INDEX

GENERAL INFORMATION

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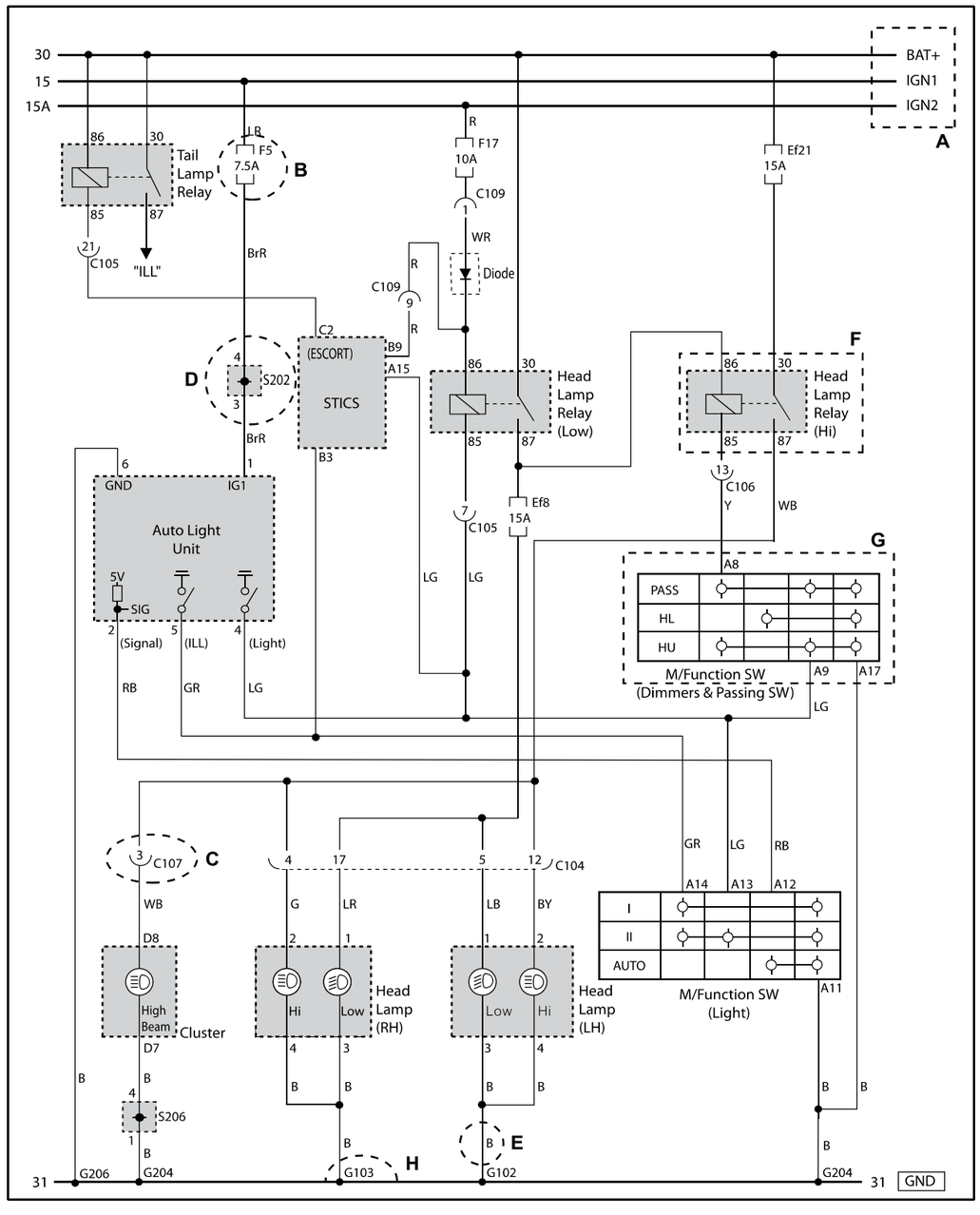
Memo

Memo

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)

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)

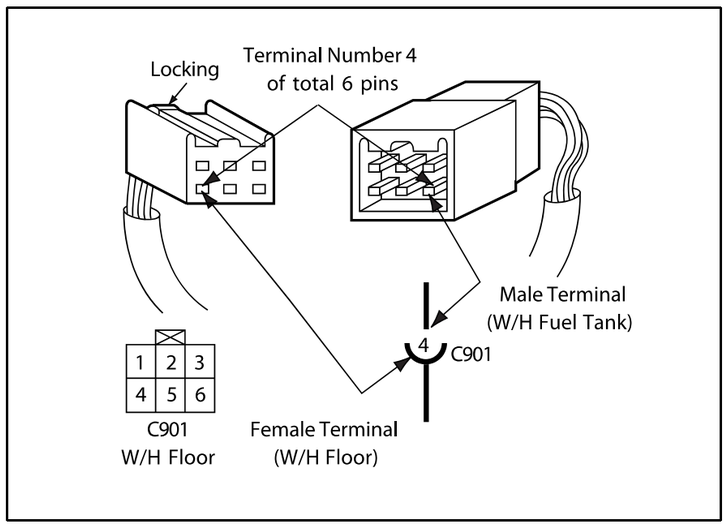
5) WIRING HARNESS COLOR IDENTIFICATION

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	

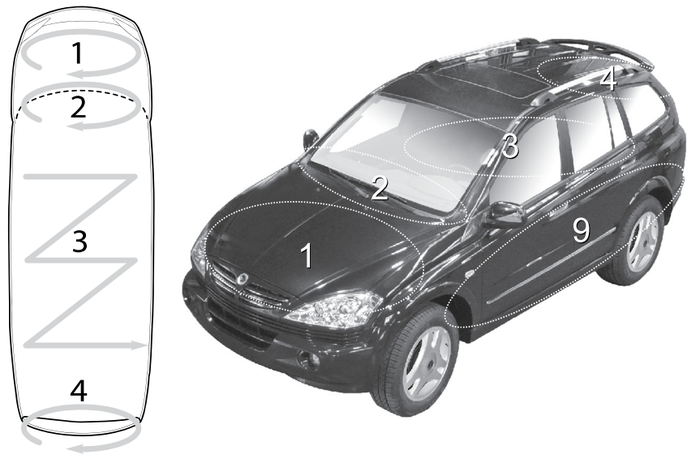
7) PART LOCATION ACCORDING TO PART NUMBER

▶ **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.

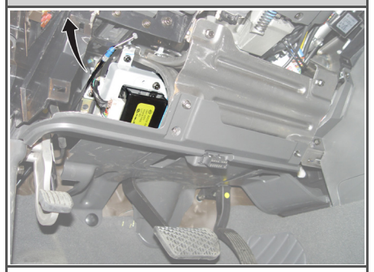
8) ELECTRIC SYMBOLS

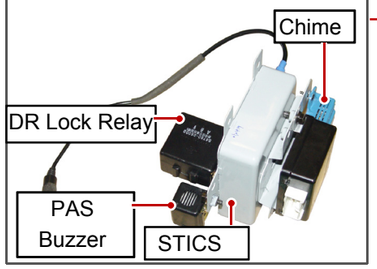
Items	Symbols	Items	Symbols
Resistance		Lamp	
Rheostat		Single Bulb	
Coil, Inductance		Double Bulb	
Condenser, Capacitor		Transistor : PNP type	
Ground, Earth		Transistor : NPN type	
Diode		~Meter, ~Gauge	
Zener Diode		Voltmeter	V
Photo Diode		Amperemeter	A
Light Emitting Diode		Switch	
Battery		Thermistor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

2. LAYOUT OF ELECTRICAL SYSTEM

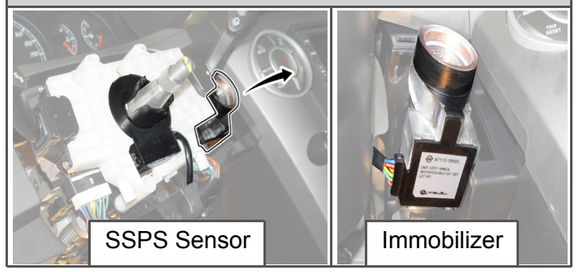
1) POSITION OF INTERIOR UNIT & SENSOR

Under the I/P (Driver Seat)





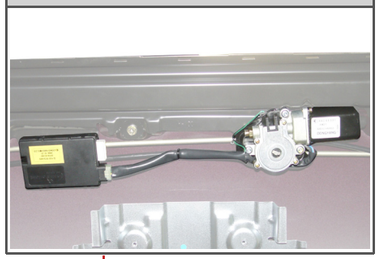
A SSPS Sensor (D27DT) / Immobilizer



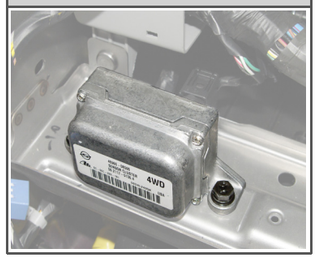
Rain Sensing Unit (Auto Light)/ECM

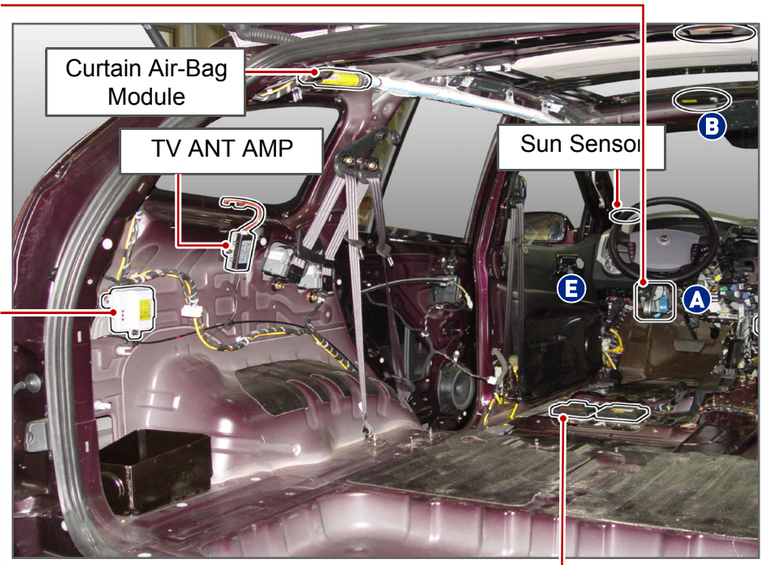


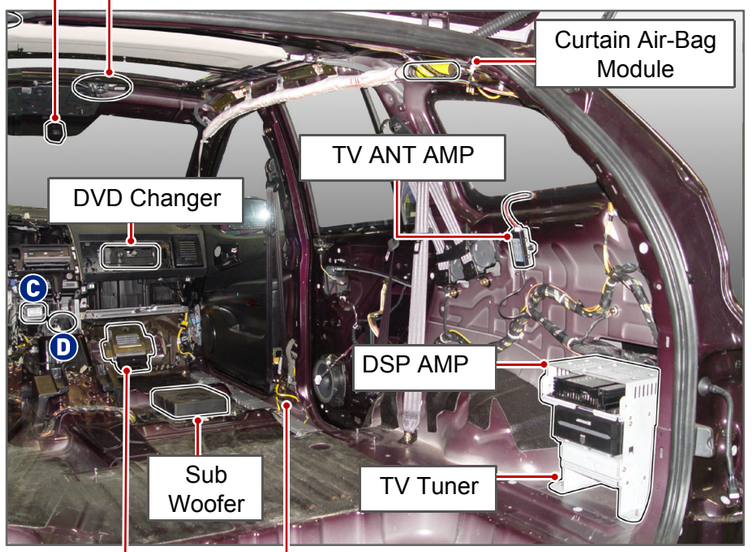
B S/Roof Unit / Motor



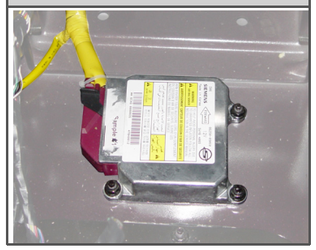
C Sensor Cluster



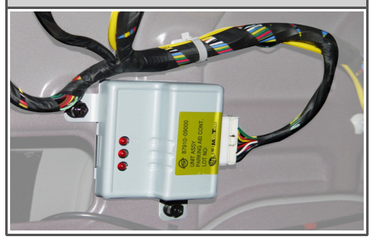




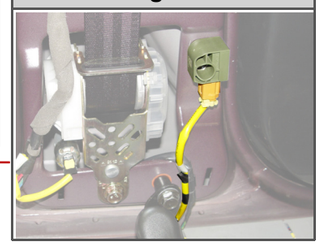
D Air-Bag ECU



PAS Unit



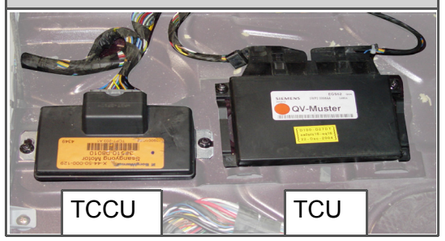
Curtain Air-Bag Sensor



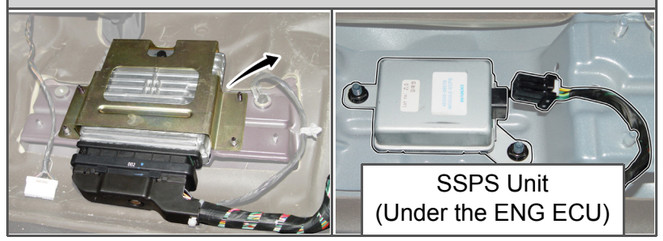
E Driver Seat Memory SW



TCCU / TCU



ENG ECU / SSPS Unit



Incar Sensor



Modification basis	
Application basis	
Affected VIN	

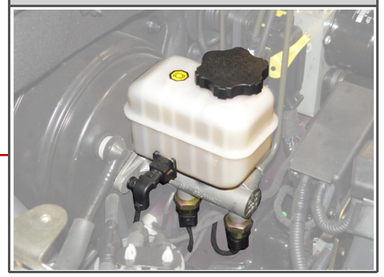
2) ENGINE ROOM SWITCH, UNIT & SENSOR

FFH Ass'y





ESP Pressure Sensor 1,2

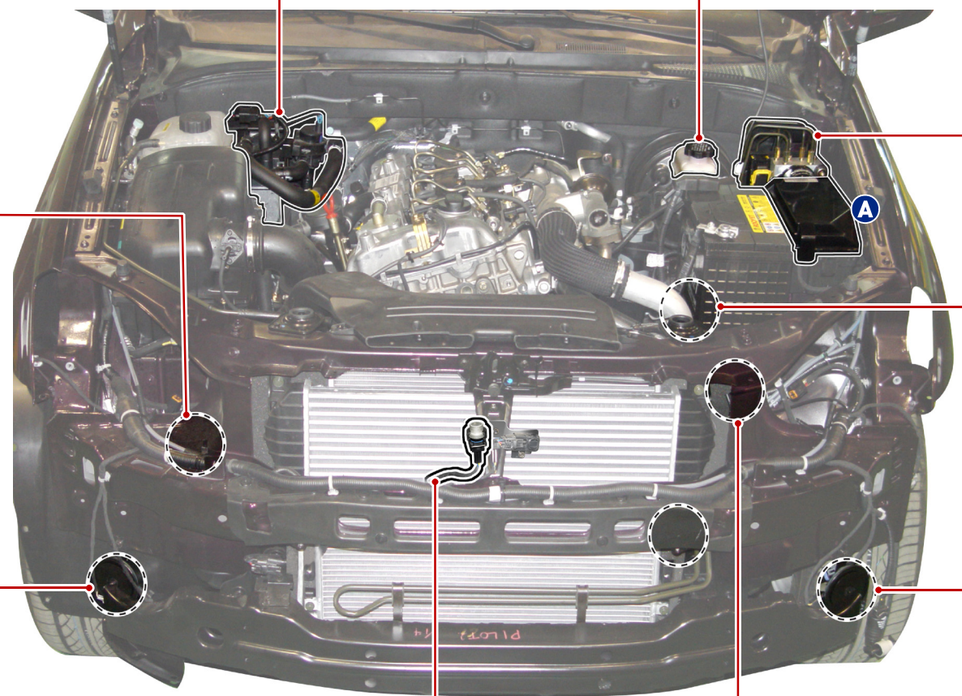


ABS (ESP) HECU

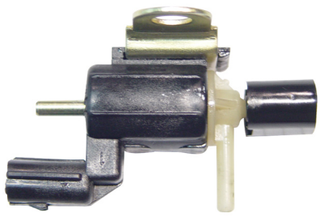


Receiver Dryer/
Tripple Pressure SW





IWE Solenoid Valve (4WD)



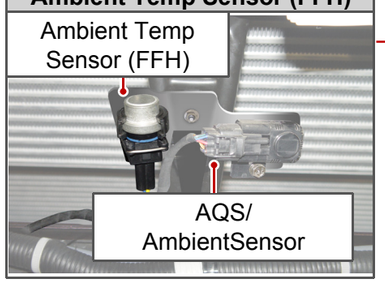
(Under the BATT TRAY)

Horn (RH)

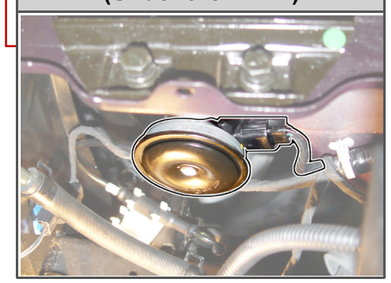


Horn (LH)

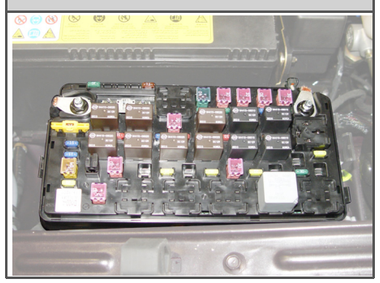
AQS Sensor/
Ambient Temp Sensor (FFH)



Burglar Horn
(Under the BATT)

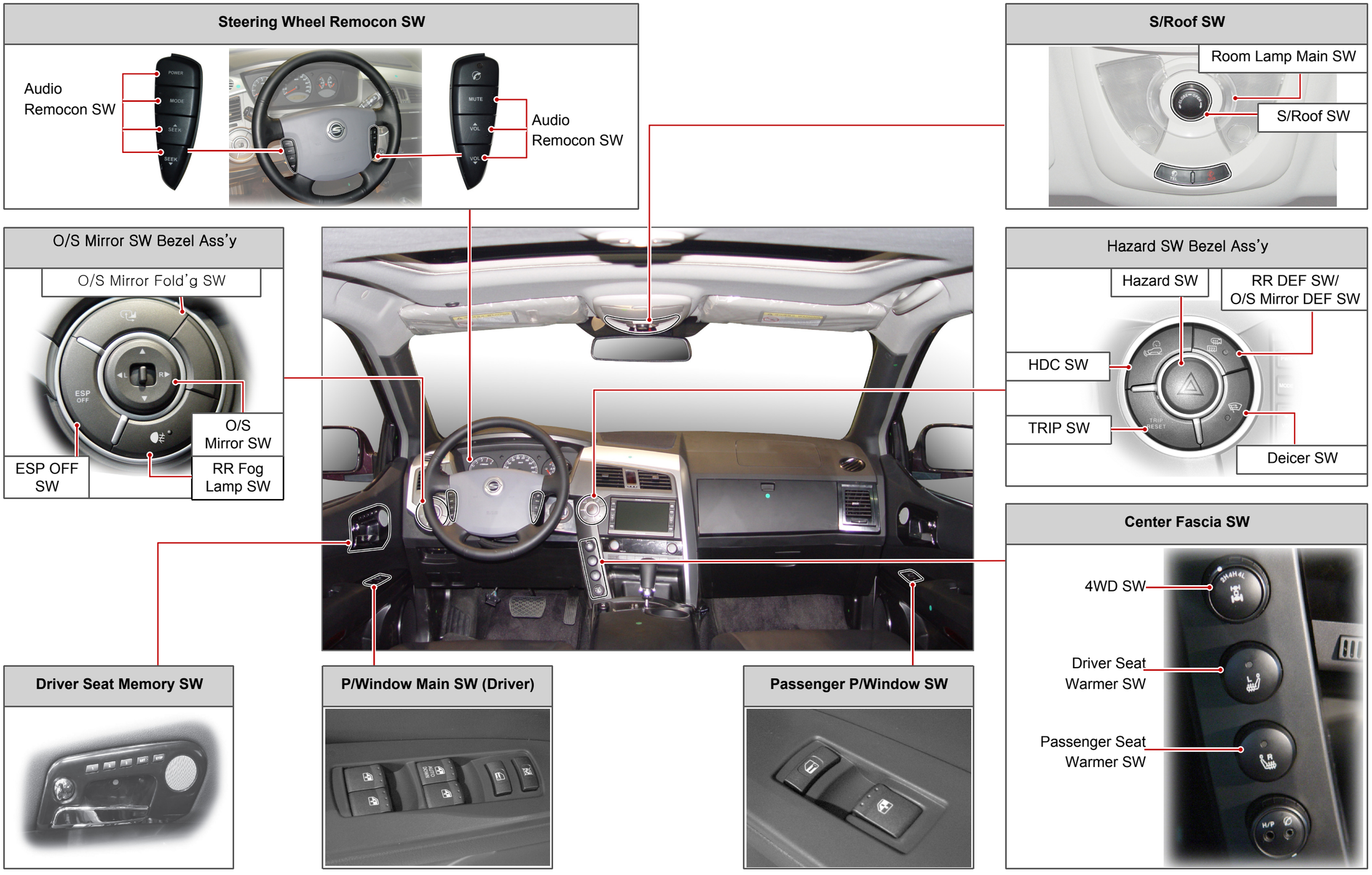


A Fuse & Relay Box



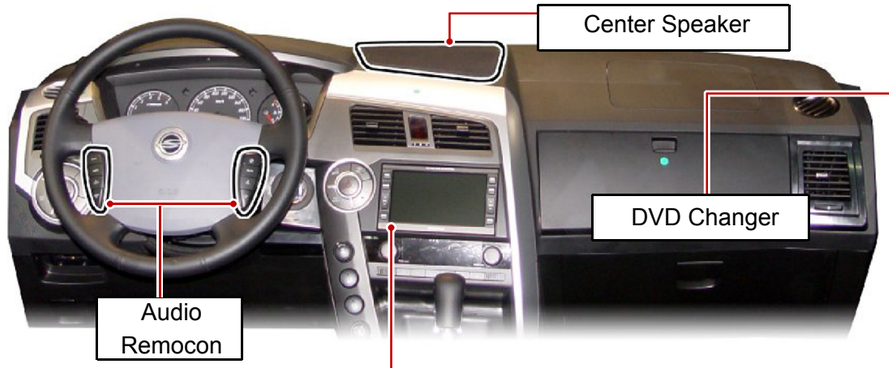
Modification basis	
Application basis	
Affected VIN	

3) INTERIOR SWITCH O/S Mirror SW Bezel Ass'y Steering



Modification basis	
Application basis	
Affected VIN	

4) AV SYSTEM



Position: Upper the G/Box panel



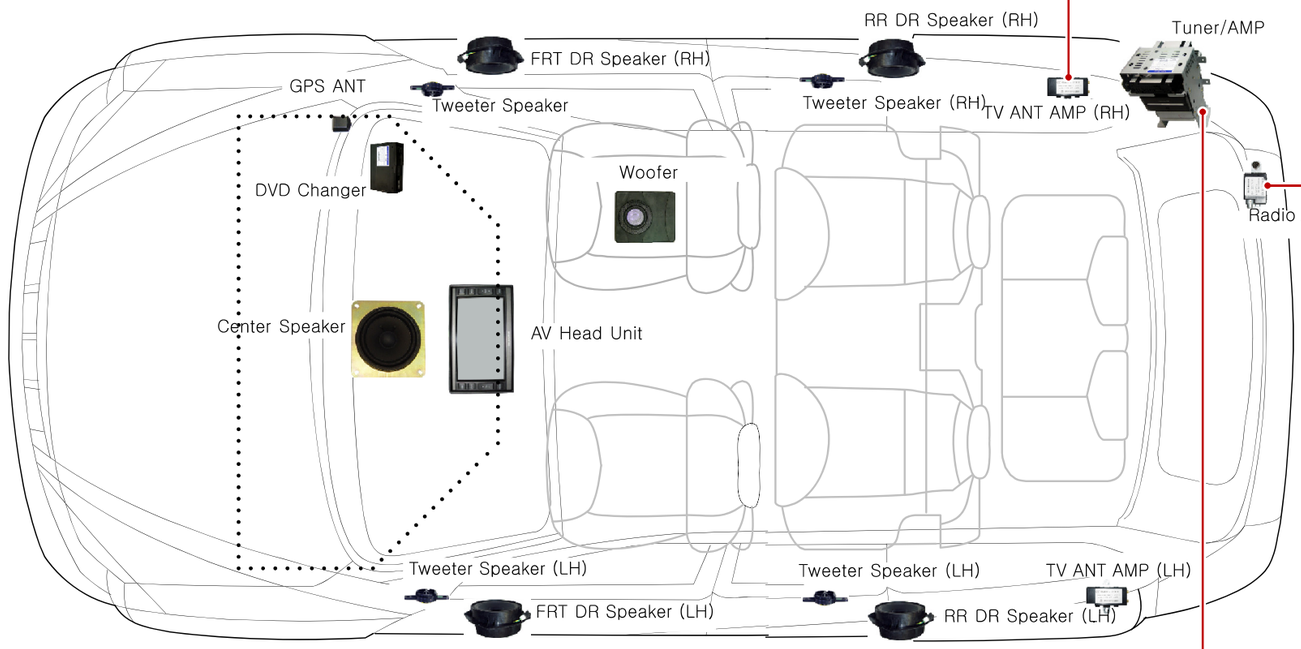
TV ANT AMP (RH)



DVD + Tape







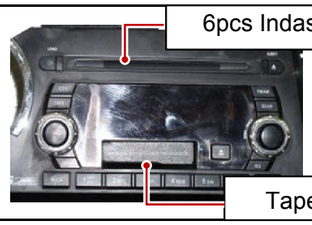
Radio ANT AMP



Woofer



Etc Audio Head Unit

6pcs INDASH CD+TAPE+RADIO	CD+RAIDIO
6pcs Indash  Tape	CD Insert 

AV SYSTEM

DSP/AMP

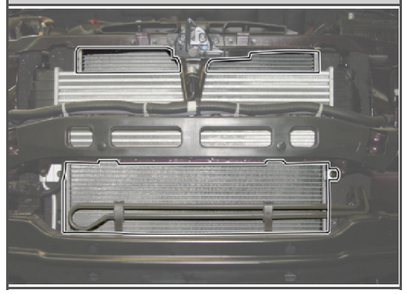
Tuner

Modification basis	
Application basis	
Affected VIN	

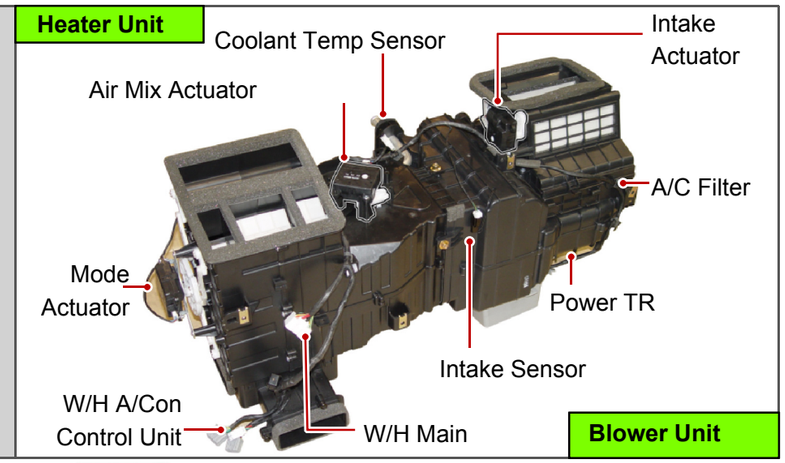
5) A/CON SYSTEM

Type	Ⓐ A/Con Controller
FATC	
Manual A/C	

Condensor



Ⓑ **A/Con Module Ass'y**



Ⓔ Sun Sensor (Upper the IP LH)





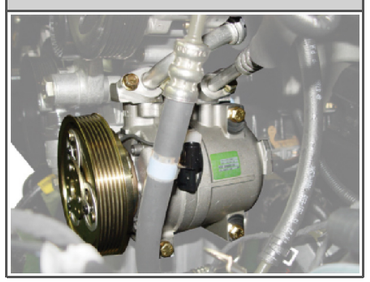
Receiver Dryer (LH)



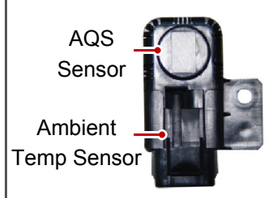
Ⓓ AQS Mode SW



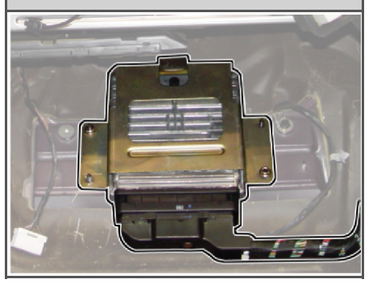
Compressor



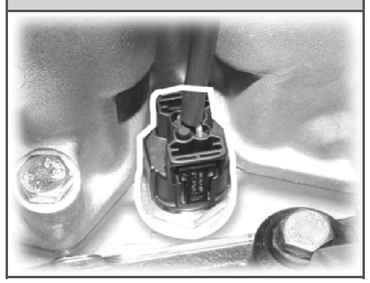
AQS/Ambient Temp Sensor



Ⓒ ENG ECU



Coolant Temp Sensor



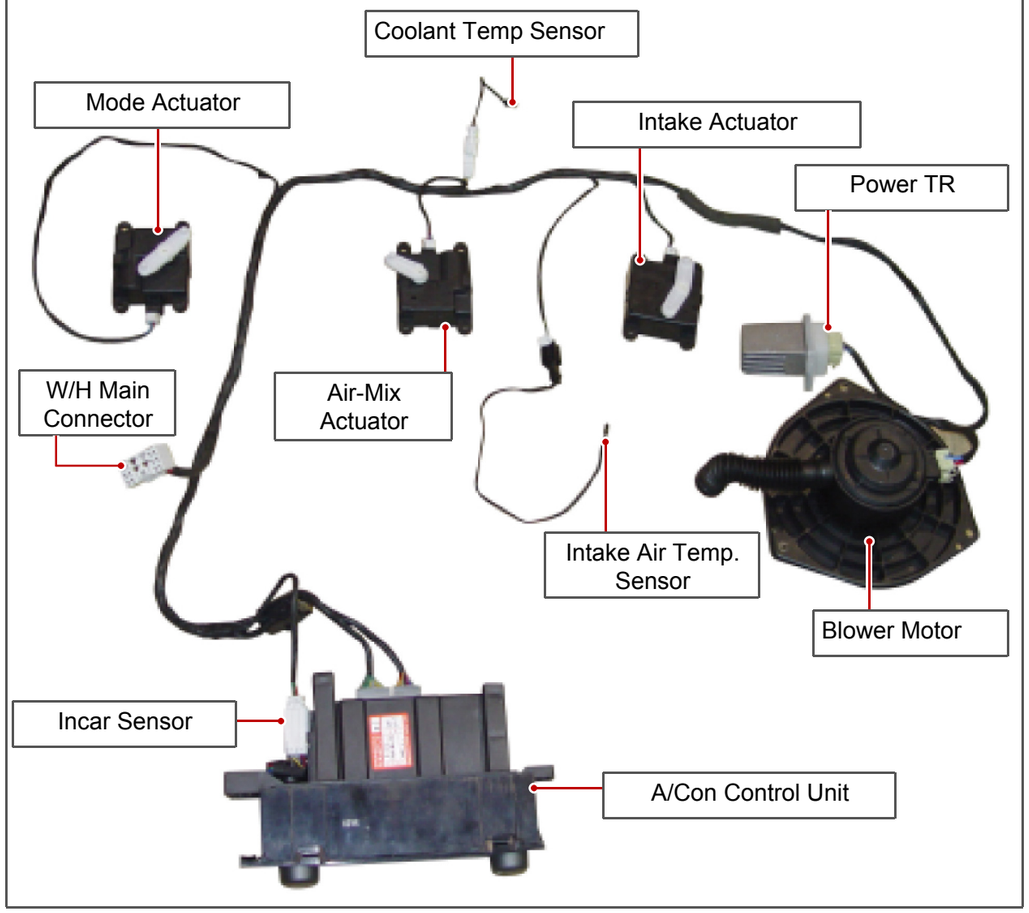
Modification basis	
Application basis	
Affected VIN	

▶ AIR-DUCT LAY-OUT



▶ W/H A/CON MODULE

A/Con Wiring Setting



Memo

Memo

8201-00/8210-00/8210-02/8210-03/8210-09/8210-10/8210-06/8210-07/8210-08

WIRING

8201-00 WIRING HARNESS,
COMPONENTS LOCATION..... 3

CONNECTOR/GROUND

8210-00 W/H ENGINE ROOM..... 19
8210-02 W/H MAIN..... 20
8210-03 W/H FLOOR..... 21
8210-09 W/H ROOF..... 23
8210-10 W/H TAIL GATE..... 23
8210-06 W/H DRIVER DOOR..... 24
8210-07 W/H PASSENGER DOOR..... 24
8210-08 W/H RR DOOR..... 25

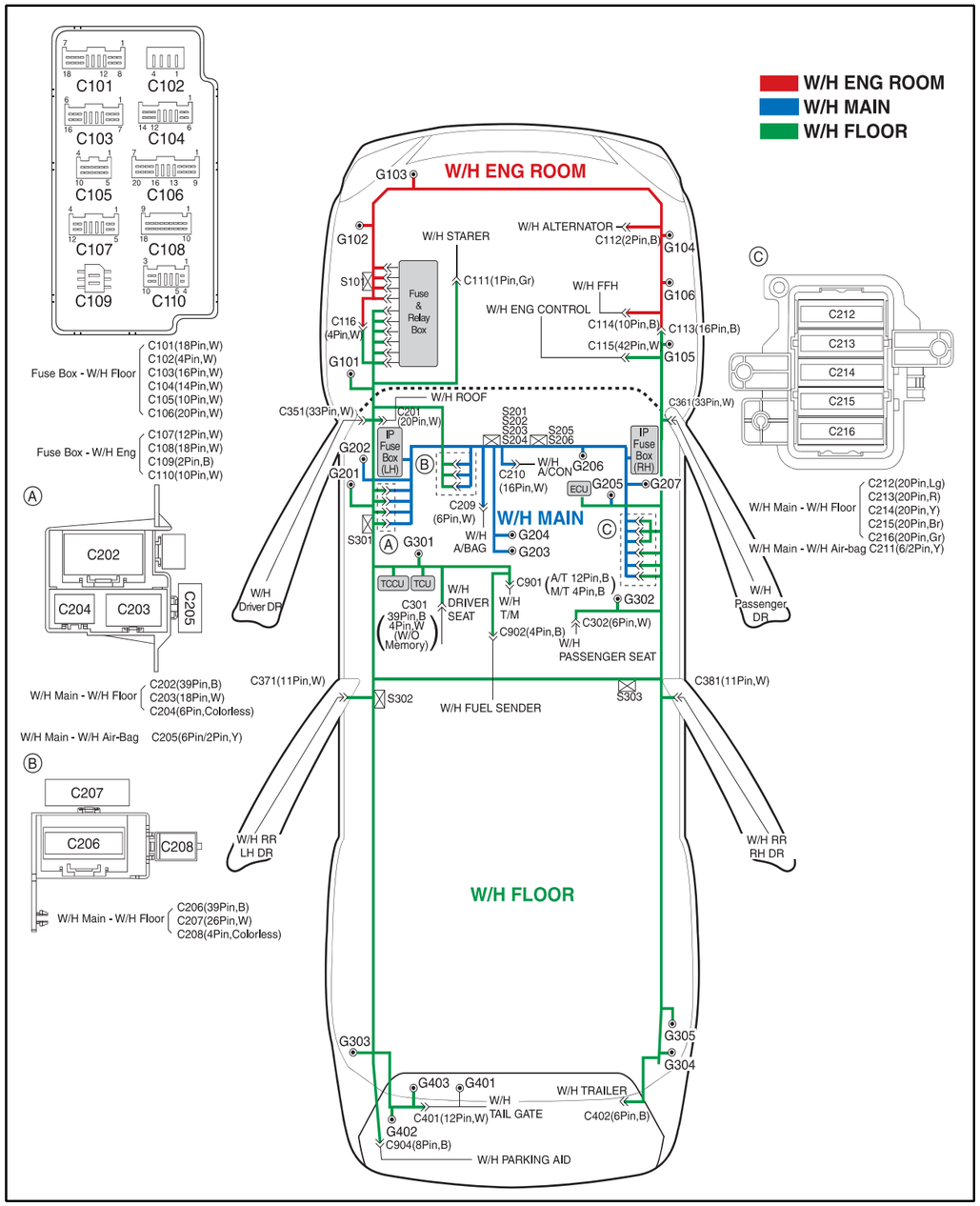
Memo

Memo

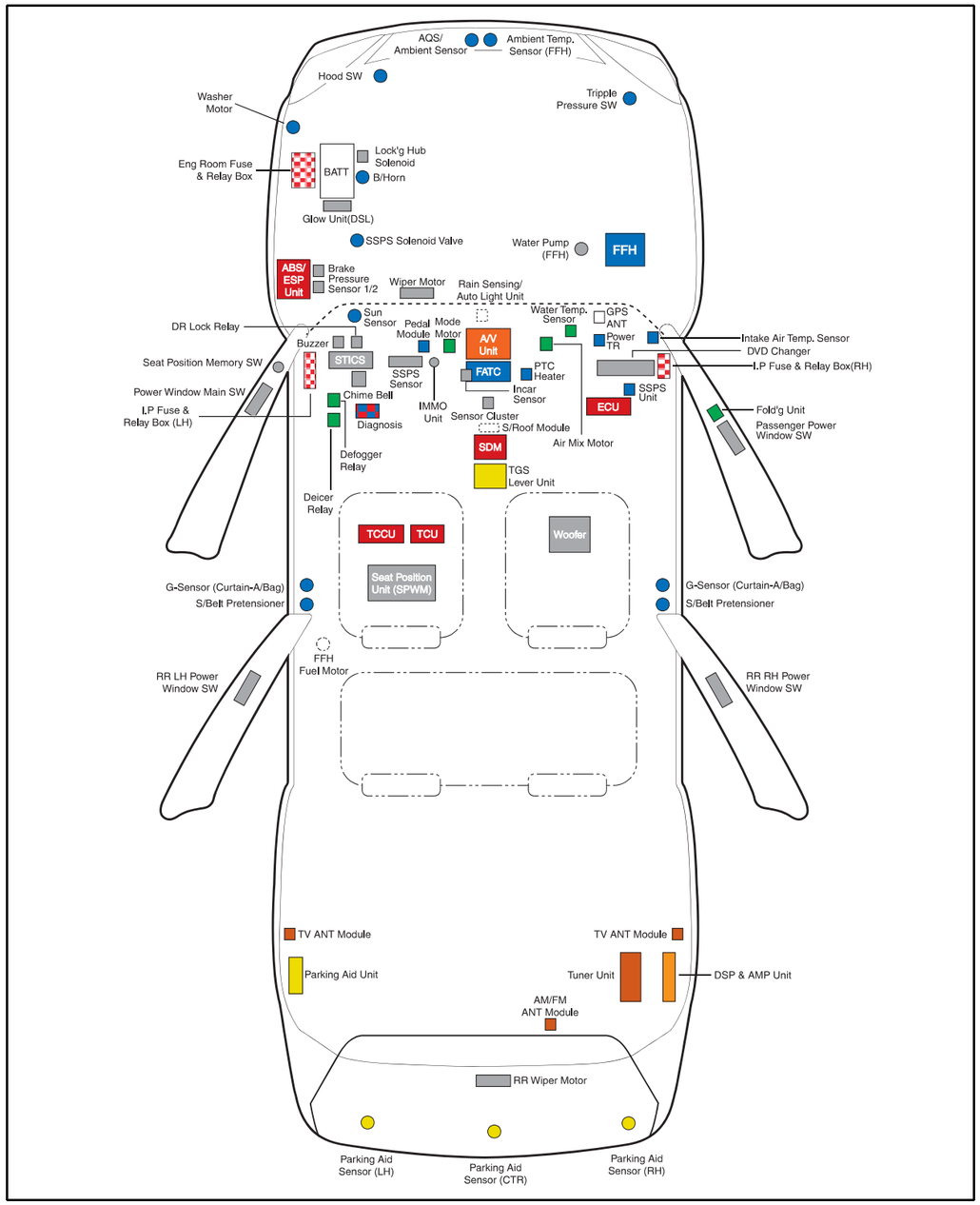
WIRING HARNESS

S.G.N. 8201-00 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 (18Pin, 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	Only D20DT
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	
C116 (4Pin, White)	W/H Eng - W/H Floor	Inside 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	
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	
C205 (6Pin, Yellow)	W/H Main - W/H A/Bag	Driver Cowl Side C/Holder	Curtain A/Bag
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
C209 (6Pin, White)	W/H Main - W/H A/Bag	Upper the Driver Legroom	A/Bag
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	
C211 (6Pin, Yellow)	W/H Main - W/H A/Bag	Passenger Cowl Side C/Holder	Curtain A/Bag
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	
C216 (20Pin, Gray)	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
C301 (4Pin, 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, Black)	W/H Floor - W/H T/Gate	Under the RH T/Gate	
C402 (6Pin, Black)	W/H Floor - W/H Trailer	Under RH Bumper	
C901 (12Pin, Black)	W/H Floor - W/H T/M	Upper the T/M	A/T
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	
C904 (8Pin, Black)	W/H Floor - W/H PAS	Under LH Bumper	

Modification basis	
Application basis	
Affected VIN	

▶ GROUND

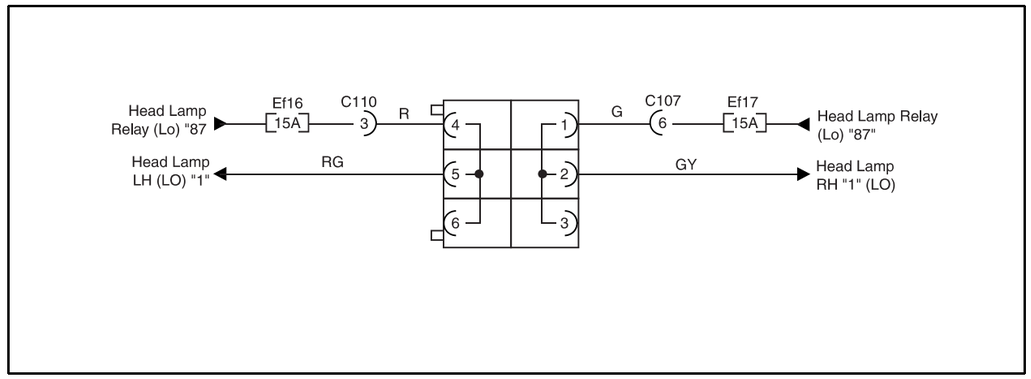
Connector Number	Connecting Wiring Harness	Connector Position	Remark
G101	W/H Floor	ABS/ESP Modulator	ABS/ESP
G102	W/H Eng Room	Behind LH Head Lamp	
G103	W/H Eng Room	LH FRT END PNL (LH Head Lamp Side)	
G104	W/H Eng Room	Behind RH Head Lamp	
G105	W/H Floor	RH Cowl Side PNL (Beside C114)	A/Bag
G106	W/H 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 (W/H A/Bag)	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 LH T/Gate	Heater Glass
G403	W/H Floor	Upper the LH T/Gate	

▶ SPLICE PACK

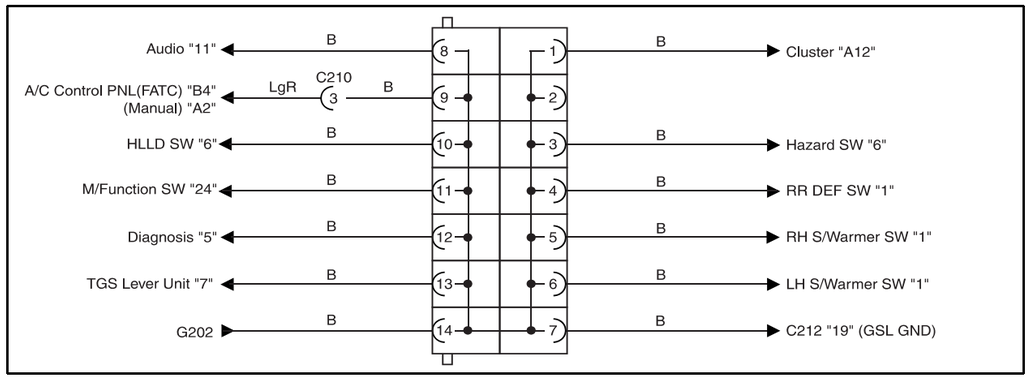
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
S101 (6Pin, Black)	W/H Eng	Inside the Eng Room Fuse & Relay Box	Head Lamp
S201 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	
S202 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	CAN
S203 (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 (14Pin, 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	
S303 (8Pin, Black)	W/H Floor	Under the Passenger "B" PLR W/H Protector	DR Lock

4) SPLICE PACK CIRCUIT

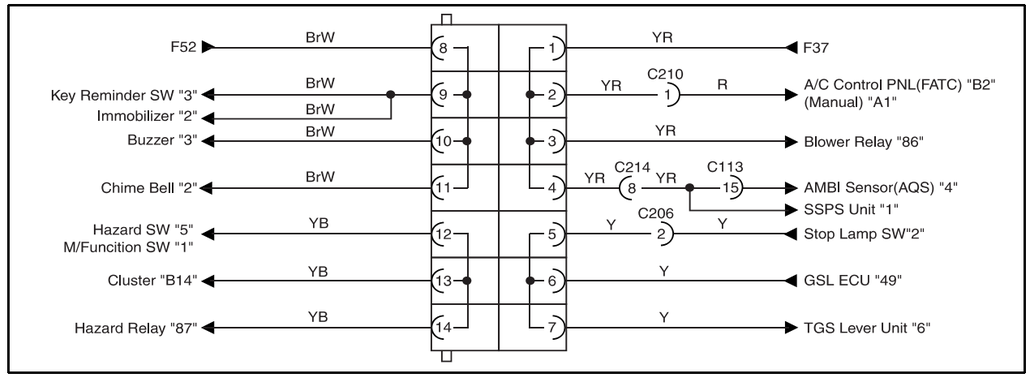
▶ S101



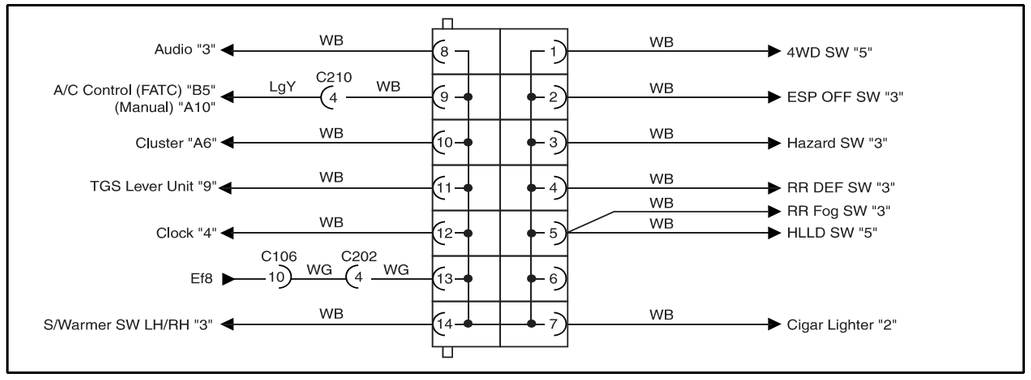
▶ S203 (GND)



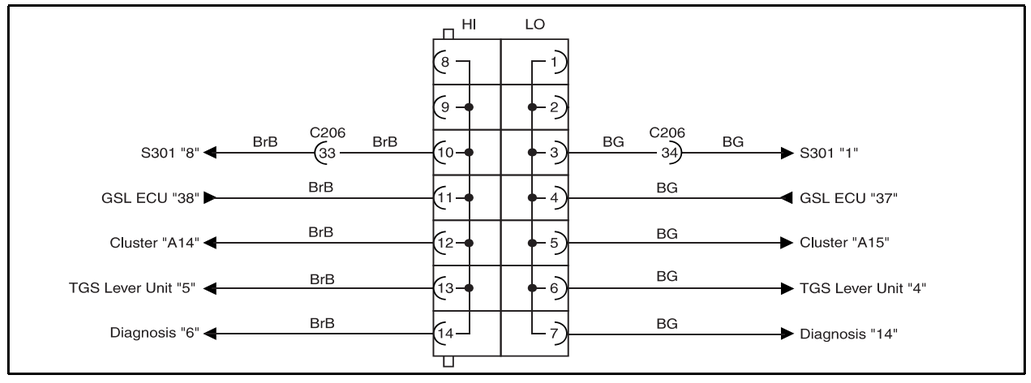
▶ S201



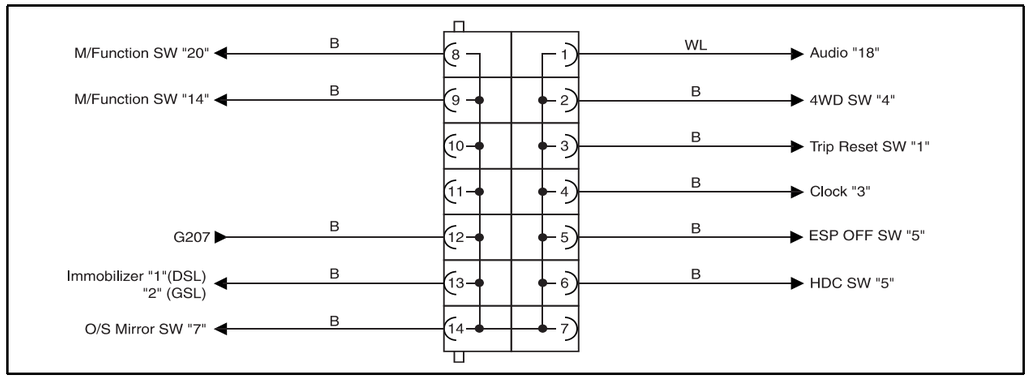
▶ S204 (ILL+)



▶ S202 (CAN)

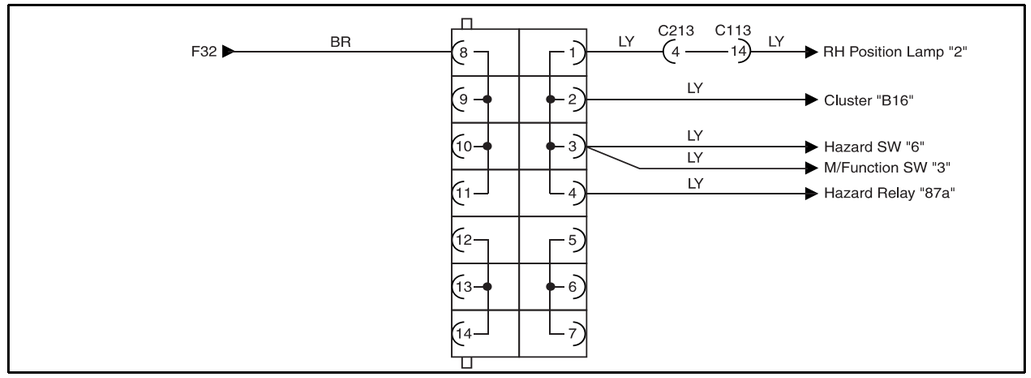


▶ S205 (GND)

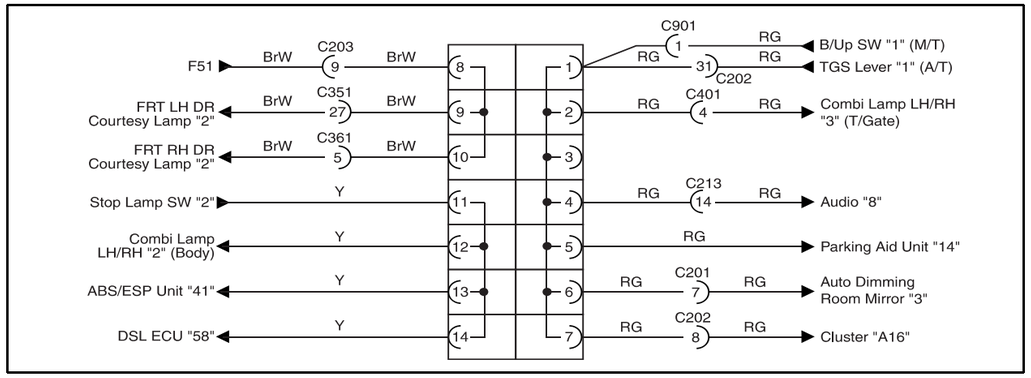


Modification basis	
Application basis	
Affected VIN	

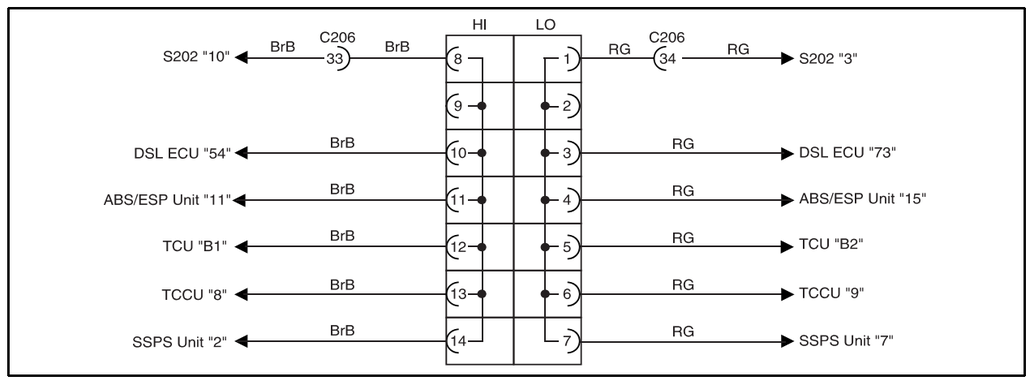
▶ S206



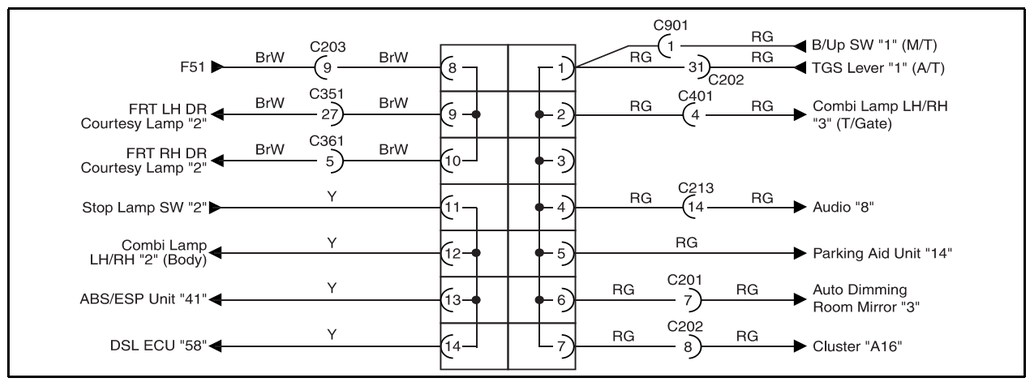
▶ S303



▶ S301 (CAN)



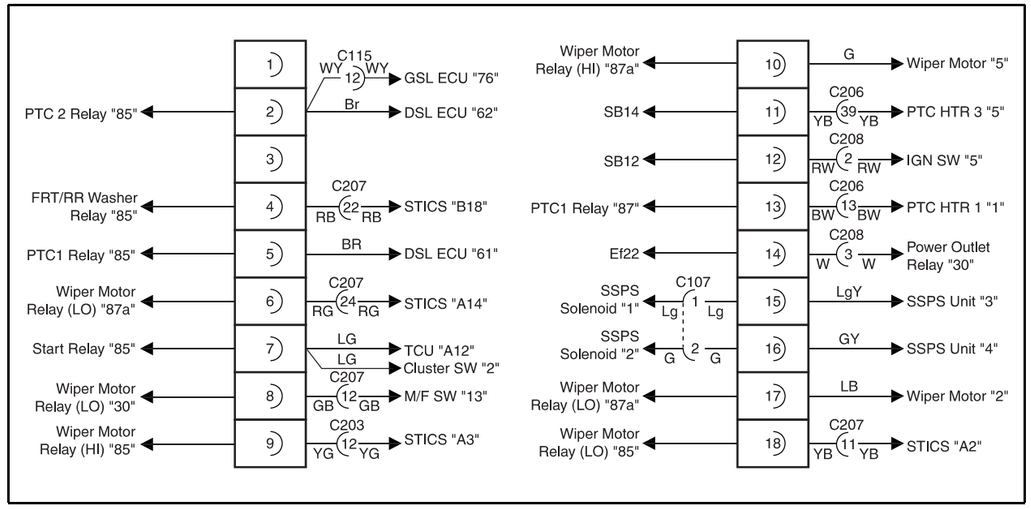
▶ S302



Modification basis	
Application basis	
Affected VIN	

5) CONNECTOR

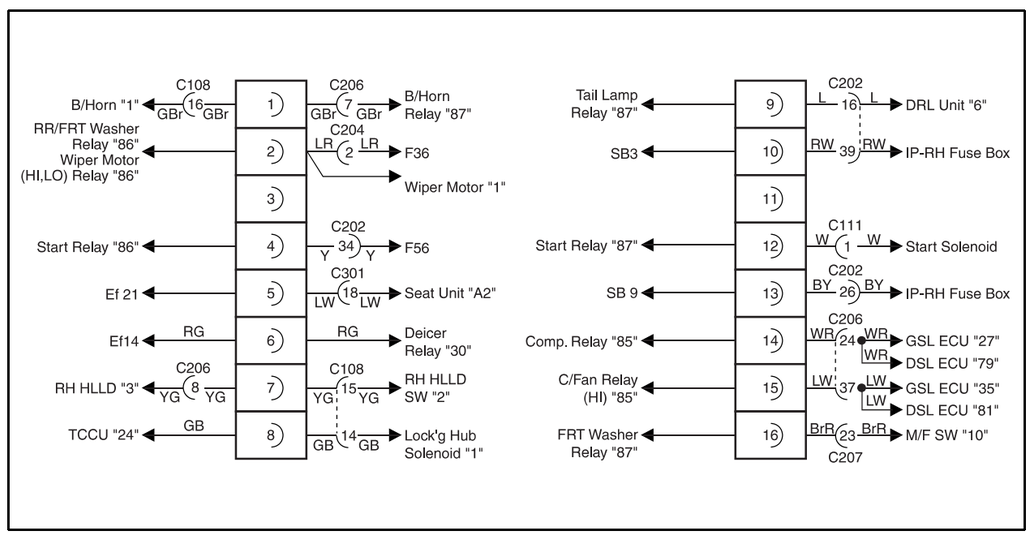
▶ C101



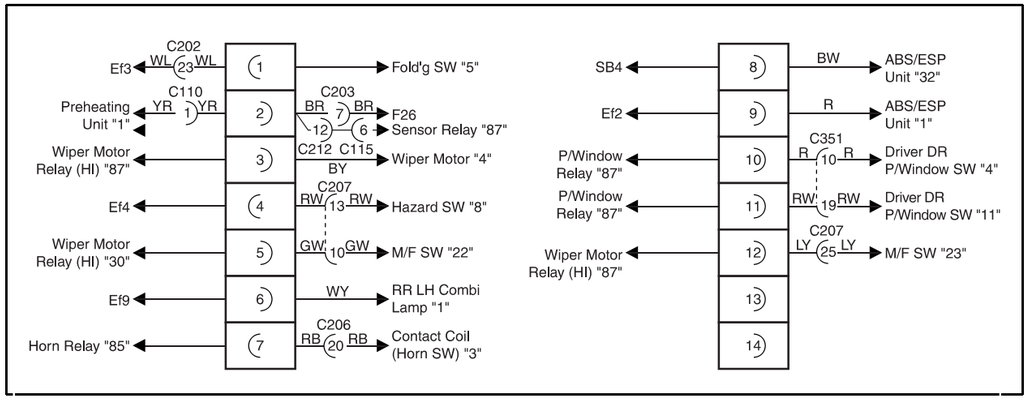
▶ C102



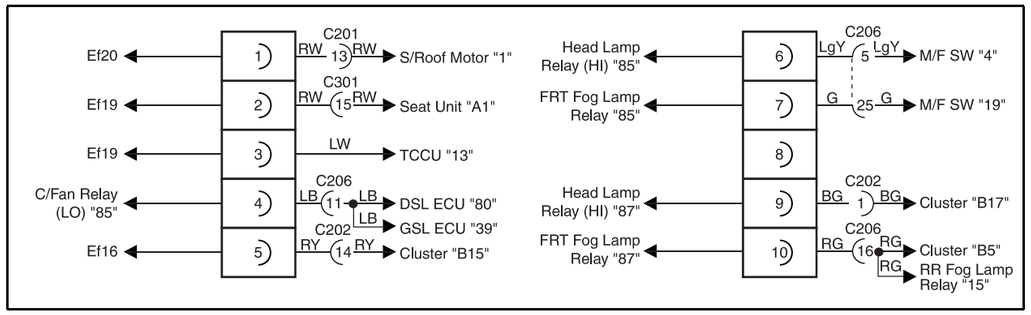
▶ C103



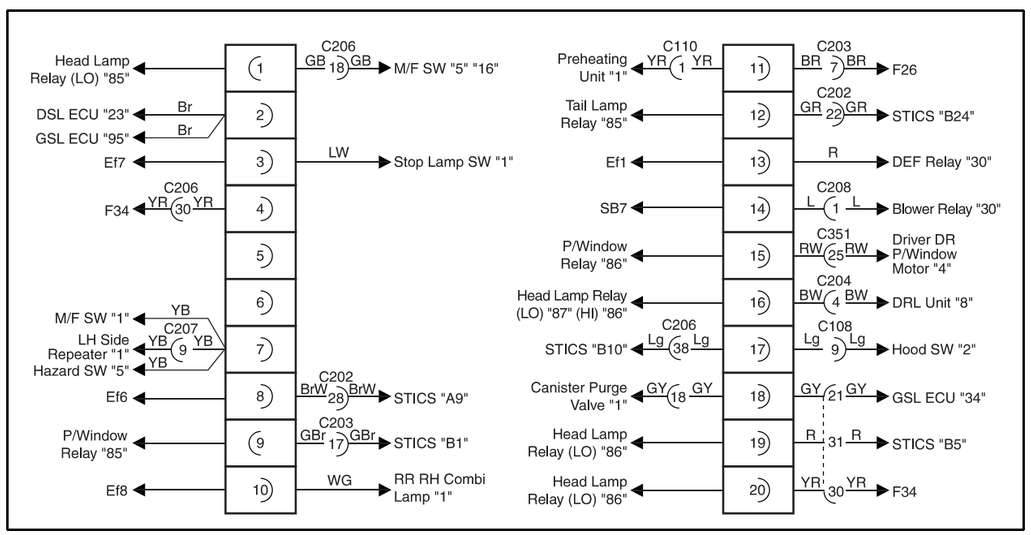
▶ C104



▶ C105

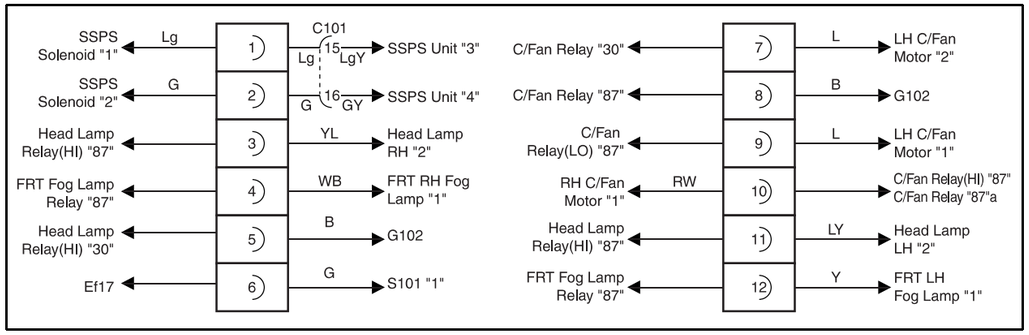


▶ C106

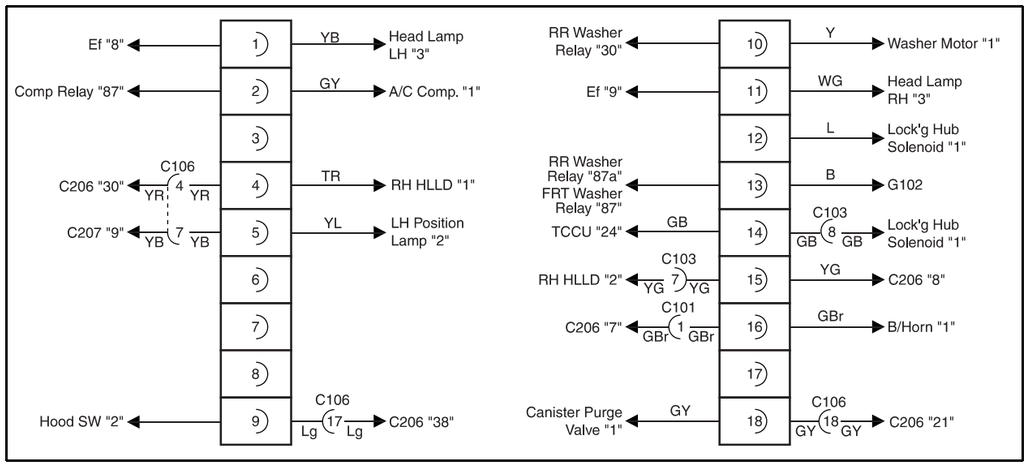


Modification basis	
Application basis	
Affected VIN	

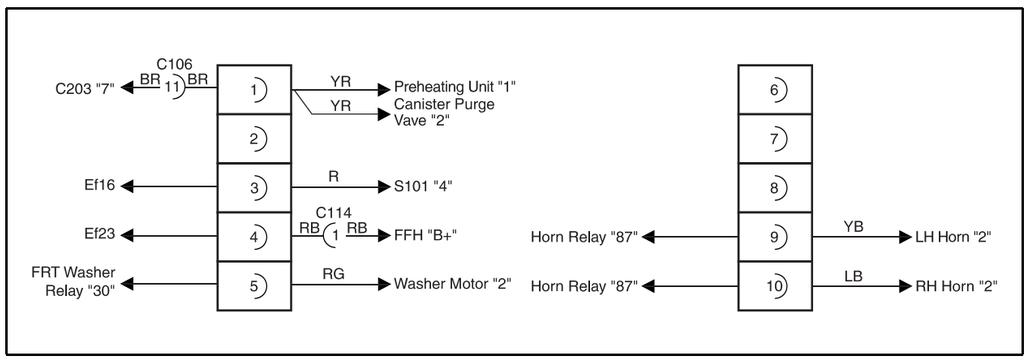
▶ C107



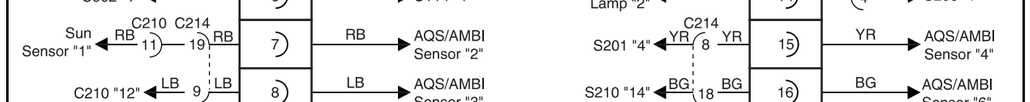
▶ C108



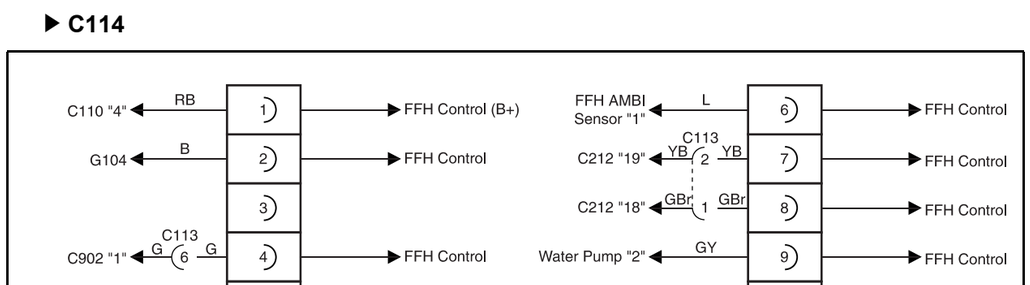
▶ C110



▶ C111



▶ C112

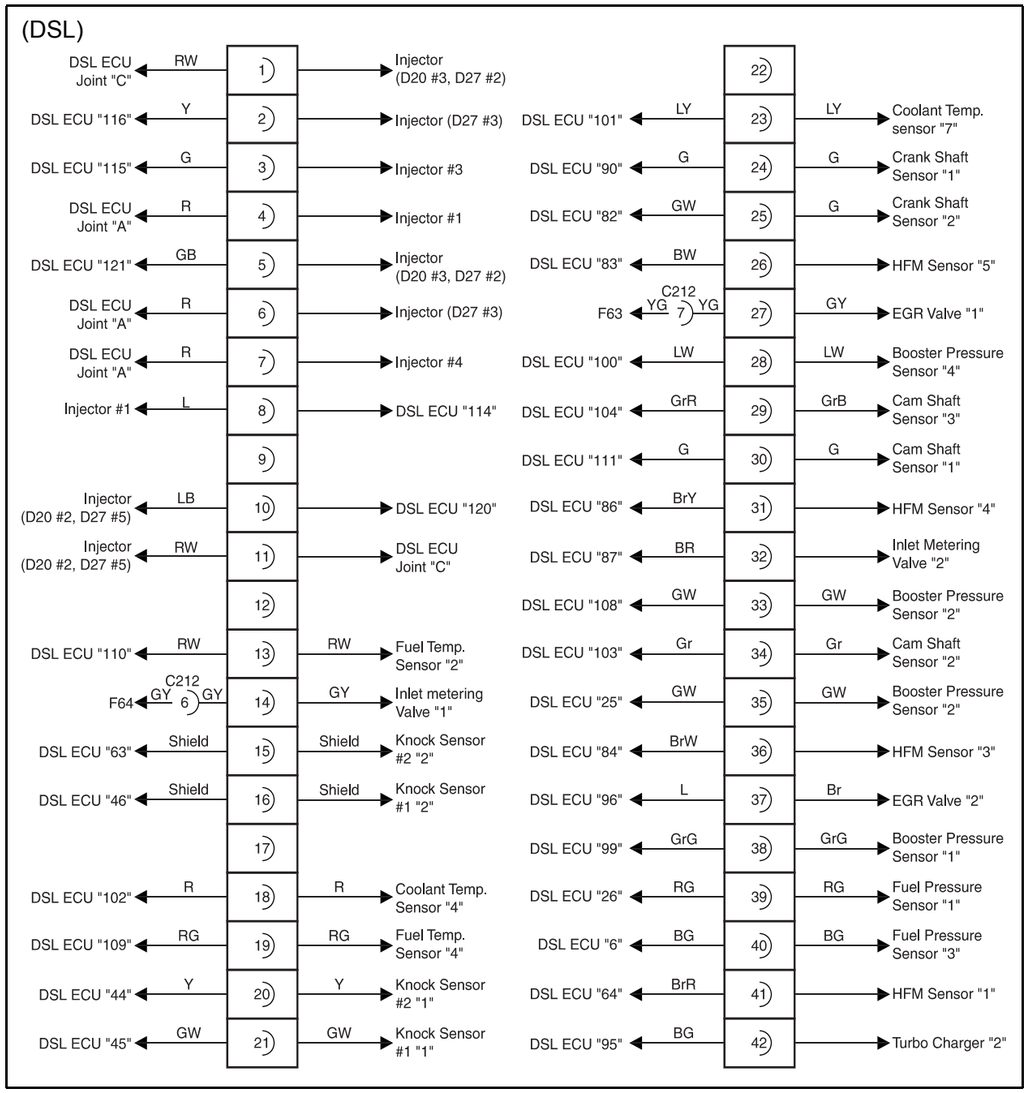


▶ C113

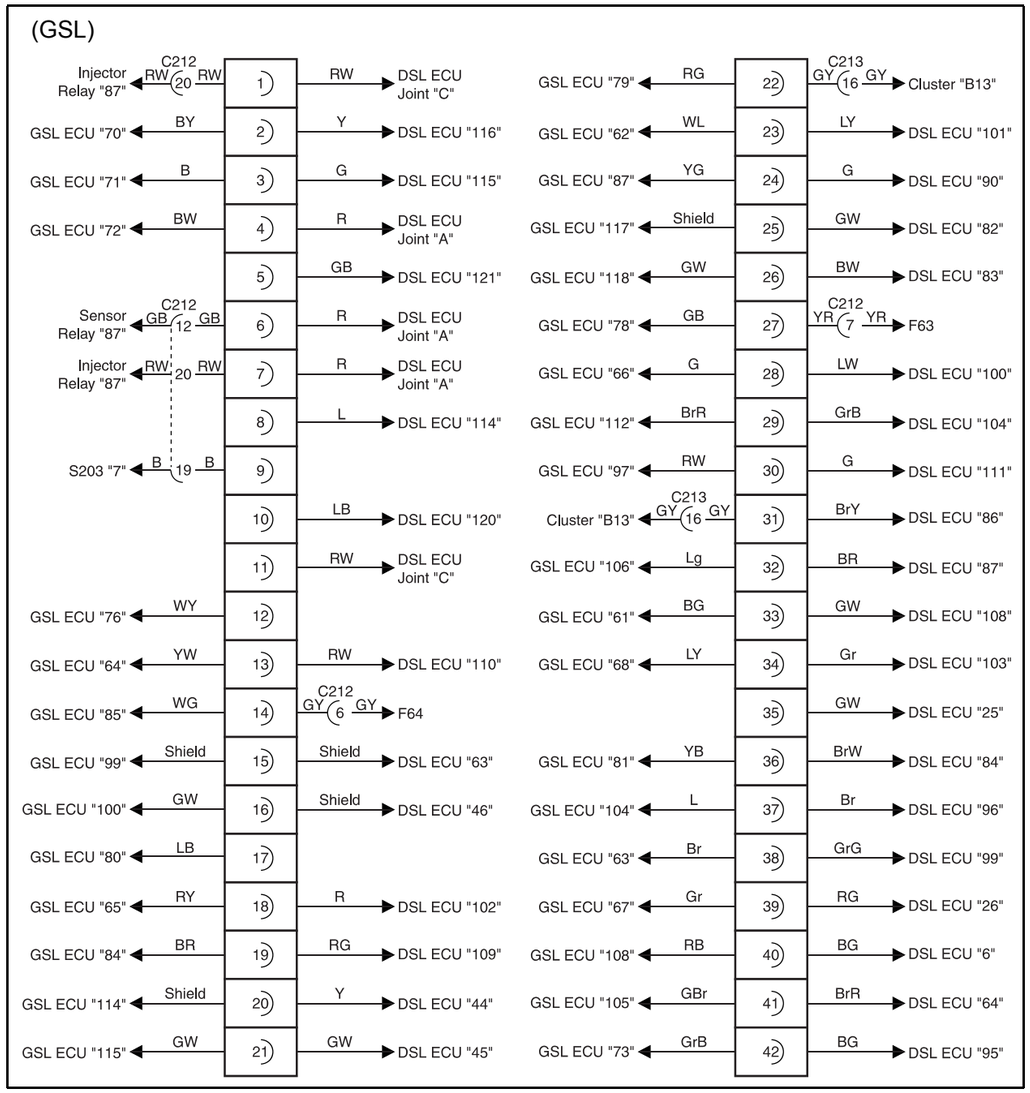
▶ C114

Modification basis	
Application basis	
Affected VIN	

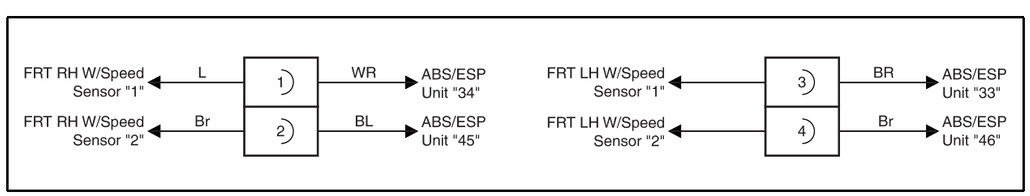
▶ C115



▶ C115

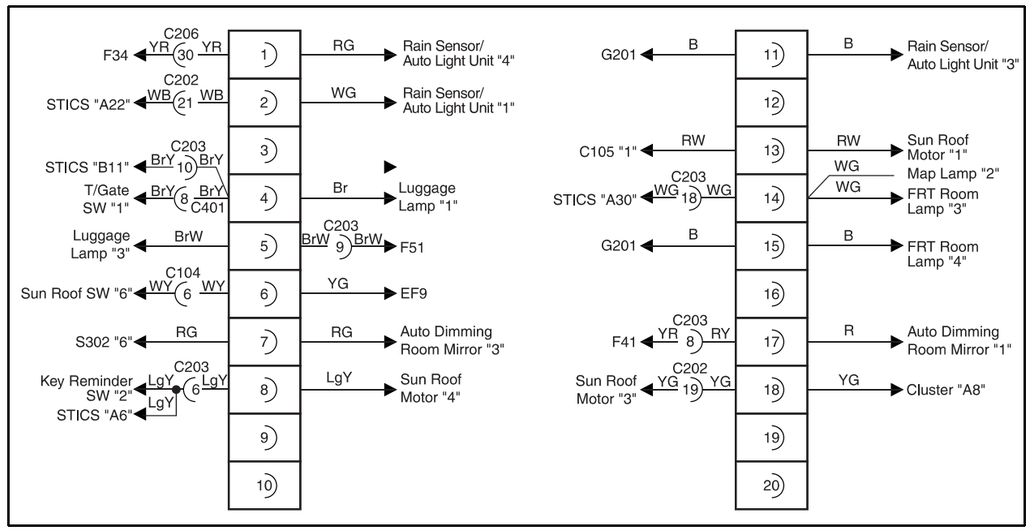


▶ C116

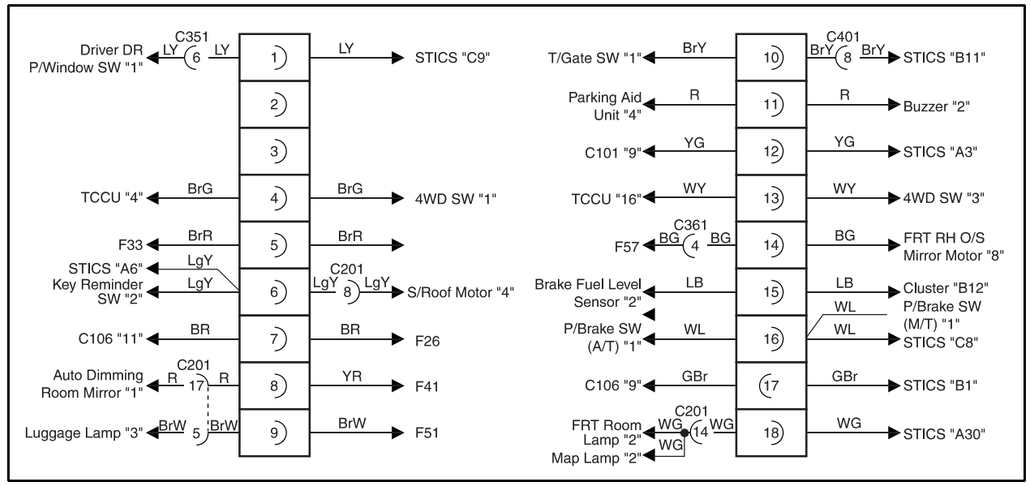


Modification basis	
Application basis	
Affected VIN	

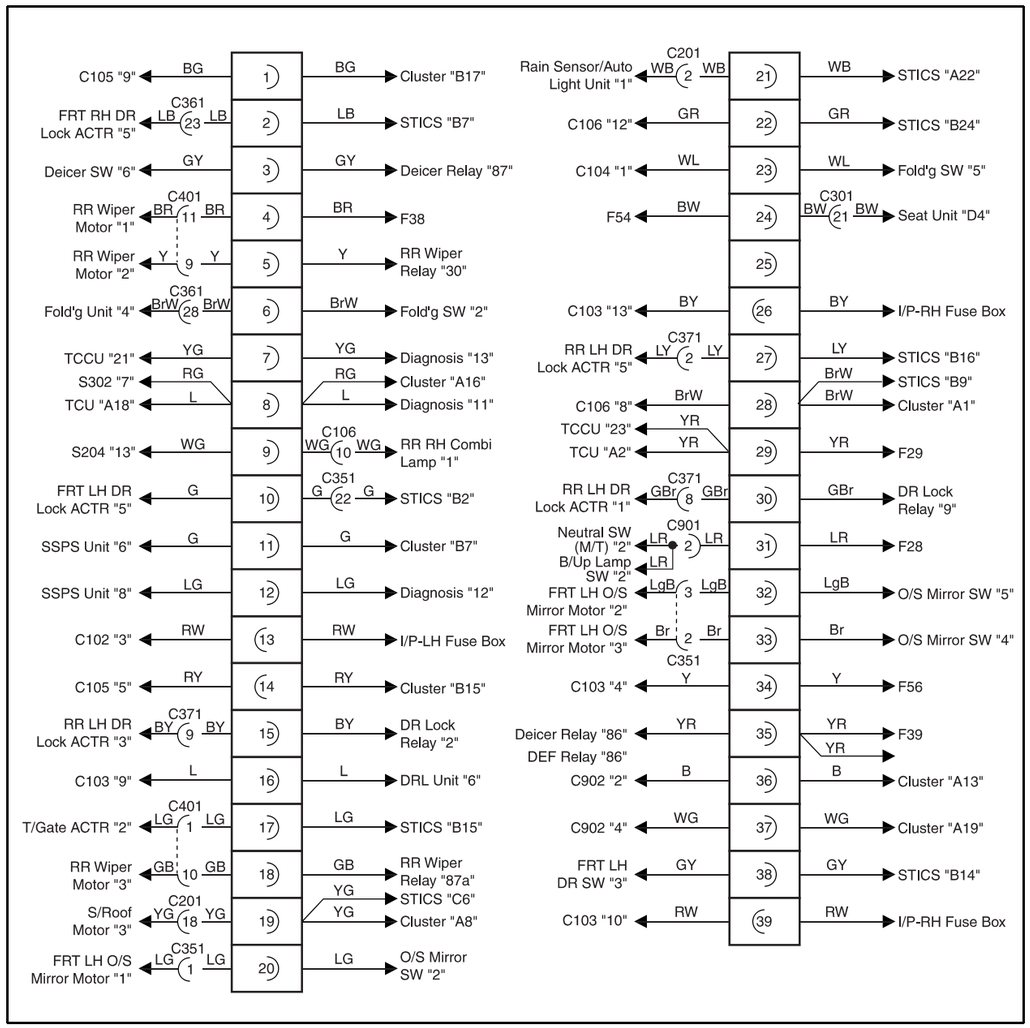
▶ C201



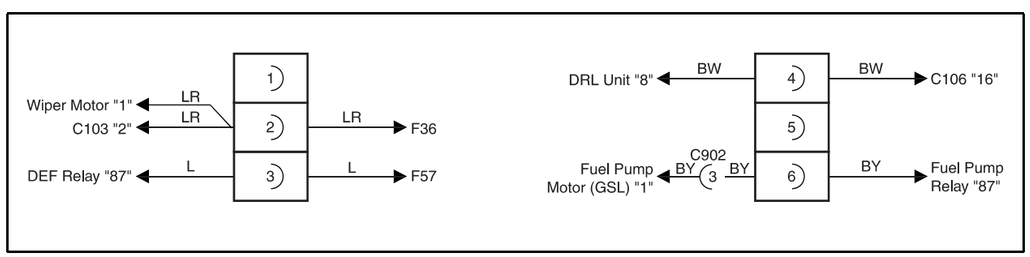
▶ C203



▶ C202

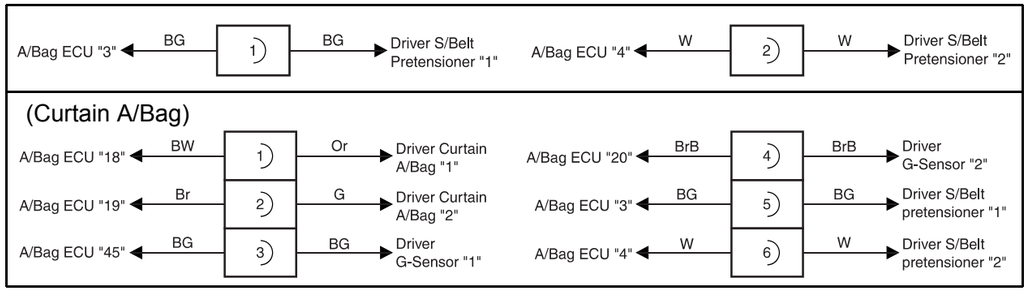


▶ C204

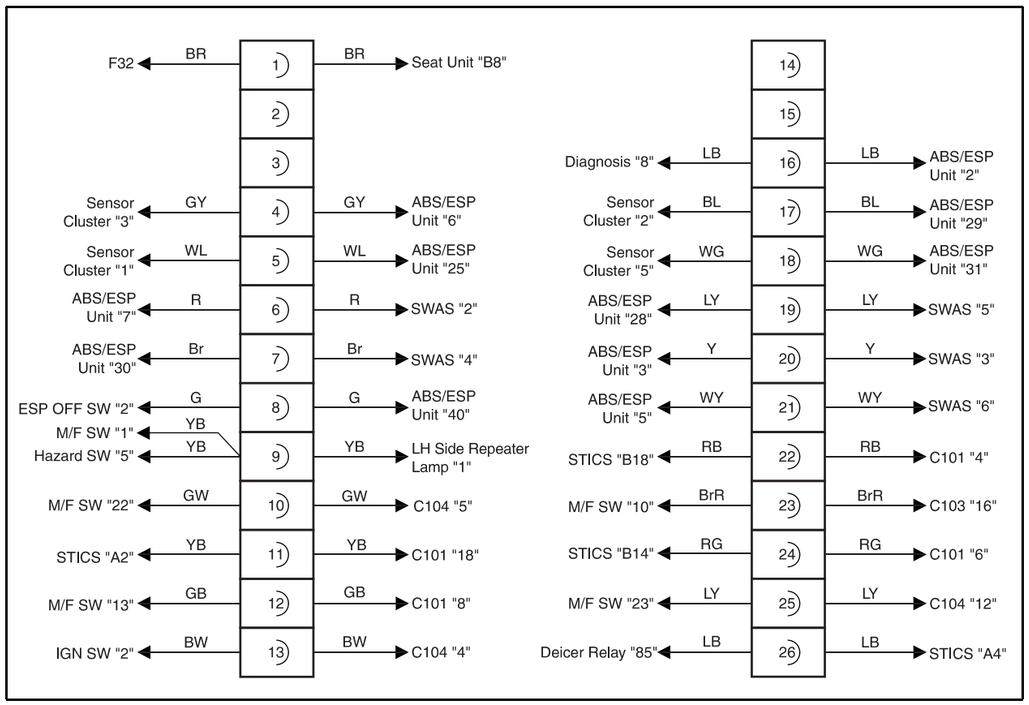


Modification basis	
Application basis	
Affected VIN	

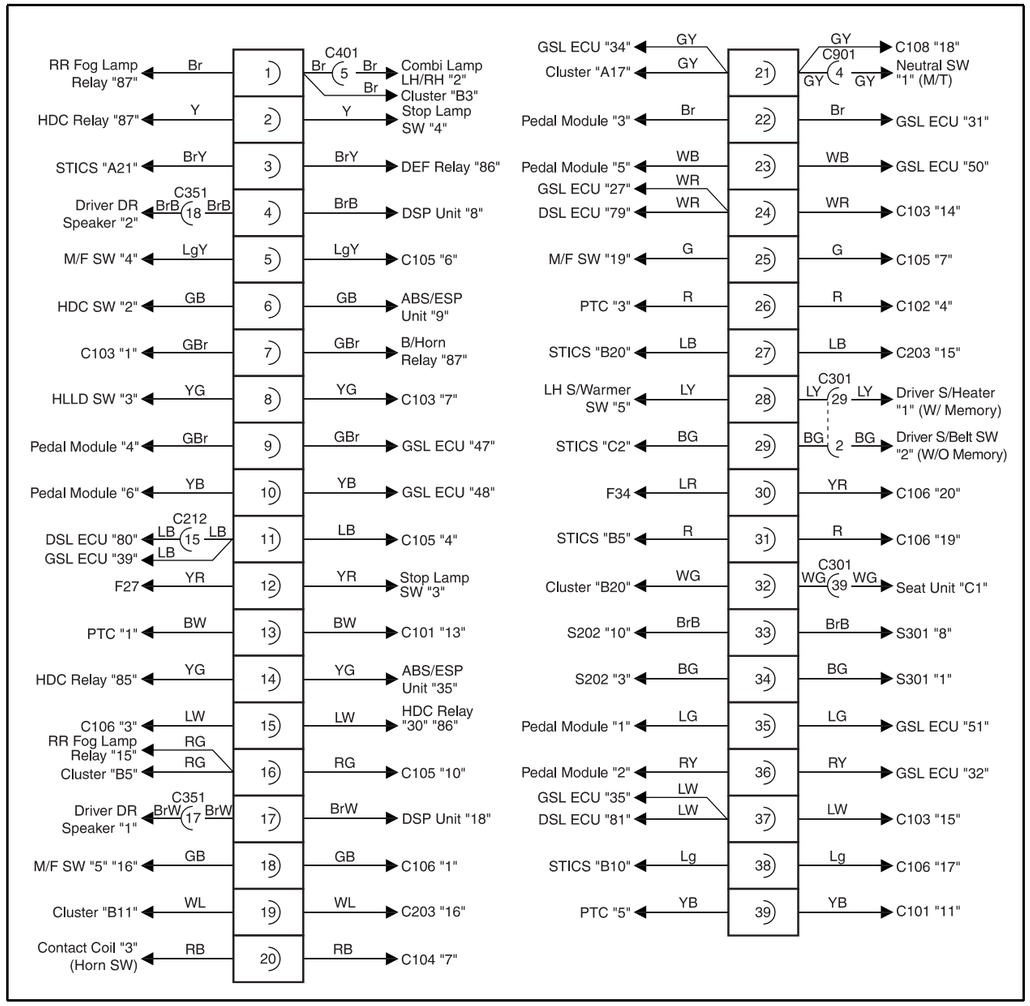
▶ C205



▶ C207

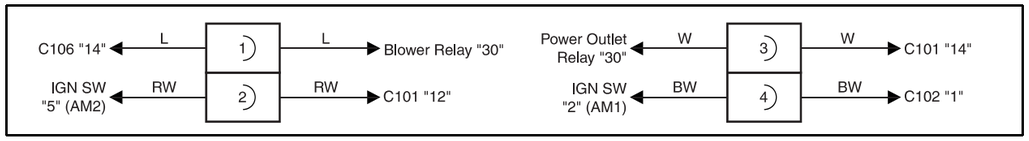


▶ C206

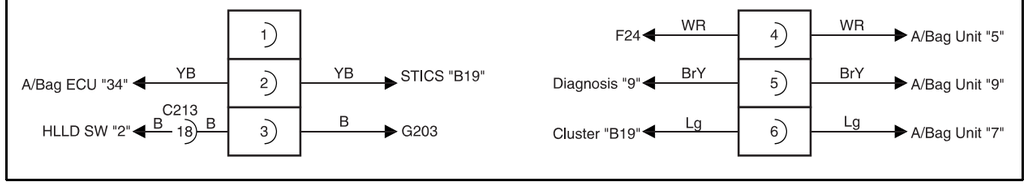


Modification basis	
Application basis	
Affected VIN	

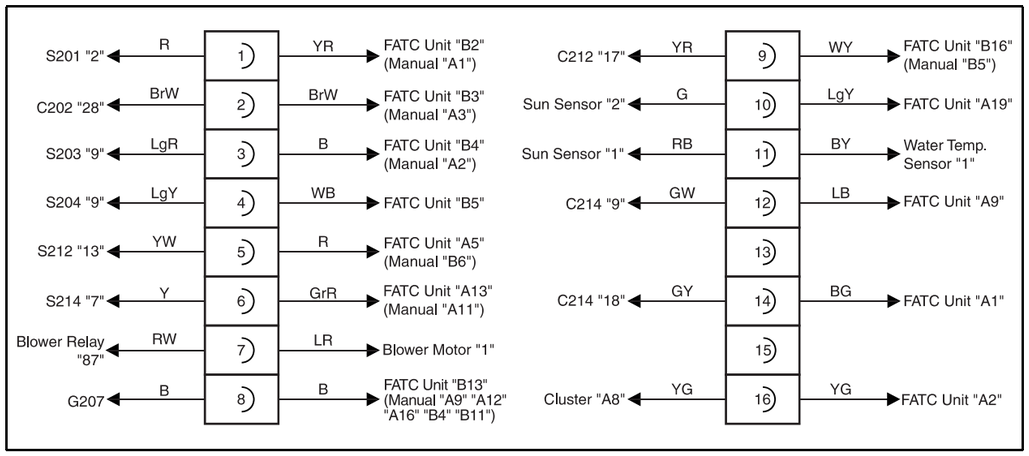
▶ C208



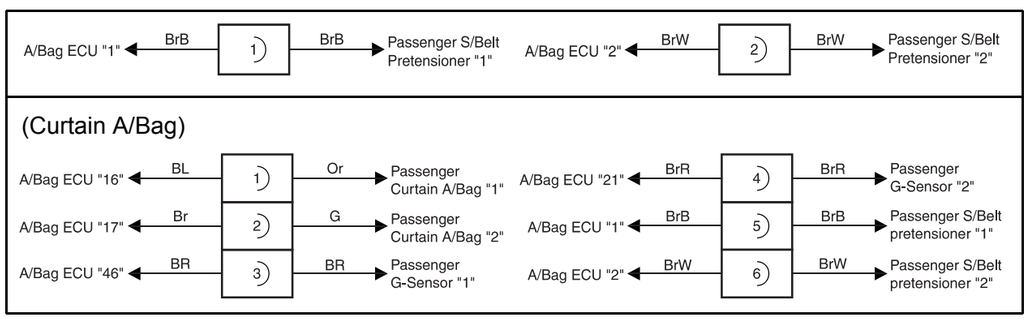
▶ C209



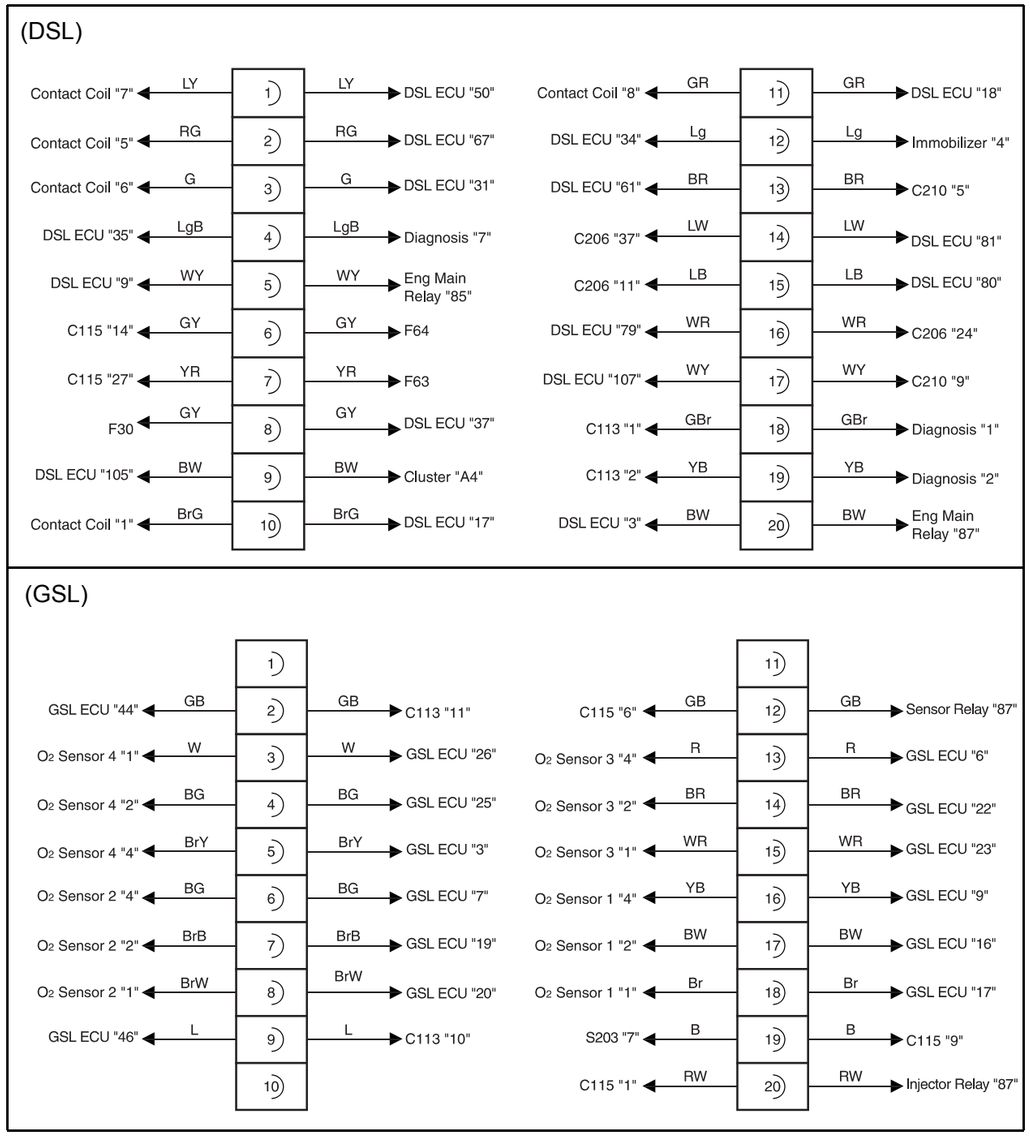
▶ C210



▶ C211

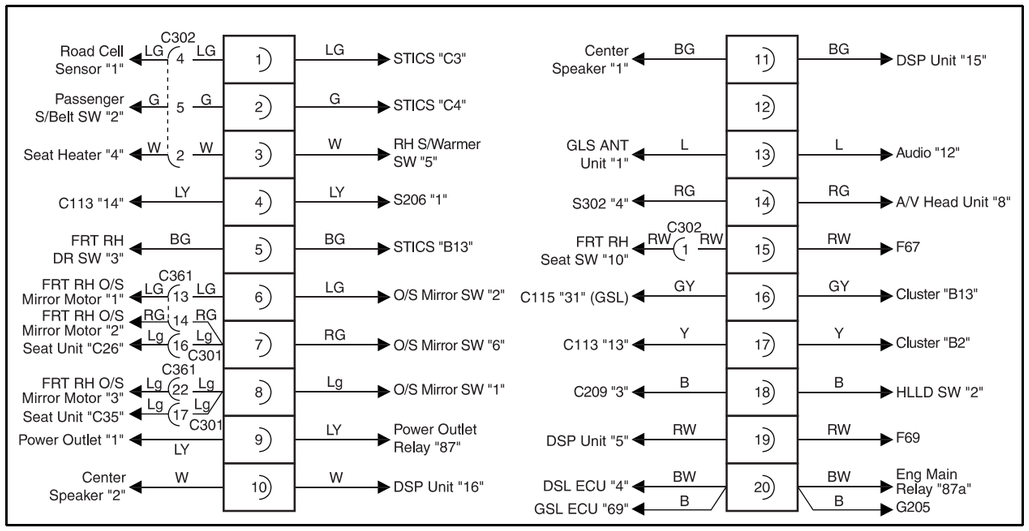


▶ C212

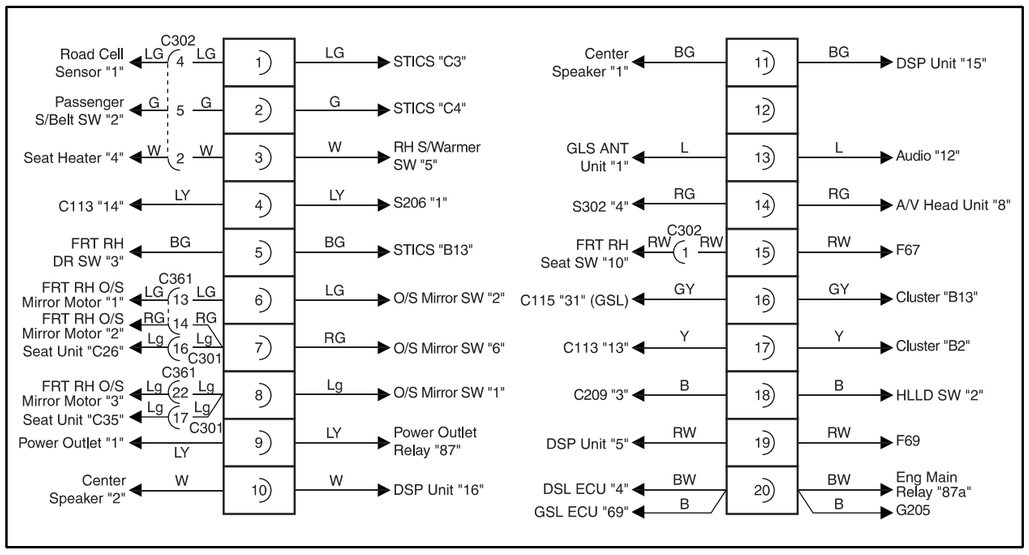


Modification basis	
Application basis	
Affected VIN	

▶ C213

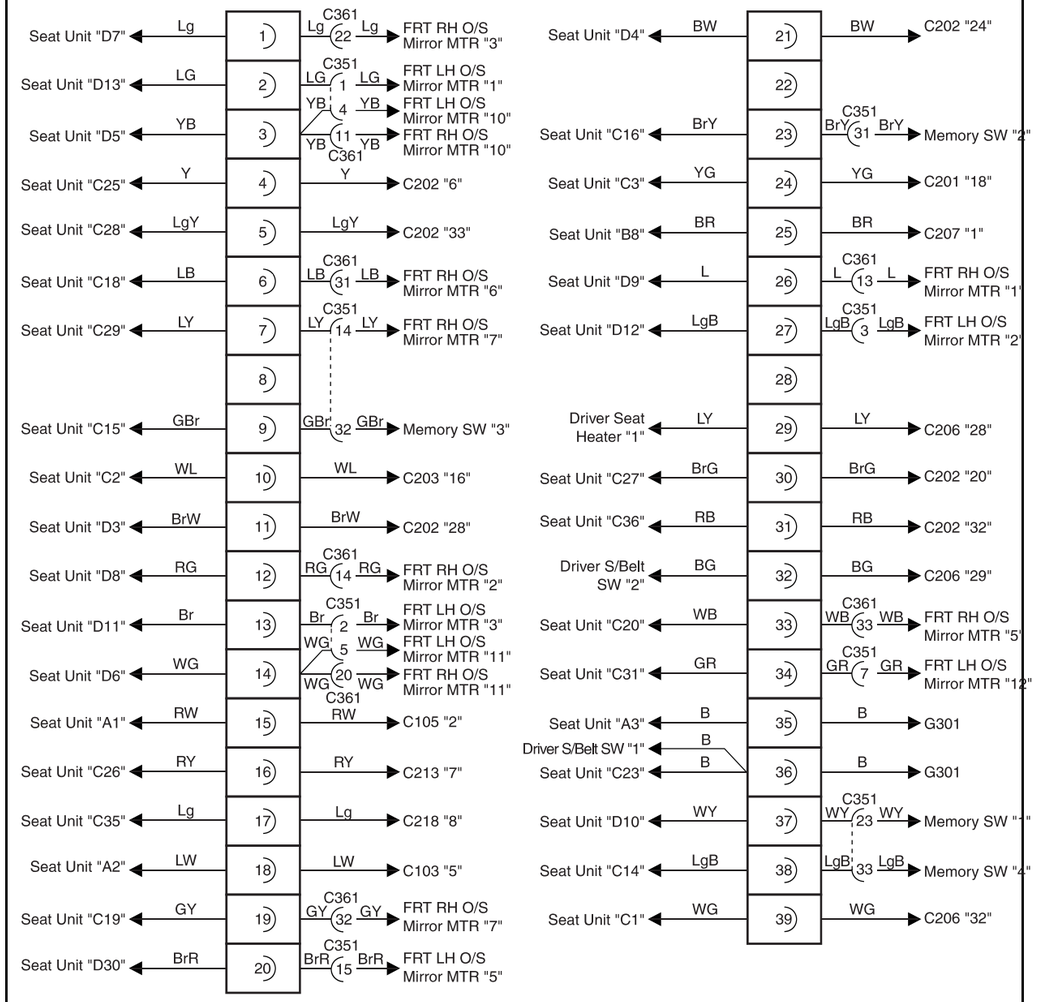


▶ C214



▶ C301

(Power Seat, W/ Memory)

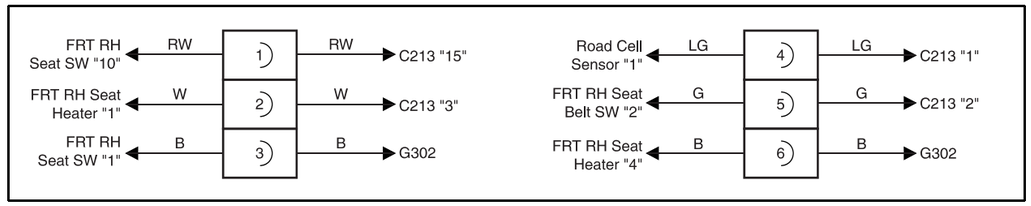


(Manual Seat, W/O Memory)

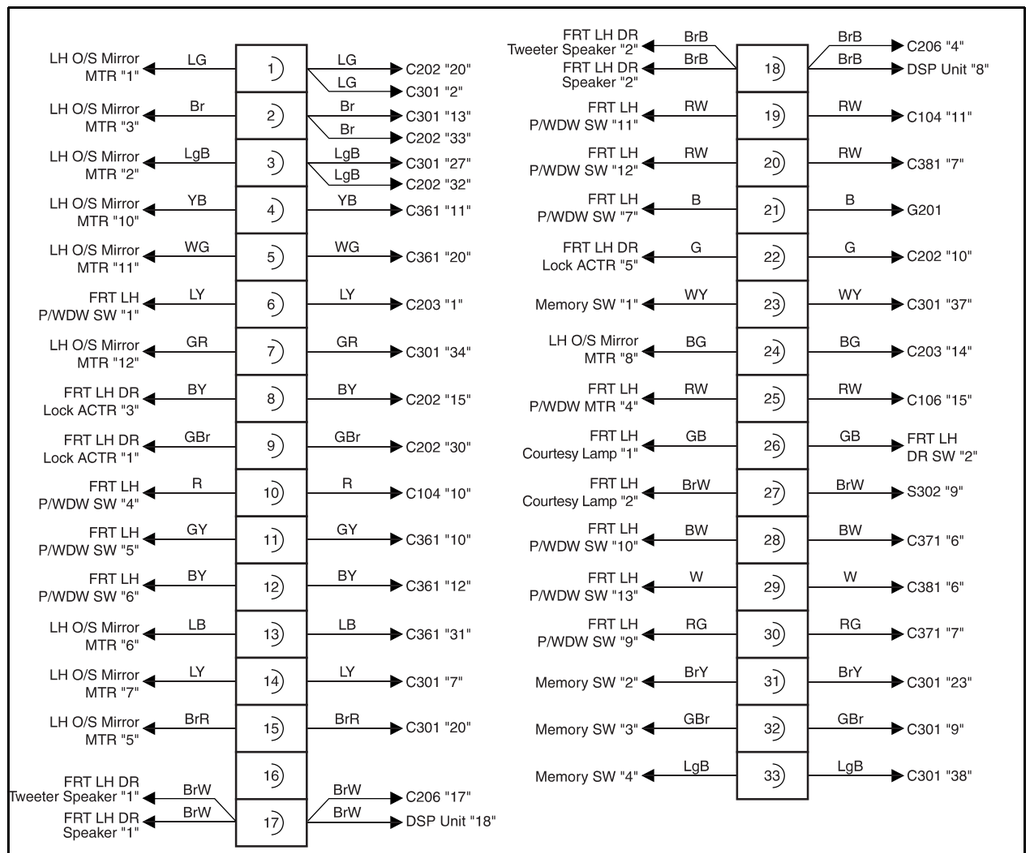


Modification basis	
Application basis	
Affected VIN	

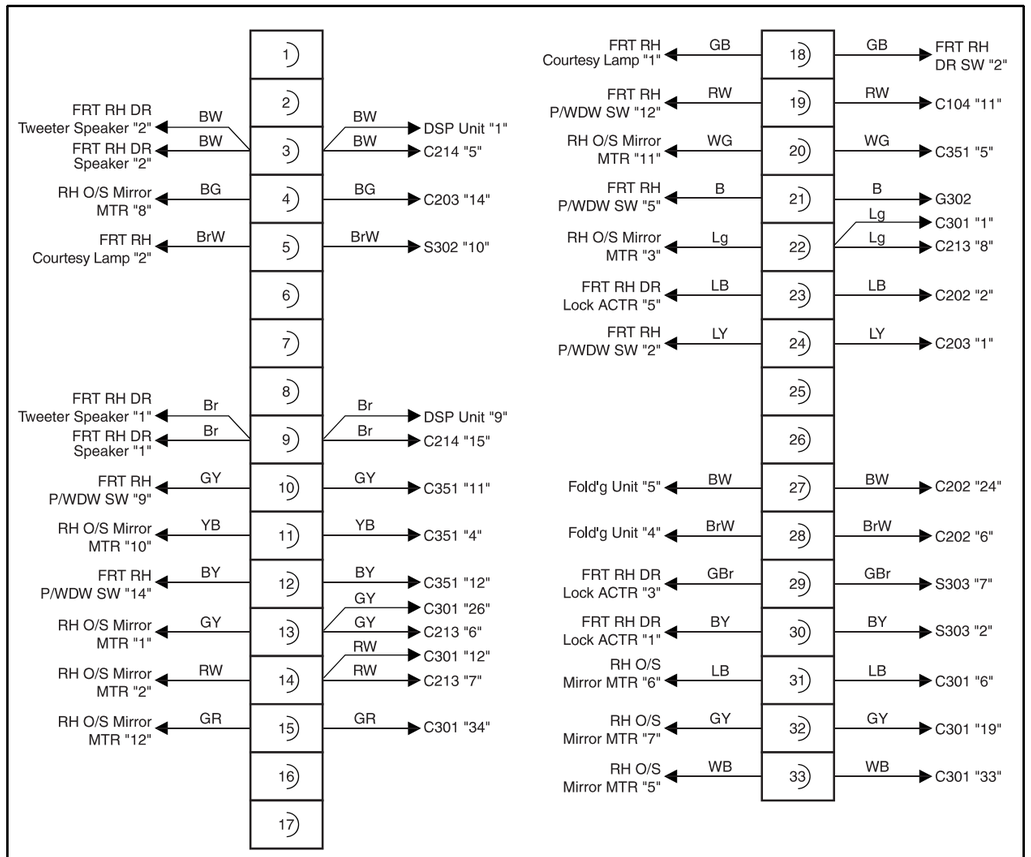
▶ C302



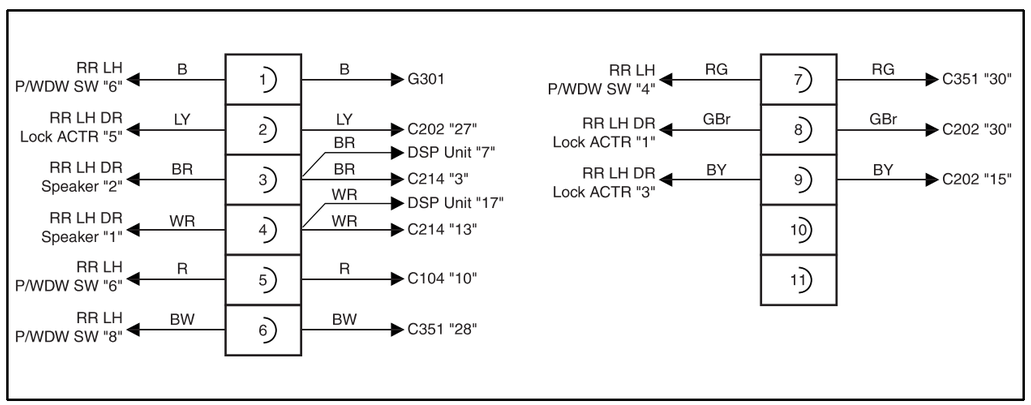
▶ C351



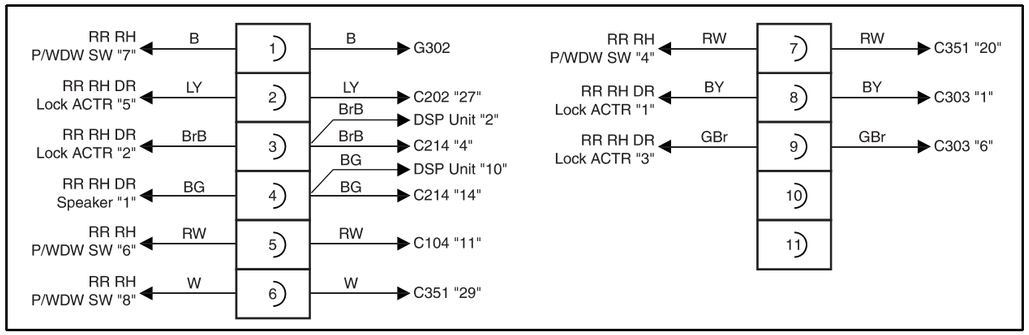
▶ C361



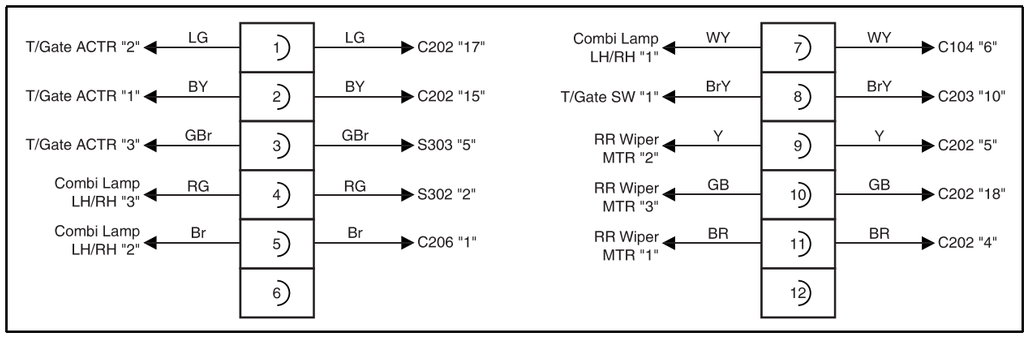
▶ C371



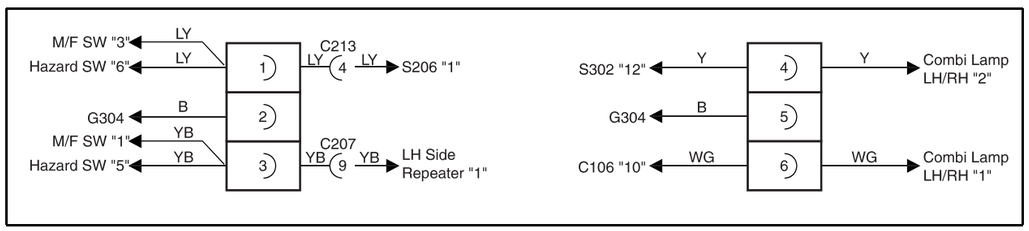
▶ C381



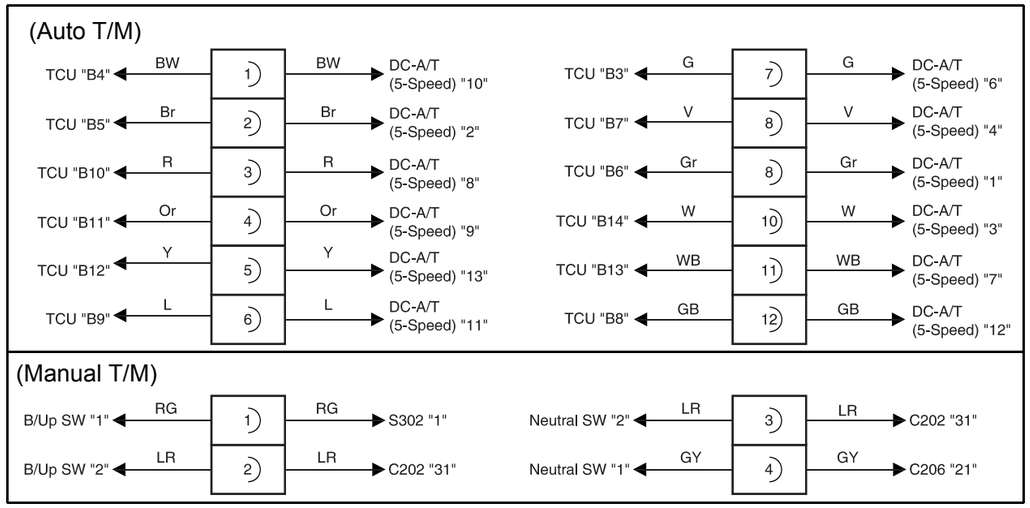
▶ C401



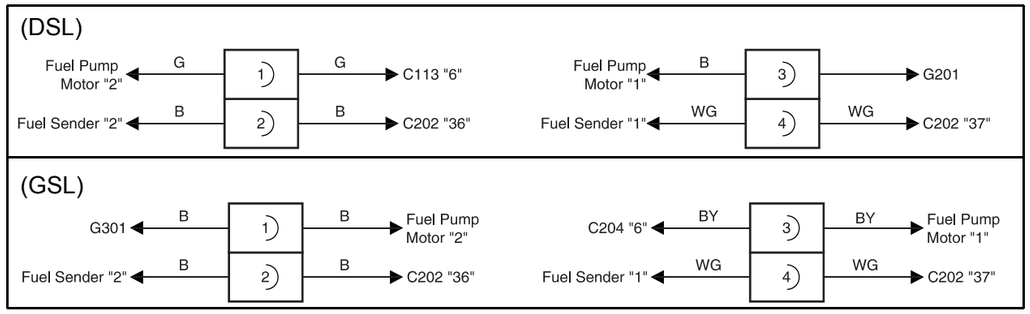
▶ C402



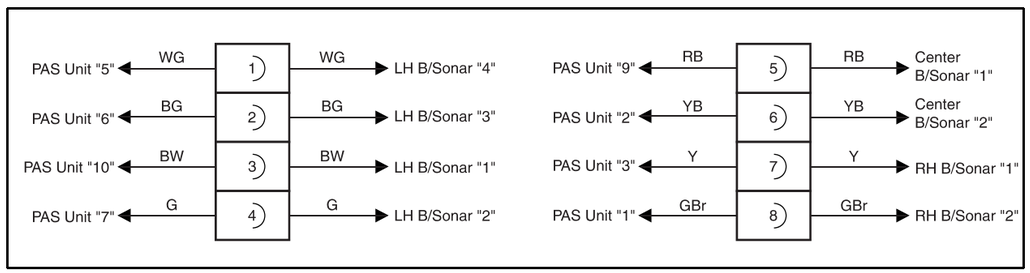
▶ C901



▶ C902

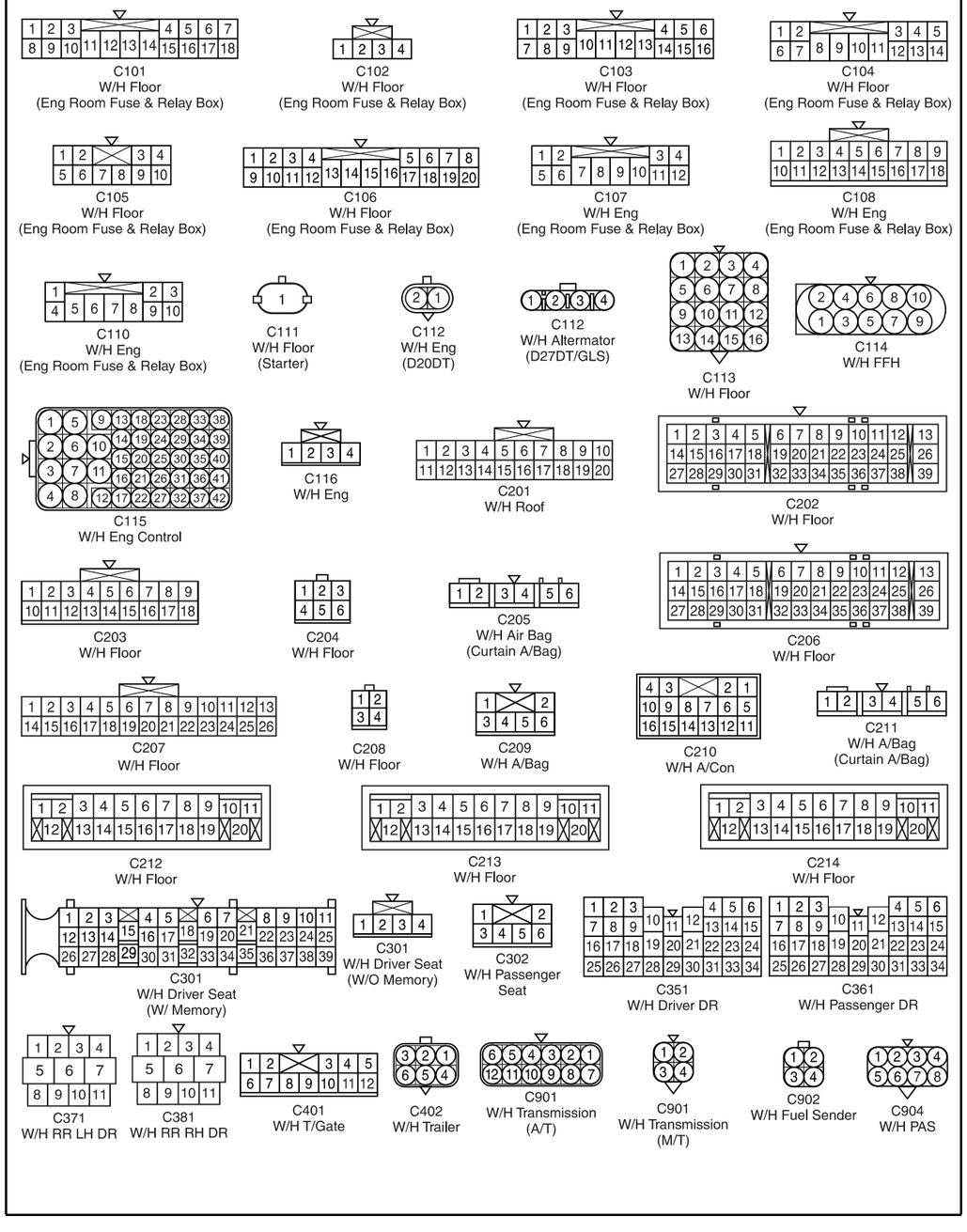


▶ C904

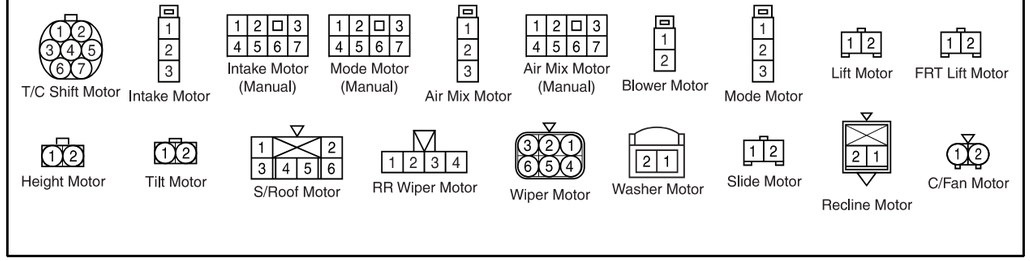


Modification basis	
Application basis	
Affected VIN	

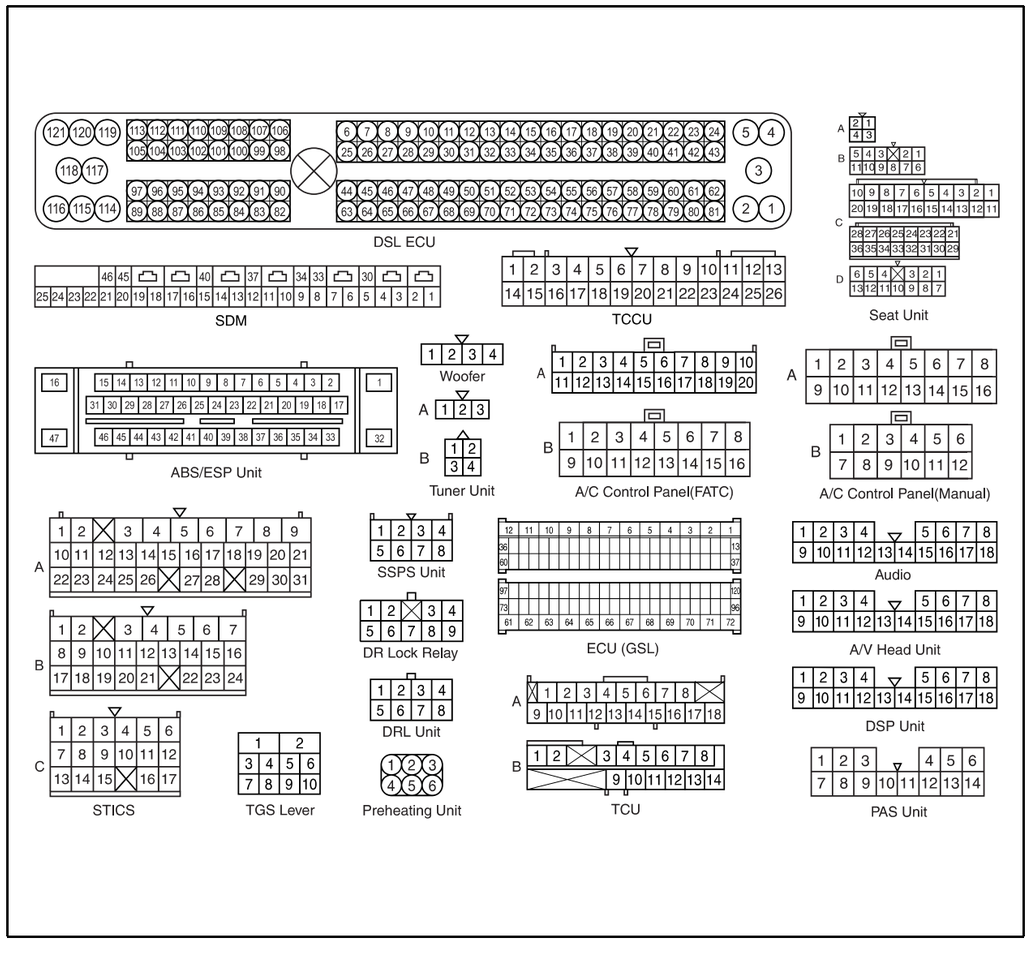
▶ WIRNING CONNECTOR



▶ MODE CONNECTOR

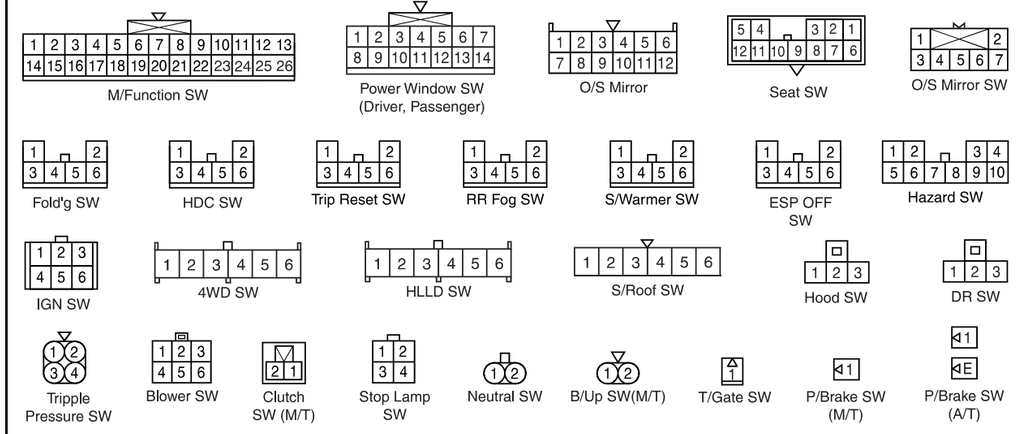


▶ UNIT CONNECTOR

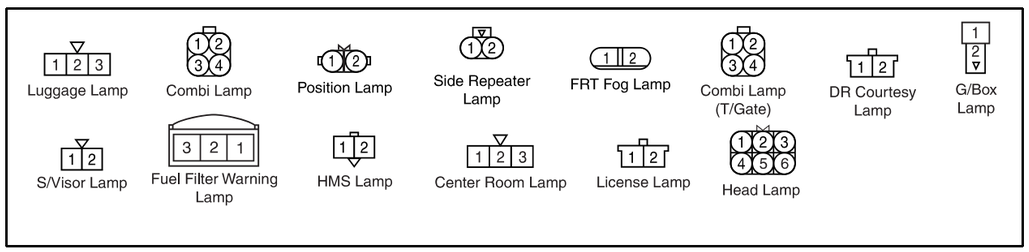


Modification basis	
Application basis	
Affected VIN	

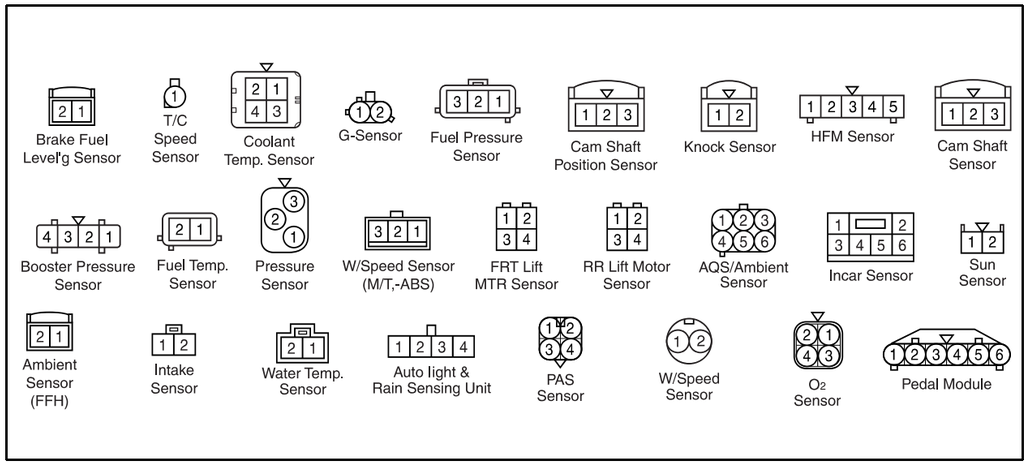
▶ SWITCH CONNECTOR



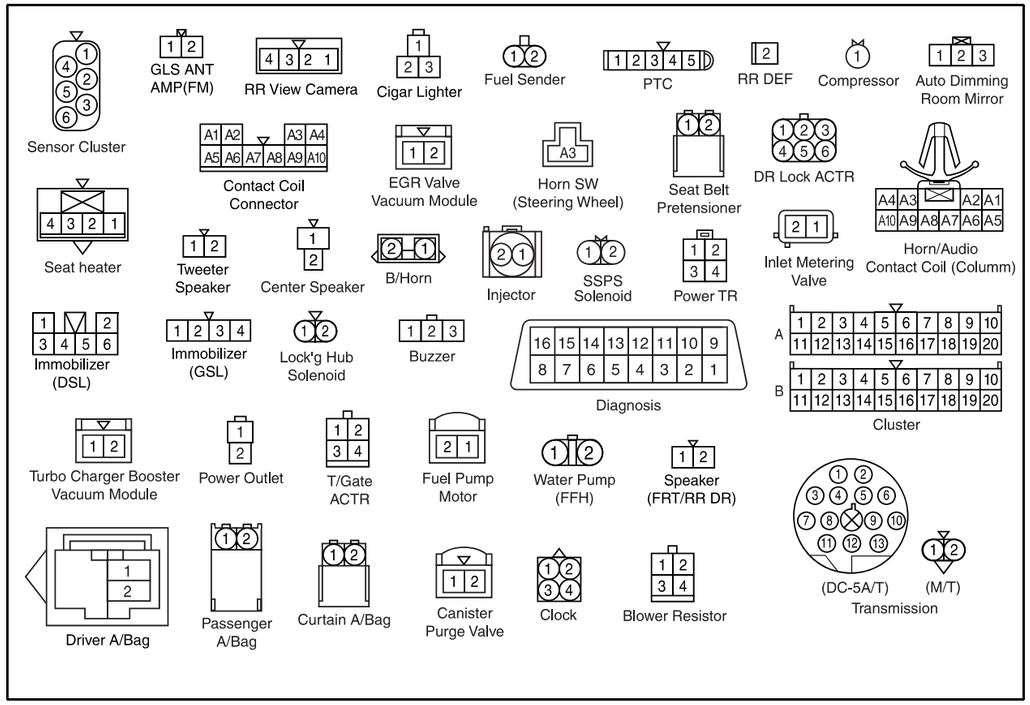
▶ LAMP CONNECTOR



▶ SENSOR CONNECTOR



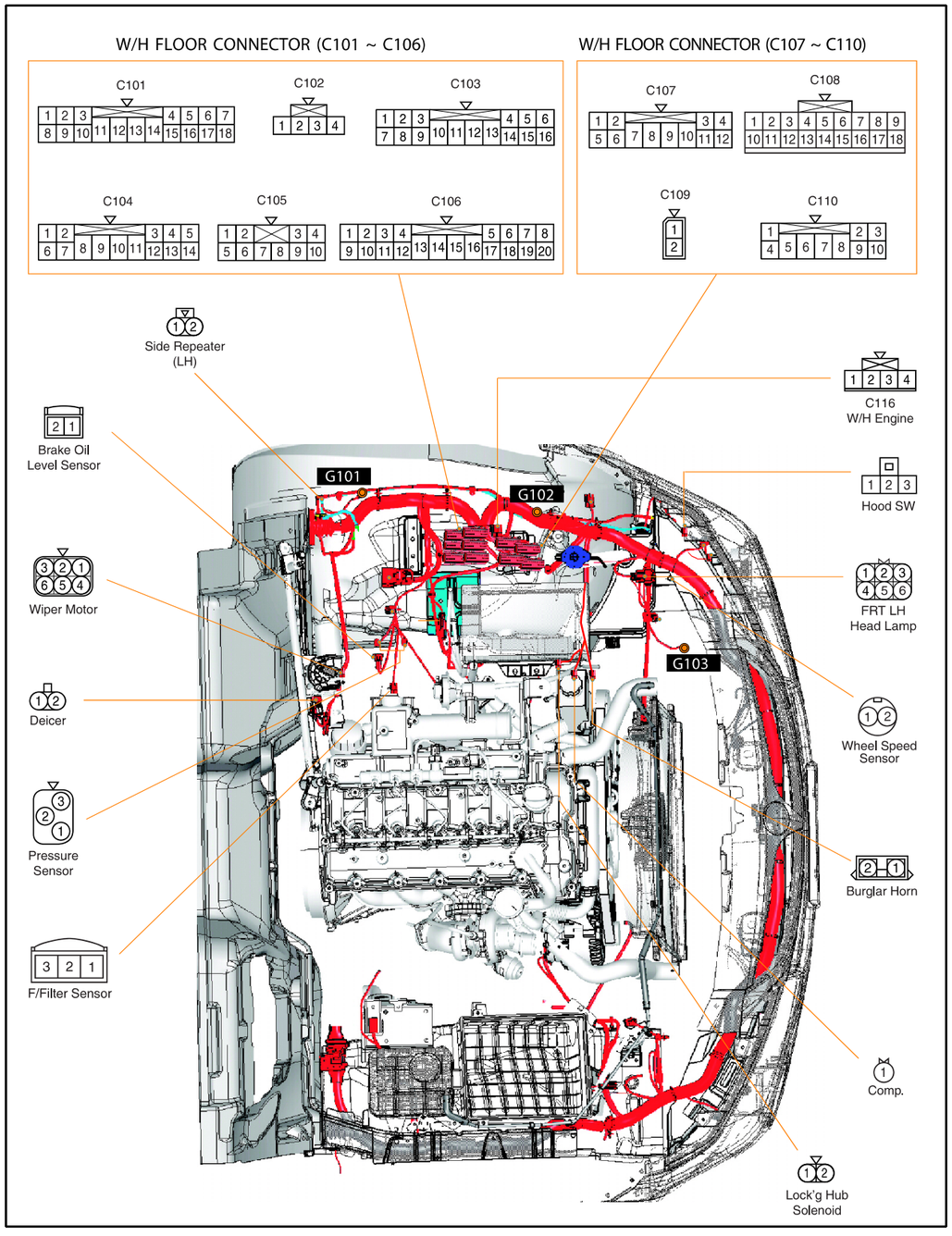
▶ ETC.

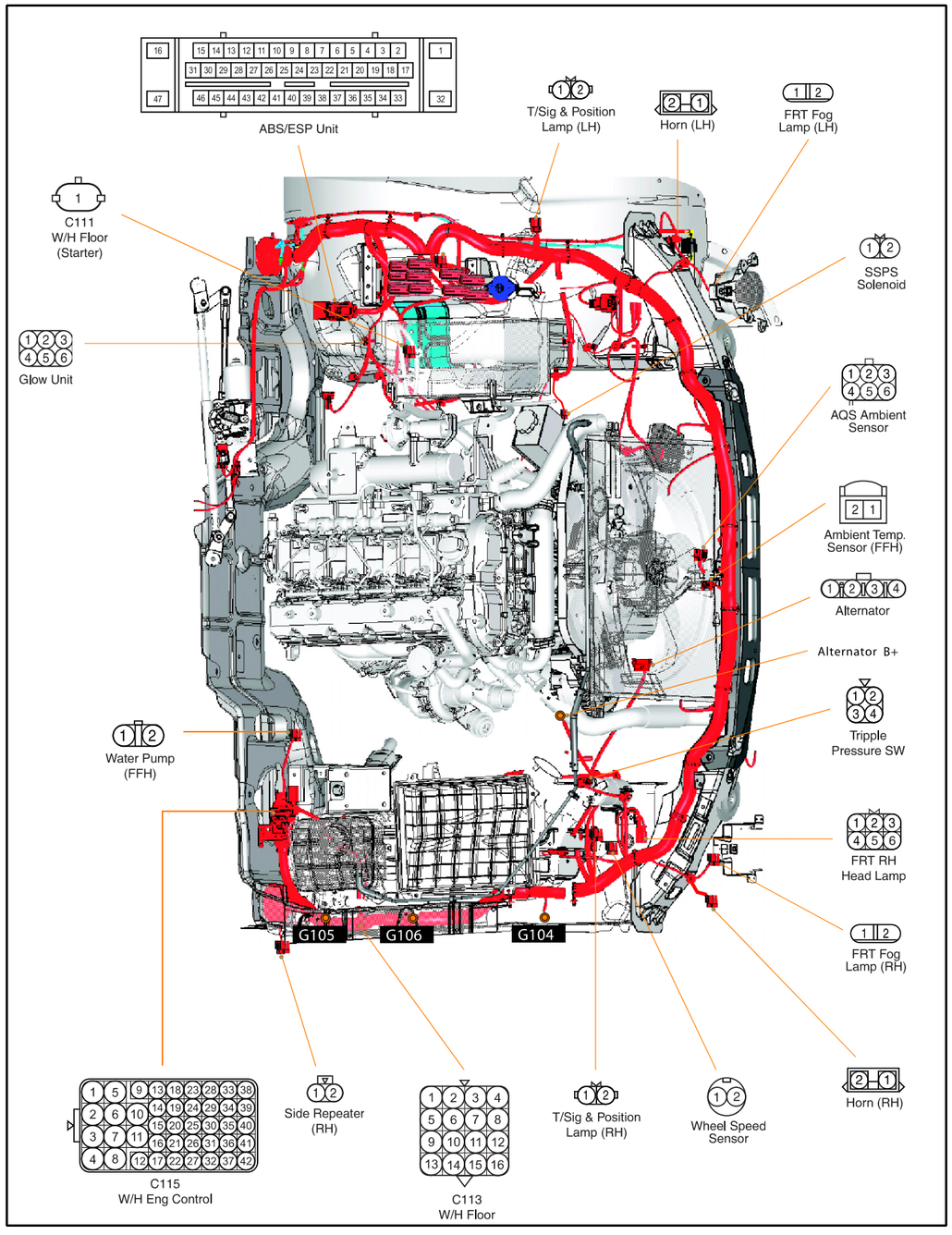


Modification basis	
Application basis	
Affected VIN	

CONNECTOR

S.G.N. 8210-00 **W/H ENGINE ROOM**

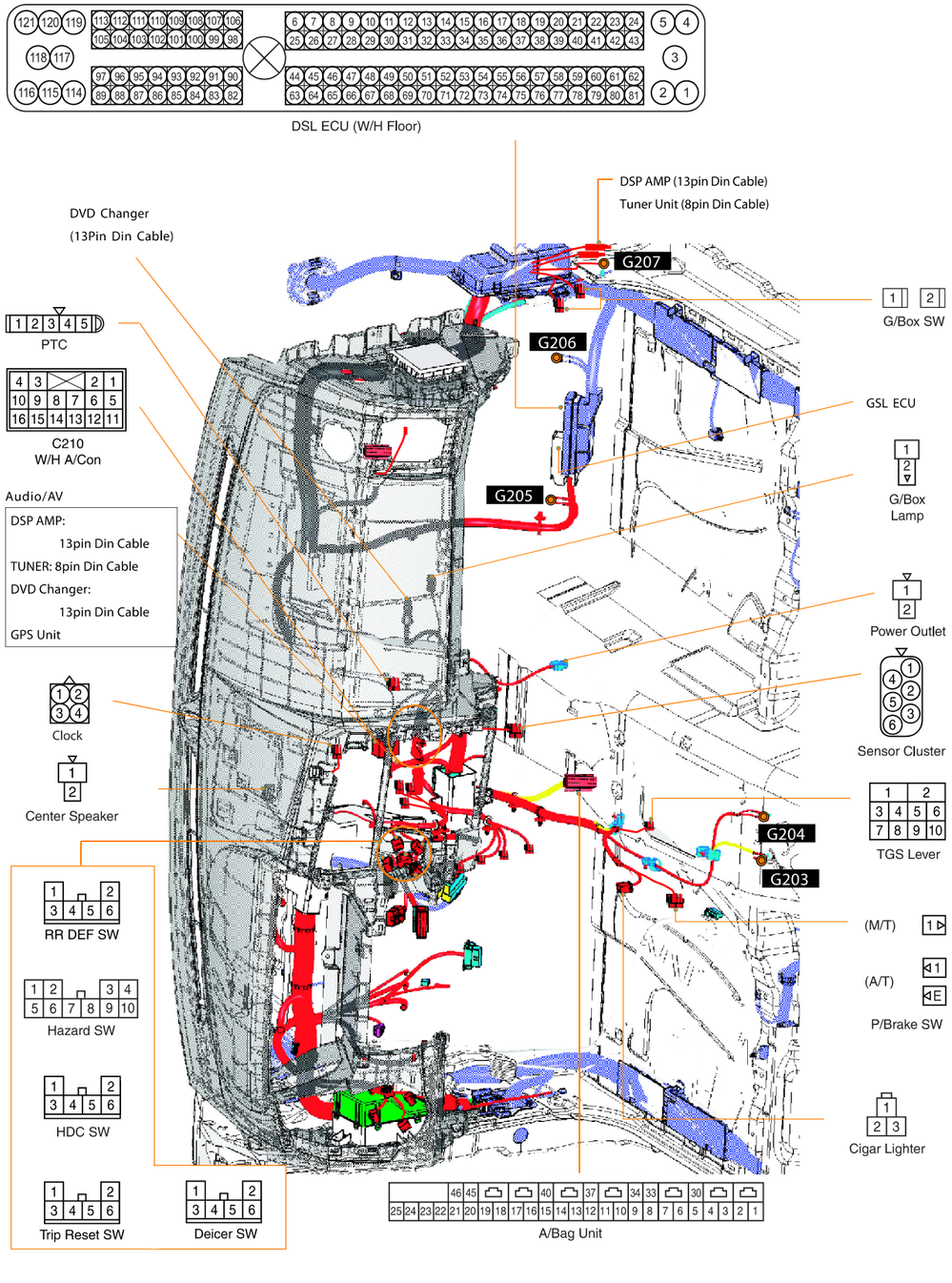


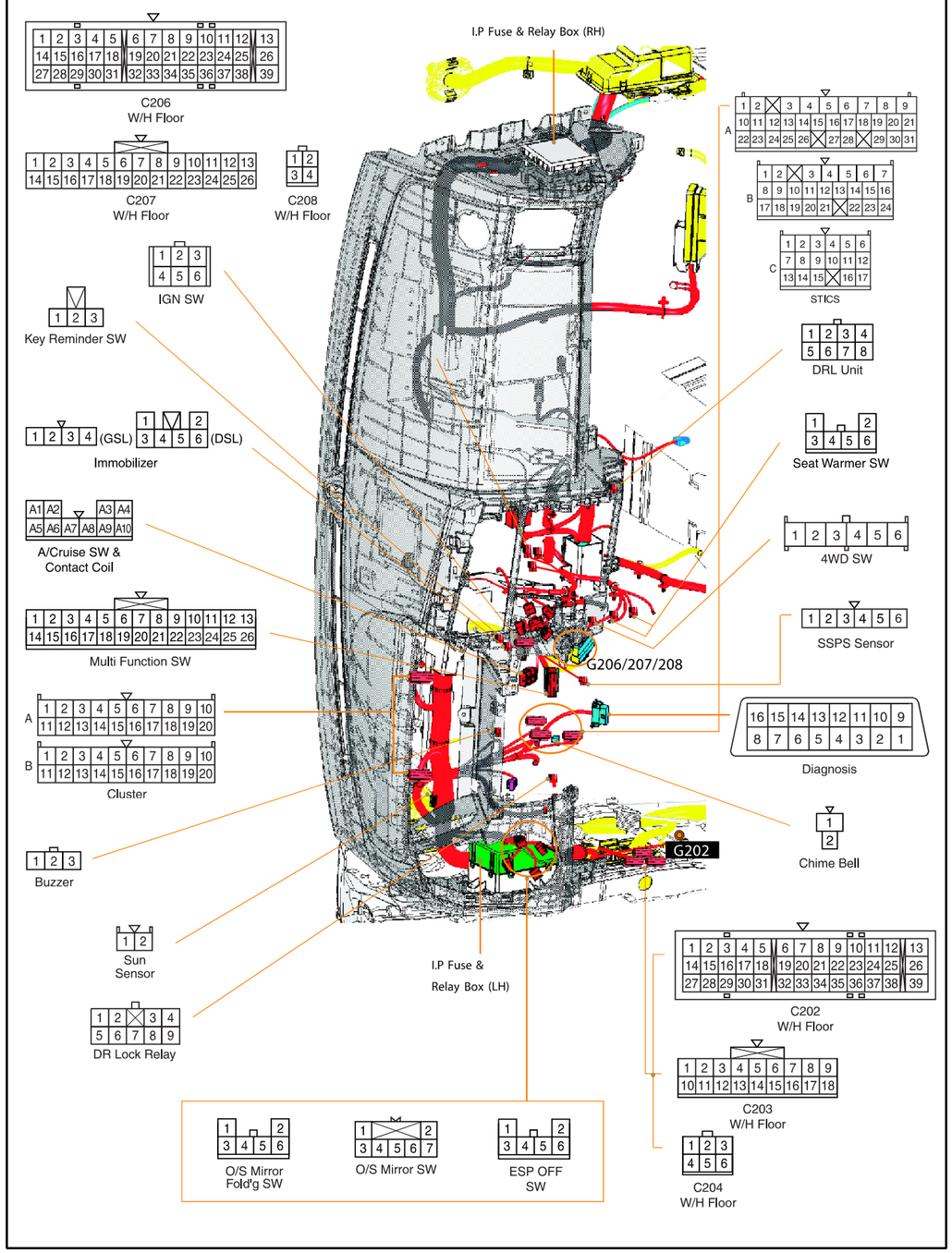


Modification basis	
Application basis	
Affected VIN	

S.G.N. 8210-02

W/H MAIN





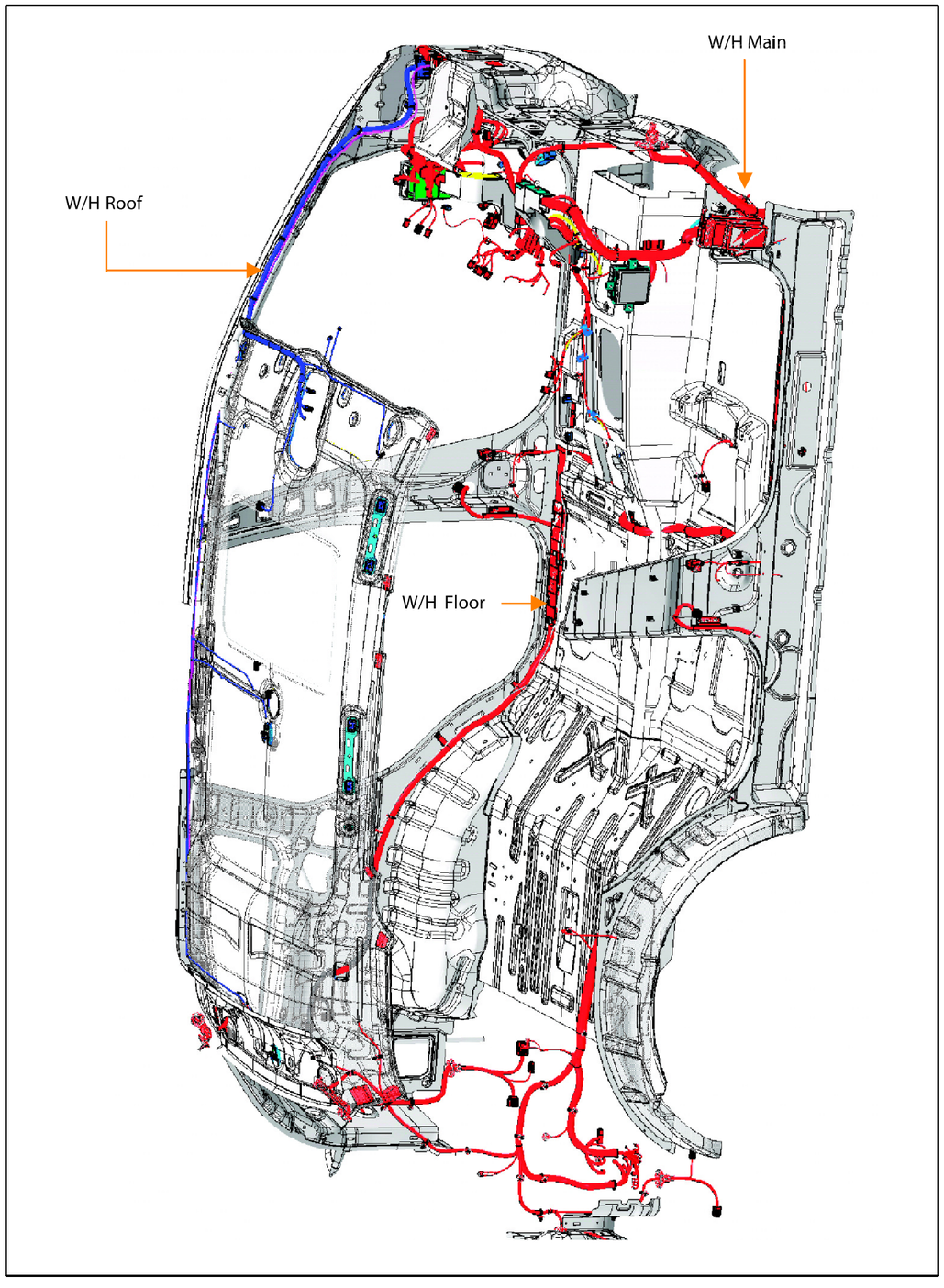
CONNECTOR/GROUND

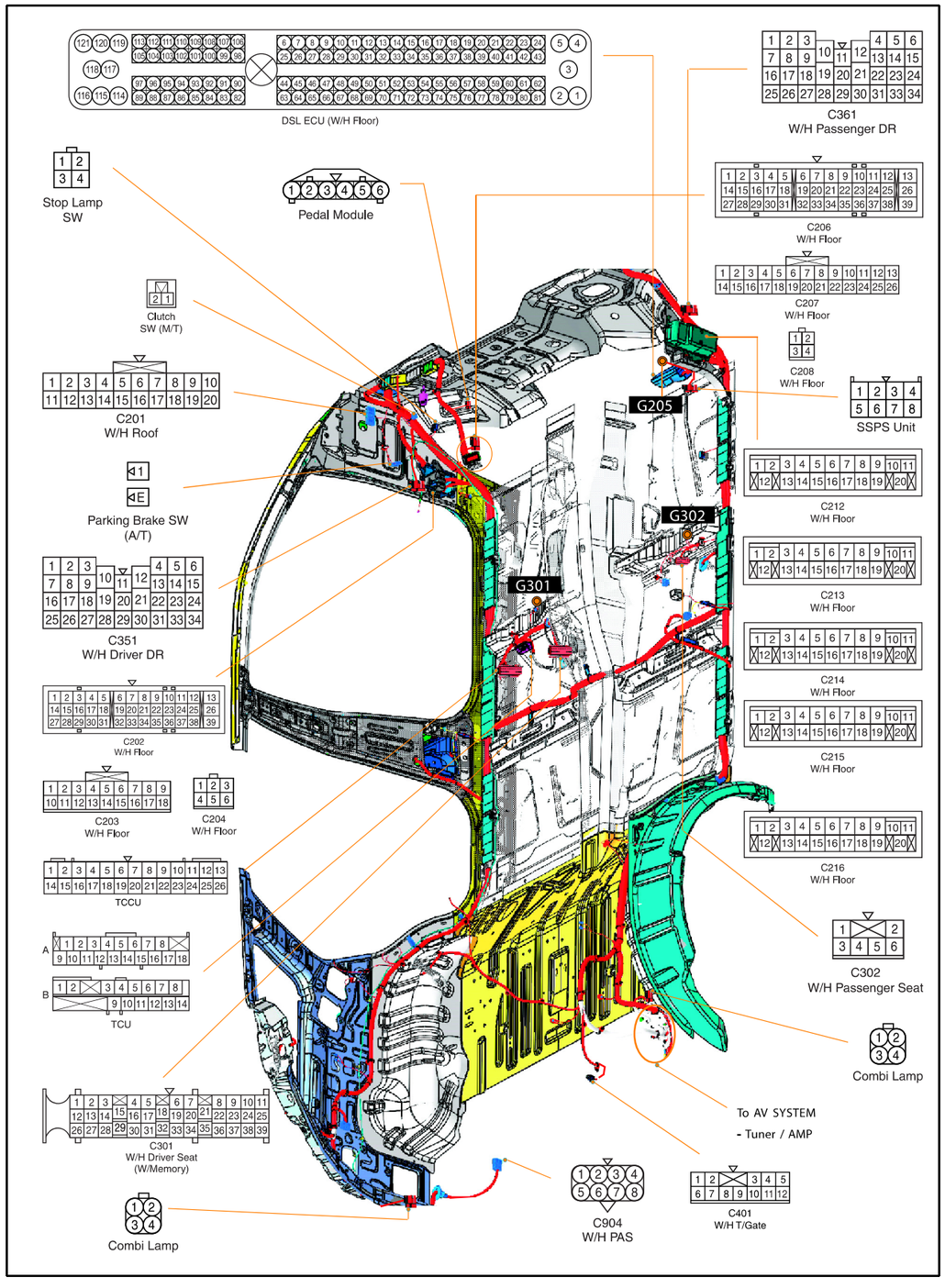
KYRON 2005.10

Modification basis	
Application basis	
Affected VIN	

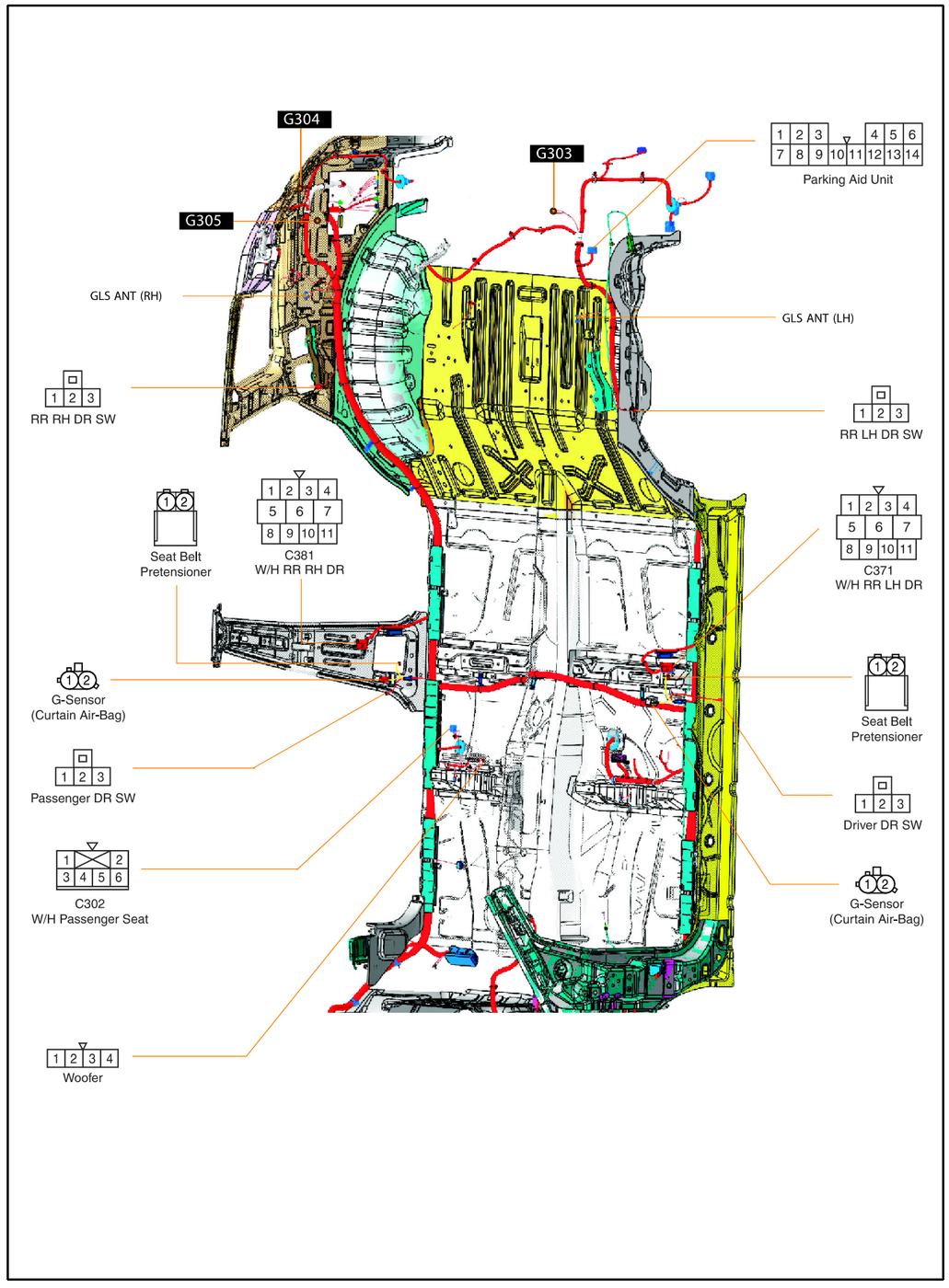
S.G.N. 8210-03

W/H FLOOR



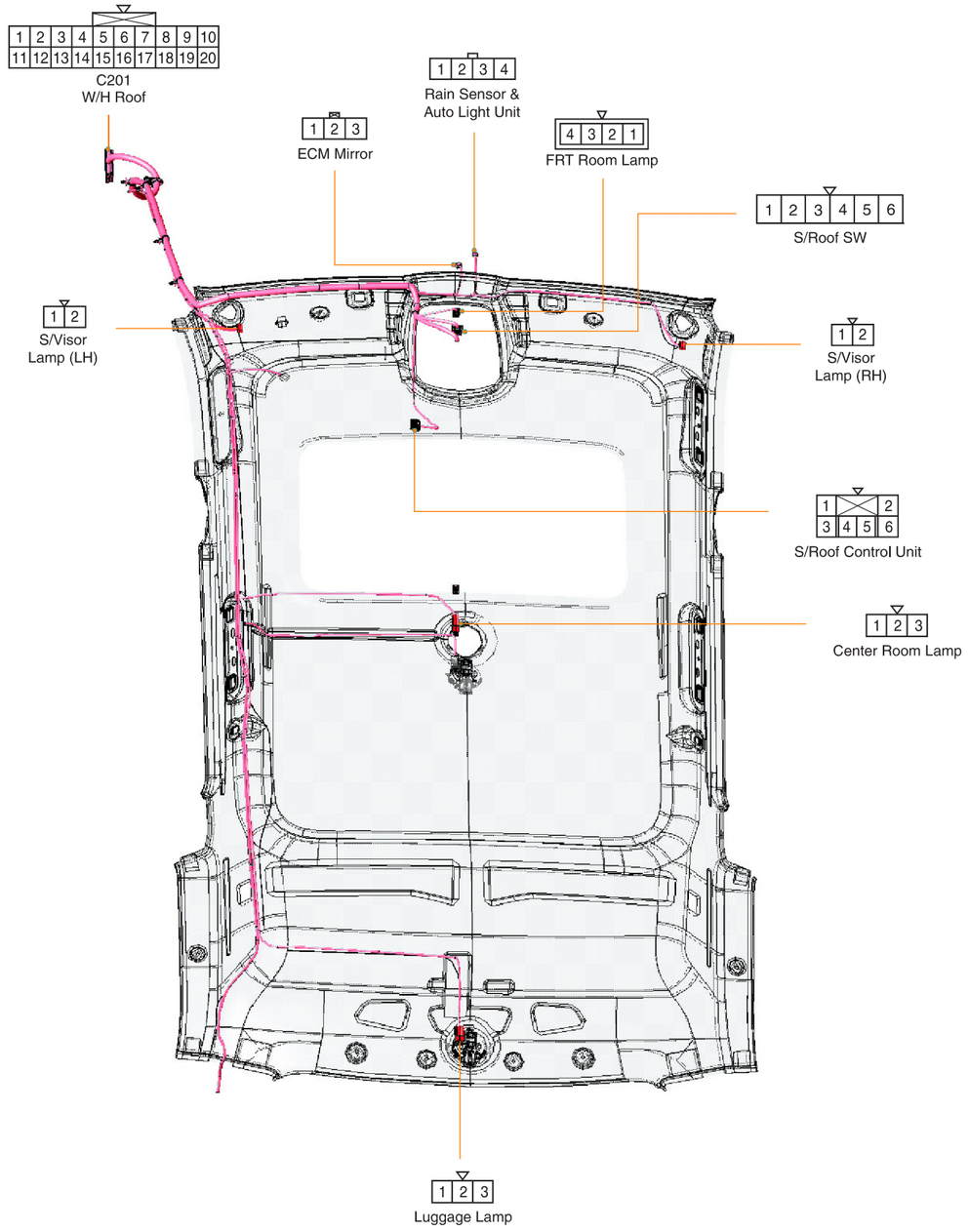


Modification basis	
Application basis	
Affected VIN	

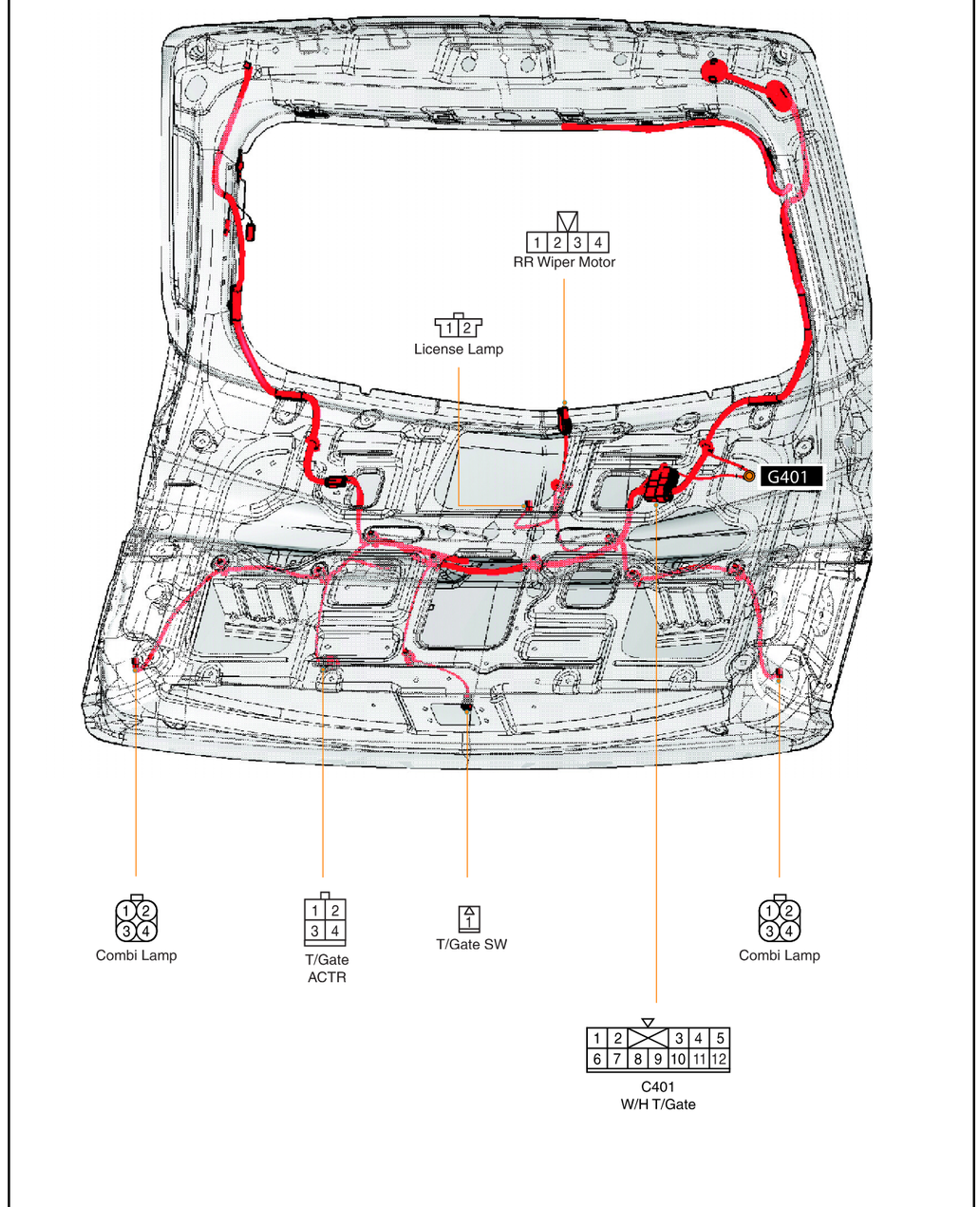


Modification basis	
Application basis	
Affected VIN	

S.G.N. 8210-09 W/H ROOF

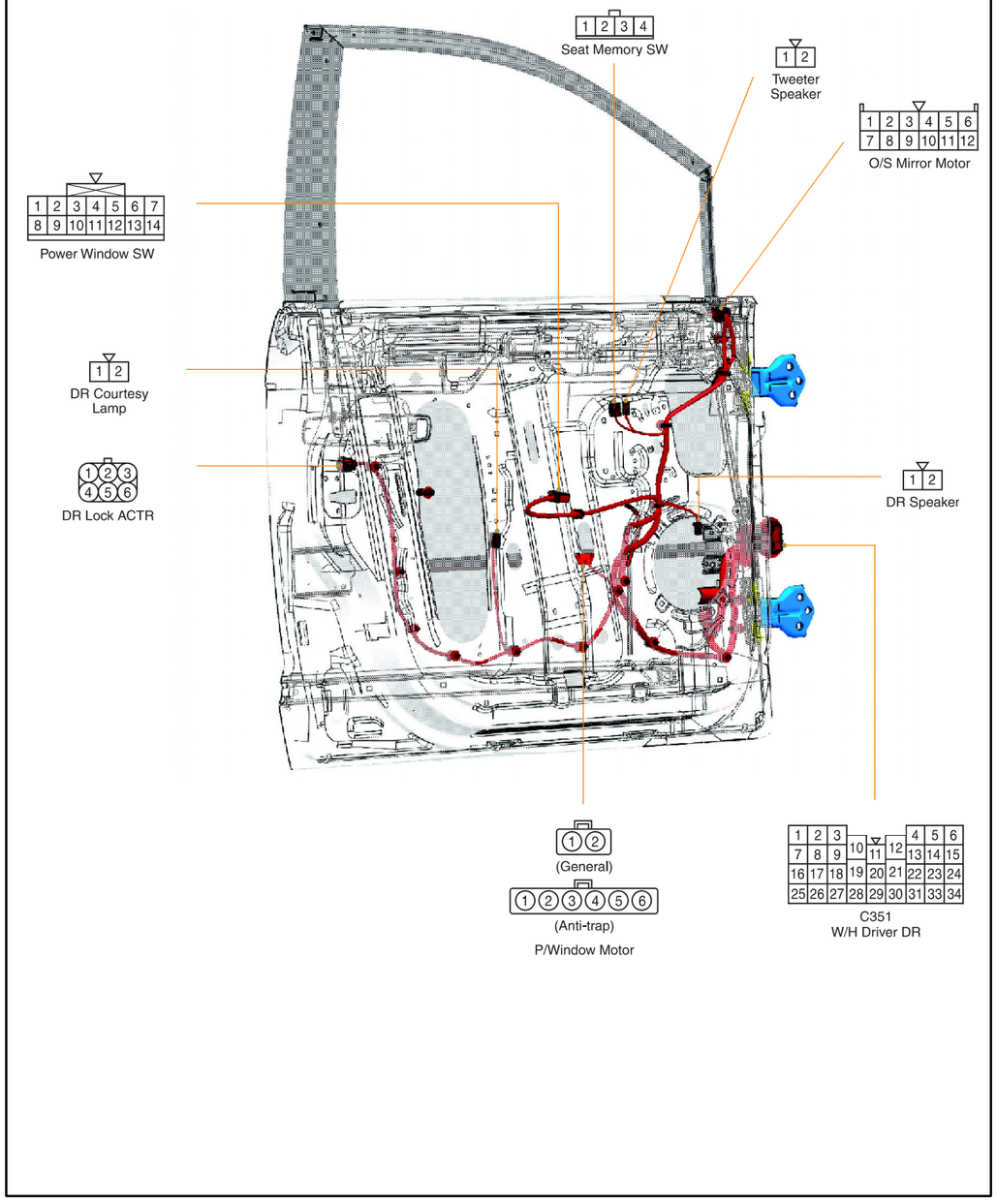


S.G.N. 8210-10 W/H TAIL GATE

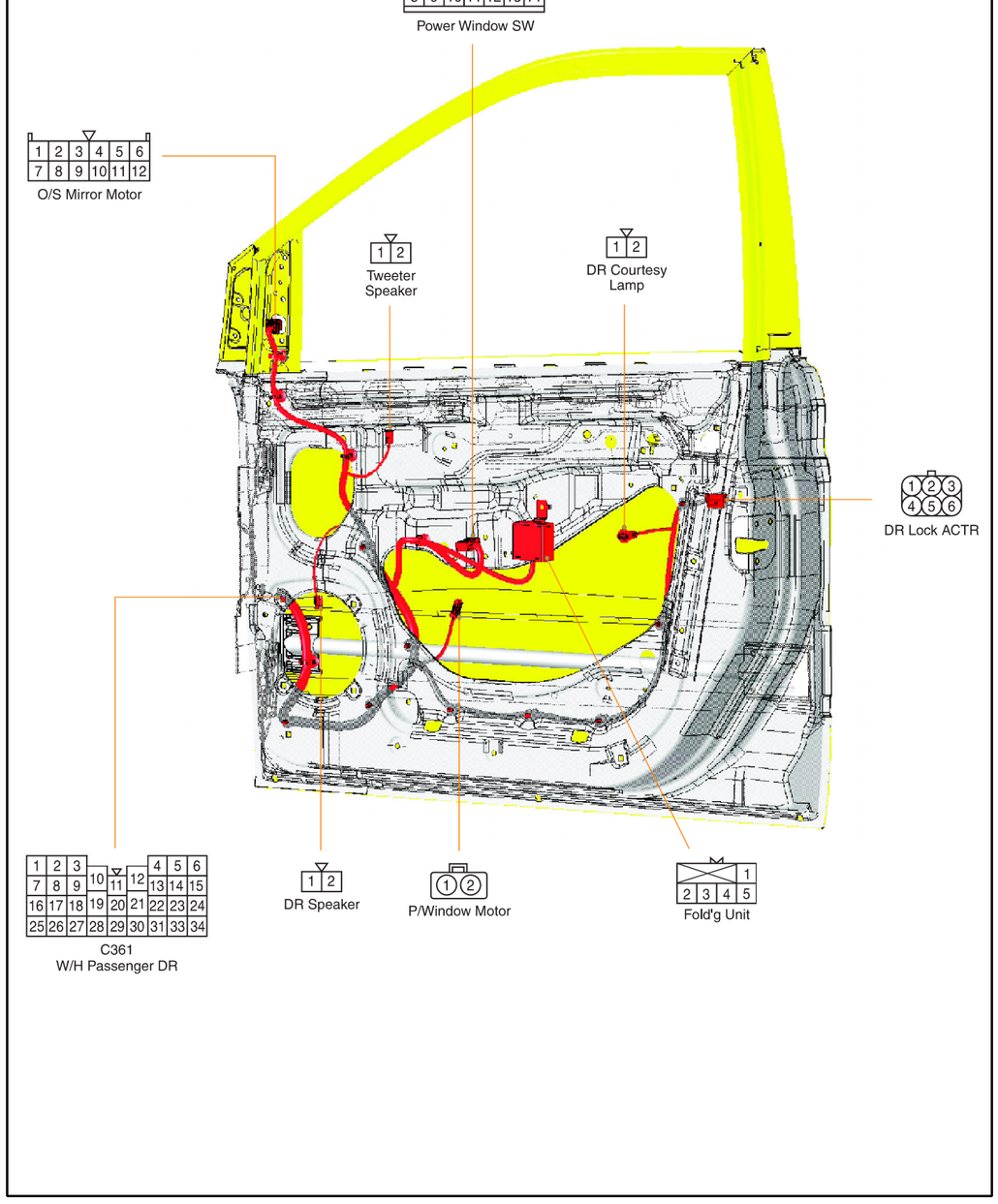


Modification basis	
Application basis	
Affected VIN	

S.G.N. 8210-06 W/H DRIVER DOOR



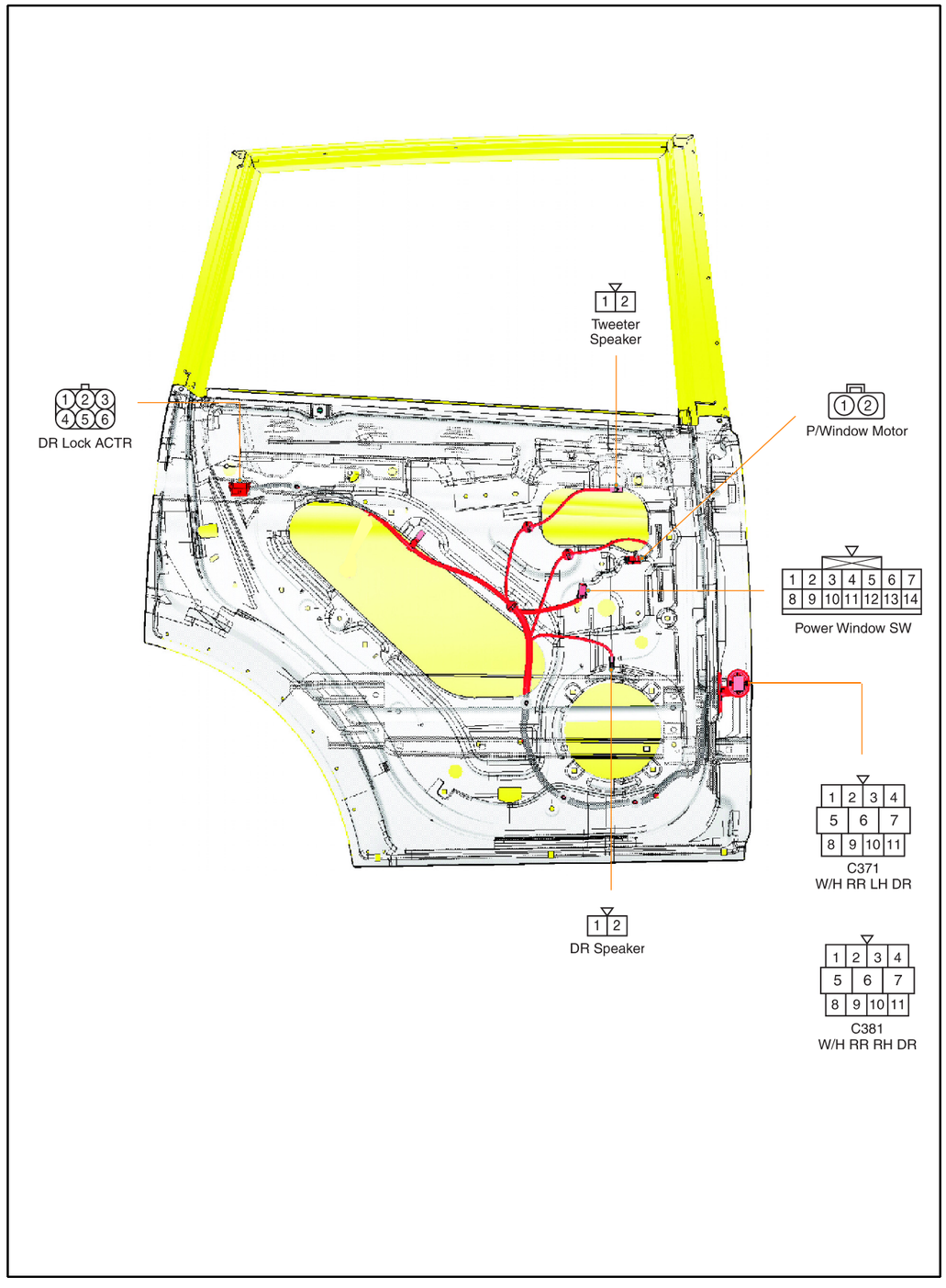
S.G.N. 8210-07 W/H PASSENGER DOOR



Modification basis	
Application basis	
Affected VIN	

S.G.N. 8210-08

W/H RR DOOR



Modification basis	
Application basis	
Affected VIN	

Memo

Memo

POWER DISTRIBUTION

8410-02/8410-04/8401-06

FUSE/RELAY

8410-02 ENGINE ROOM FUSE & RELAY BOX..... 3
8410-04 I/P - LH FUSE & RELAY BOX..... 5
8401-06 I/P - RH FUSE & RELAY BOX..... 6

ELECTRICITY DIVIDE

8210-02 ENGINE ROOM FUSE & RELAY BOX CIRCUIT..... 7
8410-04 I/P - LH FUSE & RELAY BOX CIRCUIT..... 10
8410-06 I/P - RH FUSE & RELAY BOX CIRCUIT..... 15

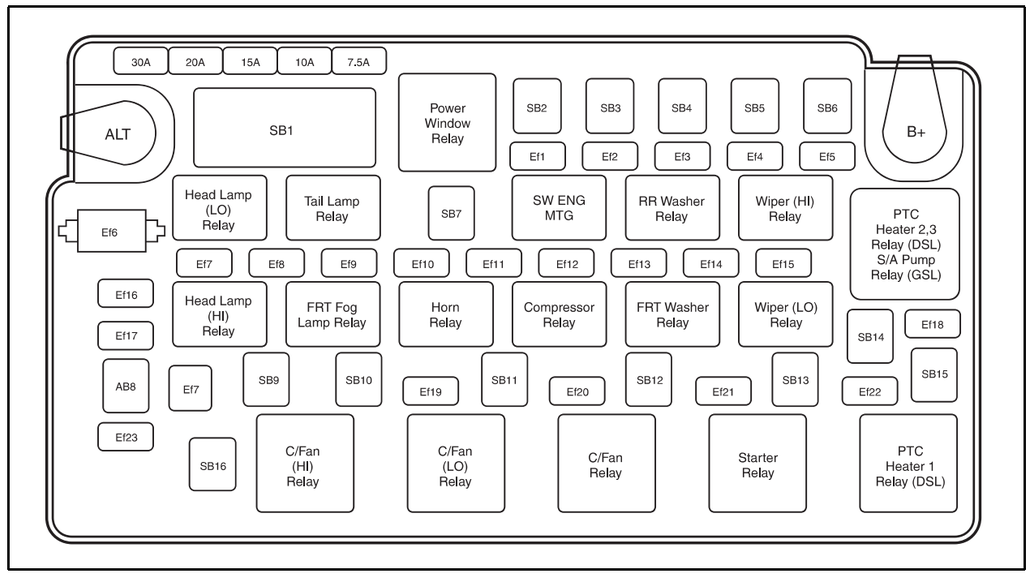
Memo

Memo

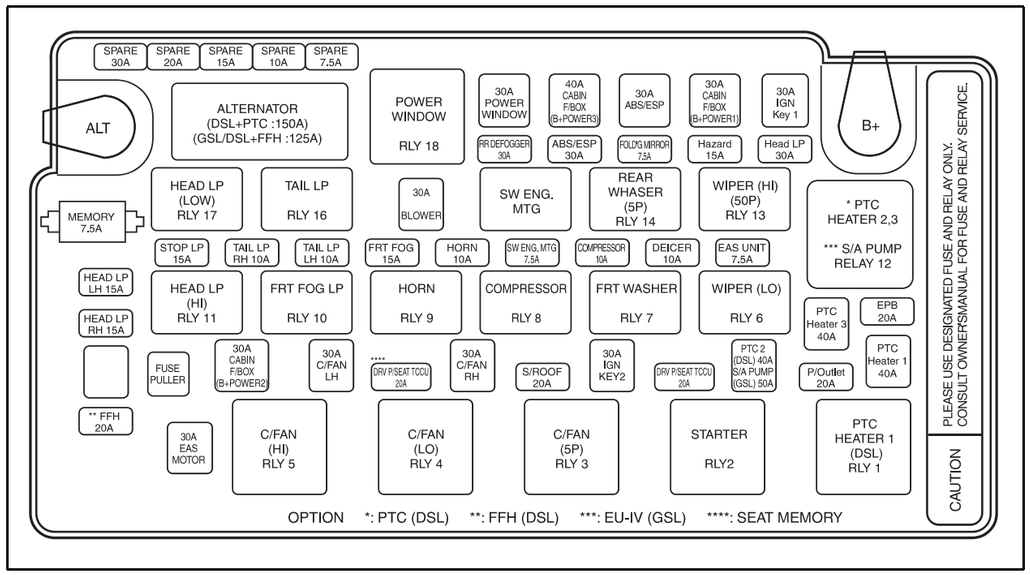
FUSE & RELAY

S.G.N. 8410-02 ENGINE ROOM FUSE & RELAY BOX

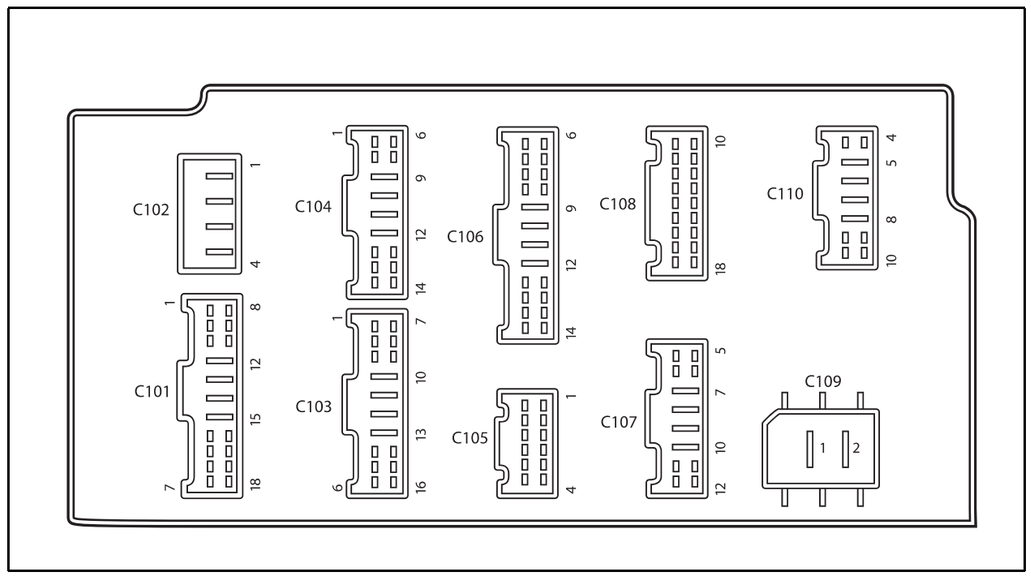
1) UPPER



3) ENGINE ROOM FUSE & RELAY BOX



2) LOW



Modification basis	
Application basis	
Affected VIN	

4) USAGE OF FUSE IN ENGINE ROOM FUSE BOX

Fuse No.	Capacity	Usage	Fuse No.	Capacity	Usage
SB1	150A/125A	Alternator (PTC/FFH)	Ef5	30A	Head Lamp
SB2	30A	Power Window	Ef6	7.5A	Memory
SB3	40A	IP-RH Fuse Box (B+) F65~F71	Ef7	15A	Stop Lamp
SB4	30A	ABS/ESP	Ef8	10A	Tail Lamp (RH)
SB5	30A	IP-LH Fuse Box (B+) F44~F50	Ef9	10A	Tail Lamp (LH)
SB6	30A	IGN Key 1	Ef10	15A	FRT Fog
SB7	30A	Blower Motor	Ef11	10A	Horn
SB8	-	-	Ef12	7.5A	Hub Solenoid
SB9	30A	IP-LH Fuse Box (B+) F51~F55	Ef13	10A	Compressor
SB10	30A	C/Fan LH	Ef14	10A	Deicer
SB11	30A	C/Fan RH	Ef15	-	-
SB12	30A	IGN Key 2	Ef16	15A	Head Lamp (LH)
SB13	40A	P.T.C Heater 2 (DSL)	Ef17	15A	Head Lamp (RH)
	50A	S/Air Pump (GSL)	Ef18	-	-
SB14	40A	P.T.C Heater 3 (DSL)	Ef19	20A	Driver P/Seat (Memory)
SB15	40A	P.T.C Heater 1 (DSL)	Ef20	20A	S/Roof
Ef1	30A	RR Defogger	Ef21	20A	Driver P/Seat
Ef2	30A	ABS/ESP	Ef22	20A	P/Outlet
Ef3	7.5A	Fold'g Mirror	Ef23	20A	FFH
Ef4	15A	Hazard			

5) 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. 8410-04

I/P – LH FUSE & RELAY BOX

1) I/P - LH FUSE & RELAY BOX

	7.5A SPARE		10A SPARE	F24 10A	A/BAG	F41 7.5A	O/SIDE MRR DIGITAL CLOCK ECM MRR, S/ROOF
F25 7.5A	CLUSTER STICS	F42 15A	C/LIGHTER		15A SPARE		20A SPARE
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				
F29 10A	TCU, TGS TCCU	F46 20A	*GSL INJECTOR				
F30 10A	ENG ECU	F47 10A	*GSL SENSOR				
F31 -	SPARE	F48 -	SPARE				
F32 7.5A	SEAT UNIT EAS, EPB	F49 7.5A	DRL				
F33 10A	ABS/ESP	F50 -	SPARE				
F34 7.5A	HEAD LP R/SNR& AUTO LIGHT DRL	F51 10A	RR FOG LAMP INTERIOR LAMP				
F35 15A	S/WARMER	F52 7.5A	IMMOBILIZER BUZZER, CHIME				
F36 20A	FRT WIPER WASHER	F53 15A	DOOR LOCK/UNLOCK B/HORN				
F37 7.5A	PWR OUTLET A/CON	F54 7.5A	SEAT UNIT FOLDING DIAGNOSIS				
F38 10A	RR WIPER	F55 -	SPARE				
F39 7.5A	STICS FRT & RR GLASS HEATER	F56 10A	STARTER GSL ECU				
F40 -	SPARE	F57 7.5A	DEF IND O/S MRR DEF				

FLASHER UNIT

RR WIPER

BURGLAR HORN

*HDC
H D C

SPARE

SPARE

RR FOG LAMP

FUSE PULLER

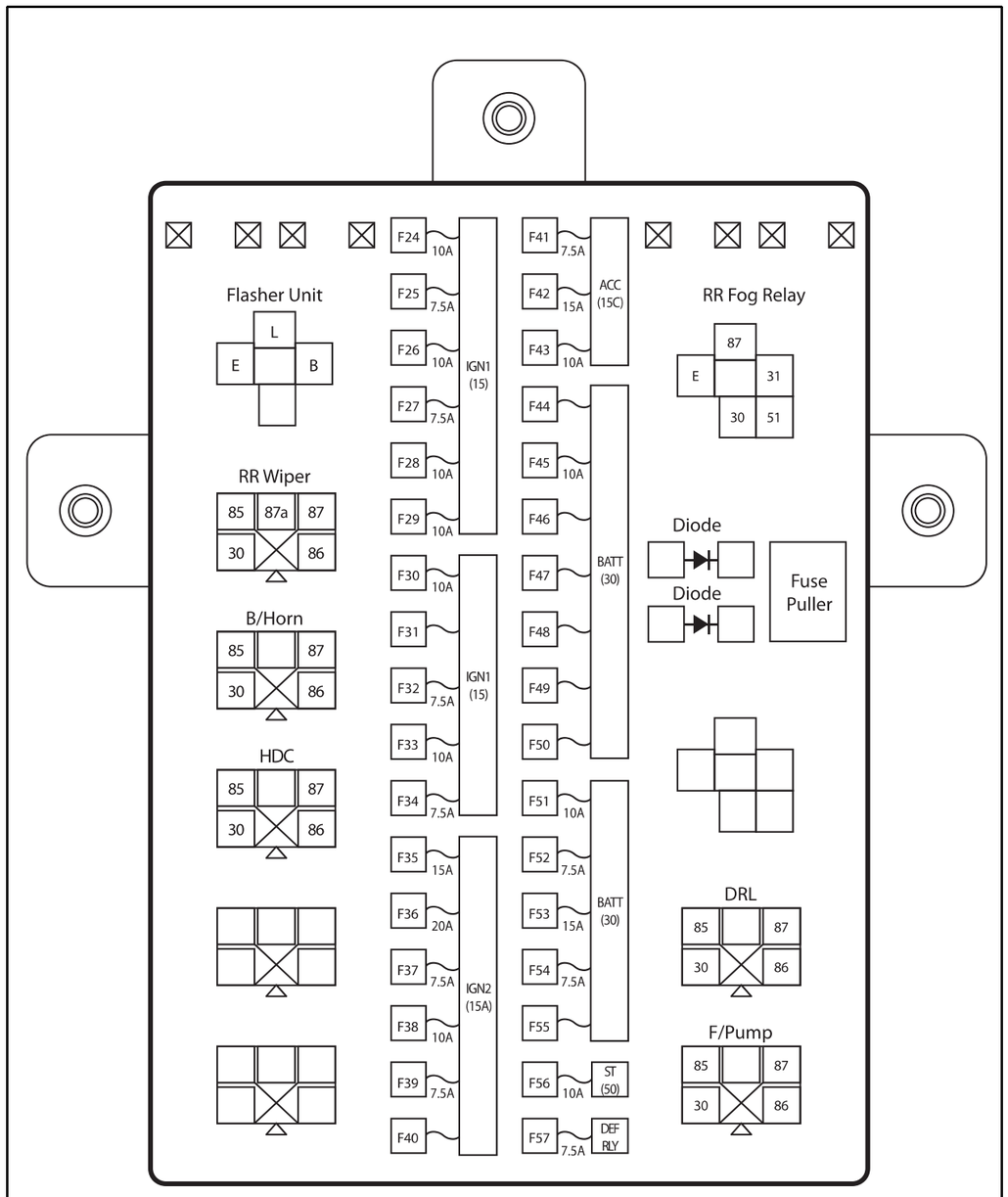
SPARE

D R L

*GSL
F/PUMP

* PLEASE USE THE DESIGNATED FUSE AND RELAY

2) POWER SUPPLY

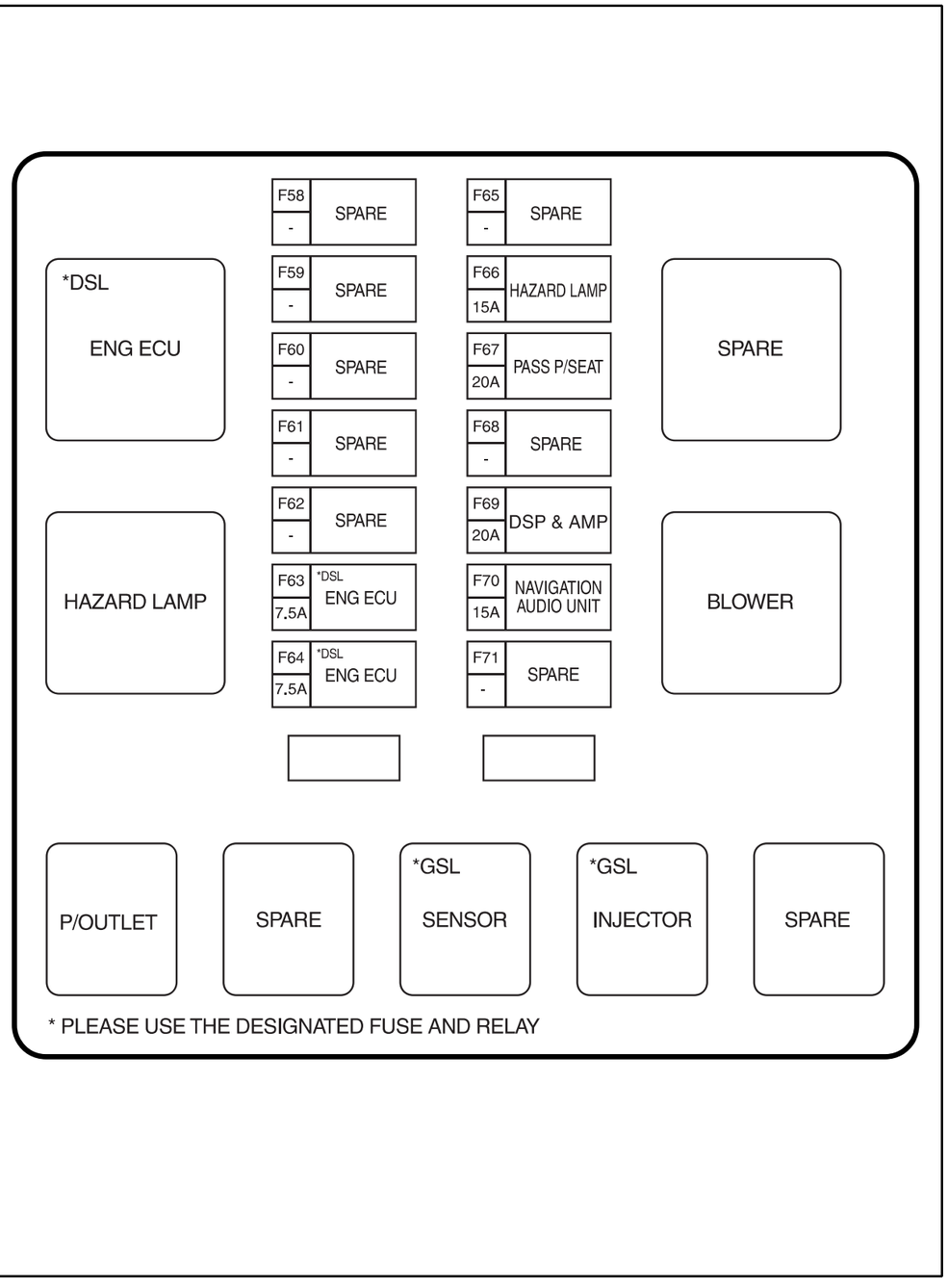


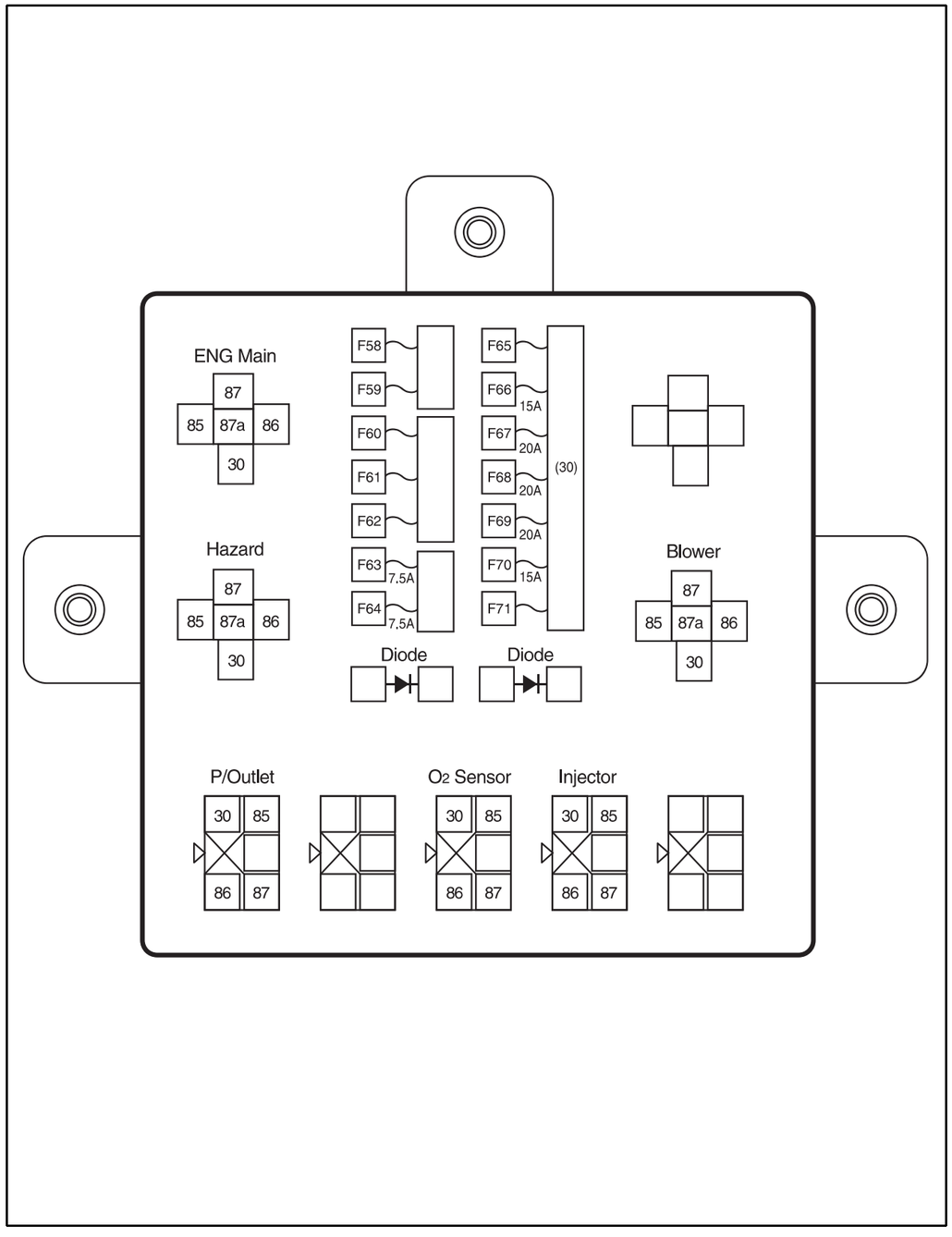
Modification basis	
Application basis	
Affected VIN	

S.G.N. 8410-06

I/P – RH FUSE & RELAY BOX

1) I/P - RH FUSE & RELAY BOX



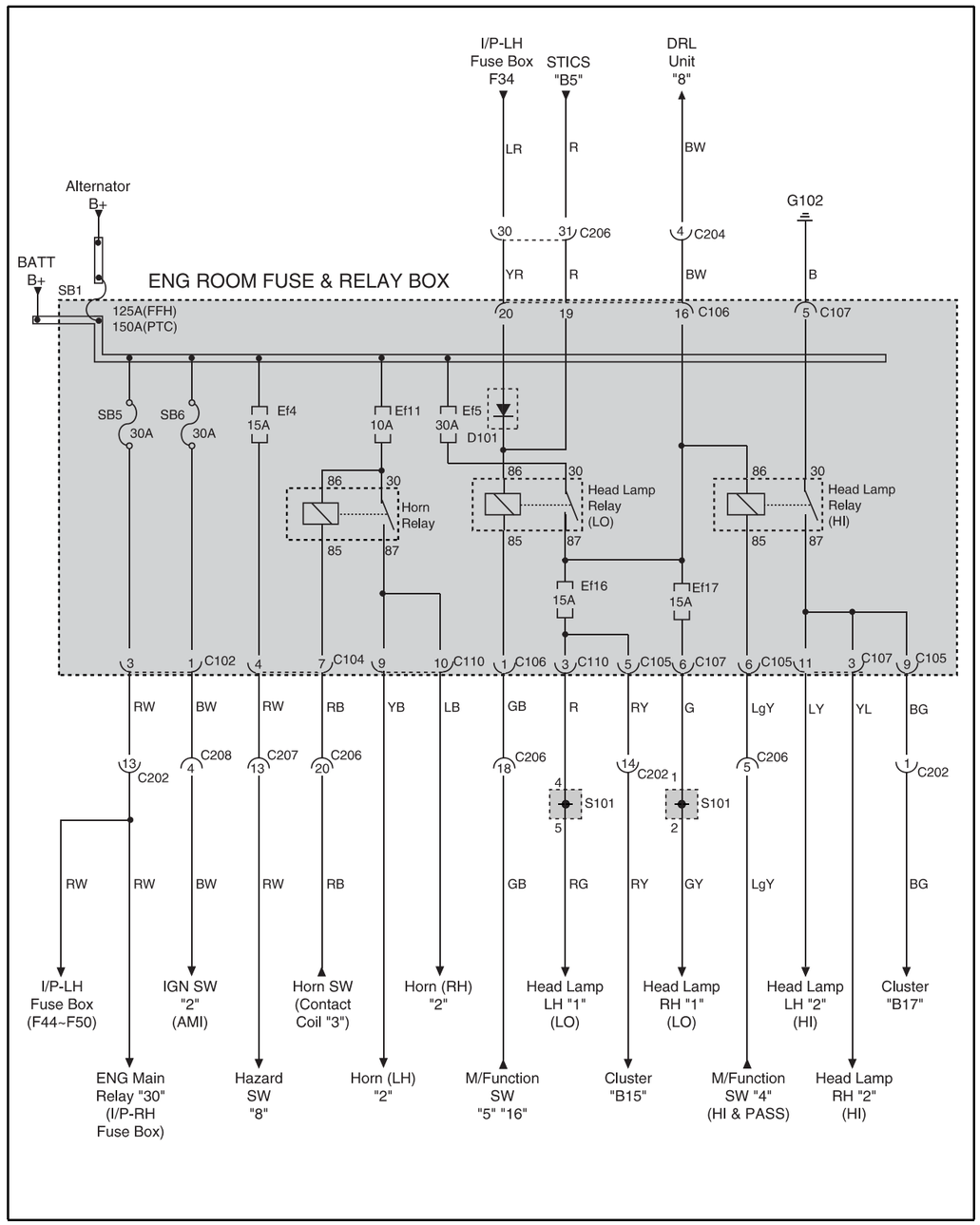


Modification basis	
Application basis	
Affected VIN	

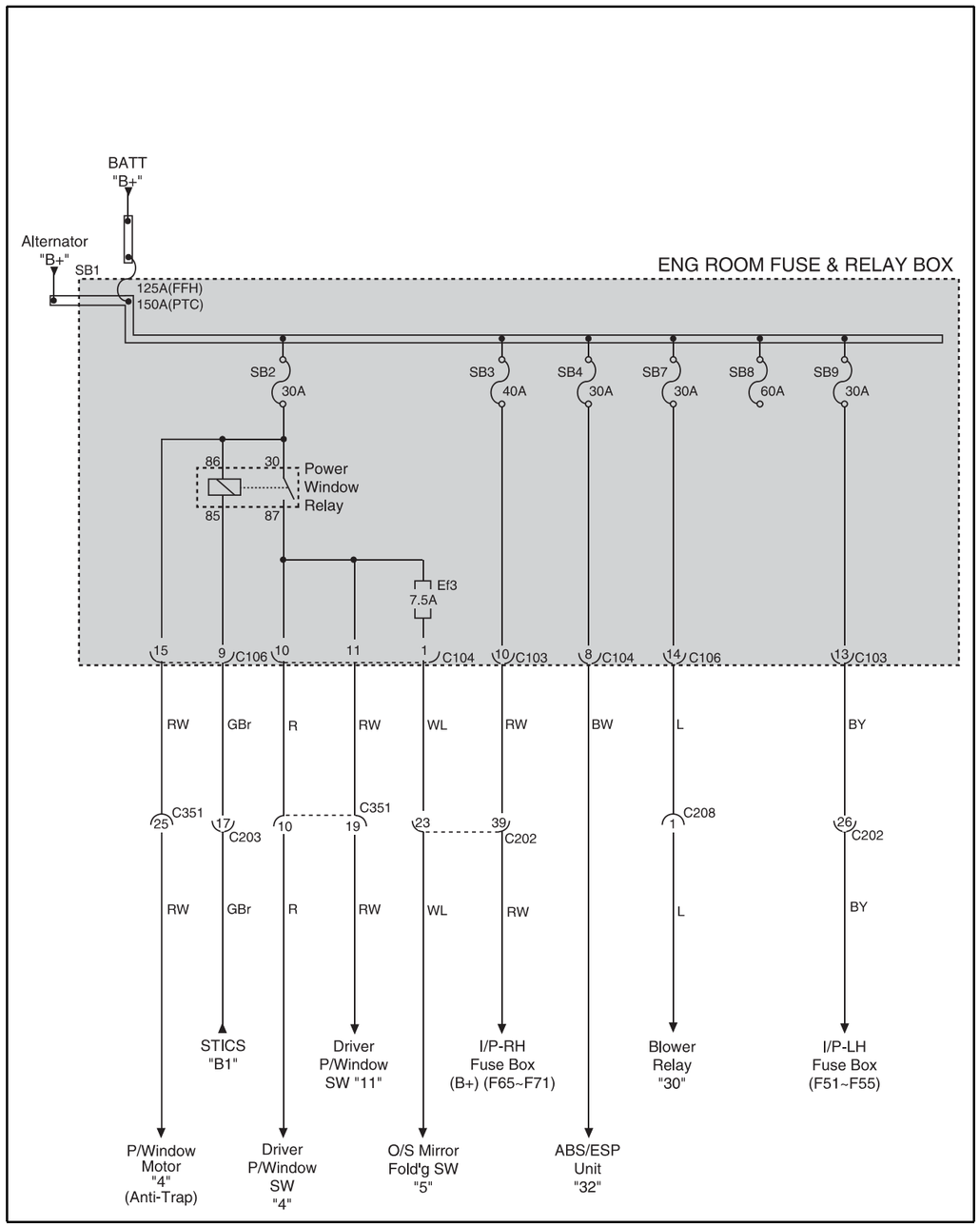
ELECTRICITY DIVIDE

SGN 8210-02 ENGINE ROOM FUSE & RELAY BOX CIRCUIT

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

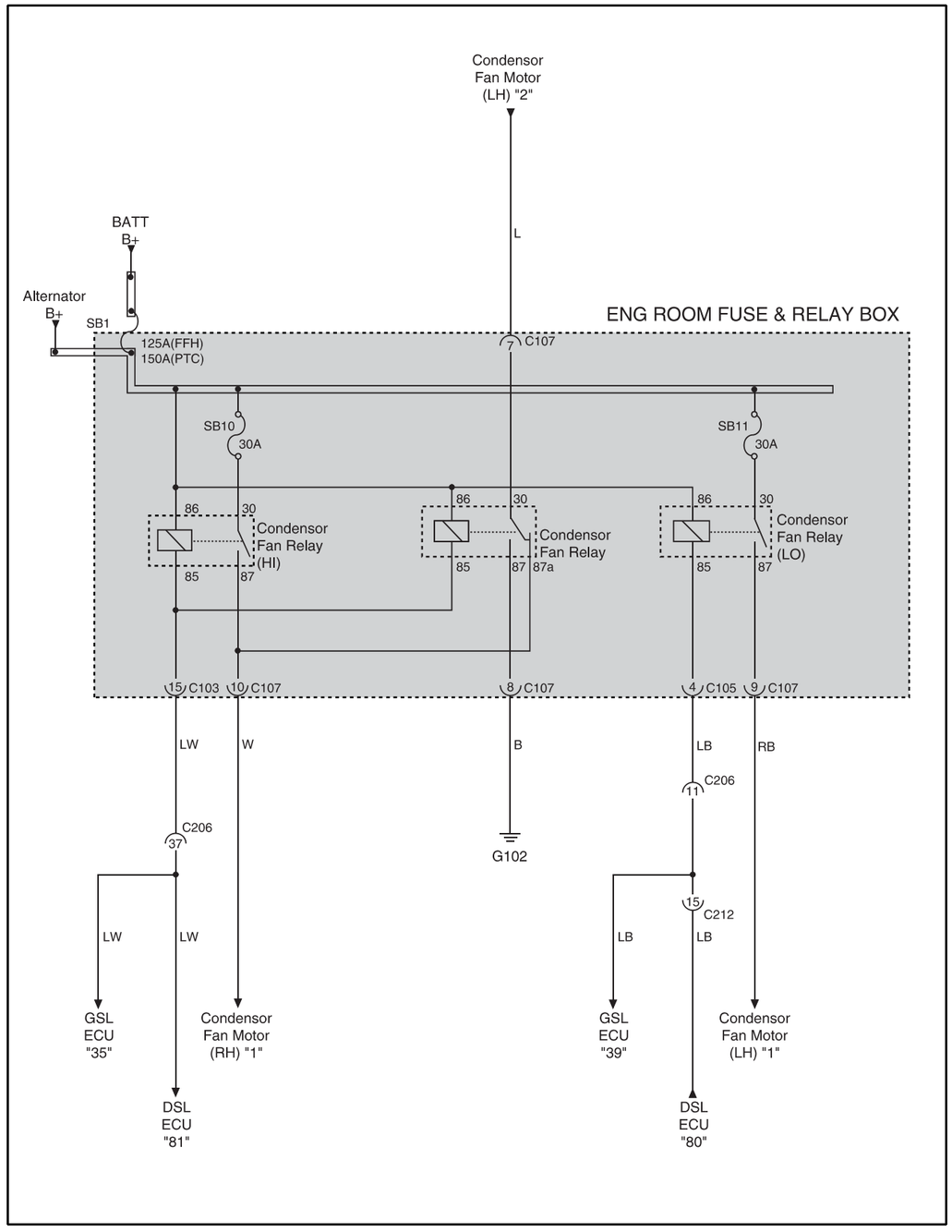


(2) SB2 ~ SB4, SB7 ~ SB9, Ef3, P/WINDOW RELAY

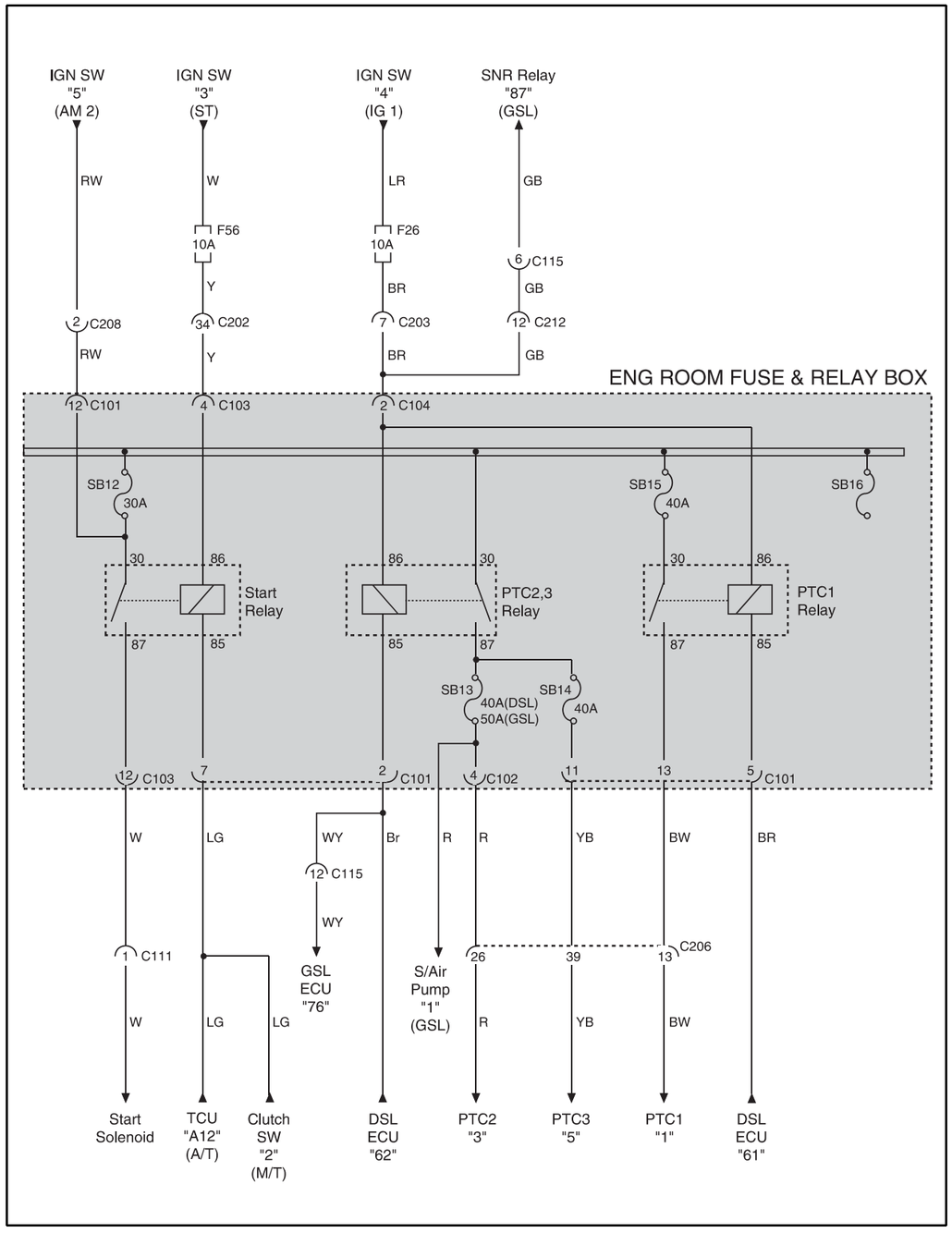


Modification basis	
Application basis	
Affected VIN	

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

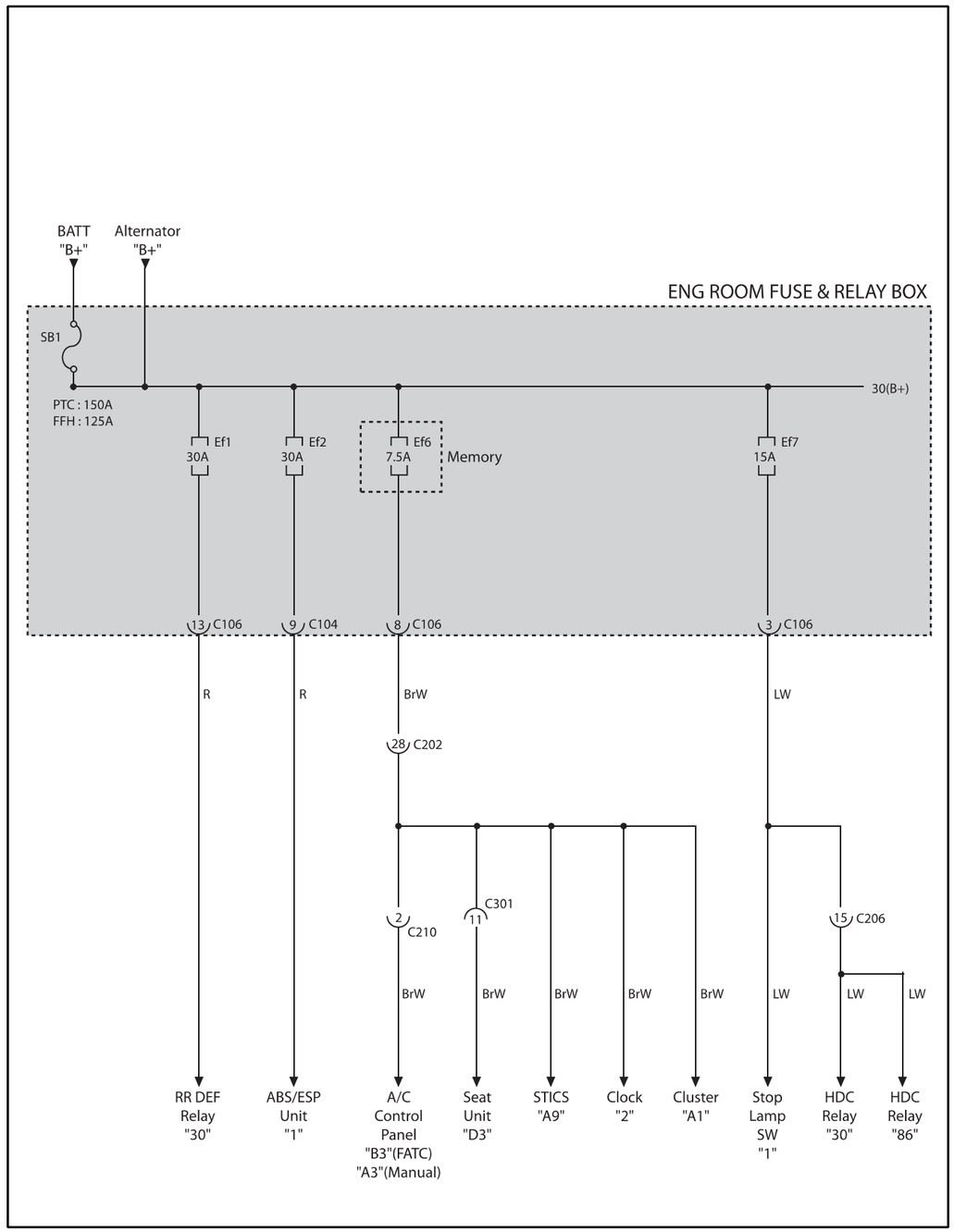


(4) SB12 ~ SB16, START RELAY, PTC RELAY

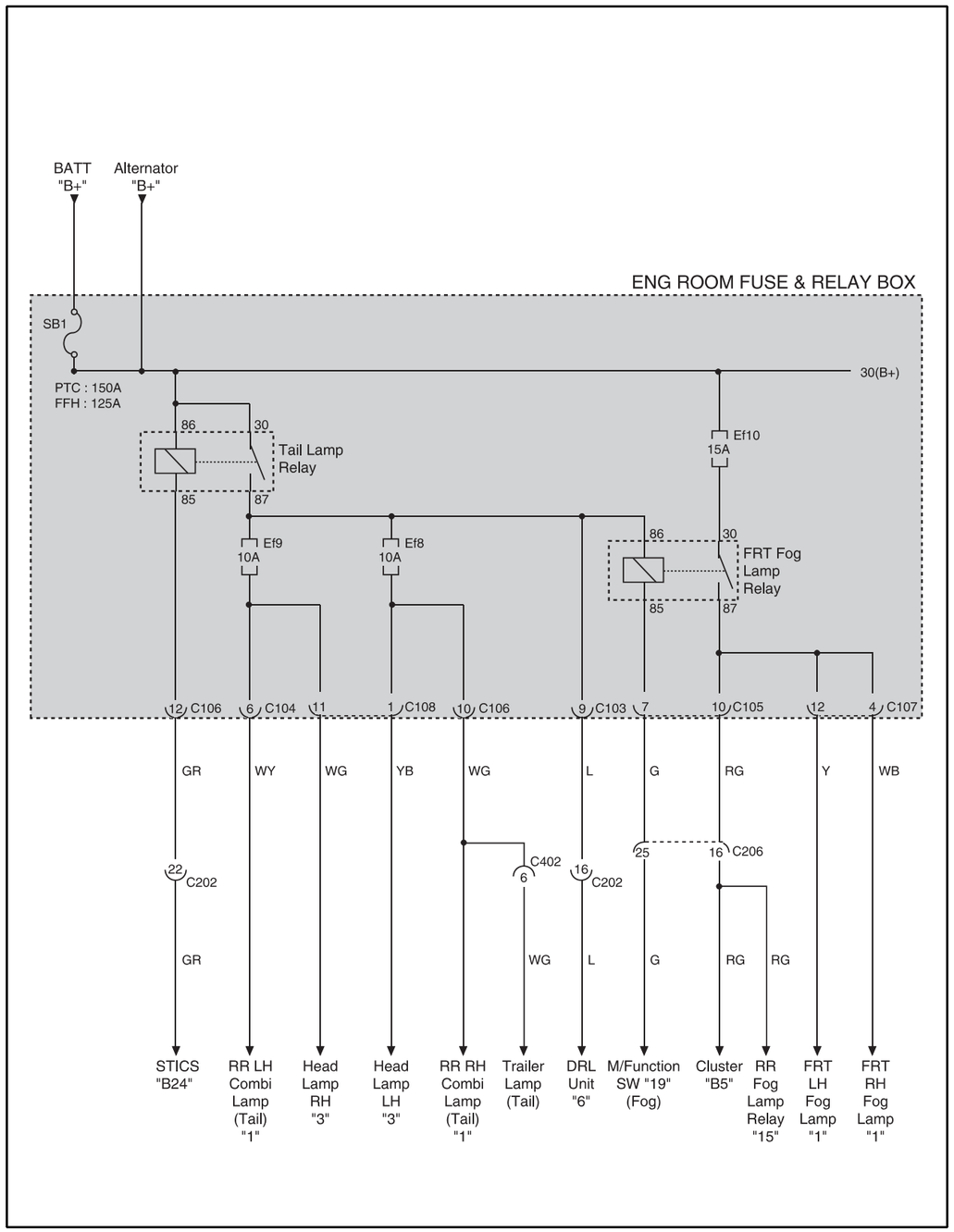


Modification basis	
Application basis	
Affected VIN	

(5) Ef1, Ef2, Ef6, Ef7

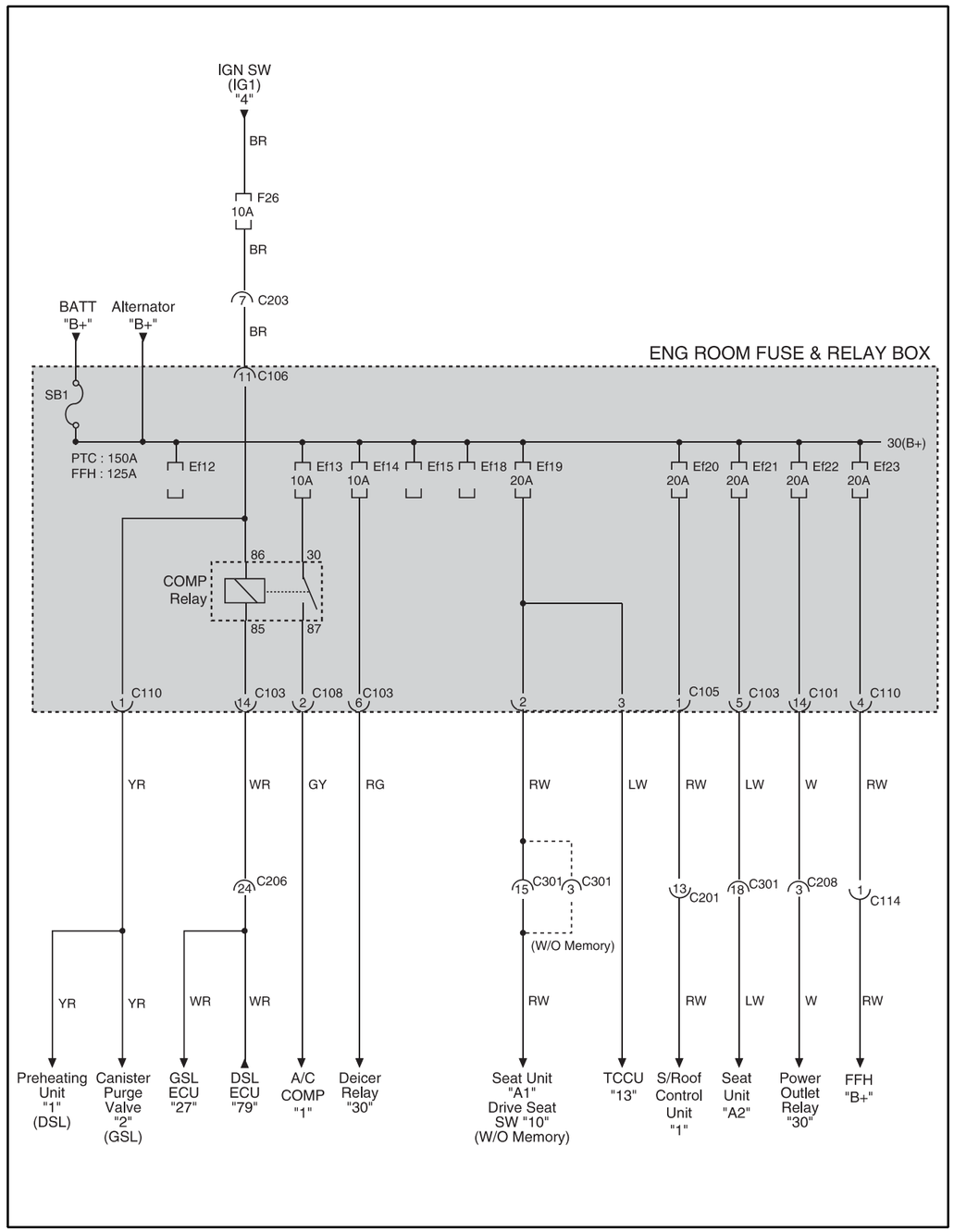


(6) Ef8 ~ Ef10, TAIL LAMP RELAY, FRT FOG LAMP RELAY

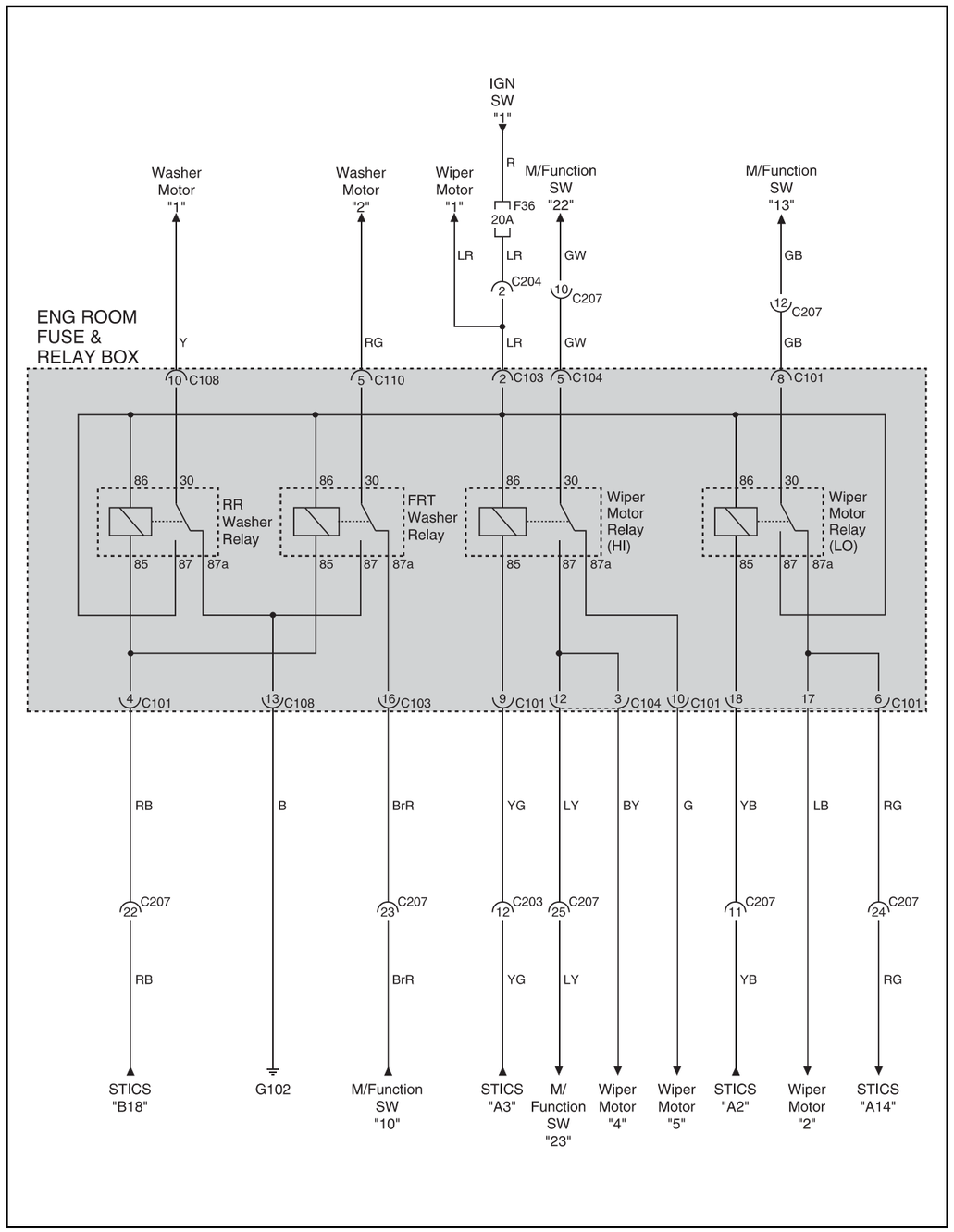


Modification basis	
Application basis	
Affected VIN	

(7) Ef12 ~ Ef15, Ef18 ~ Ef23, COMPRESSOR RELAY



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

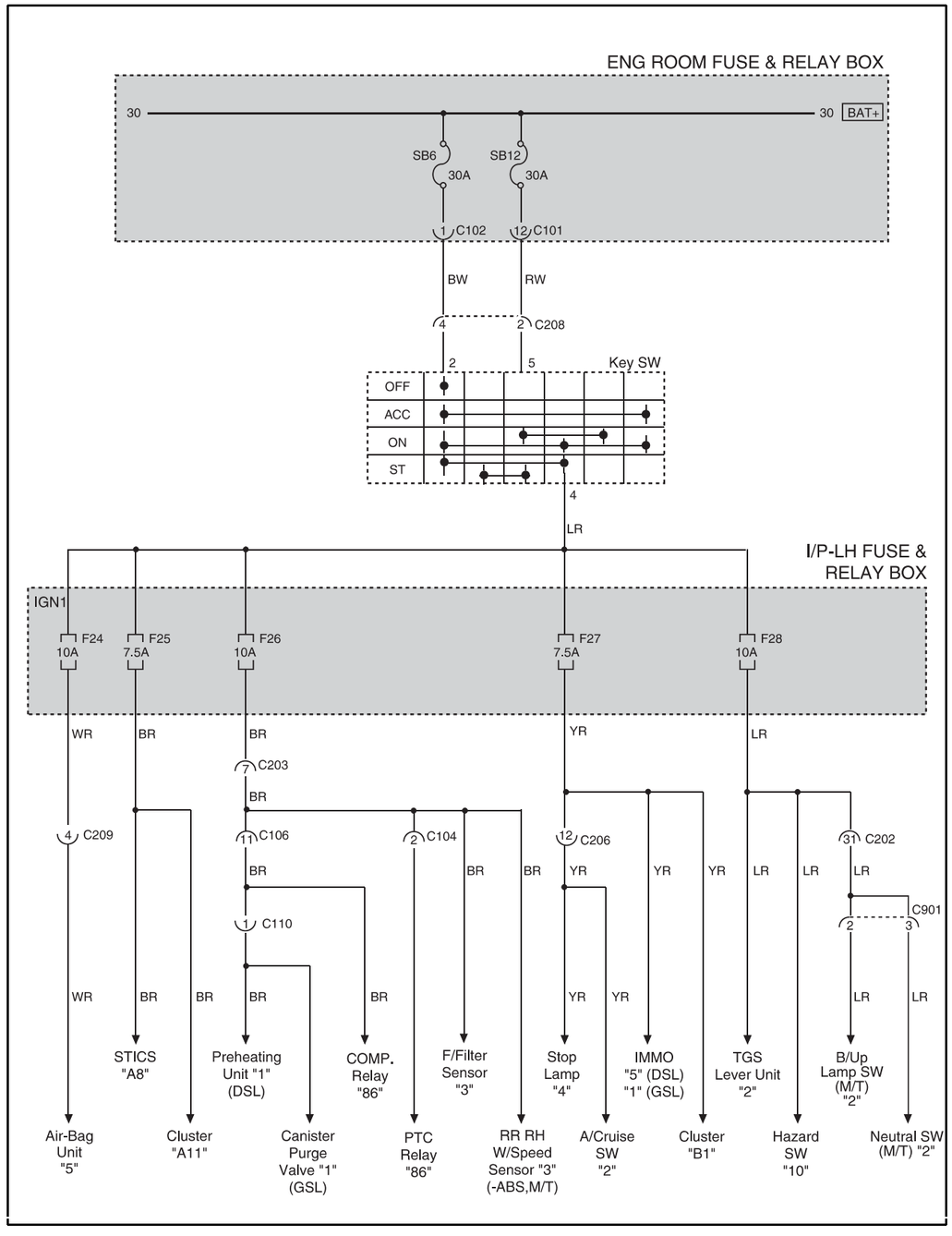


Modification basis	
Application basis	
Affected VIN	

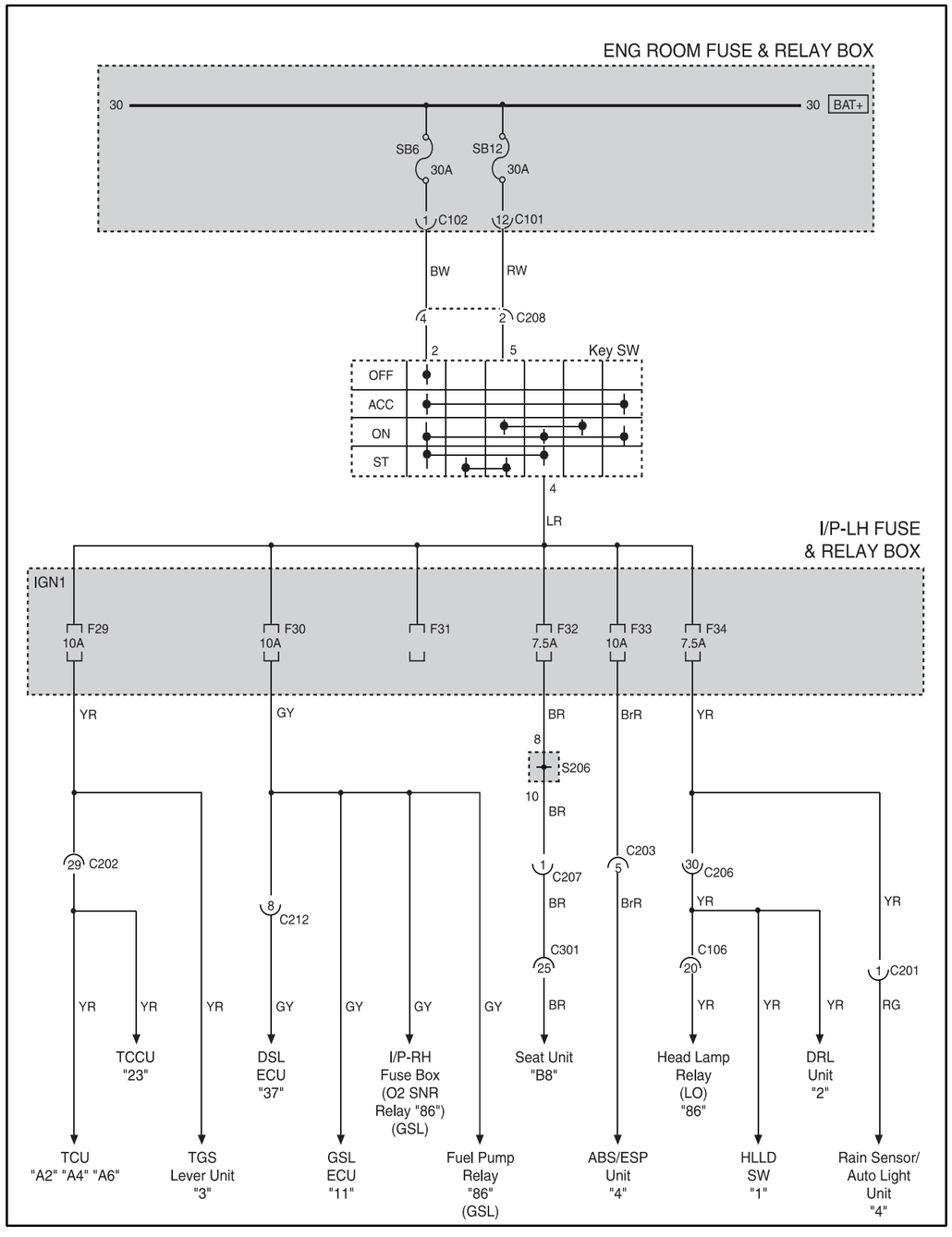
S.G.N. 8410-04

I/P - LH FUSE & RELAY BOX CIRCUIT

(1) F24 ~ F28

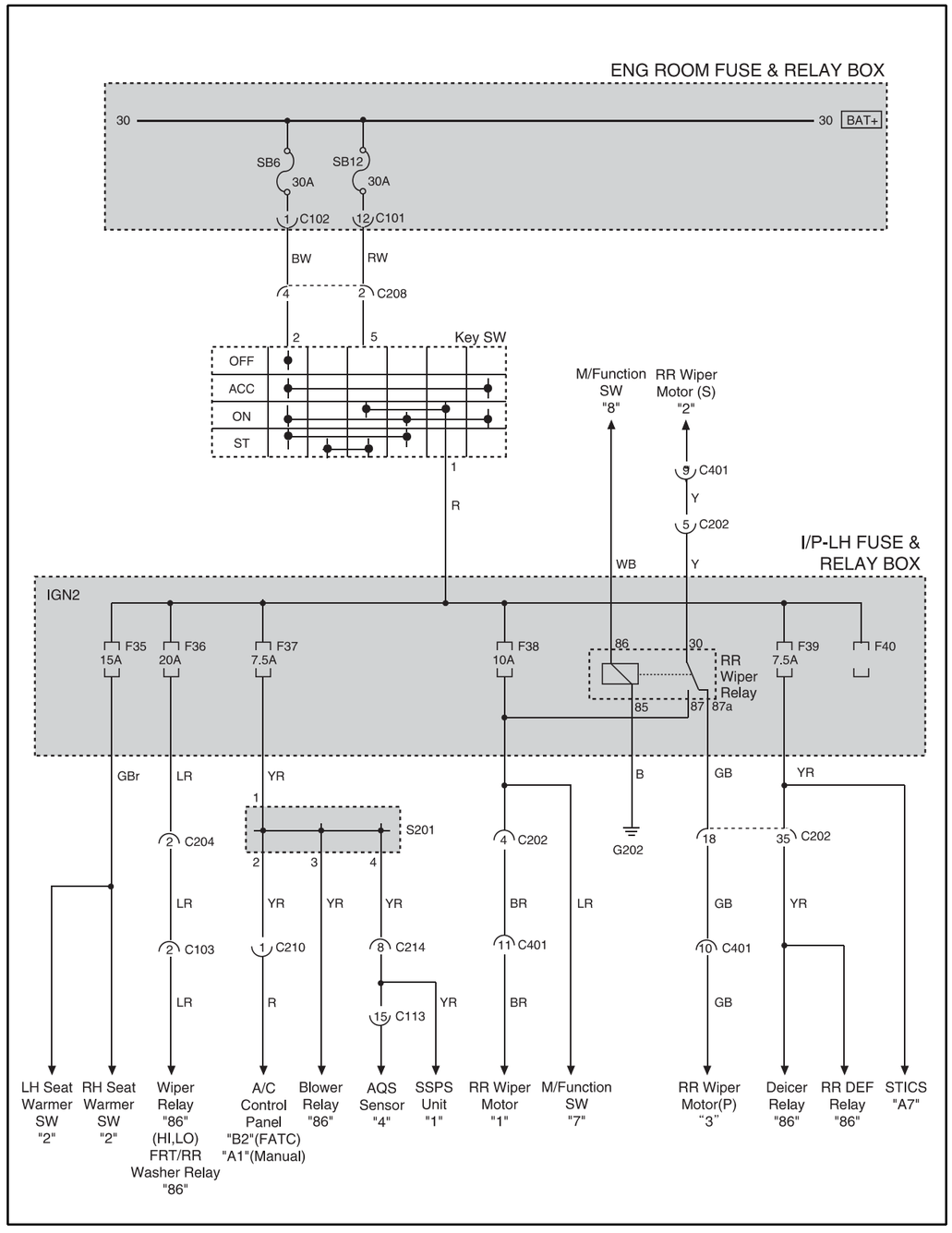


(2) F29 ~ F34

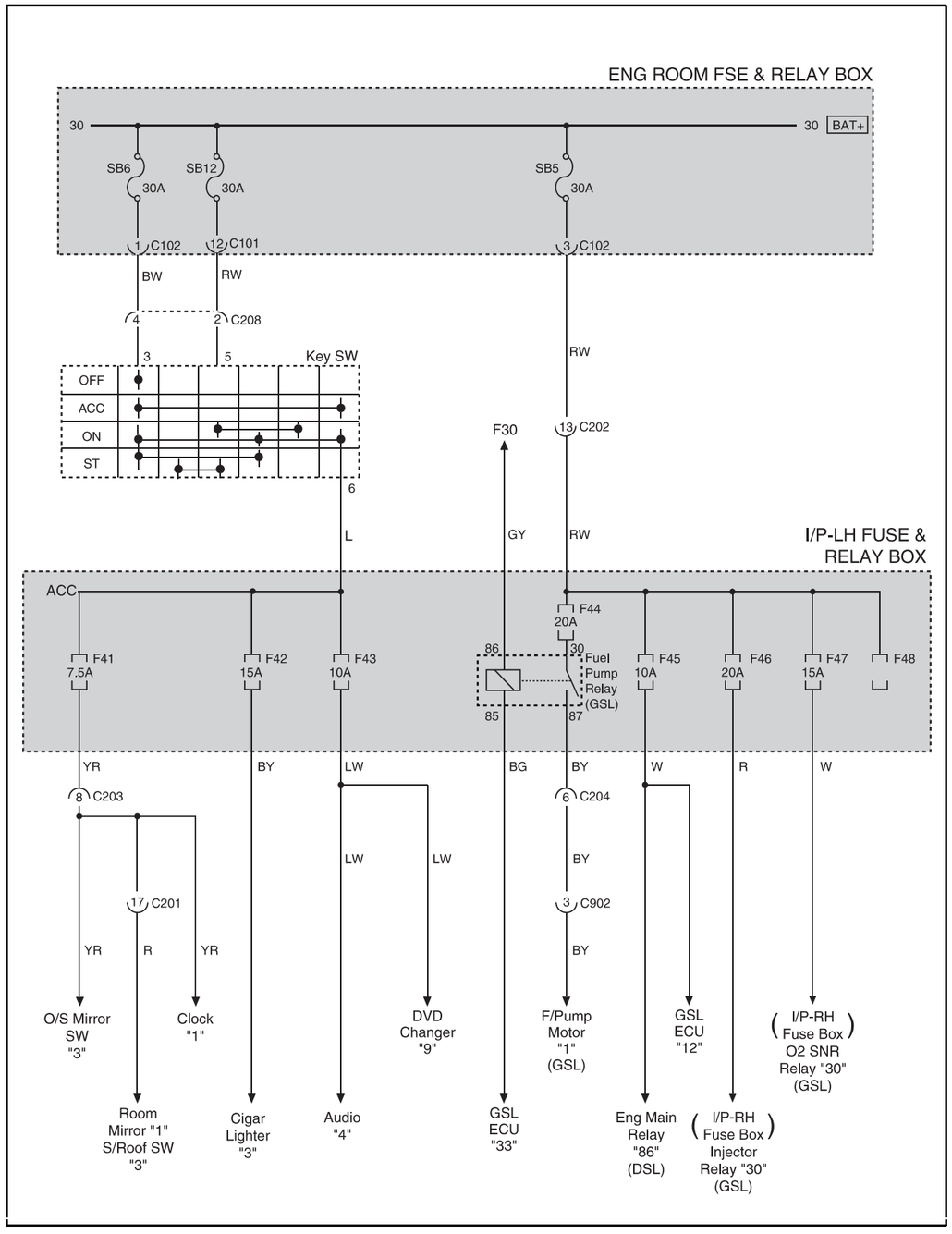


Modification basis	
Application basis	
Affected VIN	

(3) F35 ~ F40, RR WIPER RELAY

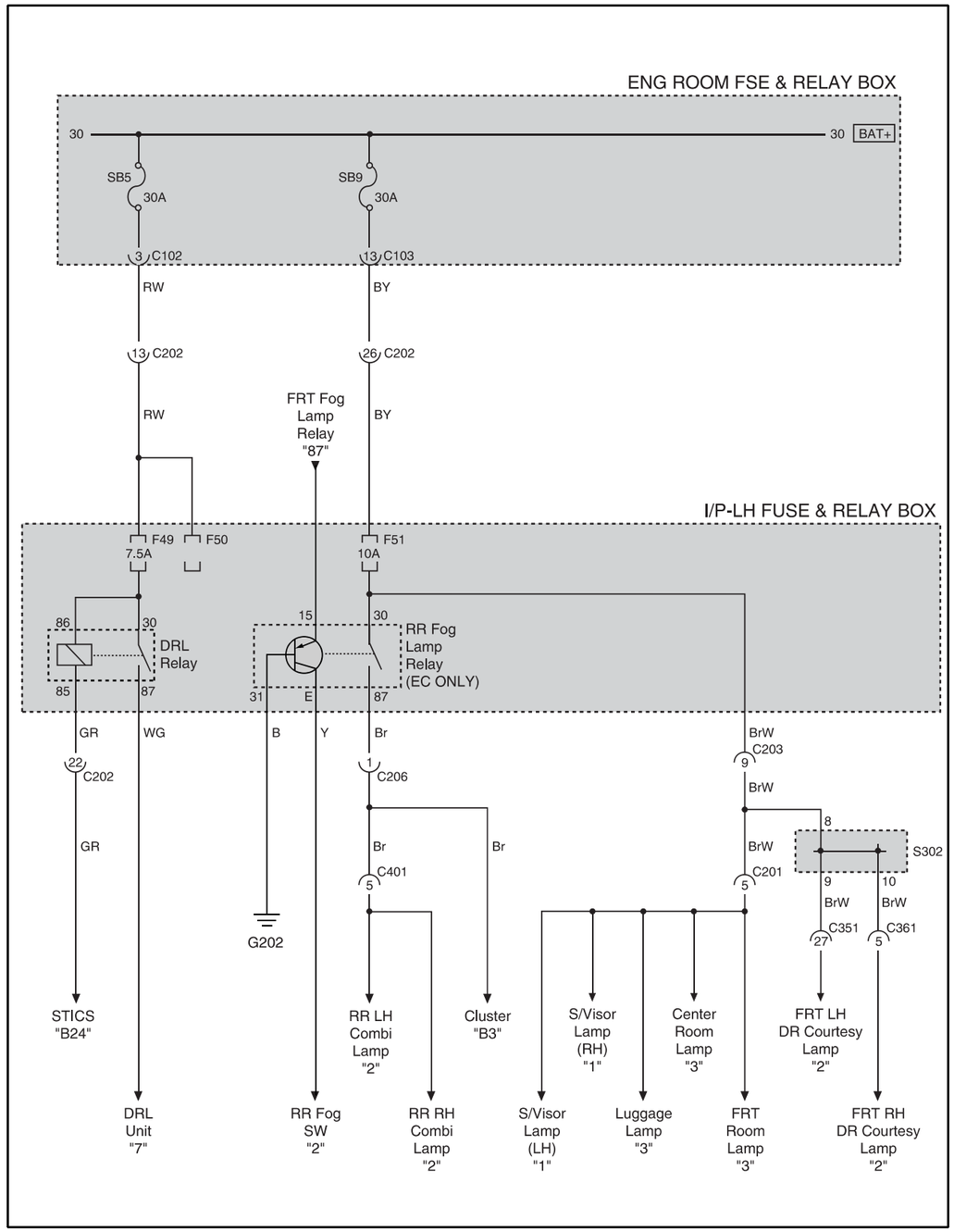


(4) F41 ~ F48

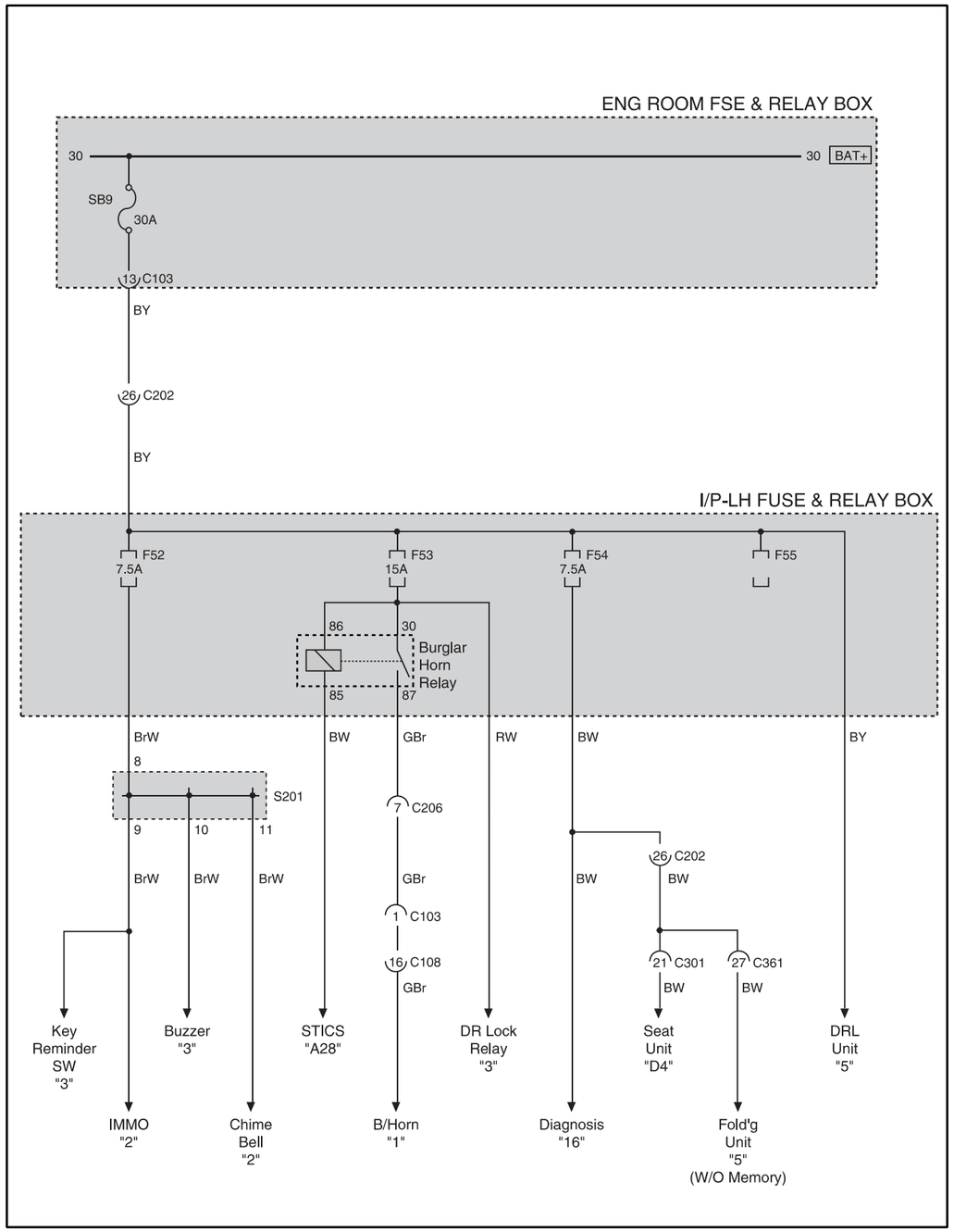


Modification basis	
Application basis	
Affected VIN	

(5) F49 ~ F51, DRL RELAY, RR FOG LAMP RELAY

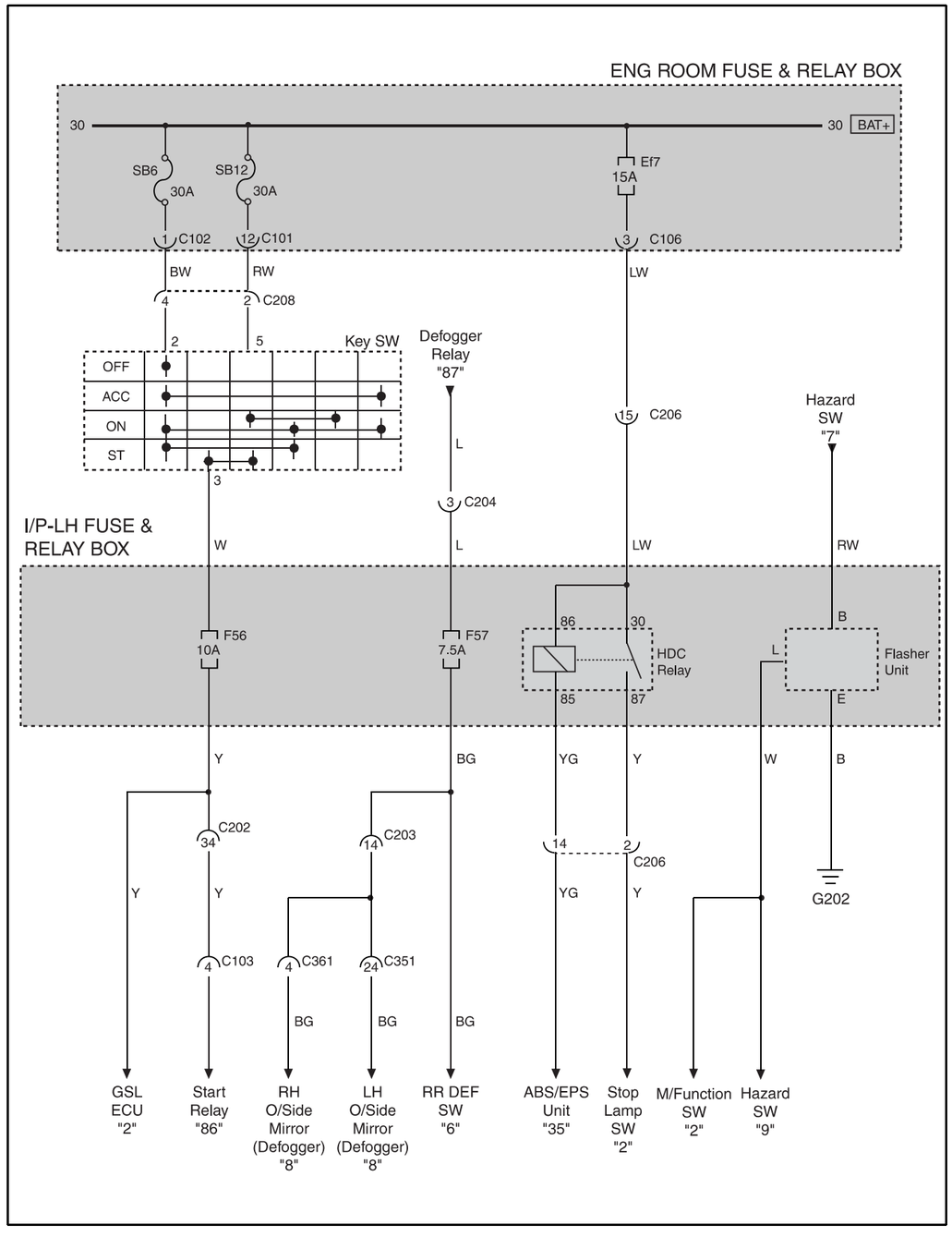


(6) F52 ~ F55, BURGLAR HORN RELAY



Modification basis	
Application basis	
Affected VIN	

(7) F56 ~ F57, HDC RELAY, FLASHER UNIT

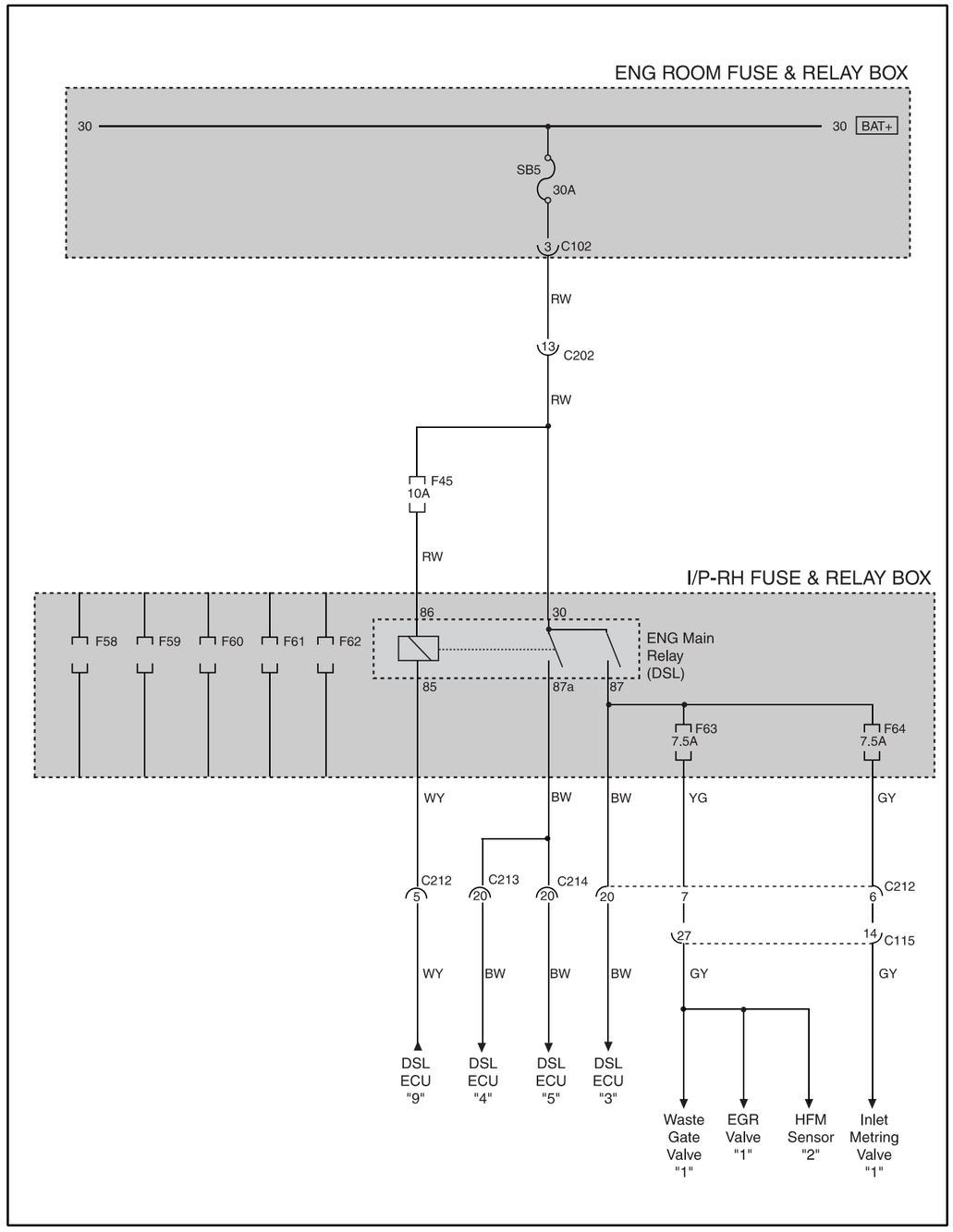


Modification basis	
Application basis	
Affected VIN	

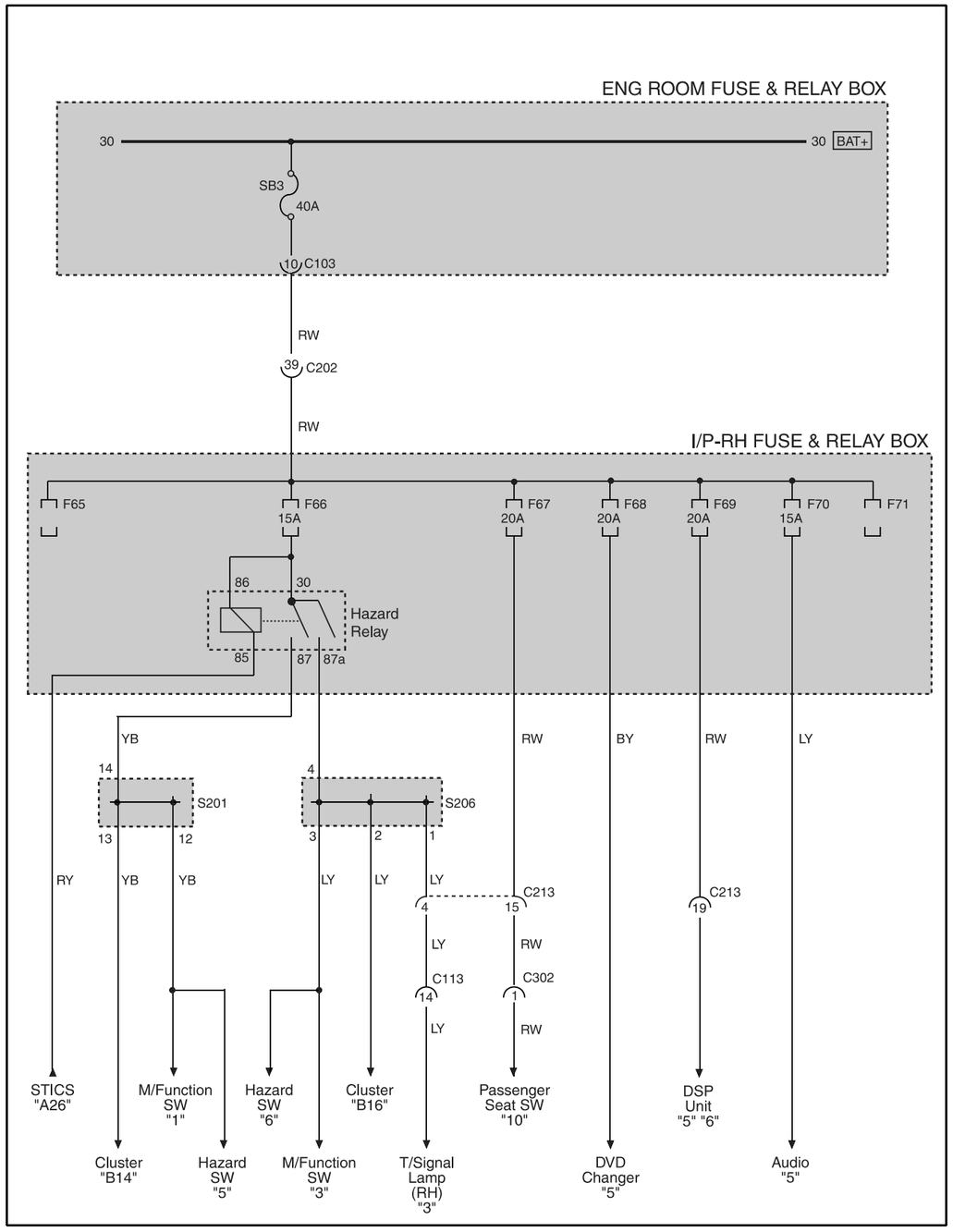
S.G.N. 8410-06

I/P - RH FUSE & RELAY BOX CIRCUIT

(1) F58 ~ F64, ENG MAIN RELAY

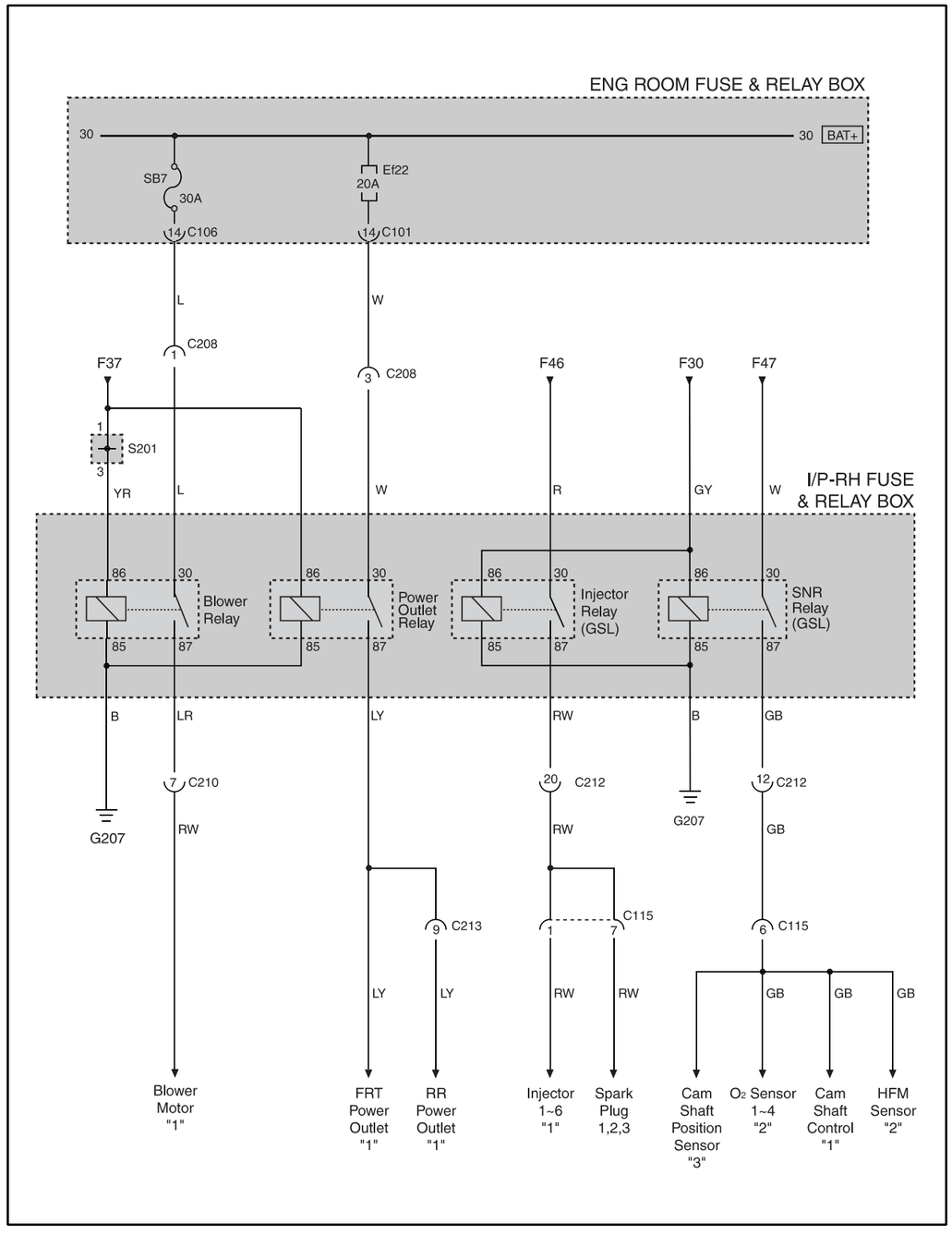


(2) F65 ~ F71, HAZARD RELAY



Modification basis	
Application basis	
Affected VIN	

(3) BLOWER RELAY, P/OUTLET RELAY, INJECTOR RELAY, SNR RELAY



Modification basis	
Application basis	
Affected VIN	

CIRCUIT

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-

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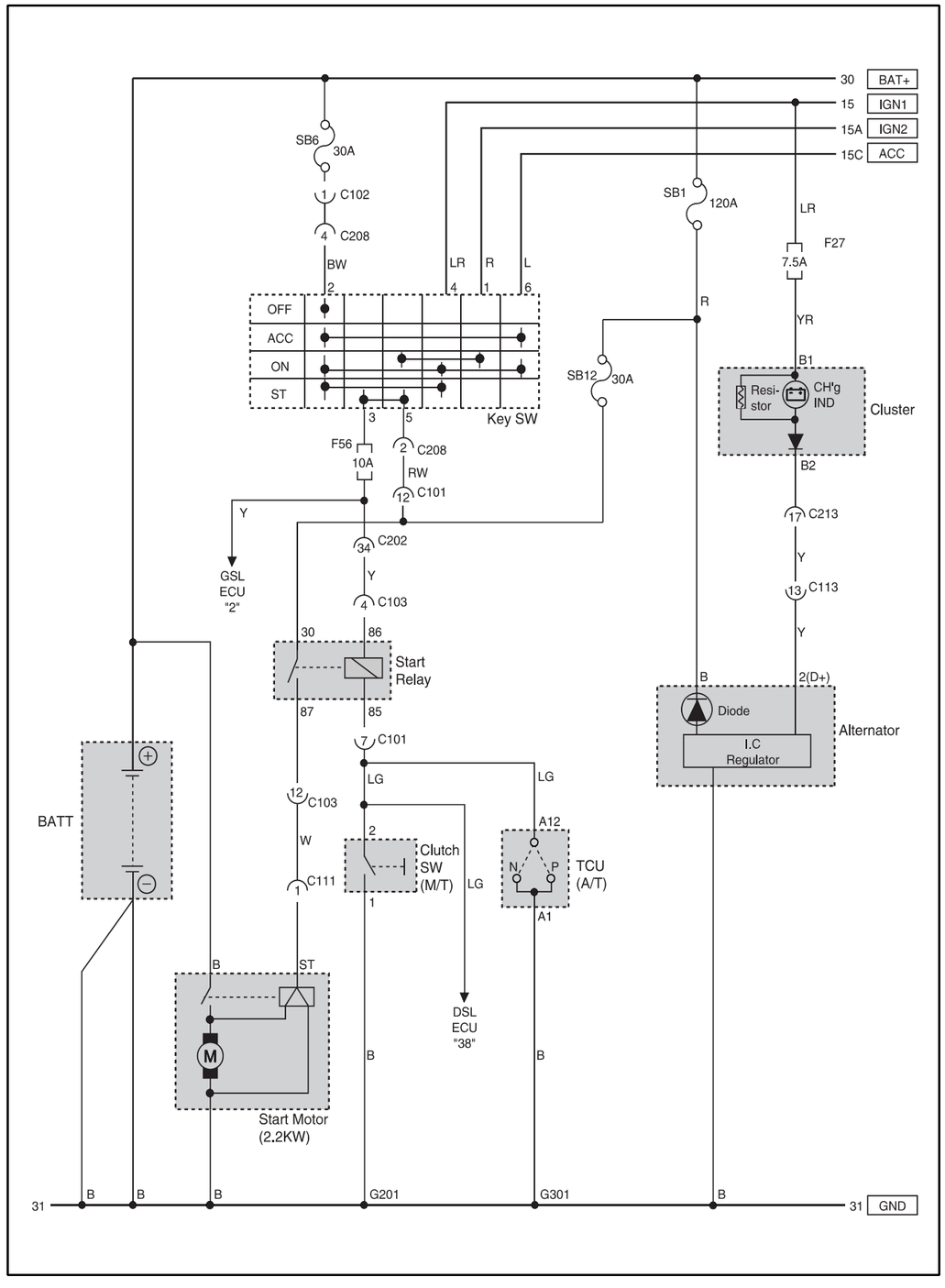
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Memo

Memo

S.G.N. 1461-01

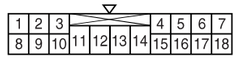
STARTING & CHARGING



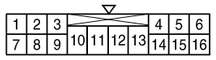
1) CONNECTOR INFORMATION

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
C113 (16Pin, Black)	W/H Eng W/H Floor	Inside RH Fender PNL	
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	
G201	W/H Floor	Under the Driver Cowl Side PNL	Under C/Holder
G301	W/H Floor	Under the Driver Seat	

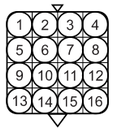
2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION


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

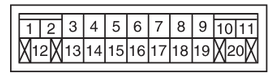

C102
W/H Floor
(Eng Room Fuse & Relay Box)


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


C111
W/H Floor
(Starter)

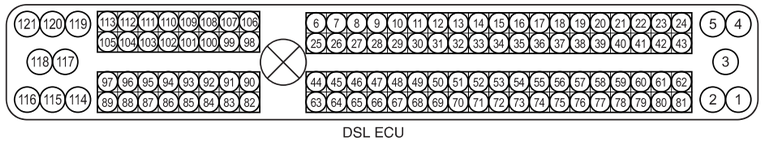

C113
W/H Floor


C208
W/H Floor

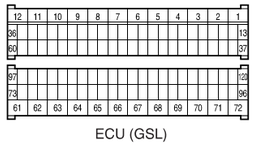

C213
W/H Floor

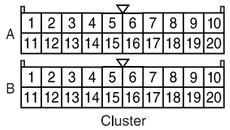

Clutch SW (M/T)

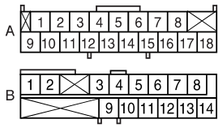

IGN SW


DSL ECU


Alternator


ECU (GSL)

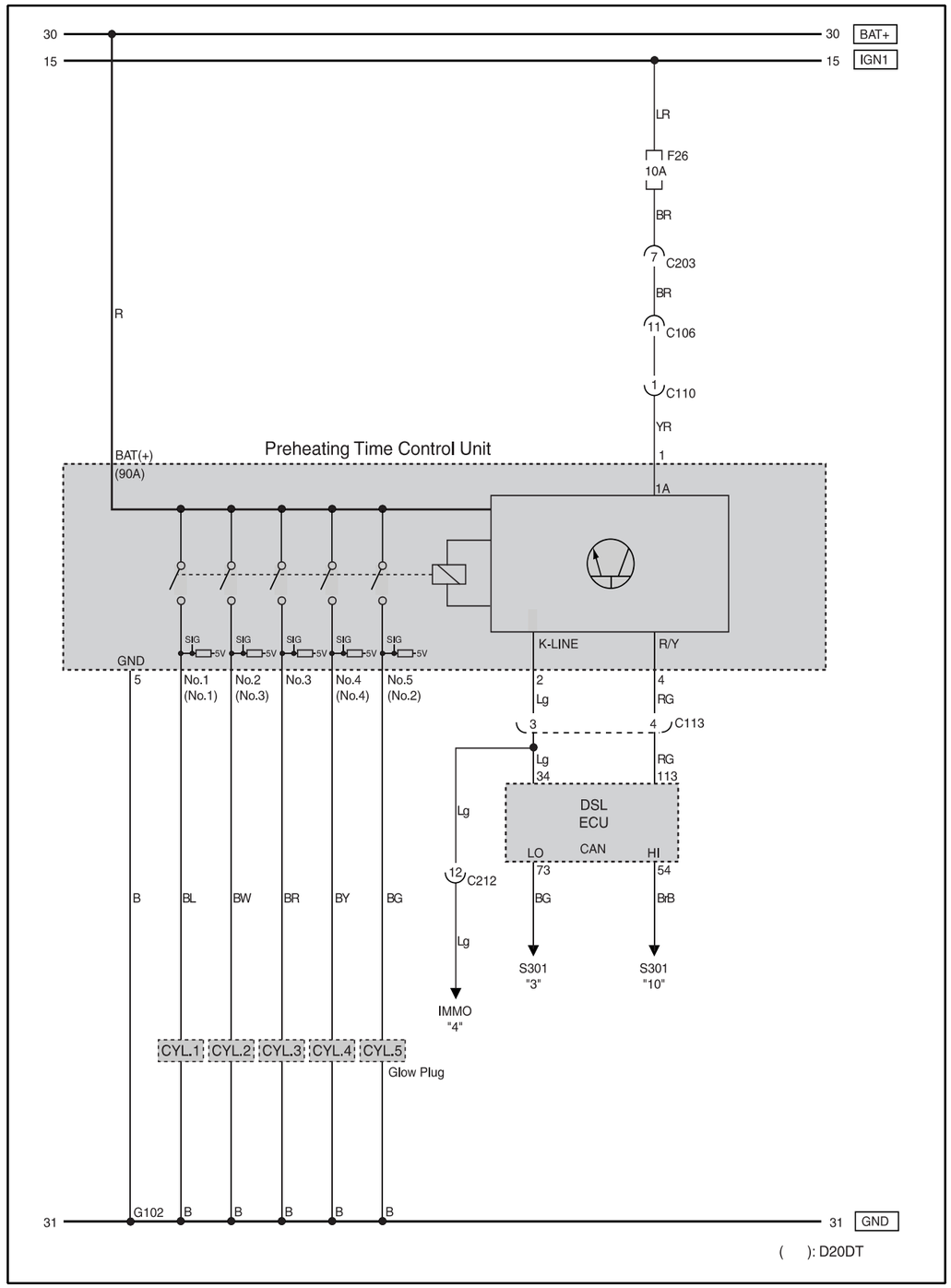

Cluster


TCU

Modification basis	
Application basis	
Affected VIN	

S.G.N. 2820-01

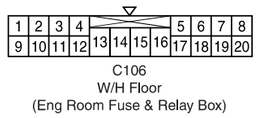
PREHEATING CIRCUIT

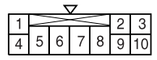


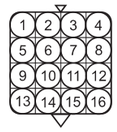
1) CONNECTOR INFORMATION

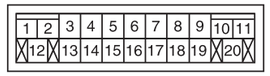
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C106 (20Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C110 (10Pin, White)	W/H Eng Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C113 (16Pin, Black)	W/H Eng W/H Floor	Inside RH 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

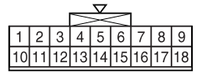
2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION


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

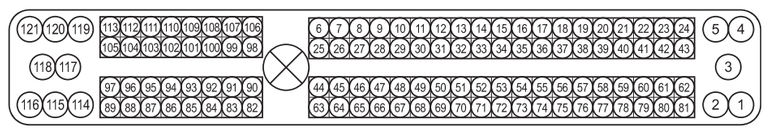

C110
W/H ENG
(Eng Room Fuse & Relay Box)


C113
W/H Floor


C212
W/H Floor


C203
W/H Floor


Preheating Time
Control Unit


DSL ECU

CIRCUIT

KYRON 2005.10

Modification basis	
Application basis	
Affected VIN	

3) CIRCUIT DESCRIPTION

Glow plug is installed on the cylinder head (combustion chamber) in the DSL preheating control unit system.
Cold starting performance has improved and exhaust gas during cold starting has reduced.
ECU receives coolant temperature and engine speed to control; after monitoring the engine preheating/post
heating and glow plug diagnosis function, the fault contents will be delivered to ECU.

▶ **Engine preheating/post heating functions**

▶ **Preheating relay activation by ECU controls**

- Senses engine temperature and controls the preheating/post heating time.
- Preheating warning light.

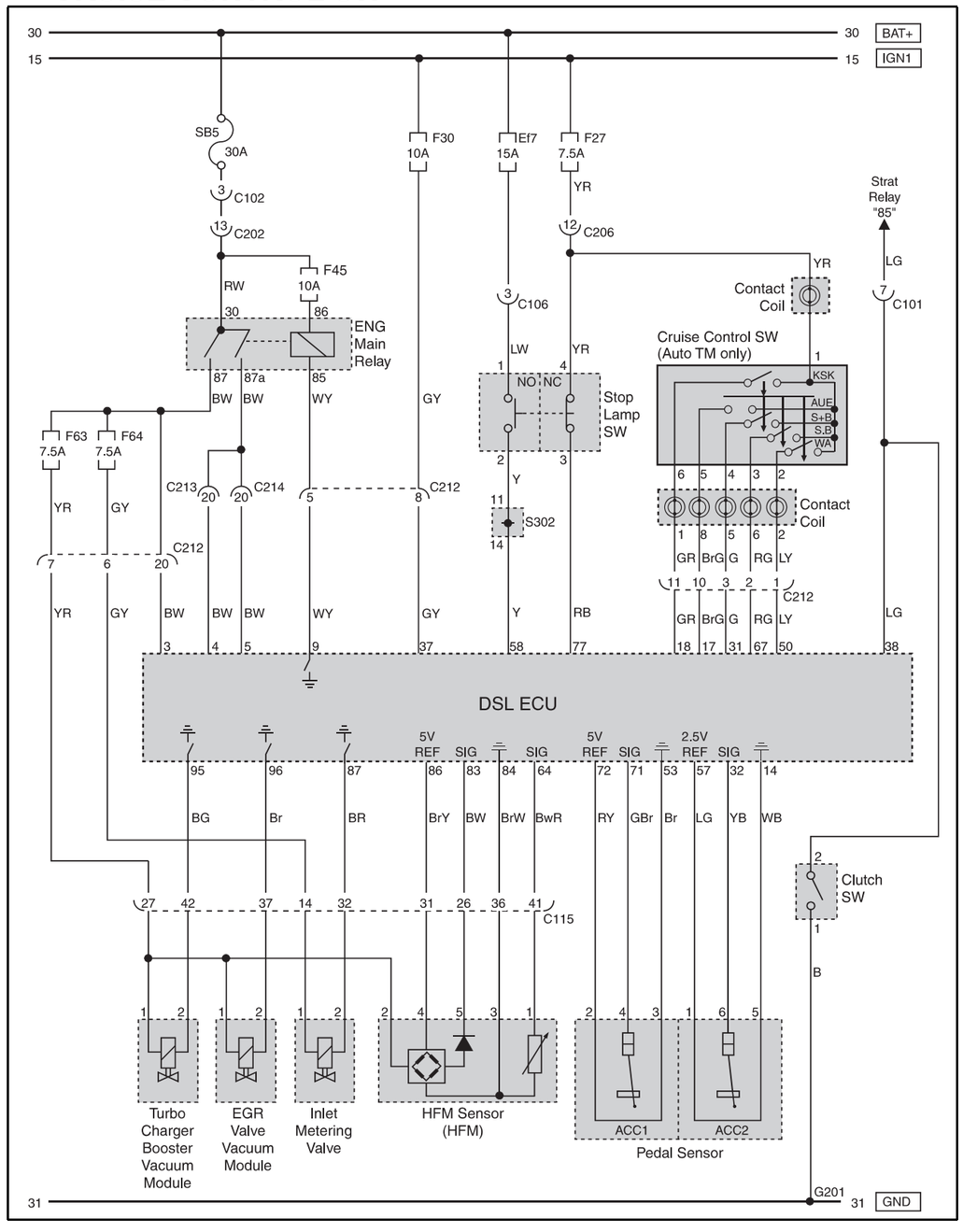
▶ **K-LINE for information exchanges between preheating unit and ECU**

- Transmits preheating unit self-diagnosis results to ECU.
- Transmits glow plug diagnosis results and operating status to ECU.

S.G.N. 1491-01

ECU (ENGINE CONTROL UNIT - DSL)

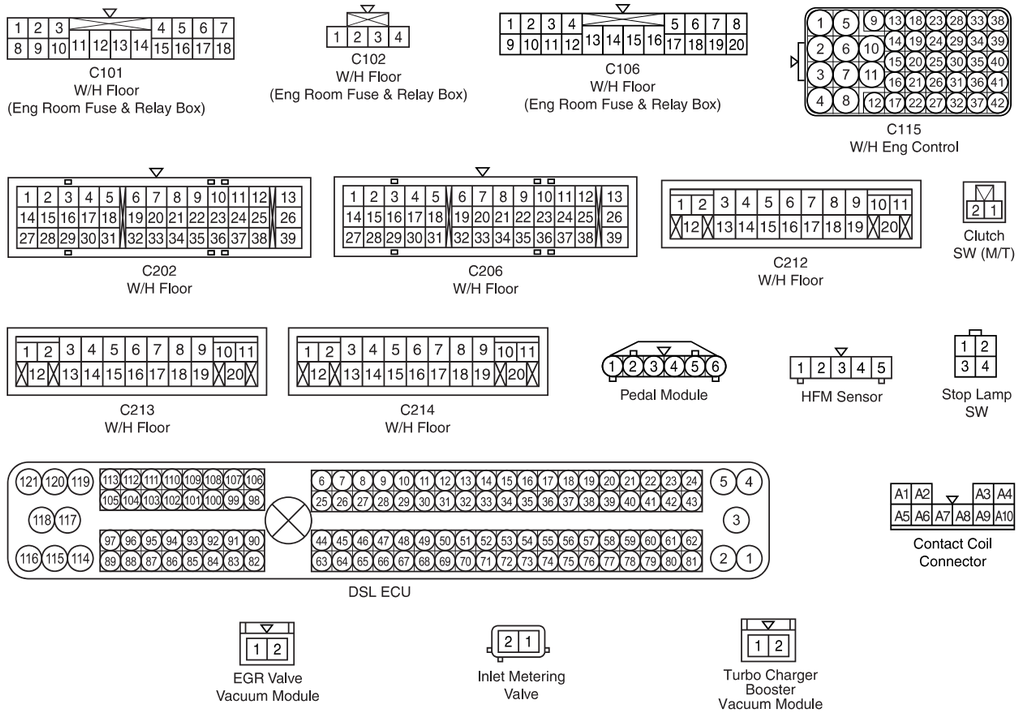
1) ENG MAIN RELAY, PEDAL MODULE, HFM SENSOR, VALVE, CRUISE CONTROL SW



(1) CONNECTOR INFORMATION

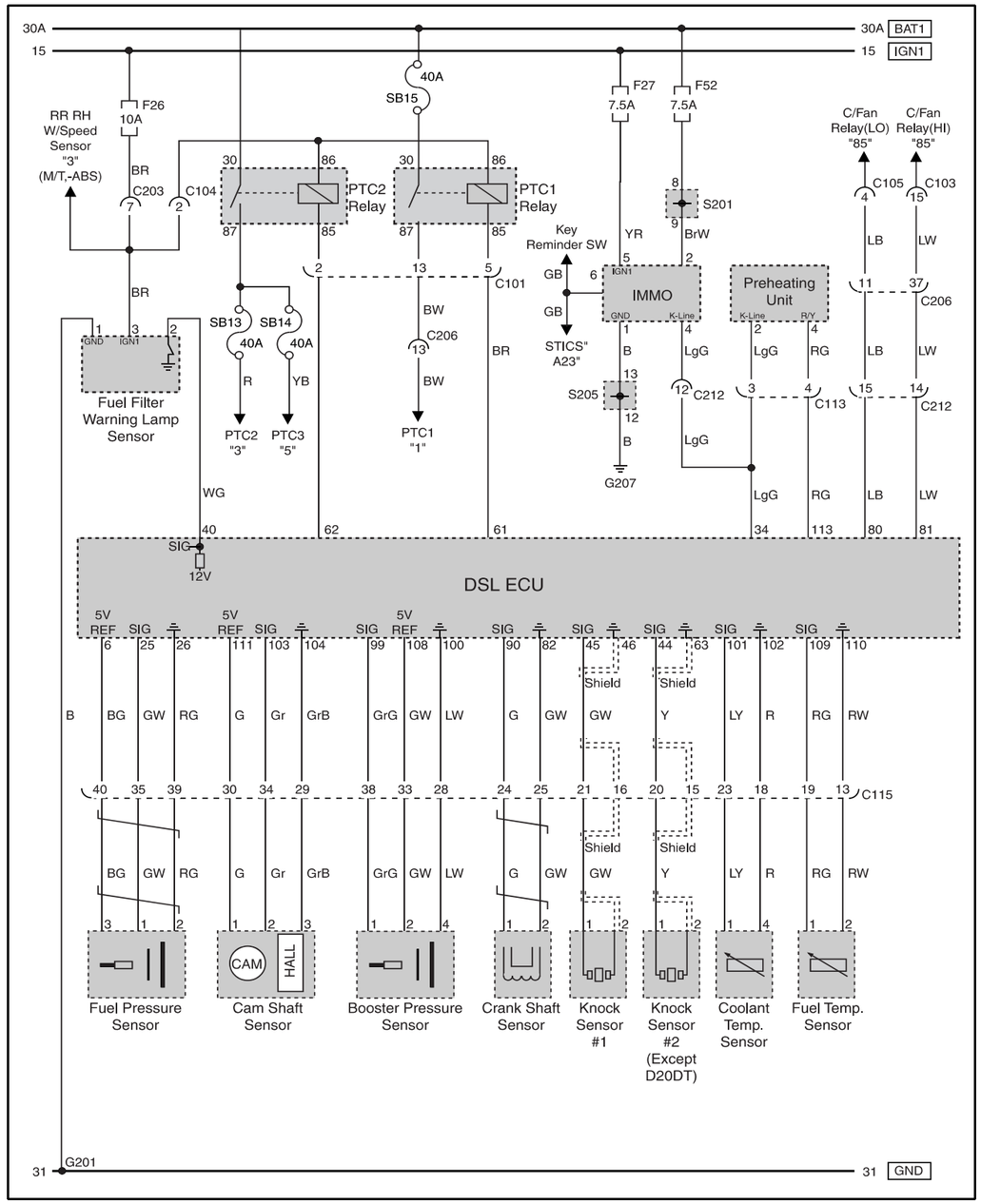
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C102 (4Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
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	
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



Modification basis	
Application basis	
Affected VIN	

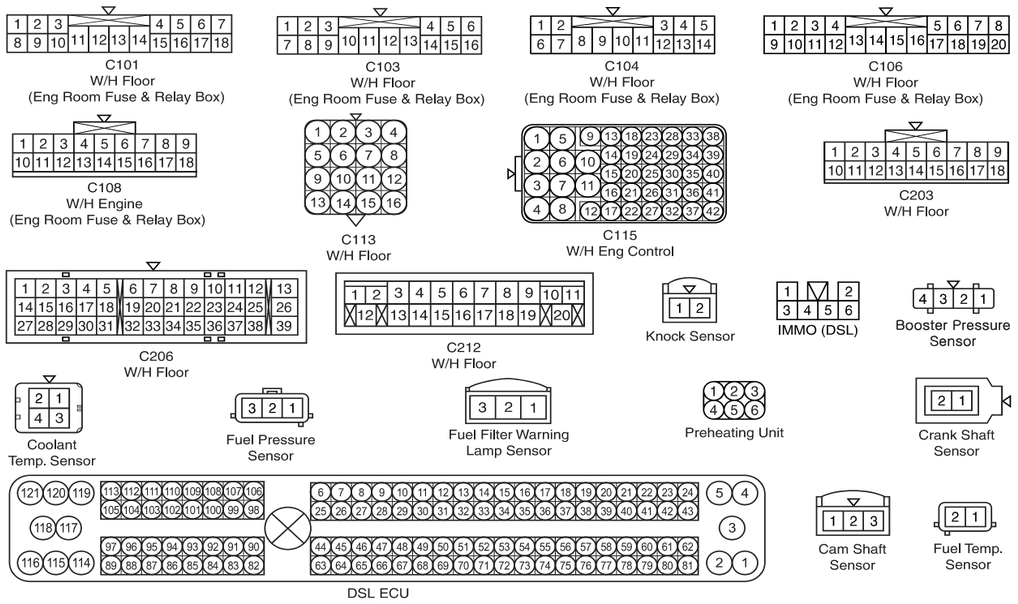
2) FUEL FILTER WARNING LAMP, IMMOBILIZER, SENSOR CIRCUIT (FUEL PRESSURE, CAM SHAFT, BOOSTER PRESSURE, CRANK SHAFT, KNOCK, COOLANT TEMP., FUEL TEMP.)



(1) CONNECTOR INFORMATION

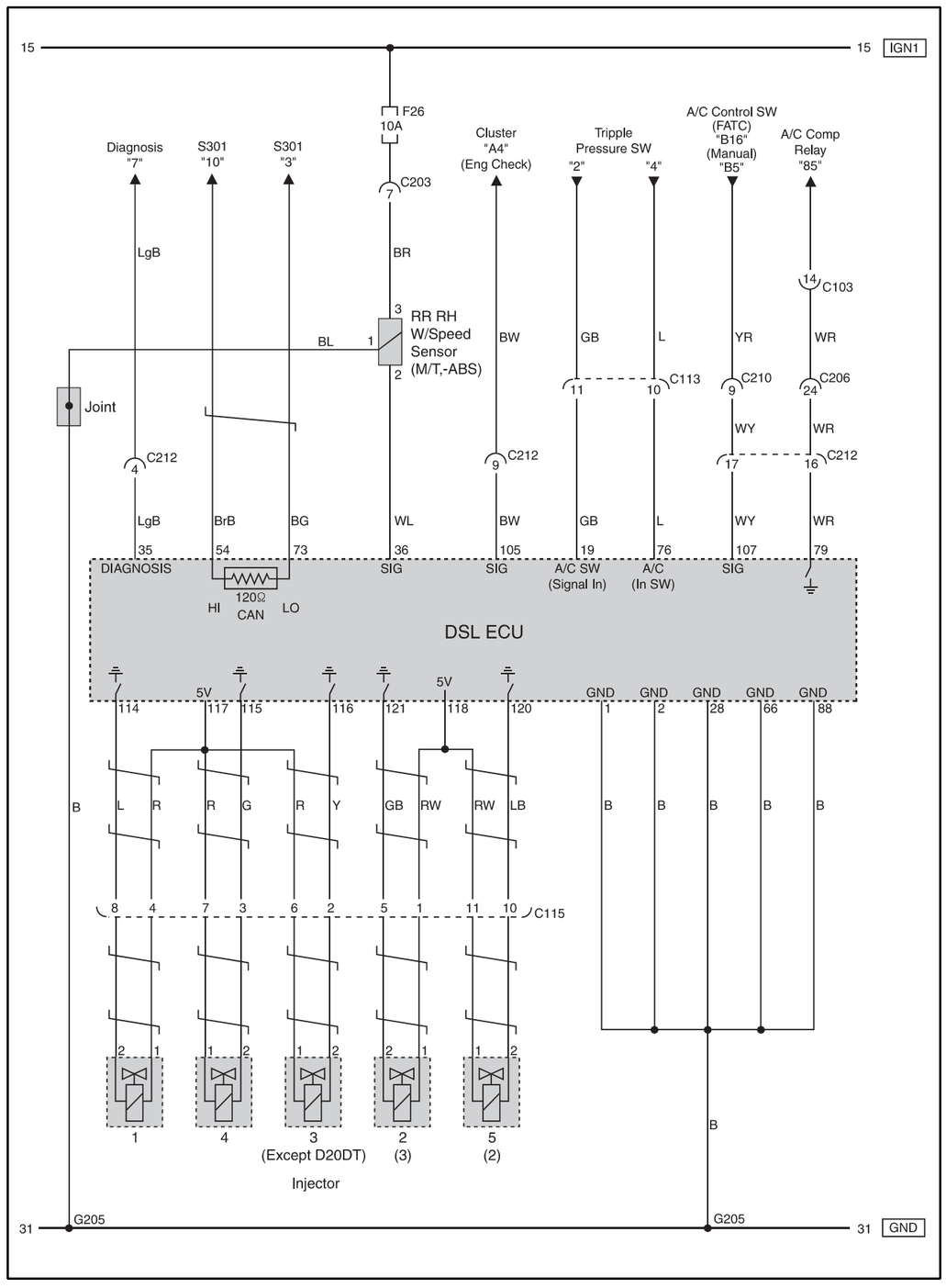
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (18Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C103 (16Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C104 (14Pin, White)	W/H Floor Eng Room Fuse & 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)	
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	

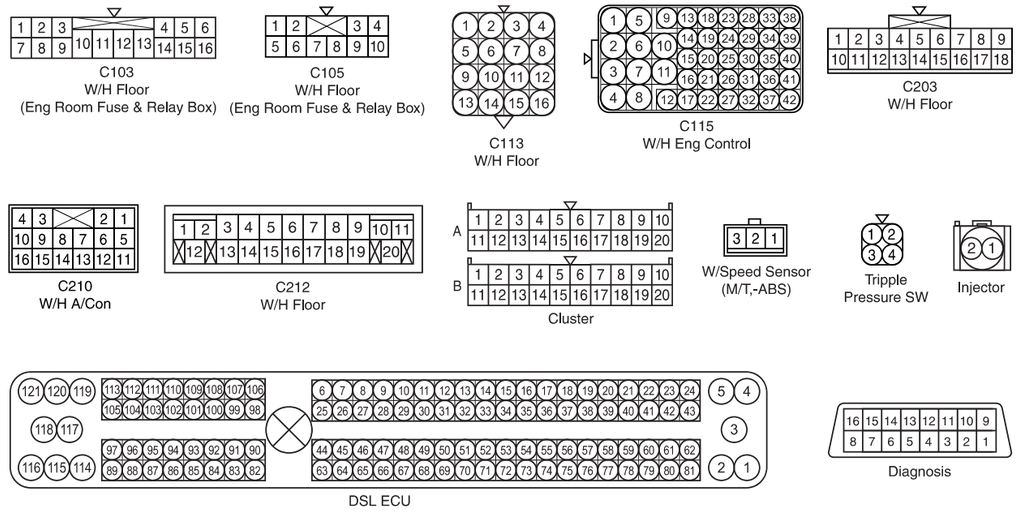
3) INJECTOR, CAN LINE



(1) CONNECTOR INFORMATION

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
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	
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



CIRCUIT

KYRON 2005.10

Modification basis	
Application basis	
Affected VIN	

(3) CIRCUIT DESCRIPTION

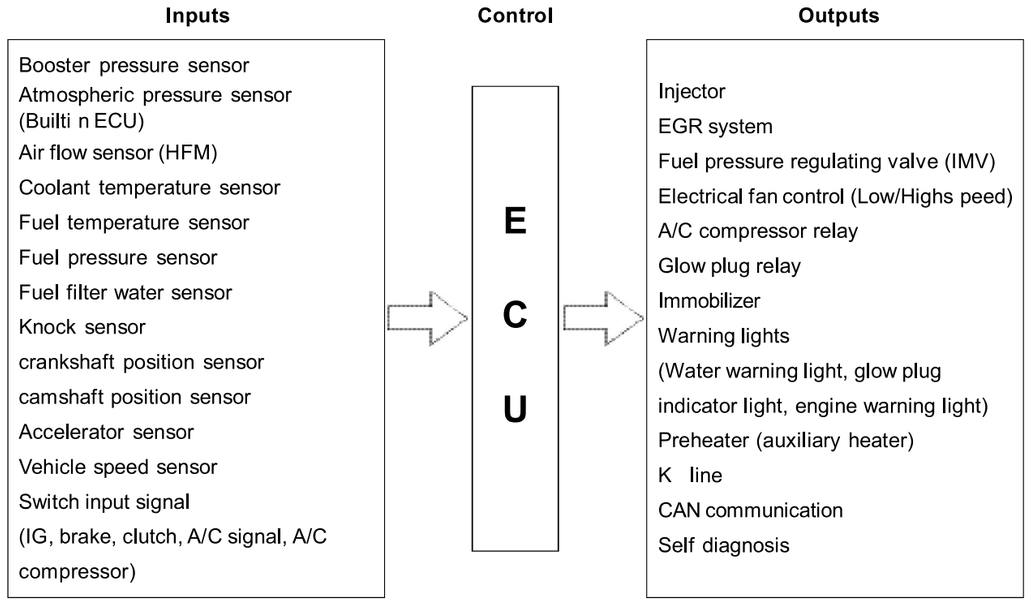
A. INPUT SIGNAL OF ECU

According to input signals from various sensors, engine ECU calculates driver's demand (position of the acceleratorpedal)and then controls overall operating performance of engine and vehicle on that time.
ECU receives signals from sensorsthrough data line and then performs effective engine air-fuel ratio controls based onthose signals.
Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determinesinjection order and ECU detects driver's pedal position (driver's demand) through electrical signal that generated byvariable resistance changes in accelerator pedal sensor.
Air flow (hot film) sensor detects intake air volume and then transmits to ECU.
Especially, the engine ECU controls theair-fuel ratio by recognizing instant air volume changes through air flow sensor to pursue low emission gases (EGR valvecontrol).
Furthermore, the ECU uses signals from coolant temperature and air temperature sensor, booster pressuresensor and atmospheric pressure sensor as compensation signal to respond to injection start and pilot injection setvalues and to various operations and variables.

B. CONTROL FUNCTION OF ECU

- Controls by operating stages:
  To make optimum combustion under every operating stage, ECU should calculate
- proper injection volume ineach stage by considering various factors.
  Starting injection volume control:
  During initial starting, injecting fuel volume will be calculated by function of temperature and engine crankingspeed.
  Starting injection continues from when the ignition switch is turned to ignition position to till the engine reachesto allowable minimum speed.
- Driving mode control:
  If the vehicle runs normally, fuel injection volume will be calculated by accelerator pedal travel and engine rpmand the drive map will be used to match the drivers inputs with optimum engine power.

C. ECU INPUTS·OUTPUTS



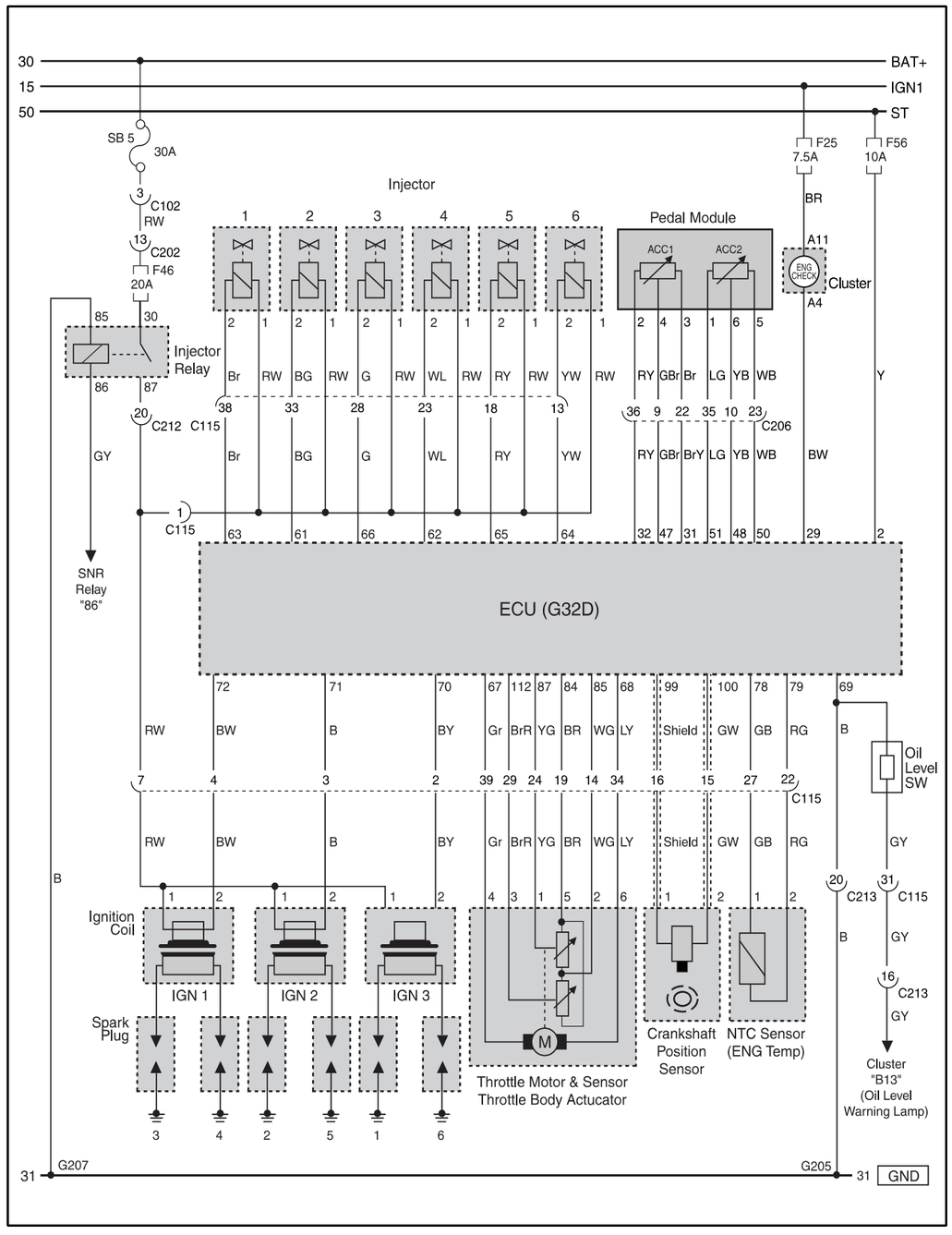
D. STRUCTURE AND FUNCTION OF ECU

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.

S.G.N. 1491-01

ECU (ENGINE CONTROL UNIT - GSL G32)

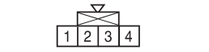
1) IGN COIL, INJECTOR, PEDAL MODULE, THROTTLE SENSOR

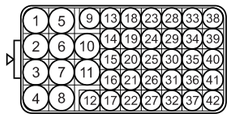


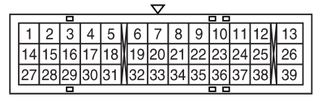
(1) CONNECTOR INFORMATION

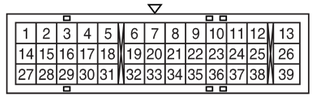
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C102 (4Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C115 (42Pin, Black)	W/H Floor W/H Eng Control	Right Eng Room Dash PNL	
C202 (39Pin, Black)	W/H Main W/H Floor	Driver Cowl Side C/Holder	
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	

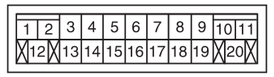
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

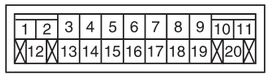

C102
W/H Floor
(Eng Room Fuse & Relay Box)

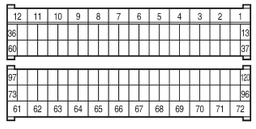

C115
W/H Eng Control

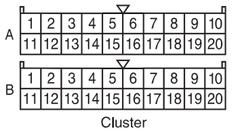

C202
W/H Floor

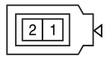

C206
W/H Floor

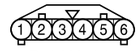

C212
W/H Floor


C213
W/H Floor


ECU (GSL)

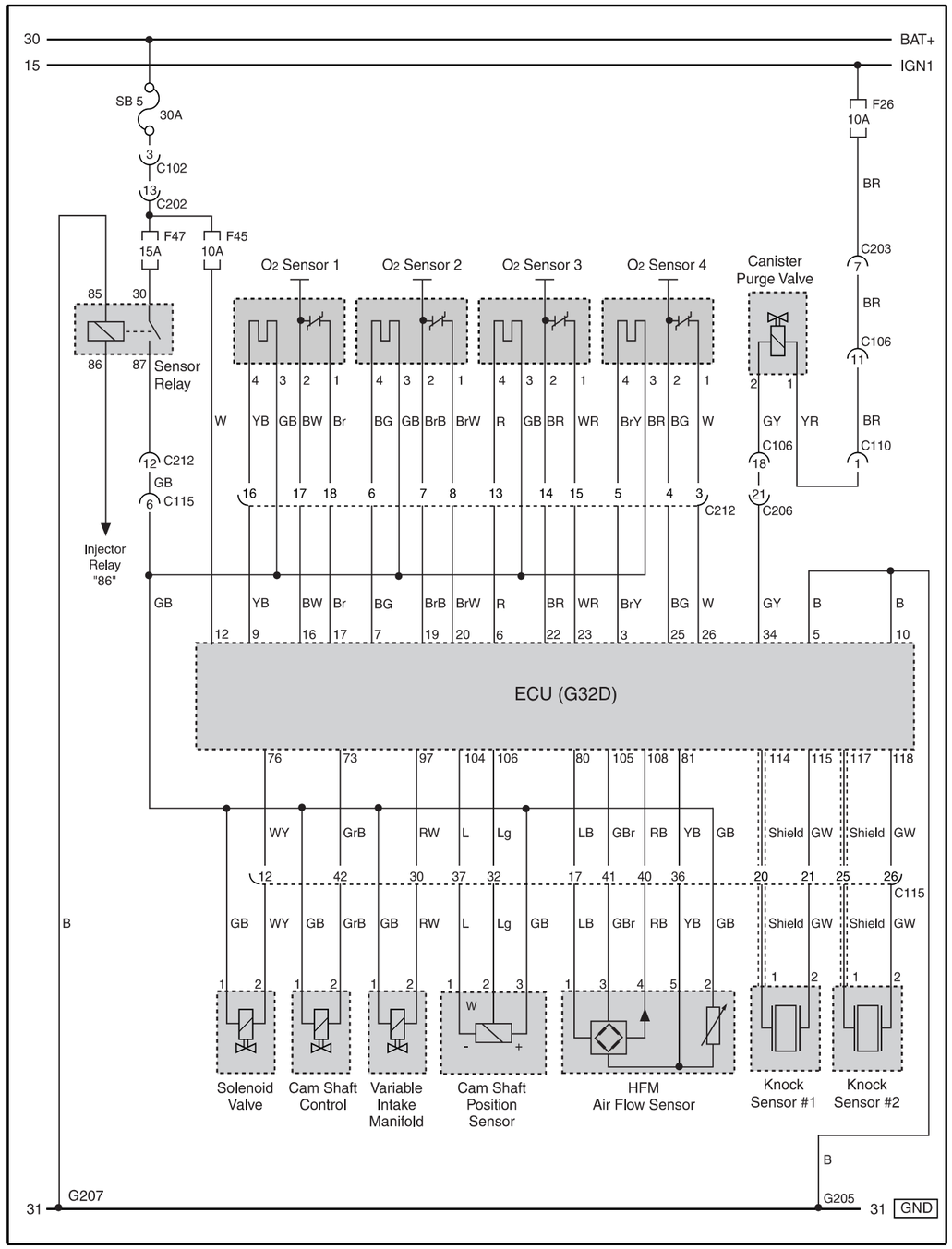

Cluster


Crank Shaft Position Sensor


Pedal Module

Modification basis	
Application basis	
Affected VIN	

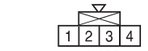
2) O_2 SENSOR, CPS, KNOCK SENSOR, HFM SENSOR, CANISTER PURGE VALVE



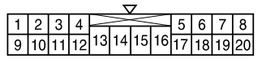
(1) CONNECTOR INFORMATION

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	

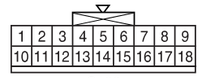
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



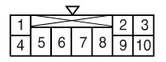
C102
W/H Floor
(Eng Room Fuse & Relay Box)



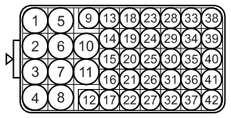
C106
W/H Floor
(Eng Room Fuse & Relay Box)



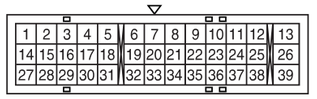
C108
W/H Engine
(Eng Room Fuse & Relay Box)



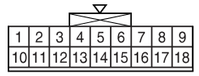
C110
W/H ENG
(Eng Room Fuse & Relay Box)



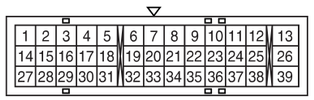
C115
W/H Eng Control



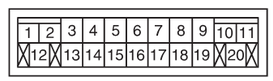
C202
W/H Floor



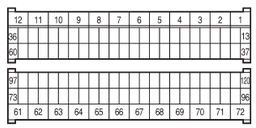
C203
W/H Floor



C206
W/H Floor



C212
W/H Floor



ECU (GSL)



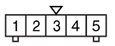
Knock Sensor



Cam Shaft Position Sensor



Canister Purge Valve



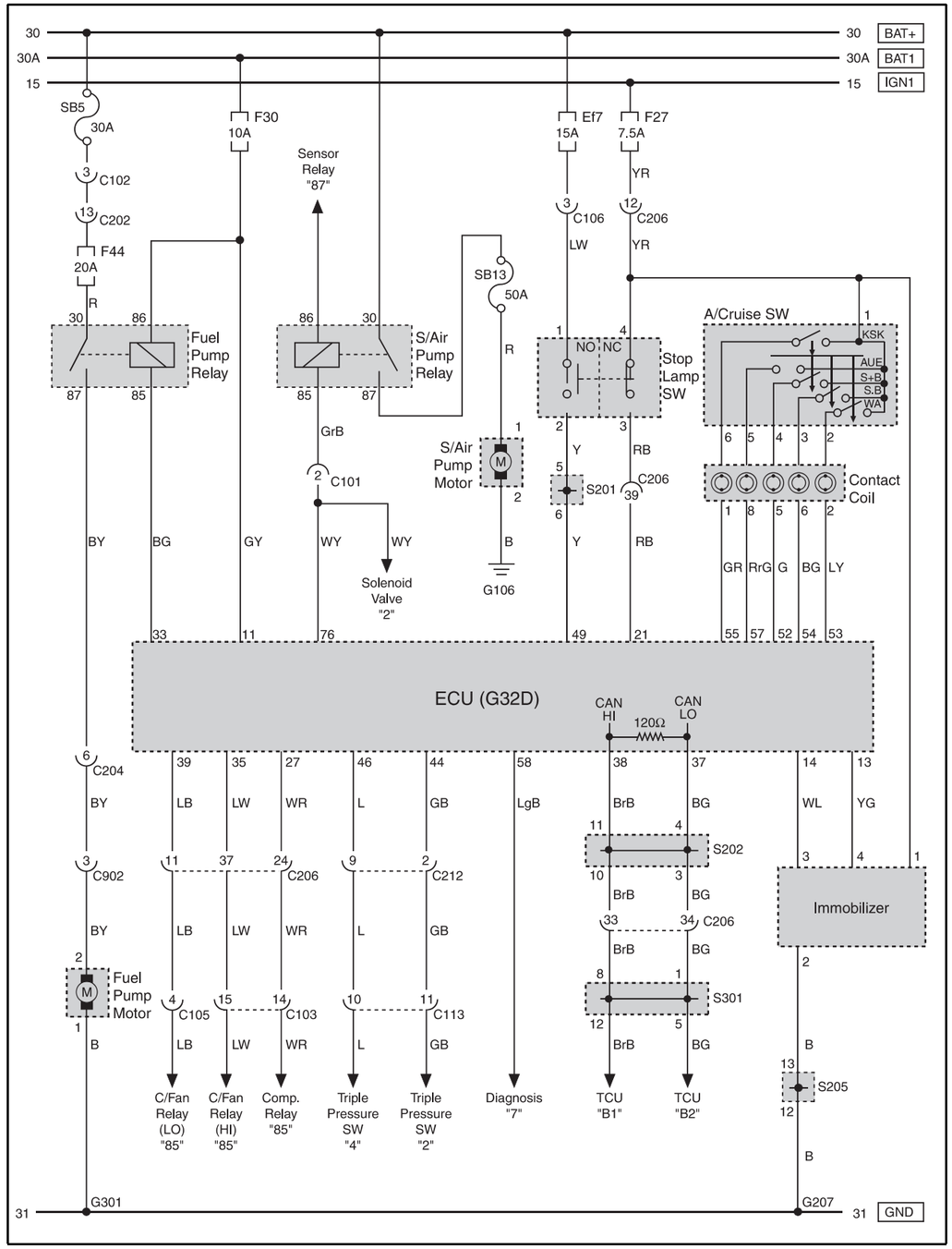
HFM Sensor



O_2 Sensor 1~4

Modification basis	
Application basis	
Affected VIN	

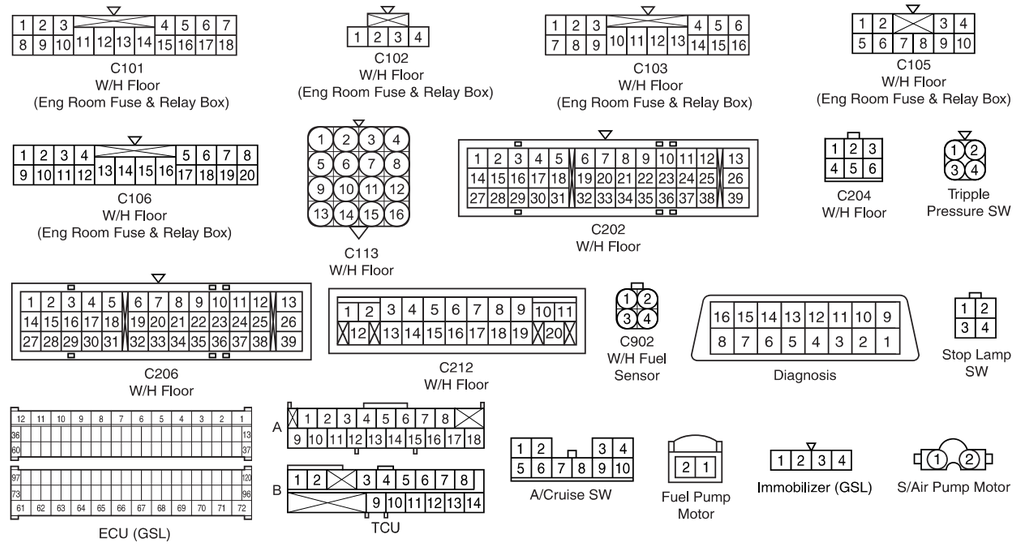
3) S/AIR PUMP, STOP LAMP, CRUISE CONTROL SW, FUEL PUMP, IMMOBILIZER



(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

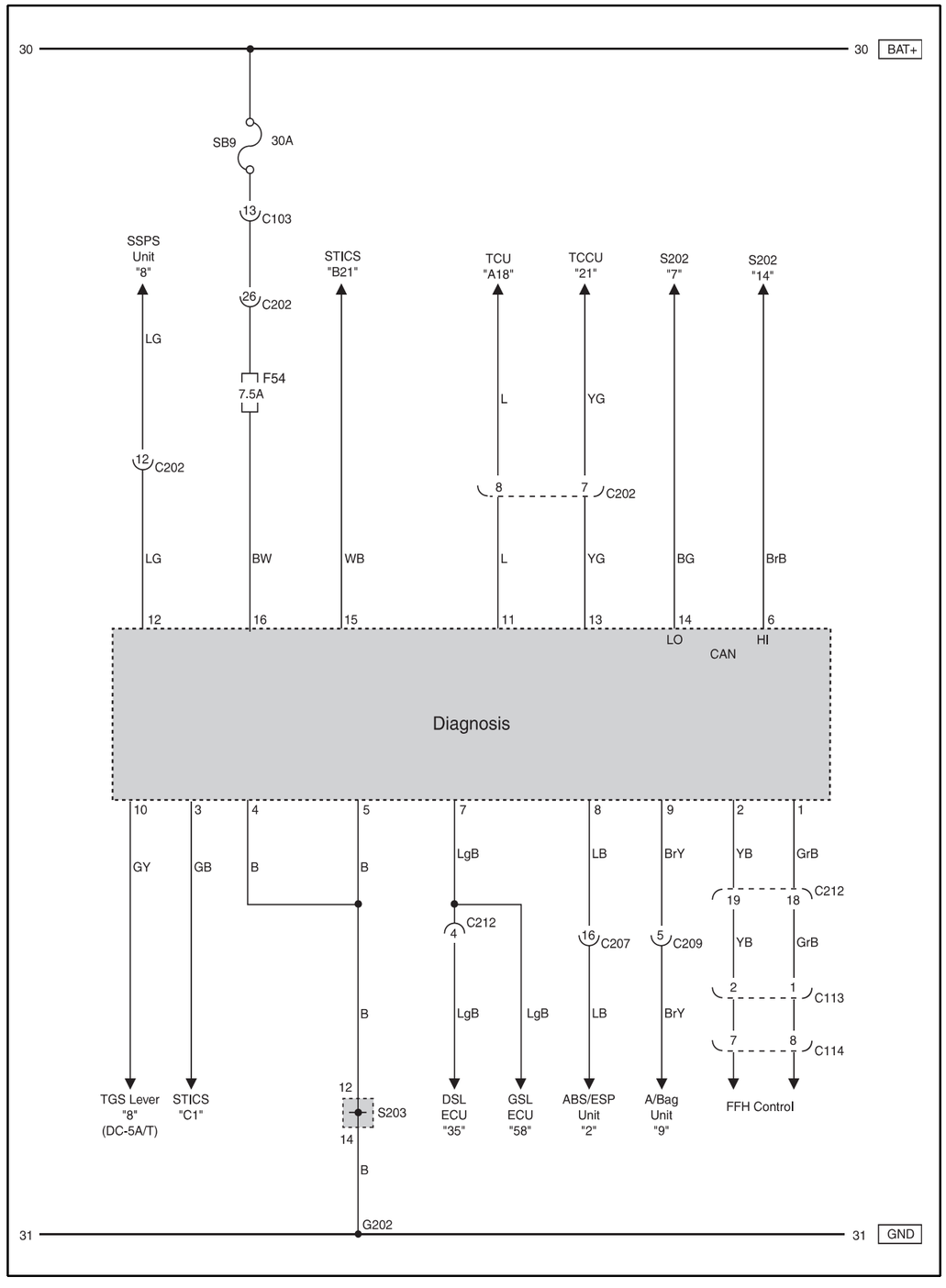
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



Modification basis	
Application basis	
Affected VIN	

S.G.N. 8210-01

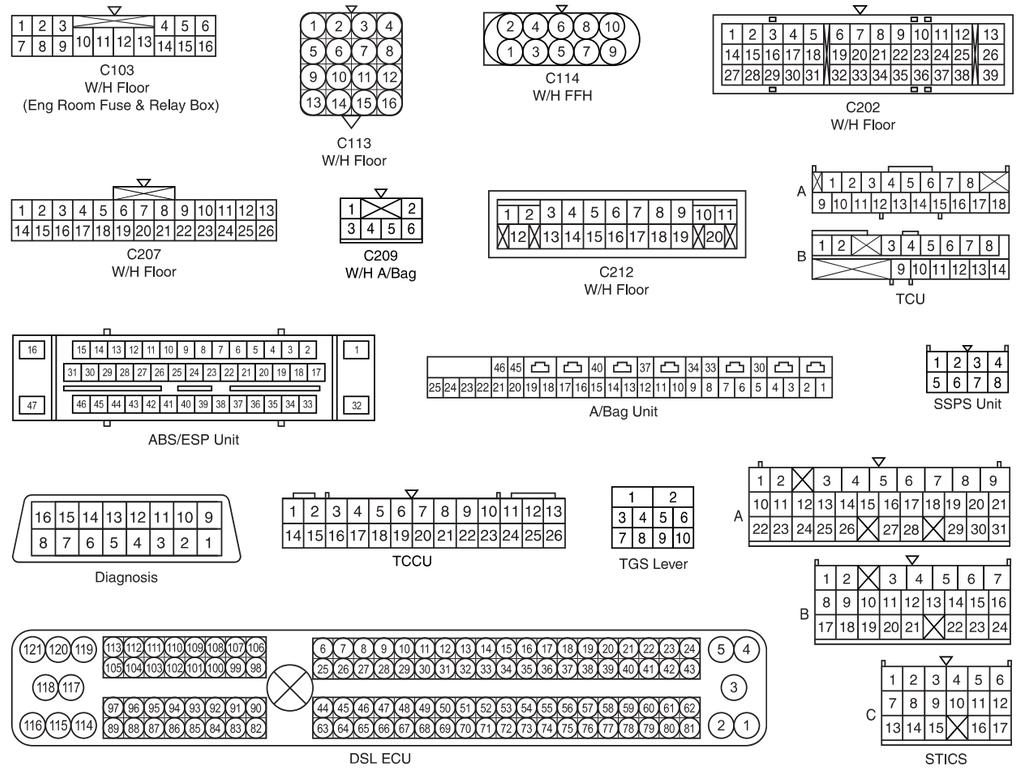
DIAGNOSIS CIRCUIT



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
C209 (6Pin, White)	W/H Main W/H A/Bag	Upper the Driver Legroom	A/Bag
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

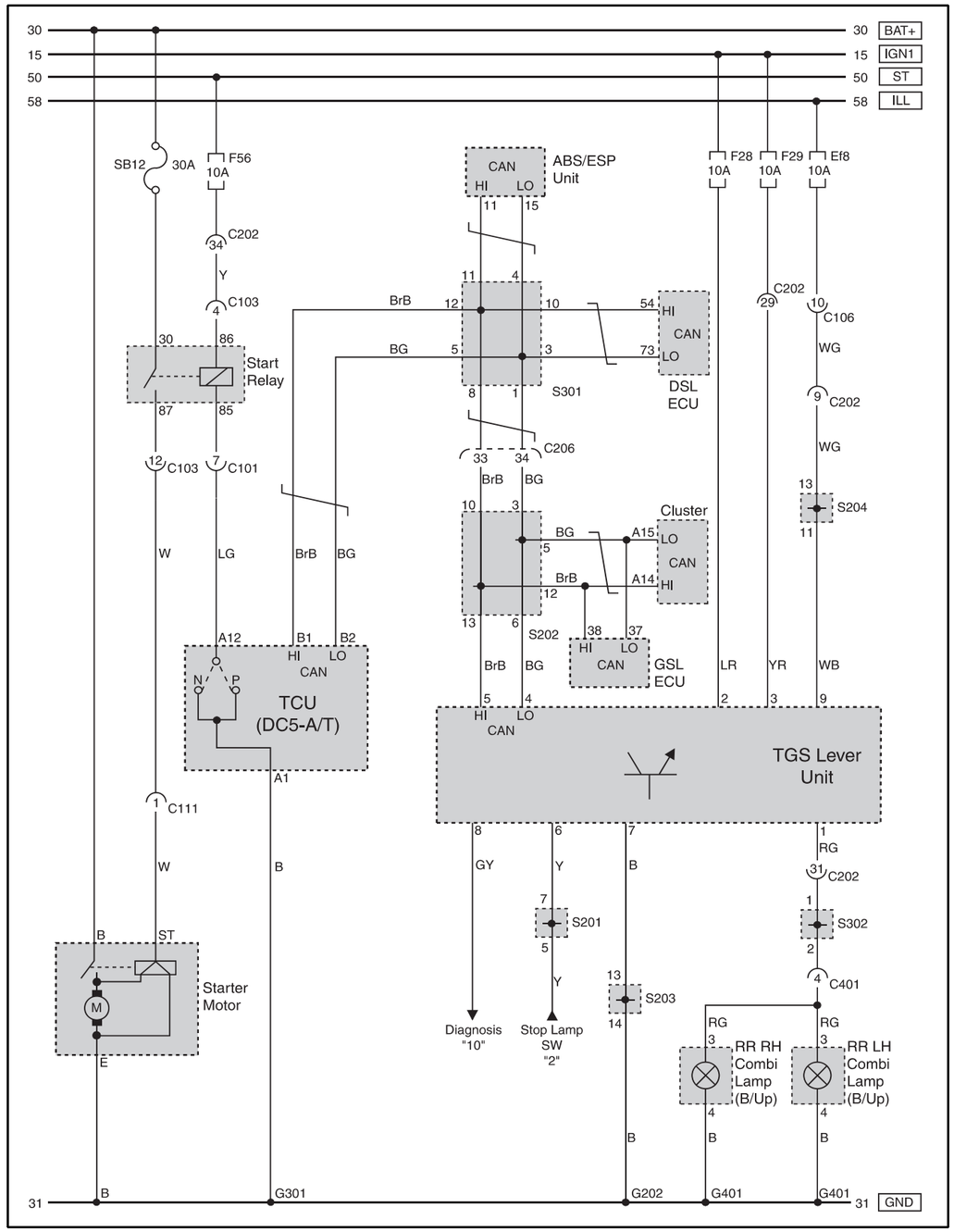


Modification basis	
Application basis	
Affected VIN	

S.G.N. 3110-01

TCU (DC5 - A/T)

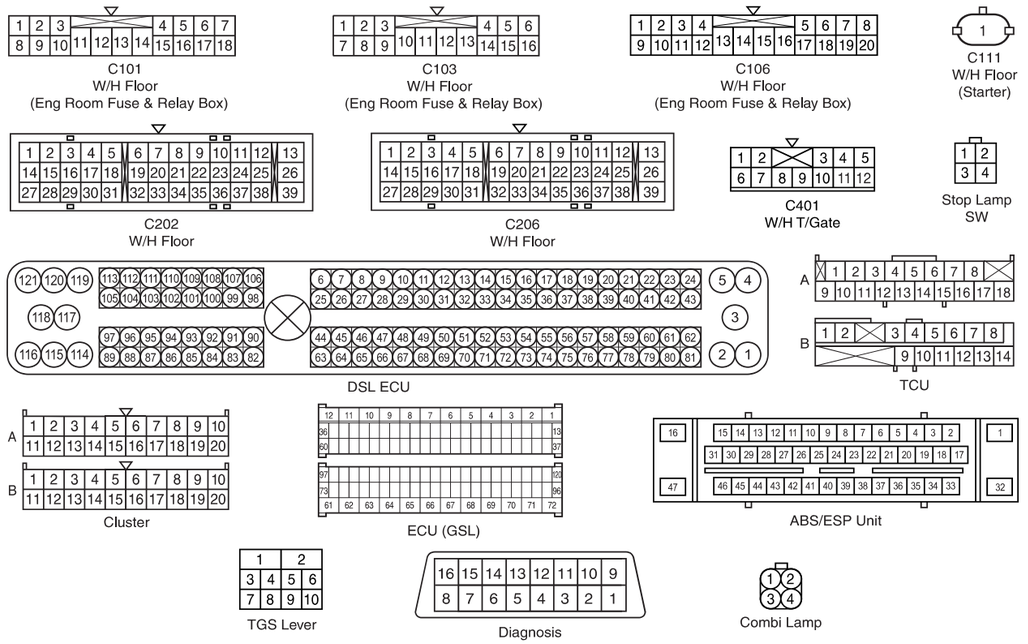
1) START MOTOR, TGS LEVER, CAN LINE



(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	
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
C401 (12Pin, Black)	W/H Floor W/H T/Gate	Upper the RH 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
S204 (14Pin, Black)	W/H Main	RH Protector of the Driver Legroom	ILL
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

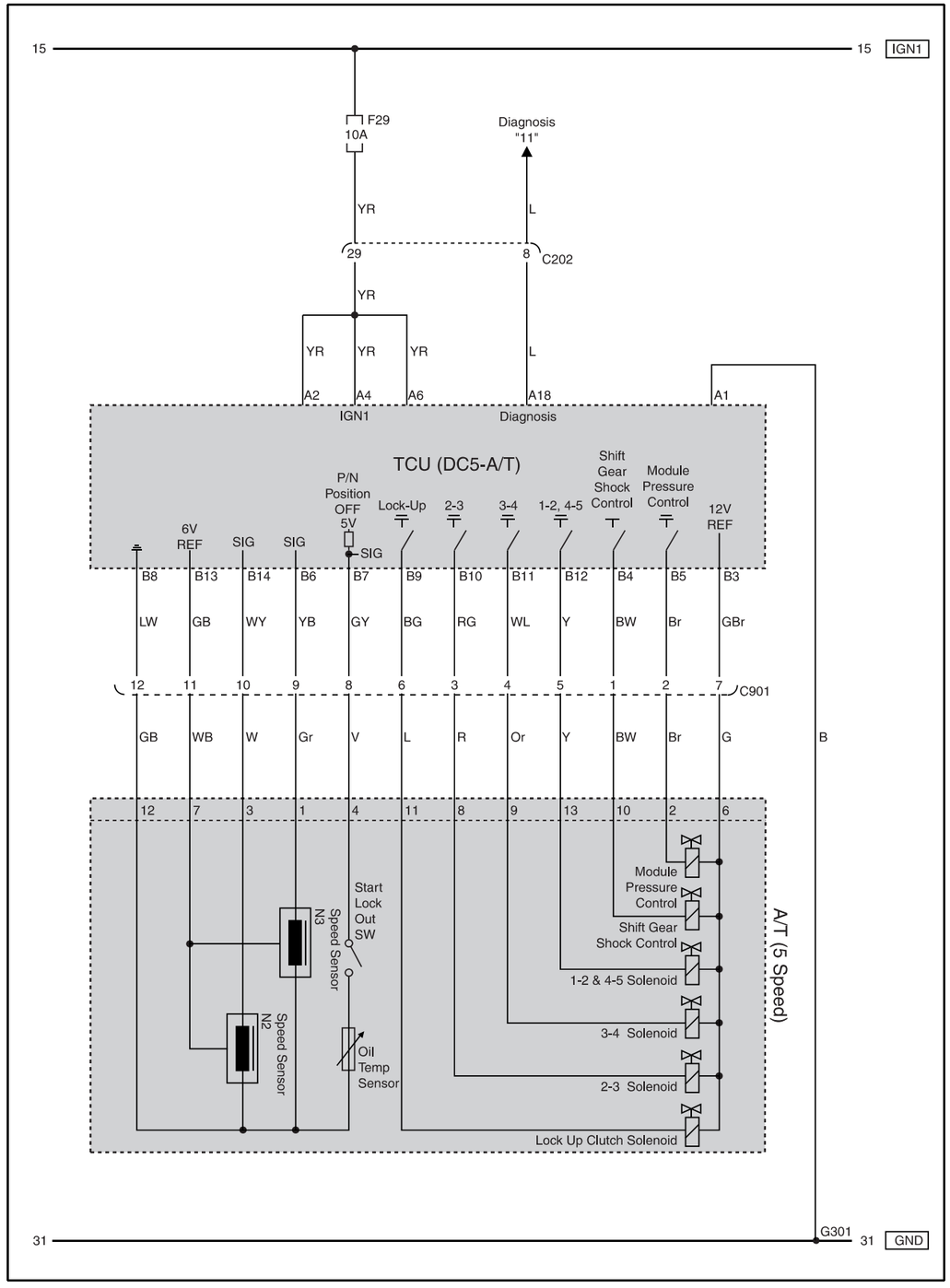


CIRCUIT

KYRON 2005.10

Modification basis	
Application basis	
Affected VIN	

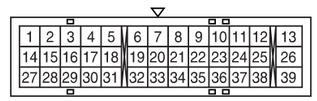
2) SOLENOID, OIL TEMP SENSOR, SPEED SENSOR (N2, N3)



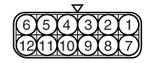
(1) CONNECTOR INFORMATION

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	A/T
G301	W/H Floor	Under the Driver Seat	

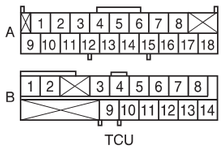
(2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



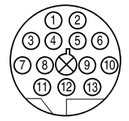
C202
W/H Floor



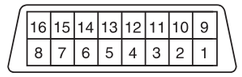
C901
W/H Transmission (A/T)



TCU



Transmission (5AT)



Diagnosis

Modification basis	
Application basis	
Affected VIN	

(3) CIRCUIT DESCRIPTION

A. FUNCTION

TCU controls the gear groups according to the driving conditions.
It receives the driving data from many sensors and switches as input signals.
It is also connected with ECU, HECU, instrument panel and selector lever control unit.

▶ **Shifting Method**

Basic shift operation includes up-shift and down-shift for all gear groups. The shift control unit determines driving resistance, accelerator pedal position, vehicle speed and some parameters (road surface condition, up hill and down hill gradients, trailer driving conditions, catalytic converter conditions, driving habits and automatic transmission oil temperature) to select a shift gear.

▶ **Down Shif**

When engine speed increases excessively, the down shift does not occur.
To get an engine brake effect during downhill driving, **the current gear is maintained in speed control mode.**

▶ **Engine RPM Adjustment**

During shifting, the engine torque is reduced to optimize the shift operation by delaying the ignition time.

▶ **Lock-Up Clutch Control**

The lockup clutch in torque converter is activated in 3rd, 4th and 5th gear and operates in sequence via PWM solenoid valve.

▶ **Others**

The transmission is automatically controlled to compensate durability and wear.
The shift control values such as shifting point, shifting time, pressure during shifting, and lockup clutch control are permanently saved and the diagnosis is partially available.

B. SELECTOR LEVER CONTROL UNIT

▶ **Selector lever control unit functions as follows**

- Informing the selector lever's position to other units via CAN.
- Turning on the selector lever indicator while tail lamp is turning on.
- Turning on the back-up lamp during reverse driving.
  Operating the parking/reverse lock system.

C. MODE SWITCH

The mode switch is installed beside the selector lever and it has two modes of "S" mode (Standard Mode) and "W" mode (Winter Mode).

- "S" mode is used in normal driving (starts off with 1st gear). TCU (Transmission Control Unit) provides pleasant driving by changing the shifting pattern according to the driving habits (downhill gripping: approx. 11 ~ 13.5 %)
- When "W" mode is selected, the Winter mode indicator in meter cluster comes on, and the vehicle starts off with 2nd gear to achieve smooth starting on the icy or slippery road.

In winter mode, the up shift becomes faster and the down shift becomes slower for improving fuel consumption.
The "W" mode is automatically changed to "S" mode in full throttle or kick-down operation. The vehicle can starts off with 2nd reverse gear (gear ratio: 1.92 ~ 1.93) when the "W" mode is selected.
It is very useful on icy and slippery road. However, in this case, the "W" switch should be selected before placing the selector lever to "R" position.

▶ Even though **"W"** mode is selected, the vehicle starts off with **1st gear in following**

When the system recognizes the mode switch operation, the selector lever control unit sends the control signal TCU via CAN communication.

- When the selector lever is in "1" position.
- When fully depressing the accelerator pedal or when starting off with kick-down condition.

D. REVERSE/PARKING (R/P) LOCK SYSTEM

Reverse (R) lock system is a safety system that prevents the selector lever from shifting to "P" or "R" position by activating the solenoid valve when the selector lever unit determines that the vehicle speed exceeds 10km/h by checking the speed signal from wheel speed sensor via CAN communication.
Parking (P) lock system uses the signals from brake switch other than conventional cable system to shift to other positions. The wiring harness for detecting brake switch operation is connected to selector lever control unit.

E. STARTER LOCK-OUT CONTACT SWITCH

The starter lock-out contact is installed beside oil temperature sensor and is actuated by a cam rail, which is located on the latching plate.
In the selector lever positions "P" and "N", the permanent magnet is moved away from the reed contact. This opens the reed contact and the transmission control module receives an electrical signal. The transmission control module activates the starter lock-out relay module. This closes the electrical circuit to the starter in selector lever positions "P" and "N" via the starter lock-out relay module. In other words, when the selector lever is in driving positions, the contact is closed and the starter cannot be operated.

Modification basis	
Application basis	
Affected VIN	

F. OIL TEMPERATURE SENSOR

The oil temperature sensor is installed in hydraulic control unit and is connected in series with the starter lock-out contact.
This means that the temperature signal is transferred to TCU when the starter lock-out contact is closed.
The oil temperature has a considerable effect on the shifting time and therefore the shift quality. By measuring the oil temperature, shift operations can be optimized in all temperature ranges.

G. SPEED SENSOR

The speed sensors are fixed to the shell of the hydraulic control unit via the contact tabs. A leaf spring, which rests against the valve body, presses the
speed sensors against the transmission housing.
This ensures a precise distance between speed sensors and impulse rings. speed sensor (n3) detects the speed of the front sun gear and speed sensor (n2) detects the speed of the front planetary carrier.
If the speed sensor is defective, the transmission is operated in emergency driving mode. Below table shows the detection of speed sensor.

Gear	N2	N3
1	•	
2	•	•
3	•	•
4	•	•
5	•	
R (S mode)	•	
R (W mode)	•	•

H. LOCKUP SOLENOID VALVE

This valve activates and releases the lockup clutch by adjusting the current to solenoid valve according to engine throttle opening value and output shaft speed. The lockup clutch operates in 3rd, 4th and 5th gear with steps to reduce shift shocks.

Working Current	1.5 ~ 2.0 A
Operating distance	0.2 mm
Resistance	2.5 ± 0.2 Ω (25°C)
Operating range	3, 4, 5 shift

I. MODULATING PRESSURE (MP) AND SHIFT PRESSURE (SP) CONTROL SOLENOID VALVE

These valves control the modulating pressure and the shift pressure by applying appropriate electric current to solenoid valves according to driving condition of engine and transmission.
When the electric current from TCU is high/low, the regulated pressure decreases / increases.

Working Current	0 ~ 1.0 A
Operating distance	0.6 mm
Resistance	5 ± 0.2 Ω (25°C)

J. CHARACTERISTICS OF UP/DOWNSHIFT SOLENOID VALVE

The solenoid valve remains energized and therefore open until the shift process is completed according to the engine and transmission conditions.
If a solenoid valve is energized, it opens and transmits shift valve pressure to the corresponding command valve.

Working Current	1.5 ~ 2.0 A
Operating distance	0.2 mm
Resistance	3.8 ± 0.2 Ω (25°C)

K. DTC (DIAGNOSIS TROUBLE CODE) OF DC5AT

( ): DC No.

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 CANCo ntroller 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 CANCo ntroller 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.
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 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 Ω
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 Ω
P2310	CAN: Faulty brake system communi cation	Check CAN communication line H and L. Check ABS/ESP unit. Check the related harness for open, short and contact.

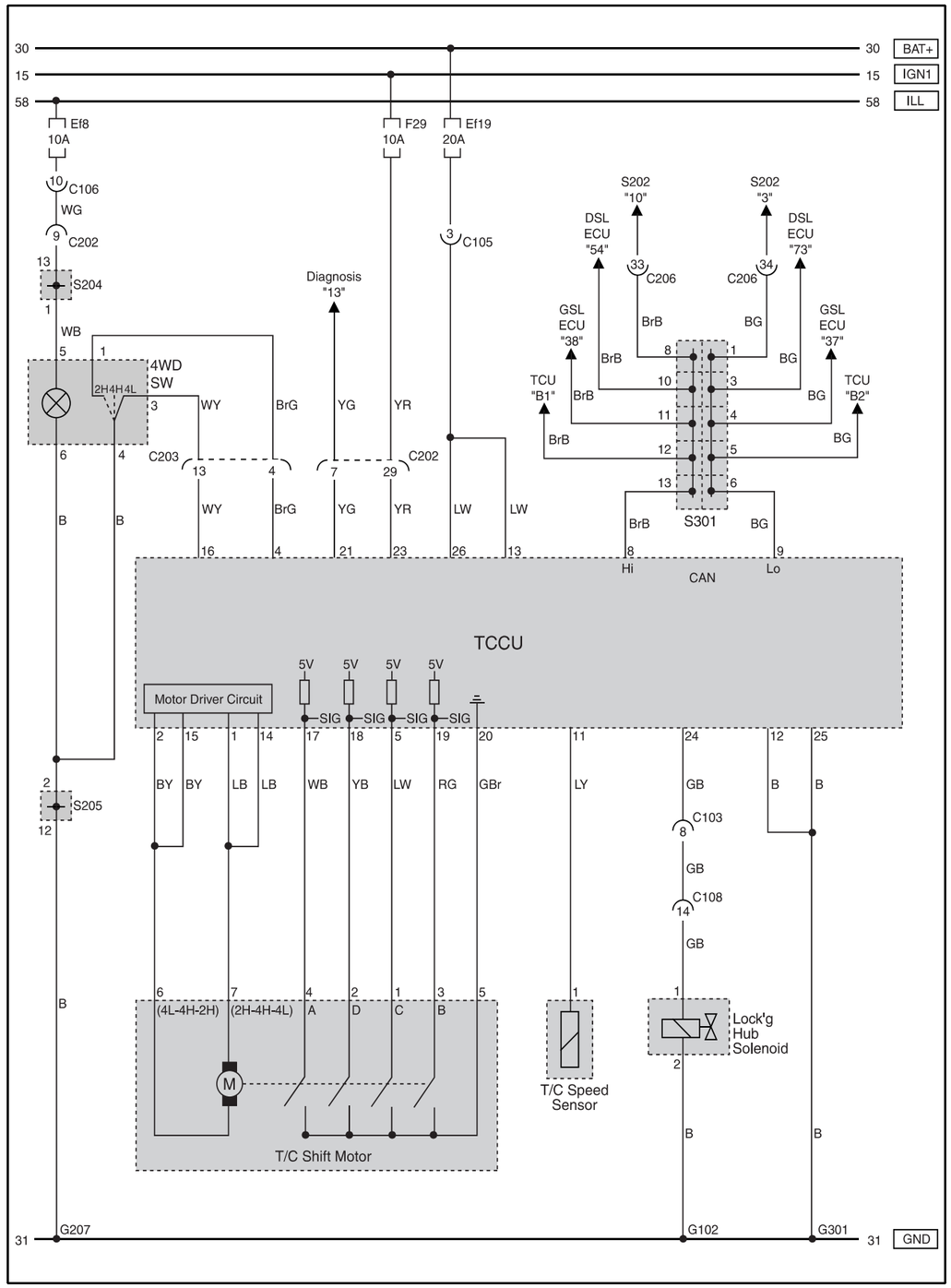
Trouble Code	Defectives	Action
P2311	CAN: Faulty ECU communication	Check CAN communication line H and L. Check engine ECU. Check the related harness for open, short and contact.
P2312	CAN: Faulty ECU communication	Check CAN communication line H and L. Check engine ECU. Check the related harness for open, 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 communi cation	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.
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 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.
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

S.G.N. 3410-01

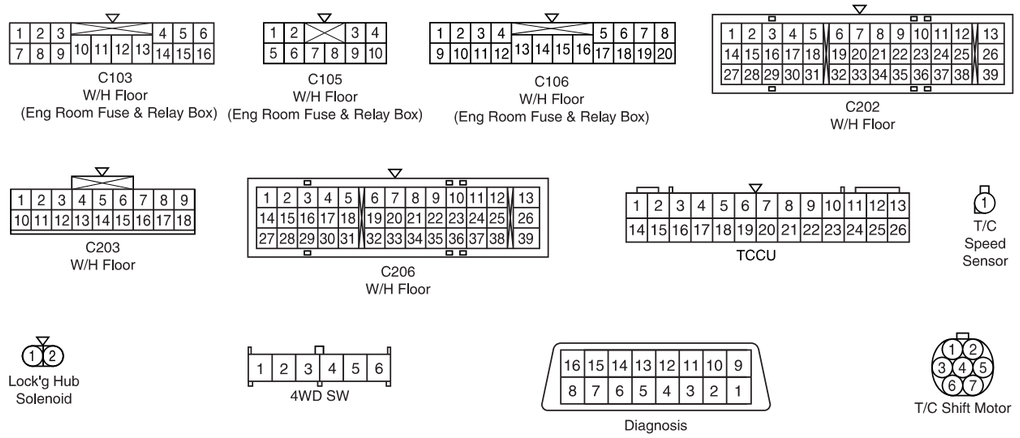
TCCU



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	

3) CIRCUIT DESCRIPTION

(1) 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, 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)) through the CAN communication.
- Delete the pin related to the speed sensor from TCCU pins.
- Change the transfer case wiring connector from No.4 pin to No.1 pin. (Power and ground related to the speed sensor)
  The new TCCU is available to install on the vehicle with the conventional DI engine part time TCCU.

NOTE

- Instrument panel: 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 ther devices.

(2) 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.

(3) TCCU PIN NUMBERS AND DESCRIPTION

T/C: Transfer Case

Pin No.	Function	Input/Output	Description
1	Motor HI LO	Output	This is a terminal that outputs the input signal to the T/C motor during the 4WD switch operation. When switching the 2WD mode to 4WD mode, the battery power is supplied to "Motor Hi Lo" and the opposite side is earthed, and vice versa.
2	Motor LO HI	Output	
3			
4	4WD switch	Input	Switch position converting (2H4 H) recognition
5	Position 2	Input	Detecting shift motor position 2 position.
6			
7			
8	CAN H	Both	These lines are sharing the information among the related units through the CAN communication. The differences from the conven tional part time T/C models are that the speed sensing type tone wheel in T/C has been eliminated and the speed signal comes from the ABS/ESP HECU or the instrument panel.
9	CAN L		
10			
11	EMC (Electronic magnetic clutch)	Output	Supplying the voltage to clutch coil for all shifting operations • When supplying power: Battery voltage • When no power supplied: Ground power
12	Ground	Input	Provide the ground to TCCU
13	Battery	Input	Battery voltage supplying terminal to operate the system
14	Motor High Low	Output	Same as No.1, 2 pin
15	Motor Low High	Output	
16	High Low switch	Input	Recognition converting switch between 4H and 4L
17	Position 4	Input	Detecting shift motor position 4 position.
18	Position 1	Input	Detecting shift motor position 1 position.
19	Position 3		Detecting shift motor position 3 position.
20	Position return	Input	Providing the ground related to shift motor sensor plate.
21	K Line	Both	Connected to trouble diagnosis connector
22			
23	Ignition power	Input	Power supply terminal when ignition switch is ON
24	Solenoid power supply	Output	Locking hub system applied to KYRON makes difference in related to the conventional part time system and the vacuum supply in operating process.
25	Ground		
26	Battery		

(4) SYSTEM OPERATION

▶ 2H → 4H

- Change the 4WD switch in instrument panel from 2H to 4H.
- This shift is available during driving.
- The "4WD HIGH" indicator in meter cluster comes on.

▶ 4H → 2H

- Change the 4WD switch in instrument panel from 2H to 4H.
- This shift is available during driving.
- The "4WD HIGH" indicator in meter cluster goes out.

▶ 4H → 4L

- This function is only available when the speed signal from speed sensor is about to stop (below 2 km/h).
- This function is only available when the clutch pedal is depressed (manual transmission) or the selector lever is selected to the "N" position (automatic transmission). (TCCU must recognize the clutch pedal signal or "N" signal.)
- Change the 4WD switch in instrument panel from 4H to 4L.
- The "4WD LOW" warning lamp in meter cluster flickers during this process, then goes out when the shift is completed.
- The "4WD CHECK" warning lamp comes on when the system is defective.

(5) SHIFT MOTOR CONNECTOR

When selecting a position in the 4WD switch (2H, 4H, 4L), TOD control unit exactly changes the motor position to 2H, 4H and 4L by detecting the electric signals from position encoder that monitors motor position.

Pin	Function
1	Position A
2	Position B
3	Position C
4	Position D
5	Position ground
6	Control (4L 4H 2H)
7	Control (2H 4H 4L)

(6) MAGNETIC CLUTCH COIL POWER SUPPLY CONNECTOR

The transfer case integrated in KYRON doesn't have an internal speed sensor and receives the speed signal from ABS/ESP HECU or the instrument panel (Non-ABS vehicle) via CAN communication.
Therefore, there are not extra terminals for speed sensor power supply and ground.

Pin	Function
A	Magnetic clutch coil power supply

(7) SELF-DIAGNOSIS TEST

TCCU detects the transfer case systems malfunctions and indicates malfunctioning part(s) through flickering of the "4WD CHECK" indicator.
Connect Scan-I to the diagnostic connector located under the steering wheel.

The transfer case system is malfunctioning when

- The "4WD CHECK" indicator remains on after 0.6 second when turning the ignition switch ON.
- The "4WD CHECK" indicator continuously comes on during driving.

Connect Scan-I to the diagnostic connector and read the defective code with the ignition switch "ON" (refer to Diagnosis Table).
After repairing, erase the defective code stored in TCCU.

Modification basis	
Application basis	
Affected VIN	

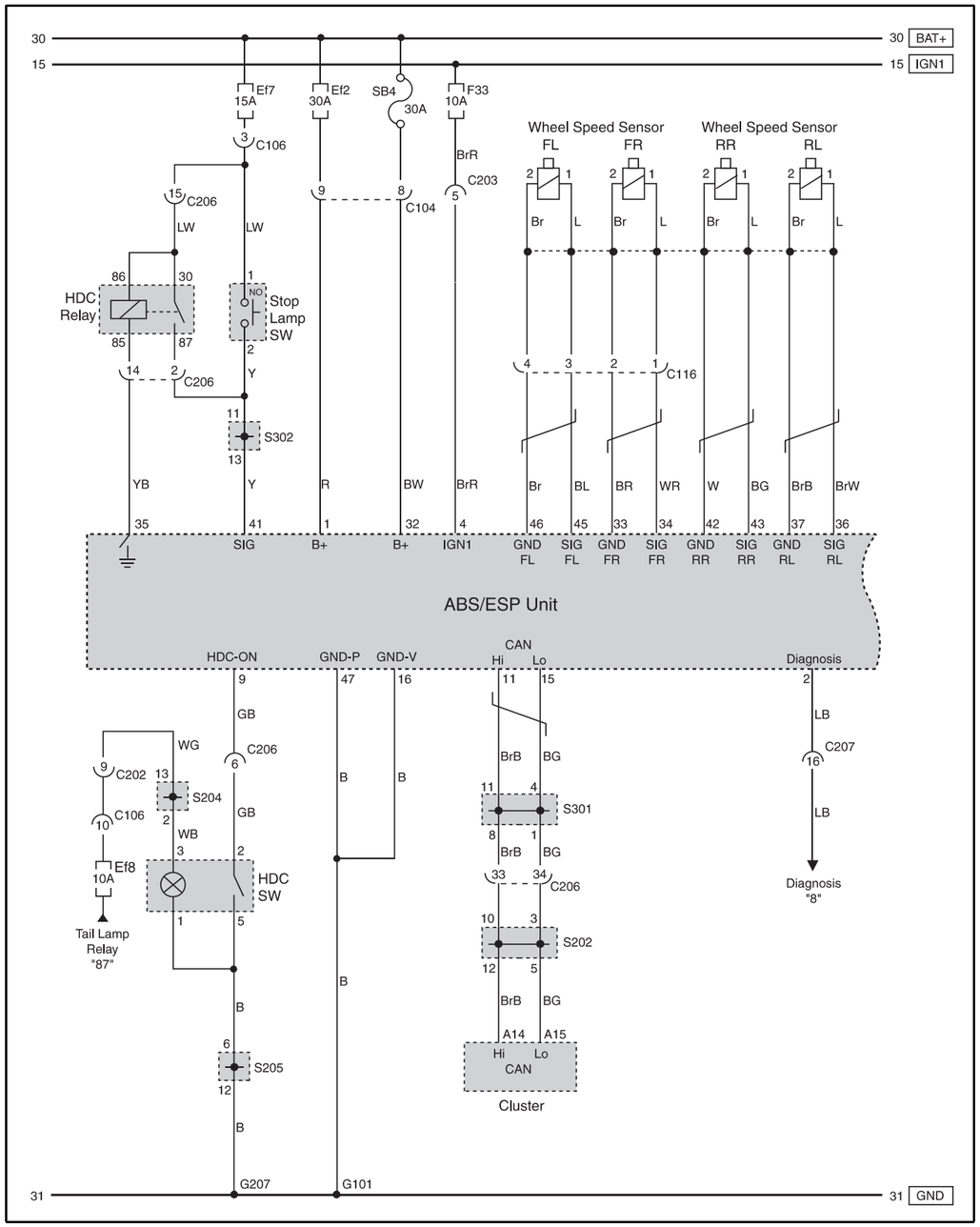
(8) DIAGNOSTIC TROUBLE CODE

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 condi tions are satisfied and no error. Replace TCCU if necessary.
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.

S.G.N. 4892-01

ABS/ESP

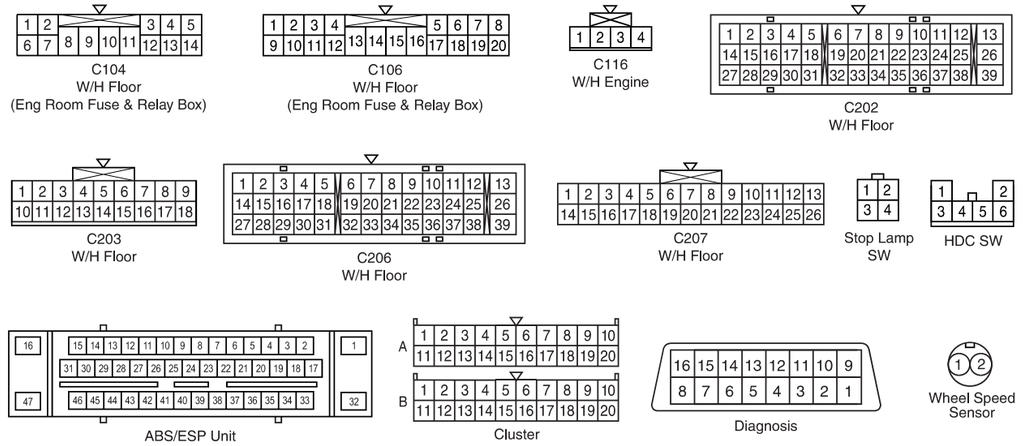
1) W/SPEED SENSOR, STOP LAMP SW, DIAGNOSIS, WARNING LAMP (ABS/ESP), HDC



(1) CONNECTOR INFORMATION

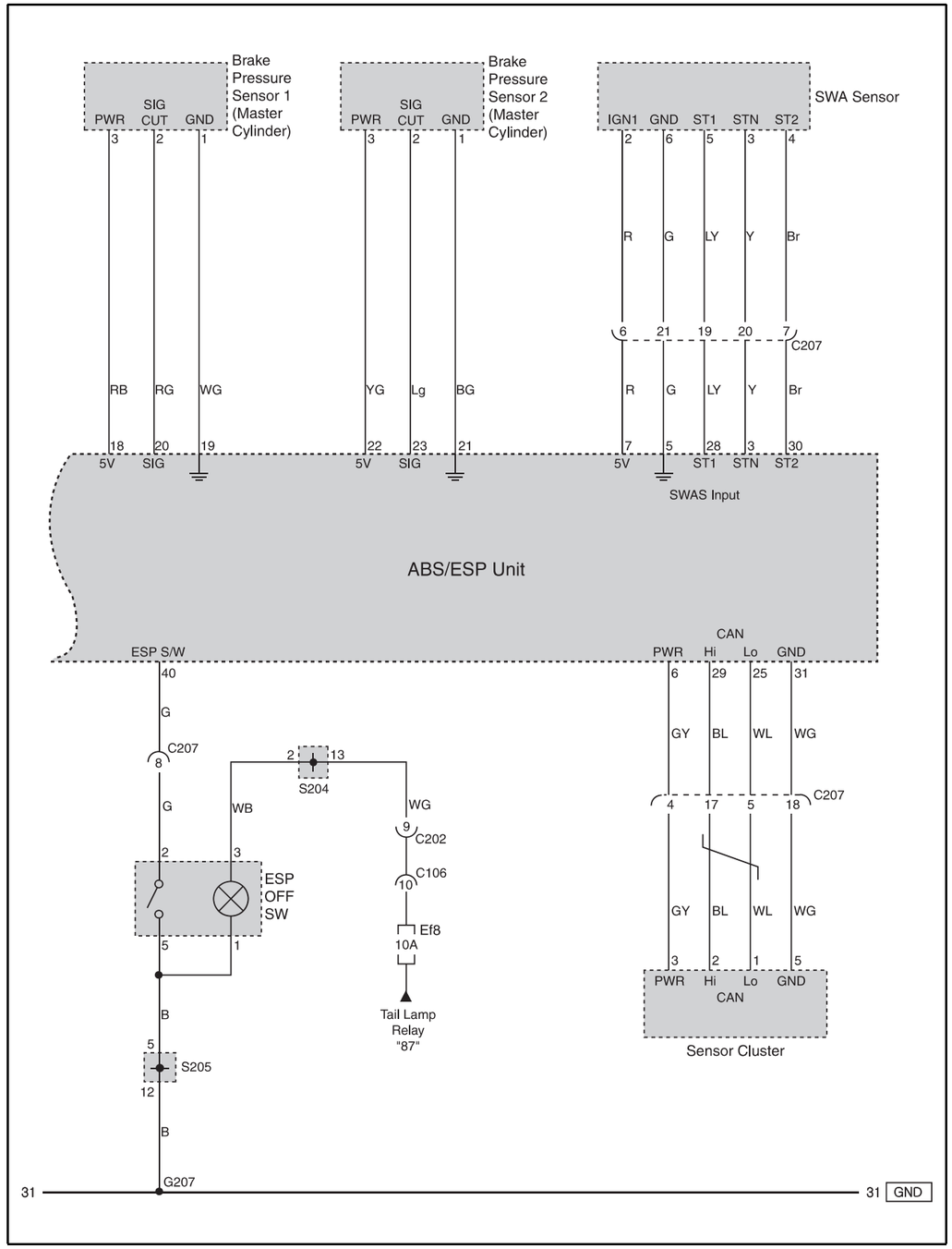
Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C104 (14Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C106 (20Pin, White)	W/H Floor Eng Room Fuse & Relay Box	Eng Room Fuse & Relay Box	
C116 (4Pin, White)	W/H Eng W/H Floor	Inside Fuse & 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
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	

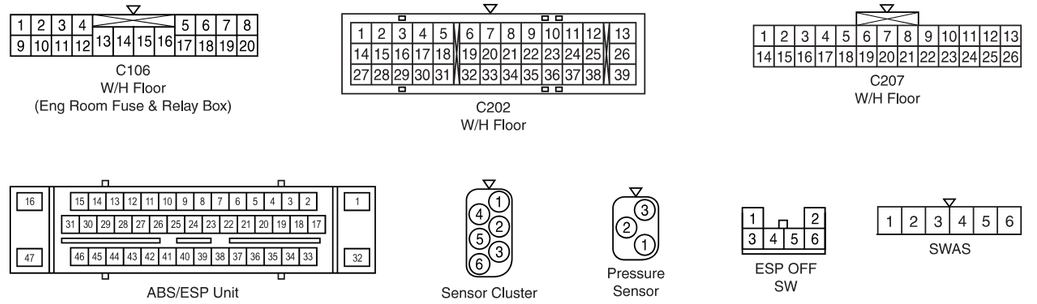
2) PRESSURE SENSOR, S.W.A SENSOR, SENSOR CLUSTER, ESP OFF SW



(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	
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) CIRCUIT DESCRIPTION

A. ABS COMPONENTS

Newly introduced ABS has a different shape of integrated hydraulic modulator and HECU (Hydraulic and Electronic Control Unit) compared to existing ABS. And, the wheel speed sensor uses different method to detect wheel speed. The basic function of the ABS that maintains the vehicle stability by controlling the steerability of the vehicle when braking has not been changed.

B. ACTIVE WHEEL SPEED SENSOR

The speed sensor used in traditional ABS is made of permanent magnet and transmits the output voltage that changes as the wheel rotor rotates to the HECU system. New wheel speed sensor detects the wheel speed through the current value that depends on the resistance that changes according to the magnetic field by using four resisters and supplying the 12 V power supply to the sensor.

▶ **Specifications**

Item	Specifications	Reference
Supplying voltage	DC 12V	
Air gap	Front: 0.335 ~ 0.945 mm	Cannot measure the air gap
	Rear: 0.309 ~ 0.958 mm	
Output current (vehicle speed: at 2.75 km/h)	7mA (Lo) ~ 14mA (Hi) +20 % / 1 6 %	
Tightening torque	Front: 19 ~ 25 Nm	7.5 ~ 20 V
	Rear: 6 ~ 10 Nm	

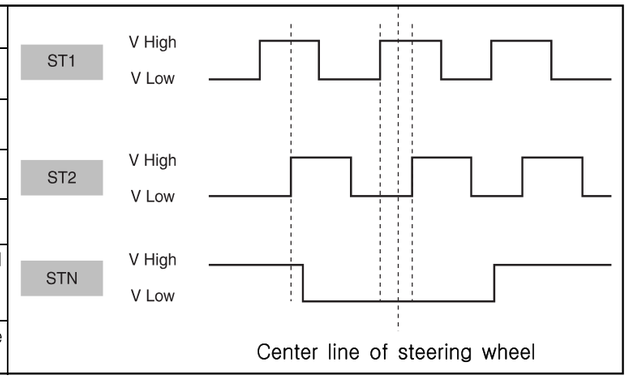
C. HBA (HYDRAULIC BRAKE ASSIST SYSTEM)

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.

D. SWAS : STEERING WHEEL ANGLE SENSOR

The steering wheel angle sensor is located between clock spring and multifunction switch. This sensor is used for recognition of driver's intends.
If the sensor is replaced with new one, it can detect the neutral position after the vehicle is moving over 20 km/h for more than 5 seconds.

Working voltage	9 ~16 V
Number of pulse per revolution	45 Pulses /1rev
Duty	Approx. 50 %
High - V	3.0 ~ 4.1 V
Low - V	1.3 ~ 2.0 V
ST1 and ST2	Detects steering wheel angle and angular velocity as an average value
STN	Detects the center value of steering wheel



E. HDC (Hill Descent Control) SYSTEM

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**

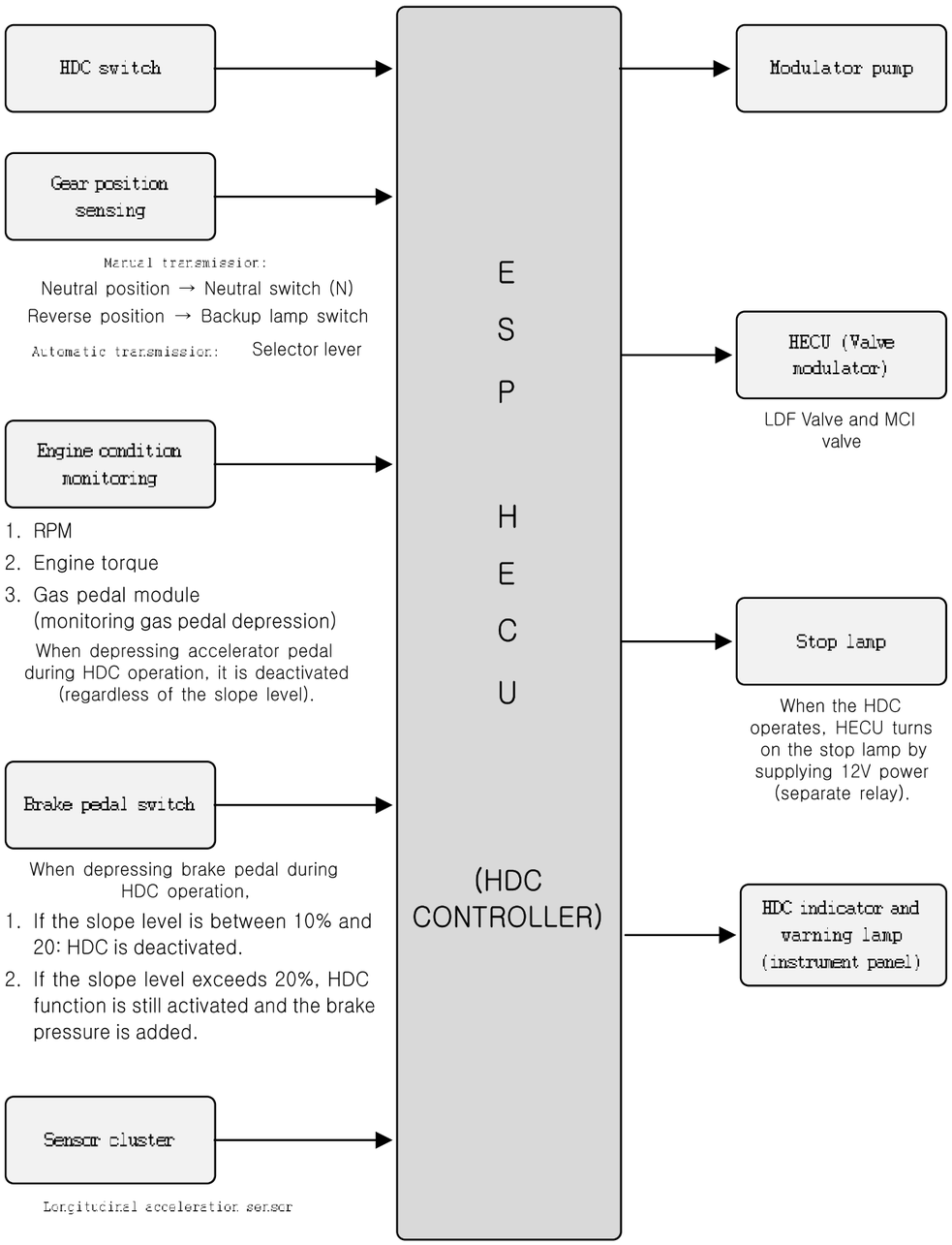
When depressing the accelerator pedal or brake pedal, HDC system is changed to stand-by mode.
When depressing the accelerator pedal again, HDC starts its operation again.
Therefore, drivers can control the vehicle speed to a desired level by operating the accelerator pedal.

▶ **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	

F. INPUT/OUTPUT SIGNALS FOR HDC OPERATION



G. 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>HDC</td><td>HDC</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="4">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>

H. ESP (ELECTRONIC STABILITY PROGRAM)

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.

I. SENSOR CLUSTER (YAW RATE SENSOR + LATERAL ACCELERATION SENSOR + LONGITUDINAL ACCELERATION SENSOR)

Descriptions	Specifications
Supplying voltage	Approx. 5 V (4.75 ~ 5.25 V)
Output voltage when stop	Approx. 2.5 V (Ignition switch "ON")
Output range	0.2 ~ 4.8 V
Operation start speed	−75°/s ~ +75°/s

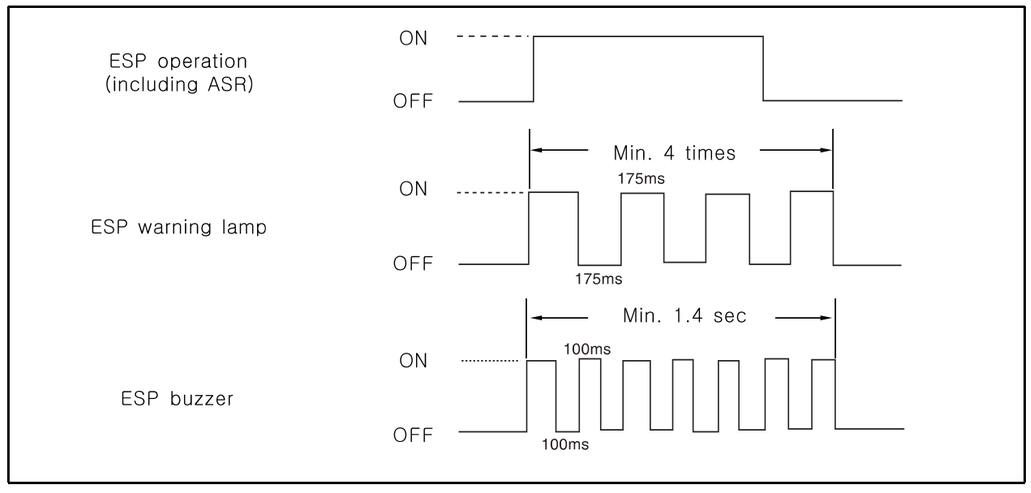
J. PRESSURE SENSOR

▶ **Specificatons**

Descriptions	Specifications
Supplying voltage	4.75 ~ 5.25 V
Output range	0.25 ~ 4.75 V
Output voltage when stop	2.5 V

K. ESP WARNING LAMP BLINKING IN CONTROL

ESP warning lamp blinks when ESP control is activated. If the activation reaches a certain limitation, a beep sounds to warn the driver.
The ESP warning lamp goes off when ESP function is deactivated.
Even when the ESP is operated for a very short period of time, the ESP warning lamp blinks minimum of 4 times every 175 milliseconds and the buzzer sounds for at least 1.4 seconds with 100 ms interval.



L. ESP SYSTEM CANCELLATION USING THE ESP OFF SWITCH

When the ESP switch at the center switch panel is pushed (for over approximately 150 ms), the ESP system will be cancelled and the vehicle will be driven regardless of the output values from the corresponding sensors.
Then, the ESP warning lamp on the instrument panel comes on.

M. 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 switch at the center switch panel is pushed (for over approximately 150 ms) while the ESP system is not operating.

Modification basis	
Application basis	
Affected VIN	

N. ABS/ESP TROUBLE DIAGNOSIS

o: Applied x: N/A

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	Front LH Wheel speed sensor	C1011 (5011) C1012 (5012)	Wheel speed sensor front left-electrical Wheel speed sensor front left-other	ABS	ESP
	1. C1011 (5011) Cause - Defective front LH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector - Check HECU connector - Check the harness connection 2. C1012 (5012) Cause - 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 Action - 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			O	O
	Front RH Wheel speed sensor	C1021 (5021) C1022 (5022)	Wheel speed sensor front right-electrical Wheel speed sensor front right-other		
	1.C1021 (5021) Cause - Defective front RH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector - Check HECU connector - Check the harness connection 2.C1022 (5022) Cause - 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 Action - 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			O	O

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	Rear RH Wheel speed sensor	C1031 (5031) C1032 (5032)	Wheel speed sensor rear left-electrical Wheel speed sensor rear left-other	ABS	ESP
	1. C1031 (5031) Cause - Defective rear RH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector - Check the HECU connector - Check the harness connection 2. C1032 (5032) Cause - 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 Action - 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			O	O
	Rear LH Wheel speed sensor	C1041 (5041) C1042 (5042)	Wheel speed sensor rear left-electrical Wheel speed sensor rear left-other		
	1. C1041 (5041) Cause - Defective rear LH wheel speed sensor - Short or poor contact wire to sensor Action - Check the wheel speed sensor connector - Check the HECU connector - Check the harness connection 2. C1042 (5042) Cause - 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 Action - 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			O	O

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	Pressure sensor	C1051 (5051)	Defective input sensor	ABS	ESP
	Cause - Abnormal signals from pressure sensor - Defective pressure sensor or harness Action - Check the pressure sensor connector			X	O
	Steering wheel angle sensor	C1061 (5061)	Defective steering wheel angle sensor		
	Cause - 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 Action - 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)			X	O
	Sensor cluster	C1073 (5073) C1074 (5074)	Sensor cluster -electrical Sensor cluster-internal		
	1. C1073 (5073) Cause - Operating voltage exceeds specified range (Hi: 18.0 ± 1.0 V / Lo: 6.5 ± 0.5 V) - Poor contact or installation of harness Action - Check the sensor cluster connector - Replace the sensor cluster 2. C1074 (5074) Cause - 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 Action - Replace the sensor			X	O

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

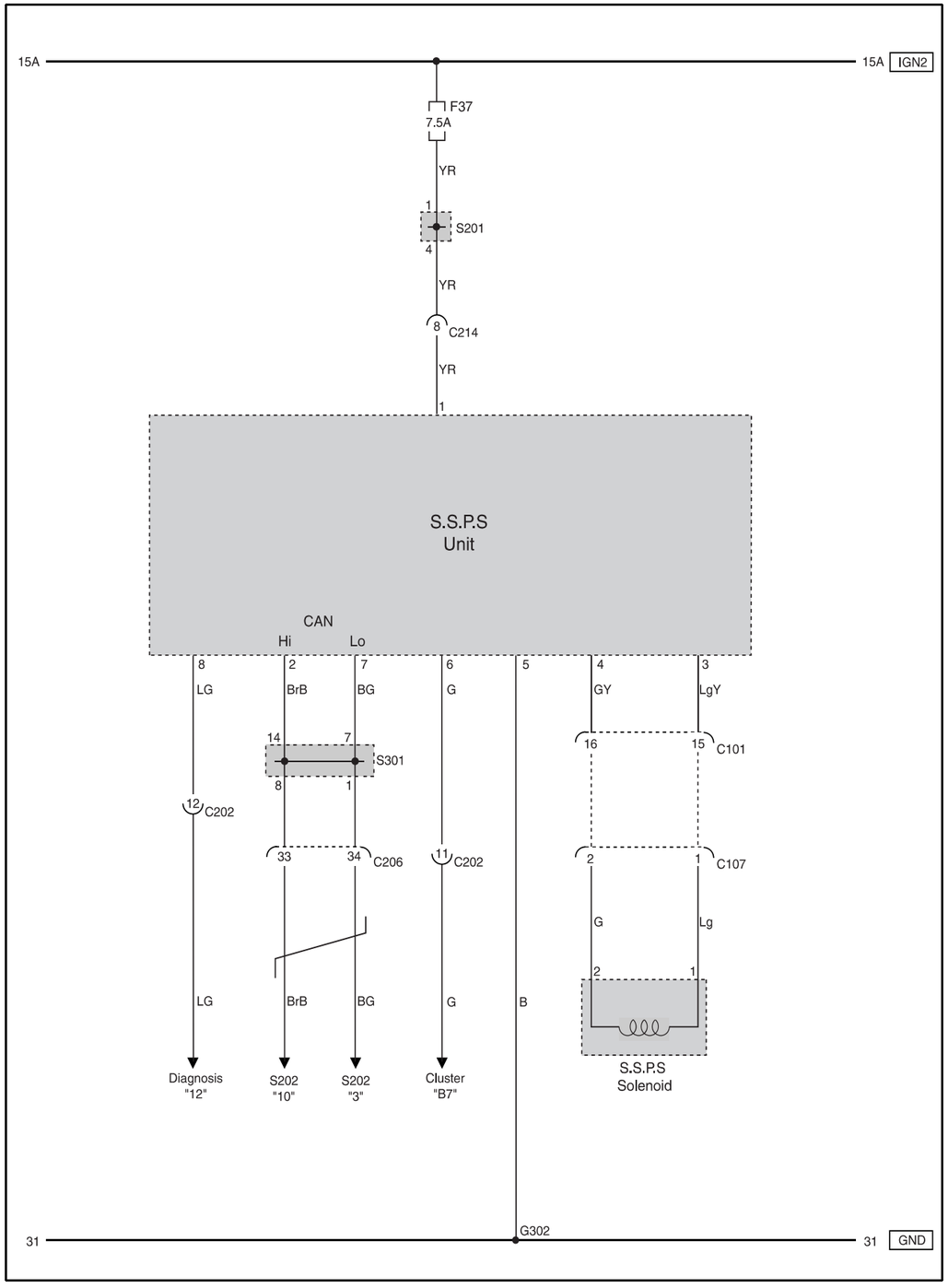
Modification basis	
Application basis	
Affected VIN	

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

Function	Defective Components	Trouble Code	Descriptions	System	
CAN Communication Monitoring	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
	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

S.G.N. 4620-12

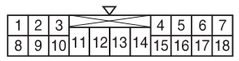
S.S.P.S (SPEED SENSITIVE POWER STEERING



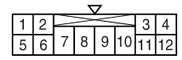
1) CONNECTOR INFORMATION

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	
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	
G302	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
S301 (14Pin, Black)	W/H Main	Beside Driver Seat W/H Protector	CAN

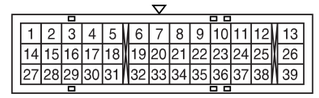
2) CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



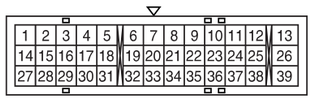
C101
W/H Floor
(Eng Room Fuse & Relay Box)



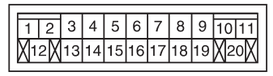
C107
W/H Eng
(Eng Room Fuse & Relay Box)



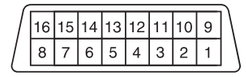
C202
W/H Floor



C206
W/H Floor



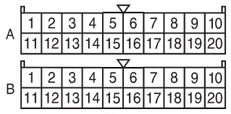
C214
W/H Floor



Diagnosis



SSPS Unit



Cluster



SSPS
Solenoid

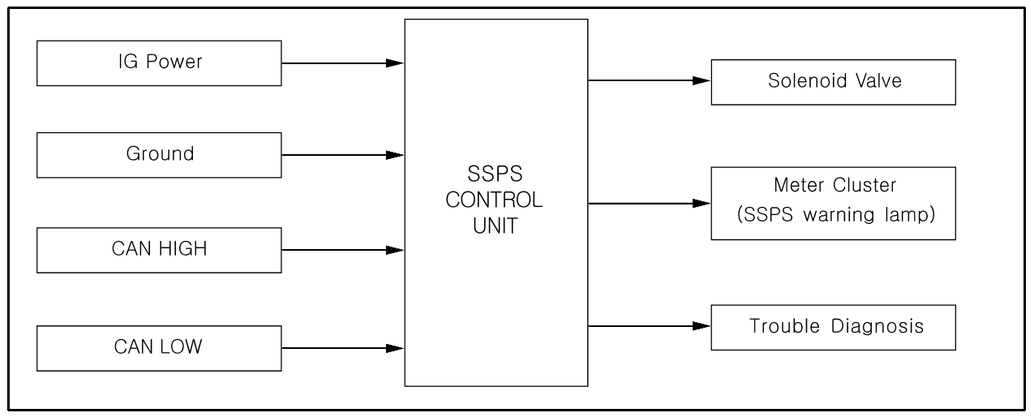
Modification basis	
Application basis	
Affected VIN	

3) CIRCUIT DESCRIPTION

(1) SSPS (SPEED SENSITIVE POWER STEERING)

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.

(2) INPUT/OUTPUT OF SSPS CONTROL UNIT



(3) SSPS CONFIGURATION

A. 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.

B. Reaction device

This device increases the steerability effect by binding the input shaft with supplied hydraulic pressure from PCV.

C. Solenoid valve

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.

▶ **Specifications**

Description	Specification
Voltage Rating	DC 12 V
Current Rating	1.0 A
Resistance	6.7 ± 1W

▶ **Electric Current Check**

· Disconnect the solenoid valve connector (waterproof connector) and install the ammeter between the solenoid valve connector and the wiring harness.

NOTE
- Do not ground the solenoid terminal.

- When the vehicle speed is at 0 km/h, check whether the electric current for solenoid is in specified range and check that the current is reduced as the vehicle speed increases.

Current	0.9 ~ 1.1 A (vehicle speed at 0 km/h)

D. SSPS Control Unit

- 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.
  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”.
  When a trouble occurs in the system, the SSPS control unit generates a trouble code using fail safe function.

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Modification basis	
Application basis	
Affected VIN	

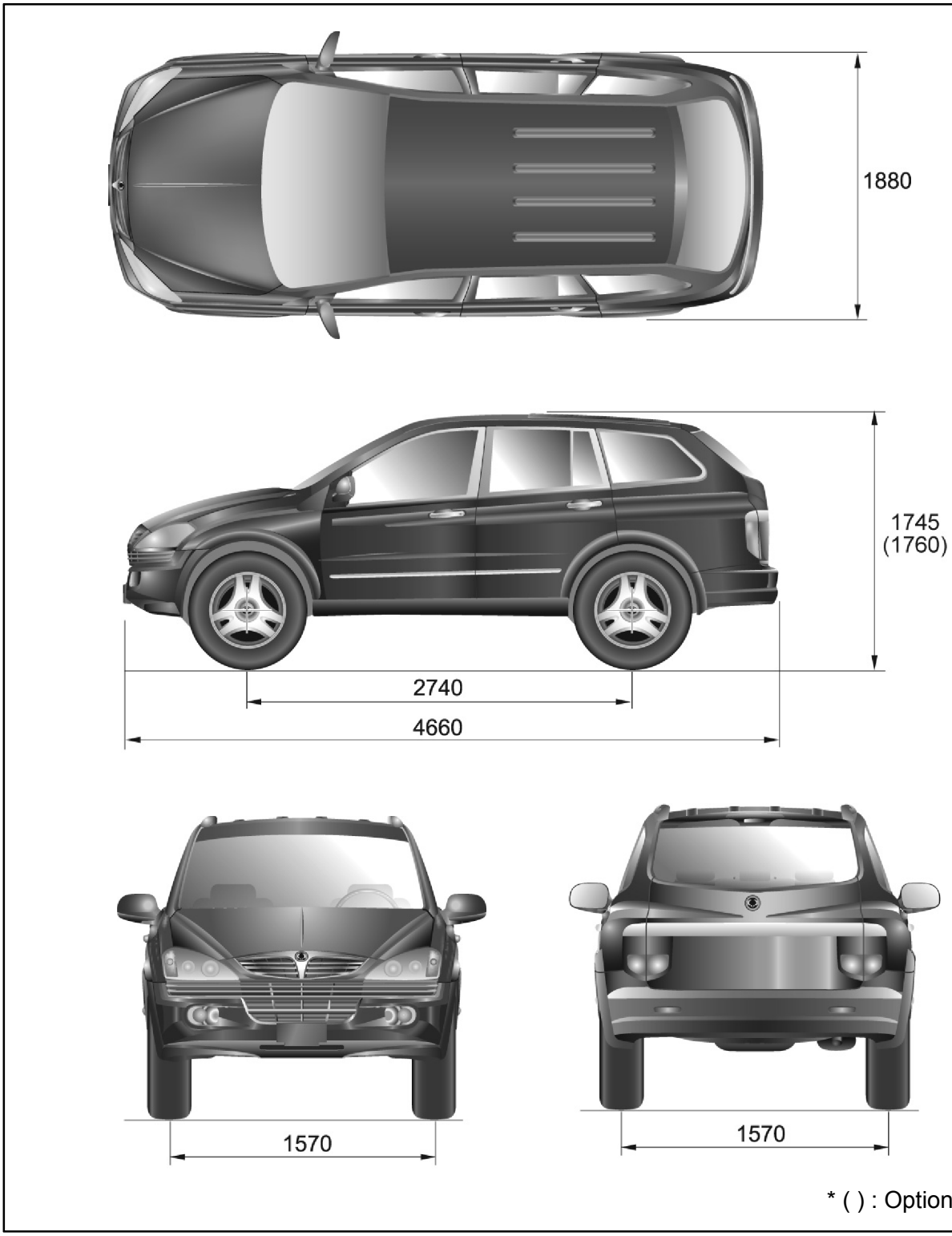
GENERAL

0000-00

GENERAL

1. DIMENSIONS

Unit: mm



* ( ) : Optional

Modification basis	
Application basis	
Affected VIN	

2. SPECIFICATIONS

* ( ) Optional

Descriptions			Diesel	Remarks
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	
	Curb vehicle weight (kg)	A/T	2WD: 1,920 / 4WD: 2,028	
		M/T	2WD: 1,893 / 4WD: 2,001	
	Fuel		Diesel	
	Fuel tank capacity (ℓ)		75	
Engine	Engine name		D20DT	
	Numbers of cylinders/Compression ratio		4 / 18:1	
	Total displacement (cc)		1,998	
	Camshaft arrangement		DOHC	
	Max. power	A/T	141 ps / 4,000 rpm	
		M/T	141 ps / 4,000 rpm	
	Max. torque	A/T	310 Nm / 1,800 ~ 2,750 rpm	
		M/T	310 Nm / 1,800 ~ 2,750 rpm	
	Idle speed		750 ± 20 rpm	
	Cooling system		Water- cooled / forced circulation	
	Coolant capacity (ℓ)		11.5	
	Lubrication type		Gear pump, forced circulation	
	Max. oil capacity (ℓ)		8.2	
	Turbocharger and cooling type		Turbocharger, air-cooled	
Manual Transmission	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 Transmission	Model		Electronic, 5-speed	
	Operating type		Floor change type	
	Gear ratio	1st	3.951	
		2nd	2.423	
		3rd	1.486	
		4th	1.000	
		5th	0.833	
		Reverse 1st	3.147	
		Reverse 2nd	1.930	
Transfer Case	Model		Part-time	
	Type		Planetary gear type	
	Gear ratio	High (4H)	1.000 : 1	
		Low (4L)	2.483 : 1	

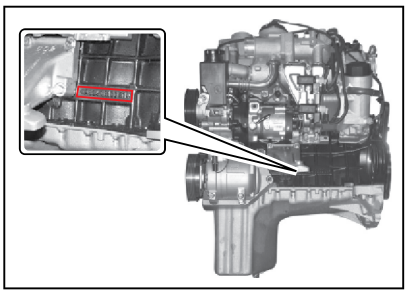
Modification basis	
Application basis	
Affected VIN	

* ( ) Optional

Descriptions			Diesel	Remarks
Clutch (M/T)	Operating type		Hydraulic type	
	Disc type		Dry single diaphragm type	
Power Steering	Type		Rack and pinion	
	Steering angle	Inner	36.2°	
		Outer	32.4°	
Front Axle	Drive shaft type		Ball joint type	
	Axle housing type		Build-up type	
Rear Axle	Drive shaft type	Solid axle suspension	Semi-floating type	
	Axle housing type		Build-up type	
Brake	Master cylinder type		Tandem type	
	Booster type		Vacuum assisted booster type	
	Brake type	Front wheels	Disc type	
		Rear wheels	Drum (disc)	
	Parking brake		Cable type (internal expansion)	
Suspension	Front suspension		Wishbone + coil spring	
	Rear suspension	Solid axle suspension	5-link + coil spring	
Air Conditioner	Refrigerant (capacity)		R-134a (650 ± 30g)	
	Battery type / Capacity (V-AH)		MF / 12 - 90	
Electrical	Starter capacity (V-kW)		12 - 2.2	
	Alternator capacity (V-A)		12 - 140 (12 - 115)	

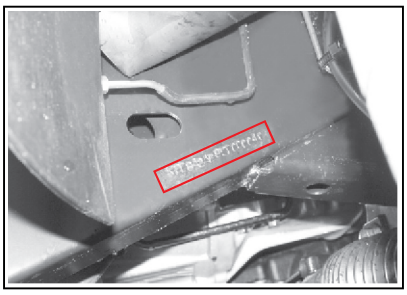
3. VEHICLE IDENTIFICATION

1. Engine Number

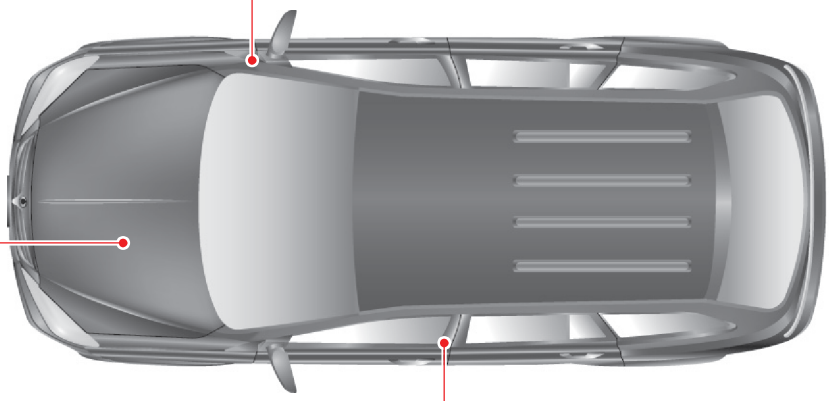


The engine number is stamped on the lower area of cylinder block behind the Intake manifold.

2. Chassis Number



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



3. Certification Label



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

Modification basis	
Application basis	
Affected VIN	

4. MAINTENANCE SCHEDULE

1) EU ONLY

* Use only approved Ssangyong genuine parts.

Descriptions		Daily Check	Weekly Check	Service Interval
Engine Oil and Oil Filter		○	–	Change every 15,000 km or 12 months (But, shorten the service interval under severe conditions)
Coolant		○	–	Change every 60,000 km or 3 years. And, inspect and replenish as necessary.
Brake / Clutch Fluid		○	–	Change every 2 years (Inspect frequently)
Brake Pipes and Hoses		–	–	Periodic check: every 15,000 km or 1 year, replace as necessary.
Brake Pad, Shoe, and Disc		–	–	Periodic check: every 15,000 km, adjust or replace as necessary.
Air Cleaner Element		–	○	Clean every 15,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)
Fuel Filter		–	–	Replace every 30,000 km (Draining water from fuel filter: whenever replacing the engine oil)
Automatic Transmission Fluid		–	–	Inspect every 15,000 km or 12 months (But change every 60,000 km under severe conditions)
Manual Transmission Fluid		–	–	Inspect 15,000 km, change every 60,000 km (Frequent check of oil leak)
Transfer Case Fluid		–	–	Inspect 15,000 km, change every 60,000 km (Frequent check of oil leak)
Axle Oil	Front	–	–	Inspect frequently, change every 30,000 km
	Rear	–	–	Inspect frequently, change every 30,000 km
Air Conditioner Filter		–	–	Change every 10,000 km (But, shorten the service interval under severe conditions)

Severe Conditions in Engine

- 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

Severe Conditions in Automatic Transmission and Axle

- Towing a trailer or off-road driving
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Severe Conditions in Air Conditioner Filter

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

Severe Conditions in Air Cleaner Element

- Pollutant area or off-road driving

*** EU Countries**

- Only countries that belong to EU. (It does not apply to all countries in EU.)

2) General

* Use only approved Ssangyong genuine parts.

Descriptions		Daily Check	Weekly Check	Service Interval
Engine Oil and Oil Filter		○	–	Initial change: 5,000 km, change every 10,000 km or 12 months (But, shorten the service interval under severe conditions)
Coolant		○	–	Change every 60,000 km or 3 years. And, inspect and replenish as necessary.
Additional Water Separator: A.W.S.		–	–	Inspect 10,000 km, change every 150,000 km or 5 years
Brake / Clutch Fluid		○	–	Change every 2 years (Inspect frequently)
Brake Pipes and Hoses		–	–	Initial check: 1,000 km, periodic check: every 20,000 km or 1 year, replace as necessary.
Brake Pad, Shoe, and Disc		–	–	Periodic check: every 10,000 km, adjust or replace as necessary.
Air Cleaner Element		–	○	Initial clean: 5,000 km, clean every 10,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)
Fuel Filter		–	–	Replace every 25,000 km (Draining water from fuel filter: whenever replacing the engine oil)
Automatic Transmission Fluid		–	–	Inspect every 10,000 km or 6 months (But change every 60,000 km under severe conditions)
Manual Transmission Fluid		–	–	Inspect 10,000 km, change every 60,000 km (Frequent check of oil leak)
Transfer Case Fluid		–	–	Inspect 10,000 km, change every 60,000 km (Frequent check of oil leak)
Axle Oil	Front	–	–	Inspect frequently, change every 30,000 km
	Rear	–	–	Inspect frequently, change every 30,000 km
Air Conditioner Filter		–	–	Change every 10,000 km (But, shorten the service interval under severe conditions)

Severe Conditions in Engine

- 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 hilly or mountainous terrain, sandy or dusty area
- High load driving such as trailer towing

Severe Conditions in Automatic Transmission and Axle

- Towing a trailer or off-road driving
- Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Severe Conditions in Air Conditioner Filter

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

Severe Conditions in Air Cleaner Element

- Pollutant area or off-road driving

Modification basis	
Application basis	
Affected VIN	

5. RECOMMENDED FLUIDS AND LUBRICANTS

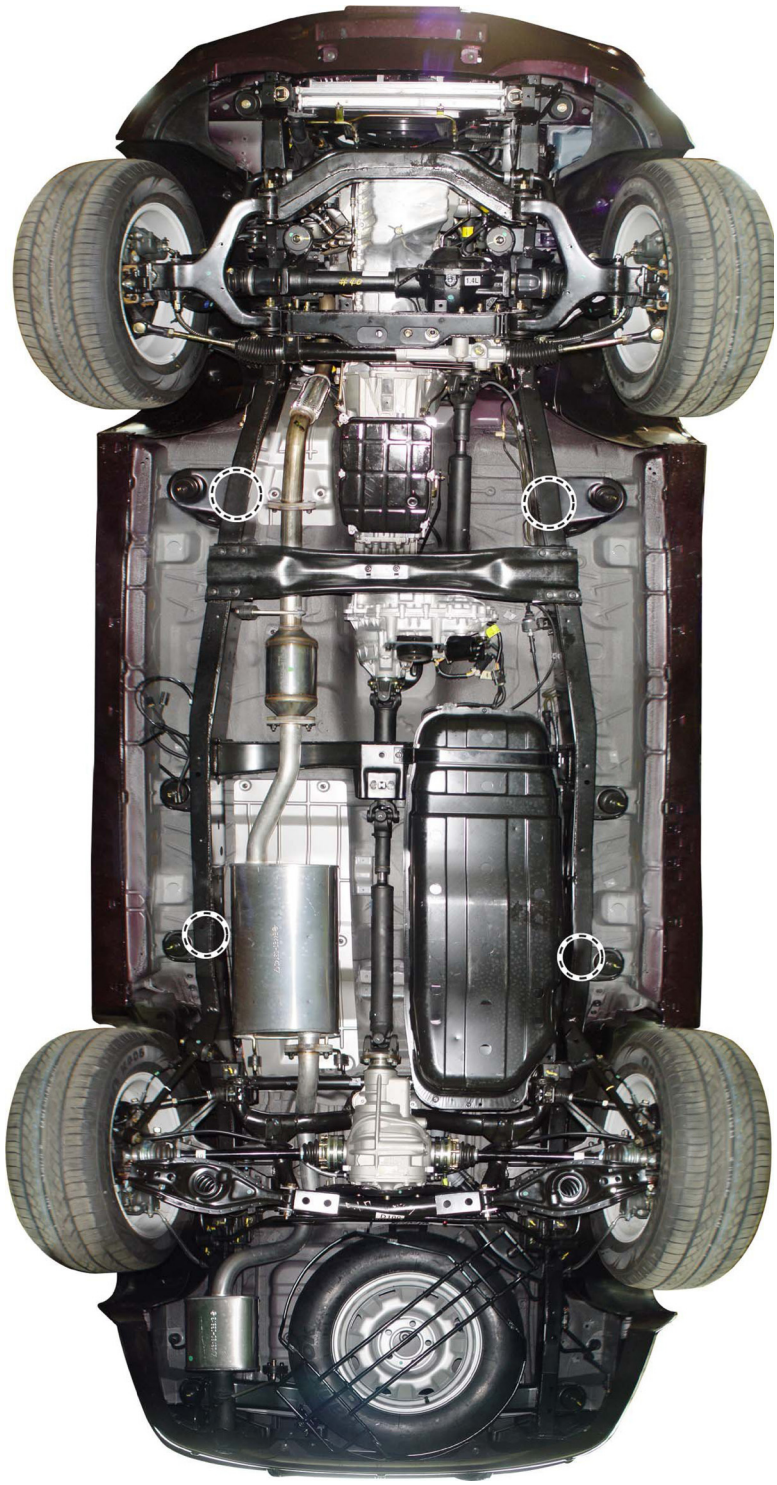
Descriptions			Capacity	Specifications
Engine Oil			≒ 7.5 ℓ	Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3)
Engine Coolant			≒ 11.5 ℓ	Ssangyong genuine coolant
Automatic Transmission Fluid			≒ 8.0 ℓ	Ssangyong genuine oil (Shell ATF 3353 or Fuchs ATF 3353)
Manual Transmission Fluid			4WD: ≒ 3.6 ℓ 2WD: ≒ 3.4 ℓ	Ssangyong genuine oil (ATF DEXRON II)
Transfer Case Fluid			≒ 1.3 ℓ	Ssangyong genuine oil (ATF DEXRON III)
Axle Oil	Front	Automatic Transmission	≒ 1.4 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
		Manual Transmission	≒ 1.4 ℓ	
	Rear	Solid Axle Suspension	≒ 1.9 ℓ	Ssangyong genuine oil (SAE 80W/90, API GL-5)
Brake / Clutch Fluid			As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid			≒ 1.0 ℓ	Ssangyong genuine oil (ATF DEXRON III)

CAUTION

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

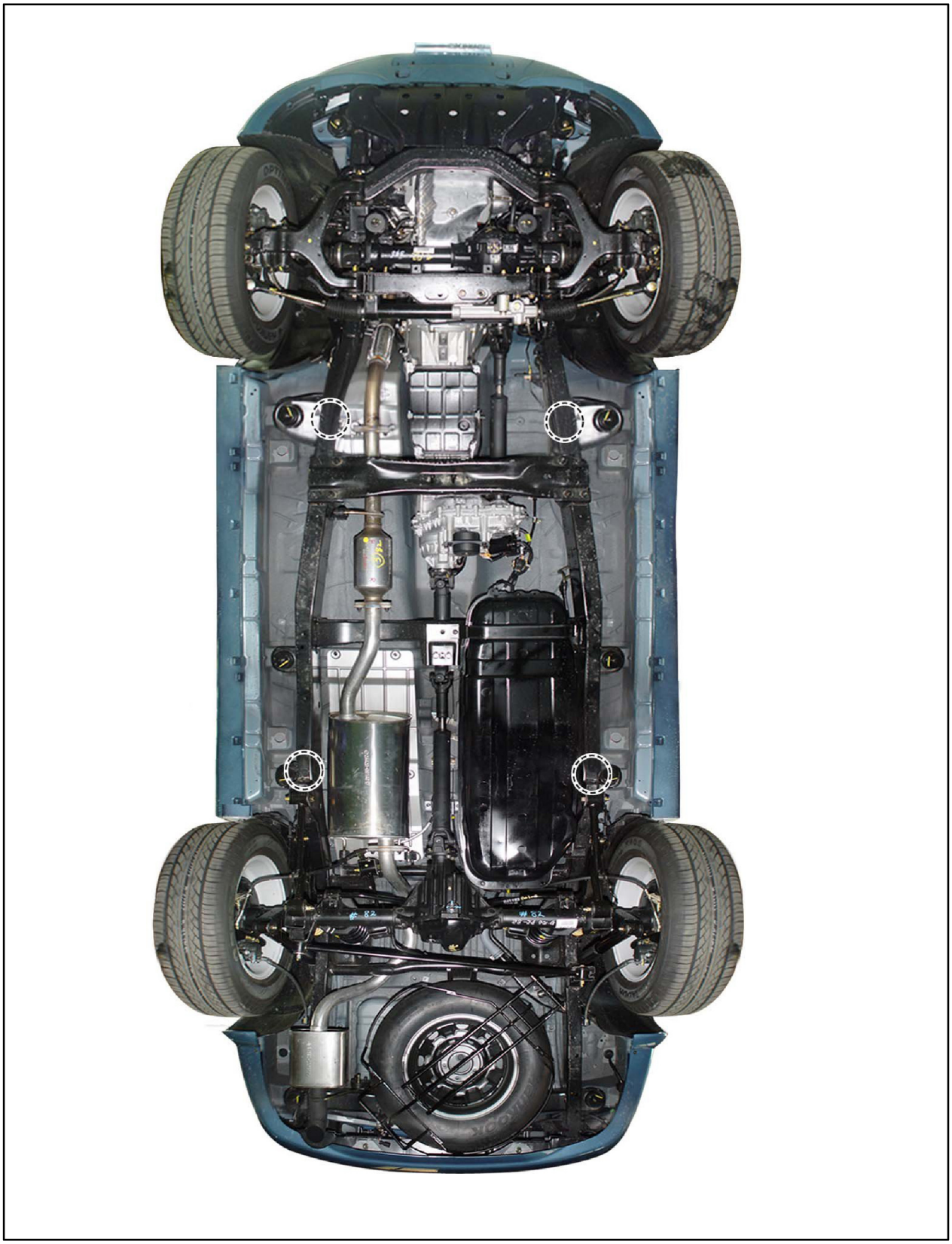
6. JACK-UP POINTS

1) IRS - Lifting Point (Dotted Circles)



Modification basis	
Application basis	
Affected VIN	

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



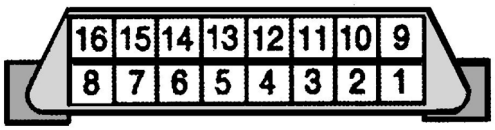
Modification basis	
Application basis	
Affected VIN	

7. PIN ARRANGEMENT OF DIAGNOSTIC CONNECTOR

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







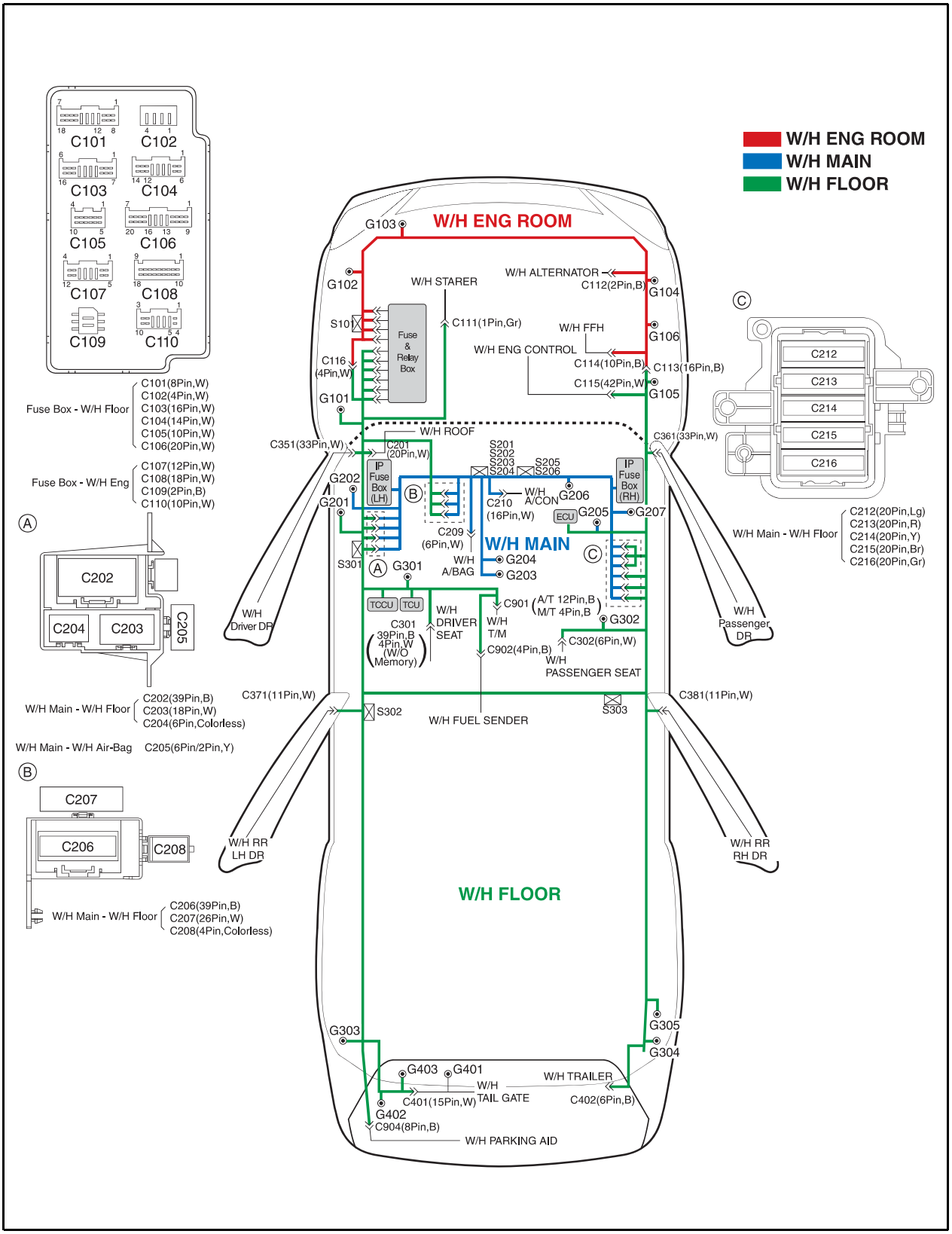
1) Functions of Terminal

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 +

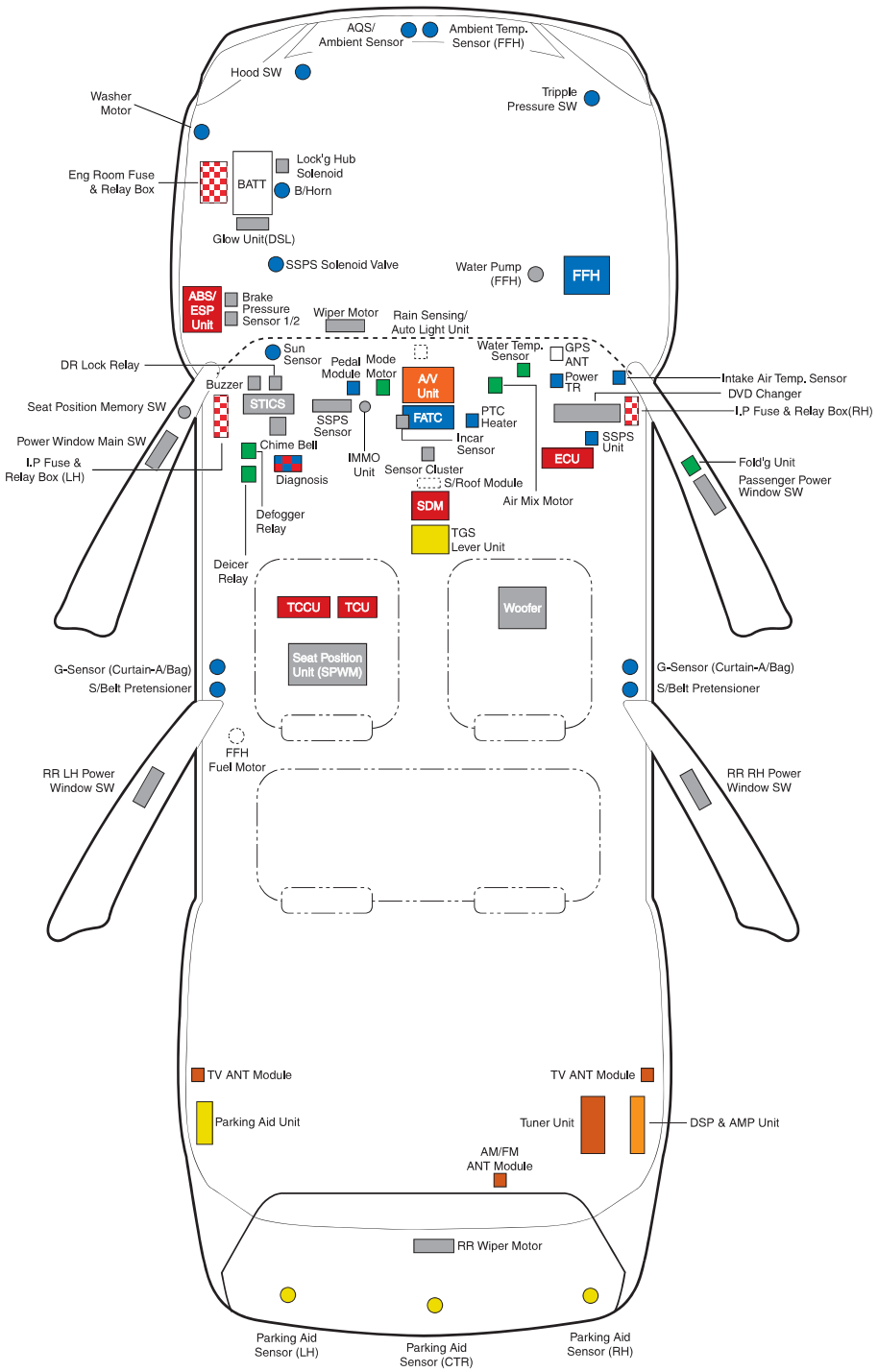
Modification basis	
Application basis	
Affected VIN	

8. ELECTRIC COMPONENTS AND LAYOUT

1) Wiring Harness Arrangement



2) Components Locator

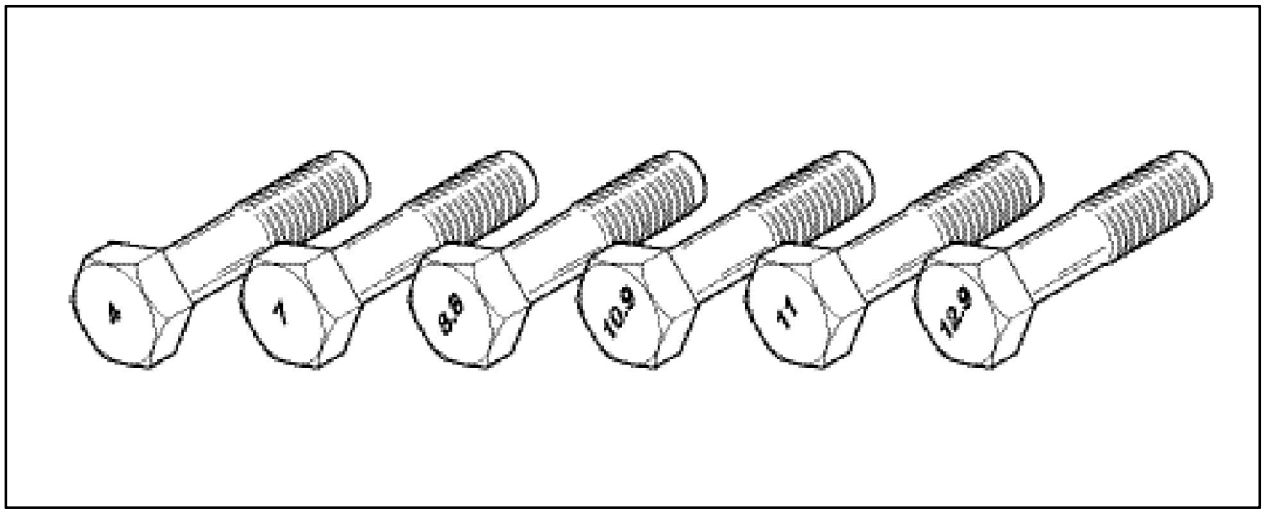


Modification basis	
Application basis	
Affected VIN	

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	

ENGINE GENERAL

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GENERAL

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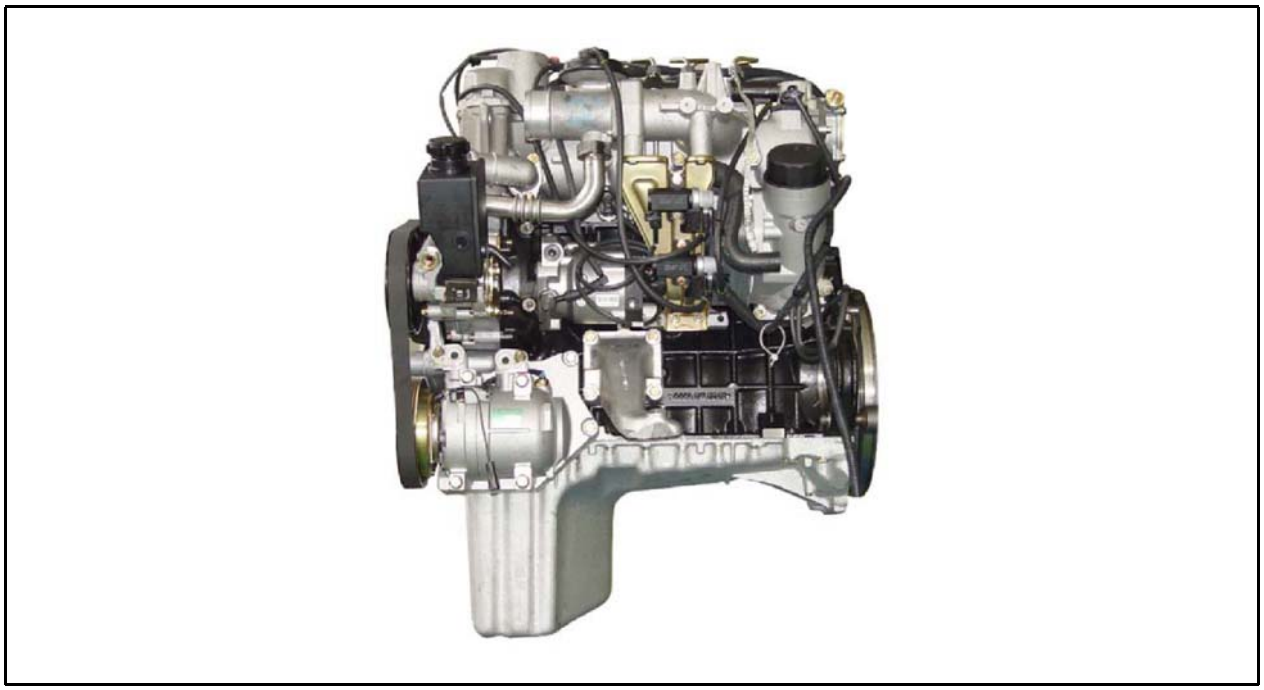
ENGINE GENERAL

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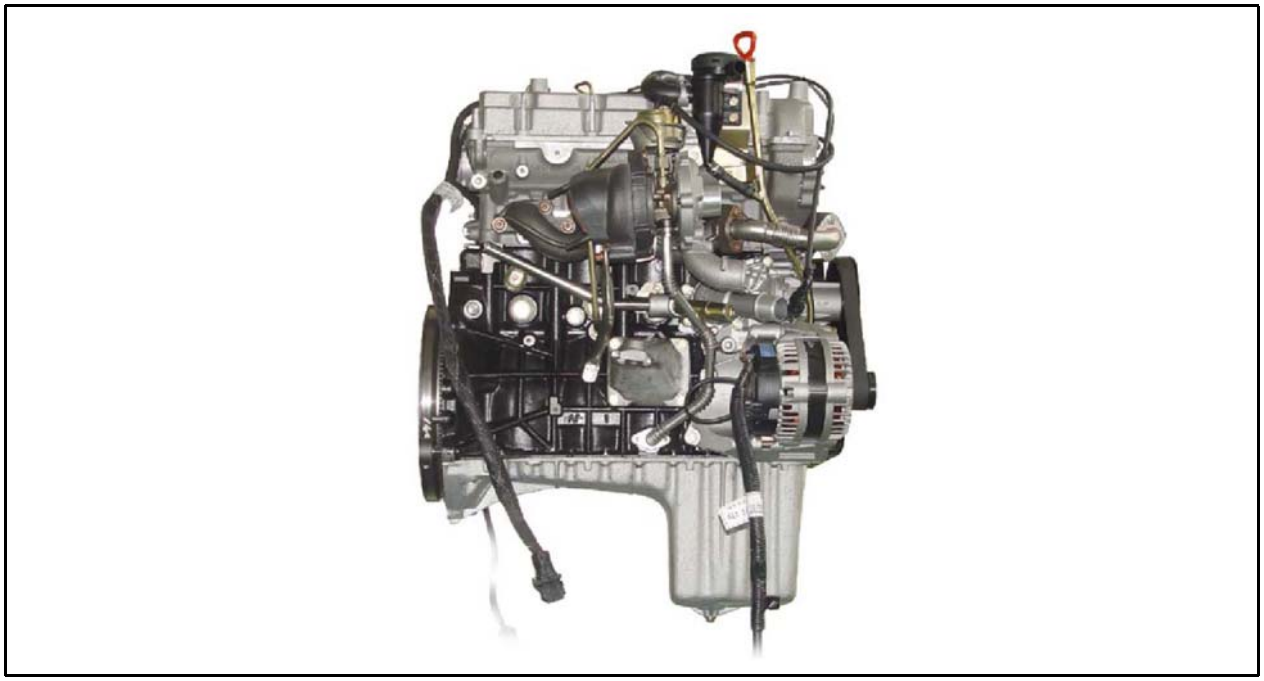
GENERAL

1. ENGINE ASSEMBLY LAYOUT

1) LH SIDE VIEW



2) RH SIDE VIEW

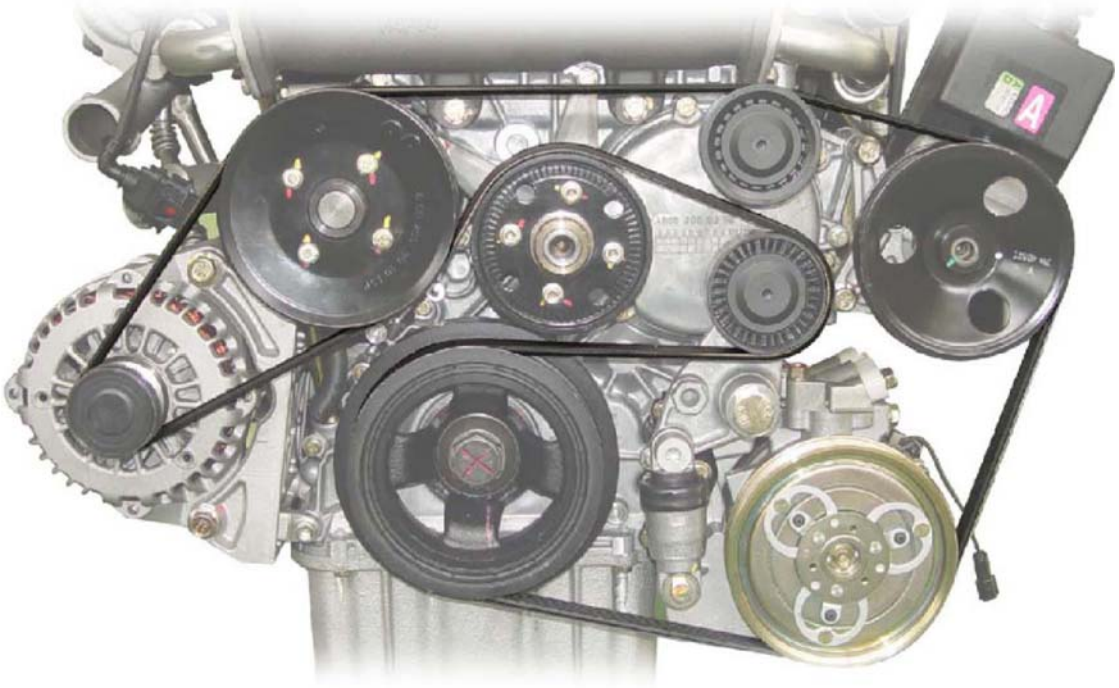


Modification basis	
Application basis	
Affected VIN	

3) FRONT VIEW



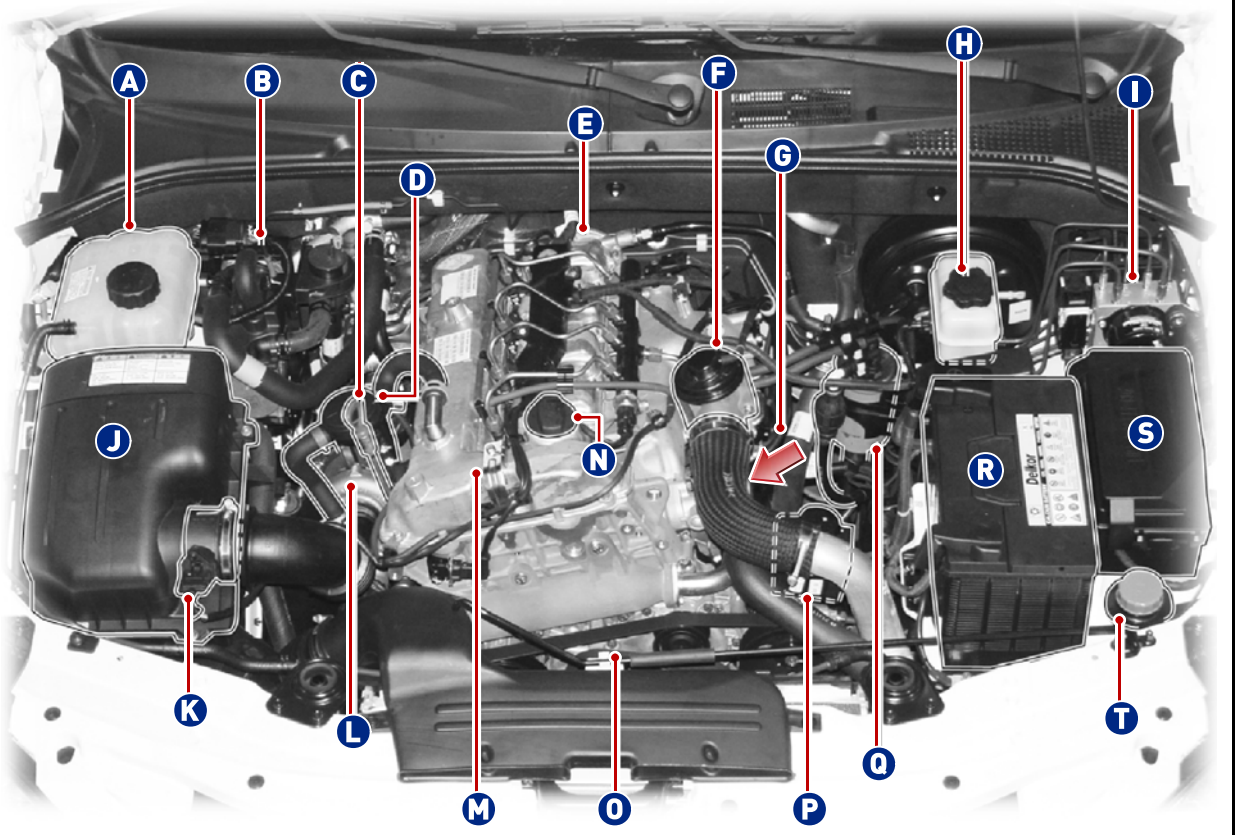
4) FAN BELT



Modification basis	
Application basis	
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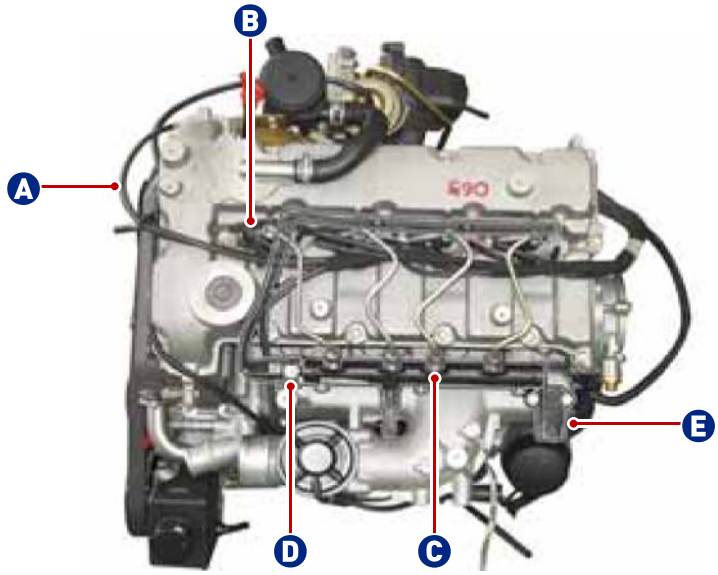
2. ENGINE CONTROLS LAYOUT

1) ECU Related Componets



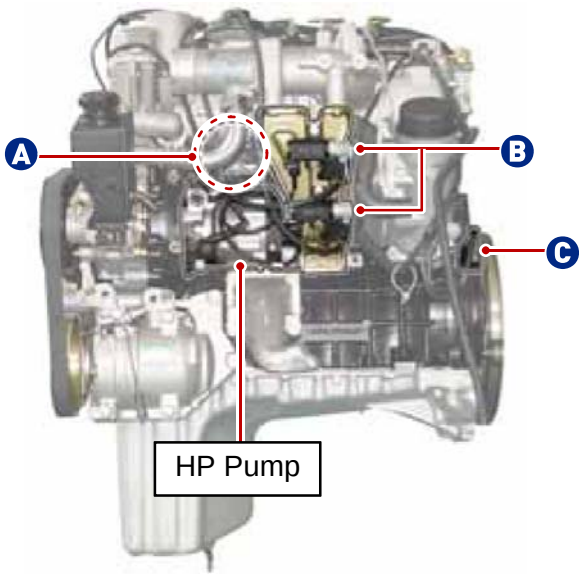
NO.	FUNCTION	NO.	FUNCTION
A	Coolant reservoir	K	HFM sensor
B	FFH	L	VGT turbo charger
C	Engine oil dipstick	M	Engine
D	Oil separator(PCV valve)	N	Engine oil filler cap
E	Vacuum pump	O	PWM electric fan & fan shroud
F	EGR valve	P	Power steering oil reservoir
G	Vacuum modulator	Q	Fuel filter & priming pump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

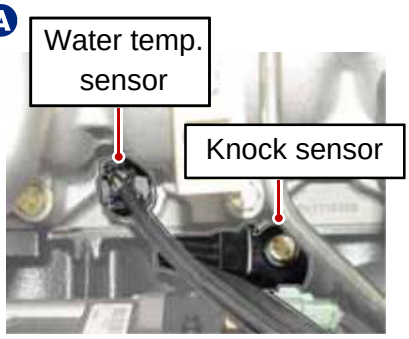
2) Engine And Sensors



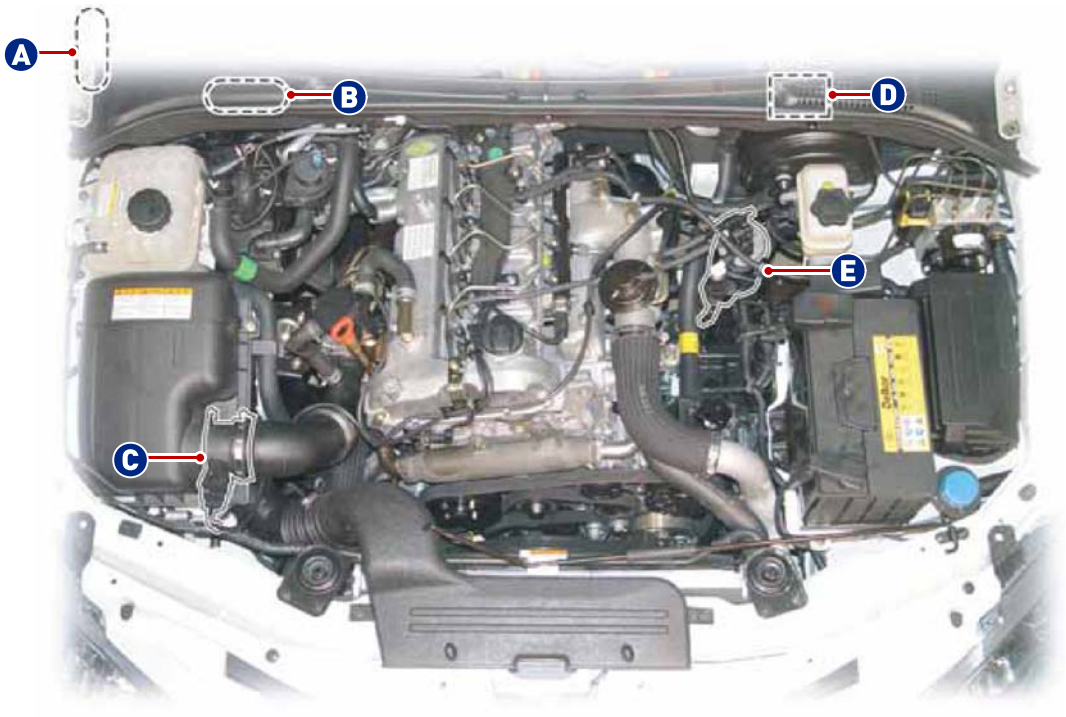
Camshaft Position Sensor	Injector	Glow Plug
A 	B 	B 
Common Rail	**Fuel Pressure Sensor (Common Rail)**	**Booster Pressure Sensor**
C 	D 	E 

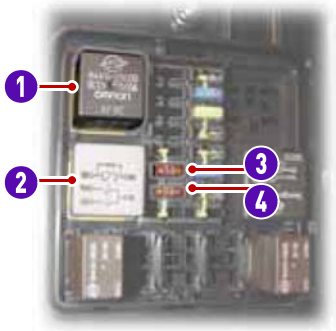
Modification basis	
Application basis	
Affected VIN	



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
	

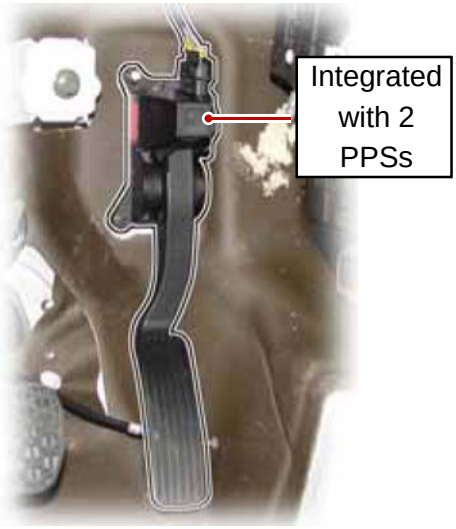
Modification basis	
Application basis	
Affected VIN	

C HFM Sensor

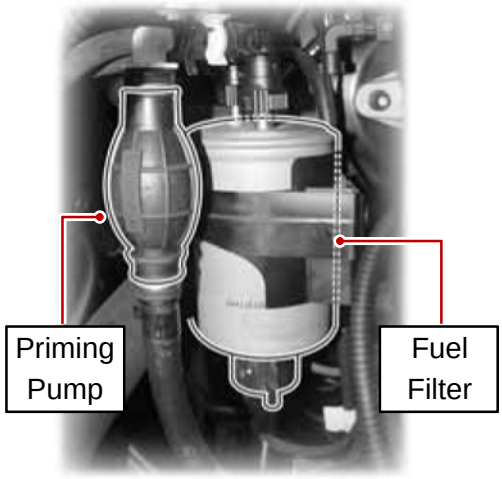




D Accelerator Pedal Module

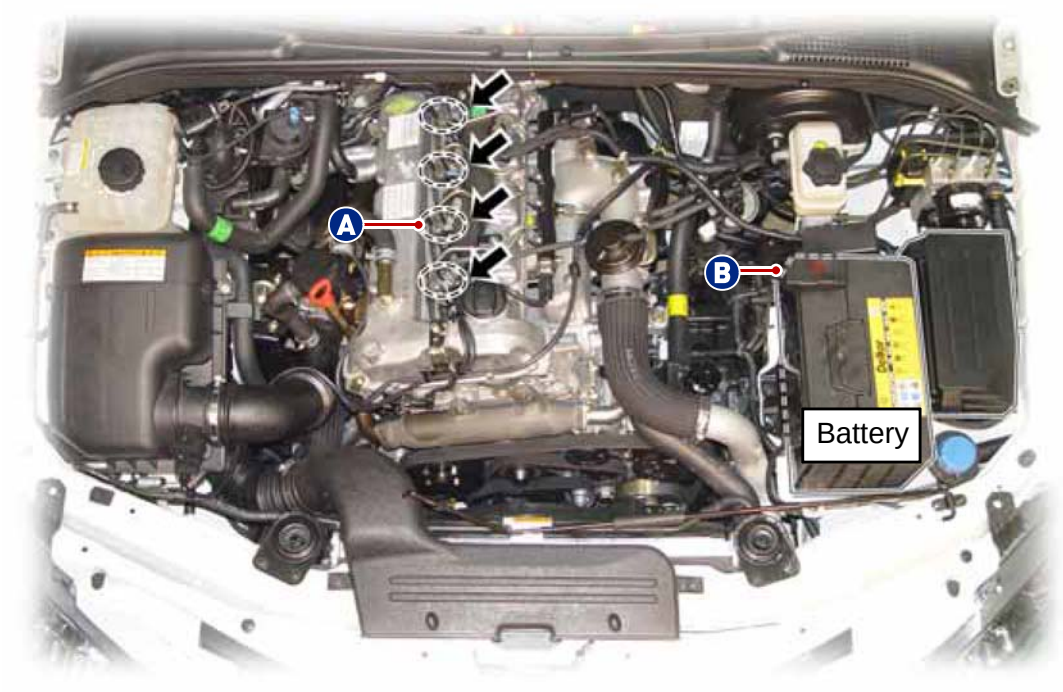


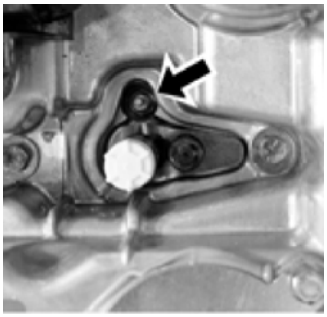
E Fuel Filter Sensor

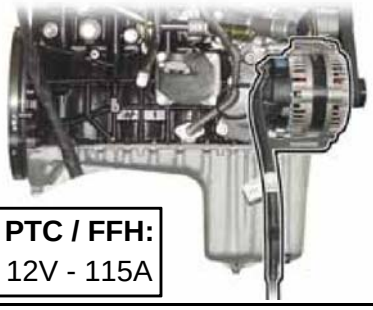
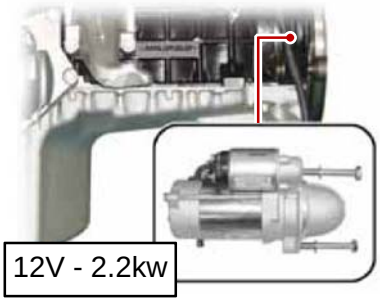


Service Interval (Fuel Filter)	
EU Only	Replace every 30,000 km (Draining water from fuel filter: whenever replacing the engine oil)
General	Replace every 25,000 km (Draining water from fuel filter: whenever replacing the engine oil)

3. ELECTRICAL COMPONENTS AND PRE HEATING SYSTEM



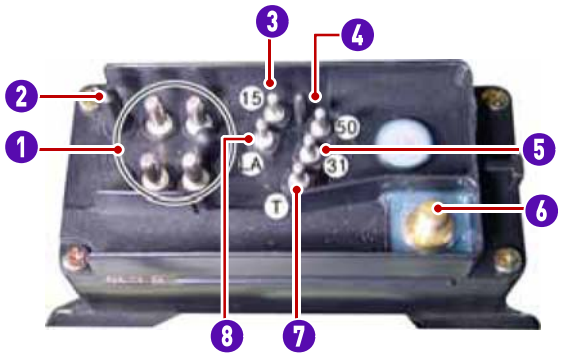
A Glow Plug		Preheat Warning Lamp (Cluster)
		

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

Modification basis	
Application basis	
Affected VIN	

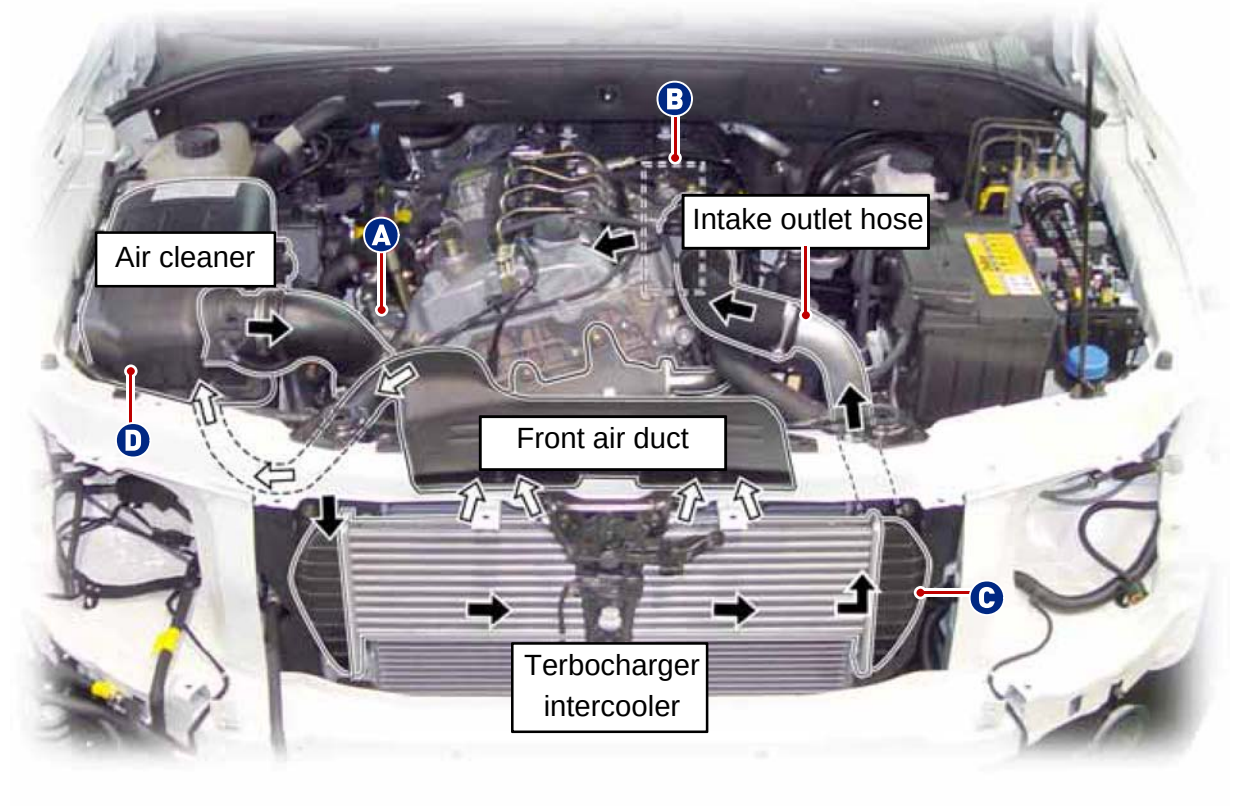
B Preheat Control Unit

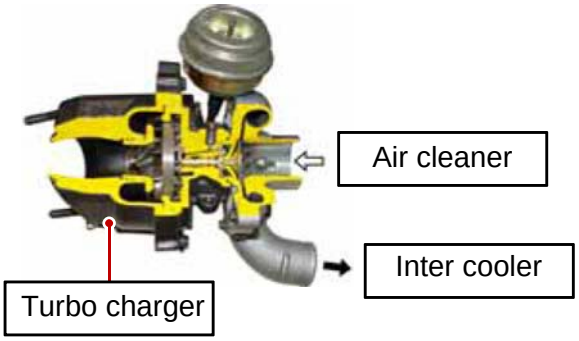
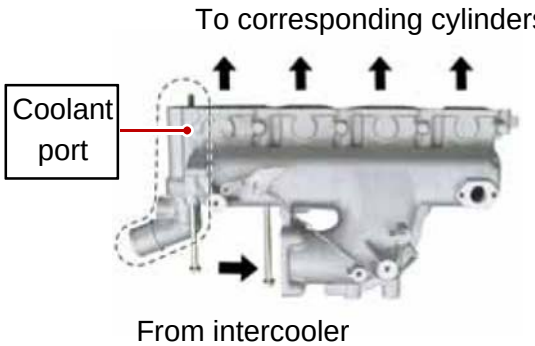




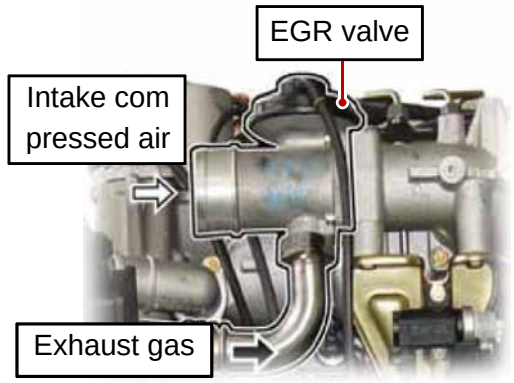
NO.	FUNCTION
1	Glow plug terminal (#1 ~ #4)
2	No G5 for 4 cylinders (Without D20DT)
3	IG1 power supply terminal
4	Glow plug control signal (ECU113)
5	Ground terminal
6	Battery main wire
7	Preheat completion transmit terminal : No use for vehicle without remote engine start
8	K-line (ECU 34)

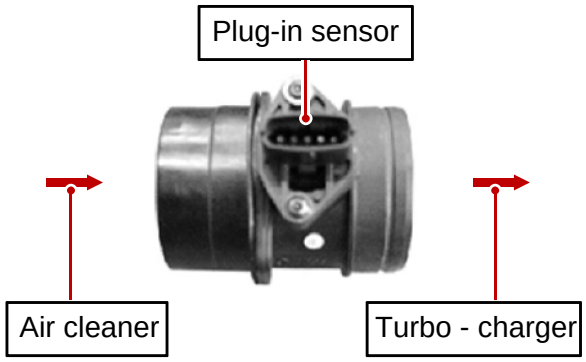
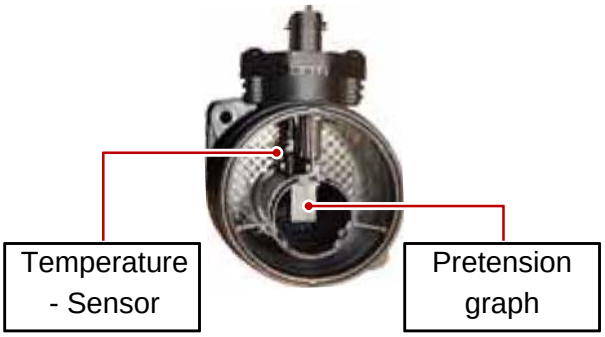
4. INTAKE SYSTEM



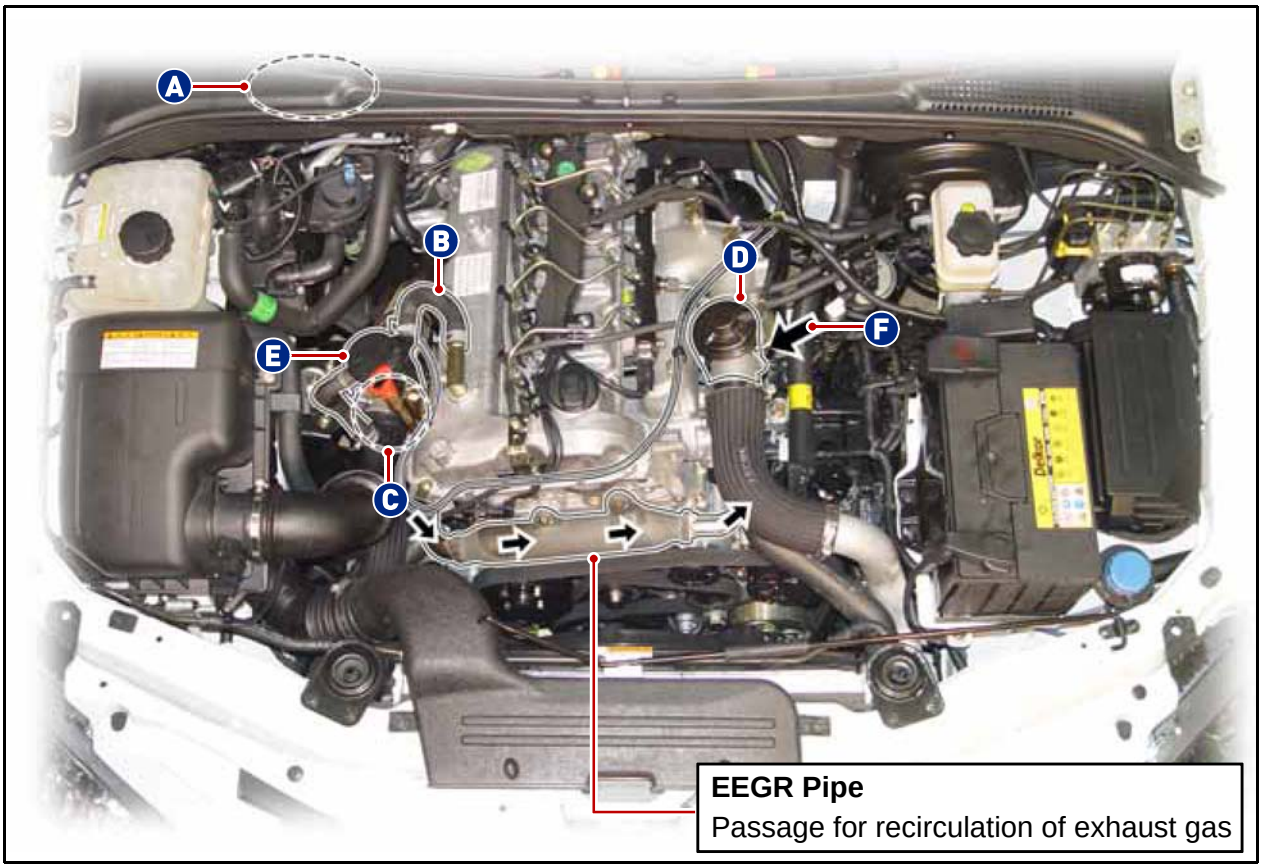
A Supplying Compressed Air with Turbocharger's Operation	B Intake Manifold
	

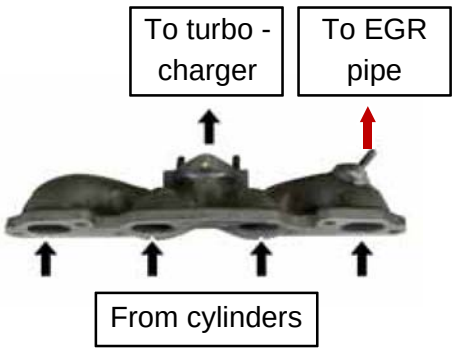
Modification basis	
Application basis	
Affected VIN	

Recirculation of Exhaust Gas when EGR Valve Operates	Ⓒ Turbocharger Intercooler
	

Ⓓ HFM Sensor	
	

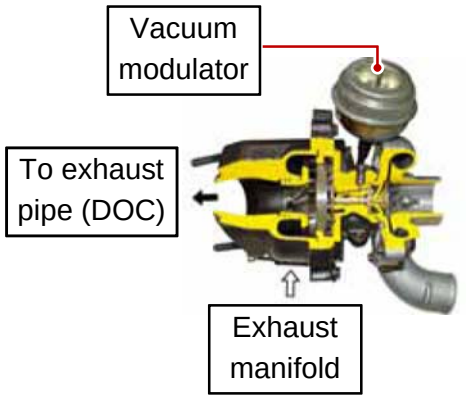
5. EXHAUST SYSTEM LAYOUT



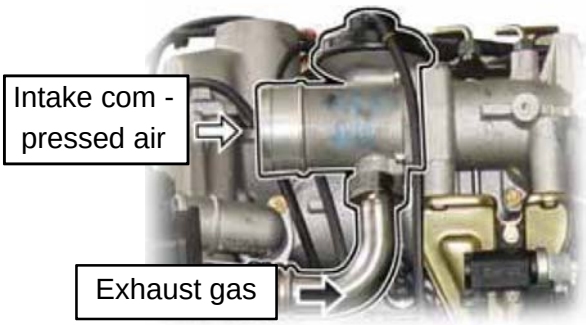
A DOC (Diesel Catalytic Converter)	B Exhaust Manifold
	

Modification basis	
Application basis	
Affected VIN	

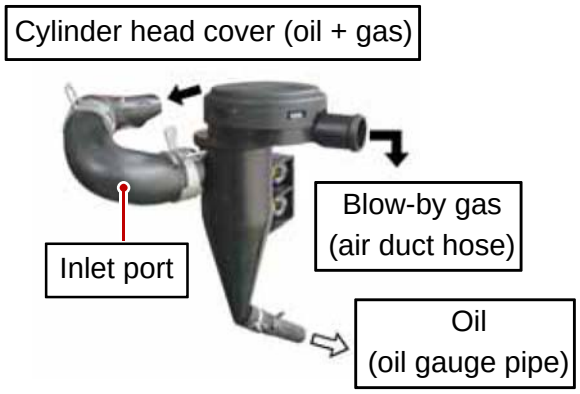
C VGT Turbocharger



D EGR Valved

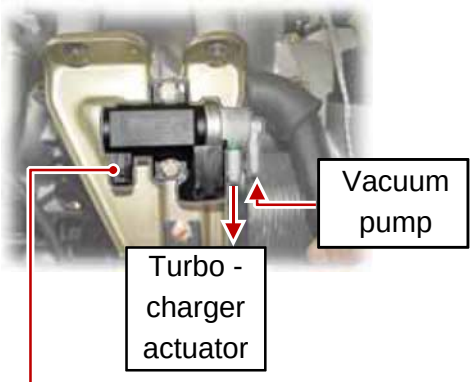


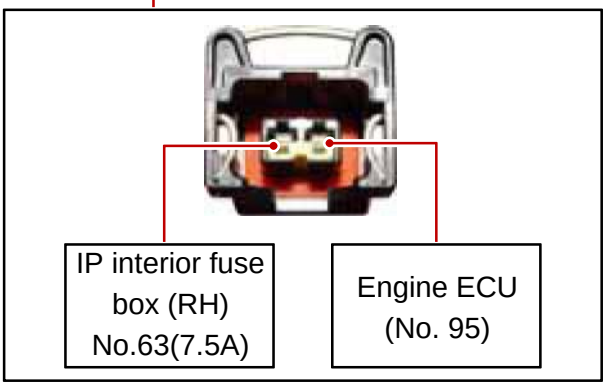
E PCV Oil Separator



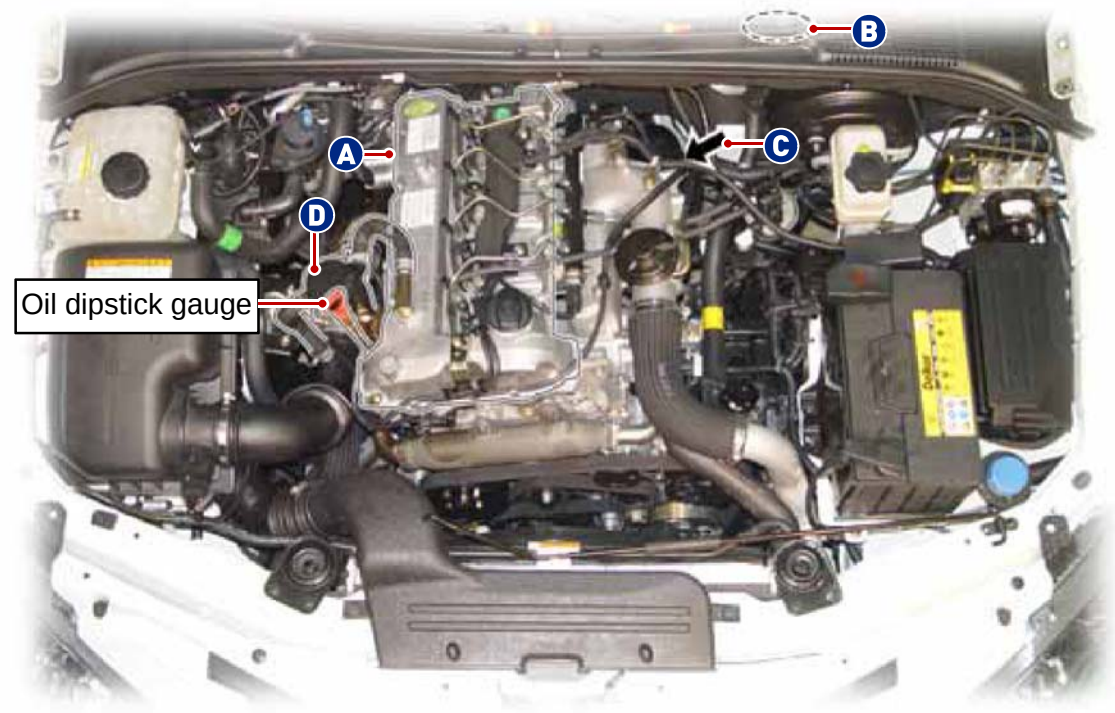
The first separation will happen when blow-by gas passes through baffle plates in cylinder head cover. Then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port.
Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering 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





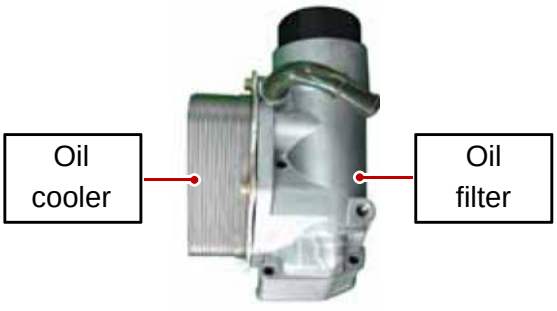
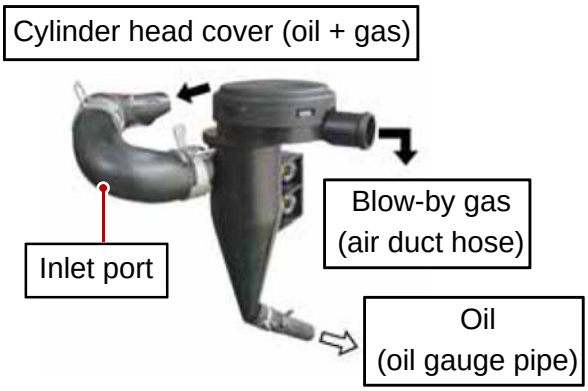
6. LUBRICATION SYSTEM LAYOUT



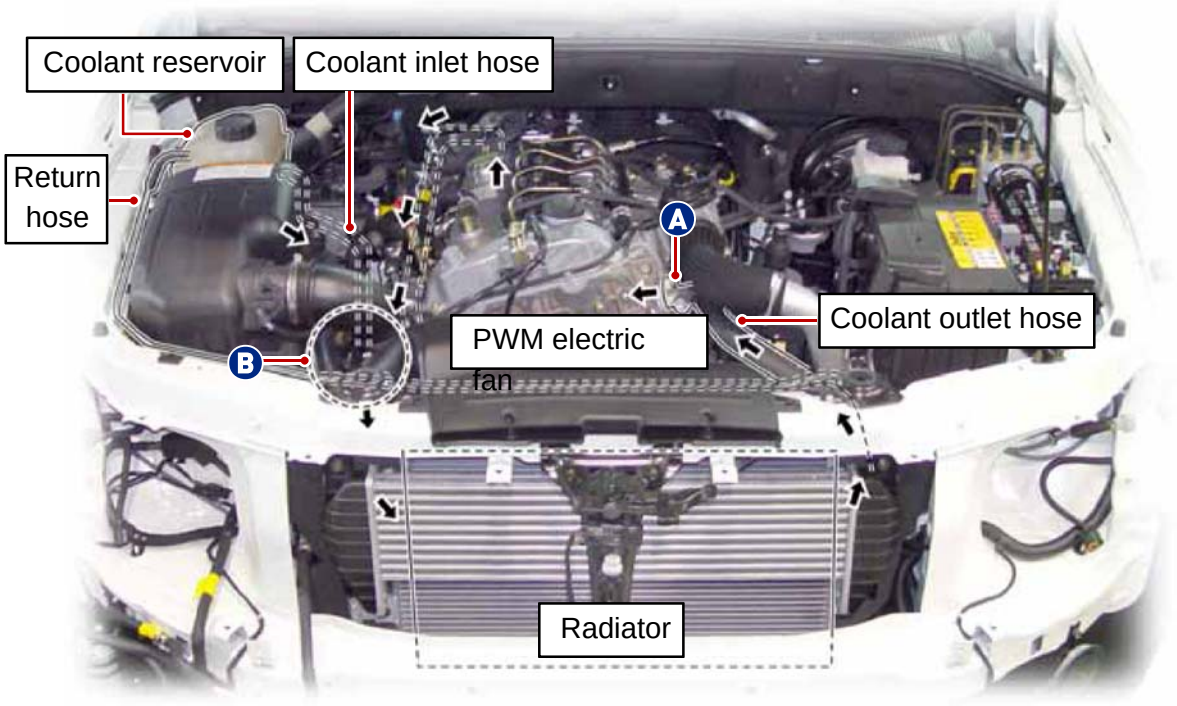
Cylinder Head Cover A	Oil Pressure Warning Lamp (Cluster) B
	

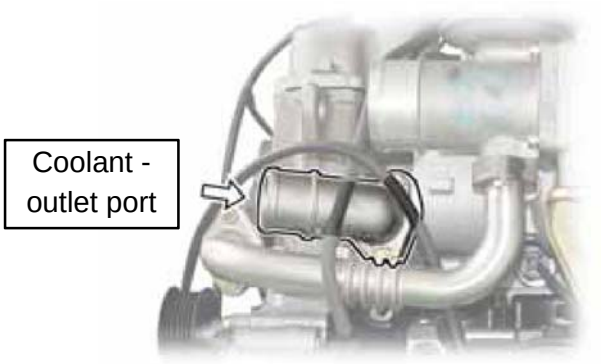
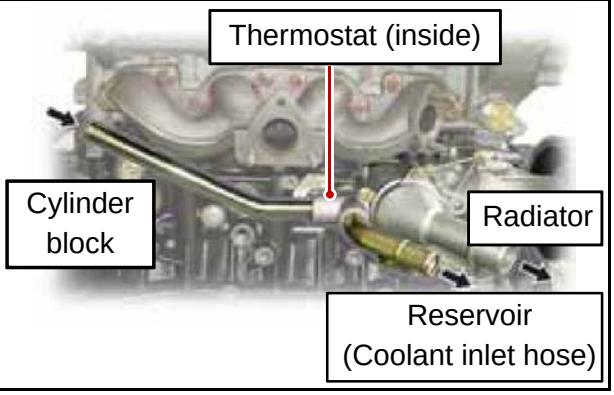
Oil Pan and Baffle Plate (Integrated Type)	Oil Strainer
	

Modification basis	
Application basis	
Affected VIN	

Ⓒ Oil Filter & Oil Cooler	Ⓓ 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

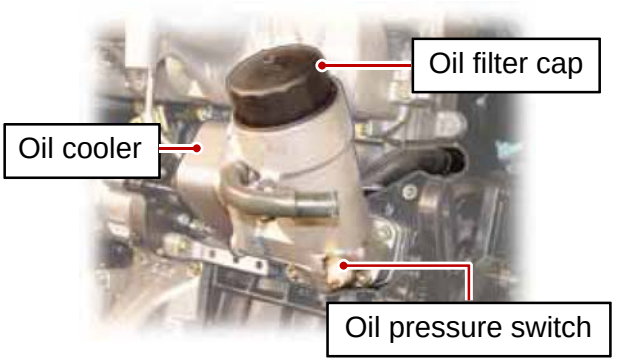


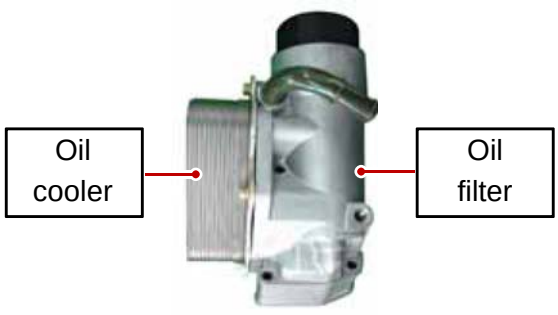
A Coolant Port	B Water Pump & Pipe
	

Radiator Assembly	Cooling Fan and Fan Clutch
	

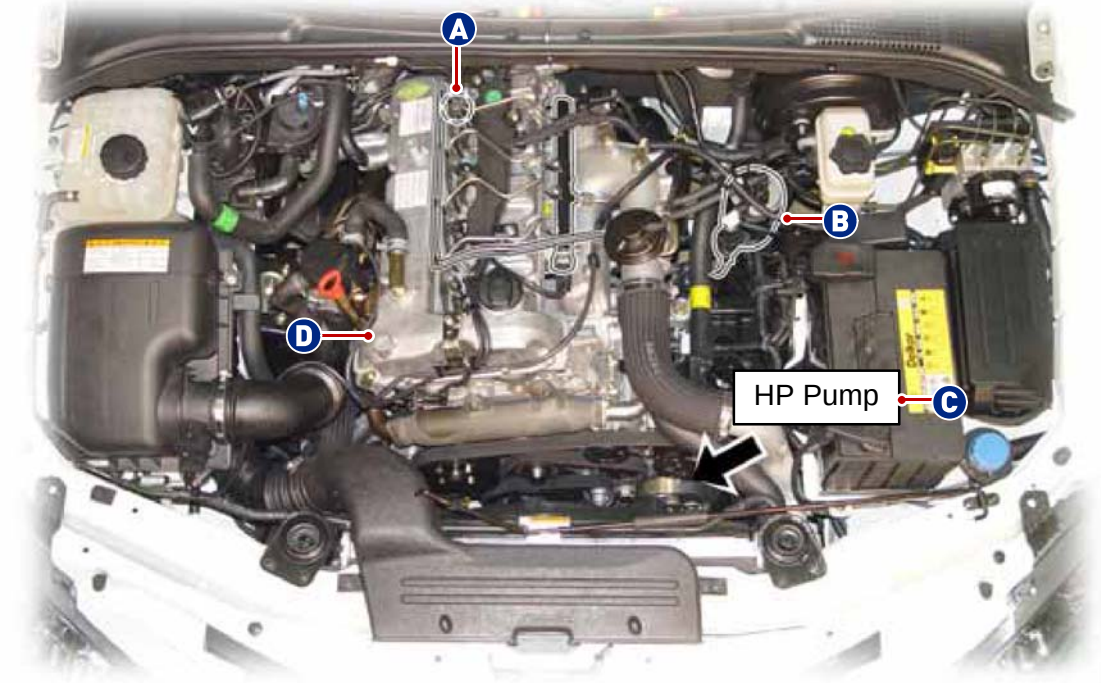
Modification basis	
Application basis	
Affected VIN	

Engine Oil Filter & Cooler





8. FUEL SYSTEM LAYOUT

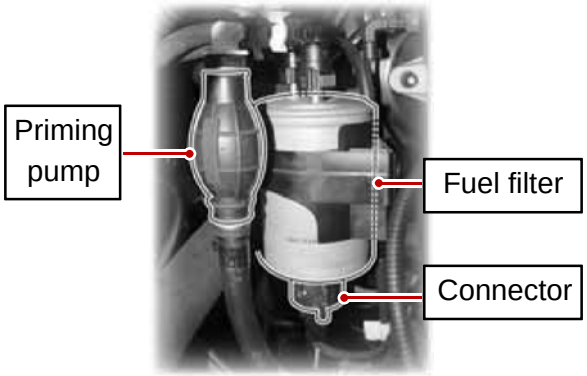


A Injector

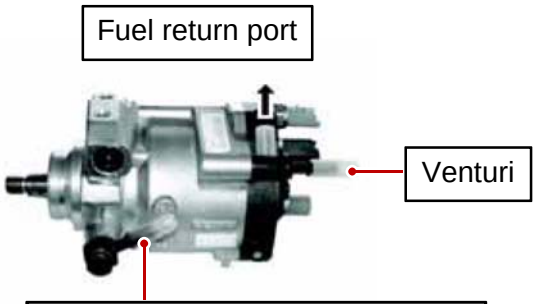


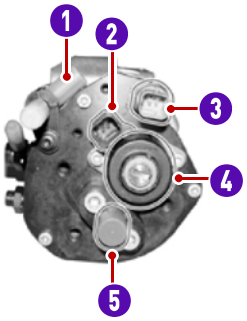


B Fuel Filter & Priming Pump



C HP Pump

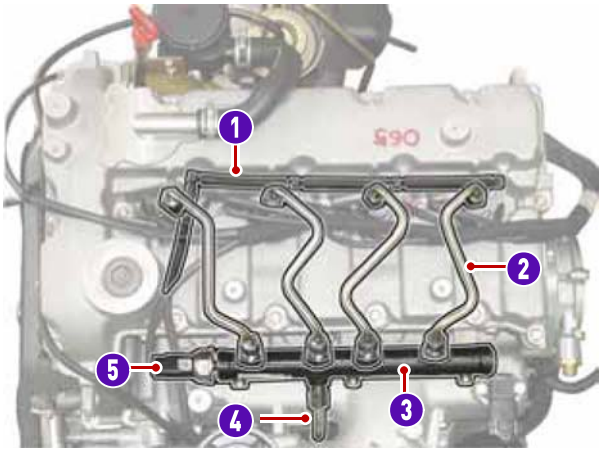




1. Fuel return port
2. Fuel tempera - ture sensor
3. IMV connector
4. IMV valve
5. High pres - sure fuel supply port

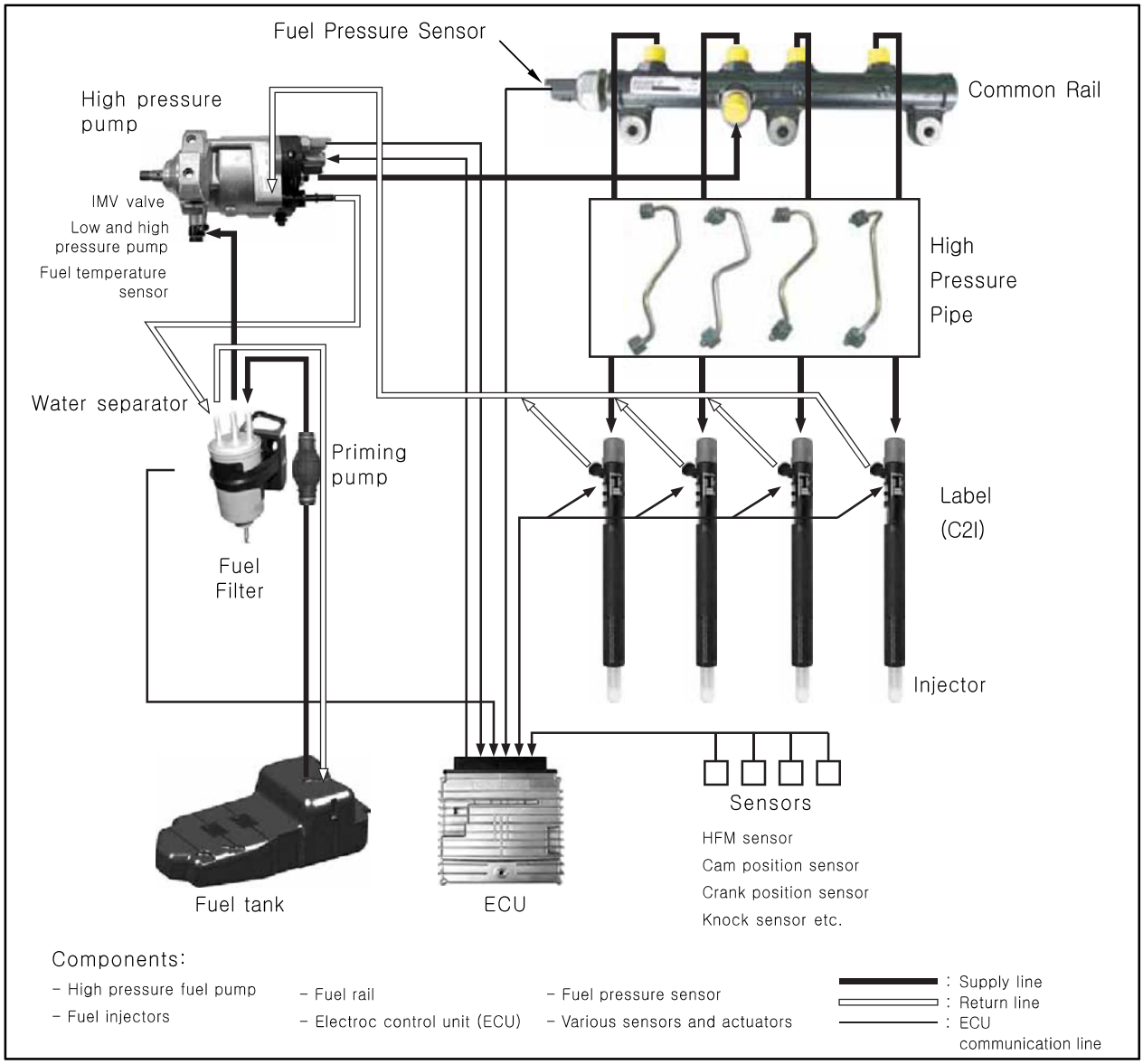
Modification basis	
Application basis	
Affected VIN	

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.

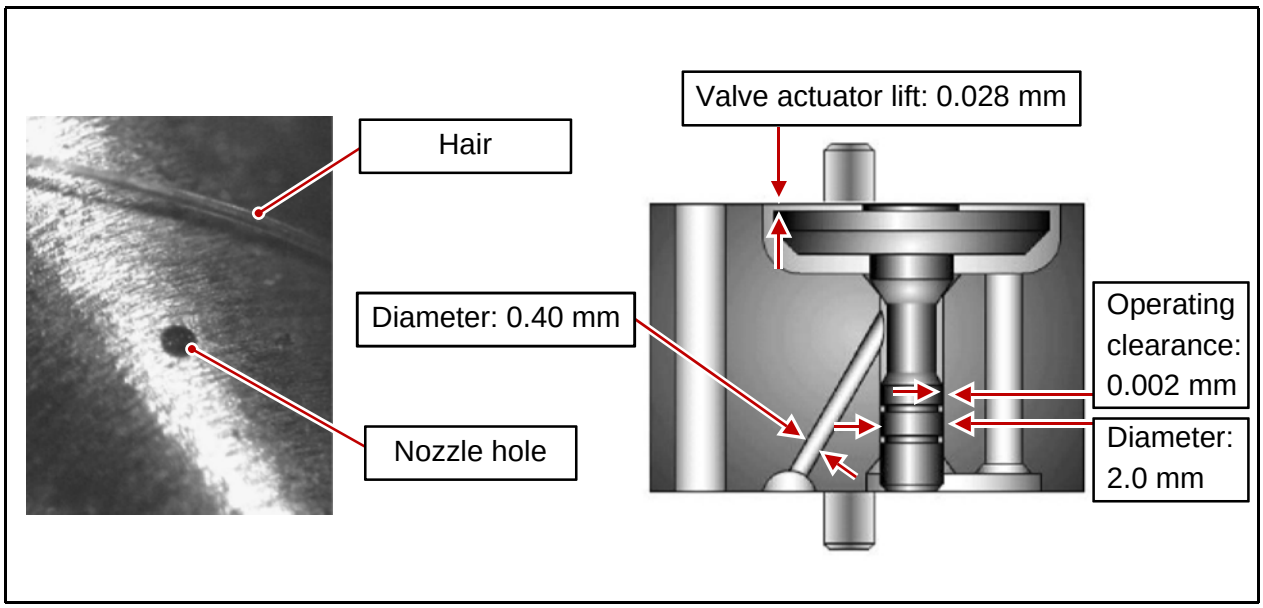
Modification basis	
Application basis	
Affected VIN	

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.

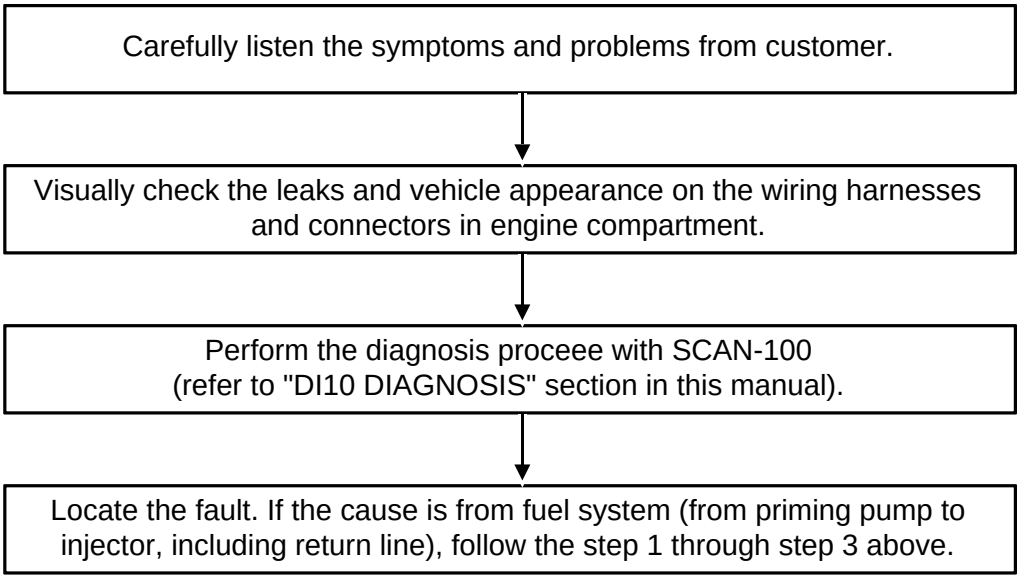
You can compare the thickness of injector nozzle hole and hair as shown in below figure (left side). The right side figure shows the clearance between internal operating elements.



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

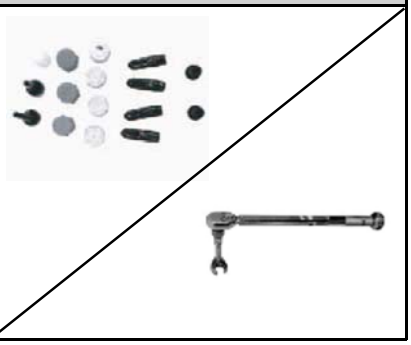
1. Always keep the workshop and lift clean (especially, from dust).
2. Always keep the tools clean (from oil or foreign materials).
3. Wear a clean vinyl apron to prevent the fuzz, dust and foreign materials from getting into fuel system.
   Wash your hands and do not wear working gloves.
4. Follow the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

↓

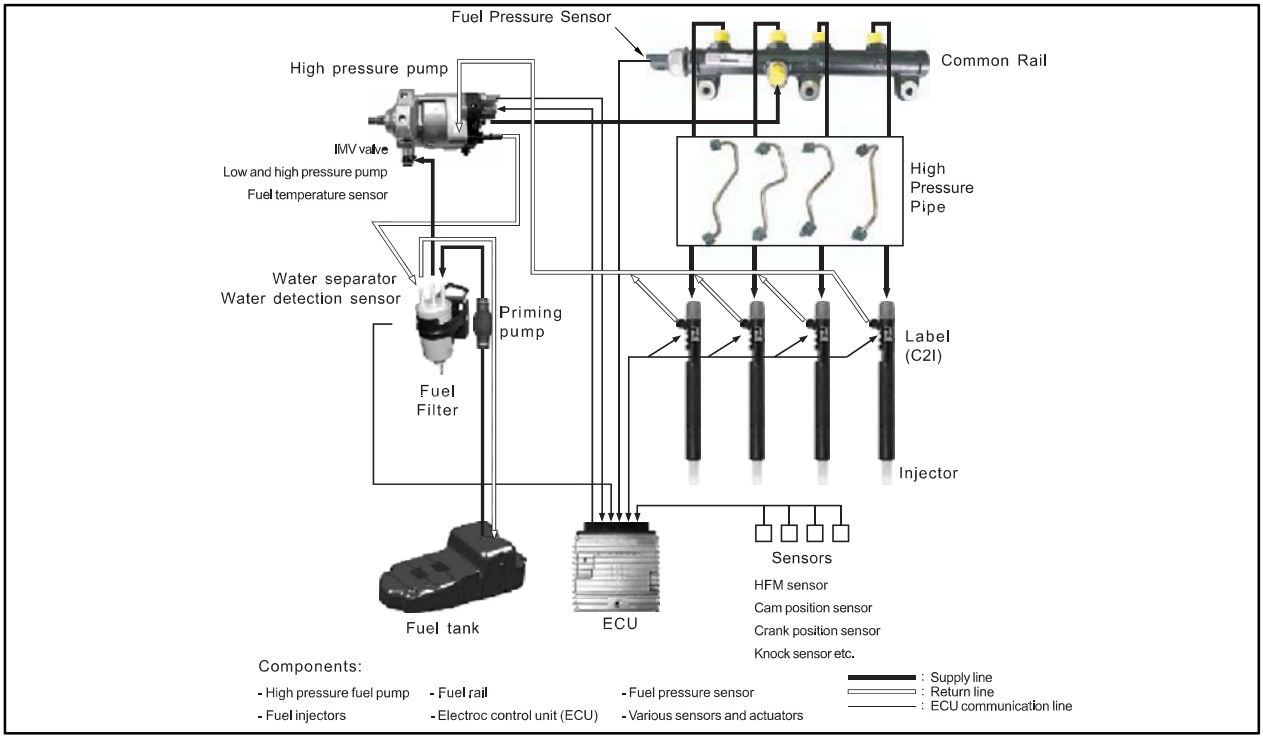
Use special tools and torque wrench to perform the correct works.

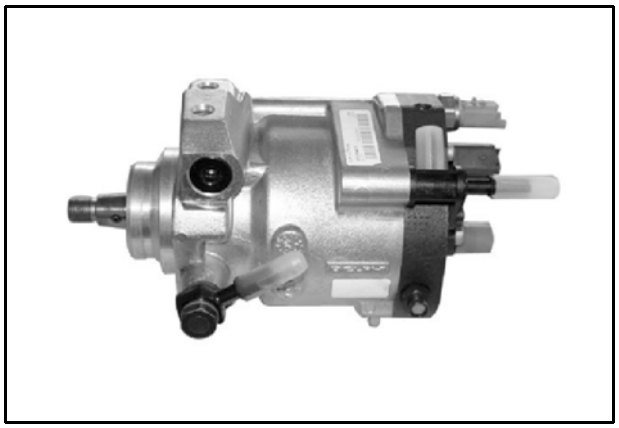
Once disconnected, the fuel pipes between HP pump and fuel rail and between fuel rail and each injector should be replaced with new ones. The pipes should be tightened tospecified tightening torques during installation. Over or under torques out of specified range may cause damages and leaks at connections. 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.

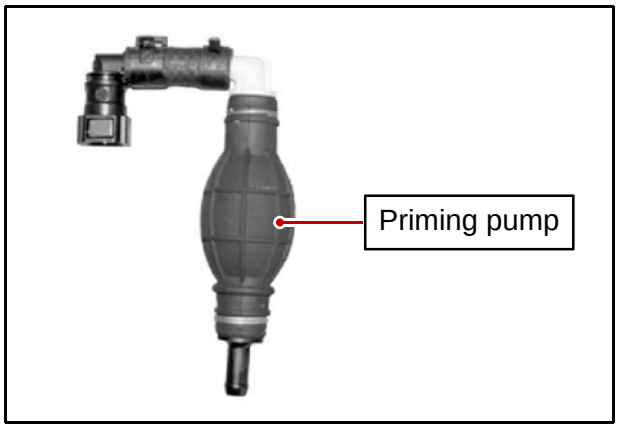
↓

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



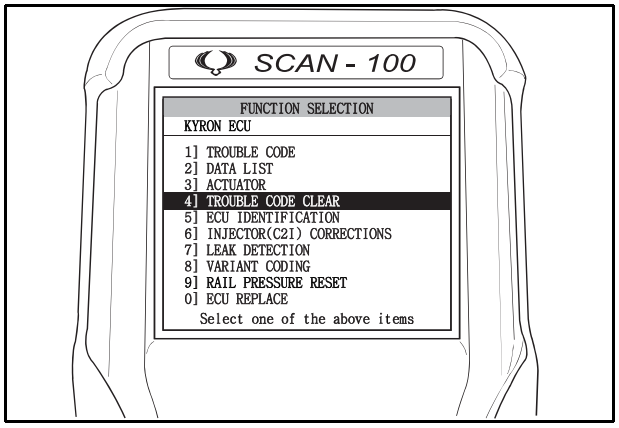


7. Plug the removed components with clean and undamaged sealing caps and store it into the box to keep the conditions when it was installed.
8. Clear the high pressure offset value by SCAN-100 after replacing the high pressure pump.



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

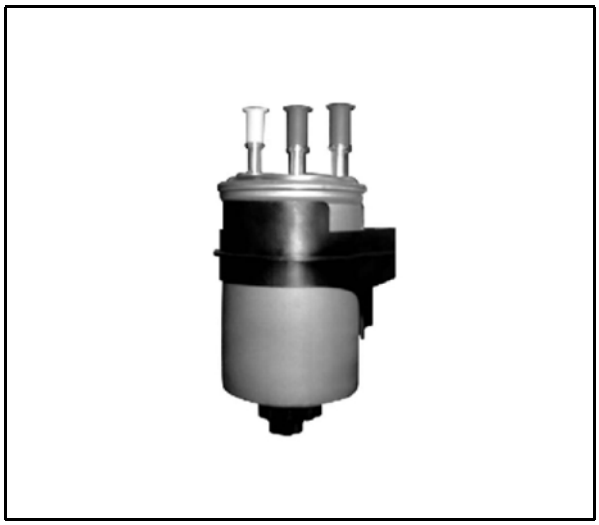
▶ System Supplement Against Paraffin Separation.

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.

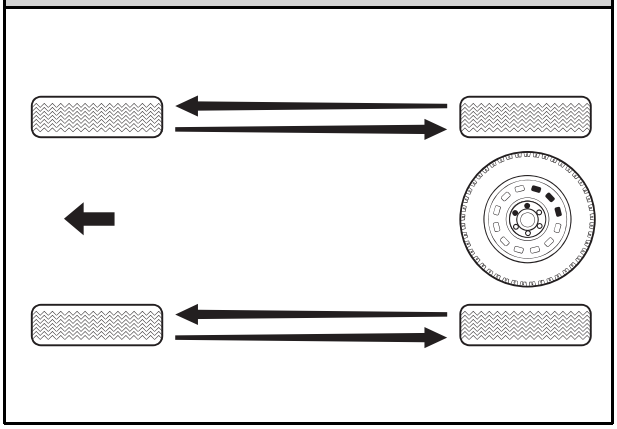
▷ **Brake System Service**

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

▷ **Tire and Wheel Inspection and Rotation**

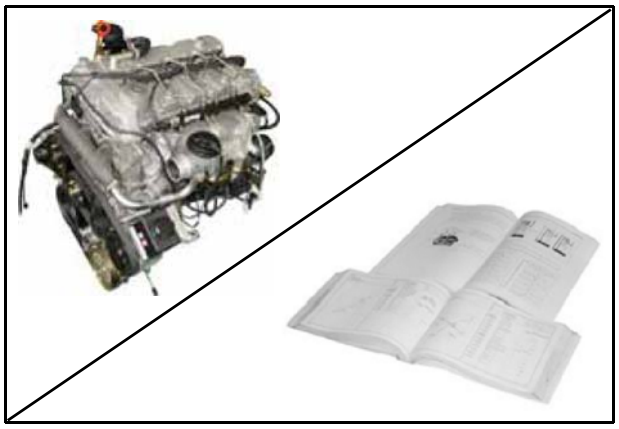
Check the tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate the tires. If irregular or premature wear exists, check the wheel alignment and check for damaged wheels. While the tires and wheels are removed, inspect the brakes.

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 engine.
5. 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.

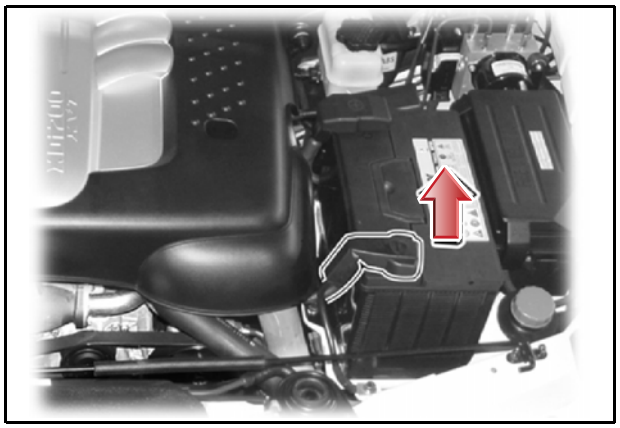
If fine dust or foreign material enters into DI engine's fuel system, there can be serious damages between HP pump and injectors. So, be sure to cover removed fuel system components with cap and protect removed parts not to be contaminated with dirt. (Refer to cleanness in this manual while working on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

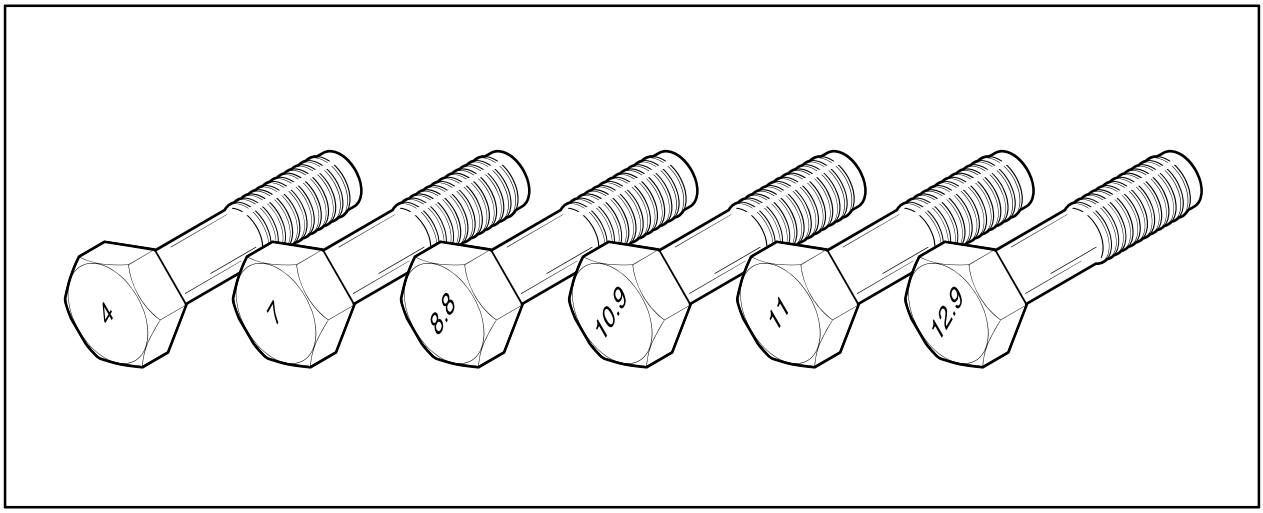
Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. 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.

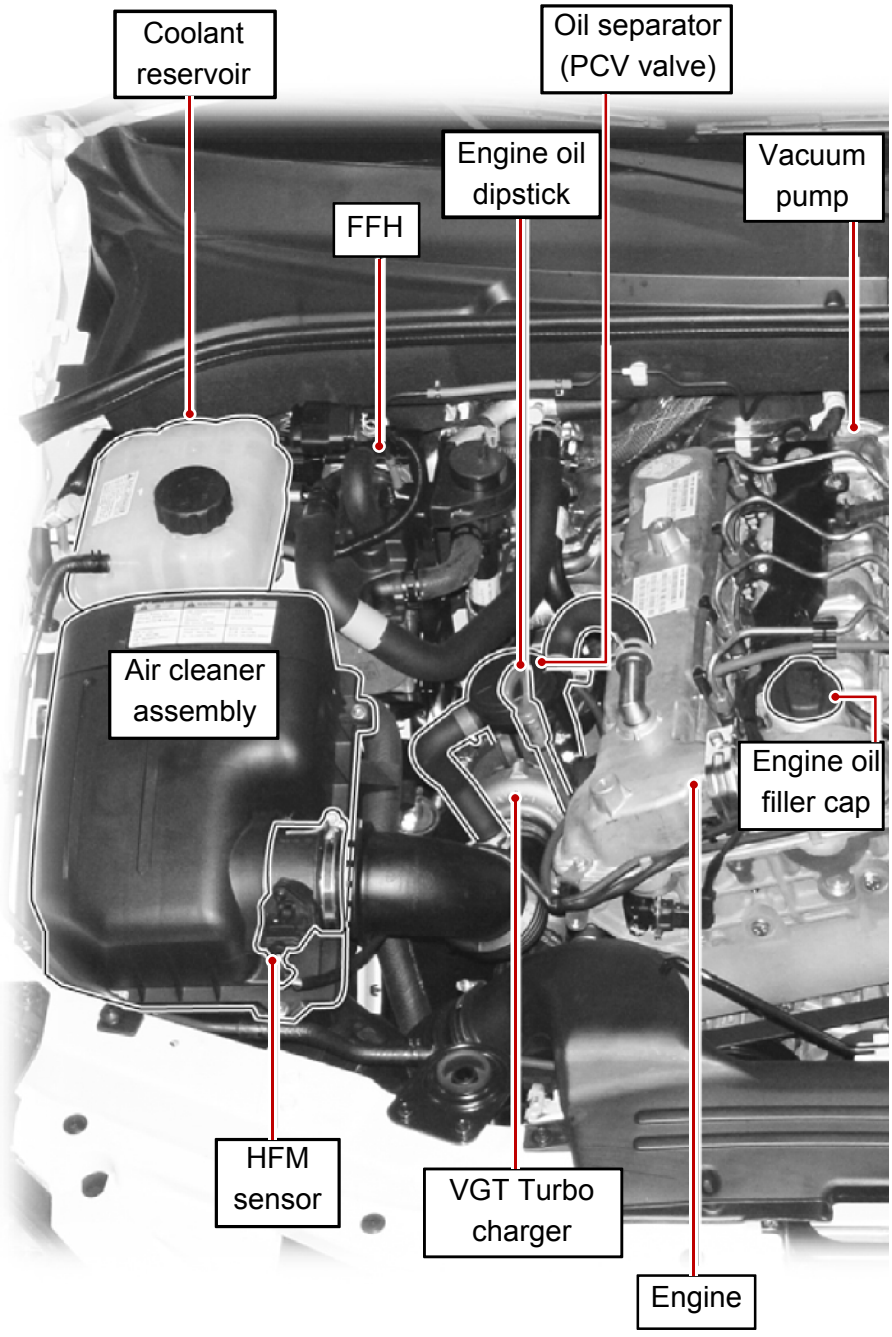
Modification basis	
Application basis	
Affected VIN	

ENGINE ASSEMBLY 1212-01

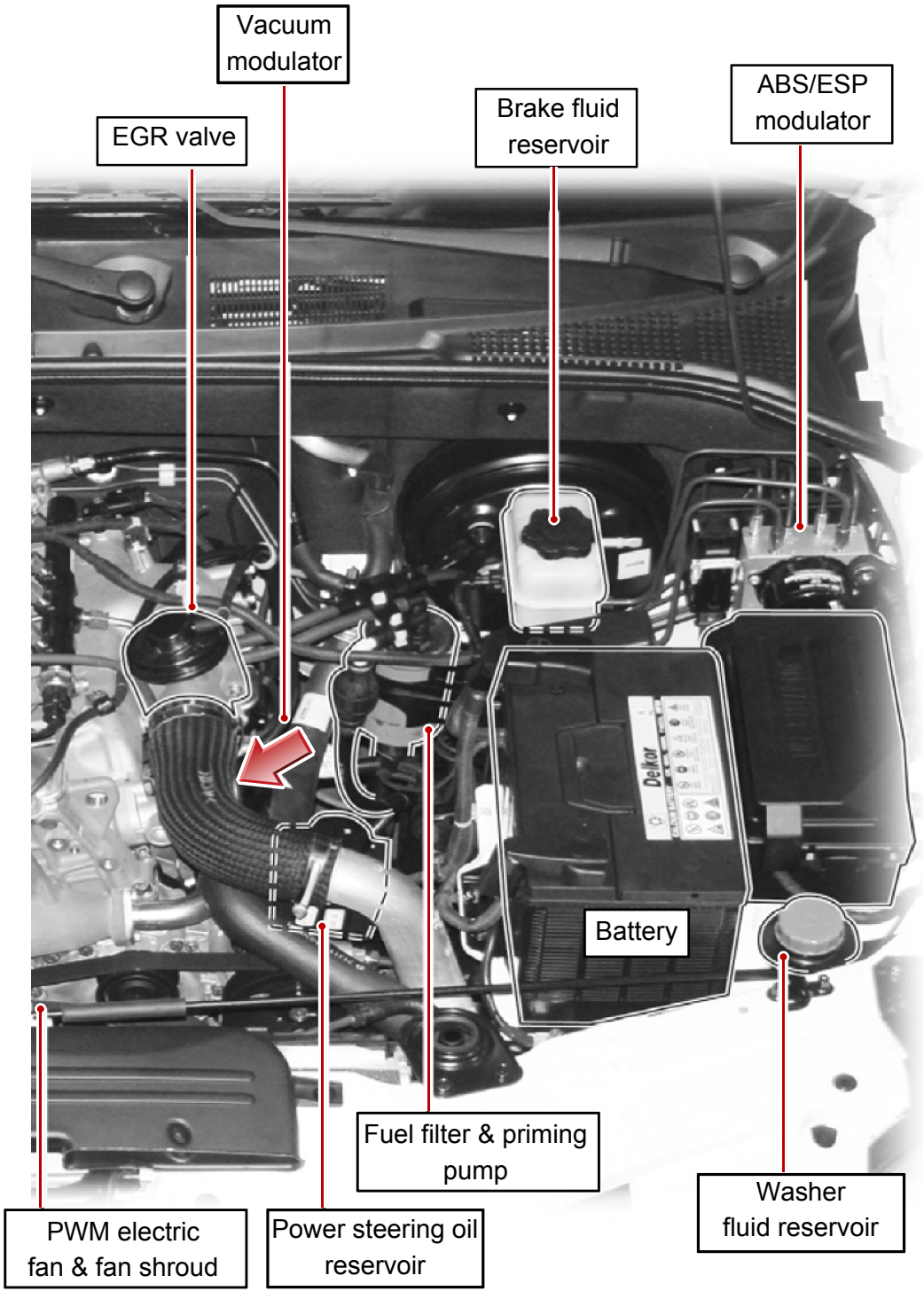
GENERAL

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.



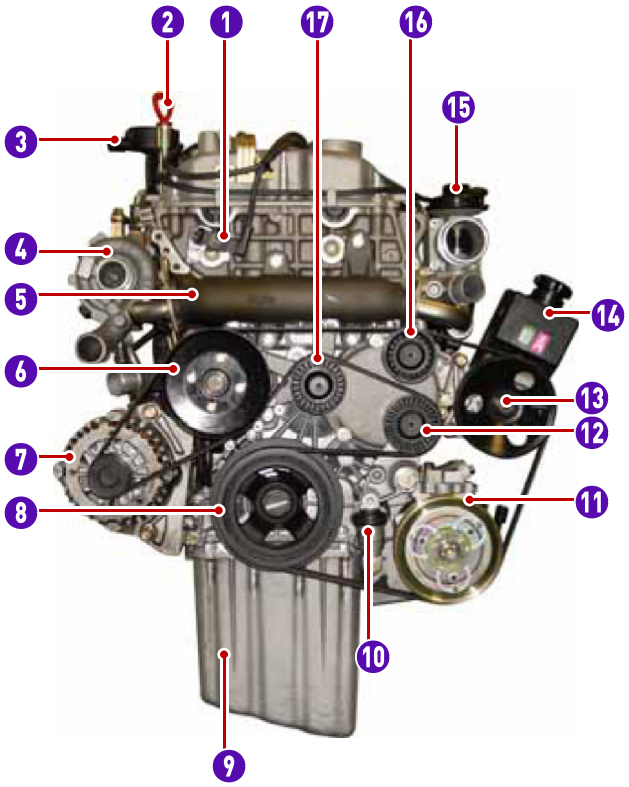
Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

1) Engine Structure

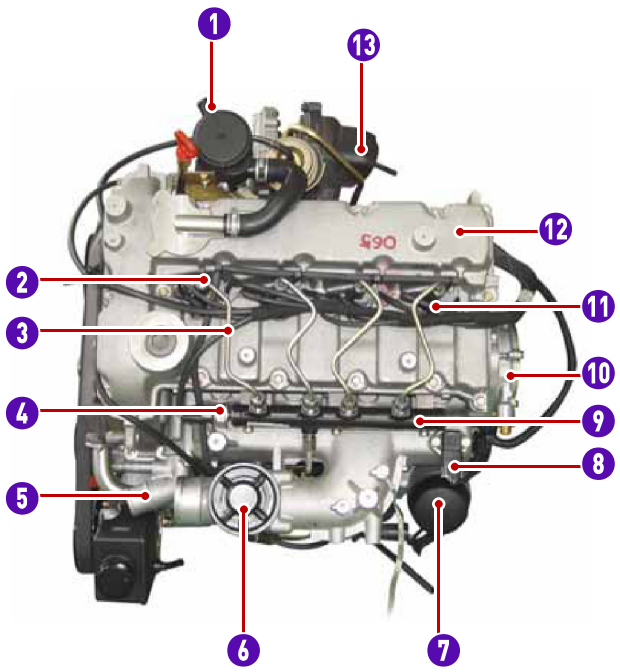
Front View



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

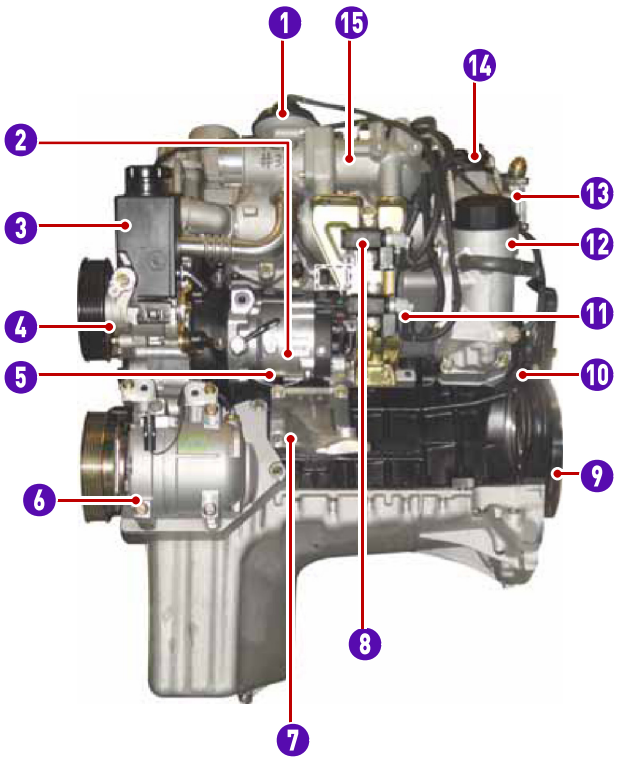
Modification basis	
Application basis	
Affected VIN	

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

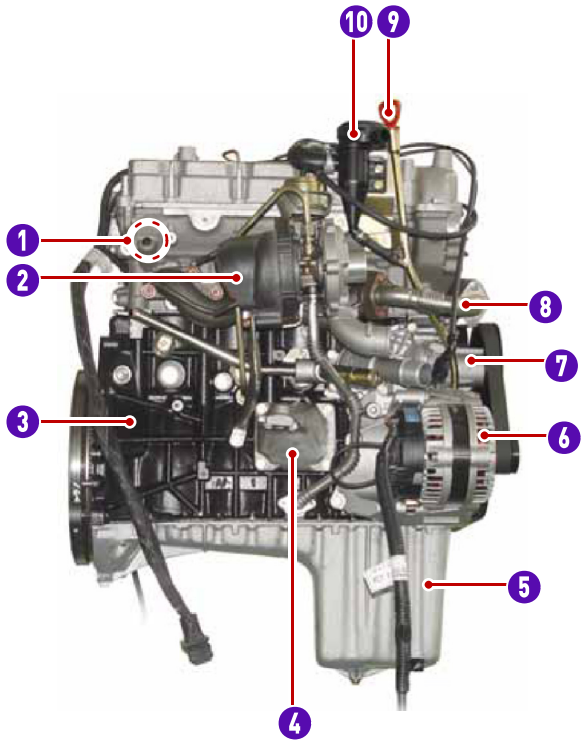
Right Side View



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

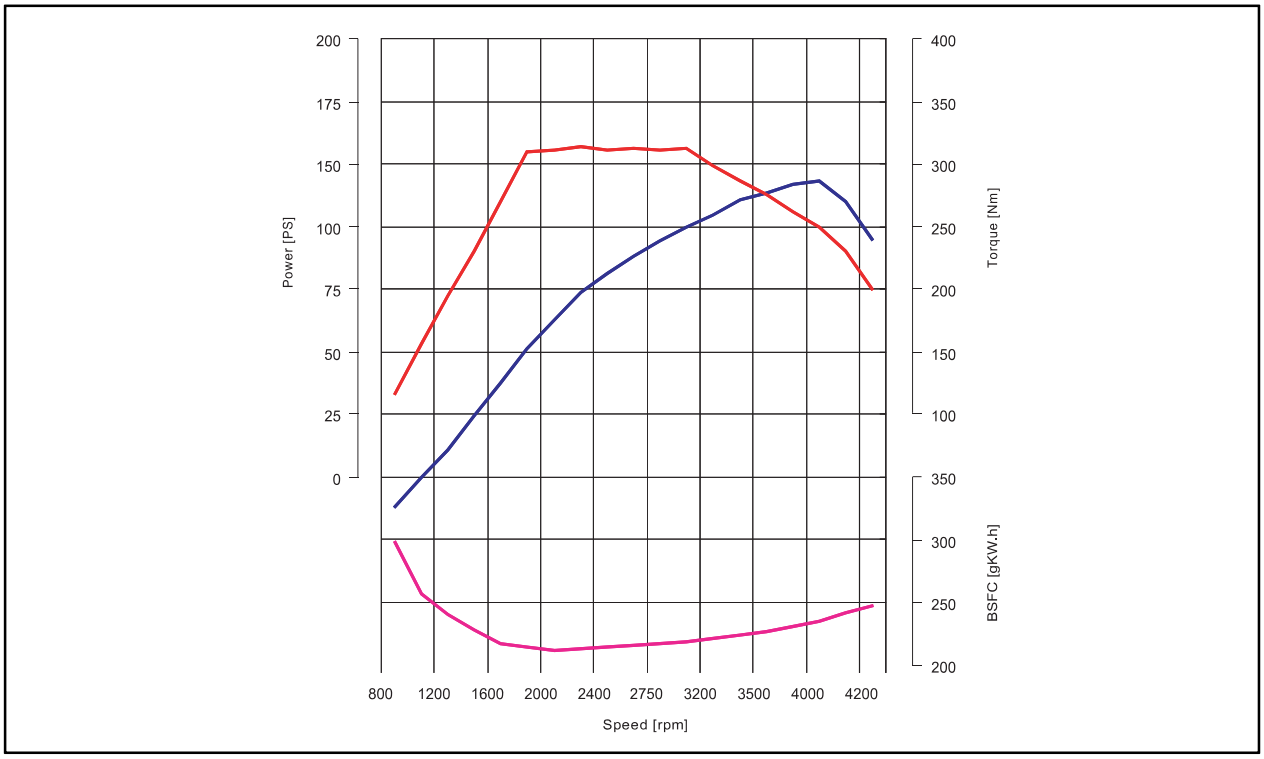
1) Specifications

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

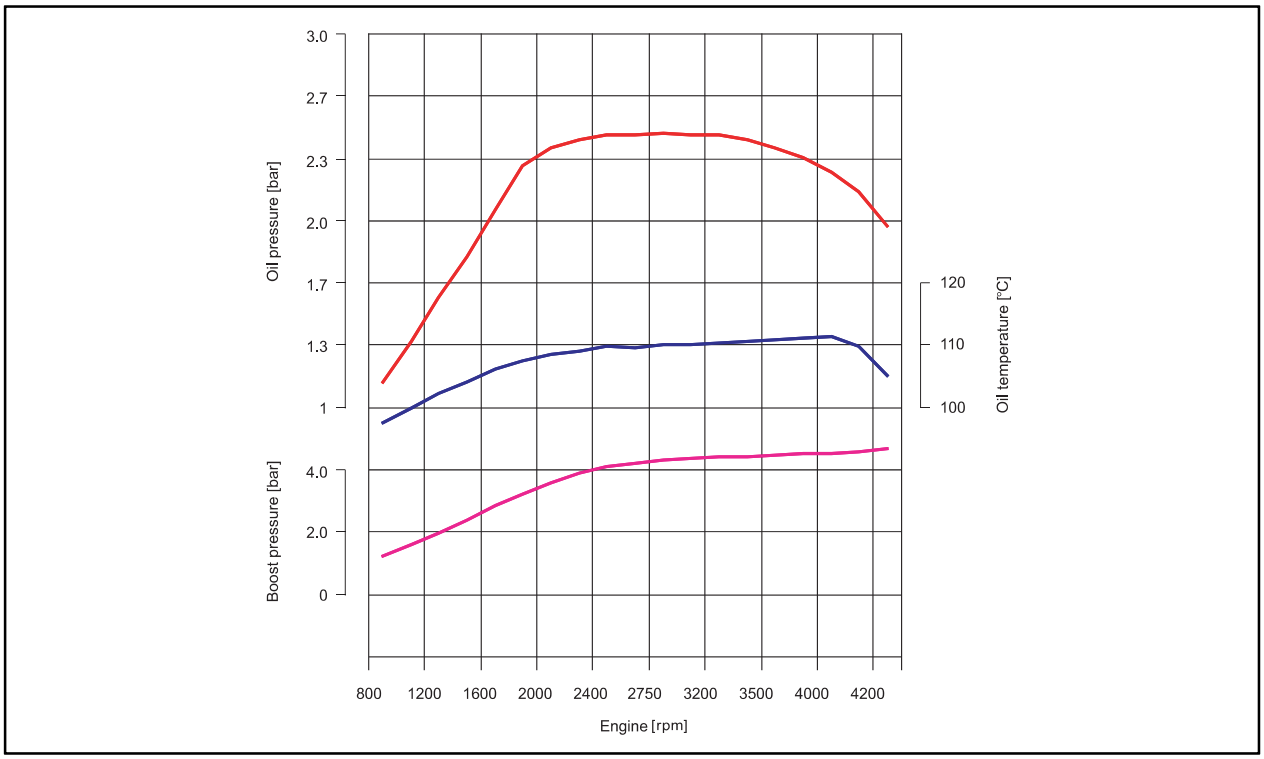
Modification basis	
Application basis	
Affected VIN	

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

Modification basis	
Application basis	
Affected VIN	

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

Modification basis	
Application basis	
Affected VIN	

NO.	Name	Size	Quantity	Tightening Torque (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
		GAP	-	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.

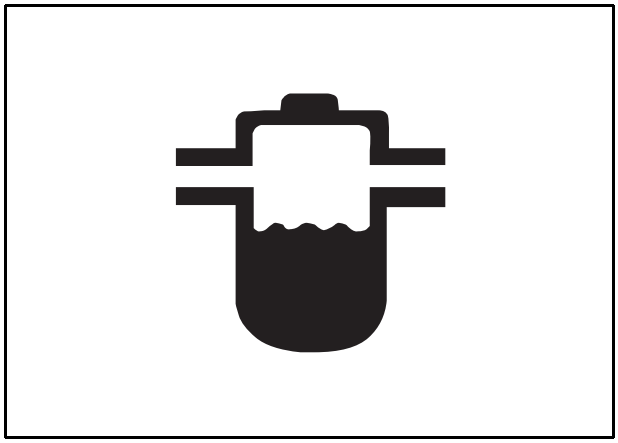
1) DI Engine

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.

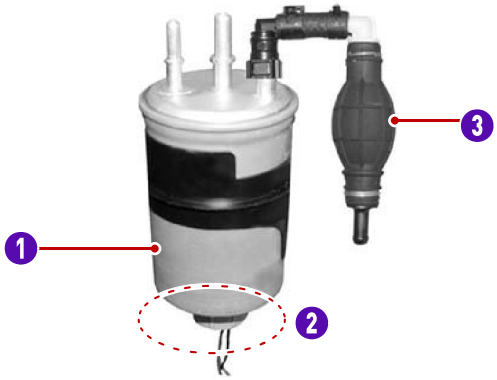
4) Priming Pump

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

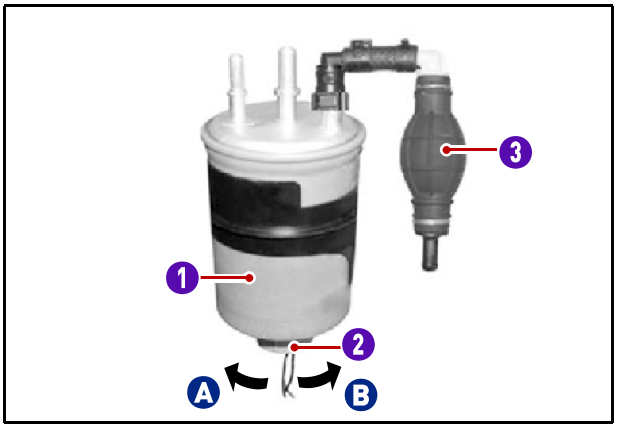
- When replaced the fuel filter or drained the water from fuel filter, press the priming pump until it becomes rigid before starting the engine.
- The water drain from fuel filter should be performed whenever changing the engine oil.

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.

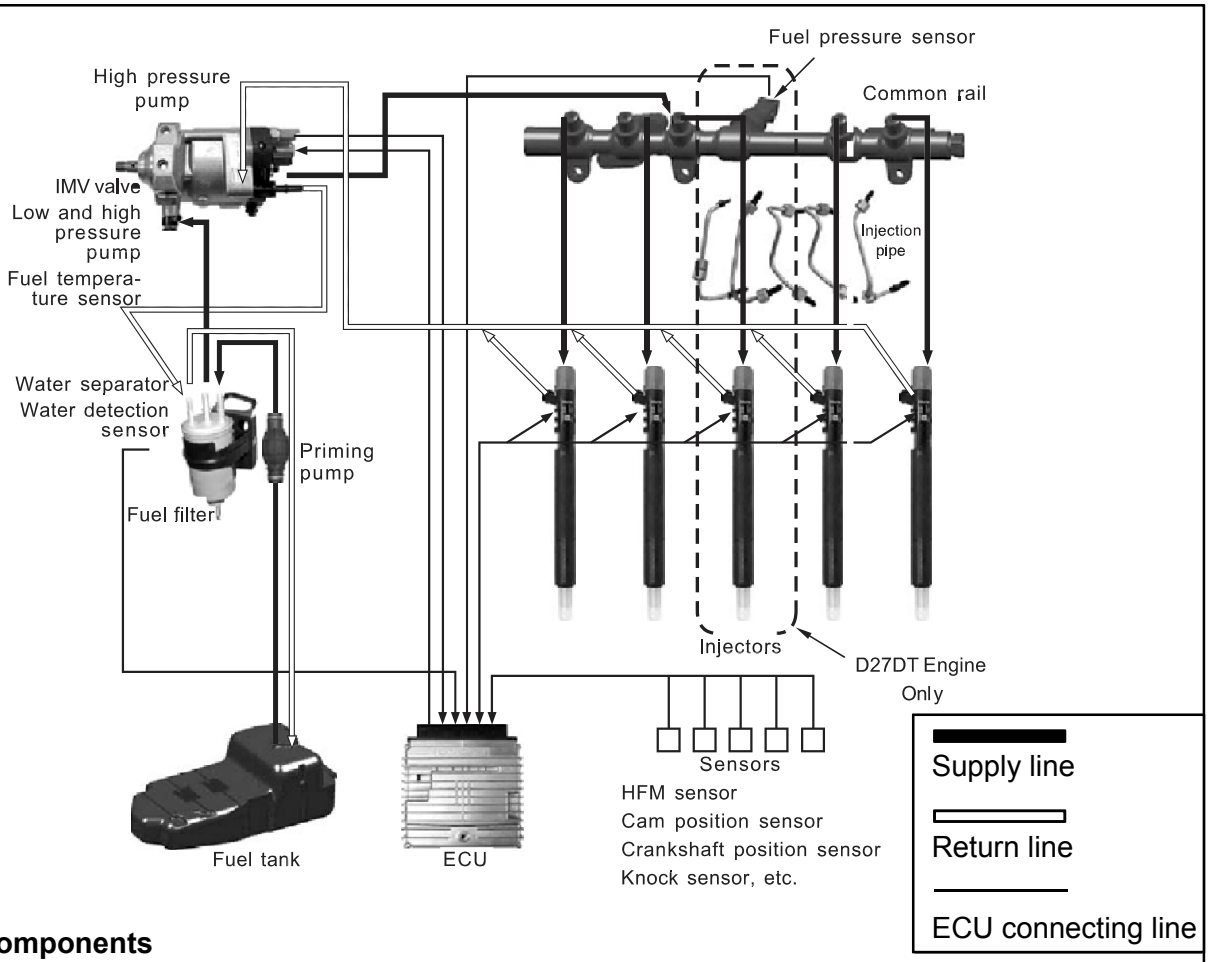


4. Press the priming pump until it becomes rigid.
5. Start the engine and check the conditions.

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.

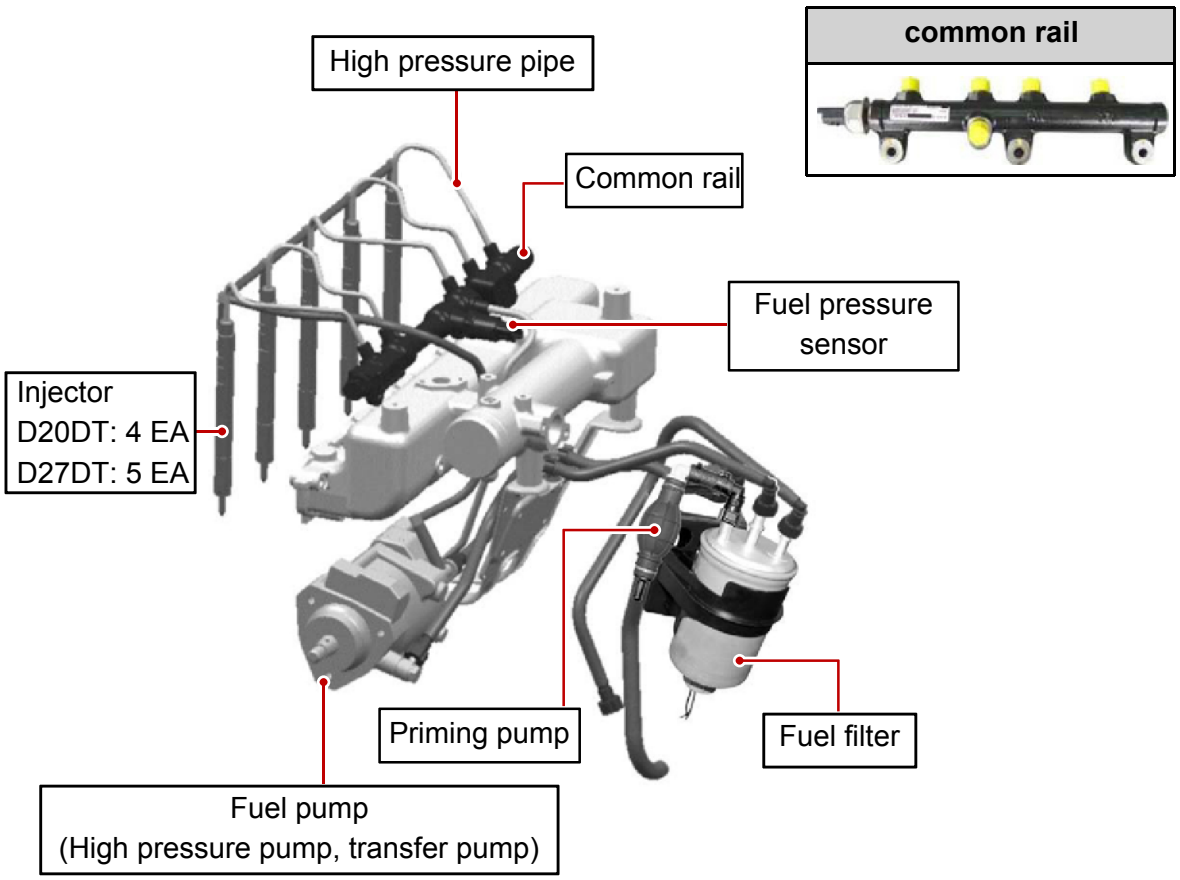
ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's 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	

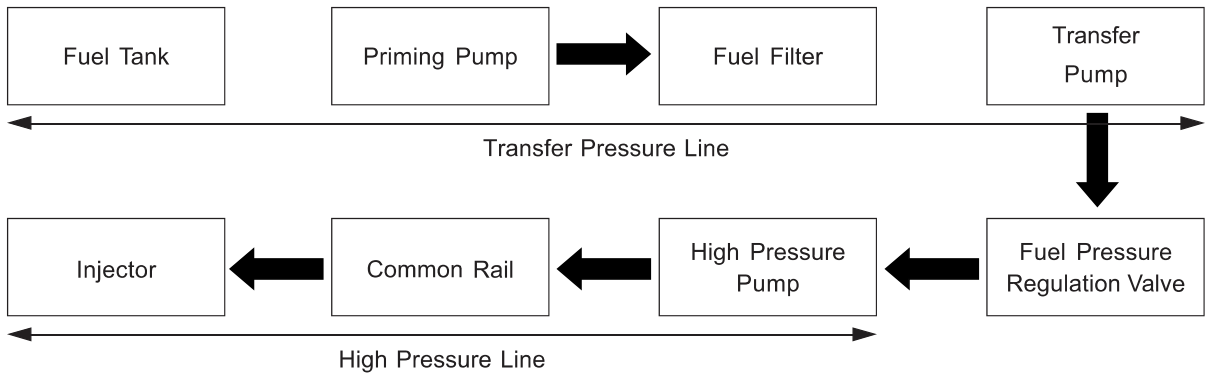
2. COMPOSITION OF FUEL SYSTEM

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.

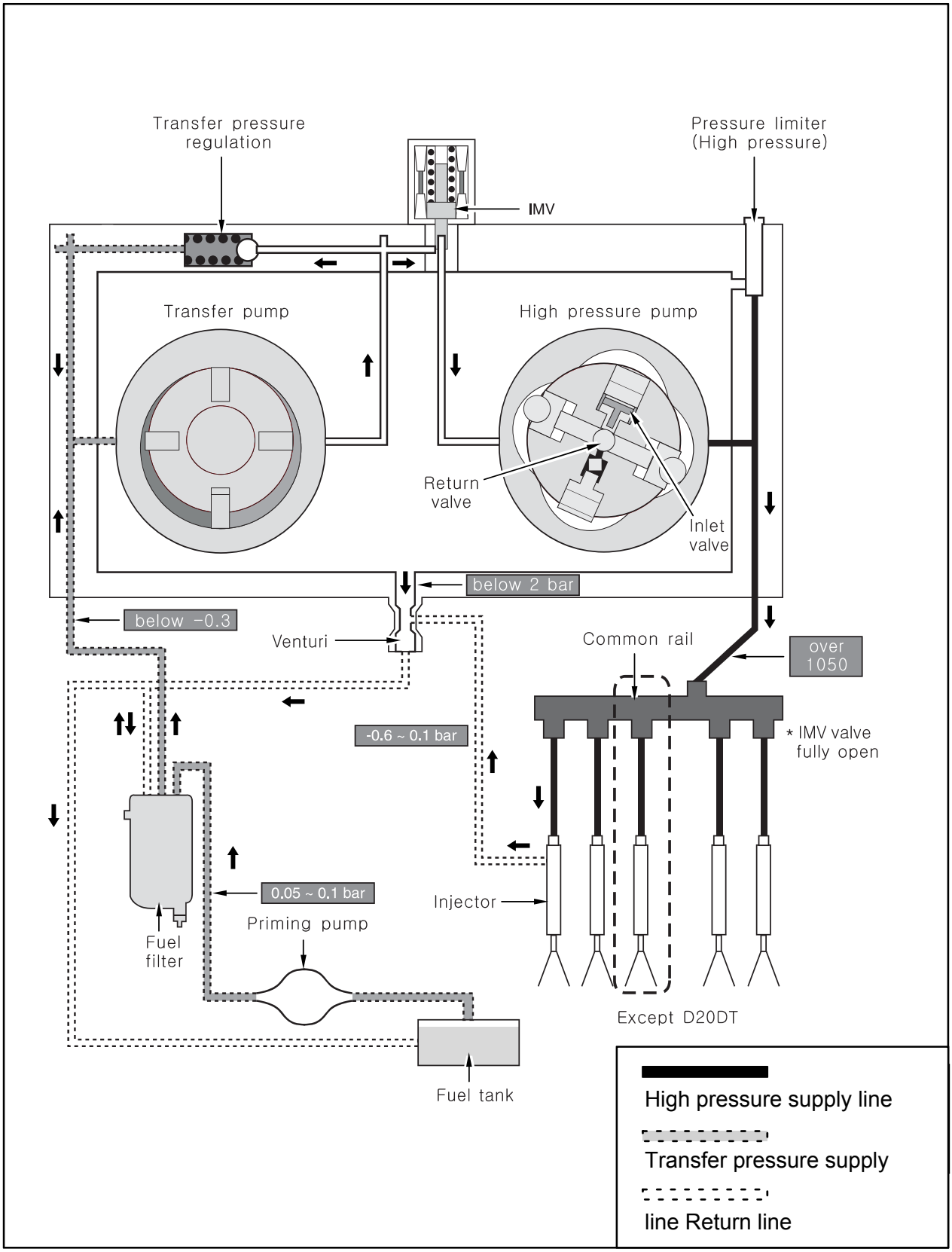
Fuel Line System



Fuel route



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



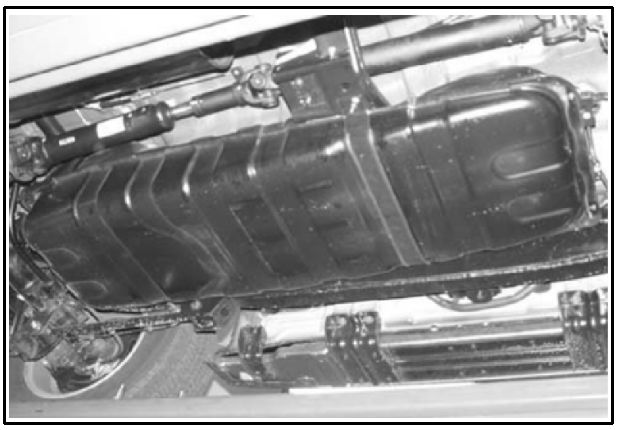
Modification basis	
Application basis	
Affected VIN	

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).

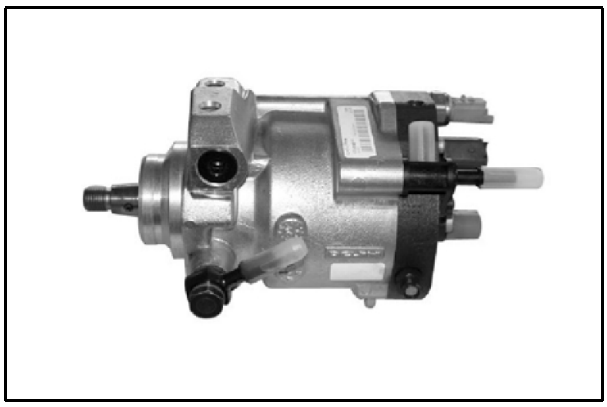
Modification basis	
Application basis	
Affected VIN	

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)



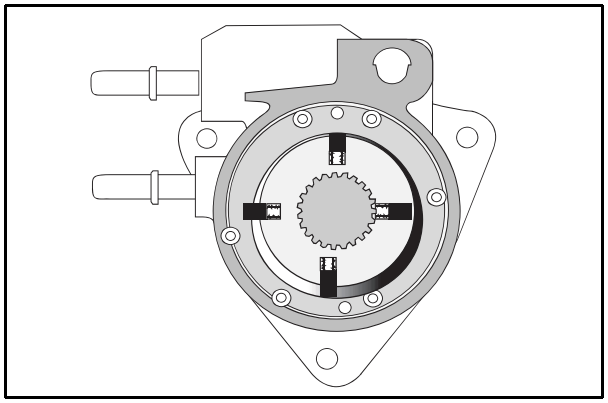
Fuel line transfers high pressure fuel. Accordingly, it is made of steel to endure intermittent high frequency pressure changes that occur under maximum system pressure and injection stops. Injection lines between rail and injectors are all in the same length; it means the lengths between the rail and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



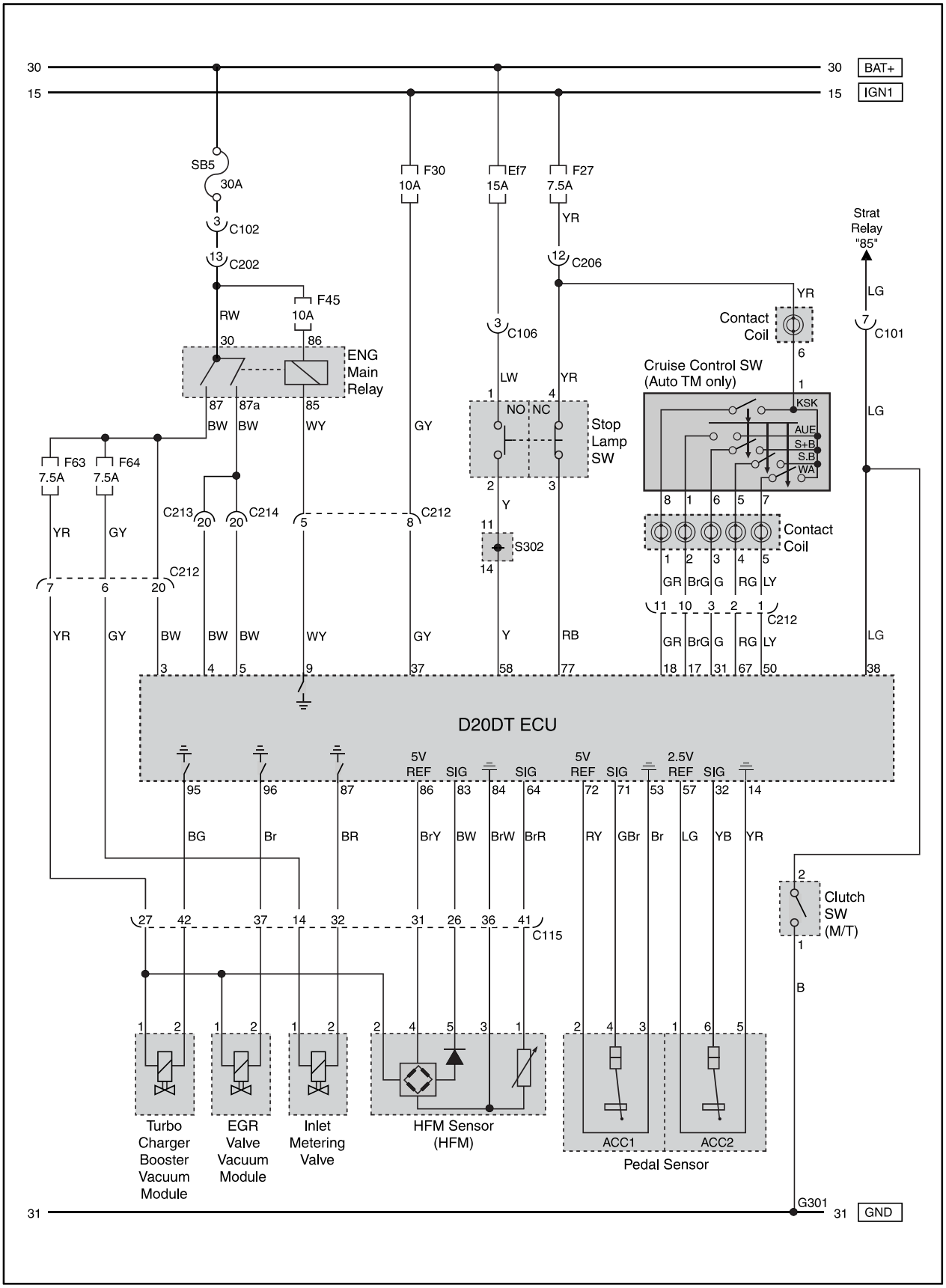
The transfer pump is included in the housing of the high pressure pump. The transfer pump is the volumetric blade type pump. To deliver the continuously required fuel volume, the pump transfers fuel from the fuel tank to high pressure pump.

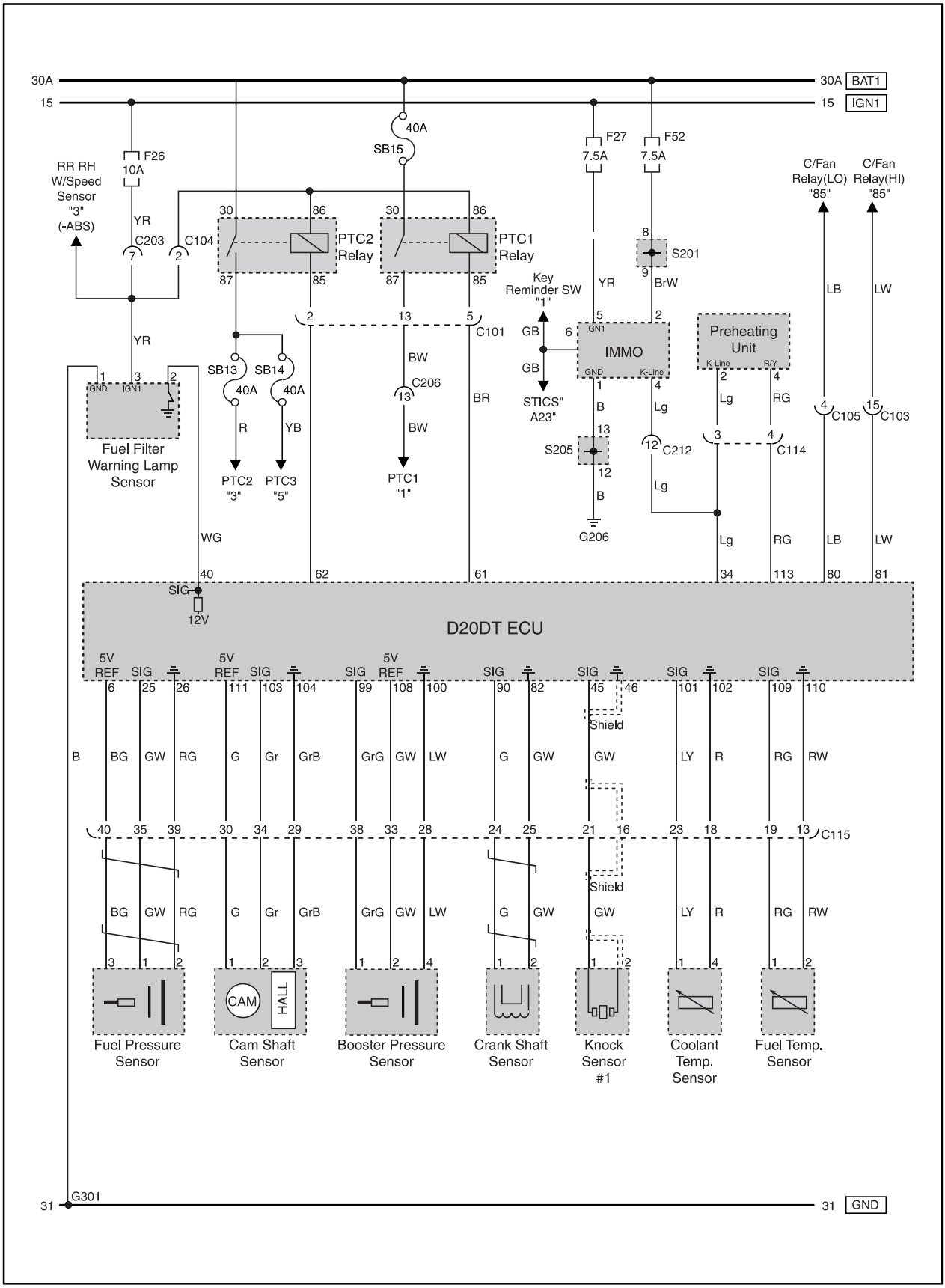
6) Fuel Filter Replacement

- 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

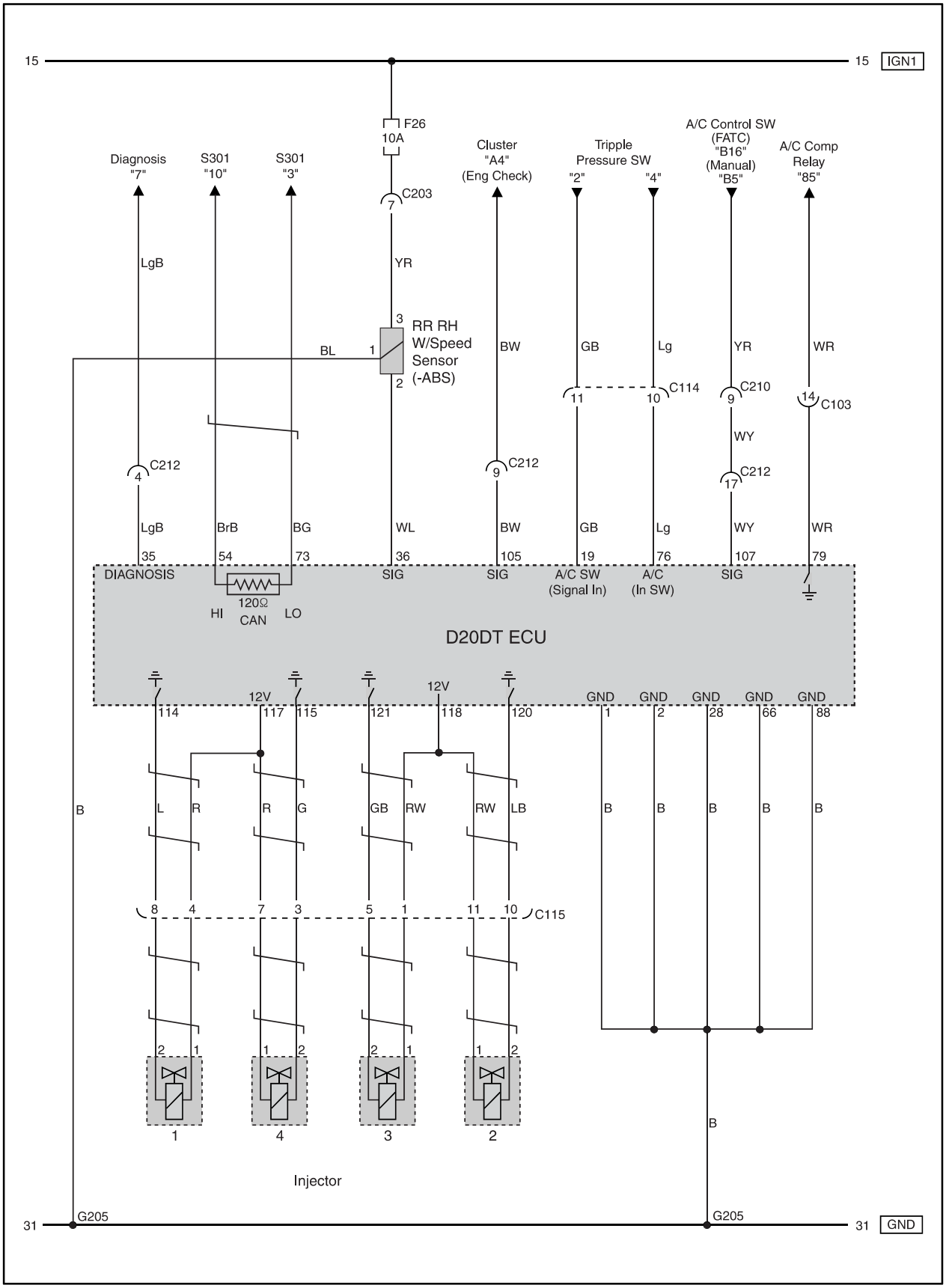
Modification basis	
Application basis	
Affected VIN	

6. CIRCUIT DIAGRAM





Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

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.

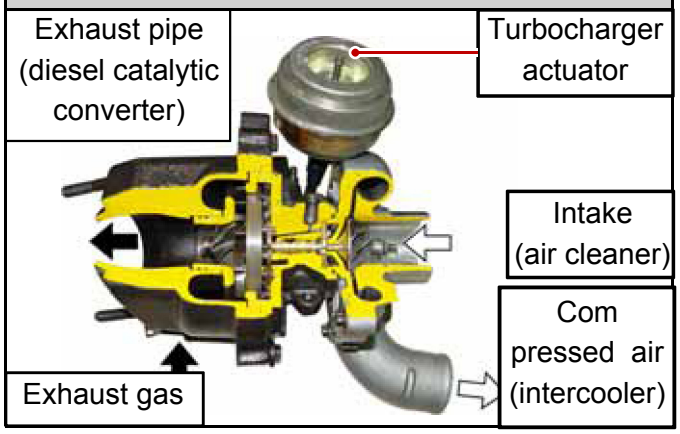
OVERVIEW AND OPERATION PROCESS

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



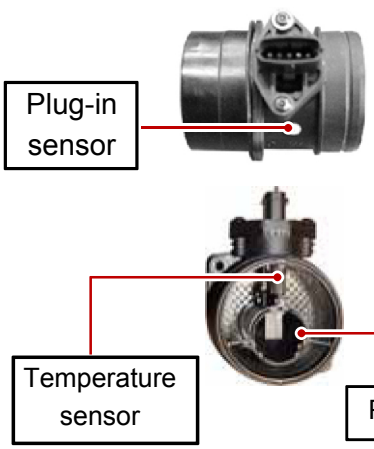
HFM Sensor

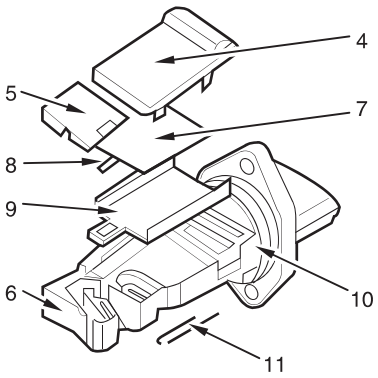
The HFM sensor is installed in the air intake passage between the air cleaner and the intake manifold. It measures the air volume supplied to the combustion chamber and the air temperature.

Major Functions

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



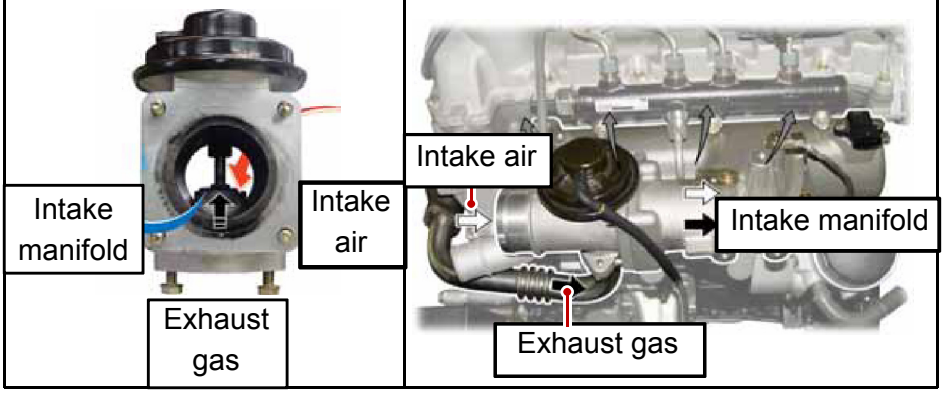


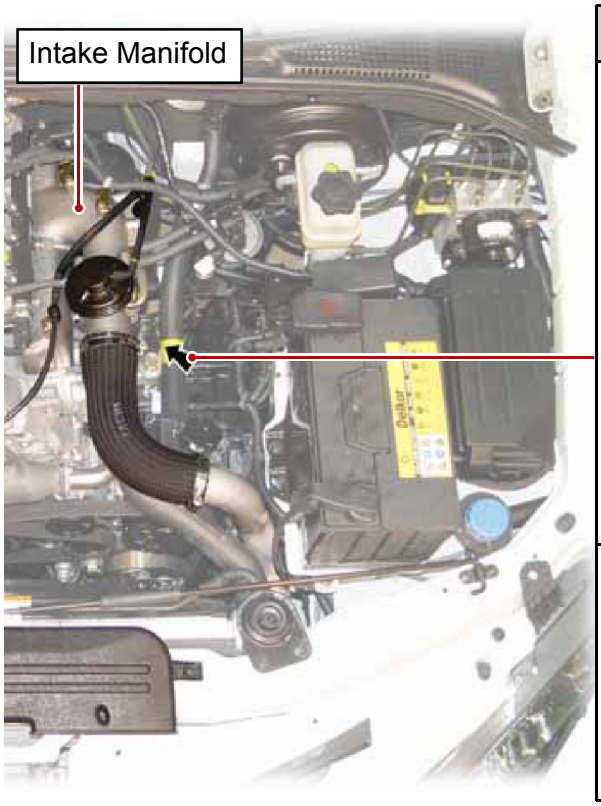


1. Plug-in sensor
2. Cylinder housing
3. Protection grid
4. Hybrid cover
5. Measuring duct cover
6. Housing
7. Hybrid
8. Sensor
9. Mounting plate
10. O-ring
11. Temperature sensor

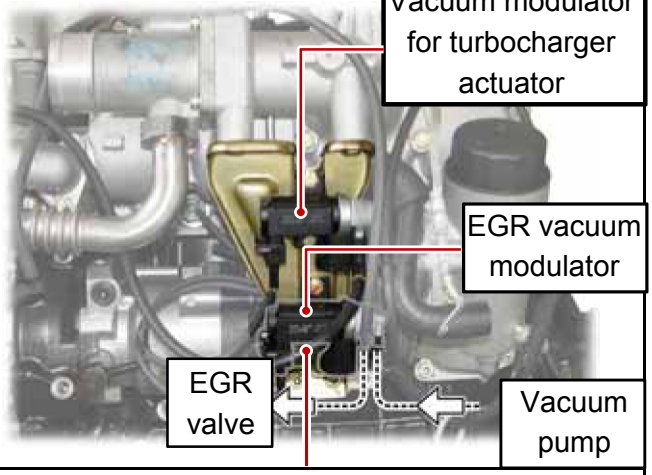
Modification basis	
Application basis	
Affected VIN	

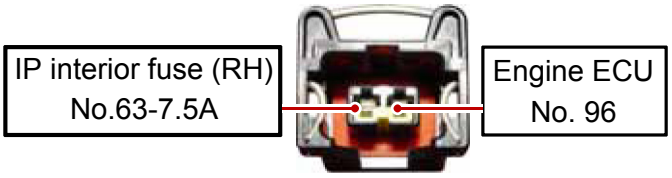
EGR Valve and Its Location
(* For details, refer to "EGR" section.)





Vacuum Modulator



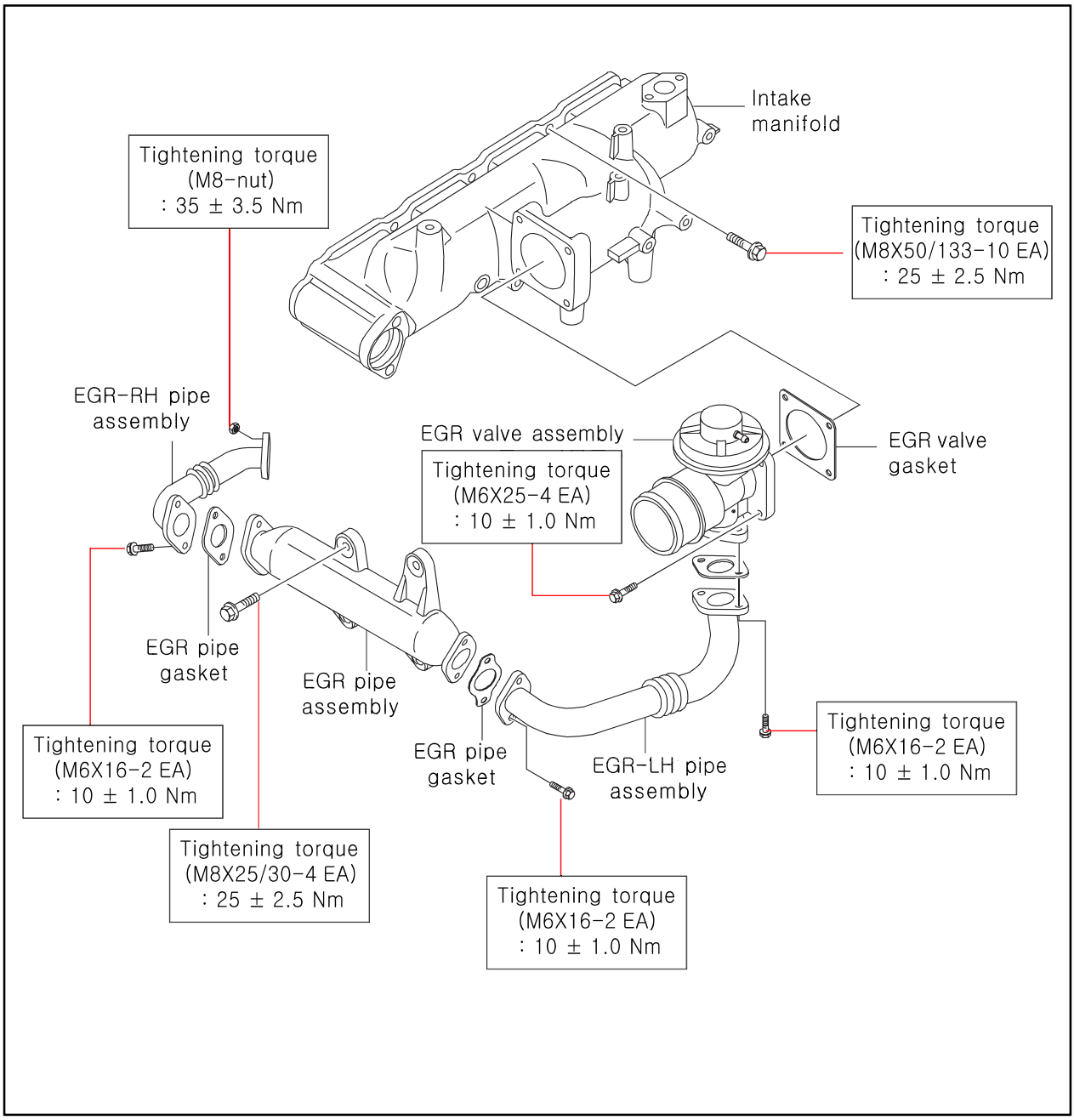


Turbocharger Intercooler

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

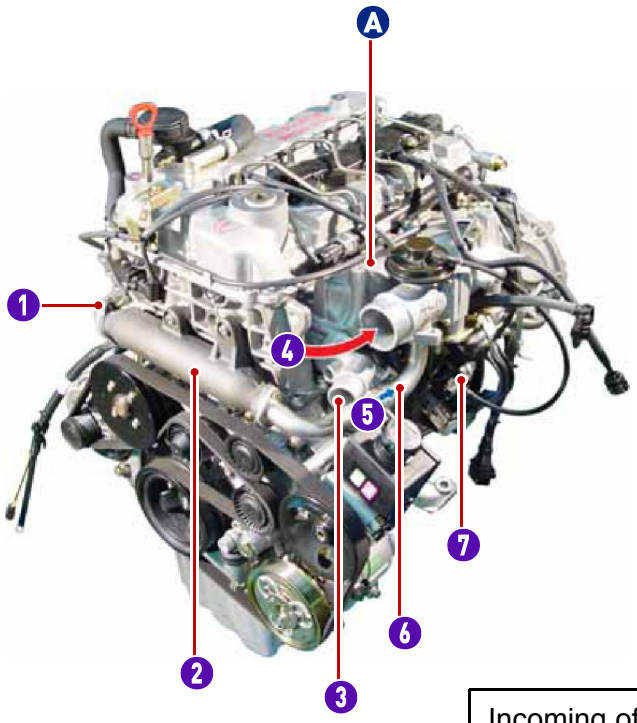
(1) Intake Manifold Assembly

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.

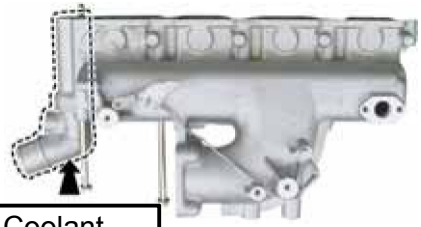
CAUTION

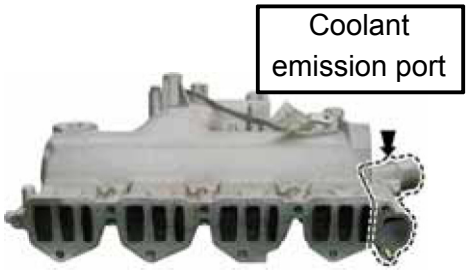
- The inlet port and coolant outlet port is integrated together. Therefore, be careful not to let the residual coolant in the manifold enter the inlet port when removing the intake manifold. Also, replace the gasket with a new one and tighten it to the specified torque (25 ± 2.5 Nm).

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



A Intake Manifold

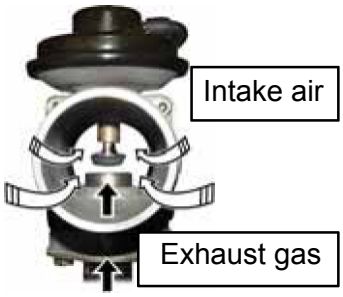




Incoming of intake air (No operation of EGR valve)



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



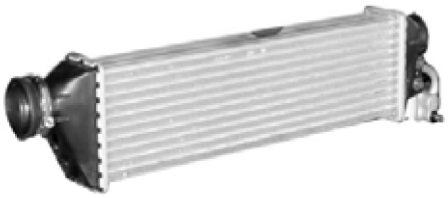
1. EGR pipe (RH)	5. Exhaust gas
2. EGR pipe (center)	6. EGR pipe (LH)
3. Coolant emission port	7. Vacuum modulator to the EGR valve
4. Intake air (intercooler)	

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

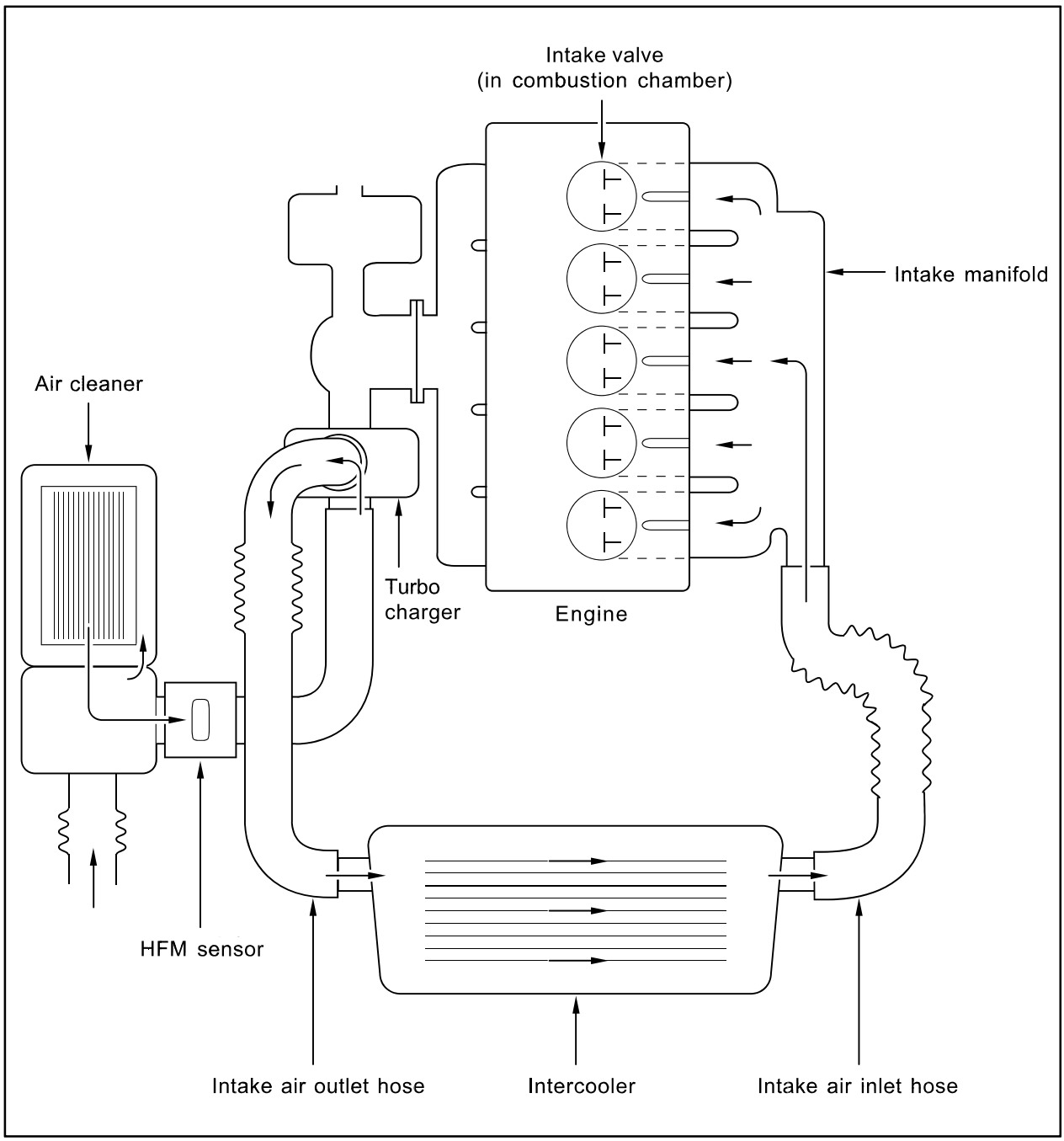




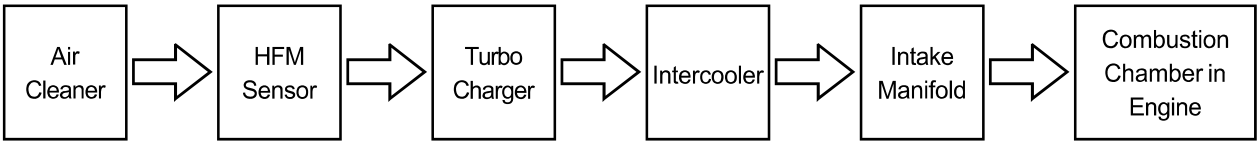
CAUTION

- 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.

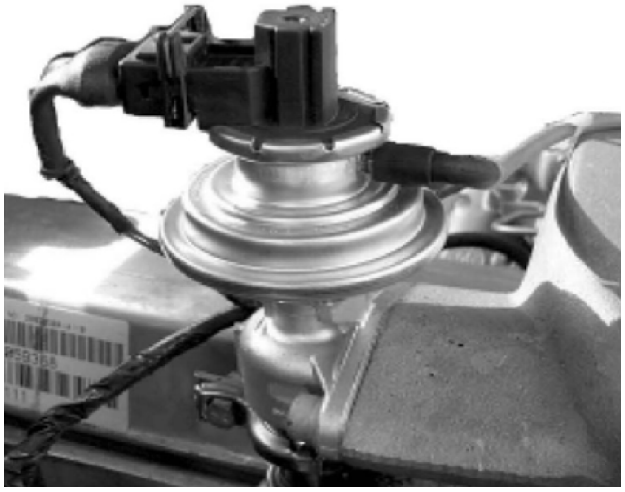
As previously explained, this car has a separate controller to control the HUBER EGR and, in accordance with various input element, the controller controls EGR valve by regulating the force of vacuum being applied to the EGR valve through PWM control. At this time, the controller has to receive feedback 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.

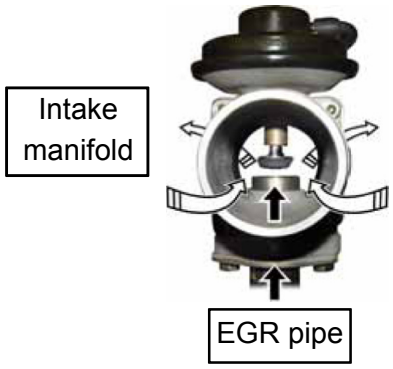
In other word, to reduce the amount of the fuel injection in no-load rapid acceleration mode, the IDI engine's HUBER EGR utilizes solenoid valve to disconnect the connection circuit between intake manifold and ALDA causing negative pressure to occur in the vacuum modulator to reduce the amount of fuel 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.

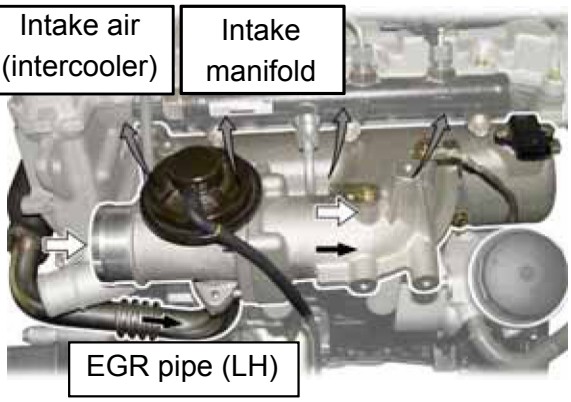
Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

1. EXHAUST SYSTEM LAYOUT

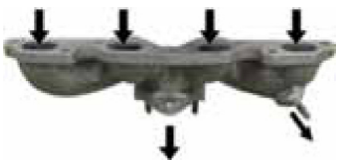
EGR Valve and Installation Location

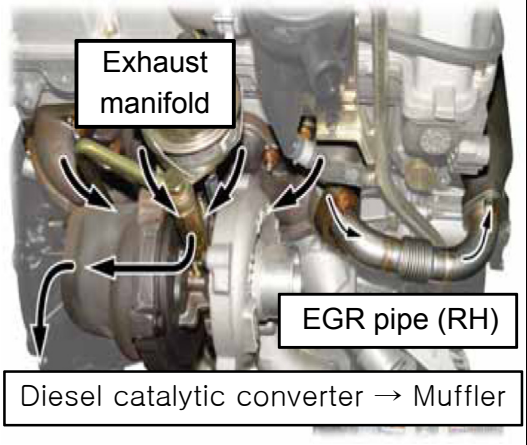




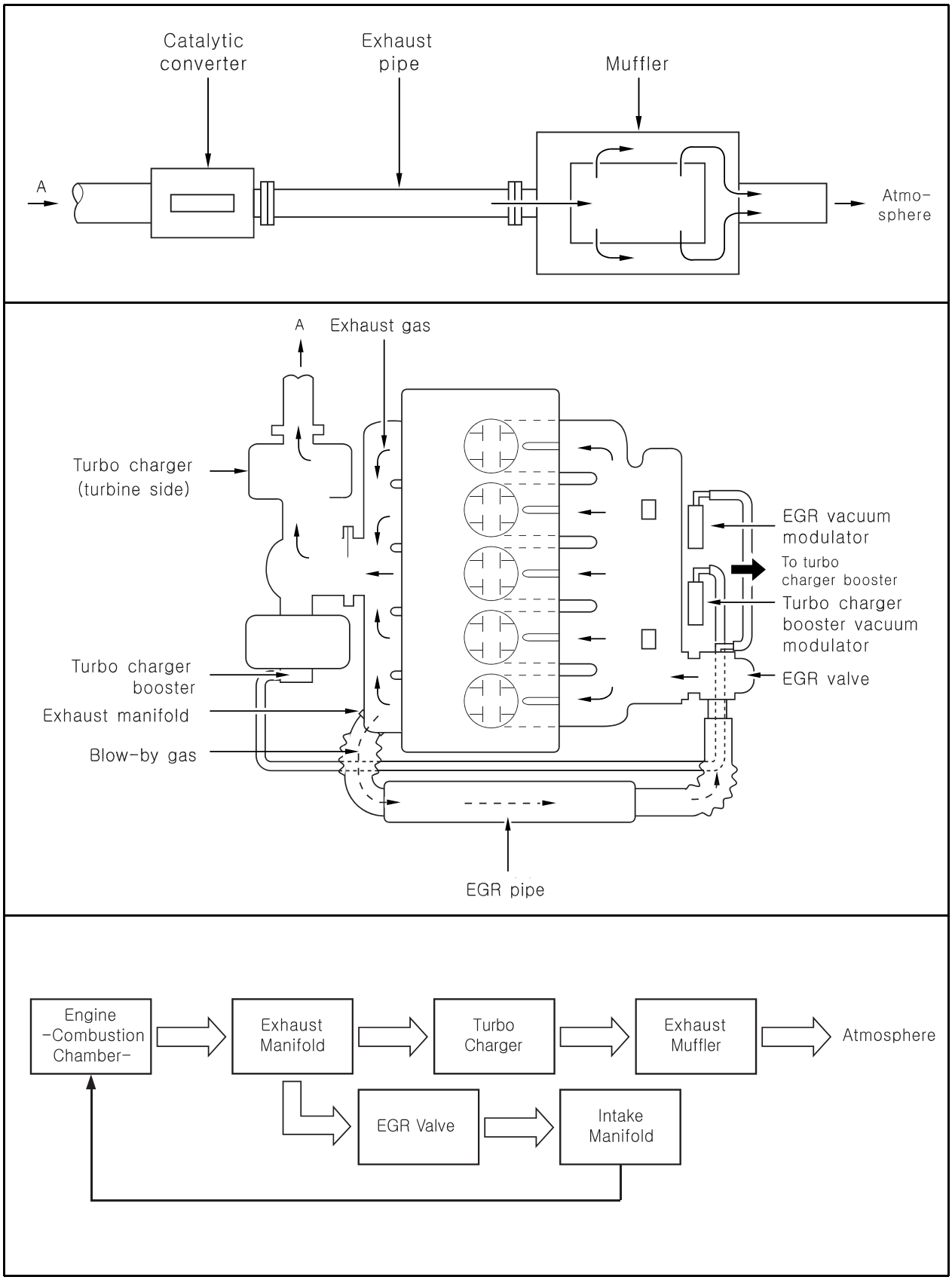


Exhaust Manifold





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

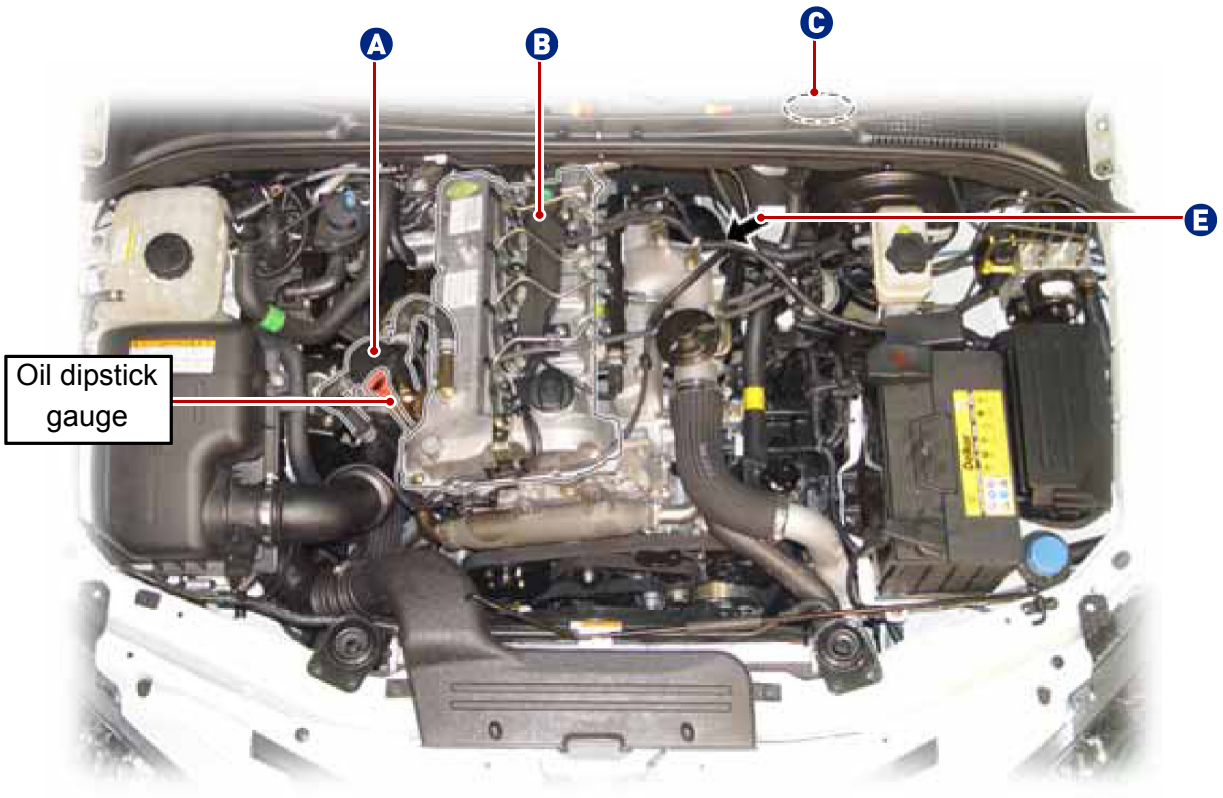


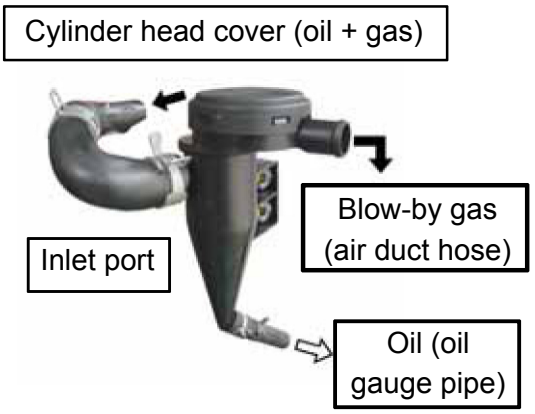
- Operating temperature: −40 ~ 140°C
- Operating pressure: 0.3 ~ 0.55 bar
- Permissible pressure: 10 bar

OVERVIEW AND PERATION PROCESS

1. LAYOUT AND OVERVIEW

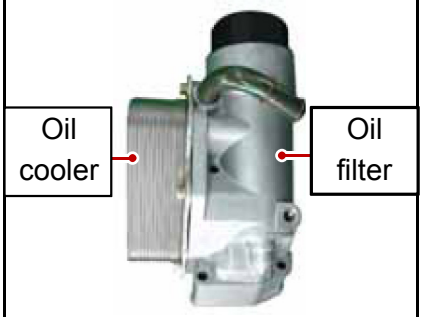
1) Lubrication System



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	

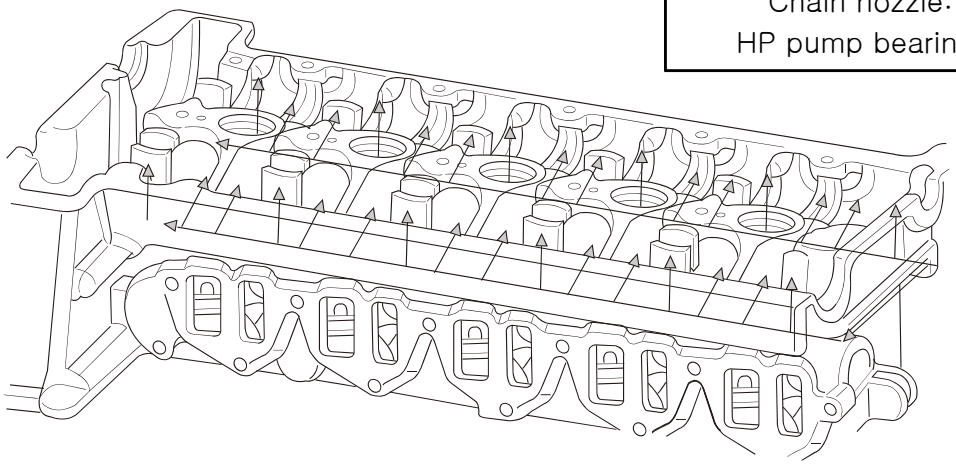
B Cylinder Head Cover	C Oil pressure Warning Lamp (Cluster)
	

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

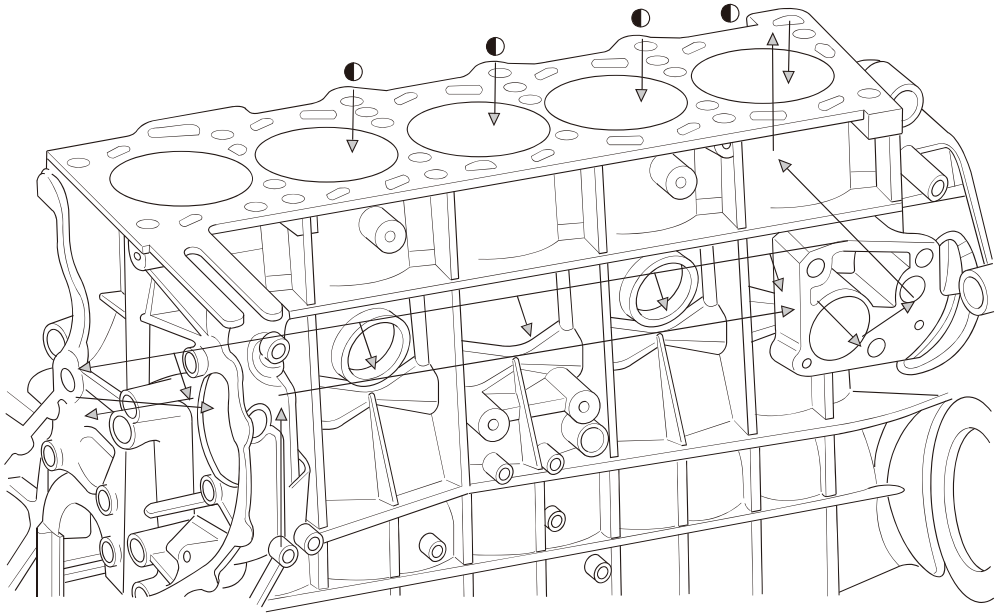
2) Lubrication System Layout

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

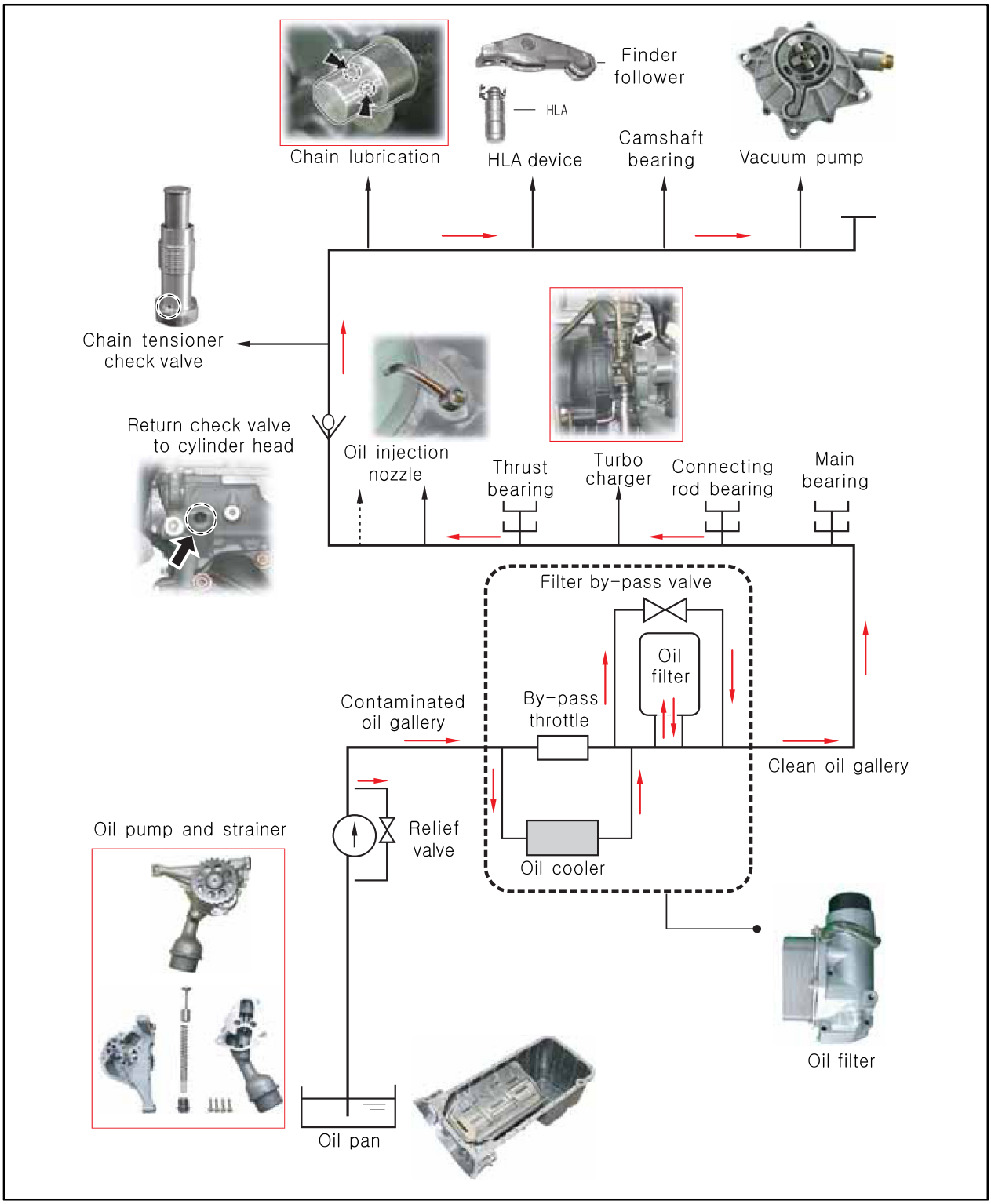


Cylinder Block



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

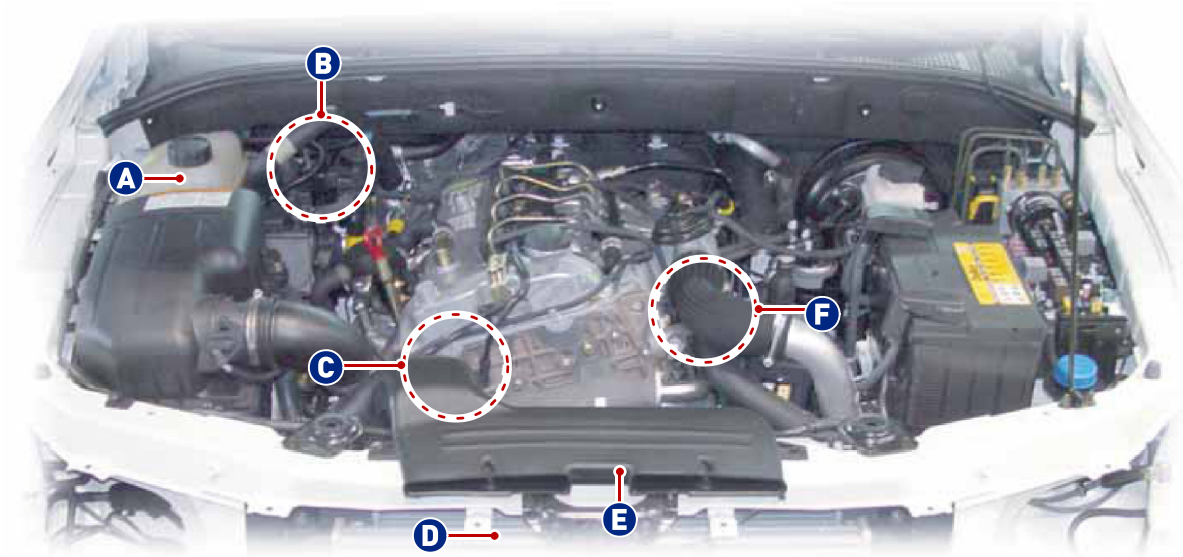
1. ENGINE COOLING SPECIFICATIONS

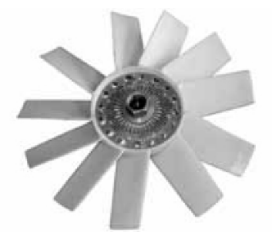
Descriptio n		Unit	Specificatio n
Cooling system	Type	-	Water cooling forced circulation
Coolant	Capacity	ℓ	11.3
Thermostat	Type	-	Wax pellet type
	Initial opening temperature	℃	85
	Fully opening temperature	℃	100
	Fully closing temperature	℃	83
	Stroke	mm	min. 8
Cooling fan	Blades		5
	Diameter	mm	320 (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 

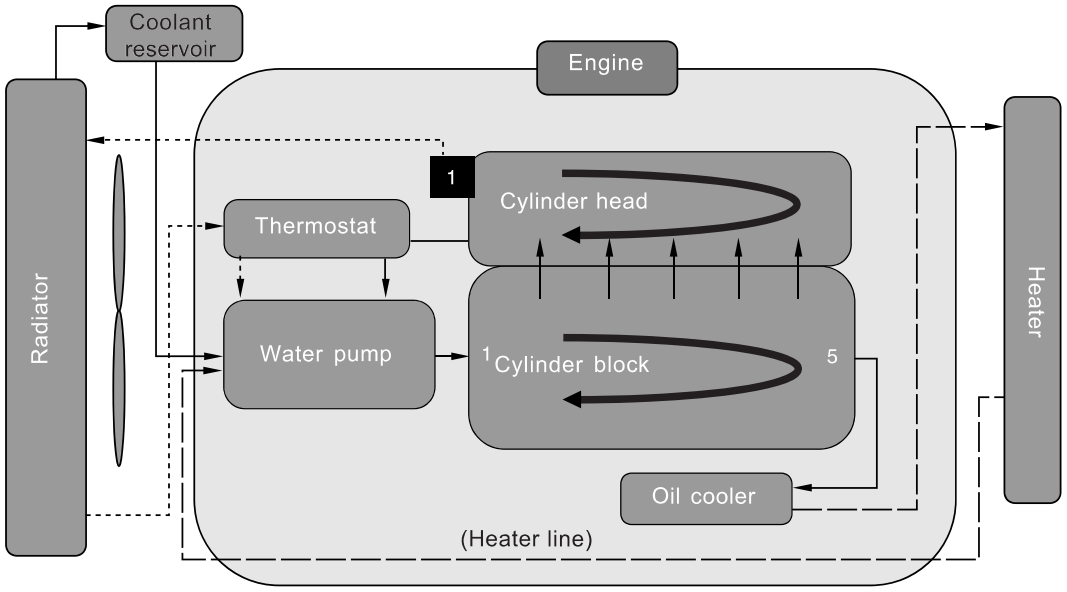


Radiator Assembly	Cooling Fan and Fan Clutch	Coolant Temperature Sensor
D 	E 	F 

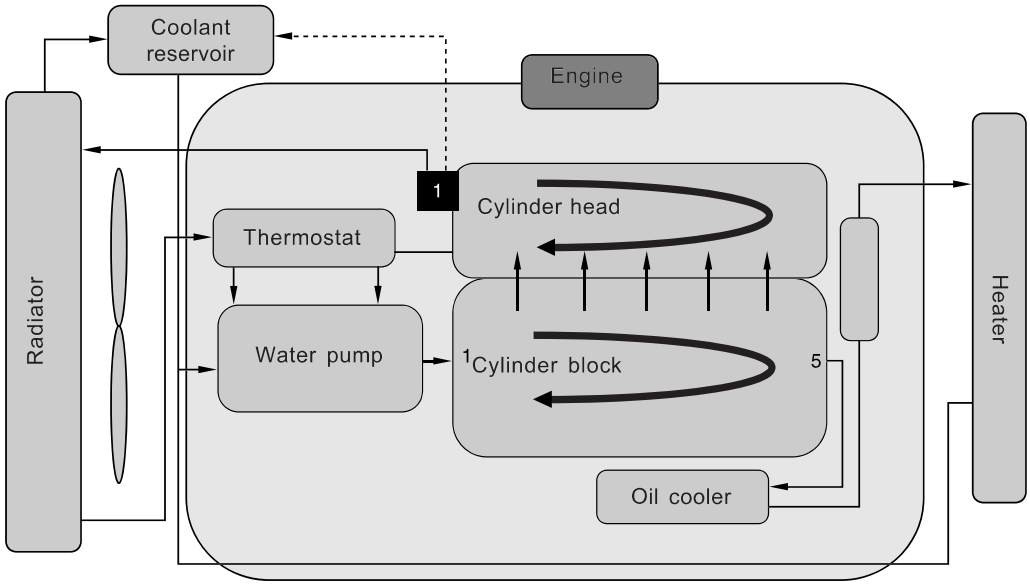
Modification basis	
Application basis	
Affected VIN	

2. COOLING SYSTEM FLOW

PTC Engine Coolant Flows

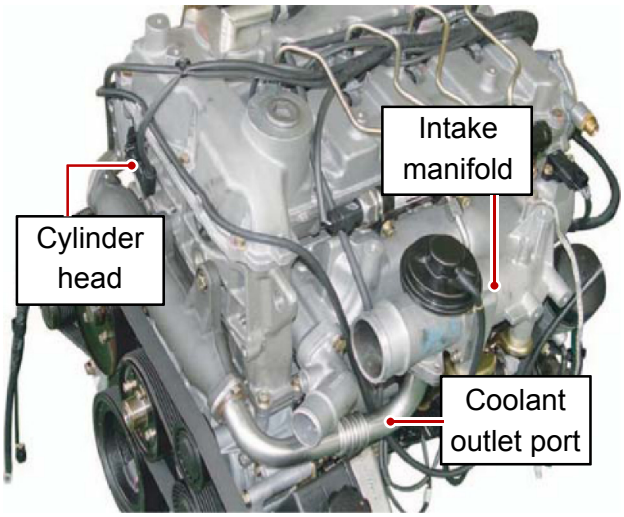


FFH Engine Coolant Flows



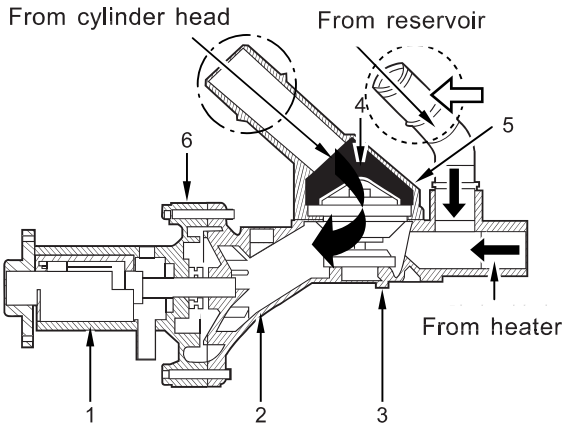
- Cylinder block side
  · Block #5 → Oil cooler → Heater → Heater water pump inlet pipe → Water pump
- Cylinder head side
  · Cylinder head → Coolant outlet port (intake #1) → Radiator → Water pump

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

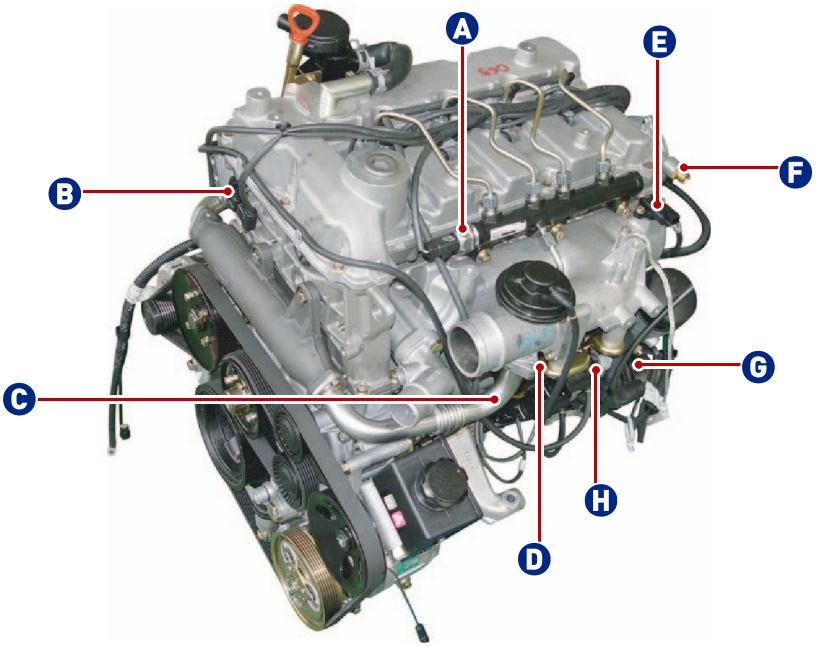
1.SPECIFICATIONS OF ENGINE ELECTRIC

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

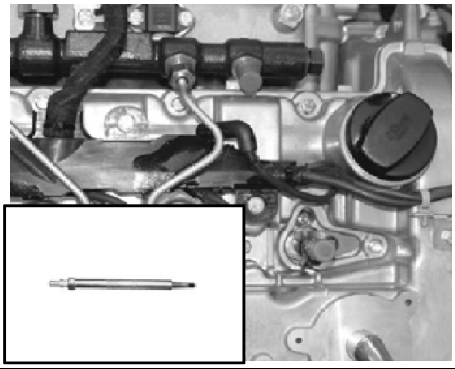
Fuel Pressure Sensor	Camshaft Position Sensor	Coolant Temperature Sensor	Fuel Temperature Sensor
A 	B 	C 	D 

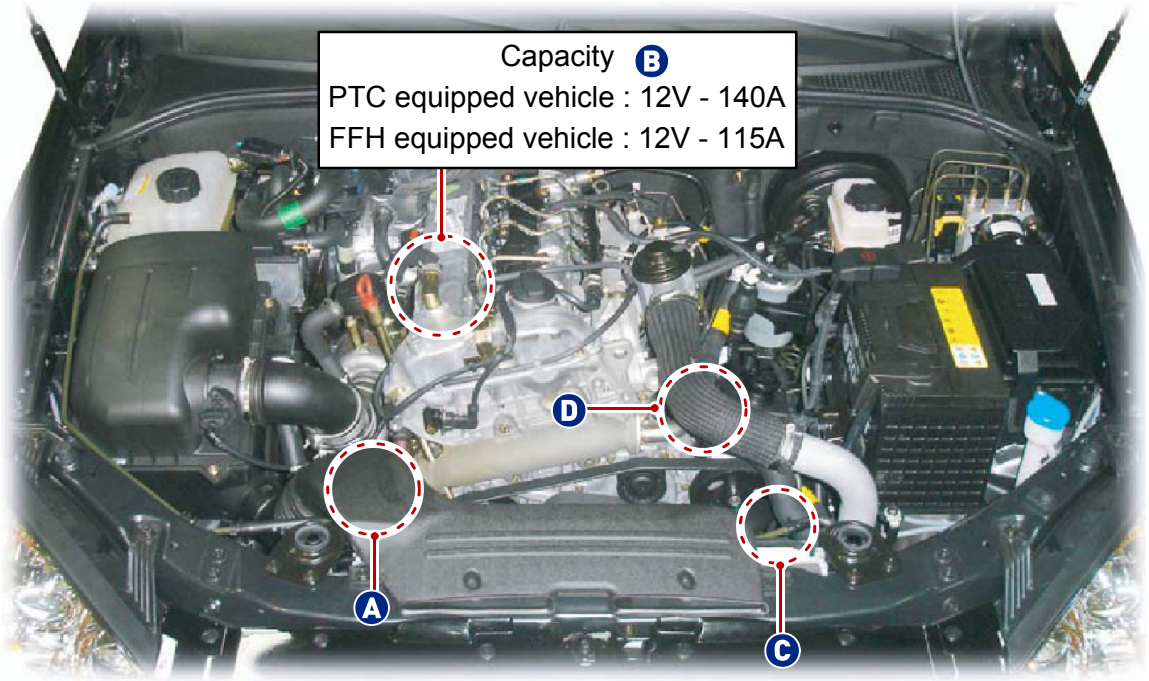


Booster Pressure Sensor	Oil Pressure Switch	Crankshaft Position Sensor	Knock Sensor (1 EA)
E 	F 	G 	H 

Modification basis	
Application basis	
Affected VIN	

2. COMPONENTS OF ELECTRIC DEVICES IN ENGIN

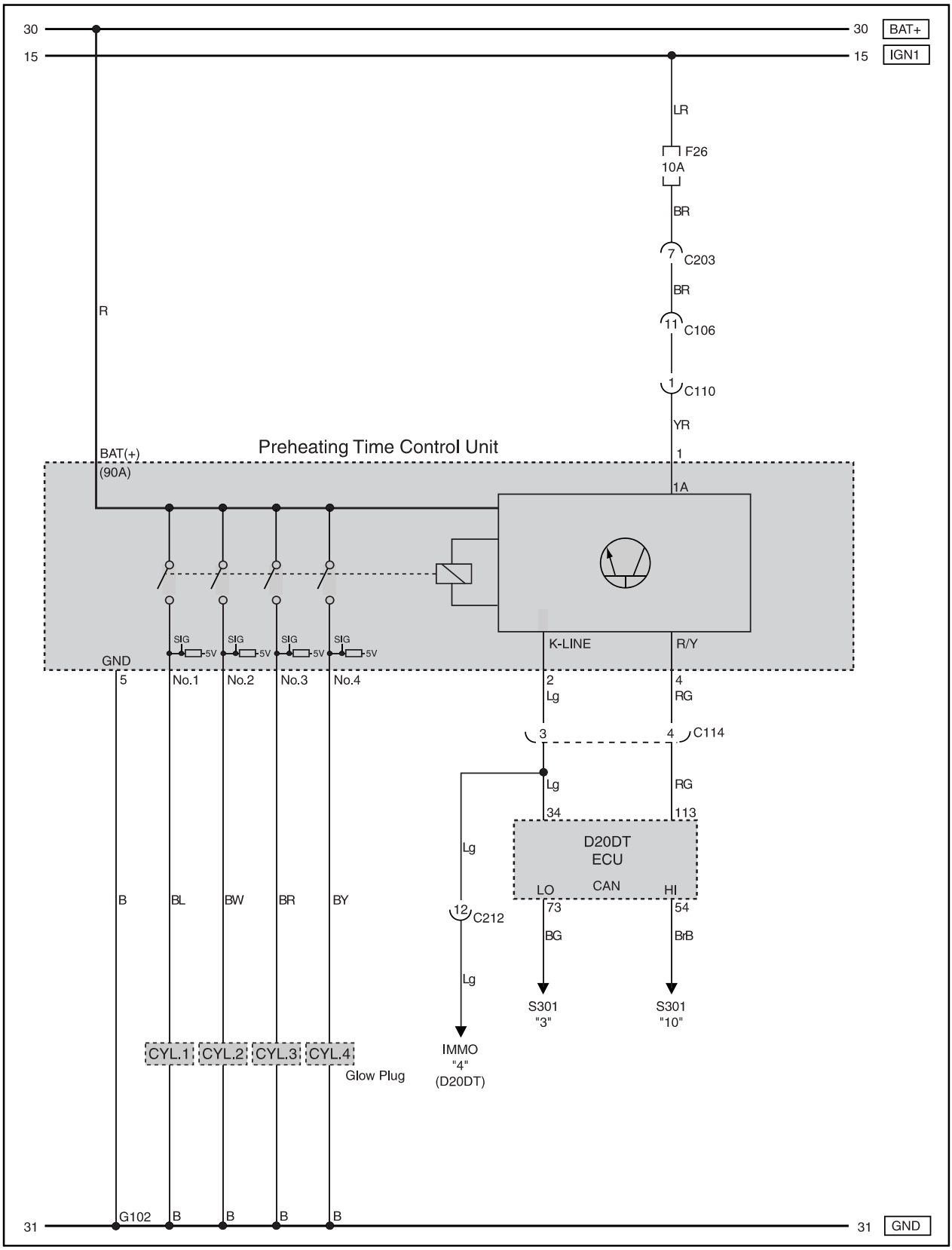
Alternator	Glow Plug
A 	B 



Air Conditioner Compressor	Starter
C 	D 

3. CIRCUIT DIAGRAM OF PREHEATING SYSTEM

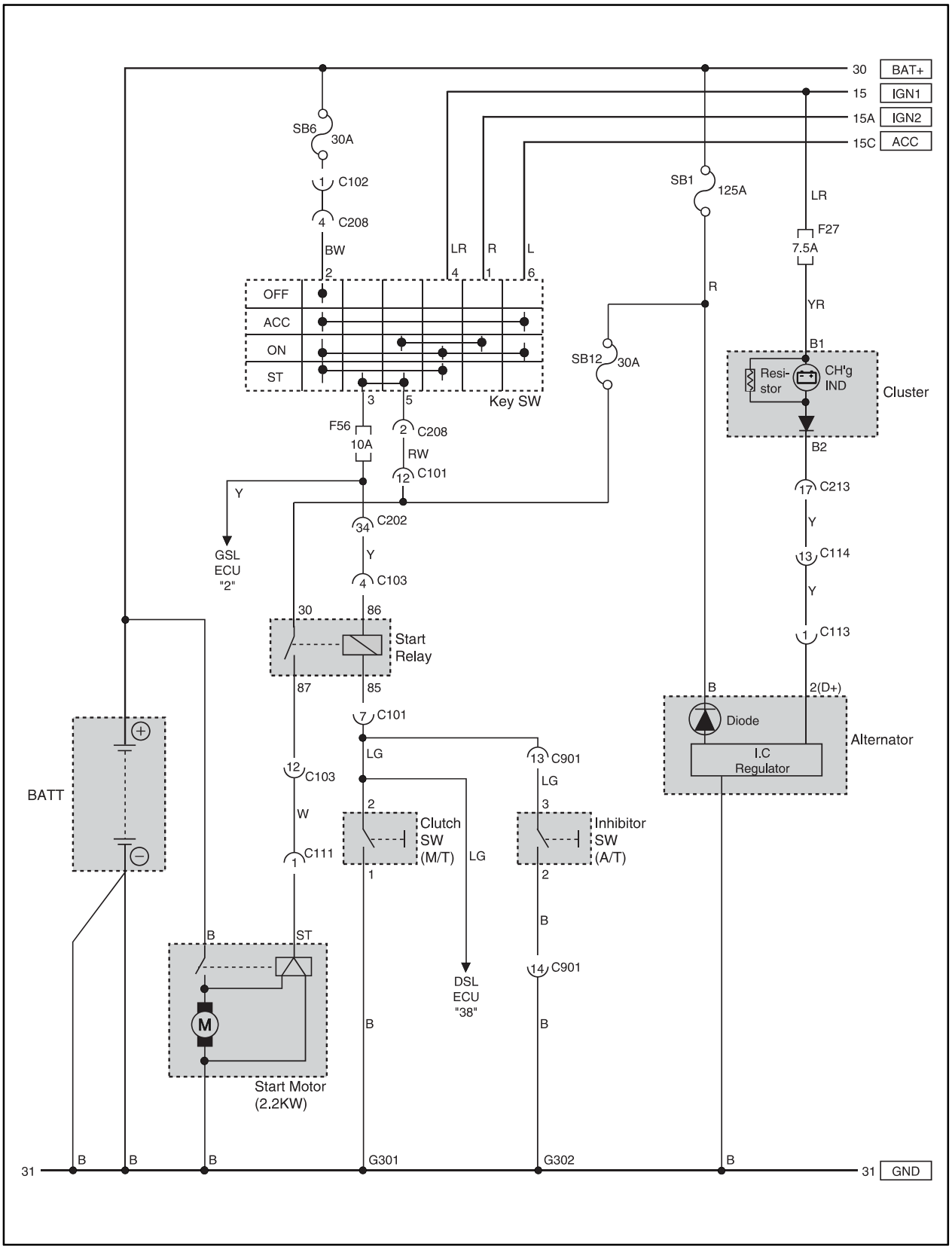
1) Preheating



Modification basis	
Application basis	
Affected VIN	

4. CIRCUIT DIAGRAM OF STARTING AND ALTERNATOR

1) Starting & Charging

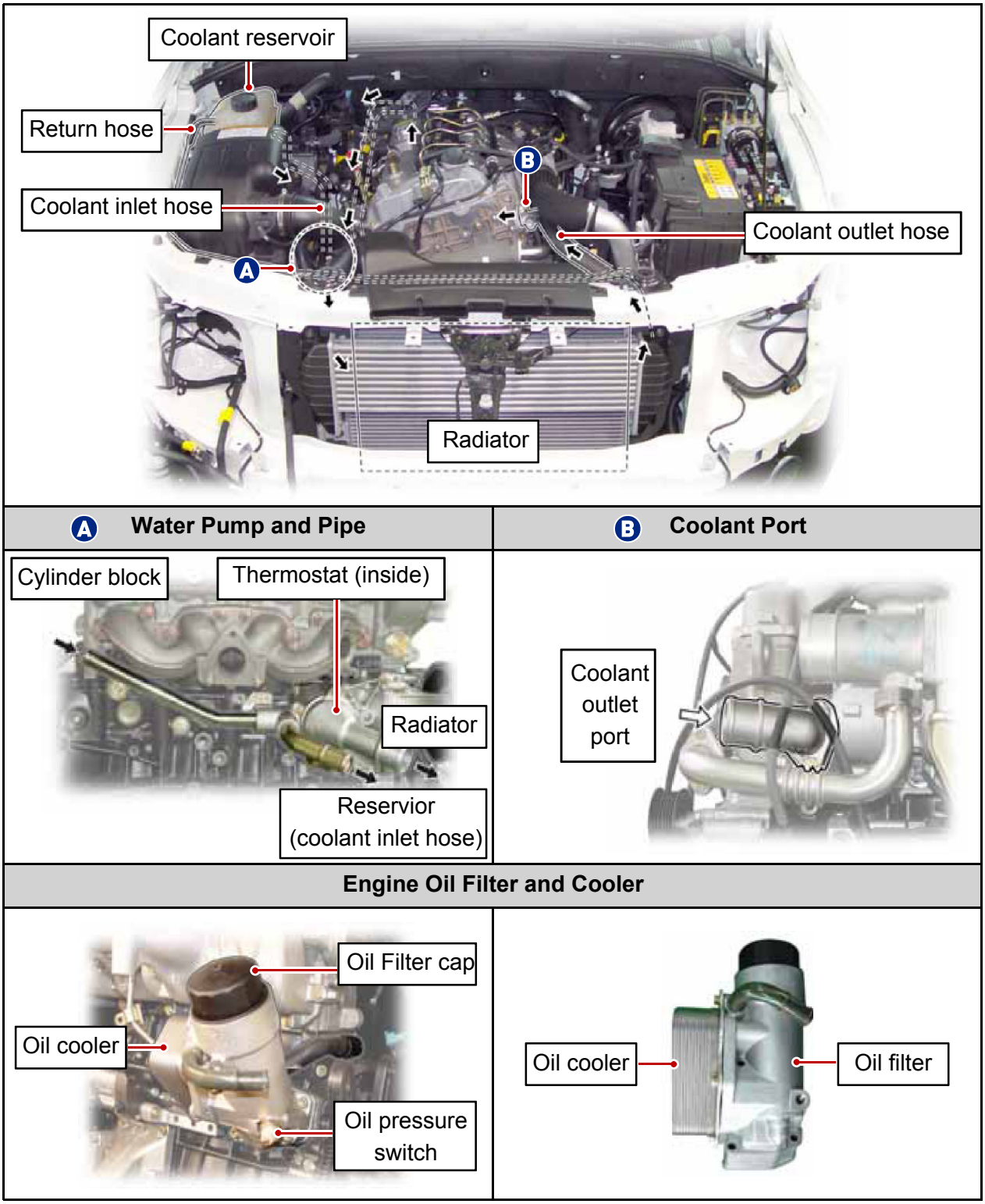


Modification basis	
Application basis	
Affected VIN	

EGINE CONTROL SYSTEM 1491-01

GENERAL

1. ENGINE ECU AND OTHER COMPONENTS



Modification basis	
Application basis	
Affected VIN	

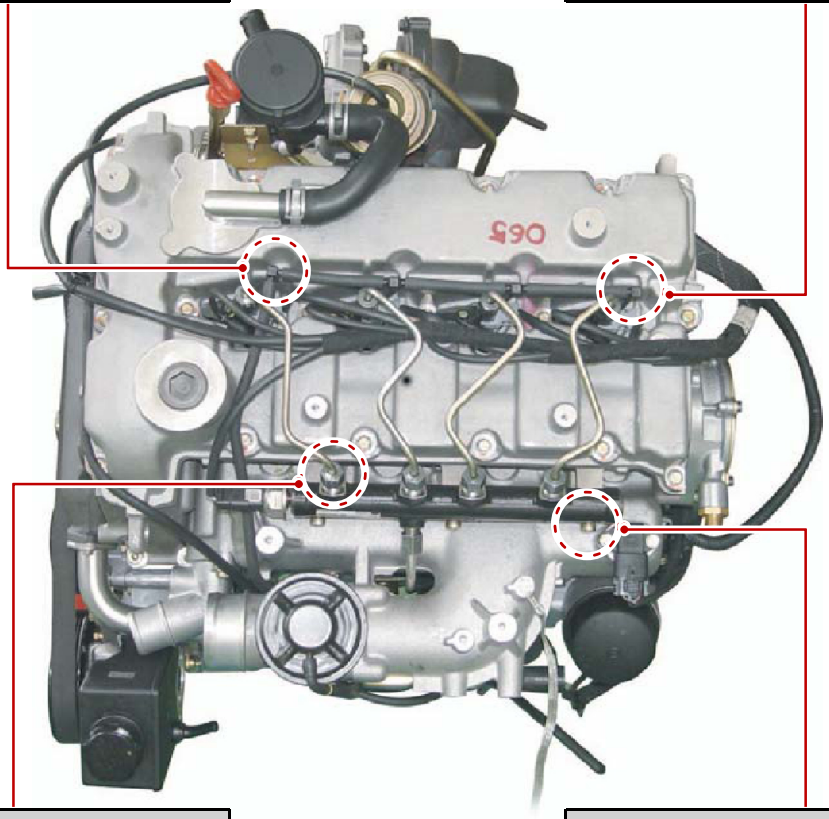
2. TOP VIEW

Fuel Pressure Sensor

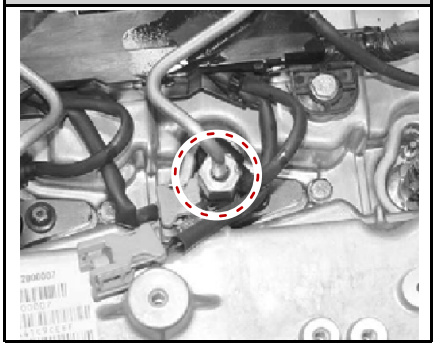


Booster Pressure Sensor

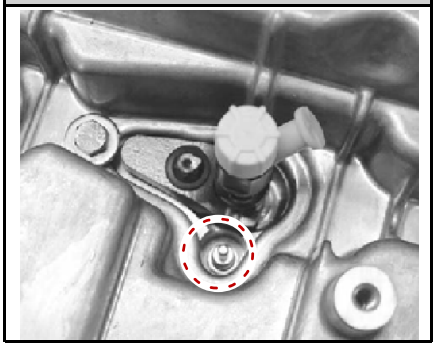




Injectors (4 EA)

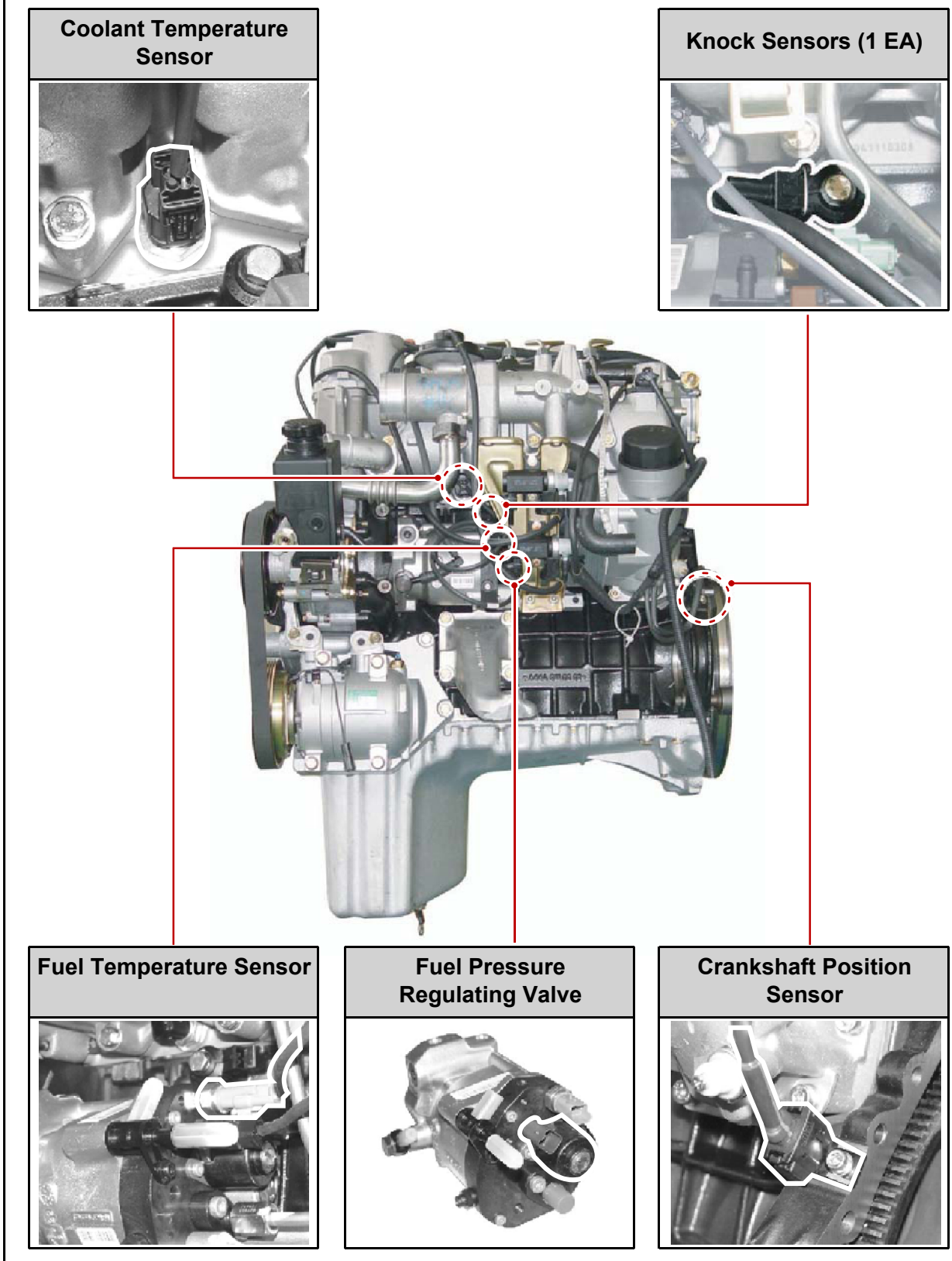


Glow Plugs (4 EA)



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.

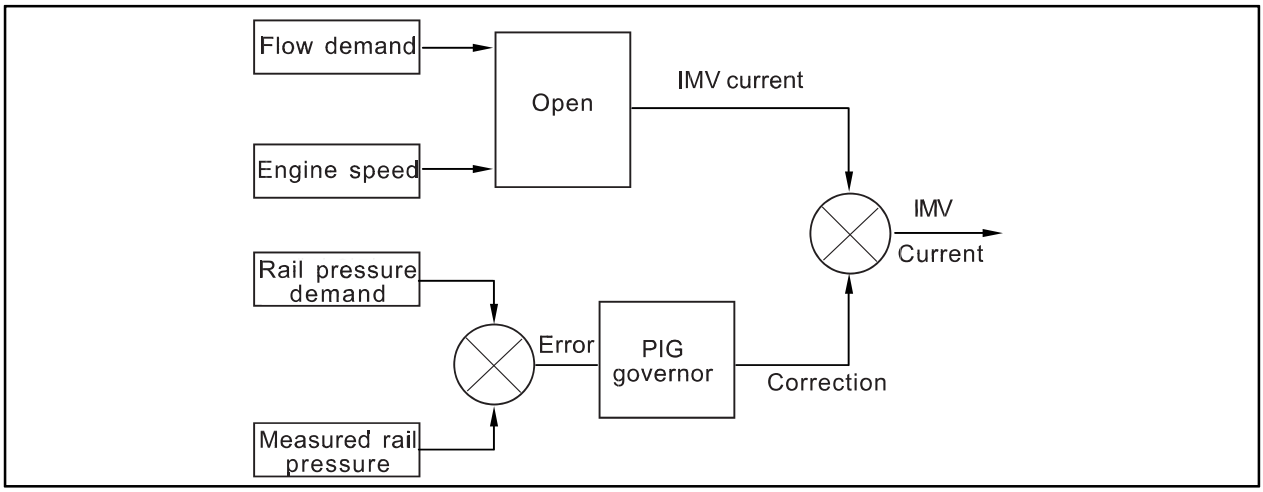
- When engine speed and load are high
  - The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.
- When engine speed and load are low
  - The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will 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.

Modification basis	
Application basis	
Affected VIN	

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.

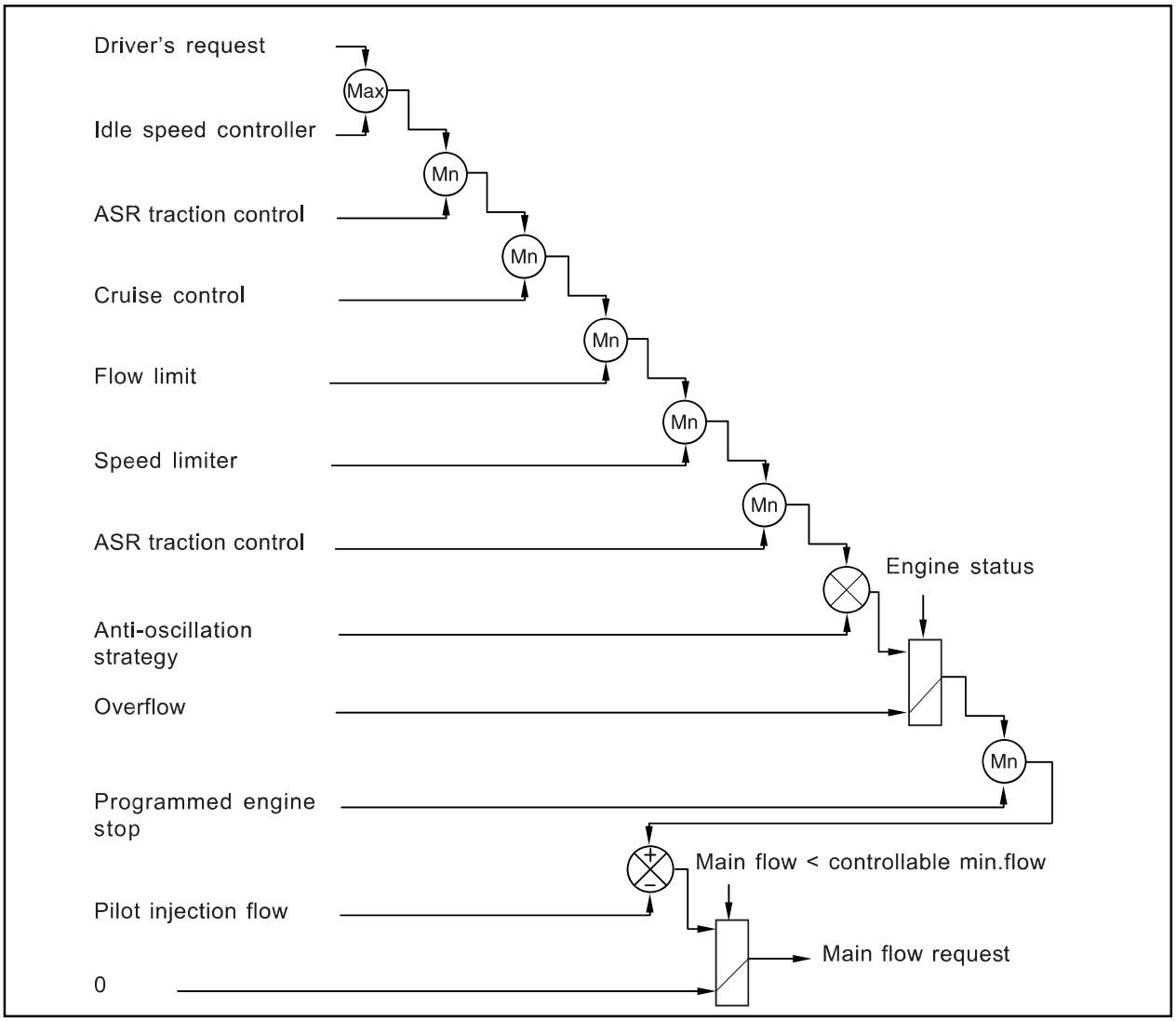
A switch makes it possible to change over from the supercharge fuel to the total fuel according to the state of the engine.

- 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.

Modification basis	
Application basis	
Affected VIN	

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

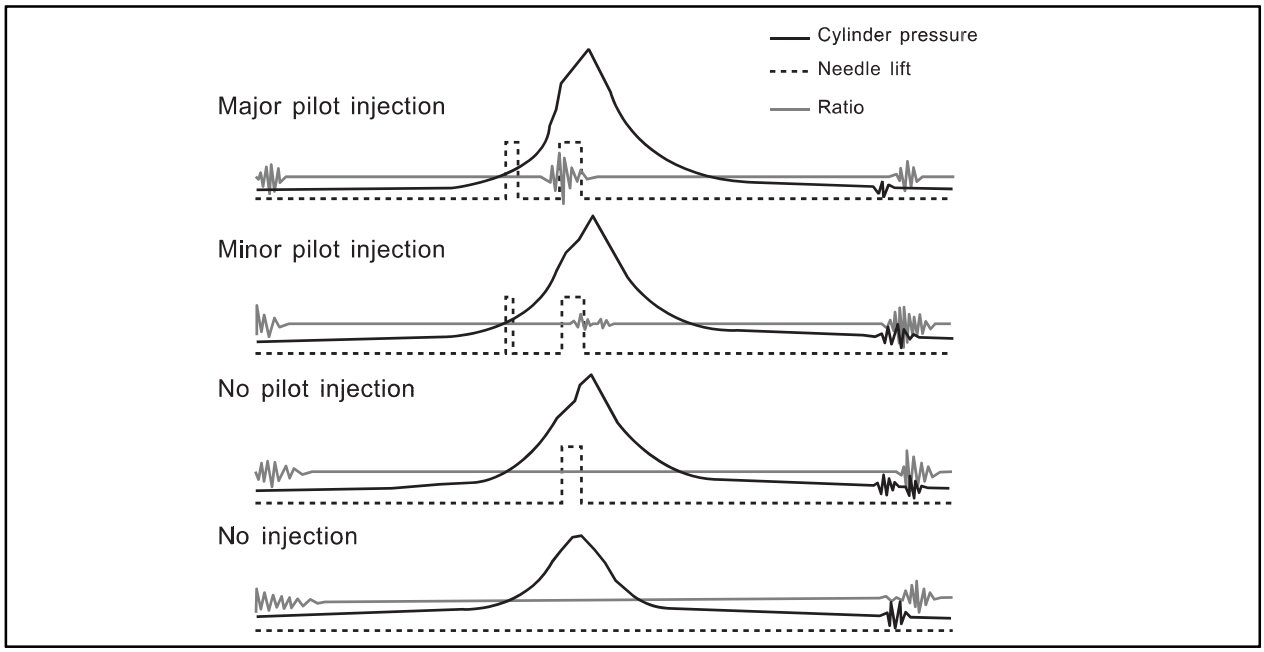
▶ **Resetting the pilot injection**

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

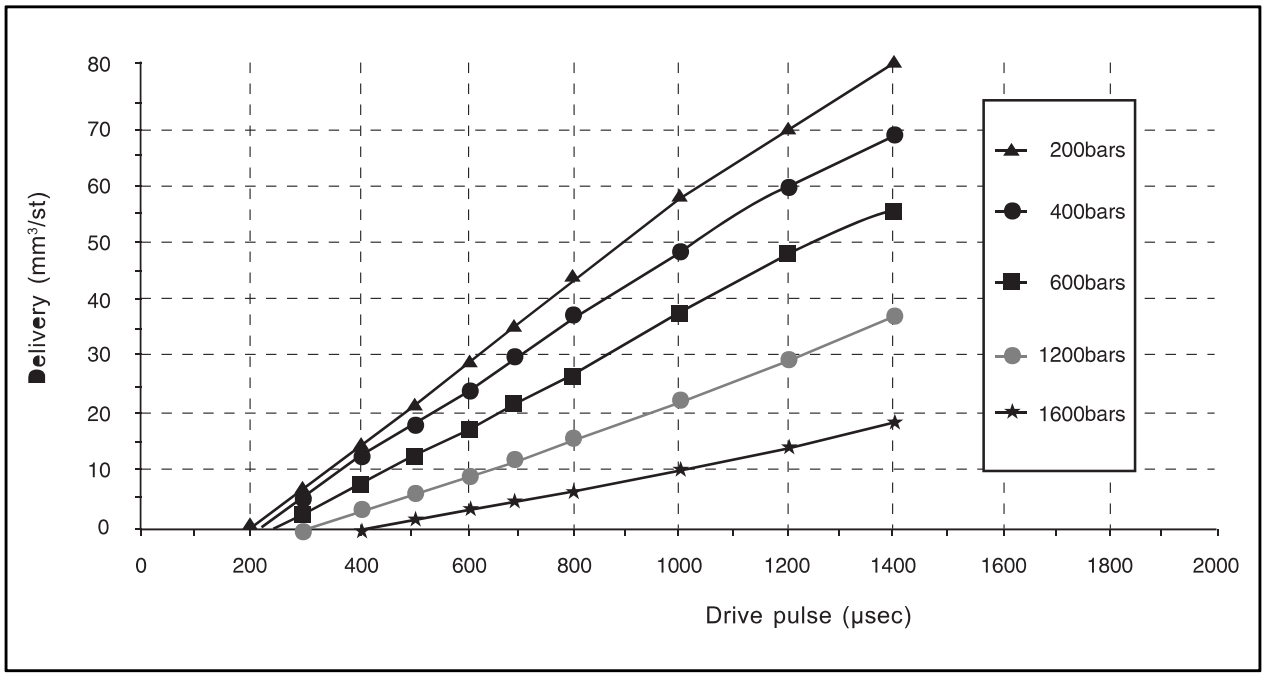
This strategy permits the detection of a fault in the sensor or in the wiring loom connecting the sensor to the ECU.

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.

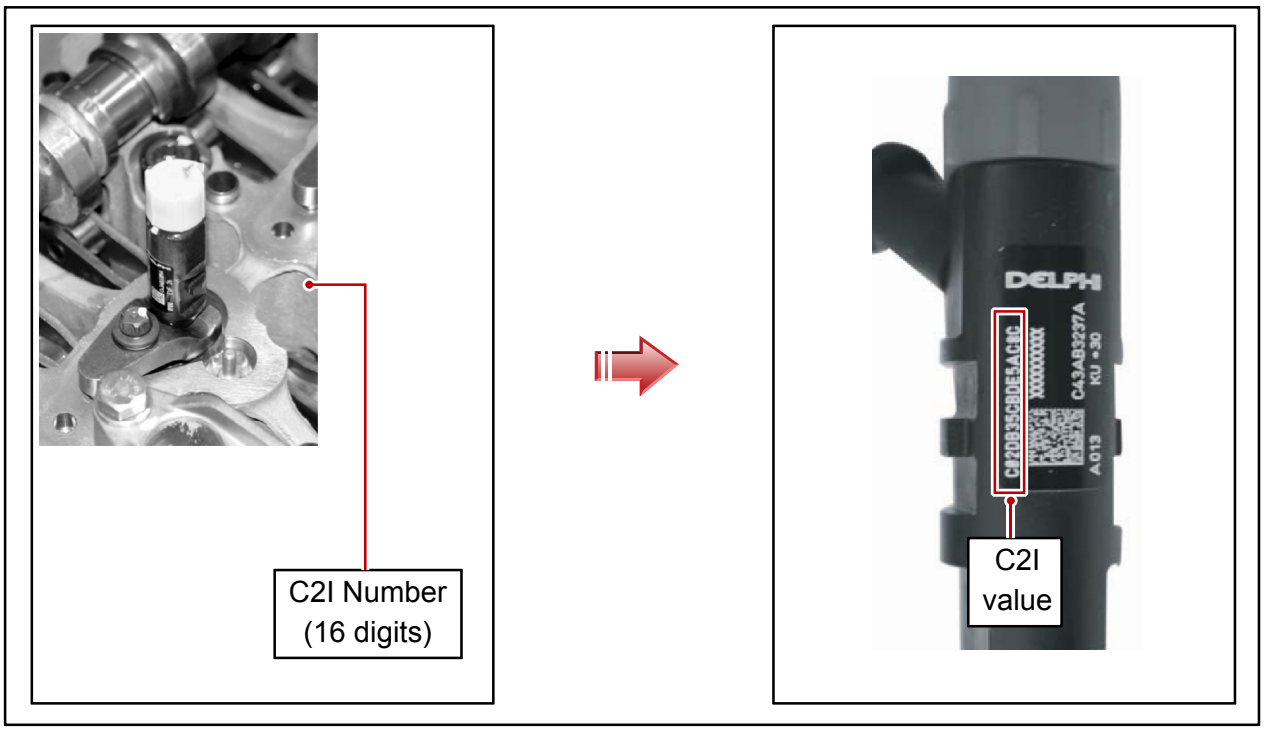
This high level of accuracy requires very low machining tolerances (few ㎛).

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.

Modification basis	
Application basis	
Affected VIN	

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

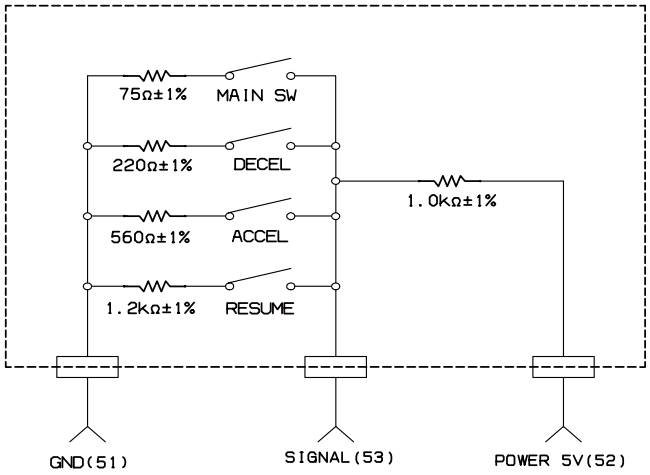
Use the cruise control system only when (a) the traffic is not jammed, (b) driving on motorways or highways where there is no sudden change in the driving condition due to traffic lights, pedestrian, etc.

WARNING

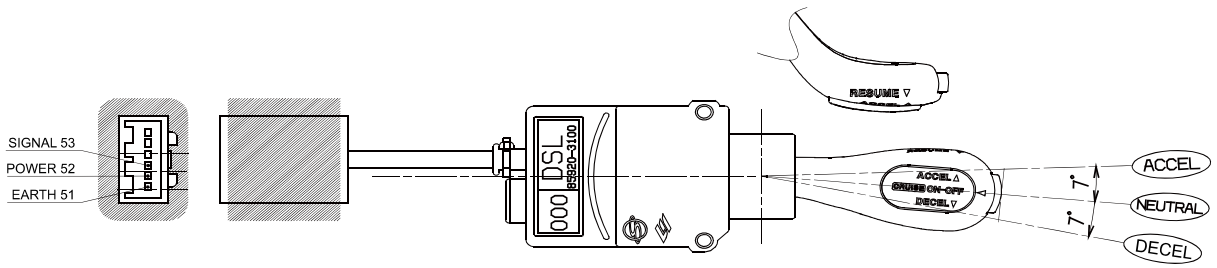
Use the cruise control system only when driving on motorways or highways. Do not use the cruise control system where the road conditions are as follows:
- When there is strong wind or cross wind.
- Heavy traffic.
- Slippery roads or steep decline.

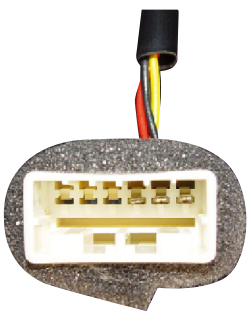
Modification basis	
Application basis	
Affected VIN	

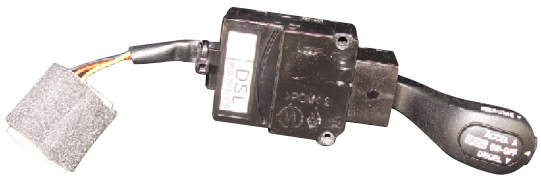
2. CIRCUIT DIAGRAM



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	

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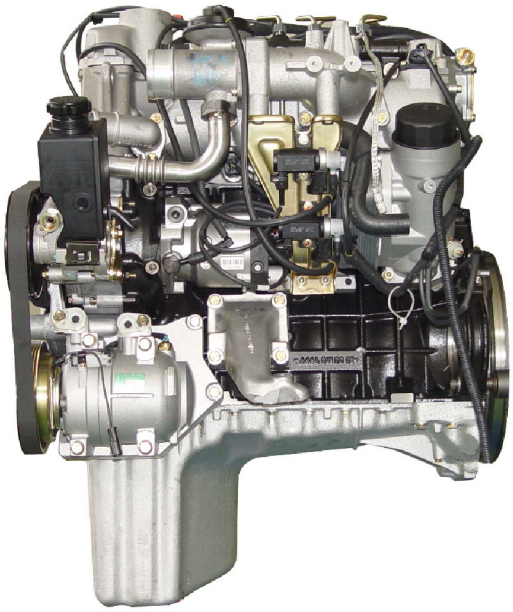
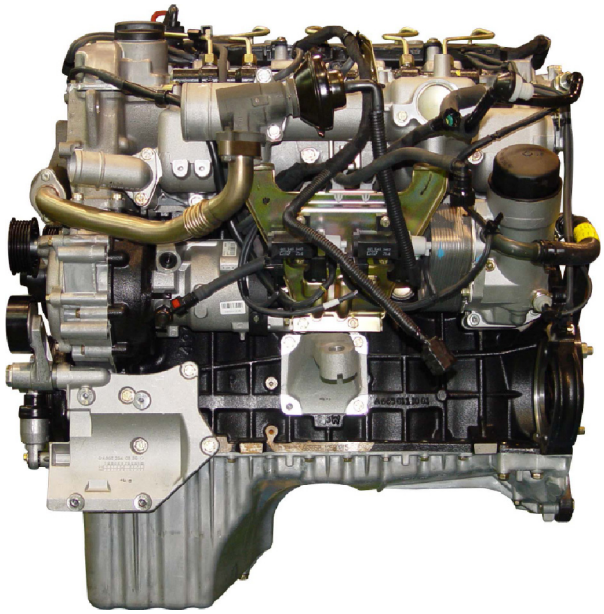
ENGINE GENERAL

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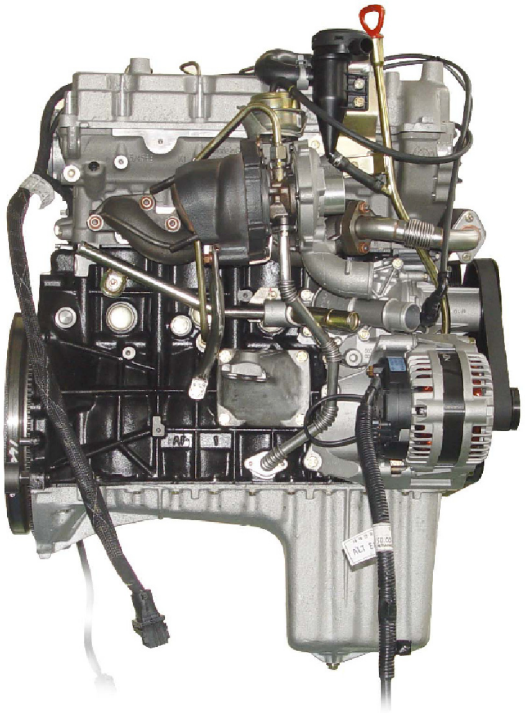
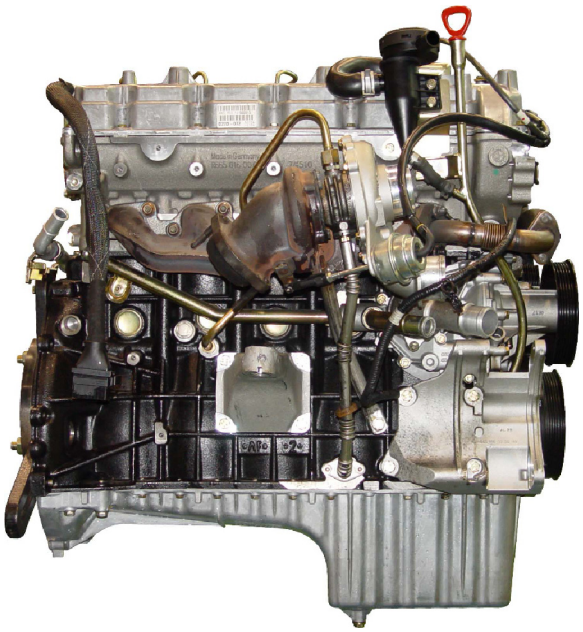
GENERAL

1. ENGINE ASSEMBLY LAYOUT

1) LH Side View

D20DT

D27DT


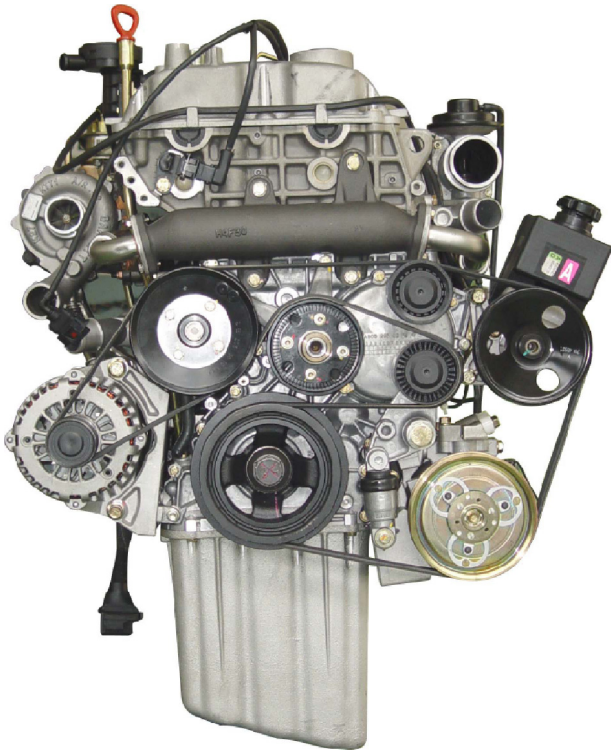
2) RH side view

D20DT

D27DT


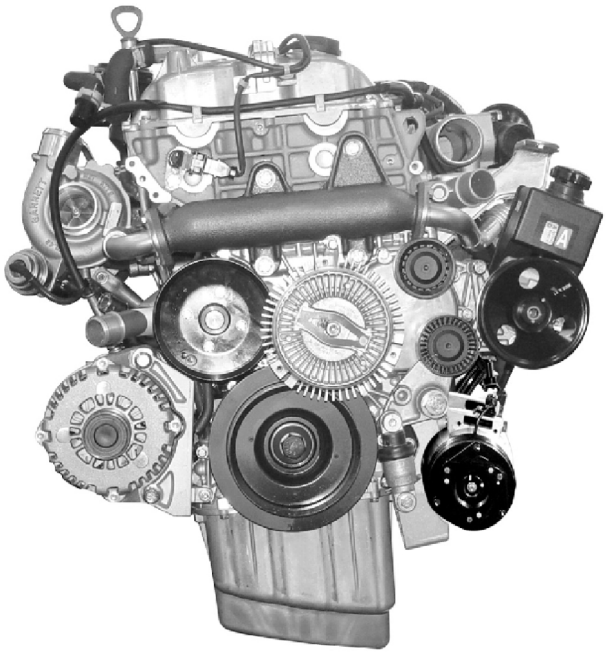
Modification basis	
Application basis	
Affected VIN	

3) Front view

D20DT

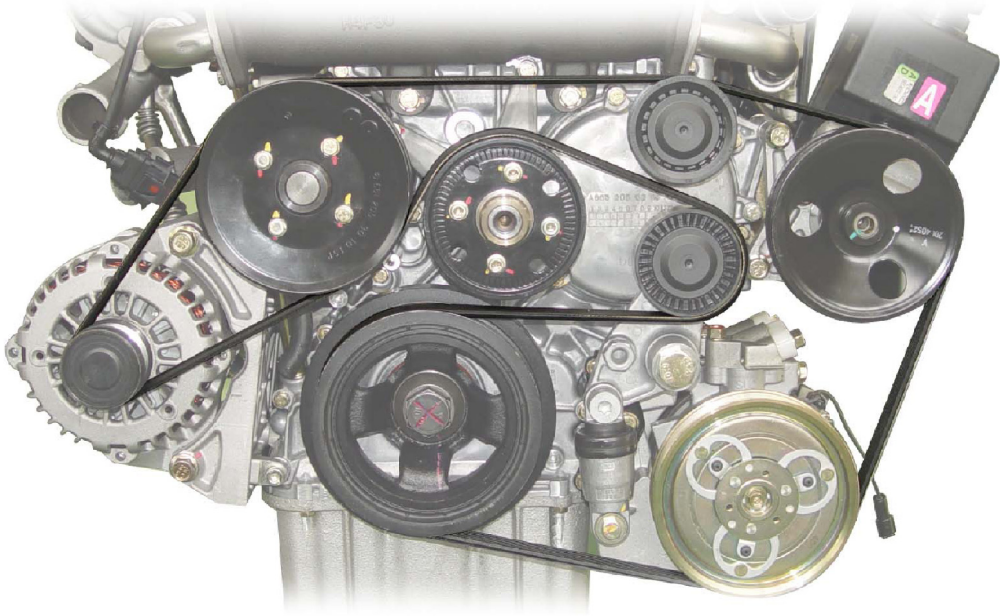
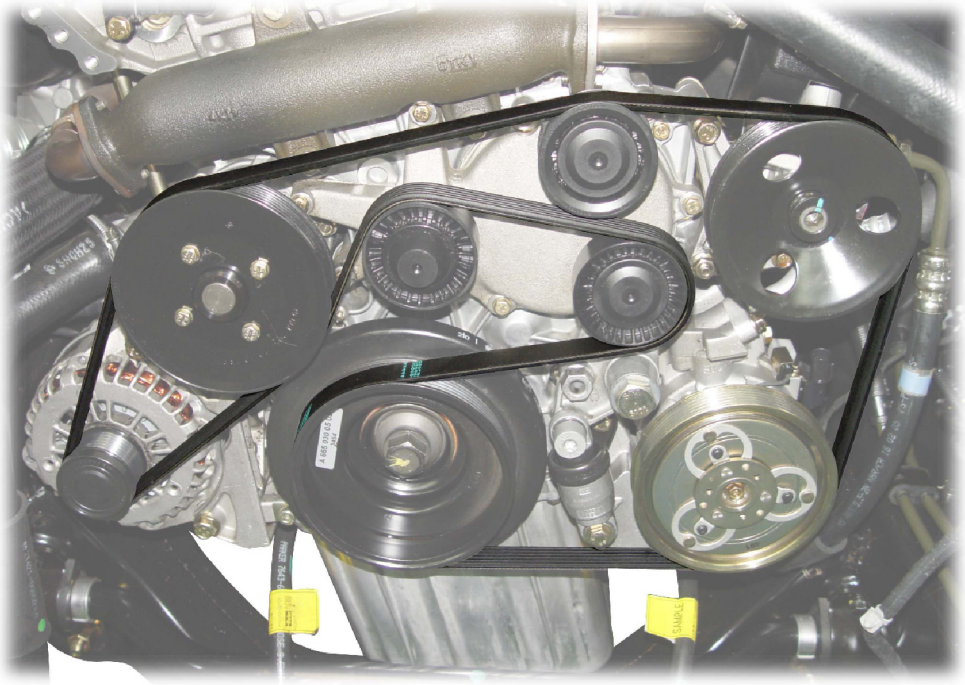


D27DT



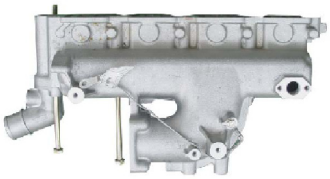
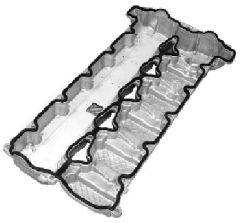
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Affected VIN	

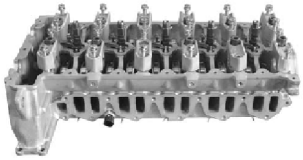
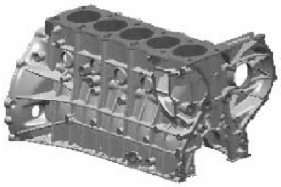
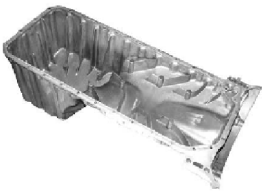
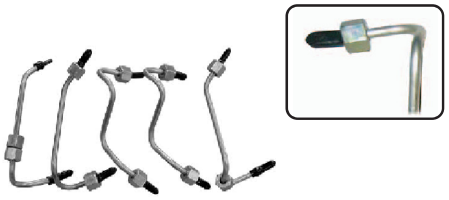
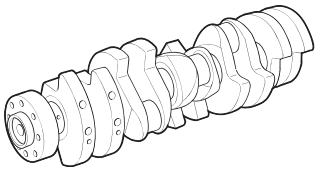
4) Fan belt

D20DT

D27DT


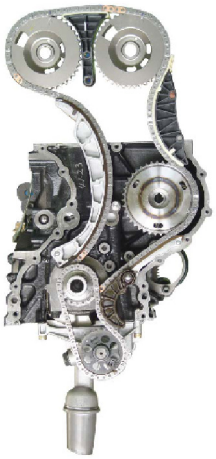
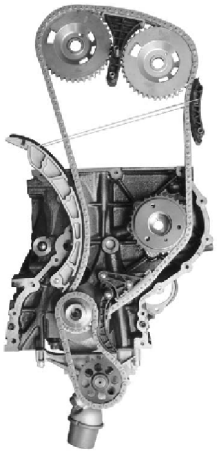
Modification basis	
Application basis	
Affected VIN	

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		

Modification basis	
Application basis	
Affected VIN	

Components	D20DT	D27DT
Sprocket - HP pump		
Timing chain devices		
Chain double bush	D20DT  D27DT 	
Tensioner rail		
Oil pump assy		

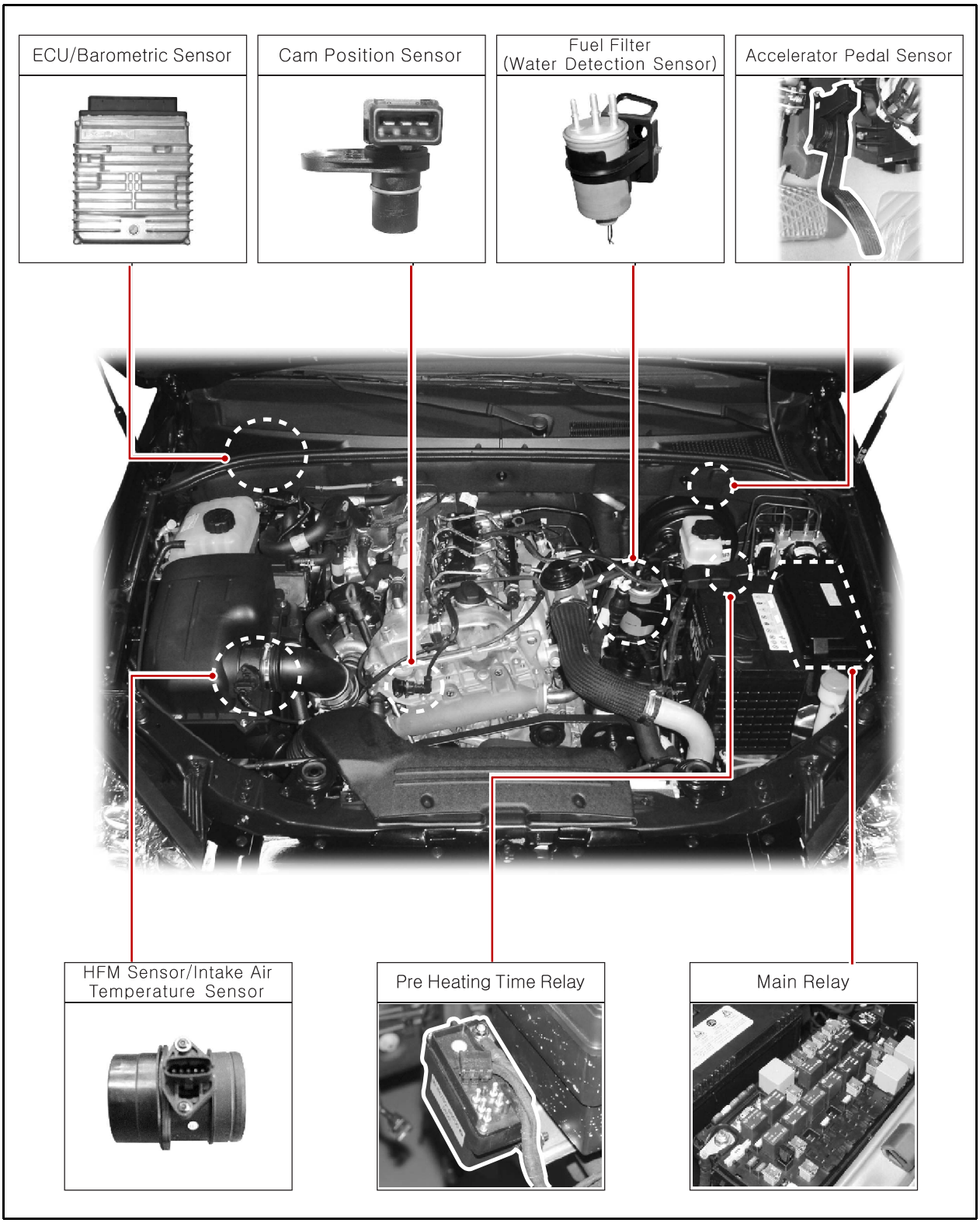
Components	D20DT	D27DT
Clamping rail comp		
Guid rail LWR		
EGR pipe - LH		
Fuel injector		

Modification basis	
Application basis	
Affected VIN	

3. ENGINE CONTROLS LAYOUT

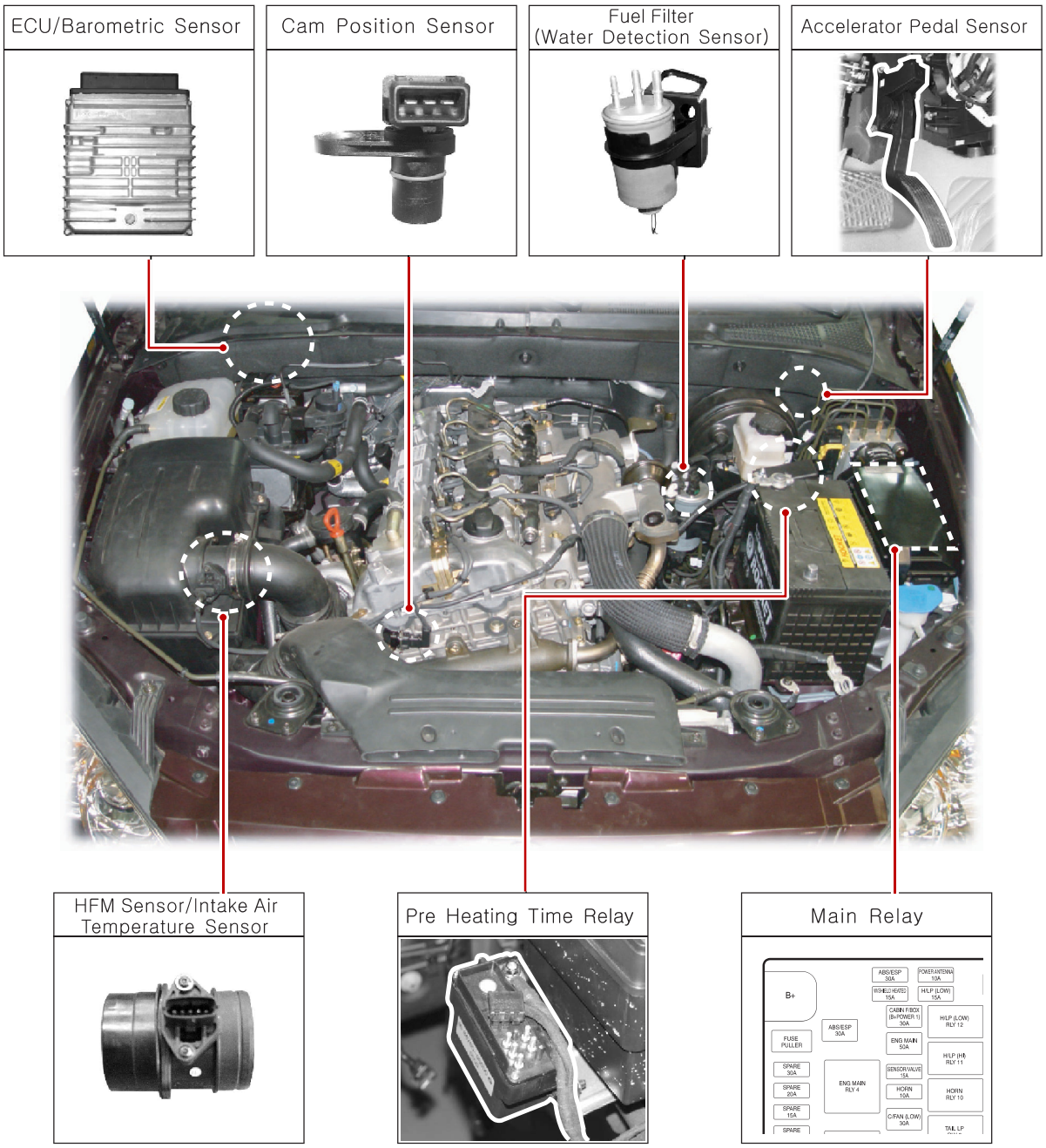
1) Ecu related componets

(1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

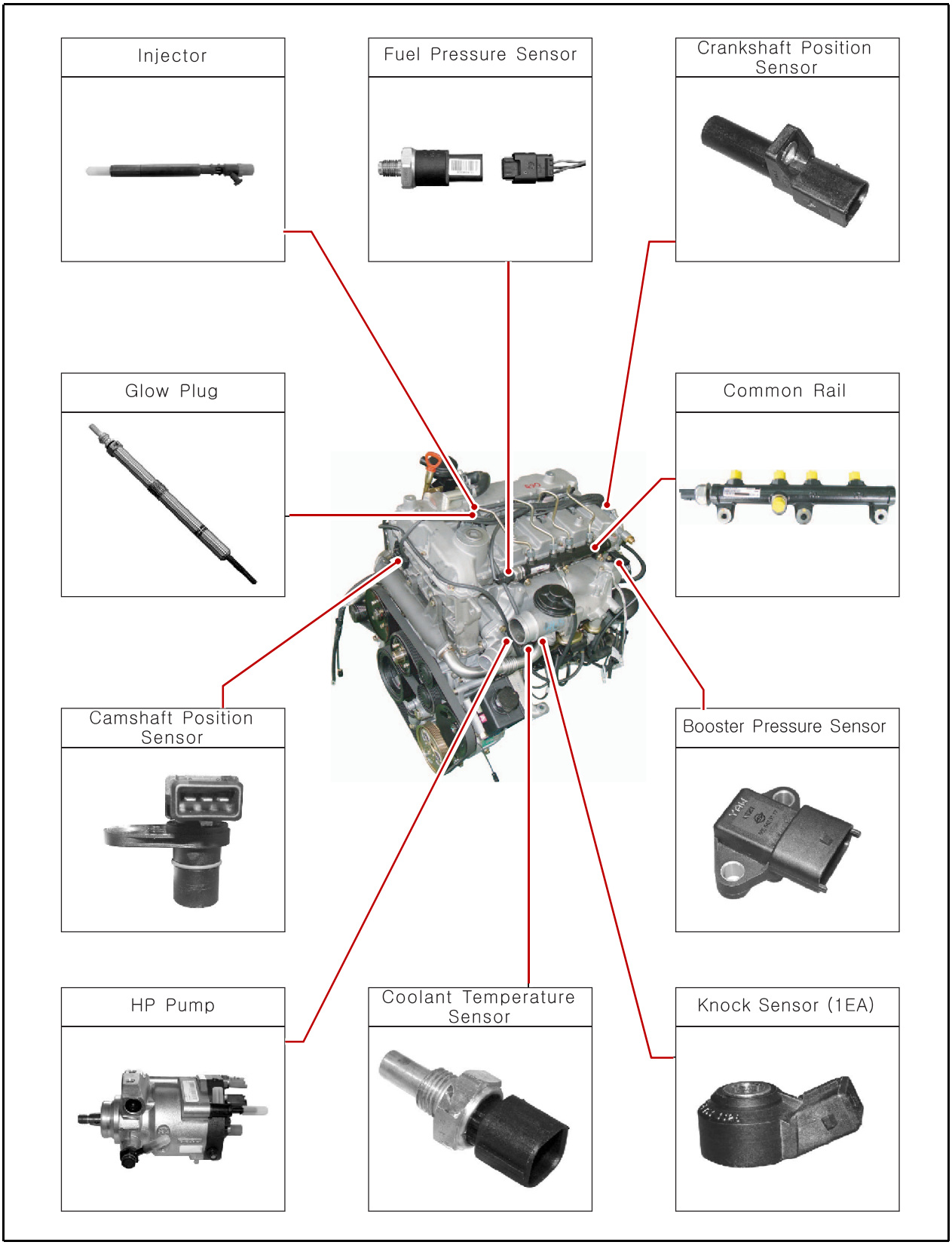
(2) D27DT Engine



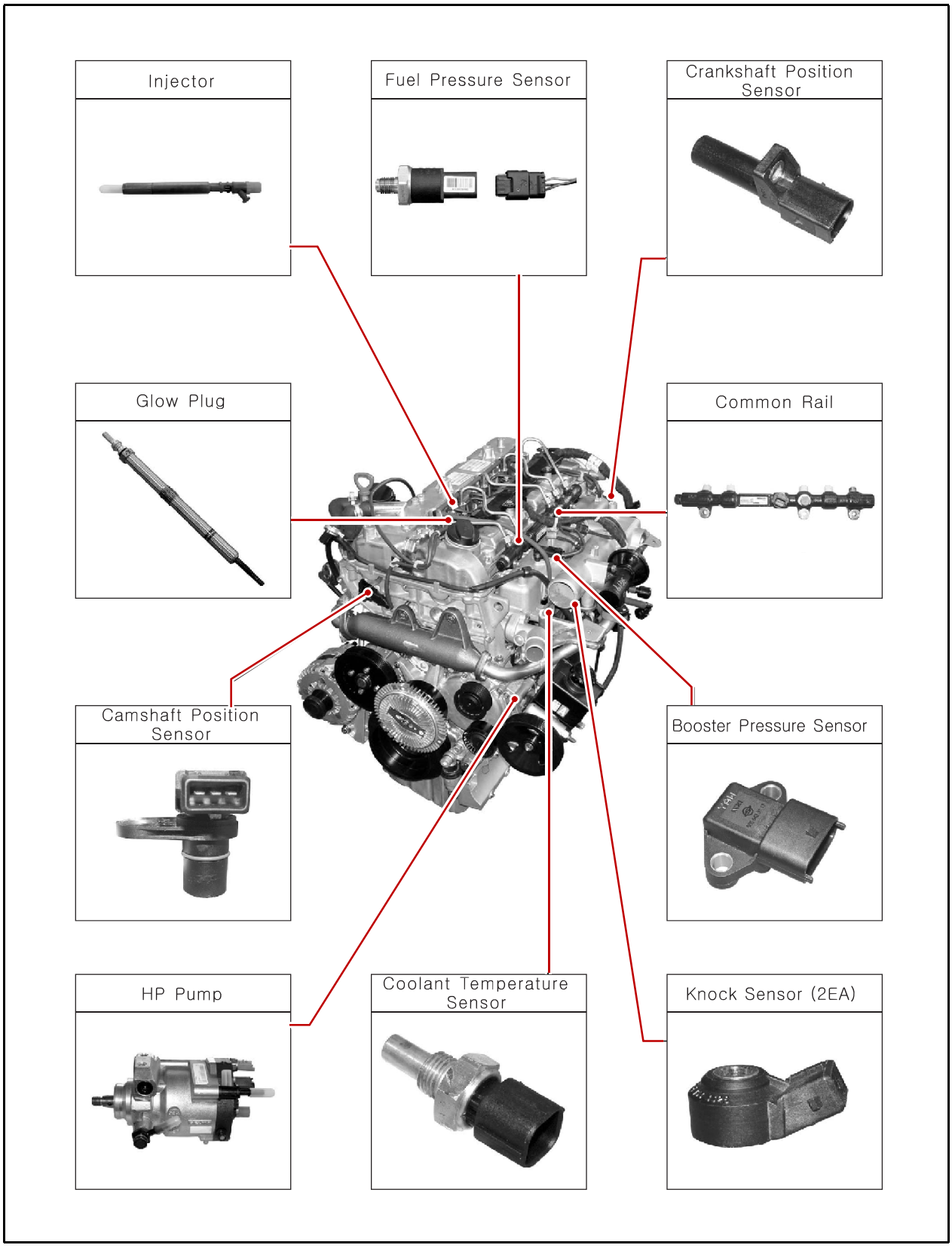
Modification basis	
Application basis	
Affected VIN	

2) ENGINE AND SENSORS

(1) D20DT Engine



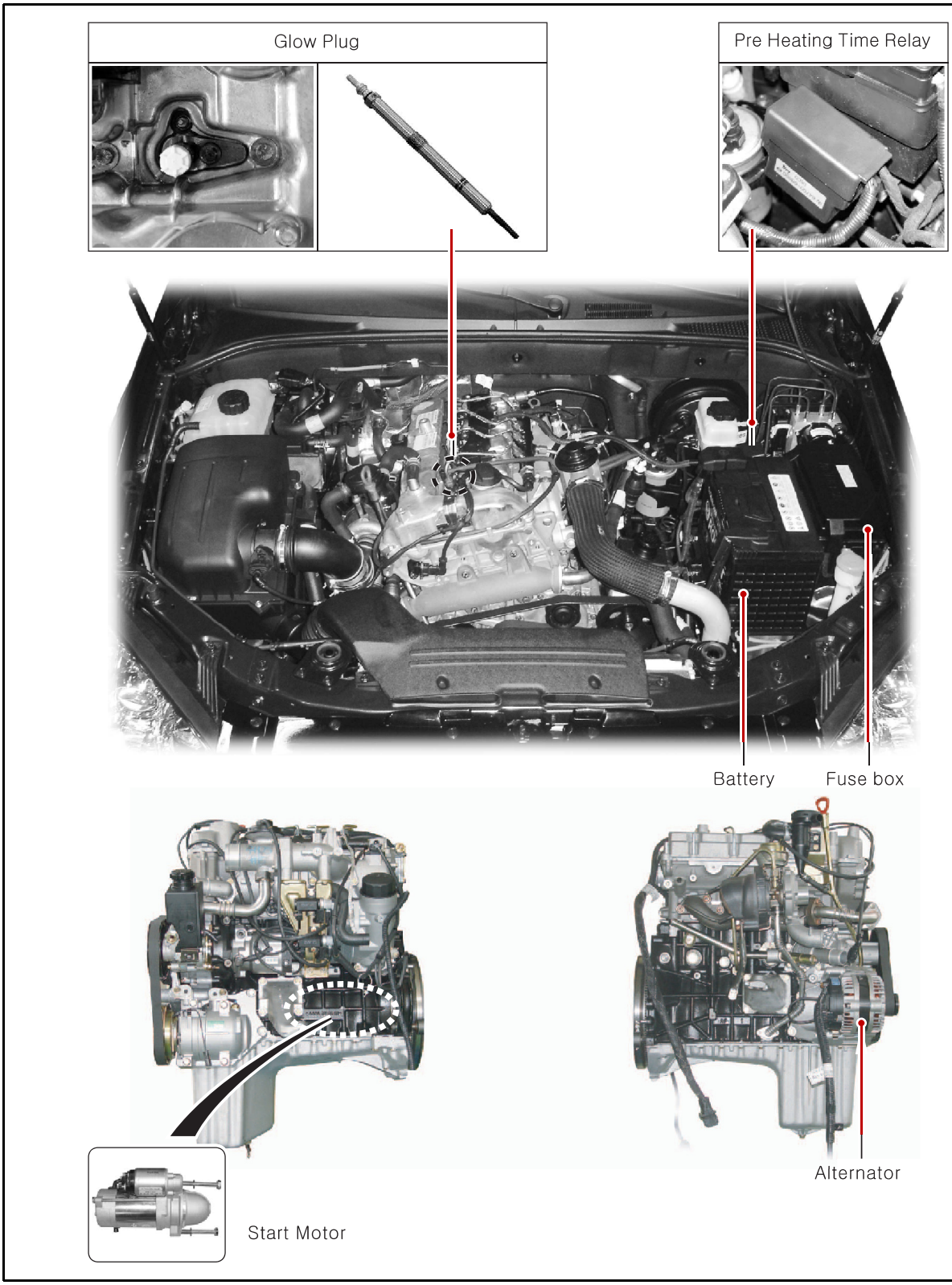
(2) D27DT Engine



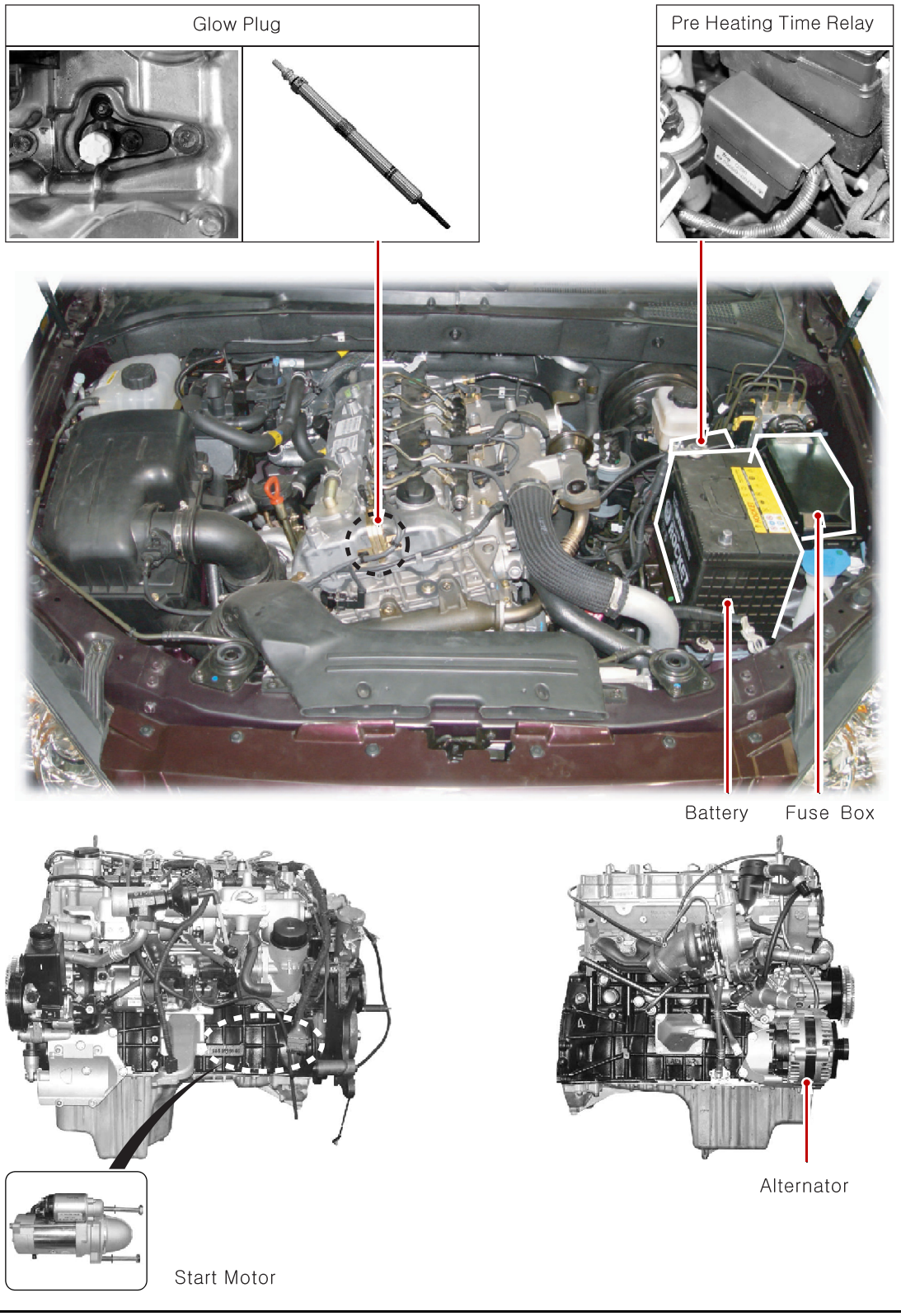
Modification basis	
Application basis	
Affected VIN	

4. ELECTRICAL COMPONENTS AND PREHEATING SYSTEM

1) D20DT Engine



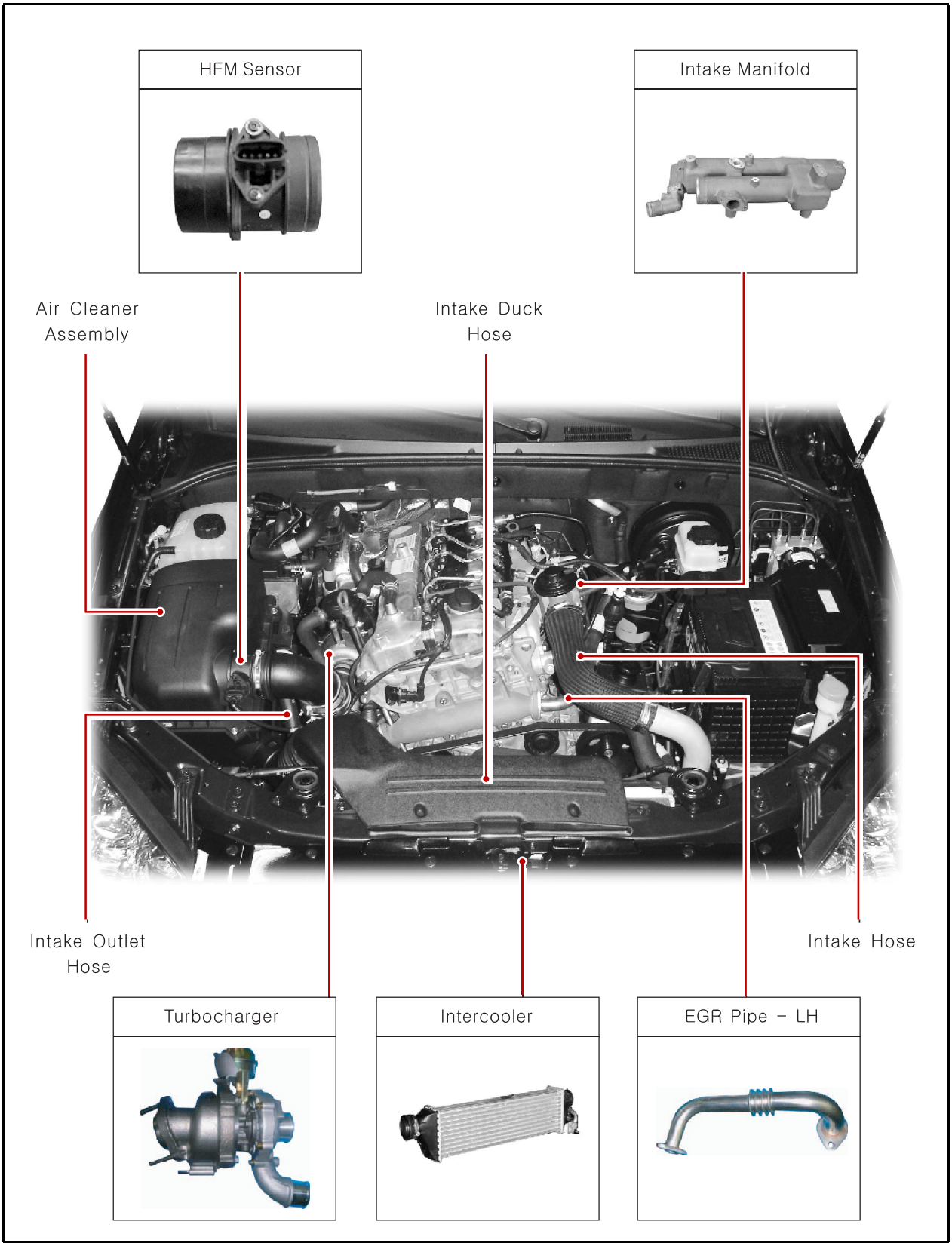
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

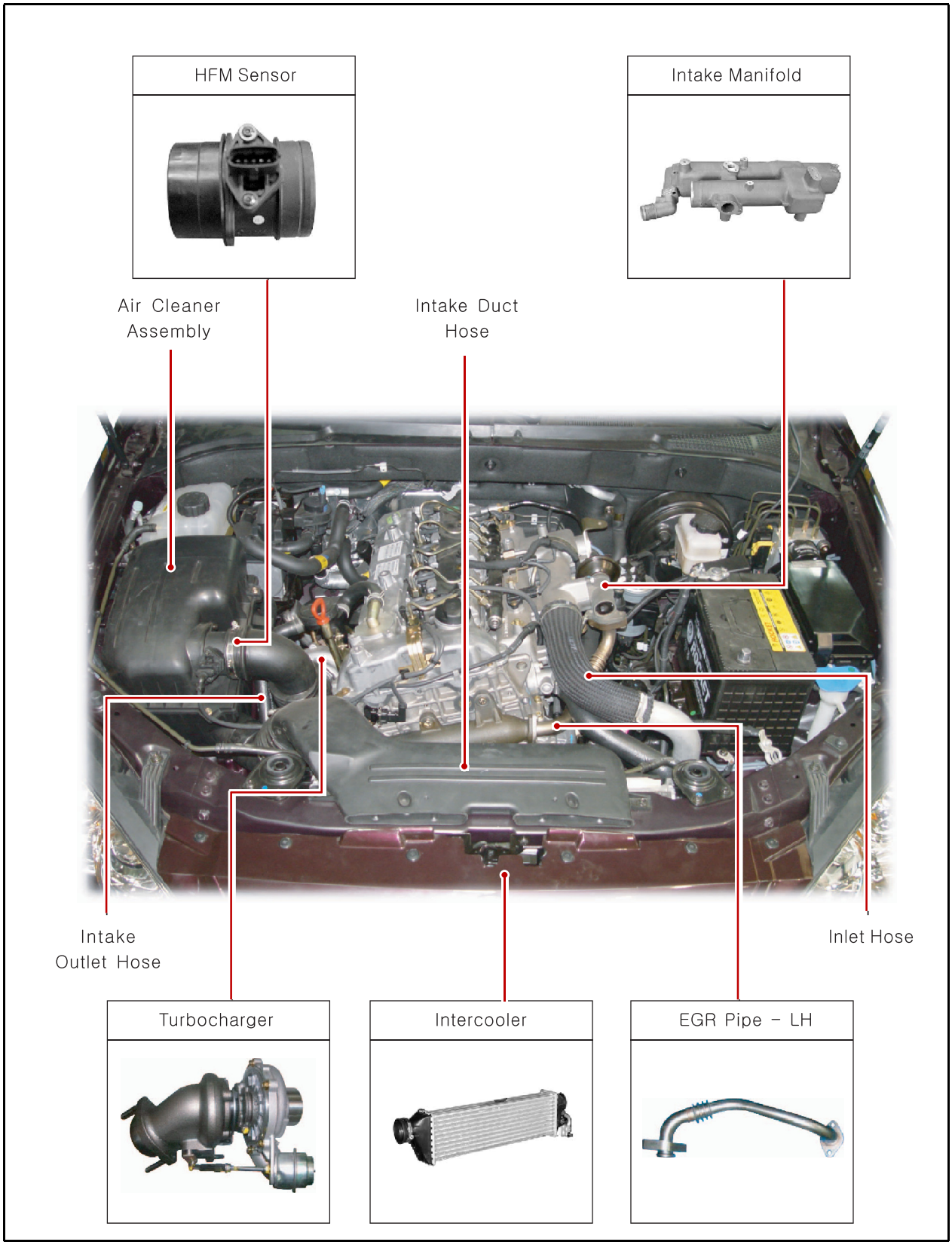
5. INTAKE SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

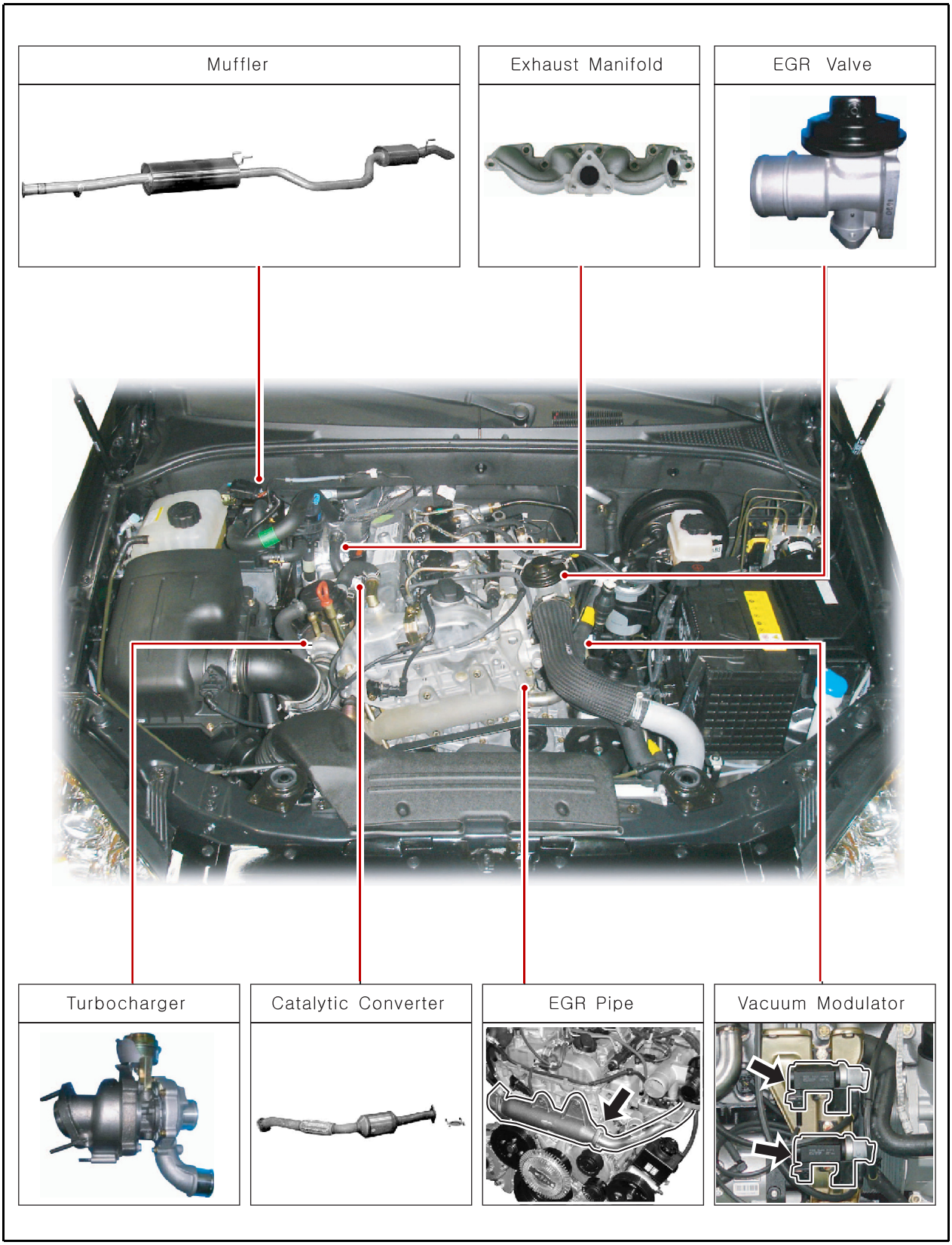
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

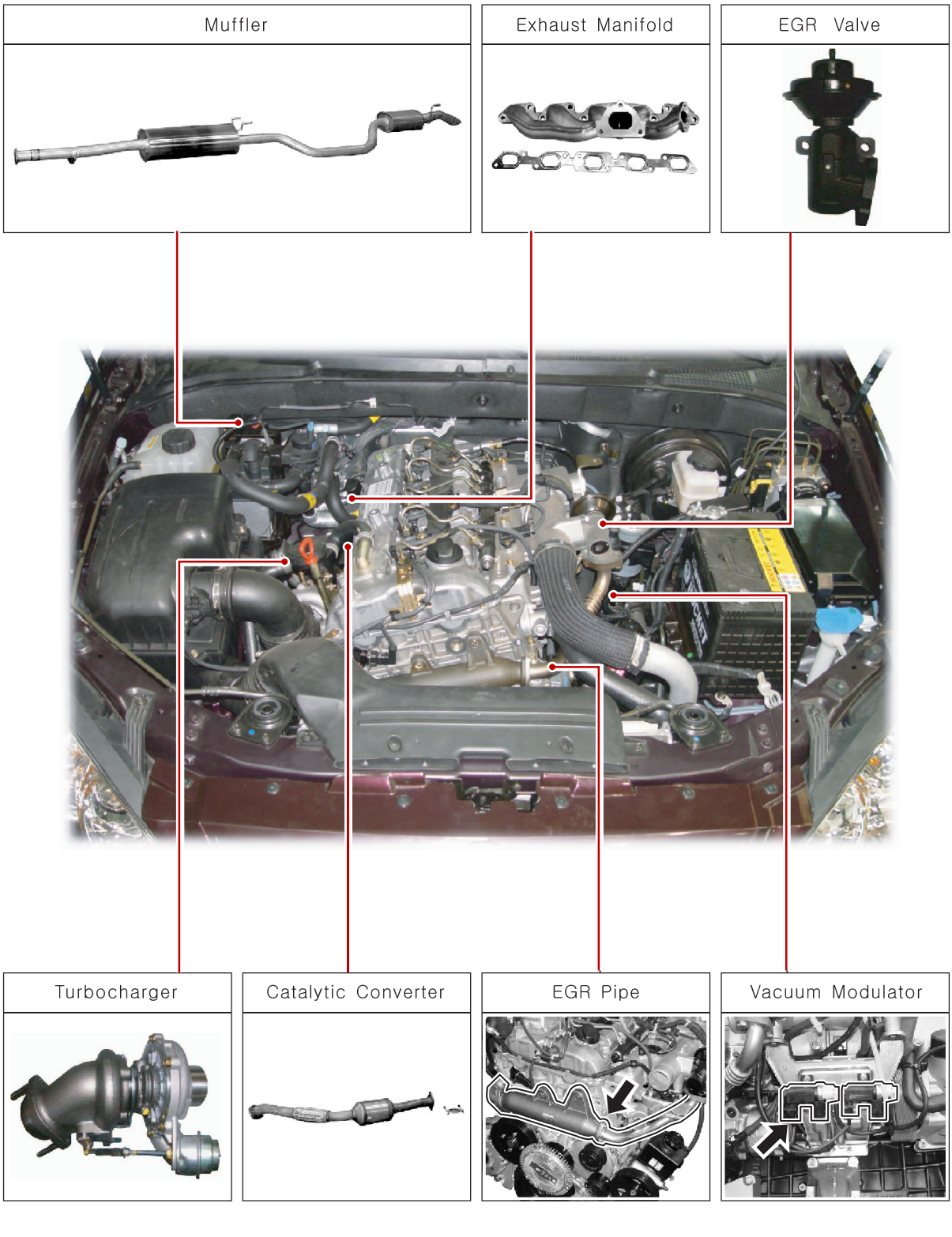
6. EXHAUST SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

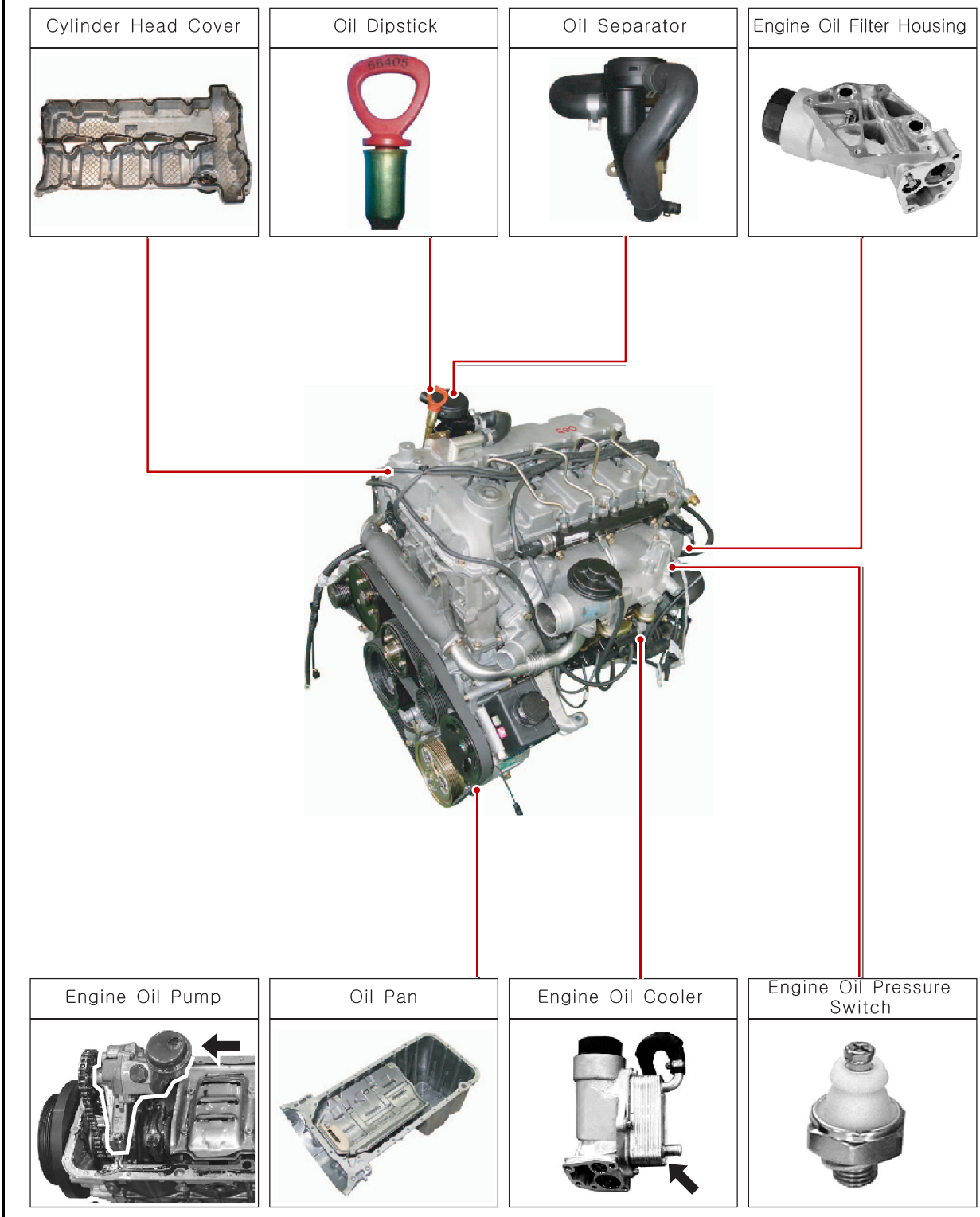
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

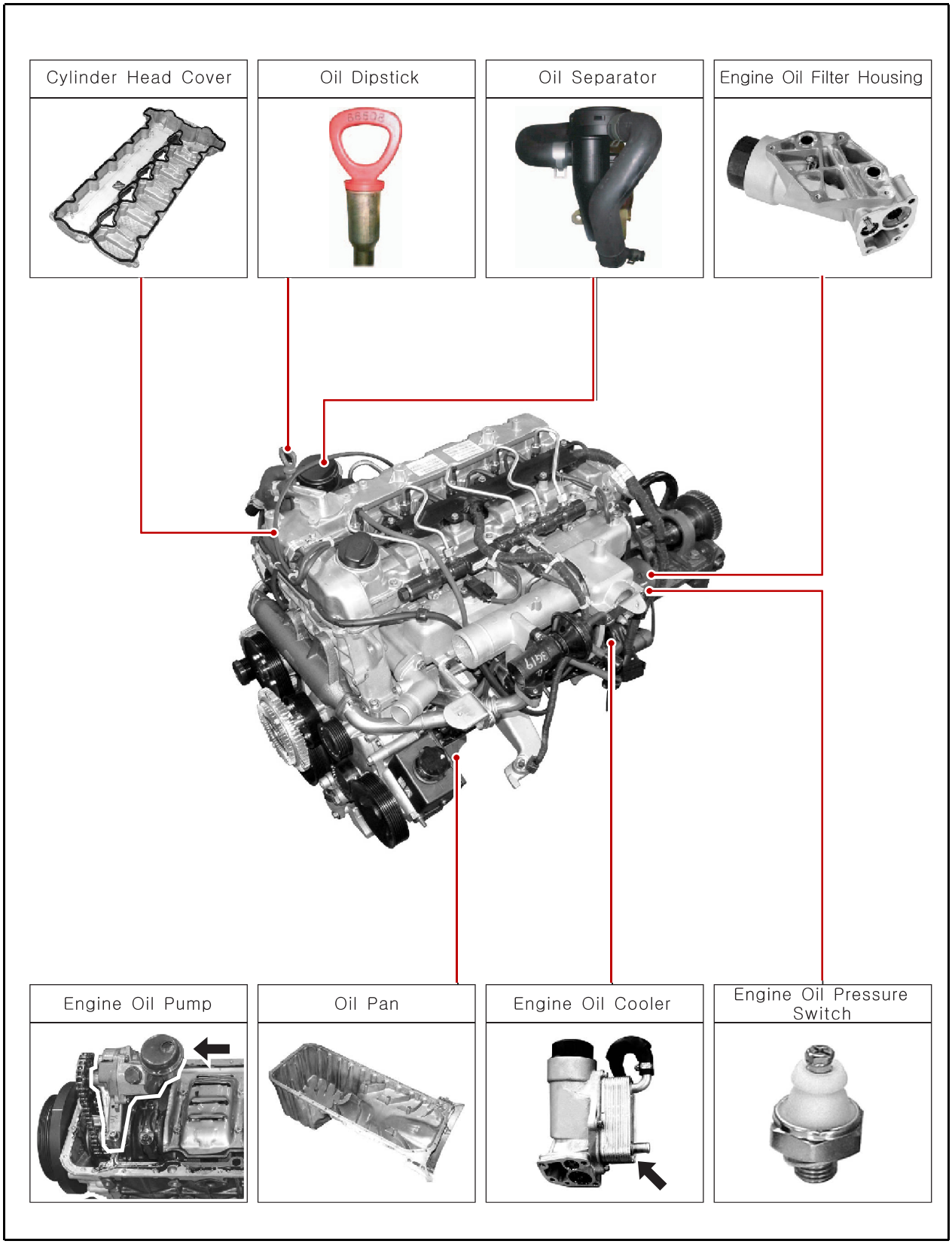
7. LUBRICATION SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

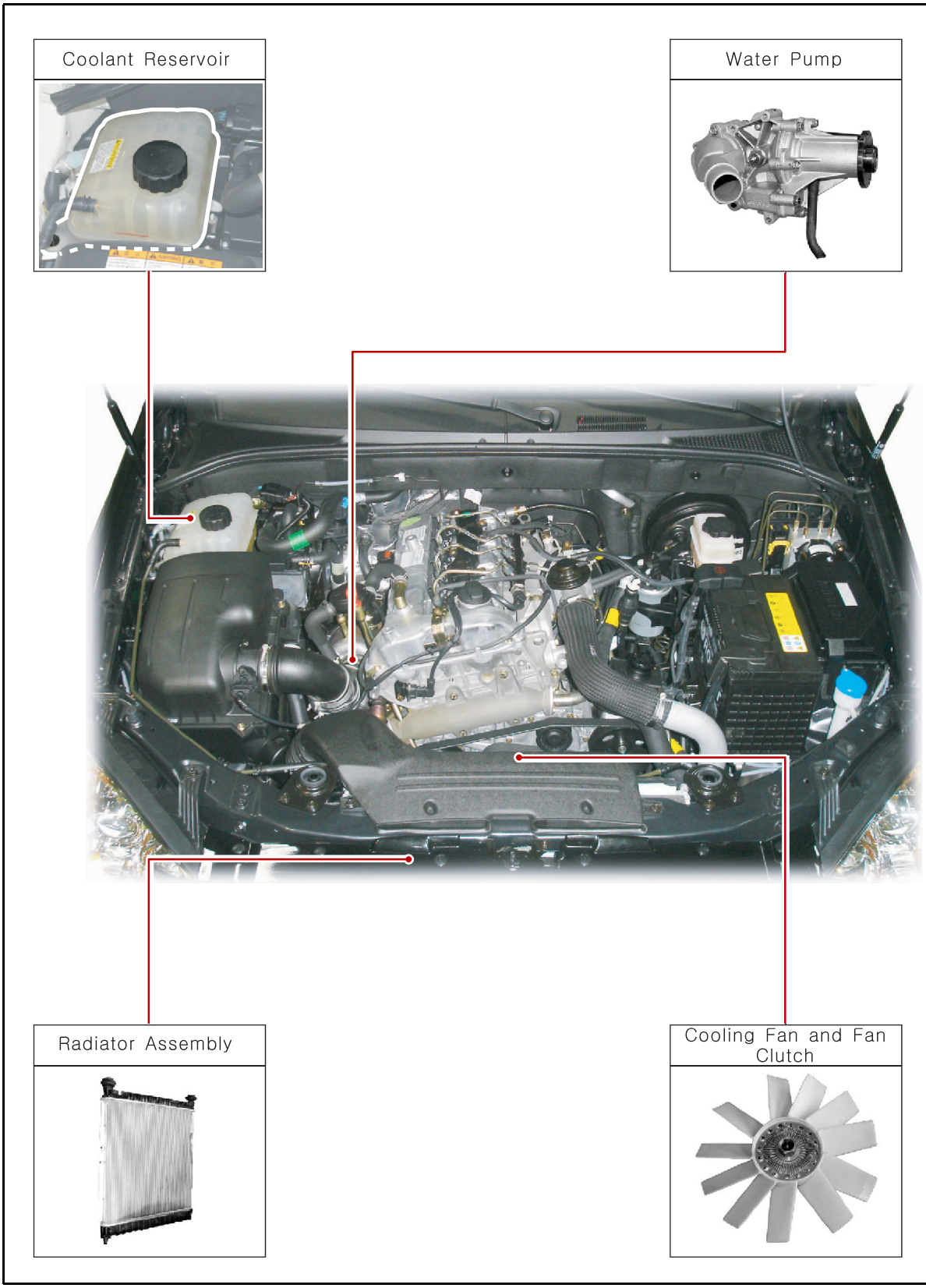
2) D27DT Engine



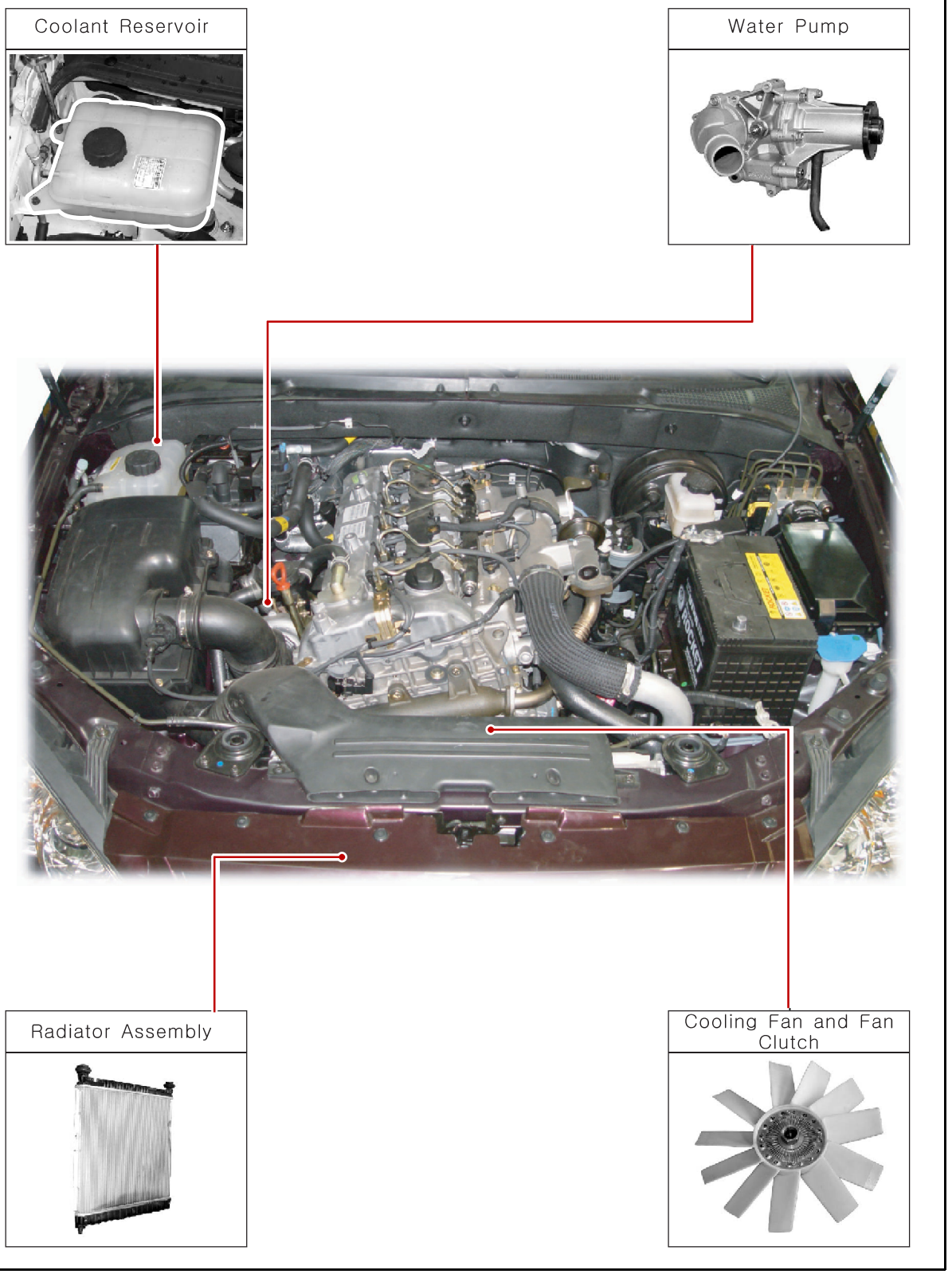
Modification basis	
Application basis	
Affected VIN	

8. COOLING SYSTEM LAYOUT

1) D20DT Engine



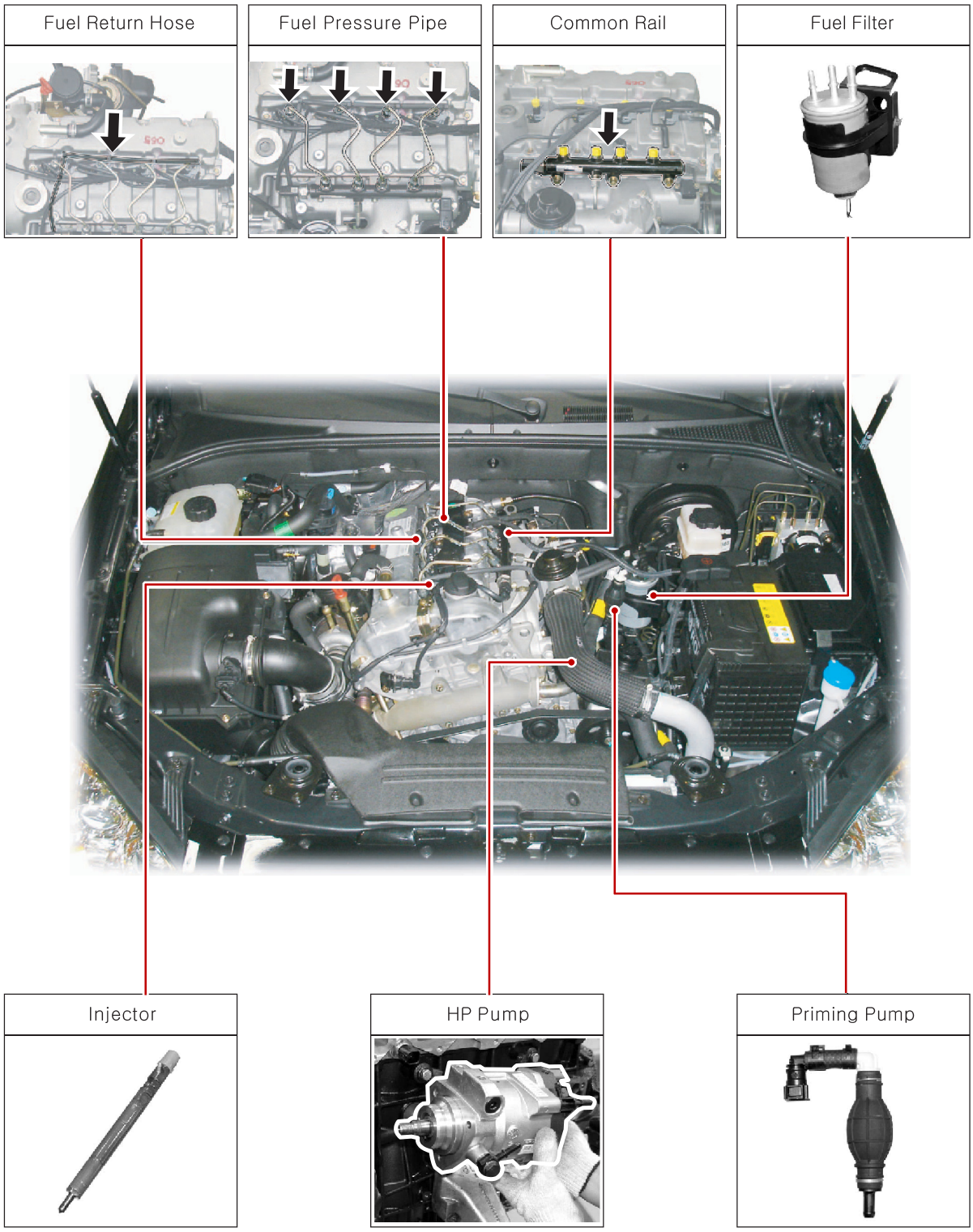
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

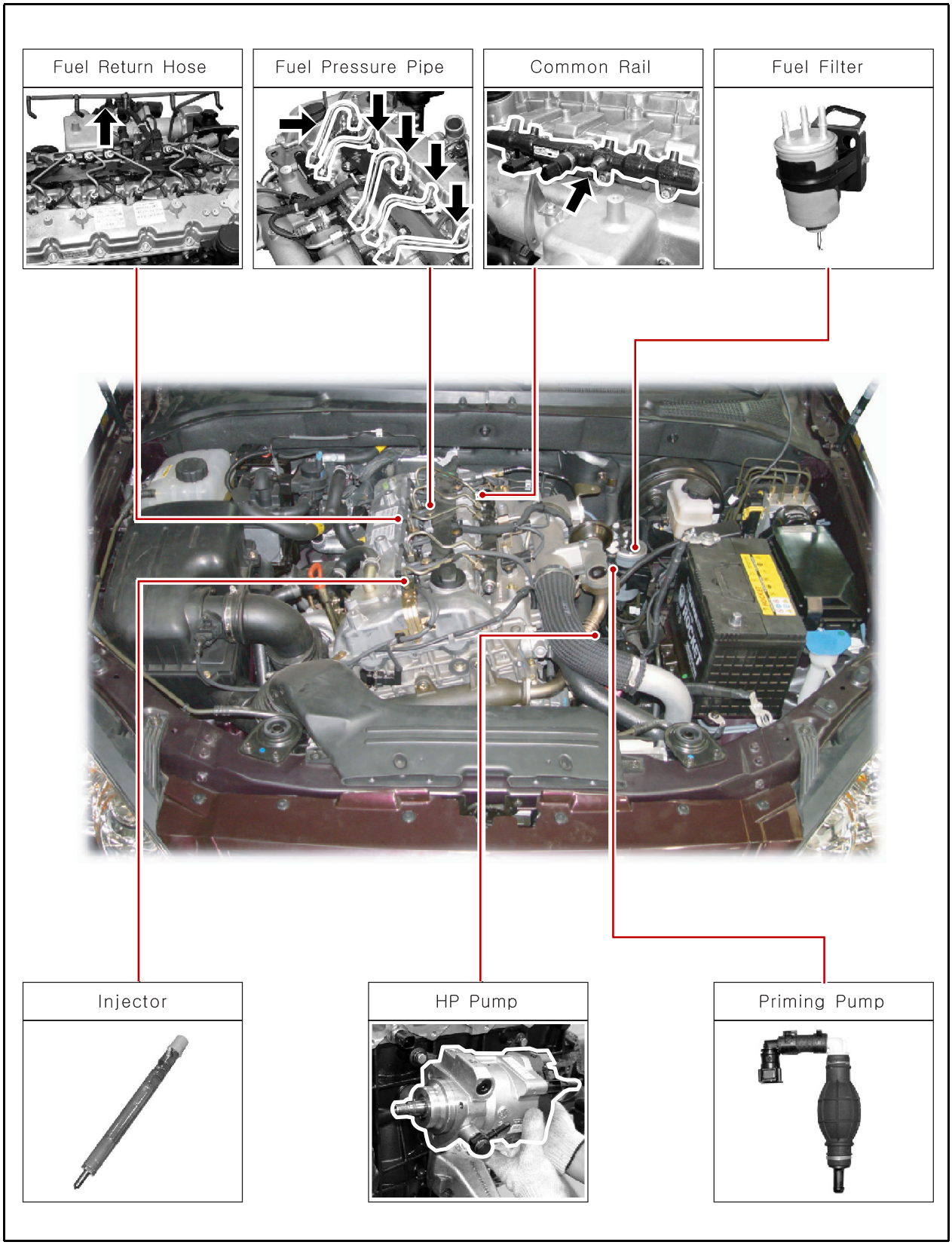
9. FUEL SYSTEM LAYOUT

1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

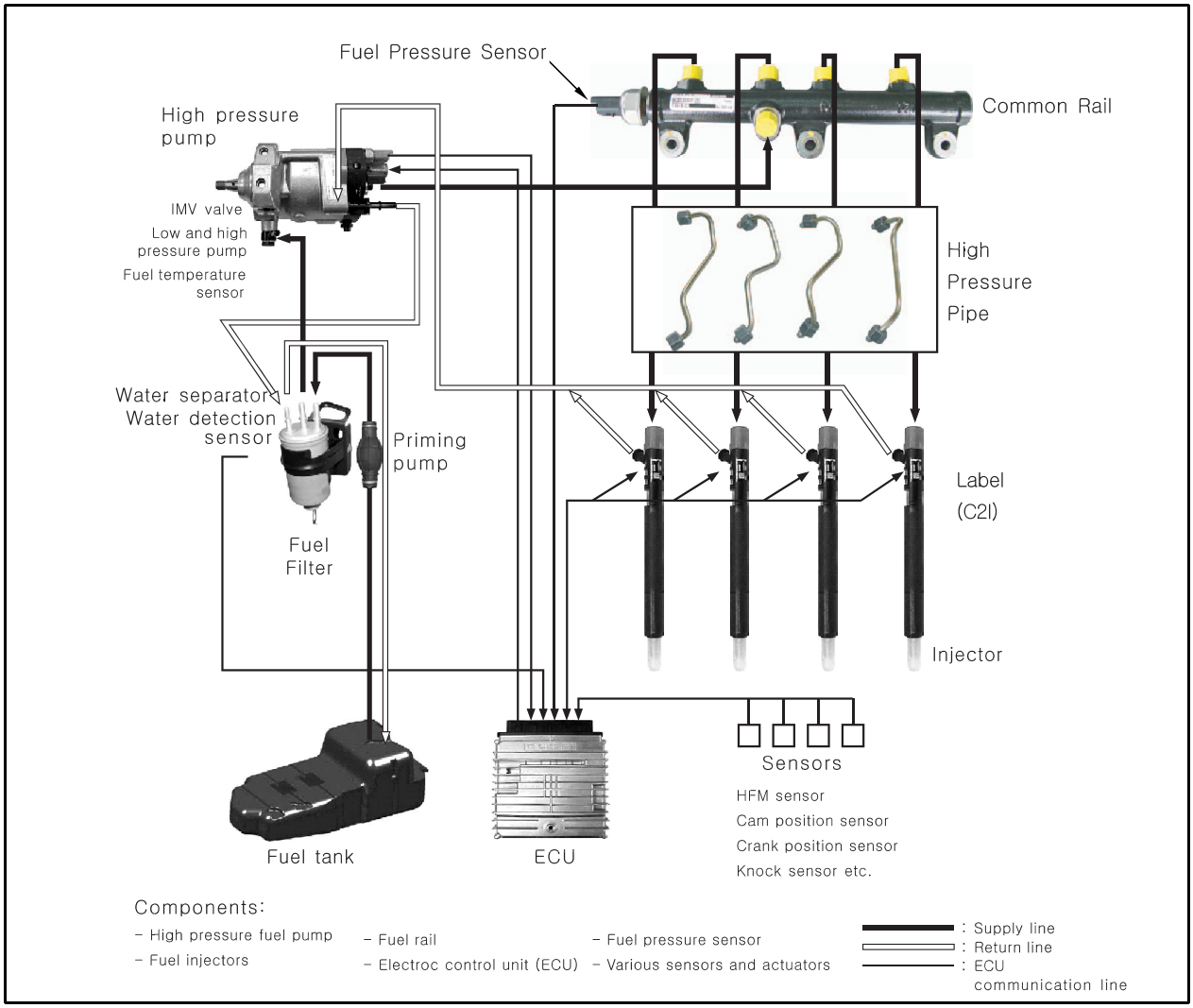
2) D27DT Engine



Modification basis	
Application basis	
Affected VIN	

10. FUEL SUPPLY SYSTEM

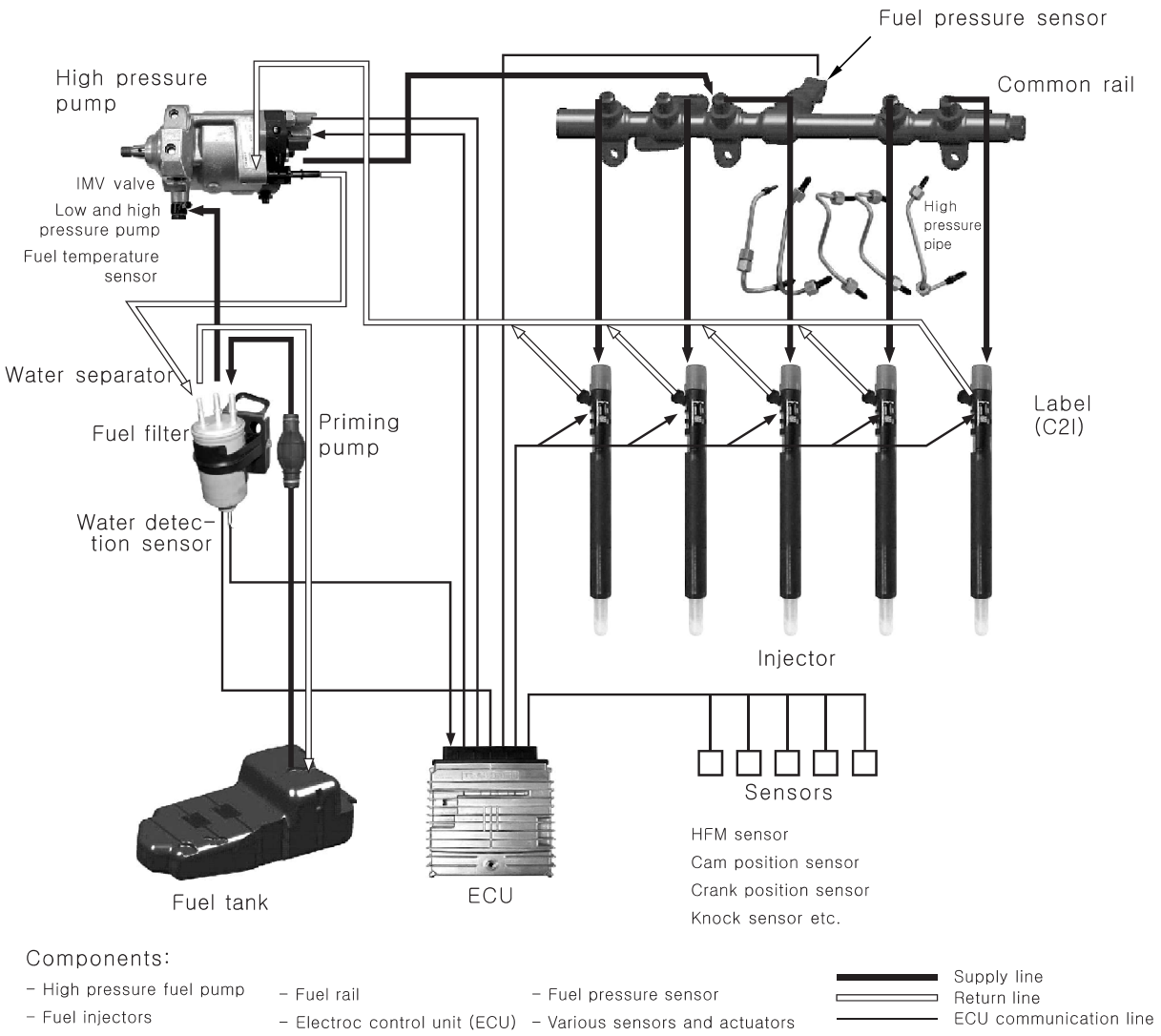
1) D20DT Engine



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

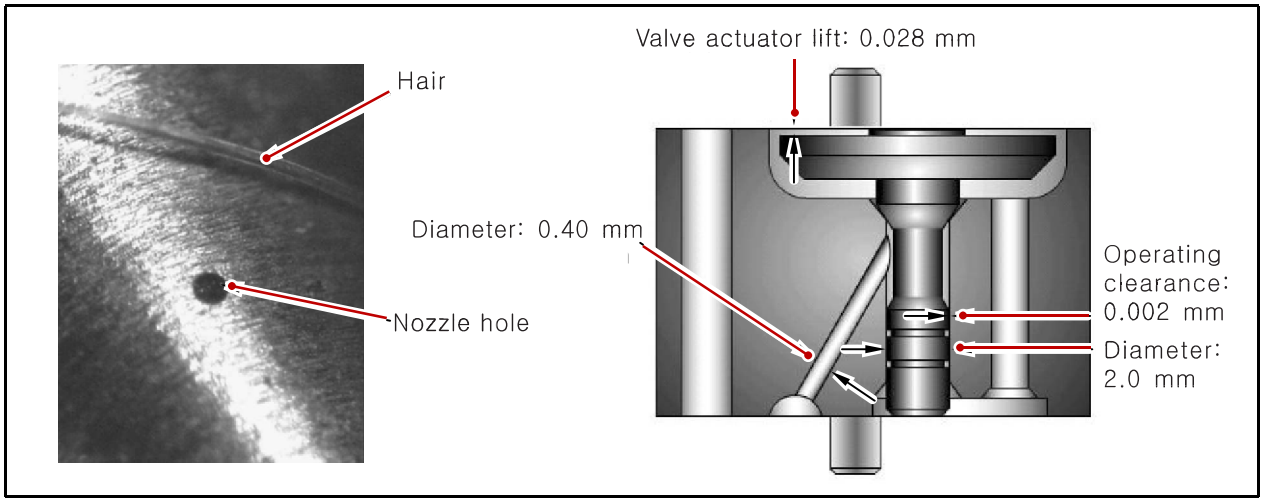


Modification basis	
Application basis	
Affected VIN	

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).

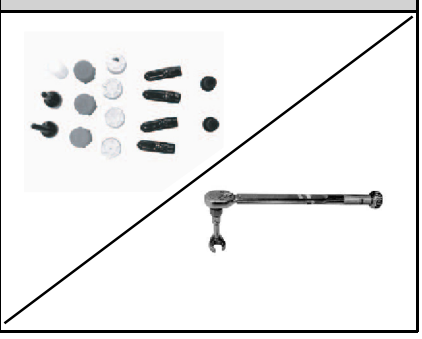
↓

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)

↓

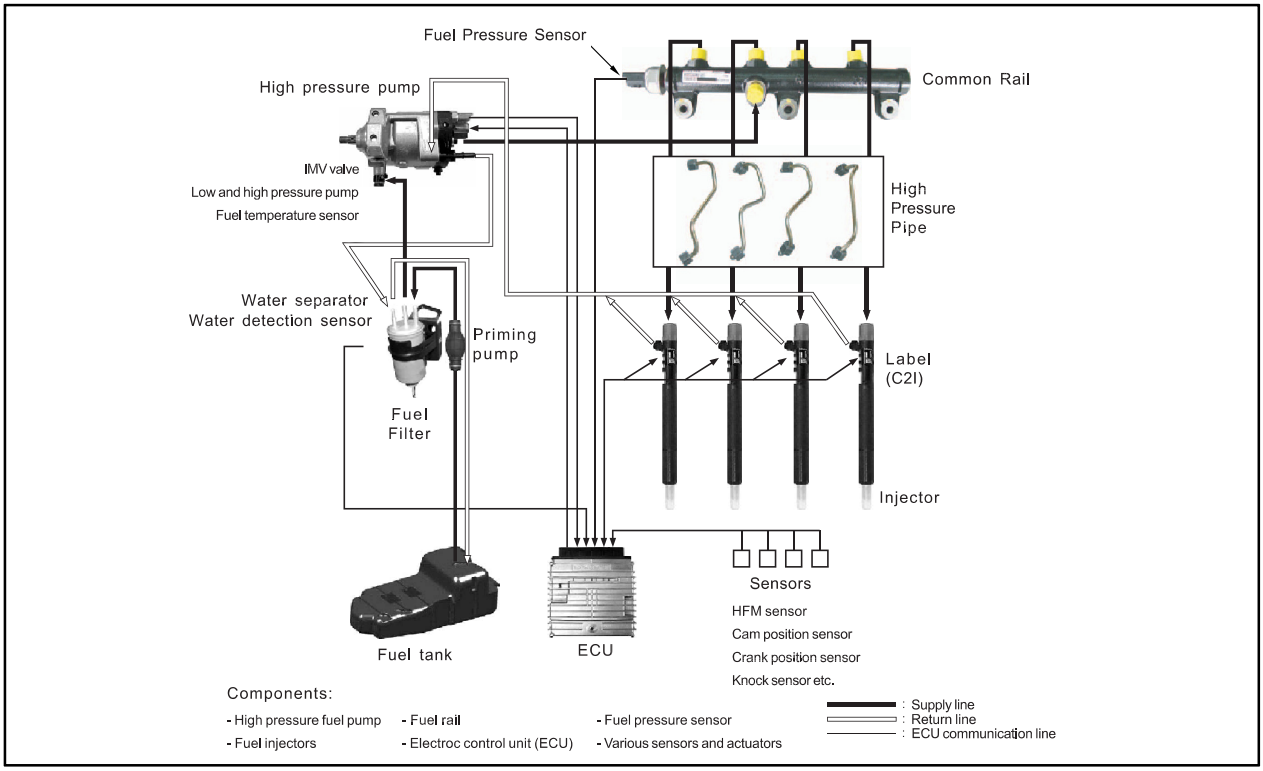
Use special tools and torque wrench to perform the correct works.

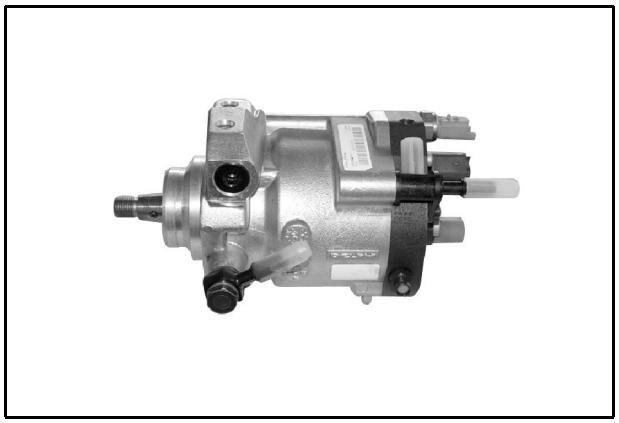
Once disconnected, the fuel pipes between HP pump and fuel rail and between fuel rail and each injector should be replaced with new ones. The pipes should be tightened to specified tightening torques during installation. Over or under torques out of specified range may cause damages and leaks at connections. 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.

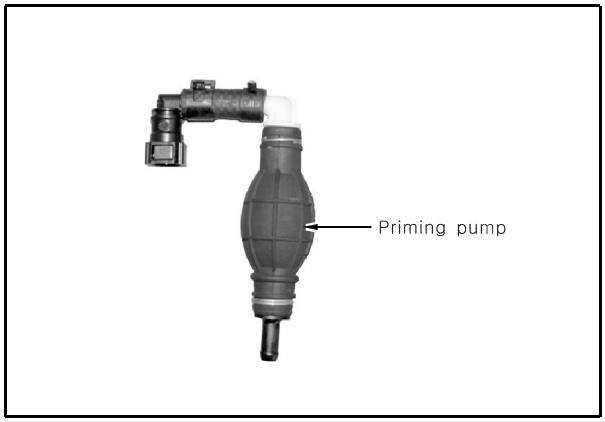
↓

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





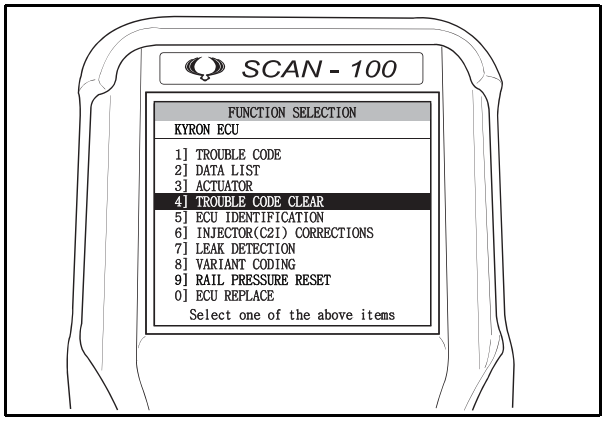
7. Plug the removed components with clean and undamaged sealing caps and store it into the box to keep the conditions when it was installed.
8. Clear the high pressure offset value by SCAN- 100 after replacing the high pressure pump.



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

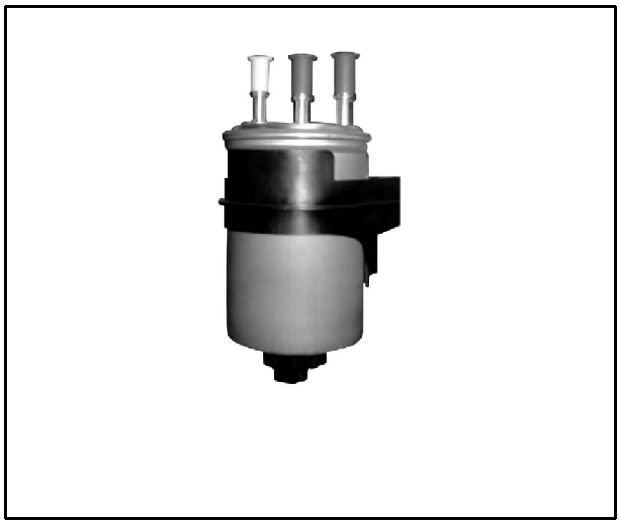
▶ SYSTEM SUPPLEMENT AGAINST PARAFFIN SEPARATION.

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.

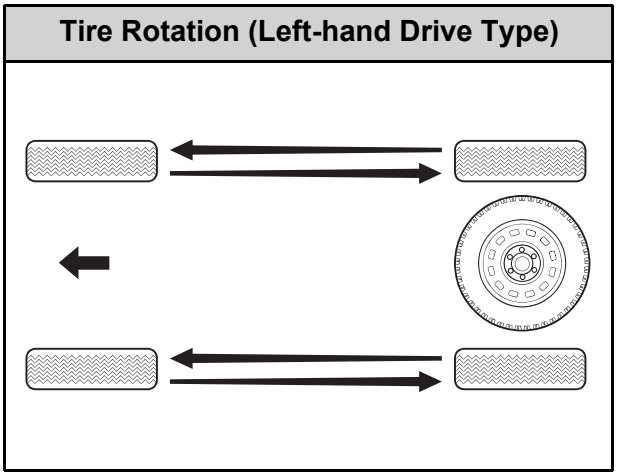
▷ **Brake System Service**

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.

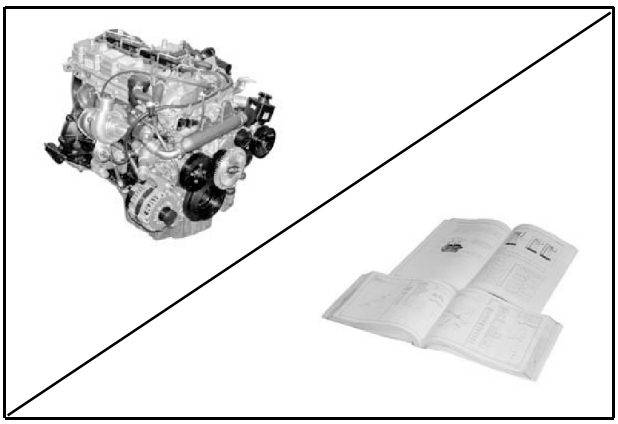
Tire Rotation (Left-hand Drive Type)



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)

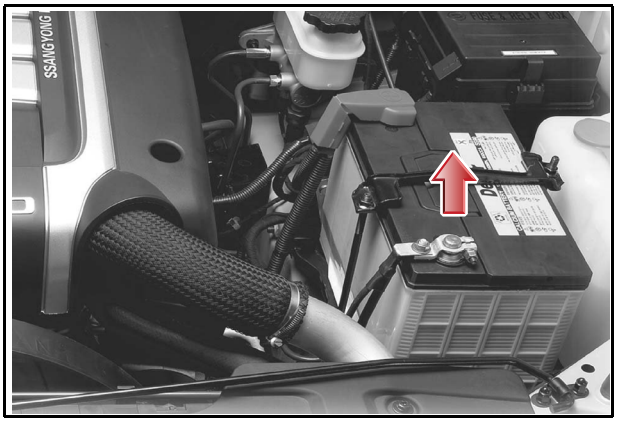
▶ Electrical equipment

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.

Modification basis	
Application basis	
Affected VIN	

14. DURING SERVICE WORK FOR INSPECTION



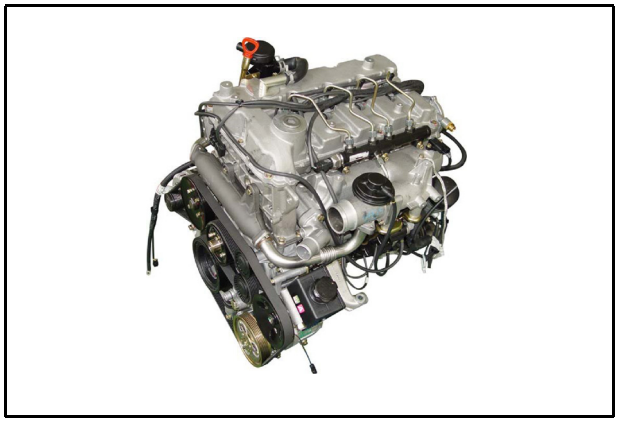
1. Before lifting up the vehicle with lift, correctly support the lifting points and lift up.
2. When using a jack, park the vehicle on the level ground and block front and rear wheels. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
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.

Modification basis	
Application basis	
Affected VIN	

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.

Modification basis	
Application basis	
Affected VIN	

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

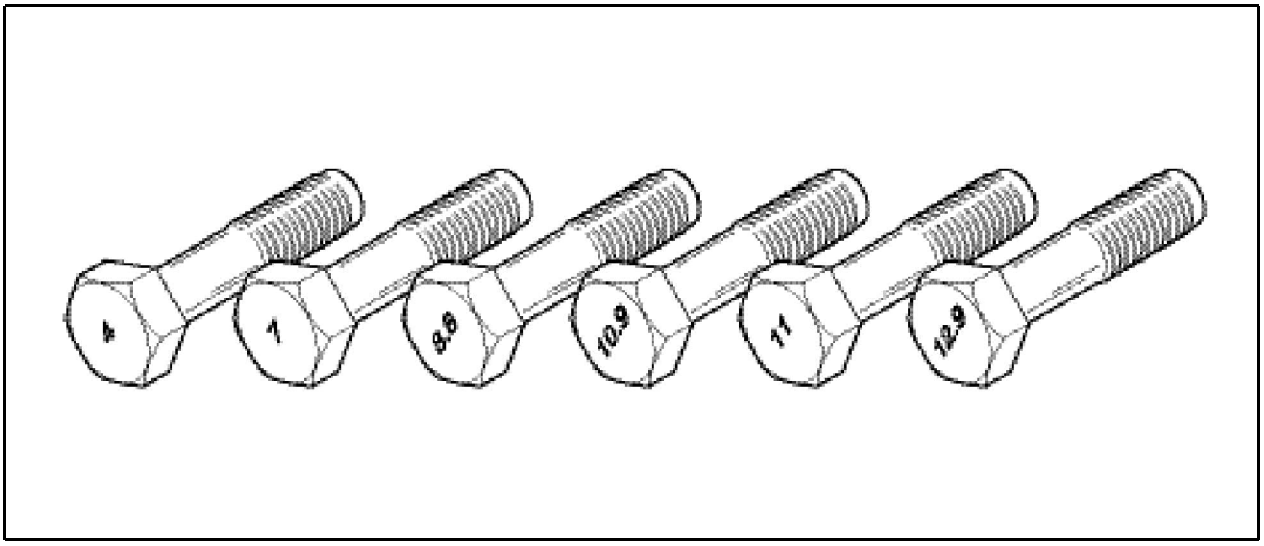
Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. 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

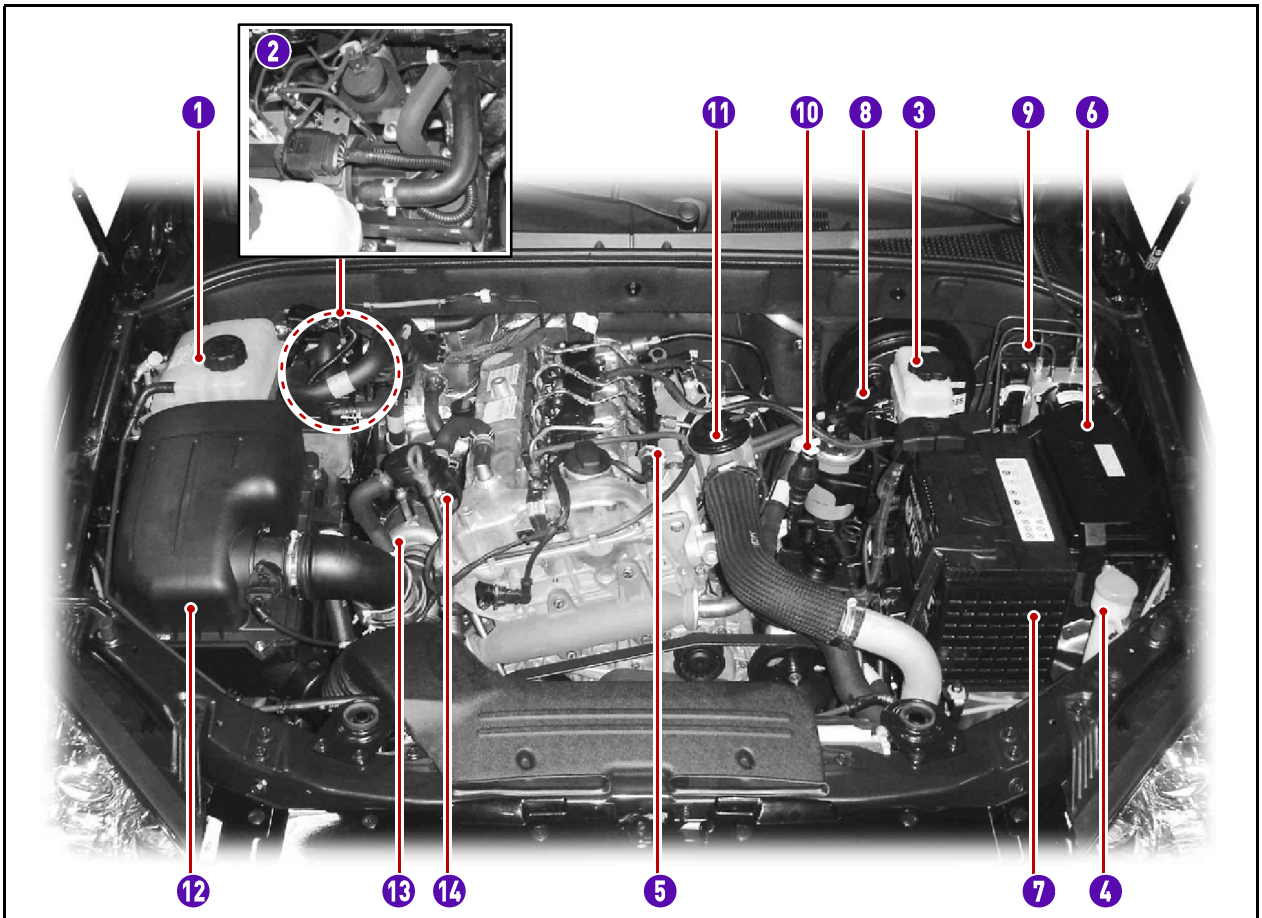
ENGINE ASSEMBLY 1114-01

GENERAL

1. MA4JOR COMPONENTS IN ENGINE AND ENGINE COMPARTMENT

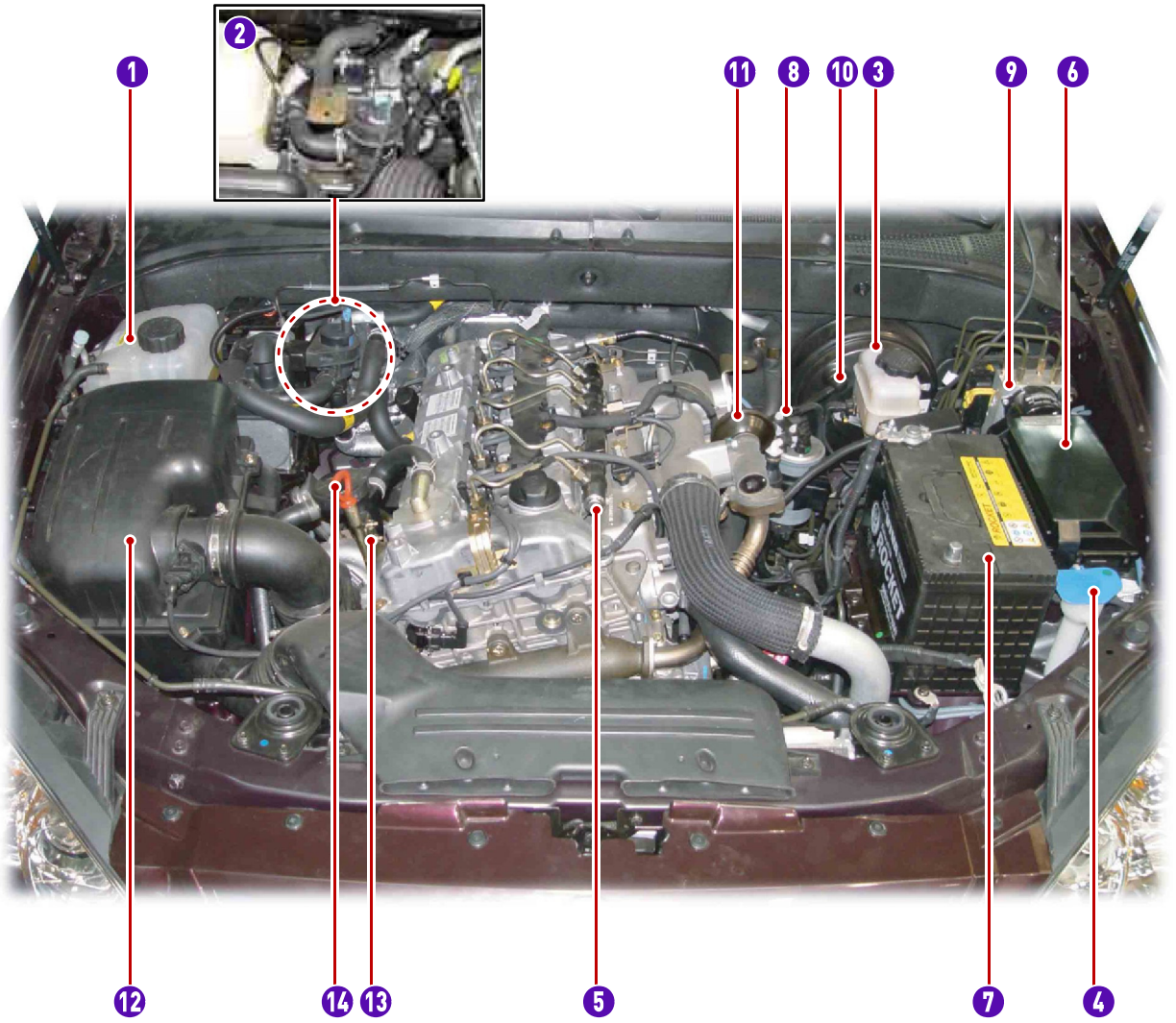
1) D20DT ENGINE

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



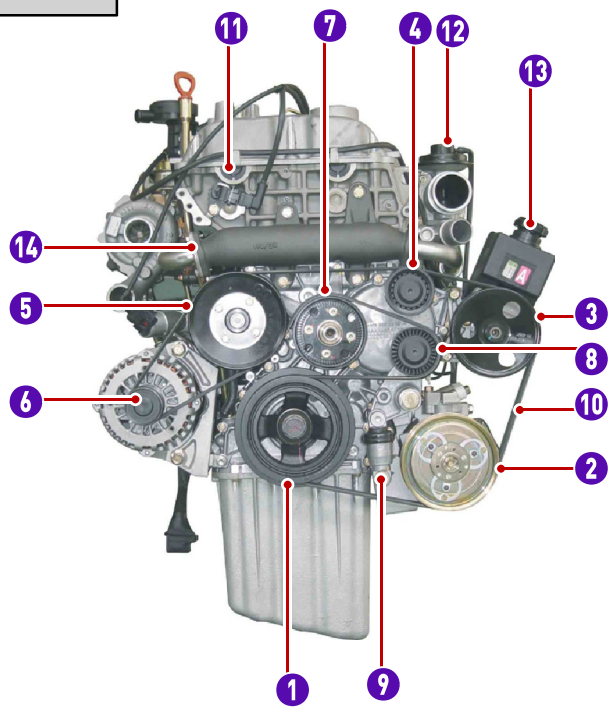
1	Coolant reservoir	8	Fuel filter
2	FFH device	9	ABS/ESP unit
3	Brake fluid reservoir	10	Priming pump
4	Washer fluid reservoir	11	EGR valve
5	Common rail	12	Air cleaner assembly
6	Fuse box	13	Turbo charger
7	Battery	14	Oil dipstick

Modification basis	
Application basis	
Affected VIN	

2. ENGINE STRUCTURE

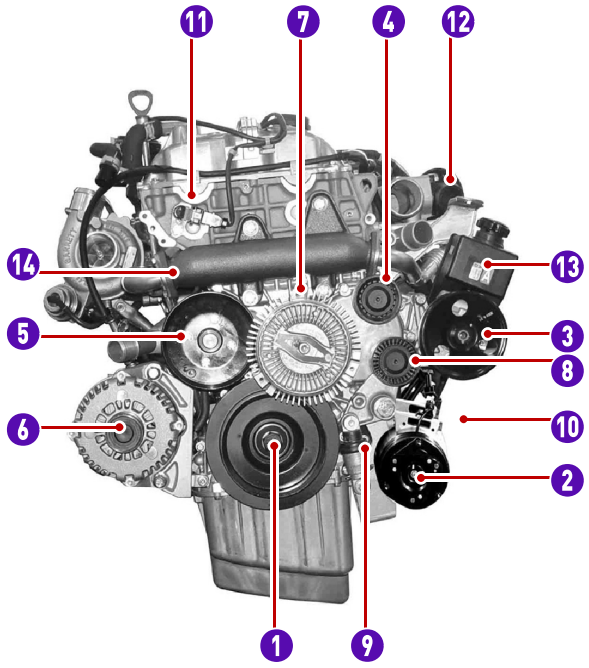
1) Front View

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

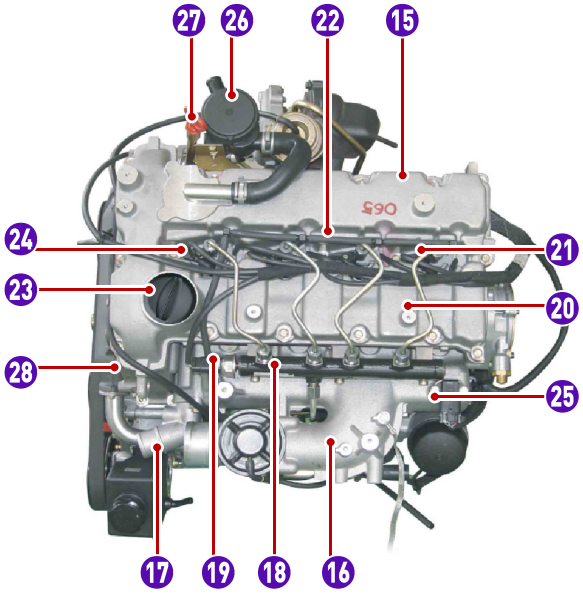
D27DT



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2	Air conditioner compressor
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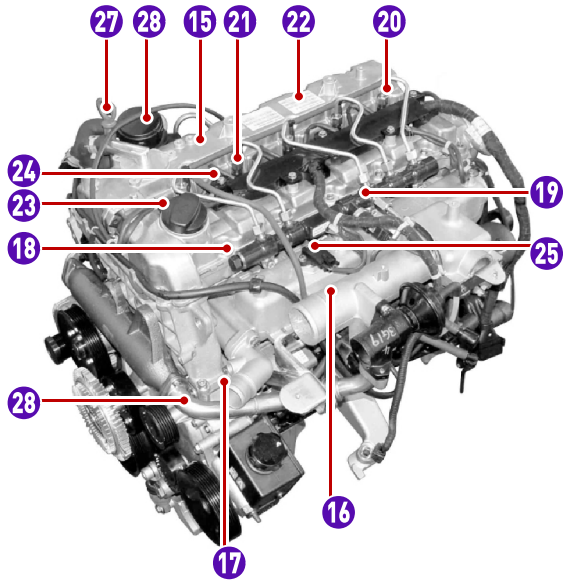
2) Top View

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

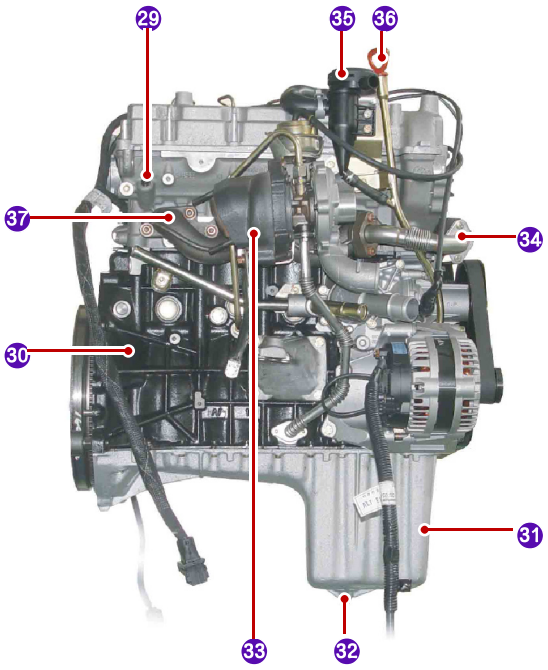


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16	Intake manifold
17	Water outlet port
18	Common rail
19	Fuel pressure sensor
20	Fuel pipe
21	Injector
22	Fuel return line
23	Oil filler cap
24	Glow plug
25	Booster pressure sensor
26	PCV valve and oil separator
27	Oil dipstick
28	EGR-LH pipe

Modification basis	
Application basis	
Affected VIN	

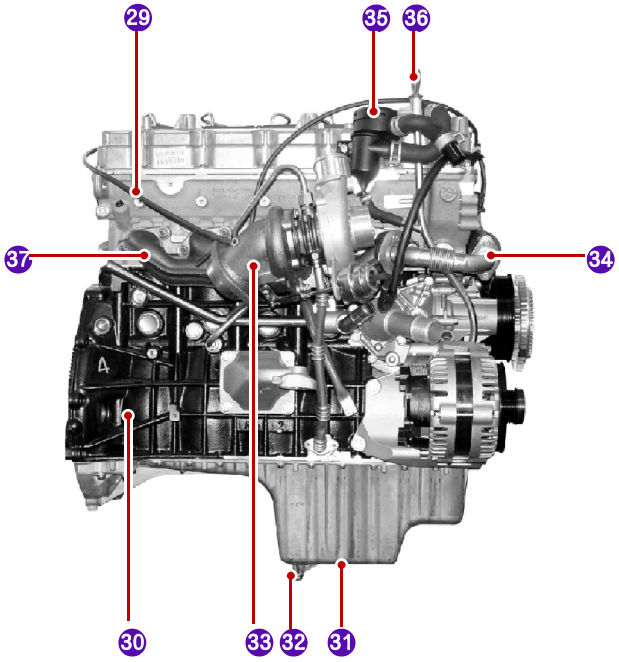
3) Right Side View

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

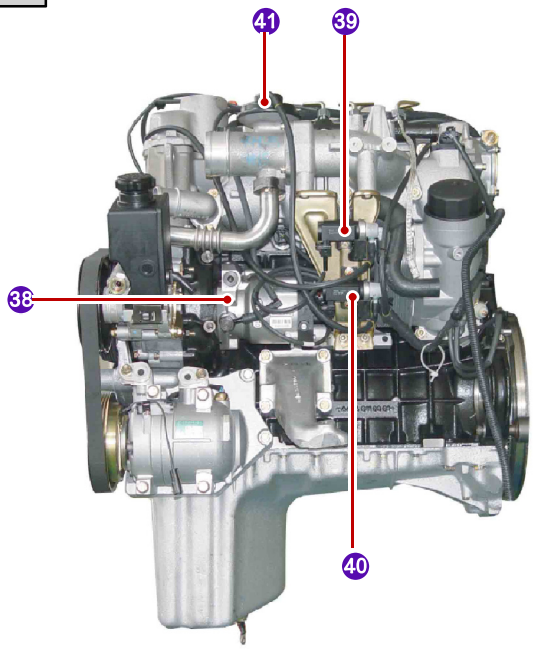
D27DT



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

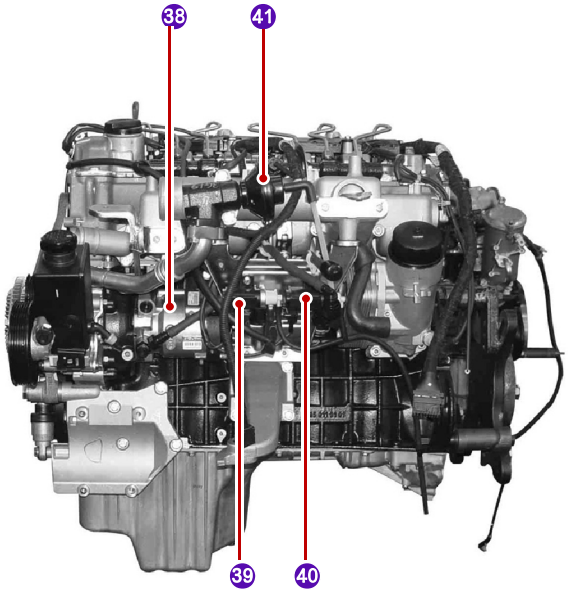
4) Left Side View

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

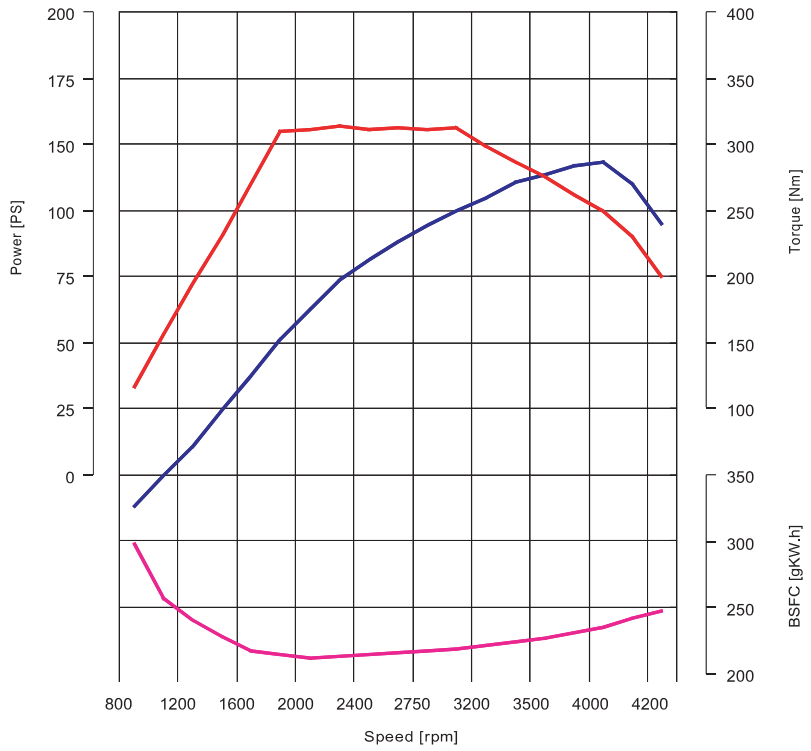
Description			D20DT	D27DT
Engine	Type/Number of cylinders		D20DT/4-cylinder	D27DT/5-cylinder
Cylinder	Inner diameter (mm)		86.2	86.2
	Stroke (mm)		85.6	92.4
Displacement (cc)			1998	2696
Compression ratio			17.5:1	18:1
Maximum output (ps/rpm)			141/4,000	165/4,000
Maximum torque (Nm/rpm)			310/1,800 ~ 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

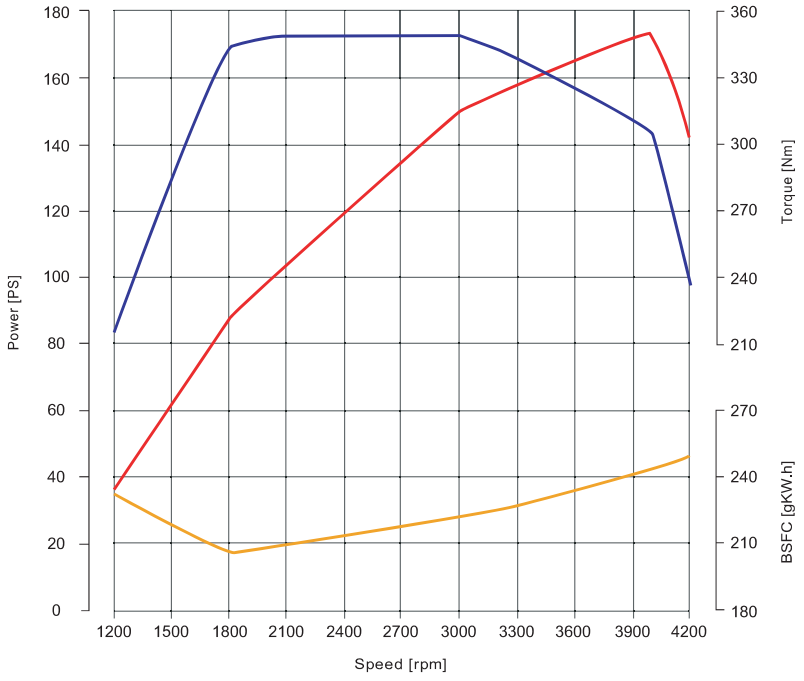
(1) Vehicle with A/T

▶ Output and Torque

D20DT engine



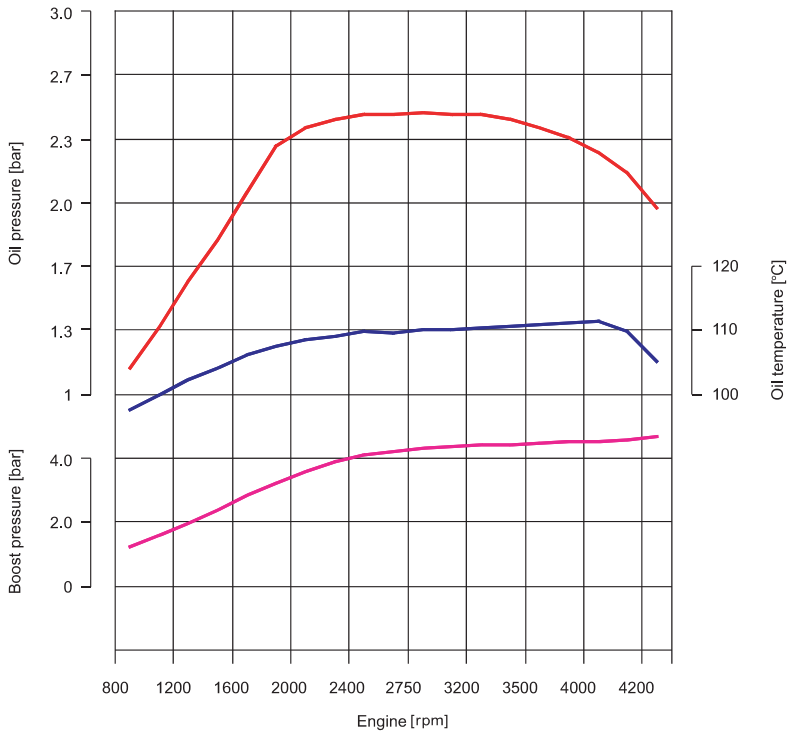
D27DT engine



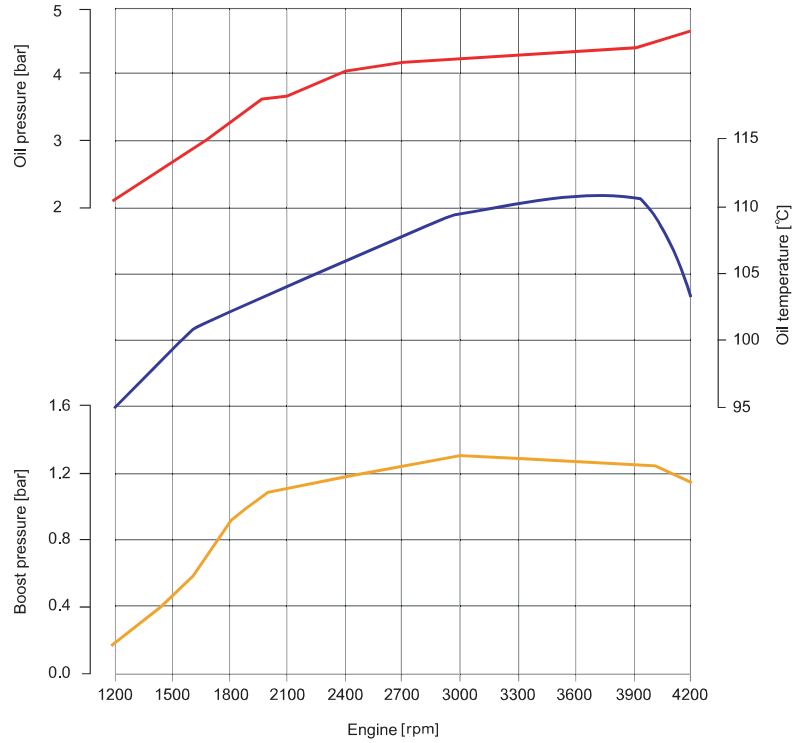
Modification basis	
Application basis	
Affected VIN	

▶ Oil Temperature/Pressure and Boost Pressure

D20DT engine



D27DT engine

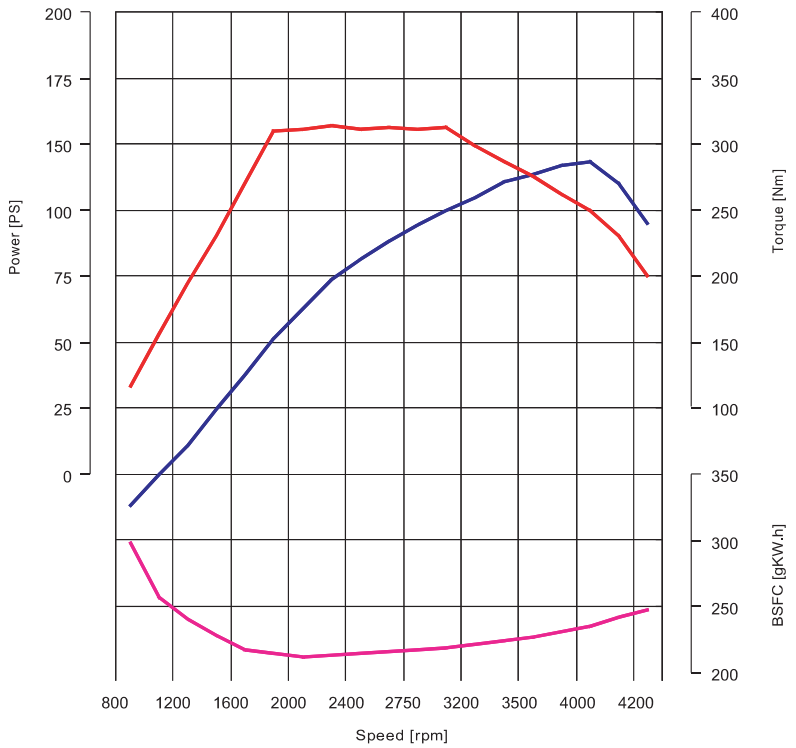


Modification basis	
Application basis	
Affected VIN	

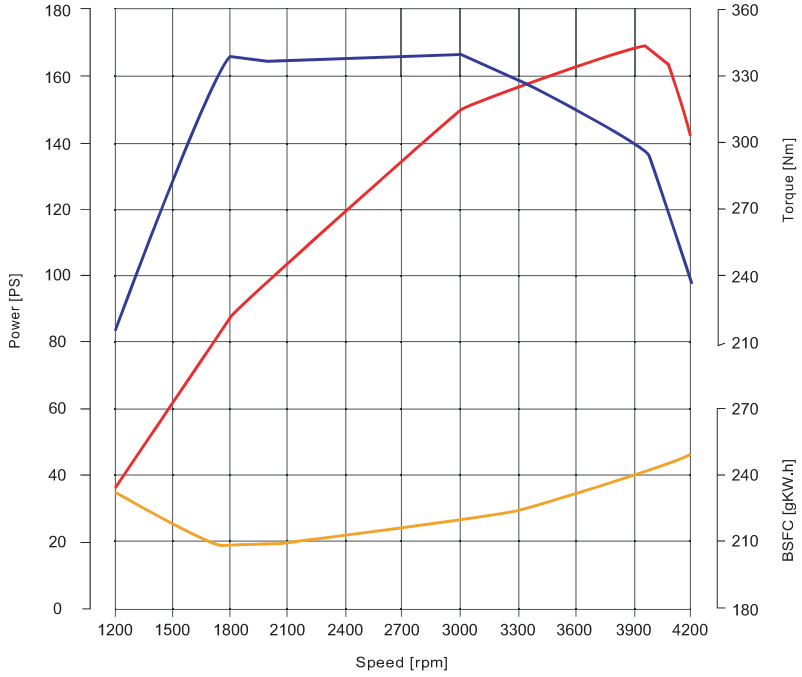
(2) Vehicle with M/T

▶ Output and Torque

D20DT engine



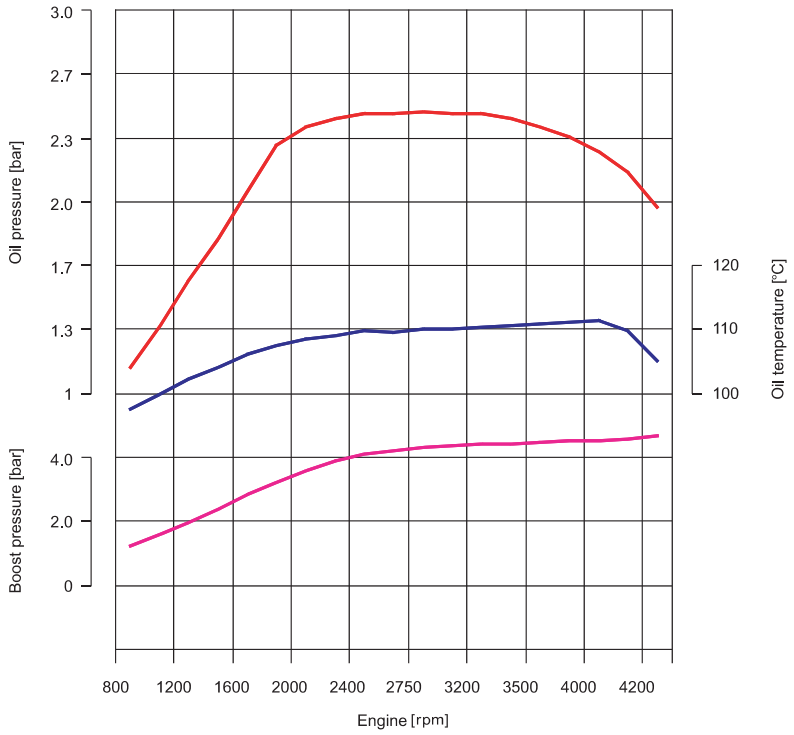
D27DT engine



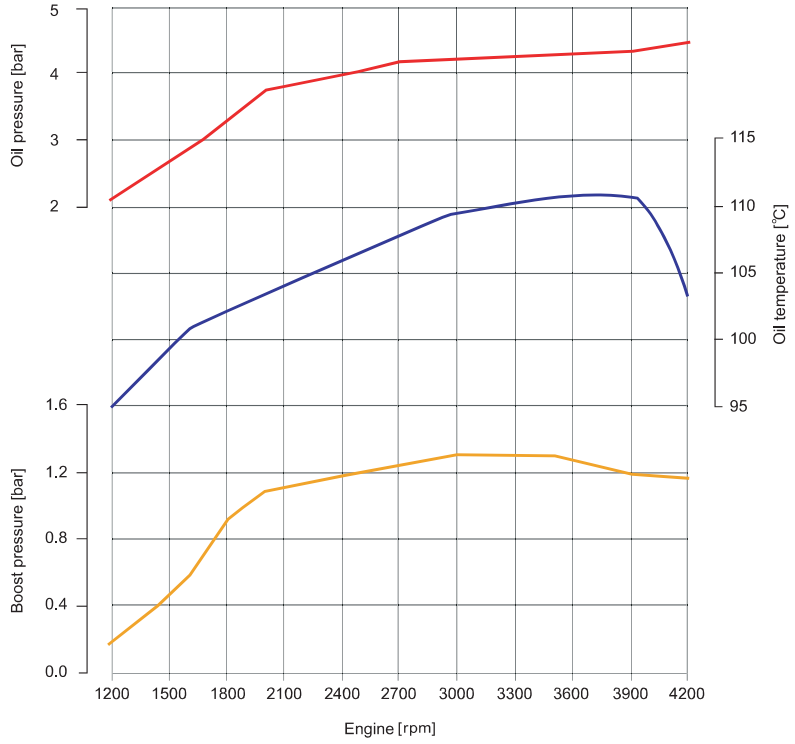
Modification basis	
Application basis	
Affected VIN	

▶ 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.

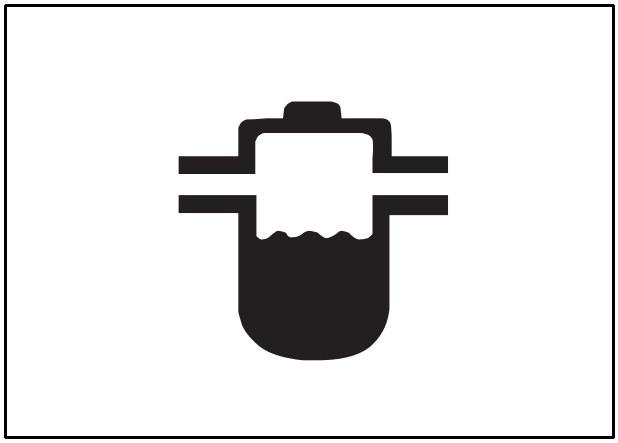
1) DI Engine

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

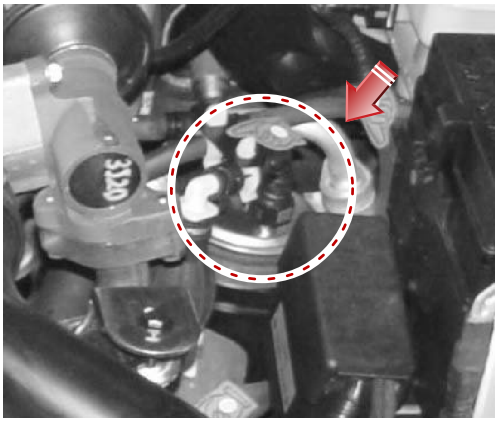
The priming pump installed in fuel pump is the device to fill the fuel into the fuel filter. When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

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

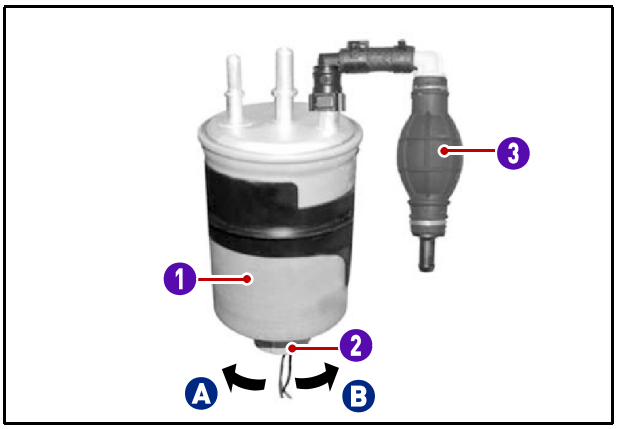
- When replaced the fuel filter or drained the water from fuel filter, press the priming pump until it becomes rigid before starting the engine.
- The water drain from fuel filter should be performed whenever changing the engine oil.

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.

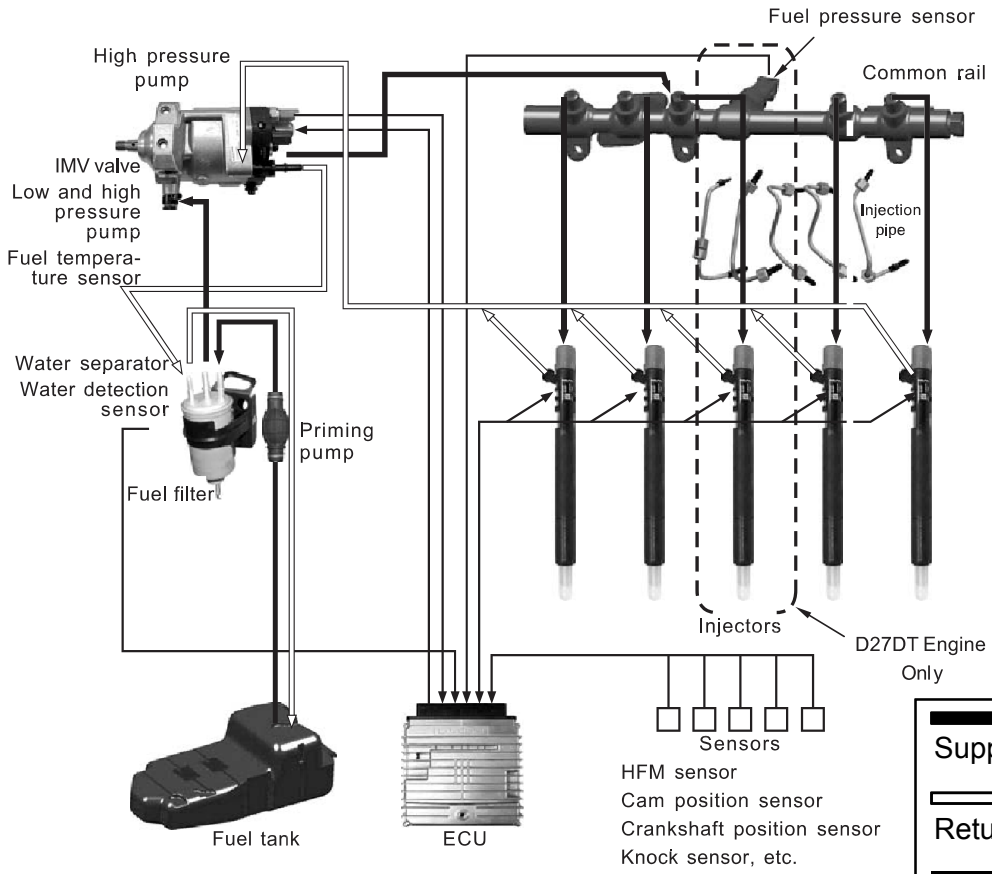


4. Press the priming pump until it becomes rigid.
5. Start the engine and check the conditions.

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.

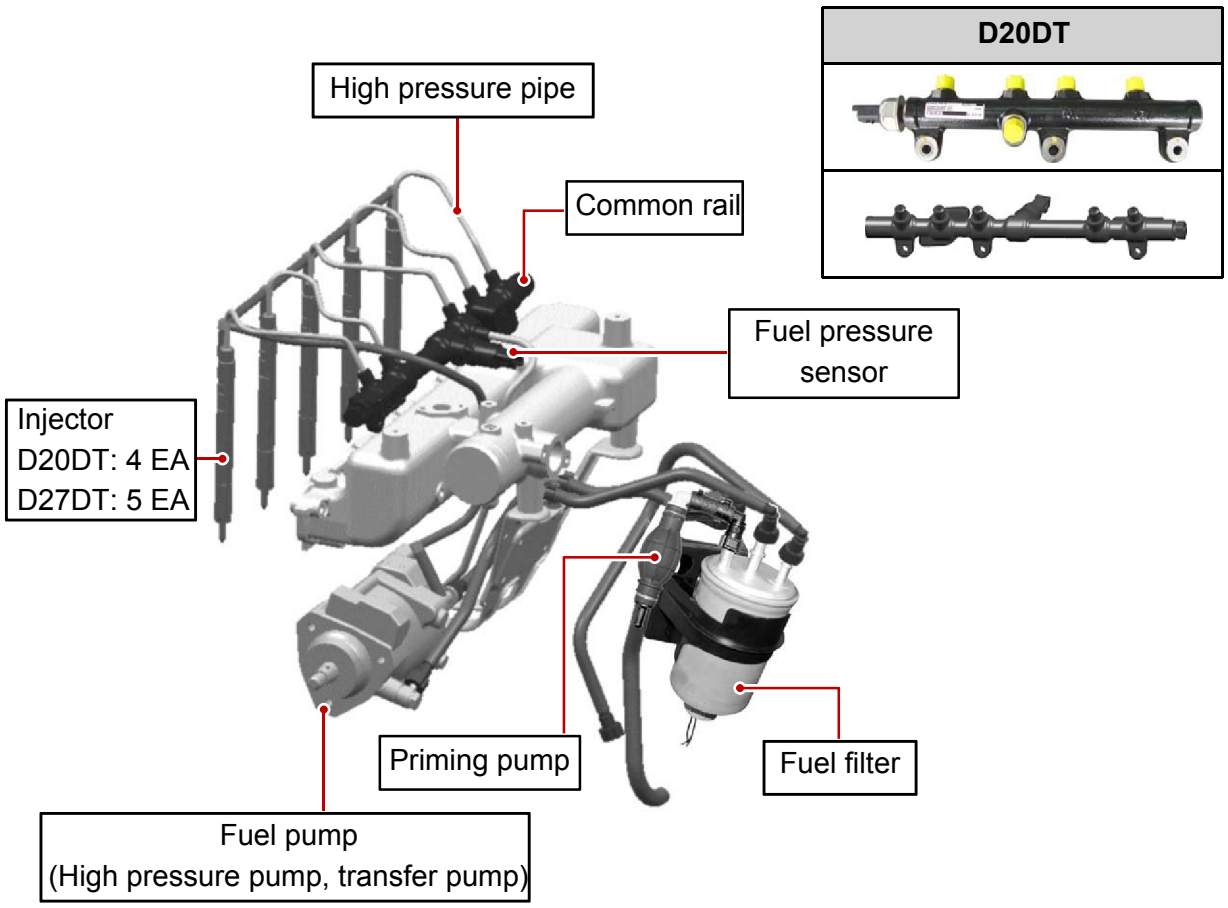
ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's 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	

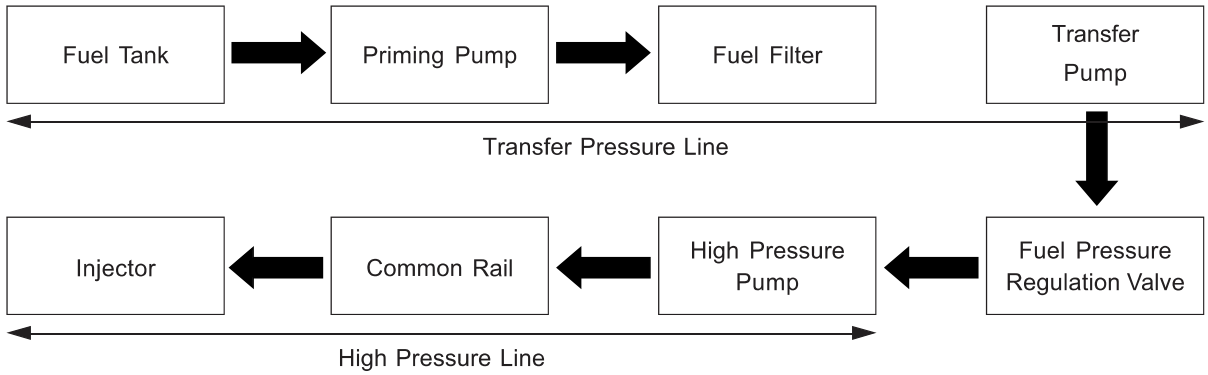
2. COMPOSITION OF FUEL SYSTEM

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

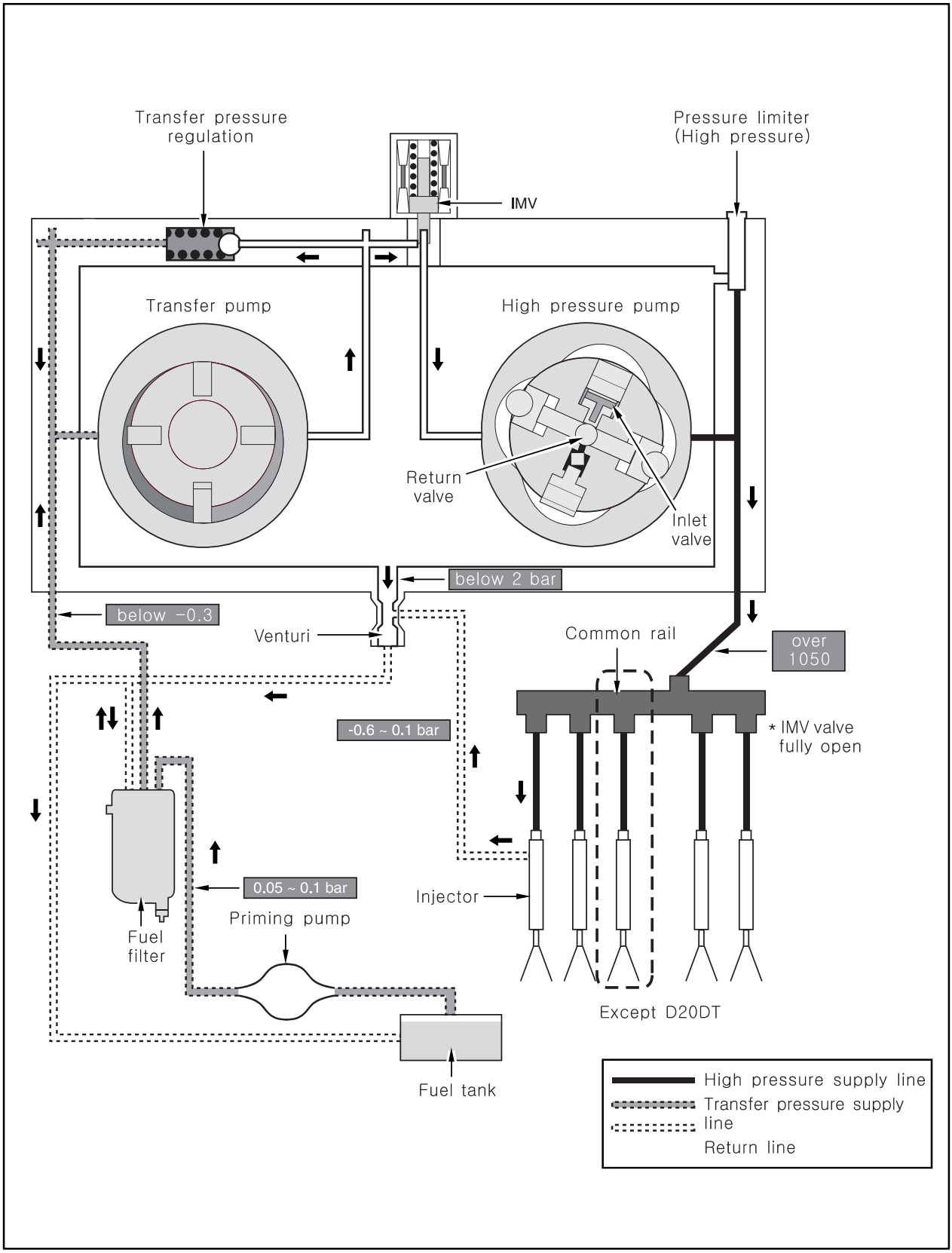


Fuel route



Modification basis	
Application basis	
Affected VIN	

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



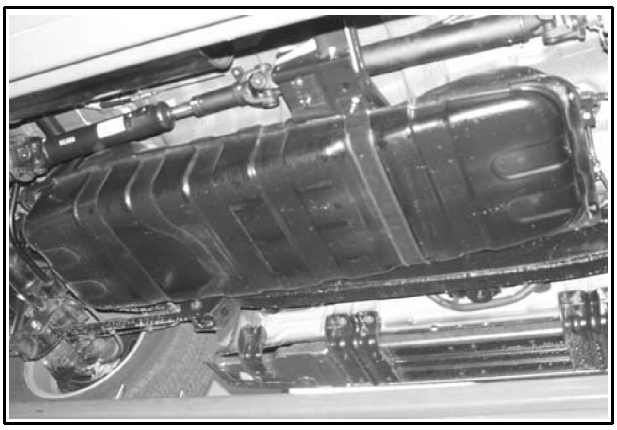
Modification basis	
Application basis	
Affected VIN	

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).

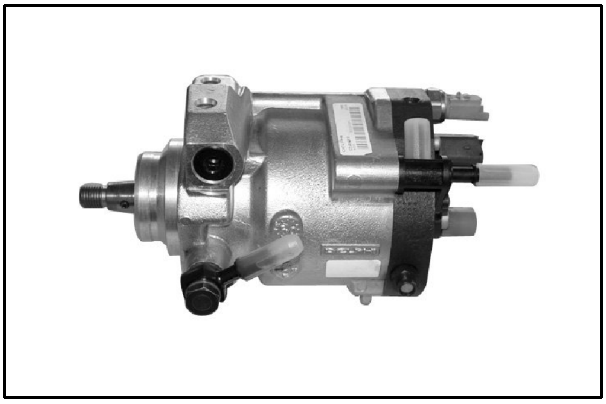
Modification basis	
Application basis	
Affected VIN	

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

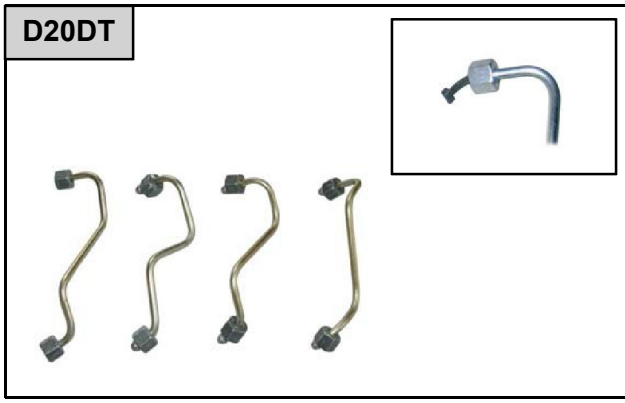


It stores fuel transferred from high pressure pump and also stores actual high pressure of fuel. Even though the injectors inject fuel from the rail, the fuel pressure in the rail is maintained to a specific value. It is because the effect of accumulator is increased by unique elasticity of fuel. Fuel 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.

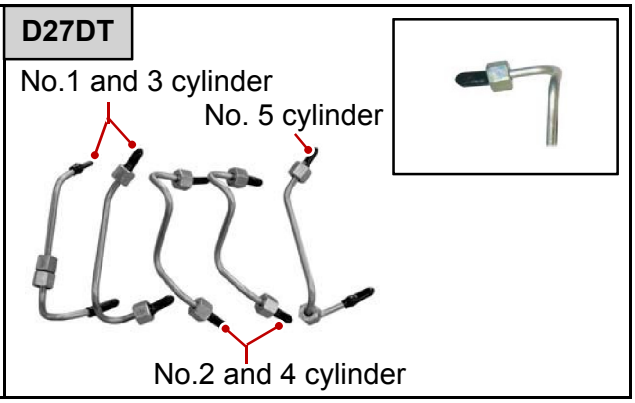
3) High pressure pipe (fuel pipe)

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



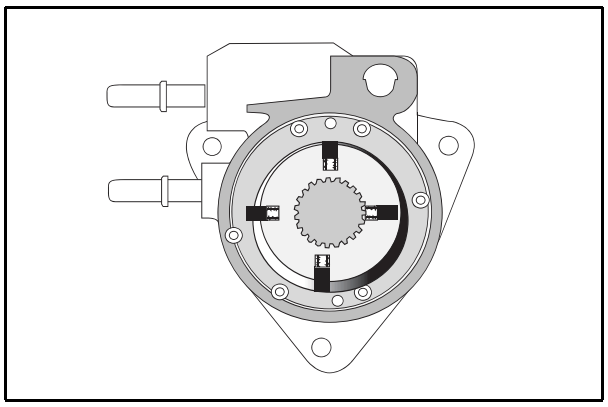
4) Injectors



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



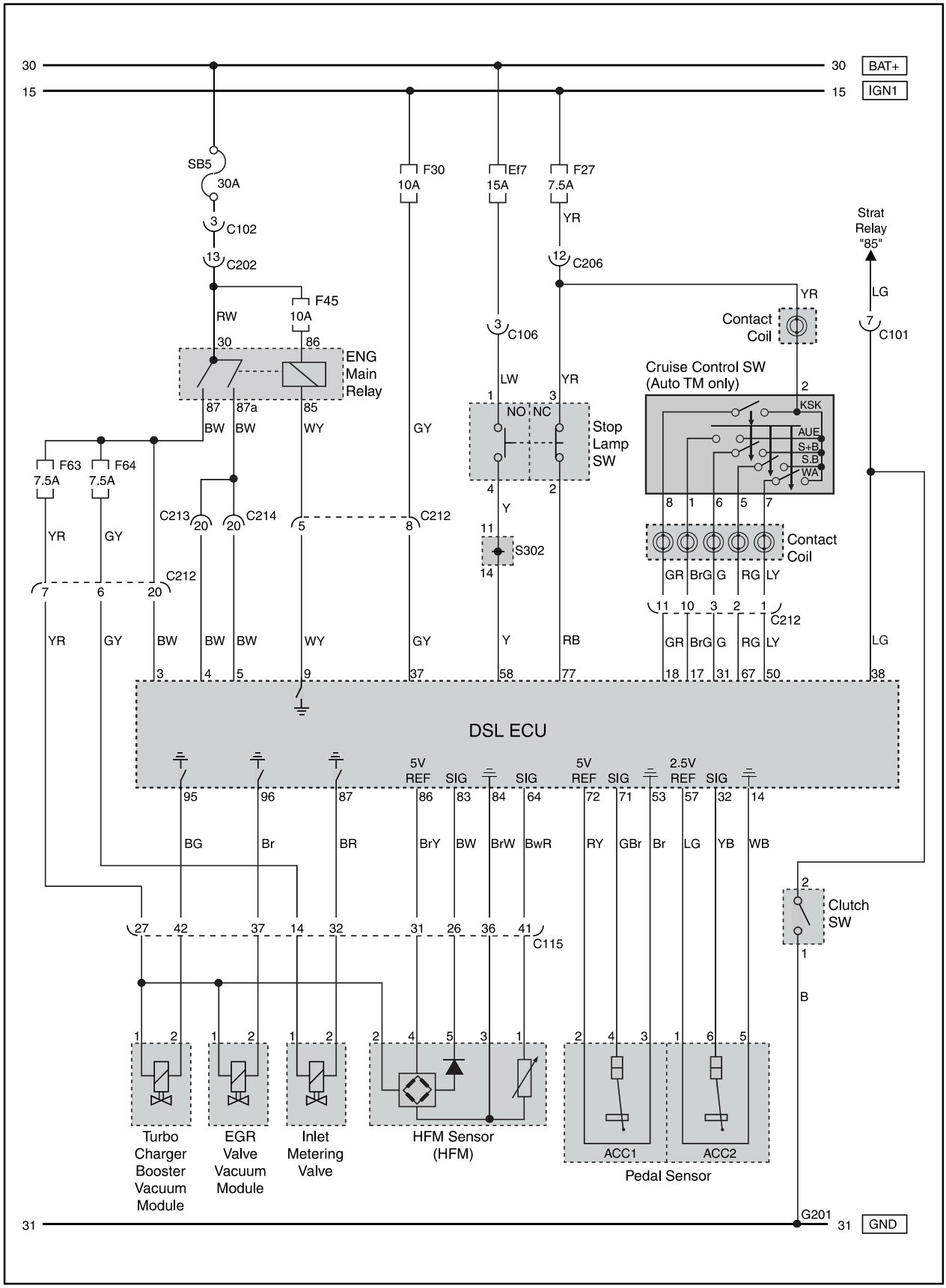
The transfer pump is included in the housing of the high pressure pump. The transfer pump is the volumetric blade type pump. To deliver the continuously required fuel volume, the pump transfers fuel from the fuel tank to high pressure pump.

Modification basis	
Application basis	
Affected VIN	

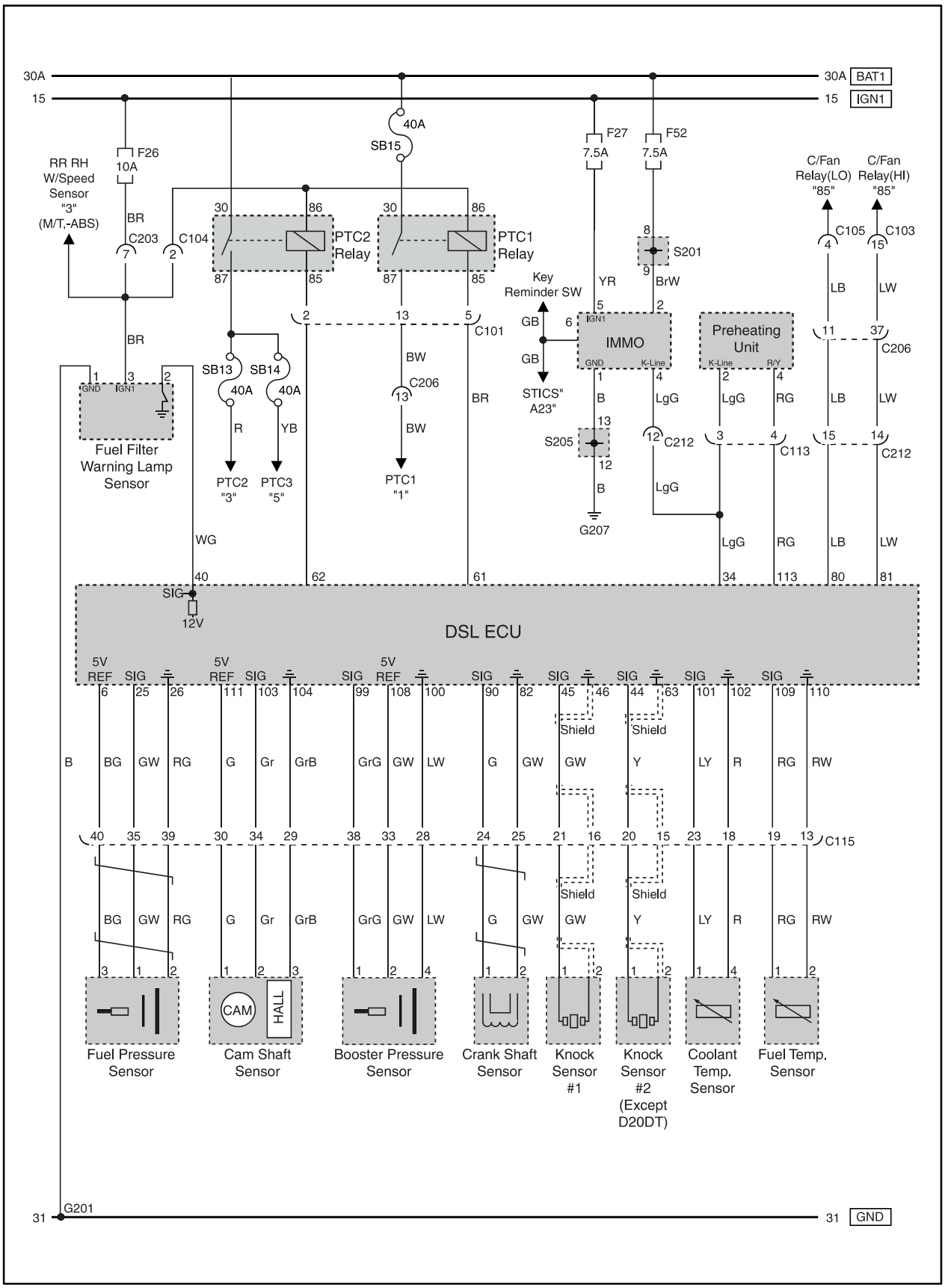
6) Fuel filter replacement

- 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

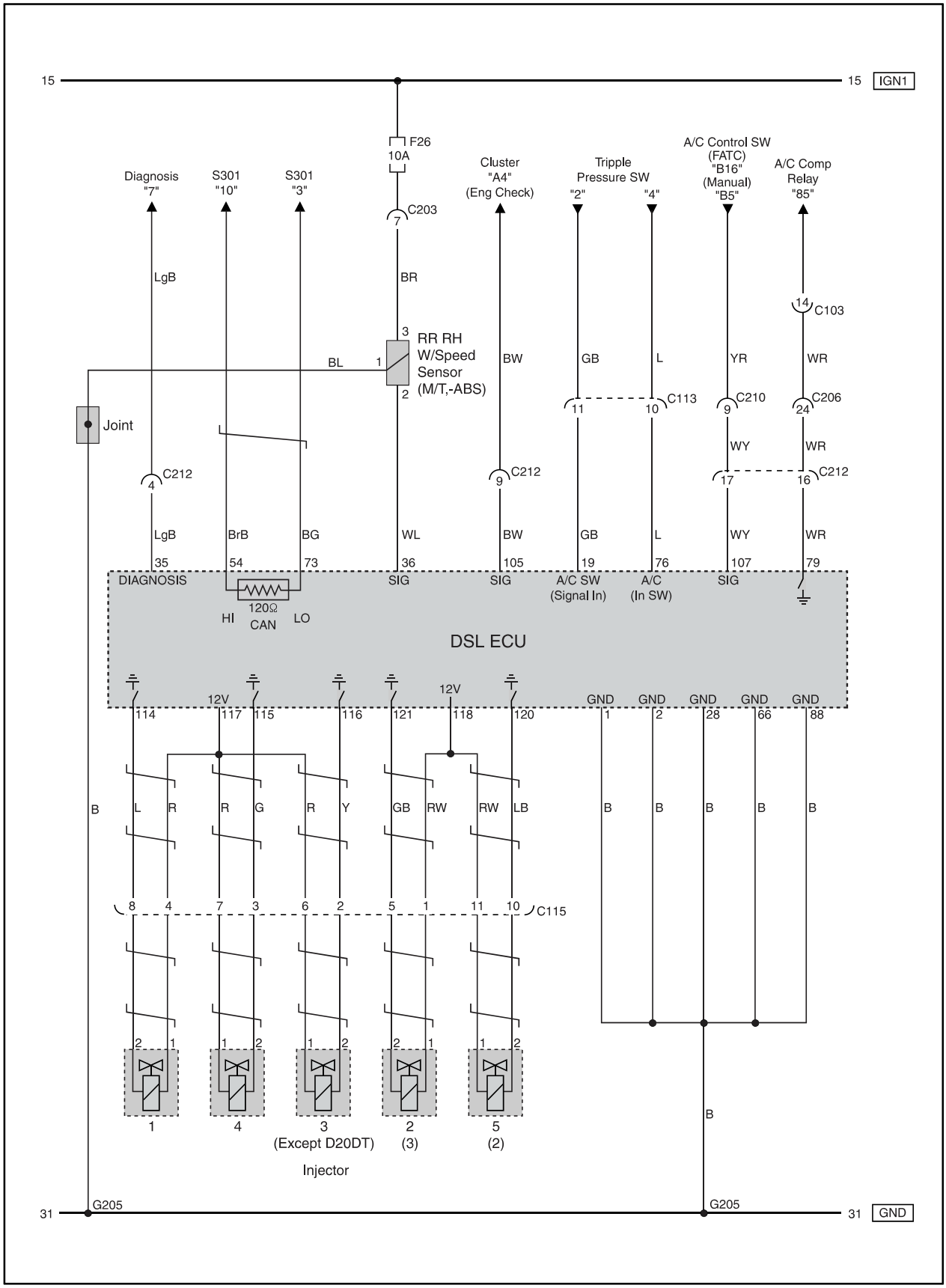
7) Circuit Diagram



Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

INTAKE SYSTEM

2321-01

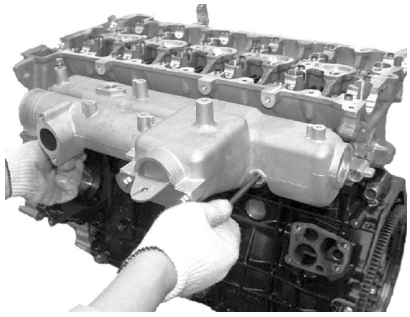
GENERAL

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.

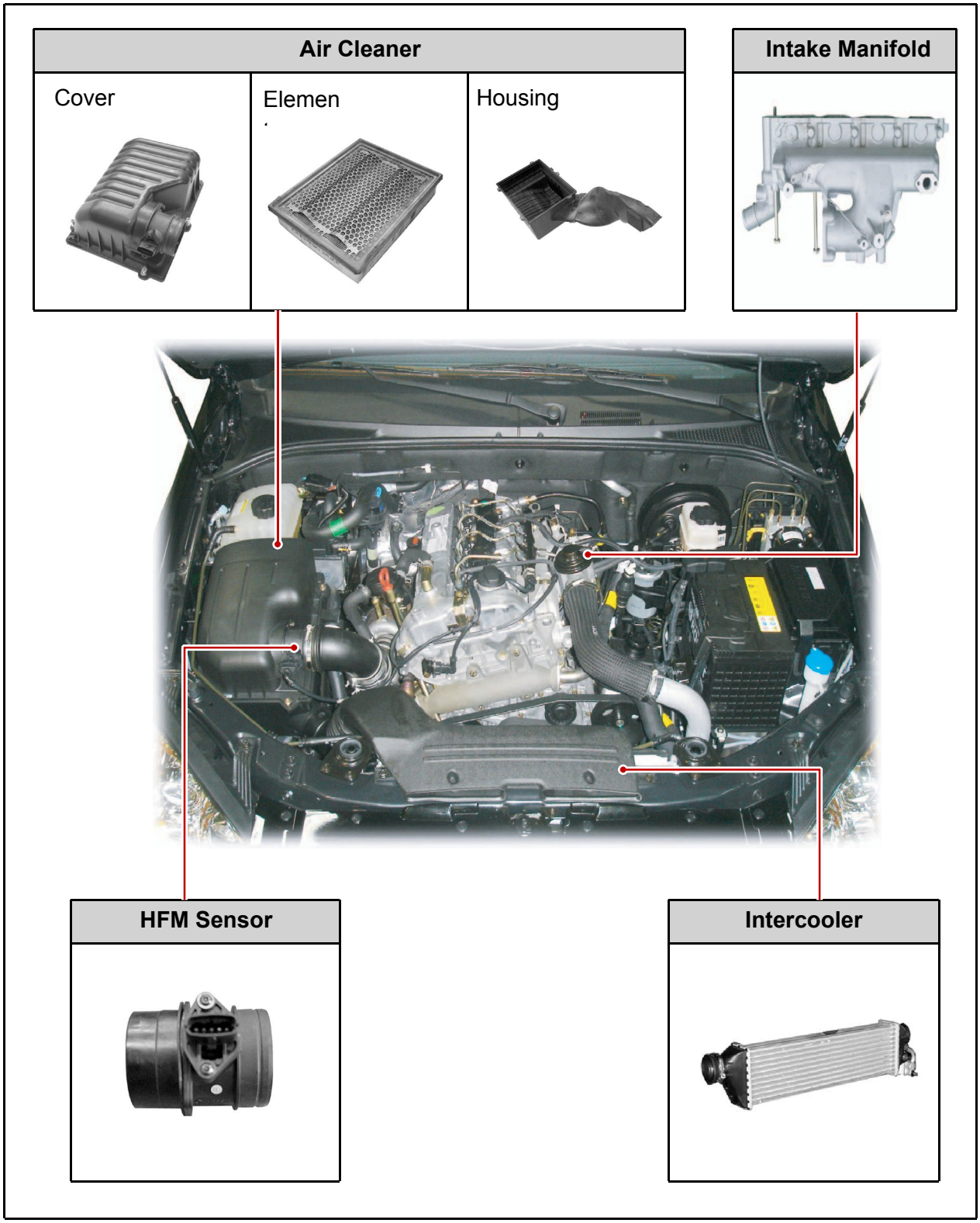
2) Special Tools and Equipment

Special Tools and Equipment	Application
Y99220112B Intake manifold guide pin 	Installation of intake manifold 

OVERVIEW AND OPERATION PROCESS

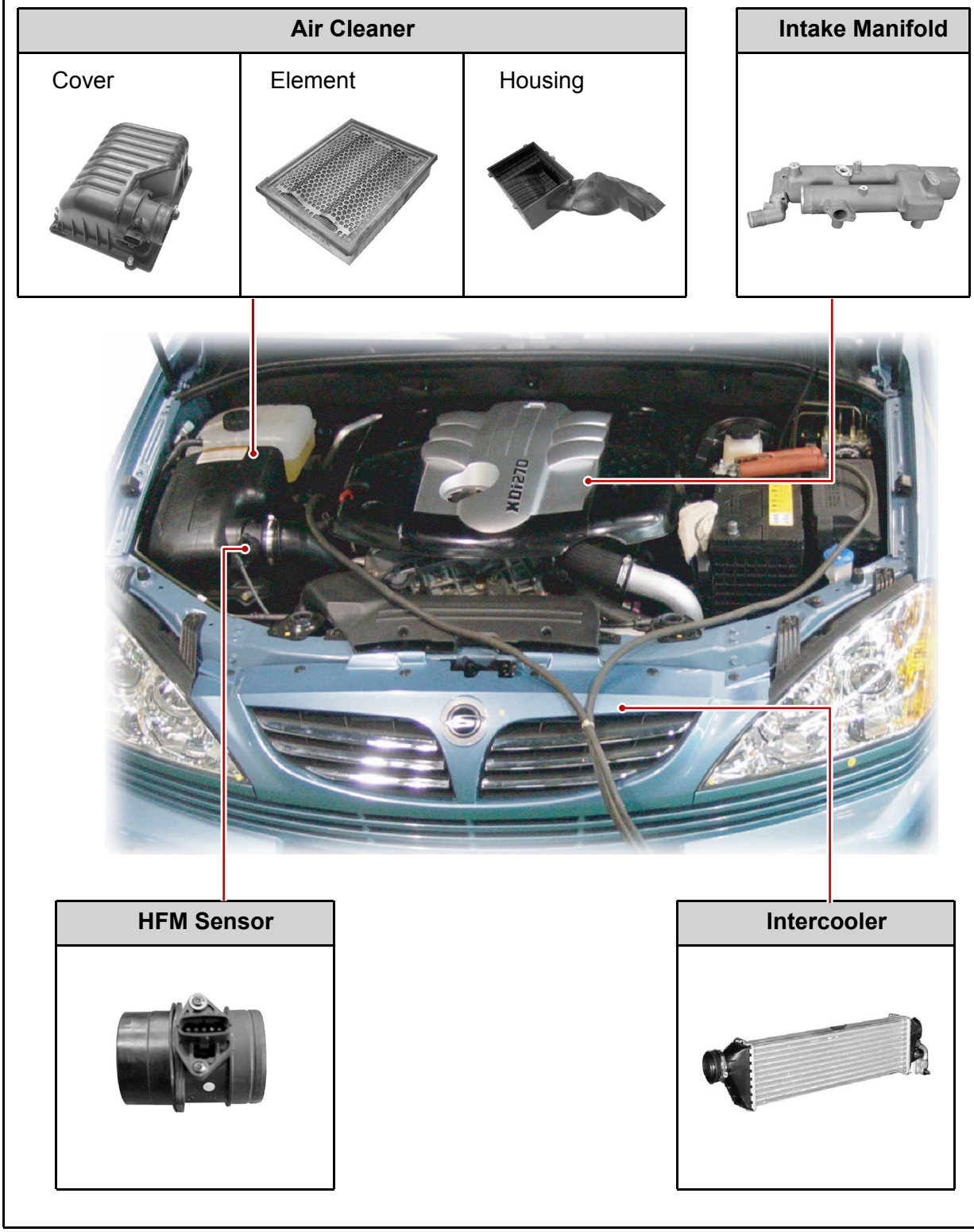
1. ENGINE INTAKE COMPONENTS LOCATOR

1) D20DT Engine



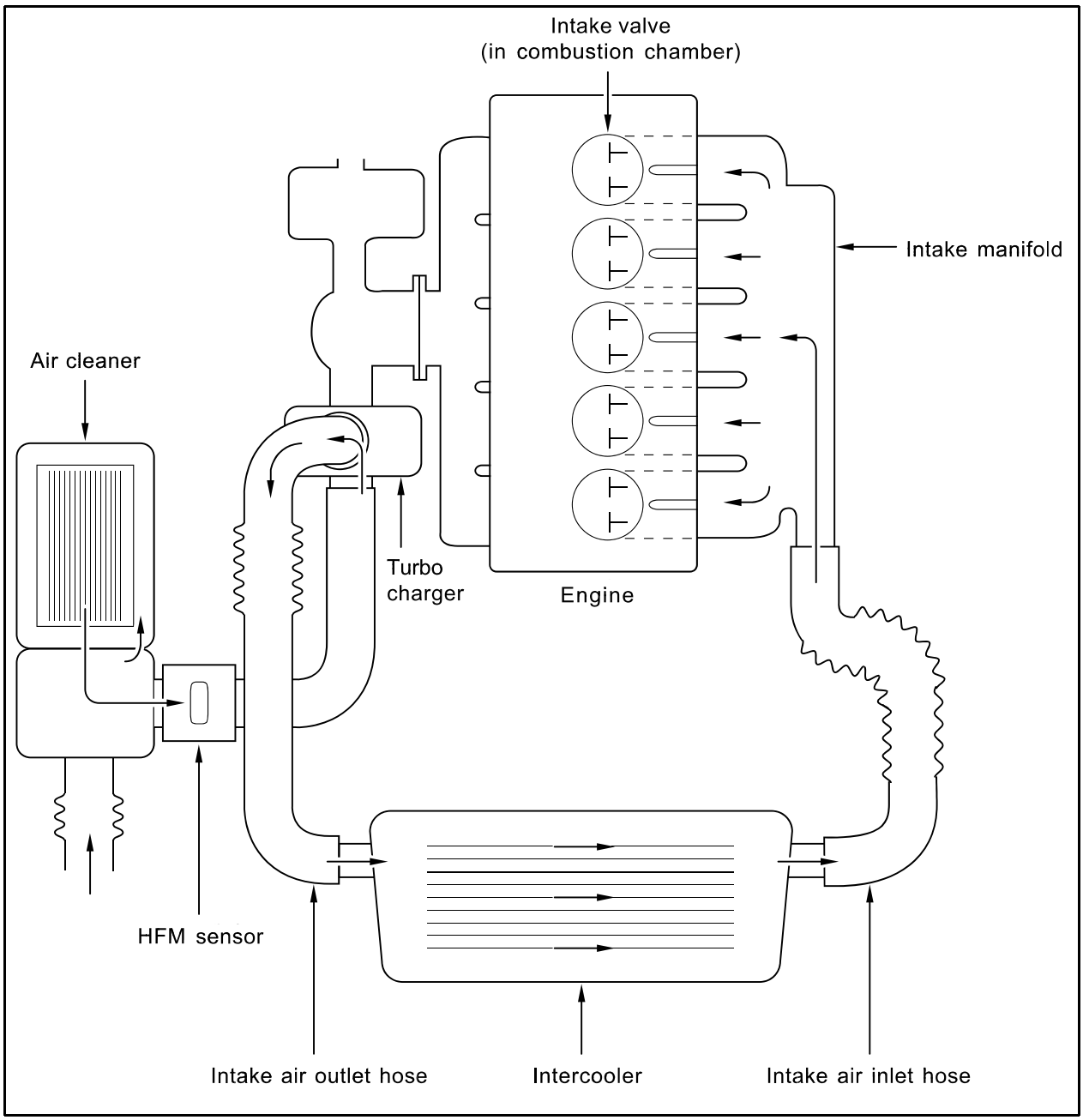
Modification basis	
Application basis	
Affected VIN	

2) D27DT Engine

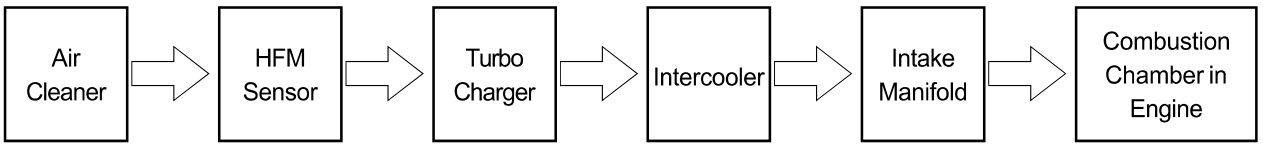


Modification basis	
Application basis	
Affected VIN	

2. AIR FLOWS



1) Work Flow of Intake System



Modification basis	
Application basis	
Affected VIN	

EXHAUST SYSTEM 1913-01

GENERAL

1. INSPECTION BEFORE DIAGNOSIS

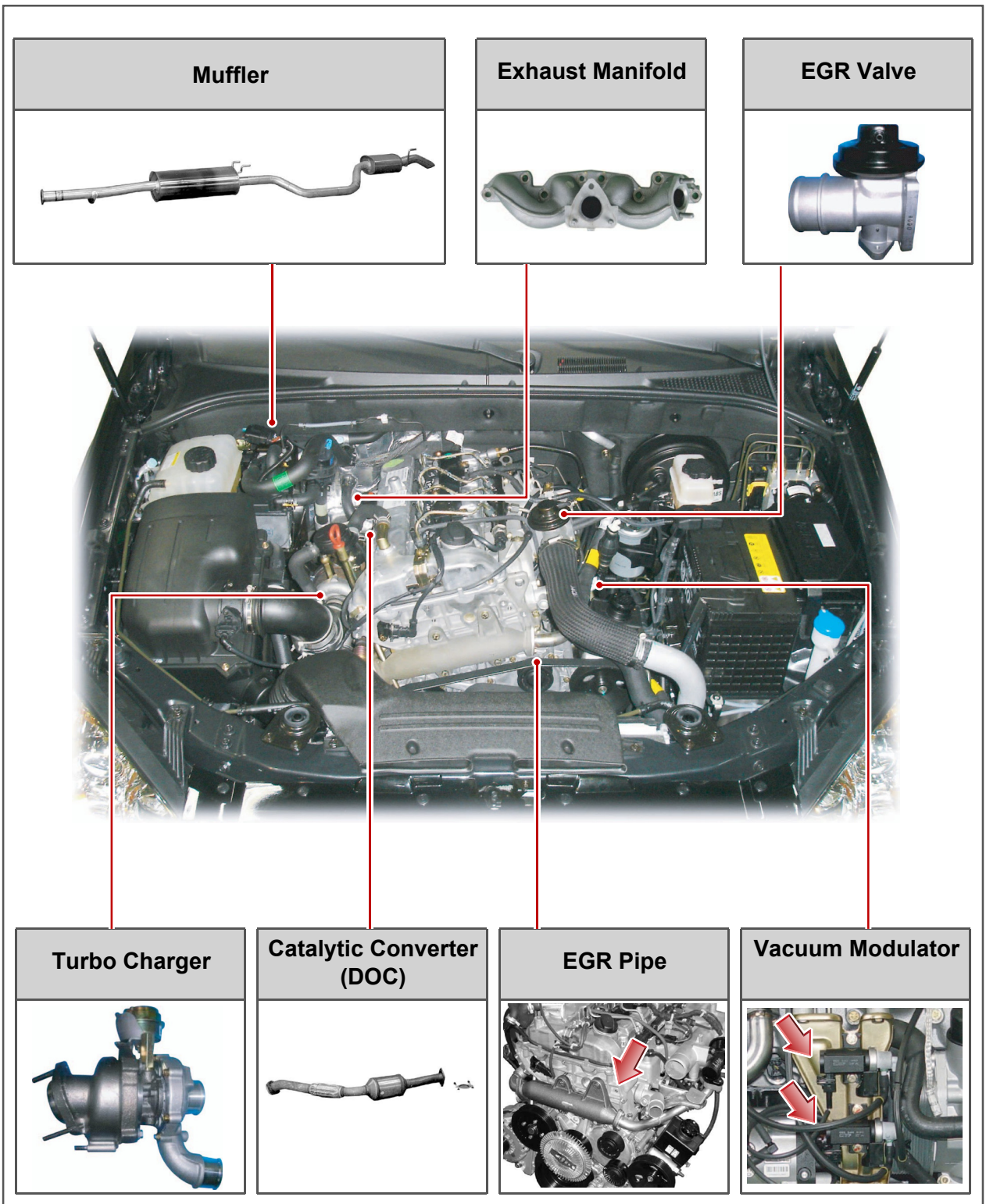
The base of making diagnosis on the EGR related system is the inspection on the connections of the vacuum hoses in related system as the first priority.
When abnormal condition occurs with the EGR system, the basic approach is, as described in prior sentence, making detail inspections of vacuum circuits 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.

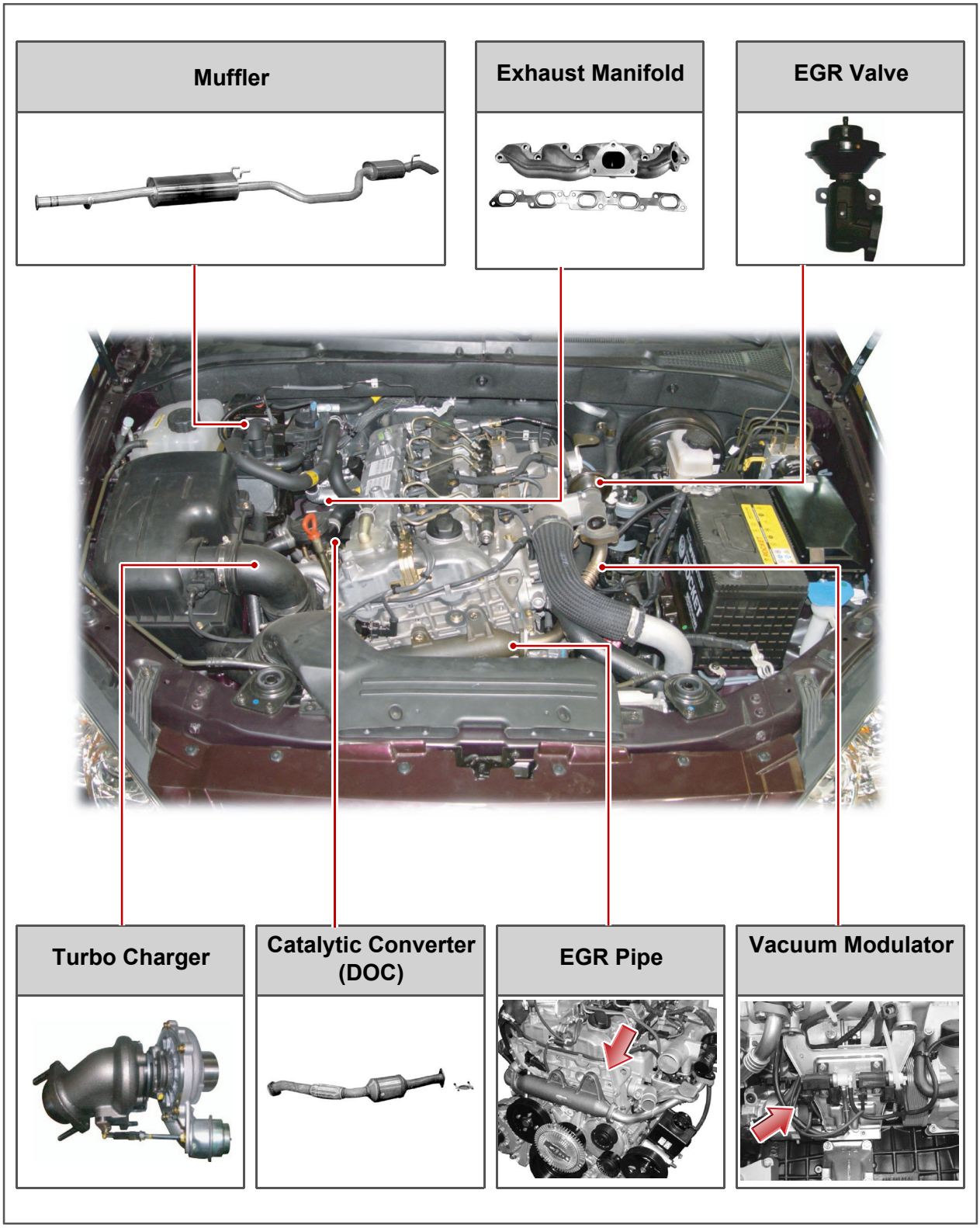
D20DT	D27DT
	
HUBER EGR System for IDI Engine (Including the EGR Valve Potentiometer)	EGR System for DI Engine

OVERVIEW AND OPERATION PROCESS

1. COMPONENTS LOCATOR OF EXHAUST SYSTEM

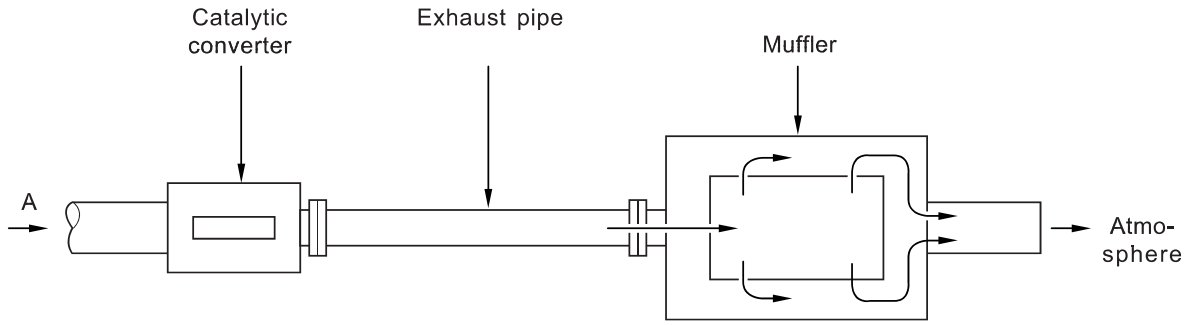
1) D20DT ENGINE

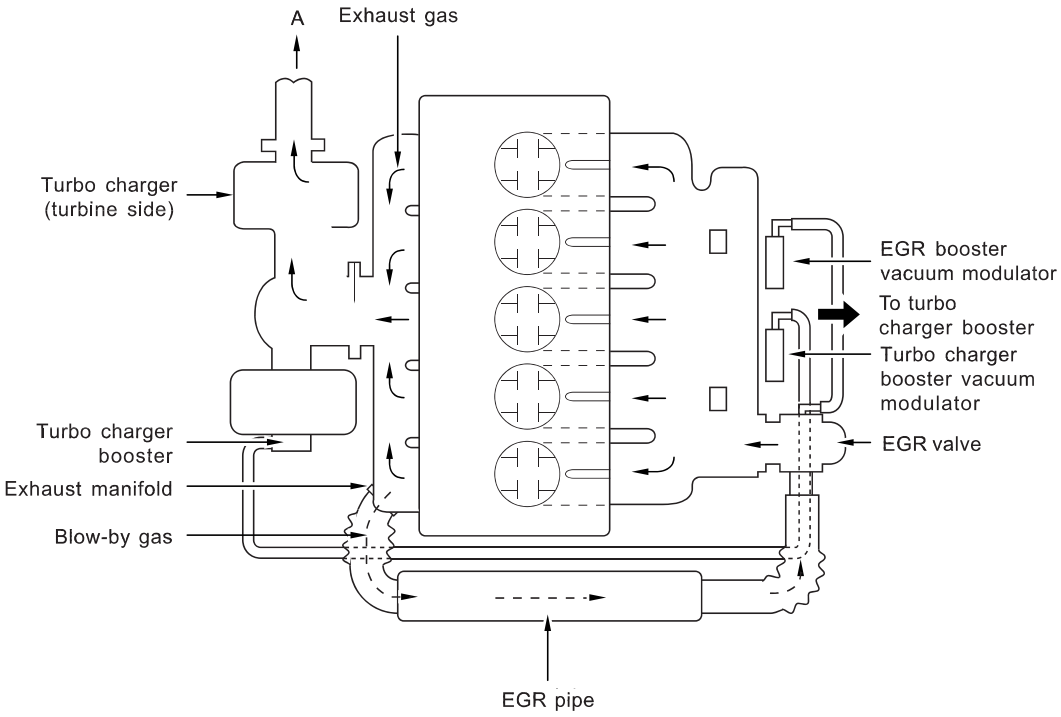


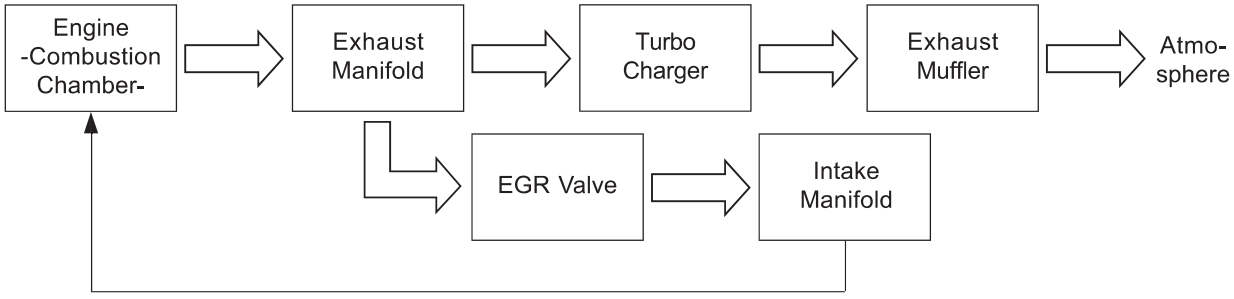


Modification basis	
Application basis	
Affected VIN	

2. EXHAUST GAS FLOWS







Modification basis	
Application basis	
Affected VIN	

ENGINE 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:

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



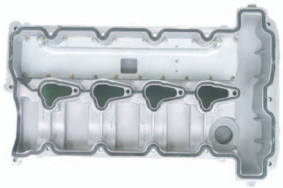
▶Oil Pressure Switch

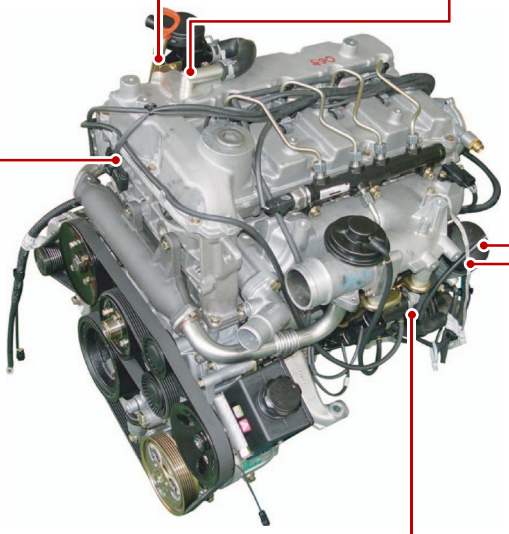
1. Operating temperature: −40 ~ 140°
2. Operating pressure: 0.3 ~ 0.55 bar
3. Permissible pressure: 10 bar

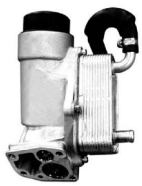
OVERVIEW AND OPERATION PROCESS

1. COMPONENTS OF LUBRICATION SYSTEM

1)D20DT ENGINE

Cylinder Head Cover	Oil Dipstick	Oil Separator	Oil Filter
			

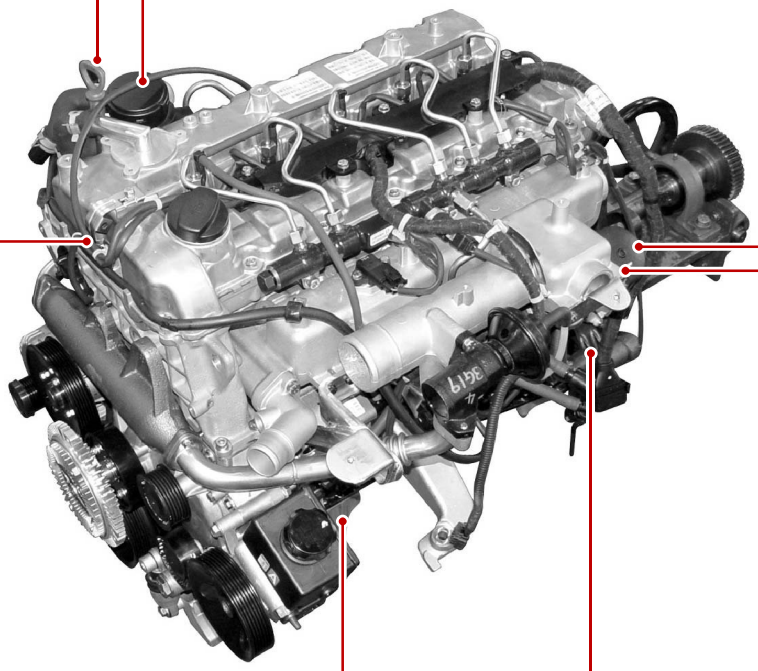


Oil Pump	Oil Pan	Oil Cooler	Oil Pressure Switch
			

Modification basis	
Application basis	
Affected VIN	

2)D27DT Engine

Cylinder Head Cover	Oil Dipstick	Oil Separator	Oil Filter
			



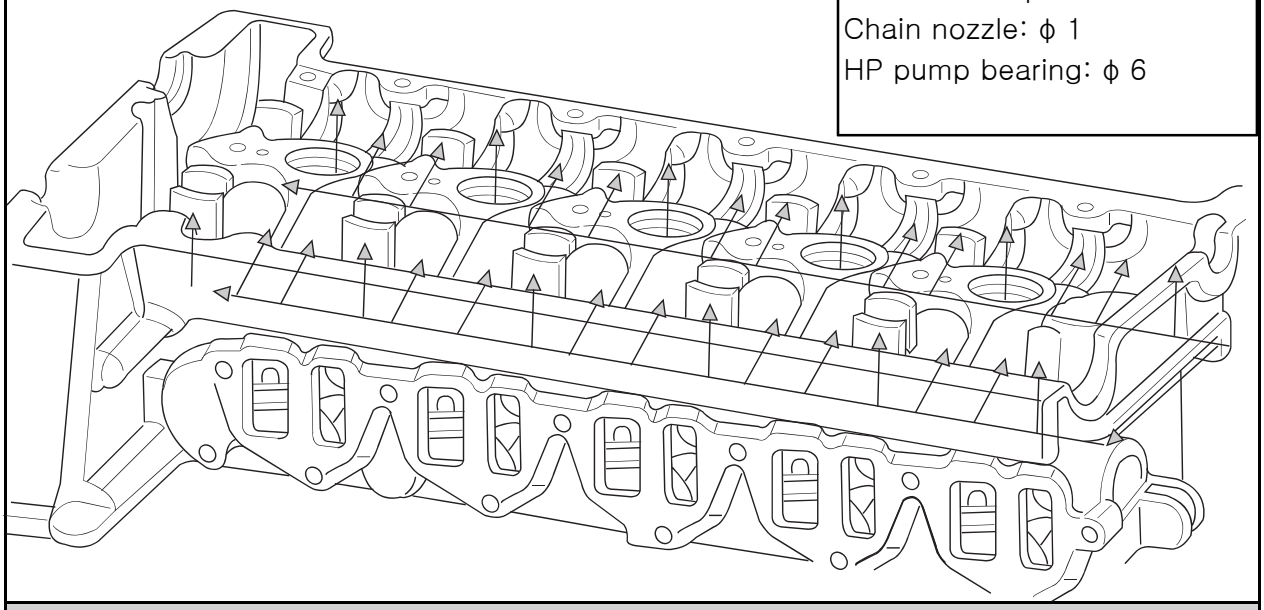
Oil Pump	Oil Pan	Oil Cooler	Oil Pressure Switch
			

Modification basis	
Application basis	
Affected VIN	

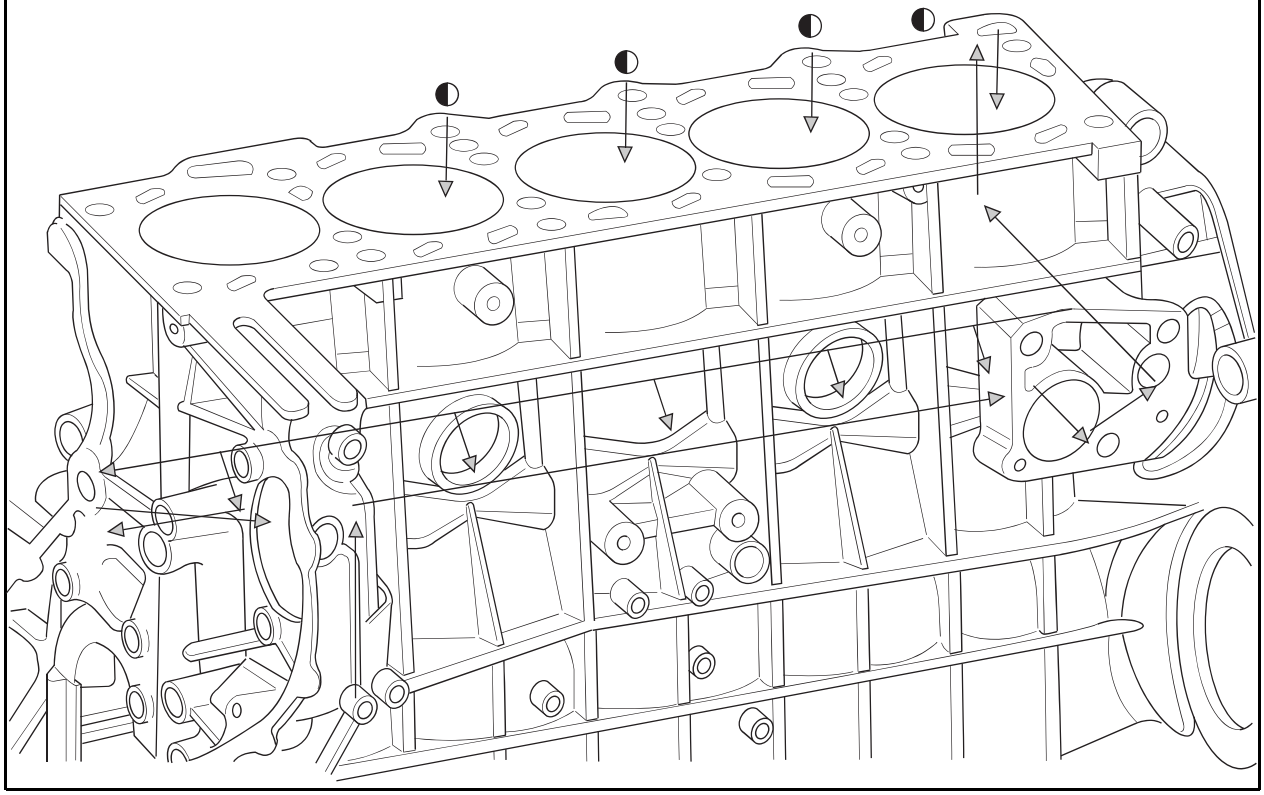
2. LUBRICATION SYSTEM LAYOUT

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

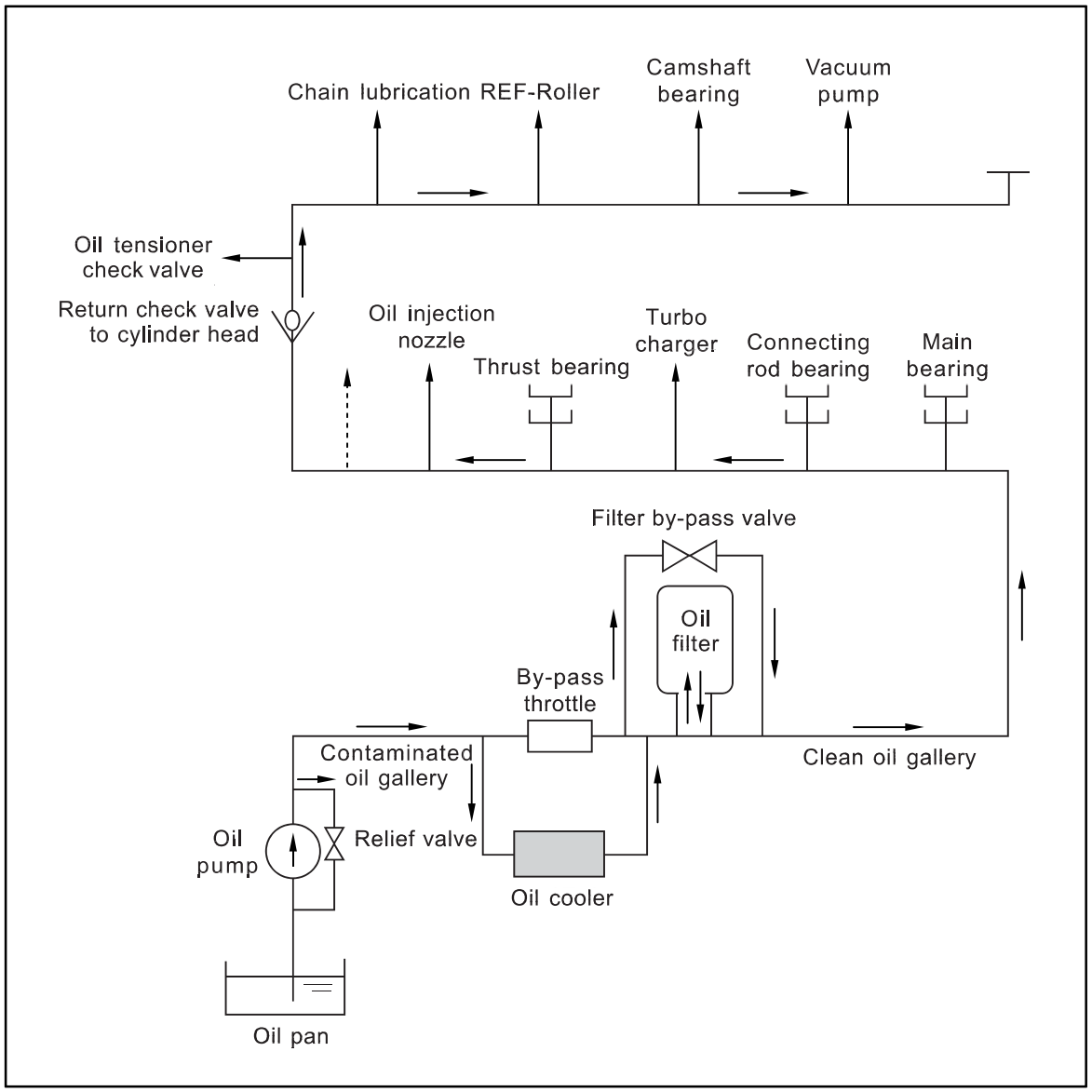


Cylinder Block



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

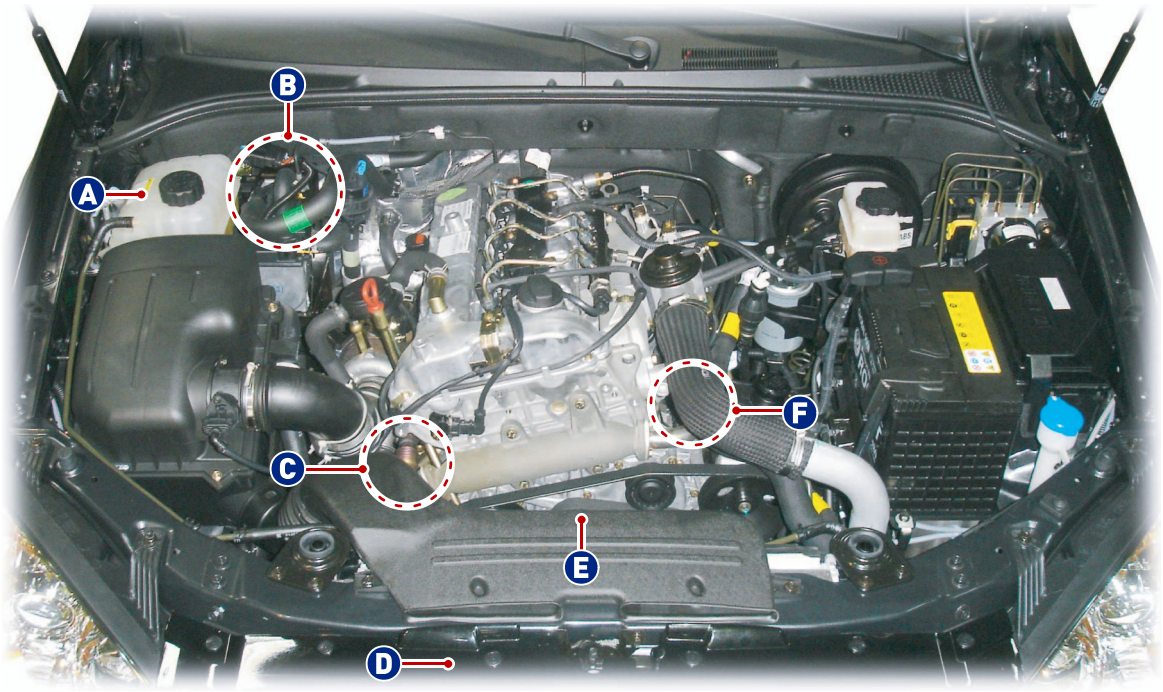
Descriptio n		Unit	Specificatio n
Cooling system	Type	-	Water cooling forced circulation
Coolant	Capacity	ℓ	11.3
Thermostat	Type	-	Wax pellet type
	Initial opening temperature	℃	85
	Fully opening temperature	℃	100
	Fully closing temperature	℃	83
	Stroke	mm	min. 8
Cooling fan	Blades		5
	Diameter	mm	320 (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

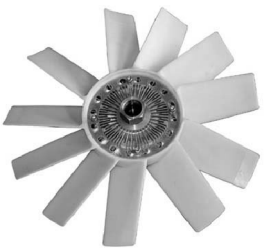
OVERVIEW AND OPERATION PROCESS

1. COMPONENTS ENGINE COOLING

1) D20DT Engine

Coolant Reservoir	FFH	Water Pump
A 	B 	C 

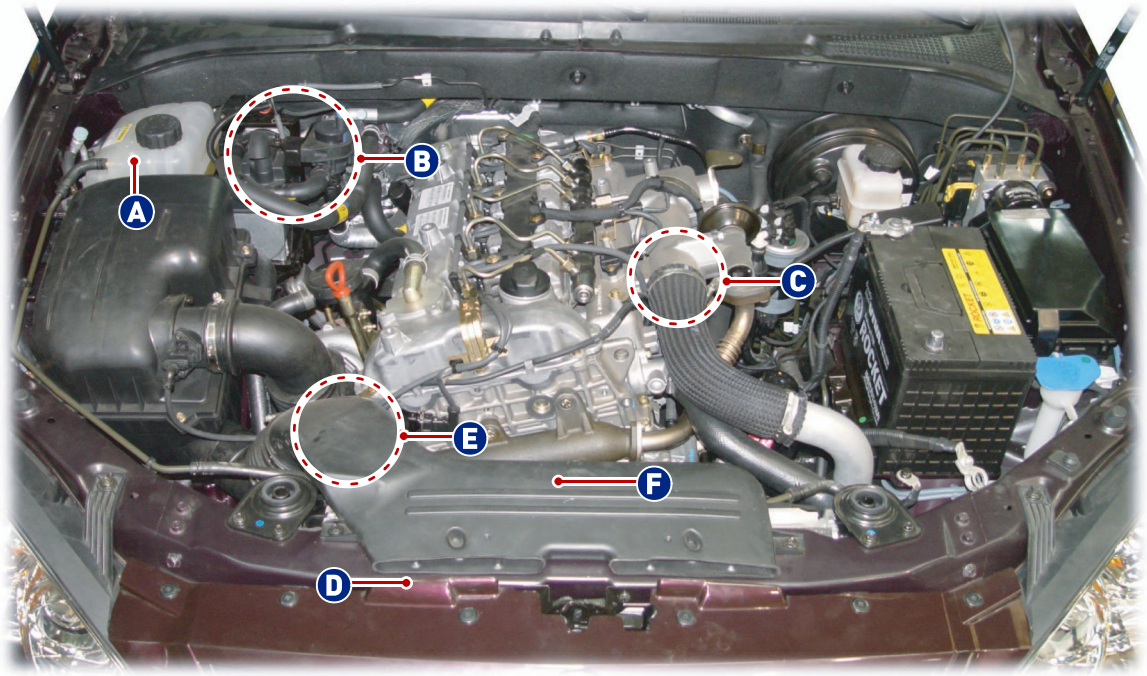


Radiator Assembly	Cooling Fan and Fan Clutch	Coolant Temperature Sensor
D 	E 	F 

Modification basis	
Application basis	
Affected VIN	

2) D27DT Engine

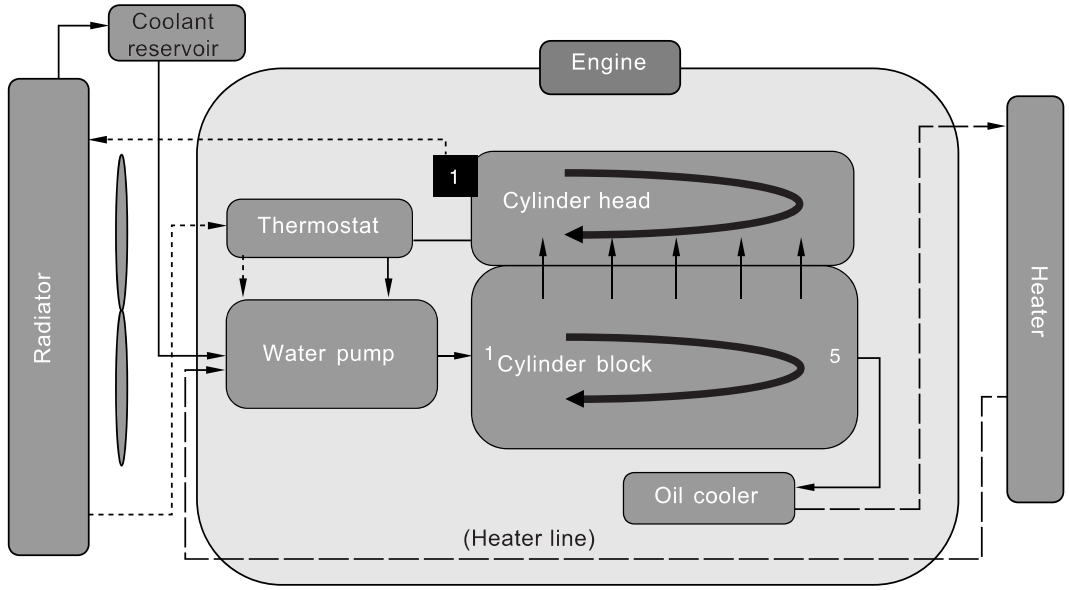
Coolant Reservoir	FFH	Coolant Temperature Sensor
A 	B 	C 



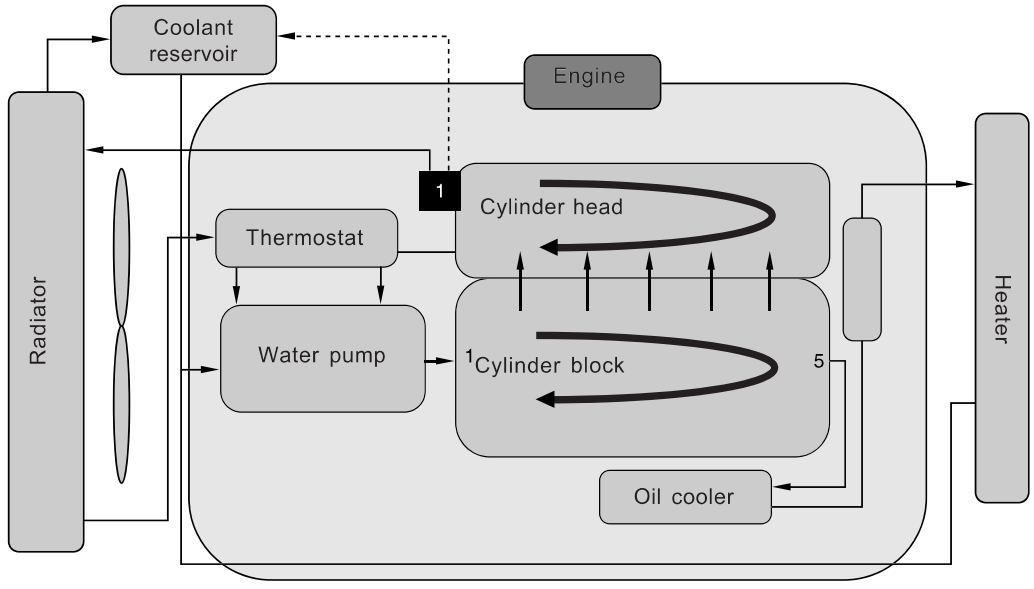
Radiator	Water Pump	Cooling Fan
D 	E 	F 

2. COOLING SYSTEM FLOW

PTC Engine Coolant Flows



FFH Engine Coolant Flows

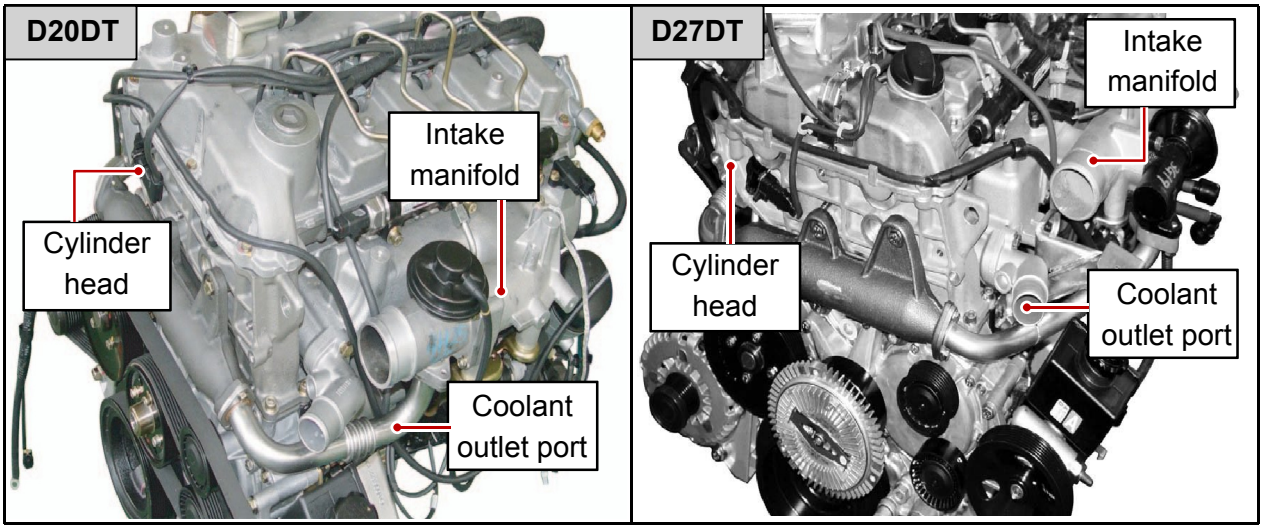


- Cylinder block side
  · Block #5 → Oil cooler → Heater → Heater water pump inlet pipe → Water pump
- Cylinder head side
  · Cylinder head → Coolant outlet port (intake #1) → Radiator → Water pump

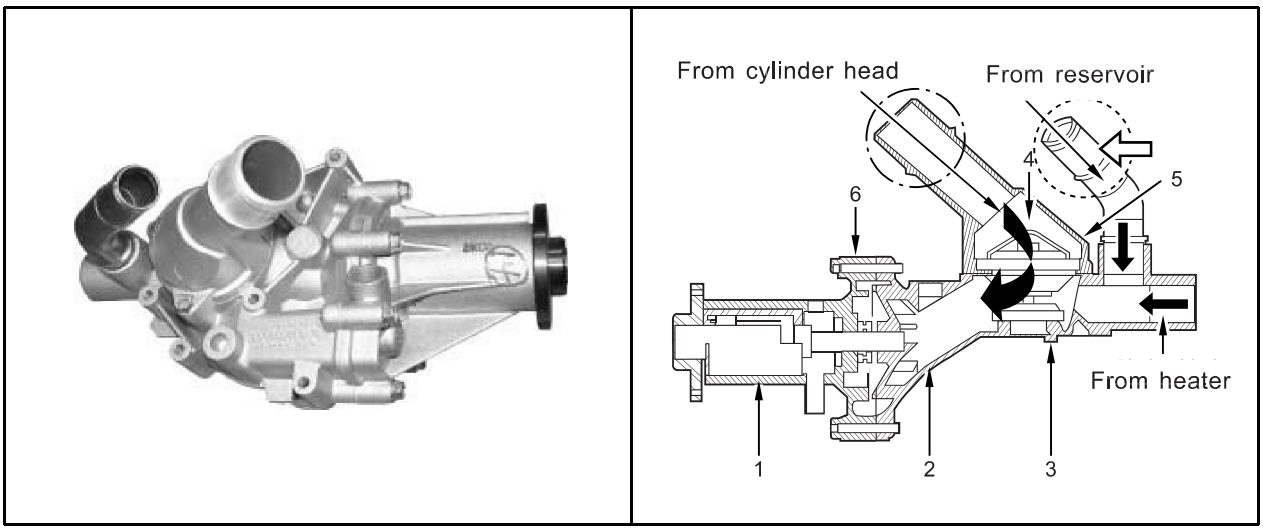
Modification basis	
Application basis	
Affected VIN	

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

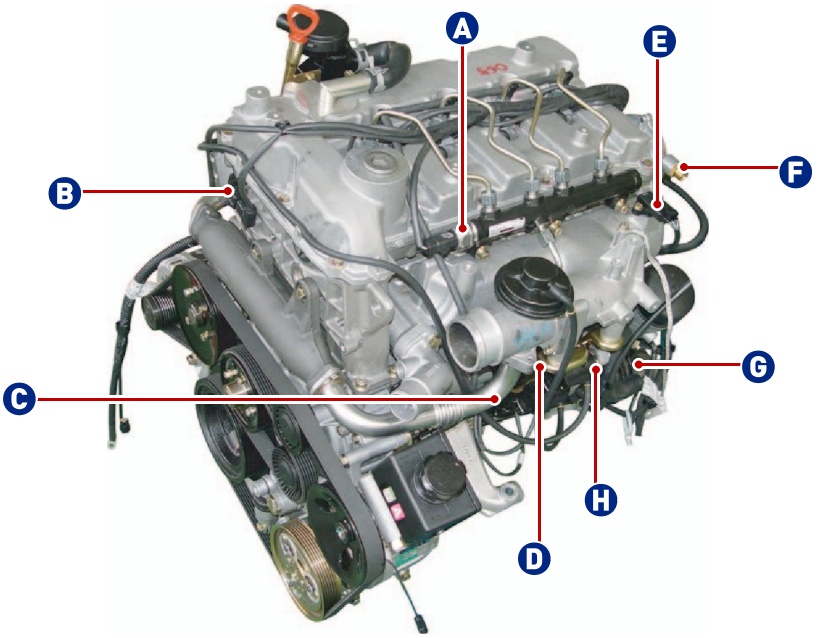
Descriptio			Unit	pecificatio n
Starter	Type		-	WP220
	Output power		Kw	2.2
	No load test □ 12 volts		A	160
	Drive pinion speed at no load		rpm	4500
	Drive pinion speed at load		rpm/A	1700/430
	Brush length		mm	18
	Armature diameter		mm	55
	Armature run-out		mm	0.1
	Segment groove depth		mm	21.7
Alternator	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 

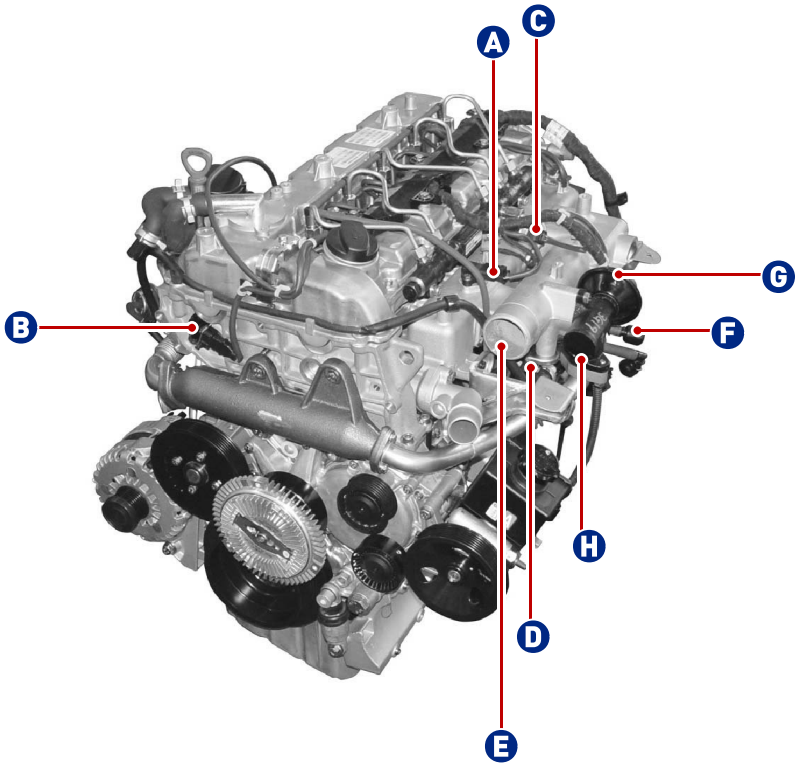


Booster Pressure Sensor	Oil Pressure Switch	Crankshaft Position Sensor	Knock Sensor (1 EA)
E 	F 	G 	H 

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 ENGIN

1) D20DT ENGINE

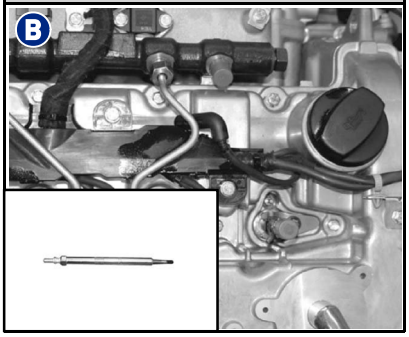
Alternator

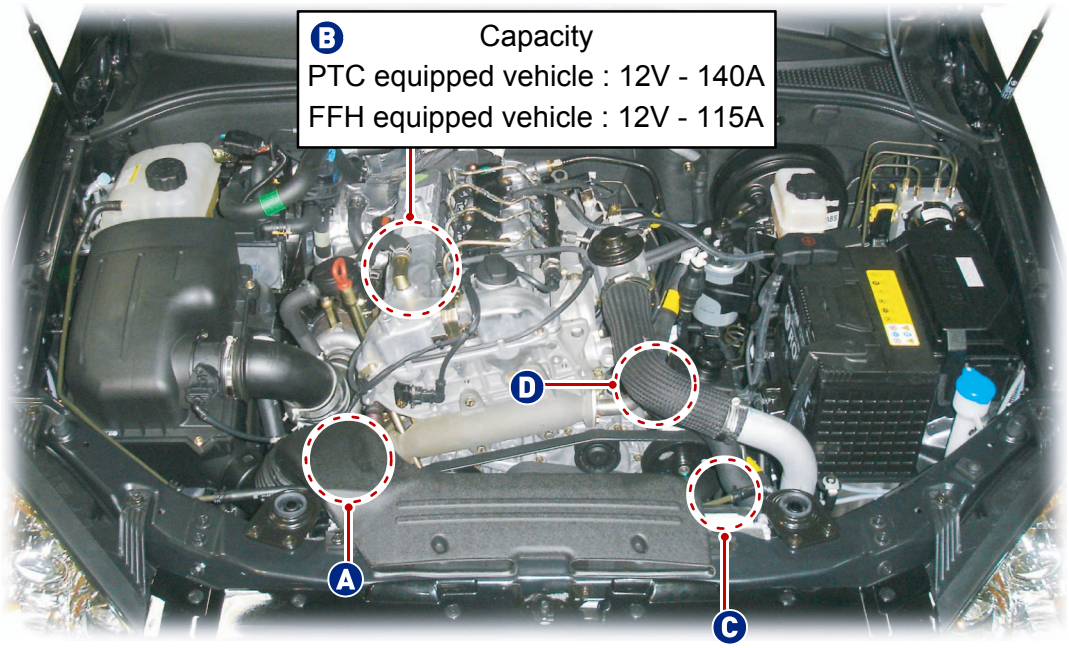
A



Glow Plug

B





Air Conditioner Compressor

C



Starter

D



Modification basis	
Application basis	
Affected VIN	

1) D27DT ENGINE

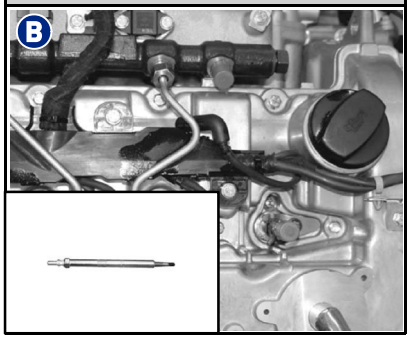
Alternator

A

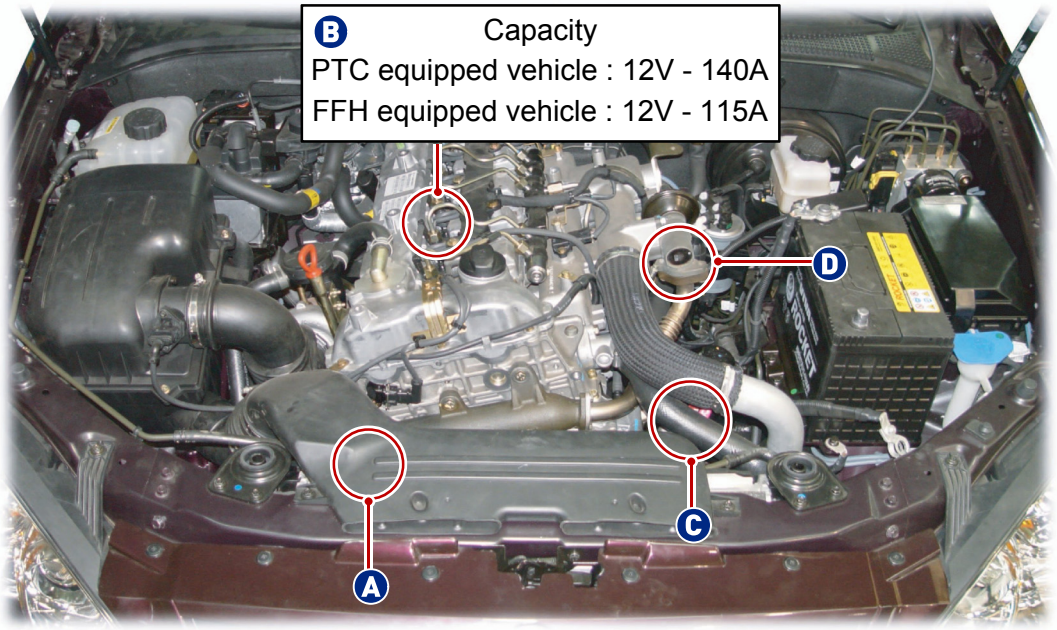


Glow Plug

B



B Capacity
PTC equipped vehicle : 12V - 140A
FFH equipped vehicle : 12V - 115A



Air Conditioner Compressor

C



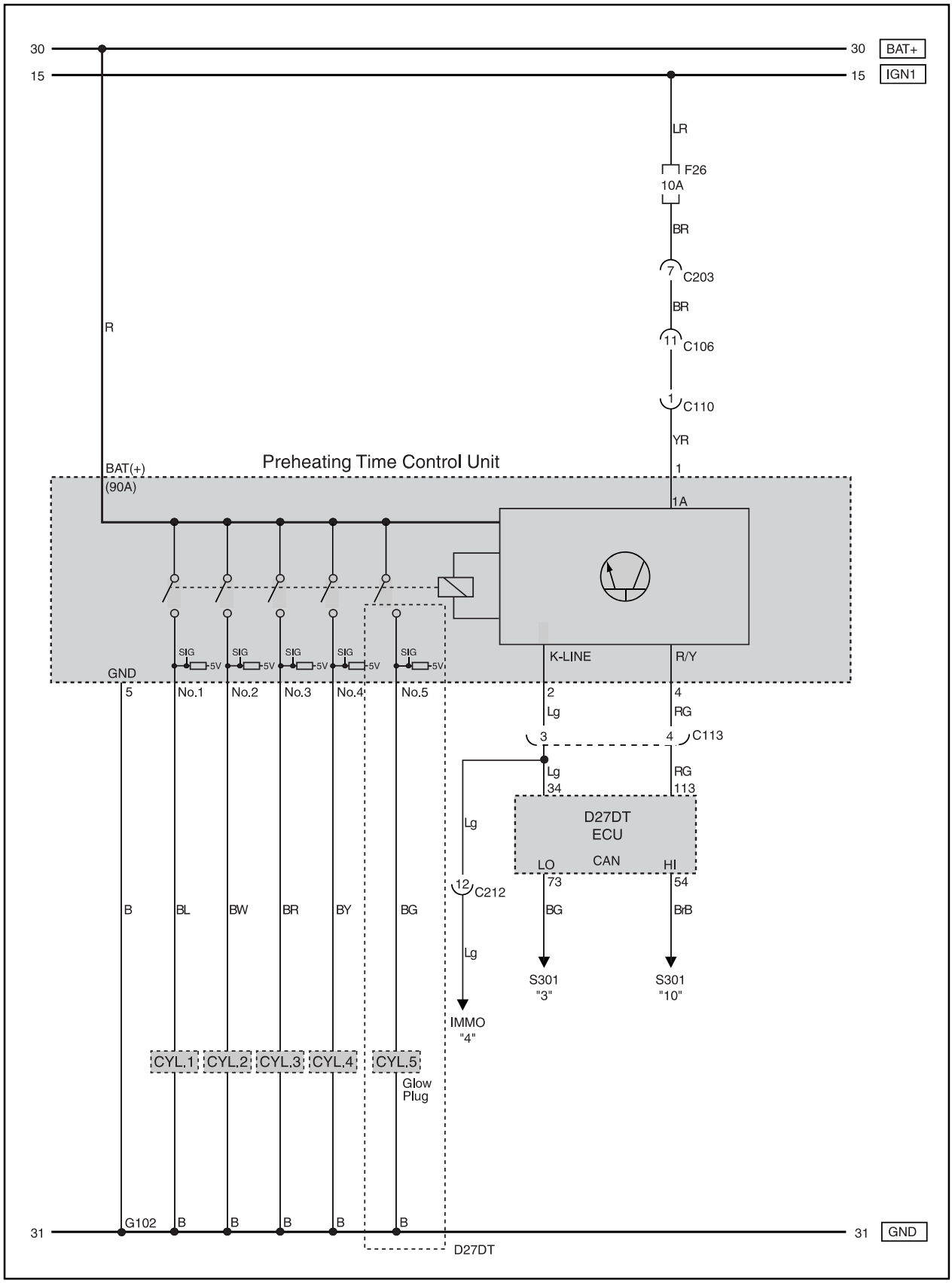
Starter

D



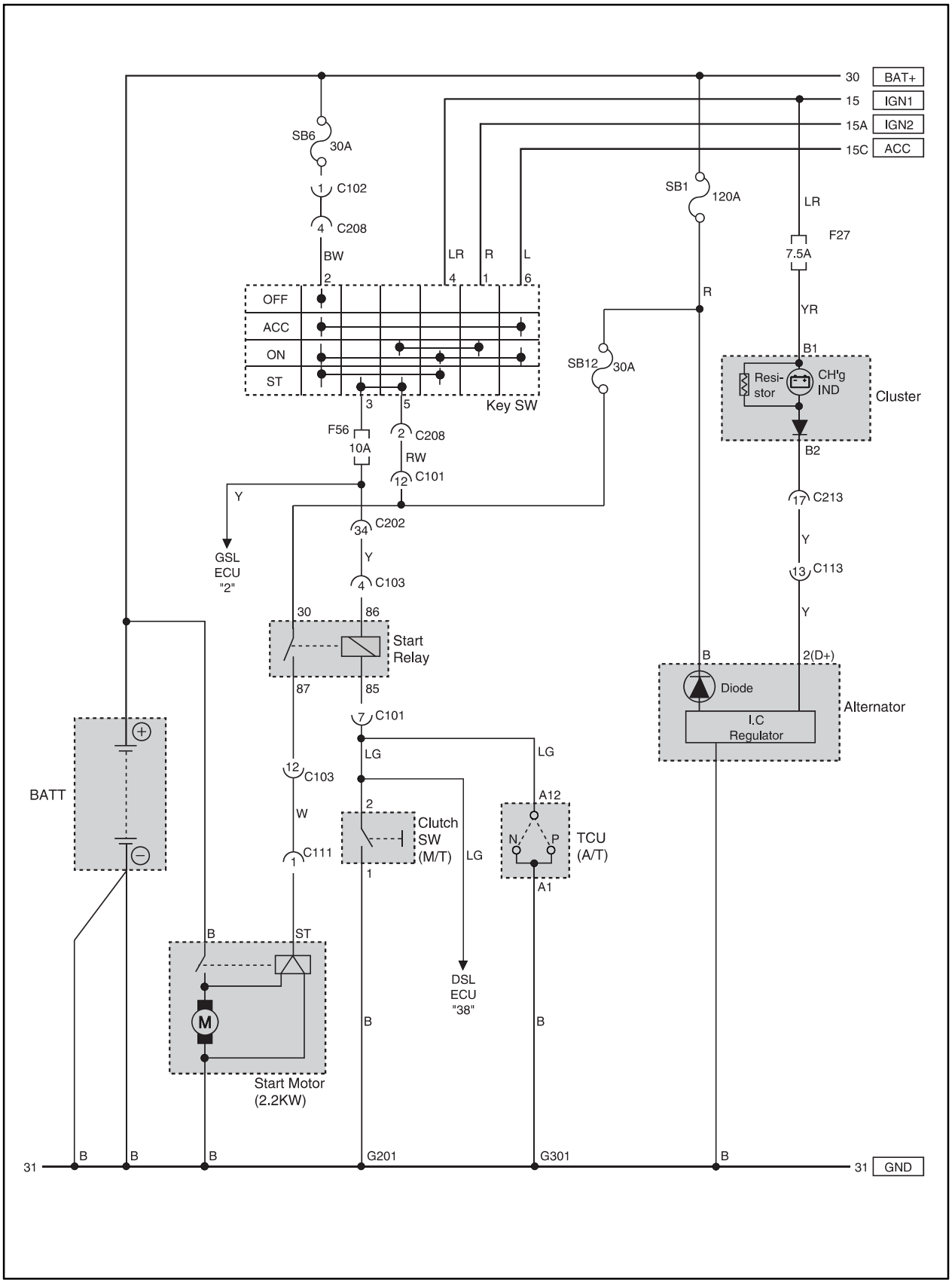
Modification basis	
Application basis	
Affected VIN	

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	

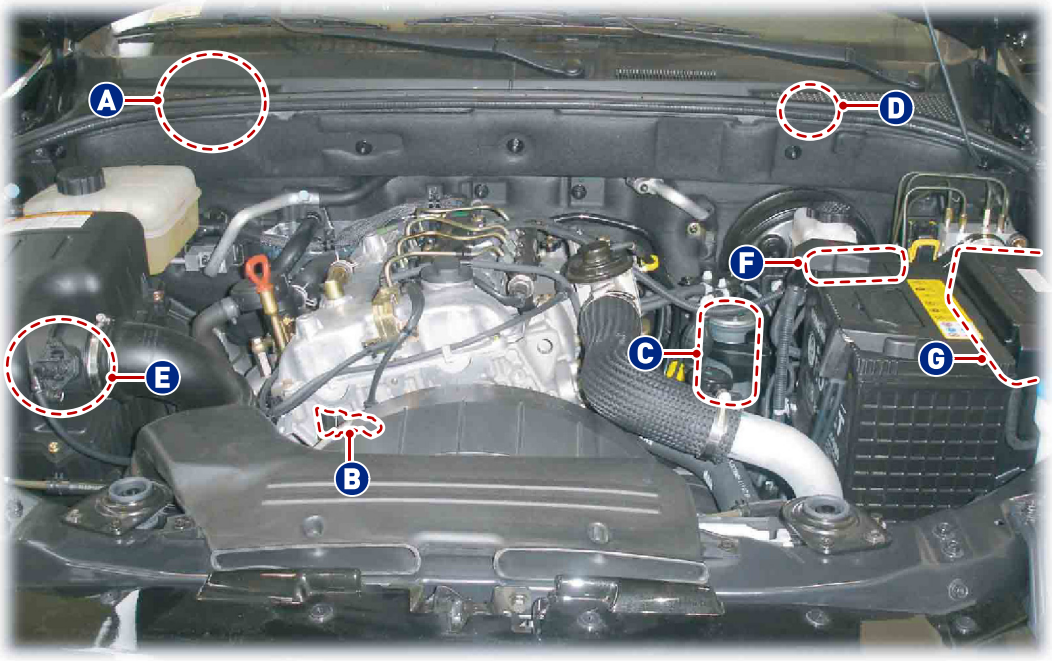
EGINE CONTROL SYSTEM

1491-01

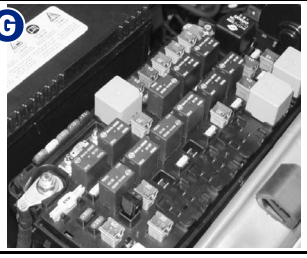
GENERAL

1. ENGINE ECU AND OTHER COMPONENTS

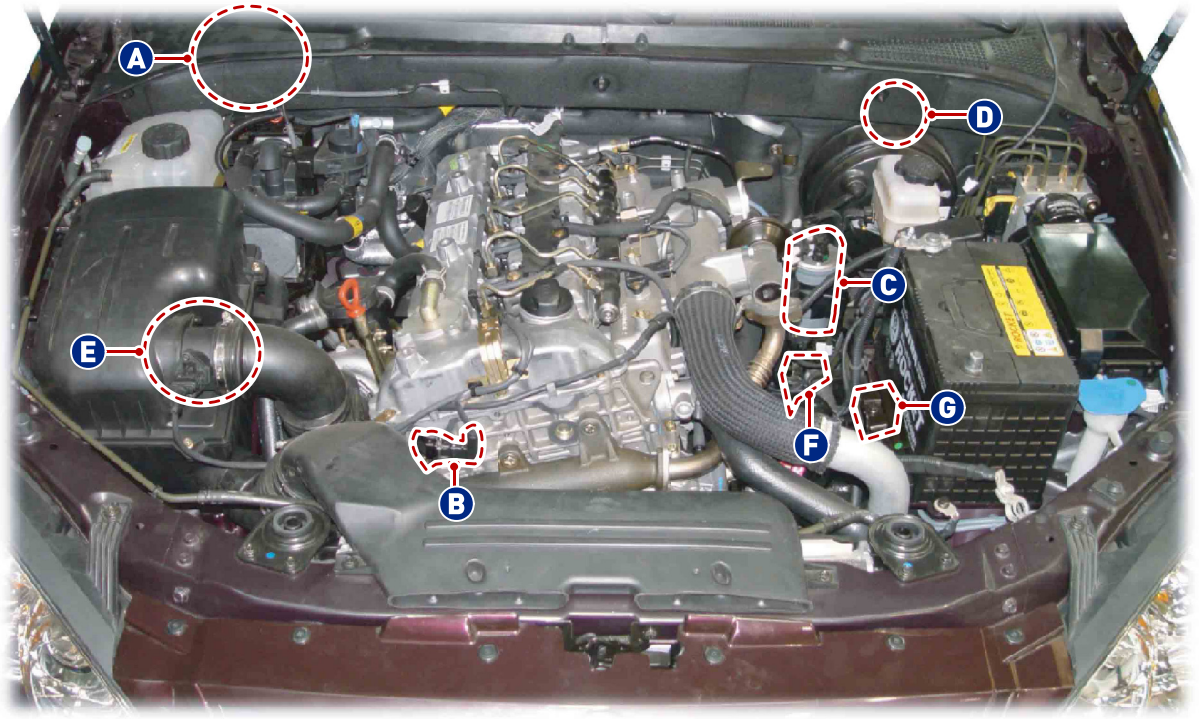
1) D20DT Engine

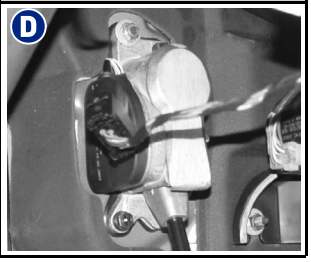


ECU/Barometric Sensor	Camshaft Position Sensor	Fuel Filter (Water Sensor)	Accelerator Pedal Sensor
A 	B 	C 	D 

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

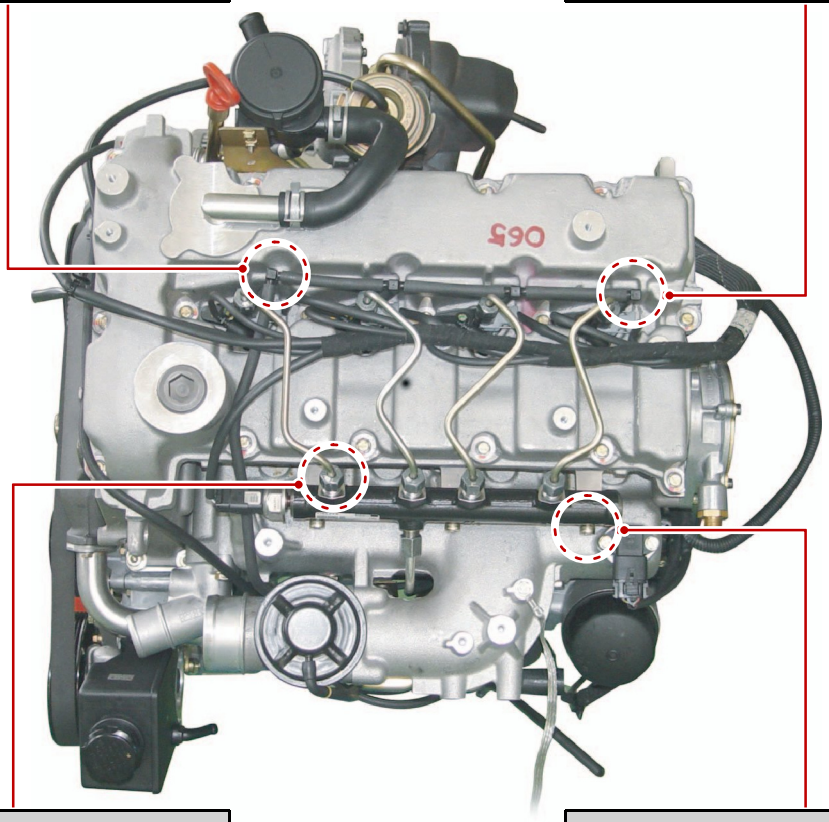
(1) D20DT Engine

Fuel Pressure Sensor

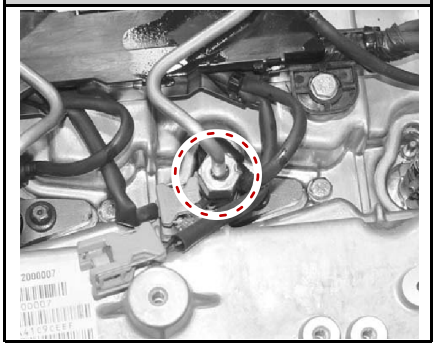


Booster Pressure Sensor

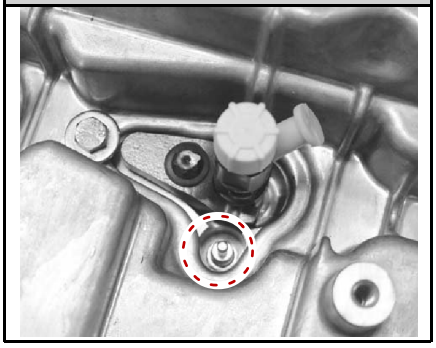




Injectors (4 EA)

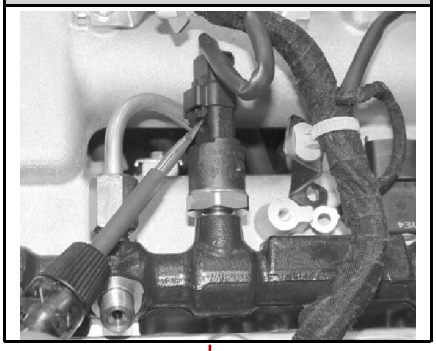


Glow Plugs (4 EA)



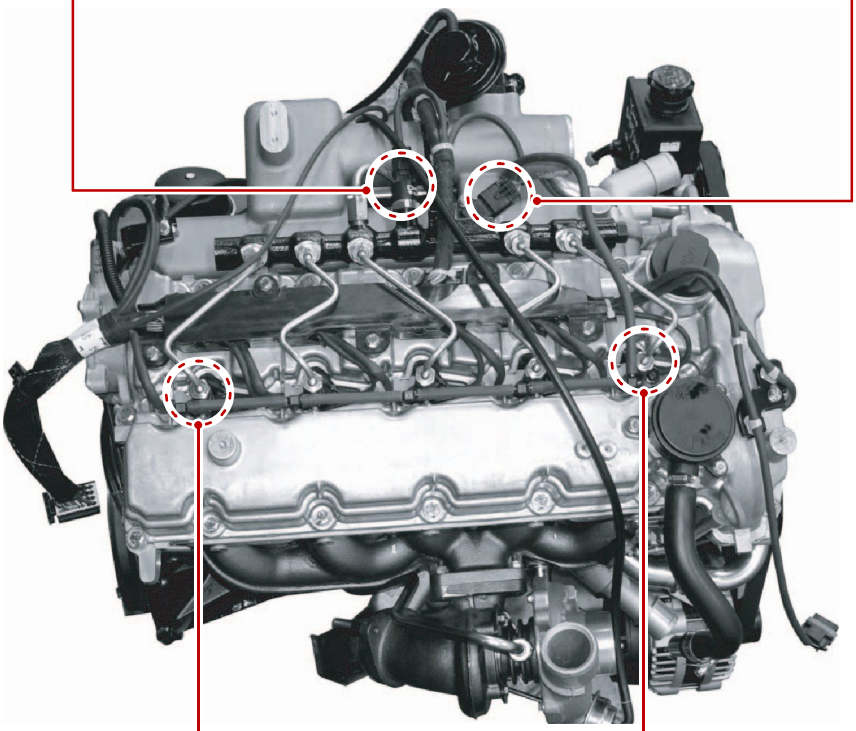
(2) D27DT Engine

Fuel Pressure Sensor

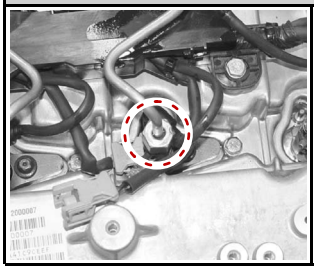


Booster Pressure Sensor



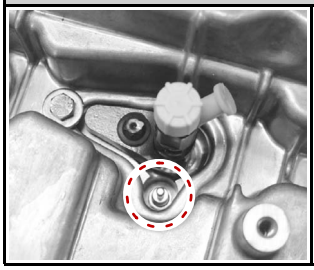


Injectors (5 EA)





Glow Plugs (5)

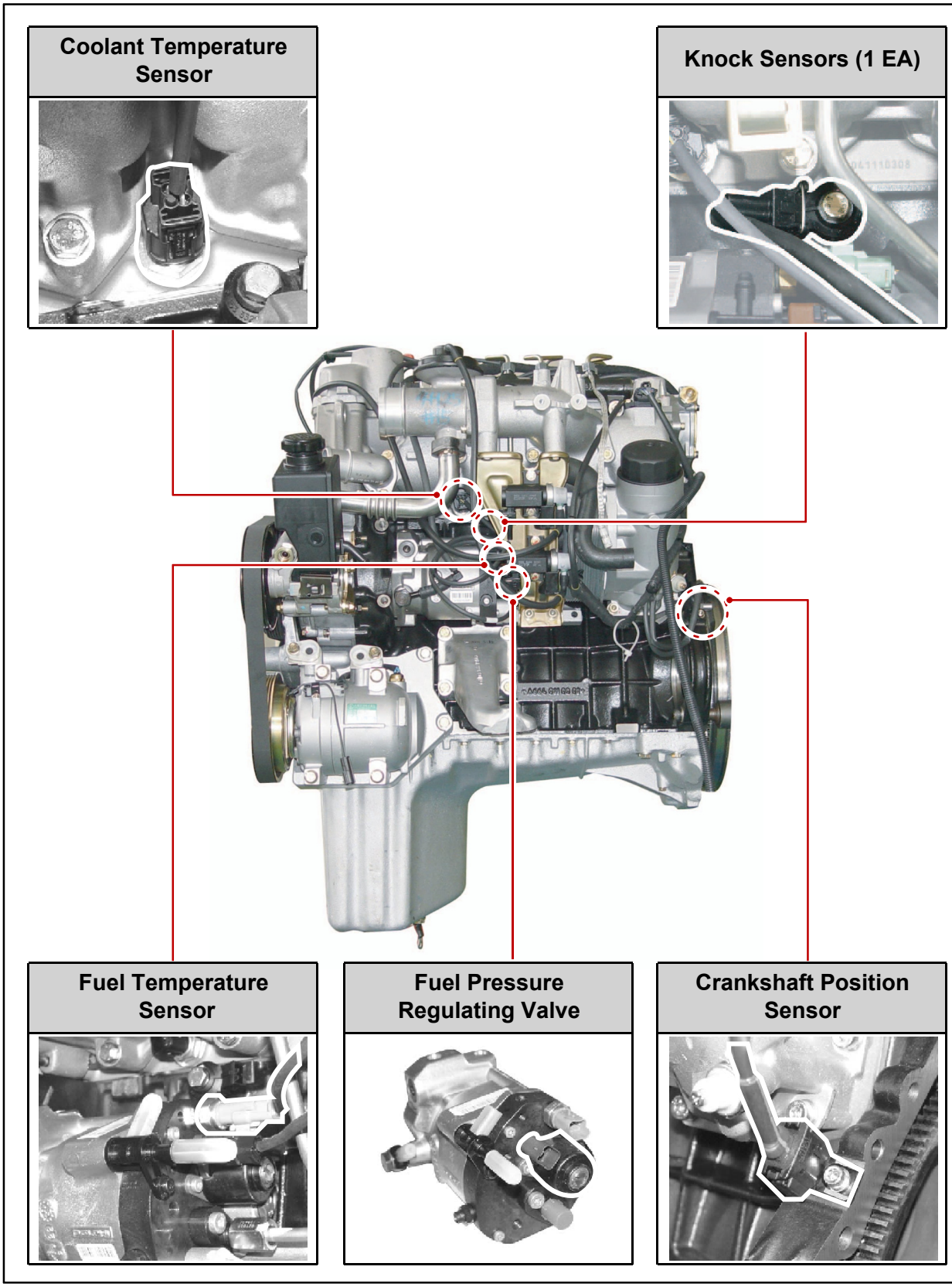




Modification basis	
Application basis	
Affected VIN	

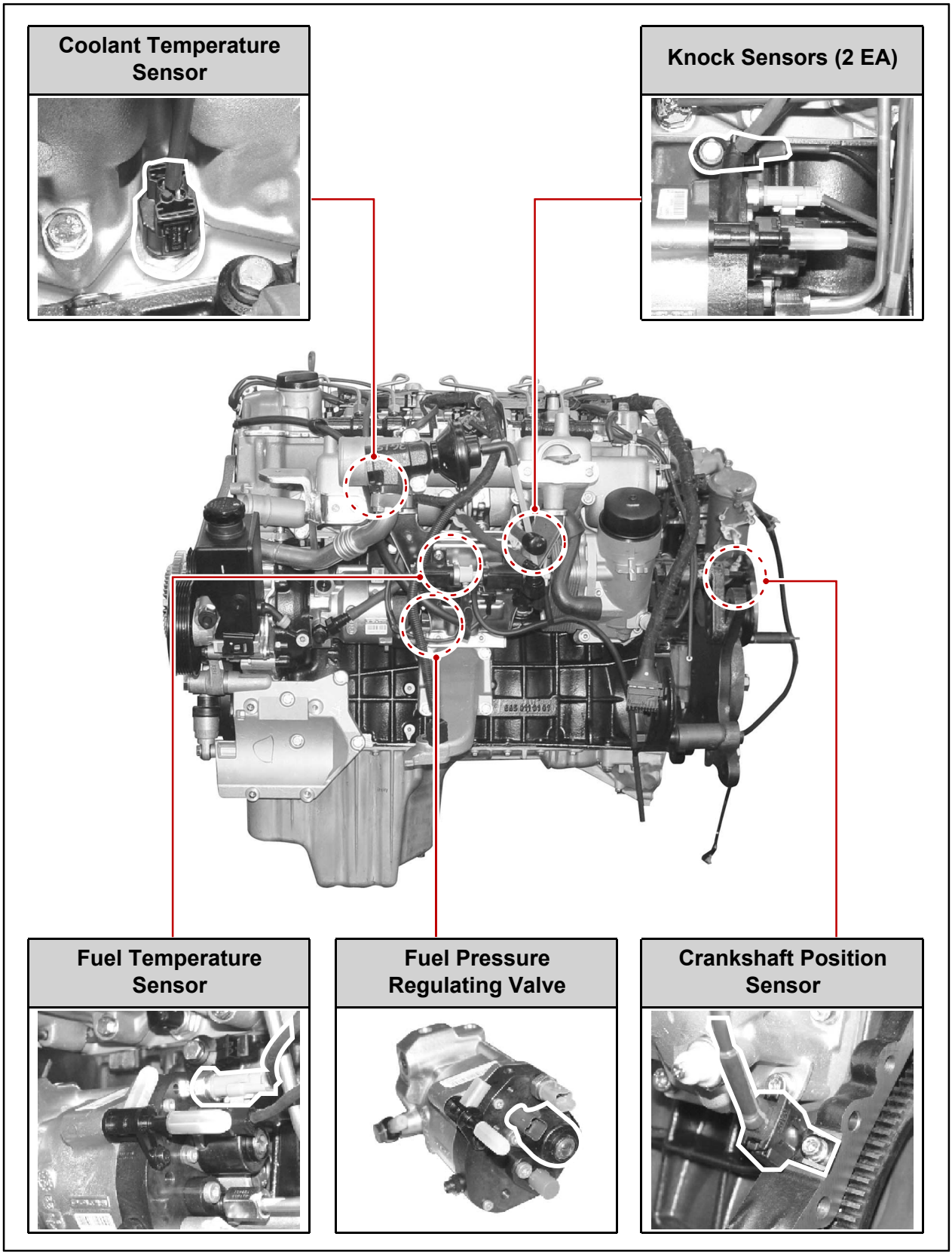
4) SIDE VIEW

(1) D20DT Engine



Modification basis	
Application basis	
Affected VIN	

(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.

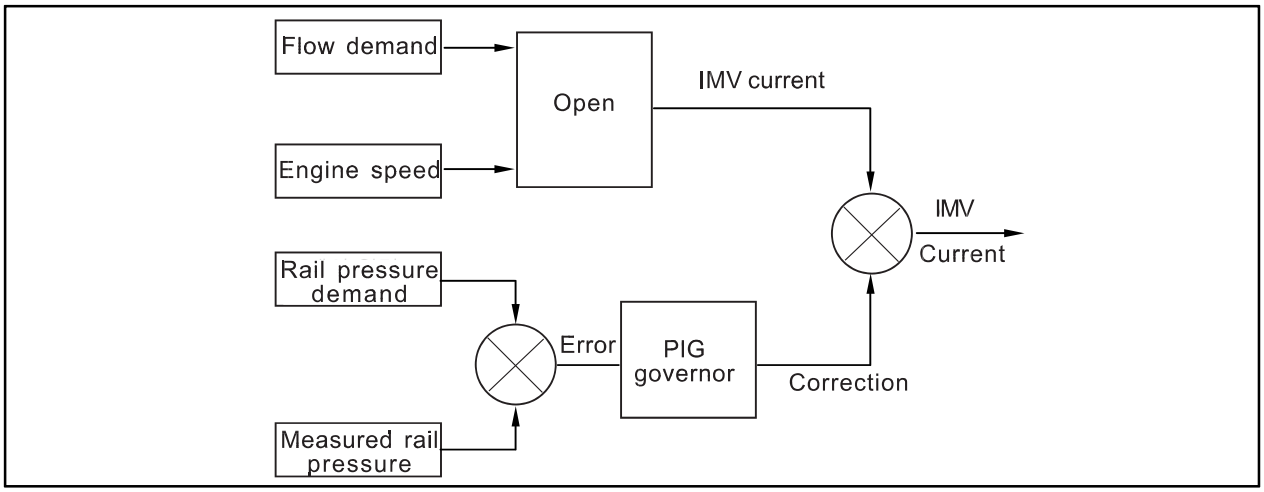
- When engine speed and load are high
  · The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.
- When engine speed and load are low
  · The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will 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.

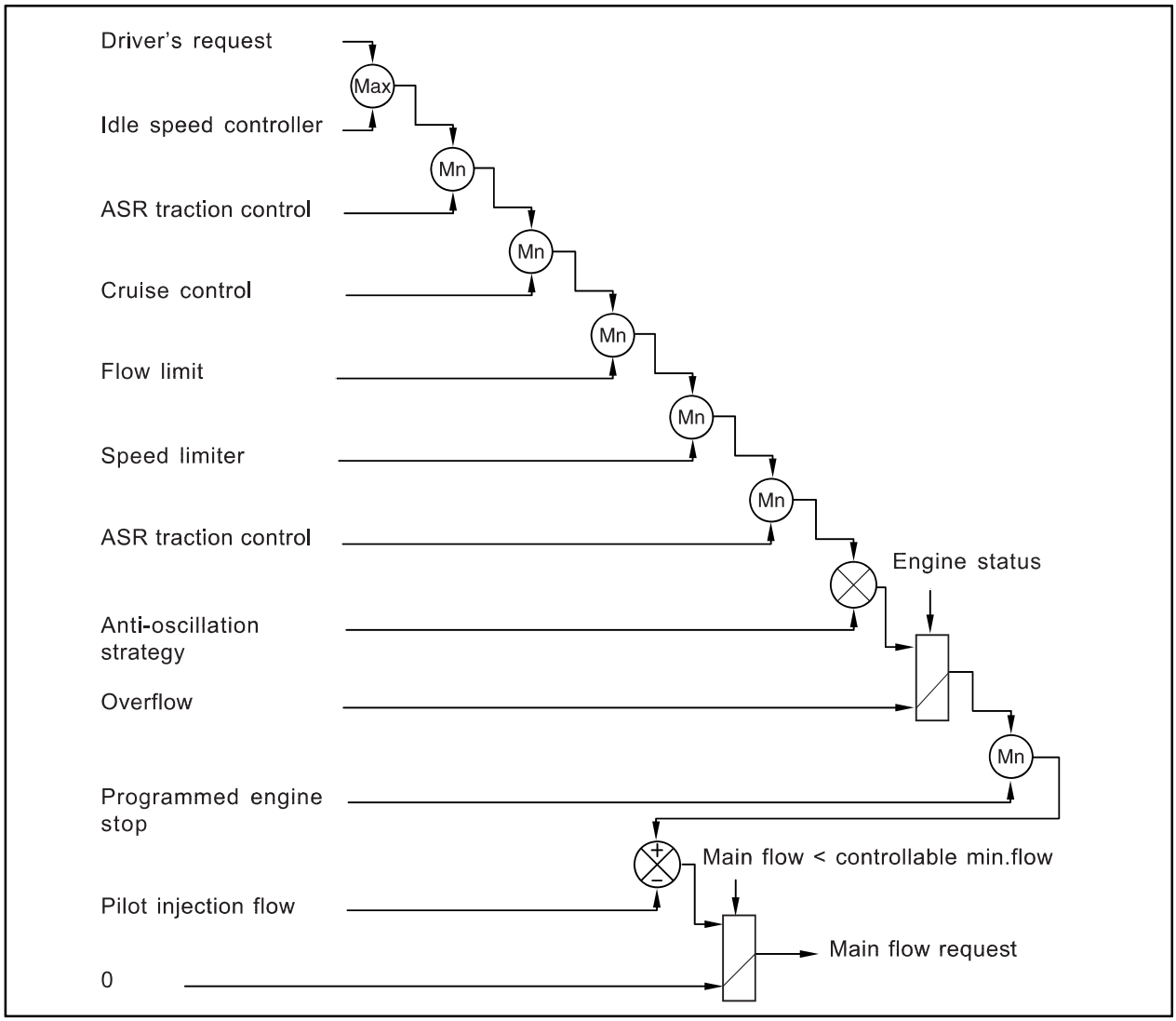
Modification basis	
Application basis	
Affected VIN	

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

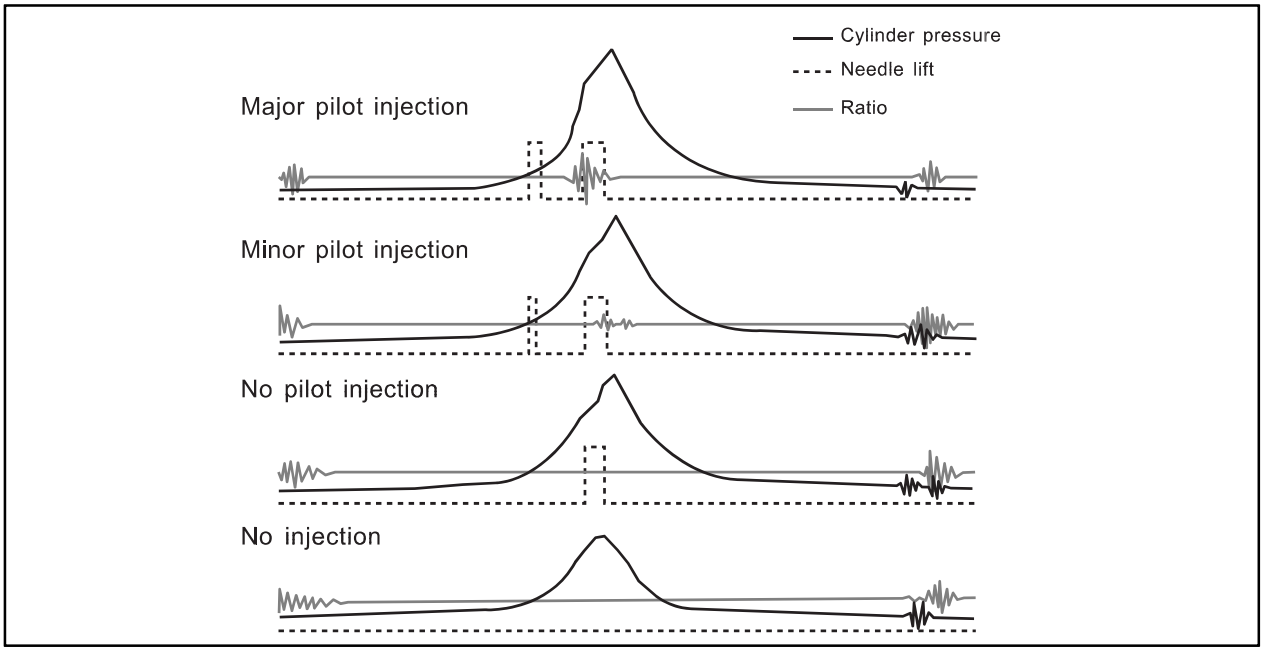
▶ Resetting the pilot injection

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**

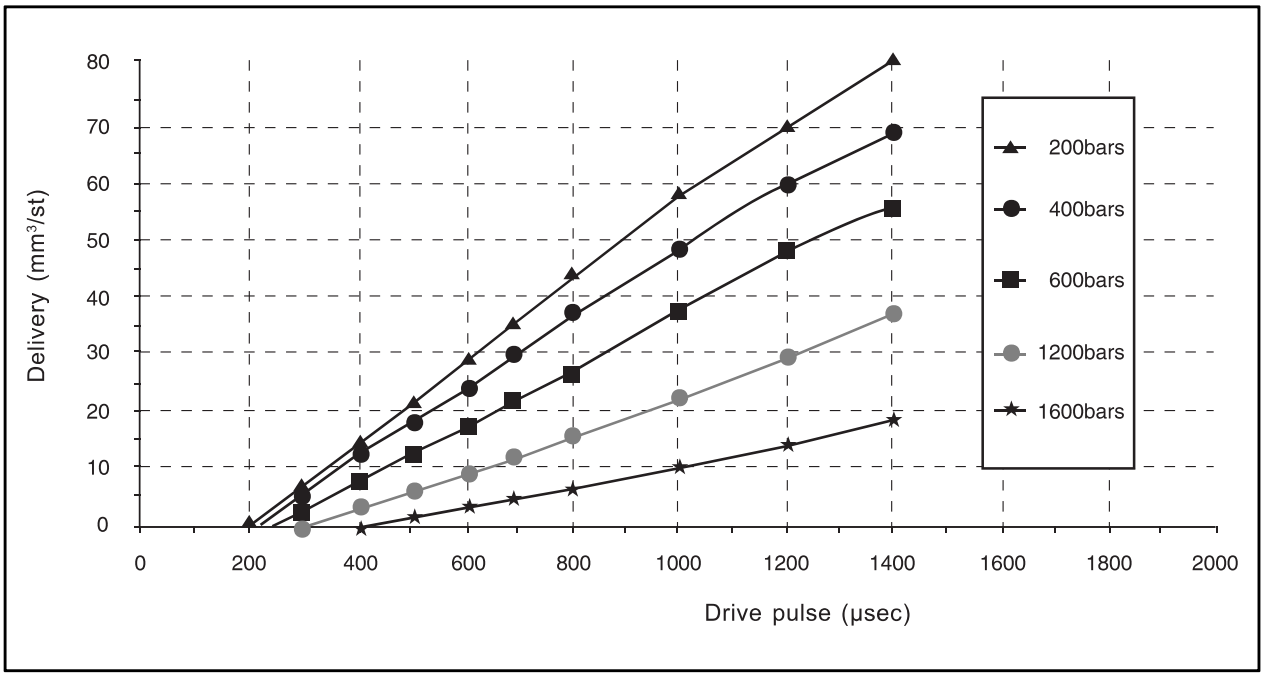
This strategy permits the detection of a fault in the sensor or in the wiring loom connecting the sensor to the ECU.

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.

Modification basis	
Application basis	
Affected VIN	

7. INDIVIDUAL INJECTOR CALIBRATION (C2I)

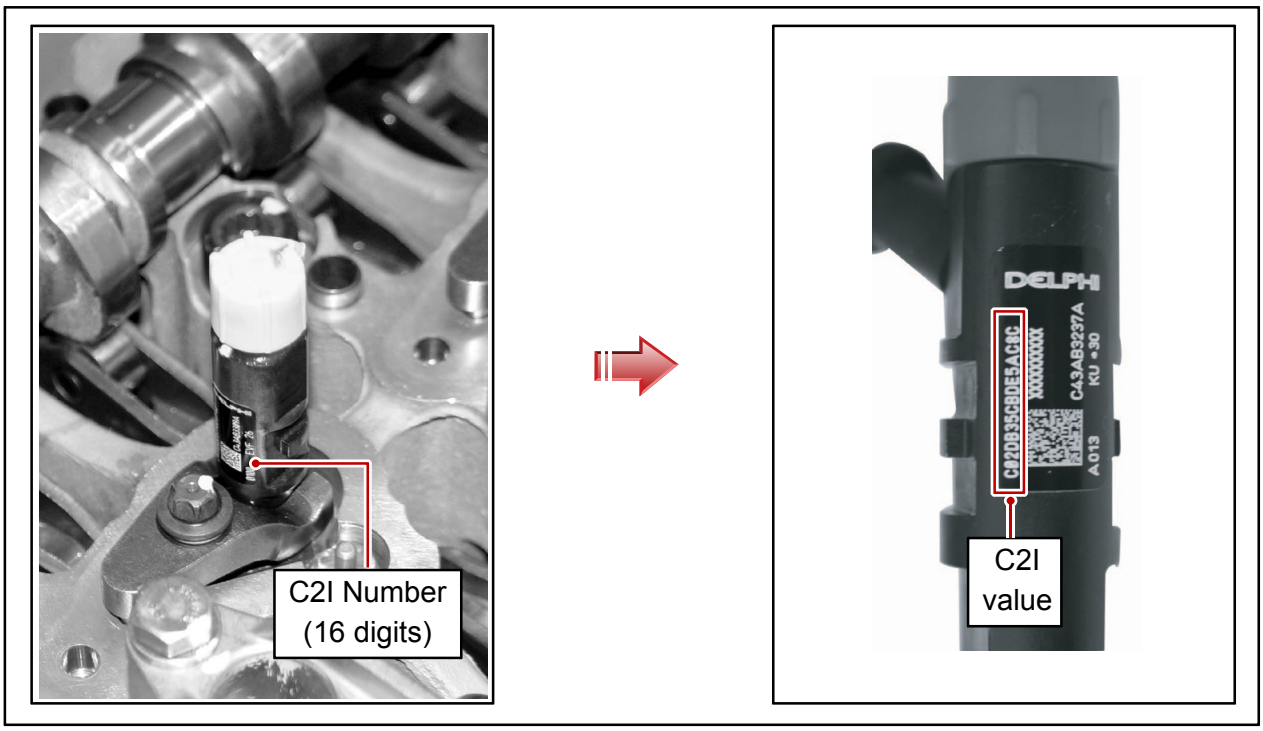
Injected fuel is proportional to square root of injection time and rail pressure.
It is function between pulse and rail pressure and fuel injection curve is called injector characteristics curve having the following shape.



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	

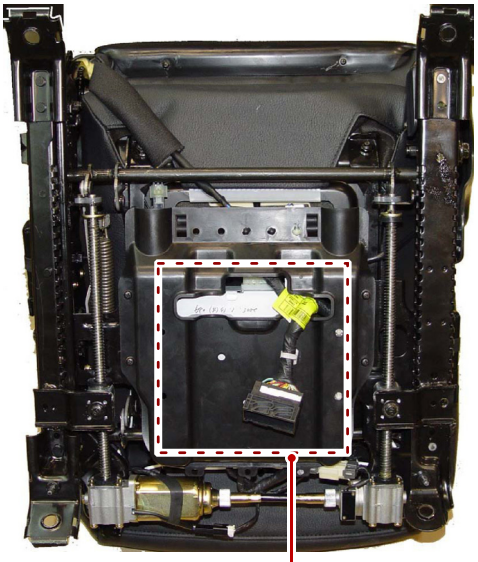
Memo

SPWM (Seat Position With Memory) UNIT

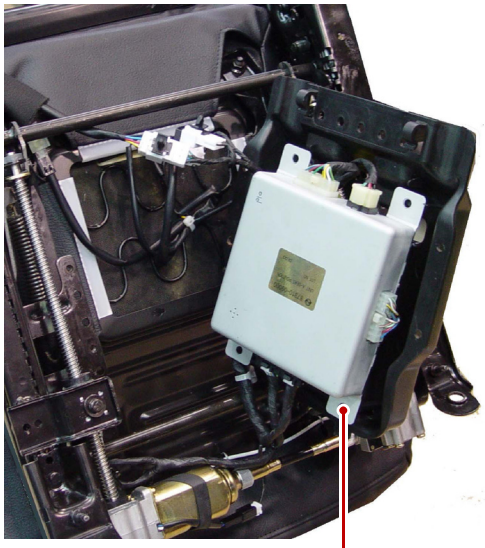
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GENERAL

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



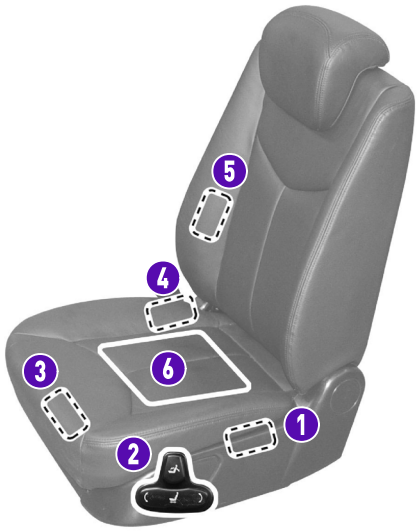
Outside rearview mirror folding switch



SPWM Unit



Seat Position With Memory COMPONENTS

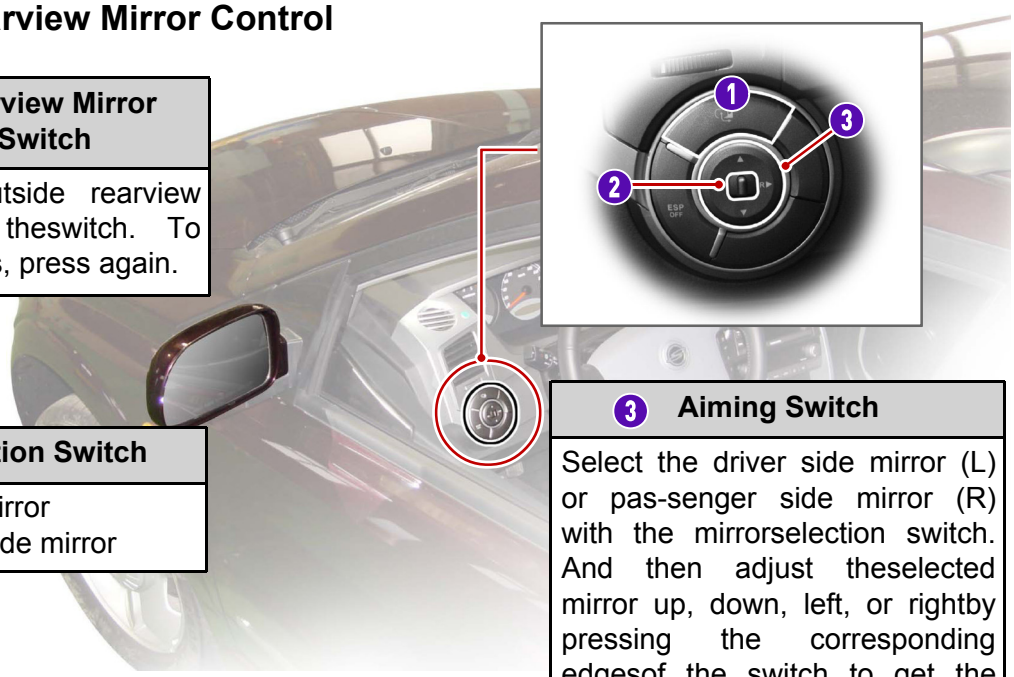


1. Front cushion motor/sensor
2. Seat adjusting switch
3. Sliding motor/sensor
4. Rear cushion motor/sensor
5. Reclining motor/sensor
6. SPWM Unit

Modification basis	
Application basis	
Affected VIN	

2. SEAT POSITION WITH MEMORY OPERATIONS

1) Outside Rearview Mirror Control



Outside Rearview Mirror ① Folding Switch

To fold the outside rearview mirrors, press theswitch. To unfold the mirrors, press again.

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.

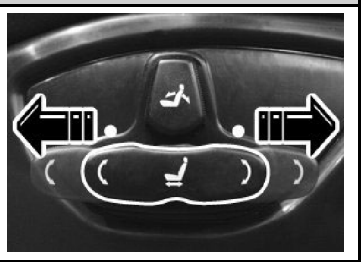
2) Seat Position Control



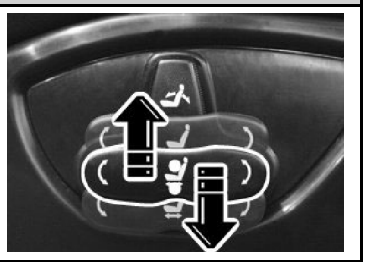




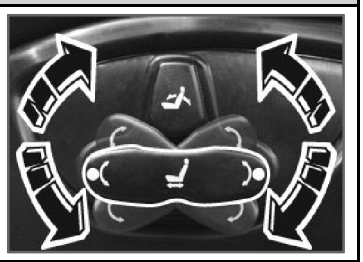
Seat Slide Adjustment



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 MEMORY INPUT/OUTPUT OF SPWM UNIT

Seat memory power →

Seat sliding, rear lift power →

Seat reclining, front lift power →

Instrument panel:
gear shift lever at "P" position →

In the vehicle equipped with automatic transmission, the position memory recall is not available if the gear shift lever is not in "P" position.

Parking brake operation →

In the vehicle equipped with manual transmission, the position memory recall is not available if the parking brake is released.

Vehicle speed signal →

If vehicle speed is over 3 km/h, the position memory recall is not available.

Outside rearview mirror folding switch  →

Outside rearview mirror adjusting switch →

Power seat control switch  →

Seat memory switch  →

SPWM UNIT

→ **Sliding motor**

→ **Cushion front motor**

→ **Cushion rear motor**

→ **RH outside rearview mirror folding/unfolding motor**

→ **LH outside rearview mirror folding/unfolding motor**

→ **RH outside mirror Up/ Down adjustment motor**

→ **RH outside mirror Left/ Right adjustment motor**

→ **LH outside mirror Up/ Down adjustment motor**

→ **LH outside mirror Left/ Right adjustment motor**

The changes of each motor are always monitored by the sensor in the motor.

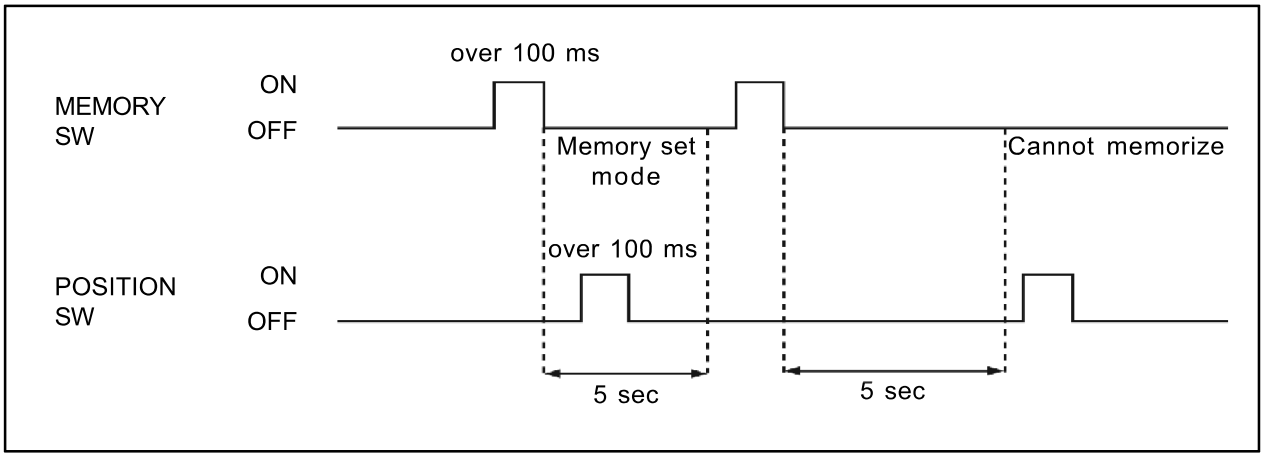
Modification basis	
Application basis	
Affected VIN	

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.

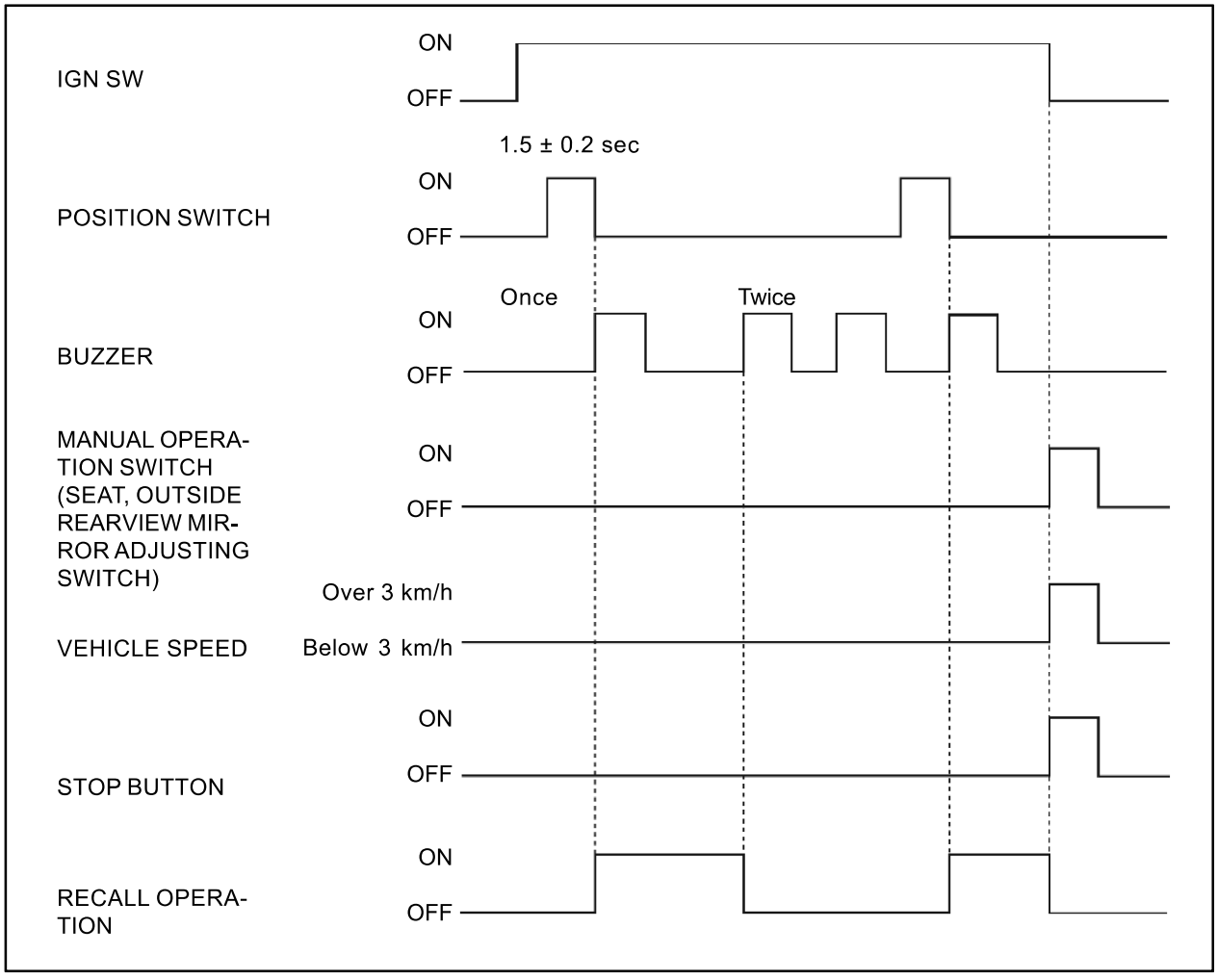


- If any of the following conditions is met, the memory set mode is canceled.
  - · No switch inputs within 5 seconds after pressing SET button.
  - · When adjusting the seat or outside rearview mirror positions during the memory recall operation.
  - · When turning off the ignition switch.
  - · When 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	

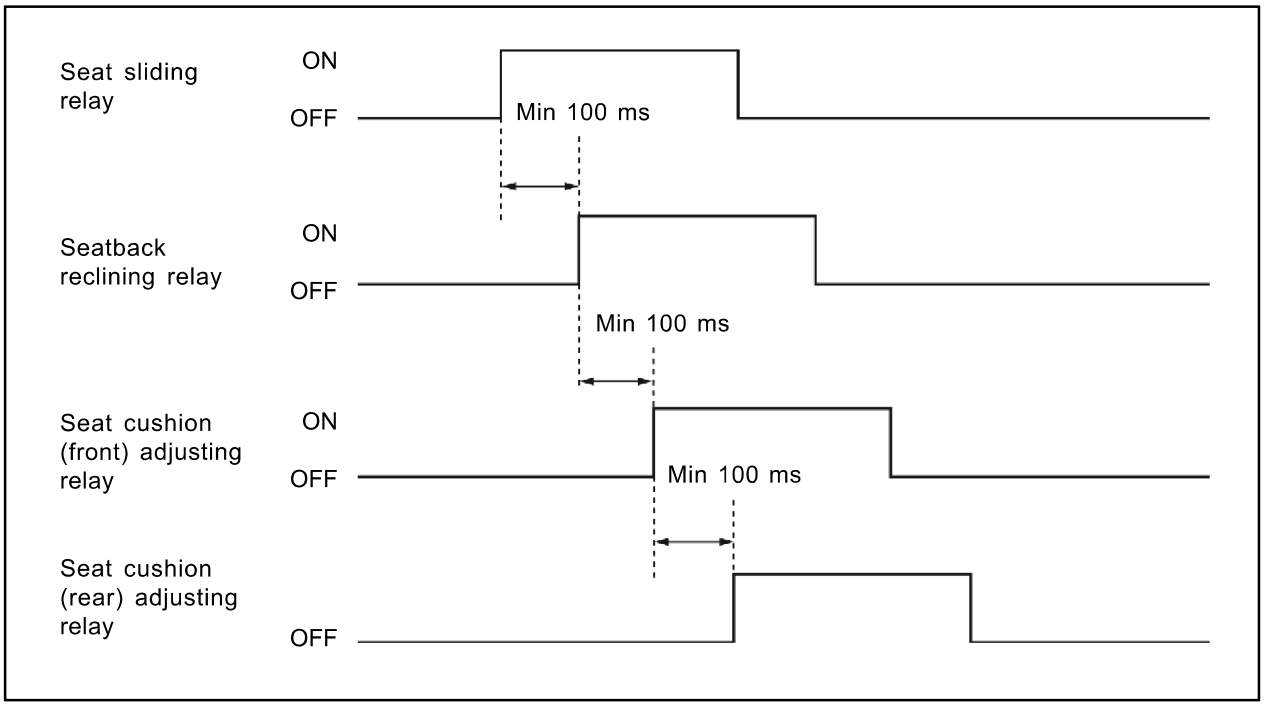
2) POWER SEAT

▶ 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

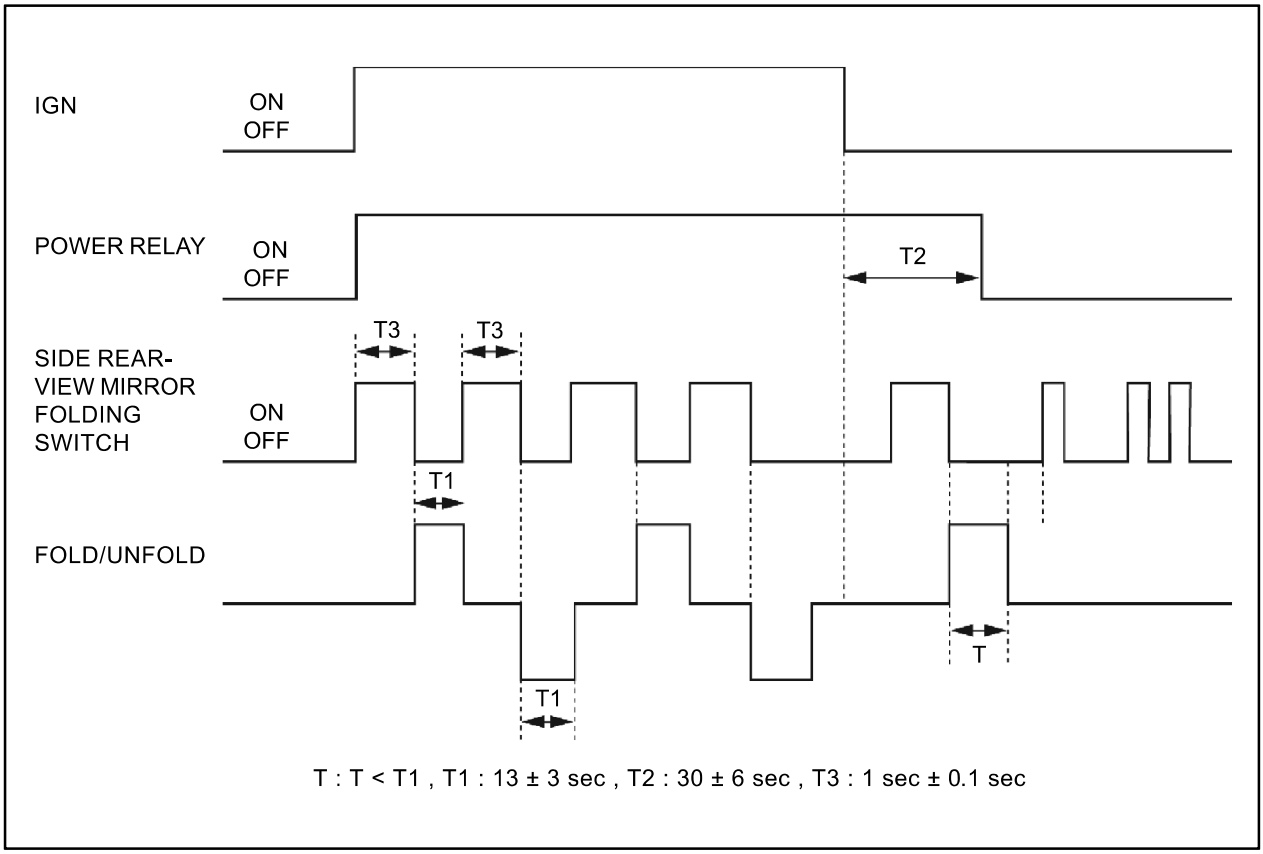
- Rated voltage : DC 12 V
- Operating voltage : DC 9 ~ 16 V
- Current consumption : Max. 300 mA (not including the load)
- Operating temperature range : −30°C ~ 75°C
- Reserve temperature range : −40°C ~ 85°C

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	

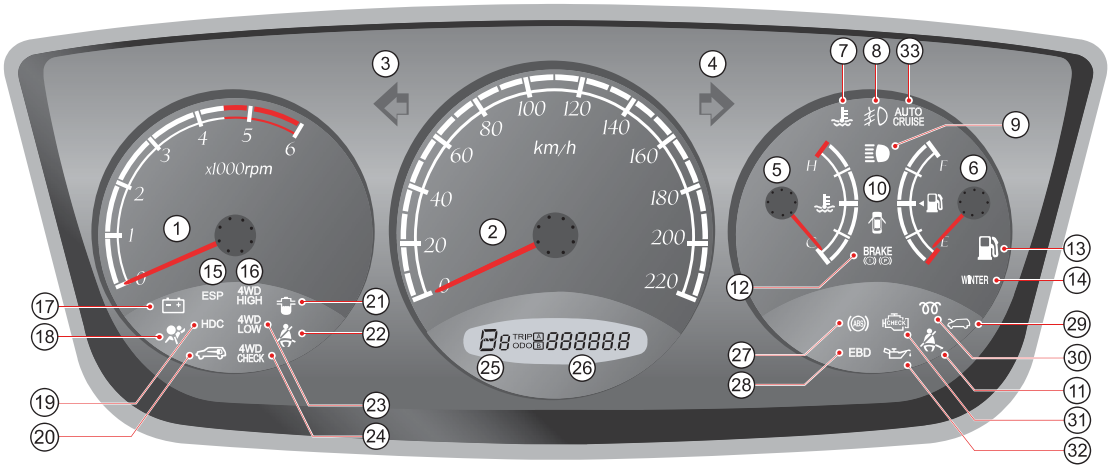
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8010-01

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.



1. Ta chometer
2. S peedometer
3. Left turn signal indicator
4. Right turn signal indicator
5. E ngine coolant temperature gauge
6. F uel gauge
7. E ngine overheat warning light
8. Fog lamp indicator
9. High beam indicator
10. Door ajar warning light
11. S ea 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

Modification basis	
Application basis	
Affected VIN	

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

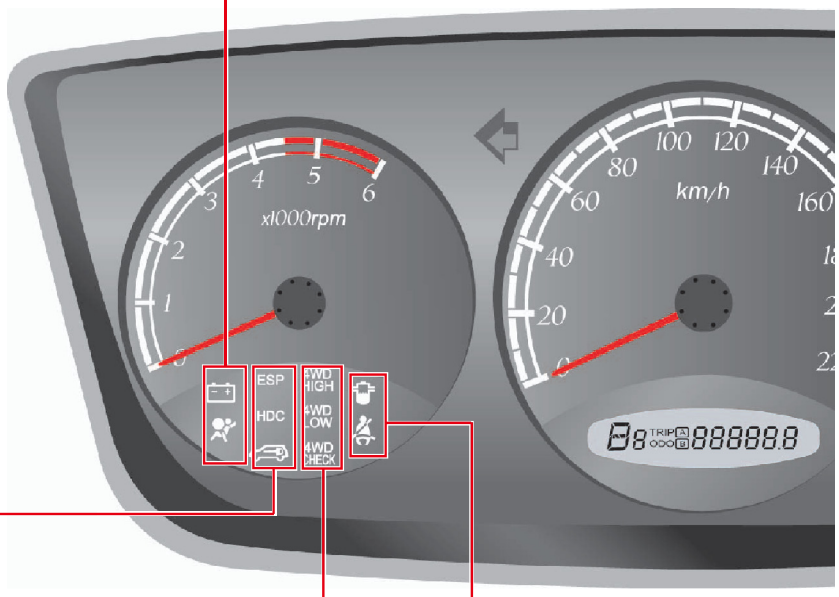
This indicator comes on when the ignition key is communicating with the engine control unit (during engine starting) for approx. 0.5 seconds.

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

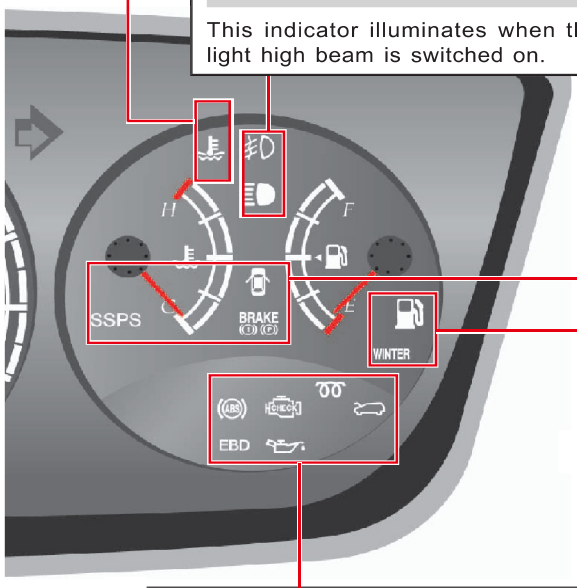
When the engine coolant temperate is abnormally hot (over 120°C), the engine overheat warning light blinks and a warning buzzer sounds. (check the coolant system)

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.

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.

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.

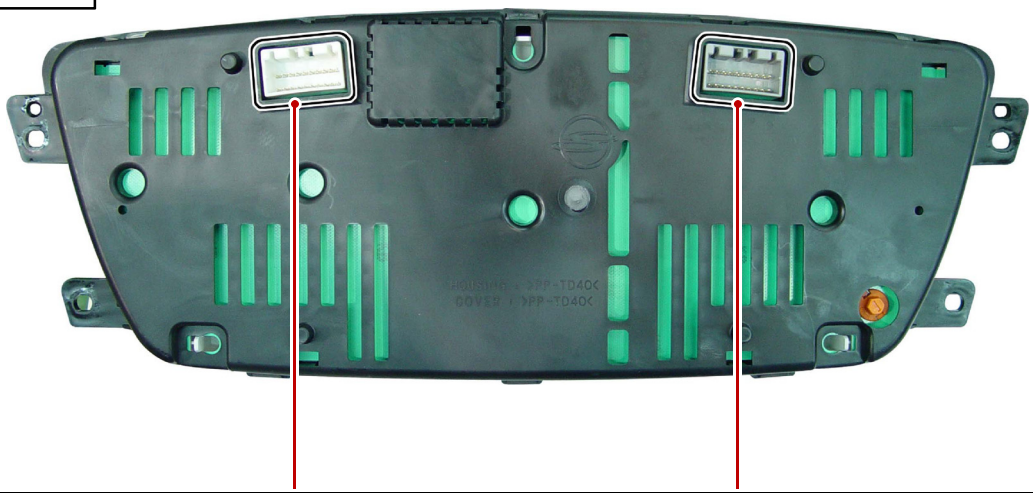
OVERVIEW AND OPERATION PROCESS

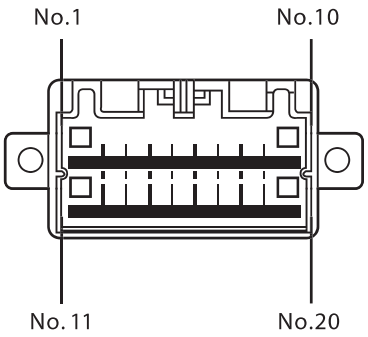
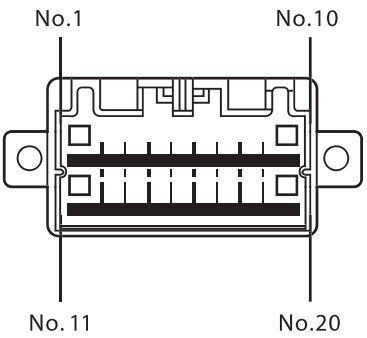
1. CLUSTER CONFIGURATION

Front View



Rear View

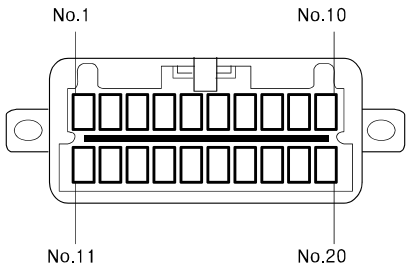


Main Connector	Sub Connector
	

Modification basis	
Application basis	
Affected VIN	

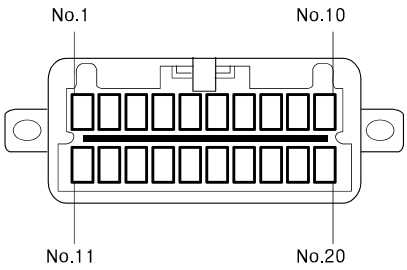
▶ Connector Pin Arrangement

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	-

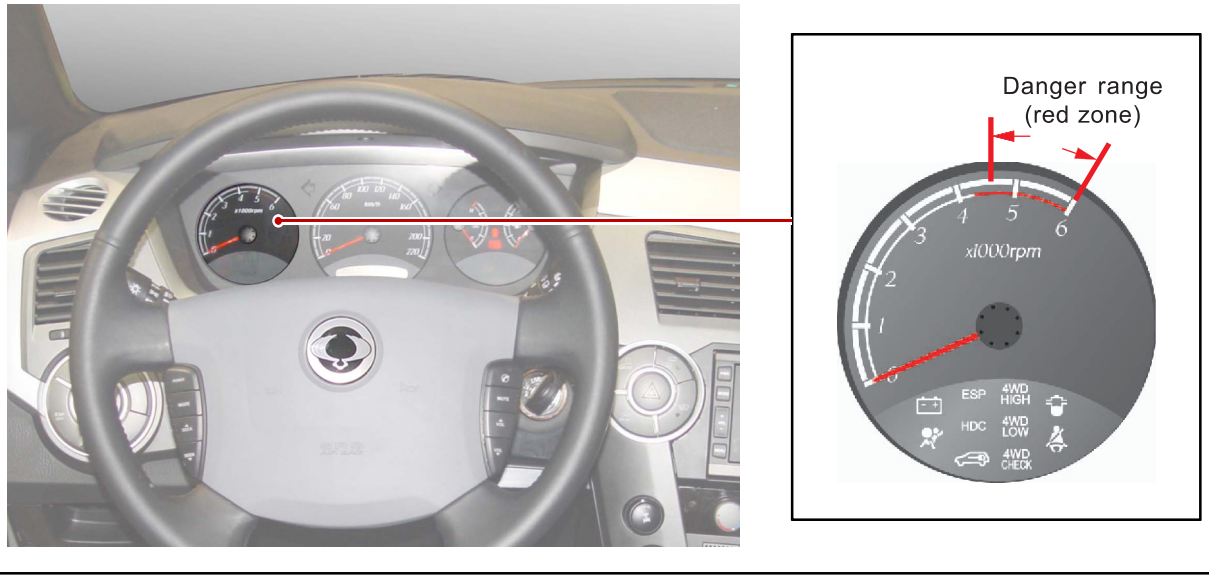
Sub Connector - 20 pins



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.

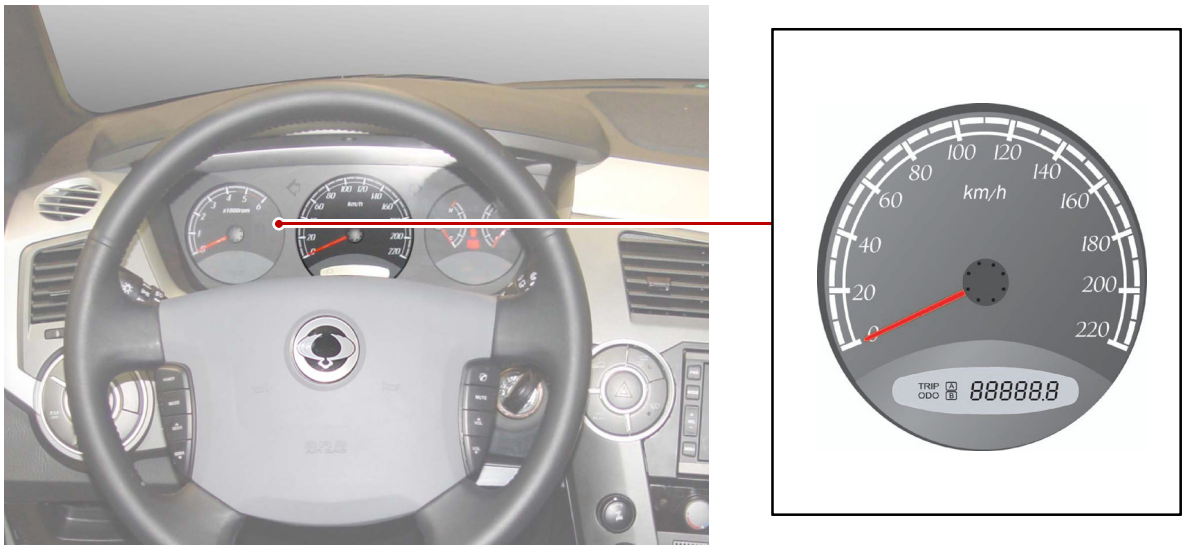
- Connect the tachometer for tune-up test and start the engine.
- Eliminate the hysteresis by tapping the tachometer.
- Compare the values on the tester and tachometer and replace the tachometer if the tolerance is excessive.

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

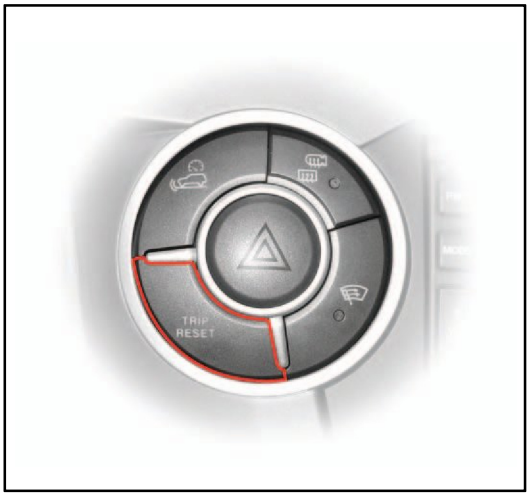
- When the resistance value by coolant temperature is within the specified range, check thermostat, waterpump, radiator related coolant circuit for normal operation. Also, check the wiring harnesses and connectorsfor proper connection.

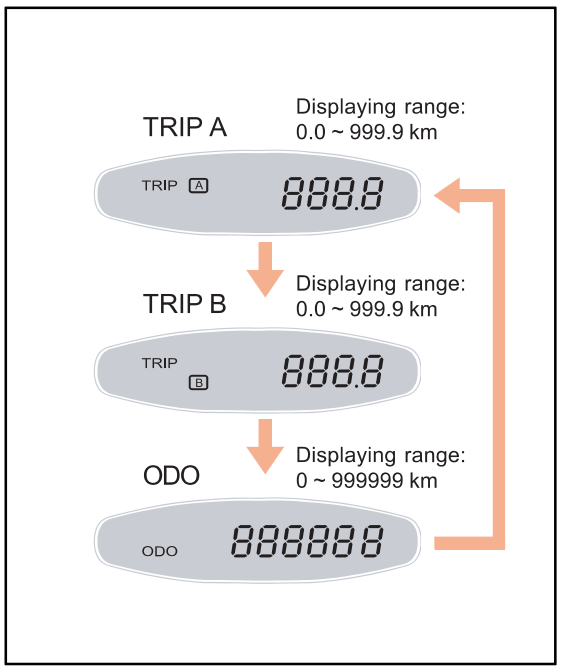
5) TRIP ODOmeter (TRIP A, TRIP B) and ODOmeter



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="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>HDC</td><td>HDC</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</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="4">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>

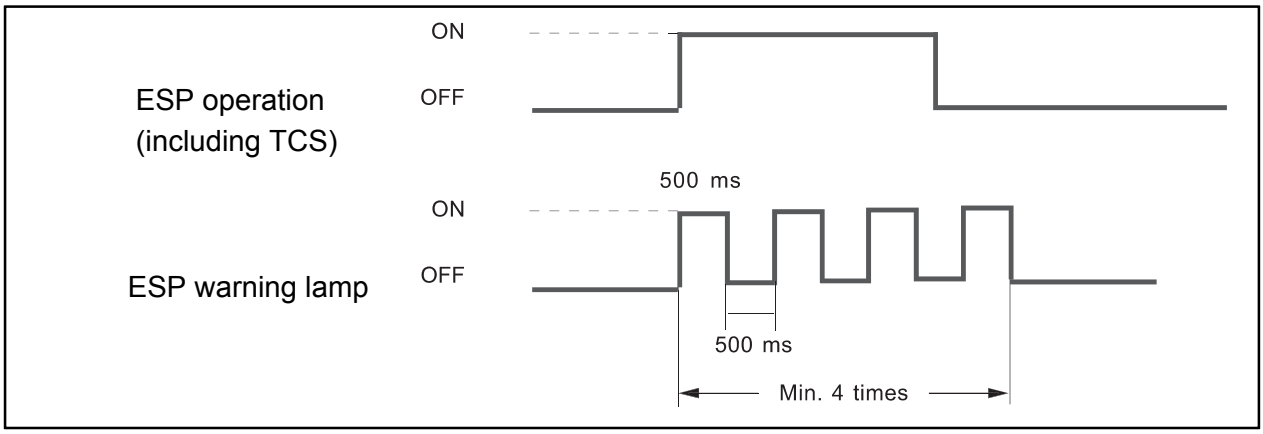
CAUTION

- 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

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.

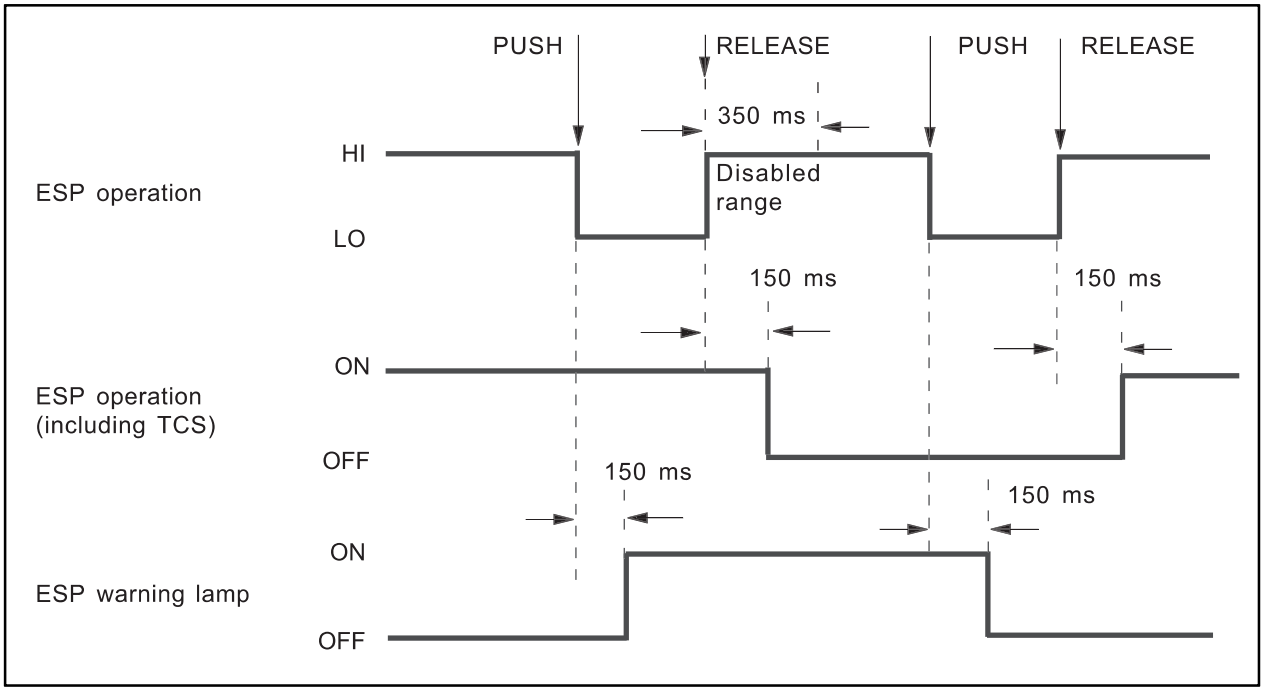
Modification basis	
Application basis	
Affected VIN	

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.

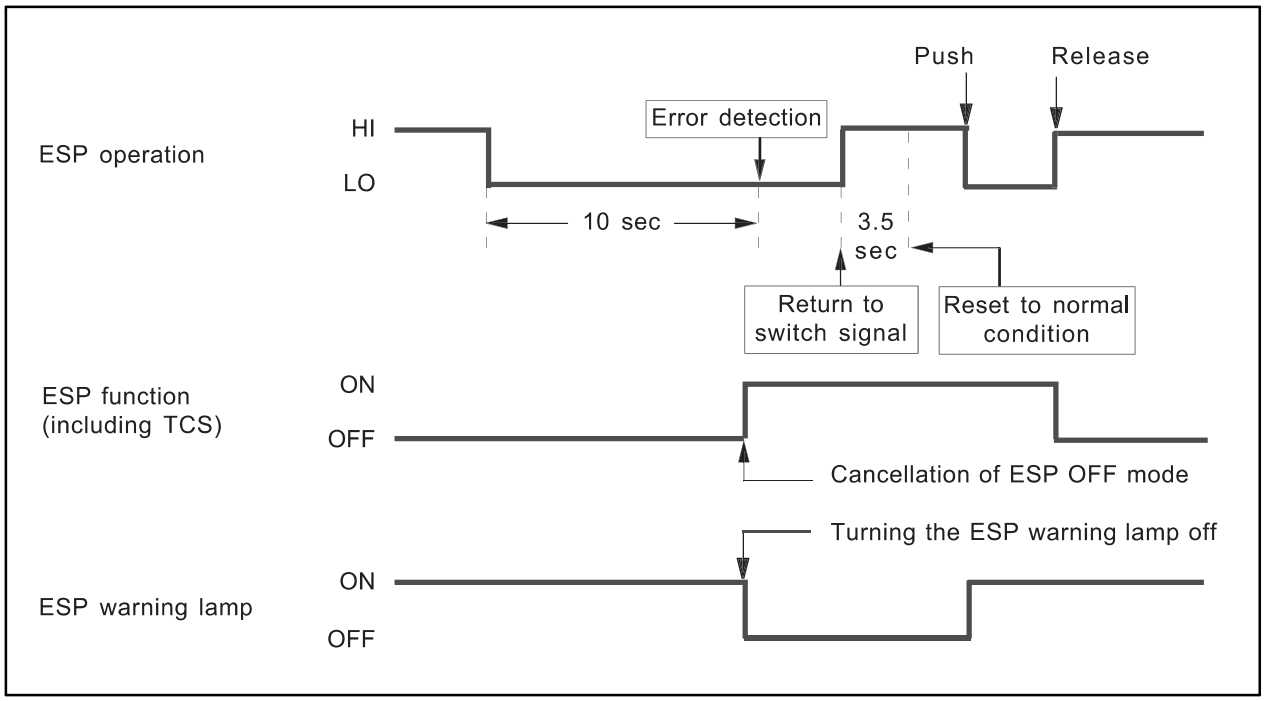


CAUTION

- 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.

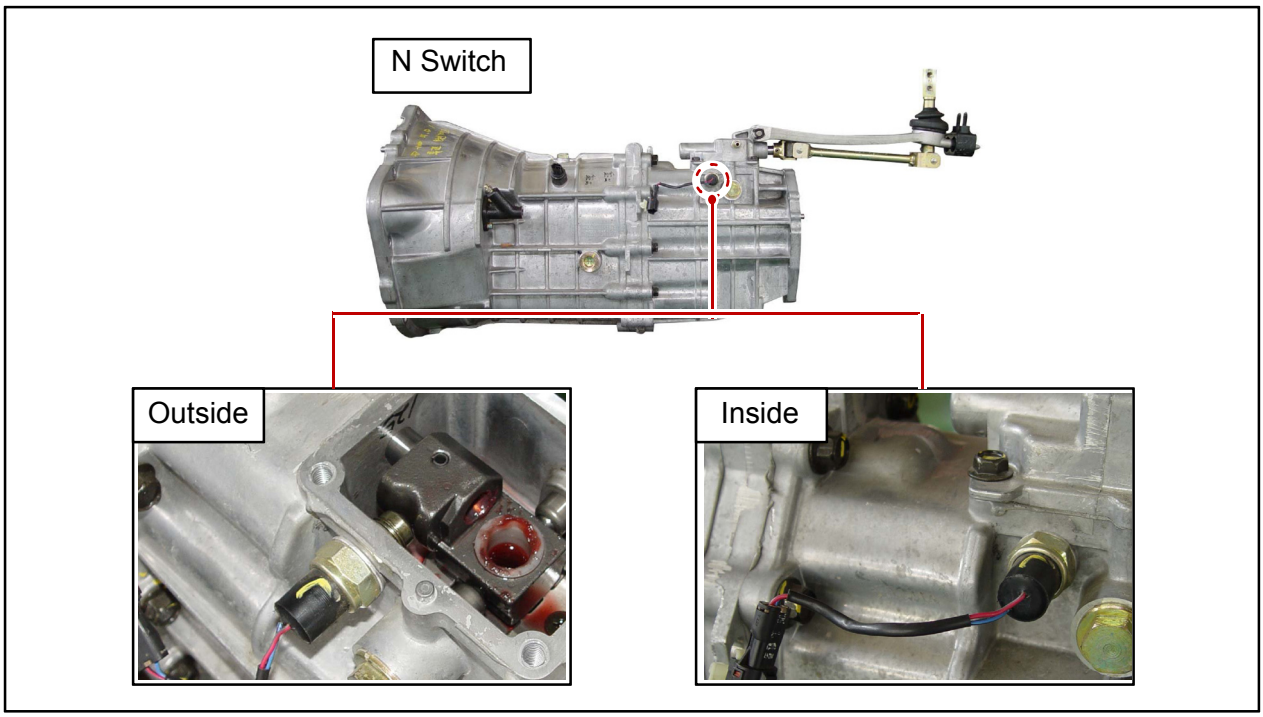
- Manual transmission: operates in the 1st gear or reverse gear position (does not operate in the neutral position).
- Automatic transmission: operates in all hear positions except P (parking) and N (neutral) position.

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.

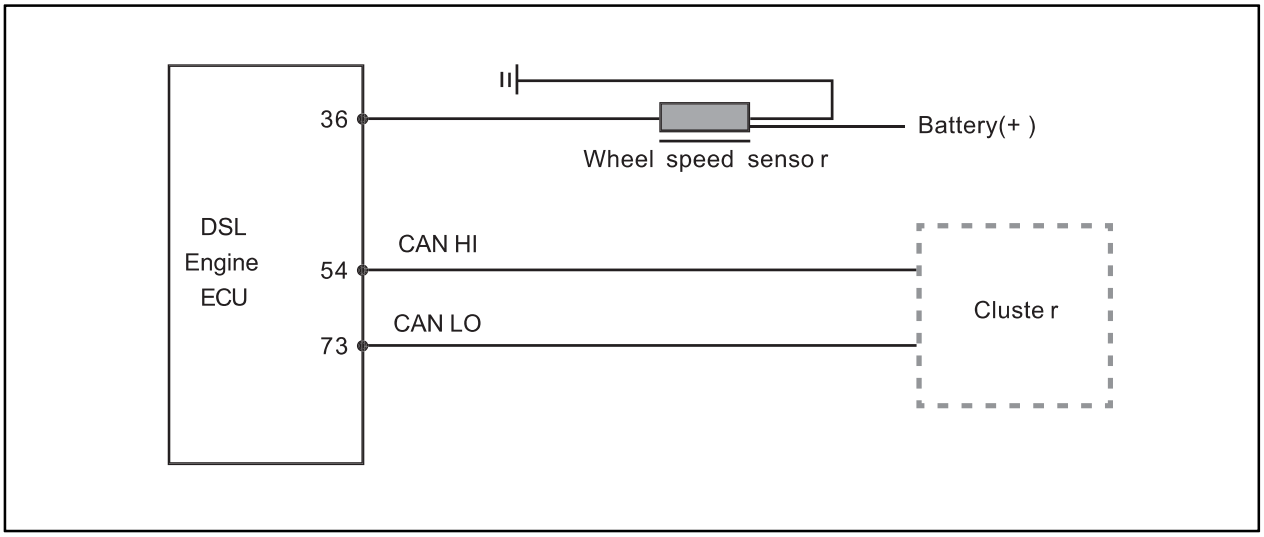


Modification basis	
Application basis	
Affected VIN	

7) Vehicle Speed Input to Non-ABS Equipped Vehicle

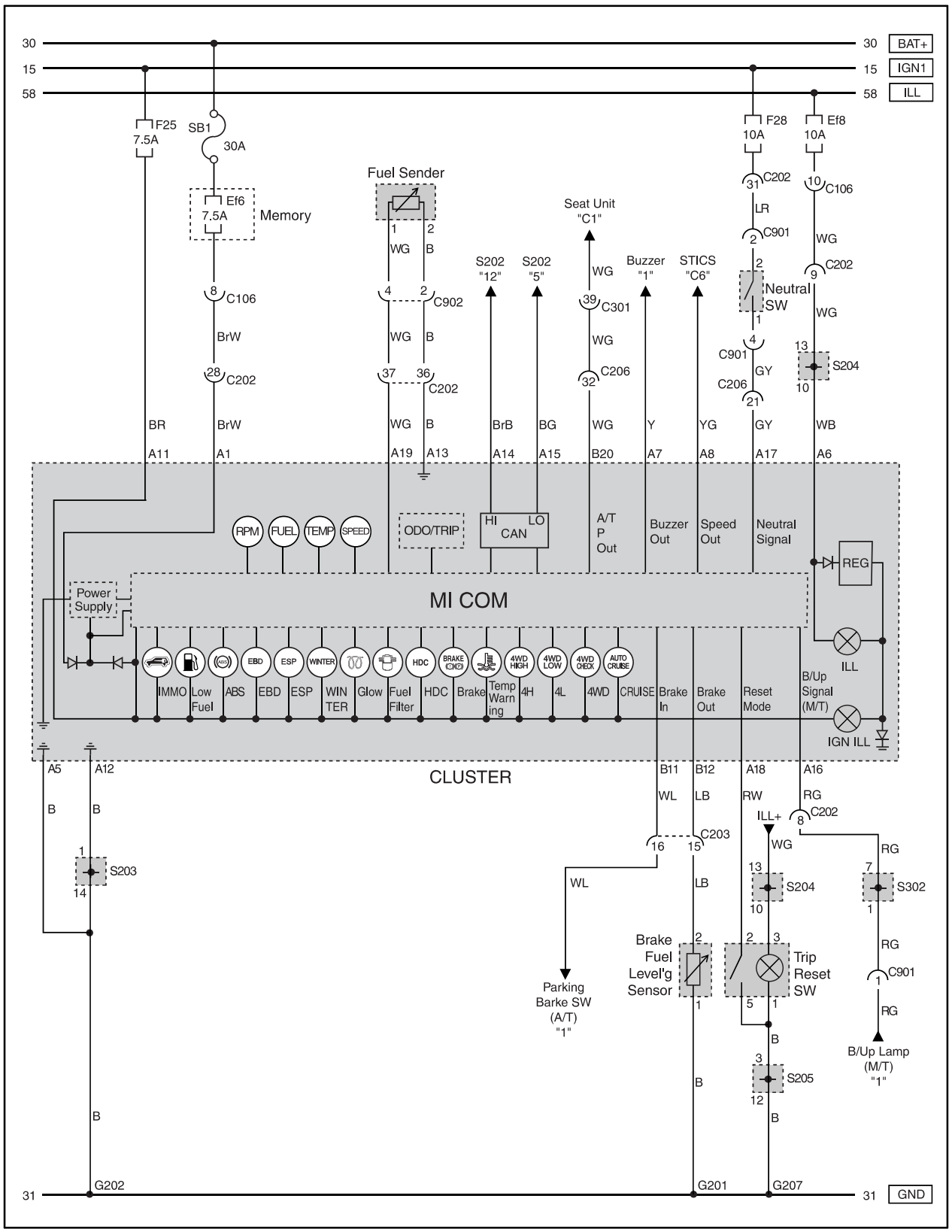
The wheel speed sensor is installed on the rear right wheel regardless of the ABS/ESP installation.

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.



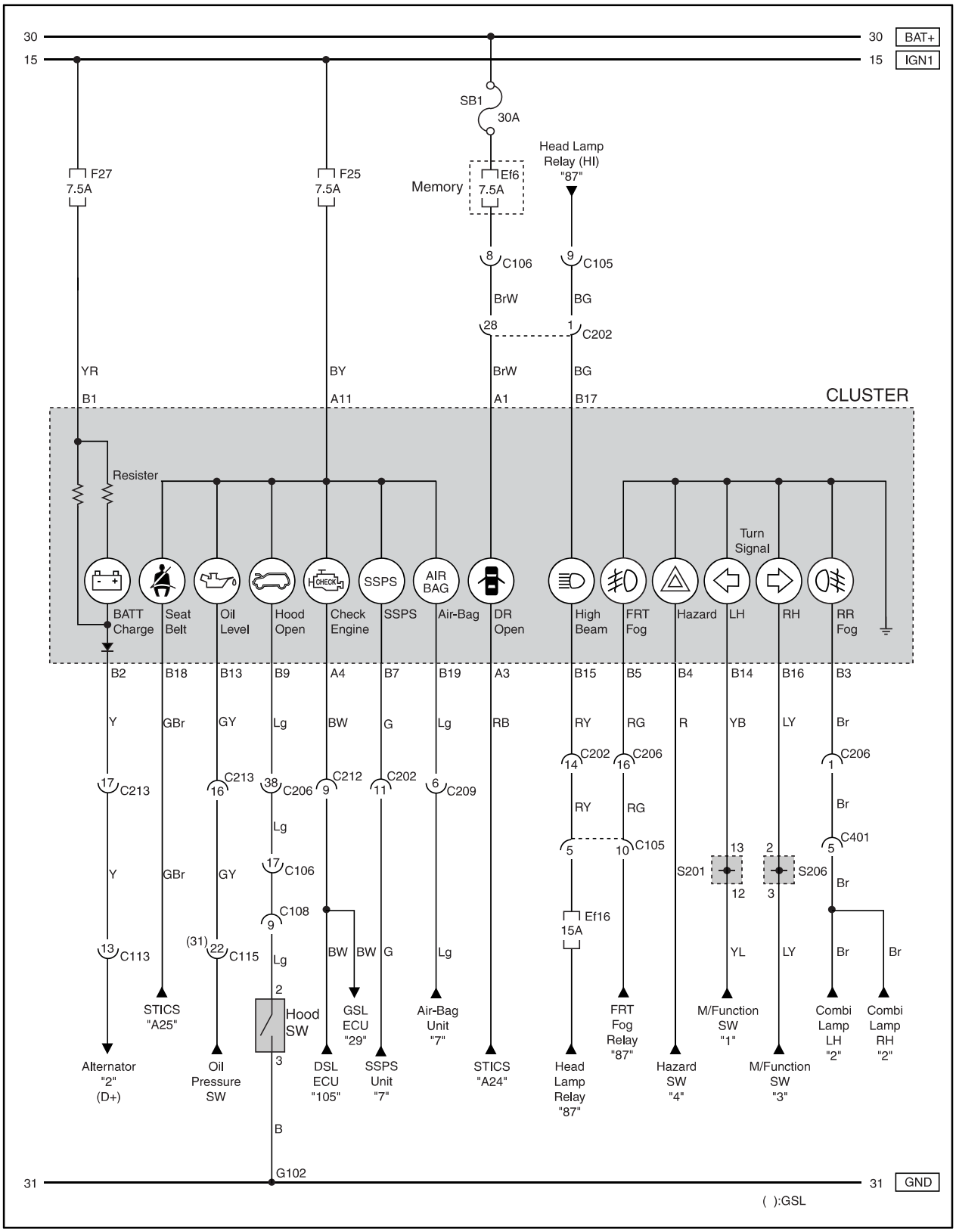
5. CLUSTER ELECTRICAL WIRING DIAGRAMS

▶ **Gauge (speed, RPM, fuel, temp), Warning Lamp (fuel, fuel filter, ABS/ESP, brake, HDC, 4WD)**



Modification basis	
Application basis	
Affected VIN	

▶ Warning Lamp (batt charge, oil, hood, door, eng check, air bag, ssps,seat belt), Turn Signal, Fog Lamp, Hazard



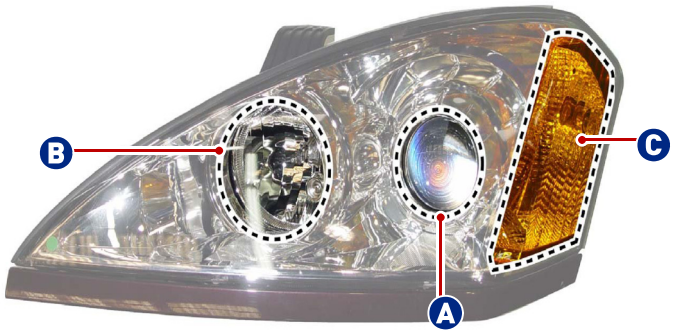
Modification basis	
Application basis	
Affected VIN	

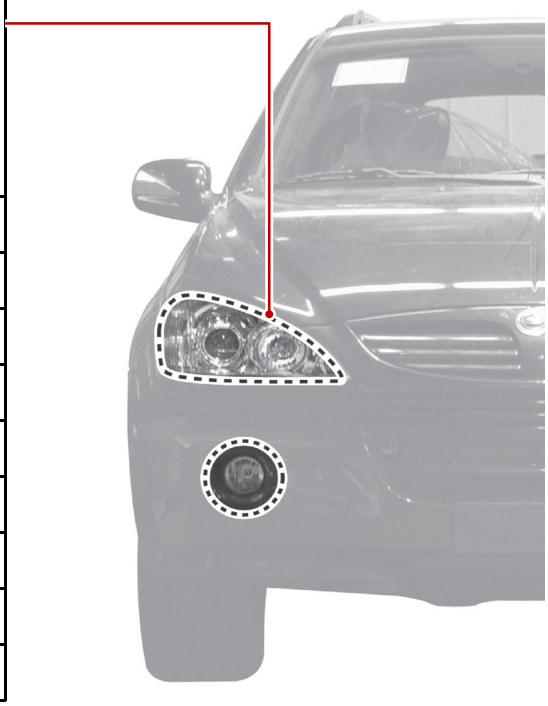
LAMP 8310-01

GENERAL

1. LOCATIONS OF LAMPS AND SPECIFICATIONS

1)Exterior Lamps

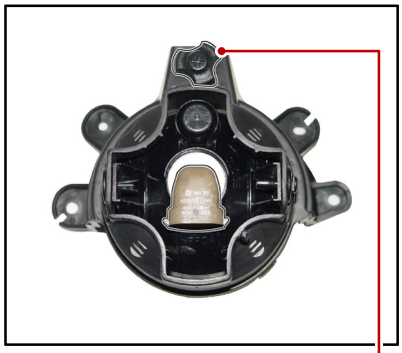
Headlamp Assembly

A Low Beam
one at each side (12V / 55W)
B High Beam
one at each side (12V/55W)
B Position Lamp
EU: one at each side (12V/W5W)
C Position lamp and Turn Signal Lamp
General: one at each side (12V/28W/8W)
EU: one at each side (12V/P21W)



Modification basis	
Application basis	
Affected VIN	

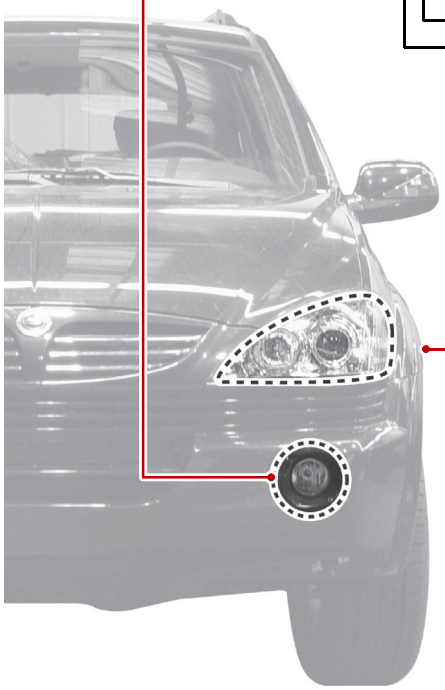
Fog Lamp Assembly





Fog Lamp
General: one at each side (12V/27W)
EU: one at each side (12V/H27W)

Fog lamp angle adjustment



Side Repeater Assembly

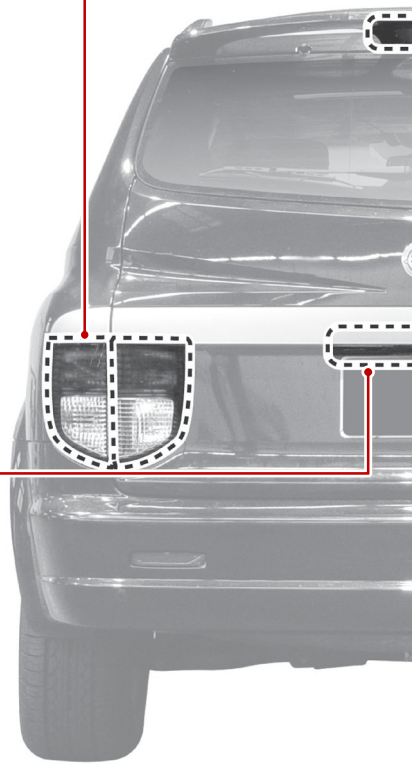


General: one at each side (12V/5W)
EU: one at each side (12V/W5W)

Turn Signal Lamp/Stop Lamp Assembly



A	**T/Stop Lamp**
	General: LH-1 (12V/27W/8W)
	EU: LH-1 (12V/P21W/5W)
B	**Turn Signal Lamp**
	General: one at each side (12V/27W)
	EU: one at each side (12V/PY21W)



Lamp Assembly



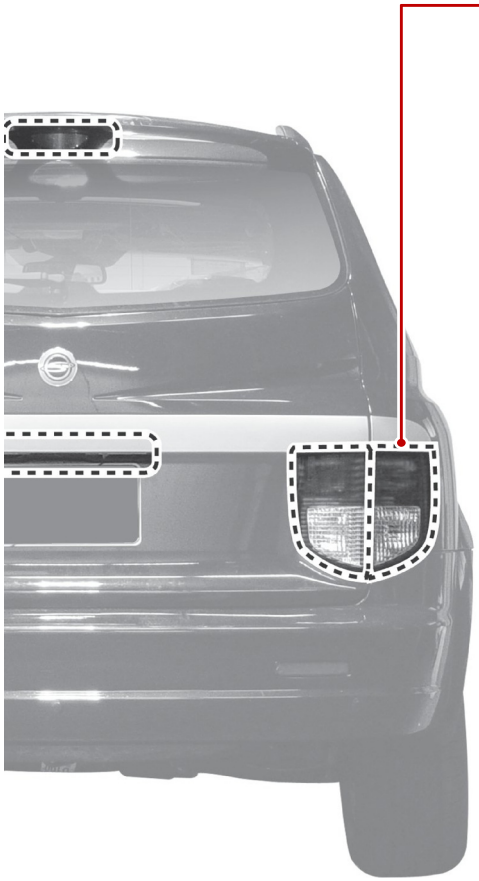
License Plate Reflector Assembly



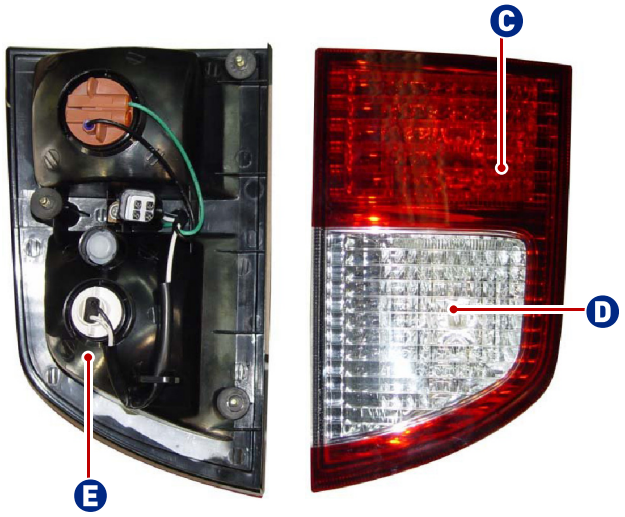
General: one at each side (12V/5W)

EU: one at each side (12V/W5W

Modification basis	
Application basis	
Affected VIN	



Tail Lamp / Reversing Lamp / Rear Fog Lamp Assembly



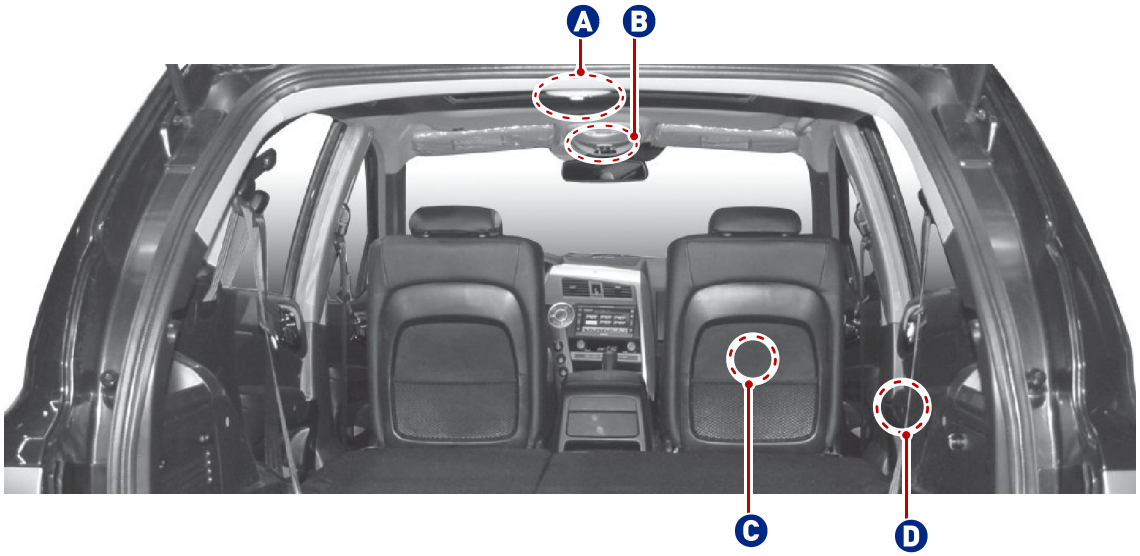
C	**Tail Lamp**
	General: one at each side (12V/27W/8W)
	EU: one at each side (12V/P21W/5W)
D	**Reversing Lamp**
	General: one at each side (12V/16W)
E	**Rear Fog Lamp**
	General: one at each side (12V/P21W)

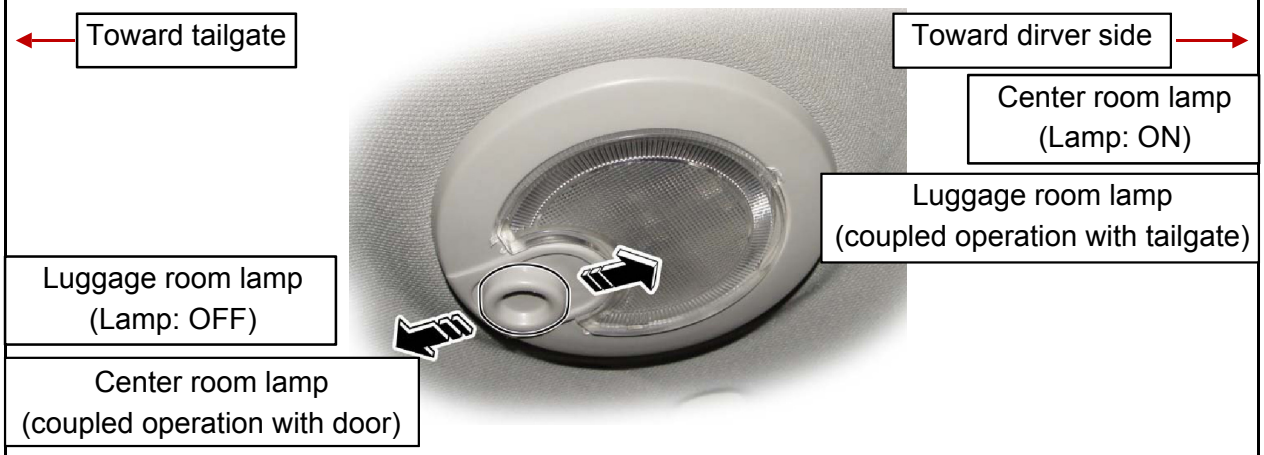
High Mounted Stop Lamp Assembly



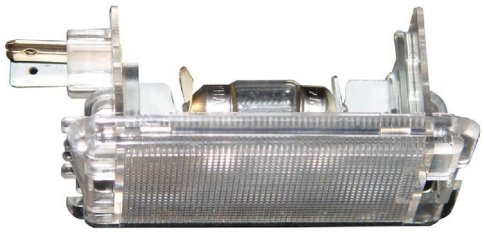
Modification basis	
Application basis	
Affected VIN	

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

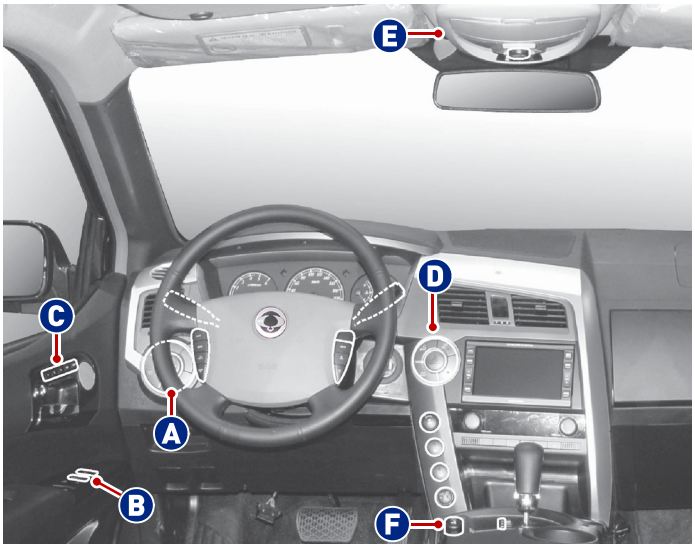


The driver's room lamp and the passenger's room lamp are separately turned on when pressing the switch (1, 2). However, the front lamps are turned on when opening a door and turned off when closing it. The front room lamps and center are turned on when pressing the room lamp main switch (3).

SWITCHES / ELECTRIC DEVICES 8510-13

GENERAL

1. SWITCH ARRANGEMENT



▶ Outside Rearview Mirror Folding Switch A

To fold the outside rearview mirrors, press the switch. To unfold the mirrors, press it again.

▶ ESP OFF Switch A

If you press the ESP OFF switch, the ESP function stops and the indicator lamp in instrument panel comes on. Press this switch again to resume the ESP function. At this time, the indicator lamp goes out.

▶ Driver's Power Window Switch B

Driver can controls all door windows (Open/Close/Lock/Unlock) and doors (Lock/Unlock) with this switch unit

▶ Seat Position Memory Switch C

The position memory is available for up to three drivers. Each driver can set his/ her own driver's seat and outside rearview mirrors' positions and it will be separately stored in the integrated computer. If somebody has moved the seat, the memory positions can be recalled automatically by pressing the position button.

D

▶ HDC Switch 1

When this button is pressed once, HDC is ready for use. The green HDC indicator comes on the instrument panel. When the button is pressed again, HDC is deactivated and the indicator goes off. (Refer to ABS/ESP section.)



▶ Tailgate Glass and Out side Rearview Mirror Heated Glass Switch 2

Press this switch to turn on the tailgate and outside rearview mirror defogger. It will operate for about 12 minutes.

▶ Windshield Heated Glass Switch 3

Press this switch to turn on the windshield heated glass. It will operate for about 12 minutes.

▶ TRIP Switch 4

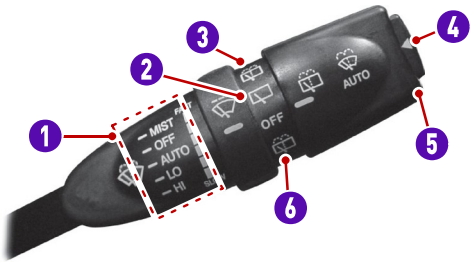
To choose a desired driving distance display mode, press the switch: Changing sequence:
ODO - TRIP A - TRIP B - ODO

Modification basis	
Application basis	
Affected VIN	

Additional Functions of Multifunction Switch







Front wiper operation range ❶
(move the wiper lever up/down)

Rear wiper operation ❷

Washer fluid will be sprayed ❸
onto the rear window glass once during rear wiper operation.

Auto Washer Switch ❹

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 will be sprayed again and the wiper will automatically operate 3 times.

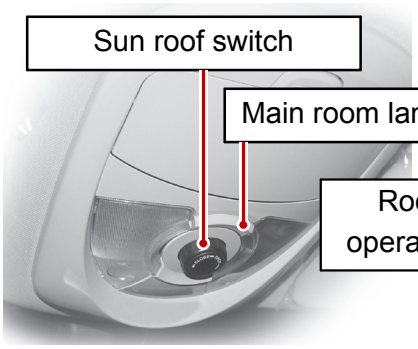
Front Wiper and Washer Coupled Operation ❺

Pull the lever briefly (below 0.6 seconds): One wiping cycle Pull and hold the lever for more than 0.6 seconds: Three wiping cycles with washer spray

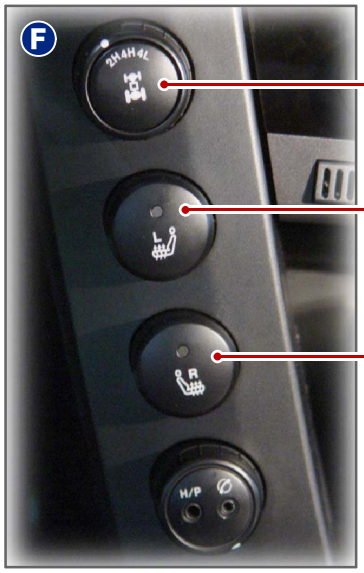
Washer fluid will be sprayed onto ❻

the rear window glass and the wiper will also operate once.

Ⓔ

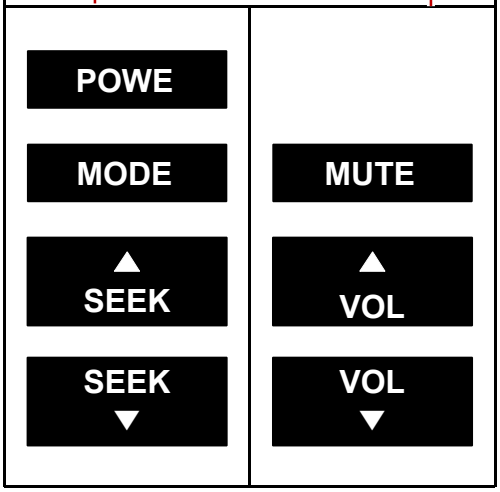


Ⓕ



Audio Remote Control Switch





Modification basis	
Application basis	
Affected VIN	

WIPER AND WASHER SYSTEM 7810-01

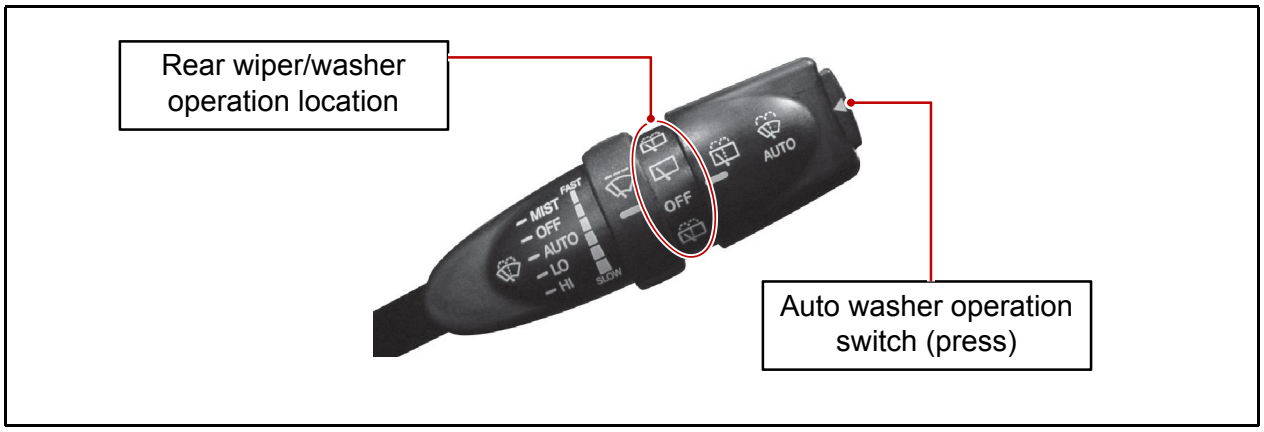
GENERAL

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.

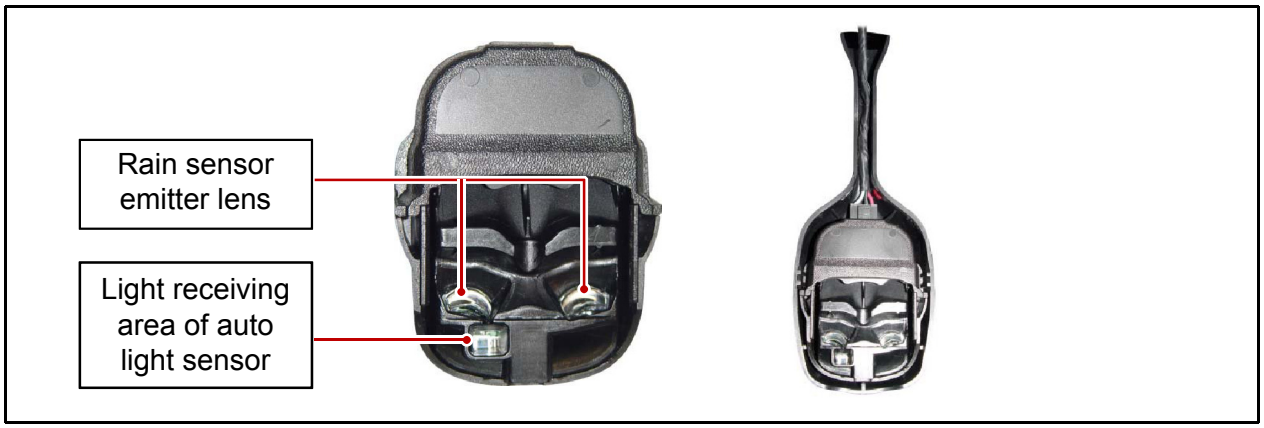
The characteristics of the wiper and washer system including basic functions of manual wiper are as follows.

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

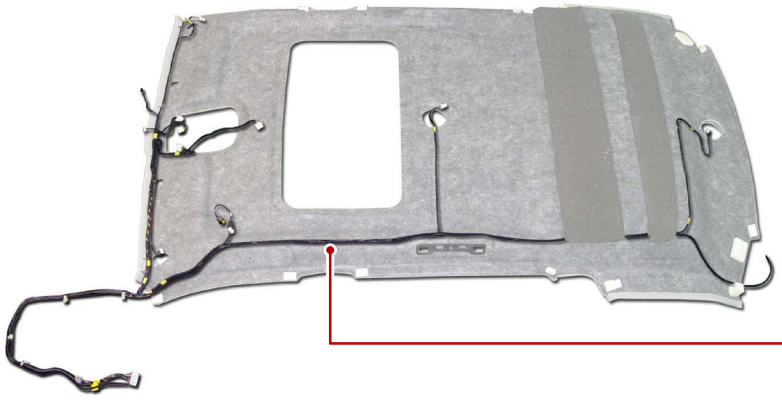


The rain sensor unit is installed on a proper location to detect the rain drops and the illumination intensity.

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

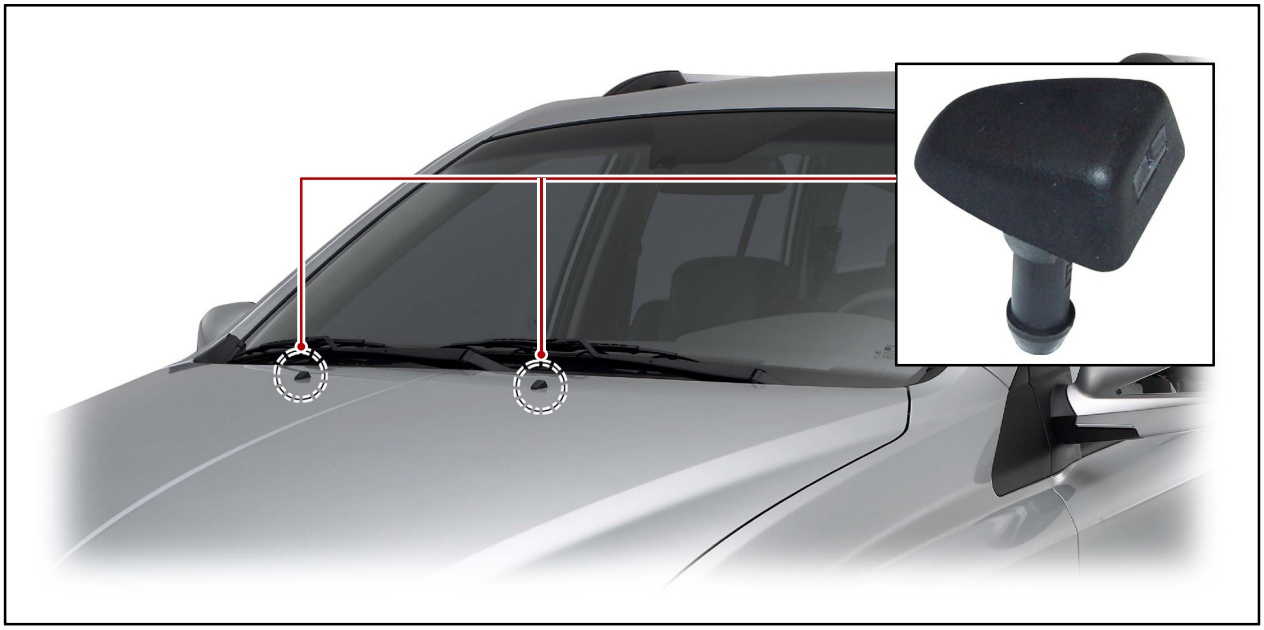


Rear washer hose and roof wiring harness are fixed at the headlining section with silicone.

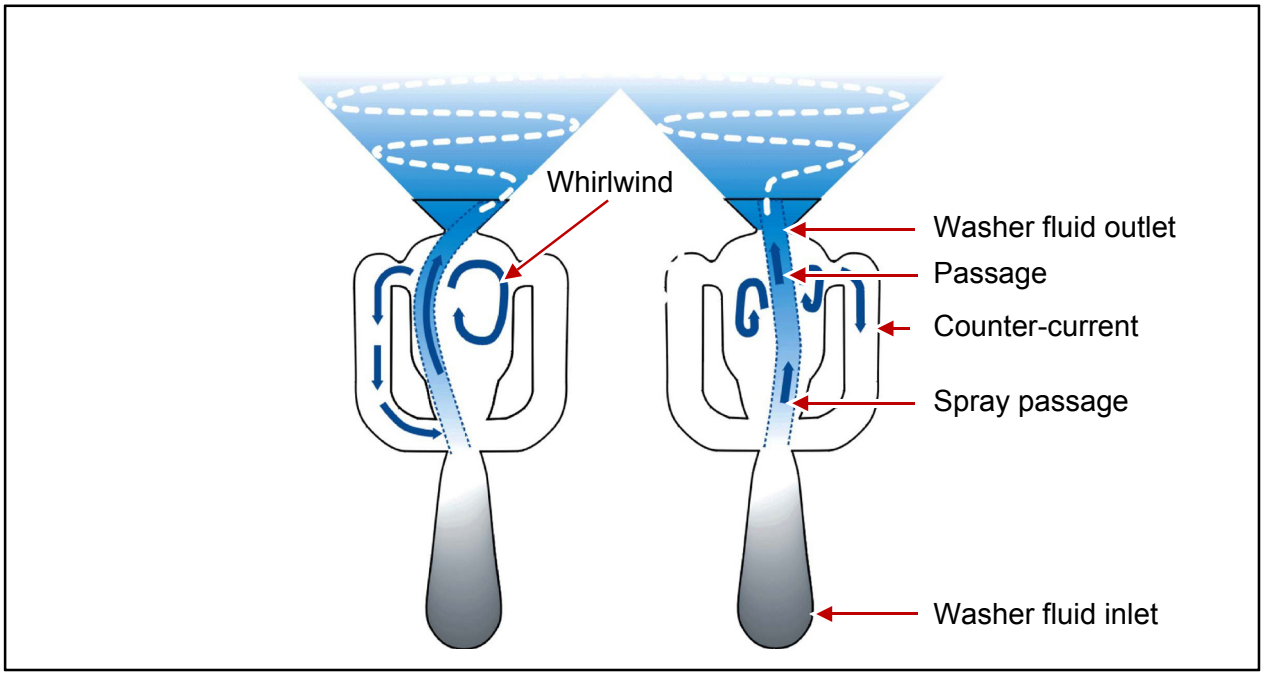
Modification basis	
Application basis	
Affected VIN	

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.



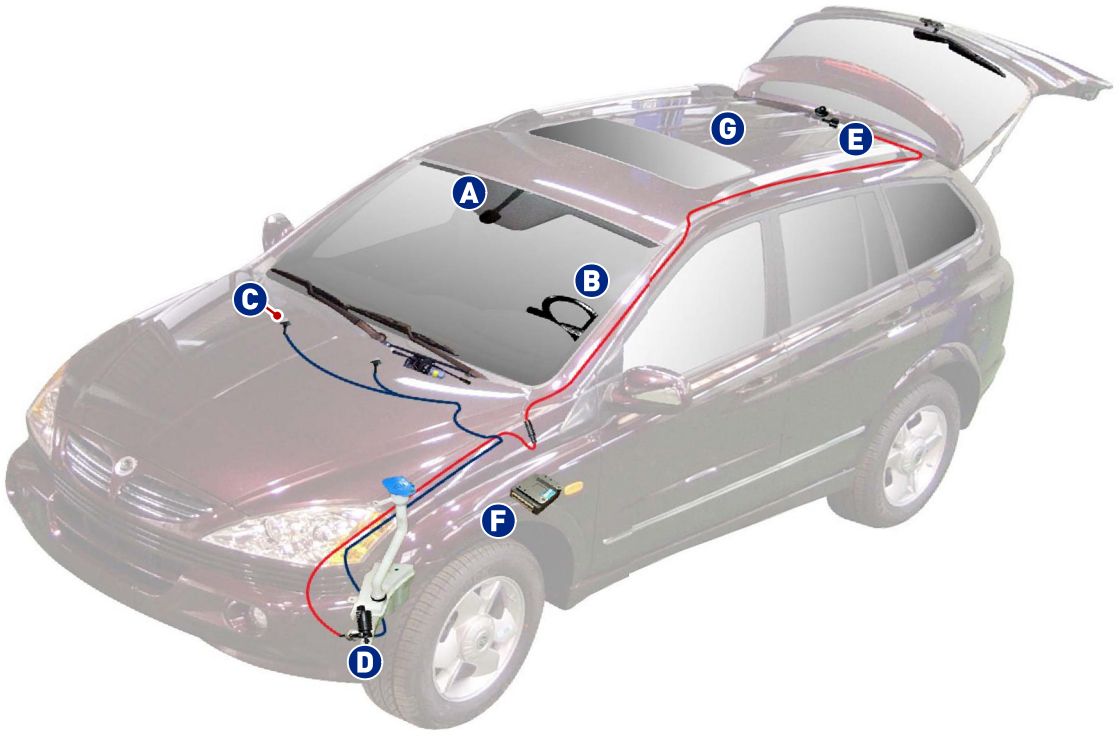
This is a shape of the inside of nozzle.
It is designed to change the spraying direction continuously according to the spraying time. (fan-shape)
The figure below shows the changes of spraying direction according to the spraying time.

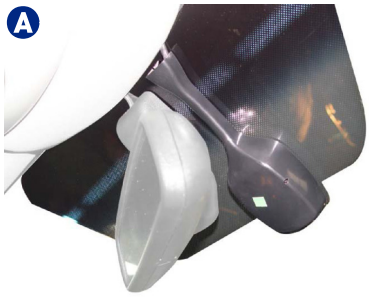


It is designed to be changed spraying direction using the whirlwind and backflow generated in nozzle.

Overview and Operation Process

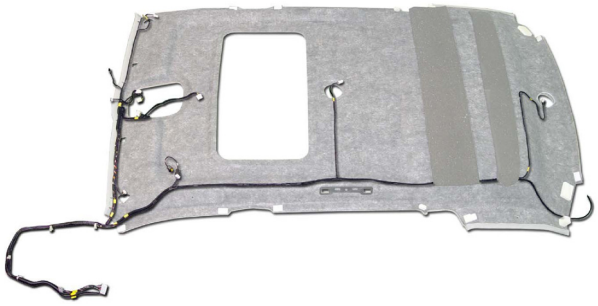
1. SYSTEM LAYOUT OF WIPER AND WASHER (WITH RAIN SENSOR)



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).

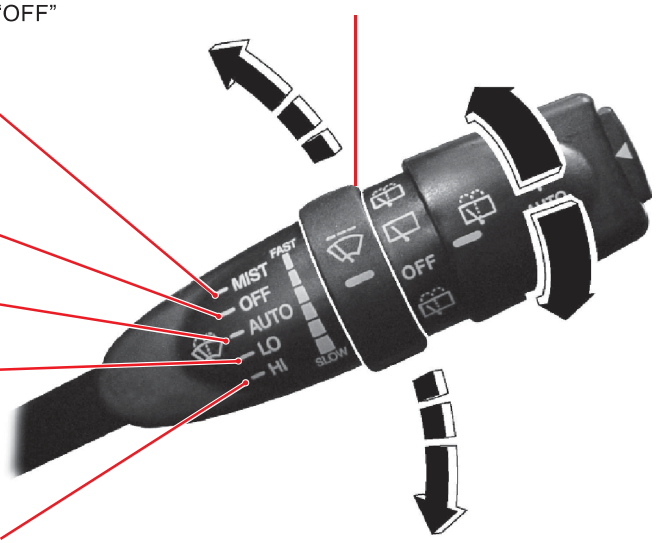
LO

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.

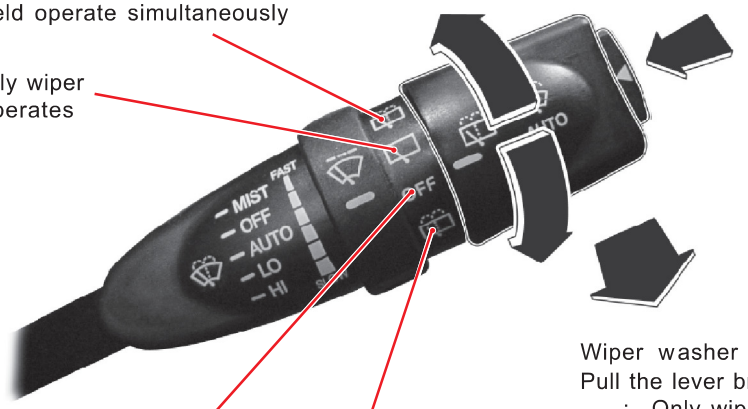


Wiper and washer fluid for rear wind-shield operate simultaneously

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.

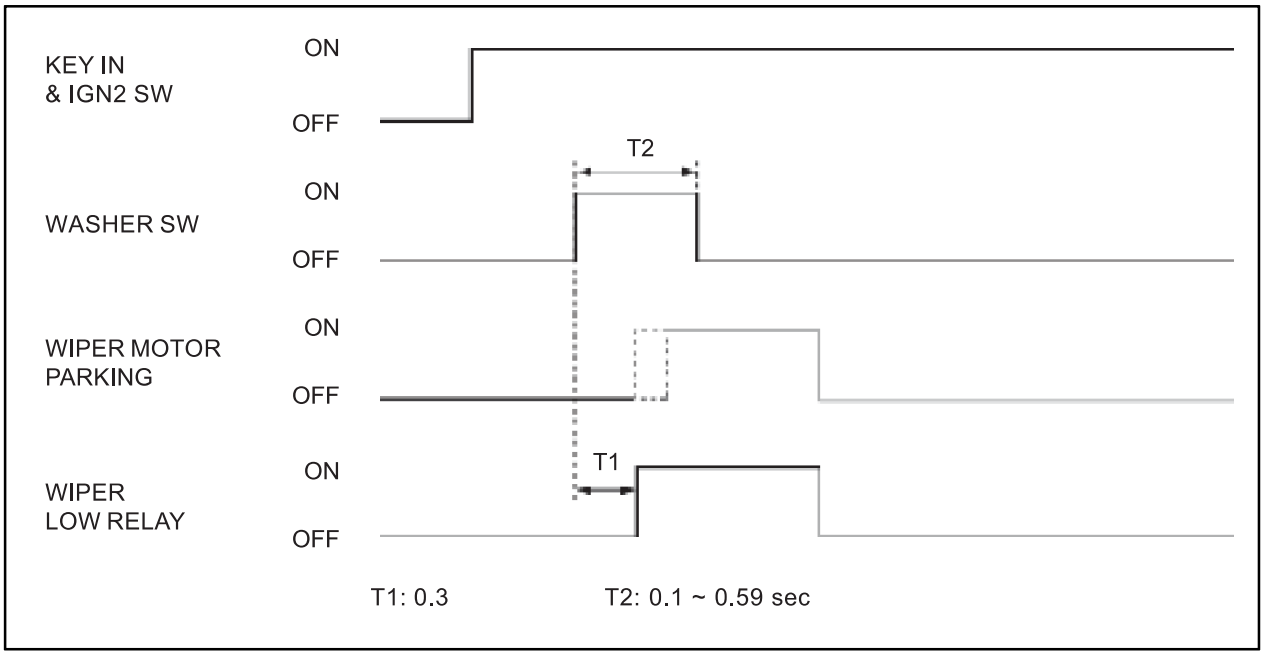
Wiper washer fluid coupled function
Pull the lever briefly (below 0.6 seconds)
: Only wiper operates
Pull and hold the lever for more than 0.6 seconds
: Wiper operates 3 times
Washer fluid coupled operation

Modification basis	
Application basis	
Affected VIN	

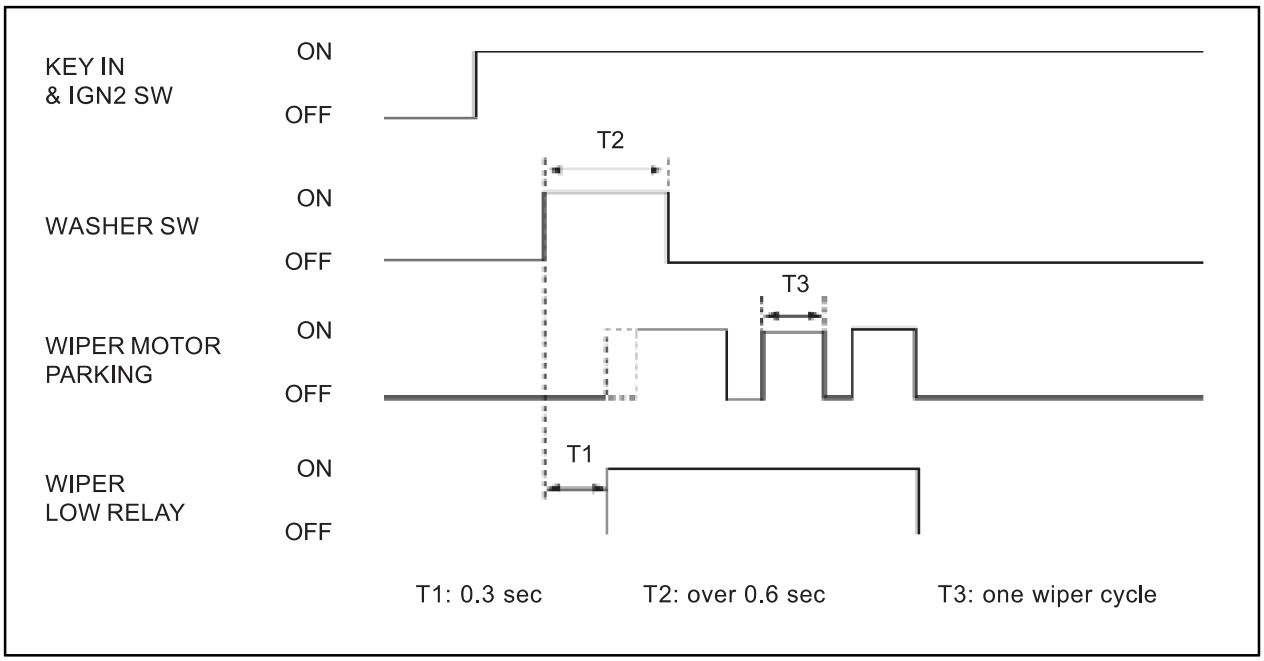
2) STICS Control Logic Related to Wiper and Washer

(1) Wiper MIST and Front Washer Coupled Wiper

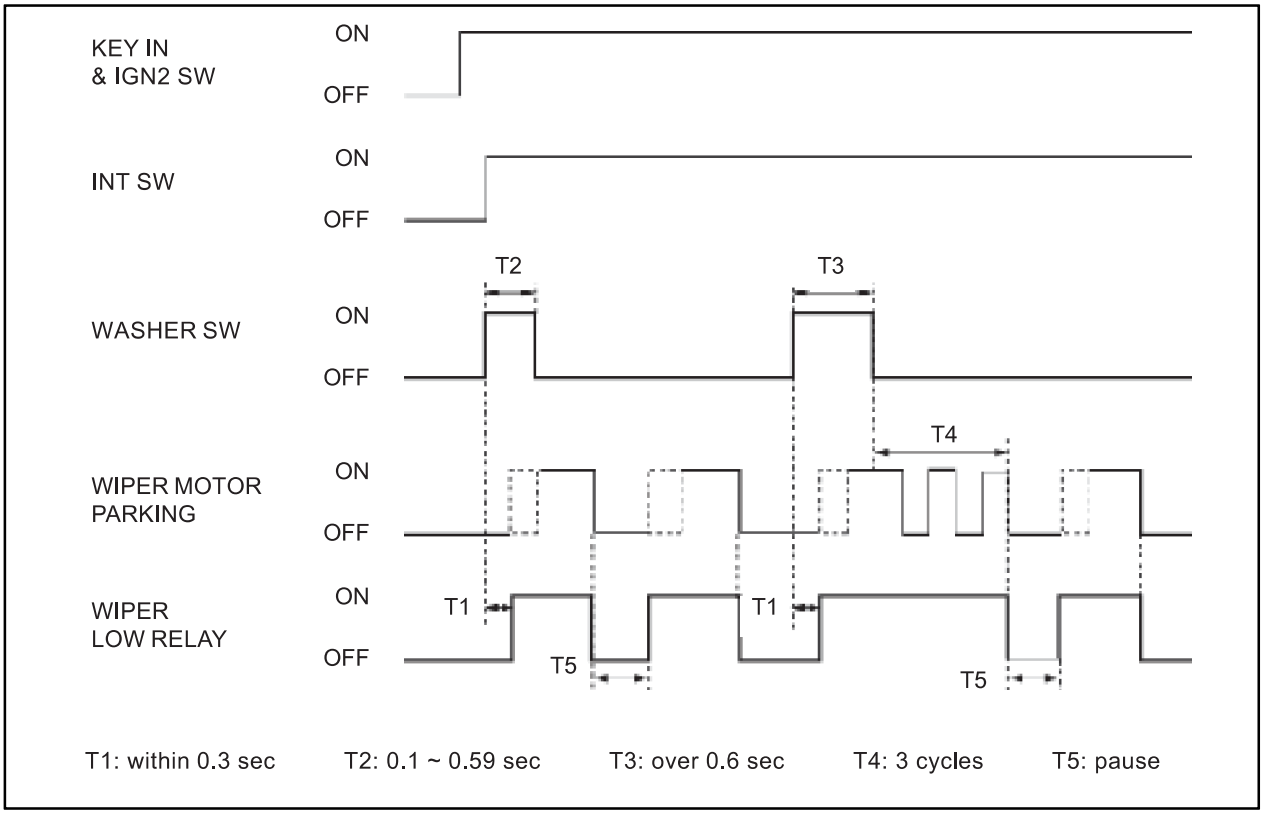
- The wiper relay is turned on 0.3 seconds after turning "ON" the washer switch for 0.1 ~ 0.59 seconds with the ignition key "ON", and it is turned off when the parking terminal is turned off.



- 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.

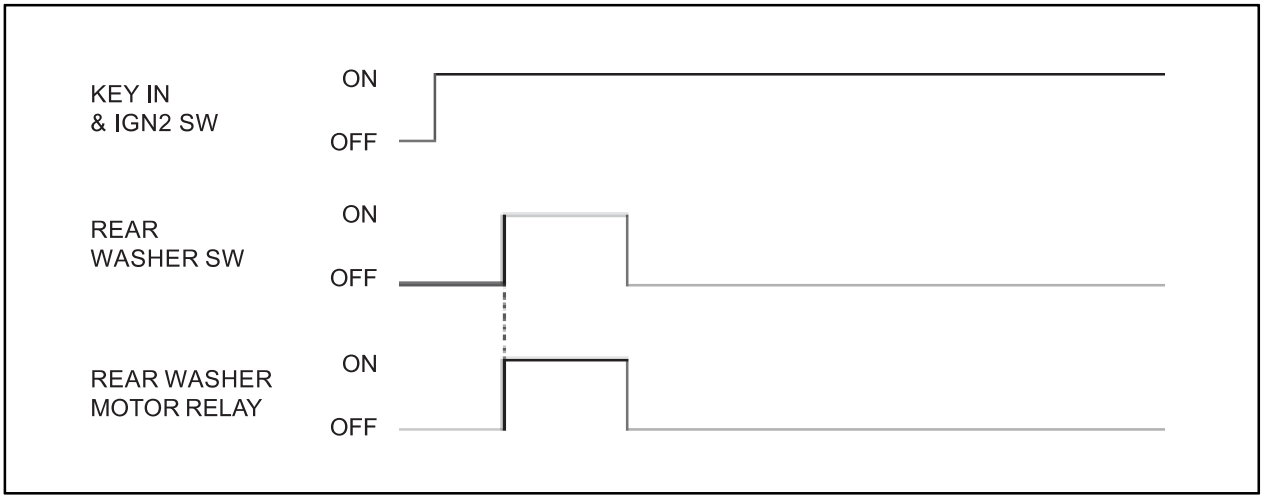


- When the washer switch is ON for more than 0.6 seconds during the wiper operation by the INT switch, the operation in step (2) is performed. When it is ON for a certain period of time (0.1 to 0.59 seconds), the operation in step (1) is performed.



(2) Rear Washer Motor Control

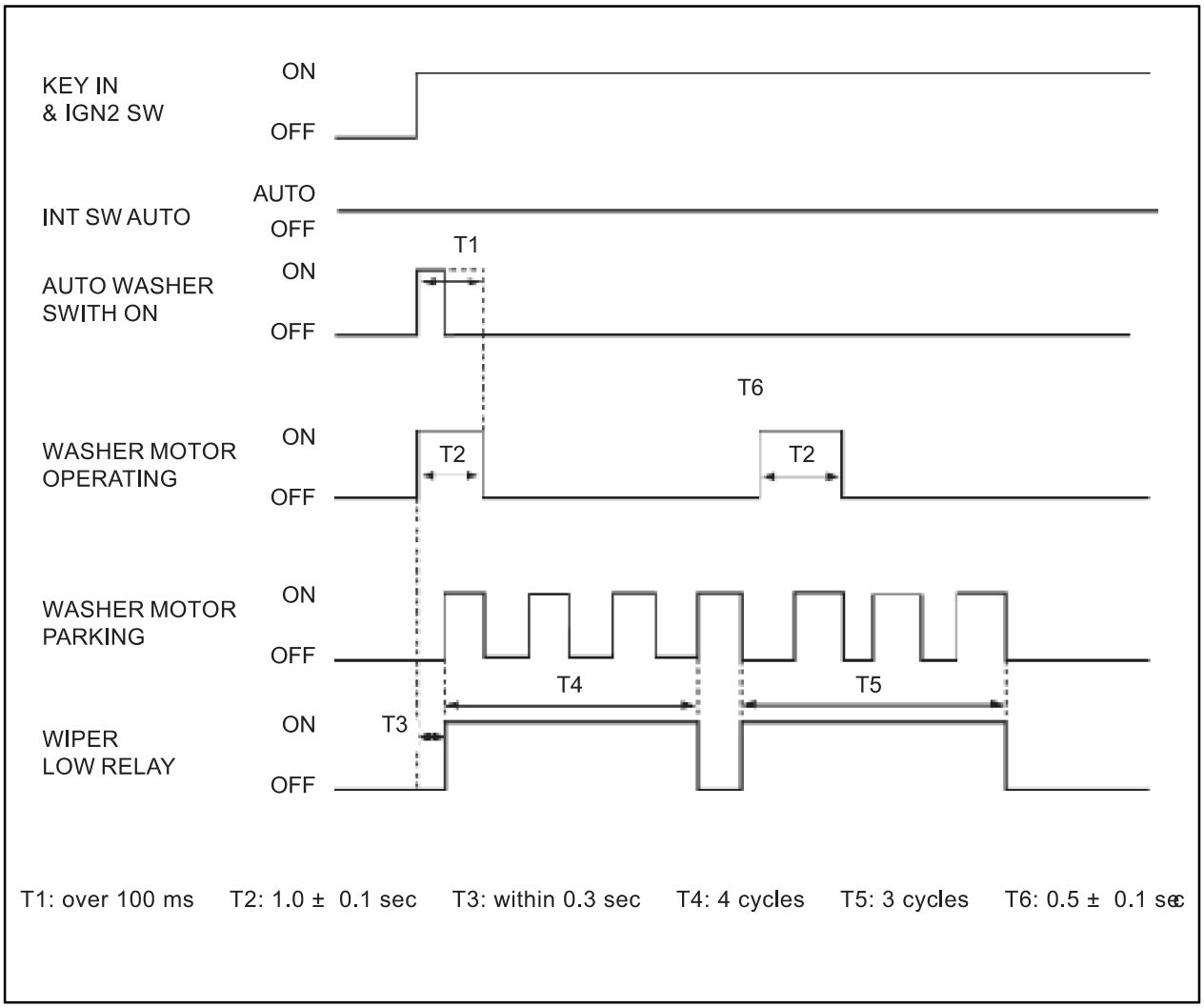
- When the rear washer switch is turn on with the ignition switch "ON", the rear washer motor relay output is activated from the time when the rear washer switch is turned on, and it is deactivated when the rear washer switch is turned off.
- It cannot be activated while the front washer switch or the auto washer and wiper (AFW: Advanced Fast Washer) is in operation.



Modification basis	
Application basis	
Affected VIN	

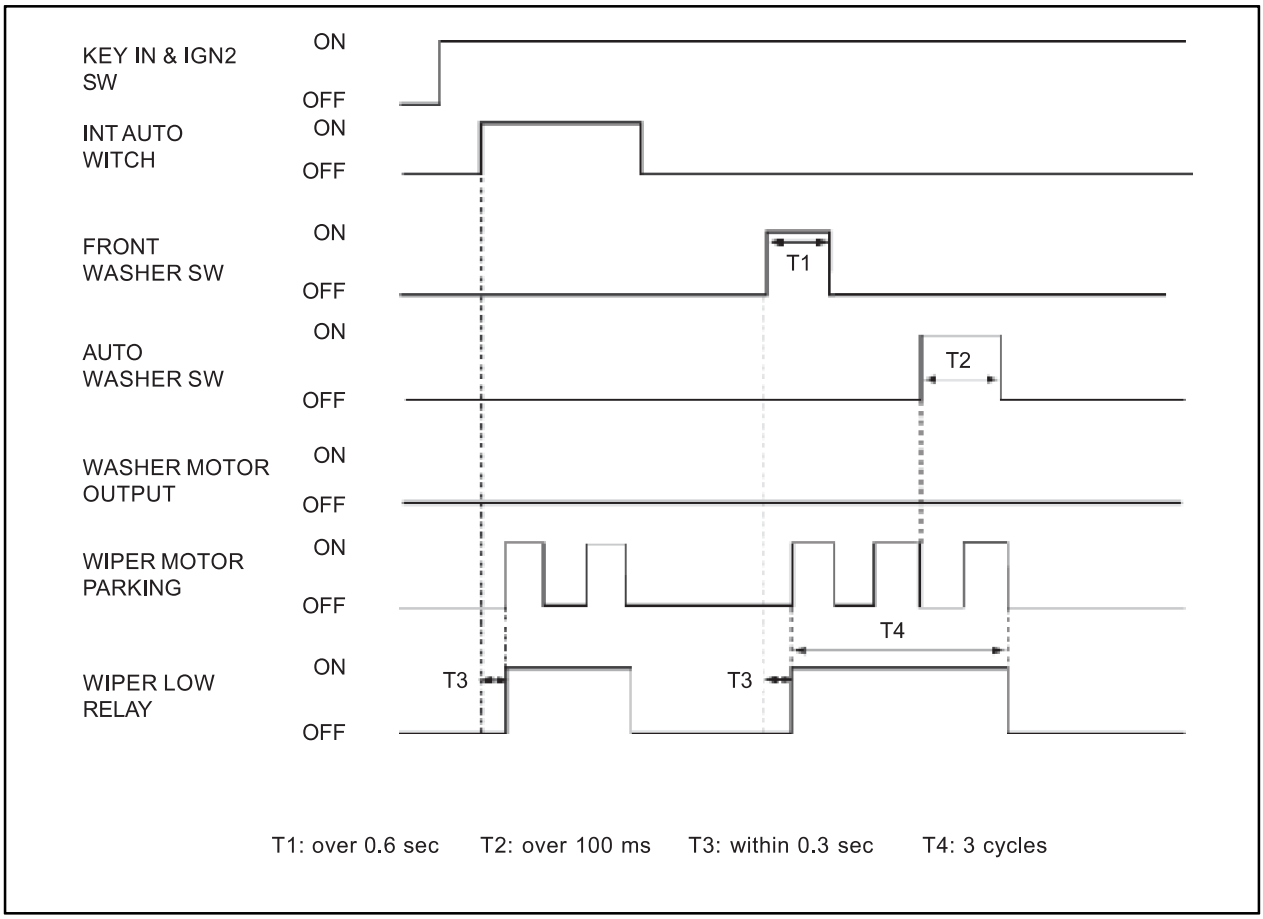
(3) Auto Washer and Wiper Switch (AFW)

- 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.

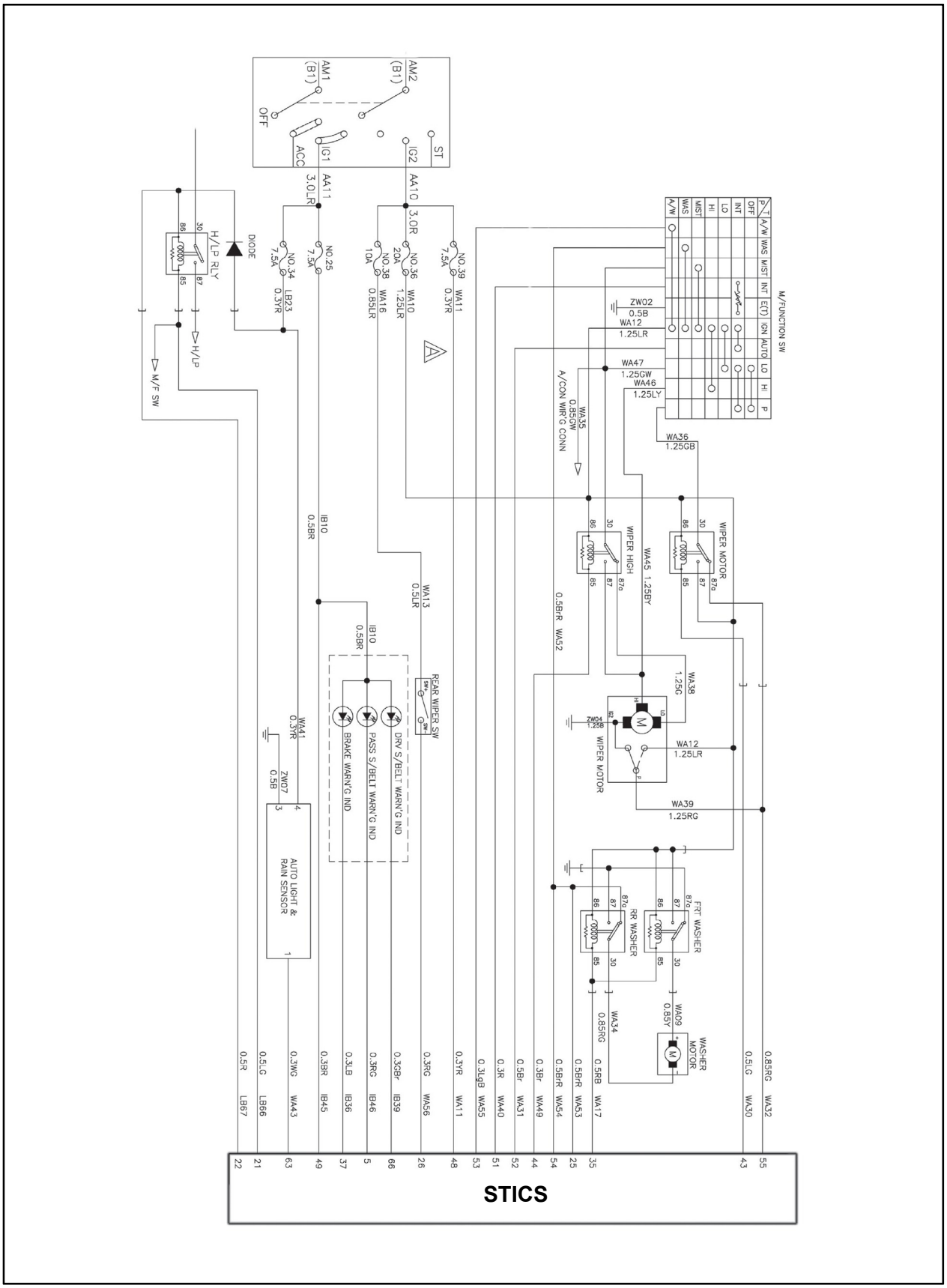


(5) Priorities in Washer Operations

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	

RAIN SENSING SYSTEM (WITH AUTO LIGHT SENSOR) 8610-09

GENERAL

1. RAIN SENSING SYSTEM (WITH AUTO LIGHT SENSOR) OVERVIEW

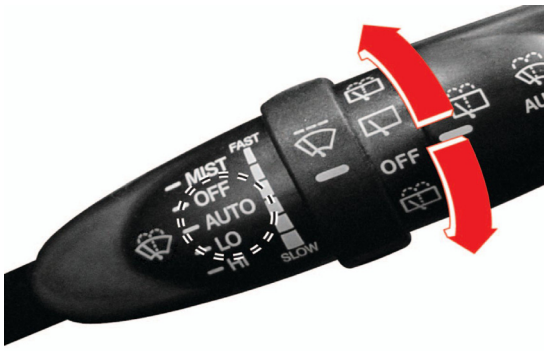
The rain sensing wiper unit in this vehicle doesn't control the wiper directly.
The rain sensing unit detects the amount of rain drops and sends the operating signal to STICS, and STICS drives the wiper directly.

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.

Horizon autolight sensor

Auto light sensor

Vertical autolight sensor

Enlarged auto light sensor section



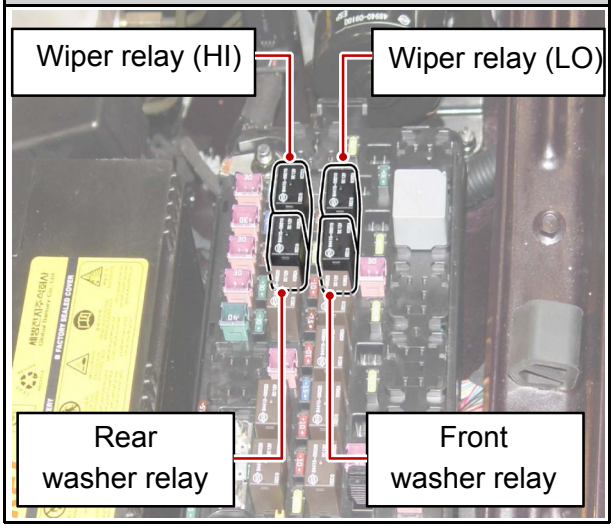
1) STICS

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	

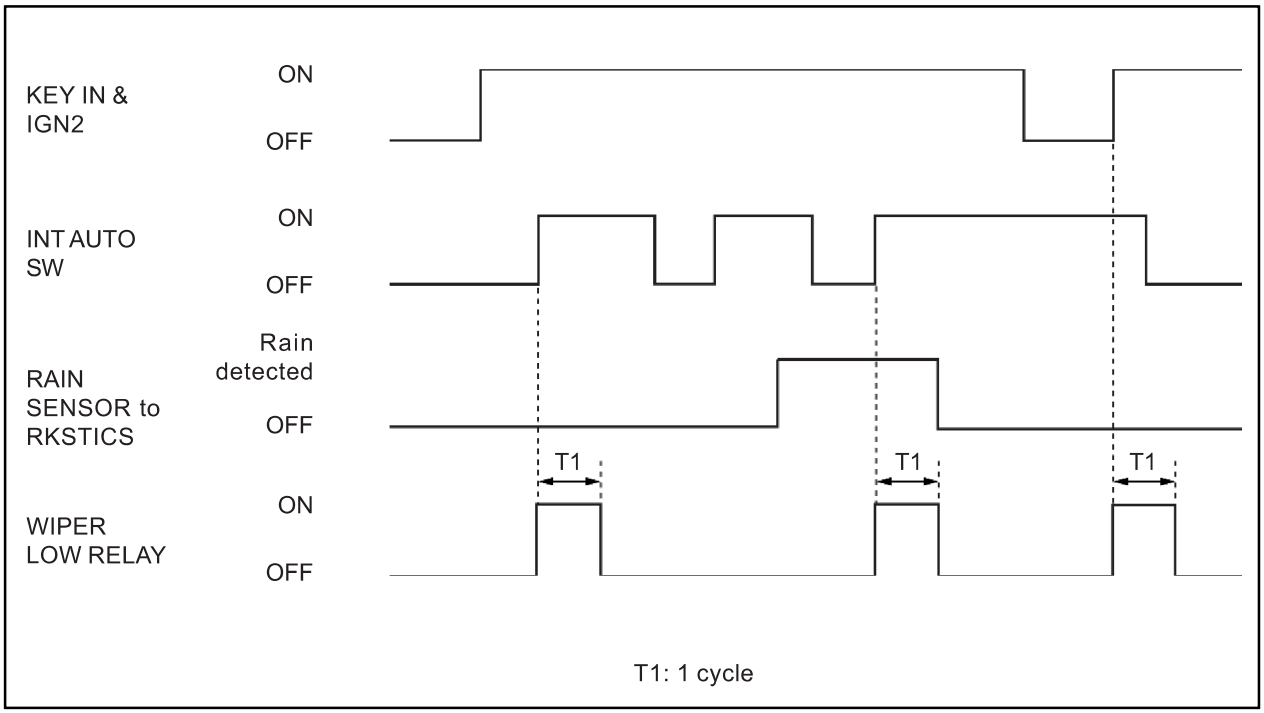
OVERVIEW AND OPERATION PROCESS

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).

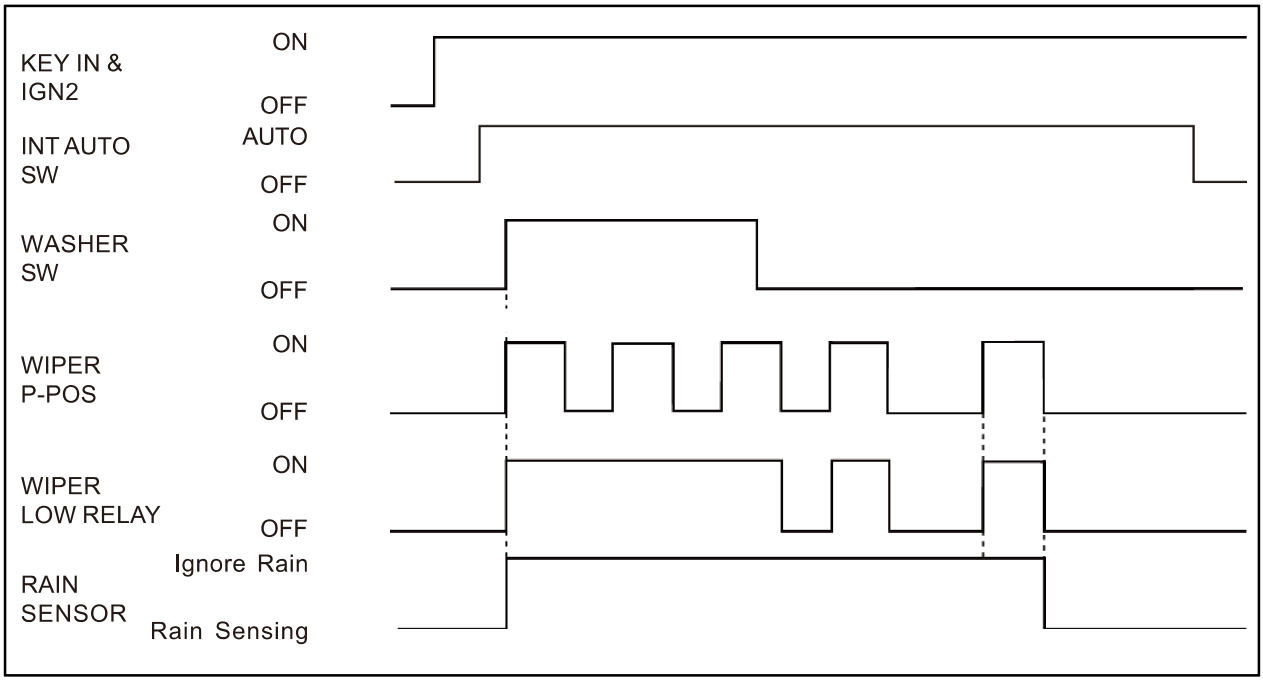
When the wiper switch is turned to "ON" position again from other positions, the system Drives the wiper motor through LOW relay one cycle only when the rain sensor detects the "Rain Detected" signal.



T1: 1 cycle

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.

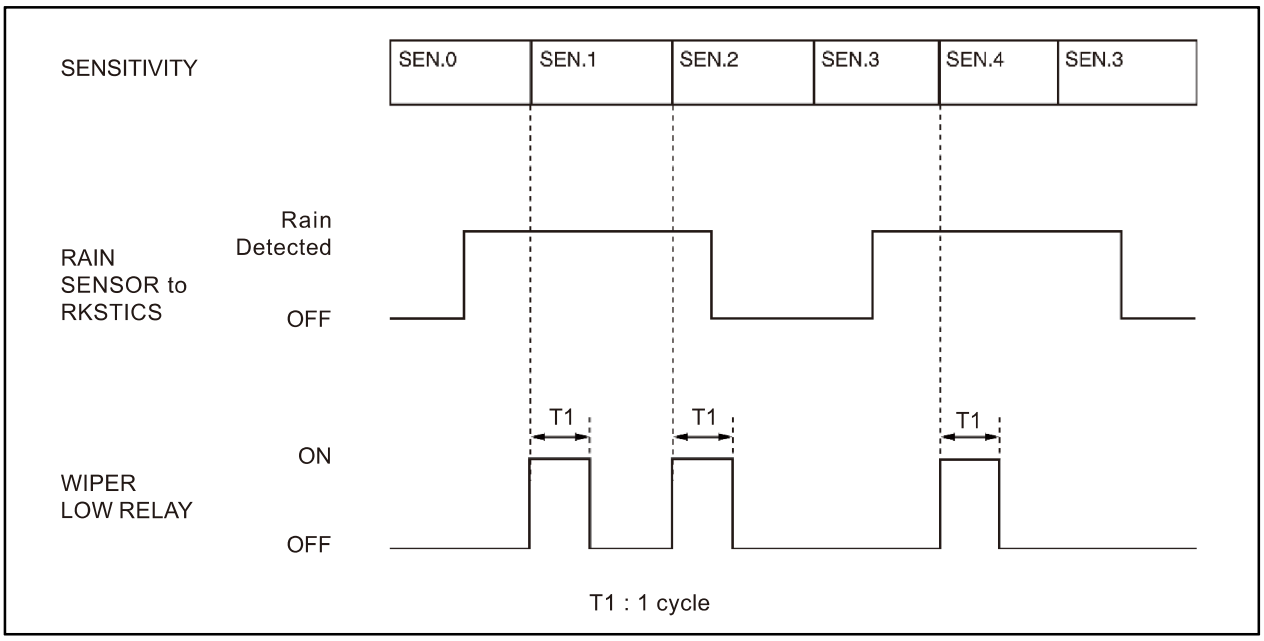


Modification basis	
Application basis	
Affected VIN	

3) Rain Sensing Sensitivity Control

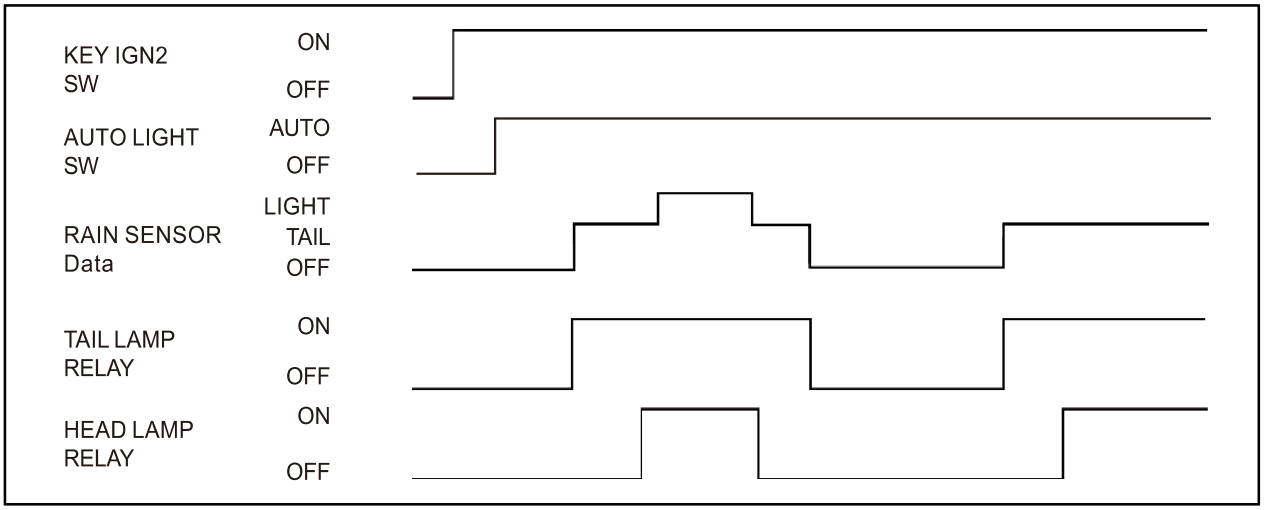
- The wiper relay (LO) is turned on and the wiper motor runs one cycle when the volume sensitivity is increased (ex: from 0 to 1) (while the ignition key is in "ON" position, the wiper switch is in "AUTO" position, and the wiper motor is in "Parked" position). However, the wiper motor can be operated 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

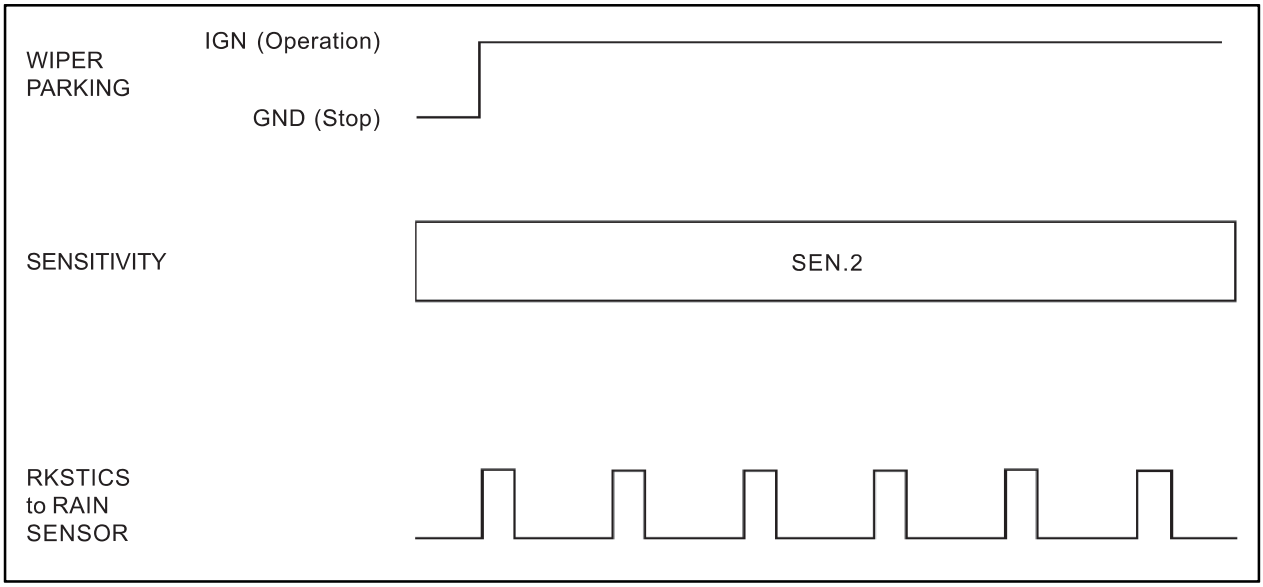
- Only when the auto light switch is in "AUTO" position, control the tail lamp and headlamp by communicating with the rain sensor (while the ignition key is in "ON" position).



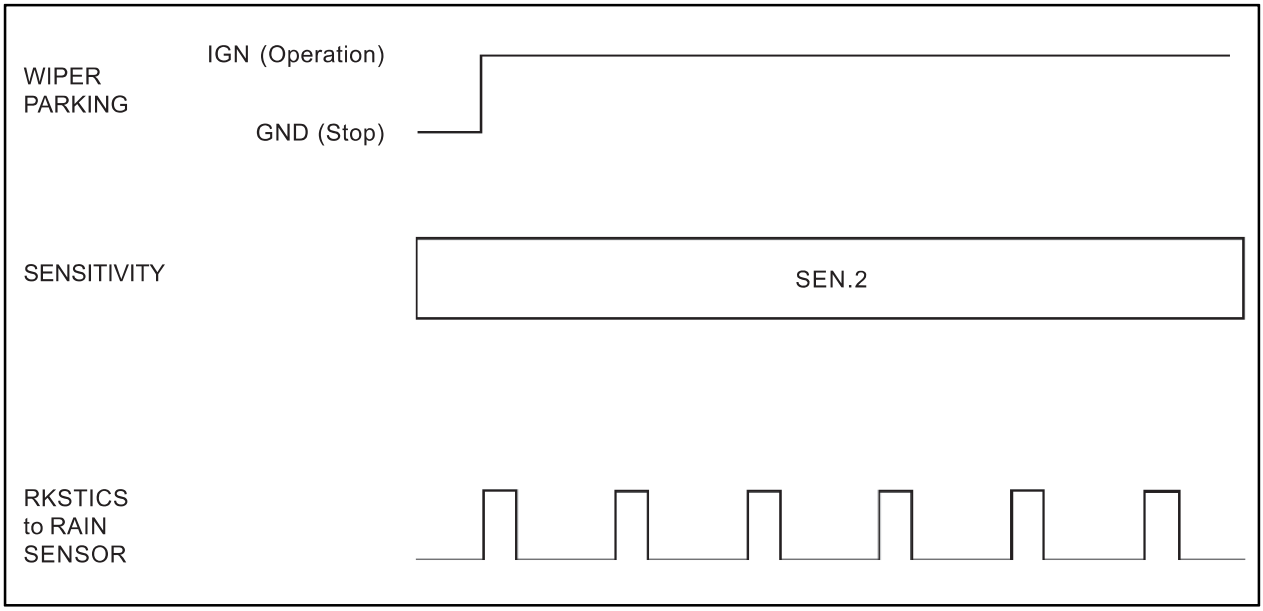
Modification basis	
Application basis	
Affected VIN	

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.**



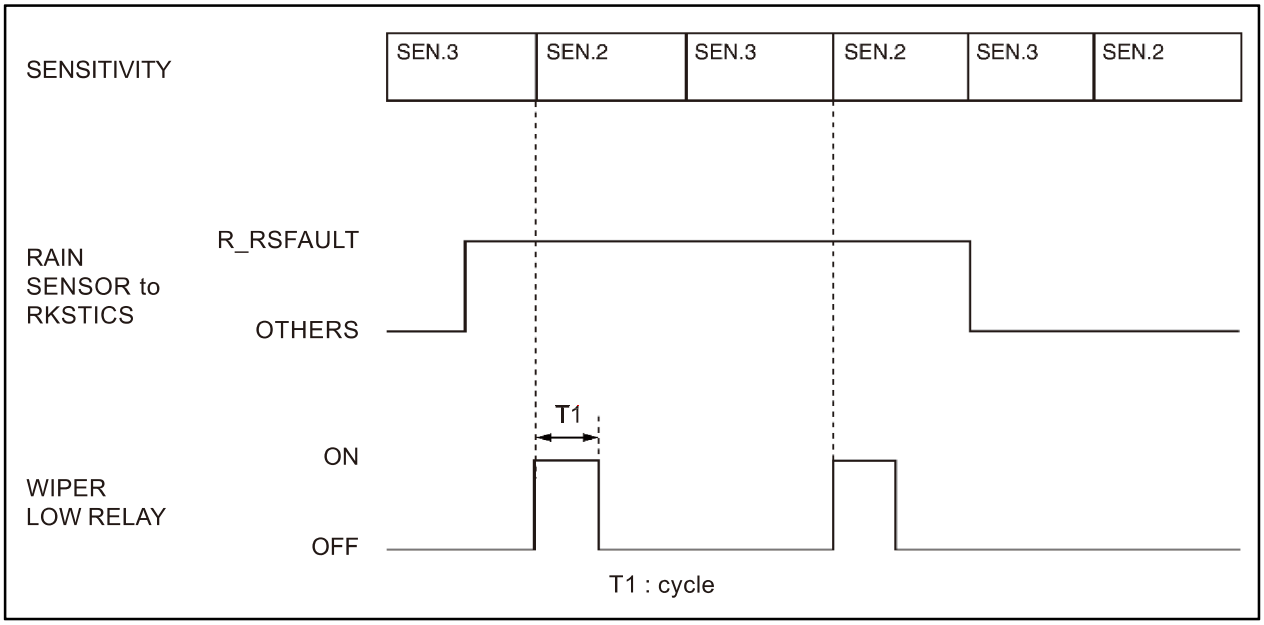
- When the parking terminal is fixed to IGN (HIGH), the wiper system outputs the operating signal of current sensitivity for 2 seconds, then continuously outputs the parking signal of current sensitivity (while the ignition key is in "ON" position and the INT switch is in "ON" position).
- **The wiper motor runs only when the rain sensor requires.**



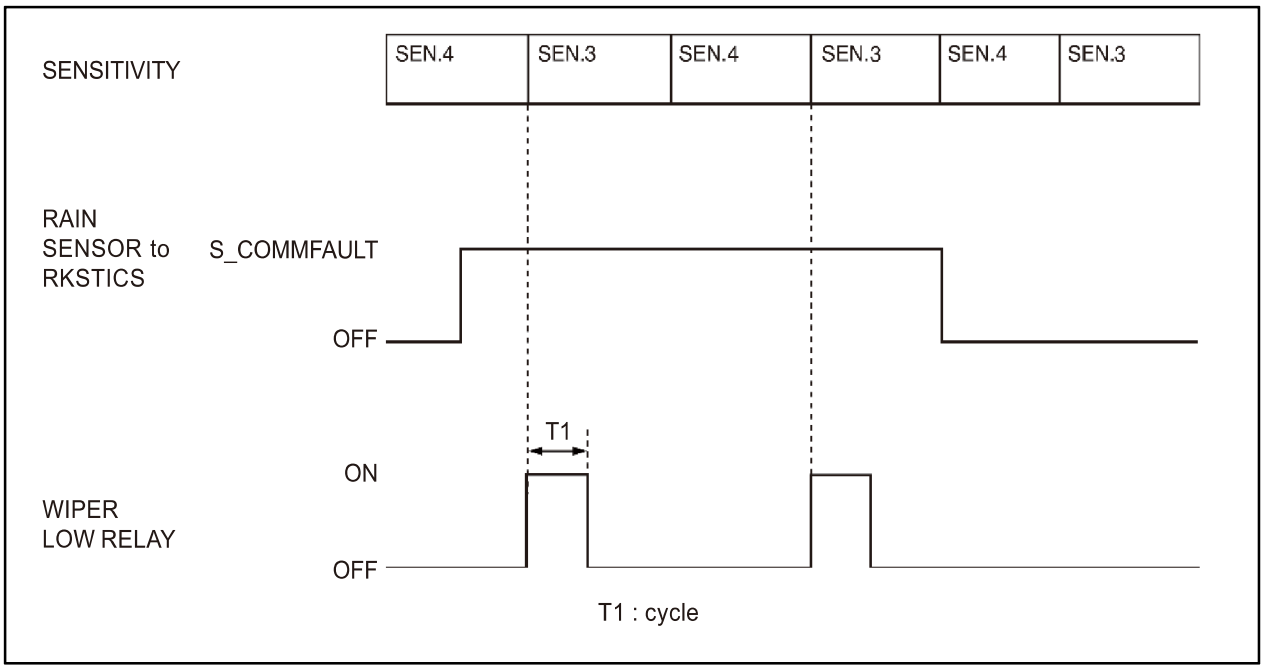
Modification basis	
Application basis	
Affected VIN	

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**

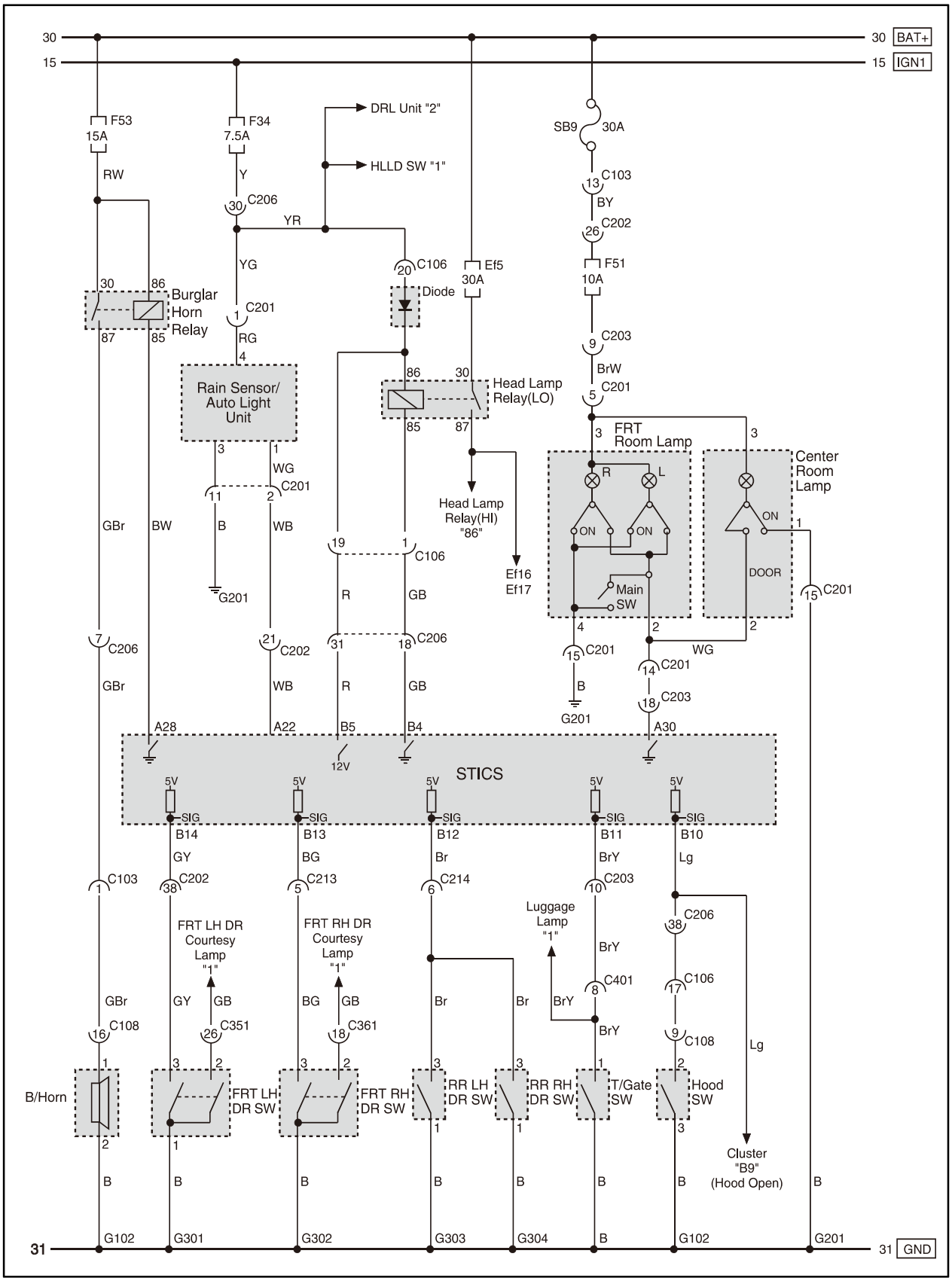
- If it rains heavy which requires the highest INT speed, the headlamps are turned on automatically.

▶ **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

8790-03

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 number of displaying bars is decreased and the alarm interval becomes faster as the obstacle approaches.

This supplementary system is to secure the safety distance for parking.

Descriptions		Value	Descriptions		Value
Rated voltage		DC 12 V	Operating temperature		-30°C ~ +80°C
Operating voltage		DC 9 V ~ 16 V	Storage temperature		-40°C ~ +85°C
Current consumption	Unit	Below 100 mA	Relative humidity		95% RH max
	Sensor	Below 20 mA (each)	Weight	Unit	160g ± 10g max
Sensor insulating resistance		Over 5 MW		Sensor	70g ± 10g max

1) Parking Aid Unit



▶ **Detecting type**
- Super sonic wave

▶ **Detecting distance**
- 25 cm ~ 120 cm
  (distance between sensor and obstacle)

2) Parking Aid Sensor



▶ **Type**
- Piezo ceramic element

▶ **Frequency**
- 40 KHz ± 2 KHz

▶ **Detecting range (13.5 V)**

▶ **Horizontal**
- Min. 20° at 110 ± 5 cm Min. 100° at 50 ± 5 cm

▶ **Vertical**
- Min. 20° at 110 ± 5 cm Min. 60° at 50 ± 5 cm



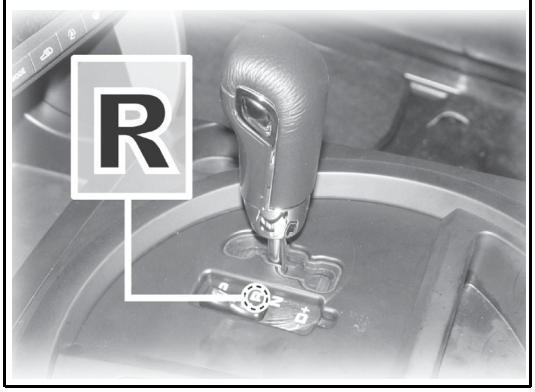
Modification basis	
Application basis	
Affected VIN	

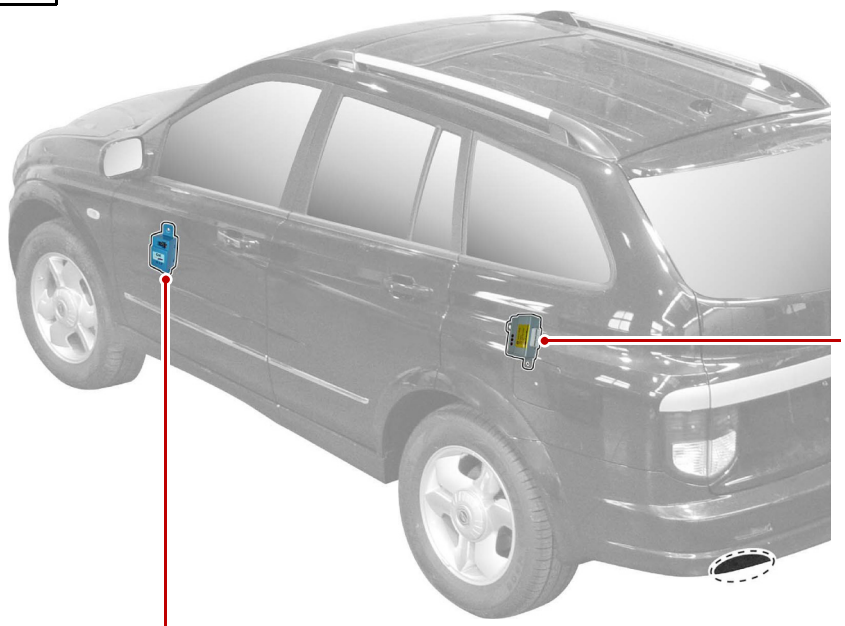
2. SYSTEM CONFIGURATION OVERVIEW

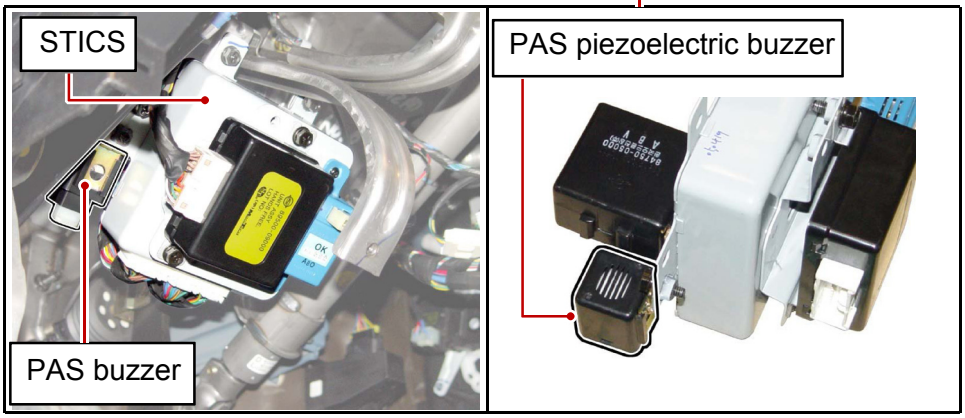
The parking aid device is integrated in the rear bumper and it uses three Piezoelectric elements to measure vertical and horizontal distance to obstacles.

When placing the gear selector lever to "R" position, the designated unit (PAS unit) activates the parking aid sensors to measure the distance to obstacles.

Gear Selector Lever (R Position)

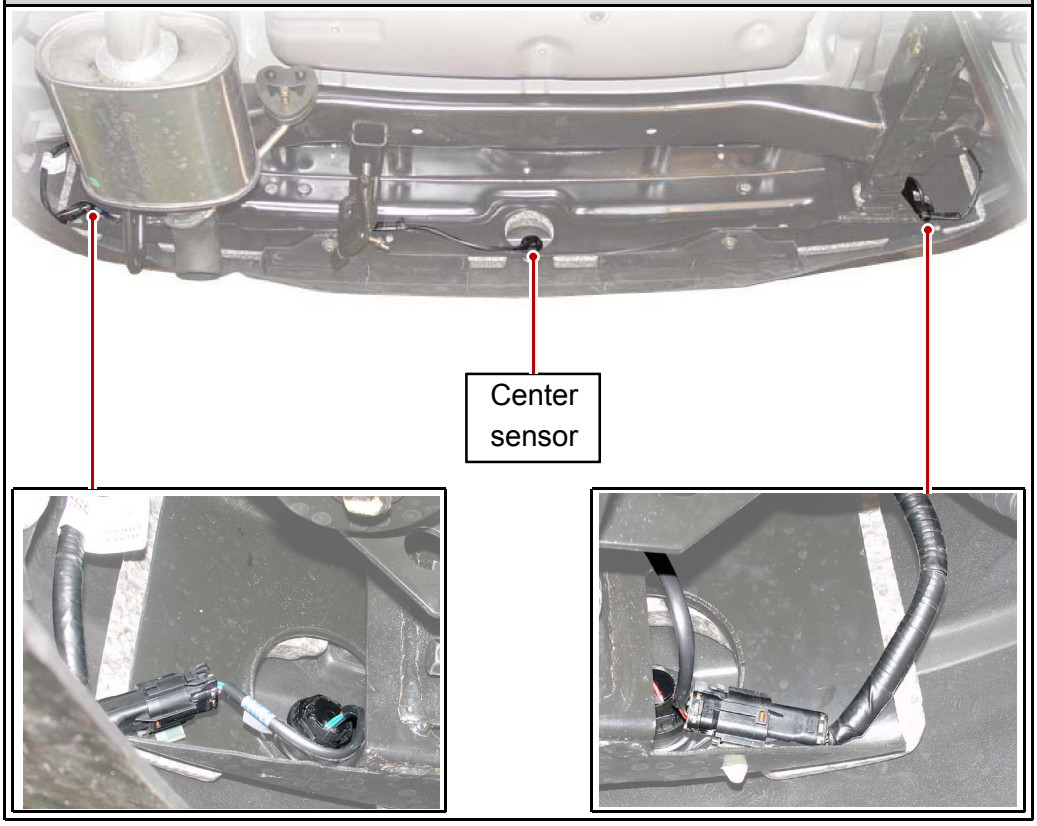






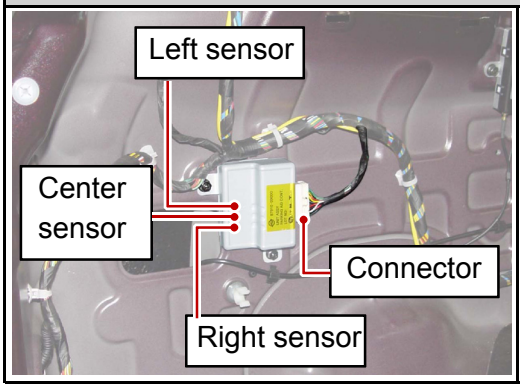
Modification basis	
Application basis	
Affected VIN	

Left/Right/Center Sensor Location





Parking Aid Unit





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.

- The parking aid system is just a supplemental device to help your parking operation.
- Always keep the safety precautions.
- Do not press or shock the sensors by hitting or high-pressure water gun while washing, or the sensors will be damaged.
- 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".
- If the system is in abnormal operating conditions, a beep sounds for 3 seconds when the gear selector lever is moved into "R" position with the ignition key "ON" or engine running. However, it is also occurred when the obstacle is within 50 cm from the rear bumper.

1) The parking aid system will not work or improperly work under following cases

▶ Certain obstacles that sensors can not detect
- Wires, ropes, chains.
- Cotton, sponge, clothes, snow that absorb ultrasonic waves.
- Obstacles lower than the bumper. (ex. drain ditch or mud puddle)

▶ 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.

▶ 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).

▶ 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

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATION PROCESS

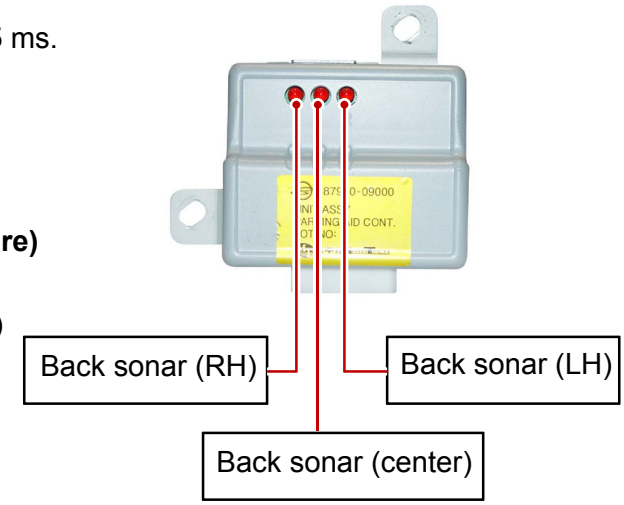
1. ALARM INTERVAL OF PARKING AID SYSTEM

Alarm interval and display changes according to the distance as below:
While reversing, if obstacles are within stage 1, the warning beep sounds with long intervals. If within stage 2, the warning beep sounds with short intervals and if within stage 3, the warning beep sounds continuously.

Stage	L, C, R sensor	Interval (msec)	Remark
1	81 ~ 120 cm		"Beep ——— "
2	51 ~ 80 cm		"Beep -, Beep -, Beep -"
3	25 ~ 50 cm		"Beep ——— "

2. TROUBLESHOOTING OF SENSOR

When the power is applied (gear selector lever is in "R" position), the sensor will be diagnosed once. If found any failure due to open circuit to sensor or communication error, warning buzzer sounds for 3 seconds and the data on failed sensor transmits to the instrument panel to light up the corresponding LED.
If normal, the warning buzzer sounds only for 65 ms.



▶ **Whenever the power is applied, the diagnosis mode is initiated.**

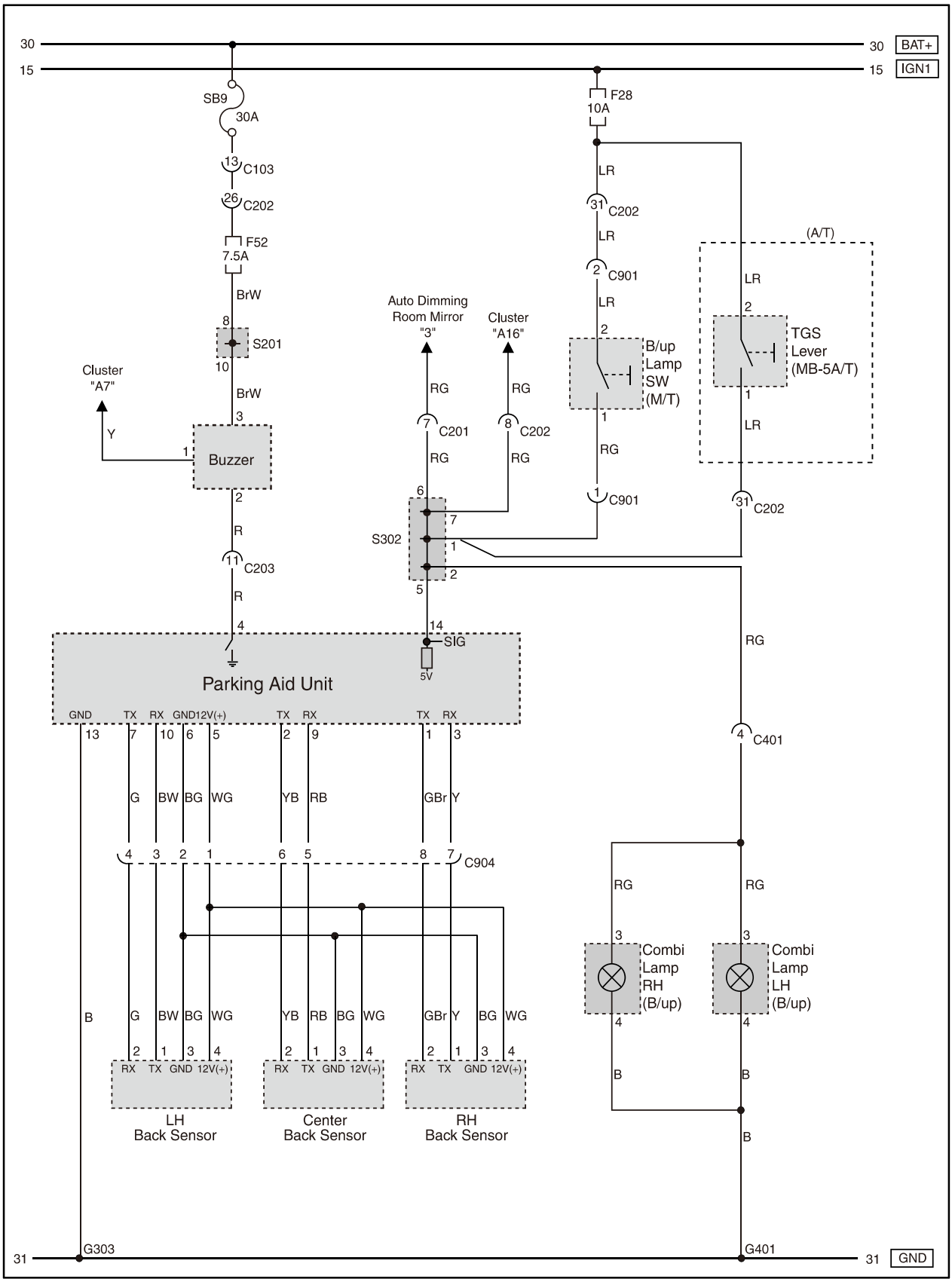
▶ **Sensor failure conditions (conditions for warning beep due to failure)**

- Sensor failure conditions (conditions for warning beep due tofailure)
- Open in sending circuit
- Open in receiving circuit
- Open in power circuit (+, -)

▶ Warning beeps

When failed (also when diagnosing the unit)		
When normal		

3. PAS CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

AV

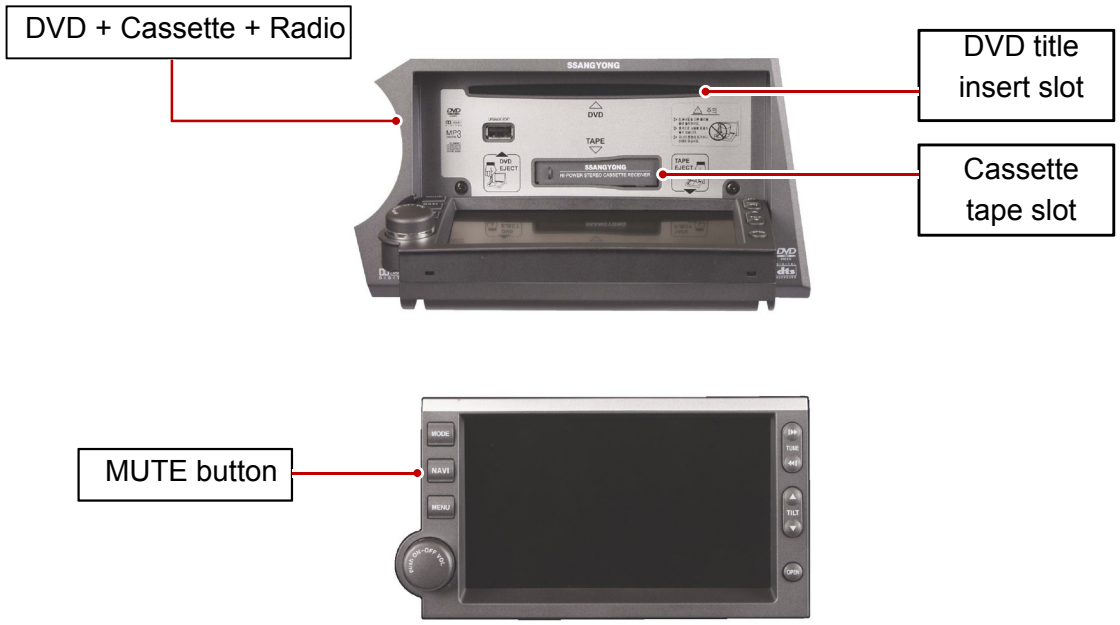
8930-14

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

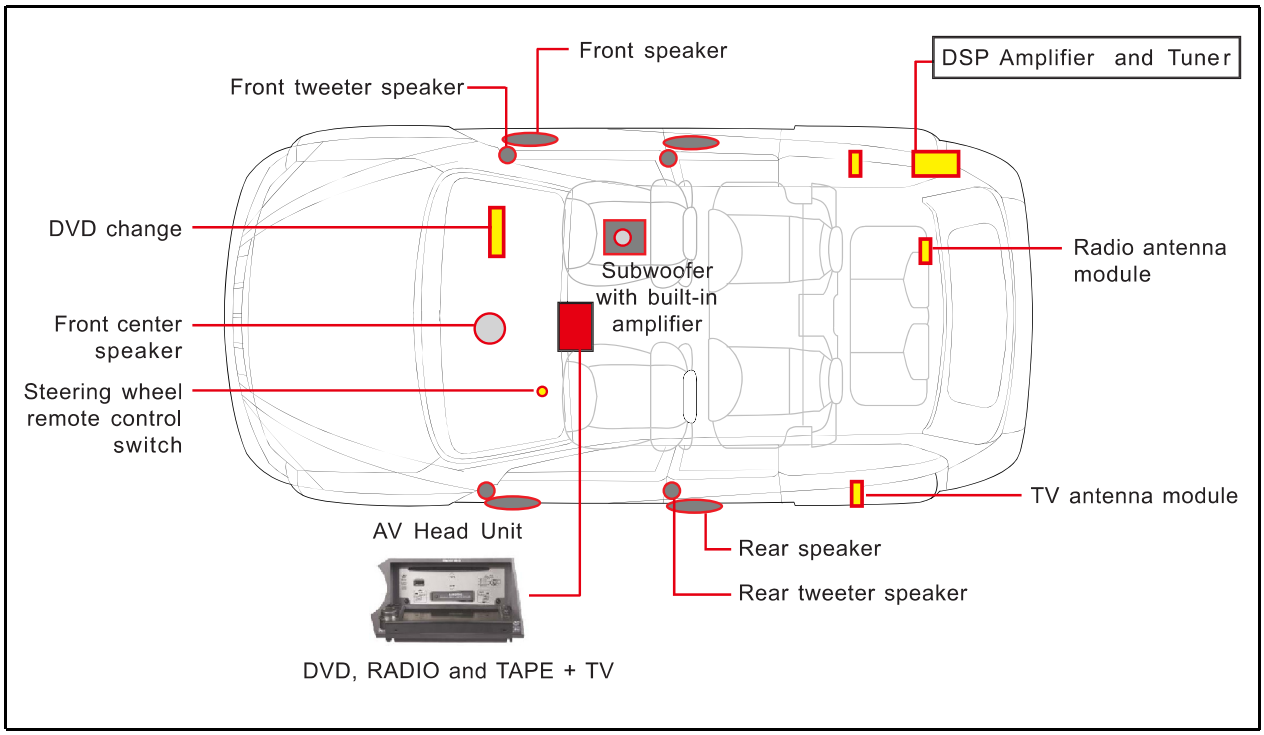


Modification basis	
Application basis	
Affected VIN	

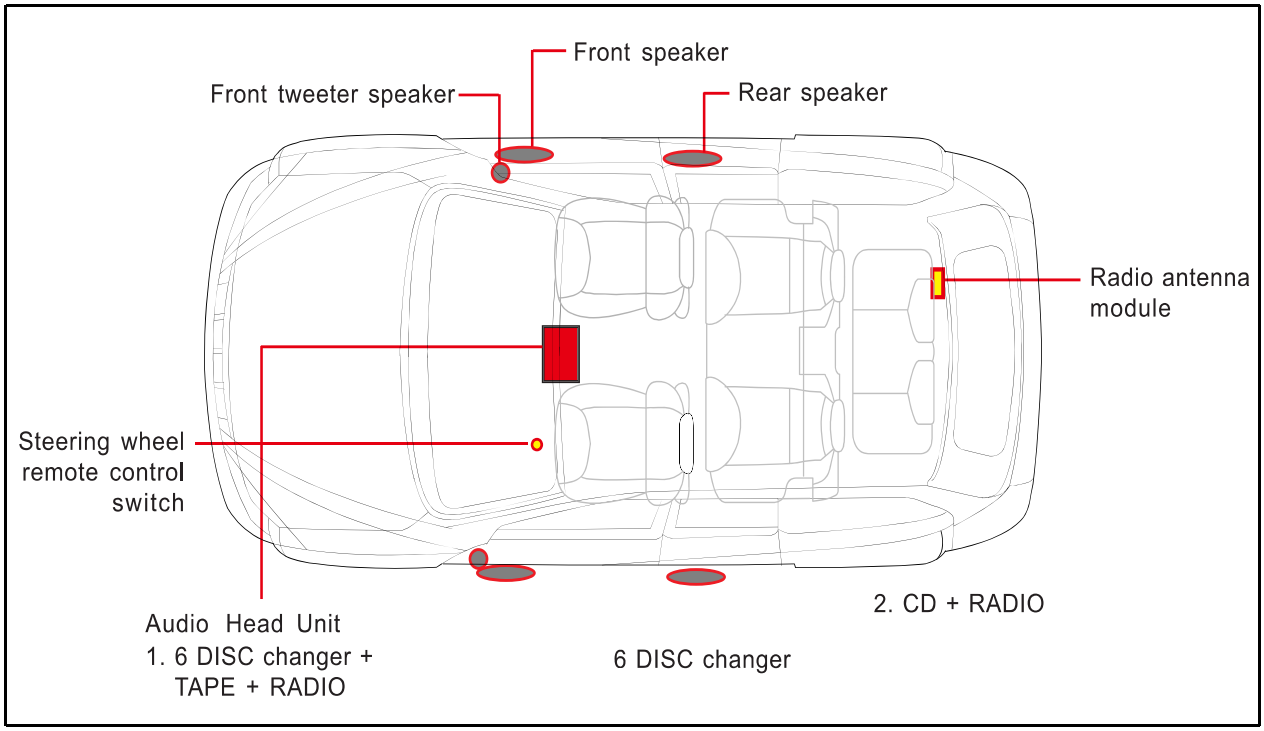
OVERVIEW AND OPERATION PROCESS

1. AV SYSTEM CONFIGURATION

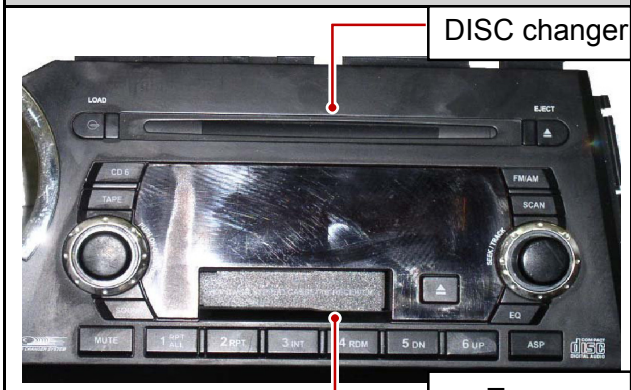
▶ AV System (DVD Head Unit + DVD Changer)



▶ Audio System - 6 Speakers



Modification basis	
Application basis	
Affected VIN	

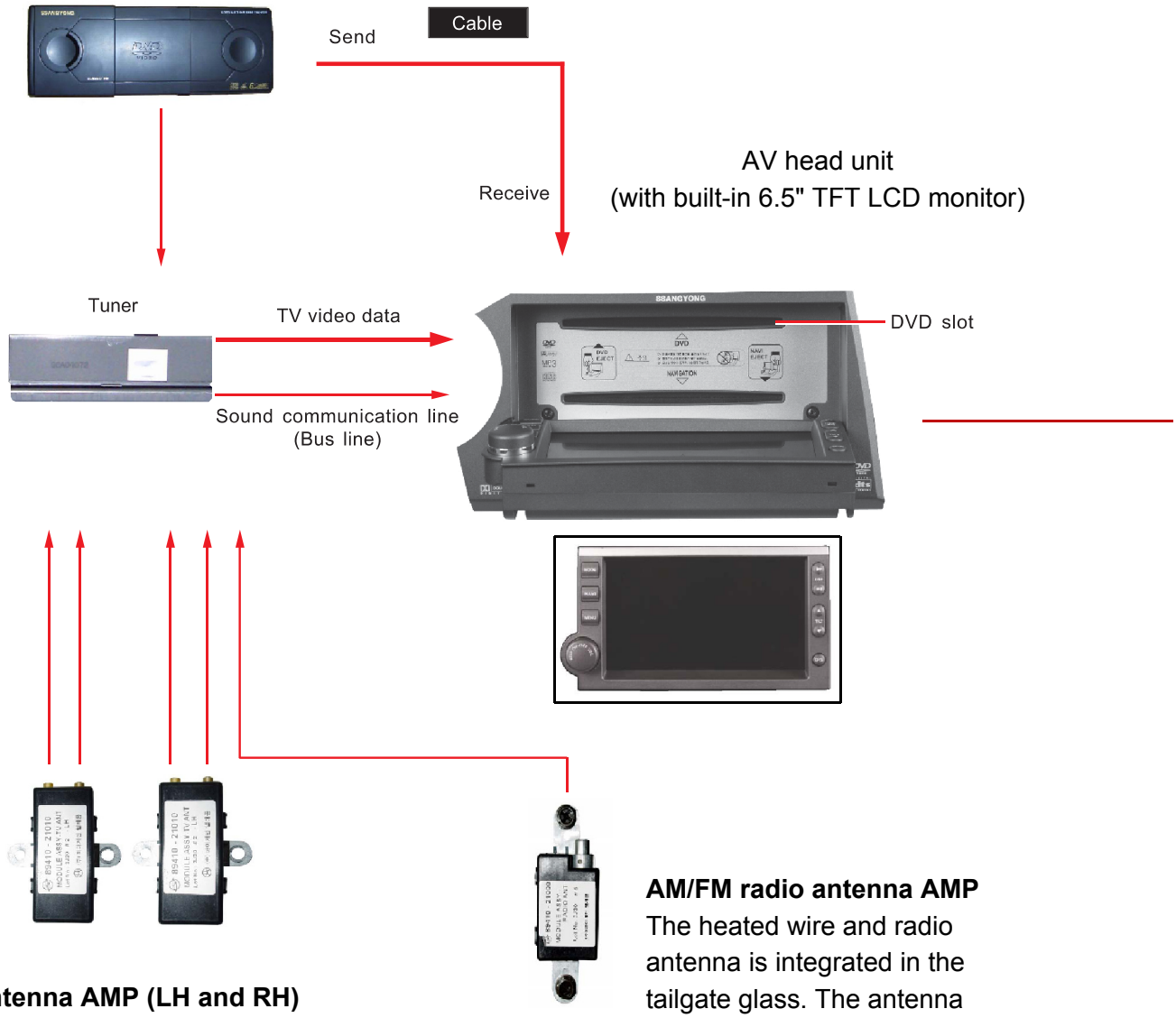
6 DISC changer + TAPE + RADIO	CD + RADIO
	

Modification basis	
Application basis	
Affected VIN	

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.



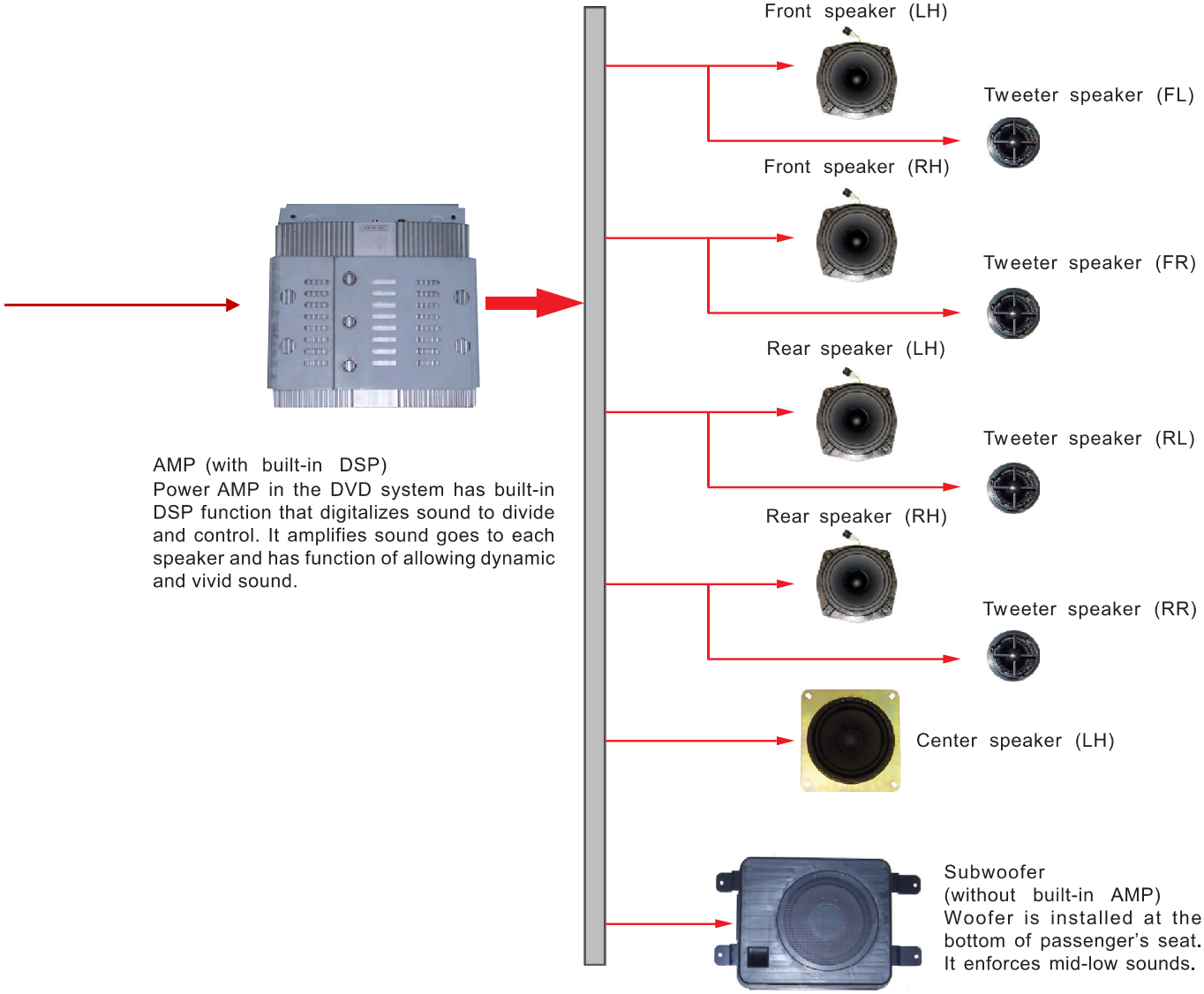
TV antenna AMP (LH and RH)

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.

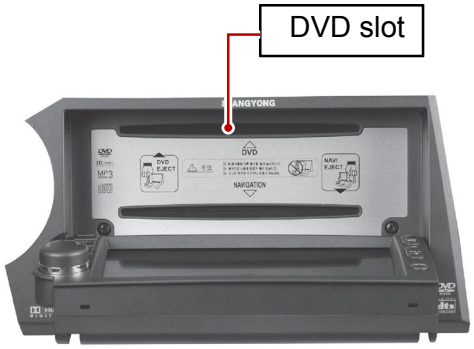
Subwoofer
(without built-in AMP)
Woofer is installed at the bottom of passenger's seat. It enforces mid-low sounds.

Modification basis	
Application basis	
Affected VIN	

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



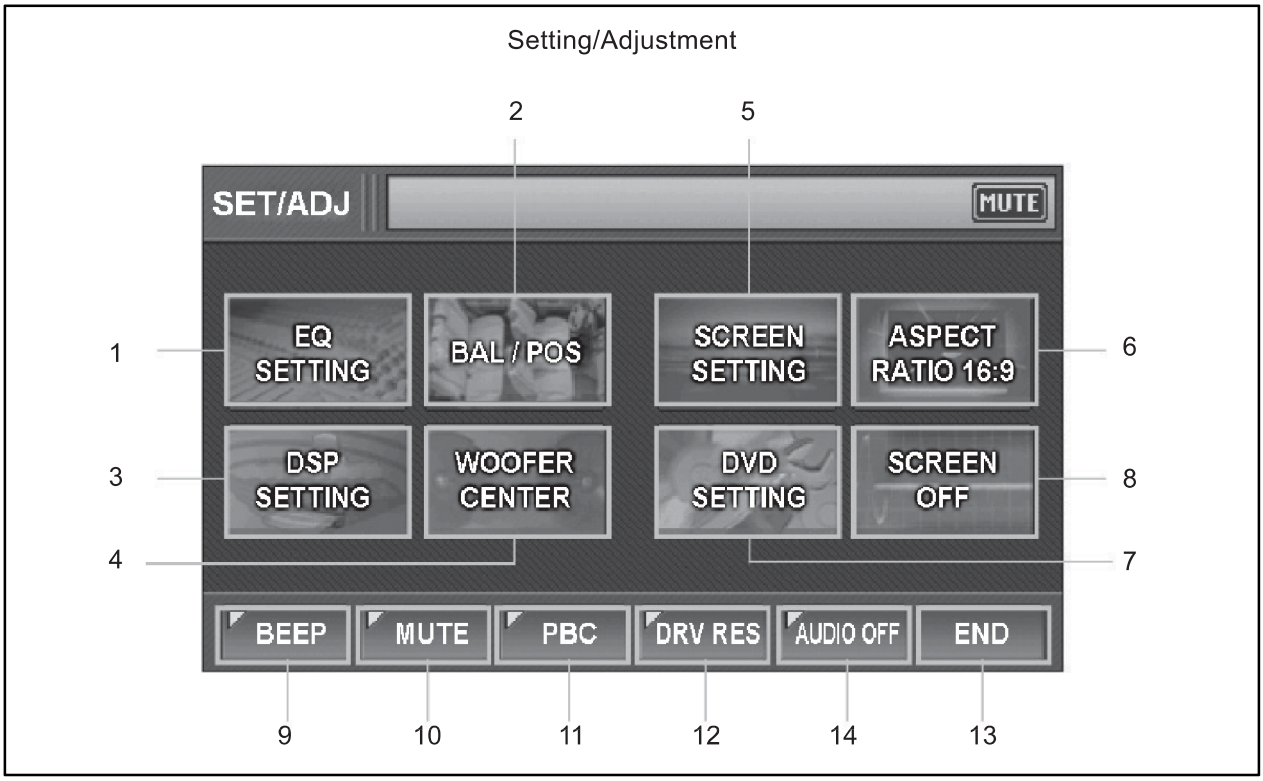
Modification basis	
Application basis	
Affected VIN	

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

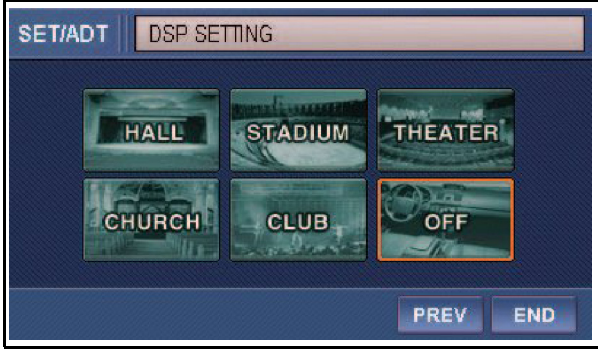


Turn the AV system ON.

Press "MODE" button to select a mode.

When pressing "RADIO" section on the screen, the "RADIO" mode screen is displayed.

DSP control

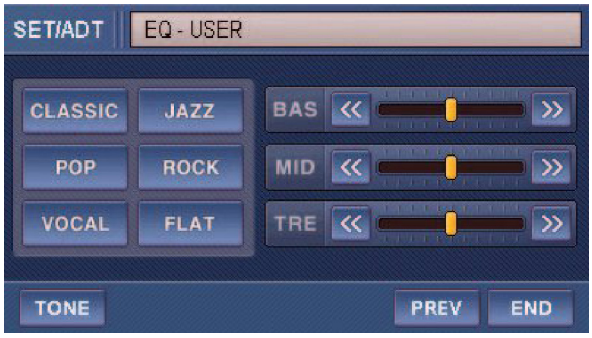


Selecting an acoustic perspective

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

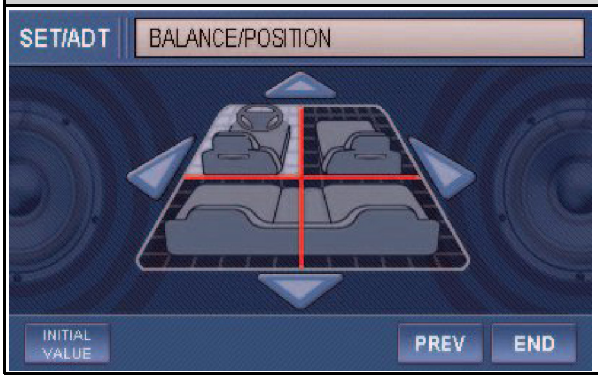


Adjusting the sound according to the music genre Press "EQ SETTING" button in "SET/ADJ" screen and adjust the sound.

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).

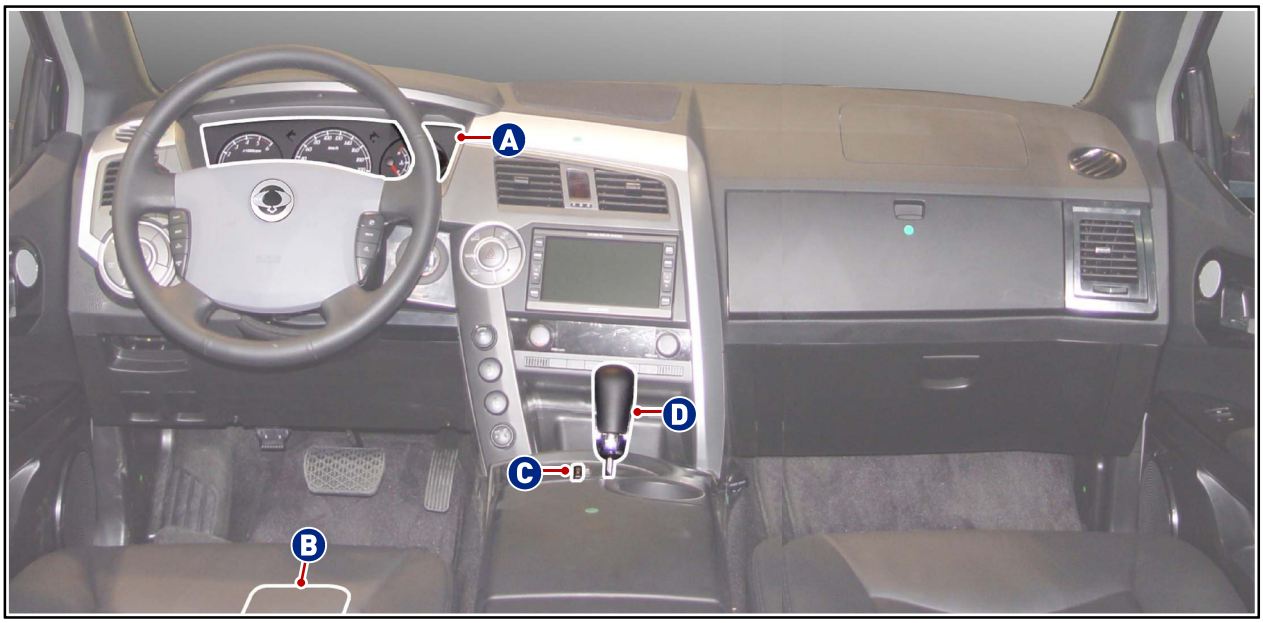
To, adjust the balance, use the arrows on the screen.

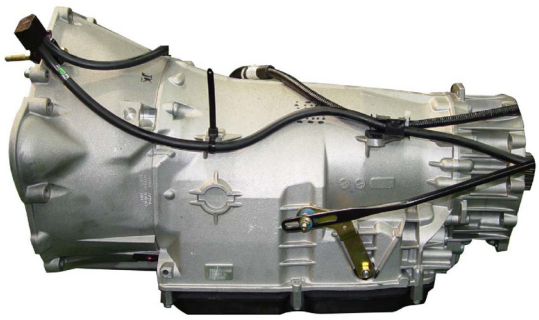
* BALANCE function and POSITION function cannot be used simultaneously.

AUTOMATIC TRANSMISSION (DC 5-SPEED) 3650-01

GENERAL

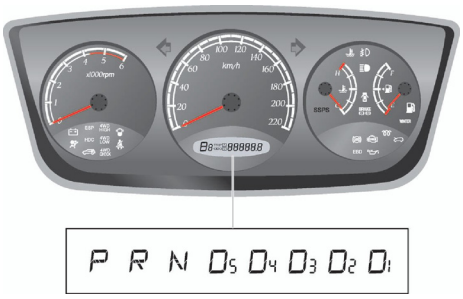
1. AUTOMATIC TRANSMISSION OVERVIEW



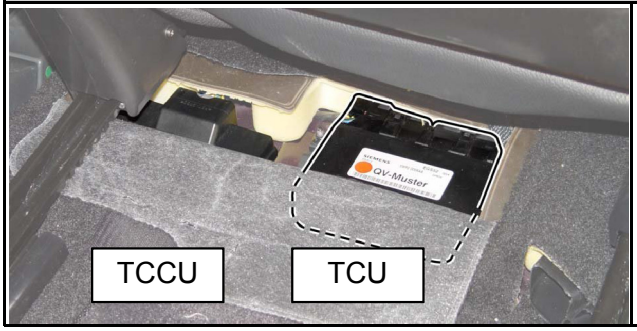
DC 5-speed Automatic Transmission Assembly	
	T-Tronic DC 5-speed automatic transmission is an electronically controlled 5-speed transmission with a lockup clutch in the torque converter. The ratios for the gears are realized by three planetary gear sets. The 5th gear is designed with a step-up ratio 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

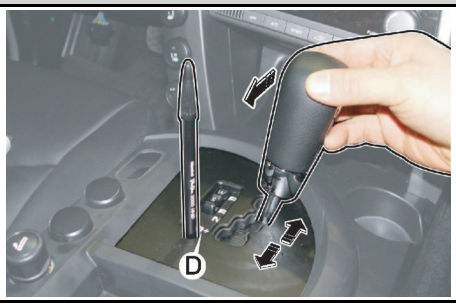


B TCU Assembly





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



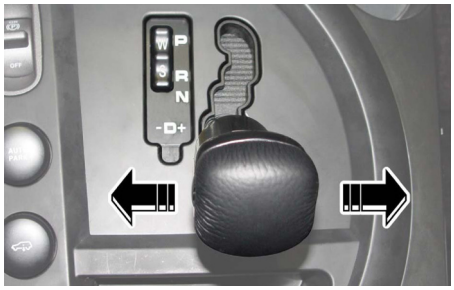
"S" mode is used in normal driving.
When "W" mode is selected, the vehicle starts from 2nd gear (forward and reverse) to achieve smooth starting on the slippery road.

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.

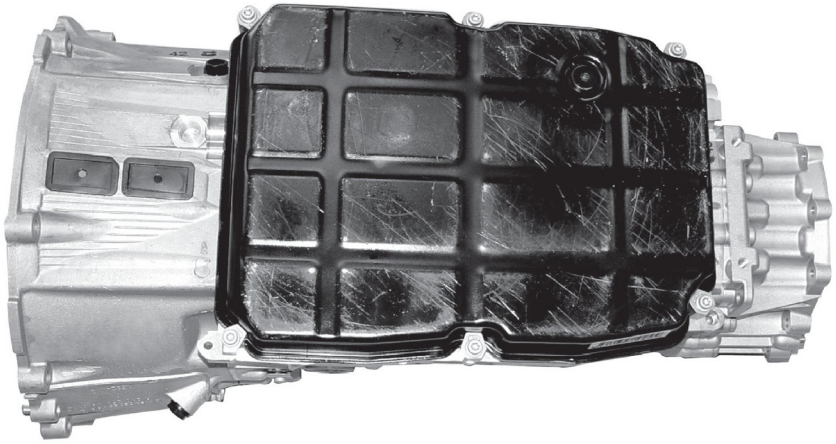
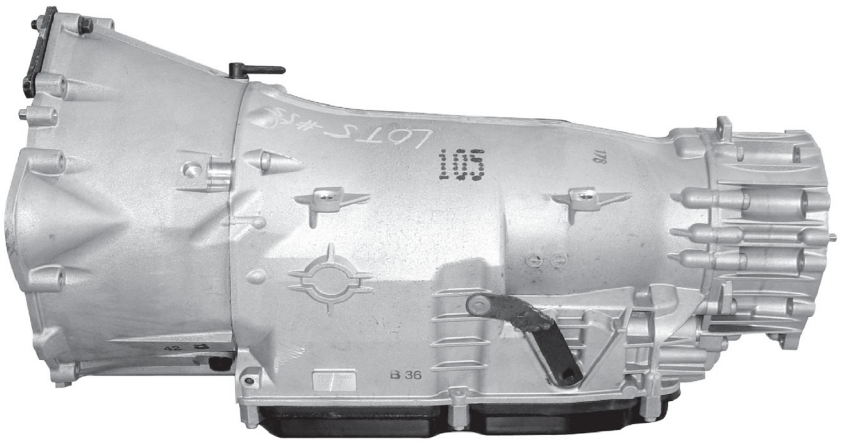


Upshift (Manual Mode)

1→ 2 → 3 → 4 → D

The shiftable gear is up by one step as the lever is moved to right (+) direction.

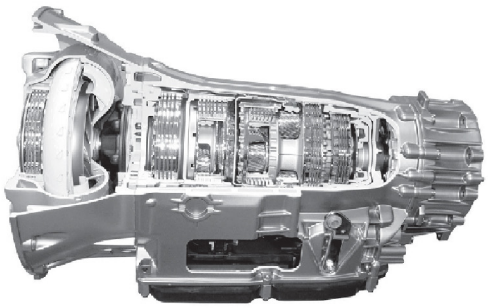
2. AUTOMATIC TRANSMISSION (DC 5-SPEED) APPEARANCE

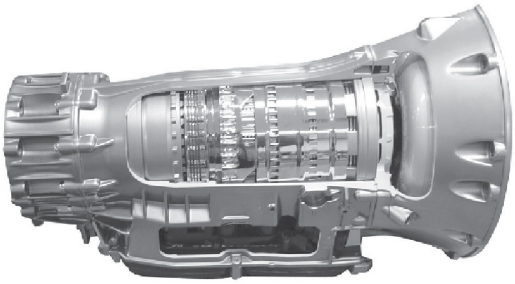
Left Side



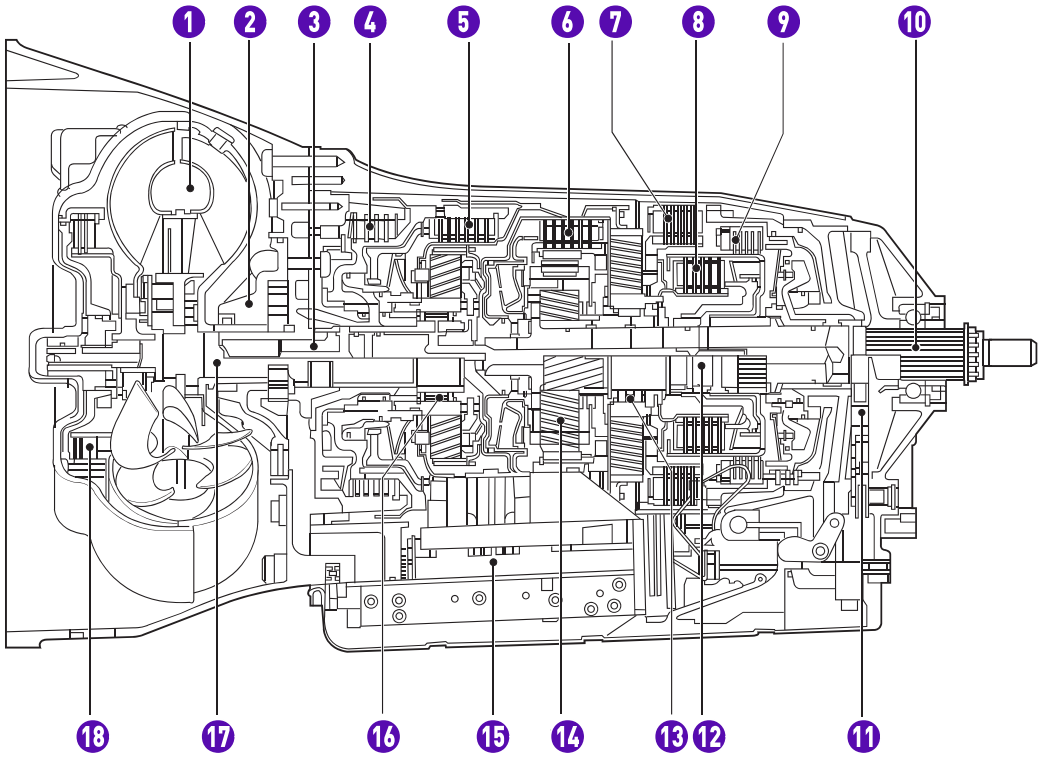
With Torque Converter	Without Torque Converter	Rear View
		

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	

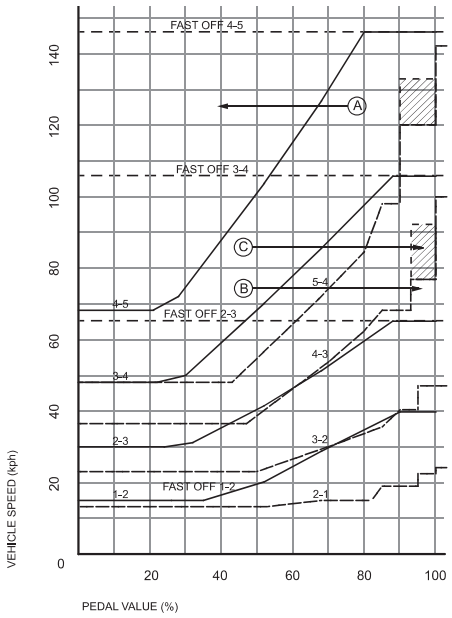
Item		5-Speed Automatic Transmission
Mode switch		W (Winter)
		S (Standard)
One-way clutch		F1, F2
Planetary gear set	Number of planetary gear set pinion (Front, Center, Rear)	4, 4, 4
Disc clutch	C1	Single side friction plate
	C2	Double side friction plate
	C3	Single side friction plate
Disc brake	B1	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).

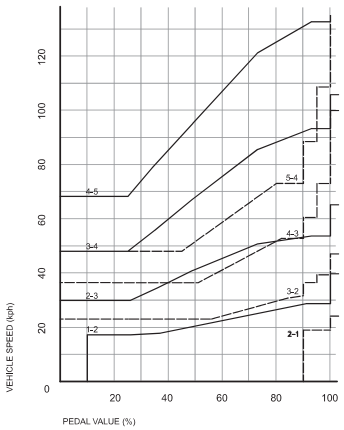
4th gear: 1.000

5th gear: 0.833

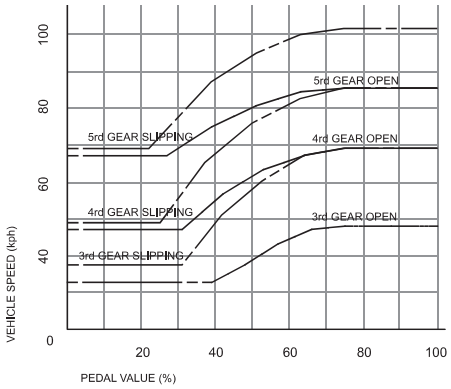
Rev. 1st gear: 3.147

Rev. 2nd gear: 1.93

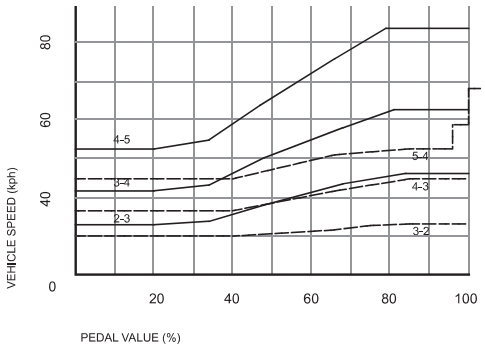
WINTER Mode (2WD)



Lockup Mode (Open/Slipping)



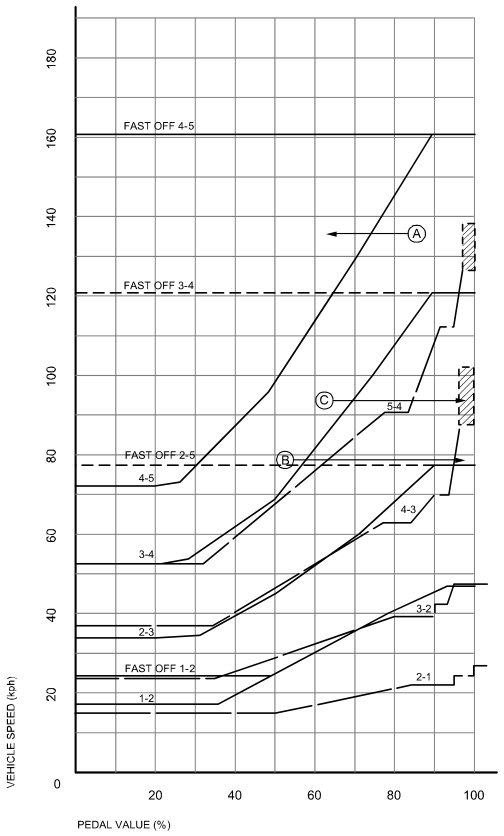
Low Mode (4WD)



Modification basis	
Application basis	
Affected VIN	

D27DT

Standard Mode



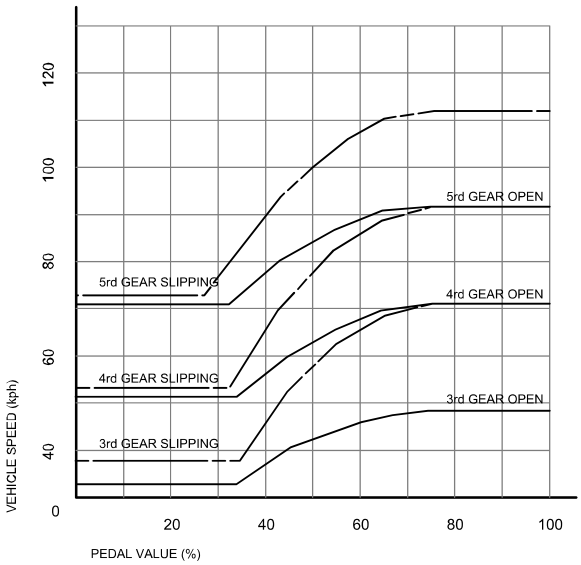
Upshift:
Downshift:
Lockup (slipping):
Unlock (open):
FAST OFF:
Dynamic shift zone:

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).

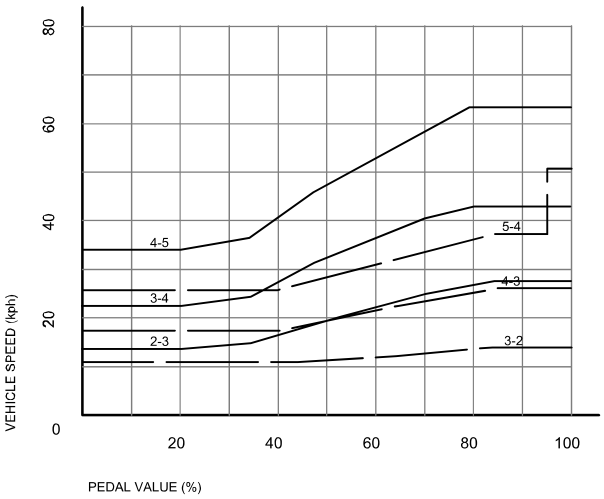
Dynamic shift zone:
When operating the accelerator pedal (B), the 4 → 3 shift is completed by kick-down signal after completion of 4 → 3 shift (100% of pedal position). When promptly operating the accelerator pedal (C), the 4 → 3 shift is done in shaded area (93% of pedal position).

4th gear: 1.000
5th gear: 0.833
Rev. 1st gear: 3.147
Rev. 2nd gear: 1.93

Lockup Mode (Open/Slipping)



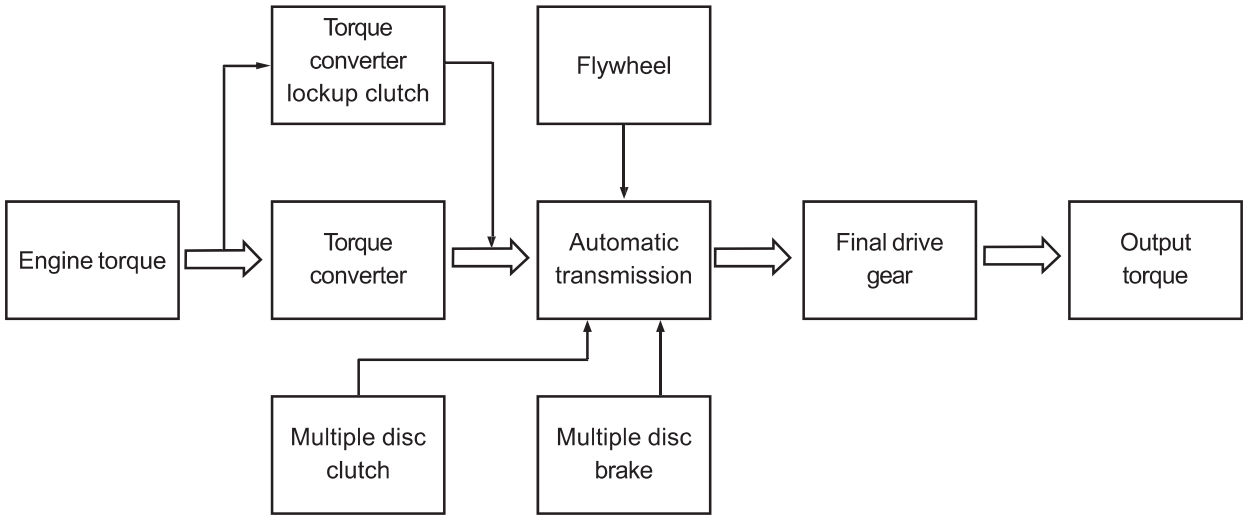
WINTER Mode



Modification basis	
Application basis	
Affected VIN	

▶ General Characteristics

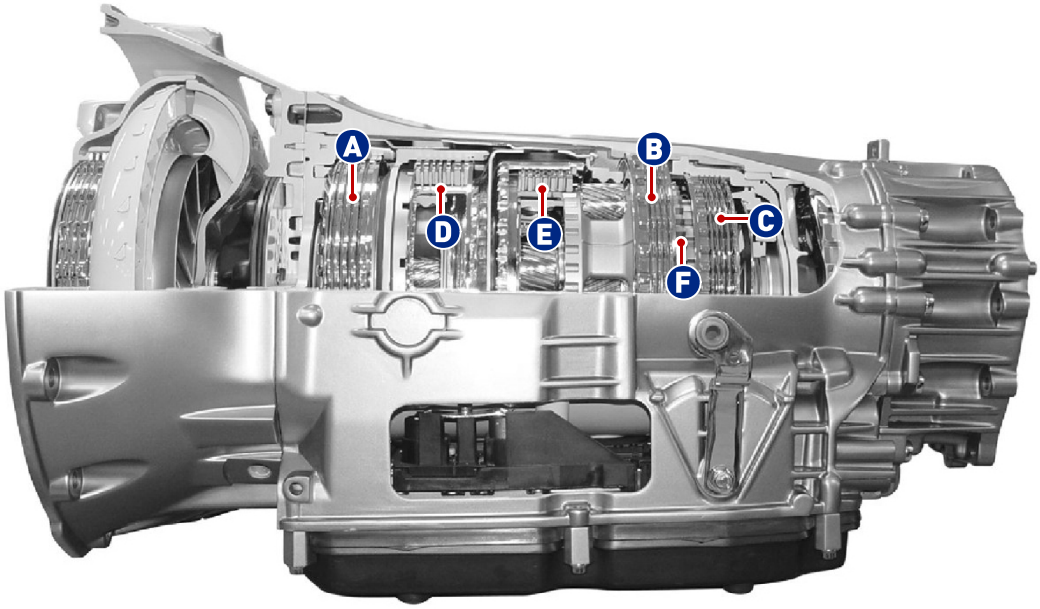
Characteristic	Function and Effect
Slope recognition (down hill, up hill)	Slope is recognized based on engine RPM and accelerator pedal position. → Delays up shift
Engine torque reduction	Ignition timing is delayed to reduce torque at all shifting moments. → Improves shift quality
Engine rpm limitation	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 

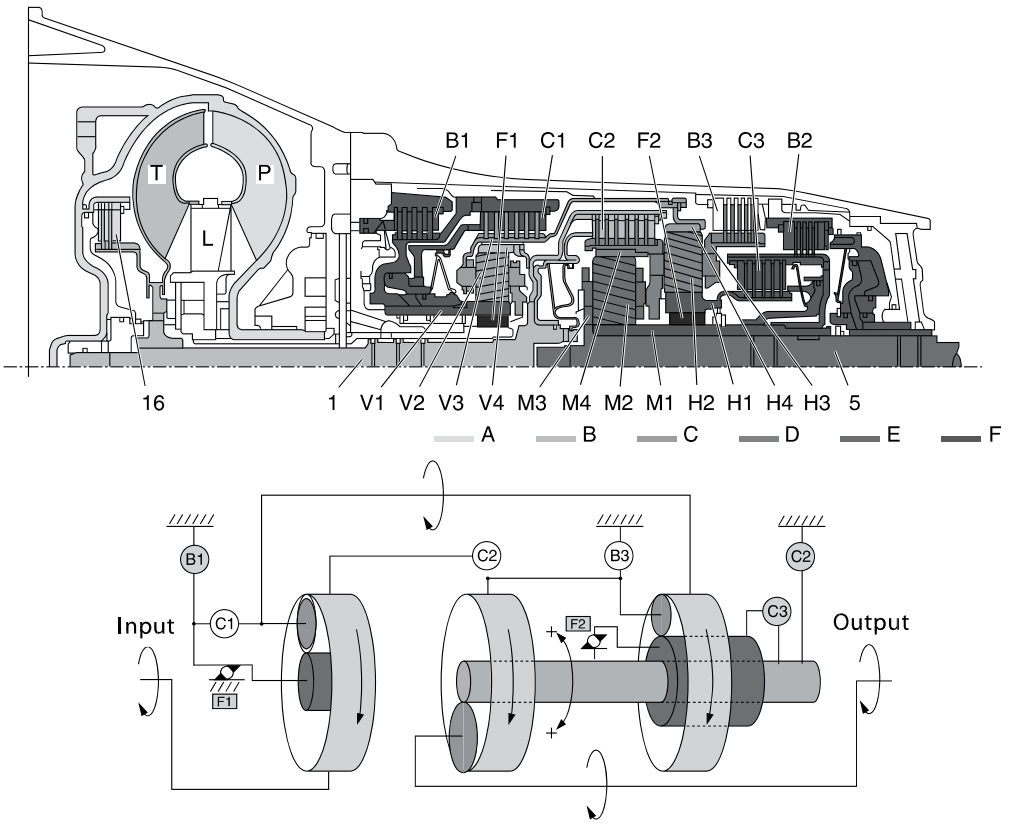
▶ Shifting Elements

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)



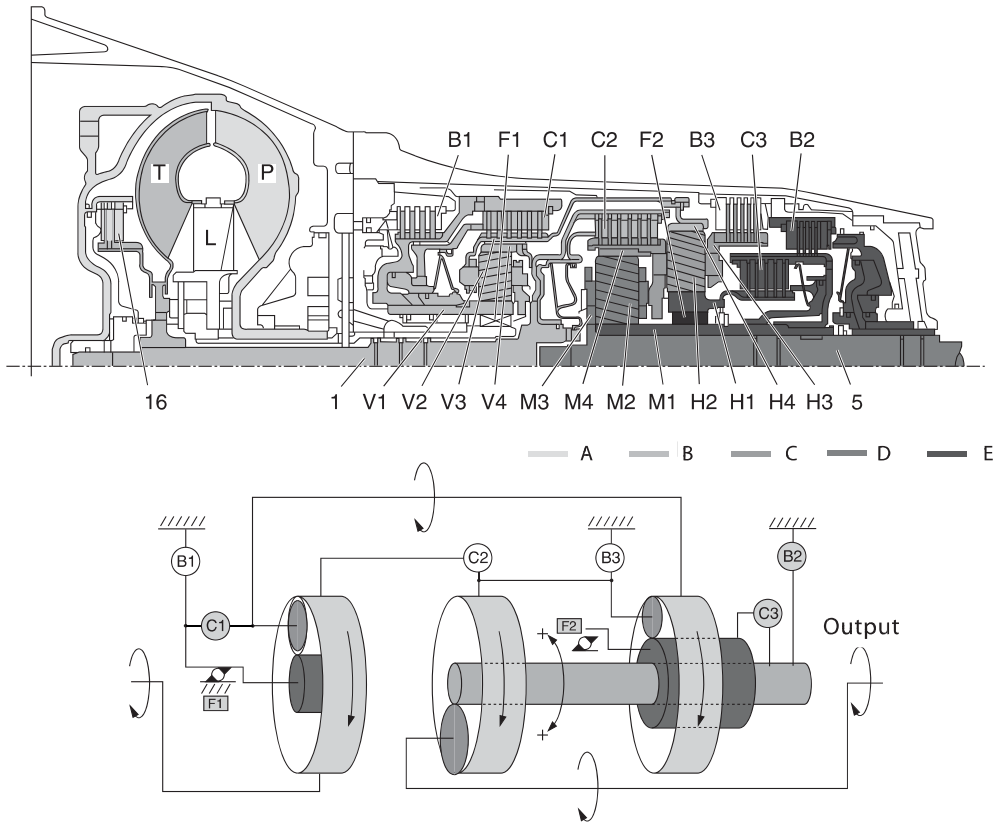
16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. 3rd gear ratio
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

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

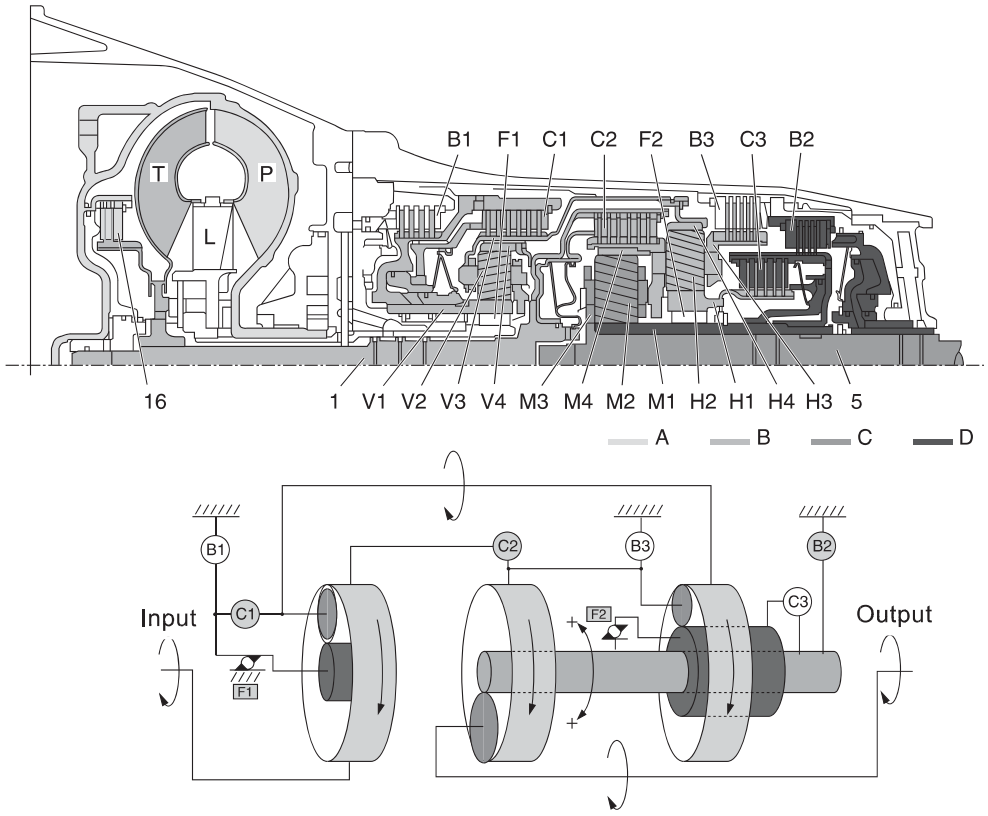
1. Input shaft: Clockwise rotation
2. Sun gear and planetary gear carrier: Clockwise rotation by C1 activation
3. Rear ring gear: Clockwise rotation
4. Rear sun gear: Locked by F2 and B2, Planetary gear carrier: Rotation with reduced speed
5. Center ring gear: Clockwise rotation
6. Sun gear: Locked by 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)

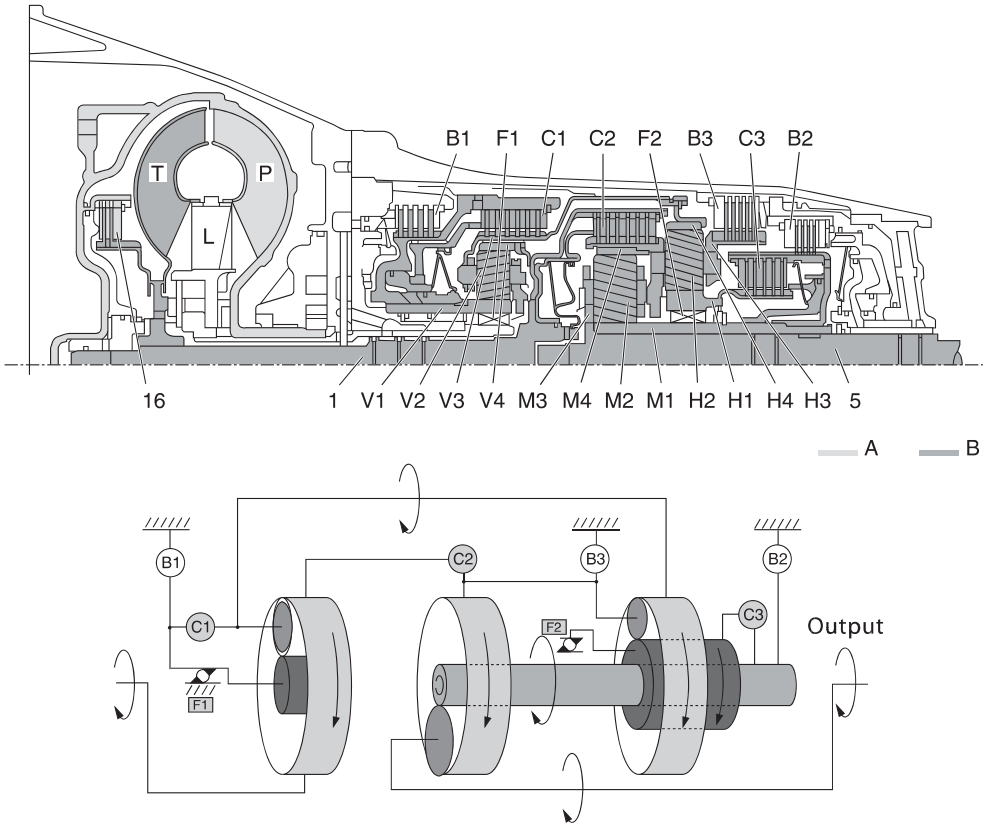


16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

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)



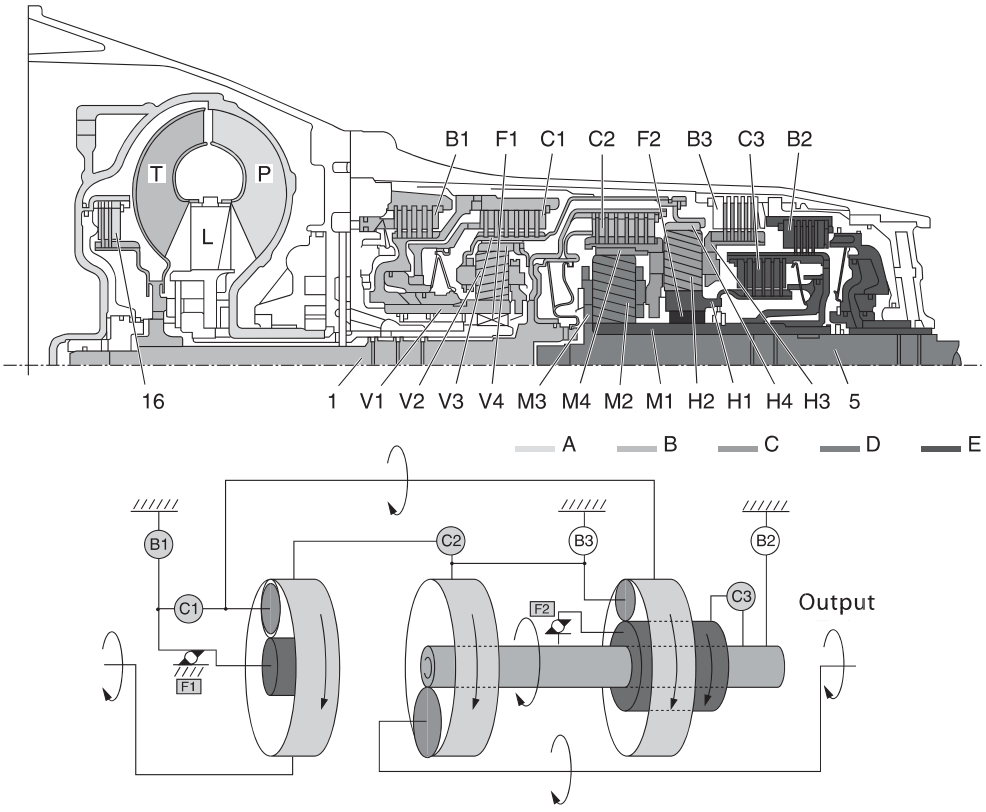
16. Torque converter lockup clutch
L. Stator
T. Turbine wheel
A. Engine speed
M. Center planetary gear set
V. Front planetary gear set
B. Planetary gear set
P. Impeller

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)



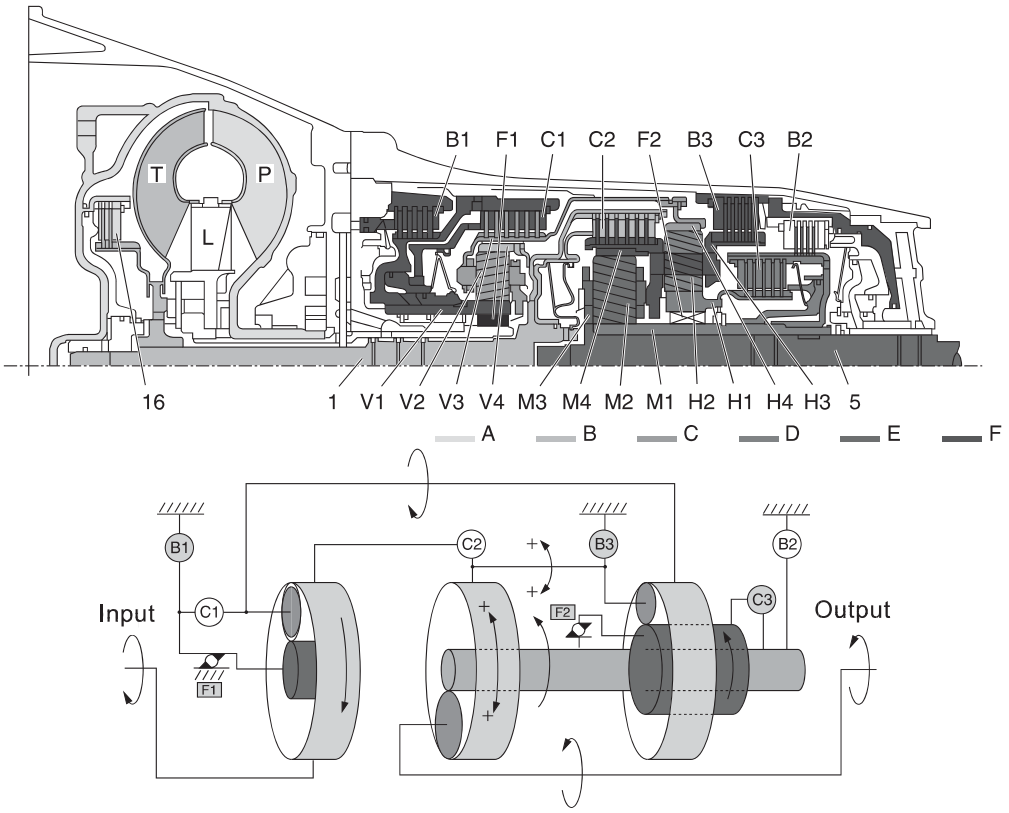
16. Torque converter lockup clutch
A. Engine speed
B. Transmission, input shaft
C. 1st gear ratio
D. 2nd gear ratio
E. 3rd gear ratio
F. Locking elements
H. Rear planetary gear set
L. Stator
M. Center planetary gear set
P. Impeller
T. Turbine wheel
V. Front planetary gear set

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

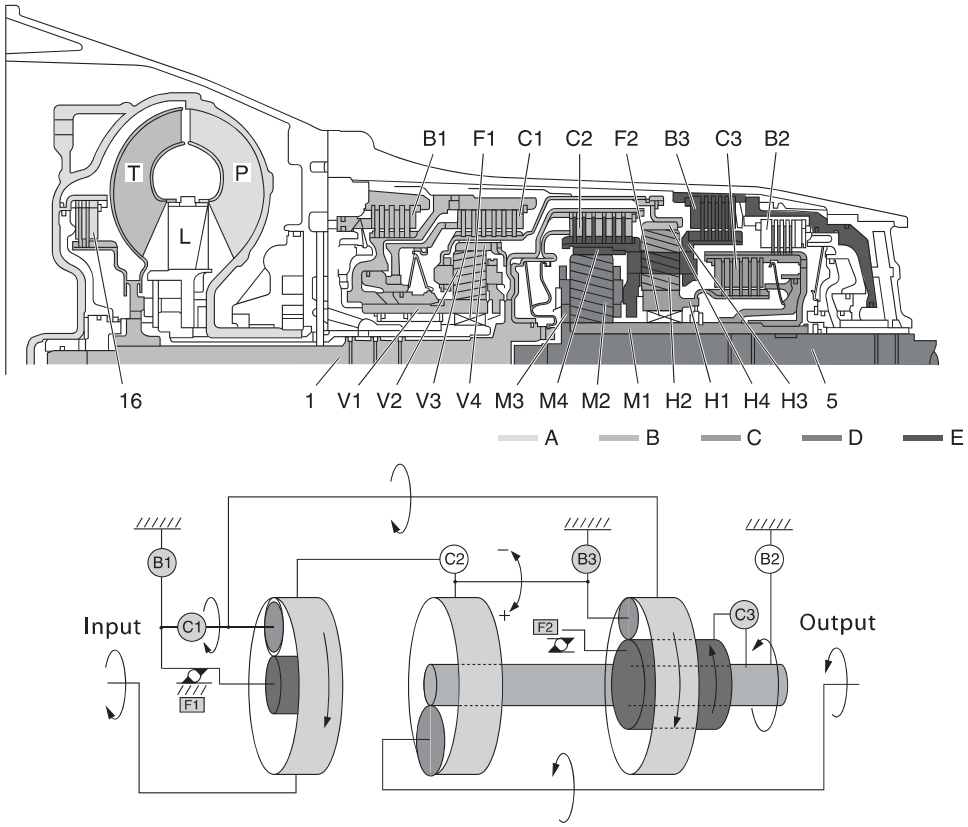
1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Front sun gear: Locked by one-way clutch F1
4. Front planetary gear carrier: Clockwise rotation (reduced speed)
5. Rear planetary gear ring gear: Clockwise rotation
6. Rear planetary gear carrier: Locked by B3
7. Rear sun gear 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

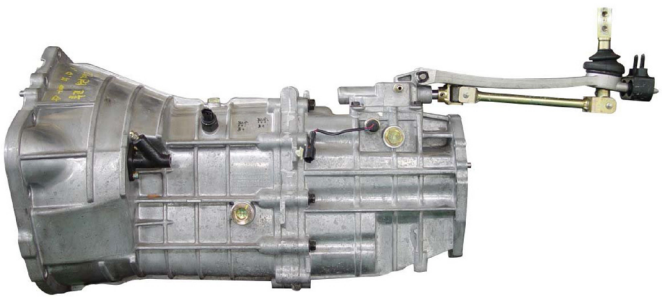
1. Input shaft: Clockwise rotation
2. Front ring gear: Clockwise rotation
3. Front planetary gear carrier: Clockwise rotation by clutch C1 activation (direct connection)
4. Rear ring gear: Clockwise rotation
5. Rear planetary gear carrier and center ring gear: Locked by brake B3
6. Rear sun gear and 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)	●		●			●		

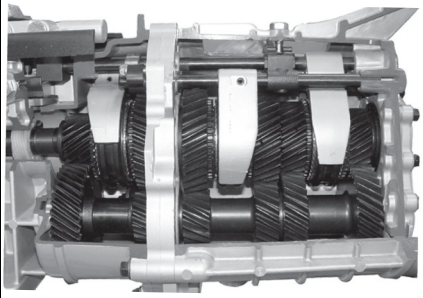
GENERAL

1. OVERVIEW AND CHARACTERISTICS OF MANUAL TRANSMISSION

1) SYSTEM COMPONENTS

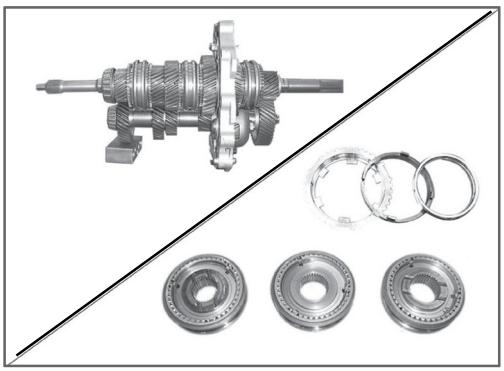


Inside



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.

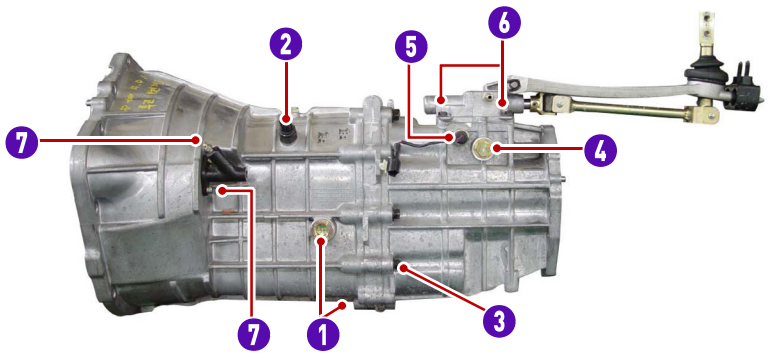
2. SPECIFICATIONS AND TIGHTENING TORQUE OF MANUAL TRANSMISSION

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

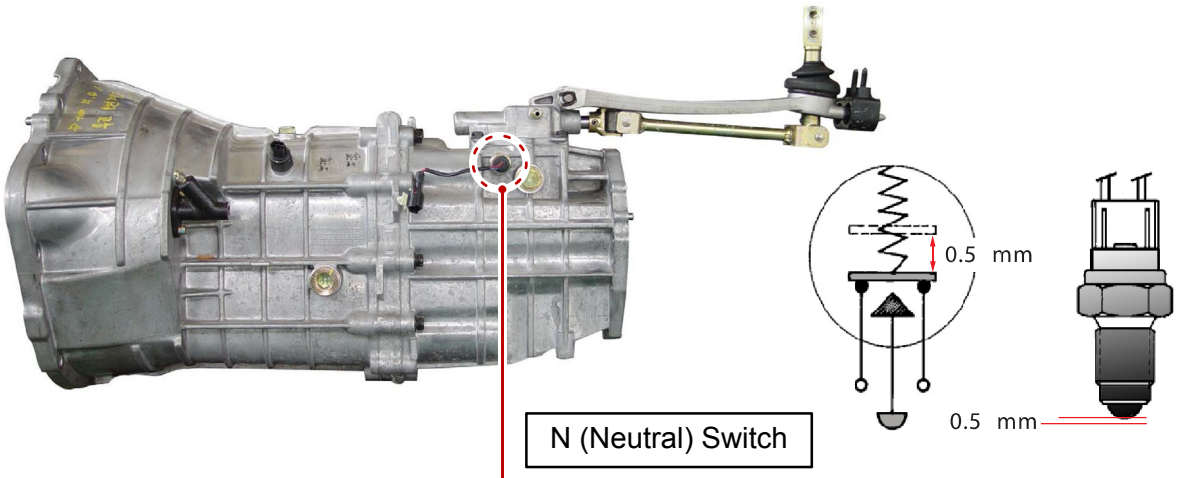


Modification basis	
Application basis	
Affected VIN	

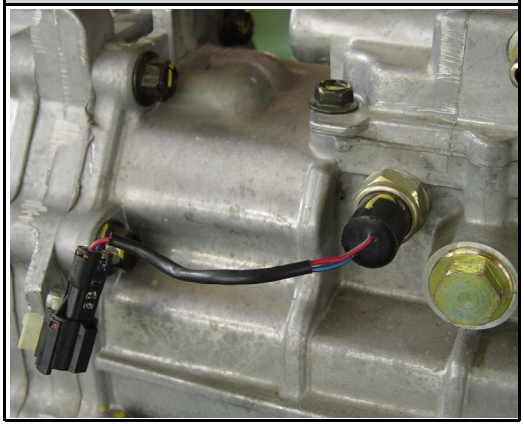
OVERVIEW AND OPERATION PROCESS

1. MANUAL TRANSMISSION SYSTEM

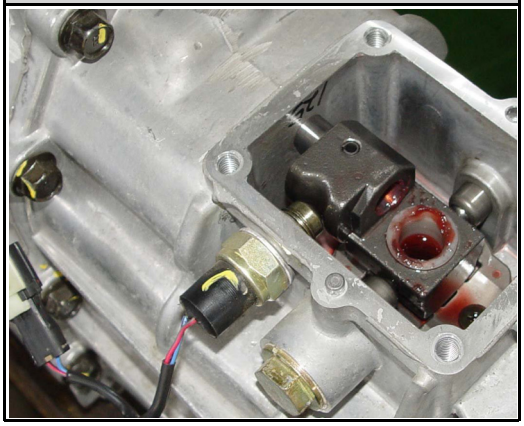
1) Neutral Switch



Outside N Switch



Inside N Switch



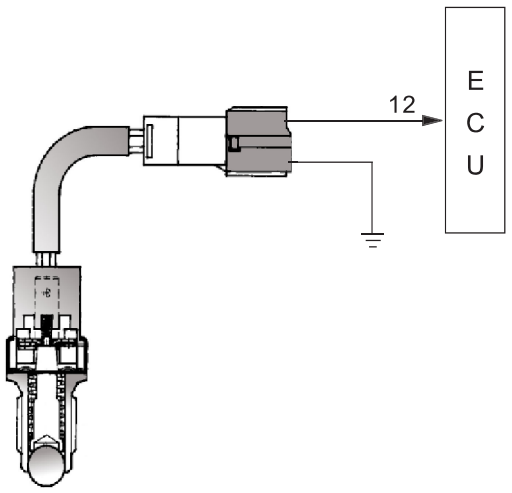
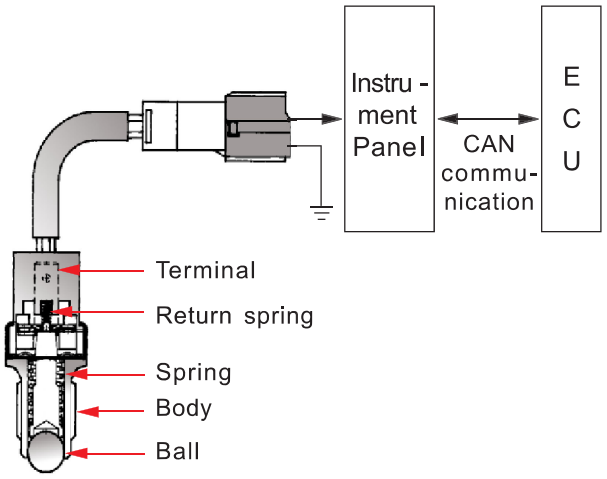
2) Function of N Switch

▶ **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

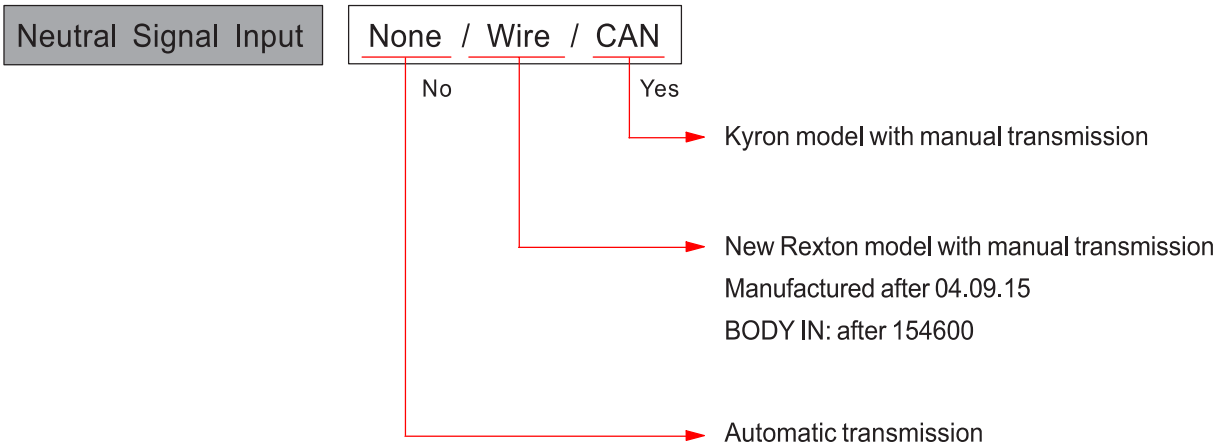
- The G sensor within the sensor cluster measures the actual road inclination. However, it may recognize a sharp turn or rough road as a downhill with a inclination exceeding 10%, and the HDC may operate.

※ 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	Diesel engine equipped vehicle: 140 mm
	Pedal free play	5 ~ 10 mm
Clutch disc	Type	Single dry diaphragm
	Dimension of facing	240 × 155 × 4.0 mm
	Facing size/quantity	263 cm^2 / 2
	Thickness of disc	Free: 9.4 ~ 10 mm When loaded: 9.0 ± 0.3 mm
Clutch cover assembly setting force		Min. 720 kg
Clutch master cylinder	Stroke	28.4 mm
	Inner diameter	ϕ17.04 mm
Concentric slave cylinder	Stroke	7.0 mm
	Sectional area	706 mm^2
Clutch fluid		DOT3 or DOT4

2. TIGHTTENING TORQUE

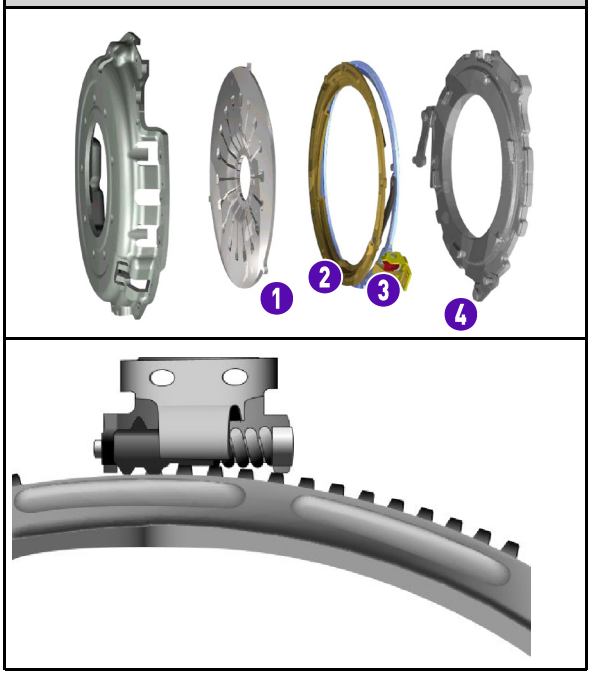
Description	Tightening Torque
Clutch housing bolt (8 locations)	49 ~ 59 Nm
Clutch cover (pressure plate) bolt	21 ~ 27 Nm
Concentric slave cylinder bolt (3 locations)	10 ~ 16 Nm
Concentric slave cylinder flare nut	20 ~ 25 Nm
Adapter flare nut	20 ~ 25 Nm
Clutch oil pipe flange nut	15 ~ 18 Nm
Master cylinder 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.

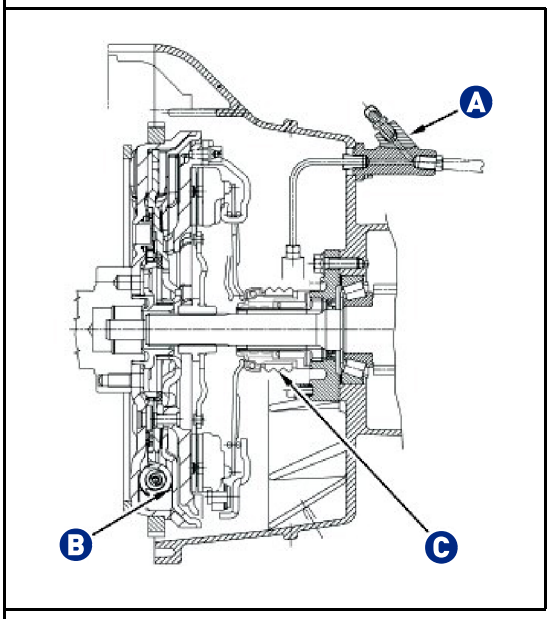
▶ **Operating Elements**

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



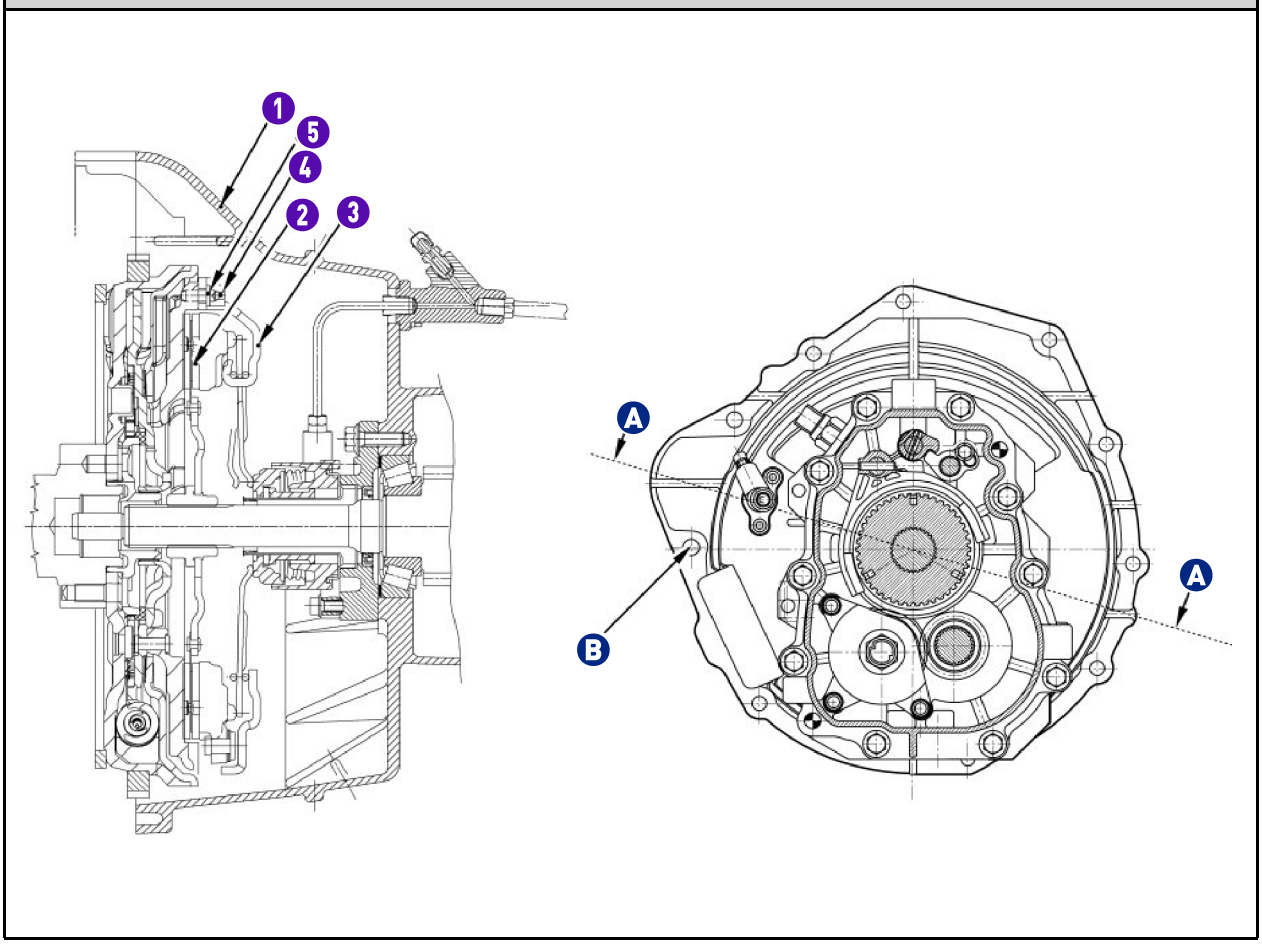


C Concentric Slave Cylinder





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

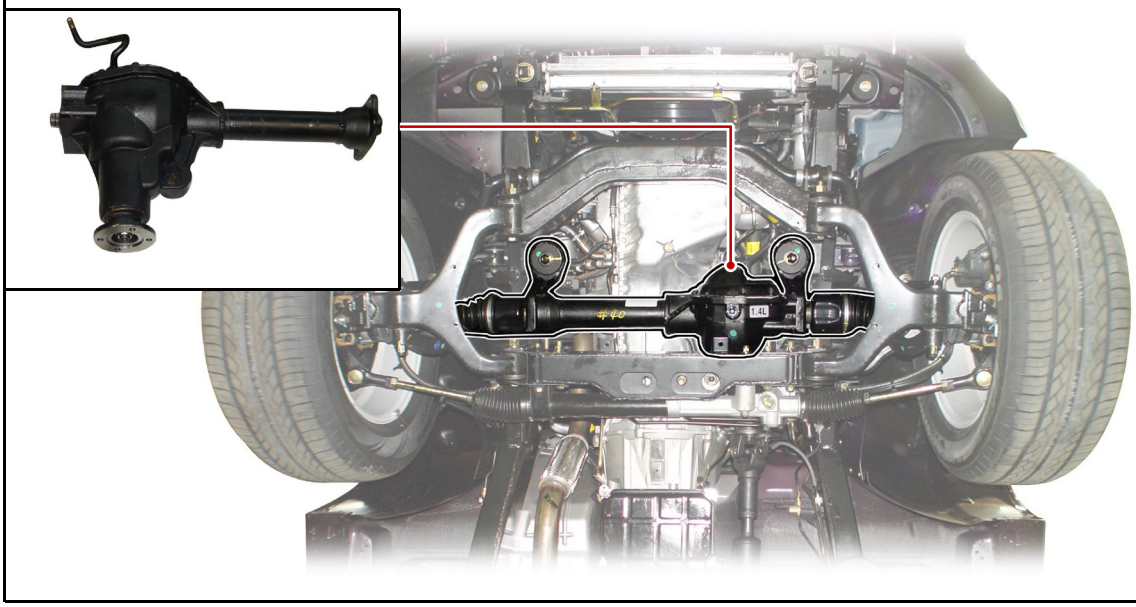
Location		Front axle				Rear axle	
Specification		M/T		A/T		Independent suspension	5-link
Torque		-		-		5,164 Nm	-
Gear ratio		D20DT	D27DT	D20DT	D27DT	←	←
		4.27	3.91	3.54	3.31		
Gear	Type	→		→		Hypoid	←
	Size	f 198.1mm		←		218 mm (diameter)	f 243.8mm
	Offset	30 mm		←		Less than 30 mm	-
Housing		Steel 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

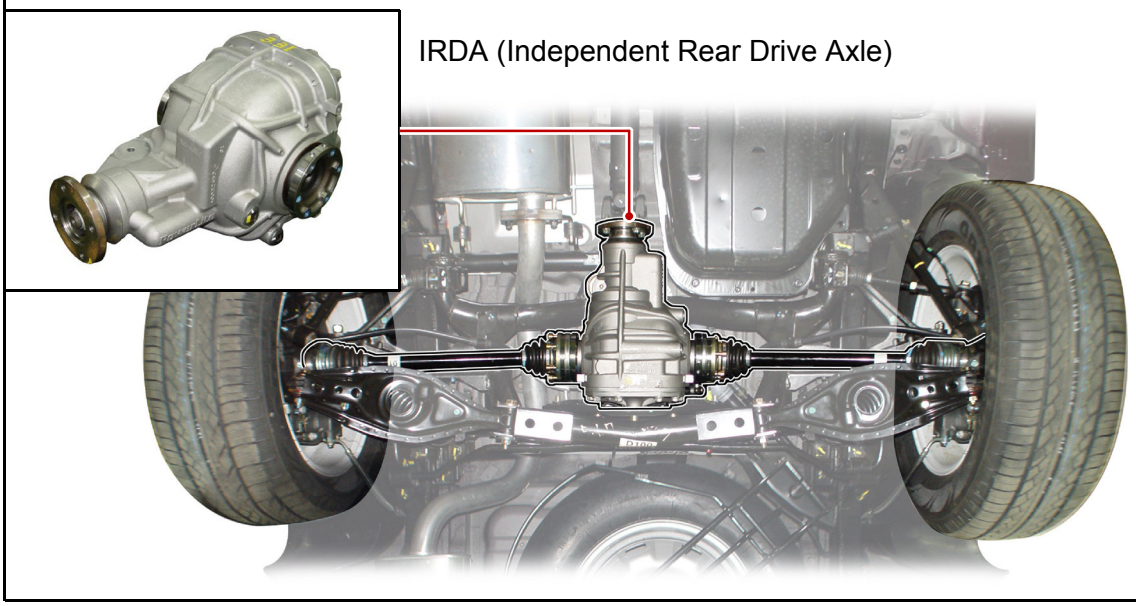
Compared to previous models, in addition to existing 5-link suspension, the IRDA (Independent Rear Drive Axle) is adopted for the independent type suspension in this vehicle.
The below figures for rear axle show the rear axle with the independent type suspension (4WD, A/T).

Front Axle



Rear Axle

IRDA (Independent Rear Drive Axle)



Modification basis	
Application basis	
Affected VIN	

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

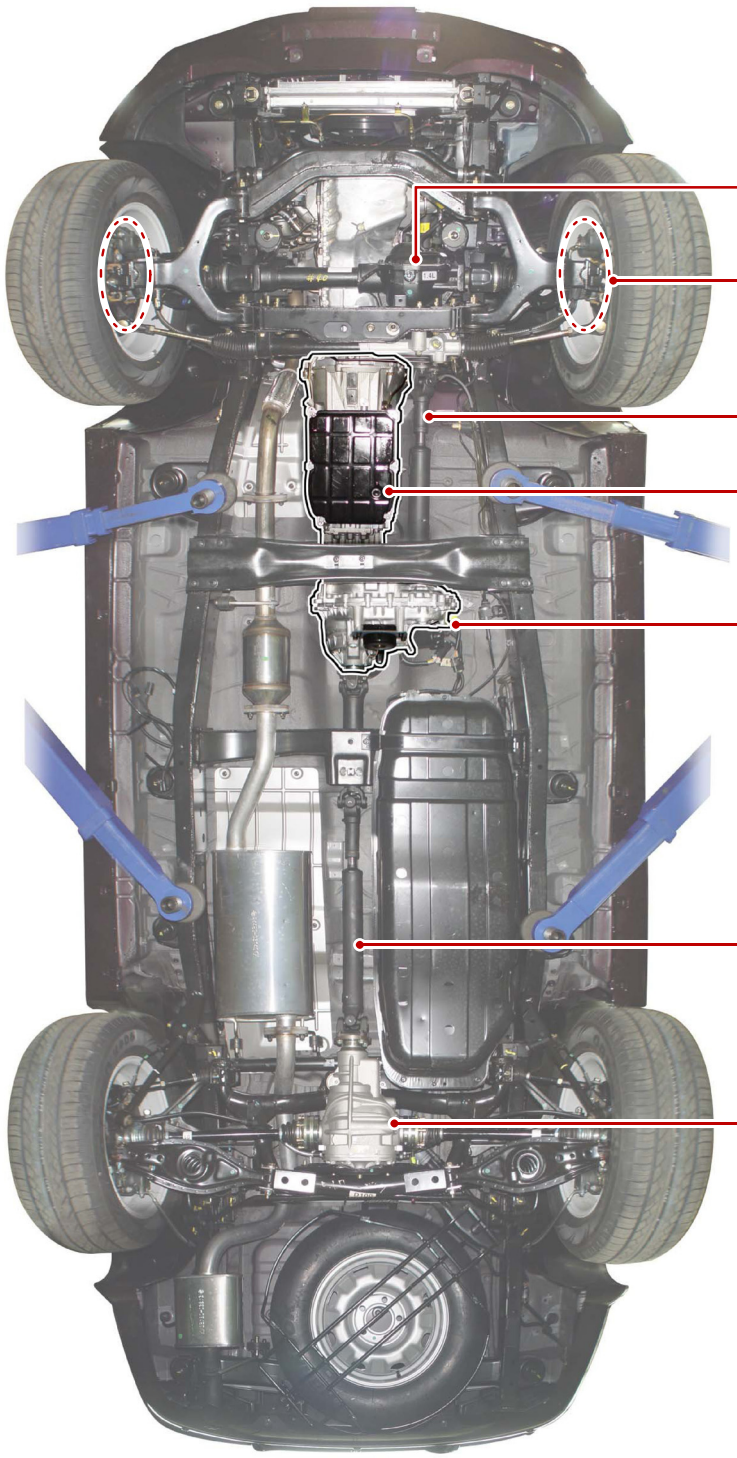
- In non-ABS vehicle, the vehicle speed sensor is installed on the rear drive axle. The engine ECU sends the speed signal to the instrument panel, and then the instrument panel provides the information to TCCU and other devices.

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

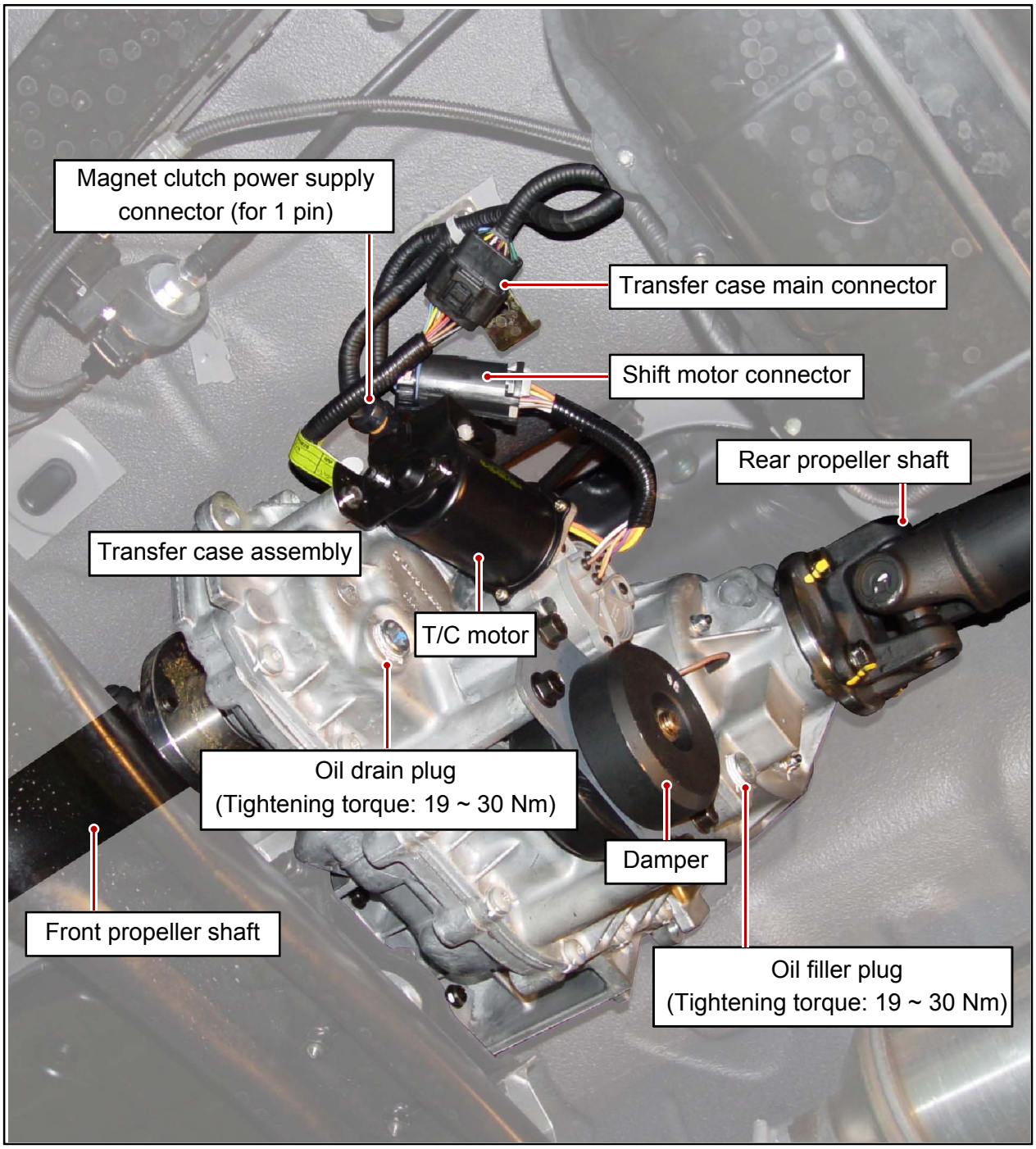
OVERVIEW AND OPERATION PROCESS

1. STRUCTURE



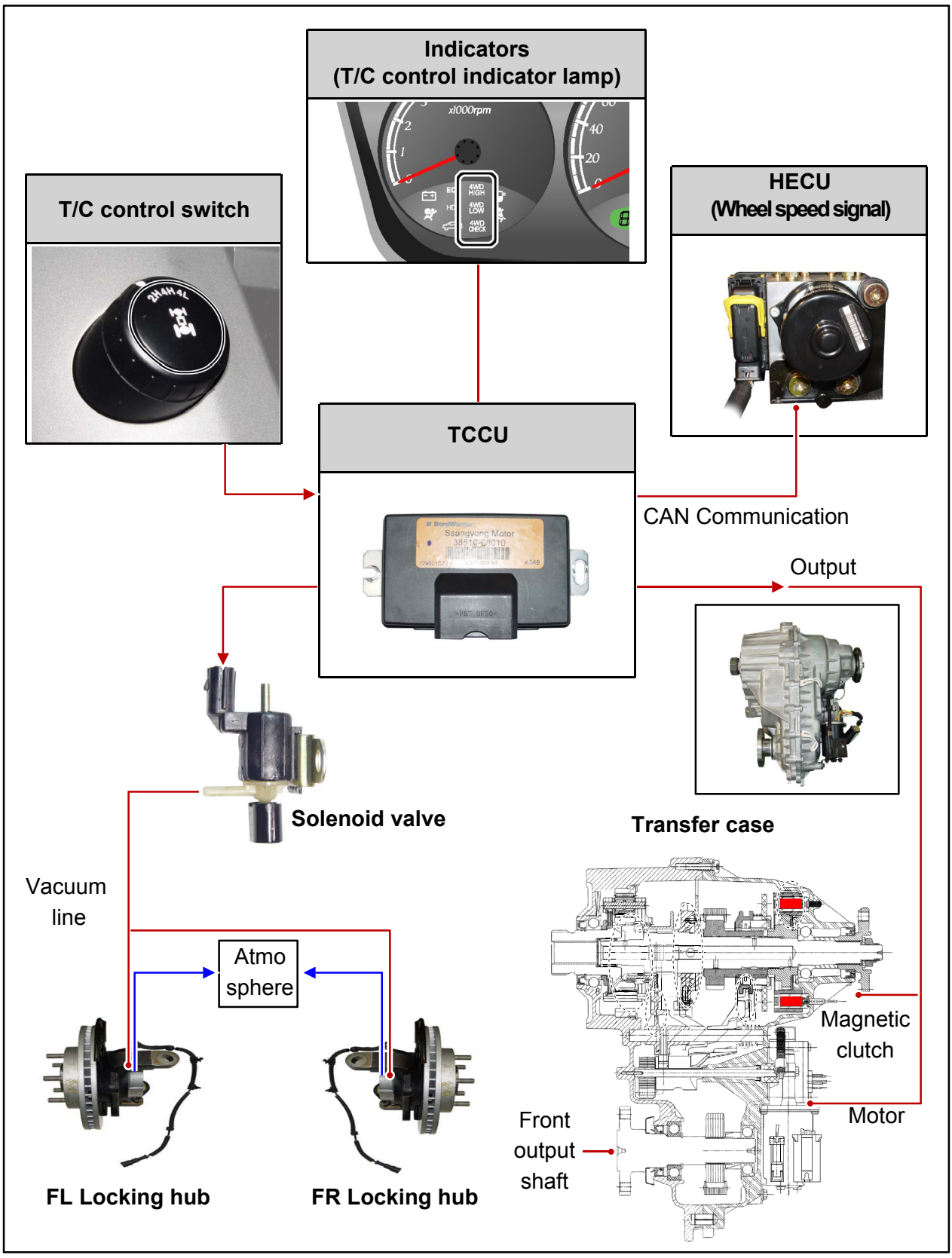
Modification basis	
Application basis	
Affected VIN	

1) Components Location



2. SYSTEM LAYOUT AND FUNCTIONS

1) System Layout



Modification basis	
Application basis	
Affected VIN	

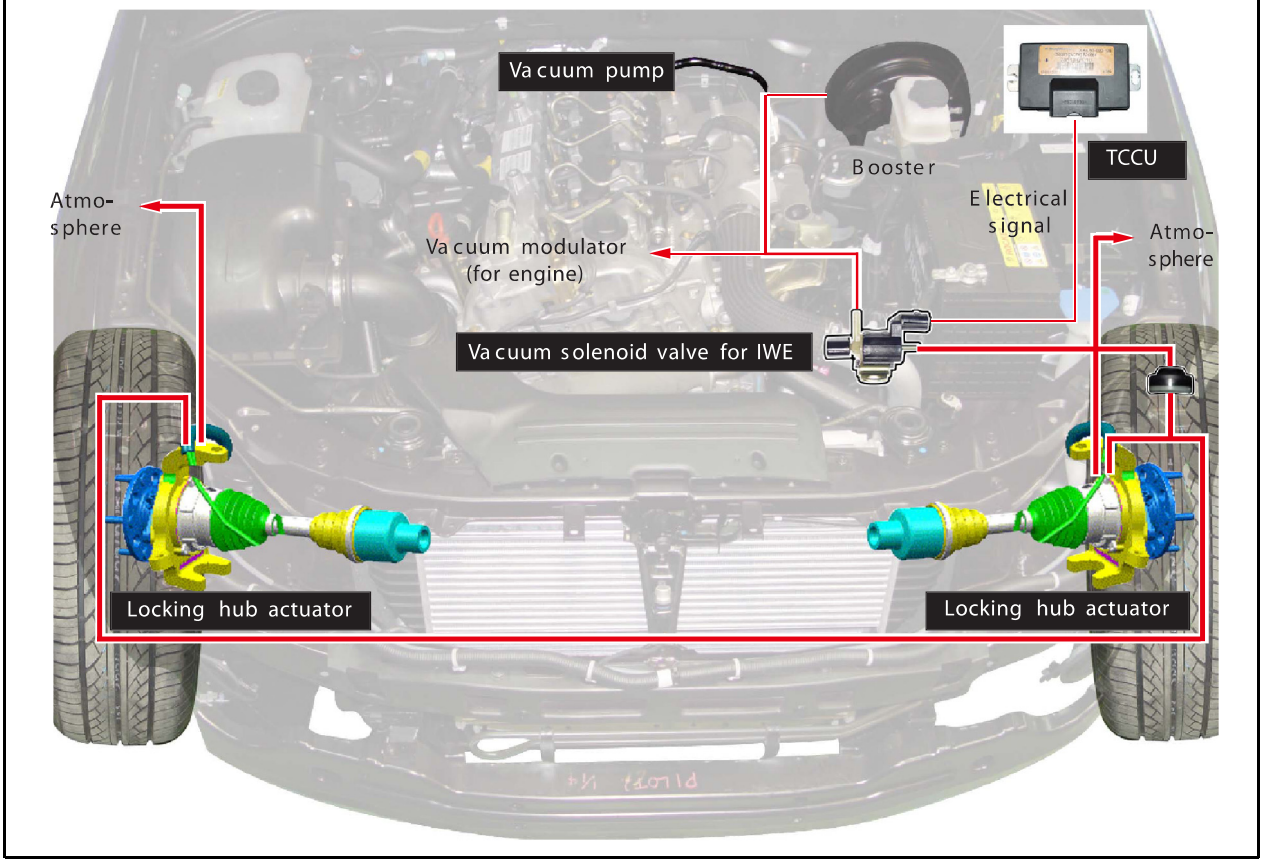
3. LOCKING HUB SYSTEM

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.

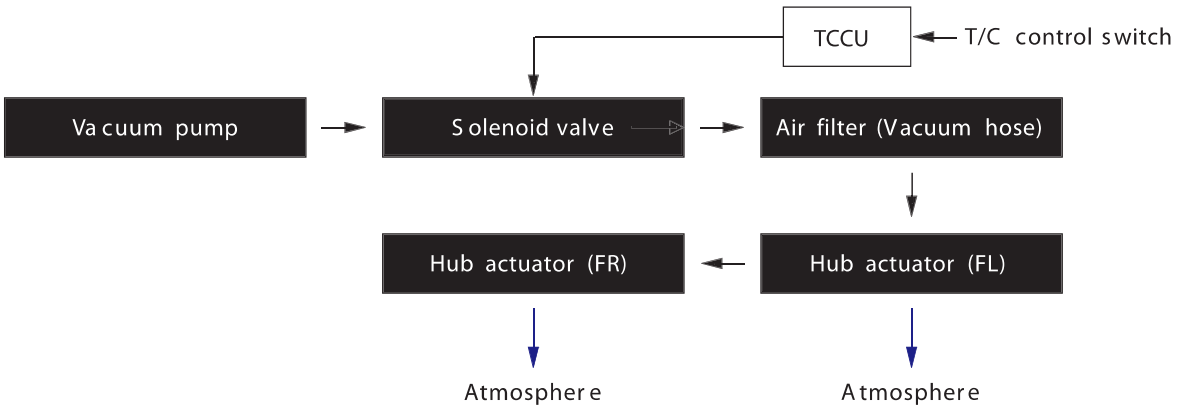
The vacuum locking hub that is applied to Kyron uses the IWE (Integrated Wheel End) system, and in this system, the vacuum is generated only within the hub actuator.

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



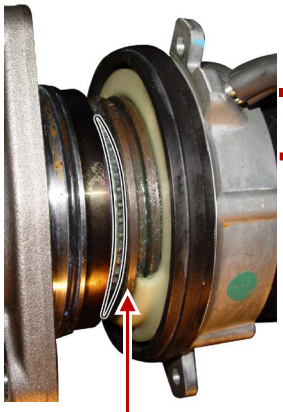
Vacuum operation during 2WD mode

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



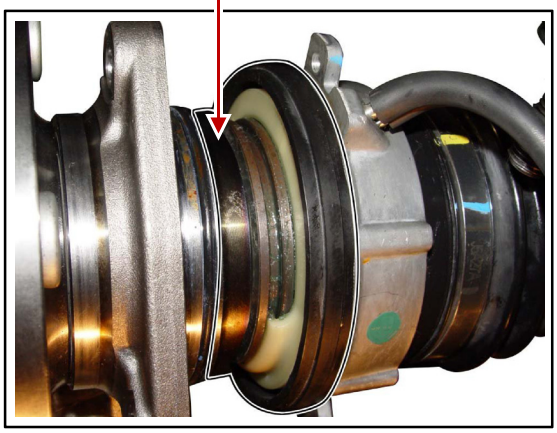
Atmosphere
(in 4WD mode)

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)

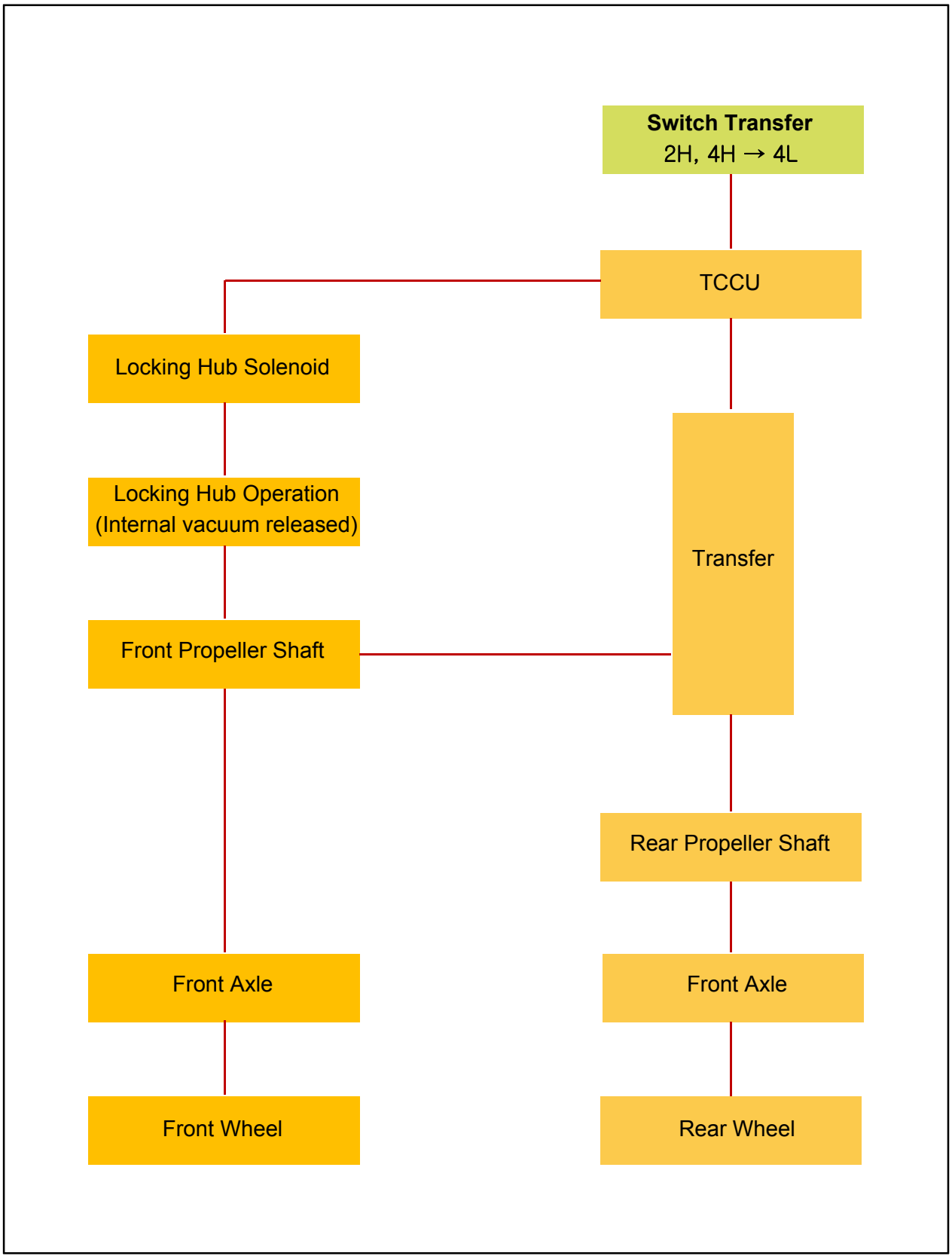
The vacuum pressure is released from the hub actuator. At this time, the front hub end gear is engaged.



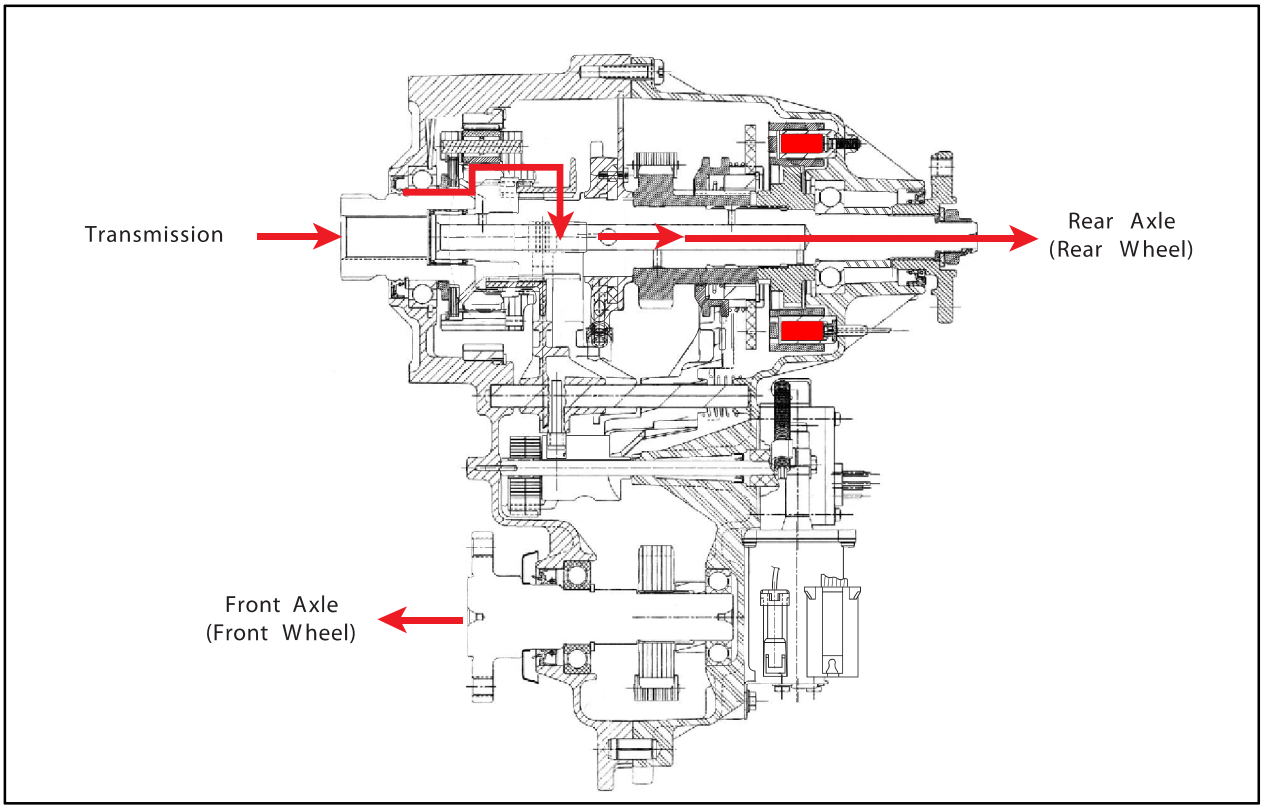
Modification basis	
Application basis	
Affected VIN	

4. POWER FLOW

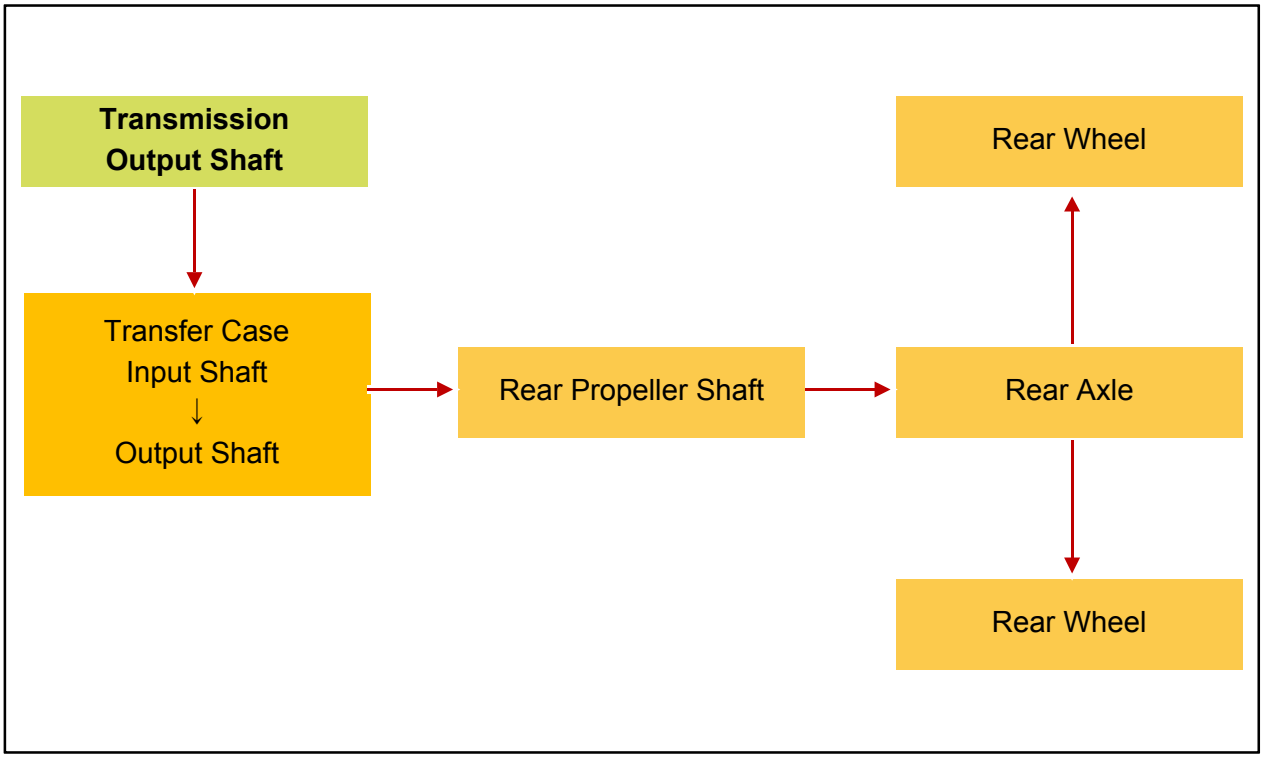
1) POWER FLOW



2) 2H MODE (2WD)

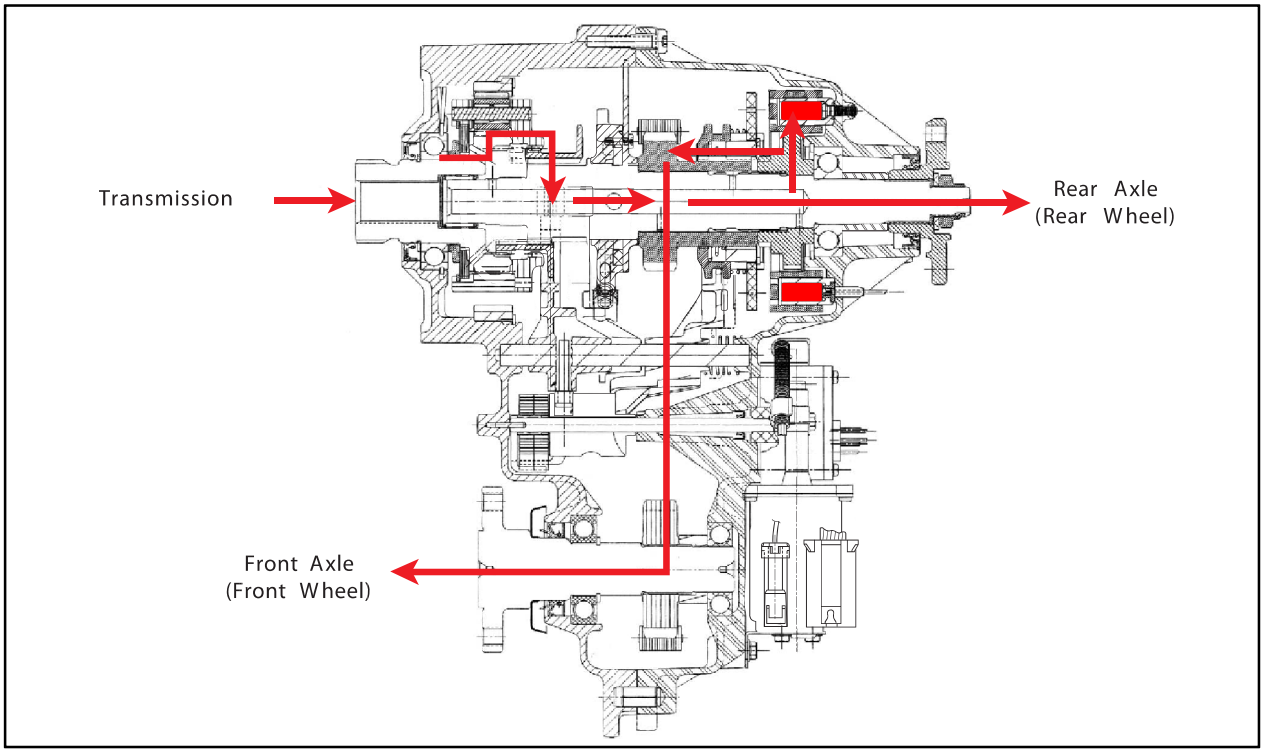


▶ **Power Flow**

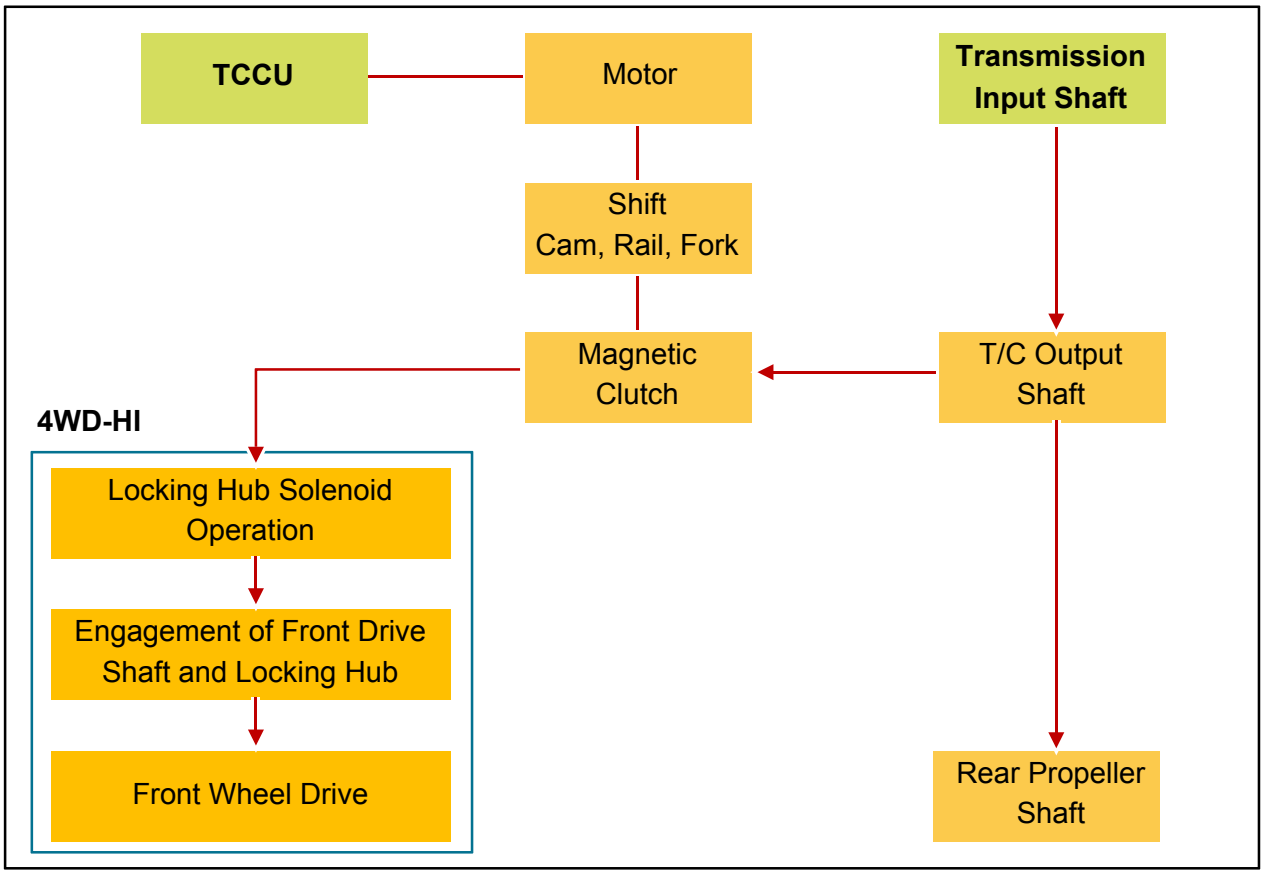


Modification basis	
Application basis	
Affected VIN	

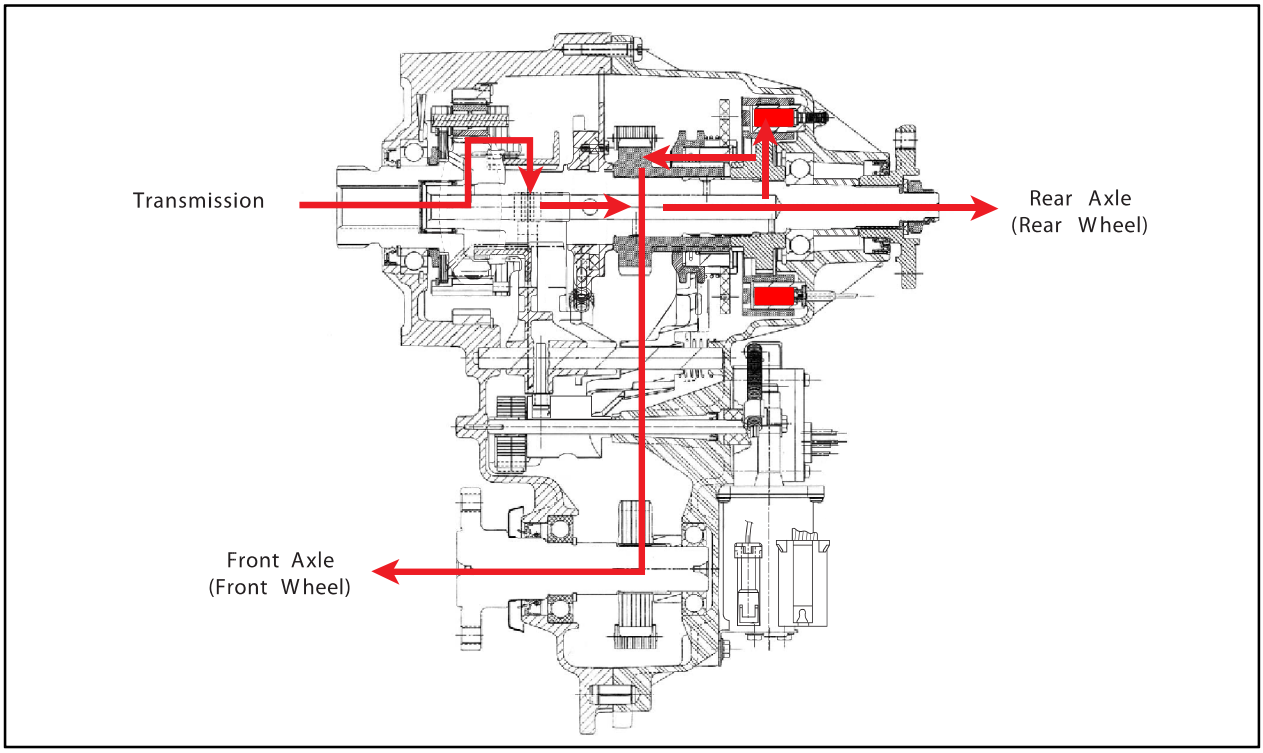
3) 4H MODE (4WD - HIGH SPEED)



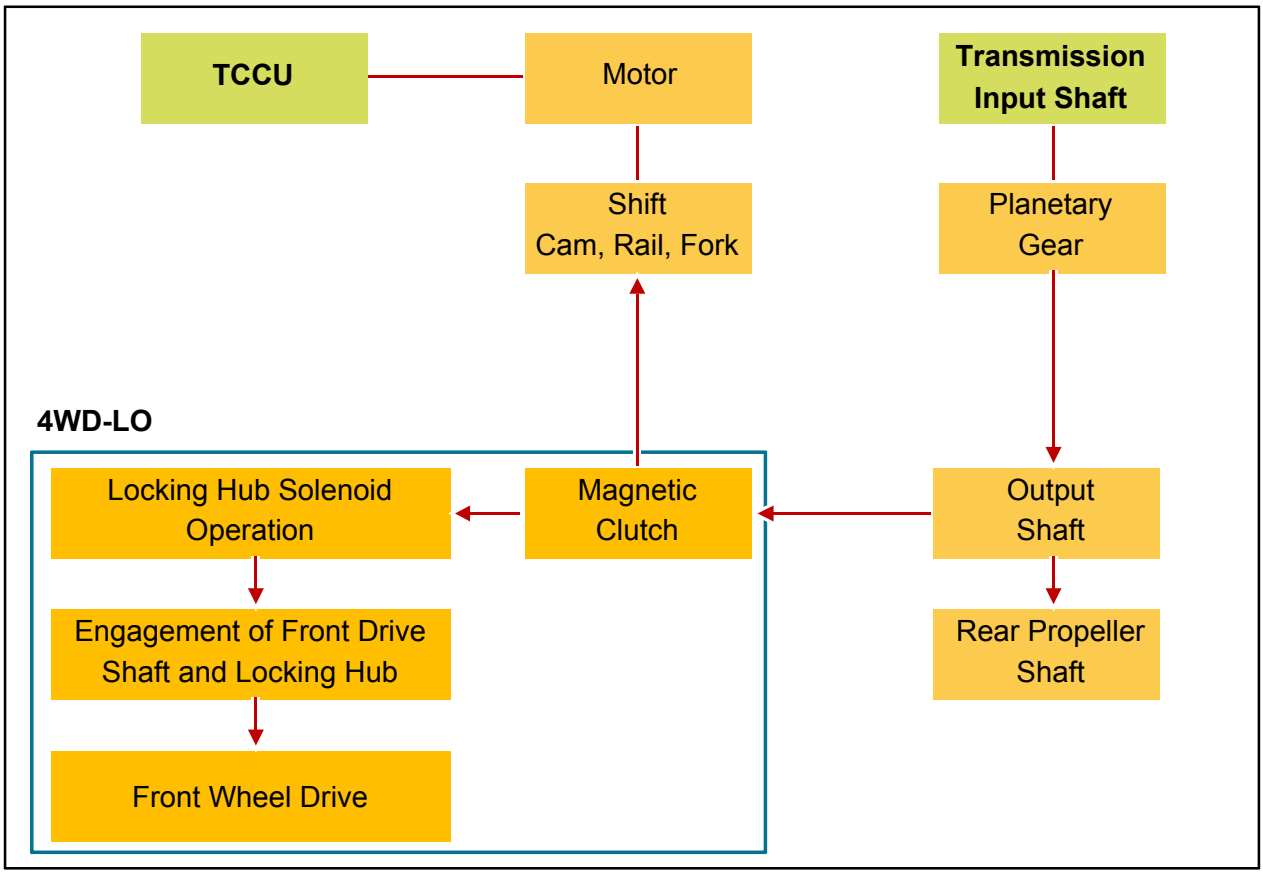
▶ **Power Flow**



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

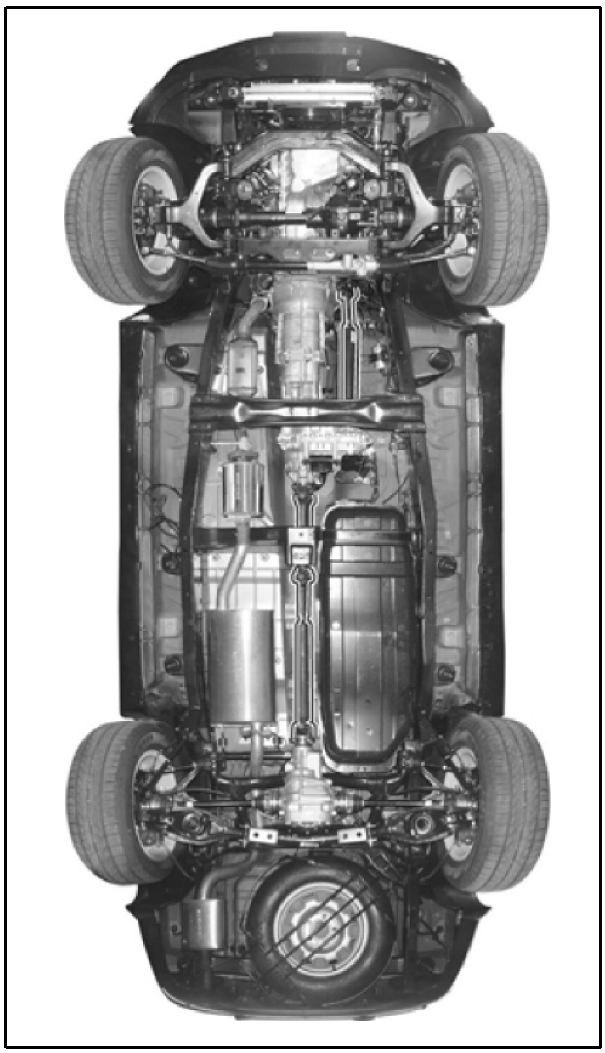
GENERAL

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.

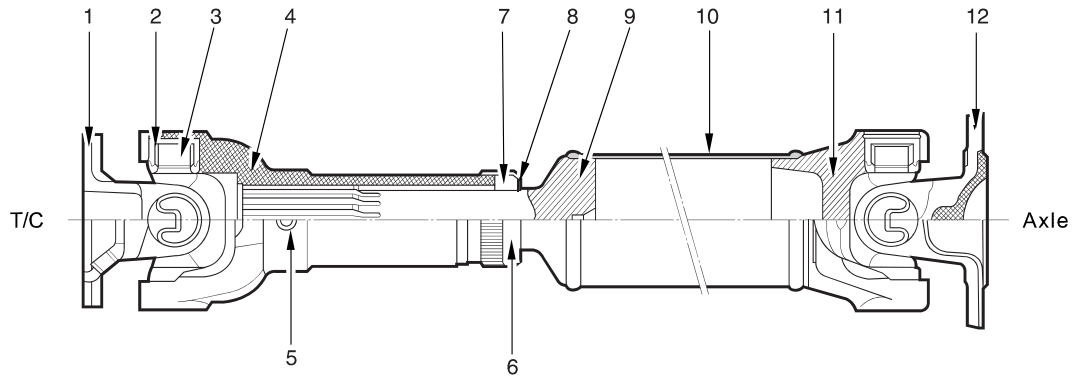
Both ends of propeller shaft are connected to the spider and the center of propeller shaft is connected to the spline to accommodate the changes of the height and length. The rubber bushing that covers the intermediate bearing keeps the balance of rear propeller shaft and absorbs its vibration.

Modification basis	
Application basis	
Affected VIN	

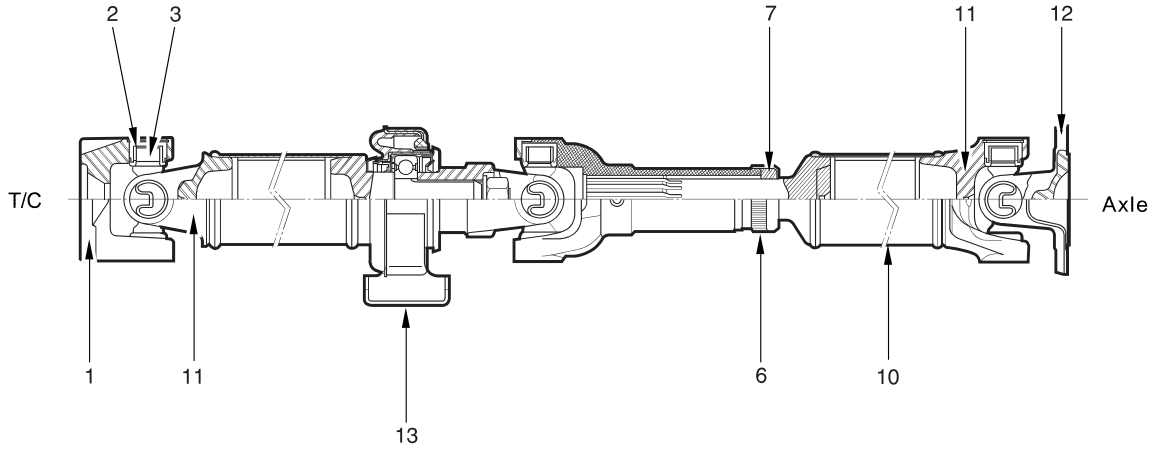
2. COMPONENT LOCATOR

1) Cross Sectional View

Front propeller shaft

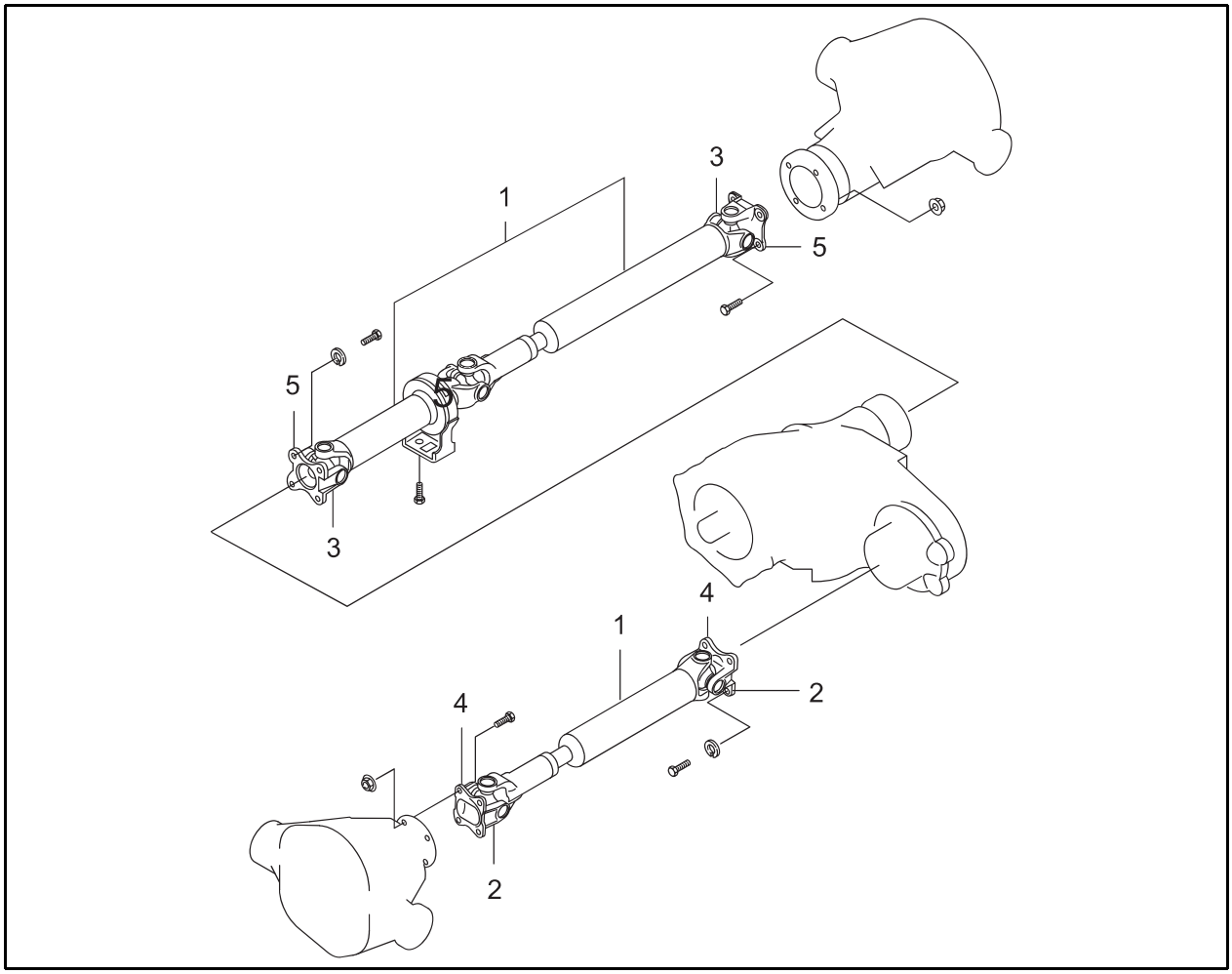


Rear Propeller Shaft



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

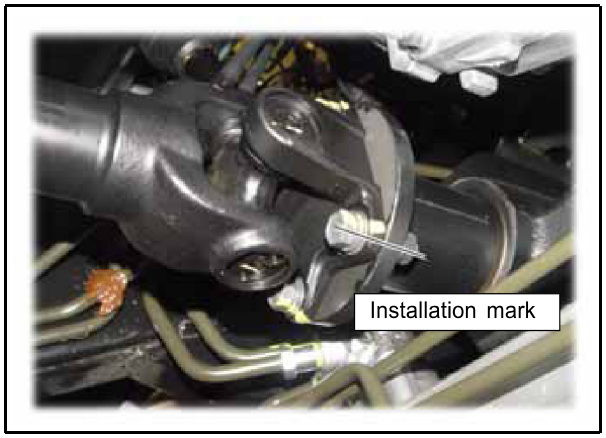
FRONT PROPELLER SHAFT

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.



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.

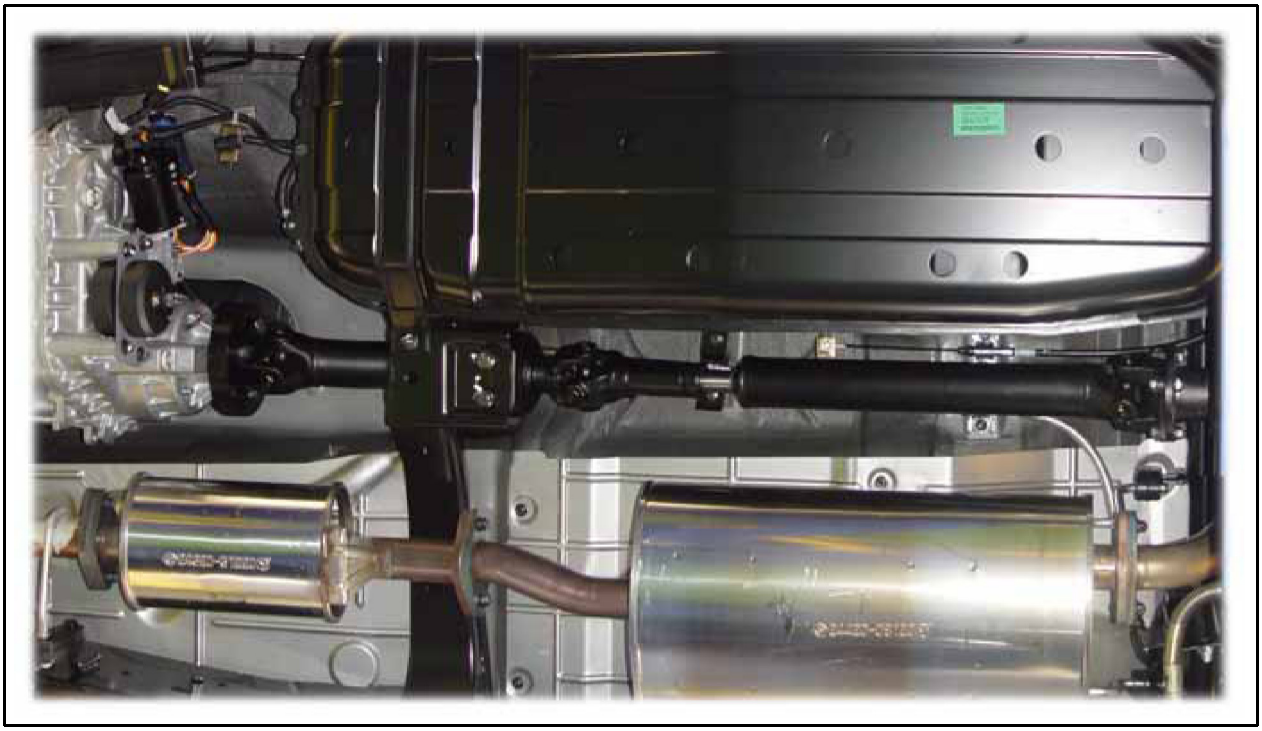


3. Remove the front propeller shaft.

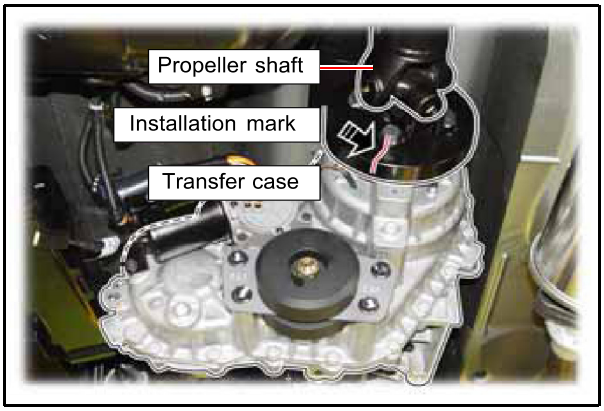
Modification basis	
Application basis	
Affected VIN	

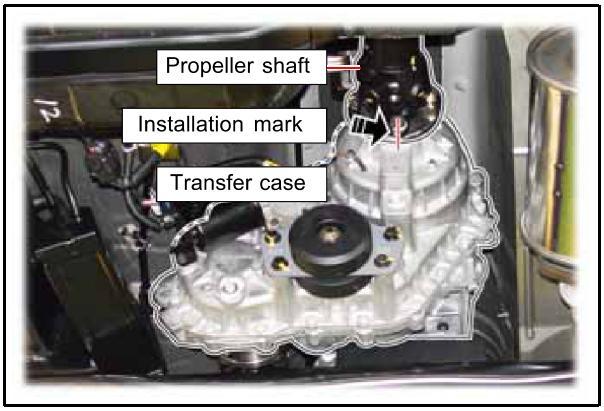
S.G.N. 3310-06

REAR PROPELLER SHAFT



1. Remove the yoke mounting bolt and nut on the transfer case side of the rear propeller shaft.

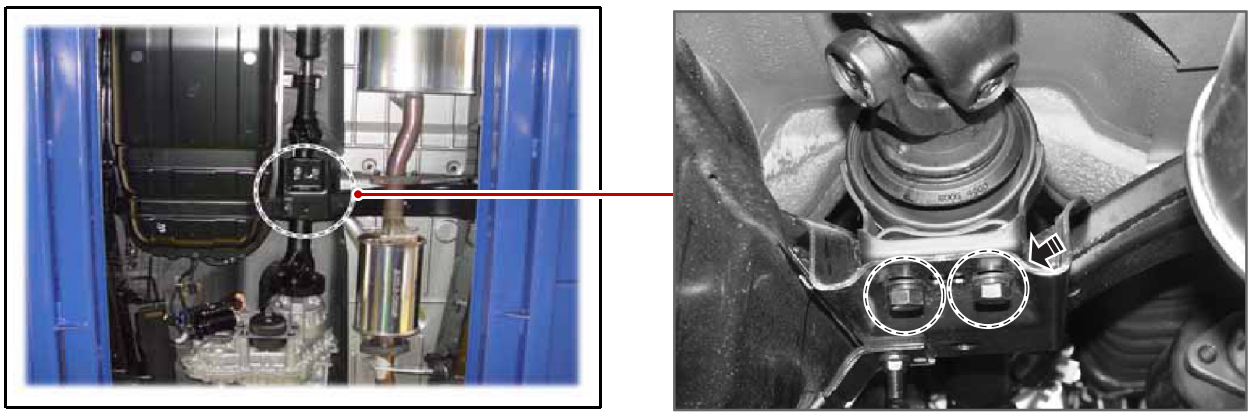




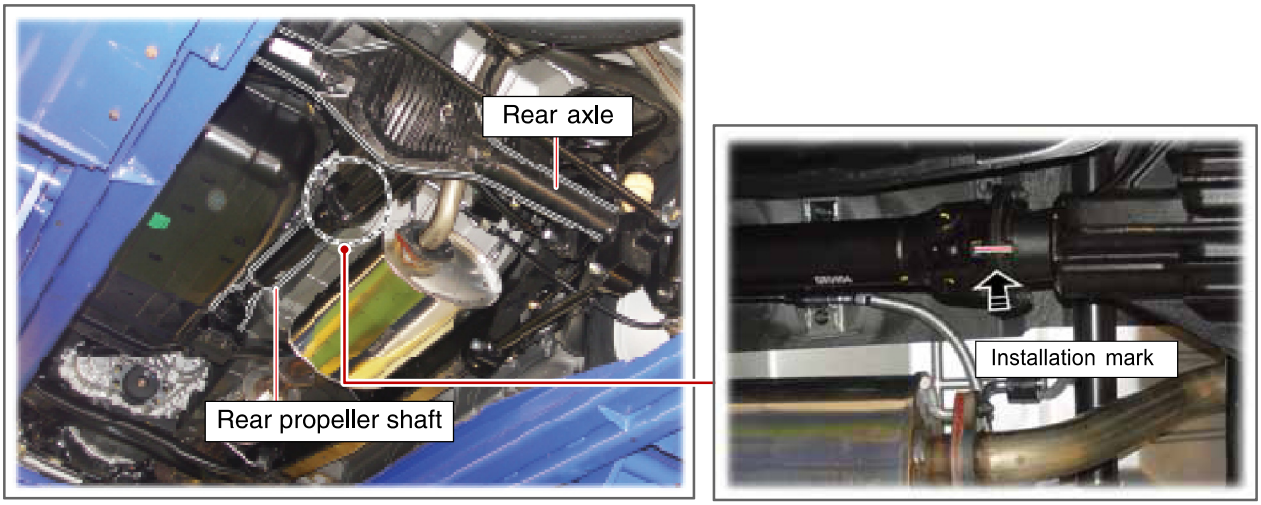
CAUTION

- 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.

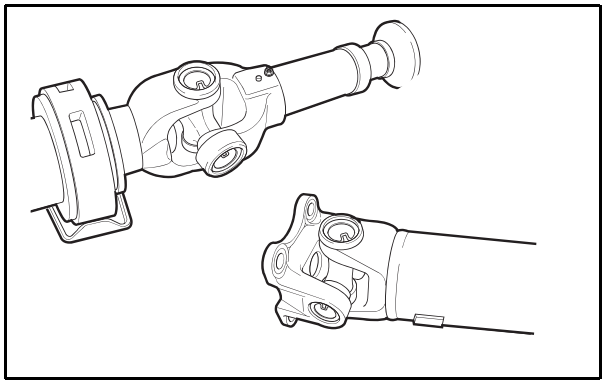


3. Remove the yoke and flage mounting bolts and nuts on the rear axle side of the rear propeller shaft. Then, remove the rear propeller shaft.



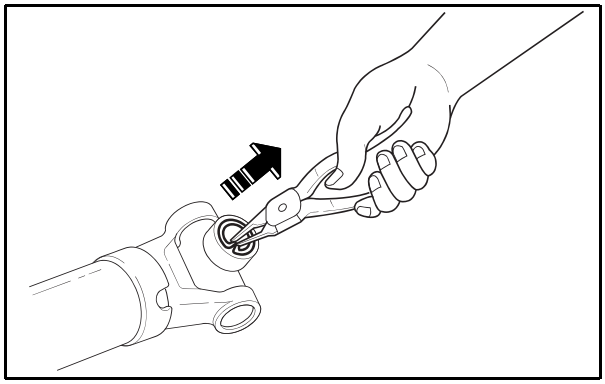
Modification basis	
Application basis	
Affected VIN	

S.G.N.
3310-00 DISASSEMBLY AND REASSEMBLY PROPELLER SHAFT

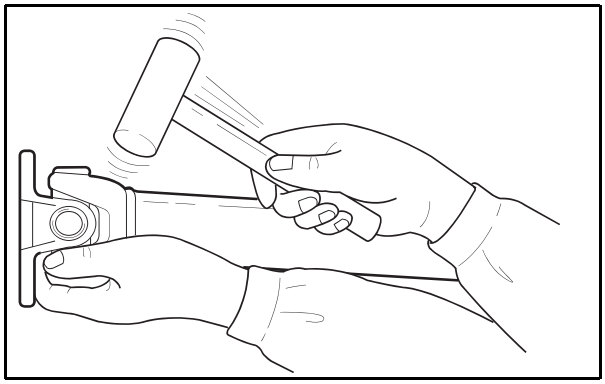


1) Disassembly

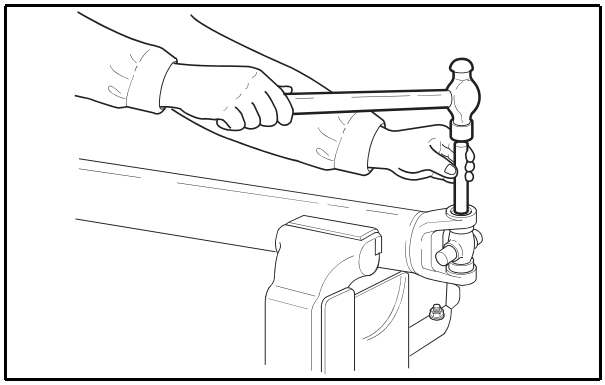
1. Place an alignment mark and remove the propeller shaft.
2. Place an alignment on the spiders before removing.



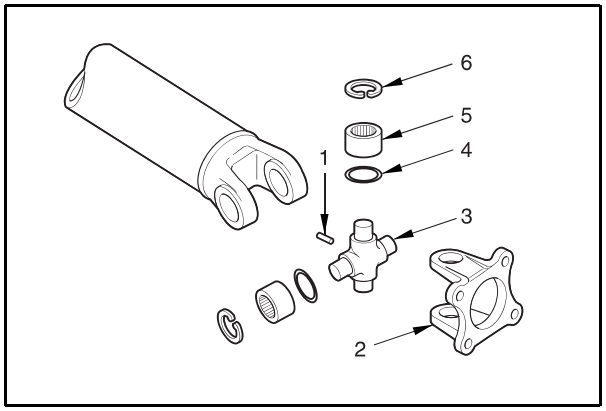
3. Remove the snap ring with snap ring pliers.



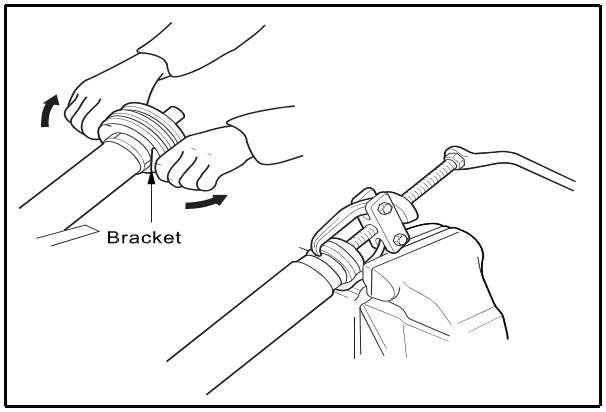
4. Tap the yoke shoulder on shaft with copper hammer to remove the roller bearing. Remove the other bearings with same manner.



5. If it cannot be removed, hold the welding area with vise and remove the needle bearing by using a suitable drift and hammer.

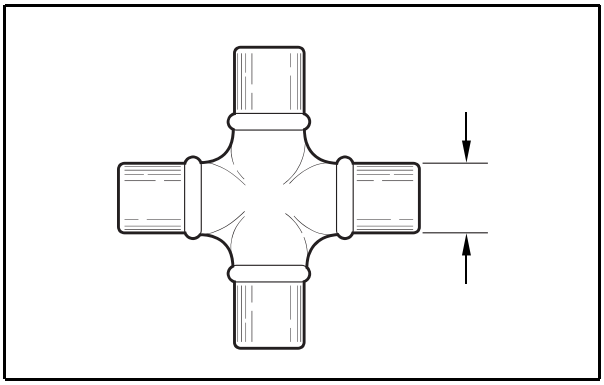


6. Disassemble the universal joint.
   The universal joint compensates the angle changes due to vertical movement of the axle shaft.



7. Remove the intermediate bearing bracket and remove the bearing with special tool.

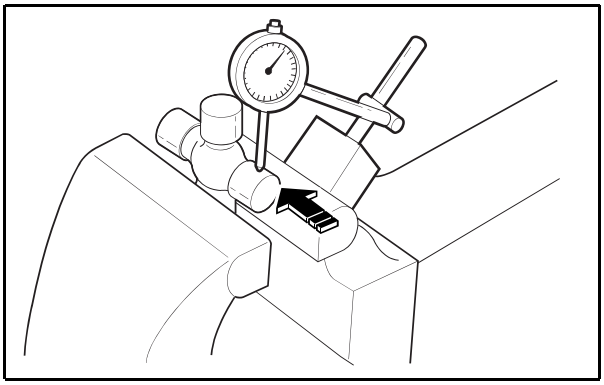
Modification basis	
Application basis	
Affected VIN	



2) Check

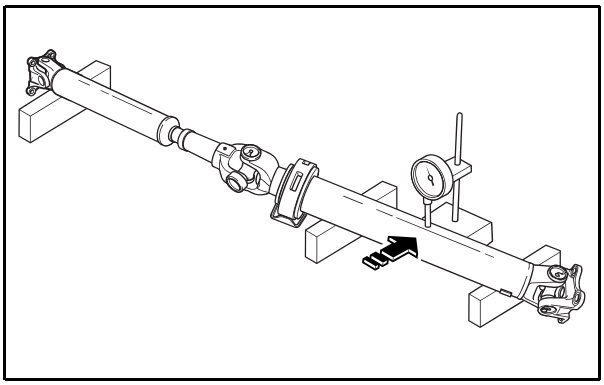
1. Visual Check Check the components for wear and crack and replace if needed.
2. Outer diameter of spider journal.

Specified value	17.893 mm
Limit	17.910 mm



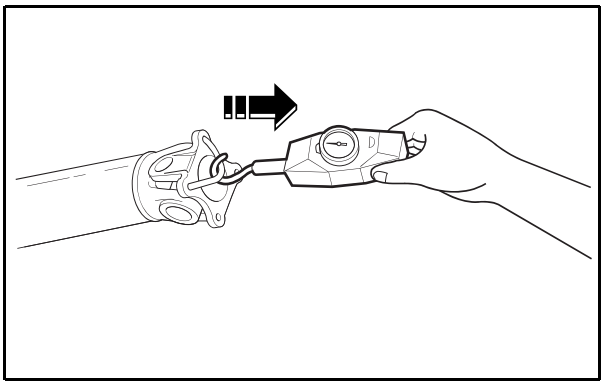
3. Clearance between spider journal and bearing.

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.

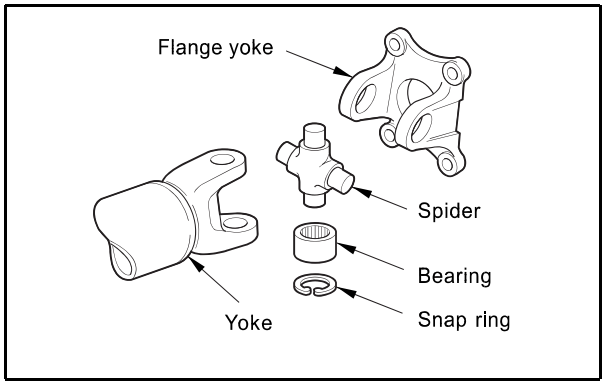
Limit	0.4 mm



5. Starting torque of universal joint.

Specified value	3 ~ 8 kg.cm

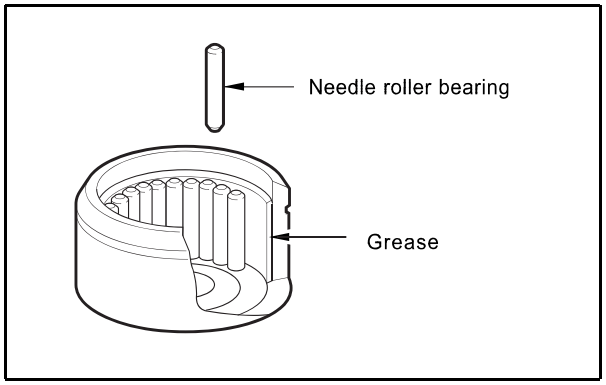
6. Major causes of vibration
   - Balance weights missing
   - Excessive run-out of propeller shaf
   - When using the general bolts
   - Excessive wear of universal joint
   - Stuck in sleeve joint
   - Vibration is mainly caused by the angle changes in front and rear universal joint. It normally occurs when the vehicle speed is 60 ~ 100 km/h.



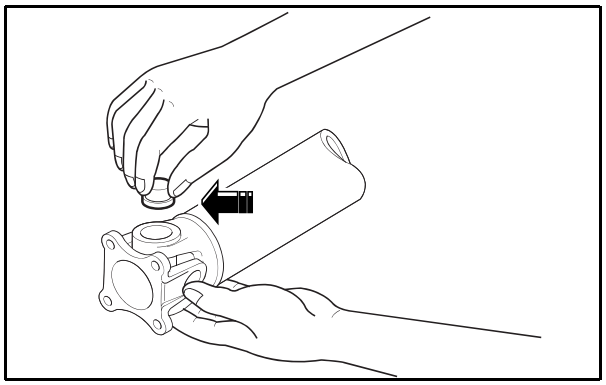
3) Assembly

Clean the components and replace if damaged.

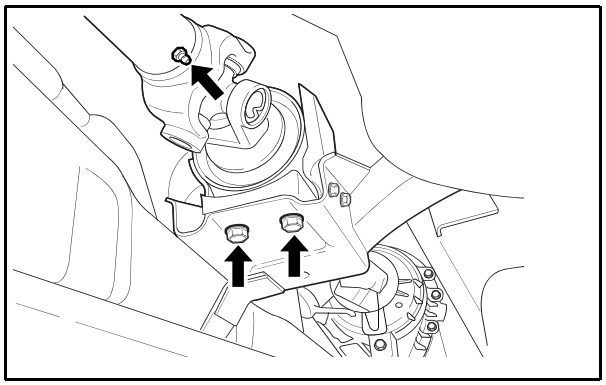
1. Align the alignment marks on the yoke and assemble the spider, bearing and snap ring.



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	

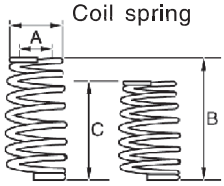
SUSPENSION 4411-01

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.

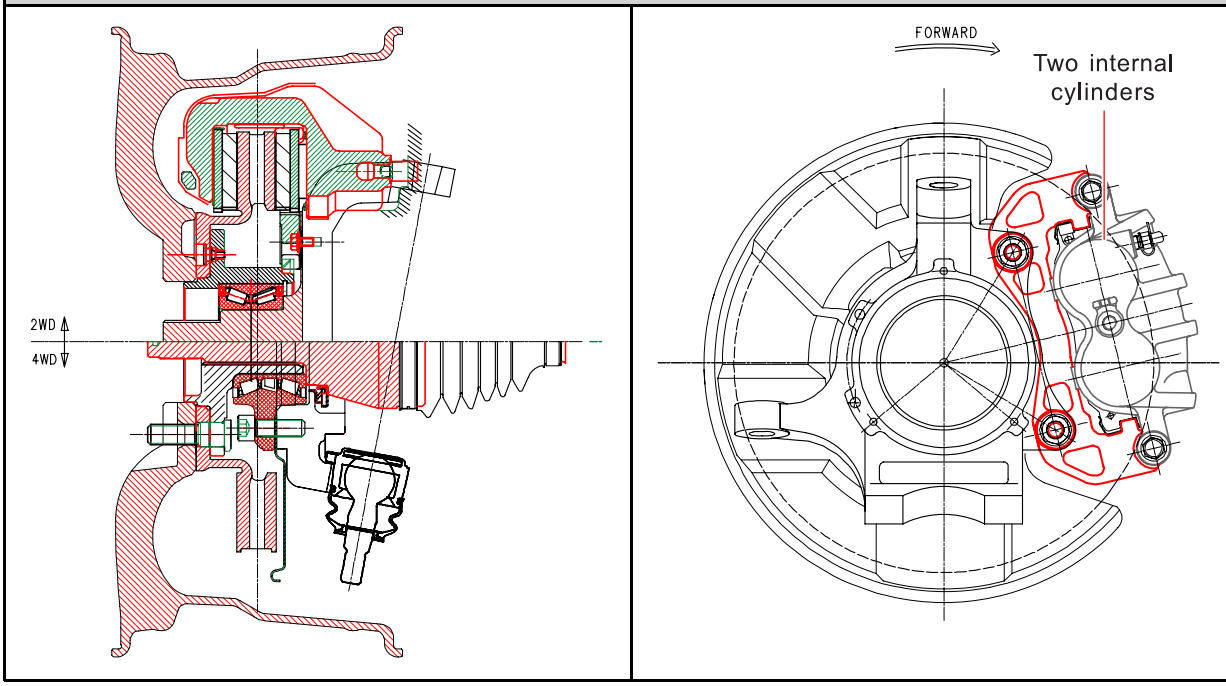
Parking brake system: The hand operated type parking brake is installed on vehicles with the manual transmission and the foot operated type parking brake is installed on vehicles with the automatic transmission.

	
Hand Operated Type (Vehicle with Manual Transmission)	Foot Operated Type (Vehicle with Automatic Transmission)

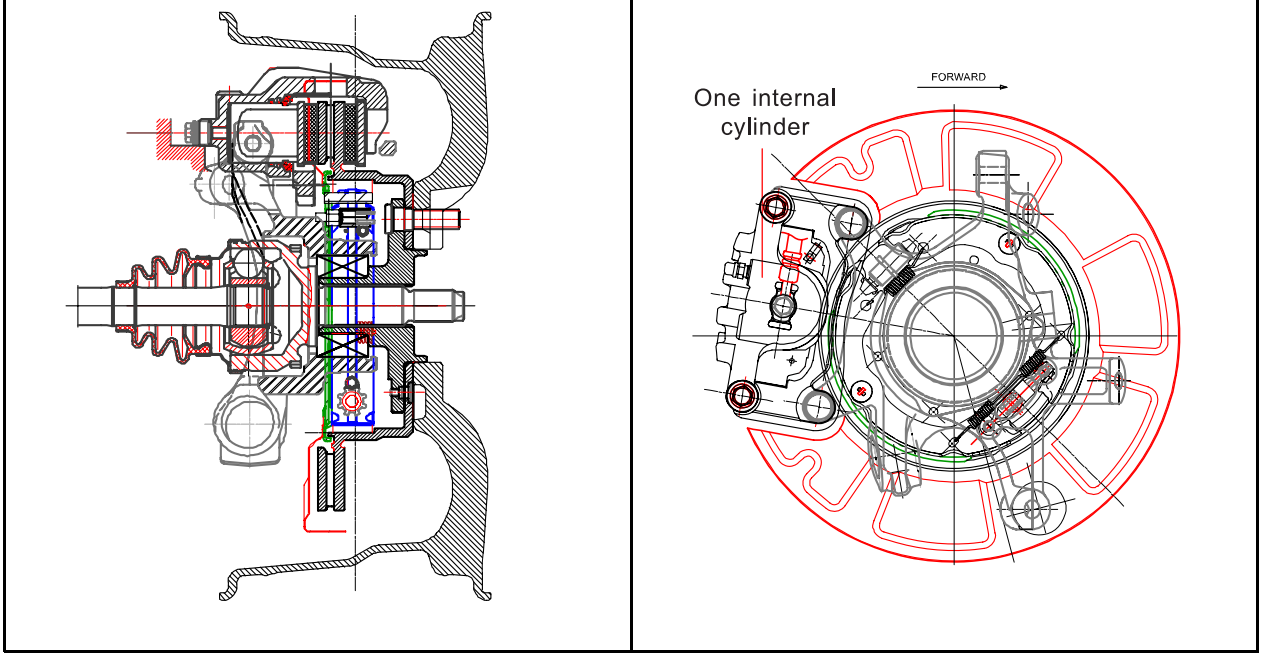
Modification basis	
Application basis	
Affected VIN	

3) SECTIONAL DRAWING

Front Disc Brake

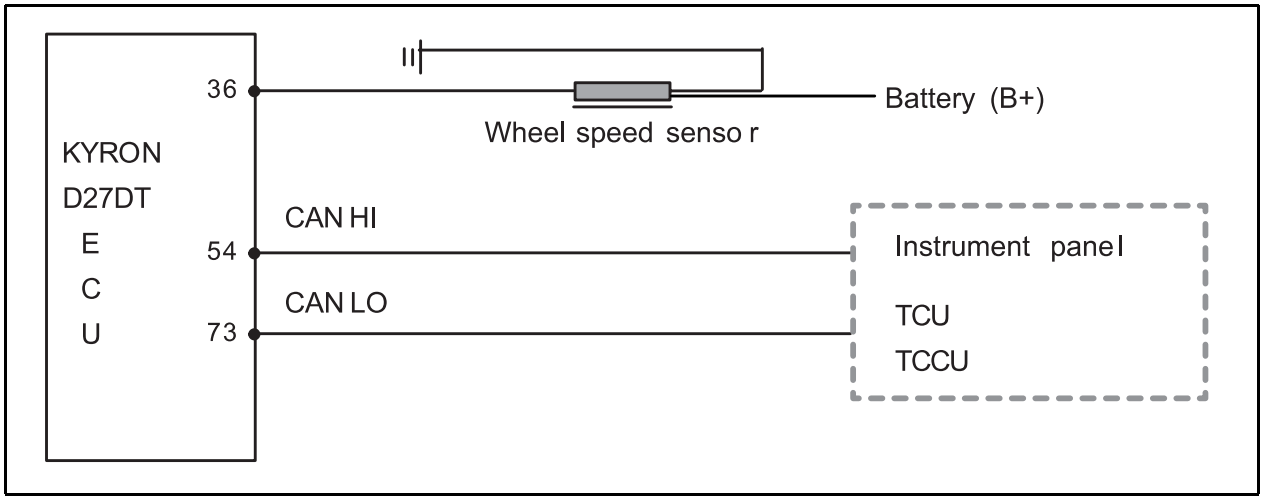


Rear Disc Brake



4) NON-ABS EQUIPPED VEHICLE ? WITH ONE WHEEL SPEED SENSOR

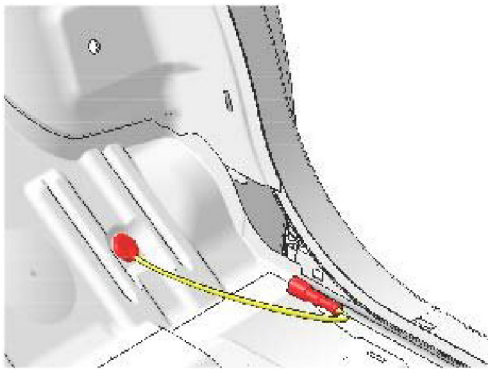
The wheel speed sensor is installed on the rear right wheel regardless of the ABS/ESP installation.
This sensor is to signal the vehicle speed to the engine ECU, TCCU, transmission, and instrument panel.
There is no separate unit to process the wheel speed sensor signal.
The wheel speed sensor is connected to the engine ECU (terminal 36), where its signal is processed, and is connected to other related systems through CAN communication.



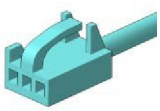
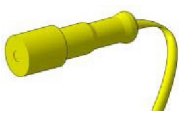
Location of the wheel speed sensor (rear right wheel)



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)

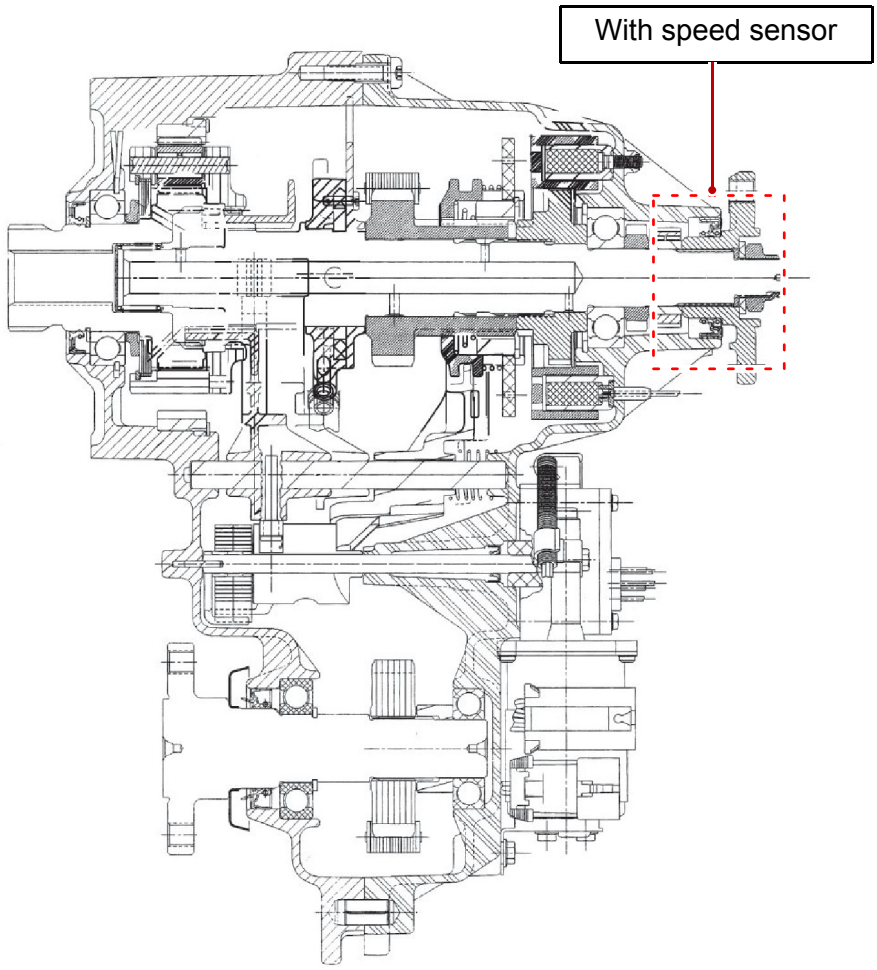
1) GENERAL INFORMATION OF ESP SYSTEM

Differences compared to other models: Appearance of wheel speed sensor, Location, Layout of relevant components

ESP HECU	Active Wheel Speed Sensor	HDC Switch
		

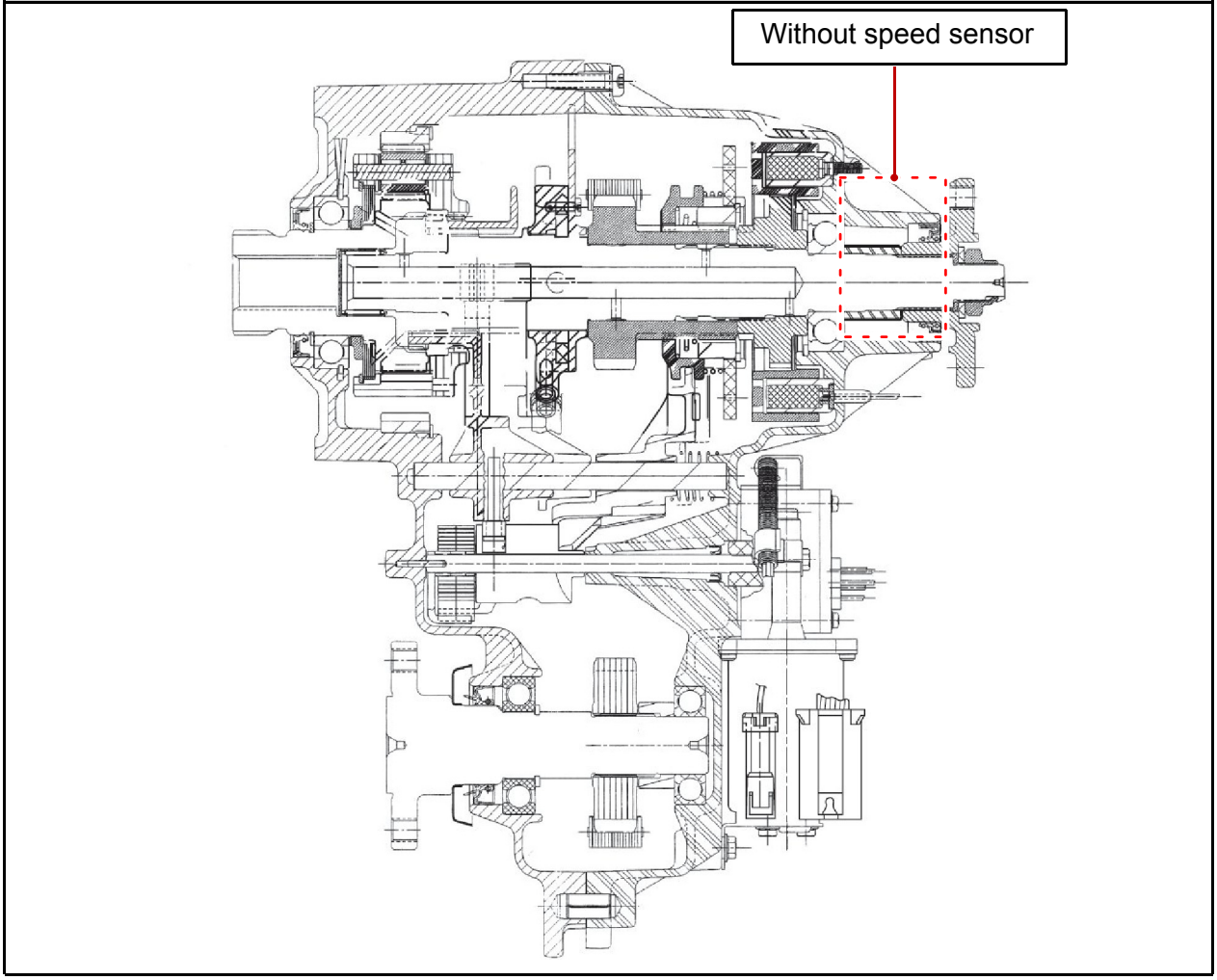
The transfer case (T/C) installed on this vehicle doesn't have the internal speed sensing device and receives the speed signal for T/C control from ESP HECU via CAN bus.

[Conventional T/C]



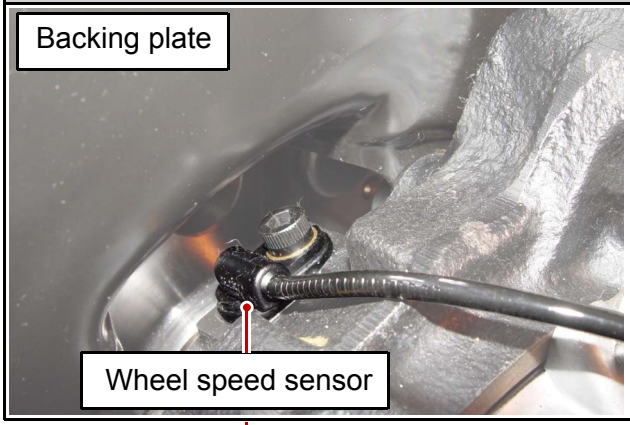
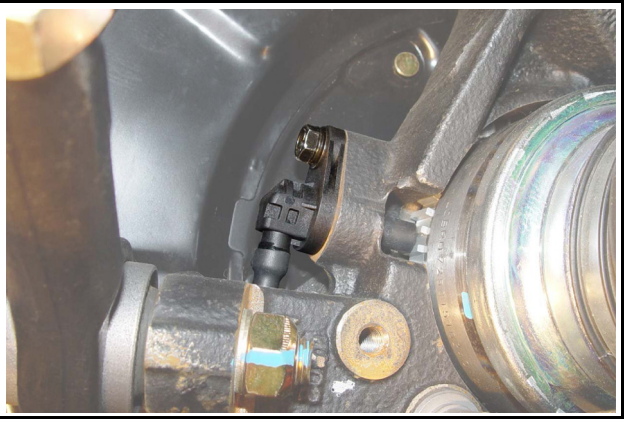
Modification basis	
Application basis	
Affected VIN	

[New T/C]

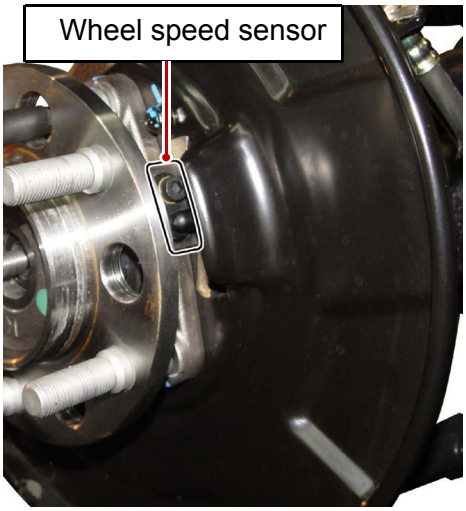


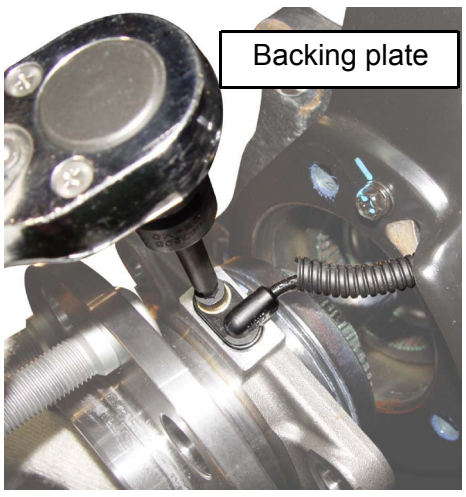
Modification basis	
Application basis	
Affected VIN	

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

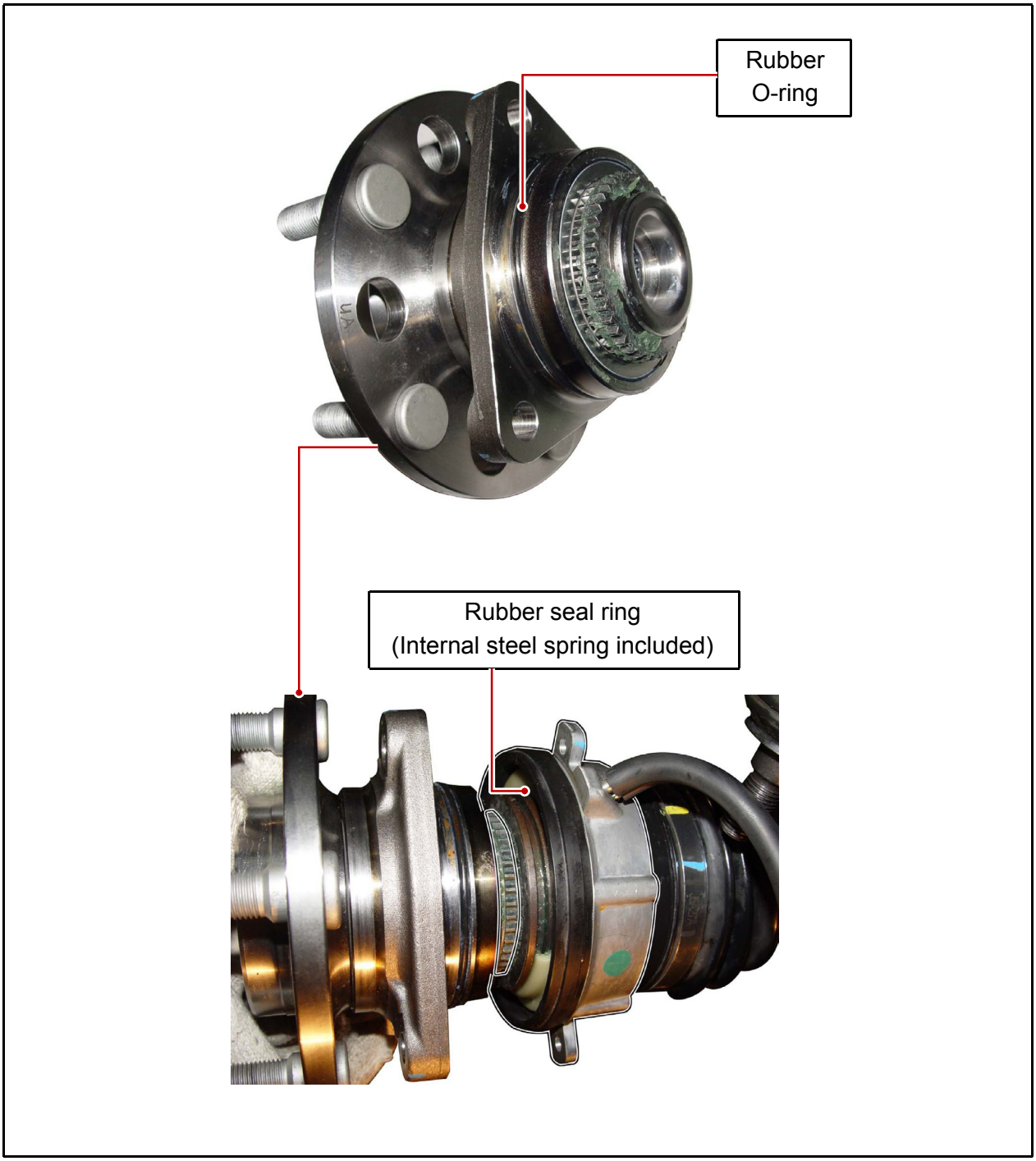




Modification basis	
Application basis	
Affected VIN	

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.

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

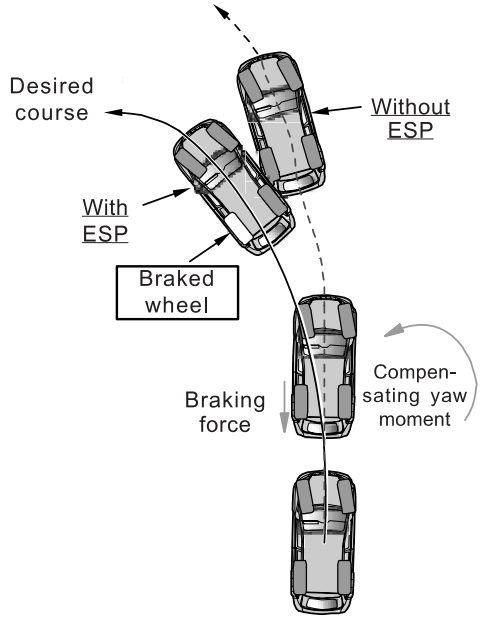
1) Understeer & Oversteer Control

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.

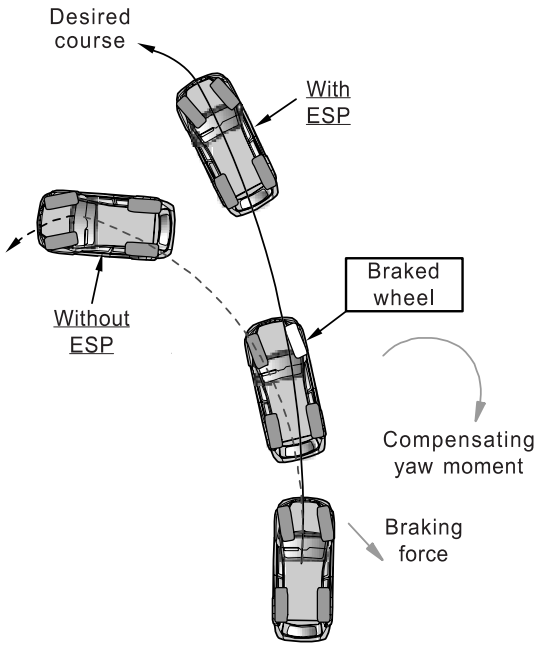
The yaw rate sensor, lateral sensor and longitudinal sensor in the sensor cluster and the steering wheel angle sensor under the steering column detect the spin present at any wheels during over-steering, under-steering or cornering. The ESP ECU controls against over-steering or under-steering during 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

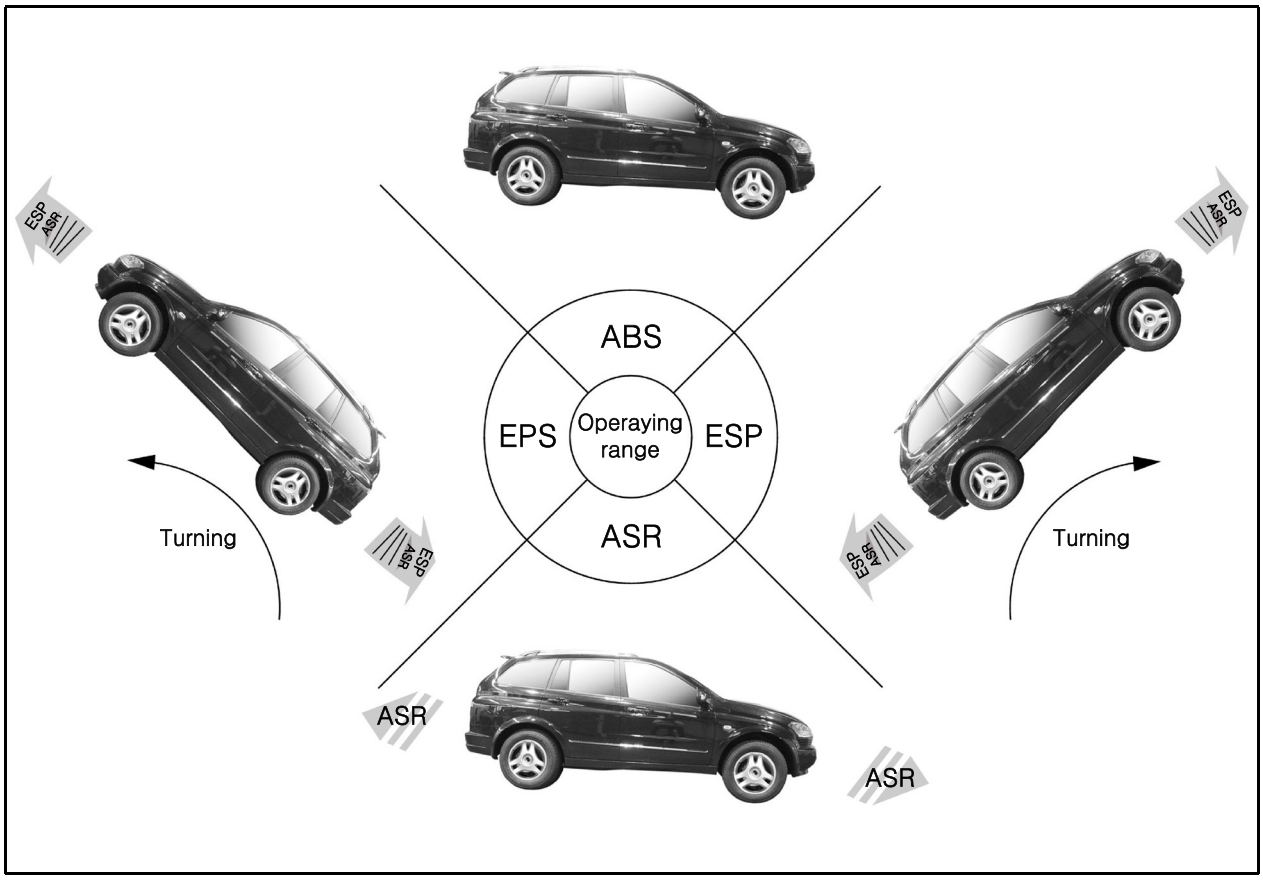
The ESP system recognizes the directional angle with the steering wheel angle sensor and senses the slipping route that occurs towards the vehicle cornering direction during oversteering with the yaw rate sensor and the lateral sensor.
Then the ESP system **applies the brake at the front outer wheel** 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.

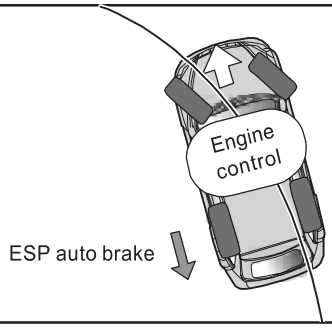
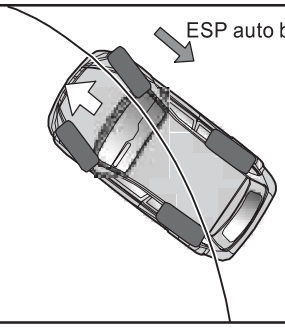
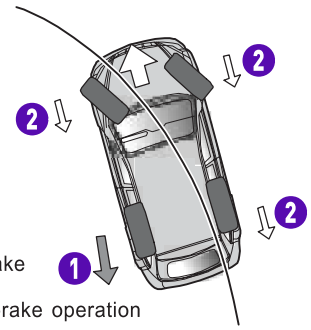
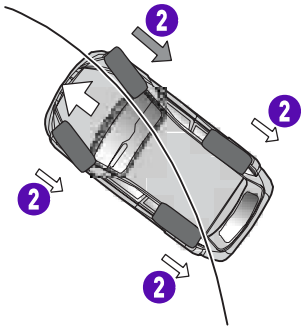
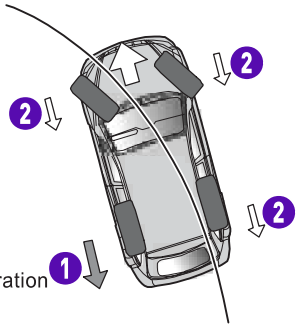
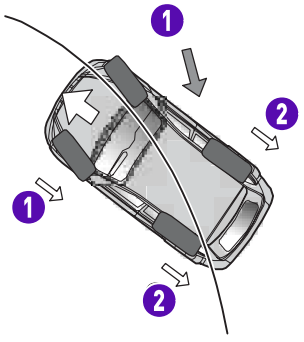
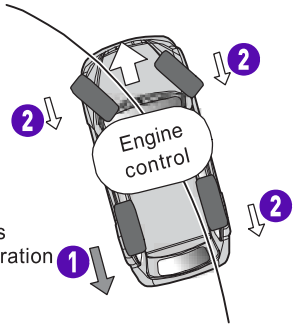
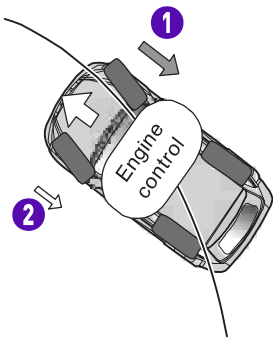
When various systems operate simultaneously under a certain situation, there may be vehicle control problems due to internal malfunction of a system or simultaneous operations. In order to compensate to this problem, the ESP system sets the priority among systems.
The system operates in the order of 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	

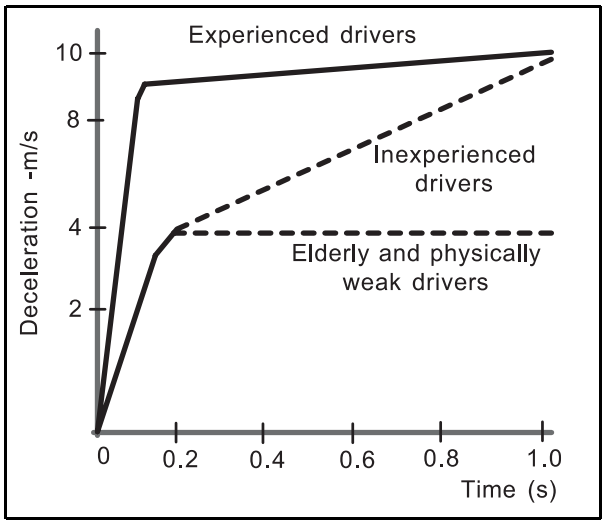
3) Vehicle Control During Cornering

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.



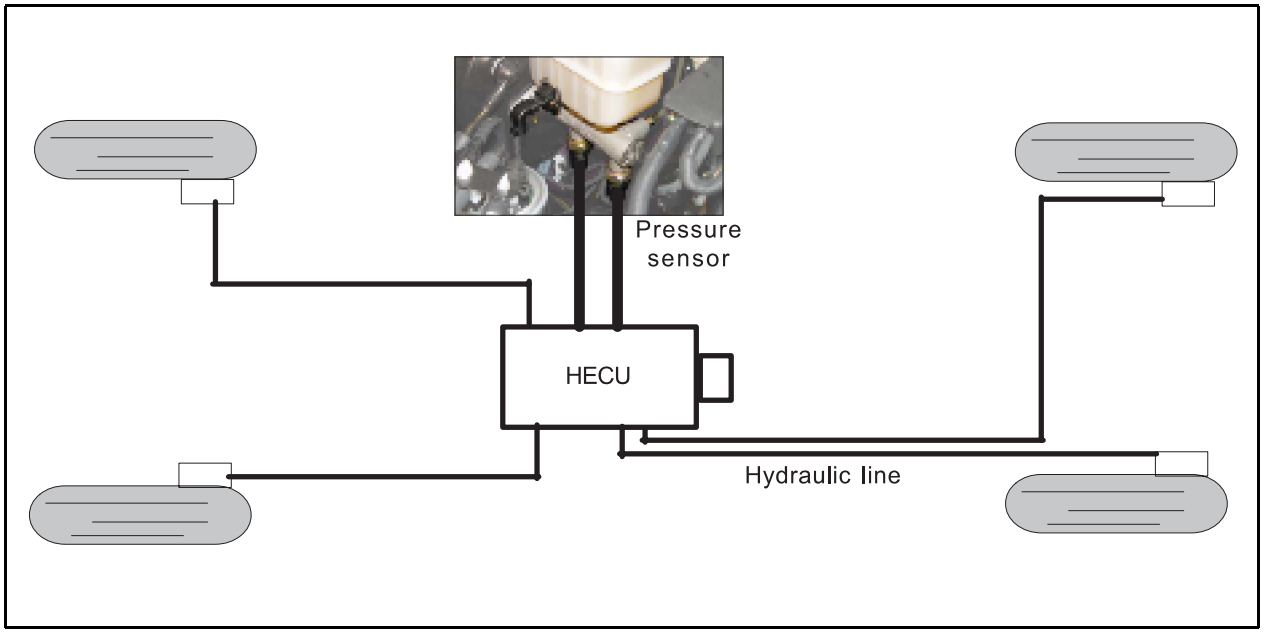
An inexperienced, elderly or physically weak driver may suffer from the accident by not fully pressing the brake pedal when hard braking is required under emergency. The HBA System increases the braking force under urgent situations to enhance the inputted braking force from the driver.

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.



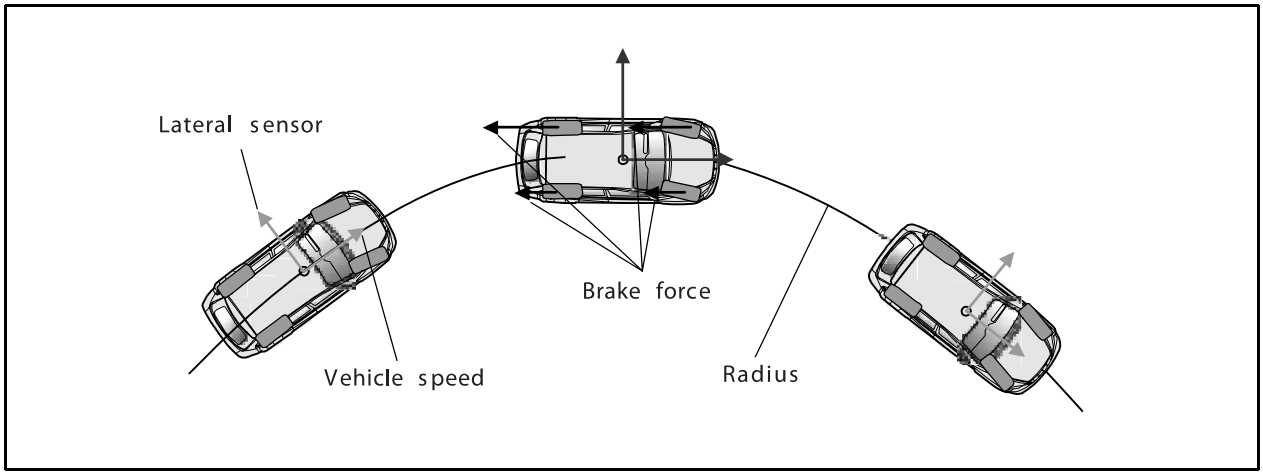
Operating conditions:
1. Pressure: over 20 bar
2. Pressure changes: over 1500 bar/sec
3. Vehicle speed: over 7 Km/h

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.

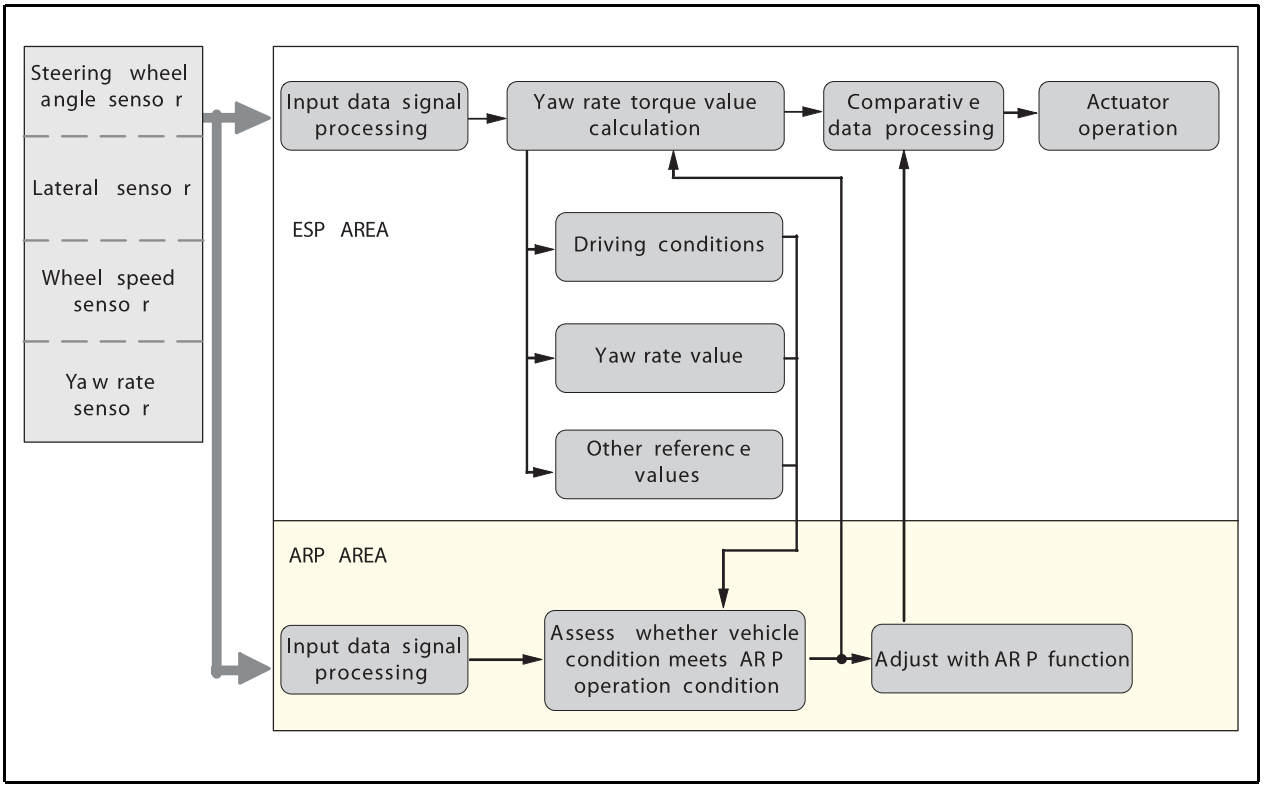
One must note that the ARP system, just as general assistant devices including the ABS, is only a safety assistant device using the ESP system and its function is useless when the situation overcomes the physical power.

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)

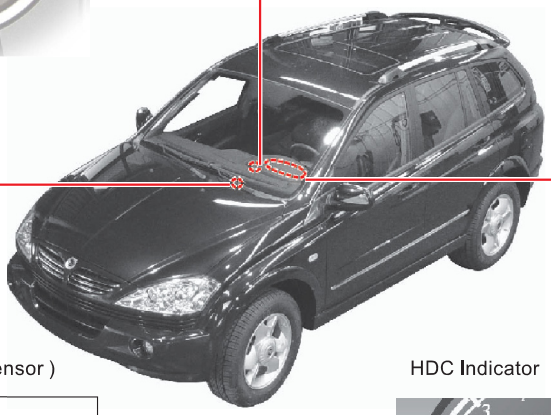
1) System Overview

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.

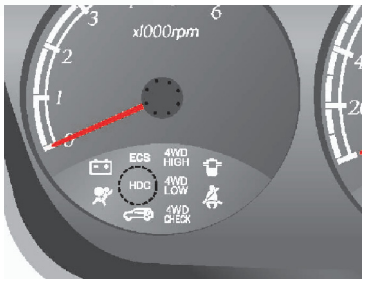


Sensor Cluster (G Sensor)



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

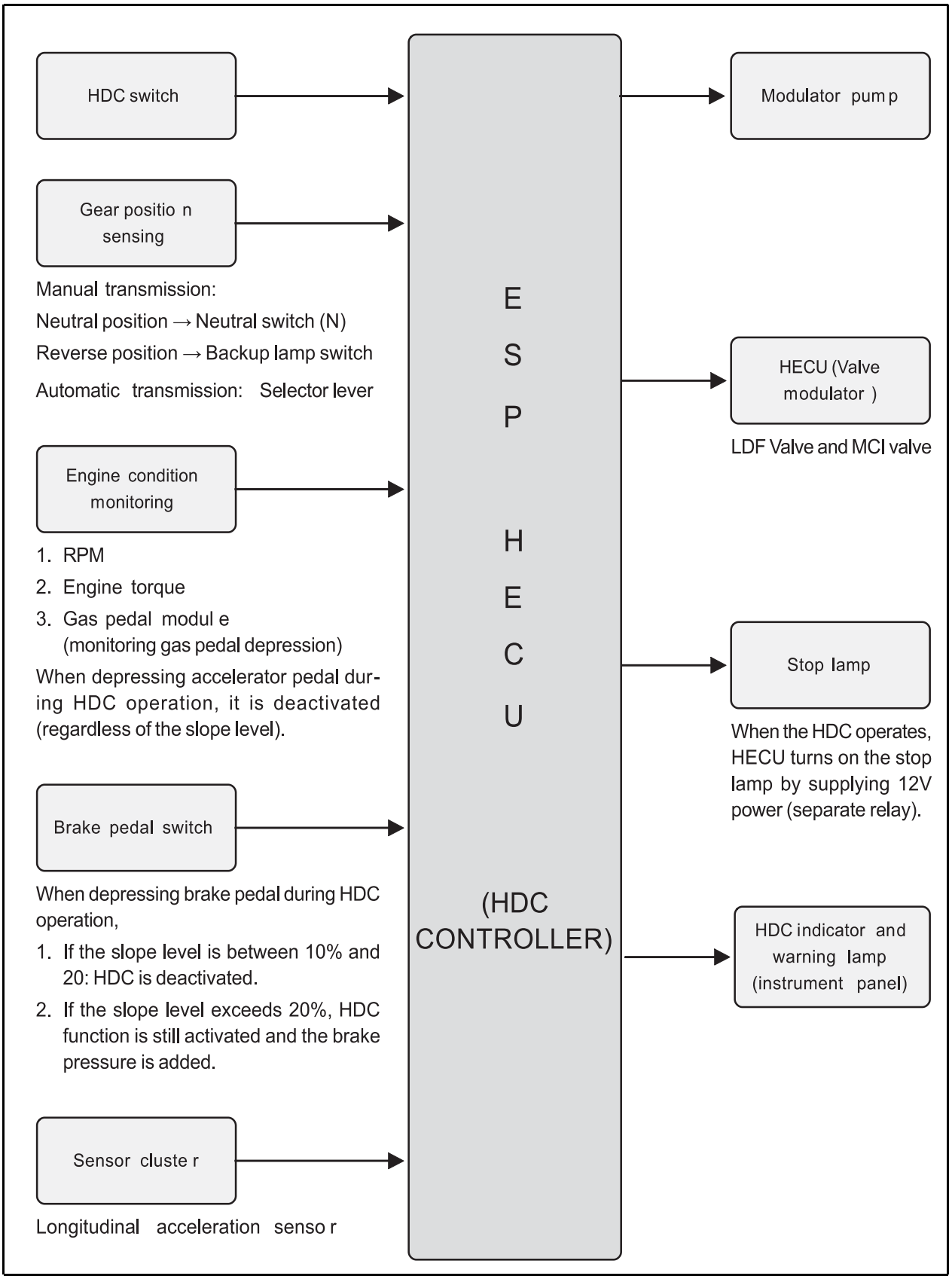
When depressing the accelerator pedal or brake pedal, HDC system is changed to stand-by mode. When depressing the accelerator pedal again, HDC starts its operation again. Therefore, drivers can control the vehicle speed to a desired level by operating the accelerator pedal.

▶ 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="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></td><td></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
(goes off after 1.8 seconds)</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="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="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:

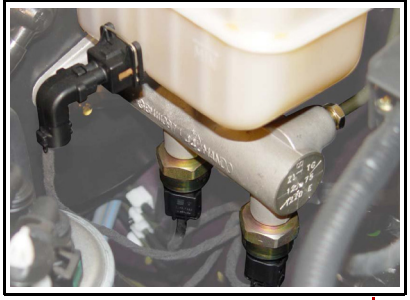
- Initial ignition ON
- HDC system error occurs
- Brake system overheat

Modification basis	
Application basis	
Affected VIN	

Memo

6. ESP COMPONENTS AND LOCATIONS

Master cylinder pressure sensor



Sensor cluster: (Yaw rate + lateral sensor +longitudinal sensor)



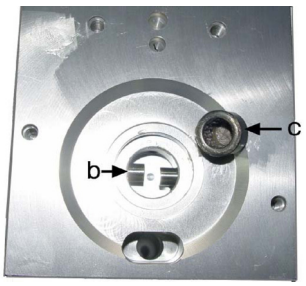
Steering wheel angle sensor



HECU (Valve body and ECU integrated type)

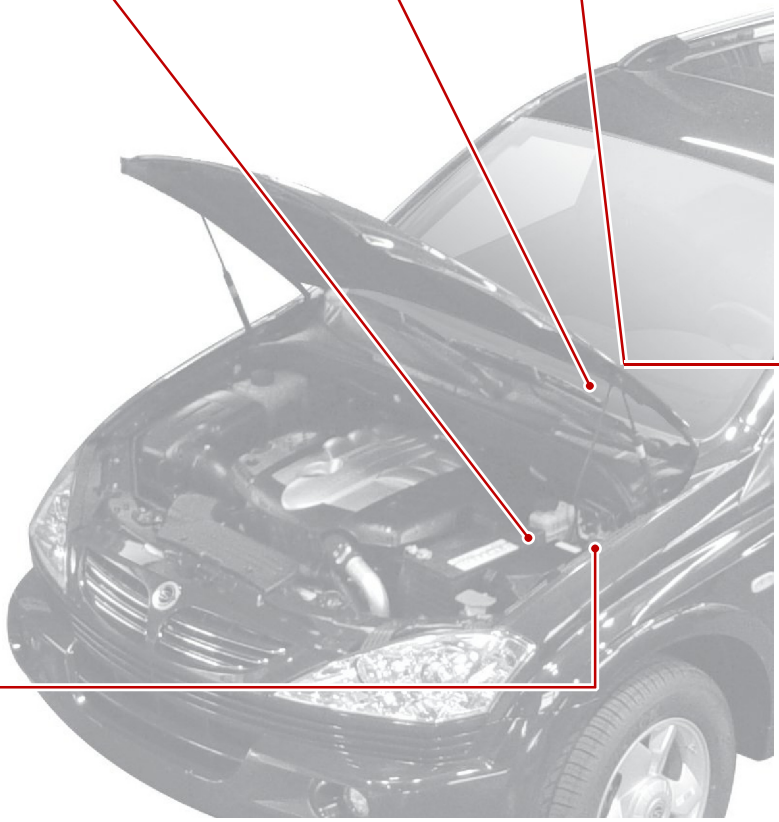


Valve body



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

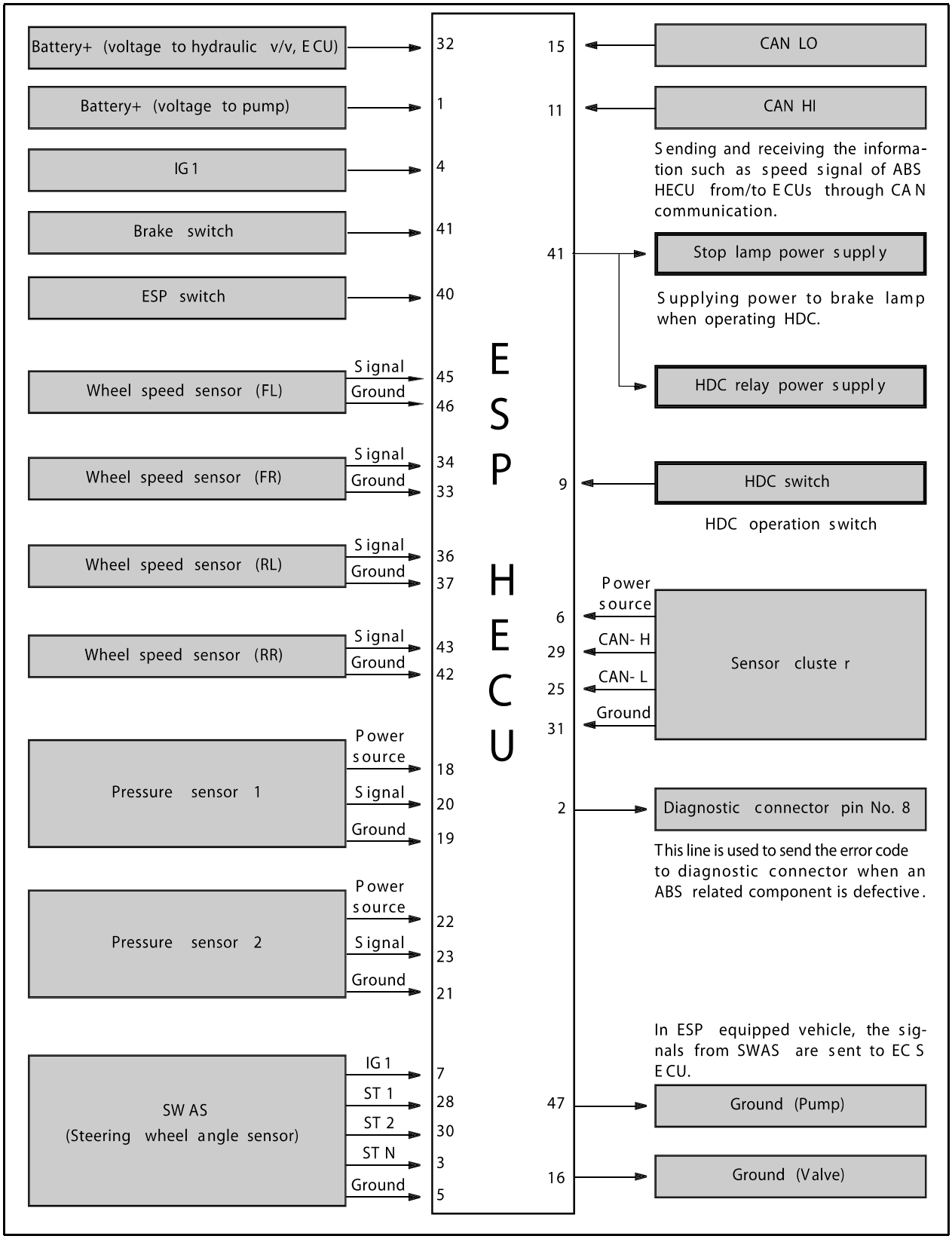


ABS / ESP Indicator



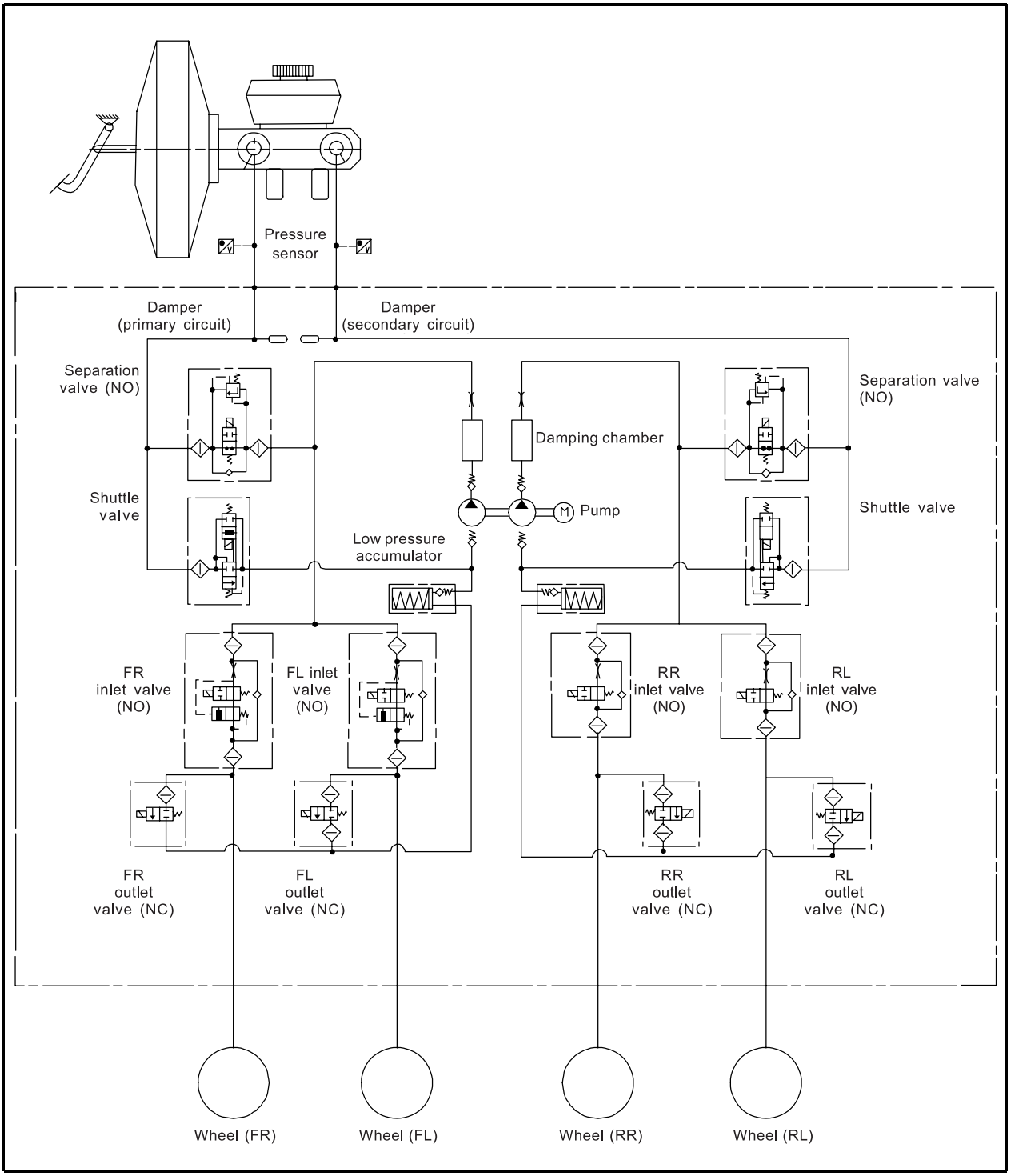
7. INPUT/OUTPUT SIGNALS FOR HDC OPERATION

▶ Input/Output of ESP System



Modification basis	
Application basis	
Affected VIN	

8. ESP HYDRAULIC CIRCUIT DIAGRAM



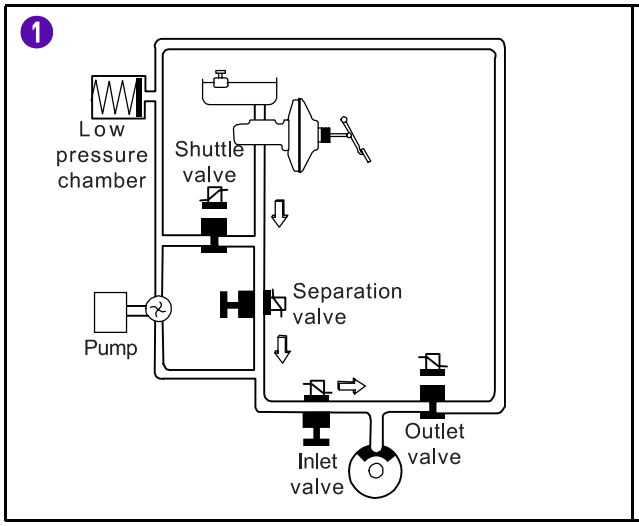
Modification basis	
Application basis	
Affected VIN	

9. HYDRAULIC PRESSURE FOR EACH ESP OPERATING RANGE

1) ESP Operating Explanation

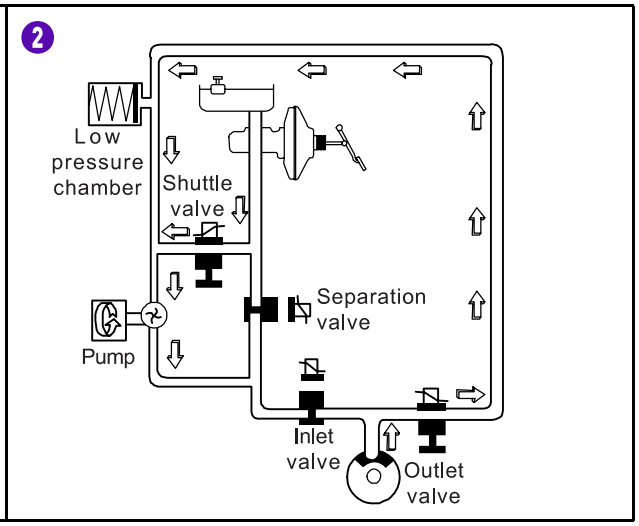
When equipped with ABS, the braking force at each wheel will be controlled with 3-channel 4-sensor method. And when equipped with ESP, 4 wheels will be controlled independently with 4-channel method. (When controlling ABS system only, it will be operated with 3-channel method.)
When compared to the vehicle 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.

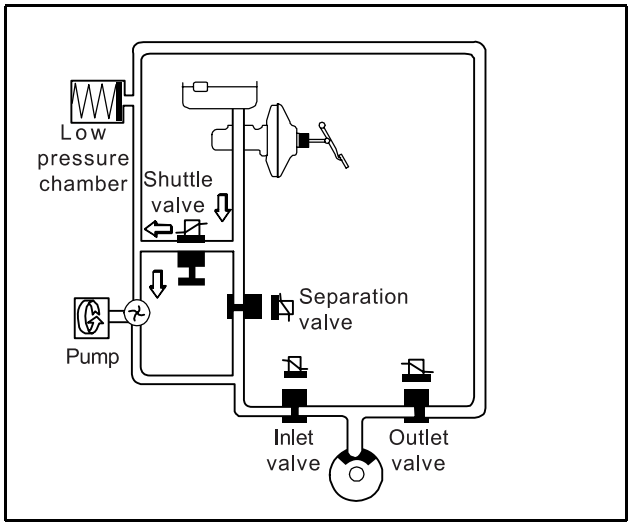


▶ **ESP Hydraulic unit (decreased pressure)**

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.

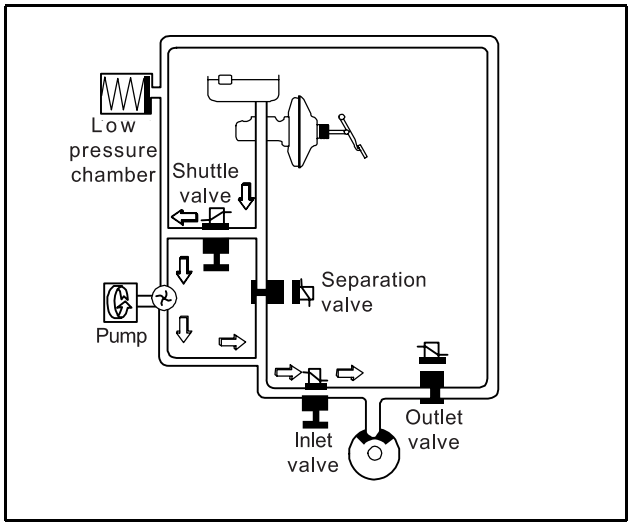
Modification basis	
Application basis	
Affected VIN	

▶ 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.

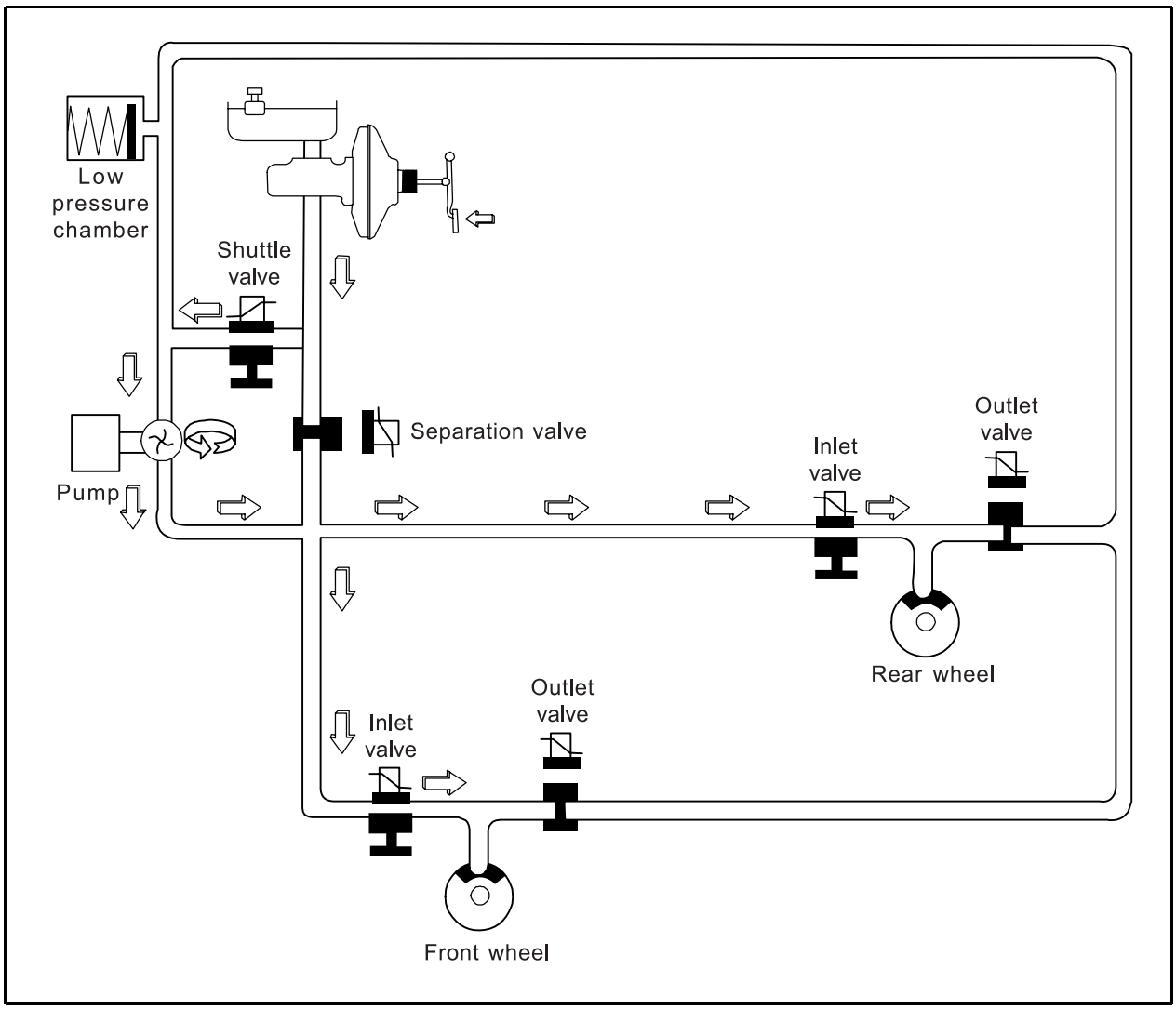
▶ ESP unit circuit (when the pressure is increased)



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	

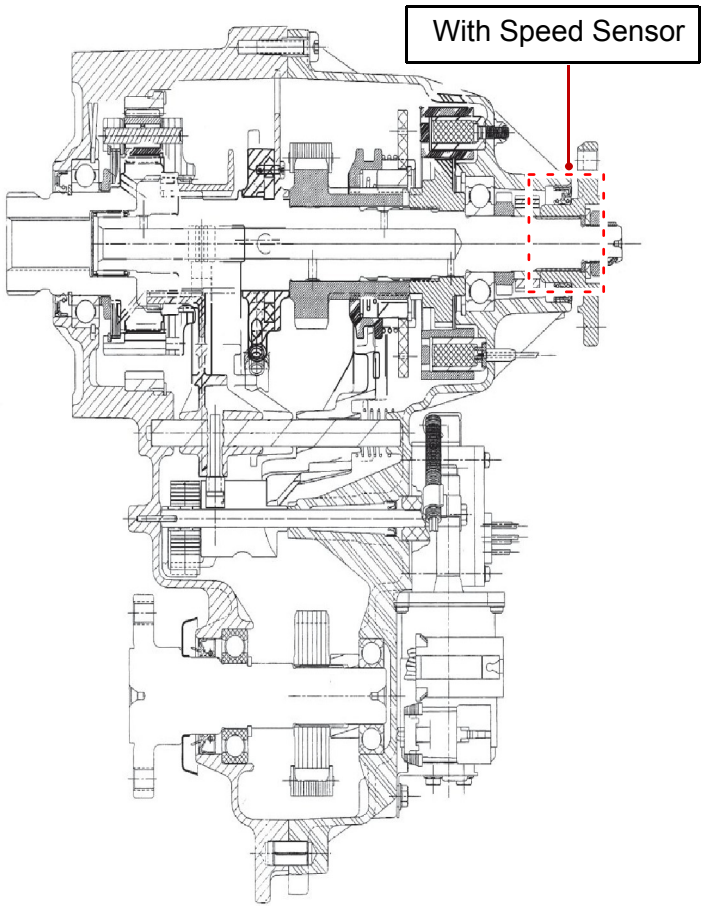
11. GENERAL INFORMATION OF ABS SYSTEM

Differences compared to other models: Appearance of wheel speed sensor, Location, Layout of relevant components

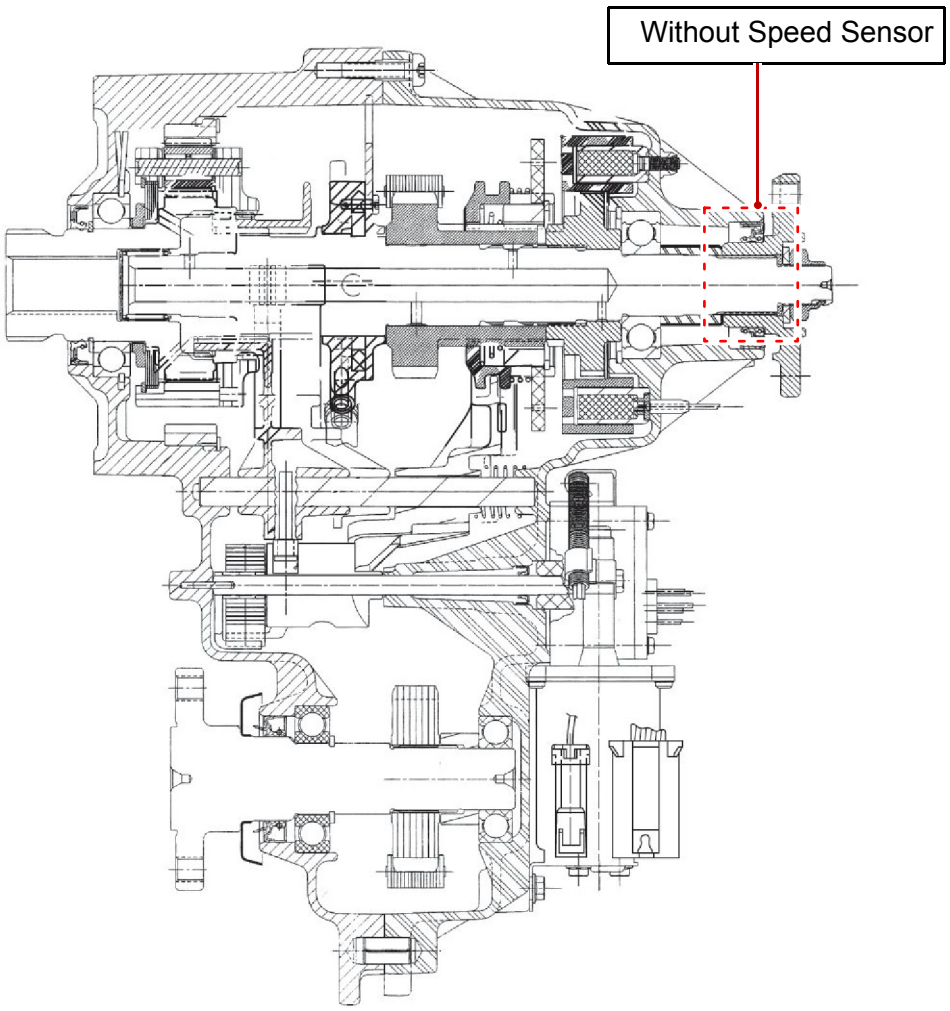
ABS HECU	Active Wheel Speed Sensor (for 4WD)
	

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

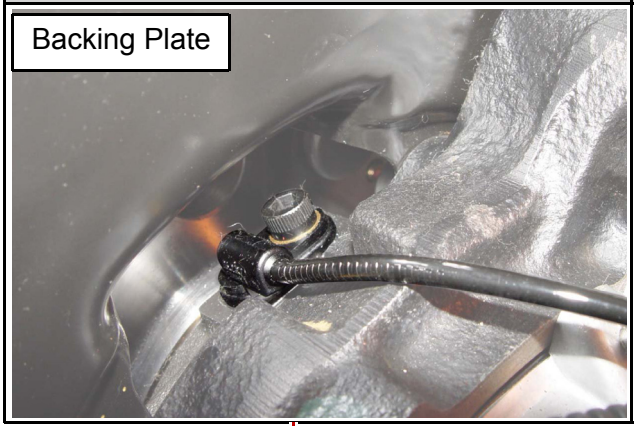
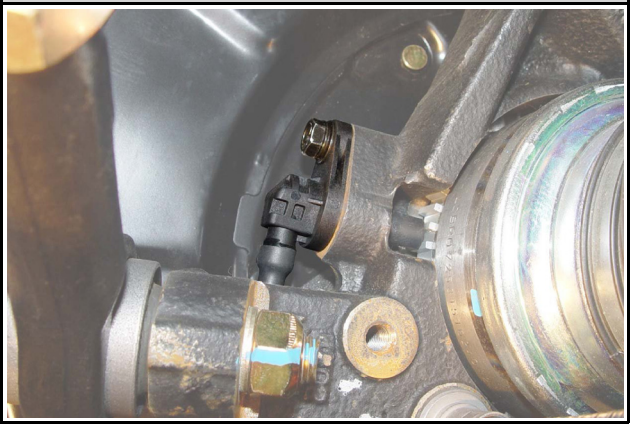


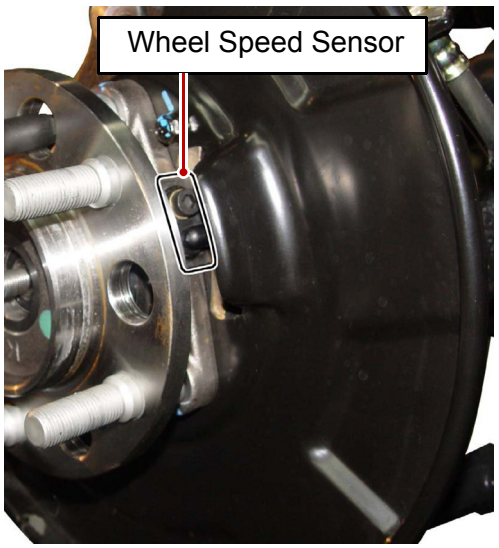
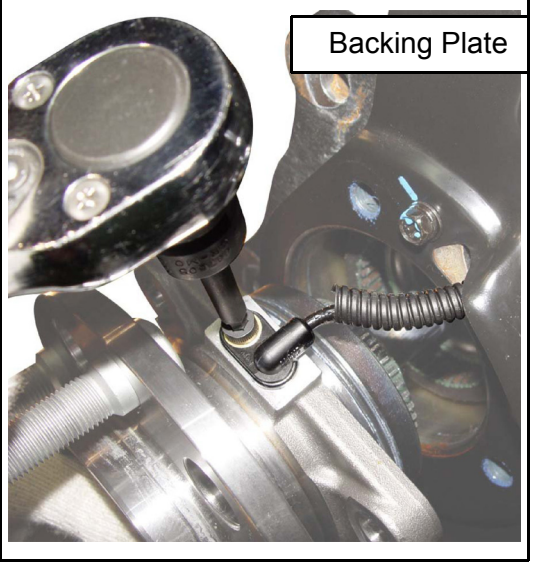
New Transfer Case



Modification basis	
Application basis	
Affected VIN	

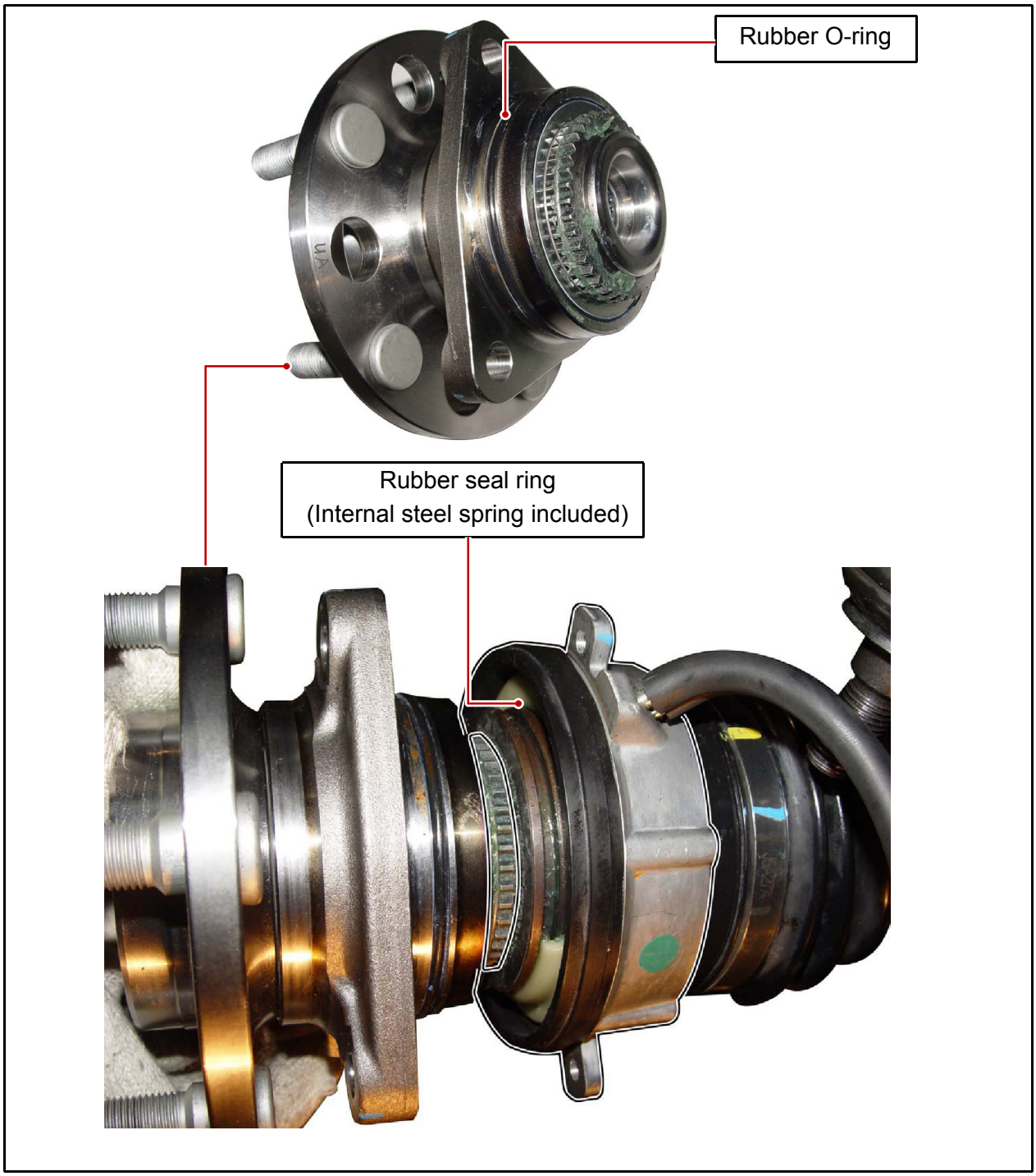
Cautions When Removing the Front Wheel Speed Sensor
The locking hub system of the KYRON part time 4WD utilizes a different hub actuator from the conventional approach. It utilizes IWE (Integrated Wheel End) system that locks the 4WD depending on the vacuum condition within the actuator. Thus, the wheel 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.

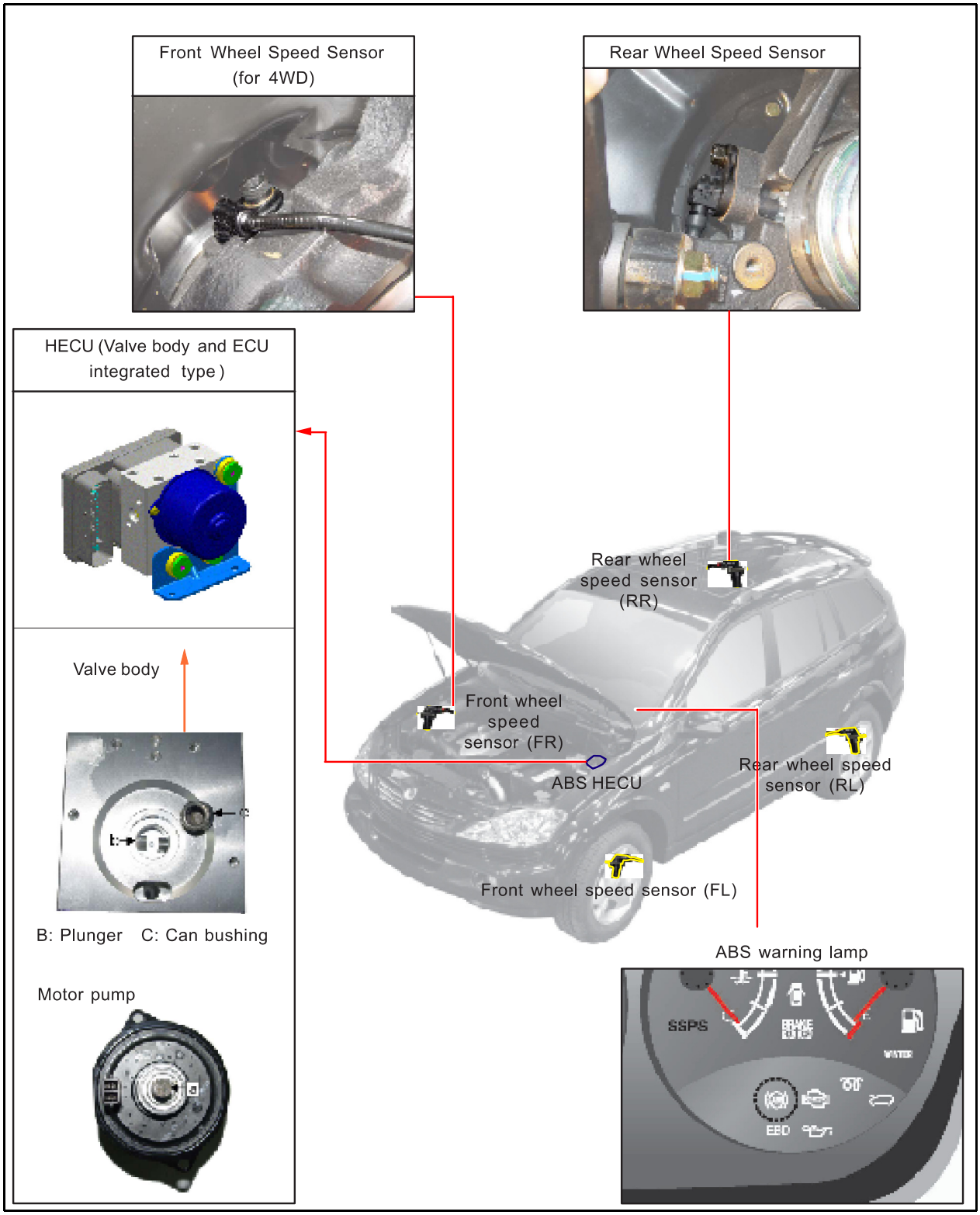


Please refer to the part time transfer case section for more specific information.

Modification basis	
Application basis	
Affected VIN	

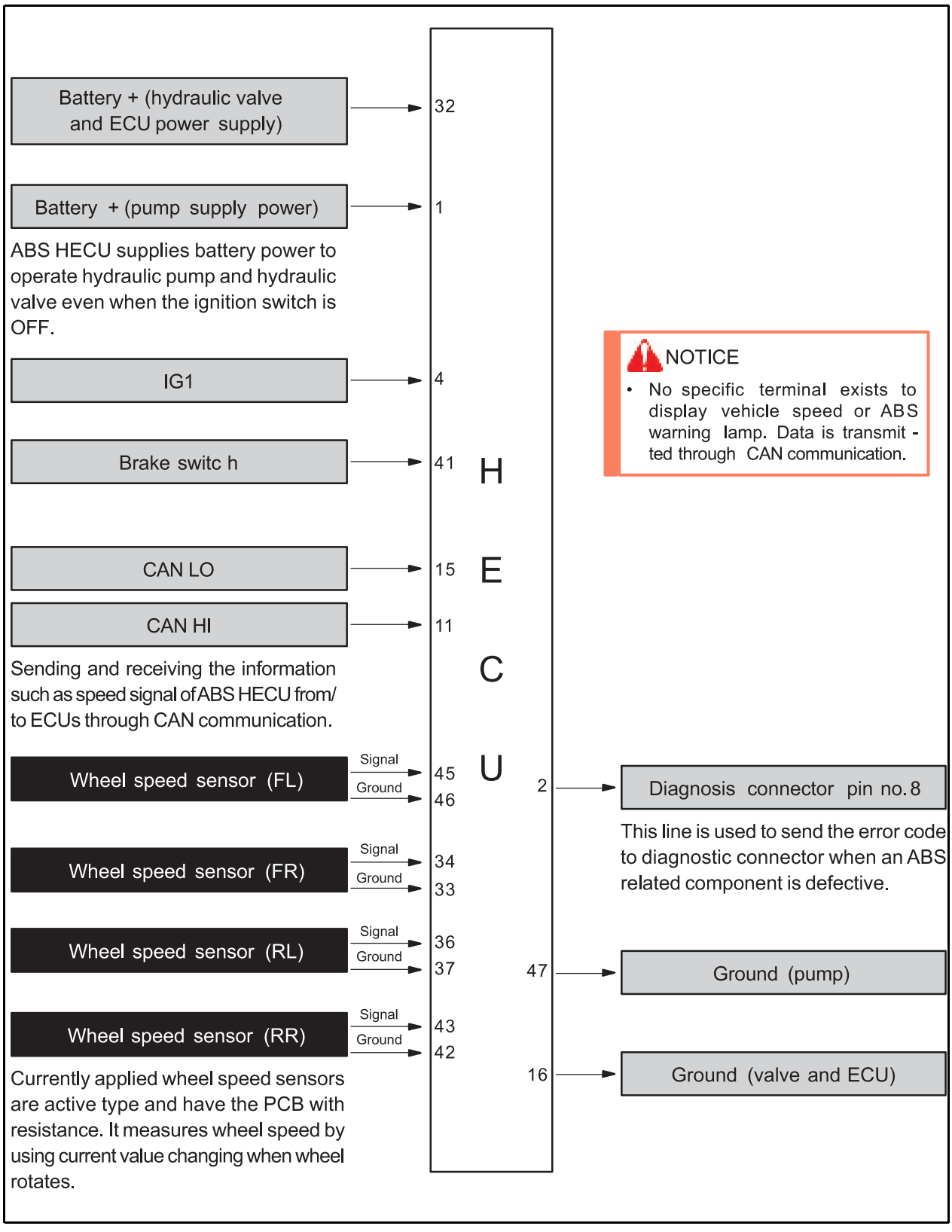
12. CONFIGURATION OF ABS SYSTEM

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.



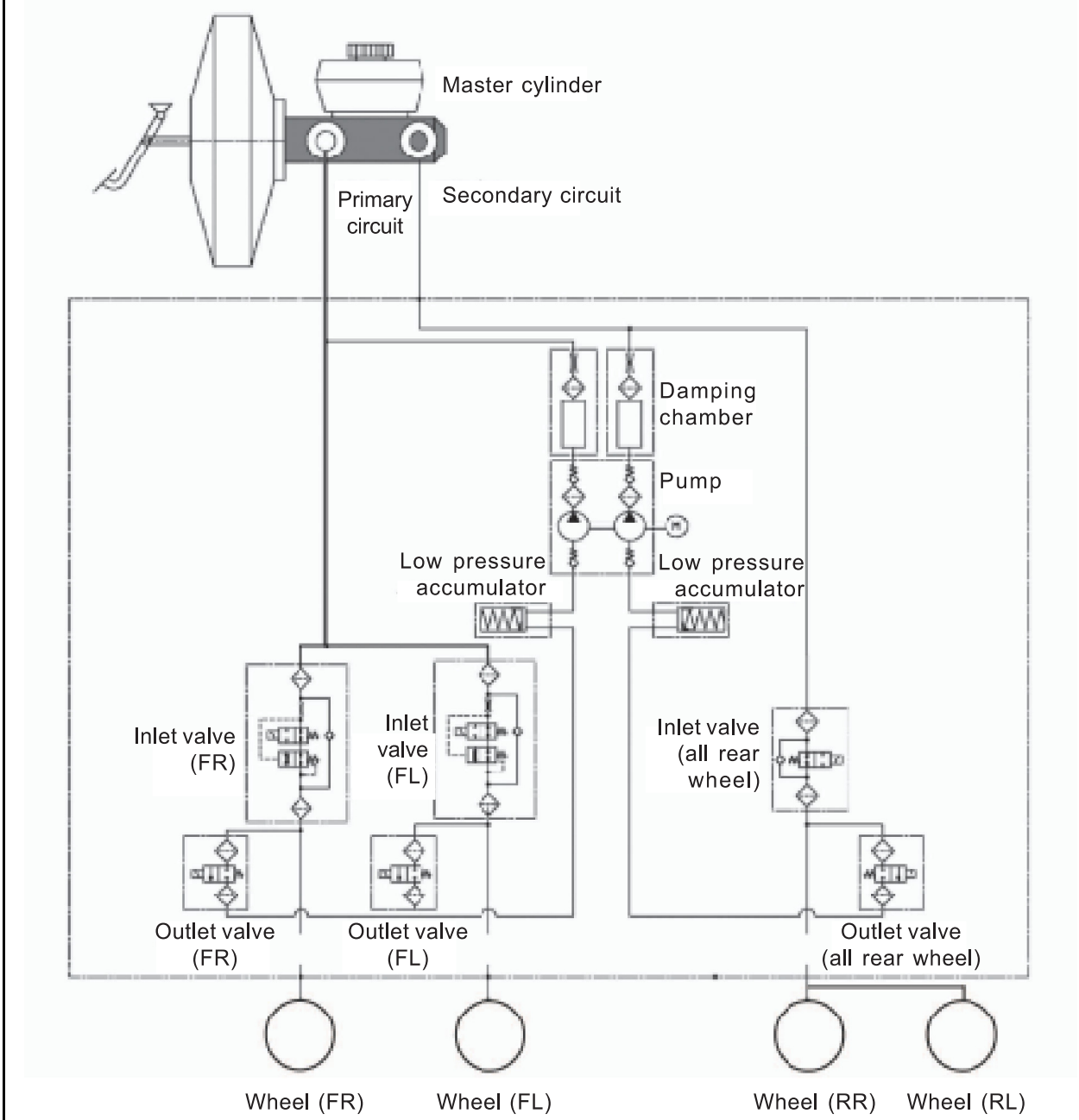
13. INPUT AND OUTPUT DIAGRAM OF ABS

▶ Input/Output of ABS (without TPMS)



Modification basis	
Application basis	
Affected VIN	

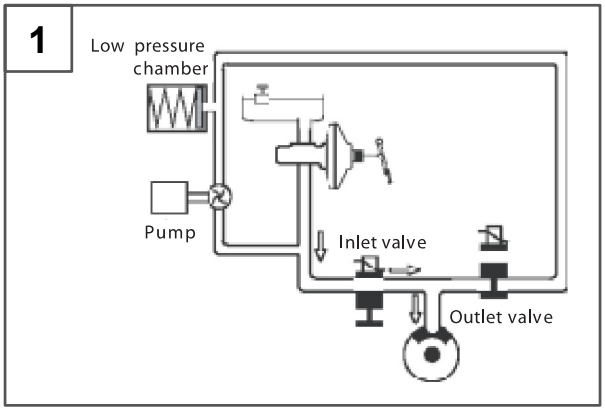
14. HYDRAULIC CIRCUIT OF ABS



The vehicle equipped only with the ABS controls the wheel's braking force using or channel 4-sensor method.

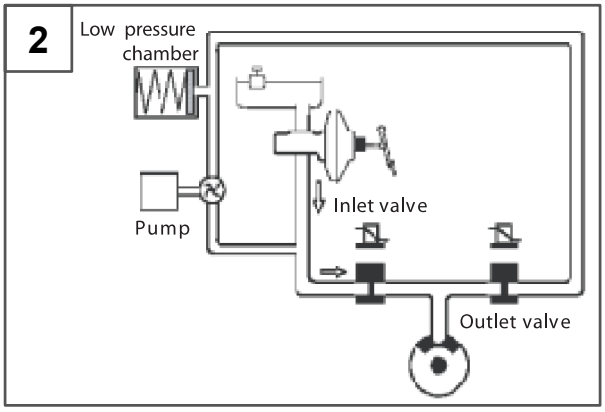
The front wheels that are the primary circuit of the brake system is composed of two wheel speed sensors and two channel valves system with two inlet valves and two outlet valves. The rear wheels that are the secondary circuit of the brake system is composed of two wheel speed sensors, one inlet valve 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**

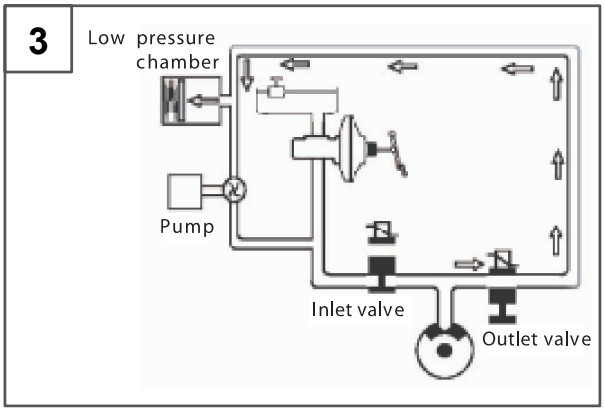
- The hydraulic pressure in the master cylinder increases through the vacuum booster and it is delivered to the wheel via the normal open inlet valve. At this moment, the normally- closed outlet valve is closed. The speed of the wheel that hydraulic pressure is delivered reduces gradually.



▶ **No Hydraulic Pressure Circuit when ABS is Operating**

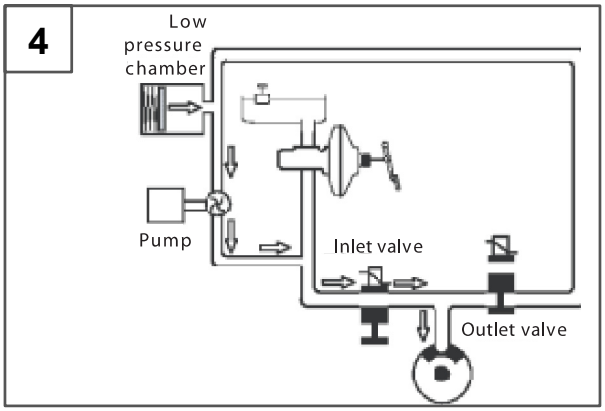
- As hydraulic pressure on each wheel increases, the wheel tends to lock. In order to prevent the wheel from locking, the hydraulic valve modulator operates the inlet valve control solenoid to close the inlet valve and stop the hydraulic pressure increases. At this moment, the outlet valve is closed. 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.

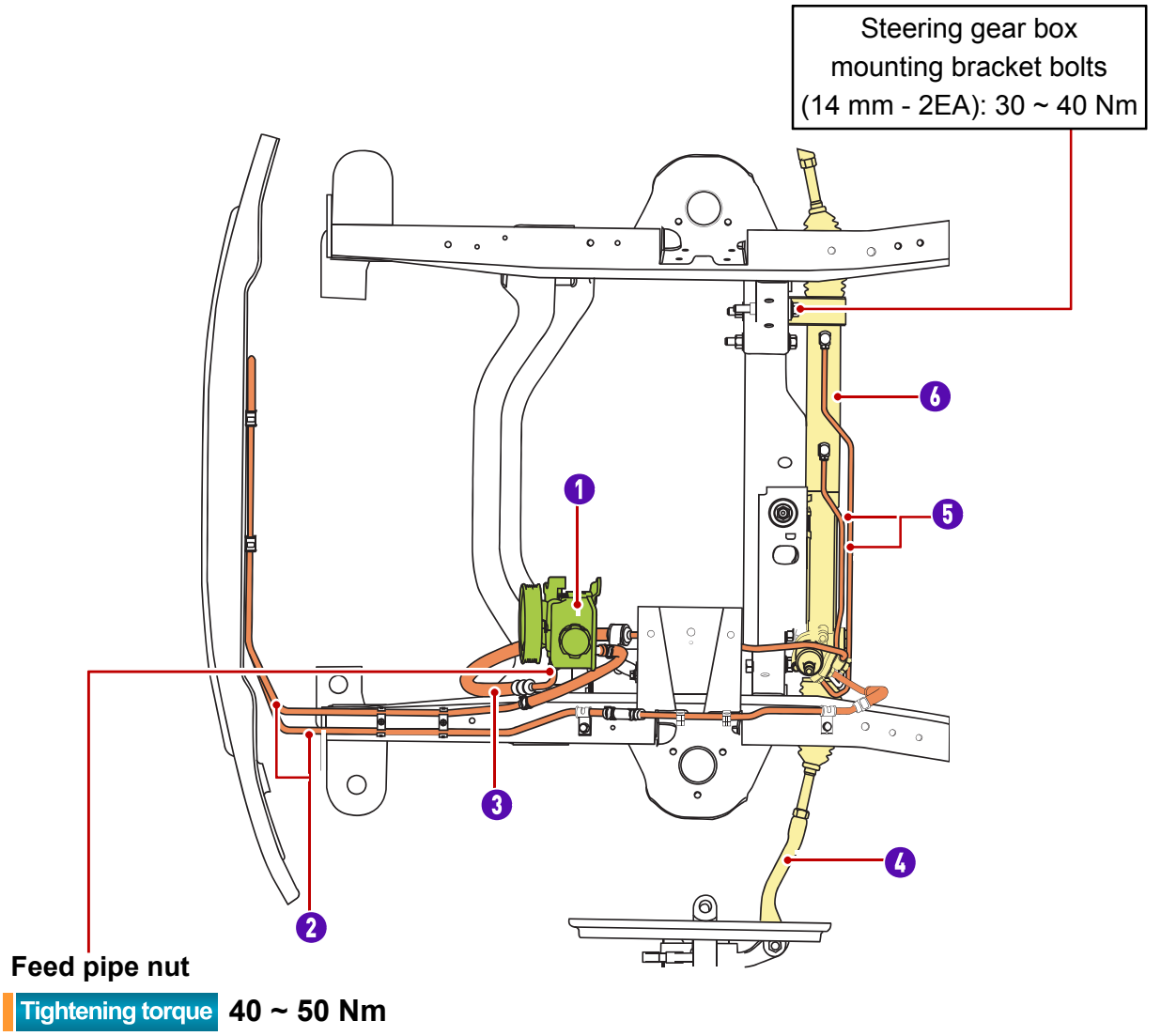
In this case, the operating force of the steering wheel is conveyed to the pinion, and the movement of the pinion moves the rack through the pinion gear combined to the rack gear.

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

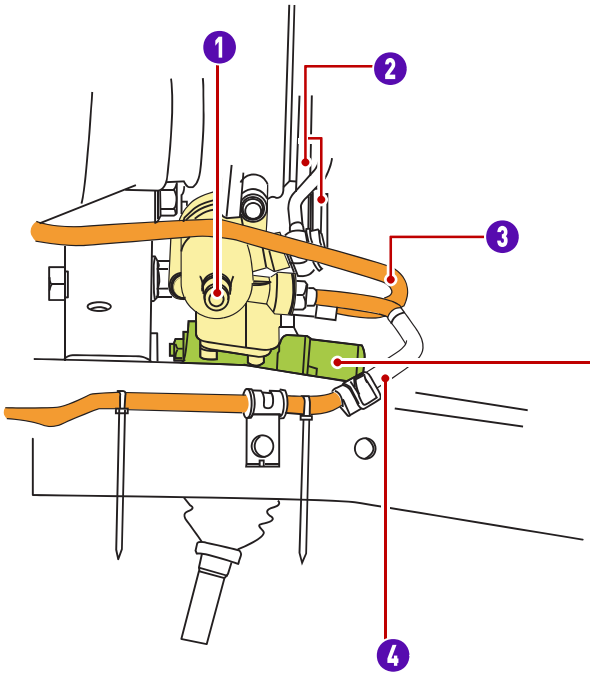
1. POWER STEERING SYSTEM LAYOUT



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

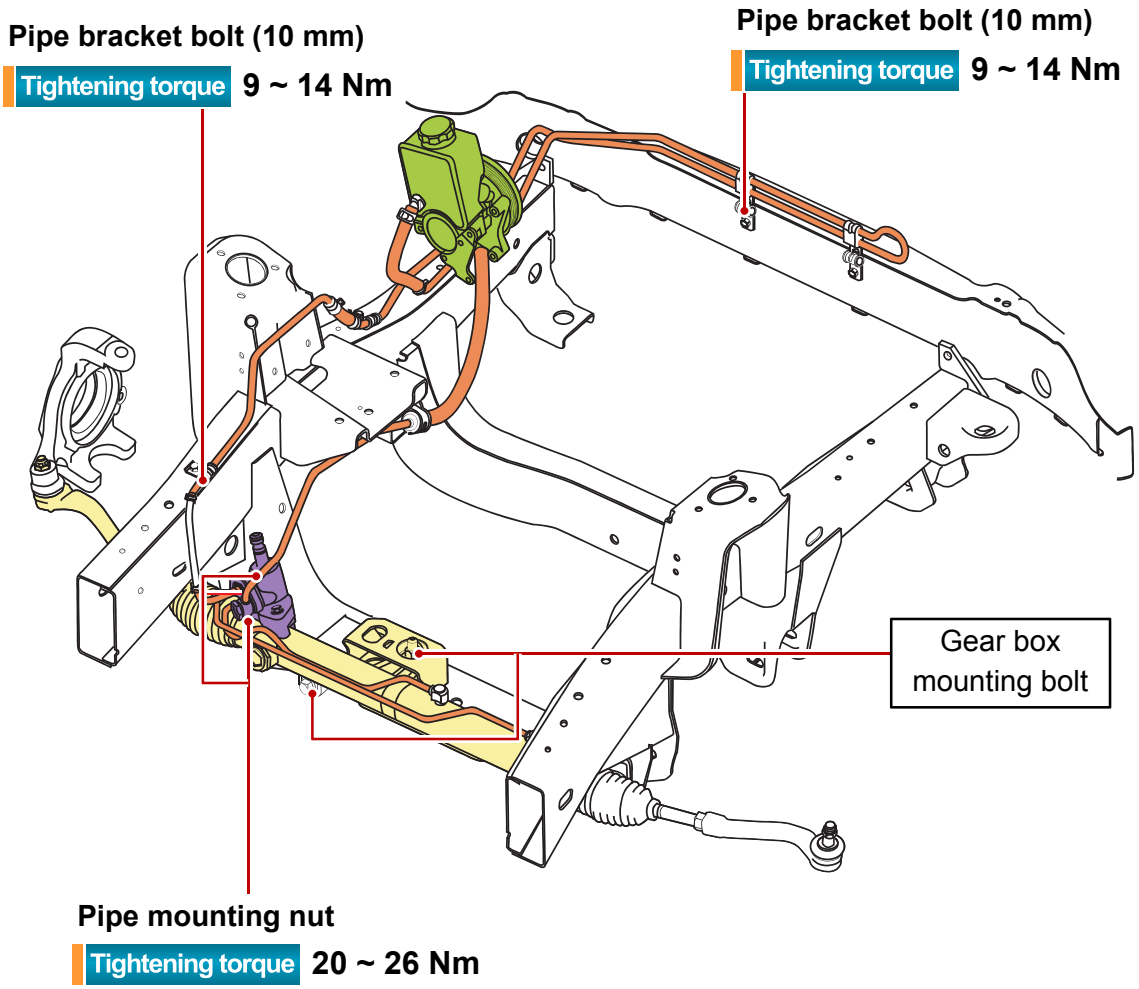


SSPS Solenoid Valve

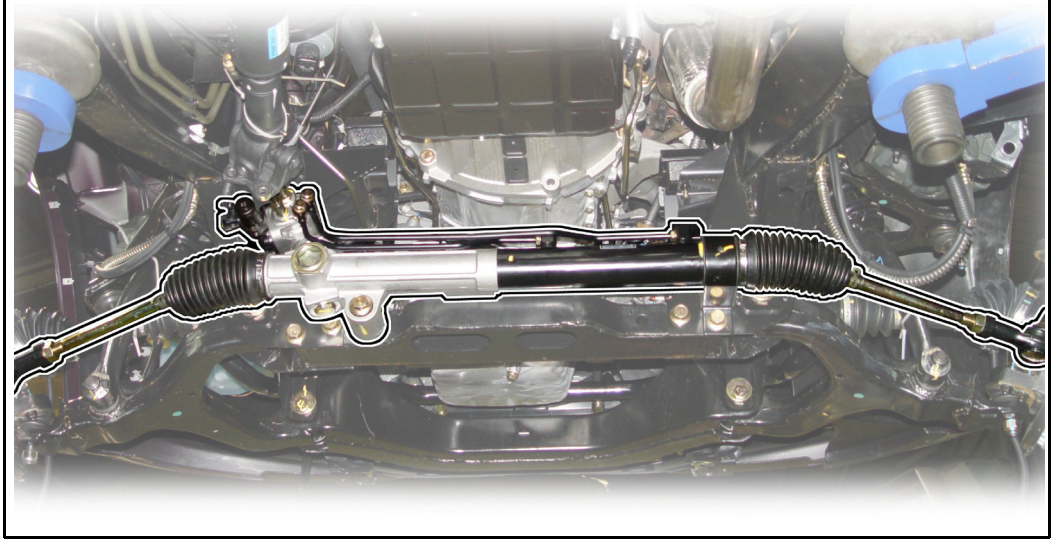


cannot be replaced

1. Power steering gear box	3. Power steering high pressure hose and pipe
2. Gear box pipe	4. Return hose and pipe

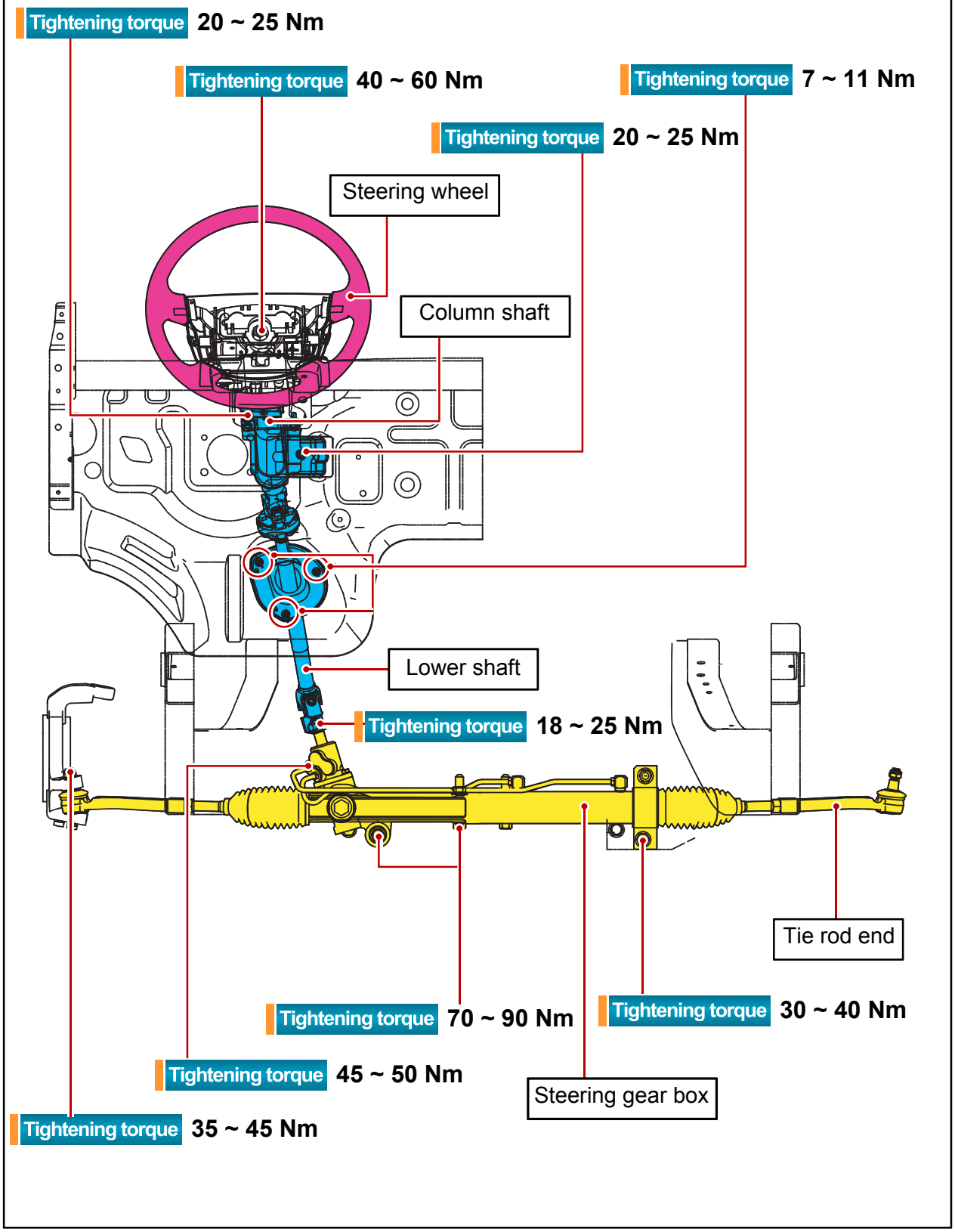


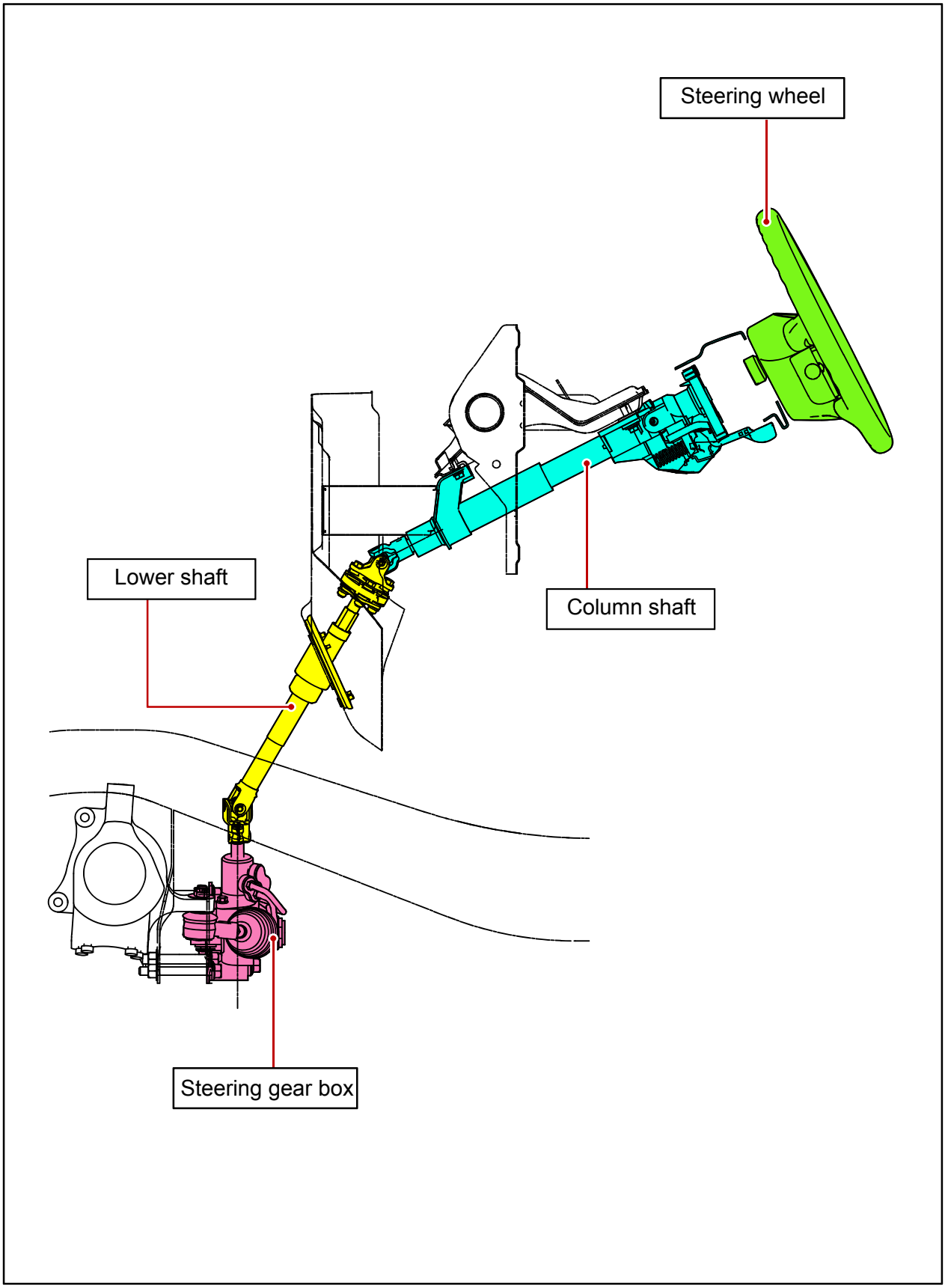
Installation Drawing of SSPS



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



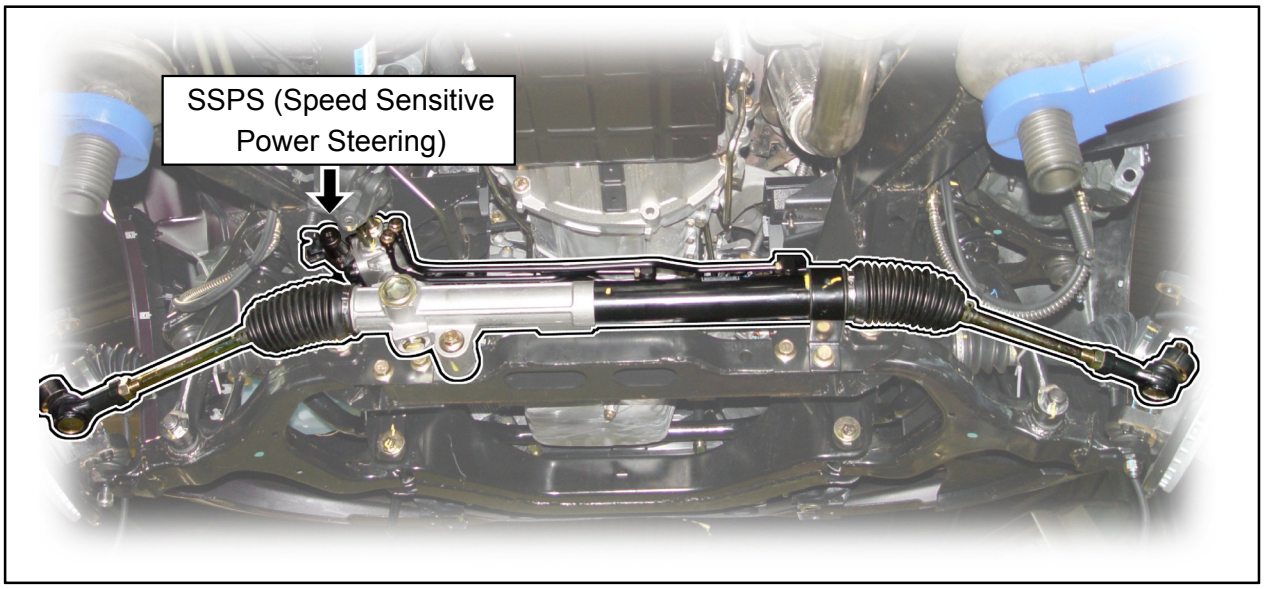
Modification basis	
Application basis	
Affected VIN	

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.

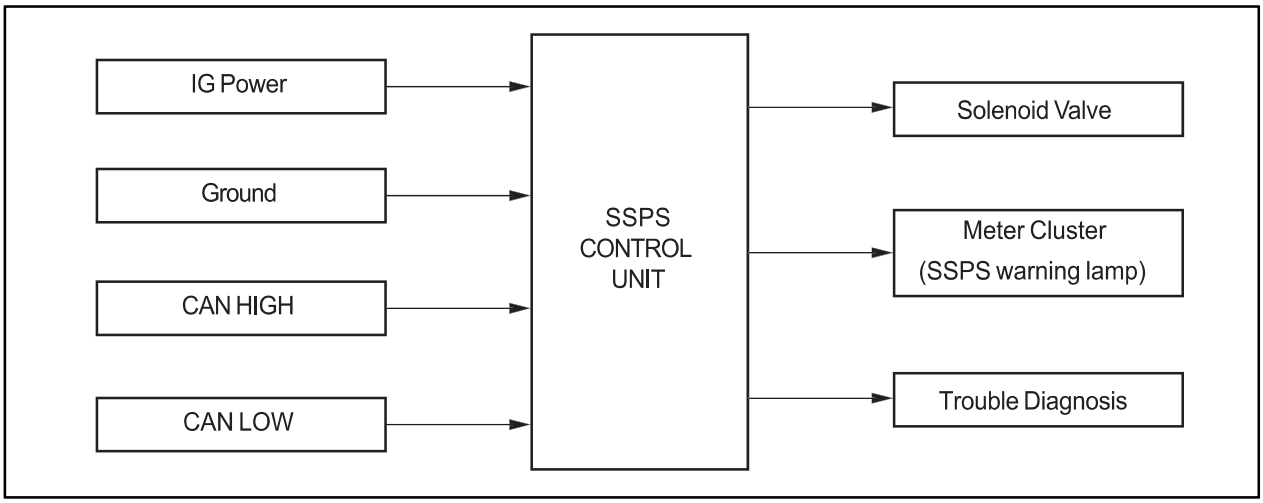


CAUTION

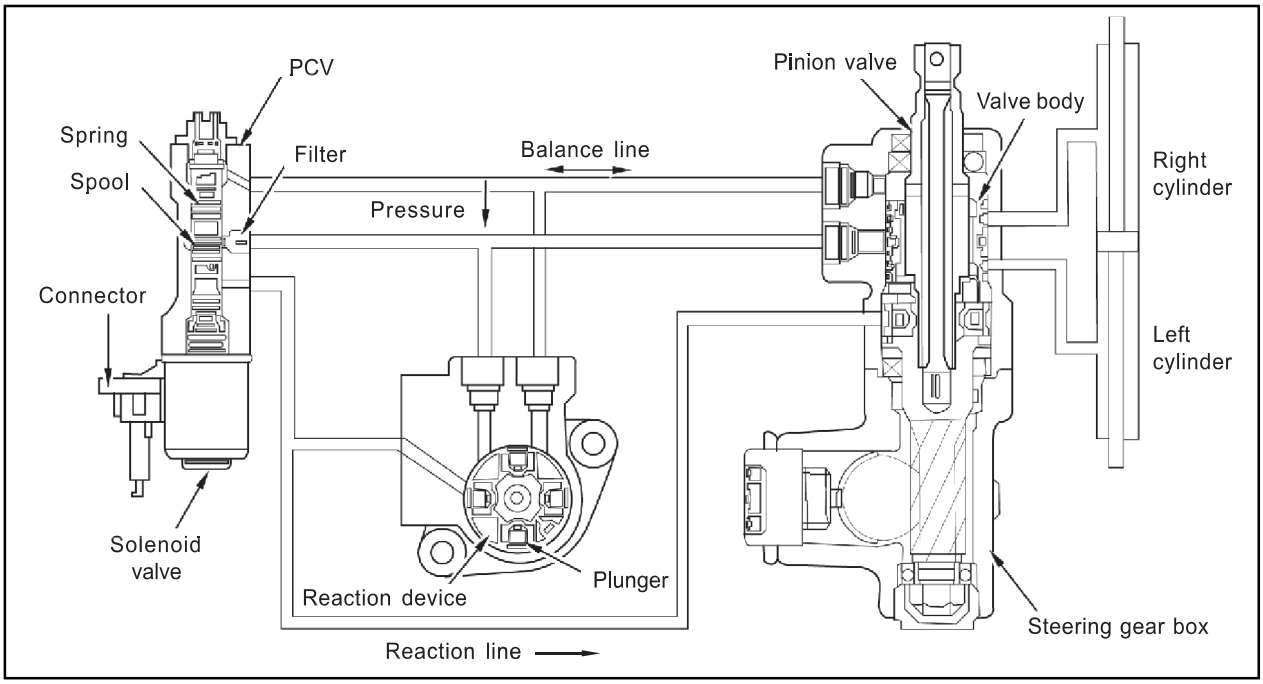
- If the SSPS solenoid valve is defective, the power steering assembly should be replaced.

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

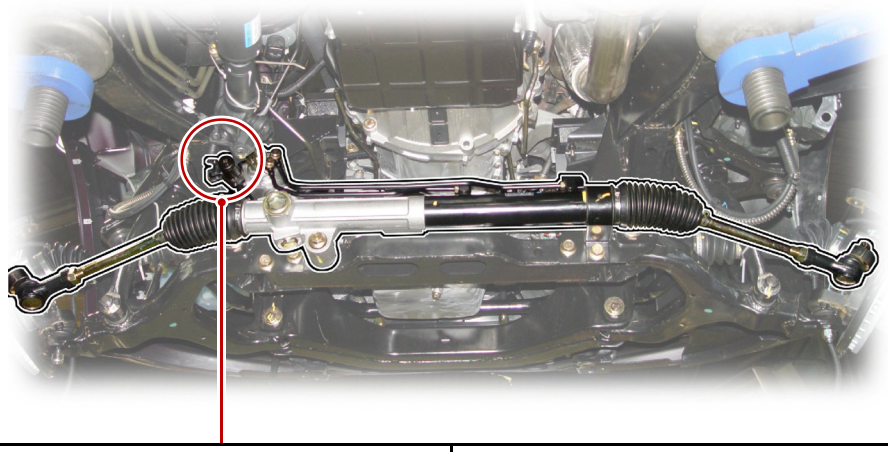
This valve determines the valve spool position in PCV with the electric current supplied from SSPS control unit.

Modification basis	
Application basis	
Affected VIN	

3. S.S.P.S OPERATIONS

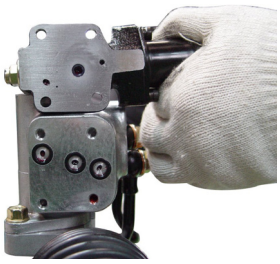
1) SOLENOID VALVE

(1) LOCATION





Cannot be replaced



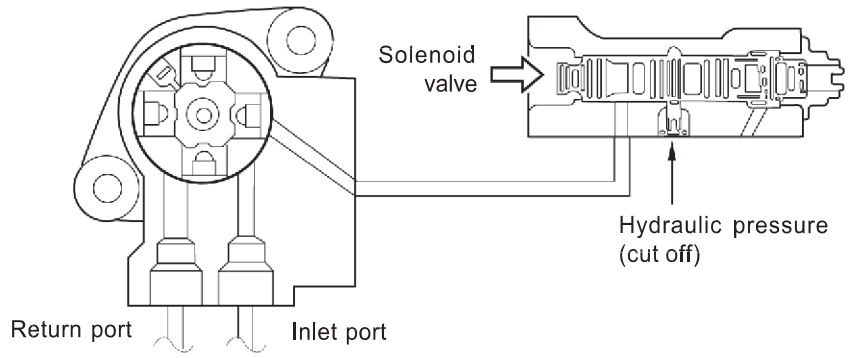
The SSPS control unit controls the amount of electric current to the solenoid valve according to the vehicle speed. In other words, the solenoid valve controls the hydraulic pressure applied to reaction plunger by changing the valve spool position that is linked with solenoid valve according to the amount 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

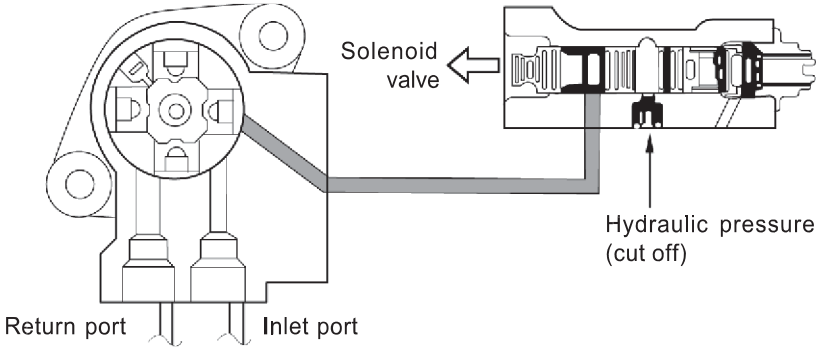
(3) OPERATION

▶ **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**

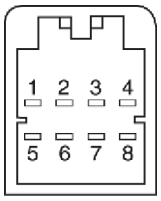


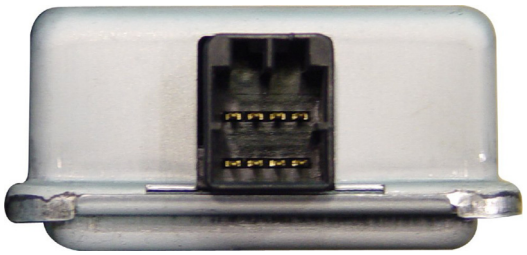
1) The shaft operating force of solenoid rod is reduced due to the reduction of output current from the SSPS control unit.
2) The coil spring pulls the PCV spool toward solenoid valve to open it.
3) The hydraulic pressure from pump flows to pinion reaction area through orifice and applies reaction force 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

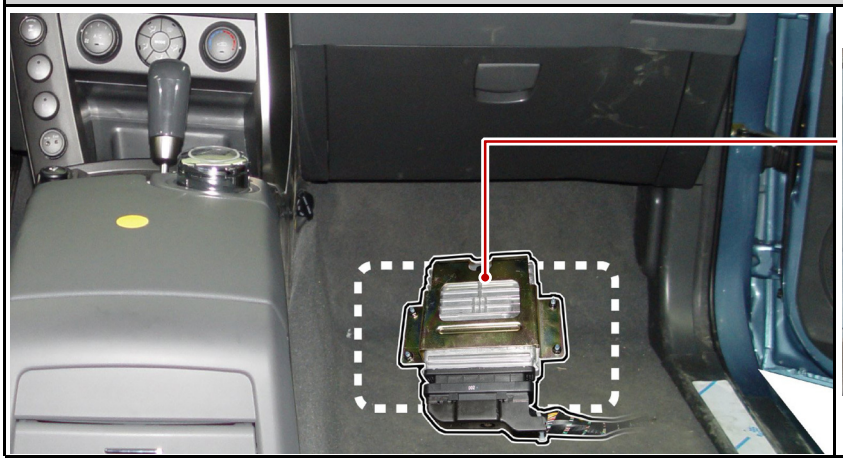
1. To provide proper steerability to a driver, the SSPS control unit controls the solenoid valve by receiving the vehicle speed and the throttle position data via CAN communication.
2. The SSPS control unit controls the working current for the solenoid valve with PWM type duty ratio of 333 Hz frequency 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.

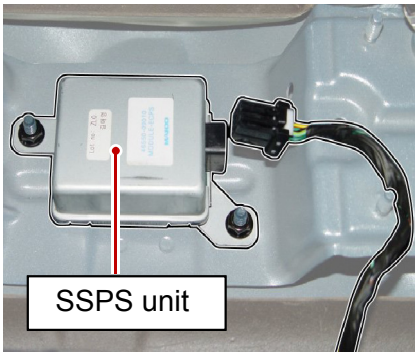




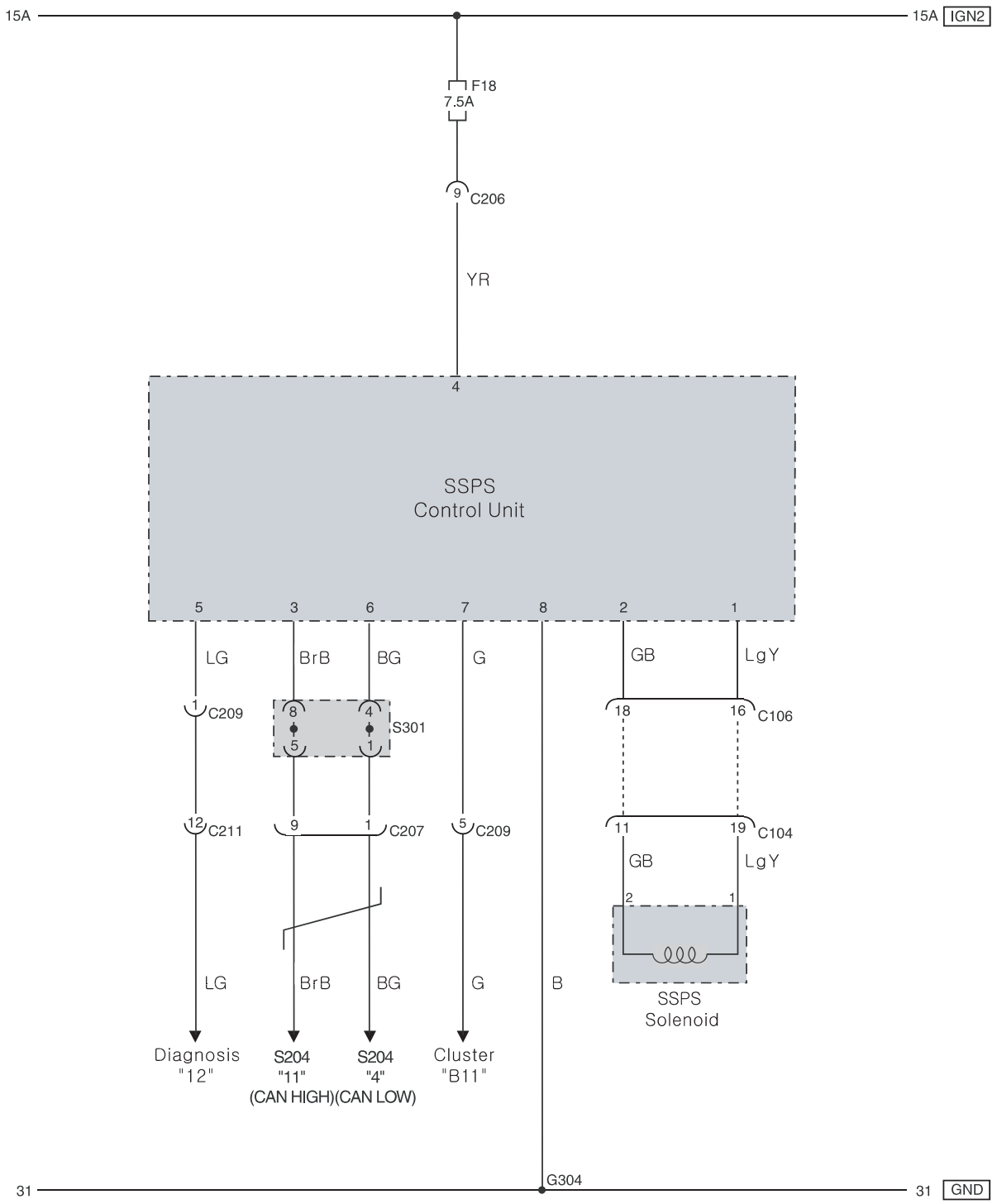
Pin No.	Function
1	Ignition Power Supply
2	CAN HIGH
3	Solenoid
4	Solenoid
5	Ground
6	Warning Lamp (SSPS)
7	CAN LOW
8	Self Diagnosis

Location



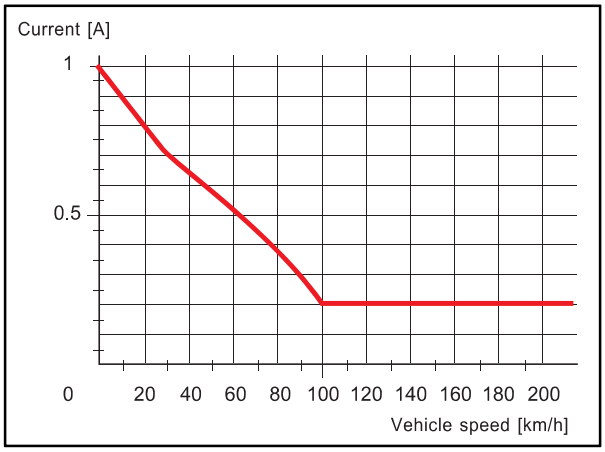


3) CIRCUIT DIAGRAM



Modification basis	
Application basis	
Affected VIN	

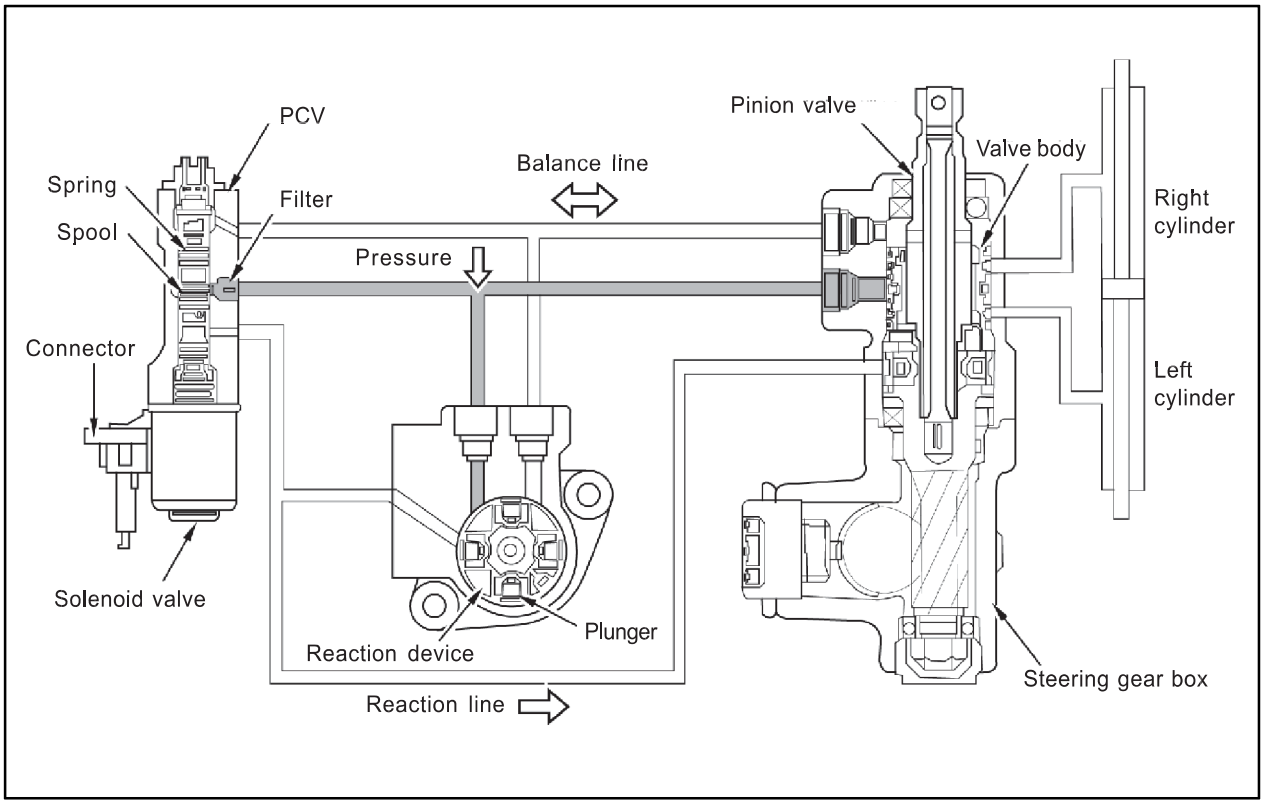
4) S.S.P.S SYSTEM CONTROL



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.

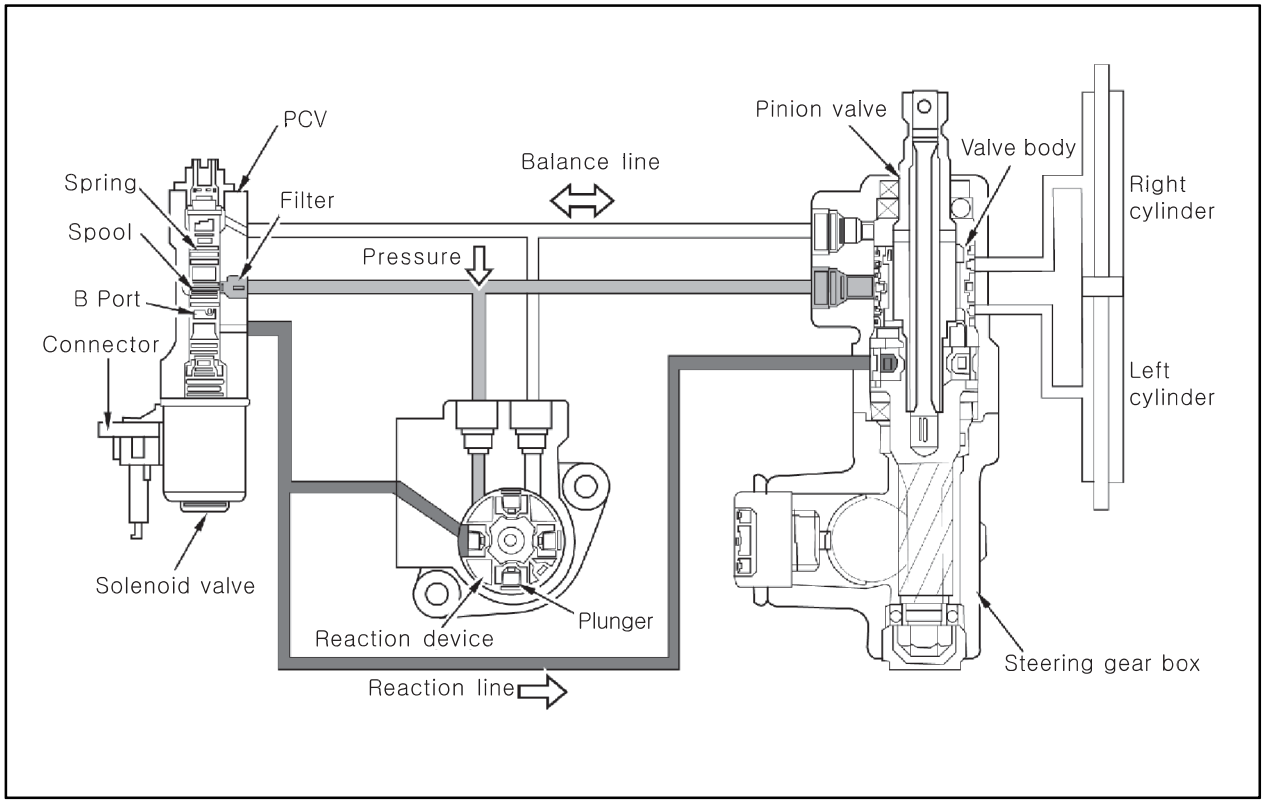
▶ During parking and low speed driving

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	

AIR CONDITIONING SYSTEM 6810-15

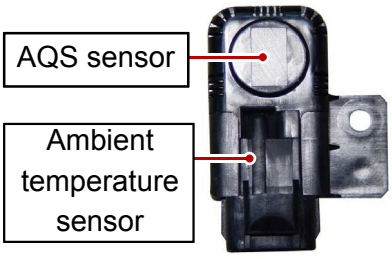
GENERAL

1. SYSTEM LAYOUT AND COMPONENTS

Type	Air Conditioner Controller
FATC	B 
Manual air conditioner	B 

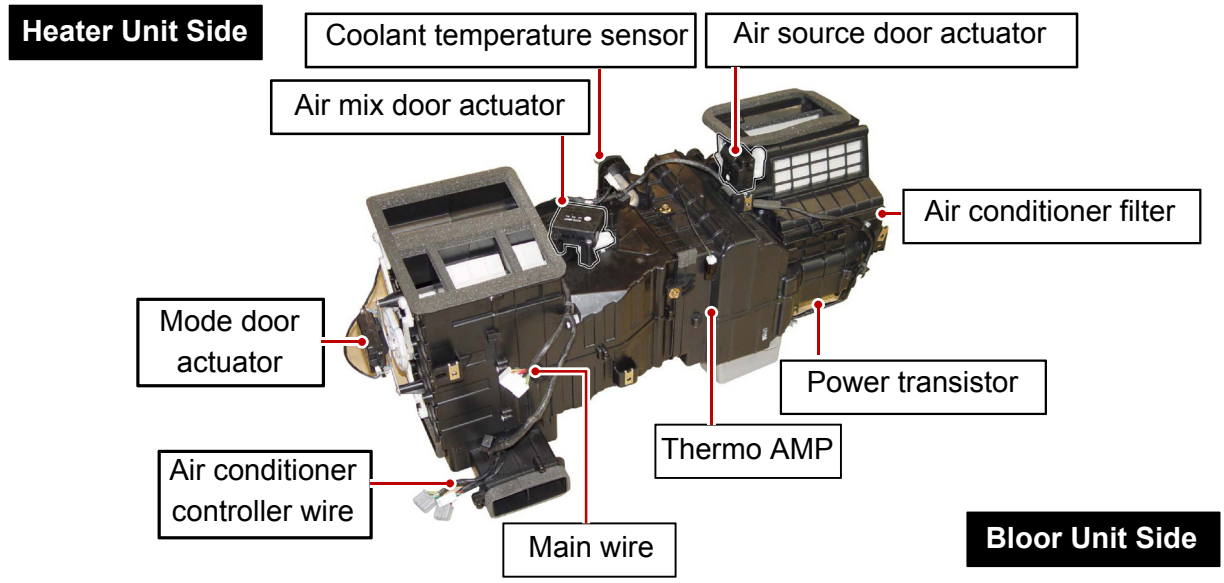
Sun Sensor - Instrument Panel Upper Left
A 
It changes sun load coming through front windshield into current to input to FATC controller.

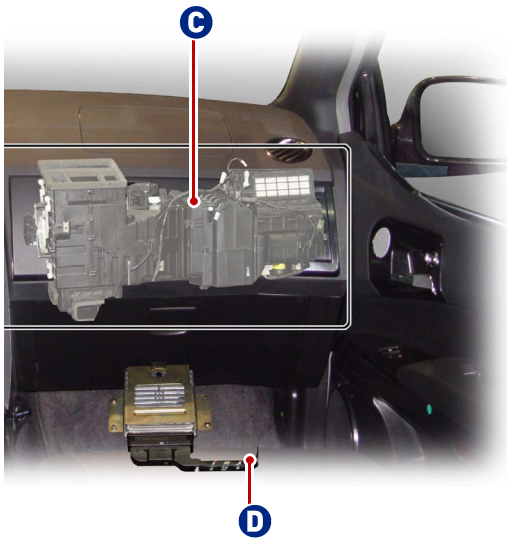


AQS Switch	Compressor	AQS Sensor and Ambient Temperature Sensor
B 		
A function that turns on/off the air source selection and air quality system.		This sensor is installed at the front bottom of engine compartment. This changes the air source mode by detecting the air pollution.

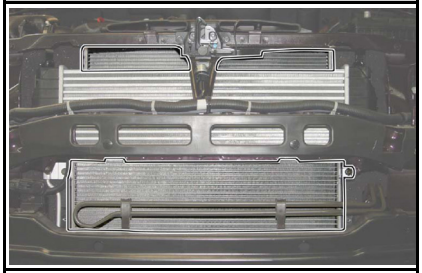
Modification basis	
Application basis	
Affected VIN	

C Front AirConditioner Module Assembly - Inside of Instrume

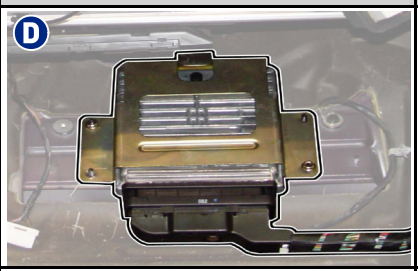
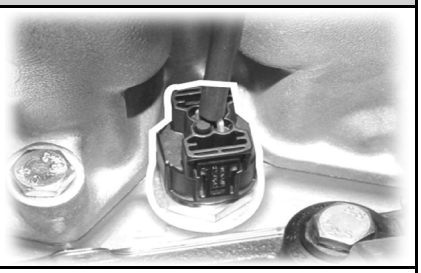




Condenser



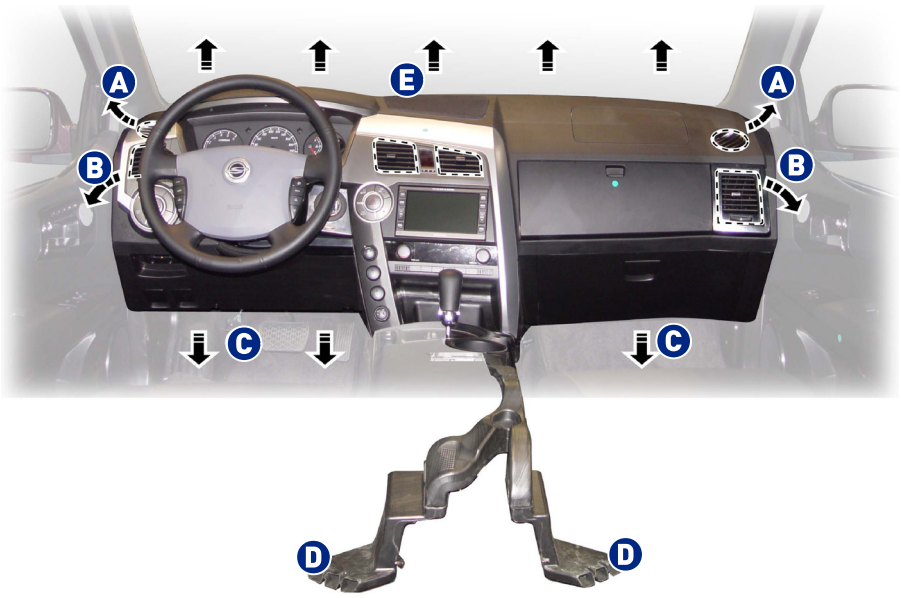
Installed in front of vehicle and condenses vapor refrigerant into low temperature and high pressure liquid refrigerant..

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.

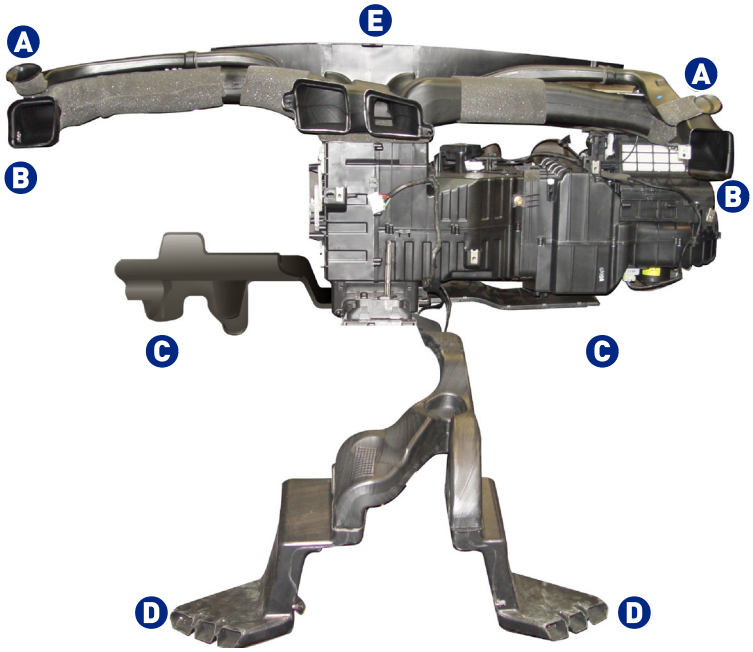
OVERVIEW AND OPERATION PROCESS

1. VENTILATION SYSTEM COMPONENTS

▶ Locations of Vents



▶ Air Duct



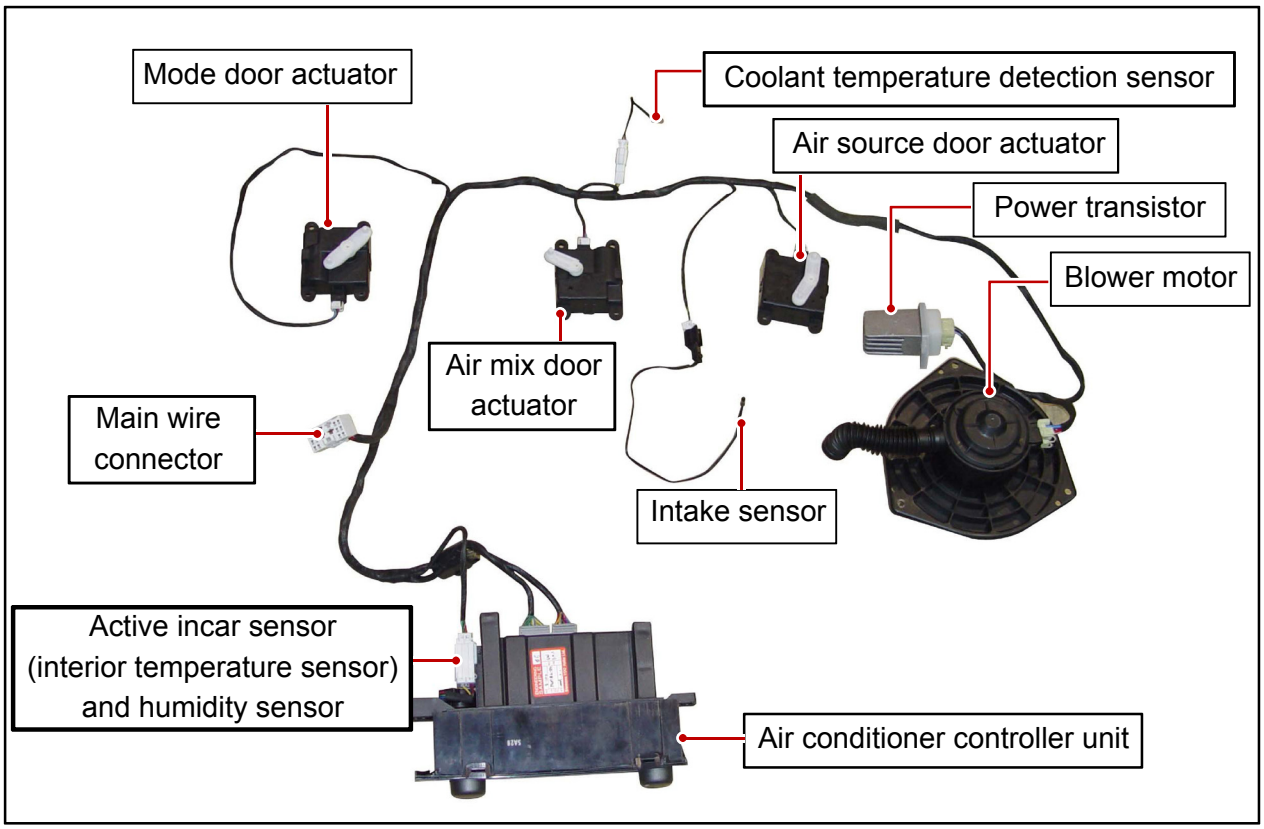
Modification basis	
Application basis	
Affected VIN	

▶ **Air Duct Layout**



2. AIR CONDITIONER MODULE WIRING AND LAYOUT

1) FRONT AIR CONDITIONER MODULE WIRING LAYOUT



3. AIR CONDITIONER MODULE WIRING AND LAYOUT

1) LOCATIONS

Coolant Temperature Sensor

A



Air Source Door Actuator

B



C



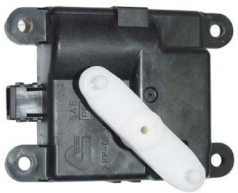
Air Conditioner Filter

D



Mode Door Actuator

E



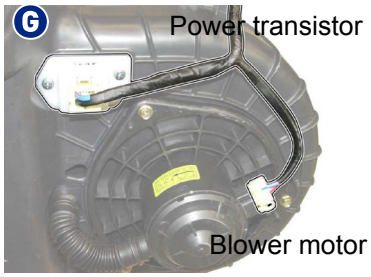
Intake Sensor

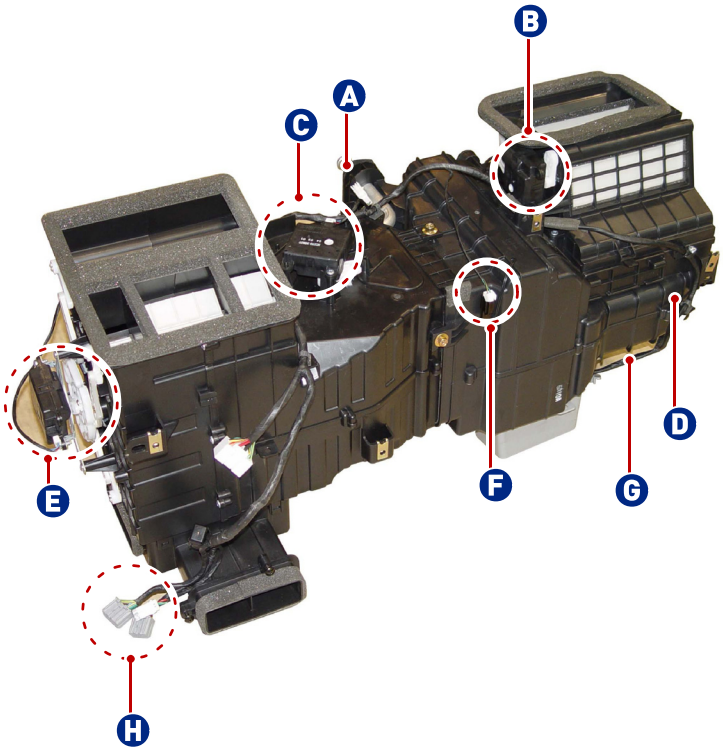
F



Power Transistor/Blower Motor

G





A/C Controller Unit

H



Interior temperature and humidity sensor

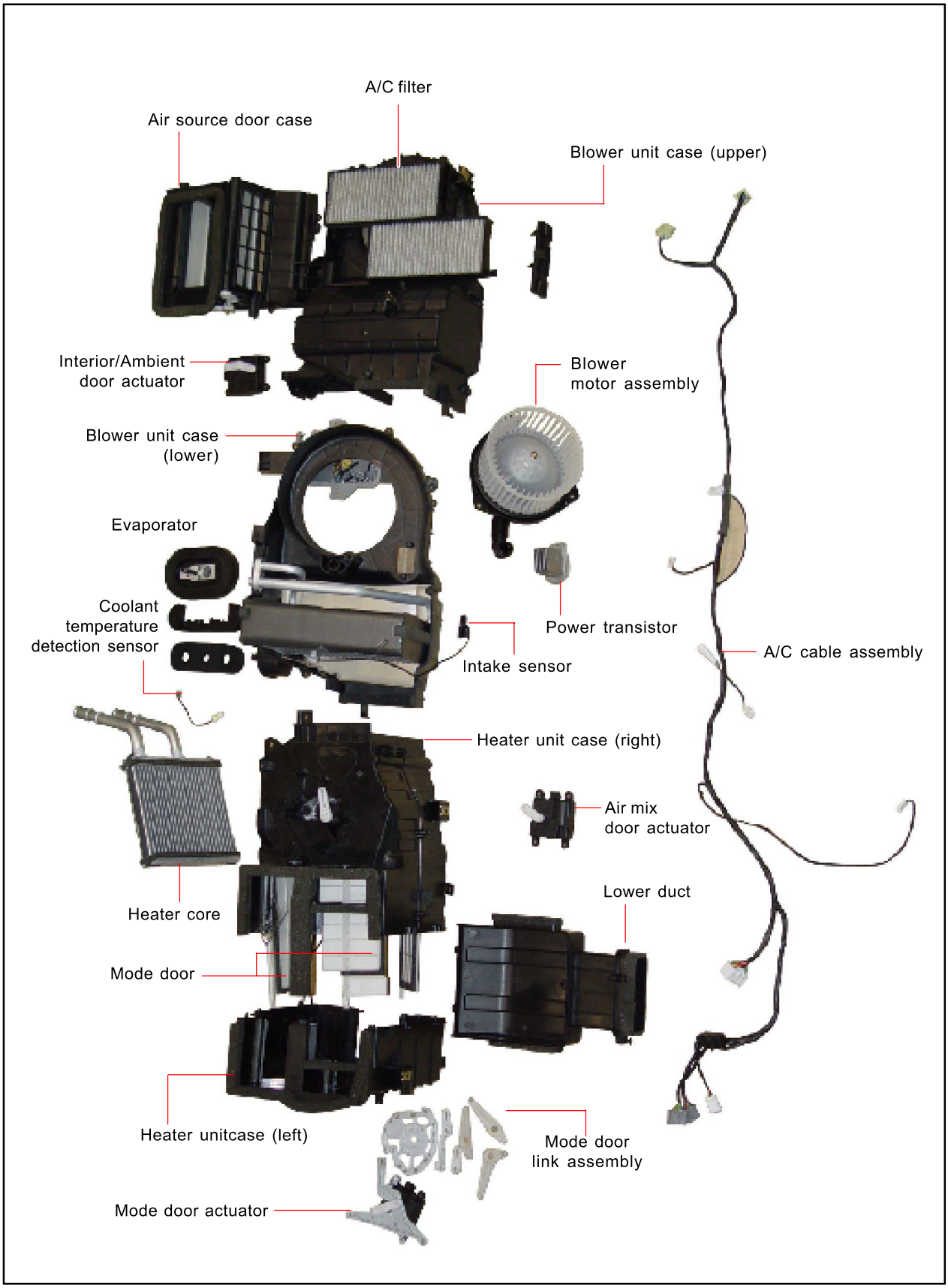
Interior Temperature Sensor (Interior Humidity Sensor)

H



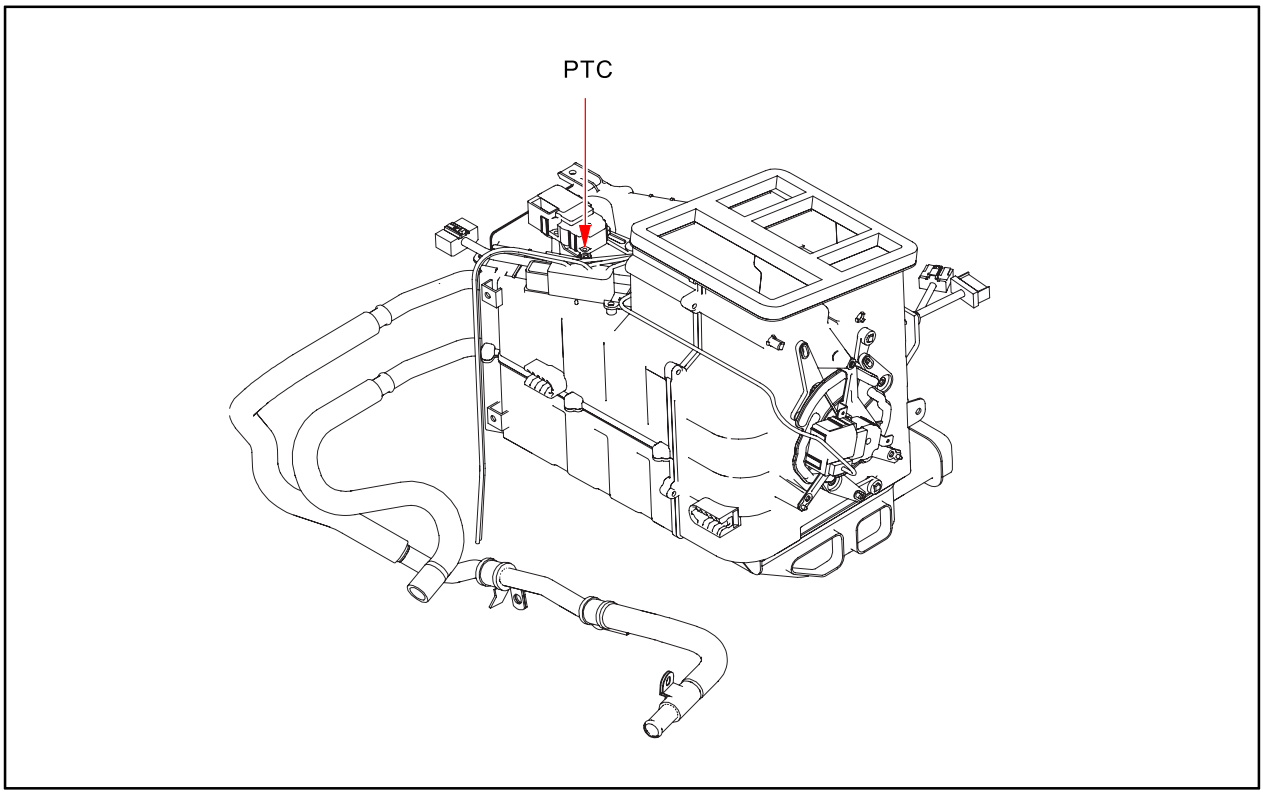
Modification basis	
Application basis	
Affected VIN	

2) Components

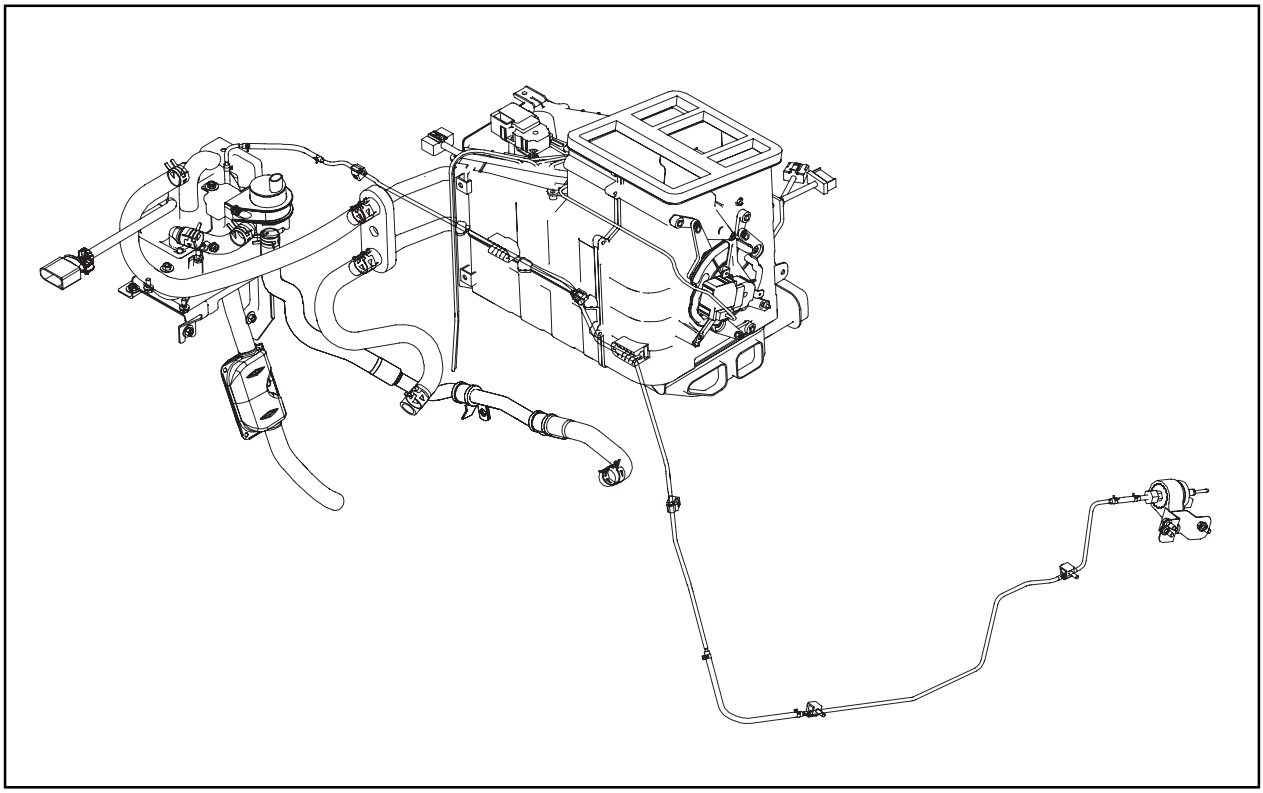


4. PTC HEATER AND FFH HEATER LAYOUT

1) PTC HEATER ASSEMBLY LAYOUT



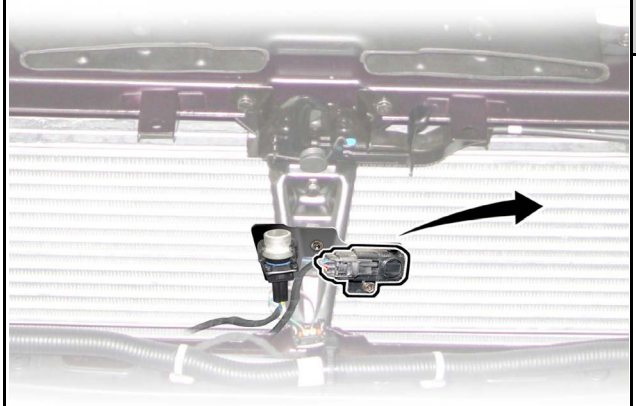
2) FFH HEATER ASSEMBLY LAYOUT



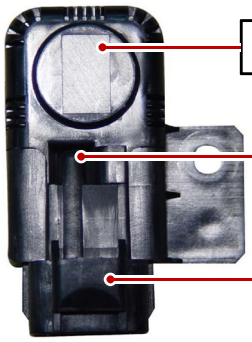
Modification basis	
Application basis	
Affected VIN	

5. AIR QUALITY SYSTEM (AQS)

1) COMPONENTS OF AQS



AQS sensor and ambient temperature sensor



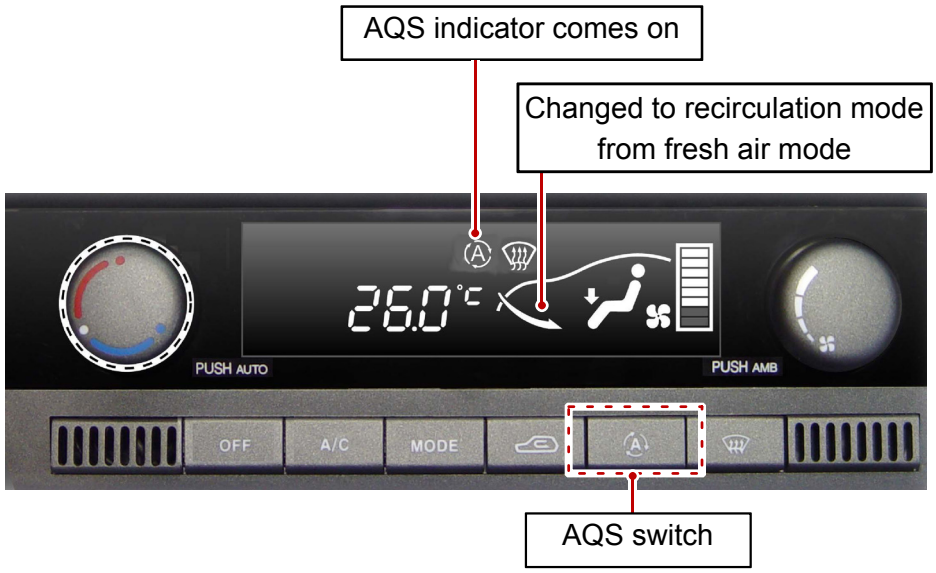
2) AQS OPERATION

1. Air Quality System (AQS) changes the air source selection to recirculation mode when polluted air is detected through AQS sensor. The air source selection returns back to fresh air intake mode after a specified period or the polluted air disappears.



Press the AUTO switch

2. When pressing the AQS switch, the AQS indicator on display window comes on, and the air source selection is automatically changed to recirculation mode (REC). At this moment, the self diagnosis and preheating mode of AQS is performed for 35 seconds.



CAUTION

- When pressing DEF switch during in this process, the AQS indicator goes out and the air source selection is changed to fresh air mode from recirculation mode.
- When pressing the AQS switch again, the self diagnosis and preheating mode of AQS operates only for the remaining time.

Modification basis	
Application basis	
Affected VIN	

3. After the self diagnosis and preheating mode of AQS is completed, the AQS system operates according to the air pollution.
   If the air pollution is not serious, the AQS system changes the air source selection to fresh air mode.
4. Although turning off the air conditioner while the AQS is in operation, the AQS stays ON (indicator on). However, if the air conditioner is turned on by turning the ignition switch ON from OFF, the AQS stops its operation and the indicator goes out and the display window shows the initial screen.

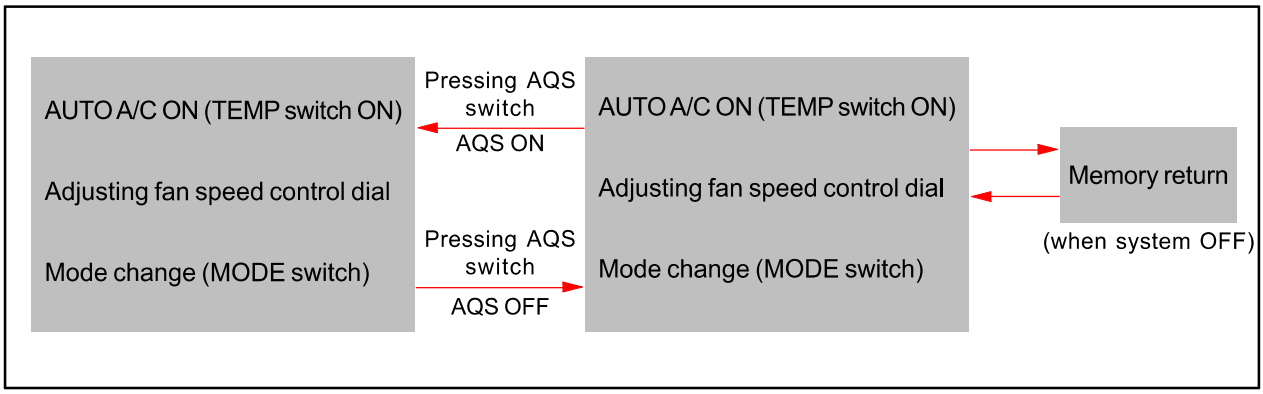


CAUTION

- If the AQS switch is pressed in, the AQS function works regardless of air conditioner controller operation.

5. The modes available AQS function:
   - AUTO mode
   - Fan speed control dial operation mode
   - A/C switch operation. At this mode, the AQS system operates according to the AQS switch operation.

CAUTION
- If the ignition switch is turned off with AQS ON, the AQS is turned on when turning the ignition switch on again.



6. The AQS is turned off:
   - When pressing the defroster switch
   - When pressing the recirculation mode switch

Modification basis	
Application basis	
Affected VIN	

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.



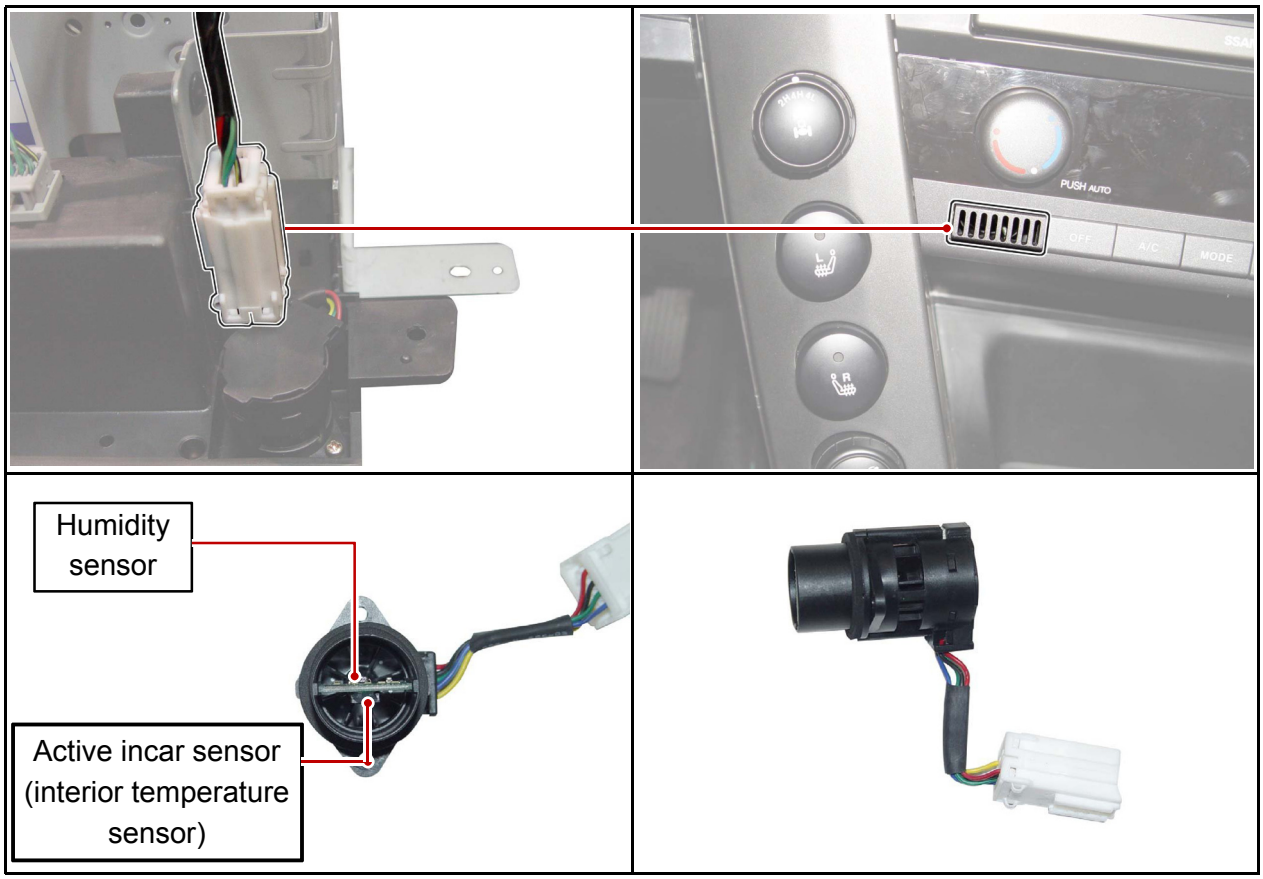
▶ Inspection

- 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.

2) Active Incar/Humidity Sensor: AIH Sensor

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

(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 senor hole and then sends the voltage value according to the changed resistance to FATC controller.

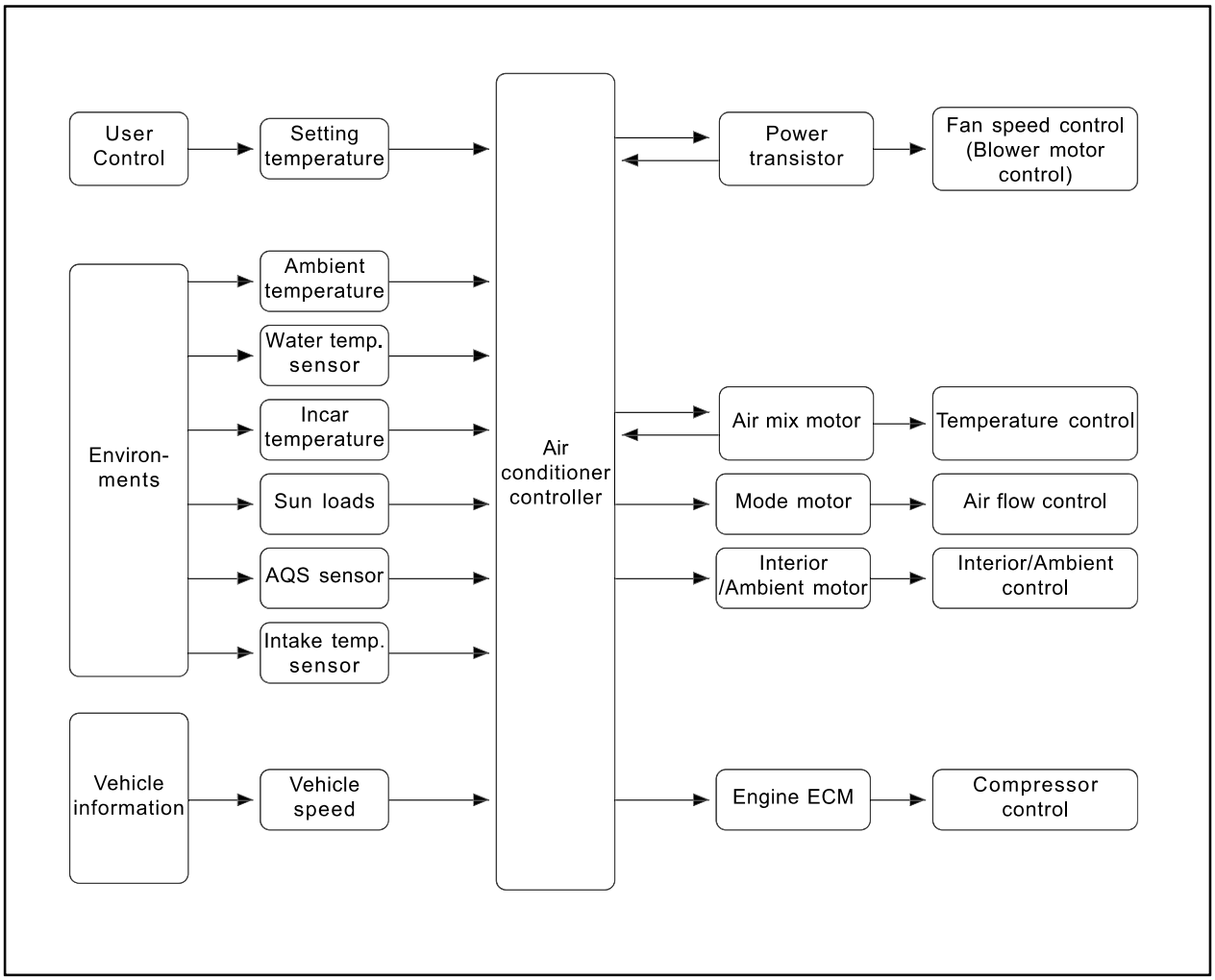
▶ **Humidity sensor**

This sensor detects the interior humidity with humidity cell and then sends the voltage value according to the changed humidity to FATC controller.

Modification basis	
Application basis	
Affected VIN	

7. AIR CONDITIONER SYSTEM DIAGRAM

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



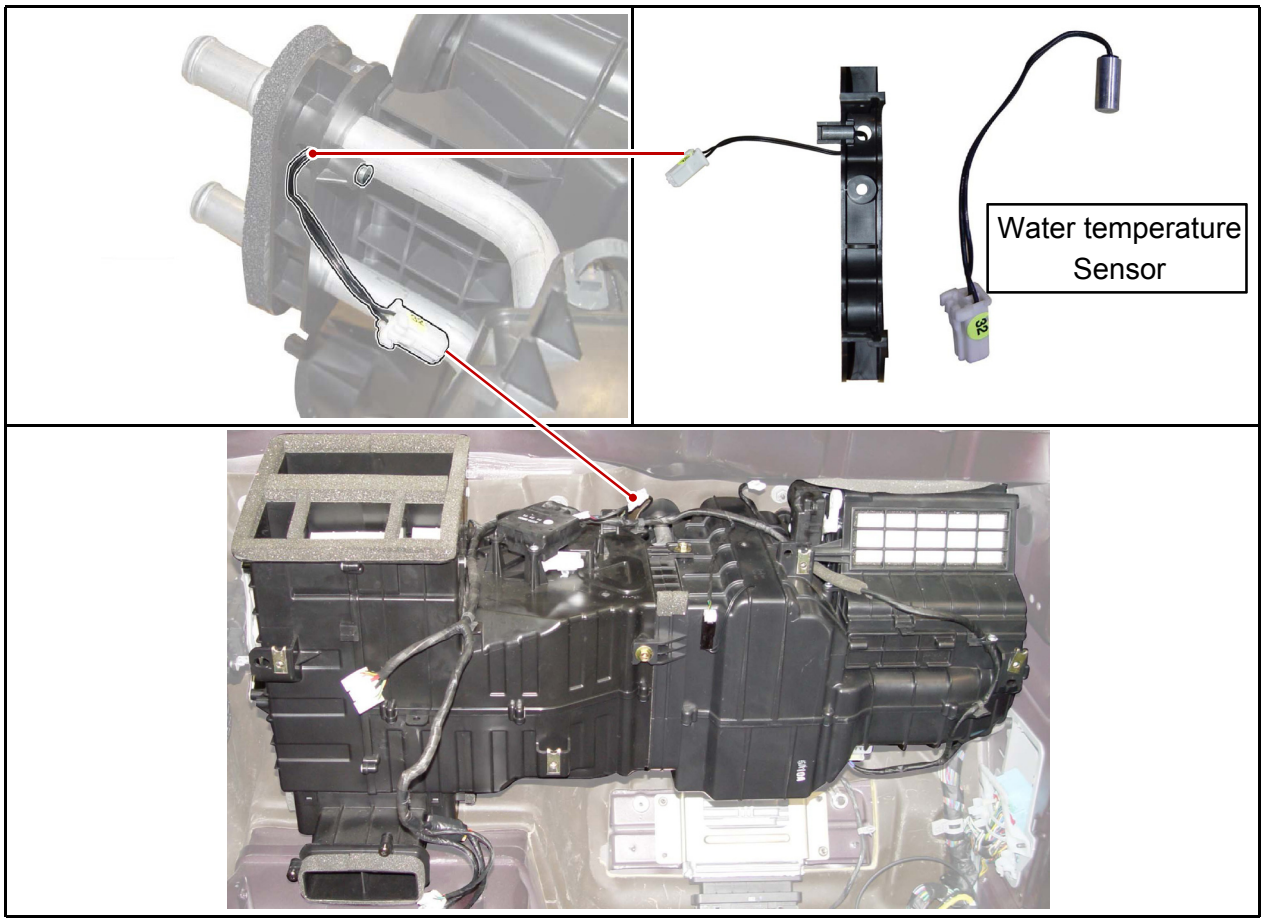
1) Air Conditioner Compressor Control by Engine ECU

In case of current 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.

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

8. AIR CONDITIONER MODULE SENSORS AND ACTUATORS

1) Water Temperature Sensor



(1) Inspection

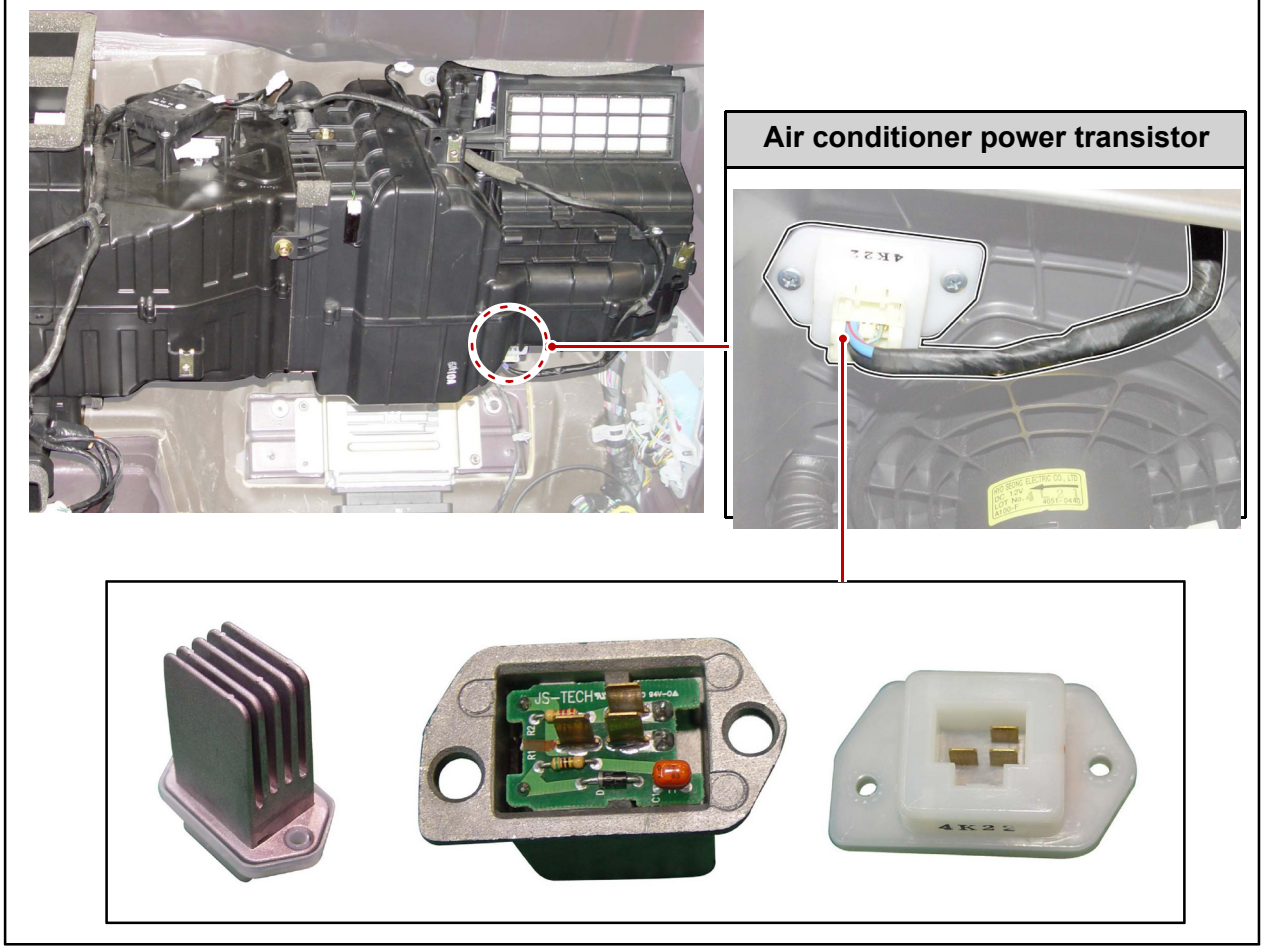
If the water temperature sensor defect code (DTC 3) is set, check as below.

- 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.

Modification basis	
Application basis	
Affected VIN	

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:

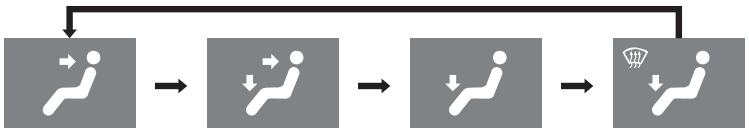
Stage	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Blower (V)	4.5	6.0	7.5	9.0	11	Max HI

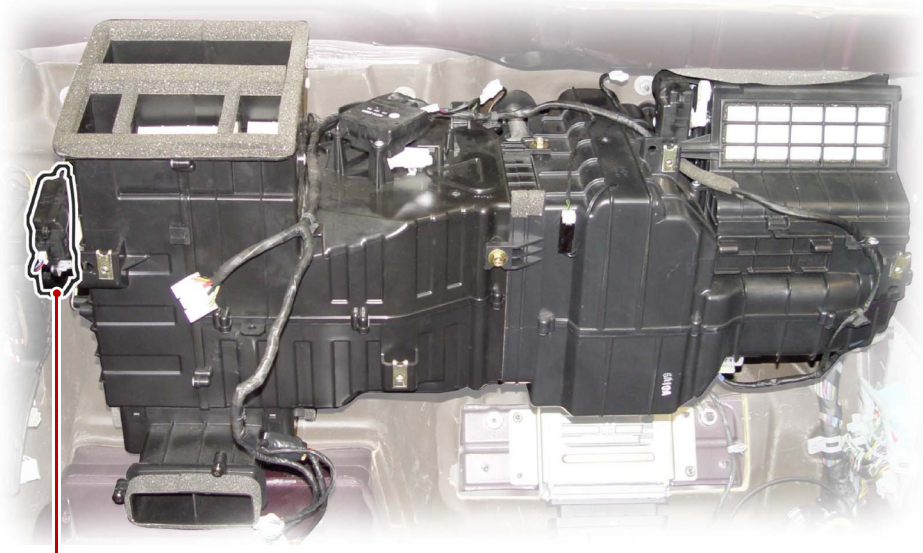
- If the voltage is out of specified value, check the circuit for open. If the circuit is in normal condition, replace the power transistor.

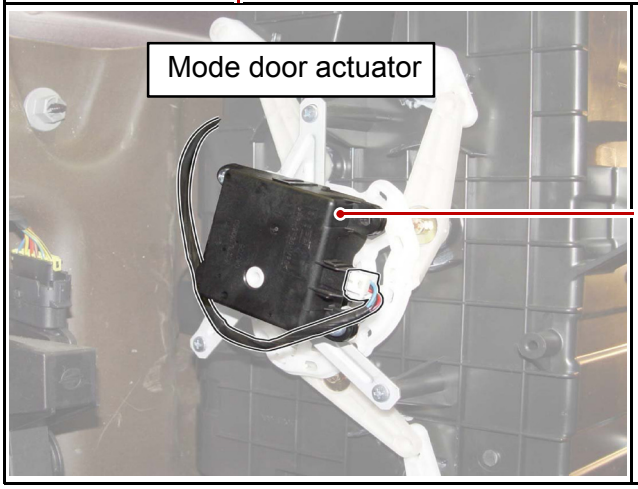
3) Mode Door Actuator

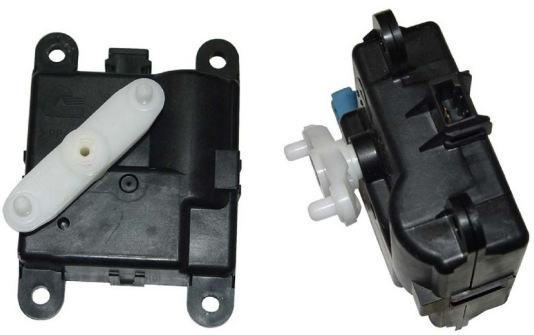
The mode door actuator is an actuator that closes, opens and adjusts the mode door for VENT, FOOT and DEF mode to change the air flow directions according to FATC controller. Under the FATC controller AUTO mode, it stays on DEF mode until the engine coolant temperature reaches at normal operating level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







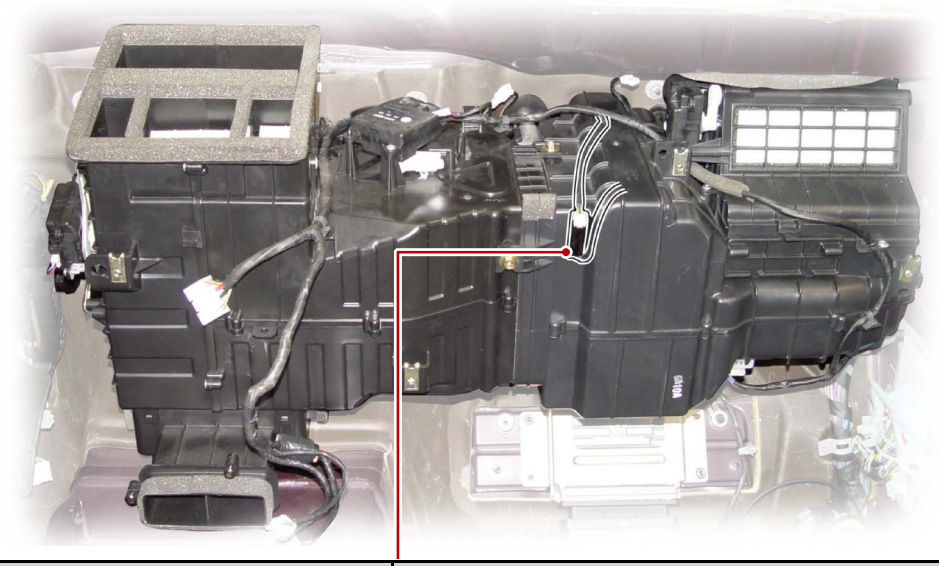


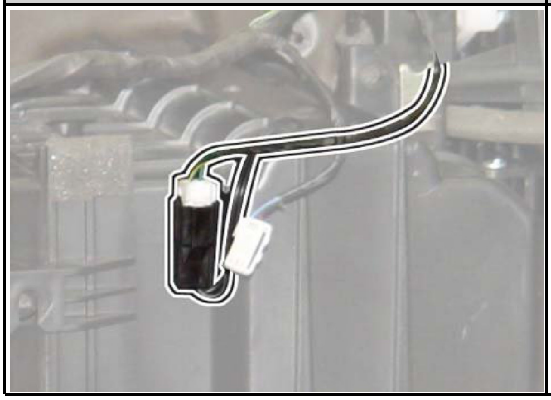


Modification basis	
Application basis	
Affected VIN	

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.

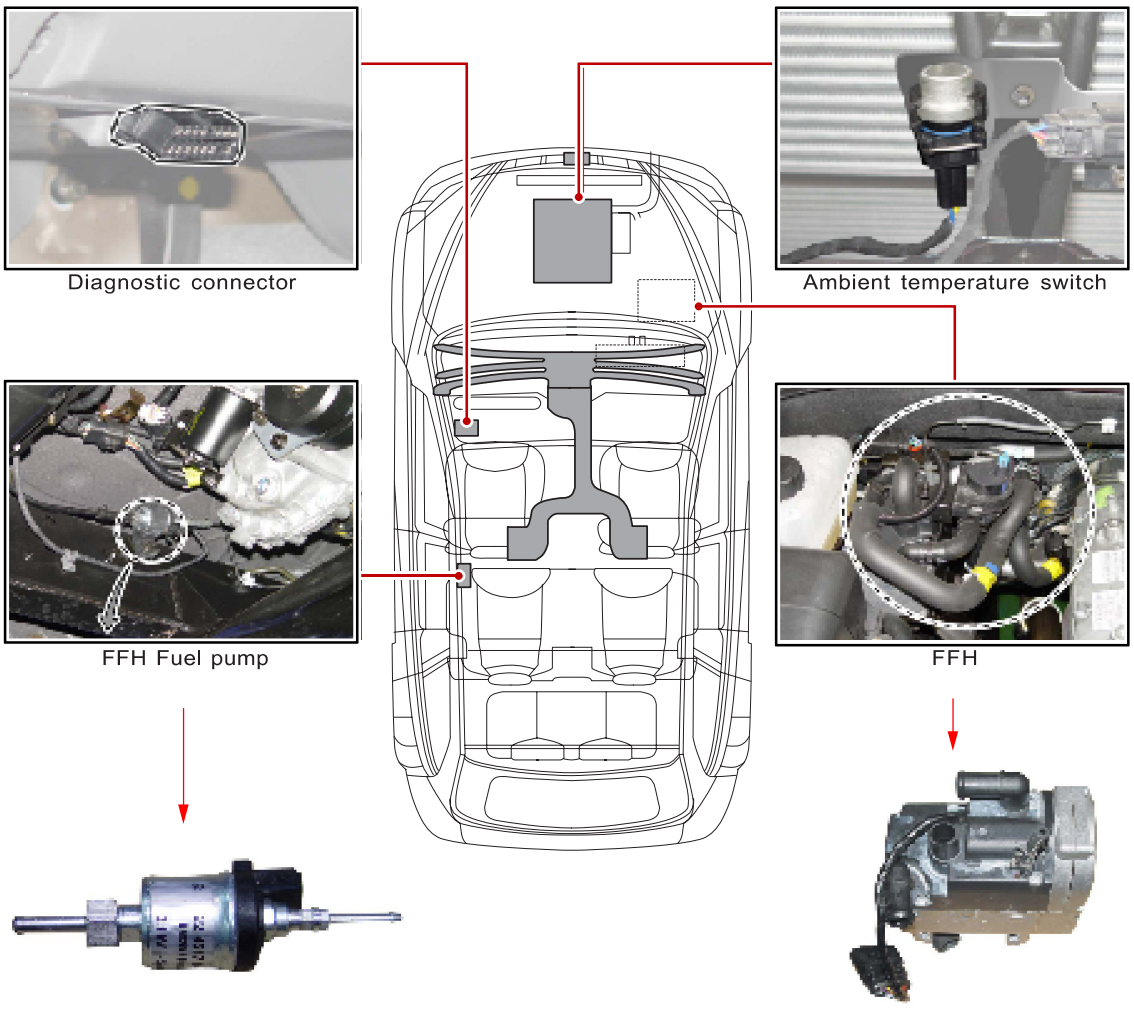
9. FFH (FUEL FIRED HEATER) SYSTEM COMPONENTS

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



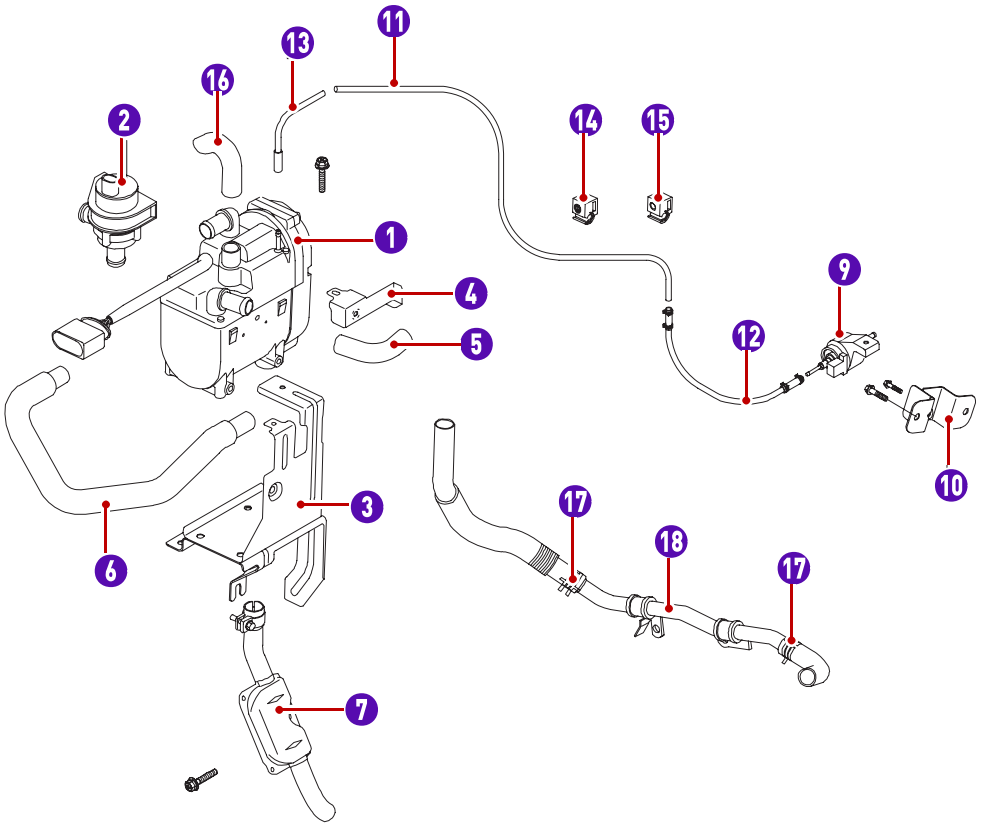
Modification basis	
Application basis	
Affected VIN	

2) FFH LAYOUT

(1) Components

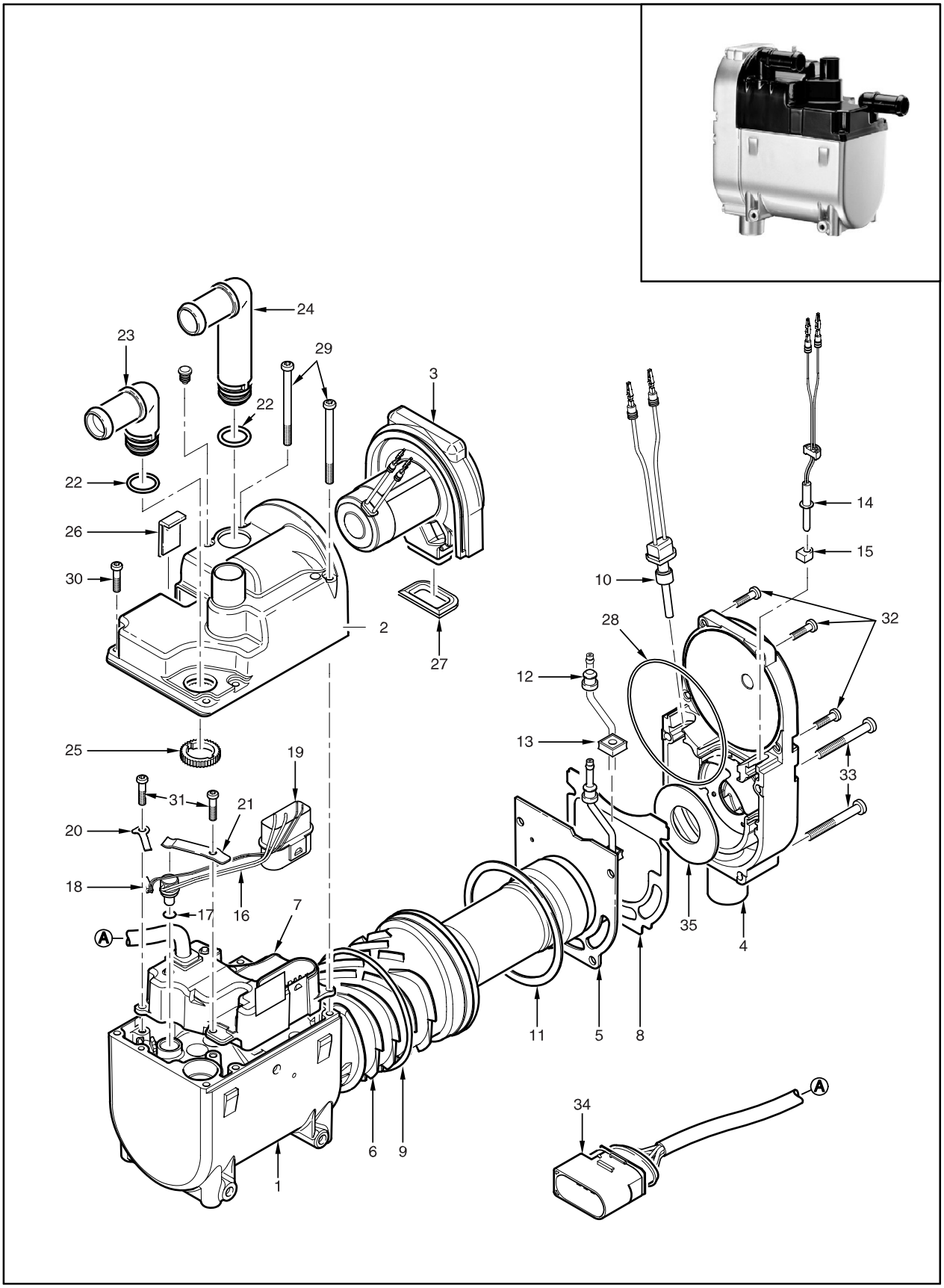




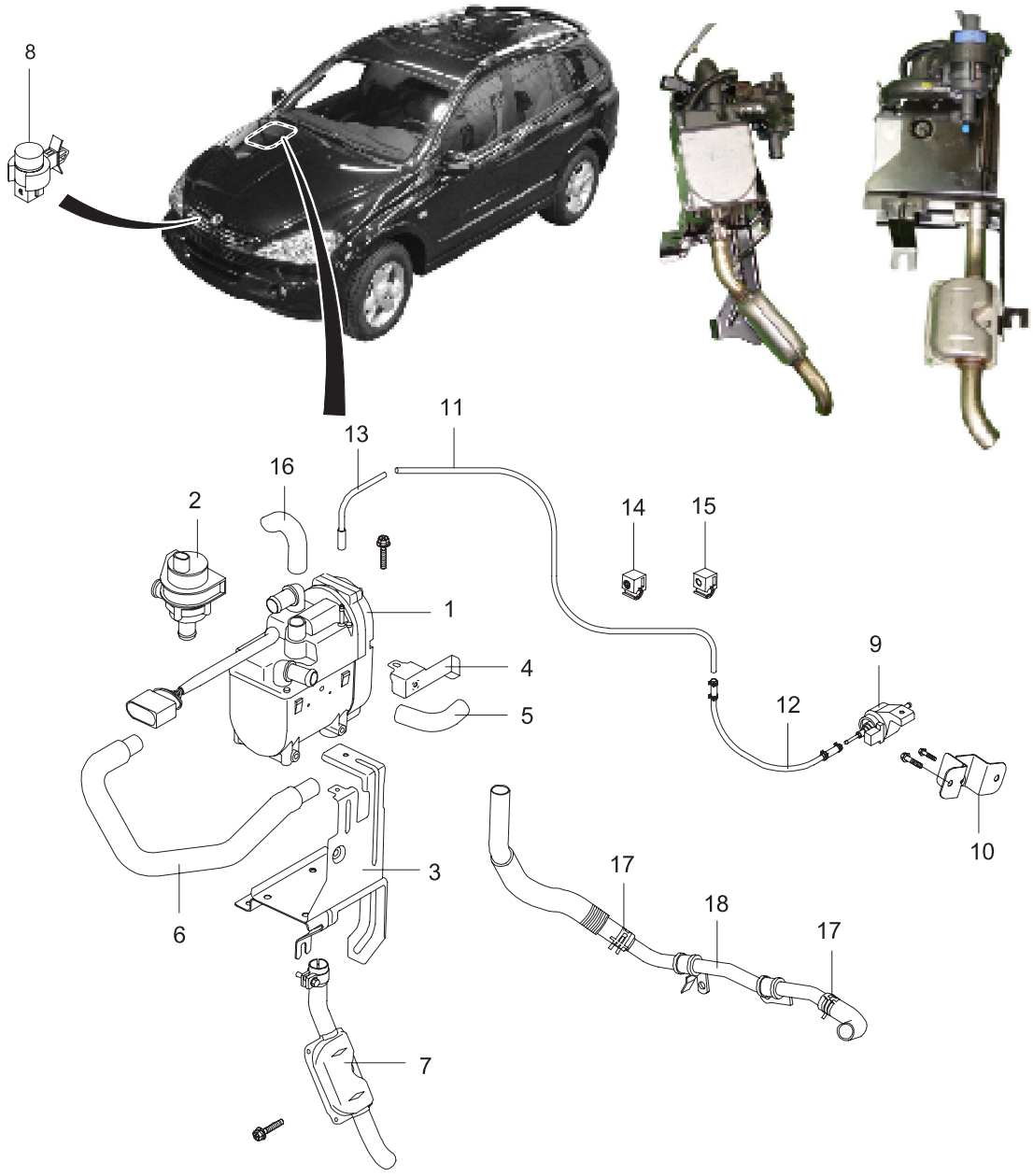


1. FFH assembly	7. FFH pipe assembly & silencer	13. Fuel pipe NO.3
2. Water pump and bracket assembly	8. Ambient temperature switch	14. Tube clip mounting
3. FFH bracket assembly	9. FFH fuel pump	15. Tube clip mounting
4. FFH water pump bracket	10. Fuel pump bracket	16. Intake hose
5. FFH NO.3 inlet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

(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

Modification basis	
Application basis	
Affected VIN	

(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	

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**

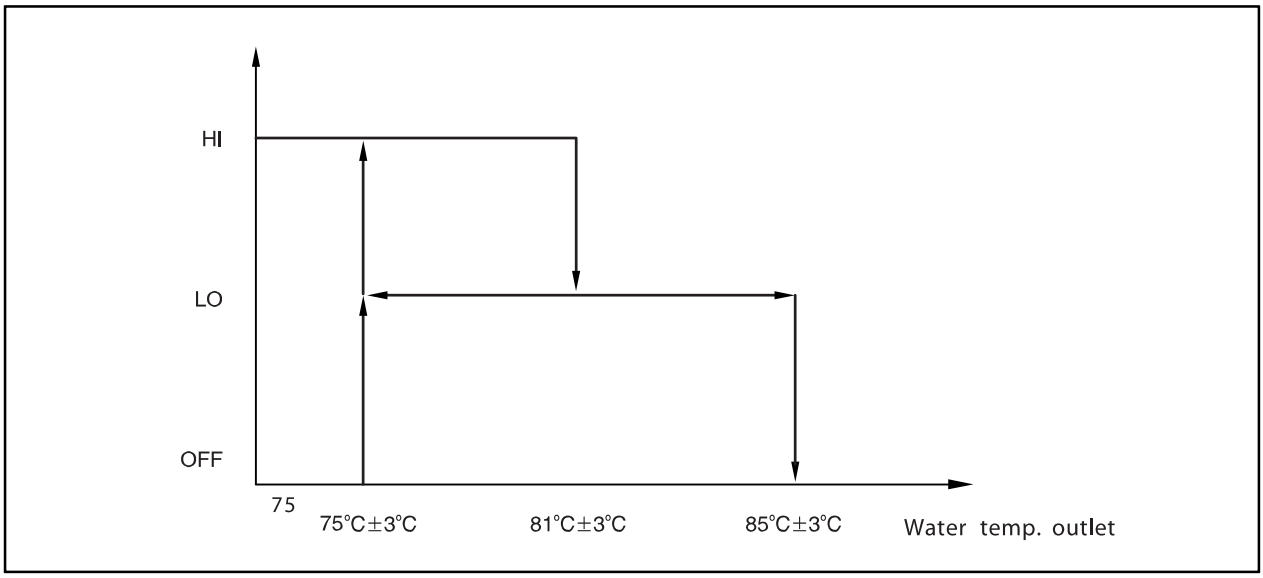
- Ambient temperature: below 5°C
- Coolant temperature: below 75°C

▶ **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.

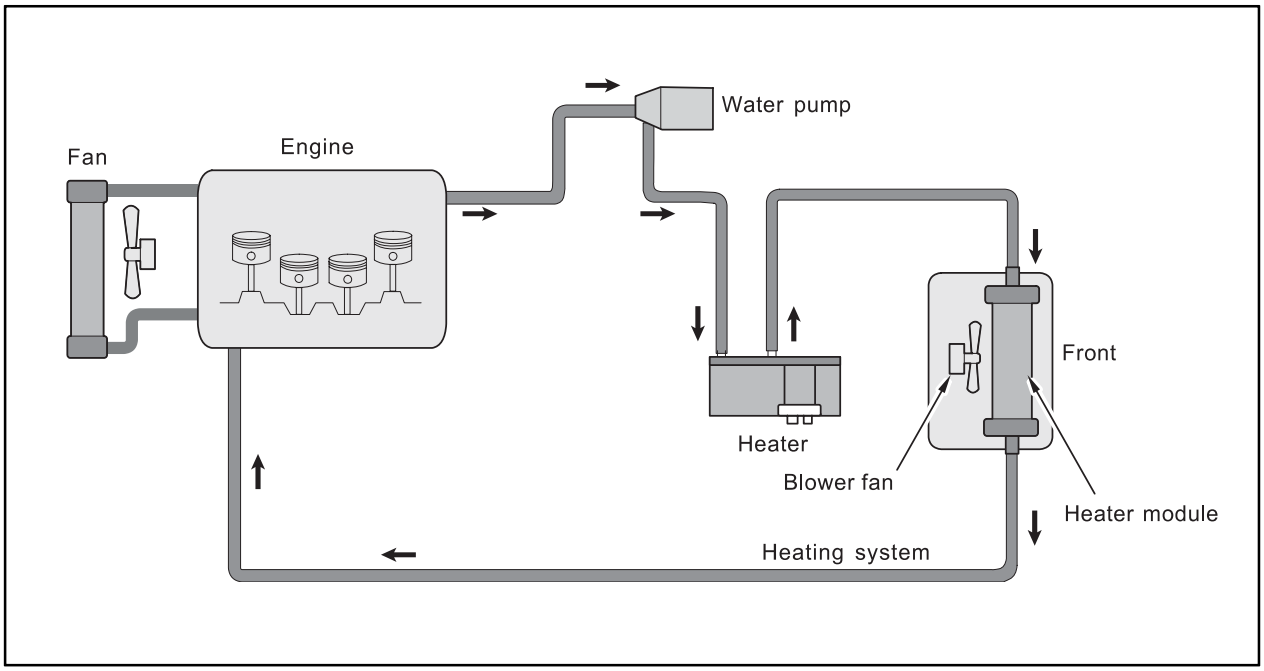
(2) FFH Operations According To the Changes of Coolant Temperature



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.

Modification basis	
Application basis	
Affected VIN	

2) Coolant Circulating Route



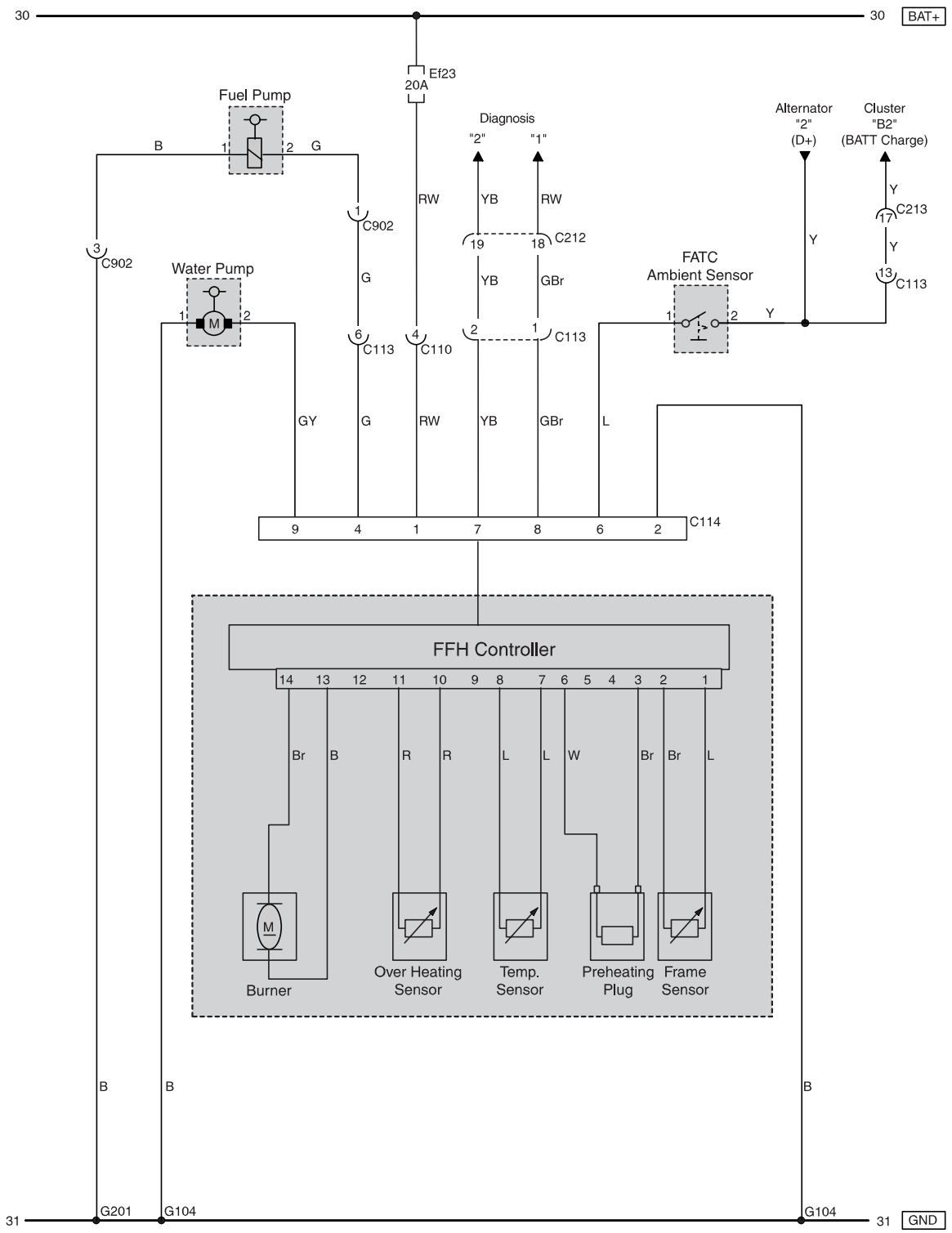
3) Connecting the Coolant Circuit

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.

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

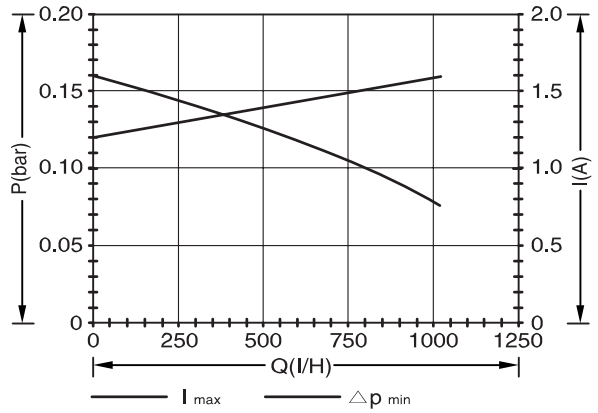
If an emergency shutdown -EMERGENCY OFF- is necessary during operation, proceed as follows;

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

6) Specification - Water Pump

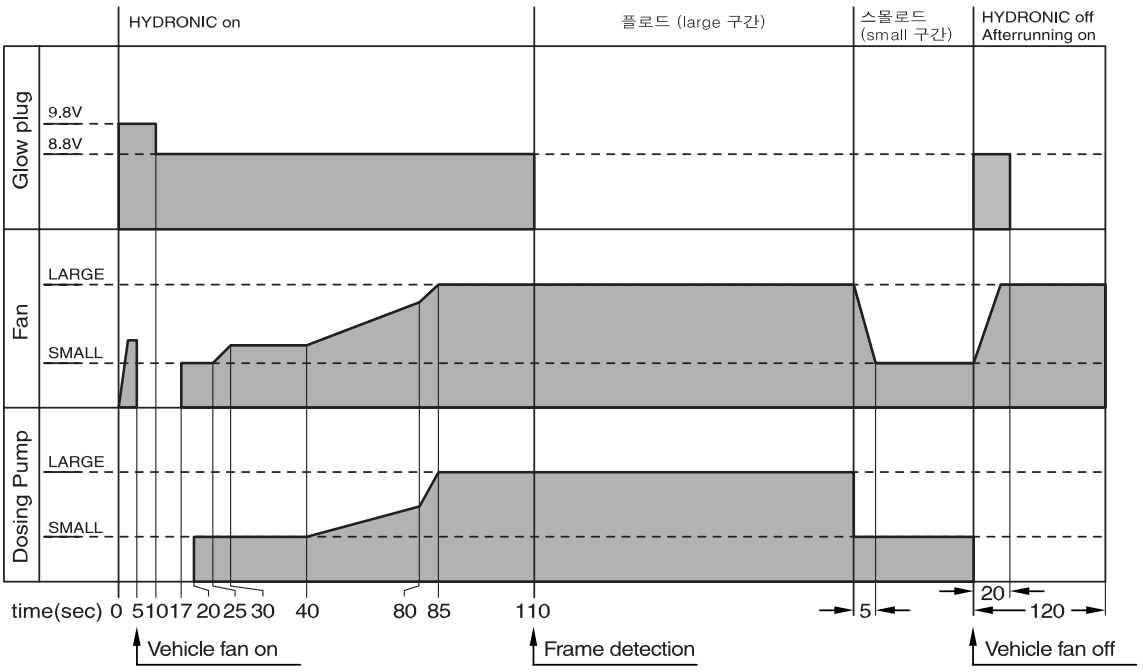
Rated voltage	12 V
Operating voltage	9 V ~ 15 V
Power consumption	16 W
Pumping capacity (0.1 bar)	800 l/h
Operating temperature	-40°C ~ 135°C
Weight	0.28 kg

7) Characteristic Curve of Water Pump (12 V)

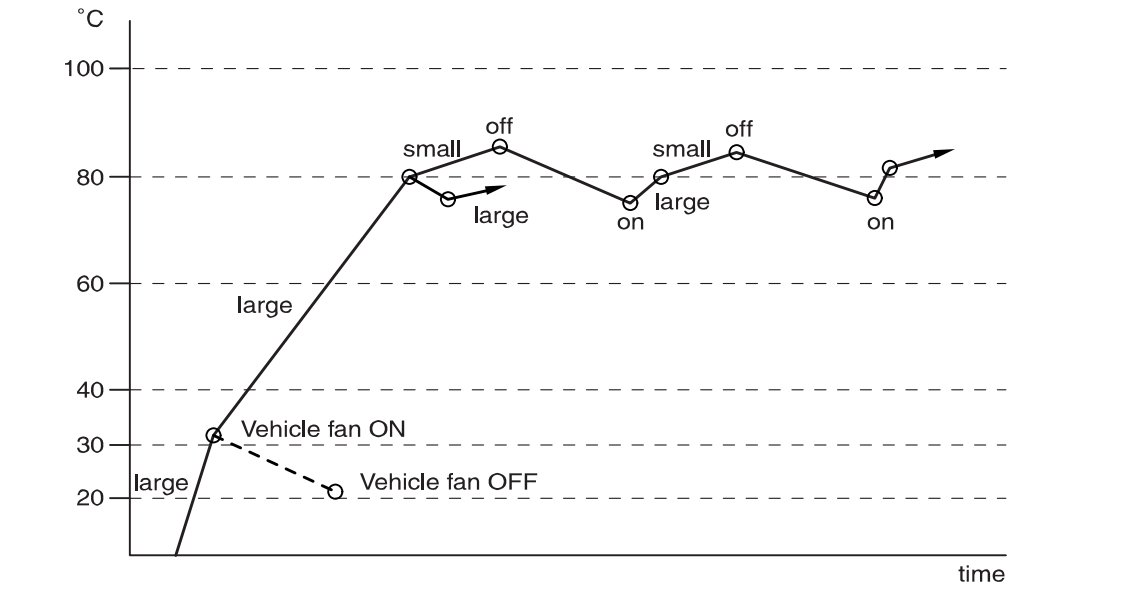


Modification basis	
Application basis	
Affected VIN	

8) Function Diagram



9) Switching Diagram According to Temperature Changes



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

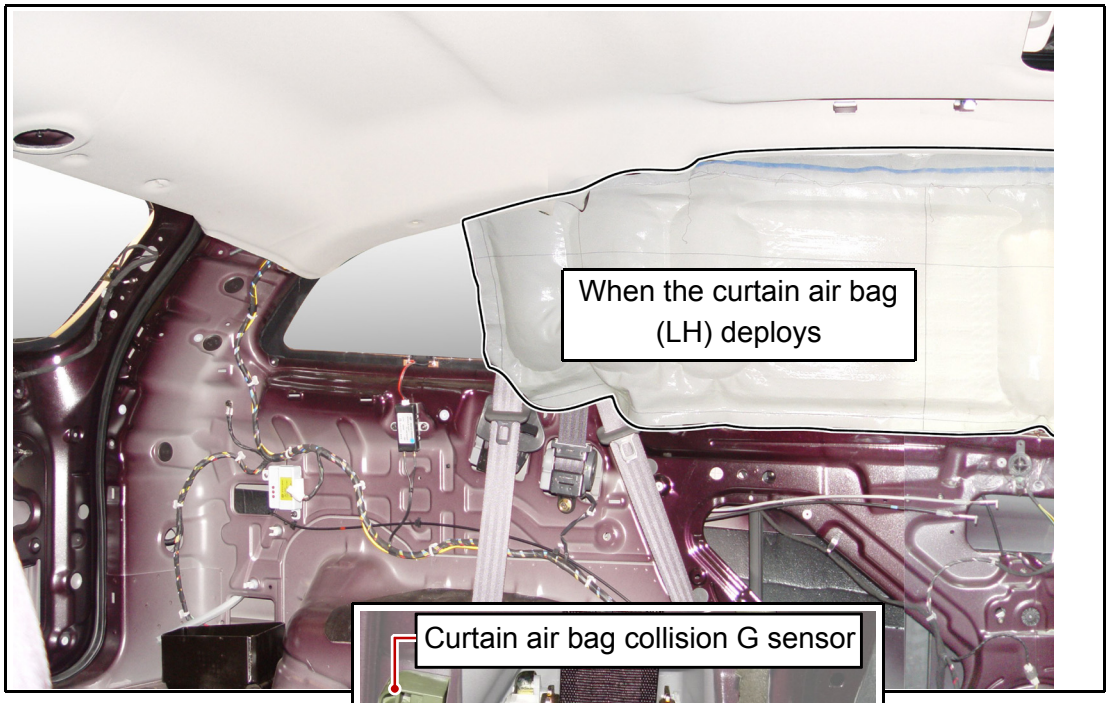
- When an air bag deploys (curtain air bags and seat belt pretensioners included), the air bag unit must be replaced. Please do not attempt to delete the failure code with SCAN-100 because some data about the deployment situation are stored in the unit.
- The air bag related components, especially the 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	

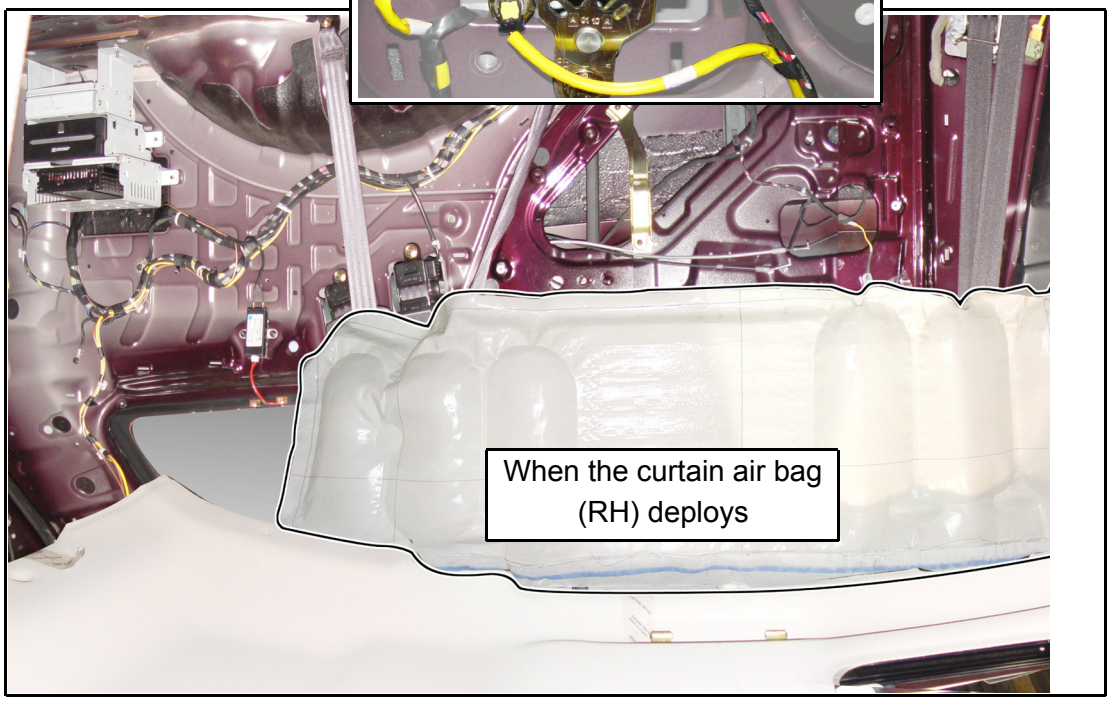
Memo

2. LOCATIONS AND RELATED COMPONENTS

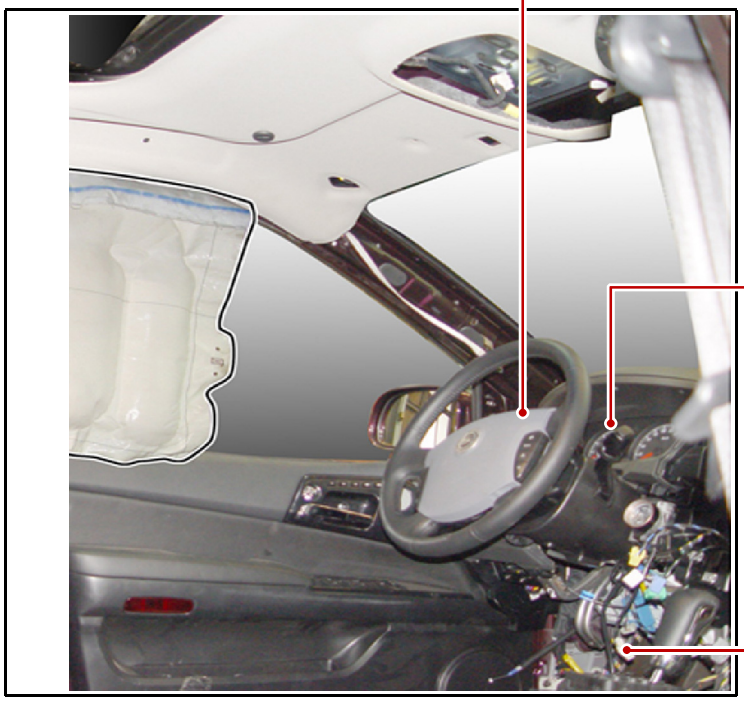
▶ LH

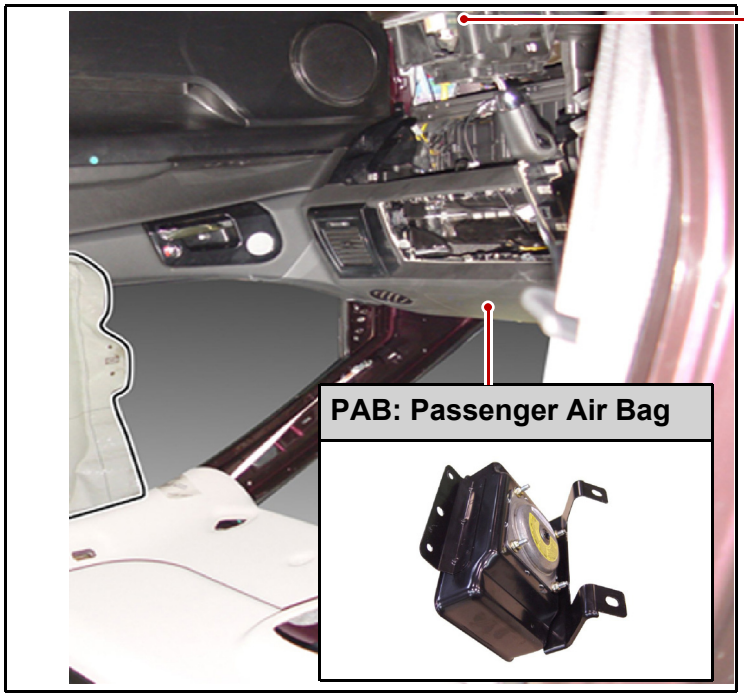


▶ RH



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.

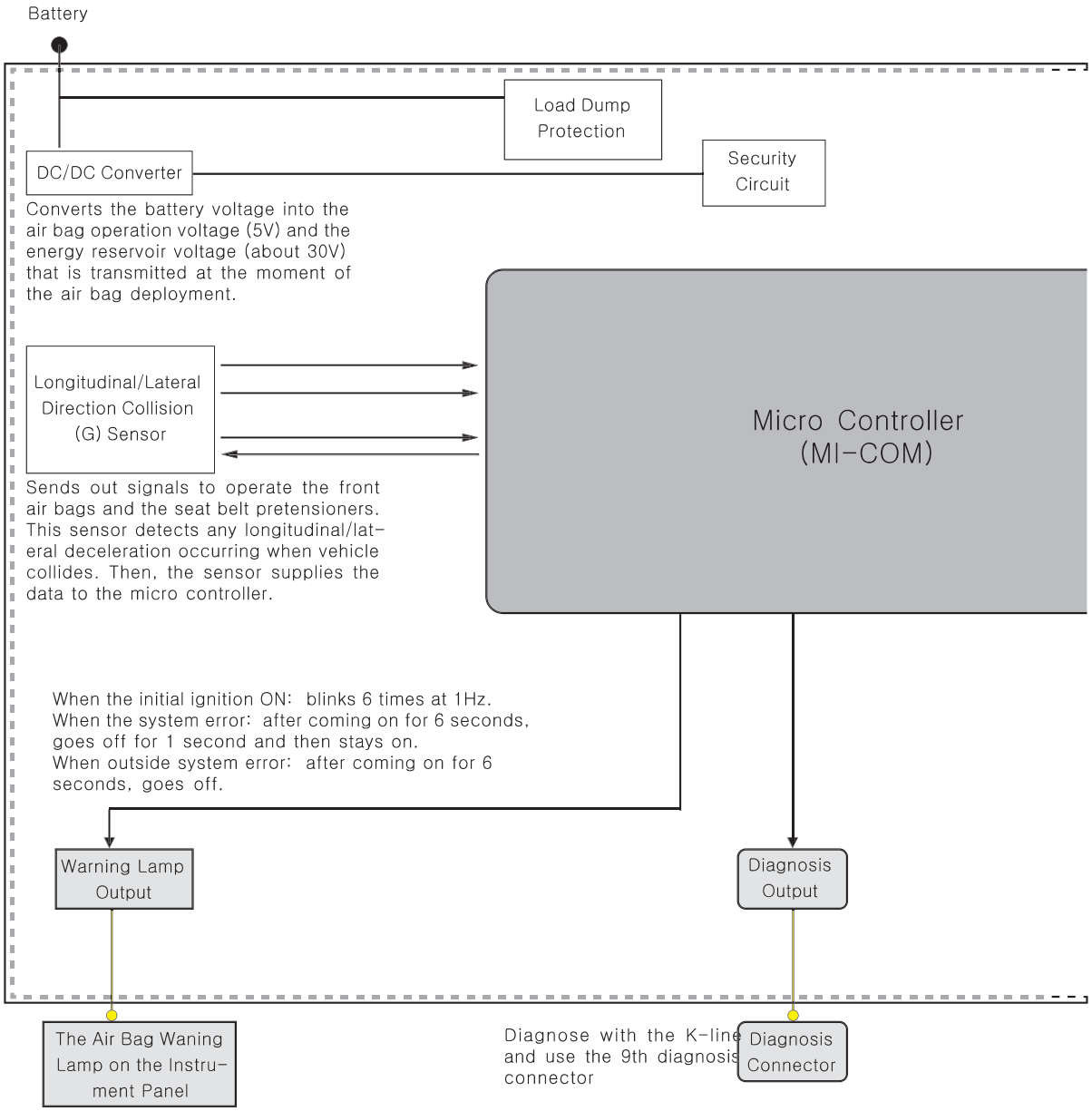
PAB: Passenger Air Bag

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.

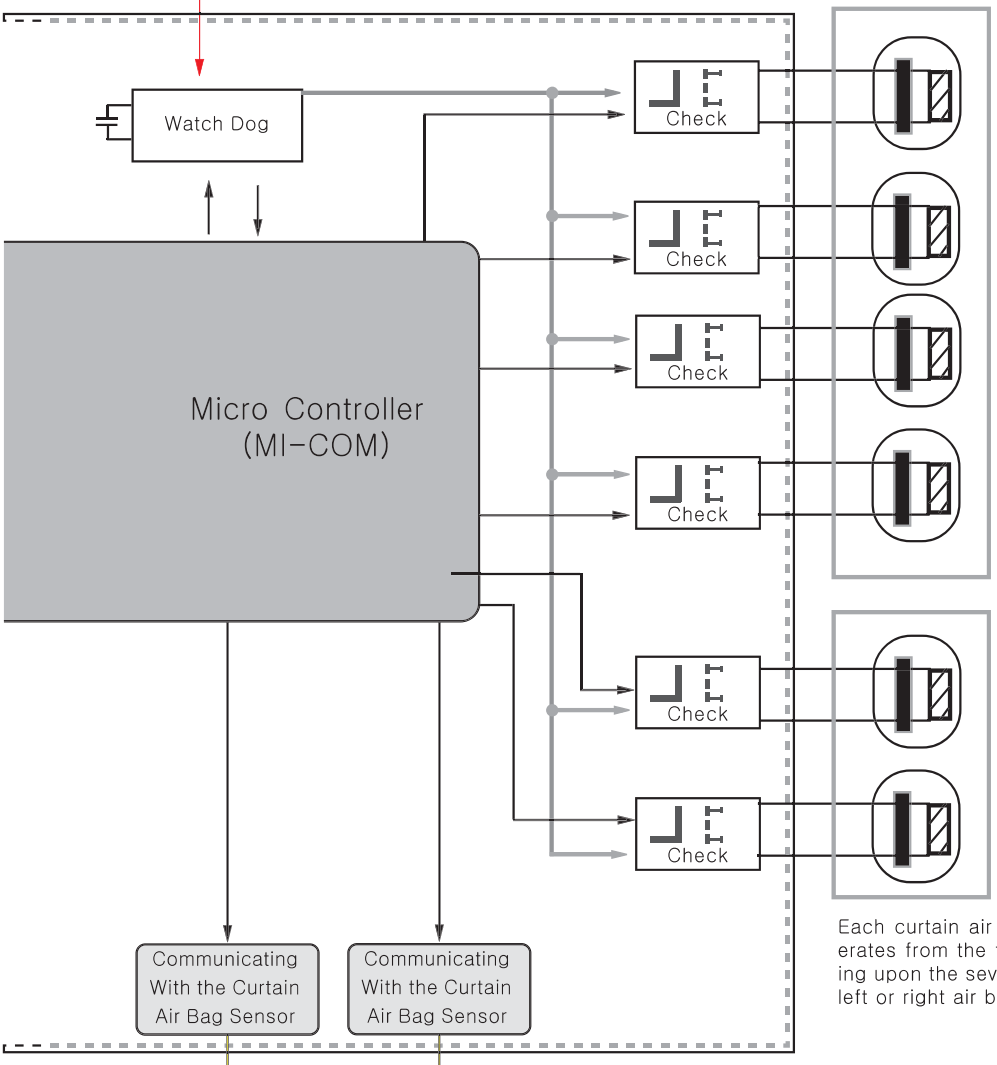
▶ **Air Bag System Block Diagram (Functions and Roles Included)**



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.

4. AIR BAG MODULE AND OTHER COMPONENTS

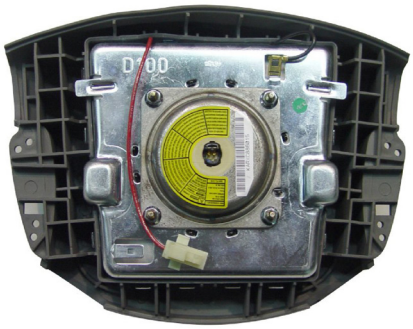
This section describes the air bag module installed in Kyron.
The module consists of the inflator, the cushion, and the mounting cover.

1) DAB: Driver Air Bag

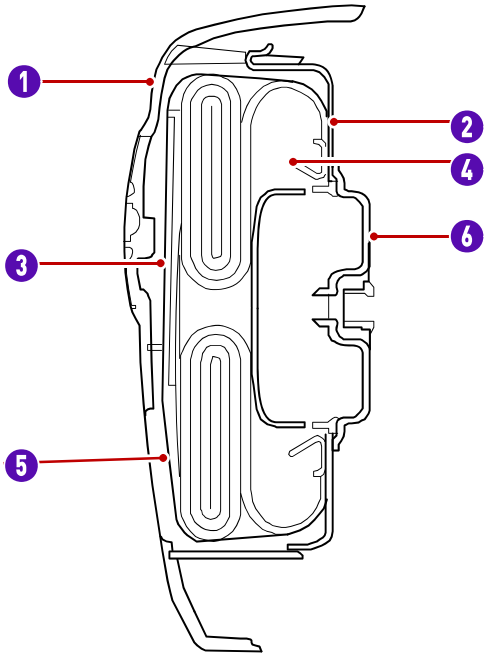
The driver's air bag is installed inside the steering wheel.
If the acceleration sensor (inside the air bag unit) is activated by the deceleration from vehicle collision, the detonation is fired by the electrical signal of the air bag unit.
Then, the detonation sets off explosives and nitrogen gas is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

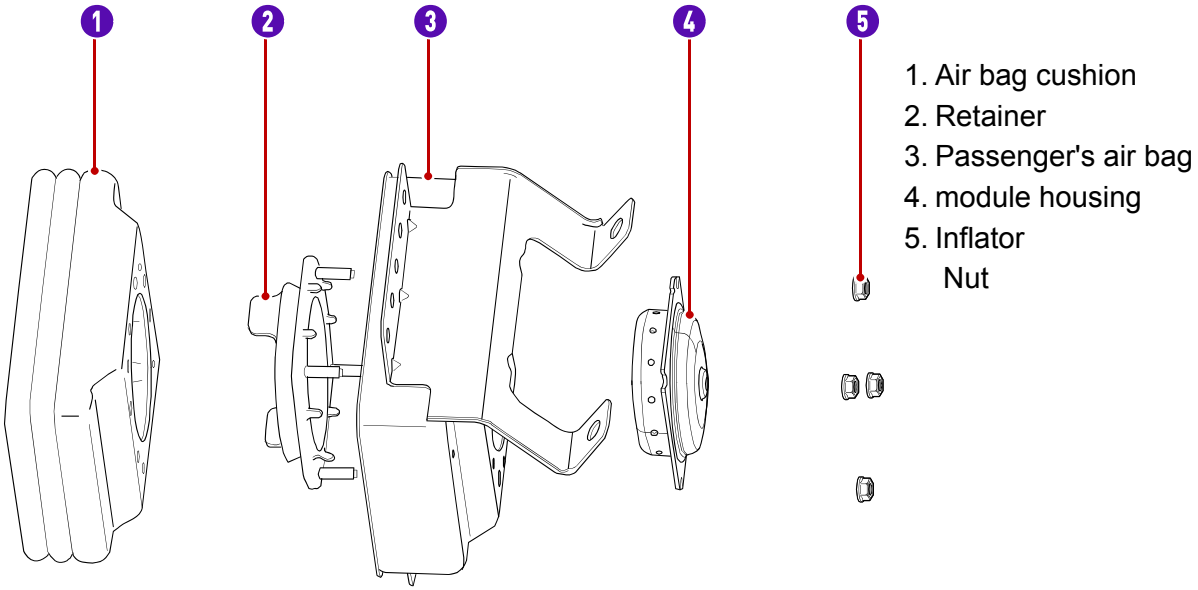
Modification basis	
Application basis	
Affected VIN	

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



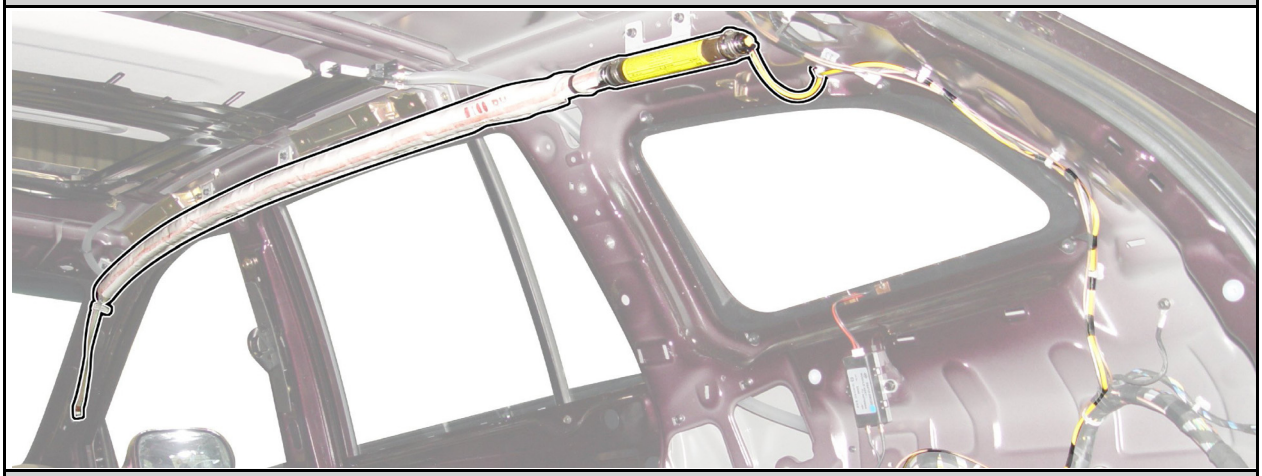
1. Air bag cushion
2. Retainer
3. Passenger's air bag
4. module housing
5. Inflator
   Nut

3) Curtain Air Bag (CAB)

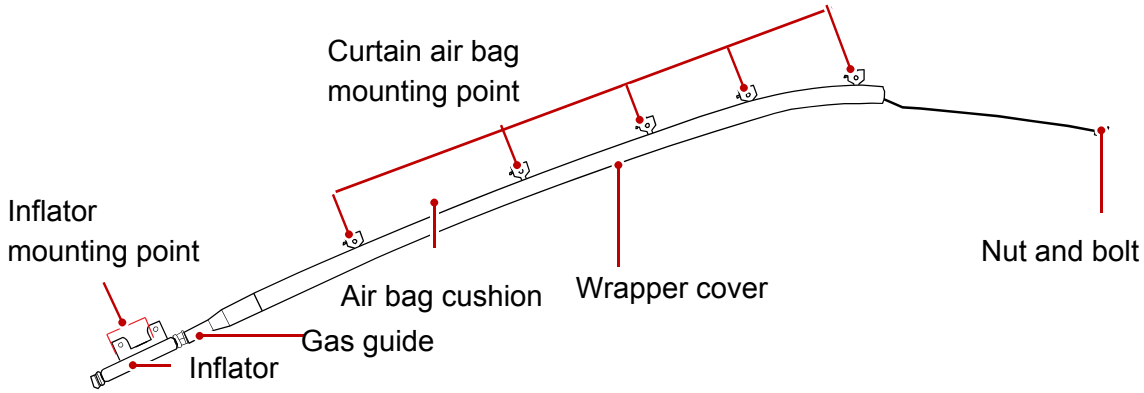
The curtain air bags are installed on both sides of the roof side rails and inside the headlinings. Each curtain air bag is also composed of the air bag cushion and the inflator that has the detonator, explosives, and the gas generator.

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.

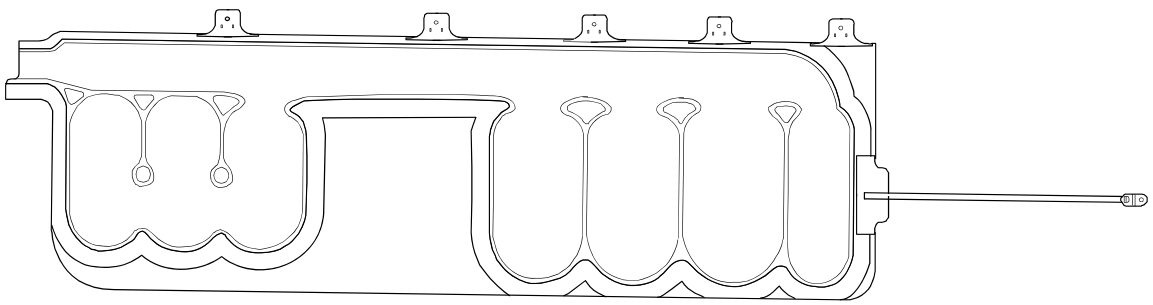
When the Curtain Air Bag is Installed



Terms of the Curtain Air Bag



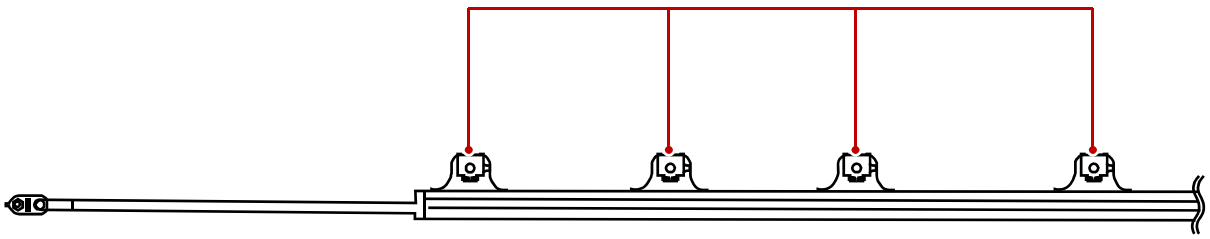
When the Curtain Air Bag Deploys



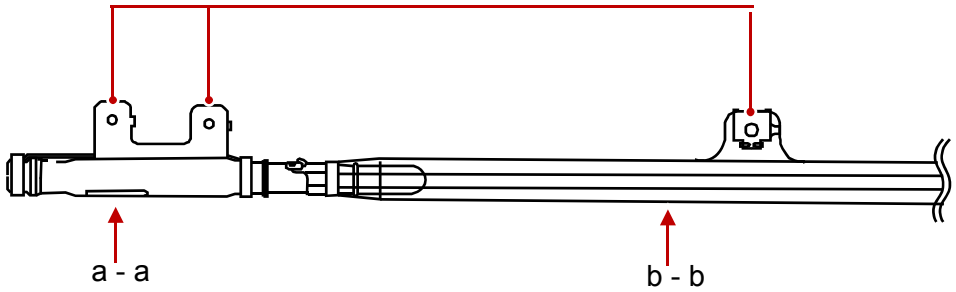
Modification basis	
Application basis	
Affected VIN	

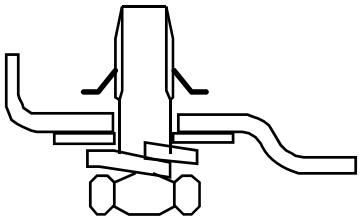
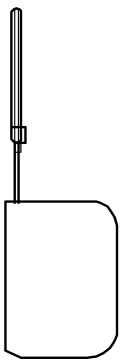
(1) Components

Tightening torque: 8 ~ 10 Nm



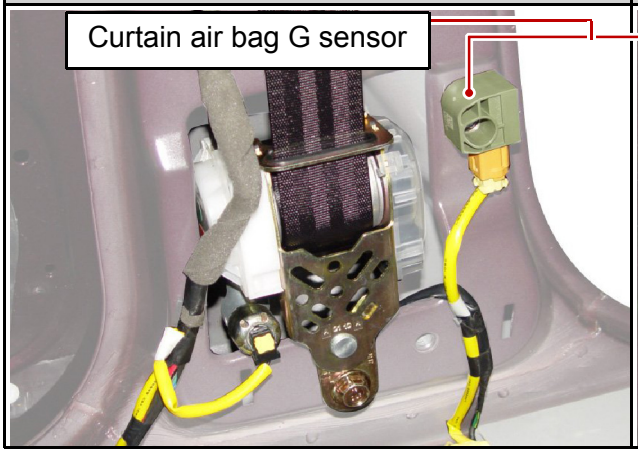
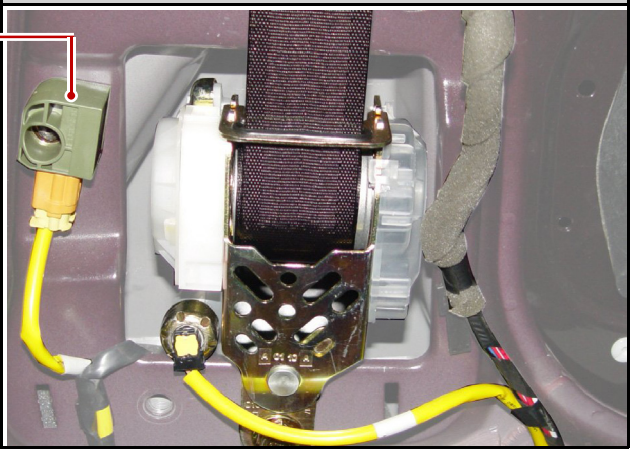
Tightening torque: 8 ~ 10 Nm



Sectimal view a-a	Sectimal view b-b
	

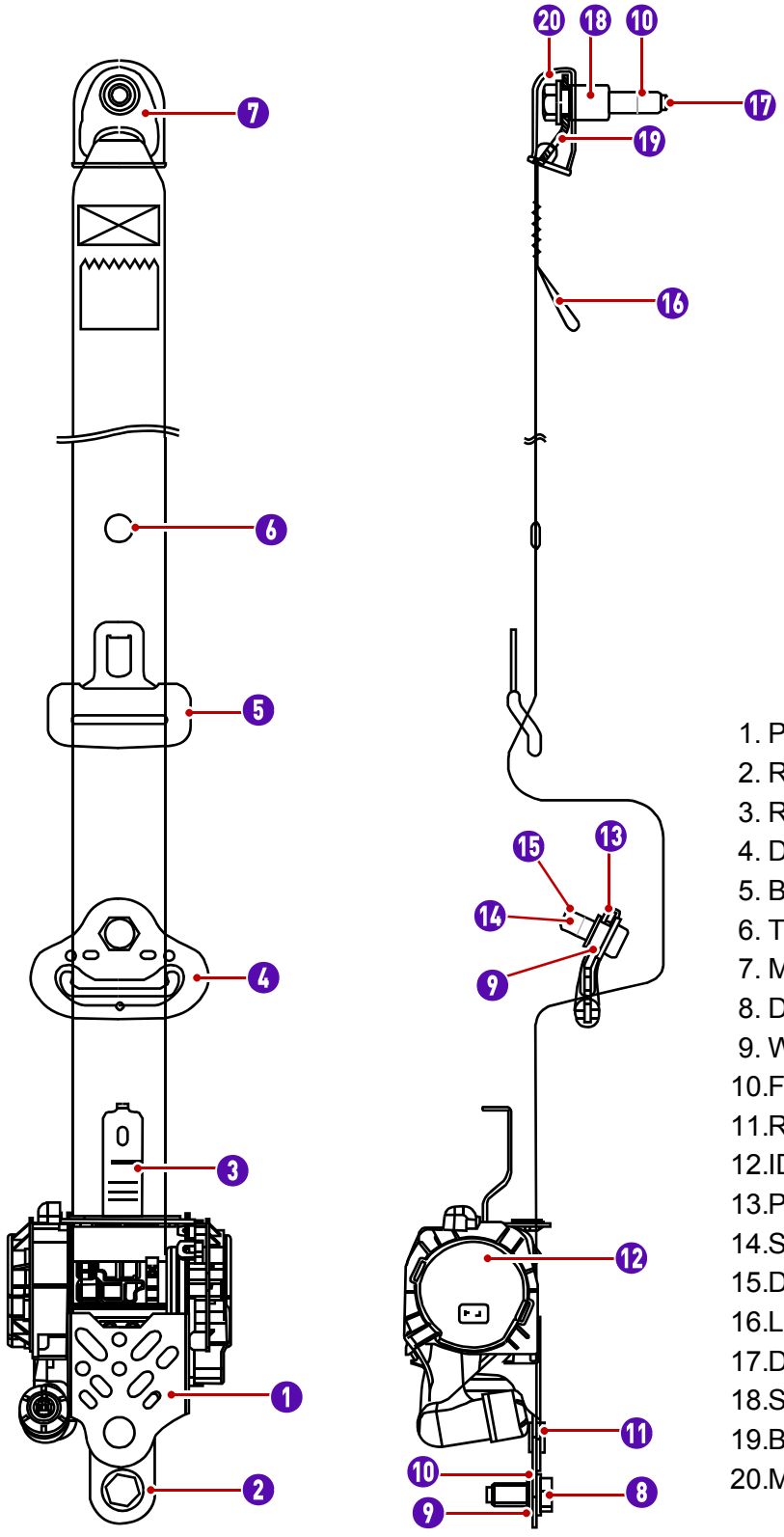
4) Driver and Passenger BPT (Belt Pre-Tensioner)

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

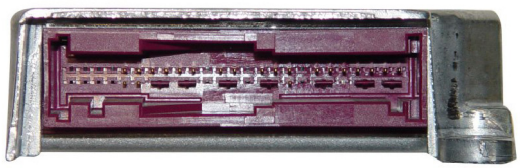
Modification basis	
Application basis	
Affected VIN	

5)Air Bag Unit

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



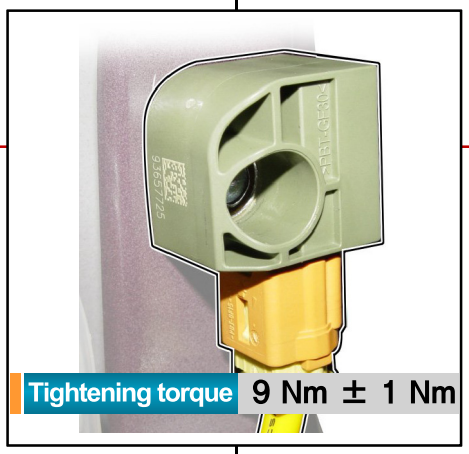
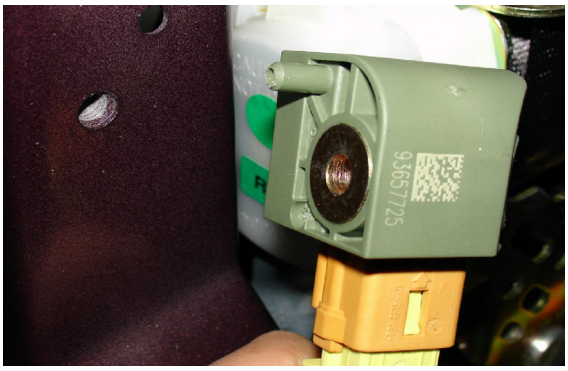
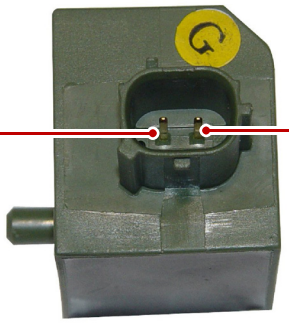
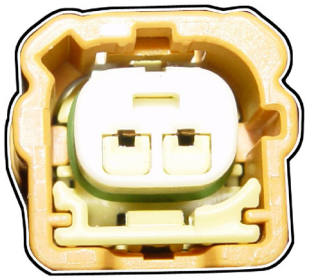
Location of Air Bag

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)

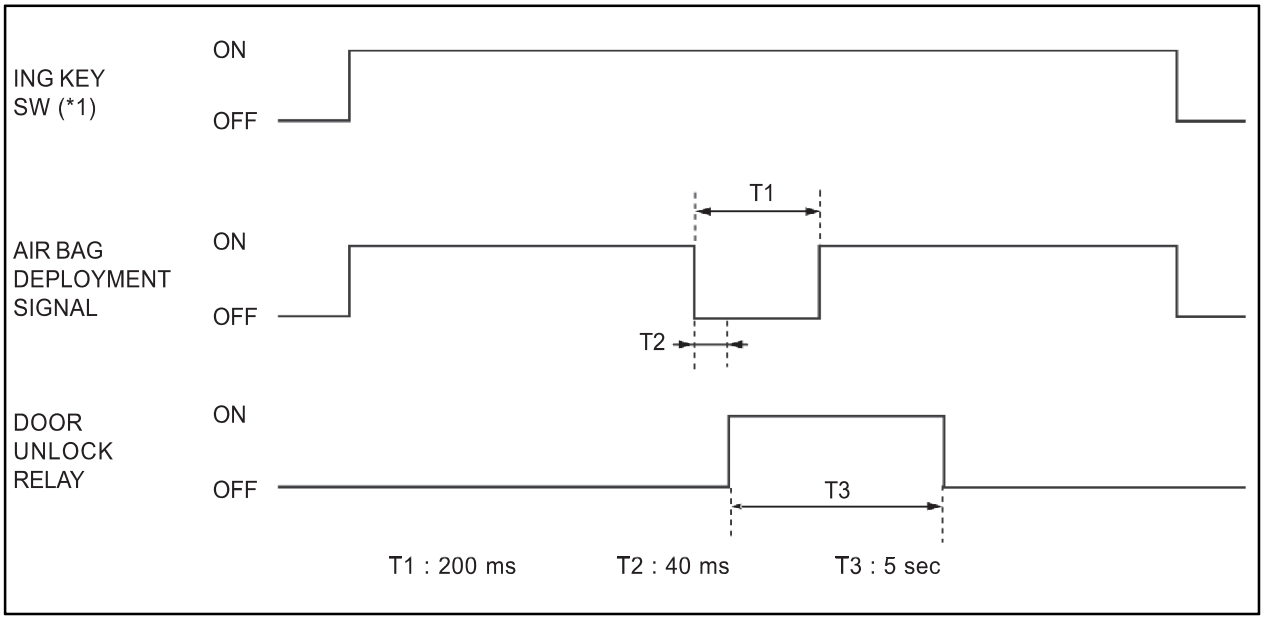
When any air bag deploys, another signal is sent to the sticks to do two basic security operations.

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.

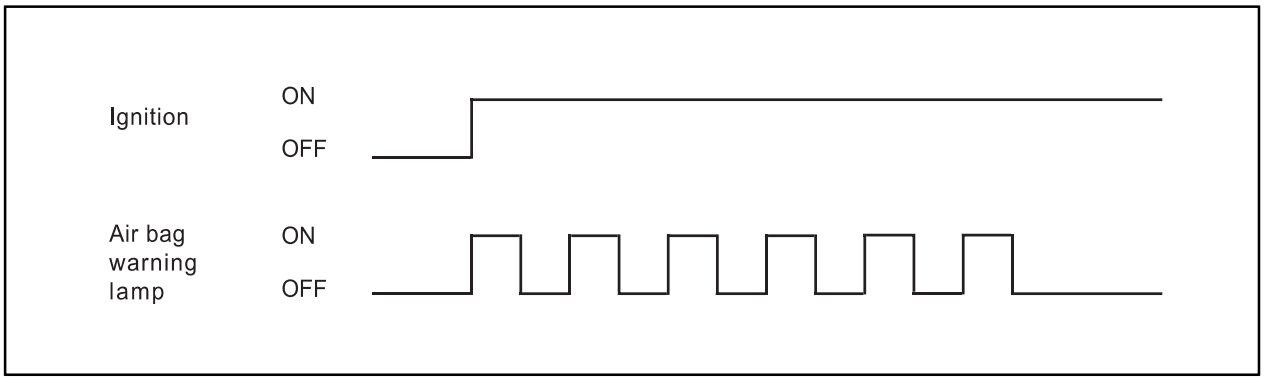
Modification basis	
Application basis	
Affected VIN	

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.

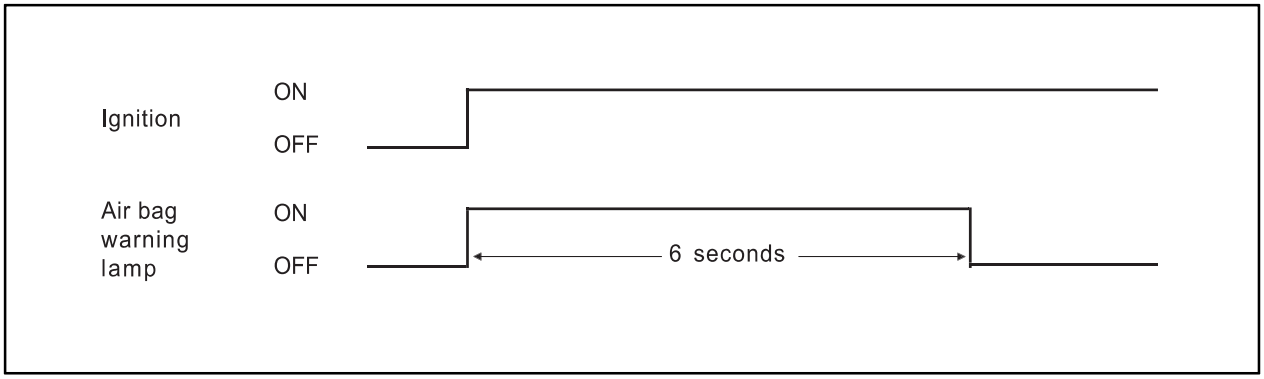
1) When Turning the Ignition Switch to ON Position

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.



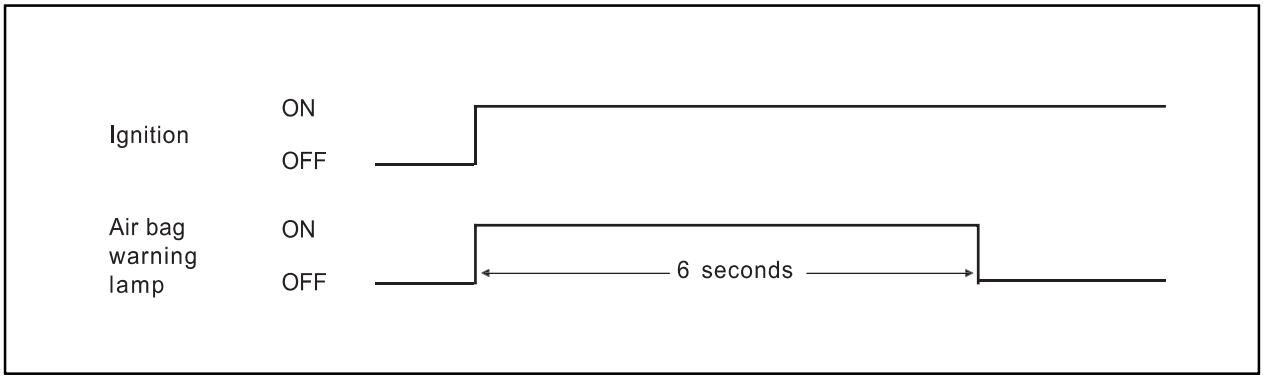
2) When Turning the Ignition Switch to the ON Position

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.



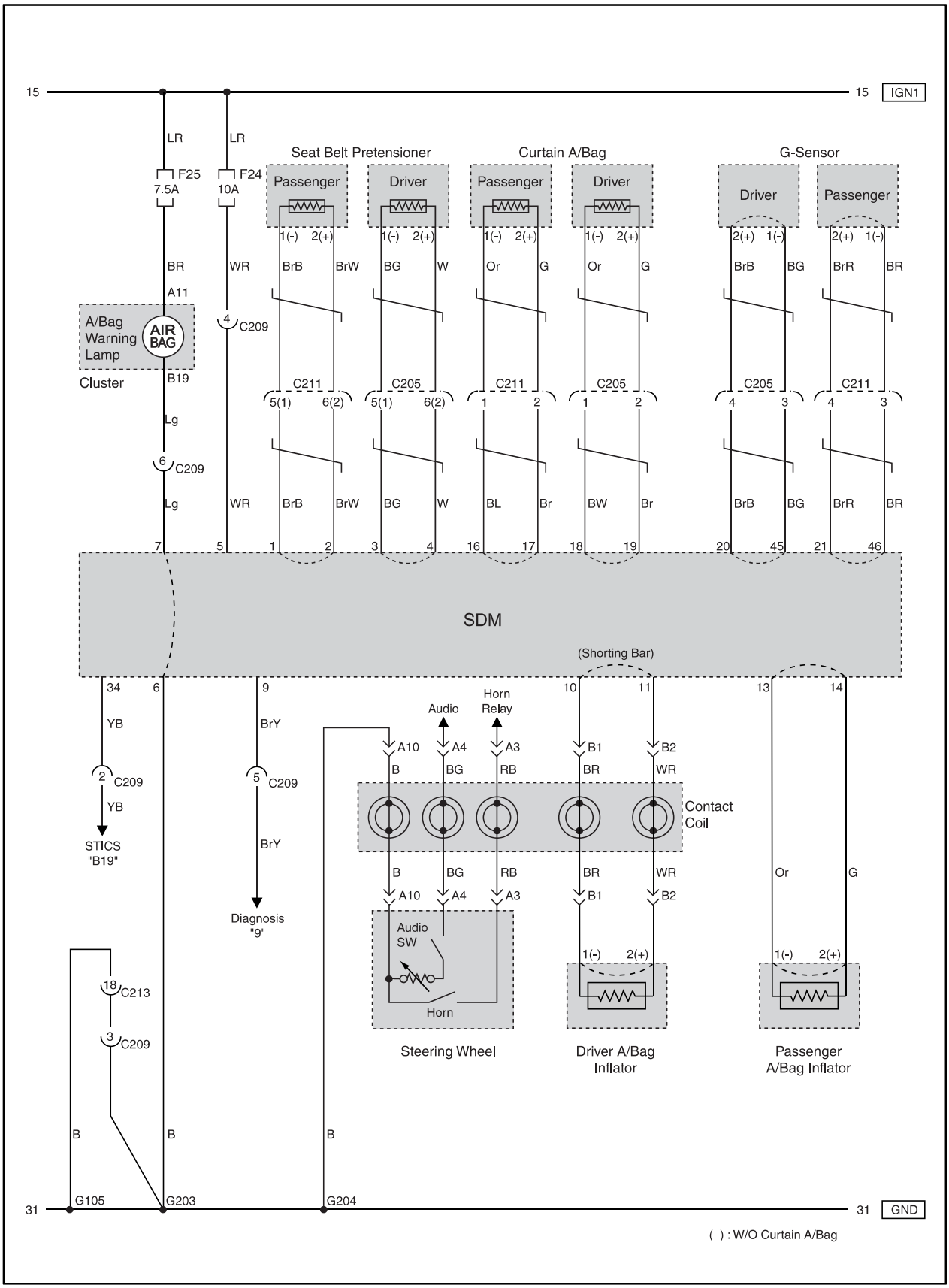
3) When the Air Bag Unit Receives Any Malfunction Signals from the Other Systems

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

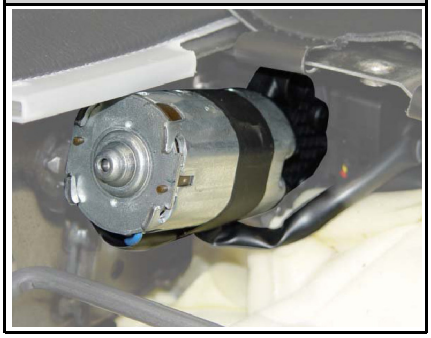
1. SEAT OVERVIEW

1)FRONT SEAT (DRIVER'S SEAT)



Lumbar support lever

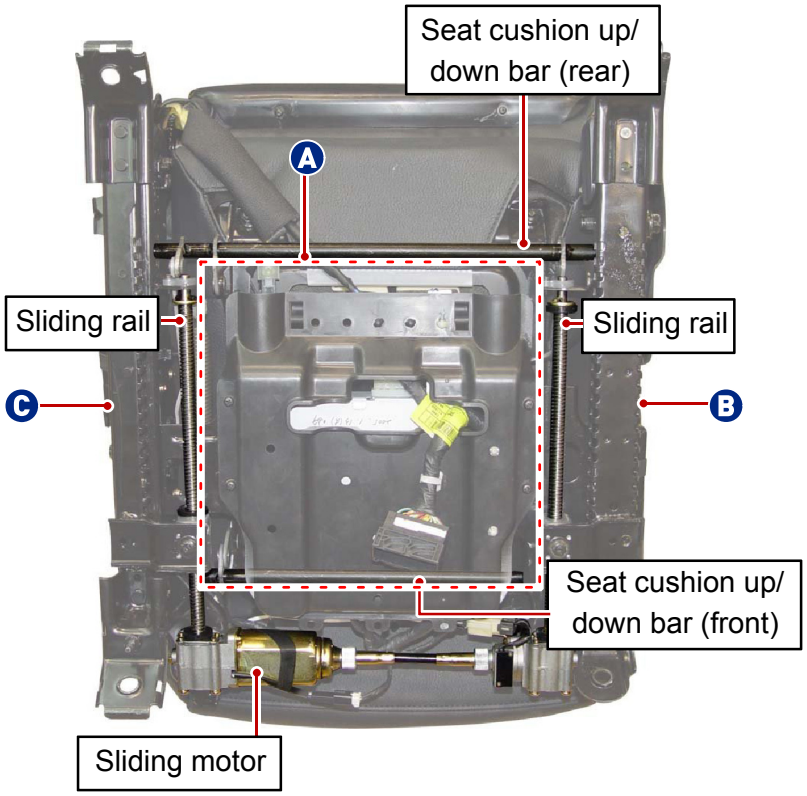
Reclining Motor

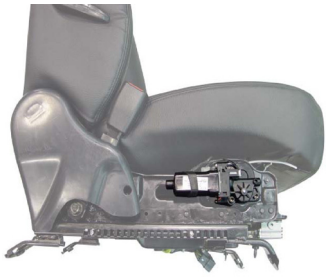


OVERVIEW AND OPERATION PROCESS

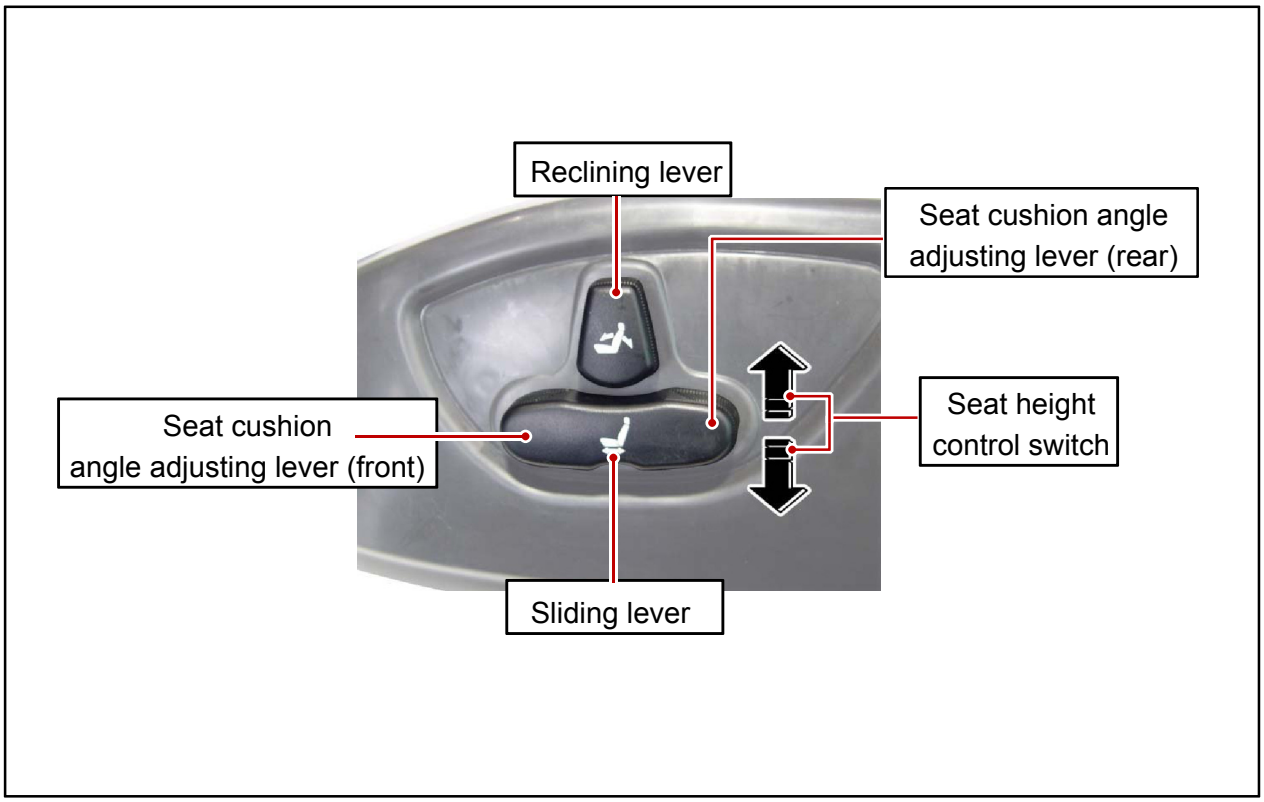
1. SEAT OVERVIEW

1) Front Seat (Driver's Seat)



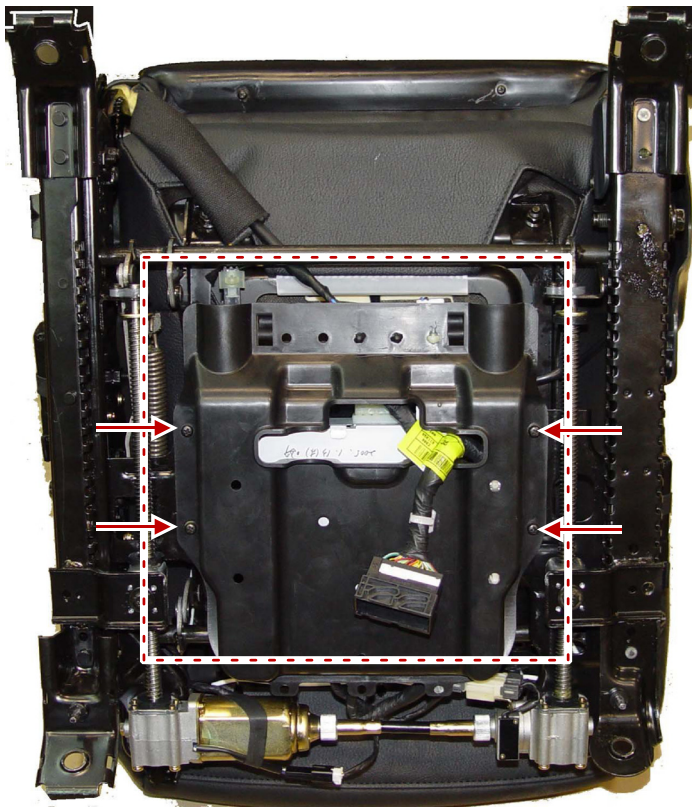
SPWM (Seat Position With Memory) Unit	Seat Cushion Motor (Front)	Seat Cushion Motor (Rear)
A 	B 	C 

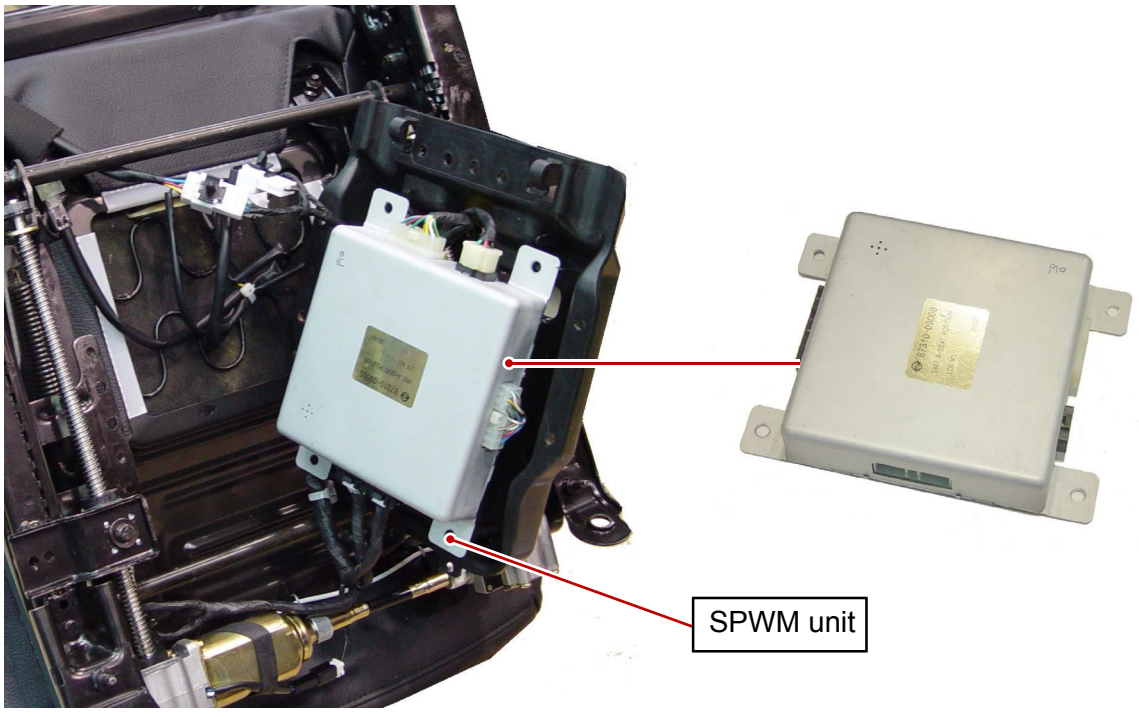
Modification basis	
Application basis	
Affected VIN	



Modification basis	
Application basis	
Affected VIN	

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





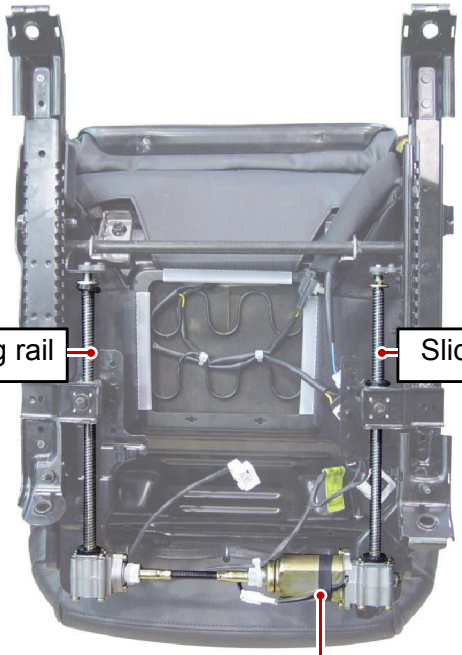
Modification basis	
Application basis	
Affected VIN	

2) Front Seat (Passenger Seat)



Reclining Motor





Sliding rail

Sliding rail

Sliding motor

Reclining lever

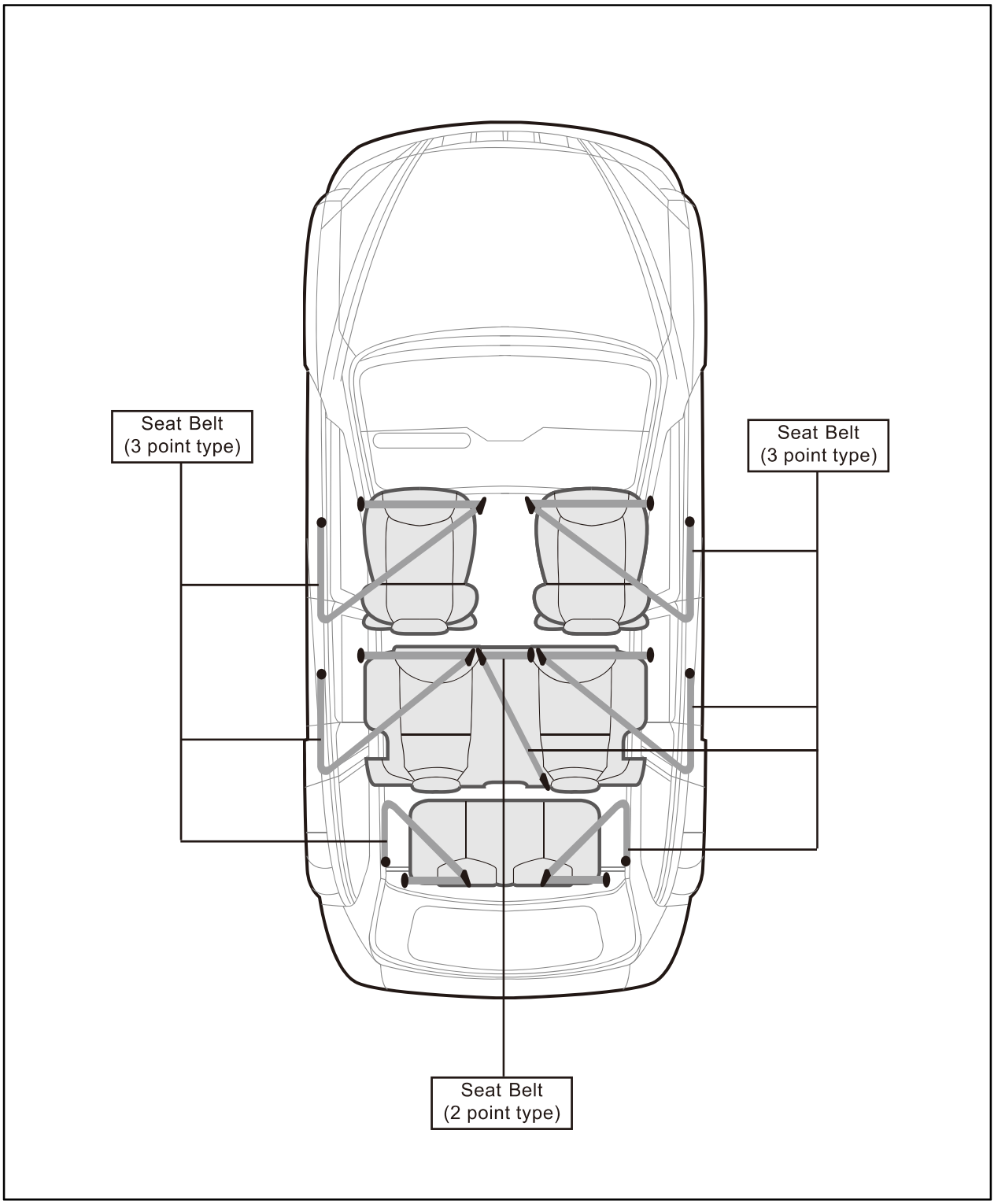


Sliding lever
(No seat height control function)

Modification basis	
Application basis	
Affected VIN	

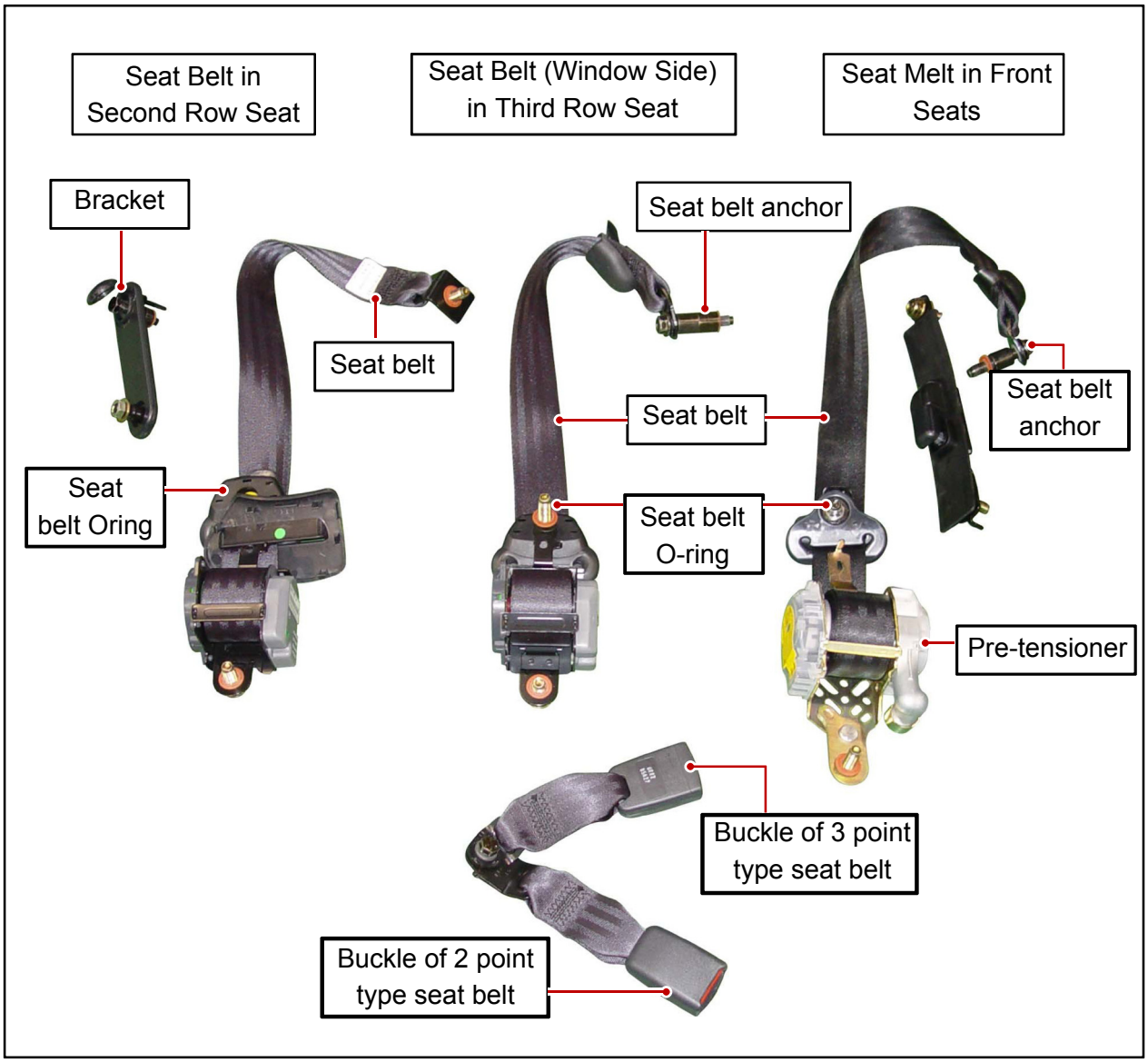
2. SEAT BELT OVERVIEW

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)



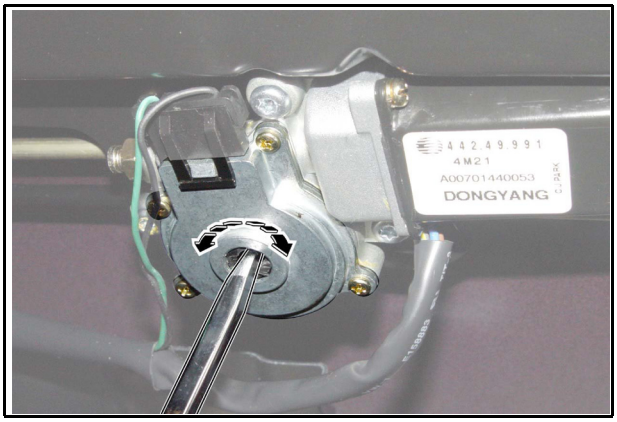
2. point type seat belt is installed only in the center seat of second row seat.

SUNROOF SYSTEM

7340-01

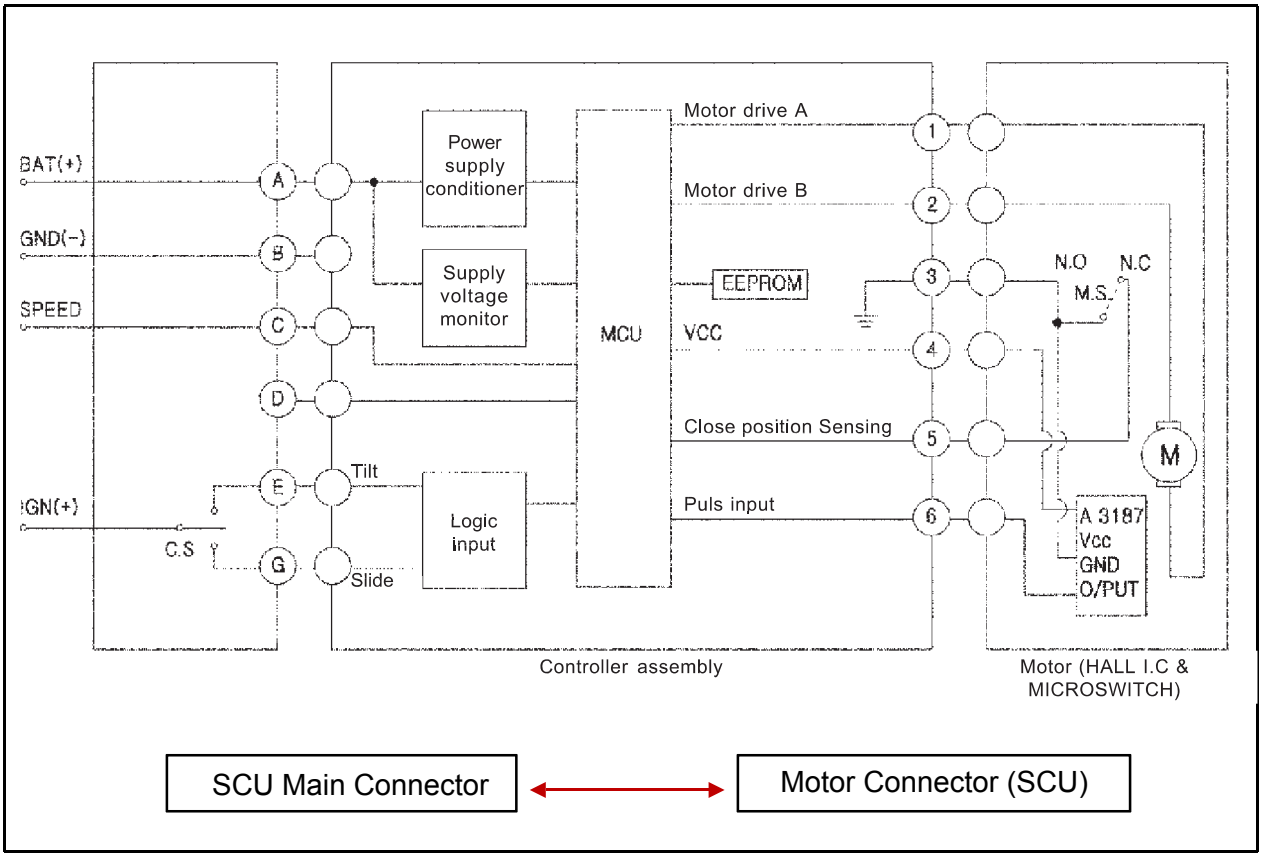
GENERAL

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)

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

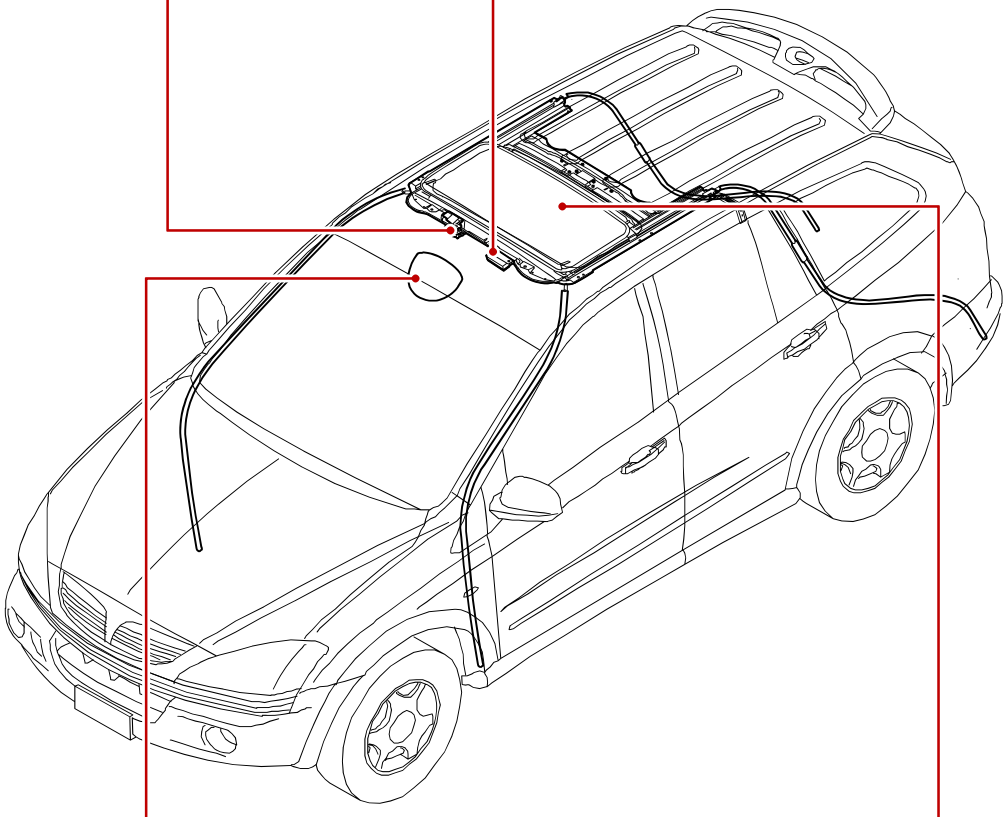
1. SUNROOF COMPONENTS AND LOCATIONS

Sunroof Motor



Sunroof Control Unit (SCU)





Sunroof Switch

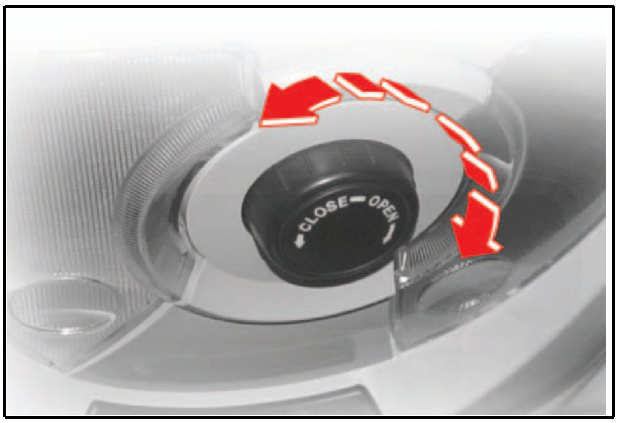


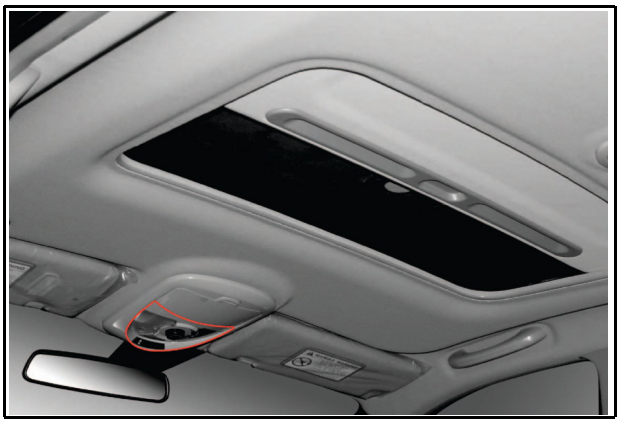
Sunroof Assembly



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

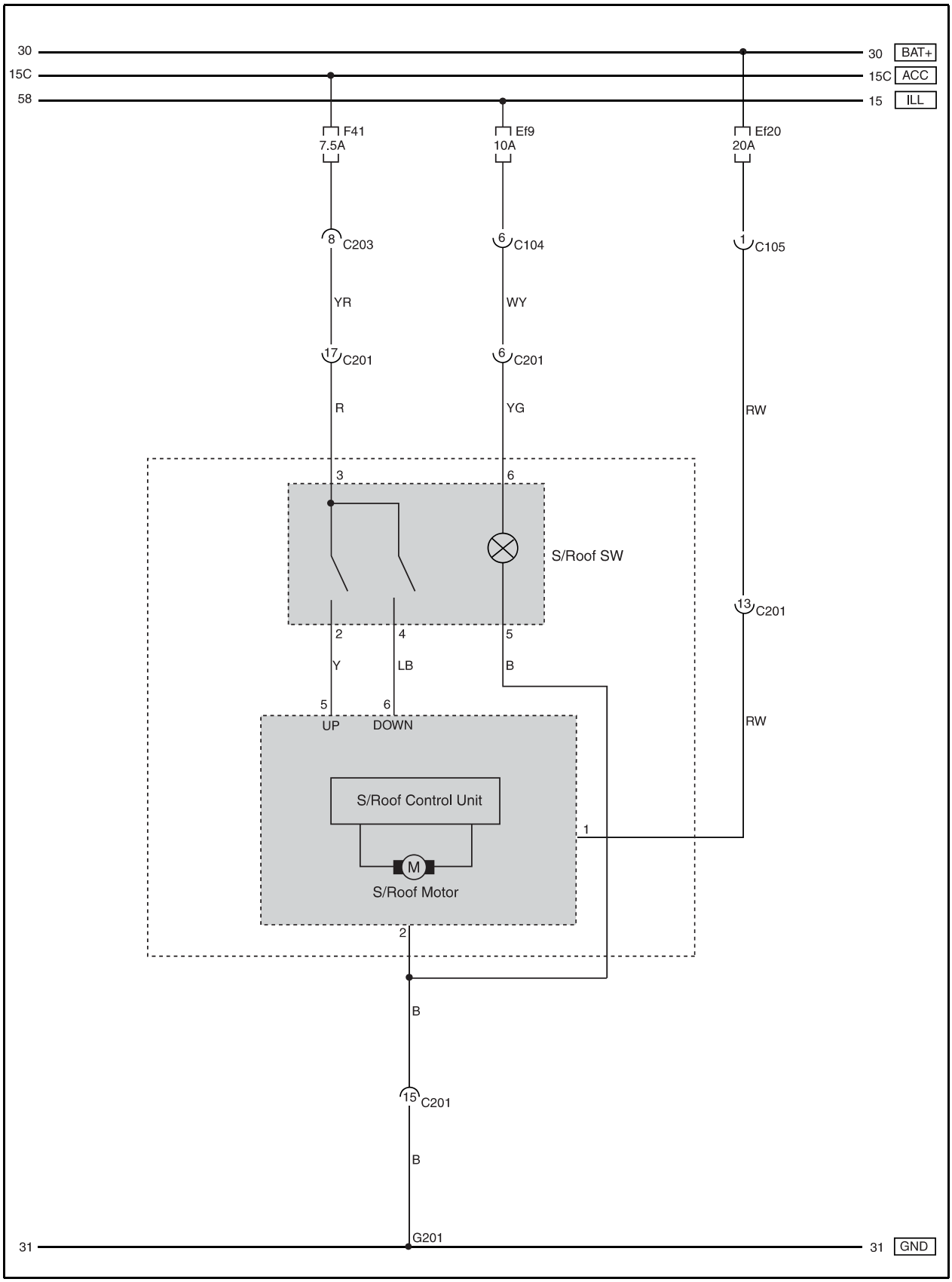
Tilt-up
To tilt-up the sunroof, rotate the sunroof switch counterclockwise (CLOSE direction) with the sunroof fully closed.

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

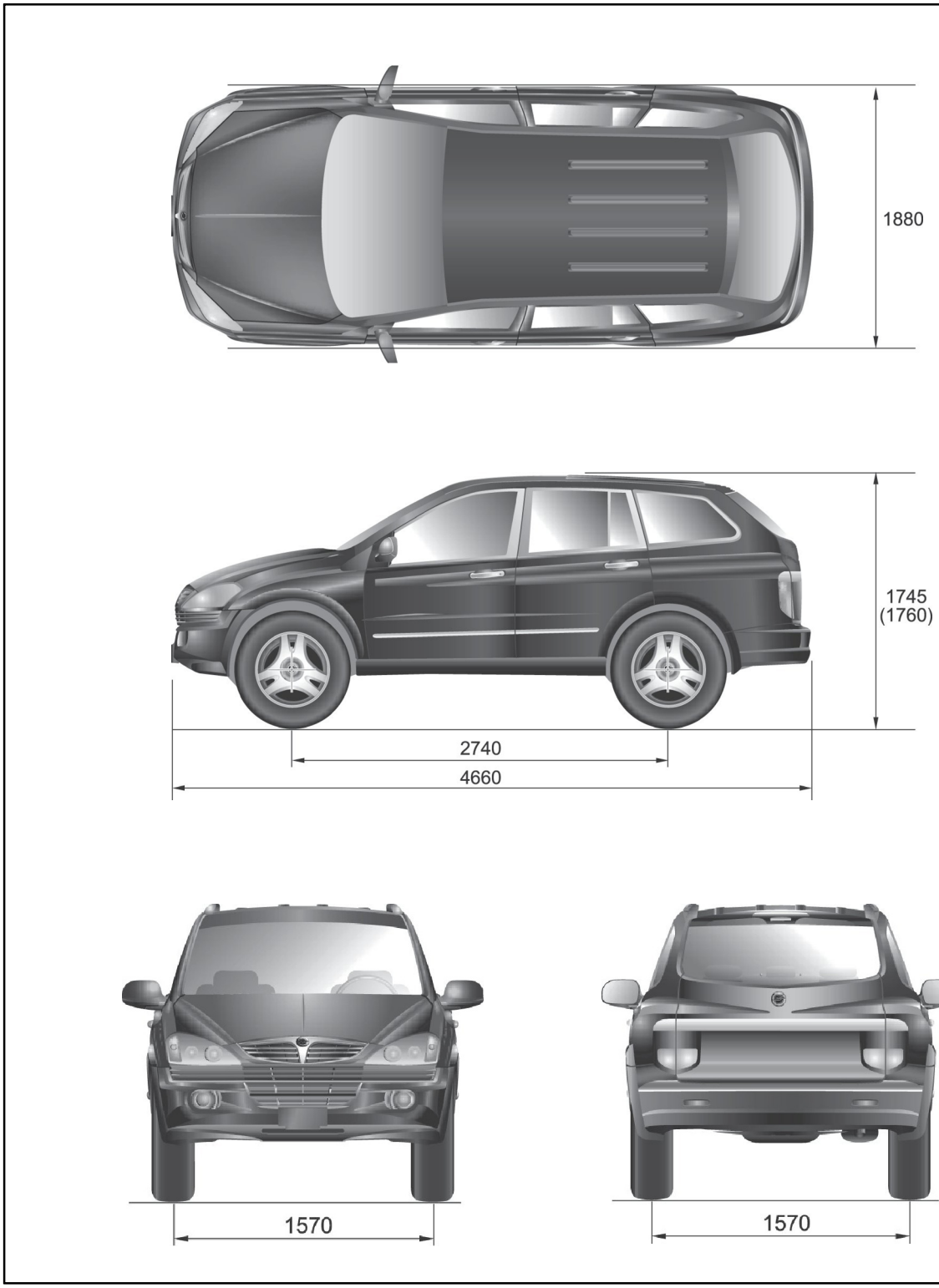
NO DATA

BODY REPAIR

4110-01

GENERAL

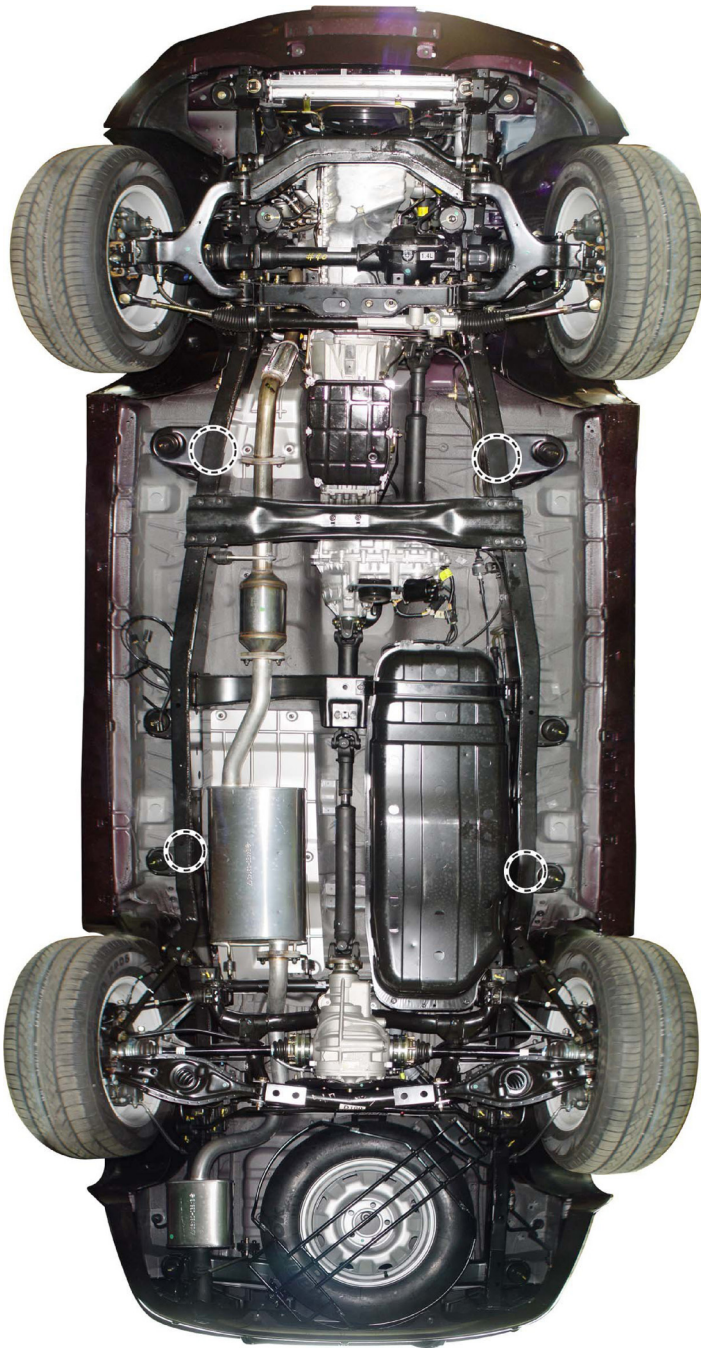
1. DIMENSIONS



Modification basis	
Application basis	
Affected VIN	

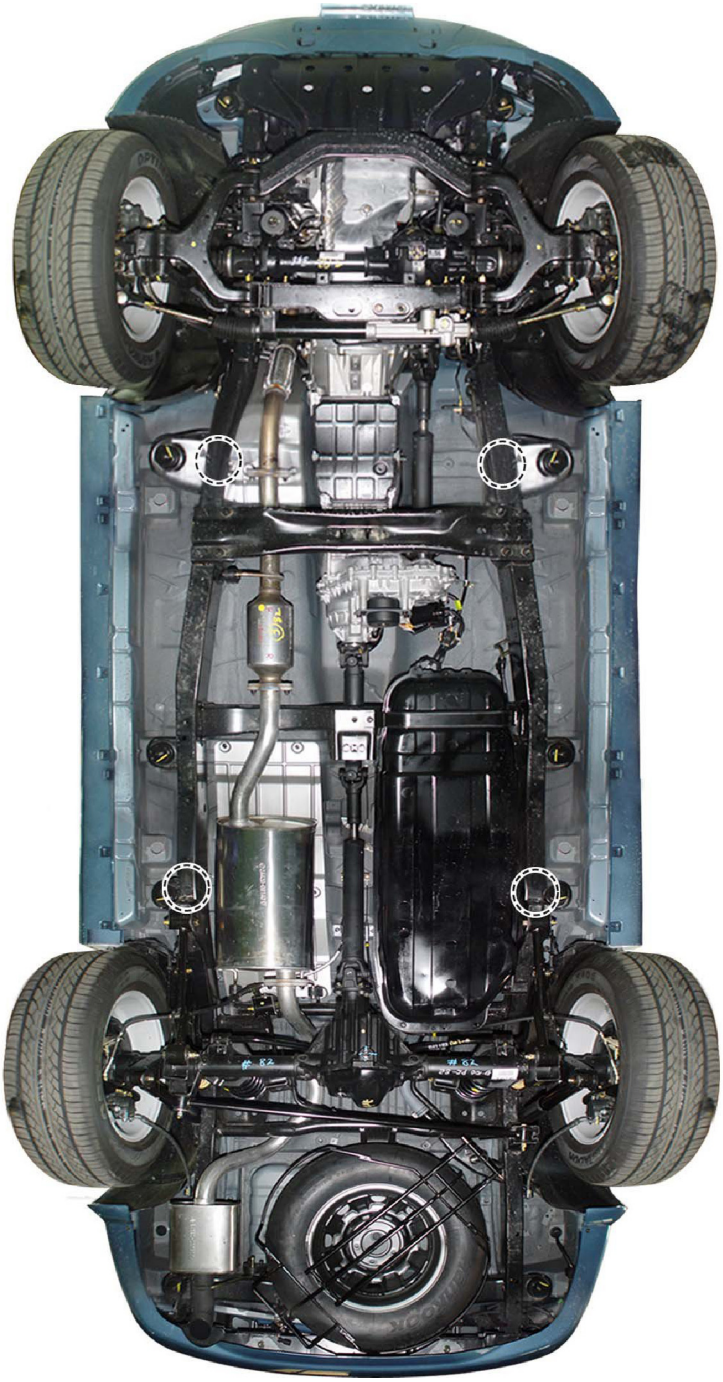
2. JACK-UP POINTS

1) IRS - Lifting Point (Dotted Circles)



Modification basis	
Application basis	
Affected VIN	

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

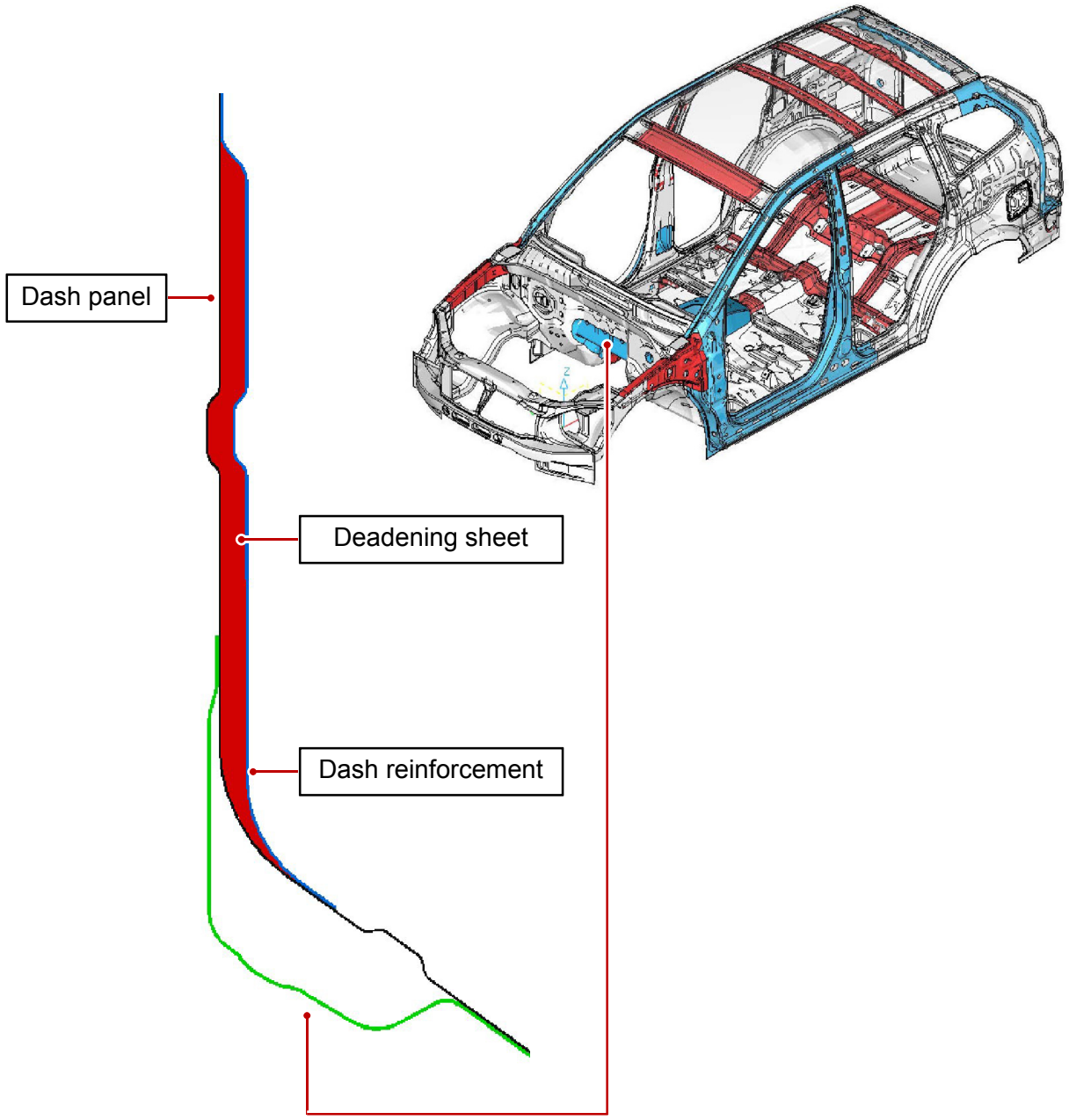


Modification basis	
Application basis	
Affected VIN	

3. DESIGN CHANGES FOR IMPROVING NVH PERFORMANCE

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

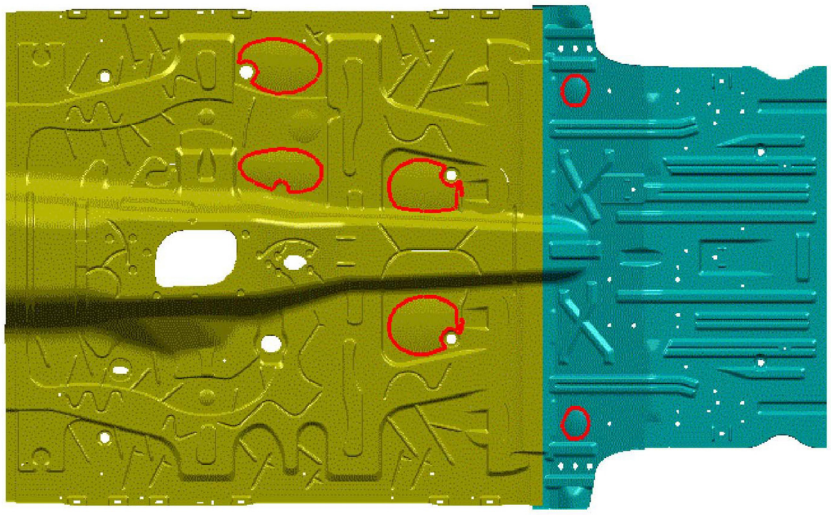
Blocks the noise from engine and transmission and improves the reinforcement of vehicle body.



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

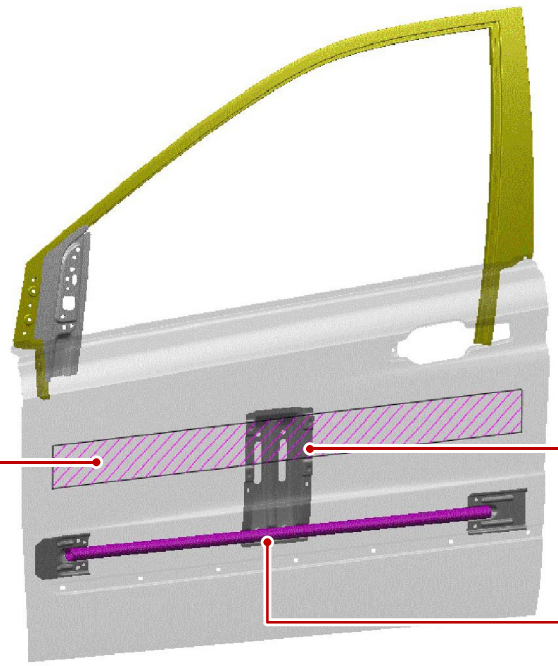
Modification basis	
Application basis	
Affected VIN	

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



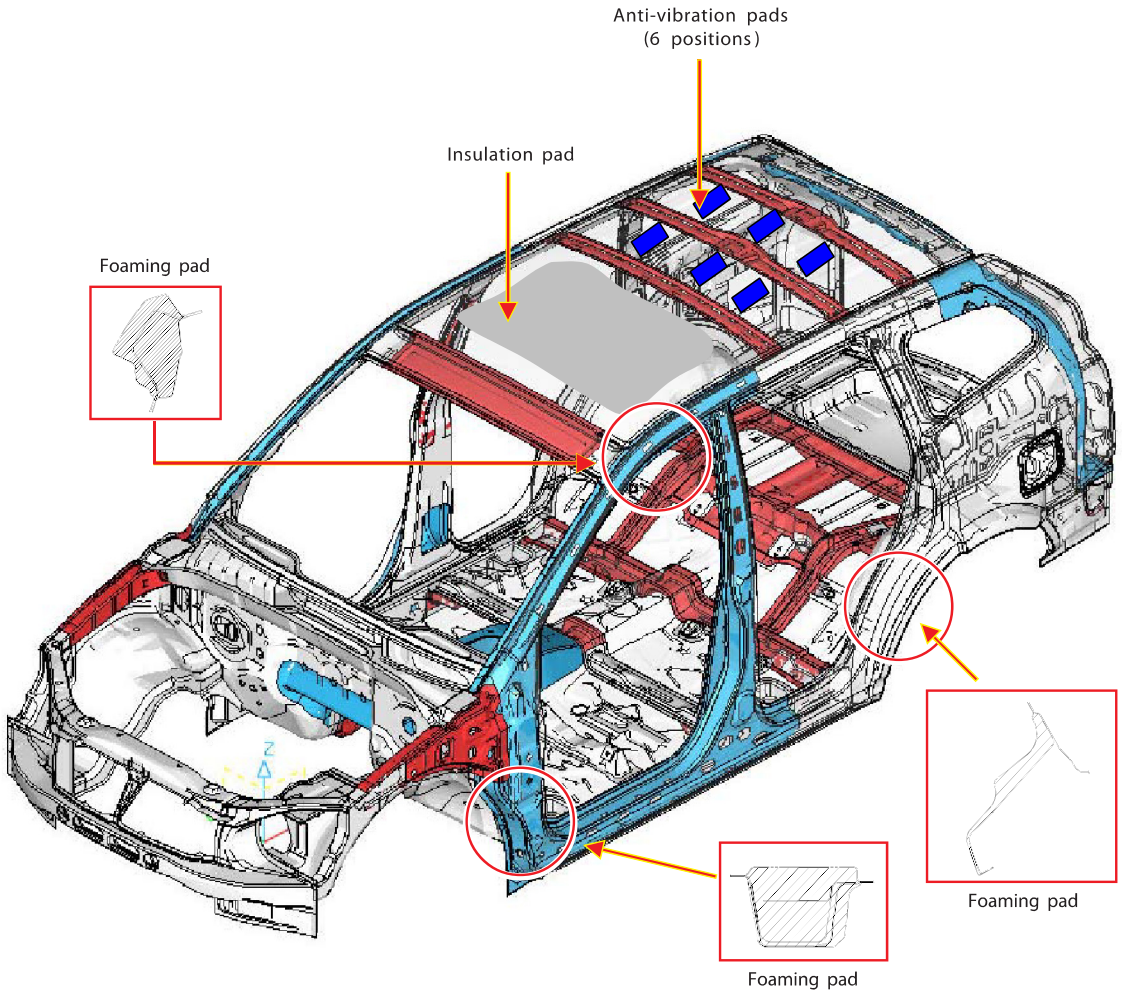
3) Applied BPR (Body Panel Reinforcement) Sealer to the Door Outer Panel

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

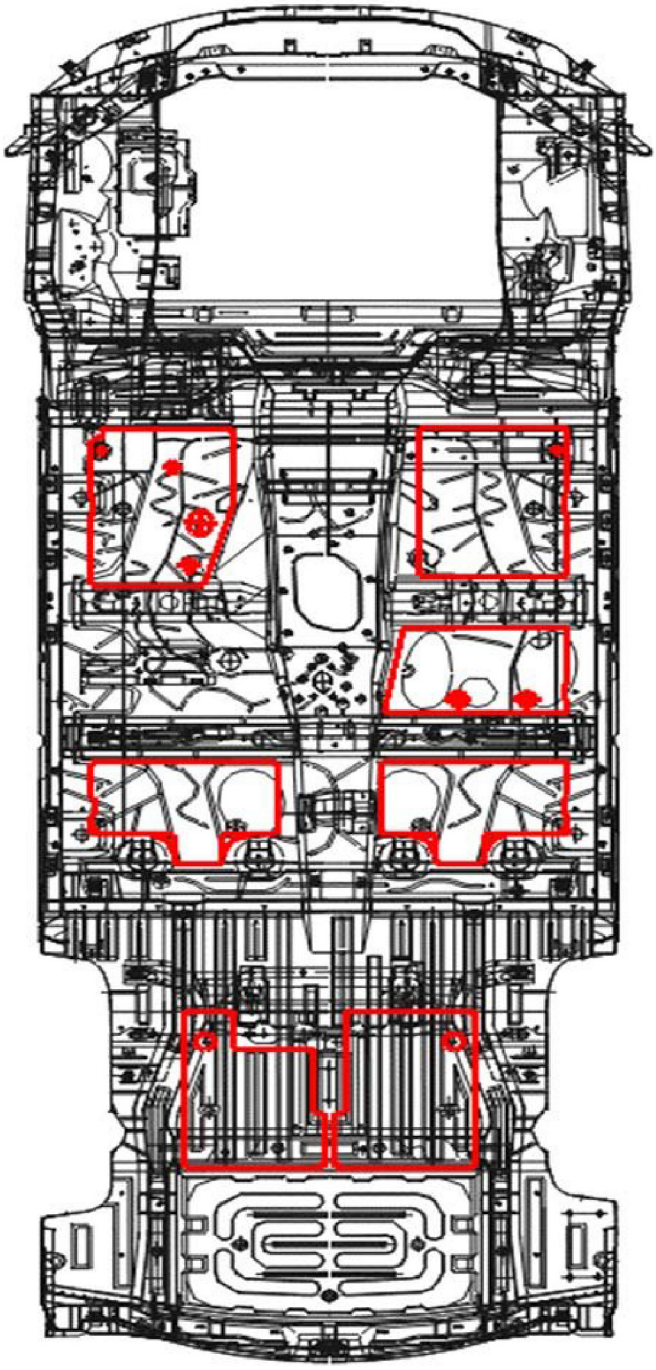
BPR sealer is sprayed by robot and is designed to reinforce the body panel and reduce the noise.



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

DIAGNOSIS

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

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	
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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	
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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	
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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

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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

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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.	

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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

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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

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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

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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

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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

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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	
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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	
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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	
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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	
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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><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>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>
<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>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.						

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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

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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

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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.						

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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.						

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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.						

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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	
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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	
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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	
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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	

<table>
<tr><th>DTC</th><th>Trouble</th><th>Help</th><th>Torque Reduc-tion (max.50%)</th><th>Torque Reduc-tion (max.20%)</th><th>Delayed Engine Stop</th><th>Immedi-ately Engine Stop</th><th>Limp Home Mode</th><th>Engine Check Warning Lamp</th></tr>
<tr><td>P1683</td><td>Defective CAN communiction of glow plug controller</td><td>- No GCU CAN signal
- Details: refer to P2673.</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>P2031</td><td>Front exhaust gas temperature sensor - faulty voltage supply</td><td>- 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.</td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>P2032</td><td>Front exhaust gas temperature sensor - low signal</td><td>- 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.
<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>
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</table></td><td></td><td></td><td></td><td></td><td></td><td>O</td></tr>
</table>

<table>
<tr><th>DTC</th><th>Trouble</th><th>Help</th><th>Torque Reduc-tion (max.50%)</th><th>Torque Reduc-tion (max.20%)</th><th>Delayed Engine Stop</th><th>Immedi-ately 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>
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<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>

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<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>
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<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>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				

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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

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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	
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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	
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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.

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.

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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	
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<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	
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<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>
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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**

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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**

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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.

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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.

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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

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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.

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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

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

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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

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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

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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.

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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

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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

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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)

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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.

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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

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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

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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

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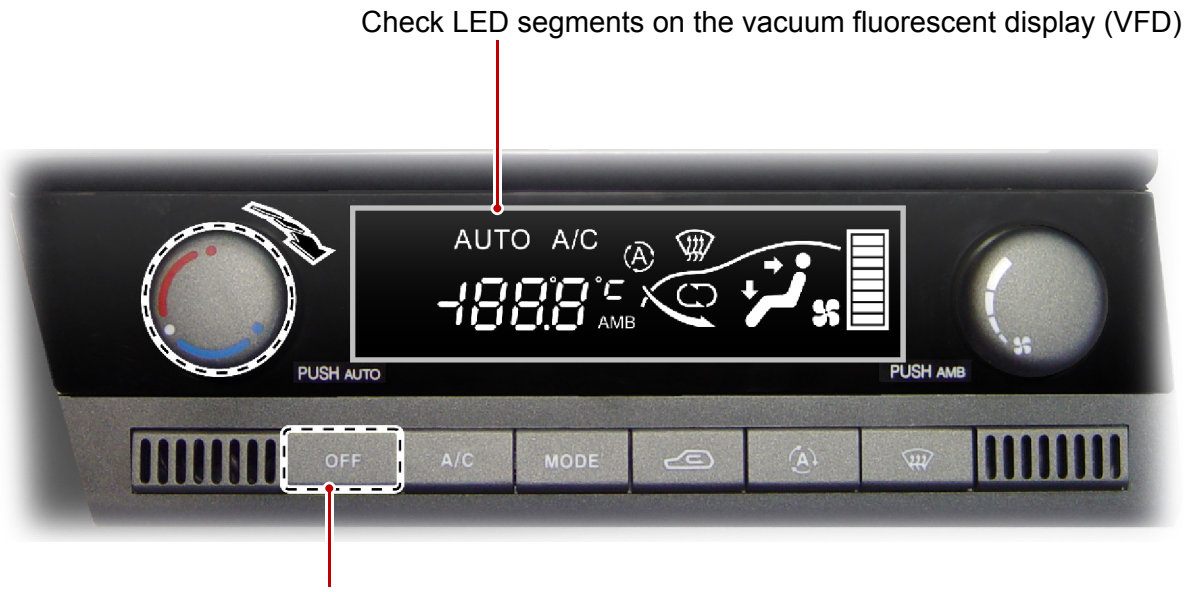
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DIAGNOSIS

1. SELF DIAGNOSIS

1) Starting Self Diagnosis

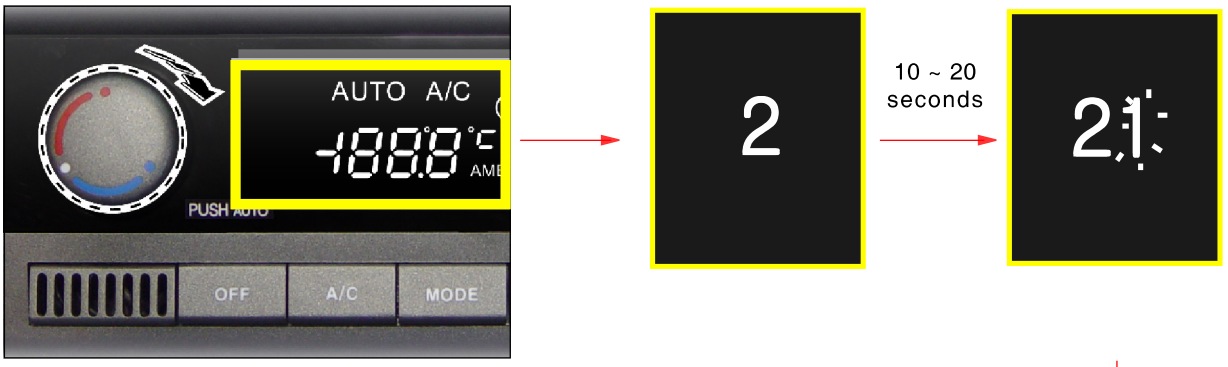
Turn the ignition switch to ON position and press OFF switch for more than 5 seconds within 10 seconds.



2) Set in Trouble Diagnosis Step 2

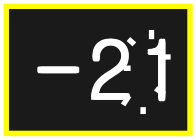
In this step, check the air mix door and sensors for defect.

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

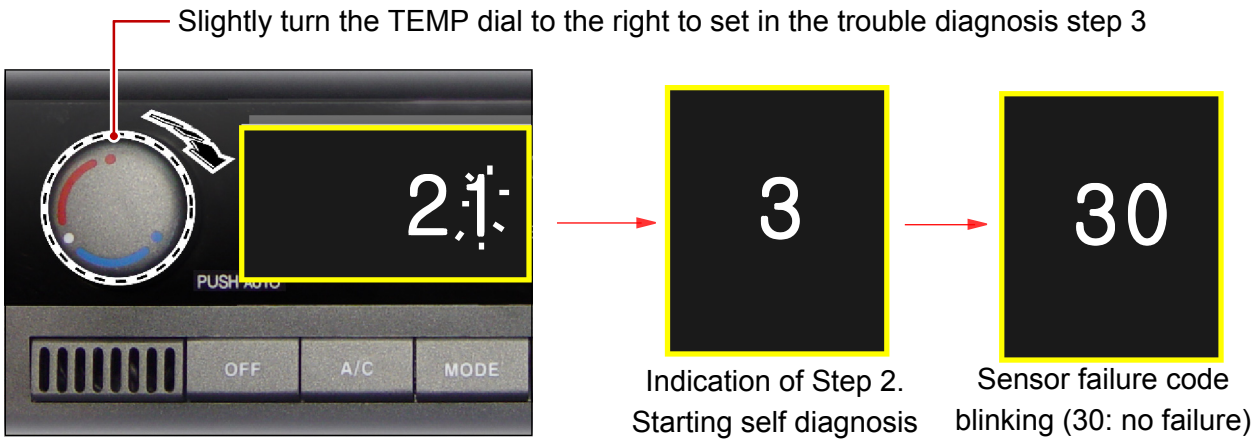
Trouble Code

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	-	

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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.

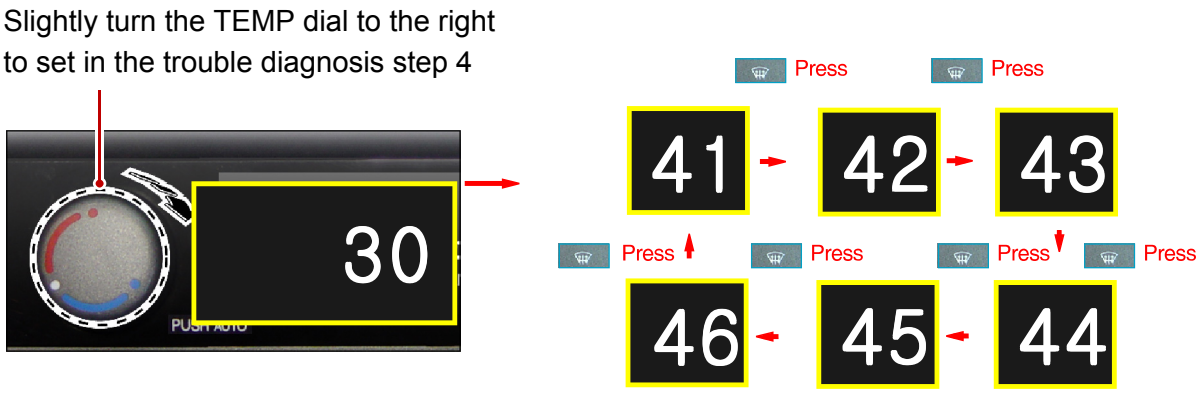


Trouble Code

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.

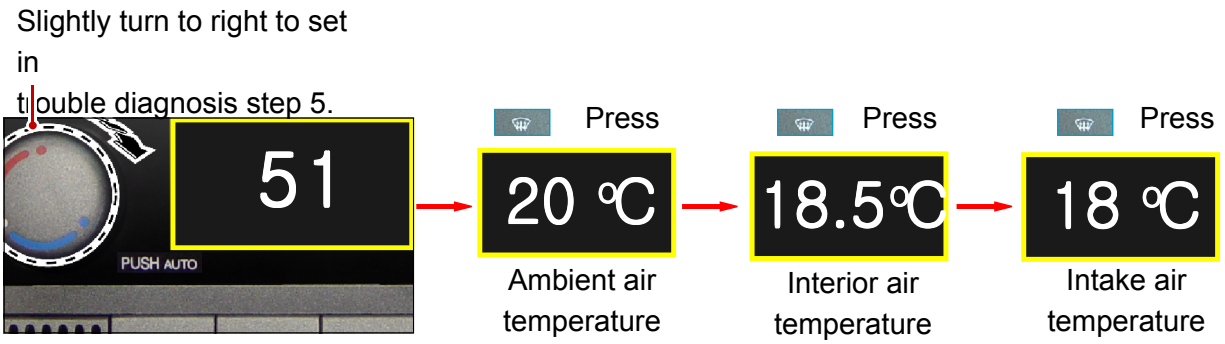


Function Check

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

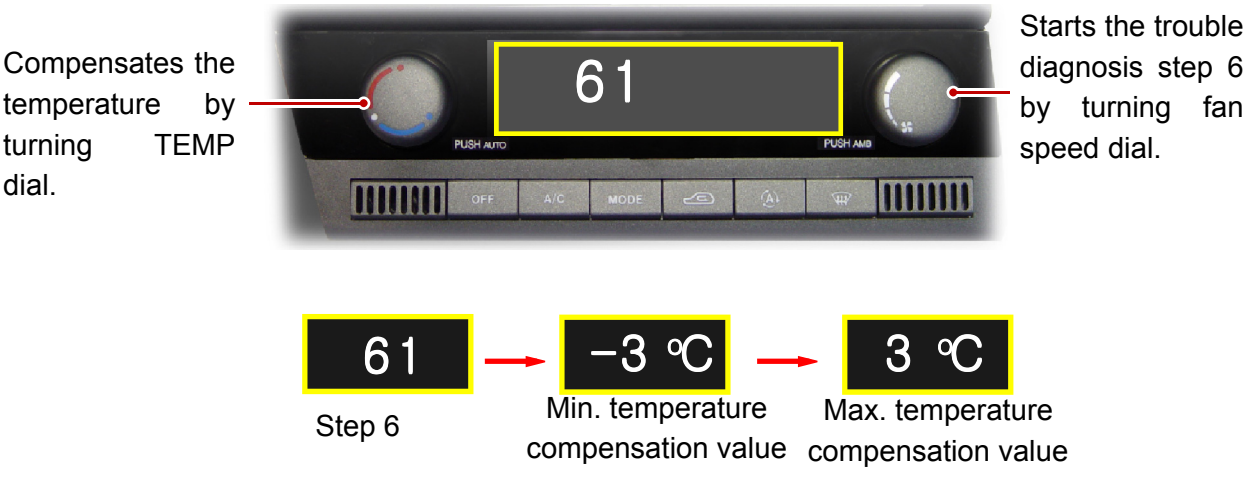
5) Set in Trouble Diagnosis Step 5

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.



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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.

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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.

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P/TRUNK

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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>

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RAIN SENSOR

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DIAGNOSIS

1. TROUBLE SHOOTING..... 3

RAIN SENSOR

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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.

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STICS

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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.

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TC

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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.

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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

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TCU

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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

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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.

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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	