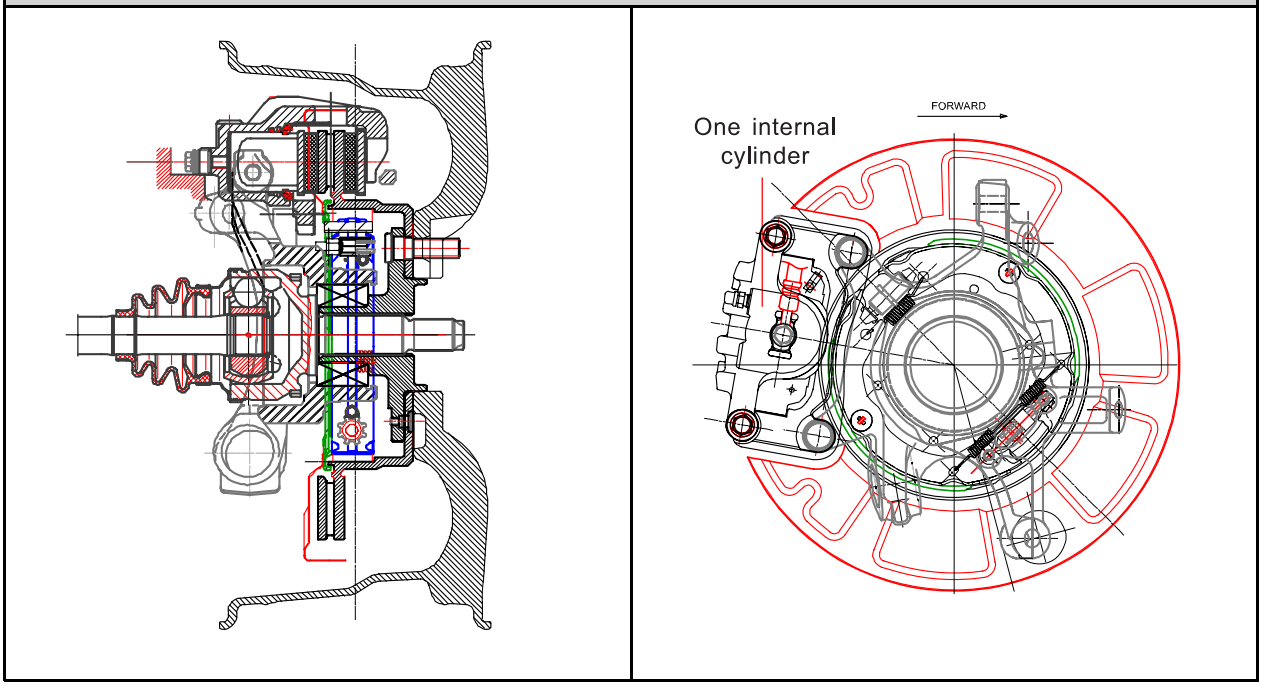
Modification basis	
Application basis	
Affected VIN	

3) SECTIONAL DRAWING

Front Disc Brake

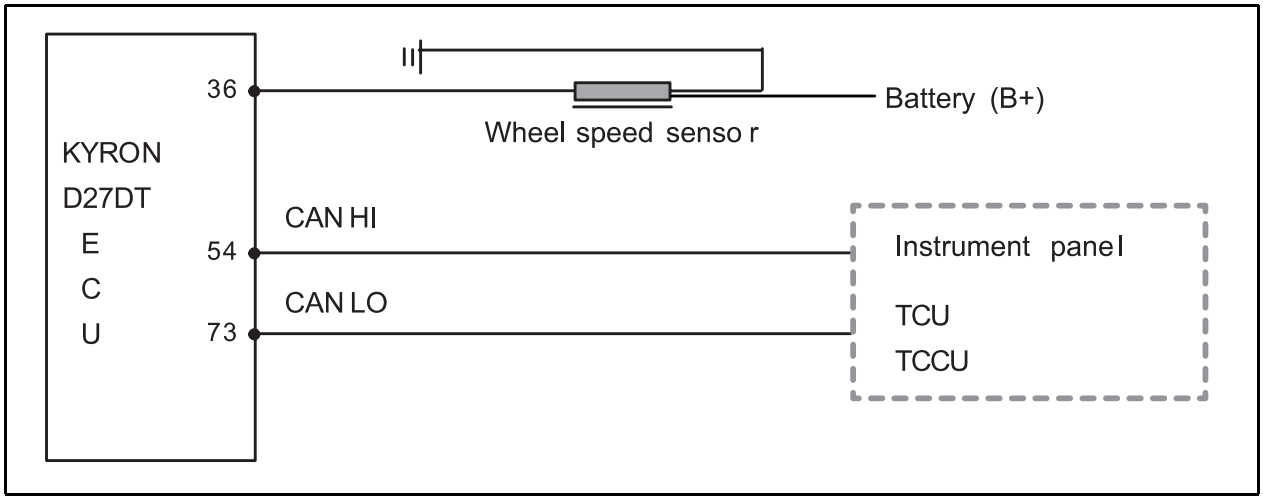


Rear Disc Brake

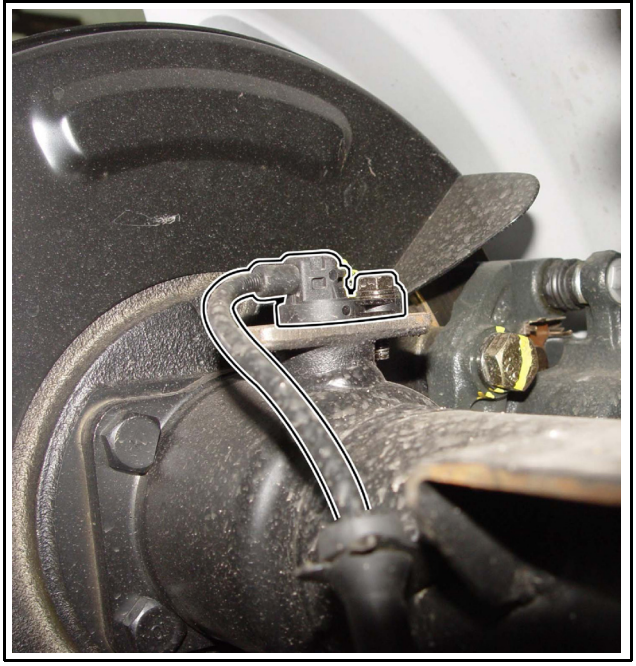


4) NON-ABS EQUIPPED VEHICLE ? WITH ONE WHEEL SPEED SENSOR

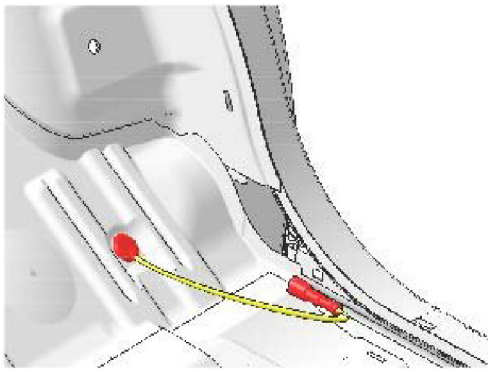
The wheel speed sensor is installed on the rear right wheel regardless of the ABS/ESP installation.
This sensor is to signal the vehicle speed to the engine ECU, TCCU, transmission, and instrument panel.
There is no separate unit to process the wheel speed sensor signal.
The wheel speed sensor is connected to the engine ECU (terminal 36), where its signal is processed, and is connected to other related systems through CAN communication.



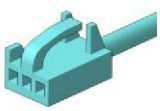
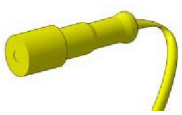
Location of the wheel speed sensor (rear right wheel)



Location of the Sensor Connector



Connector Appearance

In vehicle without ABS	In vehicle with ABS/ESP
	

Modification basis	
Application basis	
Affected VIN	

2. BRAKE SYSTEM SPECIFICATIONS

Description		NON-ABS (5-link suspension)	ABS/ESP	
			5-link suspension	Independent suspension (IRS)
Brake pedal	Pedal ratio	4.0 : 1		
	Max. operating stroke	150 mm		
	Free play	1 ~ 4 mm		
Brake master cylinder	Type	Tandem type (with level sensor)		
	I.D. of cylinder	φ25.4 mm		
Brake booster	Type	Vacuum assisted type		
	Booster pressure ratio	9 : 1		
Front brake	Type	Ventilated disc type		
	I.D. of caliper cylinder	2 x φ43 mm	2 x φ45 mm	
	Pad thickness	10.5 mm	10.5 mm	
	Brake pad wear limit	2 mm	2 mm	
	Disc plate thickness	26 mm	28 mm	
	Disc plate wear limit	24 mm	25.4 mm	
	I.D./O.D. of disc plate	φ294 /φ184 mm	φ294 /φ184 mm	
Rear brake	Type	Drum type	Solid disc type	Ventilated disc type
	I.D. of drum	φ254 mm	-	-
	W x L x T	55 x 243 x 5	-	-
	I.D. of wheel cylinder	φ23.81 mm	-	-
	I.D. of caliper cylinder	-	φ42.9 mm	φ42.9 mm
	Brake pad thickness	-	10 mm	10 mm
	Wear limit of brake pad	-	2 mm	2 mm
	Disc plate thickness	-	10.4 mm	20 mm
	Wear limit of disc plate	-	8.5 mm	18.4 mm
	I.D./O.D. of disc plate	-	φ299/φ220 mm	φ307/φ214 mm
Parking brake	Type	Mechanical type, rear wheels operated		Mechanical type, rear wheels operated
	Operation type	Manual type - Hand (MT)/Foot (AT)		Manual type - Foot
	I.D. of drum	φ254 mm	φ190 mm	φ190 mm
Brake fluid	Capacity	0.7 ~ 0.8 ℓ		
	Specification	DOT4		

3. BRAKE OPERATION AND NOISE

This section describes the noise phenomena possibly occurring in the brake system operation. Distinguish between the information given below and the actual problems and then, inspect the vehicle and take appropriate measures.

▶ Noise Phenomena and Causes

Phenomenon 1. If depressing the brake when the engine is cold, "screeching" sound always occurs and, after driving for a while, it disappears.

This usually occurs in the morning. When the temperature goes down, the dew condensation phenomenon sets moisture on the brake disc as the window frost forms. Due to this moisture, the iron within the brake disc and pad oxidizes, forming undetectable micro-rusts on the disc surface.
When starting the engine under this condition, noise may sound due to the friction of micro-rusts. When operating the brake several times, the disc temperature goes up and the micro-rusts come off and the noise goes away.
Depending on the driving conditions, noise gets louder when slightly depressing the brake pedal and oppositely, noise is smaller when deeply depressing the brake pedal. This is simply a physical phenomenon, called "morning effect" in professional terms, and does not imply any problems with the brake system.

Phenomenon 2. Slip or screech after the brake pad replacement.

This usually occurs when the bed-in is not made between the disk and the pad's friction material. The bed-in is a state that the brake system normally works and gives no noise out, when, after about 300 km city driving, the contact area of the pad friction material is enlarged and the disk is in complete contact with the pad's friction material. Therefore, for some time after the brake disk/pad replacement, the brake system poorly operates or noise (abnormal sound) occurs due to the partial contact.

Phenomenon 3. "Groaning" sound occurs in the automatic transmission vehicle when slightly taking the foot off the brake pedal to slowly start after waiting for the signal, or slightly depressing the brake pedal

This is the noise "Creep groan" that occurs when, in both the automatic and manual transmission, slightly releasing the brake pedal in the neutral gear at downhill roads. It frequently occurs at the low braking power and low speed, through the following process. When operating the brake system at low speed and low pressure, adhesion and slip repeatedly take place between the brake disk and the friction material, and this makes the braking power inconstant, instantly increasing or decreasing, and gives out the brake noise. It is also a physical phenomenon and has no relation with the brake performance.

Modification basis	
Application basis	
Affected VIN	

4. ESP SYSTEM RELATED PRECAUTIONS

1. The HDC system is intended for use only on off-roads with a slope level exceeding 10%. Thus, do not use it on public road.
2. Too frequent use of HDC system may weaken the durability of the ESP HECU and related systems.
3. Driver must turn the HDC switch to OFF position when driving on public and level roads. As mentioned previously, when a driver make sharp turns or drive on rough roads, the HDC may suddenly operate for these sudden shocks influence the G sensor values. When such occurs, the driver may panic because the vehicle speed drops sharply and the driver will experience difficulty in controlling the vehicle.
4. During the HDC operation, a loud noise and the vehicle vibration may occur from the HECU and the brake system, but this is a normal condition during the HDC operation.
5. The warning lamp flashes and warning beep sounds when the ESP is operating
   When the ESP operates during vehicle movement, the ESP warning lamp on the instrument panel flashes and beep comes on every 0.1 seconds.

1) CAUTIONS WHEN USING HDC SYSTEM

Customers must first acquaint themselves with the HDC operation related information, e.g. operation conditions and non-operation conditions, because they may feel unfamiliar with its function and operation process. The noise during the HDC operation is very different from that during the ABS/ESP operation. This noise may be irritating and accompany some vibration, because, on steep hills, it attempts to control the physical properties of the vehicle weight with the braking power.

Below is the summary of precautions to remember in HDC operation.

CAUTION

- The HDC system is intended for use only on off-roads with a slope level exceeding 10%. Thus, do not use it on public road.
- Too frequent use of HDC system may weaken the durability of the ESP HECU and related systems.
- Driver must turn the HDC switch to OFF position when driving on public and level roads. As mentioned previously, when a driver make sharp turns or drive on rough roads, the HDC may suddenly operate for these sudden shocks influence the G sensor values. When such occurs, the driver may panic because the vehicle speed drops sharply and the driver will experience difficulty in controlling the vehicle.
- During the HDC operation, a loud noise and the vehicle vibration may occur from the HECU and the brake system, but this is a normal condition during the HDC operation.

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. ESP SYSTEM OF GENERAL INFORMATION

The ESP system consists of basic ABS functions, the vehicle position control depending on the driving conditions and the road conditions, the HBA (Hydraulic Brake Assist System) that improves the braking power in an emergency, the ARP (Active Rollover Protection) that obstructs the physical tendency to rollover during sharp turns and prevents the vehicle rollover by quickly and firmly controlling the engine output and the brake.

The HDC (Hill Descent Control) is newly introduced function that helps drivers maintain their speed automatically by switch operation when driving slowly on steep hills (over 10%: about 5.71° (degree)).

ESP HECU	HDC Switch / Indicator
	

Functions applied on ESP system are as follows.

1. ABS (Anti-Lock Brake System)
2. EBD (Electronic Brake-Force Distribution)
3. ABD (Automatic Braking Differential)
4. ASR (Acceleration Slip Regulation)
5. AYC (Active Yaw Control, Understeer Oversteer control)
6. HBA (Hydraulic Brake Assist System)
7. ARP (Active Rollover Protection)
8. HDC (Hill Descent Control)

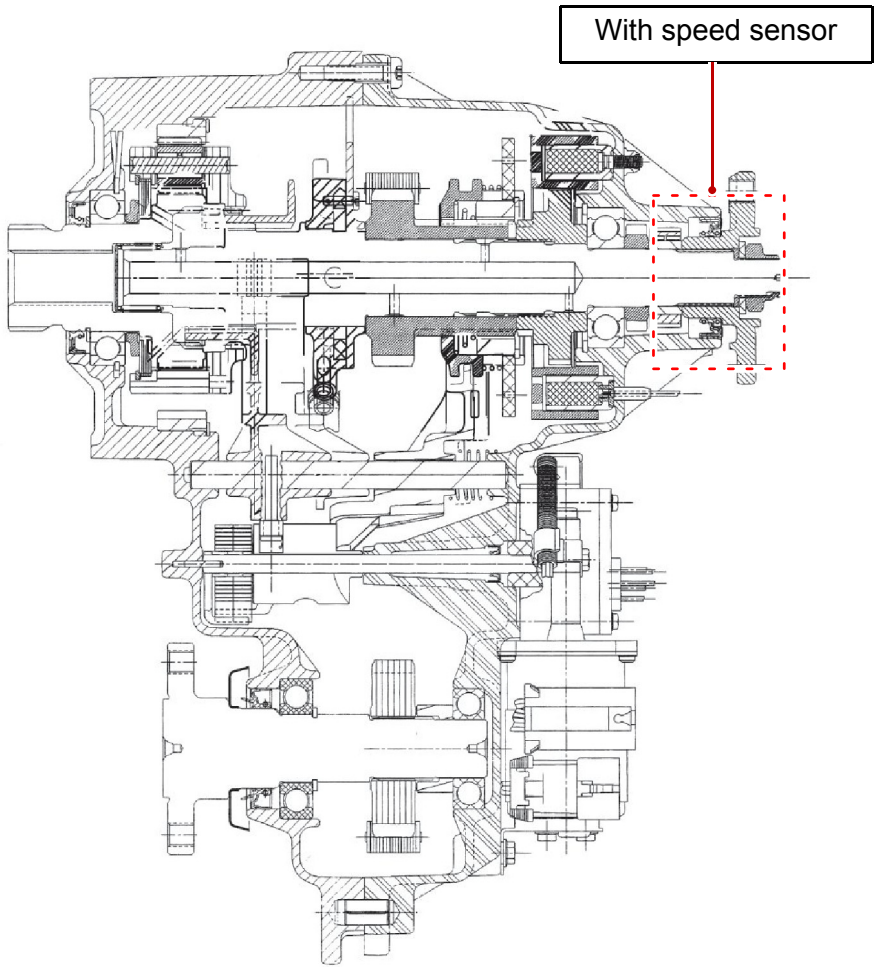
1) GENERAL INFORMATION OF ESP SYSTEM

Differences compared to other models: Appearance of wheel speed sensor, Location, Layout of relevant components

ESP HECU	Active Wheel Speed Sensor	HDC Switch
		

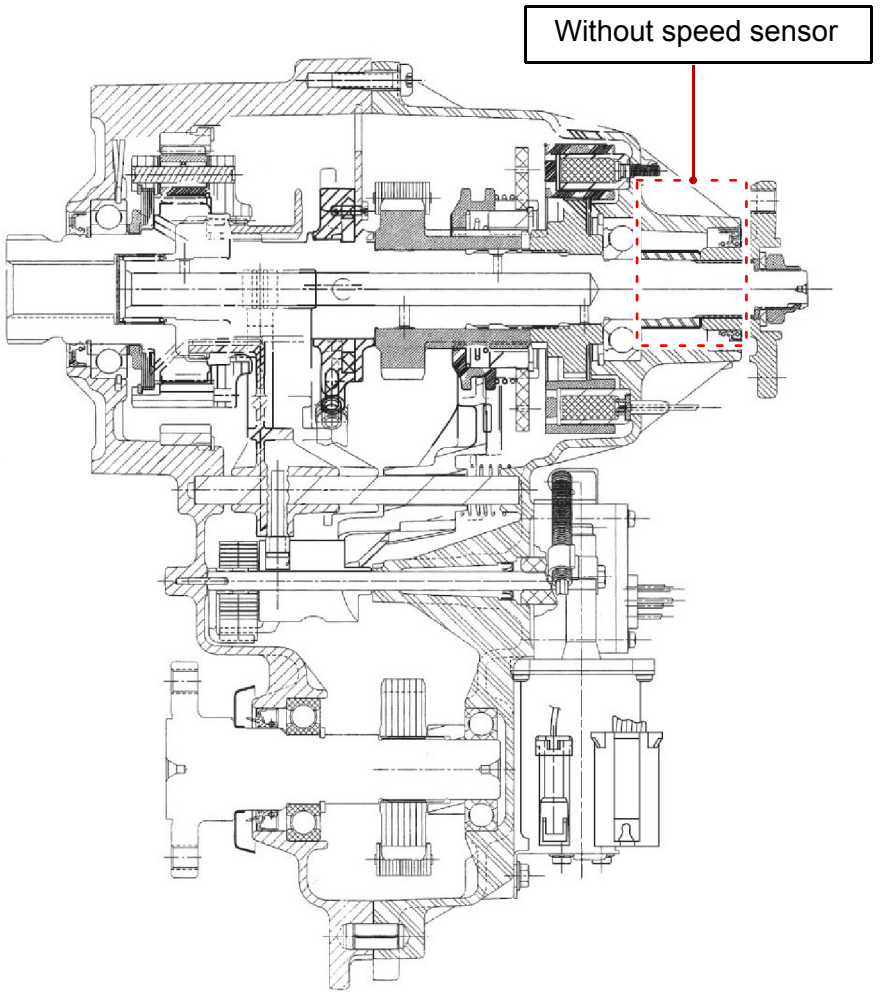
The transfer case (T/C) installed on this vehicle doesn't have the internal speed sensing device and receives the speed signal for T/C control from ESP HECU via CAN bus.

[Conventional T/C]



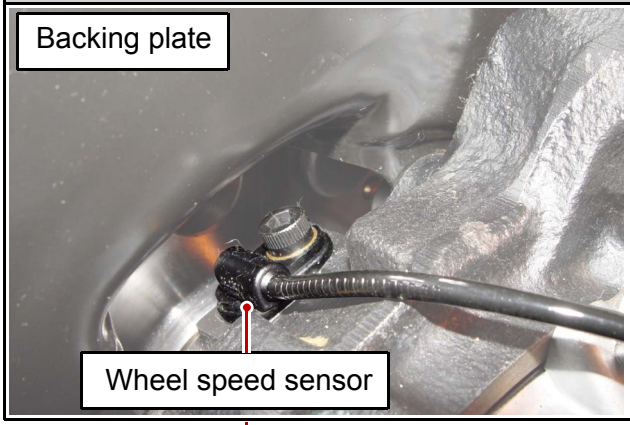
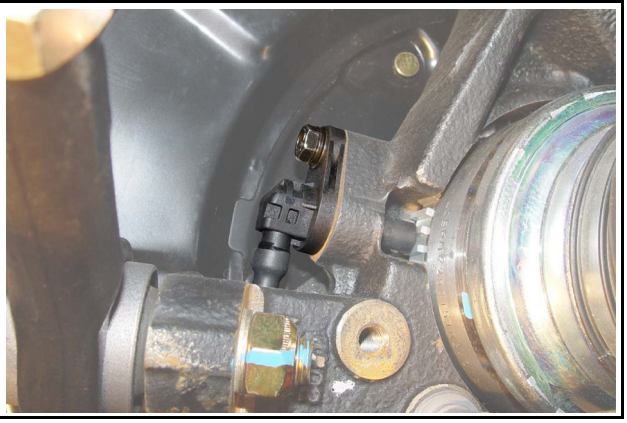
Modification basis	
Application basis	
Affected VIN	

[New T/C]

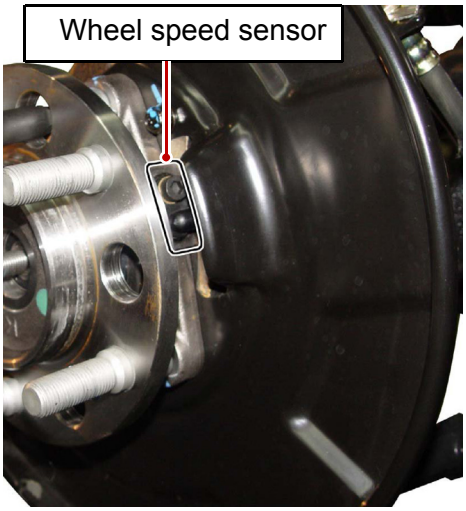


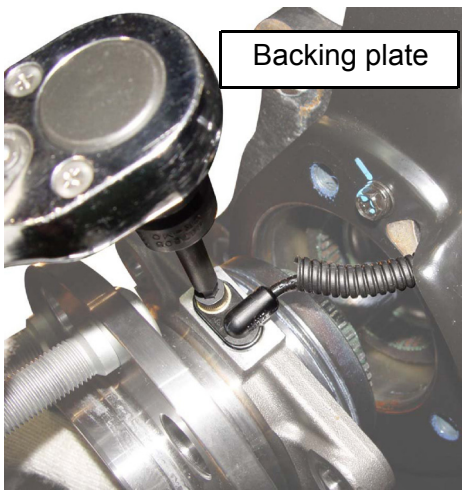
Modification basis	
Application basis	
Affected VIN	

Cautions When Removing the Front Wheel Speed Sensor
The locking hub system of the KYRON part time 4WD utilizes a different hub actuator from the conventional approach. It utilizes IWE (Integrated Wheel End) system that locks the 4WD depending on the vacuum condition within the actuator. Thus, the wheel speed sensor is installed on the front wheel end area. It is installed inside the backing plate to be protected from heat and foreign materials. Therefore, the **front wheel end system (including disc) should be removed before removing the front wheel speed sensor.**

Front Wheel Speed Sensor (4WD)	Rear Wheel Speed Sensor (IRS Type)
	

Wheel Speed Sensor

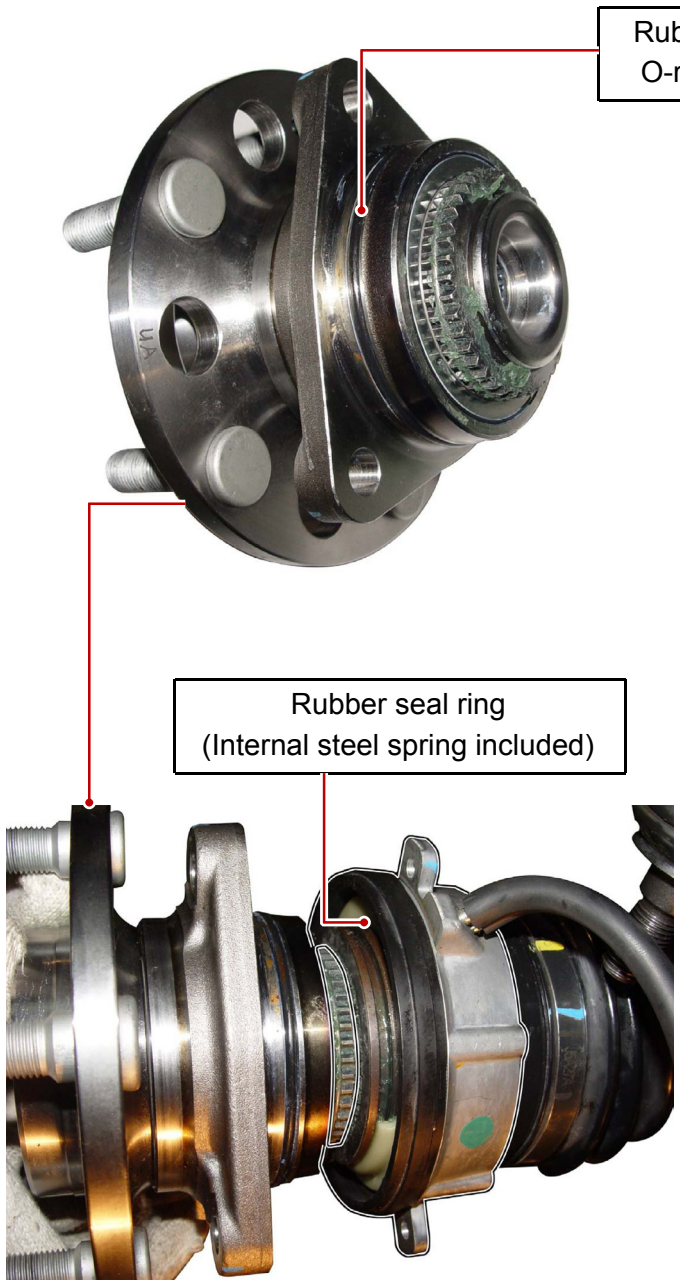




Modification basis	
Application basis	
Affected VIN	

The rubber O-ring in IWE (Integrated Wheel End) should be replaced with new one when the front wheel end has been removed.
The rubber O-ring prevents moisture and foreign materials from entering the IWE system.

In addition, when installing the hub actuator of the IWE system, you must install it from the same angle as the drive shaft to prevent the rubber seal ring inside the actuator from being squeezed.



Please refer to the part time transfer case section for more specific information.

Modification basis	
Application basis	
Affected VIN	

When the ESP system is added to the ABS system, some devices will be added to the HECU (Hydraulic & Electronic Control Unit) and wheel speed sensor used in the ABS system.
The devices are as follows:

1. 2 pressure sensors installed on the master cylinder
2. Sensor cluster (integrated yaw rate sensor and lateral sensor) and longitudinal sensor installed in IP.
3. SWAS (Steering Wheel Angle Sensor) installed in the steering column.

▶ Comparison with ABS System

Name	Specifications		Locatio n
	ABS	ESP	
HECU (Hydraulic & Electronic Control Unit)	CPU: PEC 1 (32 bit) Clock Frequency: 28 MHz Memory: 512 KB EEP ROM: 1 KB	CPU: PEC 1 (32 bit) Clock Frequency: 33 MHz Memory: 512 KB EEP ROM: 1 KB New software version: KM 20	beside of brake booster
Wheel Speed Sensor	Active Type	Active Type	Mounted in each wheel (×4EA) Front airgap: 0.335 ~ 0.945 mm Rear airgap: 0.309 ~ 0.958 mm
Steering Wheel Angle Sensor	N/A	Maximum angular velocity: 1500°/sec Working voltage: 9 ~ 16 V	In steering wheel
Sensor Cluster	N/A	Integrated yaw rate sensor and lateral sensor. Also, used for sensing G value for HDC (Hill Descent Control).	Behind the center audio in instrument panel
Pressure Sensor	N/A	Analog Output	Under master cylinder

Modification basis	
Application basis	
Affected VIN	

Memo

2. PRINCIPLE OF ESP

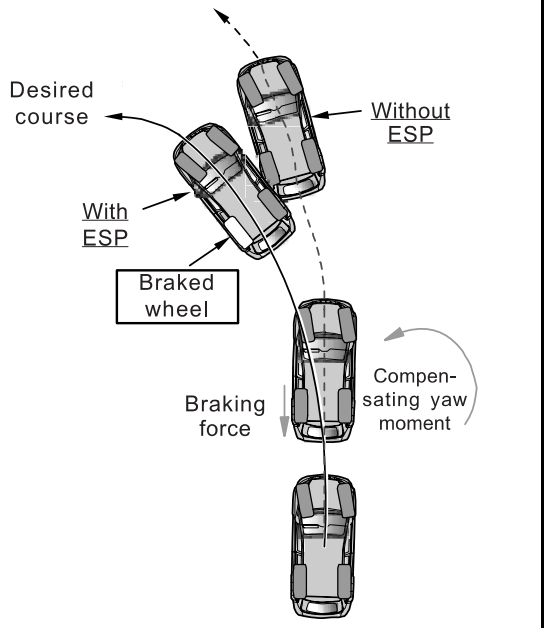
1) Understeer & Oversteer Control

ESP (Electronic Stability Program) recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake.
This system is developed to help the driver avoid the danger of losing the control of the vehicle stability due to under-steering or over-steering during cornering.

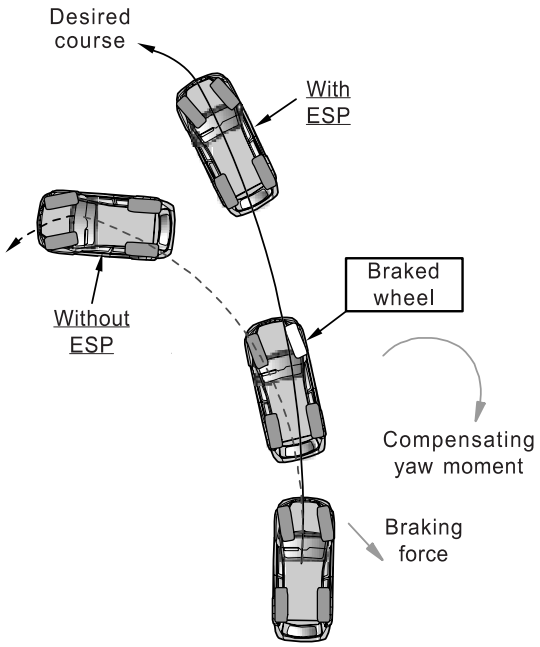
The yaw rate sensor, lateral sensor and longitudinal sensor in the sensor cluster and the steering wheel angle sensor under the steering column detect the spin present at any wheels during over-steering, under-steering or cornering. The ESP ECU controls against over-steering or under-steering during cornering by controlling the vehicle stability using the input values from the sensors and applying the brakes independently to the corresponding wheels.

The system also controls during cornering by detecting the moment right before the spin and automatically limiting the engine output (coupled with the ASR system).

Under Steering



Over Steering



Modification basis	
Application basis	
Affected VIN	

▶ Understeering

Understeering is when the steering wheel is steered to a certain angle during driving and the front tires slip toward the reverse direction of the desired direction.
Generally, vehicles are designed to have under steering.
The vehicle can return back to inside of cornering line when the steering wheel is steered toward the inside even when the vehicle front is slipped outward. As the centrifugal force increases, the tires can easily lose the traction and the vehicle tends to slip outward when the curve angle gets bigger and the speed increases.

▶ Oversteering

Oversteering is when the steering wheel is steered to a certain angle during driving and the rear tires slip outward losing traction.
When compared with under steering vehicles, the controlling of the vehicle is difficult during cornering and the vehicle can spin due to rear wheel moment when the rear tires lose traction and the vehicle speed increases.

▶ ESP controls during under steering

The ESP system recognizes the directional angle with the steering wheel angle sensor and senses the slipping route that occurs reversely against the vehicle cornering direction during understeering with the yaw rate sensor and the lateral sensor.
Then the ESP system **applies the brake at the rear inner wheel** to compensate the yaw moment value. In this way, the vehicle does not lose its driving direction and the driver can steer the vehicle as driver intends.

▶ ESP controls during oversteering

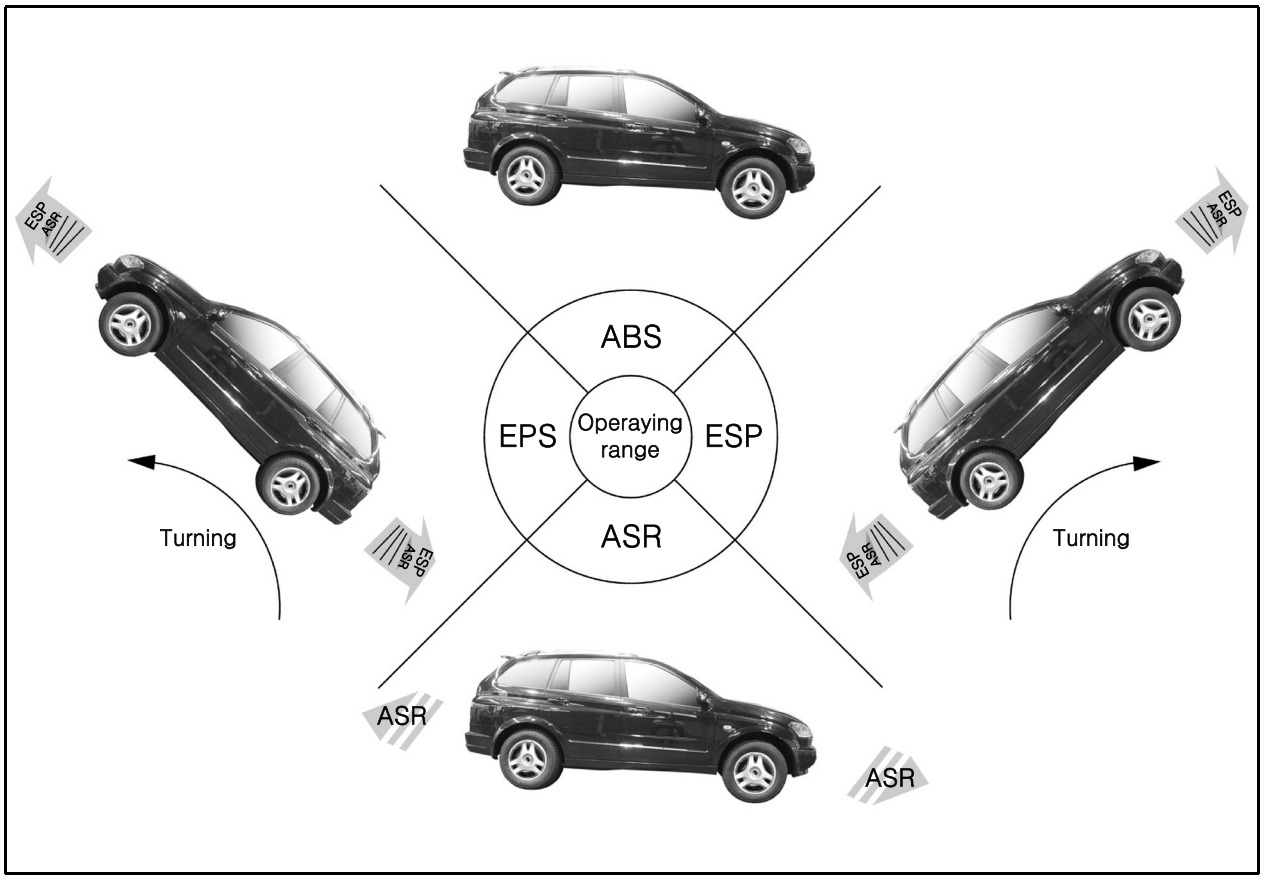
The ESP system recognizes the directional angle with the steering wheel angle sensor and senses the slipping route that occurs towards the vehicle cornering direction during oversteering with the yaw rate sensor and the lateral sensor.
Then the ESP system **applies the brake at the front outer wheel** to compensate the yaw moment value. In this way, the vehicle does not lose its driving direction and the driver can steer the vehicle as he or she intends.

2) ESP Control

As the single-track vehicle model used for the calculations is only valid for a vehicle moving forward, ESP intervention never takes place during backup.

The ESP system includes the ABS/EBD and ASR systems allowing the system to be able to operate depending to the vehicle driving conditions. For example, when the brakes are applied during cornering at the speed of 100 km/h, the ABS system will operate at the same time the ASR or ABD systems operate to reduce the power from the slipping wheel. And when yaw rate sensor detects the rate exceeding 4 degree/seconds, the ESP system is activated to apply the brake force to the corresponding wheel to compensate the yaw moment with the vehicle stability control function.

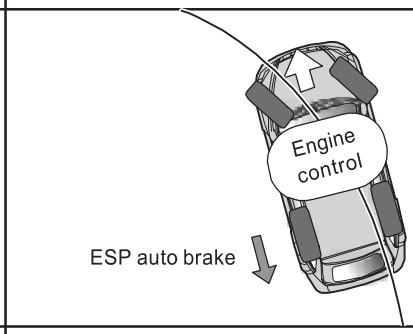
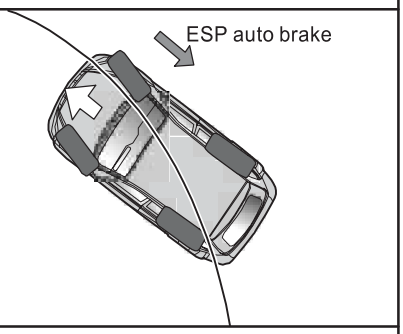
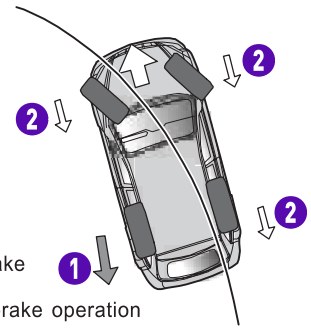
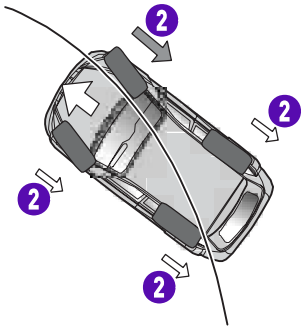
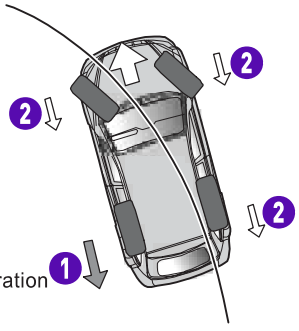
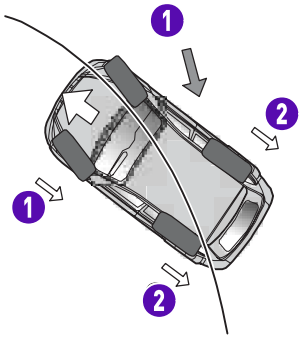
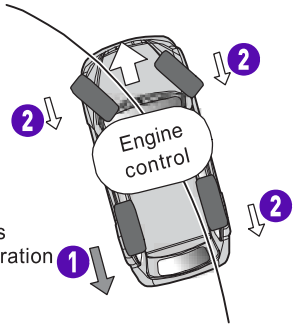
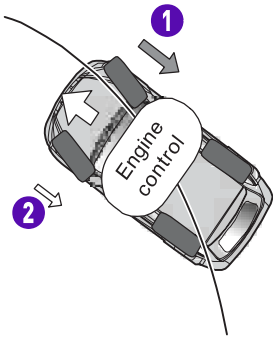
When various systems operate simultaneously under a certain situation, there may be vehicle control problems due to internal malfunction of a system or simultaneous operations. In order to compensate to this problem, the ESP system sets the priority among systems.
The system operates in the order of TCS (ASR or ABD), ESP and ABS.
The order may be changed depending on the vehicle driving situations and driving conditions.



Modification basis	
Application basis	
Affected VIN	

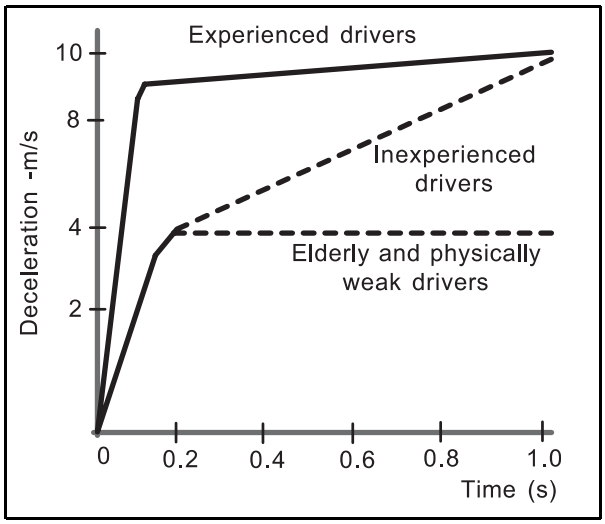
3) Vehicle Control During Cornering

The figure below shows the vehicle controls by ESP system under various situations such as when the brake pedal is pressed (or not pressed) during cornering and when the ABS is operating or when just the conventional brake is operating during braking.
It also includes the vehicle conditions when the TCS that is included in the ESP system is operating.

Operations	Understeering Control	Oversteering Control
Only ESP operating No braking by driver		
ESP + Conventional brake (ABS not operating)		
ESP + ABS brake		
ESP + TCS (Engine Control)		

3. HBA (HYDRAULIC BRAKE ASSIST SYSTEM)

HBA (Hydraulic Brake Assist) system helps in an emergency braking situation when the driver applies the brake fast, but not with sufficient pressure, which leads to dangerously long braking distance. ECU recognizes the attempt at full braking and transmits the signal calling for full brake pressure from the hydraulic booster.



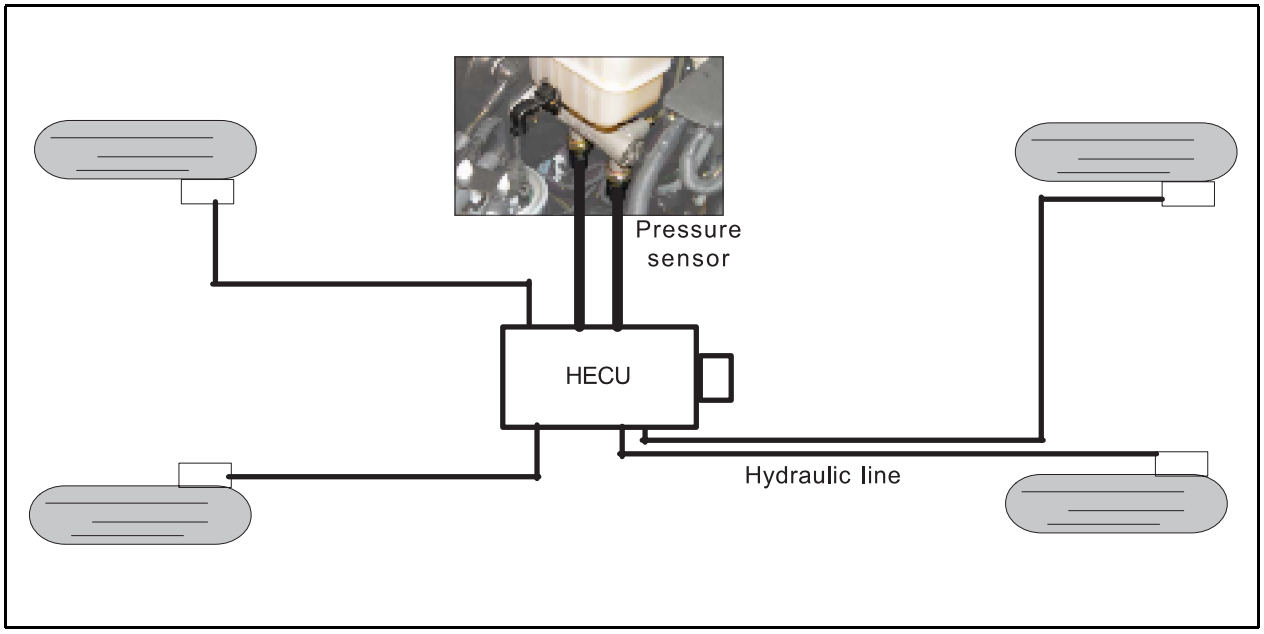
An inexperienced, elderly or physically weak driver may suffer from the accident by not fully pressing the brake pedal when hard braking is required under emergency. The HBA System increases the braking force under urgent situations to enhance the inputted braking force from the driver.

Based on the fact that some drivers depress the brake pedal too soft even under when hard braking is necessary, the HECU system is a safety supplementary system that builds high braking force during initial braking according to **pressure value of the brake pressure sensor** and **the pressure changes of the pressure sensor intervals.**

When the system is designed to apply high braking force when brake pedal is depressed softly by an elderly or physically weak driver, the vehicle will make abrupt stopping under normal braking situation due to high braking pressure at each wheels.

Modification basis	
Application basis	
Affected VIN	

The brake pressure value and the changed value of the pressure sensor are the conditions in which the HBA System operates.
There are 2 pressure sensors under the master cylinder. When the ESP ECU system determines that emergency braking is present, the pump operates, the brake fluid in the master cylinder is sent to the pump and the braking pressure is delivered to the wheels via the inlet valves.
If the drive depresses the brake pedal slowly, the pressure change is not high. In this case, only the conventional brake system with booster is activated.



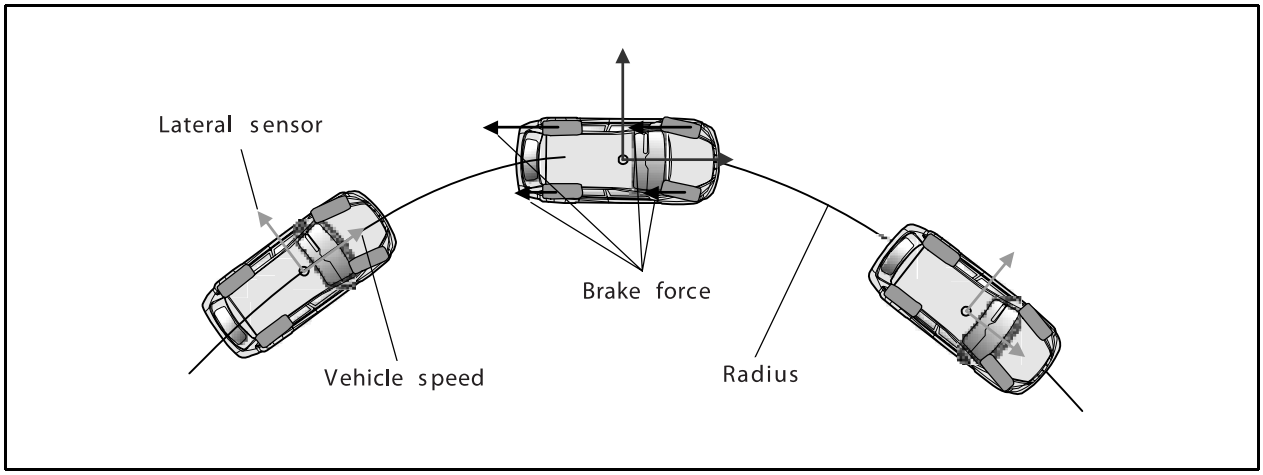
Operating conditions:
1. Pressure: over 20 bar
2. Pressure changes: over 1500 bar/sec
3. Vehicle speed: over 7 Km/h

4. ARP (ACTIVE ROLL-OVER PROTECTION)

The ARP (Active Roll-over Protection) system is a safety assistant device that minimizes, by controlling brakes and the engine, the physical tendency of the vehicle rollover during sharp lane changes or U-turns. For the system, software is added to the existing ESP system and no additional device or switch is needed.

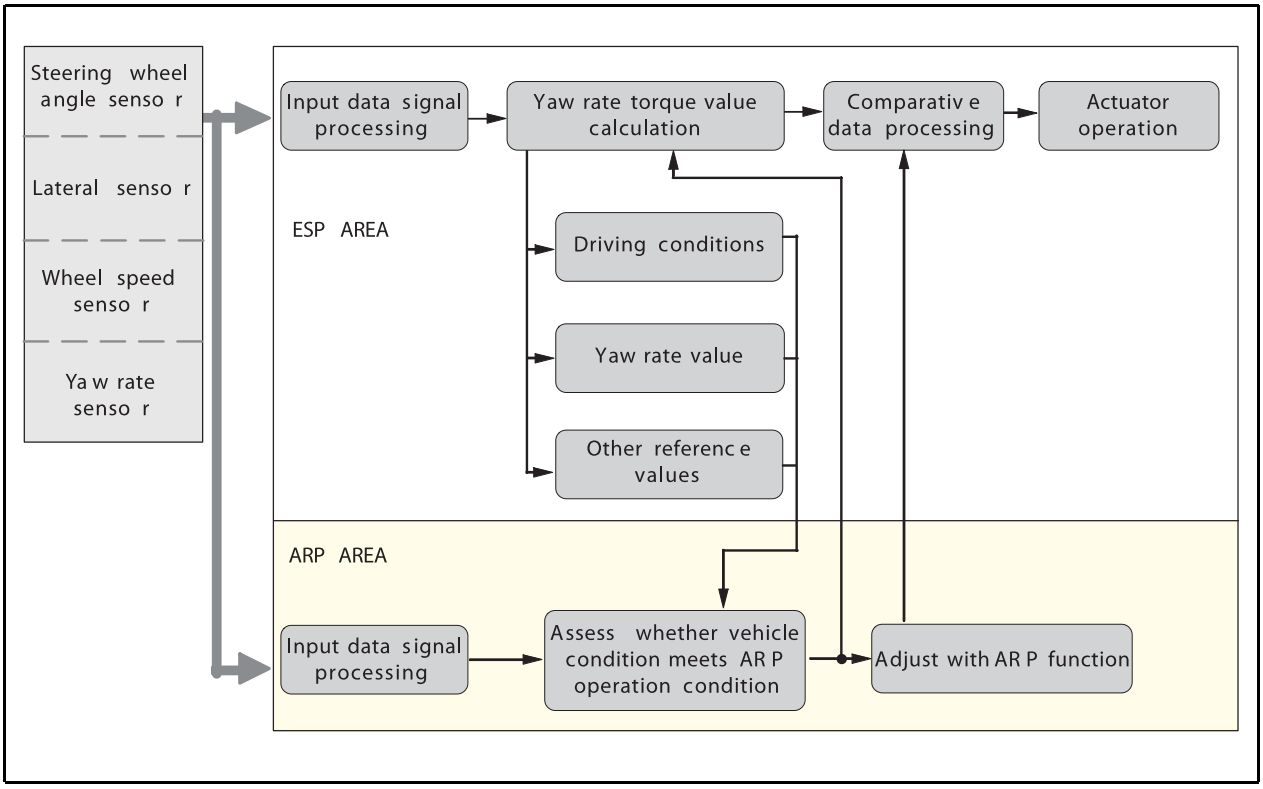
One must note that the ARP system, just as general assistant devices including the ABS, is only a safety assistant device using the ESP system and its function is useless when the situation overcomes the physical power.

Following picture shows how the ARP compensates the vehicle position by varying each wheel's braking power to overcome the physical tendency of the vehicle rollover during sharp turns.



Modification basis	
Application basis	
Affected VIN	

The vehicle driving condition is controlled by the internally programmed logic according to the input signals from wheel speed sensor, steering angle sensor and lateral sensor.



CAUTION

· During the ARP operation, vehicle safety (rollover prevention) takes the first priority and thus, stronger engine control is in effect. Consequently, the vehicle speed decreases rapidly, so the driver must take caution for the vehicle may drift away from the lane.

5. HDC (HILL DESCENT CONTROL)

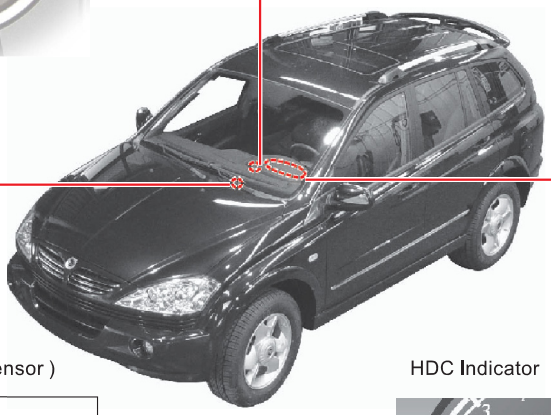
1) System Overview

The HDC system is an automatic descent control device that allows the vehicle to automatically decelerate to about 7 km/h by 0.1G, on steep roads (slope level exceeding 10%) through a separately installed switch operation.
When the vehicle speed reaches below 7 km/h (refer to the information below), the HDC automatically terminates the operation.

HDC Switch



When you see a steep downhill ahead, press the HDC switch and the green HDC indicator comes on. When the G sensor within the sensor cluster detects a slope level exceeding 10%, the ESP's HDC function operates. When this occurs, the green HDC indicator flashes along with a loud operation sound.

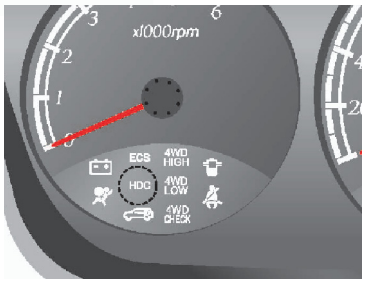


Sensor Cluster (G Sensor)



The G Sensor within the sensor cluster detects the steepness of driving roads. When the HDC switch is in operation, if the G sensor detects a downhill steepness exceeding 10%, it transmits the HDC operation signal to the ESP HECU.

HDC Indicator (Instrument Panel)



When you press the HDC switch, the green HDC indicator comes on, and when the HDC operates, the green HDC indictor flashes at 0.5 second of interval.

HDC
Red letters

HDC
Green letters

CAUTION

· The G sensor in sensor cluster measures the actual road steepness. However, it may recognize a sharp turn or rough road as a downhill road with a slope level exceeding 10%, and the HDC may operate.

Modification basis	
Application basis	
Affected VIN	

Memo

2) HDC (Hill Descent Control) System Operating Conditions

1. When HDC switch is turned ON and

2. Gearshift lever position (Forward/Reverse) and

Manual transmission: operates in the 1st gear or reverse gear position (does not operate in neutral position).
Automatic transmission: operates in any position except for P (parking) or N (neutral) positions.

CAUTION

- The **vehicles with manual transmission** do not have a separate device or switch that detects the 1st gear. It only detects the forward/reverse driving direction of the vehicle through backup lamp switch and neutral switch, and cannot solely detect the 1st gear position. The reason for noting the 1st gear above, though the HDC also operates in 2nd gear position, is because the engine may turn off during the HDC operation process. You may face a very dangerous situation if the engine turns off at a steep hill.
- The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. For manual transmission equipped vehicle, HDC system should operated only in 1st gear.

3. When not depressing the accelerator pedal or brake pedal. and

4. The vehicle speed is above 7 km/h (in Automatic transmission/4H mode). and

CAUTION

- The vehicle speed given in step (3) varies according to the vehicle driving mode, and the speed ranges by the vehicle driving mode and condition are as follows.

Modification basis	
Application basis	
Affected VIN	

1) Speed available in HDC mode (slope)

Forward driving	2H/4H mode: vehicle speed below 50 km/h (operation slope level: 10%, termination slope level: when it reaches 8%) 4L mode: vehicle speed below 25 km/h (operation slope level: 10%, termination slope level: when it reaches 5%)
Reverse driving	2H/4H mode: vehicle speed below 50 km/h (operation slope level: 8%, termination slope level: when it reaches 5%) 4L mode: vehicle speed below 25 km/h (operation slope level: 8%, termination slope level: when it reaches 4%)

2) HDC target speed in 2H/4H mode

(The HDC target speed is the speed that the HDC is not terminated even after the vehicle speed reaches 7 km/h, but is converted to the stand-by mode. When the vehicle speed increases again as a result of the increase of the road steepness, etc., the HDC goes into operation.)

Forward driving: 7 km/h
Reverse driving: 7 km/h (automatic transmission), 8.5 km/h (manual transmission)

3) HDC target speed in 4L mode

Forward and reverse driving: 3 km/h

5. Vehicle position control function in ESP and HBA function are not in operation:

and

The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. If the ESP function is in operation, HDC operation is overridden.

6. Slope level exceeds 10%.

When the slope level exceeds 10%, the HDC operates until the vehicle reaches the speed value given in step (4).

▶ When the slope level is between 10% and 20% during the HDC operation

When depressing the accelerator pedal or brake pedal, HDC system is changed to stand-by mode. When depressing the accelerator pedal again, HDC starts its operation again. Therefore, drivers can control the vehicle speed to a desired level by operating the accelerator pedal.

▶ When the slope level exceeds 20% during the HDC operation

When depressing the accelerator pedal, HDC system is changed to stand-by mode.
When depressing the brake pedal, HDC continues its operation and the braking power is increased.
In this case, HECU sounds an abnormal noise and brake pedal may be very rigid, but this is a normal condition due to HDC operation.

3) HDC (Hill Descent Control) System Non-Operation Conditions

1. When HDC switch is turned OFF or

2. Gearshift lever has passed neutral (N) position. or

CAUTION
· Vehicle with manual transmission: Sensing at the neutral switch
· Vehicle with automatic transmission: Sensing at the selector lever unit

3. When the vehicle speed is out of the specified values. or

4. When the ESP related functions, e.g. vehicle position control, HBA, ARP is activated during HDC operation. or

The HDC is the device to improve the engine brake effect during downhill driving on a steep hill. If the ESP function is in operation, HDC operation is overridden.

5. When the internal temperature of HDC system goes over 450°C **due to long downhill driving on a steep hill with HDC operated.** or

There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating numbers and conditions of HDC.

CAUTION
· The red HDC warning lamp blinks when the internal temperature goes over 350°C. When it reaches 450°C, the HDC warning lamp comes on. The HDC can be operated in the range even where the HDC warning lamp blinks.

6. When the slope level is below 10%

When the slope level exceeds 10%, the HDC operates until the vehicle reaches the speed condition given in step (4).

▶ When the slope level is between 10% and 20% during the HDC operation

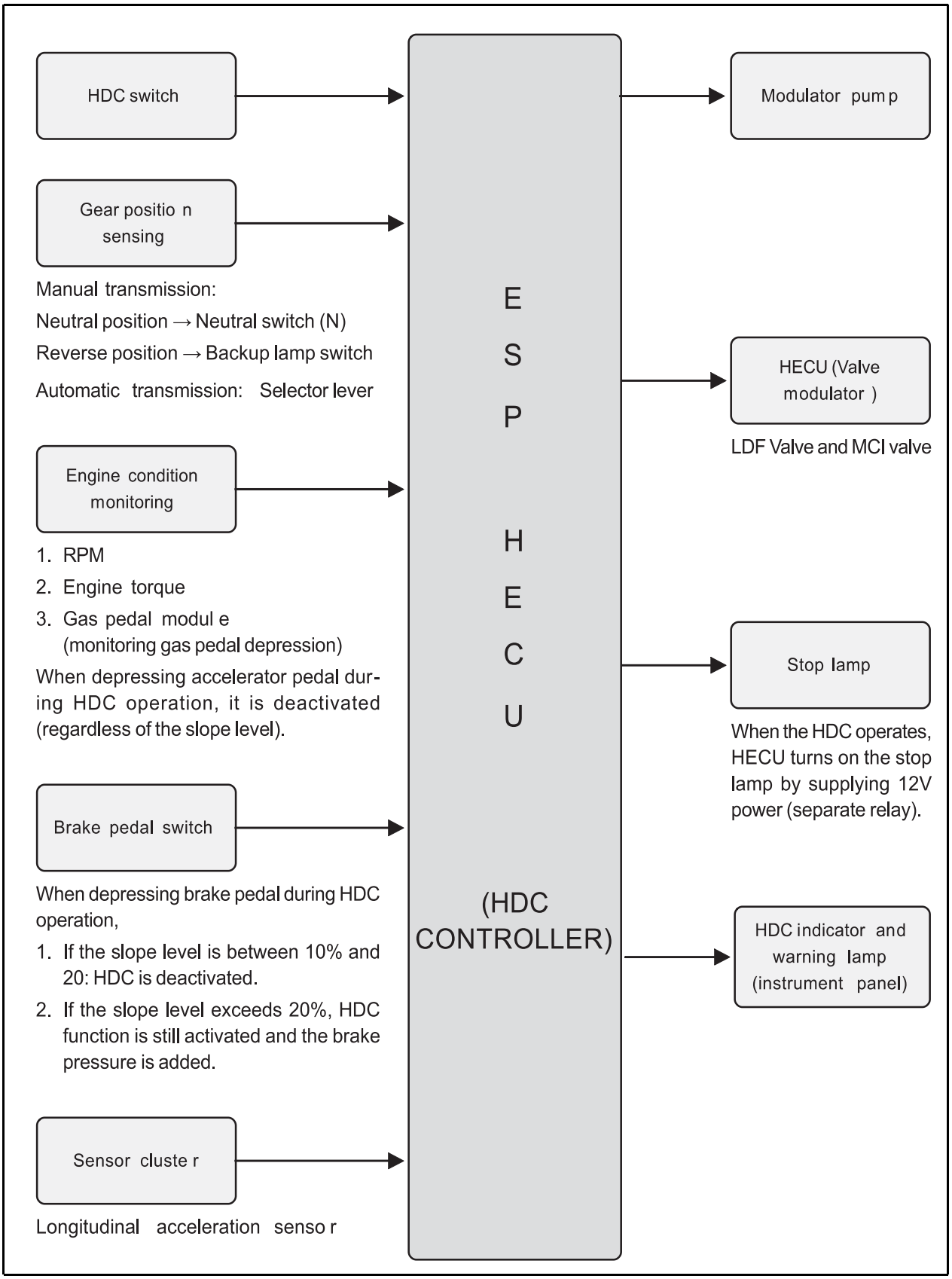
When depressing the accelerator pedal or brake pedal, HDC system is changed to stand-by mode. When depressing the accelerator pedal again, HDC starts its operation again. Therefore, drivers can control the vehicle speed to a desired level by operating the accelerator pedal.

▶ When the slope level exceeds 20% during the HDC operation

When depressing the accelerator pedal, HDC system is changed to stand-by mode. When depressing the brake pedal, HDC continues its operation and the braking power is increased. In this case, HECU sounds an abnormal noise and brake pedal may be very rigid, but this is a normal condition due to HDC operation.

Modification basis	
Application basis	
Affected VIN	

4) Input/Output Signals for HDC Operation



Modification basis	
Application basis	
Affected VIN	

5) Operation of HDC Indicator Controller

This table describes the coming-on and blinking mode of HDC indicator according to the HDC switch operation (ON/OFF).

The HDC indicator on the instrument panel has two modes; green (function lamp) and red (warning lamp). The HDC switch is a push & self return type switch ? when you press it once, it starts to operate and when you press it again, it stops the operation.

<table>
<tr><td colspan="3" rowspan="3">HDC Operation Mode</td><td>HDC Indicator</td><td>HDC Warning Lamp</td></tr>
<tr><td>Green</td><td>Red</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="3">Initial ignition ON (From hence, this signifies operation mode after the engine starts. Even when HDC switch is ON, if the ignition is OFF, HDC operation stops automatically.)</td><td>OFF</td><td>ON
(goes off after 1.8 seconds)</td></tr>
<tr><td rowspan="2">Not available</td><td colspan="2">HDC switch OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="2">HDC system error</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="2">Stand-by</td><td colspan="2">HDC switch ON</td><td>ON</td><td>OFF</td></tr>
<tr><td colspan="4">The HDC switch is turned ON, but HDC system is in stand-by mode because the operating requirements are not met.</td></tr>
<tr><td rowspan="2">In operation</td><td colspan="2">HDC system is operating.</td><td>Blinking (0.5 seconds of interval)</td><td>OFF</td></tr>
<tr><td colspan="4">The HDC switch is turned ON, and the operating requirements are met. HDC is operating with operating sound.</td></tr>
<tr><td rowspan="3">System overheat</td><td rowspan="2">High brake system temperature (over 350°C)</td><td>HDC stand-by mode</td><td>OFF</td><td>Blinking</td></tr>
<tr><td>HDC is operating</td><td colspan="2">Alternate blinking of green and red lamp (0.5 seconds of interval)</td></tr>
<tr><td colspan="2">Too high brake system temperature (over 450°C)</td><td>OFF</td><td>ON</td></tr>
<tr><td colspan="4">There is no specific temperature sensor in the system, but a programmed logic inside the HECU predicts the temperature based on the operating numbers and conditions of HDC (HDC cannot be operated).</td></tr>
</table>

CAUTION

Basically, the brake system's basic functions can work even when there are problems with the HDC system.

As given in the table above, the HDC warning lamp comes on when:

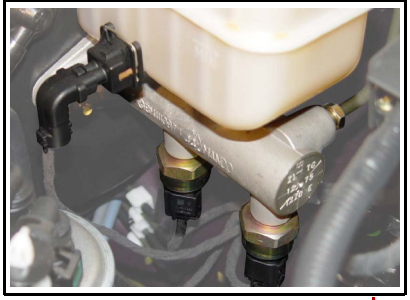
- Initial ignition ON
- HDC system error occurs
- Brake system overheat

Modification basis	
Application basis	
Affected VIN	

Memo

6. ESP COMPONENTS AND LOCATIONS

Master cylinder pressure sensor



Sensor cluster: (Yaw rate + lateral sensor +longitudinal sensor)



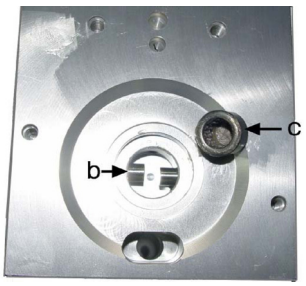
Steering wheel angle sensor



HECU (Valve body and ECU integrated type)

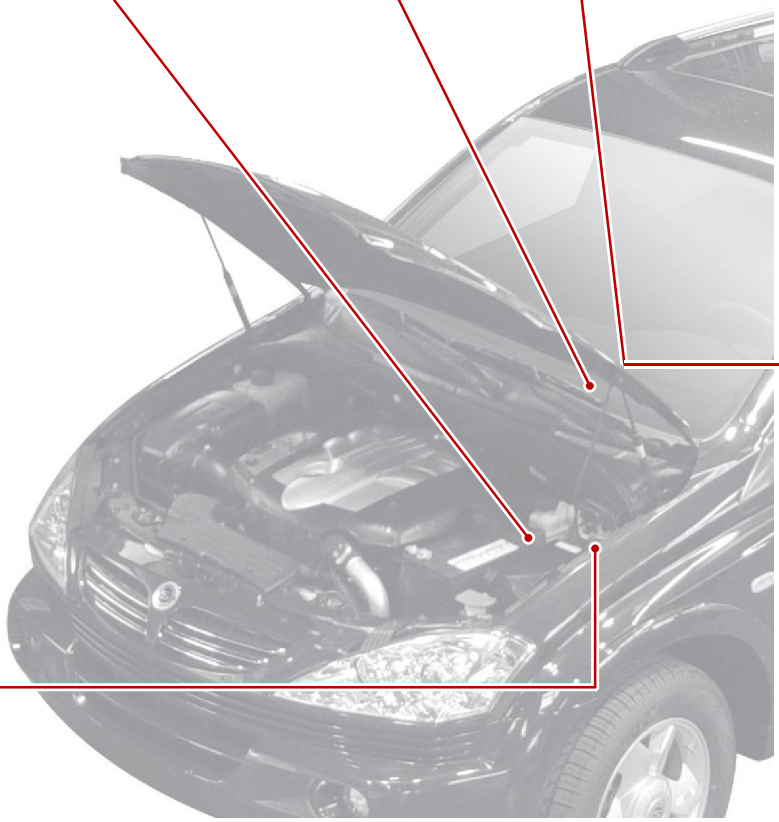


Valve body



Motor pump





Modification basis	
Application basis	
Affected VIN	

▶ Comparison with ABS System

No	Name	ESP Component		Remark
1	HECU	0	0	ESP system contains ESP OFF switch and HDC switch.
2	Pressure sensor	0	N/A	
3	Wheel speed sensor	0	0	
4	Sensor cluster	0	N/A	
5	Steering wheel angle sensor	0	N/A	

Active Wheel Speed Sensor



HDC Switch



HDC Indicator





ESP OFF Switch

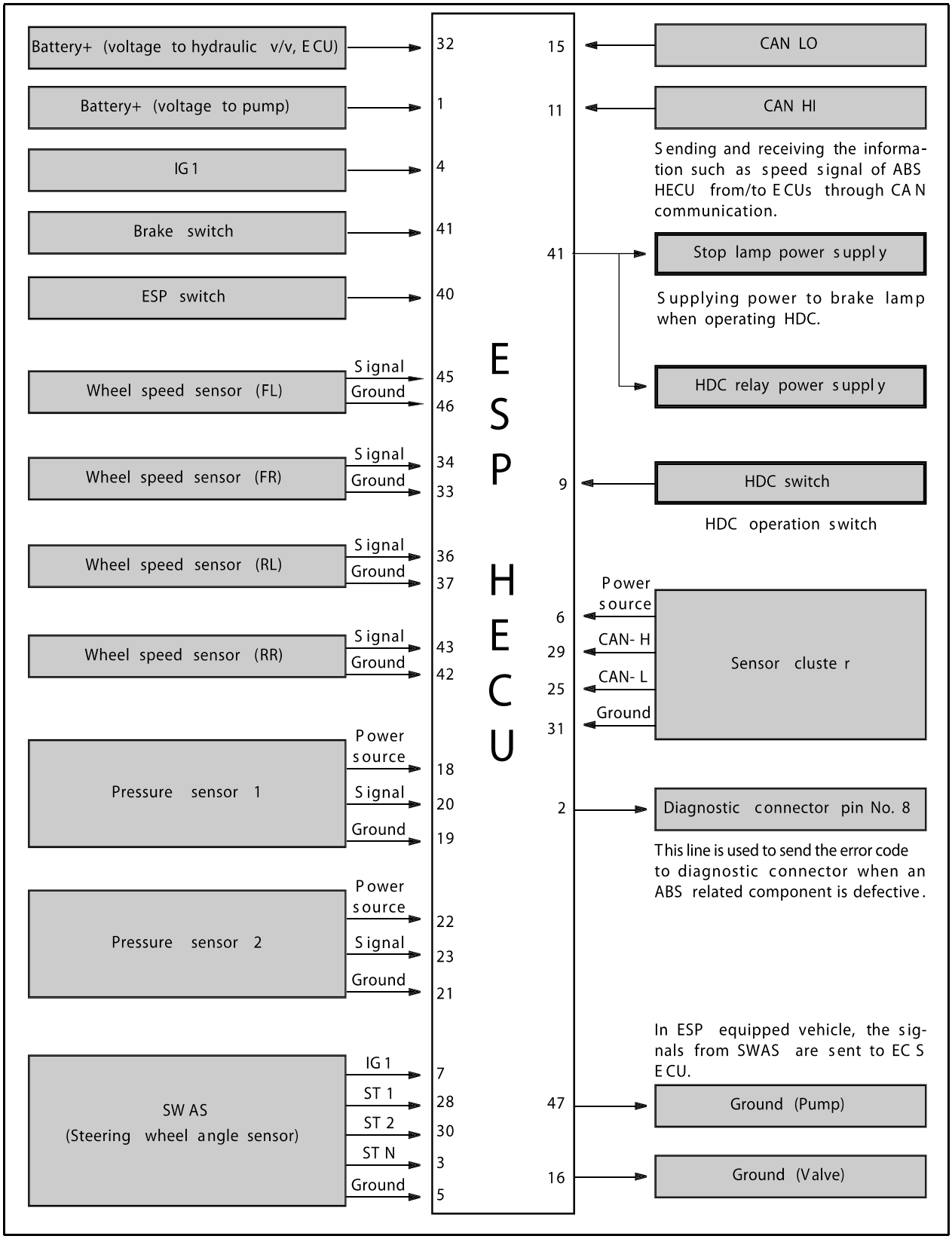


ABS / ESP Indicator



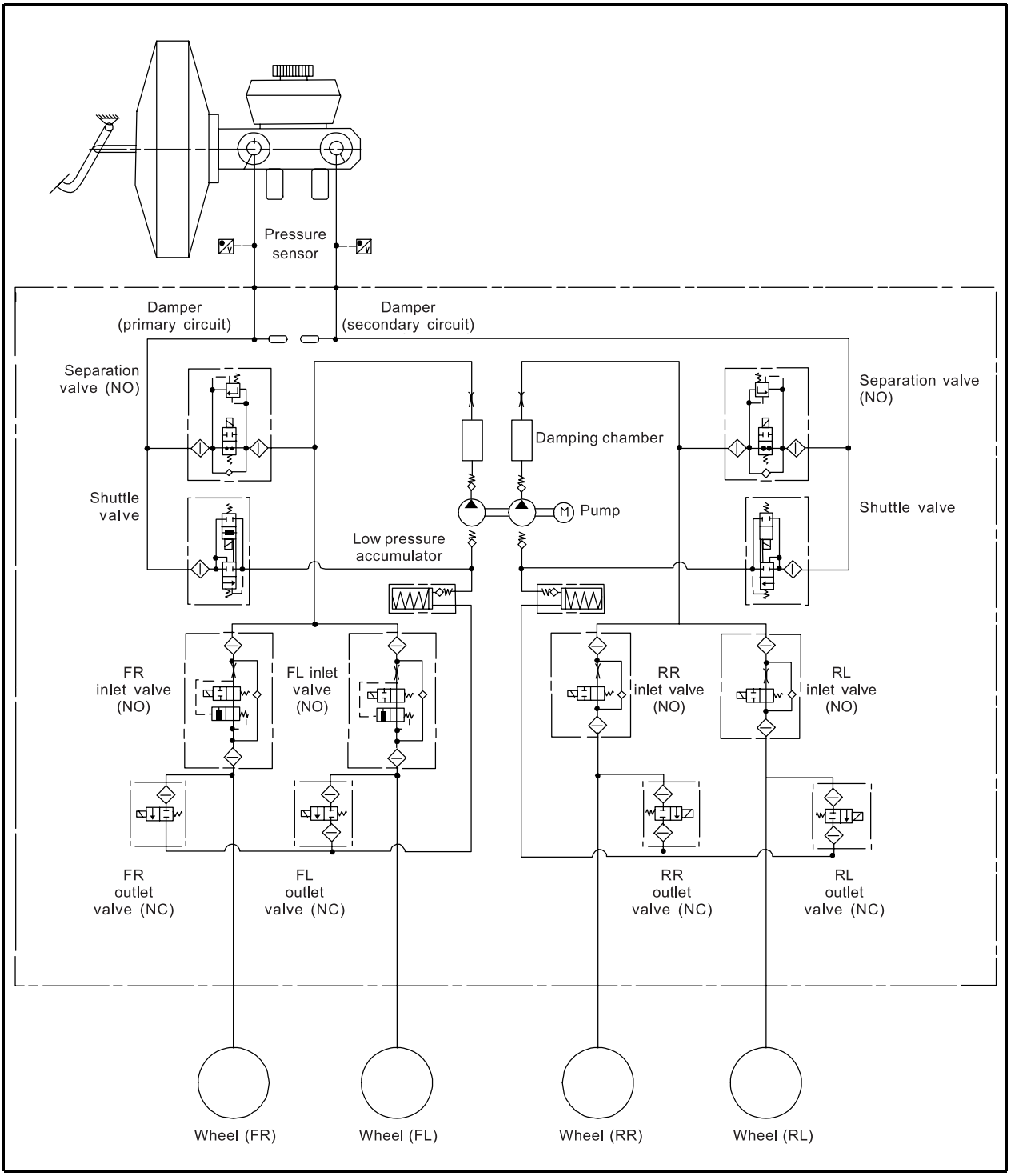
7. INPUT/OUTPUT SIGNALS FOR HDC OPERATION

▶ Input/Output of ESP System



Modification basis	
Application basis	
Affected VIN	

8. ESP HYDRAULIC CIRCUIT DIAGRAM



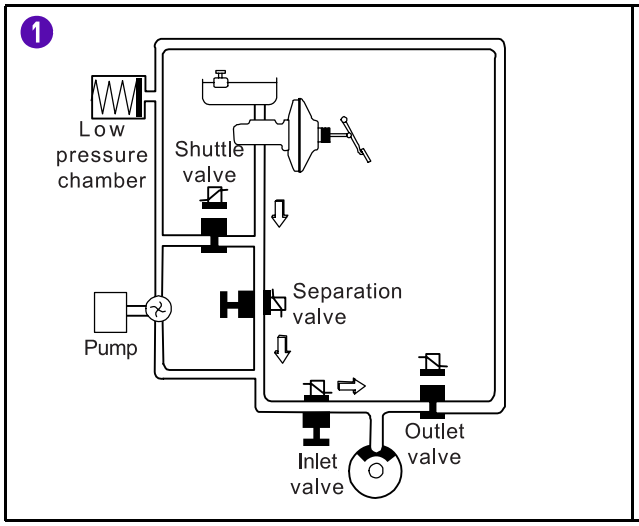
Modification basis	
Application basis	
Affected VIN	

9. HYDRAULIC PRESSURE FOR EACH ESP OPERATING RANGE

1) ESP Operating Explanation

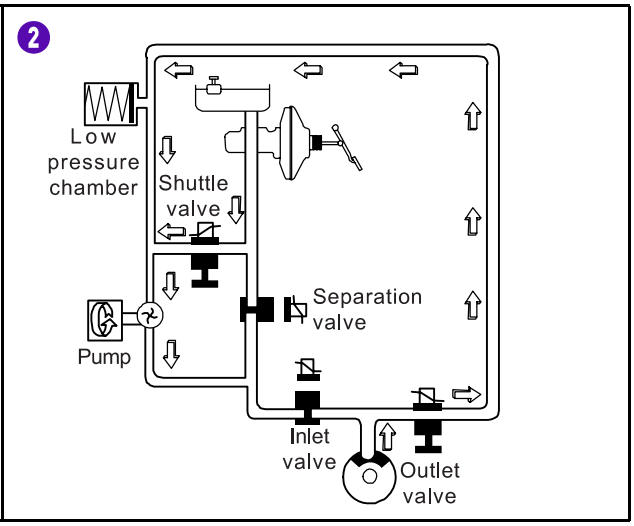
When equipped with ABS, the braking force at each wheel will be controlled with 3-channel 4-sensor method. And when equipped with ESP, 4 wheels will be controlled independently with 4-channel method. (When controlling ABS system only, it will be operated with 3-channel method.)
When compared to the vehicle equipped with ABS/EBD only, the internal hydraulic circuit has a normally-open separation valve and a shuttle valve in primary circuit and in secondary circuit.
When the vehicle brakes are not applied during engine running or when applying the non-ABS operating brakes, the normally-open separation valve and the inlet valve are open, whereas the normally-closed shuttle valve and the outlet valve are closed. When the ESP system is operating, the normally-open separation valve will be closed by the solenoid valve operation and the hydraulic circuit will be established by the shuttle valve. Then, the inlet and outlet valves will be closed or open depending on the braking pressure increase, decrease or unchanged conditions.

For details, refer to **"Hydraulic Pressure for each ESP Operating Range".**



▶ **ESP Hydraulic unit in idling and normal braking position**

In this position, the separation valve and the inlet valve are open (normal open), the electrically operated shuttle valve and the outlet valve are closed.
When the brake is applied under these conditions, the brake fluid will be sent to each wheel via the separation valve and inlet valve.

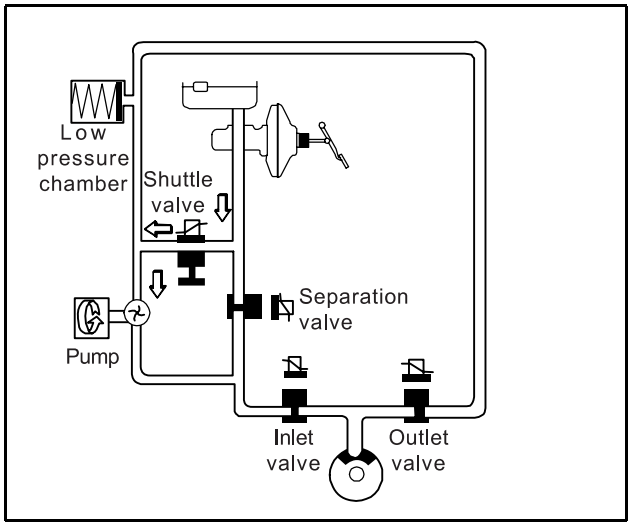


▶ **ESP Hydraulic unit (decreased pressure)**

The pressure decreases just before the wheel speed drops and the wheels. The inlet valve closes and the outlet valve opens as in the ABS HECU and the oil is gathered at the low pressure chamber while no additional oil is being supplied. Then the pump operates to allow fast oil drainage.

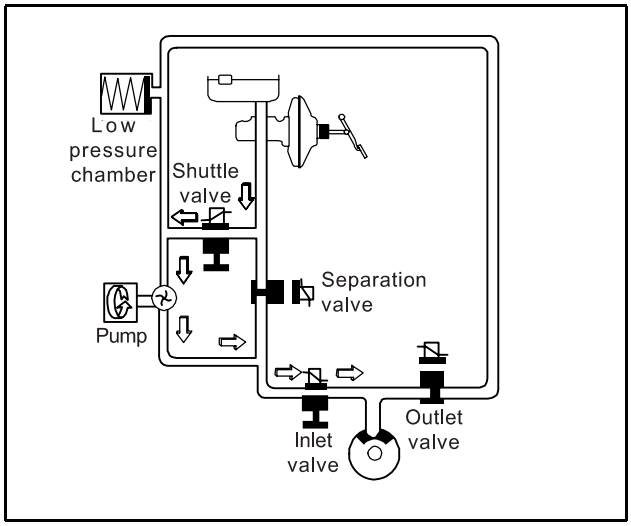
Modification basis	
Application basis	
Affected VIN	

▶ ESP unit circuit (when the pressure is maintained)



The Inlet valve and outlet valve will be closed to maintain the pressure in the hydraulic circuit applied at the wheels. By closing the valves, the hydraulic pressure at the wheels will not be lost or supplied any more. During ESP operation, the separation valve closes and only the shuttle valve at the pump opens.

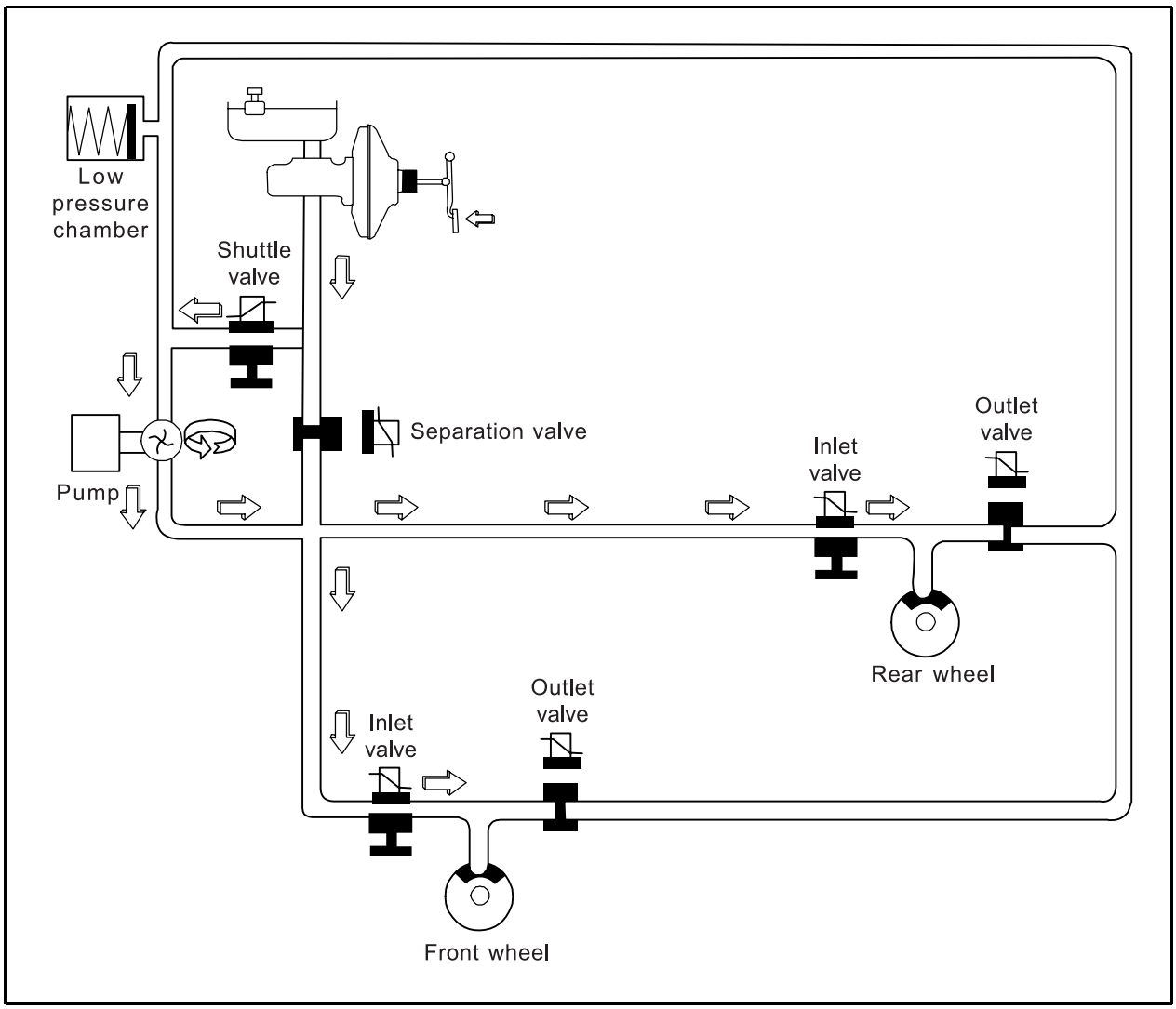
▶ ESP unit circuit (when the pressure is increased)



The shuttle valve and inlet valve will be open and the separation valve and outlet valve will be closed. Then, the pump is operated.

When ESP operates while the ABS is operating, the pressure will be increased continuously until just before the corresponding wheel gets locked.

10. HYDRAULIC CIRCUIT OF HBA (HYDRAULIC BRAKE ASSIST)



The above figure shows one front and one rear wheel and the same hydraulic circuit forms as in the ESP operation.

When HECU recognizes that it is an emergency and it is required for hard braking, depending on the pressure value of the brake pressure sensor and pressure changes caused by the pressure sensor timing, it operates the pump immediately to apply the brake pressure at the wheels. Then, the pressure in the pump increases until just before the corresponding wheel gets locked. The motor still keeps rotating and the outlet valve and the separation valve are will stay closed.

When the wheel starts to lock, the HBA function cancels and switches to ABS operation.

Modification basis	
Application basis	
Affected VIN	

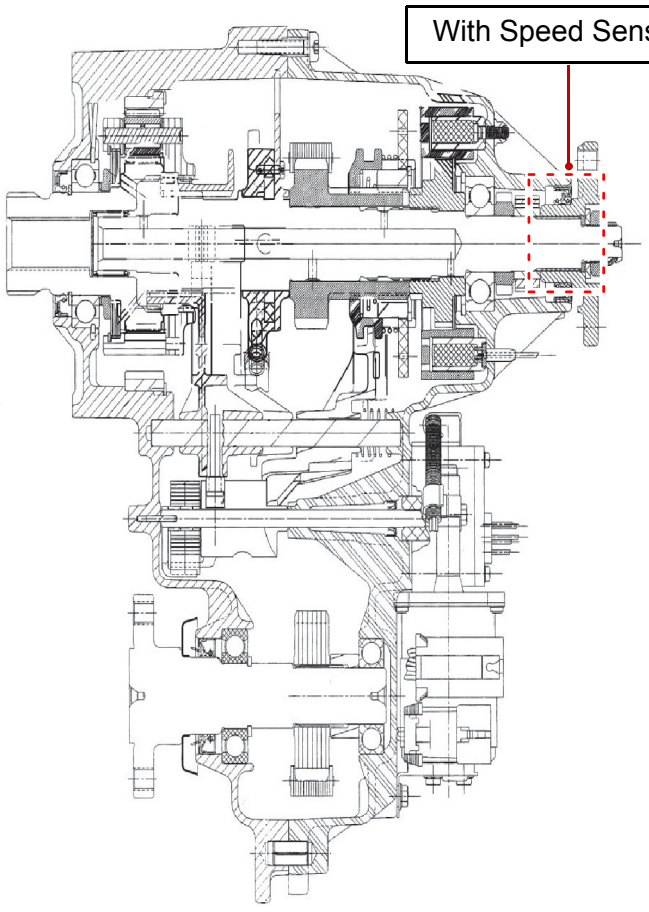
11. GENERAL INFORMATION OF ABS SYSTEM

Differences compared to other models: Appearance of wheel speed sensor, Location, Layout of relevant components

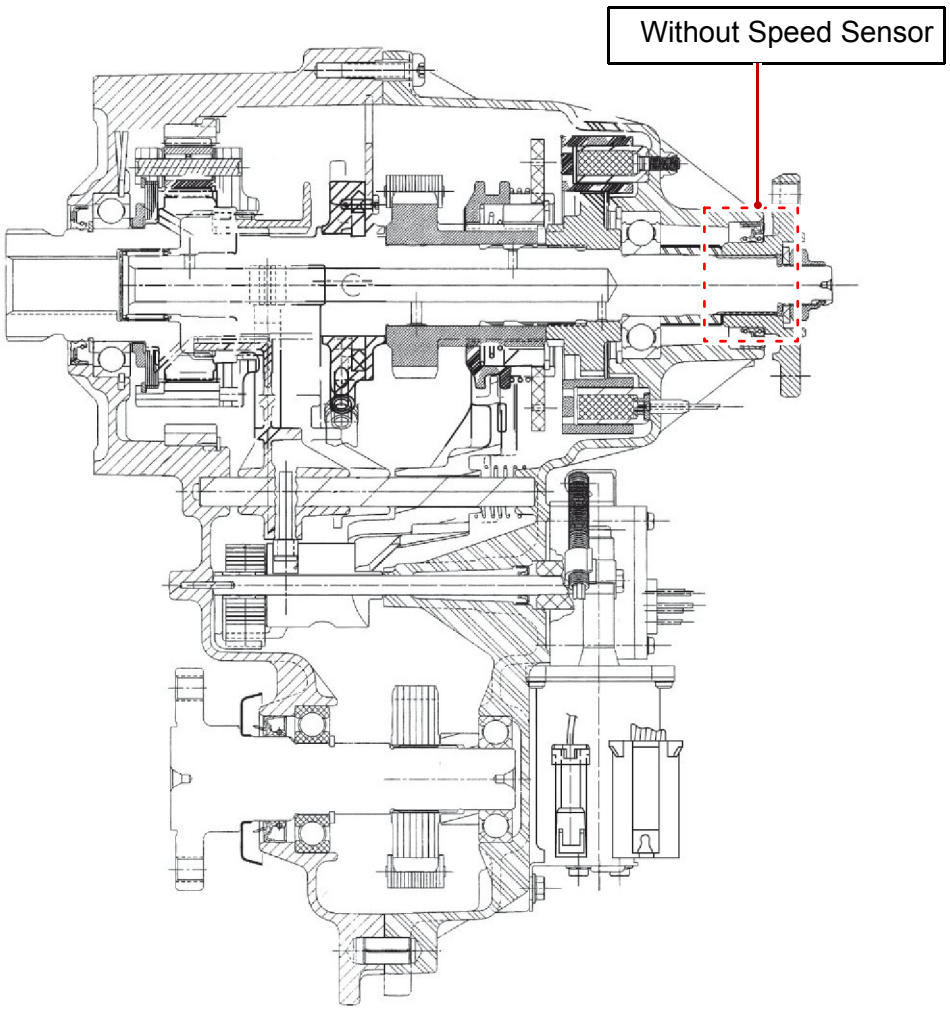
ABS HECU	Active Wheel Speed Sensor (for 4WD)
	

The transfer case (T/C) installed on this vehicle doesn't have the internal speed sensing device and receives the speed signal for T/C control from ABS HECU.

Conventional Transfer Case

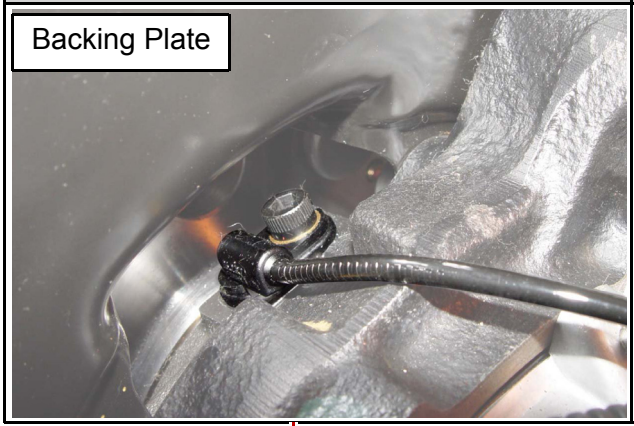
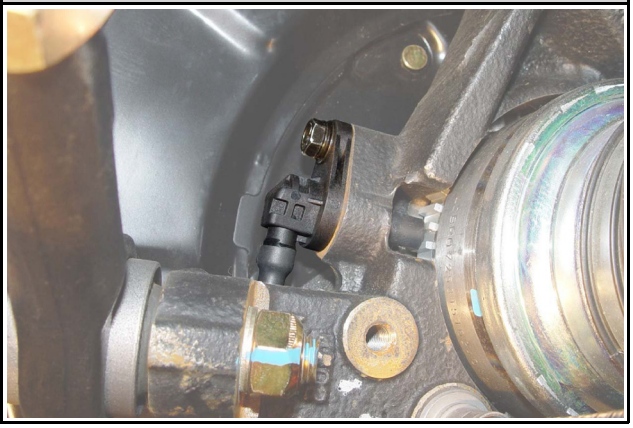


New Transfer Case

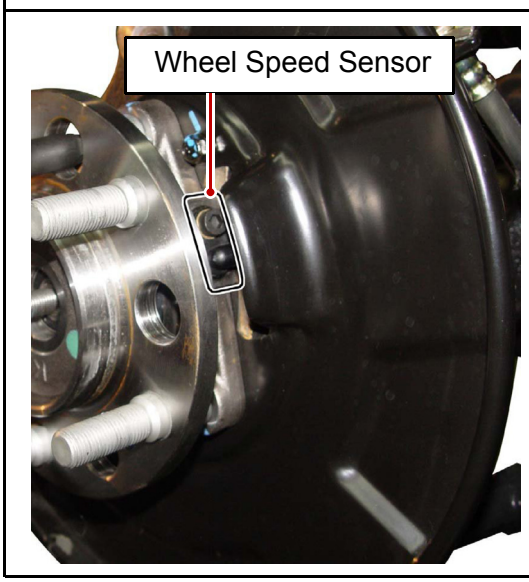


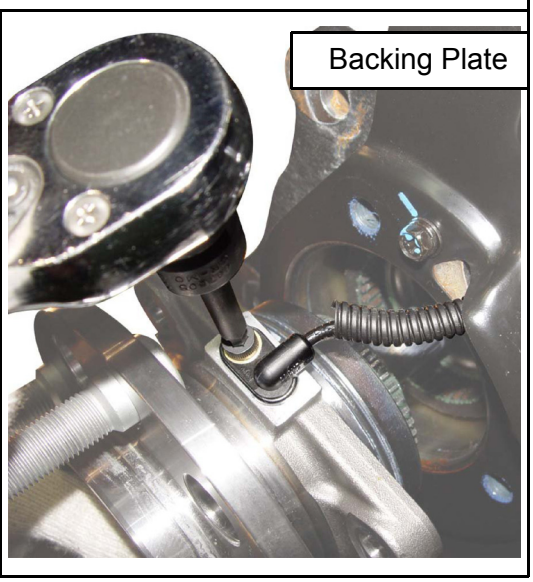
Modification basis	
Application basis	
Affected VIN	

Cautions When Removing the Front Wheel Speed Sensor
The locking hub system of the KYRON part time 4WD utilizes a different hub actuator from the conventional approach. It utilizes IWE (Integrated Wheel End) system that locks the 4WD depending on the vacuum condition within the actuator. Thus, the wheel speed sensor is installed on the front wheel end area. It is installed inside the backing plate to be protected from heat and foreign materials. Therefore, **the front wheel end system (including disc) should be removed before removing the front wheel speed sensor.**

Front Wheel Speed Sensor	Rear Wheel Speed Sensor
	

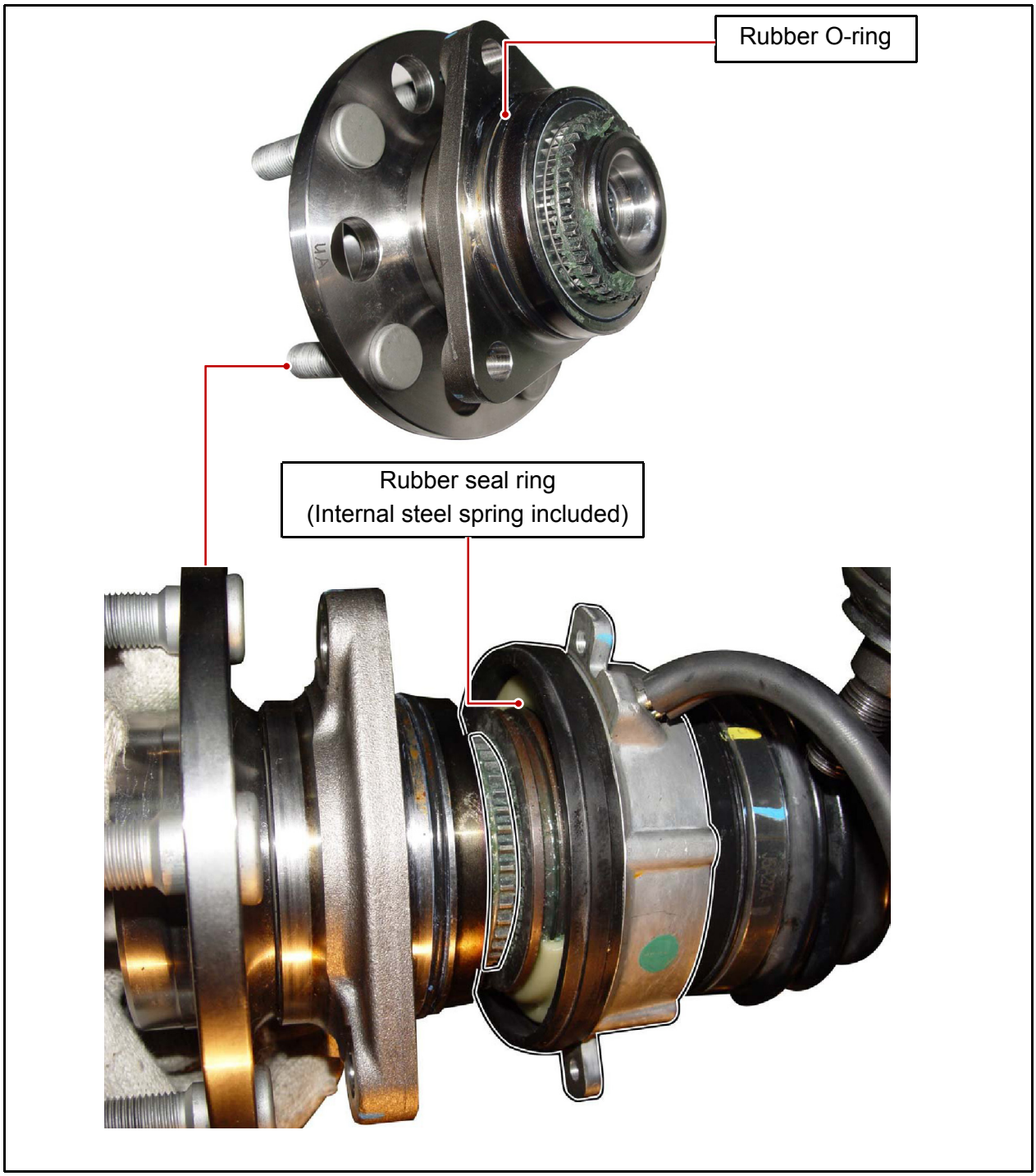
Wheel Speed Sensor





The rubber O-ring in IWE (Integrated Wheel End) should be replaced with new one when the front wheel end has been removed.
The rubber O-ring prevents moisture and foreign materials from entering the IWE system.

In addition, when installing the hub actuator of the IWE system, you must install it from the same angle as the drive shaft to prevent the rubber seal ring inside the actuator from being squeezed.

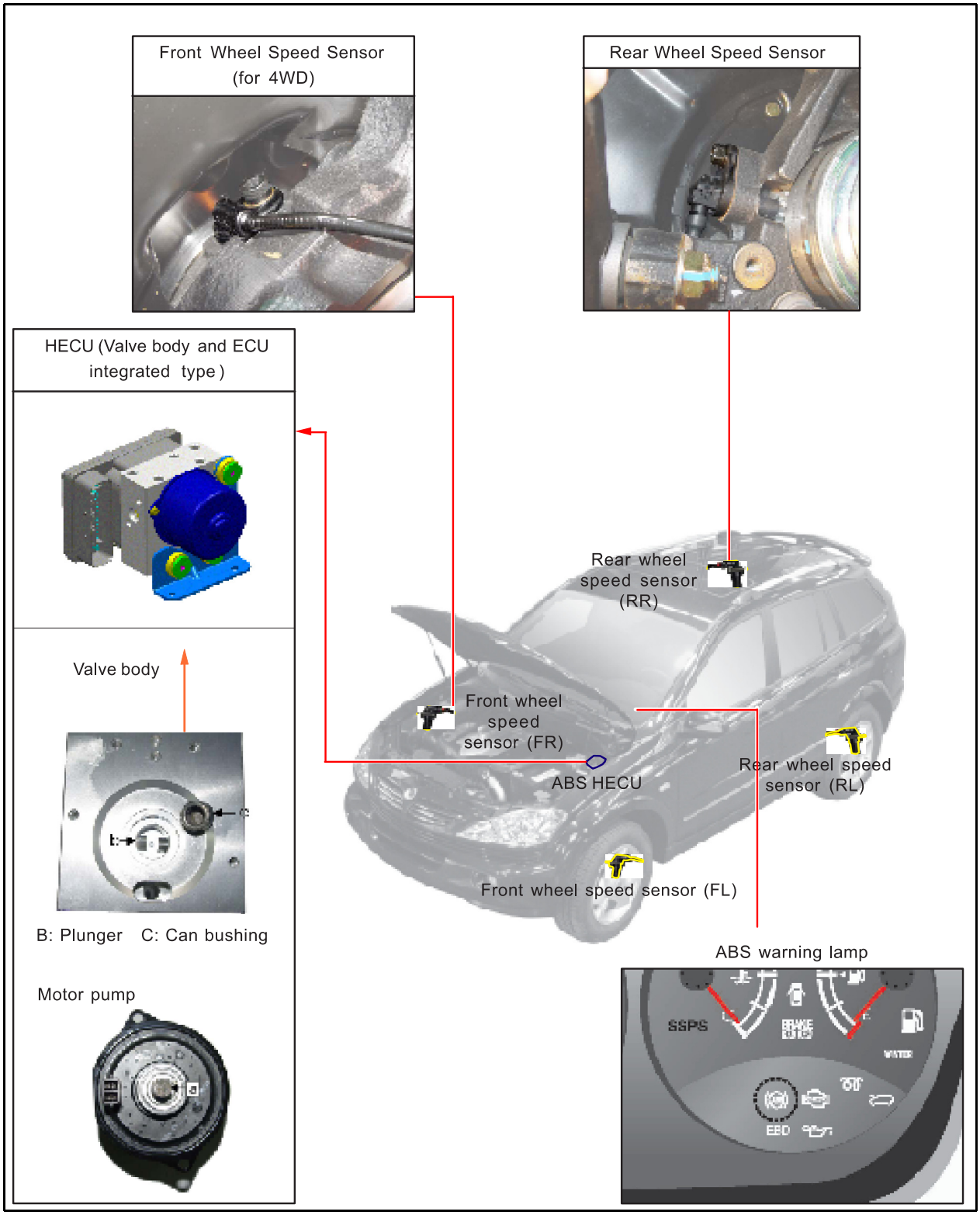


Please refer to the part time transfer case section for more specific information.

Modification basis	
Application basis	
Affected VIN	

12. CONFIGURATION OF ABS SYSTEM

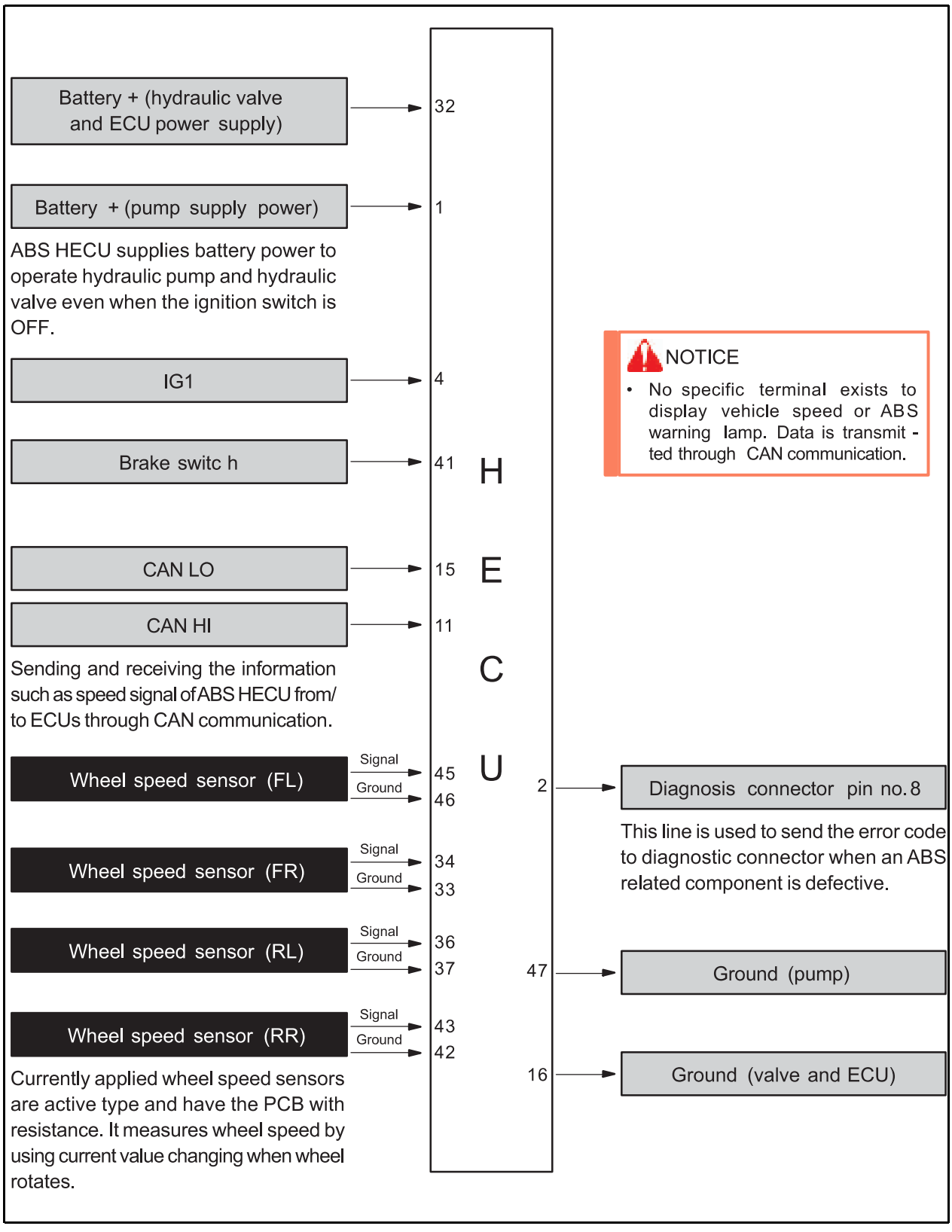
The following figure shows the basic system components of the ABS. This system consists of HECU (valve body and ECU integrated type), front wheel speed sensor, and rear wheel speed sensor.



Modification basis	
Application basis	
Affected VIN	

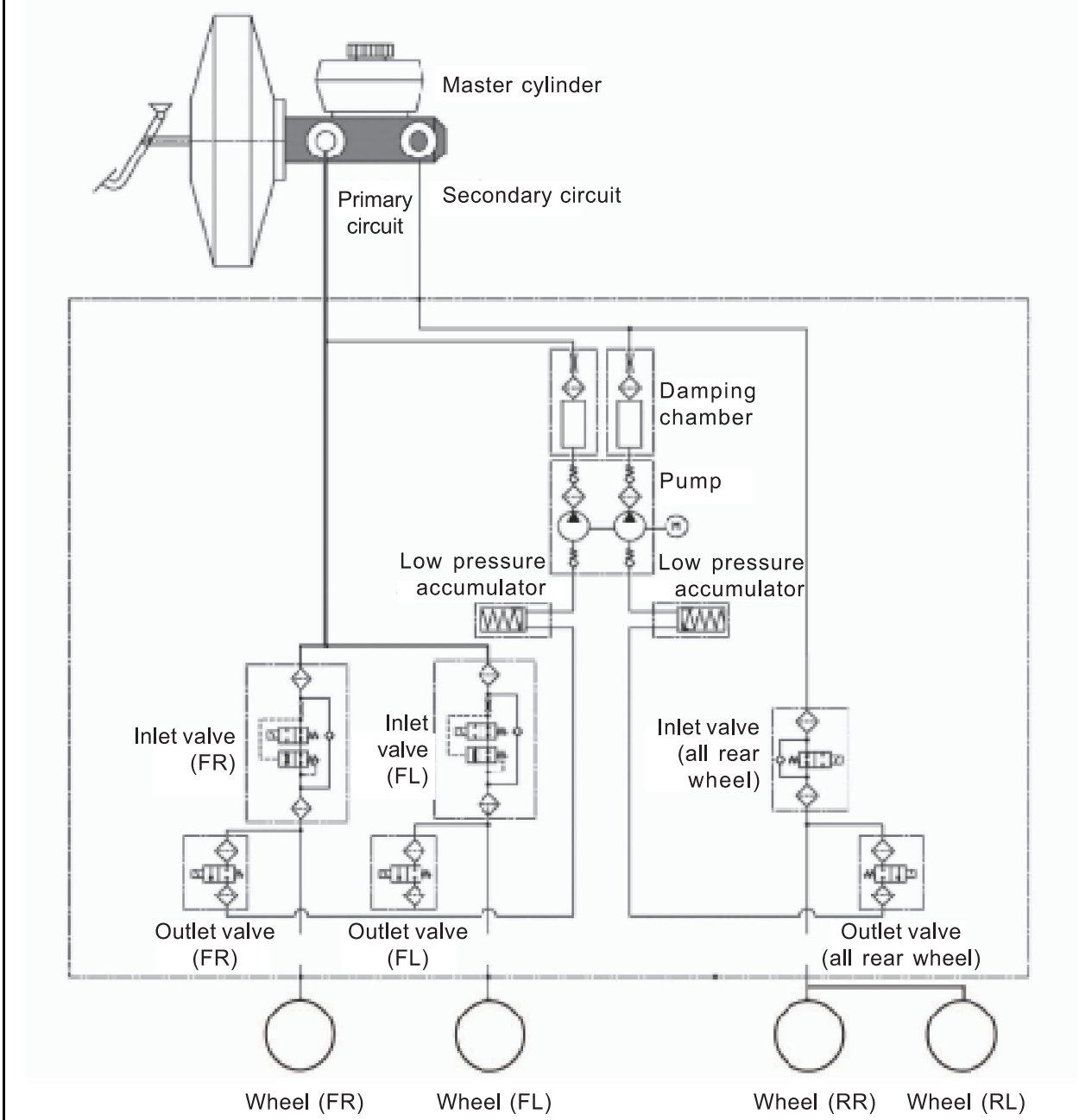
13. INPUT AND OUTPUT DIAGRAM OF ABS

▶ Input/Output of ABS (without TPMS)



Modification basis	
Application basis	
Affected VIN	

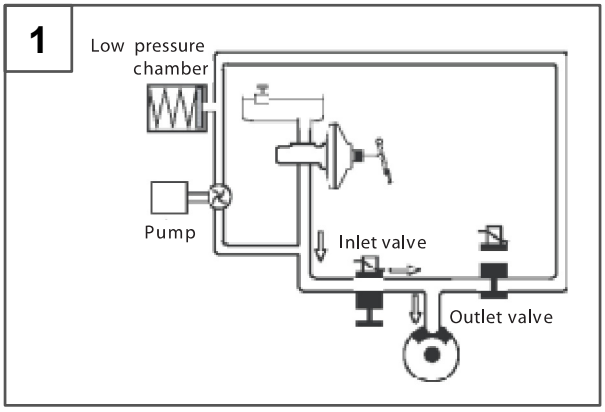
14. HYDRAULIC CIRCUIT OF ABS



The vehicle equipped only with the ABS controls the wheel's braking force using or channel 4-sensor method.

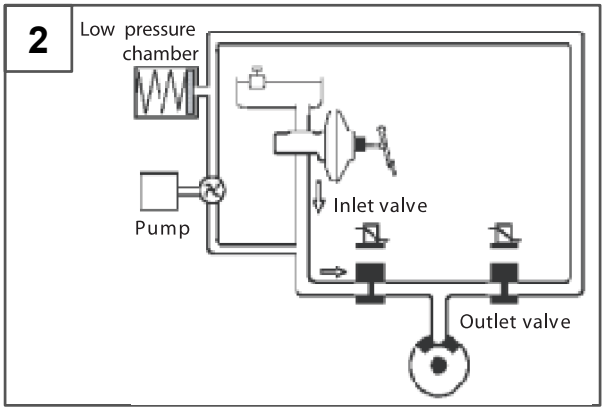
The front wheels that are the primary circuit of the brake system is composed of two wheel speed sensors and two channel valves system with two inlet valves and two outlet valves. The rear wheels that are the secondary circuit of the brake system is composed of two wheel speed sensors, one inlet valve and one outlet valve. This system is similar to the one from the previous model.

15. ABS CIRCUIT IN EACH OPERATION RANGE



▶ **Hydraulic Pressure Circuit when ABS is Not Operating**

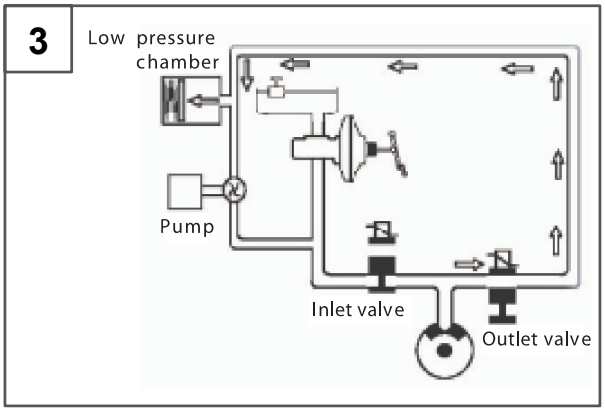
- The hydraulic pressure in the master cylinder increases through the vacuum booster and it is delivered to the wheel via the normal open inlet valve. At this moment, the normally- closed outlet valve is closed. The speed of the wheel that hydraulic pressure is delivered reduces gradually.



▶ **No Hydraulic Pressure Circuit when ABS is Operating**

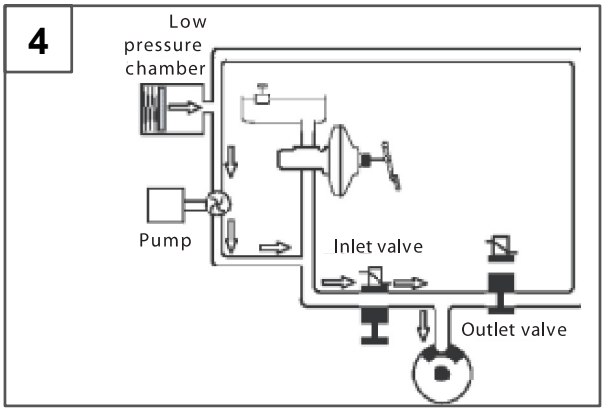
- As hydraulic pressure on each wheel increases, the wheel tends to lock. In order to prevent the wheel from locking, the hydraulic valve modulator operates the inlet valve control solenoid to close the inlet valve and stop the hydraulic pressure increases. At this moment, the outlet valve is closed. This procedure helps the wheel to maintain a stable hydraulic pressure.

Modification basis	
Application basis	
Affected VIN	



▶ Pressure Decreases in the Circuit when ABS is Operating

- Even when the hydraulic pressure on each circuit is stable, the wheel can be locked as the wheel speed decreases.
This is when the ABS ECU detects the wheel speed and the vehicle speed and gives the optimized braking without locking the wheels. In order to prevent from hydraulic pressure increases, the inlet valve is closed and the outlet valve is opened. Also, the oil is sent to the low pressure chamber and the wheel speed increases again. The ABS ECU operates the pump to circulate the oil in the low pressure chamber to the master cylinder. This may make the driver to feel the brake pedal vibration and some noises.



▶ Pressure Increases in the Circuit when ABS is Operating

- As the wheel speed increases, the inlet valve opens and the wheel's pressure increases due to the master cylinder pressure. The oil in the low pressure chamber circulates to the wheel by the pump and the wheel speed decreases as the hydraulic pressure at wheel increases.
This operation continues repetitively until there are no signs that the ABS ECU is locking the wheels. When the ABS hydraulic pressure control takes place, there may be some vibration and noises at the brake pedal.

POWER STEERING SYSTEM 4610-00

GENERAL

1. POWER STEERING SYSTEM OVERVIEW

The power steering has been designed to make the wheel move more easily than in a manual steering system. The hydraulic power assists the process utilizing hydraulic fluid. The fluid increases pressure in the power steering pump and aids the movement of the steering mechanism.

The power steering system consists of pump, oil reservoir, rack and gear box.

The power steering pump is a vane type and delivers hydraulic pressure to operate the power steering system.

The pressure relief valve in the pump controls the discharging pressure.

The rotary valve in the rack and the pinion gear directs the oil from the power steering pump to one side of the rack piston. The integrated rack piston converts the hydraulic pressure to linear movement. The operating force of the rack moves the wheels through the tie rod, the tie rod end and the steering knuckle. Even though the hydraulic pressure cannot be generated, a driver can steer the vehicle without power assist but it needs very high steering force.

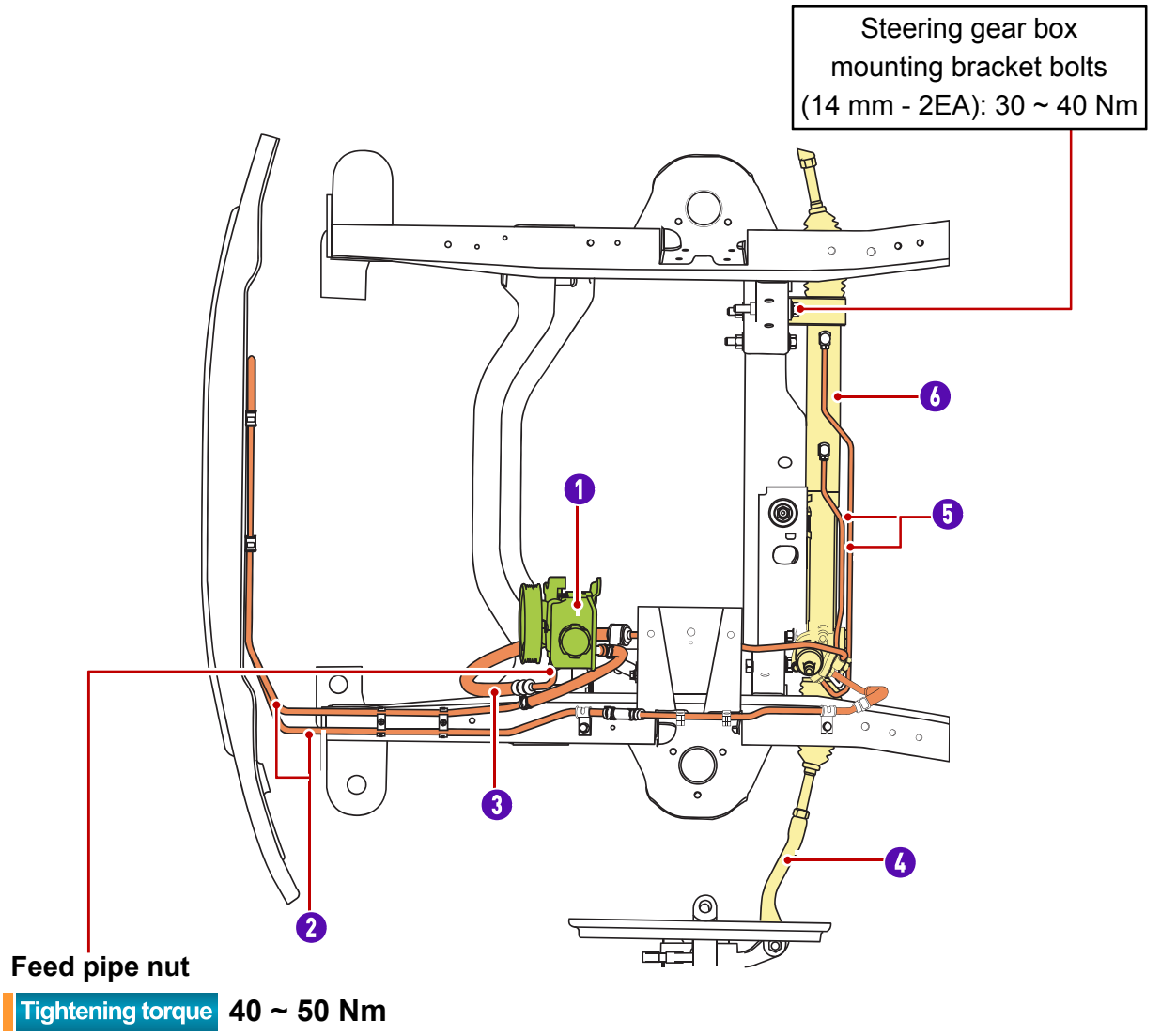
In this case, the operating force of the steering wheel is conveyed to the pinion, and the movement of the pinion moves the rack through the pinion gear combined to the rack gear.

2. POWER STEERING SPECIPICATIONS

Description			Spec ification
Steering wheel	Type		4-spoke type
	Outer diameter (mm)		390
Steering gear box	Type		Rack and pinion
	Gear ratio		?
	Steering angle	Inner	36° 20'
		Outer	32° 40'
Oil pump	Type		Vane type
	Maximum pressure (kgf/cm²)		85 ~ 92
	Displacement (ℓ /min)		10.5
	Pulley size (mm)		124
Tilt column adjusting angle	Up		4°
	Down		8°
Minimum turning radius (m)			5.7
Oil	Specification		ATF Dexron III
	Capacity (ℓ)		1.0

OVERVIEW AND OPERATION PROCESS

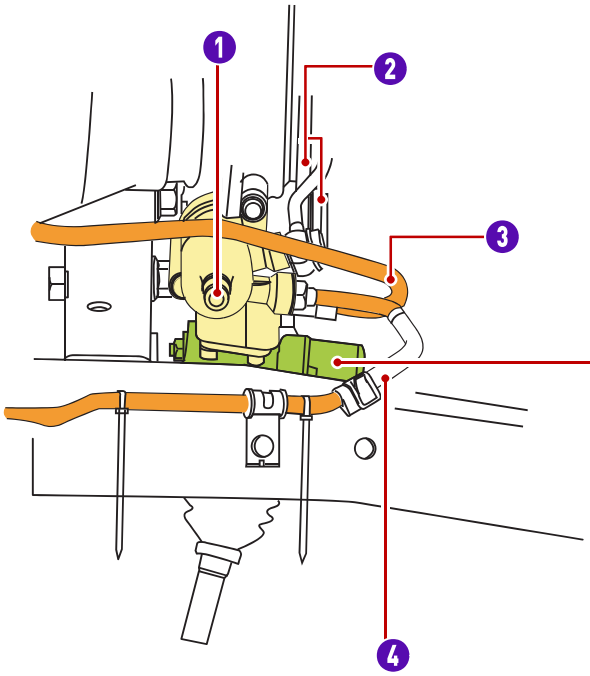
1. POWER STEERING SYSTEM LAYOUT



1. Power steering pump assembly	4. Tie rod end
2. Power steering return pipe	5. Power steering gear box pipe
3. Power steering high pressure hose and pipe	6. Power steering gear box assembly

Modification basis	
Application basis	
Affected VIN	

With SSPS

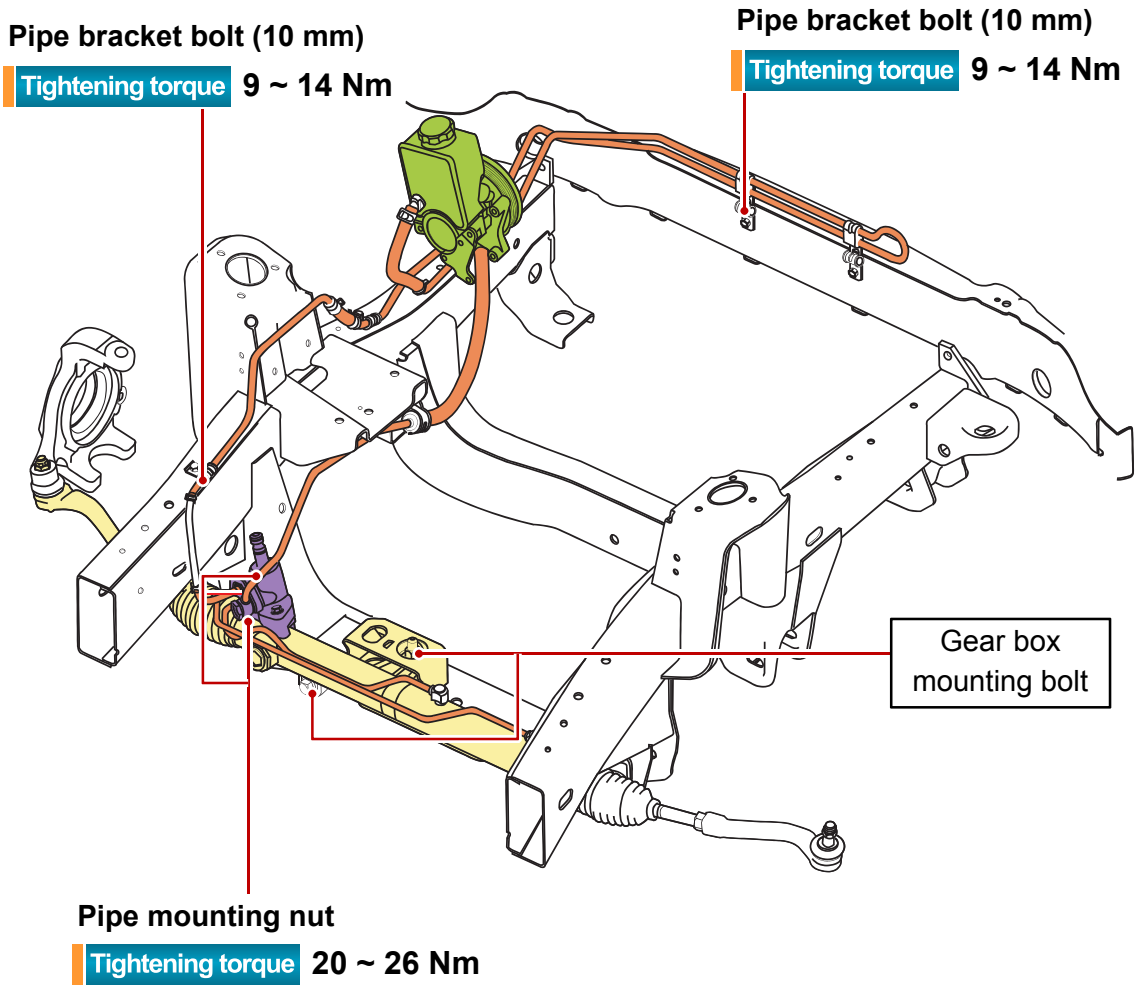


SSPS Solenoid Valve



cannot be replaced

1. Power steering gear box	3. Power steering high pressure hose and pipe
2. Gear box pipe	4. Return hose and pipe

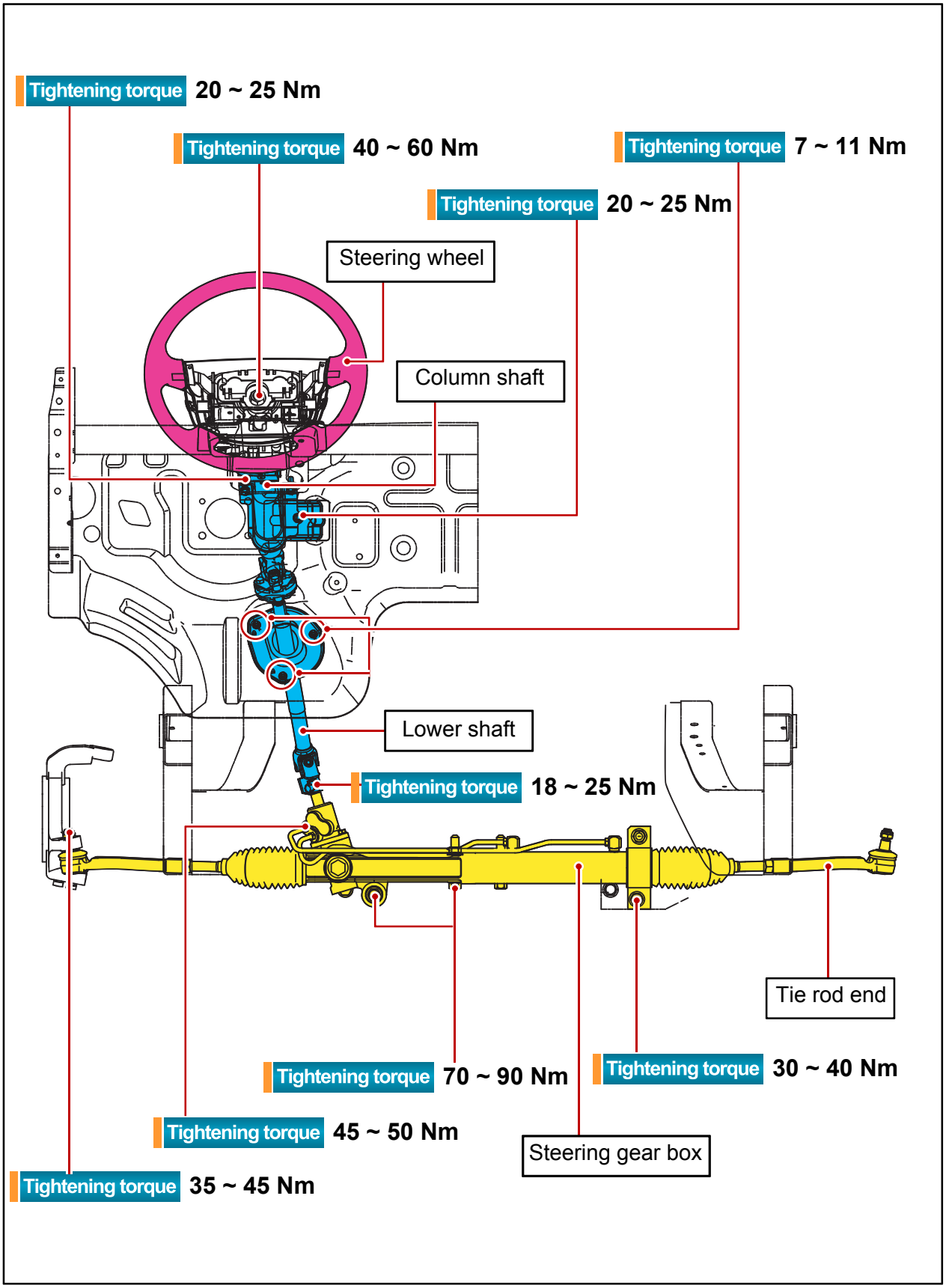


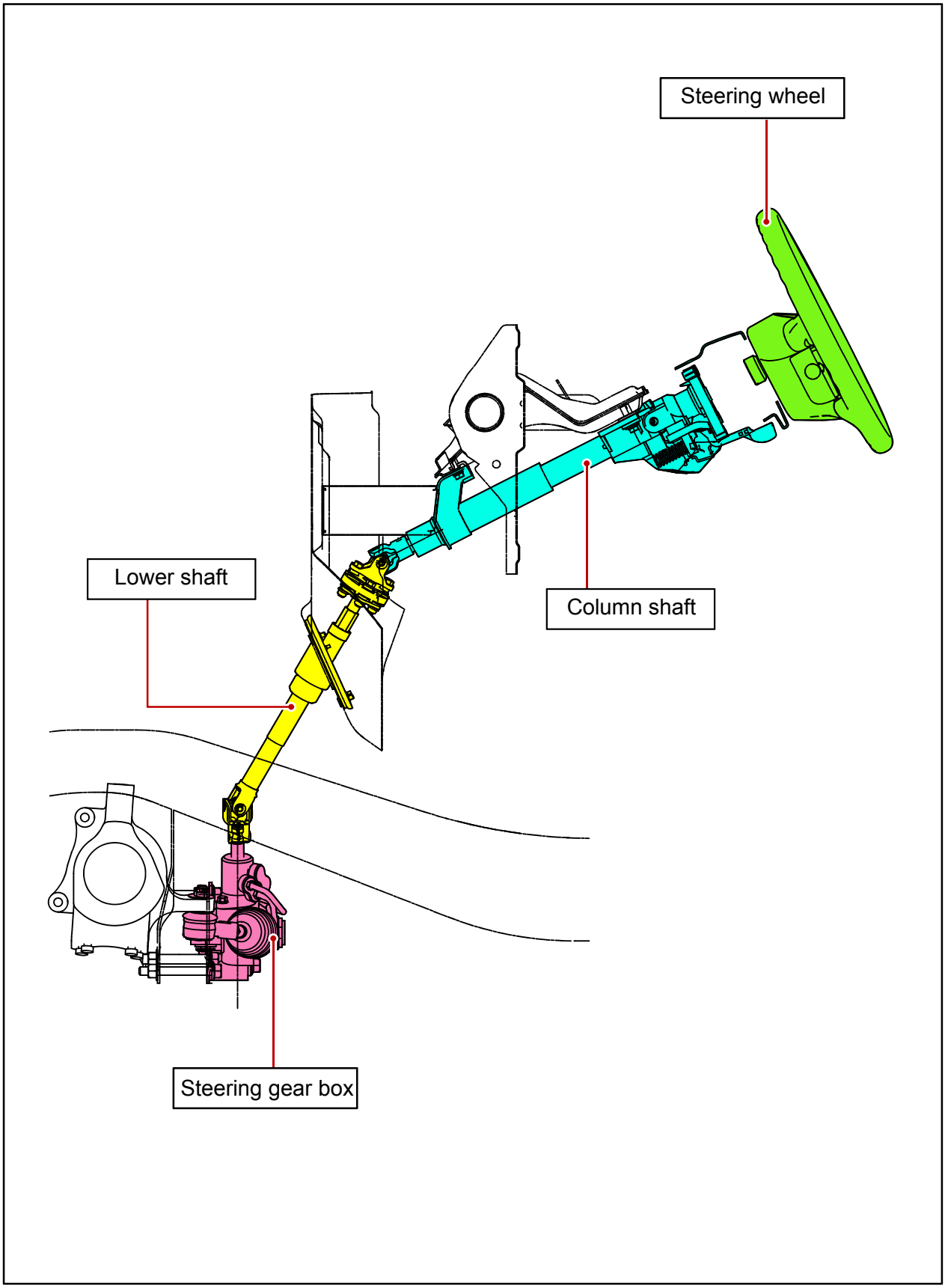
Installation Drawing of SSPS



Modification basis	
Application basis	
Affected VIN	

▶ Components


Tightening torque 20 ~ 25 Nm
Tightening torque 40 ~ 60 Nm
Tightening torque 7 ~ 11 Nm
Tightening torque 20 ~ 25 Nm
Steering wheel
Column shaft
Lower shaft
Tightening torque 18 ~ 25 Nm
Tie rod end
Tightening torque 70 ~ 90 Nm
Tightening torque 30 ~ 40 Nm
Tightening torque 45 ~ 50 Nm
Steering gear box
Tightening torque 35 ~ 45 Nm



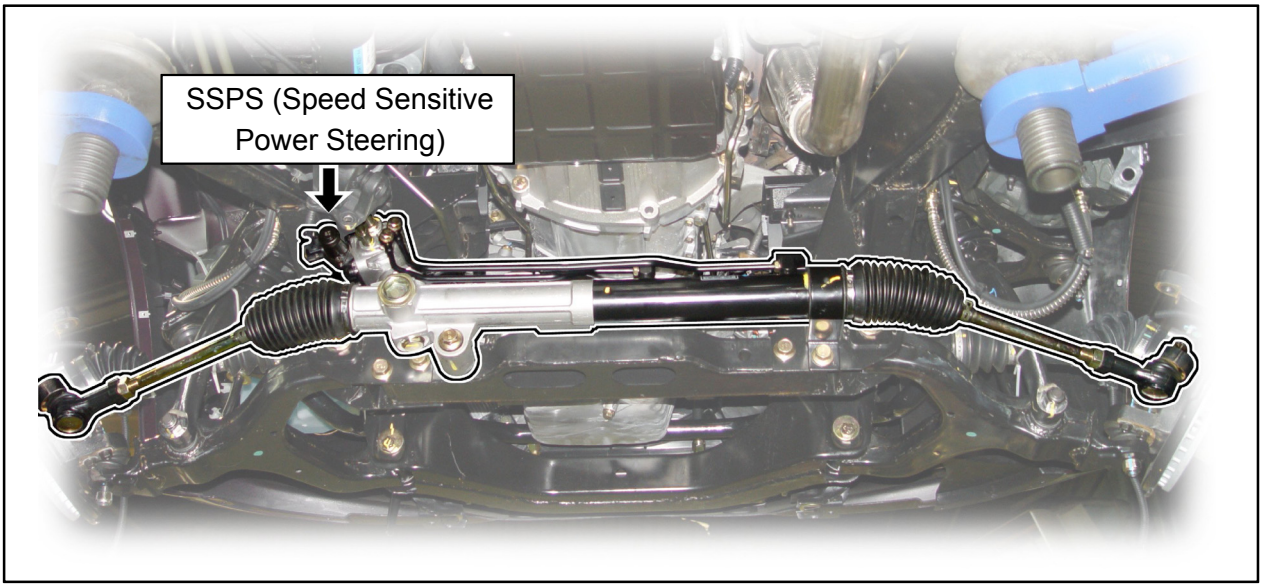
Modification basis	
Application basis	
Affected VIN	

2. SSPS (SPEED SENSING POWER STEERING) OVERVIEW AND FUNCTIONS

1) OVERVIEW

In the conventional constant power assist steering system, the steerability gets lighter as vehicle speed rises, and this may cause a dangerous situation. Where as having heavy steerability in high speed driving makes it difficult to manipulate the steering wheel when vehicle is in stop. This steering system solves this problem as the steerability is changed according to the vehicle speed, which is called Speed Sensitive Power Steering (SSPS).

SSPS, by providing appropriate steerability to a driver according to the changes of vehicle speed, gives steering stability. The power steering control unit adjusts the hydraulic pressure to reaction plunger by controlling the pressure solenoid valve located in the gear box to optimize the steerability. In other words, the steering wheel gets lighter by adjusting steerability in stop or low speed and provides steering stability by adjusting steering wheel to become heavier in high speed.

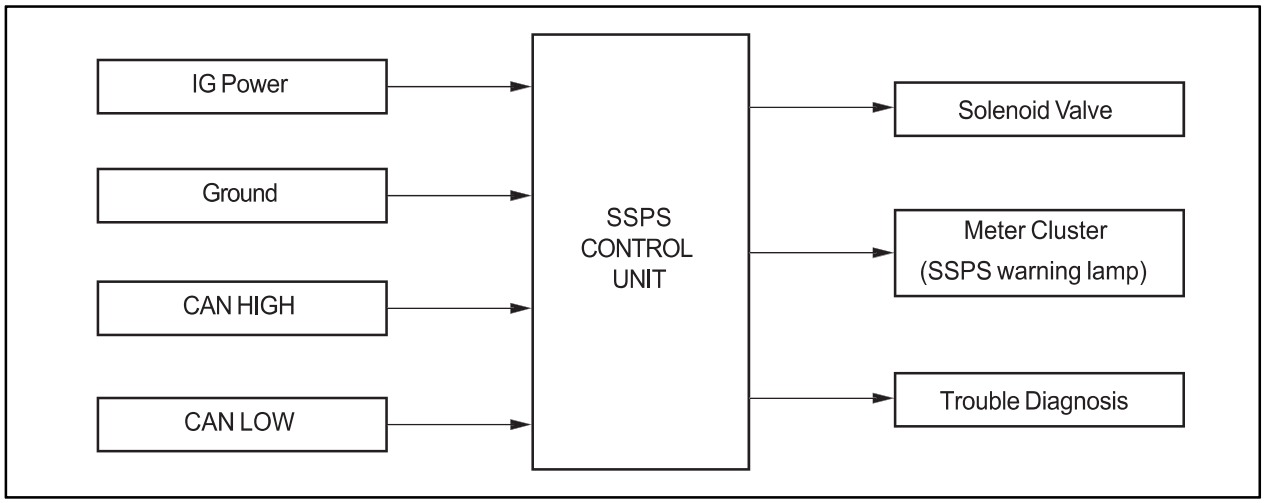


CAUTION

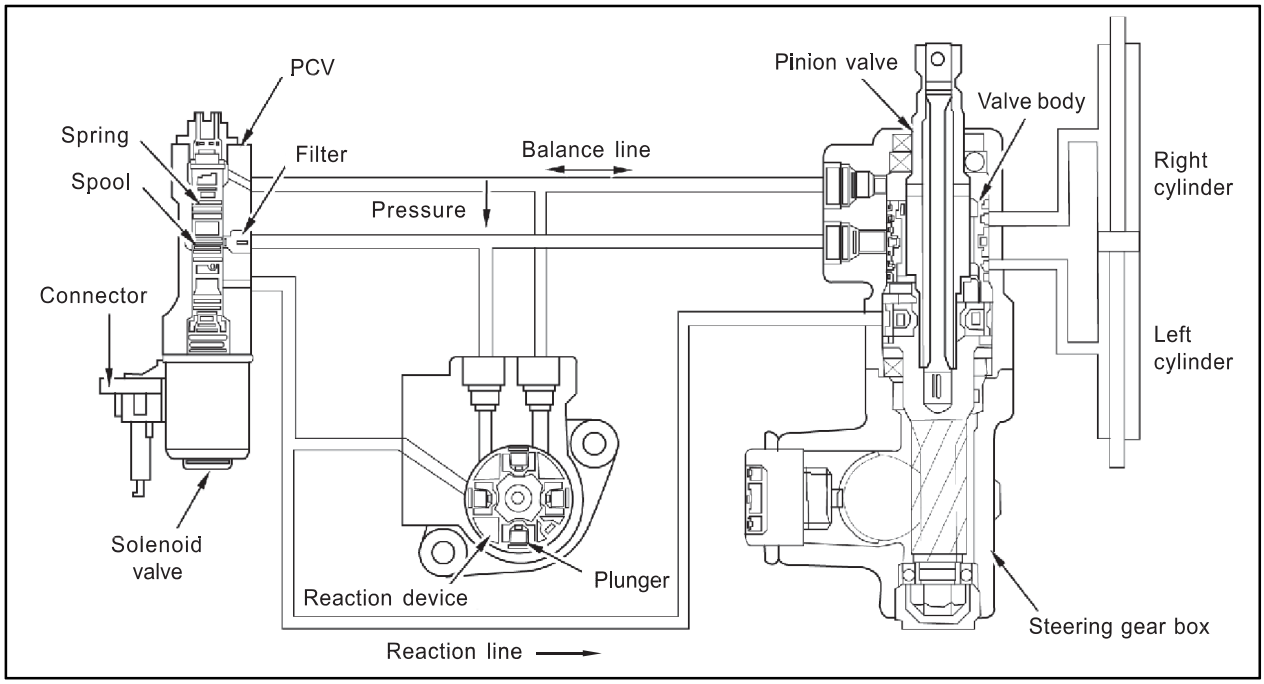
- If the SSPS solenoid valve is defective, the power steering assembly should be replaced.

2) FUNCTION

▶ Input/Output of SSPS Control Unit



▶ SSPS Configuration



PCV (Pressure Control Valve)

This valve controls the hydraulic pressure supplied to reaction device by moving the spool valve according to the changes of solenoid valve.

Reaction device

This device increases the steerability effect by binding the input shaft with supplied hydraulic pressure from PCV.

Solenoid valve

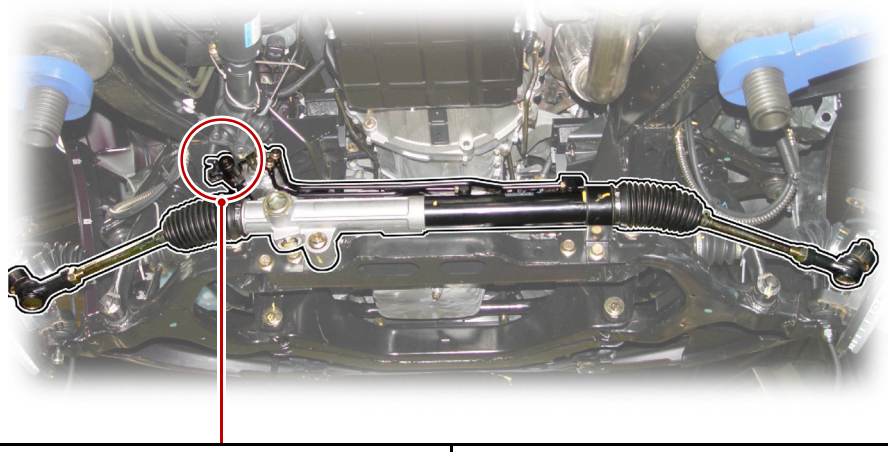
This valve determines the valve spool position in PCV with the electric current supplied from SSPS control unit.

Modification basis	
Application basis	
Affected VIN	

3. S.S.P.S OPERATIONS

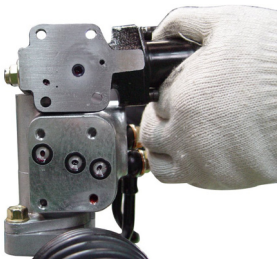
1) SOLENOID VALVE

(1) LOCATION





Cannot be replaced



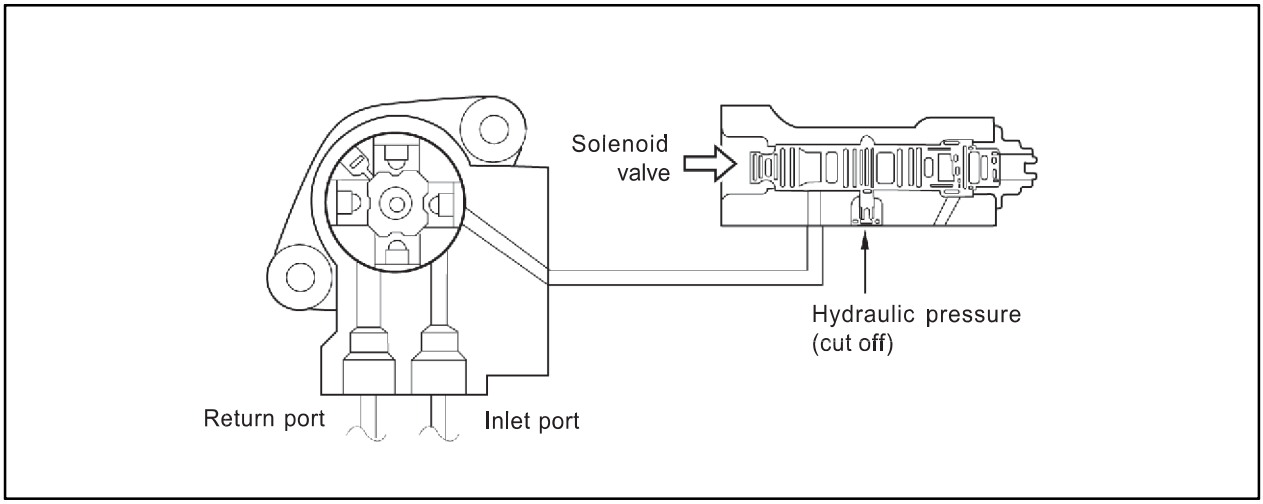
The SSPS control unit controls the amount of electric current to the solenoid valve according to the vehicle speed. In other words, the solenoid valve controls the hydraulic pressure applied to reaction plunger by changing the valve spool position that is linked with solenoid valve according to the amount of electric current. The changes of hydraulic pressure applied to input shaft according to the pressure changes applied to the reaction plunger provide proper steerability based on the amount of electric current.

(2) Specifications

Description	Specification
Voltage Rating	DC 12 V
Current Rating	1.0 A
Resistance	6.7 ± 1 W

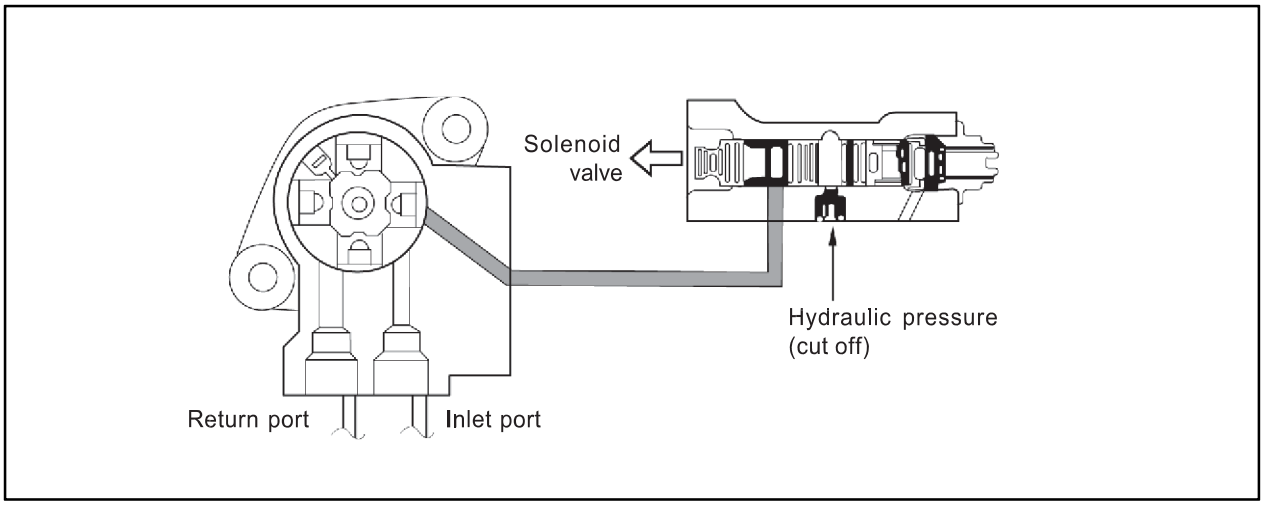
(3) OPERATION

▶ **During parking and low speed driving**



1) The SSPS control unit outputs nearly maximum electrical current.
2) The solenoid rod pushes the PCV spool to the right side.
3) The hydraulic pressure coming from pump is not supplied to the reaction device as the spool orifice is cut off.
4) The hydraulic pressure is cut off and the manipulation of steering wheel becomes lighter.

▶ **In medium and high speed driving**

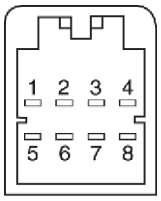


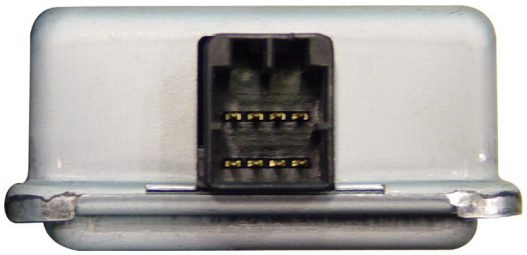
1) The shaft operating force of solenoid rod is reduced due to the reduction of output current from the SSPS control unit.
2) The coil spring pulls the PCV spool toward solenoid valve to open it.
3) The hydraulic pressure from pump flows to pinion reaction area through orifice and applies reaction force to reaction plunger.
4) At this time, the reaction plunger transmits the reaction force to V-groove in input shaft to provide heavy steerability.

Modification basis	
Application basis	
Affected VIN	

2) SSPS CONTROL UNIT

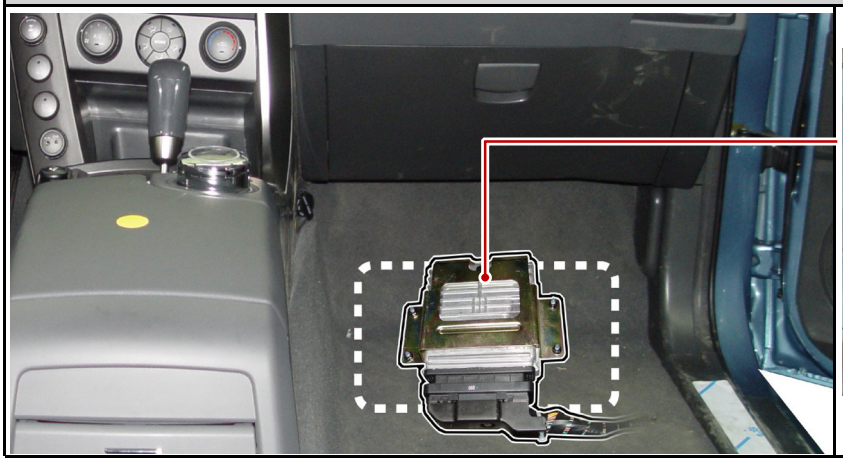
1. To provide proper steerability to a driver, the SSPS control unit controls the solenoid valve by receiving the vehicle speed and the throttle position data via CAN communication.
2. The SSPS control unit controls the working current for the solenoid valve with PWM type duty ratio of 333 Hz frequency and sets the target current to 1A during 1 second after the ignition is "ON".
3. When a trouble occurs in the system, the SSPS control unit generates a trouble code using fail safe function.

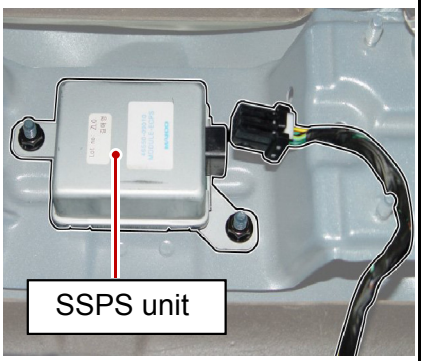




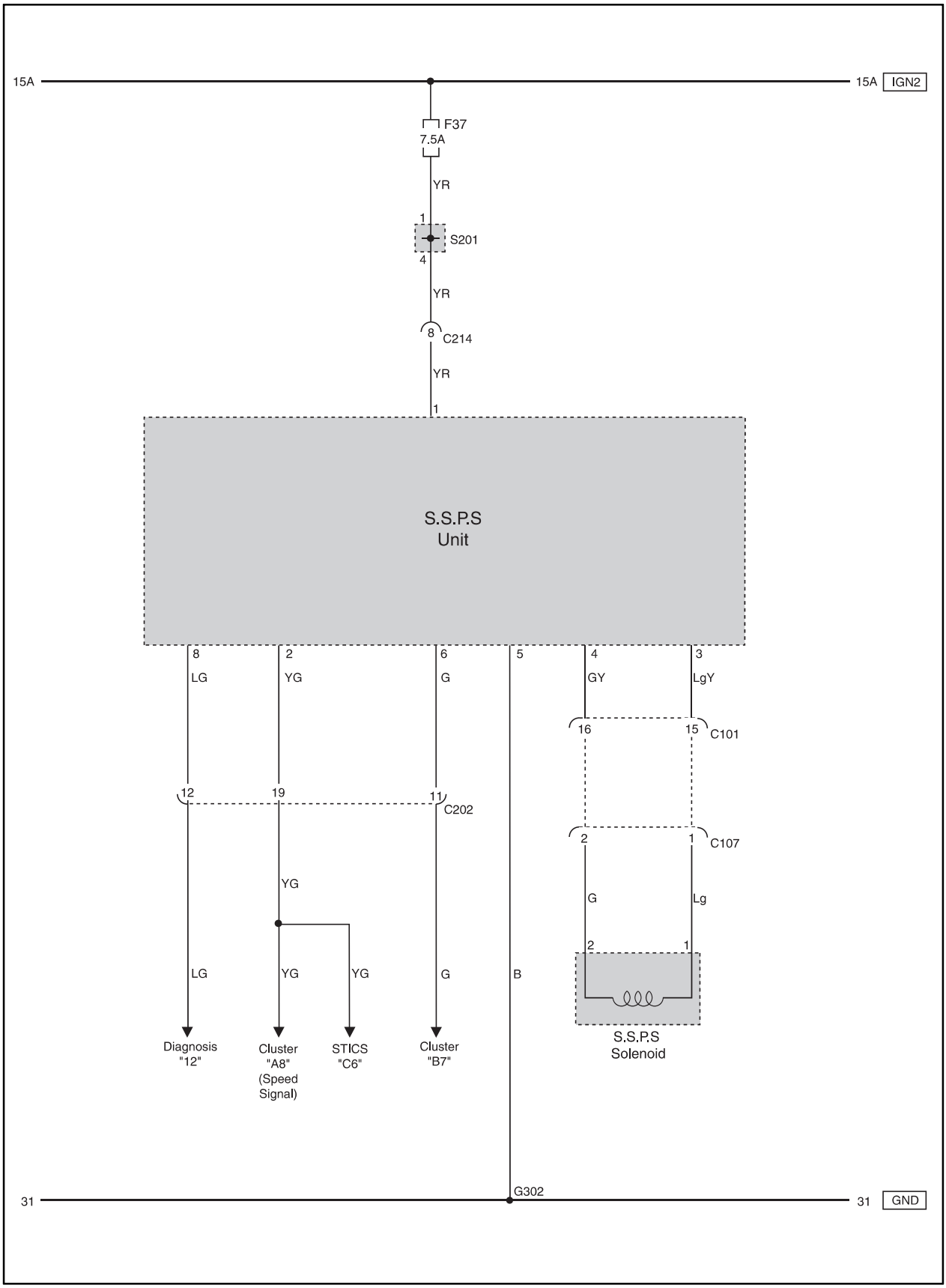
Pin No.	Function
1	Ignition Power Supply
2	CAN HIGH
3	Solenoid
4	Solenoid
5	Ground
6	Warning Lamp (SSPS)
7	CAN LOW
8	Self Diagnosis

Location



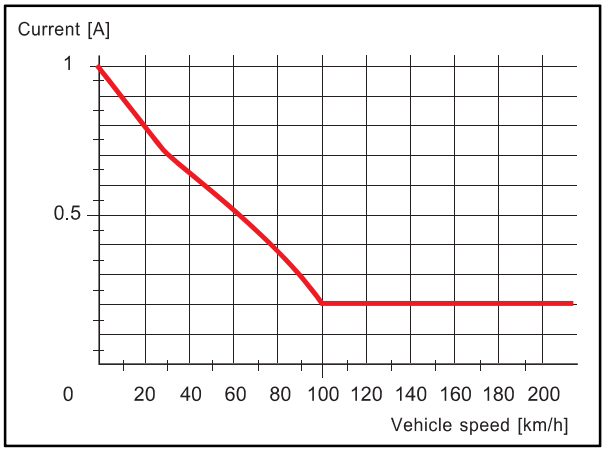


3) CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

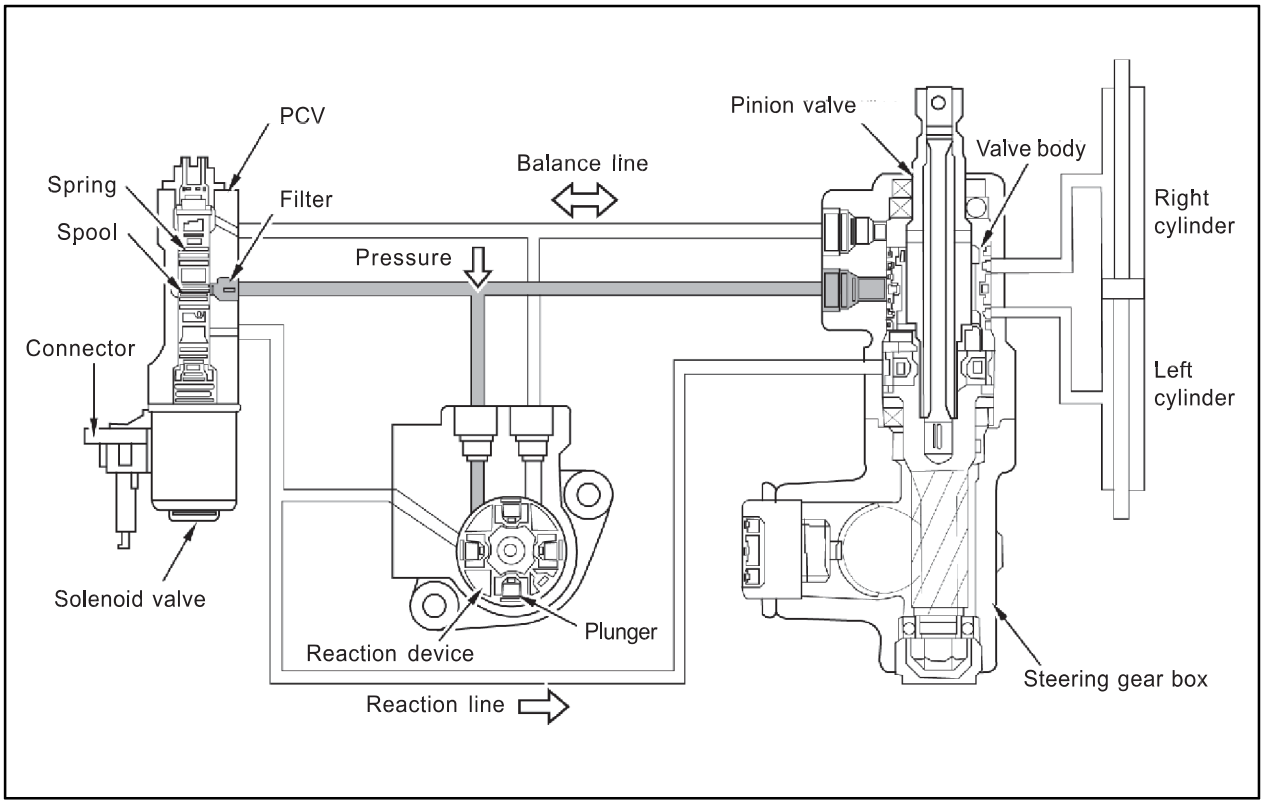
4) S.S.P.S SYSTEM CONTROL



The SSPS system, according to the vehicle speed, enables to achieve proper steering characteristics by controlling hydraulic pressure to reaction plunger located in input shaft of power steering gear box. In other words, the SSPS control unit enhances the parking conveniences by controlling duty type current control. It provides heavy steerability with low current as the vehicle speed increases. Also, it provides light steerability with high current as the vehicle speed decreases.

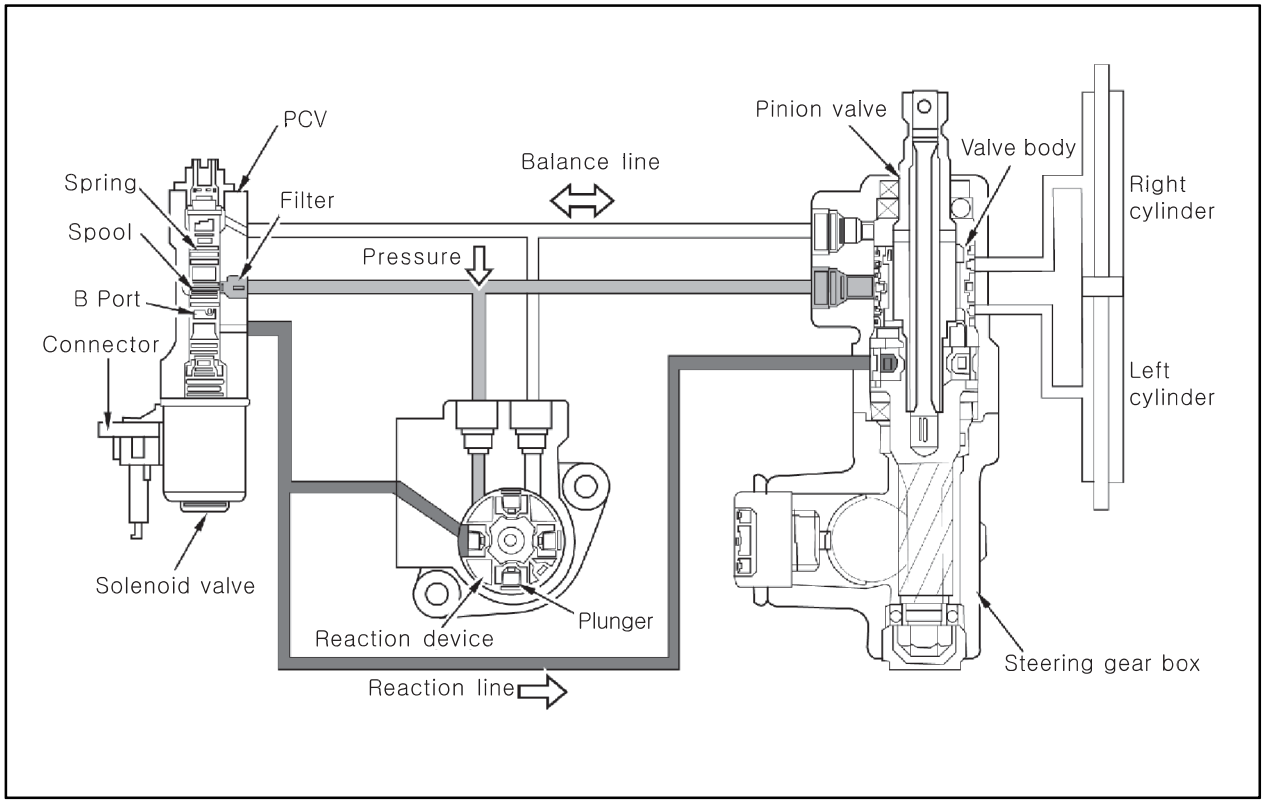
▶ During parking and low speed driving

During parking and driving in low speed, the control unit supplies approx. 1 A of electric current to solenoid valve. Then, the spool located in PCV compresses the upper spring and elevates upward, and the working pressure from oil pump (A port) is not able to flow to the reaction plunger (C port). As a result, the pressing force from the reaction plunger disappears and the steerability enhances.



▶ During high speed driving

During high speed driving, the control unit supplies weak electric current to solenoid valve. Then, the spool located PCV moves from top to bottom, and the working pressure (A port) from oil pump is applied to reaction plunger (C port) through B port. As a result, the pressing force from reaction plunger against input shaft is increased and the steerability becomes heavier.



Modification basis	
Application basis	
Affected VIN	