2006 Mazda5 Service Highlights

FOREWORD

This manual explains components, system operations and functions for the Mazda5.

For proper repair and maintenance, a thorough familiarization with this manual is important, and it should always be kept in a handy place for quick and easy reference.

All the contents of this manual, including drawings and specifications, are the latest available at the time of printing.
As modifications affecting repair or maintenance occur, relevant information supplementary to this volume will be made available at Mazda dealers.
This manual should be kept up-to-date.

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Mazda Motor Corporation
HIROSHIMA, JAPAN

APPLICATION:
This manual is applicable to vehicles beginning with the Vehicle Identification Numbers (VIN), and related materials shown on the following page.

CONTENTS

Title	Section
GENERAL INFORMATION	00
ENGINE	01
SUSPENSION	02
DRIVELINE/AXLE	03
BRAKES	04
TRANSMISSION/TRANSAXLE	05
STEERING	06
HEATER, VENTILATION & AIR CONDITIONING (HVAC)	07
RESTRAINTS	08
BODY & ACCESSORIES	09

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VEHICLE IDENTIFICATION NUMBERS (VIN)

JM1 CR193*6# 100001—
JM1 CR19L*6# 100001—
JM1 CR293*6# 100001—
JM1 CR29L*6# 100001—

RELATED MATERIALS

Material Name	MNAO Part No.	Mazda Material No.
1995, 1996, 1997, 1998, 1999, 2000 OBD-II Service Highlights	9999–95–OBD2–00	3344–1U–99K
Automatic Transaxle Workshop Manual FN4A-EL	9999–95–FN4A–04	1793–1U–03I

GENERAL INFORMATION

00
SECTION

GENERAL INFORMATION 00-00

00–00 GENERAL INFORMATION

AIM OF DEVELOPMENT 00–00–2
Product Concept **00–00–2**
Vehicle Outline **00–00–2**
VEHICLE IDENTIFICATION NUMBER (VIN) CODE 00–00–7
VEHICLE IDENTIFICATION NUMBER (VIN) 00–00–7
UNITS. 00–00–8
Conversion to SI Units (Système International d'Unités) **00–00–8**
Rounding Off **00–00–8**
Upper and Lower Limits **00–00–8**
NEW STANDARD 00–00–8

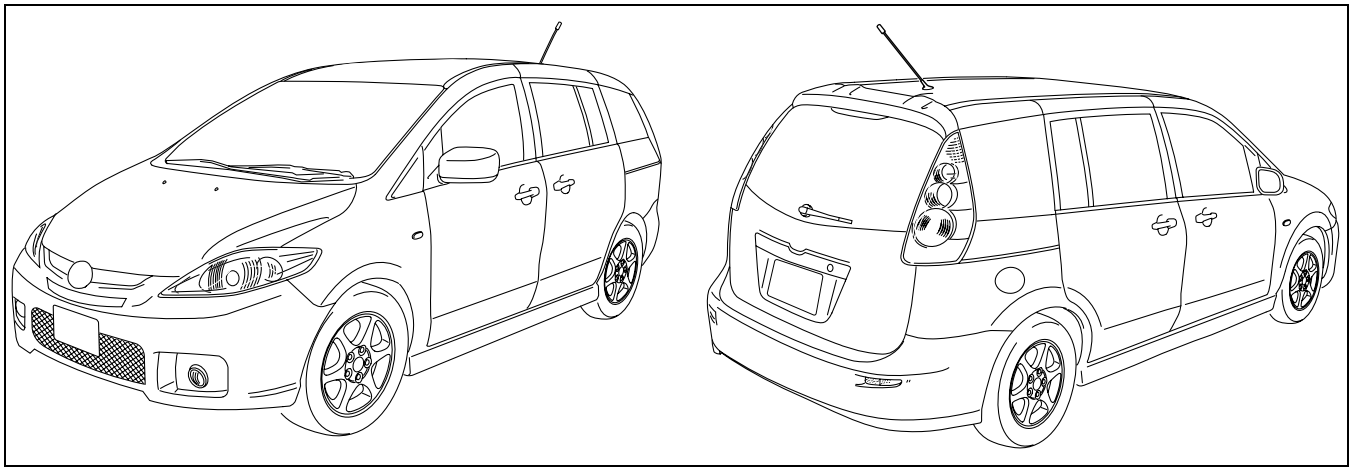
AIM OF DEVELOPMENT

EPU000000000S01

Product Concept

- **Communicative & Dynamic Space Wagon**
  - — The new generation Space Wagon has achieved an optimal balance between 'Functionality/ Communicativeness' and 'Driveability/Design'.
  - — All occupants, not only the driver, can enjoy the functional space in full comfort.

External View



EPU000ZS3002

Vehicle Outline

Packaging

- The 6-passenger cabin affords ride comfort for each passenger, and the center open space provides for enhanced passenger interaction.
- The best-in-class wheel base realizes advanced driving stability.
- Adoption of wide-open sliding doors on both sides.
  - — Ingress/Egress improvement
- Adoption of seat sliding and double-folding functions
  - — Achievement of optimum functionality for each seat

Design theme

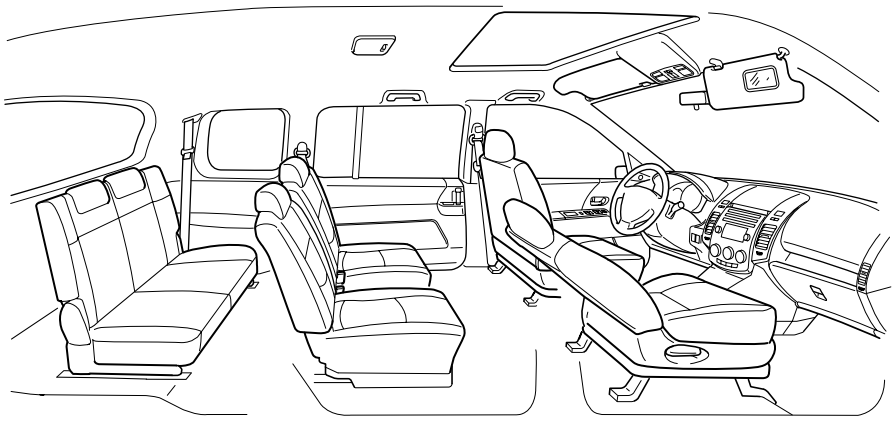
- Stylish & Clean

Design image keywords

- Sweeping wedge shape
- Feeling of solid packaging
- Compactness

Interior

- Achievement of a smooth dashboard surface
- The audio unit, climate control unit, and shift knob locations are integrated in the center panel to achieve a refined appearance.
- The adoption of ergonomic principles on many parts realizes excellent operability and a functional interior design.



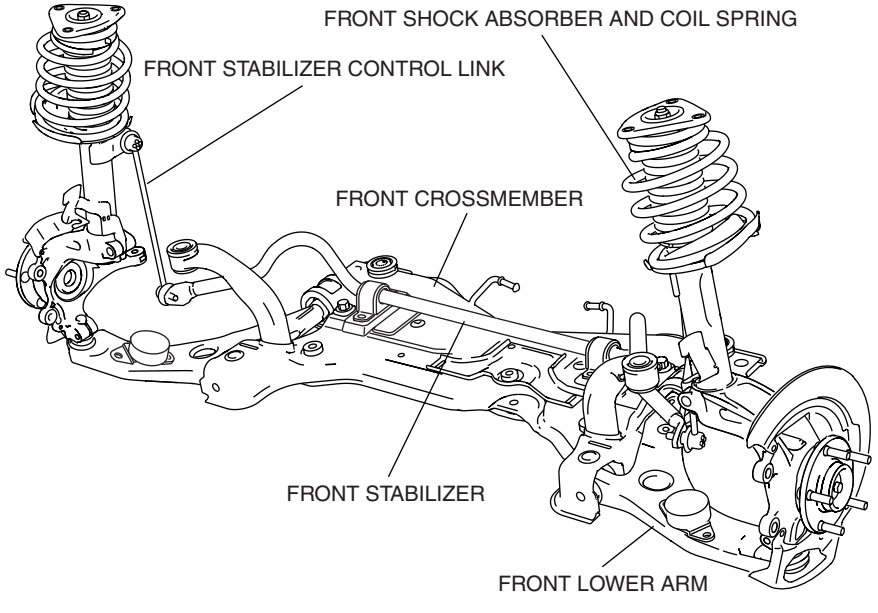
EPU000ZS3003

Engine

- The lightweight, aluminum alloy cylinder block and lower block provide superior vibration resistance. Superior crank support stiffness combined with lightweight pistons and connecting rods have been adopted for a comfortable, linear drive feel.
- Low-tension piston rings, and shimless tappets have been adopted to minimize friction losses and improve fuel economy.

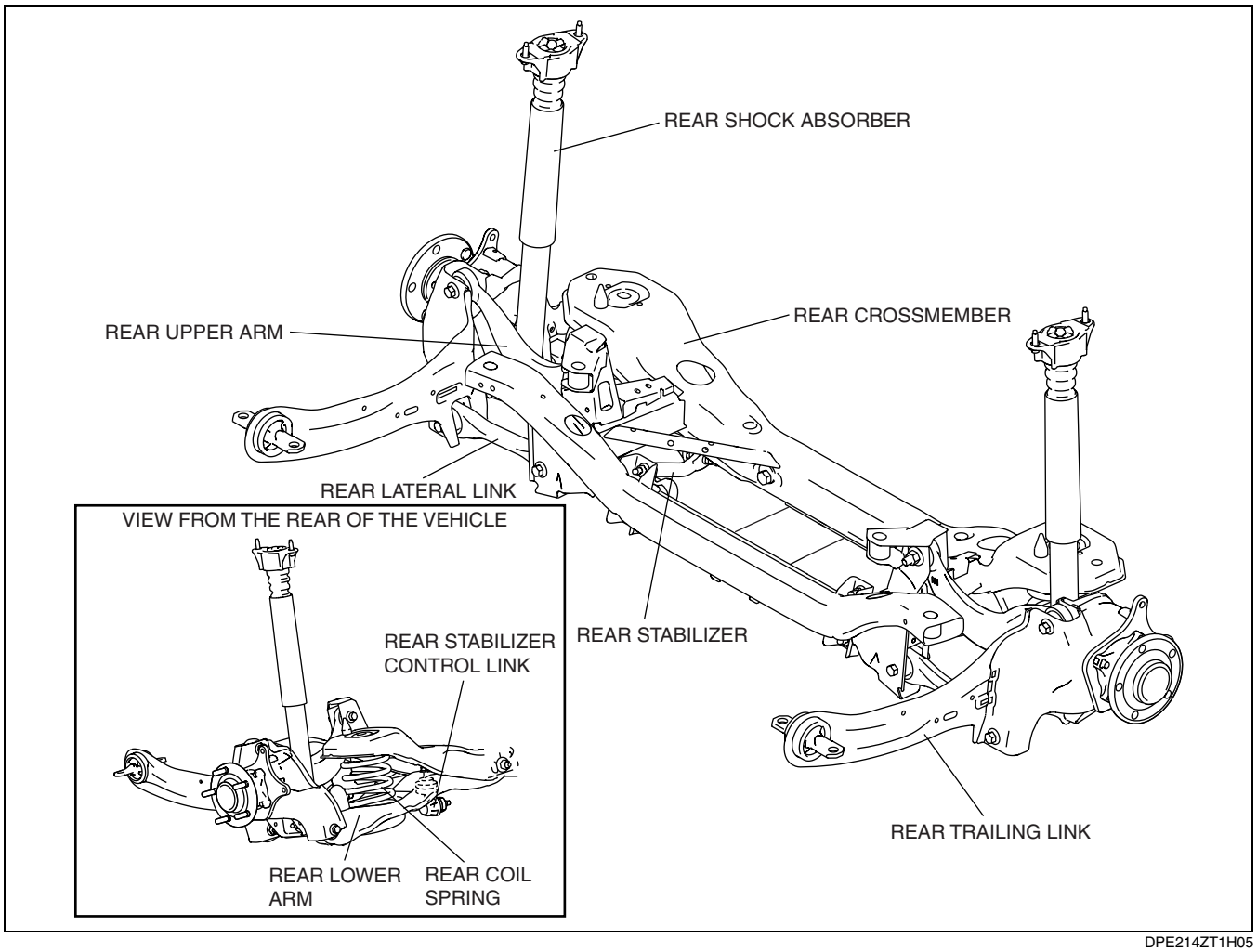
Suspension

- Front suspension
  - — Strut-type suspension adopted
  - — A liquid-filled bushing for the lower arm adopted
  - — A separated input type shock absorber mount has been adopted for improved steering stability and riding comfort.



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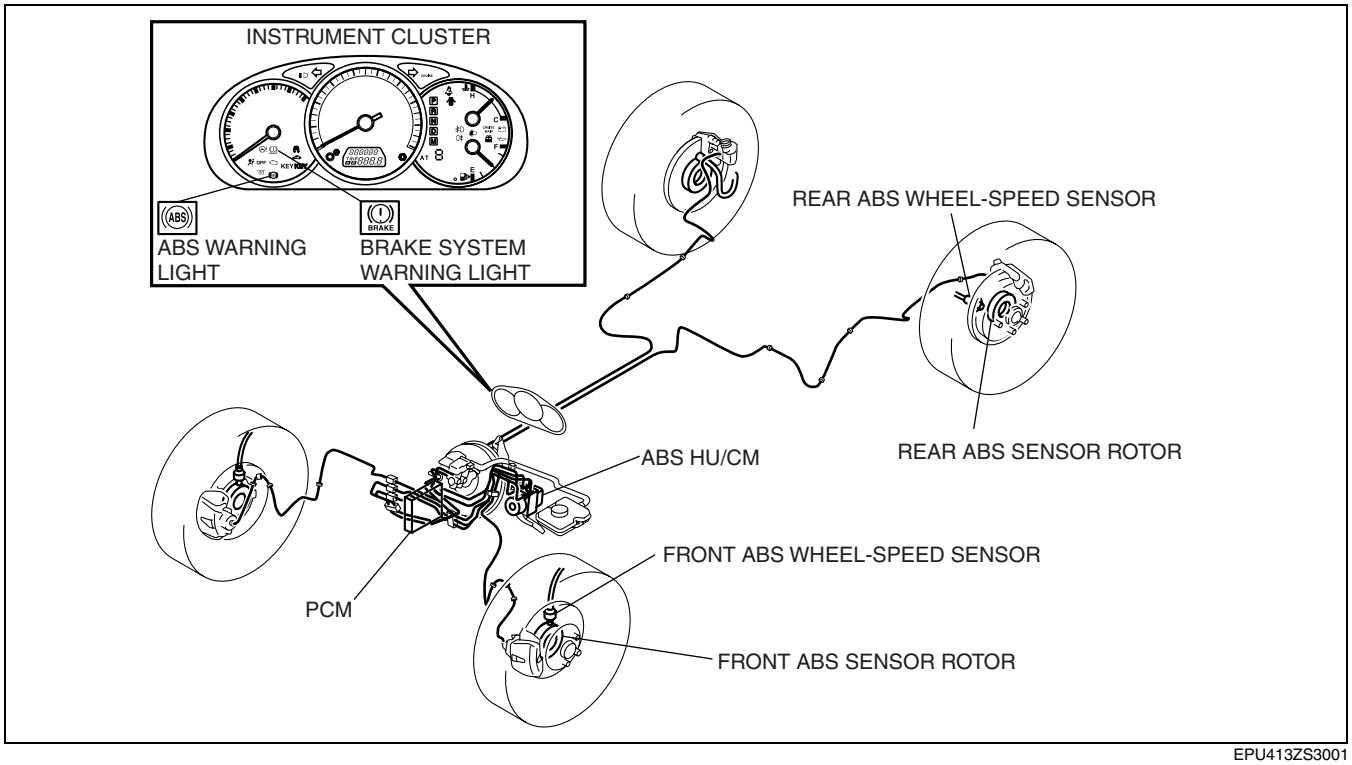
- Rear suspension
  — An E-type multi-link rear suspension adopted
  — A wider occupancy space has been achieved due to the separated positioning of the shock absorber and coil spring.



DPE214ZT1H05

Brakes

- Lever-type parking brake adopted
- Brake assist system provides enhanced brake force based on light braking effort.
- Linear, responsive braking function with an outstanding feeling of security and control characteristics.
  - — Stability and steerability is maintained during braking control due to the adoption of ABS for all models, together with Electronic Brakeforce Distribution (EBD).
  - — A large-sized single diaphragm (10 inch) has been adopted, for the power brake unit ensuring high brake functionality.
  - — An intrusion-minimizing brake pedal, which minimizes the amount of rearward pedal thrust in a frontal collision, has been adopted.
  - — A brake-assist function has been adopted to supplement pedal braking force and reduce speed in a shorter distance during emergency braking.



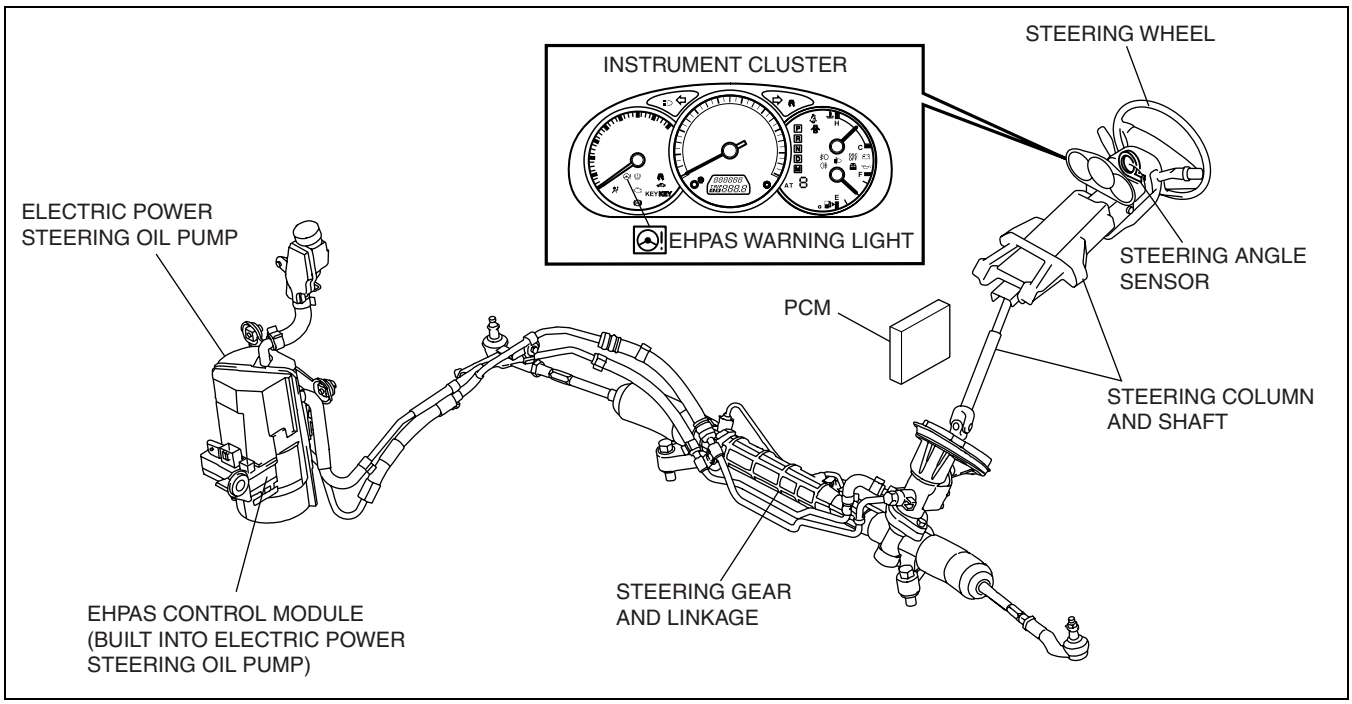
EPU413ZS3001

Automatic transmission

- A slope-control function saves the driver from having to make frequent use of the brake pedal on slopes, providing the driver a feeling of smooth shift control.
- A higher 4th gear ratio promotes fuel economy during high-speed cruising.
- An expanded lockup range covers lower vehicle speeds. A control function adds lockup during deceleration that contributes to improved fuel economy and reduced CO_2 emissions.

Steering

- Power steering
  — Electro Hydraulic Power Assist Steering (EHPAS) adopted.



EPU614ZS3001

Safety

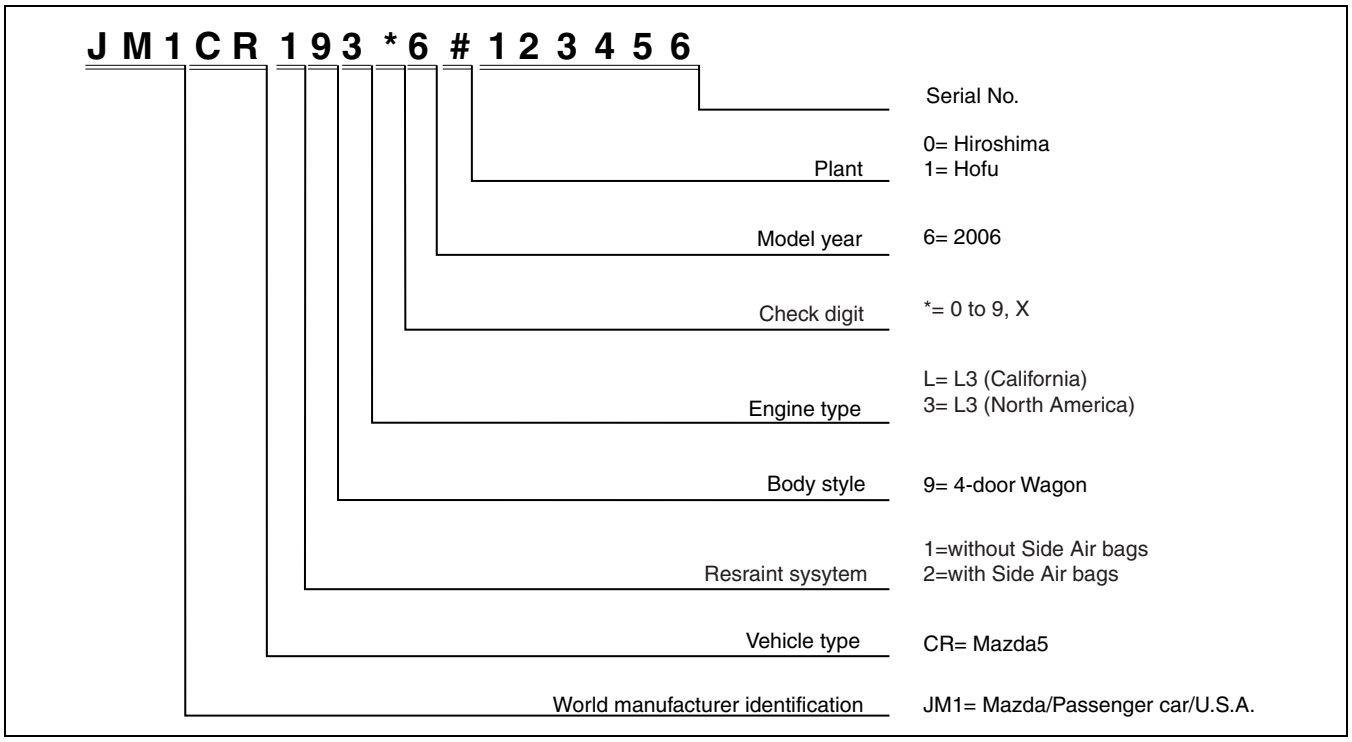
- The adoption of the triple-H, strenghtened frames on the floor, sides and roof areas provides enhanced protection.
- Injuries in a pedestrian-vehicle collision are minimized by the increased space between the hood and engine.
- Dual-inflator type air bags that control deployment of the air bags in two stages by detecting the scale of an impact have been adopted for front-seat passengers.
- Side air bags that effectively protect the chest area have been adopted for the front seats.
- Large curtain air bags have been adopted that deploy and cover the front and rear side windows to protect the heads of the front and rear passengers.
- Pre-tensioner and load limiter mechanisms have been adopted for the front seat belts.
- Seat belt reminders have been adopted for the prevention of unfastened seat belts.
- Both ISO FIX and tether strap anchors are provided in the second and third-row seats for child-restraint securing.
- An immobilizer system has been adopted. This anti-theft device prevents the engine from being started unless the encrypted identification code, transmitted from a special electronic chip embedded in the key, corresponds with the identification code registered in the vehicle.

Equipment for enhanced comfort

- Left/right sliding doors
  — Auto closure
- KARAKURI storage box
  — Storage space is provided with storage boxes under the seat bottoms of the second row seats.

VEHICLE IDENTIFICATION NUMBER (VIN) CODE

EPU000000000S02



EPU000ZS3001

VEHICLE IDENTIFICATION NUMBER (VIN)

EPU000000000S03

JM1 CR193*6# 100001—
JM1 CR19L*6# 100001—
JM1 CR293*6# 100001—
JM1 CR29L*6# 100001—

UNITS

EPU000000000S04

Electrical current	A (ampere)
Electric power	W (watt)
Electric resistance	ohm
Electric voltage	V (volt)
Length	mm (millimeter)
	in (inch)
Negative pressure	kPa (kilo pascal)
	mmHg (millimeters of mercury)
	inHg (inches of mercury)
Positive pressure	kPa (kilo pascal)
	kgf/cm^2 (kilogram force per square centimeter)
	psi (pounds per square inch)
Torque	N·m (Newton meter)
	kgf·m (kilogram force meter)
	kgf·cm (kilogram force centimeter)
	ft·lbf (foot pound force)
	in·lbf (inch pound force)
Volume	L (liter)
	US qt (U.S. quart)
	Imp qt (Imperial quart)
	ml (milliliter)
	cc (cubic centimeter)
	cu in (cubic inch)
	fl oz (fluid ounce)
Weight	g (gram)
	oz (ounce)

Conversion to SI Units (Système International d'Unités)

- All numerical values in this manual are based on SI units. Numbers shown in conventional units are converted from these values.

Rounding Off

- Converted values are rounded off to the same number of places as the SI unit value. For example, if the SI unit value is 17.2 and the value after conversion is 37.84, the converted value will be rounded off to 37.8.

Upper and Lower Limits

- When the data indicates upper and lower limits, the converted values are rounded down if the SI unit value is an upper limit and rounded up if the SI unit value is a lower limit. Therefore, converted values for the same SI unit value may differ after conversion. For example, consider 2.7 kgf/cm^2 in the following specifications:

  210—260 kPa {2.1—2.7 kgf/cm^2, 30—38 psi}
  270—310 kPa {2.7—3.2 kgf/cm^2, 39—45 psi}

- The actual converted values for 2.7 kgf/cm^2 are 265 kPa and 38.4 psi. In the first specification, 2.7 is used as an upper limit, so the converted values are rounded down to 260 and 38. In the second specification, 2.7 is used as a lower limit, so the converted values are rounded up to 270 and 39.

NEW STANDARD

EPU000000000S05

- Following is a comparison of the previous standard and the new standard.

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
AP	Accelerator Pedal	—	Accelerator Pedal	
APP	Accelerator Pedal Position	—	Accelerator Pedal Position	
ACL	Air Cleaner	—	Air Cleaner	
A/C	Air Conditioning	—	Air Conditioning	

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
BARO	Barometric Pressure	—	Atmospheric Pressure	
B+	Battery Positive Voltage	V_B	Battery Voltage	
—	Brake Switch	—	Stoplight Switch	
—	Calibration Resistor	—	Corrected Resistance	#6
CMP sensor	Camshaft Position Sensor	—	Crank Angle Sensor	
LOAD	Calculated Load Voltage	—	—	
CAC	Charge Air Cooler	—	Intercooler	
CLS	Closed Loop System	—	Feedback System	
CTP	Closed Throttle Position	—	Fully Closed	
CPP	Clutch Pedal Position	—	Clutch Position	
CIS	Continuous Fuel Injection System	EGI	Electronic Gasoline Injection System	
CS sensor	Control Sleeve Sensor	CSP sensor	Control Sleeve Position Sensor	#6
CKP sensor	Crankshaft Position Sensor	—	Crank Angle Sensor 2	
DLC	Data Link Connector	—	Diagnosis Connector	
DTM	Diagnostic Test Mode	—	Test Mode	#1
DTC	Diagnostic Trouble Code(s)	—	Service Code(s)	
DI	Distributor Ignition	—	Spark Ignition	
DLI	Distributorless Ignition	—	Direct Ignition	
EI	Electronic Ignition	—	Electronic Spark Ignition	#2
ECT	Engine Coolant Temperature	—	Water Thermo	
EM	Engine Modification	—	Engine Modification	
—	Engine Speed Input Signal	—	Engine RPM Signal	
EVAP	Evaporative Emission	—	Evaporative Emission	
EGR	Exhaust Gas Recirculation	—	Exhaust Gas Recirculation	
FC	Fan Control	—	Fan Control	
FF	Flexible Fuel	—	Flexible Fuel	
4GR	Fourth Gear	—	Overdrive	
—	Fuel Pump Relay	—	Circuit Opening Relay	#3
FSO solenoid	Fuel Shut Off Solenoid	FCV	Fuel Cut Valve	#6
GEN	Generator	—	Alternator	
GND	Ground	—	Ground/Earth	
HO2S	Heated Oxygen Sensor	—	Oxygen Sensor	With heater
IAC	Idle Air Control	—	Idle Speed Control	
—	IDM Relay	—	Spill Valve Relay	#6
—	Incorrect Gear Ratio	—	—	
—	Injection Pump	FIP	Fuel Injection Pump	#6
—	Input/Turbine Speed Sensor	—	Pulse Generator	
IAT	Intake Air Temperature	—	Intake Air Thermo	
KS	Knock Sensor	—	Knock Sensor	
MIL	Malfunction Indicator Lamp	—	Malfunction Indicator Light	
MAP	Manifold Absolute Pressure	—	Intake Air Pressure	
MAF	Mass Air Flow	—	Mass Air Flow	
MAF sensor	Mass Air Flow Sensor	—	Airflow Sensor	
MFL	Multiport Fuel Injection	—	Multiport Fuel Injection	
OBD	On-Board Diagnostic	—	Diagnosis/Self Diagnosis	
OL	Open Loop	—	Open Loop	
—	Output Speed Sensor	—	Vehicle Speed Sensor 1	
OC	Oxidation Catalytic Converter	—	Catalytic Converter	
O2S	Oxygen Sensor	—	Oxygen Sensor	
PNP	Park/Neutral Position	—	Park/Neutral Range	
PID	Parameter Identification	—	Parameter Identification	

New Standard		Previous Standard		Remark
Abbreviation	Name	Abbreviation	Name	
—	PCM Control Relay	—	Main Relay	#6
PSP	Power Steering Pressure	—	Power Steering Pressure	
PCM	Powertrain Control Module	ECU	Engine Control Unit	#4
—	Pressure Control Solenoid	—	Line Pressure Solenoid Valve	
PAIR	Pulsed Secondary Air Injection	—	Secondary Air Injection System	Pulsed injection
—	Pump Speed Sensor	—	NE Sensor	#6
AIR	Secondary Air Injection	—	Secondary Air Injection System	Injection with air pump
SAPV	Secondary Air Pulse Valve	—	Reed Valve	
SFI	Sequential Multipoint Fuel Injection	—	Sequential Fuel Injection	
—	Shift Solenoid A	—	1-2 Shift Solenoid Valve	
		—	Shift A Solenoid Valve	
—	Shift Solenoid B	—	2-3 Shift Solenoid Valve	
		—	Shift B Solenoid Valve	
—	Shift Solenoid C	—	3-4 Shift Solenoid Valve	
3GR	Third Gear	—	3rd Gear	
TWC	Three Way Catalytic Converter	—	Catalytic Converter	
TB	Throttle Body	—	Throttle Body	
TP	Throttle Position	—	—	
TP sensor	Throttle Position Sensor	—	Throttle Sensor	
TCV	Timer Control Valve	TCV	Timing Control Valve	#6
TCC	Torque Converter Clutch	—	Lockup Position	
TCM	Transmission (Transaxle) Control Module	—	EC-AT Control Unit	
—	Transmission (Transaxle) Fluid Temperature Sensor	—	ATF Thermosensor	
TR	Transmission (Transaxle) Range	—	Inhibitor Position	
TC	Turbocharger	—	Turbocharger	
VSS	Vehicle Speed Sensor	—	Vehicle Speed Sensor	
VR	Voltage Regulator	—	IC Regulator	
VAF sensor	Volume Air Flow Sensor	—	Air flow Sensor	
WUTWC	Warm Up Three Way Catalytic Converter	—	Catalytic Converter	#5
WOT	Wide Open Throttle	—	Fully Open	

#1: Diagnostic trouble codes depend on the diagnostic test mode
#2: Controlled by the PCM
#3: In some models, there is a fuel pump relay that controls pump speed. That relay is now called the fuel pump relay (speed).
#4: Device that controls engine and powertrain
#5: Directly connected to exhaust manifold
#6: Part name of diesel engine

ENGINE

01
SECTION

OUTLINE 01-00
ON-BOARD
DIAGNOSTIC [L3]. 01-02
MECHANICAL [L3] 01-10
LUBRICATION [L3]. 01-11
COOLING SYSTEM [L3]. 01-12
INTAKE-AIR SYSTEM [L3] 01-13
FUEL SYSTEM [L3] 01-14
EXHAUST SYSTEM [L3] 01-15
EMISSION SYSTEM [L3]. 01-16
CHARGING SYSTEM [L3]. . . . 01-17
IGNITION SYSTEM [L3]. 01-18
STARTING SYSTEM [L3]. 01-19
CONTROL SYSTEM [L3]. 01-40

01–00 OUTLINE

ENGINE ABBREVIATIONS [L3] 01–00–1
ENGINE FEATURES [L3]. 01–00–2
Mechanical **01–00–2**
Lubrication **01–00–2**
Cooling System. **01–00–2**
Intake air System **01–00–2**
Fuel System **01–00–2**
Emission System. **01–00–2**
Charging System **01–00–3**
Ignition System. **01–00–3**
Starting System **01–00–3**
Control System. **01–00–3**
ENGINE SPECIFICATION [L3] 01–00–3
Specification. **01–00–3**
Engine oil specification. **01–00–5**

ENGINE ABBREVIATIONS [L3]

EPU010002000S01

AAS	Air Adjusting Screw
ABDC	After Bottom Dead Center
ABS	Antilock Brake System
ACC	Accessories
ATDC	After Top Dead Center
ATX	Automatic Transaxle
BBDC	Before Bottom Dead Center
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CM	Control Module
DC	Drive Cycle
DOHC	Double Overhead Camshaft
DSC	Dynamic Stability Control
EX	Exhaust
FFD	Freeze Frame Data
HU	Hydraulic Unit
IG	Ignition
IN	Intake
KOEO	Key On Engine Off
KOER	Key On Engine Running
M	Motor
MTX	Manual Transaxle
OCV	Oil Control Valve

PATS	Passive Anti-theft System
PC	Pending Code
PCV	Positive Crankcase Ventilation
PID	Parameter Identification
P/S	Power Steering
SEI	Single Electric Ignition
SST	Special Service Tool
TAS	Throttle Adjust Screw
TDC	Top Dead Center
VBC	Variable Boost Control
WDS	Worldwide Diagnostic System

ENGINE FEATURES [L3]

EPU010002000S02

Mechanical

Improved power performance	• Variable valve timing mechanism adopted
Reduced weight	• Aluminum alloy cylinder head and cylinder block adopted • Aluminum alloy engine mount bracket adopted • Plastic cylinder head cover adopted
Reduced engine noise and vibration	• Silent timing chain adopted • Crankshaft pulley with torsional damper adopted • Pendulum type engine mount adopted • Deep, skirt-type cylinder block adopted, composed of an integrated main bearing cap together with a ladder frame structure
Improved serviceability	• Drive belt auto tensioner adopted • Timing chain adopted • Engine front cover with service holes adopted • Stretch-type A/C drive belt adopted

Lubrication

Reduced noise	• Aluminum alloy oil pan adopted
Reduced weight	• Plastic oil strainer adopted • Resin oil filter cover adopted
Improved lubricity	• Trochoid gear type oil pump adopted • Oil jet valves adopted • Water-cooled type oil cooler adopted

Cooling System

Reduced weight	• Cross flow type radiator with aluminum core and plastic tank adopted • Stainless steel thermostat with plastic thermostat cover adopted
Miniaturization	• Built-in type water pump adopted
Reduced engine noise and vibration	• Electric cooling fan adopted • Fan control module adopted
Reduced power consumption	• Fan control module adopted
Improved serviceability	• Longer-life new engine coolant (type FL22) adopted

Intake air System

Improved engine torque	• Variable intake-air system adopted
Improved noise reduction	• Resonance chamber adopted
Improved emission gas purification	• Variable tumble system adopted

Fuel System

Improved serviceability	• Nylon tubes adopted for fuel hoses in the engine compartment and around the fuel tank, and quick release connectors adopted for joints
Reduction of evaporative gas	• Returnless fuel system adopted

Emission System

Improved exhaust gas purification	• EGR system adopted • Catalytic converter system adopted

Charging System

Improved reliability	• Battery duct adopted
Miniaturization	• Non-regulator type generator with built-in power transistor adopted

Ignition System

Improved reliability	• Independent ignition control system with distributorless ignition coil adopted
Improved durability	• Spark plug with an iridium alloy center electrode and platinum tip ground electrode adopted

Starting System

Improved startability	• Reduction type starter adopted
Improved safety	• Starter interlock switch adopted (MTX)

Control System

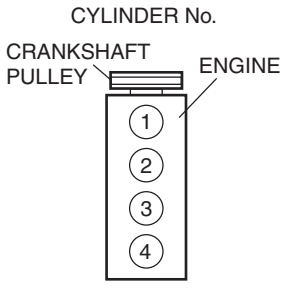
Improved engine torque and output	• Variable intake-air control adopted • Variable valve timing control adopted
Improved emission performance	• Variable tumble control adopted • EGR system adopted
Wiring harness simplification	• CAN adopted

ENGINE SPECIFICATION [L3]

EPU010002000S03

Specification

Item				Specifications
				L3 (2.3 L)
MECHANICAL				
Cylinder arrangement and number				In-line, 4-cylinder
Combustion chamber				Pentroof
Valve system				DOHC, timing chain driven, 16 valves
Displacement			(ml {cc, cu in})	2,261 {2,261, 137.9}
Bore × stroke			(mm {in})	87.5 × 94.0 {3.44 × 3.70}
Compression ratio				9.7:1
Compression pressure			(kPa {kgf/cm^2, psi} [rpm])	1,372 {14.00, 199.1} [290]
Valve timing	IN	Open	BTDC (°)	0—25
		Close	ABDC (°)	62—37
	EX	Open	BBDC (°)	42
		Close	ATDC (°)	5
Valve clearance		IN	(mm {in})	0.22—0.28 {0.0087—0.0110} [Engine cold]
		EX		0.27—0.33 {0.0107—0.0129} [Engine cold]
LUBRICATION SYSTEM				
Type				Force-fed type
Oil pressure (reference value) [oil temperature: 100°C {212°F}]			(kPa {kgf/cm^2, psi} [rpm])	337—591 {3.44—6.03, 49.0—85.8} [3,000]
Oil pump	Type			Trochoid gear type
	Relief valve opening pressure (reference value)		(kPa {kgf/cm^2, psi}	420—520 {4.28—5.30, 60.9—75.4}
Oil cooler	Type			Water-cooled
Oil filter	Type			Full-flow, paper element
	Bypass pressure		(kPa {kgf/cm^2, psi})	80—120 {0.82—1.22, 11.6—17.4}
Oil capacity (approx. quantity)	Total (dry engine)		(L {US qt, Imp qt})	4.6 {4.9, 4.0}
	Oil replacement		(L {US qt, Imp qt})	3.9 {4.1, 3.4}
	Oil and oil filter replacement		(L {US qt, Imp qt})	4.3 {4.5, 3.8}

Item			Specifications	
			L3 (2.3 L)	
COOLING SYSTEM				
Type			Water-cooled, Electromotive	
Coolant capacity (approx. quantity)		(L {US qt, Imp qt})	7.0 {7.4, 6.2}	
Water pump	Type		Centrifugal, V-ribbed belt-driven	
Thermostat	Type		Wax, bottom-bypass	
	Opening temperature	(°C {°F})	80—84 {176—183}	
	Full-open temperature	(°C {°F})	97 {207}	
	Full-open lift	(mm {in})	8.0 {0.31} or more	
Radiator	Type		Corrugated fin	
Cooling system cap	Cap valve opening pressure	(kPa {kgf/cm^2, psi})	93.2—122.6 {0.95—1.25, 13.5—17.8}	
Cooling fan	Type		Electric	
	Number of blades		7	
	Outer diameter	(mm {in})	360 {14.2}	
	Fan motor output	(W)	240	
FUEL SYSTEM				
Injector	Type		Hi-ohmic	
	Type of fuel delivery		Top-feed	
	Type of drive		Voltage	
Pressure regulator	Regulating pressure	(kPa {kgf/cm^2, psi})	approx. 390 {3.98, 56.6}	
Fuel tank	Capacity	(L {US gal, Imp gal})	60 {16, 13}	
Fuel	Type		Regular unleaded fuel	
EMISSION SYSTEM				
Catalyst	Type		WU-TWC (monolith)	WU-TWC (monolith), TWC (monolith)
Evaporative emission control system	Type		Charcoal canister type	
PCV system	Type		Closed type	
CHARGING SYSTEM				
Battery	Voltage	(V)	12	
	Type and capacity (5-hour rate)	(A·h)	50D20L (40), 80D26L (55)	
Generator	Output	(V-A)	12-90	
	Regulated voltage		Controlled by PCM	
	Self diagnosis function			
IGNITION SYSTEM				
Ignition system	Type		SEI (Single Electronic Ignition)	
	Spark advance		Electronic	
	Firing order		1—3—4—2 (all cylinders independent firing) 	
Spark plug	Type		L303 18 110	

Item			Specifications
			L3 (2.3 L)
STARTING SYSTEM			
Starter	Type		Coaxial reduction
	Output	(kW)	1.4
CONTROL SYSTEM			
EGR control	Type		Stepping motor type

Engine oil specification

Item	U.S.A. and CANADA	Except U.S.A. and CANADA
Engine oil grade	(ILSAC)	API SL or ILSAC
Engine oil viscosity	5W–20	

01–02 ON-BOARD DIAGNOSTIC [L3]

ON-BOARD DIAGNOSTIC OUTLINE [L3] 01–02–1
Features 01–02–1
Block Diagram 01–02–1
DIAGNOSTIC TEST MODE [L3] 01–02–2
Sending Diagnostic Data 01–02–2
Sending Freeze Frame Data 01–02–3
Sending Emission-related Malfunction Code 01–02–4
Sending Intermittent Monitoring System Test Results 01–02–6
Sending Continuous Monitoring System Test Results 01–02–7
DLC-2 Outline 01–02–7
DTC DETECTION LOGIC AND CONDITIONS [L3] 01–02–7
KOEO/KOER SELF-TEST [L3] 01–02–16
KOEO (Key ON, Engine Off) Self-test 01–02–16
KOER (Key ON, Engine Running) Self-test 01–02–16
PID/DATA MONITOR AND RECORD [L3] 01–02–19
SIMULATION TEST [L3] 01–02–21
DIAGNOSTIC SYSTEM WIRING DIAGRAM [L3] 01–02–22

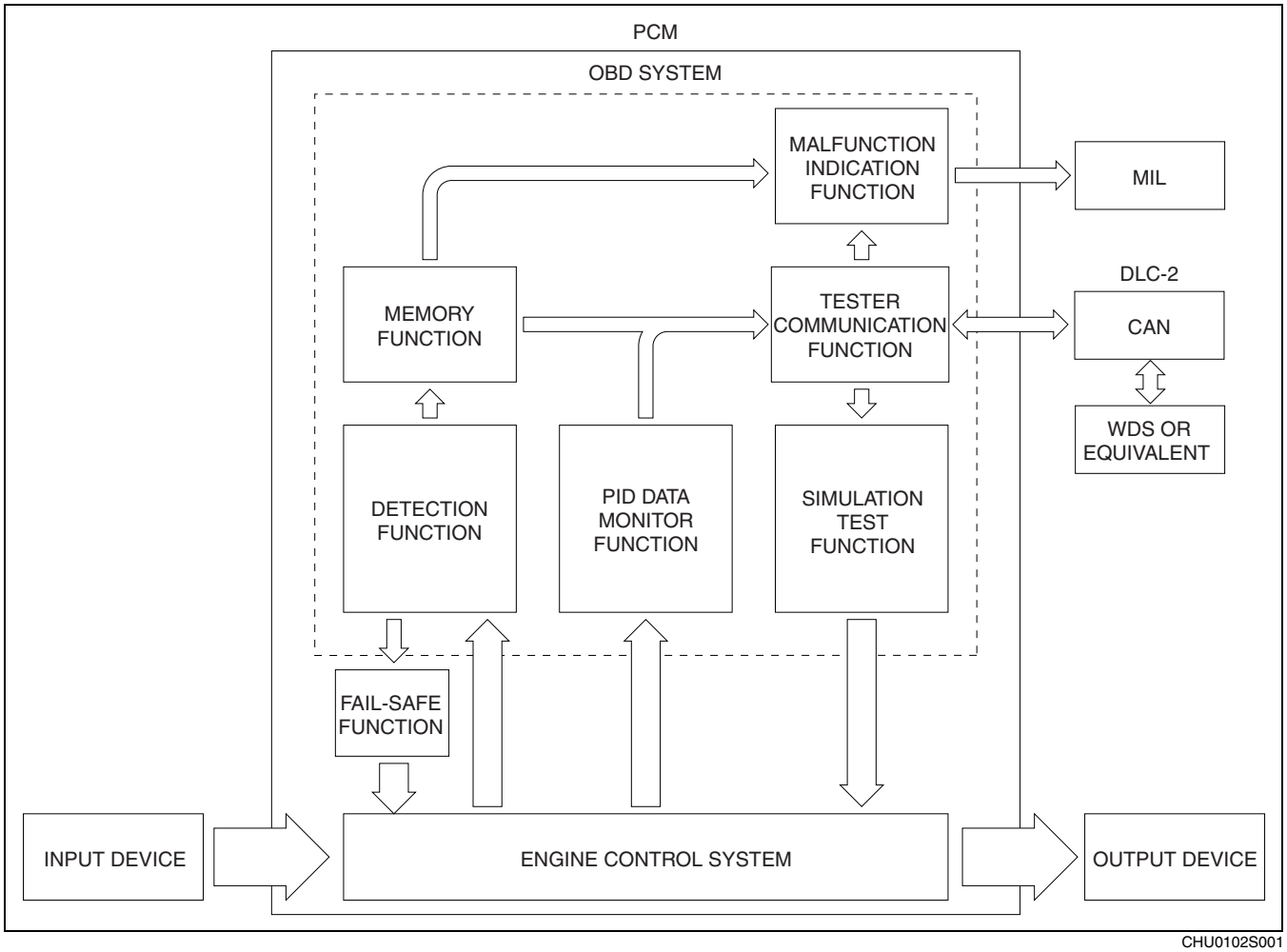
ON-BOARD DIAGNOSTIC OUTLINE [L3]

EPU010200000S01

Features

To meet the OBD-II regulations	• Diagnostic test modes adopted
Improved serviceability	• DTCs adopted • KOEO/KOER self-test function adopted • PID/DATA monitor function adopted • Simulation test function adopted

Block Diagram



CHU0102S001

DIAGNOSTIC TEST MODE [L3]

EPU010200000S02

- To meet OBD-II regulations, the following diagnostic test modes have been adopted.

Diagnostic test mode	Item
Mode 01	Sending diagnostic data (PID data monitor/On-board system readiness test)
Mode 02	Sending freeze frame data
Mode 03	Sending emission-related malfunction code (DTC)
Mode 04	Clearing/resetting emission-related malfunction information
Mode 06	Sending intermittent monitoring system test results (DMTR)
Mode 07	Sending continuous monitoring system test results (pending code)
Mode 09	Request vehicle information

Sending Diagnostic Data

PID data monitor

- The PID data monitor items are shown below.

PID data monitor table

Support item	Condition/unit	
Fuel system loop status	Refer to list below	
Engine load calculated value	%	
Engine coolant temperature	°C	°F
Short fuel trim	%	
Long fuel trim	%	
Intake manifold absolute pressure	kPa	
Engine speed	rpm	
Vehicle speed	km/h	mph
Spark advance	BTDC	
Intake air temperature	°C	°F
Mass air flow	g/s	
Throttle position (sensor No.1)	%	
Oxygen sensor location	–	
Front heated oxygen sensor	V	%
Rear heated oxygen sensor	V	%
OBD requirement to which vehicle designed	–	
Time since engine start	sec.	
Distance travelled while MIL is activated	km	miles
Desired EGR valve opening angle	%	
Desired purge solenoid valve control duty	%	
Fuel level	%	
Number of warm-ups since DTCs cleared	–	
Distance travelled since DTCs cleared	km	miles
Barometric pressure	kPa	
Estimated catalyst converter temperature	°C	°F
PCM power supply voltage	V	
Absolute load value	%	
Relative throttle position	%	
Throttle position (sensor No.2)	%	
Accelerator pedal position (sensor No.1)	%	
Accelerator pedal position (sensor No.2)	%	
Desired throttle valve opening angle	%	

Meaning of fuel system loop status

- The following information is displayed on the tester.
  - — Feedback stops: ECT is lower than the determined feedback zone.
  - — Feedback operating: HO2S being used for feedback is normal.
  - — Feedback stops: Open loop due to driving condition
  - — Feedback stops: Open loop due to detected system fault
  - — Feedback operating: Malfunction occurred in HO2S (rear) system

On-board system readiness test

- The items supported by the on-board system readiness test are shown below.

Continuous monitoring system

— HO2S heater
— Fuel system
— Misfire
— CCM

Intermittent monitoring system

— HO2S
— Catalyst

Sending Freeze Frame Data

- The Freeze Frame Data monitor items are shown below.

Freeze Frame Data monitor table

Support item	Condition/unit	
DTC that caused required FFD storage	–	
Fuel system loop status	Refer to list below	
Engine load calculated value	%	
Engine coolant temperature	°C	°F
Short fuel trim	%	
Long fuel trim	%	
Intake manifold absolute pressure	kPa	
Engine speed	rpm	
Vehicle speed	km/h	mph
Spark advance	BTDC	
Intake air temperature	°C	°F
Mass air flow	g/s	
Throttle position (sensor No.1)	%	
Time since engine start	sec.	
Desired EGR valve opening angle	%	
Desired purge solenoid valve control duty	%	
Fuel level	%	
Number of warm-ups since DTCs cleared	–	
Distance travelled since DTCs cleared	km	miles
Barometric pressure	kPa	
Estimated catalyst converter temperature	°C	°F
PCM power supply voltage	V	
Absolute load value	%	
Relative throttle position	%	
Throttle position (sensor No.2)	%	
Accelerator pedal position (sensor No.1)	%	
Accelerator pedal position (sensor No.2)	%	
Desired throttle valve opening angle	%	

Meaning of fuel system loop status

- The following information is displayed on the tester.
  — Feedback stops: ECT is lower than the determined feedback zone.
  — Feedback operating: HO2S being used for feedback is normal.
  — Feedback stops: Open loop due to driving condition
  — Feedback stops: Open loop due to detected system fault
  — Feedback operating: Malfunction occurred in HO2S (rear) system

Sending Emission-related Malfunction Code

- The DTCs are shown below.

×: Applicable
—: Not applicable

DTC No.	Condition	MIL	DC	Monitor item	Memory function
P0011	CMP timing over-advanced	ON	1	CCM	×
P0012	CMP timing over-retarded	ON	2	CCM	×
P0016	CKP-CMP correlation	ON	2	CCM	×
P0031	Front HO2S heater circuit low input	ON	2	HO2S heater	×
P0032	Front HO2S heater circuit high input	ON	2	HO2S heater	×
P0037	Rear HO2S heater circuit low input	ON	2	HO2S heater	×
P0038	Rear HO2S heater circuit high input	ON	2	HO2S heater	×
P0069	Manifold absolute pressure/atmospheric pressure correlation	ON	2	CCM	×
P0101	MAF sensor circuit range/performance problem	ON	2	CCM	×
P0102	MAF sensor circuit low input	ON	1	CCM	×
P0103	MAF sensor circuit high input	ON	1	CCM	×
P0107	MAP sensor circuit low input	ON	1	CCM	×
P0108	MAP sensor circuit high input	ON	1	CCM	×
P0111	IAT sensor circuit range/performance problem	ON	2	CCM	×
P0112	IAT sensor circuit low input	ON	1	CCM	×
P0113	IAT sensor circuit high input	ON	1	CCM	×
P0116	ECT sensor circuit range/performance problem	ON	1	Engine cooling system	×
P0117	ECT sensor circuit low input	ON	1	Engine cooling system	×
P0118	ECT sensor circuit high input	ON	1	Engine cooling system	×
P0122	TP sensor No.1 circuit low input	ON	1	CCM	×
P0123	TP sensor No.1 circuit high input	ON	1	CCM	×
P0125	Excessive time to enter closed loop fuel control	ON	2	Engine cooling system	×
P0126 P0128	Coolant thermostat stuck open	ON	2	Engine cooling system	×
P0131	Front HO2S circuit low input	ON	2	HO2S	×
P0132	Front HO2S circuit high input	ON	2	HO2S	×
P0133	Front HO2S circuit problem	ON	2	HO2S	×
P0134	Front HO2S no activity detected	ON	2	HO2S	×
P0137	Rear HO2S circuit low input	ON	2	HO2S	×
P0138	Rear HO2S circuit high input	ON	2	HO2S	×
P0139	Rear HO2S circuit malfunction	ON	2	HO2S	×
P0140	Rear HO2S no activity detected	ON	2	HO2S	×
P0222	TP sensor No.2 circuit low input	ON	1	CCM	×
P0223	TP sensor No.2 circuit high input	ON	1	CCM	×
P0300	Random misfire detected	Flash/ON	1 or 2	Misfire	×
P0301	Cylinder No.1 misfire detected	Flash/ON	1 or 2	Misfire	×
P0302	Cylinder No.2 misfire detected	Flash/ON	1 or 2	Misfire	×
P0303	Cylinder No.3 misfire detected	Flash/ON	1 or 2	Misfire	×
P0304	Cylinder No.4 misfire detected	Flash/ON	1 or 2	Misfire	×
P0327	KS circuit low input	ON	1	CCM	×
P0328	KS circuit high input	ON	1	CCM	×
P0335	CKP sensor circuit problem	ON	1	CCM	×
P0340	CMP sensor circuit problem	ON	1	CCM	×
P0401	EGR flow insufficient detected	ON	2	EGR system	×
P0403	EGR valve (stepper motor) circuit malfunction	ON	2	CCM	×

DTC No.	Condition	MIL	DC	Monitor item	Memory function
P0421	Catalyst system efficiency below threshold	ON	2	Catalyst	×
P0441	Evaporative emission control system incorrect purge flow	ON	2	EVAP system	×
P0442	Evaporative emission control system leak detected (small leak.)	ON	2	EVAP system	×
P0443	Purge solenoid valve circuit problem	ON	2	CCM	×
P0446	Change over valve (COV) (EVP system leak detection pump) stuck close	ON	2	CCM	×
P0455	Evaporative emission control system leak detected (gross leak)	ON	2	EVAP system	×
P0456*1	Evaporative emission system leak detected (very small leak)	ON	2	EVAP system	×
P0461	Fuel gauge sender unit circuit range/performance	ON	2	CCM	×
P0462	Fuel gauge sender unit circuit low input	ON	2	CCM	×
P0463	Fuel gauge sender unit circuit high input	ON	2	CCM	×
P0480	Fan control circuit problem	OFF	1	Other	×
P0500	VSS circuit problem	ON	2	CCM	×
P050A	Cold start idle air control system performance	ON	2	CCM	×
P050B	Cold start ignition timing performance	ON	2	CCM	×
P0505	IAC system problem	OFF	—	Other	—
P0506	Idle control system RPM lower than expected	ON	2	CCM	×
P0507	Idle control system RPM higher than expected	ON	2	CCM	×
P0564	Cruise control switch circuit malfunction	OFF	1	Other	×
P0571	Brake switch circuit malfunction	OFF	1	Other	×
P0601	Internal control module memory check sum error	ON	1	CCM	×
P0602	PCM programming error	ON	1	CCM	×
P0604	PCM RAM error	ON	1	CCM	×
P0606	ECM/PCM processor	ON	1	CCM	×
P0607	PCM performance problem	OFF	1	Other	×
P0610	PCM vehicle options error	ON	1	CCM	×
P0638	Throttle actuator control range/performance	ON	1	CCM	×
P0661	Variable intake-air solenoid valve circuit low input	OFF	1	Other	×
P0662	Variable intake-air solenoid valve circuit high input	OFF	1	Other	×
P0703	Brake switch input circuit problem	ON	2	CCM	×
P0704*2	Clutch pedal position (CPP) switch input circuit problem	ON	2	CCM	×
P0850*2	Neutral switch input circuit problem	ON	2	CCM	×
P1260	Immobilizer system problem	OFF	1	Other	×
P2004	Variable tumble shutter valve stuck open	ON	2	CCM	×
P2006	Variable tumble shutter valve stuck closed	ON	2	CCM	×
P2009	Variable tumble solenoid valve circuit low input	ON	2	CCM	×
P2010	Variable tumble solenoid valve circuit high input	ON	2	CCM	×
P2088	Oil control valve (OCV) actuator circuit low	ON	1	CCM	×
P2089	Oil control valve (OCV) actuator circuit high	ON	1	CCM	×
P2096	Target A/F feedback system too lean	ON	2	Fuel system	×
P2097	Target A/F feedback system too rich	ON	2	Fuel system	×
P2100	Throttle actuator circuit open	ON	1	CCM	×
P2101	Throttle actuator circuit range/performance	ON	1	CCM	×
P2102	Throttle actuator circuit low input	ON	1	CCM	×
P2103	Throttle actuator circuit high input	ON	1	CCM	×
P2107	Throttle actuator control module processor error	ON	1	CCM	×
P2108	Throttle actuator control module performance error	ON	1	CCM	×
P2119	Throttle actuator control throttle body range/ performance problem	ON	1	CCM	×

DTC No.	Condition	MIL	DC	Monitor item	Memory function
P2122	Accelerator pedal position (APP) sensor No.1 circuit low input	ON	1	CCM	×
P2123	Accelerator pedal position (APP) sensor No.1 circuit high input	ON	1	CCM	×
P2126	Accelerator pedal position (APP) sensor No.2 circuit range/performance problem	ON	1	CCM	×
P2127	Accelerator pedal position (APP) sensor No.2 circuit low input	ON	1	CCM	×
P2128	Accelerator pedal position (APP) sensor No.2 circuit high input	ON	1	CCM	×
P2135	Throttle position sensor No.1/No.2 voltage problem	ON	1	CCM	×
P2138	Accelerator pedal position (APP) sensor No.1/No.2 voltage problem	ON	1	CCM	×
P2177	Fuel system too lean at off idle	ON	2	Fuel system	×
P2178	Fuel system too rich at off idle	ON	2	Fuel system	×
P2187	Fuel system too lean at idle	ON	2	Fuel system	×
P2188	Fuel system too rich at idle	ON	2	Fuel system	×
P2195	Front HO2S signal stuck lean	ON	2	HO2S	×
P2196	Front HO2S signal stuck rich	ON	2	HO2S	×
P2228	BARO sensor circuit low input	ON	1	CCM	×
P2229	BARO sensor circuit high input	ON	1	CCM	×
P2401	EVAP system leak detection pump motor circuit low	ON	2	Other	×
P2402	EVAP system leak detection pump motor circuit high	ON	2	Other	×
P2404	EVAP system leak detection pump sense circuit problem	ON	2	Other	×
P2405	EVAP system leak detection pump sense circuit low input	ON	2	Other	×
P2407	EVAP system leak detection pump sense circuit intermittent	ON	2	Other	×
P2502	Charging system voltage problem	OFF	1	Other	×
P2503	Charging system voltage low	OFF	1	Other	×
P2504	Charging system voltage high	OFF	1	Other	×
P2507	PCM B+ voltage low	ON	1	CCM	×
P2610	PCM internal engine off timer performance	ON	2	CCM	×

*1 : California emission regulation applicable model
*2 : MTX model

Sending Intermittent Monitoring System Test Results

- The items supported by the sending intermittent monitoring system are shown below.

TEST ID	Description	Related system
10:01:01	HO2S (Front) rich-to-lean sensor threshold voltage (constant)	HO2S
10:01:02	HO2S (Front) lean-to-rich sensor threshold voltage (constant)	
10:01:03	Low HO2S (Front) voltage for switch time calculation (constant)	
10:01:04	High HO2S (Front) voltage for switch time calculation (constant)	
10:01:05	HO2S (Front) rich-to-lean response time (calculated)	
10:01:06	HO2S (Front) lean-to-rich response time (calculated)	
10:01:0A	HO2S (Front) period (calculated)	
10:02:03	Low HO2S (Rear) voltage for switch time calculation (constant)	
10:02:04	High HO2S (Rear) voltage for switch time calculation (constant)	
10:02:05	HO2S (Rear) rich-to-lean response time (calculated)	
10:21:80	HO2S (Front) and HO2S (Rear) switching time ratio	Catalyst
10:31:83	EGR pressure variation	EGR

TEST ID	Description	Related system
10:3A:80	EVAP system leak detection pump large leak check	EVAP
10:3B:80	EVAP system leak detection pump small leak check	
10:3C:80*1	EVAP system leak detection pump very small leak check	
10:3D:80	Purge flow monitor	
10:A2:0B	Cylinder No.1 average misfire counts for last 10 DC	Misfire
10:A2:0C	Cylinder No.1 misfire counts for last/current DC	
10:A3:0B	Cylinder No.2 average misfire counts for last 10 DC	
10:A3:0C	Cylinder No.2 misfire counts for last/current DC	
10:A4:0B	Cylinder No.3 average misfire counts for last 10 DC	
10:A4:0C	Cylinder No.3 misfire counts for last/current DC	
10:A5:0B	Cylinder No.4 average misfire counts for last 10 DC	
10:A5:0C	Cylinder No.4 misfire counts for last/current DC	
10:E1:80	Heat radiation ratio	Thermostat
10:E1:81	Engine coolant temperature	

*1 : California emission regulation applicable model

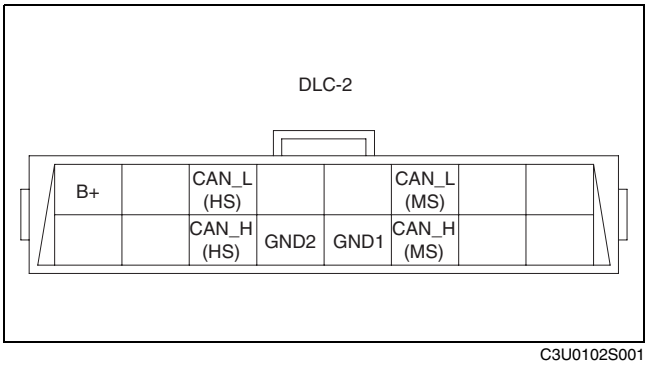
Sending Continuous Monitoring System Test Results
- These appear when a problem is detected in a monitored system.

1-drive cycle type
- If any problems are detected in the first drive cycle, pending codes will be stored in the PCM memory, as well as DTCs.
- After pending codes are stored, if the PCM determines that the system is normal in any future drive cycle, the PCM deletes the pending codes.

2-drive cycle type
- The code for a failed system is stored in the PCM memory in the first drive cycle. If the problem is not found in the second drive cycle, the PCM determines that the system returned to normal or the problem was mistakenly detected, and deletes the pending code when the ignition switch is turned to the ON position in the next drive cycle. If the problem is found in the second drive cycle too, the PCM determines that the system has failed, and stores the pending codes, and the DTCs.
- After pending codes are stored, if the PCM determines that the system is normal in any future drive cycle, the PCM deletes the pending codes.

DLC-2 Outline
- The DLC-2 located in the driver compartment is a service connector defined by EOBD regulations.
- The following are functions for each terminal.

Terminal name	Function
B+	Battery positive voltage
CAN_H (HS)	CAN communication line (HS)
CAN_L (HS)	CAN communication line (HS)
GND1	Ground (chassis)
GND2	Ground (signal)
CAN_H (MS)	CAN communication line (MS)
CAN_L (MS)	CAN communication line (MS)



C3U0102S001

DTC DETECTION LOGIC AND CONDITIONS [L3]

EPU010200000S03

P0011 CMP Timing over-advanced
- The actual valve timing is over-advanced by **17**° from the target valve timing when the OCV is controlled in the maximum valve timing retard condition.
  Monitoring condition
  — Engine speed is **below 4,000 rpm**
  — Engine coolant temperature is **70—110°C {158—230°F}**

P0012 CMP Timing over-retarded
- Actual valve timing is over-retarded by **10**° from the target valve timing for **5 s** when the OCV system control is within the feed-back range.
  Monitoring condition
  — Engine speed is **below 4,000 rpm**
  — Engine coolant temperature is **70—110°C {158—230°F}**

P0016 CKP-CMP correlation
- The PCM monitors the input pulses from the CKP sensor and CMP sensor. If the input pulse pick-up timing do not match each other, the PCM determines that the camshaft position does not coincide with the crankshaft position.

P0031 Front HO2S heater circuit low input
- The PCM monitors the front HO2S heater output voltage. If the PCM turns the front HO2S heater off or on but the front HO2S heater circuit remains low voltage, the PCM determines that the front HO2S heater circuit has malfunction.

P0032 Front HO2S heater circuit high input
- The PCM monitors the front HO2S heater output voltage. If the PCM turns the front HO2S heater off or on but the front HO2S heater circuit remains high voltage, the PCM determines that the front HO2S heater circuit has malfunction.

P0037 Rear HO2S heater circuit low input
- The PCM monitors the rear HO2S heater output voltage. If the PCM turns the rear HO2S heater off or on but the rear HO2S heater circuit remains low voltage, the PCM determines that the rear HO2S heater circuit has malfunction.

P0038 Rear HO2S heater circuit high input
- The PCM monitors the rear HO2S heater output voltage. If the PCM turns the rear HO2S heater off or on but the rear HO2S heater circuit remains high voltage, the PCM determines that the rear HO2S heater circuit has malfunction.

P0069 Manifold absolute pressure/atmospheric pressure correlation
- PCM monitors differences between intake manifold vacuum and atmospheric pressure. If the difference is **below -12 kPa {-90 mmHg, -3.5 inHg}** or **above 12 kPa {90 mmHg, 3.5 inHg}** when the following conditions are met, the PCM determines that there is a MAP sensor performance problem.
  MONITORING CONDITION
  — **12—15 s** from when ignition switch is turned off.
  — Intake air temperature is **above -10°C {14°F}**.
  — Engine coolant temperature is **above 70°C {158°F}**.

P0101 MAF sensor circuit range/performance problem
- PCM monitors mass intake air flow amount when the engine is running.
  — If mass intake air flow amount is **above 50 l/s** for **5 s** and engine speed is **below 2,000 rpm** with engine running, PCM determines that detected mass intake air flow amount is too high.
  — If mass intake air flow amount is **below 6.0—57.8 l/s** (The value depends on engine speed.) for **5 s** and engine speed is **above 1,000 rpm** with engine running and throttle opening angle is **above 50%**, PCM determines that detected mass intake air flow amount is too low.

P0102 MAF sensor circuit low input
- The PCM monitors input voltage from the MAF sensor when the engine running. If the input voltage at PCM terminal 1AC is **below 0.21 V**, the PCM determines that the MAF circuit has malfunction.

P0103 MAF sensor circuit high input
- The PCM monitors the input voltage from the MAF sensor when the engine running. If the input voltage at PCM terminal 1AC is **above 4.9 V**, the PCM determines that the MAF circuit has malfunction.

P0107 MAP sensor circuit low input
- The PCM monitors the input voltage from the MAP sensor when the intake air temperature is **above -10 °C {14 °F}**. If the input voltage at PCM terminal 2AL is **below 0.1V**, the PCM determines that the MAP sensor circuit has a malfunction.
  Monitoring Condition
  — Calculated load: **13—32%**

P0108 MAP sensor circuit high input
- The PCM monitors the input voltage from the MAP sensor when the intake air temperature is **above -10 °C {14 °F}**. If input the voltage at PCM terminal 2AL is **above 4.92 V**, the PCM determines that the MAP sensor circuit has malfunction.
  Monitoring Condition
  — Calculated load: **13—32%**

P0111 IAT circuit range/performance problem
- If intake air temperature is higher than engine coolant temperature by **18 °C {32.4 °F} for 1.2 s** with ignition switch on*, the PCM determines that there is a intake air temperature sensor circuit range/performance problem.
  *: Ignition switch on when **6 h** or more has passed since the previous ignition switch off

P0112 IAT sensor circuit low input
- The PCM monitors the IAT sensor signal at PCM terminal 1AH. If the PCM detects the IAT sensor voltage **below 0.16 V**, the PCM determines that the IAT sensor circuit has malfunction.

P0113 IAT sensor circuit high input
- The PCM monitors the IAT sensor signal at PCM terminal 1AH. If the PCM detects the IAT sensor voltage **above 4.84 V**, the PCM determines that IAT sensor circuit has malfunction.

P0116 ECT sensor circuit range/performance problem
- The PCM monitors the maximum value and minimum value of engine coolant temperature when the engine is started and **5 min** have been passed after leaving the vehicle **6 h or more**. If difference between maximum and minimum values of engine coolant temperature is **below 6 °C {10.8 °F}** the PCM determines that there is an ECT circuit range/performance problem.

P0117 ECT sensor circuit low input
- The PCM monitors the ECT sensor signal at PCM terminal 2AK. If the PCM detects the ECT sensor voltage **below 0.2 V**, the PCM determines that the ECT sensor circuit has malfunction.

P0118 ECT sensor circuit high input
- The PCM monitors the ECT sensor signal at PCM terminal 2AK. If the PCM detects the ECT sensor voltage is **above 4.58 V**, the PCM determines that the ECT sensor circuit has malfunction.

P0122 TP sensor No.1 circuit low input
- If the PCM detects the TP sensor voltage at PCM terminal 2M is **below 0.2 V** while the engine running to on, the PCM determines that the TP circuit has malfunction.

P0123 TP sensor No.1 circuit high input
- If the PCM detects the TP sensor voltage at PCM terminal 2M is **above 4.85 V** while the engine is running, the PCM determines that the TP circuit has malfunction.

P0125 Excessive time to enter closed loop fuel control
- The PCM monitors the ECT sensor signal at PCM terminal 2AK after engine is started while the engine is cold. If the engine coolant temperature does not reach the expected temperature for specified period, the PCM determines that it has taken an excessive amount of time for the engine coolant temperature to reach the temperature necessary to start closed-loop fuel control.

P0126 Coolant thermostat stuck open
- If the ECT signal never exceeds **71 °C {160 °F}** after engine start for specified period, PCM determines that the coolant thermostat is stuck open.
  MONITORING CONDITIONS
  — IAT: **above -10 °C {14 °F}**
  — Vehicle speed: **over 6 km/h {3.7 mph}**

P0128 Coolant thermostat stuck open
- PCM monitors MAF, IAT, VSS and EAT signals and calculate radiator's heat radiation ratio while following monitoring conditions are met. If calculated value exceeds threshold, PCM determines that the coolant thermostat is stuck open.
  MONITORING CONDITIONS
  — IAT: **above -10°C {14 °F}**
  — ECT at engine start: **Below 36 °C {97 °F}**
  — Difference between ECT at engine start and minimum IAT: **Below 6 °C {10.8 °F}**
  — Vehicle speed: **over 30 km/h {18 mph}**

P0131 Front HO2S circuit low input
- The PCM monitors the front HO2S output voltage when the following conditions are met. If output voltage is less than **0.1 V** for **41 s**, the PCM determines that the front HO2S signal remains lean.
  MONITORING CONDITION
  — Fuel injection control system status: feedback zone
- The PCM monitors the input voltage from the front HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the front HO2S does not even **exceed 0.1 V** though the short term fuel trim is controlled up to **25%** for **9.6 s**, the PCM determines that sensor circuit is not activated.
  MONITORING CONDITIONS
  — HO2S, HO2S heater and TWC Repair Verification Drive Mode
  — Following conditions are met
    - Time from engine start is **above 49.8 s** (ECT when engine start is **20 °C {68 °F}**).

P0132 Front HO2S circuit high input
- The PCM monitors the input voltage from the front HO2S. If the input voltage from the front HO2S sensor is **above 1.2 V** for **0.8 s**, the PCM determines that circuit input is high.

P0133 Front HO2S circuit problem

- PCM monitors inversion cycle period, lean-to-rich response time and rich-to-lean response time of the sensor. PCM calculates the average of the inversion cycle period-specified inversion cycles, average response time from lean-to-rich, and from rich-to-lean when monitoring conditions are met. If the following conditions are met, PCM determines that circuit has malfunction.
  — The average value of the inversion cycle period or the lean-to-rich/rich-to-lean response time is more than the threshold value the following monitoring conditions are met.

  MONITORING CONDITIONS

  — HO2S heater, HO2S, and TWC Repair Verification Drive Mode
  — Following conditions are met:
    - Calculation load is **17—50% (MT),17—59% (AT)** (at engine speed **2,000 rpm**).
    - Engine speed is **1,500—4,000 rpm**.
    - Vehicle speed is above **3.76 km/h {2.33 MPH}**.
    - Engine coolant temperature is **above -10 °C {14 °F}**.
    - Front HO2S signal inversion cycle is **above 10 cycles**.
  — The inversion cycle period and the lean-to-rich/rich-to-lean response time cannot be measured even once even though the accumulated occurrence time of the following monitoring conditions has exceeded the prescribed time limit.

  MONITORING CONDITIONS

  — Following conditions are met:
    - Calculation load is **17—50% (MT),17—59% (AT)** (at engine speed **2,000 rpm**).
    - Engine speed is **1,500—4,000 rpm**.
    - Vehicle speed is above **3.76 km/h {2.33 MPH}**.
    - Engine coolant temperature is **above -10 °C {14 °F}**.

P0134 Front HO2S no activity detected

- The PCM monitors the input voltage from the front HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the front HO2S does not even **exceed 0.55 V** though the short term fuel trim is controlled up to **25%** for **9.6 s**, the PCM determines that sensor circuit is not activated.

  MONITORING CONDITIONS

  — HO2S, HO2S heater and TWC Repair Verification Drive Mode
  — Following conditions are met
    - Time from engine start is **above 49.8 s** (ECT when engine start is **20 °C {68 °F}**).
  — Front HO2S voltage is **above 0.1 V**

P0137 Rear HO2S circuit low input

- The PCM monitors input voltage from rear HO2S. If the input voltage from the rear HO2S sensor is below **0.1 V** for **41.6 s** the PCM determines that circuit input is low.

  MONITORING CONDITIONS

  - HO2S, HO2S heater and TWC repair verification drive mode
  - Following conditions are met.
    — Engine speed is **above 1,500 rpm**.
    — Engine coolant temperature **above 70 °C {158 °F}**.
    — Fuel injector control in rear HO2S closed loop control
- The PCM monitors the input voltage from the rear HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the rear HO2S does not even **exceed 0.1 V** though the short term fuel trim is controlled up to **25%** for **9.6 s**, the PCM determines that sensor circuit input is low.

  MONITORING CONDITIONS

  - HO2S, HO2S heater and TWC repair verification drive mode
  - Following conditions are met for **above 20.8 s**
    - Engine speed is **above 1,500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.

P0138 Rear HO2S circuit high input

- The PCM monitors input voltage from rear HO2S. If the input voltage from the rear HO2S sensor is **above 1.2 V** for **0.8 s**, the PCM determines that circuit input is high.

P0139 Rear HO2S circuit problem

- The PCM monitors inversion cycle period, rich-to-lean response time of the sensor. The PCM detects the rich-to-lean response time slower than 80 s 5 times when following conditions are met, the PCM determines that circuit has malfunction.

  MONITORING CONDITIONS

  — HO2S heater, HO2S, and TWC Repair Verification Drive Mode
  — Following conditions are met:
    - Engine speed is **above 500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.
    - Rear HO2S output voltage is **above 0.4 V**.

P0140 Rear HO2S no activity detected

- The PCM monitors the input voltage from the rear HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the rear HO2S does not even **exceed 0.55 V** though the short term fuel trim is controlled up to **25%** for **9.6 s**, the PCM determines that sensor circuit is not activated.

  MONITORING CONDITIONS

  — HO2S, HO2S heater and TWC repair verification drive mode
  — Following conditions are met for **above 20.8 s**
    - Engine speed is **above 1,500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.
  — Rear HO2S voltage is **above 0.1 V**

P0222 TP sensor No.2 circuit low input

- The PCM monitors the input voltage from TP sensor No.2 when the engine is running. If the input voltage is **below 0.2 V**, the PCM determines that the TP sensor No.2 circuit input voltage is low.

P0223 TP sensor No.2 circuit high input

- The PCM monitors the input voltage from TP sensor No.2 when the engine is running. If the input voltage is **above 4.85 V**, the PCM determines that the TP sensor No.2 circuit input voltage is high.

P0300 Random misfire detected

- The PCM monitors CKP sensor input signal interval time. The PCM calculates change of interval time for each cylinder. If change of interval time exceeds preprogrammed criteria, the PCM detects misfire in the corresponding cylinder. While the engine is running, the PCM counts number of misfires that occurred at 200 crankshaft revolutions and 1,000 crankshaft revolutions and calculates misfire ratio for each crankshaft revolution. If the ratio exceeds the preprogrammed criteria, the PCM determines that a misfire, which can damage catalytic converter or affect emission performance, has occurred.

P0301, P0302, P0303, P0304 Cylinder No.1, No.2, No.3, No.4 misfire detected

- The PCM monitors CKP sensor input signal interval time. The PCM calculates the change of interval time for each cylinder. If the change of interval time exceeds the preprogrammed criteria, the PCM detects a misfire in the corresponding cylinder. While the engine is running, the PCM counts number of misfires that occurred at 200 crankshaft revolutions and 1,000 crankshaft revolutions and calculates misfire ratio for each crankshaft revolution. If the ratio exceeds the preprogrammed criteria, the PCM determines that a misfire, which can damage catalytic converter or affect emission performance, has occurred.

P0327 KS circuit low input

- The PCM monitors input signal from the KS when the engine is running. If the input voltage at PCM terminals between 2Q and 2R is **below 0.01 V**, the PCM determines that the KS circuit has malfunction.

P0328 KS circuit high input

- The PCM monitors the input signal from the KS when the engine is running. If the input voltage at PCM terminals between 2Q and 2R is **above 4.6 V**, the PCM determines that KS circuit has a malfunction.

P0335 CKP sensor circuit problem

- If the PCM does not receive input voltage from the CKP sensor for **4.2 s** while MAF is **2.0 g/s {0.26 lb/min.} or above**, the PCM determines that the CKP sensor circuit has malfunction.

P0340 CMP sensor circuit problem

- The PCM monitors input voltage from the CMP sensor when the engine is running. If the CMP sensor signal timing inferred from the CKP sensor signal has deviated, PCM determines that CMP circuit has malfunction.

P0401 EGR flow insufficient detected

- PCM monitors difference in intake manifold pressures when EGR is operated and when it is stopped. If the difference is too small, PCM determines that EGR flow insufficient.

P0403 EGR valve (stepper motor) circuit problem

- The PCM monitors the input voltage from EGR valve. If voltage at PCM terminals 2AU, 2AR, 2AY and/or 2AV remain low or high, the PCM determines that the EGR valve circuit has malfunction.

P0421 Warm up catalyst system efficiency below threshold

- The PCM compares the number of front HO2S and rear HO2S inversions for a predetermined time. The PCM monitors the rear HO2S inversion counts when the following conditions are met: The PCM detects inversion ratio. If the inversion ratio is below threshold, the PCM determine that catalyst system has deteriorated.
  — The front HO2S inversion counts is as prescribed when the following monitoring conditions are met:
  — The accumulated occurrence time of the following monitoring conditions has exceeded the prescribed time limit:

  MONITORING CONDITION

  — Engine speed is **1,600—3,000 rpm**.
  — Calculated TWC temperature is **above 400 °C {752 °F}**.
  — Calculated load is **15—48%** (at engine speed **2,000 rpm**)

P0441 Evaporative emission control system incorrect purge flow

- PCM measures the purge line pressure, which is the vacuum when a following condition. If vacuum between charcoal canister and intake manifold does not reach the specified, PCM determines that the EVAP system has clogging.
  MONITORING CONDITION
  — Engine speed: **1,500—3,650 rpm [MT],** 1,220—3,800 rpm [AT]
  — Throttle opening angle: **19%** (At engine speed is **2500 rpm**)
  — Vehicle speed: **70—136 km/h {43.4—84.5 mph} [MT]/35—136 km/h {21.7—84.5 mph} [AT]**

P0442 Evaporative emission control system leak detected (small leak)

- PCM measures the pump load current (EVAP line pressure) when the specified period has passed after EVAP system is sealed when monitoring conditions are met. If the load does not reach the reference current value within the specified period, PCM determines that the EVAP system has small leak.
  MONITORING CONDITION
  — The ignition switch is turned off.
  — IAT: **5—35 °C {41—95 °F}**
  — Battery voltage: **11 V or above**
  — Atmospheric pressure: **72.2 kPa {542 mmHg, 21.3 inHg} or above**
  — Fuel tank level: **15—85%**
  — Time from engine off: **5 h 10 min**

P0443 Purge solenoid valve circuit problem

- The PCM monitors the input voltages from the purge solenoid valve. If the voltage at PCM terminal 2AN remains low or high, the PCM determines that the purge solenoid valve circuit has malfunction.

P0446 Change over valve (COV) (EVAP system leak detection pump) stuck close

- The PCM monitors pump load current (EVAP line pressure), while evaporative leak monitor is operating. When the decrease in pump load current is less than the specification after the reference current value has been obtained, the PCM determines change over valve (COV) in EVAP system leak detection pump has a malfunction.

P0455 Evaporative emission control system leak detected (gross leak)

- PCM measures the pump load current (EVAP line pressure) when the specified period has passed after EVAP system is sealed when monitoring conditions are met. If the load does not reach the reference current value within the specified period, PCM determines that the EVAP system has gross leak.
  MONITORING CONDITION
  — IG switch OFF
  — IAT: **5—35 °C {41—95 °F}**
  — Battery voltage: **11 V or above**
  — Atmospheric pressure: **72.2 kPa {542 mmHg, 21.3 inHg} or above**
  — Fuel tank level: **15—85%**
  — Time from engine off: **5 h 10 min**

P0456 Evaporative emission control system leak detected (very small leak)

- PCM measure the pump load current (EVAP line pressure) when a specified period has passed after EVAP system is sealed when monitoring conditions are met. If the load does not reach the reference load value or rate of the load increase lower than the specified within a specified period, PCM determines that the EVAP system has very small leak.
  MONITORING CONDITION
  — IG switch OFF
  — IAT: **5—35 °C {41—95 °F}**
  — Battery voltage: **11 V or above**
  — Atmospheric pressure: **72.2 kPa {542 mmHg, 21.3 inHg} or above**
  — Fuel tank level: **15—85%**
  — Time from engine off: **5h 10 min**

P0461 Fuel gauge sender unit circuit range/performance problem

- The PCM monitors the fuel tank level difference before and after the PCM-calculated fuel consumption has reached **more than 25 L {26.4 US qt, 22 Imp qt}**. If the difference is **less than 5%**, the PCM determines that there is a fuel gauge sender unit circuit range/performance problem.

P0462 Fuel gauge sender unit circuit low input

- The PCM monitors the fuel level signal and fuel gauge sender unit output voltage from the instrument cluster. If the PCM detects a fuel level or fuel gauge sender unit output voltage that is too low, the PCM determines that the fuel gauge sender unit circuit has a malfunction.

P0463 Fuel gauge sender unit circuit high input

- The PCM monitors the fuel level signal and fuel gauge sender unit output voltage from the instrument cluster. If the PCM detects a fuel level or fuel gauge sender unit output voltage that is too high, the PCM determines that the fuel gauge sender unit circuit has a malfunction.

P0480 Fan control circuit problem
- The PCM monitors the input voltages from the fan control module. If the voltage at PCM terminal 1W remains low or high, the PCM determines that fan control circuit has malfunction.

P0500 VSS circuit problem
- Wheel speed signal from ABS HU/CM is invalid value when following conditions are met:
  - — Shift range in except P, N or R range (ATX)
  - — Neutral switch and clutch switch are OFF (MTX)
  - — Load is above **40%**
  - — Engine speed is **2,000 rpm or above**
  - — Brake switch is OFF

P050A Cold start idle air control system performance
- Actual idle speed is lower than expected by **100 rpm** for **8.4 s** when target idle speed is **above 0 rpm** at cold start or ignition retard value is **above 8.9 °C {48 °F}.**

Note
- If atmospheric pressure is **less than 72.3 kPa {542 mmHg, 21.3 inHg}** or intake air temperature is below **-10 °C {14 °F},** the PCM cancels diagnosis of P0506.

P050B Cold start ignition timing performance
- The PCM monitors actual ignition timing using the CKP sensor while electronic spark advance control fast idle correction operating. If the ignition timing is out of specified range, the PCM determines that the ignition timing at cold condition has performance problem.

P0505 IAC system problem
- The PCM cannot control idle speed toward target idle speed while KOER self test.

P0506 Idle control system RPM lower than expected
- Actual idle speed is lower than expected by **100 rpm** for **14 s**, when brake pedal is depressed (brake switch is on).

P0507 Idle control system RPM higher than expected
- Actual idle speed is higher than expected by **200 rpm** for **14 s**, when the brake pedal is depressed (brake switch is on).

P0564 Cruise control switch circuit malfunction
- The PCM monitors the cruise control switch signal at PCM terminal 1AD. If the PCM detects that any one of following switches (Main, CANCEL, SET/COAST, RESUME/ACCEL) remains on for **2 min**, the PCM determines that the cruise control switch circuit has a malfunction.

P0571 Brake switch circuit problem
- The PCM monitors changes in input voltage for brake switch No.1 and No.2 (signal from instrument cluster). If the PCM detects that both brake switches No.1 and No.2 remain on or off for **15 s**, it determines that the brake switch circuit has a malfunction.

P0601 PCM memory check sum error
- PCM internal memory check sum error

P0602 PCM programming error
- No configuration data in the PCM

P0604 PCM random access memory error
- PCM internal random access memory error

P0606 ECM/PCM processor
- The PCM internal CPU malfunction

P0607 PCM performance problem
- PCM internal malfunction.

P0610 PCM vehicle options error
- PCM data configuration error

P0638 Throttle actuator control circuit range/performance problem
- The PCM compares the actual TP with the target TP when the engine is running. If the difference is more than the specification, the PCM determines that there is a throttle actuator control circuit range/performance problem.

P0661 Variable intake-air solenoid valve circuit low input
- The PCM monitors the variable intake-air solenoid valve control signal at PCM terminal 2AJ. If the PCM turns variable intake-air solenoid valve off but voltage at PCM terminal 2AJ still remains low, the PCM determines that variable intake-air solenoid valve circuit has malfunction.

P0662 Variable intake-air solenoid valve circuit high input
- The PCM monitors the variable intake-air solenoid valve control signal at PCM terminal 2AJ. If the PCM turns variable intake-air solenoid valve on but voltage at PCM terminal 2AJ still remains high, the PCM determines that the variable intake-air solenoid valve circuit has malfunction.

P0703 Brake switch input circuit problem
- The PCM monitors changes in input voltage from the brake switch. If the PCM does not detect PCM terminal 1AU voltage changes while alternately accelerating and decelerating 8 times, the PCM determines that brake switch circuit has malfunction.

P0704 CPP switch input circuit problem
- The PCM monitors changes in input voltage from the CPP switch. If the PCM does not detect PCM terminal 1O voltage changes while the vehicle runs and stops 8 times alternately, the PCM determines that the CPP switch circuit has malfunction.

P0850 Neutral switch input circuit problem
- The PCM monitors changes in input voltage from the neutral switch. If the PCM does not detect PCM terminal 1S voltage changes while running vehicle with vehicle speed **above 30 km/h {19 mph}** and clutch pedal turns press and depress 10 times repeatedly, the PCM determines that the neutral switch circuit has malfunction

P1260 Immobilizer system problem
- The instrument cluster detects an immobilizer system malfunction.

P2004 Variable tumble shutter valve stuck open
- PCM monitors mass variable tumble shutter valve position using variable tumble position sensor. If PCM turns variable tumble solenoid valve on but variable tumble position still remain open (Variable tumble position sensor off), PCM determines that variable tumble shutter valve has been stuck open.

P2006 Variable tumble shutter valve stuck closed
- PCM monitors mass variable tumble shutter valve position using variable tumble position sensor. If PCM turns variable tumble solenoid valve off but variable tumble position still remain close (Variable tumble position sensor on), PCM determines that variable tumble shutter valve has been stuck closed.

P2009 Variable tumble solenoid valve circuit low input
- The PCM monitors variable tumble solenoid valve control signal at PCM terminal 2AI. If the PCM turns variable tumble solenoid valve off but voltage at PCM terminal 2AI still remains low, the PCM determines that variable tumble solenoid valve circuit has malfunction.

P2010 Variable tumble solenoid valve circuit high input
- The PCM monitors the variable tumble solenoid valve control signal at PCM terminal 2AI. If the PCM turns variable tumble solenoid valve on but the voltage at PCM terminal 2AI still remains high, the PCM determines that the variable tumble solenoid valve circuit has malfunction.

P2088 OCV circuit low
- The PCM monitors the OCV voltage. If the PCM detects the OCV control voltage (calculated from the OCV) is below the threshold voltage (calculated from the battery positive voltage), the PCM determines that the OCV circuit has a malfunction.

P2089 OCV circuit high
- The PCM monitors the OCV voltage. If the PCM detects the OCV control voltage (calculated from the OCV) is above the threshold voltage (calculated from battery positive voltage), the PCM determines that the OCV circuit has a malfunction.

P2096 Target A/F feedback system too lean
- The PCM monitors the target A/F fuel trim when under the target A/F feedback control. If the fuel trim is more than the specification, the PCM determines that the target A/F feedback system is too lean.
  Monitoring condition
  - Rear HO2S voltage is **above 0.1 V**

P2097 Target A/F feedback system too rich
- The PCM monitors the target A/F fuel trim when under the target A/F feedback control. If the fuel trim is more than specification, the PCM determines that the target A/F feedback system is too rich.

P2100 Throttle actuator circuit open
- The PCM monitors the electronic throttle valve motor current. If the PCM detects the electronic throttle valve motor current is below the threshold current, the PCM determines that the electronic throttle valve motor circuit has a malfunction.

P2101 Throttle actuator circuit range/performance
- The PCM monitors the input voltage from the drive-by-wire relay when the PCM turns the drive-by-wire relay on. If the input voltage is **less than 5.0 V**, the PCM determines that the drive-by-wire relay control circuit voltage is low.
- The PCM monitors the input voltage from the drive-by-wire relay when the PCM turns the drive-by-wire relay off. If the input voltage is **more than 5.0 V**, the PCM determines that the drive-by-wire relay control circuit voltage is high.

P2102 Throttle actuator circuit low input
- The PCM monitors the throttle actuator circuit current.If the PCM detects that throttle actuator circuit current is excessive low, the PCM determines that the throttle actuator circuit has a malfunction.

P2103 Throttle actuator circuit high input
- The PCM monitors the throttle actuator circuit current. If the PCM detects that throttle actuator circuit current is excessive high, the PCM determines that the electronic throttle actuator circuit has a malfunction.

P2107 Throttle actuator control module processor error
- Throttle actuator control module internal processor error

P2108 Throttle actuator control module performance error
- PCM detects either following conditions, PCM determines that throttle actuator control system has malfunction.
  - — TP sensor power supply voltage **below 4.4 V**
  - — TP sensor No.1 output voltage **below 0.20 V or above 4.85 V** (DTC P0122 or DTC P0123)
  - — TP sensor No.2 output voltage **below 0.20 V or above 4.85 V** (DTC P0222 or DTC P0223)
  - — PCM internal circuit for TP sensor No.1 input circuit malfunction.

P2119 Throttle actuator control throttle body range/performance problem
- The PCM compares the TP with the default TP when the ignition switch is off. If the TP is higher than the default TP, the PCM determines that there is a throttle actuator control throttle body range/performance problem.

P2122 APP sensor No.1 circuit low input
- The PCM monitors the input voltage from APP sensor No.1 when the engine is running. If the input voltage is **less than 0.12 V**, the PCM determines that the APP sensor No.1 circuit input voltage is low.

P2123 APP sensor No.1 circuit high input
- The PCM monitors the input voltage from APP sensor No.1 when the engine is running. If the input voltage is **above 4.5 V**, the PCM determines that the APP sensor No.1 circuit input voltage is high.

P2126 APP sensor No.2 range/performance problem
- The PCM monitors the APP sensor duty signal. If the input signal (duty signal) is too high or too low than the set value, or the input signal intervals are too short or too long, the PCM determines that the APP sensor No.2 has a malfunction.

P2127 APP sensor No.2 circuit low input
- The PCM monitors the input voltage from APP sensor No.2 when the engine is running. If the input voltage is **5.28 V** for **1s**, the PCM determines that the APP sensor No.2 circuit has malfunction.

P2128 APP sensor No.2 circuit high input
- The PCM monitors the input voltage from APP sensor No.2 when the engine is running. If the input voltage is **7.2 V** for **1s**, the PCM determines that the APP sensor No.2 circuit has malfunction.

P2135 TP sensor No.1/No.2 voltage correlation problem
- The PCM compares the input voltage from TP sensor No.1 with the input voltage from TP sensor No.2 when the engine is running. If the difference is more than the specification, the PCM determines that there is a TP sensor No.1/No.2 voltage correlation problem.

P2138 APP sensor No.1/No.2 voltage correlation problem
- The PCM compares the input voltage from APP sensor No.1 with the input voltage from APP sensor No.2 when the engine is running. If the difference is more than the specification, the PCM determines that there is an APP sensor No.1/No.2 angle correlation problem.

P2177 Fuel system too lean at off idle
- PCM monitors short term fuel trim (SHRTFT), long term fuel trim (LONGFT) during closed loop fuel control at off-idle. If the LONGFT and the sum total of these fuel trims exceed preprogrammed criteria. PCM determines that fuel system is too lean at off-idle.

P2178 Fuel system too rich at off idle
- PCM monitors short term fuel trim (SHRTFT), long term fuel trim (LONGFT) during closed loop fuel control at off-idle. If the LONGFT and the sum total of these fuel trims exceed preprogrammed criteria. PCM determines that fuel system is too rich at off-idle.

P2187 Fuel system too lean at idle
- PCM monitors short term fuel trim (SHRTFT) and long term fuel trim (LONGFT) during closed loop fuel control at idle. If the LONGFT and the sum total of these fuel trims exceed preprogrammed criteria. PCM determines that fuel system is too lean at idle.

P2188 Fuel system too rich at idle
- PCM monitors short term fuel trim (SHRTFT), long term fuel trim (LONGFT) during closed loop fuel control at idle. If the LONGFT and the sum total of these fuel trims exceed preprogrammed criteria. PCM determines that fuel system is too rich at idle.

P2195 Front HO2S signal stuck lean
- The PCM monitors the front HO2S output voltage when the following conditions are met. If output voltage is less than **0.45 V** for **41 s**, the PCM determines that the front HO2S signal remains lean.
  MONITORING CONDITION
  - — Fuel injection control system status: feedback zone
  - — Front HO2S voltage is **above 0.1 V**

P2196 Front HO2S signal stuck rich
- The PCM monitors the front HO2S output voltage when the following conditions are met. If output voltage is more than **0.45 V** for **41 s**, the PCM determines that the front HO2S signal remains rich.
  MONITORING CONDITION
  - — Fuel injection control system status: feedback zone

P2228 BARO sensor circuit low input
- PCM monitors input voltage from BARO sensor. If input voltage is **below 1.95 V**, PCM determines that BARO sensor circuit has malfunction.

P2229 BARO sensor circuit high input
- PCM monitors input voltage from BARO sensor. If input voltage is **above 4.45 V**, PCM determines that BARO sensor circuit has malfunction.

P2401 EVAP system leak detection pump motor circuit low
- The PCM monitors pump load current (EVAP line pressure), while evaporative leak monitor is operating. If the pump load current is lower than specified, the PCM determines EVAP system leak detection pump motor circuit has a malfunction.

P2402 EVAP system leak detection pump motor circuit high
- The PCM monitors pump load current (EVAP line pressure), while evaporative leak monitor is operating. If the pump load current is higher than specified, the PCM determines EVAP system leak detection pump motor circuit has a malfunction.

P2404 EVAP system leak detection pump sense circuit problem
- The PCM monitors the pump load current (EVAP line pressure), while the EVAP leak monitor is operating. After obtaining the reference current value, If the pump load current is greater than or equal to the reference current value plus **2 mA** within the specified time, the PCM determines that the air filter has a malfunction.

P2405 EVAP system leak detection pump sense circuit low input
- The PCM monitors pump load current (EVAP line pressure), while evaporative leak monitor is operating. If the current is lower than the specification while the PCM obtains the reference current value, the PCM determines EVAP system leak detection pump orifice has a malfunction.

P2407 EVAP system leak detection pump sense circuit intermittent
- The PCM monitors pump load current (EVAP line pressure), while evaporative leak monitor is operating. When either of the following is detected 8 times or more successively, the PCM determines EVAP system leak detection pump heater has a malfunction:
  - — While obtaining the reference current value, the change in pump load current exceeds the specification.
  - — After obtaining the reference current value, the pump load current is kept lower than the maximum pump load current for more than the specified time.

P2502 Charging system voltage problem
- PCM judges generator output voltage is **above 17 V** or battery voltage is **below 11 V** during engine running.

P2503 Charging system voltage low
- PCM needs **more than 20 A** from generator, and judges generator output voltage to be **below 8.5 V** during engine running.

P2504 Charging system voltage high
- PCM judges generator output voltage is **above 18.5 V** or battery voltage is **above 16.0 V** during engine running.

P2507 PCM B+ voltage low
- The PCM monitors the voltage of back-up battery positive terminal at PCM terminal 1BA. If the PCM detected battery positive terminal voltage **below 2.5 V** for **2 s**, the PCM determines that the backup voltage circuit has malfunction.

P2610 PCM internal engine off timer performance
- PCM internal engine off timer is damaged.

KOEO/KOER SELF-TEST [L3]

EPU010200000S04

- The self-test function consists of the KOEO (Key On Engine Off) self-test, performed when the ignition switch is turned to the ON position and the engine is stopped; and the KOER (Key On Engine Running) self-test, performed when idling. If a malfunction is detected when either self-test is executed, a DTC is displayed on the WDS or equivalent. Using the self-test function, the present malfunction or a successful repair is readily confirmed. Refer to the self-test function table for the corresponding DTCs.

KOEO (Key ON, Engine Off) Self-test
- The KOEO self-test is a powertrain control system self-diagnosis, performed when the ignition switch is turned to the ON position and the engine is stopped. A KOEO self-test begins when the connected WDS or equivalent sends an execute command to the PCM.
- As the KOEO self-test is performed, the PCM performs the inspection for set DTCs and if a malfunction is detected the DTC is displayed on the WDS or equivalent.

KOER (Key ON, Engine Running) Self-test
- The KOER self-test is a powertrain control system self-diagnosis, performed when the ignition switch is turned to the ON position and the engine is idling. A KOER self-test begins when the connected WDS or equivalent sends an execute command to the PCM.
- As the KOER self-test is performed, the PCM performs the inspection for set DTCs and if a malfunction is detected the DTC is displayed on the WDS or equivalent.

KOEO/KOER self-test table

×: Applicable
—: Not applicable

DTC No.	Condition	Test condition	
		KOEO	KOER
P0011	CMP timing over-advanced	—	×
P0012	CMP timing over-retarded	—	×
P0016	CKP-CMP correlation	—	—
P0031	Front HO2S heater circuit low input	×	×
P0032	Front HO2S heater circuit high input	×	×
P0037	Rear HO2S heater circuit low input	×	×
P0038	Rear HO2S heater circuit high input	×	×
P0069	Manifold absolute pressure/atmospheric pressure correlation	—	—
P0101	MAF sensor circuit range/performance problem	—	—
P0102	MAF sensor circuit low input	×	×
P0103	MAF sensor circuit high input	×	×
P0107	MAP sensor circuit low input	×	×
P0108	MAP sensor circuit high input	×	×
P0111	IAT sensor circuit range/performance problem	—	—
P0112	IAT sensor circuit low input	×	×
P0113	IAT sensor circuit high input	×	×
P0116	ECT sensor circuit range/performance problem	—	—
P0117	ECT sensor circuit low input	×	×
P0118	ECT sensor circuit high input	×	×
P0122	TP sensor No.1 circuit low input	×	×
P0123	TP sensor No.1 circuit high input	×	×
P0125	Excessive time to enter closed loop fuel control	—	—
P0126	Coolant thermostat stuck open	—	—
P0128		—	—
P0131	Front HO2S circuit low input	×	×
P0132	Front HO2S circuit high input	×	×
P0133	Front HO2S circuit problem	—	—
P0134	Front HO2S no activity detected	—	×
P0137	Rear HO2S circuit low input	×	×
P0138	Rear HO2S circuit high input	×	×
P0139	Rear HO2S circuit malfunction	—	—
P0140	Rear HO2S no activity detected	—	×
P0222	TP sensor No.2 circuit low input	×	×
P0223	TP sensor No.2 circuit high input	×	×
P0300	Random misfire detected	—	×
P0301	Cylinder No.1 misfire detected	—	×
P0302	Cylinder No.2 misfire detected	—	×
P0303	Cylinder No.3 misfire detected	—	×
P0304	Cylinder No.4 misfire detected	—	×
P0327	KS circuit low input	×	×
P0328	KS circuit high input	×	×
P0335	CKP sensor circuit problem	—	—
P0340	CMP sensor circuit problem	—	—
P0401	EGR flow insufficient detected	—	×
P0403	EGR valve (stepper motor) circuit malfunction	×	×
P0421	Catalyst system efficiency below threshold	—	—
P0441	Evaporative emission control system incorrect purge flow	—	×
P0442	Evaporative emission control system leak detected (small leak.)	—	×
P0443	Purge solenoid valve circuit problem	×	×
P0446	Change over valve (COV) (EVP system leak detection pump.) stuck close	—	×
P0455	Evaporative emission control system leak detected (gross leak.)	—	×

DTC No.	Condition	Test condition	
		KOEO	KOER
P0456*1	Evaporative emission system leak detected (very small leak)	—	×
P0461	Fuel gauge sender unit circuit range/performance	—	—
P0462	Fuel gauge sender unit circuit low input	×	×
P0463	Fuel gauge sender unit circuit high input	×	×
P0480	Fan control circuit problem	×	×
P0500	VSS circuit problem	—	—
P050A	Cold start idle air control system performance	—	×
P050B	Cold start ignition timing performance	—	×
P0505	IAC system problem	—	×
P0506	Idle control system RPM lower than expected	—	—
P0507	Idle control system RPM higher than expected	—	—
P0564	Cruise control switch circuit malfunction	—	—
P0571	Brake switch circuit malfunction	—	—
P0601	Internal control module memory check sum error	×	×
P0602	PCM programming error	×	×
P0604	PCM RAM error	×	×
P0606	ECM/PCM processor	×	×
P0607	PCM performance problem	×	×
P0610	PCM vehicle options error	×	×
P0638	Throttle actuator control range/performance	—	—
P0661	Variable intake-air solenoid valve circuit low input	×	×
P0662	Variable intake-air solenoid valve circuit high input	×	×
P0703	Brake switch input circuit problem	—	—
P0704*2	CPP switch input circuit problem	—	—
P0850*2	Neutral switch input circuit problem	—	—
P1260	Immobilizer system problem	×	—
P2004	Variable tumble shutter valve stuck open	—	×
P2006	Variable tumble shutter valve stuck closed	—	×
P2009	Variable tumble solenoid valve circuit low input	×	×
P2010	Variable tumble solenoid valve circuit high input	×	×
P2088	OCV actuator circuit low	×	×
P2089	OCV actuator circuit high	×	×
P2096	Target A/F feedback system too lean	—	—
P2097	Target A/F feedback system too rich	—	—
P2100	Throttle actuator circuit open	×	×
P2101	Throttle actuator circuit range/performance	—	×
P2102	Throttle actuator circuit low input	×	×
P2103	Throttle actuator control motor circuit high input	×	×
P2107	Throttle actuator control module processor error	—	×
P2108	Throttle actuator control module performance error	—	×
P2119	Throttle actuator control throttle body range/performance problem	—	×
P2122	Accelerator pedal position (APP) sensor No.1 circuit low input	×	×
P2123	Accelerator pedal position (APP) sensor No.1 circuit high input	×	×
P2126	Accelerator pedal position (APP) sensor No.2 circuit range/performance problem	×	×
P2127	Accelerator pedal position (APP) sensor No.2 circuit low input	×	×
P2128	Accelerator pedal position (APP) sensor No.2 circuit high input	×	×
P2135	Throttle position sensor No.1/No.2 voltage correlation	×	×
P2138	Accelerator pedal position (APP) sensor No.1/No.2 voltage correlation	×	×
P2177	Fuel system too lean at off idle	—	×
P2178	Fuel system too rich at off idle	—	×
P2187	Fuel system too lean at idle	—	×
P2188	Fuel system too rich at idle	—	×

DTC No.	Condition	Test condition	
		KOEO	KOER
P2195	Front HO2S signal stuck lean	—	—
P2196	Front HO2S signal stuck rich	—	—
P2228	BARO sensor circuit low input	×	×
P2229	BARO sensor circuit high input	×	×
P2401	EVAP system leak detection pump motor circuit low	—	×
P2402	EVAP system leak detection pump motor circuit high	—	×
P2404	EVAP system leak detection pump sense circuit problem	—	×
P2405	EVAP system leak detection pump sense circuit low input	—	×
P2407	EVAP system leak detection pump sense circuit intermittent	—	×
P2502	Charging system voltage problem	—	×
P2503	Charging system voltage low	—	×
P2504	Charging system voltage high	—	×
P2507	PCM B+ voltage low	×	×
P2610	PCM internal engine off timer performance	—	—

*1 : California emission regulation applicable model
*2 : MTX model

PID/DATA MONITOR AND RECORD [L3]

EPU010200000S05

- The PID/DATA monitor items are shown below.

PID/DATA monitor item table

—: Not applicable

Item	Definition	Unit/Condition	PCM terminal
AAT	Ambient air temperature	°C	—
AC_REQ	Refrigerant pressure switch (low pressure switch, high pressure switch	On/Off	1AP
ACCS	A/C relay control signal in PCM	On/Off	1AN
ALTF	Generator field coil control duty value	%	2AQ
ALTT V	Generator output voltage	V	2AM
APP	Accelerator pedal position	%	1Y 1AL
APP1	Accelerator pedal position	V %	1Y
APP2	Accelerator pedal position	V %	1AL
ARPMDES	Target engine speed	RPM	—
BARO	Barometric pressure	kPa | Bar | psi V	—
BOO	Brake switch	On/Off	1AU
BPA	Brake pressure applied switch	On/Off	—
CATT11_DSD	Estimated catalytic converter temperature	°C | °F	—
COLP	Refrigerant pressure switch (medium pressure switch)	On/Off	1R
CPP*1	Clutch pedal position	On/Off	1O
CPP/PNP*1	Shift lever position	Drive/Neutral	1S
DTCCNT	Number of DTC detected	—	—
ECT	Engine coolant temperature	°C | °F V	2AK
EQ_RAT11_DSS	Theoretical air/fuel ratio coefficient to calculate target air/fuel ratio	—	—
ETC_ACT	Electronic throttle control actual	°	2I 2M
ETC_DSD	Electronic throttle control desired	% °	2I 2M
EVAPCP	Purge solenoid valve duty value	%	2AN

Item	Definition	Unit/Condition	PCM terminal
FAN_DUTY	Fan control duty value	%	1W
FLI	Fuel level	%	—
FP	Fuel pump relay	On/Off	1AR
FUELPW	Fuel injector duration	ms	2BB 2BC 2BD 2AZ
FUELSYS	Fuel system status	OL/CL/ OL-Drive/ OL-Fault/ CL-Fault	—
GENVDSD	Target generator voltage	V	—
HTR11	Front HO2S heater control	On/Off	2G
HTR12	Rear HO2S heater control	On/Off	2C
IAT	Intake air temperature	°C | °F V	1AH
IMRC	Variable tumble control	On/Off	2AI
IMTV	Variable intake-air control	On/Off	2AJ
INGEAR	Gears are engaged	On/Off	1O 1S
IVS	CTP condition	Idle/Off Idle	—
KNOCKR	Knocking retard	°	2Q 2R
LDP_EVAPCP *2	EVAP system leak election pump detect incorrect	A	—
LDP_IDL	EVAP system leak detection pump idle current	A	—
LDP_MON	EVAP system leak detection pump monitoring current	A	—
LDP_REF	EVAP system leak detection pump reference current	A	—
LDP_SLDV	EVAP system small leak detection value	A	—
LDP_VSL_FV*2	EVAP system small leak detection fail value	mA/sec	—
LDP_VSL_SV*2	EVAP system small leak detection safe value	mA/sec	—
LDP_VSLDV*2	EVAP system small leak detection value	mA/sec	—
LOAD	Engine load	%	—
LONGFT1	Long term fuel trim	%	—
MAF	Mass air flow	g/s V	1AC
MAP	Manifold absolute pressure	kPa, Bar, psi V	2AL
MIL	Malfunction indicator lamp	On/Off	—
MIL_DIS	Travelled distance since MIL illuminated	km | mile	—
O2S11	Front HO2S	V	2AG
O2S12	Rear HO2S	V	2AH
RFCFLAG	PCM adaptive memory produce verification	Learnt/Not Learnt	—
RO2FT1	Rear oxygen sensor fuel trim	No unit	2AH
RPM	Engine speed	RPM	2Y 2Z
SCCS	Cruise control switch	V	1AD
SEGRP	EGR control	Step	2AR 2AU 2AV 2AY

Item	Definition	Unit/Condition	PCM terminal
SEGRP DSD	EGR valve position desired	%	—
SHRTFT1	Short term fuel trim (front)	%	—
SHRTFT11	Short term fuel trim (front)	%	2AG
SHRTFT12	Short term fuel trim (rear)	%	2AH
SPARKADV	Ignition timing	° (BTDC)	2U 2V
test	Test mode	On/Off	—
TIRESIZE	Tire revolution per mile	rev/mile	—
TP REL	Throttle position signal (relative value)	%	2I 2M
TP1	TP sensor 1	V	2M
		%	
TP2	TP sensor 2	V	2I
		%	
TPCT	TP sensor voltage at CTP	V	2I 2M
VPWR	Battery positive voltage	V	1BA 1BE
VSS	Vehicle speed	KPH | MPH	1J*2
VT ACT1	Actual valve timing	°	2AF
VT DIFF1	Difference between target valve timing and actual valve timing	°	—
VT DUTY1	OCV control	%	2AF
VTC	Variable tumble control	Off/On	2AI

*1 : MTX
*2 : California emission regulation applicable model

SIMULATION TEST [L3]

EPU010200000S06

- The simulation items are shown below.

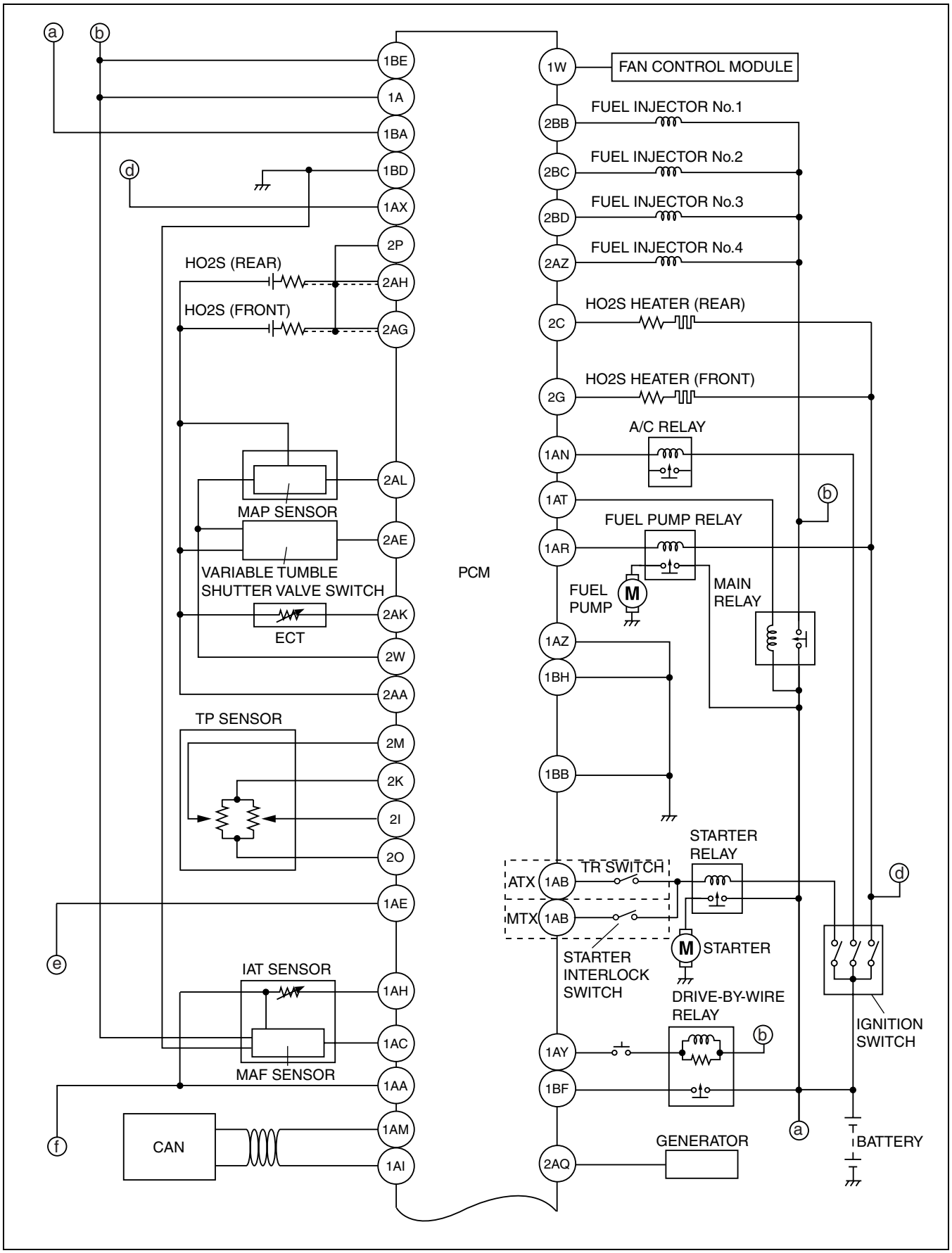
Simulation item table

×: Applicable
—: Not applicable

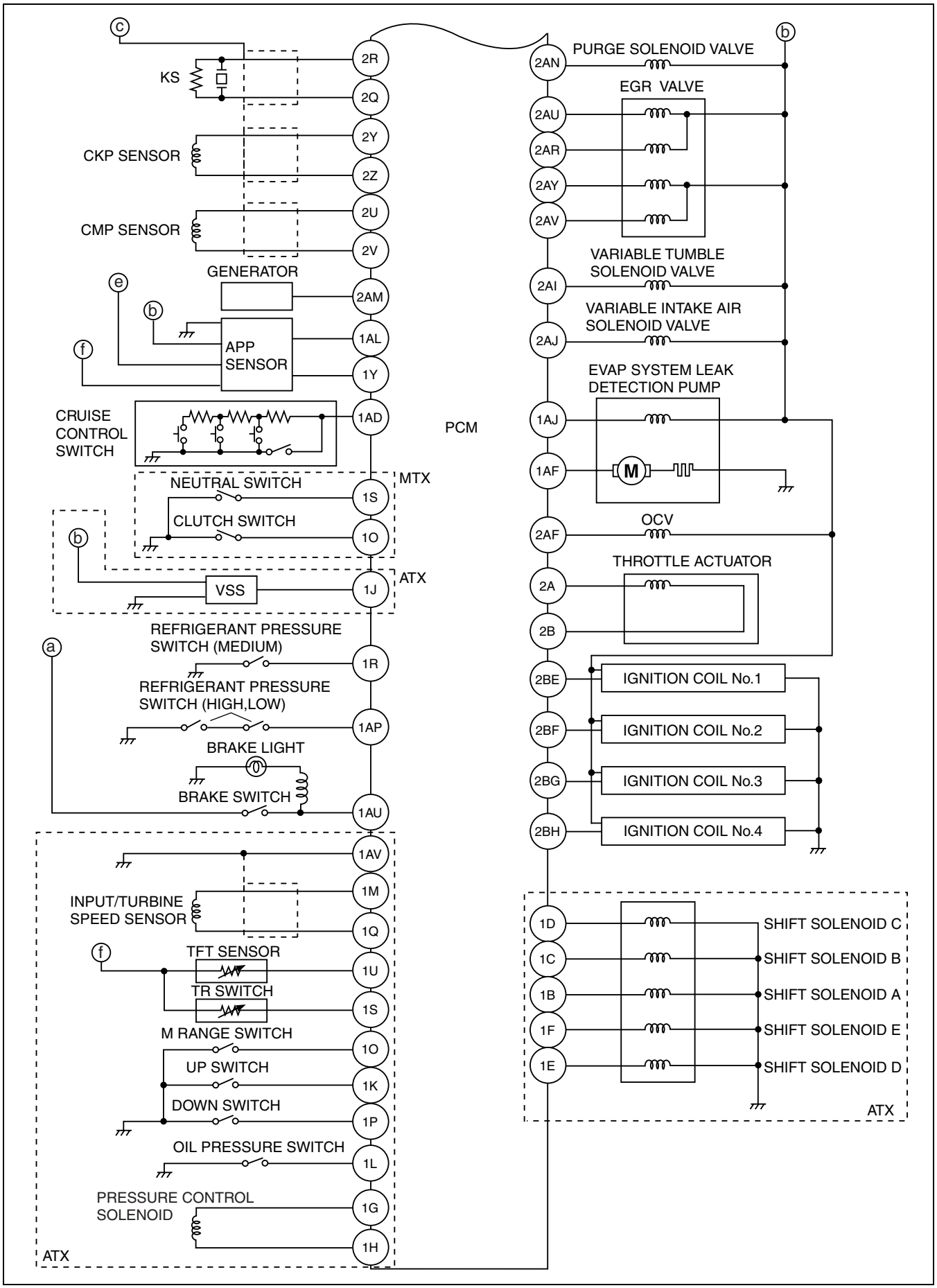
Item	Applicable component	Unit/condition	Test condition		PCM terminal
			KOEO	KOER	
ACCS	A/C relay	On/Off	×	×	1AN
ALTF	Generator (field coil)	0% Only	—	×	2AQ
EVAPCP	Purge solenoid valve	%	×	×	2AN
FAN_DUTY	Variable fan duty cycle	%	×	×	1W
FP	Fuel pump relay	On/Off	×	×	1AR
FUELPW1	Fuel injector (FP1, RP1)	%	—	×	2AZ, 2BB, 2BC, 2BD
GENVDSD	Target generator voltage	V	—	×	—
HTR11	Front HO2S heater	On/Off	×	×	2AH
HTR12	Rear HO2S heater	On/Off	×	×	2C
IMRC	Intake manifold runner control	On/Off	×	×	2AI
IMTV	Intake manifold tuning valve	On/Off	×	×	2AJ
INJ_1	Injector No.1	Off/—	—	×	2BB
INJ_2	Injector No.2	Off/—	—	×	2BC
INJ_3	Injector No.3	Off/—	—	×	2BD
INJ_4	Injector No.4	Off/—	—	×	2AZ
SEGRP	EGR valve stepping motor position	Step	×	×	2AR, 2AU, 2AV, 2AY
test	TEN terminal	Off/On	×	×	—
VT DUTY1 Wt	CMP sensor	%	×	×	2U

DIAGNOSTIC SYSTEM WIRING DIAGRAM [L3]

EPU010200000S07



EPU140ZT4501



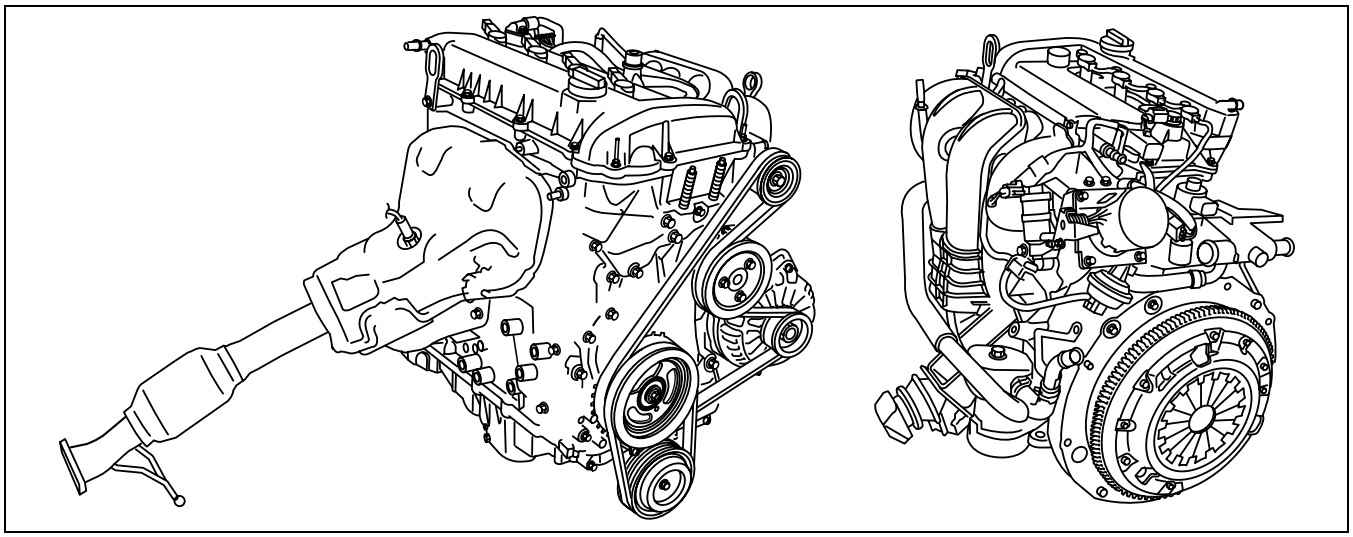
EPU140ZT4502

01–10 MECHANICAL [L3]

ENGINE STRUCTURAL VIEW [L3] 01–10–2
CYLINDER HEAD COVER CONSTRUCTION [L3]. 01–10–2
CYLINDER HEAD CONSTRUCTION [L3] 01–10–3
CYLINDER HEAD GASKET CONSTRUCTION [L3]. 01–10–3
CYLINDER BLOCK CONSTRUCTION [L3] 01–10–4
CRANKSHAFT, MAIN BEARING CONSTRUCTION [L3]. 01–10–5
BALANCER UNIT OUTLINE [L3] 01–10–7
Outline 01–10–7
Structure 01–10–7
Operation 01–10–8
CRANKSHAFT PULLEY CONSTRUCTION [L3]. 01–10–9
ENGINE FRONT COVER CONSTRUCTION [L3]. 01–10–10
PISTON, PISTON RING, PISTON PIN CONSTRUCTION [L3]. 01–10–11
CONNECTING ROD, CONNECTING ROD BEARING CONSTRUCTION [L3] 01–10–12
DRIVE BELT CONSTRUCTION [L3] 01–10–13
ENGINE MOUNT OUTLINE [L3]. 01–10–14
ENGINE MOUNT CONSTRUCTION [L3] 01–10–15
VALVE MECHANISM OUTLINE [L3] 01–10–16
VALVE MECHANISM STRUCTURAL VIEW [L3] 01–10–17
VALVE, VALVE SPRING, VALVE SEAL, VALVE GUIDE CONSTRUCTION [L3] 01–10–17
CAMSHAFT CONSTRUCTION [L3]. 01–10–18
CAMSHAFT SPROCKET CONSTRUCTION [L3] 01–10–20
CRANKSHAFT SPROCKET CONSTRUCTION [L3] 01–10–20
TIMING CHAIN, CHAIN TENSIONER CONSTRUCTION [L3] 01–10–21
TAPPET CONSTRUCTION [L3]. 01–10–22
VARIABLE VALVE TIMING MECHANISM OUTLINE [L3] 01–10–22
VARIABLE VALVE TIMING MECHANISM FUNCTION [L3]. 01–10–23
Variable Valve Timing Mechanism 01–10–23
VARIABLE VALVE TIMING MECHANISM CONSTRUCTION [L3] 01–10–24
Hydraulic Pressure Flow Diagram. 01–10–25
VARIABLE VALVE TIMING MECHANISM OPERATION [L3] 01–10–26
VARIABLE VALVE TIMING ACTUATOR CONSTRUCTION [L3] 01–10–28
OIL CONTROL VALVE (OCV) CONSTRUCTION [L3] 01–10–28

ENGINE STRUCTURAL VIEW [L3]

EPU011002000S01

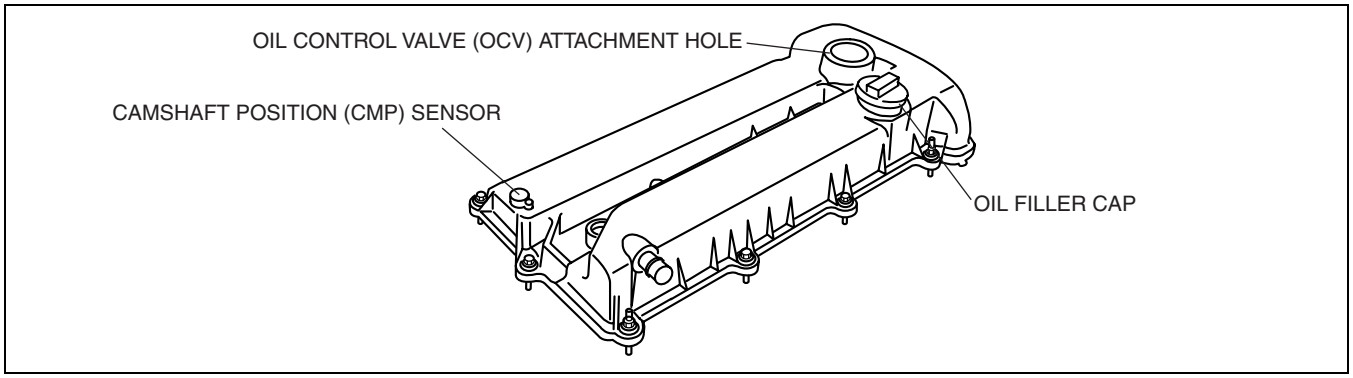


C3U2206T050

CYLINDER HEAD COVER CONSTRUCTION [L3]

EPU011010220S01

- The cylinder head cover is made of integrated plastic, which is lightweight and sound absorbent.
- The oil filler cap is a bayonet type. The boss for installing the camshaft position (CMP) sensor is provided at the rear of the cylinder head cover.
- There is a hole to install the oil control valve (OCV).

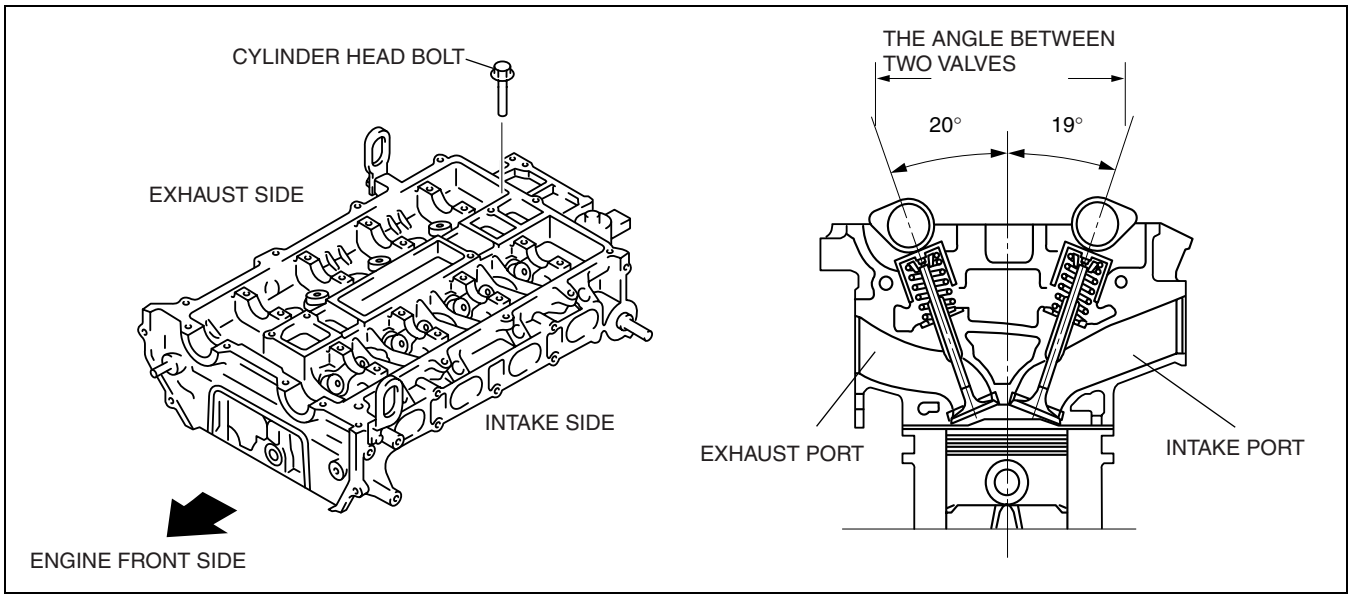


EPU110ZS3001

CYLINDER HEAD CONSTRUCTION [L3]

EPU011010100S01

- The cylinder head is made of a high heat conductive, lightweight aluminium alloy, which is quenched.
- Compact, pentroof-type combustion chambers have been adopted. The spark plugs are mounted at the top of the combustion chambers to improve combustion efficiency.
- The intake/exhaust port layout is a cross flow type, (the angle between two valves is 39°, the two intake valves and the two exhaust valves per cylinder) which improves air intake/exhaust efficiency.
- The cylinder head bolts are plastic region tightening bolts to be tightened in five steps to insure tightening stability.

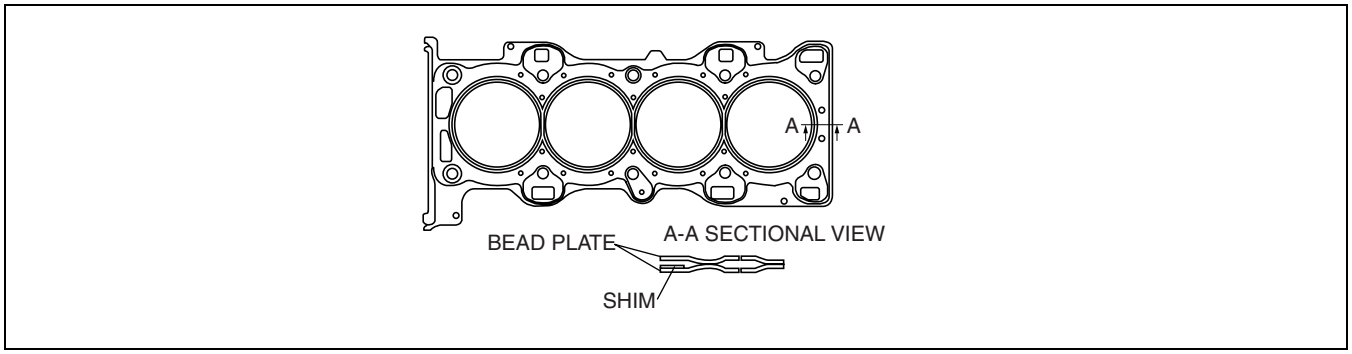


EPU110ZS3002

CYLINDER HEAD GASKET CONSTRUCTION [L3]

EPU011010271S01

- Cylinder head gaskets are two layer-metal gasket.

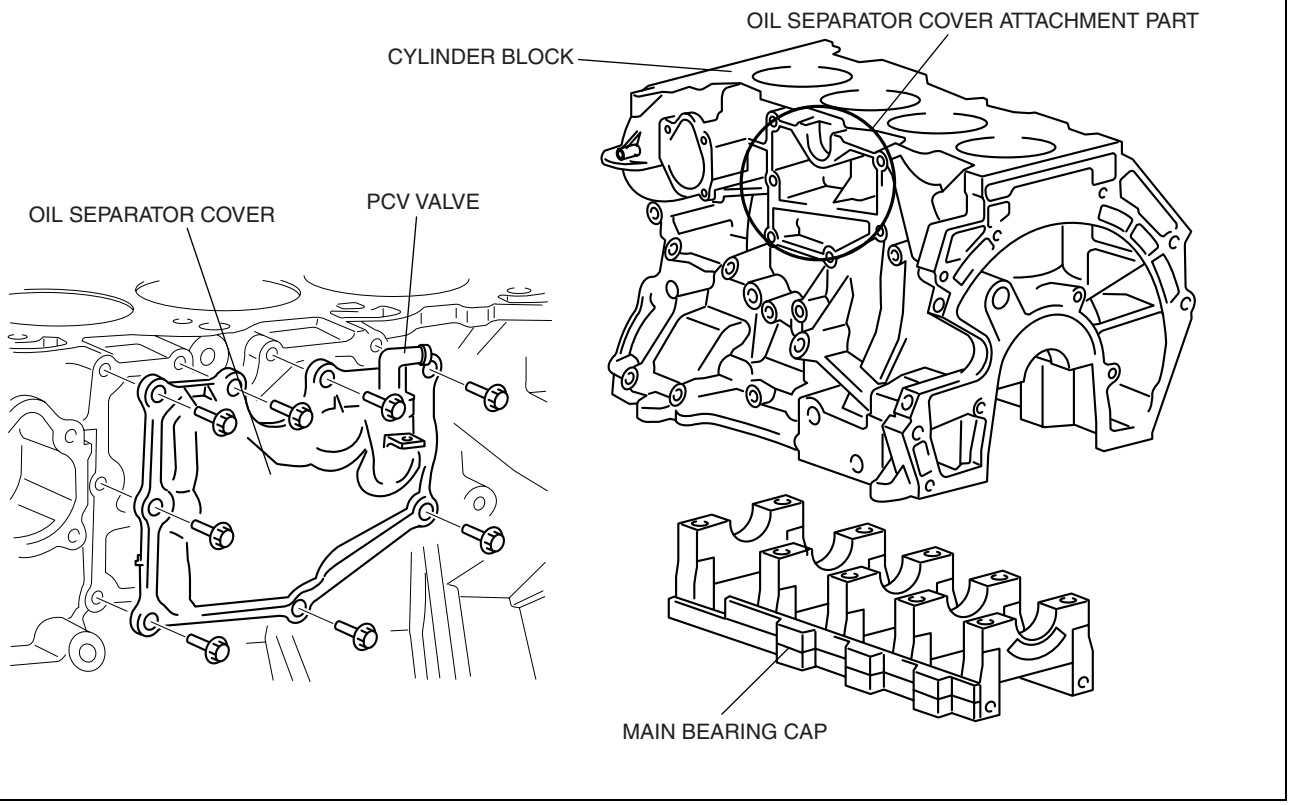


C3U0110N160

CYLINDER BLOCK CONSTRUCTION [L3]

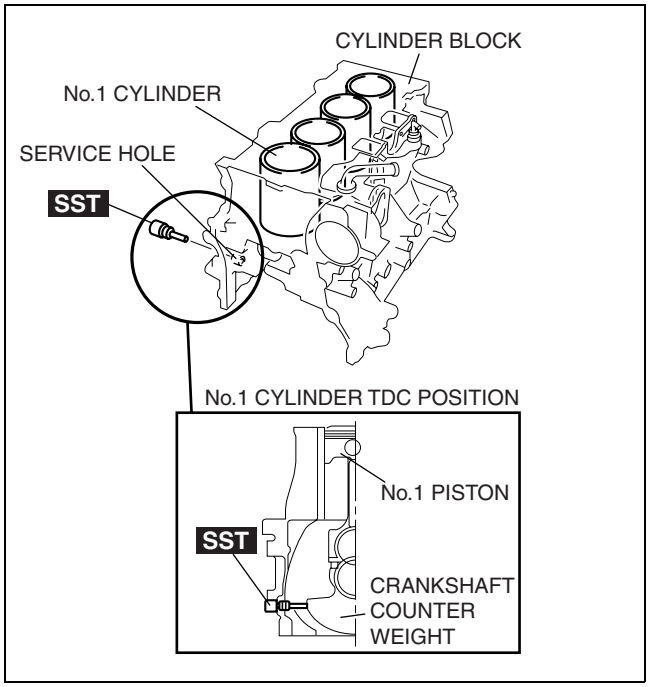
EPU011010300S01

- The cylinder block is made of aluminum alloy, which is cast with the cast iron liner, improving heat radiation and decreasing weight.
- The cylinder block is a deep skirt type and forms a ladder frame structure with the integrated main bearing cap. The water jacket of the cylinder block is a closed deck type. Its higher rigidity reduces vibration and noise.
- The cylinder block has an oil separator cover on the opposite side of the fresh air intake, PCV (positive crankcase ventilation) valve and oil separator function, to improve blow-by gas ventilation efficiency.
- There is no positioning tab where the upper and lower main bearings are installed.
- The main bearing cap bolts are plastic region tightening bolts to be tightened in two steps to insure tightening stability.



C3U0110N161

- The service hole for installing the **SST**, which is used for detecting the No.1 cylinder TDC position, is located at the right side of the cylinder block. The TDC position can be detected when the **SST** edge touches the cutting surface of the No.1 counter weight.

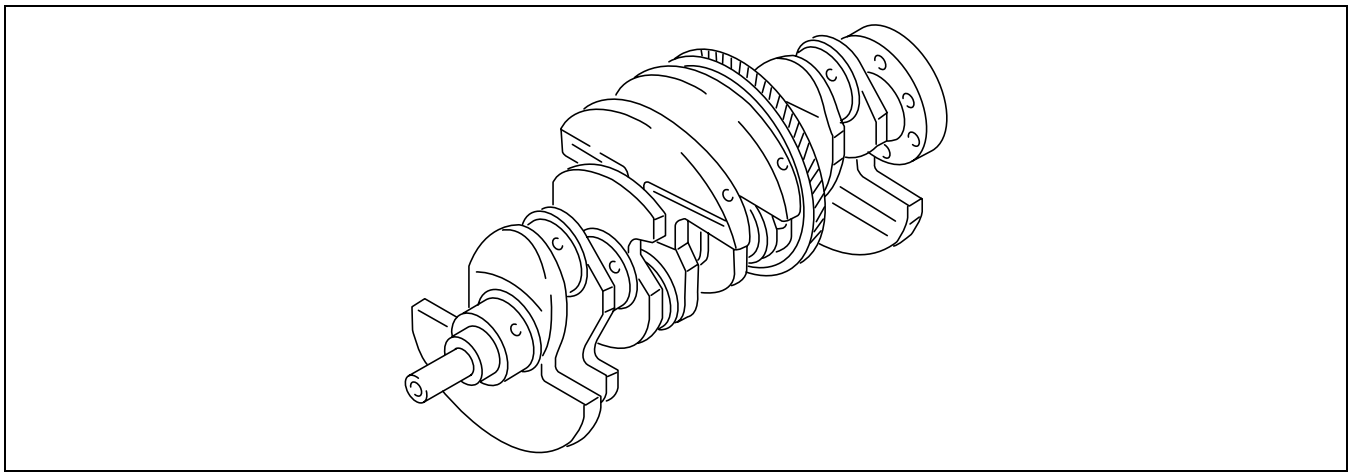


EPU110ZS3014

CRANKSHAFT, MAIN BEARING CONSTRUCTION [L3]

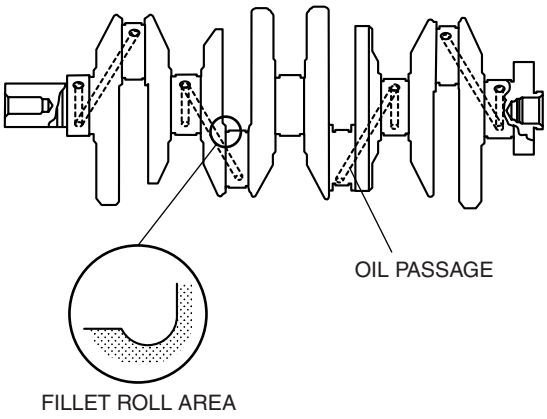
EPU011011301S01

- A five axle-hole, four counter weight cast iron crankshafts have been adopted.
- There is no positioning key where the crankshaft sprocket and crankshaft pulley are installed. The crankshaft sprocket must be installed using the **SST** with the No.1 cylinder aligned with TDC position. Tightening pressure on the tightening bolt is used to secure the crankshaft sprocket and crankshaft pulley.



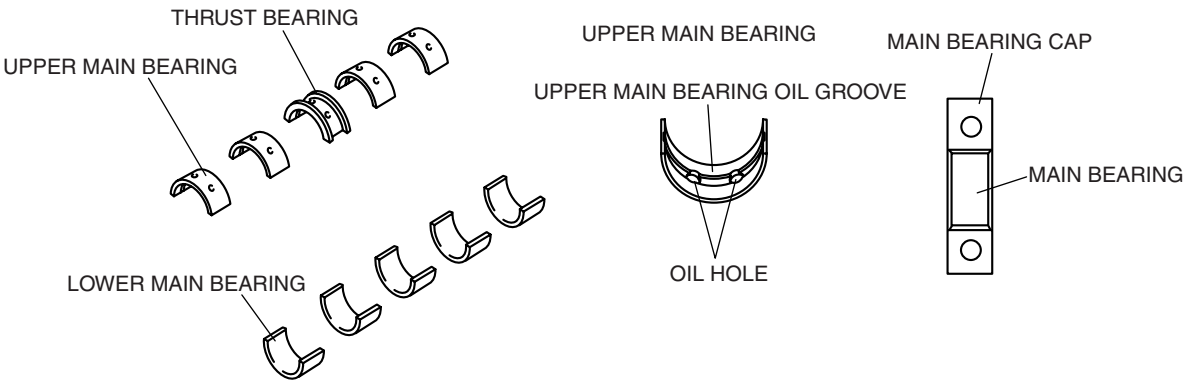
EPU110ZS3003

- An oil line for supplying oil to each journal is provided in the crankshaft. Crank pins and fillets on both sides of the journal are rolled to bear heavy loads.



EPU110ZS3004

- Upper and lower main bearings are made of aluminum alloy and the upper side No.3 journal bearing is integrated with the thrust bearing. The upper main bearing has oil grooves and oil holes.
- There is no upper and lower bearings positioning tab for installing the main journal.
- Measure and attach the main bearings (upper and lower) so that they are positioned at the center of the main bearing cap.



C3U0110N055

- Three kinds of main bearings are available depending on the oil clearance.

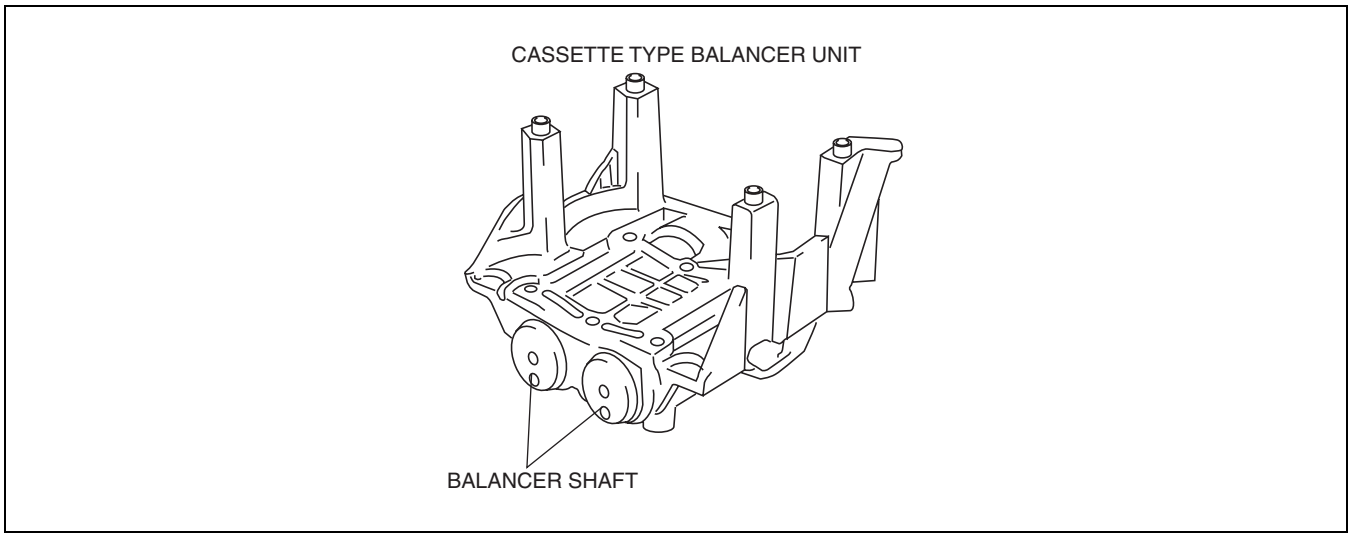
Bearing size	Bearing thickness (mm {in})
Standard	2.506—2.509 {0.0987—0.0988}
0.25 {0.01} Oversize	2.628—2.634 {0.1035—0.1037}
0.50 {0.02} Oversize	2.753—2.759 {0.1084—0.1086}

BALANCER UNIT OUTLINE [L3]

EPU011011301S02

Outline

- The cassette type balancer, which is separated from the engine, has been adopted.



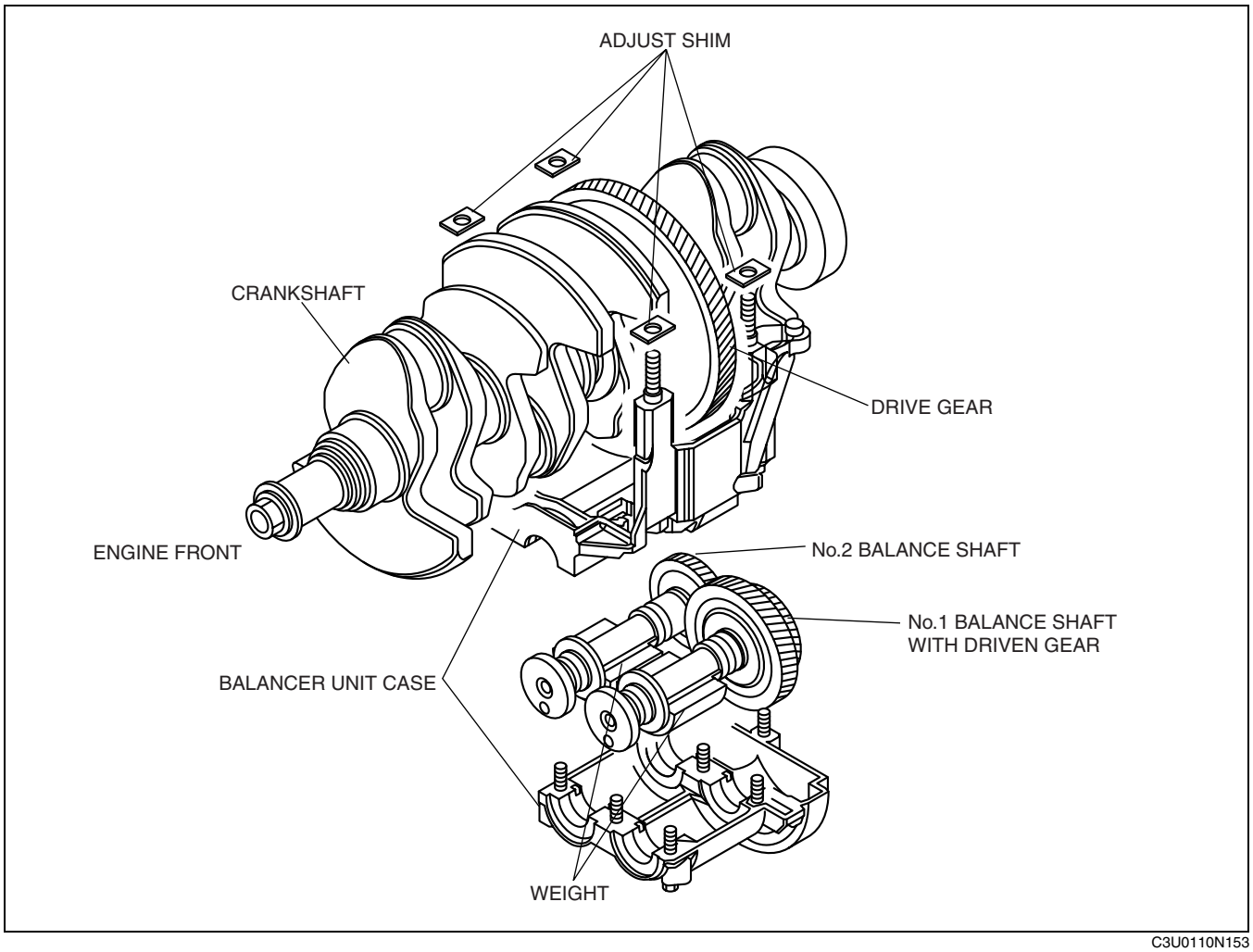
C3U0110N156

Structure

- The balancer unit consists of two balancer shafts (No.1 and No.2) with weights, the balancer unit case and the adjust shim which adjusts the amount of backlash in the crankshaft.
- The two balancer shafts (No.1 and No.2) are driven by the drive gear which is attached to the crankshaft.
- The balancer unit cannot be disassembled because it is a precision unit.

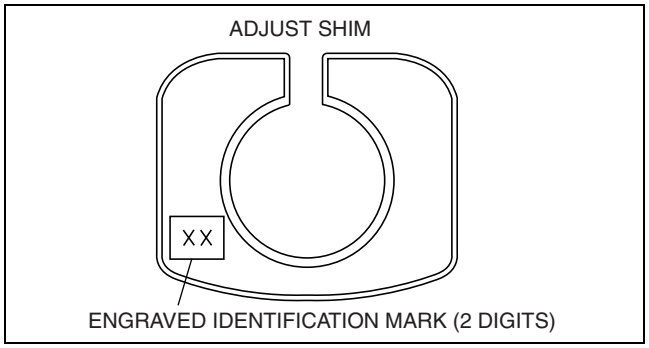
Operation

- The rotary motion is transmitted from the drive gear, which is between the back of the No.3 cylinder and No.4 main journal, directly to the No.1 balance shaft with driven gear. Then the balance unit transmits the rotation motion to the No.2 balance shaft. The ratio of gears, which are attached to the No.1 and No. 2 balancer shafts, has been set so that the gear rotates at twice the velocity of the crankshaft. The rotation velocity of the balancer shaft counterbalances (generates force in the opposite direction) the rotation inertial force (secondary inertial rotation force) from the crankshaft.



C3U0110N153

- Replace the adjust shim to adjust backlash. There are 40 kinds of adjuster shim depending on the thickness. The adjuster shim can be determined by checking the engraved identification mark (2 digits) on it.

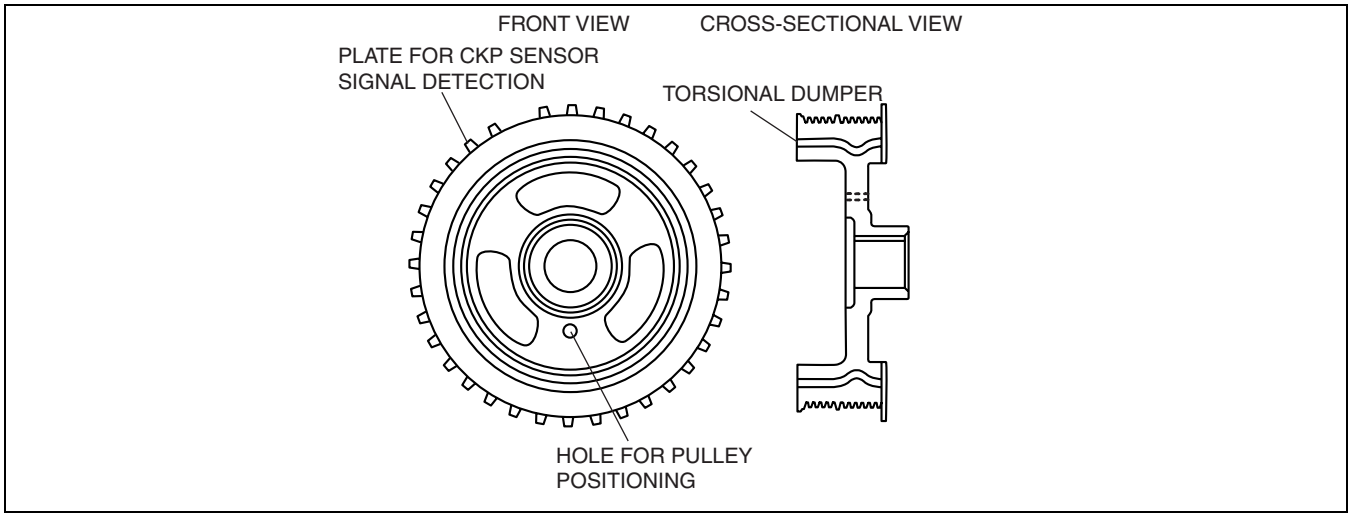


EPU110ZS3015

CRANKSHAFT PULLEY CONSTRUCTION [L3]

EPU011011371S01

- A crankshaft position (CKP) signal detecting plate has been adopted for the crankshaft pulley. The torsional damper, which prevents the crankshaft from wobbling, has also been adopted for the crankshaft.
- There is no positioning key slot on the crankshaft pulley. Instead, the positioning hole on the crankshaft pulley and the engine front cover are used for aligning the crankshaft pulley with the crankshaft.
- The crankshaft pulley lock bolt is plastic region tightening bolt to be tightened in two steps to insure crankshaft pulley tightening stability.

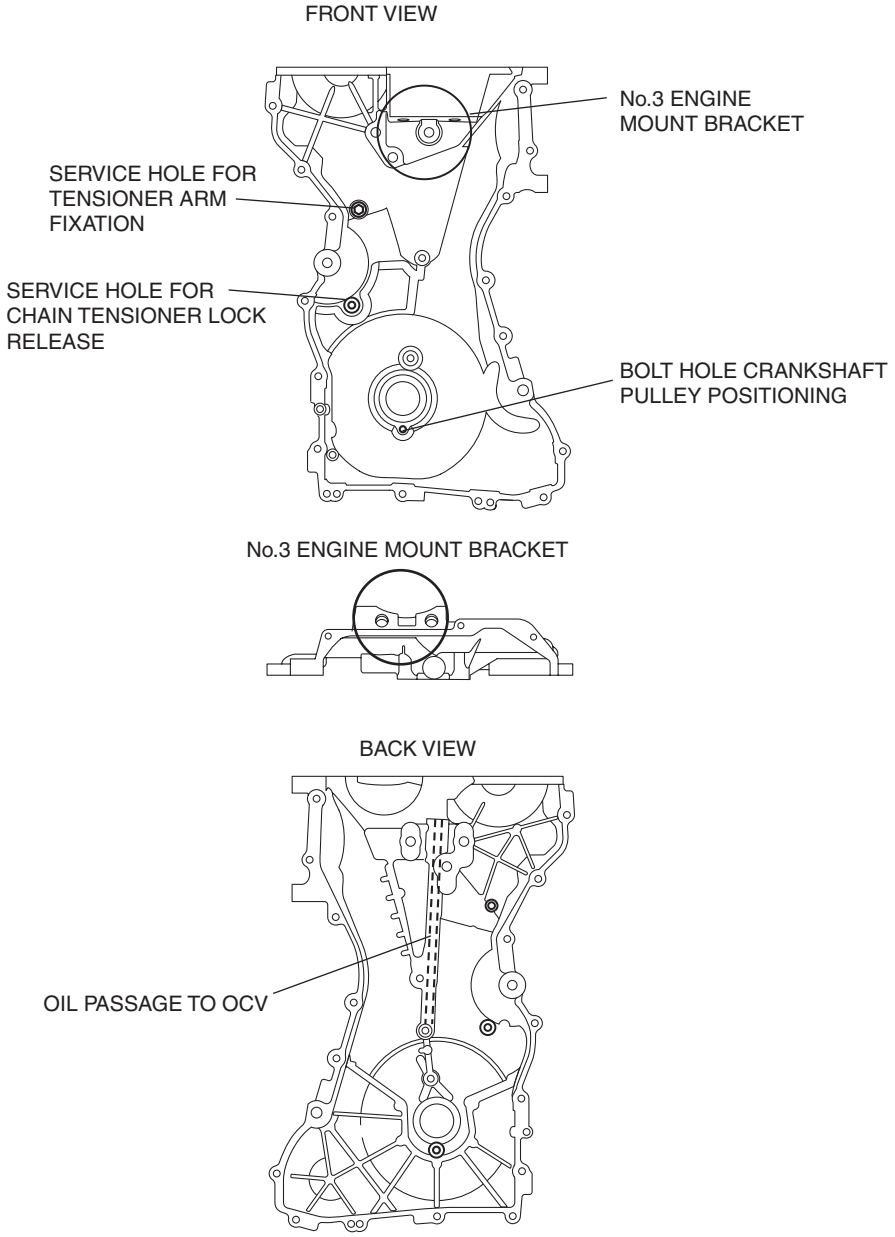


C3U0110N056

ENGINE FRONT COVER CONSTRUCTION [L3]

EPU011010501S01

- The engine front cover is made of aluminum alloy, and is integrated with the No.3 engine-mounting bracket, to improve noise absorption and weight reduction.
- The bolt hole for crankshaft pulley positioning, the service hole for unlocking the chain adjuster ratchet, and the service hole for securing the tensioner arm when loosening the timing chain, are on the engine front cover.



EPU110ZS3005

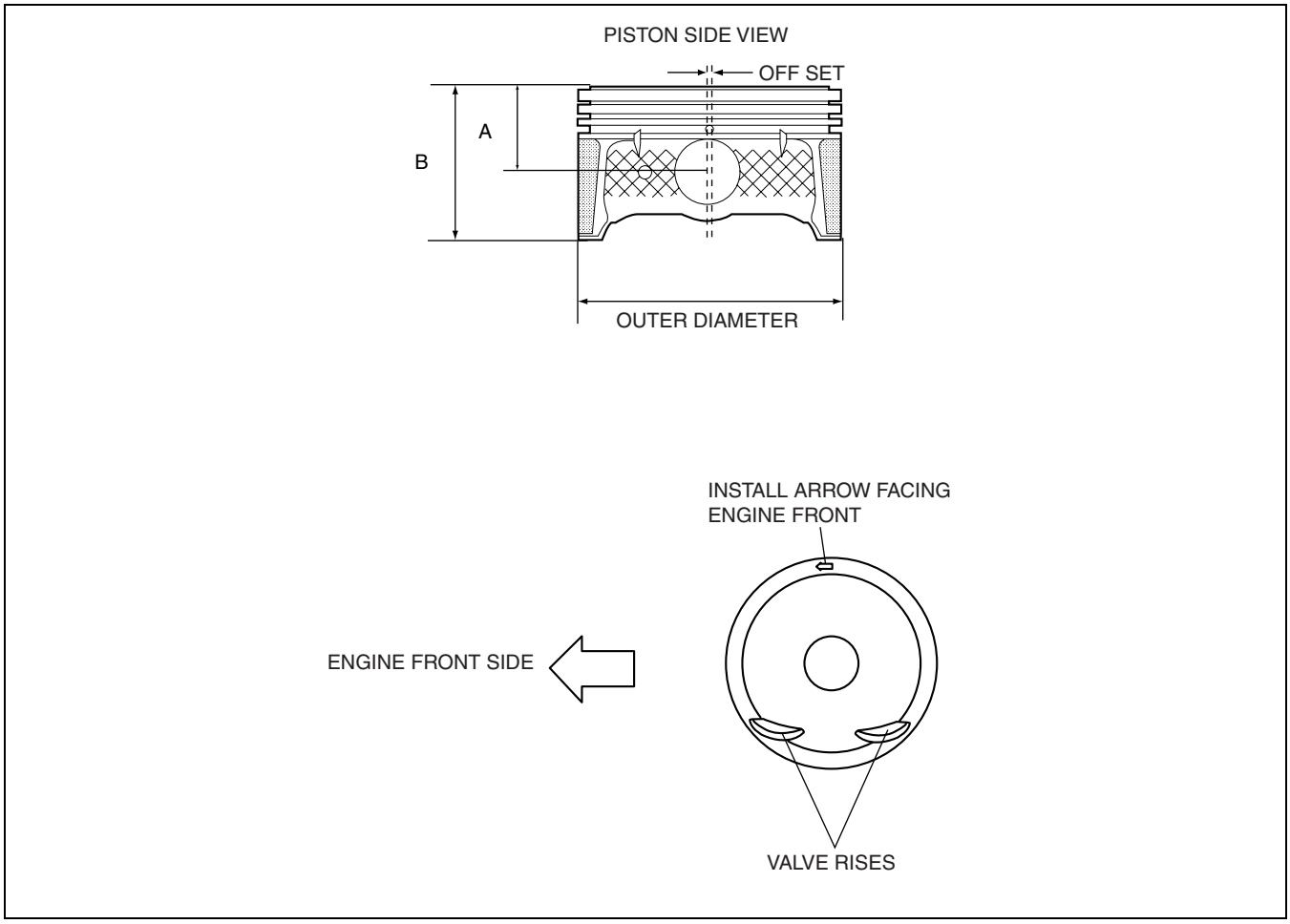
PISTON, PISTON RING, PISTON PIN CONSTRUCTION [L3]

EPU011011010S01

- The pistons are made of aluminium alloy, which withstands heat and is highly conductive.
- The piston skirt is coated with graphite to reduce friction.
- The offset pistons are used to reduce piston-slapping noise.
- To prevent the piston from being reassembled in the wrong direction, a front mark (←) is on the piston.
- Pistons and connecting rods cannot be disassembled because they are shrinkage fit.

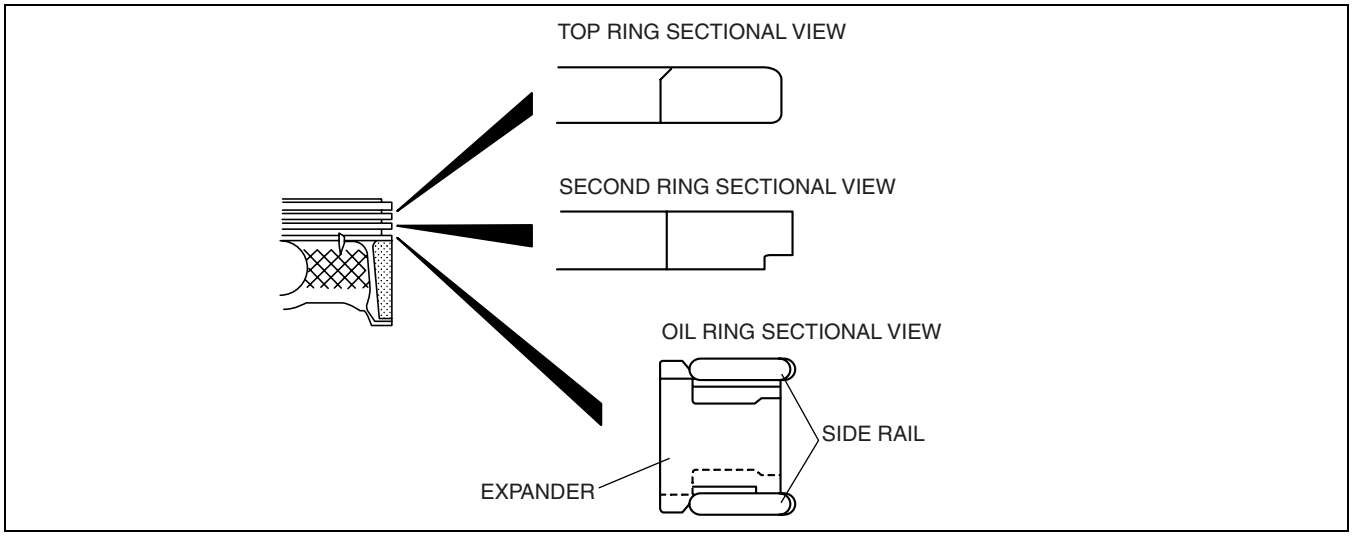
Piston Specification.

Outer diameter	mm {in}	87.465—87.495 {3.4435—3.4446}
Offset quantity	mm {in}	0.8 {0.04}
Compression height: A	mm {in}	28.5 {1.122}
Piston height: B	mm {in}	51.0 {2.0078}



EPU110ZS3006

- The following piston rings have been adopted: Barrel face ring for top ring, taper under cut ring for second ring, 2 scuff rings and an expander for the oil ring.
- The piston pin is made of chrome steel alloy, which has superior rigidity.
- The connecting rod and the piston pin are shrinkage fit, so that it cannot be disassembled.

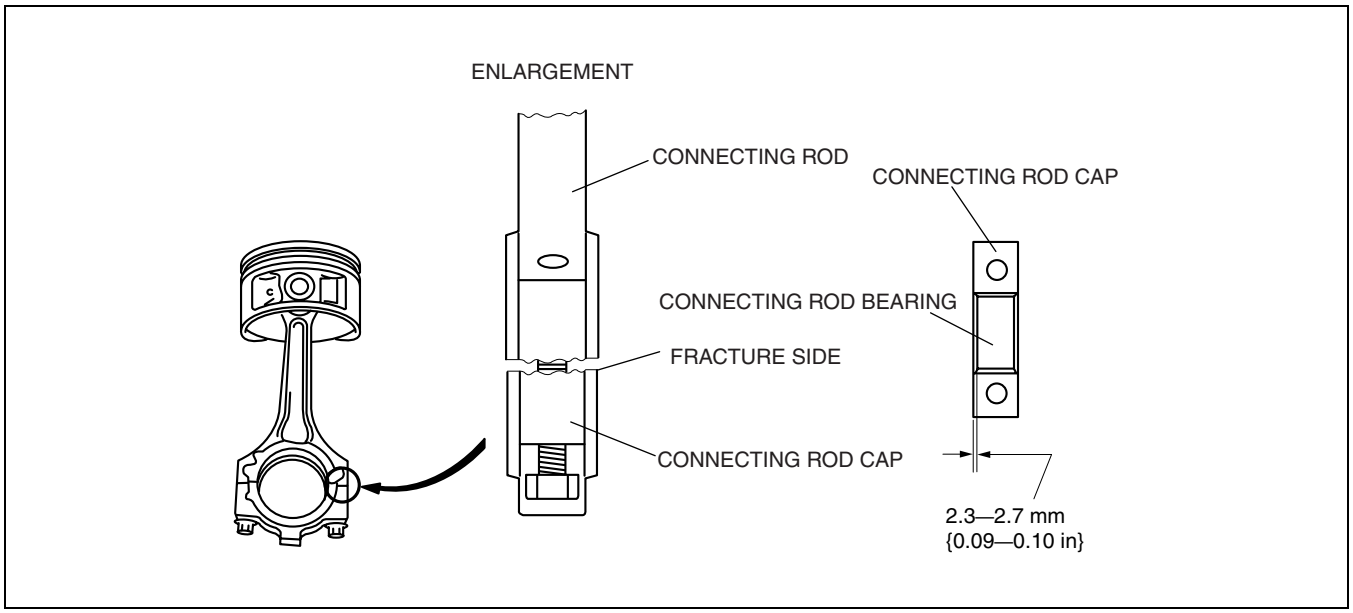


EPU110ZS3007

CONNECTING ROD, CONNECTING ROD BEARING CONSTRUCTION [L3]

EPU011011211S01

- The connecting rod is made of structural sintered alloy to improve rigidity.
- The connecting rod, the piston, and the piston pin are shrinkage fit, so that they cannot be disassembled.
- The connecting rod bolts are plastic region tightening bolts to be tightened in two steps to insure tightening stability.
- There is no positioning tab for the connecting rod bearing. When installing the bearing, measure the position of the bearing so that the position reaches the center of the connecting rod and the bearing cap, and install it.
- The large end of the connecting rod and the connecting rod cap were originally formed as a single unit and then it was cut into the connecting rod and the cap. The form of the cutting surface is used as the alignment mark for the connecting rod and cap.



C3U0110N060

- The upper lower bearing of the connecting rod bearing is made of aluminum alloy.
- There are three kinds of connecting rod bearings depending on the oil clearance.

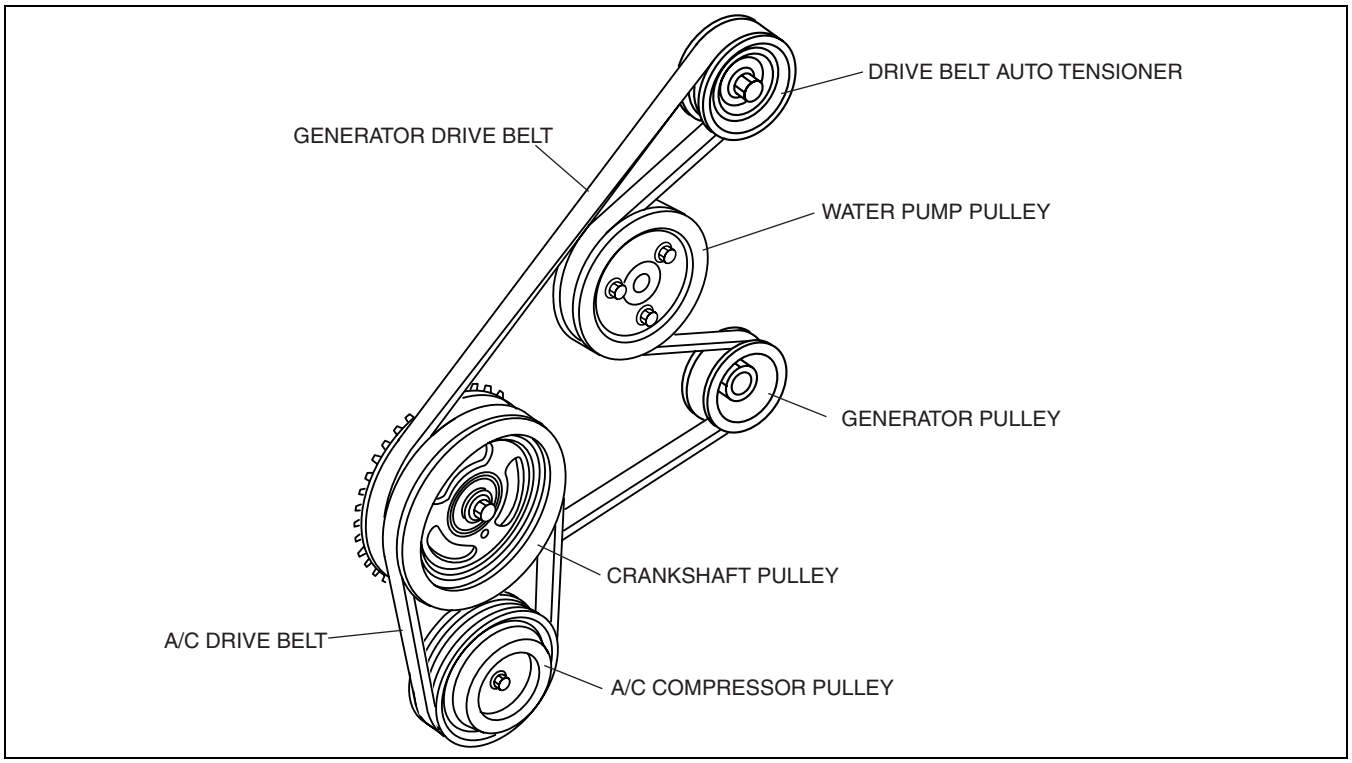
Bearing size	Bearing thickness (mm {in})
Standard	1.496—1.502 {0.0589—0.0591}

Bearing size	Bearing thickness (mm {in})
0.50 {0.02} Oversize	1.746—1.752 {0.0688—0.0690}
0.25 {0.01} Oversize	1.621—1.627 {0.0639—0.0641}

DRIVE BELT CONSTRUCTION [L3]

EPU011015800S01

- A generator drive belt auto tensioner with an embedded coil spring has been adopted to automatically maintain optimal drive belt tension.
- With the adoption of maintenance-free A/C drive belt, specified tension of the belt is maintained. When replacing the A/C drive belt, remove it by cutting it off, and install a new one using the specified jig.

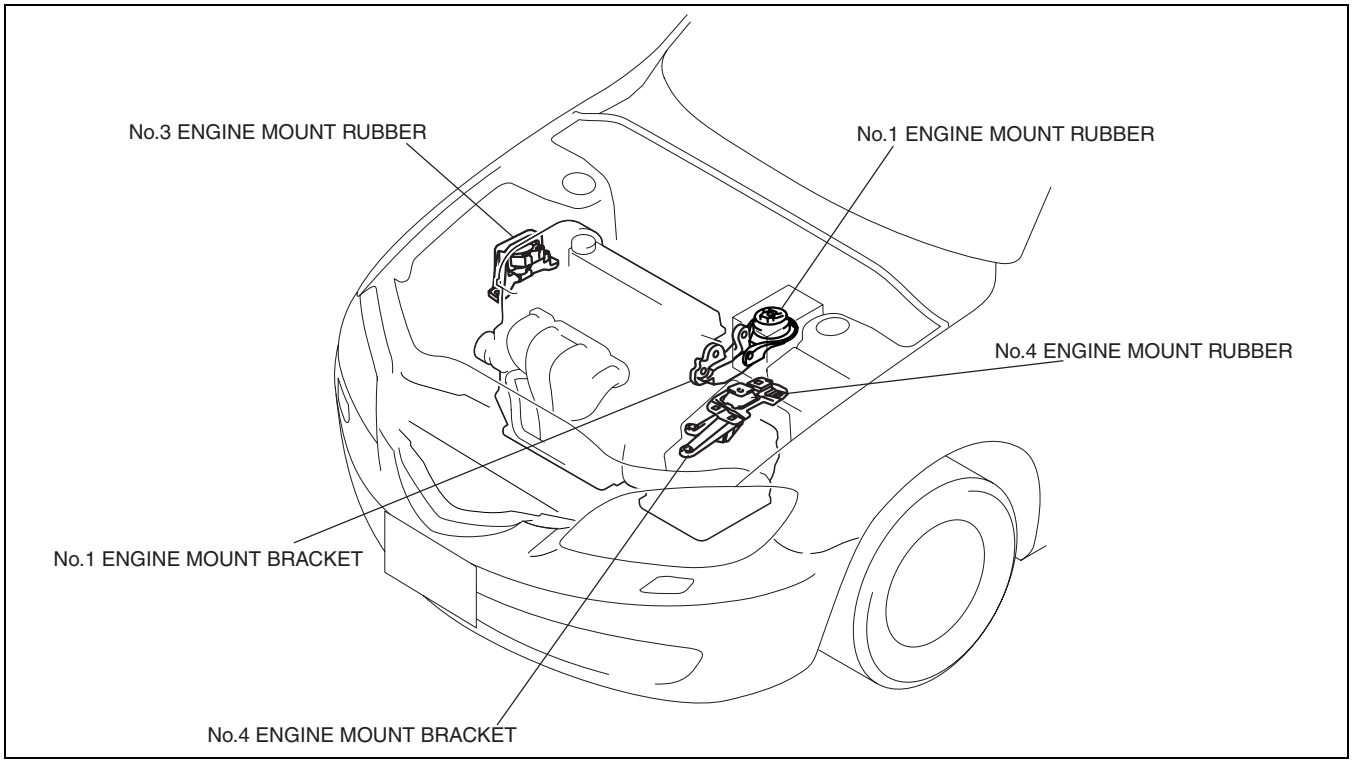


C3U0110N061

ENGINE MOUNT OUTLINE [L3]

EPU011039000S01

- The pendulum-type layout of the engine mounting reduces noise in the cabin.
- The engine is supported at three points and simplification of engine mount composition has been attained.
- An oil-filled No.3 engine mount rubber has been adopted to reduce noise and vibration in the cabin.
- The surface of the No.3 engine mount is made of aluminium alloy to decrease weight.

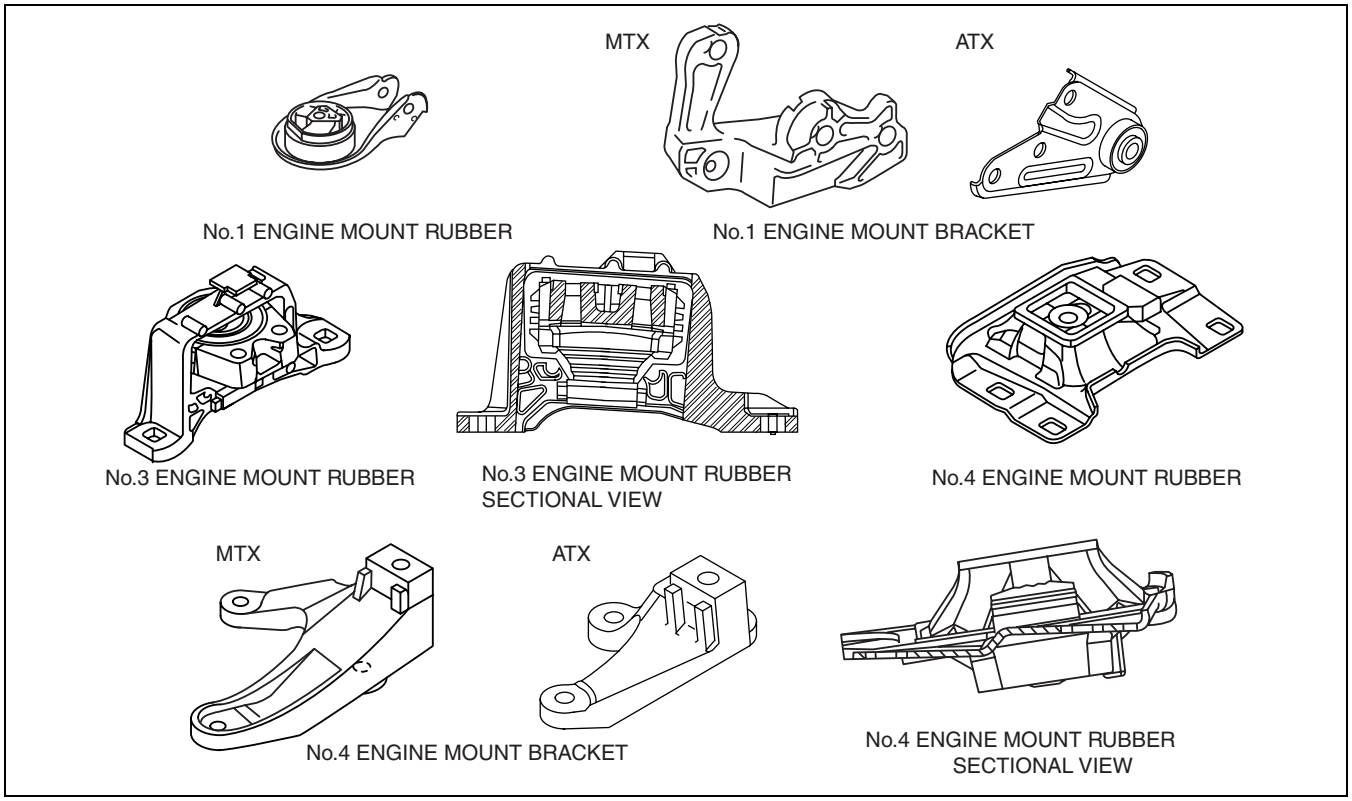


C3U0110N062

ENGINE MOUNT CONSTRUCTION [L3]

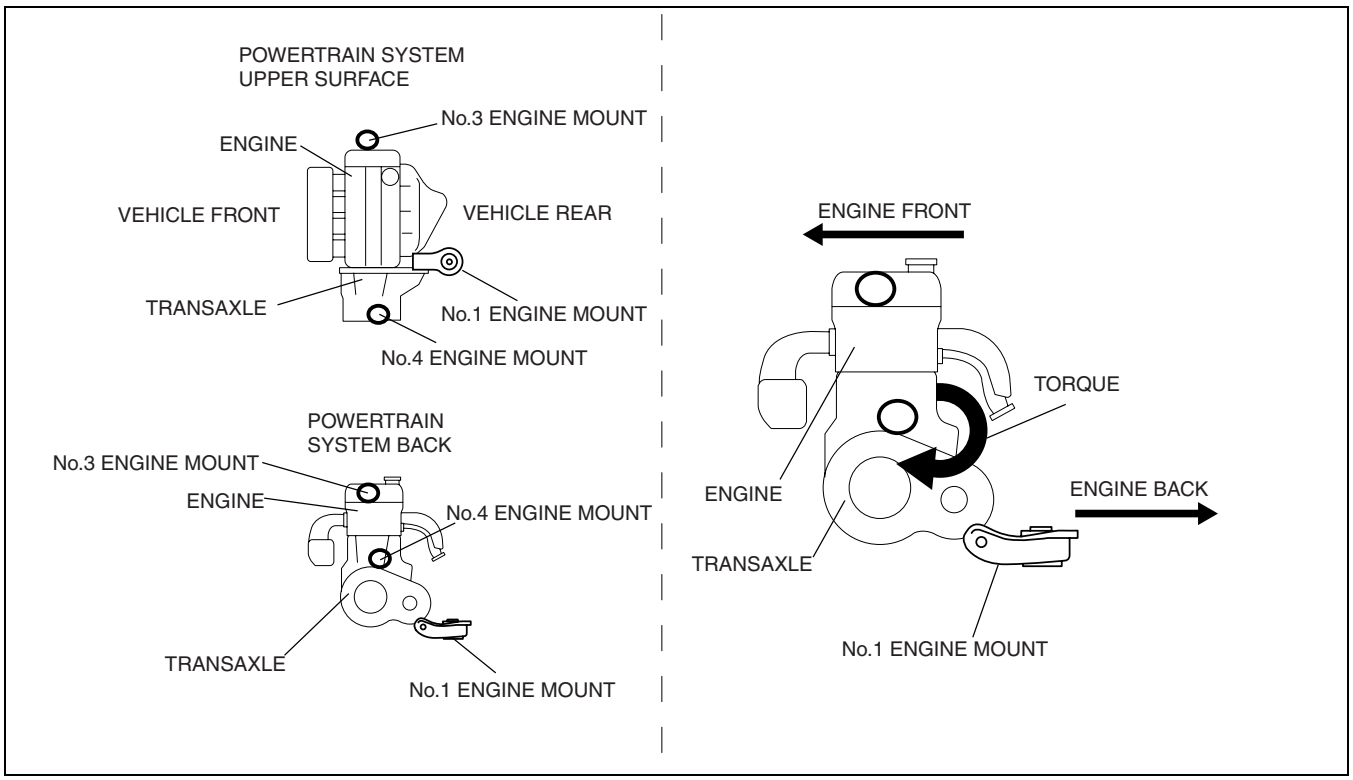
EPU011039000S02

- The No.1 engine mounting rubber regulates backlash from the powertrain.
- The No.3 engine mounting rubber is oil-filled for noise reduction and vibration isolation.
- The installation structure of the N0.4 engine mount has been simplified for serviceability improvement.



EPU110ZS3016

- The engine is supported at the following three points: front part of the engine (No.3 engine mounting), one side of the transaxle (No.1 engine mounting), and rear upper part of the transaxle (No.4 engine mounting). The supporting point at the side of the transaxle (No.1 engine mounting) has been set at the lowest edge of the transaxle. With this layout, No.1 engine mounting absorbs the rotation force, generated under the engine torque fluctuation and transmitted to the powertrain, and distributes the rotation force to the front and rear part of the engine (pendulum).



C3U0110N157

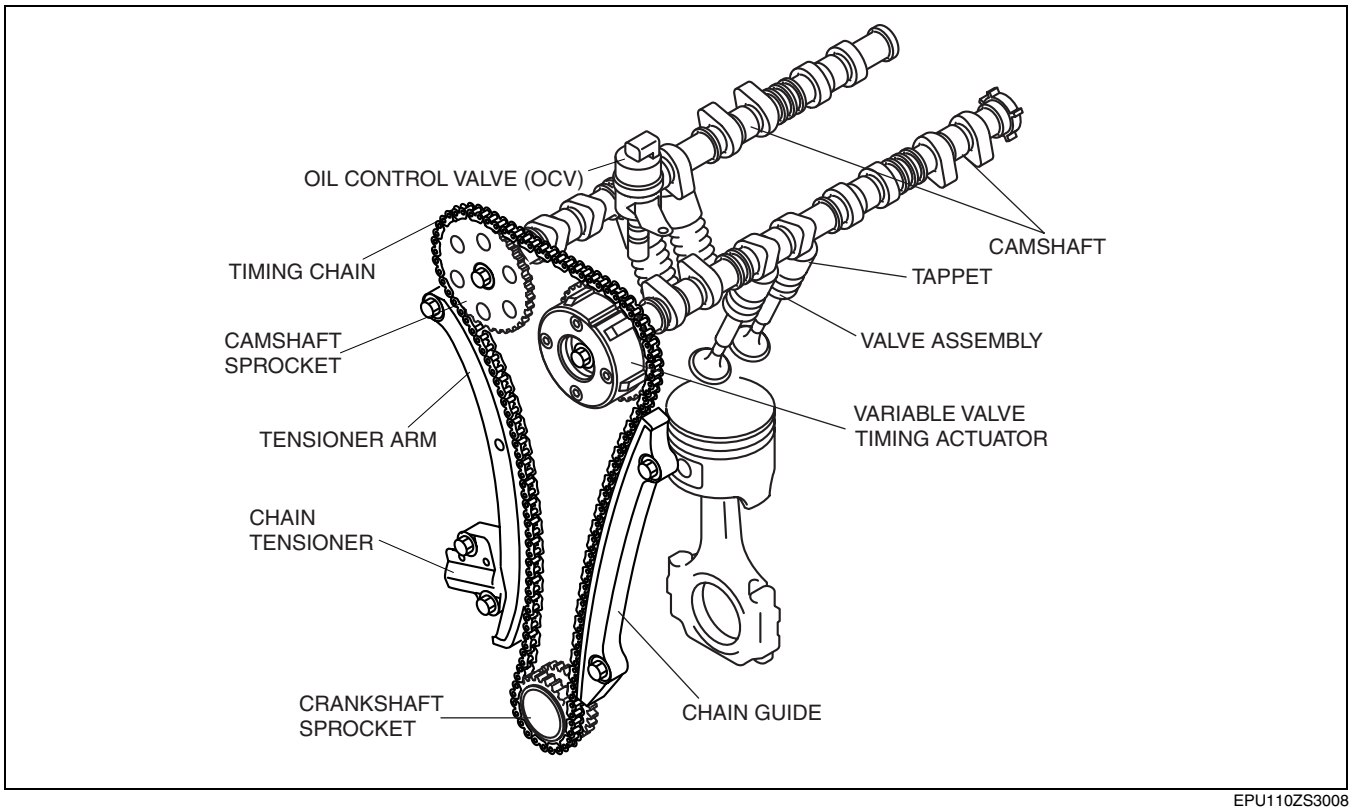
VALVE MECHANISM OUTLINE [L3]

EPU011012111S01

- There are two intake ports and two exhaust ports for each cylinder. There are a total of sixteen valves directly driven by two camshafts.
- The variable valve timing mechanism, which insures the best valve timing depending on the drive condition by constantly changing the phase of the intake port side camshaft, has been adopted.

VALVE MECHANISM STRUCTURAL VIEW [L3]

EPU011012111S02



EPU110ZS3008

VALVE, VALVE SPRING, VALVE SEAL, VALVE GUIDE CONSTRUCTION [L3]

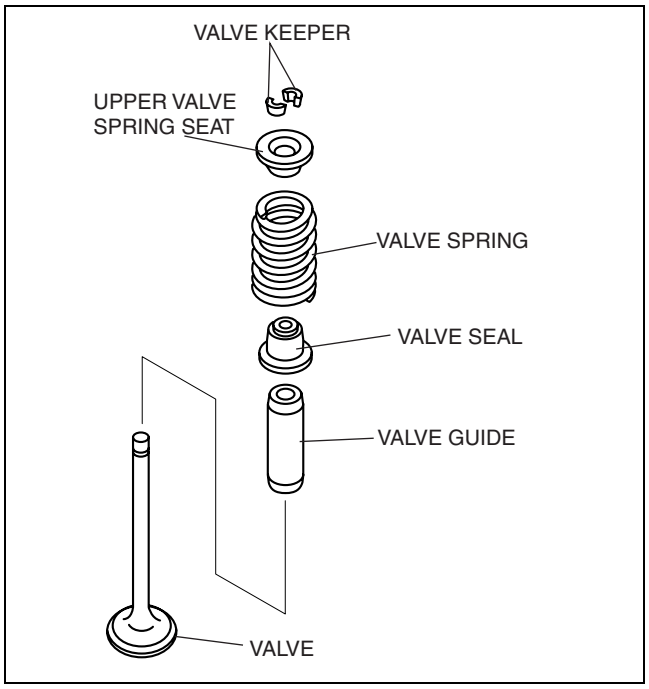
EPU011012111S03

- The valves are made of heat-resistant steel. There are two intake valves and two exhaust valves per cylinder.

VALVE SPEC.

valve full length	(mm {in})	Intake valve: Approx. 103.4 {4.070} Exhaust valve: Approx. 104.7 {4.120}
Intake valve head diameter	(mm {in})	Approx. 35 {1.38}
Exhaust valve head diameter	(mm {in})	Approx. 30 {1.18}
Stem diameter	(mm {in})	Intake valve: Approx. 5.5 {0.22} Exhaust valve: Approx. 5.5 {0.22}

- The intake valve and the exhaust valve are tufftride processed to improve adhesion resistance.
- The valve spring is a beehive type. It has been improved by reducing the size of the upper seat.
- The valve guide is made of sintered alloy to improve abrasion resistance.
- The valve seal is integrated with the lower spring seat to simplify the unit and improve serviceability.



C3U0110N065

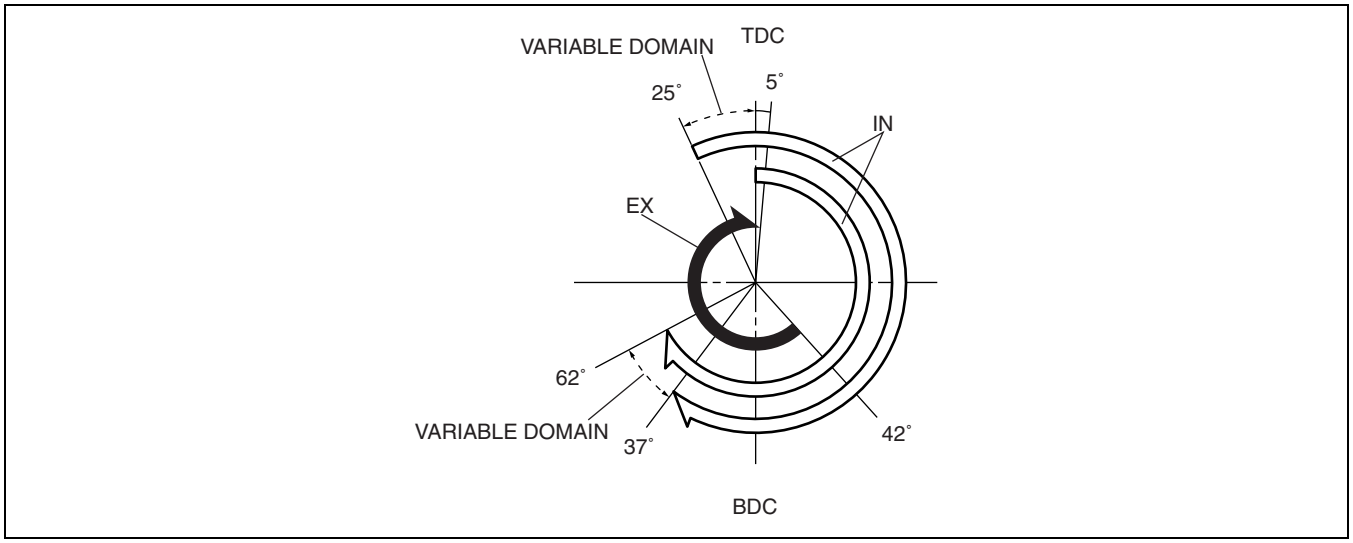
CAMSHAFT CONSTRUCTION [L3]

EPU011012420S01

- A cast iron, highly rigid five axis journal camshaft has been adopted to insure higher reliability.
- Camshaft endplay is regulated at the flange of the No.1 journal.
- Lubricating oil is supplied through the oil supply hole at each journal. Additionally the cam nose part is chill cast to improve abrasion resistance, and the width of the cam heel part is shortened to reduce weight
- There is no positioning pin or key slot for the camshaft sprocket at the end of the camshaft.
- There is an oil line, by which the oil supplied to the variable valve timing actuator, located intake port side camshaft (front of camshaft).

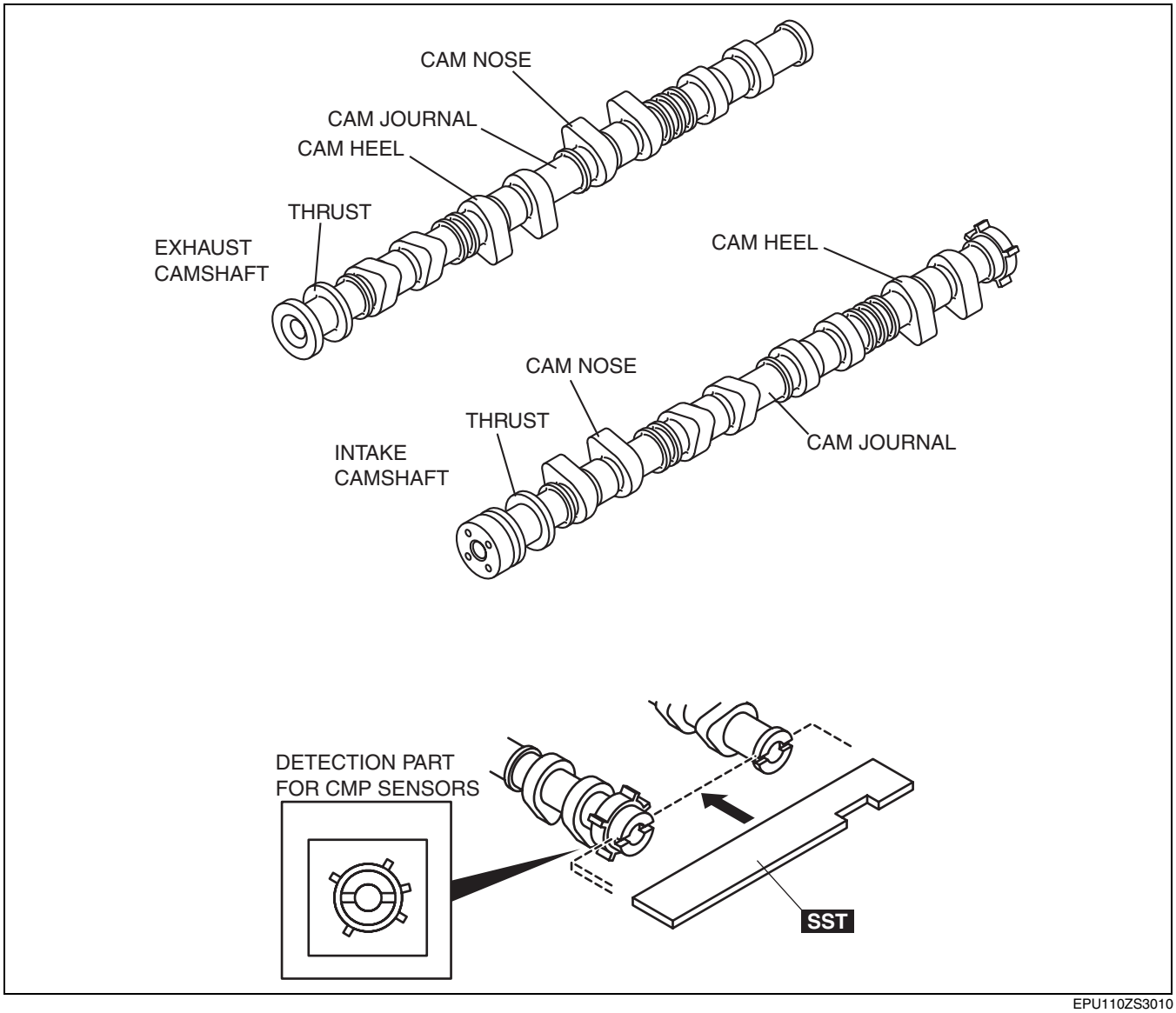
Camshaft Specification

ITEM	IN	EX
LIFT (mm {in})	9.1 {0.35}	7.8 {0.31}
Overlap (°)	5—30	



EPU110ZS3009

- The detection unit or the camshaft position (CMP) sensor, which is integrated with the camshaft, is on the intake camshaft.
- The groove for securing the No.1 cylinder TDC for the camshaft, is provided at the rear of the intake and exhaust camshaft.
- The detection unit (trigger plate) for the camshaft position (CMP) sensor is at the intake port side camshaft.

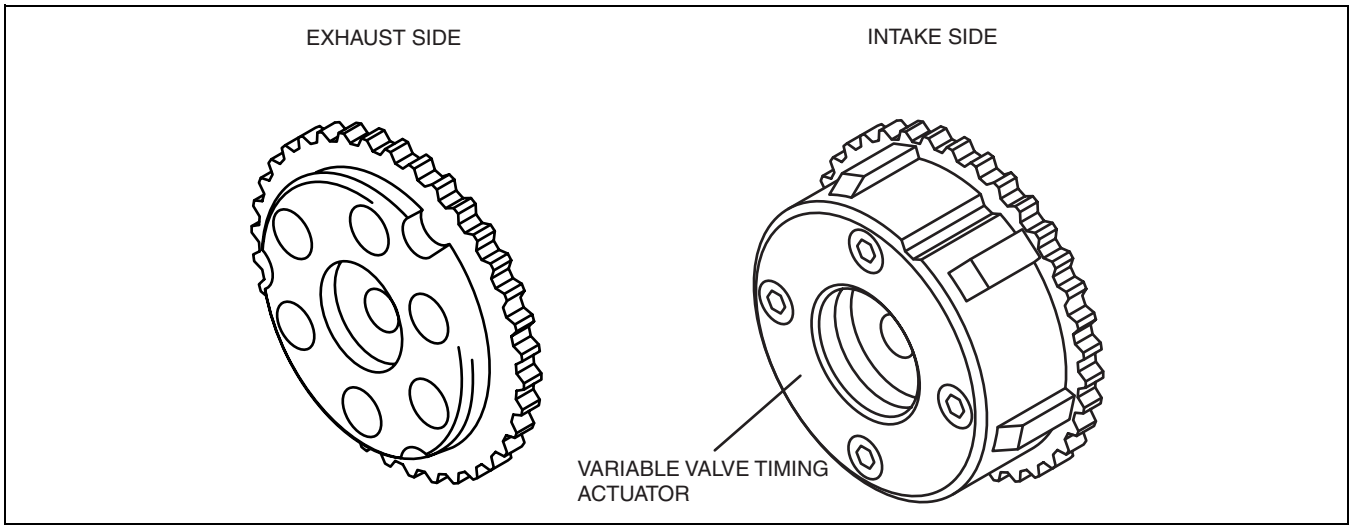


EPU110ZS3010

CAMSHAFT SPROCKET CONSTRUCTION [L3]

EPU011012420S02

- Sintered alloy, which has high rigidity, has been adopted for the camshaft sprocket and is hardened to improve the abrasion resistance at the contact point with the timing chain.



EPU110ZS3011

CRANKSHAFT SPROCKET CONSTRUCTION [L3]

EPU011012420S03

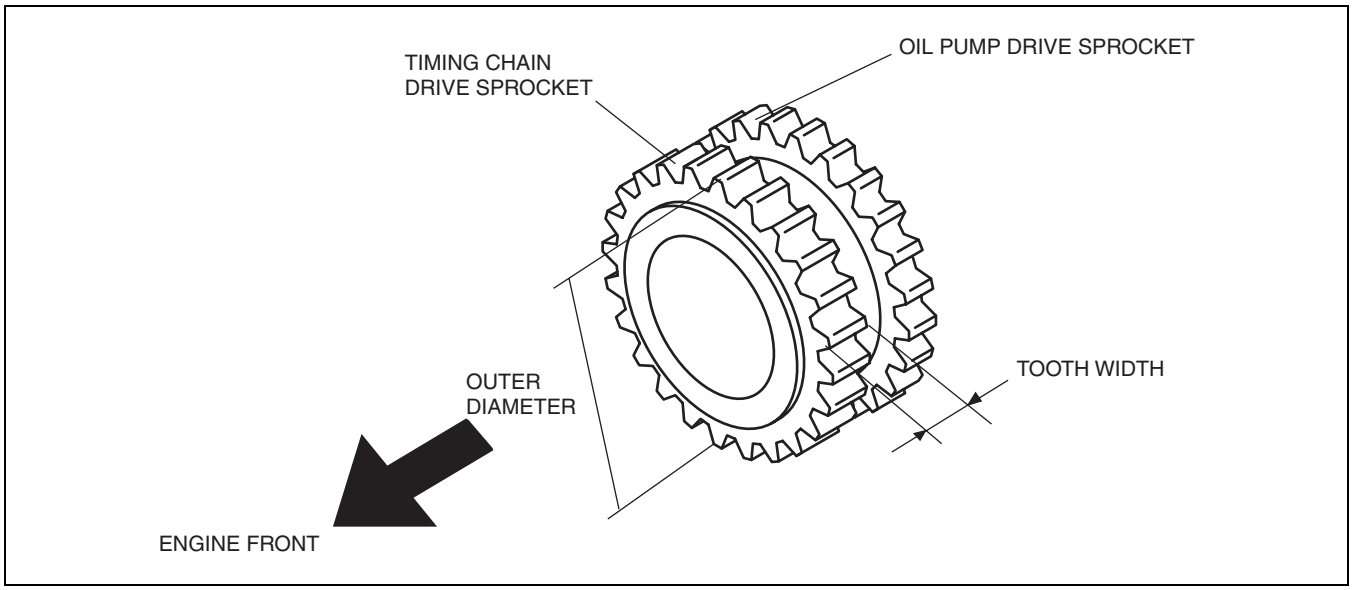
- High-strength chromium steel has been adopted for the crankshaft sprocket. Due to carbonizing protection, abrasion resistance at all chain contact points is increased.
- The crankshaft sprocket consists of the timing chain sprocket and oil pump sprocket, which are integrated into a single unit.
- The keyway on the crankshaft sprocket, used to position the crankshaft during installation, has been eliminated.

Timing Drive Sprocket Specification

Outer diameter	(mm {in})	Approx. 48.495 {1.9093}
Tooth width	(mm {in})	Approx. 8.03 {0.316}

Oil Pump Drive Sprocket Specification

Outer diameter	(mm {in})	Approx. 48.495 {1.9093}
Tooth width	(mm {in})	Approx. 5.93 {0.233}



C3U0110N067

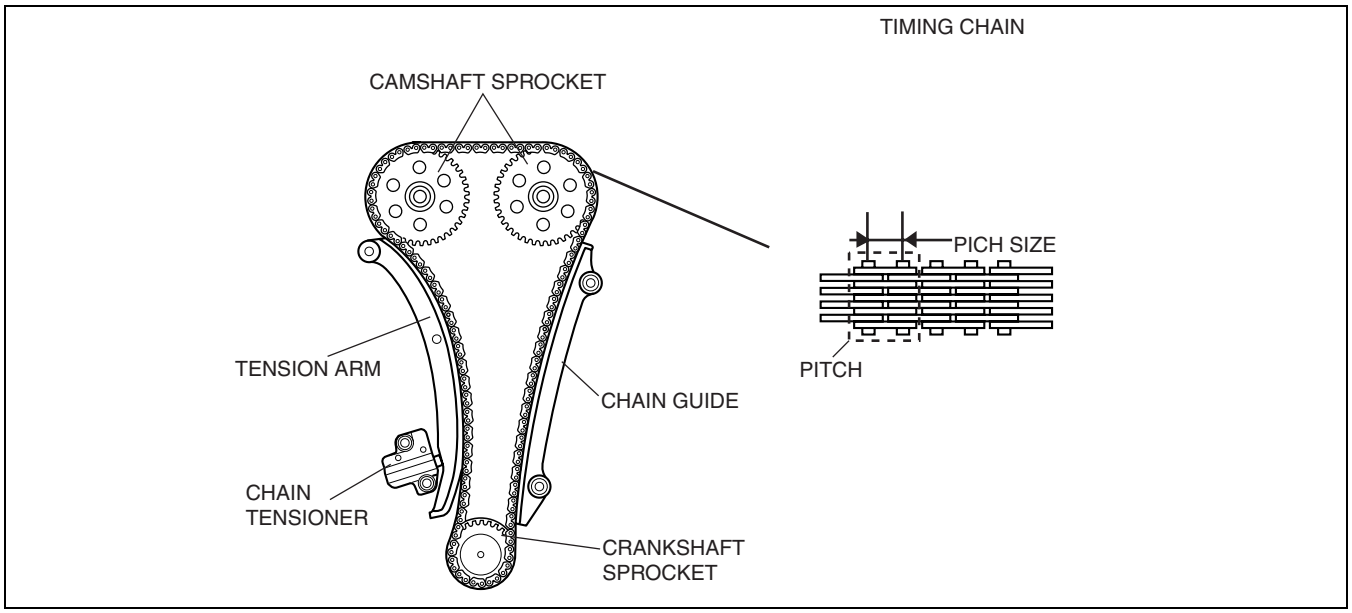
TIMING CHAIN, CHAIN TENSIONER CONSTRUCTION [L3]

EPU011012201S01

- A silent chain (link grounding type) type has been adopted for the timing chain to reduce tapping noise caused by sprocket engagement.
- Engine oil inside the engine front cover lubricates the timing chain and each sprocket. The pin part of the timing chain is nitride processed to improve abrasion resistance.

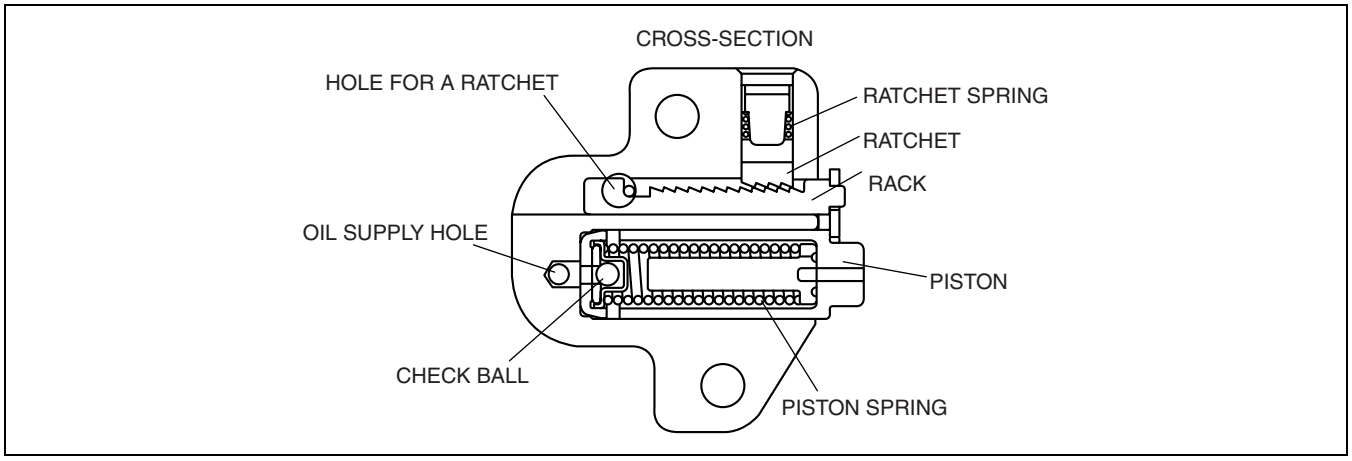
Timing Chain Specification

Pitch size	(mm {in})	6.35 {0.25}



EPU110ZS3012

- An oil pressure type chain tensioner has been adopted for the timing chain tensioner. The tension of the timing chain is constantly maintained using oil pressure and spring force in the chain tensioner.
- The oil pressure type chain tensioner consists of the following parts: Piston spring that depresses the tensioner arm, and a check ball that maintains pressure to the tensioner arm.



C3U0110N071

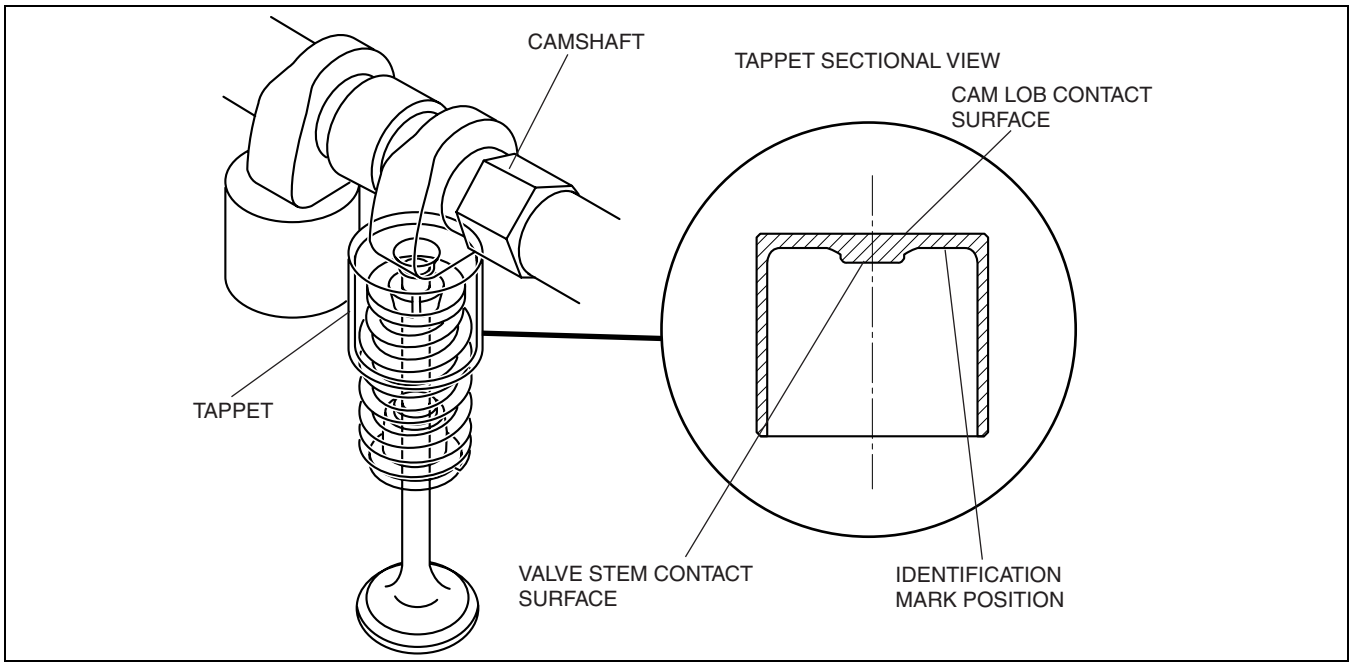
TAPPET CONSTRUCTION [L3]

EPU011012431S01

- The tappet is a shimless tappet which is integrated with the shim.
- The tappet surface is phosphate-coated to in order to improve initial familiarity nature.
- The valve clearance can be adjusted by replacing the tappet. There are 35 kinds of tappets depending on the thickness. The tappet kind can be determined by the engraved identification mark.

Tappet Specification

Discernment mark	Tappet thickness (mm {in})	The number of jumps (mm {in})
725—625	3.725—3.625 {0.1467—0.1427}	0.025 {0.00098}
602—122	3.602—3.122 {0.1418—0.1229}	0.02 {0.00078}
100—000	3.100—3.000 {0.1220—0.1181}	0.025 {0.00098}

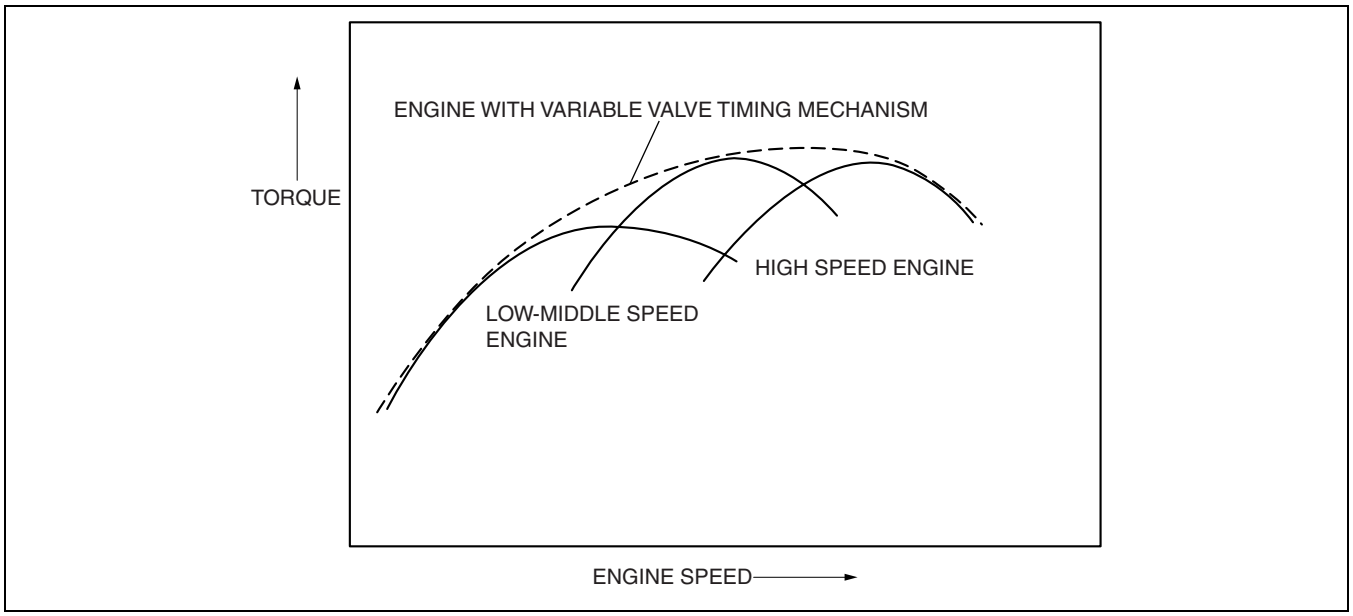


C3U0110N072

VARIABLE VALVE TIMING MECHANISM OUTLINE [L3]

EPU011012111S04

- A variable timing mechanism has been adopted. This provides optimum valve timing according to engine operation conditions by continuously modifying the phases of the intake camshaft and crankshaft.



C3U0110N073

VARIABLE VALVE TIMING MECHANISM FUNCTION [L3]

EPU011012111S05

Variable Valve Timing Mechanism

Function

- The variable valve timing mechanism continuously modifies the phases of the variable valve timing actuator and the intake camshaft using hydraulic pressure controlled by the oil control valve (OCV) so that optimal valve timing is obtained according to engine operation conditions.
- The oil control valve (OCV) operation is based on signals from the PCM according to engine operation conditions and it controls hydraulic pressure to the variable valve timing actuator.

Operation and purpose according to driving condition

Idling range, light load range

- Due to a reduction in the amount of overlap, less combusted gas is returned to the intake port. This stabilizes idle speed in the idling range, improving fuel economy, and also ensures engine stability in the light load range.

Medium load range

- Overlap amount has been increased and the EGR ratio inside the cylinder is higher. This reduces engine friction loss (pumping loss), lowering the combustion temperature and reducing the amount of NOx in the exhaust gas. The amount of hydrocarbon emission has also been reduced through reignition of non-combusted gas.

Heavy load, low-middle speed range

- The intake valve is closed early, and high volumetric efficiency is obtained to improve low-middle speed torque.

Heavy load, high speed range

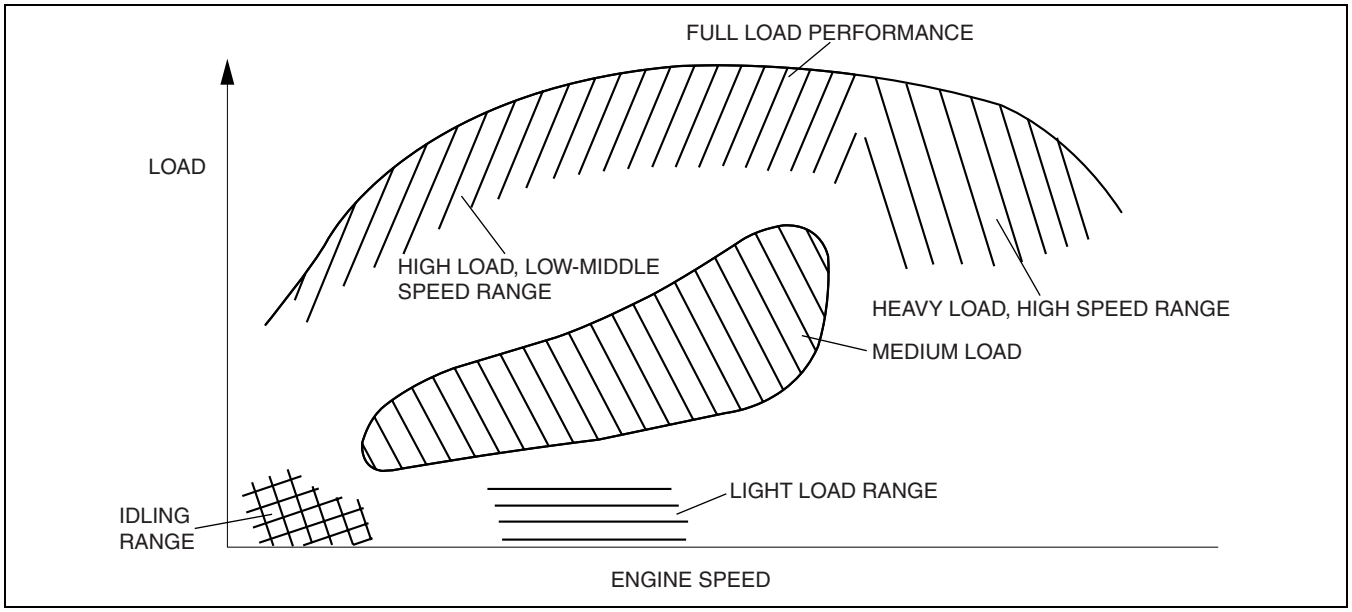
- Timing for intake valve closure is delayed and high volumetric efficiency is obtained to improve maximum output.

When temperature is low

- The overlap amount has been minimized to prevent combusted gas from returning to the intake port and to reduce the additional fuel injection amount. This improves fuel economy and stabilizes fast idle speed.

When engine is started or stopped

- Startability has been improved because the overlap amount has been minimized to prevent combusted gas from returning to the intake port.

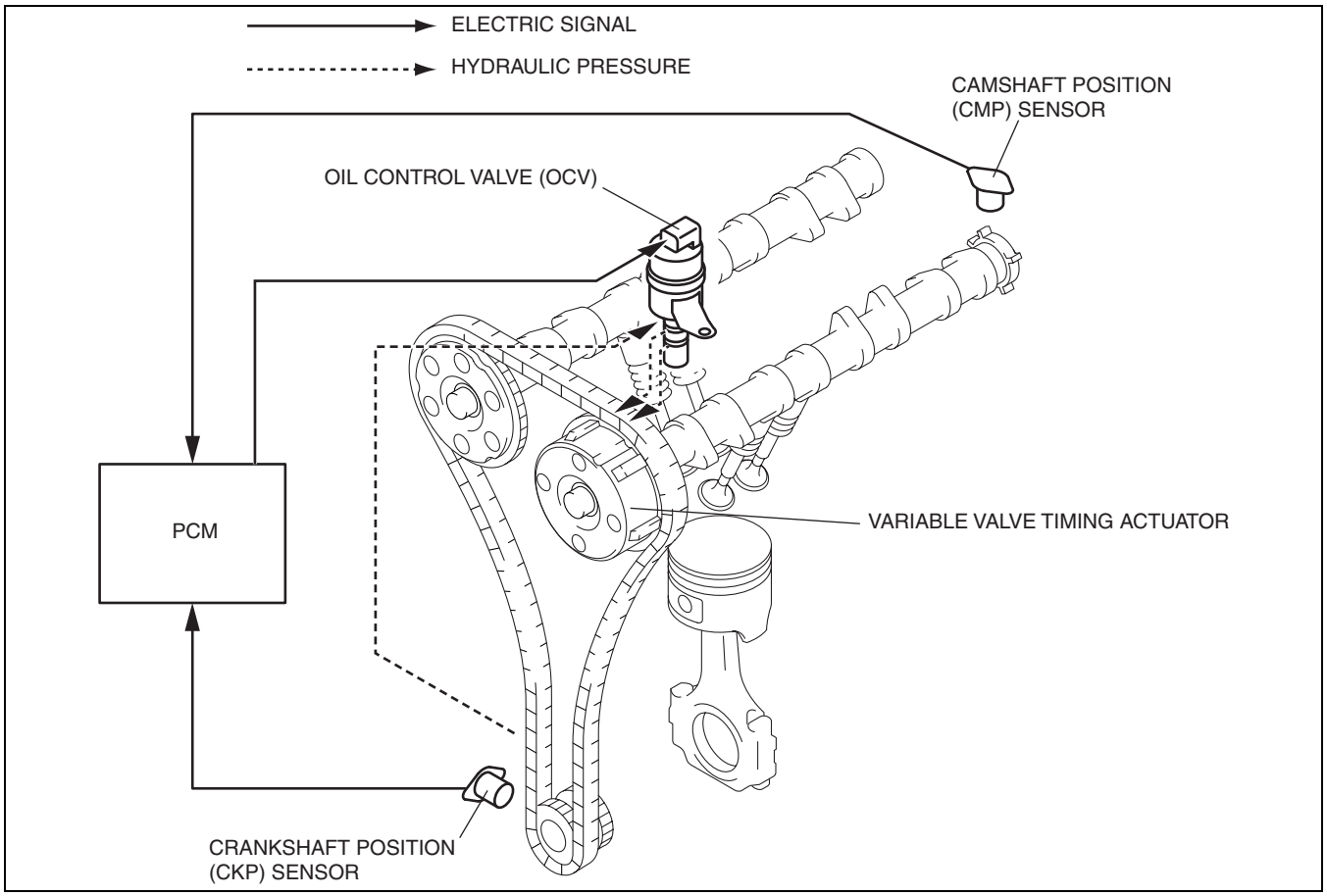


EPU110ZS3017

VARIABLE VALVE TIMING MECHANISM CONSTRUCTION [L3]

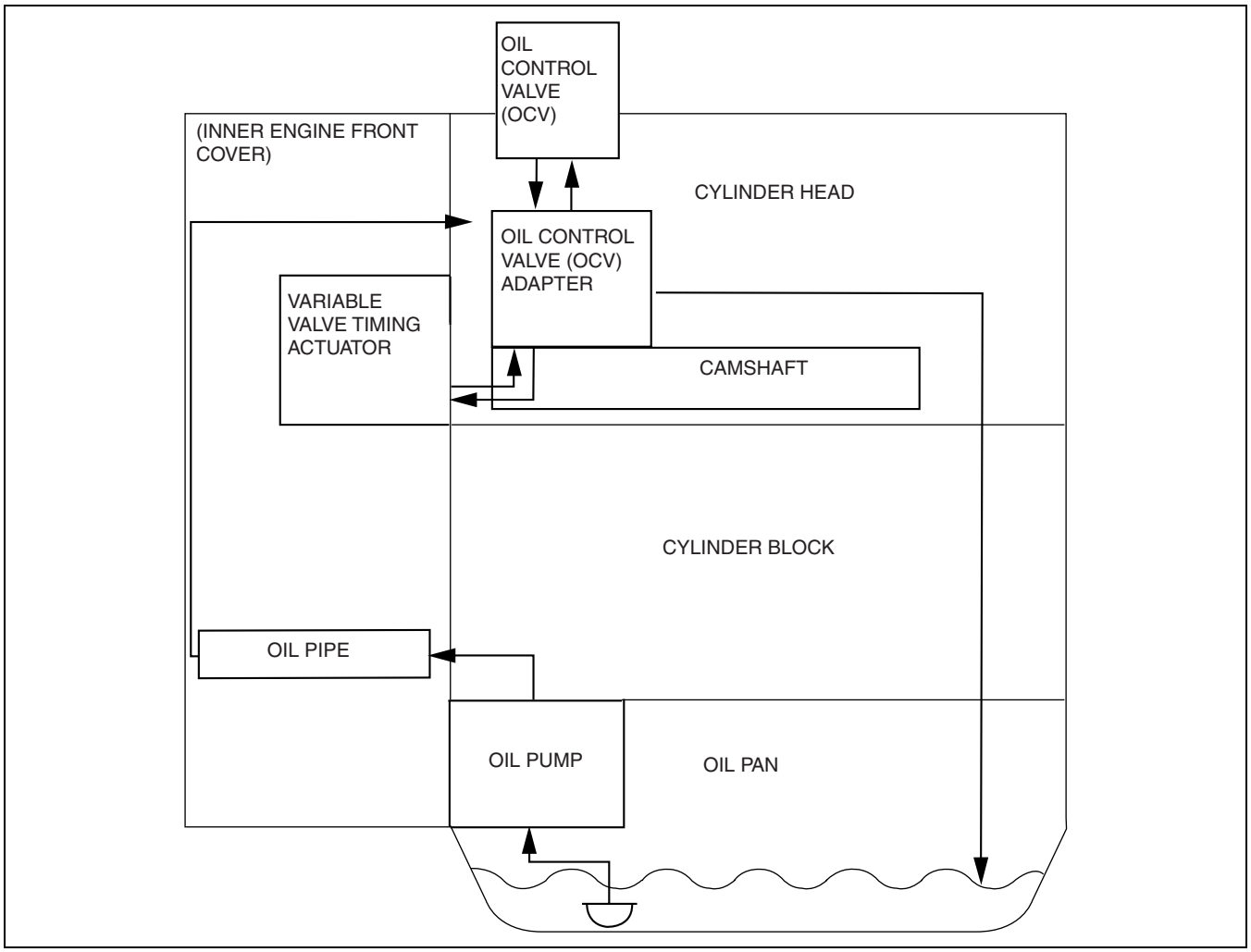
EPU011012111S06

- The variable valve timing mechanism consists of a variable valve timing actuator, oil control valve (OCV), CKP sensor, CMP sensor, and the PCM.



A6A2211N114

Hydraulic Pressure Flow Diagram



EPU110ZS3013

Component and function

Variable valve timing actuator	• Continuously modifies the phases of the intake camshaft and crankshaft using hydraulic pressure from the oil control valve (OCV).
Oil control valve (OCV)	• Operated by current (duty signal) from the PCM. Switches the hydraulic oil passages to the variable valve timing actuator.
CKP sensor	• Inputs engine revolution signal to the PCM.
CMP sensor	• Inputs cylinder identification signal to the PCM.
PCM	• Controls the oil control valve (OCV) so that optimum valve timing is obtained according to engine operation conditions.

VARIABLE VALVE TIMING MECHANISM OPERATION [L3]

EPU011012111S07

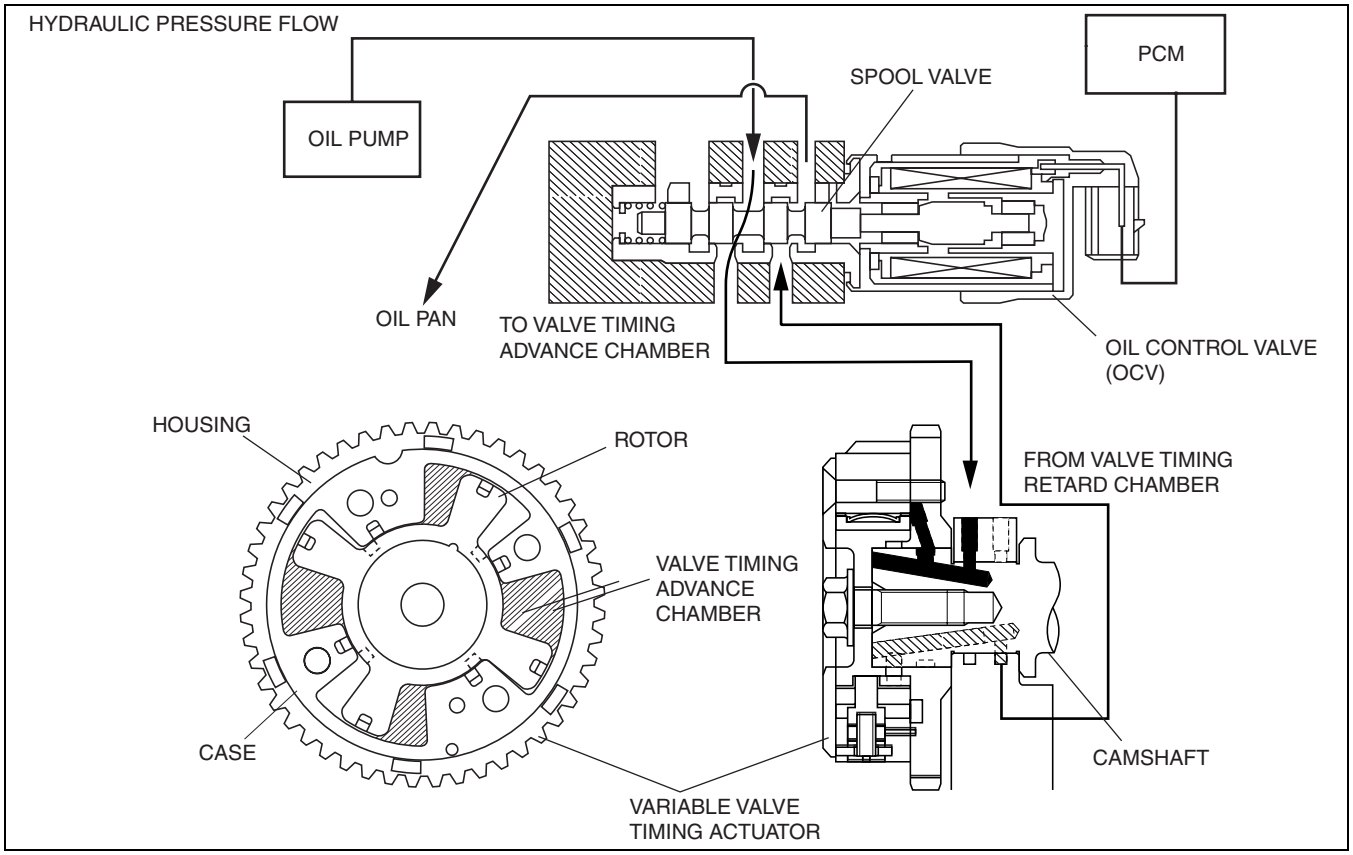
- The variable valve timing actuator has two hydraulic chambers: a valve timing advance chamber and a valve timing retard chamber. They are located between the integrated housing of the camshaft sprocket and the camshaft integrated rotor. The oil pump supplies engine oil to each chamber. Hydraulic pressure applied to each chamber is controlled by the oil control valve (OCV), and the relative phases of the camshaft sprocket and the camshaft are modified to obtain optimum valve timing according to engine operation conditions.

At engine start

- When the stopper pin in the variable valve timing actuator engages with the rotor, which is at the position of maximum valve timing retard due to spring force, the camshaft sprocket and the camshaft rotate as one unit. When there is a advance signal from the PCM and the stopper pin is disengaged, it is possible to modify the relative angles of the camshaft sprocket and the camshaft.

Advancing valve timing

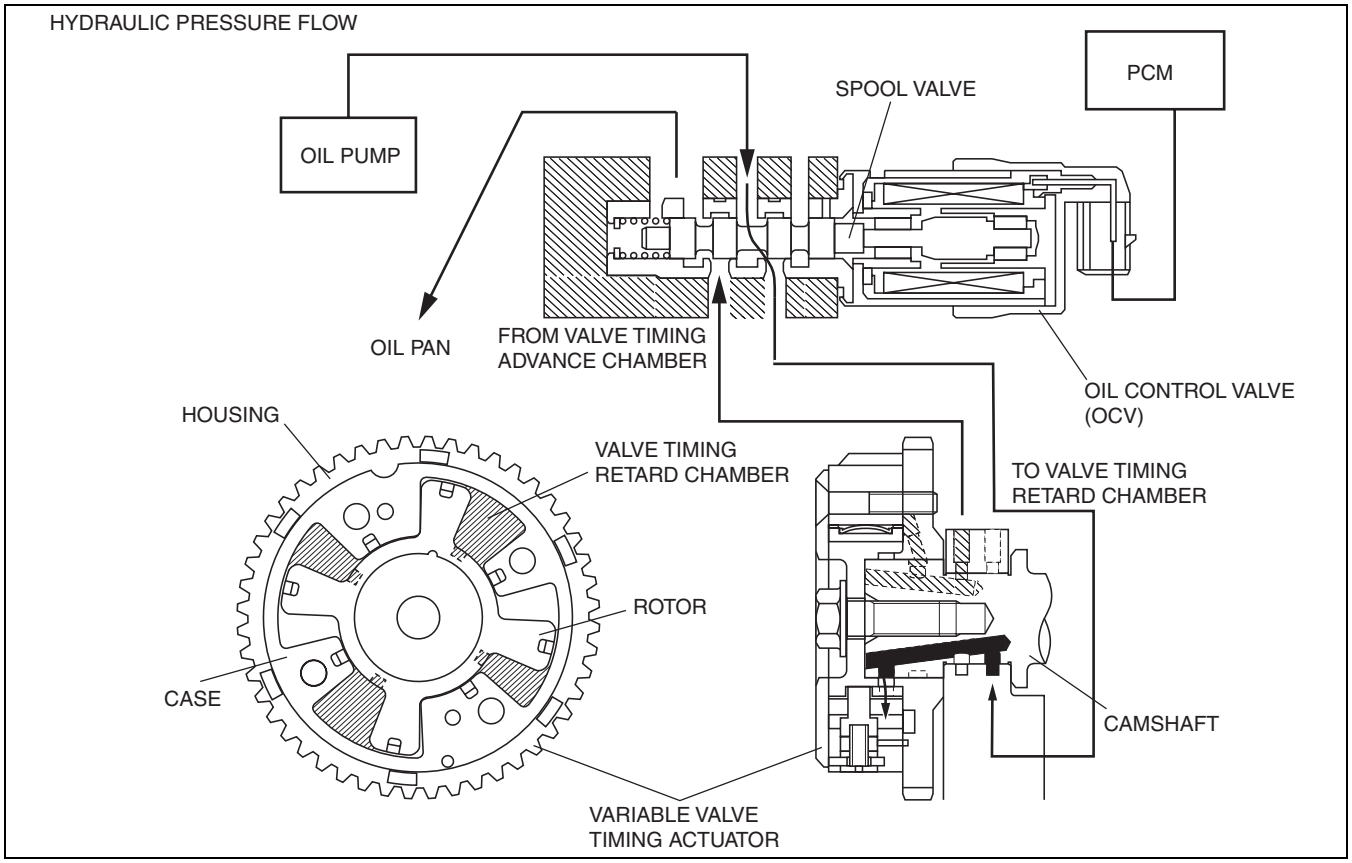
- When the spool valve in the oil control valve (OCV) moves to the left according to the PCM signal, hydraulic pressure from the oil pump feeds into the valve timing advance passage, and finally to the valve timing advance chamber in the variable valve timing actuator. Then, the rotor integrated with the camshaft rotates in the valve timing advance direction, against the housing driven by the crankshaft, and the valve timing is advanced.



C3U0110N169

Retarding valve timing

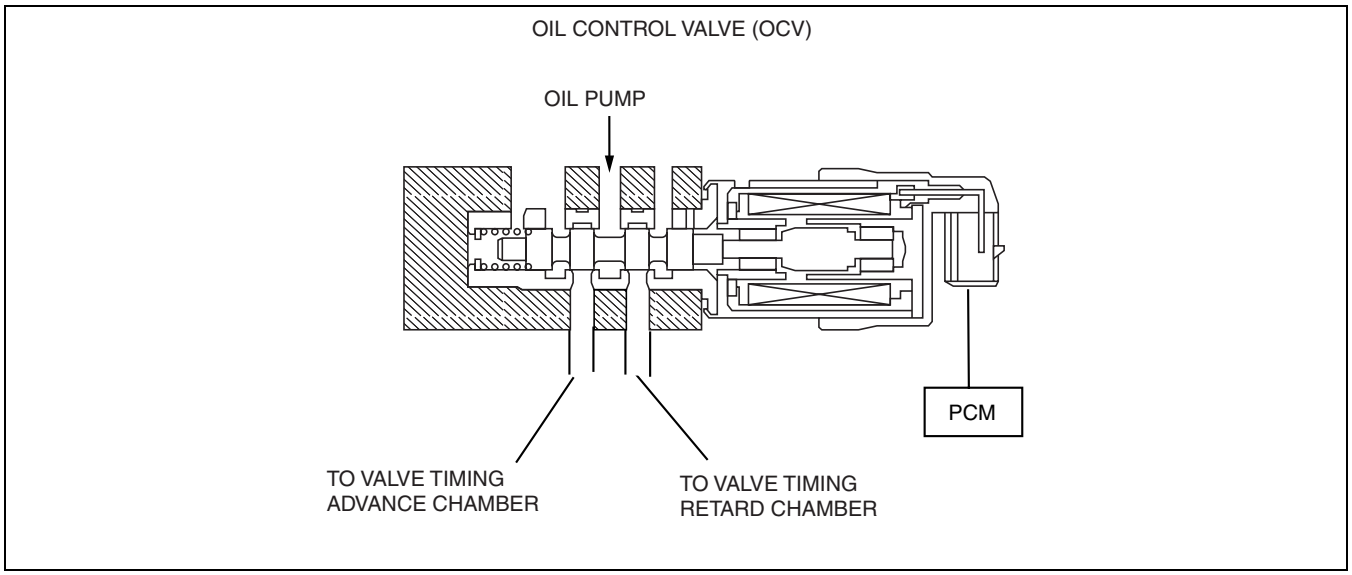
- When the spool valve in the oil control valve (OCV) moves to the right according to the PCM signal, hydraulic pressure from the oil pump feeds into the valve timing retard passage, and finally to the valve timing retard chamber in the variable valve timing actuator. Then, the rotor integrated with the camshaft rotates in the valve timing retard direction, against the housing driven by the crankshaft, and valve timing is retarded.



C3U0110N163

Maintaining intermediate valve timing

- The spool valve in the oil control valve (OCV) is located near the middle of the valve timing advance and retard positions. Because of this, hydraulic pressures are maintained in both valve timing advance and retard chambers of the variable valve timing actuator. At the same time, relative angles of the rotor and the housing are fixed and maintained, resulting in fixed valve timing.

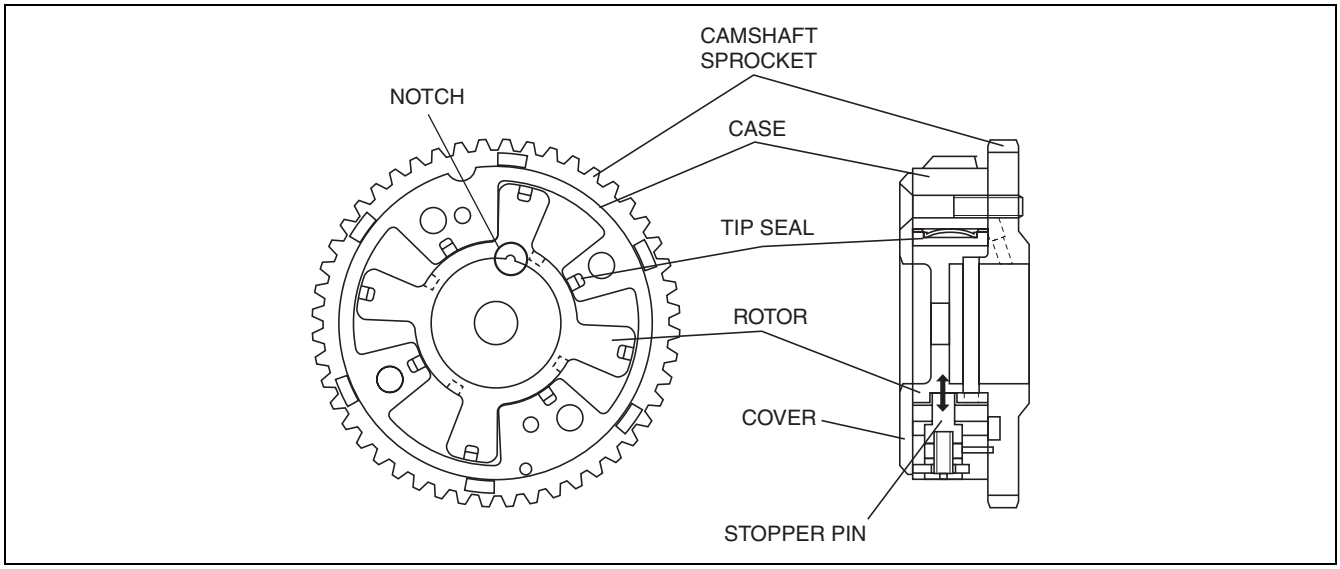


C3U0110N170

VARIABLE VALVE TIMING ACTUATOR CONSTRUCTION [L3]

EPU011002000S02

- The variable valve timing actuator consists of the following: a housing case integrated with the camshaft sprocket, a cover, a camshaft integrated rotor, and a stopper pin that retains the rotor and sprocket when the engine stops. Also, the rotor has a chip seal that seals the valve timing advance chamber and the valve timing retard chamber.
- The cover and rotor of the variable valve timing actuator are notched, and are used as alignment marks when inspecting the variable valve timing actuator. (L3)

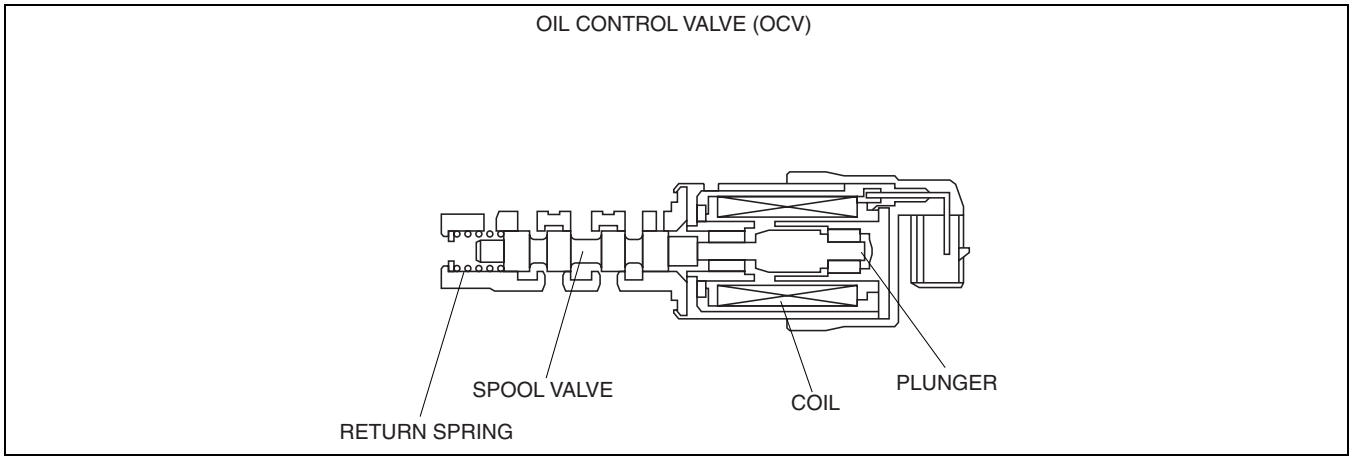


C3U0110N077

OIL CONTROL VALVE (OCV) CONSTRUCTION [L3]

EPU011002000S03

- The oil control valve (OCV) consists of a spool valve that switches the passages for engine oil, a coil that moves the spool valve, a plunger, and a return spring.



C3U0110N162

01–11 LUBRICATION [L3]

LUBRICATION SYSTEM OUTLINE [L3] 01–11–1
Features 01–11–1
LUBRICATION SYSTEM STRUCTURAL VIEW [L3] 01–11–1
LUBRICATION SYSTEM FLOW DIAGRAM[L3] 01–11–2
OIL FILTER CONSTRUCTION [L3] 01–11–3
OIL COOLER CONSTRUCTION [L3] 01–11–3
OIL PAN CONSTRUCTION [L3]. 01–11–4
OIL STRAINER CONSTRUCTION [L3] 01–11–4
OIL PUMP CONSTRUCTION [L3] 01–11–5
OIL JET VALVE CONSTRUCTION/OPERATION [L3] 01–11–6
Construction 01–11–6
Operation 01–11–6

LUBRICATION SYSTEM OUTLINE [L3]

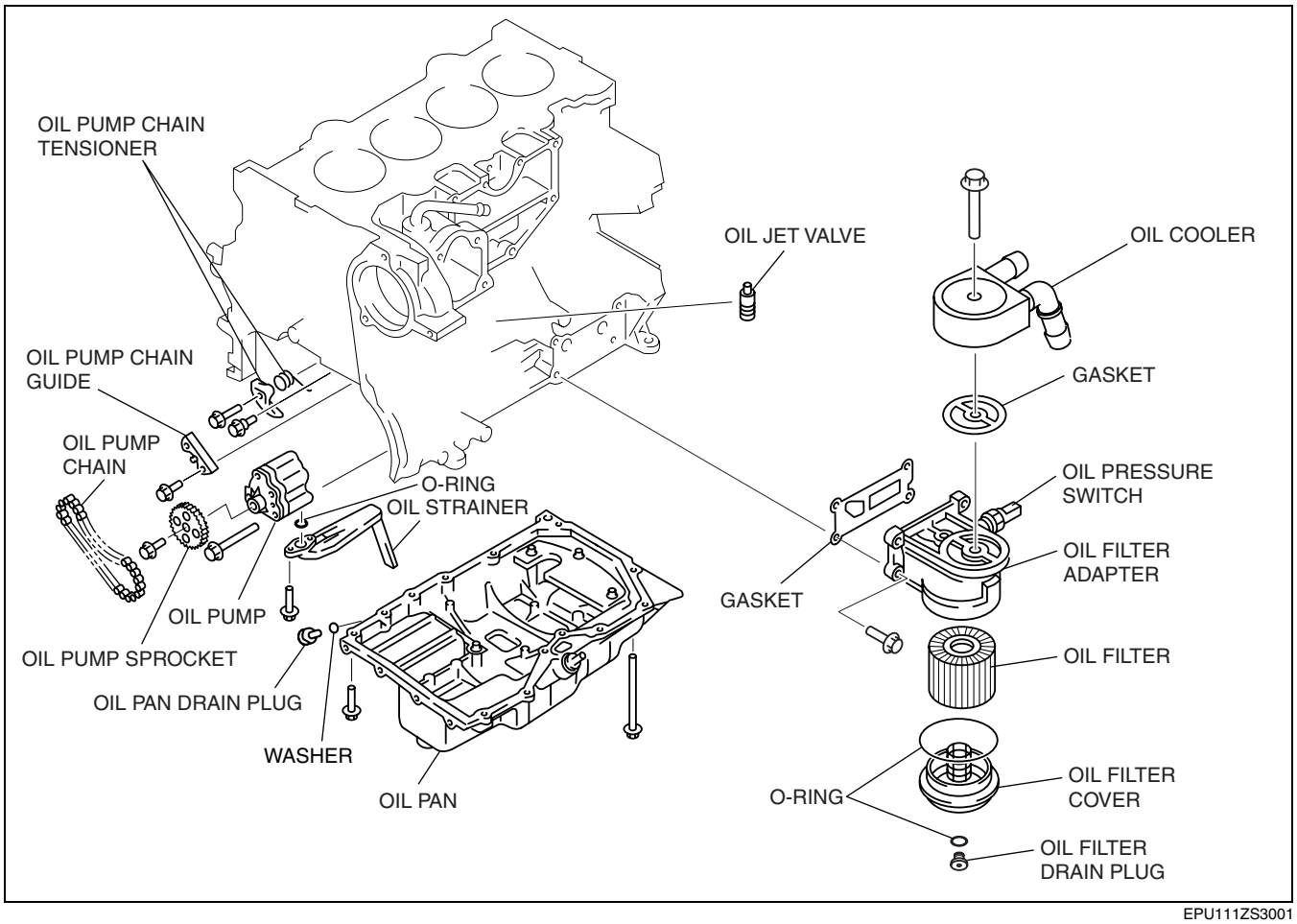
EPU011100000S01

Features

Reduced noise	• Aluminum alloy oil pan adopted
Reduced weight	• Plastic oil strainer adopted • Resin oil filter cover adopted
Improved lubricity	• Trochoid gear type oil pump adopted • Oil jet valves adopted • Water-cooled type oil cooler adopted

LUBRICATION SYSTEM STRUCTURAL VIEW [L3]

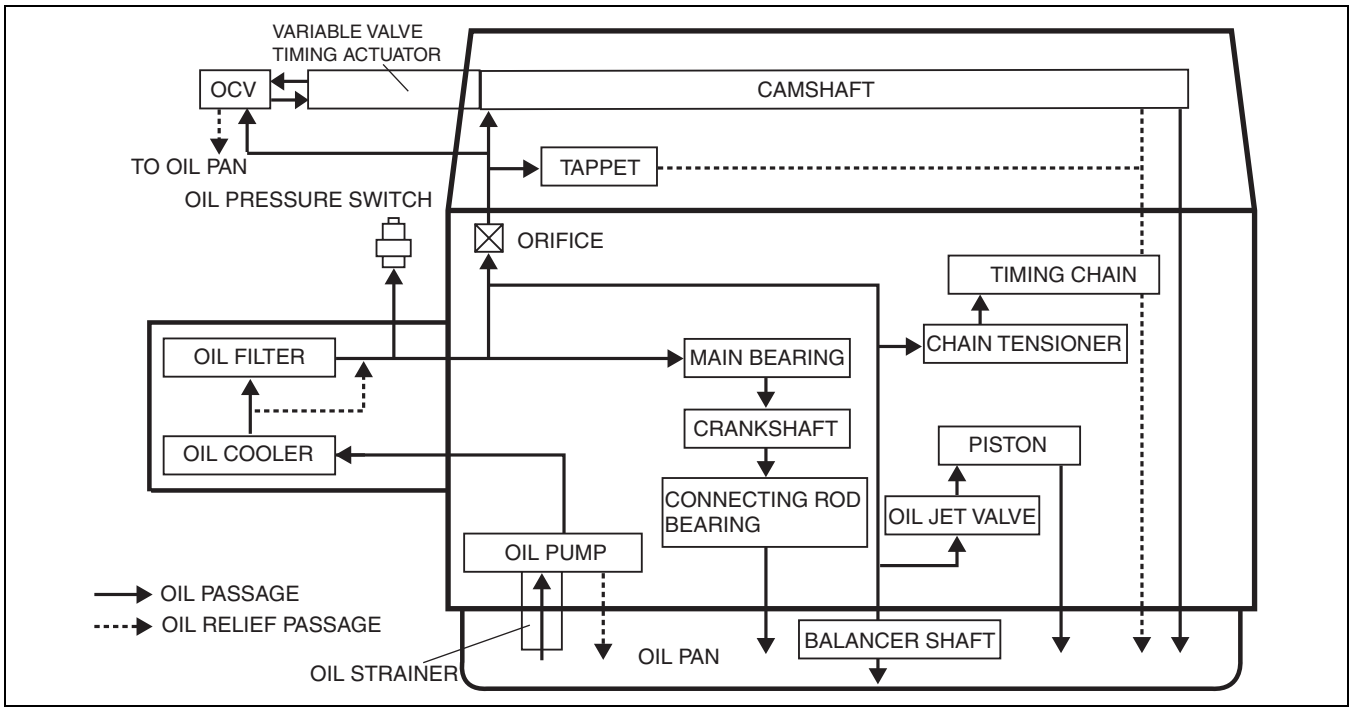
EPU011100000S02



EPU111ZS3001

LUBRICATION SYSTEM FLOW DIAGRAM [L3]

EPU011100000S03



EPU111ZS3002

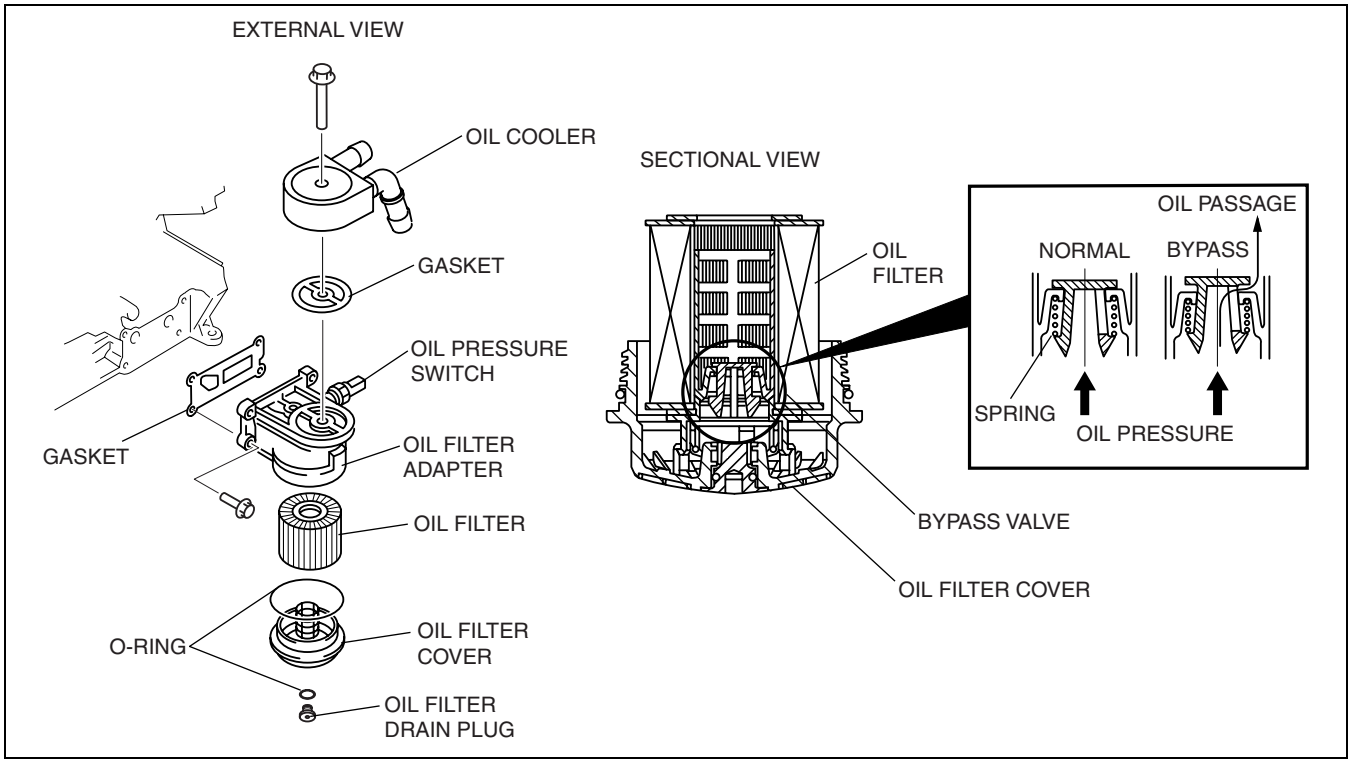
OIL FILTER CONSTRUCTION [L3]

EPU011114300S01

- The oil filter component is installed on the left surface (vehicle front) of the cylinder block.
- An aluminum oil filter adapter has been adopted for weight reduction. The oil pressure switch and oil cooler are installed on the oil filter adapter.
- A resin oil filter cover has been adopted for weight reduction. A drain plug has been installed on the bottom of the oil filter cover to improve replacement serviceability.
- An environment-friendly oil filter made of incinerable polyester has been adopted. Only the filter paper needs to be replaced.

Oil filter specification

Item		Specification
Outer diameter	(mm {in})	65.2—65.8 {2.57—2.59}
Height	(mm {in})	72.6—74.4 {2.86—2.92}

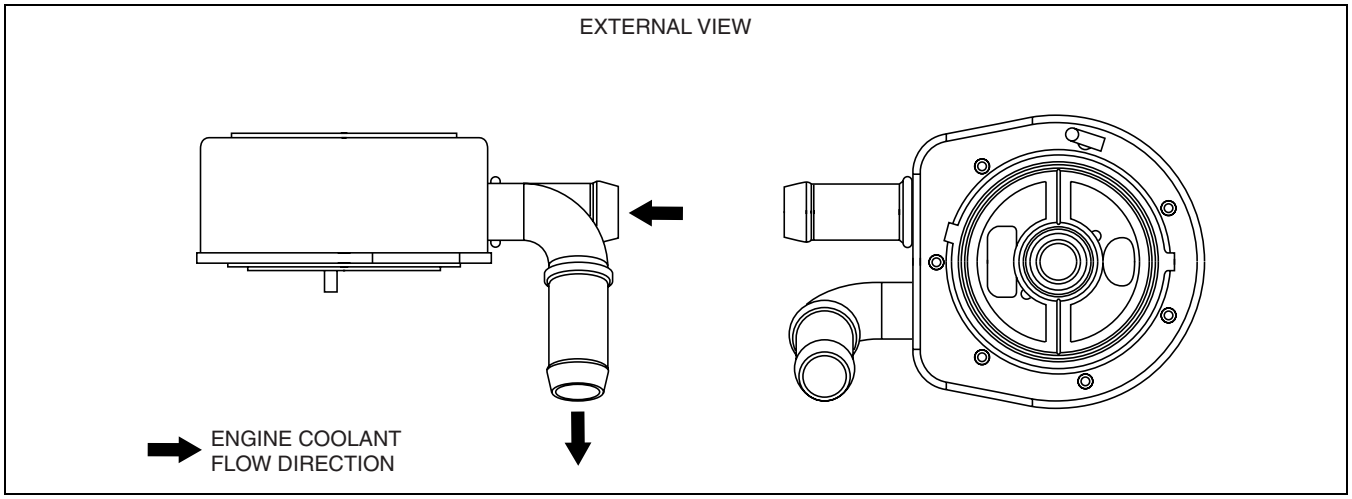


EPU111ZS3003

OIL COOLER CONSTRUCTION [L3]

EPU011114700S02

- A water-cooled type oil cooler has been adopted to reduce the engine oil degradation.
- The oil cooler is attached to the oil filter adapter.

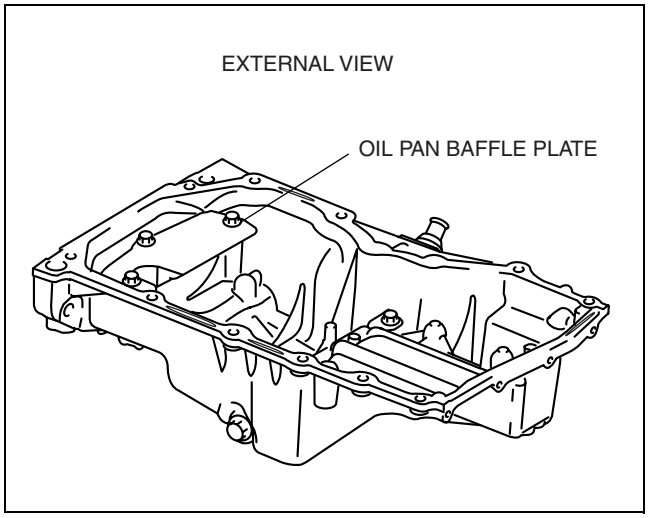


E6U111ZNB003

OIL PAN CONSTRUCTION [L3]

EPU011110040S01

- An aluminum alloy oil pan has been adopted for noise reduction.
- An oil pan baffle plate has been adopted inside the oil pan to stabilize engine oil diffusion by crankshaft rotation and oil level when the vehicle rolls.
- A silicon sealant with excellent sealing qualities has been adopted. Also, sealing slots have been adopted on the oil pan attachment side to improve sealing performance.

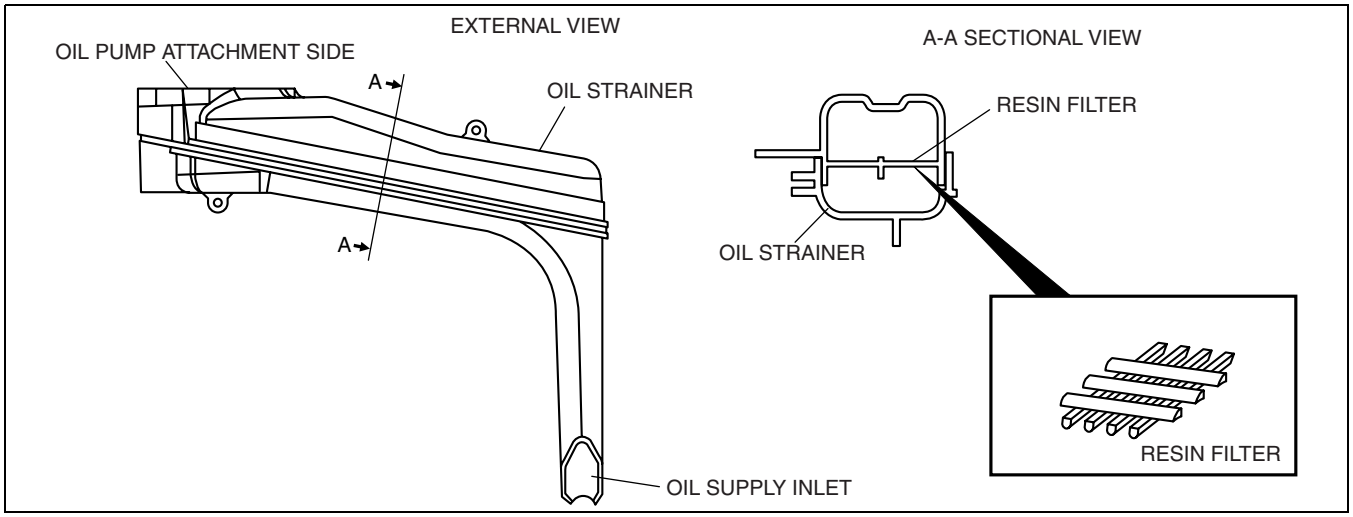


EPU111ZS3004

OIL STRAINER CONSTRUCTION [L3]

EPU011114240S02

- A plastic oil strainer with a resin filter in the middle of the strainer has been adopted for weight reduction.

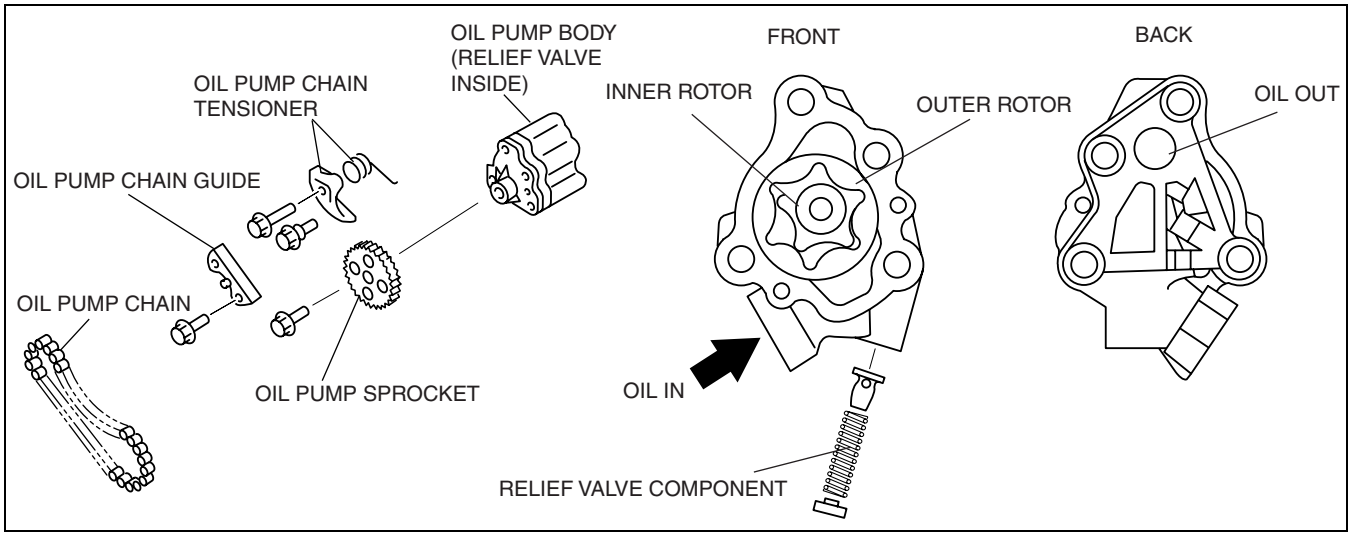


C3U0111S018

OIL PUMP CONSTRUCTION [L3]

EPU011114100S01

- The oil pump is installed inside the engine front cover. The crankshaft drives the inner rotor through the oil pump chain and oil pump sprocket.
- The oil pump component consists of the oil pump body, oil pump sprocket, oil pump chain, oil pump chain guide, and oil pump chain tensioner.
- An efficient and compact five-lobe epitrochoid and six-flank inner envelope type gear has been adopted on the oil pump.
- The oil pump consists of the inner and outer rotors, relief valve, and oil pump body.
- The oil pump cannot be disassembled. If there is an oil pump malfunction, replace it as a single unit.

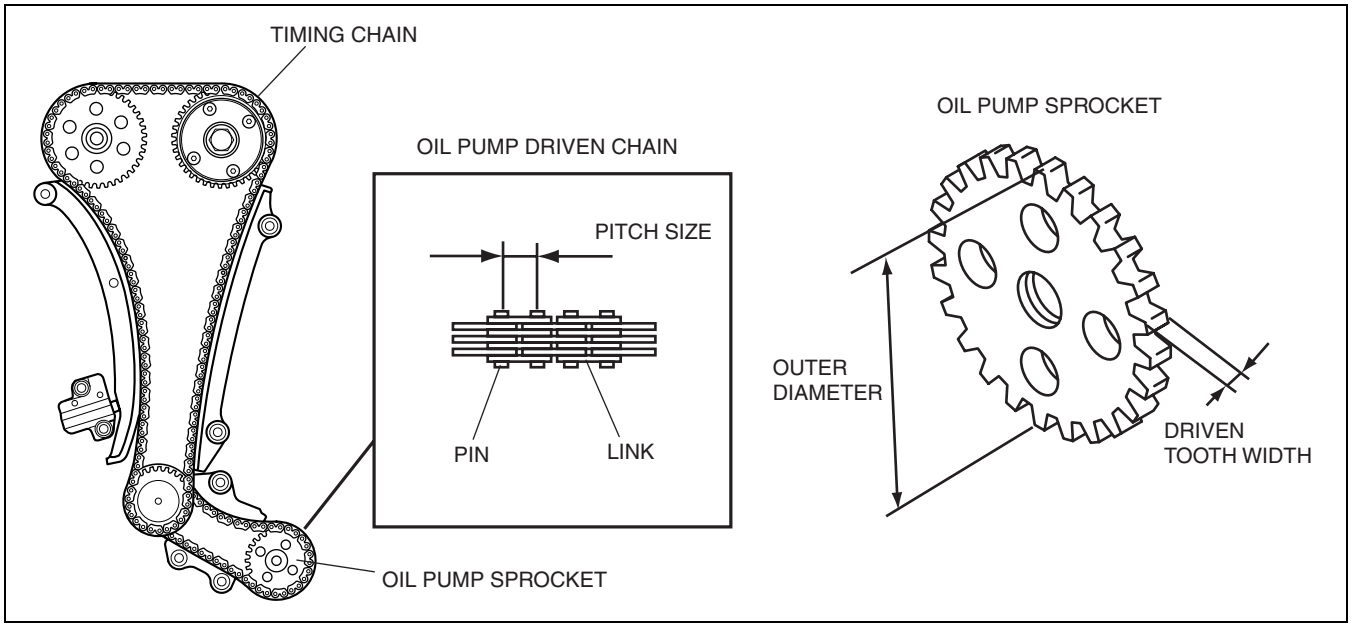


EPU111ZS3008

Oil pump specification

Item	Engine speed [rpm]	Specification [kPa {kgf/cm^2, psi}]
Oil discharge pressure (reference value) [Oil temperature: 100 °C {212 °F}]	1,500	180—387 {1.84—3.95, 26.2—56.1}
	3,000	337—591 {3.44—6.03, 49.0—85.8}
Relief valve opening pressure (reference value)		420—520 {4.28—5.30, 60.9—75.4}

- A silent chain (link connecting type) has been adopted to the oil pump chain to reduce chain operation noise when the chain and the sprocket engage.
- The engine oil in the engine front cover lubricates the oil pump chain. Wear resistance has been improved using nitriding processing of the pins constructing the oil pump chain.
- The sintered material in the oil pump sprocket has been furnace hardened to improve durability.



EPU111ZS3005

Oil pump driven chain, oil pump sprocket specification

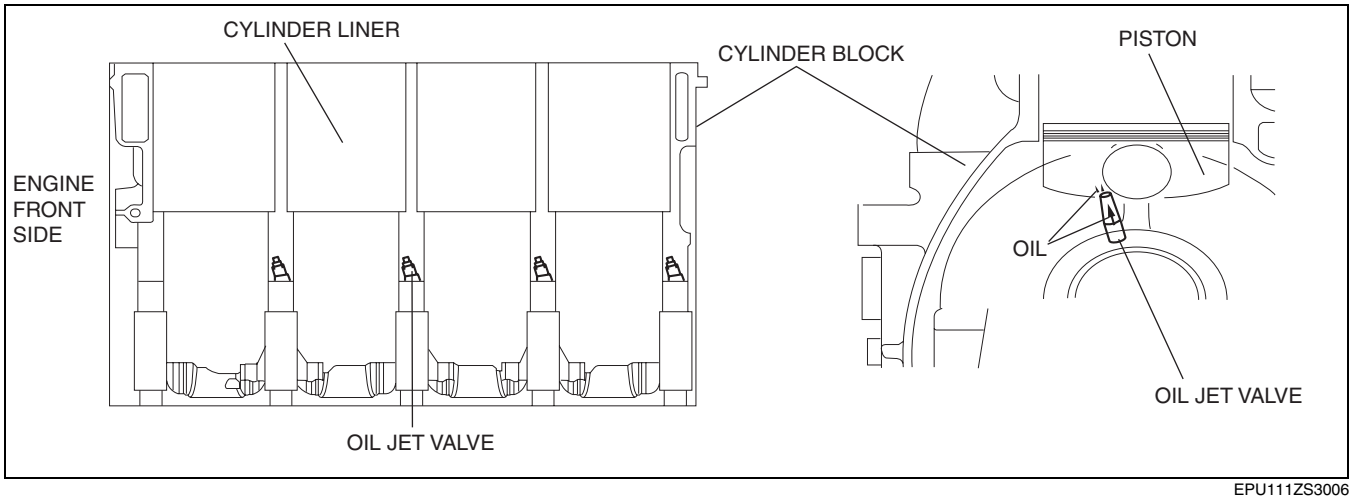
Item		Specification [mm {in}]
Oil pump driven chain	Pitch size	6.35 {0.25}
Oil pump sprocket	Outer diameter	46.46 {1.829}
	Driven tooth width	5.7 {0.23}

OIL JET VALVE CONSTRUCTION/OPERATION [L3]

EPU011110730S01

Construction

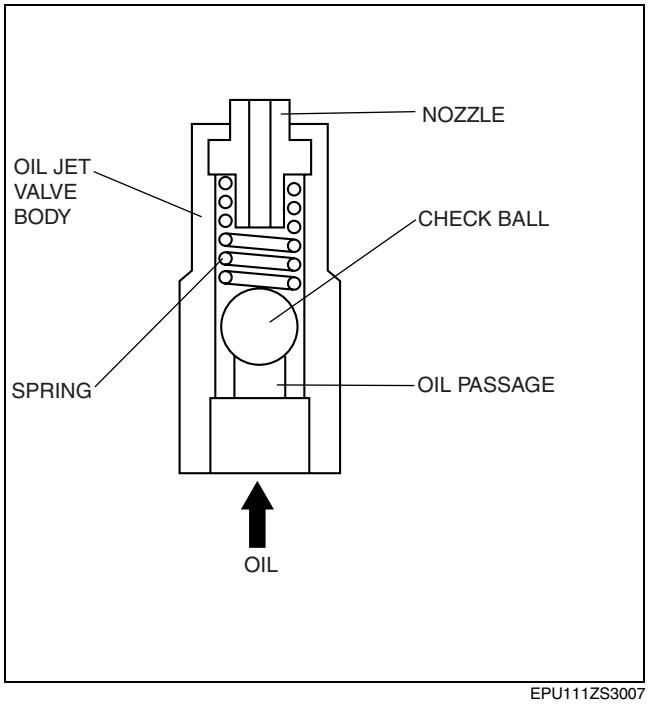
- The oil jet valves are installed in the cylinder block (in the main journal). The oil jet valve nozzles are installed pointed toward the back surface of each piston.
- The oil jet valves are designed to maintain optimum oil pressure in the engine by controlling the oil injection according to the oil pressure applied to the check ball in the oil jet valves.



EPU111ZS3006

Operation

- Oil pressure applied to the check-ball in the oil jet valve opens and closes the oil passage-way to the nozzle and controls oil injection starting and stopping.
- Oil pressure greater than the specified value applied to the check-ball in the oil jet valve opens the oil passage to the spring-pressed nozzle, starting injection. Conversely, oil pressure less than the specified value applied to the check-ball blocks the oil passage by spring force, stopping injection.



EPU111ZS3007

01–12 COOLING SYSTEM [L3]

COOLING SYSTEM OUTLINE [L3] 01–12–1
Features..... **01–12–1**
COOLING SYSTEM STRUCTURAL VIEW [L3] 01–12–1
COOLING SYSTEM FLOW DIAGRAM [L3] 01–12–2
COOLING SYSTEM CAP CONSTRUCTION [L3]..... 01–12–2
RADIATOR CONSTRUCTION [L3]..... 01–12–3
THERMOSTAT CONSTRUCTION/OPERATION [L3] 01–12–3
Construction..... **01–12–3**
Operation..... **01–12–3**
WATER PUMP CONSTRUCTION/OPERATION [L3] 01–12–4
Construction **01–12–4**
Operation **01–12–4**
COOLING FAN COMPONENT CONSTRUCTION [L3] 01–12–4
FAN CONTROL MODULE CONSTRUCTION/OPERATION [L3] 01–12–5
Construction **01–12–5**
Operation **01–12–5**
Fail-safe function.....**01–12–5**

COOLING SYSTEM OUTLINE [L3]

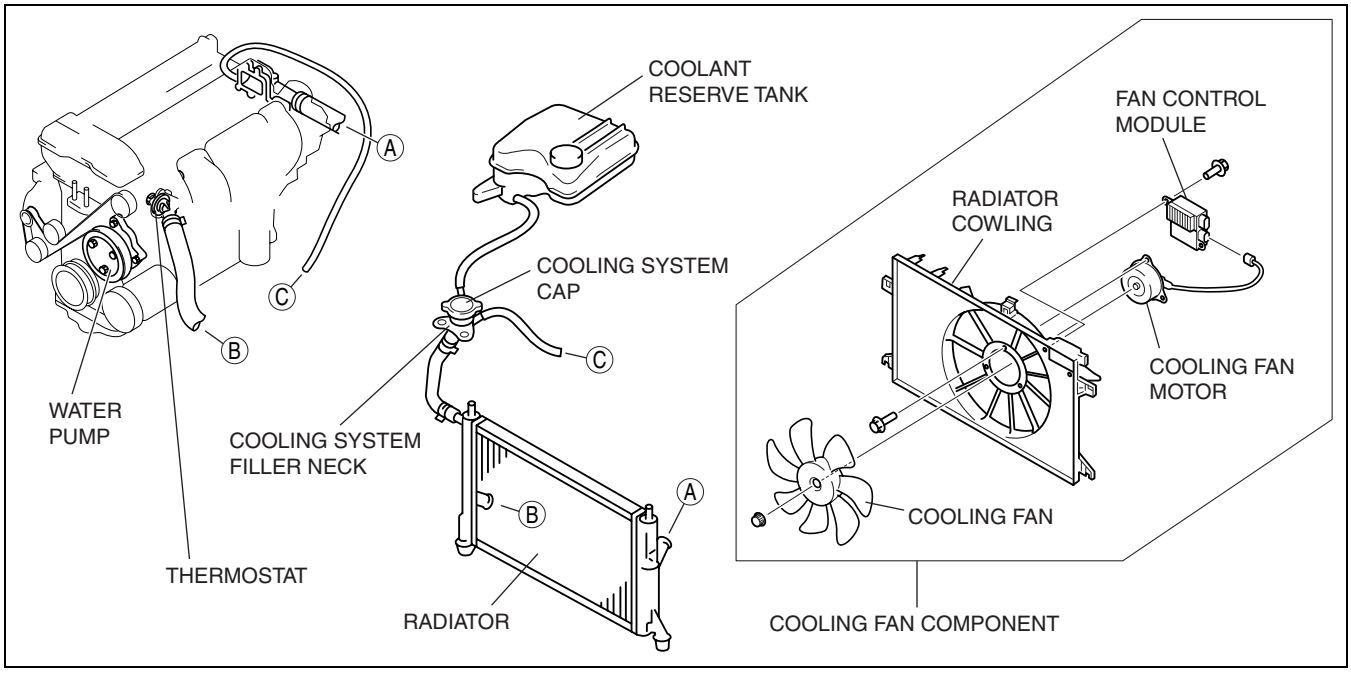
EPU011200000S01

Features

Reduced weight	• Cross flow type radiator with aluminum core and plastic tank adopted • Stainless steel thermostat with plastic thermostat cover adopted
Miniaturization	• Built-in type water pump adopted
Reduced engine noise and vibration	• Electric cooling fan adopted • Fan control module adopted
Reduced power consumption	• Fan control module adopted
Improved serviceability	• Longer-life new engine coolant (type FL22) adopted

COOLING SYSTEM STRUCTURAL VIEW [L3]

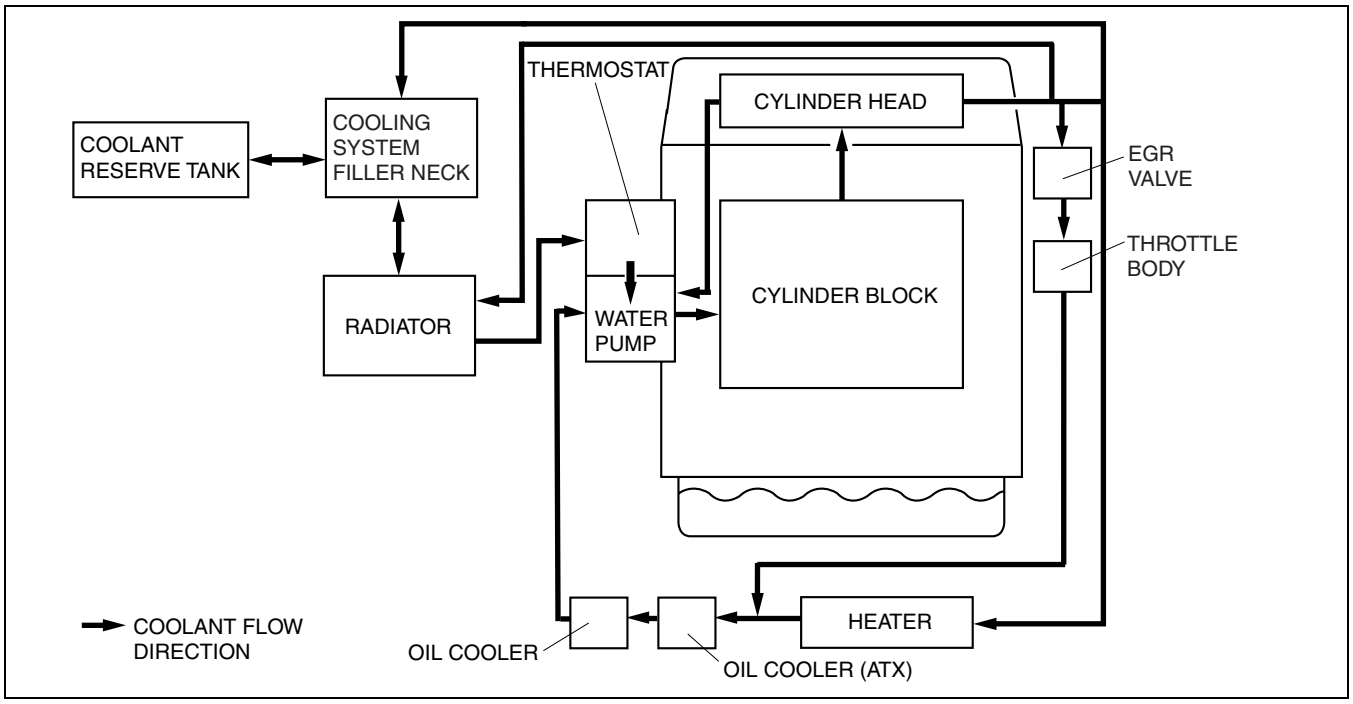
EPU011200000S02



EPU112ZS3001

COOLING SYSTEM FLOW DIAGRAM [L3]

EPU011200000S03

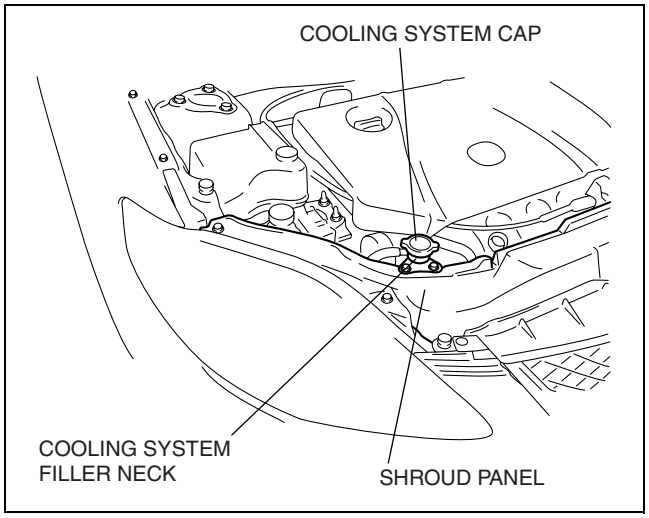


EPU112ZS3002

COOLING SYSTEM CAP CONSTRUCTION [L3]

EPU011215201S01

- A low-pressure type cap has been adopted for the cooling system cap.
- The cooling system cap is installed on the cooling system filler neck attached to the shroud panel.

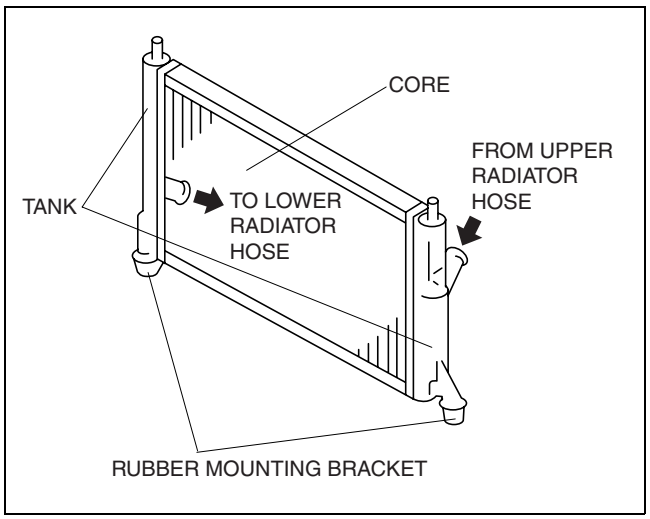


EPU112ZS3003

RADIATOR CONSTRUCTION [L3]

EPU011215200S01

- A cross-flow radiator with corrugated fins is used to improve cooling performance.
- The radiator tanks are made of plastic and the core is made of aluminum for weight reduction.
- Rubber-insulated mounting brackets are utilized on the underside of the radiator to decrease vibration.



EPU112ZS3004

THERMOSTAT CONSTRUCTION/OPERATION [L3]

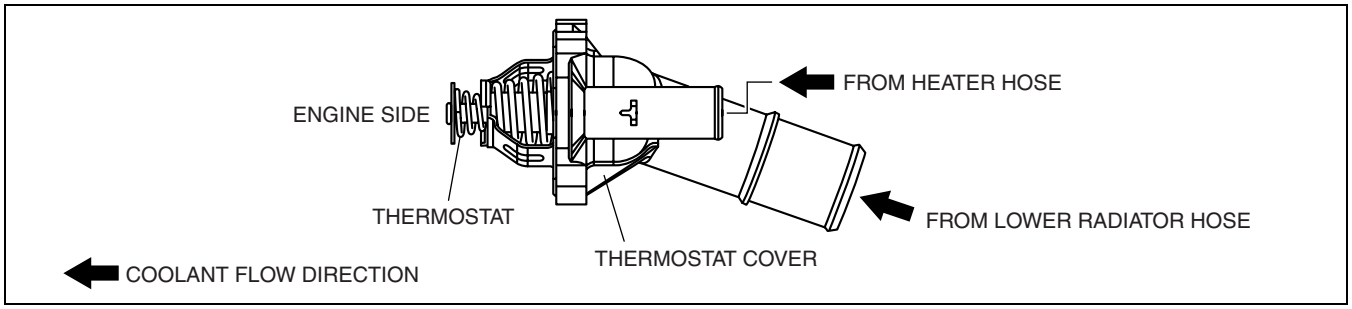
EPU011215171S01

Construction

- A wax-type thermostat with a jiggle-valve has been adopted.

Operation

- When the engine coolant temperature reaches 80—84 °C {176—183 °F}, the valve starts opening to allow engine coolant to flow from the radiator stabilizing the engine coolant temperature. When the engine coolant temperature decreases to approx. 75 °C {167 °F}, the valve closes to stop the engine coolant flow from the radiator.



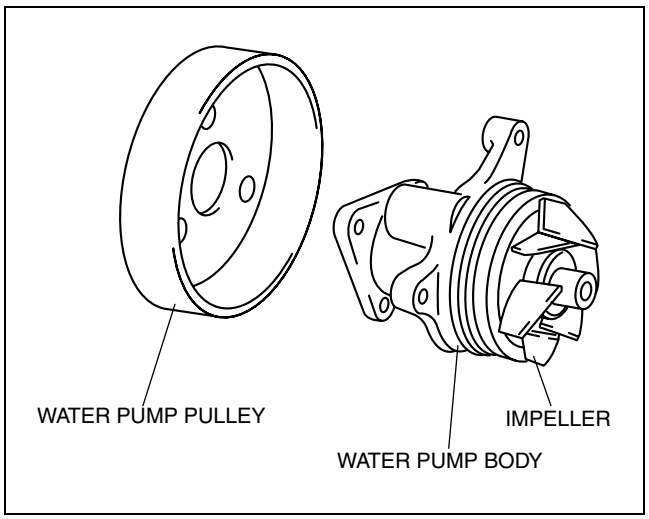
E5U112ZS5005

WATER PUMP CONSTRUCTION/OPERATION [L3]

EPU011215010S01

Construction

- The aluminum alloy water pump with the impeller built into the cylinder block has been adopted for size reduction.
- The water pump is not serviceable and must be replaced as a unit if it has a malfunction.



C3E0112T019

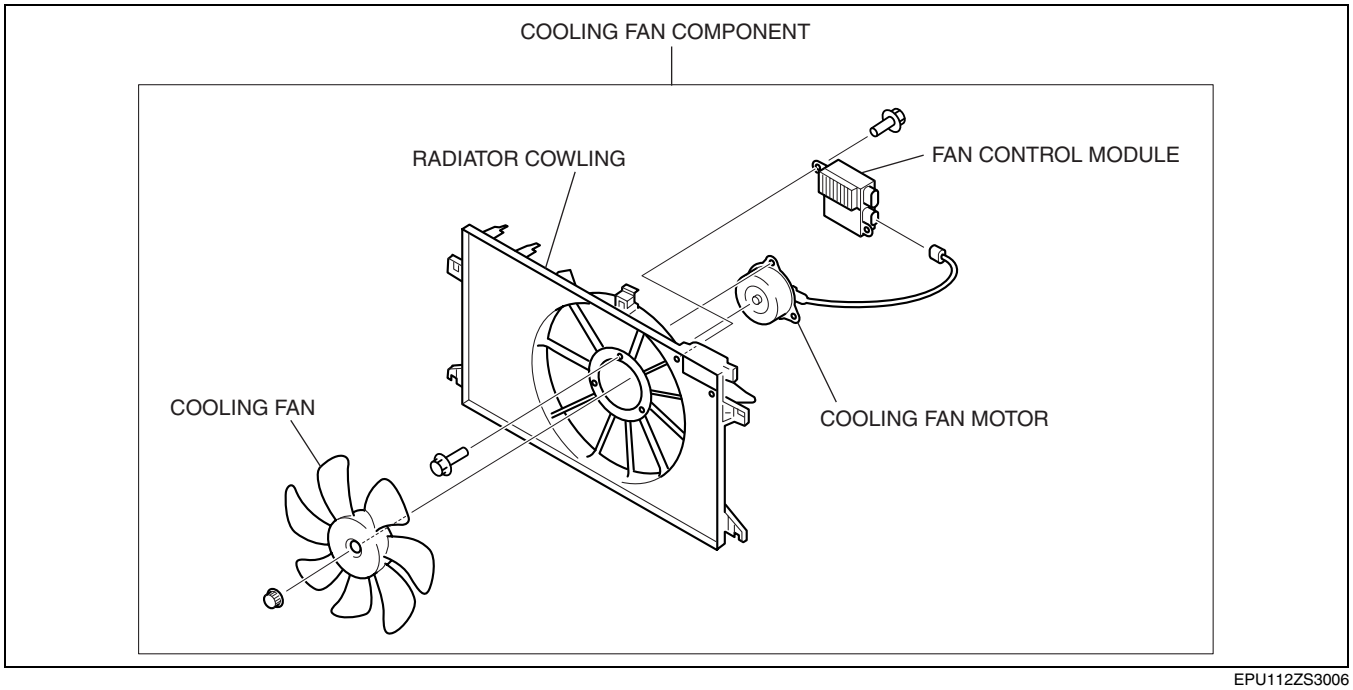
Operation

- The water pump is driven by the generator drive belt.

COOLING FAN COMPONENT CONSTRUCTION [L3]

EPU011215140S01

- The cooling fan component consists of the radiator cowling, cooling fan, cooling fan motor, and fan control module.
- Electric cooling fan, which operates according to the fan control signal sent from the PCM to the fan control module, has been adopted. Due to this, engine noise has been reduced and rapid engine warming-up is possible.
- The radiator cowling and cooling fan are made of plastic for weight reduction.



EPU112ZS3006

Cooling fan, cooling fan motor specification

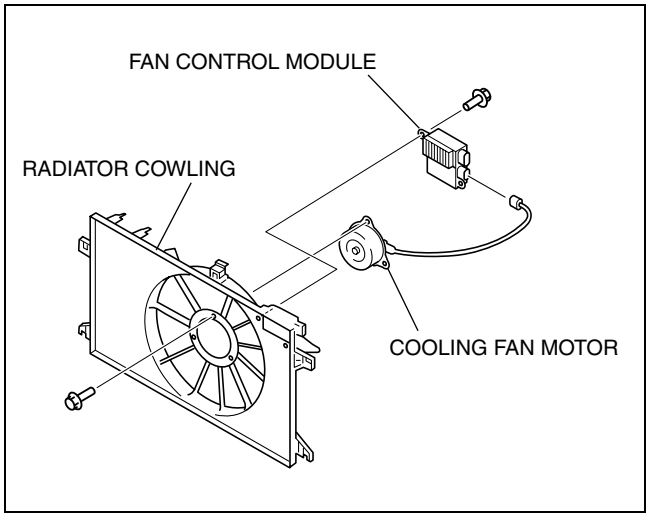
Item			Specification
Cooling fan	Number of blades		7
	Outer diameter	(mm {in})	360 {14.2}
Cooling fan motor output		(W)	240

FAN CONTROL MODULE CONSTRUCTION/OPERATION [L3]

EPU011215150S01

Construction

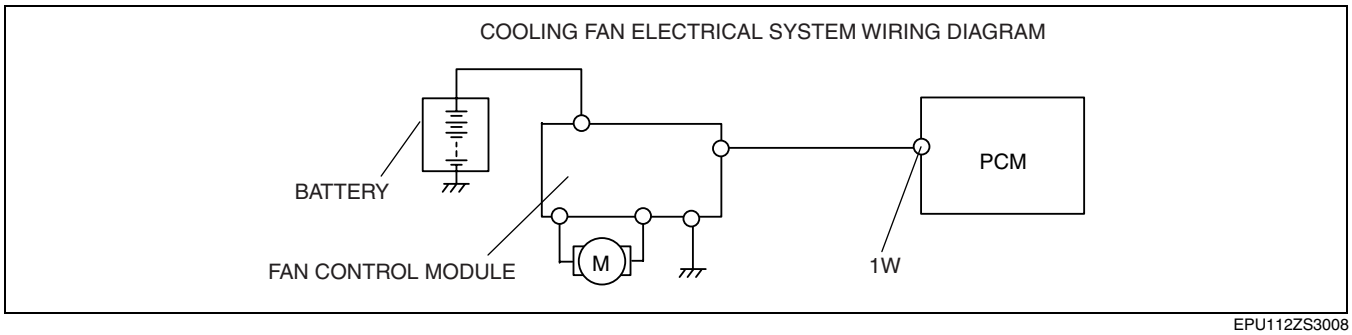
- Fan control module is installed on the radiator cowling.



EPU112ZS3007

Operation

- The fan control module drives the fan motor based on the cooling fan control signal sent by the PCM according to the following:
  - — Engine coolant temperature
  - — Vehicle speed
  - — Battery voltage
  - — Whether refrigerant pressure switch is on or off
  - — Whether magnetic clutch is on or off
- The fan control module allows continuously variable control of the fan motor rotation rate reducing fan operation noise and power consumption.



EPU112ZS3008

Fail-safe function

1. Over-current fail-safe
   - — If current to the fan motor exceeds the specified value, the cooling fan motor stops running for a specified period of time.
2. Over-heat fail-safe
   - — If the internal temperature of the fan control module exceeds a specified temperature, the cooling fan motor starts running at high speed. If the temperature continues to increase and exceeds a specified temperature, the cooling fan motor stops running. (When the ignition switch is turned off, it returns to normal operation.)
3. Input signal open circuit fail-safe
   - — If there is an open circuit in the wiring harness between the PCM and fan control module, the cooling fan motor runs at high speed.

01–13 INTAKE-AIR SYSTEM [L3]

INTAKE AIR SYSTEM OUTLINE [L3] 01–13–1
Features 01–13–1
INTAKE AIR SYSTEM STRUCTURAL VIEW [L3] 01–13–2
INTAKE AIR SYSTEM DIAGRAM [L3] 01–13–2
INTAKE AIR SYSTEM HOSE ROUTING DIAGRAM [L3] 01–13–3
RESONANCE CHAMBER FUNCTION [L3] 01–13–4
AIR CLEANER CONSTRUCTION [L3] 01–13–4
THROTTLE BODY FUNCTION [L3] 01–13–4
THROTTLE BODY CONSTRUCTION/OPERATION [L3] 01–13–5
Construction 01–13–5
Operation 01–13–5
INTAKE MANIFOLD CONSTRUCTION [L3] 01–13–5
VARIABLE INTAKE AIR SYSTEM FUNCTION [L3] 01–13–6
VARIABLE INTAKE AIR SYSTEM STRUCTURE [L3] 01–13–6
VARIABLE INTAKE AIR SYSTEM OPERATION [L3] 01–13–7
At engine speed less than 4,600 rpm (variable intake air shutter valve is closed) 01–13–7
At engine speed of 4,600 rpm or more (variable intake air shutter valve is open) 01–13–7
VARIABLE TUMBLE SYSTEM FUNCTION [L3] 01–13–7
VARIABLE TUMBLE SYSTEM STRUCTURE [L3] 01–13–8
VARIABLE TUMBLE SYSTEM OPERATION [L3] 01–13–8
Engine speed approx. 3,750 rpm or more and engine coolant temperature approx. 60×C {140×F} and more (variable tumble shutter valve is closed) 01–13–8
VARIABLE INTAKE AIR SOLENOID VALVE FUNCTION [L3] 01–13–8
VARIABLE INTAKE AIR SOLENOID VALVE CONSTRUCTION/OPERATION [L3] 01–13–9
Construction 01–13–9
Operation 01–13–9
VARIABLE TUMBLE SOLENOID VALVE FUNCTION [L3] 01–13–9
VARIABLE TUMBLE SOLENOID VALVE CONSTRUCTION/OPERATION [L3] 01–13–9
Construction 01–13–9
Operation 01–13–9
VARIABLE INTAKE AIR SHUTTER VALVE ACTUATOR FUNCTION [L3] 01–13–9
VARIABLE INTAKE AIR SHUTTER VALVE ACTUATOR CONSTRUCTION/OPERATION [L3] 01–13–10
Construction 01–13–10
Operation 01–13–10
VARIABLE TUMBLE SHUTTER VALVE ACTUATOR FUNCTION [L3] 01–13–10
VARIABLE TUMBLE SHUTTER VALVEACTUATOR CONSTRUCTION/OPERATION [L3] 01–13–10
Construction 01–13–10
Operation 01–13–10

INTAKE AIR SYSTEM OUTLINE [L3]

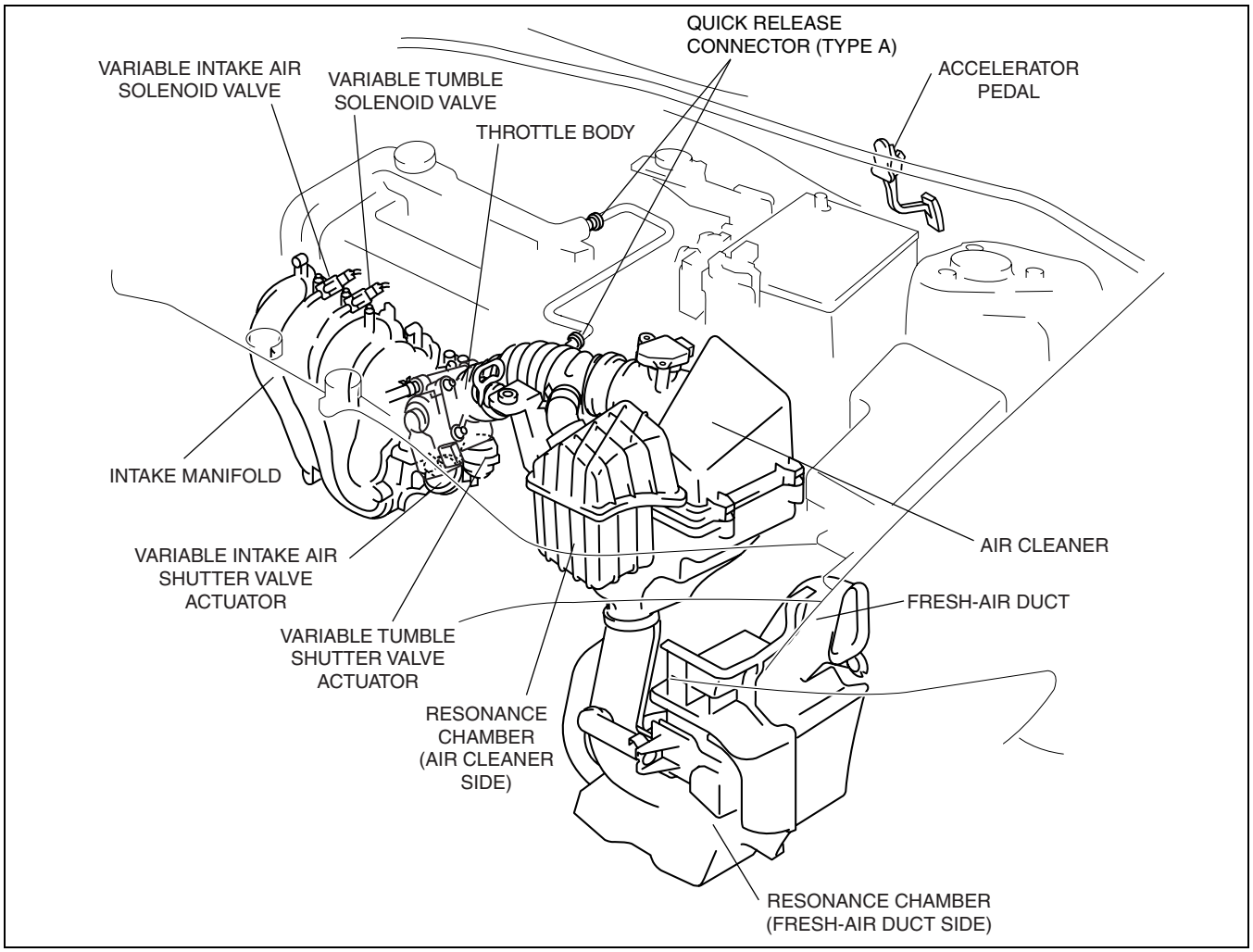
EPU011300000S01

Features

Improved engine torque	• Variable intake air system adopted
Improved noise reduction	• Resonance chamber adopted
Improved emission gas purification	• Variable tumble system adopted

INTAKE AIR SYSTEM STRUCTURAL VIEW [L3]

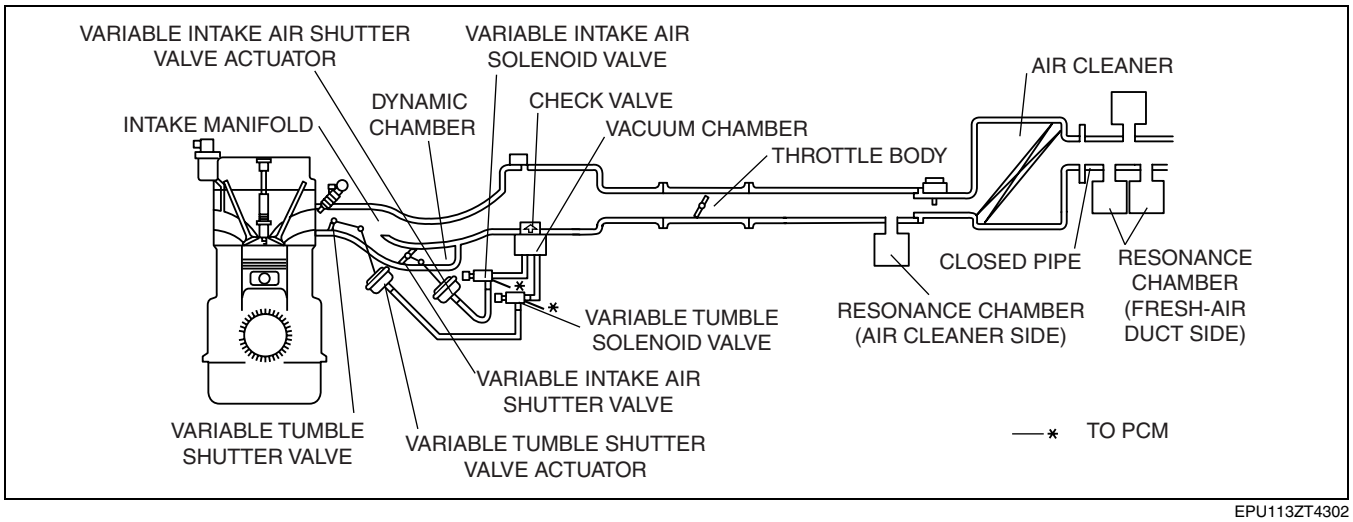
EPU011300000S03



EPU113ZT4301

INTAKE AIR SYSTEM DIAGRAM [L3]

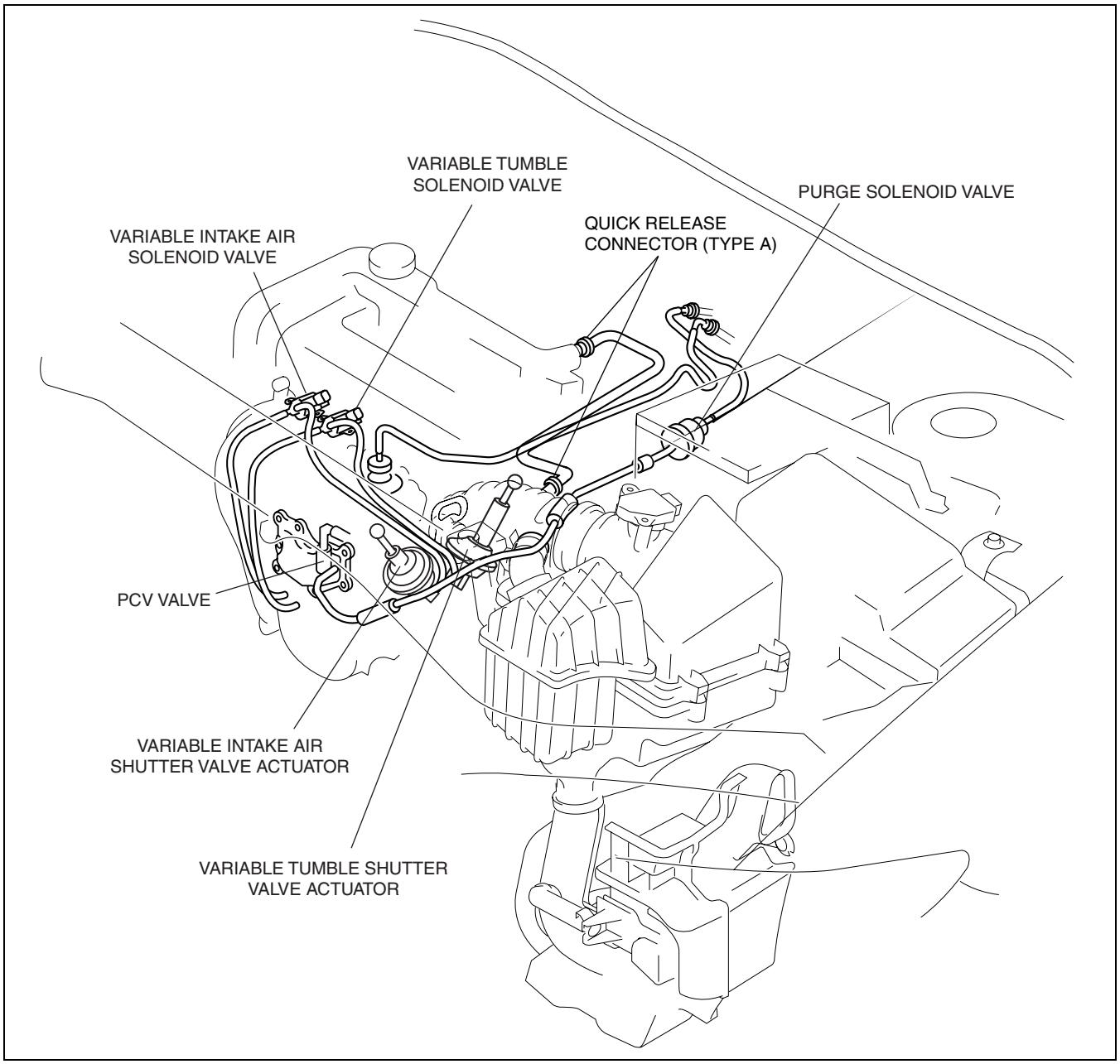
EPU011300000S04



EPU113ZT4302

INTAKE AIR SYSTEM HOSE ROUTING DIAGRAM [L3]

EPU011300000S06

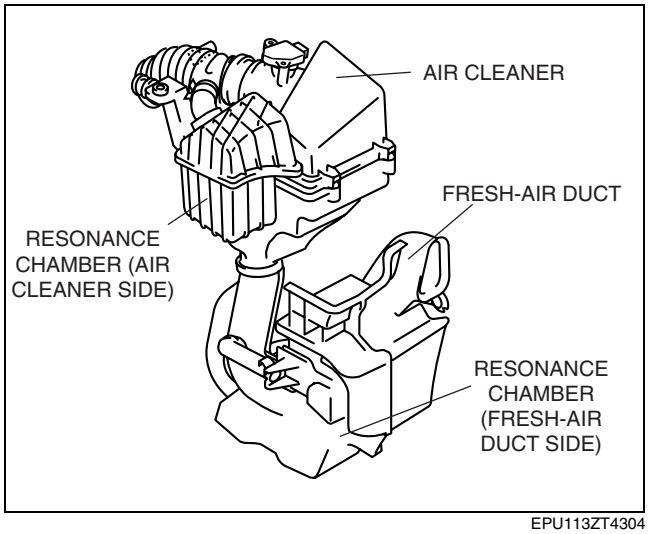


EPU113ZT4303

RESONANCE CHAMBER FUNCTION [L3]

EPU011313191S01

- Installed on the fresh air duct and air cleaner to reduce intake air noise.

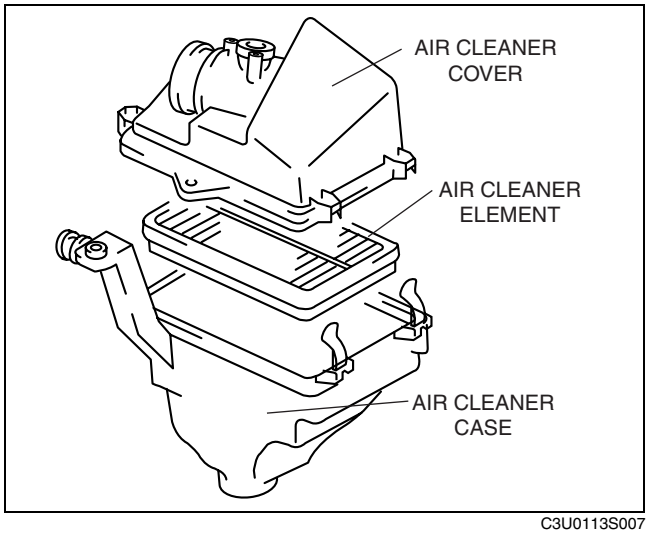


EPU113ZT4304

AIR CLEANER CONSTRUCTION [L3]

EPU011313300S01

- Mainly composed of the air cleaner case, air cleaner cover, and air cleaner element.
- Non-woven fabric (dry type) element has been adopted.



C3U0113S007

THROTTLE BODY FUNCTION [L3]

EPU011313640S01

- A throttle body with a single, electronic-control, motor-operated valve has been adopted in place of the previous cable-controlled throttle valve type.
- The PCM determines the throttle valve opening angle based on driving conditions, and operates the motor accordingly.
- The throttle valve opening angle is feedback to the PCM by the TP sensor.

THROTTLE BODY CONSTRUCTION/OPERATION [L3]

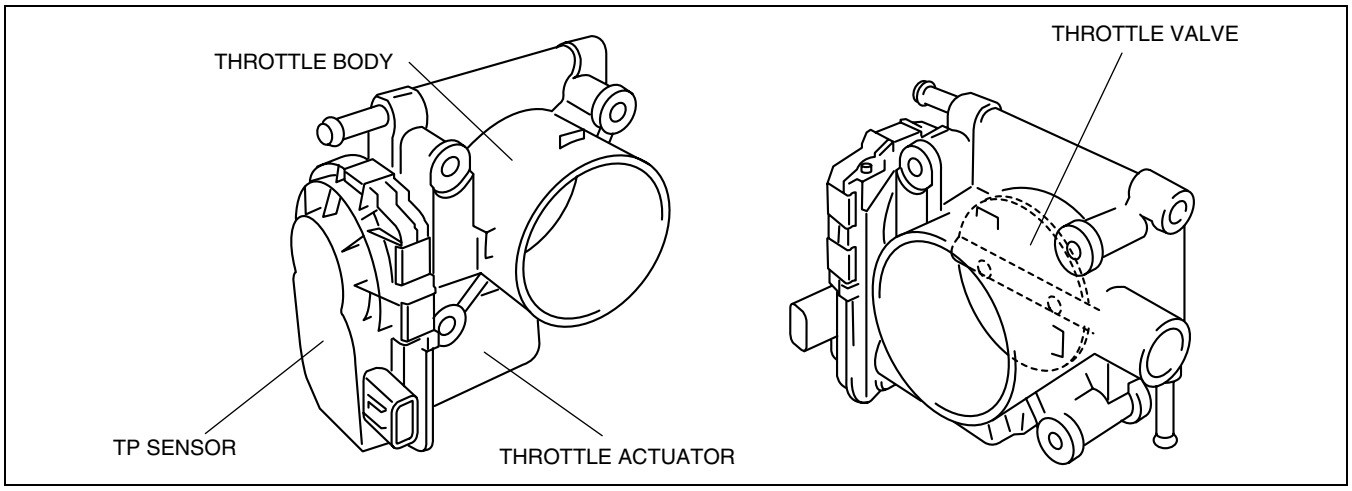
EPU011313640S02

Construction

- The throttle body mainly consists of the throttle valve, TP sensor, and throttle actuator.
- A low-energy consuming DC motor has been adopted for the throttle actuator to improve response performance.
- To keep moisture from freezing inside the throttle body, and thus prevent the throttle valve from getting stuck, engine coolant is circulated through the throttle body.
- To prevent the possible loss of PCM data and throttle body settings, the throttle body cannot be disassembled.

Operation

- When the throttle actuator is not energized, the throttle valve is maintained slightly open due to force of the return spring.

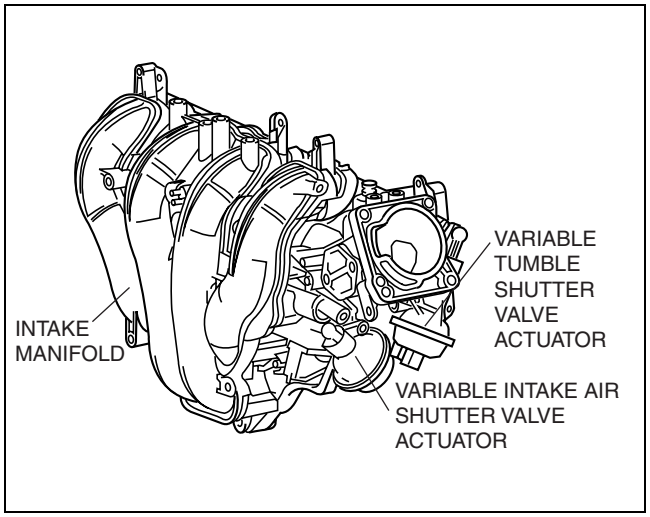


C3U0113S008

INTAKE MANIFOLD CONSTRUCTION [L3]

EPU011313100S01

- The intake manifold mainly consists of the variable intake air shutter valve actuator and variable tumble shutter valve actuator.
- Made of hard plastic for weight reduction.

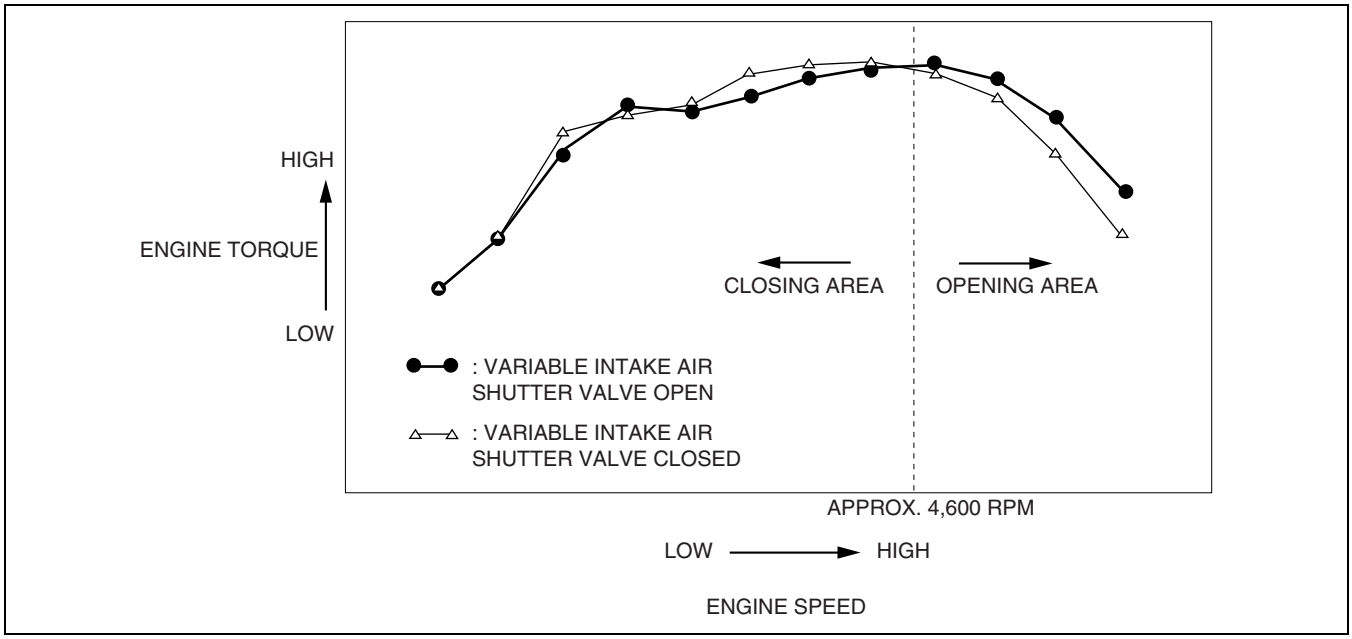


EPU0113S009

VARIABLE INTAKE AIR SYSTEM FUNCTION [L3]

EPU011300020S02

- The variable intake air system maintains high torque from the low to high engine speed ranges.
- Changes the effective intake manifold length when the engine speed borders on **4,600 rpm** to enhance the inertia charging effect. As a result, higher torque is obtained in all ranges.
- For the variable intake air control, refer to CONTROL SYSTEM, Variable Intake-Air Control (See 01–40–15 VARIABLE INTAKE AIR CONTROL OUTLINE [L3].)



EPU0113S202

Inertia charging effect

— Airflow in the intake air pipe pulsates according to the opening and closing of the intake valve. When the intake valve closes, intake air is compressed near the intake valve due to inertia force. The resulting pressure wave is reflected to the throttle valve side by the intake valve and the wave is then reflected back to the intake valve side when it reaches the dynamic chamber. The effective intake manifold length is controlled so that the pressure wave returns to the intake valve at the intake stroke. Due to this, air intake volume increases, resulting in higher torque.

Effective intake manifold length

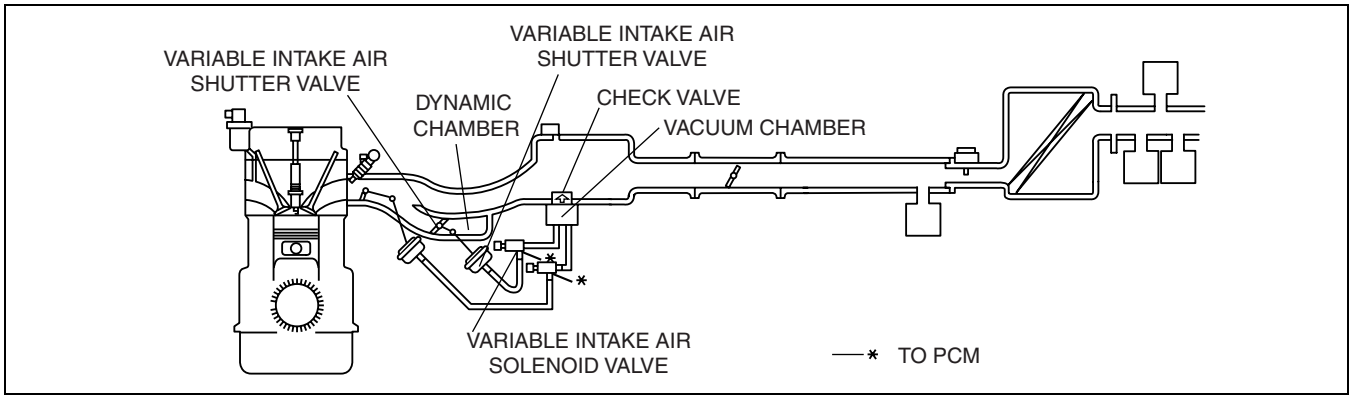
— The effective intake manifold length is the length from the intake valve to the dynamic chamber.

— The effective intake manifold length changes according to the positioning of the reflected pressure wave transmitted through the intake air pipe by the opening and closing of the variable intake air shutter valve in the intake manifold.

VARIABLE INTAKE AIR SYSTEM STRUCTURE [L3]

EPU011300020S03

- Mainly consists of the variable intake air solenoid valve, variable intake air shutter valve, variable intake air shutter valve actuator and vacuum chamber.



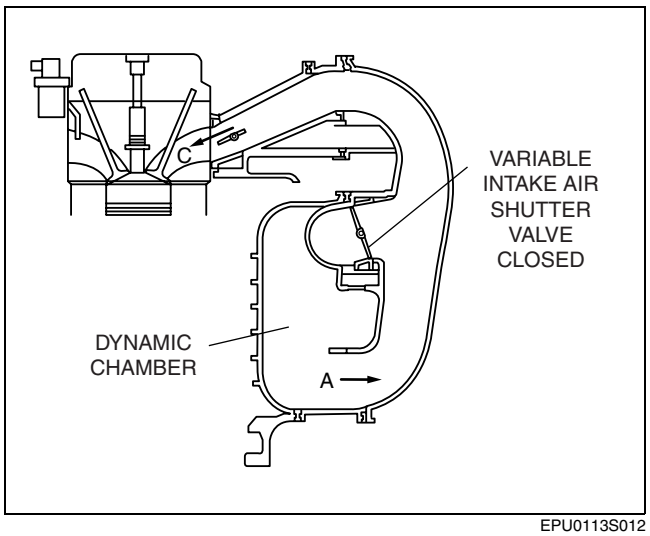
EPU113ZT4305

VARIABLE INTAKE AIR SYSTEM OPERATION [L3]

EPU011300020S05

At engine speed less than 4,600 rpm (variable intake air shutter valve is closed)

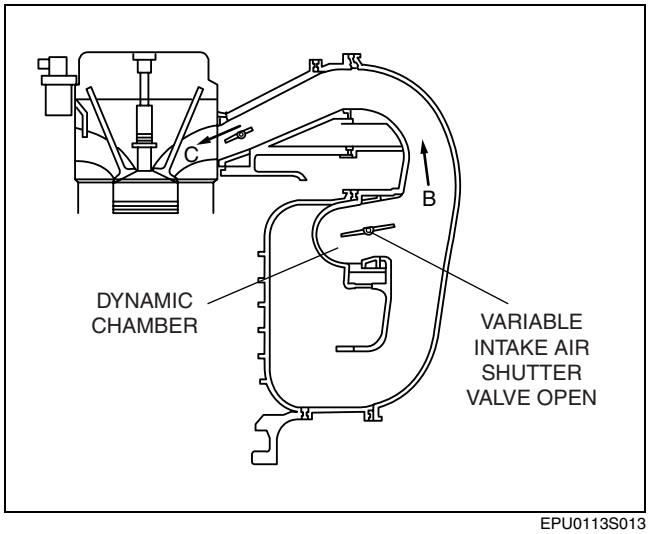
- Intake manifold vacuum is applied to the variable intake air shutter valve by the operation of the variable intake air solenoid valve, closing the variable intake air shutter valve.
- Under this condition, the effective intake manifold length is from the intake valve to the dynamic chamber (A—C). An inertia charging effect is obtained due to this elongated intake manifold length, air intake volume increases, and higher torque is obtained at low to medium engine speeds.



EPU0113S012

At engine speed of 4,600 rpm or more (variable intake air shutter valve is open)

- The variable intake air shutter valve is open.
- Under this condition, the effective intake manifold length is from the intake valve to the chamber (B—C). The intake air inertia effect is obtained at high engine speeds due to this shortened intake air pipe, increasing intake airflow amount in the cylinder, and higher torque at high engine speeds is obtained.



EPU0113S013

VARIABLE TUMBLE SYSTEM FUNCTION [L3]

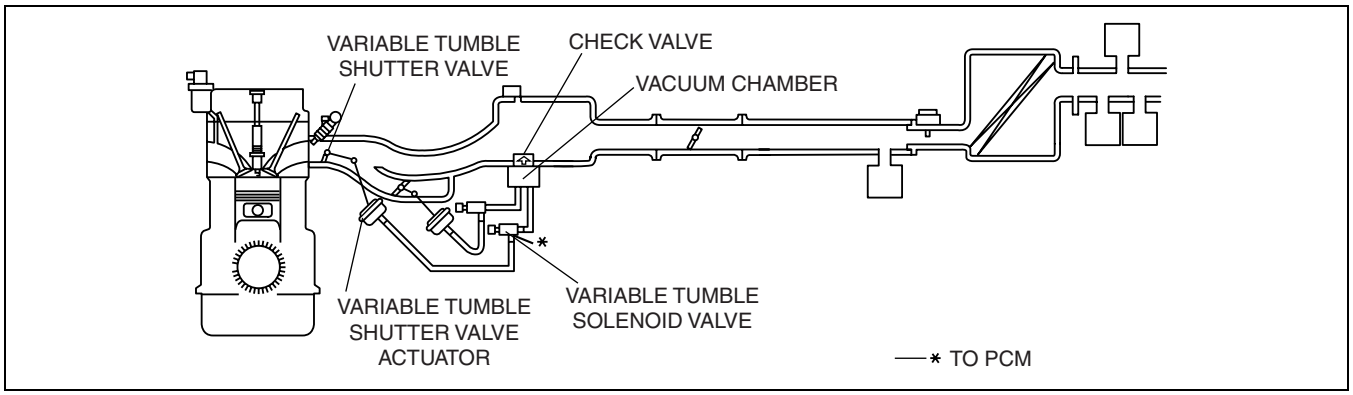
EPU011300050S01

- The variable tumble system functions to lower emissions at cold-engine start.
- At cold-engine start, the variable tumble system increases intake airflow speed by closing the shutter valve and narrowing the intake passage. As a result, the air-fuel mixture quality from the injector is improved. Additionally, the creation of a powerful air tumble in the combustion chamber promotes the atomization of the air-fuel mixture. Due to this, exhaust emission efficiency is improved.
- For the variable tumble control, refer to CONTROL SYSTEM, Variable Tumble Control. (See01–40–16 VARIABLE TUMBLE CONTROL OUTLINE [L3].)

VARIABLE TUMBLE SYSTEM STRUCTURE [L3]

EPU011300050S02

- Mainly consists of the variable tumble solenoid valve, variable tumble shutter valve, variable tumble shutter valve actuator, and vacuum chamber.



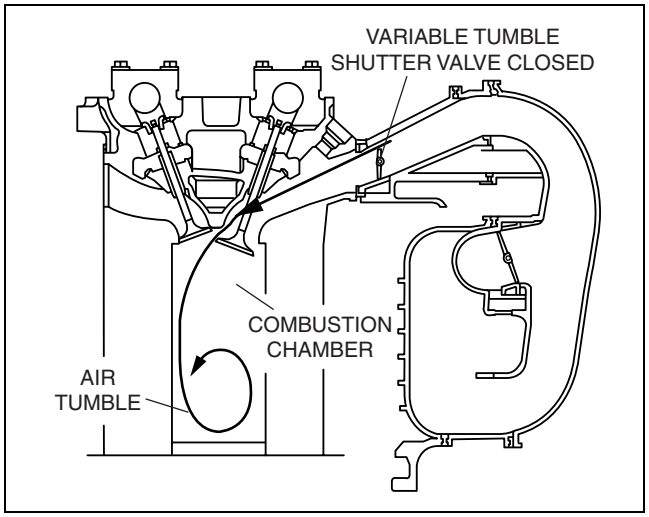
EPU113ZT4306

VARIABLE TUMBLE SYSTEM OPERATION [L3]

EPU011300050S04

Engine speed approx. 3,750 rpm or more and engine coolant temperature approx. 60°C {140°F} and more (variable tumble shutter valve is closed)

- Intake manifold vacuum is applied to the variable tumble shutter valve actuator by the operation of the variable tumble solenoid valve, closing the variable tumble shutter valve. At this time, the intake passage is narrower than normal, increasing intake airflow speed and also creating a powerful air tumble in the combustion chamber.



C3U0113S015

VARIABLE INTAKE AIR SOLENOID VALVE FUNCTION [L3]

EPU011318742S01

- Switches the intake manifold vacuum passage between the intake manifold and the actuator.

VARIABLE INTAKE AIR SOLENOID VALVE CONSTRUCTION/OPERATION [L3]

EPU011318742S03

Construction

- Mainly composed of the solenoid coil, spring, and plunger.

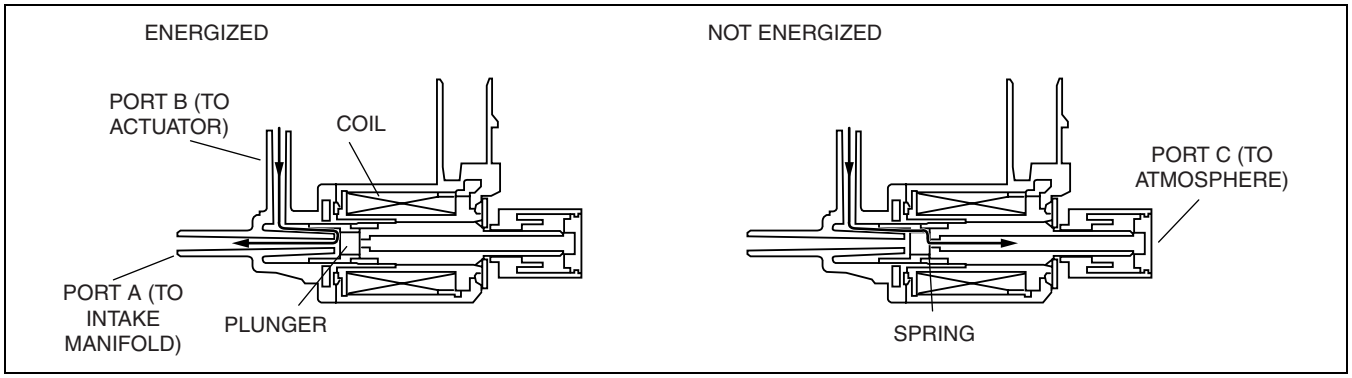
Operation

Energized

- The solenoid coil magnetizes, pulling the plunger. The passage between A and B ports opens due to the plunger being pulled, and intake manifold vacuum is applied to the actuator.

Not energized

- The intake manifold vacuum passage is blocked, and the passage between ports B and C opens, depressurizing the actuator.



C3U0113S017

VARIABLE TUMBLE SOLENOID VALVE FUNCTION [L3]

EPU011318745S01

- Switches the intake manifold vacuum passage between the intake manifold and the actuator.

VARIABLE TUMBLE SOLENOID VALVE CONSTRUCTION/OPERATION [L3]

EPU011318745S03

Construction

- Mainly composed of the solenoid coil, spring, and plunger.

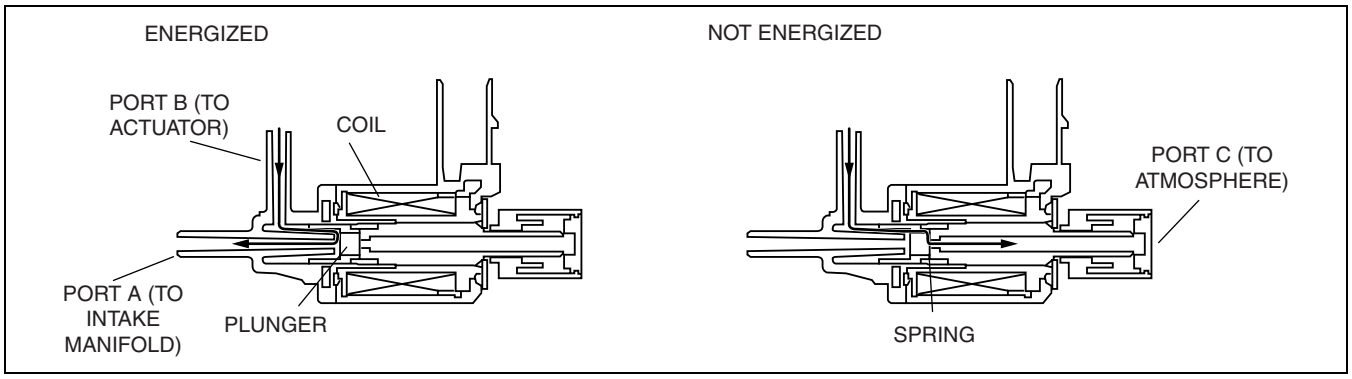
Operation

Energized

- The solenoid coil magnetizes, pulling the plunger. The passage between A and B ports opens due to the plunger being pulled, and intake manifold vacuum is applied to the actuator.

Not energized

- The intake manifold vacuum passage is blocked, and the passage between ports B and C opens, depressurizing the actuator.



C3U0113S017

VARIABLE INTAKE AIR SHUTTER VALVE ACTUATOR FUNCTION [L3]

EPU011320132S01

- Opens and closes the shutter valve.

VARIABLE INTAKE AIR SHUTTER VALVE ACTUATO-R CONSTRUCTION/OPERATION [L3]

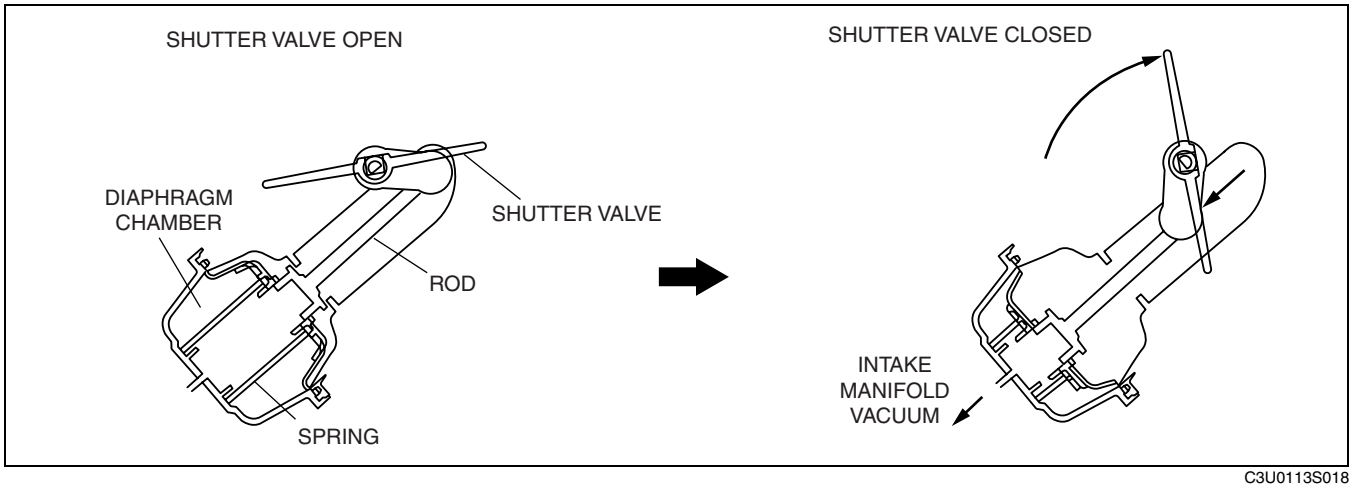
EPU011320132S02

Construction

- Mainly consists of the body, rod and diaphragm chamber spring.

Operation

- Normally, the spring force presses against the rod, keeping the shutter valve open. When vacuum is applied to the diaphragm chamber from the intake manifold, the rod is pulled, closing the shutter valve.



C3U0113S018

VARIABLE TUMBLE SHUTTER VALVE ACTUATOR FUNCTION [L3]

EPU011320135S01

- Opens and closes the shutter valve.

VARIABLE TUMBLE SHUTTER VALVE ACTUATOR CONSTRUCTION/OPERATION [L3]

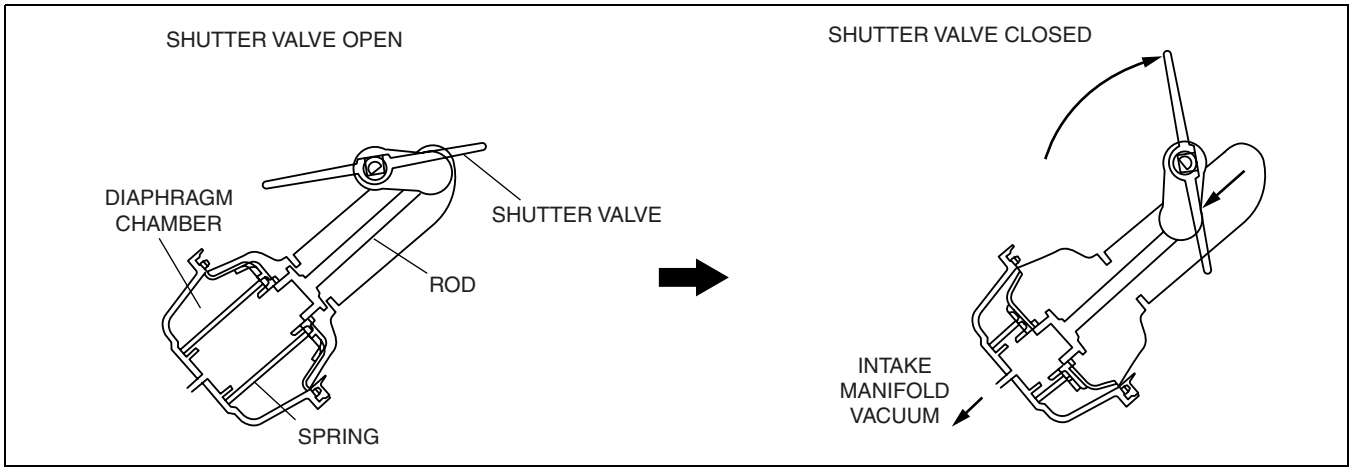
EPU011320135S02

Construction

- Mainly consists of the body, rod and diaphragm chamber spring.

Operation

- Normally, the spring force presses against the rod, keeping the shutter valve open. When vacuum is applied to the diaphragm chamber from the intake manifold, the rod is pulled, closing the shutter valve.



C3U0113S018

01–14 FUEL SYSTEM [L3]

FUEL SYSTEM OUTLINE [L3] 01–14–1
Features **01–14–1**
Specification **01–14–1**
FUEL SYSTEM STRUCTURAL VIEW [L3] 01–14–2
Engine Compartment Side **01–14–2**
Fuel Tank Side **01–14–3**
FUEL SYSTEM FLOW DIAGRAM [L3] 01–14–3
Fuel Flow **01–14–3**
RETURNLESS FUEL SYSTEM OUTLINE [L3] 01–14–3
RETURNLESS FUEL SYSTEM OPERATION [L3] 01–14–4
FUEL TANK CONSTRUCTION [L3] 01–14–4
NONRETURN VALVE FUNCTION [L3] 01–14–4
NONRETURN VALVE CONSTRUCTION/OPERATION [L3] 01–14–4
Type: Built Into Fuel Tank **01–14–4**
Type: Built Into Fuel-fille Pipe **01–14–4**
FUEL PUMP UNIT FUNCTION [L3] 01–14–4
FUEL PUMP UNIT CONSTRUCTION/OPERATION [L3] 01–14–5
Fuel Pump Unit **01–14–5**
Pressure Regulator **01–14–5**
QUICK RELEASE CONNECTOR (FUEL SYSTEM) FUNCTION [L3] 01–14–5
QUICK RELEASE CONNECTOR (FUEL SYSTEM) CONSTRUCTION/OPERATION [L3] 01–14–6
Type A **01–14–6**
Type B **01–14–7**
FUEL INJECTOR FUNCTION [L3] 01–14–7
FUEL INJECTOR CONSTRUCTION/OPERATION [L3] 01–14–8
FUEL PUMP RELAY FUNCTION [L3] 01–14–8

FUEL SYSTEM OUTLINE [L3]

EPU011400000S01

Features

Improved serviceability	• Nylon tubes adopted for fuel hoses in the engine compartment and around the fuel tank, and quick release connectors adopted for joints
Reduction of evaporative gas	• Returnless fuel system adopted

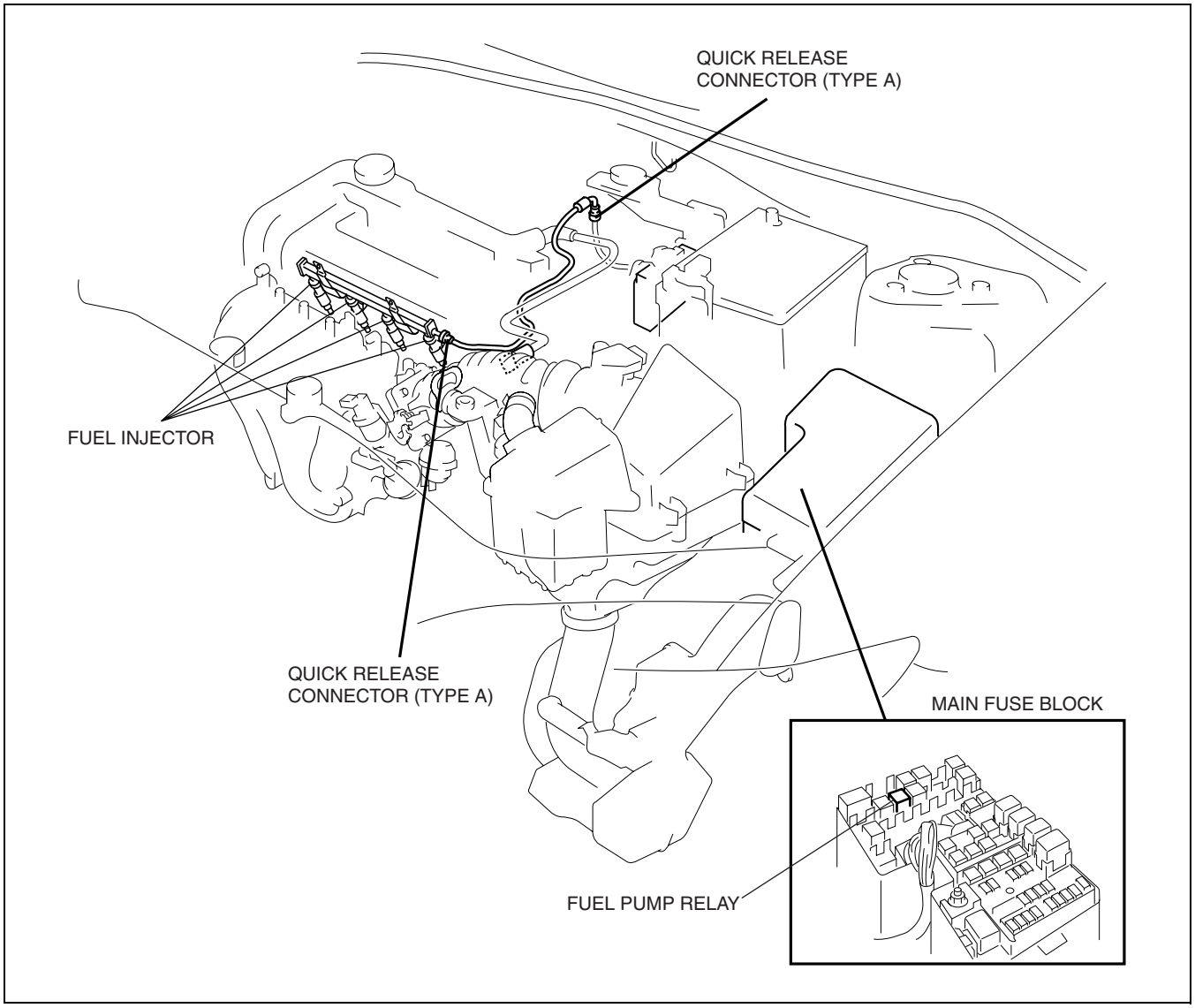
Specification

Item		Specification
Injector	Type	Hi-ohmic
	Type of fuel delivery	Top-feed
	Type of drive	Voltage
Pressure regulator control pressure (kPa {kgf/cm^2, psi})		Approx. 390 {3.98, 56.6}
Fuel pump type		Electric
Fuel tank capacity (L {US gal, Imp gal})		60 {16, 13}
Fuel type		Regular unleaded fuel

FUEL SYSTEM STRUCTURAL VIEW [L3]

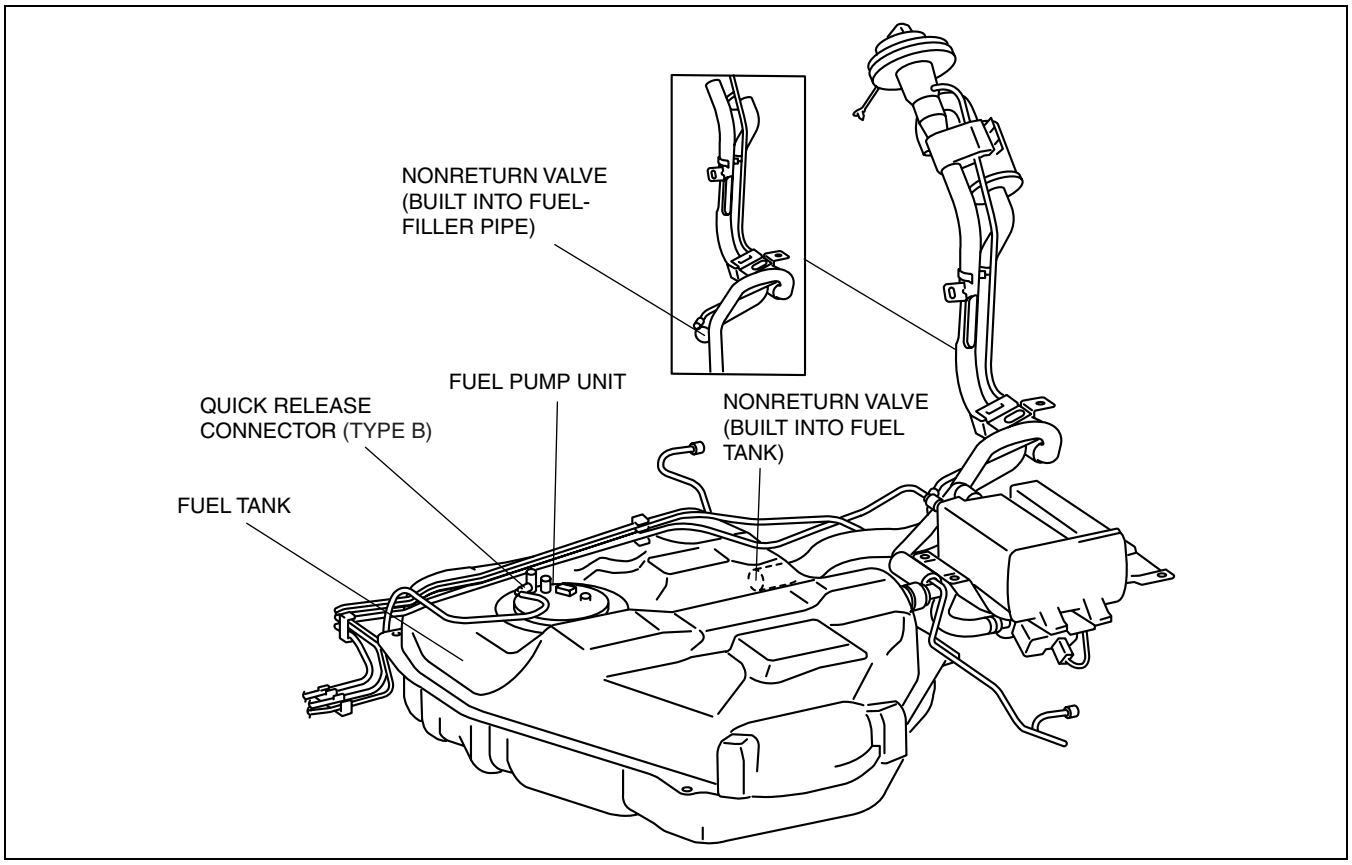
EPU011400000S02

Engine Compartment Side



EPU114ZT4301

Fuel Tank Side

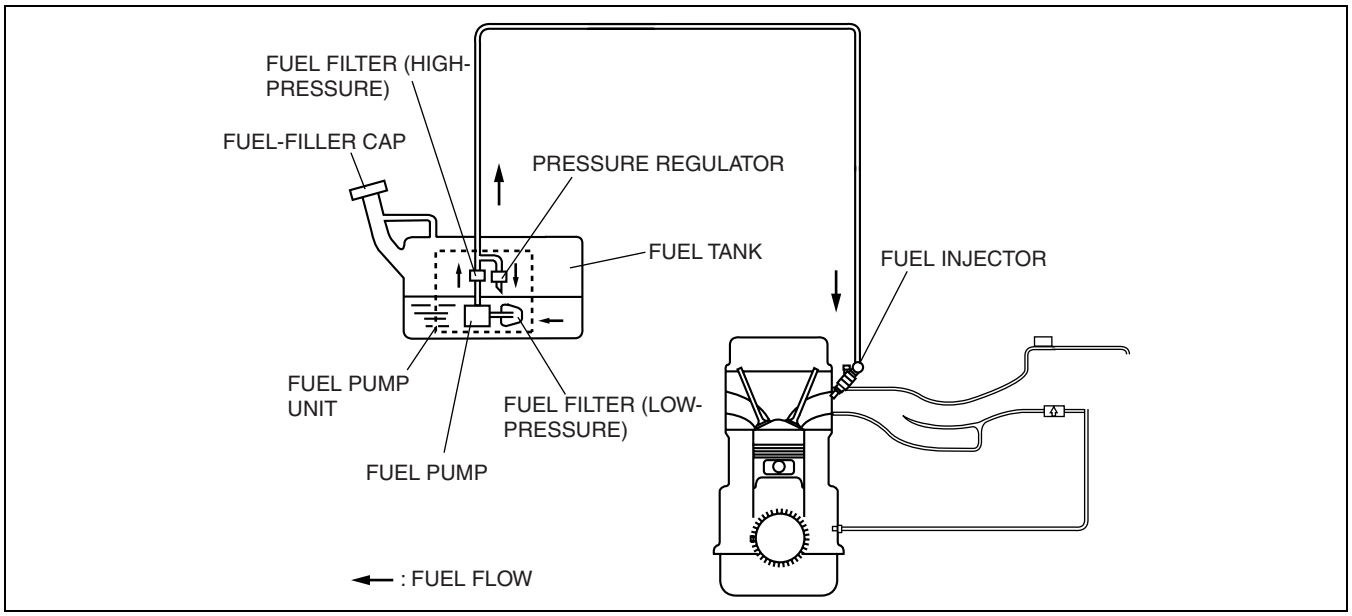


EPU114ZT4501

FUEL SYSTEM FLOW DIAGRAM [L3]

EPU011400000S03

Fuel Flow



EPU114ZT4302

RETURNLESS FUEL SYSTEM OUTLINE [L3]

EPU011400000S04

- The returnless fuel system reduces fuel evaporation in the fuel tank.
- The pressure regulator located in the fuel tank prevents fuel return from the engine compartment side, thereby maintaining a low fuel temperature in the fuel tank. Due to this, formation of evaporative gas produced by a rise in fuel temperature is suppressed.
- The pressure regulator is built into the fuel pump unit in the fuel tank.

RETURNLESS FUEL SYSTEM OPERATION [L3]

EPU011400000S05

- Fuel in the fuel tank is pumped out through the fuel filter (low-pressure) by the fuel pump, filtered by the fuel filter (high-pressure), and then regulated to a specified pressure by the pressure regulator.
- The pressure regulated fuel is sent to the fuel injectors.
- After pressure regulation, unnecessary fuel is returned from the pressure regulator to inside the fuel pump unit.

FUEL TANK CONSTRUCTION [L3]

EPU011442110S01

- Capacity is **60 L {16 US gal, 13 Imp gal}**.
- A rollover valve and a fuel shut-off valve are built-in. For the rollover valve and the fuel shut-off valve, refer to the emission system.
- Made of hard plastic for weight reduction.

NONRETURN VALVE FUNCTION [L3]

EPU011442270S01

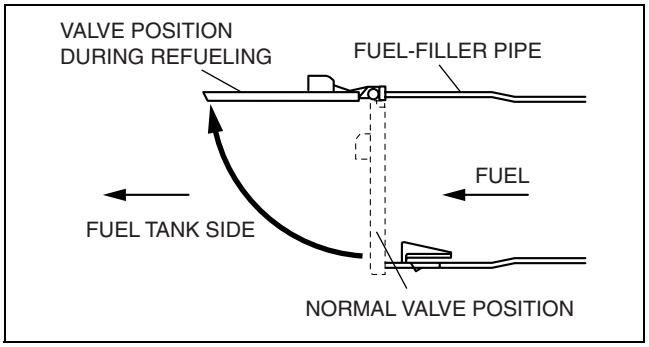
- Prevents fuel from spouting out due to evaporative gas pressure in the fuel tank when removing the fuel-filler cap.

NONRETURN VALVE CONSTRUCTION/OPERATION [L3]

EPU011442270S02

Type: Built Into Fuel Tank

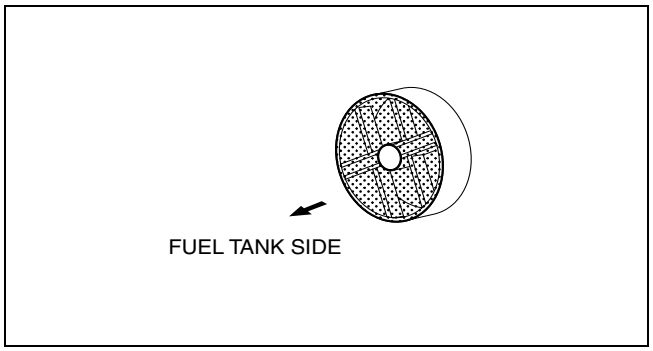
- A single valve type has been adopted.
- Installed on the fuel tank.
- Under normal conditions, this valve is closed as shown by the dotted line. When refueling, it opens to the position shown by the solid line due to the flow of fuel. When refueling is finished, the valve returns to the normal valve position due to spring force.



EPU114ZT4303

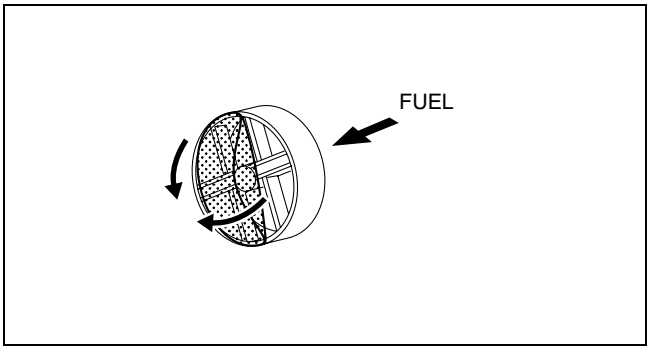
Type: Built Into Fuel-fille Pipe

- The nonreturn valve is installed to the end of the fuel-filler pipe.



EPU114ZW9901

- The film opens in the specified direction by the passage of the fuel.



EPU114ZW9902

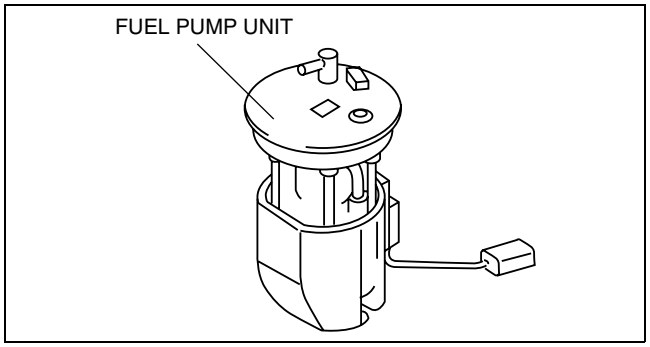
FUEL PUMP UNIT FUNCTION [L3]

EPU011413350S01

- The fuel pump suctions fuel from the fuel tank and pumps it to the fuel distributor.

FUEL PUMP UNIT CONSTRUCTION/OPERATION [L3]

EPU011413350S02



EPU114ZT4601

Fuel Pump Unit

- Mainly consists of a fuel filter (high-pressure), pressure regulator, fuel pump, fuel reserve cup, and fuel filter (low-pressure).
- A pressure regulator is built-in due to the adoption of a returnless fuel system.
- A hard-plastic fuel pump unit, with an integrated fuel filter (high-pressure) and fuel pump, has been adopted to simplify the fuel line.
- Fuel in the fuel reserve cup is suctioned out through the fuel filter (low-pressure) by the fuel pump, and pumped to the fuel filter (high-pressure). Return fuel is sent back to the fuel reserve cup or the fuel tank through the jet pump.
- If return fuel pressure exceeds the specified value, the relief valve discharges return fuel into the fuel pump unit without passing it through the venturi. Due to this, return fuel pressure is maintained below the specified value.

Pressure Regulator

- Built into the fuel pump unit due to adoption of a returnless fuel system.
- Mainly consists of a spring, release valve and diaphragm.
- Pressurizes fuel discharged by the fuel pump to **approx. 390 kPa {3.98 kgf/cm^2, 56.6 psi}** using the spring, diaphragm and release valve, and then pumps it to the fuel distributor.
- If fuel pressure exceeds **approx. 390 kPa {3.98 kgf/cm^2, 56.6 psi}**, the release valve opens to discharge unnecessary fuel pressure.

QUICK RELEASE CONNECTOR (FUEL SYSTEM) FUNCTION [L3]

EPU011442692S03

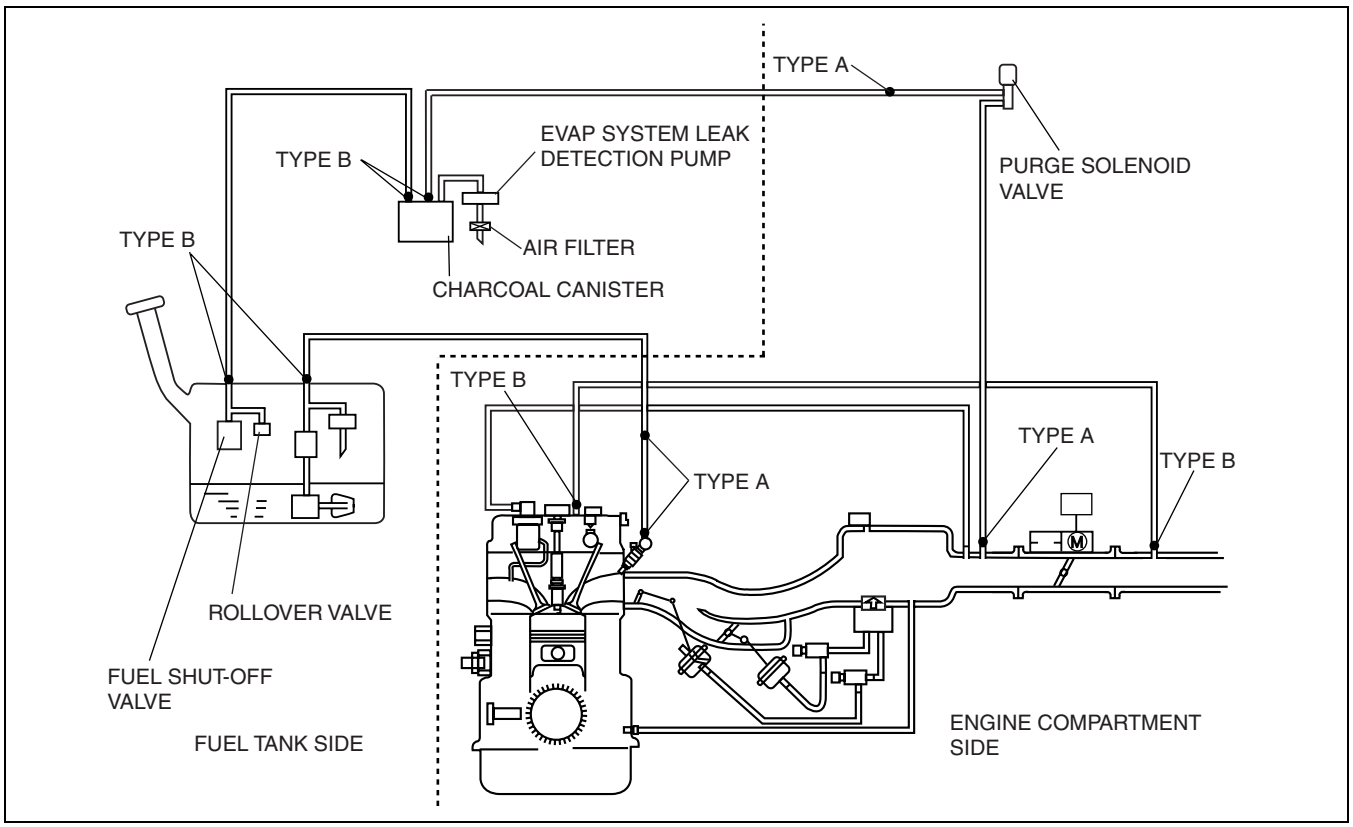
- Quick release connectors that can be easily connected/disconnected have been adopted to improve serviceability.

QUICK RELEASE CONNECTOR (FUEL SYSTEM) CONSTRUCTION/OPERATION [L3]

EPU011442692S04

- There are two types of quick release connectors.

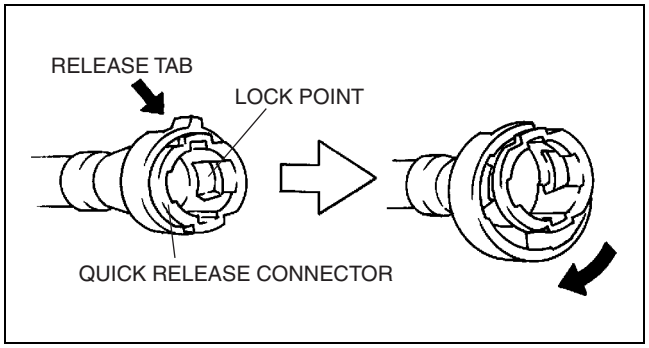
Quick release connector locations



EPU114ZW4803

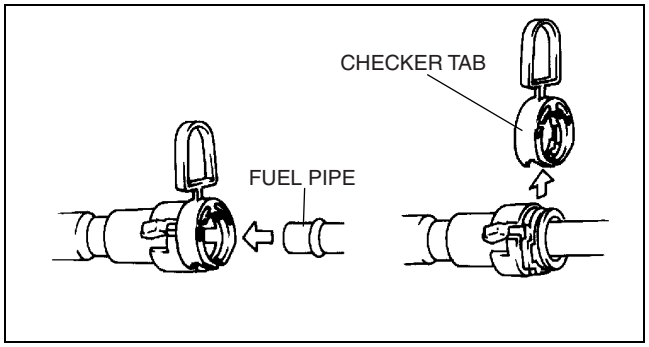
Type A

- An **SST** is not used with this type.
- Mainly consists of a retainer and O-ring. The quick release connector is integrated with the fuel hose and therefore cannot be disassembled.
- When the quick release connector is connected, the fuel pipe projection is locked at the clamp lock point. By pushing the clamp release tab to expand the clamp, the lock point is released allowing the fuel pipe to be disconnected.
- To connect the quick release connector properly, push it into the fuel pipe until a locking click sound is heard.



C3U0114S091

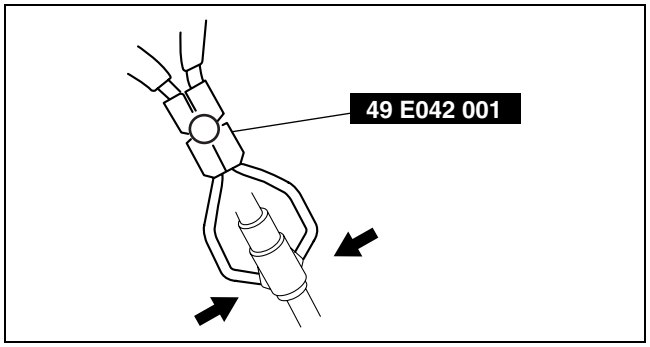
- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the fuel pipe, the lock is released and the checker tab comes off. Due to this, it can be verified that the quick release connector is completely connected.



C3U0114S092

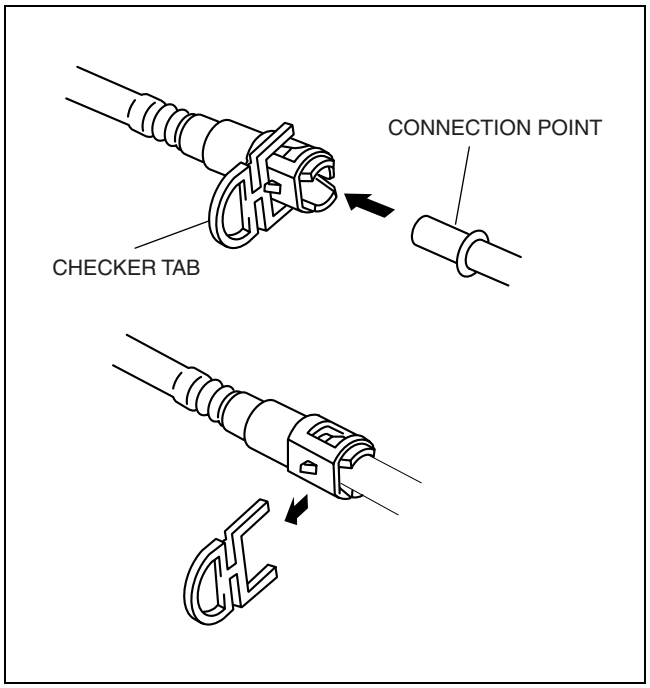
Type B

- The connector can be disconnected by pinching the retainer tab with the **SST** and pulling the connector.
- To connect the quick release connector properly, push it into the connection point until a locking click sound is heard



CPJ114ZWB881

- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the connection point, the lock is released and the checker tab comes off. Due to this, it can be verified that the quick release connector is completely connected.



EPU113ZT4610

FUEL INJECTOR FUNCTION [L3]

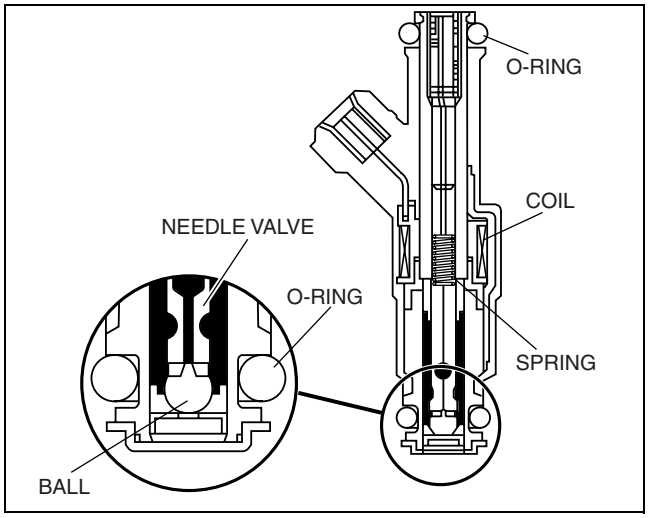
EPU011413250S01

- Injects fuel according to fuel injector control signals from the PCM.

FUEL INJECTOR CONSTRUCTION/OPERATION [L3]

EPU011413250S02

- Installed on the cylinder head.
- Mainly consists of a coil, spring, needle valve and ball.
- A signal is sent from the PCM causes excitation current to pass through the coil and thereby pull in the needle valve. Since the ball that opens and closes the injection opening is integrated with the needle valve, it is pulled together with the needle valve and fuel is injected.
- The amount of injection is determined by the open time of the needle valve (equal to the energization time of the coil).



C3U0114S111

FUEL PUMP RELAY FUNCTION [L3]

EPU011400000S06

- Controls the fuel pump on/off according to control signals from the PCM.

01–15 EXHAUST SYSTEM [L3]

EXHAUST SYSTEM OUTLINE [L3] 01–15–1
Features **01–15–1**
EXHAUST SYSTEM STRUCTURAL VIEW [L3] 01–15–1

EXHAUST SYSTEM OUTLINE [L3]

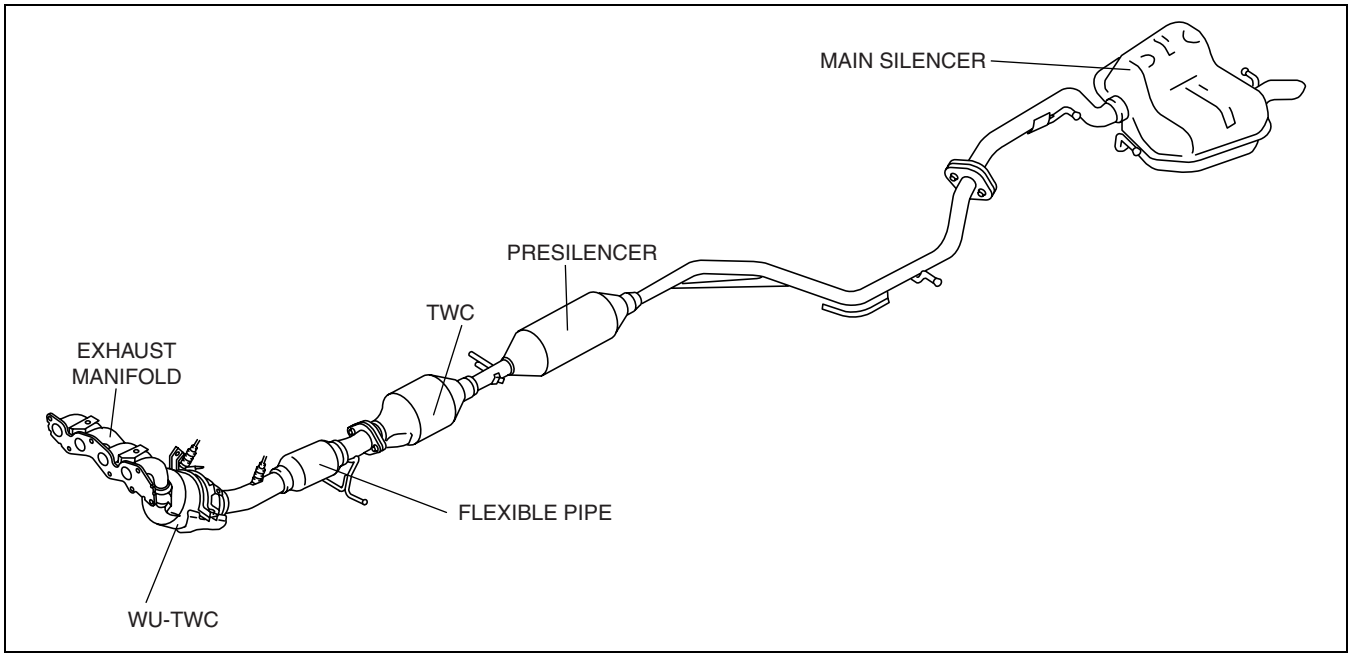
EPU011500000S01

Features

- The exhaust piping is shorter due to the placement of the exhaust manifold at the rear of the engine for improved exhaust performance. Moreover, due to the shorter distance to the catalytic converter, temperature decrease of exhaust emission is prevented and catalyst is more efficient.

EXHAUST SYSTEM STRUCTURAL VIEW [L3]

EPU011500000S02



EPU115ZT4301

01–16 EMISSION SYSTEM [L3]

EMISSION SYSTEM OUTLINE [L3] 01–16–1
Feature 01–16–1
Specification 01–16–1
EMISSION SYSTEM STRUCTURAL VIEW [L3] 01–16–2
Engine Compartment Side 01–16–2
Exhaust System 01–16–2
Fuel Tank Side 01–16–3
EXHAUST PURIFICATION SYSTEM OUTLINE [L3] 01–16–3
Feature 01–16–3
EGR SYSTEM OUTLINE [L3] 01–16–3
Features 01–16–3
EGR SYSTEM STRUCTURE [L3] 01–16–4
EGR SYSTEM OPERATION [L3] 01–16–4
EGR VALVE FUNCTION [L3] 01–16–4
EGR VALVE CONSTRUCTION/OPERATION [L3] 01–16–4
CATALYTIC CONVERTER SYSTEM OUTLINE [L3] 01–16–4
Feature 01–16–4
CATALYTIC CONVERTER SYSTEM STRUCTURE [L3] 01–16–5
CATALYTIC CONVERTER SYSTEM OPERATION [L3] 01–16–5
POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OUTLINE [L3] 01–16–5
Feature 01–16–5
POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM STRUCTURE [L3] 01–16–5
POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OPERATION [L3] 01–16–5
POSITIVE CRANKCASE VENTILATION (PCV) VALVE FUNCTION [L3] 01–16–6
POSITIVE CRANKCASE VENTILATION (PCV) VALVE CONSTRUCTION/OPERATION [L3] 01–16–6
PURGE SOLENOID VALVE FUNCTION [L3] 01–16–6
PURGE SOLENOID VALVE CONSTRUCTION/OPERATION [L3] 01–16–6
FUEL-FILLER CAP FUNCTION [L3] 01–16–6
FUEL-FILLER CAP CONSTRUCTION/OPERATION [L3] 01–16–6
ROLLOVER VALVE FUNCTION [L3] 01–16–7
ROLLOVER VALVE CONSTRUCTION/OPERATION [L3] 01–16–7
FUEL SHUT-OFF VALVE FUNCTION [L3] 01–16–7
FUEL SHUT-OFF VALVE CONSTRUCTION/OPERATION [L3] 01–16–7
CHARCOAL CANISTER FUNCTION [L3] 01–16–7
CHARCOAL CANISTER CONSTRUCTION/OPERATION [L3] 01–16–7
EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP FUNCTION [L3] 01–16–7
EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP CONSTRUCTION/OPERATION [L3] 01–16–8
Structure 01–16–8
Operation 01–16–8
AIR FILTER FUNCTION [L3] 01–16–9
AIR FILTER CONSTRUCTION/OPERATION [L3] 01–16–9

EMISSION SYSTEM OUTLINE [L3]

EPU011600000S01

Feature

Improved exhaust gas purification	• EGR system adopted • Catalytic converter system adopted

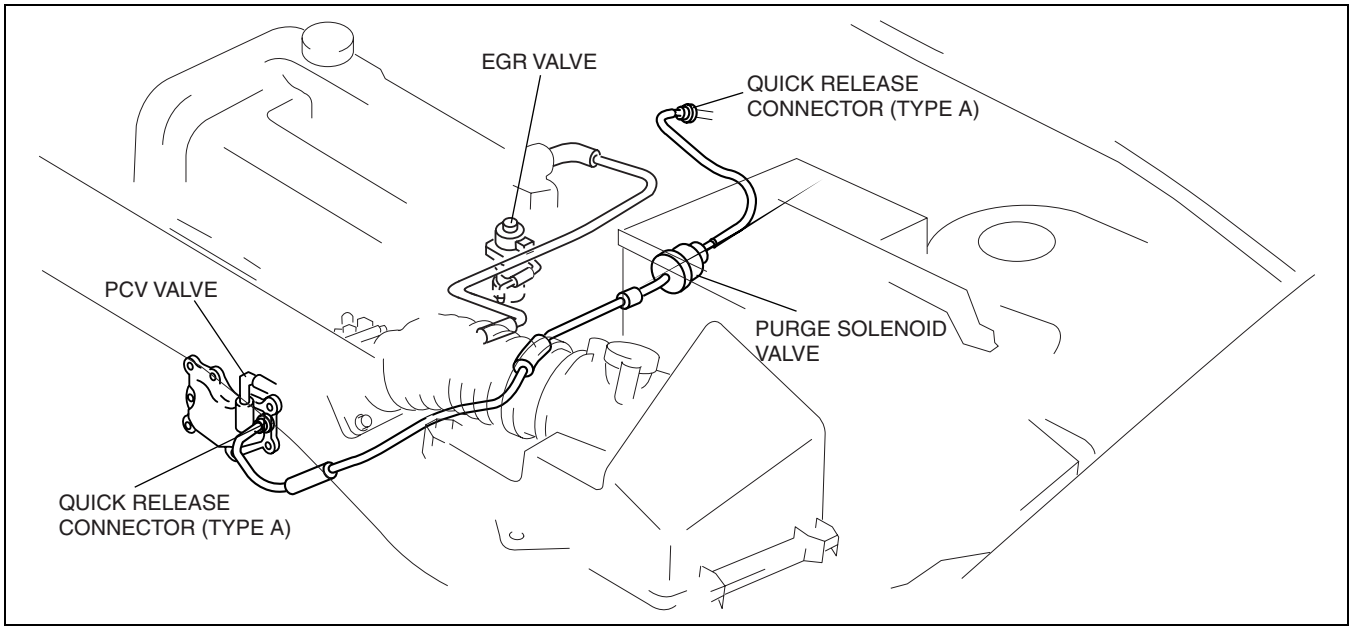
Specification

Item	Specification
EGR type	Stepping motor
Catalyst form	WU-TWC (monolith), TWC (monolith)
Evaporative emission (EVAP) control system	Charcoal canister type
Positive crankcase ventilation (PCV) system	Closed type

EMISSION SYSTEM STRUCTURAL VIEW [L3]

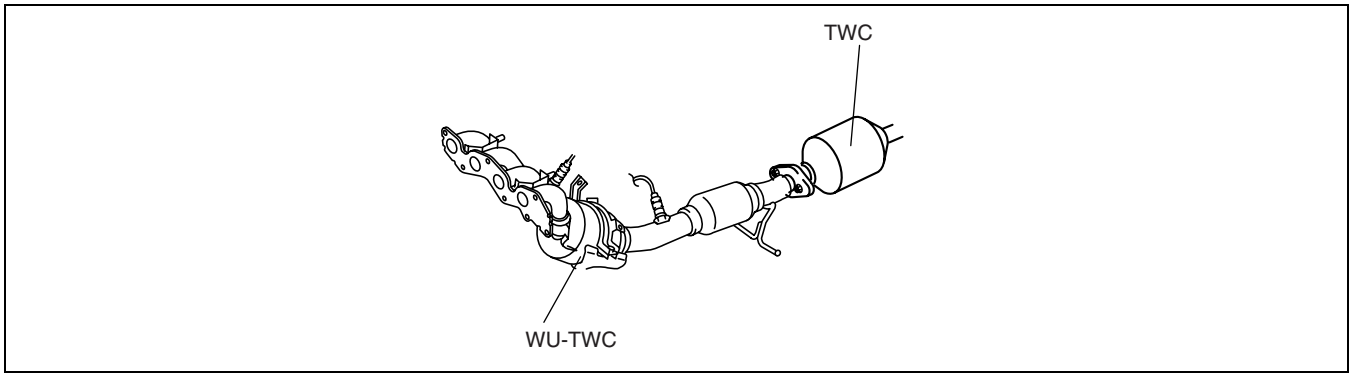
EPU011600000S02

Engine Compartment Side



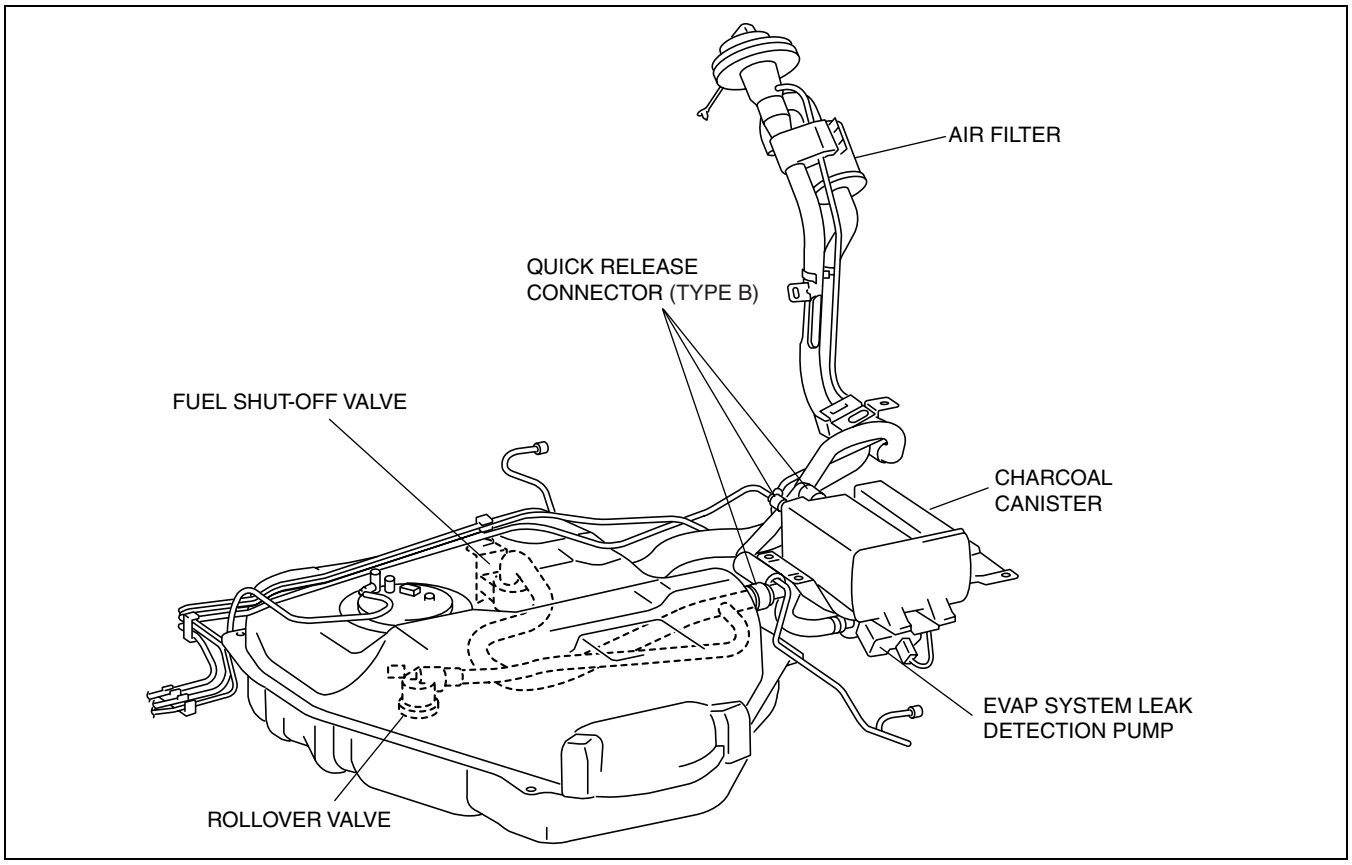
C3U0116S013

Exhaust System



C3U0116S014

Fuel Tank Side



EPU116ZT4501

EXHAUST PURIFICATION SYSTEM OUTLINE [L3]

EPU011600010S01

Feature

- The EGI system (fuel injection control, ignition control) burns fuel supplied to the engine at the theoretical air/fuel ratio for improved purification efficiency of the catalytic converter system.

EGR SYSTEM OUTLINE [L3]

EPU011600020S01

Features

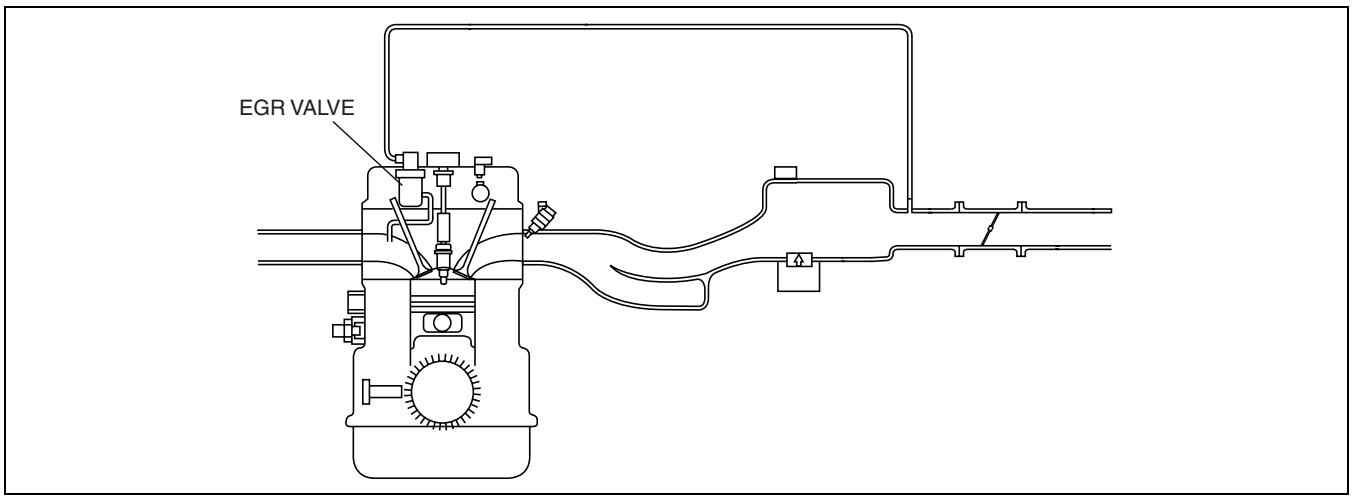
- An EGR valve with a stepping motor has been adopted for optimum control according to engine operation conditions.
- For control of EGR system, refer to CONTROL SYSTEM, EGR CONTROL. (See 01–40–28 EGR CONTROL OUTLINE [L3], 01–40–29 EGR CONTROL BLOCK DIAGRAM [L3], 01–40–29 EGR CONTROL OPERATION [L3].)

EGR SYSTEM STRUCTURE [L3]

EPU011600020S02

- Consists of an EGR valve and EGR pipe to conduct exhaust gas to the intake air system.

System diagram



EPU0116S021

EGR SYSTEM OPERATION [L3]

EPU011600020S03

- The high occurrence of NO_X at high temperatures has been reduced by recirculating exhaust gas to the combustion chamber in order to lower the combustion temperature.
- The exhaust gas flows along the EGR passage in the cylinder head and into the EGR valve. Exhaust gas that has flowed past the EGR valve flows through the EGR passage and EGR pipe, and is conducted to the intake manifold.

EGR VALVE FUNCTION [L3]

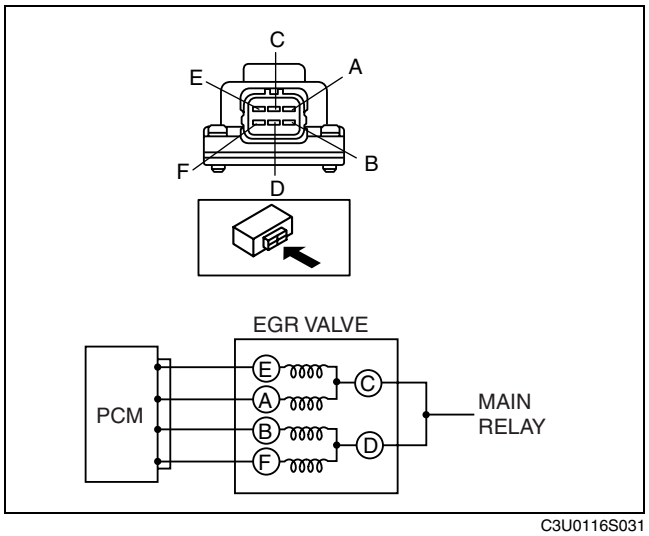
EPU011620300S01

- Adjusts the amount of exhaust gas to be recirculated from the exhaust system to the combustion chamber based on the EGR control signal from the PCM.

EGR VALVE CONSTRUCTION/OPERATION [L3]

EPU011620300S02

- Consists of a rotor, coils, and a spring.
- Operates based on the signal from the PCM to drive the EGR valve stepping motor.
- The PCM determines the optimum EGR valve opening angle based on the engine speed and intake air amount when the engine is completely warmed up and drives the EGR valve.



C3U0116S031

CATALYTIC CONVERTER SYSTEM OUTLINE [L3]

EPU011600050S01

Feature

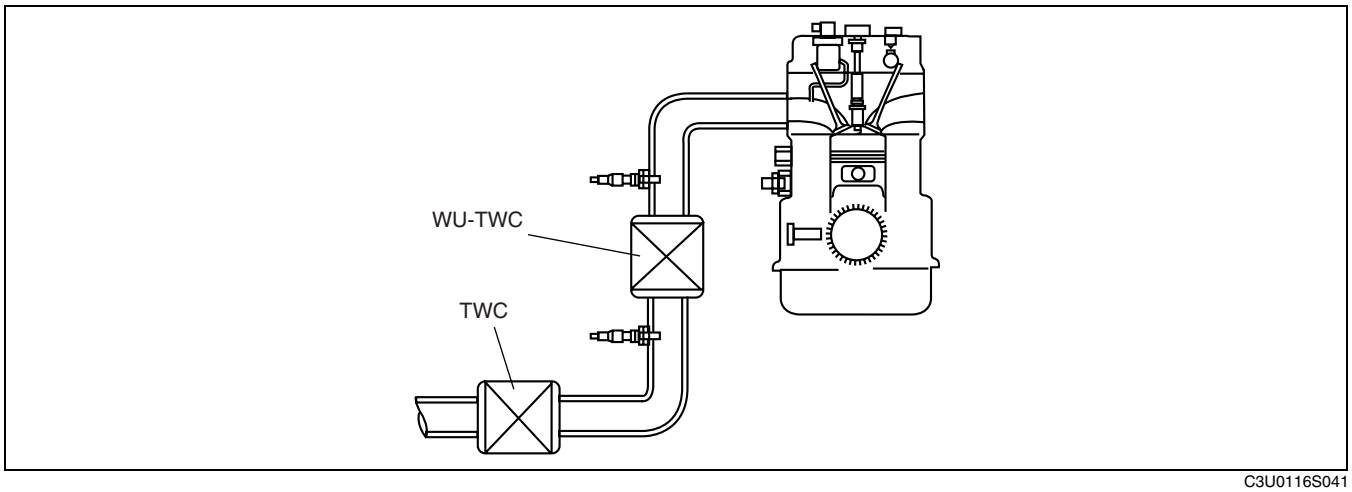
- Purifies contaminants in the exhaust gas by utilizing a chemical reaction in a three way catalytic converter.

CATALYTIC CONVERTER SYSTEM STRUCTURE [L3]

EPU011600050S02

- Consists of a three way catalytic converter and insulator.
- A catalytic converter utilizing a platinum—palladium—rhodium system has been adopted.

System diagram



C3U0116S041

CATALYTIC CONVERTER SYSTEM OPERATION [L3]

EPU011600050S03

- Contaminants in the exhaust gas (HC, CO, NO_X) are purified by oxidization and deoxidization while passing through the catalytic converter.
  - — Oxidization process
    - Noxious HC (hydrocarbon) and CO (carbon monoxide) are bonded to oxygen which is converted to non-noxious carbon dioxide and water.
      $O_2 + HC + CO \rightarrow CO_2 + H_2O$
  - — Deoxidization process
    - Noxious NO_X (nitrogen oxide) is converted to non-noxious nitrogen and oxygen. A part of the oxygen generated at this time is used in the oxidization process.
      $NO_X \rightarrow N_2 + O_2$

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OUTLINE [L3]

EPU011600040S01

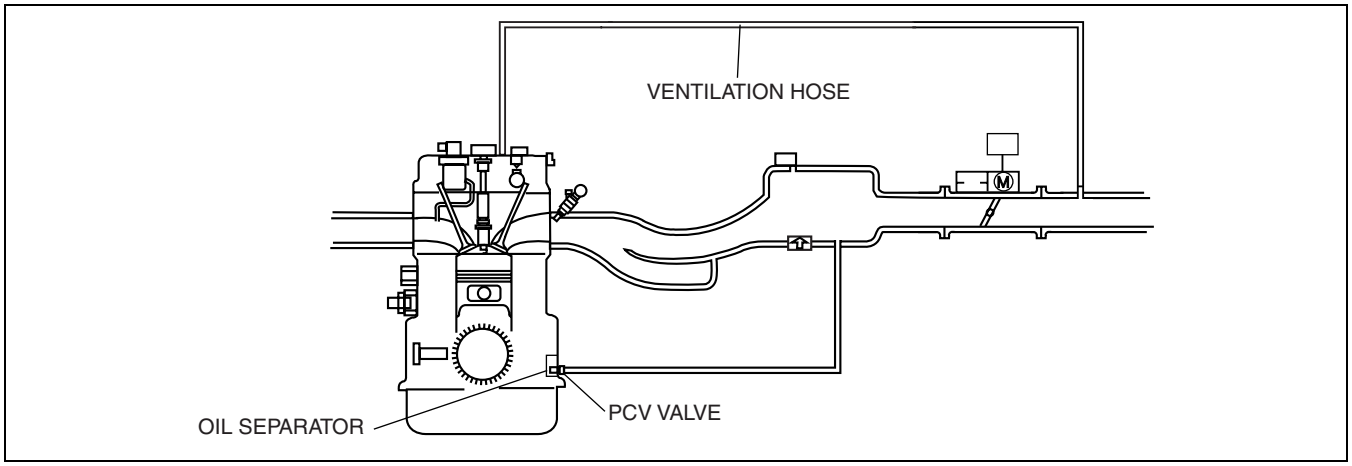
Feature

- A closed type PCV system has been adopted.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM STRUCTURE [L3]

EPU011600040S02

- Consists of a PCV valve and ventilation hose.
- The PCV valve is installed on the oil separator.



C3U0116S051

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OPERATION [L3]

EPU011600040S03

- Blowby gas (unburnt gas), including CO and HC exhausted from the crankcase, is forced into the intake air system and burned in the combustion chamber to prevent its atmospheric release.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE FUNCTION [L3]

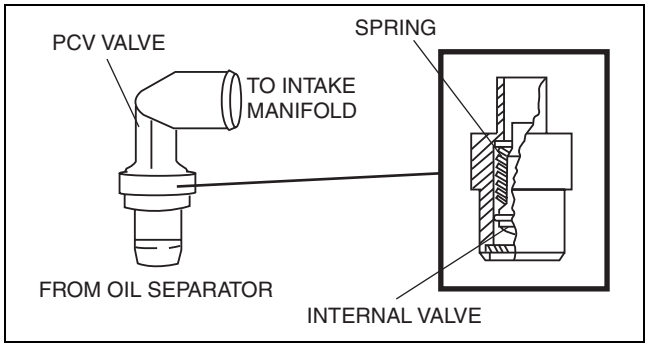
EPU011613890S01

- Adjusts the amount of blowby gas conducted to the intake air system according to the intake manifold vacuum.
- Regulates the air (including blowby gas) passing from the cylinder head cover to the intake manifold during low load (when vacuum in the intake manifold is high) to ensure an optimum air/fuel ratio.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE CONSTRUCTION/OPERATION [L3]

EPU011613890S02

- Consists of a spring and valves.
- The PCV valve ensures the passage of blowby gas by opening the valve according to the intake manifold vacuum, and adjusts the amount of gas by spring force.



C3U0116S061

PURGE SOLENOID VALVE FUNCTION [L3]

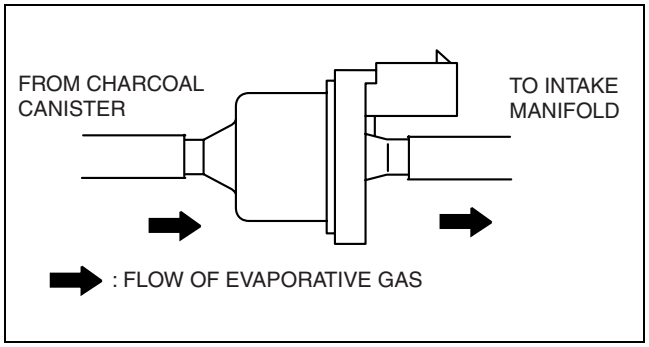
EPU011618744S01

- Adjusts the amount of evaporative gas to be introduced to the intake air system.

PURGE SOLENOID VALVE CONSTRUCTION/OPERATION [L3]

EPU011618744S02

- Installed on the water outlet case.
- Consists of a coil, spring and plunger.
- Opens and closes the passage in the solenoid valve according to the purge solenoid valve control signal (duty signal) from the PCM to control the amount of evaporative gas to be introduced to the intake manifold according to engine operation conditions.
- The signal sent from the PCM energizes the coil and it becomes magnetized, pulling the plunger. The passage between the ports opens when the plunger is pulled, and evaporative gas is introduced to the intake air system according to intake manifold vacuum.



C3U0116S081

FUEL-FILLER CAP FUNCTION [L3]

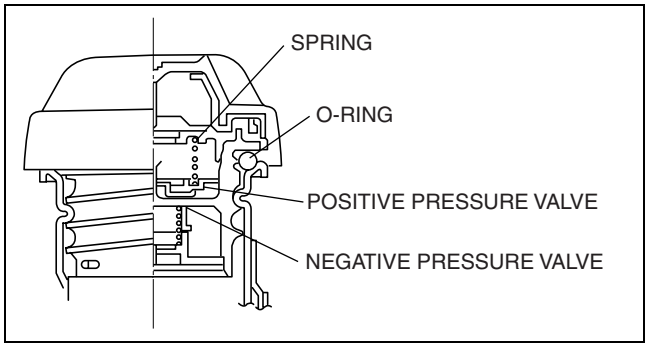
EPU011642250S01

- If the evaporative gas passage is closed for some reason, the fuel filler cap prevents the generation of positive or negative pressure in the fuel tank, protecting it from deformation.

FUEL-FILLER CAP CONSTRUCTION/OPERATION [L3]

EPU011642250S02

- Consists of a positive pressure valve, negative pressure valve, spring, and O-ring.
- When there is positive pressure in the fuel tank due to evaporative gas, the evaporative gas is released into the atmosphere. When there is negative pressure, air is introduced to the fuel tank.
- The positive pressure valve and negative pressure valve opening pressures are high, therefore the positive and negative pressure valves are normally not open.



C3U0116S091

ROLLOVER VALVE FUNCTION [L3]

EPU011642720S01

- The rollover valve prevents fuel flow into the evaporative gas passage during sudden cornering or vehicle rollover.

ROLLOVER VALVE CONSTRUCTION/OPERATION [L3]

EPU011642720S02

- The rollover valve cannot be removed or installed as it is built into the fuel tank.
- The rollover valve consists of a valve, float, and spring.
- The rollover valve utilizes a combination of float weight, spring force, and buoyancy. When the float is sunk in the fuel, the float (valve) closes to block the sealing surface of the passage.

FUEL SHUT-OFF VALVE FUNCTION [L3]

EPU011642990S01

- The fuel shut-off valve prevents fuel from flowing to the charcoal canister during tight turns or vehicle rollover.
- The fuel shut-off valve releases evaporative gas to the charcoal canister.
- During refueling, the fuel shut-off valve closes to prevent a fuel overflow.

FUEL SHUT-OFF VALVE CONSTRUCTION/OPERATION [L3]

EPU011642990S02

- The fuel shut-off valve cannot be removed or installed as it is built into the fuel tank.
- The fuel shut-off valve mainly consists of a valve, float, spring.
- During refueling or due to fuel sloshing, the float is flooded with fuel and the floating force causes the valve to close. Also, during vehicle rollover, the valve closes due to balance between the float gravity and spring.

CHARCOAL CANISTER FUNCTION [L3]

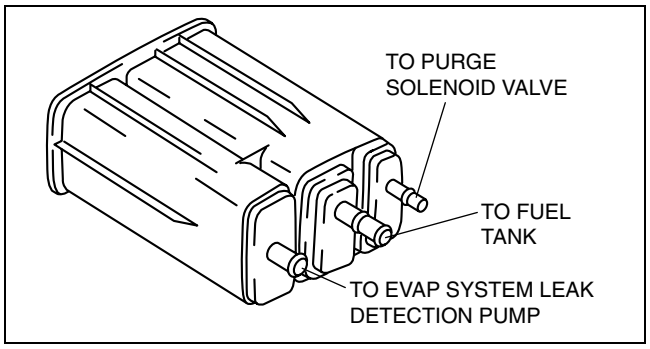
EPU011613970S01

- The charcoal canister contains activated charcoal that temporarily absorbs evaporative gas.

CHARCOAL CANISTER CONSTRUCTION/OPERATION [L3]

EPU011613970S02

- Installed on the rear of the fuel tank.
- During purge solenoid valve operation, atmosphere enters the charcoal canister from the atmospheric orifice to entirely flood the activated charcoal and release the evaporative gas.



EPU116ZT4502

EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP FUNCTION [L3]

EPU011618581S01

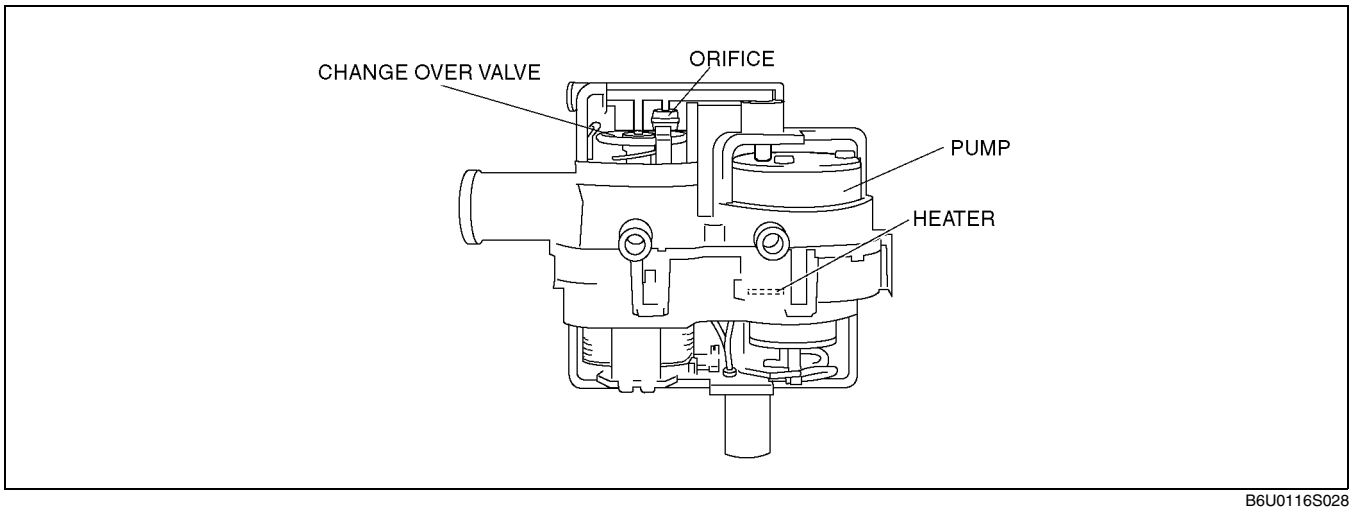
- The internal pump pressurizes the emission system by pumping air to check clogging and leakage in the emission system.

EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP CONSTRUCTION/OPERATION [L3]

EPU011618581S02

Structure

- Orifice
  - — Has a **0.5 mm {0.02 in}** hole
- Pump
  - — Force-feeds air to the orifice and the EVAP lines
- Heater
  - — Removes moisture inside the pump
- Change over valve
  - — Operated by a solenoid valve to switch air passages

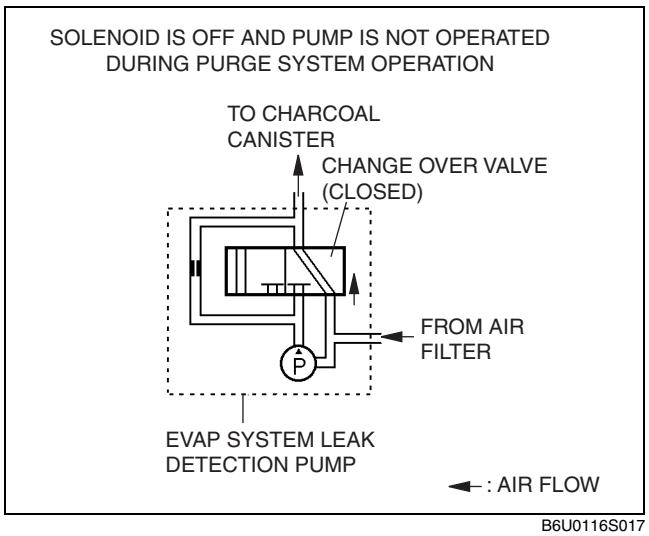


B6U0116S028

Operation

Evaporative system monitor is not operated

- The passage between the charcoal canister and the air filter is connected.

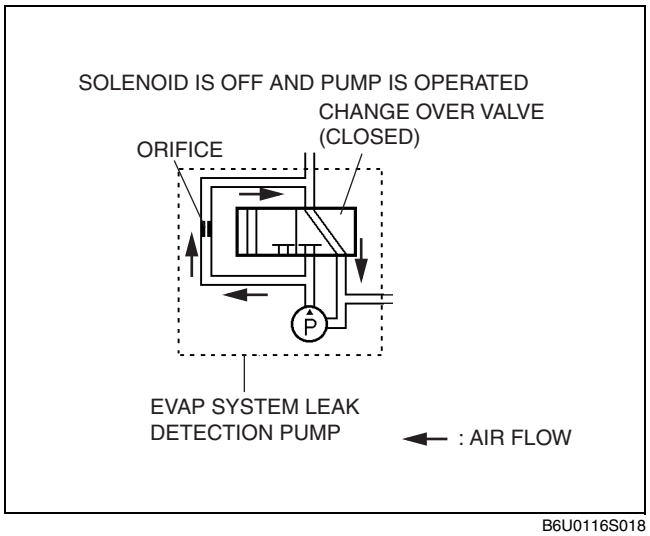


B6U0116S017

Evaporative system monitor is operated
When obtaining the reference current value

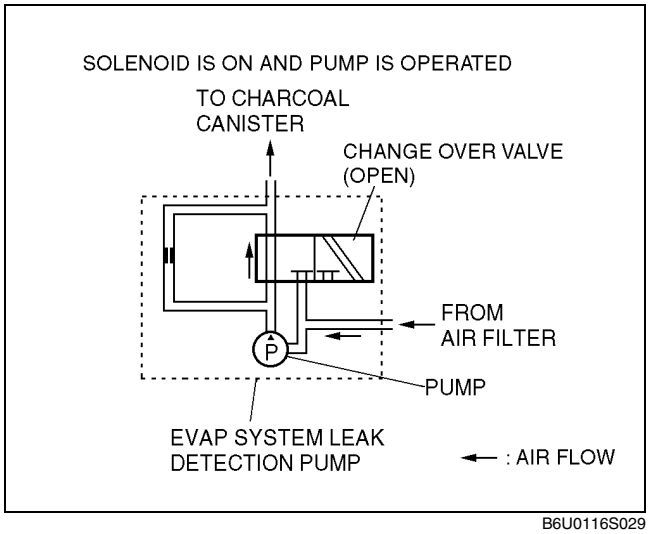
- Air is sent from the pump to the orifice.

Small leak and very small leak determination



B6U0116S018

- Air taken from the air filter is sent to the charcoal canister via the pump.



B6U0116S029

AIR FILTER FUNCTION [L3]

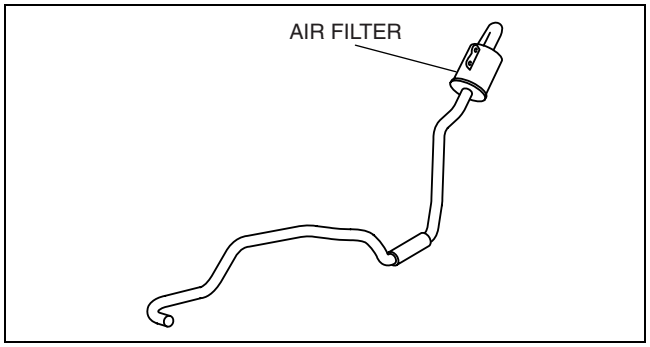
EPU011613988S01

- The air filter filters dust from the air drawn to the charcoal canister.

AIR FILTER CONSTRUCTION/OPERATION [L3]

EPU011613988S02

- The air filter is located in the EVAP system leak detection pump on the atmosphere side.



EPU113ZT4611

01–17 CHARGING SYSTEM [L3]

CHARGING SYSTEM OUTLINE [L3] 01–17–1
Features **01–17–1**
CHARGING SYSTEM STRUCTURAL VIEW [L3] 01–17–1
BATTERY CONSTRUCTION [L3] 01–17–2
GENERATOR CONSTRUCTION [L3] 01–17–2

CHARGING SYSTEM OUTLINE [L3]

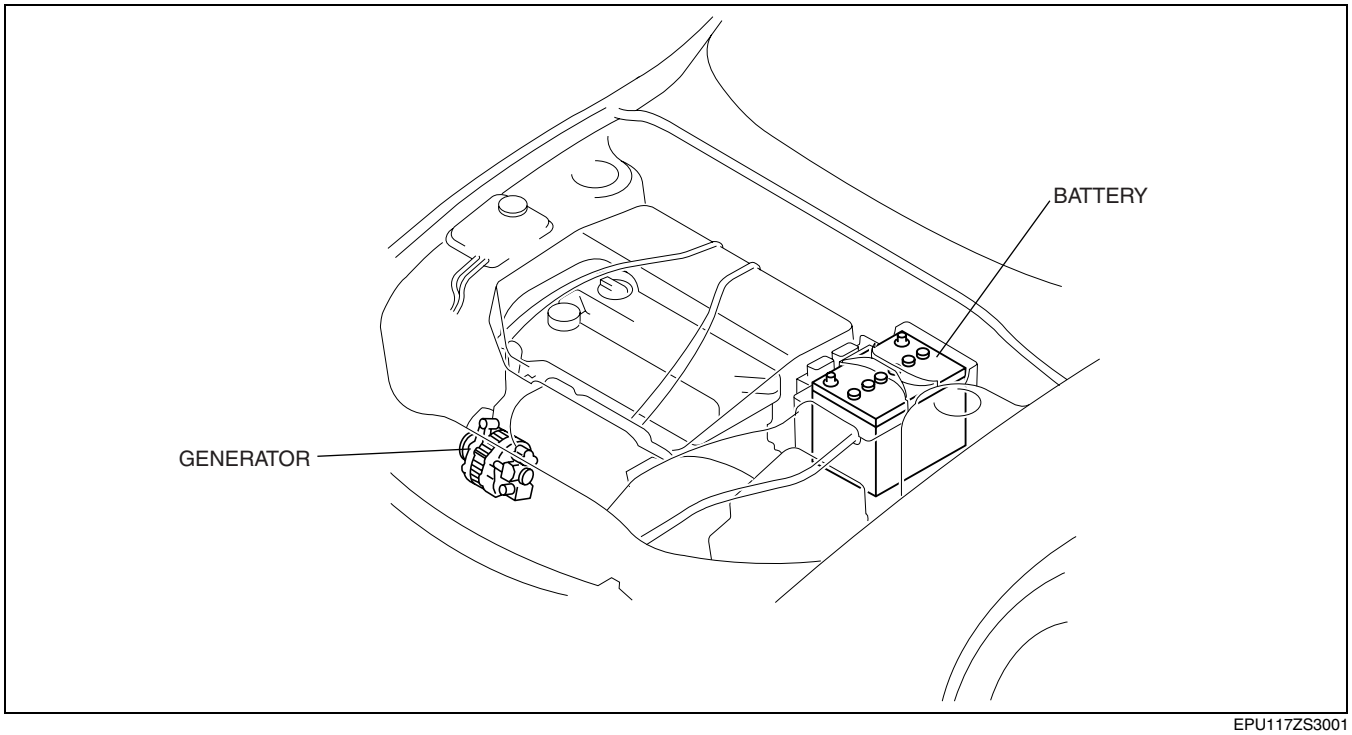
EPU011700000S01

Features

Improved reliability	• Battery duct adopted
Miniaturization	• Non-regulator type generator with built-in power transistor adopted

CHARGING SYSTEM STRUCTURAL VIEW [L3]

EPU011700000S02

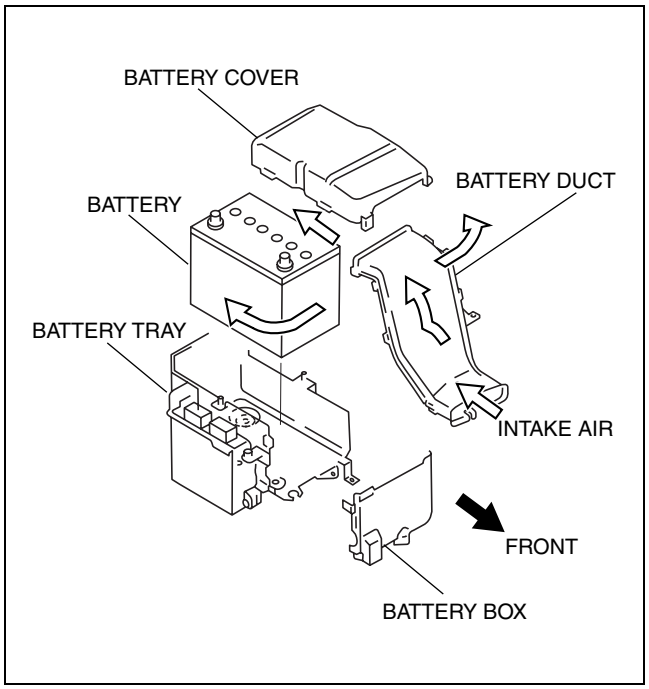


EPU117ZS3001

BATTERY CONSTRUCTION [L3]

EPU011718520S01

- Air that passes through the battery duct when the vehicle is moving is used to cool the battery, preventing battery degradation from the heat created through chemical reaction, improving reliability.

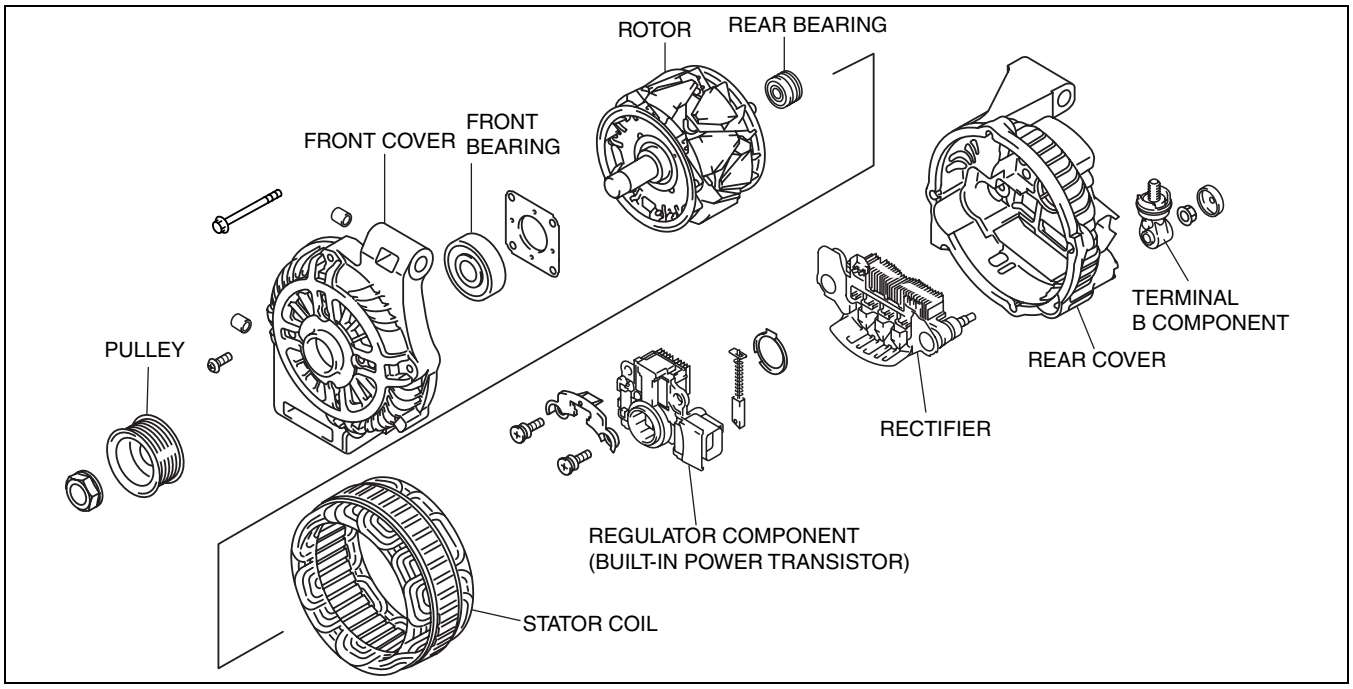


C3U0117S006

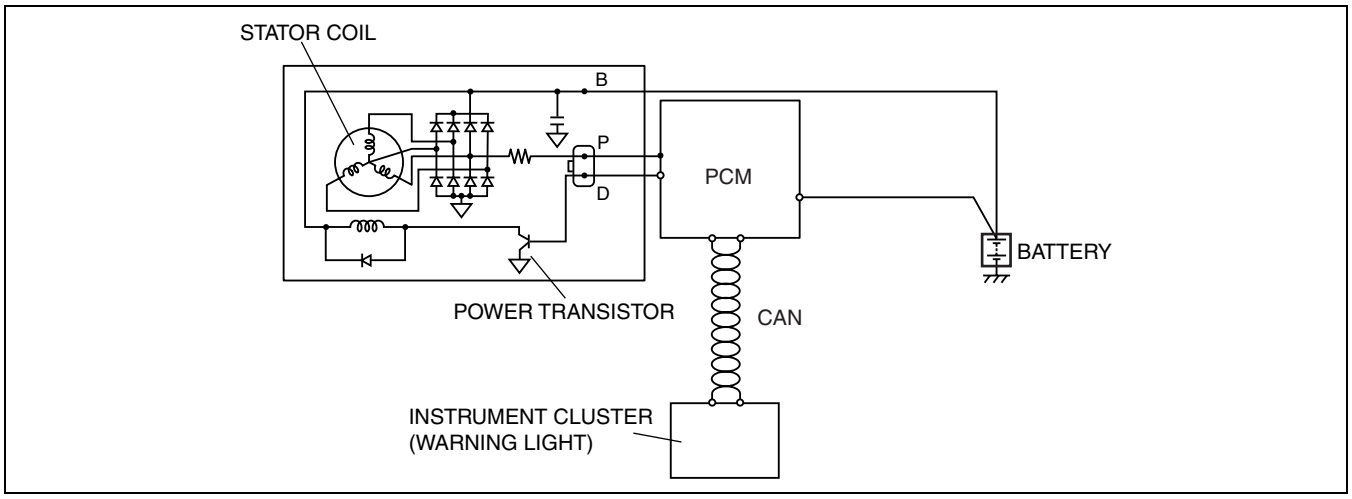
GENERATOR CONSTRUCTION [L3]

EPU011718300S01

- With the elimination of the voltage regulator, generator control is carried out by the PCM. Excitation current in the field coil is increased or decreased by the duty signal from the PCM sent to the power transistor built into the generator.



C3U0117S009



C3E0117T007

- The generator warning light in the instrument cluster illuminates under the following conditions.
  — Charging system voltage problem
  — Charging system voltage low input
  — Charging system voltage high input
  — IAT sensor circuit low input
  — IAT sensor circuit high input

01–18 IGNITION SYSTEM [L3]

IGNITION SYSTEM OUTLINE [L3]..... 01–18–1
Features..... **01–18–1**
IGNITION SYSTEM STRUCTURAL VIEW [L3] 01–18–1
IGNITION COIL CONSTRUCTION/OPERATION [L3] 01–18–2
Construction **01–18–2**
Operation **01–18–2**
SPARK PLUG CONSTRUCTION [L3] 01–18–3

IGNITION SYSTEM OUTLINE [L3]

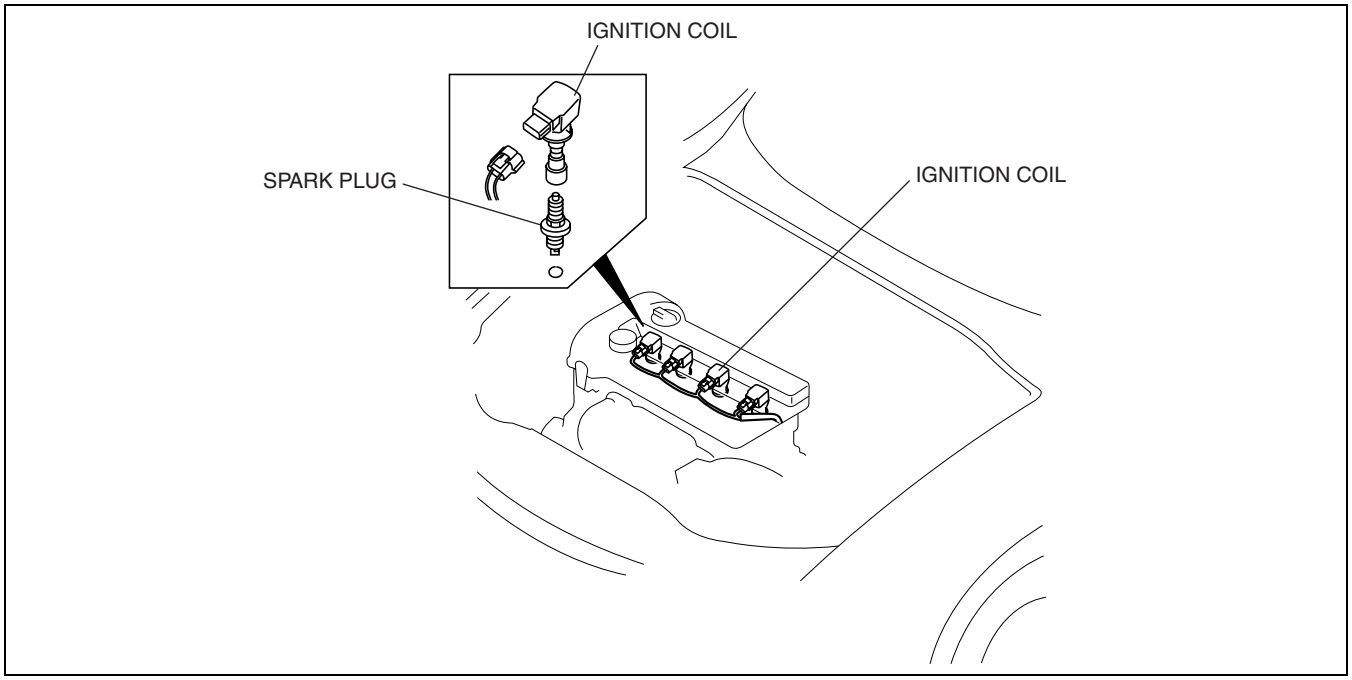
EPU011800000S01

Features

Improved reliability	• Independent ignition control system with distributorless ignition coil adopted
Improved durability	• Spark plug with an iridium alloy center electrode and platinum tip ground electrode adopted

IGNITION SYSTEM STRUCTURAL VIEW [L3]

EPU011800000S02



EPU118ZS3001

IGNITION COIL CONSTRUCTION/OPERATION [L3]

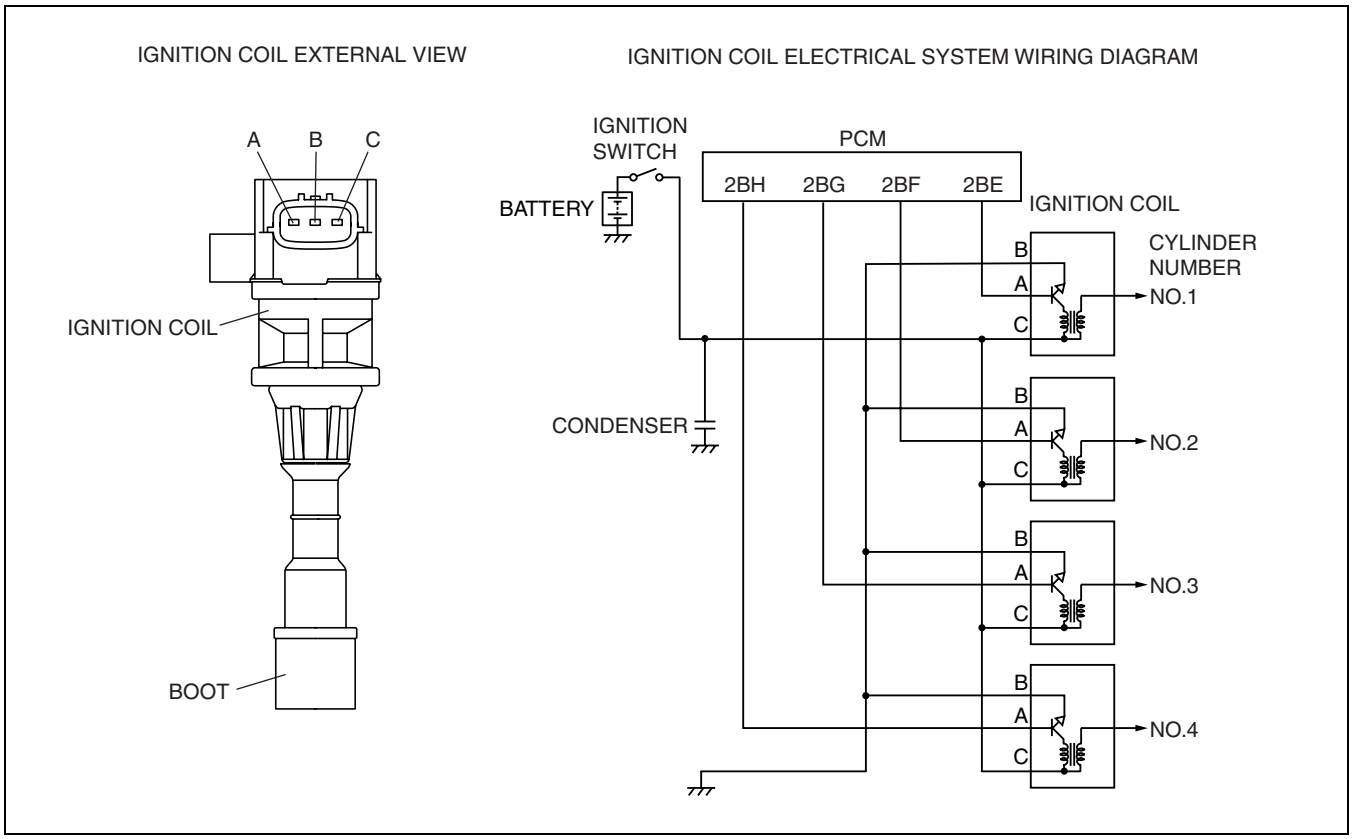
EPU011818100S01

Construction

- Direct ignition coils installed directly to each spark plug have been adopted. By adopting direct ignition coils, high-tension leads have been eliminated in order to simplify the parts of the ignition system, preventing voltage reduction, and improving the firing efficiency.
- Independent firing control has been adopted to eliminate firing without spark, increasing firing energy.
- The direct ignition coil consists of an ignition coil, ignition coil connector, and boot area, which has the same function as the current high-tension lead.
- The igniter has been integrated into each ignition coil.

Operation

- The firing timing of the coil is controlled by the PCM for optimum ignition timing control.



EPU118ZS3002

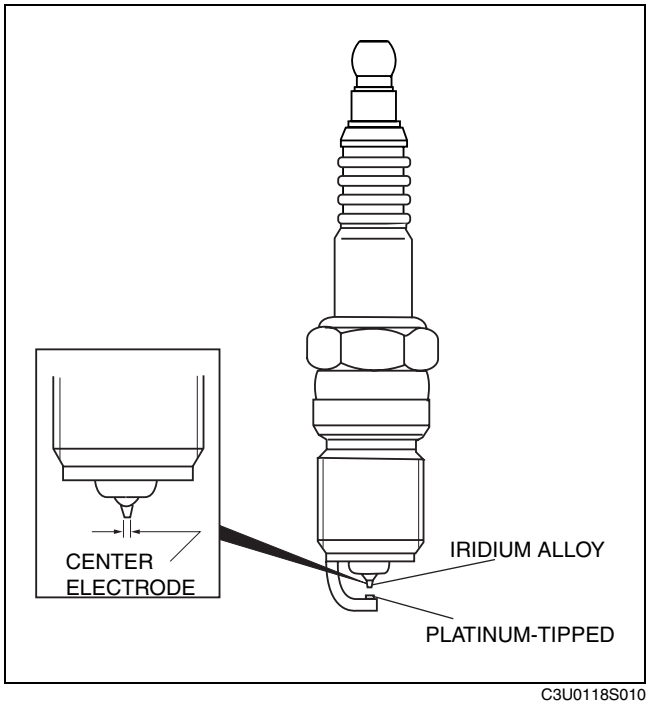
Terminal layout

Terminal		Signal
Three terminals	A	Ignition coil control signal
	B	Ground
	C	Power supply

SPARK PLUG CONSTRUCTION [L3]

EPU011818110S01

- An iridium spark plug with excellent durability and firing performance has been adopted.
- The extremely thin, center electrode has a diameter of 0.6 mm {0.024 in} and is made of iridium alloy.
- Durability has been improved by the use of a platinum-tipped grounding electrode.
- Based on the thinner electrode (center electrode), electric discharge has been reduced and ignition has been improved, resulting in stable ignition performance under any driving conditions.



C3U0118S010

01–19 STARTING SYSTEM [L3]

STARTING SYSTEM OUTLINE [L3] 01–19–1
Features 01–19–1
STARTING SYSTEM STRUCTURAL VIEW [L3] 01–19–1
STARTER CONSTRUCTION [L3] 01–19–1
STARTER INTERLOCK SWITCH CONSTRUCTION/OPERATION [MTX] 01–19–2
Construction 01–19–2
Operation 01–19–2

STARTING SYSTEM OUTLINE [L3]

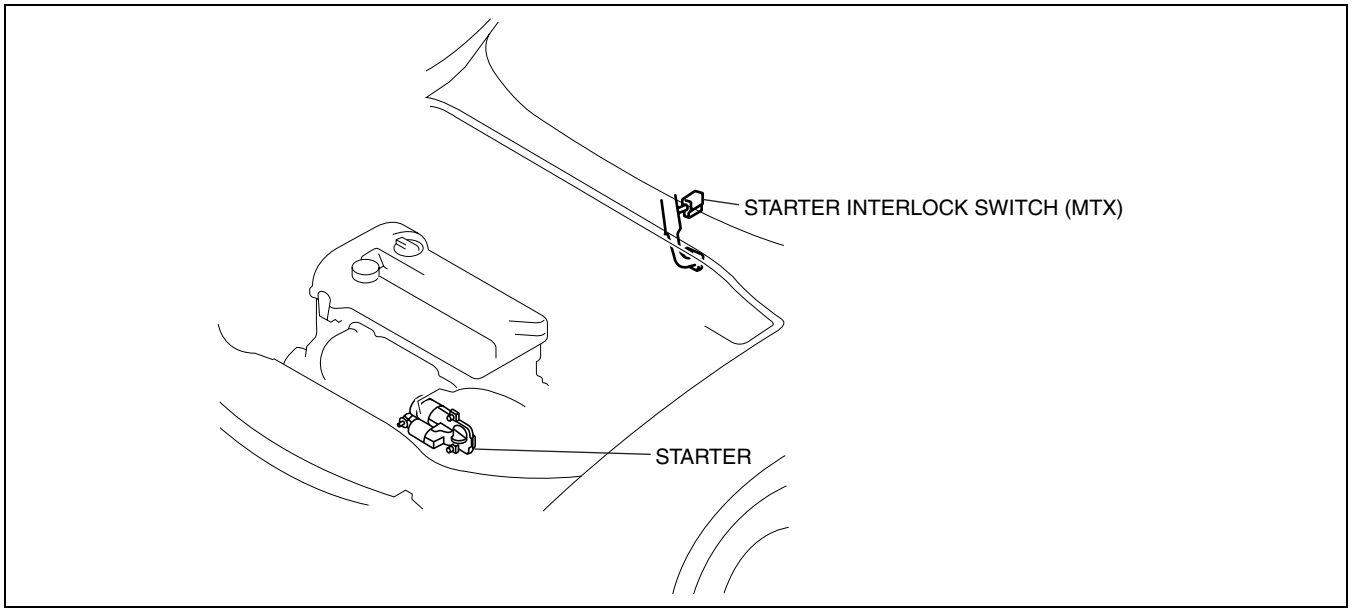
EPU011900000S01

Features

Improved startability	• Reduction type starter adopted
Improved safety	• Starter interlock switch adopted (MTX)

STARTING SYSTEM STRUCTURAL VIEW [L3]

EPU011900000S02

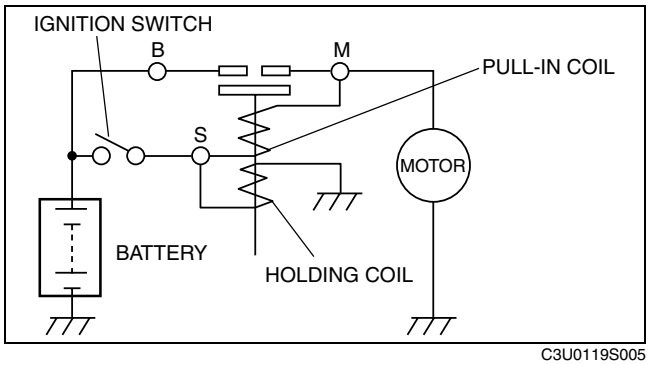


EPU119ZS3001

STARTER CONSTRUCTION [L3]

EPU011918400S01

- A high torque coaxial reduction type starter has been adopted.



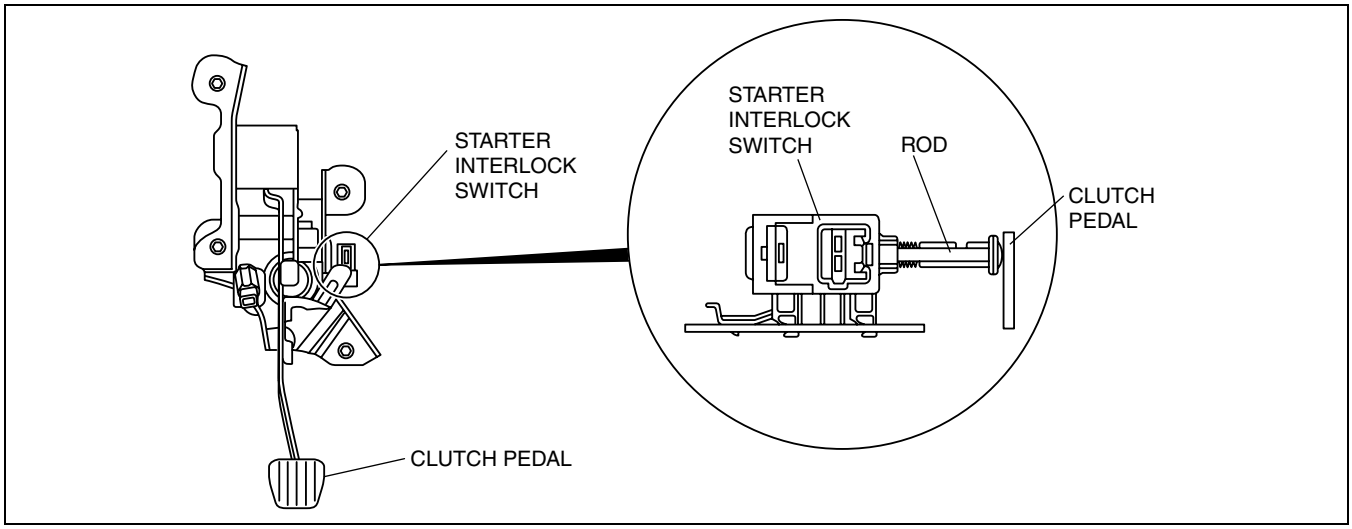
C3U0119S005

STARTER INTERLOCK SWITCH CONSTRUCTION/OPERATION [MTX]

EPU011943440S01

Construction

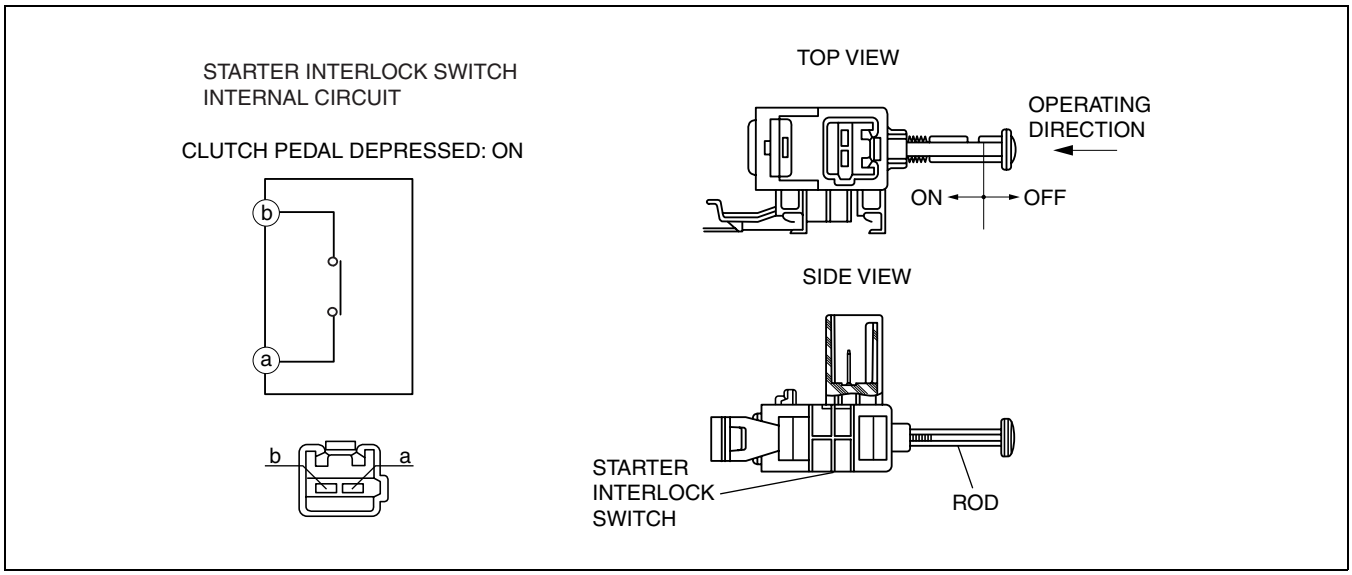
- The starter interlock switch mechanism prevents vehicle surge when the engine is started, enhancing the safety. The engine cannot be started unless the clutch is depressed.
- The mechanism is provided with a starter interlock switch on the circuit between the ignition switch and the starter.



EPU119ZS3002

Operation

- Depressing the clutch pedal presses the starter interlock switch rod. At this time, the starter interlock switch is on, and the power circuit to starter closes. Accordingly, the starter operates only when the clutch is depressed whereby the engine can be started.



E5U119ZS5003

01–40 CONTROL SYSTEM [L3]

ENGINE CONTROL SYSTEM OUTLINE [L3] 01–40–3
Features 01–40–3
Specification 01–40–3
ENGINE CONTROL SYSTEM STRUCTURAL VIEW [L3] 01–40–4
ENGINE CONTROL SYSTEM DIAGRAM [L3] 01–40–5
ENGINE CONTROL SYSTEM WIRING DIAGRAM [L3] 01–40–6
ENGINE CONTROL SYSTEM BLOCK DIAGRAM [L3] 01–40–8
ENGINE CONTROL SYSTEM RELATION CHART [L3] 01–40–9
ELECTRONIC THROTTLE CONTROL OUTLINE [L3] 01–40–10
ELECTRONIC THROTTLE CONTROL BLOCK DIAGRAM [L3] 01–40–10
ELECTRONIC THROTTLE CONTROL OPERATION [L3] 01–40–11
Target Throttle Valve Opening Angle Calculation 01–40–11
Throttle Valve Opening Angle Learning 01–40–11
Fail-safe 01–40–11
IDLE AIR CONTROL (IAC) OUTLINE [L3] 01–40–11
IDLE AIR CONTROL (IAC) BLOCK DIAGRAM [L3] 01–40–12
IDLE AIR CONTROL (IAC) OPERATION [L3] 01–40–13
Target throttle valve opening angle determination 01–40–13
IAC target airflow amount 01–40–13
Target idle speed 01–40–14
FULLY-CLOSED THROTTLE POSITION LEARNING FUNCTION BLOCK DIAGRAM [L3] 01–40–14
FULLY-CLOSED THROTTLE POSITION LEARNING FUNCTION OPERATION [L3] 01–40–14
Fully-closed throttle learning value (fully-closed throttle voltage value) update 01–40–14
Inhibition condition of fully-closed throttlelearning 01–40–14
VARIABLE INTAKE AIR CONTROL OUTLINE [L3] 01–40–15
VARIABLE INTAKE AIR CONTROL BLOCK DIAGRAM [L3] 01–40–15
VARIABLE INTAKE AIR CONTROL OPERATION [L3] 01–40–16
VARIABLE TUMBLE CONTROL OUTLINE [L3] 01–40–16
VARIABLE TUMBLE CONTROL BLOCK DIAGRAM [L3] 01–40–16
VARIABLE TUMBLE CONTROL OPERATION [L3] 01–40–16
Operation conditions 01–40–16
Inhibition conditions 01–40–16
VARIABLE VALVE TIMING CONTROL OUTLINE [L3] 01–40–16
VARIABLE VALVE TIMING CONTROL BLOCK DIAGRAM [L3] 01–40–17
VARIABLE VALVE TIMING CONTROL OPERATION [L3] 01–40–17
Cleaning Mode 01–40–17
Maximum Cam Retard Mode 01–40–17
Feedback Hold Mode 01–40–18
Feedback Mode 01–40–18
Advance spark speed correction 01–40–19
Valve timing determination 01–40–19
FUEL INJECTION CONTROL OUTLINE [L3] 01–40–19
FUEL INJECTION CONTROL BLOCK DIAGRAM [L3] 01–40–20
FUEL INJECTION CONTROL OPERATION [L3] 01–40–21
Operation 01–40–21
Injection time 01–40–21
Determination of effective injection time 01–40–22
Fuel cut 01–40–24
FUEL PUMP CONTROL OUTLINE [L3] 01–40–25
FUEL PUMP CONTROL BLOCK DIAGRAM [L3] 01–40–25
FUEL PUMP CONTROL OPERATION [L3] 01–40–25
Operation Condition 01–40–25
Operation Inhibition Condition 01–40–25
ELECTRONIC SPARK ADVANCE OUTLINE [L3] 01–40–25
ELECTRONIC SPARK ADVANCE BLOCK DIAGRAM [L3] 01–40–26
ELECTRONIC SPARK ADVANCE OPERATION [L3] 01–40–27
Ignition method 01–40–27
Determination of Ignition Timing 01–40–27
Ignition inhibition condition 01–40–28
EGR CONTROL OUTLINE [L3] 01–40–28
EGR CONTROL BLOCK DIAGRAM [L3] 01–40–29
EGR CONTROL OPERATION [L3] 01–40–29
Stepping motor operation principles 01–40–29
Control outline 01–40–30
Target EGR valve position 01–40–30
Inhibition conditions 01–40–30
PURGE CONTROL OUTLINE [L3] 01–40–31
PURGE CONTROL BLOCK DIAGRAM [L3] 01–40–31
PURGE CONTROL OPERATION [L3] 01–40–31
Determination of purge solenoid valve energization time 01–40–31
Calculation method for purge flow amount 01–40–31
Operation conditions 01–40–32
HO2S HEATER CONTROL OUTLINE [L3] 01–40–32
HO2S HEATER CONTROL BLOCK DIAGRAM [L3] 01–40–32

HO2S HEATER CONTROL OPERATION [L3] 01–40–32
Front 01–40–32
A/C CUT-OFF CONTROL OUTLINE [L3] 01–40–33
A/C CUT-OFF CONTROL BLOCK DIAGRAM [L3] 01–40–33
A/C CUT-OFF CONTROL OPERATION [L3] 01–40–33
ELECTRICAL FAN CONTROL OUTLINE [L3]. 01–40–33
ELECTRICAL FAN CONTROL BLOCK DIAGRAM [L3] 01–40–34
ELECTRICAL FAN CONTROL OPERATION [L3] 01–40–34
STARTER CUT-OFF CONTROL OUTLINE [L3]. 01–40–34
STARTER CUT-OFF CONTROL BLOCK DIAGRAM [L3] 01–40–35
STARTER CUT-OFF CONTROL OPERATION [L3] 01–40–35
GENERATOR CONTROL OUTLINE [L3] 01–40–35
GENERATOR CONTROL BLOCK DIAGRAM [L3] 01–40–36
GENERATOR CONTROL OPERATION [L3] 01–40–36
Determination of field coil excitation time 01–40–36
Control 01–40–36
CONTROLLER AREA NETWORK (CAN) OUTLINE [L3] 01–40–37
Data sent. 01–40–37
Data received 01–40–37
PCM FUNCTION [L3]. 01–40–37
Function List 01–40–37
PCM CONSTRUCTION/OPERATION [L3] 01–40–38
Structure 01–40–38
NEUTRAL SWITCH FUNCTION [MTX] [L3]. 01–40–38
NEUTRAL SWITCH CONSTRUCTION/OPERATION [MTX] [L3]. 01–40–38
CLUTCH PEDAL POSITION (CPP) SWITCH FUNCTION [MTX] [L3] 01–40–38
CLUTCH PEDAL POSITION (CPP) SWITCH CONSTRUCTION/OPERATION [MTX] [L3]. 01–40–39
ENGINE COOLANT TEMPERATURE (ECT) SENSOR FUNCTION [L3] 01–40–39
ENGINE COOLANT TEMPERATURE (ECT) SENSOR CONSTRUCTION/OPERATION [L3] 01–40–39
INTAKE AIR TEMPERATURE (IAT) SENSOR FUNCTION [L3] 01–40–40
INTAKE AIR TEMPERATURE (IAT) SENSOR CONSTRUCTION/OPERATION [L3]. 01–40–40
CRANKSHAFT POSITION (CKP) SENSOR FUNCTION [L3]. 01–40–41
CRANKSHAFT POSITION (CKP) SENSOR CONSTRUCTION/OPERATION [L3]. 01–40–41
CAMSHAFT POSITION (CMP) SENSOR FUNCTION [L3]. 01–40–42
CAMSHAFT POSITION (CMP) SENSOR CONSTRUCTION/OPERATION [L3]. . . 01–40–42
VARIABLE TUMBLE SHUTTER VALVE SWITCH OUTLINE [L3]. 01–40–42
VARIABLE TUMBLE SHUTTER VALVE SWITCH CONSTRUCTION/OPERATION [L3]. 01–40–42
THROTTLE POSITION (TP) SENSOR FUNCTION [L3]. 01–40–43
THROTTLE POSITION (TP) SENSOR CONSTRUCTION/OPERATION [L3]. 01–40–43
ACCELERATOR PEDAL POSITION (APP) SENSOR FUNCTION [L3] 01–40–43
ACCELERATOR PEDAL POSITION (APP) SENSOR CONSTRUCTION/OPERATION [L3]. 01–40–44
MASS AIR FLOW (MAF) SENSOR FUNCTION [L3]. 01–40–44
MASS AIR FLOW (MAF) SENSOR CONSTRUCTION/OPERATION [L3]. 01–40–45
HEATED OXYGEN SENSOR (HO2S) FUNCTION [L3]. 01–40–45
HEATED OXYGEN SENSOR (HO2S) CONSTRUCTION/OPERATION [L3]. 01–40–46
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR FUNCTION [L3] 01–40–46
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CONSTRUCTION/OPERATION [L3]. 01–40–47
KNOCK SENSOR (KS) FUNCTION [L3]. 01–40–47
KNOCK SENSOR (KS) CONSTRUCTION/OPERATION [L3]. 01–40–47
BAROMETRIC PRESSURE (BARO) SENSOR FUNCTION [L3]. 01–40–47
BAROMETRIC PRESSURE (BARO) SENSOR CONSTRUCTION/OPERATION [L3]. 01–40–48

ENGINE CONTROL SYSTEM OUTLINE [L3]

EPU014000000S01

Features

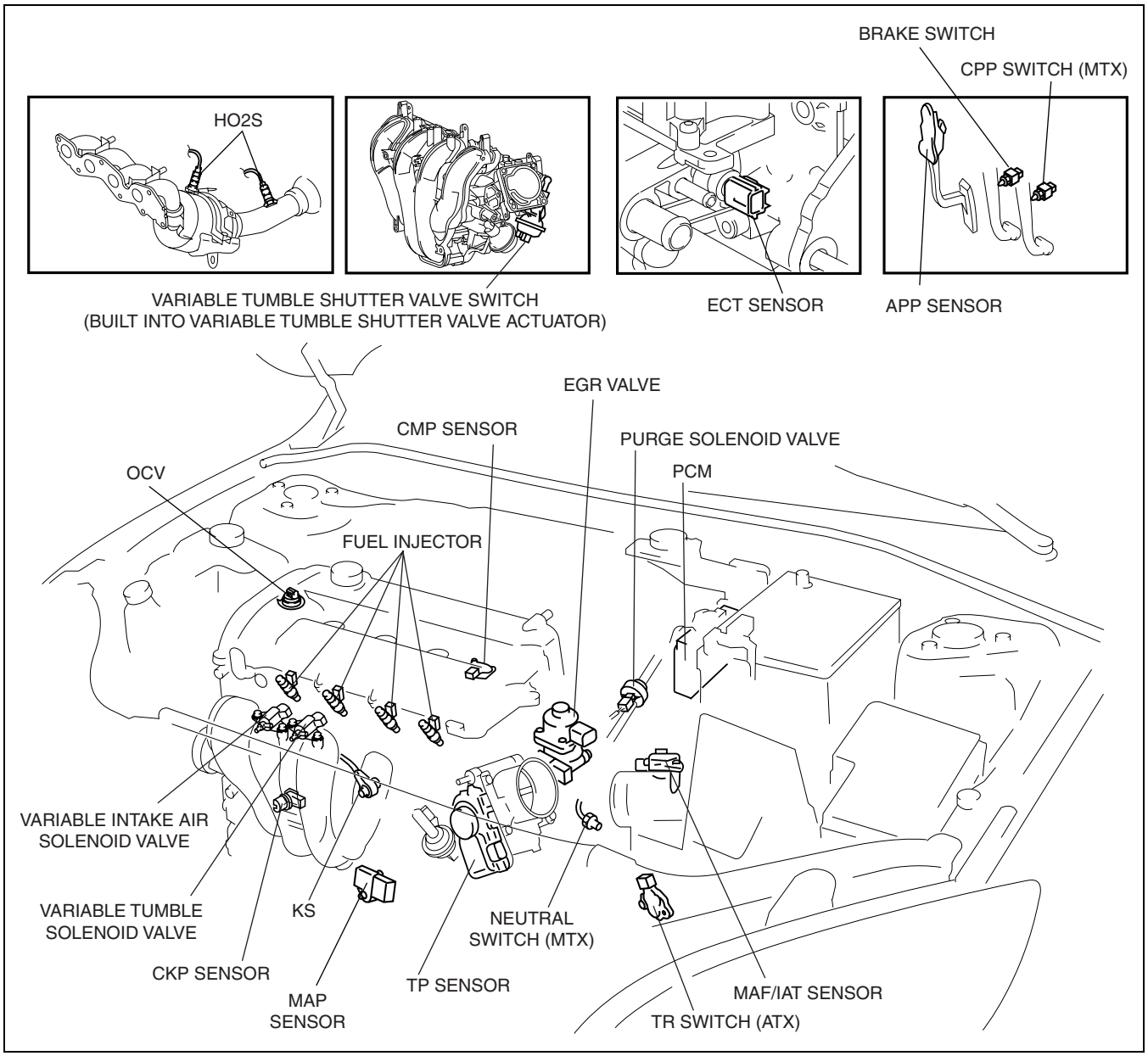
Improved driveability	• Variable intake air control adopted • Variable valve timing control adopted
Improved exhaust emission performance	• Variable tumble control adopted • EGR control adopted
Wiring harness simplification	• CAN adopted

Specification

Item	Specification
Neutral switch (MTX)	ON/OFF
CPP switch (MTX)	ON/OFF
ECT sensor	Thermistor
IAT sensor (Inside MAF)	Thermistor
TP sensor	Hall element
APP sensor	Inductance coil
Throttle valve actuator	DC motor
MAF sensor	Hot-wire
Front HO2S	Zirconia element (Stoichiometric air/fuel ratio sensor)
Rear HO2S	Zirconia element (Stoichiometric air/fuel ratio sensor)
BARO sensor	Piezoelectric element
KS	Piezoelectric element
MAP sensor	Piezoelectric element
CKP sensor	Magnetic pickup
CMP sensor	Magnetic pickup
Brake switch	ON/OFF

ENGINE CONTROL SYSTEM STRUCTURAL VIEW [L3]

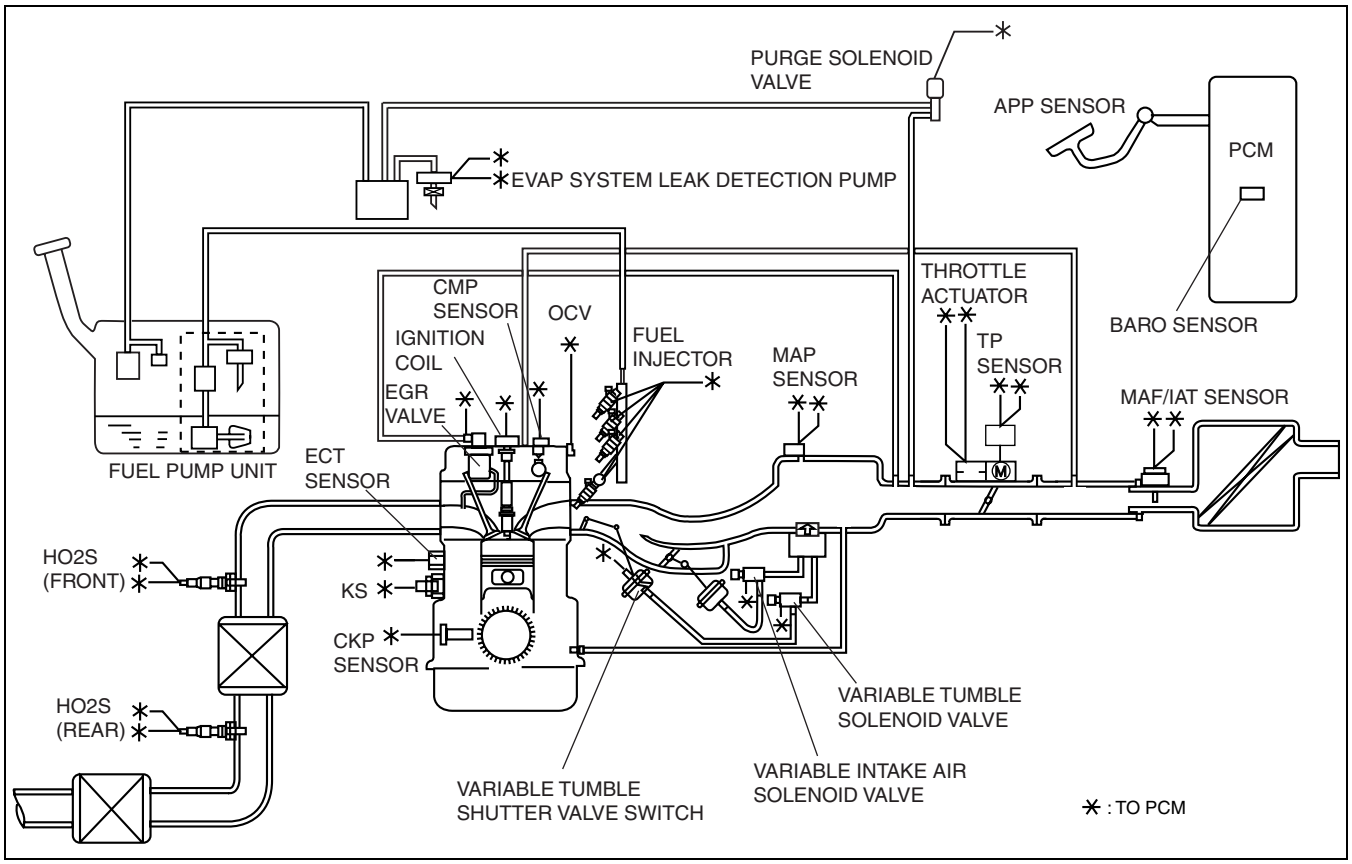
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ENGINE CONTROL SYSTEM DIAGRAM [L3]

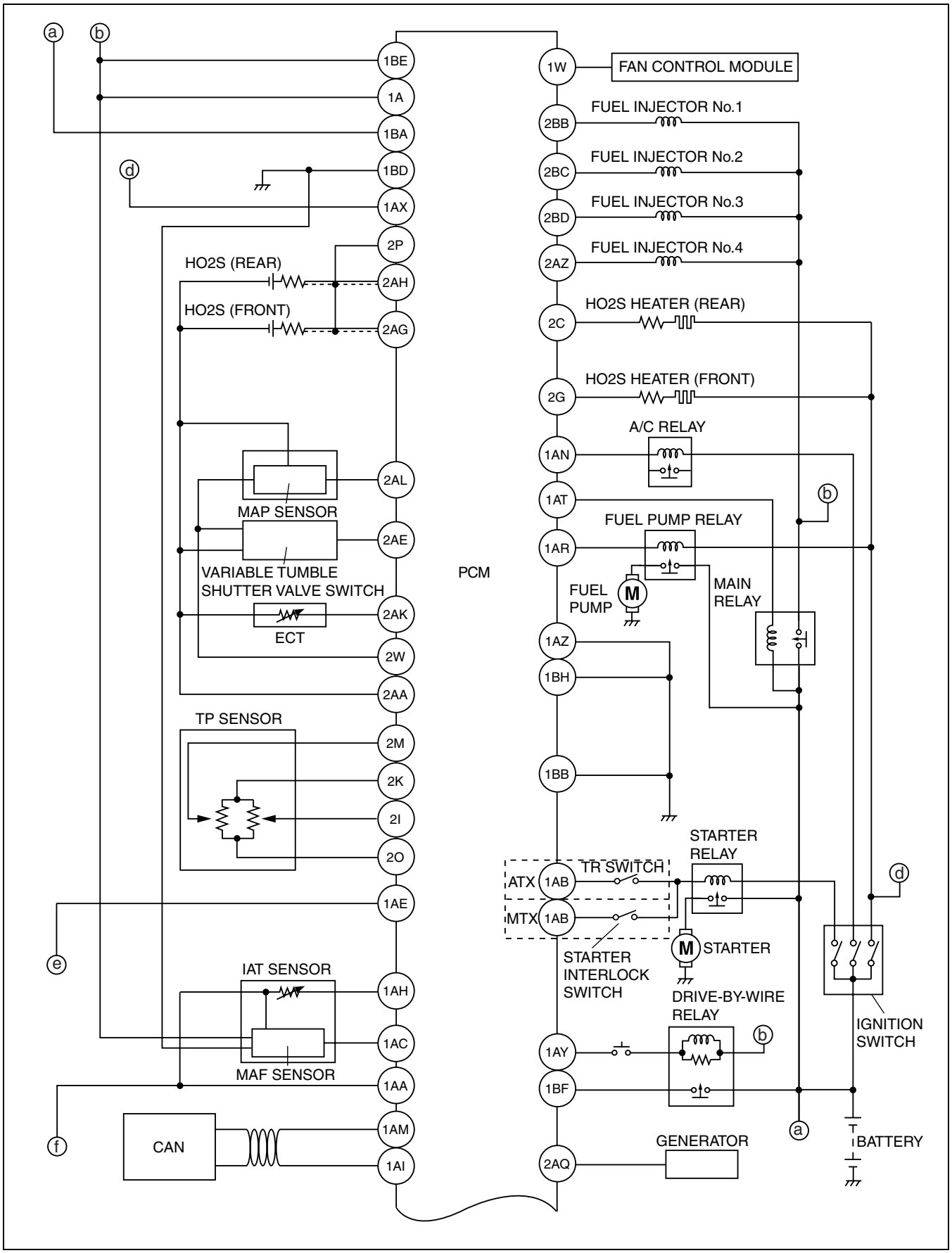
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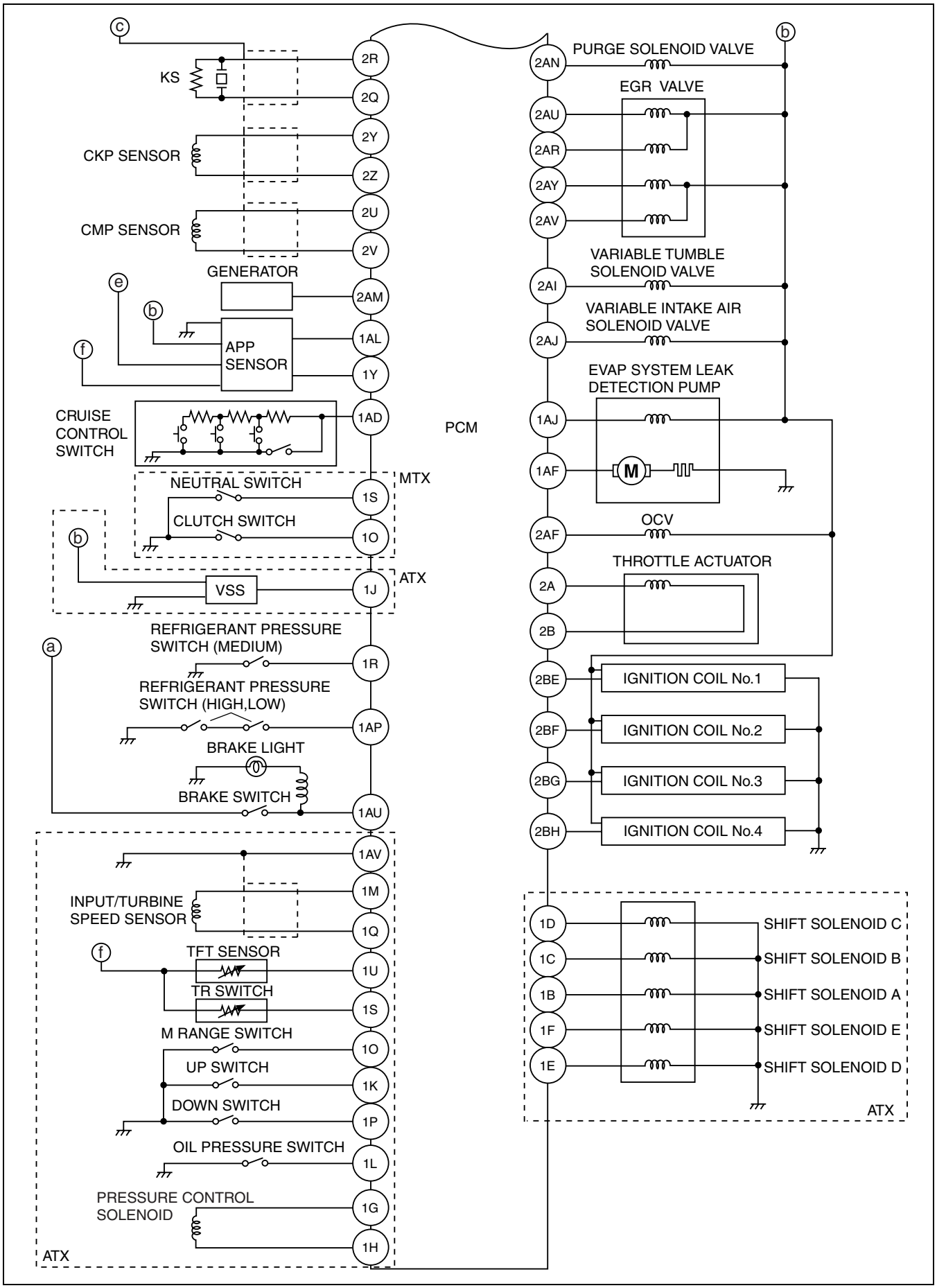
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ENGINE CONTROL SYSTEM WIRING DIAGRAM [L3]

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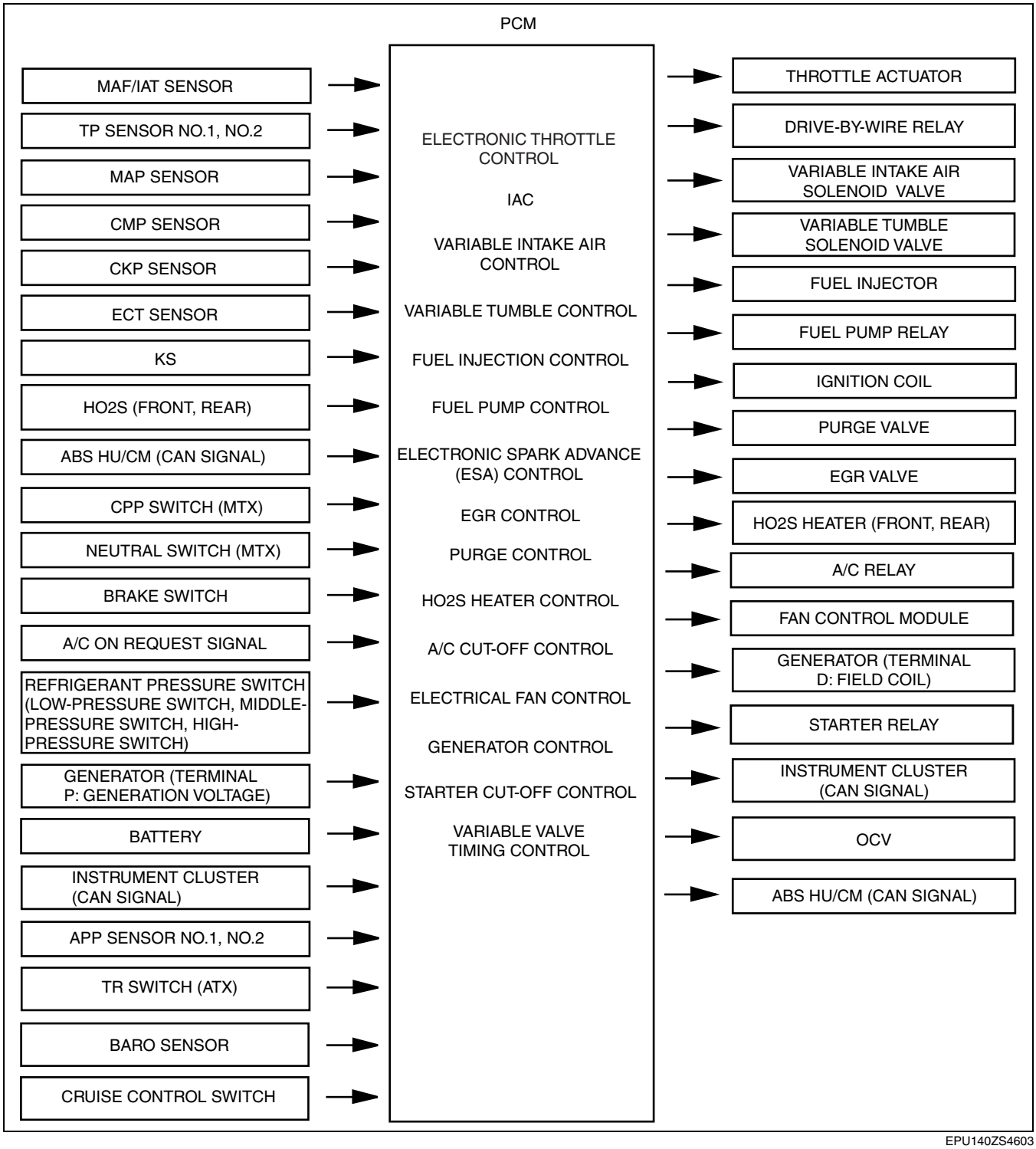
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ENGINE CONTROL SYSTEM BLOCK DIAGRAM [L3]

EPU014000000S05



EPU140ZS4603

ENGINE CONTROL SYSTEM RELATION CHART [L3]

EPU014000000S06

X: Applied

Item	ELECTRONIC THROTTLE CONTROL	IAC	VARIABLE INTAKE AIR CONTROL	VARIABLE TUMBLE CONTROL	VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	ESA CONTROL	EGR CONTROL	EVAPORATIVE PURGE CONTROL	HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	STARTER CUT-OFF CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	CRUISE CONTROL	CAN
Input device																	
IAT sensor		X				X		X	X	X	X				X		
MAF sensor		X			X	X		X	X	X	X						
TP sensor No.1, No.2	X	X		X	X	X		X	X	X	X	X	X				
APP sensor No.1, No.2	X	X				X		X				X					
MAP sensor		X				X		X				X					
ECT sensor		X		X	X	X		X	X	X	X	X	X		X		
CMP sensor					X	X		X									
CKP sensor		X	X	X	X	X	X	X	X	X	X	X			X		
KS								X									
Front HO2S						X											
Rear HO2S						X											
BARO sensor		X				X					X						
Neutral switch (MTX)		X				X		X				X				X	
CPP switch (MTX)		X				X		X				X				X	
TR switch (ATX)		X				X		X				X					
Brake switch		X				X		X								X	
Instrument cluster (A/C on request signal)		X				X		X				X	X				
Refrigerant pressure switch (low pressure switch, high pressure switch)		X				X		X				X	X				
Refrigerant pressure switch (medium pressure switch)		X											X				
Battery						X					X		X		X		
Generator (Terminal P: starter coil)		X											X		X		
Vehicle speed signal		X				X			X	X			X		X	X	X
Cruise control switch																X	
Instrument cluster (CAN signal)		X															X
Output device																	
Throttle actuator	X	X														X	
Drive-by-wire relay	X																
Variable intake air solenoid valve			X														
Variable tumble solenoid valve				X													
OCV					X												
Fuel injector						X											
Fuel pump relay							X										
Ignition coil								X									

Item	ELECTRONIC THROTTLE CONTROL	IAC	VARIABLE INTAKE AIR CONTROL	VARIABLE TUMBLE CONTROL	VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	ESA CONTROL	EGR CONTROL	EVAPORATIVE PURGE CONTROL	HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	STARTER CUT-OFF CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	CRUISE CONTROL	CAN
EGR valve									X								
Purge solenoid valve										X							
Front HO2S heater											X						
Rear HO2S heater											X						
A/C relay												X					
Fan control module													X				
Starter relay														X	X		
Generator (Terminal D: field coil)															X		
ABS HU/CM (With ABS) (CAN signal)																	X
Instrument cluster (CAN signal)																	X

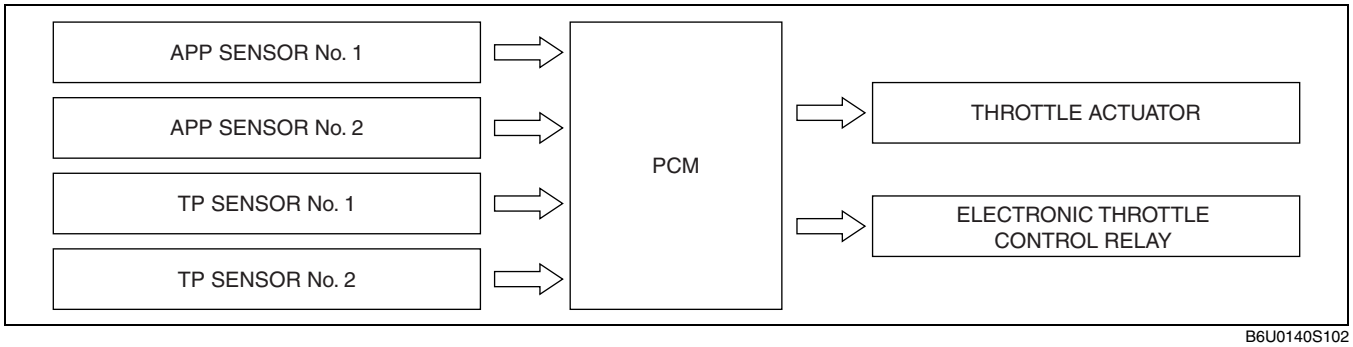
ELECTRONIC THROTTLE CONTROL OUTLINE [L3]

EPU014000000S07

- By controlling the throttle actuator, the PCM sets an optimal throttle valve opening angle according to the engine conditions.
- The PCM calculates a target throttle valve opening angle based on the accelerator pedal depression amount. The PCM sends electrical current to the throttle actuator to achieve the target opening angle.
- The engine idling speed can be controlled through PCM control of the throttle valve. Due to this, the previous IAC valve has been eliminated.

ELECTRONIC THROTTLE CONTROL BLOCK DIAGRAM [L3]

EPU014000000S08



B6U0140S102

ELECTRONIC THROTTLE CONTROL OPERATION [L3]

EPU014000000S09

Target Throttle Valve Opening Angle Calculation

- The PCM calculates the target throttle valve opening angle based on signals from accelerator pedal position (APP) sensors No.1 and No.2.
- In order to change the actual throttle valve opening angle to the calculated target opening angle, the PCM controls the direction and size of the current sent to the throttle actuator.
- Throttle position (TP) sensors No.1 and No.2 detect the actual throttle valve opening angle.

Throttle Valve Opening Angle Learning

- After the ignition switch is turned off, the PCM opens and closes the throttle valve. At this time, the input voltage of the TP sensor at the fully closed position and the fully open position is stored.
- This learned voltage measurement at the fully closed and open position is used when correcting the throttle opening angle.

Fail-safe

- If the PCM detects any of the following malfunctions, it limits the throttle valve opening angle, performs fuel cut and other control measures to limit engine output, as well as stopping the flow of electricity to the throttle actuator. When this flow of electricity is stopped, the throttle valve is limited to the minimum opening angle possible for driving:
  - — TP sensor No.1 malfunction
  - — TP sensor No.2 malfunction
  - — APP sensor No.1 malfunction
  - — APP sensor No.2 malfunction
  - — Throttle actuator malfunction
  - — PCM internal circuit (for electronic throttle control) malfunction
  - — Throttle body (throttle valve and return spring) malfunction

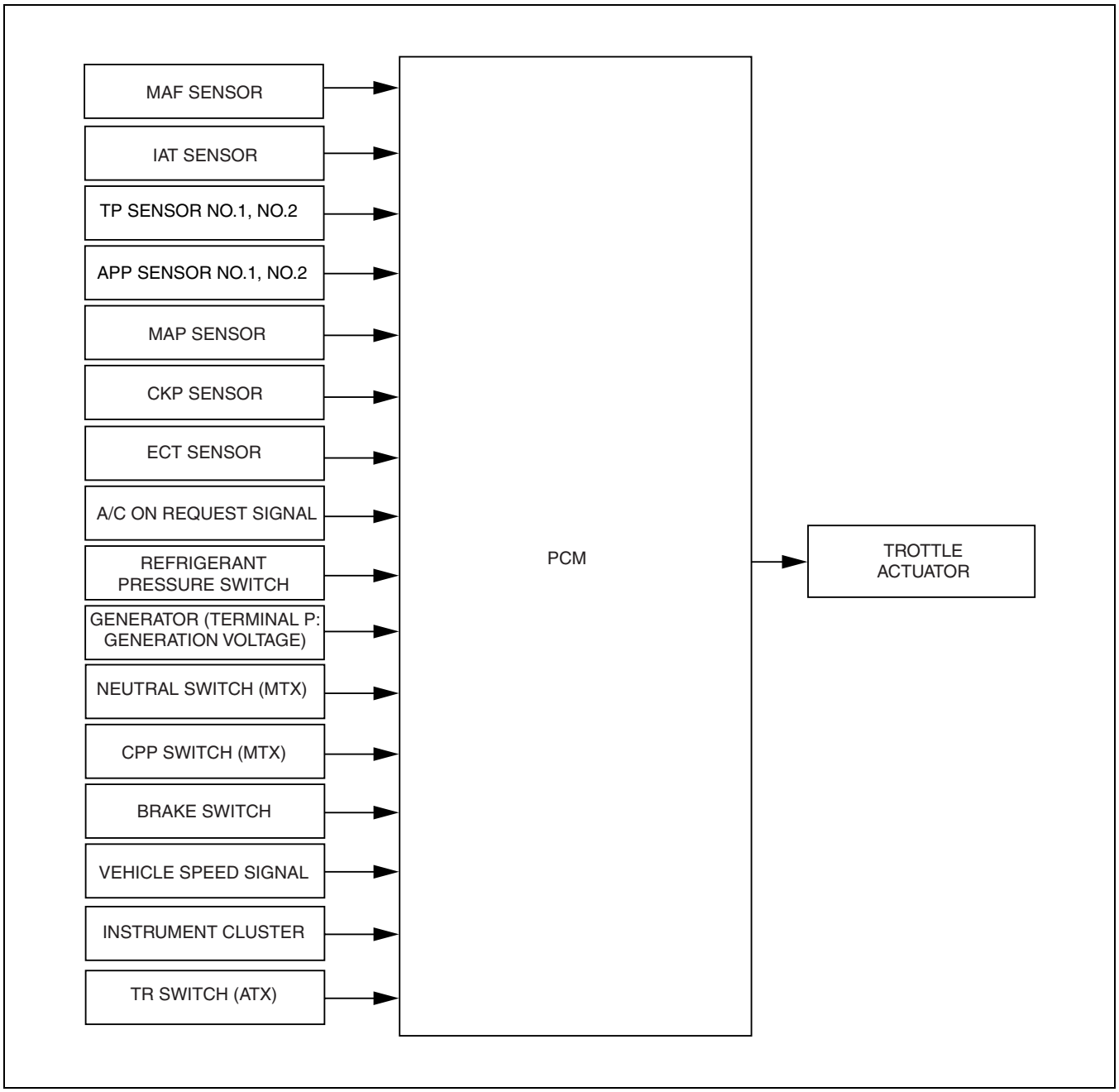
IDLE AIR CONTROL (IAC) OUTLINE [L3]

EPU014000000S10

- In order to ensure idling stability, the PCM controls the throttle valve and sets an optimal throttle valve opening angle based on the engine operating conditions.

IDLE AIR CONTROL (IAC) BLOCK DIAGRAM [L3]

EPU014000000S11



EPU0140S006

IDLE AIR CONTROL (IAC) OPERATION [L3]

EPU014000000S57

Target throttle valve opening angle determination

- The PCM calculates the intake airflow amount required to provide idling stability (IAC target airflow amount), and according to that, determines the target throttle valve opening angle.
- When the engine is cranking, the PCM sets the IAC target airflow amount according to the engine coolant temperature, and opens the throttle valve to that set value.

IAC target airflow amount

- The IAC target airflow amount is calculated by the PCM by subtracting the estimated value for the intake airflow amount which does not pass through the throttle valve from the calculated intake airflow amount required for idling stability (required volume weight).

  Required volumetric airflow amount

  — The required volumetric airflow amount is calculated from the target charging efficiency as corrected by the changes in intake airflow amount (due to the difference in vacuum pressure in the areas before and after the throttle valve) and in intake airflow density (which changes according to intake airflow temperature change).

  Target charging efficiency

  — The target charging efficiency is the charging efficiency* required to match engine operating conditions.

  — The target charging efficiency is calculated by adding all necessary corrections matching engine operating conditions to the basic charging efficiency as determined according to engine coolant temperature.

* : Charging efficiency is the ratio of the actual intake airflow amount over the maximum amount of airflow (mass) which can fill a cylinder. This figure grows larger in proportion to the increase in engine load.

Correction	Target	Conditions	Correction amount
A/C load correction	Prevents decrease in idle speed due to A/C operation.	A/C is operating.	A/C operation time→correction
Electrical load correction	Prevents decrease in idle speed due to electrical load operation.	Idle speed during electrical load operation and under any condition during driving	High electrical load→large correction
D-range correction (ATX)	Prevents decrease in idle speed due to shifting into D-range	D-range signal is input.	Low idle speed when shifted to D range→large correction
Dashpot correction	Prevents decrease in idle speed due to insufficient intake air amount during deceleration.	Decelerated	High engine speed→large correction
Correction at engine start	Prevents decrease in idle speed after engine start.	After cranking and engine start	Low ECT→large correction
Hot engine restart correction	Prevents decrease in idle speed from hot engine restart.	Just after cranking and engine start when the ECT is **60 °C {140 °F} or more the IAT is 50 °C {122 °F} or more**	High intake airflow temperature→large correction
Feedback correction A	Sets idle speed to target engine speed.	Idle speed during idling (vehicle is stopped) is over or under the target engine speed (except during test mode when the engine speed is **300 rpm or less**).	Actual idle speed Target engine speed or less→volume increase correction Target engine speed or more→volume decrease correction
Feedback correction B	Sets to the target engine speed when the idle speed has decreased in the range not corrected by feedback correction A, and prevents a decrease in idle speed.	During deceleration at fully closed throttle, the engine speed is the target engine speed or more and when the feedback correction A is not performed (except during test mode).	Large difference between actual idle speed and target engine speed→large correction
Engaged coasting clutch volume increase correction	Reduces shock when the transaxle coasting clutch is engaged.	When coasting clutch is engaged.	High vehicle speed→large correction
Learning correction	Stores intake air volume changes based on differences between engines and changes due to aged deterioration, and feedback.	During feedback correction A when ECT is **85 °C {185 °F} or more**.	During idling→average value of feedback correction A

Target idle speed

- The target idle speed for various engine operation conditions are as follows:

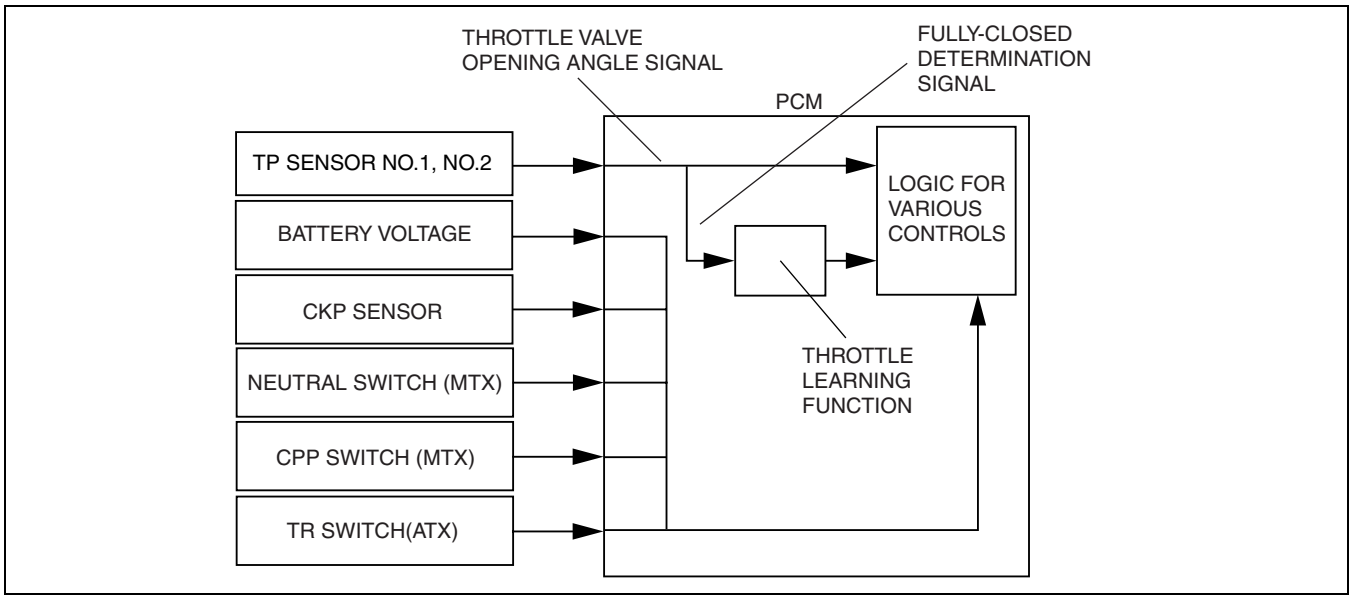
Standard

Load status		Idle speed (rpm) N position, D range (ATX), Neutral position (MTX)		
		ATX		MTX
		N position	D range	
No load		650—750	550—650	600—700
Electrical loads on*1	38—48 A	650—750	600—700	650—750
	Above 48 A	700—800	670—770	700—800
A/C on	Low load*2	650—750	650—750	700—800
	High load*3	670—770	670—770	700—800

*1 : Generator generating current value
*2 : Refrigerant pressure switch (medium pressure switch) is off.
*3 : Refrigerant pressure switch (medium pressure switch) is on.

FULLY-CLOSED THROTTLE POSITION LEARNING FUNCTION BLOCK DIAGRAM [L3]

EPU014000000S14



C3U0140S007

FULLY-CLOSED THROTTLE POSITION LEARNING FUNCTION OPERATION [L3]

EPU014000000S15

Fully-closed throttle learning value (fully-closed throttle voltage value) update

- If the calculated average value for the fully-closed throttle falls below the current fully-closed throttle learning value, the PCM updates the calculated average value as a new value.
- When the throttle valve is considered to be fully-closed, the average fully-closed throttle value when all of the following conditions are met is calculated by averaging several sample values that are detected.
  - — No load with vehicle stopped (MTX: neutral, ATX: P or N position)
  - — If throttle valve opening angle has not changed
  - — Other than when in test mode
  - — Engine speed is **less than 3,000 rpm**.

Inhibition condition of fully-closed throttle learning

- If any of the following conditions are met, the PCM determines that there is a fully-closed throttle learning difficulty and substitutes a set value (fixed value) for the fully-closed throttle learning value.
  - — During Test mode
  - — Throttle position sensor damage (DTCs P0122, P0123 detected)
  - — Battery terminals reconnected
  - — If fully-closed throttle learning value exceeds the set upper limit value
  - — If fully-closed learning value decreases below set lower limit value.

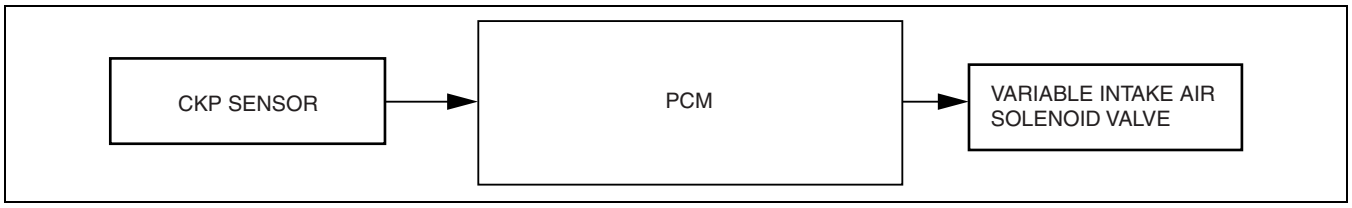
VARIABLE INTAKE AIR CONTROL OUTLINE [L3]

EPU014000000S16

- Energizes the variable intake air solenoid valve according to engine speed for enhanced inertia charging effect.

VARIABLE INTAKE AIR CONTROL BLOCK DIAGRAM [L3]

EPU014000000S17



EPU0140S008

VARIABLE INTAKE AIR CONTROL OPERATION [L3]

EPU014000000S18

- The PCM energizes the variable intake air solenoid valve when the engine speed is **less than 4,600 rpm**, opening the variable intake air shutter valve to enhance the inertia charging effect at the low engine speed range.
- The PCM blocks energization to the variable intake air solenoid valve when the engine speed is **4,600 rpm or more**, closing the variable intake shutter valve to enhance the inertia charging effect at the high engine speed range.

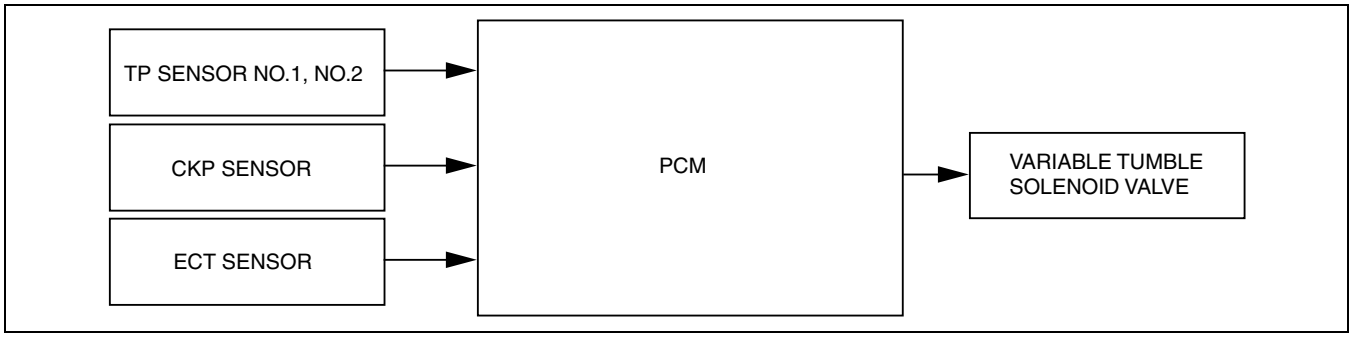
VARIABLE TUMBLE CONTROL OUTLINE [L3]

EPU014000000S19

- At cold engine start, the following occur due to the closing of the variable tumble shutter valve for improved cold engine exhaust emission performance.
  - — Improved intake airflow speed near injectors
  - — Strong air tumble occurs in the combustion changer, promoting vaporization mixture of intake air and fuel

VARIABLE TUMBLE CONTROL BLOCK DIAGRAM [L3]

EPU014000000S20



C3U0140S009

VARIABLE TUMBLE CONTROL OPERATION [L3]

EPU014000000S21

Operation conditions

- When all of the following conditions are met, the PCM energizes the coil of variable tumble solenoid valve. As a result, negative pressure is introduced to the diaphragm chamber of the variable tumble shutter valve actuator, pulling the actuator rod and closing the variable tumble shutter valve.
  - — Engine speed **less than 3,750 rpm**
  - — Engine coolant temperature less than **less than 60 °C {140 °F}**
  - — Throttle valve opening angle is at the specified value or less (changes according to engine speed)

Inhibition conditions

- When a DTC for the engine coolant temperature sensor or throttle position sensor has been stored, the variable tumble control is inhibited and the variable tumble shutter valve is constantly open.

VARIABLE VALVE TIMING CONTROL OUTLINE [L3]

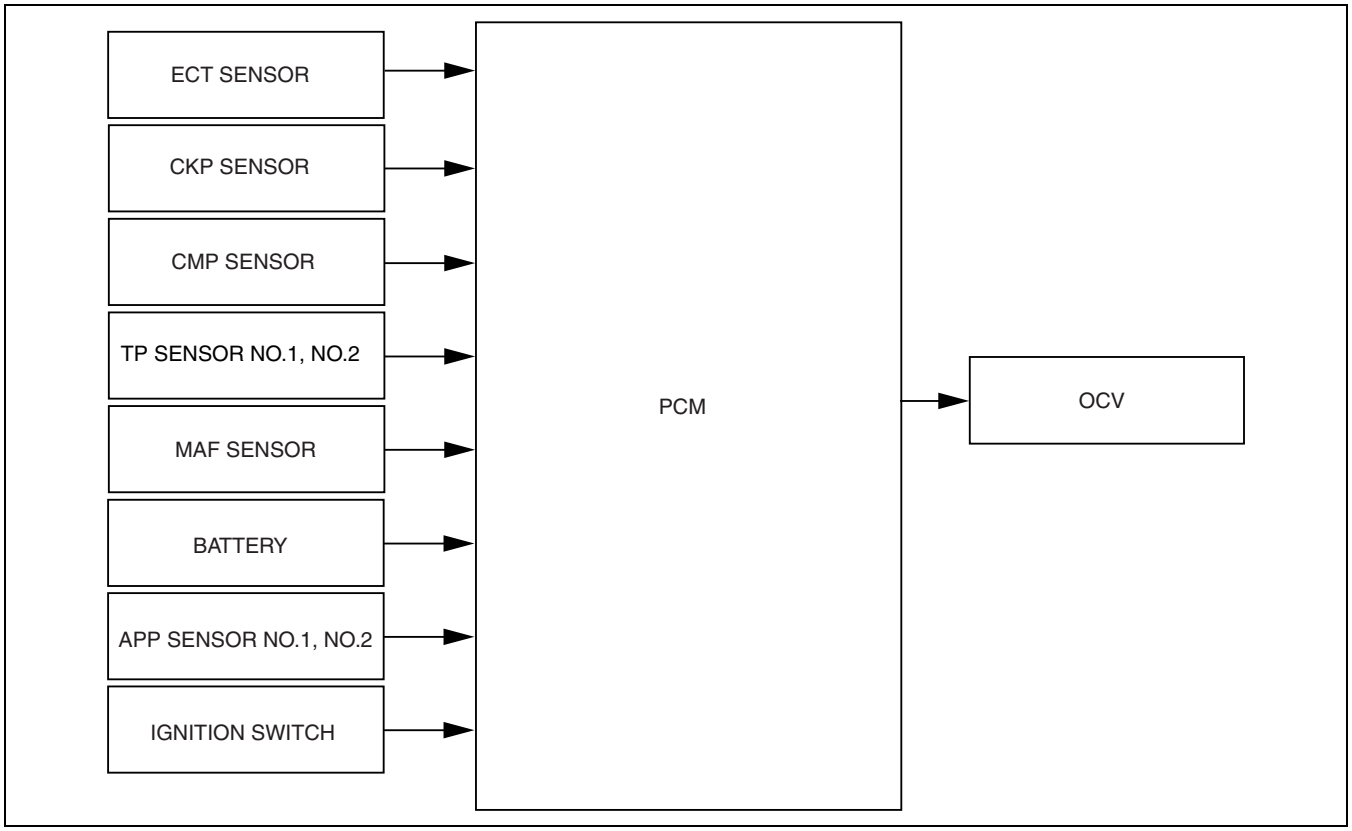
EPU014000000S22

- Variable valve timing control changes the intake valve timing according to engine operation conditions to improve engine output, fuel economy, and exhaust emission performance.

VARIABLE VALVE TIMING CONTROL BLOCK DIAGRAM [L3]

EPU014000000S23

- Based on the signals from the input sensors, the PCM determines the valve timing suitable for the engine operation conditions, drives the OCV, and switches the hydraulic passages of the variable valve timing actuator to provide appropriate valve timing.



C3U0140S010

VARIABLE VALVE TIMING CONTROL OPERATION [L3]

EPU014000000S24

- The PCM divides the oil control valve OCV drive range into four modes according to engine operation conditions. The OCV drive current is determined based on the target current calculated in each mode.

Cleaning Mode
Mode execution condition

- When the following condition is met:
  — IAC feedback execution condition

Purpose

- Cleaning mode is to remove foreign material in the OCV hydraulic passages.

Operation

- The target current in the cleaning mode is fixed at **100 mA** or **1,000 mA**. A current of **100 mA** and **1,000 mA** flows to the OCV alternately at certain intervals. When **100 mA** current is supplied, the OCV opens the hydraulic passage for the retard chamber and hydraulic pressure from the oil pump is introduced to the retard chamber. When **1,000 mA** current is supplied, the OCV opens the hydraulic passage for the advance chamber and hydraulic pressure is introduced from the oil pump to the advance chamber. After repeating this operation several times, foreign material mixed in the OCV is removed and the cleaning mode is completed.

Maximum Cam Retard Mode
Mode execution condition

- When any of the following conditions are met:
  — Cranking
  — Idling after completion of cleaning mode
  — DTC stored for the following devices:
    - ECT sensor, CKP sensor, CMP sensor, TP sensor, MAF sensor, OCV

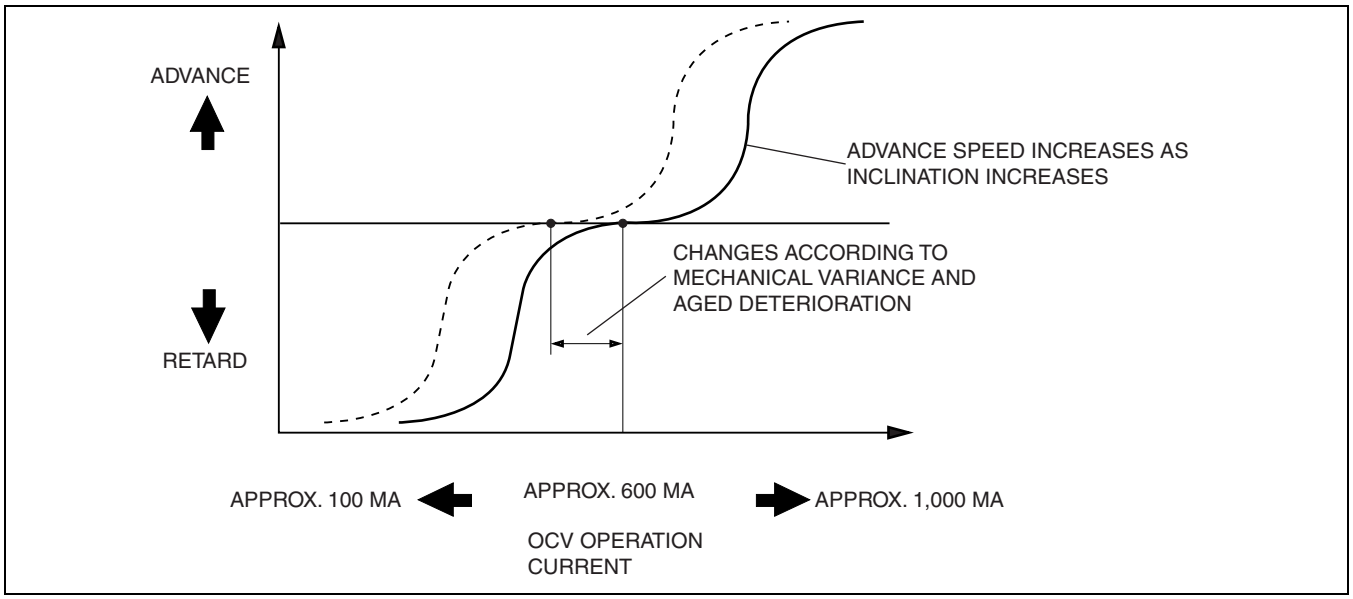
Purpose
- Maximum cam retard mode stabilizes engine speed by maximally retarding the valve timing when the engine speed is low during idling.

Operation
- When the target current in the maximum cam retard mode is fixed at **100 mA**. When **100 mA** current is supplied, the OCV opens the hydraulic passage for the retard chamber and hydraulic pressure from the oil pump is introduced to the retard chamber. Because of this, the variable valve timing actuator is fixed at the maximum retard position (minimum overlap).

Feedback Hold Mode
Mode execution condition
- Target valve timing and actual valve timing are almost the same.

Purpose
- The feedback hold mode holds the valve timing by returning the OCV spool valve to the neutral position when target valve timing suitable for the engine operation conditions is obtained.

Operation
- Though the target current in the feedback hold mode is basically around **600 mA**, feedback operation is performed at all times so that the present OCV drive current approaches the target current. Because the hold current changes due to mechanical variation between engines and deterioration due to aging on OCV internal parts, the PCM continues to learn the changing current (hold current learning value) to maintain the spool valve in the neutral position.



C3U0140S011

Feedback Mode
Mode execution condition
- Except during cleaning, maximum cam retard, or feedback hold modes.

Purpose
- Feedback mode obtains valve timing suitable for engine operation conditions by performing the feedback operation so that present OCV drive current is set closer to the target current determined by the PCM according to engine operation conditions.

Operation
- Based on engine operation conditions, the target current is set between **100 mA** (maximum retard) and **1,000 mA** (maximum advance), using the neutral point of approx. **600 mA** as a reference. Actually, the target current is calculated by subtracting the current necessary for obtaining the target advance/retard amount, using a reference at the hold-current learning value calculated from the neutral position of the spool valve.

Advance spark speed correction
- If there is a large difference between the target valve timing and the actual valve timing, the target current correction is applied so that it is set closer to the target valve timing more quickly to raise the advance spark speed by advancing the spool valve initialization operation.
- The variable valve timing actuator advance spark speed increases as the hydraulic passage in the OCV widens and decreases as it narrows.

Valve timing determination
- The PCM controls current to the OCV to obtain optimum valve timing suitable for the engine operation conditions (target valve timing).
- The PCM compares target valve timing with actual valve timing, and feeds back the result to change valve timing smoothly.

Target valve timing
- Determined according to engine speed and charging efficiency.

Actual valve timing
- Means present valve timing. Actual valve timing is calculated by adding the maximum cam retard learning value for energization from the value detected by the CMP and CKP sensors.

Cam maximum retard learning value
- Though the intake camshaft valve timing (including maximum retard position) is detected based on the difference between the signal from the sensor and signal from the CKP sensor, the difference between the signals deviates due to the sensor installation condition. Because of this, the PCM stores the difference between the signal build-ups at the maximum OCV retard position to prevent deviation in valve timing detection.

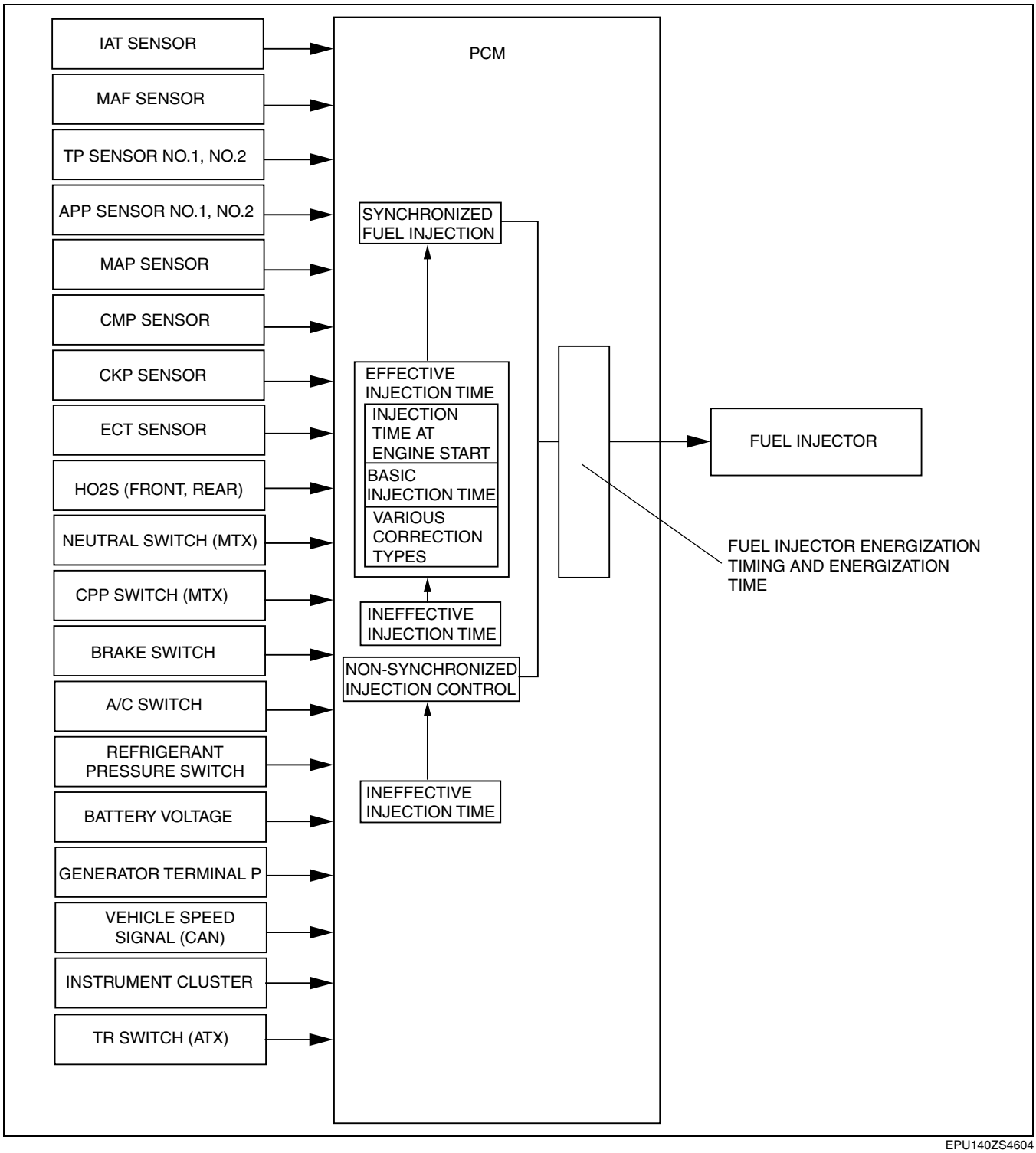
FUEL INJECTION CONTROL OUTLINE [L3]

EPU014000000S25

- Performs optimum fuel injection according to engine operation conditions.
- The PCM determines the engine operation conditions based on the signals from the following input devices and drives the injectors at the optimum fuel injection time (fuel injection amount) and the fuel injection timing to inject fuel. For the construction/operation of the fuel injector, refer to “FUEL SYSTEM, FUEL INJECTOR CONSTRUCTION/OPERATION”.

FUEL INJECTION CONTROL BLOCK DIAGRAM [L3]

EPU014000000S26



EPU140ZS4604

FUEL INJECTION CONTROL OPERATION [L3]

EPU014000000S27

Operation

Injection timing

- There is synchronized fuel injection, which performs fuel injection by the setting of the crankshaft position, and non-synchronized fuel injection which performs fuel injection when the condition for fuel injection is met regardless of the crankshaft position.

Synchronized fuel injection

- The crankshaft rotation is synchronized by each intake and exhaust stroke of the cylinders, and fuel injection is performed by the fuel injection timing and the injection amount corresponding to the input signals of the following sensors.
  — CKP sensor, MAF sensor, ECT sensor, IAT sensor

Non-synchronized fuel injection

- The crankshaft rotation is not synchronized and fuel injection is performed by the injection timing and injection amount as triggered by the input signals of the following sensors.
  — TP sensor, MAF sensor, ECT sensor, IAT sensor

Relation between synchronized and non-synchronized fuel injection

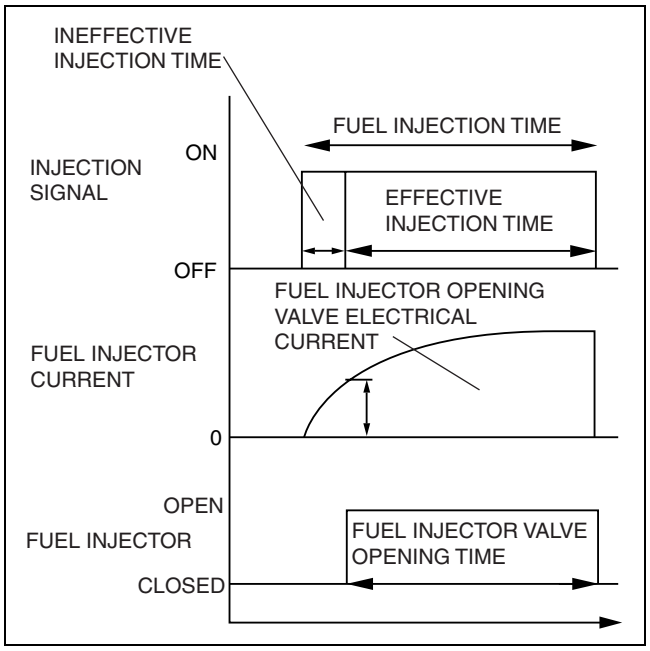
- If synchronized and non-synchronized fuel injection happen to occur together, fuel is injected by adding the fuel injection timing of both.

Injection time

- The PCM calculates the fuel injection amount according to the engine operation conditions as the fuel injection time and energizes the fuel injectors.

Fuel injector energization time and operation conditions

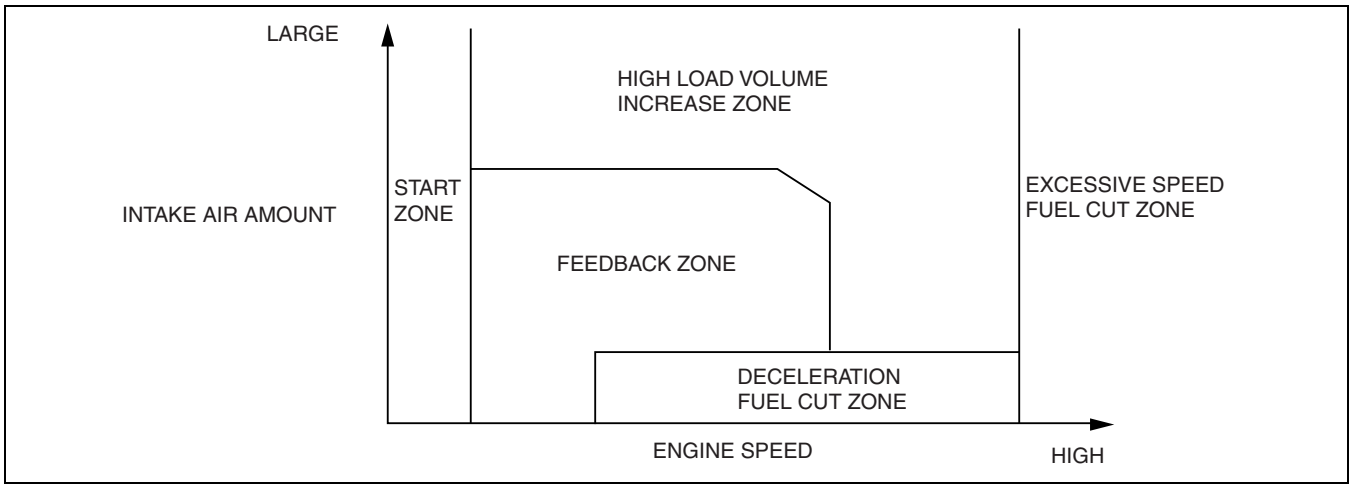
- The fuel injectors cause an operation delay with the start of energization from the PCM. The PCM calculates the fuel injection time by adding the non-injection time (ineffective injection time) with the actual injection time (effective injection time), and energizes the fuel injectors for this time.
- The fuel injection time is based on the following formula:
  Fuel injection time = effective injection time + ineffective injection time
  Ineffective injection time
  — The fuel injectors cause a delay in operation due to a delay in the build-up of operation current from coil inductance with the start of energization, and by the mass of the needle valve and plunger, and spring resistance. This delay is the ineffective injection time.
  — The non-injection time is affected by the change in battery voltage. Accordingly, the PCM sets the non-injection time according to the battery voltage
  Effective injection time
  — The fuel injector opening valve time which is the actual fuel injection time is called the effective injection amount.



C3U0140S014

Determination of effective injection time

- The PCM divides the engine operation conditions into control zones according to engine speed and engine load and determines the effective injection time at each control zone to perform optimum air/fuel ratio control in all engine driving ranges.



C3U0140S015

Start zone
Purpose

- Improved engine startability

Operation condition

- When engine speed is **500 rpm or less**.

Determination of fuel injection time

- According to engine coolant temperature (ECT sensor) and engine speed (CKP sensor)

Feedback Zone
Purpose

- Improved fuel economy
- Improved exhaust gas purification

Control condition

- During engine operation other than high load volume increase zone and engine start zone.

Determination of fuel injection time

- During normal driving, the amounts of various correction types are added to the basic injection time to set to the theoretical air/fuel ratio.

High load volume increase zone
Purpose

- Improved driveability
- TWC protection

Control condition

- Either the charging efficiency or the throttle valve opening angle is a fixed value or more.

Determination of fuel injection time

- Corrections are added to the basic injection amount and the high load coefficient is calculated according to the engine speed, mass intake airflow amount and the throttle valve opening angle.

Excessive speed fuel cut zone
Purpose

- Engine protection

Control conditions

- When the engine speed is **6,800 rpm or more** (WOT).
- When engine speed is **5,500 rpm or more** and the engine coolant temperature is **approx. -15 °C {5 °F} or less**.
- When the following conditions continue for **2 min or more**:
  - — Vehicle is stopped.
  - — Engine speed is **5,000 rpm or more**.
  - — Engine coolant temperature is **approx. 117 °C {243 °F}**.

Note

- The PCM determines that the driver continues to unintentionally depress the accelerator pedal

Determination of fuel injection time
- Fuel injection time is set to 0 (fuel cut).

Deceleration fuel cut zone
Purpose
- Improved fuel economy
- Prevents overheating of the catalytic converter

Control conditions
- When the engine conditions are as follows (**10 s or longer** after engine start):
  — Fully closed throttle valve
  — When the engine speed is at set value or more (differs depending on the ECT) (charging efficiency at fixed value or more, mass airflow sensor normal)

Determination of fuel injection time
- The fuel injection time is set to 0 (fuel cut).

Calculation method list for fuel injection time

A: Fuel injection time base, B: Correction for fuel injection time

Contents (Fuel injection time, calculation method, or determination method)		Control zone				
		Start	Feedback	High load volume increase	Excessive speed fuel cut	Deceleration fuel cut
Injection time at start	**Set value according to engine coolant temperature (low engine coolant temperature→long injection time)**	A				
Basic injection time	**Basic injection time = charging efficiency x fuel flow coefficient**		A	A		
Fuel cut	**Fuel injection time = 0**				A	A
Ineffective injection time	**Set time according to injector performance**	A	A	A		
Volume increase correction at engine start	Purpose: Maintains stability of engine speed just after engine start **Correction condition** • Specified time according to engine coolant temperature directly after engine start **Correction amount** • Low engine coolant temperature→large correction • Low intake air temperature→large correction	B	B			
Front HO2S feedback correction	Purpose: Controls air/fuel ratio to the theoretical air/fuel ratio **Correction condition** • When engine coolant temperature is at set value or more **Correction amount** • Front HO2S electromotive force is approx. **0.45 V or more**→volume decrease correction • Front HO2S electromotive force is approx. **less than 0.45 V** →volume increase correction		B			
Rear HO2S feedback correction	Purpose: Corrects feedback amount according to deterioration of front HO2S and catalytic converter **Correction condition** • Engine coolant temperature is at set value or more • Engine speed is **500—4000 rpm** • Charging efficiency is **10—80%** **Correction amount** • According to rear HO2S electromotive force→correction		B			
D-range correction (ATX)	Purpose: Ensures engine speed stability during D-range shifting **Correction condition** • Throttle valve fully-closed and shifted into D range **Correction amount** • Low engine coolant temperature→large correction		B			

High load volume increase correction	Purpose: Improved engine output, decrease of exhaust gas temperature **Correction condition** • According to engine speed when the throttle valve opening angle is the fixed value or more, otherwise, according to engine speed and charging efficiency **Correction amount** • High engine speed, high charging efficiency→large correction			B		
Warm-up volume increase correction	Purpose: When engine coolant temperature is low, maintains combustion stability **Correction condition** • While at set engine coolant temperature **Correction amount** • High charging efficiency, low engine coolant temperature→large correction		B	B		
A/C load increase correction	Purpose: Maintains engine speed stability during A/C operation **Correction condition** • A/C is operating **Correction amount** • Low engine coolant temperature→large correction		B	B		
Acceleration increase correction	Purpose: Corrects fuel injection delay during acceleration to ensure drive stability **Correction condition** • When acceleration amount (change in the amount of charging efficiency) is at set value or more **Correction amount** • Low engine coolant temperature→large correction • Large acceleration amount→large correction		B	B		
Deceleration volume increase correction	Purpose: Ensures engine speed stability after fuel cut recovery **Correction condition** • When recovery from fuel cut **Correction amount** • Low engine speed→large correction		B			
Learning correction	Purpose: Corrects deviation in air/fuel ratio from changes due to aged deterioration of mechanical devices **Correction condition** • Under any condition except purge control **Correction amount** • Learning value based on average of feedback correction value		B	B		
Intake air pressure correction	Purpose: Corrects ineffective charging time deviation from change in intake manifold vacuum **Correction condition** • Under any condition except start zone **Correction amount** • More intake manifold vacuum→large correction		B	B		

Fuel cut
- Includes fuel cut under the following conditions except fuel cut at excessive engine speed according to engine operation and deceleration fuel cut.

Sensor damage fuel cut
Purpose
- To prevent engine damage from abnormal ignition due to a malfunction input of a cylinder identification or the engine speed signal.

Control condition
- When damage to the crankshaft position sensor or camshaft position sensor is detected.

Dechoke control
Purpose
- To improve engine starting startability when spark plugs are flooded.

Control conditions
- When cranking close to fully-open throttle valve

Fuel cut during immobilizer system activation
Purpose
- To prevent vehicle theft

Execution conditions
- When an engine stop request signal is received from the immobilizer system, the PCM force-stops the fuel injectors. Therefore the engine stops.

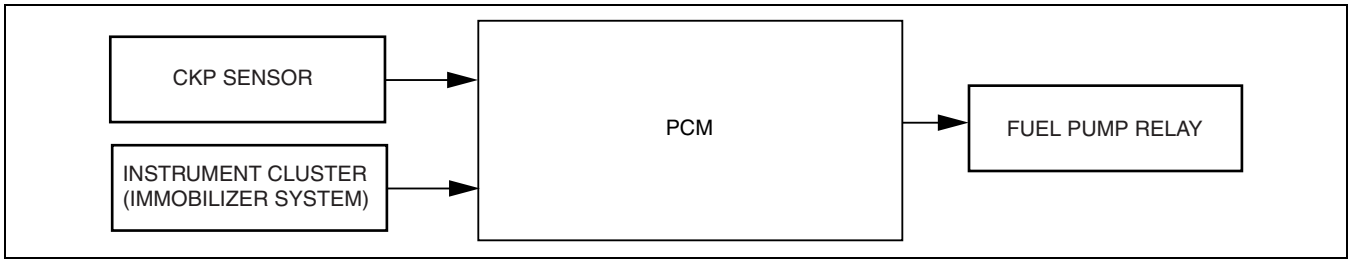
FUEL PUMP CONTROL OUTLINE [L3]

EPU014000000S28

- The fuel pump is operated when the ignition switch is turned to the ON position to improve startability. As a result, fuel pressure increases rapidly and stable fuel control is performed.

FUEL PUMP CONTROL BLOCK DIAGRAM [L3]

EPU014000000S29



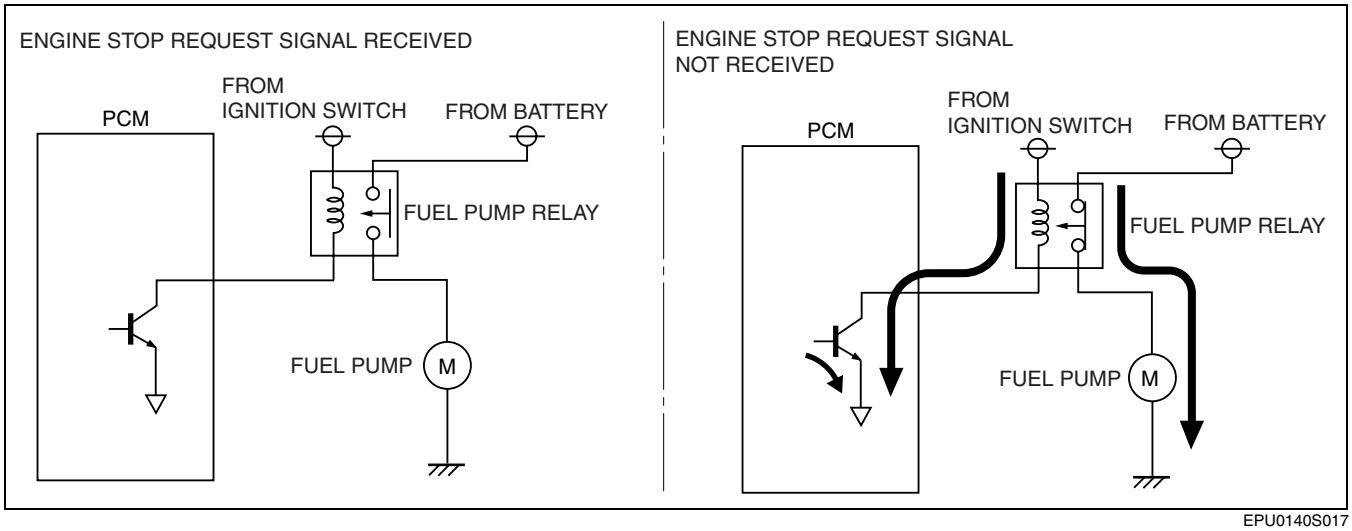
C3U0140S016

FUEL PUMP CONTROL OPERATION [L3]

EPU014000000S30

Operation Condition
- When the ignition switch is turned to the ON position, the PCM turns the fuel pump relay on for **1 s**, then off.
- When it is detected that the CKP signal rises during cranking, the fuel pump relay turns on.
- When the engine is stopped, the fuel pump relay turns off.

Operation Inhibition Condition
- When receiving an engine stop request signal from the immobilizer system, the PCM force-stops control of the fuel injectors. As a result, the engine does not start.



EPU0140S017

ELECTRONIC SPARK ADVANCE OUTLINE [L3]

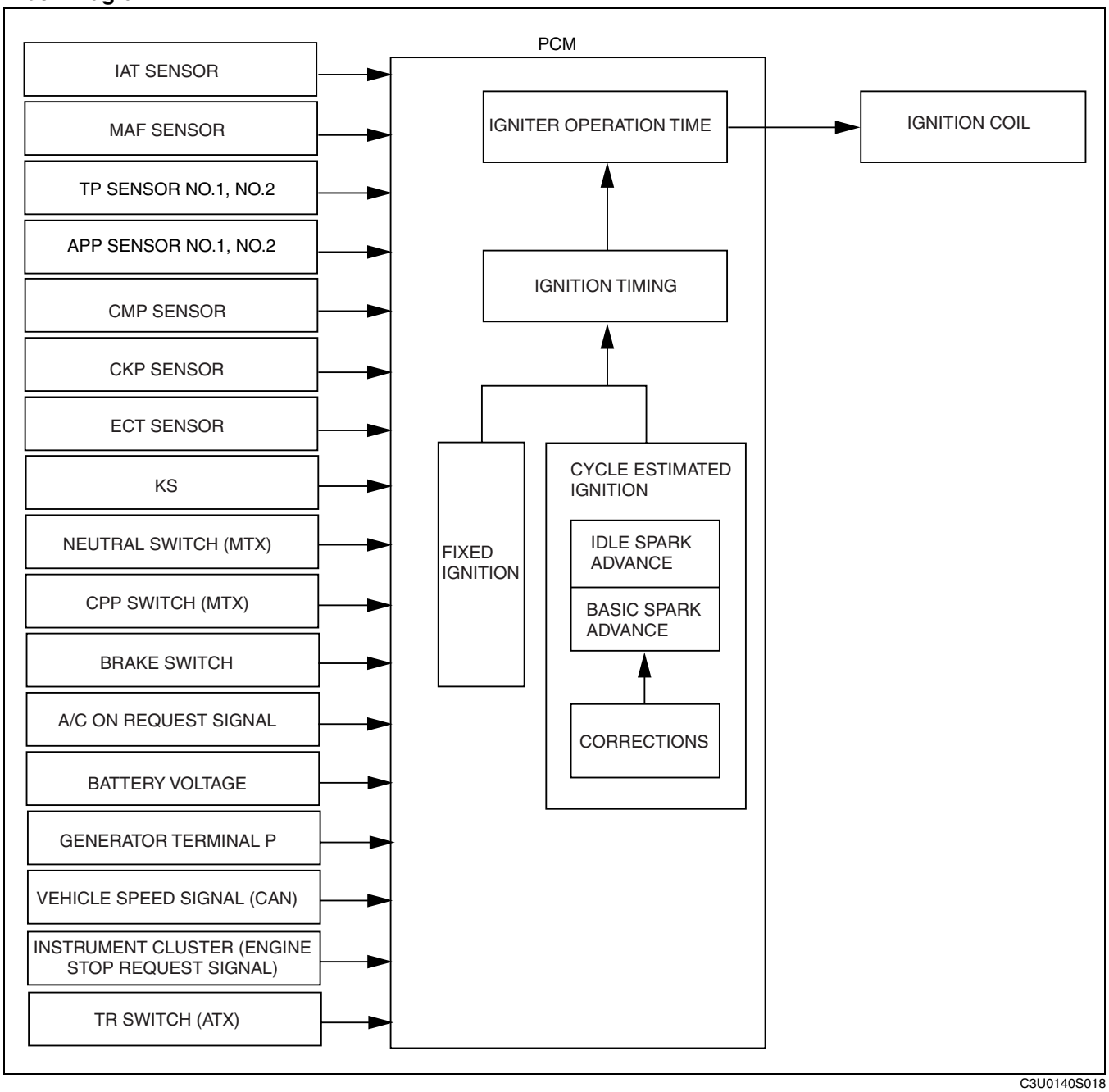
EPU014000000S31

- Controls ignition to optimum timing according to engine operation conditions.
- Serviceability has been improved by eliminating the necessity of ignition timing.
- The PCM determines the engine operation conditions based on input signals from sensors, blocks current to the ignition coils by the calculated ignition timing, and discharges (ignition) the sparks plugs based on the effect of electromagnetic mutual induction.

ELECTRONIC SPARK ADVANCE BLOCK DIAGRAM [L3]

EPU014000000S32

Block Diagram



C3U0140S018

ELECTRONIC SPARK ADVANCE OPERATION [L3]

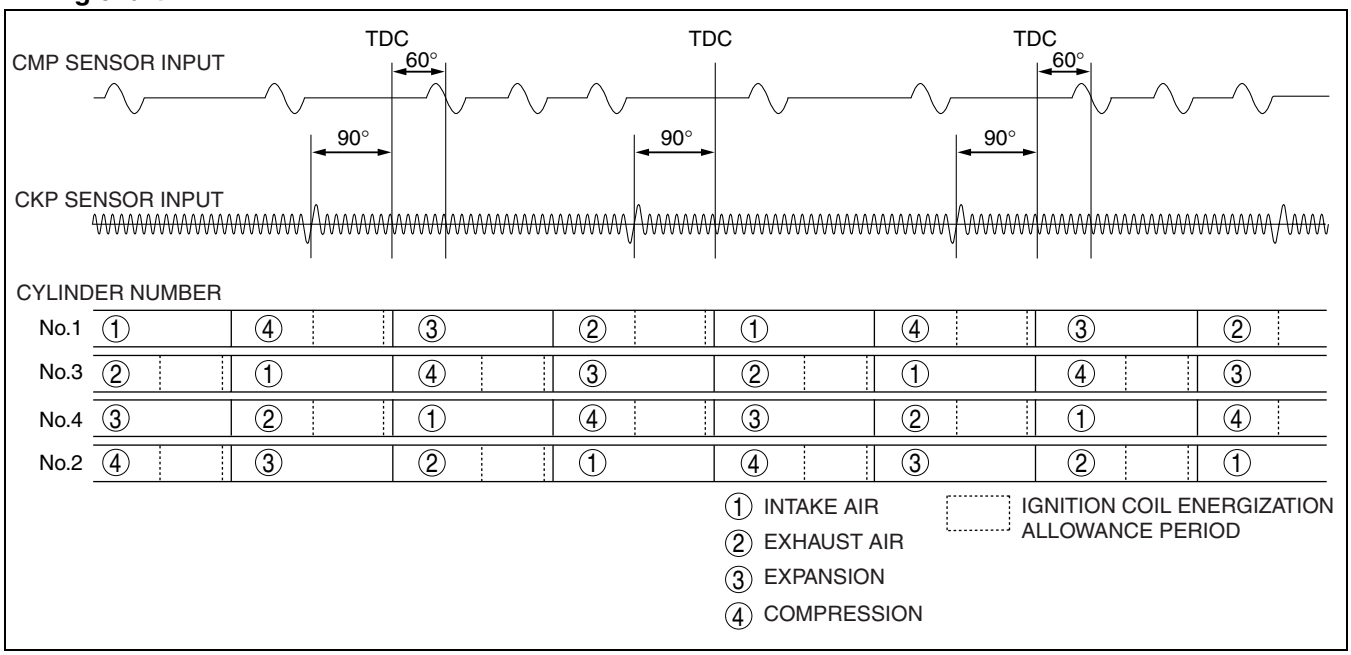
EPU014000000S33

Ignition method

- The PCM excites the ignition coils employing either fixed ignition or cycle estimated ignition according to engine operation conditions.

Ignition method	Ignition timing	Ignition coil energization period
Fixed ignition	Fixed at BTDC **10**°	Fixed period at BTDC **10**° to end of energization
Cycle estimated ignition	Ignition at timing appropriate to engine operation conditions based on input signals	• Energization time (ignition coil energization time) to igniter is determined according to battery voltage • Cylinder independent ignition

Timing chart

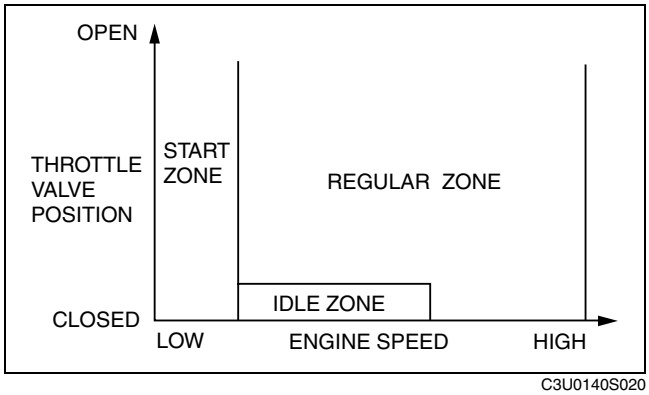


EPU140ZT4201

Determination of Ignition Timing

Division of control zones

- The PCM divides the engine control operations into each control zone according to the engine speed and throttle valve opening angle to determine the ignition timing by each of the control zones to perform optimum ignition control under all engine operation conditions.



C3U0140S020

Control zone	Control condition	Ignition method
Start zone	Engine speed is **500 rpm or less**. When mass airflow sensor is damaged.	Fixed ignition
Idle zone	Fully-closed throttle valve when engine speed is the target idle speed + **1,750 rpm or less**	Determines ignition timing adding each correction to the idle spark advance
Cycle estimated zone	Engine operation except start zone and idle zone	Determines ignition timing adding each correction to the basic spark advance

Ignition timing calculation method table

A: Ignition timing base, B: Correction for ignition timing

Contents		Calculation method or determination method for ignition timing, advance value and correction	Control zone		
			Start zone	Idling zone	Cycle estimated zone
Fixed ignition		**Fixed at BTDC approx. 10° CA**	A		
Cycle estimated ignition	**Idle spark advance**	Set value according to target speed and charging efficiency*		A	
	Basic spark advance	Set value according to engine speed and charging efficiency*			A
Correction	Engine coolant temperature advance correction	Purpose: Ensures combustion stability when engine coolant temperature is low **Except during idling** • High charging efficiency*, low engine coolant temperature→large correction		B	B
	Warm-up promotion spark retard correction	Purpose: Activates the catalytic converter earlier **Approx. 20.8 s after engine start** • According to engine coolant temperature→correction		B	
	Feedback correction	Purpose: Ensures idling stability **During idling (inhibited during test mode)** • Large difference between actual engine speed and target engine speed→large correction • Small difference between actual engine speed and target engine speed→small correction		B	
	EGR correction	Purpose: Prevents deviation of required ignition timing during EGR gas feed **When EGR valve position is the specified value or more except during EGR valve initialization** • According to engine speed and charging efficiency*→correction			B
	Deceleration fuel cut recovery retard correction	Purpose: Reduces shock after recovery from deceleration fuel cut and during re-acceleration while in deceleration fuel cut **Re-acceleration after recovery from deceleration fuel cut and while in deceleration fuel cut** • Low engine coolant temperature→large correction		B	B
	Acceleration spark retard correction	Purpose: Prevents knocking and shock during sudden acceleration **Acceleration when charging efficiency* volume increase (acceleration amount) is specified value or more** • High acceleration amount→high retard			B
	Standing start spark retard correction	Purpose: Prevents shock when vehicle accelerates from a standing start **When vehicle accelerates from a standing start** • According to engine speed, throttle valve opening angle, engine coolant temperature and intake air temperature→correction			B
	Knocking spark retard correction	Purpose: Knocking suppression **When knocking is detected while driving under high load** • Large amount of knocking→large correction			B

* : Charging efficiency is ratio of actual intake air amount to maximum air charging amount (mass volume) of cylinder. This value increases proportionately to the increase in engine load.

Ignition inhibition condition

- When receiving an engine stop request signal from the immobilizer system, the PCM force-stops control of ignition coils. As a result, the engine does not start.

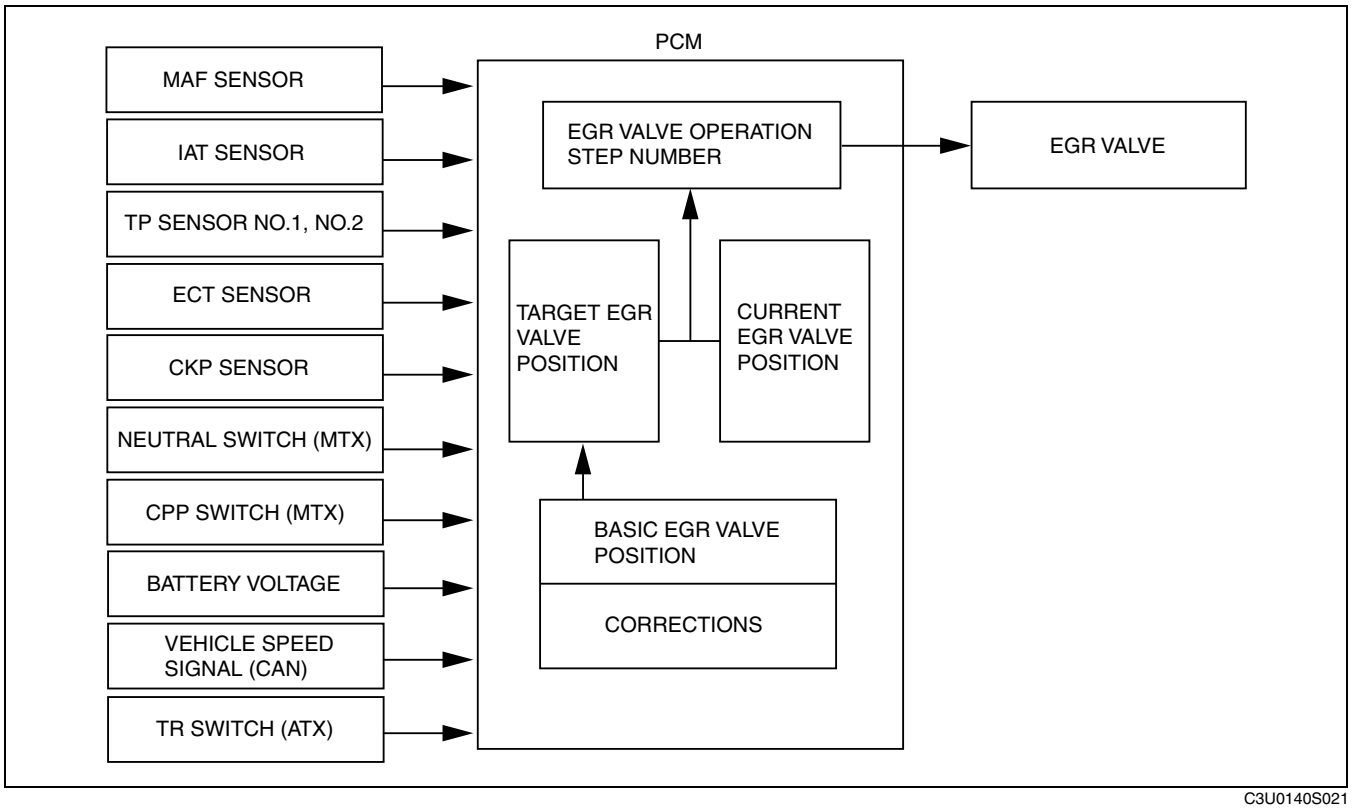
EGR CONTROL OUTLINE [L3]

EPU014000000S34

- Adjusts the EGR valve to the optimum opening angle according to engine operation conditions.
- The valve in the EGR valve allows for more precise control by being driven by the stepping motor.

EGR CONTROL BLOCK DIAGRAM [L3]

EPU014000000S35



C3U0140S021

EGR CONTROL OPERATION [L3]

EPU014000000S36

Stepping motor operation principles

- The PCM opens/closes the EGR valve by controlling the amount of stepping motor rotation (step number).
- The stepping motor operates by the combination of coils No.1—4, according to the stepping motor step number.

Energization condition for each coil

ON: Energization, OFF: Non-energization

When current step number divided by four	Evenly divisible	One leftover	Two leftover	Three leftover
No.1 coil	ON	ON	OFF	OFF
No.2 coil	OFF	OFF	ON	ON
No.3 coil	OFF	ON	ON	OFF
No.4 coil	ON	OFF	OFF	ON

Example of energization condition for each coil and step number

ON: Energization, OFF Non-energization

Step number	0	1	2	3	4	5	6	7	8	9	10	30	52
Coil No.1 (PCM terminal 2AU)	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
Coil No.2 (PCM terminal 2AR)	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON
Coil No.3 (PCM terminal 2AY)	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
Coil No.4 (PCM terminal 2AV)	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	ON	OFF

- The energization condition of stepping motor coils No.1—4 can be verified by verifying the step number from “SEGRP” on the PID/data monitor function of the WDS.

Control outline

- The PCM constantly calculates the optimum target EGR valve position according to the engine operation conditions and controls the EGR stepping motor step number so that the current EGR valve position is close to the target.
- If the current EGR valve position is smaller than the target EGR position (deviation is a positive number), the PCM increases the stepping motor step number and opens the EGR valve. If larger (deviation is a negative number), the PCM decreases the stepping motor step number and closes the EGR valve. Step numbers are increased or decreased by one step at a time.

Target EGR valve position

- The PCM determines the value to increase or decrease the EGR valve opening angle according to the engine operation conditions. The PCM determines the target EGR valve position through each correction based on the basic EGR valve position that is set according to the engine speed and load.

Target EGR valve position determination table

Contents		Method for calculating or determining the EGR valve position and correction
Basic EGR valve position		Within steps 0—52 in the stepping motor determined as follows: • When the engine speed is **1,200—4,200 rpm** and the charging efficiency*1 is within **12.5—100%**, the engine speed and charging efficiency are determined to be at basic position • When the EGR control inhibition conditions are met, step 0
Correction *2	Engine coolant temperature correction	Purpose: Improved driveability **Engine coolant temperature is 50—55 °C {122—131 °F}** • The step number is restricted between **0—50%** of the basic EGR valve position (low engine coolant temperature—low step number) according to the engine coolant temperature. **Engine coolant temperature is 55—65 °C {131—149 °F}** • The step number is restricted between **50—100%** of the basic EGR valve position (low engine coolant temperature→low step number) according to the engine coolant temperature.
	Intake air temperature correction	Purpose: Improved driveability **Intake air temperature is 50 °C {122 °F} or less** • Step number is restricted to **100%** of the basic EGR valve position (basic EGR valve position = step number) **Intake air temperature is 50 °C {122 °F} or more** • Step number is restricted between **40—100%** of basic EGR valve position (low intake air temperature→large step number)
	Acceleration/ deceleration correction	Purpose: Improved driveability **During acceleration/deceleration, when the throttle valve opening angle fluctuation rate is the set value or more** • During acceleration→step number is restricted to **20%** of basic EGR valve position • During deceleration→step number is restricted to **0%** of basic EGR valve position

*1 : The charging efficiency is the ratio of the actual amount of intake air to the maximum air charging amount (mass volume) of the cylinder. This value increases proportionately to the increase in engine load.

*2 : The correction is to restrict the basic EGR valve position value. Except for the above conditions and inhibition conditions, the correction value is 100%, and the target EGR valve position equals the EGR valve position value.

Inhibition conditions

- To improve driveability and ensure exhaust emission performance, the EGR valve closes when any of the following conditions are met. ( ) indicate input/output devices.
  - — When throttle valve is fully closed (throttle position sensor)
  - — When vehicle is stopped (speed sensor)
  - — When the fuel injection control is in the high volume increase zone
  - — The engine coolant temperature is **50 °C {122 °F} or less** (engine coolant temperature sensor)
  - — During deceleration (throttle position sensor)
  - — Engine speed is **less than 1,200 rpm** or **more than 4,200 rpm** (crankshaft position sensor)
  - — Charging efficiency is **less than 12.5%** (crankshaft position sensor, mass airflow sensor)
  - — During traction control

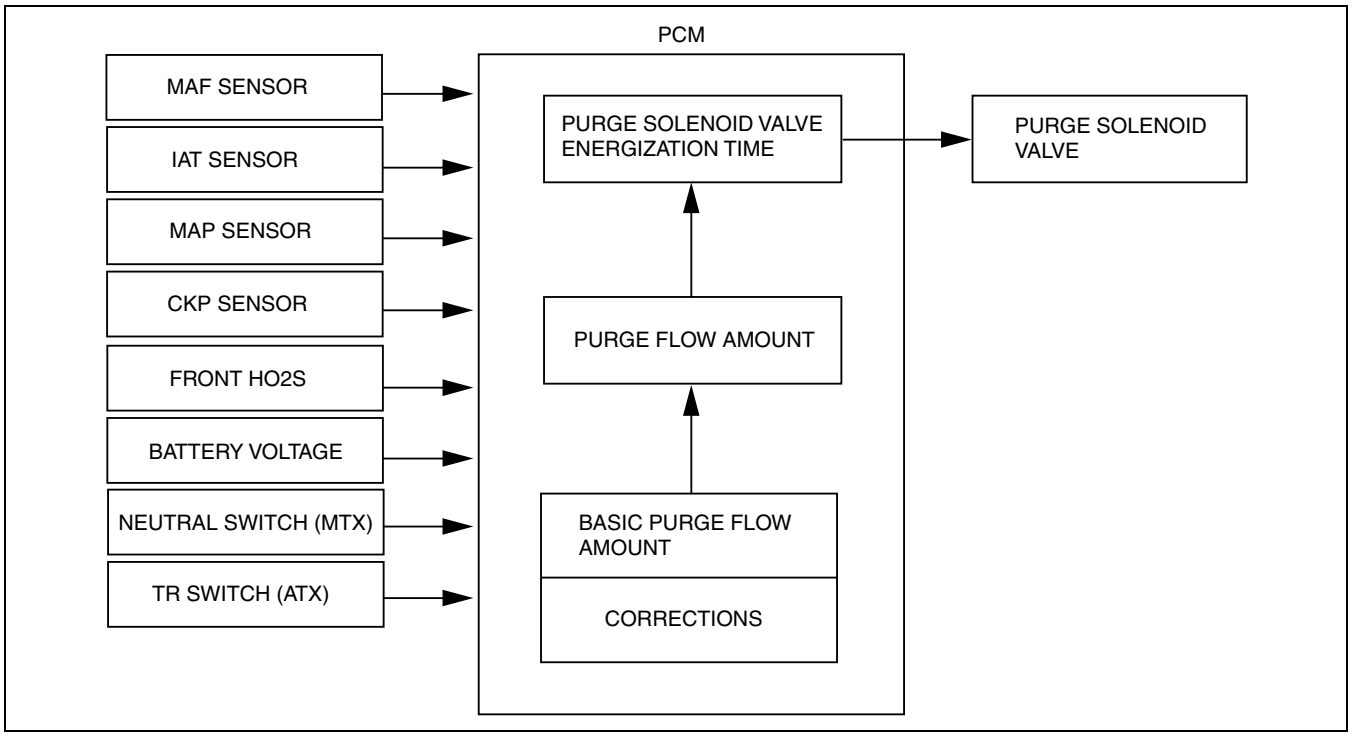
PURGE CONTROL OUTLINE [L3]

EPU014000000S37

- An appropriate amount of evaporative gas is fed into the dynamic chamber by the driving of the purge solenoid valve according to the engine operation conditions to ensure driveability and prevent release of evaporative gas into the atmosphere.
- The PCM determines the engine operation conditions based on the signals from the input devices indicated in the figure below to drive the purge solenoid valve. For the construction/operation of the purge solenoid valve, refer to “EMISSION SYSTEM, PURGE SOLENOID VALVE, CONSTRUCTION/OPERATION”.

PURGE CONTROL BLOCK DIAGRAM [L3]

EPU014000000S38



EPU0140S022

PURGE CONTROL OPERATION [L3]

EPU014000000S39

Determination of purge solenoid valve energization time

- The PCM determines the target purge flow amount according to engine operation conditions as the basic flow amount. The actual operation delays the build-up of operation current from coil inductance and corrects energization time according to fluctuation in battery voltage to cause operation delay based on the mass of the needle valve and plunger, and spring resistance. The lower the rate of battery positive voltage, the longer the energization time.

Calculation method for purge flow amount

- The PCM determines the purge flow amount through the addition of each correction to the basic purge flow amount.

Contents		Calculation or determination method of purge flow amount and correction
Basic purge flow amount		The basic purge flow amount is determined by multiplying the intake air temperature correction to the purge mass volume which is calculated by multiplying the base purge rate and the intake air mass volume, which differs according to engine conditions.
Correction	Purge startup correction	Purpose: Prevents a sudden change in air/fuel ratio during the startup of purge control. **During purge control startup** • When purge control operation conditions are met→correction
	Volume decrease correction	Purpose: Decreases the amount of purge flow and stabilize the air/fuel ratio. **When the fuel injection control feedback correction value is unstable** • According to the front HO2S feedback condition

Operation conditions

- For purge control during normal driving, the PCM sends a duty signal to the purge solenoid valve when all of the following conditions are met.
  — Fuel injection control is in the feedback zone or the high load volume increase zone.
  — Airflow passage damage related DTC is not stored.
  — Engine coolant temperature is **78 °C {172 °F} or more**.

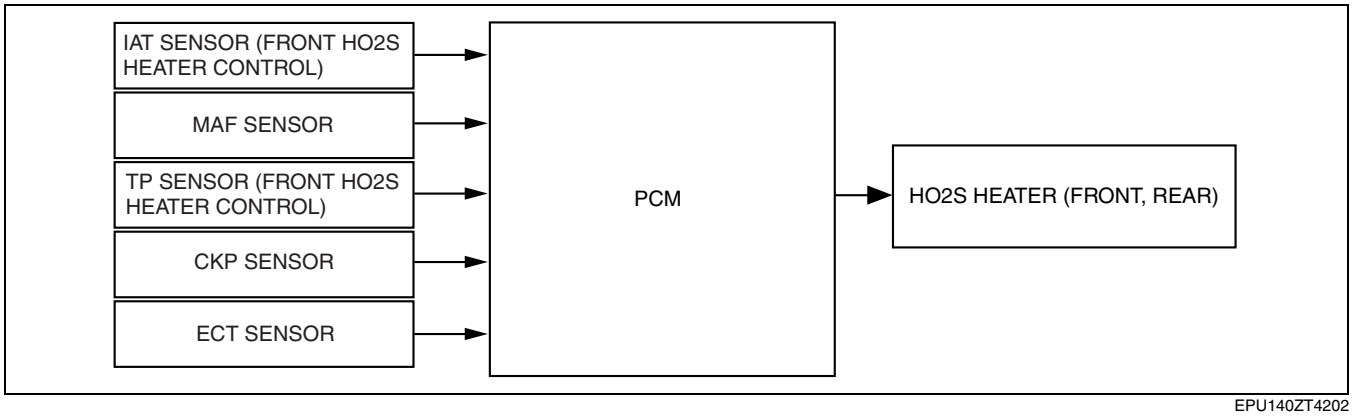
HO2S HEATER CONTROL OUTLINE [L3]

EPU014000000S40

- Stabilized oxygen concentrations, even when the exhaust gas temperature is low, are detected by controlling of the HO2S, enabling feedback control of the fuel injection control even during cold-engine starting, improving emission performance when cold.
- When the exhaust gas temperature is high, the HO2S is protected from sharp rises in its temperature by stopping energization to the HO2S heater.
- Emission performance improvement and protection of the HO2S have both been achieved by the duty control of the front and rear HO2S according to the engine operation conditions (exhaust gas temperature).

HO2S HEATER CONTROL BLOCK DIAGRAM [L3]

EPU014000000S41



EPU140ZT4202

HO2S HEATER CONTROL OPERATION [L3]

EPU014000000S42

Front

Operation condition

- The PCM operates the front HO2S heater according to engine operation conditions as shown in the table below.

Drive duty ratio	Activation condition
20%	• Engine coolant temperature **5 °C {41 °F} or less**
35%	• At engine start • When a DTC indicating a damaged engine coolant temperature sensor, throttle position sensor or intake air temperature sensor is detected.
35—45%	• Oxygen activation condition
60%	• Oxygen non-activation condition
100%	• For a fixed period of time after engine start when the engine coolant temperature at engine start is **50 °C {122 °F} or less** than the engine coolant temperature when the engine is stopped from a previous operation (differs from engine coolant temperature at engine start [lower engine coolant temperature→longer time])

Inhibition conditions

- When all of the following conditions are met (for **6 s**):
  — During torque reduction execution
  — Engine speed is **5,000 rpm or more**.
  — Throttle opening angle **85% or more**
- Engine speed **4,000 rpm or more**
- During high load
- When HO2S is damaged
- When ignition switch is turned to the ON position while engine is stopped

Rear

Operation conditions

- When all of the following conditions are met:
  - — After fixed period of time from engine start
  - — Engine speed is less than **4,000 rpm**.
  - — Except during torque reduction execution
  - — During low load

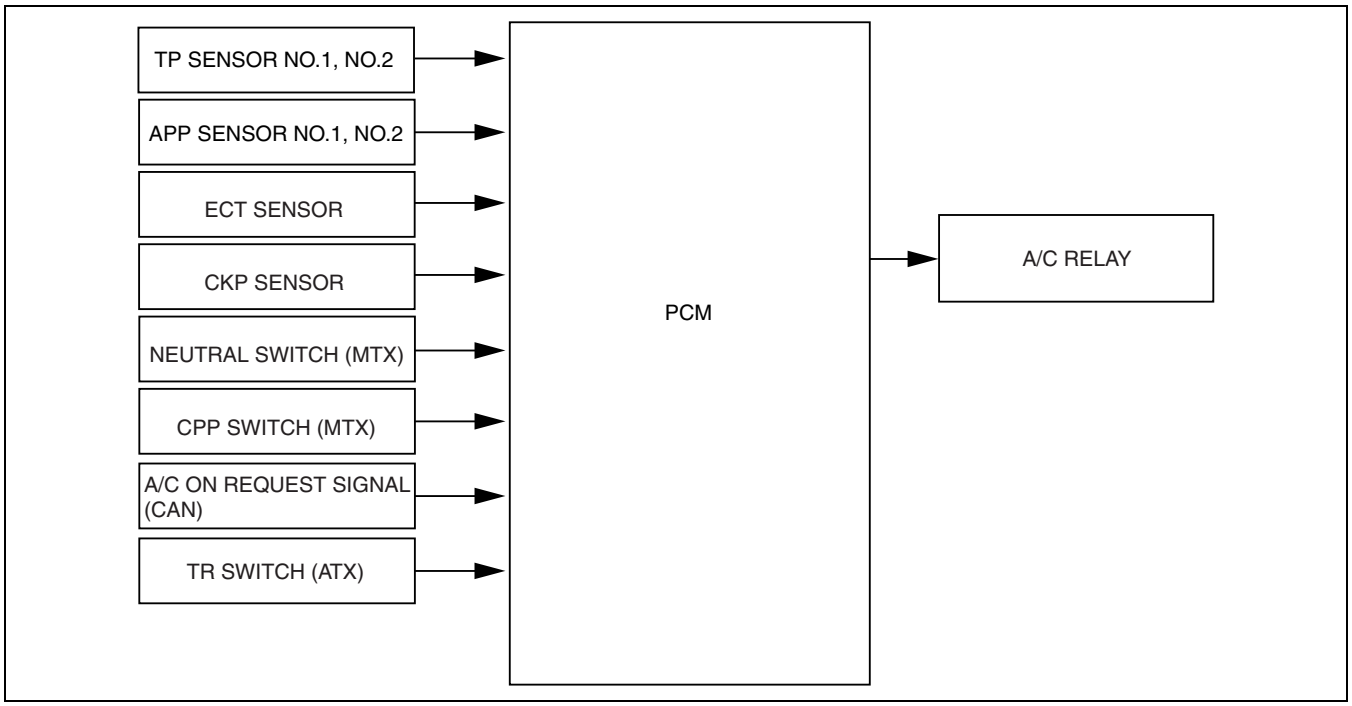
A/C CUT-OFF CONTROL OUTLINE [L3]

EPU014000000S43

- Through energization and non-energization to the A/C relay (magnetic clutch) according to engine operation conditions, acceleration performance and engine reliability have been improved.

A/C CUT-OFF CONTROL BLOCK DIAGRAM [L3]

EPU014000000S44



EPU0140S024

A/C CUT-OFF CONTROL OPERATION [L3]

EPU014000000S45

- The PCM stops energization to the A/C relay when any of the following conditions are met:

A/C cut-off control operation conditions

Operation condition	A/C relay non-energization period	Purpose
At engine start	**Approx. 4 s**	Improved startability
At drive-away	**Approx. 3 s**	Improved drive-away performance
During acceleration (throttle valve opening angle **50% or more**)	**Approx. 5 s**	Improved acceleration performance
When the engine coolant temperature is **113 °C {235 °F}**	Repeatedly turns on and off **every 10 s** until the engine coolant temperature is less than **approx. 110 °C {230 °F}**	Improved engine reliability
When the engine coolant temperature is **118 °C {244 °F} or more**	Until the engine coolant temperature decreases to less than **approx. 113 °C {235 °F}**	Improved engine reliability
At high engine speed (engine speed **5,330 rpm or more**)	**Approx. 5 s**	Improved engine speed stability

ELECTRICAL FAN CONTROL OUTLINE [L3]

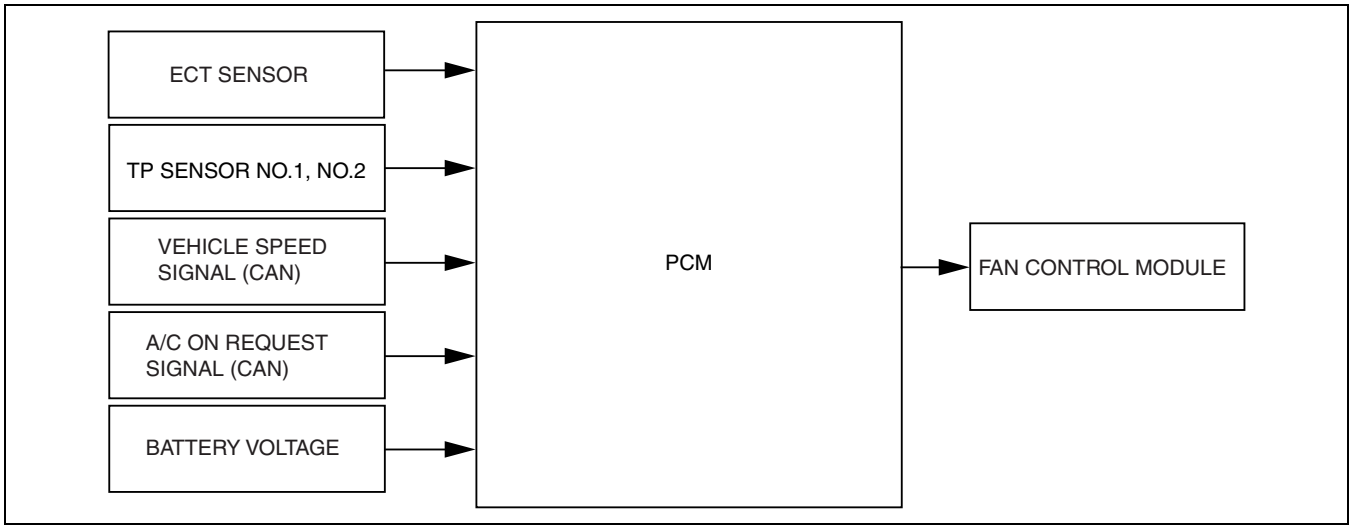
EPU014000000S46

- Through cooling of the radiator and condenser by operation of the cooling fan according to vehicle conditions, engine reliability and cooling performance have been improved.

ELECTRICAL FAN CONTROL BLOCK DIAGRAM [L3]

EPU014000000S47

- The PCM determines the engine operation conditions based on input signals from the sensors, calculating the optimum fan motor rotation speed as the fan motor drive duty ratio, and sends a signal to the fan control module to control the cooling fan rotation speed.



C3U0140S025

ELECTRICAL FAN CONTROL OPERATION [L3]

EPU014000000S56

- The PCM compares the duty ratios determined at the engine coolant temperature and refrigerant pressure controls and sends the higher duty ratio as the control signal to the fan control module.

Engine coolant temperature control

PCM output duty ratio	Engine operation conditions
100 %	• Engine coolant temperature is 108°C {226°F} or more.
75 %	• Engine coolant temperature is 106—108°C {223—226 °F}.
0 %	• Engine coolant temperature is less than 100 °C {212 °F}.

Refrigerant pressure control

PCM output duty ratio	Engine operation conditions
75 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is on.
65 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is off. — Vehicle speed is 45 km/h {27 mph} or less.
60 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is off. — Vehicle speed is 45—85 km/h {28—52 mph}.
0 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is off. — Vehicle speed is 85 km/h {53 mph} or more.
	• A/C is off.

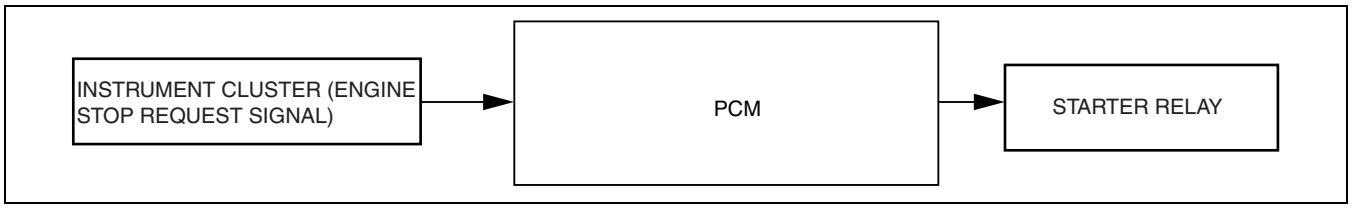
STARTER CUT-OFF CONTROL OUTLINE [L3]

EPU014000000S49

- Theft deterrence has been improved by controlling energization to the starter relay according to an engine stop request signal from the immobilizer system.

STARTER CUT-OFF CONTROL BLOCK DIAGRAM [L3]

EPU014000000S50



C3U0140S026

STARTER CUT-OFF CONTROL OPERATION [L3]

EPU014000000S51

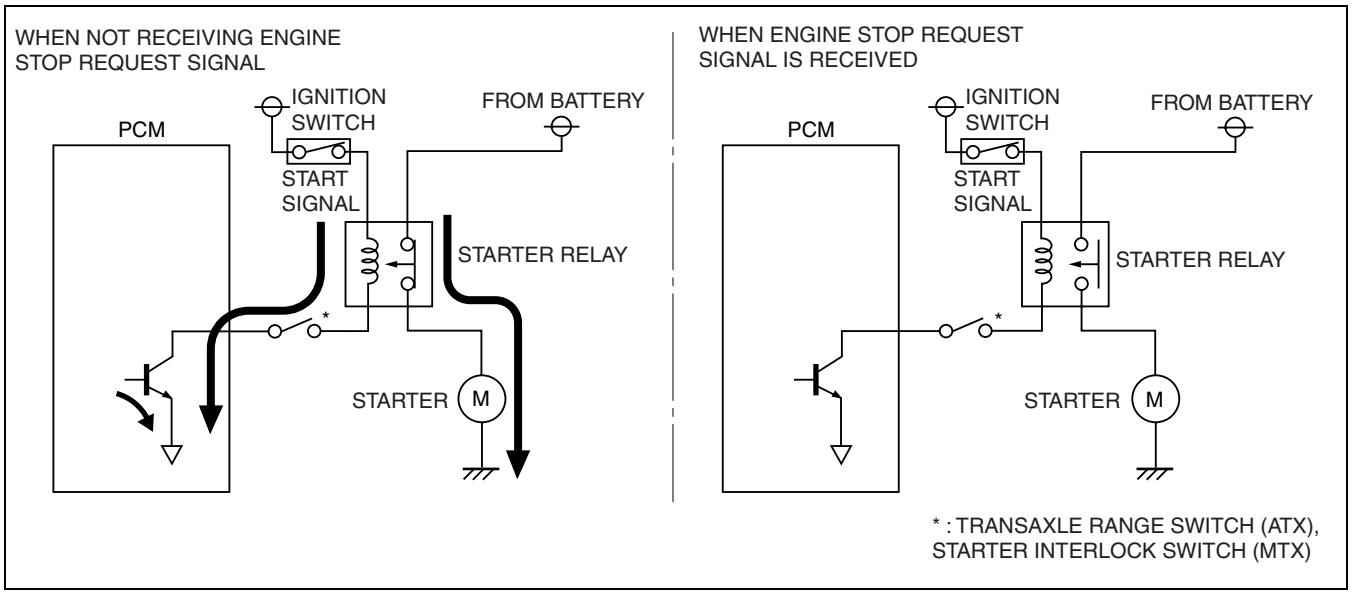
- The PCM stops energization of the starter relay according to an engine stop request from the immobilizer system.

  When receiving engine stop request signal

  — The PCM does not establish a ground to the starter circuit. Therefore, the starter motor does not rotate because there is no energization of the starter relay even if the ignition switch is turned to the START position, and the engine does not start.

  When not receiving engine stop request signal

  — The PCM establishes a ground to the starter circuit. Therefore, when the ignition switch is turned to the START position, the starter relay is energized and the starter motor rotates. As a result, the engine starts normally.



EPU0140S027

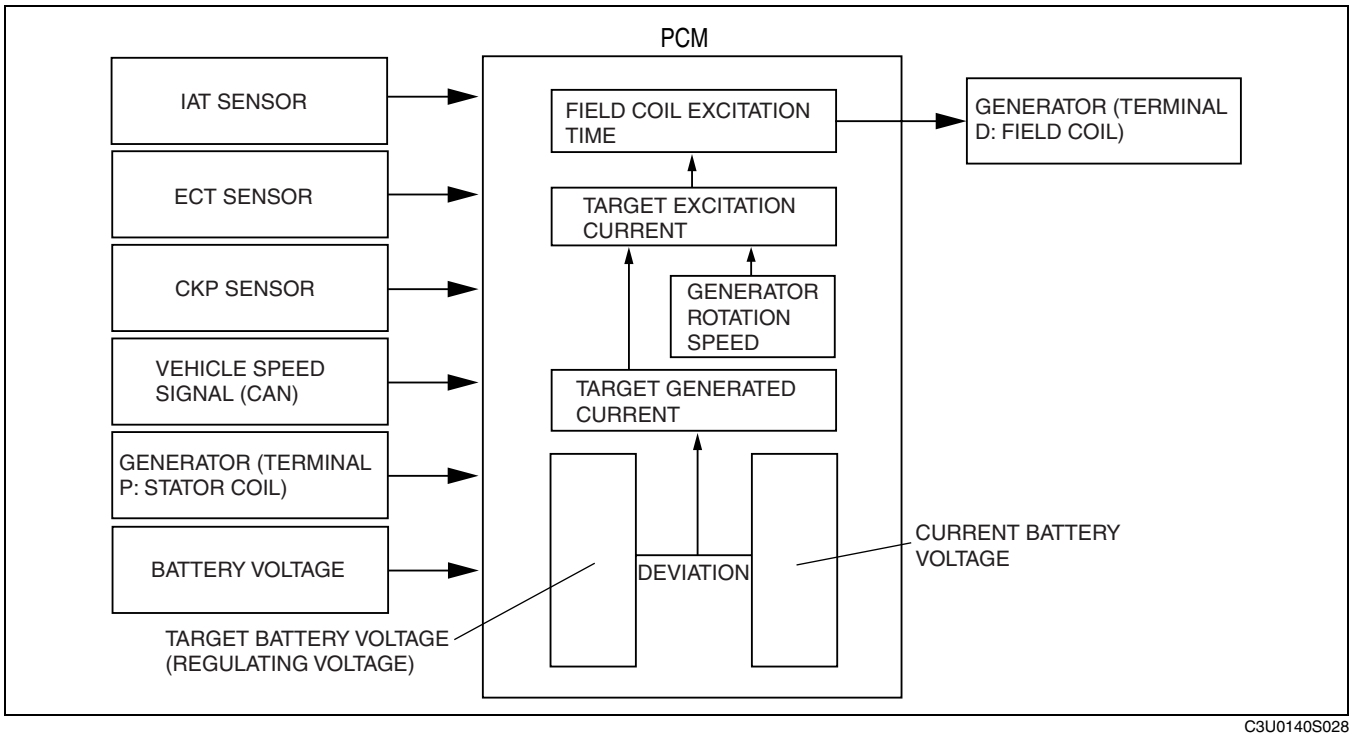
GENERATOR CONTROL OUTLINE [L3]

EPU014000000S52

- Idling stability and the corresponding load performance have been improved by optimum control of generator voltage according to engine operation and electrical load conditions.
- The PCM determines the engine operation and electrical load conditions based on the input signals from input devices shown in the figure below and controls the excitation time of the generator field coils.

GENERATOR CONTROL BLOCK DIAGRAM [L3]

EPU014000000S53

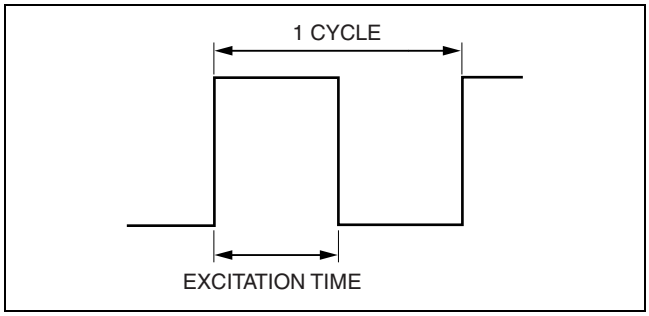


C3U0140S028

GENERATOR CONTROL OPERATION [L3]

EPU014000000S54

Determination of field coil excitation time



C3U0140S029

- By sending a duty signal to the power transistor built into the generator, the PCM increases and decreases the field coil excitation current.
- The field coil excitation current changes according to changes in the power transistor excitation time by changing the duty signal duty ratio. For example, when the battery voltage is low, the duty signal duty ratio sent to power transistor is higher, and the excitation current to the field coils increases.

Control

- To maintain optimum battery voltage, the PCM calculates the target excitation current based on the targeted generator current (target generated current) and the generator rotation speed at the time.
- The generator rotation speed is calculated from the generator pulley and crankshaft pulley ratios, and the engine speed.
- The PCM compares the target battery voltage (regulating voltage) calculated from the intake airflow temperature, engine speed and vehicle speed with the current battery voltage and, based on this difference, calculates the required generator current.
- When an electrical load is applied, the target rotation speed increases during idling because the battery voltage decreases due to the increased power consumption.

CONTROLLER AREA NETWORK (CAN) OUTLINE [L3]

EPU014000000S55

- The PCM sends and receives data to and from other modules via the CAN system. Refer to Section 09 for a detailed explanation of the CAN. (See 09–40–8 CAN SYSTEM DESCRIPTION.)

Data sent

- Engine speed
- Vehicle speed
- ATX gear position/selector lever position (ATX)
- Neutral switch position (MTX)
- CPP switch position (MTX)
- Engine torque
- Throttle valve opening angle
- Brake pedal position
- Transaxle specifications
- TCC status (ATX)
- Engine specification
- Immobilizer-related information
- AT warning light on request (ATX)
- Engine coolant temperature
- Travelled distance
- Fuel injection amount
- MIL on request
- Generator warning light on request

Data received

- Brake system status (EBD/ABS)
- Wheel speed (LF, RF, LR, RR)
- Fuel tank level
- Immobilizer-related information
- A/C on request
- Transaxle in reverse position

PCM FUNCTION [L3]

EPU014018880S01

Function List

- The control descriptions are as shown below.

Function	Description
Electronic throttle control	By controlling the throttle actuator, the PCM sets an optimal throttle valve opening angle according to the engine conditions.
IAC	In order to ensure idling stability, the PCM controls the throttle valve and sets an optimal throttle valve opening angle based on the engine operating conditions.
Fully-closed throttle position learning control	The fully-closed throttle voltage of the throttle position sensor, obtained through learning, is used for the throttle valve opening angle correction.
Variable intake air control	Switches energization of the variable shutter valve actuator according to engine speed to enhance the inertia charging effect.
Variable tumble control	At cold engine start, the following effects occur due to the closing of the variable tumble control for improved cold engine emission performance. • Improved intake airflow speed near injectors • Strong air tumble occurs in the combustion changer, promoting vaporization mixture of intake air and fuel
Variable valve timing control	Changes the intake valve timing according to engine operation conditions to improve engine output, fuel economy and exhaust emission performance.
Fuel injection control	Performs optimum fuel injection according to engine operation conditions.
Fuel pump control	Performs energization of the fuel pump relay only when the engine is running (operates fuel pump) to improve stability and durability.
ESA control	Controls ignition to optimum timing according to engine operation conditions.
Evaporative purge control	An appropriate amount of evaporative gas is fed into the dynamic chamber by the driving of the purge solenoid valve according to the engine operation conditions to ensure driveability and prevent release of fuel vapor gas into the atmosphere.
EGR control	Adjusts the EGR to the optimum opening angle according to engine operation conditions.
HO2S heater control	Based on the control of the front and rear HO2S heater, a stabilized oxygen concentration is detected even at low exhaust gas temperature and feedback control of fuel injection even during cold engine start is made possible for improved cold temperature emission performance.

Function	Description
A/C cut-off control	The current application (energize/non-energize) to the A/C relay (magnetic clutch) is controlled according to the engine operation conditions to prevent deterioration of engine performance, damage to the engine, and deterioration of the A/C function.
Electrical fan control	Through cooling of the radiator and condenser by operation of the cooling fan according to vehicle conditions, engine reliability and cooling performance have been improved.
Starter cut-off control	Theft deterrence has been improved by controlling energization to the starter relay according to an engine stop request signal from the immobilizer system.
Generator control	Generator output is optimized according to the engine operation and electrical load conditions, ensuring idling stability and anti-load performance.
CAN	Used for communication with the EHPAS control module, ABS HU/CM, instrument cluster and DLC-2.

PCM CONSTRUCTION/OPERATION [L3]

EPU014018880S02

Structure

- A 120-pin (two-block) PCM connector has been adopted.

NEUTRAL SWITCH FUNCTION [MTX] [L3]

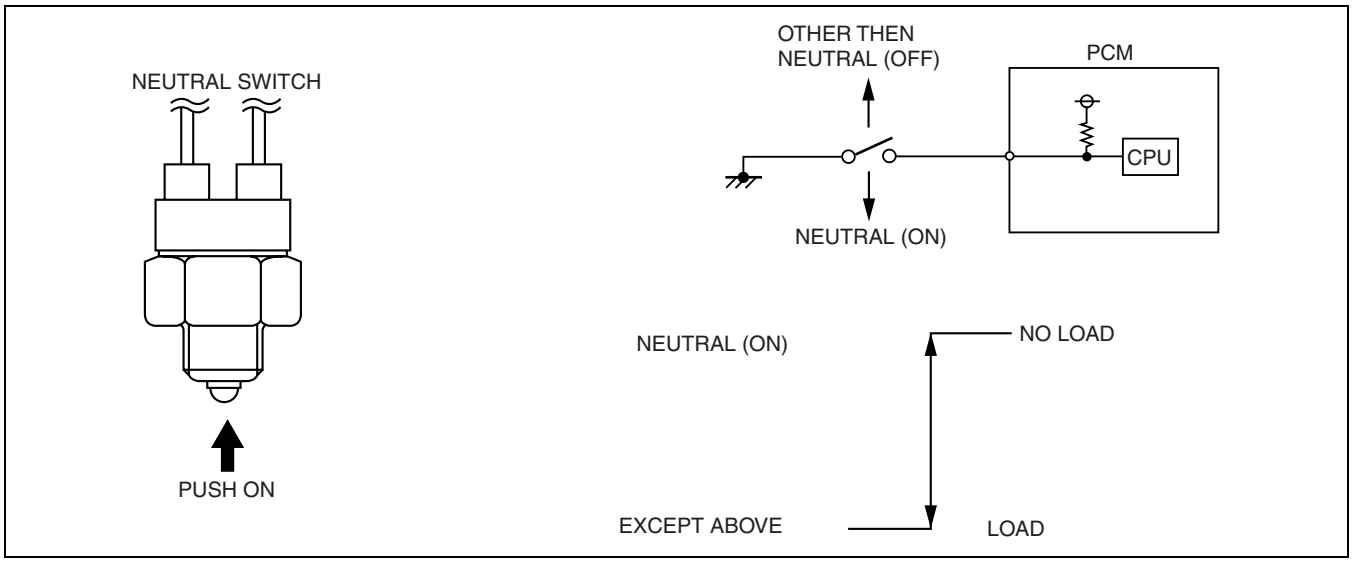
EPU014017640S01

- The neutral switch detects the neutral position of the gearshift lever.

NEUTRAL SWITCH CONSTRUCTION/OPERATION [MTX] [L3]

EPU014017640S02

- When the shift lever is in the neutral position, the contact closes (ON) and the PCM detects a voltage of **0 V**. When the shift lever is not in the neutral position, the contact opens (OFF) and the PCM detects a voltage of **12 V**.



C3U0140S030

CLUTCH PEDAL POSITION (CPP) SWITCH FUNCTION [MTX] [L3]

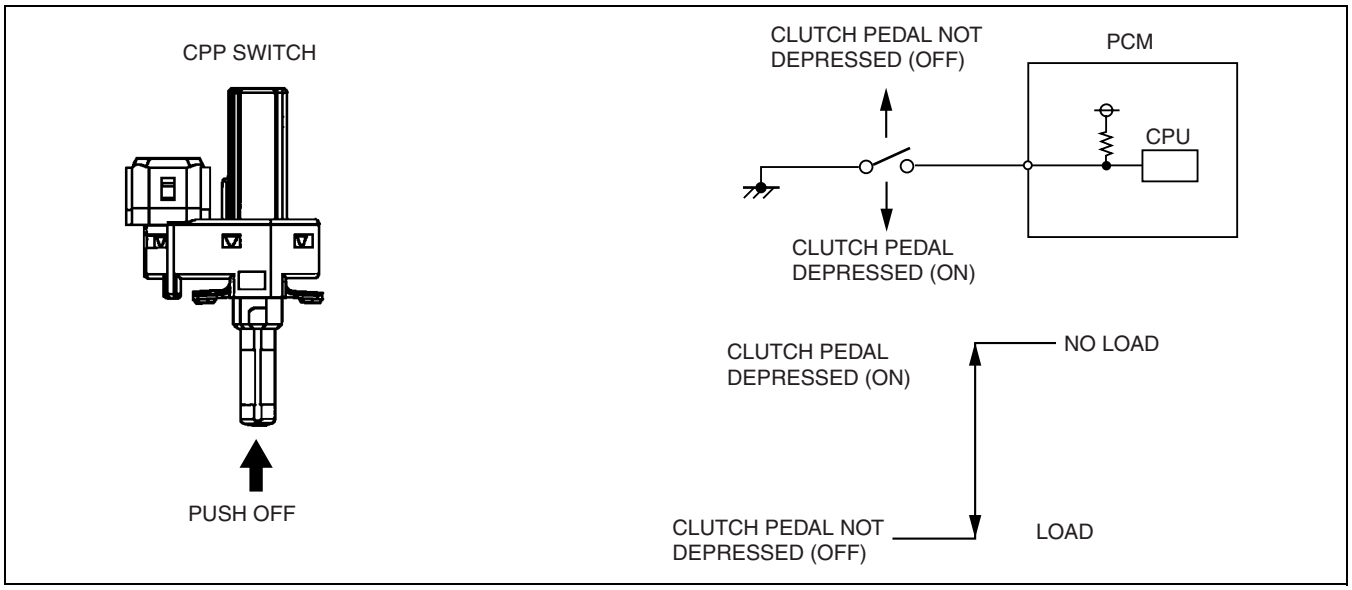
EPU014018660S01

- This switch determines whether the engine is under a load condition (condition in which the engine output is transmitted to the powertrain) or under a no-load condition (condition in which the engine output is not transmitted to the powertrain).
- Detects the clutch engagement condition.

CLUTCH PEDAL POSITION (CPP) SWITCH CONSTRUCTION/OPERATION [MTX] [L3]

EPU014018660S02

- When the clutch pedal is depressed, the contact closes (ON) and the PCM detects a voltage of **0 V**. When the clutch pedal is not depressed, the contact opens (OFF) the PCM detects a voltage of **12 V**.



C3U0140S031

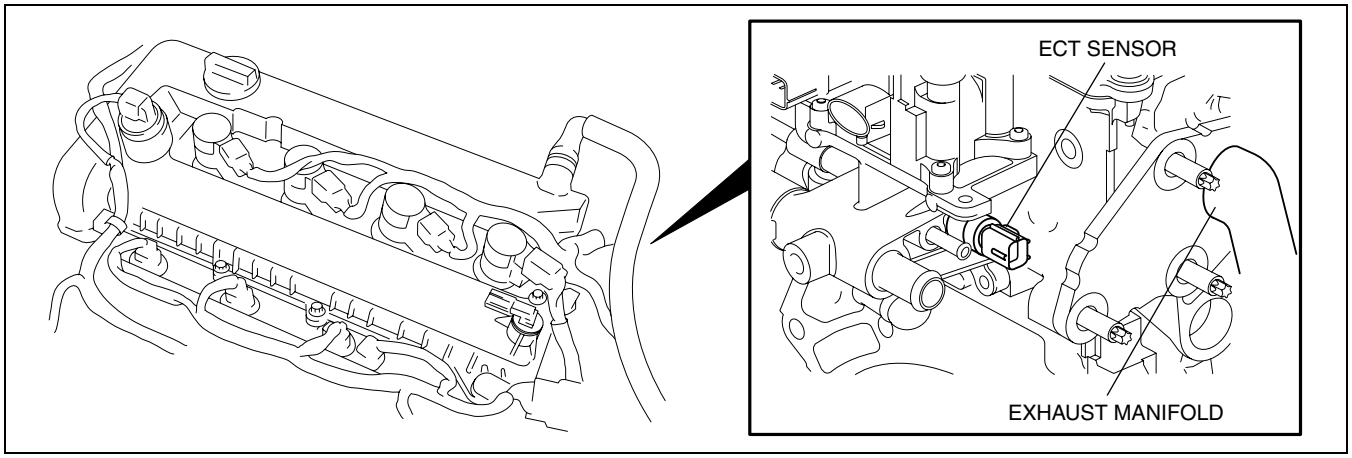
ENGINE COOLANT TEMPERATURE (ECT) SENSOR FUNCTION [L3]

EPU014018841S01

- Detects the engine coolant temperature.

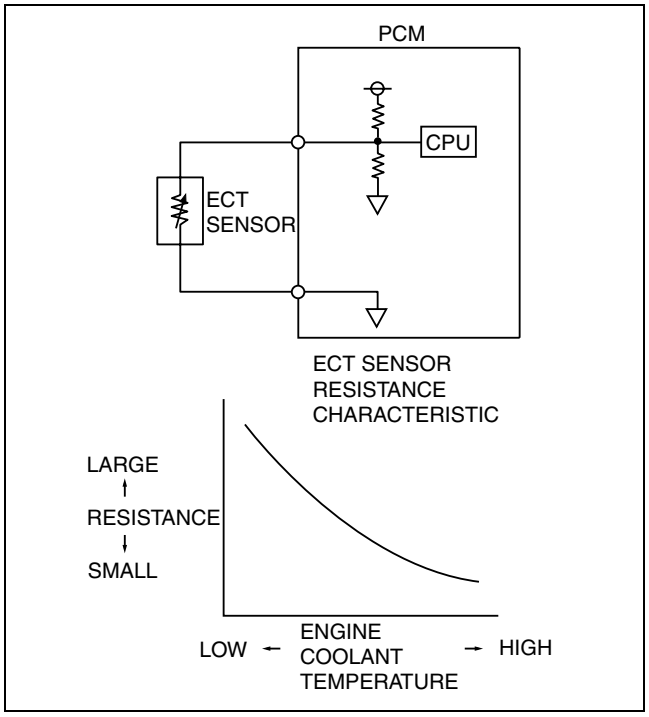
ENGINE COOLANT TEMPERATURE (ECT) SENSOR CONSTRUCTION/OPERATION [L3]

EPU014018841S02



C3U0140S032

- Installed on the water bypass tube (directly below the ignition coil).
- The ECT is a thermistor type, the resistance changes according to the engine coolant temperature.
- The resistance decreases if the engine coolant temperature increases, and increases if the engine coolant temperature decreases.



C3U0140S033

INTAKE AIR TEMPERATURE (IAT) SENSOR FUNCTION [L3]

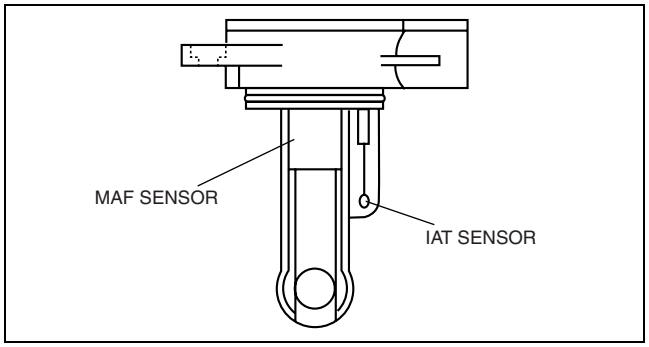
EPU014018842S01

- Detects air temperature inducted in the engine.

INTAKE AIR TEMPERATURE (IAT) SENSOR CONSTRUCTION/OPERATION [L3]

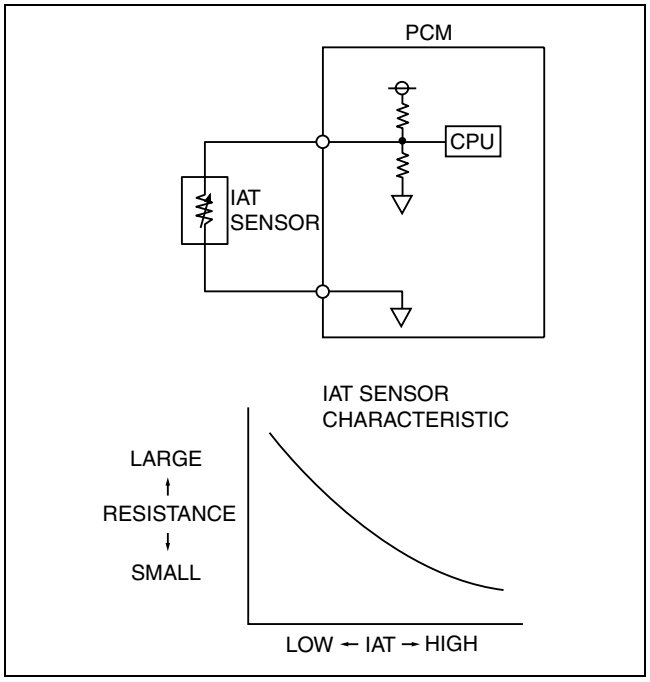
EPU014018842S02

- Built into the MAF sensor.



C3U0140S034

- The IAT sensor is a thermistor type, the resistance changes according to the intake air temperature.
- The resistance decreases if the intake air temperature increases and conversely increases if the intake air temperature decreases.



C3U0140S035

CRANKSHAFT POSITION (CKP) SENSOR FUNCTION [L3]

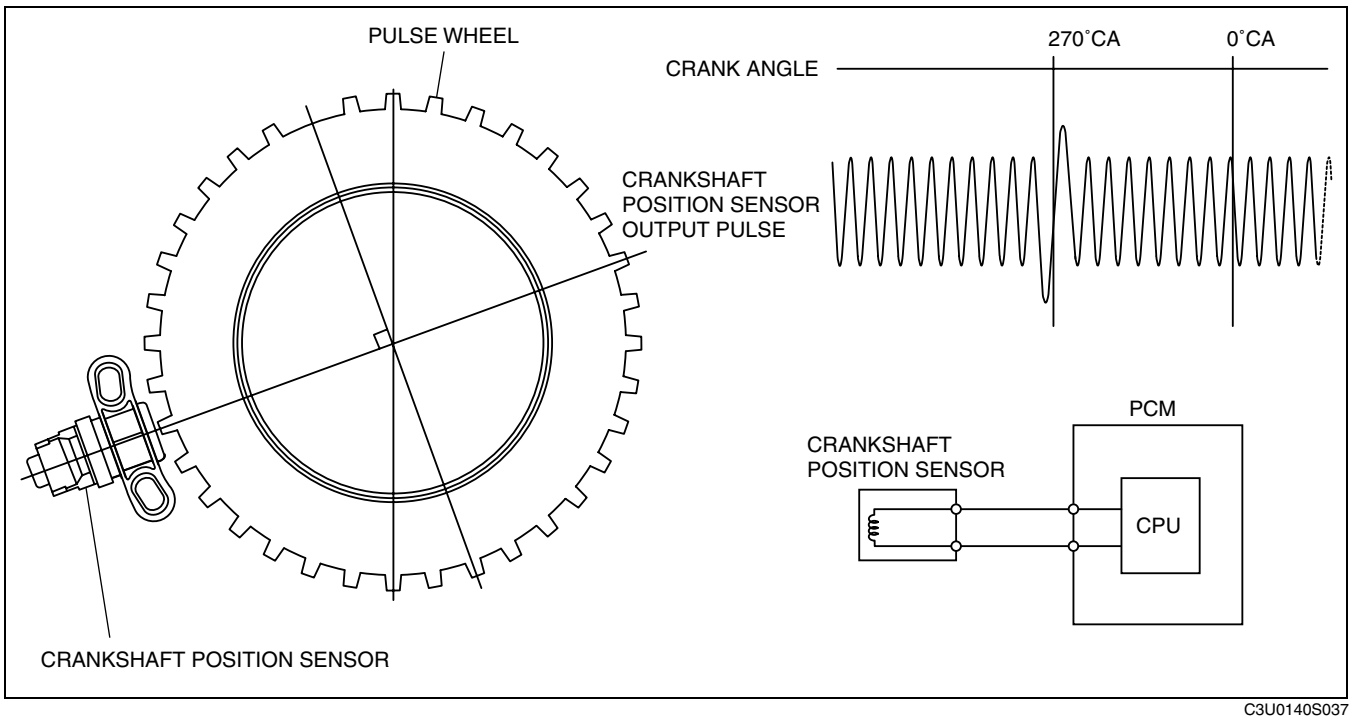
EPU014018220S01

- Detects the pulse wheel rotation pulse as the engine crank angle signal.

CRANKSHAFT POSITION (CKP) SENSOR CONSTRUCTION/OPERATION [L3]

EPU014018220S02

- Installed on the side surface of the cylinder block (driver's side). Assembled at the ninth pulse position (**90** °) from the area where there is no single projection on the crankshaft position sensor pulse wheel.
- The crankshaft position sensor pulse wheel has 35 projections and spaces with **10** ° of crank angle between each projection.
- The fluctuation in magnetic flux density detected by the magnetic pickup coil in the crankshaft position sensor is input to the PCM as voltage.
- If the crankshaft position sensor is removed/installed or replaced, magnetized objects such as metal shavings adhering to the sensor could cause fluctuation in the magnetic flux of the magnetic pickup coil, causing abnormal sensor output which could adversely affect engine control.



C3U0140S037

CAMSHAFT POSITION (CMP) SENSOR FUNCTION [L3]

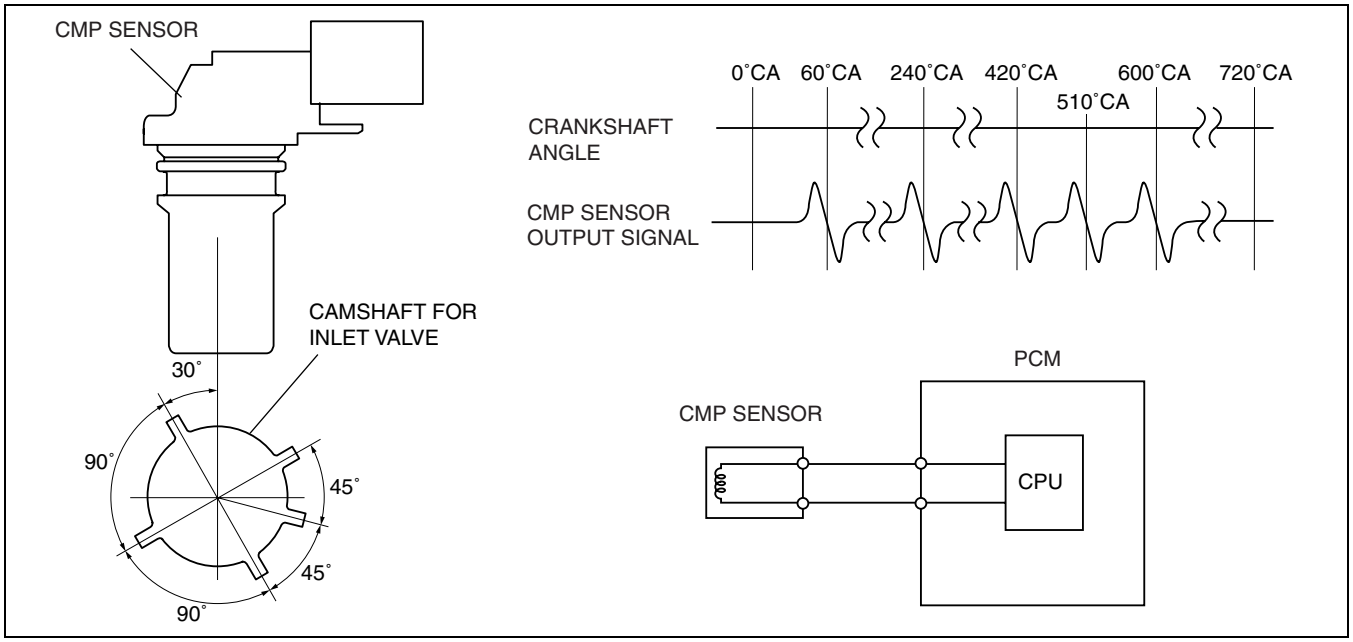
EPU014018230S01

- Detects the position **60**° after TDC of compression in the No.1 cylinder (Cam angle **30**°).

CAMSHAFT POSITION (CMP) SENSOR CONSTRUCTION/OPERATION [L3]

EPU014018230S02

- Installed on the engine head cover.
- Detects one pulse per one camshaft rotation from the projection on the intake manifold side of the camshaft.
- The projection detects the position **60**° after TDC of compression in the No.1 cylinder.
- The change in the amount of magnetic flux density detected by the magnetic pickup coil in the camshaft position sensor is input to the PCM as voltage.
- If the camshaft position sensor is removed/installed or replaced, magnetized objects such as metal shavings adhering to the sensor could cause distortion in the magnetic flux of the magnetic pickup coil, causing abnormal sensor output which could adversely affect the engine control.



EPU140ZT4203

VARIABLE TUMBLE SHUTTER VALVE SWITCH OUTLINE [L3]

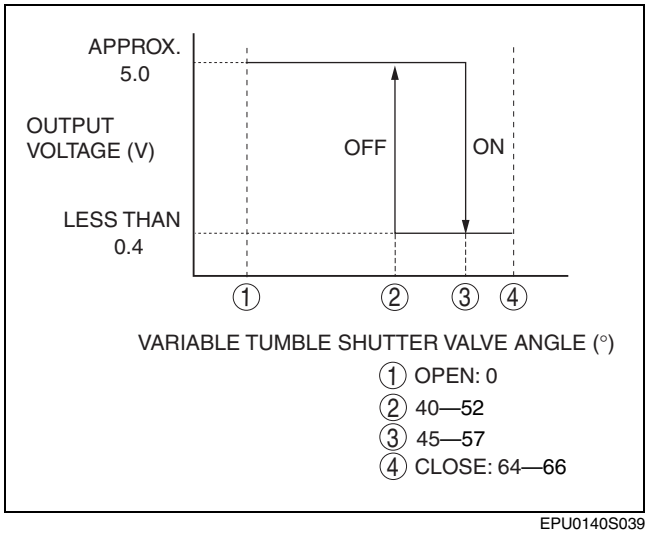
EPU014018995S01

- The variable tumble shutter valve switch detects whether the variable tumble shutter valve is open or closed.
- A Hall effect type switch has been adopted for the variable tumble shutter valve switch.

VARIABLE TUMBLE SHUTTER VALVE SWITCH CONSTRUCTION/OPERATION [L3]

EPU014018995S02

- The variable tumble shutter valve switch is built into the variable tumble shutter valve actuator.
- The output voltage characteristic of the variable tumble shutter valve switch is as shown in the figure.



EPU0140S039

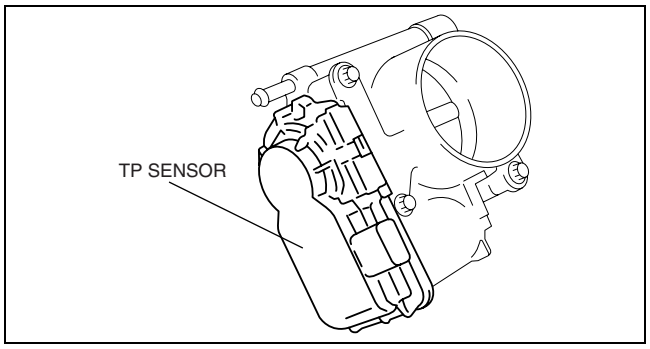
THROTTLE POSITION (TP) SENSOR FUNCTION [L3]

EPU014018910S01

- Detects the throttle valve opening angle.

THROTTLE POSITION (TP) SENSOR CONSTRUCTION/OPERATION [L3]

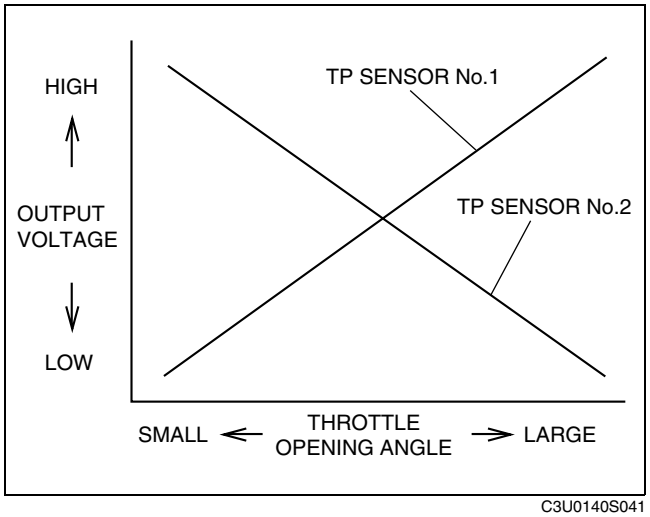
EPU014018910S02



C3U0140S040

- The sensor is built into the throttle body and detects the throttle valve opening angle.
- The Hall element design has been adopted for the sensor.
- A non contact type sensor has been adopted to improve durability.
- The TP sensor is composed of the main sensor and sub sensor, and detects the throttle valve opening angle with these two sensors (main and sub).
- Even if a malfunction occurs in either one of the sensors, the detection is performed with a normal sensor and drive-by-wire control is maintained.
- If both the MAIN and SUB sensors for the TP sensor malfunction, signals necessary for the drive-by-wire control are not input to the PCM and the drive-by-wire control is disabled.
- However, even though the drive-by-wire control is disabled, the throttle valve opening angle necessary for minimum driving is maintained mechanically.

TP Sensor Voltage Characteristics



C3U0140S041

ACCELERATOR PEDAL POSITION (APP) SENSOR FUNCTION [L3]

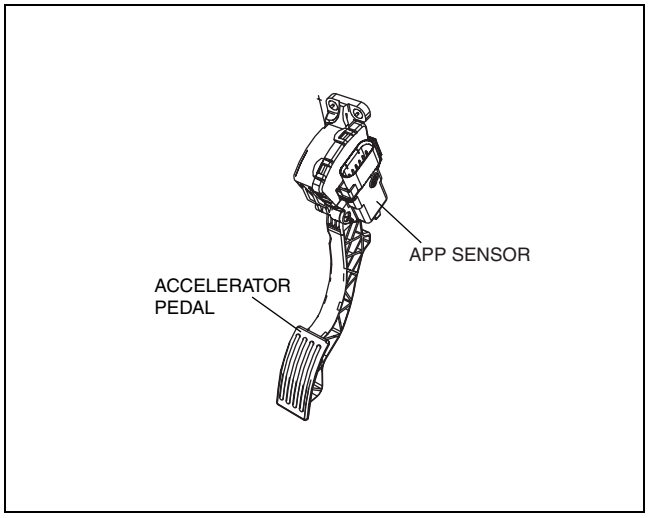
EPU014041609S01

- Detects how much the AP is depressed.

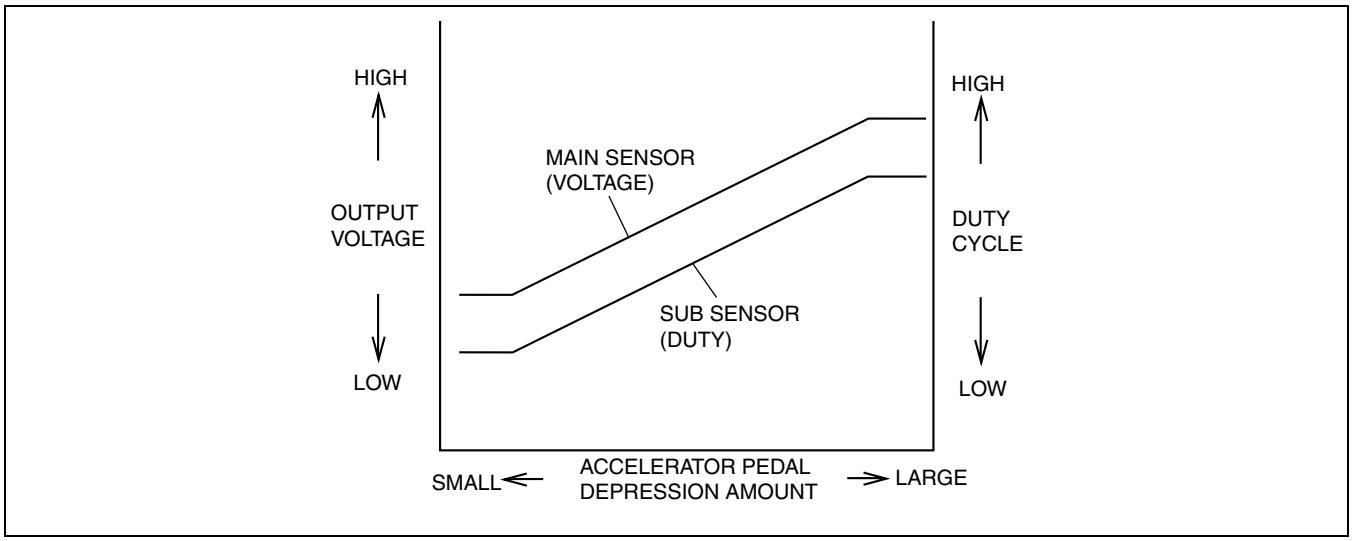
ACCELERATOR PEDAL POSITION (APP) SENSOR CONSTRUCTION/OPERATION [L3]

EPU014041609S02

- The sensor is installed on the AP and detects how much the AP is depressed.
- The Hall element design has been adopted on the sensor.
- A non contact type sensor has been adopted to improve durability.
- The APP sensor is composed of the main sensor and sub sensor, and detects the accelerator opening angle with these two sensors (main and sub).
- The main sensor output a duty signal, and the sub sensor output a voltage signal.
- Even if a malfunction occurs in either one of the sensors, the detection is performed with a normal sensor drive-by-wire control is maintained.
- If both the main and sub sensors for the APP sensor malfunction, signals necessary for the drive-by-wire control are not input to the PCM and the drive-by-wire control is disabled.
- However, even though the drive-by-wire control is disabled, the throttle valve opening angle necessary for minimum driving is maintained mechanically.



C3U0140S057



EPU0140S056

MASS AIR FLOW (MAF) SENSOR FUNCTION [L3]

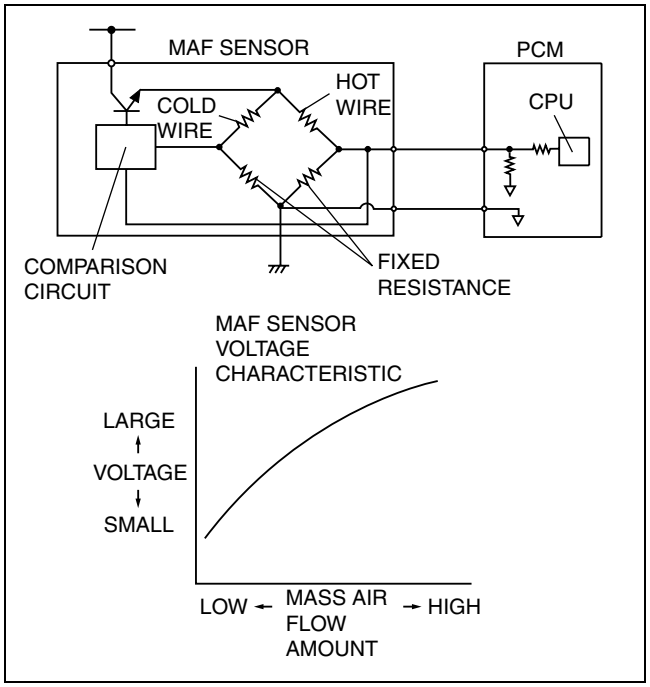
EPU014013215S01

- Detects the air amount (mass airflow amount) inducted into the engine.

MASS AIR FLOW (MAF) SENSOR CONSTRUCTION/OPERATION [L3]

EPU014013215S02

- Built into the intake air temperature sensor.
- Converts the mass intake airflow amount to voltage.
- When the temperature of the metal decreases, the resistance decreases. Using this characteristic, the hot wire captures heat from the flow of intake air and converts the intake airflow amount to voltage.
- The cold wire converts intake air density to voltage from the ambient temperature of the cold wire, using the characteristic of air whereby the intake air density decreases due to the increase in intake air temperature.
- The voltages obtained by the hot wire (intake airflow amount) and the cold wire are compared and the electric potential becomes stable by supplying the difference in voltage to the transistor. The voltage supplied to the hot wire is output as the mass intake airflow amount.



EPU0140S044

HEATED OXYGEN SENSOR (HO2S) FUNCTION [L3]

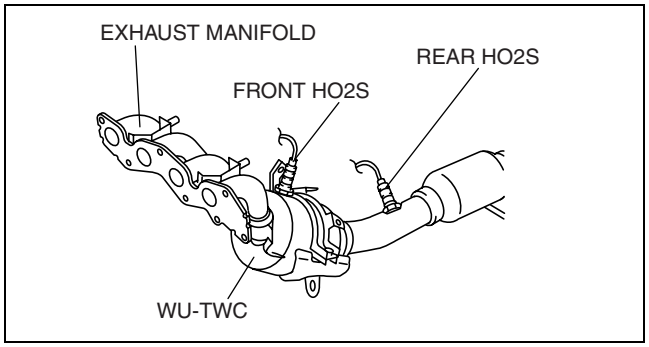
EPU014018860S01

- Detects the oxygen concentration in the exhaust gas.
- A heater has been adopted, allowing stable detection of the oxygen concentration even when the exhaust gas temperature is low.

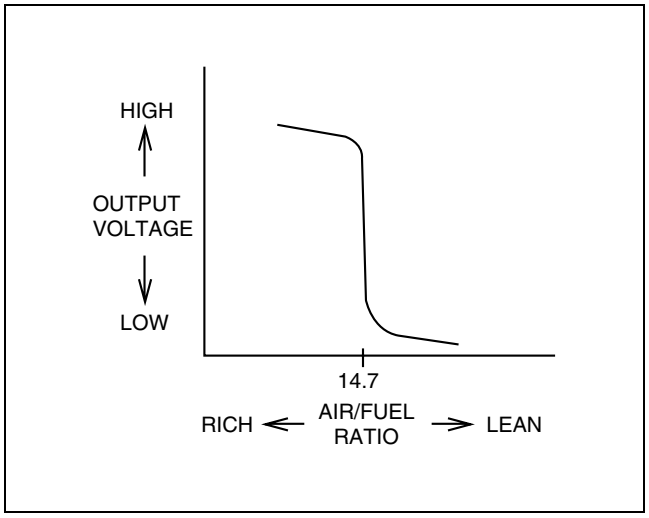
HEATED OXYGEN SENSOR (HO2S) CONSTRUCTION/OPERATION [L3]

EPU014018860S02

- Installed on the front and back of the WU-TWC.
- A heater is built into the sensor to facilitate the activation of the HO2S at engine startup (when the exhaust gas temperature is low).
- A zirconium element is used on the sensor. When there is a difference between the oxygen concentration inside and outside the element, electromotive force is generated by the movement of oxygen ions (inside of the zirconium element: atmosphere, outside: exhaust gas). The electromotive force changes significantly at the boundary of the stoichiometric air/fuel ratio (A/F=14.7). The PCM receives the voltage generated from the HO2S directly, and increases or decreases the fuel injection amount by the fuel injection control so that it is close to the stoichiometric air/fuel ratio.
- When the temperature of the zirconium element is low, electromotive force is not generated. Therefore the HO2S is heated by a built-in heater, facilitating the oxygen sensor activation. Due to this, the sensor is efficiently activated even immediately after cold-engine startup, and a stable sensor output can be obtained.



C3U0140S046



CHU0140S075

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR FUNCTION [L3]

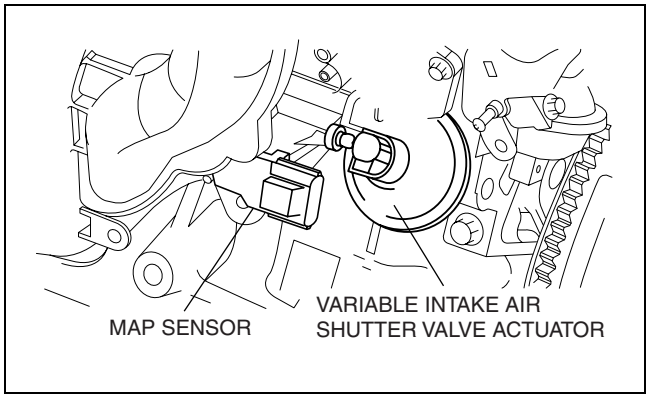
EPU014018210S01

- Detects intake air pressure in the intake manifold.

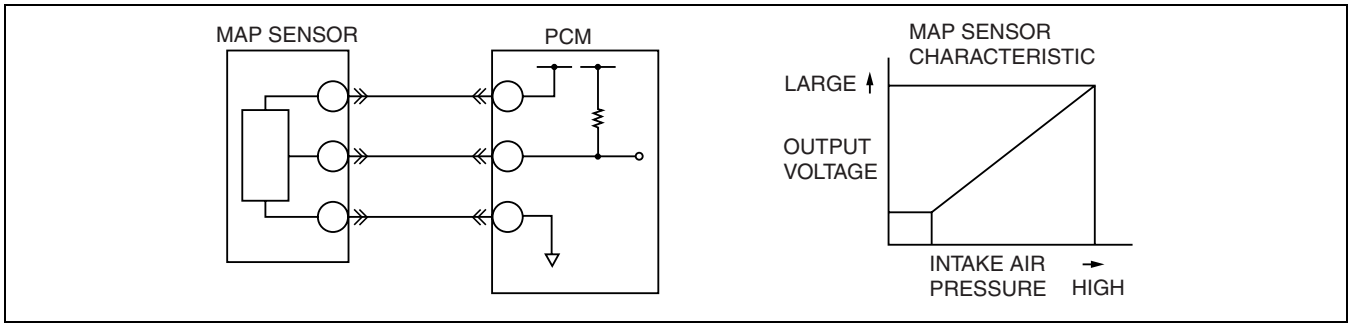
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CONSTRUCTION/OPERATION [L3]

EPU014018210S02

- When pressure is applied to the piezoelectric element in the sensor, an electric potential difference occurs. Output voltage increases as the intake air pressure increases.



C3U0140S048



C3U0140S049

KNOCK SENSOR (KS) FUNCTION [L3]

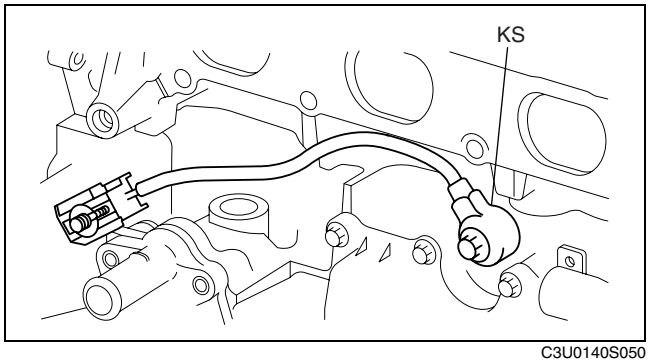
EPU014018920S01

- Detects abnormal combustion in the engine.

KNOCK SENSOR (KS) CONSTRUCTION/OPERATION [L3]

EPU014018920S02

- Installed on the front of the cylinder block (intake manifold side).
- Converts vibration from abnormal combustion in the engine to voltage using the piezoelectric effect in the semi-conductor and outputs it to the PCM.
- The piezoelectric effect is a phenomenon in which a difference in electric potential is produced on the surface of a piezoelectric element by the application of tensile load or pressure from a certain direction. Tensile load and pressure applied to the KS originates from engine vibration caused by abnormal combustion in the engine. The difference in electric potential, which results from the distortion by the vibration, is sent to the PCM as a knocking signal.



C3U0140S050

BAROMETRIC PRESSURE (BARO) SENSOR FUNCTION [L3]

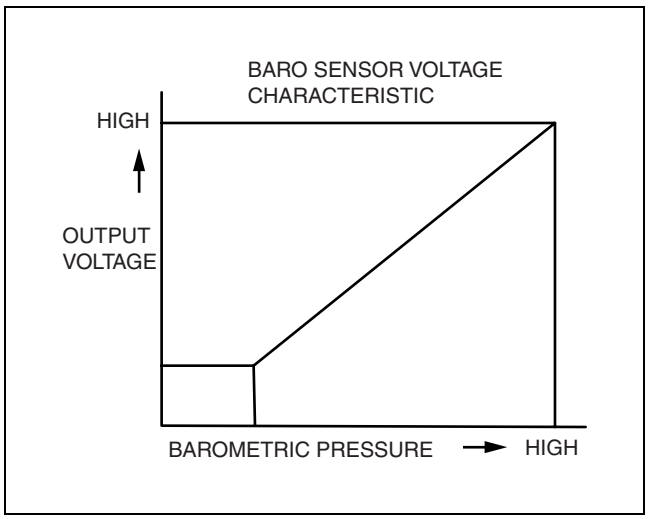
EPU014018211S01

- Detects the BARO.

BAROMETRIC PRESSURE (BARO) SENSOR CONSTRUCTION/OPERATION [L3]

EPU014018211S03

- The BARO sensor is integrated with PCM.
- The piezoelectric element is enclosed in the sensor and the electric potential difference changes as the BARO drops. The output voltage decreases as the BARO decreases.



EPU0140ZT2012

SUSPENSION

02
SECTION

OUTLINE 02-00
ON-BOARD DIAGNOSTIC 02-02
WHEEL AND TIRES 02-12
FRONT SUSPENSION 02-13
REAR SUSPENSION 02-14

02–00 OUTLINE

SUSPENSION ABBREVIATIONS 02–00–1
SUSPENSION FEATURES. 02–00–1
SUSPENSION SPECIFICATIONS 02–00–2
Suspension **02–00–2**
Wheel and Tire **02–00–2**

SUSPENSION ABBREVIATIONS

EPU020000000S03

CAN	Controller Area Network
CM	Control Module
RF signal(s)	Radio Frequency signal(s)
OFF	Switch Off
ON	Switch On
PID	Parameter Identification
TPMS	Tire Pressure Monitoring System
WDS	Worldwide Diagnostic System

SUSPENSION FEATURES

EPU020000000S01

Improved rigidity and handling stability	• E-type multi-link rear suspension adopted
Improved handling and riding comfort	• Four-point rubber mount system front crossmember adopted • Oil-filled bushing for front lower arm • Front shock absorber with large bore piston adopted • Front spring layout optimized • Separated input type front shock absorber mount adopted
Enlarged trunk compartment	• Separated positioning of rear shock absorber and coil spring adopted
Improved marketability	• Adhesive-type balance weights adopted
Environmental consideration	• Steel balance weights adopted to reduce the use of lead
Tire condition maintenance assistance	• Tire pressure monitoring system (TPMS) adopted

SUSPENSION SPECIFICATIONS

EPU020000000S02

Suspension

Item					Specification
Front suspension	Type				Strut type
	Spring type				Coil spring
	Shock absorber type				Low-pressure gas charged, cylindrical, double-acting
	Stabilizer	Type			Torsion bar
		Diameter		(mm {in})	23 {0.90}
	Wheel alignment (Unloaded*)	Total toe-in	Tire [Tolerance ±4 {0.15}]	(mm {in})	2 {0.08}
			Rim inner		1±3 {0.04±0.12}
				Degree	0°11′±22′
		Maximum steering angle [Tolerance ±3°]		Inner	40°30′
				Outer	33°48′
		Caster angle (Reference) [Tolerance ±1°]			3°01′
		Camber angle (Reference) [Tolerance ±1°]			-0°42′
		Steering axis inclination (Reference)			13°59′
Rear suspension	Type				Multi-link
	Spring type				Coil spring
	Shock absorber type				High-pressure gas charged, cylindrical, double-acting (monotube type)
	Stabilizer	Type			Torsion bar
		Diameter		(mm {in})	20 {0.79}
	Wheel alignment (Unloaded*)	Total toe-in	Tire [Tolerance ±4 {0.15}]	(mm {in})	2 {0.08}
			Rim inner		1±3 {0.04±0.12}
				Degree	0°11′±22′
		Camber angle [Tolerance ±1°]			-1°18′
		Thrust angle [Tolerance ±48′]			0°

* : Unloaded: Fuel tank is full. Engine coolant and engine oil are at specified level. Spare tire, jack and tools are in designated position.

Wheel and Tire

Standard tire

Item			Specification	
Tire	Size		P205/55R16 89H	205/50R17 89V
Wheel	Size		16 x 6 1/2J	17 x 6 1/2J
	Material		Aluminum alloy	
	Offset	(mm {in})	52.5 {2.07}	
	Pitch circle diameter	(mm {in})	114.3 {4.50}	

Temporary spare tire

Item			Specification
Tire	Size		T125/70D16
Wheel	Size		16 x 4T
	Material		Steel
	Offset	(mm {in})	45 {1.8}
	Pitch circle diameter	(mm {in})	114.3 {4.50}

02–02 ON-BOARD DIAGNOSTIC

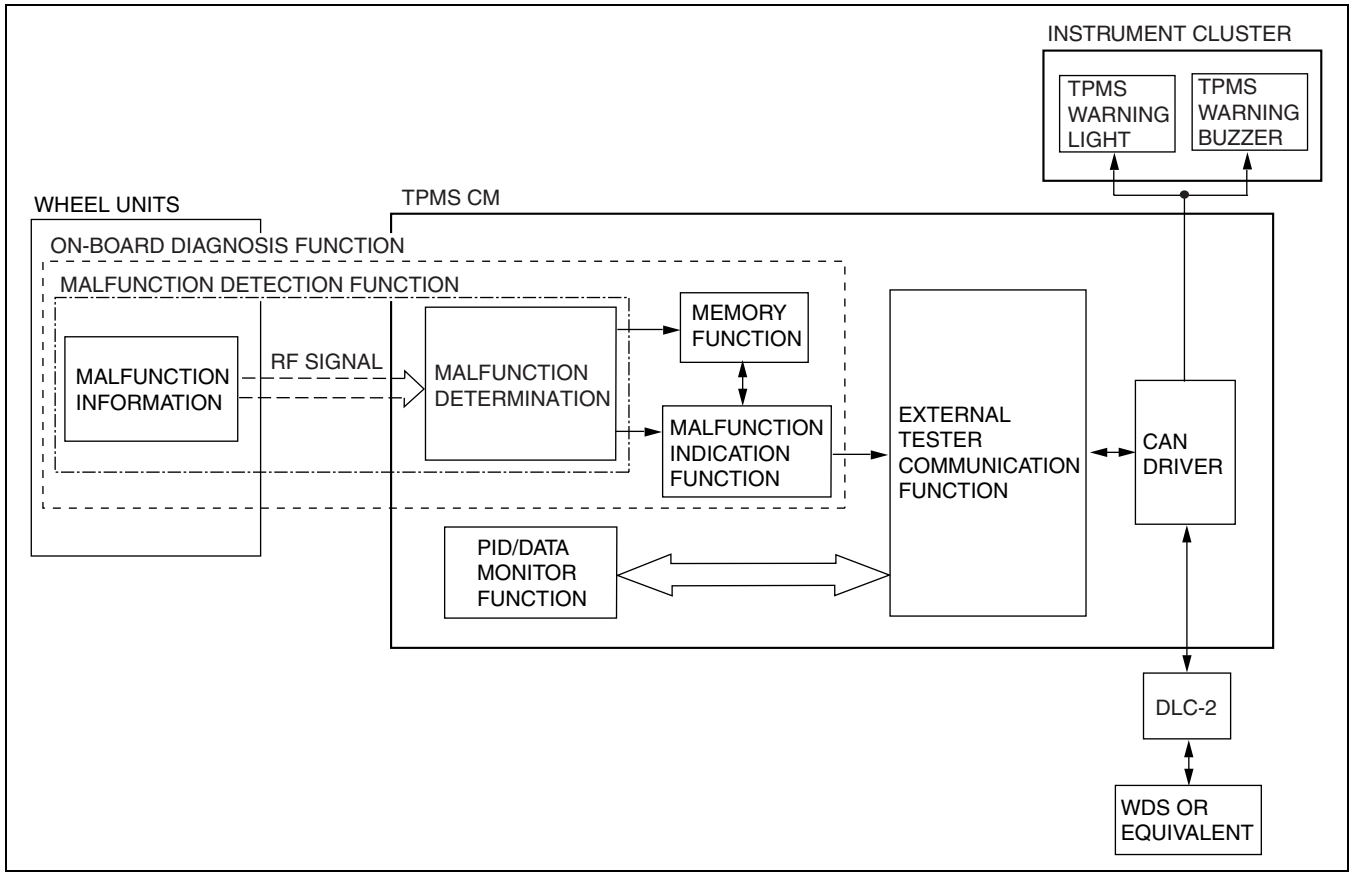
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [TIRE PRESSURE MONITORING SYSTEM (TPMS)] 02–02–1
Block Diagram 02–02–1
ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)] 02–02–2
Malfunction Detection Function 02–02–2
Malfunction Display Function 02–02–2
Memory Function 02–02–2
DTC TABLE 02–02–2
ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)] 02–02–3
ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)] 02–02–3
External Tester Communication Function 02–02–3
Serial Communication 02–02–3
DLC-2 CONSTRUCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)] 02–02–4

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [TIRE PRESSURE MONITORING SYSTEM (TPMS)]

EPU020237020S01

- The on-board diagnostic system consists of a malfunction detection system that detects abnormalities in input/output signals when the ignition switch is at the ON position, a data monitor function that reads out specified input/output signals.
- The Data Link Connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the WDS or equivalent to the DLC-2.
- In addition to DTC read-out, the WDS or equivalent is used to clear DTCs using the display screen of the diagnostic tester, and to access the data monitor, providing enhanced malfunction diagnosis and improved serviceability.

Block Diagram



CHU0202S001

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)]

EPU020237020S02

Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the tire pressure monitoring system (TPMS) control module based on abnormal signals from the wheel units when the ignition switch is at the ON position or driving the vehicle.
- The TPMS warning light illuminates for **approx. 3.0 s** when the ignition switch is turned to the ON position to inspect for open circuits in the light.

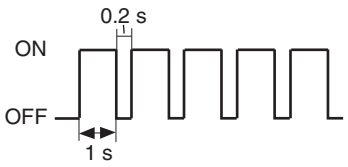
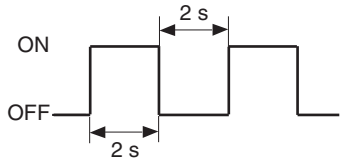
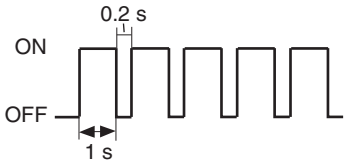
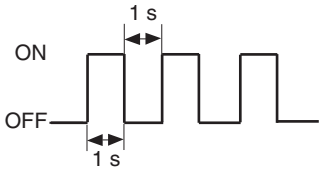
Malfunction Display Function

- When the malfunction detection function detects a malfunction, the TPMS warning light illuminates to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the CAN communication line. At the same time, malfunction detection results are sent to the memory functions.

Memory Function

- The memory function stores DTCs for malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition switch has been turned off (LOCK position), even if the malfunctioning signal system has returned to normal.
- Since the TPMS control module has a built-in non-volatile memory, DTCs are not cleared even if the battery is removed. Therefore, it is necessary to clear the memory after performing repairs. Refer to the Workshop Manual for the DTC clearing procedure.

DTC TABLE

Malfunction location	DTC (WDS or equivalent)	TPMS warning light illumination condition	TPMS warning light illumination pattern
TPMS control module	B1342	Illuminated	
System configuration malfunction	B2477	Not illuminated	–
Wheel unit 1 internal fault	B2868	Illuminated	
Wheel unit 2 internal fault	B2869	Illuminated	
Wheel unit 3 internal fault	B2870	Illuminated	
Wheel unit 4 internal fault	B2871	Illuminated	
CAN bus communication error	U0516	Illuminated	
CAN system communication error	U1900	Not illuminated	–
Wheel unit 1 communication malfunction	U2616	Illuminated	
Wheel unit 2 communication malfunction	U2617	Illuminated	
Wheel unit 3 communication malfunction	U2618	Illuminated	
Wheel unit 4 communication malfunction	U2619	Illuminated	

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)]

EPU020237020S03

- This function allows access to certain data values, input signal, calculated values, and system status information.

PID/DATA monitor table

PID name	Description (Input/output part)	Operation/unit (WDS or equivalent)
CCNT_TPMS	Number of continuous trouble code set	–
LAST_ID*	Last received tire transmitter ID code value	–
PRS_WU1*	Tire pressure (wheel unit No.1)	kPa/psi
PRS_WU2*	Tire pressure (wheel unit No.2)	kPa/psi
PRS_WU3*	Tire pressure (wheel unit No.3)	kPa/psi
PRS_WU4*	Tire pressure (wheel unit No.4)	kPa/psi
TEMP_WU1*	Temperature (wheel unit No.1)	Celsius/Fahrenheit
TEMP_WU2*	Temperature (wheel unit No.2)	Celsius/Fahrenheit
TEMP_WU3*	Temperature (wheel unit No.3)	Celsius/Fahrenheit
TEMP_WU4*	Temperature (wheel unit No.4)	Celsius/Fahrenheit
VBATT	Battery positive voltage	V
VSS	Vehicle speed	KPH/MPH
WARN_1	Transmitter identifier with warning value 1	–
WARN_2	Transmitter identifier with warning value 2	–
WARN_3	Transmitter identifier with warning value 3	–
WARN_4	Transmitter identifier with warning value 4	–

* : Data transmission from the wheel unit occurs when the vehicle speed is **25 km/h {15.5 mph} or more**. Due to this, the current air pressure and temperature data can only be displayed after the vehicle is driven at **25 km/h {15.5 mph} or more**. Also, the LAST_ID, and tire pressure and internal tire air temperature data are erased when the TPMS control unit connector and the battery terminal are disconnected. If the TPMS control unit is replaced or the battery terminals are disconnected, drive the vehicle at **25 km/h {15.5 mph} or more** and display the tire pressure PID after the data transmission.

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)]

EPU020237020S04

External Tester Communication Function

- The external tester communication function communicates diagnostic information (reading DTCs and reading input/output signal) by sending and receiving signals between the TPMS control module and an external tester.

Connection and communication information

	External tester	
	WDS or equivalent	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: CAN communication line	Serial communication
PID/Data monitor function	Input/output: CAN communication line	Serial communication

Serial Communication

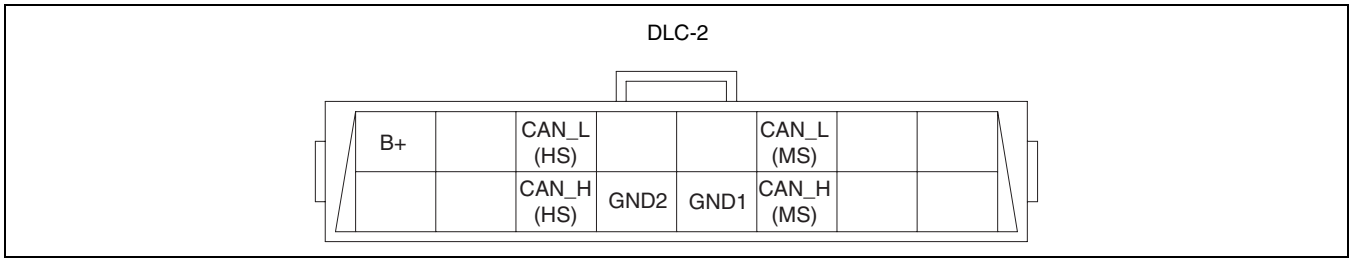
- Serial communication (synchronous communication) is a method of communication in which many pieces of information are sent and received instantaneously through a single wire.
- By connecting the WDS or equivalent to DLC-2, diagnostic information can be sent and received between the WDS or equivalent and the TPMS control module via the CAN communication line.
- The TPMS control module receives signals for the malfunction detection function and data monitor function from the WDS or equivalent, and sends information about DTCs and input/output part operating conditions to the WDS or equivalent.

Diagnostic function	Signal received	Signal sent
Malfunction detection function	DTC verification signal	DTC
PID/Data monitor function	Request signal to read selected monitor item	Monitor information for requested monitor item

DLC-2 CONSTRUCTION [TIRE PRESSURE MONITORING SYSTEM (TPMS)]

EPU020237020S05

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been adopted.
- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The connector has a 16-pin construction that includes the CAN_H (HS), CAN_L (HS), CAN_H (MS), CAN_L (MS), GND1, GND2 and B+ terminals.



C3U0402S002

Terminal	Function
CAN_L (HS)	Serial communication Lo terminal (HS)
CAN_H (HS)	Serial communication Hi terminal (HS)
CAN_L (MS)	Serial communication Lo terminal (MS)
CAN_H (MS)	Serial communication Hi terminal (MS)
GND1	Body GND terminal
GND2	Serial communication GND terminal
B+	Battery power supply terminal

02–12 WHEEL AND TIRES

WHEELS AND TIRES OUTLINE 02–12–1
WHEELS AND TIRES STRUCTURAL VIEW 02–12–1
TIRE PRESSURE MONITORING SYSTEM (TPMS) OUTLINE 02–12–2
TIRE PRESSURE MONITORING SYSTEM (TPMS) STRUCTURAL VIEW 02–12–2
TIRE PRESSURE MONITORING SYSTEM (TPMS) WIRING DIAGRAM 02–12–3
TIRE PRESSURE MONITORING SYSTEM (TPMS) CONSTRUCTION/OPERATION 02–12–4
Construction **02–12–4**
Operation **02–12–4**
Component Parts/Function **02–12–4**
WHEEL UNIT CONSTRUCTION/OPERATION 02–12–5
Construction **02–12–5**
Operation **02–12–5**
Sensing Function **02–12–5**
Self-diagnostic Function **02–12–5**
TIRE PRESSURE MONITORING SYSTEM (TPMS) WARNING LIGHT, TIRE PRESSURE MONITORING SYSTEM (TPMS) WARNING BUZZER CONSTRUCTION 02–12–6
TIRE PRESSURE MONITORING SYSTEM (TPMS) CONTROL MODULE CONSTRUCTION/OPERATION 02–12–6
Construction **02–12–6**
Operation **02–12–6**
CONTROLLER AREA NETWORK (CAN) OUTLINE 02–12–7
Transmitted Information **02–12–7**
Received Information from PCM **02–12–7**

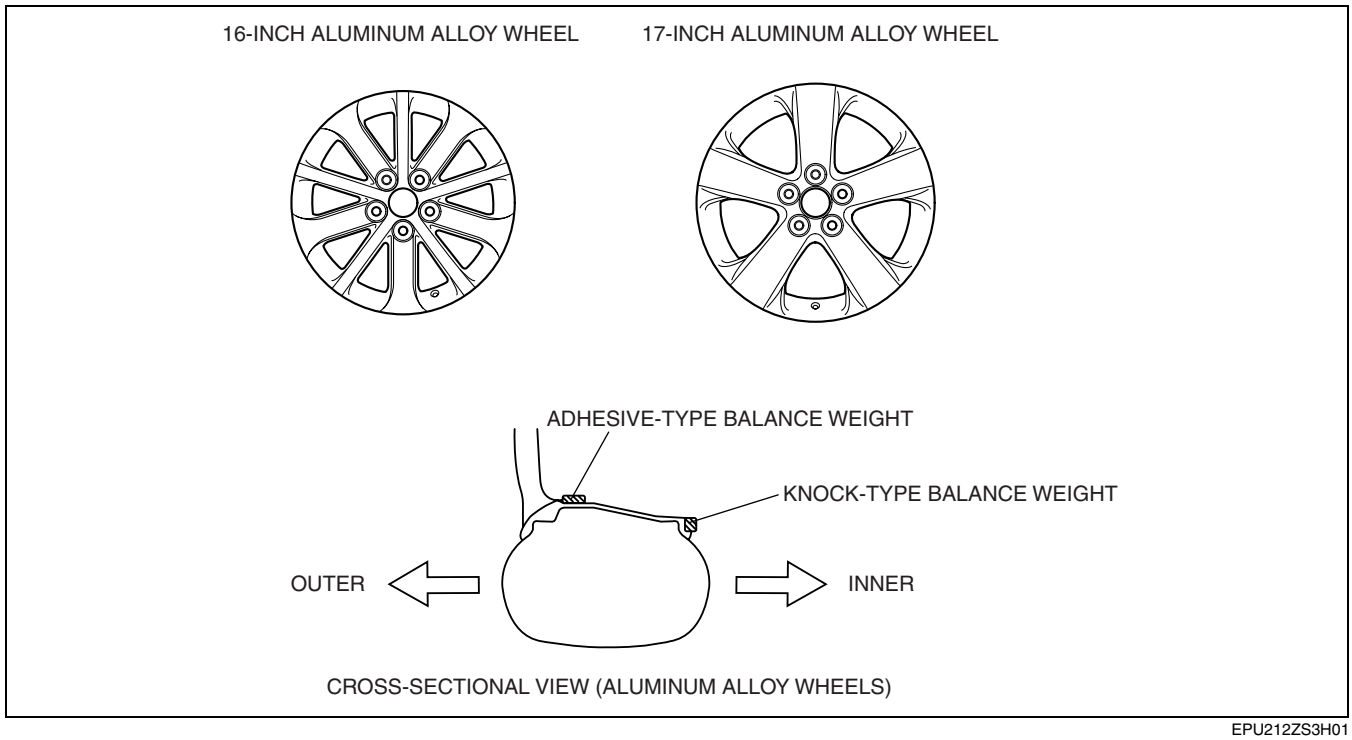
WHEELS AND TIRES OUTLINE

EPU021200000S01

- An adhesive-type balance weights has been adopted to the outer side of the wheels. Due to this, a stylish wheel design is realized.
- In consideration of the environment, steel balance weights have been adopted to reduce the use of lead in the vehicle.

WHEELS AND TIRES STRUCTURAL VIEW

EPU021200000S02



EPU212ZS3H01

TIRE PRESSURE MONITORING SYSTEM (TPMS) OUTLINE

EPU021237020S01

- The tire pressure monitoring system (TPMS) has been adopted to assist the driver in understanding the tire status. It alerts the driver with the TPMS warning light and buzzer if an excessive drop in air pressure is detected.

Caution

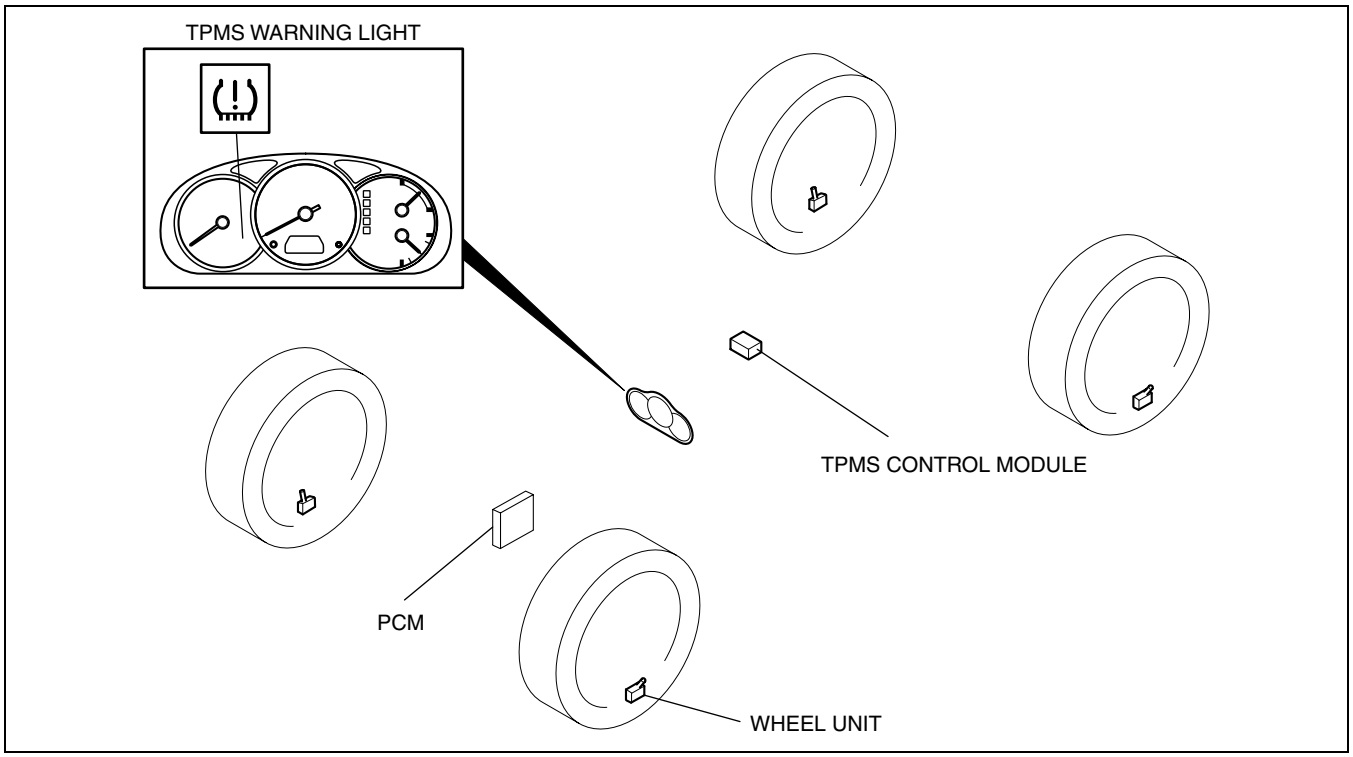
- **Each wheel unit has its own preset identification code. If a system component is replaced, the system becomes inoperative since the TPMS control module cannot recognize the identification codes. Therefore, be sure to configure the identification codes of wheel units when any of the following items have been performed. For the identification code configuration procedure, refer to the Workshop Manual.**
  - **— Disc wheel replacement**
  - **— Wheel unit replacement**
  - **— TPMS control module replacement**

Note

- Perform tire pressure adjustment before driving. (When tires are cold.)
- Tire pressure changes due to changes in ambient temperature and internal tire temperature.
  - — In an area or a season with varying of temperatures, tire pressure will change due to ambient temperature change. If the tire pressure is lower than the lower-limit pressure due to low ambient temperature, the TPMS warning light may illuminate. Adjust the pressure when the TPMS warning light illuminates.
  - — Tire pressure rises after driving because the internal temperature of the tire is high, If tire pressure is adjusted to the standard value when the internal temperature of the tire is high, the tire pressure lowers when the internal temperature decreases to the same level as the ambient temperature. If the tire pressure is lower than the lower-limit temperature, the TPMS warning light may illuminate.
- As a general reference, air pressure changes **approx.10 kPa {0.1 kgf/cm^2, 1.5 psi}** when the temperature changes **10 °C {50 °F}**.

TIRE PRESSURE MONITORING SYSTEM (TPMS) STRUCTURAL VIEW

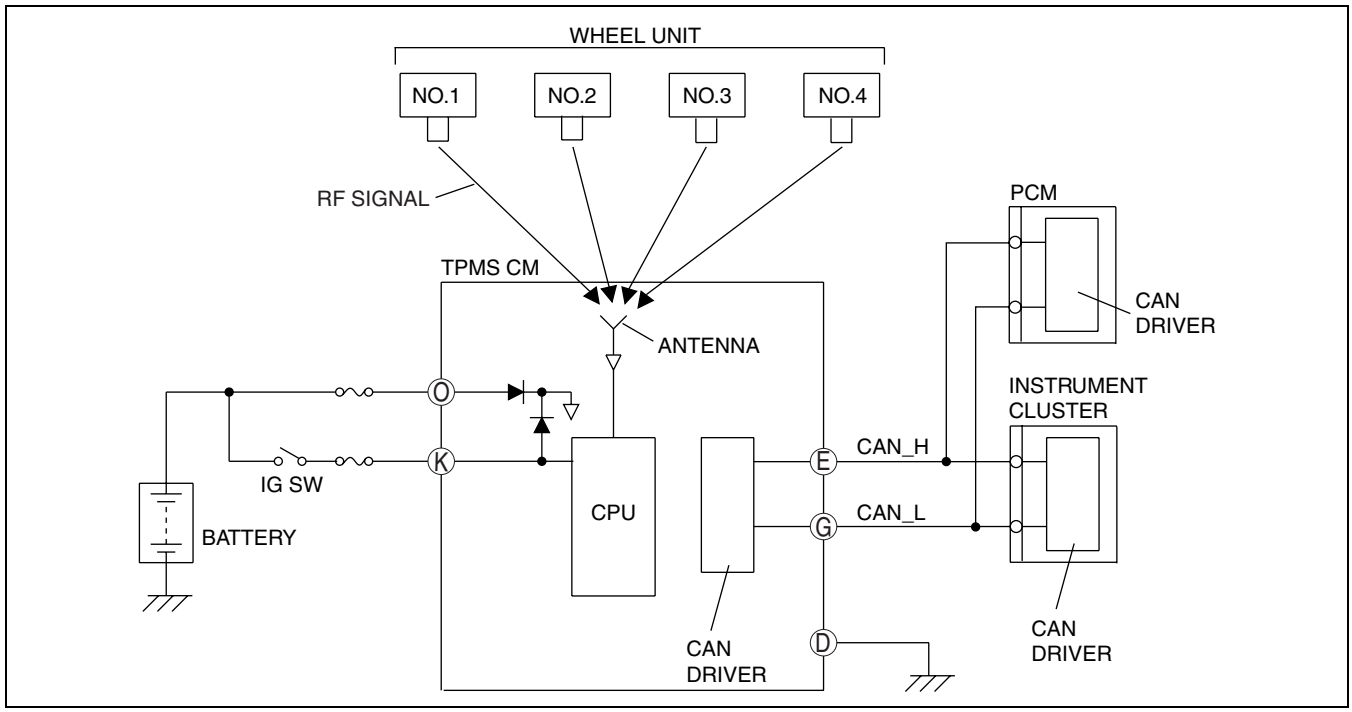
EPU021237020S02



EPU212ZS3003

TIRE PRESSURE MONITORING SYSTEM (TPMS) WIRING DIAGRAM

EPU021237020S03



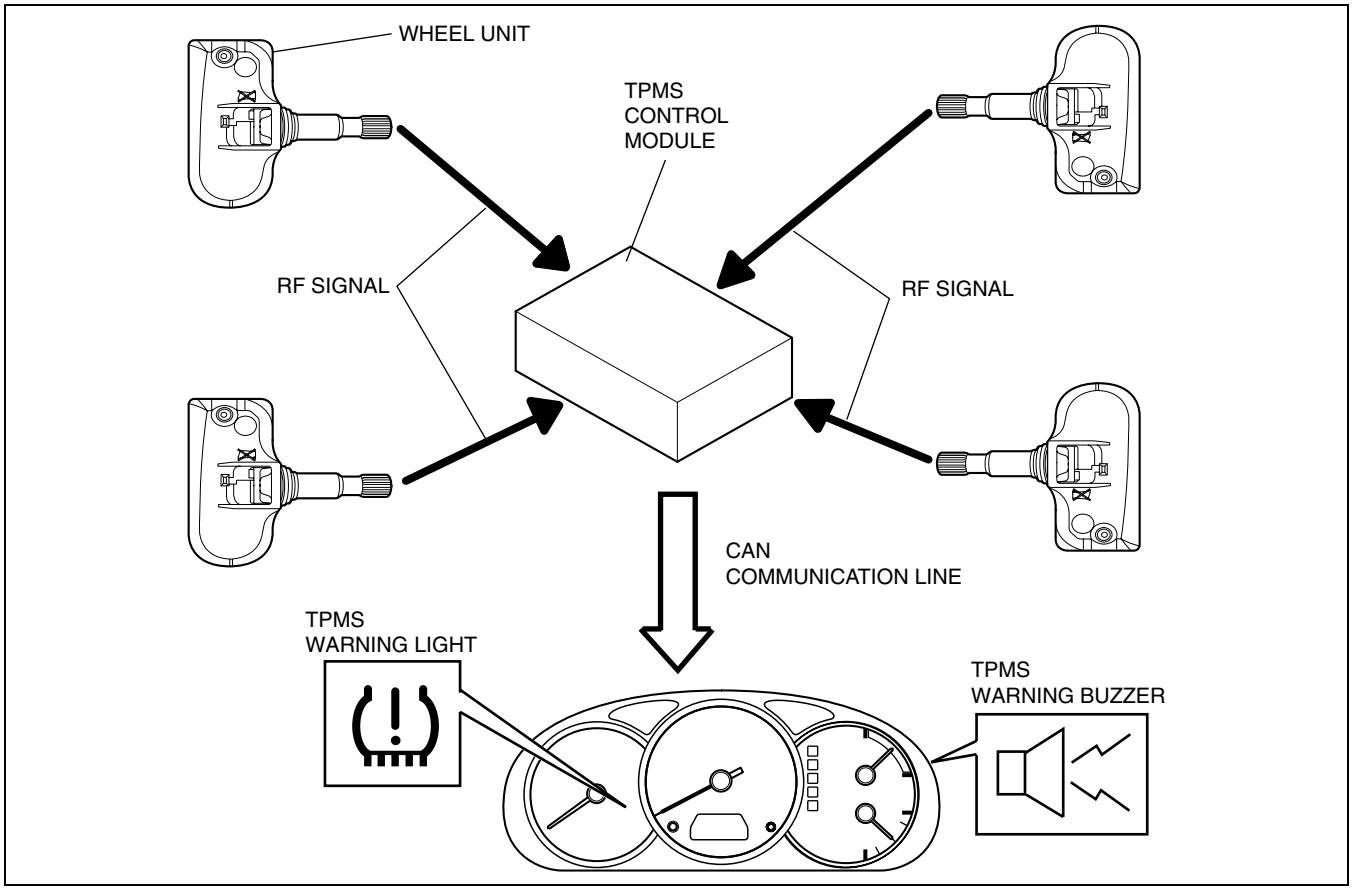
CHU0202W001

TIRE PRESSURE MONITORING SYSTEM (TPMS) CONSTRUCTION/OPERATION

EPU021237020S04

Construction

- The TPMS consists of wheel units that detect air pressure, temperature and acceleration of each tire, and a TPMS control module that receives data (RF signals) sent from the wheel units to monitor the air pressure of each tire.



EPU212ZS3002

Operation

- The wheel unit installed to each wheel sends data on air pressure, temperature and acceleration of each tire by means of RF signals. The TPMS control module receives these signals with a built-in antenna.
- The TPMS control module monitors the air pressure of each tire based on the tire data sent from each wheel unit. If the module detects an excessive drop in air pressure, the module illuminates the TPMS warning light and sounds the TPMS warning buzzer via CAN communication to alert the driver.

Component Parts/Function

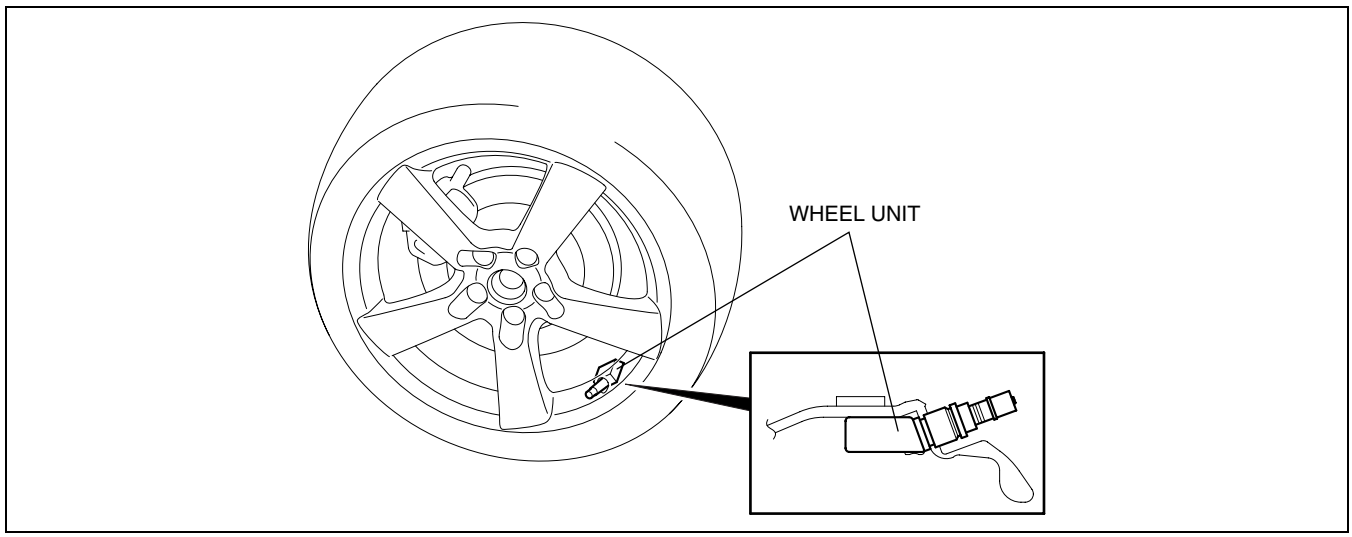
Part name		Function
Wheel unit		• Monitors air pressure, temperature, and acceleration of each tire, and sends RF signals. • Sends data if any abnormality is detected in the wheel unit.
TPMS control module		• Receives RF signals from the wheel units and monitors the air pressure of each tire. If it determines from these signals that tire pressure is abnormal, it controls the TPMS warning light and buzzer via CAN communication to alert the driver. • Controls the on-board diagnostic system if it receives an abnormal signal from the wheel unit.
PCM	Vehicle speed signal	• Inputs vehicle speed signals to the TPMS control module via CAN communication.
Instrument cluster	TPMS warning light	• If the TPMS control module detects abnormal air pressure, the light is illuminated to alert the driver. • If any abnormality is detected in the system, the light is flashed to inform the driver.
	TPMS warning buzzer	• If the TPMS control module detects abnormal air pressure, the buzzer is sounded to alert the driver.

WHEEL UNIT CONSTRUCTION/OPERATION

EPU021237140S01

Construction

- The wheel unit is installed to the rim of each wheel with a nut. It monitors air pressure, temperature and acceleration of the tire, and sends the data as RF signals.
- The wheel unit also serves as a tire valve.



DPE212ZT1002

Operation

- The wheel unit operates on a built-in battery, and regularly sends tire data as RF signals. The data it sends is retrieved using a sensing function that monitors tire pressure and temperature, and a self-diagnostic function that detects battery status and sensor malfunction.
- To maximize the life of the built-in battery, the unit uses the detected air pressure and acceleration to determine vehicle conditions such as driving and long stops, and operates in a mode appropriate to vehicle conditions so that battery consumption is minimized.
- Each wheel unit has its own identification code that is sent together with tire data and is used to verify which tire has abnormal tire pressure. Therefore, when the wheel unit or the TPMS control module is replaced, the identification codes must be configured.

Sensing Function

- The sensing function periodically monitors the following data and sends it to the TPMS control module.
  - — Tire pressure
  - — Tire temperature
  - — Tire acceleration
  - — Voltage of the built-in battery
- Intervals of tire data monitoring and data transmission to the TPMS control module differ depending on the operational mode (varies according to vehicle conditions).

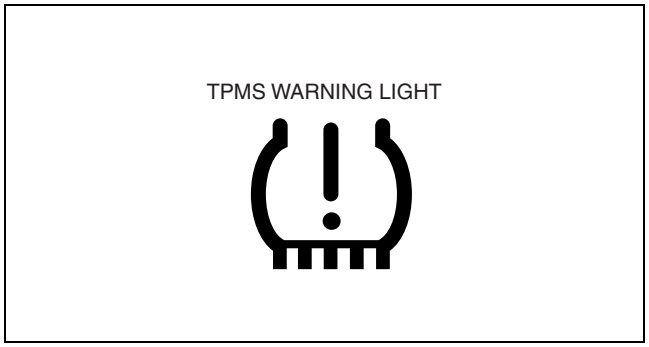
Self-diagnostic Function

- The self-diagnostic function continuously performs malfunction diagnosis for each sensing function item. If any abnormality is found by the malfunction diagnosis, the data is sent to the TPMS control module.

TIRE PRESSURE MONITORING SYSTEM (TPMS) WARNING LIGHT, TIRE PRESSURE MONITORING SYSTEM (TPMS) WARNING BUZZER CONSTRUCTION

EPU021237140S02

- The TPMS warning light and the TPMS warning buzzer are built into the instrument cluster.
- In the event of any abnormality in tire pressure or in the system, signals from the TPMS control module illuminate the warning light and sound the warning buzzer to alert the driver.
- Signals from the TPMS control module are sent through the CAN communication lines.



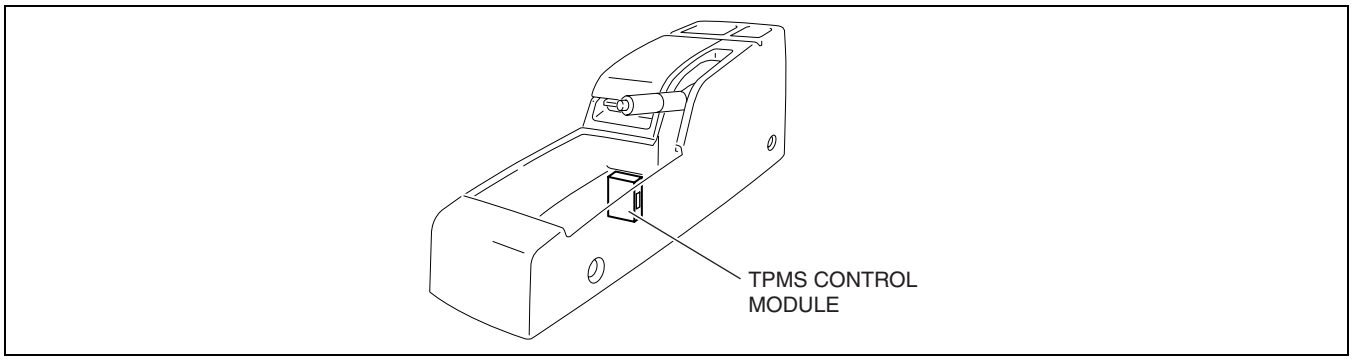
CHU0212S010

TIRE PRESSURE MONITORING SYSTEM (TPMS) CONTROL MODULE CONSTRUCTION/OPERATION

EPU021267502S01

Construction

- The TPMS control module is installed in front of the parking brake lever.



EPU212ZS3004

Operation

- Through the built-in antenna, the TPMS control module receives data on each tire transmitted from the wheel units.
- The module monitors the tire pressure of each tire and the wheel units for abnormalities using the received data. If any abnormality is found, it controls the TPMS warning light and buzzer to alert and notify the driver.
- The TPMS control module controls the following functions based on the received data:

Function list

Identification code recognition function	• Recognizes whether received signals are from own wheel units.
Tire pressure determination/warning function	• Compares received tire pressure data with preset values in the TPMS control module. If the pressure is determined to be too low, the module alerts the driver via the TPMS warning light and buzzer.

Identification code recognition function

- Since the identification codes of wheel units mounted on the vehicle have been configured in the TPMS control module, the module can verify the identification codes sent from the wheel units against the configured identification codes.
- When the received identification code agrees with the configured identification code, data such as tire pressure is updated according to the received RF signal. When the identification code does not agree, that signal data is ignored.

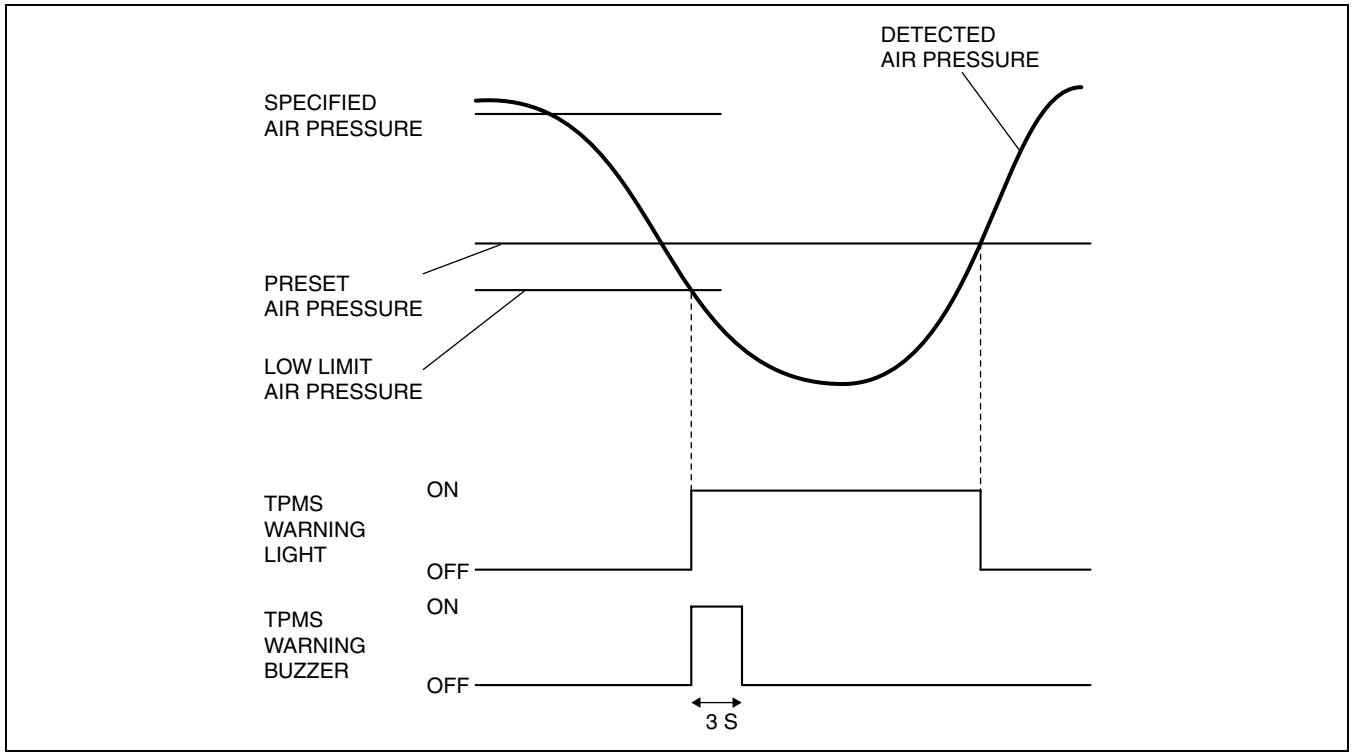
Tire pressure determination and warning function

- The TPMS control module determines the tire pressure status of each wheel by comparing tire pressure data received from the wheel units with the preset values in the module.
- When an abnormality is determined from the data, the module sends control signals through CAN communication to the instrument cluster that cause the TPMS warning buzzer to sound and the TPMS warning light to illuminate. This alerts the driver of abnormal tire pressure.
- The tire pressure monitoring function is classified into the two low-pressure determinations.
- The informing/warning of an abnormal tire pressure determination takes precedence over the informing/warning of a missing signal or malfunction determination.

Low-pressure determination

- When tire pressure data sent from a wheel unit is lower than the detection value configured in the TPMS control module, the module determines that the tire for that wheel unit has low tire pressure.
  - — If low tire pressure is determined when the ignition is on, the TPMS control module illuminates the TPMS warning light built into the instrument cluster and sounds the TPMS warning buzzer for **3 s** to alert the driver.
  - — If low tire pressure is determined when the ignition is off, the module performs an open-circuit check[*1] on the TPMS warning light after the ignition is turned on, and then illuminates the TPMS warning light and sounds the TPMS warning buzzer for **3 s** to alert the driver.
- The low-pressure determination is retained until tire pressure data from the applicable wheel unit returns to the preset value.
  - — If tire pressure data that is higher than the specified value is received when the ignition is on, the TPMS control module turns out the TPMS warning light.
  - — If tire pressure data that is higher than the specified value is received when the ignition is off, the module performs an open-circuit check[*1] on the TPMS warning light after the ignition is turned on and turns out the TPMS warning light.

[*1]: The TPMS control modules turns on the TPMS warning light for **3 s** after the ignition is turned on for an open-circuit check of the TPMS warning light.



CHU0212S004

CONTROLLER AREA NETWORK (CAN) OUTLINE

EPU021267502S02

- The TPMS control module transmits/receives information using the CAN system. See Section 09 for detailed information regarding the CAN system.

Transmitted Information

- TPMS warning light on request
- TPMS warning buzzer on request

Received Information from PCM

- Vehicle speed

02–13 FRONT SUSPENSION

FRONT SUSPENSION OUTLINE 02–13–1
FRONT SUSPENSION STRUCTURAL VIEW 02–13–1
FRONT SHOCK ABSORBER CONSTRUCTION 02–13–1
FRONT LOWER ARM CONSTRUCTION 02–13–2
FRONT CROSSMEMBER CONSTRUCTION 02–13–2

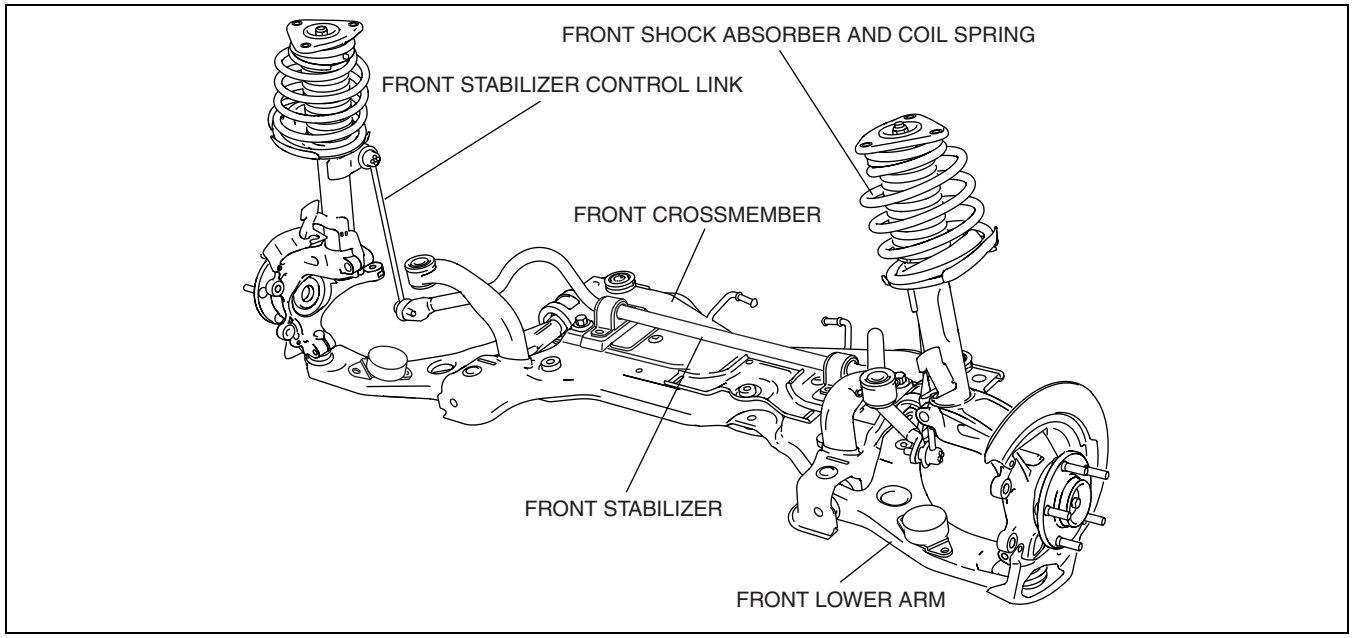
FRONT SUSPENSION OUTLINE

EPU021300000S01

- A strut-type front suspension has been adopted.
- Due to the tight connection of the four-point rubber mounts to the body, high handling stability and improved riding comfort is provided together with low NVH (Noise, Vibration, Harshness) with no loss of mount rigidity.

FRONT SUSPENSION STRUCTURAL VIEW

EPU021300000S02



EPU213ZS3H02

FRONT SHOCK ABSORBER CONSTRUCTION

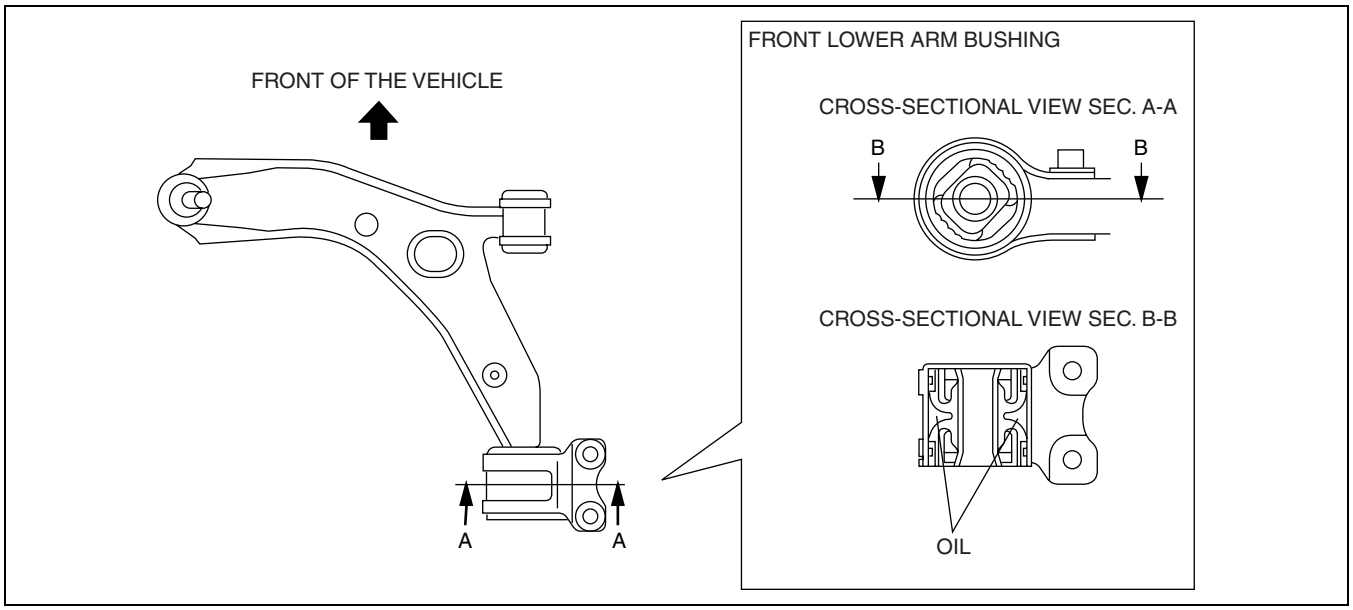
EPU021334700S01

- Excellent response shock absorbers with large-diameter pistons and built-in rebound springs which suppress inner wheel lifting during cornering have been adopted for improved riding comfort and handling stability.
- Separated input type front shock absorber mounts have been adopted. Due to this, the shock absorbers function efficiently, improving steering stability and riding comfort.
- In addition, to reduce shock absorber inner friction that occurs when lateral force acts on the shock absorbers, the coil springs have been optimally positioned.

FRONT LOWER ARM CONSTRUCTION

EPU021334300S01

- An oil-filled bushing has been adopted for the backside of the front lower arm. Due to this, superior handling stability and riding comfort, and low NVH (Noise, Vibration, Harshness) have been achieved.

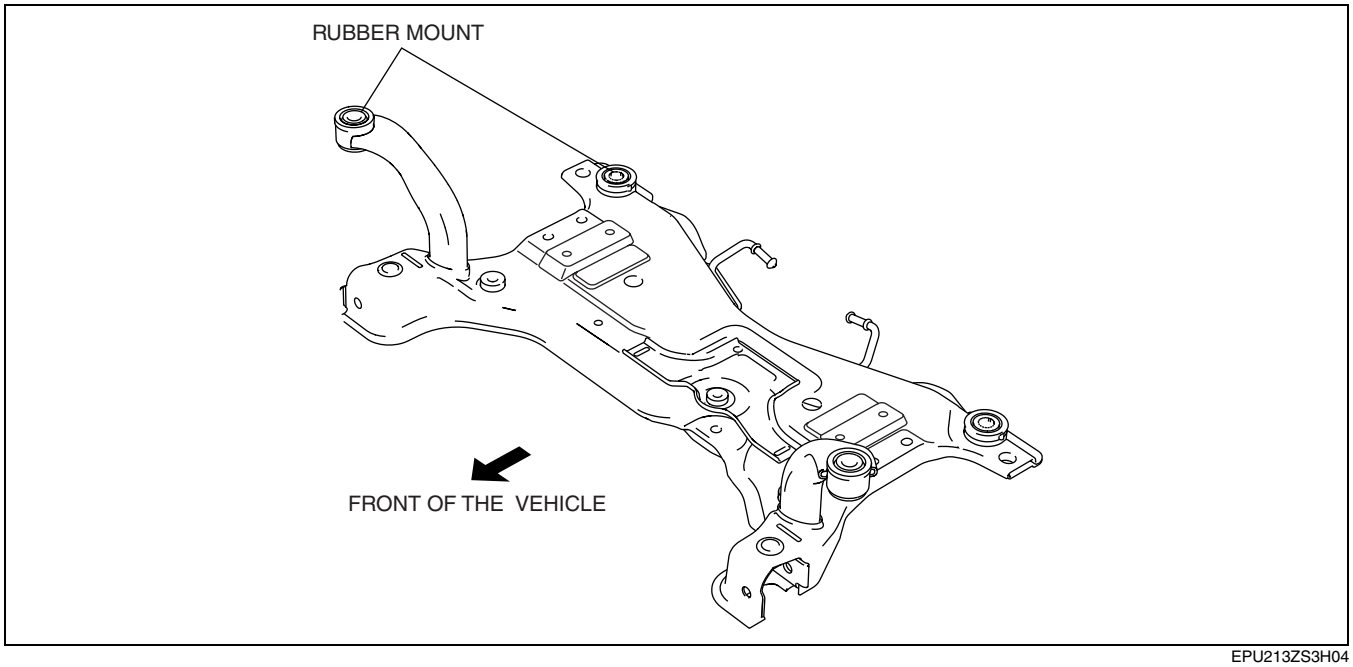


B3E0213TH03

FRONT CROSSMEMBER CONSTRUCTION

EPU021334800S01

- A four-point rubber mount system has been adopted for the front crossmember. Due to this, the application of preload in the vertical direction has improved rigidity providing enhanced handling stability, and the utilization of horizontal flexibility has improved riding comfort.



EPU213ZS3H04

02–14 REAR SUSPENSION

REAR SUSPENSION OUTLINE 02–14–1
REAR SUSPENSION STRUCTURAL VIEW 02–14–1
MULTI-LINK REAR SUSPENSION CONSTRUCTION 02–14–2
Optimized Link and Shock Absorber Layout 02–14–2
REAR SHOCK ABSORBER CONSTRUCTION 02–14–3
REAR CROSSMEMBER CONSTRUCTION 02–14–3

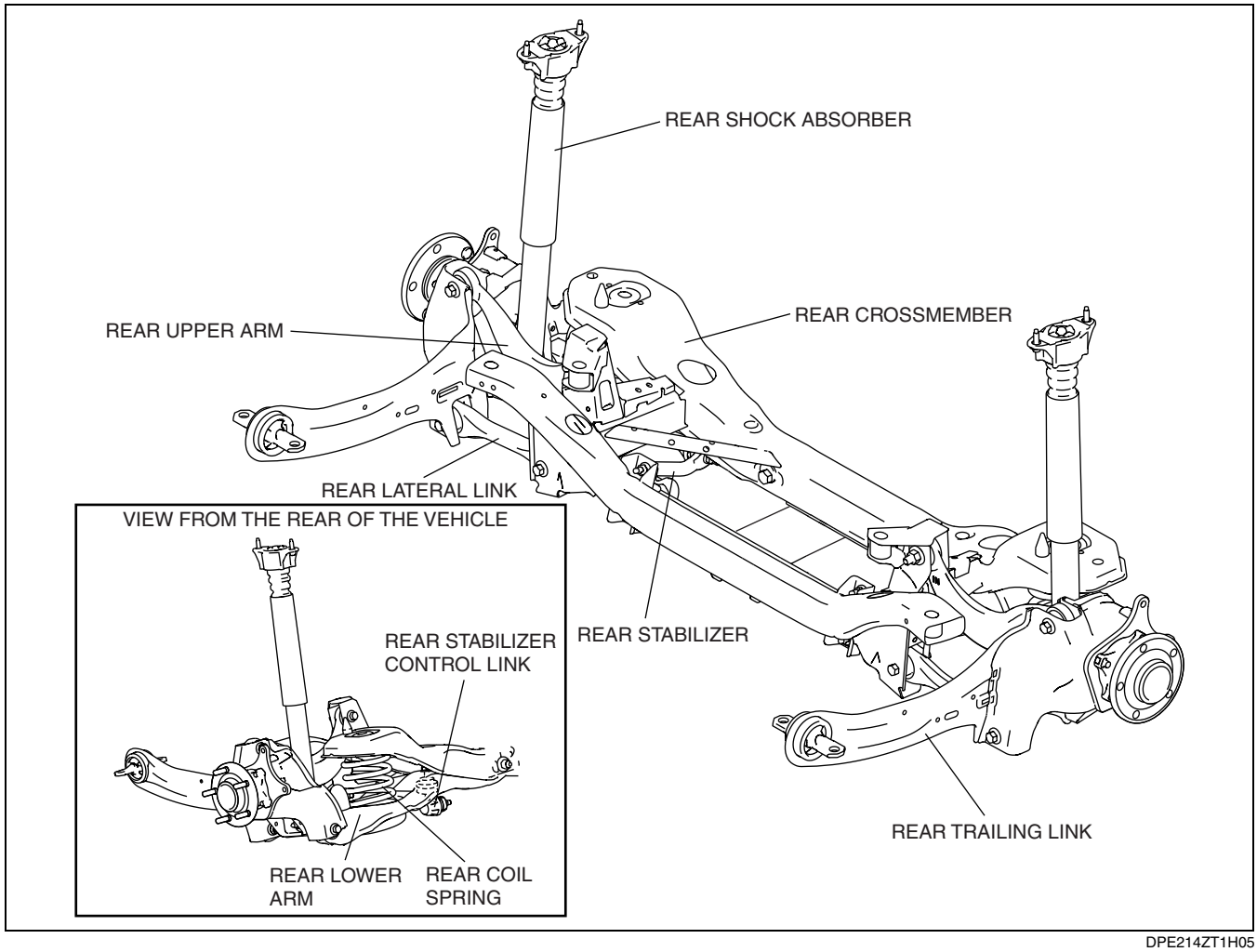
REAR SUSPENSION OUTLINE

EPU021400000S01

- An E-type multi-link rear suspension has been adopted.
- A wider luggage compartment is ensured due to the separated positioning of the shock absorber and coil spring.
- Also due to the separated positioning of the shock absorber and coil spring, side force on the shock absorber is reduced so that the suspension system operates smoothly and riding comfort is improved.

REAR SUSPENSION STRUCTURAL VIEW

EPU021400000S02



DPE214ZT1H05

MULTI-LINK REAR SUSPENSION CONSTRUCTION

EPU021400000S03

Optimized Link and Shock Absorber Layout

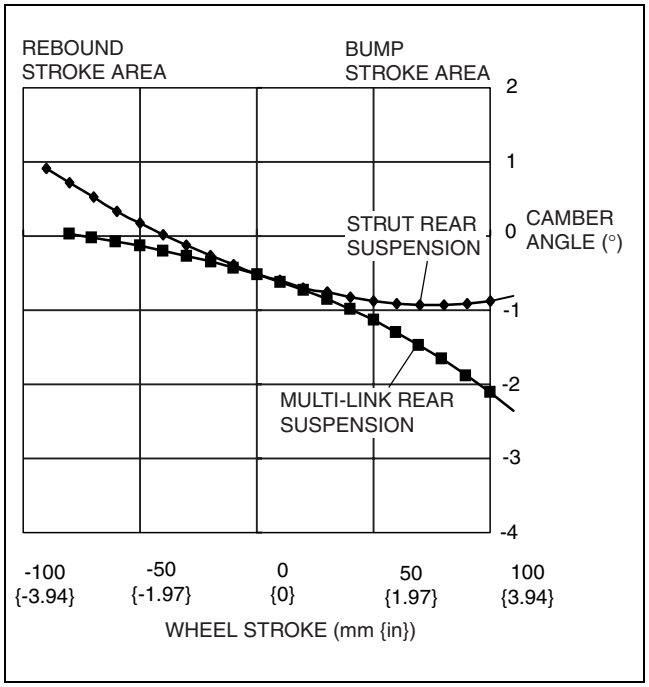
Optimized camber angle

- Change of camber angle to ground during wheel stroke is minimized due to the optimization of the lower and upper arm lengths. Due to this high gripping power is assured under any driving condition and handling stability is improved.

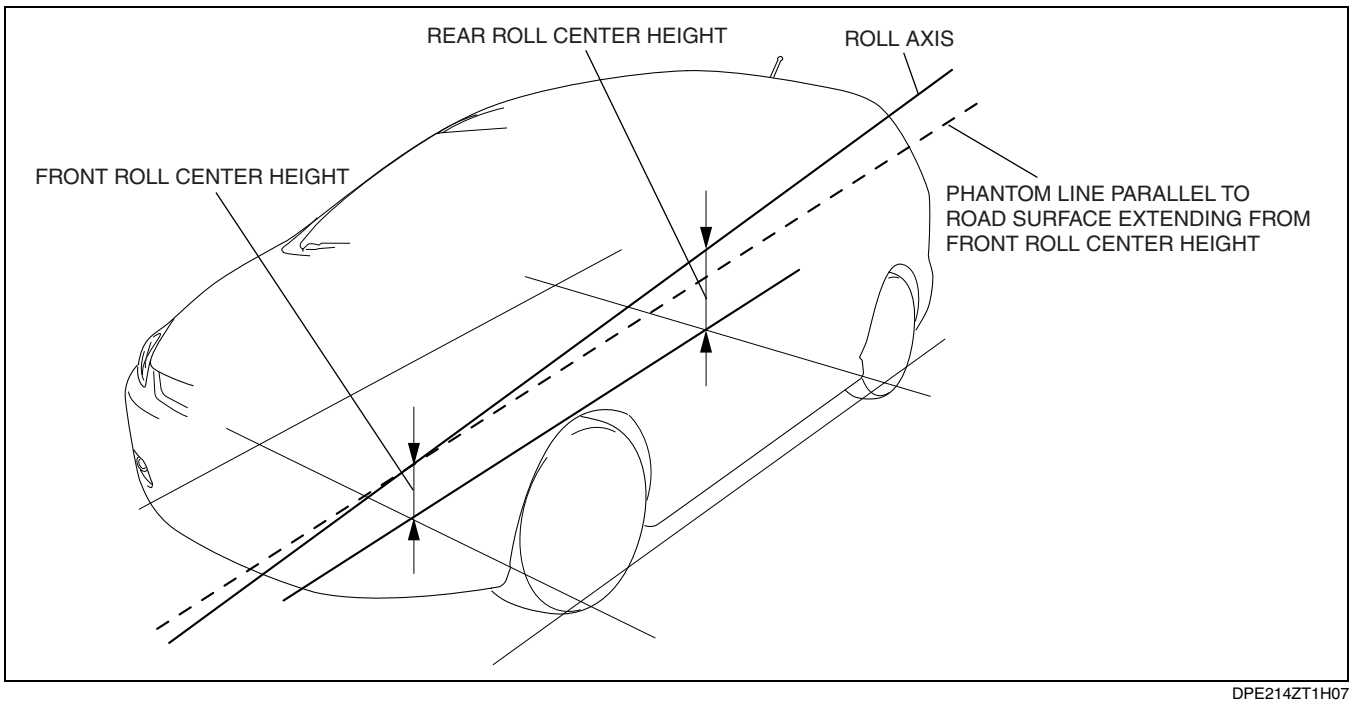
Camber control characteristic comparison

Optimized roll axis position

- Lateral force acting on the shock absorbers is reduced due to the separated positioning of the rear coil spring and shock absorber, enabling smooth operation of the suspension system and thereby improving riding comfort.
- Additionally, the height of the front roll center is set lower than the rear. Due to this, driveability is improved while cornering.



B3E0214TH06

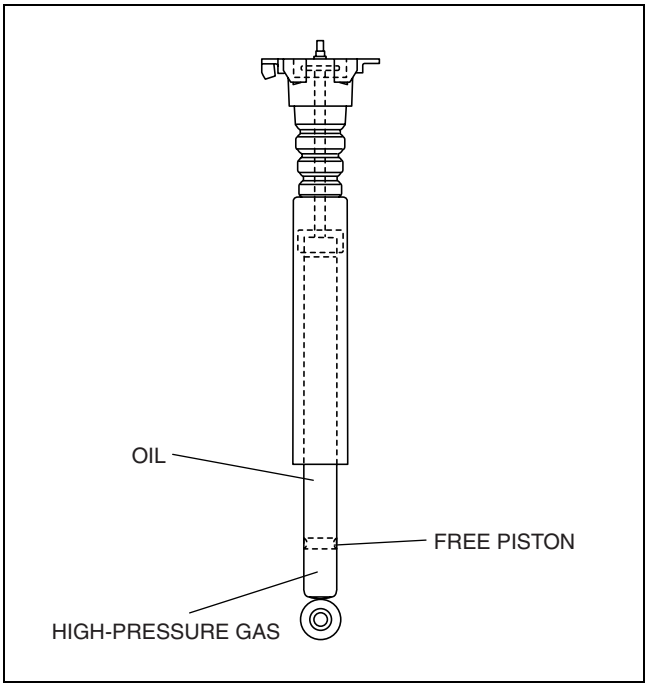


DPE214ZT1H07

REAR SHOCK ABSORBER CONSTRUCTION

EPU021428700S01

- Monotube shock absorbers with superior damping characteristics such as response have been adopted, improving handling stability and riding comfort.
- Chambers that are gas-pressurized via a free piston have been equipped to provide excellent oil cooling capability and minimized cavitation. Due to this, stable damping force is provided.

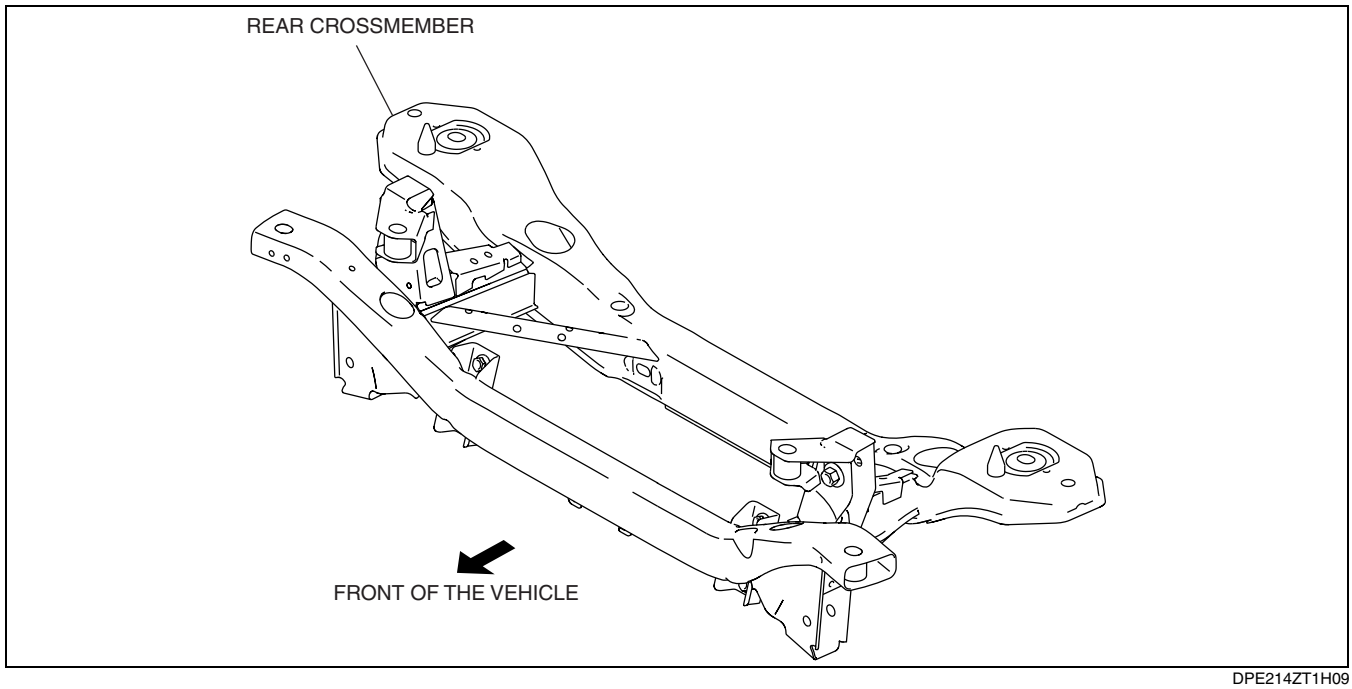


DPE214ZT1H08

REAR CROSSMEMBER CONSTRUCTION

EPU021428400S01

- Due to the use of a hollow-steel construction rear crossmember, weight reduction is achieved while rigidity is improved.
- The rear crossmember is tightly connected to the vehicle body in six points, ensuring high rigidity.



DPE214ZT1H09

DRIVELINE/AXLE

03 SECTION

OUTLINE 03-00
FRONT AXLE 03-11
REAR AXLE 03-12
DRIVE SHAFT 03-13

03–00 OUTLINE

DRIVELINE/AXLE ABBREVIATIONS. 03–00–1
DRIVELINE/AXLE FEATURES 03–00–1
DRIVELINE/AXLE SPECIFICATIONS 03–00–1

DRIVELINE/AXLE ABBREVIATIONS

EPU030000000S01

ATX	Automatic Transaxle
LH	Left Hand
RH	Right Hand
MTX	Manual Transaxle

DRIVELINE/AXLE FEATURES

EPU030000000S02

Improved driveability	• Unit-design, double angular ball bearings with low rotational resistance adopted for rear axles • Bell-shaped constant velocity joint adopted for wheel-side joint of front drive shaft • Tripod-shaped constant velocity joint adopted for differential-side joint of front drive shaft (ATX, MTX (LH)) • Double offset-shaped constant velocity joint adopted for differential-side joint of front drive shaft (MTX (RH))
Reduced vibration and noise	• Bell-shaped constant velocity joint adopted for wheel-side joint of front drive shaft • Tripod-shaped constant velocity joint adopted for differential-side joint of front drive shaft (ATX, MTX (LH)) • Double offset-shaped constant velocity joint adopted for differential-side joint of front drive shaft (MTX (RH))
Improved serviceability	• Unit bearings that require no preload adjustment adopted for the rear wheels

DRIVELINE/AXLE SPECIFICATIONS

EPU030000000S03

Item			Specifications	
			ATX	MTX
Front axle				
Wheel bearing type			Angular ball bearing	
Rear axle				
Wheel bearing type			Angular ball bearing	
Front drive shaft				
Joint type	Wheel side		Bell joint	
	Differential side	RH	Tripod joint	Double offset joint
		LH		Tripod joint
Shaft diameter	RH	(mm {in})	26.0 {1.02}	
	LH			
Joint shaft				
Shaft diameter		(mm {in})	28.0 {1.10}	40.0 {1.57}

03–11 FRONT AXLE

FRONT AXLE OUTLINE 03–11–1
Features **03–11–1**
FRONT AXLE CROSS-SECTIONAL VIEW 03–11–1

FRONT AXLE OUTLINE

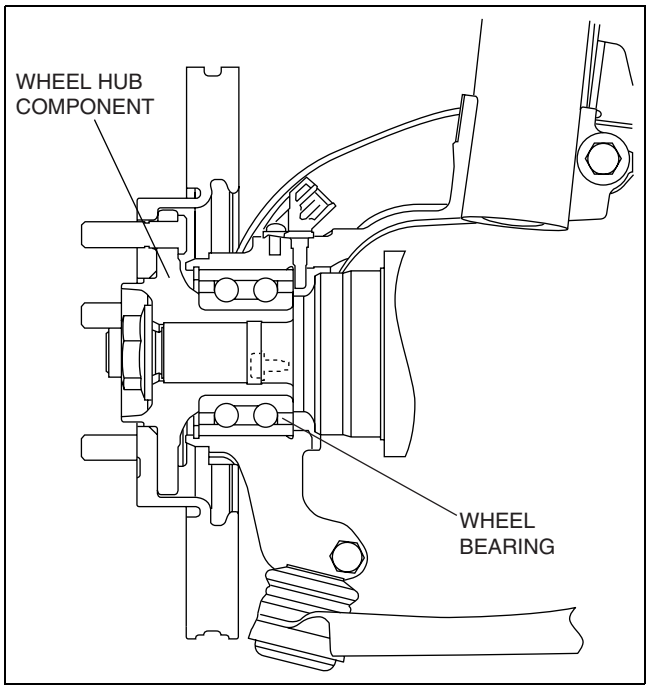
EPU031104000S01

Features

- Angular ball bearings with low rotational resistance have been adopted for the front axle wheel bearing. Due to this, driveability has been improved.

FRONT AXLE CROSS-SECTIONAL VIEW

EPU031104000S02



EPU311ZS3001

03–12 REAR AXLE

REAR AXLE OUTLINE 03–12–1
Features **03–12–1**
REAR AXLE CROSS-SECTIONAL VIEW 03–12–1

REAR AXLE OUTLINE

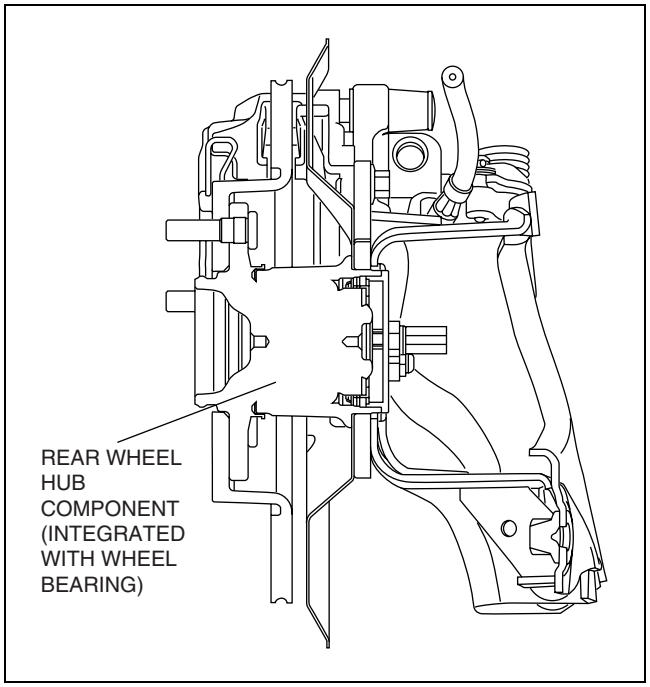
EPU031205000S01

Features

- Unit-design angular ball bearings have been adopted, improving driveability and serviceability.

REAR AXLE CROSS-SECTIONAL VIEW

EPU031205000S02



EPU312ZS3001

03–13 DRIVE SHAFT

FRONT DRIVE SHAFT OUTLINE 03–13–1
Construction **03–13–1**
FRONT DRIVE SHAFT STRUCTURAL VIEW 03–13–1
JOINT SHAFT OUTLINE 03–13–2
Construction **03–13–2**

FRONT DRIVE SHAFT OUTLINE

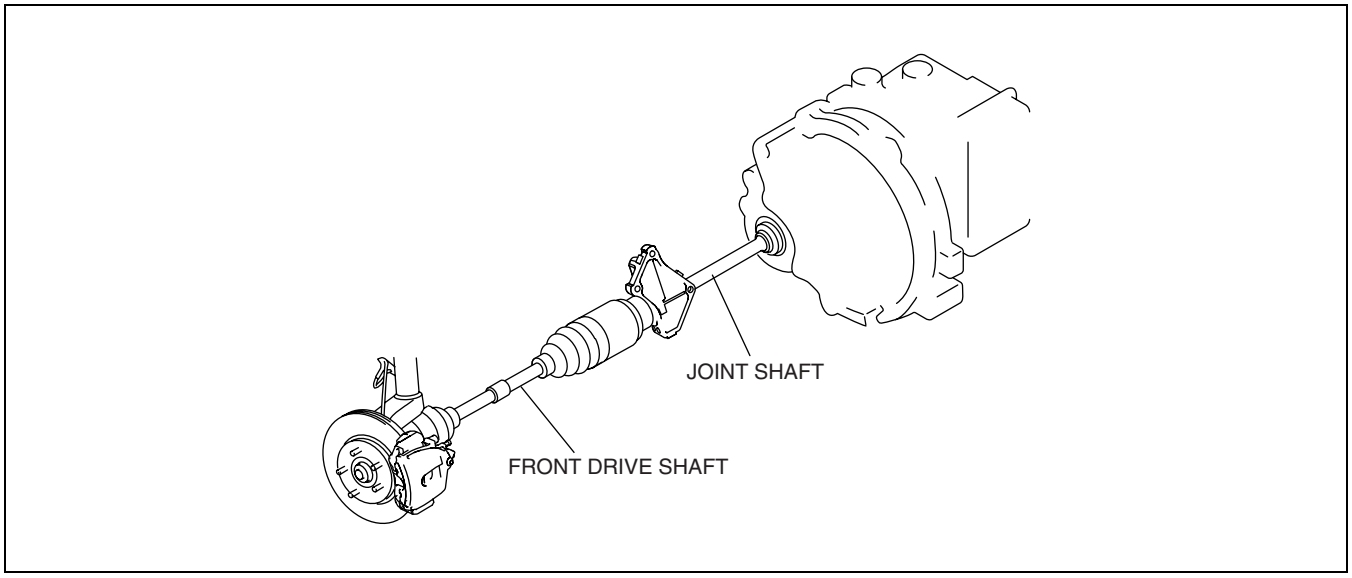
EPU031325500S01

Construction

- A bell joint has been adopted for the wheel-side constant velocity joint, reducing vibration and noise.
- A tripod joint and double offset joint have been adopted for the differential side constant velocity joint to reduce booming noise during high-speed driving and vibration when idling.
- The double offset joint type drive shaft (MTX LH side) is a single unit.

FRONT DRIVE SHAFT STRUCTURAL VIEW

EPU031325500S02



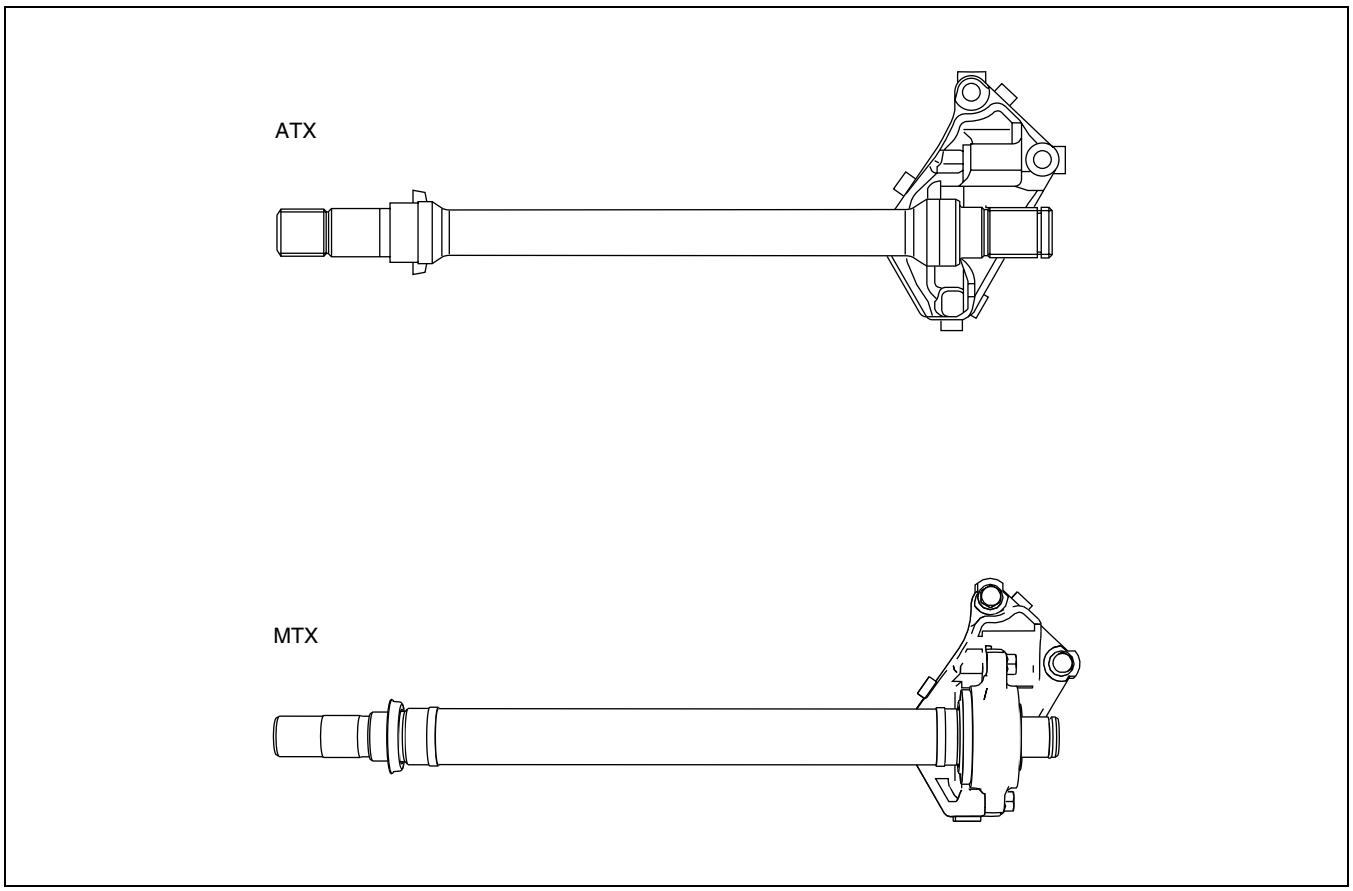
EPU313ZS3001

JOINT SHAFT OUTLINE

EPU031325700S01

Construction

- A joint shaft has been adopted to make the right and left sides of the drive shaft isometric, reducing torque steer* when accelerating quickly from a standstill and improving driveability.



EPU313ZS3002

*Torque steer
The vehicle pulls to one side during acceleration from a standstill or normal acceleration due to a right-left difference in momentum created by engine torque.

BRAKES

04
SECTION

OUTLINE 04-00
ON-BOARD DIAGNOSTIC 04-02
CONVENTIONAL BRAKE SYSTEM 04-11
PARKING BRAKE SYSTEM 04-12
ANTILOCK BRAKE SYSTEM 04-13

04–00 OUTLINE

BRAKE ABBREVIATIONS 04–00–1
BRAKE FEATURES 04–00–1
BRAKE SPECIFICATIONS 04–00–2

BRAKE ABBREVIATIONS

EPU040000000S01

ABS	Antilock Brake System
ATX	Automatic Transaxle
CAN	Controller Area Network
CM	Control Module
CPU	Central Processing Unit
EBD	Electronic Brakeforce Distribution
HU	Hydraulic Unit
IG	Ignition
LF	Left Front
LR	Left Rear
MTX	Manual Transaxle
OFF	Switch Off
ON	Switch On
PID	Parameter Identification
RF	Right Front
RR	Right Rear
SW	Switch
WDS	Worldwide Diagnostic System

BRAKE FEATURES

EPU040000000S02

Improved safety	• Intrusion minimizing brake pedal adopted • Large power brake unit (10 inch) with attached mechanical brake assist mechanism adopted • Electronic brakeforce distribution (EBD) control adopted • ABS adopted
Improved braking force	• Large diameter front disc brakes adopted • Large diameter rear disc brakes adopted
Improved serviceability	• Enhanced malfunction diagnosis system for use with WDS or equivalent
Improved operability	• Center lever type parking brake, adjustable from vehicle interior, adopted
Size and weight reduction	• Integrated construction of the hydraulic unit (HU) and control module (CM) adopted for the ABS HU/CM • Semi-conductor element type ABS wheel-speed sensor adopted • Magnetic encoder type ABS sensor rotor adopted
Improved brake pedal operability	• A master cylinder with smaller diameter long-stroke type has been adopted

BRAKE SPECIFICATIONS

EPU040000000S03

Item		Specification
Brake pedal	Type	Suspended design
	Pedal lever ratio	2.8
	Max. stroke (mm {in})	117 {4.61}
Master cylinder	Type	Tandem
	Cylinder bore (mm {in})	22.2 {0.874}
Front brake (disc)	Type	Ventilated disc
	Cylinder bore (mm {in})	57 {2.2}
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	5,140 × 12.0 {7.967 × 0.47}
	Disc plate dimensions (mm {in})	300 × 25 {11.8 × 0.98}
Rear brake (disc)	Type	Solid disc
	Cylinder bore (mm {in})	38 {1.5}
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	2,700 × 10.8 {4.185 × 0.43}
	Disc plate dimensions (mm {in})	302 × 11 {11.9 × 0.43}
Power brake unit	Type	Vacuum multiplier, single diaphragm
	Outer diameter (mm {in})	272.1 {10.71}
Rear wheel braking force control device	Type	Electronic brakeforce distribution (EBD)
Brake piping	Piping layout	X pattern
Parking brake	Type	Mechanical design, rear two-wheel braking
	Operating method (application/release)	Manually operated lever design
	Play adjustment method	Auto-adjusting
Brake fluid	Type	SAE J1703, FMVSS 116 DOT-3

04–02 ON-BOARD DIAGNOSTIC

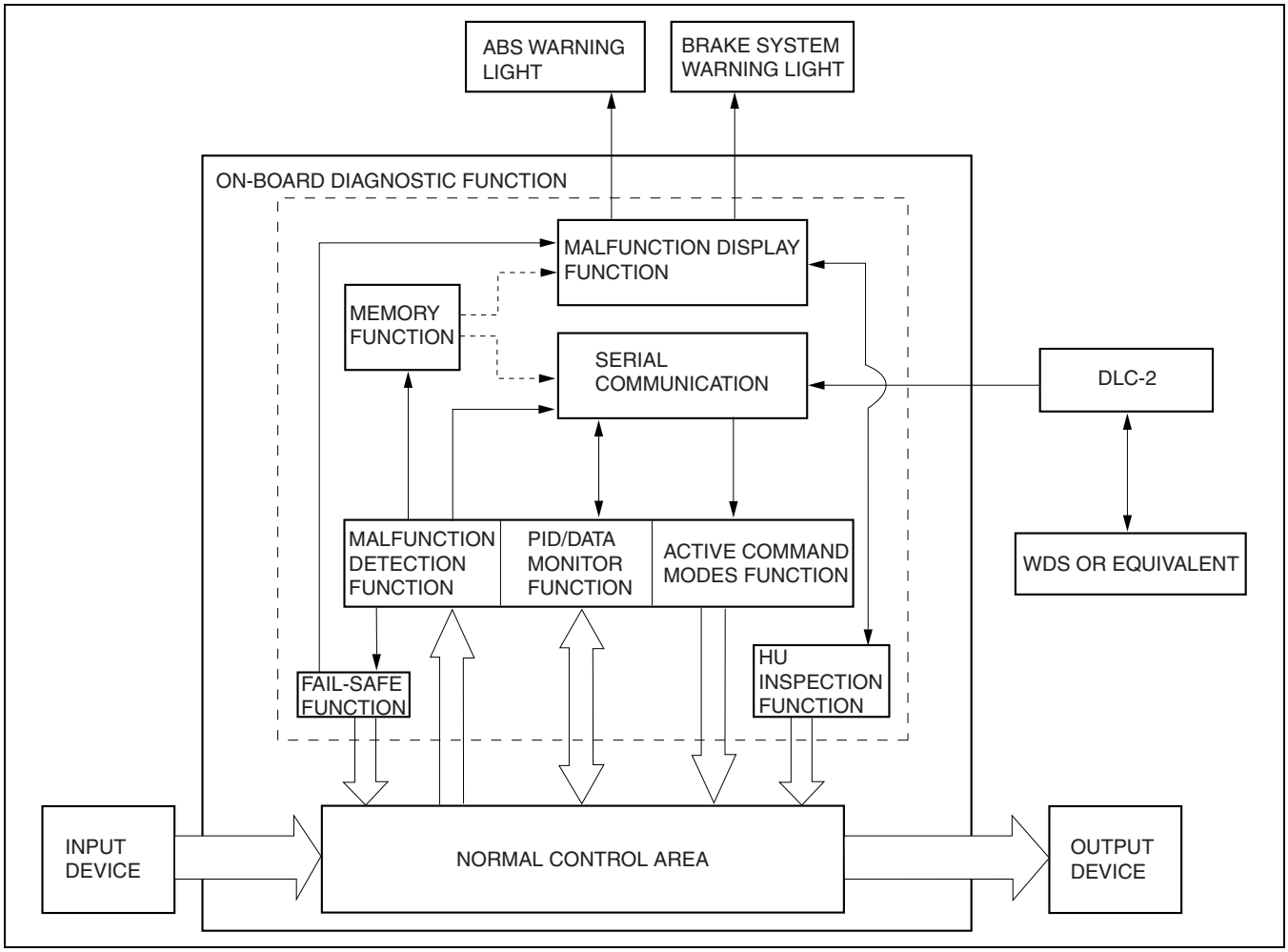
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [ABS] 04–02–2
Block Diagram **04–02–2**
ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [ABS] 04–02–3
Malfunction detection function **04–02–3**
Memory function **04–02–3**
Fail-safe function **04–02–3**
ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [ABS] 04–02–4
PID/DATA Monitor Table **04–02–4**
ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION [ABS] 04–02–4
Active Command Modes Function Table **04–02–4**
ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [ABS] 04–02–5
Connections/Communication Contents **04–02–5**
Serial communication **04–02–5**
DLC-2 CONSTRUCTION [ABS] 04–02–6

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [ABS]

EPU040243750S01

- The on-board diagnostic system consists of a malfunction detection system that detects abnormalities in input/output signals when the ignition switch is at the ON position, a data monitor function that reads out specified input/output signals and a active command modes function that allows for override operation of output parts (such as solenoid valves).
- The data link connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis and detecting/repair into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the WDS or equivalent to the DLC-2.
- In addition to DTC read-out, the WDS or equivalent is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor and active command modes functions, providing enhanced malfunction diagnosis and improved serviceability.

Block Diagram



C3U0402S001

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [ABS]

EPU040243750S02

Malfunction detection function

- The malfunction detection function detects malfunctions in the input/output signal system of the ABS HU/CM when the ignition switch is at the ON position.
- When the ABS HU/CM are started up, the following malfunction detections are performed.
  - — The ABS and brake system warning lights illuminate for **approx. 3.0 s** when the ignition switch is turned to the ON position to inspect for open circuits in the lights. At the same time, the fail-safe relay is operated, and the input/output signals of each part is monitored for malfunction diagnosis. After starting to drive, the first time the vehicle speed is **approx. 10 km/h {6.2 mph} or more** the pump motor is operated and malfunction diagnosis is performed again. Input/output signals are monitored for malfunction determination when the ignition switch is at the ON position.
- When malfunctions are detected, the corresponding lights are illuminated to alert the driver. Using the external tester communication function, DTCs can be output through the CAN_H and CAN_L of the DLC-2. At the same time, malfunction detection results are sent to the memory and fail-safe functions.

Memory function

- The memory function stores DTCs of malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition switch has been turned off (LOCK position), even if the malfunctioning signal system has returned to normal.
- Since the ABS control modules have built-in non-volatile memory, DTCs are not cleared even if the battery is removed. Therefore, it is necessary to clear the memory after performing repairs. Refer to the Workshop Manual for the DTC clearing procedure.

Fail-safe function

- When the malfunction detection function determines a malfunction, each light illuminates to advise the driver. At this time, the fail-safe function controls the ABS and EBD as shown in the fail-safe function malfunction contents table.

Warning

- **If EBD control is suspended the rear wheels could lock-up before the front wheels. If this occurs, the vehicle could swerve and become unstable. Therefore always inspect the system immediately if EBD control is suspended.**

Fail-safe Function Malfunction Contents

Malfunction location	DTC	Fail-safe function			
		Warning light illumination status		Control status	
	WDS or equivalent display	ABS warning light	Brake system warning light (when parking brake is released)	ABS control	EBD control
Power supply system	B1317	Illuminated	Illuminated	Control disabled	Control disabled
	B1318*1		Illuminated *2		Control disabled*2
			Not illuminated *3		Control enabled*3
ABS HU/CM (internal malfunction)	B1342	Illuminated	Illuminated	Control disabled	Control disabled
	C1267				
Pump motor, motor relay	C1095	Illuminated	Not illuminated	Control disabled	Control enabled
ABS sensor rotor	C1141	Illuminated	Not illuminated *4	Control disabled	Control enabled*5
	C1142				
	C1143				
	C1144				
ABS wheel-speed sensor	C1145	Illuminated	Not illuminated *4	Control disabled	Control enabled*5
	C1155				
	C1165				
	C1175				

Malfunction location	DTC	Fail-safe function			
		Warning light illumination status		Control status	
	WDS or equivalent display	ABS warning light	Brake system warning light (when parking brake is released)	ABS control	EBD control
ABS wheel-speed sensor/ABS sensor rotor	C1233	Illuminated	Not illuminated *4	Control disabled	Control enabled*5
	C1234				
	C1235				
	C1236				
Brake switch	C1446	Not illuminated	Not illuminated	Control enabled	Control enabled
CAN line	U1900	Not illuminated *6	Not illuminated *6	Control enabled	Control enabled
	U2012				

*1 : Detected if vehicle speed is **20 km/h {12.4 mph} or more**.
*2 : Detected regardless of time if at **approx. 8 V**.
*3 : Detected if condition of **approx. 9.7 V or less** continues for **210 ms or more**.
*4 : Illuminates when two wheels or more have a malfunction.
*5 : Control disabled when two wheels or more have a malfunction.
*6 : Illuminates depending on malfunction contents.

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [ABS]

EPU040243750S03

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the ABS HU/CM and reading them out in real-time.

PID/DATA Monitor Table

WDS or equivalent display	Input/output part name	Unit/Operation (WDS display)
BOO_ABS	Brake switch	On/Off
CCNTABS	DTC (amount detected)	—
LF_WSPD	ABS wheel-speed sensor (LF)	KPH/MPH
LR_WSPD	ABS wheel-speed sensor (LR)	KPH/MPH
RF_WSPD	ABS wheel-speed sensor (RF)	KPH/MPH
RR_WSPD	ABS wheel-speed sensor (RR)	KPH/MPH

ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION [ABS]

EPU040243750S04

- The active command modes function is used for optionally selecting simulation items of input/output parts preset in the ABS HU/CM, and to operate them regardless of CM control.
- To protect the hydraulic unit interior, operate output related parts for only **2 s or less** when using the active command modes function.

Active Command Modes Function Table

Command name	Output part name	Operation	Operating condition
LF_INLET	LF inlet solenoid valve	On/Off	Ignition switch at ON
LF_OUTLET	LF outlet solenoid valve		
LR_INLET	LR inlet solenoid valve		
LR_OUTLET	LR outlet solenoid valve		
PMP_MOTOR	Pump motor		
RF_INLET	RF inlet solenoid valve		
RF_OUTLET	RF outlet solenoid valve		
RR_INLET	RR inlet solenoid valve		
RR_OUTLET	RR outlet solenoid valve		

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [ABS]

EPU040243750S05

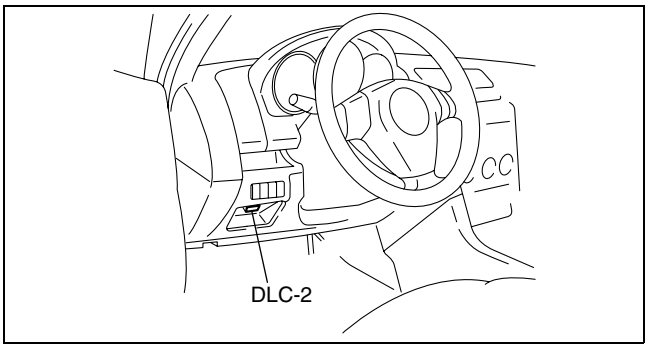
- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, and operation of input/output parts) between the ABS HU/CM and an external tester.

Connections/Communication Contents

	External tester	
	WDS or equivalent	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: CAN_H (HS), CAN_L (HS)	Serial communication
PID/DATA monitor function	Input/output: CAN_H (HS), CAN_L (HS)	Serial communication
Active command modes function	Input/output: CAN_H (HS), CAN_L (HS)	Serial communication

Serial communication

- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the WDS or equivalent to the DLC-2, diagnostic data can be sent and received between the WDS or equivalent and the ABS HU/CM using the CAN_H and CAN_L terminals (within the DLC-2).
- The ABS HU/CM receives the command signals of the malfunction detection function, PID/data monitor function, and the active command modes function from the WDS or equivalent, and sends DTCs and data regarding the operating condition and status of each input/output part to the WDS or equivalent.



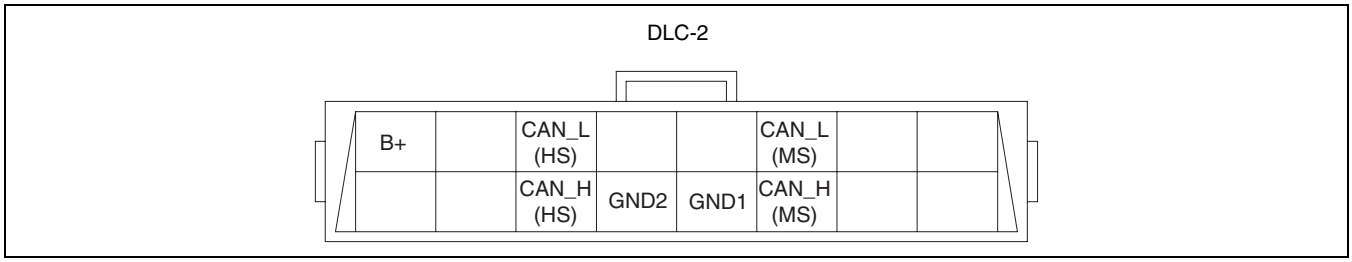
EPU402ZW3002

Diagnostic function name	Signal received	Signal sent
Malfunction detection function	DTC verification signal	Diagnostic trouble code
PID/DATA monitor function	Command signal to read selected monitor item	Monitored data for requested monitor item
Active command modes function	Operation command signal for selected active command modes item	Output part drive signal

DLC-2 CONSTRUCTION [ABS]

EPU040243750S06

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been adopted.
- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The connector has a 16-pin construction that includes the CAN_H (HS), CAN_L (HS), CAN_H (MS), CAN_L (MS), GND1, GND2 and B+ terminals.



C3U0402S002

Terminal	Function
CAN_L (HS)	Serial communication Lo terminal (HS)
CAN_H (HS)	Serial communication Hi terminal (HS)
CAN_L (MS)	Serial communication Lo terminal (MS)
CAN_H (MS)	Serial communication Hi terminal (MS)
GND1	Body GND terminal
GND2	Serial communication GND terminal
B+	Battery power supply terminal

04–11 CONVENTIONAL BRAKE SYSTEM

CONVENTIONAL BRAKE SYSTEM OUTLINE 04–11–1
CONVENTIONAL BRAKE SYSTEM STRUCTURAL VIEW 04–11–1
INTRUSION-MINIMIZING BRAKE PEDAL FUNCTION 04–11–2
INTRUSION-MINIMIZING BRAKE PEDAL OPERATION 04–11–2
MASTER CYLINDER CONSTRUCTION 04–11–2
POWER BRAKE UNIT FUNCTION 04–11–3
Function 04–11–3
POWER BRAKE UNIT CONSTRUCTION/OPERATION 04–11–4
Construction 04–11–4
Operation 04–11–4
FRONT BRAKE (DISC) CONSTRUCTION 04–11–6
REAR BRAKE (DISC) CONSTRUCTION 04–11–6

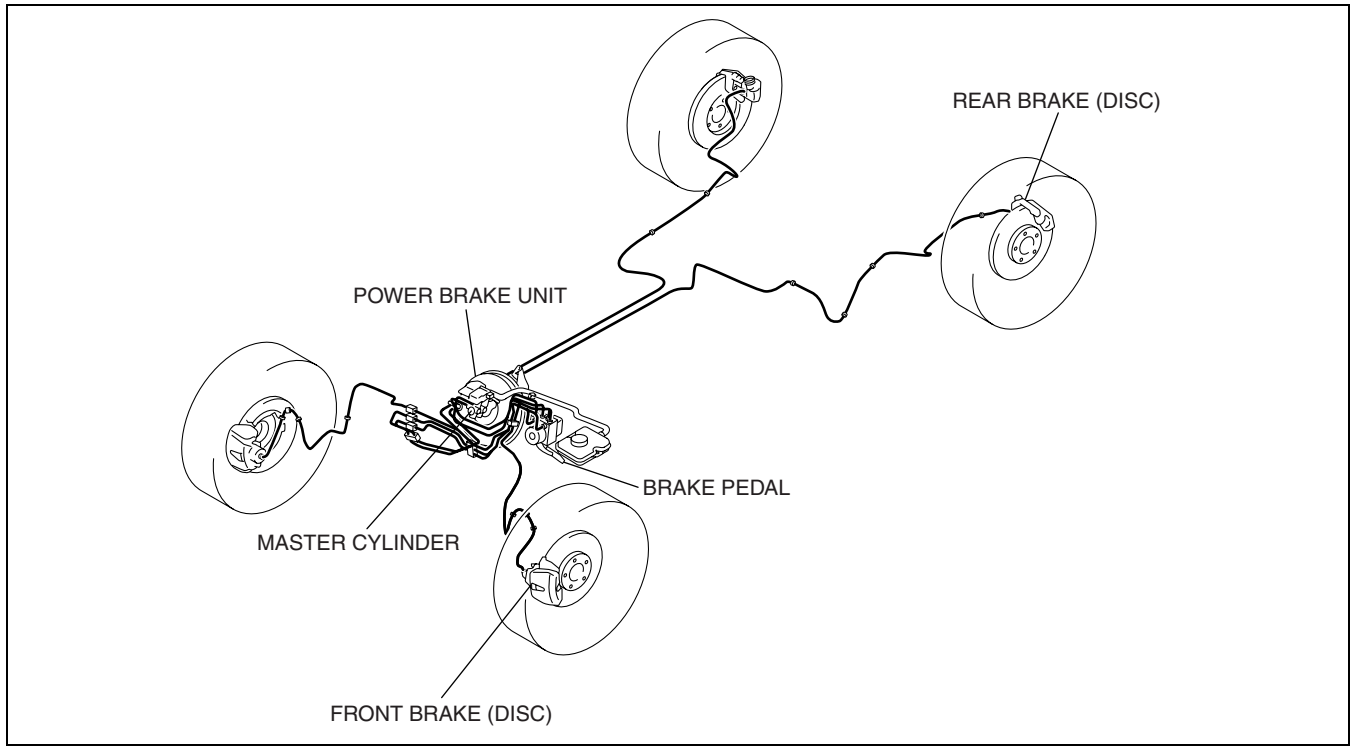
CONVENTIONAL BRAKE SYSTEM OUTLINE

EPU041100000S01

- A brake pedal with an intrusion minimizing mechanism has been adopted. As a result, driver safety has been improved.
- A small diameter long-stroke type master cylinder has been adopted, improving operability and response.
- A large diameter, single diaphragm power brake unit with a mechanical assist mechanism has been adopted, improving braking force and safety.
- A large diameter, ventilated disc-type front brake has been adopted, improving braking force.
- A large diameter, solid disc-type rear brake has been adopted, improving braking force.

CONVENTIONAL BRAKE SYSTEM STRUCTURAL VIEW

EPU041100000S02



EPU411ZS3001

INTRUSION-MINIMIZING BRAKE PEDAL FUNCTION

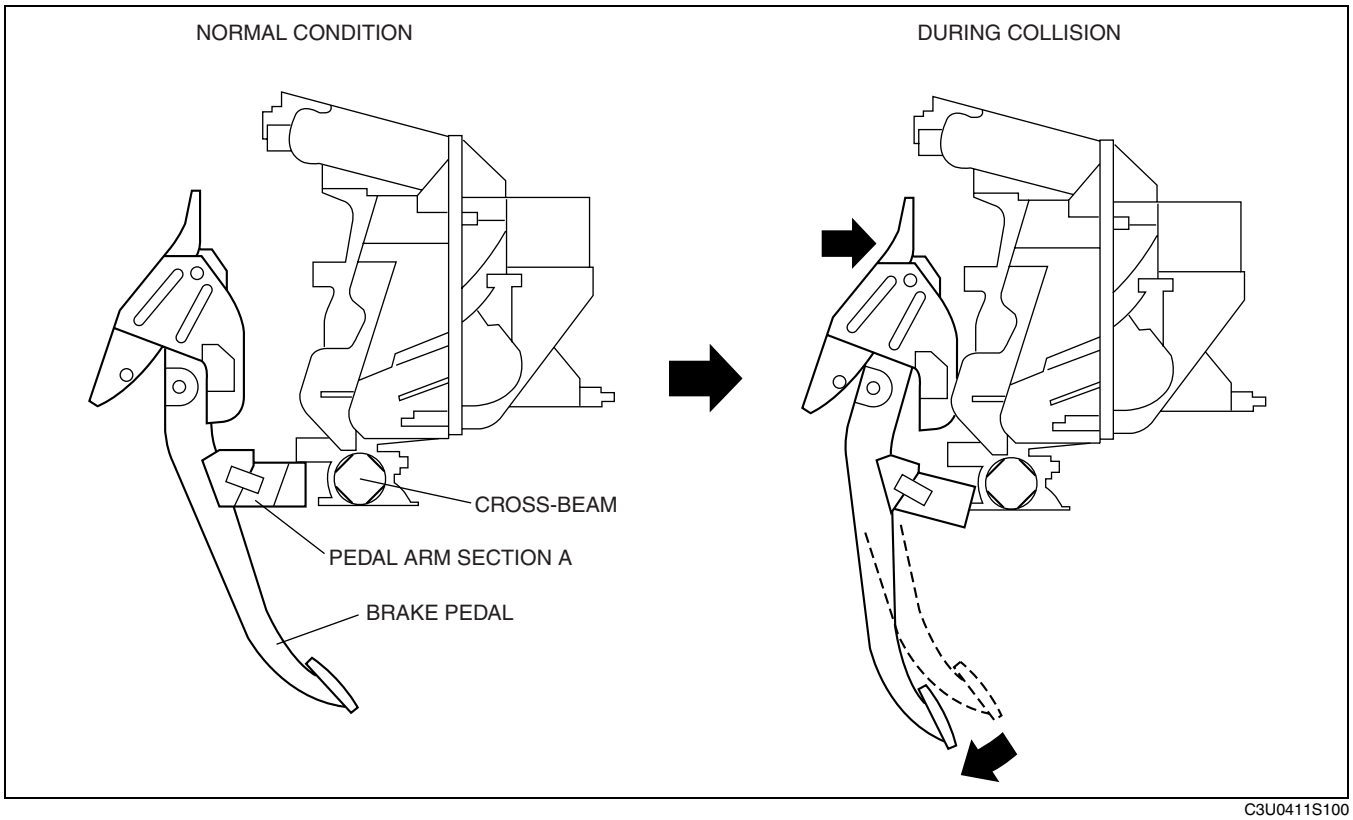
EPU041143300S01

- An intrusion-minimizing brake pedal, which minimizes the amount of rearward pedal thrust in a frontal collision, has been adopted. Due to this, impact force to the lower body of the driver is softened.

INTRUSION-MINIMIZING BRAKE PEDAL OPERATION

EPU041143300S02

- In a frontal collision, the brake pedal is forced rearward by the movement of the engine and other parts.
- Pedal arm section A of the rearward moving brake pedal contacts the cross-beam.
- Pedal arm section A rotates where it contacts the cross-beam, preventing rearward movement of the brake pedal.

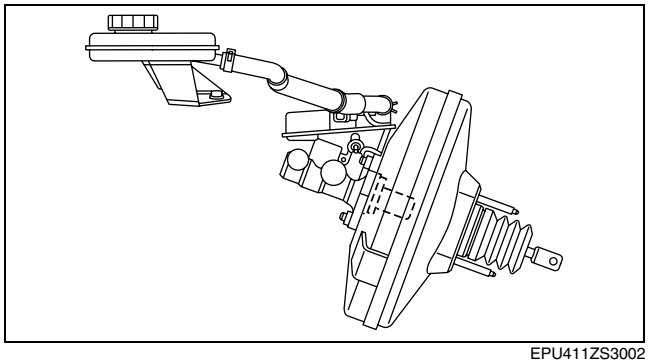


C3U0411S100

MASTER CYLINDER CONSTRUCTION

EPU041143400S01

- With the adoption of the master cylinder having a long stroke and small diameter (**22.2 mm {0.874 in}**), brake pedal operability has been improved.
- Except for the reserve tank, the master cylinder cannot be disassembled. Therefore, if there is any malfunction in the interior of the master cylinder, replace the cylinder component without disassembling.



EPU411ZS3002

POWER BRAKE UNIT FUNCTION

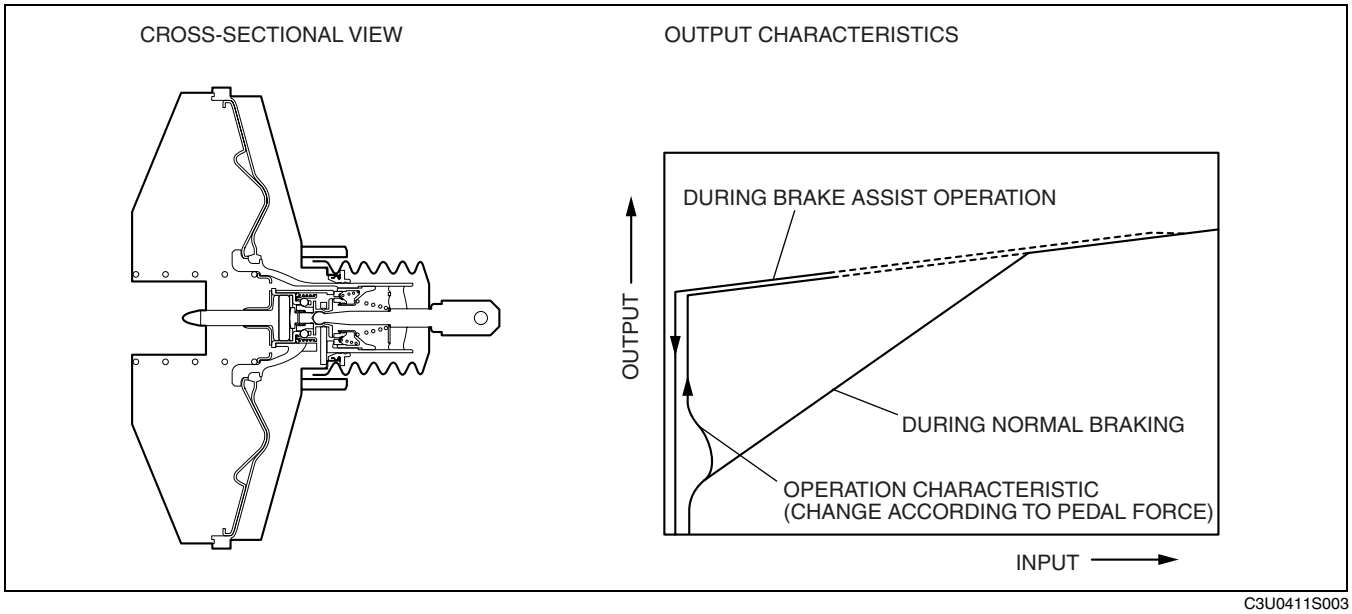
EPU041143800S01

Function

- A 10-inch, single diaphragm type power brake unit has been adopted for all models, achieving compatibility between high braking performance and excellent brake feeling.
- With the adoption of a brake assist function, brake system (including ABS during emergency braking) effectiveness has been further improved.
  - — The brake assist function operates by aiding braking operation during emergency braking or other times when a high amount of brake power is required.
  - — Inexperienced drivers or drivers who panic during emergency braking may apply the brakes quickly but without sufficient force, or they may apply sufficient force but cannot maintain it for a continuous period. In these cases, the normal vehicle braking performance cannot exert sufficient force.
  - — The brake assist function determines, based on brake pedal depression speed and force, if emergency braking is occurring. If it occurs, the power brake unit applies maximum braking power.
- The structure of the brake assist function, built into the power brake unit, is simple and mechanical, to ensure a high level of reliability.

Note

- When the brake pedal is depressed, the following effects may be felt. These are normal effects of the brake assist operation and do not indicate an abnormality.
  - — When the brake pedal is depressed strongly or depressed at higher speeds, the pedal will feel softer but the brakes will be applied strongly.
  - — When the brake pedal is depressed strongly or depressed at higher speeds, a clicking noise from the brake booster may be heard.
- The brake assist equipment does not supersede the functionality of the main braking system.



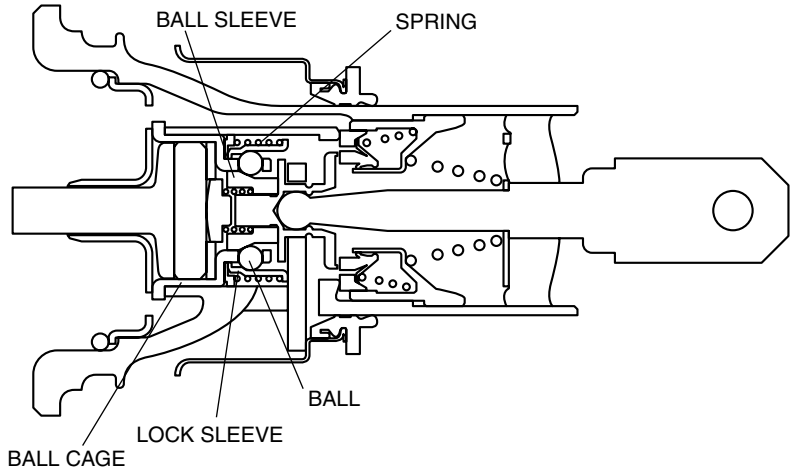
C3U0411S003

POWER BRAKE UNIT CONSTRUCTION/OPERATION

EPU041143800S02

Construction

- The basic construction of the power brake unit with brake assist function is the same as a conventional unit with the addition of the following parts:
  - — Ball
  - — Ball cage
  - — Ball sleeve
  - — Lock sleeve
  - — Spring

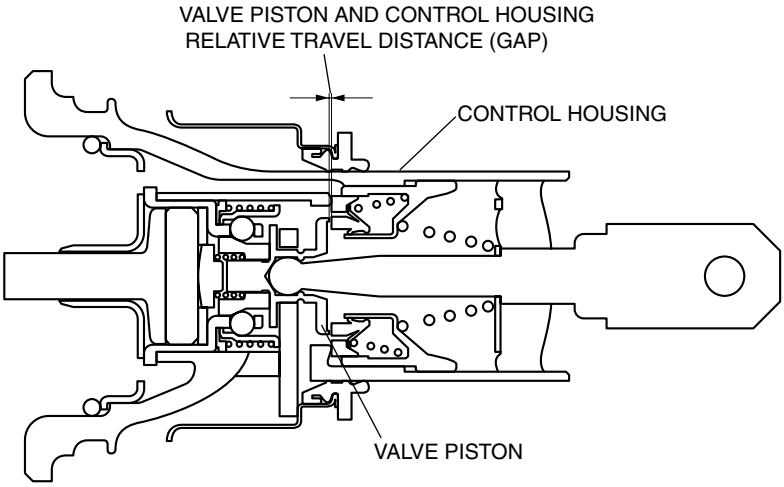


ADA6912T006

Operation

Operation outline

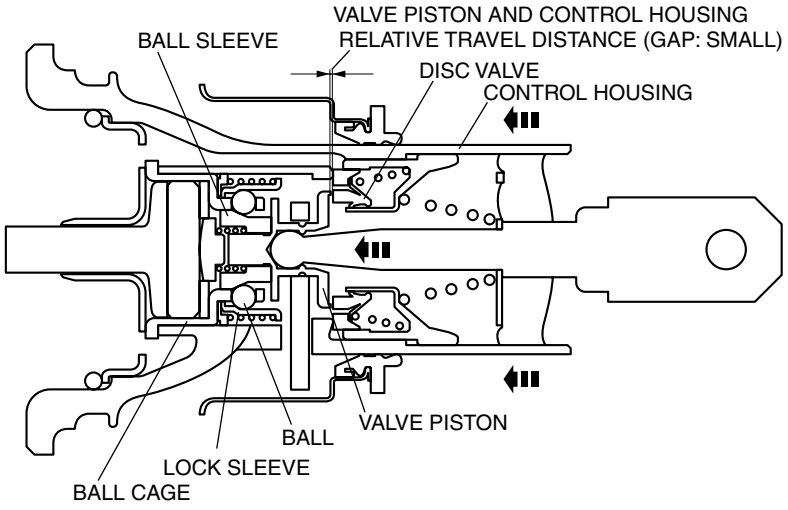
- When the brake pedal is depressed, the valve piston, inside the power brake unit, moves ahead of the control housing to create a relative travel distance which the brake assist function utilizes. This relative travel distance varies in relation to pedal speed depression and force in the following ways.
  - — Slow and weak pedal force applied (normal braking): Small relative travel distance
  - — Quick and strong pedal force applied (emergency braking): Large relative travel distance
- The brake assist function determines emergency braking when the relative difference exceeds the specified amount.



ADA6912T007

During normal braking

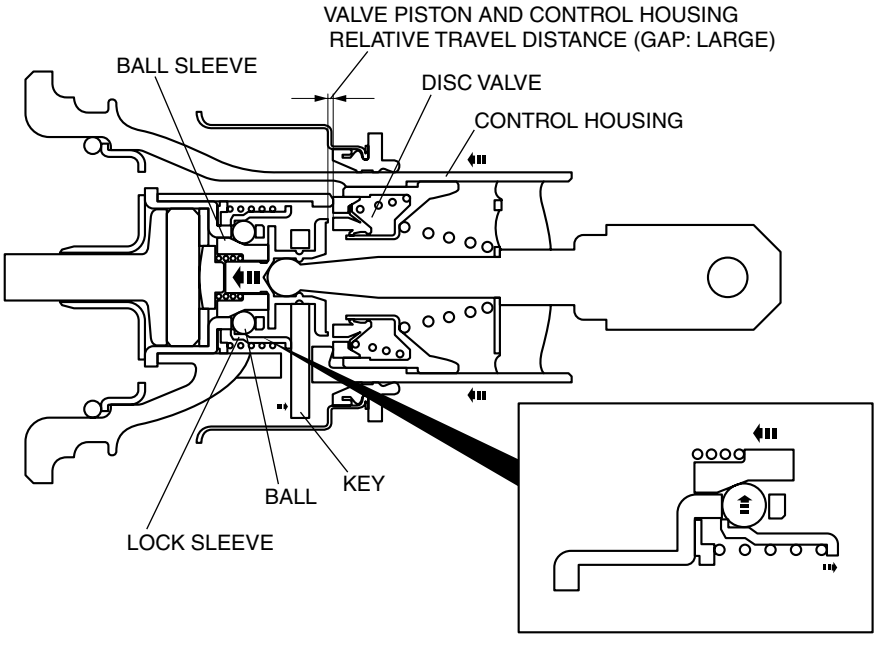
- During normal braking, due to the relative travel distance of the valve piston and control housing being extremely small, the lock sleeve is held in its original position by the force applied by the spring. At the same time, the ball cage remains free to move axially and the balls remain free to move vertically.
- Therefore, the ball sleeve moves following the control housing, thereby closing the disc valve. This allows hydraulic pressure to be applied in relation to the pedal force of the driver.



ADA6912T008

During brake assist operation

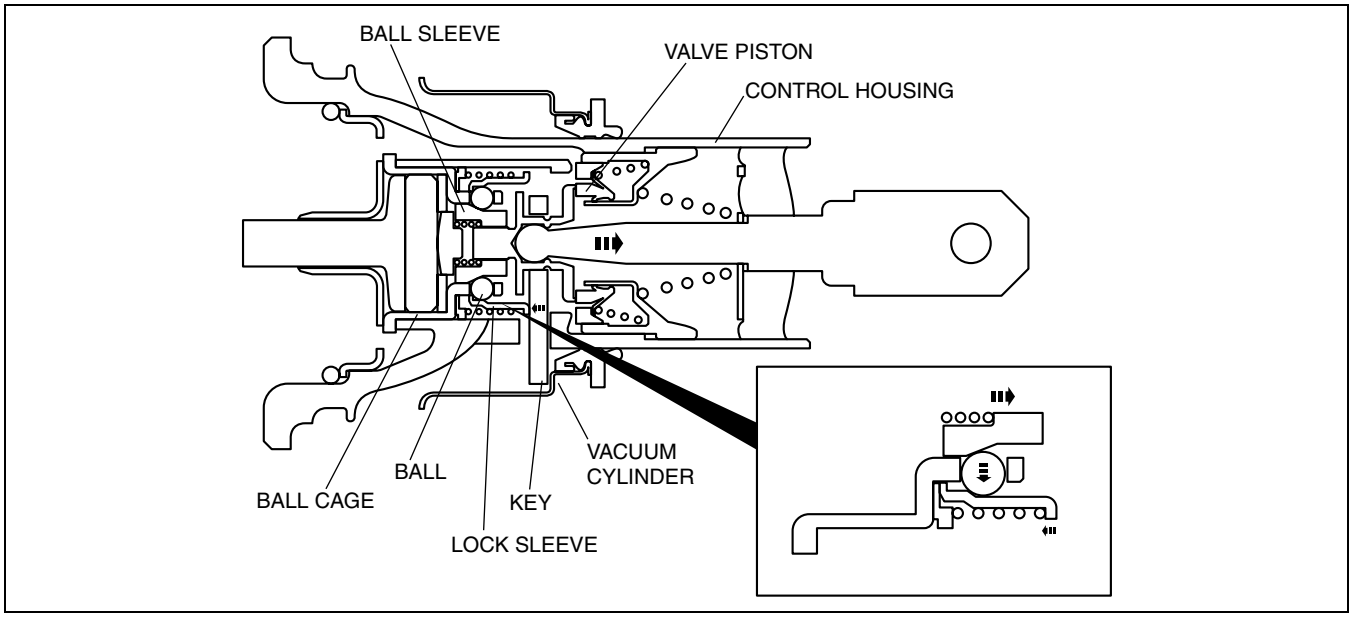
- During emergency braking, the relative travel distance of the valve piston and control housing exceeds the specified amount for brake assist. When this occurs, the balls are moved in over the slope of the ball sleeve and the lock sleeve is moved up against the key. Due to this, the balls become locked and the ball sleeve can no longer be moved in the closing direction of the disc valve.
- As a result, the brake assist functions by maintaining the increased hydraulic pressure in the power brake unit at its maximum (wheel locking limit), regardless of the pedal force applied.
- The amount of change in braking force during brake assist operation is the same as the brake pedal stroke amount (pedal force).



ADA6912T009

After brake assist release

- When the brake pedal is fully released, the control housing and valve piston return to their original position. The key is pressed against the vacuum cylinder, and the lock sleeve is slid back to its original position the same time as the balls are moved outward by the ball sleeve.
- As a result, the ball sleeve is again free to move axially and the balls are free to move vertically. Braking operation returns to normal.

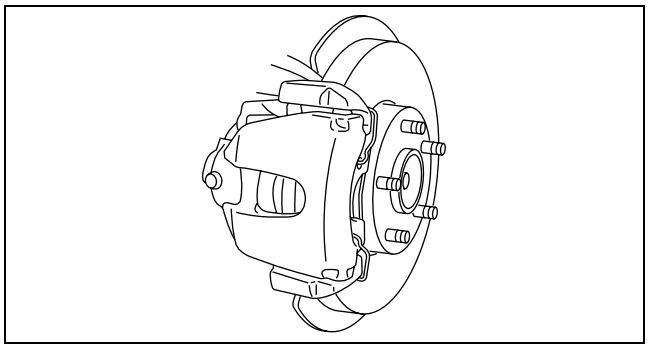


ADA6912T010

FRONT BRAKE (DISC) CONSTRUCTION

- Large diameter, ventilated disc type front brakes with a **300 mm {11.8 in}** diameter and a **25 mm {0.98 in}** thickness have been adopted, improving braking force and fade resistance.

EPU041133980S01

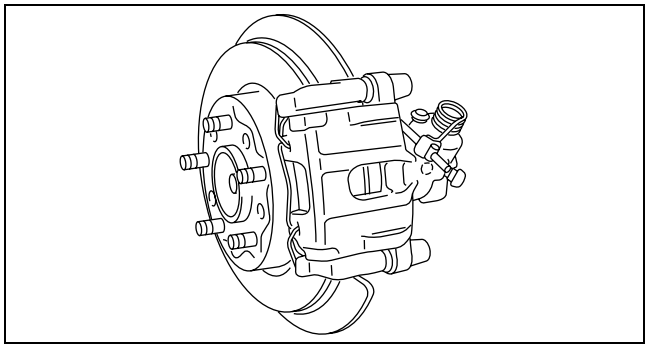


B3E0411T014

REAR BRAKE (DISC) CONSTRUCTION

- Large diameter, solid-disc type rear brakes with a **302 mm {11.9 in}** diameter and **11 mm {0.43 in}** thickness have been adopted, improving braking force and fade resistance.

EPU041126980S01



B3E0411T015

04–12 PARKING BRAKE SYSTEM

PARKING BRAKE SYSTEM OUTLINE 04–12–1

PARKING BRAKE SYSTEM STRUCTURAL VIEW 04–12–1

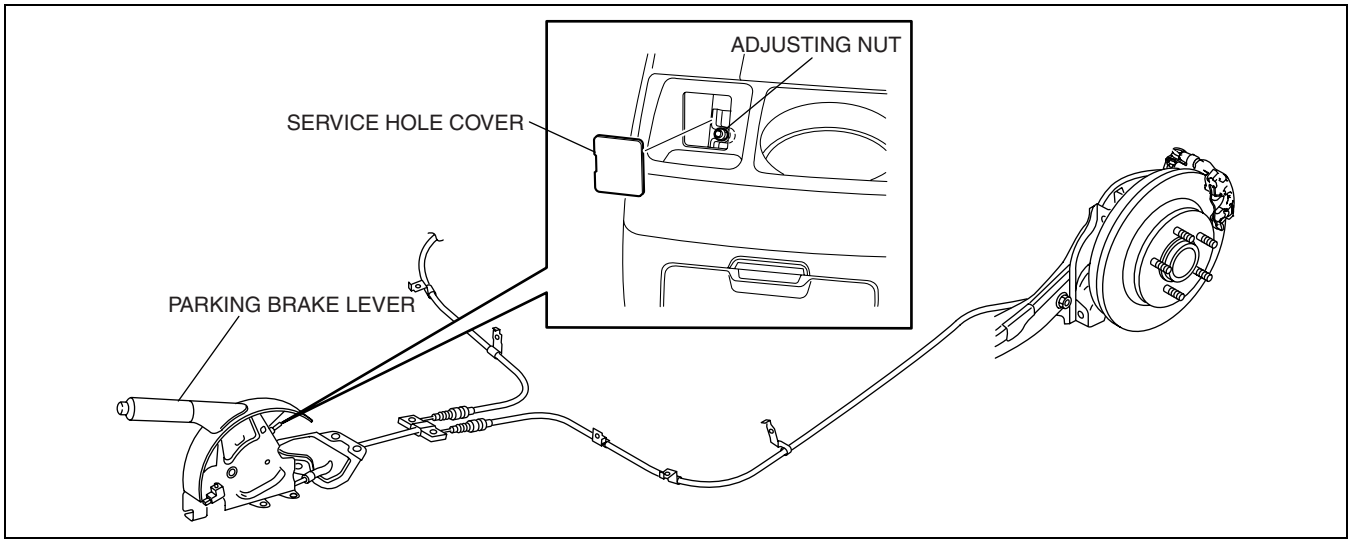
PARKING BRAKE SYSTEM OUTLINE

EPU041200000S01

- A center lever type parking brake that can be adjusted from the vehicle interior has been adopted, improving operability.
- Parking brake lever adjustment can easily be performed by removing the service hole cover in the center console, improving serviceability.

PARKING BRAKE SYSTEM STRUCTURAL VIEW

EPU041200000S02



EPU412ZS3001

04–13 ANTILOCK BRAKE SYSTEM

ABS OUTLINE 04–13–1
ABS STRUCTURAL VIEW 04–13–1
ABS SYSTEM WIRING DIAGRAM 04–13–2
ABS HU/CM CONSTRUCTION 04–13–2
Construction **04–13–2**
ABS HU PART FUNCTION 04–13–2
ABS HU PART CONSTRUCTION/OPERATION 04–13–3
Construction **04–13–3**
Operation **04–13–4**
ABS CM PART FUNCTION 04–13–6
Function **04–13–6**
Function Table **04–13–6**
ABS CONTROL OUTLINE 04–13–6
ABS CONTROL OPERATION 04–13–7
Operating Condition Transition Diagram **04–13–7**
EBD CONTROL OUTLINE 04–13–7
EBD CONTROL OPERATION 04–13–8
Operating Condition Transition Diagram **04–13–8**
CONTROLLER AREANETWORK (CAN) OUTLINE 04–13–9
Data sent **04–13–9**
Data received **04–13–9**
ABS WHEEL-SPEED SENSOR AND ABS SENSOR ROTOR FUNCTION 04–13–9
Function **04–13–9**
ABS WHEEL-SPEED SENSOR AND ABS SENSOR ROTOR CONSTRUCTION/OPERATION 04–13–9
Construction **04–13–9**
Operation **04–13–10**

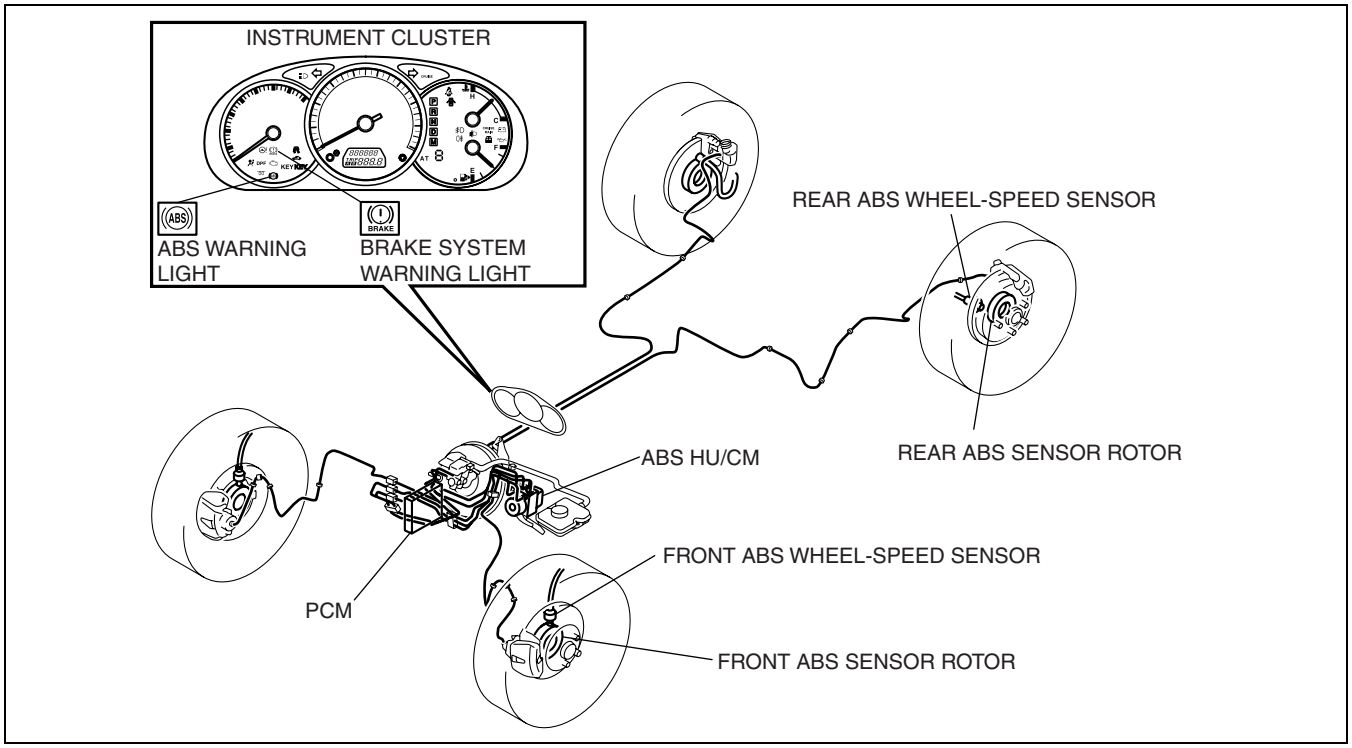
ABS OUTLINE

EPU041300000S01

- The ABS HU/CM, integrating both the hydraulic unit (HU) and control module (CM), has been adopted, resulting in size and weight reduction.
- A semi-conductor element type ABS wheel-speed sensor has been adopted, improving reliability and reducing size and weight.
- A magnetic encoder type ABS sensor rotor that is integrated with the wheel hub component has been adopted, improving reliability and reducing size and weight.
- Electronic brakeforce distribution (EBD) control has been adopted, resulting in improved safety and handling stability.

ABS STRUCTURAL VIEW

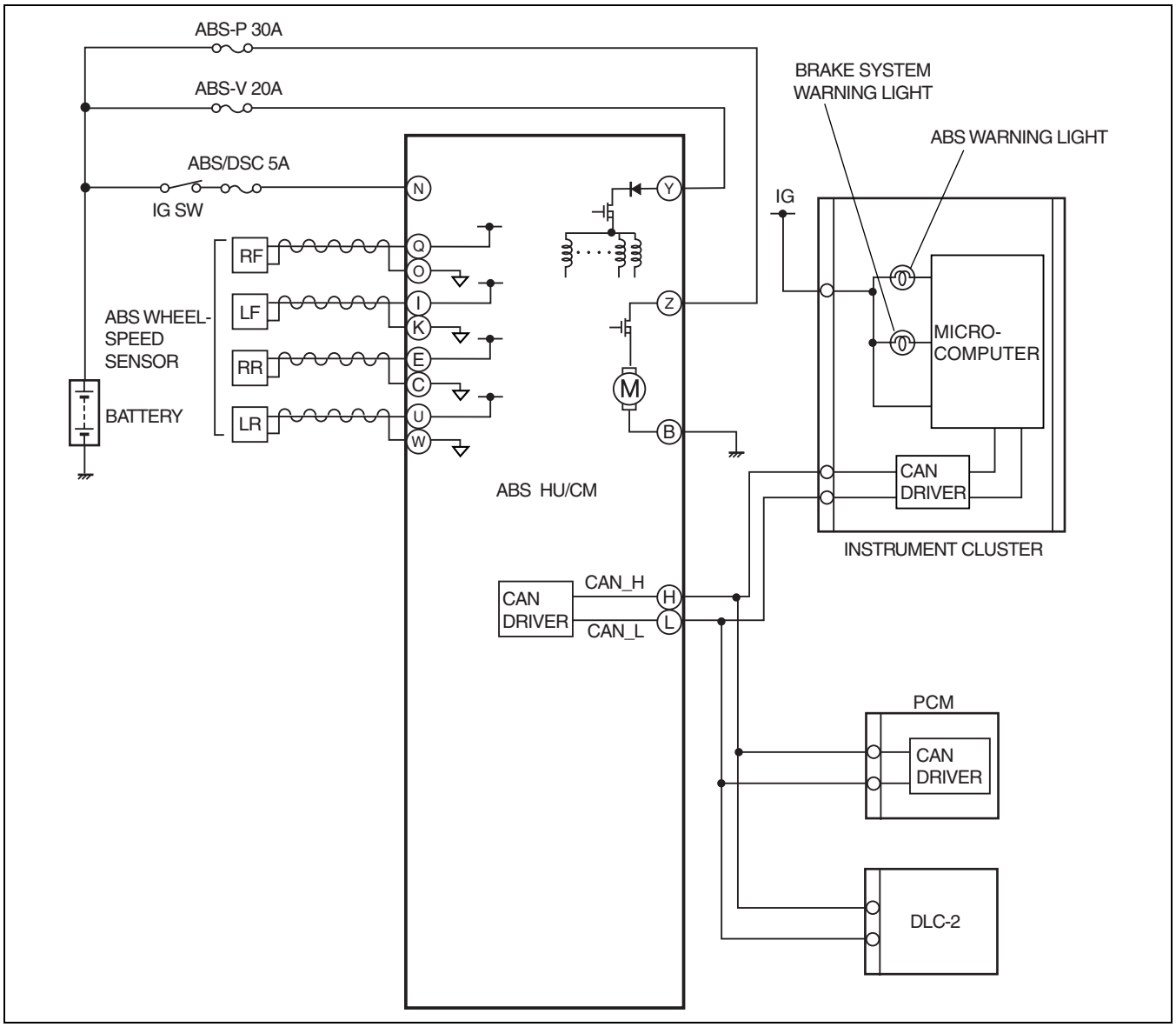
EPU041300000S02



EPU413ZS3001

ABS SYSTEM WIRING DIAGRAM

EPU041300000S03



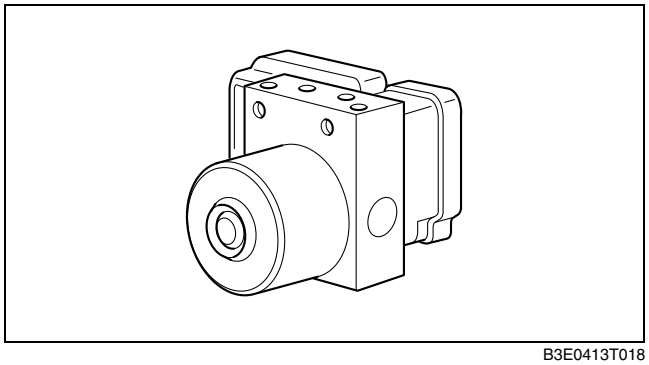
DPE402AW1001

ABS HU/CM CONSTRUCTION

EPU041343750S01

Construction

- A high reliability, reduced size and weight ABS HU/CM, integrating both the ABS HU and ABS CM, has been adopted.



B3E0413T018

ABS HU PART FUNCTION

EPU041343750S02

- The ABS HU adjusts the fluid pressure to the caliper pistons by controlling (on/off) each solenoid valve and pump motor according to signals from the ABS CM.

ABS HU PART CONSTRUCTION/OPERATION

EPU041343750S03

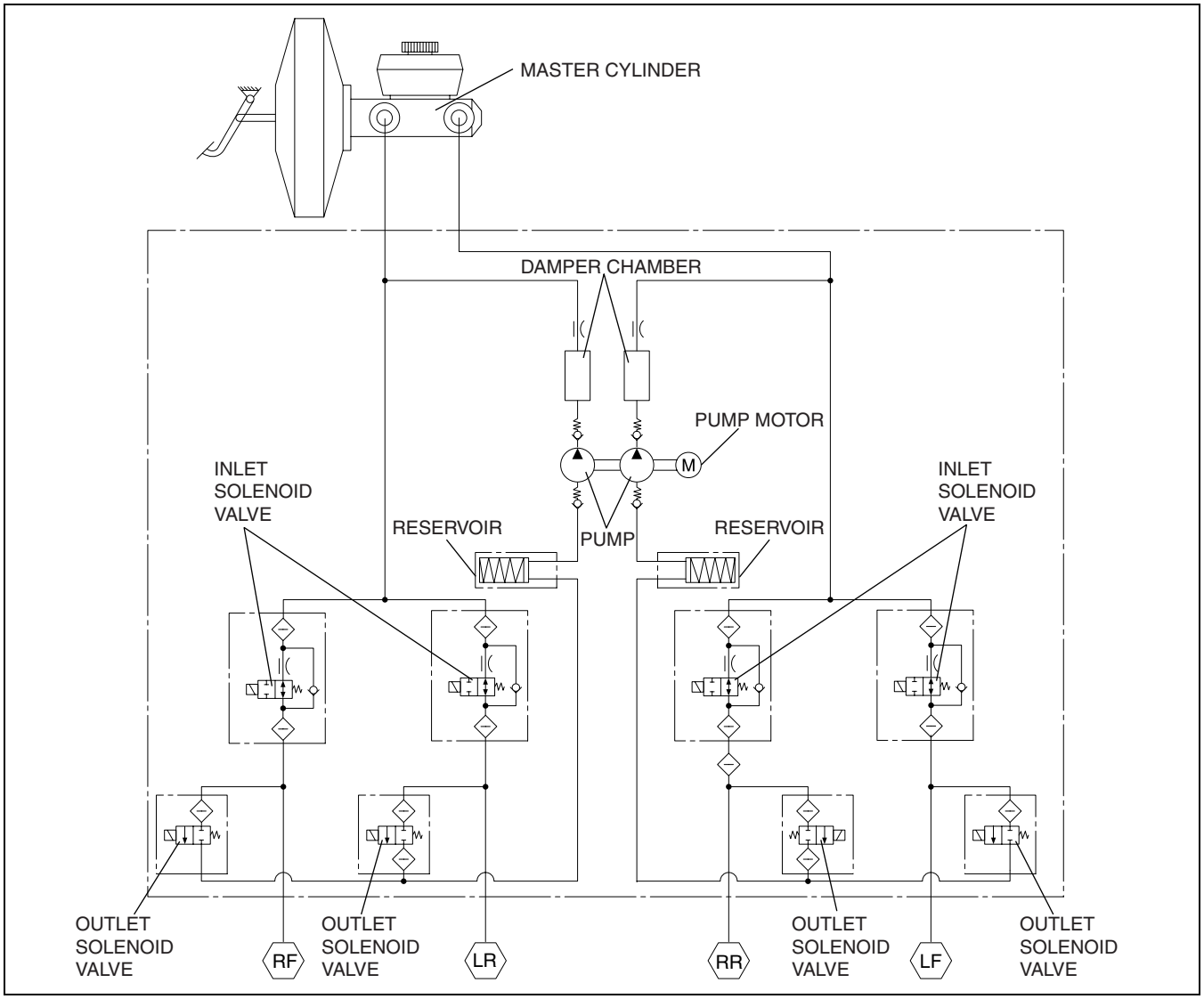
Construction

- The ABS HU mainly consists of the inlet/outlet solenoid valves, pump motor (pump) and reservoir.

Function Of Main Component Parts

Part name	Function
Inlet solenoid valve	• Adjusts the fluid pressure in each brake system according to ABS CM signals.
Outlet solenoid valve	• Adjusts the fluid pressure in each brake system according to ABS CM signals.
Reservoir	• Temporarily stores the brake fluid from the caliper piston to ensure smooth pressure reduction.
Pump	• Returns brake fluid stored in the reservoir back to the master cylinder.
Pump motor	• Operates the pump according to ABS CM signals.

Hydraulic Circuit Diagram



C3U0413S002

Operation

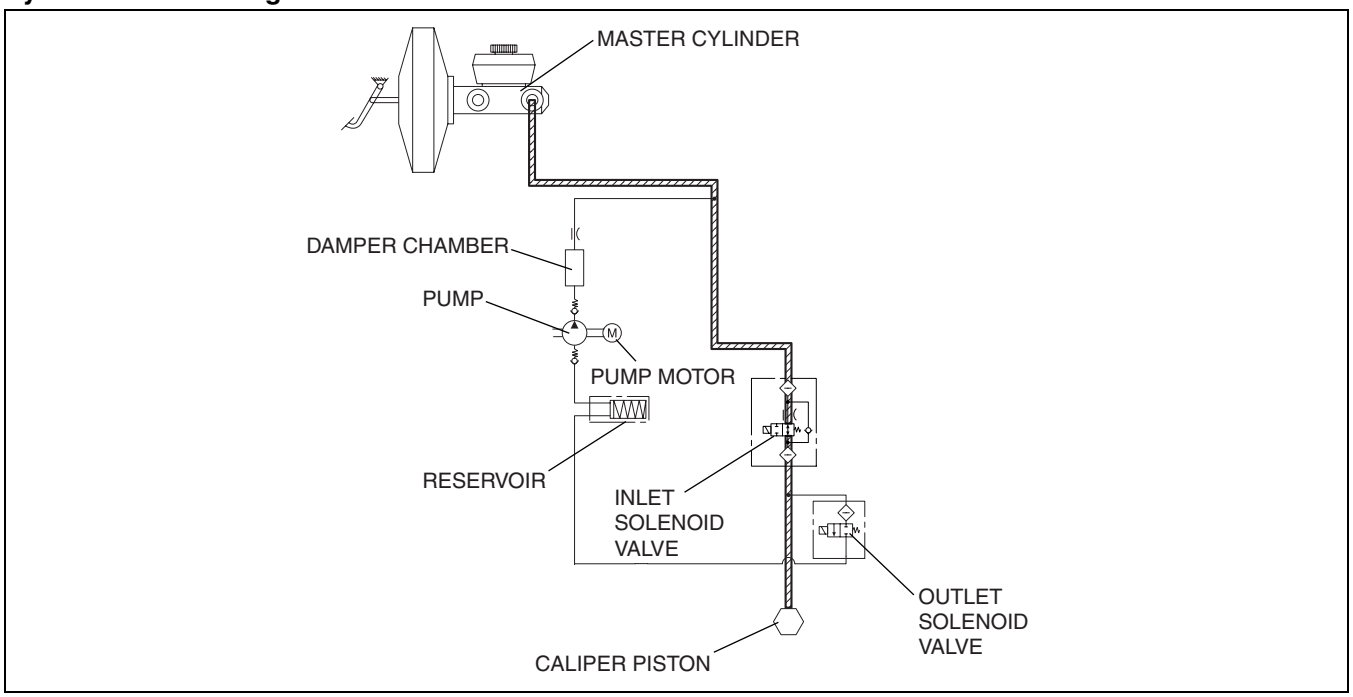
During normal braking

- During normal braking, the solenoid valves are not energized and all of them are off. When the brake pedal is depressed, brake fluid pressure is transmitted from the master cylinder, through the inlet solenoid valves, and then to the caliper piston. (The figure shows control for one front wheel only.)

Solenoid valve operation table

Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
LF	RF	LR	RR	LF	RF	LR	RR	
OFF (open)				OFF (closed)				Stopped

Hydraulic Circuit Diagram



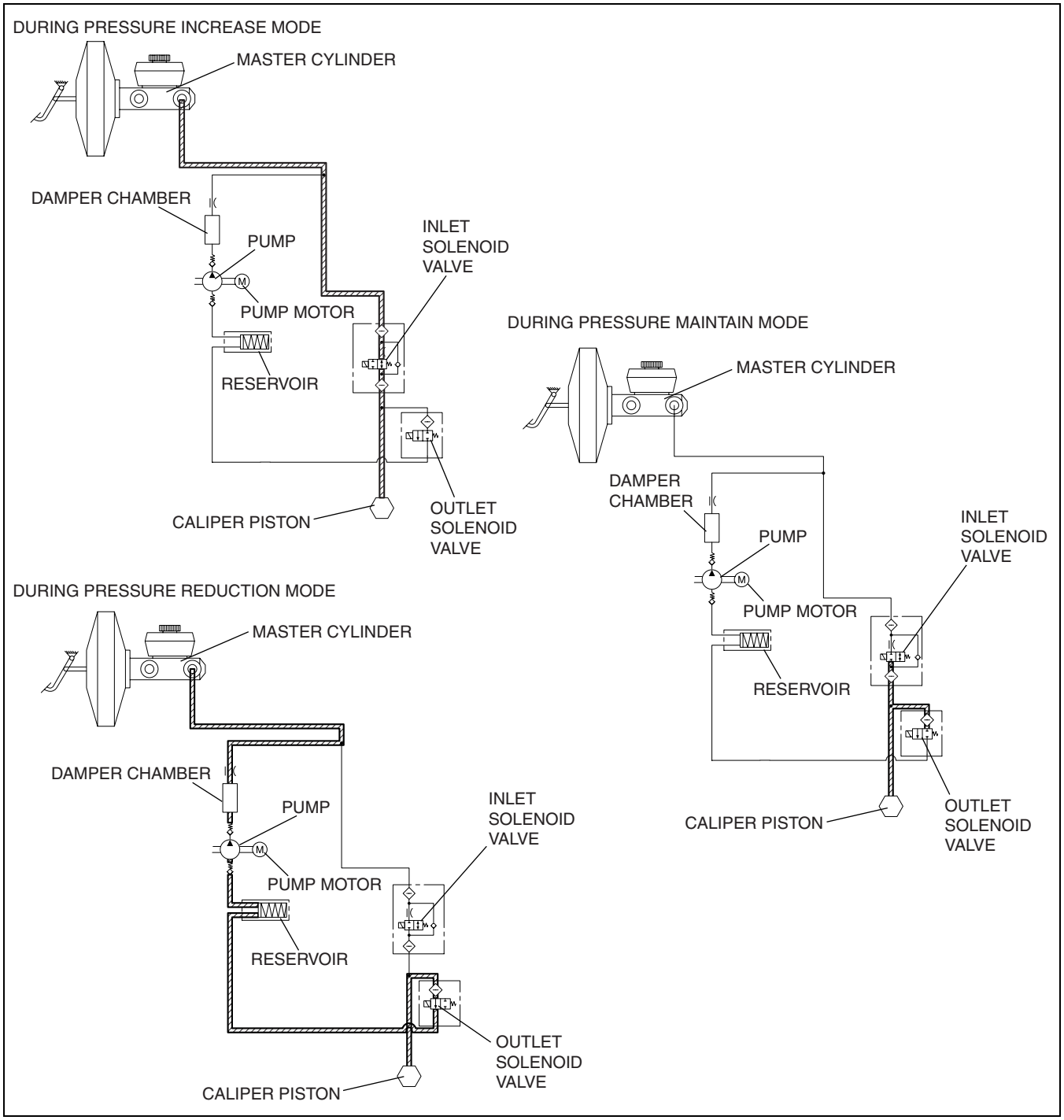
C3U0413S003

During ABS and EBD control

- When wheel lock-up is about to occur, the inlet and outlet solenoid valves are energized and controlled in three pressure modes (increase, maintain, or reduction), thereby adjusting brake fluid pressure. Brake fluid during pressure reduction is temporarily stored in the reservoir and afterwards the pump motor operates the pump to return the fluid to the master cylinder. (The figure shows control for one front wheel only.)

Solenoid valve operation table

	Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
	LF	RF	LR	RR	LF	RF	LR	RR	
During pressure increase mode	OFF (open)				OFF (closed)				Stopped
During pressure maintain mode	ON (closed)				OFF (closed)				Stopped
During pressure reduction mode	ON (closed)				ON (open)				Operation



C3U0413S004

ABS CM PART FUNCTION

EPU041343750S04

Function

- The ABS CM detects the vehicle wheel speeds based on the signals from the four ABS wheel- speed sensors. The CM calculates the rotation condition of each wheel from the relation between the detected vehicle wheel speed and the estimated (based on the detected speed) vehicle speed from there on. It then accordingly controls brake fluid pressure to each wheel to prevent lock-up.

Function Table

Function name	Contents
ABS control function	• Controls brake fluid pressure when braking to maintain directional stability, ensure steerability and reduce stopping distance.
Electronic brakeforce distribution (EBD) control function	• Constantly controls proper distribution of brake fluid pressure to the front and rear wheels according to vehicle load, road surface and vehicle speed conditions to prevent early lock-up of the rear wheels.
CAN signal function	• Outputs the wheel speed signal and ABS system warning control data via CAN lines.
On-board diagnostic system	• Main components of the ABS control system have a self-diagnosis function. In case a malfunction occurs, warning lights illuminate to alert the driver, and at the same time a DTC is stored in the ABS HU/CM. • When a malfunction is determined as a result of the on-board diagnostic test, system control is suspended or limited to prevent any dangerous situation while driving.

ABS CONTROL OUTLINE

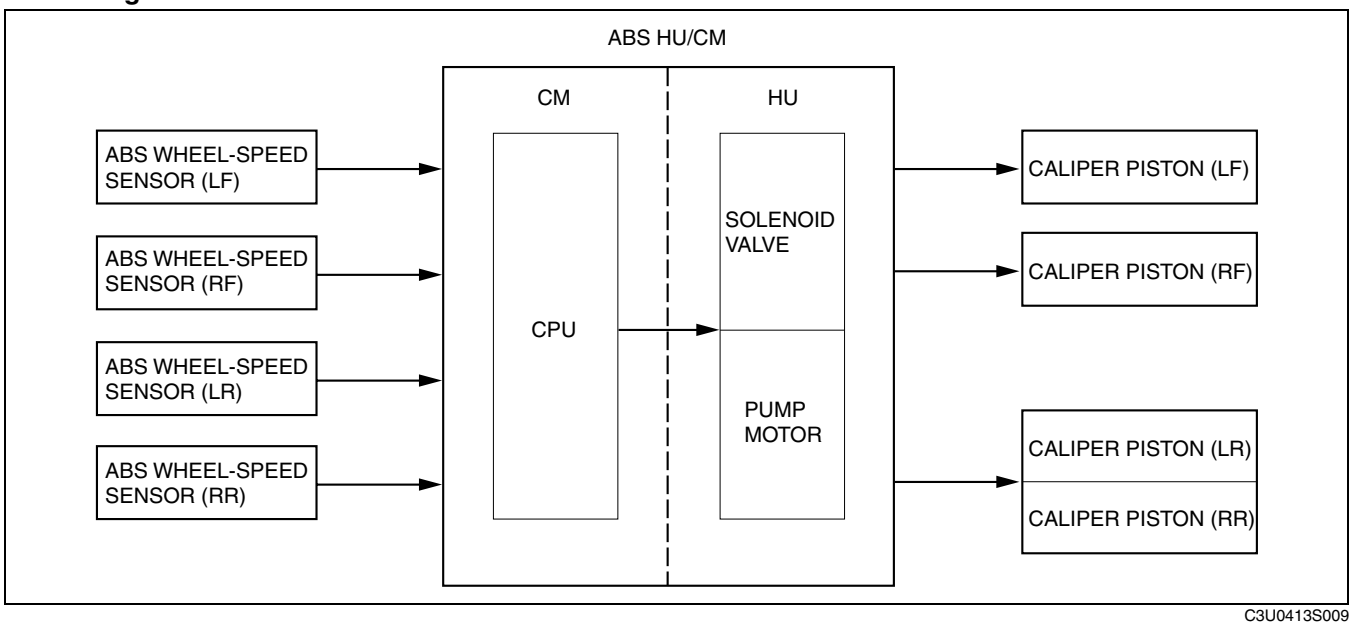
EPU041343750S05

- ABS control occurs when wheel slip is determined by the ABS CM (based on the four ABS wheel-speed sensors). Then, the ABS HU inlet and outlet solenoid valves are operated and brake fluid pressure is controlled accordingly to prevent wheel lock-up.
- Use of ABS control during emergency braking or on slippery road surfaces allows directional stability to be maintained, steerability ensured and stopping distance to be reduced.
- The ABS control system has independent front wheel control and unified control (select low) for the rear wheels.

Note

- Select low control: A control system in which the left and right vehicle wheel speeds are compared and brake fluid pressure is controlled according to the wheel most likely to lock-up.

Block Diagram



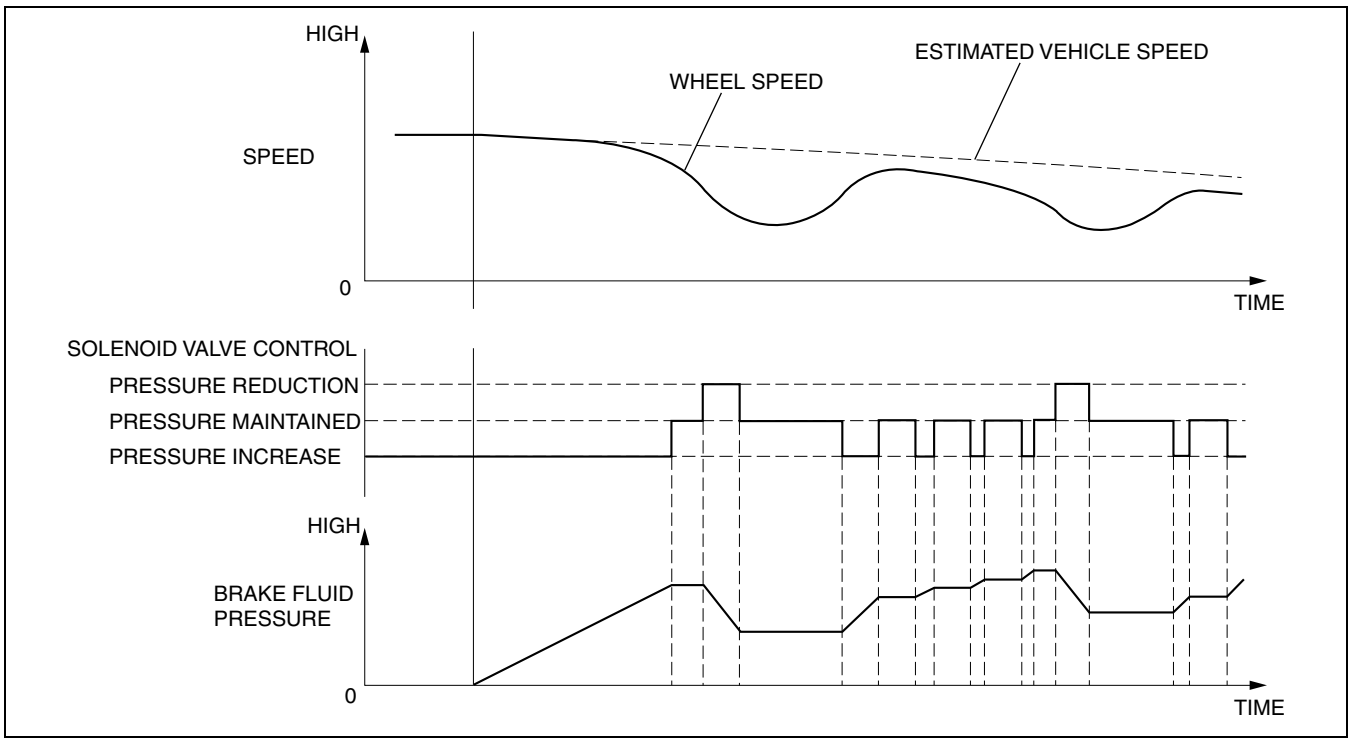
C3U0413S009

ABS CONTROL OPERATION

EPU041343750S06

- When the ABS CM determines wheel slip conditions based on the signals from the ABS wheel-speed sensors during braking, the ABS CM operates the ABS HU inlet and outlet solenoid valves, reducing and maintaining brake fluid pressure in accordance with the wheel slip factors. Then, when the wheel slip condition has passed, brake fluid pressure is increased and maintained, ensuring braking with a constantly stable brake force.

Operating Condition Transition Diagram



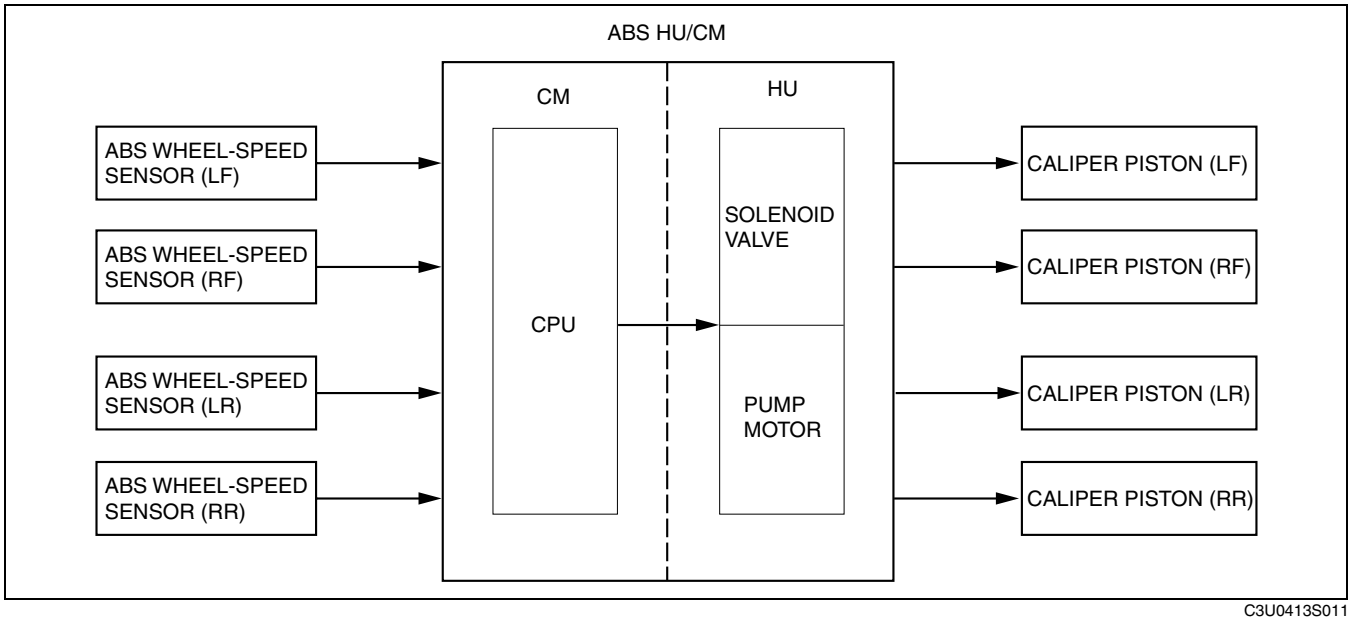
C3U0413S010

EBD CONTROL OUTLINE

EPU041343750S07

- EBD control uses the ABS system to control brake fluid pressure distribution to the rear wheels so that they do not lock-up prior to the front wheels during braking, thereby preventing the loss of handling stability.
- EBD control has independent control systems for both the front and rear wheels.
- EBD control constantly and properly distributes brake fluid pressure regardless of vehicle weight.

Block Diagram



C3U0413S011

EBD CONTROL OPERATION

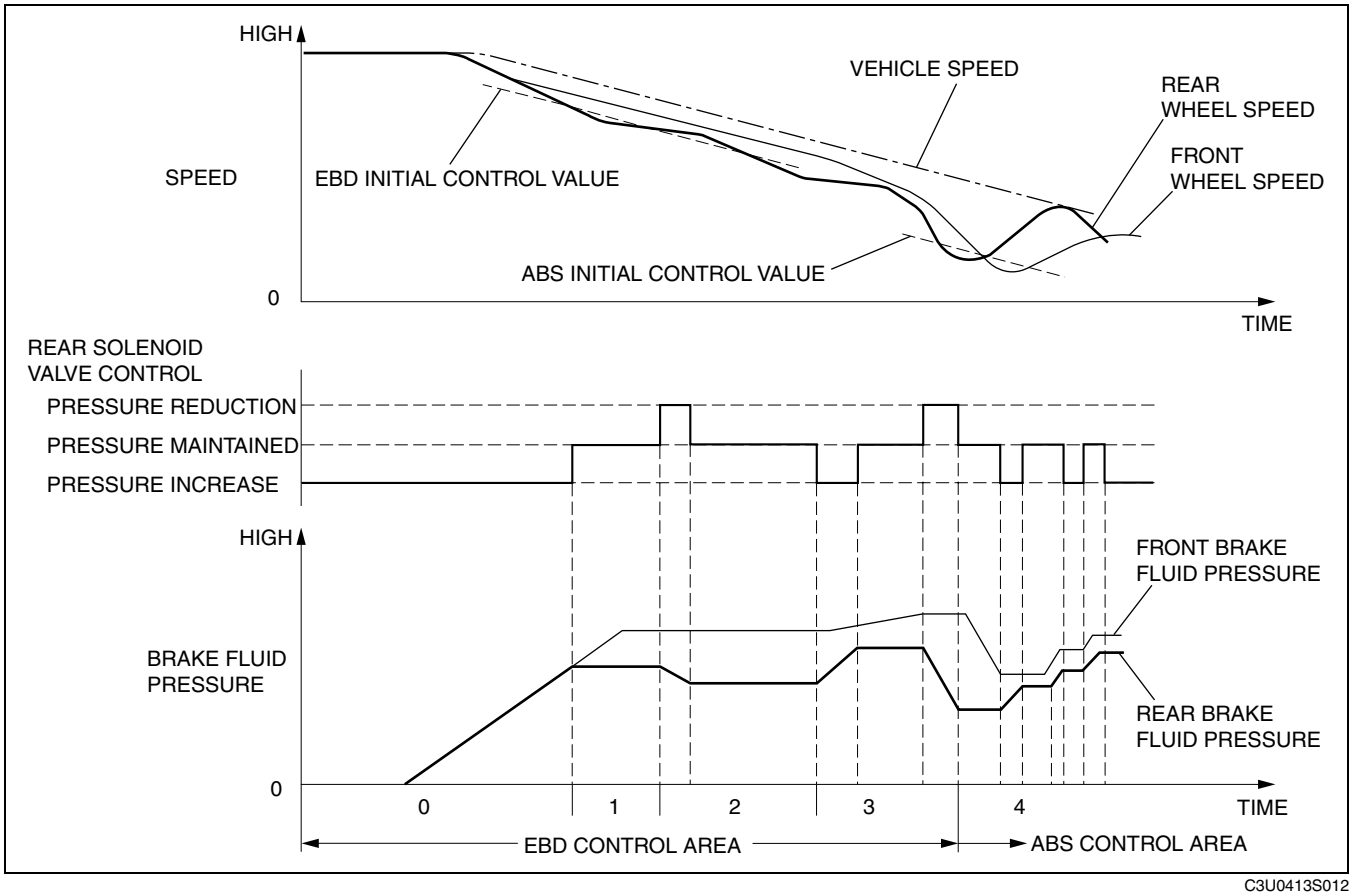
EPU041343750S08

- EBD control detects the slip ratio between the front and rear wheels from the ABS wheel-speed sensor signals. If the slip ratio of the rear wheels as compared to the front wheels is larger than the fixed limit, the ABS HU/CM reduces brake pressure being distributed to the rear wheels. Due to this, brake pressure distribution is constantly controlled in the proper proportion and in relation to vehicle load, road surface conditions and vehicle speed.
- Determination of the rear wheel slip ratio, based on a comparison of the lowest front wheel speed and the estimated vehicle speed with the rear wheel speeds, is divided into conditions 0-4 shown in the table below.
- The ABS HU outlet and inlet solenoid valves are operated and the brake fluid pressure controlled according to these conditions.
- If ABS control conditions are met during EBD control, EBD control is stopped and ABS control is given priority.

Status	Rear wheel slip ratio determination	EBD control	Solenoid valve	Comment
0	No slip	No control	Pressure increase	—
1	α%—β%	Control	Pressure maintained	—
2	β% or more	Control	Reduction/maintained	—
3	After EBD control, slip ratio is γ%	Control	Increase/maintain	—
4	Front wheel slip ratio is δ% or more	Control	Pressure reduction/ maintained/ increase	ABS control operates

— : Specified value

Operating Condition Transition Diagram



C3U0413S012

CONTROLLER AREA NETWORK (CAN) OUTLINE

EPU041343750S09

- The ABS HU/CM sends and receives data to and from other modules via the CAN system. Refer to Section 09 for a detailed explanation of the CAN. (See 09–40–6 CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE.)

Data sent

- Brake system condition
- Wheel speeds of all four wheels
- Brake system warning light illumination request
- ABS warning light illumination request

Data received

- Brake pedal position
- Tire size

ABS WHEEL-SPEED SENSOR AND ABS SENSOR ROTOR FUNCTION

EPU041343720S01

Function

- The ABS wheel-speed sensor and ABS sensor rotor detect the rotation condition of each wheel and transmit this information to the ABS HU/CM.
- The signal from the ABS wheel speed sensor is the primary signal that the ABS HU/CM uses when carrying out control.

ABS WHEEL-SPEED SENSOR AND ABS SENSOR ROTOR CONSTRUCTION/OPERATION

EPU041343720S02

Construction

- The ABS wheel speed sensor utilizes a semi-conductor element that contains an active drive circuit (MR element*). The front sensor is installed on the steering knuckle and the rear sensor is installed on the rear wheel hub component.
- The ABS sensor rotor utilizes a magnetic encoder system that functions with magnetic rubber, and is integrated into the wheel hub component. Therefore, if there is any malfunction of the ABS sensor rotor, replace the wheel hub component.

*: A magneto-resistive force means that an exterior magnetic field acts on the element, changing the resistance of the element.

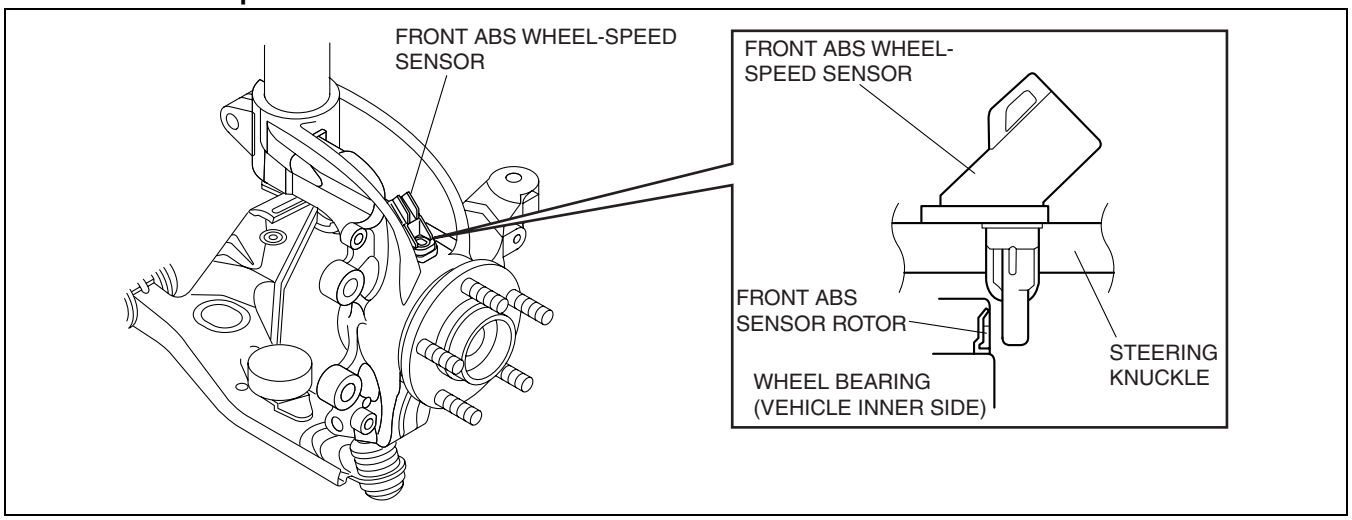
Caution

- **When inspecting the ABS wheel speed sensor, do not use a tester to inspect resistance. It is possible that the voltage from the tester could damage the semiconductor inside the ABS wheel speed sensor. Inspect using the PID data monitor of the WDS or equivalent.**

Note

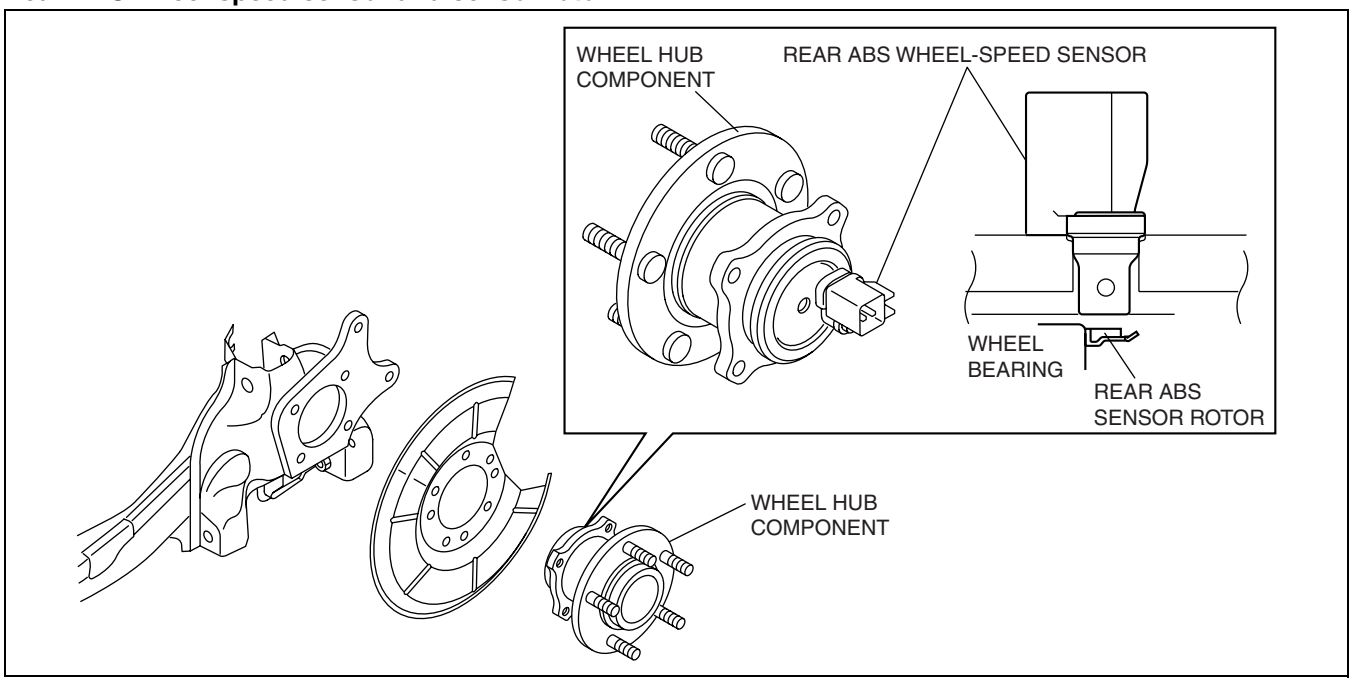
- Magnetic encoder: A plate that has positive and negative poles (marked out) in a continuous, alternating line.

Front ABS wheel-speed sensor and sensor rotor



C3U0413S013

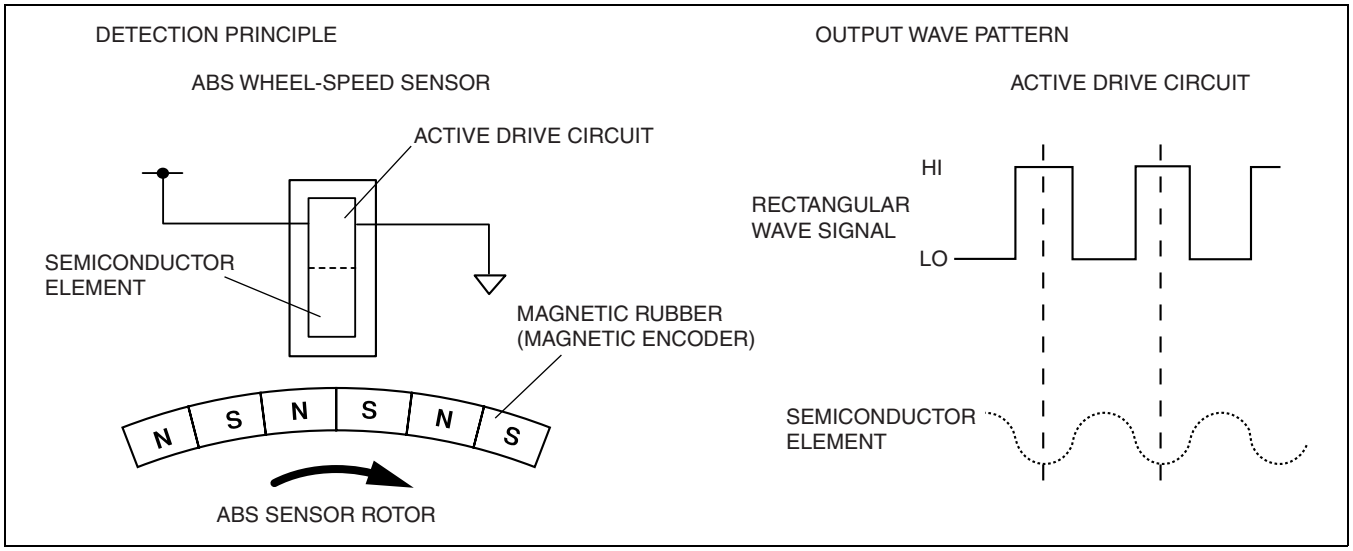
Rear ABS wheel-speed sensor and sensor rotor



C3U0413S014

Operation

- As the ABS sensor rotor rotates, the magnetic flux between the ABS wheel speed sensor and the ABS sensor rotor change periodically. This periodic change is in proportion to the rotation speed.
- The semiconductor element in the wheel speed sensor detects the change in magnetic flux, and the active drive circuit converts it to a rectangular wave signal for the current, which is transmitted to the ABS HU/CM.
- For every single rotation of the ABS sensor rotor, 44 rectangular wave pulse signals are output. The CM in the ABS HU/CM calculates the wheel speed from the periodicity of these pulses.



C3U0413S015

TRANSMISSION/TRANSAXLE

05
SECTION

OUTLINE 05-00
ON-BOARD DIAGNOSTIC 05-02
CLUTCH 05-10
MANUAL TRANSAXLE 05-15
MANUAL TRANSAXLE SHIFT MECHANISM [G35M-R] 05-16
AUTOMATIC TRANSAXLE . . . 05-17
AUTOMATIC TRANSAXLE SHIFT MECHANISM 05-18

05–00 OUTLINE

TRANSMISSION/TRANSAXLE ABBREVIATIONS 05–00–1
TRANSMISSION/TRANSAXLE FEATURES 05–00–2
TRANSMISSION/TRANSAXLE SPECIFICATIONS 05–00–2
Clutch 05–00–2
Manual Transaxle [G35M-R] 05–00–2
Automatic Transaxle [FN4A-EL] 05–00–3
Automatic Transaxle Shift Mechanism 05–00–3

TRANSMISSION/TRANSAXLE ABBREVIATIONS

EPU050000000S01

ACC	Accessories
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
CCM	Comprehensive Component Monitor
CPU	Central Processing Unit
DC	Drive Cycle
EC-AT	Electronically Controlled Automatic Transaxle
MTX	Manual Transaxle
O/D	Overdrive
1GR	First Gear
2GR	Second Gear
5GR	Fifth Gear

TRANSMISSION/TRANSAXLE FEATURES

EPU050000000S02

CLUTCH	
Improved operability	• A hydraulic clutch control mechanism is used.
MTX [G35M-R]	
Improved operability	• Linked, triple cone synchronizer mechanism adopted for 1st and 2nd gears • Linked, double cone synchronizer mechanism adopted for 3rd and 4th gears • Double-ball construction detent balls adopted (small balls positioned on the backside of the balls inserted in the rod end) • Optimal control rod end load characteristics • Special surface finish (bushings with teflon coating for low friction resistance adopted) used on shafts of linkage parts (shift rod, crank lever, control rod) • Optimal positioning of reverse link support/leverage points
Improved reliability	• A double engagement prevention mechanism (interlock mechanism) has been adopted.
Mis-shift prevention	• A cam-type reverse lock-out mechanism has been adopted.
ATX [FN4A-EL]	
Superior shift quality	• Direct electric shift control has been adopted. • Feedback control system has been adopted. • Centrifugal balance clutch chamber has been adopted. • Engine-transaxle total control system has been adopted.
High efficiency, compactness, lightweight	• A miniature trochoid gear oil pump with torque converter direct drive has been adopted. • Slip control system has been adopted.
Improved reliability	• A variable resistor type TR switch has been adopted.
Improved driveability	• A control feature for climbing hills has been adopted, improving driveability when climbing.
Improved marketability	• The Sport AT has been adopted.
Improved operability	• A shift mechanism which the selector lever is located on the center of the dashboard has been adopted.
Mis-shift prevention	• A key interlock system has been adopted. • A shift-lock system has been adopted.
Emergency bypass assurance	• A shift-lock release mechanism has been adopted.

TRANSMISSION/TRANSAXLE SPECIFICATIONS

EPU050000000S03

Clutch

Item			Specification
Manual transaxle type			**G35M-R**
Clutch control			Hydraulic
Clutch cover	Spring type		Diaphragm
	Set load	(N {kgf, lbf})	5,200 {531, 1,169}
Clutch disc	Outer diameter	(mm {in})	228 {8.98}
	Inner diameter	(mm {in})	170 {6.69}
Clutch pedal	Type		Suspended
	Pedal ratio		5.7
	Full stroke	(mm {in})	135 {5.31}
Clutch master cylinder inner diameter		(mm {in})	19.12 {0.753}
Clutch release cylinder inner diameter		(mm {in})	20.64 {0.813}
Clutch fluid type			SAE J1703, FMVSS 116 DOT-3

Manual Transaxle [G35M-R]

Item		Specification
Manual transaxle type		**G35M-R**
Operation system		Cable
Shift assist	Forward	Synchromesh
	Reverse	Selective sliding and synchromesh

Item			Specification
Manual transaxle type			**G35M-R**
Gear ratio	1GR		3.307
	2GR		1.842
	3GR		1.310
	4GR		0.970
	5GR		0.755
	Reverse		3.166
Final gear ratio			4.388
Oil	Grade		API service GL-4 or GL-5
	Viscosity	All season	SAE 75W-90
		Above 10°C {50°F}	SAE 80W-90
	Capacity (approx. quantity)	(L {US qt, Imp qt})	2.87 {3.03, 2.53}

Automatic Transaxle [FN4A-EL]

Item			Specification
Automatic transaxle type			**FN4A-EL**
Gear ratio		1GR	2.816
		2GR	1.553
		3GR	1.000
		4GR	0.695
		Reverse	2.279
Final gear ratio			4.416
ATF	Type		ATF M-V
	Capacity (Approx. quantity) (L {US qt, Imp qt})		7.2 {7.6, 6.3}
Torque converter stall torque ratio			1.85
Hydraulic system (number of drive/driven gear plates)	Forward clutch		4/4
	3-4 clutch		3/3
	Reverse clutch		2/2
	Low and reverse brake		5/5
Band servo (mm {in})	Servo diameter (Piston outer dia.)		64.6 {2.54}
Front planetary gear (Number of teeth)		Front sun gear	49
		Front pinion gear	20
		Front internal gear	89
Rear planetary gear (Number of teeth)		Rear sun gear	43
		Rear pinion gear	27
		Rear internal gear	98
Primary gear (number of teeth)			86
Secondary gear (number of teeth)			82
Output gear (number of teeth)			19
Ring gear (number of teeth)			88

Automatic Transaxle Shift Mechanism

Item	Specification
Automatic transaxle type	**FN4A-EL**
Operation system	Cable
Selector lever type	Sport AT

05–02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC (OBD) SYSTEM OUTLINE [FN4A-EL] **05–02–1**
ON-BOARD DIAGNOSTIC (OBD) SYSTEM BLOCK DIAGRAM [FN4A-EL] **05–02–2**
MALFUNCTION DETECTION FUNCTION [FN4A-EL] **05–02–2**
Malfunction Detection Function **05–02–2**
DTC Table **05–02–2**
MEMORY FUNCTION [FN4A-EL] **05–02–3**
MALFUNCTION INDICATION FUNCTION [FN4A-EL] **05–02–3**
FAIL-SAFE FUNCTION [FN4A-EL] **05–02–3**
PARAMETER IDENTIFICATION (PID) DATA MONITORING FUNCTION [FN4A-EL] **05–02–6**
Monitor Item Table **05–02–6**
SIMULATION FUNCTION [FN4A-EL] **05–02–7**
Simulation Item Table **05–02–7**
DLC-2 OUTLINE [FN4A-EL] **05–02–7**

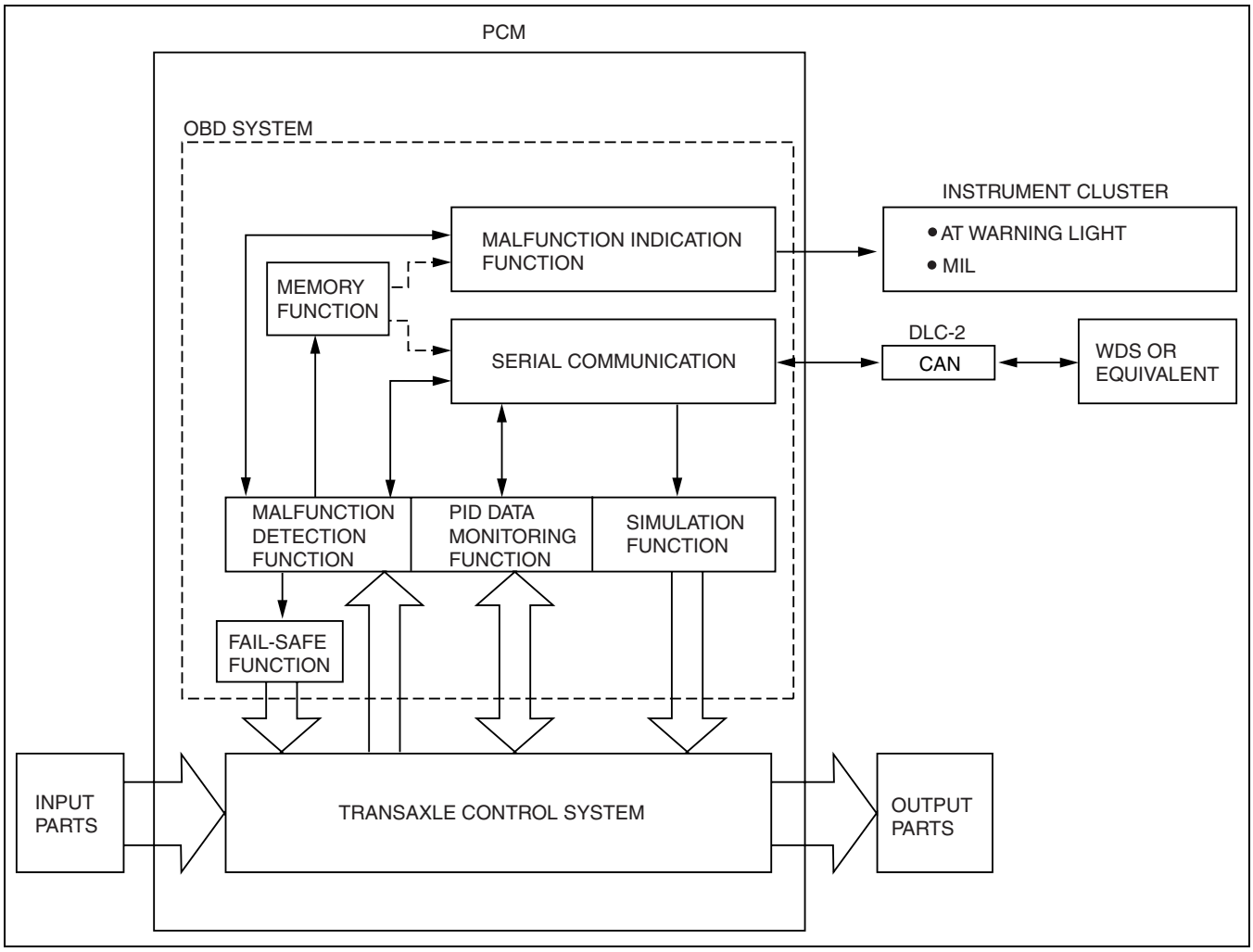
ON-BOARD DIAGNOSTIC (OBD) SYSTEM OUTLINE [FN4A-EL]

EPU050200000S01

- The OBD system has the following functions:
  - — Malfunction detection function: detects malfunctions of the input/output devices and system components of the ATX.
  - — Fail-safe function: fixes the output device function and input value of the sensors/switches to ensure minimum vehicle drivability when a malfunction is detected.
  - — Memory function: stores the DTC when a malfunction is detected.
  - — PID data monitoring function: monitors the input/output signal and calculated value of the PCM and sends the monitoring data to the WDS or equivalent.
  - — Simulation function: Allows override operation of simulation items for input/output system parts preset in the PCM.

ON-BOARD DIAGNOSTIC (OBD) SYSTEM BLOCK DIAGRAM [FN4A-EL]

EPU050200000S02



EPU502ZS3001

MALFUNCTION DETECTION FUNCTION [FN4A-EL]

EPU050200000S03

Malfunction Detection Function

- In the malfunction detection function, the PCM detects malfunctions in the automatic transmission while driving.
- When vehicle driving conditions correspond with a preset malfunction detection condition, the PCM determines that the automatic transmission has a malfunction and stores the corresponding DTC.
- When a malfunction is detected, stored DTCs can be retrieved using the WDS or equivalent connected to the DLC-2.

DTC Table

×: Available

DTC No.	Condition	MIL	AT warning light illuminates	DC	Monitor item	Memory function
P0706	Transaxle range (TR) switch circuit range/performance	ON	YES	2	CCM	X
P0707	Transaxle range (TR) switch circuit low input	ON	YES	1	CCM	X
P0708	Transaxle range (TR) switch circuit high input	ON	YES	2	CCM	X
P0711	Transaxle fluid temperature (TFT) sensor circuit range/ performance (stuck)	ON	NO	2	CCM	X
P0712	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to ground)	ON	YES	1	CCM	X
P0713	Transaxle fluid temperature (TFT) sensor circuit malfunction (open circuit)	ON	YES	1	CCM	X
P0715	Input/turbine speed sensor circuit malfunction	ON	YES	1	CCM	X

DTC No.	Condition	MIL	AT warning light illuminates	DC	Monitor item	Memory function
P0720	Vehicle speed sensor (VSS) circuit malfunction	ON	YES	2	CCM	X
P0731	Gear 1 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0732	Gear 2 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0733	Gear 3 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0734	Gear 4 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0741	Torque converter clutch (TCC) (stuck off)	OFF	YES	1	CCM	X
P0742	Torque converter clutch (TCC) (stuck on)	OFF	YES	1	CCM	X
P0745	Pressure control solenoid malfunction	OFF	YES	1	CCM	X
P0751	Shift solenoid A stuck off	ON	YES	2	CCM	X
P0752	Shift solenoid A stuck on	ON	YES	2	CCM	X
P0753	Shift solenoid A malfunction (electrical)	ON	YES	1	CCM	X
P0756	Shift solenoid B stuck off	ON	YES	2	CCM	X
P0757	Shift solenoid B stuck on	ON	YES	2	CCM	X
P0758	Shift solenoid B malfunction (electrical)	ON	YES	1	CCM	X
P0761	Shift solenoid C stuck off	ON	YES	2	CCM	X
P0762	Shift solenoid C stuck on	ON	YES	2	CCM	X
P0763	Shift solenoid C malfunction (electrical)	ON	YES	1	CCM	X
P0766	Shift solenoid D stuck off	ON	YES	2	CCM	X
P0767	Shift solenoid D stuck on	OFF	YES	2	CCM	X
P0768	Shift solenoid D malfunction (electrical)	ON	YES	1	CCM	X
P0771	Shift solenoid E stuck off	ON	YES	2	CCM	X
P0772	Shift solenoid E stuck on	ON	YES	2	CCM	X
P0773	Shift solenoid E malfunction (electrical)	ON	YES	1	CCM	X
P0841	Oil pressure switch circuit malfunction	OFF	NO	2	CCM	X
P0894	Forward clutch torque transmission	OFF	YES	1	CCM	X

MEMORY FUNCTION [FN4A-EL]

EPU050200000S04

- The memory function stores malfunction information detected in the malfunction detection function. Once malfunction information is stored, the memory will not be cleared even when the ignition switch is turned off (LOCK position) or the malfunction is repaired.
- The stored memory (malfunction information) can be cleared using the WDS or equivalent, or by disconnecting the negative battery cable.

MALFUNCTION INDICATION FUNCTION [FN4A-EL]

EPU050200000S05

- The malfunction indication function illuminates the MIL or AT warning light when the malfunction detection function when it determines there is a malfunction.

FAIL-SAFE FUNCTION [FN4A-EL]

EPU050200000S06

- In the fail-safe function, minimum vehicle drivability is obtained by changing the signals that are determined to be malfunctions by the malfunction detection function to the preset values, and limiting PCM control.

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0706	Transaxle range (TR) switch circuit range/ performance	• No TR signal (P, R, N or D range/ position) input to PCM terminal 1S when the engine speed is **530 rpm or more**, vehicle speed is **20 km/h {12 mph} or more** and voltage at PCM terminal 1S is **0.5 V or more**.	• Inhibits gear shifting and maximizes line pressure	Disabled
P0707	Transaxle range (TR) switch circuit low input	• Input voltage from the TR switch to PCM terminal 1S is **0.5 V or less** when the engine speed is **530 rpm or more** and vehicle speed is **20 km/h {12 mph} or more**.	• Inhibits gear shifting and maximizes line pressure	Disabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0708	Transaxle range (TR) switch circuit high input	• Input voltage from the TR switch to PCM terminal 1S is **4.79 V or more** when the engine speed is **530 rpm or more** and vehicle speed is **20 km/h {12 mph} or more**.	• Inhibits gear shifting and maximizes line pressure	Disabled
P0711	Transaxle fluid temperature (TFT) sensor circuit range/performance (Stuck)	• Input voltage from the TFT sensor to PCM terminal 1U and 1AA is maintained at **0.03 V or less** when **180 s** have passed after the engine is started and the vehicle is driven for **90 s or more** at vehicle speed **between 25—59 km/h {15—36 mph}**, and then **60 km/h {37 mph} or more** for **60 s or more**. • Detected ATF temperature is **less than 20°C {68 °F}** when intake air temperature immediately after engine start is **-7 °C {19.4 °F} or more** and estimated ATF temperature while vehicle is driven is **more than 55° C {131 °F}**.	N/A	Disabled
P0712	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to ground)	• Input voltage from the TFT sensor to PCM terminal 1U and 1AA is maintained at **0.06 V or less** when the vehicle speed is **20 km/h {12 mph} or more**.	• Sets temperature to cold condition and maximizes line pressure	Disabled
P0713	Transaxle fluid temperature (TFT) sensor circuit malfunction (open circuit)	• Input voltage from the TFT sensor to PCM terminal 1U and 1AA is maintained at **4.67 V or more** when vehicle speed is **20 km/h {12 mph} or more**.	• Sets temperature to cold condition	Disabled
P0715	Input/turbine speed sensor circuit malfunction	• No input/turbine speed sensor signal to PCM terminals 1M and 1Q when the vehicle speed is **41 km/h {25 mph} or more** and selector lever position is at D or M range.	• Inhibits 4GR	Disabled
P0720	Vehicle speed sensor (VSS) circuit malfunction	• No VSS signal is input to PCM terminal 1J when and engine coolant temperature is **60 °C {140 °F} or more**, input/turbine speed sensor signal is **1,500 rpm or more** and selector lever position is at D or M range.	• Vehicle speed signal calculated from input/ turbine speed sensor	Enabled
P0731	Gear 1 incorrect (incorrect gear ratio detected)	• Revolution ratio of the forward clutch drum to differential gear case revolution is **2.185 or less** while in 1GR.	• Inhibits 1GR and maximizes line pressure	Enabled
P0732	Gear 2 incorrect (incorrect gear ratio detected)	• Revolution ratio of the forward clutch drum to differential gear case revolution is **1.277 or less** or **2.185 or more** while in 2GR.	• Inhibits 2GR and maximizes line pressure	Enabled
P0733	Gear 3 incorrect (incorrect gear ratio detected)	• Revolution ratio of the forward clutch drum to differential gear case revolution is **0.848 or less** or **2.185 or more** while in 3GR. • Revolution ratio of the forward clutch drum to differential gear case revolution is **within 1.404—1.704** while in 3GR (TCC no operating).	N/A	Enabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0734	Gear 4 incorrect (incorrect gear ratio detected)	• Revolution ratio of the forward clutch drum to differential gear case revolution is **0.6 or less** or **1.277 or more** while in 4GR. • Revolution ratio of the forward clutch drum to differential gear case revolution is **within 0.91—1.09** while in 4GR (TCC no operating).	• Inhibits 4GR and maximizes line pressure	Enabled
P0741	Torque converter clutch (TCC) (stuck off)	• Difference between the engine speed and turbine speed is **more than 100 rpm** while TCC is operating.	• Inhibits TCC and maximizes line pressure	Disabled
P0742	Torque converter clutch (TCC) (stuck on)	• Difference between the engine speed and turbine speed is **50 rpm or less** while TCC is not operating.	• Inhibits TCC and maximizes line pressure	Disabled
P0745	Pressure control solenoid malfunction	• Voltage is stuck at **0 V** or **B+** at pressure control solenoid control terminal 1G of the PCM when the solenoid valve operates according to PCM calculation.	N/A	Enabled
P0751	Shift solenoid A stuck off	• Revolution ratio of the forward clutch drum to differential gear case revolution is **within 0.91—1.09** in 4GR and DTCs not output	• Inhibits 4GR and TCC and maximizes line pressure	Disabled
P0752	Shift solenoid A stuck on	• Input/turbine speed sensor signal is **187.5 rpm or more** in D range	• Inhibits 1GR, 2GR, and 3GR and maximizes line pressure	Enabled
P0753	Shift solenoid A malfunction (electrical)	• Voltage is stuck at **0 V** or **B+** at shift solenoid A control terminal 1B of the PCM when the solenoid valve operates according to PCM calculation.	• Inhibits 4GR and TCC and maximizes line pressure	Disabled
P0756	Shift solenoid B stuck off	• Revolution ratio of the forward clutch drum to differential gear case revolution is **2.185 or less** in 1GR and DTCs not output.	• Inhibits 1GR and 4GR and maximizes line pressure	Enabled
P0757	Shift solenoid B stuck on	• Revolution ratio of the forward clutch drum to differential gear case revolution is **1.277 or less** or **2.185 or more** in D range 2GR. • Revolution ratio of the forward clutch drum to differential gear case revolution is **0.6 or less** or **1.277 or more** in D range 4GR.	• Inhibits 2GR and 4GR and maximized line pressure	Enabled
P0758	Shift solenoid B malfunction (electrical)	• Voltage is stuck at **0 V** or **B+** at shift solenoid B control terminal 1C of the PCM when the solenoid valve operates according to PCM calculation.	• Inhibits 1GR and 4GR and maximizes line pressure	Enabled
P0761	Shift solenoid C stuck off	• Revolution ratio of the forward clutch drum to differential gear case revolution is **2.185 or less** in D range 1GR. • Revolution ratio of the forward clutch drum to differential gear case revolution is **1.277 or less** or **2.185 or more** in D range 2GR.	• Inhibits 1GR and 2GR and maximizes line pressure	Enabled
P0762	Shift solenoid C stuck on	• Revolution ratio of the forward clutch drum to differential gear case revolution is **within 1.404—1.704** in D range 3GR.	• Inhibits 3GR and 4GR and maximizes line pressure	Enabled
P0763	Shift solenoid C malfunction (electrical)	• Voltage is stuck at **0 V** or **B+** at shift solenoid C control terminal 1D of the PCM when the solenoid valve operates according to PCM calculation.	• Inhibits 1GR and 2GR and maximizes line pressure	Enabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0766	Shift solenoid D stuck off	• Revolution ratio of the forward clutch drum to differential gear case revolution is **0.6 or less** or **1.277 or more** in D range 4GR.	• Inhibits 4GR and maximizes line pressure	Enabled
P0767	Shift solenoid D stuck on	• Revolution ratio of the forward clutch drum to differential gear case revolution is **0.848 or less** or **2.185 or more** in D range 3GR.	• Inhibits 2GR, 4GR, and TCC and maximizes line pressure	Disabled
P0768	Shift solenoid D malfunction (electrical)	• Voltage is stuck at **0 V** or **B+** at shift solenoid D valve control terminal 1E of the PCM when the solenoid valve operates according to PCM calculation.	• Inhibits 4GR and maximizes line pressure	Enabled
P0771	Shift solenoid E stuck off	• Difference between engine speed and turbine speed is **more than 100 rpm** while driving in 4GR is at D range during TCC operation.	• Inhibits TCC and maximized line pressure	Disabled
P0772	Shift solenoid E stuck on	• Difference between the engine speed and turbine speed is **50 rpm or less** while driving in 4GR at D range while TCC is not operating.	• Inhibits 1GR and maximizes line pressure	Enabled
P0773	Shift solenoid E malfunction (electrical)	• Voltage is stuck at **0 V** or **B+** at shift solenoid E control terminal 1F of the PCM when the solenoid valve operates according to PCM calculation.	• Inhibits TCC and maximized line pressure	Disabled
P0841	Oil pressure switch circuit malfunction	• No oil pressure switch signal input when revolution ratio of forward clutch drum revolution to differential gear case revolution is **within 0.91—3.08** while in 1, 2 or 3GR. • Oil pressure switch signal input when revolution ratio of forward clutch drum revolution to differential gear case revolution is **within 0.61—0.79** while in 4GR.	N/A	Enabled
P0894	Forward clutch torque transmission	• Turbine speed does not fall to **less than 187 rpm 3 s or more** after starting the engine with the vehicle stopped (brake applied) and the selector lever shifted to D range from N position.	• Driving restricted to 4GR	Enabled

PARAMETER IDENTIFICATION (PID) DATA MONITORING FUNCTION [FN4A-EL]

EPU050200000S07

- The PID mode allows access to certain data values, analog and digital input and output, calculations and system state information.

Monitor Item Table

Item	Definition	Unit/ Condition	PCM terminal
DWN SW	Down switch	On/Off	1P
GEAR	Gear commanded by module	1/2/3/4	N/A
HTM_CNT	Indicates number of high oil temperature mode (ATF temperature at 130 °C {266 °F} or more) operations	—	N/A
HTM_DIS	Indicates travel distance after operation of high oil temperature mode (ATF temperature at 130 °C {266 °F} or more)	km	N/A
LINEDES	Target line pressure	kPa | inHg	N/A
LPS	Pressure control solenoid control signal in PCM	A	1H 1G
MNL SW	M range switch	On/Off	1O
OP_SW_B	Oil pressure switch	On/Off	1L
OSS	Output shaft speed	RPM	1J

Item	Definition	Unit/ Condition	PCM terminal
SSA/SS1	Shift solenoid A control signal in PCM	%	1B
SSB/SS2	Shift solenoid B control signal in PCM	%	1C
SSC/SS3	Shift solenoid C control signal in PCM	%	1D
SSD/SS4	Shift solenoid D control signal in PCM	On/Off	1E
SSE_SS5	Shift solenoid E control signal in PCM	On/Off	1F
TFT	ATF temperature	°C | °F	1U
TFTV	ATF temperature signal voltage	V	1U
THOP	Throttle position signal in PCM	%	2I, 2K
TR	Transaxle range	P/R/N/D	1S
TR_SENS	TR switch signal voltage	V	1S
TSS	Input/turbine speed	RPM	1M 1Q
UP SW	Up switch	On/Off	1K

SIMULATION FUNCTION [FN4A-EL]

EPU050200000S08

- By using the WDS or equivalent, simulation items for input/output parts preset in the PCM can be optionally selected and operated regardless of PCM control conditions.

Simulation Item Table

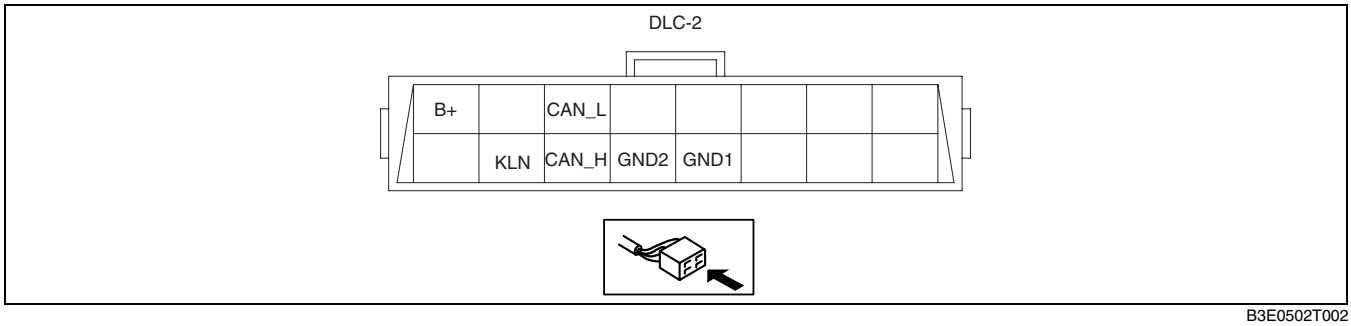
X: Available

Simulation item	Applicable component	Unit/Condition	Operation		PCM terminal
			IG ON	Idle	
LPS	Pressure control solenoid control signal in PCM	%		X	1H 1G
SSA/SS1	Shift solenoid A control signal in PCM	%		X	1B
SSB/SS2	Shift solenoid B control signal in PCM	%		X	1C
SSC/SS3	Shift solenoid C control signal in PCM	%		X	1D
SSD/SS4	Shift solenoid D control signal in PCM	On/Off		X	1E
SSE_SS5	Shift solenoid E control signal in PCM	On/Off		X	1F

DLC-2 OUTLINE [FN4A-EL]

EPU050200000S09

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been adopted.
- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The connector has a 16-pin construction that includes the KLN, CAN_H, CAN_L, GND1, GND2 and B+ terminals.



B3E0502T002

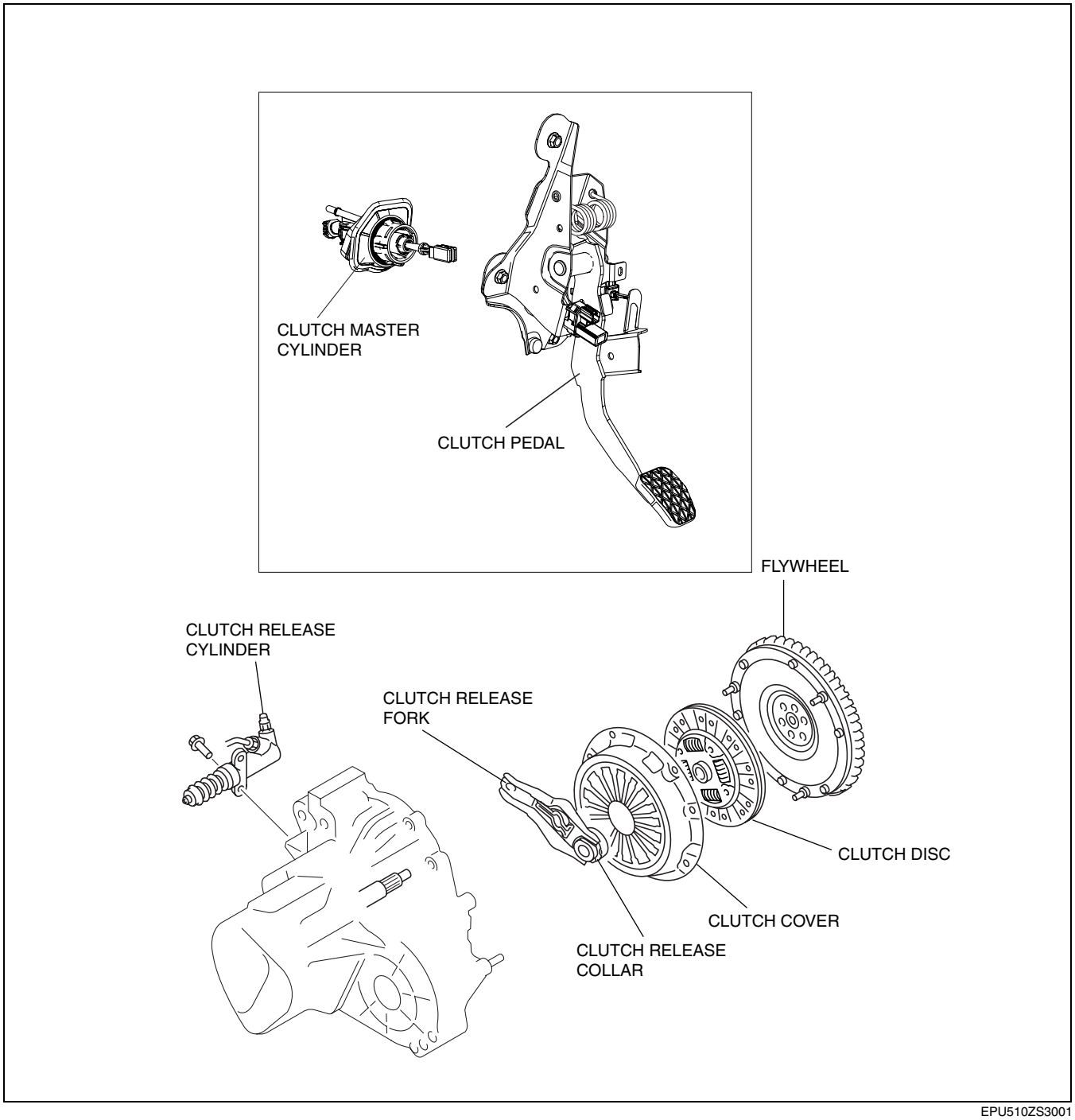
Terminal	Function
KLN	Serial communication terminal (malfunction diagnosis use)
CAN_L	Serial communication terminal (Lo)
CAN_H	Serial communication terminal (Hi)
GND1	Body ground terminal
GND2	Serial communication ground terminal
B+	Battery power supply terminal

05–10 CLUTCH

CLUTCH STRUCTURAL VIEW. 05–10–1

CLUTCH STRUCTURAL VIEW

EPU051016003S01



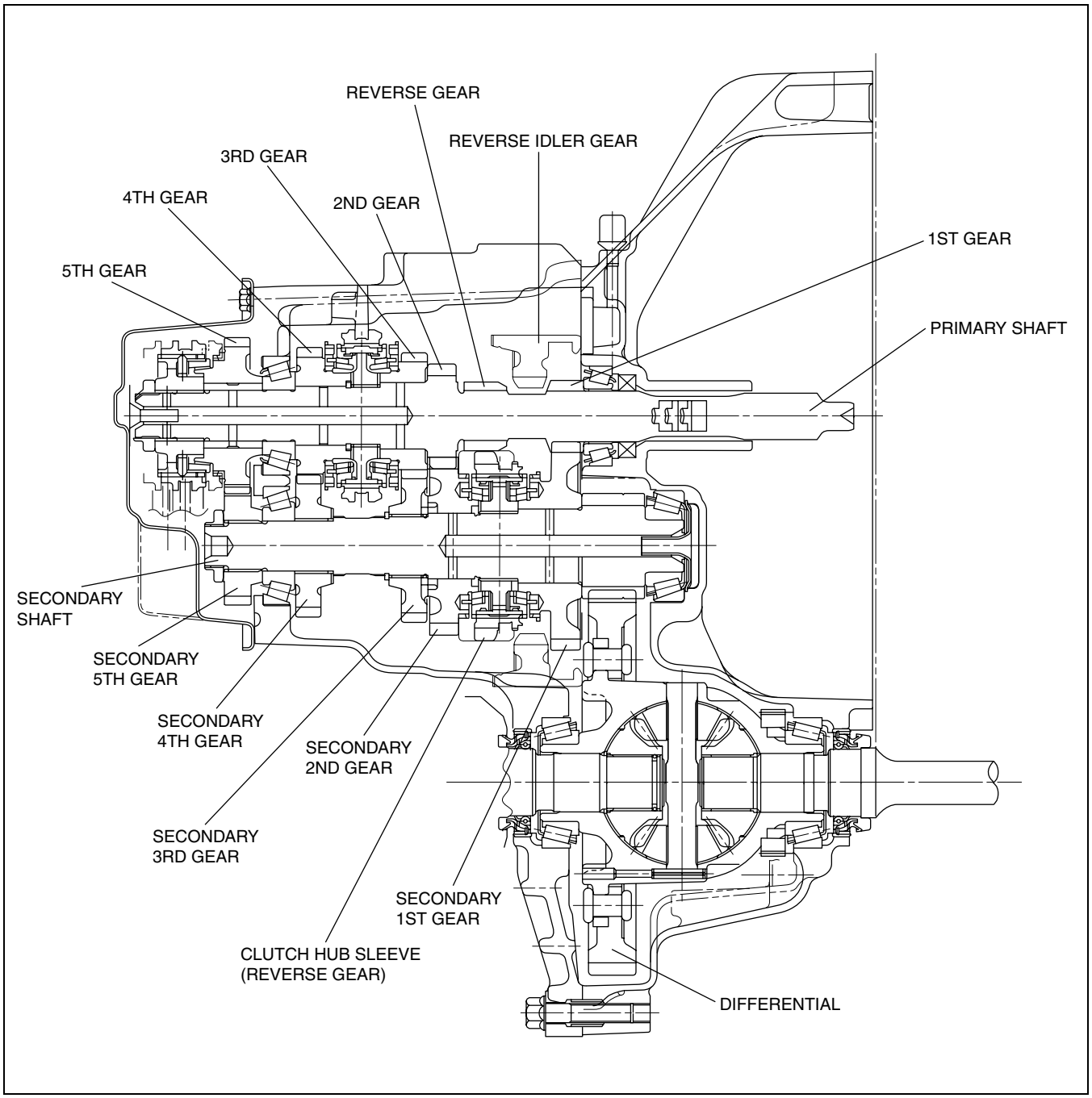
EPU510ZS3001

05–15 MANUAL TRANSAXLE

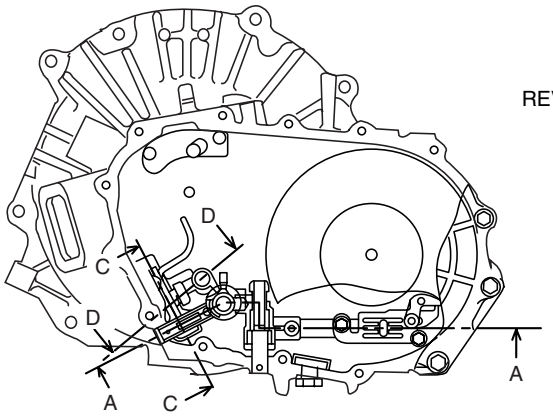
MANUAL TRANSAXLE CROSS-SECTIONAL VIEW [G35M-R] 05–15–2
MANUAL TRANSAXLE POWER FLOW [G35M-R] 05–15–4
CONTROL ROD CONSTRUCTION/OPERATION [G35M-R] 05–15–5
TRIPLE CONE SYNCHRONIZER MECHANISM STRUCTURE [G35M-R] 05–15–6
Features 05–15–6
TRIPLE CONE SYNCHRONIZER MECHANISM OPERATION [G35M-R] 05–15–7
DOUBLE CONE SYNCHRONIZER MECHANISM OUTLINE [G35M-R] 05–15–7
DOUBLE CONE SYNCHRONIZER MECHANISM CONSTRUCTION/OPERATION [G35M-R] 05–15–8
SHIFT INTERLOCK MECHANISM FUNCTION [G35M-R] 05–15–8
SHIFT INTERLOCK MECHANISM OPERATION [G35M-R] 05–15–8
Structure 05–15–8
REVERSE LOCKOUT MECHANISM FUNCTION [G35M-R] 05–15–9
REVERSE LOCKOUT MECHANISM OPERATION [G35M-R] 05–15–10

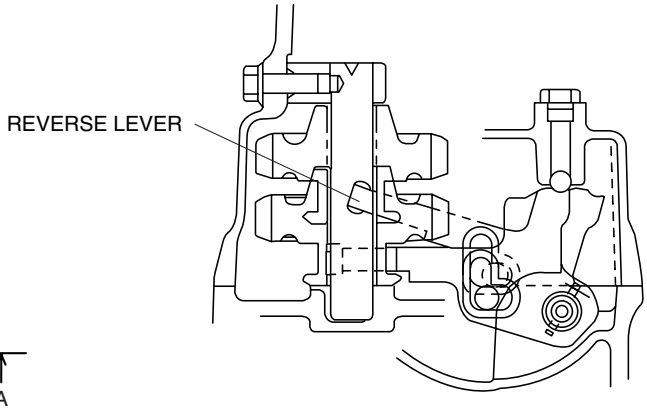
MANUAL TRANSAXLE CROSS-SECTIONAL VIEW [G35M-R]

EPU051500000S01

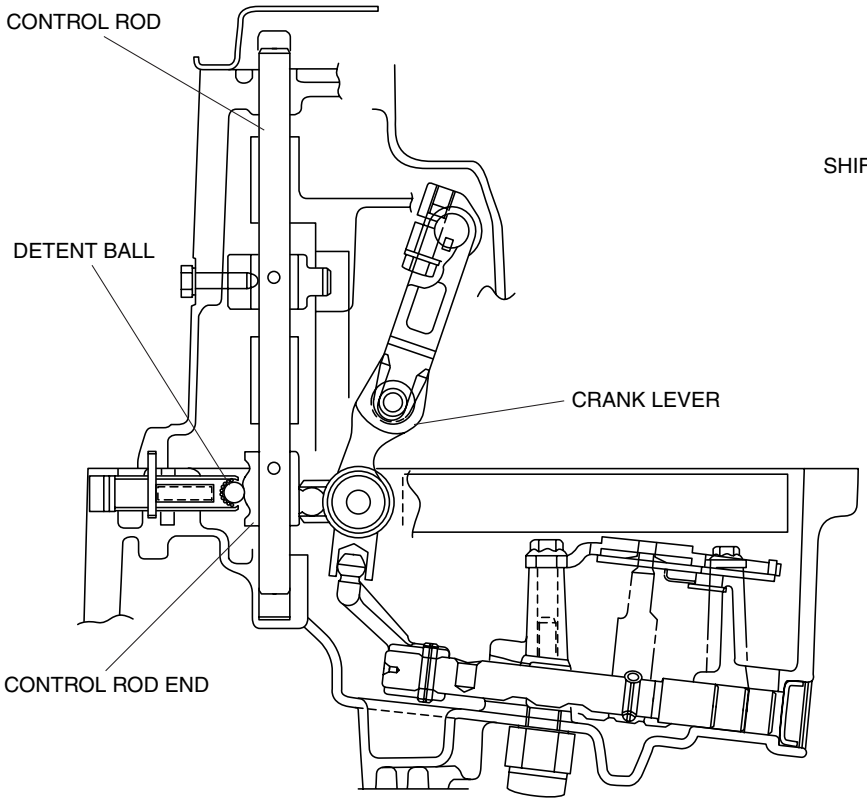


EPU515ZS3001

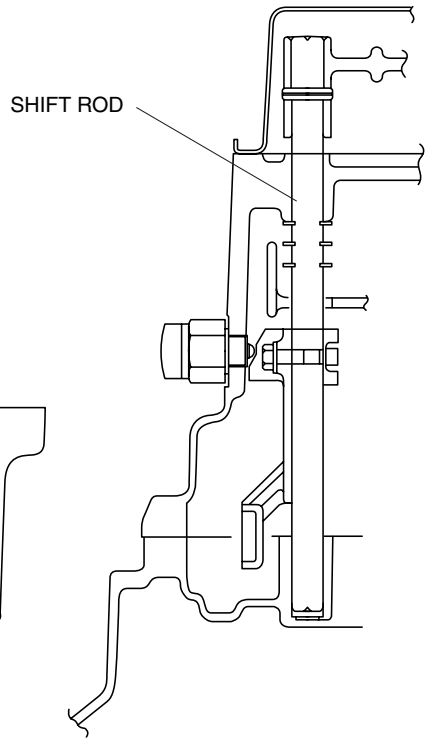




SEC. C — C
REVERSE LINK PARTS



SEC. A —A

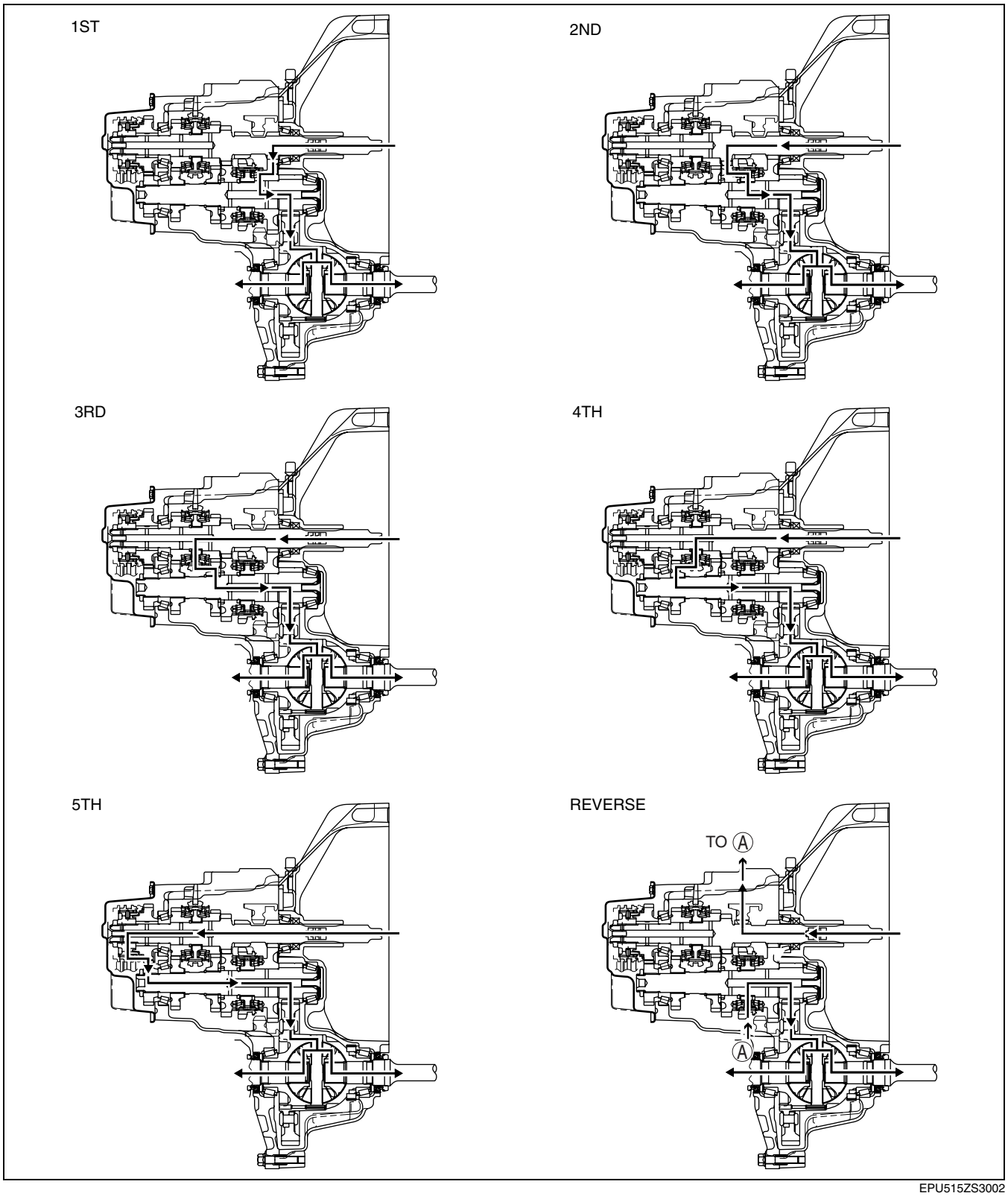


SEC. D —D

C3U0515S001

MANUAL TRANSAXLE POWER FLOW [G35M-R]

EPU051500000S02

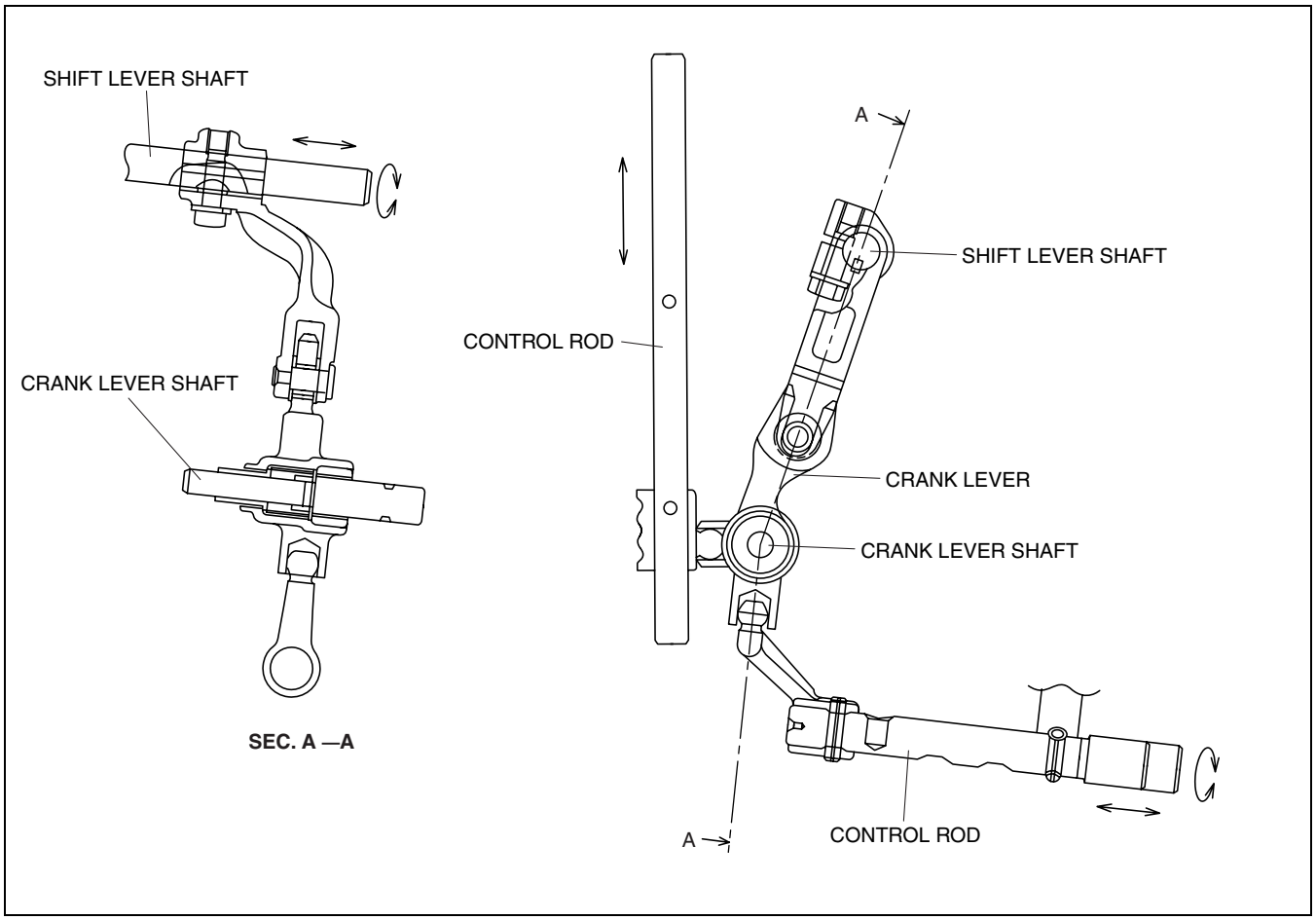


EPU515ZS3002

CONTROL ROD CONSTRUCTION/OPERATION [G35M-R]

EPU051500000S03

- Movement of the shift lever when operated is transmitted as follows, resulting in gear shifting: cable→shift lever shaft→crank lever shaft→control rod.



C3U0515S003

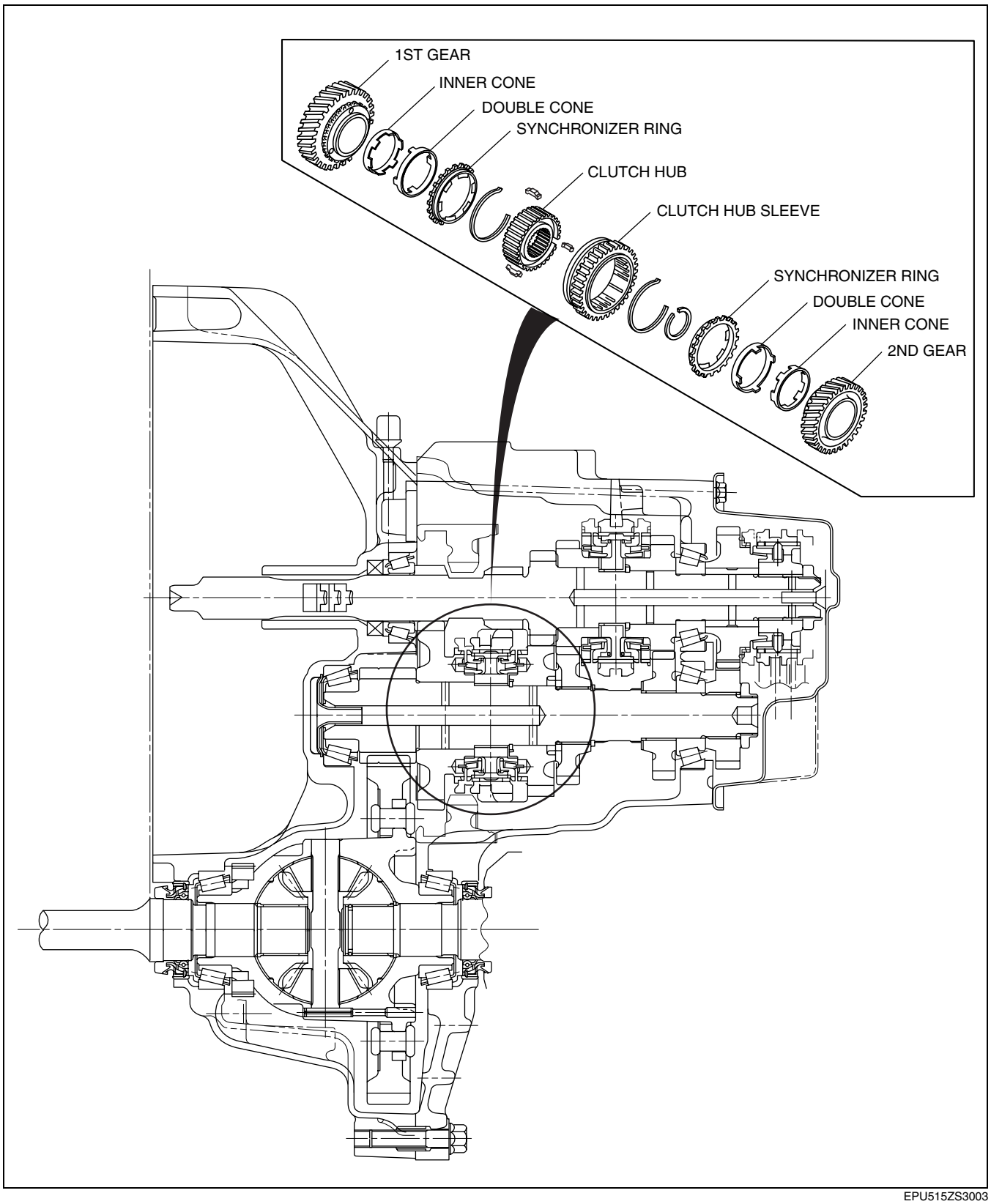
TRIPLE CONE SYNCHRONIZER MECHANISM STRUCTURE [G35M-R]

EPU051500000S04

Features

- A triple cone synchronizer mechanism is used for the 1st and 2nd gears.
- The triple cone synchronizer mechanism is a compact device capable of heavy duty meshing.
- The synchronizer mechanism reduces meshing time and improves operation.
- The triple cone synchro mechanism includes a synchronizer ring, double cone, and an inner cone.
- The inner part of the inner cone is used as a friction surface.

Structure

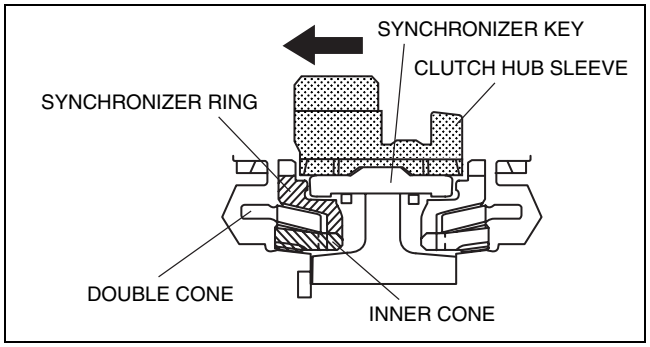


EPU515ZS3003

TRIPLE CONE SYNCHRONIZER MECHANISM OPERATION [G35M-R]

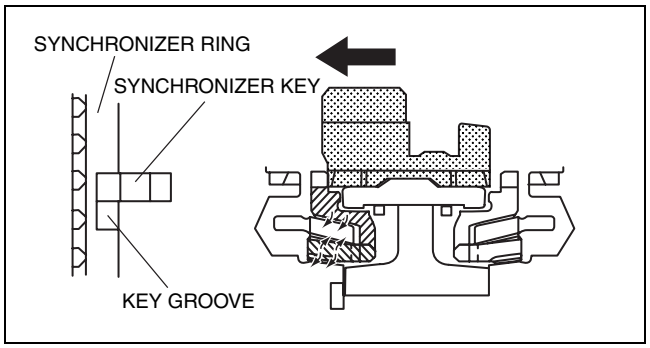
EPU051500000S05

1. When the hub sleeve moves to the left (in the direction of the arrow), the synchronizer key presses against the synchronizer ring.



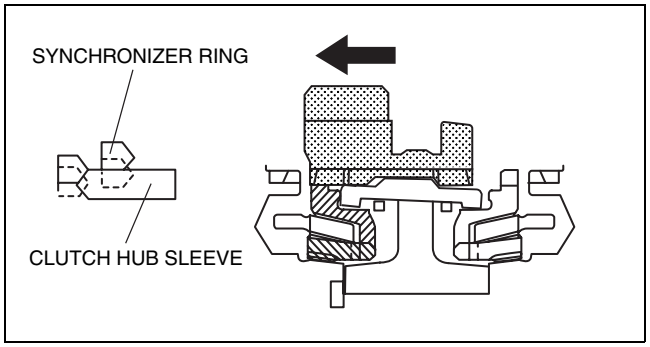
EPU515ZS3004

2. As the hub sleeve continues moving to the left, the key causes friction between the synchronizer ring, double cone, inner cone and 2nd gear. The synchronizer ring turns only the distance that the key groove gap allows, aligning the teeth of the hub sleeve and the synchronizer ring. As the hub sleeve continues moving, the friction between the cones becomes greater, and the difference between the rotational speeds of the synchronizer ring, inner cone, and double cone (unified with the gear) gradually disappears.



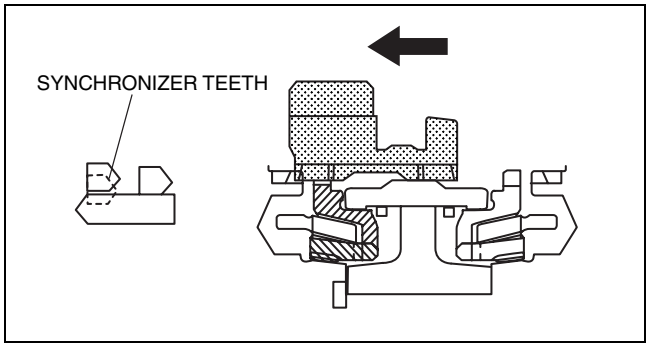
EPU515ZS3005

3. The hub sleeve then moves up onto the synchronizer key and engages the synchronizer ring.



EPU515ZS3006

4. The hub sleeve then engages the synchronizer teeth of the gear to complete shifting.



EPU515ZS3007

DOUBLE CONE SYNCHRONIZER MECHANISM OUTLINE [G35M-R]

EPU051500000S06

- A linked, double cone synchronizer mechanism has been adopted for 3rd and 4th gears.
- The double cone synchronizer mechanism consists of a synchronizer ring, double cone, and inner cone the same as a triple cone synchronizer mechanism.

DOUBLE CONE SYNCHRONIZER MECHANISM CONSTRUCTION/OPERATION [G35M-R]

EPU051500000S07

- The basic construction of the double cone synchronizer mechanism is the same as a triple cone synchronizer mechanism except that the inner side of the inner cone is not used as a friction surface.
- The basic construction of the double cone synchronizer mechanism is the same as a triple cone synchronizer mechanism except that friction force is not generated because there is no contact surface between the inner cone and each gear.
- For the triple cone synchronizer mechanism operation, refer to the triple cone synchronizer mechanism. (See 05–15–7 TRIPLE CONE SYNCHRONIZER MECHANISM OPERATION [G35M-R].)

SHIFT INTERLOCK MECHANISM FUNCTION [G35M-R]

EPU051500000S08

- This provides reliable double-engagement prevention.

SHIFT INTERLOCK MECHANISM OPERATION [G35M-R]

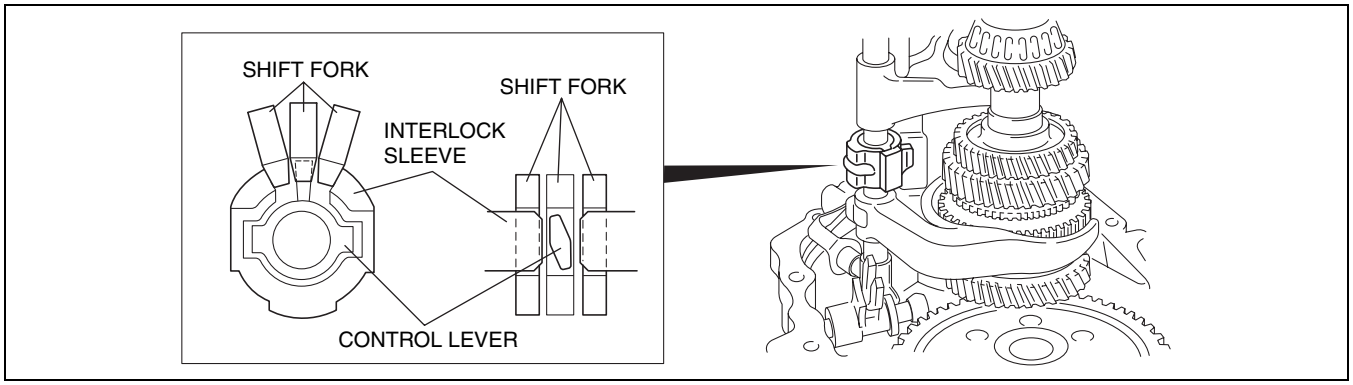
EPU051500000S09

Structure

- During shifting, the shift rods, except for the one in operation, are locked in the neutral position by the interlock sleeve.

Neutral condition

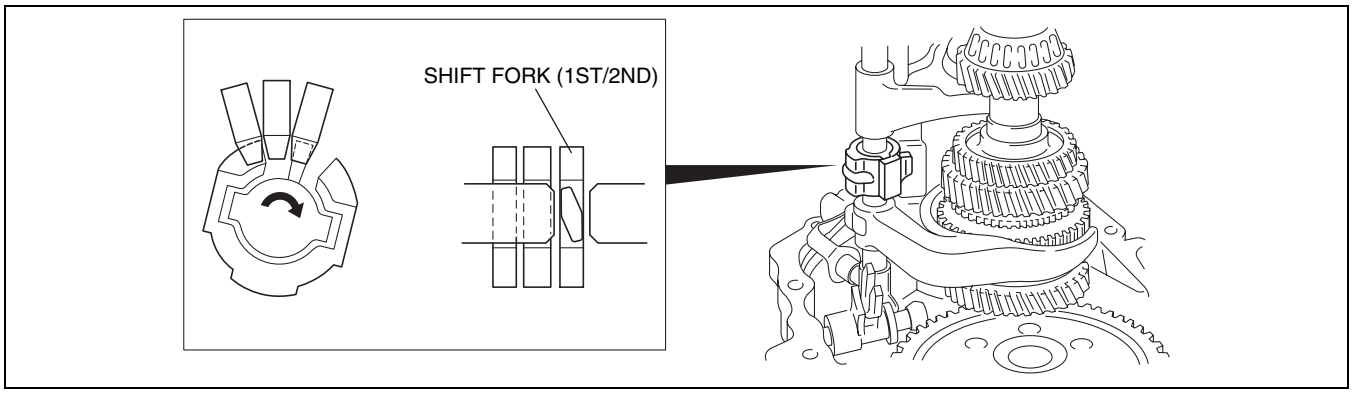
- The interlock sleeve fits into the notches of the 1st/2nd and 5th/reverse shift forks.
  The control lever fits into the notch of the 3rd/4th shift fork.



C3U0515S009

Select condition

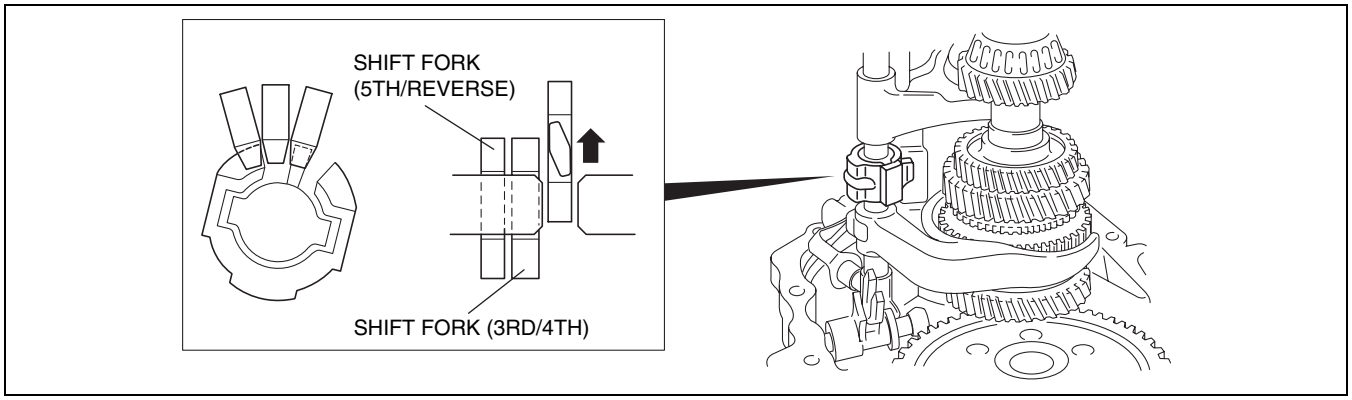
- The shift lever is moved laterally to the 1st/2nd position.
  Both the control lever and the interlock sleeve turn in the direct shown by the arrow.
  The control lever fits into the notch of the 1st/2nd shift fork.
  The interlock sleeve fits into the notches of the 3rd/4th and 5th/reverse shift forks.



C3U0515S010

Shift condition

- The shift lever is moved vertically to the 2nd position.
  The control lever moves up the 1st/2nd shift fork and the change to 2nd gear is complete.
  The interlock sleeve holds the 3rd/4th and 5th/reverse shift forks at the neutral position, preventing double engagement of gears.
  The operation procedure is the same for other gear positions.



C3U0515S011

REVERSE LOCKOUT MECHANISM FUNCTION [G35M-R]

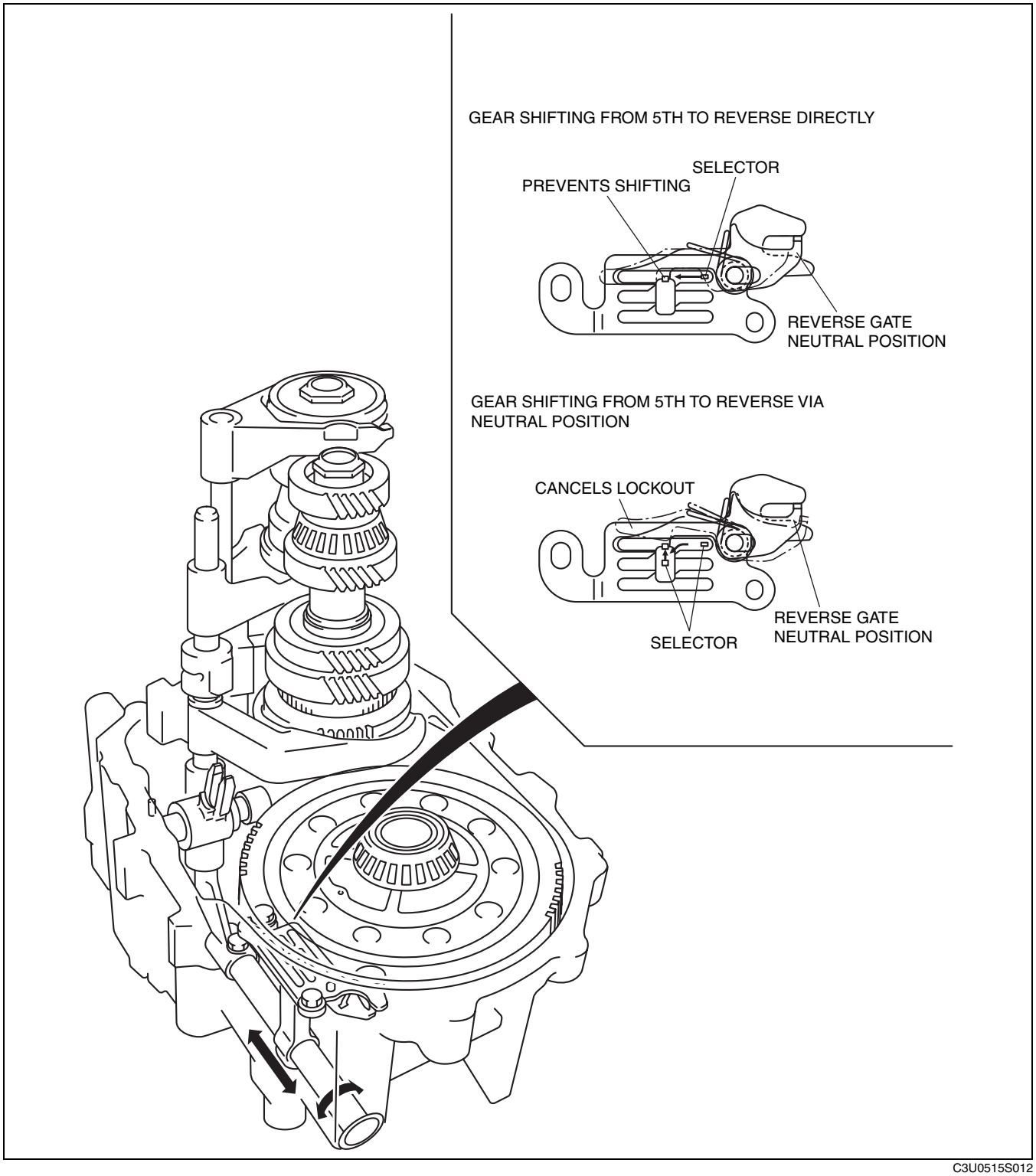
EPU051500000S10

- The reverse lockout mechanism prevents the driver from accidentally shifting into reverse gear when downshifting from 5th to 4th gear.

REVERSE LOCKOUT MECHANISM OPERATION [G35M-R]

EPU051500000S11

- If, when downshifting from 5th to 4th, the gear shift lever is shifted into reverse unintentionally, the reverse gate locks the gear shift lever's movement to prevent operation error.
  When shifting again into reverse, temporarily returning the gear shift lever to the neutral position to push out the reverse gate cancels the lock and enables shifting to take place.



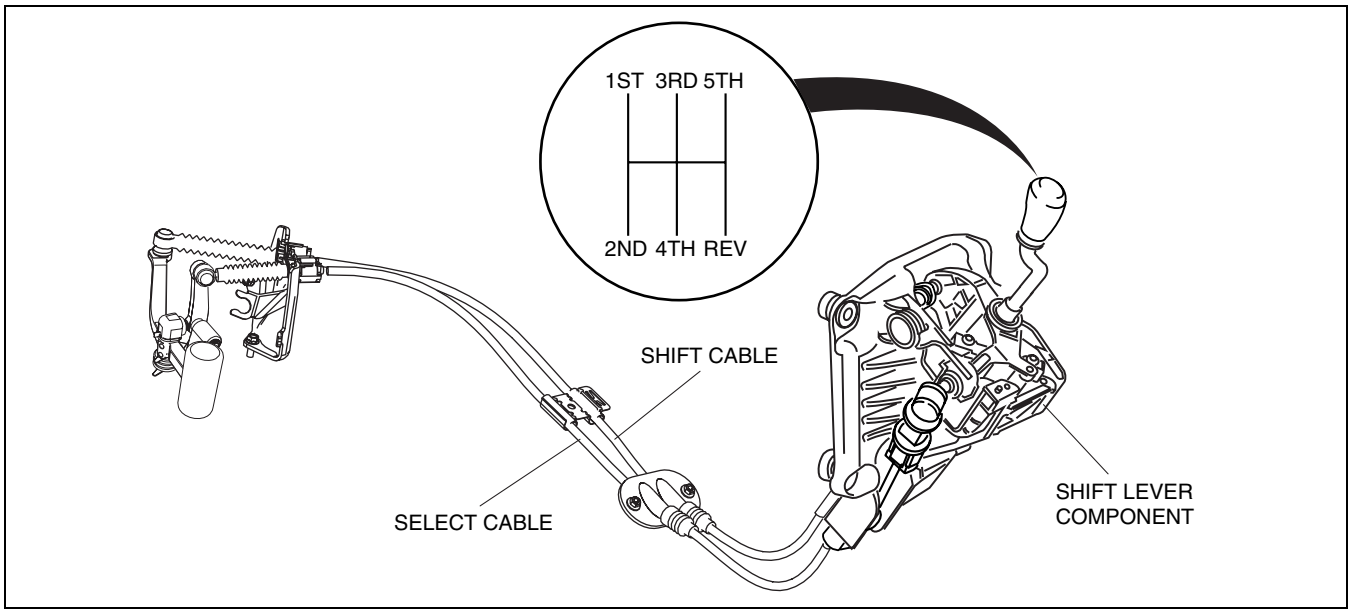
C3U0515S012

05–16 MANUAL TRANSAXLE SHIFT MECHANISM [G35M-R]

MANUAL TRANSAXLE SHIFT MECHANISM STRUCTURAL VIEW 05–16–1

MANUAL TRANSAXLE SHIFT MECHANISM STRUCTURAL VIEW

EPU051646010S01



EPU516ZS3001

05–17 AUTOMATIC TRANSAXLE

AUTOMATIC TRANSAXLE OUTLINE [FN4A-EL] 05–17–2
AUTOMATIC TRANSAXLE CROSS-SECTIONALVIEW [FN4A-EL] 05–17–3
OUTLINE OF OPERATION [FN4A-EL] 05–17–4
EC-AT OPERATION CHART [FN4A-EL] 05–17–5
POWERFLOW OUTLINE [FN4A-EL] 05–17–5
POWERFLOW STRUCTURE [FN4A-EL] 05–17–6
POWERFLOW OPERATION [FN4A-EL] 05–17–7
Component description 05–17–7
CENTRIFUGAL BALANCE CLUTCH OUTLINE [FN4A-EL]. 05–17–13
CENTRIFUGAL BALANCE CLUTCH STRUCTURE [FN4A-EL] 05–17–14
CENTRIFUGAL BALANCE CLUTCH OPERATION [FN4A-EL] 05–17–14
OUTPUT GEAR OUTLINE [FN4A-EL] 05–17–15
TORQUE CONVERTER OUTLINE [FN4A-EL] 05–17–16
OIL PUMP OUTLINE [FN4A-EL] 05–17–17
OIL PUMP STRUCTURE [FN4A-EL] 05–17–17
OIL PUMP OPERATION [FN4A-EL] 05–17–18
CONTROL VALVE BODY OUTLINE [FN4A-EL] 05–17–19
FORWARD CLUTCH, 3-4 CLUTCH HYDRAULIC CIRCUIT OUTLINE [FN4A-EL] 05–17–20
TRANSAXLE RANGE (TR) SWITCH FUNCTION [FN4A-EL] 05–17–20
TRANAXLE RANGE (TR) SWITCH CONSTRUCTION/OPERATION [FN4A-EL] 05–17–21
VEHICLE SPEED SENSOR (VSS) FUNCTION [FN4A-EL] 05–17–21
VEHICLE SPEED SENSOR (VSS) CONSTRUCTION/OPERATION [FN4A-EL] 05–17–22
INPUT/TURBINE SPEED SENSOR FUNCTION [FN4A-EL] 05–17–22
INPUT/TURBINE SPEED SENSOR CONSTRUCTION/OPERATION [FN4A-EL] 05–17–22
TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR FUNCTION [FN4A-EL] 05–17–23
TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR CONSTRUCTION/OPERATION [FN4A-EL]. 05–17–23
ELECTRONIC CONTROL SYSTEM OUTLINE [FN4A-EL]. 05–17–23
ELECTRONIC CONTROL SYSTEM CONSTRUCTION [FN4A-EL] 05–17–24
ELECTRONIC CONTROL SYSTEM BLOCK DIAGRAM [FN4A-EL]. 05–17–25
ELECTRONIC CONTROL ITEMS AND CONTENTS [FN4A-EL] 05–17–25
COMPONENT DESCRIPTIONS (ELECTRONIC CONTROL) [FN4A-EL]. 05–17–26
INPUT/OUTPUT SIGNAL AND RELATED CONTROLS [FN4A-EL]. 05–17–26
LINE PRESSURE CONTROL OUTLINE [FN4A-EL]. 05–17–27
PRESSURE CONTROL SOLENOID (LINEAR TYPE) OUTLINE [FN4A-EL]. 05–17–28
PRESSURE CONTROL SOLENOID (LINEAR TYPE) OPERATION [FN4A-EL]. 05–17–28
SHIFT CONTROL STRUCTURE [FN4A-EL]. 05–17–29
Features 05–17–29
Structure 05–17–29
SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) OUTLINE [FN4A-EL]. 05–17–29
SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) FUNCTION [FN4A-EL]. 05–17–30
SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) OPERATION [FN4A-EL]. 05–17–30
SHIFT SOLENOID D AND E (ON/OFF TYPE) OUTLINE [FN4A-EL]. 05–17–30
SHIFT SOLENOID D AND E (ON/OFF TYPE) FUNCTION [FN4A-EL]. 05–17–31
SHIFT SOLENOID D AND E (ON/OFF TYPE) OPERATION [FN4A-EL]. 05–17–31
DRIVING MODE DETERMINATION OPERATION [FN4A-EL]. 05–17–31
DIRECT ELECTRIC SHIFT CONTROL OUTLINE [FN4A-EL] 05–17–32
DIRECT ELECTRIC SHIFT CONTROL OPERATION [FN4A-EL]. 05–17–33
When Shifting NÆD or NÆR Shift 05–17–33
Up-Down Shift 05–17–33
MANUAL MODE SHIFT CONTROL STRUCTURE [FN4A-EL] 05–17–34
Features 05–17–34
Structure 05–17–34
MANUAL MODE SHIFT CONTROL OPERATION [FN4A-EL]. 05–17–34
Manual mode shift. 05–17–34
Shift diagram 05–17–35
AT WARNING LIGHT FUNCTION [FN4A-EL]. 05–17–35
AT WARNING LIGHT CONSTRUCTION/OPERATION [FN4A-EL]. 05–17–36

SELECTOR INDICATOR LIGHT FUNCTION [FN4A-EL]. 05–17–36
SELECTOR INDICATOR LIGHT CONSTRUCTION/OPERATION [FN4A-EL]. 05–17–37
Construction **05–17–37**
Operation **05–17–37**
FEEDBACK CONTROL STRUCTURE [FN4A-EL]. 05–17–37
Features **05–17–37**
Structure **05–17–37**
FEEDBACK CONTROL OPERATION [FN4A-EL]. 05–17–38
ENGINE-TRANSAXLE TOTAL CONTROL STRUCTURE [FN4A-EL]. 05–17–38
Features **05–17–38**
Structure **05–17–38**
ENGINE-TRANSAXLE TOTAL CONTROL OPERATION [FN4A-EL] 05–17–38
TORQUE CONVERTER CLUTCH (TCC) CONTROL OUTLINE [FN4A-EL] 05–17–39
TORQUE CONVERTER CLUTCH (TCC) OPERATION [FN4A-EL] 05–17–40
TCC Release **05–17–40**
TCC Engaging Operation. **05–17–41**
Determination of TCC Inhibition. **05–17–41**
SLOPE MODE CONTROL OUTLINE [FN4A-EL] 05–17–42
SLOPE MODE CONTROL OPERATION [FN4A-EL] 05–17–42
Climbing hill **05–17–42**
COOLING SYSTEM OUTLINE [FN4A-EL] 05–17–43

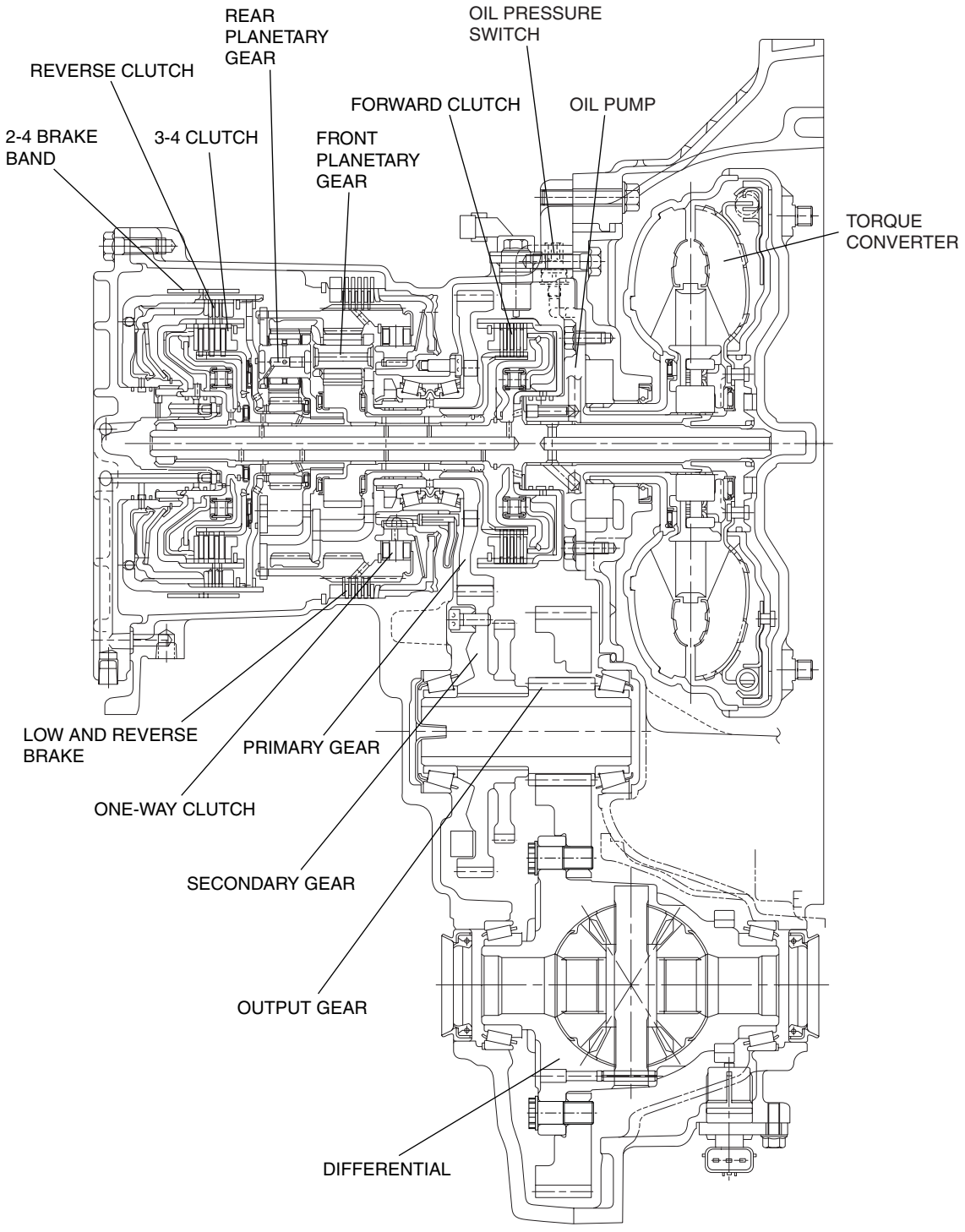
AUTOMATIC TRANSAXLE OUTLINE [FN4A-EL]

EPU051700000S01

- A manual mode shift control has been adopted.
  - — The manual mode shift control is activated by moving the selector lever from the D to M range position.
  - — The automatic shift system automatically shifts between 1GR and 4GR. The manual shift system allows for free gear position selection by manually operating the selector lever forward and back.

AUTOMATIC TRANSAXLE CROSS-SECTIONALVIEW [FN4A-EL]

EPU051700000S02

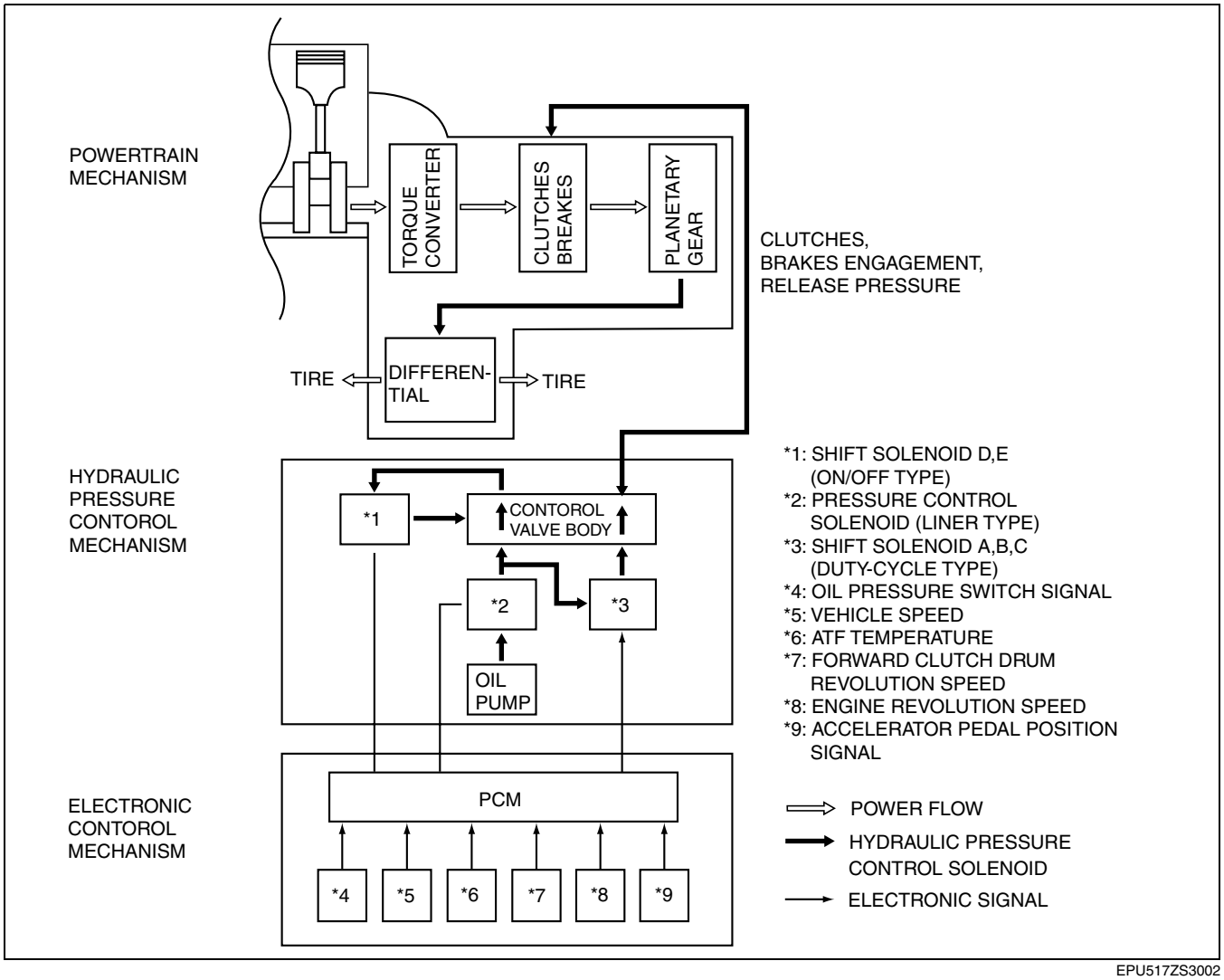


EPU517ZS3001

OUTLINE OF OPERATION [FN4A-EL]

EPU051700000S03

- The operation of the electronic automatic transaxle is classified into three systems: the electronic control mechanism, the hydraulic pressure control mechanism, and the powertrain mechanism (includes the torque converter mechanism). The operation of each system is as follows:
  - — Electronic control mechanism
    - According to the signals from the switches and sensors in the input system, the PCM outputs the signal which matches the present driving condition to the linear type solenoid, ON/OFF type solenoids and the duty-cycle type solenoids in the hydraulic pressure control mechanism.
  - — Hydraulic pressure control mechanism
    - According to the signals from the PCM, each solenoid operates to switch the hydraulic passages in the control valve body and controls the clutch engagement pressure.
    - The line pressure is adjusted by the linear type pressure control solenoid. The hydraulic passages are switched by the ON/OFF type solenoids (shift solenoids D and E.) And the clutch engagement pressure is controlled by the duty-cycle type solenoids (shift solenoids A, B, and C).
  - — Powertrain mechanism
    - The driving force from the engine is transmitted through the torque converter to the transaxle.
    - The transmitted driving force operates each clutch and brake according to the clutch engagement pressure from the duty-cycle type solenoid, and the planetary gears change the gear ratio to the optimal driving force. The changed driving force is transmitted through the differential to the axle shaft and then the tires.



EPU517ZS3002

EC-AT OPERATION CHART [FN4A-EL]

EPU051700000S04

Position/Range	Mode	Gear position		Shift pattern			Transaxle							Operation of shift solenoid				
										2–4 brake band				Solenoid valve (duty-cycle type)			Solenoid valve (ON / OFF type)	
				Shift	TCC	Engine brake	Forward clutch	3–4 clutch	Reverse clutch	Applied	Released	Low and reverse brake	One-way clutch	Shift solenoid A	Shift solenoid B	Shift solenoid C	Shift solenoid D	Shift solenoid E
P	–	Neutral	–	–										–	–	–	ON	OFF
R	–	Reverse	2.279	–		×			×			×		OPEN	OPEN	OPEN	OFF	OFF
N	–	Neutral	–	–										–	–	–	ON	OFF
D	*1 POWER/ NORMAL	1GR	2.816	↕			×						⊗	OPEN	CLOSE	CLOSE	OFF	OFF
		2GR	1.553	↕		×	×			×				OPEN	OPEN	CLOSE	OFF	OFF
		3GR	1.000	↕		×	×	×		×*3	×			OPEN	OPEN	OPEN	OFF	OFF
		4GR	0.695			×		×		×				CLOSE	OPEN	OPEN	ON	OFF
		4GR *2 TCC ON	0.695		×	×		×		×				CLOSE	OPEN	OPEN	ON	ON
M	MANUAL	1GR	2.816	↕		×	×					×	⊗	OPEN	OPEN	CLOSE	ON	ON
		2GR	1.553	↕		×	×			×				OPEN	OPEN	CLOSE	OFF	OFF
		3GR	1.000	↕		×	×	×		×*3	×			OPEN	OPEN	OPEN	OFF	OFF
		4GR	0.695	↕		×		×		×				CLOSE	OPEN	OPEN	ON	OFF
		4GR TCC ON	0.695	↕	×	×		×		×				CLOSE	OPEN	OPEN	ON	ON

↕ : Automatic shift according to set speed and throttle opening angle
↕ : Manual shift based on selector lever operation
↕ : Consecutive shift by tapping selector lever two times in the down-shift (—) direction or up-shift (+) direction
*1 : Automatically switches between POWER and NORMAL modes according to accelerator pedal depressing speed
*2 : Performs TCC operation in NORMAL mode
*3 : Indicates operation although the band servo remains deactivated due to the large area of the release pressure side.
× : Operating
⊗ : Transmits the torque only when driving

OPEN: Engages the line pressure to the clutch pressure (Solenoid de-energized)
CLOSE: Drains the clutch pressure (Solenoid energized)
ON: Engages the output port and the supply port (Solenoid reducing pressure)
OFF: Engages the output port and the drain port (Drains the output port)

EPU517ZS3015

POWERFLOW OUTLINE [FN4A-EL]

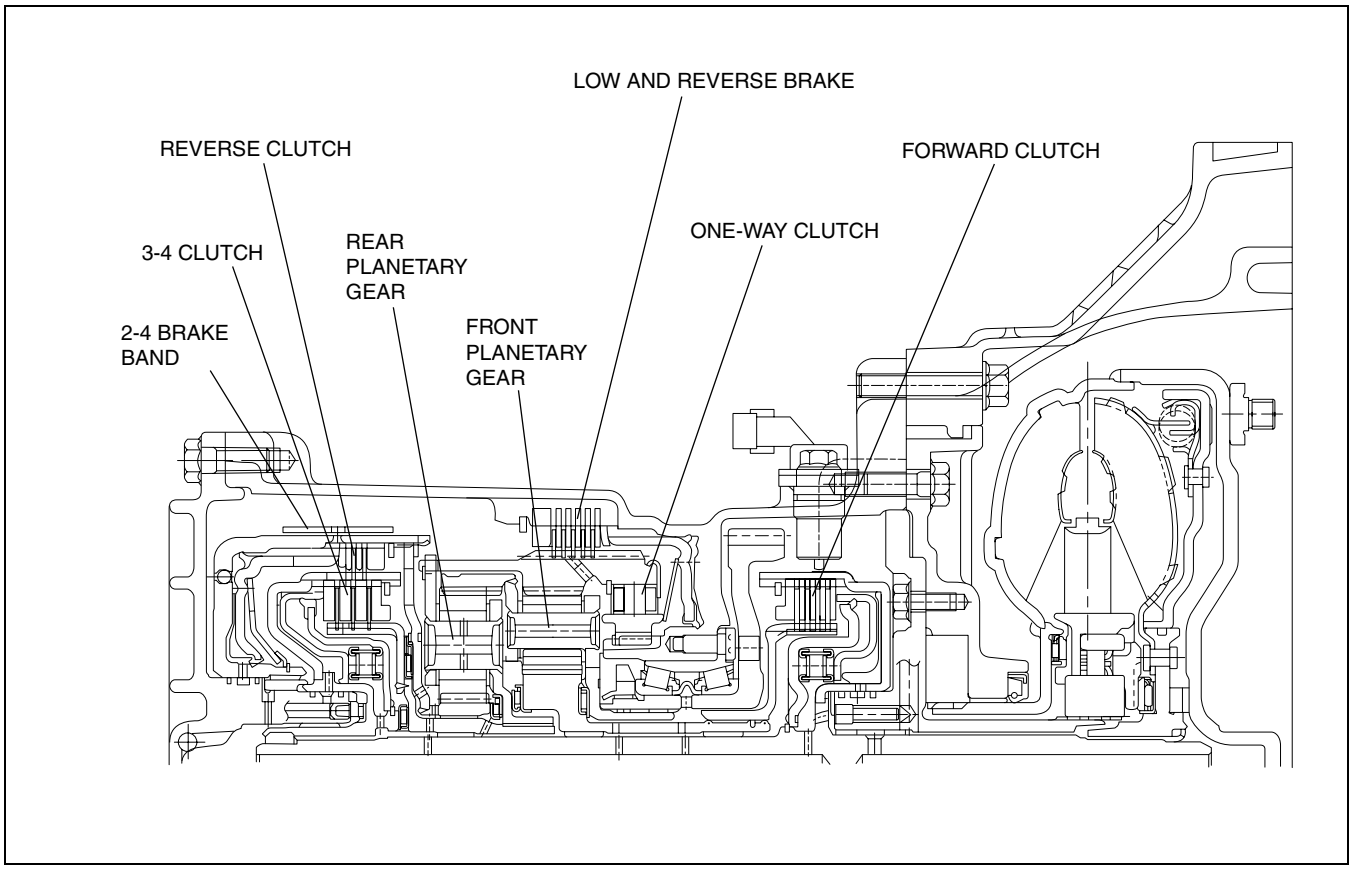
EPU051700000S05

- In the powertrain mechanism, hydraulic pressure is transmitted from the control valves or shift solenoid A, B, or C (duty-cycle type) to operate the clutches and brakes, and the planetary gear changes the gear ratio according to the vehicle driving condition.

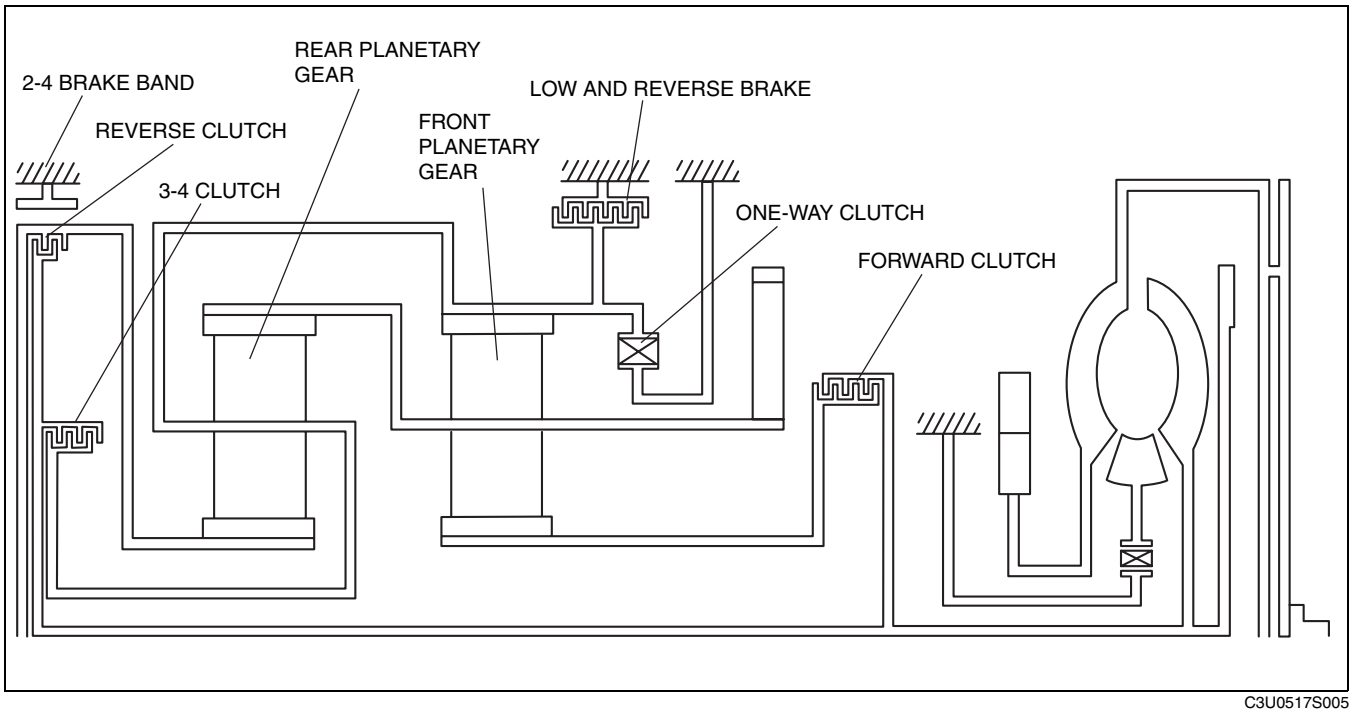
POWERFLOW STRUCTURE [FN4A-EL]

EPU051700000S06

- The powertrain mechanism of the FN4A-EL type consists of three pairs of clutches, brake, band brake, one-way clutch, and two pairs of single type planetary gears.



C3U0517S004



C3U0517S005

POWERFLOW OPERATION [FN4A-EL]

EPU051700000S07

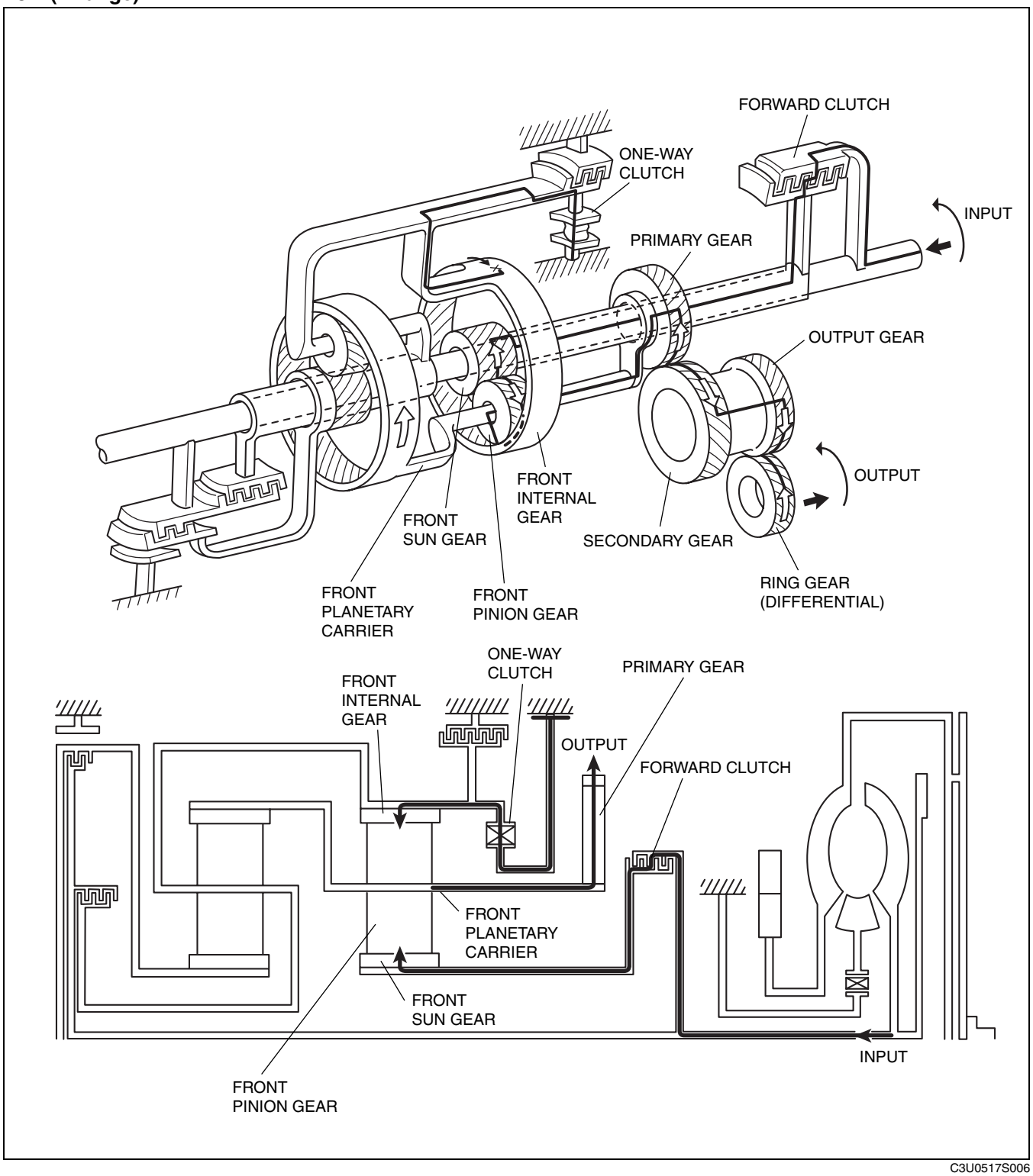
Component description

Component	Function
Forward clutch	• Transmits the input torque from the turbine shaft to the front sun gear. • Operates in the forward range of the first, second, or third gear position.
3-4 clutch	• Transmits the input torque from the turbine shaft to the rear planetary carrier. • Operates in the forward range of the third or fourth gear position.
Reverse clutch	• Transmits the input torque from the turbine shaft to the rear sun gear. • Operates when the vehicle is backing up.
2-4 brake band	• Locks rotation of the reverse drum and fixes the rear sun gear. • Operates in the second or fourth gear position.
Low and reverse brake	• Fixes the rotation of the front internal gear. • Operates when the vehicle is backing up or in the first gear position (M range 1GR).
One-way clutch	• Locks the counterclockwise rotation of the front internal gear in the first gear position.
Planetary gear	• The planetary gear functions as a transmission due to the engagement/ disengagement of clutches and/or brakes, converts the transmitted driving force of the turbine shaft and transmits it to the output gear.

Note

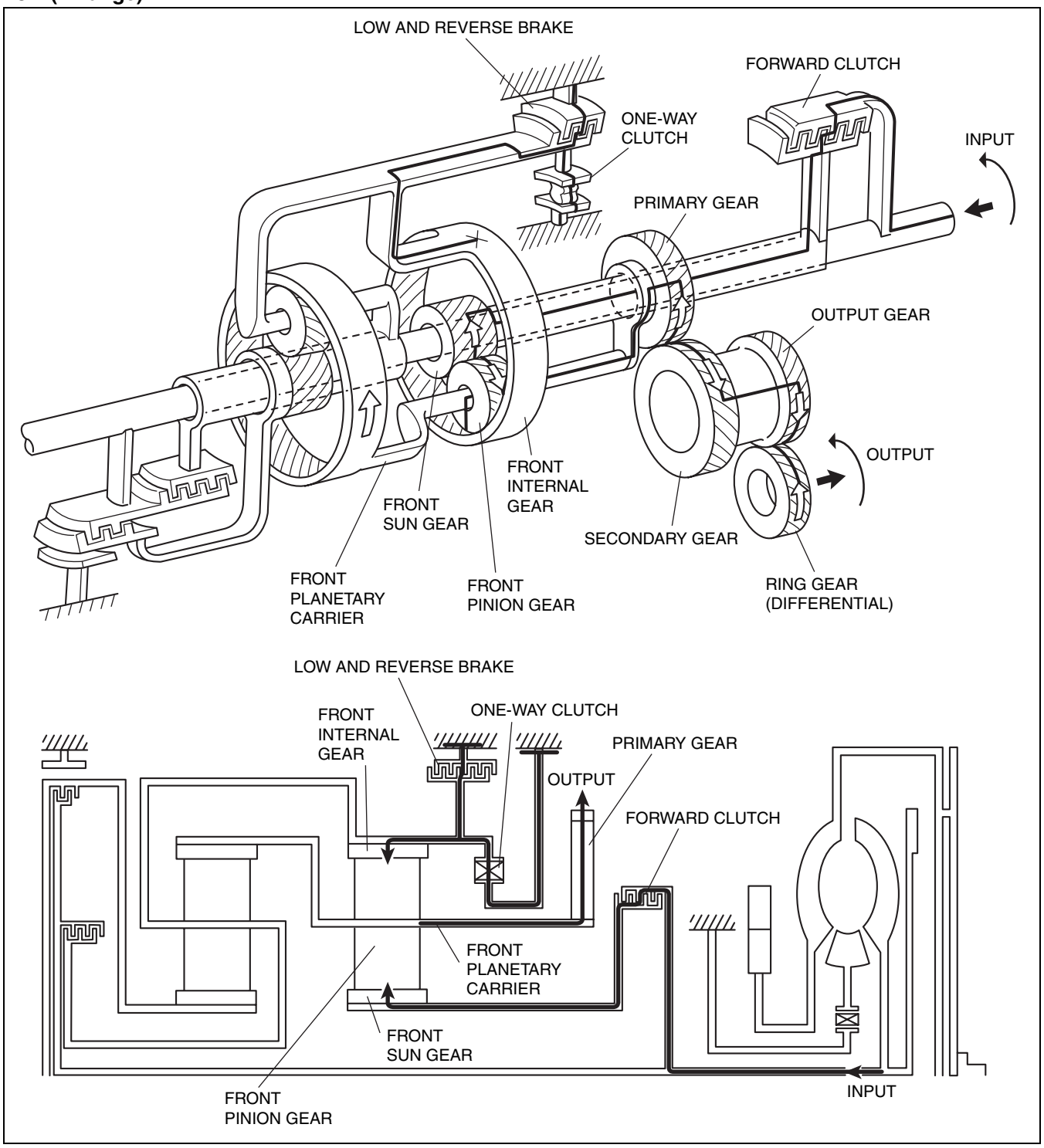
- All directions of rotation are viewed from the torque converter.

1GR (D range)



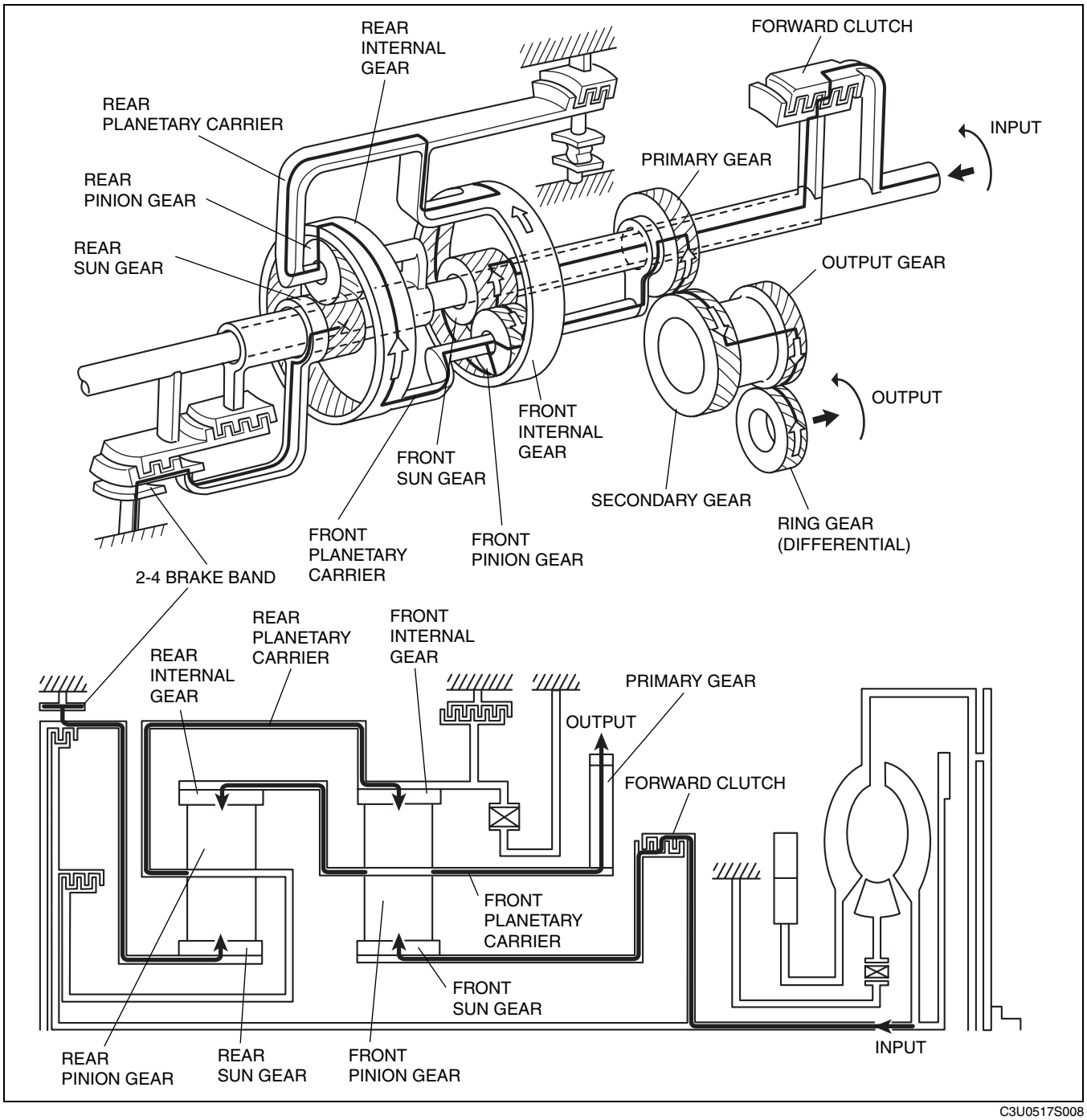
C3U0517S006

1GR (M range)



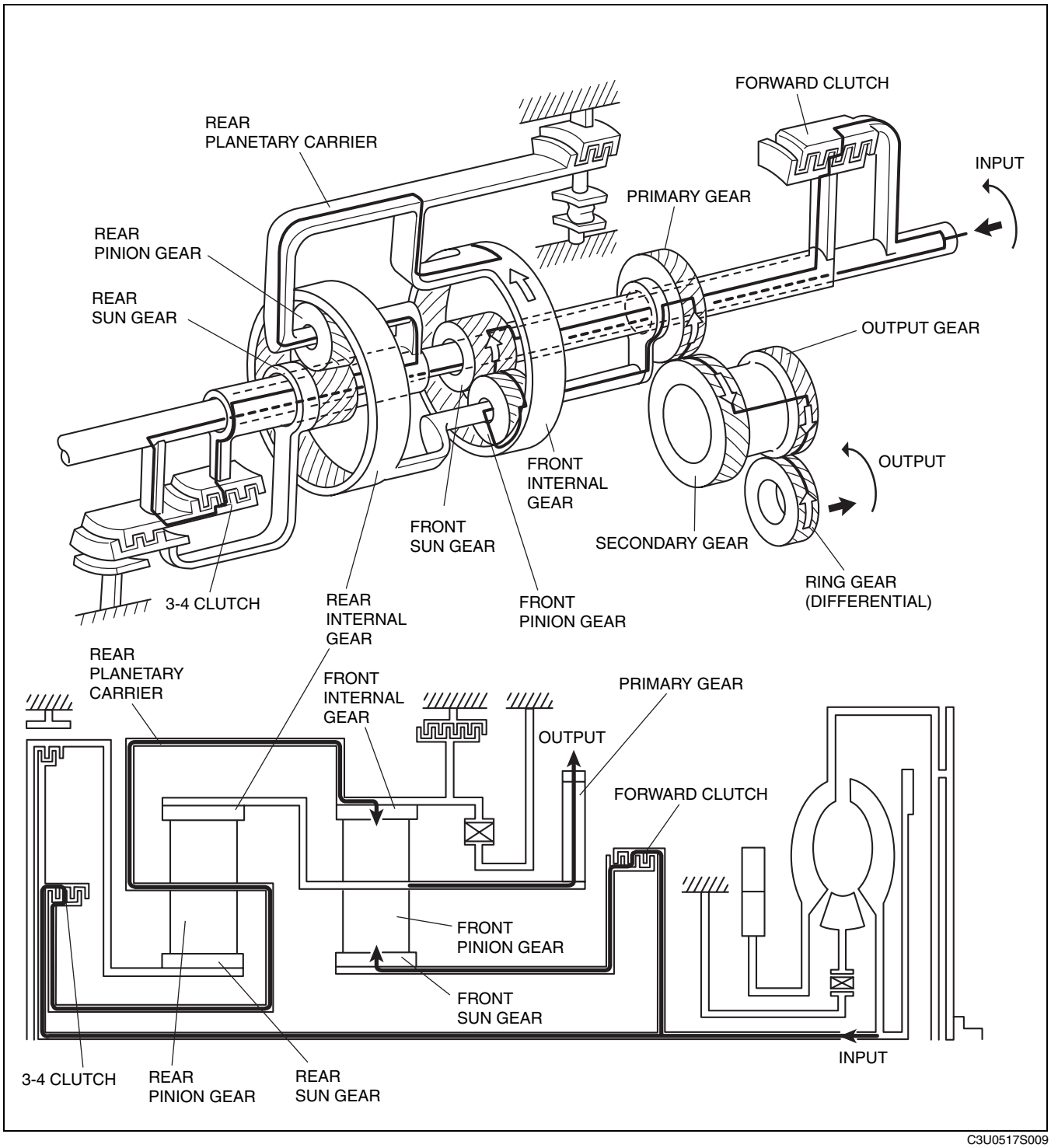
C3U0517S007

2GR



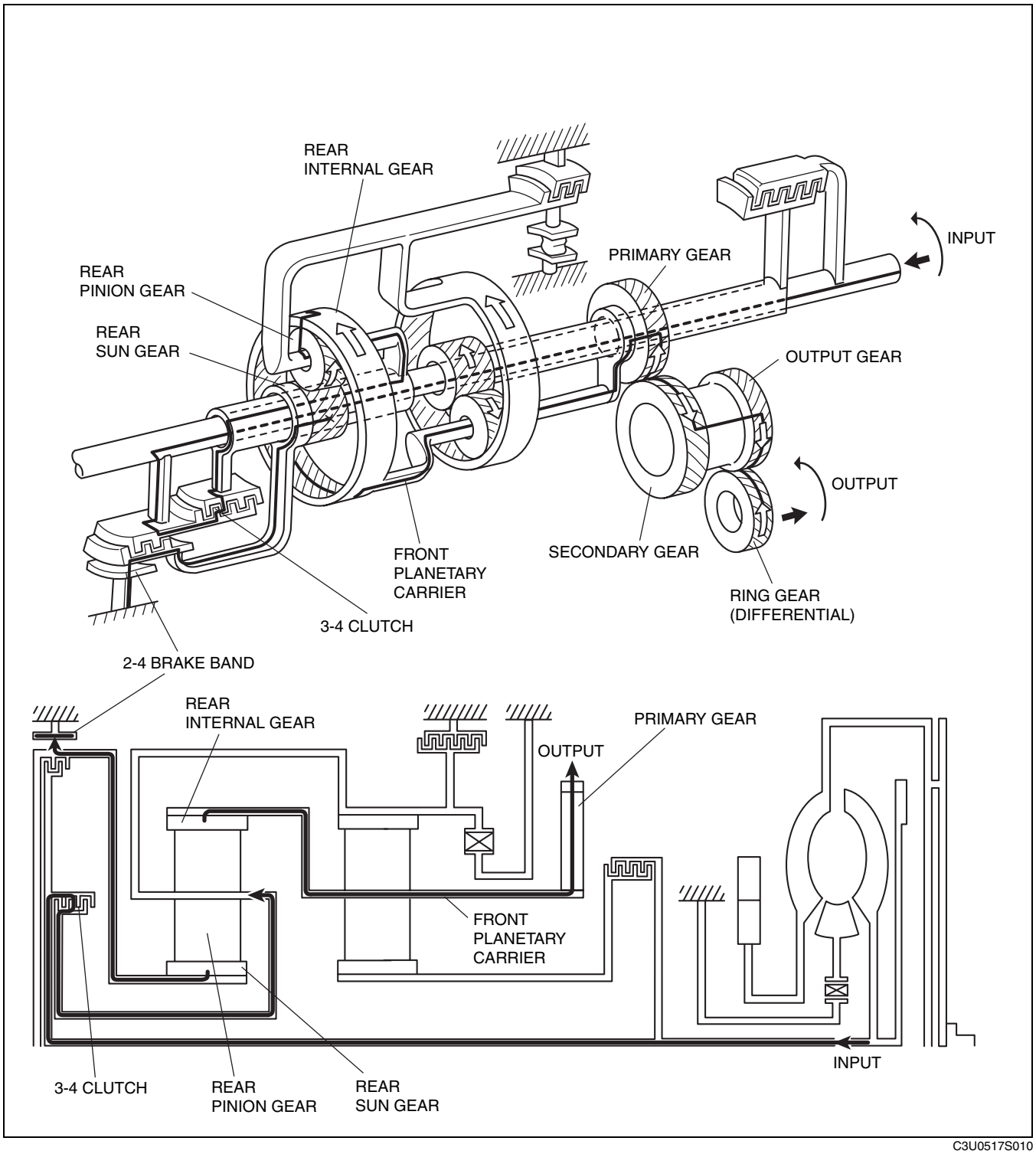
C3U0517S008

3GR



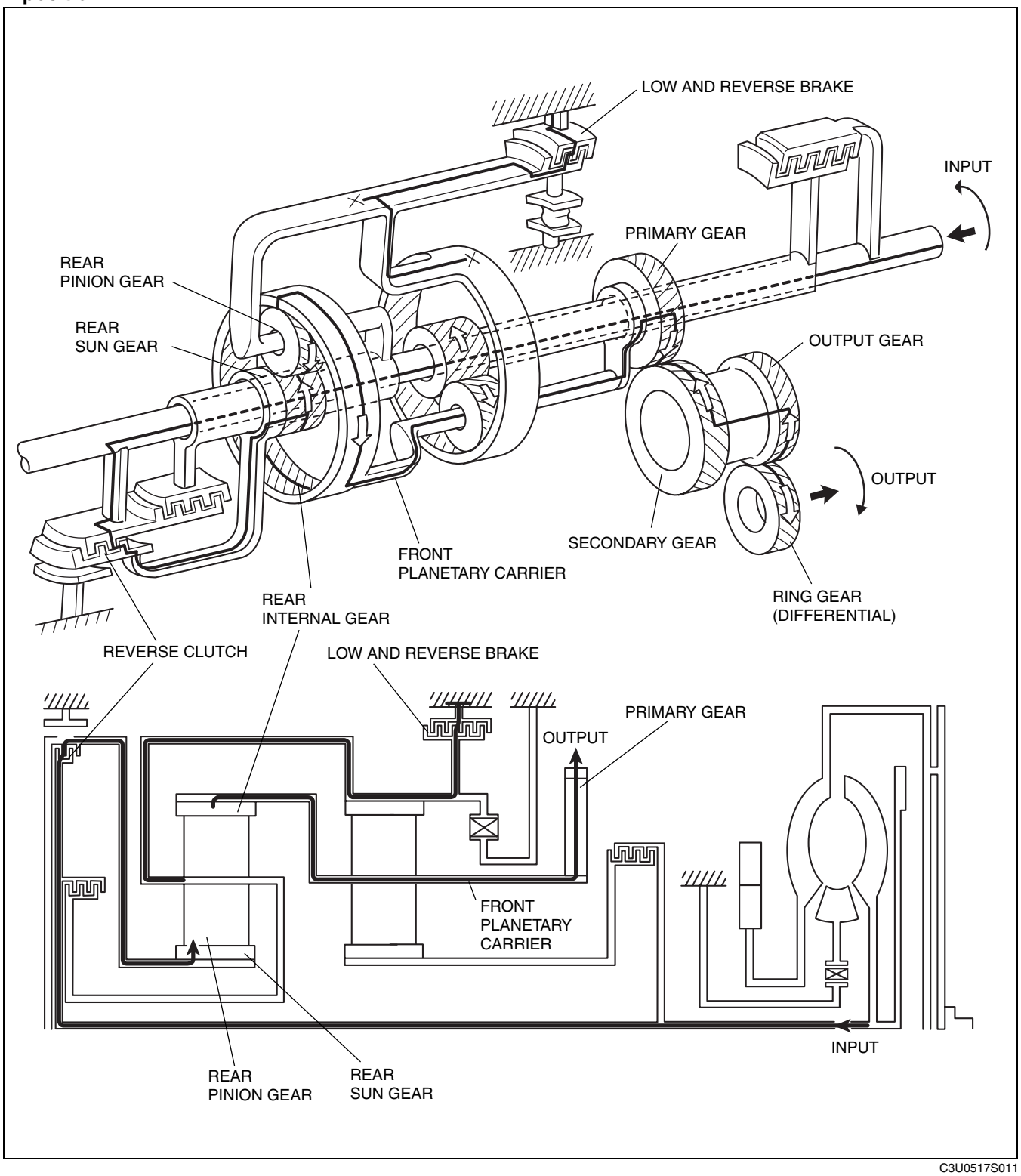
C3U0517S009

4GR



C3U0517S010

R position



C3U0517S011

CENTRIFUGAL BALANCE CLUTCH OUTLINE [FN4A-EL]

EPU051719500S01

- A centrifugal balance clutch mechanism, which cancels the centrifugal oil pressure, has been adopted to improve clutch control.
- A bonded seal piston (press-worked component of a piston and a seal) has been adopted for each clutch and brake to reduce the piston size and weight.

CENTRIFUGAL BALANCE CLUTCH STRUCTURE [FN4A-EL]

EPU051719500S02

- The centrifugal balance clutch chambers are installed opposite the clutch chamber. The centrifugal balance clutch chambers are constantly filled with ATF from an exclusive hydraulic passage of the turbine shaft.

CENTRIFUGAL BALANCE CLUTCH OPERATION [FN4A-EL]

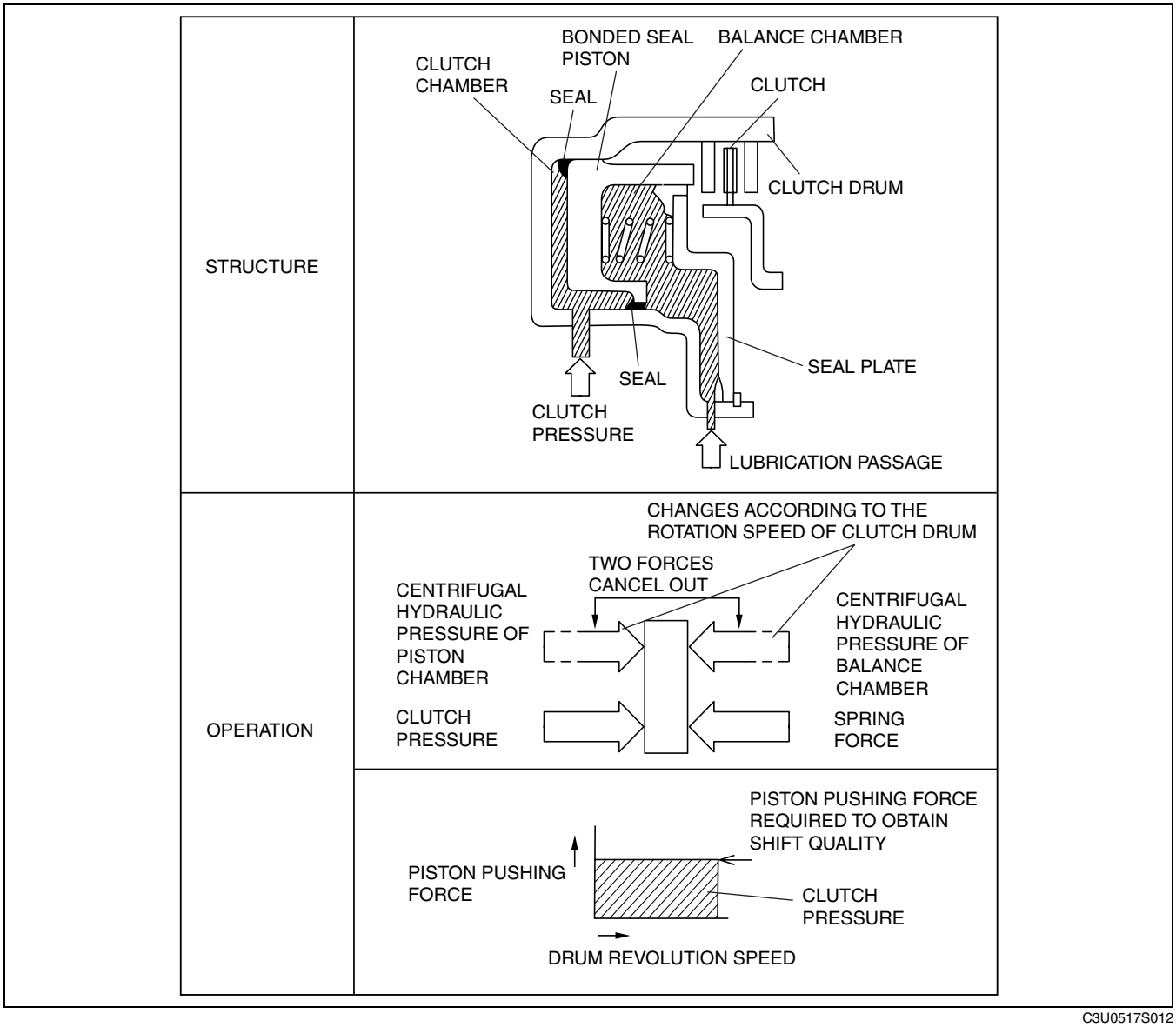
EPU051719500S03

When clutch pressure is not applied

- When the clutch drum rotates, centrifugal force acts on the residual ATF in the clutch chamber to push against the piston. However, centrifugal force also acts on the ATF filling the centrifugal balance clutch chamber to push back the piston. As a result, the two forces are cancelled out and the piston remains stationary, thus preventing clutch engagement.

When clutch pressure is applied

- When clutch pressure is applied to the clutch chamber, the clutch pressure overcomes the oil pressure and spring force in the opposite centrifugal balance clutch chamber, and pushes the piston to engage the clutches. Because the centrifugal force acting on the clutch pressure in the clutch chamber is canceled by another centrifugal force acting on the ATF filling the centrifugal balance clutch chamber, the influence of the centrifugal force created by the clutch drum revolution speed is eliminated. As a result, stable piston pushing force is obtained in all rotation ranges, and smoother shifts can be made.

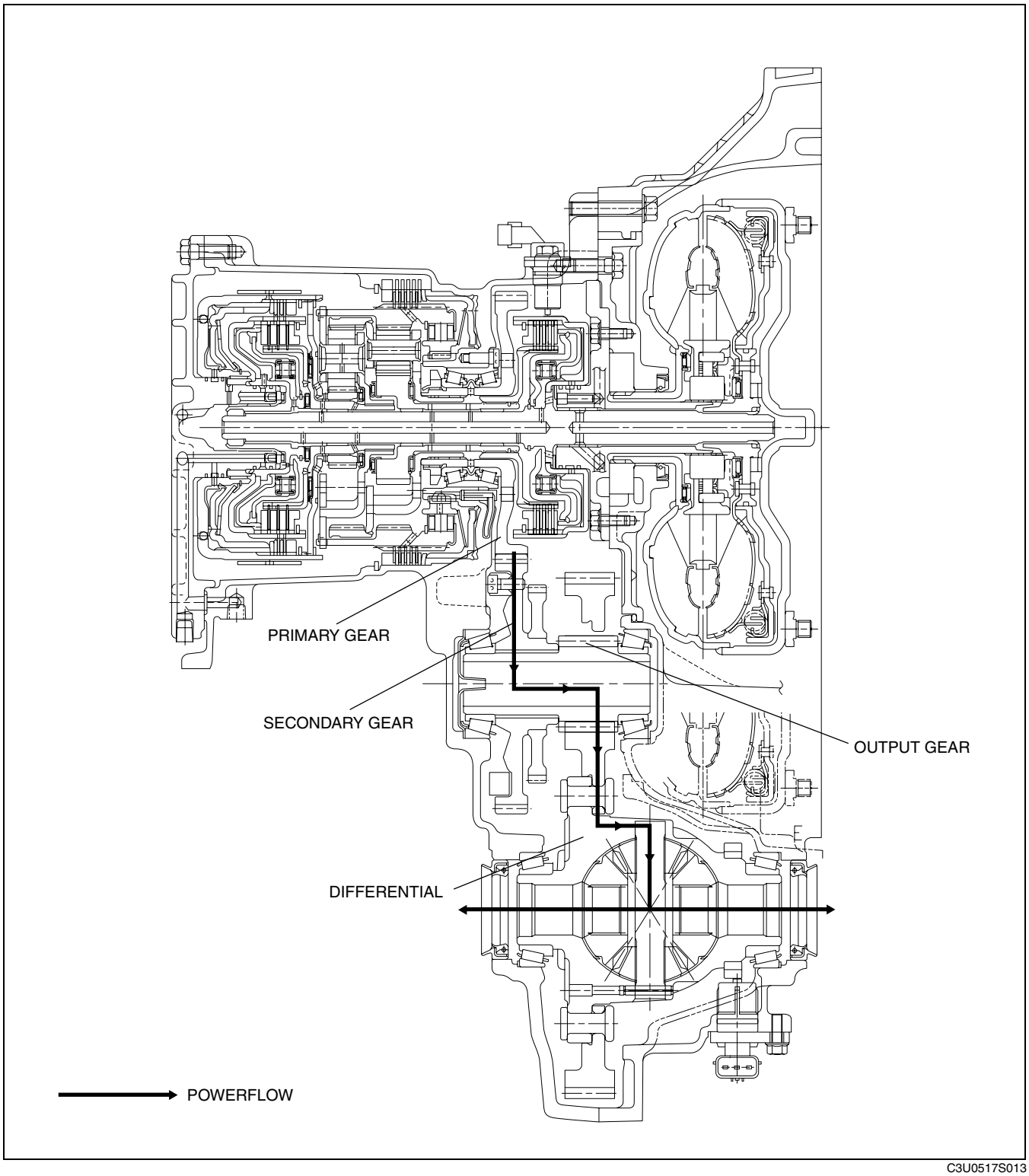


C3U0517S012

OUTPUT GEAR OUTLINE [FN4A-EL]

EPU051719204S01

- The two-step final drive mechanism has been adopted by arranging the secondary gear and the output gear on the output gear shaft to miniaturize the transaxle.

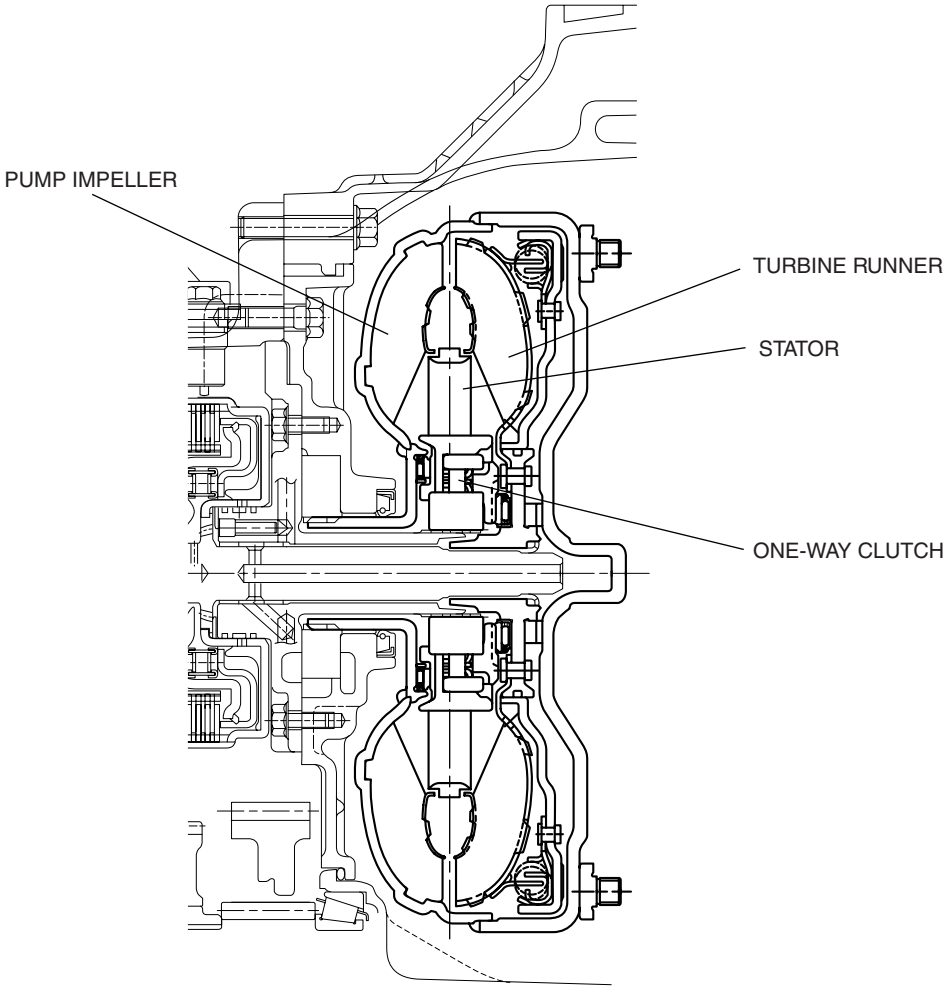


C3U0517S013

TORQUE CONVERTER OUTLINE [FN4A-EL]

EPU051719100S01

- The torque converter clutch mechanism mechanically engages the pump impeller and the turbine runner under a specified condition, and transmits the power, not through the fluid, but directly, preventing the slip loss of the torque converter.
- The torque converter has obtained sufficient transaxle efficiency and torque converting ratio that matches the output characteristic of each engine.

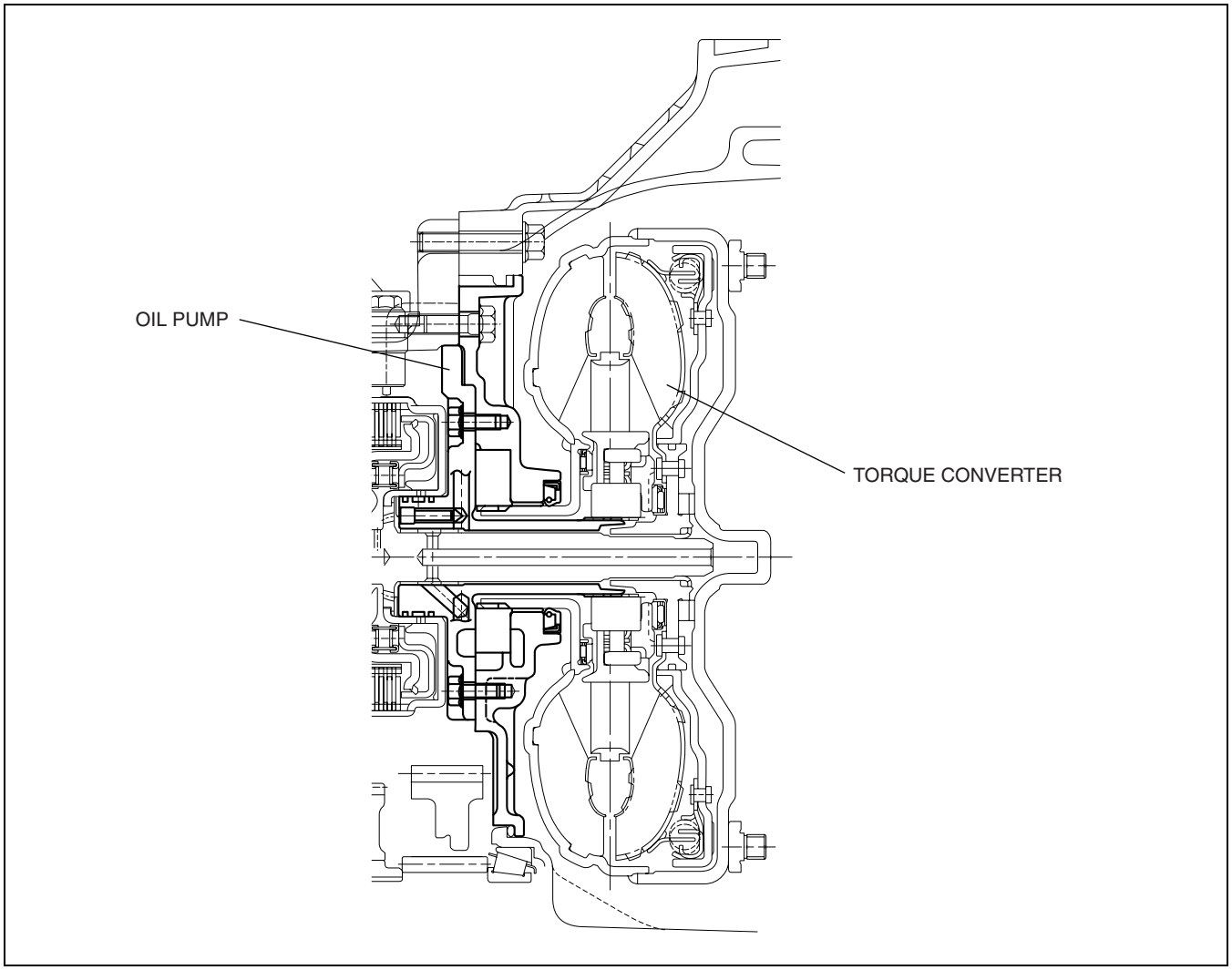


EPU517ZS3016

OIL PUMP OUTLINE [FN4A-EL]

EPU051719220S01

- The light-weight, compact, and quiet trochoid gear type oil pump has been adopted to reduce the pump driving torque.
- The direct drive type oil pump has been adopted and placed behind the torque converter.

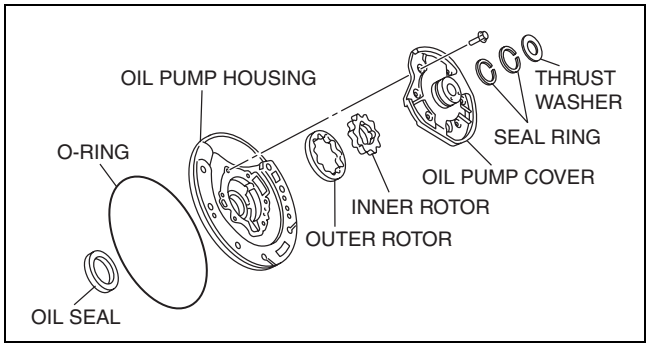


C3U0517S015

OIL PUMP STRUCTURE [FN4A-EL]

EPU051719220S02

- The outer rotor and the inner rotor are installed in the oil pump housing.
- The inner rotor in the oil pump housing is driven by the torque converter.

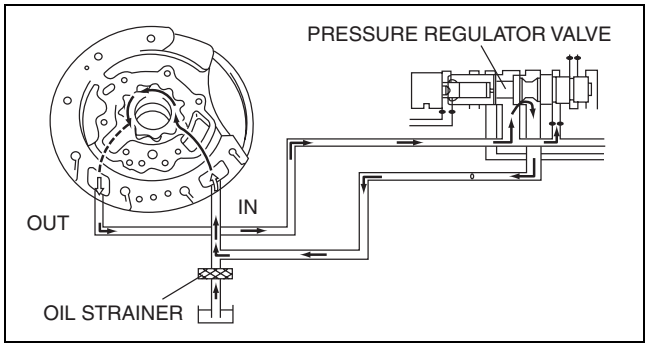


C3U0517S016

OIL PUMP OPERATION [FN4A-EL]

- When the inner rotor in the oil pump rotates, the ATF is drawn to the oil pump and then discharged from the oil pump. The discharge amount is proportional to the rotating speed of the torque converter. The ATF discharge amount is controlled by the pressure regulator valve and the pressure control solenoid.

EPU051719220S03

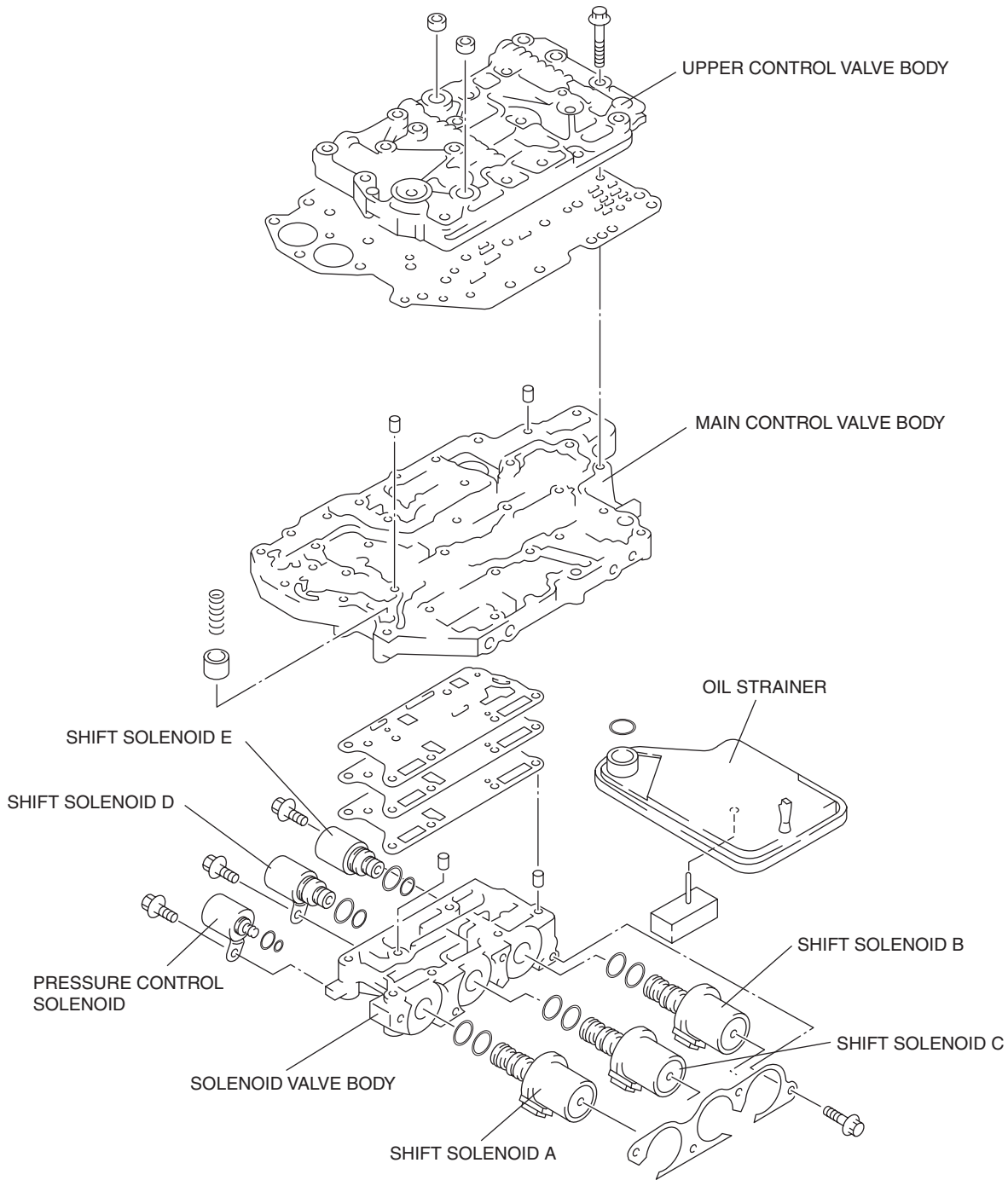


C3U0517S017

CONTROL VALVE BODY OUTLINE [FN4A-EL]

EPU051721100S01

- The control valve body is composed of three bodies: the upper control valve body, main control valve body, and the solenoid control valve body.
- Because the clutch engagement pressure is controlled electronically, the hydraulic circuits are simplified, the valve types are reduced, and the control valve body is miniaturized.
- The nonwoven fabric oil strainer is installed in the control valve body to prevent contamination.

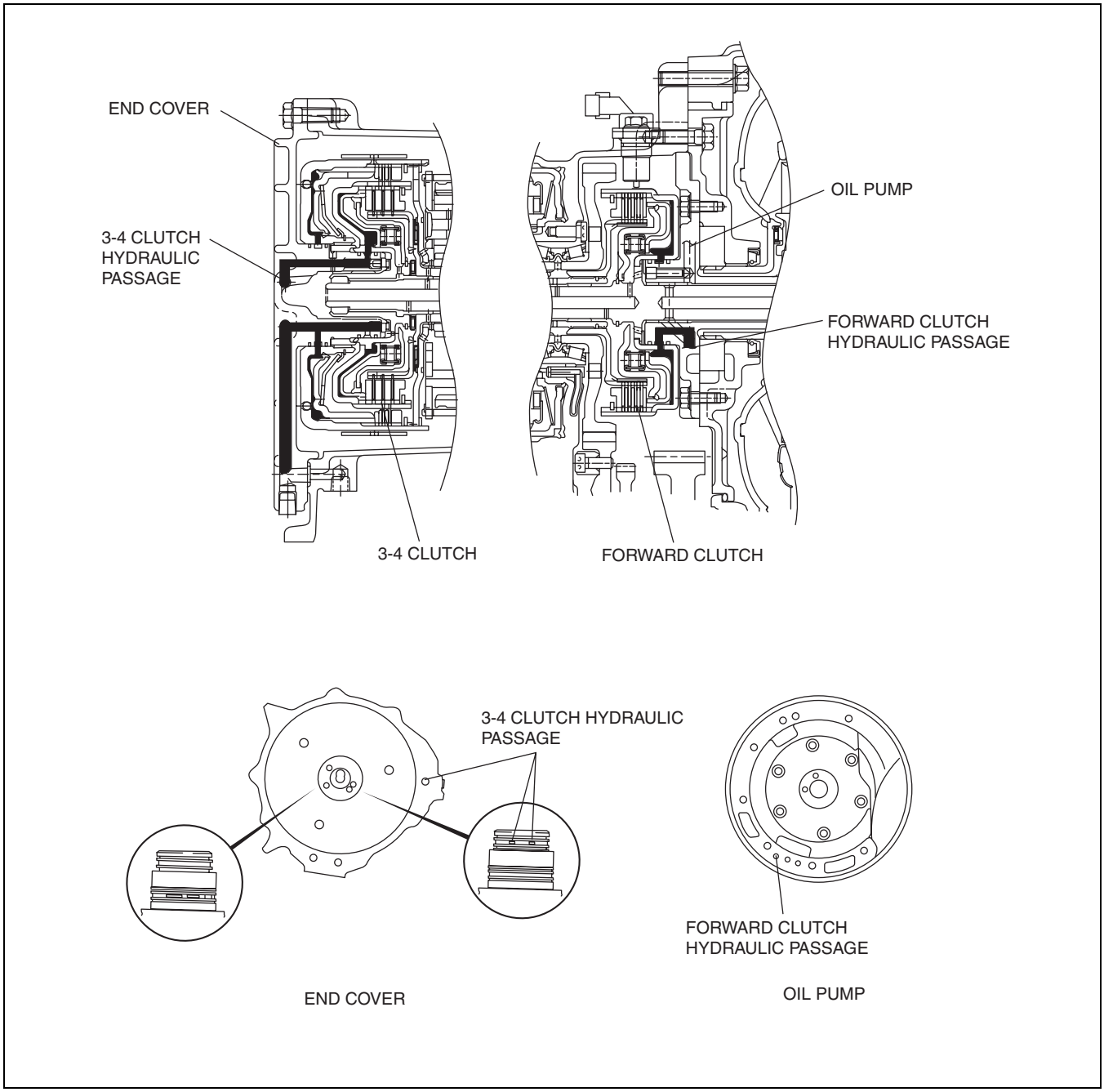


C3U0517S018

FORWARD CLUTCH, 3-4 CLUTCH HYDRAULIC CIRCUIT OUTLINE [FN4A-EL]

EPU051719500S04

- By designing exclusive passages for the forward clutch and the 3-4 clutch in the transaxle case, via the oil pump and end cover the hydraulic pressure passages are shortened and control during clutch engagement is improved.



C3U0517S019

TRANSAXLE RANGE (TR) SWITCH FUNCTION [FN4A-EL]

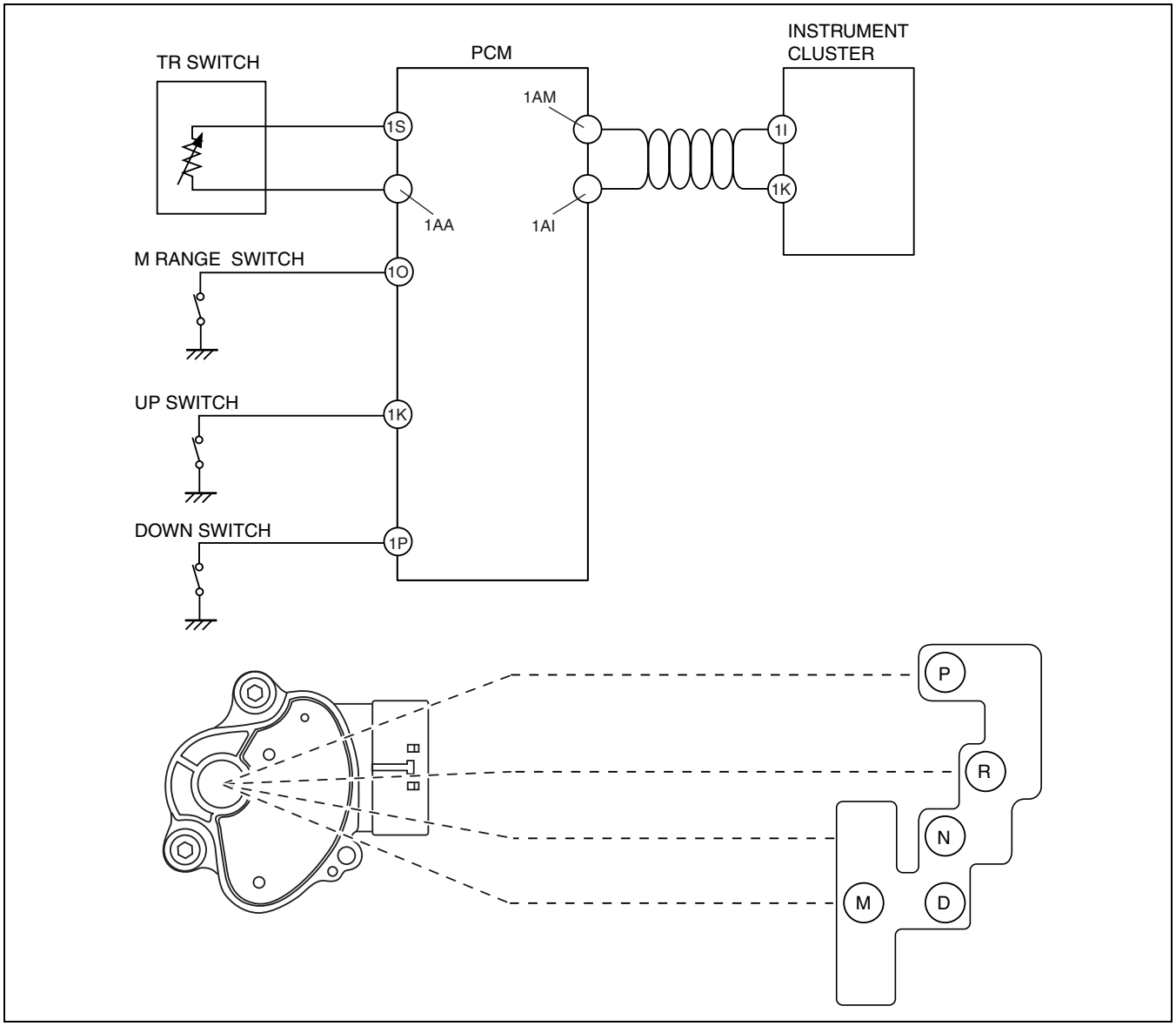
EPU051719200S01

- The transaxle range switch detects the selector lever position and sends a signal to the PCM and the instrument cluster.

TRANAXLE RANGE (TR) SWITCH CONSTRUCTION/OPERATION [FN4A-EL]

EPU051719200S02

- A variable resistor type switch has been adopted for the transaxle range switch.
- Because the transaxle range switch and the selector lever are connected by the selector cable, the transaxle range switch indicates a specified resistance according to selector lever operation and from this the PCM determines the selector lever position. The corresponding signal are sent from the PCM to other related parts.



C3U0517S014

VEHICLE SPEED SENSOR (VSS) FUNCTION [FN4A-EL]

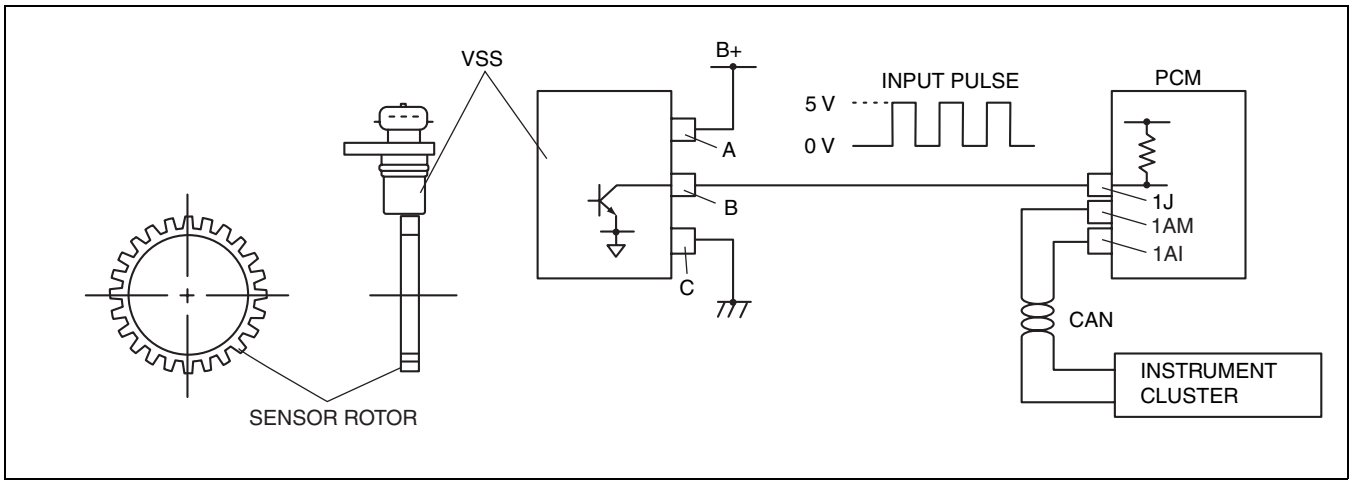
EPU051719200S03

- The VSS is located in the converter housing with clearance between it and the sensor rotor in the differential case, and detects the differential rotating speed.

VEHICLE SPEED SENSOR (VSS) CONSTRUCTION/OPERATION [FN4A-EL]

EPU051719200S04

- The VSS is a GMR element type. A 24-pulse signal is generated per rotation of the sensor rotor and the VSS sends this signal to the PCM.
- Consists of an IC in which a giant magneto resistive (GMR) element and signal processing circuit have been integrated, and a magnet. Signal reliability has been improved with the adoption of the GMR element resulting in the signal amplitude being wider compared to the hall element.
- Signal detection uses the special characteristics of GMR to change the electrical resistance corresponding to the magnetic field.
- The size (GMR output) of the magnetic field detected by the GMR element is changed into short waves as a sensor output signal at the signal processing circuit.
- The PCM performs EC-AT control based on the VSS and throttle position sensor signals.
- The PCM also outputs the vehicle speed signal to the instrument cluster.



C3U0517S020

INPUT/TURBINE SPEED SENSOR FUNCTION [FN4A-EL]

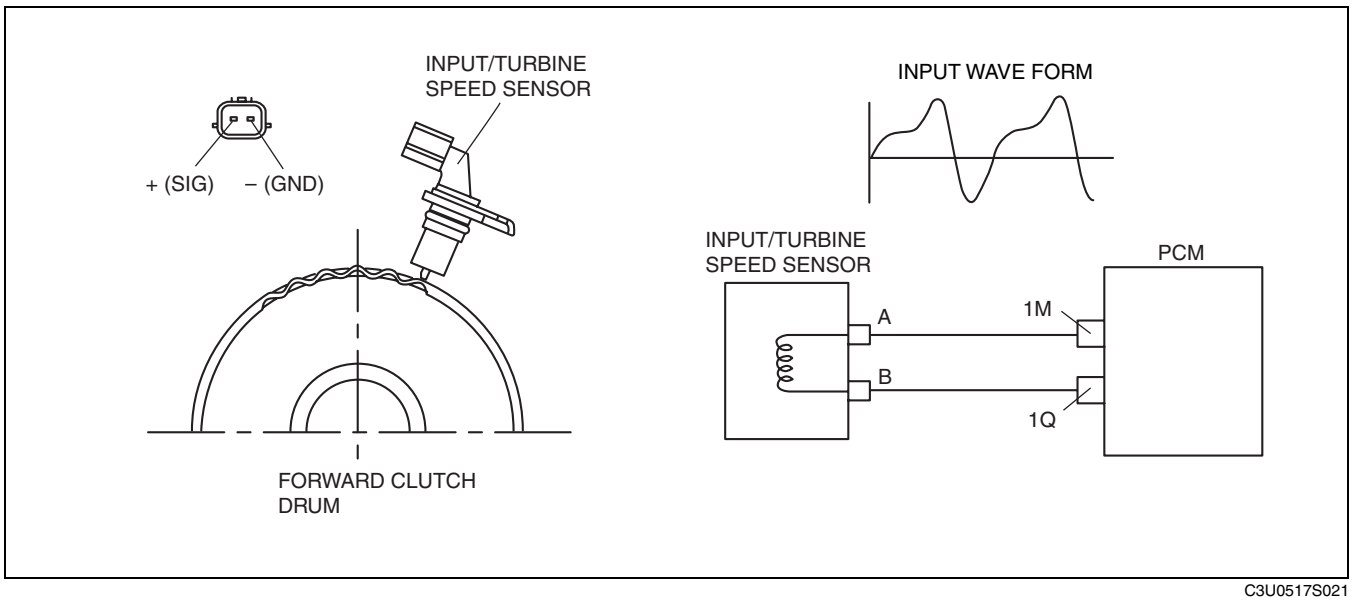
EPU051719200S05

- The input/turbine speed sensor is located in the transaxle case with clearance between it and the forward clutch drum, and detects the rotating speed of the forward clutch drum (turbine).

INPUT/TURBINE SPEED SENSOR CONSTRUCTION/OPERATION [FN4A-EL]

EPU051719200S06

- The input/turbine speed sensor is a magnetic pickup type. A 32-pulse signal is generated per rotation of the forward clutch drum, and input to the PCM.
- The PCM detects the shift start and end timing according to the signal from the input/turbine speed sensor, and performs detailed control, improving shift quality.



C3U0517S021

TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR FUNCTION [FN4A-EL]

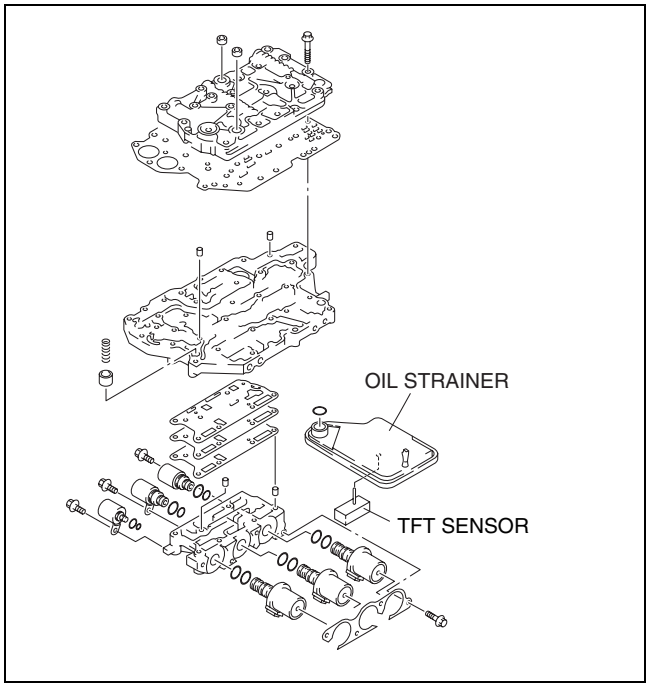
EPU051719200S07

- The TFT sensor, which is installed in the oil strainer, detects the ATF temperature in the oil pan, and sends the control signal to the PCM. The PCM controls the driving pattern selection and the TCC based on the signal from the TFT sensor.

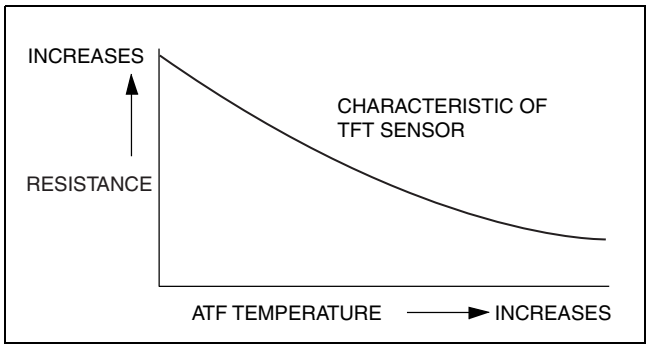
TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR CONSTRUCTION/OPERATION [FN4A-EL]

EPU051719200S08

- The TFT sensor is a thermistor type and the resistance changes according to the ATF temperature.
- The characteristic of the resistance is as shown in the figure below: when the ATF temperature increases, the resistance decreases, and when the ATF temperature decreases, the resistance increases.



C3U0517S022



C3U0517S023

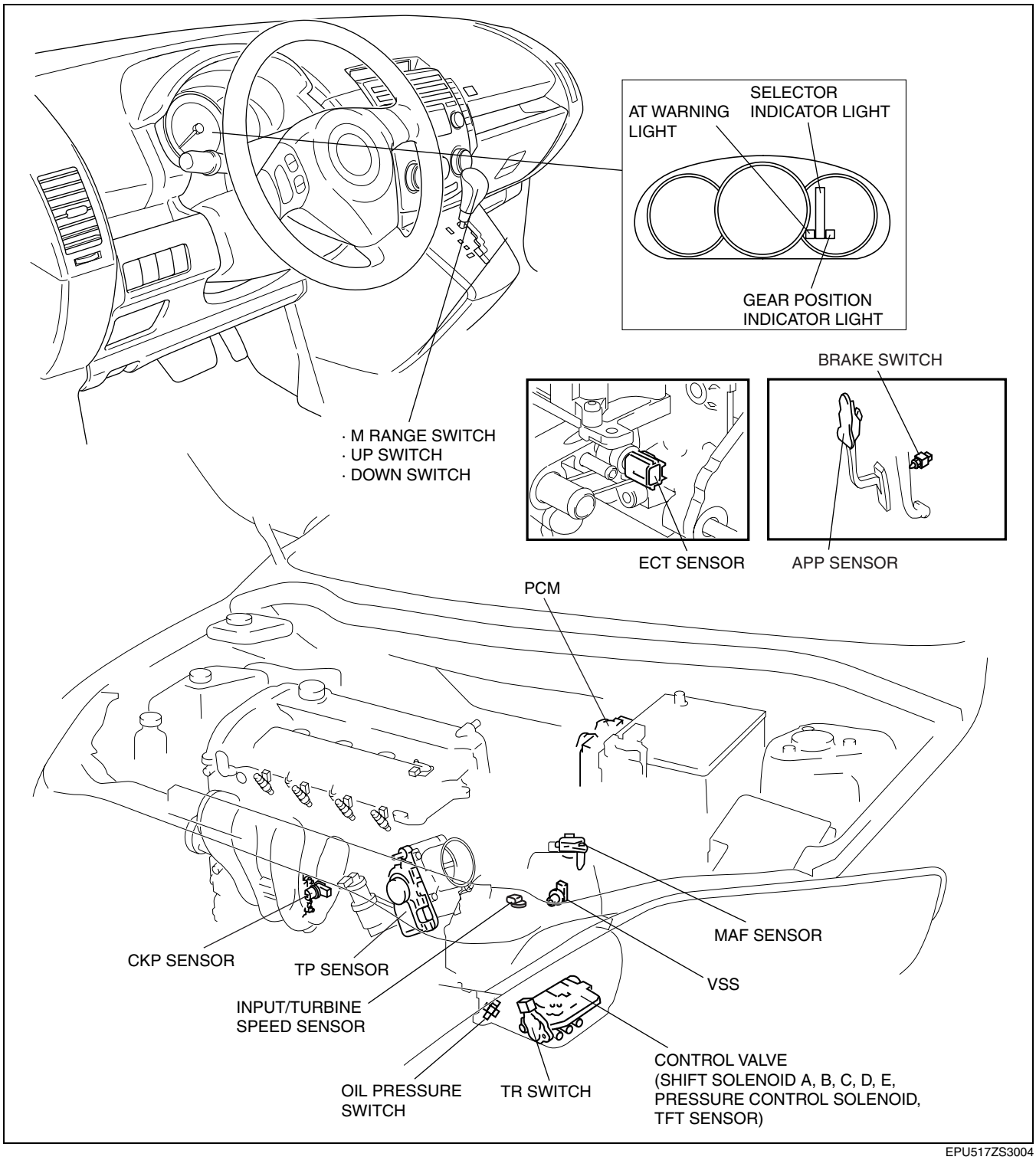
ELECTRONIC CONTROL SYSTEM OUTLINE [FN4A-EL]

EPU051718880S01

- A PCM that is integrated with the PCM for engine control has been adopted for transaxle control. The PCM outputs the control signal to the engine and the transaxle according to the signal from each sensor and/or switch.
- Due to the adoption of the line pressure adjusting control by the linear type pressure control solenoid and the clutch engaging pressure control by duty-cycle type shift solenoids A, B, and C, excellent shift quality is obtained.

ELECTRONIC CONTROL SYSTEM CONSTRUCTION [FN4A-EL]

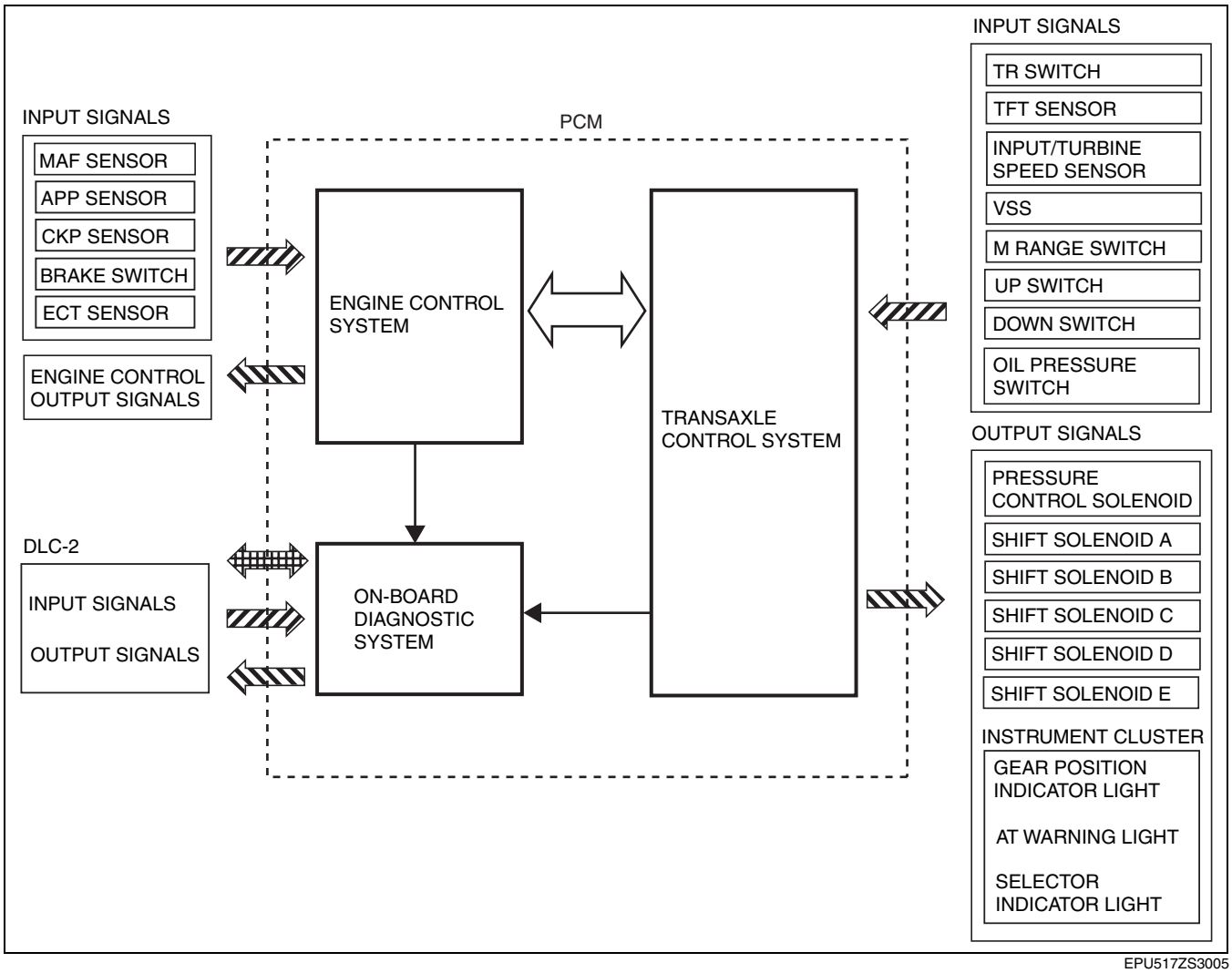
EPU051718880S02



EPU517ZS3004

ELECTRONIC CONTROL SYSTEM BLOCK DIAGRAM [FN4A-EL]

EPU051718880S03



EPU517ZS3005

ELECTRONIC CONTROL ITEMS AND CONTENTS [FN4A-EL]

EPU051718880S04

Item	Content
Line pressure control	• Using linear type pressure control solenoids, adjusts line pressure according to engine load condition and vehicle driving condition.
Shift control	• Detects engine load condition and vehicle speed, and switches to the most suitable gear position according to the preset shift diagram. • In D range, automatically switches between POWER and NORMAL modes according to accelerator pedal depressing speed.
Clutch pressure direct control (Direct electric shift control)	• With duty-cycle type shift solenoids A, B, and C, directly performs electronic control for clutch engagement pressure according to engine load condition and vehicle driving condition.
Feedback control	• Performs real-time feedback correction for clutch engagement pressure to achieve target shifts. • Performs optimal correction for clutch engagement pressure to reduce changes in engine performance and/or elapsed transaxle.
Engine-transaxle total control	• Optimally controls engine output torque when shifting. • Operates optimal clutch engagement pressure corresponding to engine output torque.
TCC control	• According to preset TCC point, performs TCC operation via smooth TCC.
Slope mode control	• Changes the shift point to prevent frequent shifting up/down when climbing hills.
On-board diagnostic system	• Detects and/or memorizes failure of input/output part and transaxle condition.
Manual mode shift control	• Shifts to selected gear position by manual shifting of the selector lever forward and back.

COMPONENT DESCRIPTIONS (ELECTRONIC CONTROL) [FN4A-EL]

EPU051718880S05

Part name			Function
Input system	M range switch		• Selects driving modes (M range) and changes driving patterns.
	Up switch		• Detects shift up request.
	Down switch		• Detects shift down request.
	TR switch		• Detects selector lever ranges/positions.
	APP sensor		• Detects the accelerator pedal depressing amount.
	Input/turbine speed sensor		• Detects the forward clutch drum (input) revolution speed.
	Oil pressure switch		• Detects the forward clutch pressure.
	VSS		• Detects the differential gear case (output) revolution speed.
	Brake switch		• Detects the use of service brake.
	TFT sensor		• Detects the ATF temperature.
	ECT sensor		• Detects the engine coolant temperature.
	CKP sensor		• Detects the engine revolution speed.
	MAF sensor		• Detects the intake air amount.
Output system	Linear type	Pressure control solenoid	• Adjusts the line pressure.
	Duty-cycle type	Shift solenoid A	• Controls the clutch engagement pressure.
		Shift solenoid B	• Controls the clutch engagement pressure.
		Shift solenoid C	• Controls the clutch engagement pressure.
	ON/OFF type	Shift solenoid D	• Switches the hydraulic passages for bypass valve and 3-4 shift valve.
		Shift solenoid E	• Switches the hydraulic passages for low and reverse shift valve, TCC, and control valve.
	AT warning light		• Illuminates when failure is detected by diagnosis function.
	Speedometer signal		• Outputs the vehicle speed signal to speedometer.

INPUT/OUTPUT SIGNAL AND RELATED CONTROLS [FN4A-EL]

EPU051718880S06

Component	Control item								
	Line pressure control	Shift control	Clutch pressure direct control (Direct electric shift control)	Feedback control	Engine-transaxle total control	Torque converter clutch control	Slope mode control	On-board diagnostic function	Manual mode shift control
Input									
M range switch		X	X						X
Up switch		X	X						X
Down switch		X	X						X
TR switch	X	X	X						
APP sensor	X	X	X			X		X	
Input/turbine speed sensor	X	O	X	X		X		X	
VSS	X	X	X			X	X	X	X
Brake switch						X			
TFT sensor	X	X	X	X		X		X	
ECT sensor						X		X	
CKP sensor	X		X		X	X		X	
MAF sensor	X		X	X	X		X	X	
Oil pressure switch		X	X						
Output									
Pressure control solenoid	X							X	
Shift solenoid A		X	X	X		X	X	X	

Component	Control item								
	Line pressure control	Shift control	Clutch pressure direct control (Direct electric shift control)	Feedback control	Engine-transaxle total control	Torque converter clutch control	Slope mode control	On-board diagnostic function	Manual mode shift control
Shift solenoid B		X	X	X				X	
Shift solenoid C		X	X	X				X	
Shift solenoid D		X					X	X	
Shift solenoid E		X				X	X	X	
AT warning light		X						X	
Speedometer signal									

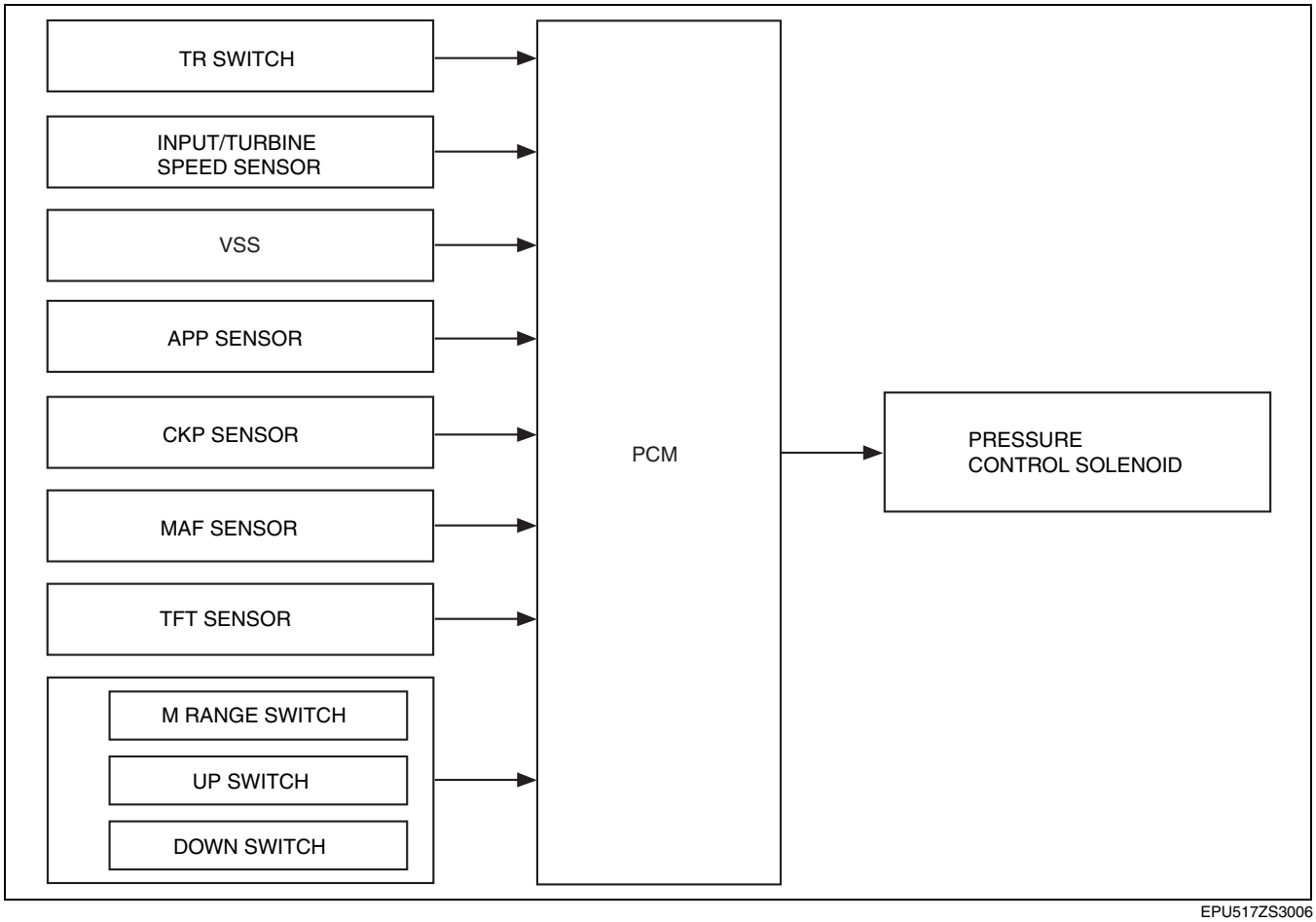
X : Available

O : Back up

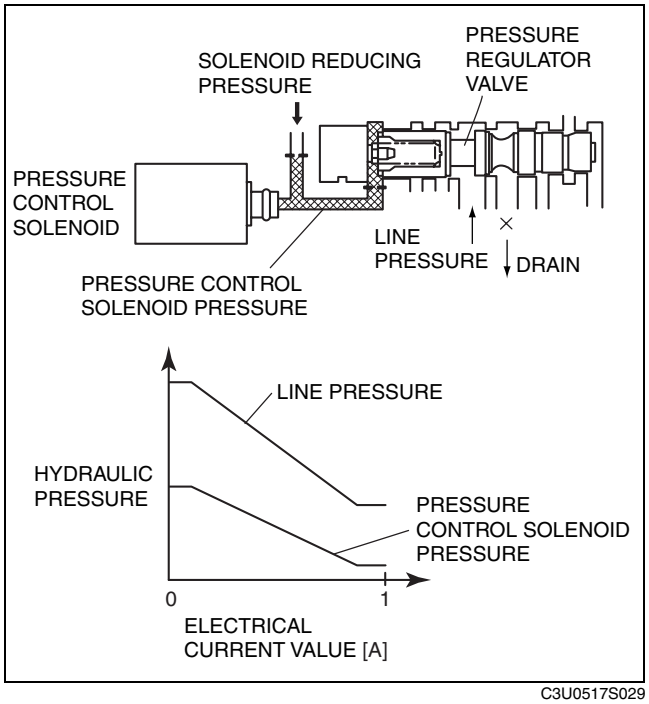
LINE PRESSURE CONTROL OUTLINE [FN4A-EL]

EPU051718880S07

- The PCM determines the optimum line pressure and drives the liner-type pressure control solenoid based on input signals in accordance with the vehicle driving conditions including the engine torque (calculated from throttle opening angle, vehicle speed, engine speed, gear position, intake air rate, and other operational parameters). As a result, the line pressure is controlled very accurately and closely.



EPU517ZS3006



C3U0517S029

PRESSURE CONTROL SOLENOID (LINEAR TYPE) OUTLINE [FN4A-EL]

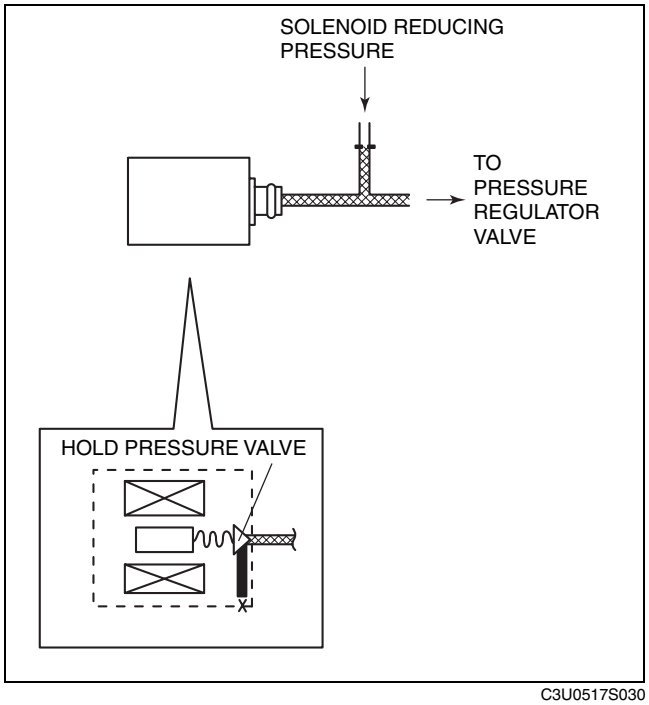
EPU051721101S01

- A pressure control solenoid with high stability in hydraulic pressure has been adopted for the line pressure control.
- Because the pressure control solenoid controls the hydraulic pressure according to the current value, the degree of freedom in control increases. The controllability is maintained even under aeration, and pressure variation can be reduced.

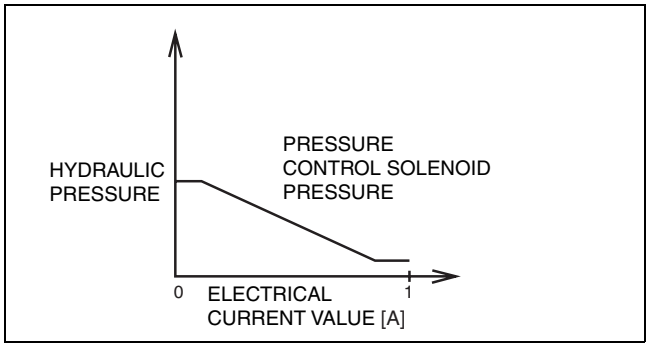
PRESSURE CONTROL SOLENOID (LINEAR TYPE) OPERATION [FN4A-EL]

EPU051721101S02

- By changing the electrical current value (0 A—1 A) inside the solenoid, the pressure control solenoid adjusts the hold power of the hold pressure valve, controlling the pressure control solenoid pressure to the prescribed hydraulic pressure.



C3U0517S030



C3U0517S031

SHIFT CONTROL STRUCTURE [FN4A-EL]

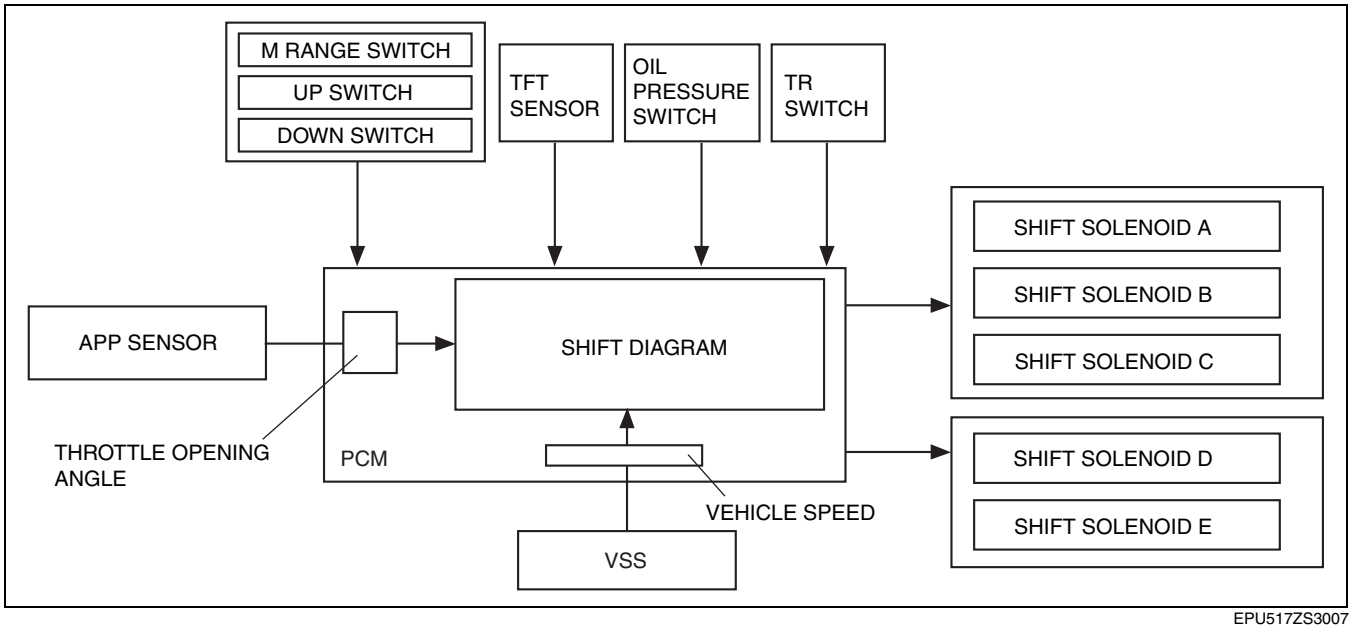
EPU051718880S08

Features

- An automatic shift system in the D range and a manual shift system have been adopted for the AT system. The automatic shift system, with automatic shifting between 1GR and 4GR. The manual shift system allows option gear position selection by manually operating the selector lever forward and back.
- In the D range, automatic shifting occurs between 1GR and 4GR. Moreover, in the M range, the specialized AT manual mode shift control is available.
  - — Shifting is controlled by the PCM which, based on range/position determination, selects and determines the shift diagram. In the D range the automatic shift diagram is followed and in the M range the manual mode shift diagram is followed.
- The TCC is engaged in D range, 4GR.
- The selector lever indicator light and the gear position indicator light are built into the instrument cluster.

Structure

System diagram



EPU517ZS3007

SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) OUTLINE [FN4A-EL]

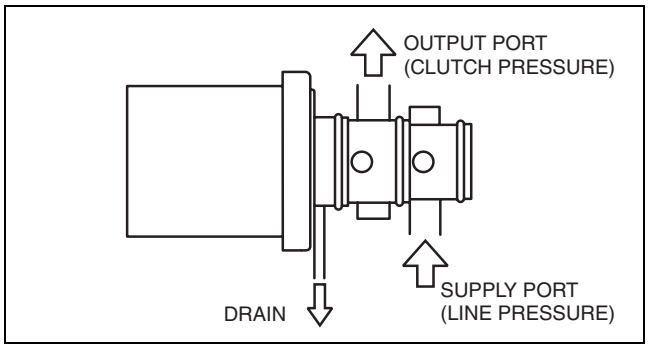
EPU051721101S03

- A clutch pressure direct control, which supplies the clutch pressure directly to each clutch and/or brake, has been adopted. A three-way duty-cycle type solenoids with excellent controllability have been adopted, to improve response.

SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) FUNCTION [FN4A-EL]

EPU051721101S04

- The duty-cycle type shift solenoid adjusts the amount of output pressure according to the signal from the PCM, and controls the pressure of each clutch.
- The duty-cycle type shift solenoid, which switches on/off at 50 Hz (20 ms cycle) and controls the output pressure, is adopted. By changing the on time ratio a cycle (0—100 %), the solenoid adjusts the time ratio of the open (supply) and close (drain), and maintains the clutch pressure at the designated hydraulic pressure. As a result, the clutch pressure rises when the duty ratio (50 Hz on time ratio) is reduced, and falls when the duty ratio is raised.



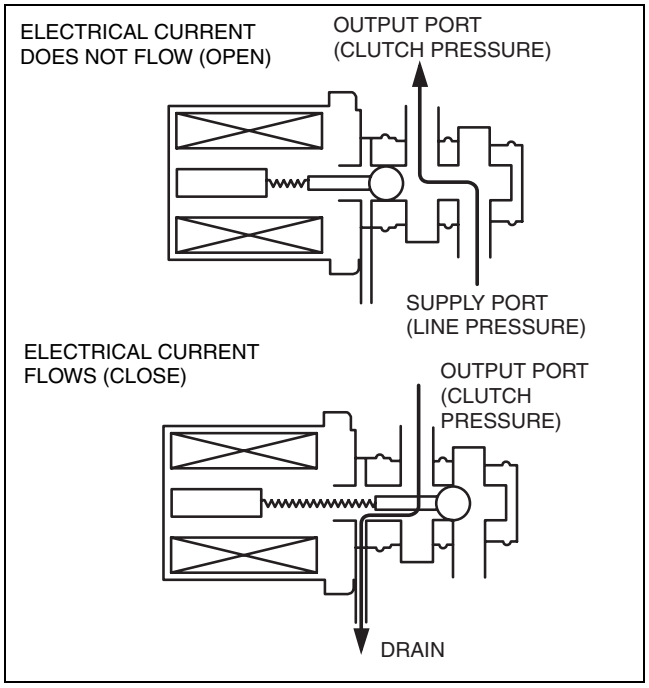
C3U0517S035

SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) OPERATION [FN4A-EL]

EPU051721101S05

Open:When the electrical current does not flow, the supply port (line pressure) in the solenoid opens and is engaged with the output port (clutch pressure). As a result, hydraulic pressure is supplied to the hydraulic passage for the clutch pressure.

Close:When the electrical current flows, the supply port (line pressure) in the solenoid closes and the output port (clutch pressure) and the drain port are engaged to drain the clutch pressure.



C3U0517S036

SHIFT SOLENOID D AND E (ON/OFF TYPE) OUTLINE [FN4A-EL]

EPU051721101S06

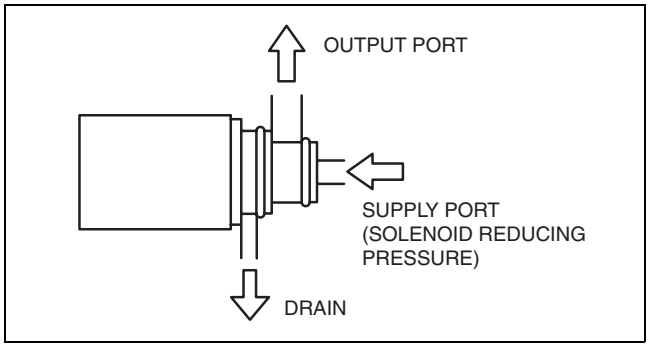
- A compact, light-weight three-way solenoid has been adopted for shift solenoids D and E to reduce consumption discharge amount.

Shift solenoid	Function
Shift solenoid D	Switches the bypass valve and 3-4 shift valve.
Shift solenoid E	Switches the low and reverse shift valve and TCC control valve.

SHIFT SOLENOID D AND E (ON/OFF TYPE) FUNCTION [FN4A-EL]

EPU051721101S07

- An on/off type solenoid valve switches the supply drain of output port according to the electrical current flow switching.



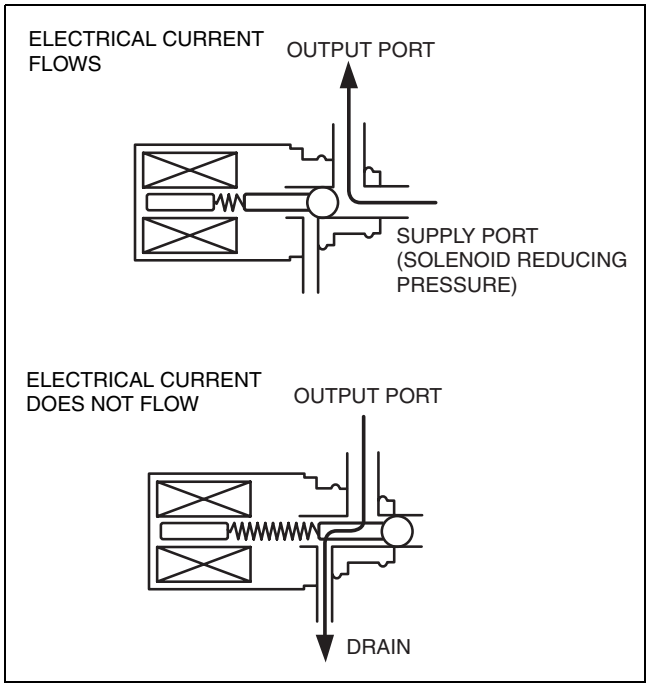
C3U0517S037

SHIFT SOLENOID D AND E (ON/OFF TYPE) OPERATION [FN4A-EL]

EPU051721101S08

On: When the electrical current flows, the output port and the supply port (solenoid reducing pressure) are engaged in the solenoid, and the output pressure becomes equivalent to the solenoid reducing pressure.

Off: When the electrical current does not flow, the output port and the drain port are engaged in the solenoid, and the output pressure is drained.



C3U0517S038

DRIVING MODE DETERMINATION OPERATION [FN4A-EL]

EPU051718880S09

D range

- When above a certain vehicle speed and the accelerator pedal depressing speed is above the preset value, the driving mode is automatically switched to POWER mode, and shifts the shift point to high speed side.
- When the ATF temperature is high or low, the mode is automatically switched to each shift pattern: when the ATF temperature is high, the TCC point is shifted to low speed side, and when the ATF temperature is low, 4GR is inhibited.

M range

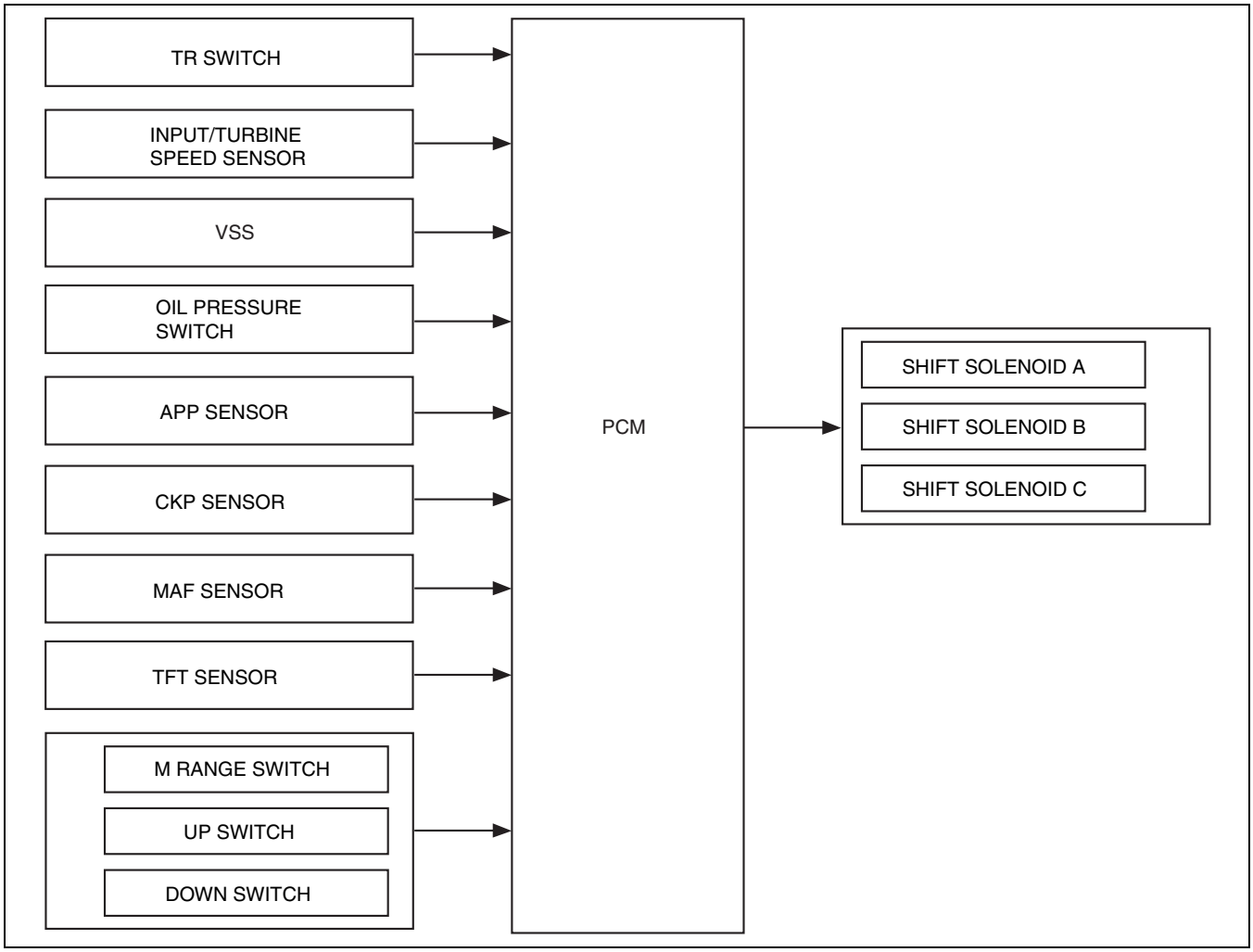
- When the selector lever is shifted over from the D to M range position, the M range switch in the selector lever component turns on, sending a manual mode command signal to the PCM which activates the manual mode shift control.

DIRECT ELECTRIC SHIFT CONTROL OUTLINE [FN4A-EL]

EPU051718880S10

- The PCM determines the optimum clutch engagement pressure and drives the duty-cycle shift solenoids based on input signals in accordance with the vehicle driving conditions including the engine torque (calculated from accelerator pedal depressing amount, vehicle speed, engine speed, gear position, intake air rate, and other operational parameters).
- By driving the duty-cycle solenoid valves, and performing the electronic control of the clutch engagement pressure directly through the PCM, minute hydraulic control, which could not be obtained by the clutch engagement pressure control with the accumulator, is obtained.

Block diagram



EPU517ZS3008

DIRECT ELECTRIC SHIFT CONTROL OPERATION [FN4A-EL]

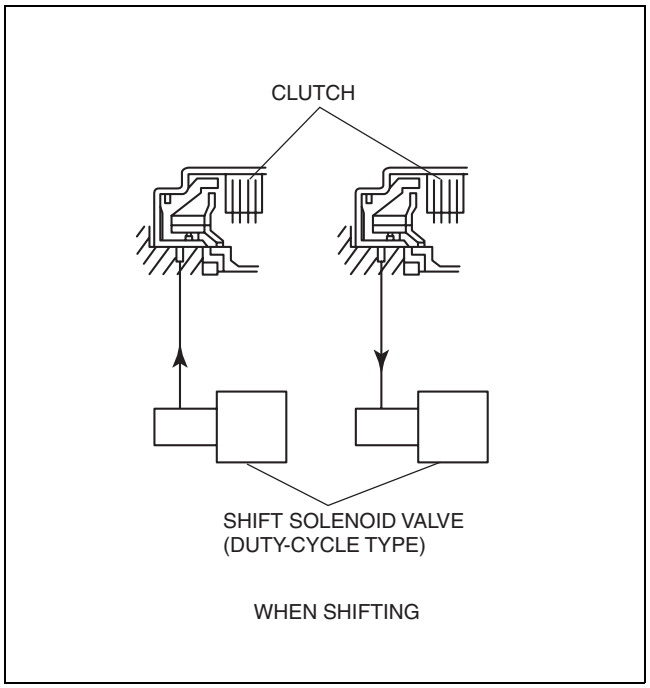
EPU051718880S11

When Shifting N→D or N→R Shift

- When shifting N→D or N→R, the pressure control solenoid is driven to control the clutch engagement pressure optimally.

Up-Down Shift

- The clutch engagement pressure is directly controlled to be optimal by the duty-cycle solenoid valves.
- When shifting 2GR→3GR, 3GR→4GR, 3GR→2GR, or 4GR→3GR, the clutch pressures of engagement side and release side are controlled simultaneously. As a result, the clutch capacities of both clutches are controlled relatively when switching the clutches. This prevents sudden increases in engine speed and clutch interlocks during shifting, realizing smooth and responsive shifting.



C3U0517S040

MANUAL MODE SHIFT CONTROL STRUCTURE [FN4A-EL]

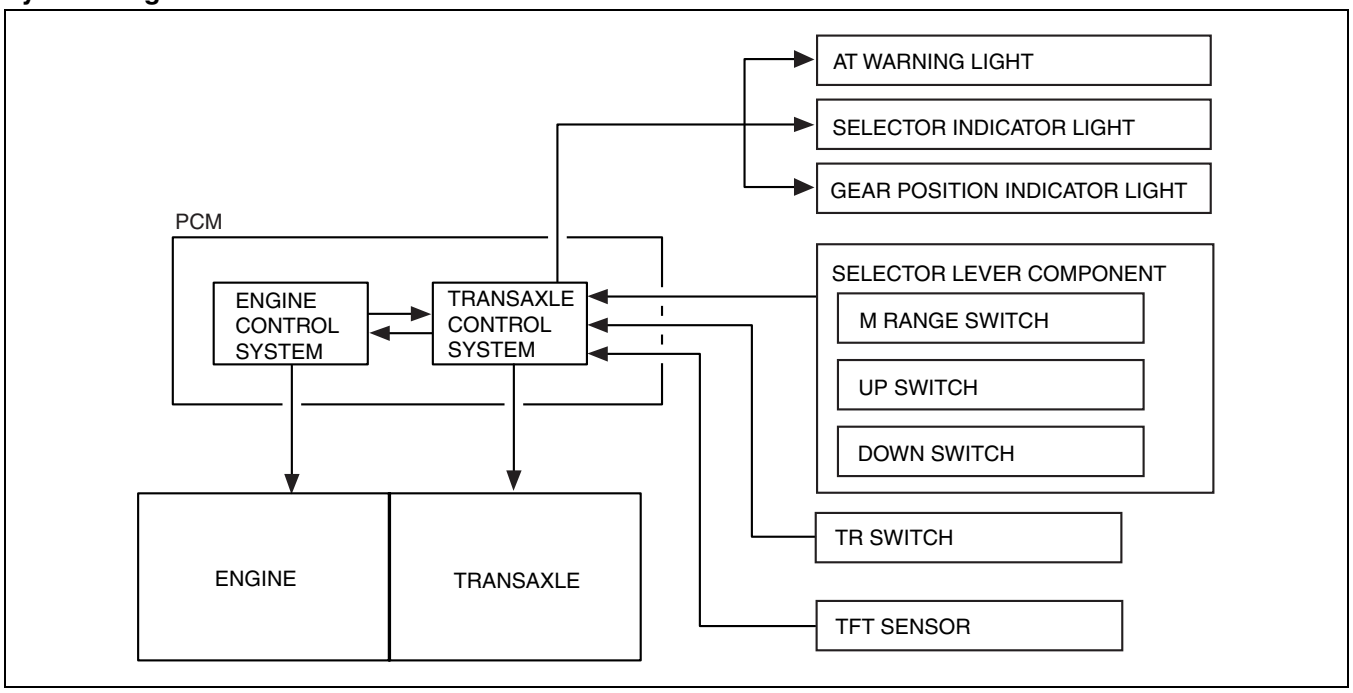
EPU051718880S12

Features

- The manual mode shift control is activated by moving the selector lever from the D to M range position (selector lever is shifted over toward driver side).
- Manual mode shift control with a manual shifting system allowing selection of gear positions by manual operation of the selector lever forward (–) and back (+) has been adopted. Moreover, engine braking for all gears in manual mode according to the gear ratio is available.
  - — Shifting between 1GR and 2GR when the vehicle is stopped is possible. Moreover, when shifting from the D to M range while driving, the same gear position is maintained.
  - — Consecutive shifting in the M range has been adopted. When shifting down from M range 4GR or 3GR, and shifting up from M range 1GR or 2GR, one gear can be skipped over by rapidly tapping the selector lever two times in the down-shift (–) direction or up-shift (+) direction.
- Selector lever position and gear position indicator lights, built into the instrument cluster, have been adopted. The gear position indicator light displays the selected gear position.
  - — The selector indicator light includes a selector lever position indicator that displays selector lever positions and, in M range, a gear position indicator light that displays gear positions.

Structure

System diagram



EPU517ZS3009

MANUAL MODE SHIFT CONTROL OPERATION [FN4A-EL]

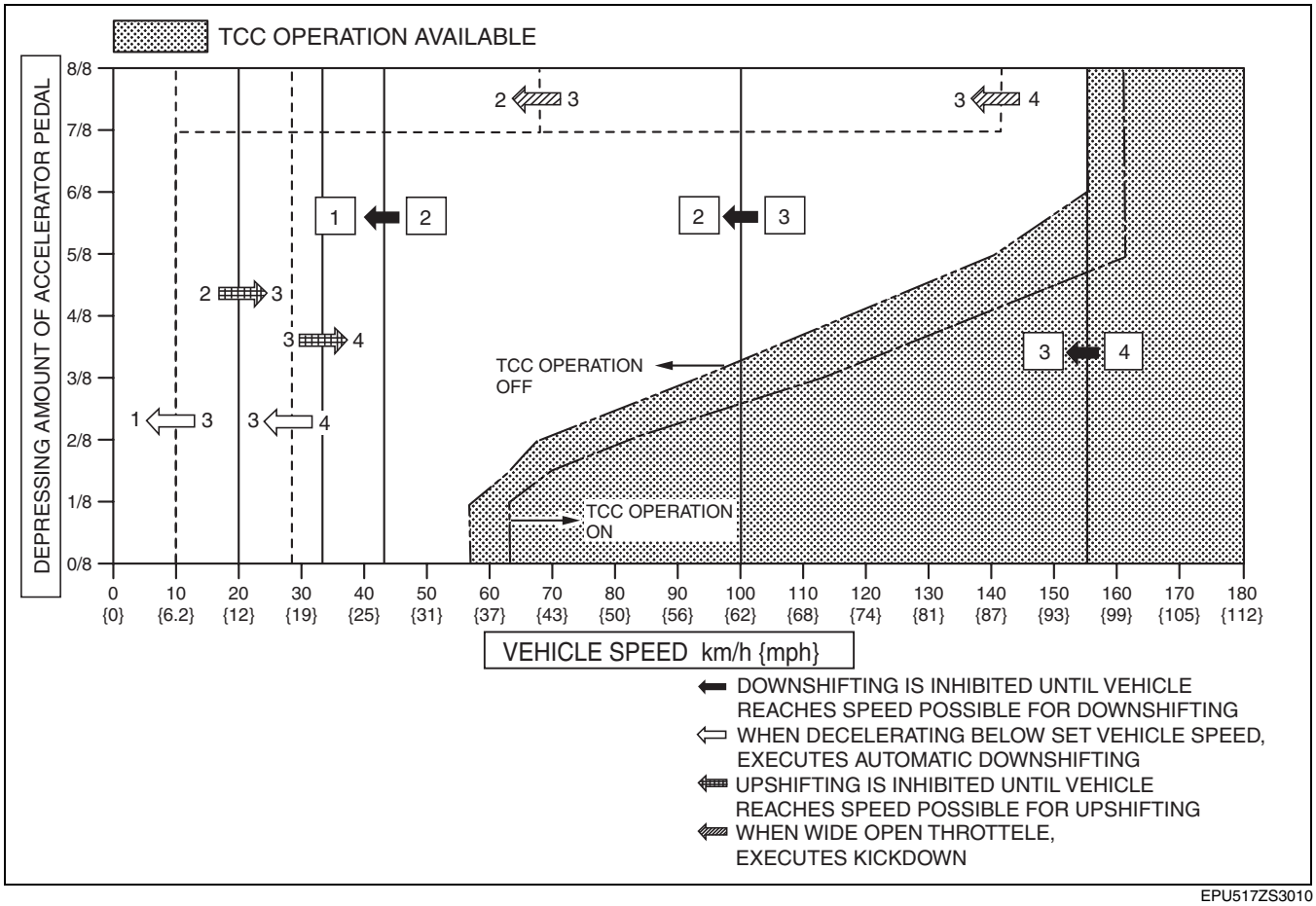
EPU051718880S13

Manual mode shift

- When the selector lever is shifted over from the D to M range position, the M range switch in the selector lever component turns on, sending a manual mode command signal to the PCM which activates the manual mode shift control.
- When in manual mode and the selector lever is operated in the back (+) direction, the up switch in the selector lever component is turned on and an up-shift command signal is input to the PCM.
  - — The PCM, triggered by the up-shift command signal, carries out shifting by outputting an operation signal to the shift solenoid if the ATF temperature is not low (for 3GR only), vehicle speed is higher than the set speed and the gear position is 3GR or lower.
- Conversely, when the selector lever is operated in the forward (–) direction, the down switch in the selector lever component turns on, and a down-shift command signal is input to the PCM.
  - — The PCM, triggered by the down-shift command signal, carries out shifting by outputting an operation signal to the shift solenoid if the vehicle speed is less than the set speed and the gear position is 2GR or above.
- The PCM utilizes a specialized M range automatic shift diagram. Due to this, restriction of manual shift demand and automatic control of downshifting is carried out, reducing load on the ATX, preventing engine over-rev and ensuring drive stability.

Condition	Shift control	Note
2GR→3GR up-shift command at low speed	• To reduce load on the ATX, upshifting is inhibited until vehicle reaches speed possible for upshifting	—
3GR→4GR up-shift command at low speed		
3GR→4GR up-shift command, low ATF temperature	• To reduce load on the ATX, upshifting to 4GR is inhibited	
4GR→3GR down-shift command, above set speed	• To prevent engine over-rev, downshifting is inhibited until vehicle reaches speed possible for downshifting	• Gear position indicator light flash to alert driver
3GR→2GR down-shift command, above set speed		
2GR→1GR down-shift command, above set speed		
In 4GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 4GR to 3GR	—
In 3GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 3GR to 1GR	
Wide open throttle, at 68—141 km/h {43—87 mph} in 4GR	• To improve acceleration performance, 4GR to 3GR kickdown occurs	—
Wide open throttle, at 67 km/h {42 mph} or less in 3GR	• To improve acceleration performance, 3GR to 2GR kickdown occurs	—

Shift diagram



EPU517ZS3010

AT WARNING LIGHT FUNCTION [FN4A-EL]

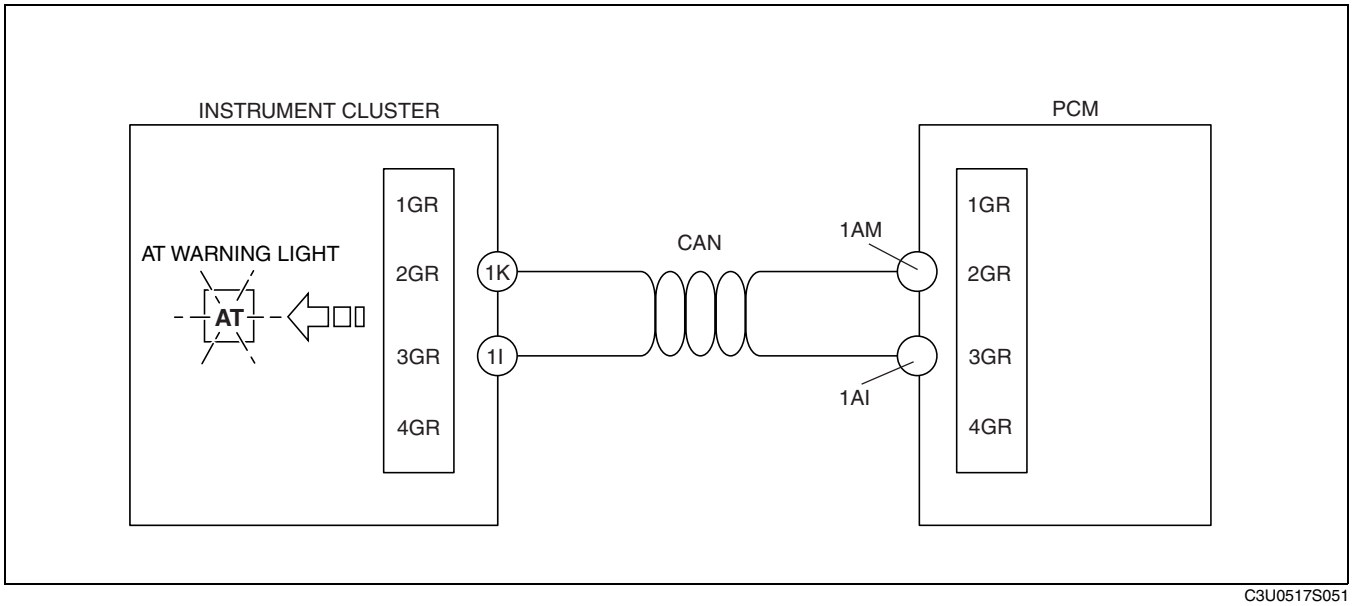
EPU051721101S09

- The AT warning light illuminates to alert the driver of a malfunction in the automatic transaxle.

AT WARNING LIGHT CONSTRUCTION/OPERATION [FN4A-EL]

EPU051721101S10

- The AT warning light is built into the instrument cluster.
- The AT warning light illuminates when the instrument cluster receives a warning signal from the PCM via CAN communication.
- The PCM sends a warning signal to the instrument cluster via CAN communication when it detects a malfunction.



C3U0517S051

SELECTOR INDICATOR LIGHT FUNCTION [FN4A-EL]

EPU051721101S11

- The selector indicator light has a selector lever position light, and a gear position indicator light that indicates gear position.
- When downshifting is cancelled in the M range, the gear position indicator light flashes two times to alert the driver that downshifting is cancelled.

SELECTOR INDICATOR LIGHT CONSTRUCTION/OPERATION [FN4A-EL]

EPU051721101S12

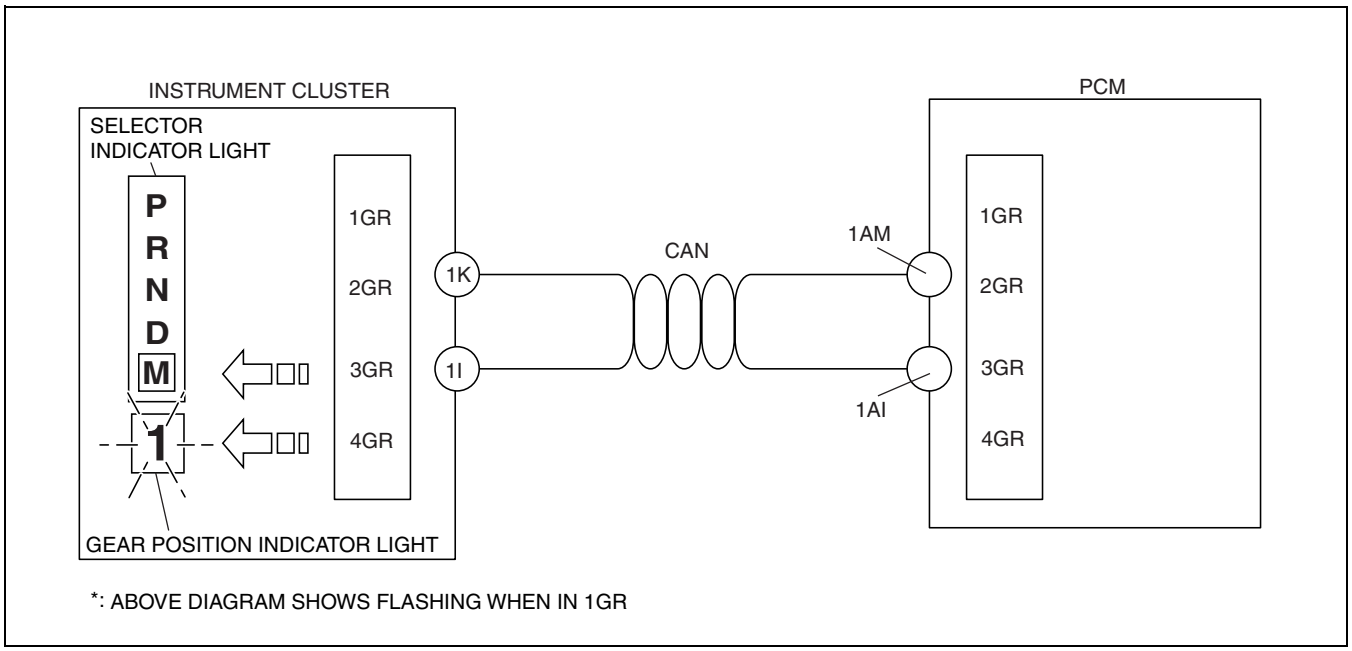
Construction

- The selector indicator light is built into the instrument cluster.
- When in the P, R, N or D range, the PCM detects the selector lever position based on an analog signal from the TR switch. When in the M range, the PCM detects the selector lever position based on a signal from the M range switch inside the selector lever component.
- When the instrument cluster receives a range signal or a gear position signal from the PCM via CAN communication, the selector lever position and the gear position indicator lights illuminate or flash accordingly.

Operation

Gear position indicator light flash

- When the driver's down-shift operation is cancelled, the gear position indicator light flash twice.
  - — When the PCM cancels a shift operation, all of the signals are pulsed ON/OFF and when finally input to the instrument cluster, the on signal (ex. M1 signal when in 1GR) and the remaining three off signals (M2, M3, M4) are reversed to off and on signals respectively.
- Based on a combination of input signals from the PCM, the instrument cluster determines the gear number (1GR displayed as "1"), and flashes the gear position number in the gear position indicator light and the selector indicator "M" light.



C3U0517S052

FEEDBACK CONTROL STRUCTURE [FN4A-EL]

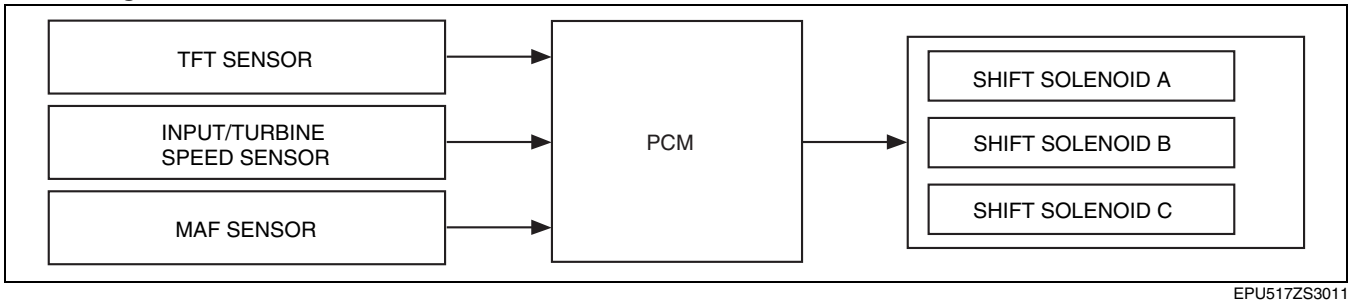
EPU051718880S20

Features

- Regulation of hydraulic pressure for engagement and disengagement is optimized through feedback and learning correction of the clutch engagement pressure.

Structure

Block diagram

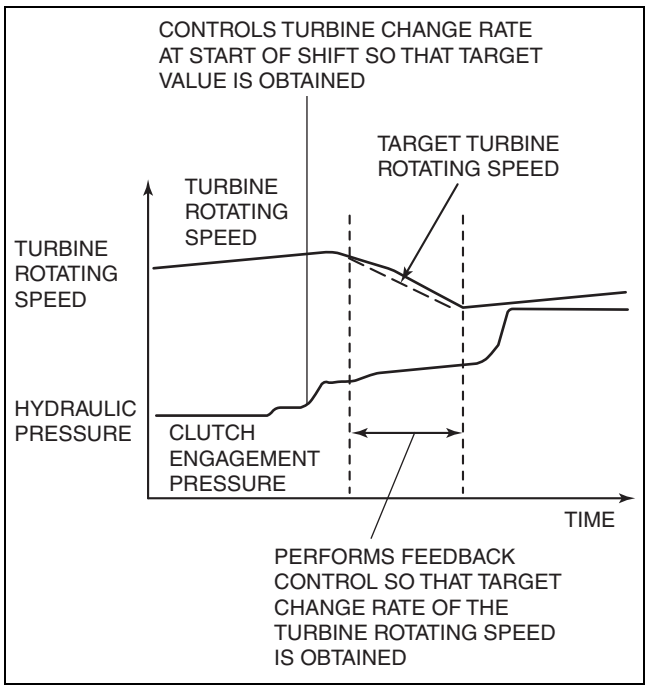


EPU517ZS3011

FEEDBACK CONTROL OPERATION [FN4A-EL]

EPU051718880S14

- When shifting, real-time feedback correction of the clutch engagement pressure is operated by the duty-cycle solenoid valves so that the speed change of the turbine shaft (change of the turbine rotating speed) matches the predetermined target value.
- Also, the clutch engagement pressure is optimally corrected so as to absorb the changes in engine performance and/or of elapsed transaxle, according to the shift results in the past.



C3U0517S042

ENGINE-TRANSAXLE TOTAL CONTROL STRUCTURE [FN4A-EL]

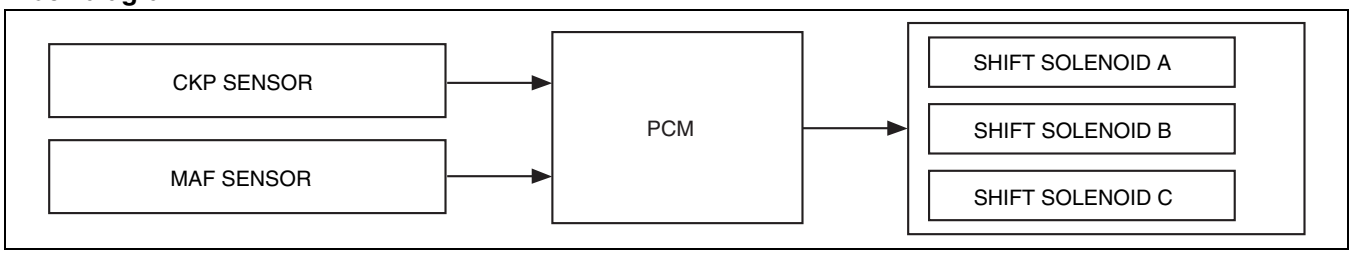
EPU051718880S21

Features

- When shifting, engine output torque is controlled for optimized clutch capacity.

Structure

Block diagram

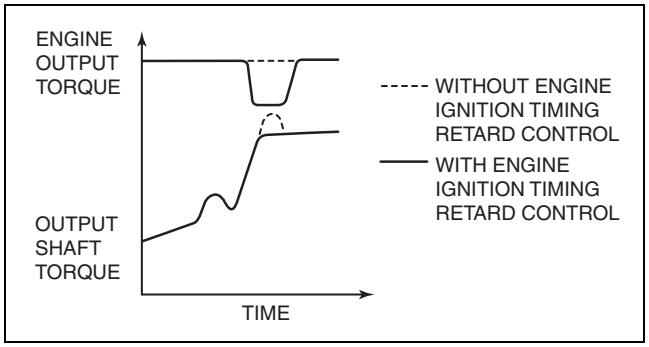


EPU517ZS3012

ENGINE-TRANSAXLE TOTAL CONTROL OPERATION [FN4A-EL]

EPU051718880S15

- When shifting, engine output torque is reduced temporarily and the clutch is engaged smoothly by engine ignition timing retard control to reduce the fluctuation of the output shaft torque during shifting.
- Engine output torque is estimated according to the engine speed, intake air amount, etc., and the clutch engagement pressure is determined according to the engine output torque. Thus the set accuracy of the clutch hydraulic pressure control is improved, realizing smooth shifting.

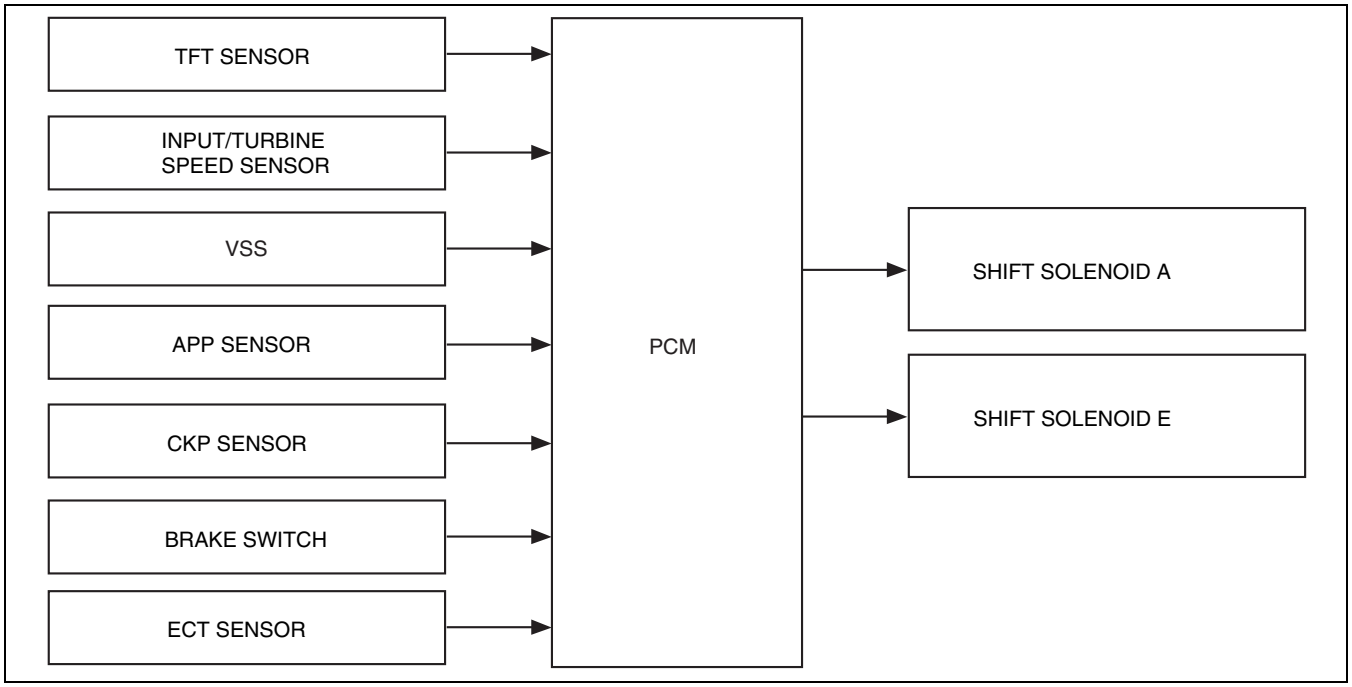


C3U0517S044

TORQUE CONVERTER CLUTCH (TCC) CONTROL OUTLINE [FN4A-EL]

EPU051718880S16

- The PCM selects and determines the TCC diagram based on the shift control results. With this TCC diagram, and according to the signals from VSS, APP sensor, and other switches and sensors, the PCM sends the signal to the duty-cycle type shift solenoids A and on/off type shift solenoid E to operate TCC control.
- Smooth TCC control, which engages the TCC gradually, has been adopted to reduce the shock when the TCC engages.



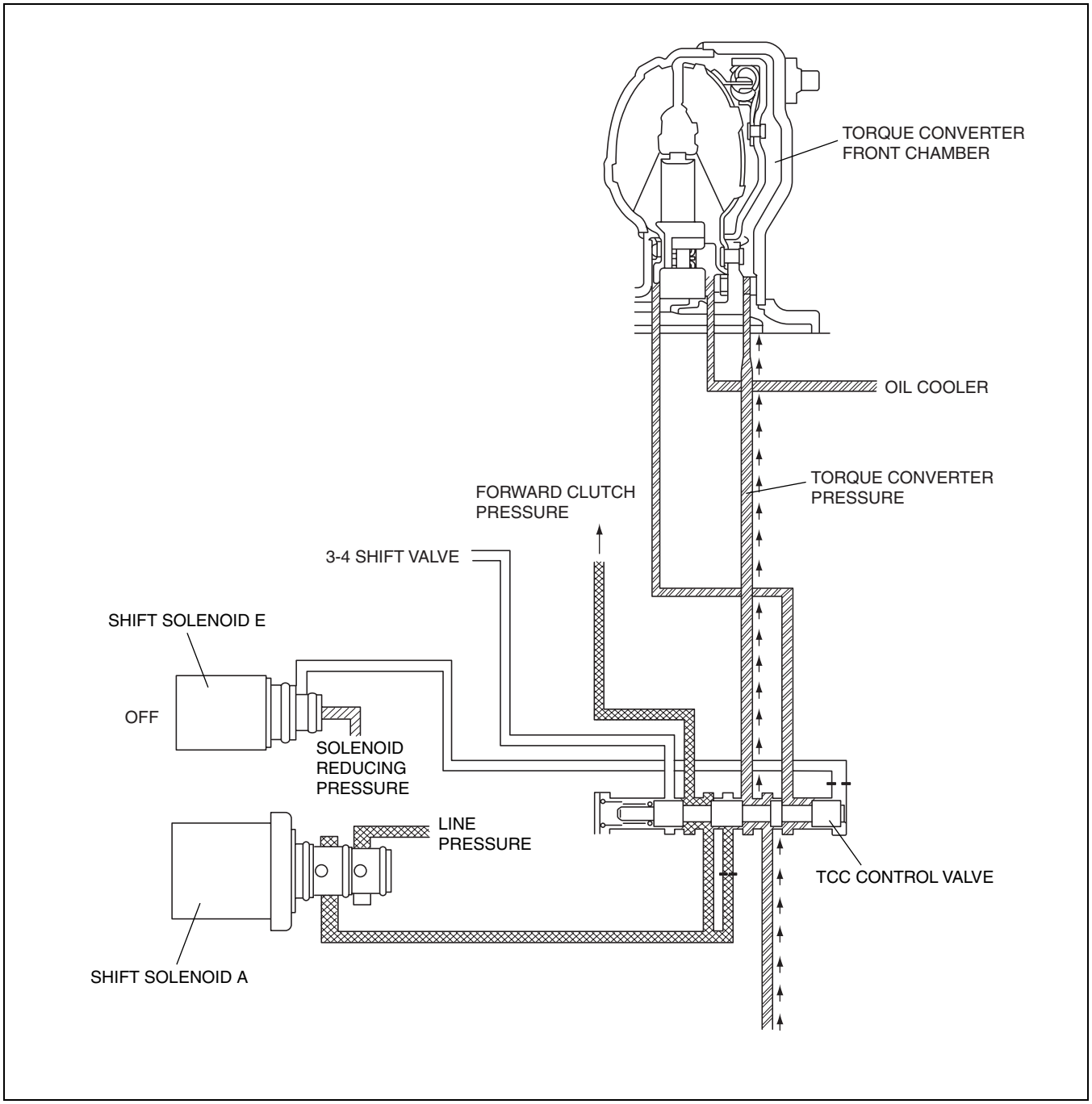
EPU517ZS3013

TORQUE CONVERTER CLUTCH (TCC) OPERATION [FN4A-EL]

EPU051718880S17

TCC Release

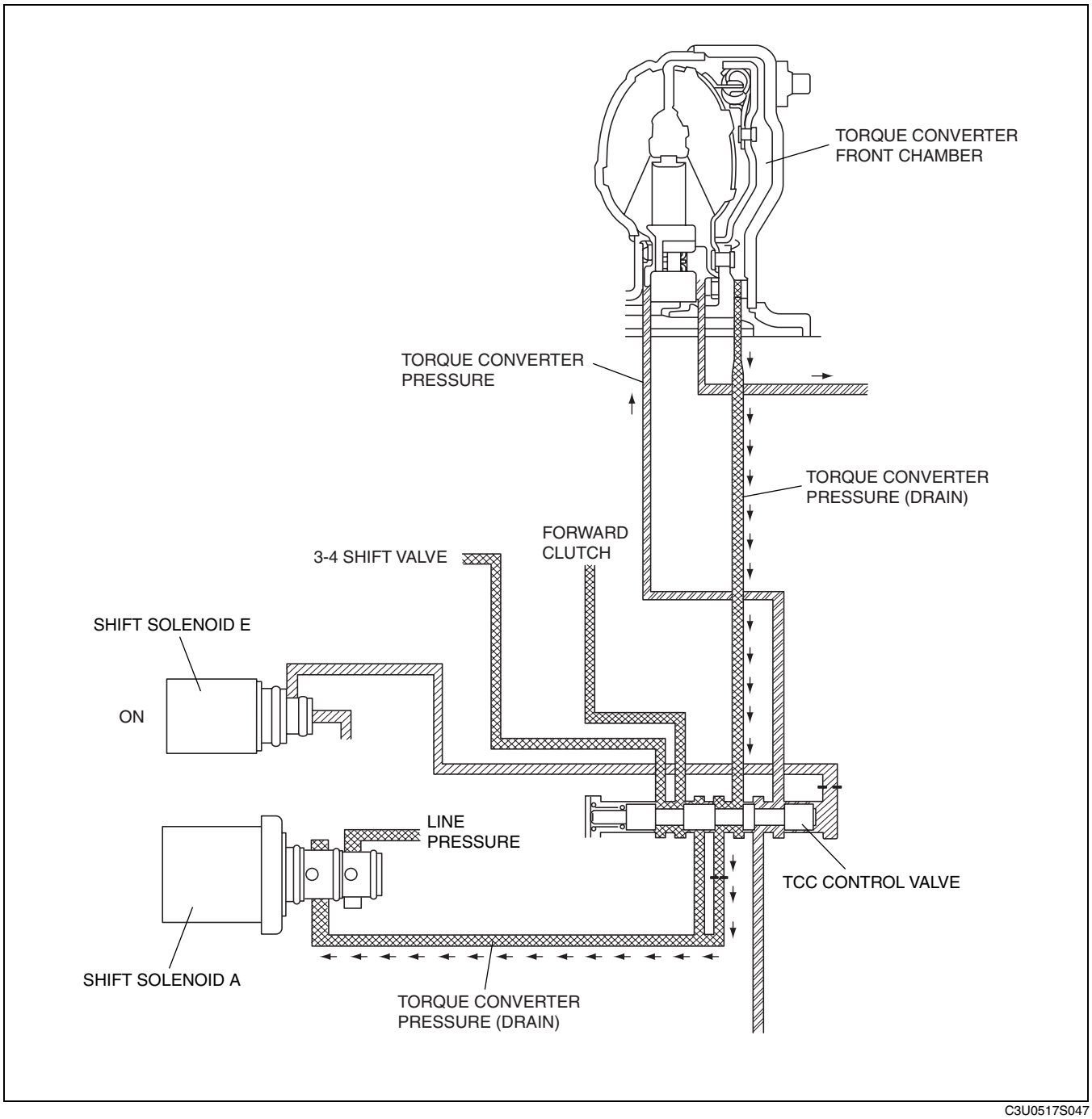
- The PCM sends an OFF signal to shift solenoid E when the TCC is determined to be released. In this condition, the TCC control valve is pushed to the right by the spring force, and torque converter pressure acts on the torque converter front chamber, releasing the TCC from the converter cover.



C3U0517S046

TCC Engaging Operation

- When the PCM determines that TCC operation is smooth, it sends an on signal to the shift solenoid E to push the TCC control valve to the left. After engaging the torque converter front chamber and shift solenoid A, the PCM gradually increases the signal of duty ratio (50 Hz ON time ratio) to shift solenoid A. As a result, the torque converter pressure acted on the torque converter front chamber is drained gradually by shift solenoid A. By reducing the torque converter pressure in the torque converter front chamber gradually in this way, the TCC is pressed smoothly to the torque converter cover, and smooth TCC operation is possible.



C3U0517S047

Determination of TCC Inhibition

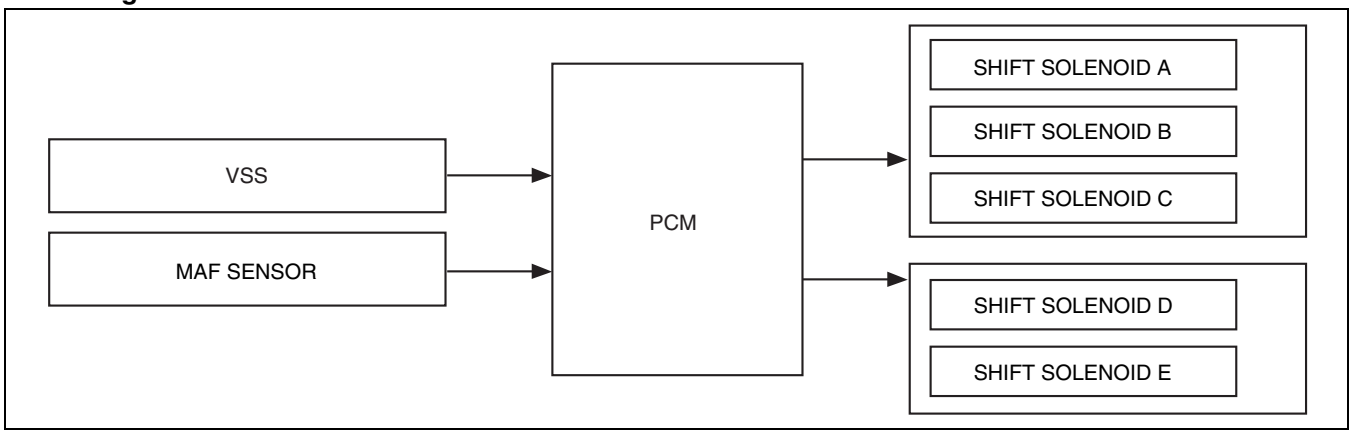
- The TCC control is inhibited when any of the following conditions are met:
- Engine coolant temperature is below 60 °C {140 °F}
- ATF temperature is low
- Brake switch is on (when depressing the brake pedal)
- Accelerator depressing speed and accelerator opening angle are above specified value
- Engine speed signal is below specified value
- Malfunction is detected by diagnosis function

SLOPE MODE CONTROL OUTLINE [FN4A-EL]

EPU051718880S18

- Climbing is determined based on the engine output torque and the vehicle acceleration, and the shift gear is controlled to realize smooth vehicle driving.

Block diagram



EPU517ZS3014

SLOPE MODE CONTROL OPERATION [FN4A-EL]

EPU051718880S19

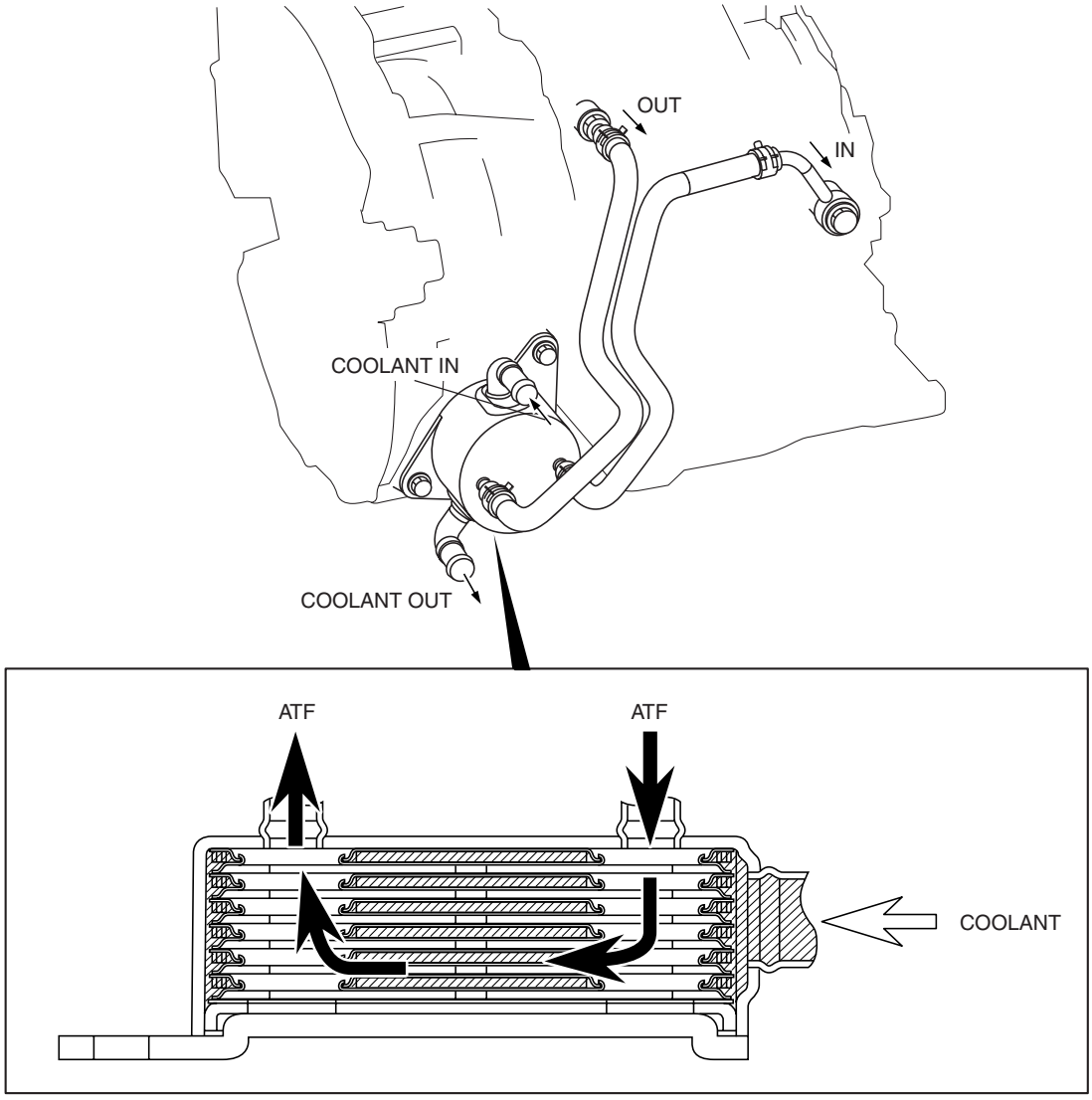
Climbing hill

- When the hill is steeper than a specified grade, unnecessary shift up is prevented by holding an appropriate shift gear.

COOLING SYSTEM OUTLINE [FN4A-EL]

EPU051719900S01

1. A water-cooled AT oil cooler installed to the converter housing has been adopted.
2. The oil cooler functions as follows:
   - ATF is cold: The ATF is warmed using coolant. (Warming function)
   - ATF is overly hot: The ATF is cooled using coolant. (Cooling function)
3. Since this oil cooler uses coolant from the heater, cold ATF is warmed rapidly causing the ATF viscosity to reduce rapidly. Reduction of friction within the AT results in improved fuel efficiency.



C3U0517S053

05–18 AUTOMATIC TRANSAXLE SHIFT MECHANISM

AUTOMATIC TRANSAXLE SHIFT MECHANISM OUTLINE 05–18–1
AUTOMATIC TRANSAXLE SHIFT MECHANISM STRUCTURAL VIEW 05–18–2
SELECTOR LEVER OUTLINE 05–18–2
SELECTOR LEVER STRUCTURE 05–18–3
M Range Switch. **05–18–3**
Up Switch. **05–18–4**
Down Switch **05–18–5**
Not P Position Switch. **05–18–6**
SHIFT-LOCK SYSTEM OUTLINE. 05–18–6
SHIFT-LOCK SYSTEM STRUCTURE. 05–18–7
SHIFT-LOCK SYSTEM OPERATION 05–18–8
Shift-lock Release Condition **05–18–8**
Shift-lock Condition (when the shift-lock conditions are not satisfied) **05–18–8**
Shift-lock Release Condition (when the shift-lock conditions are satisfied) **05–18–9**
Shift-lock Release Condition (when inserting a flathead screwdriver into the shift-lock release hole) **05–18–10**
KEY INTERLOCK SYSTEM OUTLINE 05–18–10
KEY INTERLOCK SYSTEM STRUCTURE 05–18–11
KEY INTERLOCK SYSTEM OPERATION 05–18–12
Position Other Than Park (key interlock operates) **05–18–12**
Park Position (key interlock does not operate) **05–18–12**

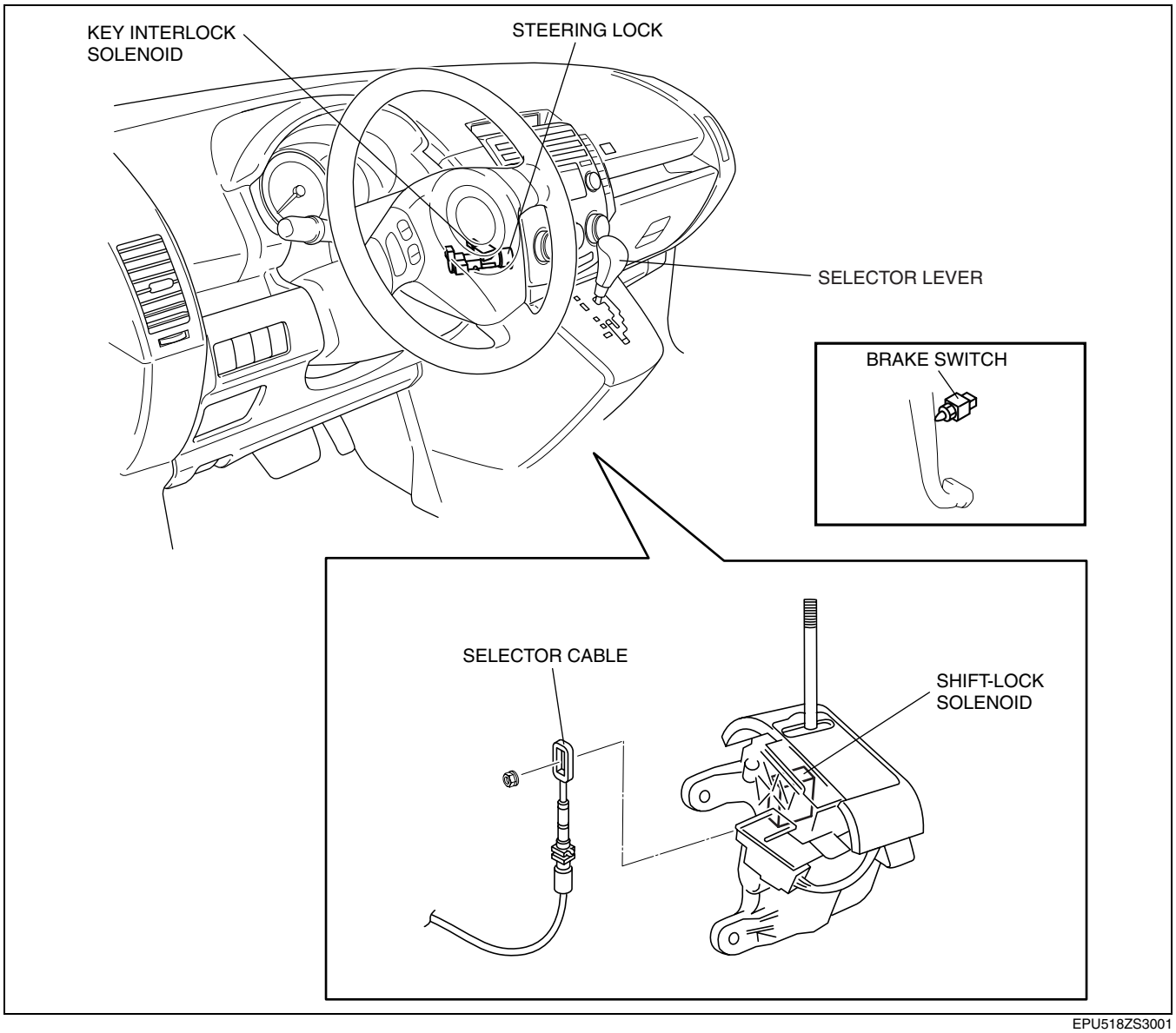
AUTOMATIC TRANSAXLE SHIFT MECHANISM OUTLINE

EPU051846010S01

- The sport AT type shift mechanism has been adopted.
- To improve operability, a shift mechanism which the selector lever is located on the center of the dashboard has been adopted.
- To prevent inadvertent selection of the wrong gear, a key interlock device and a shift-lock device have been adopted.
- The shift-lock release mechanism has been adopted for emergency bypass assurance.

AUTOMATIC TRANSAXLE SHIFT MECHANISM STRUCTURAL VIEW

EPU051846010S02



EPU518ZS3001

SELECTOR LEVER OUTLINE

EPU051846010S03

- The selector lever is located on the center of the dashboard, improving operability.

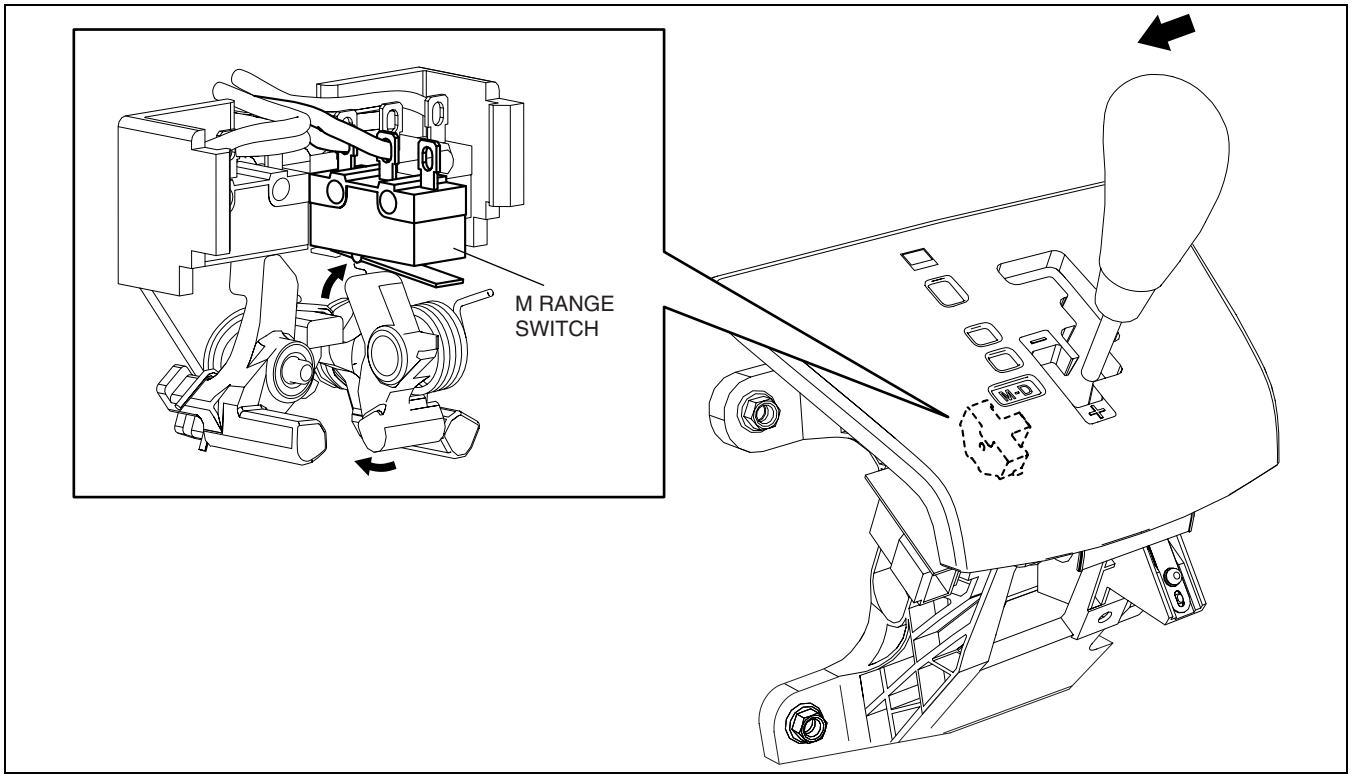
SELECTOR LEVER STRUCTURE

EPU051846010S04

M Range Switch

Outline

- The M range switch detects the selector lever in M range position and sends a manual mode request signal to the PCM.



EPU518ZS3002

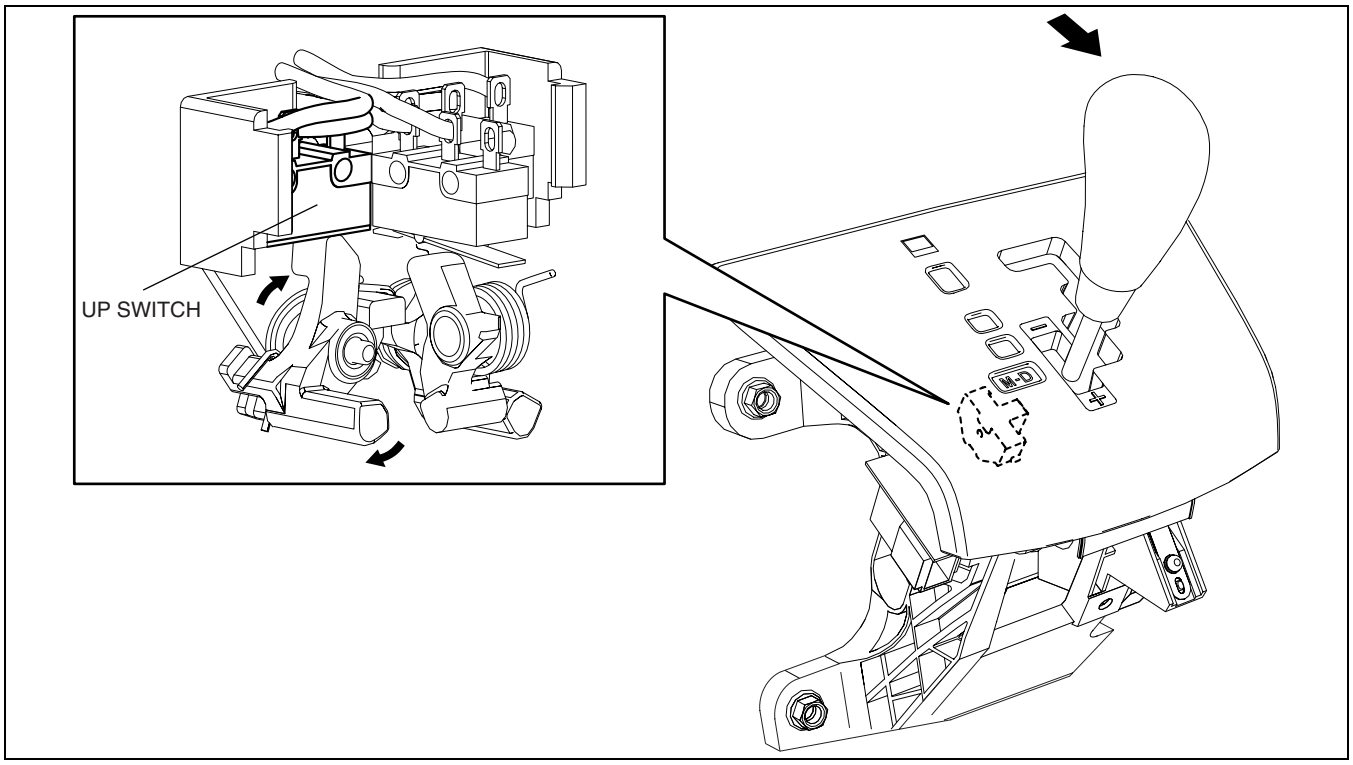
Operation

- The M range switch is an on/off type switch that turns on when the selector lever is shifted to the M range. It also remains on during up-shift and down-shift operations.

Up Switch

Outline

- The up switch detects an up-shift operation in the M range and sends an up-shift request signal to the PCM.



EPU518ZS3003

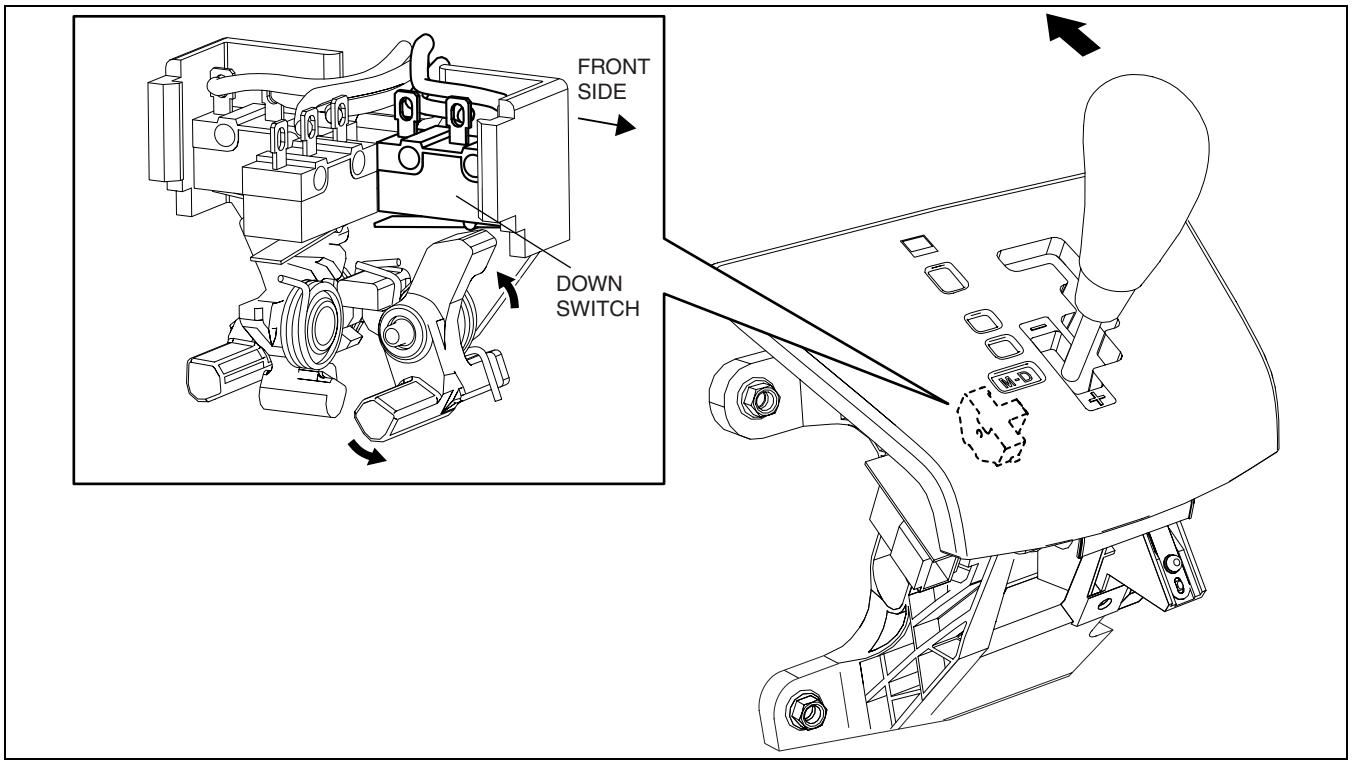
Operation

- The up switch is an on/off type switch that turns on when the selector lever is in the M range (+) side position.

Down Switch

Outline

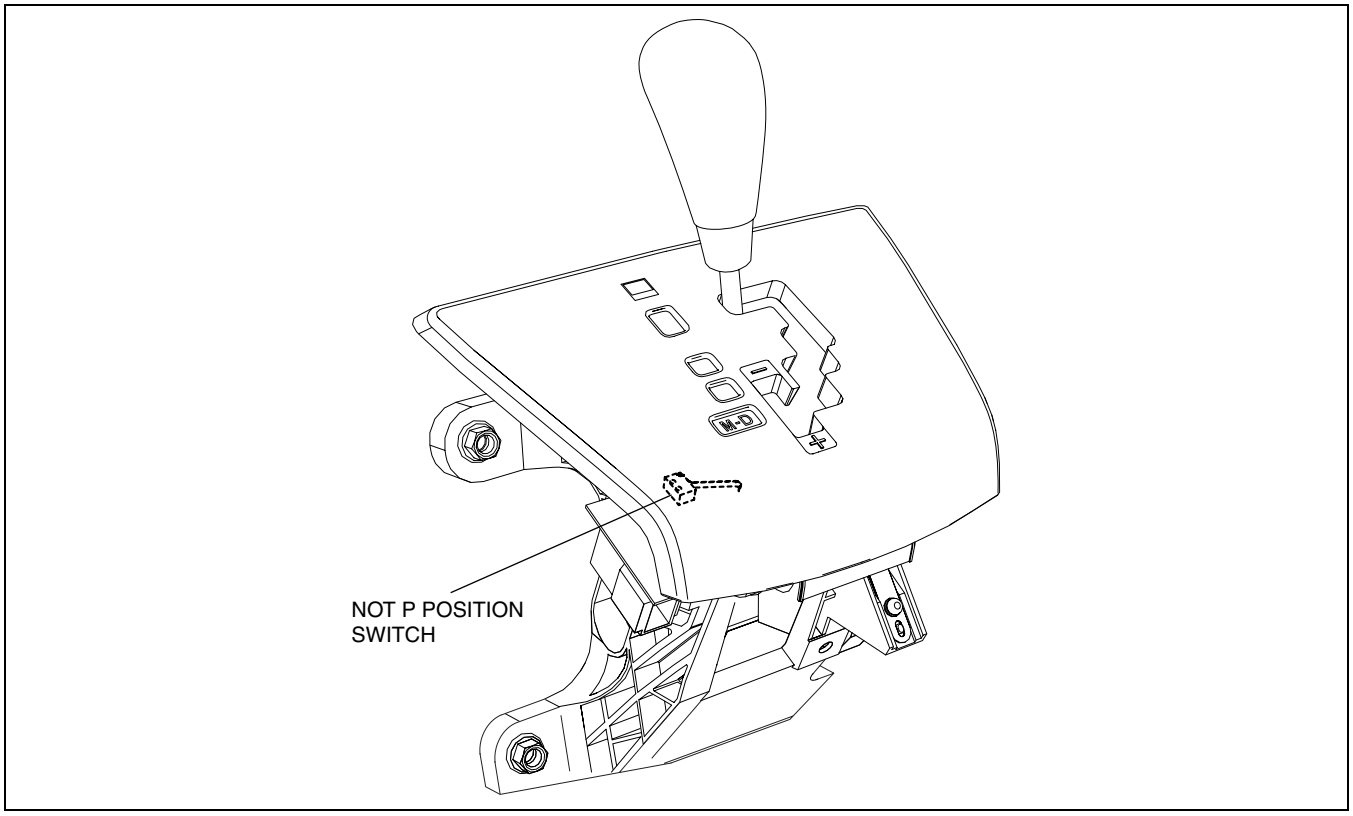
- The down switch detects a down-shift operation in the M range and sends a down-shift request signal to the PCM.



EPU518ZS3004

Operation
- The down switch is an on/off type switch that turns on when the selector lever is in the M range (–) side position.

Not P Position Switch
Outline
- The Not P position switch detects if the selector lever is not in the P position. When detected, it sends a “Not P position” signal to the key interlock solenoid.



EPU518ZS3005

Operation
- The Not P position switch is an on/off type switch which turns on when the selector lever is any position besides the P position.

SHIFT-LOCK SYSTEM OUTLINE

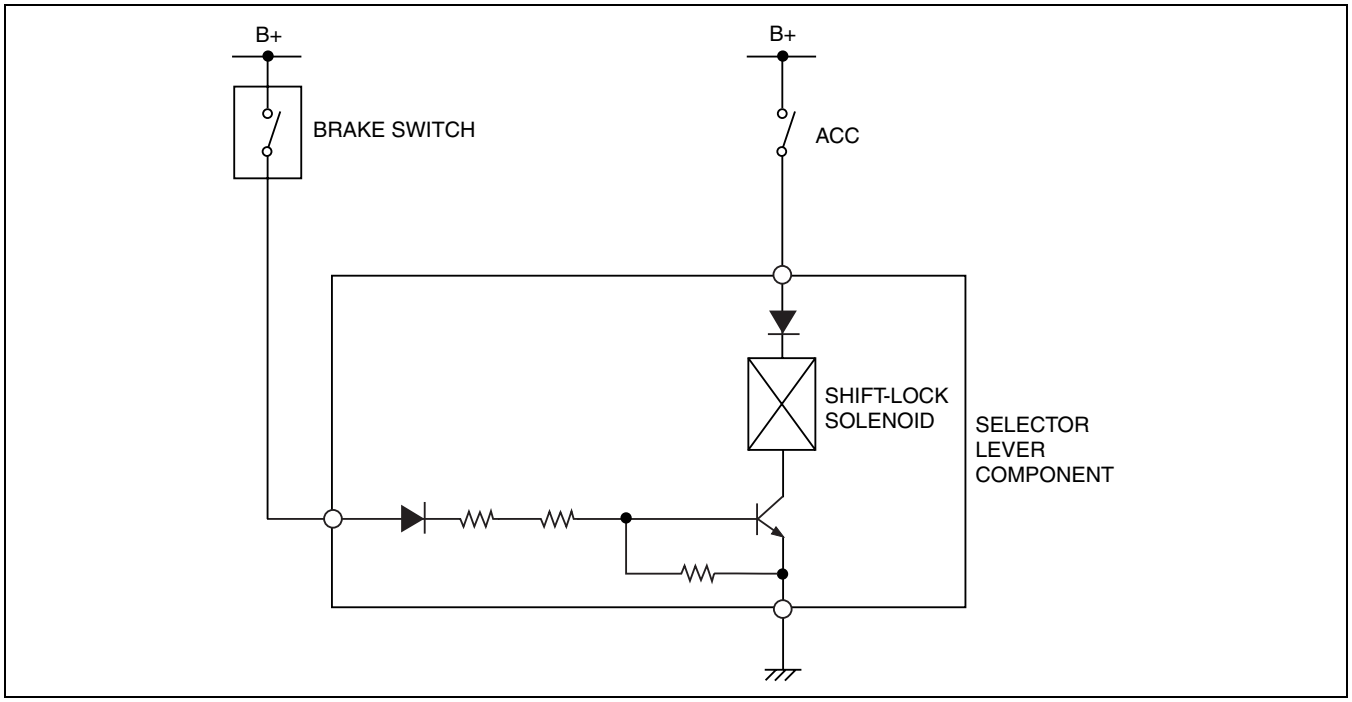
EPU051830000S01

- The shift-lock system prevents the selector lever from being shifted out of Park unless the brake pedal is depressed when the ignition switch is turned to the ON position.
- The shift-lock can be released manually by inserting a flathead screwdriver into the shift-lock release hole.

SHIFT-LOCK SYSTEM STRUCTURE

EPU051830000S02

- The shift-lock system consists of the brake switch, shift-lock solenoid, and selector lever component.



EPU518ZS3006

SHIFT-LOCK SYSTEM OPERATION

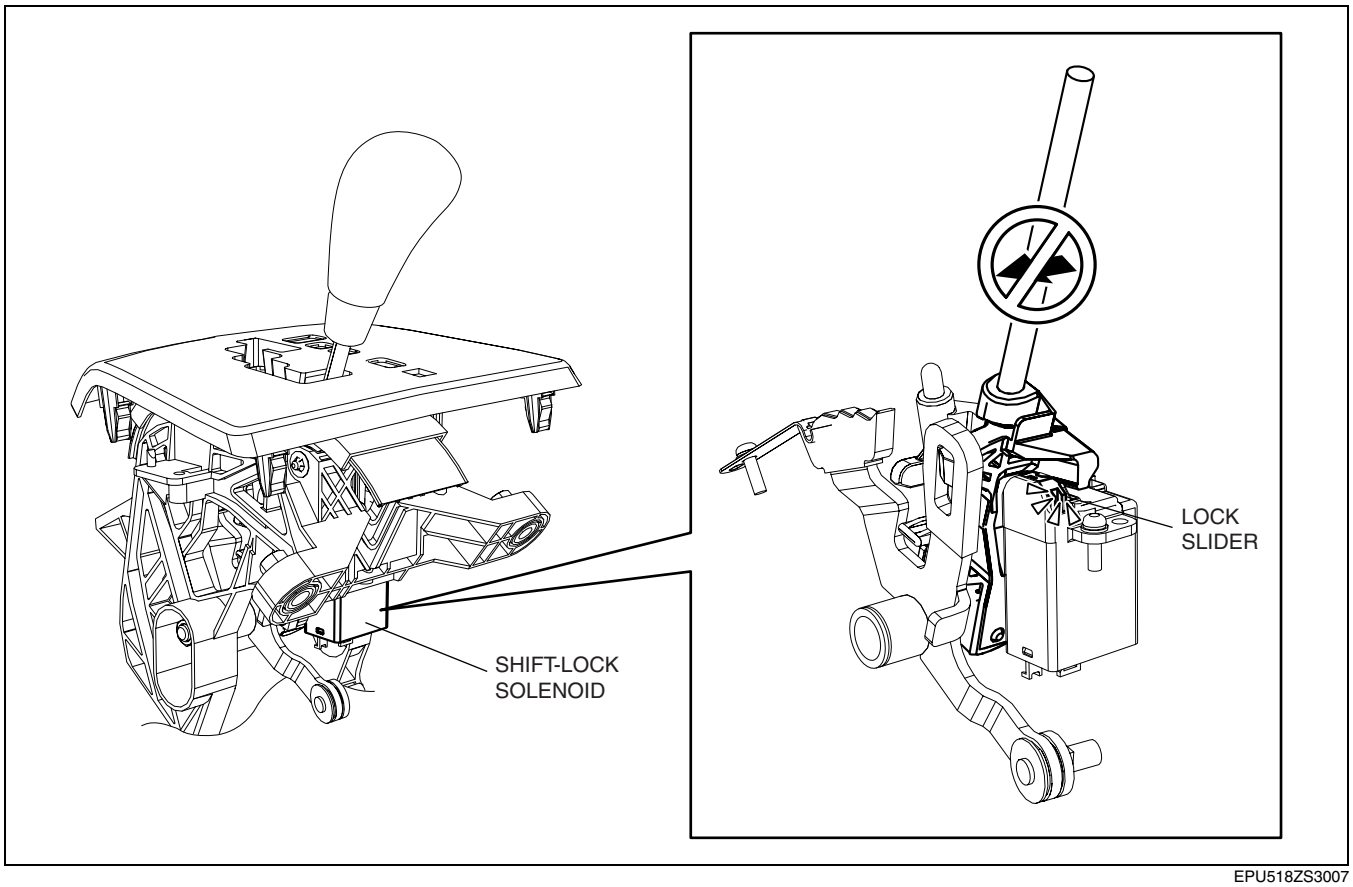
EPU051830000S03

Shift-lock Release Condition

- The shift-lock is released when the selector lever is in the P position, the ignition switch is in ACC position or ON position and the brake pedal is depressed.

Shift-lock Condition (when the shift-lock conditions are not satisfied)

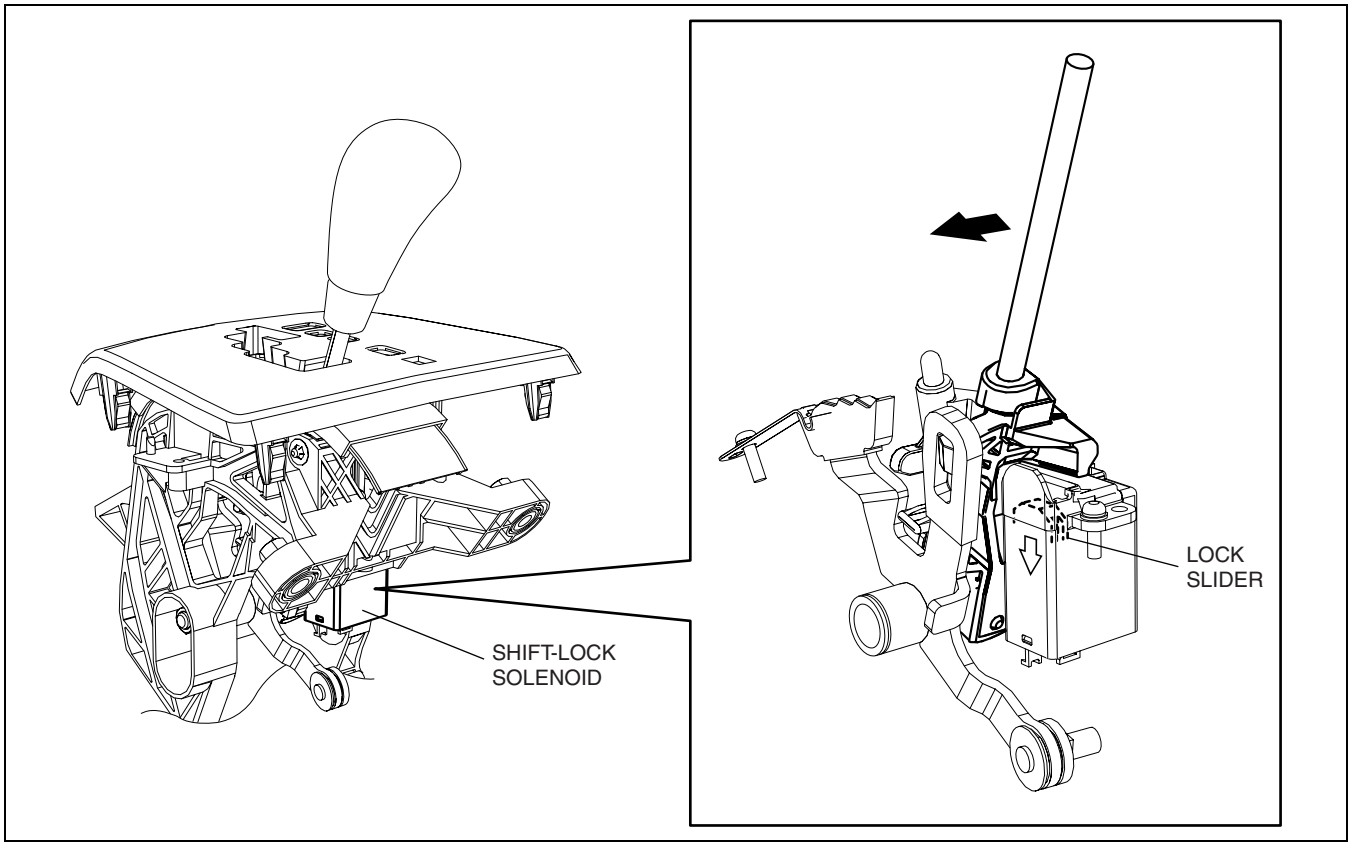
- If the shift-lock conditions are not satisfied, electrical current does not flow to the shift-lock solenoid. The lock slider therefore mechanically restricts the movement of the selector lever, preventing shifting out of Park.



EPU518ZS3007

Shift-lock Release Condition (when the shift-lock conditions are satisfied)

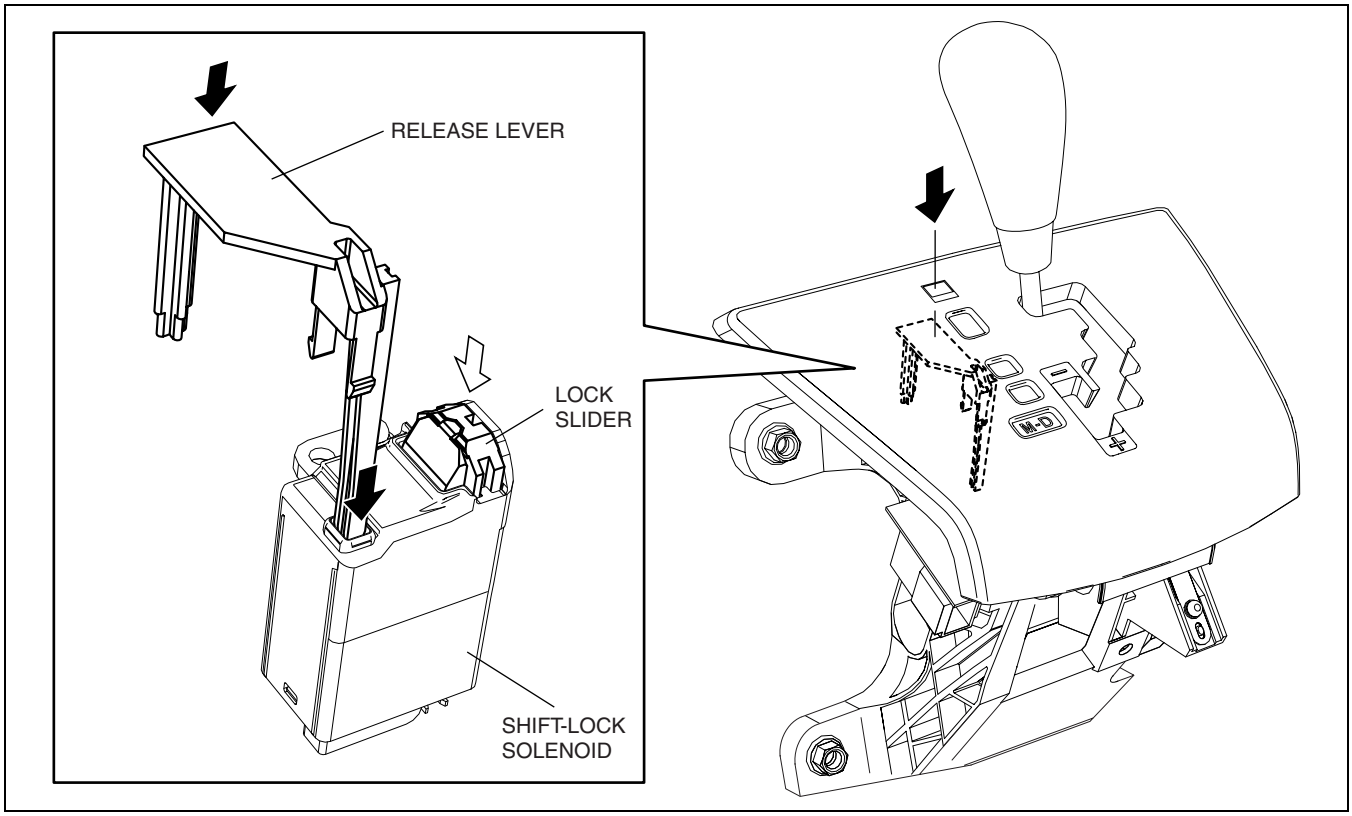
- If the shift-lock conditions are satisfied, electrical current flows to the shift-lock solenoid. The slider therefore moves toward the shift-lock solenoid and the lock slider moves to a position in which it does not restrict movement of the selector lever, allowing shifting out of Park.



EPU518ZS3008

Shift-lock Release Condition (when inserting a flathead screwdriver into the shift-lock release hole)

- To press down the lock slider, insert a flathead screwdriver into the shift-lock release hole, and press it against the release lever to lower the lever toward the shift-lock solenoid side. As a result, the selector lever is no longer restricted by the lock slider and the shift lock is released.



EPU518ZS3009

KEY INTERLOCK SYSTEM OUTLINE

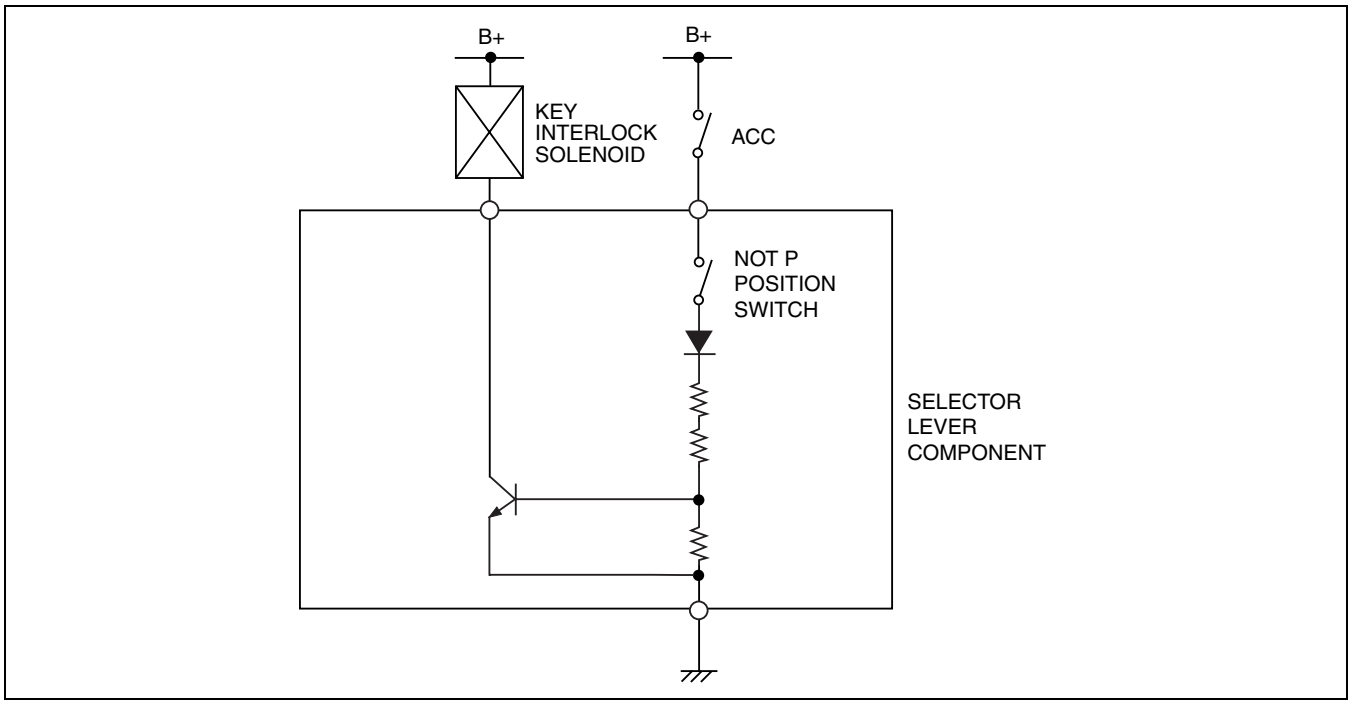
EPU051809000S01

- The key interlock system allows the key to be removed only when the selector lever is in Park.

KEY INTERLOCK SYSTEM STRUCTURE

EPU051809000S02

- The key interlock system consists of the Not P position switch (built-in selector lever component), key interlock solenoid, and steering lock.



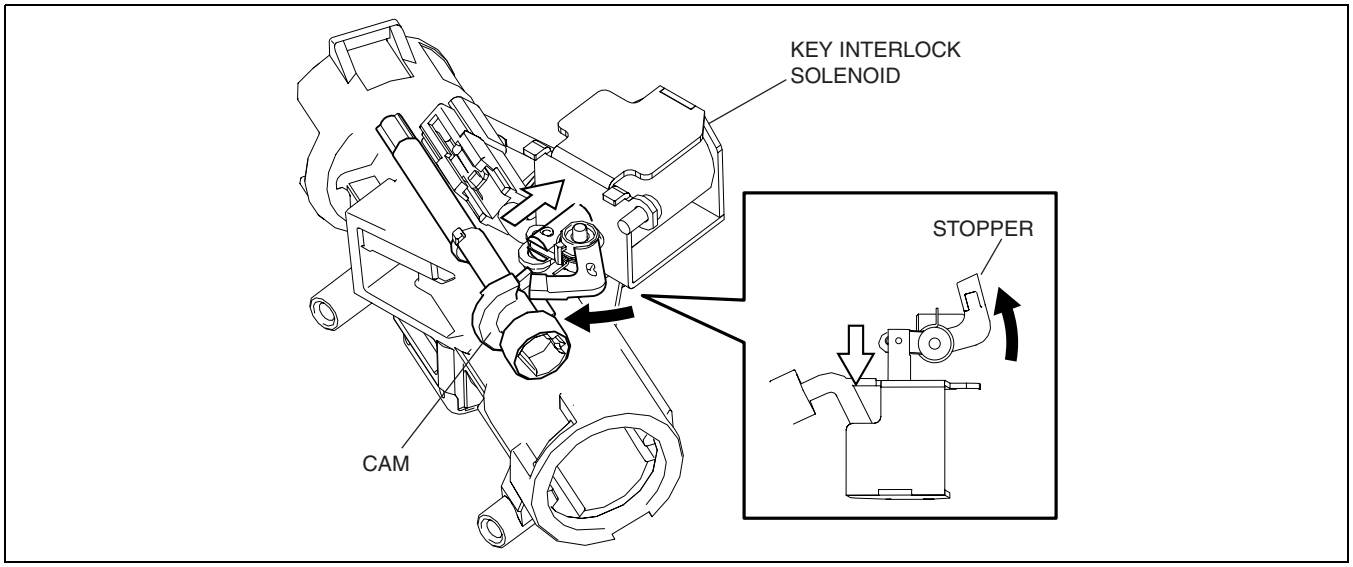
EPU518ZS3010

KEY INTERLOCK SYSTEM OPERATION

EPU051809000S03

Position Other Than Park (key interlock operates)

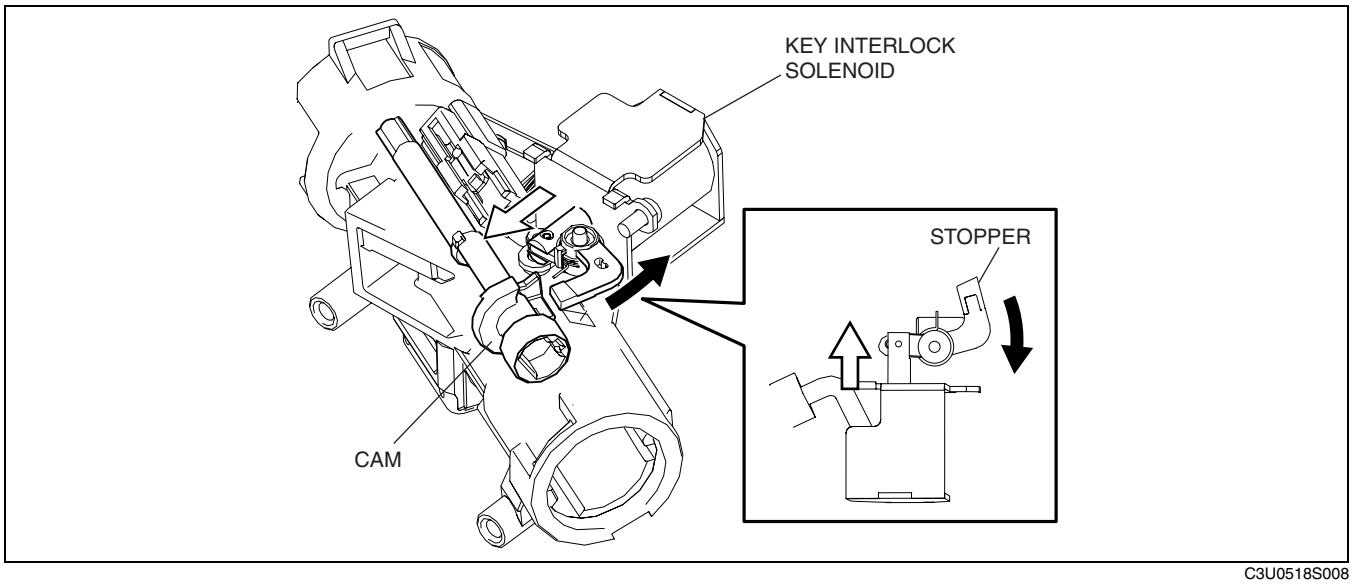
- The key interlock solenoid is energized when the selector lever is any position other than the P position. When the key interlock solenoid is energized, it pulls the solenoid slider, moving the stopper in the steering lock to contact the cam. Due to this, the key cannot be turned to the LOCK position.



C3U0518S007

Park Position (key interlock does not operate)

- The key interlock solenoid is not energized when the selector lever is in the P position. The key interlock solenoid slider is pushed by the return spring, releasing the stopper in the steering lock from the cam. Due to this, the key can be turned to the LOCK position.



C3U0518S008

STEERING

06
SECTION

OUTLINE 06-00
ON-BOARD DIAGNOSTIC 06-02
POWER STEERING 06-14

06–00 OUTLINE

STEERING ABBREVIATIONS 06–00–1
STEERING FEATURES 06–00–1
STEERING SPECIFICATIONS 06–00–1

STEERING ABBREVIATIONS

EPU060000000S01

ATF	Automatic Transaxle Fluid
CAN	Controller Area Network
EHPAS	Electro Hydraulic Power Assist Steering
OFF	Switch Off
ON	Switch On
WDS	Worldwide Diagnostic System

STEERING FEATURES

EPU060000000S02

Improved handling Improved fuel economy Improved marketability	• Electro hydraulic power assist steering (EHPAS) adopted
Improved operability	• Steering shaft with a tilt/telescope mechanism adopted
Improved safety	• Steering shaft with an energy absorbing mechanism adopted
Improved serviceability	• Enhanced malfunction diagnosis function for use with WDS or equivalent

STEERING SPECIFICATIONS

EPU060000000S03

Item				Specifications
Steering wheel	Outer diameter		(mm {in})	372 {14.6}
	Lock to lock		(turns)	2.9
Steering shaft	Shaft type			Collapsible design
	Coupling type			Cross-shaped joint design
	Tilt amount		(mm {in})	40 {1.6}
	Telescope amount		(mm {in})	50 {2.0}
Steering gear and linkage	Type			Rack and pinion design
	Rack stroke		(mm {in})	81.0 {3.19} × 2
Power steering	Power assist system			Vehicle speed sensing
	Fluid specification	Type		ATF M-**III** or equivalent (e.g. Dexron®**II**)
		Capacity* (approx. quantity)	(L {US qt, Imp qt})	0.80 {0.84, 0.70}

* : When fluid reservoir tank is at maximum volume.

06–02 ON-BOARD DIAGNOSTIC

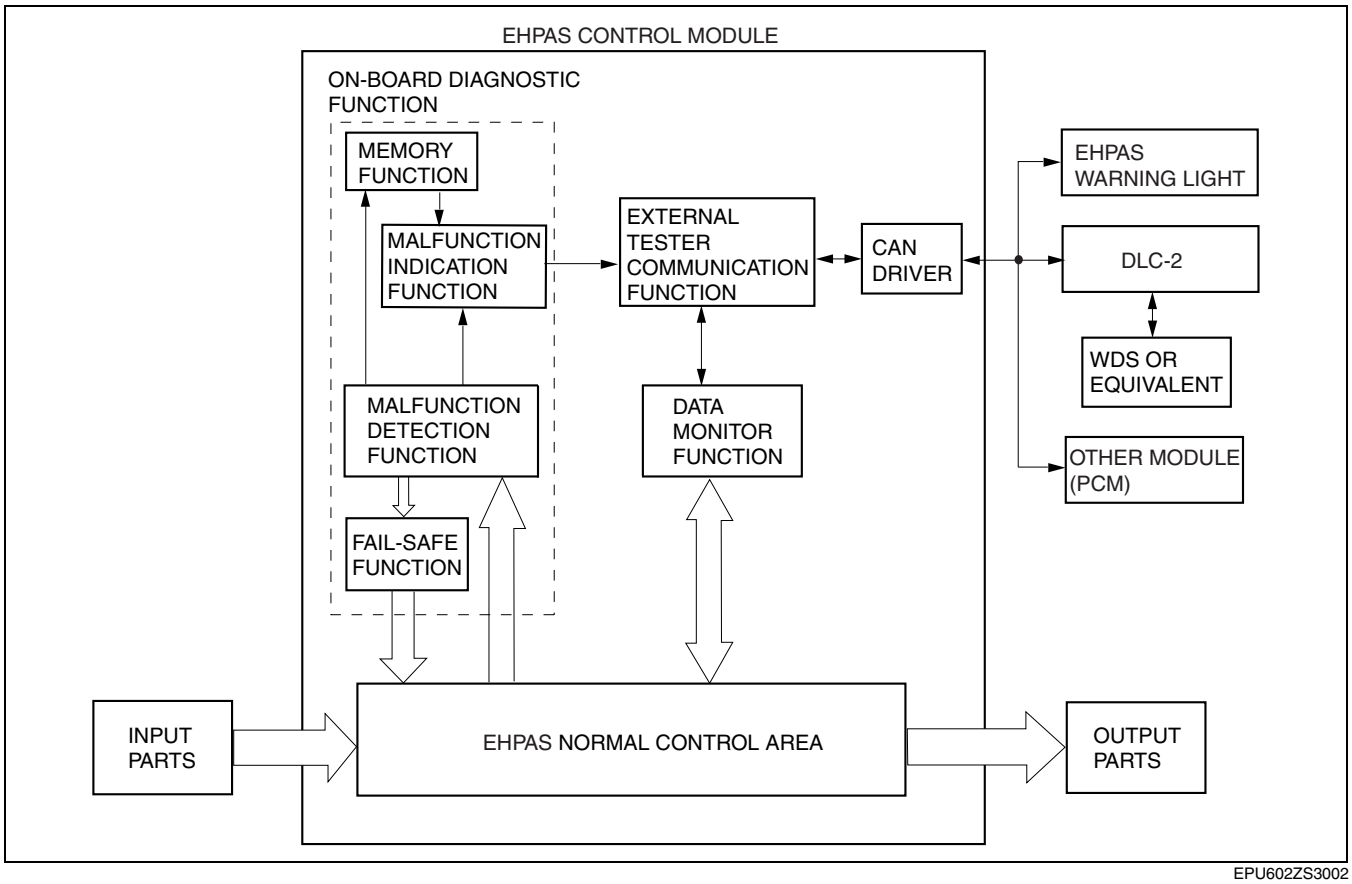
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)] 06–02–1
Block Diagram **06–02–1**
ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)] 06–02–2
Malfunction Detection Function **06–02–2**
Malfunction Display Function **06–02–2**
Memory Function **06–02–2**
Fail-safe Function **06–02–2**
ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)] 06–02–3
ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)] 06–02–4
Outline **06–02–4**
DLC-2 CONSTRUCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)] 06–02–4

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)]

EPU060200000S01

- The on-board diagnostic system consists of a malfunction detection system that detects abnormalities in input/output signals when the ignition switch is at the ON position and a PID/data monitor function that reads out specified input/output signals.
- The Data Link Connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis into a single place, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the WDS or equivalent to the DLC-2.
- In addition to DTC read-out, the WDS or equivalent is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor, providing enhanced malfunction diagnosis and improved serviceability.

Block Diagram



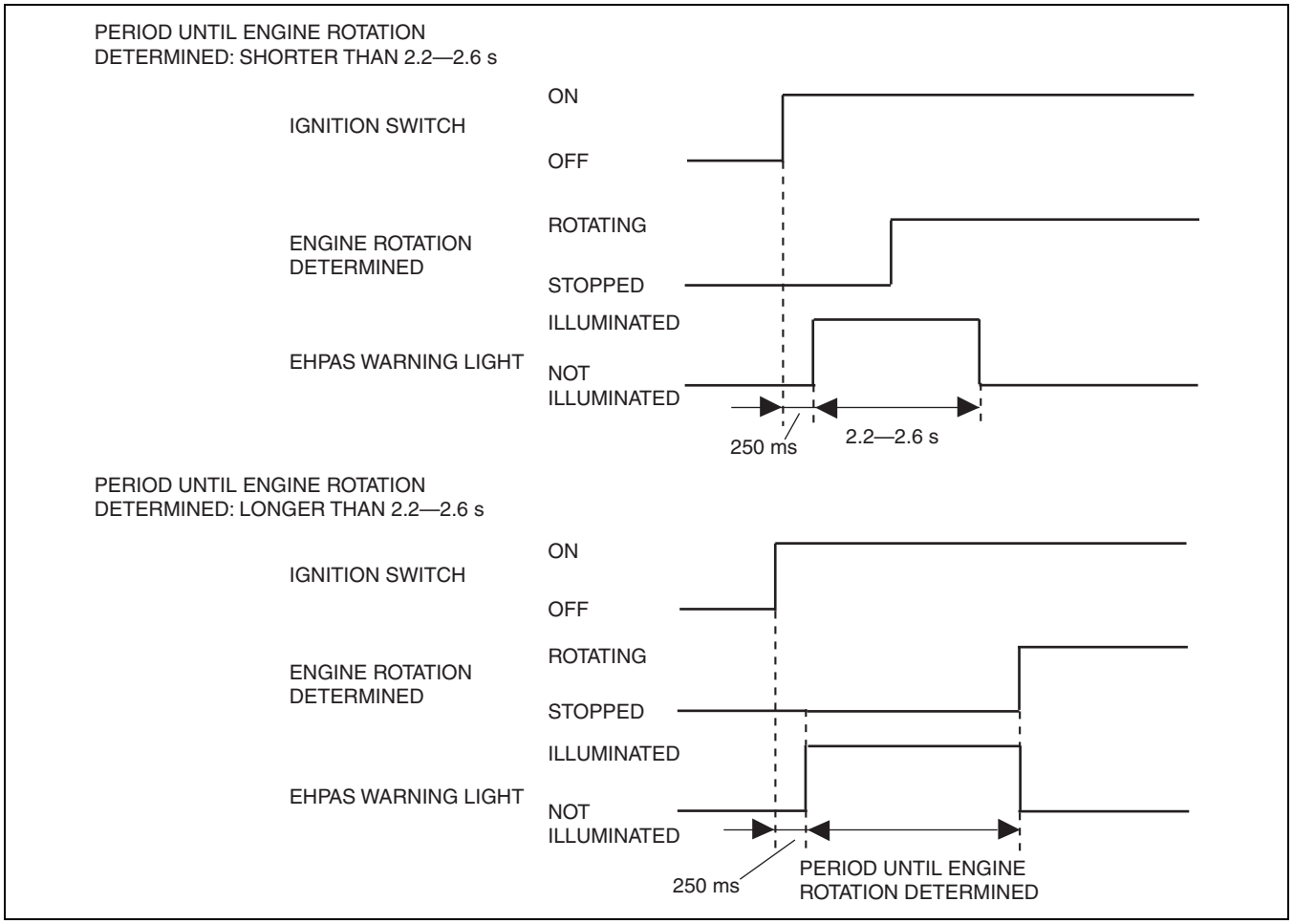
EPU602ZS3002

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)]

EPU060200000S02

Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the EHPAS control module (built into the electric power steering oil pump) when the ignition switch is at the ON position or driving the vehicle.
- The EHPAS warning light illuminates according to the following figure when the ignition switch is turned to the ON position to inspect for open circuits in the light.



EPU602ZS3001

Malfunction Display Function

- When the malfunction detection function detects a malfunction, the EHPAS warning light illuminates to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the CAN line. At the same time, malfunction detection results are sent to the memory and fail-safe functions.

Memory Function

- The memory function stores DTCs of malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition switch has been turned off (LOCK position), even if the malfunctioning signal system has returned to normal.
- Since the EHPAS control module has a built-in non-volatile memory, DTCs are not cleared even if the battery is removed. Therefore, it is necessary to clear the memory after performing repairs. Refer to the Workshop Manual for the DTC clearing procedure.

Fail-safe Function

- When the malfunction detection function determines a malfunction, the EHPAS warning light illuminates to advise the driver. At this time, the fail-safe function disables system control or gradually reduces the assist power.

DTC Table

System malfunction location	DTC (WDS or equivalent display)	Fail-safe function	
		EHPAS warning light illumination status	Control status
Electric power steering oil pump	B1238	Illuminated	Control disabled
Battery power supply	B1317	Illuminated[*1]	Control disabled[*2]
	B1318	Illuminated[*3]	Control disabled[*2]
Electric power steering oil pump (control module)	B1342	Illuminated	Control disabled
IG power supply	B1352	Illuminated	Control continues
Module configuration	B2477	Illuminated	Control disabled
Electric power steering oil pump (motor)	C1099	Illuminated	Control disabled
Steering angle sensor	C1278	Illuminated	Control continues[*4]
CAN line	U0073	Illuminated	Control continues[*5]
	U0100	Illuminated	Control continues[*5]
	U2023	Illuminated	Control continues[*6]

[*1] : Illuminates when battery voltage is more than **17 V**.
[*2] : Controlled motor speed is decreased to **391 rpm per s** until it is set at **0 rpm,** and control is disabled.
[*3] : Illuminates when battery voltage is less than **9 V**.
[*4] : Controlled steering speed is decreased to **100 degree per s** until it is set at **0 degree,** and control continues.
[*5] : Motor is stopped: Maintained at condition when stopped. Motor is rotating: Controlled vehicle speed is increased to **20 km/h {12 mph} per s** until it is set at **200 km/h {124 mph}**, engine speed is set at **1,000 rpm**, and control continues.
[*6] : Motor is stopped: Engine speed and vehicle speed assimilation stops. After the motor is restarted, vehicle speed is set at **200 km/h {124 mph}** and engine speed is set at **1,000 rpm**, and control continues. Motor is rotating: Engine speed and vehicle speed assimilation stops. Engine speed is set at **1,000 rpm** and vehicle speed is set at **200 km/h {124 mph}**, and control continues.

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)]

EPU060200000S03

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the EHPAS control module and reading them out in real-time.

Command name (WDS or equivalent display)	Input/output part	Unit/operation (WDS or equivalent display)
CCNT	DTC (Number of continuous DTCs)	—
ENGRPM	Engine speed signal	RPM
MTR_AMP	Motor operating current signal	A
RPM_ACT	Actual motor speed signal	RPM
RPM_TGT	Target motor speed signal	RPM
STEER_RATE	Steering angle sensor	°/s
TEMP_BOARD	Circuit temperature	°F/°C
VPWR	EHPAS control module supply voltage	V
VSS	Vehicle speed signal	KPH/MPH

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)]

EPU060200000S04

Outline

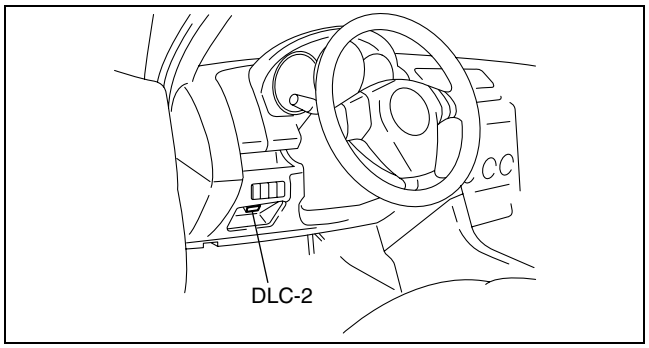
- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs) between the EHPAS control module and an external tester.

Connections/Communication Contents

	External tester	
	WDS	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: CAN_H (HS), CAN_L (HS)	Serial communication
PID/DATA monitor function	Input/output: CAN_H (HS), CAN_L (HS)	Serial communication

Serial communication

- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the WDS or equivalent to the DLC-2, diagnostic data can be sent and received between the WDS or equivalent and the EHPAS control module via CAN lines.
- The EHPAS control module receives the command signals of the malfunction detection function and PID/data monitor function from the WDS or equivalent, and sends DTCs and data regarding the operating status of each input/output part to the WDS or equivalent.



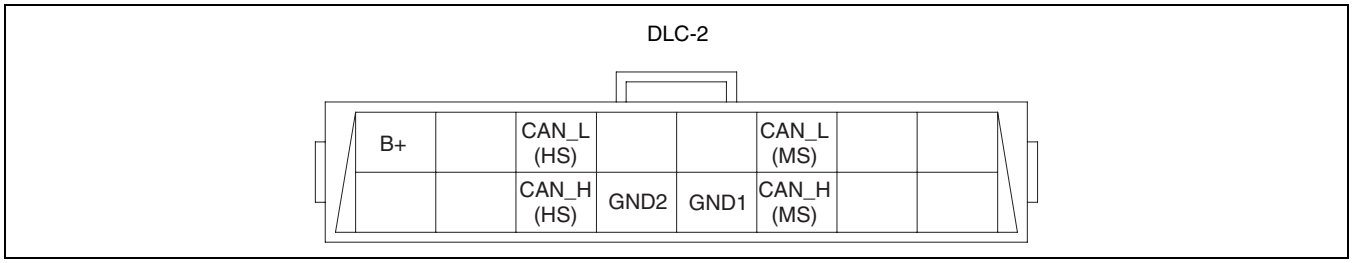
EPU402ZW3002

Diagnostic function name	Signal received	Signal sent
Malfunction detection function	DTC verification signal	Diagnostic trouble code
PID/DATA monitor function	Command signal to read selected monitor item	Monitored data for requested monitor item

DLC-2 CONSTRUCTION [ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS)]

EPU060200000S05

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been added.
- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted for this connector. The connector has a 16-pin construction that includes the CAN_H (HS), CAN_L (HS), CAN_H (MS), CAN_L (MS), GND1, GND2 and B+ terminals.



B3E0602W005

Terminal	Function
CAN_L (HS)	Serial communication Lo terminal (HS)
CAN_H (HS)	Serial communication Hi terminal (HS)
CAN_L (MS)	Serial communication Lo terminal (MS)

Terminal	Function
CAN_H (MS)	Serial communication Hi terminal (MS)
GND1	Body GND terminal
GND2	Serial communication GND terminal
B+	Battery power supply terminal

06–14 POWER STEERING

POWER STEERING OUTLINE 06–14–1
POWER STEERING STRU CTURAL VIEW 06–14–1
STEERING GEAR AND LINKAGE CONSTRUCTION 06–14–2
ELECTRIC POWER STEERING OIL PUMP CONSTRUCTION. 06–14–2
ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) OUTLINE 06–14–3
ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) WIRING DIAGRAM 06–14–3
ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) CONSTRUCTION/OPERATION 06–14–4
Construction. **06–14–4**
Operation **06–14–4**
Component Parts/Function **06–14–4**
ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) CONTROLMODULE CONSTRUCTION/OPERATION 06–14–5
Construction **06–14–5**
Operation **06–14–5**
CONTROLLER AREA NETWORK (CAN) OUTLINE 06–14–6
Data sent. **06–14–6**
Data received **06–14–6**
STEERING COLUMN CONSTRUCTION 06–14–6
ENERGY ABSORBING SYSTEM CONSTRUCTION/OPERATION 06–14–7
Construction **06–14–7**
Operation **06–14–7**

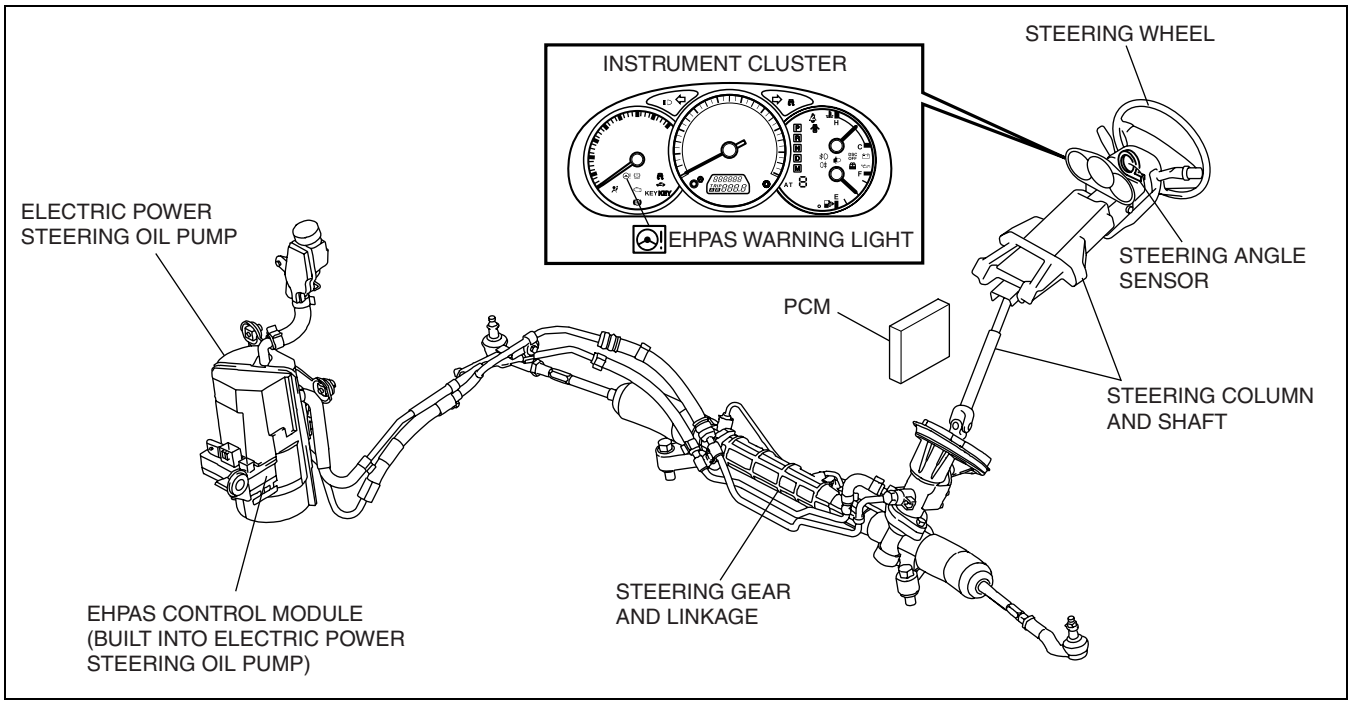
POWER STEERING OUTLINE

EPU061400000S01

- Excellent steering feel and smooth handling from low to high speeds is provided due to the adoption of electro hydraulic power assist steering (EHPAS). Engine load is reduced, improving fuel economy, due to the adoption of an electric power steering oil pump.

POWER STEERING STRUCTURAL VIEW

EPU061400000S02

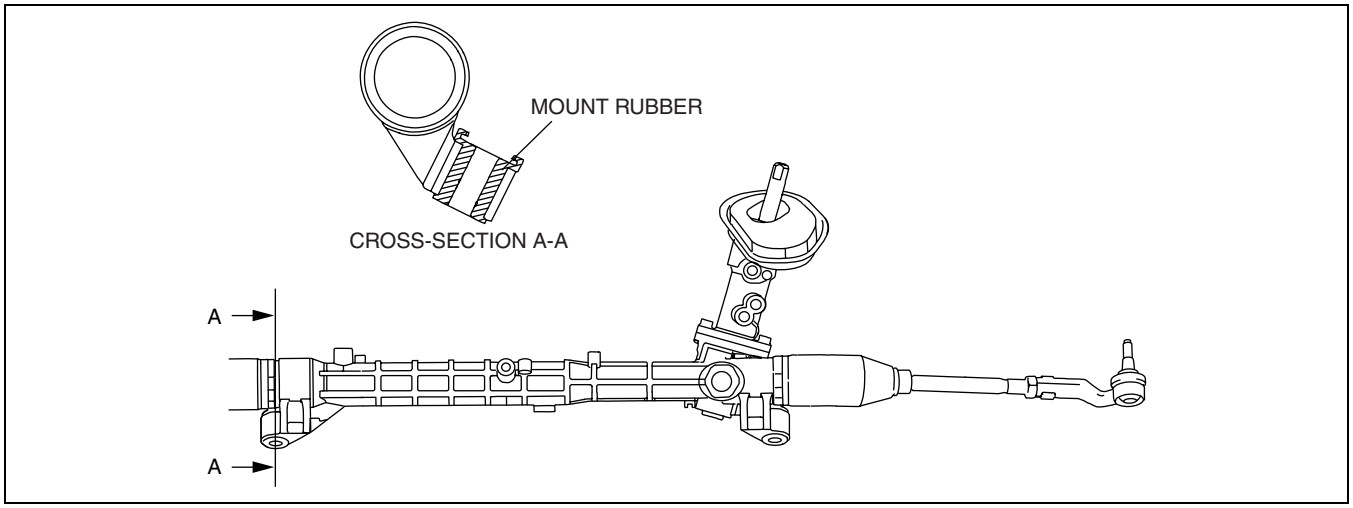


EPU614ZS3001

STEERING GEAR AND LINKAGE CONSTRUCTION

EPU061432960S01

- A size and weight reduced rack and pinion system steering gear has been adopted.
- Heightened support rigidity has been achieved due to the integration of the steering gear mounts (two locations) and gear housing, improving response and steering stability.

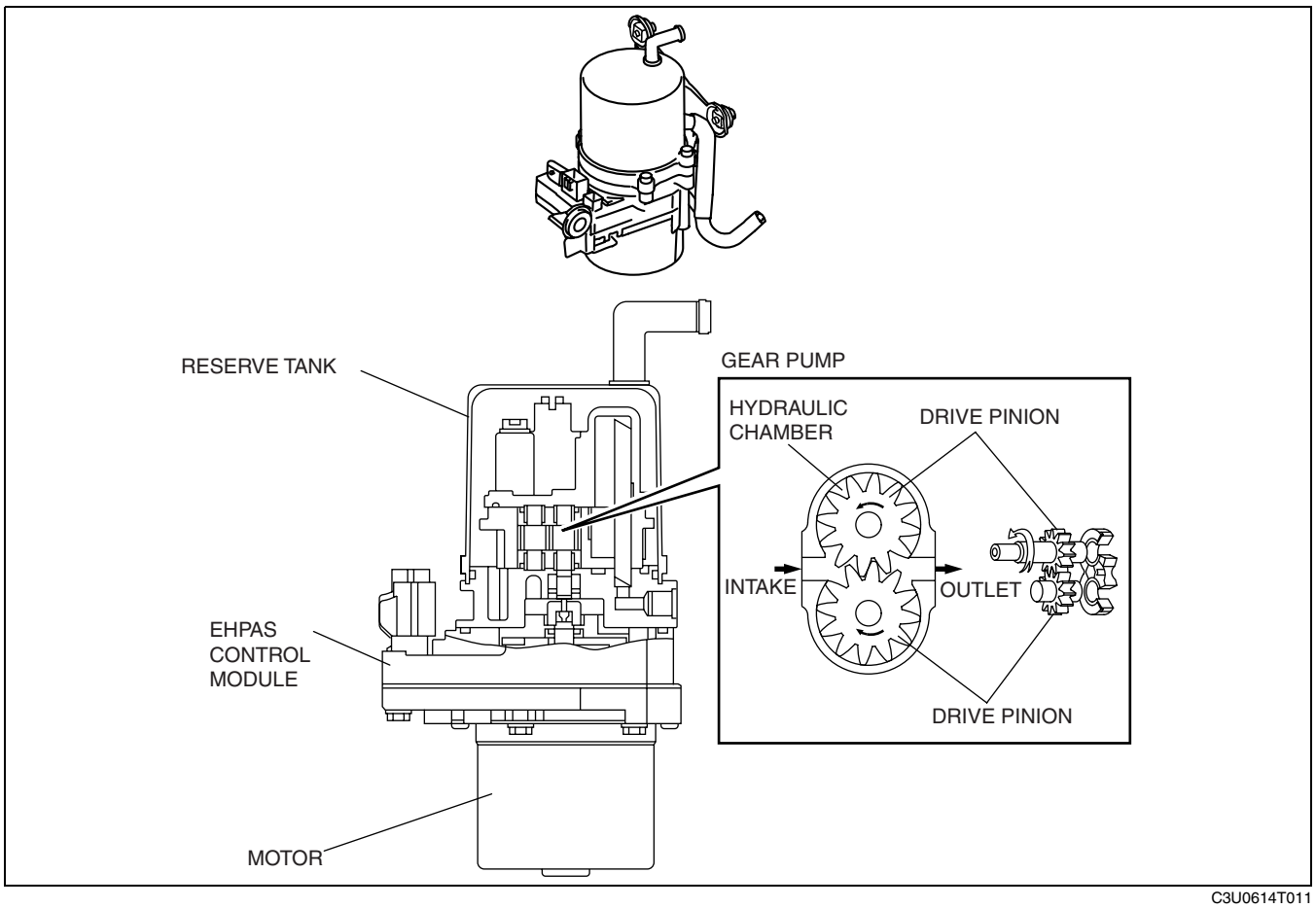


EPU614ZS3002

ELECTRIC POWER STEERING OIL PUMP CONSTRUCTION

EPU061432650S02

- Electric power steering oil pump has been adopted to reduce engine load. This allows for an improvement in fuel economy while conserving the performance and feeling of conventional hydraulic power steering.
- Size and weight reduction is achieved due to the integration of the electric power steering oil pump, motor, reserve tank, and electro hydraulic power assist steering (EHPAS) control module.



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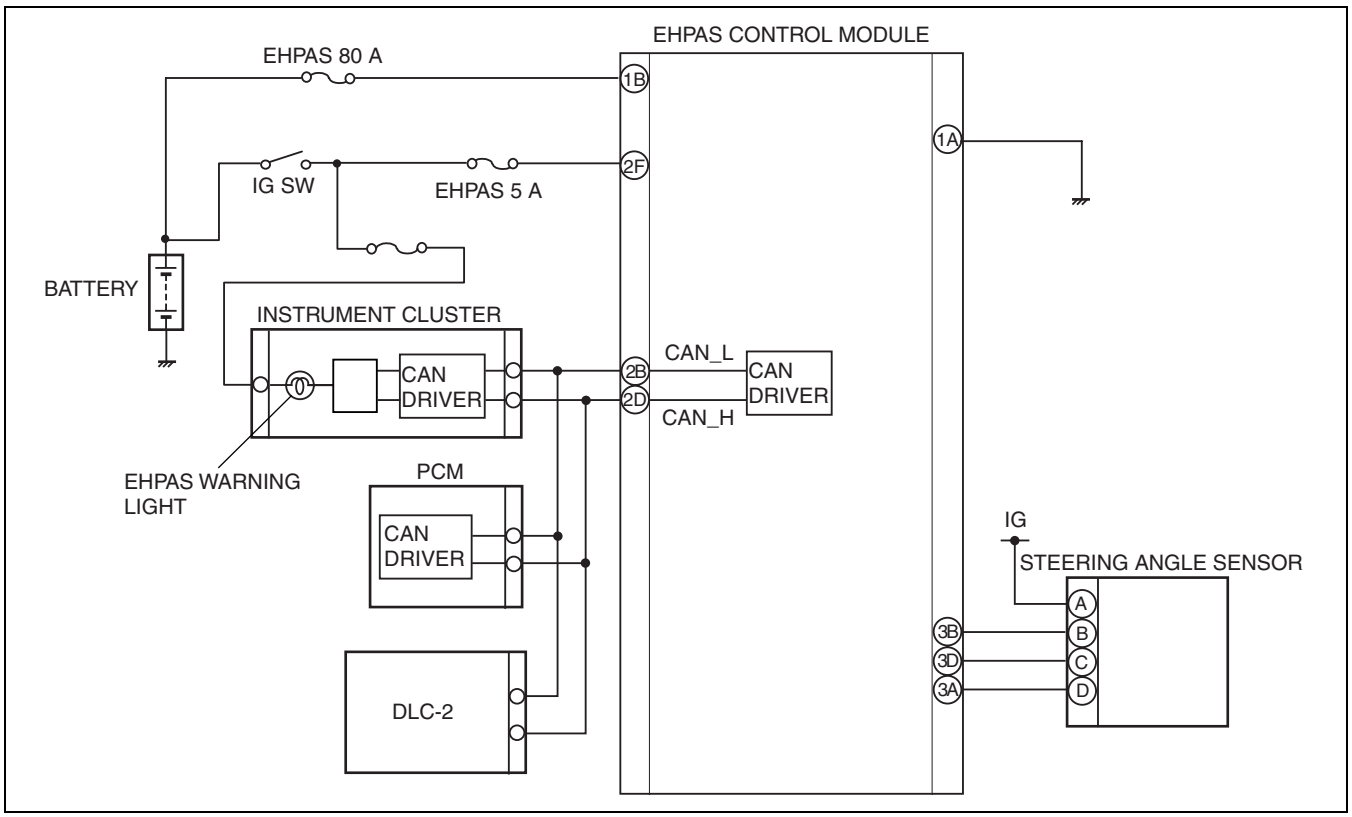
ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) OUTLINE

EPU061400000S03

- EHPAS has been adopted for all models. Engine load is reduced due to the electric power steering oil pump operating independently of the engine. This allows for an improvement in fuel economy while conserving the performance and feeling of conventional hydraulic power steering.
- When replacing the electric power steering oil pump, configuration procedure must be done to match the vehicle information with a new EHPAS control module.

ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) WIRING DIAGRAM

EPU061400000S04



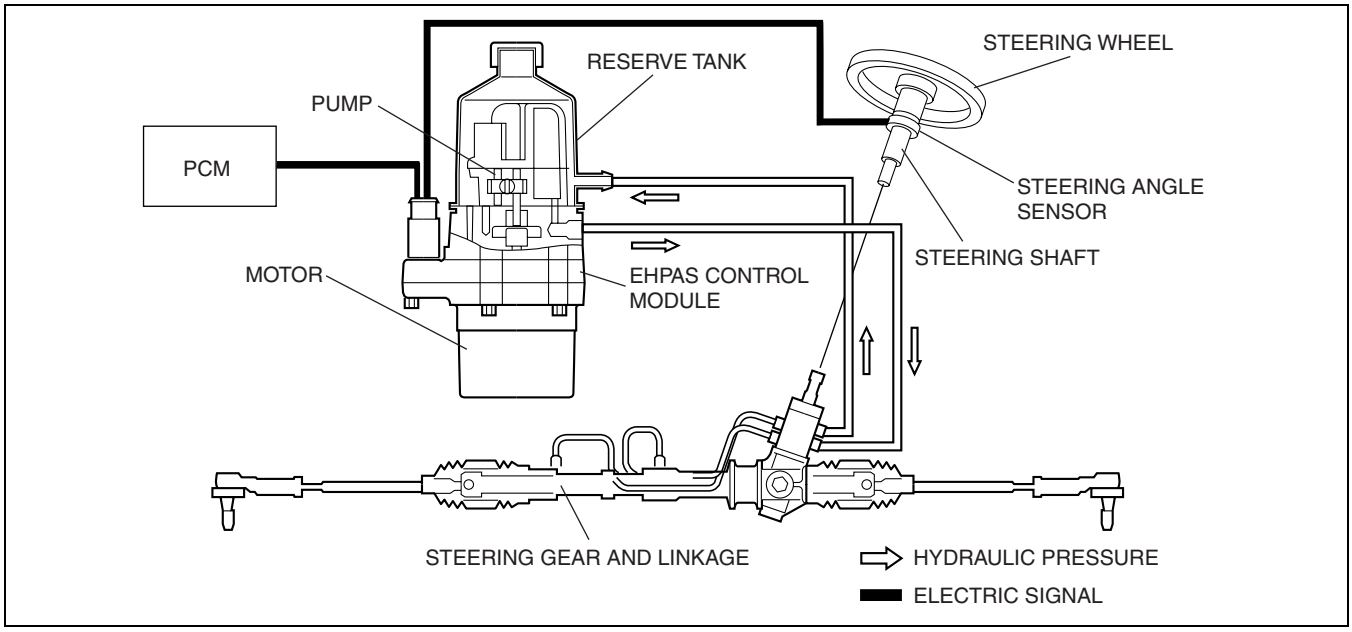
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ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) CONSTRUCTION/OPERATION

EPU061400000S05

Construction

- The EHPAS system consists of the following parts:
  - — Manual steering mechanism:
    Consists of the steering wheel, steering shaft, steering gear and linkage
  - — Assist mechanism:
    Consists of the motor and gear pump that are incorporated into the electric power steering oil pump.
  - — Control system:
    Consists of the EHPAS control module incorporated into the electric power steering oil pump, the steering angle sensor installed on the combination switch, and the vehicle and engine speed signals input from the PCM.



EPU614ZS3003

Operation

Power Assist Mechanism Operation

- According to the steering action of the driver, the steering angle sensor detects the steering speed, and then outputs a steering speed signal to the EHPAS control module. The EHPAS control module uses the steering speed signal, vehicle speed signal, and other vehicle conditions, to determine the proper motor speed.
- Based on the motor seed determined by the EHPAS control module, the current from the motor drive circuit to the EHPAS motor is controlled to within the target current amount and the oil pump operates accordingly.
- The hydraulic pressure created by the oil pump is used to assist the shaft to turn axially. Due to this, the steering operation load on the driver is reduced.

Component Parts/Function

- The EHPAS system consists of the following parts. While each part has a regular function in other systems, only the function during EHPAS control is listed.

Part name	Function
Electric power steering oil pump (with built-in motor, reserve tank, and EHPAS control module)	• Calculates the proper assist current based on the signal input from the steering angle sensor and the vehicle and engine speed signals input from the PCM via CAN lines, controls the motor and performs power assist. • Controls the on-board diagnostic system and fail-safe function when there is a malfunction in the EHPAS system.
steering angle sensor	• Transmits the steering speed to the EHPAS control module.
PCM	• Outputs the vehicle and engine speed signals to the EHPAS control module via CAN lines.
Instrument cluster	• The EHPAS warning light illuminates to advise the driver when a system malfunction is detected.

ELECTRO HYDRAULIC POWER ASSIST STEERING (EHPAS) CONTROL MODULE CONSTRUCTION/ OPERATION

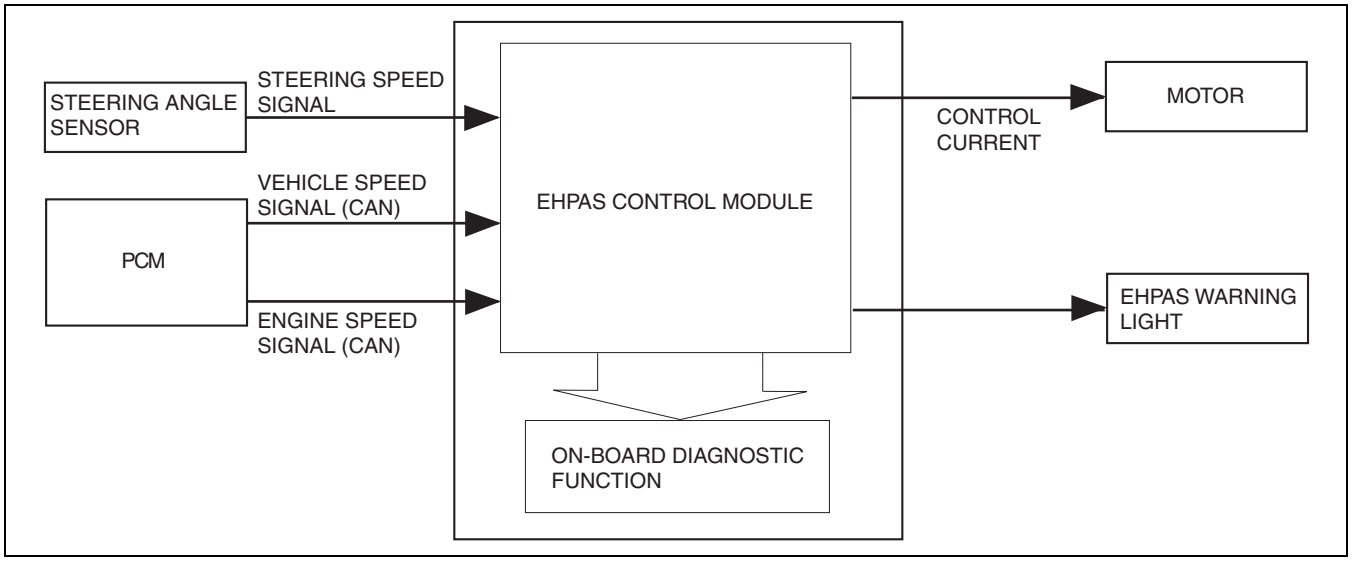
EPU061400000S06

Construction

- The EHPAS control module is built into the electric power steering oil pump.
- The module calculates the proper assist current based on the steering speed signal from the steering angle sensor installed on the steering gear and linkage, and the vehicle and engine speed signals from the PCM via CAN communication, and then outputs the control current to the motor.

Function Table

Control item	Function
Motor current control	• Calculates the proper assist current based on the steering speed, and vehicle and engine speeds, and outputs a control current to the motor.
On-board diagnostic function	• A function that allows important parts of the control system to perform self-diagnosis. In case a malfunction occurs, the EHPAS warning light illuminates to advise the driver, and at the same time a DTC is stored in the EHPAS control module. • When a malfunction is determined as a result of the on-board diagnosis, system control is suspended or limited to prevent any dangerous occurrence while driving.

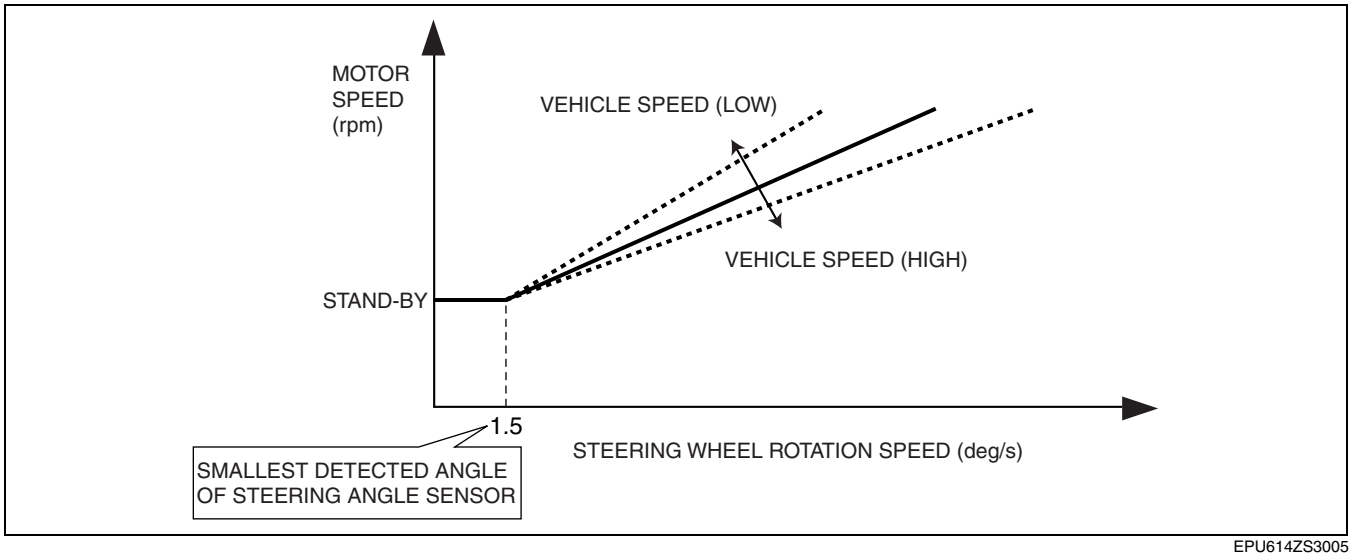


EPU614ZS3004

Operation

Motor current control

- The proper assist current is calculated based on the steering speed from the steering angle sensor, and the vehicle and engine speed signals from the PCM, and then the current output to the motor is controlled so that the motor speed is as specified according to the following table.



EPU614ZS3005

CONTROLLER AREA NETWORK (CAN) OUTLINE

EPU061400000S07

- The EHPAS control module sends and receives data to and from other modules via the CAN. Refer to Section 09 for a detailed explanation of the CAN. (See 09–40–6 CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE.)

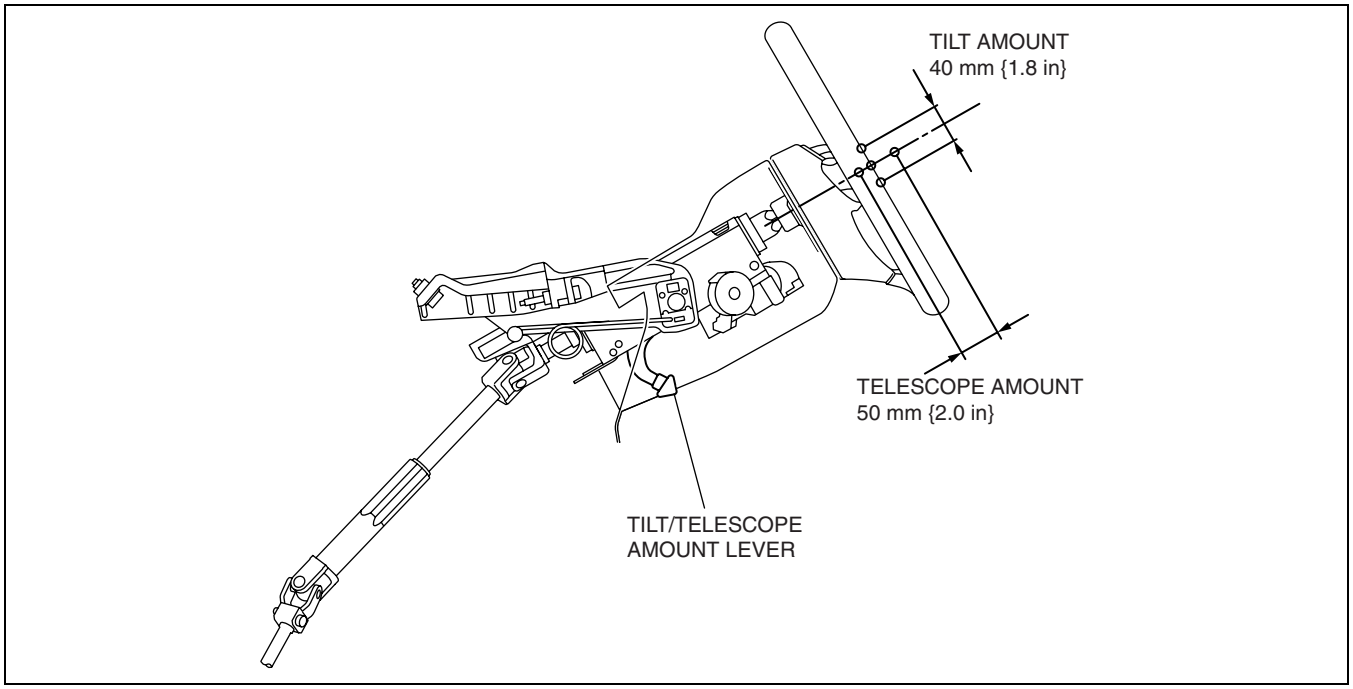
Data sent
- EHPAS warning light illumination request
- Steering angle

Data received
- Vehicle speed
- Engine speed

STEERING COLUMN CONSTRUCTION

EPU061432010S01

- A steering column equipped with a tilt / telescoping system has been adopted for all models for improved operability.
- The tilt system is adjustable by **40 mm {1.8 in}** in the up / down direction, the telescoping system is adjustable by **50 mm {2.0 in}** in the forward / backward direction.



EPU614ZS3006

ENERGY ABSORBING SYSTEM CONSTRUCTION/OPERATION

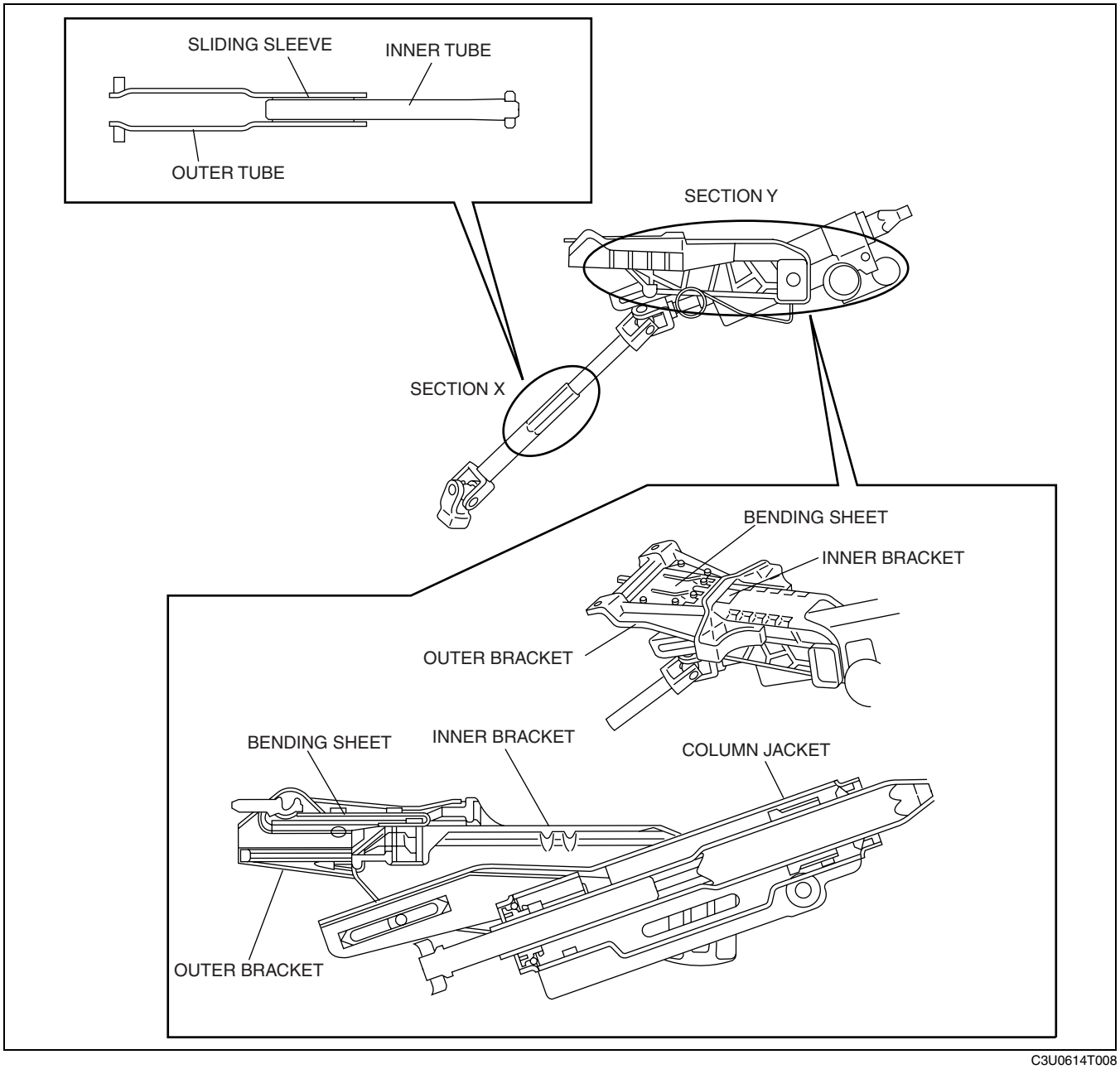
EPU061432010S02

Construction

- Due to impact absorbing mechanisms at two points on the steering shaft, when a collision occurs, the steering shaft effectively absorbs the impact energy that would be transmitted to the driver, thereby reducing injury.

Operation

- At the moment of a collision, the rearward collapse of the steering gear and linkage (first stage impact) due to the impact energy from the front causes the intermediate shaft to contract. At this time, the sliding sleeve between the outer and inner tubes of the intermediate shaft slides and the impact energy is absorbed through this friction. (Section X in the figure)
- Then, as the steering wheel contacts the body of the driver (second stage impact), the column jacket and inner bracket slide together as a single unit along the guide. The impact energy is then absorbed due to force that deforms the bending sheet connected between the inner and outer brackets. (Section Y in the figure)



C3U0614T008

HEATER, VENTILATION & AIR CONDITIONING (HVAC)

07
SECTION

OUTLINE 07-00
ON-BOARD DIAGNOSTIC 07-02
BASIC SYSTEM 07-11
CONTROL SYSTEM 07-40

07–00 OUTLINE

HVAC ABBREVIATION 07–00–1
HVAC FEATURES 07–00–1
HVAC SPECIFICATIONS
[FULL-AUTO AIR CONDITIONER] 07–00–2
Basic System **07–00–2**
Control System **07–00–2**
HVAC SPECIFICATIONS
[MANUAL AIR CONDITIONER] 07–00–3
Basic System **07–00–3**
Control System **07–00–3**

HVAC ABBREVIATION

EPU070000000S01

A/C	Air Conditioning
BCM	Body Control Module
B+	Battery Positive Voltage
CAN	Controller Area Network
CPU	Central Processing Unit
HI	High
IG	Ignition
ISO	International Organization for Standardization
LO	Low
M	Motor
MAX	Maximum
OFF	Switch Off
ON	Switch On
PCM	Powertrain Control Module
POWER MOS FET	POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR
REC	Recirculate
SW	Switch

HVAC FEATURES

EPU070000000S02

Reduced weight	• Integrated A/C unit adopted
Improved air conditioning performance	• Sub-cooling system to multi-flow condenser adopted
Improved comfort	• Air filter adopted

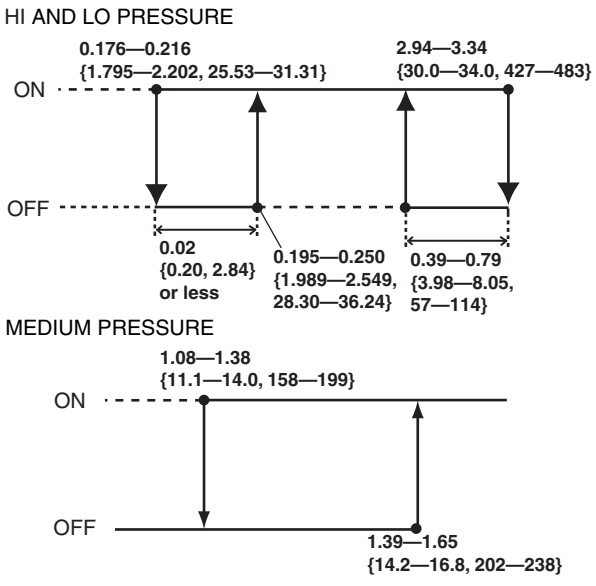
HVAC SPECIFICATIONS [FULL-AUTO AIR CONDITIONER]

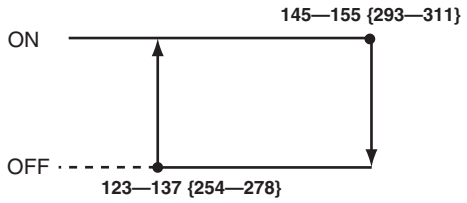
EPU070000000S03

Basic System

Item			Specification
Heating capacity		(kW {kcal/h})	4.550 {3,913}
Cooling capacity		(kW {kcal/h})	3.960 {3,406}
Refrigerant	Type		R-134a
	Regular amount (approx. quantity)	(g {oz})	500 {17.7}
A/C compressor	Type		Vane-rotary
	Discharge capacity	(ml {cc, fl oz})	120 {120, 4.06}
	Max. allowable speed	(rpm)	7,200
	Lube oil — Type		ATMOS GU10
	Lube oil — Sealed volume (approx. quantity)	(ml {cc, fl oz})	160 {160, 5.41}
Condenser	Type		Multiflow (sub-cooling type)
	Radiated heat	(kW {kcal/h})	6.600 {5,680}
	Receiver/drier capacity	(ml {cc, fl oz})	180 {180, 6.08}
	Desiccant		Synthetic zeolite
Expansion valve	Type		Block type
Evaporator	Type		Double-tank drawn cup
Temperature control			Reheat full air mix type

Control System

Item			Specification
Airflow volume (during heater operation)	Blower motor	(m^3/h)	300
Electricity consumption (during heater operation)	Blower motor	(W)	256
Airflow volume (during air conditioner operation)	Blower motor	(m^3/h)	450
Electricity consumption (during air conditioner operation)	Blower motor	(W)	256
	Magnetic clutch	(W)	49.7
Magnetic clutch clearance		(mm {in})	0.3—0.5 {0.012—0.019}
Fan type	Blower motor		Sirocco fan
Refrigerant pressure switch	Type		Triple-pressure
	Operating pressure	(MPa {kgf/cm^2, psi})	

Item		Specification
Thermal protector	Type	Bimetallic (Indirect sensing type)
	Operating temperature (°C {°F})	
Sensor	Solar radiation sensor	Photodiode
	Ambient temperature sensor	Thermistor
	Passenger compartment temperature sensor	
	Evaporator temperature sensor	
Actuator	Air intake actuator	Sliding contact type
	Air mix actuator	Potentiometer type
	Airflow mode actuator	

HVAC SPECIFICATIONS [MANUAL AIR CONDITIONER]

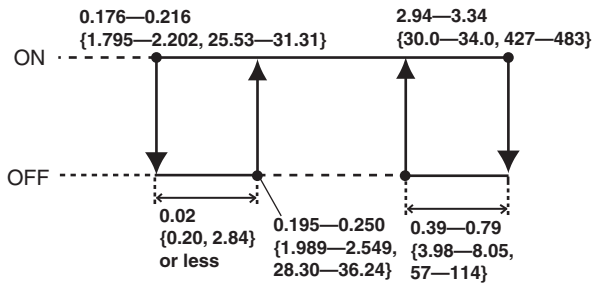
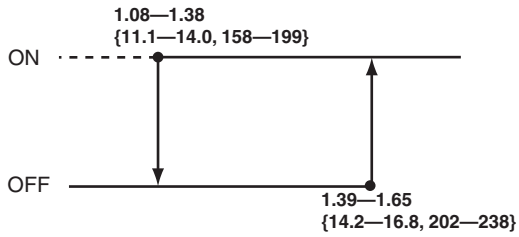
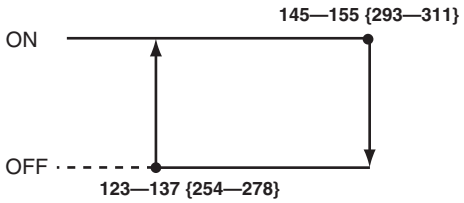
EPU070000000S04

Basic System

Item			Specification
Heating capacity (kW {kcal/h})			4.550 {3,913}
Cooling capacity (kW {kcal/h})			3.960 {3,406}
Refrigerant	Type		R-134a
	Regular amount (approx. quantity) (g {oz})		500 {17.7}
A/C compressor	Type		Vane-rotary
	Discharge capacity (ml {cc, fl oz})		120 {120, 4.06}
	Max. allowable speed (rpm)		7,200
	Lube oil	Type	ATMOS GU10
		Sealed volume (approx. quantity) (ml {cc, fl oz})	160 {160, 5.41}
Condenser	Type		Multiflow (sub-cooling type)
	Radiated heat (kW {kcal/h})		6.600 {5,680}
	Receiver/drier capacity (ml {cc, fl oz})		180 {180, 6.08}
	Desiccant		Synthetic zeolite
Expansion valve	Type		Block type
Evaporator	Type		Double-tank drawn cup
Temperature control			Reheat full air mix type

Control System

Item		Specification
Airflow volume (during heater operation)	Blower motor (m^3/h)	300
Electricity consumption (during heater operation)	Blower motor (W)	256
Airflow volume (during air conditioner operation)	Blower motor (m^3/h)	450
Electricity consumption (during air conditioner operation)	Blower motor (W)	256
	Magnetic clutch (W)	49.7
Magnetic clutch clearance (mm {in})		0.3—0.5 {0.012—0.019}
Fan type	Blower motor	Sirocco fan

Item		Specification
Refrigerant pressure switch	Type	Triple-pressure
	Operating pressure (MPa {kgf/cm^2, psi})	HI AND LO PRESSURE  MEDIUM PRESSURE 
Thermal protector	Type	Bimetallic (Indirect sensing type)
	Operating temperature (°C {°F})	
Sensor	Evaporator temperature sensor	Thermistor

07–02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC FUNCTION
OUTLINE 07–02–1
Features **07–02–1**
ON-BOARD DIAGNOSTIC FUNCTION
BLOCK DIAGRAM 07–02–1
ON-BOARD DIAGNOSTIC
FUNCTION 07–02–1
Malfunction detection function **07–02–1**
Fail-safe function **07–02–1**
Sensor Signal Delay Function **07–02–2**
Memory Function **07–02–3**
Display Function **07–02–3**
A/C Operation Check Mode **07–02–4**
DLC-2 CONSTRUCTION 07–02–5
Features **07–02–5**

ON-BOARD DIAGNOSTIC FUNCTION OUTLINE

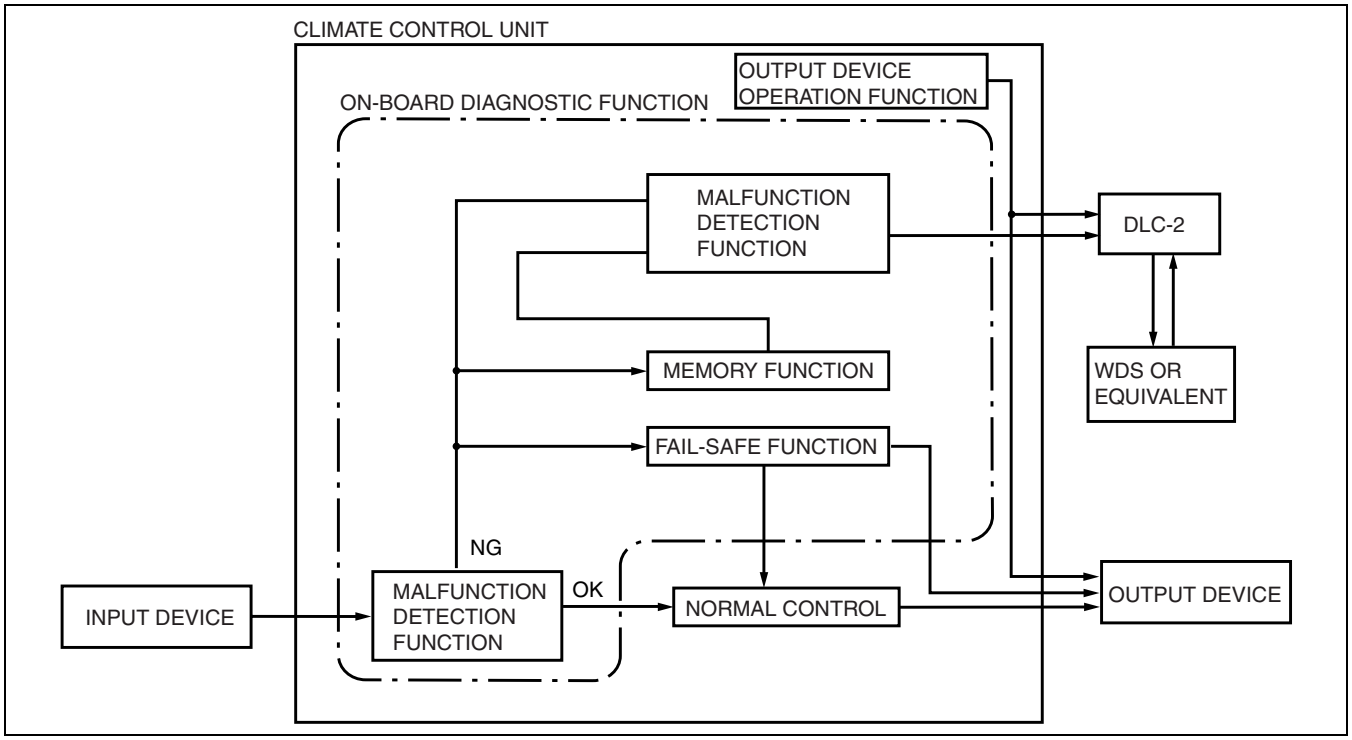
EPU070261199S01

Features

- Includes the on-board diagnostic function and A/C operation check mode. The on-board diagnostic function consists of a malfunction detection function that detects malfunctions in input/output signals, a memory function that stores detected malfunctions, a fail-safe function that prevents an operating malfunction of output parts where a malfunction is detected, and a malfunction display function that displays detected malfunctions.
- The malfunction display function and output device operation function is accessed by connecting the WDS or equivalent to the DLC-2.

ON-BOARD DIAGNOSTIC FUNCTION BLOCK DIAGRAM

EPU070261199S02



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ON-BOARD DIAGNOSTIC FUNCTION

EPU070261199S03

Malfunction detection function

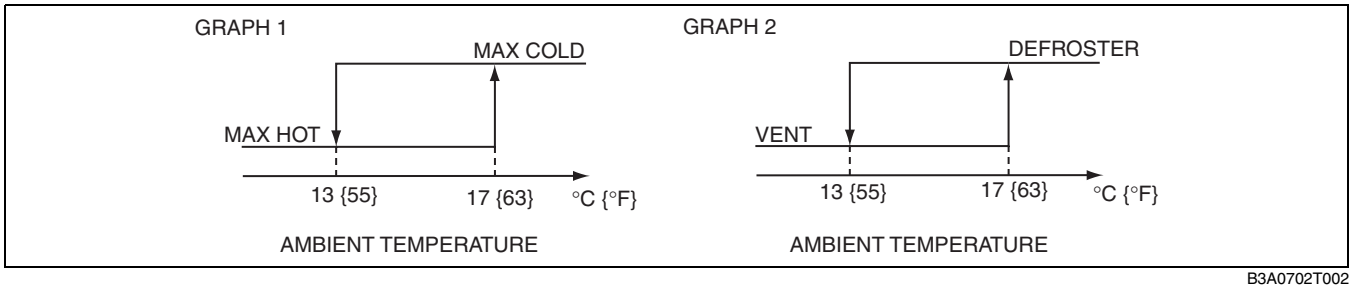
- Detects errors in the input and output signals. (The ignition switch is at the ON position or the engine is running.)
- If a malfunction is detected, a DTC is output to the DLC-2 through the malfunction display function. At the same time, malfunction detection results are sent to the fail-safe and memory functions.

Fail-safe function

- If a malfunction is detected by the malfunction detection function and a malfunction is determined, the following controls are performed to prevent an operating malfunction of the full-auto air conditioner and malfunction of output parts.

Fail-safe Function Table

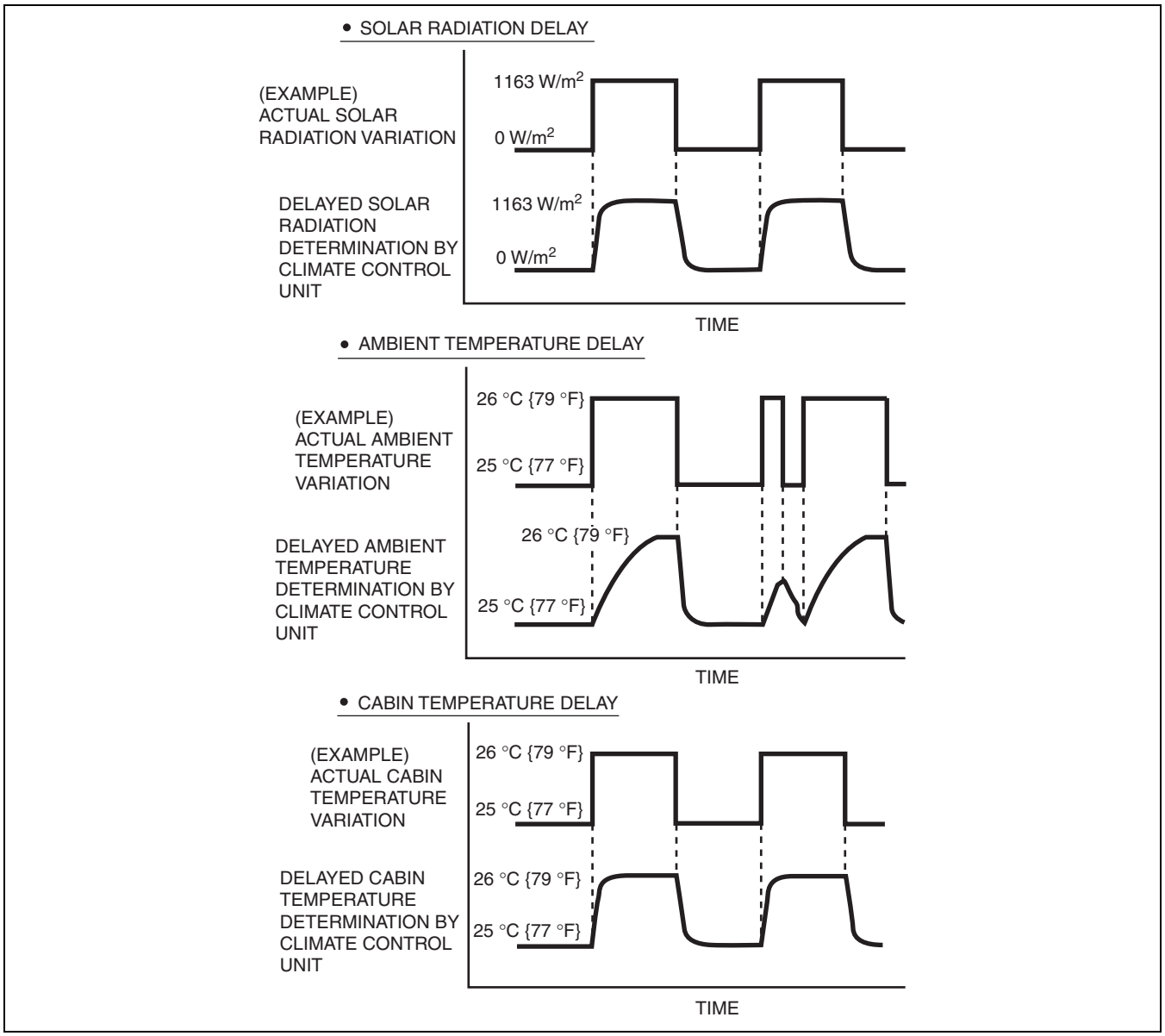
Part where malfunction is determined	Malfunction determined when IG SW at ON	Malfunction already exists when IG SW turned to ON
Passenger compartment temperature sensor	Passenger compartment temperature sensor input value is fixed at the value right before the malfunction.	Passenger compartment temperature sensor input value is fixed at **25 °C {77 °F}**.
Ambient temperature sensor	Ambient temperature sensor input value is fixed at the value right before the malfunction.	Ambient temperature sensor input value is fixed at **15 °C {59 °F}**.
Evaporator temperature sensor	Evaporator temperature sensor input value is fixed at **0 °C {32 °F}**.	←
Solar radiation sensor	Solar radiation sensor value is fixed at the value right before the malfunction.	Solar radiation sensor value is fixed at **0 W/m^2**.
Engine coolant temperature sensor	Engine coolant temperature sensor input value is fixed at **85 °C {185 °F}**.	←
Air mix actuator (potentiometer)	Air mix actuator drive signal is stopped right when the malfunction is determined. However, it is fixed at MAX COLD when the manually set temperature is at **60** and fixed at MAX HOT when the manually set temperature is at **90**.	Control based on ambient temperature. (See Graph 1.) However, it is fixed at MAX COLD when the manually set temperature is at **60** and fixed at MAX HOT when the manually set temperature is at **90**.
Airflow mode actuator (potentiometer)	Airflow mode actuator drive signal is stopped right when the malfunction is determined. • However, for manual operation using the MODE switch, only vent mode is operable. • The defroster switch is operable.	Control based on ambient temperature. (See Graph 2.) • However, for manual operation using the MODE switch, only vent mode is operable. • The defroster switch is operable.
Air mix actuator (motor lock)	Air mix actuator drive signal is stopped right when the malfunction is determined. After this, a drive signal is output to the air mix actuator and malfunction determination is performed **approx. every 5 min**.	After the IG SW is at ON, the air mix actuator drive signal is again output normally. After this, a drive signal is output to the air mix actuator and malfunction determination is performed **approx. every 5 min**.
Airflow mode actuator (motor lock)	Airflow mode actuator drive signal is stopped right when the malfunction is determined. After this, a drive signal is output to the airflow mode actuator and malfunction determination is performed **approx. every 5 min**.	After the IG SW is at ON, the airflow mode actuator drive signal is again output normally. After this, a drive signal is output to the airflow mode actuator and malfunction determination is performed **approx. every 5 min**.



B3A0702T002

Sensor Signal Delay Function

- Due to factors such as direct and intermittent sunlight (travelling through a city or highway tunnel), or radiant heat from the ground under a parked vehicle as well as the opening and closing of doors, the amount of solar radiation, and the ambient and cabin temperatures may change intermittently, partially, or suddenly. If control was performed based exactly on these variations, the air conditioning function would be negatively effected and smooth control could not occur. In order to prevent this, the climate control unit delays the input signals for solar radiation, and the ambient and cabin temperature as shown in the following figure. Stable control occurs due to the reading out of an average of all the variations.
- When the engine is re-started after being temporarily stopped, the ambient temperature sensor may detect a temperature higher then the actual ambient temperature. To prevent this, when the engine coolant temperature exceeds the specified value, the detected ambient temperature is corrected based on the data for the ambient temperature before the engine was stopped that is stored in climate control unit and control is performed accordingly.



B3A0702T003

Memory Function
- Stores the signal determined to be malfunctioning by the malfunction detection function, and the memory is not cleared even if the ignition switch is turned off (LOCK position) or the malfunction has been repaired.
- Clear stored malfunction data by connecting the WDS or equivalent to the DLC-2.

Display Function
- This function is for outputting present or past malfunctions via the DLC-2 as DTCs.
- DTCs output via the DLC-2 can be read out using the WDS or equivalent.

Malfunction Display Mode
- Present and past malfunctions in the control system circuits (open/short circuits) are detected, and the DTCs indicated in the table are displayed on the WDS or equivalent. Since once a past malfunction is stored, it will remain stored even after the malfunction has been repaired, clear past malfunctions after completing repairs.
- Clear stored past malfunctions by connecting the WDS or equivalent to the DLC-2.

DTC Table

DTC	Malfunction location	Detected condition	Memory function
B1251	Passenger compartment temperature sensor	Passenger compartment temperature sensor circuit open	X
B1253		Passenger compartment temperature sensor circuit short (body ground)	X
B1255	Ambient temperature sensor	Ambient temperature sensor circuit open	X
B1257		Ambient temperature sensor circuit short (body ground)	X
B1260	Solar radiation sensor	Solar radiation sensor circuit short (power supply)	X
B1261		Solar radiation sensor circuit short (body ground)	—
B1274	Airflow mode actuator (potentiometer)	Airflow mode actuator (potentiometer) circuit short (power supply)	X
B1275		Airflow mode actuator (potentiometer) circuit short (body ground)	X
B1282	Air mix actuator (potentiometer)	Air mix actuator (potentiometer) circuit short (power supply)	X
B1283		Air mix actuator (potentiometer) circuit short (body ground)	X
B1947	Evaporator temperature sensor	Evaporator temperature sensor circuit short (body ground)	X
B2014		Evaporator temperature sensor circuit open	X
B2832	Airflow mode actuator (motor lock)	Airflow mode actuator motor lock	X
B2834	Air mix actuator (motor lock)	Air mix actuator motor lock	X
U0140	CAN communication system	Reception error in signal from BCM	X
U0155		Reception error in signal from ICM (HEC)	X
U0516		BUS OFF error	X

A/C Operation Check Mode

- The climate control unit forces operation of output related moving parts as indicated in the operation check table regardless of input related parts, while simultaneously changing the display on the information display as well as illuminating each switch indicator light automatically. A malfunctioning part can be determined by verifying that each transition is as indicated in the operation check table through visual inspection, listening to the operation sound, or placing a hand on the air vent.

WDS or equivalent display	Target part	Operation condition	Monitor display*
All indicator light illumination verification	Climate control unit	All A/C indicator lights illuminated	All illuminated
Blower motor speed	Blower motor	OFF→ 1ST→2ND→3RD→ 4TH→ 5TH→6TH→ 7TH	1
Air mix door opening angle	Air mix door	0 %→50 %→100 %→50 %	20.0 (0%) 20.5 (50%) 21.0 (100%) 20.5 (50%)
Airflow mode door switching	Airflow mode door	VENT→BI-LEVEL → HEAT→HEAT/DEF →DEFROSTER	3
Air intake door switching (A/C compressor)	Air intake door A/C compressor	FRESH ⇔ REC ON ⇔ OFF	4

* : Shown on the information display (at the set temperature display) according to each WDS or equivalent display.

DLC-2 CONSTRUCTION

EPU070261199S04

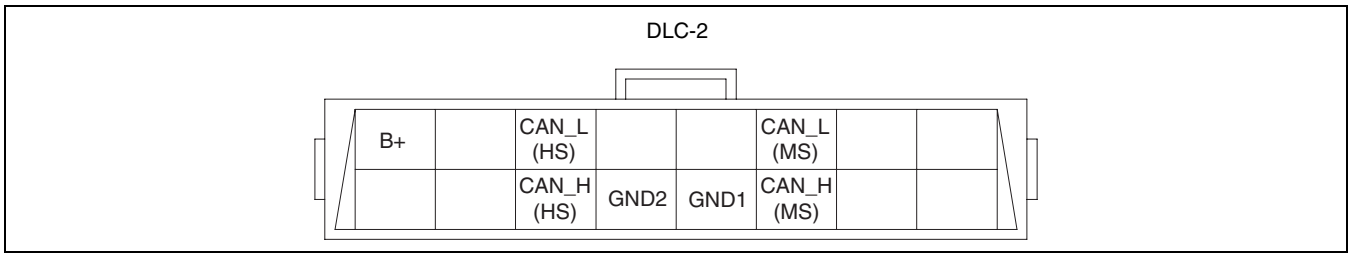
Features

Outline

- A connector (DLC-2) conforming to International Organization for Standardization (ISO) standards has been added.
- Communication using the DLC-1 FEN terminal has been eliminated. Due to this, DTCs cannot be read out using a disc monitor or circuit tester.

DLC-2

- Shape and terminal arrangement as stipulated by the ISO international standard has been adopted for this connector. The connector has a 16-pin construction that includes the CAN_H (HS), CAN_L (HS), CAN_H (MS), CAN_L (MS), GND1, GND2 and B+ terminals.



B3A0702T004

Terminal	Function
CAN_L (HS)	Serial communication LO terminal (HS)
CAN_H (HS)	Serial communication HI terminal (HS)
CAN_L (MS)	Serial communication LO terminal (MS)
CAN_H (MS)	Serial communication HI terminal (MS)
GND1	Body GND terminal
GND2	Serial communication GND terminal
B+	Battery power supply terminal

07–11 BASIC SYSTEM

BASIC SYSTEM OUTLINE **07–11–1**
BASIC SYSTEM STRUCTURAL VIEW **07–11–1**
Ventilation System **07–11–1**
Refrigerant System **07–11–2**
BASIC SYSTEM FLOW DIAGRAM **07–11–3**
Ventilation System **07–11–3**
Refrigerant System **07–11–3**
A/C UNIT CONSTRUCTION/OPERATION **07–11–4**
Construction **07–11–4**
Operation **07–11–5**
AIR FILTER FUNCTION **07–11–7**
A/C COMPRESSOR CONSTRUCTION **07–11–7**
CONDENSER CONSTRUCTION **07–11–7**
REFRIGERANT LINE CONSTRUCTION **07–11–8**
Spring-lock Coupling **07–11–8**

BASIC SYSTEM OUTLINE

EPU071100000S01

Reduced Weight

- A/C unit with integrated cooling and heater units adopted to reduce weight.

Improved Air Conditioning Performance

- Sub-cooling system with an integrated condenser and receiver/drier adopted to facilitate evaporator operation. This system also reduces the number of parts and the amount of refrigerant.

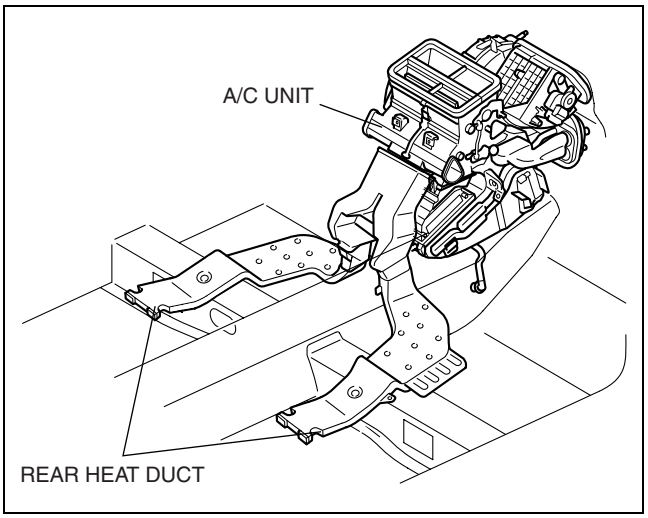
Improved Comfort

- Air filter, which cleans air flowing into passenger compartment, adopted.

BASIC SYSTEM STRUCTURAL VIEW

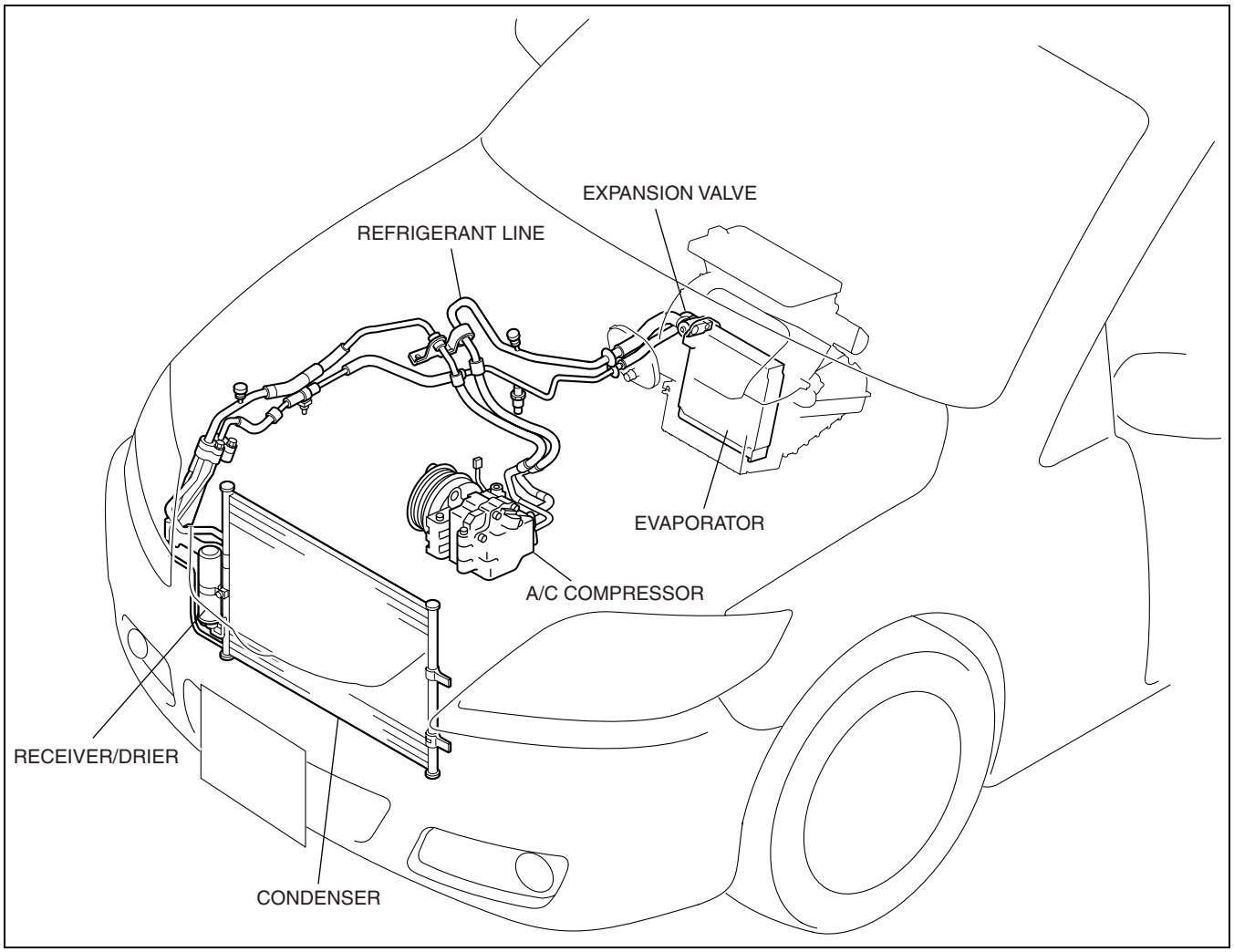
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Ventilation System



EPU711ZT3101

Refrigerant System

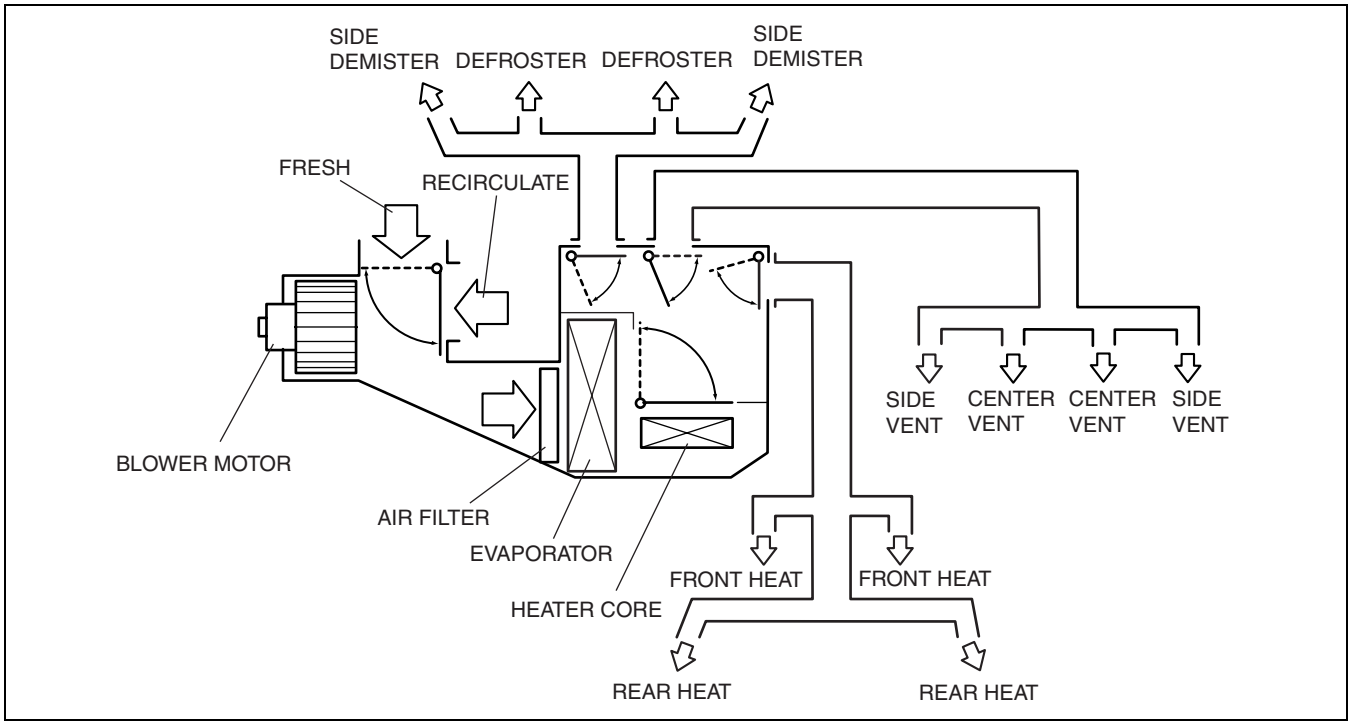


EPU711ZT3102

BASIC SYSTEM FLOW DIAGRAM

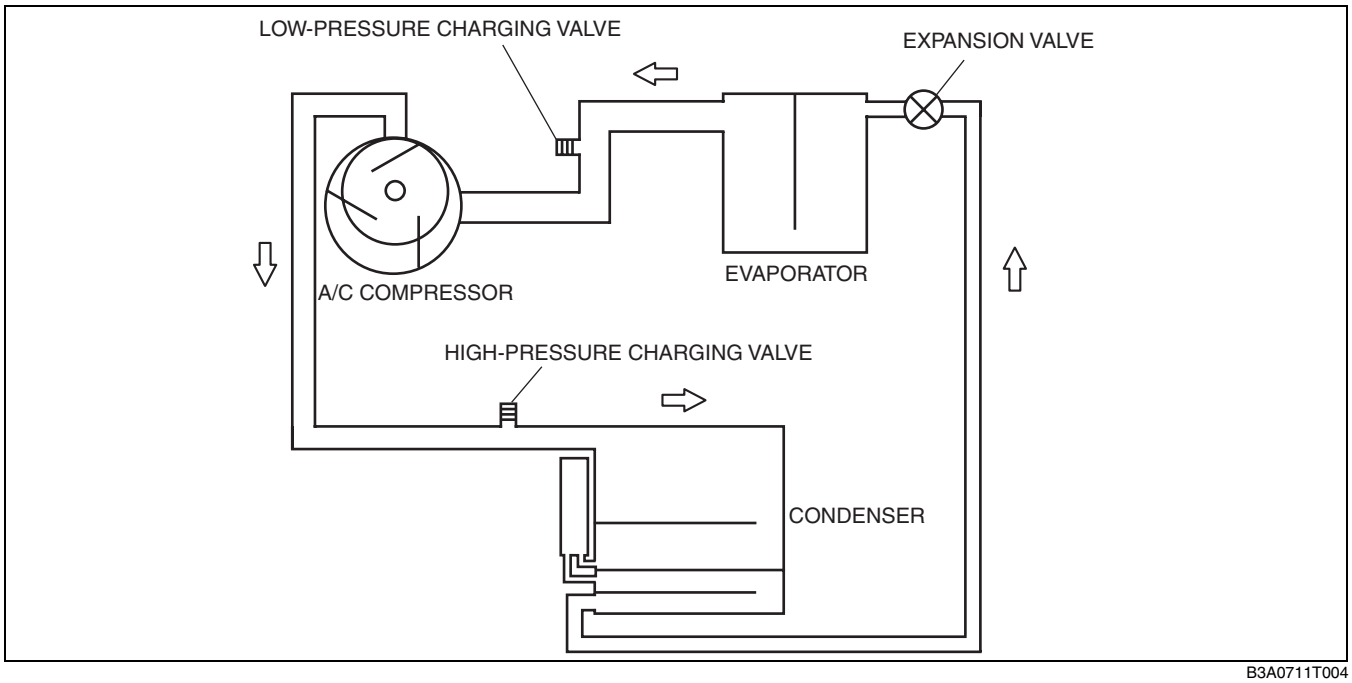
EPU071100000S03

Ventilation System



EPU711ZT3103

Refrigerant System



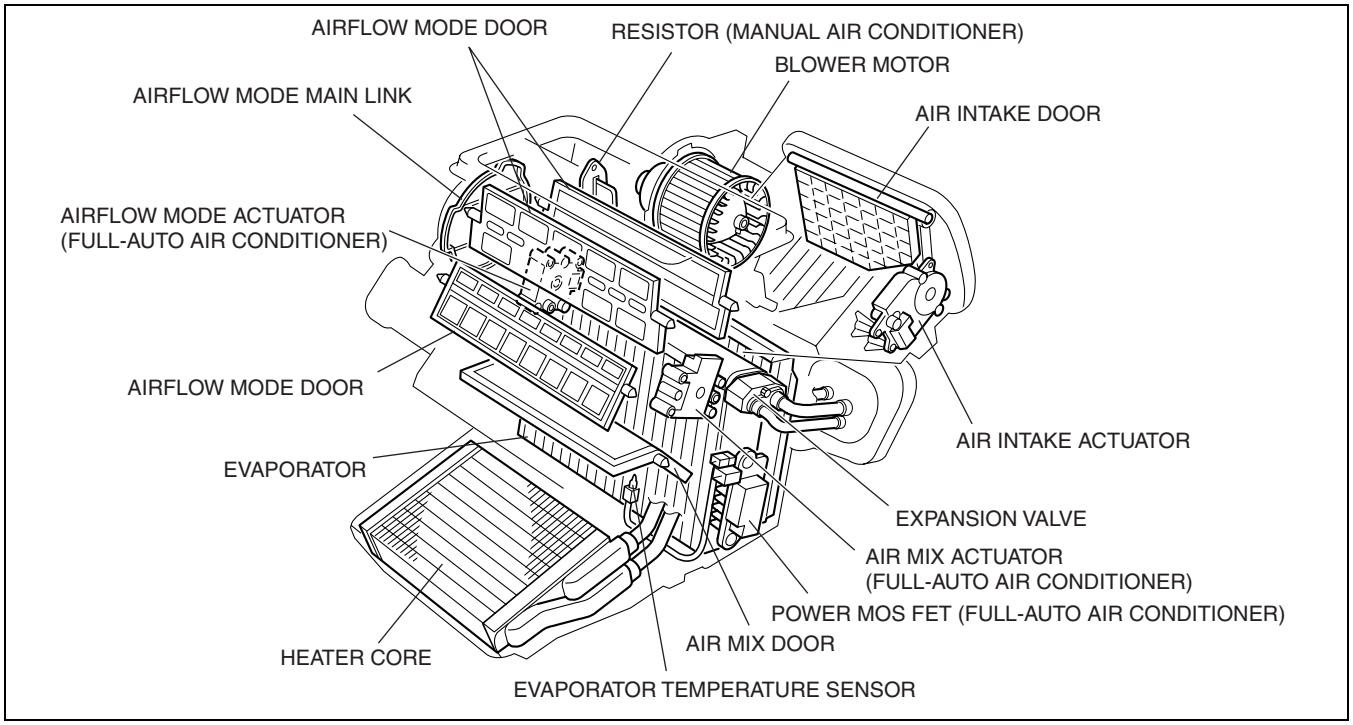
B3A0711T004

A/C UNIT CONSTRUCTION/OPERATION

EPU071161133S01

- The A/C unit which integrates the blower, cooling and heater units has been adopted.

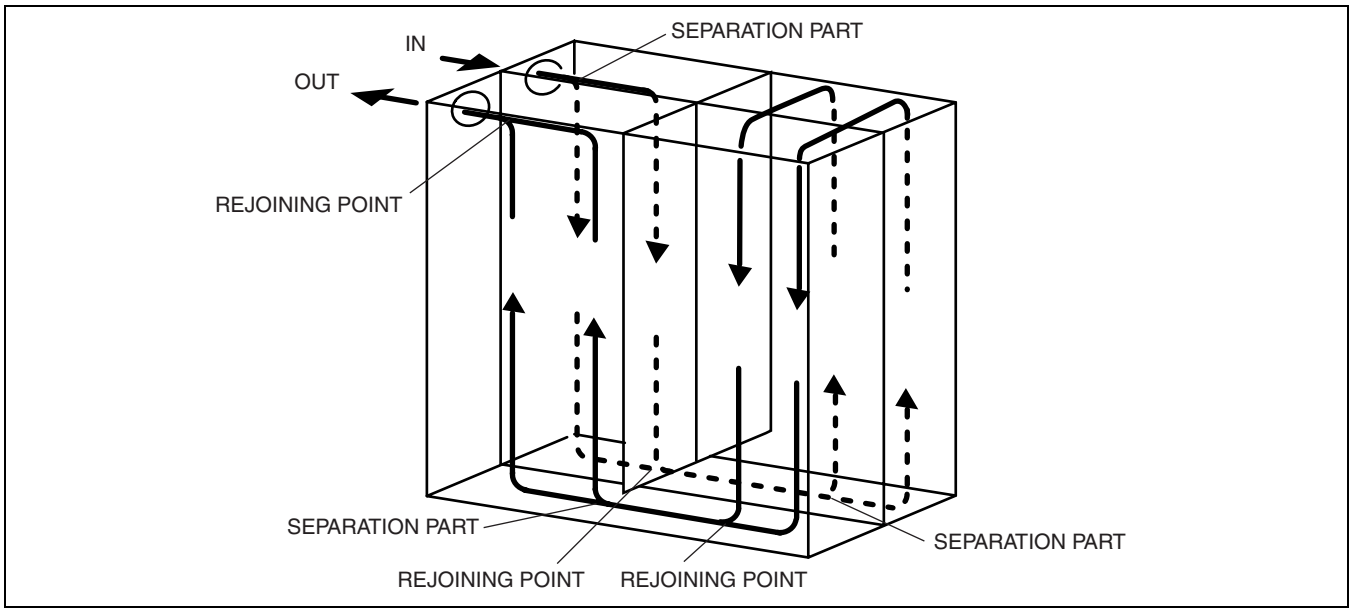
Construction



EPU711ZT3104

Evaporator

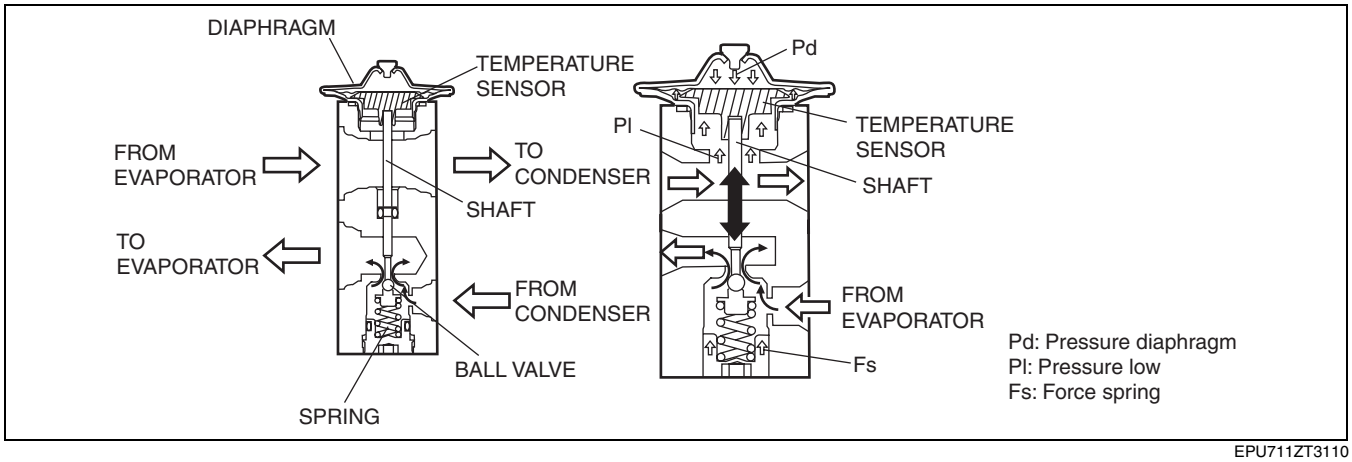
- The double-tank drawn cup is the same as the previous model except that a new refrigerant flow pattern has been adopted. Due to this, size and weight reduction is achieved while maintaining performance.



C3U0711S006

Expansion valve

- The expansion valve causes a sudden decrease in the pressure of the liquid refrigerant. This atomizes the refrigerant, making it easier for the evaporator to vaporize it. The expansion valve also regulates the flow volume of the refrigerant sent to the evaporator.
- The amount of refrigerant delivered to the evaporator is adjusted by the opening angle of the ball valve in the expansion valve.
- Opening angle is adjusted by a balance of the R-134a pressure (Pd) in the diaphragm, and a composite force of evaporator discharge pressure (PI) against the lower part of the diaphragm and spring force (Fs) pushing up the ball valve. When PI increases, the temperature of the temperature sensor near the diaphragm rises and the Pd heated by the R-134a in the diaphragm increases. When the Pd increases more than PI + Fs, the diaphragm is pushed down, and the shaft attached to end of the temperature sensor rod pushes down the ball valve, increasing the amount of liquid refrigerant flow. When the evaporator discharge refrigerant temperature decreases, PI + Fs increases more than Pd, the ball valve is pushed up, and the amount of liquid refrigerant flow decreases.

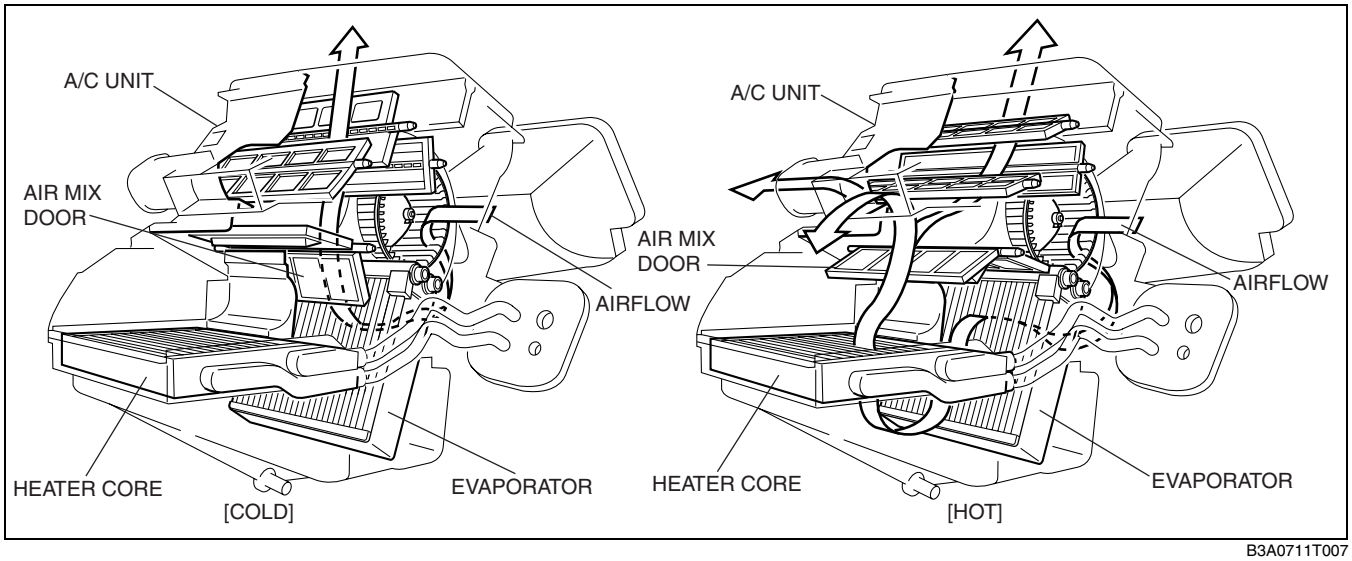


EPU711ZT3110

Operation

Air Mix Door Operation

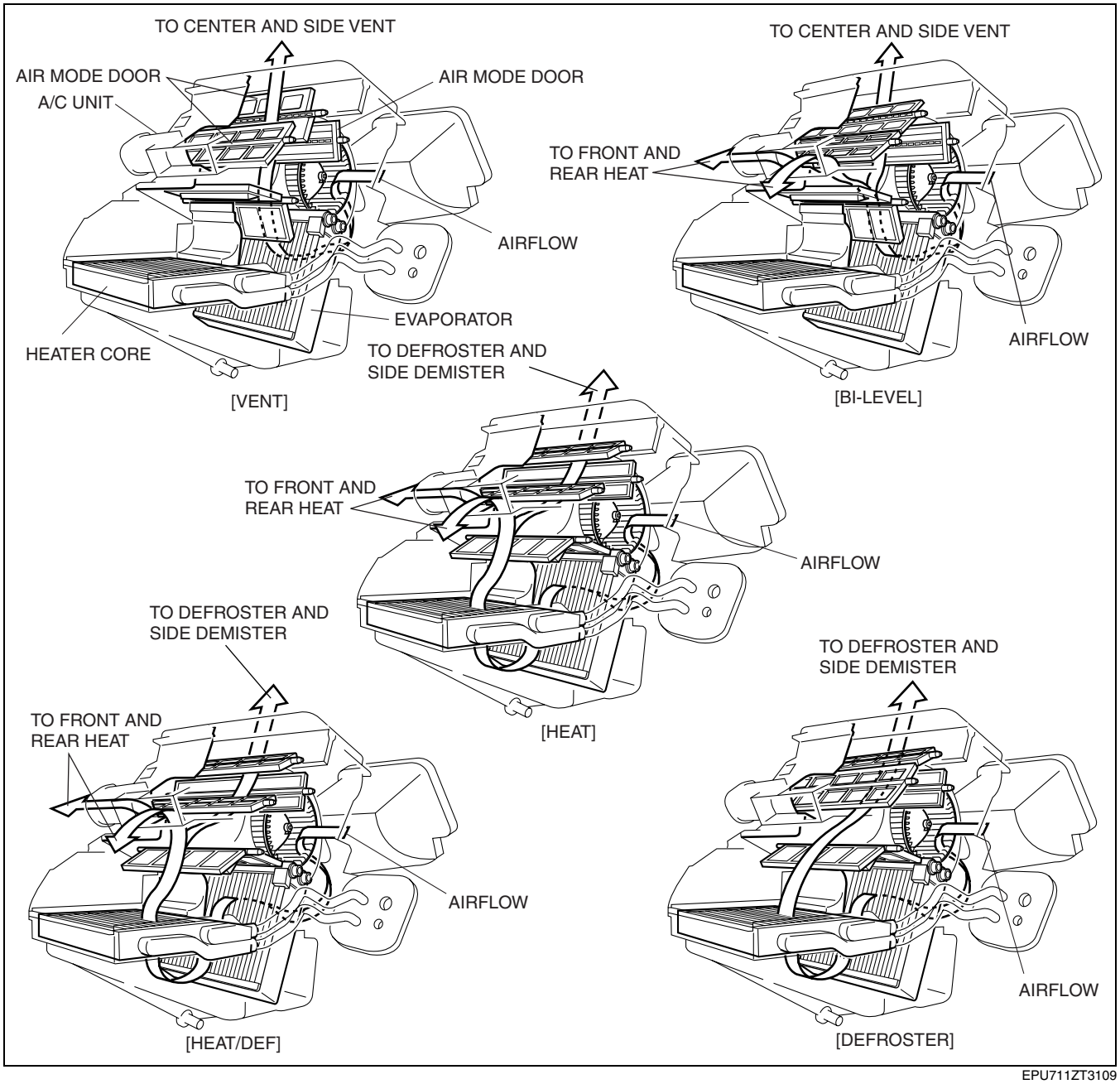
- The air mix door, installed in the A/C unit, controls HOT or COLD position, depending on the position of the temperature control dial. As a result, airflow distribution changes, and the airflow temperature is controlled.



B3A0711T007

Airflow Mode Door Operation

- The airflow mode doors move to VENT, BI-LEVEL, HEAT, HEAT/DEF, or DEFROSTER position, depending on the position of the airflow mode selector dial. As a result, airflow mode changes.

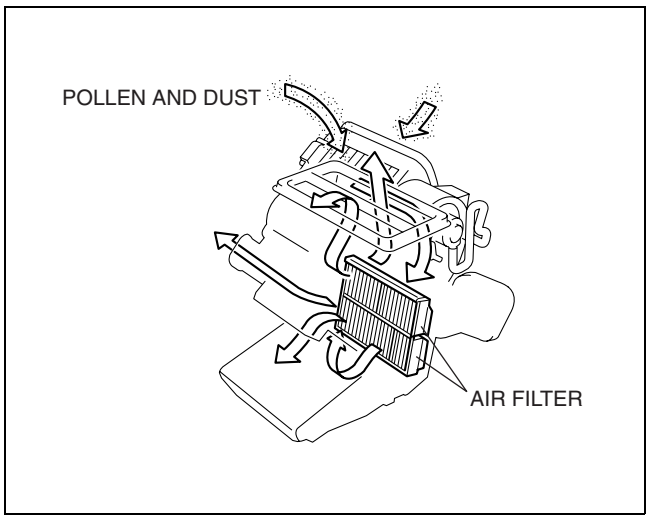


EPU711ZT3109

AIR FILTER FUNCTION

EPU071161142S01

- An air filter that can removes pollen and dust has been adopted.
- The dust filter removes pollen and dust.
- The air filter cannot be reused and must be replaced periodically.

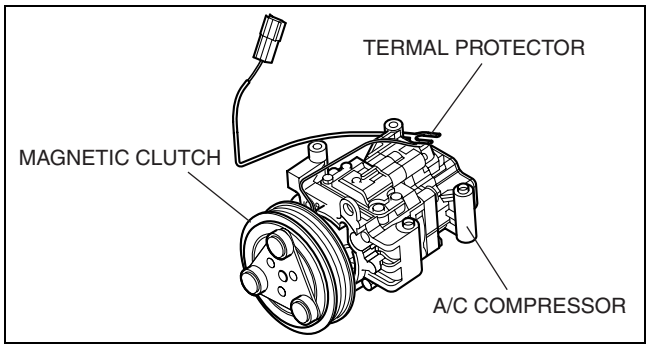


EPU711ZT3105

A/C COMPRESSOR CONSTRUCTION

EPU071161450S01

- Consists of the following parts:
- A rotary-vane type (H12A1) A/C compressor body has been adopted for size, weight, and operation vibration reduction.

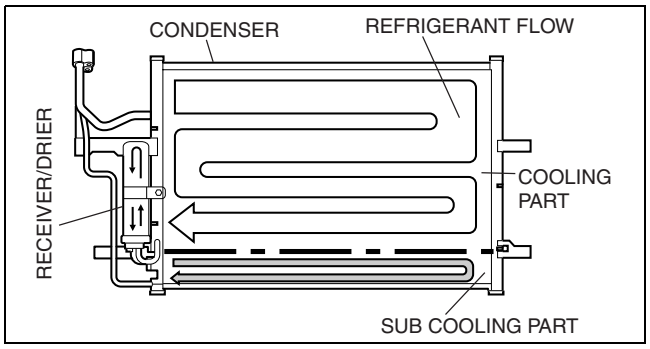


EPU711ZT3106

CONDENSER CONSTRUCTION

EPU071161480S01

- A sub cool condenser has been adopted. It is a multi-flow condenser which is equipped with a sub cooling part and integrated with a receiver/drier.
- The sub cool condenser separates liquid-gas refrigerant initially cooled at the condenser via the receiver/drier, where it returns again to the condenser sub cooling part and is cooled, accelerating liquefaction and improving cooling capacity.

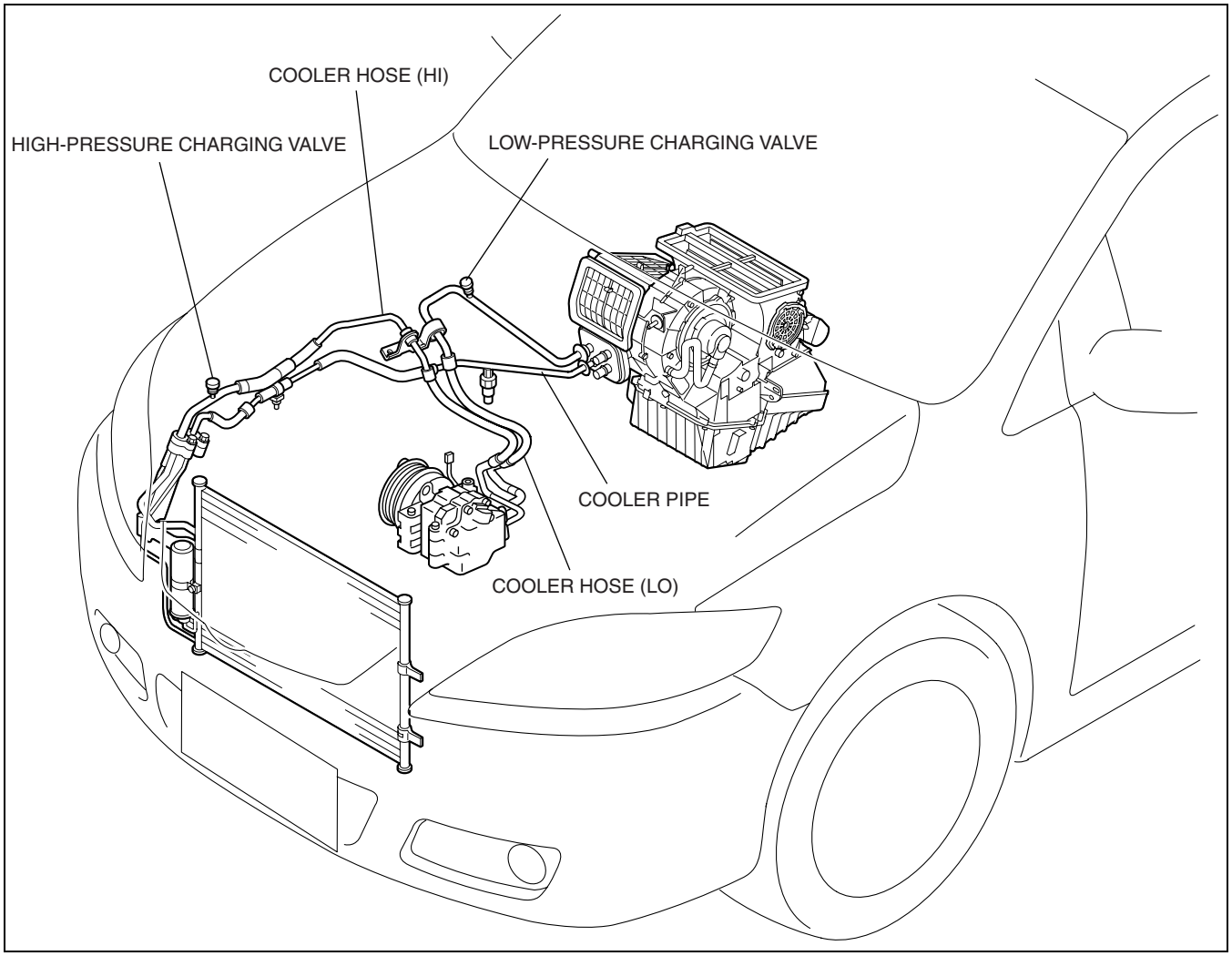


C3U0711S014

REFRIGERANT LINE CONSTRUCTION

EPU07116460S01

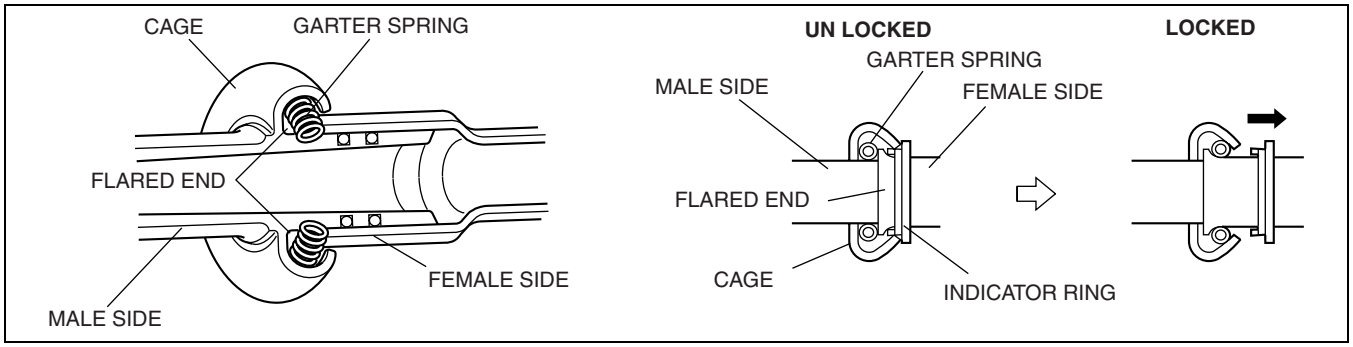
- The pipes in the refrigerant lines are made of aluminum alloy and the hoses are made of rubber (flexible hose).
- A high-pressure charging valve is located on the cooler hose (HI) and a low-pressure charging valve is located on the cooler hose (LO).



EPU711ZT3107

Spring-lock Coupling

- Spring-lock coupling is used for pipe-to-pipe connections. As a result, pipes can be connected easily, maintenance of torque is unnecessary, and serviceability is improved.
- There is a garter spring in the cage on the male side (cooler pipe or cooler hose (LO)) of spring-lock coupling type and the end of the pipe on the female side (A/C unit) is flared. When the pipes are being connected, the flared end of the female side forces the garter spring on the female side to expand, and by fully inserting the male side into the female side, the flared end is locked by the garter spring. When the cooler pipe or cooler hose (LO) is replaced, the additional indicator ring comes out after connecting, indicating that the flared end is locked.



EPU711ZT3108

07–40 CONTROL SYSTEM

CONTROL SYSTEM OUTLINE 07–40–2
CONTROL SYSTEM STRUCTURAL VIEW [FULL-AUTO AIR CONDITIONER] 07–40–2
CONTROL SYSTEM STRUCTURAL VIEW [MANUAL AIR CONDITIONER] 07–40–3
CONTROL SYSTEM WIRING DIAGRAM [FULL-AUTO AIR CONDITIONER] 07–40–4
CONTROL SYSTEM WIRING DIAGRAM [MANUAL AIR CONDITIONER] 07–40–5
AIR INTAKE ACTUATOR CONSTRUCTION 07–40–6
AIR MIX ACTUATOR CONSTRUCTION 07–40–6
AIRFLOW MODE ACTUATOR CONSTRUCTION 07–40–6
BLOWER MOTOR CONSTRUCTION 07–40–7
POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (POWER MOS FET) CONSTRUCTION 07–40–7
Function **07–40–7**
Construction/Operation **07–40–7**
RESISTOR CONSTRUCTION 07–40–8
Construction **07–40–8**
MAGNETIC CLUTCH CONSTRUCTION 07–40–8
THERMAL PROTECTOR CONSTRUCTION 07–40–8
REFRIGERANT PRESSURE SWITCH CONSTRUCTION 07–40–9
Medium-pressure switch **07–40–9**
SOLAR RADIATION SENSOR CONSTRUCTION 07–40–9
AMBIENT TEMPERATURE SENSOR CONSTRUCTION 07–40–9
PASSENGER COMPARTMENT TEMPERATURE SENSOR CONSTRUCTION 07–40–10
EVAPORATOR TEMPERATURE SENSOR CONSTRUCTION 07–40–10
CLIMATE CONTROL UNIT CONSTRUCTION [FULL-AUTO AIR CONDITIONER] 07–40–10
CAN (CONTROLLER AREA NETWORK) OUTLINE 07–40–11
Data sent/received **07–40–11**
FULL-AUTO AIR CONDITIONER FUNCTION 07–40–12
Block Diagram **07–40–12**
Control Table **07–40–12**
Control Type Transition by Switch Operation **07–40–13**
AIRFLOW TEMPERATURE CONTROL OUTLINE 07–40–14
Features **07–40–14**
AIRFLOW TEMPERATURE CONTROL SYSTEM DIAGRAM 07–40–15
AIRFLOW TEMPERATURE CONTROL OPERATION 07–40–15
Airflow Temperature Automatic Control **07–40–15**
Correction **07–40–16**
AIRFLOW VOLUME CONTROL OUTLINE 07–40–17
Features **07–40–17**
AIRFLOW VOLUME CONTROL SYSTEM DIAGRAM 07–40–17
AIRFLOW VOLUME CONTROL OPERATION 07–40–17
Airflow Volume Automatic Control **07–40–17**
Correction **07–40–18**
Airflow Volume Manual Control **07–40–19**
AIRFLOW MODE CONTROL OUTLINE 07–40–19
Features **07–40–19**
AIRFLOW MODE CONTROL SYSTEM DIAGRAM 07–40–19
AIRFLOW MODE CONTROL OPERATION 07–40–20
Airflow Mode Automatic Control **07–40–20**
Correction **07–40–20**
Airflow Mode Manual Control **07–40–20**
AIR INTAKE CONTROL OUTLINE 07–40–20
Features **07–40–20**
AIR INTAKE CONTROL SYSTEM DIAGRAM 07–40–21
AIR INTAKE CONTROL OPERATION 07–40–21
Air Intake Automatic Control **07–40–21**
Correction **07–40–21**
Air Intake Manual Control **07–40–21**
A/C COMPRESSOR CONTROL OUTLINE 07–40–21
Features **07–40–21**
A/C COMPRESSOR CONTROL SYSTEM DIAGRAM 07–40–22
A/C COMPRESSOR CONTROL OPERATION 07–40–22
A/C Compressor Automatic Control **07–40–22**
Correction **07–40–22**
A/C Compressor Manual Control **07–40–23**
CLIMATE CONTROL UNIT CONSTRUCTION [MANUAL AIR CONDITIONER] 07–40–23
MANUAL AIR CONDITIONER CONTROL SYSTEM 07–40–24
Block Diagram **07–40–24**
Outline of Control System **07–40–24**
Defroster Control **07–40–24**
A/C Compressor Control **07–40–25**

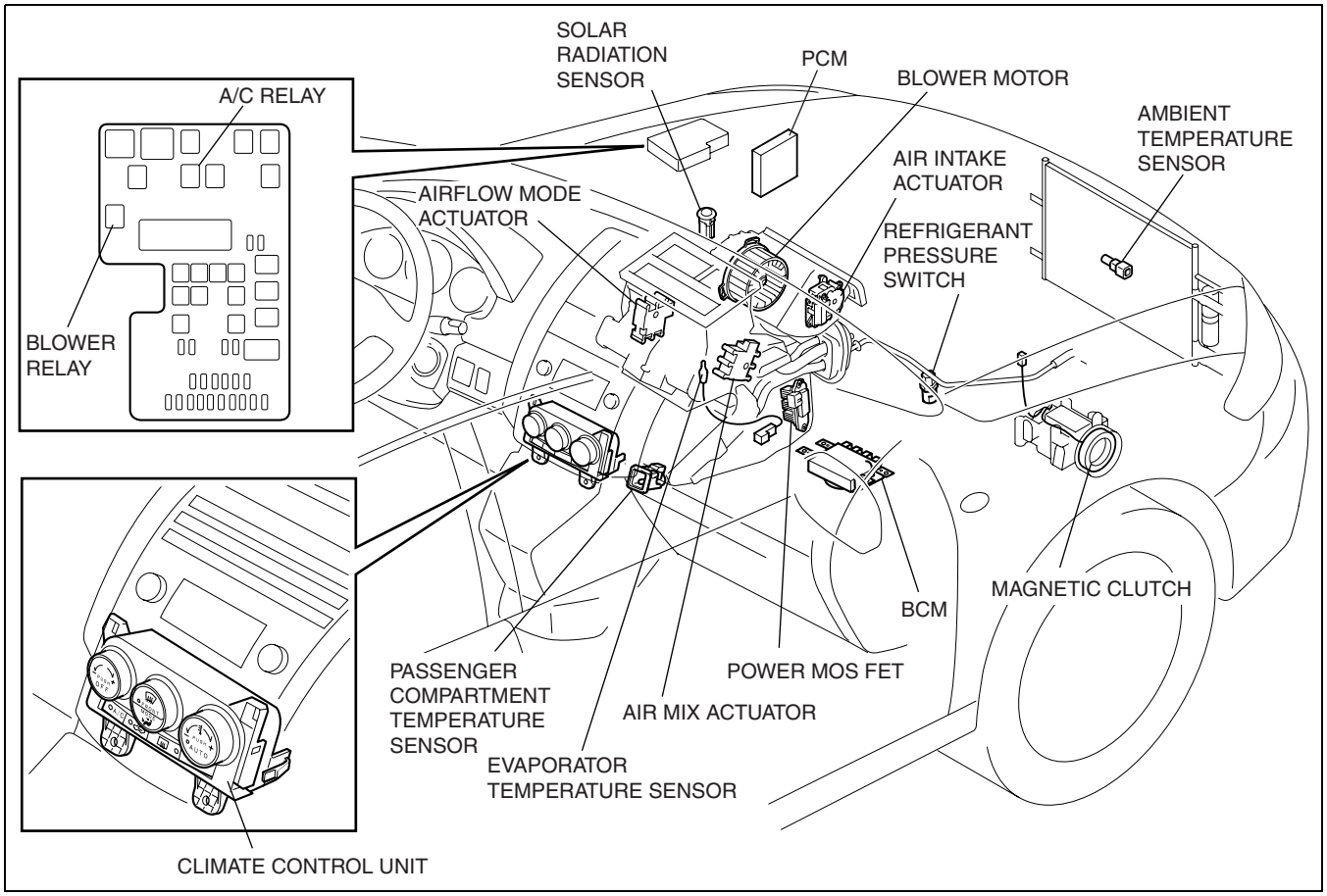
CONTROL SYSTEM OUTLINE

EPU074000000S01

Reduced fuel consumption when the A/C is operating (Reduced idling increase amount when A/C compressor is operating)	• Refrigerant pressure switch with medium-pressure switch adopted
Improved operability	• Climate control unit with enlarged operation dial and switch adopted
Simplification, size reduction	• Climate control unit integrated with A/C amplifier adopted. (Full-auto air conditioner)
Wiring harness simplification	• CAN for communication between the PCM, audio, meter, and climate control unit adopted (Full-auto air conditioner)
Improved Visibility	• To improve windshield and front door glass defogging, the climate control unit is designed to automatically turn the air intake mode to FRESH when the airflow mode selector dial is turned to HEAT, HEAT/DEF, DEFROSTER position. (Manual air conditioner)

CONTROL SYSTEM STRUCTURAL VIEW [FULL-AUTO AIR CONDITIONER]

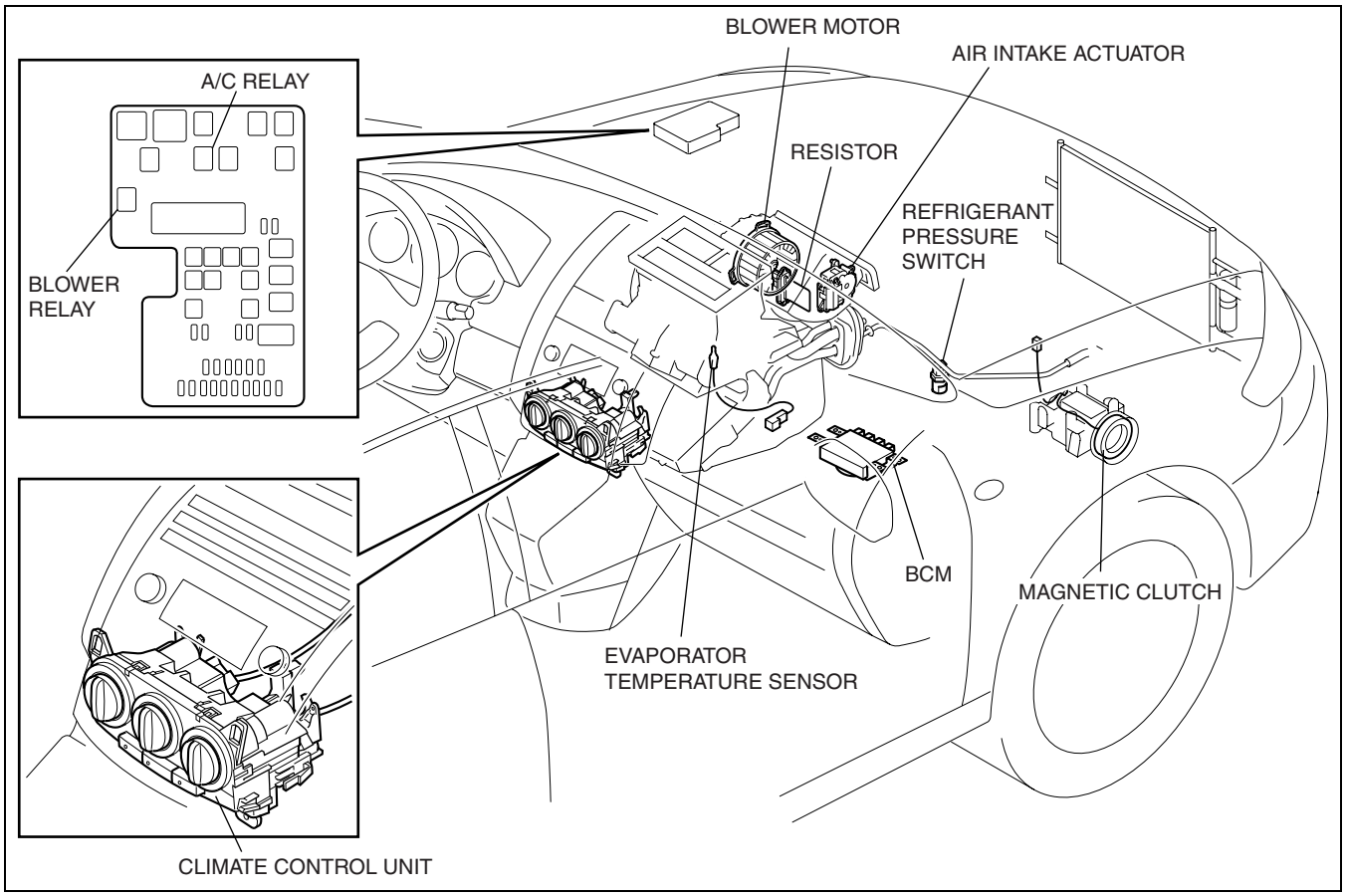
EPU074000000S02



EPU740ZT3101

CONTROL SYSTEM STRUCTURAL VIEW [MANUAL AIR CONDITIONER]

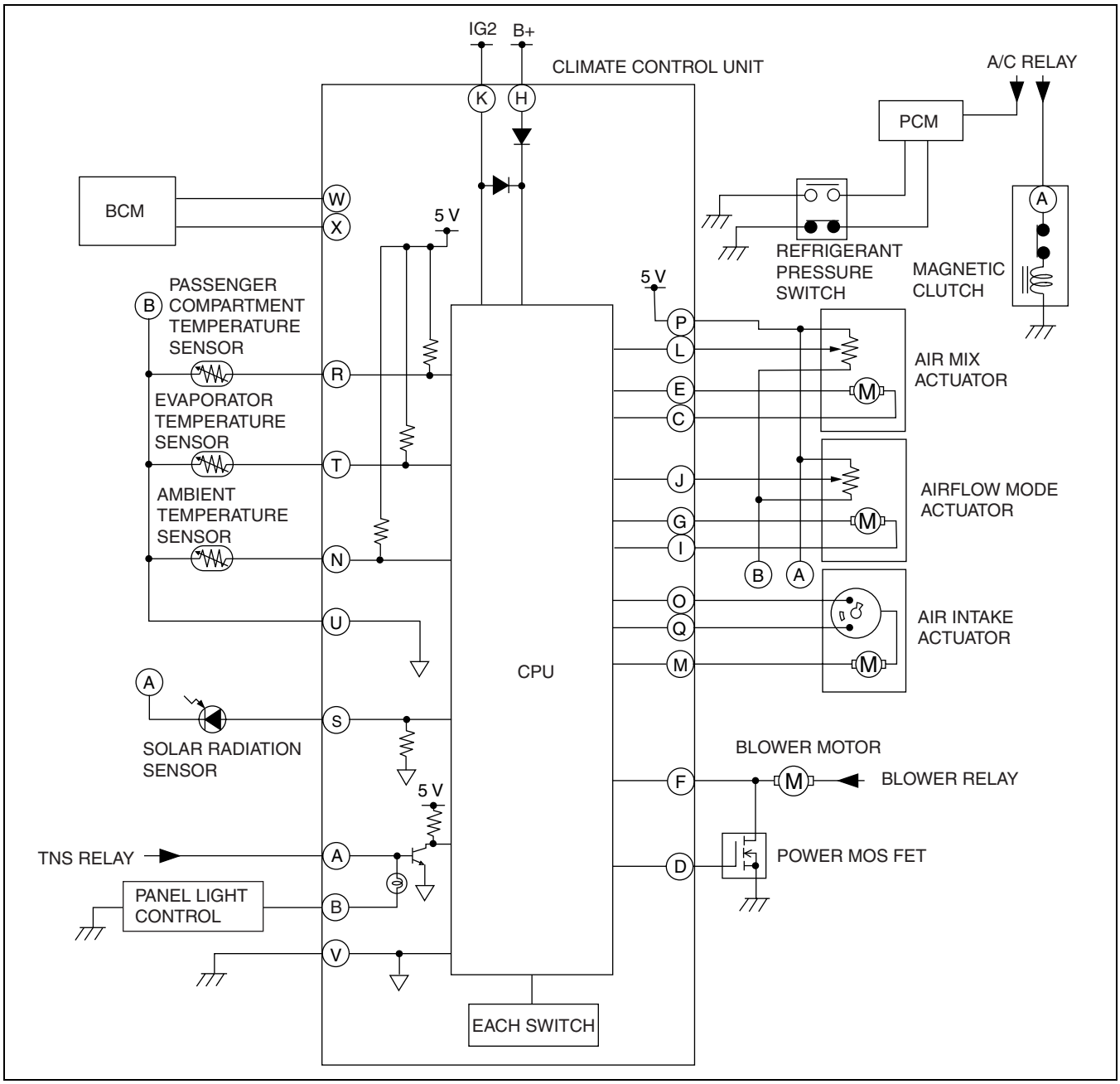
EPU074000000S03



EPU740ZT3102

CONTROL SYSTEM WIRING DIAGRAM [FULL-AUTO AIR CONDITIONER]

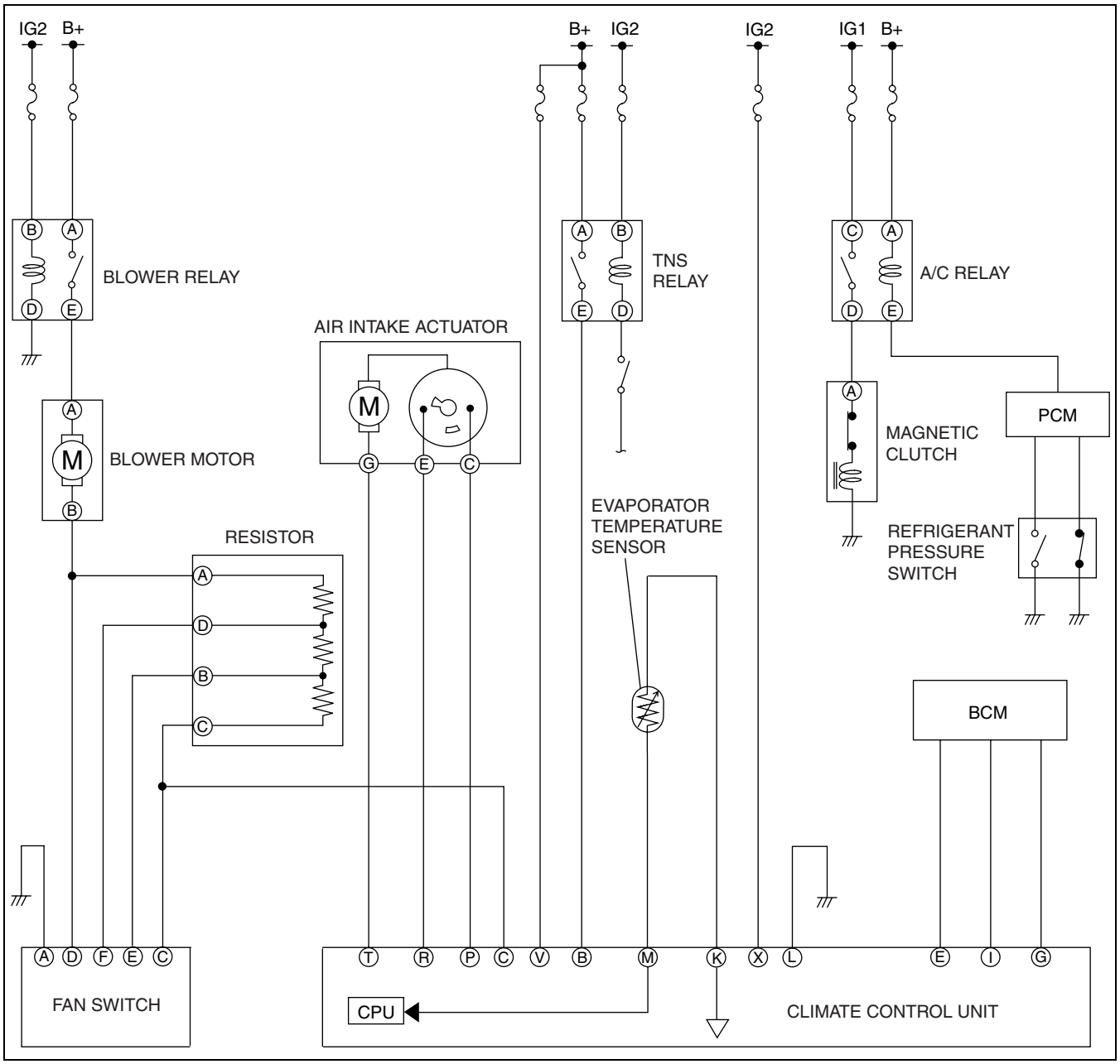
EPU074000000S04



EPU740ZT3104

CONTROL SYSTEM WIRING DIAGRAM [MANUAL AIR CONDITIONER]

EPU074000000S05

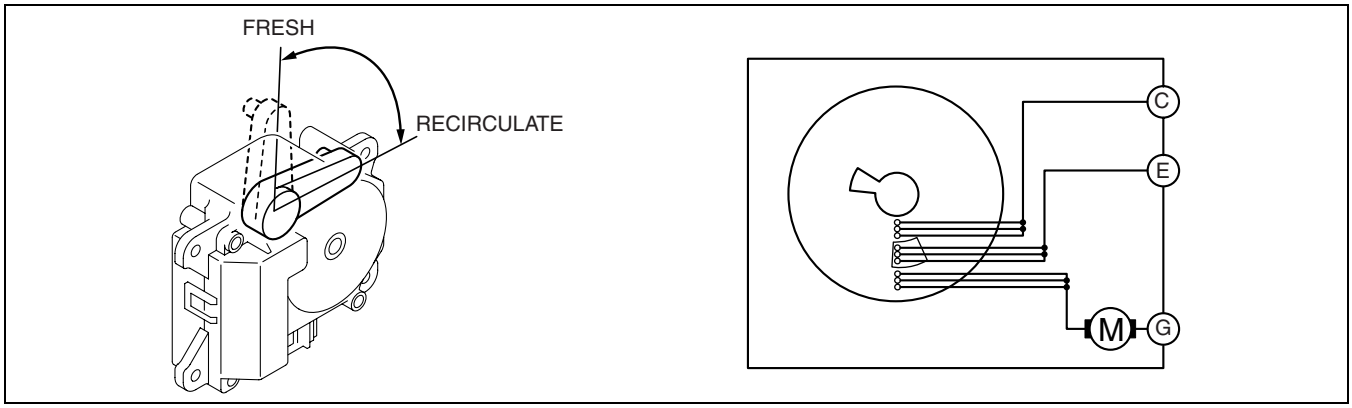


EPU740ZT3105

AIR INTAKE ACTUATOR CONSTRUCTION

EPU074061060S01

- A sliding contact type has been adopted.

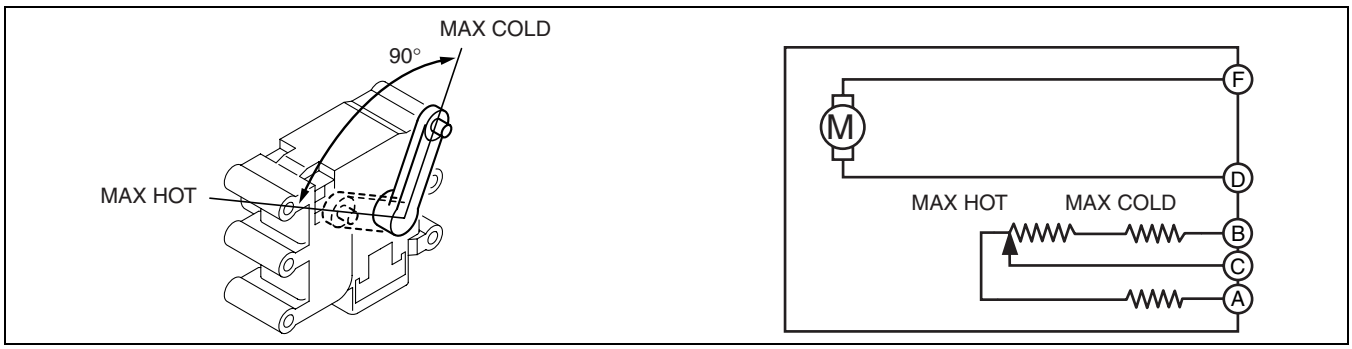


EPU740ZT3106

AIR MIX ACTUATOR CONSTRUCTION

EPU074061415S01

- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

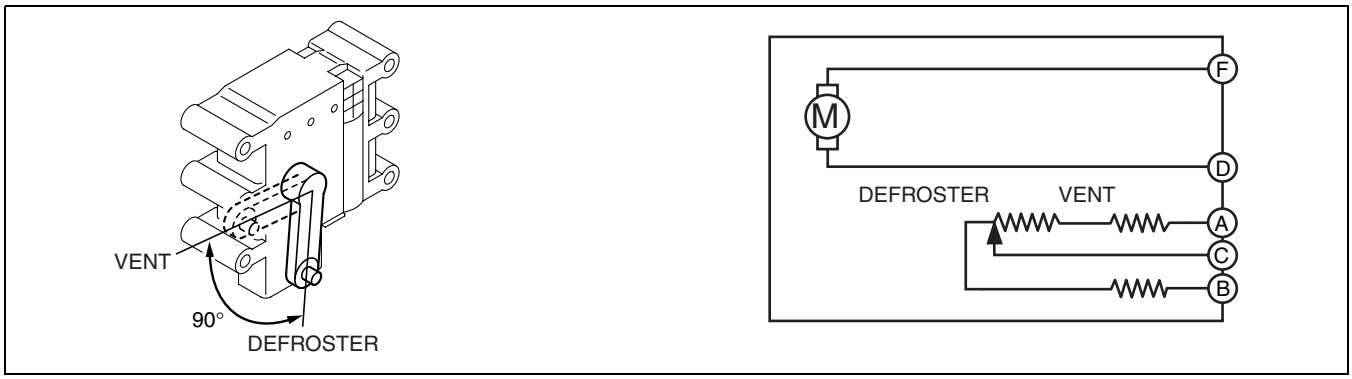


CPJ740ZNB005

AIRFLOW MODE ACTUATOR CONSTRUCTION

EPU074061070S01

- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

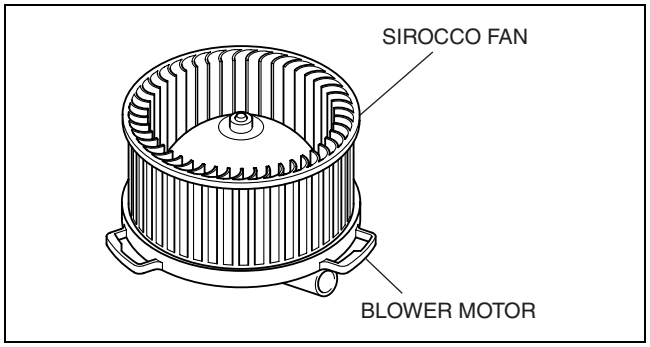


EPU740ZT3107

BLOWER MOTOR CONSTRUCTION

EPU074061020S01

- A sirocco fan has been adopted.



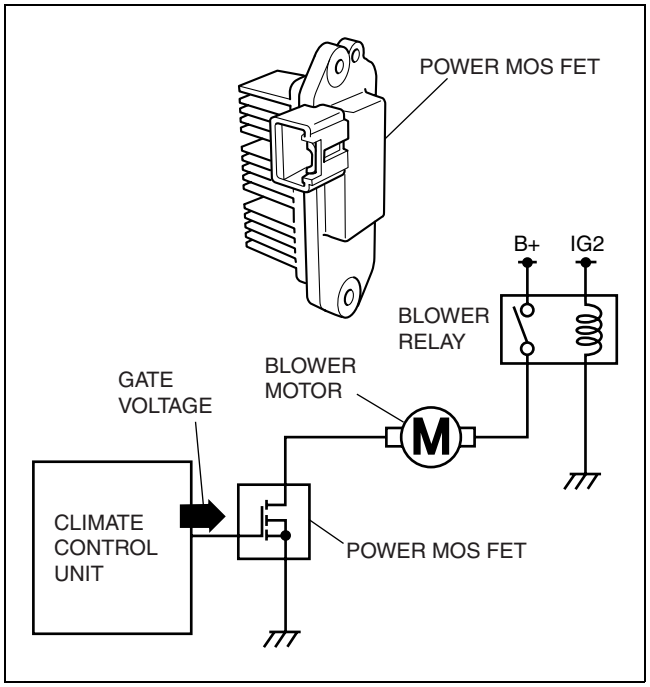
B3A0740T010

POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (POWER MOS FET) CONSTRUCTION

EPU074000116S01

Function

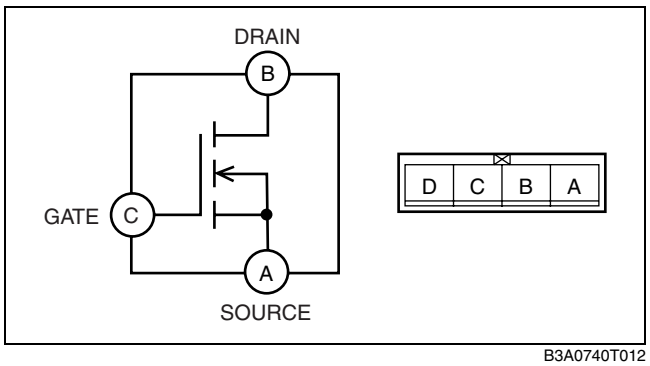
- Controls the supply voltage to the blower motor according to the gate voltage sent from the climate control unit and adjusts the rotation speed (airflow volume).



B3A0740T011

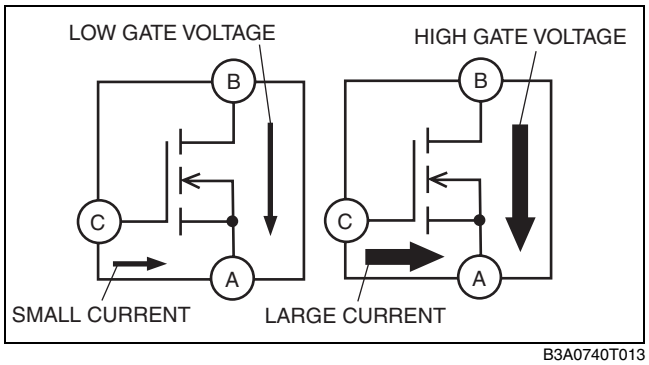
Construction/Operation

- There are three electrodes: source, gate, and drain electrodes.



B3A0740T012

- The resistance between terminals B and A (between drain and source) changes according to the voltage (gate voltage) applied to terminal C (gate).
- When the gate voltage increases, the resistance between terminals B and A decreases, allowing the current to flow easily.



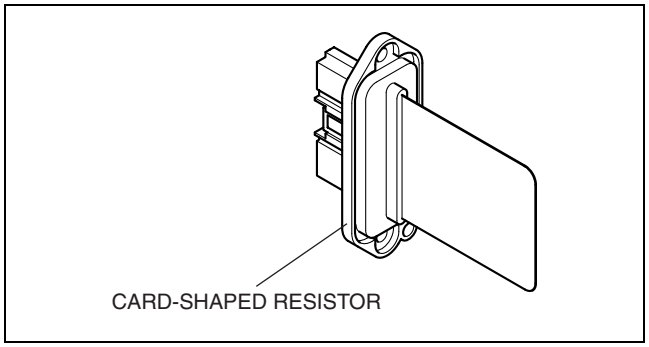
B3A0740T013

RESISTOR CONSTRUCTION

EPU074061015S01

Construction

- A thin card type has been adopted for weight reduction.

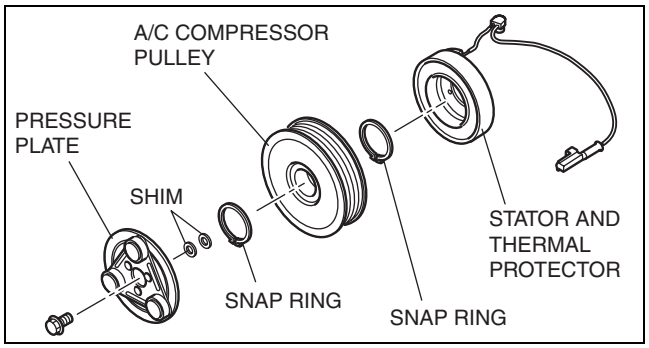


B3A0740T014

MAGNETIC CLUTCH CONSTRUCTION

EPU074061010S01

- Consists of the following parts:

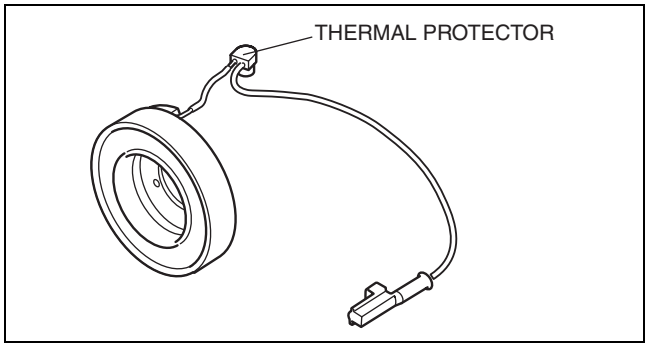


EPU740ZT3108

THERMAL PROTECTOR CONSTRUCTION

EPU074061000S01

- An indirect sensing type has been adopted, reducing the number of the component parts.



B3A0740T017

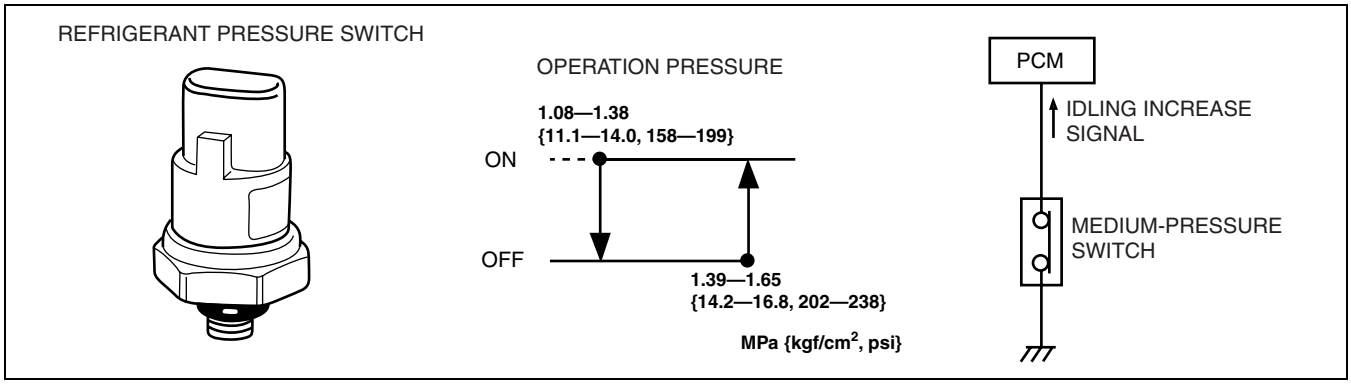
REFRIGERANT PRESSURE SWITCH CONSTRUCTION

EPU074061503S01

- A triple pressure type has been adopted.
- Consists of the low/high-pressure switch that protects the refrigerant cycle by cutting the A/C signal when pressure in the refrigerant cycle is abnormally high or low, and the medium-pressure switch that outputs an idling increase signal according to the A/C compressor operation load.

Medium-pressure switch

- When the refrigerant pressure is **approx. 1.39 MPa {14.2 kgf·cm^2, 202 psi} or more**, the contact is energized and an idling increases signal is output to the PCM.



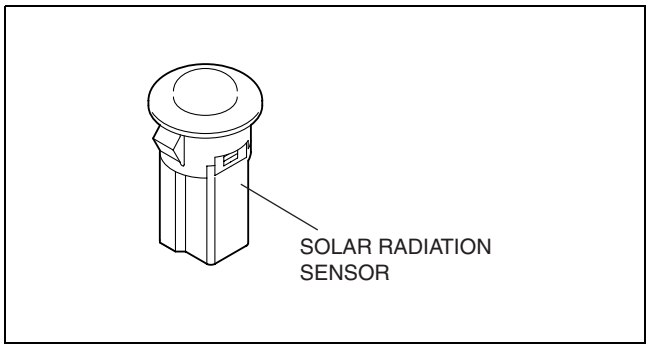
B3A0740T018

07–40

SOLAR RADIATION SENSOR CONSTRUCTION

EPU074061751S01

- A photo diode (light-receiving diode) has been adopted.

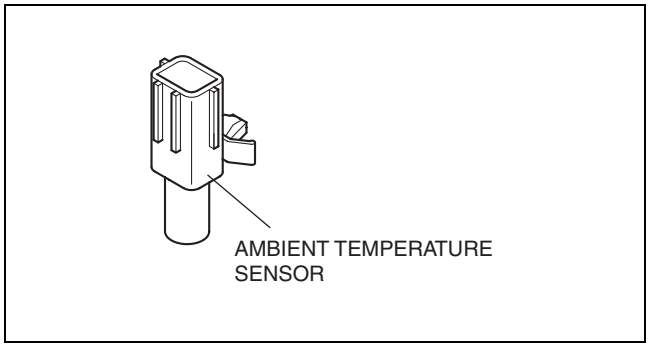


B3A0740T019

AMBIENT TEMPERATURE SENSOR CONSTRUCTION

EPU074061764S01

- A thermistor type has been adopted.

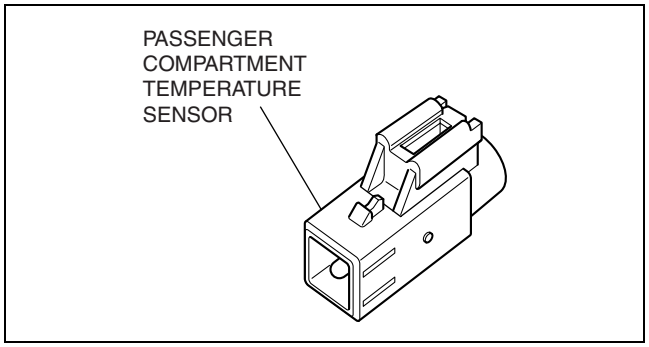


B3A0740T020

PASSENGER COMPARTMENT TEMPERATURE SENSOR CONSTRUCTION

EPU074061758S01

- A thermistor has been adopted.

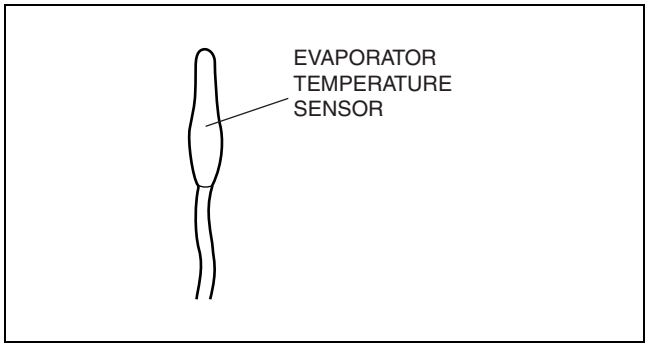


EPU740ZT3109

EVAPORATOR TEMPERATURE SENSOR CONSTRUCTION

EPU074061022S01

- A thermistor type has been adopted.

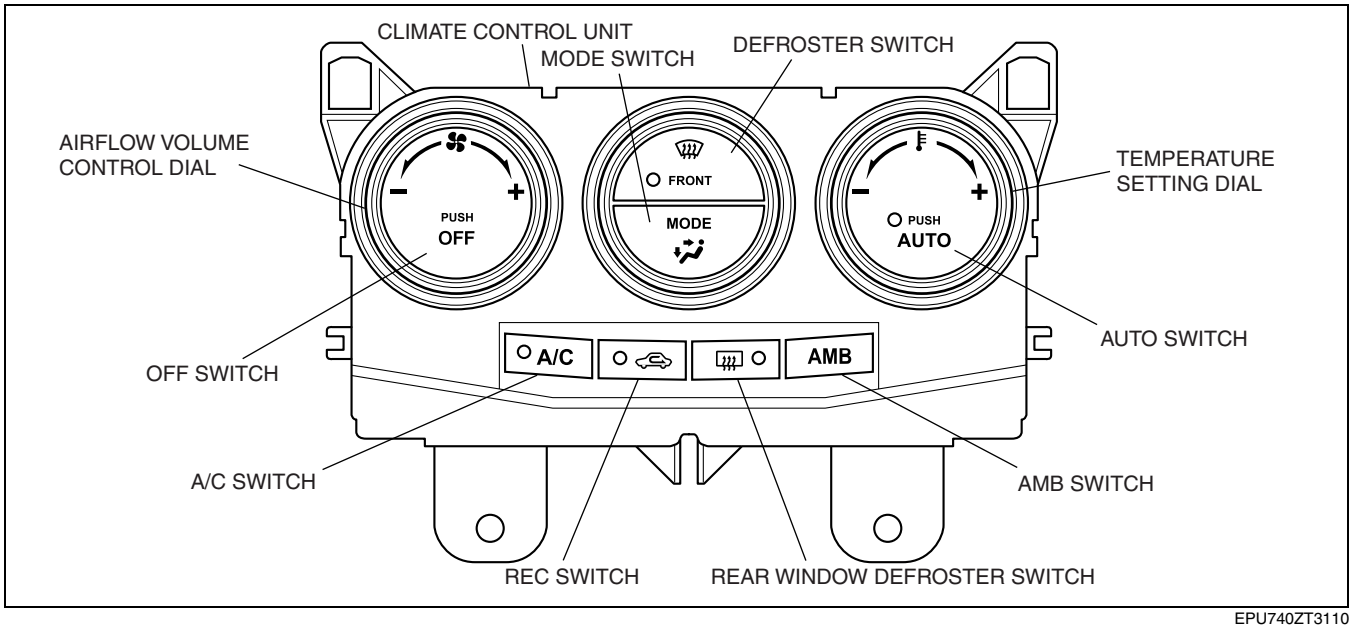


B3A0740T022

CLIMATE CONTROL UNIT CONSTRUCTION [FULL-AUTO AIR CONDITIONER]

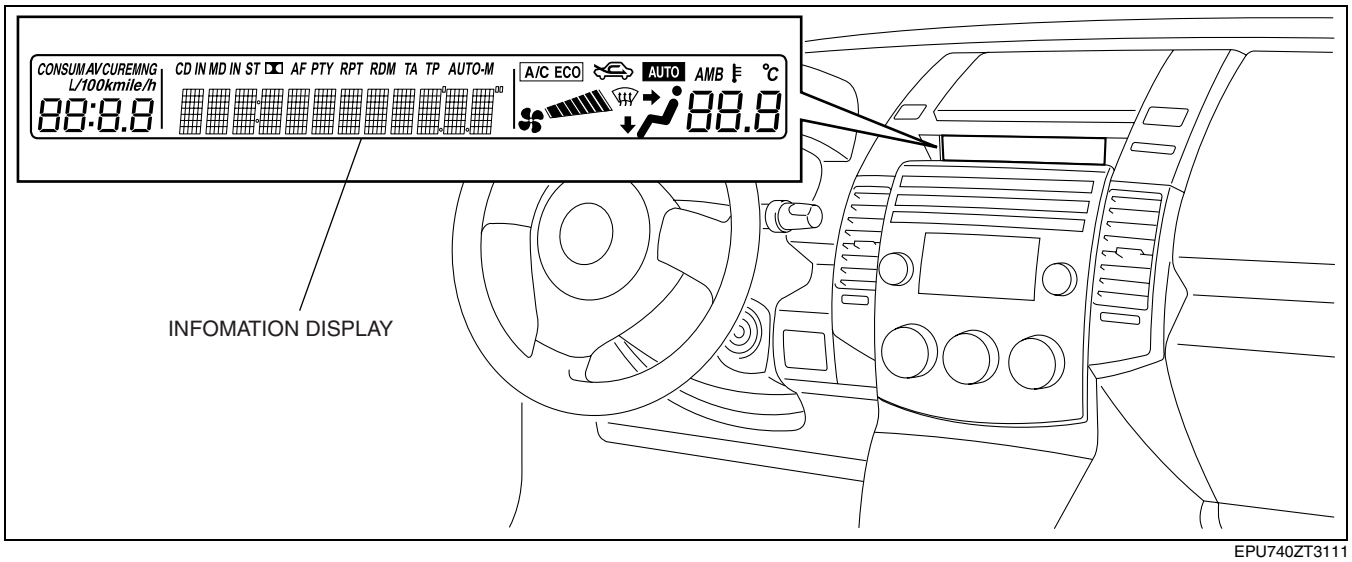
EPU074061190S01

- A logic-type climate control unit is used with the full-auto air conditioner.
- Each switches and dials have been enlarged to improve ease of operation.



EPU740ZT3110

- Information about the operating condition of the system is displayed on the information display.



EPU740ZT3111

CAN (CONTROLLER AREA NETWORK) OUTLINE

EPU074061190S02

- The climate control unit sends and receives data to and from other modules via the CAN system. Refer to Section 09-40 for a detailed explanation of the CAN.

Data sent/received
Data sent

- A/C operation status
- A/C operation status display
- Ambient temperature display
- Operation sound for climate control unit switch
- Malfunction diagnosis output

Data received

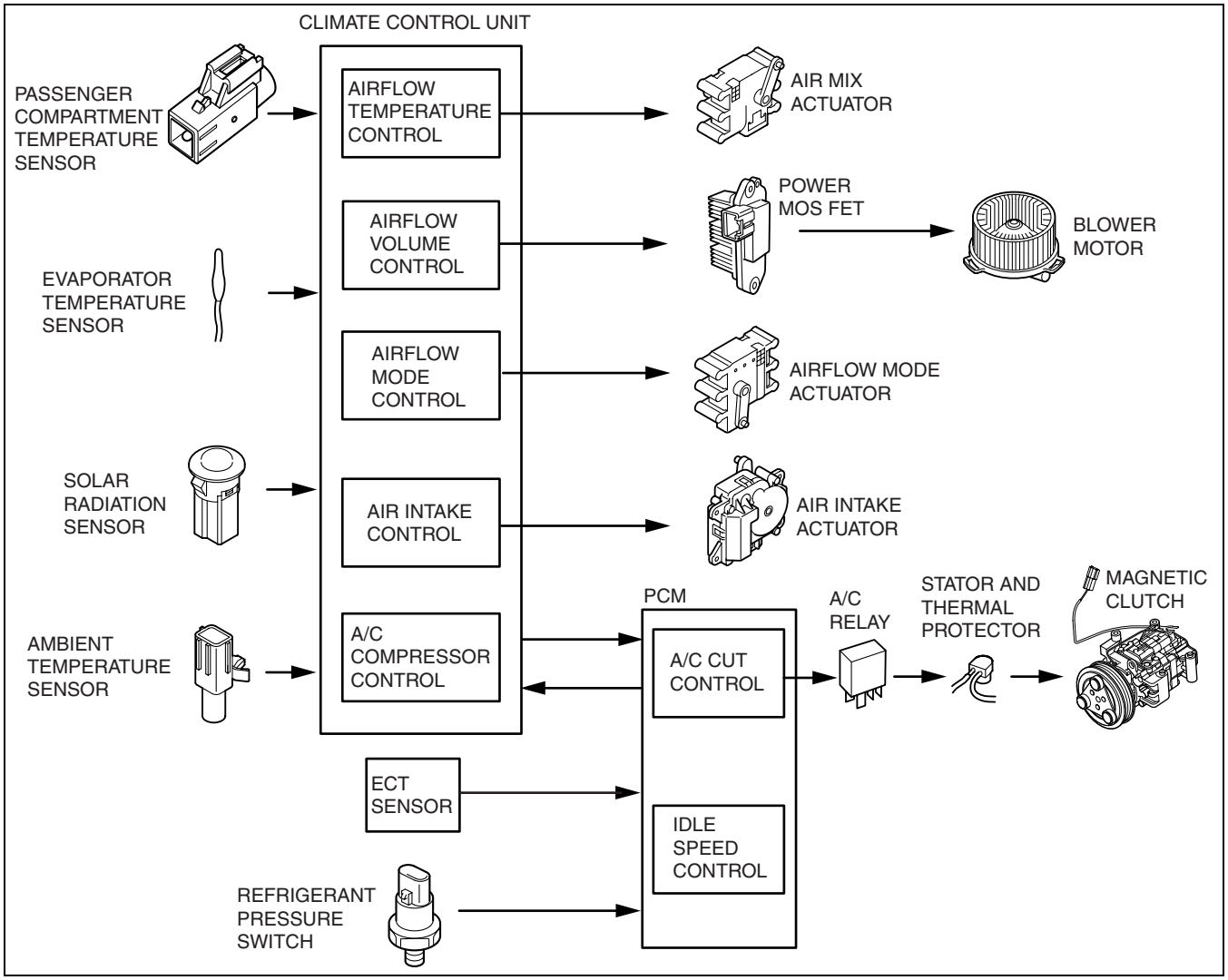
- Engine coolant temperature
- Vehicle speed signal
- Temperature display (°C/°F) determination
- Malfunction diagnosis input
- Wiper status
- R/DEF IND. signal
- Light on/off signal
- Celsius/Fahrenheit signal

FULL-AUTO AIR CONDITIONER FUNCTION

EPU074000003S01

Block Diagram

- The control system consists of input components (sensors), output components (actuators, magnetic clutch, power MOS FET, and other parts), and a control device (climate control unit).



EPU740ZT3123

Control Table

- The full-auto air conditioner system functions based on the five basic types of controls and three supplementary functions.

Basic control	Control description	Correction control
Airflow temperature control	Airflow temperature automatic control	• Air intake correction • A/C correction • MAX HOT and MAX COLD correction • Engine coolant temperature correction
Airflow volume control	Airflow volume automatic control	• Engine coolant temperature correction (warm-up correction) • Vehicle speed correction • Mild start correction • MAX HOT and MAX COLD correction • Window fogging prevention correction at start • Starting compensation correction • Defroster correction • Starting burnt-out prevention function
	Airflow volume manual control	• Defroster correction • Starting burnt-out prevention function

Basic control	Control description	Correction control
Airflow mode control	Airflow mode automatic control	• Engine coolant temperature correction (warm-up correction)
	Airflow mode manual control	—
Air intake control	Air intake automatic control	• MAX COLD correction • Defroster correction • Ambient temperature correction • A/C OFF correction
	Air intake manual control	• Defroster correction
A/C compressor control	A/C compressor automatic control	• Defroster correction • Ambient temperature correction • MAX COLD correction • Window fogging prevention correction at start
	A/C compressor manual control	• Defroster correction • Ambient temperature correction • Window fogging prevention correction at start

Supplementary function
Fail-safe function
Sensor signal delay function
On-board diagnostic function

Control Type Transition by Switch Operation
Airflow temperature control, airflow volume control

Operation switch		Airflow temperature control	Airflow volume control								
		Control prior to switch operation	Control prior to switch operation								
		Automatic control	Automatic control	Defroster correction	Manual control						
					OFF	1	2	3	4	5	6	7
OFF switch		Automatic control	OFF	OFF	OFF							
AUTO switch		Automatic control	Automatic control	Automatic control	Automatic control							
Fan switch	+	Automatic control	Manual control[*2]	Manual control[*2]	1	2	3	4	5	6	7	7
	-	Automatic control	Manual control[*3]	Manual control[*3]	1	1	1	2	3	4	5	6
MODE switch		Automatic control	Automatic control	[*5]	No change							
DEFROSTER switch		Automatic control	Defroster correction	No change	Defroster correction							
A/C switch		Automatic control	Automatic control	No change	No change							
REC switch		Automatic control	Automatic control	No change	No change							
Temperature setting dial[*1]	60	MAX COLD	MAX HI	MAX HI	No change							
	61—89	Automatic control	Automatic control	No change	No change							
	90	MAX HOT	AUTO HI[*4]	AUTO HI	No change							

[*1] : Adjusted up or down in increments of 1 within a range of 60—90. When the fan is OFF, the temperature setting can be adjusted in increments of ±1.
[*2] : Increases to the manual voltage that is closest to the auto or defroster correction voltage.
[*3] : Decreases to the manual voltage that is closest to the auto or defroster correction voltage.
[*4] : Engine coolant temperature correction takes precedence.
[*5] : Returns to condition prior to defroster operation. However, if it had been off prior to defroster operation, it switches to automatic control.

Airflow mode control, air intake control, A/C compressor control

Operation switch		Airflow mode control		Air intake control		A/C compressor control	
		Control prior to switch operation		Control prior to switch operation		Control prior to switch operation	
		Automatic control	Manual control	Automatic control	Manual control	Automatic control	Manual control
OFF switch		Fixed at mode before turned OFF*2	No change*2	Fixed at mode before turned OFF*2	No change*2	OFF	OFF
AUTO switch		Automatic control	Automatic control	Automatic control	Automatic control	Automatic control	Automatic control
Fan switch	+	Automatic control	No change	Automatic control	No change	Automatic control	No change
	-	Automatic control	No change	Automatic control	No change	Automatic control	No change
MODE switch		VENT → BI-LEVEL BI-LEVEL → HEAT HEAT → HEAT/DEF HEAT/DEF → VENT DEFROSTER → HEAT	VENT → BI-LEVEL BI-LEVEL → HEAT HEAT → HEAT/DEF HEAT/DEF → VENT DEFROSTER → HEAT	Automatic control*6	No change*6	Automatic control	DEFROSTER*3
DEFROSTER switch		DEFROSTER*2	DEFROSTER*2	Defroster correction*2	Defroster correction*2	Defroster correction*3	Defroster correction*3
A/C switch		Automatic control	No change	Automatic control	No change	A/C→OFF OFF→A/C*4 *5	A/C→OFF OFF→A/C*4 *5
REC switch		Automatic control	No change	FRESH→REC REC→FRESH *6	FRESH→REC REC→FRESH *6	Automatic control	No change
Temperature setting dial*1	60	Automatic control	No change	Automatic control	No change	Automatic control	No change
	61—89	Automatic control	No change	Automatic control	No change	Automatic control	No change
	90	Automatic control	No change	Automatic control	No change	Automatic control	No change

*1 : Adjusted up or down in increments of 1 within a range of 60—90. When the fan is OFF, the temperature setting can be adjusted in increments of ±1.
*2 : If operated during defroster correction, it returns to the condition prior to defroster operation.
*3 : If operated during defroster correction, it returns to the condition prior to defroster operation. However, if it had been off prior to defroster operation, it switches to automatic control.
*4 : When the fan is OFF, it is fixed at A/C OFF.
*5 : .The A/C compressor is fixed at on when in heat, heat/def, or defroster mode. (The display changes according to the A/C switch operation)
*6 : .When it is in heat mode, it switches to FRESH, but recognizes the REC switch operation. However, if it is in heat/defroster or defroster mode, it is fixed at FRESH and does not recognize the REC switch operation.

AIRFLOW TEMPERATURE CONTROL OUTLINE

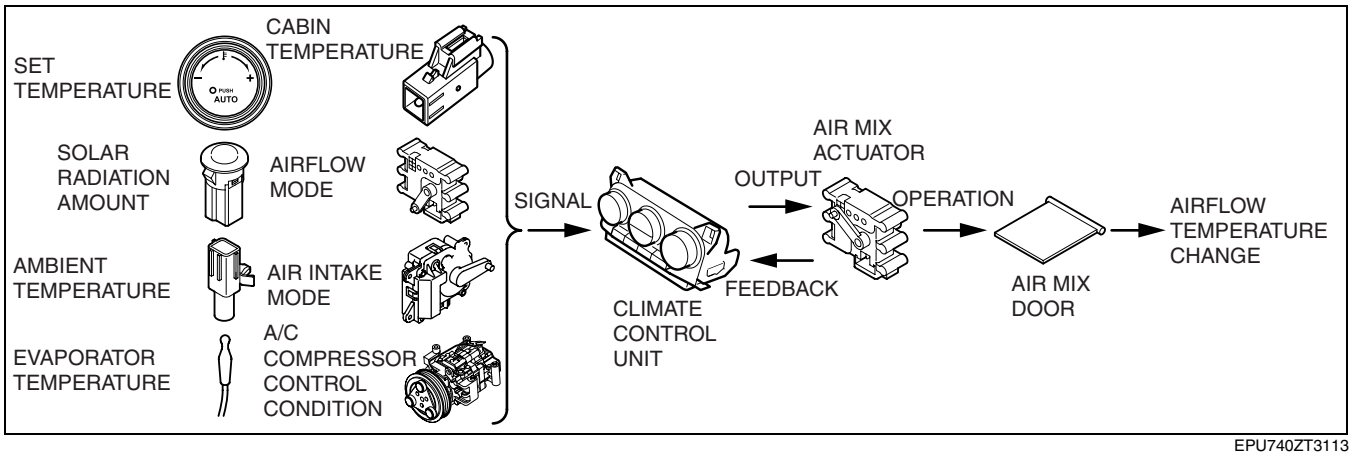
EPU074061193S01

Features

- The airflow temperature is constantly controlled automatically. The climate control unit controls the airflow temperature via the air mix actuator.

AIRFLOW TEMPERATURE CONTROL SYSTEM DIAGRAM

EPU074061193S02



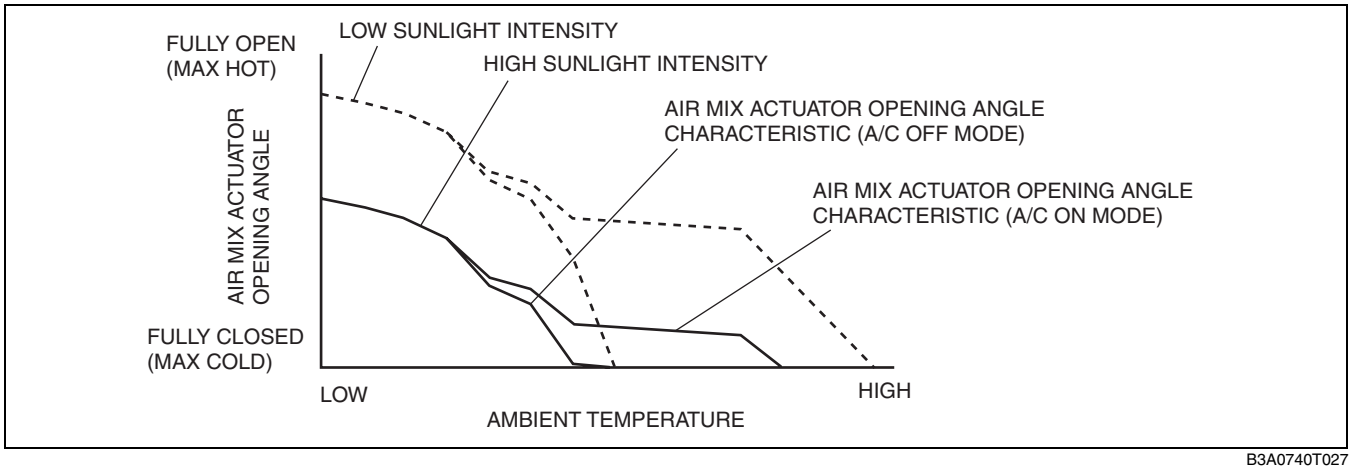
EPU740ZT3113

AIRFLOW TEMPERATURE CONTROL OPERATION

EPU074061193S03

Airflow Temperature Automatic Control

- The climate control unit calculates the air mix actuator opening angle characteristic for the given ambient temperature based on the set temperature, sunlight intensity, and airflow mode. The air mix actuator opening angle characteristic decreases as the sunlight intensity increases.
- The opening angle characteristic of the air mix actuator and the current ambient temperature are compared and the basic opening angle for the air mix actuator is determined according to the A/C compressor control status. The opening angle must maintain the target temperature (calculated control value T1) in the cabin against changes in external factors such as sunlight intensity and ambient temperature.
- If there is a difference between the target temperature (calculated control value T1) and current cabin temperature, the basic opening angle of the air mix actuator is corrected so that the cabin temperature rapidly reaches the target temperature.
- Calculated control value T1 is the target temperature in the cabin as set by the climate control unit based on differences among the set temperature, temperatures input from the sensors, and sunlight intensity. Calculated control value T1 is calculated according to the changes in the set temperature and temperatures input from the sensors.

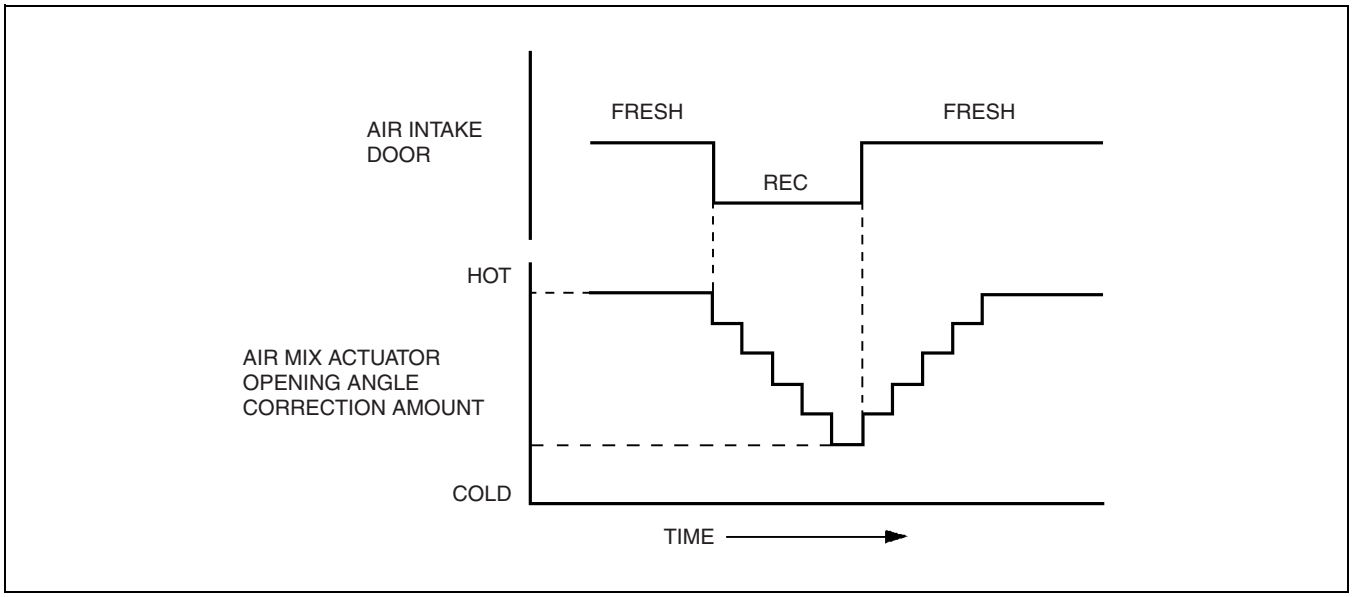


B3A0740T027

Correction

Air intake correction

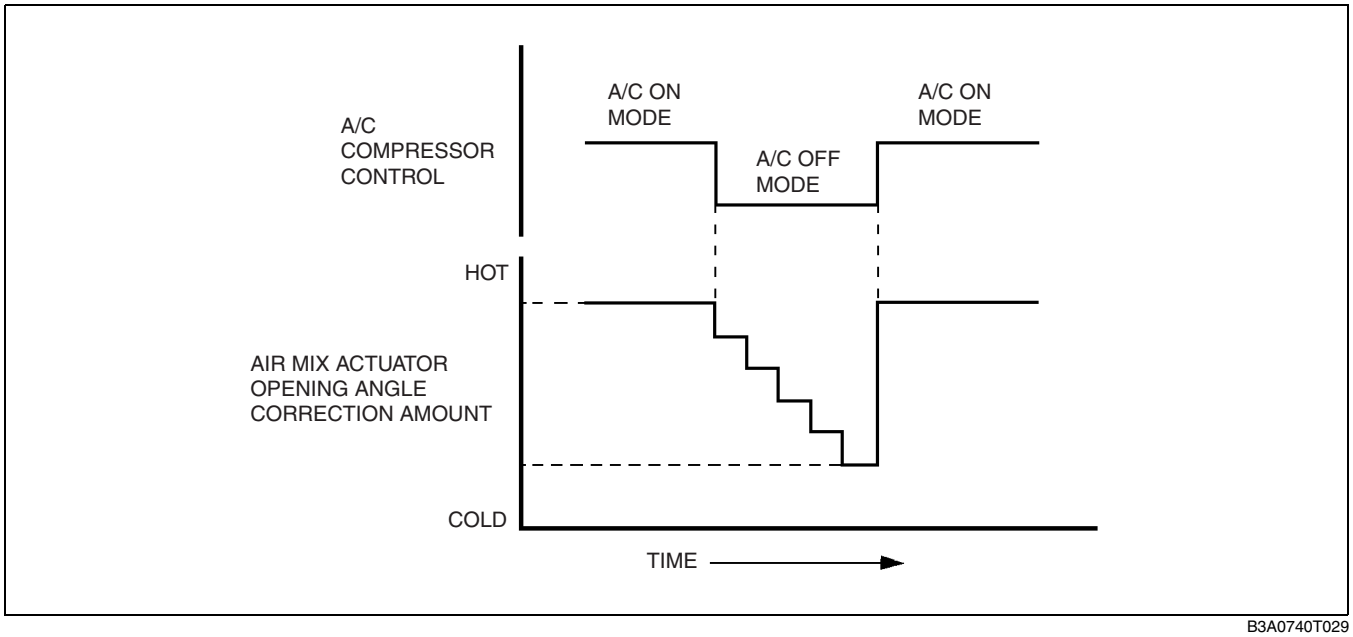
- When the air intake mode is switched from FRESH to REC when the A/C is off, a correction is added to the air mix actuator opening angle to prevent a rise in airflow temperature. In addition, this correction delays the air mix actuator operation to prevent a sudden drop in airflow temperature.



B3A0740T028

A/C correction

- When the A/C compressor control is switched from A/C ON mode to OFF mode, the opening angle of the air mix actuator is switched from the A/C ON mode opening angle to the A/C OFF mode opening angle to prevent a rise in airflow temperature. In addition, this correction delays the air mix actuator operation to prevent a sudden drop in airflow temperature. However, the operation is not delayed when the evaporator temperature is **15 °C {59 °F} or more**.



B3A0740T029

MAX HOT and MAX COLD correction

- When the temperature is set to **90**, the air mix actuator opening angle is fixed at fully open and when set to **60**, it is fixed at fully closed.

Engine coolant temperature correction

- After the engine is started in winter, the air mix actuator opening angle is corrected so that it is adjusted to the HOT side to prevent discomfort caused by cold air blown from the vent. However, the engine coolant temperature correction is not performed when the ambient temperature is **10 °C {50 °F} or more**.

AIRFLOW VOLUME CONTROL OUTLINE

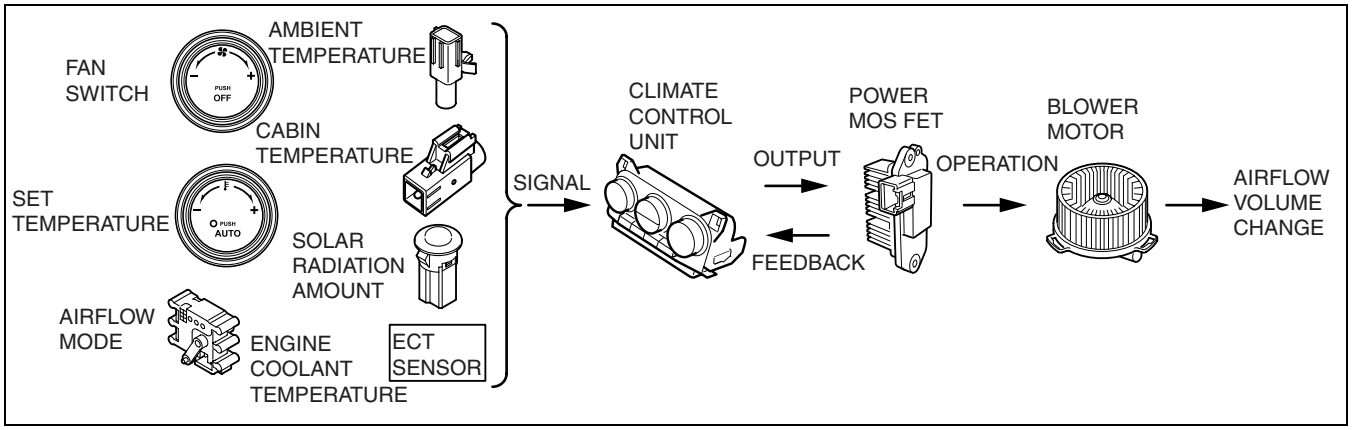
EPU074061194S01

Features

- Consists of the airflow volume automatic and manual controls with the climate control unit controlling the airflow volume (blower motor applied voltage) via the power MOS FET.

AIRFLOW VOLUME CONTROL SYSTEM DIAGRAM

EPU074061194S02



EPU740ZT3114

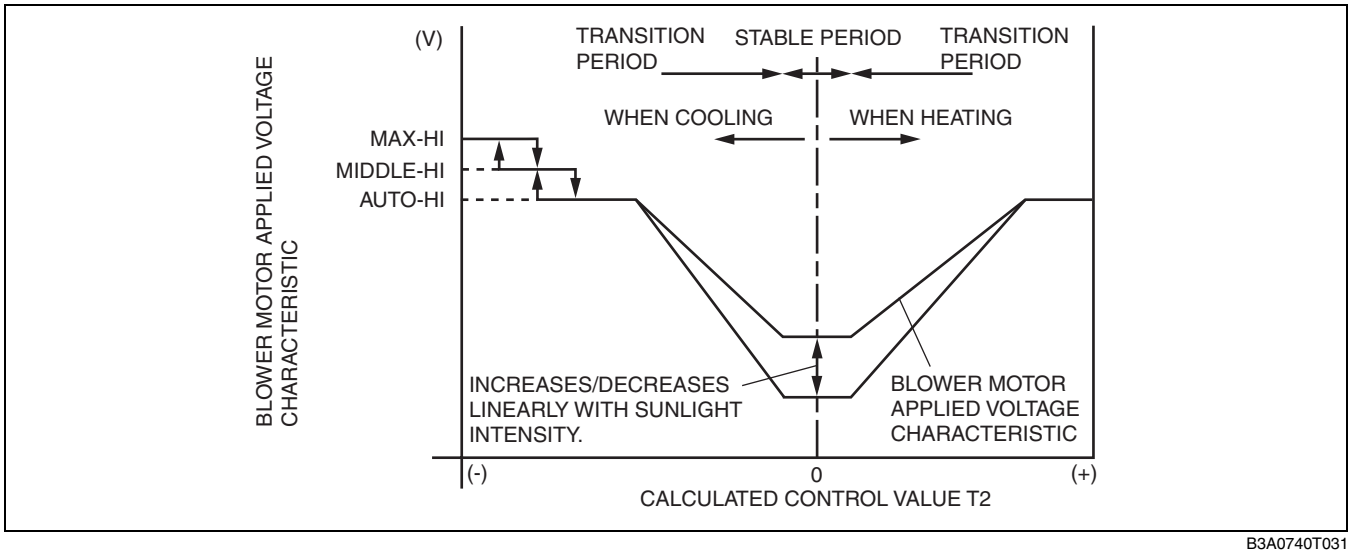
07–40

AIRFLOW VOLUME CONTROL OPERATION

EPU074061194S03

Airflow Volume Automatic Control

- The climate control unit calculates the blower motor applied voltage characteristic based on the set temperature, ambient temperature, and solar radiation amount.
- Compares the differences among this blower motor applied voltage characteristic and the target temperature (Calculated control value T2) and then determines the blower motor applied voltage (AUTO voltage).
- Calculated control value T2 is the difference between the set temperature and temperatures input from the sensors, and is used by the climate control unit to determine the target cabin temperature determined. Calculated control value T2 is constantly calculated according to the set temperature and the signals input from the sensors.

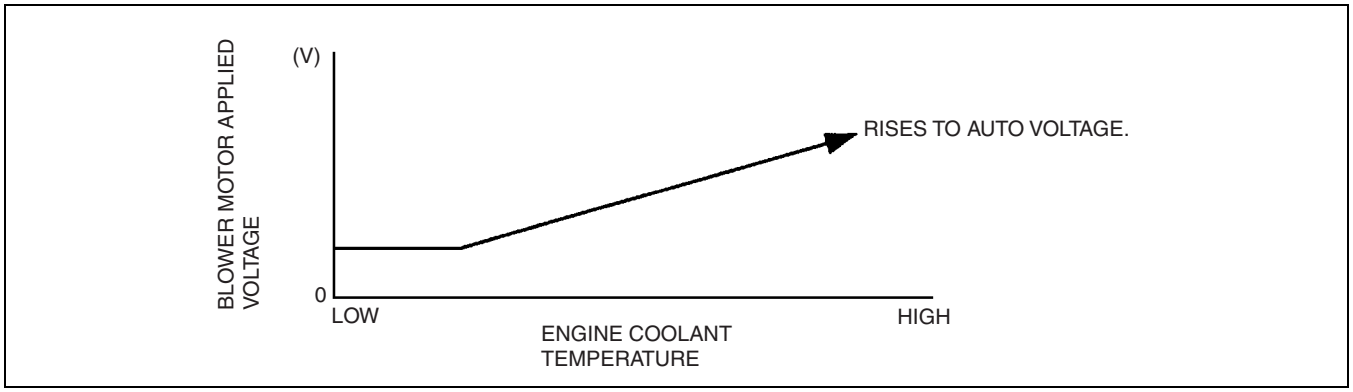


B3A0740T031

Correction

Engine coolant temperature correction (warm-up correction)

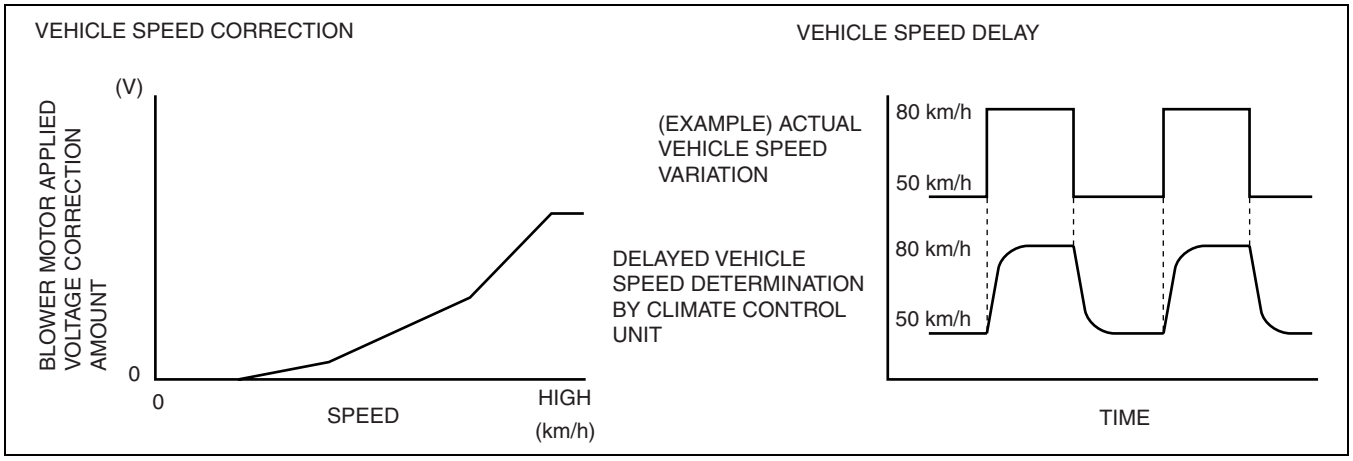
- Controls the blower motor applied voltage according to the increase in engine coolant temperature to prevent discomfort caused by a high volume of cold air blown from the vents in winter after starting the engine. However, the engine coolant temperature correction is not performed during defroster correction and when the cabin temperature is **20 °C {68 °F} or more**, and the airflow mode is in VENT mode.



B3A0740T032

Vehicle speed correction

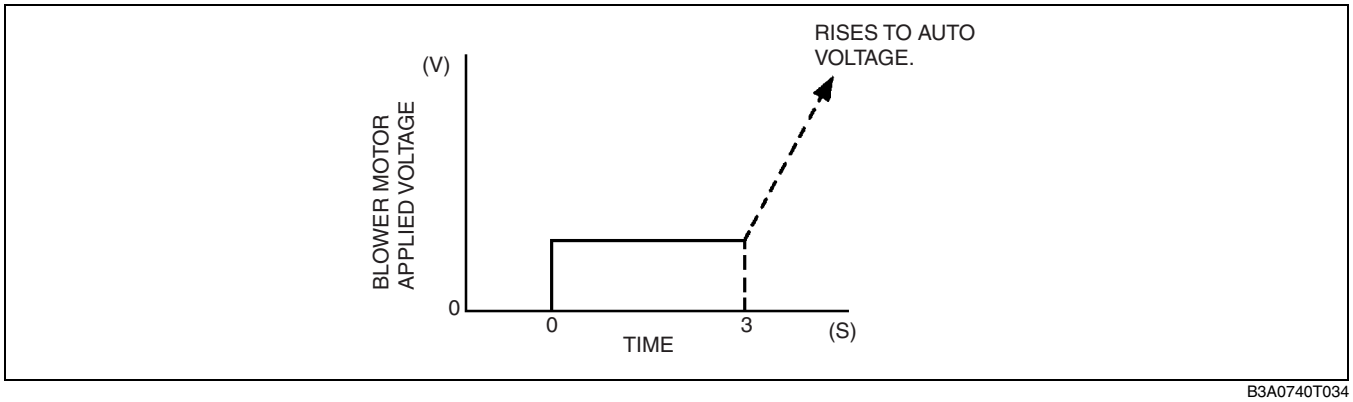
- When the air intake mode is at FRESH while driving at high speed, the airflow volume increases due to the wind blowing against the vehicle and air conditioner performance is negatively effected. To prevent this, the blower motor applied voltage is corrected according to the vehicle speed. Also the climate control unit stably performs control even when the vehicle speed is suddenly changed due to braking by delaying the input vehicle speed signal. However, the vehicle speed correction is not performed during airflow volume manual control, defroster correction, start compensation correction, fail-safe function, MAX HOT control and MAX-HI.



B3A0740T033

Mild start correction

- Limits blower motor applied voltage for **3 s** after the blower motor is started in summer to prevent discomfort caused by a high volume of hot air blown from the vent. However, the mild start correction is not performed when the cabin temperature is **20 °C {68 °F} or less** and when the airflow is in any mode other than VENT.



B3A0740T034

MAX HOT and MAX COLD correction

- When the set temperature is at **90**, the blower motor applied voltage is fixed at AUTO-HI, and when the set temperature is at **60**, the blower motor applied voltage is fixed at MAX-HI. However, MAX HOT correction is not performed during engine coolant correction.

Correction name	Set temperature	Blower motor applied voltage
MAX HOT correction	90	12.1 (V): AUTO-HI
MAX COLD correction	60	V_B: MAX-HI

Window fogging prevention correction at start

- Just after engine start, the A/C compressor is not turned on due to PCM A/C cut-off control. As air blows from the defroster when the heater is started, the windows can easily become fogged. To prevent this, blower motor applied voltage is fixed at **0 V** for **6 s** after the ignition switch is turned to the ON position. However, window fogging prevention correction at start is not performed when the airflow mode is in any mode other than HEAT, HEAT/DEF or DEFROSTER.

Starting compensation correction

- When the blower motor is started-up at the lowest speed (**3.2 V**), the blower motor applied voltage is fixed at **4.4 V for 2 s** to stabilize blower motor start-up operation.

Defroster correction

- To improve defrosting of the windows, a correction (**+2 V**) is added to the blower motor applied voltage when the defroster switch is turned on.

Starting burn-out prevention function

- When the blower motor is started-up from the stopped status with a blower motor applied voltage of **4.4 V or more**, the blower motor applied voltage is fixed at **4.4 V for 1 s** to prevent the power MOS FET from burning out due to excessive current.

Airflow Volume Manual Control

- The blower motor applied voltage (airflow volume) can be switched in seven steps with the fan switch.

Fan switch	Blower motor applied voltage
1st	4.4 V
2nd	6.1 V
3rd	7.8 V
4th	9.5 V
5th	10.8 V
6th	12.1 V
7th	B+

AIRFLOW MODE CONTROL OUTLINE

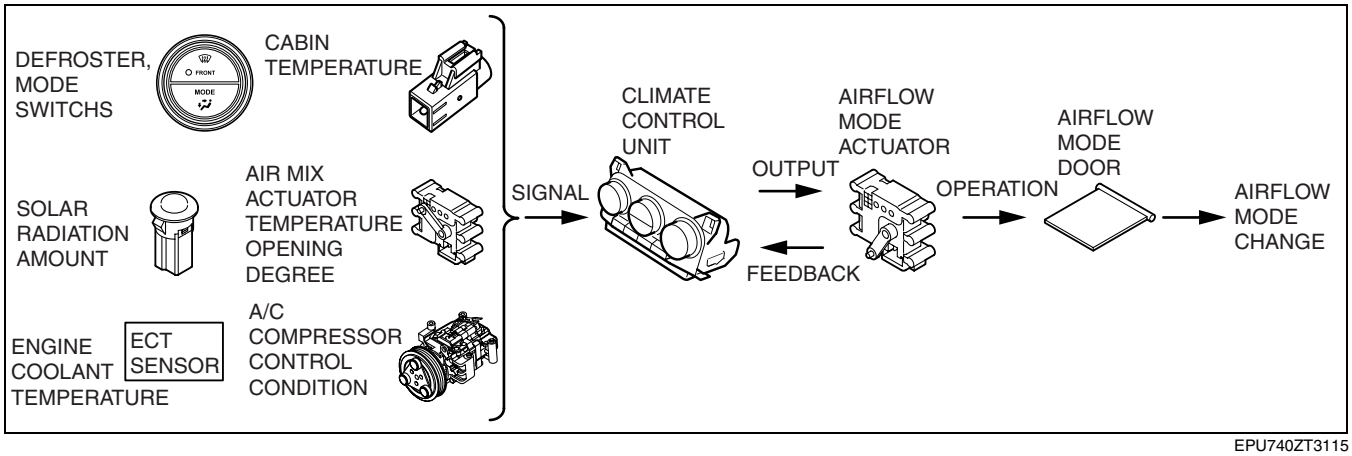
EPU074061195S01

Features

- Consists of the airflow mode automatic and manual controls with the climate control unit controlling the airflow mode via the airflow mode actuator.

AIRFLOW MODE CONTROL SYSTEM DIAGRAM

EPU074061195S02



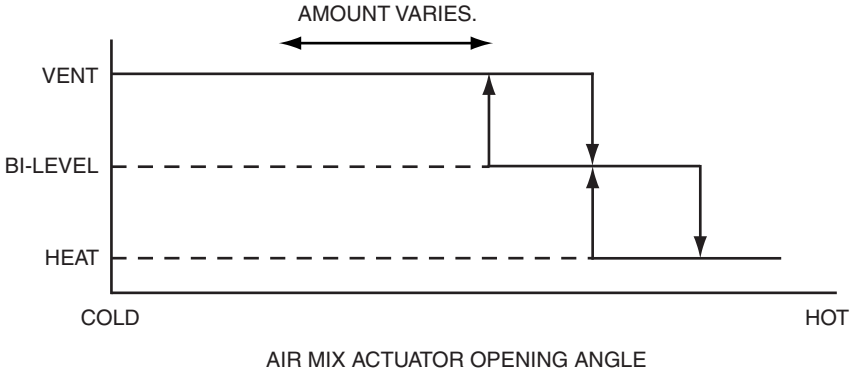
EPU740ZT3115

AIRFLOW MODE CONTROL OPERATION

EPU074061195S03

Airflow Mode Automatic Control

- The climate control unit determines the airflow mode based on the current air mix actuator opening angle.

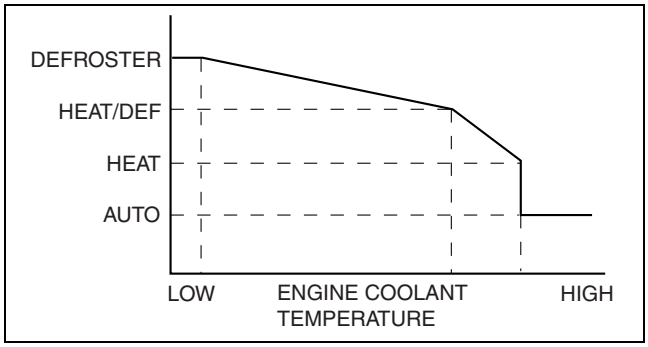


B3A0740T036

Correction

Engine coolant temperature correction (Warm-up correction)

- Switches the airflow mode after the engine is started in winter in accordance with the increase in engine coolant temperature to prevent discomfort caused by cold air blown towards the feet. The engine coolant temperature correction is performed only when the cabin temperature is **13 °C {55 °F} or less**, or the cabin temperature is **23 °C {73 °F} or less** and sunlight intensity is relatively low.



B3A0740T037

Airflow Mode Manual Control

- The airflow modes can be switched by operating the each mode switchs.

Airflow mode	Switch operated	Air vent
VENT	MODE switch	CENTER VENT, SIDE VENT
BI-LEVEL		CENTER VENT, SIDE VENT, FRONT HEAT, REAR HEAT
HEAT		FRONT HEAT, REAR HEAT, SIDE DEMISTER (low volume), DEFROSTER (low volume)
HEAT/DEF		FRONT HEAT, REAR HEAT, SIDE DEMISTER, DEFROSTER
DEFROSTER	DEFROSTER switch	SIDE DEMISTER, DEFROSTER

AIR INTAKE CONTROL OUTLINE

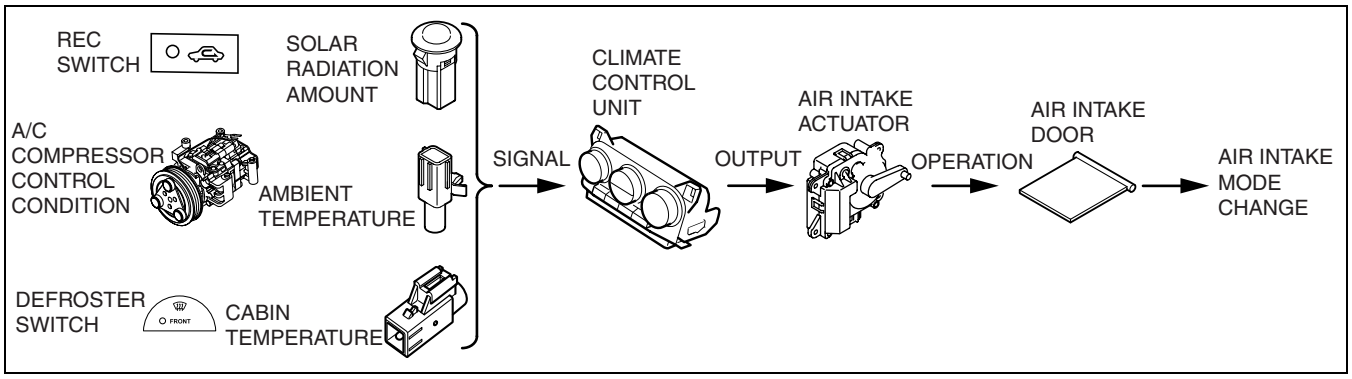
EPU074061203S01

Features

- Consists of the air intake automatic and manual controls with the climate control unit controlling the air intake mode via the air intake actuator.

AIR INTAKE CONTROL SYSTEM DIAGRAM

EPU074061203S02



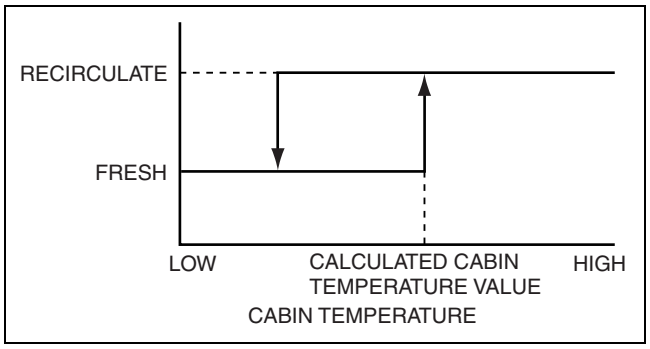
EPU740ZT3116

AIR INTAKE CONTROL OPERATION

EPU074061203S03

Air Intake Automatic Control

- The climate control unit calculates the cabin temperature based on the ambient temperature and sunlight intensity in order to cool the cabin temperature quickly according to the cooling conditions. It then compares the calculated cabin temperature and the actual cabin temperature to determine the proper air intake mode.



B3A0740T039

Correction

MAX COLD correction

- When the temperature is set to **60**, the air intake is set to REC to improve cooling effectiveness. However, the MAX COLD correction is not performed with the defroster correction or during A/C OFF mode.

Defroster correction

- When the DEFROSTER switch is turned on, the air intake is set to FRESH to improve defrosting. The air intake is set to FRESH even if it has been set to REC manually.

Ambient temperature correction

- When the ambient temperature is **5 °C {41 °F} or less**, the air intake is set to FRESH to prevent window fogging.

A/C OFF correction

- Air intake is fixed to FRESH with A/C OFF mode during the air intake automatic control.

Air Intake Manual Control

- The air intake modes can be switched by operating the REC switch.

Air intake mode	REC switch operation
FRESH	Fixed to FRESH when the REC switch is turned on during REC mode.
REC	Fixed to REC when the REC switch is turned on during FRESH mode.

A/C COMPRESSOR CONTROL OUTLINE

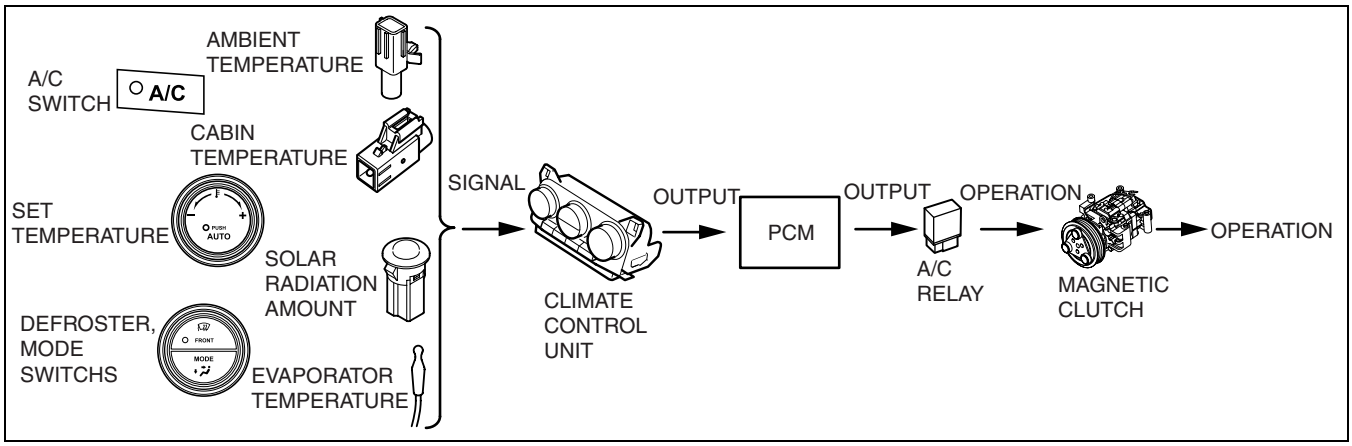
EPU074061196S01

Features

- Consists of the A/C compressor automatic and manual controls with the climate control unit outputting the A/C signal to the PCM to control the A/C compressor.
- The PCM controls the A/C relay.

A/C COMPRESSOR CONTROL SYSTEM DIAGRAM

EPU074061196S02



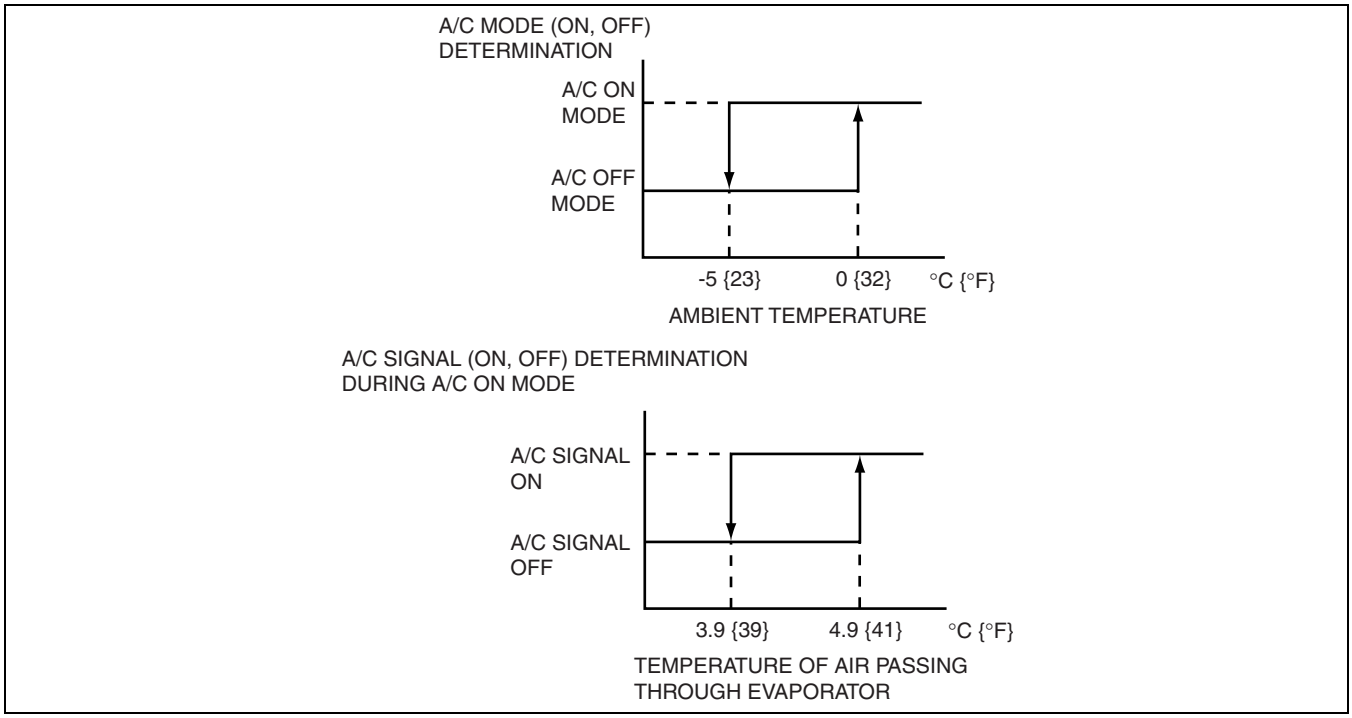
EPU740ZT3117

A/C COMPRESSOR CONTROL OPERATION

EPU074061196S03

A/C Compressor Automatic Control

- The climate control unit determines A/C ON/OFF mode based on the ambient temperature.
- In A/C ON mode, the A/C signal (magnetic clutch) is turned on/off according to the temperature of the air passing through the evaporator.



EPU740ZT3118

Correction

Defroster correction

- When the DEFROSTER switch is turned on, the system is switched to A/C ON mode and the A/C signal on/off temperature is set to **4.9/3.9 °C {41.0/39.0 °F}** to improve defrosting. However, defroster correction is not performed with the ambient temperature correction.

Ambient temperature correction

- When the ambient temperature is **-5 °C {23 °F} or less**, the A/C signal is fixed at OFF to protect the A/C compressor (to prevent A/C compressor fluid from being pressurized). During this operation, manual operation using the A/C switch is not available.

MAX COLD correction

- When the temperature is set to **60**, the A/C signal on/off temperature is set to **4.9/3.9 °C {41.0/39.0 °F}**.

Window fogging prevention correction at start

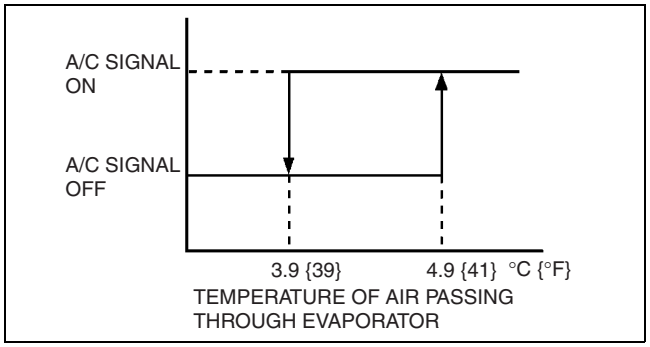
- The A/C compressor does not turn on due to PCM A/C cut-off control just after the engine is started. Therefore, the windshield and front door glass are easily fogged when the heater is turned on and air blows from the defroster. To prevent this, no A/C signal is output from the climate control unit to the PCM **for 6 s** after the ignition switch is turned to the ON position. The window fogging prevention correction at start is not performed when the airflow mode is in any mode other than HEAT, HEAT/DEF, and DEFROSTER during airflow volume automatic control.

A/C Compressor Manual Control

- A/C ON or OFF mode is selected by operating the A/C switch.

A/C mode		Operation condition
A/C ON mode	A/C MODE (A/C display)	Fixed in A/C mode.
A/C OFF mode (No display)		Fixed in A/C OFF mode.

A/C signal ON/OFF determination in A/C mode

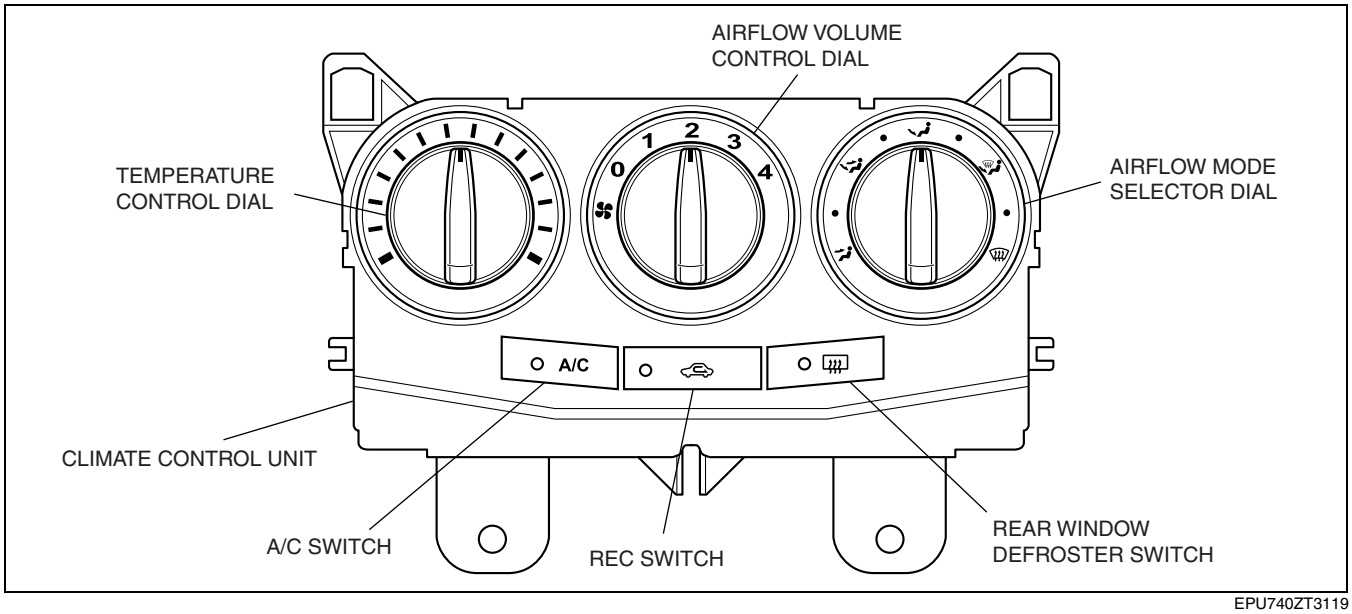


B3A0740T042

CLIMATE CONTROL UNIT CONSTRUCTION [MANUAL AIR CONDITIONER]

EPU074000003S02

- A wire-type climate control unit is used with the manual air conditioner.
- The airflow mode selector dial, temperature control dial, airflow volume control dial have been enlarged to improve ease of operation.



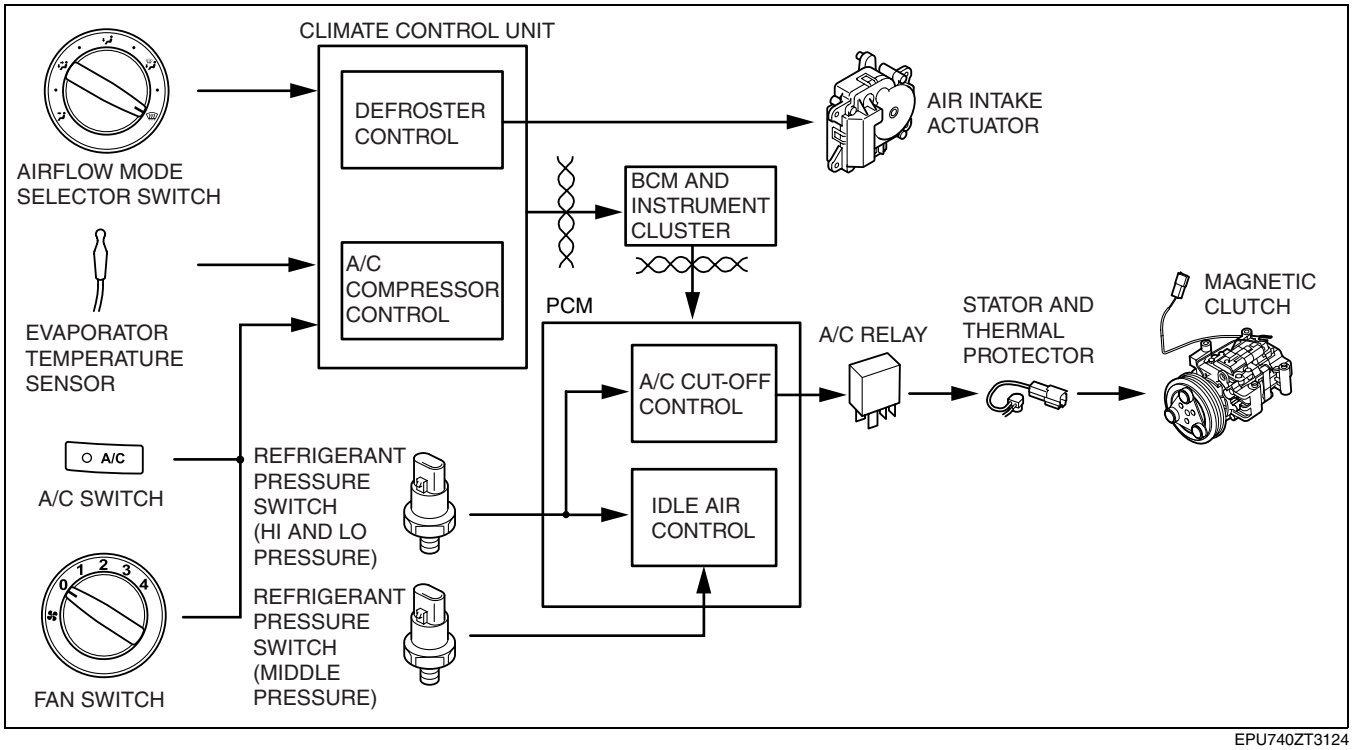
EPU740ZT3119

MANUAL AIR CONDITIONER CONTROL SYSTEM

EPU074000005S01

Block Diagram

- The climate control unit outputs an operation signal to the air intake actuator when the MODE dial is turned to HEAT, HEAT/DEF or DEFROSTER. The climate control unit controls the defroster by simultaneously outputting an A/C signal to the PCM.
- The climate control unit sends an A/C signal to the PCM via the BCM and instrument cluster based on signals sent from the A/C switch, fan switch and evaporator temperature sensor.



EPU740ZT3124

Outline of Control System

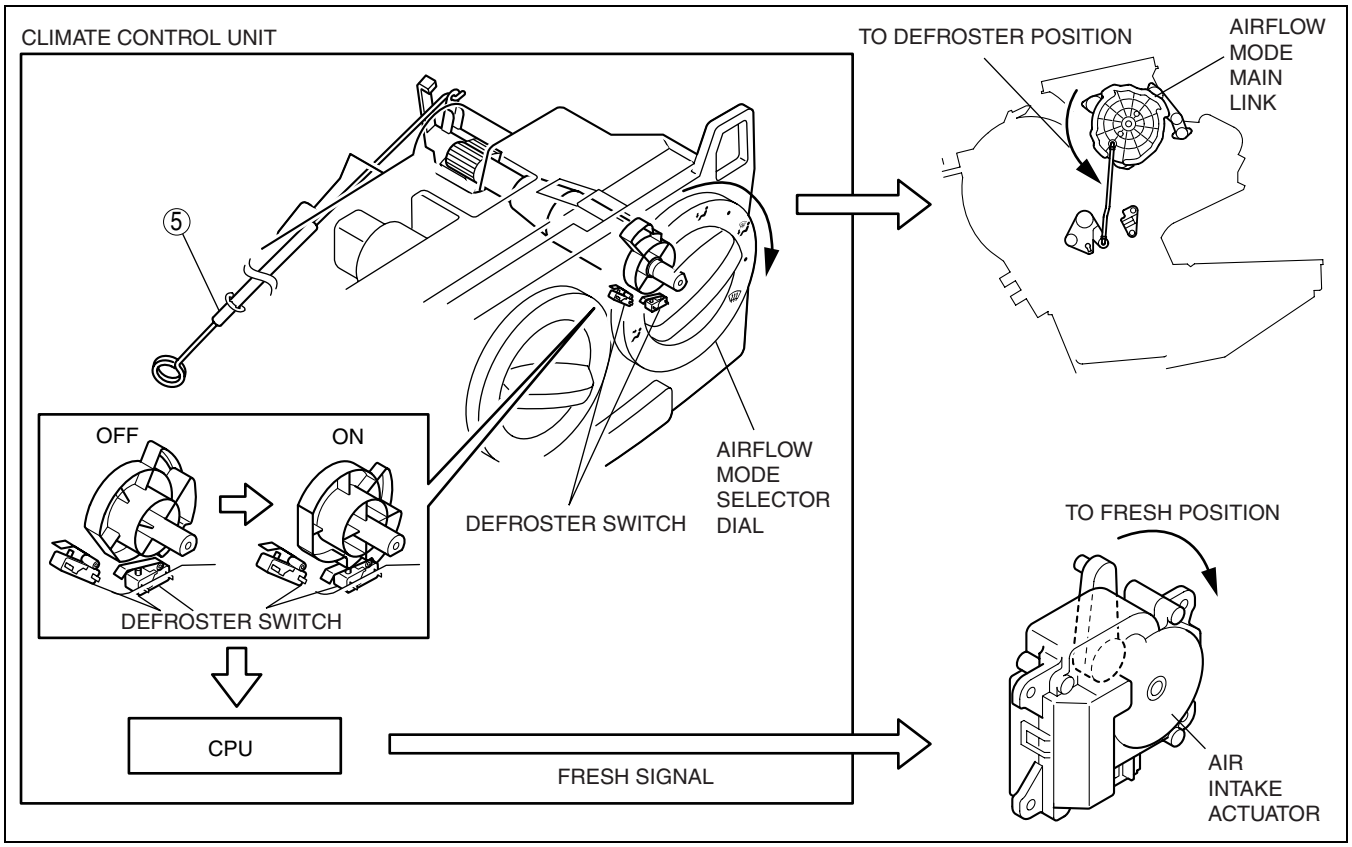
- Manual air conditioner defroster control and A/C compressor control.

Control name	Control part
Defroster control	Climate control unit
A/C compressor control	Climate control unit

Defroster Control

1. When the airflow mode selector dial is turned to HEAT, HEAT/DEF or DEFROSTER, the wire moves and the airflow mode main link switches to the selected mode. The defroster switch turns on simultaneously.
2. When the defroster switch turns on, a signal is sent to the CPU.
3. A signal is sent from the CPU to the air intake actuator and A/C compressor, the air intake mode switches to FRESH and the A/C compressor turns on.
   — For HEAT, the mode switches to REC by the REC switch. For HEAT/DEF and DEFROSTER, the mode is fixed at FRESH.

— If the A/C is off prior to defroster control, the A/C switch indicator light dose not illuminate even if the A/C compressor is on.



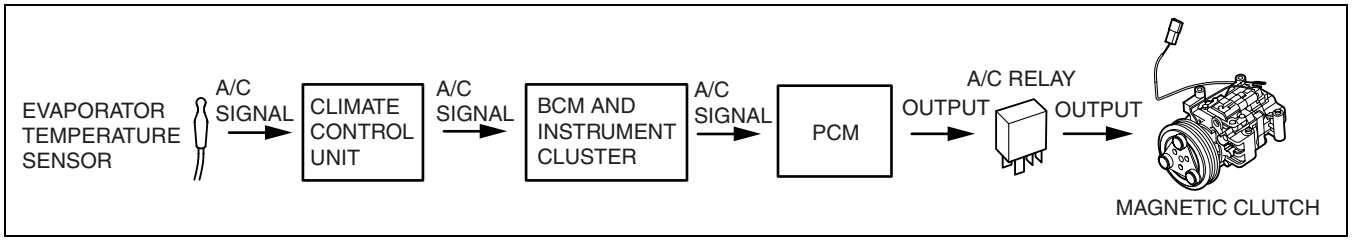
EPU740ZT3001

X: Operates
–: Does not operate

Airflow mode	Air intake mode (REC switch pushed)	Defroster control
VENT	REC ⇔ FRESH	–
BI-LEVEL	REC ⇔ FRESH	–
HEAT	REC ⇔ FRESH	x
HEAT/DEF	FRESH	x
DEFROSTER	FRESH	x

A/C Compressor Control

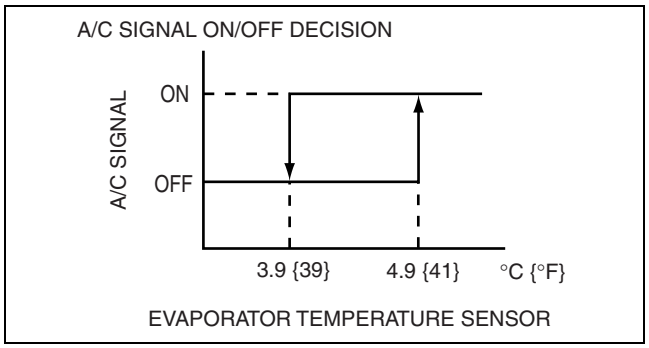
- The climate control unit sends an A/C signal to the PCM via the BCM and instrument cluster based on signals sent from the A/C switch, fan switch and evaporator temperature sensor.



EPU740ZT3125

A/C signal on/off control

- The climate control unit turns the A/C signal (magnetic clutch) on and off based on the temperature of the air passing through the evaporator when the A/C and fan switches are on. This keeps the evaporator surface temperature within the specified range, preventing the evaporator from freezing while the fan switch and A/C switch are turned on.



EPU740ZT3122

RESTRAINTS

08
SECTION

OUTLINE 08-00
ON-BOARD DIAGNOSTIC 08-02
AIR BAG SYSTEM 08-10
SEAT BELT. 08-11

08–00 OUTLINE

RESTRAINTS ABBREVIATIONS. 08–00–1
RESTRAINTS FEATURES 08–00–1

RESTRAINTS ABBREVIATIONS

EPU080000000S01

ALR	Automatic Locking Retractor
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
ELR	Emergency Locking Retractor
GND	Ground
IG	Ignition
LED	Light Emitting Diode
PAD	Passenger Air bag Deactivation
PID	Parameter Identification
SAS	Sophisticated Air bag Sensor
SST	Special Service Tool
WDS	Worldwide Diagnostic System

RESTRAINTS FEATURES

EPU080000000S02

Improved safety	• Driver-side air bag module adopted. • Passenger-side air bag module adopted. • Curtain air bag module adopted. • Side air bag module adopted. • Three-point seat belt with the following functions for front seat passengers adopted — ELR (Emergency Locking Retractor: emergency locking mechanism) — Pre-tensioner seat belt (See 08–10–15 PRE-TENSIONER SEAT BELT CONSTRUCTION/ OPERATION.) — Load limiter, which adjusts restraint force of the seat belt to reduce the possibility of injury to passengers caused by excess seat belt pressure after pre-tensioner or ELR operation • Three-point seat belt with the following functions for second-row seat passengers adopted — ELR — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism) • Three-point seat belt with the following functions for third-row seat passengers adopted — ELR — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism)

08–02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC FUNCTION OUTLINE 08–02–1
ON-BOARD DIAGNOSTIC FUNCTION 08–02–1
Self-Malfunction Diagnostic Function **08–02–1**
PID/Data Monitoring Function **08–02–6**

ON-BOARD DIAGNOSTIC FUNCTION OUTLINE

EPU080200000S01

- The air bag system has an on-board diagnostic function to facilitate the system diagnosis.
- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the air bag system-related parts; a memory function, which stores detected DTCs; a display function, which indicates system malfunctions by DTC display; a PID/data monitoring function, which reads out specific input/output signals.
- Using the WDS or equivalent, DTCs can be read out and deleted, and the PID/data monitoring function can be activated.
- The system has a fail-safe function to prevent the accidental activation of the air bags in case of an air bag system malfunction.

ON-BOARD DIAGNOSTIC FUNCTION

EPU080200000S02

Self-Malfunction Diagnostic Function

Malfunction detection function

- Detects overall malfunctions in the air bag system-related parts.

Fail-safe function

- If the SAS control module performance/function cannot be maintained due to any cause, the fail-safe function stops air bag system control and flashes the air bag system warning light to prevent the air bags from operating (deploying) accidentally.

Memory function

- Stores malfunctions in the air bag system-related parts detected by the malfunction detection function, and the stored malfunction contents are not cleared even if the ignition switch is turned to the LOCK position or the negative battery cable is disconnection.

Display function

- When the malfunction detection function detects a malfunction, the air bag system warning light illuminates to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the K-line.

DTC table

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1013	48		20	Seat weight sensor calibration error
B1046	24		10	Driver-side curtain air bag module assembly incorrect
B1047	22		8	Driver-side side air bag module assembly incorrect
B104B	63		16	Driver-side side air bag sensor No. 1 assembly incorrect
B104C	64		17	Passenger-side side air bag sensor No. 1 assembly incorrect
B104D	42		14	Crash zone sensor assembly incorrect
B104F	64		17	Passenger-side air bag sensor No. 1 system internal circuit disabled
B1051	63		16	Driver-side side air bag sensor No. 1 system internal circuit disabled
B1055	23		9	Passenger-side side air bag module assembly incorrect
B1056	25		11	Passenger-side curtain air bag module assembly incorrect
B1144	46		18	Driver-side side air bag sensor No. 2 system internal circuit disabled
B1145				Driver-side side air bag sensor No. 2 system communication error
B1146	47		19	Passenger-side side air bag sensor No. 2 system internal circuit disabled
B1147				Passenger-side side air bag sensor No. 2 system communication error
B1318	—	Continuously illuminated	1	SAS control module power supply voltage decreases (less than 9 V)
B1342	12		4	SAS control module
B1428	57		27	Seat belt warning light circuit open
B1869	—	Continuously illuminated	1	Air bag system warning light circuit open
	—	Does not illuminate	—	Air bag system warning light circuit short to body ground

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1877	33		12	Driver-side pre-tensioner seat belt circuit resistance high
B1878				Driver-side pre-tensioner seat belt circuit short to power supply
B1879				Driver-side pre-tensioner seat belt circuit short to body ground
B1881	34		13	Passenger-side pre-tensioner seat belt circuit resistance high
B1882				Passenger-side pre-tensioner seat belt circuit short to power supply
B1883				Passenger-side pre-tensioner seat belt circuit short to body ground
B1884	18		26	Passenger air bag deactivation (PAD) indicator circuit open or short to body ground
B1885	33		12	Driver-side pre-tensioner seat belt circuit resistance low
B1886	34		13	Passenger-side pre-tensioner seat belt circuit resistance low
B1916	19		6	Driver-side air bag module (inflator No. 1) circuit short to power supply
B1925	21		7	Passenger-side air bag module (inflator No. 1) circuit short to power supply
B1932	19		6	Driver-side air bag module (inflator No. 1) circuit resistance high
B1933	21		7	Passenger-side air bag module (inflator No. 1) circuit resistance high
B1934	19		6	Driver-side air bag module (inflator No. 1) circuit resistance low
B1935	21		7	Passenger-side air bag module (inflator No. 1) circuit resistance low
B1936	19		6	Driver-side air bag module (inflator No. 1) circuit short to body ground
B1938	21		7	Passenger-side air bag module (inflator No. 1) circuit short to body ground

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1992	22		8	Driver-side side air bag module circuit short to power supply
B1993				Driver-side side air bag module circuit short to body ground
B1994				Driver-side side air bag module circuit resistance high
B1995				Driver-side side air bag module circuit resistance low
B1996	23		9	Passenger-side side air bag module circuit short to power supply
B1997				Passenger-side side air bag module circuit short to body ground
B1998				Passenger-side side air bag module circuit resistance high
B1999				Passenger-side side air bag module circuit resistance low
B2226	42		14	Crash zone sensor system internal circuit disabled
B2227				Crash zone sensor system commmunication error
B2228	19		6	Driver-side air bag module (inflator No.2) circuit short to body ground
B2229	21		7	Passenger-side air bag module (inflator No.2) circuit short to body ground
B2230	19		6	Driver-side air bag module (inflator No.2) circuit short to power supply
B2231	21		7	Passenger-side air bag module (inflator No.2) circuit short to power supply
B2232	19		6	Driver-side air bag module (inflator No.2) circuit resistance high
B2233	21		7	Passenger-side air bag module (inflator No.2) circuit resistance high
B2234	19		6	Driver-side air bag module (inflator No.2) circuit resistance low
B2235	21		7	Passenger-side air bag module (inflator No.2) circuit resistance low
B2290	48		20	Passenger sensing system malfunction
B2433	51		22	Driver-side front buckle switch circuit open or short to power supply

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B2434	51		22	Driver-side front buckle switch circuit short to body ground
B2437	52		23	Passenger-side front buckle switch circuit open or short to power supply
B2438	52		23	Passenger-side front buckle switch circuit short to body ground
B2477	54		2	Configuration error
B2773	24		10	Driver-side curtain air bag module circuit resistance low
B2774				Driver-side curtain air bag module circuit resistance high
B2775				Driver-side curtain air bag module circuit short to body ground
B2776				Driver-side curtain air bag module circuit short to power supply
B2777	25		11	Passenger-side curtain air bag module circuit resistance low
B2778				Passenger-side curtain air bag module circuit resistance high
B2779				Passenger-side curtain air bag module circuit short to body ground
B2780				Passenger-side curtain air bag module circuit short to power supply
B2856	42		14	Crash zone sensor system communication data error
B2867	31		3	Poor connection of any SAS control module connectors
B2886	64		17	Passenger-side air bag sensor No. 1 system communication data error
B2887	63		16	Driver-side air bag sensor No. 1 system communication data error
C1946	49		21	Seat track position sensor circuit open
C1947	49		21	Seat track position sensor circuit short to body ground
C1948	49		21	Seat track position sensor circuit resistance not within specification

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
C1982	49		21	Seat track position sensor circuit short to power supply
U2017	63		16	Driver-side side air bag sensor No. 1 system communication error
U2018	64		17	Passenger-side side air bag sensor No. 1 system communication error

PID/Data Monitoring Function

- By using the PID/data monitoring function, the monitored item of the input/output signal, as set on the SAS control module, can be freely selected and read out in real-time.
- The WDS or equivalent is used to read out PID/data monitor information.

PID/data monitor table

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
BUCKLE_D (Driver-side buckle switch status)	Buckled/ Unbuckled	• Driver-side buckle switch on: Buckled • Driver-side buckle switch off: Unbuckled	2W
BUCKLE_P (Passenger-side buckle switch status)	Buckled/ UNbuckled	• Passenger-side buckle switch on: Buckled • Passenger-side buckle switch off: Unbuckled	2C
CCNT_RCM (Number of continuous DTCs)	—	• DTCs detected: 1—255 • No DTCs detected: 0	—
CR2D_Comm (Driver-side side air bag sensor No. 2 system communication data error)	OK/ FAULT	• Sensor normal: OK • Sensor communication malfunction: FAULT	2I, 2L
CR2D_Inter (Driver-side side air bag sensor No. 2 system internal circuit disabled)	OK/ FAULT	• Sensor normal: OK • Sensor internal malfunction: FAULT	2I, 2L
CR2D_Mount (Driver-side side air bag sensor No. 2 assembly incorrect)	OK/ FAULT	• Sensor normal: OK • Sensor Install malfunction: FAULT	2I, 2L
CR2D_Short (Driver-side side air bag sensor No. 2 system communication error)	OK/ FAULT	• Sensor normal: OK • Sensor open or short circuit: FAULT	2I, 2L
CR2P_Comm (Passenger-side side air bag sensor No. 2 system communication data error)	OK/ FAULT	• Sensor normal: OK • Sensor communication malfunction: FAULT	2U, 2R
CR2P_Inter (Passenger-side side air bag sensor No. 2 system internal circuit disabled)	OK/ FAULT	• Sensor normal: OK • Sensor internal malfunction: FAULT	2U, 2R
CR2P_Mount (Passenger-side side air bag sensor No. 2 assembly incorrect)	OK/ FAULT	• Sensor normal: OK • Senso Install malfunction: FAULT	2U, 2R
CR2P_Short (Passenger-side side air bag sensor No. 2 system communication error)	OK/ FAULT	• Sensor normal: OK • Sensor open or short circuit: FAULT	2U, 2R
IGN_V_2 (IG1 voltage)	V	• Ignition switch is at ON: B+ • Other: 0	—

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
OCS_CAL_ST* (Seat weight sensor calibration status)	Starting/ Normal End/ Commanding/ NG (Voltage)/ NG (Weight)/ Timeout/ In Process OCS Fault	• Seat weight sensor calibration start-up: Starting • Seat weight sensor calibration completed normally: Normal End • Seat weight sensor calibration command being sent: Commanding • Voltage malfunction during seat weight sensor calibration: NG (Voltage) • Weight error during seat weight sensor calibration: NG (Weight) • Seat weight sensor calibration time limit passed: Timeout • Seat weight sensor calibration being processed: In Process • Seat weight sensor or Seat weight sensor control module malfunction: OCS Fault	3B
DTC_CLR_ST* (Seat weight sensor status)	Starting Normal End In Process OCS Fault	Fault information cleared at seat weight sensor	3B
OCS_PSG_ST* (Seat weight sensor status)	Empty/ Child Adult OCS Fault	Occupant classification status determined by seat weight sensor	3B
OCSFLT_CAL (Passenger sensing system calibtration status)	OK/ FAULT	• Sensor normal: OK • Seat weight sensor calibration error: FAULT	3B
OCSFLT_COM (Passenger sensing system communication status)	OK/ FAULT	• Sensor normal: OK • Seat weight sensor control module communication error: FAULT	3B
OCSFLT_L (Passenger sensing system (LH) malfunction status)	OK/ FAULT	• Sensor normal: OK • Seat weight sensor (LH) malfunction: FAULT	3B
OCSFLT_MDL (Passenger sensing system control module malfunction status)	OK/ FAULT	• Sensor normal: OK • Seat weight sensor control module malfunction: FAULT	3B
OCSFLT_R (Passenger sensing system (RH) malfunction status)	OK/ FAULT	• Sensor normal: OK • Seat weight sensor (RH) malfunction: FAULT	3B
OCSFLT_SNS (Passenger sensing system malfunction status)	OK/ FAULT	• Sensor normal: OK • Seat weight sensor malfunction: FAULT	3B
PS_WEIGHT (Seat weight sensor measured weight of passenger)	Kg	Display of load (body weight) on passenger-side seat	2AJ
RES_AB_D (Driver-side air bag module (inflator No. 1) resistance)	Ohms	Under any condition: 1.5—4.7 ohms	1A, 1D
RES_AB_P (Passenger-side air bag (inflator No. 1) module resistance)	Ohms	Under any condition: 1.3—4.7 ohms	1V, 1S
RES_AB2_D (Driver-side air bag module (inflator No. 2) resistance)	Ohms	Under any condition: 1.5—4.7 ohms	1J, 1G
RES_AB2_P (Passenger-side air bag (inflator No. 2) module resistance)	Ohms	Under any condition: 1.3—4.7 ohms	1M, 1P
RES_CAB_D (Driver-side curtain air bag module resistance)	Ohms	Under any condition: 1.3—4.7 ohms	2B, 2E
RES_CAB_P (Passenger-side curtain air bag module resistance)	Ohms	Under any condition: 1.3—4.7 ohms	2Z, 2W

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
RES_PT_D (Driver-side pre-tensioner seat belt resistance)	Ohms	Under any condition: 1.3—4.7 ohms	2A, 2D
RES_PT_P (Passenger-side pre-tensioner seat belt resistance)	Ohms	Under any condition: 1.3—4.7 ohms	2Y, 2V
RES_SAB_D (Driver-side side air bag module resistance)	Ohms	Under any condition: 1.3—4.7 ohms	2J, 2G
RES_SAB_P (Passenger-side side air bag module resistance)	Ohms	Under any condition: 1.3—4.7 ohms	2P, 2S
TRAK_SW (Seat track position sensor state)	Forward/ Rearward	• Front seat front position: Forward • Front seat rear position: Rearward	2AB, 2AF

* : Used during seat weight sensor calibration setting. Not necessary for diagnostic.

08–10 AIR BAG SYSTEM

AIR BAG SYSTEM OUTLINE 08–10–2
AIR BAG SYSTEM STRUCTURAL VIEW 08–10–3
AIR BAG SYSTEM WIRING DIAGRAM 08–10–4
SAS CONTROL MODULE FUNCTION 08–10–4
Outline **08–10–4**
SAS CONTROL MODULE CONSTRUCTION/OPERATION 08–10–5
Front Air Bag System (Two-Step Deployment Control) **08–10–5**
Side Air Bag Sensor System **08–10–6**
Seat Position Matching Deployment Control **08–10–7**
Seat Belt Buckled/Unbuckled Condition Matching (Deployment) Control **08–10–7**
Passenger Detection System Operation (Deployment) Control **08–10–8**
SEAT TRACK POSITION SENSOR FUNCTION 08–10–8
SEAT TRACK POSITION SENSOR CONSTRUCTION/OPERATION 08–10–8
PASSENGER SENSING SYSTEM OUTLINE 08–10–8
Outline **08–10–8**
PASSENGER SENSING SYSTEM CONSTRUCTION 08–10–9
PASSENGER SENSING SYSTEM OPERATION 08–10–9
DRIVER-SIDE AIR BAG MODULE FUNCTION 08–10–11
Outline **08–10–11**
DRIVER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION 08–10–11
Inflator Operation **08–10–11**
PASSENGER-SIDE AIR BAG MODULE FUNCTION 08–10–12
Outline **08–10–12**
PASSENGER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION 08–10–12
Inflator Operation **08–10–12**
SIDE AIR BAG MODULE FUNCTION . . . 08–10–13
SIDE AIR BAG MODULE CONSTRUCTION/OPERATION 08–10–13
Construction **08–10–13**
CURTAIN AIR BAG MODULE FUNCTION 08–10–14
CURTAIN AIR BAG MODULE CONSTRUCTION/OPERATION 08–10–14
Construction **08–10–14**
PRE-TENSIONER SEAT BELT FUNCTION 08–10–15
PRE-TENSIONER SEAT BELT CONSTRUCTION/OPERATION 08–10–15
Construction **08–10–15**
Operation **08–10–16**

AIR BAG SYSTEM OUTLINE

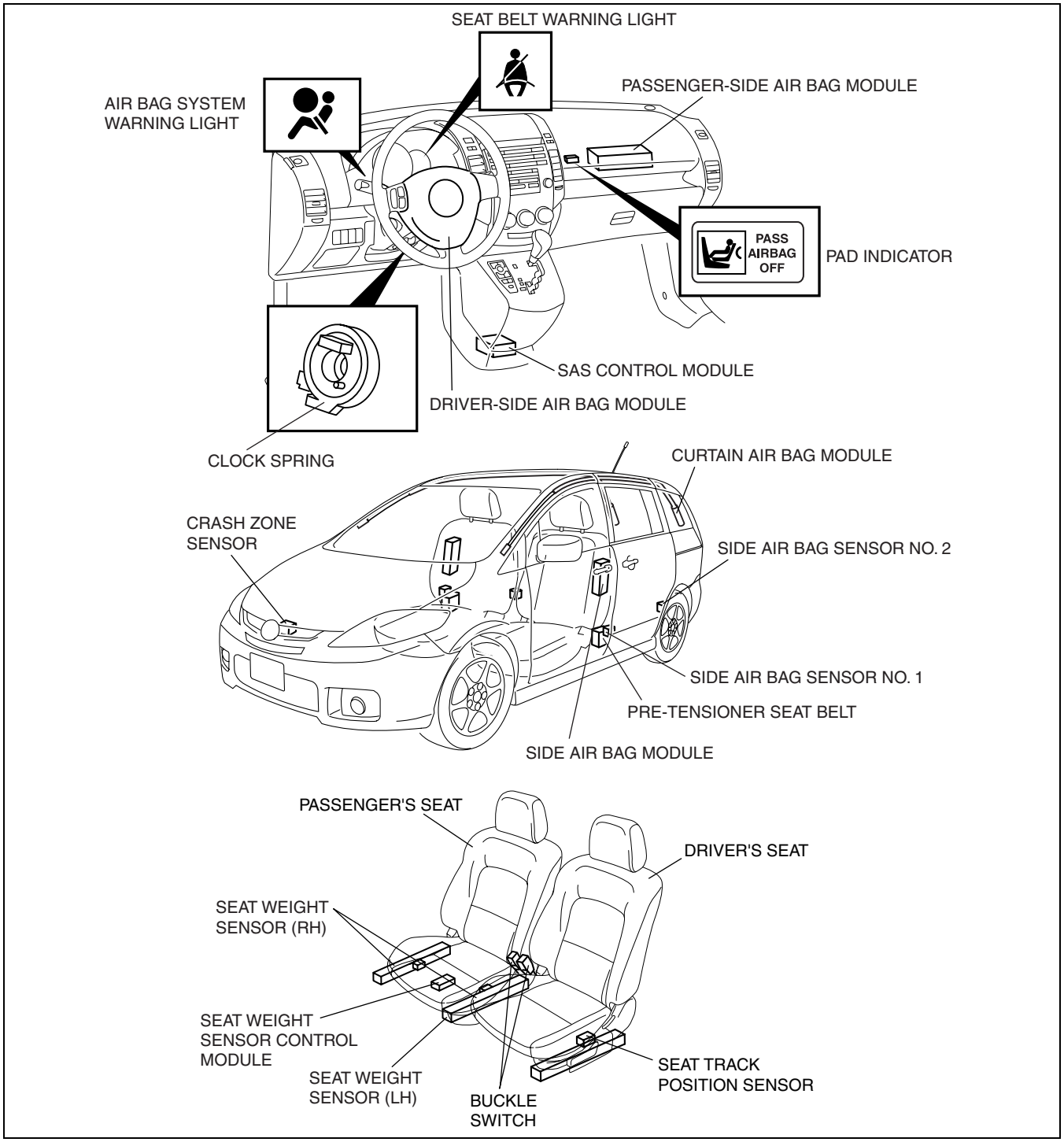
EPU081000000S01

- The air bag system is a device that supplements the passenger restraint function of the seat belts. The air bag system will not have the designed effect if the seat belts are not worn properly.
- The air bag system is composed of the following parts:

Item	Outline
SAS control module	• Two-step deployment control has been added to the front air bag system (driver and passenger-side) deployment control. • Recognizes actually equipped air bag module or pre-tensioner front buckle based on module configuration.
Crash zone sensor	• Detects degree of impact, converts to an electrical signal, and sends the signal to the SAS control module. For operation, refer to SAS control module, Air Bag Module and Pre-tensioner Front Buckle Deployment Operation. (See 08–10–5 SAS CONTROL MODULE CONSTRUCTION/OPERATION)
Side air bag sensor	
Driver-side air bag module	• Dual inflators, inflator 1 and inflator 2, have been adopted in accordance with the front air bag system two-step deployment control.
Passenger-side air bag module	
Side air bag module	• Chest-protection type side air bag module is used in accordance with the adoption of the curtain air bag module.
Curtain air bag module	• Adopted to improve safety in lateral collisions.
Pre-tensioner seat belt	• Piston-type pre-tensioner seat belt has been adopted.
Seat track position sensor	• Detects the seat track position of the driver's seat, and sends a corresponding signal to the SAS control module.
PAD indicator	• PAD indicator has been adopted to inform driver and front passenger of the deployment standby status of the passenger-side air bag module, passenger-side side air bag module, and passenger-side pre-tensioner front buckle.
Buckle switch	• Detects the buckled/unbuckled condition of the front driverside and passenger-side seat belts, and sends a corresponding signal to the SAS control module.
Air bag system warning light	• LED has been adopted.
Seat belt warning light	
Seat weight sensor	• Measures the compression weight of the load applied to the passenger-side seat by the distortion amount using two seat weight sensor and sends an electrical signal corresponding to the distortion amount to the seat weight sensor control module.
Seat weight sensor control module	• Based on the electrical signal sent from the seat weight sensor corresponding to the distortion amount, calculates the total seated weight to determine the passenger, and sends the determination result to the SAS control module.

AIR BAG SYSTEM STRUCTURAL VIEW

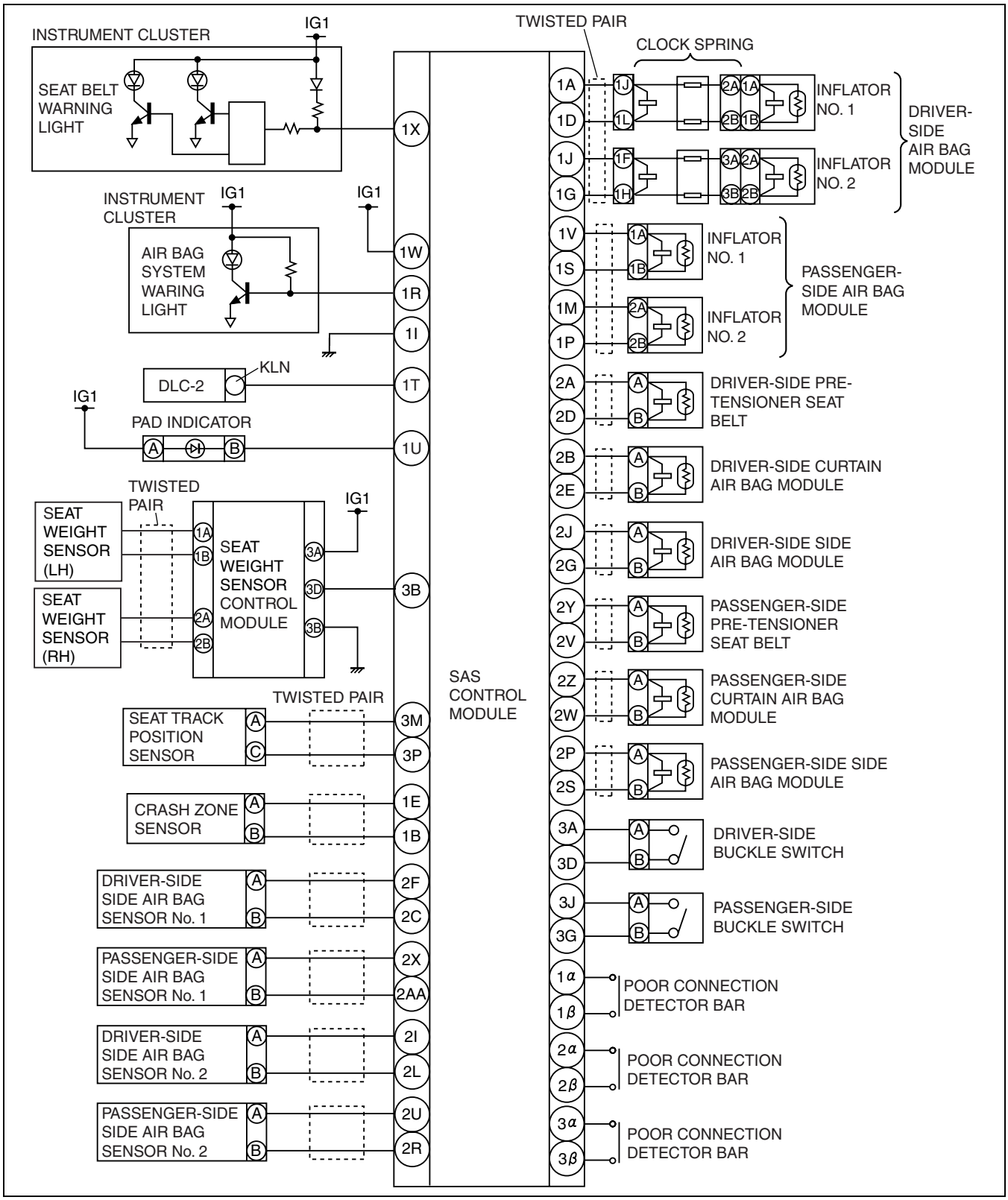
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EPU810ZT3019

AIR BAG SYSTEM WIRING DIAGRAM

EPU081000000S03



EPU810ZT3021

SAS CONTROL MODULE FUNCTION

EPU081057030S01

Outline

- A two-step air bag deployment control system has been adopted. In case of a frontal or frontal offset collision, an optimal air bag deployment force is matched to the impact force. The inflators for the driver and passenger-side air bag modules have two tiers, and deploy at either a low or high rate, according to the force of the impact.

SAS CONTROL MODULE CONSTRUCTION/OPERATION

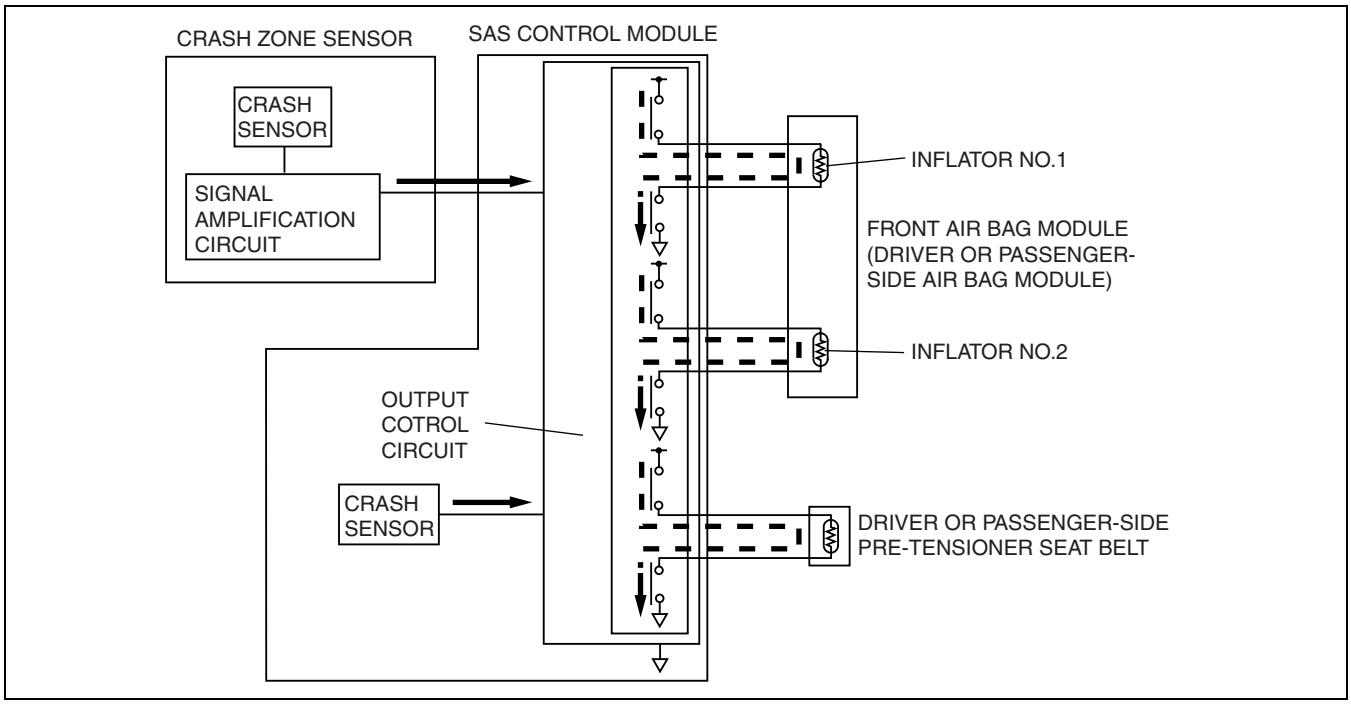
EPU081057030S02

Front Air Bag System (Two-Step Deployment Control)

1. During a frontal or frontal offset collision, the crash sensors in the crash zone sensor and the SAS control module detect the impact.
2. The level of impact detected by the crash sensors in the crash zone sensor is converted to an electric signal and sent to the SAS control module.
3. Simultaneously, the SAS control module crash sensor converts the level of impact detected to an electrical signal.
4. The SAS control module processes the calculations for the two electrical signals at the output control circuit and compares the value to a preset value.
5. The output control circuit determines the level of impact to the vehicle by the value from the crash sensors, completes an inflator No.1 or inflator No.2 ignition circuit, and sends the deployment signal to the air bag modules.

No.	Level of collision force	Air bag module deployment force	Inflator deployment pattern
1	Large	Large	Inflator No.1 and inflator No.2 deploy.
2	Small	Small	Inflator No.1 deploys.

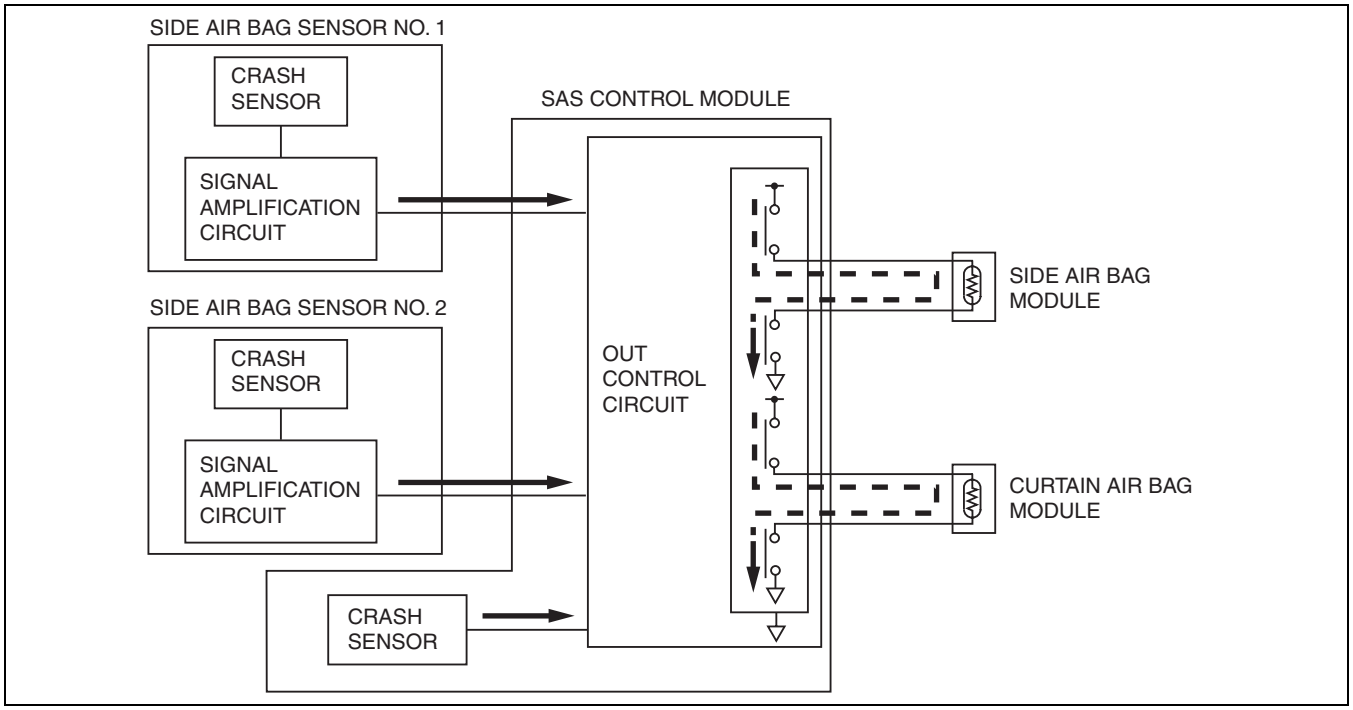
6. The SAS control module completes an ignition circuit for the pre-tensioner seat belts that is synchronized to the deployment of the driver and passenger-side air bag modules, and an operation (deployment) signal is sent to the pre-tensioner seat belts.



C3U0810S601

Side air bag system

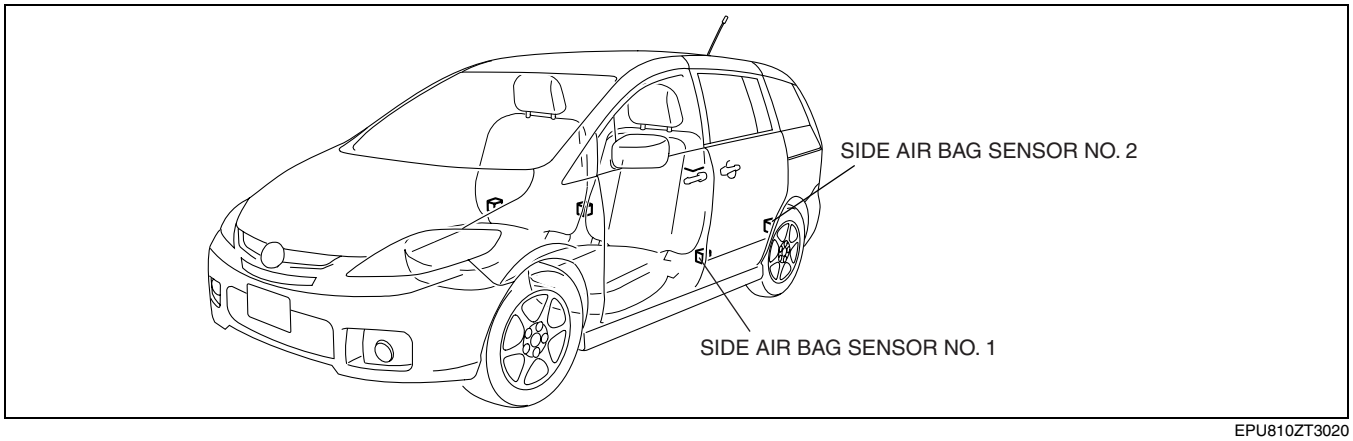
1. During a lateral collision to the vehicle, the crash sensors in the side air bag sensor No. 1, side air bag sensor No. 2 and SAS control module detect the collision.
2. The level of impact detected by the crash sensor in the side air bag sensor is converted to an electrical signal and sent to the SAS control module through the signal amplification circuit.
3. Simultaneously, the SAS control module crash sensor converts the level of impact detected to an electrical signal.
4. The SAS control module processes the calculations for the two electrical signals at the output control circuit and compares the value to a preset value.
5. The output control circuit determines the level of impact to the vehicle by the value from the crash sensors, completes a side air bag module and curtain air bag module ignition circuit, and sends the deployment signal to the air bag modules.



EPU810ZT3015

Side Air Bag Sensor System

1. To improve detection of an impact to the side of the vehicle, side air bag sensors have been placed in the front and rear (No.1: Front, No.2: Rear).

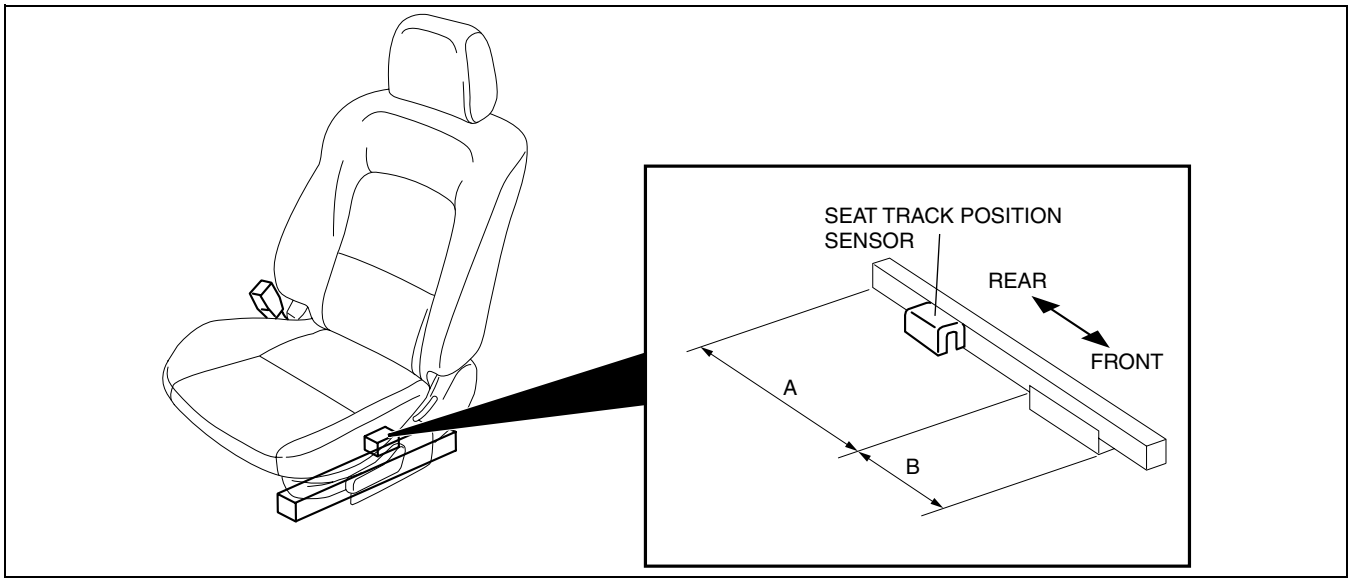


EPU810ZT3020

Seat Position Matching Deployment Control

- The SAS control module controls the air bag deployment operation pattern (deployment only inflator No.1 or both inflator No.1 and No.2) according to the seat track position of the driver's seat.
- The SAS control module detects the seat track position based on the seat position signal received from the seat track position sensor.
- When the driver's seat is in a forward position, the SAS control module deploys only inflator No.1 to lessen the air bag module deployment force.

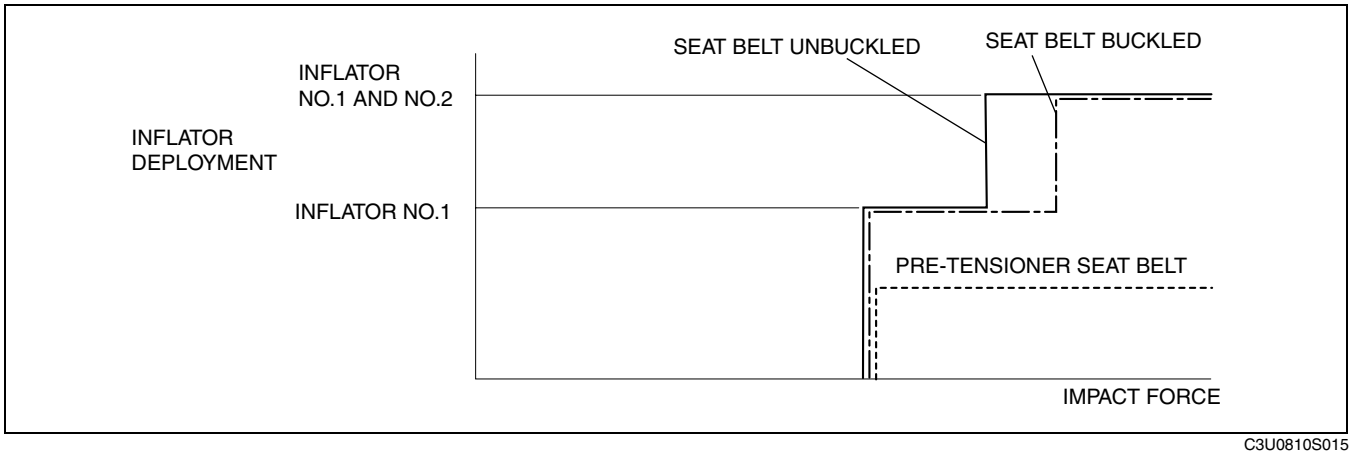
Seat Position	Air bag module deployment control
A	Normal control (only inflator No.1 deploys or both inflator No.1 and No.2 deploy)
B	Only inflator No.1 deploys



EPU810ZT3017

Seat Belt Buckled/Unbuckled Condition Matching (Deployment) Control

- The SAS control module detects the buckled or unbuckled condition of the front driver-side and passenger-side seat belts based on a signal received from the front buckle switch. Based on this signal, the necessary air bag system deployment is controlled according to the impact profile (speed) range.
- When the SAS control module detects that the front driver-side or passenger-side or seat-belt is unbuckled, it lowers the minimum specified value of the impact profile (speed) for high-output deployment (inflator No.1 and No.2 deploy simultaneously). This means that the SAS control module controls deployment so that in a collision with an impact profile which normally dose not lead to high-output deployment (inflator No.1 and No.2 deploy simultaneously) of the air bag modules, the corresponding air bag will deploy if either one of the front seat belts is unbuckled.



C3U0810S015

Passenger Detection System Operation (Deployment) Control

- The SAS control module, which receives the signal from the seat weight sensor control module, controls the passenger-side air bag module operation (deployment) and the illumination on/off for the PAD indicator based on the passenger determination result for the passenger-side seat.
- If the seat weight sensor control module determines that the passenger-side seat is occupied by a child (including the child restraint seat), the SAS control module controls the system so that the passenger-side air bag module, passenger-side side air bag module and the passenger-side pre-tensioner seat belt do not operate (deploy), even if the level of impact from the collision would normally cause the air bag modules to operate (deploy). The seat weight sensor control module also informs the driver and other passenger (passenger-side seat) that the air bag module is in non-operation (non-deployment) status by illuminating the PAD indicator.
- If the seat weight sensor control module determines that the passenger-side seat is not occupied, the SAS control module sets the air bags to non-operation (non-deployment) status, the same as when a child is determined, and turns off the PAD indicator.
- If the seat weight sensor control module determines that an adult is seated in the passenger-side seat, the SAS control module controls the system so that the passenger-side air bag module, passenger-side side air bag module and the passenger-side pre-tensioner seat belt operate (deploy) normally during a collision, and turns off the PAD indicator
- When the ignition switch is turned to the ON position, the PAD indicator illuminates for **approx. 6 s** while the SAS control module inspects for malfunctions in the circuit. If a malfunction is detected in the circuit, a DTC is displayed.

SEAT TRACK POSITION SENSOR FUNCTION

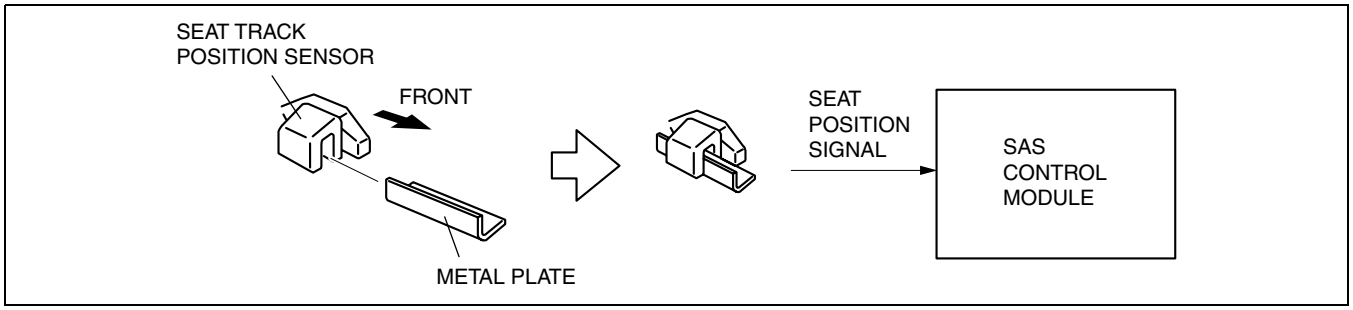
EPU081057030S03

- The seat track position sensor converts the seat position into an electrical signal and sends it to the SAS control module.

SEAT TRACK POSITION SENSOR CONSTRUCTION/OPERATION

EPU081057030S04

- The seat track position sensor consists of a Hall element (semi-conductor) and a magnet. The sensor converts the effect of the magnetic flux (produced by the magnet) on the Hall element, into an electrical signal.
- When the driver's seat is moved to a forward position, the metal plate installed near the front of the seat track passes through the groove in the seat track position sensor. When this occurs the magnetic flux of the sensor changes and that change is sent as an electrical signal to the SAS control module. The SAS control module receives this signal and determines that the driver's seat has been moved to a forward position.



CHU0810S004

PASSENGER SENSING SYSTEM OUTLINE

EPU081057031S01

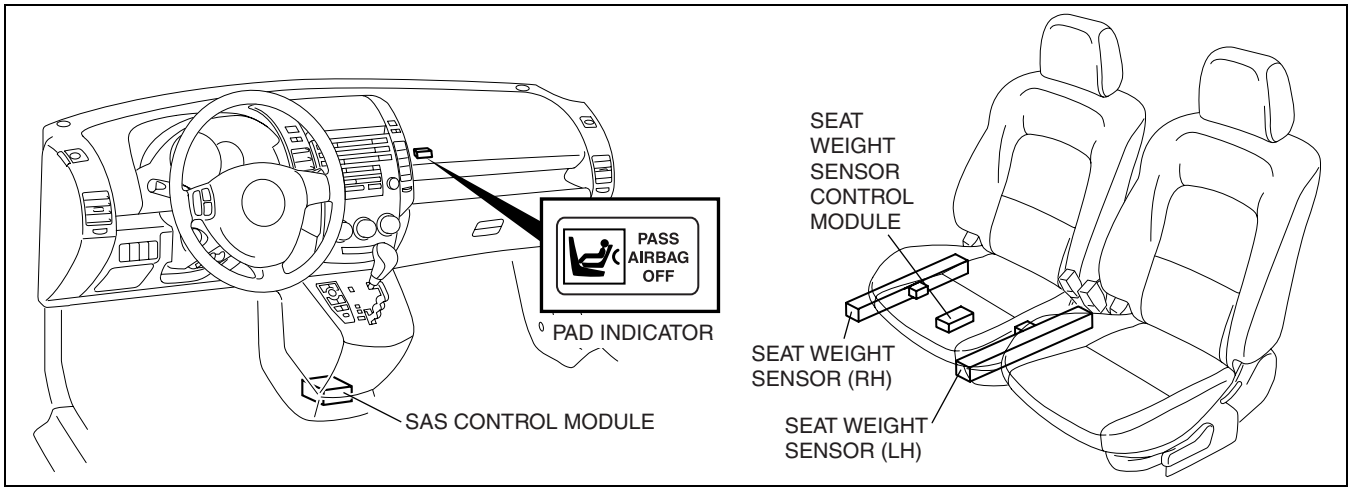
Outline

- Measures the total seated weight on the passenger-side seat, determines whether there is an adult or child (including a child-restraint seat), or that it is empty, and then controls operation (deployment) or non-operation (non-deployment) of the passenger-side air bag module and pre-tensioner seat belt.

PASSENGER SENSING SYSTEM CONSTRUCTION

EPU081057031S02

- Consists of seat weight sensors installed above the passenger-side seat rails, a seat weight sensor control module installed on the back side of the passenger-side seat cushion, the PAD indicator, and SAS control module installed in the console.



EPU810ZT3018

PASSENGER SENSING SYSTEM OPERATION

EPU081057031S03

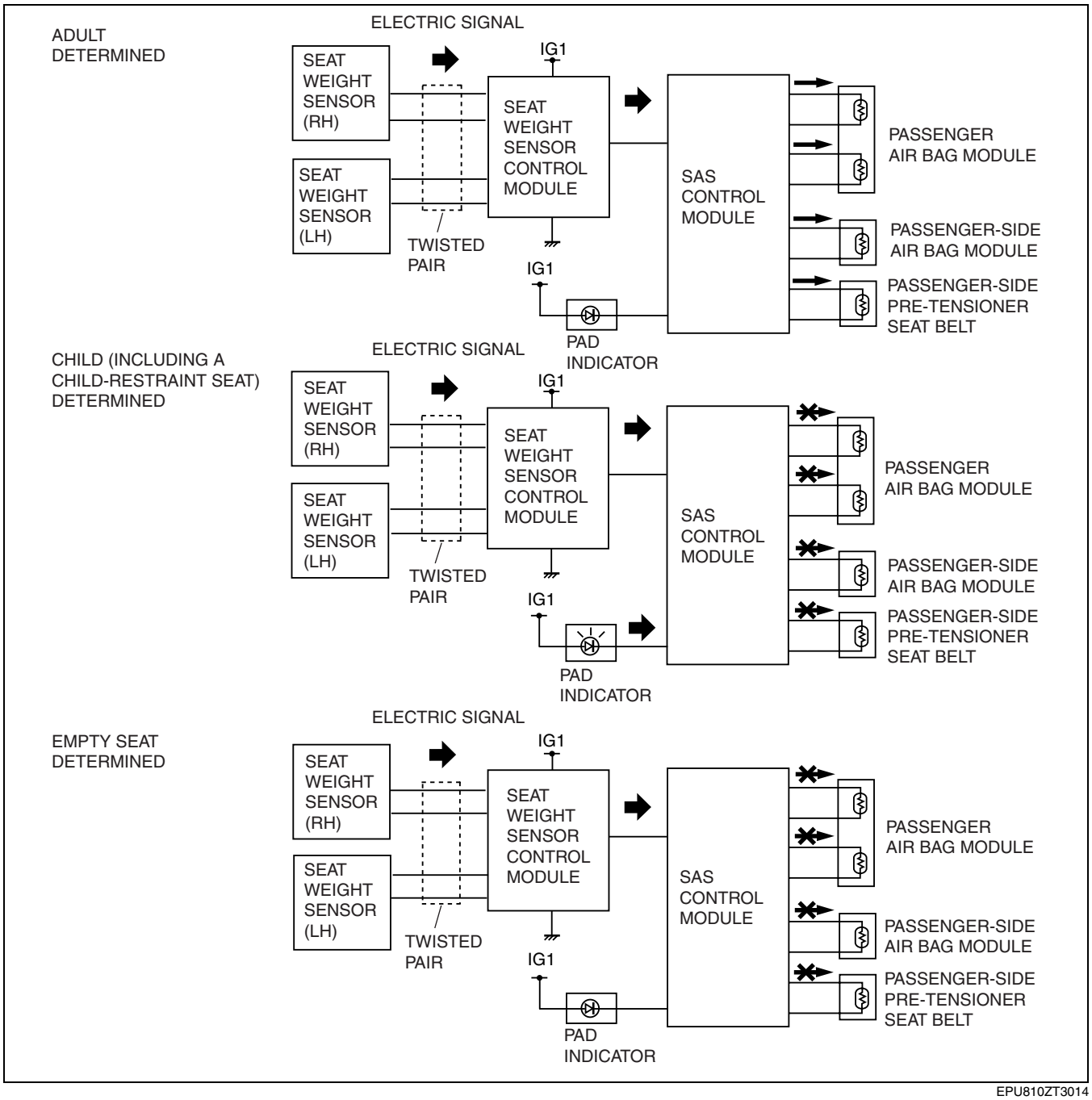
1. The load on the passenger-side front seat is converted into an electric signal by the strain gauge built into the seat weight sensor, and this signal is sent to the seat weight sensor control module.
2. The electronic signals from the two seat weight sensor are used for calculation by the seat weight sensor control module, which divides the result and then determines whether there is an adult or child (including a child-restraint seat) in the passenger-side seat, or that it is empty. The determined result is sent to the SAS control module.
3. The SAS control module performs control based on this determined result as shown in the following table when the module detects a level of impact requiring operation (deployment).

×: Possible
-: Not possible

Determined result	Determined weight	Passenger-side air bag module operation (deployment)	Passenger-side side air bag module operation (deployment)	Passenger-side pre-tensioner seat belt operation (deployment)	PAD indicator
Adult	Approx. 42 kg {93 lb} or more	×	×	×	Not illuminated
Child (including child-restraint seat)	Approx. 30 kg {66 lb} or less	-	-	-	Illuminated
Empty	Approx. 0 kg {0 lb}	-	-	-	Not illuminated

Note

- The passenger-side air bag module, the passenger-side side air bag module and the passenger-side pre-tensioner seat belt system will be turned off as the total seated weight drops toward 30 kg {66 lb} and they will be turned on again before the weight exceeds 42 kg {93 lb}.



EPU810ZT3014

Caution

- **If any of the following work is performed, perform the seat weight sensor calibration using the WDS or equivalent.**
  - **— Replacement with a new seat weight sensor**
  - **— Replacement with a new seat weight sensor control module**
  - **— Replacement with new passenger-side seat parts**
  - **— Disassembly of the passenger-side seat**
- **If any of the following work is performed, perform the seat weight sensor inspection using the WDS or equivalent.**
  - **— Removal of the passenger-side seat**
  - **— Loosening and retightening of passenger's seat fixing bolts**
  - **— Or, the vehicle is involved in a collision**

DRIVER-SIDE AIR BAG MODULE FUNCTION

EPU081057010S01

Outline

- A dual inflator, divided into inflator No.1 and No.2, has been adopted in accordance with the front air bag system two-step deployment control.

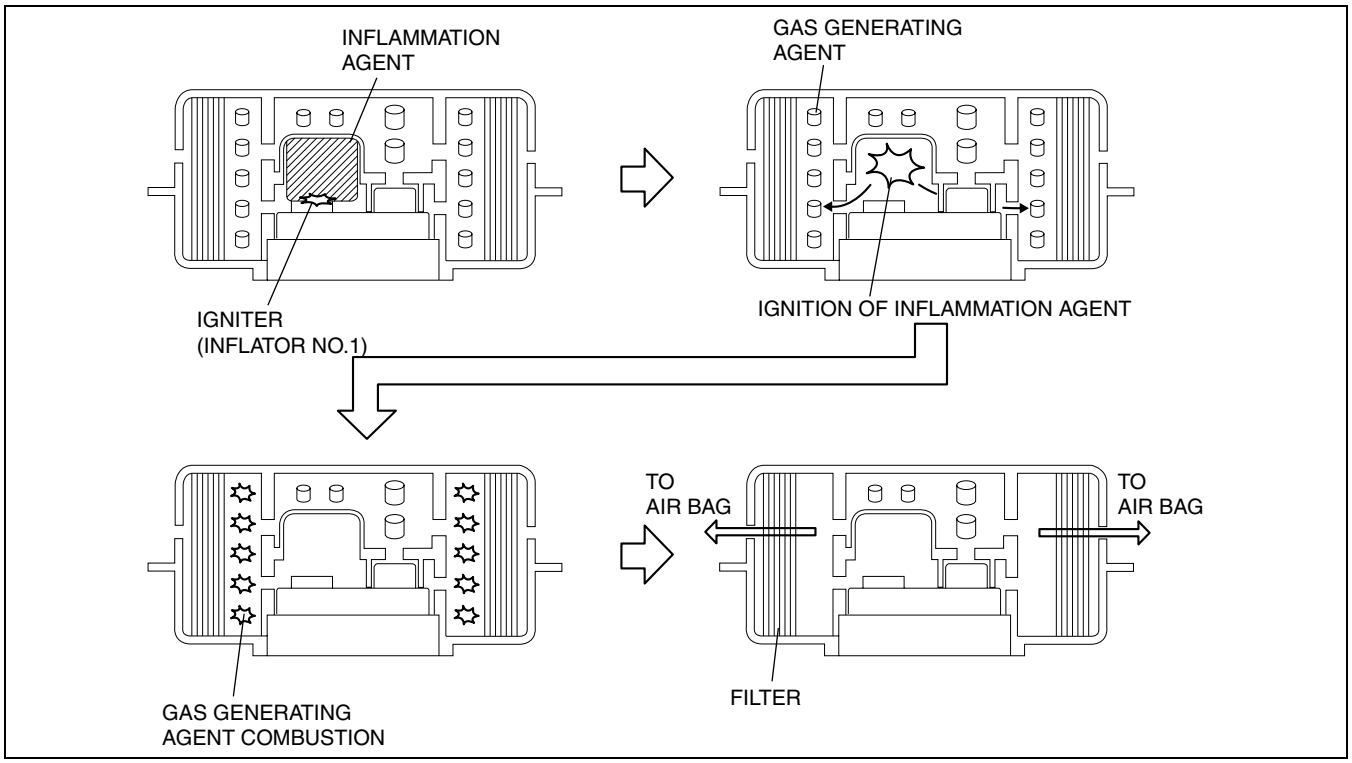
DRIVER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

EPU081057010S02

Inflator Operation

Inflator No.1

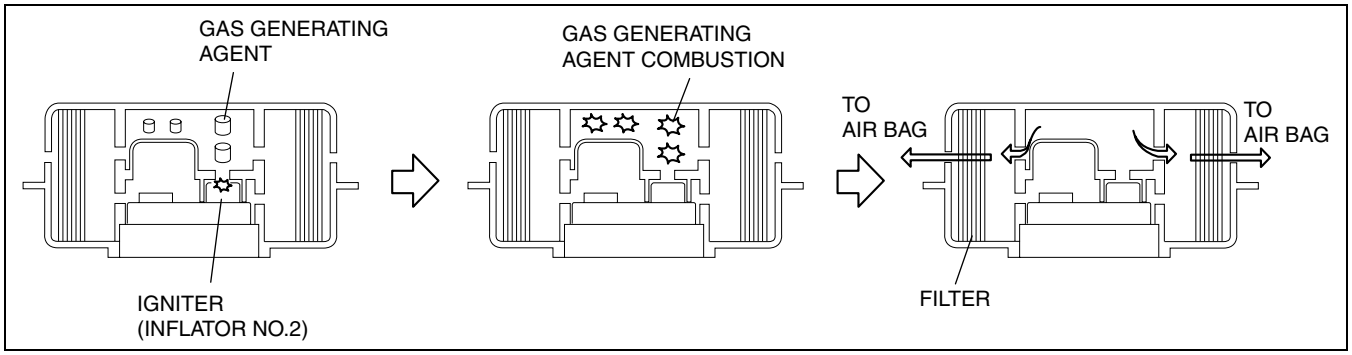
1. When the driver-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.1 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



ADA8130T003

Inflator No.2

1. When the driver-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.2 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



ADA8130T004

PASSENGER-SIDE AIR BAG MODULE FUNCTION

EPU081057050S01

Outline

- A dual inflator, divided into inflator No.1 and inflator No.2, has been adopted in accordance with the front air bag system two-step deployment control.

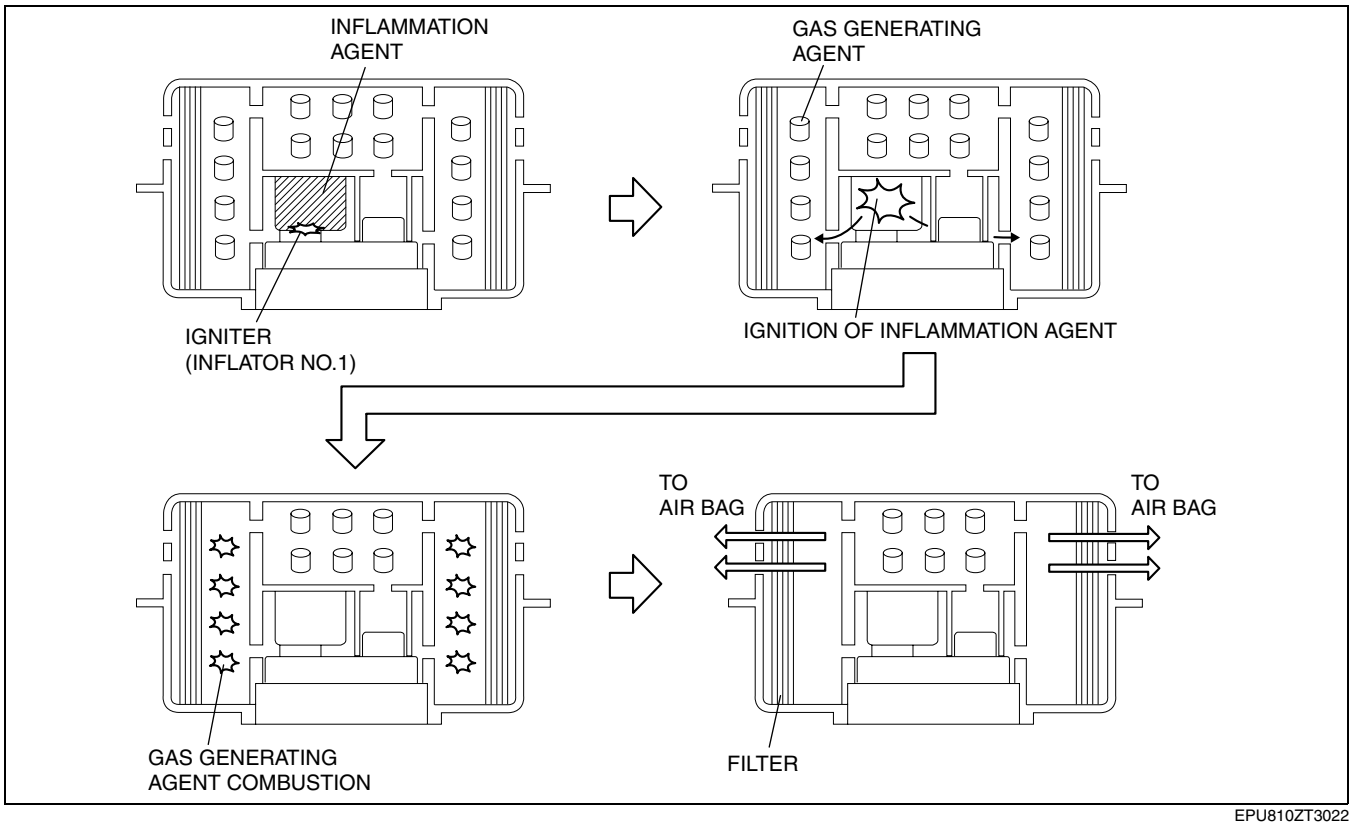
PASSENGER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

EPU081057050S02

Inflator Operation

Inflator No.1

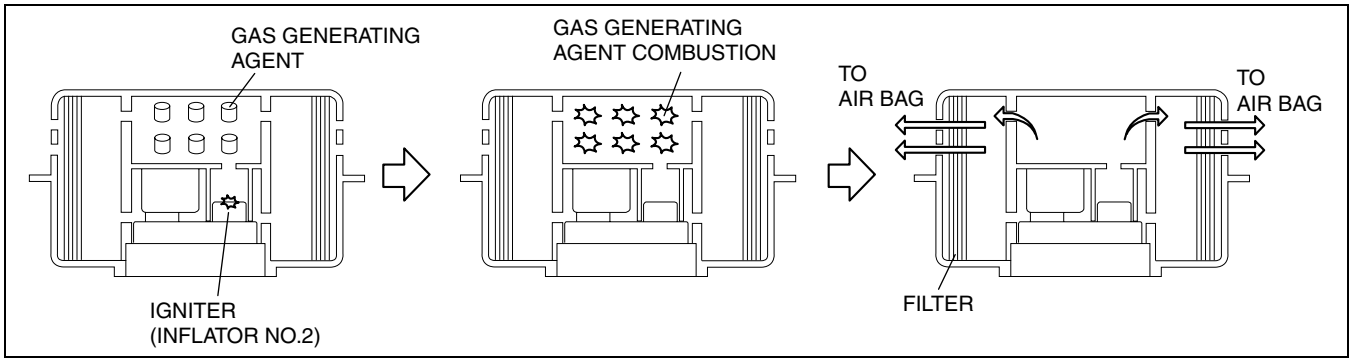
1. When the passenger-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.1 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



EPU810ZT3022

Inflator No.2

1. When the passenger-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.2 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



EPU810ZT3023

SIDE AIR BAG MODULE FUNCTION

EPU081000147S01

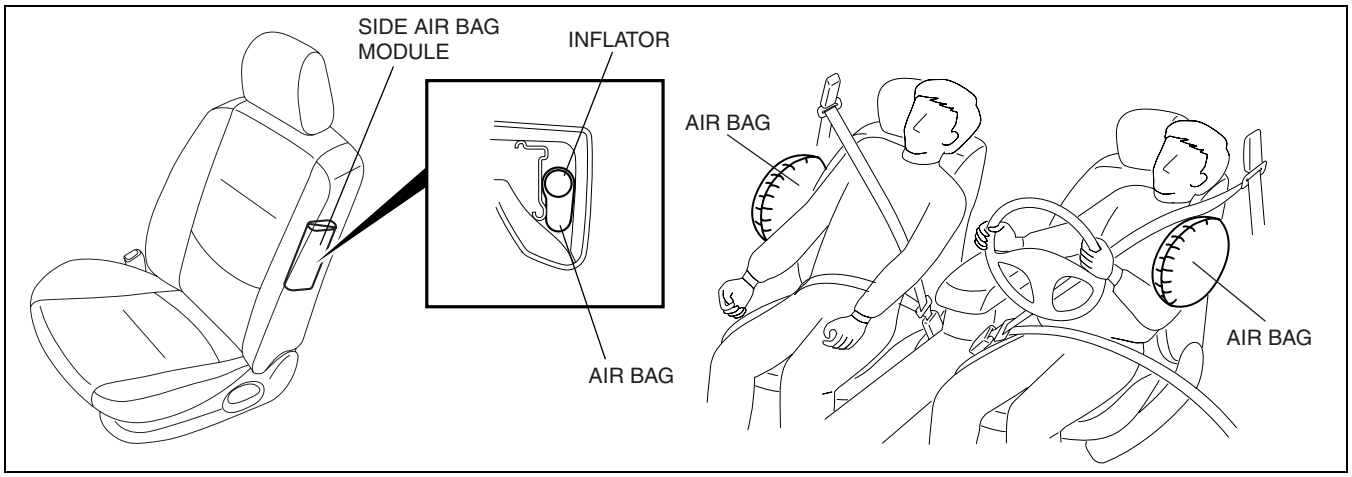
- During a collision to the side of the vehicle, the air bag operates (deploys) after receiving an operation signal from the SAS control module, defusing impact to the chest area of the driver and front passenger.
- Operates in conjunction with the curtain air bag module.

SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

EPU081000147S02

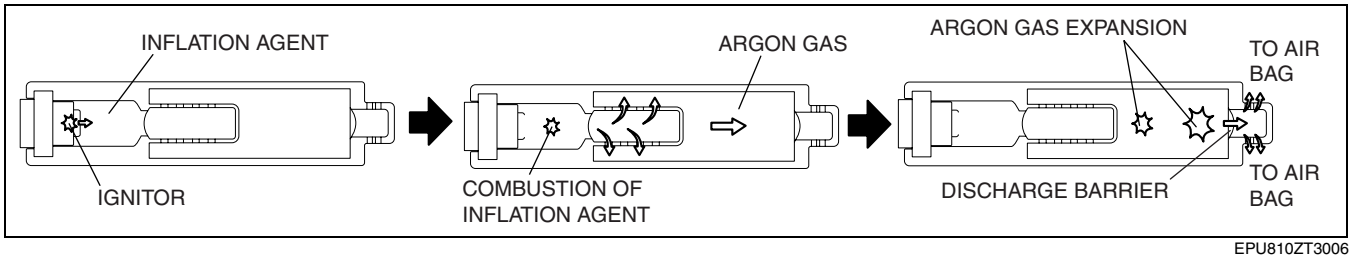
Construction

- Side air bag modules are installed on the outboard sides of the front seat backs.
- The side air bag module is composed of an inflator and air bag.
- When the air bag operates (deploys), the seat back trim is spread apart by argon gas generated from the inflator, inflating the air bag.



EPU810ZT3005

- The inflator operates in the following order:
  1. The igniter built into the inflator begins to build up heat when the operation (deployment) signal is sent from the SAS control module. The inflation agent is ignited by the build up of heat in the igniter.
  2. The argon gas expands due to the heat of the ignited inflation agent.
  3. The expanding argon gas breaks the discharge barrier, is cooled and filtered by the filter, and then injected into the air bag.



EPU810ZT3006

CURTAIN AIR BAG MODULE FUNCTION

EPU081000171S01

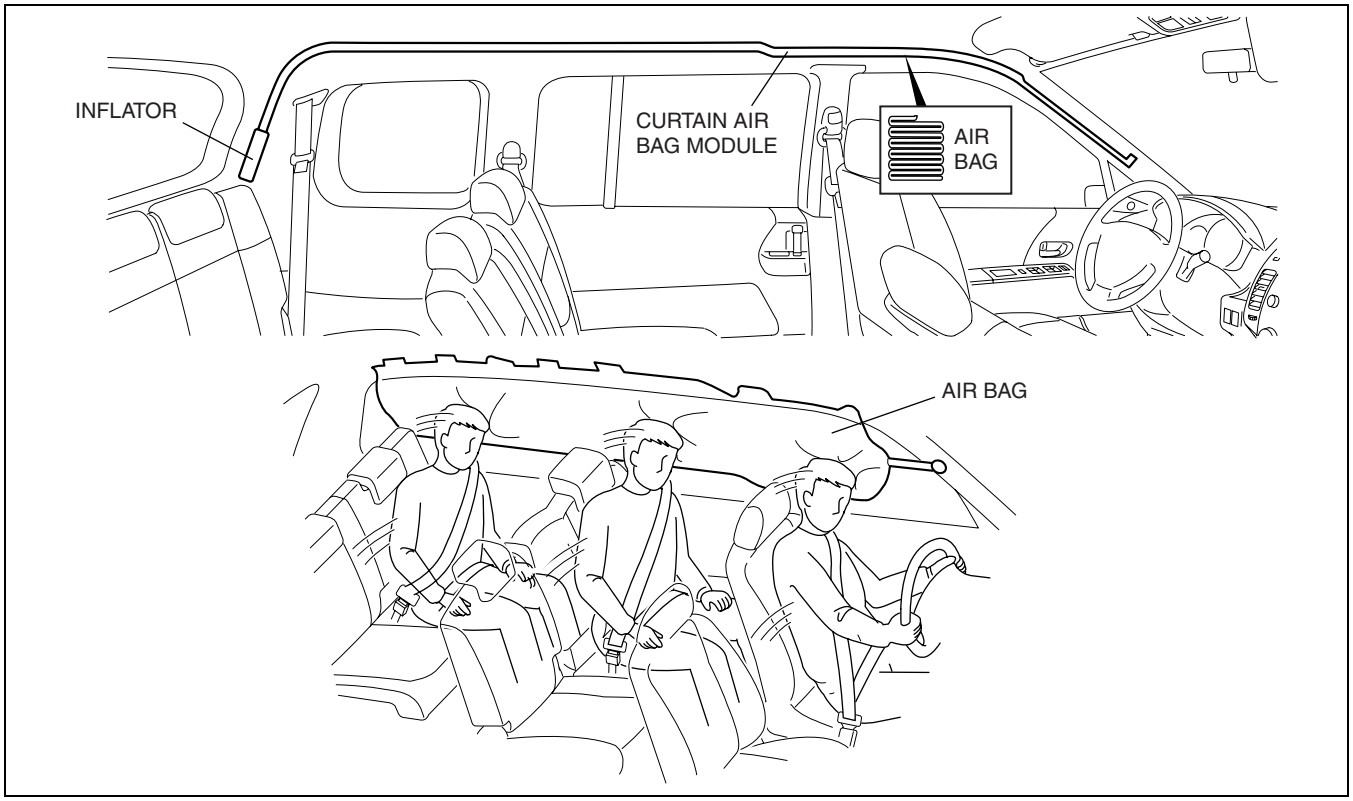
- During a lateral collision to the vehicle, the air bag operates (deploys) after receiving an operation signal from the SAS control module, defusing impact to the side of the head of the driver and other passengers (passenger-side and rear outboard-seated passenger).
- Operates in conjunction with the side air bag module.

CURTAIN AIR BAG MODULE CONSTRUCTION/OPERATION

EPU081000171S02

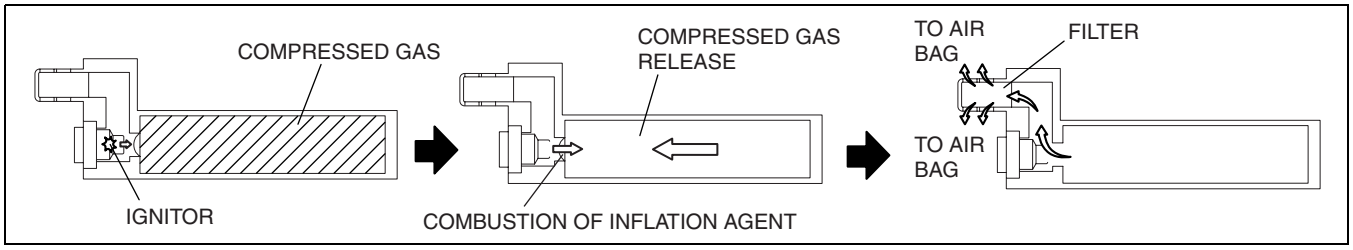
Construction

- The curtain air bag modules are equipped along the roof edge between the A and D pillars.
- The curtain air bag module is composed of the inflator and air bag.
- When the curtain air bag deploys, the pillar trim and headliner is spread apart by argon gas generated from the inflator, inflating the air bag.



EPU810ZT3007

- A stored-type inflator has been adopted instead of using an ignition agent in the inflator.
- The inflator operates in the following order:
  1. When an operation (deployment) signal is received from the SAS control module, the igniter ignites.
  2. The ignition causes the discharge area of the wall to open and compressed gas is released.
  3. The compressed gas passes through the filter and the filtrate is injected into the air bag.



EPU810ZT3008

PRE-TENSIONER SEAT BELT FUNCTION

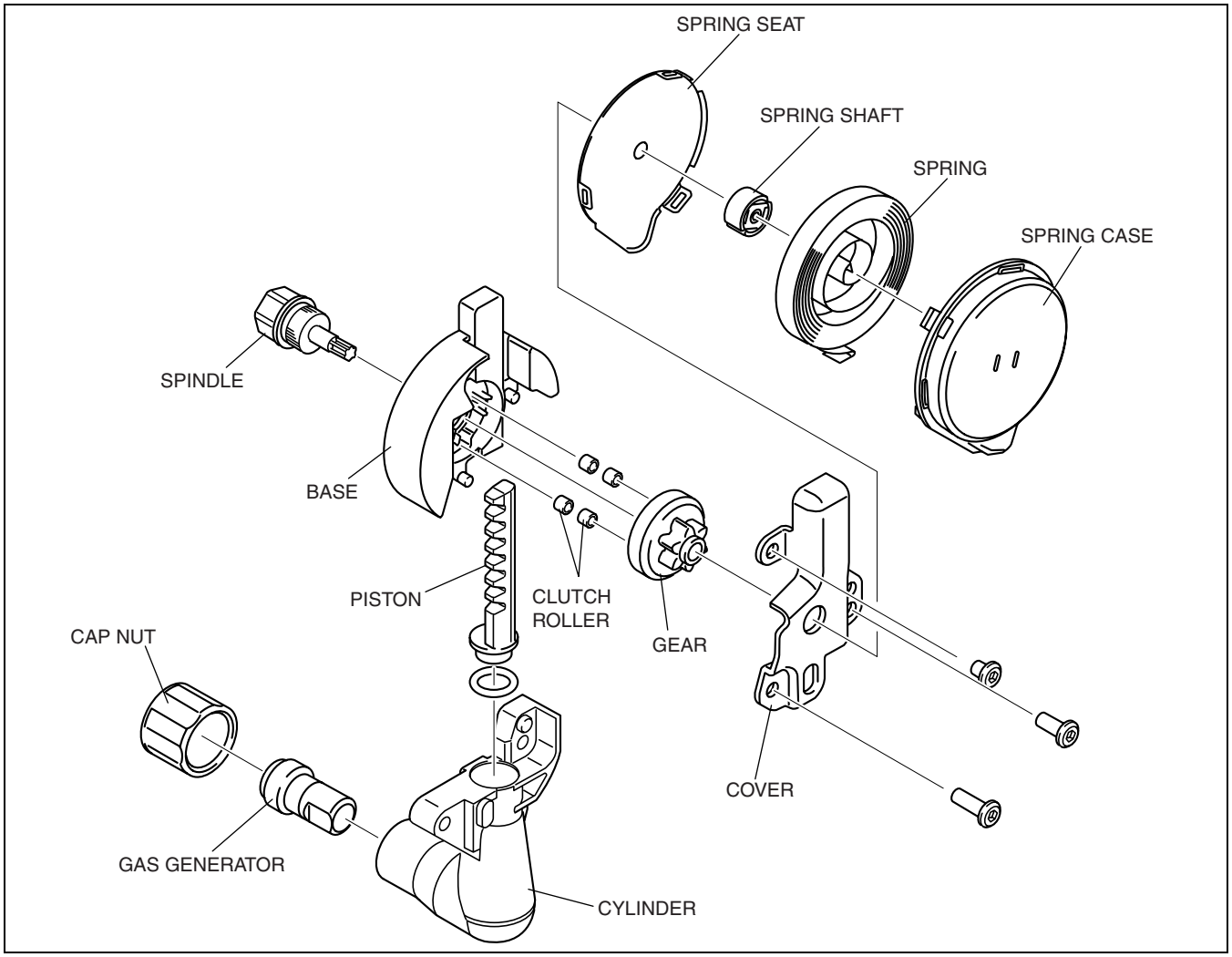
EPU081057620S01

- When front seat belts are being worn and the vehicle is involved in a frontal or frontal offset collision, the pre-tensioner seat belt system receives an operation signal from the SAS control module, causing the buckle to instantly retract and tighten the belt webbing, safely restraining the driver and front seat passenger.

PRE-TENSIONER SEAT BELT CONSTRUCTION/OPERATION

EPU081057620S02

Construction

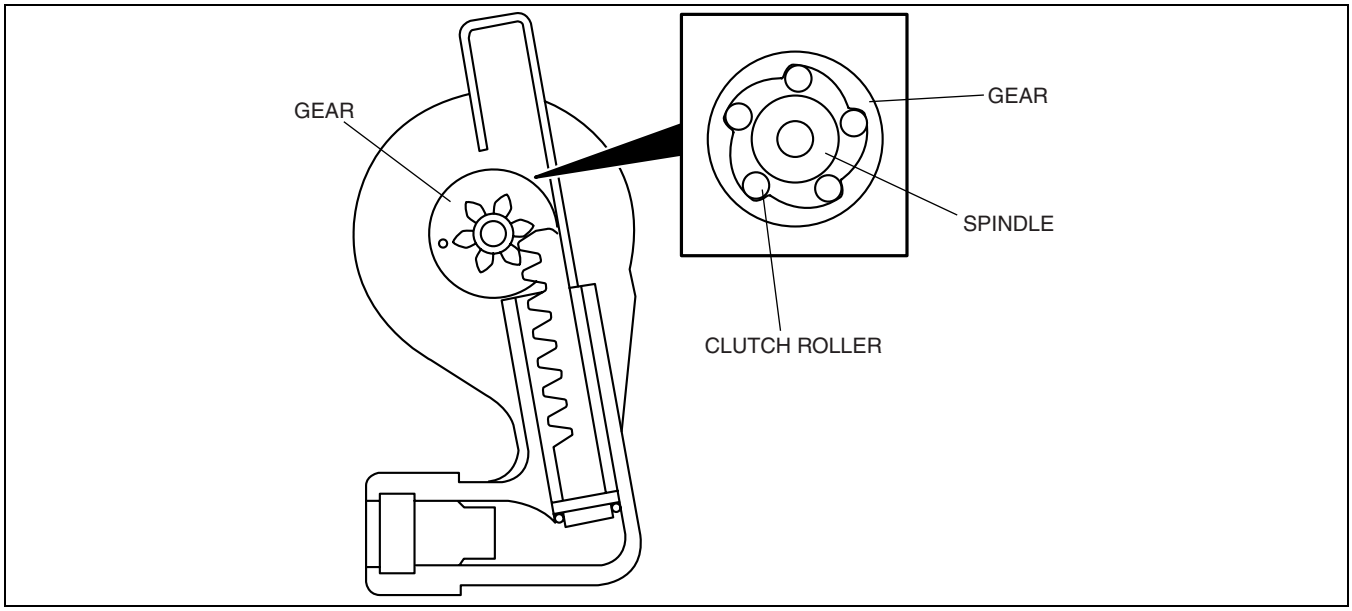


EPU810ZT3011

Operation

Normal (Seat Belt Pretensioners Not Operating)

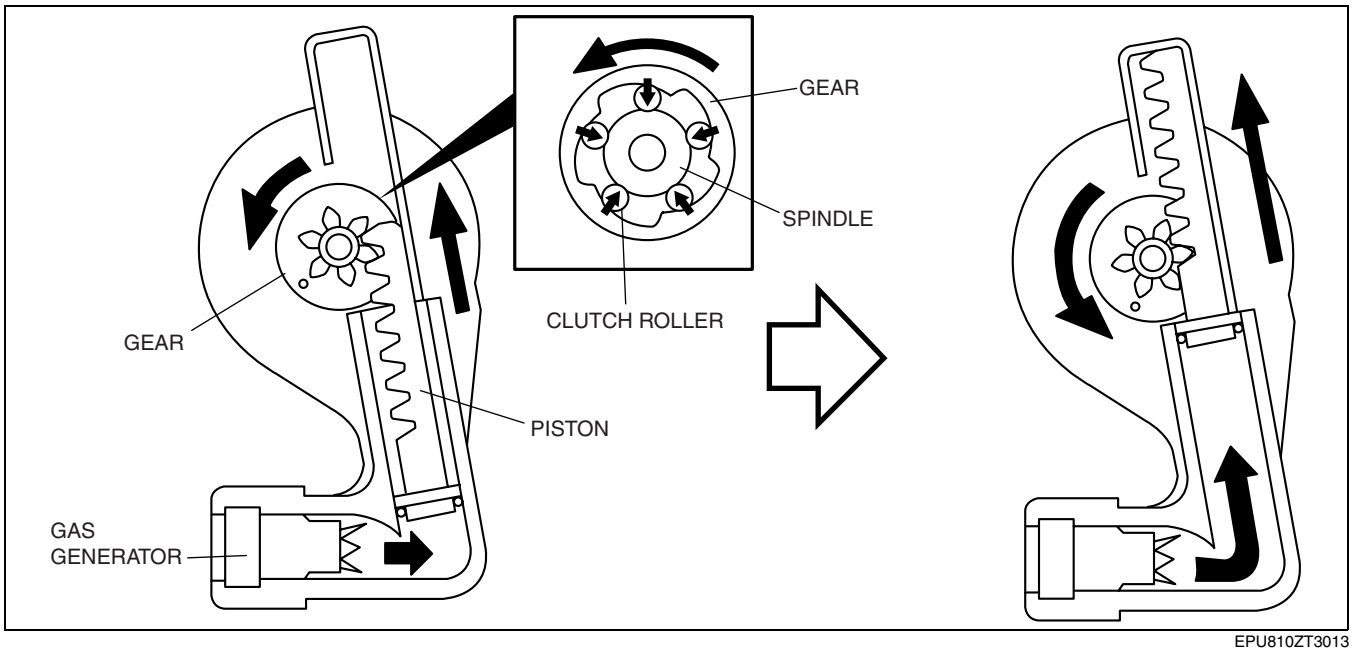
- Normally, the clutch roller installed to the outer circumference of the spindle sits in the recess of the gear and does not interfere with the spindle.
- The gear does not rotate when the belt is pulled or retracted because the spindle and gear are not engaged.



EPU810ZT3012

Seat Belt Pretensioners Operating

1. When an operation signal is received from the SAS control module, the gas generator produces gas. Due to the pressure from the gas, the piston in the cylinder is pressed up.
2. The gear rotates while the piston moves up.
3. Based on the gear rotation, the clutch roller in the gear presses against the spindle.Due to this, the gear and spindle are engaged.
4. The belt is retracted in conjunction with the gear rotation.



EPU810ZT3013

08–11 SEAT BELT

SEAT BELT OUTLINE 08–11–1
Features **08–11–1**
SEAT BELT STRUCTURAL VIEW 08–11–1
LOAD LIMITER RETRACTOR CONSTRUCTION/OPERATION 08–11–1
CHILD-RESTRAINT SEAT ANCHOR CONSTRUCTION 08–11–2

SEAT BELT OUTLINE

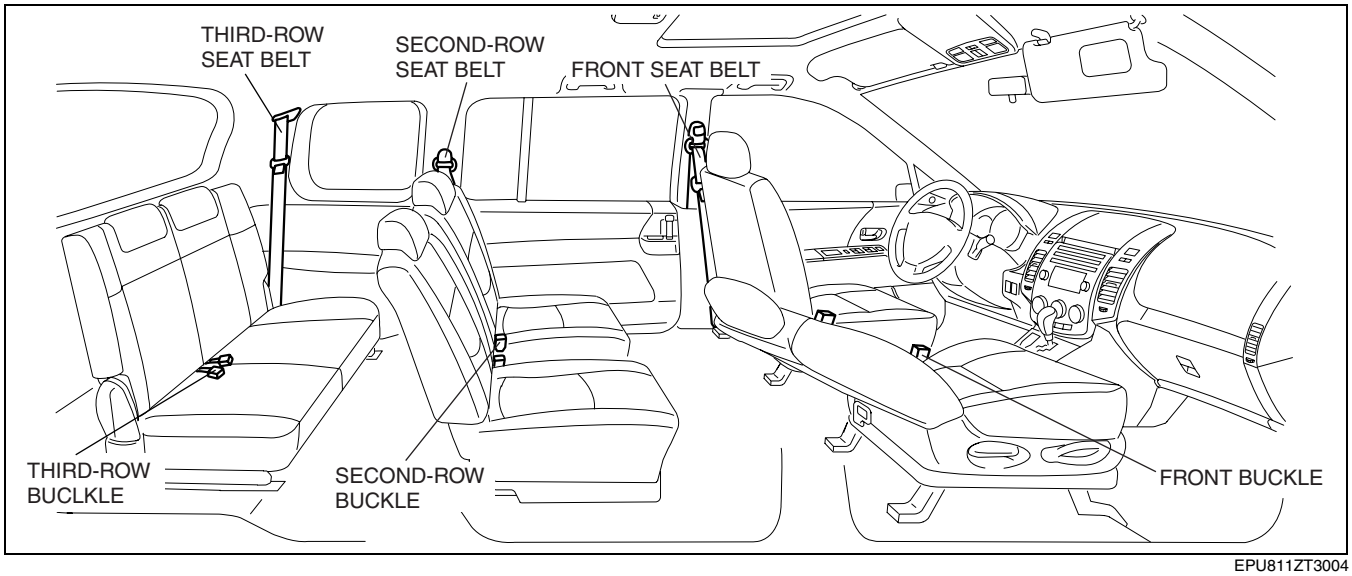
EPU081157000S01

Features

Improved safety	• Three-point seat belt with the following functions for front seat passengers adopted — ELR (Emergency Locking Retractor: emergency locking mechanism) — Pre-tensioner seat belt (See 08–10–15 PRE-TENSIONER SEAT BELT CONSTRUCTION/OPERATION.) — Load limiter, which adjusts restraint force of the seat belt to reduce the possibility of injury to passengers caused by excess seat belt pressure after pre-tensioner or ELR operation — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism)(passeger's side) • Three-point seat belt with the following functions for second-row seat passengers adopted — ELR — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism) • Three-point seat belt with the following functions for third-row seat passengers adopted — ELR — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism)

SEAT BELT STRUCTURAL VIEW

EPU081157000S02

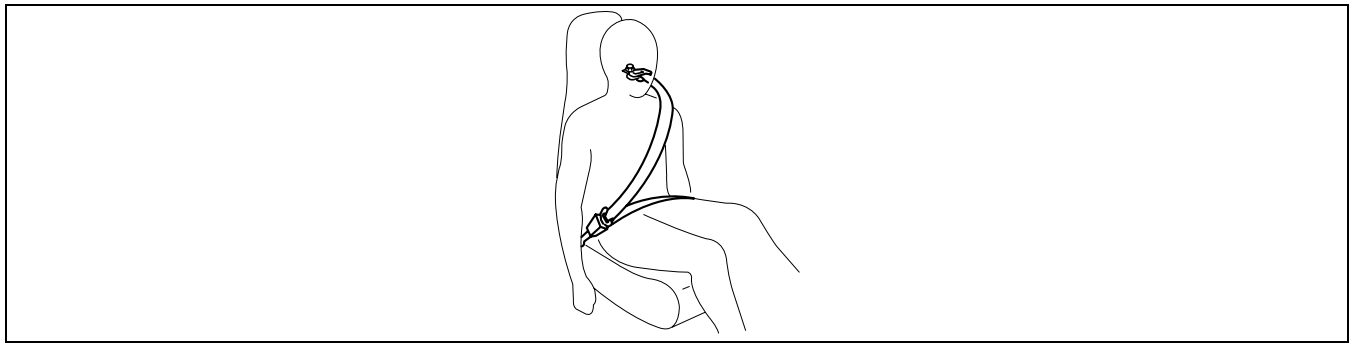


EPU811ZT3004

LOAD LIMITER RETRACTOR CONSTRUCTION/OPERATION

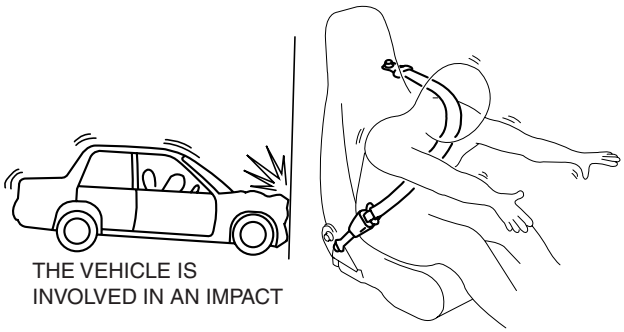
EPU081157000S03

1. Initial state



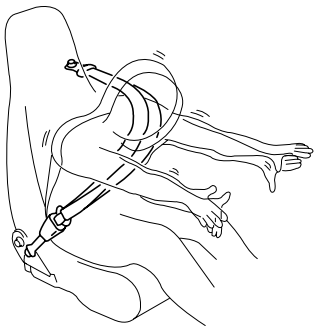
CPJ811ZNB004

2. Pre-tensioner and ELR operation
   When the vehicle has been subjected to an impact, the pre-tensioner or ELR activates, locking the belt and securing the passenger's body.



EPU811ZT3002

3. Load limiter operation
   After locking, if the force of impact transferred to the belt is strong enough to cause injury to the chest of the occupant, an adequate amount of belt is released to absorb the load applied to the chest.



CPJ811ZNB006

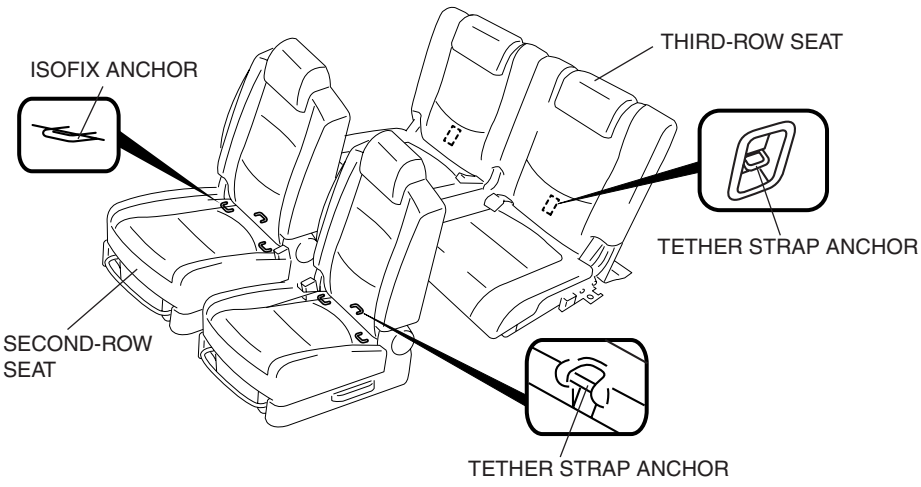
CHILD-RESTRAINT SEAT ANCHOR CONSTRUCTION

EPU081100117S01

- ISOFIX anchors for securing an ISOFIX child-restraint seat, and tether strap anchors have been adopted.

Caution

- **Installation procedure varies with the type of child-restraint seat. When installing a child-restraint seat, be sure to follow the prescribed procedure for each type.**



EPU811ZT3011

BODY & ACCESSORIES

09
SECTION

OUTLINE 09-00
BODY PANELS 09-10
DOORS AND LIFTGATE. 09-11
GLASS/WINDOWS/ MIRRORS 09-12
SEATS 09-13
SECURITY AND LOCKS 09-14
SUNROOF 09-15
EXTERIOR TRIM. 09-16
INTERIOR TRIM. 09-17
LIGHTING SYSTEMS. 09-18
WIPER/WASHER SYSTEM. 09-19
ENTERTAINMENT 09-20
POWER SYSTEMS 09-21
INSTRUMENTATION/ DRIVER INFO. 09-22
CONTROL SYSTEM 09-40

09–00 OUTLINE

BODY AND ACCESSORIES ABBREVIATIONS. 09–00–1
BODY AND ACCESSORIES NEW FEATURES 09–00–2

BODY AND ACCESSORIES ABBREVIATIONS

EPU090000000S01

A/C	Air Conditioner
ACC	Accessories
ALC	Auto Level Control
ATX	Automatic Transaxle
BCM	Body Control Module
CAN	Controller Area Network
CM	Control Module
CPU	Central Processing Unit
DLC	Data Link Connector
DRL	Daytime running light
DTC	Diagnostic Trouble Code
GND	Ground
GPS	Global Positioning System
HI	High
IG	Ignition
INT	Intermittent
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left Hand
LO	Low
M	Motor
MTX	Manual Transaxle
OFF	Switch Off
ON	Switch On
PCM	Powertrain Control Module
PID	Parameter Identification
PTC	Positive Temperature Coefficient
P/W CM	Power Window Control Module

RH	Right Hand
SW	Switch
TNS	Tail Number Side Lights
WDS	Worldwide Diagnostic System

BODY AND ACCESSORIES NEW FEATURES

EPU090000000S02

Improved marketability	• Power window system adopted • Power door lock system adopted • Keyles entry system adopted • Hard-plastic liftgate adopted
Improved convenience	• Auto light system adopted • Auto wiper system adopted • Car-navigation system adopted
Improved safety	• Triple-H structure adopted • Daytime running light (DRL) system adopted
Improved security	• Immobilizer system adopted • Theft-deterrent system adopted
Wiring harness simplification	• Controller area network (CAN) system adopted
System simplification	• Body control module adopted

09–10 BODY PANELS

BODY PANEL OUTLINE . . . . . 09–10–1 **CABIN CONSTRUCTION 09–10–1**

BODY PANEL OUTLINE

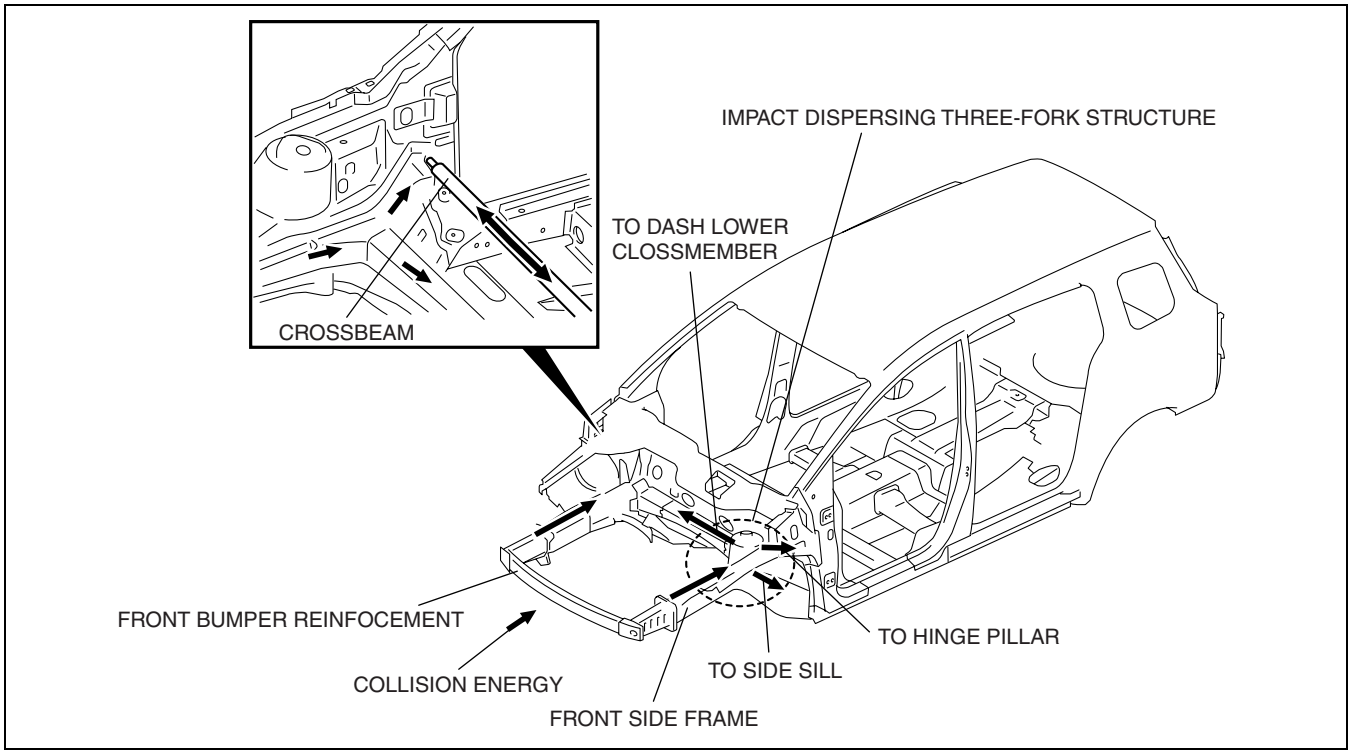
EPU091056100S01

- An H-shaped frame (triple-H structure) has been adopted.
- A highly rigid and safe body, "MAGMA" (Mazda Geometric Motion Absorption; Mazda's all-direction impact absorption body), has been adopted.

CABIN CONSTRUCTION

EPU091056100S02

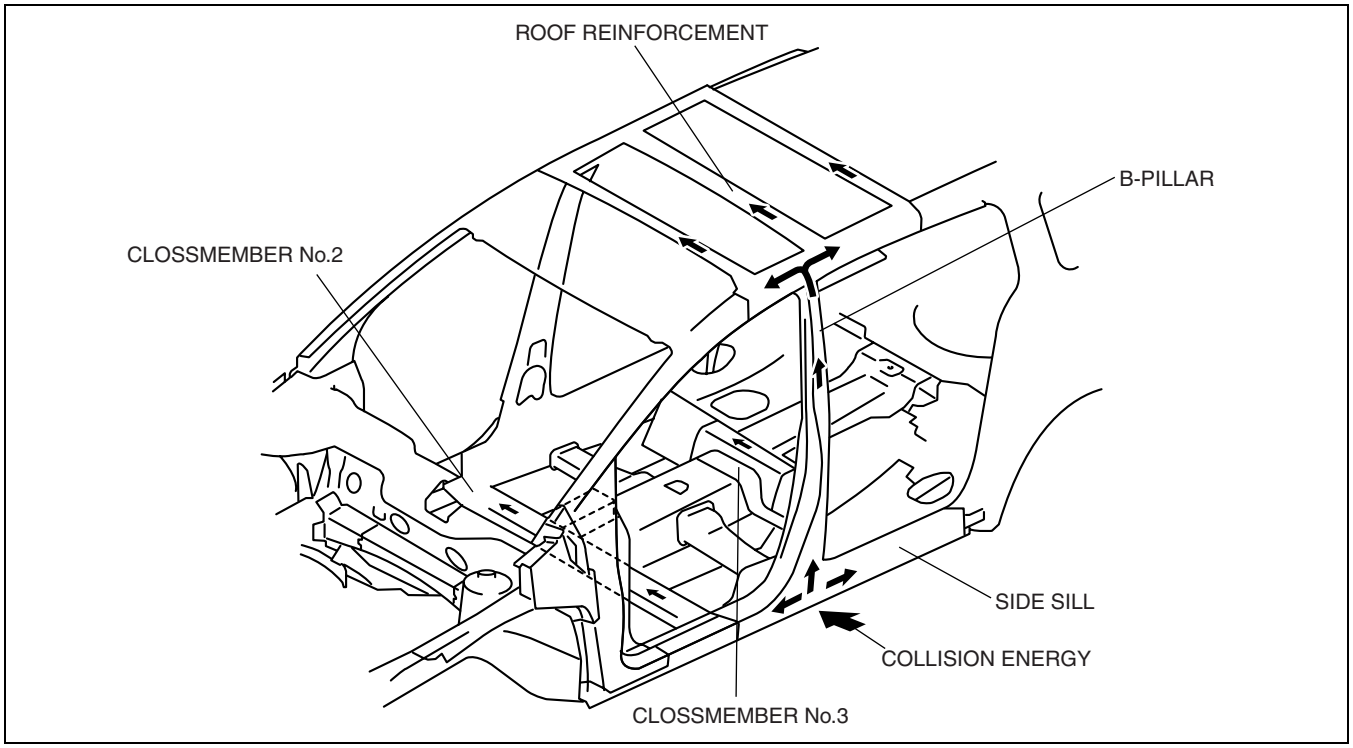
- An impact dispersing three-fork structure that disperses a frontal impact into three directions has been adopted.
- A crossbeam that suppresses the hinge pillars from moving outward during a collision has been adopted, improving the cabin strength.



EPU910ZS3001

- A distribution of reinforcement to the floor, side frames, and roof employing an H-shaped structure to reinforce each joint has been adopted. the combination of three points to each floor, side frames, and roof surface provide the strong triple H-shaped structure.

- Suppression of cabin torsion while driving, and steering performance has been improved.



EPU910ZS3002

09–11 DOORS AND LIFTGATE

DOORS AND LIFTGATE OUTLINE 09–11–1
Features..... 09–11–1
DOORS AND LIFTGATE STRUCTURAL VIEW 09–11–2
SIDE IMPACT BAR FUNCTION 09–11–2
SIDE IMPACT BAR CONSTRUCTION/OPERATION 09–11–2
EASY CLOSURE SYSTEM OUTLINE..... 09–11–2
EASY CLOSURE SYSTEM STRUCTURAL VIEW 09–11–3
EASY CLOSURE CONTROL MODULE FUNCTION 09–11–3
EASY CLOSURE CONTROL MODULE CONSTRUCTION/OPERATION 09–11–3
EASY CLOSURE MOTOR FUNCTION 09–11–3
EASY CLOSURE MOTOR CONSTRUCTION/OPERATION 09–11–3
LATCH POSITION SWITCH FUNCTION 09–11–4
LATCH POSITION SWITCH CONSTRUCTION/OPERATION.....09–11–4
EASY CLOSURE MOTOR CONTROL FUNCTION OUTLINE.....09–11–4
EASY CLOSURE MOTOR CONTROL FUNCTION SYSTEM WIRING DIAGRAM.....09–11–4
EASY CLOSURE MOTOR CONTROL FUNCTION OPERATION 09–11–5
FAIL-SAFE FUNCTION OUTLINE 09–11–6
FAIL-SAFE FUNCTION OPERATION ...09–11–6
Lock Current Detection Function.....09–11–6
Timer Function 09–11–6
LOCK MECHANISM OUTLINE 09–11–6
LOCK MECHANISM CONSTRUCTION/OPERATION.....09–11–7
Structural View 09–11–7
Operation 09–11–7
OPEN LOCK ACTUATOR CONSTRUCTION/OPERATION.....09–11–9

DOORS AND LIFTGATE OUTLINE

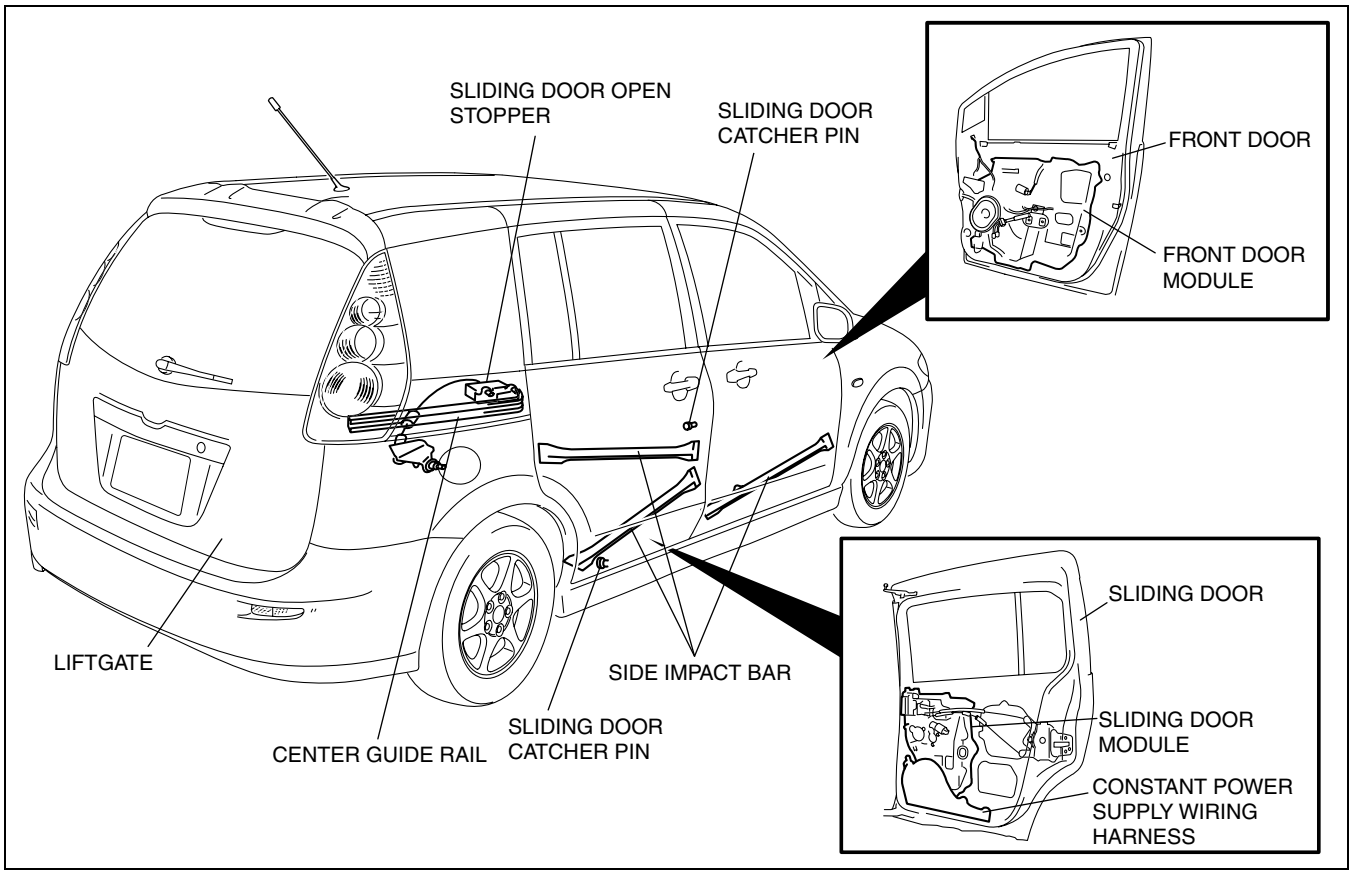
EPU091158010S01

Features

Improved marketability	• An easy closure system that assists the sliding doors to close securely when they are ajar has been adopted. (if equipped) • A constant power supply wiring harness which supplies power while the sliding door is open has been adopted. • Door modules with integrated front door/sliding door internal parts have been adopted. • A light-weight hard plastic liftgate has been adopted to reduce opening/closing operation force.
Improved safety	• A rigid side impact bar has been adopted for each front door and sliding door. • A sliding door catcher pin has been adopted. • An open-lock function which keeps the sliding door open has been adopted.
Vehicle damage prevention	• A sliding door open cancel system has been adopted to the right side of the vehicle.

DOORS AND LIFTGATE STRUCTURAL VIEW

EPU091158010S02



EPU911ZN4009

SIDE IMPACT BAR FUNCTION

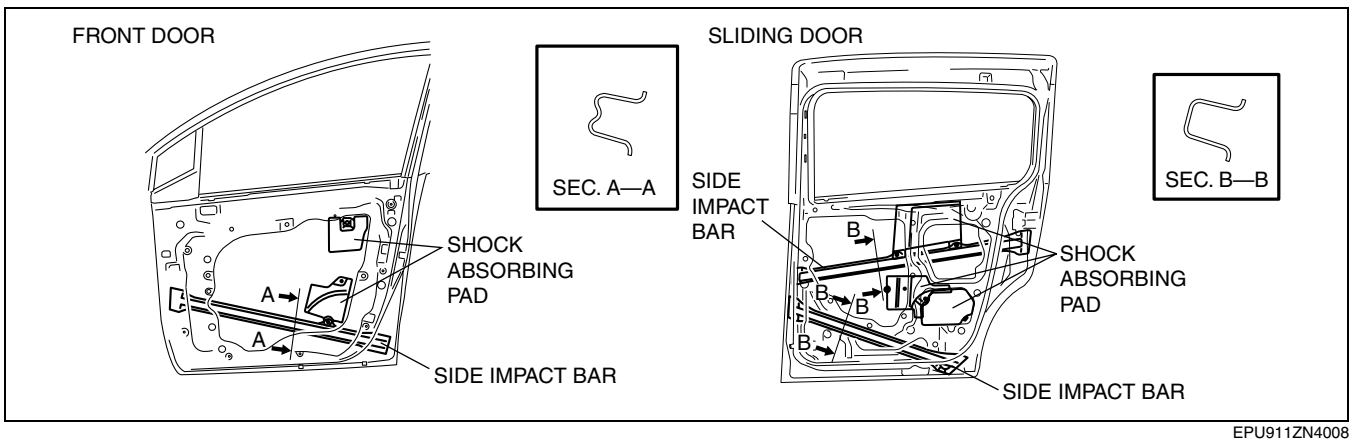
EPU091158010S03

- The side impact bar, located on the bottom part of the door, prevents the door from deforming inward by dispersing the impact to the floor in case of a side-impact collision.
- A corrugated side impact bar has been adopted to each front door, improving rigidity in case of a collision.
- The shock absorbing pad, located inside the door, functions to soften collision impact.

SIDE IMPACT BAR CONSTRUCTION/OPERATION

EPU091158010S04

- Installed to the inside of the door.



EPU911ZN4008

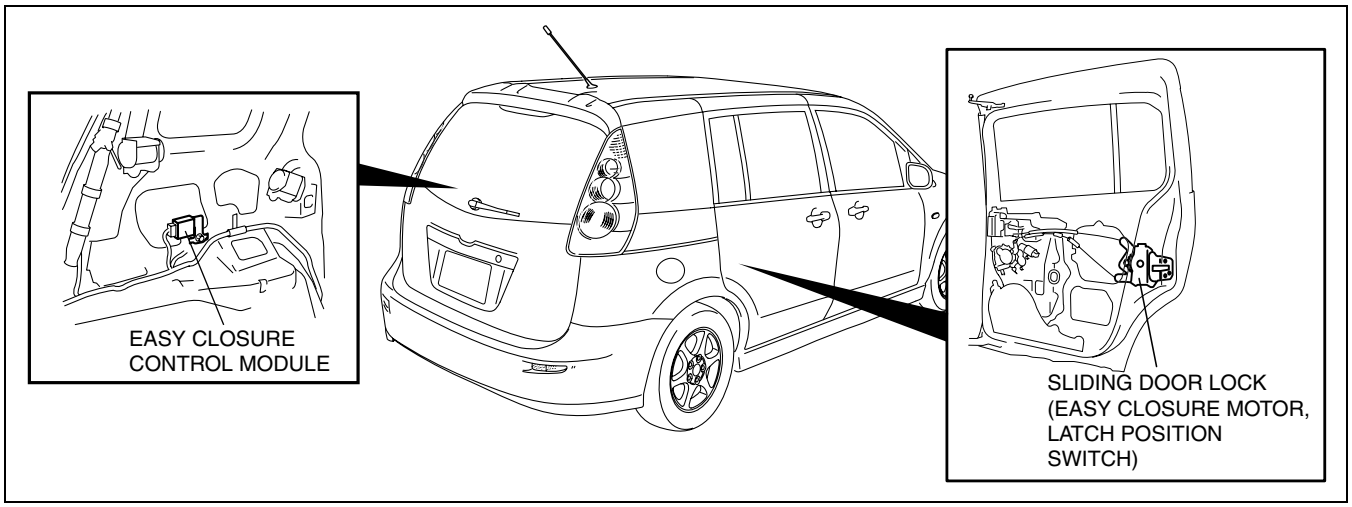
EASY CLOSURE SYSTEM OUTLINE

EPU091158010S07

- A sliding door fully closes automatically from the ajar position.

EASY CLOSURE SYSTEM STRUCTURAL VIEW

EPU091158010S08



EPU911ZN4001

EASY CLOSURE CONTROL MODULE FUNCTION

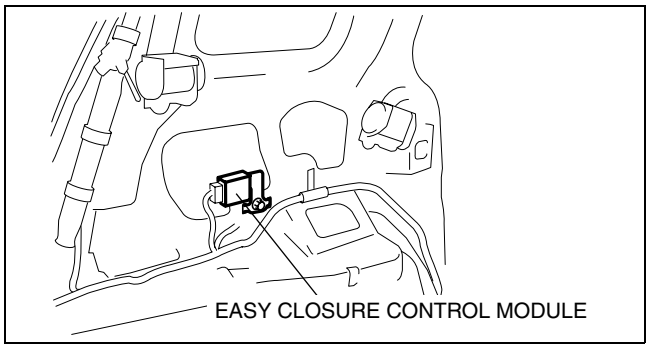
EPU091158010S09

- Fully closes the sliding door according to the latch position switch signal.
- Equipped with a fail-safe function which corrects the operation in case of an easy closure system malfunction.

EASY CLOSURE CONTROL MODULE CONSTRUCTION/OPERATION

EPU091158010S10

- Built into the installed to the inside of the trunk side trim.
- For easy closure control module operation, refer to EASY CLOSURE MOTOR CONTROL FUNCTION.



EPU911ZN4002

EASY CLOSURE MOTOR FUNCTION

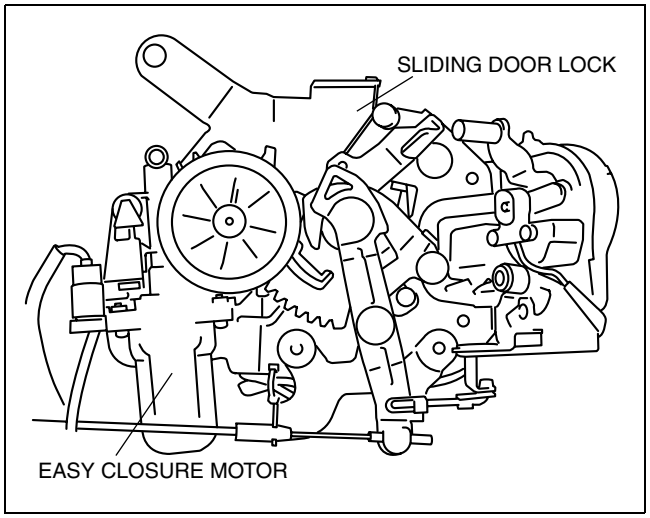
EPU091158010S11

- Fully closes the sliding door by rotating the motor normally/reversely according to a signal from the easy closure control module.

EASY CLOSURE MOTOR CONSTRUCTION/OPERATION

EPU091158010S12

- Installed to the sliding door lock.
- For easy closure motor operation, refer to LOCK MECHANISM.



EPU911ZN4010

LATCH POSITION SWITCH FUNCTION

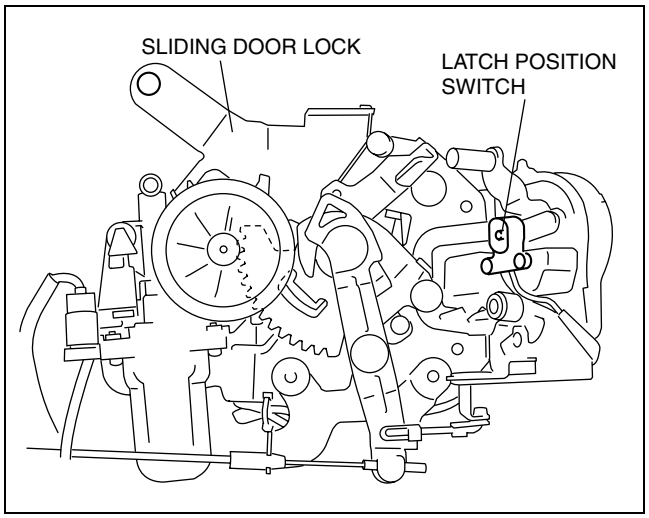
EPU091158010S13

- Detects the sliding door position based on the latch position switch.

LATCH POSITION SWITCH CONSTRUCTION/OPERATION

EPU091158010S14

- Built into the sliding door lock.
- The latch position switch are switched according to the sliding door lock latch position.



EPU911ZN4003

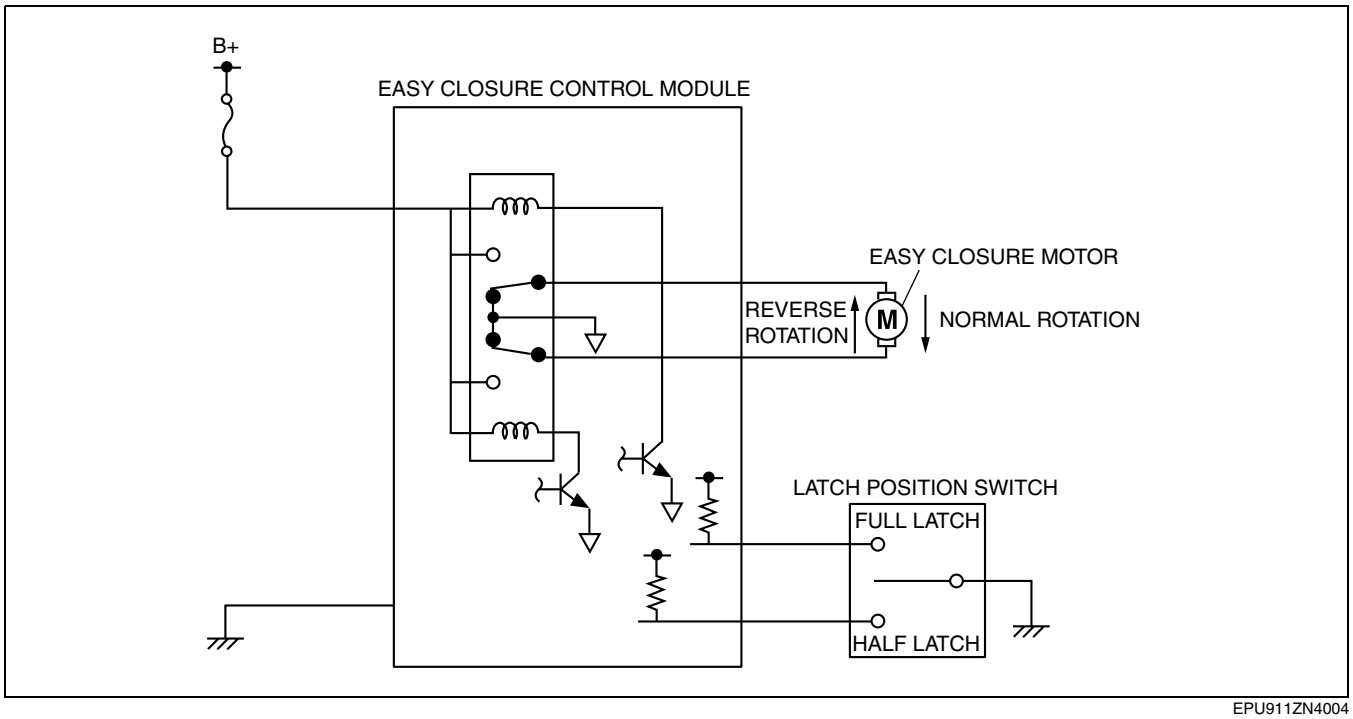
EASY CLOSURE MOTOR CONTROL FUNCTION OUTLINE

EPU091158010S15

- The easy closure control module operates the easy closure motor according to the signals from the latch position switch (sliding door position), and fully close the sliding door from the ajar position.

EASY CLOSURE MOTOR CONTROL FUNCTION SYSTEM WIRING DIAGRAM

EPU091158010S16

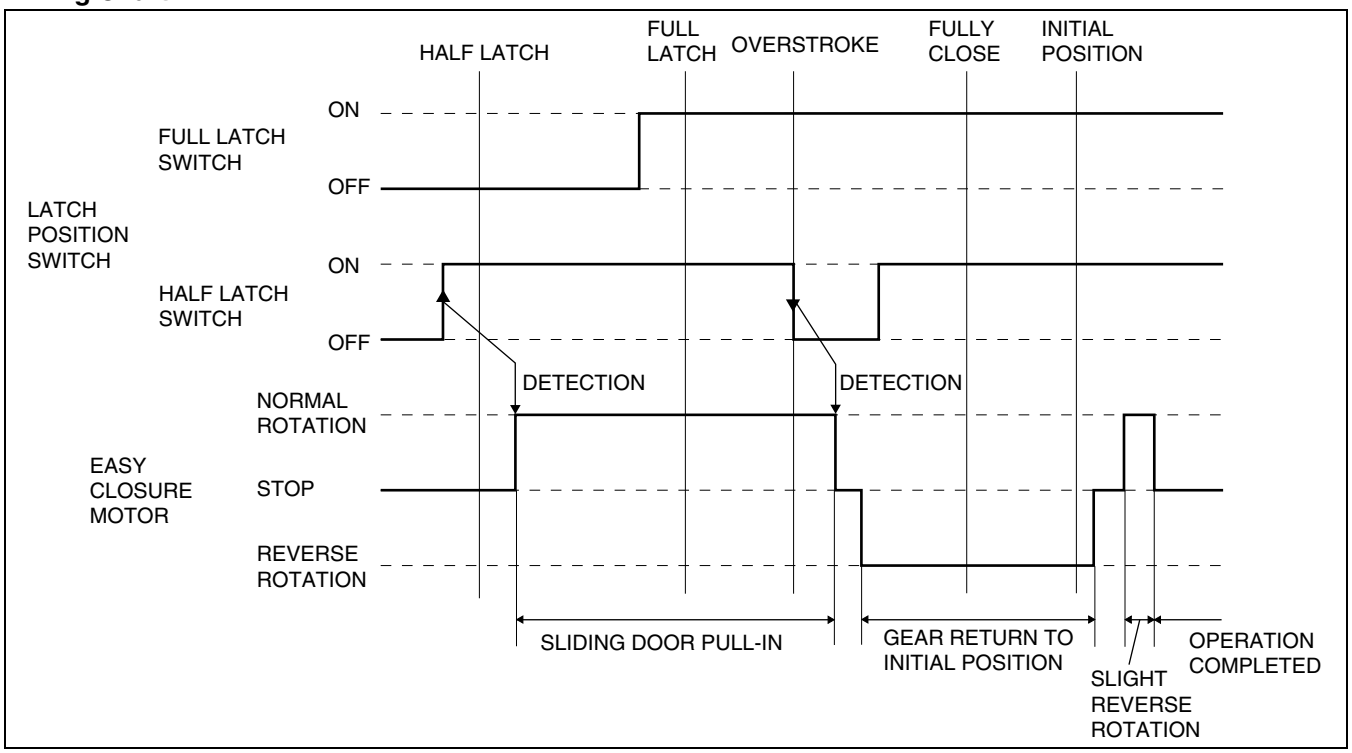


EPU911ZN4004

EASY CLOSURE MOTOR CONTROL FUNCTION OPERATION

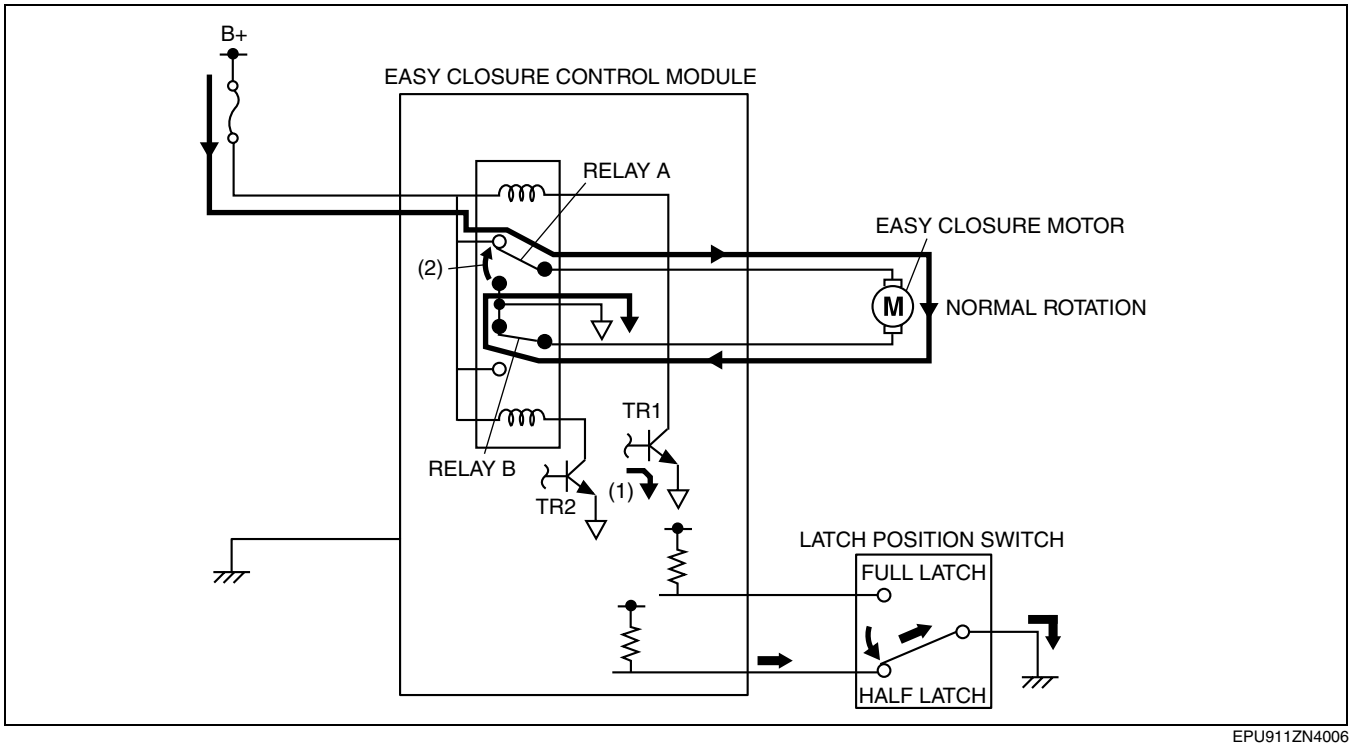
EPU091158010S17

Timing Chart



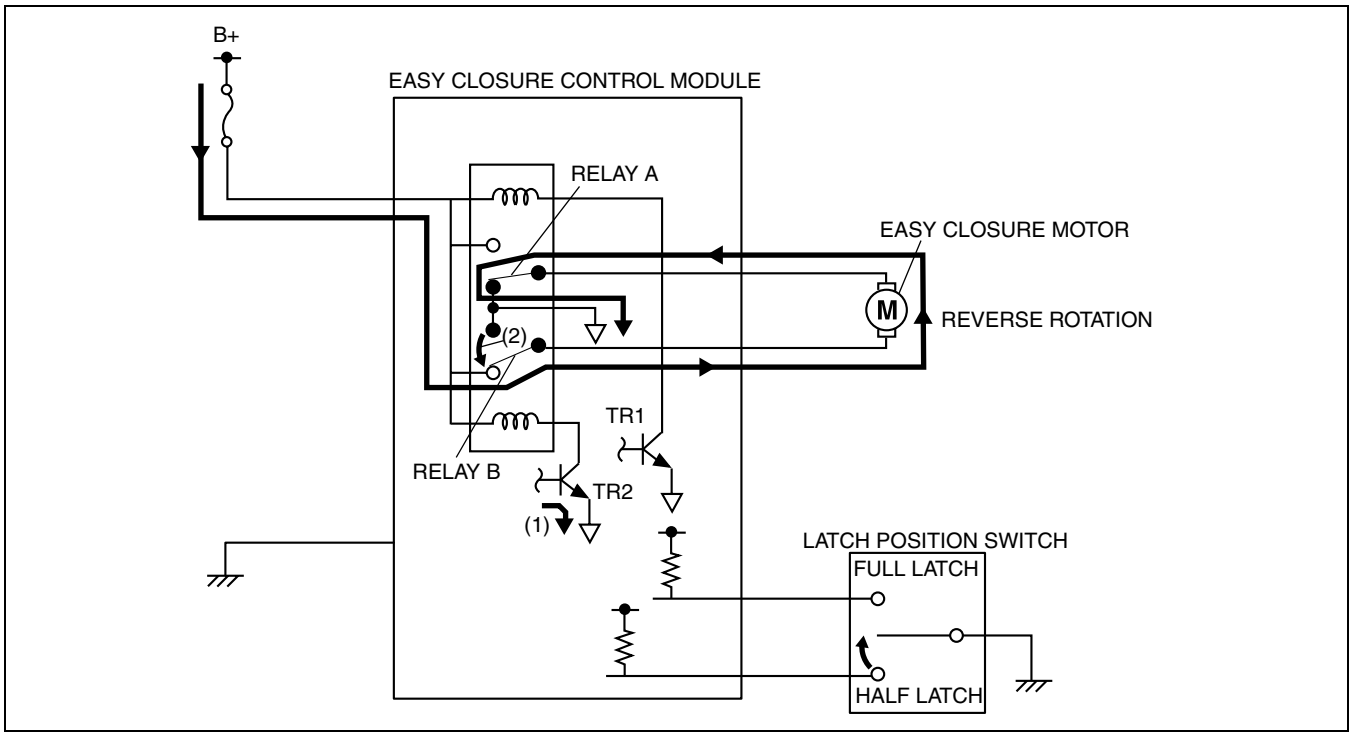
EPU911ZN4005

1. Closing
   - When the easy closure control module detects that the latch position switch half latch switch is on, TR1 turns on and TR2 turns off (1). Due to this, relay A and B are switched (2) and the motor rotates normally.



EPU911ZN4006

2. Initial position change
   - When the easy closure control module detects that the latch position switch half latch switch is has been turned from off to on, the closure motor is stopped and TR2 turns on and TR1 turns off after approx. 0.1 s. Due to this, relay A and B are switched (3) and the motor is switched from normal rotation to reverse rotation.



EPU911ZN4007

3. Slight reverse rotation to operation completed
   - When the sector gear is moved to the lock position, the easy closure control module rotates the motor reversely (normally) for approx. 0.1 s and completes the operation.

FAIL-SAFE FUNCTION OUTLINE

EPU091158010S18

- The easy closure control module is equipped with a fail-safe function to prevent related parts damage.
- If the system operates incorrectly, the fail-safe function corrects the operation.

FAIL-SAFE FUNCTION OPERATION

EPU091158010S19

Lock Current Detection Function

- If the motor normal rotation stop condition cannot be detected from the latch position switch during easy closure motor normal rotation, a motor lock is detected due to the motor operation current, and the motor is switched from normal rotation to reverse rotation.

Timer Function

- If the motor normal rotation stop condition cannot be detected form the latch position switch and the lock current detection function also cannot be detected during easy closure motor normal rotation, the motor is switched from normal rotation to reverse rotation by the timer.
- If the lock current cannot be detected during easy closure motor reverse rotation, the motor is switched from reverse rotation to slight reverse rotation.

LOCK MECHANISM OUTLINE

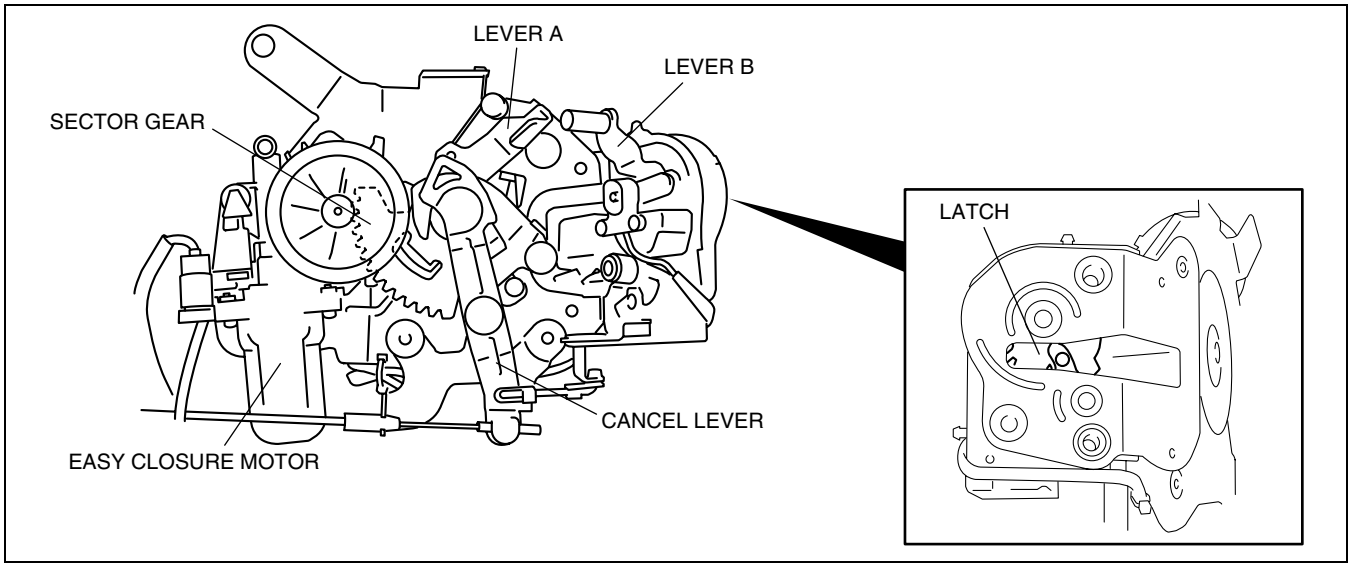
EPU091158010S20

- A sliding door is securely closed by pulling in the door lock striker with latch rotation.
- An easy closure cancellation mechanism has been adopted where the easy closure system operation stops when the sliding door handles are operated.

LOCK MECHANISM CONSTRUCTION/OPERATION

EPU091158010S21

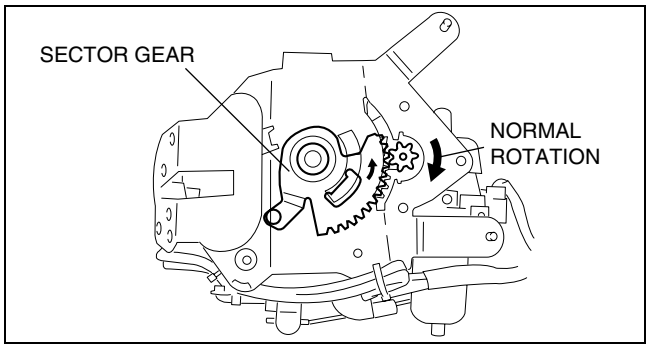
Structural View



EPU911ZN4011

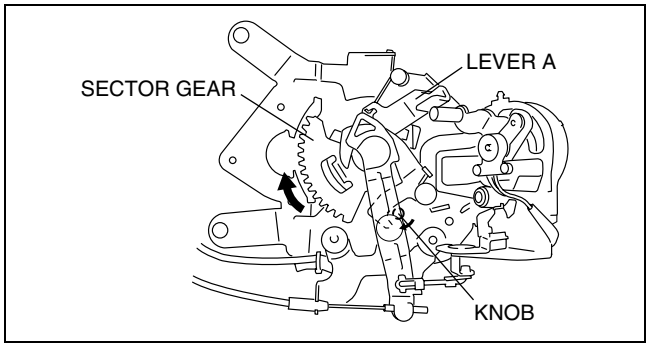
Operation

1. If the sliding door is in the ajar position, the easy closure motor rotates normally and rotates the sector gear.



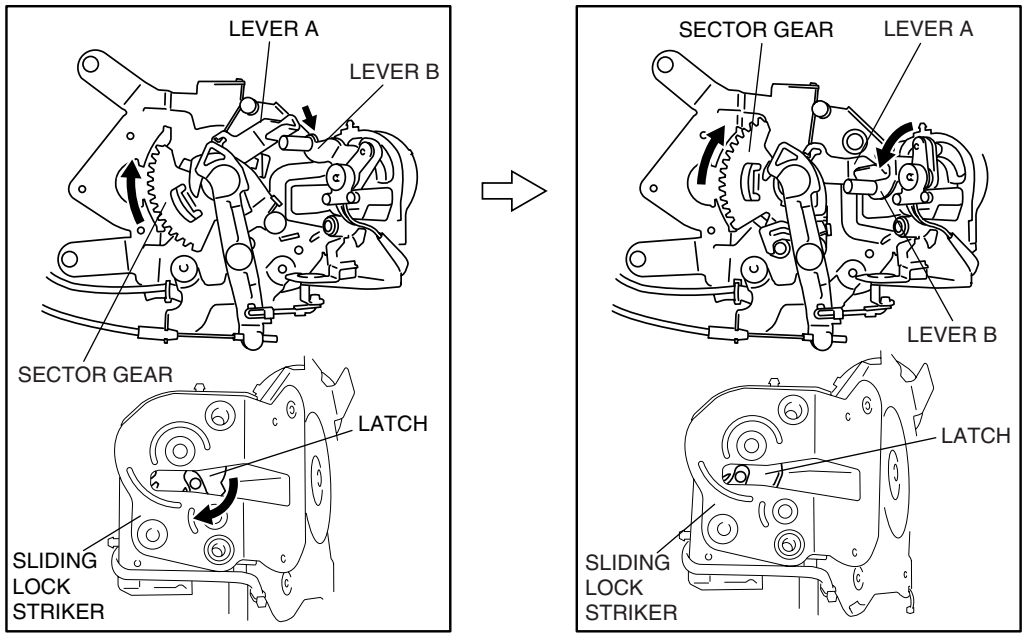
EPU911ZN4012

2. The sector gear knob press lever A and rotates it in the same direction as the sector gear rotation.



EPU911ZN4013

3. Lever A presses lever B and rotates to the lock direction. At the same time, the latch is pulled to the lock side.

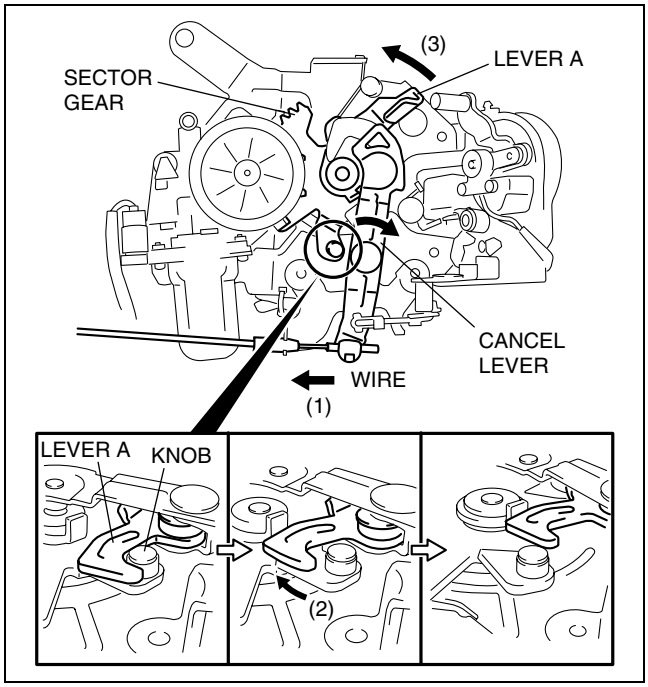


EPU911ZN4014

4. If the motor normal rotation stop condition is detected, the motor is switched from normal rotation to reverse rotation.

Easy closure cancellation

1. If the outer handle or inner handle is operated while the easy closure system is operating, the cancel lever is pulled via the wire (1).
2. The cancel lever frees the sector gear knob from lever A (2).
3. The sector gear and lever A are separated and the power from the easy closure motor is cut (3).

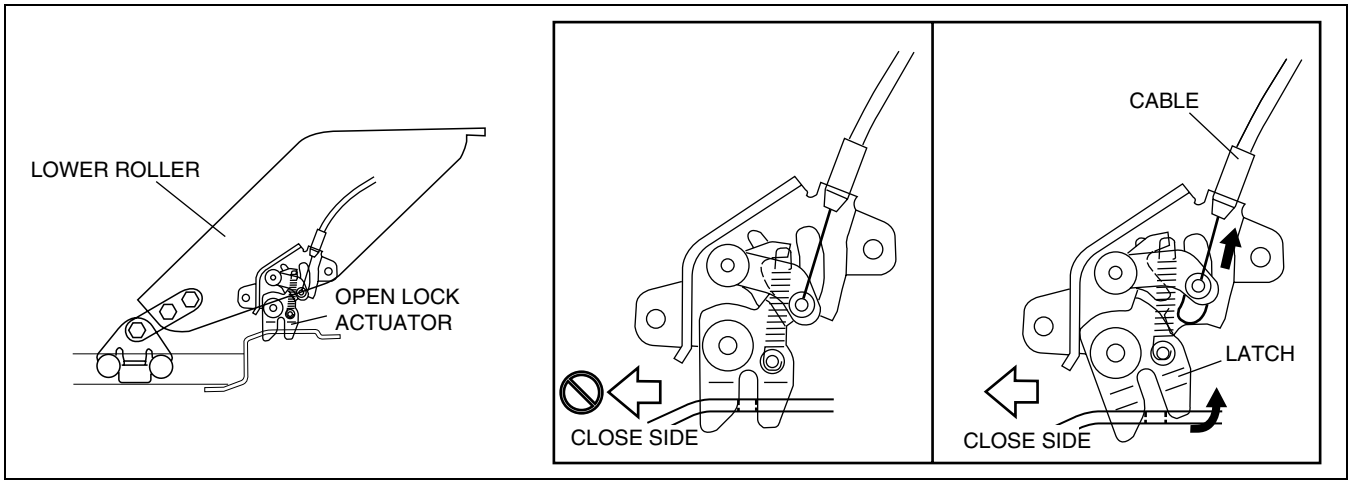


EPU911ZN4015

OPEN LOCK ACTUATOR CONSTRUCTION/OPERATION

EPU091158010S22

- When the sliding door is opened fully, the door is held at the fully open position so that it does not slide in the close direction.
- As the cable is linked with the outer and inner handles, the cable is pulled when either handle is operated. Due to this, the latch is released, and the sliding door moves.



EPU911ZN4016

09–12 GLASS/WINDOWS/MIRRORS

REAR WINDOW DEFROSTER SYSTEM OUTLINE 09–12–1
REAR WINDOW DEFROSTER SYSTEM STRUCTURAL VIEW 09–12–1
REAR WINDOW DEFROSTER SYSTEM CONSTRUCTION/OPERATION 09–12–2
POWER WINDOW SYSTEM OUTLINE 09–12–2
POWER WINDOW SYSTEM STRUCTURAL VIEW 09–12–3
POWER WINDOW SYSTEM WIRING DIAGRAM 09–12–4
POWER OUTER MIRROR OUTLINE 09–12–4
POWER OUTER MIRROR STRUCTURAL VIEW 09–12–5
POWER OUTER MIRROR SYSTEM WIRING DIAGRAM 09–12–5
POWER OUTER MIRROR OPERATION 09–12–6
Mirror Glass Adjustment 09–12–6

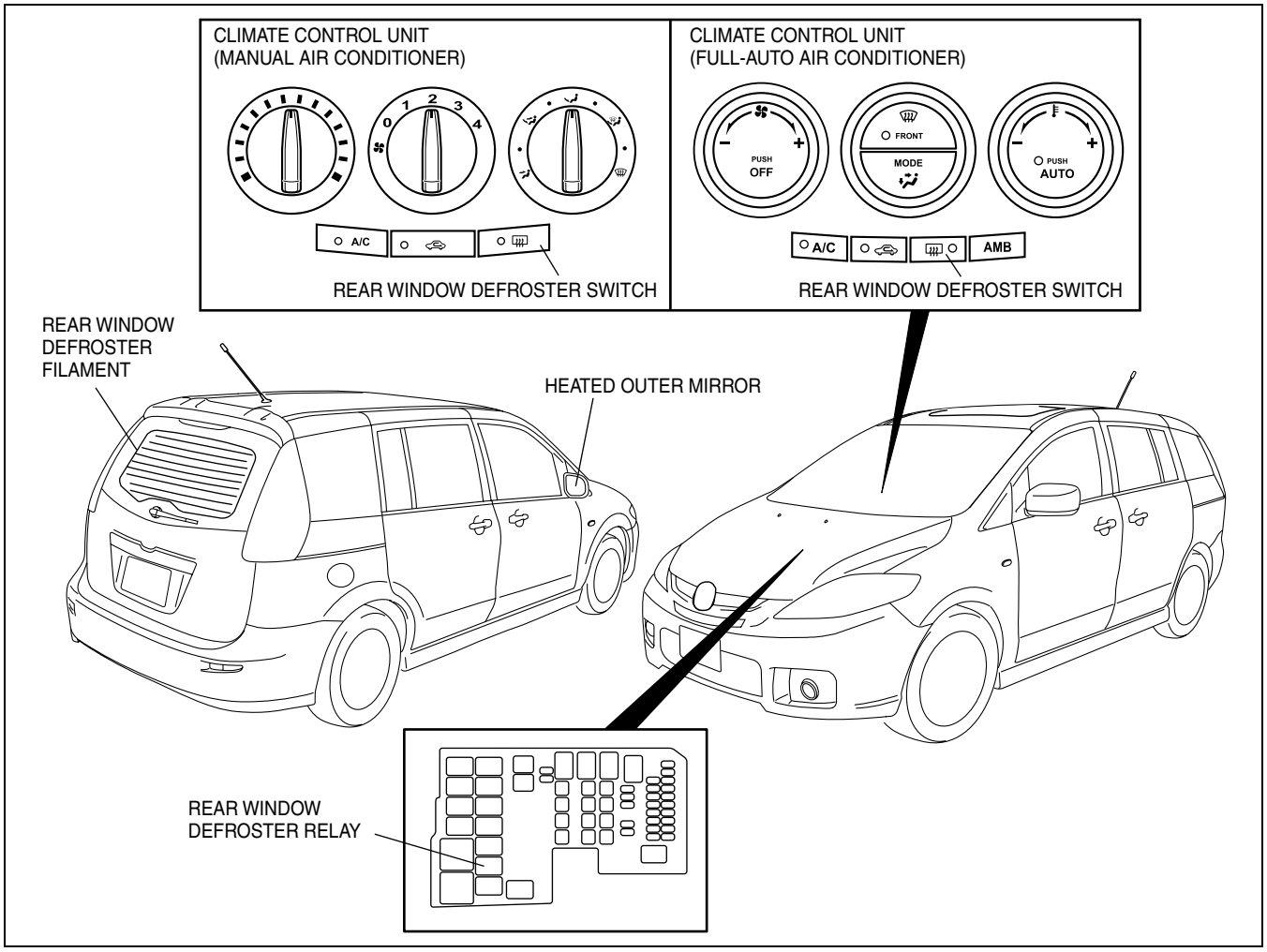
REAR WINDOW DEFROSTER SYSTEM OUTLINE

EPU091263000S01

Improved visibility	• Rear window defroster and heated outer mirror adopted

REAR WINDOW DEFROSTER SYSTEM STRUCTURAL VIEW

EPU091263000S02

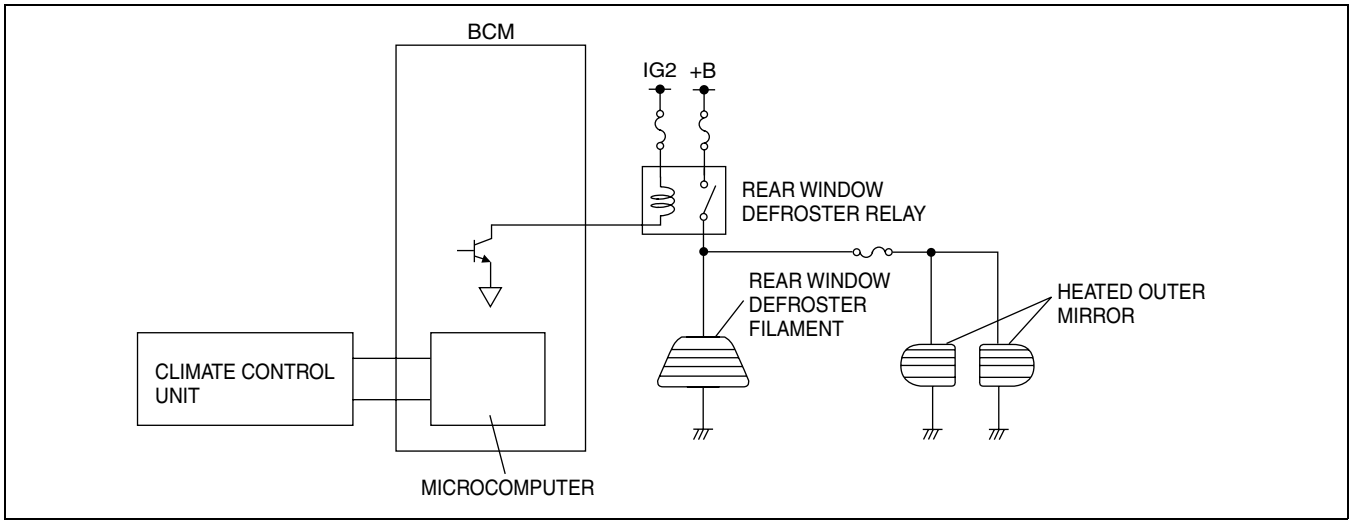


EPU912ZS3002

REAR WINDOW DEFROSTER SYSTEM CONSTRUCTION/OPERATION

EPU091263000S03

- Fogging is cleared from the rear window and outer mirror glass by heating of the filament.
- A signal is input to the BCM microcomputer when the rear defroster switch is turned on. The microcomputer turns the rear defroster relay on, causing the rear defroster and the heated outer mirror to operate.
- Approx. 10-15 min after the rear defroster switch is turned on, it is automatically turned off by the microcomputer timer control.



EPU912ZS3003

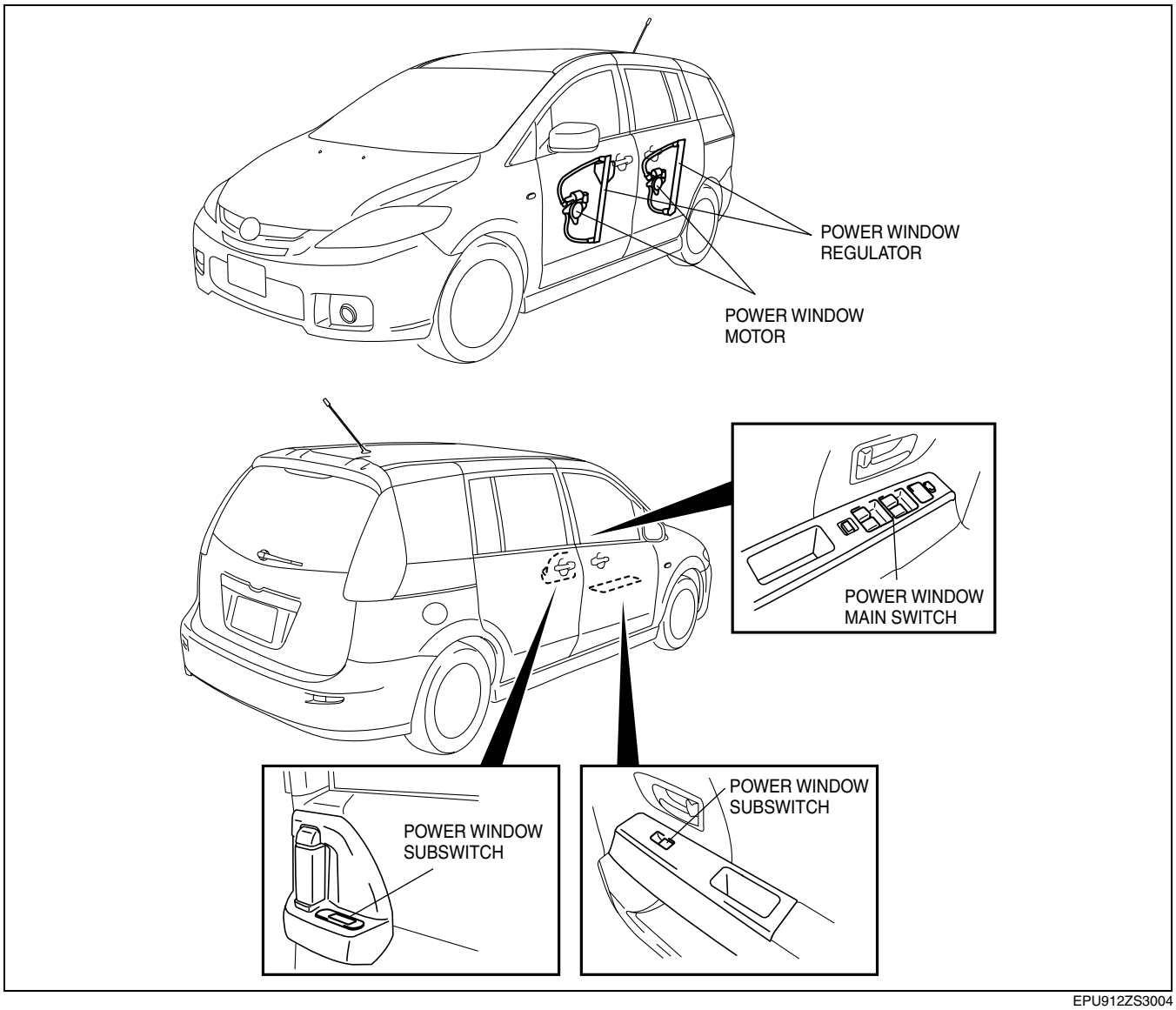
POWER WINDOW SYSTEM OUTLINE

EPU091258000S05

- The power window system has the following functions.
  - — Manual open/close function
  - — Auto open function (Driver's side)
  - — Power-cut function (Driver's side)

POWER WINDOW SYSTEM STRUCTURAL VIEW

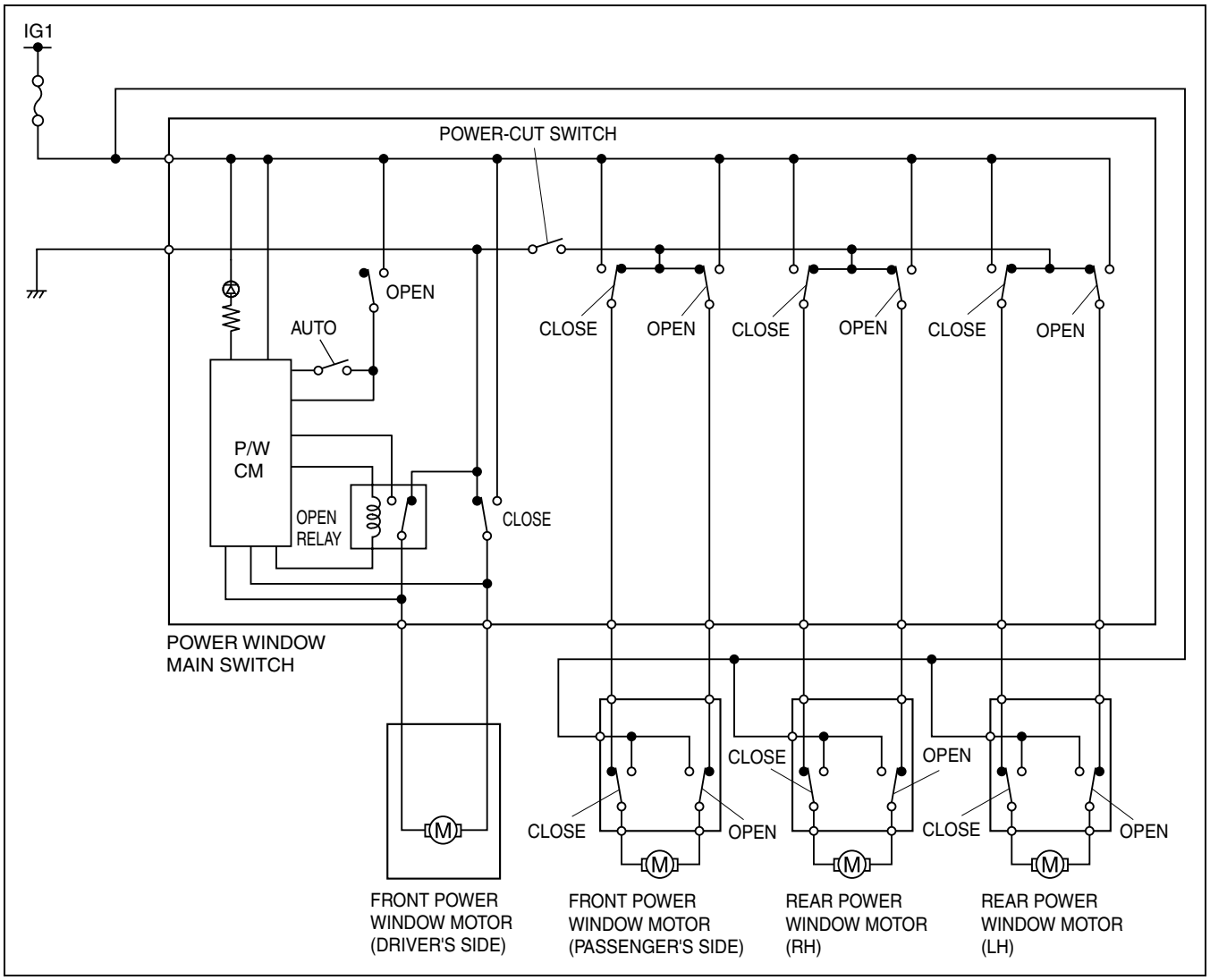
EPU091258000S02



EPU912ZS3004

POWER WINDOW SYSTEM WIRING DIAGRAM

EPU091258000S06



EPU912ZS3001

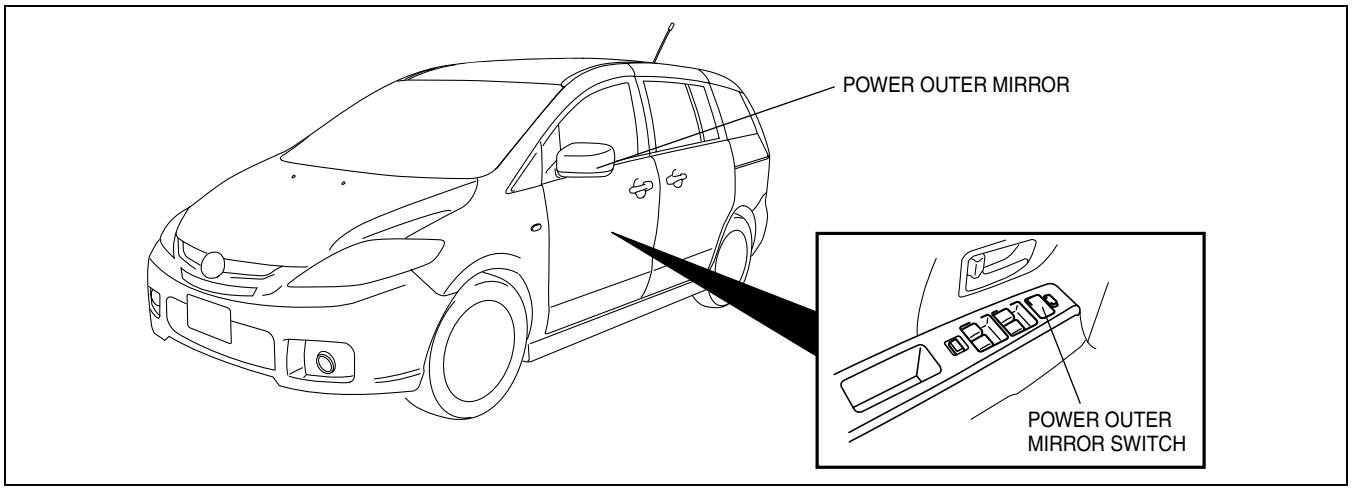
POWER OUTER MIRROR OUTLINE

EPU091269100S01

Improved convenience	• Power outer mirror (mirror glass adjusting function, and retract/return function) adopted
Improved visibility	• Heated outer mirror adopted (See 09–12–2 REAR WINDOW DEFROSTER SYSTEM CONSTRUCTION/OPERATION.)

POWER OUTER MIRROR STRUCTURAL VIEW

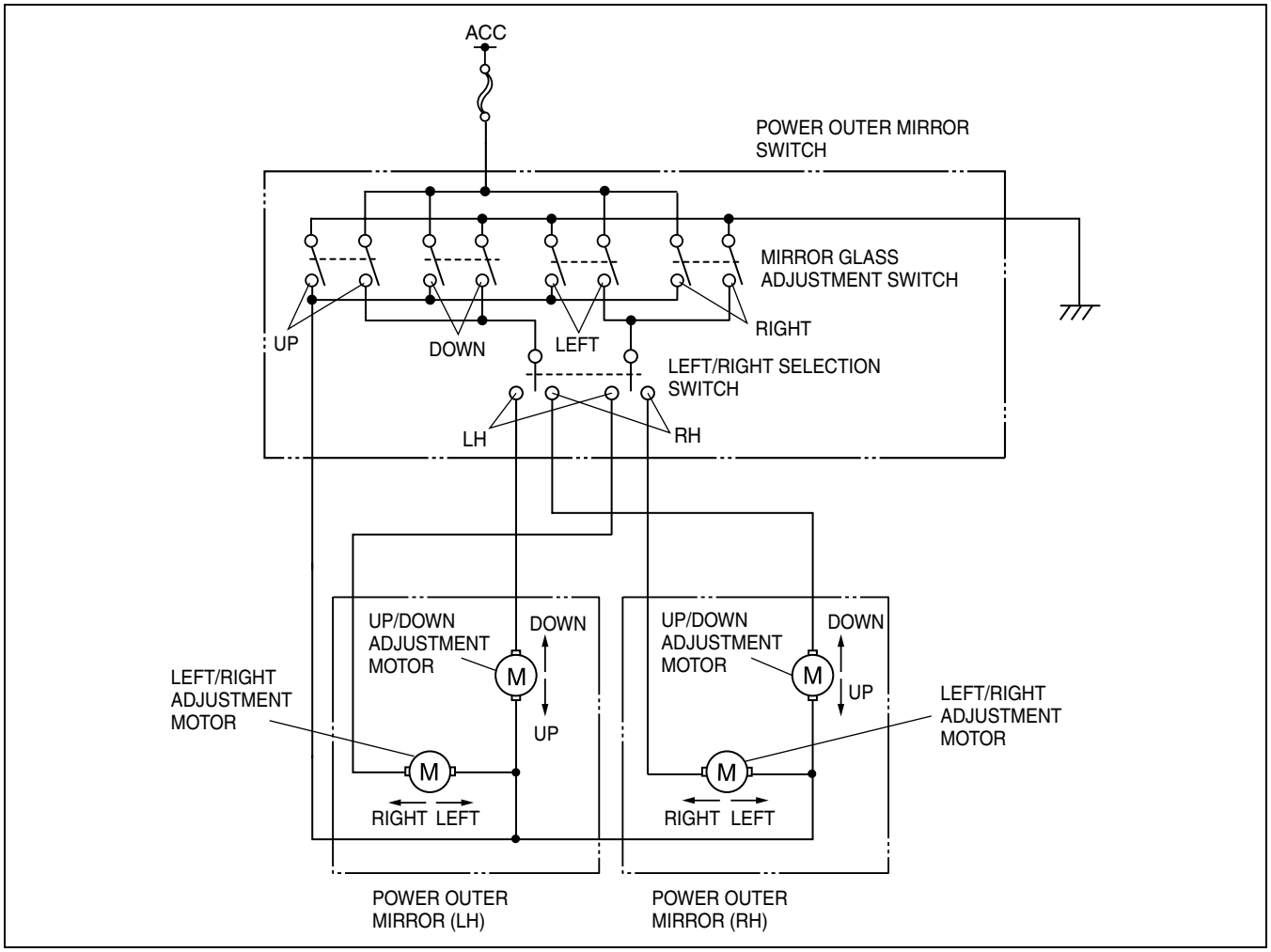
EPU091269100S02



EPU912ZS3005

POWER OUTER MIRROR SYSTEM WIRING DIAGRAM

EPU091269100S03



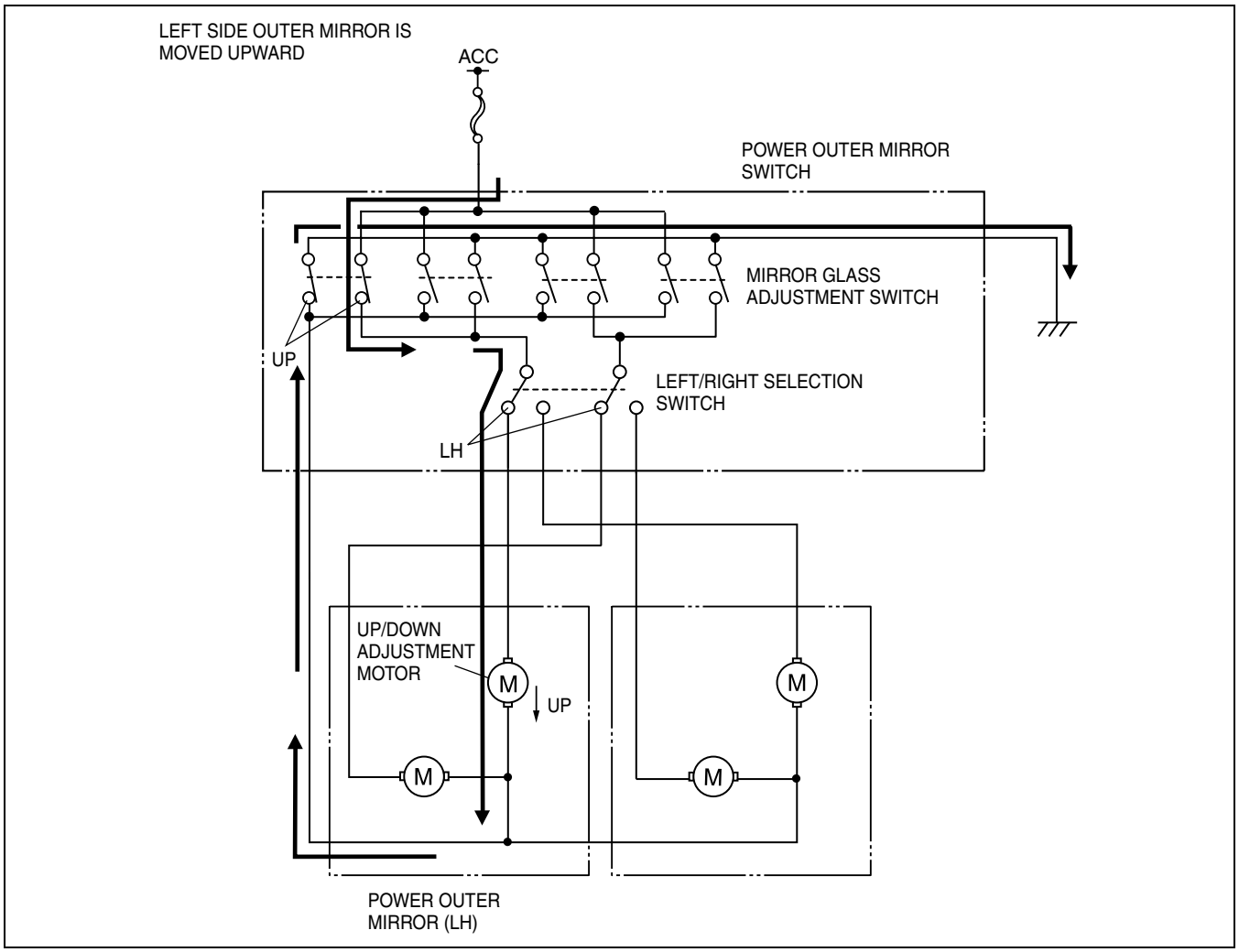
EPU912ZS3006

POWER OUTER MIRROR OPERATION

EPU091269100S04

Mirror Glass Adjustment

- The left/right selection switch establishes left or right side outer mirror circuit and current is supplied in either one of the four directions according to the position of the mirror glass adjustment switch. Due to this, the motor rotates either up or down, left or right..



EPU912ZS3007

09–13 SEATS

SEATS OUTLINE **09–13–1**
FEATURES **09–13–1**
SEATS SPECIFICATION **09–13–1**
SEATS STRUCTURAL VIEW **09–13–1**

SEATS OUTLINE

EPU091357000S01

FEATURES

Improved marketability	• 3-row, 6-passenger model specification has been adopted. • Lumbar support has been adopted for the driver-side seat. • Retractable storage box has been adopted under the seat bottom of the second-row seat (RH). • Flip fold-down system which can be operated independently for RH and LH has been adopted for the second-row seat.
Improved safety	• Built-in side air bag has been adopted for the front seats.

SEATS SPECIFICATION

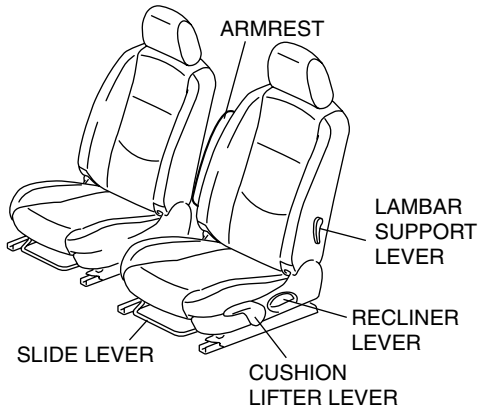
EPU091357000S02

Item	Function
Front seat	Recliner
	Slide
	Cushion lifter (Driver-side seat only)
	Lumbar support (Driver-side seat only)
	Armrest (Driver-side seat only)
	Seat track position sensor (Driver-side seat only) (See 08–10–8 SEAT TRACK POSITION SENSOR FUNCTION.)
	Seat weight sensor (Passenger-side seat only) (See 08–10–8 PASSENGER SENSING SYSTEM OUTLINE.)
	Seat weight sensor control module (Passenger-side seat only) (See 08–10–8 PASSENGER SENSING SYSTEM OUTLINE.)
	Side air bag module
Second-row seat	Flip fold-down
	Slide
	Walk-in
	Armrest
	Storage box
Third-row seat	Easy fold-down (50:50)

SEATS STRUCTURAL VIEW

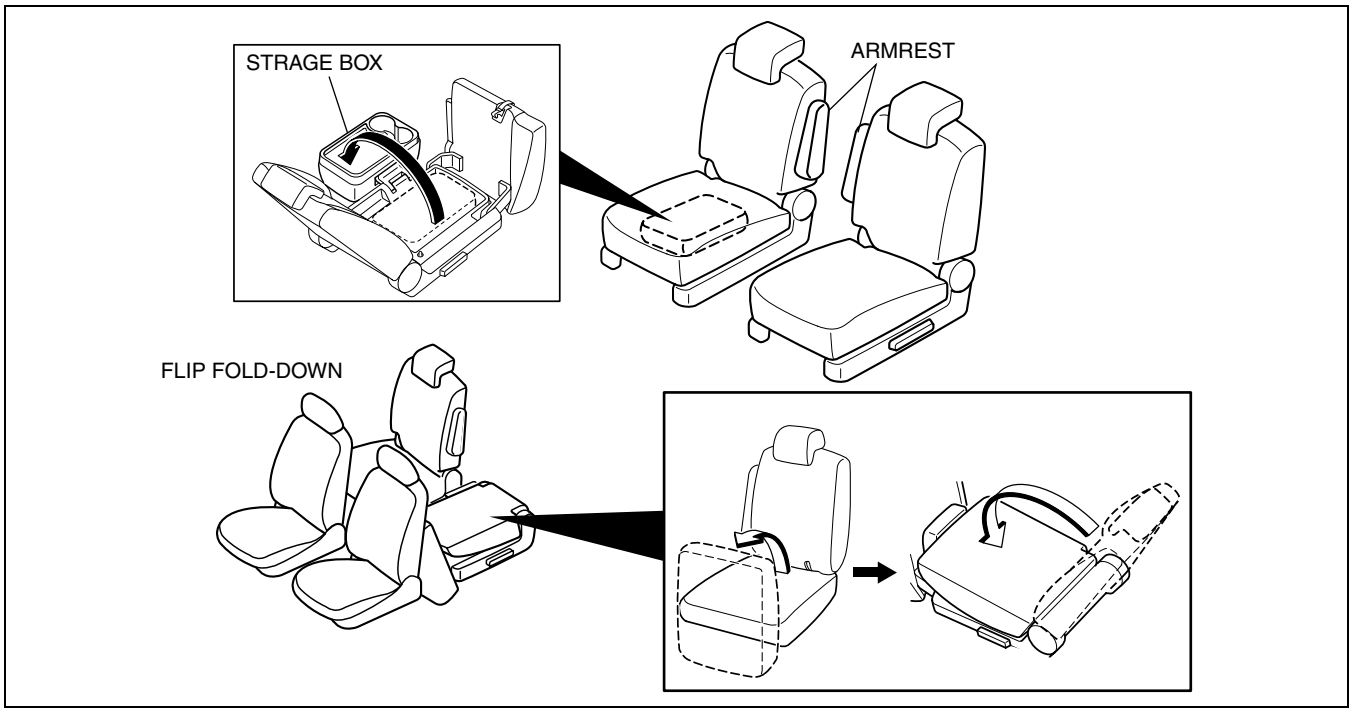
EPU091357000S03

Front Seat



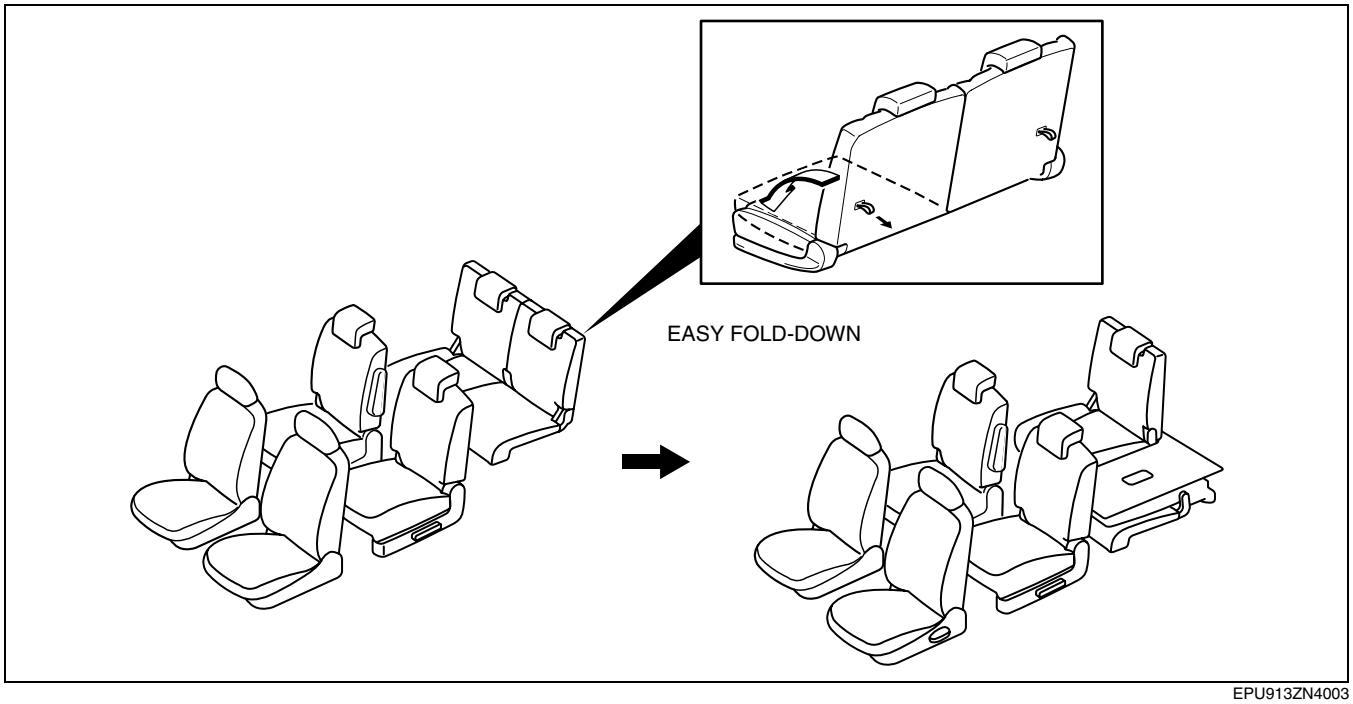
EPU913ZN4001

Second-Row Seat



EPU913ZN4002

Third-Row Seat



EPU913ZN4003

09–14 SECURITY AND LOCKS

SECURITY AND LOCKS OUTLINE 09–14–1
SECURITY AND LOCKS STRUCTURAL VIEW 09–14–2
SECURITY AND LOCKS SYSTEM WIRING DIAGRAM 09–14–3
POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM OUTLINE [KEYLESS ENTRY SYSTEM]..... 09–14–3
POWER DOOR LOCK SYSTEM CONSTRUCTION/OPERATION 09–14–4
KEYLESS ENTRY SYSTEM CONSTRUCTION/OPERATION 09–14–4
TRANSMITTER (RETRACTABLE KEY TYPE) STRUCTURAL VIEW..... 09–14–6
THEFT-DETERRENT SYSTEM OUTLINE..... 09–14–6
THEFT-DETERRENT SYSTEM STRUCTURAL VIEW 09–14–6
THEFT-DETERRENT SYSTEM WIRING DIAGRAM 09–14–7
THEFT-DETERRENT SYSTEM OPERATION 09–14–8
IMMOBILIZER SYSTEM OUTLINE..... 09–14–10
IMMOBILIZER SYSTEM STRUCTURAL VIEW.....09–14–11
IMMOBILIZER SYSTEM WIRING DIAGRAM.....09–14–11
IMMOBILIZER SYSTEM CONSTRUCTION/OPERATION.....09–14–11
Immobilizer System Release Operation 09–14–12
Immobilizer System Setting.....09–14–13
KEY CONSTRUCTION.....09–14–13
COIL ANTENNA CONSTRUCTION.....09–14–14
SECURITY LIGHT CONSTRUCTION/OPERATION.....09–14–14
Construction 09–14–14
Operation 09–14–14
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [IMMOBILIZER SYSTEM] ...09–14–15
DTC Table.....09–14–15
ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION 09–14–16
PID/Data Monitor Table.....09–14–16

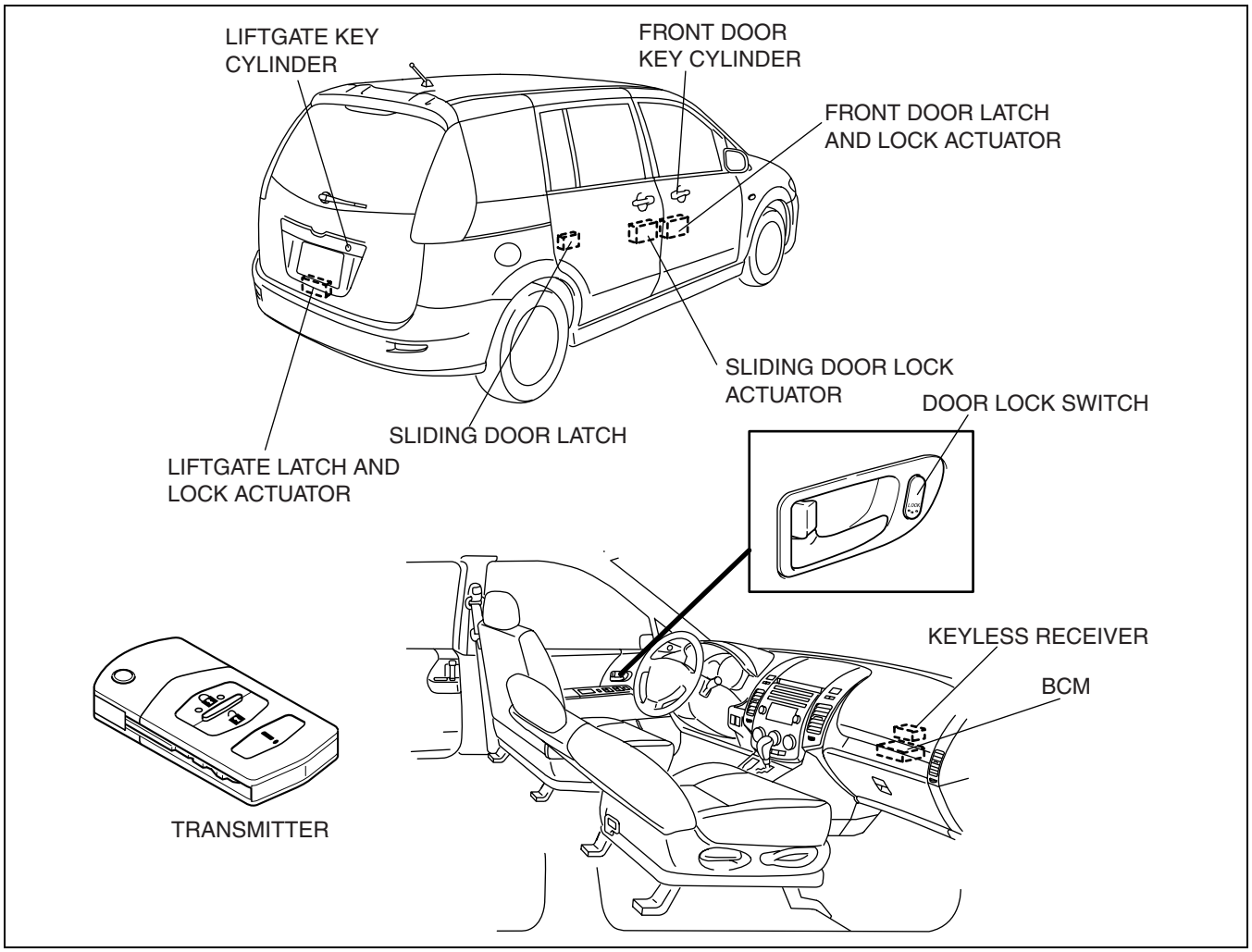
SECURITY AND LOCKS OUTLINE

EPU091400001S01

Improved marketability	• Power door lock system adopted • Keyless entry system adopted • Retractable key type transmitter adopted
Improved security	• Theft-deterrent system adopted • Immobilizer system adopted

SECURITY AND LOCKS STRUCTURAL VIEW

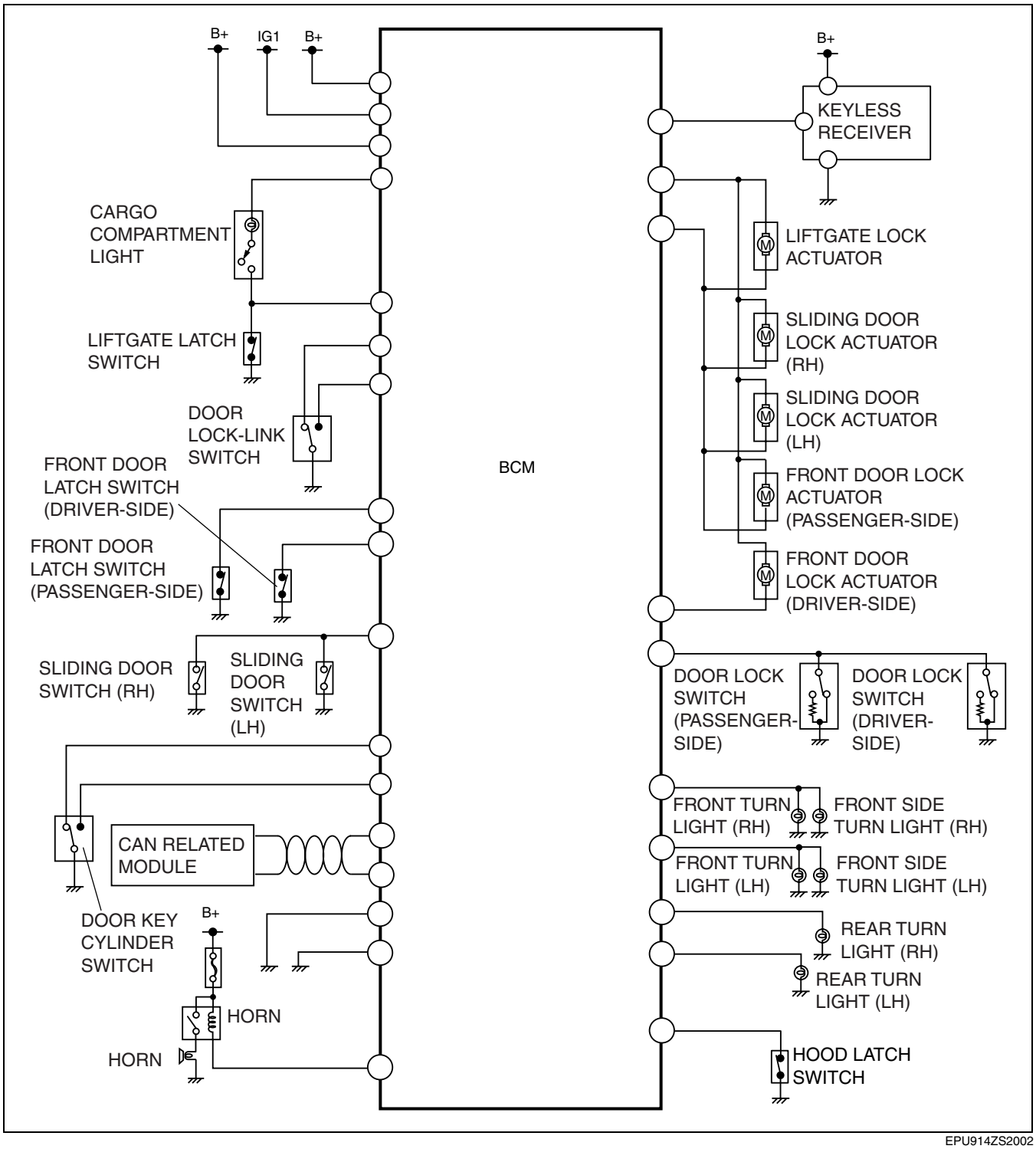
EPU091400001S02



EPU914ZS2001

SECURITY AND LOCKS SYSTEM WIRING DIAGRAM

EPU091400001S03



EPU914ZS2002

POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM OUTLINE [KEYLESS ENTRY SYSTEM]

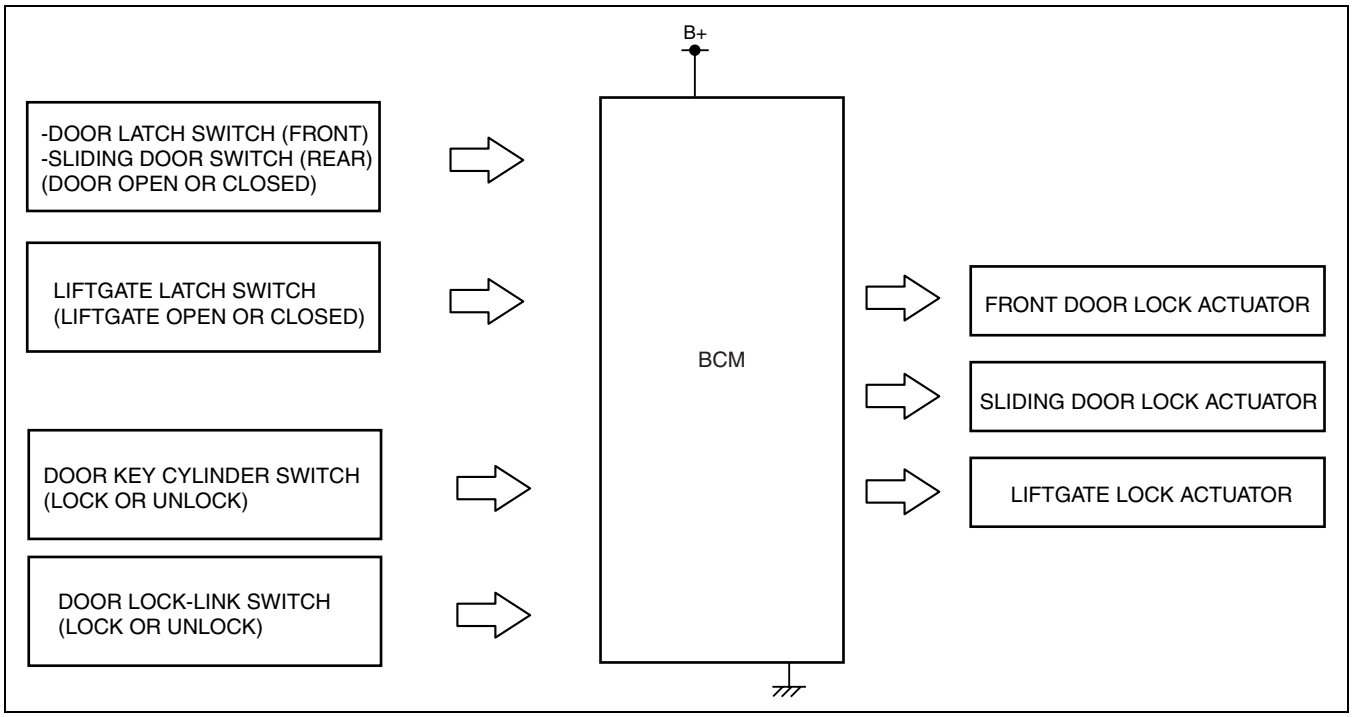
EPU091466000S01

- A retractable key type transmitter has been adopted.

POWER DOOR LOCK SYSTEM CONSTRUCTION/OPERATION

EPU091466000S07

- Consists of the following parts;
  - — BCM
  - — Front door lock actuator
  - — Sliding door lock actuator
  - — Liftgate lock actuator
  - — Door lock-link switch (built into the driver-side front door lock actuator)
  - — Door key cylinder switch (built into the driver-side front door lock actuator)
- Unlocking/locking of all doors and liftgate is performed by operation of the door key cylinder (door key cylinder switch) and driver-side door knob (door lock-link switch).
- When unlocking using the door key cylinder, operating one time will unlock the driver-side door and operating a second time will unlock the passenger-side door.
- When any door is open, locking operation using the door key cylinder or the driver-side door lock knob is cancelled and the doors are unlocked. (Lock cancel function)



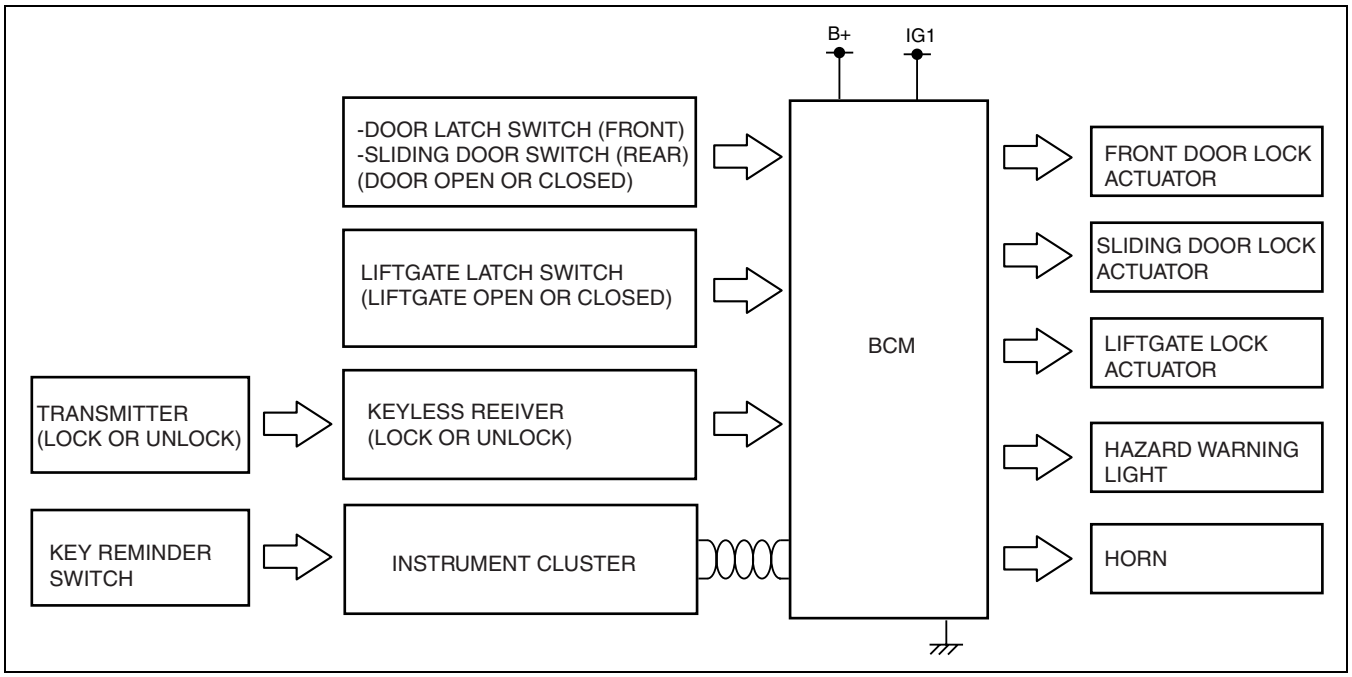
EPU914ZS2003

KEYLESS ENTRY SYSTEM CONSTRUCTION/OPERATION

EPU091466000S08

- Consists of the following parts;
  - — BCM
  - — Keyless receiver
  - — Transmitter
  - — Front door lock actuator
  - — Sliding door lock actuator
  - — Liftgate lock actuator
- The following operations can be performed using the transmitter when away from the vehicle (approx. 2.5 m {8.2 ft}):
  - — Lock all doors (by pressing the LOCK button.)
  - — Unlock all doors (by pressing the UNLOCK button.)
- When the transmitter LOCK button is pressed two times within 5 s, the horn sounds once to indicate that all doors are locked.
- An auto-locking device has been adopted that automatically locks the doors if any of the following operations are not performed within 30 s of pressing the transmitter UNLOCK button:
  - — Any door is opened.
  - — The door is locked/unlocked using the door key cylinder.
  - — The door is locked/unlocked using the driver-side door lock knob.
  - — The key is inserted the steering lock.
- In order to prevent accidental operation when driving, pushing any transmitter button will have no affect when the ignition switch is at the ON position.

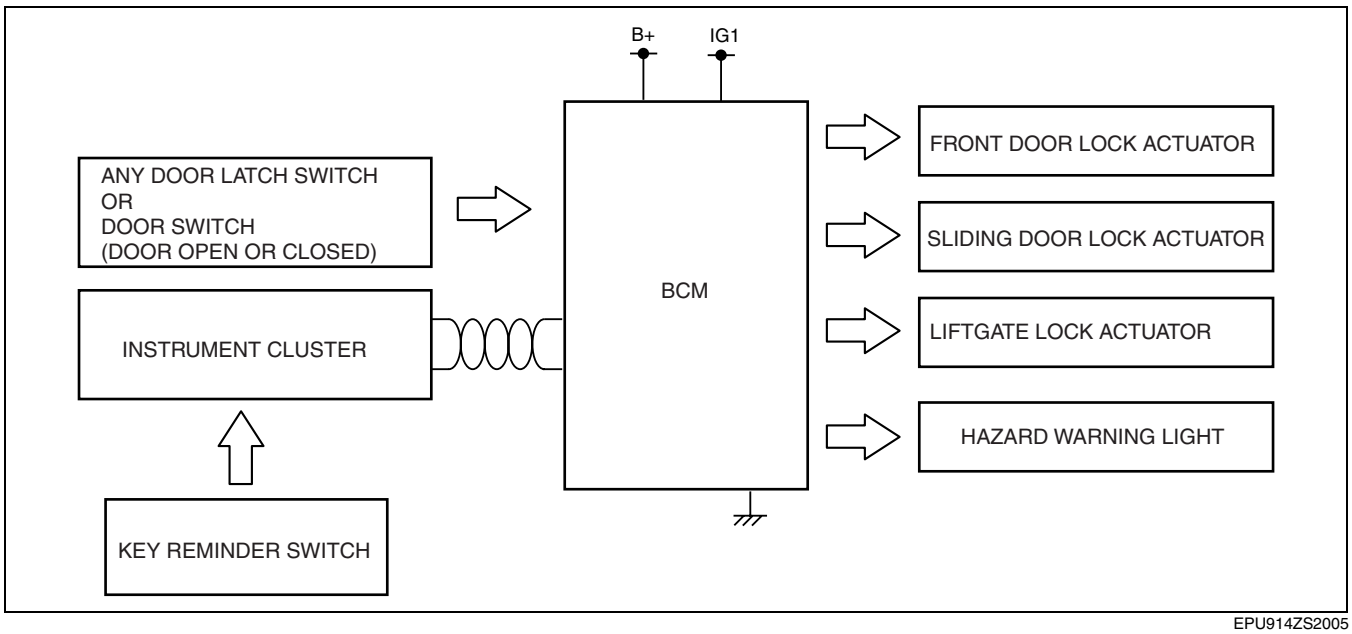
- In response to transmitter operation (lock/unlock), the hazard warning light flashes to enable visual verification of operation.
  - — When the transmitter LOCK button is pushed, the hazard warning light flashes once.
  - — When the transmitter UNLOCK button is pushed, the hazard warning light flashes twice.



EPU914ZS2004

09–14

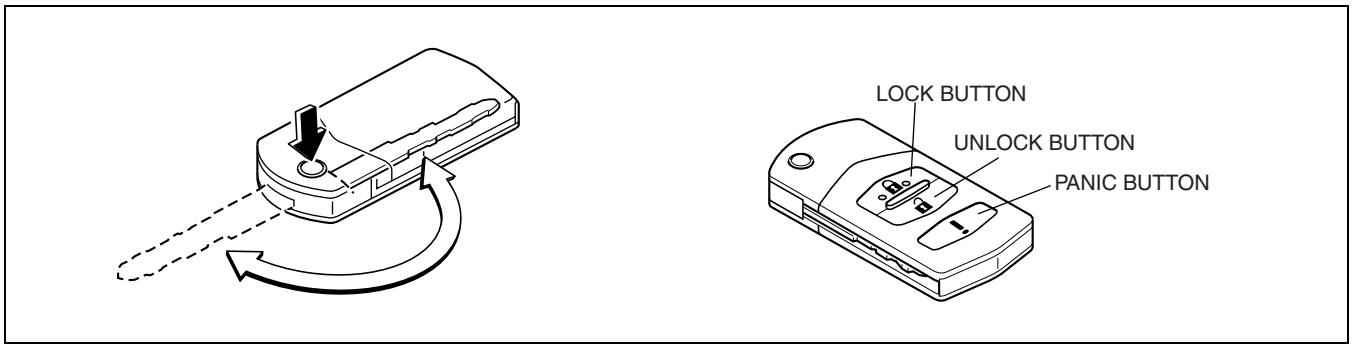
- The self-diagnostic function of the keyless entry system is accessed by combined operation of the following parts, allowing for verification of the keyless entry system operating status. For the start-up procedure of the self-diagnostic function, refer to the Mazda5 Workshop Manual.
  - — Key reminder switch
  - — Any door latch switch



EPU914ZS2005

TRANSMITTER (RETRACTABLE KEY TYPE) STRUCTURAL VIEW

EPU091466000S04



EPU914ZS2006

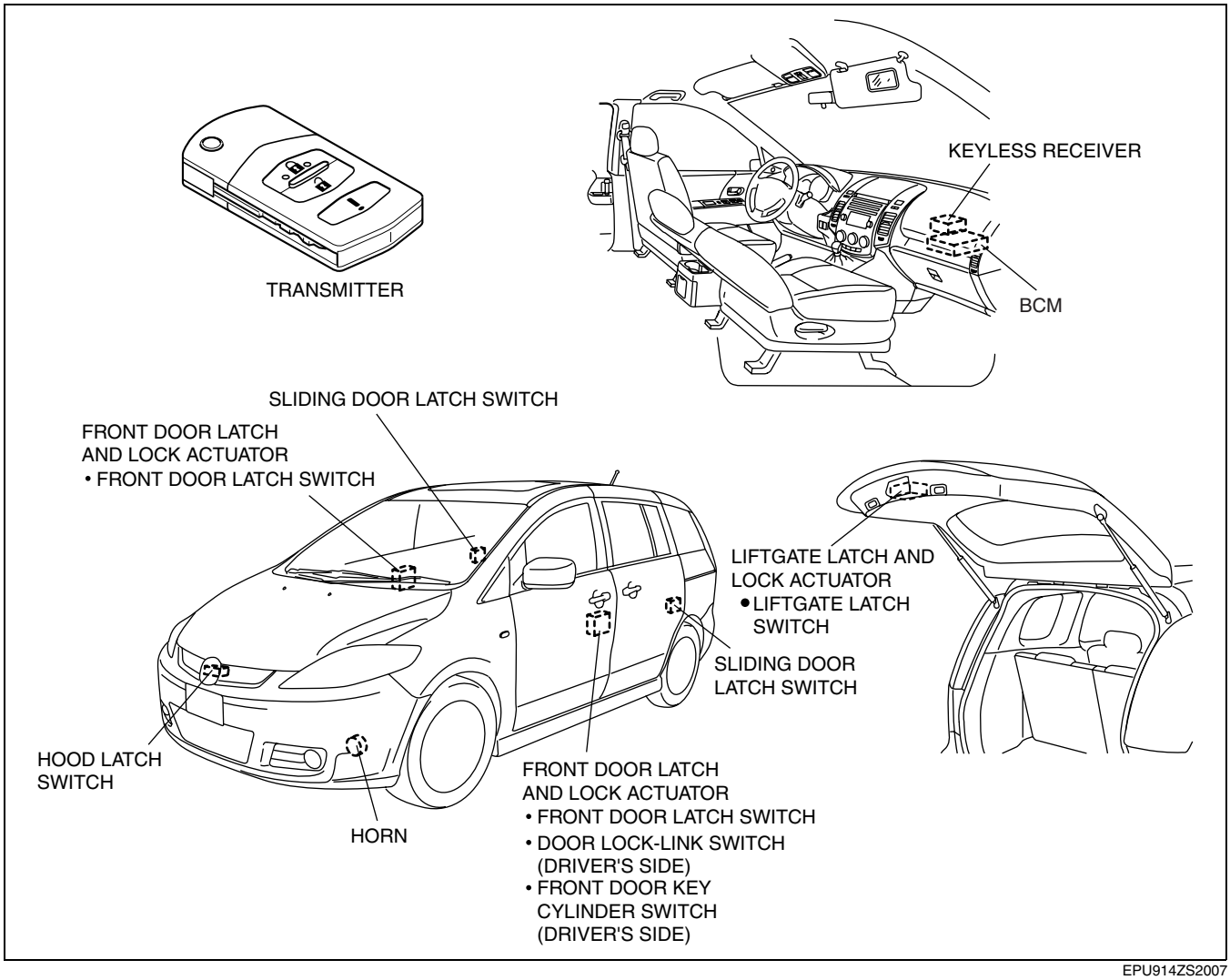
THEFT-DETERRENT SYSTEM OUTLINE

EPU091450000S01

- The theft-deterrent system includes sound and light alarms that activate when the hood, Liftgate, or a door is opened by means other than the ignition key or the transmitter. The turn lights flash and the horn sounds.
- When the ignition key is inserted into the door or trunk key cylinder and turned to unlock or the transmitter unlock button is pressed, the alarms stop.

THEFT-DETERRENT SYSTEM STRUCTURAL VIEW

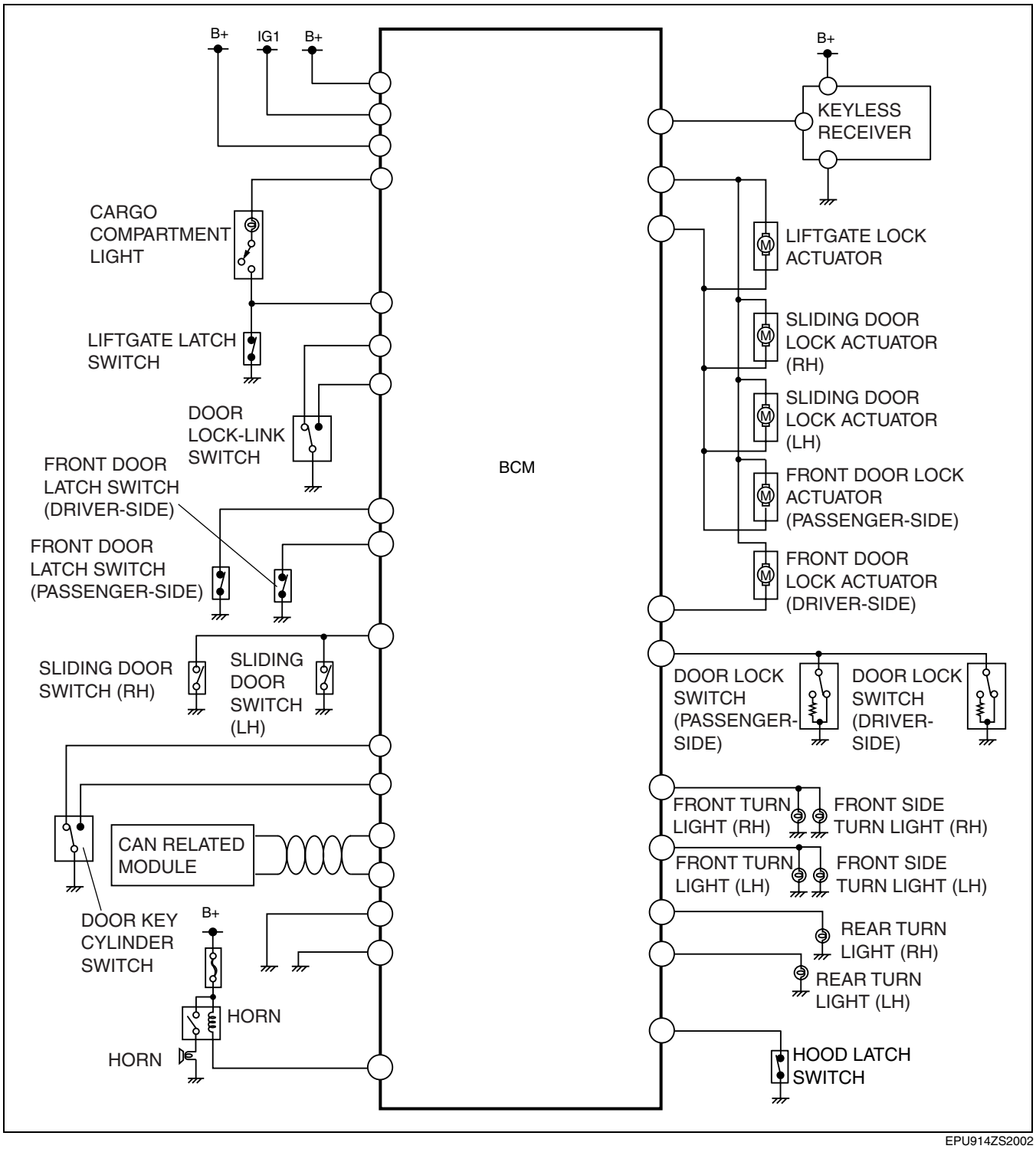
EPU091450000S02



EPU914ZS2007

THEFT-DETERRENT SYSTEM WIRING DIAGRAM

EPU091450000S03



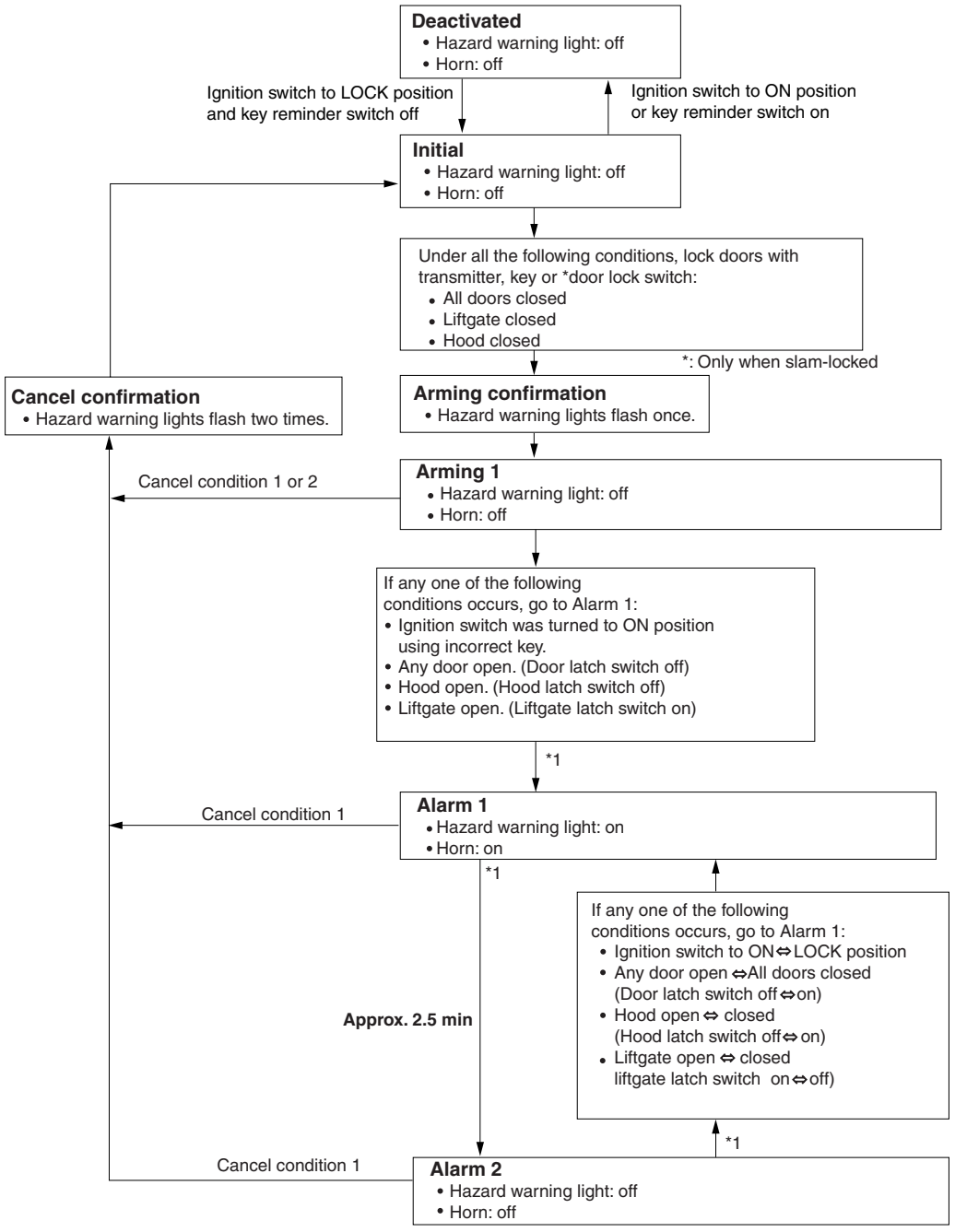
EPU914ZS2002

THEFT-DETERRENT SYSTEM OPERATION

EPU091450000S04

Item	Action	Confirmation	Note
Arming	The theft-deterrent system can be armed by performing the following operations: 1. Turn the ignition switch to ON, then to the LOCK position. 2. Remove the key from the steering lock. 3. Perform the following: • Close all doors. • Close the liftgate. • Close the hood. 4. Lock all doors.*1	• Hazard warning lights flash once.	• After the doors are locked using the transmitter or the door lock switch while any door is open, the theft-deterrent system arms when all of the doors are closed. *1: If the hood or the liftgate is open, the doors will lock but the alarm will not arm until the hood is closed.
Arming cancel	Arming can be canceled by either of the following operations: • Unlock any door using the transmitter or key. • Insert the key into the steering lock and turn the ignition switch to the ON position.	• Hazard warning lights flash two times.	-
Alarm	The alarm is triggered by any of the following operations: • Forcing open a door, the hood, or the liftgate. • Opening a door, the hood or liftgate by operating a door lock switch, the hood release lever. • Turning the ignition switch to the ON position using an invalid key.	• Hazard warning lights flash. • Horn sounds.	• The alarm continues for approx. 2.5 min, then stops.
Alarm cancel	The alarm can be canceled by either of the following operations: • Door unlocked with transmitter or key.	-	-

System flowchart



*1: If the PANIC button is pressed, the keyless entry system operates (alarm status) and the theft-deterrent system shifts to Alarm 2 status.

CANCEL CONDITION

1: Door unlock with transmitter or key.
2: Key reminder switch on and ignition switch to ON position.

EPU914ZS2008

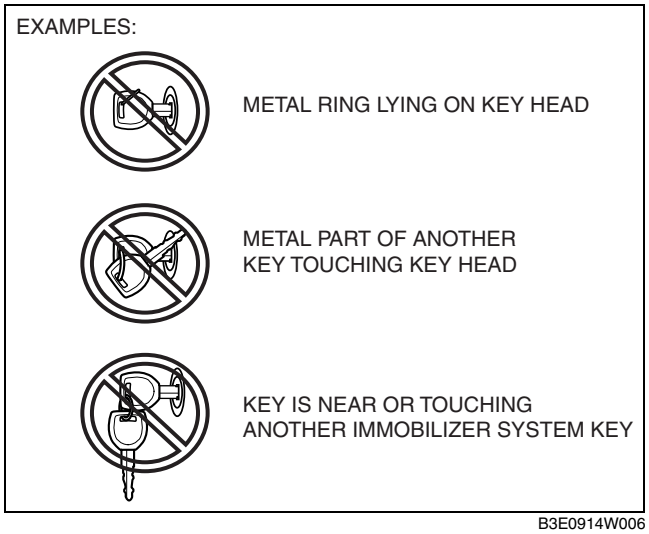
IMMOBILIZER SYSTEM OUTLINE

EPU091467000S01

- The immobilizer system is a vehicle theft prevention device that only allows keys that have previously been registered to the vehicle to start the engine. Therefore, it functions to prevent theft by means such as a forged key or electrical 'hotwiring'.
- Consists of the key (with built-in transponder), coil antenna, PCM, instrument cluster and security light (in the instrument cluster).
- The immobilizer system operates automatically when the ignition switch is turned to the LOCK or ACC position. (The security light illuminates when the immobilizer system is in operation)
- When the ignition switch is turned from the LOCK (or ACC position) to the ON (or START position) with a previously registered key, the release operation begins automatically. The engine is allowed to start only after this operation is successful. (The security light illuminates for **3 s** and then goes out when the immobilizer system has been released.)
- The immobilizer system cannot be deactivated.
- Due to immobilizer system characteristics, the engine cannot be started unless two or more keys are registered. Moreover, when performing “Instrument cluster replacement”, “PCM replacement”, or “Replacement of all the keys”, two or more keys usable with the immobilizer system must be readied.
- A maximum of eight keys can be registered for one vehicle. The PID/data monitor function can be used to verify the number of keys registered for a single vehicle.
- If there is a system malfunction or the immobilizer system is not properly released due to release operation failure, the malfunction location can be verified using the malfunction diagnosis function of the on-board diagnostic system.

Caution

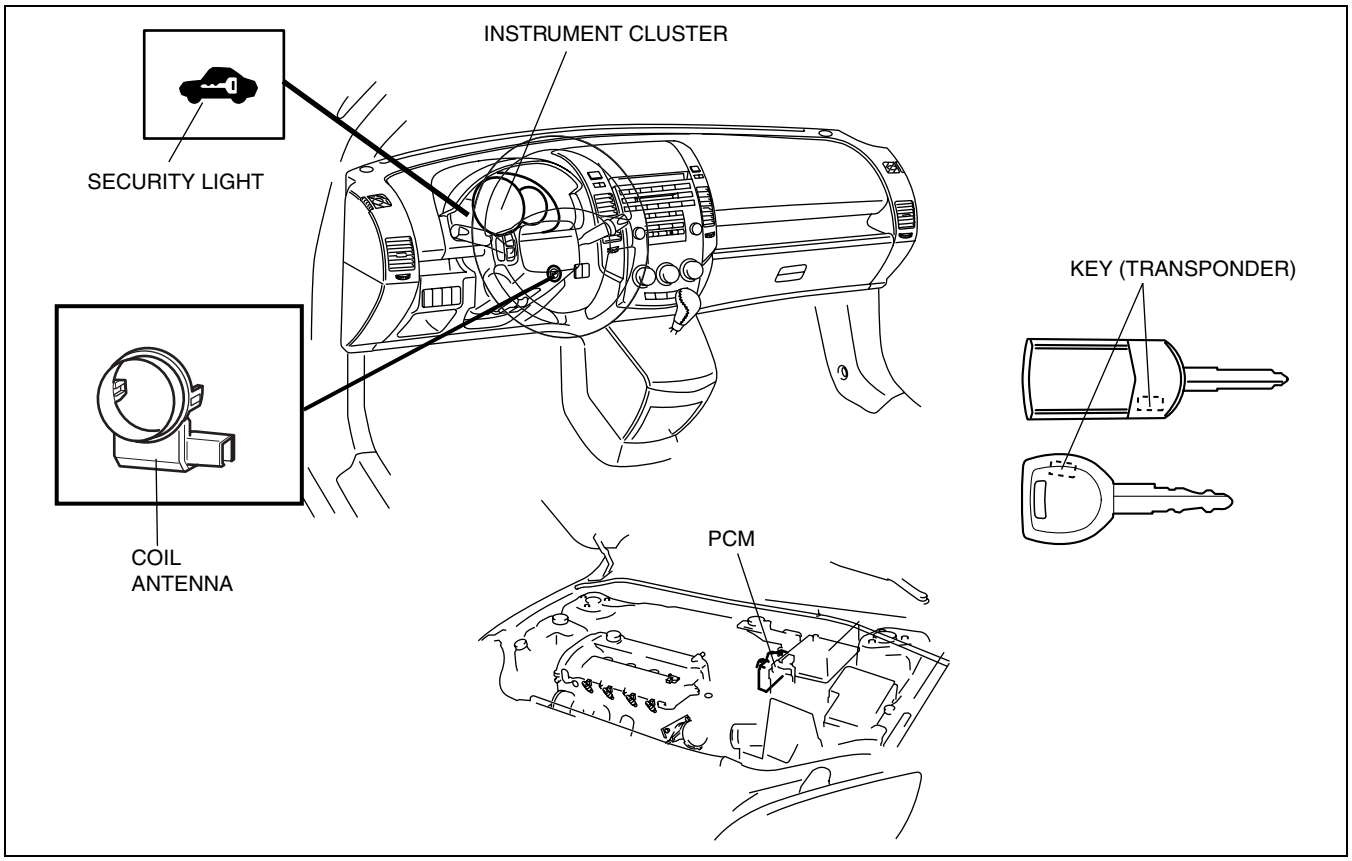
- **If any of the following items are touching or near the key head, signal communication between the key and vehicle is negatively affected, resulting in the engine not starting or a key registration error. Do not perform procedures if any of the following items are touching or near the key head.**
  - **— Any metallic object**
  - **— Spare keys or keys for other vehicles equipped with an immobilizer system**
  - **— Any electronic device, or any credit or other cards with magnetic strips**



B3E0914W006

IMMOBILIZER SYSTEM STRUCTURAL VIEW

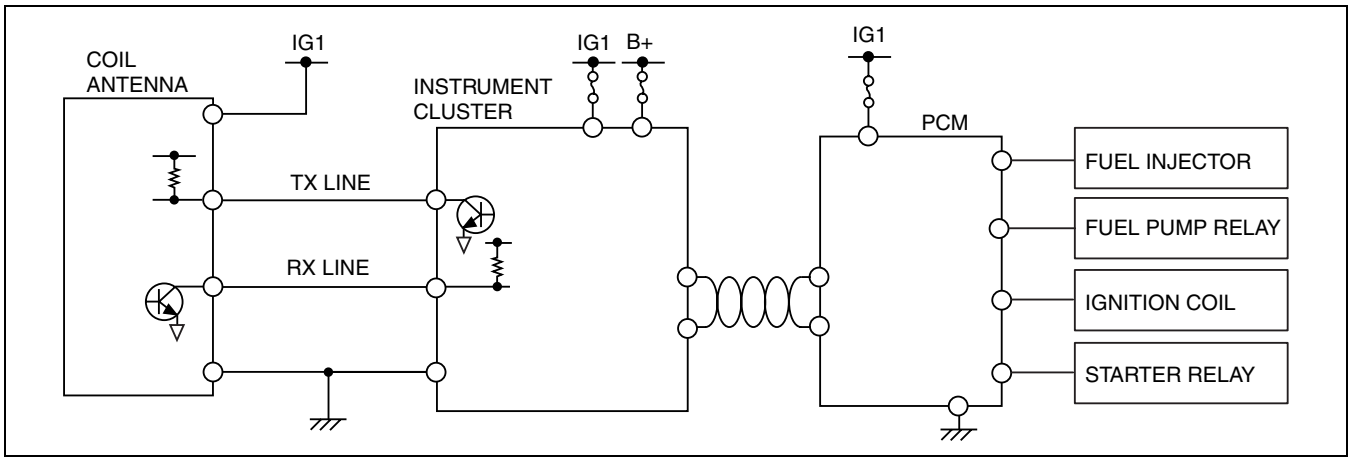
EPU091467000S02



EPU914ZS2009

IMMOBILIZER SYSTEM WIRING DIAGRAM

EPU091467000S03



C3U0914S008

IMMOBILIZER SYSTEM CONSTRUCTION/OPERATION

EPU091467000S04

- When a key is inserted into the key cylinder, the key ID number of the key and the key ID number registered in the PCM are compared. If the comparison is successful, permission is given to start the engine. For PCM control, see Section 01, CONTROL SYSTEM.
- Keys contain a unique ID number that is previously registered in the instrument cluster. Due to this, if immobilizer system component parts are replaced (such as key addition/clearing and instrument cluster replacement), it is necessary to reset the system.

Immobilizer System Release Operation

The ignition switch is turned from the LOCK (ACC) to the ON (START) position. (Security light illuminates.)

↓

(1) The instrument cluster sends data A* to the key (transponder) via the coil.

↓

(2) The key (transponder) calculates data B from received data A and sends its specific key ID number and data B to the instrument cluster via the coil.

↓

(3) The instrument cluster verifies consistency between the received key ID number and the previously registered key ID numbers.

→ UNSATISFACTORY RESULT

↓ SATISFACTORY RESULT

(4) The instrument cluster makes a calculation using received data B and compares it with sent data A.

→ UNSATISFACTORY RESULT

↓ SATISFACTORY RESULT

(5) The instrument cluster requests data for verification from the PCM.

↓

(6) The PCM sends data C* to the instrument cluster.

↓

(7) The instrument cluster calculates data D from received data C and sends it to the PCM.

↓

(8) The PCM makes a calculation using received data D and compares it with sent data C.

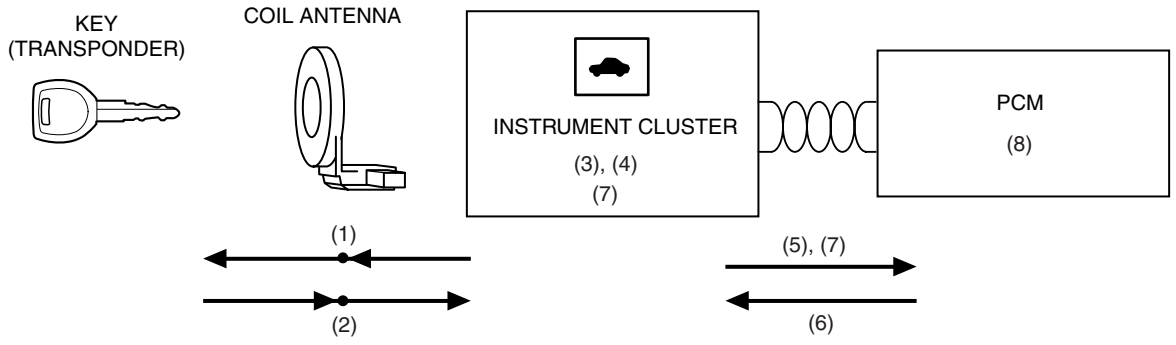
→ UNSATISFACTORY RESULT

↓ SATISFACTORY RESULT

Engine starting is permitted.
(The security light goes out after approx. 3 s.)

Engine starting is not permitted.
(After detecting the error (such as non-verification or malfunction), the security light illuminates or flashes continuously for approx. 1 min, and then a DTC is repeatedly displayed 10 times.)

*: Data A and C are different random values each time.



B3E0914T005

Immobilizer System Setting

- The immobilizer system can be set so that only the WDS or equivalent must be used to perform system procedures. When using the WDS or equivalent, first security access must be requested. Obtain security access permission according the WDS or equivalent screen and then perform system procedures.

WDS or equivalent setting items	Contents
Programming an additional ignition key	Allows key ID number registration.
Ignition key ID number clearing	Clearing and registration of key ID numbers.
Parameter reset	Initialization of either of the following: • PCM • Instrument cluster
Customer spare key programming enable	"Method for adding other keys using two keys that can start the engine" is enabled. **Note** • This is the default setting on new vehicles.
Customer spare key programming disable	"Method for adding other keys using two keys that can start the engine" is disabled. **Note** • When only the WDS or equivalent must be used to register key ID numbers, making a forged key by using two keys that can start the engine is prevented. This function is for use by rental car or other companies with vehicle fleets.

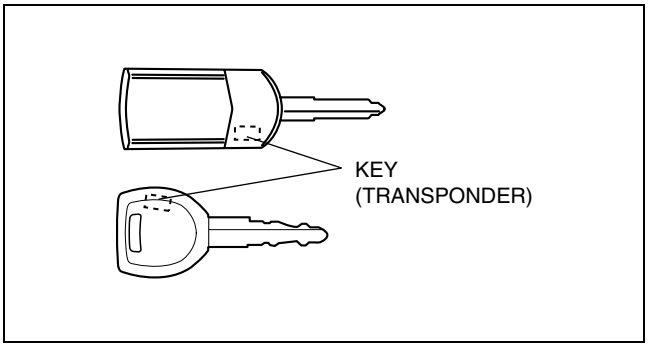
- When immobilizer system component parts (key, Instrument cluster, PCM, and coil antenna) are replaced, the system must be reset as described below. For setting method details, see Mazda3 Workshop Manual.

Component part	Setting
Key addition	Key ID number of added key must be registered. Key ID number registration is performed according to the following methods: • Method for registering other keys using two keys that can start the engine • Method using the WDS or equivalent
Key clearing	The registered key ID number can only be cleared using the WDS or equivalent. When clearing a key ID number using the WDS or equivalent, all key ID numbers are cleared.
PCM replacement	• Parameter reset must be performed. • The key ID numbers for all keys that were being used must be registered in the WDS or equivalent. Two or more keys must be registered.
Instrument cluster replacement	• Parameter reset must be performed. • The key ID numbers for all keys that were being used must be registered in the WDS or equivalent. Two or more keys must be registered.
Coil antenna replacement	Resetting of the immobilizer system does not need to be performed.

KEY CONSTRUCTION

EPU091467000S05

- Keys for use with the immobilizer system have an electronic communication device (transponder) built into the key head that retains specific electronic codes (key ID number).

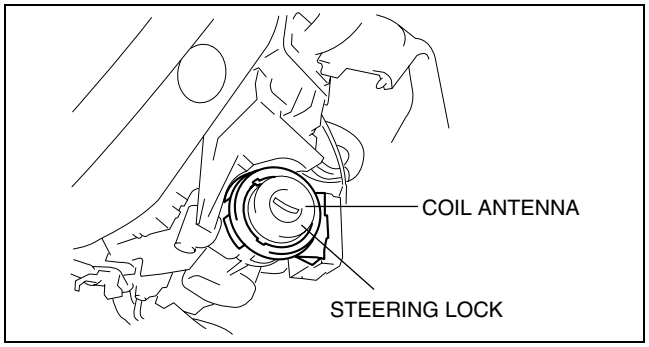


EPU914ZS2010

COIL ANTENNA CONSTRUCTION

EPU091467000S06

- Installed on the steering lock.
- Forms a magnetic field near the steering lock and receives the key signal.
- The received key signal is demodulated and input to the instrument cluster.



C3U0914S010

SECURITY LIGHT CONSTRUCTION/OPERATION

EPU091467000S07

Construction

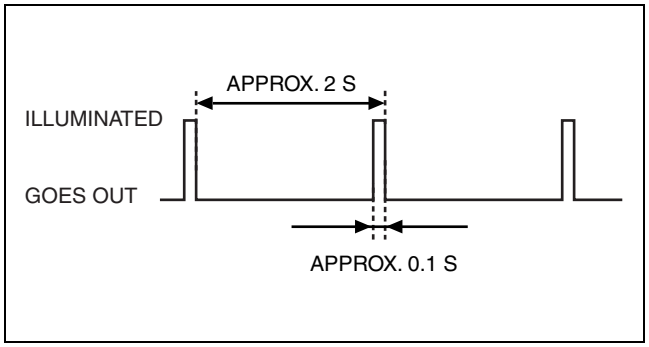
- Allows visual confirmation of immobilizer system operation.
- If any malfunction is detected in the immobilizer system, the malfunction location can be verified by the security light flashing pattern.

Note

- If there is security light system malfunction, DTCs may not be properly displayed. Always use the WDS or equivalent to verify DTCs.

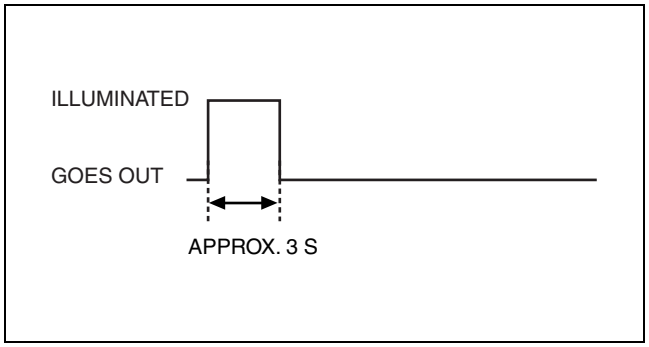
Operation

- When the immobilizer system is operating, the security light flashes repeatedly **0.1 s every 2 s**.



C3U0914S011

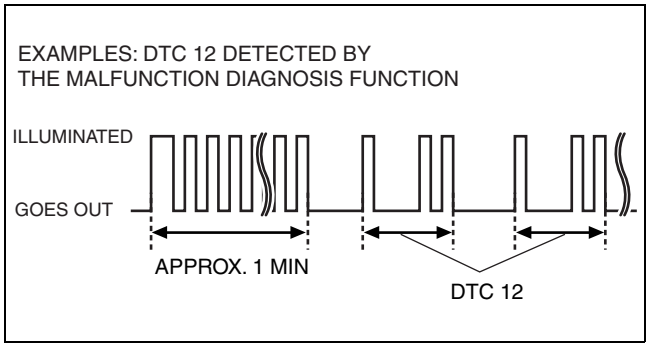
- When the immobilizer system is released normally, the security light illuminates **for 3 s** and then goes off when the ignition switch is turned to the ON position.
- If the immobilizer system is not released normally (malfunction detected by the malfunction diagnosis function), the security light displays a DTC. If this occurs, the security light flashes or illuminates **for 1 min** and then displays the DTC when the ignition switch is turned to the ON position.
  — DTC 16 and lower: Flashes



C3U0914S012

— DTC 21 and higher: Illuminated

Note
- The security light flashes to display the DTC **10 times**.
- If multiple DTCs that can be confirmed with the security light are detected, only the DTC with the lowest number of those detected will be displayed by the security light.



C3U0914S013

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [IMMOBILIZER SYSTEM]

EPU091467000S08

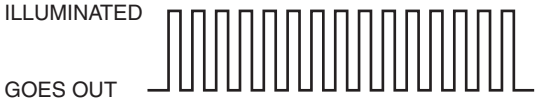
- The immobilizer system is provided with a malfunction diagnosis function.
- Malfunction diagnosis of the immobilizer system occurs automatically when the ignition switch is turned from the LOCK (ACC) to the ON (START) position.
- If the results of the malfunction diagnosis show a malfunction in the immobilizer system, the security light displays a DTC. At the same time, DTCs are stored in the PCM and instrument cluster. The stored DTCs can be verified using the WDS or equivalent.

Caution
- **Always use the WDS or equivalent to verify DTCs even if the security light display a DTC. If the security light itself has a malfunction, it is possible that a DTC may not be properly displayed. There are certain DTCs which can only be verified using the WDS or equivalent, not the security light.**
- **DTCs for the immobilizer system that are stored in the instrument cluster and PCM are cleared when the ignition switch is turned from the ON to the LOCK (ACC) position.**

Note
- If two or more malfunctions are detected as a result of malfunction diagnosis, only the DTC with the lowest number of those detected will be displayed by the security light. However, multiple DTCs are stored at the same time.
- If two or more immobilizer system DTCs are verified, first repair the part indicated by the security light displayed DTC. After completely repairing one location, turn the ignition switch from the LOCK to the ON position and perform immobilizer system malfunction diagnosis.

DTC Table

Note
- In the approx. 1 min after detecting a malfunction and before displaying the DTC, the security light will illuminate or flash the following patterns:

Security light flashing pattern (Before displaying DTC)	DTC
	11, 12, 13, 14, 15, 16
	21, 22, 23

DTC				Detection condition
Security light flashing pattern		WDS or equivalent display*		
		Instrument cluster	PCM	
11		B1681	P1260	No detected communication with the coil
12		B2103	P1260	• Coil antenna malfunction • The PCM determined a malfunction in the coil antenna even though it is normal.
13		B1600	P1260	The key ID number data cannot be read.
		B2431	P1260	Key ID number registration error
14		B1602	P1260	The instrument cluster cannot read key ID number data normally.
15		B1601	P1260	The instrument cluster has detected unregistered key ID number.
16		U2510	P1260	Communication error between the instrument cluster and the PCM (no response)
		U1147	P1260	Communication error between the instrument cluster and the PCM (mismatched conditions)
21		B1213	P1260	Only one key ID number is registered.
22		B2141	P1260	Communication error between the instrument cluster and the PCM (data transfer error)
23		B2139	P1260	ID number data in the PCM and the instrument cluster do not match.
Not illuminated		B1342	-	Instrument cluster malfunction

ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION

EPU091467000S09

- The following items can be verified:
  — Number of key ID numbers registered with the vehicle
- Use the WDS or equivalent to read the PID/data monitor.

PID/Data Monitor Table

PID name (definition)	Detected condition
NUMKEYS (Number of key ID numbers registered with the vehicle)	Number of key ID numbers registered: 0—8

09–15 SUNROOF

SLIDING SUNROOF OUTLINE. 09–15–1
SUNROOF SPECIFICATION. 09–15–1
SLIDING SUNROOF STRUCTURAL VIEW 09–15–1
SLIDING SUNROOF SYSTEM WIRING DIAGRAM 09–15–2
SLIDING SUNROOF OPERATION. 09–15–2
SUNROOF UNIT CONSTRUCTION/OPERATION 09–15–3
SUNROOF MOTOR CONSTRUCTION 09–15–4

SLIDING SUNROOF OUTLINE

EPU091569800S01

Improved comfort	• Electric sunroof with tilt function adopted • Deflector adopted to reduce wind-blast noise
Improved serviceability	• Pulse sensor (hall effect switch) adopted for system control to simplify system • Sunroof motor with built-in control module adopted

SUNROOF SPECIFICATION

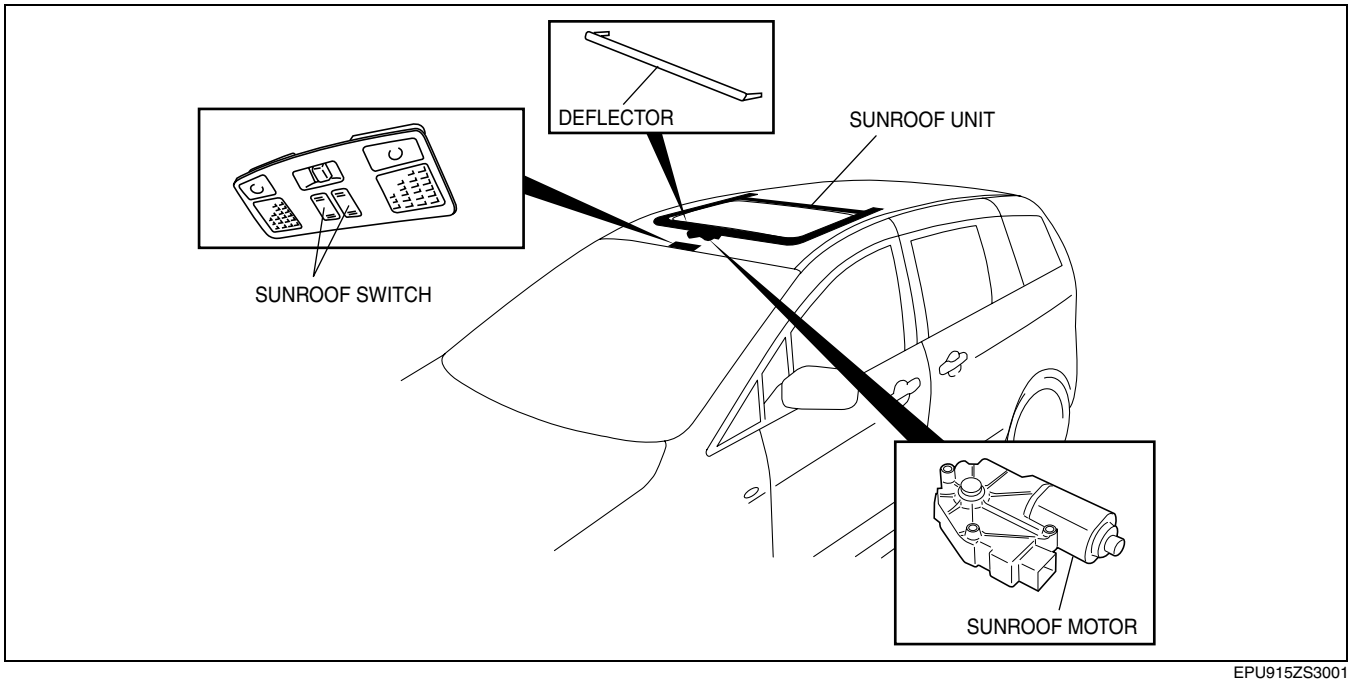
EPU091569800S02

Item	Specification
Slide system	Outer slide
Opening measurement (mm {in})	202 × 722 {7.95 × 28.4}
Tilt-up amount (mm {in})	22—28 {0.9—1.1}
Opening/closing time (s)	Slide: 2.5—5.5, Tilt: 0.9 or less

09–15

SLIDING SUNROOF STRUCTURAL VIEW

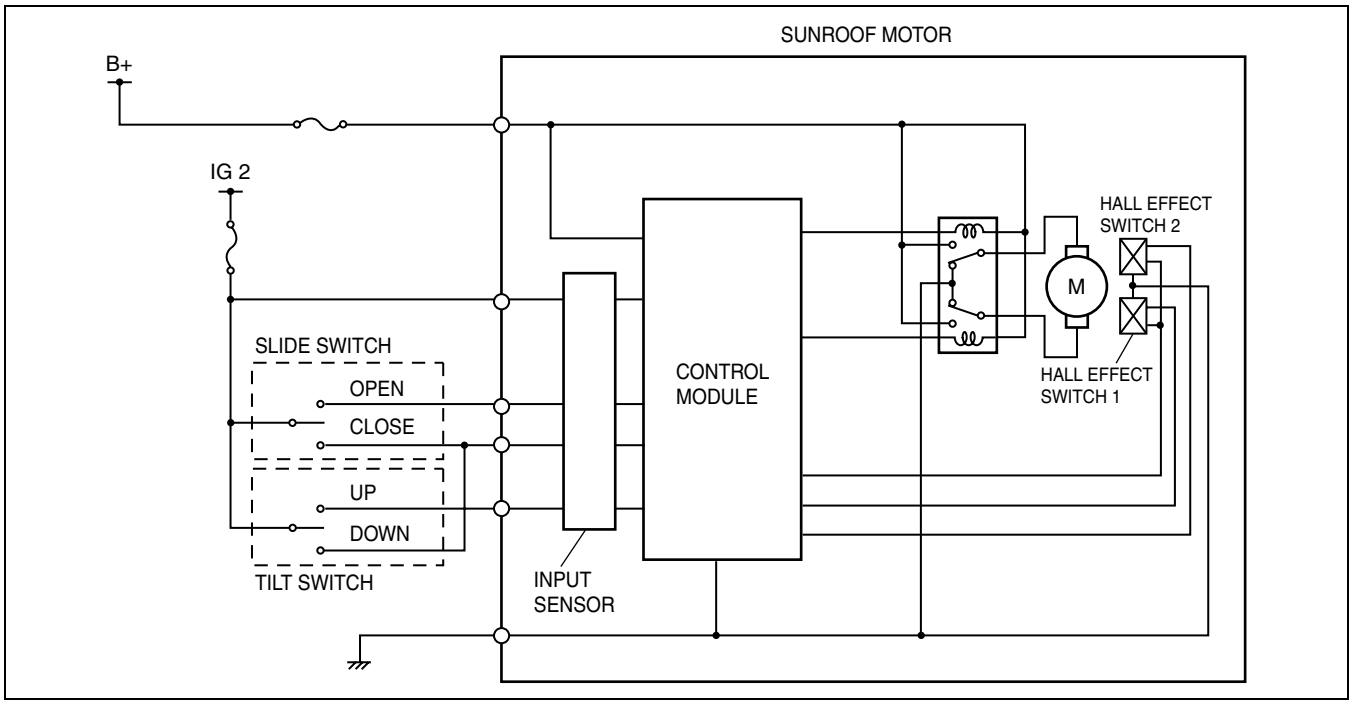
EPU091569800S03



EPU915ZS3001

SLIDING SUNROOF SYSTEM WIRING DIAGRAM

EPU091569800S04



EPU915ZS3002

SLIDING SUNROOF OPERATION

EPU091569800S05

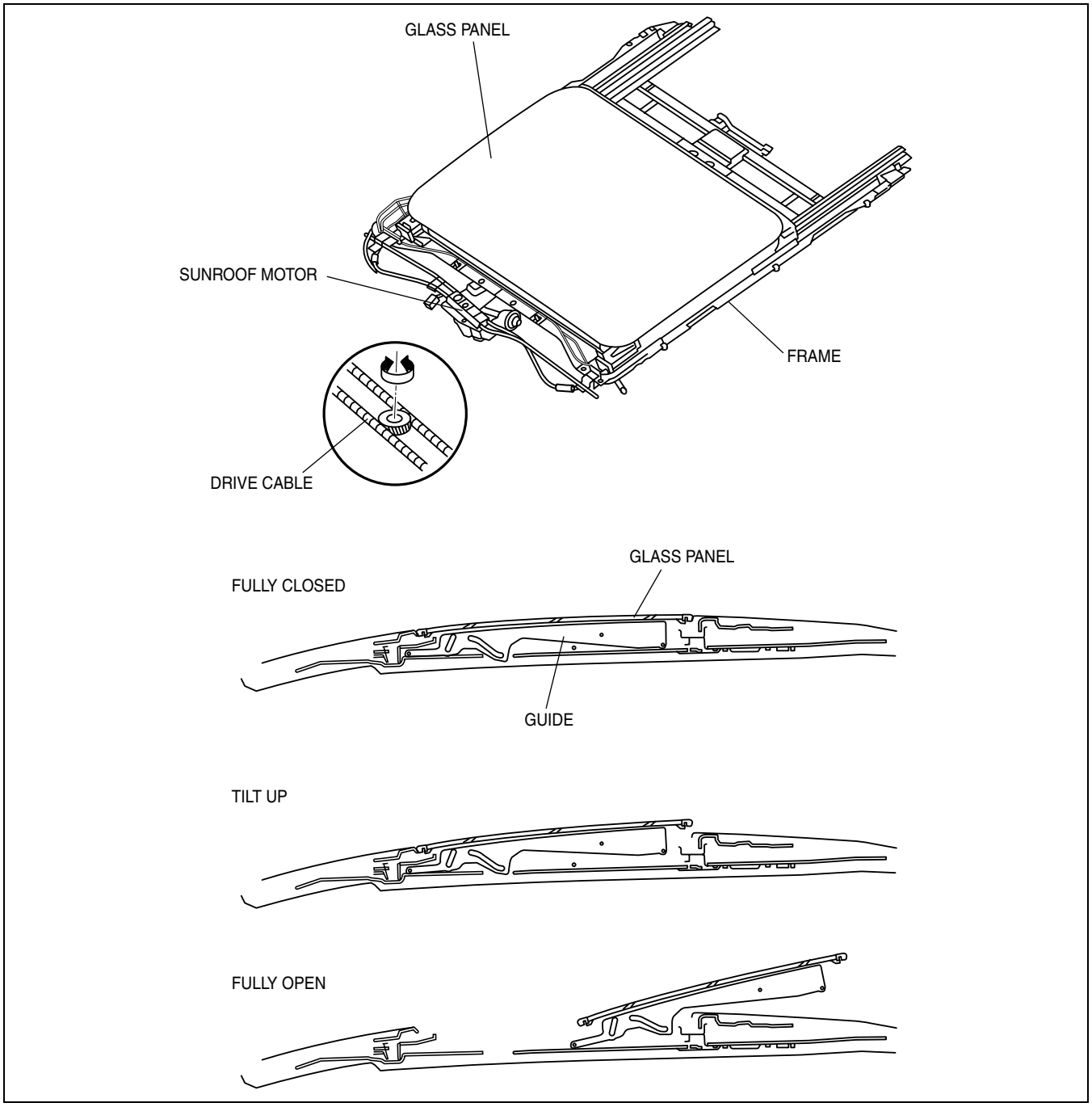
- The glass panel opens/closes using tilting and sliding operations.
- When the ignition switch is at the ON position, the sunroof operates by use of the sunroof switch.
- If the ignition switch is turned to the LOCK or ACC position while the sunroof is operating, it will stop.
- One-touch operation of the SLIDE open or the TILT up switch provides auto-operation.
- If any switch is operated during auto-operation, the sunroof stops.
- If any malfunction is detected during sunroof operation, the fail-safe function operates to ensure safety.

Item	Specification	Cancel condition
Continuous energization observation function (switch stuck-on observation function)	If the switch is continuously on for longer than the set time (60 s), operation is stopped.	The switch is turned off, then on
Continuous operation observation function	If the period of accumulated energization due to continuous opening/closing is longer than the set time (120 s), operation is stopped. (If set time is reached while closing, sunroof returns to fully open position.)	20 s after operation is stopped
Relay observation function	If the motor power supply is on continuously due to stuck breaker points in a relay on one side or similar malfunction, the other relay is turned on, cutting off energization to the motor. (Even if the ignition switch is turned to the LOCK or ACC position, the coil is energized.)	Relay is no longer stuck
Pinching detection function	If the pulse variation of hall effect switch 1 is not longer than the set time (400 ms), operation is stopped (pinching detected).	Pinching is resolved, and the switch is turned off, then on
Static load detection function	If pinching is detected while the glass panel is sliding, sliding operation is stopped. Set load: 343 N {35 kgf, 77 lbf} or more	Pinching is resolved, and the switch is turned off, then on
Hall effect switch malfunction	If an abnormal hall effect switch pulse is detected, the system enters safe mode. • Abnormality while operating: Operation stopped • Abnormal condition when the switch is operated: Glass panel operates for 400 ms in the direction of sunroof switch operation and stops.	Hall effect switch pulse is detected to be normal (Complete normal recovery is achieved only after completion of initial position setting.)

SUNROOF UNIT CONSTRUCTION/OPERATION

EPU091569850S01

- Consists of a glass panel, frame and sunroof motor.
- The drive cables inside the frame are engaged with the sunroof motor drive gear so that when the motor rotates the drive cables also move.
- The guides are fixed to the glass panel so that the panel is moved by the drive cables sliding the guides..

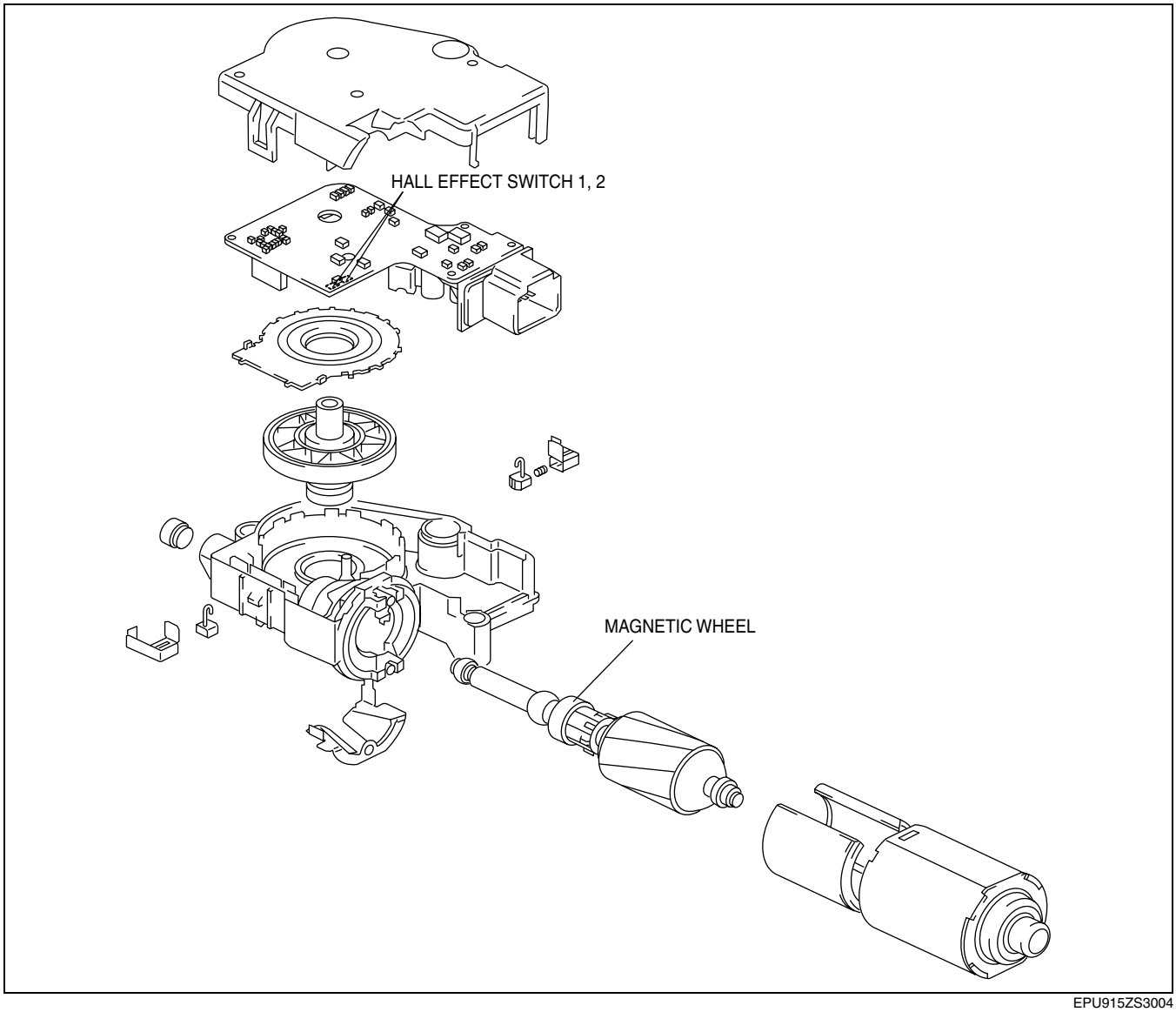


EPU915ZS3003

SUNROOF MOTOR CONSTRUCTION

EPU091569873S01

- The motor consists of gear and control parts.
- A magnetic wheel is provided on the motor shaft.
- Two hall effect switches are provided in the control part.
- The control module detects the rotation direction, speed and amount based on pulse signals from the two hall effect switches, and controls the position and static load of the glass panel accordingly.



EPU915ZS3004

09–16 EXTERIOR TRIM

EXTERIOR TRIM OUTLINE 09–16–1
EXTERIOR TRIM STRUCTURAL VIEW 09–16–1

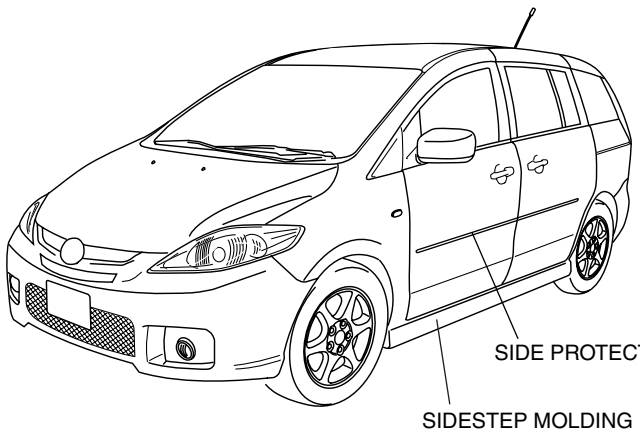
EXTERIOR TRIM OUTLINE

EPU091600000S01

- Sidestep molding has been adopted.
- Side protector has been adopted.

EXTERIOR TRIM STRUCTURAL VIEW

EPU091600000S02



EPU916ZS3000

09–17 INTERIOR TRIM

INTERIOR TRIM OUTLINE 09–17–1
INTERIOR TRIM STRUCTURAL VIEW 09–17–1

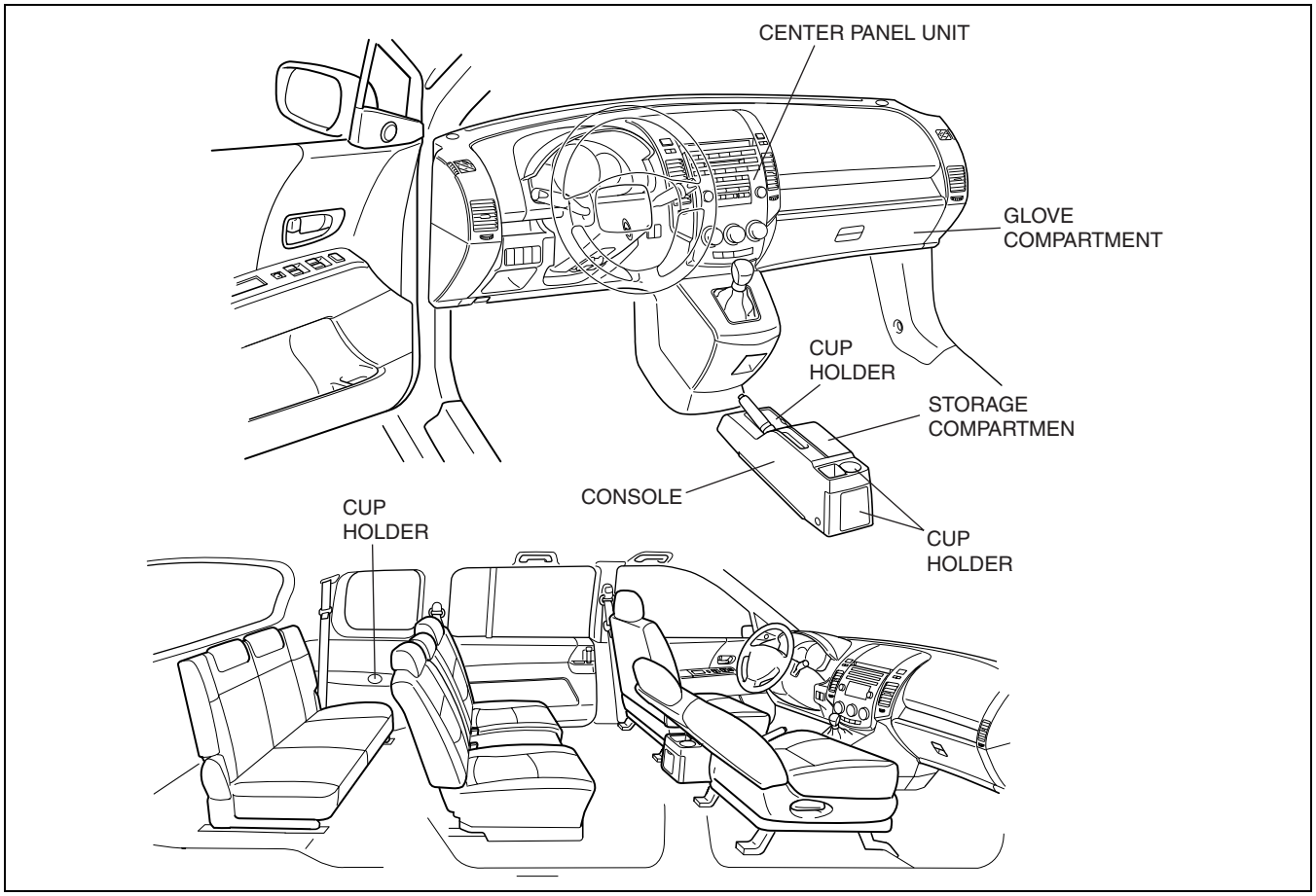
INTERIOR TRIM OUTLINE

EPU091755000S01

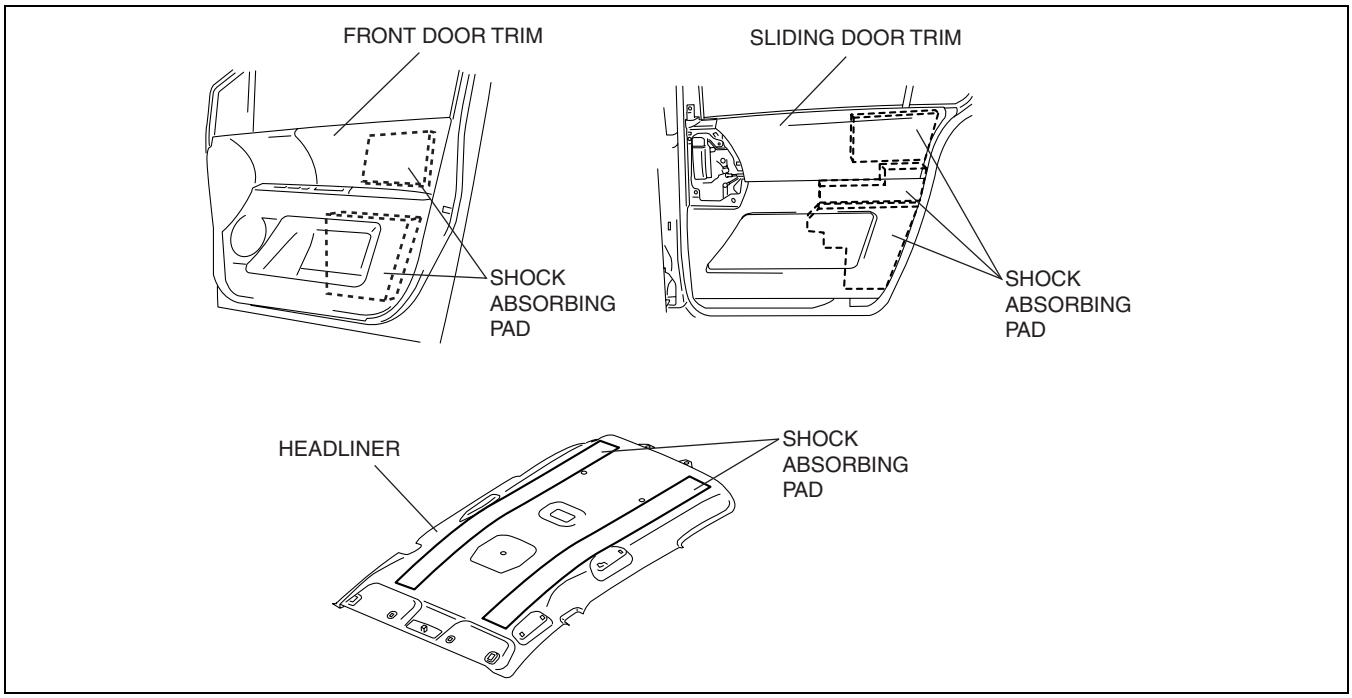
- The center panel unit with integrated audio and climate control units, is located at the center of the dashboard panel. This improves functionality and gives a unified appearance.
- Various storage spaces have been added.
- The shock absorbing pad, located inside the door trim and headliner, functions to soften collision impact.

INTERIOR TRIM STRUCTURAL VIEW

EPU091755000S02



EPU917ZS3000



EPU917ZS3001

09–18 LIGHTING SYSTEMS

LIGHTING SYSTEMS OUTLINE 09–18–1
LIGHTING SYSTEMS SPECIFICATION 09–18–1
LIGHTING SYSTEMS STRUCTURAL VIEW 09–18–2
FRONT COMBINATION LIGHT CONSTRUCTION 09–18–3
Projector-type Headlight 09–18–3
AUTO LIGHT SYSTEM OUTLINE 09–18–3
AUTO LIGHT SYSTEM STRUCTURAL VIEW 09–18–4
AUTO LIGHT SYSTEM WIRING DIAGRAM 09–18–4
AUTO LIGHT SYSTEM OPERATION 09–18–4
Operation 09–18–4
Illumination operation 09–18–5
Lights off operation 09–18–6
AUTO LIGHT SENSOR FUNCTION 09–18–6
AUTO LIGHT SENSOR OPERATION 09–18–7
Function Description 09–18–7
HIGH-MOUNT BRAKE LIGHT CONSTRUCTION 09–18–7
REAR COMBINATION LIGHT CONSTRUCTION 09–18–8
LICENSE PLATE LIGHT CONSTRUCTION 09–18–8
DRL SYSTEM OUTLINE 09–18–8
DRL SYSTEM WIRING DIAGRAM 09–18–9
DRL SYSTEM OPERATION 09–18–9
INTERIOR LIGHTING SYSTEM CONSTRUCTION 09–18–10
ROOM LIGHT CONTROL SYSTEM FUNCTION 09–18–10
ROOM LIGHT CONTROL SYSTEM OPERATION 09–18–11
IGNITION KEY ILLUMINATION FUNCTION 09–18–12
IGNITION KEY ILLUMINATION OPERATION 09–18–13
Illumination Condition 09–18–13
Cancel Condition 09–18–13
STEERING ANGLE SENSOR FUNCTION 09–18–13
STEERING ANGLE SENSOR CONSTRUCTION 09–18–14

LIGHTING SYSTEMS OUTLINE

EPU091800000S01

- Built-in front turn and parking lights have been adopted for headlights.
- Projector type headlights (low-beam) have been adopted.
- Front fog lights have been adopted. (Located in front bumper)
- Stepped reflectors have been adopted for rear combination lights.
- LEDs have been adopted for the high-mount brake light.
- Ignition key illumination that illuminates the ignition key slot has been adopted.
- Interior light control system with variable illumination period and illumination level controlled by the BCM has been adopted.

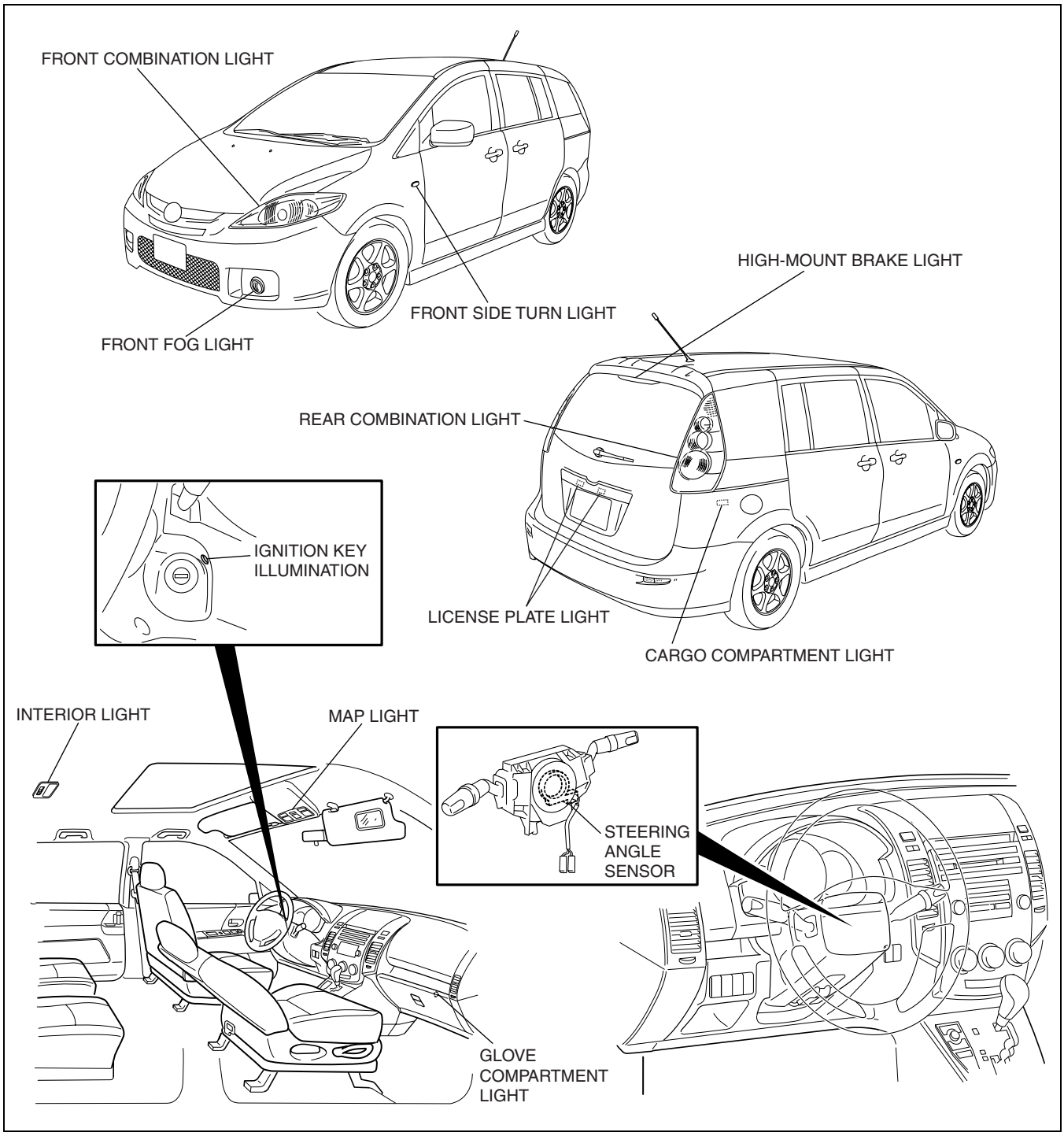
LIGHTING SYSTEMS SPECIFICATION

EPU091800000S02

Item		Specifications (W) × number
Exterior light bulb capacity	Headlight bulb (high-beam)	60 × 2
	Halogen headlight bulb (low-beam)	55 × 2
	Front turn/parking/side marker light bulb	27/8 × 2
	Front fog light bulb	55 × 2
	Front side turn light bulb	5 × 2
	Brake light/taillight bulb	21/5 × 2
	Rear turn light bulb	21 × 2
	Back-up light bulb	18 × 2
	License plate light bulb	5 × 2
	High-mount brake light bulb (LED)	2.4
Interior light bulb capacity	Map light bulb	5 × 2
	Interior light bulb	10 × 1
	Cargo compartment light bulb	8 × 1
	Glove compartment light bulb	1.7 × 1
	Ignition key illumination bulb	1.4 × 1

LIGHTING SYSTEMS STRUCTURAL VIEW

EPU091800000S03

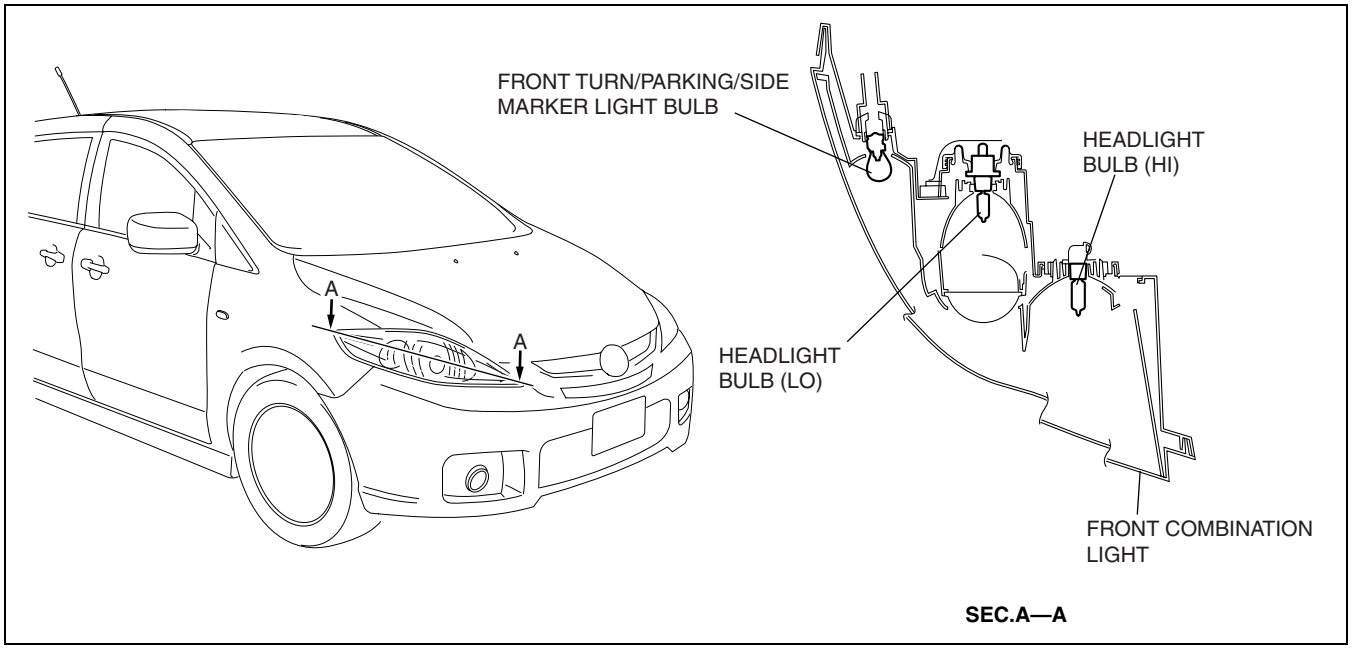


EPU918ZS3001

FRONT COMBINATION LIGHT CONSTRUCTION

EPU091851060S01

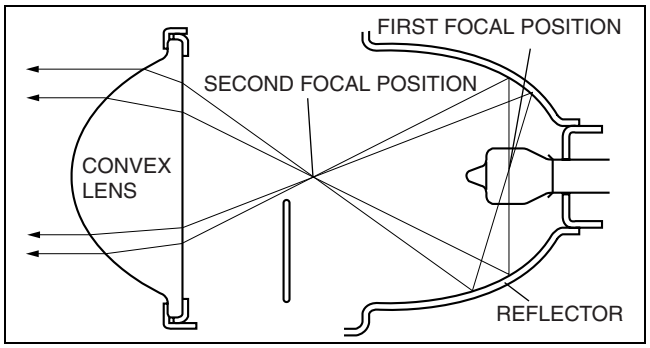
- A headlight with built-in front turn light and parking light has been adopted for design improvement.
- Projector type headlights have been adopted, and these have been incorporated, along with the front turn light and the parking light, into a single unit to reduce size.



EPU918ZS3002

Projector-type Headlight

- Light emitted from the first focal point is projected off the reflector, gathered at the second focal point, and output through the convex lens.



C3U0918S103

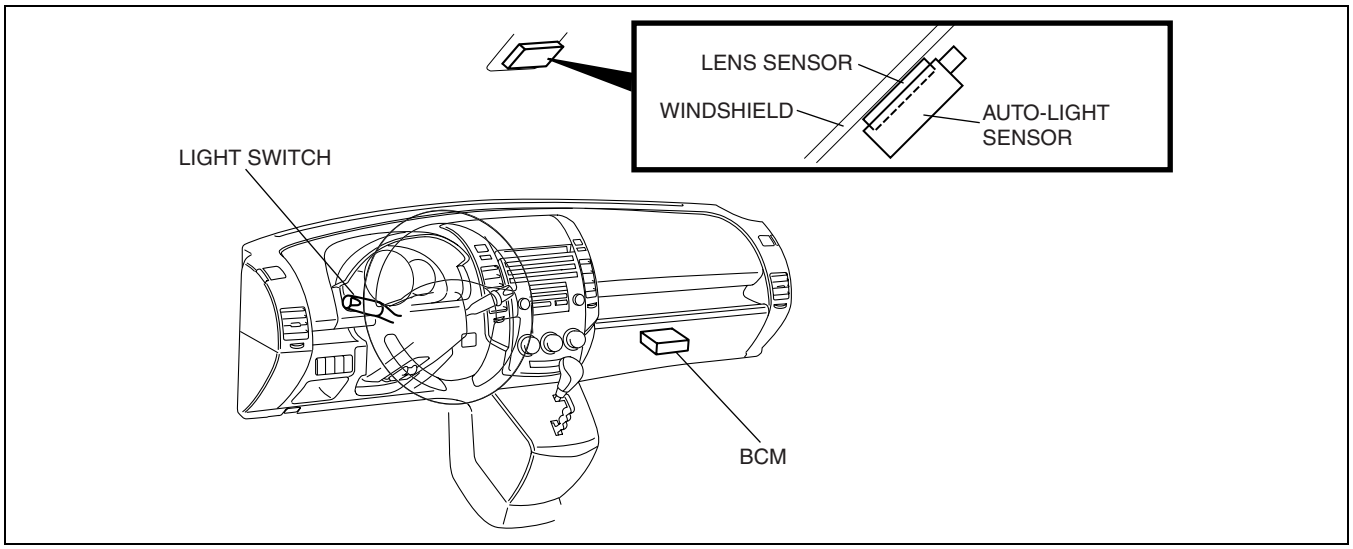
AUTO LIGHT SYSTEM OUTLINE

EPU091866500S01

- An auto light system that automatically and optimally illuminates and turns off the headlights in any situation according to the level of light above and in front of the vehicle has been adopted.

AUTO LIGHT SYSTEM STRUCTURAL VIEW

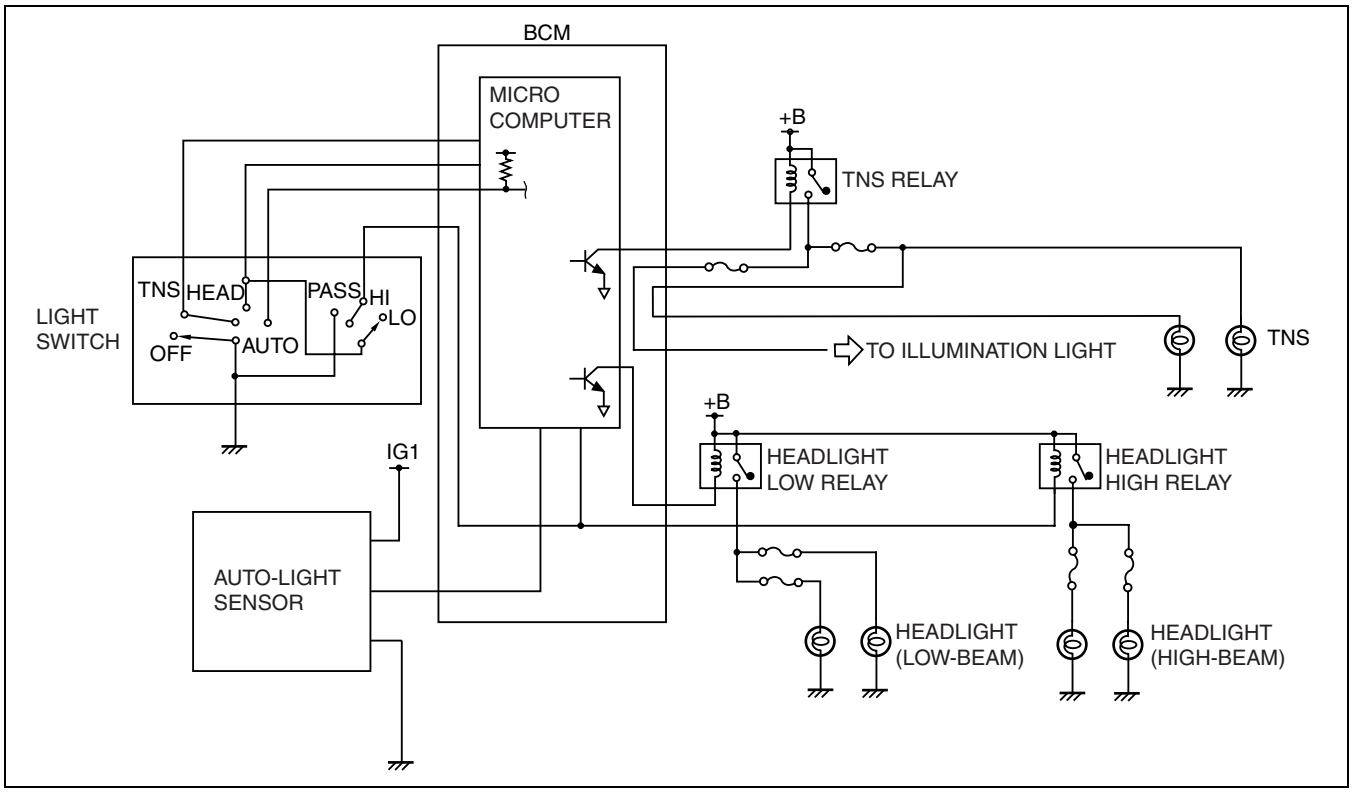
EPU091866500S02



EPU918ZS3003

AUTO LIGHT SYSTEM WIRING DIAGRAM

EPU091866500S03



EPU918ZS3004

AUTO LIGHT SYSTEM OPERATION

EPU091866500S04

Note

- The illumination intensity which operates the auto light system is approximate and a reference. It varies depending on conditions in the surrounding area (Weather, reflection off buildings).

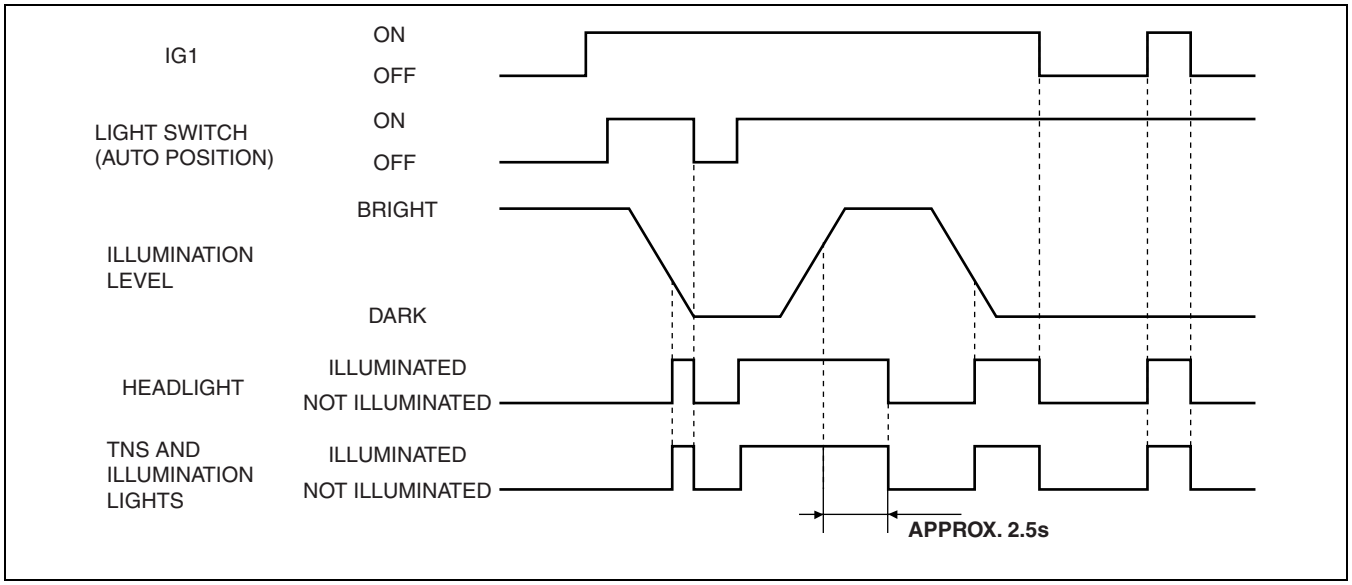
Operation

Illumination condition

- When the ignition switch is turned to the ON position and the light switch is in the AUTO position, the headlight and tail number side lights (TNS) illuminate under the following condition:
  - — The forward and upward illumination level sensors detect **approx. 2000 lux or less**.

Lights off condition

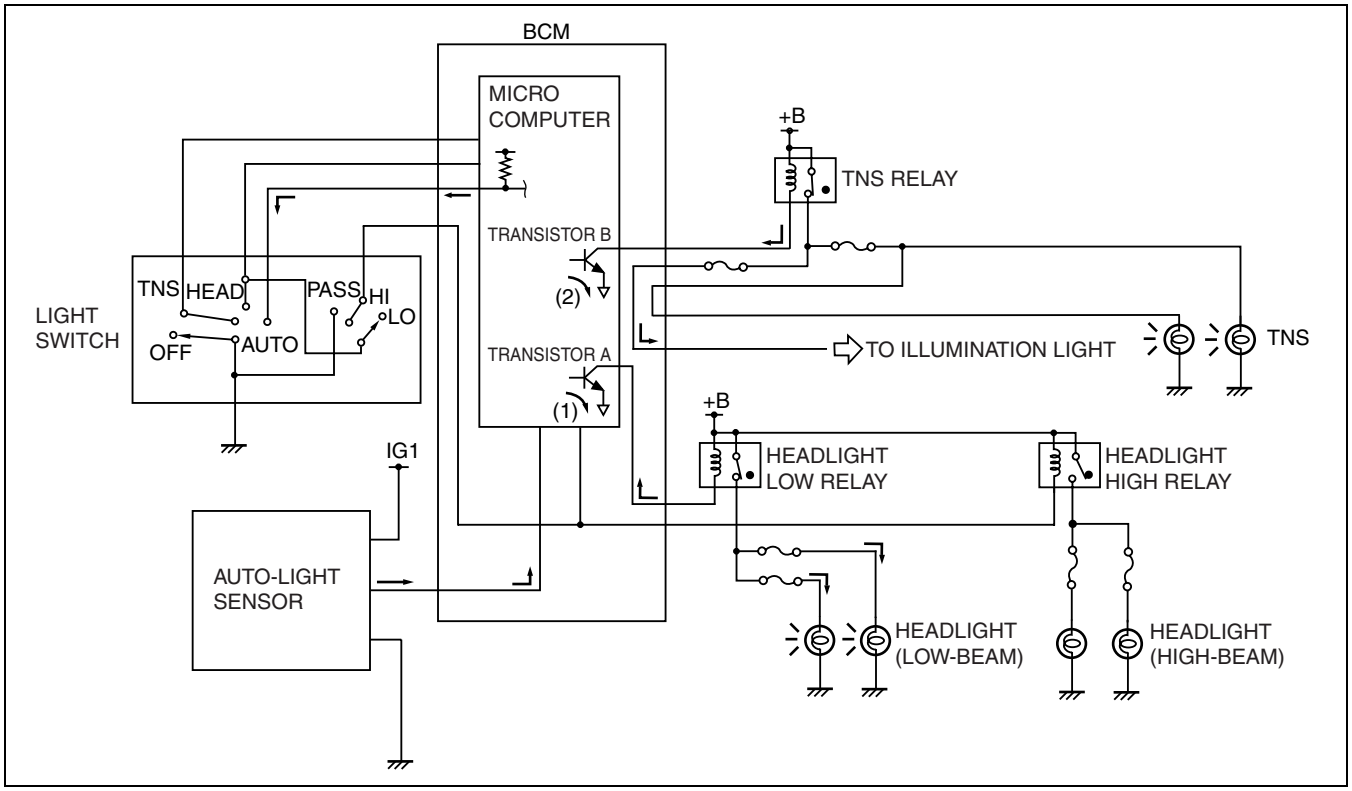
- When the light switch is in the AUTO position, the headlights and TNS turn off under the following conditions:
  — The forward and upward illumination level sensors detect **approx. 4000 lux or more for approx. 2.5 s**.
  — The ignition switch is off.
  — The light switch is in the OFF position.



EPU918ZS3005

Illumination operation

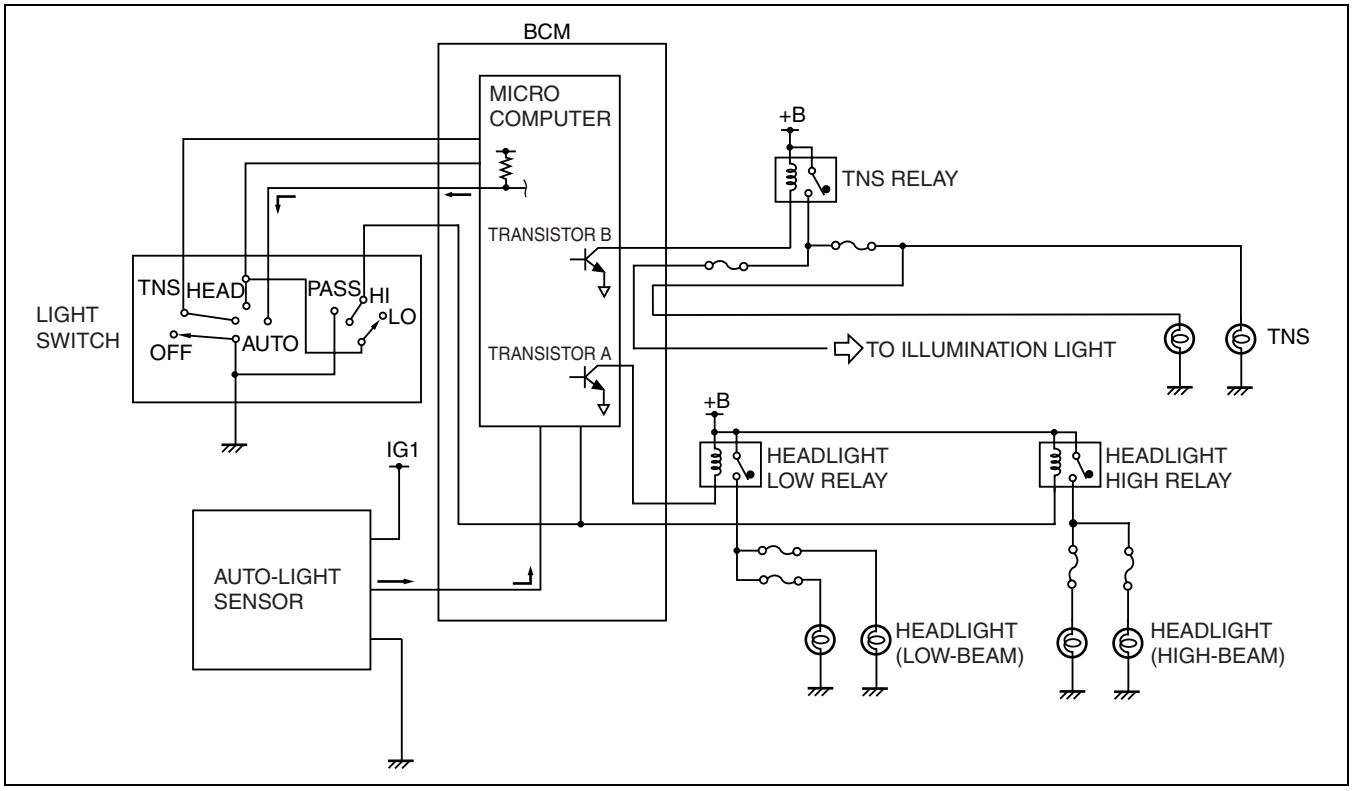
1. When the light switch is in the AUTO position the illumination sensors in the auto light sensor (installed in the windshield) detect the illumination level above and in front of the vehicle.
2. If the upward or forward illumination sensors detect **approx. 2000 lux or less** in front of and above the vehicle, a headlight illumination control signal is sent to the BCM.
3. The microcomputer in the BCM receives the control signal and sends currents (1) and (2) to transistors A and B respectively, causing the transistors to turn on.
4. When transistors A and B turn on, the headlight LO and TNS relays also turn on. At the same time, the headlights (low-beam) and TNS illuminate.



EPU918ZS3006

Lights off operation

1. When the light switch is in the AUTO position the illumination level sensors in the auto light sensor (installed in the windshield) detect the illumination level above and in front of the vehicle.
2. If the upward and forward illumination level sensor detect **approx. 4000 lux or more for 2.5 s** in front of and above the vehicle, a headlight off control signal is sent to the BCM.
3. The microcomputer in the BCM receives the control signal and turns off the currents to transistors A and B, causing the headlight (low-beam) and TNS relays to also turn off.
4. When the headlight LO and TNS relays turn off, the headlights (low-beam) and TNS also turn off.



EPU918ZS3007

AUTO LIGHT SENSOR FUNCTION

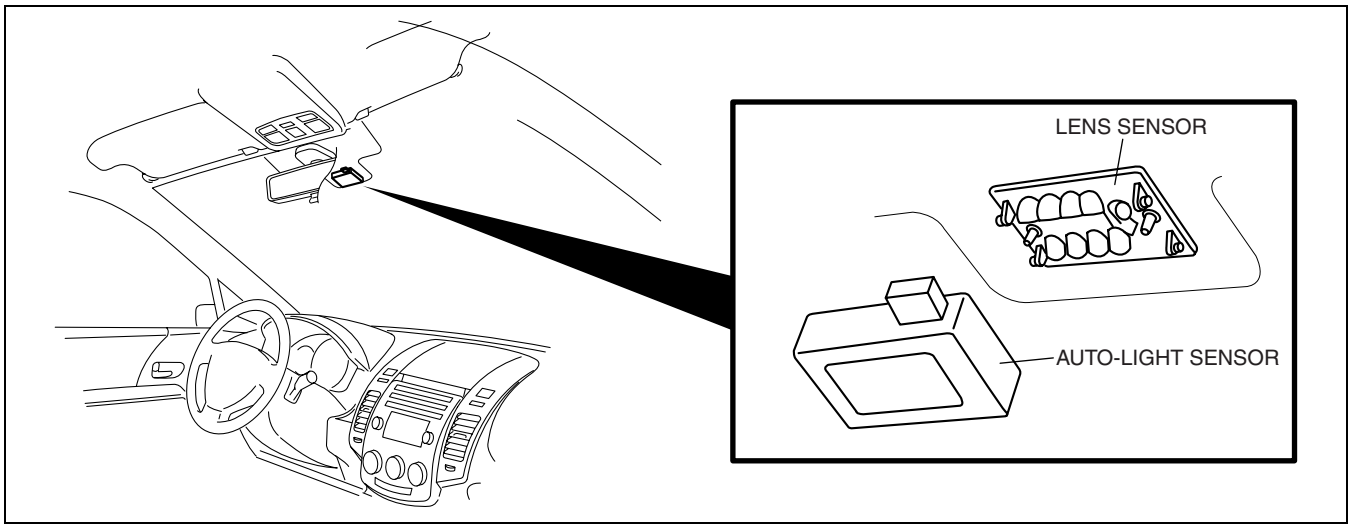
EPU091866500S05

- The auto light sensor contains upward and forward illumination sensors which detect the level of illumination above and in front of the vehicle respectively.
- If the forward illumination level sensor detects a bright level of illumination in front of the vehicle and the upward illumination level sensor detects a dark level when the headlights are on, the microcomputer in the auto light sensor prepares for turning off the lights. If both illumination level sensors detect that is necessary to turn off the headlights, they are turned off with optimal timing.
- If the forward illumination level sensor detects a dark level of illumination in front of the vehicle and the upward illumination level sensor detects a bright level when the headlights are off, the microcomputer in the auto light sensor prepares for turning on the lights If both illumination level sensors detect that is necessary to turn on the headlights, they are turned on with optimal timing.

AUTO LIGHT SENSOR OPERATION

EPU091866500S06

- Installed on the underside of the rearview mirror (windshield center) and integrated with the rain sensor as a single unit.



EPU918ZS3008

- The upward and forward illumination level sensors which detect the level of illumination above and in front of the vehicle respectively are built-in.

Function Description

Illumination level adjustment function

- The illumination level sensitivity can be switched between two levels using the WDS or equivalent.

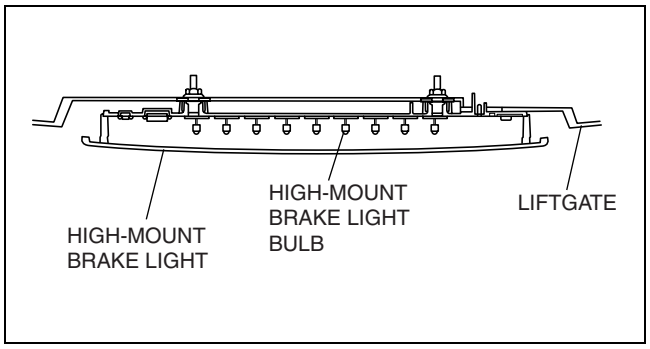
On-board diagnostic function

- If the voltage input to the auto-light sensor is not within the operational voltage (**approx. 9—16 V**), the BCM is informed of the malfunction and a BCM DTC is detected.

HIGH-MOUNT BRAKE LIGHT CONSTRUCTION

EPU091851580S01

- Installed to the liftgate with nuts.
- Using LED has resulted in reduced energy consumption.

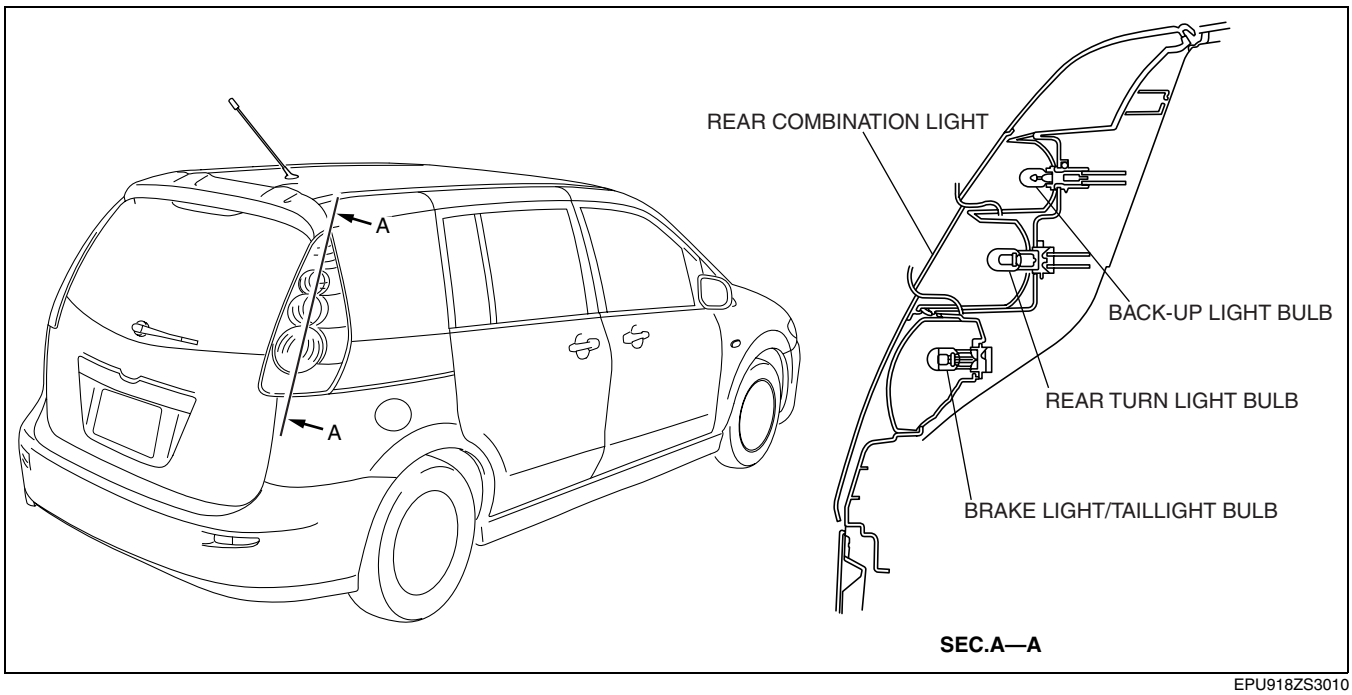


EPU918ZS3009

REAR COMBINATION LIGHT CONSTRUCTION

EPU091851150S01

- A step reflector that diffuses and reflects the light of the rear combination light bulbs, has been adopted. A flat, uncut lens has been adopted to control illumination distribution.
- A round reflector for the rear combination lights has been adopted to improve design.

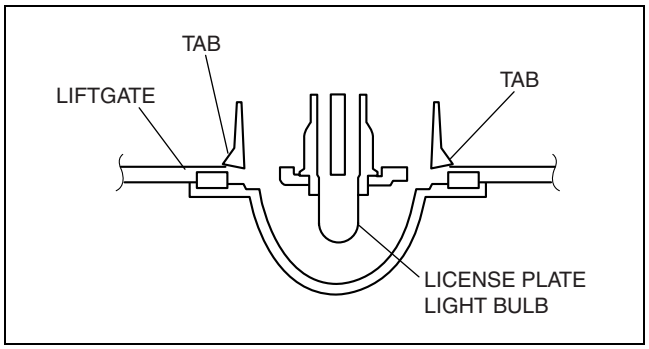


EPU918ZS3010

LICENSE PLATE LIGHT CONSTRUCTION

- Installed to the liftgate with the connecting tabs

EPU091851270S01



EPU918ZS3011

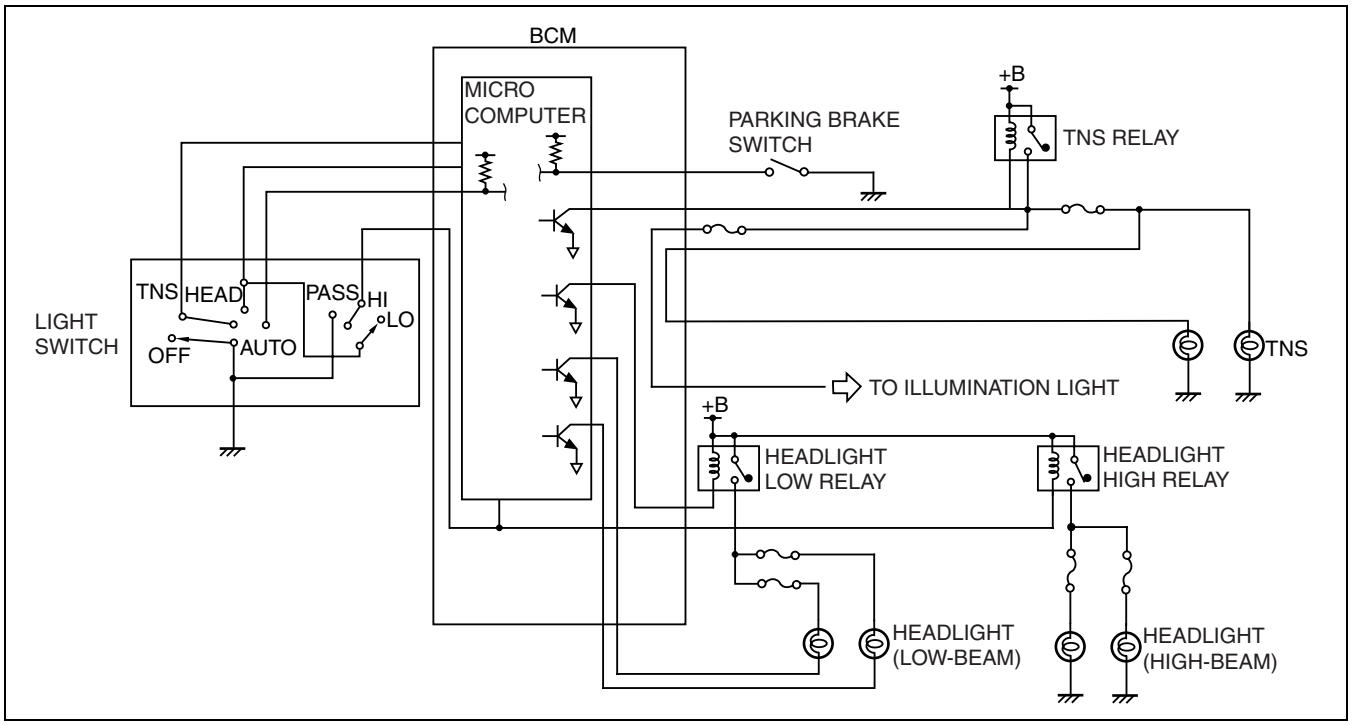
DRL SYSTEM OUTLINE

EPU091800200S01

- The DRL system automatically operates the low-beam headlights when the ignition switch is turned to the ON position and the parking brake is released.

DRL SYSTEM WIRING DIAGRAM

EPU091800200S02



EPU918ZS3012

DRL SYSTEM OPERATION

EPU091800200S03

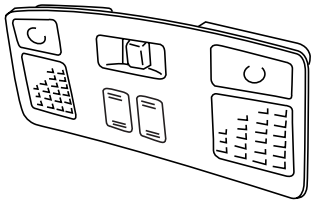
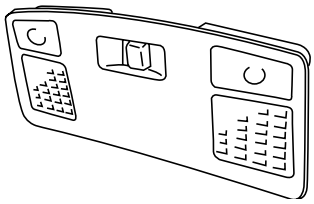
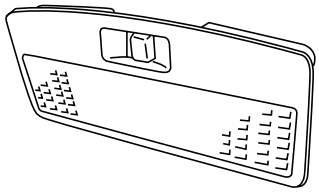
Operation condition (Input signal)					Operation condition of illumination (Output signal)		
Ignition switch	Parking brake switch	Light switch		Flash-to-pass switch	Low-beam headlight	High-beam headlight	Front fog light
ON	OFF	OFF TNS	LOW	OFF	Iluminates (DRL)	-	-
			HIGH		Iluminates (DRL)	-	-
	ON	OFF TNS	LOW		-	-	-
			HIGH		-	-	-
	-	Headlight	LOW		Iluminates	-	Iluminates
			HIGH		Iluminates	Iluminates	-
-	-	-		ON	Iluminates	Iluminates	-

INTERIOR LIGHTING SYSTEM CONSTRUCTION

EPU091851311S01

- The map and interior lights settings are controlled by the interior light control system.

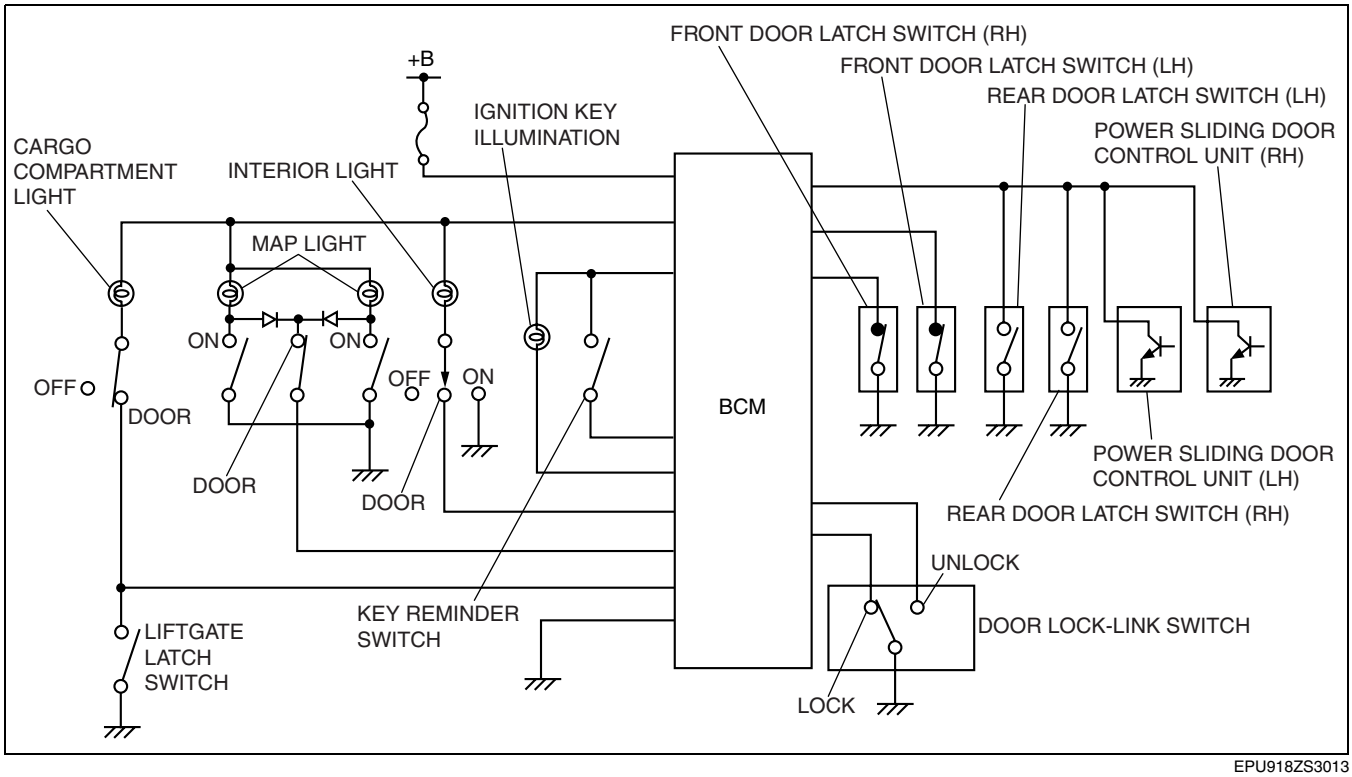
×: Equipped

Type		Installation position	Interior light control system	Roof
Map light		Front	×	Sunroof
				Normal roof
Interior light		Rear		Both

ROOM LIGHT CONTROL SYSTEM FUNCTION

EPU091851311S02

- The BCM changes the illumination condition and illumination level of the map light (Door position), and the interior light (Door position) according to whether the doors are opened or closed.



EPU918ZS3013

ROOM LIGHT CONTROL SYSTEM OPERATION

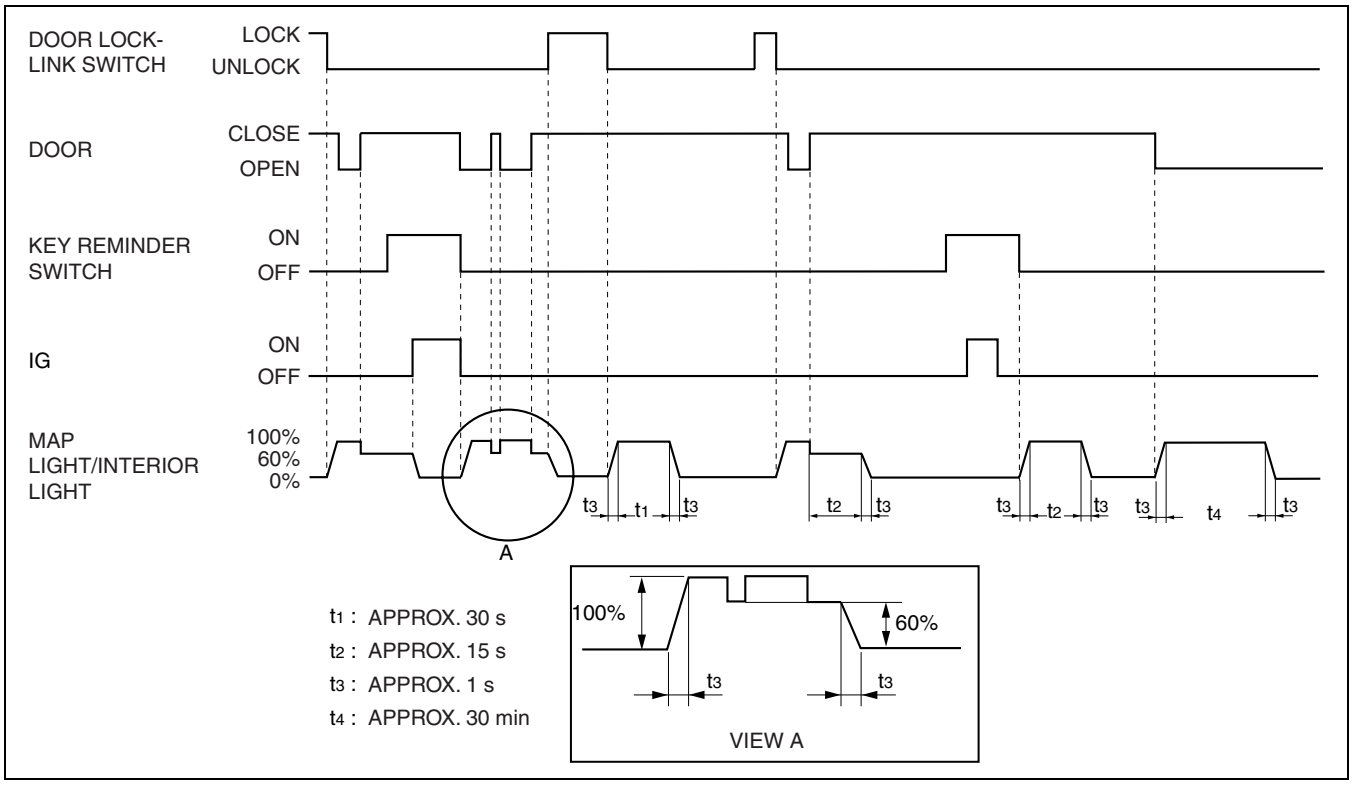
EPU091851311S03

Conditions before operation (Conditions which must be satisfied)	Operation condition	Interior light		Cancel condition (When any condition satisfied)
		Illumination time	Brightness	
• Turn the ignition switch to the LOCK or ACC position. • All doors are closed. (All door latch switches on, door switches off)	Any door open. (Any door latch switch off, door switch on)	Approx.30 min	100 %	• All doors are closed except liftgate. (All door latch switches on, door switches off) • After illumination time.*1
• Key extracted from steering lock. (Key reminder switch is off.) • All doors are closed. (All door latch switches on, door switches off) • Driver's door lock knob is locked. (Door lock-link switch is in lock position.)	Driver's door lock knob is unlocked. (Door lock-link switch is in unlock position.)	Approx.30 s	100 %	• Turn the ignition switch to the ON position. • Any door open. (Any door latch switch off, door switch on) • Driver's door lock knob is locked. (Door lock-link switch is in lock position.) • After illumination time.*1
• Key inserted into steering lock. (Key reminder switch is on.) • All doors are closed. (All door latch switches on, door switches off)	Key extracted from steering lock. (Key reminder switch is off.)	Approx.15 s	100 %	• Turn the ignition switch to the ON position. • Any door open. (Any door latch switch off, door switch on) • Driver's door lock knob is locked. (Door lock-link switch is in lock position.) • After illumination time.*1
• Turn the ignition switch to the LOCK or ACC position. • Any door is open. (Any door latch switch off, door switches on) • Driver's door lock knob is unlocked. (Door lock-link switch is in unlock position.)	All doors are closed. (All door latch switches on, door switches off)	Approx.15 s	60 %	• Turn the ignition switch to the ON position. • Any door open. (Any door latch switch off, door switch on) • Driver's door lock knob is locked. (Door lock-link switch is in lock position.) • After illumination time.*1

*1 : After interior light is turned off according to this cancel condition, the light will illuminate again when either of the following conditions are satisfied:

- After all doors are closed, then any door is reopened.
  (After all door latch switches are on and door switches are off, any door latch switch is off and door switch is on)

- After all doors are closed, then ignition switch is at the ON position. (IG ON)

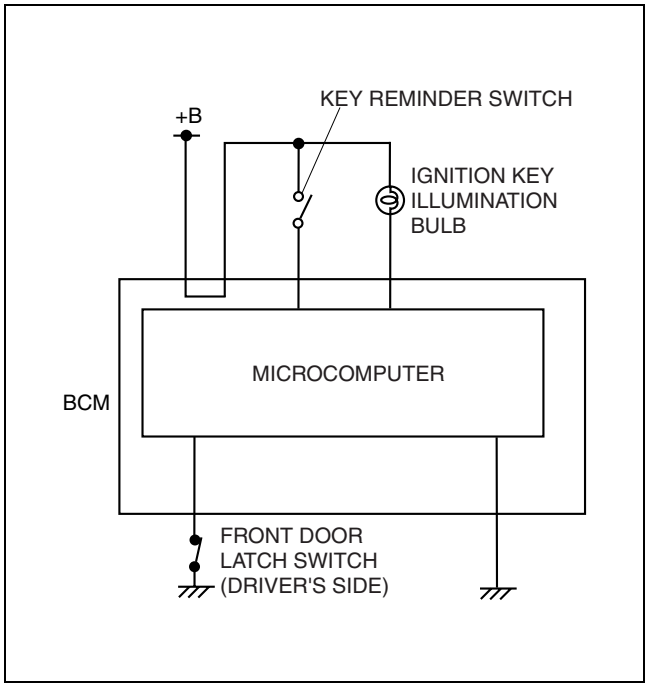


EPU918ZS3014

IGNITION KEY ILLUMINATION FUNCTION

EPU091851311S04

- The illumination time of the ignition key illumination is controlled by the microcomputer in the BCM.
- When the ignition switch is in the LOCK position (or ACC) position and the driver's door is open, the ignition key illumination is illuminated.



EPU918ZS3015

IGNITION KEY ILLUMINATION OPERATION

EPU091851311S05

Illumination Condition

- The ignition key illumination glows under all of the following conditions:
  - — Driver-side door is open. (Driver-side latch switch is on.)
  - — Ignition switch is in the LOCK or ACC position. (IG off)

Cancel Condition

- The ignition key illumination goes out under any of the following conditions:
  - — 15 s have elapsed since the driver's door was closed (After driver's door latch switch is on).
  - — Ignition switch is in the ON position. (IG on)
  - — With all the doors closed, a lock signal from the keyless entry is received.
  - — Approx. 30 min have elapsed since the driver's door open (Driver's door latch switch is off)

STEERING ANGLE SENSOR FUNCTION

EPU091866120S01

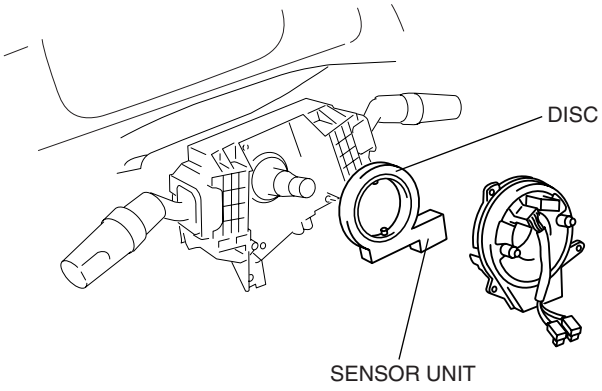
- The steering angle sensor is built into the combination switch and transmits steering angle (amount of position change) signals to each unit.

STEERING ANGLE SENSOR CONSTRUCTION

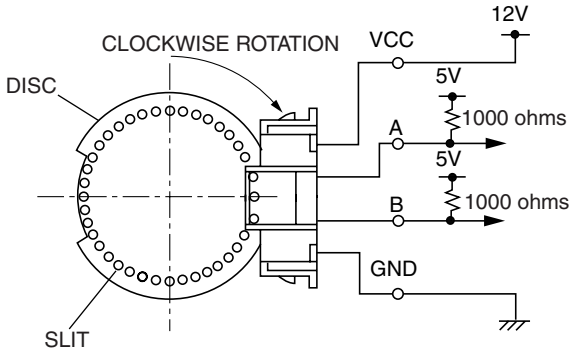
EPU091866120S02

- The steering angle sensor has a sensor unit with a photo transistor positioned opposite an LED straddling a slitted disc that moves together with the steering wheel.
- As the disc moves with the steering wheel, the LED light received by the photo transistor varies due to the slits on the disc. The photo transistor reads the variation and outputs a signal. Each unit calculates the steering angle and speed based on the phase difference between sensor A and B outputs.

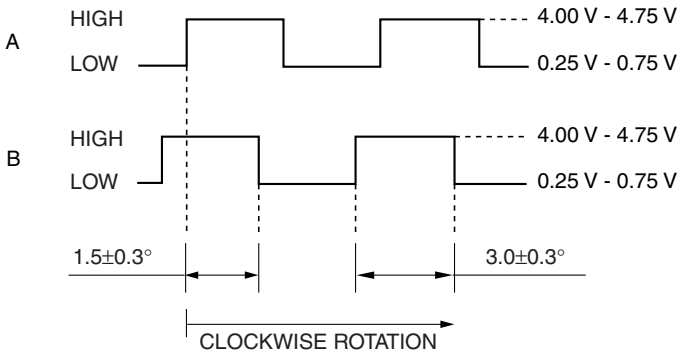
INSTALLATION POSITION



STRUCTURAL VIEW



OUTPUT WAVE PATTERN



EPU918ZS3016

09–19 WIPER/WASHER SYSTEM

WIPER/WASHER OUTLINE 09–19–1
WASHER TANK SPECIFICATION 09–19–1
WIPER/WASHER SYSTEM STRUCTURAL VIEW 09–19–2
WINDSHIELD WIPER SYSTEM OUTLINE 09–19–2
WINDSHIELD WIPER SYSTEM WIRING DIAGRAM 09–19–3
WINDSHIELD WIPER SYSTEM OPERATION 09–19–4
Continuous Operation **09–19–4**
Autostop Operation **09–19–5**
One-touch Wiper Operation **09–19–6**
Intermittent Wiper Operation **09–19–7**
Synchronized Washer And Wiper Operation **09–19–8**
REAR WIPER SYSTEM OUTLINE 09–19–8
REAR WIPER SYSTEM WIRING DIAGRAM 09–19–9
REAR WIPER SYSTEM OPERATION 09–19–10
Continuous Operation **09–19–10**
Autostop Operation **09–19–11**
Intermittent Wiper Operation **09–19–12**
Synchronized Washer And Wiper Operation **09–19–13**
AUTO WIPER SYSTEM OUTLINE 09–19–14
AUTO WIPER SYSTEM STRUCTURAL VIEW 09–19–14
AUTO WIPER SYSTEM WIRING DIAGRAM 09–19–15
AUTO WIPER SYSTEM OPERATION 09–19–16
Intermittent Operation **09–19–16**
RAIN SENSOR FUNCTION 09–19–17
Rainfall detection function **09–19–17**
Sensitivity Adjustment Function **09–19–17**
Initial Setting Function **09–19–17**
On-board Diagnostic Function **09–19–17**
Fail-Safe Function **09–19–17**
RAIN SENSOR CONSTRUCTION/OPERATION 09–19–17
Operation With No Rainfall Contacting Windshield **09–19–18**
Operation With Rainfall Contacting Windshield **09–19–18**
WASHER FLUID-LEVEL SENSOR FUNCTION 09–19–19

WIPER/WASHER OUTLINE

EPU091900000S01

Improved convenience	• A washer fluid-level sensor is installed in the windshield washer tank.
Improved marketability	• Auto wiper system adopted which enables fully automatic windshield wiper operation

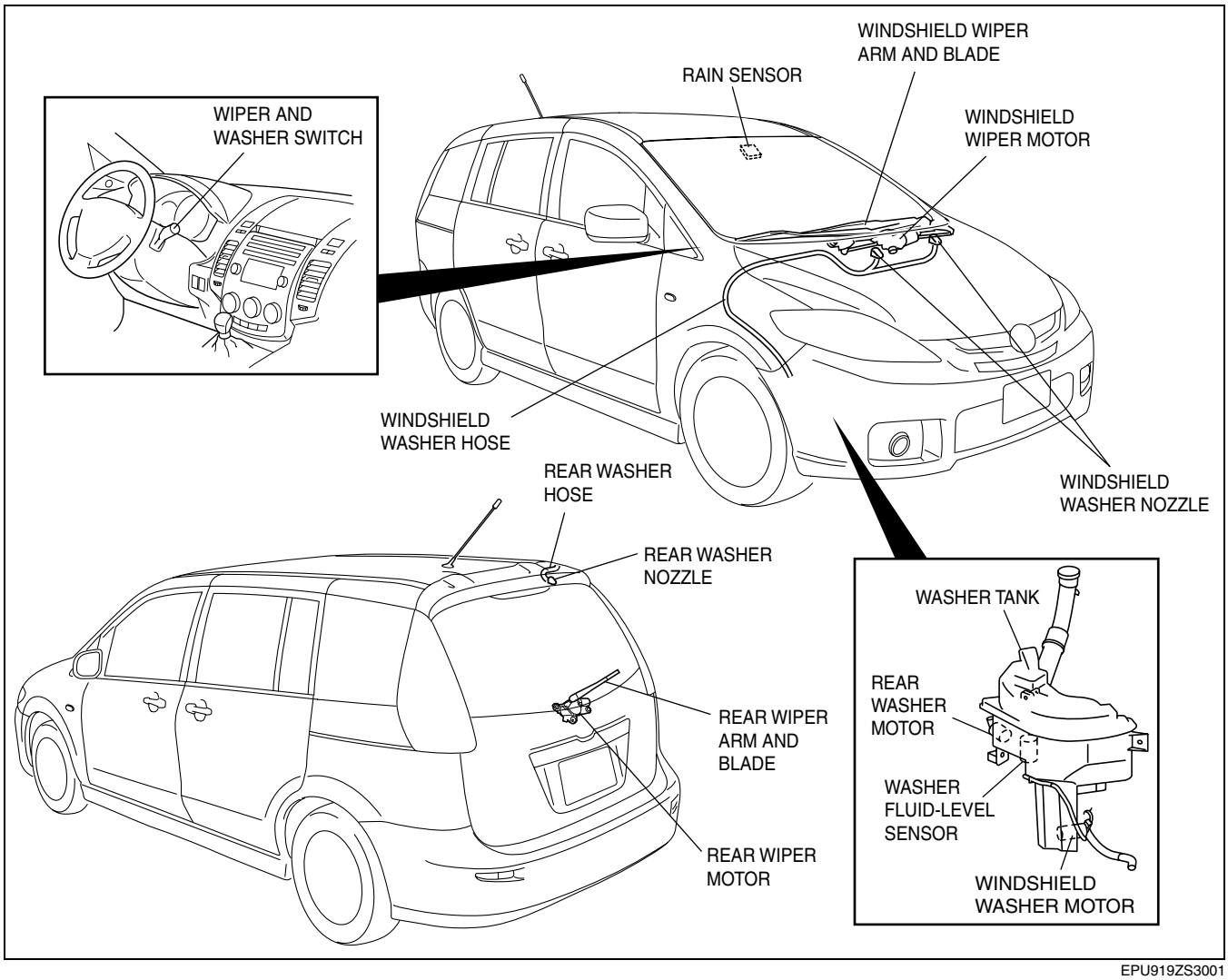
WASHER TANK SPECIFICATION

EPU091900000S02

Item	Vehicles with the washer fluid-level sensor	Vehicles without the washer fluid-level sensor
Washer tank capacity	4.0 L {4.2 US qt, 3.5 Imp qt}	2.5 L {2.6 US qt, 2.2 Imp qt}

WIPER/WASHER SYSTEM STRUCTURAL VIEW

EPU091900000S03



EPU919ZS3001

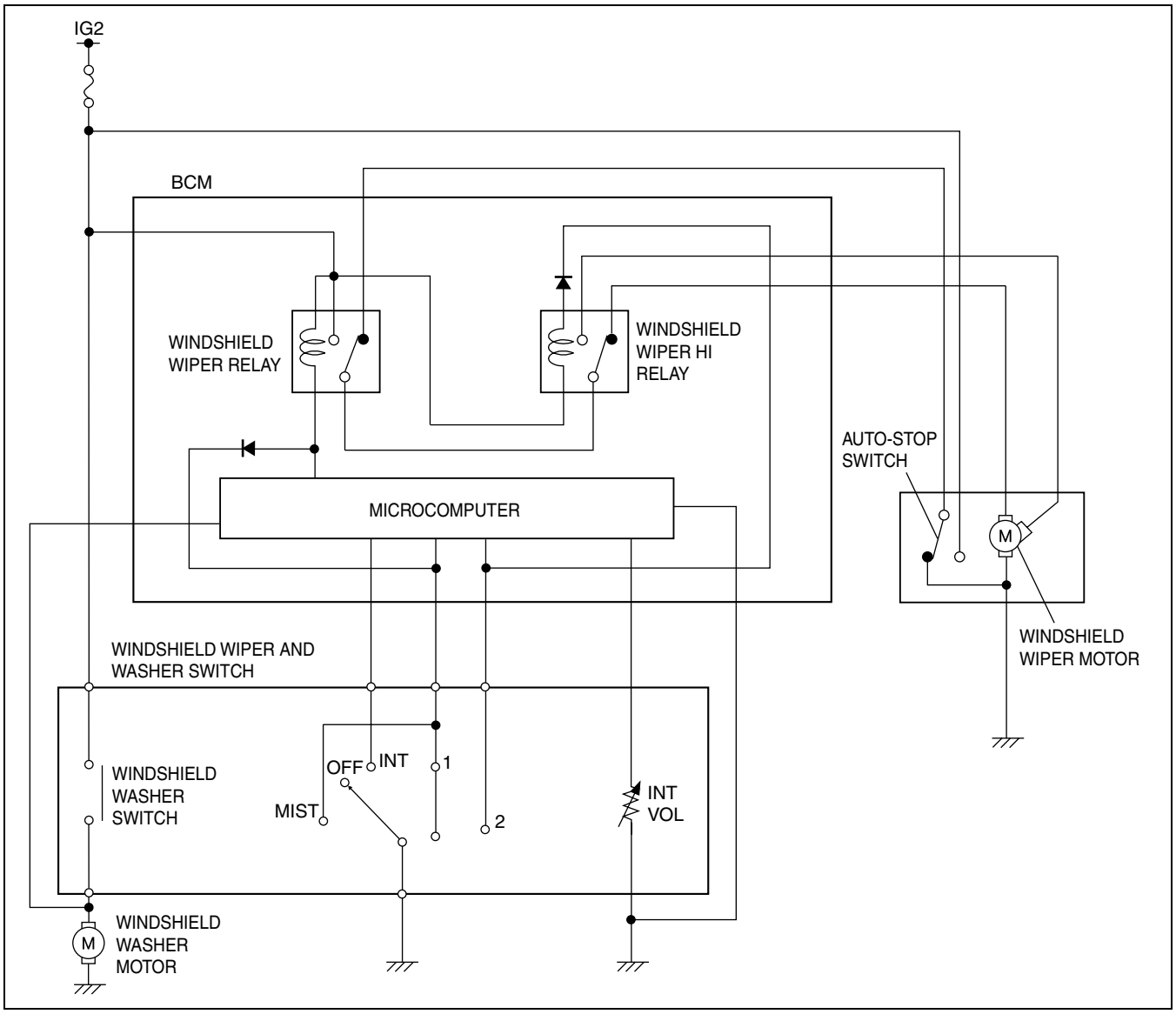
WINDSHIELD WIPER SYSTEM OUTLINE

EPU091900000S04

- The windshield wiper system has auto-stop function, one-touch function, intermittent function, and synchronized washer and wiper function with various timings.

WINDSHIELD WIPER SYSTEM WIRING DIAGRAM

EPU091900000S05



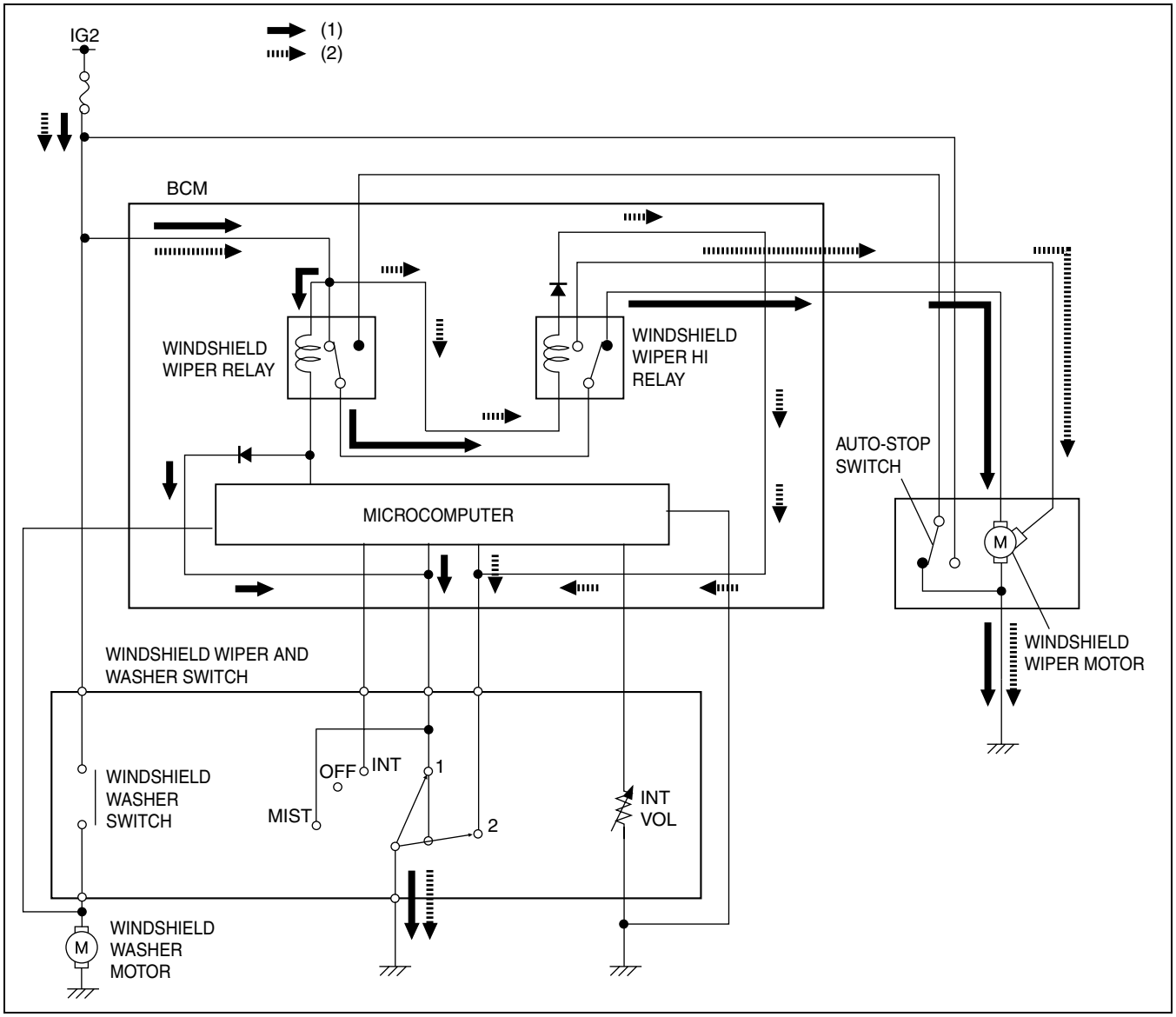
EPU919ZS3002

WINDSHIELD WIPER SYSTEM OPERATION

EPU091900000S06

Continuous Operation

1. When the windshield wiper switch is turned to 1, current (1) flows, and the windshield wiper motor operates at low speed.
2. When the windshield wiper switch is turned to 2, current (2) flows, and the windshield wiper motor operates at high speed.

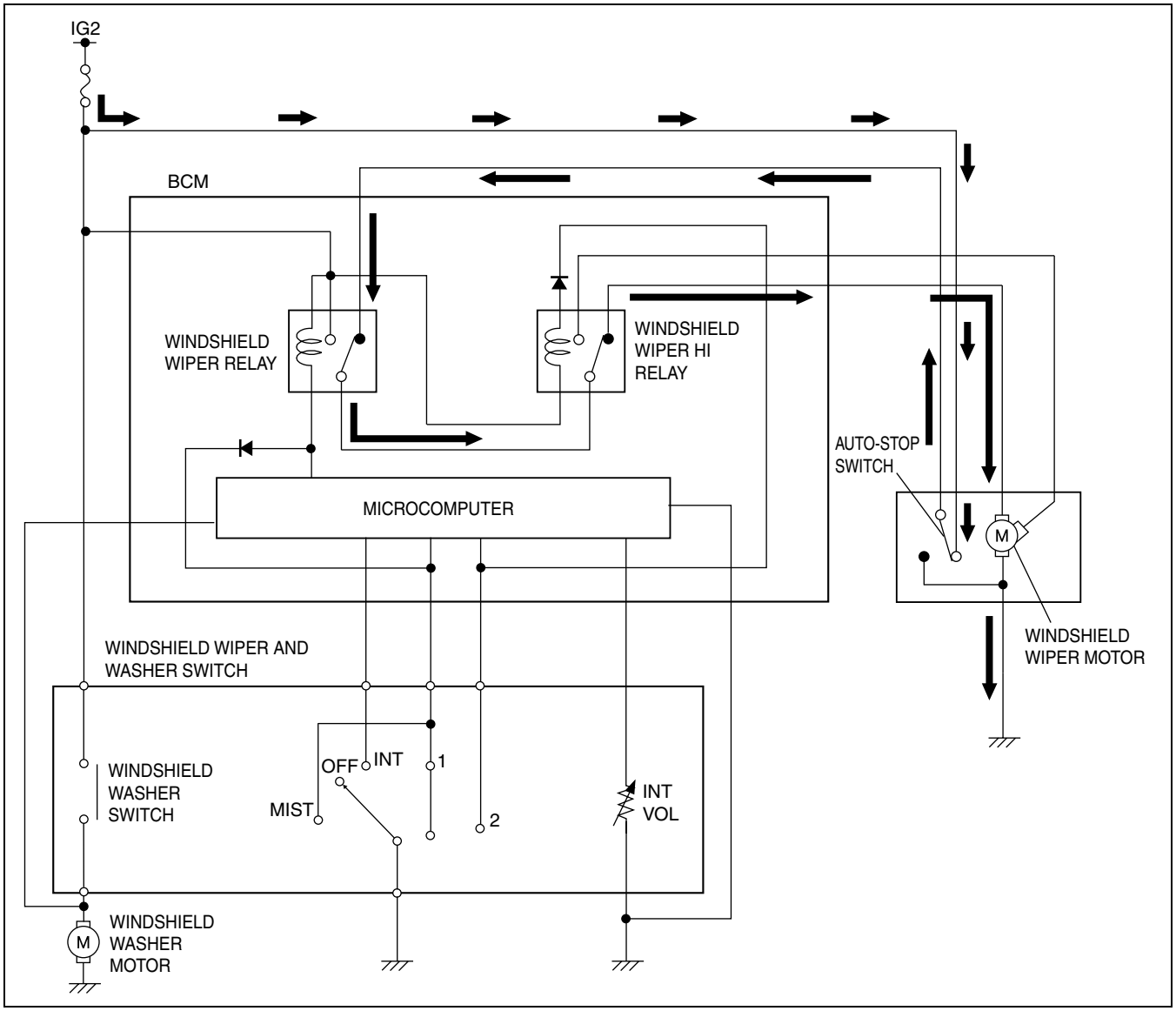


EPU919ZS3003

3. When the windshield wiper switch is turned to the OFF position, the wipers stop in the park position due to the autostop operation.

Autostop Operation

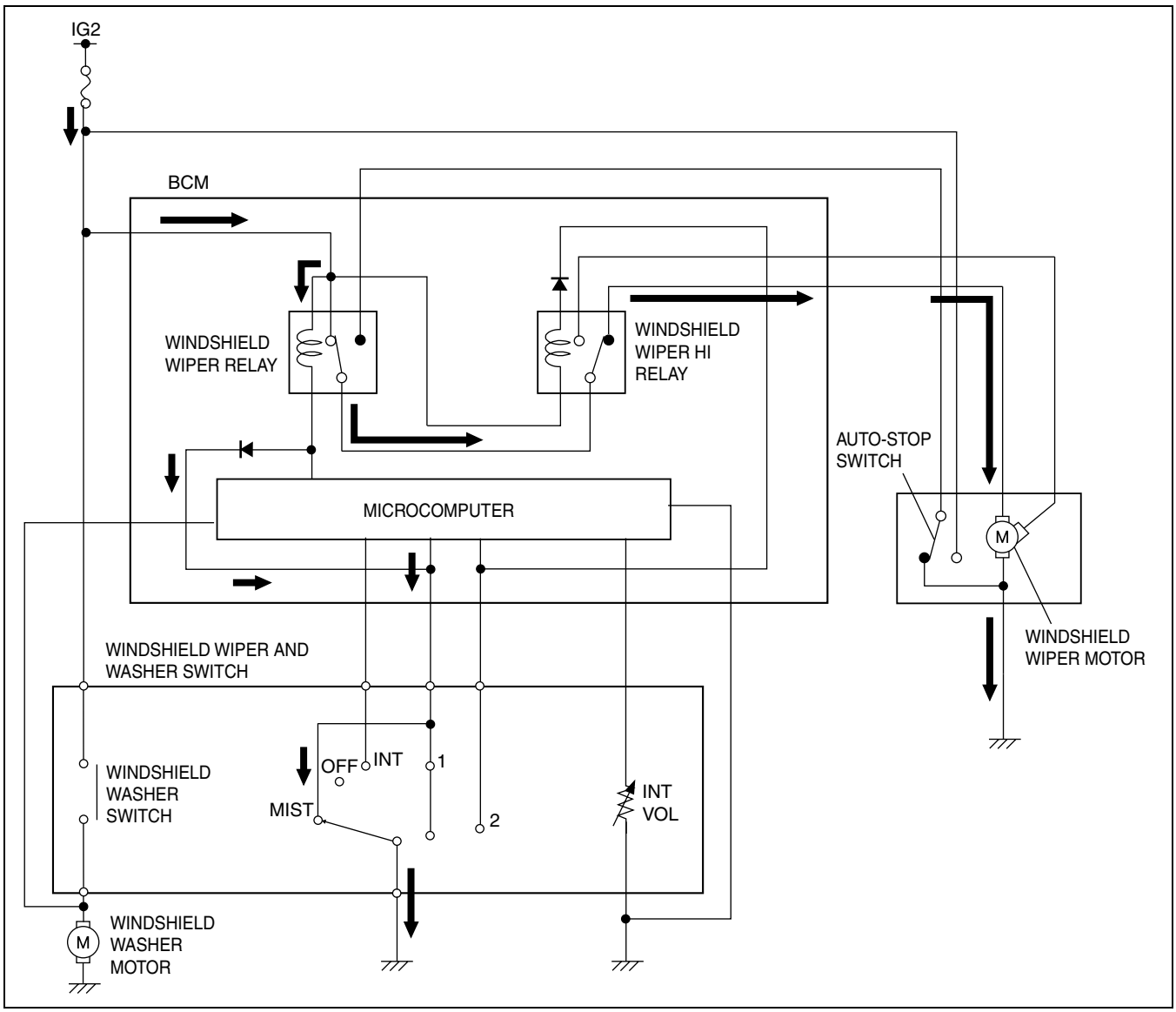
1. When the windshield wiper switch is turned to the OFF position while the wipers are operating, current flows to the autostop switch, which is on, and the windshield wiper motor operates until it returns to the park position, stopping the wipers.



EPU919ZS3004

One-touch Wiper Operation

1. When the windshield wiper lever is pulled up, the one-touch switch is on and the current flows, causing the windshield wiper motor to operate at low speed.

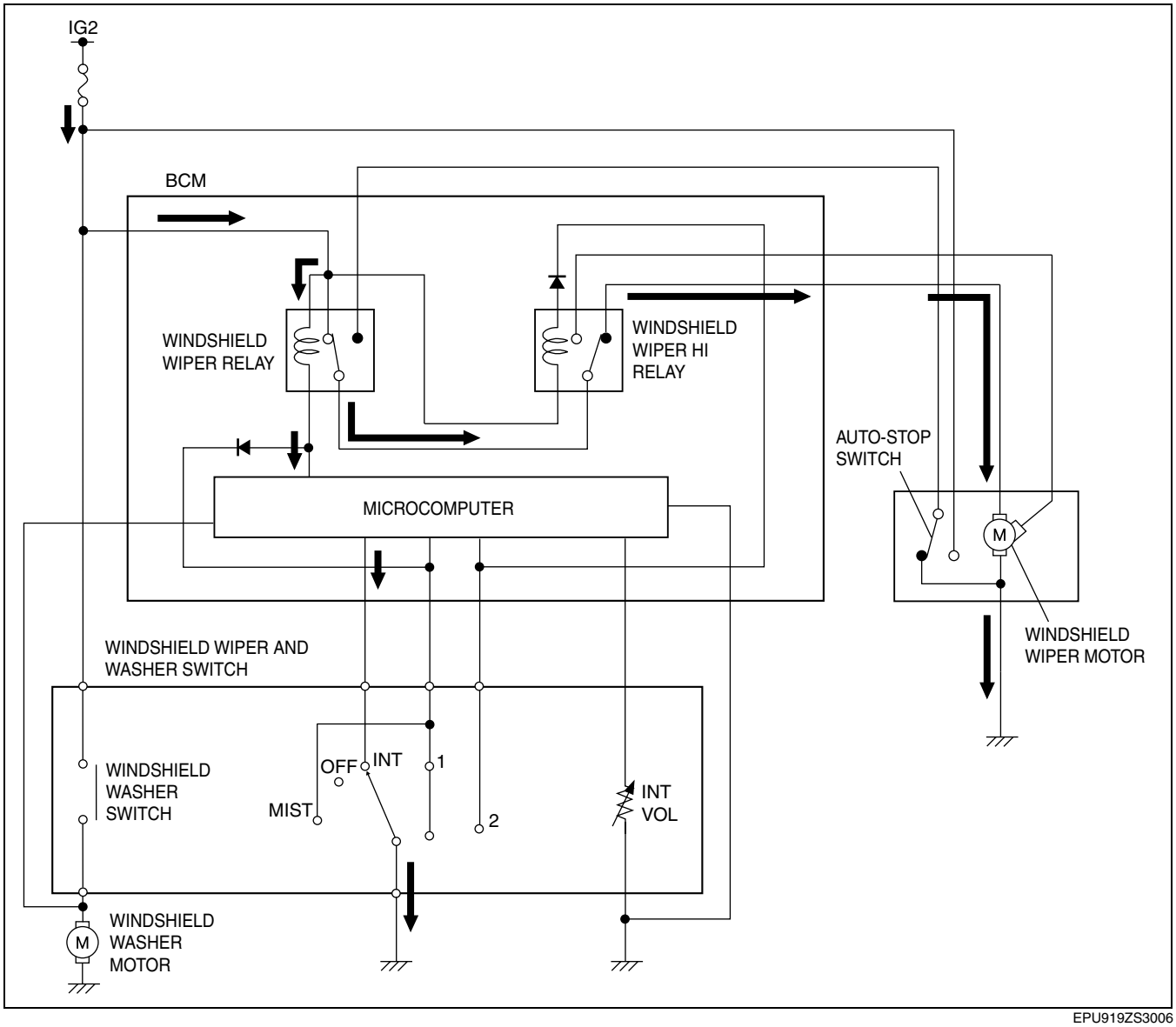


EPU919ZS3005

2. The windshield wipers operate at low speed while the windshield wiper lever is pulled up. When the windshield wiper lever is released, the wipers stop in the park position due to the autostop operation.

Intermittent Wiper Operation

1. When the windshield wiper switch is turned to the INT position, current flows to the windshield wiper motor due to a control signal from the microcomputer in the BCM, and the windshield wiper motor operates at low speed.

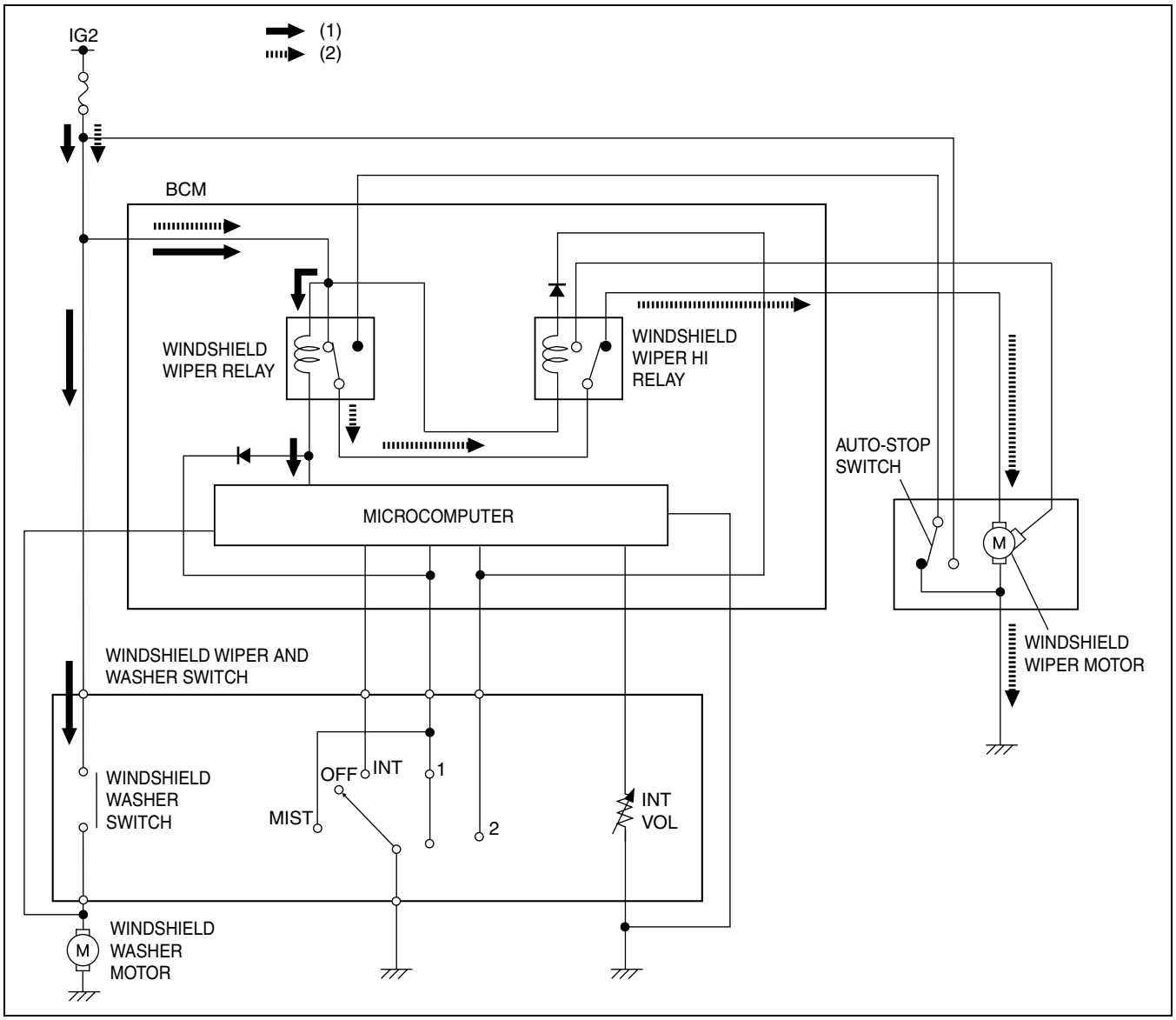


EPU919ZS3006

2. When a pre-set time has passed, current is stopped due to a control signal from the microcomputer in the BCM. Accordingly, current flow to the windshield wiper motor ceases, causing the wipers to stop at the park position due to the autostop operation. This sequence repeats causing the wipers to operate intermittently.
3. The windshield wipers operation timing (INT relay OFF to ON) during intermittent operation can be set freely using the INT volume switch.

Synchronized Washer And Wiper Operation

1. When the windshield washer switch is turned on, current (1) flows and the windshield washer motor operates, and washer fluid is sprayed. At the same time, a washer motor operation signal is sent to the INT relay causing the relay to turn on, current (2) to flow, and the windshield wiper motor to operate at low speed.



EPU919ZS3007

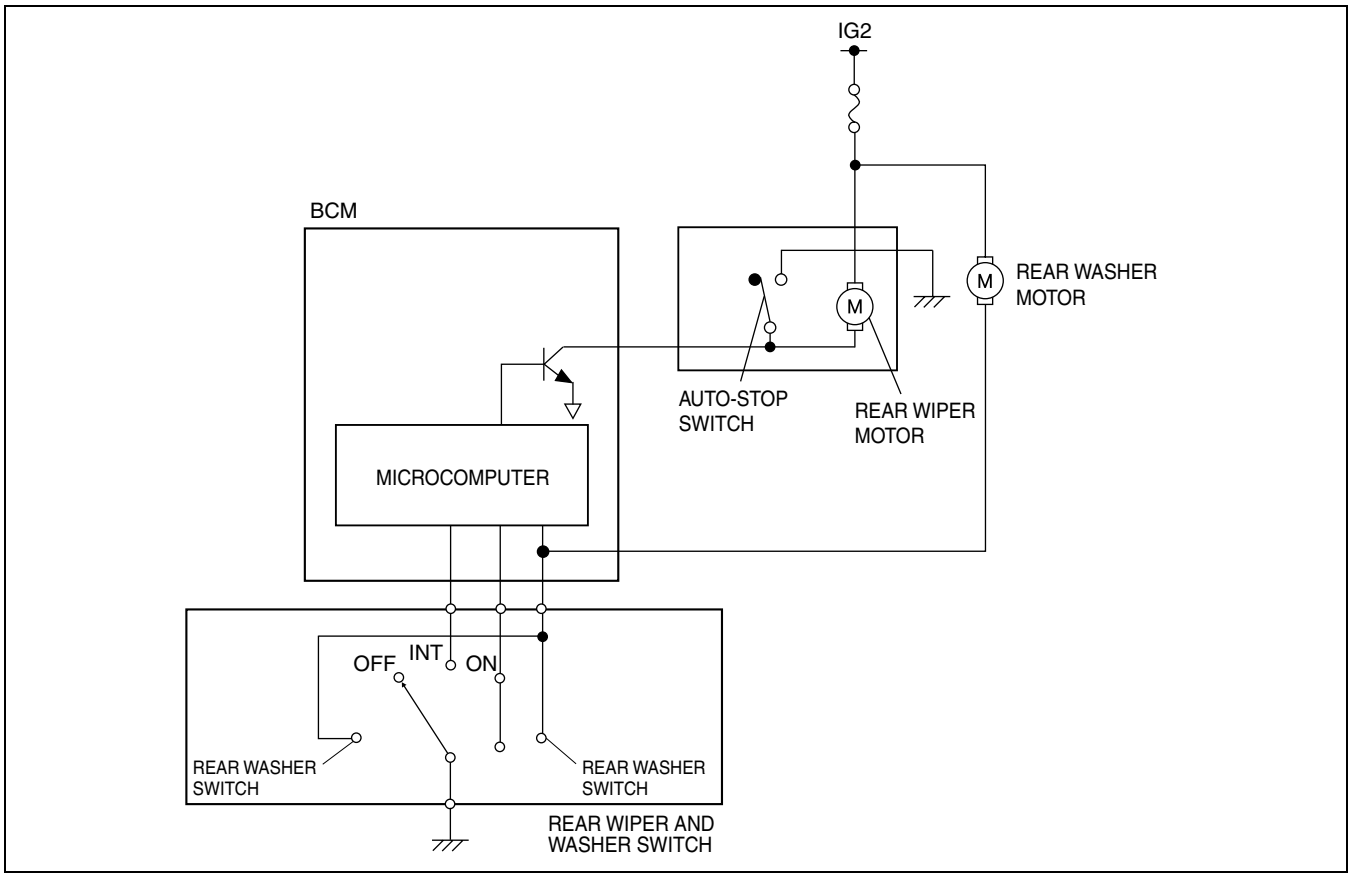
REAR WIPER SYSTEM OUTLINE

EPU091900000S07

- The rear wiper system has auto-stop function, one-touch function, intermittent function, and synchronized washer and wiper function.

REAR WIPER SYSTEM WIRING DIAGRAM

EPU091900000S08



EPU919ZS3008

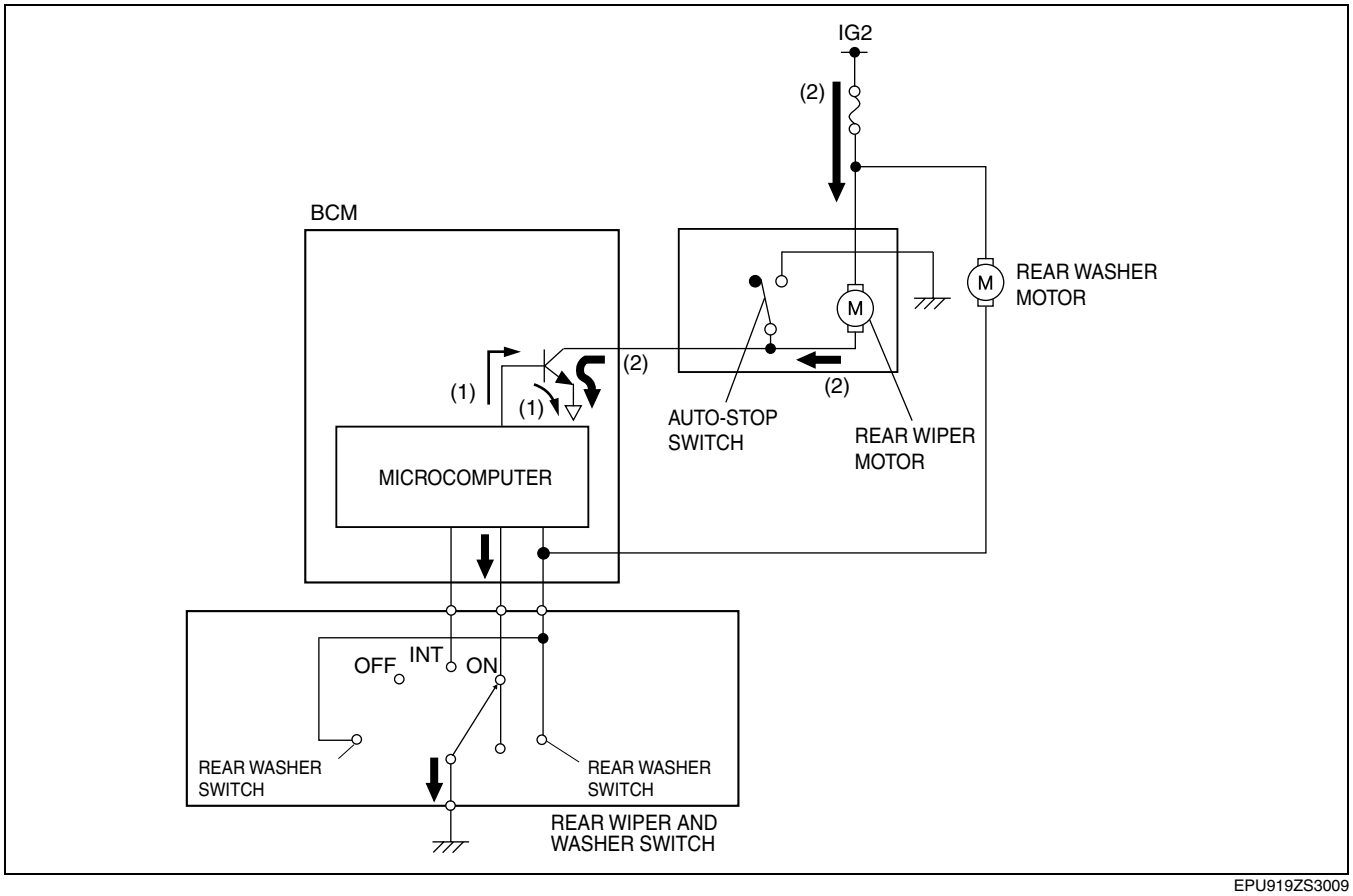
REAR WIPER SYSTEM OPERATION

EPU091900000S09

Continuous Operation

1. When the rear wiper switch is turned to the ON position, control signal (1) is output from the microcomputer in the BCM, and the transistor is turned on.
2. When the transistor is on, current (2) flows to the rear wiper motor and continuous operation starts.

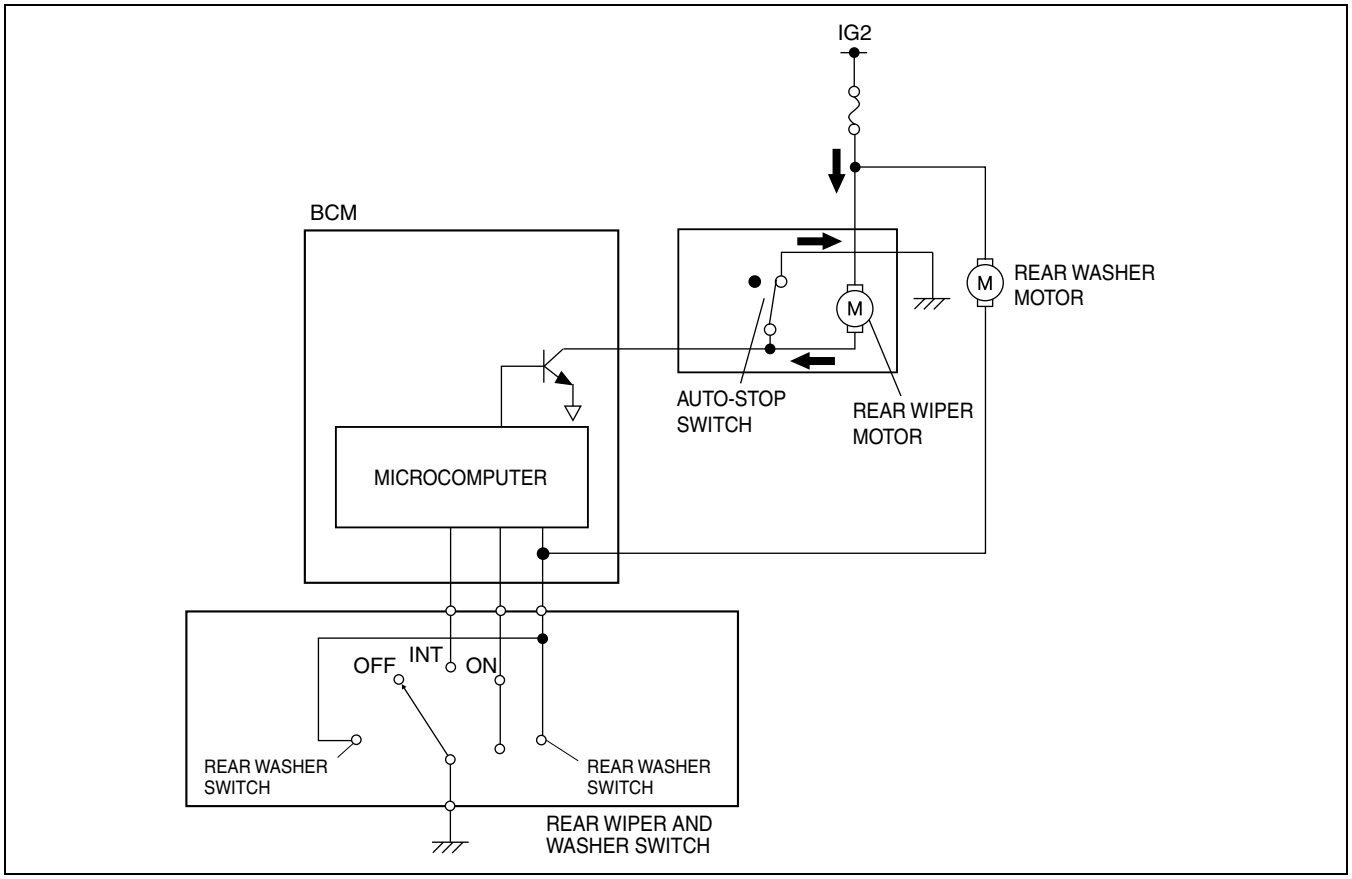
- When the rear wiper switch is turned to the OFF position while the rear wiper is operating, the rear wiper motor performs an autostop and stops in the park position.



EPU919ZS3009

Autostop Operation

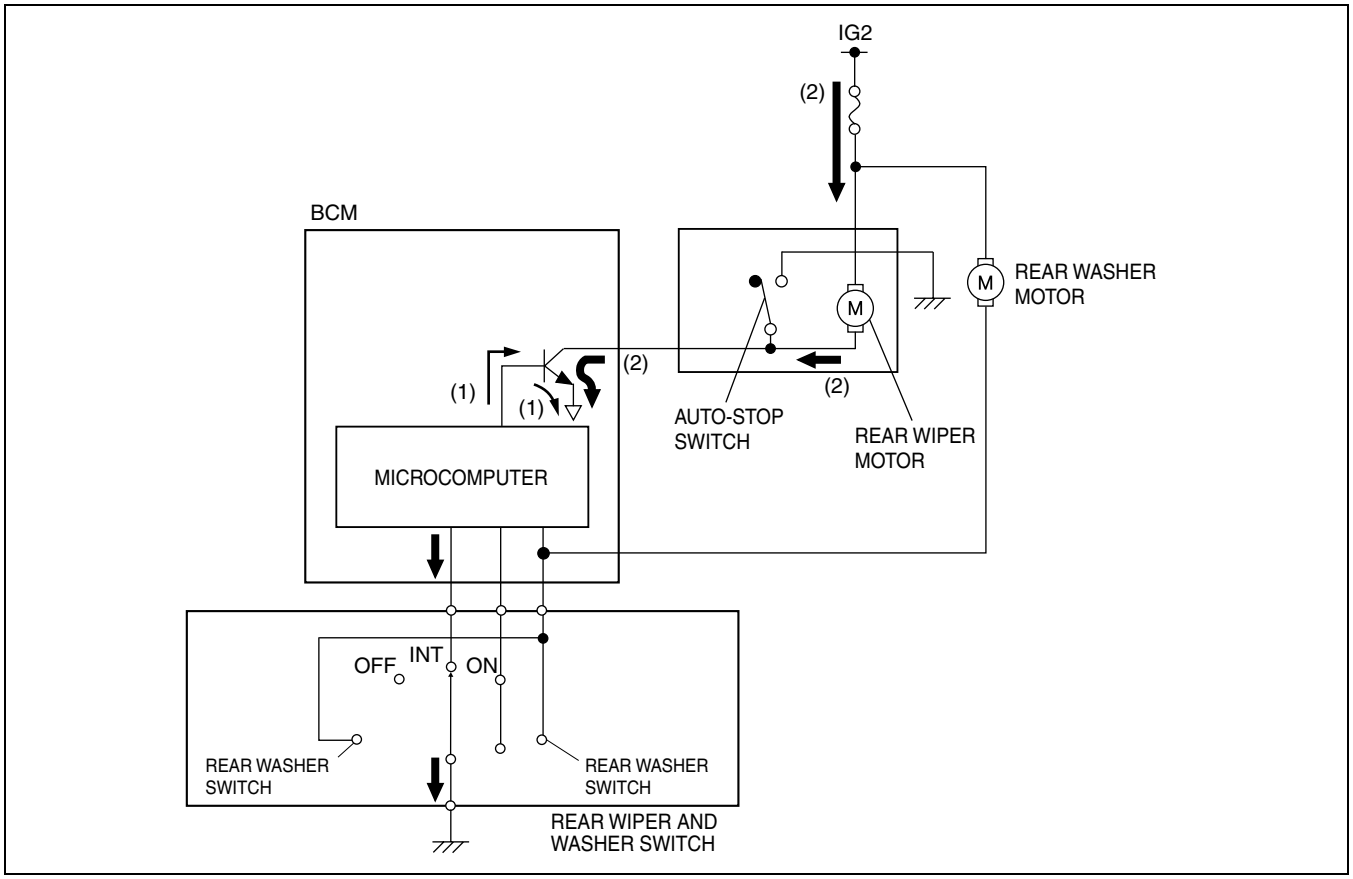
- When the rear wiper switch is turned to the OFF position while the wiper is operating, current flows to the autostop switch, which is on, and the rear wiper motor operates until it returns to the park position, stopping the wiper.



EPU919ZS3010

Intermittent Wiper Operation

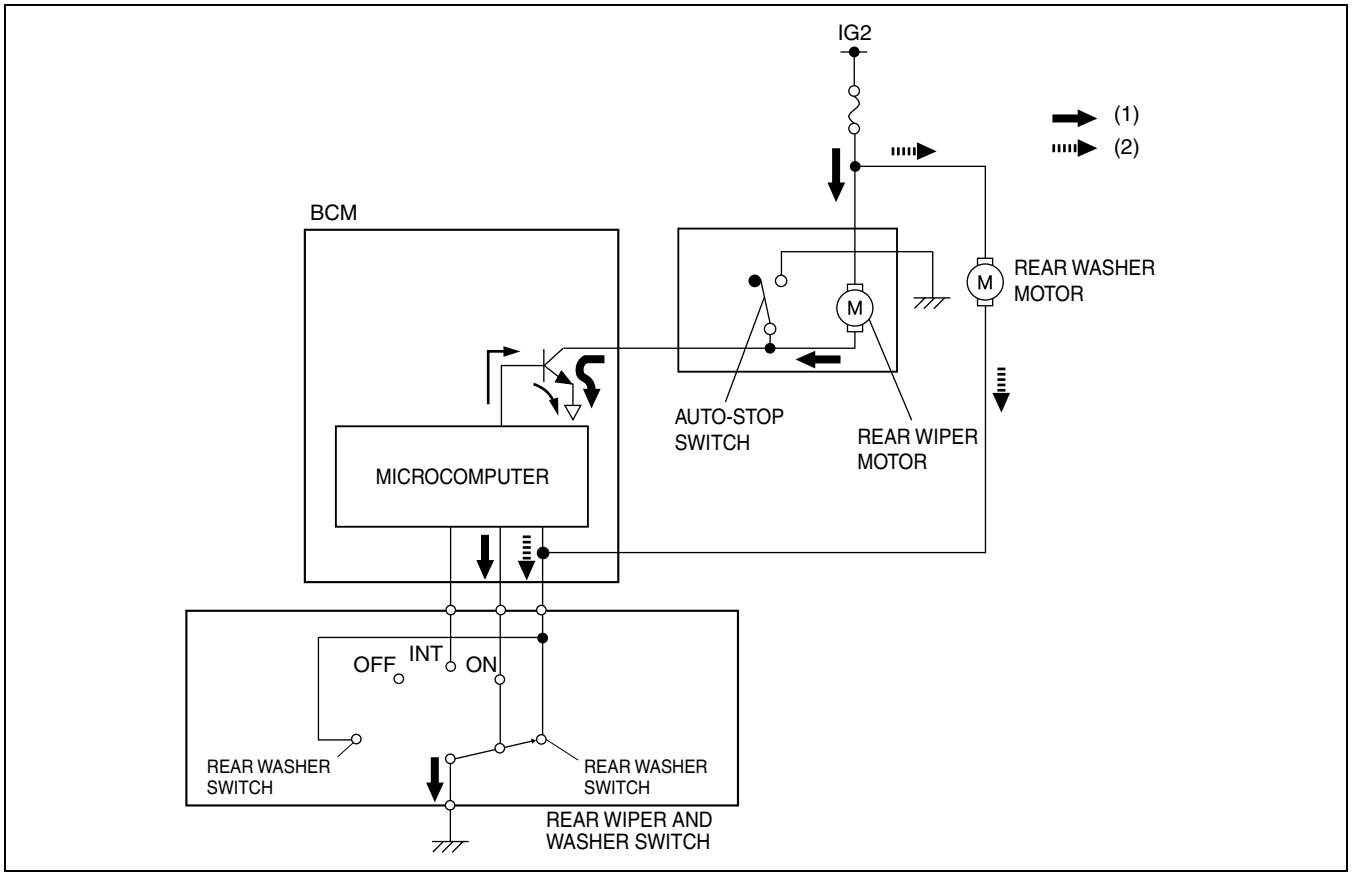
- When the rear wiper switch is turned to the INT position, the microcomputer in the BCM supplies current (1) at 10 s intervals to turn on the transistor intermittently.
- As a result, current (2) flows at 10 s intervals causing the rear wiper to operate intermittently.
- When the rear wiper switch is turned to the OFF position while the wiper is operating, the rear wiper motor performs an autostop and stops in the park position.



EPU919ZS3011

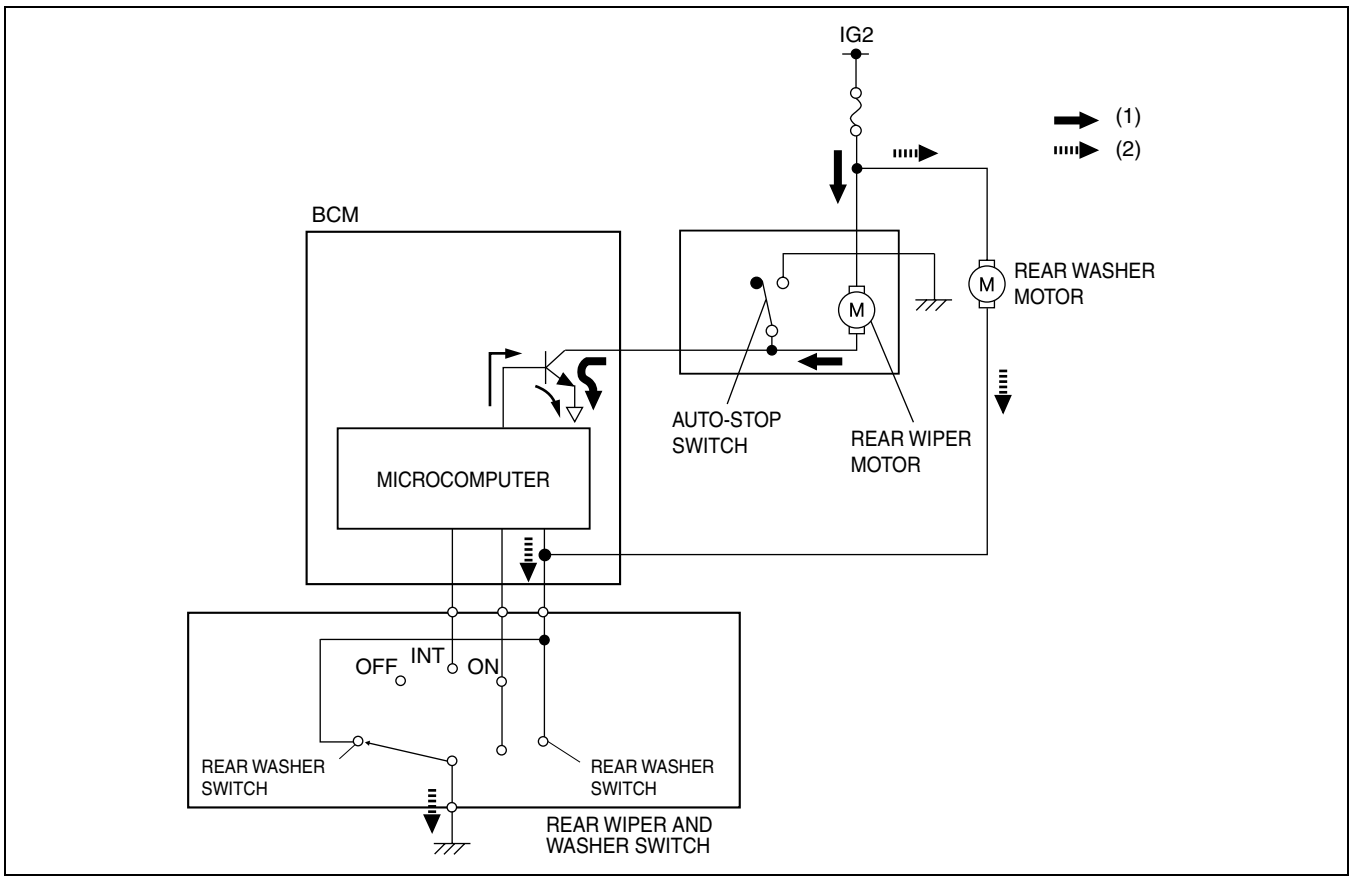
Synchronized Washer And Wiper Operation

- When the rear wiper switch is turned upward from the ON position, current (2) flows, the rear washer motor operates and washer fluid is sprayed from the rear washer nozzle.



EPU919ZS3012

- While turning the rear wiper switch downward from the OFF position, current (2) flows, the rear washer motor operates and washer fluid is sprayed from the rear washer nozzle. Current (1) flows at the same time according to the control signal from the microcomputer and the rear wiper motor operates continuously.



EPU919ZS3013

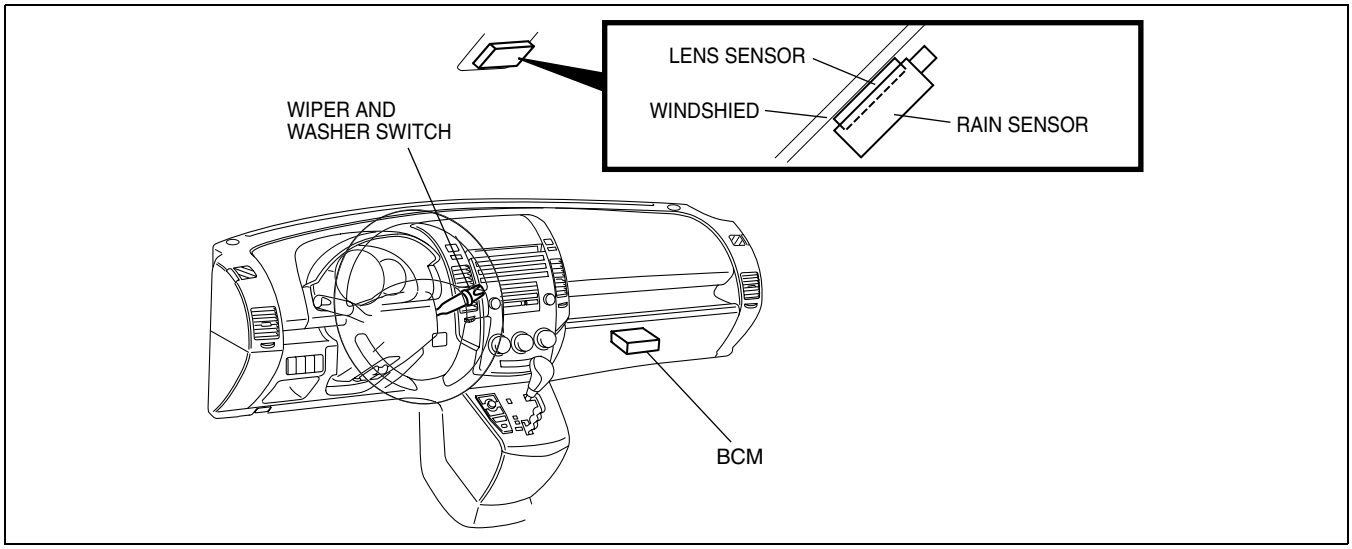
AUTO WIPER SYSTEM OUTLINE

EPU091966500S01

- An auto wiper system that detects rainfall on the windshield and automatically controls all operation (stop, interval, low, and high) has been adopted, removing the burden of operating switches from the driver.

AUTO WIPER SYSTEM STRUCTURAL VIEW

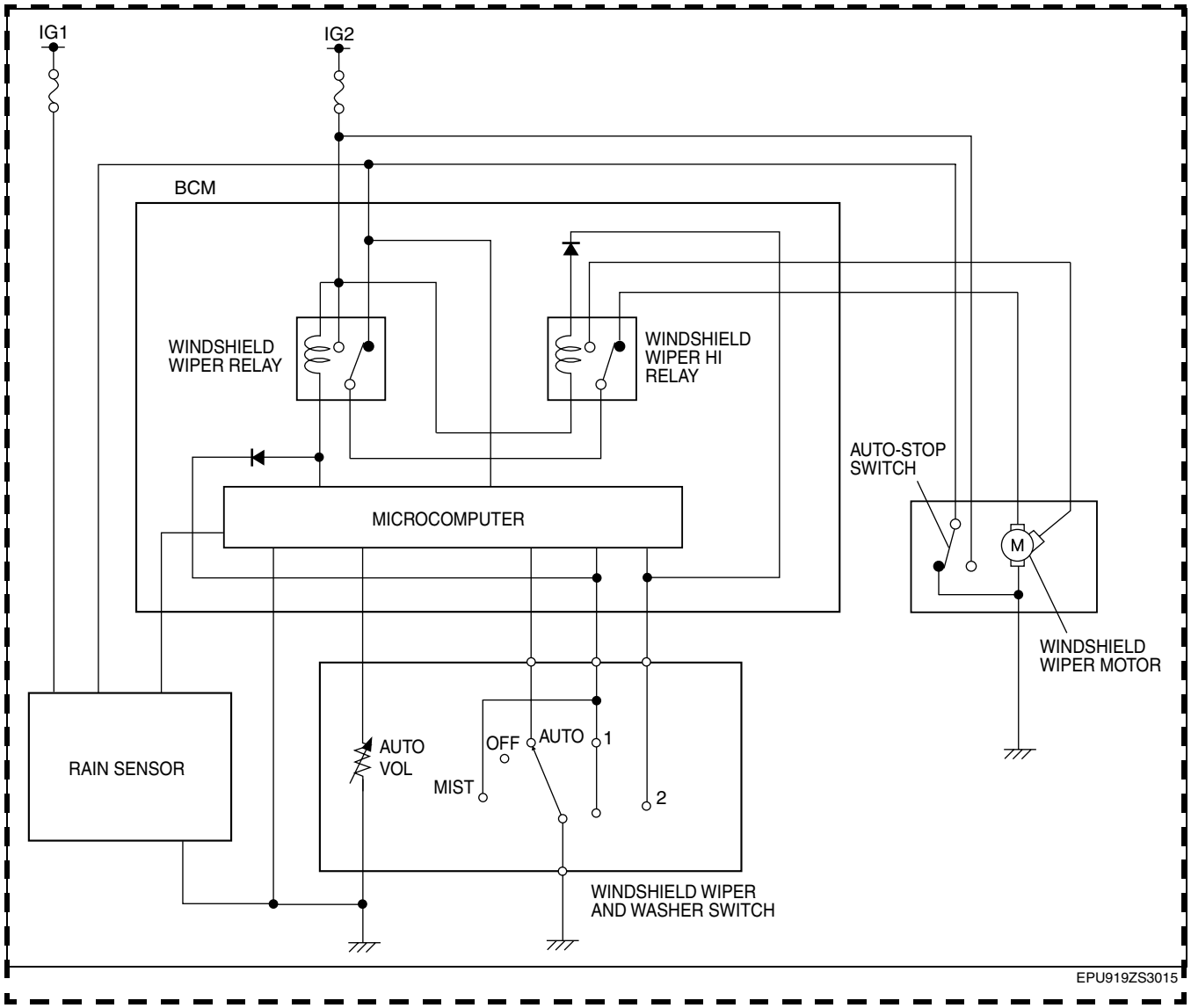
EPU091966500S02



EPU919ZS3014

AUTO WIPER SYSTEM WIRING DIAGRAM

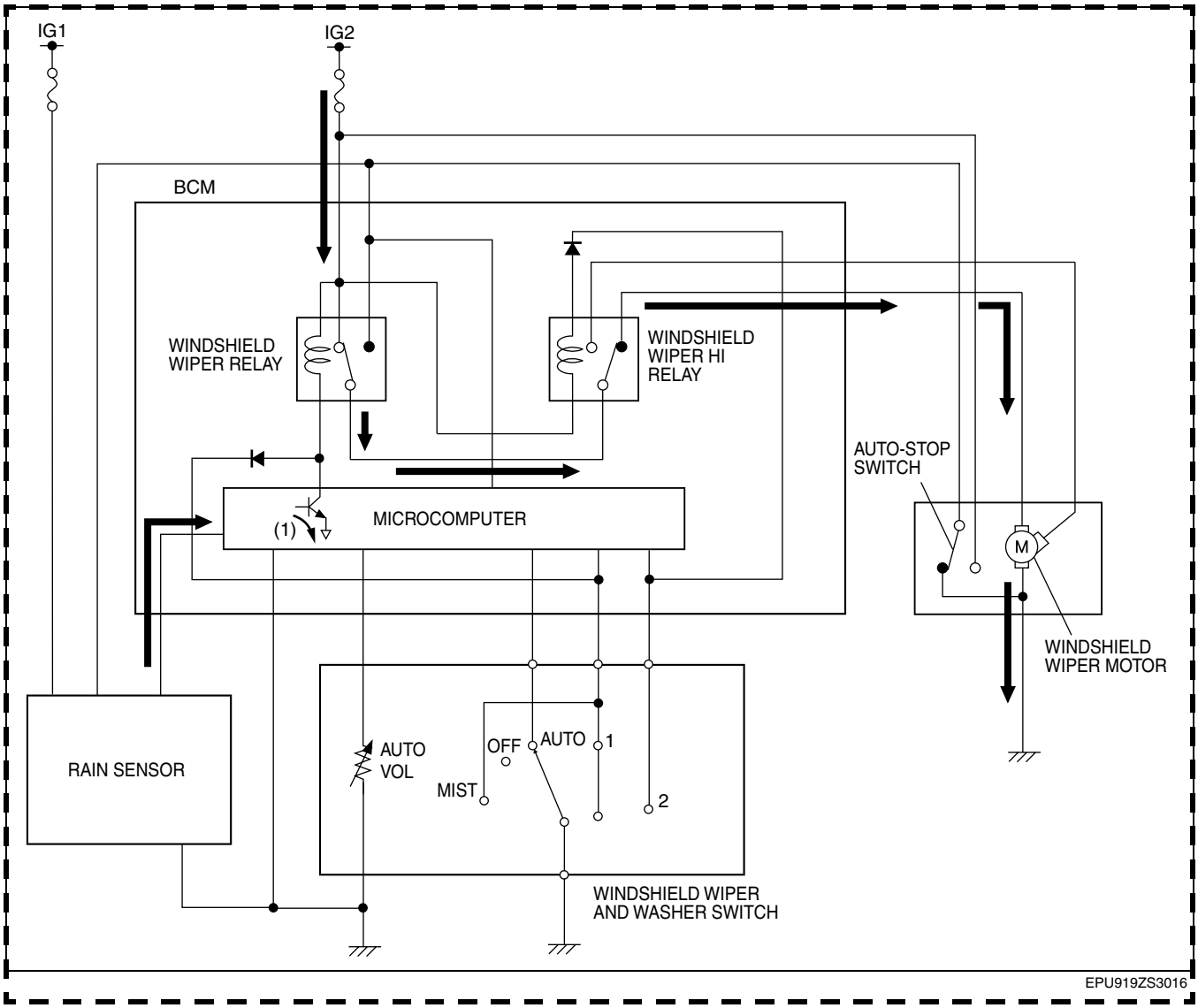
EPU091966500S03



AUTO WIPER SYSTEM OPERATION

EPU091966500S04

1. The rain sensor installed in the windshield detects rainfall amount when the wiper and washer switch is turned to the AUTO position.
2. The detected rainfall amount is converted to an electronic signal and transmitted to the BCM as a windshield wiper operation control signal.
3. When the microcomputer in the BCM receives the control signal, current (1) flows to the transistor and the transistor is turned on.
4. When the transistor turns on, the windshield wiper relay turns on.
5. When the windshield wiper relay turns on, the current flows to the windshield wiper motor, and the wiper operates at low speed.



Intermittent Operation

- If the windshield wipers are stopped and the rain sensor detects a specified amount of rainfall, the wipers are operated at low speed. The interval timing is adjusted according to the amount of rainfall detected.

Low Speed Operation

- If the windshield wipers are operating intermittently and the rain sensor detects an amount of rainfall specifc to wiper operation greater than low speed, but less than high speed, the wipers are operated continuously at low speed.

High Speed Operation

- If the windshield wipers are operating at low speed or stopped and the rain sensor detects an amount of rainfall specific to high speed operation or greater, the wipers are operated two times at high speed. If the rain sensor receives a signal for high speed operation after the wipers are operated at high speed twice, the high speed operation is continued.

RAIN SENSOR FUNCTION

EPU091966500S05

Rainfall detection function

- The LED in the rain sensor emits infrared light which is reflected off the windshield via the lens sensor and then received by the photodiode in the rain sensor. If the rate of reflected infrared light is reduced, it is determined that rain is contacting the windshield and the intensity of the rainfall is calculated from the amount of reflection rate reduction.

Sensitivity Adjustment Function

- By changing the sensitivity adjustment volume, installed on the wiper and washer switch, the sensitivity of the rain sensor can be freely adjusted.

Initial Setting Function

- When the ignition switch is turned to the ON position after replacing the rain sensor with a new one, the initial setting is stored after verifying the windshield condition.
- The initial setting of the rain sensor can be performed using the specified procedure.
  — Refer to the Workshop Manual for the initial setting procedure.

On-board Diagnostic Function

- If the voltage input to the rain sensor is not within the operational voltage (**approx. 9—16 V**), the BCM is informed of the malfunction and a BCM DTC is detected.
- If there is any malfunction in the rain sensor, the BCM is informed of the malfunction and a BCM DTC is detected.

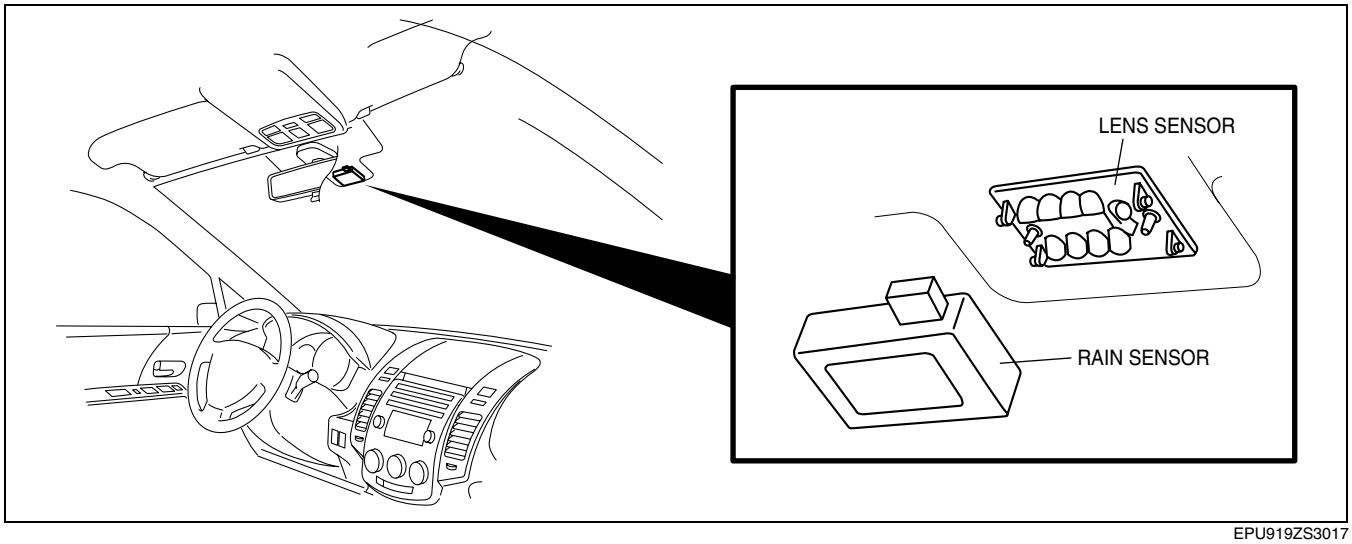
Fail-Safe Function

- If the rain sensor detects rainfall and then detects no change in the detected amount after the wipers have been operated two times, the windshield is determined to be dirty and windshield wiper operation is stopped.
- When the temperature sensor inside the rain sensor detects **approx. -10 °C {14 °F} or less** when the vehicle speed is **0 km/h {0 mph}**, the windshield wipers do not operate.

RAIN SENSOR CONSTRUCTION/OPERATION

EPU091966500S06

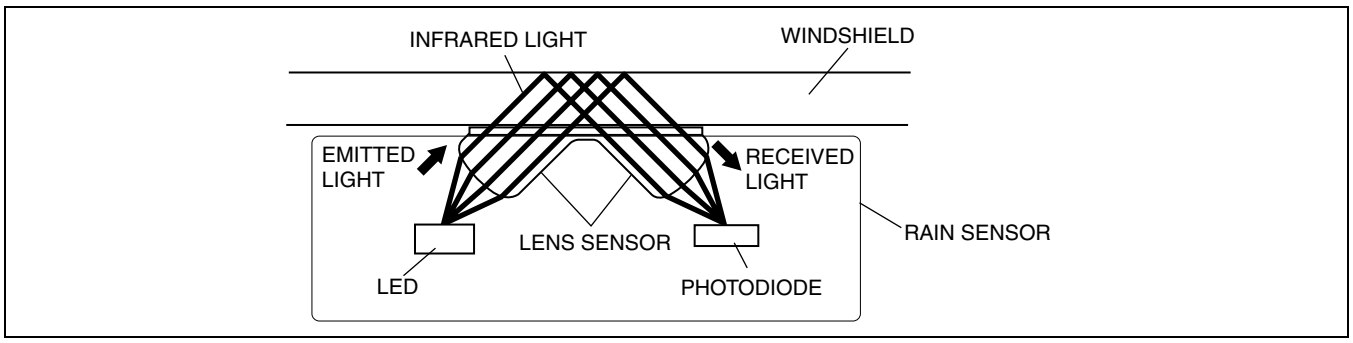
- Installed on the underside of the rearview mirror (windshield center).



EPU919ZS3017

Operation With No Rainfall Contacting Windshield

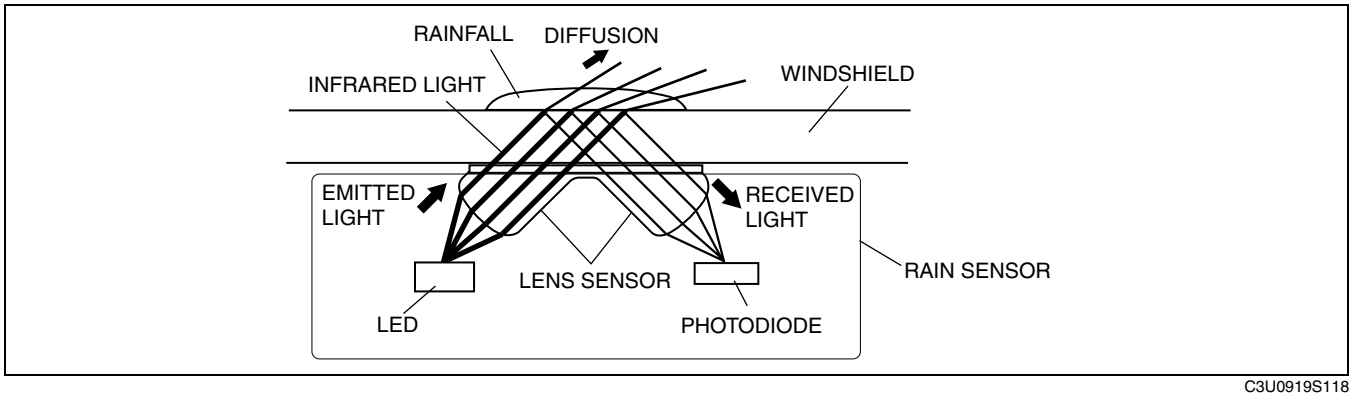
1. Infrared light is emitted from the LED in the rain sensor towards the windshield.
2. The emitted infrared light passes through the lens sensor and is reflected off the windshield.
3. The infrared light reflected off the windshield is received by the photodiode in the lens sensor.
4. The photodiode receives the light, the microcomputer in the rain sensor calculates the rainfall amount from the reflection rate, converts this to an electric signal and sends a windshield wiper control signal to the BCM.



C3U0919S117

Operation With Rainfall Contacting Windshield

1. Infrared light is emitted from the LED in the rain sensor towards the windshield.
2. Emitted infrared light passing through the lens sensor is received by the windshield and diffused by the rainfall contacting the windshield.
3. The infrared light that is not diffused is reflected by the windshield and received by the photodiode in the lens sensor.
4. The photodiode receives the light, the microcomputer in the rain sensor calculates the rainfall amount from the reflection rate, converts this to an electric signal and sends a windshield wiper control signal to the BCM.

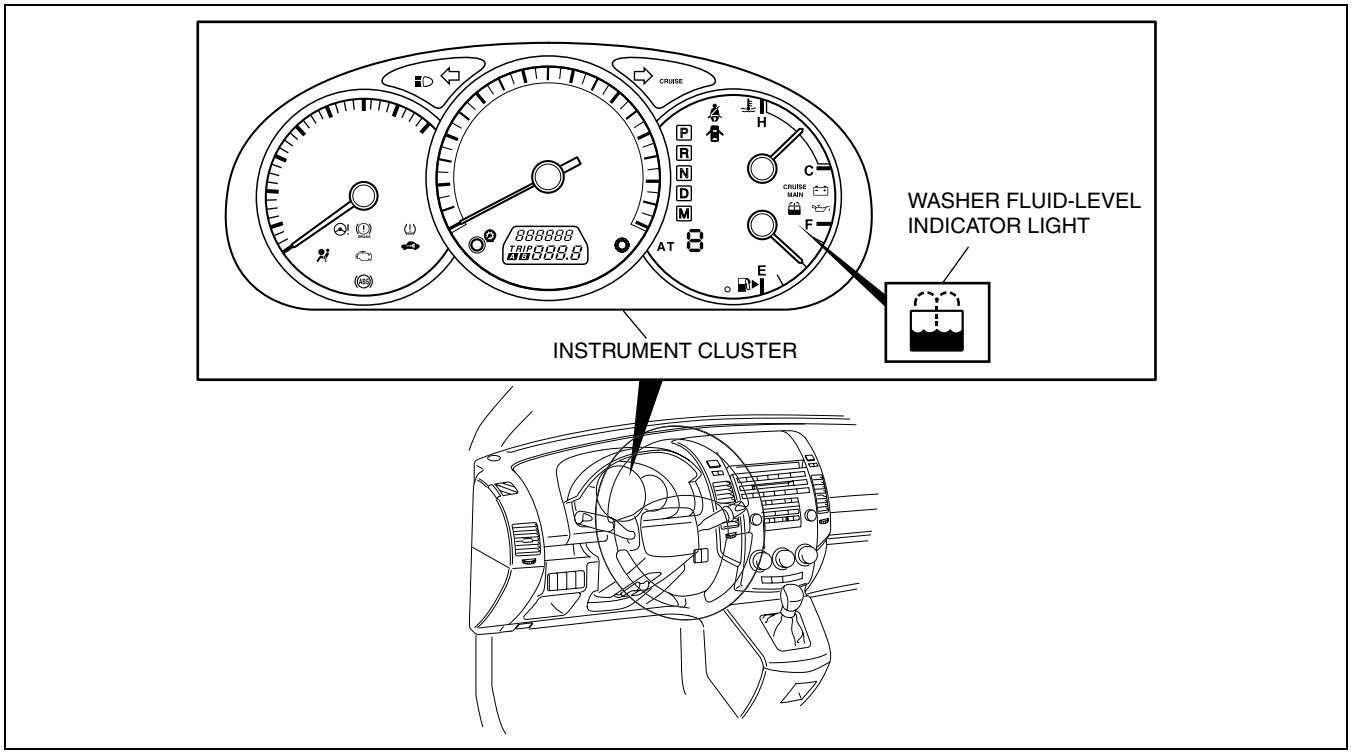


C3U0919S118

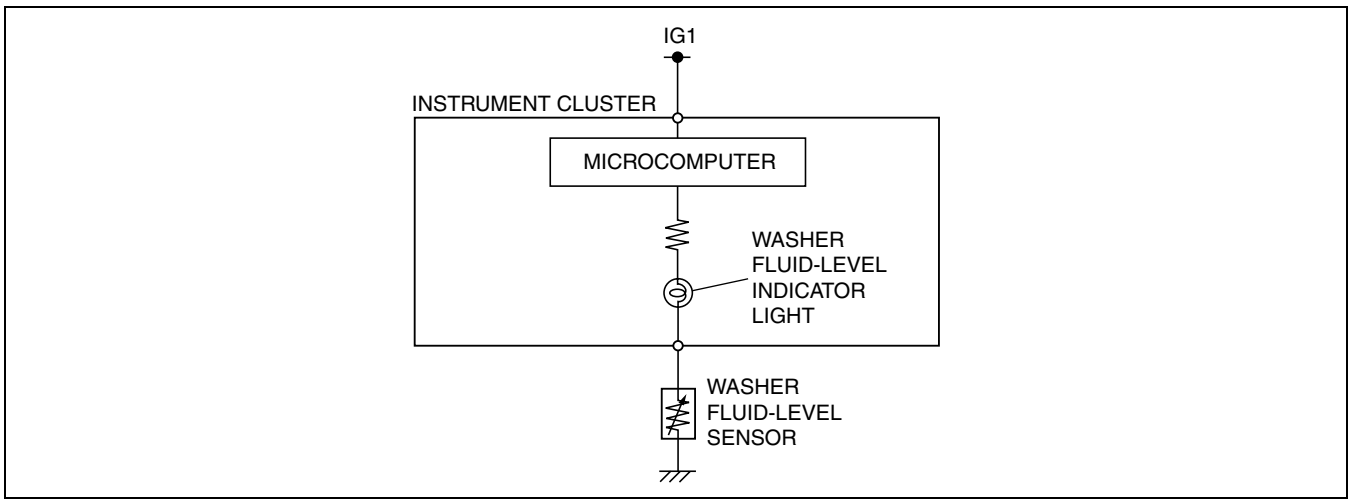
WASHER FLUID-LEVEL SENSOR FUNCTION

EPU091967488S01

- Warns the driver that the washer fluid-level is low.



EPU919ZS3018



C3U0919S120

09–20 ENTERTAINMENT

ENTERTAINMENT OUTLINE 09–20–1
AUDIO SYSTEM STRUCTURAL VIEW 09–20–2
AUDIO SYSTEM BLOCKDIAGRAM 09–20–3
AUDIO SYSTEM SPECIFICATIONS 09–20–3
Audio Unit 09–20–3
Speaker 09–20–3
CENTER PANEL UNIT OUTLINE 09–20–3
CENTER PANEL UNIT CONSTRUCTION 09–20–4
Structural View 09–20–4
Terminal Layout and Signal 09–20–5
Button Location 09–20–6
AUDIO UNIT CONSTRUCTION/OPERATION 09–20–6
Terminal Layout and Signal 09–20–6
Base Unit 09–20–7
Auto Level Control (ALC) Function (Standard Specification Vehicle) 09–20–7
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE 09–20–7
ON-BOARD DIAGNOSTIC SYSTEM FUNCTION 09–20–8
Self-diagnostic Function 09–20–8
Diagnostic Assist Function 09–20–9
CONTROLLER AREA NETWORK (CAN) OUTLINE 09–20–10
Data sent 09–20–10
Data received 09–20–10
FRONT DOOR SPEAKER CONSTRUCTION 09–20–10
REAR SPEAKER CONSTRUCTION 09–20–10
TWEETER CONSTRUCTION 09–20–10
ANTENNA CONSTRUCTION 09–20–11
Center Roof Antenna 09–20–11
AUDIO CONTROL SWITCH OUTLINE 09–20–11
AUDIO CONTROL SWITCH CONSTRUCTION/OPERATION 09–20–11
Construction 09–20–11
Operation 09–20–11
CAR-NAVIGATION SYSTEM OUTLINE 09–20–12
CAR-NAVIGATION SYSTEM STRUCTURAL VIEW 09–20–12
CAR-NAVIGATION SYSTEM BLOCK DIAGRAM 09–20–13
CAR-NAVIGATION SYSTEM SPECIFICATIONS 09–20–13
Car-navigation Unit 09–20–13
LCD Unit 09–20–13
Speaker 09–20–13
COMPONENT PART AND FUNCTION 09–20–13
CAR-NAVIGATION UNIT OUTLINE 09–20–14
CAR-NAVIGATION UNIT CONSTRUCTION 09–20–14
Structure 09–20–14
Terminal Layout and Signals 09–20–15
AUTONOMOUS NAVIGATION OPERATION 09–20–16
GYRO SENSOR FUNCTION 09–20–16
GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OUTLINE 09–20–16
GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OPERATION 09–20–16
MAP MATCHING OUTLINE 09–20–17
MAP MATCHING OPERATION 09–20–17
Map Matching Remarks 09–20–17
LCD UNIT OUTLINE 09–20–20
LCD UNIT CONSTRUCTION 09–20–21
Structural View 09–20–21
Terminal Layout and Signal 09–20–21
MICROPHONE CONSTRUCTION/OPERATION 09–20–22
Terminal Layout and Signals 09–20–22
CAR-NAVIGATION CONTROL SWITCH OUTLINE 09–20–22
CAR-NAVIGATION CONTROL SWITCH CONSTRUCTION/OPERATION 09–20–22
Construction 09–20–22
Operation 09–20–23
NAVIGATION FUNCTION 09–20–23
Outline 09–20–23
Map Screen Selection 09–20–24
Pop Up Menu 09–20–25
Destination Setting Function 09–20–26
Voice Recognition Function 09–20–27

ENTERTAINMENT OUTLINE

EPU092000001S01

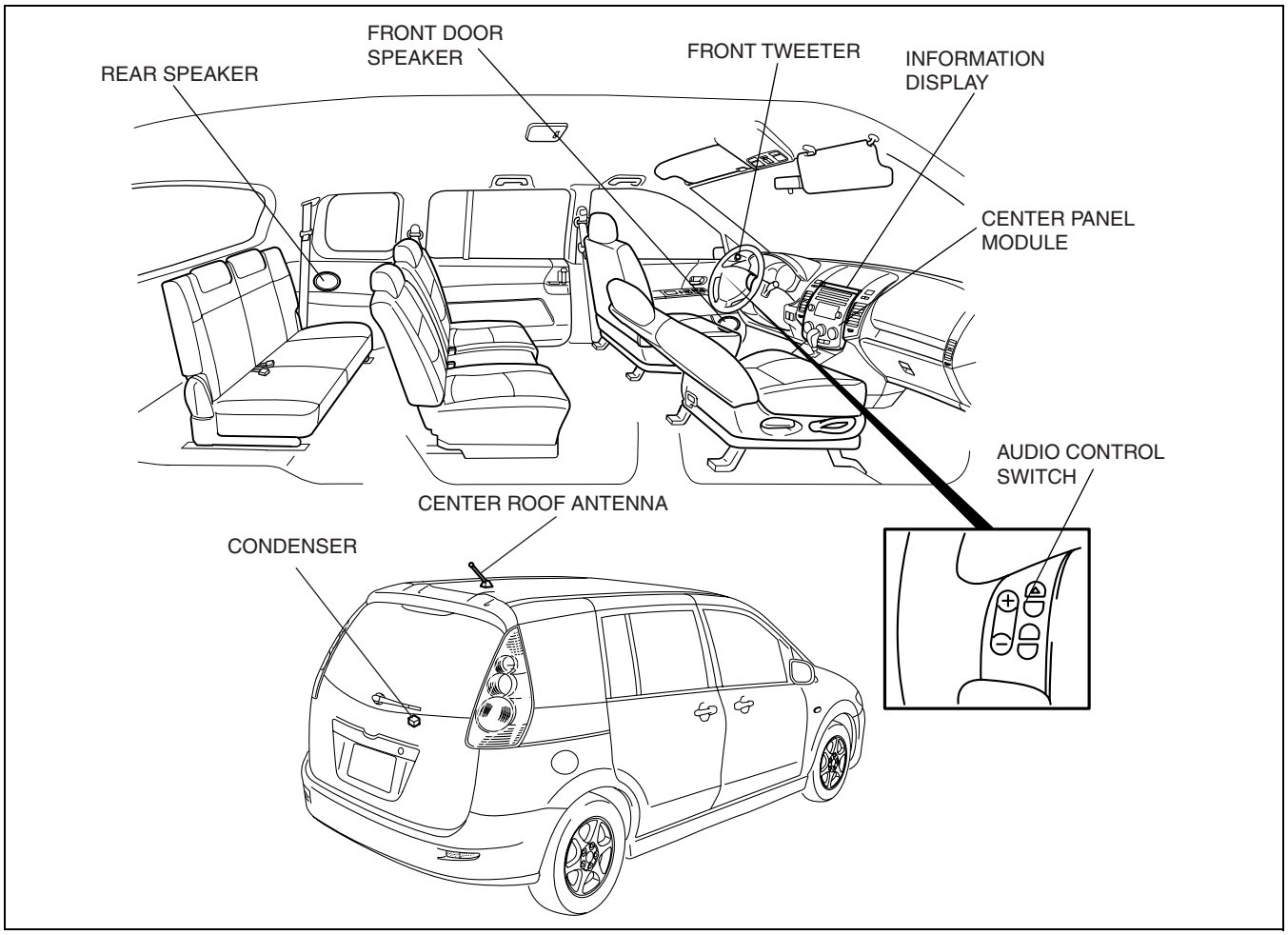
- A center panel unit, composed of the installed audio unit and the audio switches built into the center panel, has been adopted.
- The audio unit consists of the following parts:
  - — Base unit
    Type A
    - — AM/FM tuner
    - — CD player

    Type B
    - — AM/FM tuner
    - — CD changer
  - — Lower module (cassette deck or MD player)
  - — Cover
- The lower module (cassette deck or MD player) is optional accessories.

- The following speakers have been adopted (6 speakers):
  — Front door speaker
  — Rear speaker
  — Front tweeter
- A condenser has been installed on the high-mount brake light for improved noise reduction.
- All information related to the audio system is displayed on the information display's LCD.

AUDIO SYSTEM STRUCTURAL VIEW

EPU092000001S02

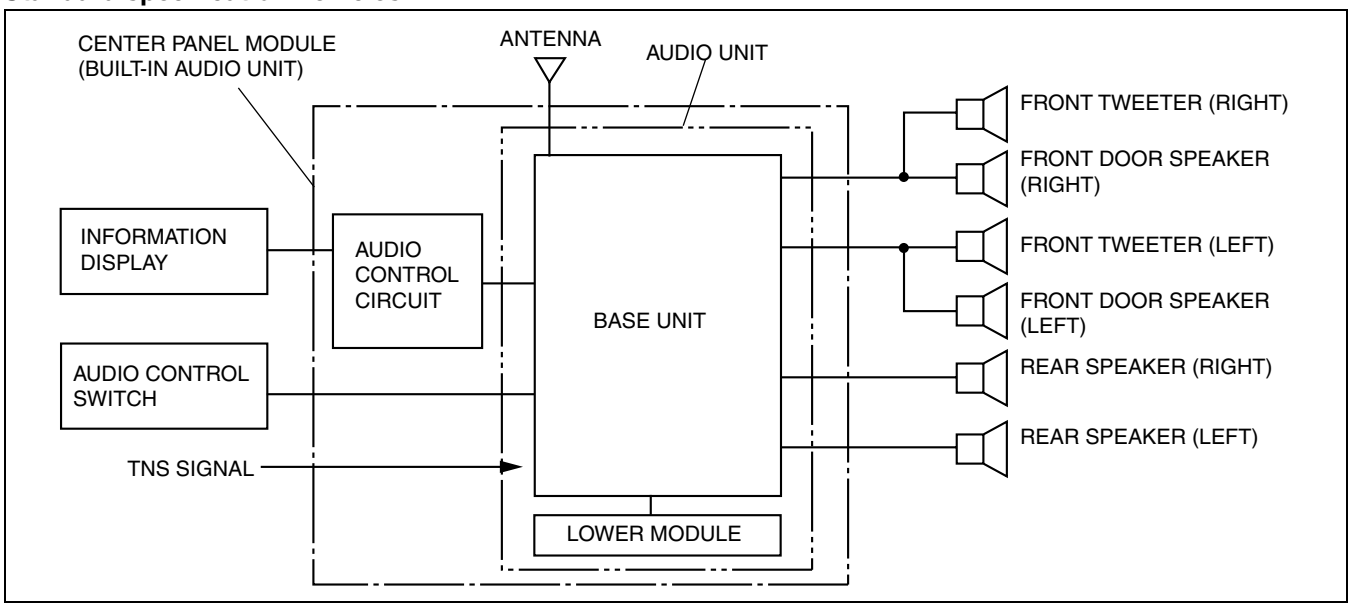


EPU920ZS2001

AUDIO SYSTEM BLOCK DIAGRAM

EPU092000001S03

Standard specification Vehicles



EPU920ZS2002

AUDIO SYSTEM SPECIFICATIONS

EPU092000001S04

Audio Unit

Item			Specification
Rated voltage		(V)	12
Frequency band	AM	(kHz)	530—1710
	FM	(MHz)	87.75—107.90
Audio amplifier maximum output power		(W)	25×4
Output impedance		(ohm)	4

Speaker

Item		Specification	
		Front door speaker/rear speaker	Front tweeter
Maximum input	(W)	35	
Impedance	(ohm)	4	
Size	(cm)	14×19	5

CENTER PANEL UNIT OUTLINE

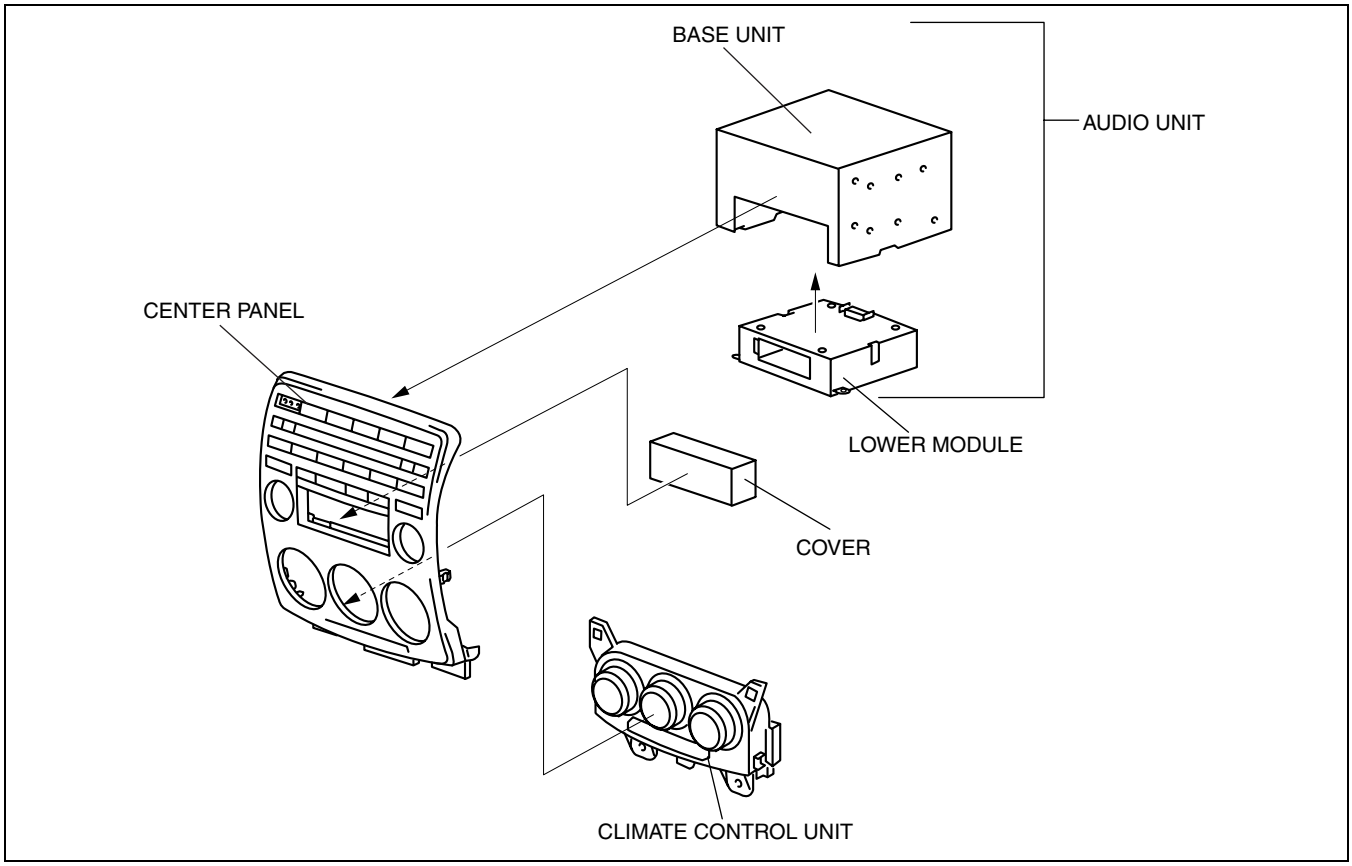
EPU092066900S01

- The center panel unit is composed of the installed audio unit and the audio switches built into the center panel.

CENTER PANEL UNIT CONSTRUCTION

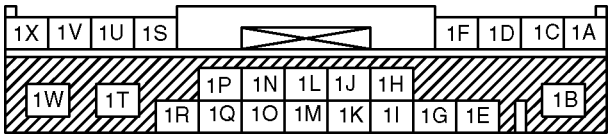
EPU092066900S02

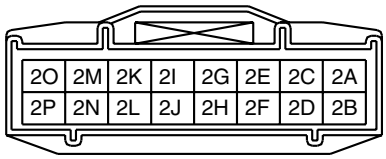
Structural View



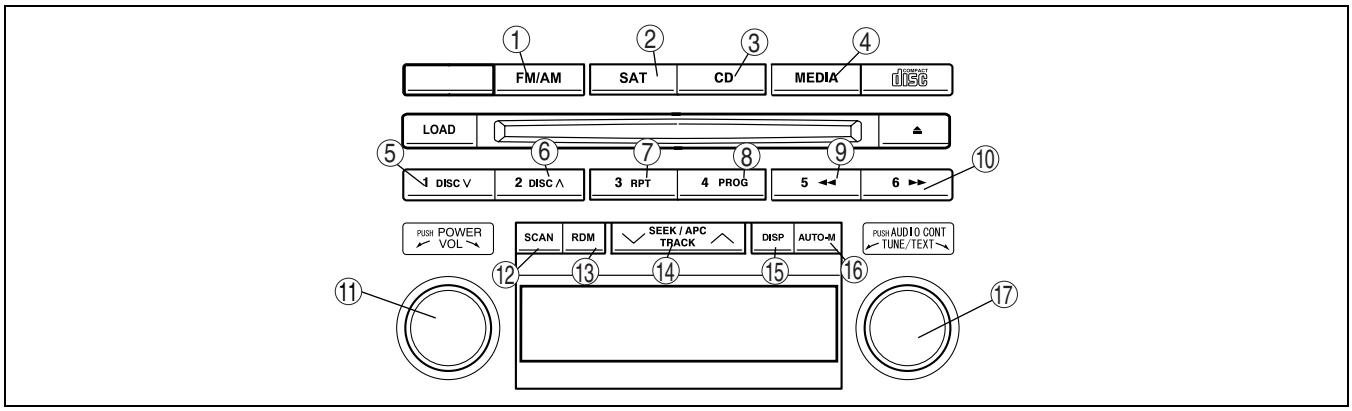
EPU920ZS2003

Terminal Layout and Signal
Audio unit

Terminal		Signal
	1A	Left front door speaker (+)
	1B	B+ (Power back up)
	1C	Left front door speaker (–)
	1D	Right front door speaker (+)
	1E	Illumination (+)
	1F	Right front door speaker (–)
	1G	Illumination (–)
	1H	Antenna
	1I	—
	1J	—
	1K	—
	1L	—
	1M	—
	1N	Audio control switch 1
	1O	CAN (+)
	1P	Audio control switch 2
	1Q	CAN (–)
	1R	ACC
	1S	Left rear speaker (+)
	1T	—
	1U	Left rear speaker (–)
	1V	Right rear speaker (+)
	1W	Power ground
	1X	Right rear speaker (–)

Terminal		Signal
	2A	—
	2B	—
	2C	Input signal RH (+)
	2D	—
	2E	Input signal LH (+)
	2F	—
	2G	—
	2H	—
	2I	—
	2J	—
	2K	—
	2L	—
	2M	RES/AUX CONT
	2N	—
	2O	—
	2P	—

Button Location



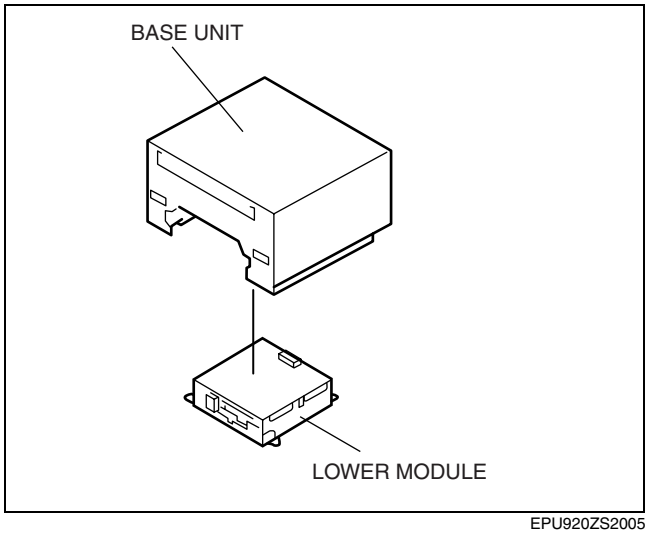
EPU920ZS2004

1	FM/AM button
2	SAT button
3	CD button
4	MEDIA button
5	Preset button “1”
6	Preset button “2”
7	Preset button “3”
8	Preset button “4”
9	Preset button “5”
10	Preset button “6”
11	POWER/VOLUME button
12	SCAN button
13	RDM button
14	SEEK button
15	DISP button
16	AUTO-M button
17	AUDIO CONT/TUNE/TEXT button

AUDIO UNIT CONSTRUCTION/OPERATION

EPU092066900S03

- The audio unit is composed of the base unit and lower module.
- Lower module availability depends on vehicle grade.



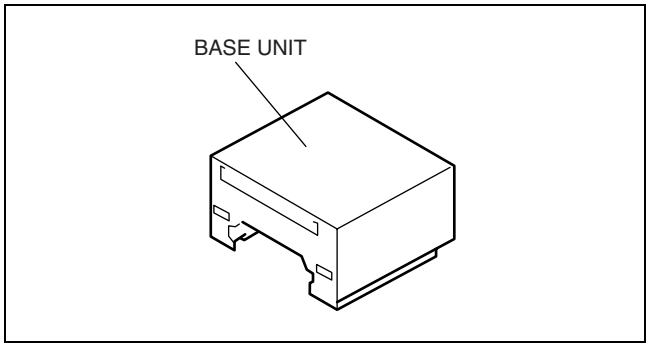
EPU920ZS2005

Terminal Layout and Signal

- (See 09–20–4 CENTER PANEL UNIT CONSTRUCTION.)

Base Unit

- The base unit controls the AM/FM tuner and lower modules.



EPU920ZS2006

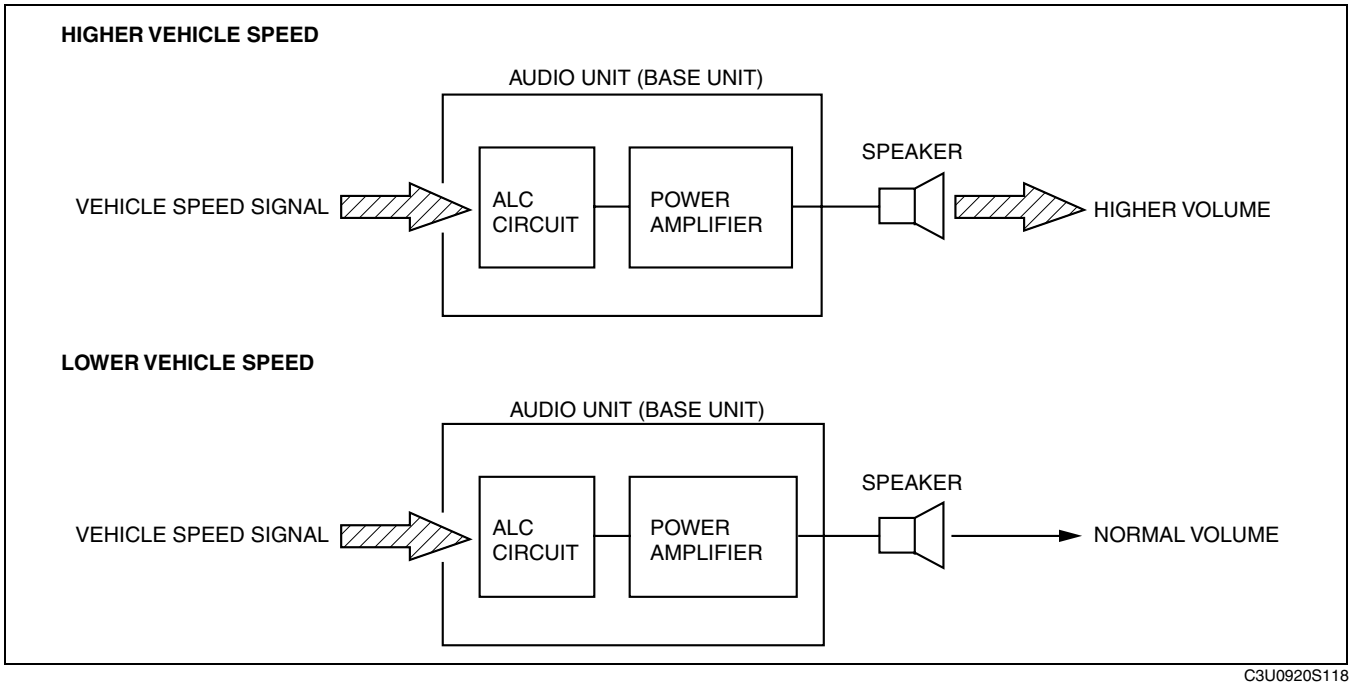
Auto Level Control (ALC) Function (Standard Specification Vehicle)

Function

- Adjusts the audio volume so that the sound is balanced against wind and road noise while driving.

Operation

- The audio unit changes the volume automatically based on the vehicle speed signal sent from the ABS HU/CM.



C3U0920S118

- The ALC function is divided into four modes that can be used effectively to match the driving conditions.

Mode	Condition
ALC OFF	ALC function cancelled
ALC LEVEL1	Outside road noise low
ALC LEVEL2	Outside road noise slightly high
ALC LEVEL3	Outside road noise high

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE

EPU092066900S04

- The on-board diagnostic system has a self-diagnostic function and diagnostic assist function to help technicians locate malfunctions.

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION

EPU092066900S05

Self-diagnostic Function

Malfunction detection function

- The malfunction detection section detects malfunctions occurring in the system.

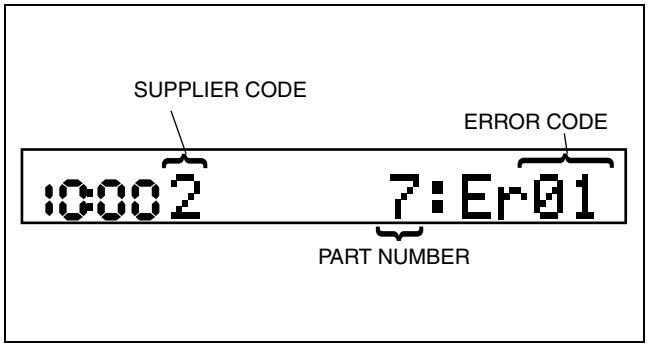
Memory function

- The memory function detects a malfunction, changes it to a DTC, and stores it in the memory. The memory can store a maximum of three DTCs. If another malfunction is detected when three DTCs are already stored, the memory function clears the oldest DTC and stores the new one.
- Once a DTC is stored, it can only be cleared by the designated procedure; not by turning the ignition switch to the LOCK position or disconnecting the negative battery cable. The procedure is mentioned in the Service Section.

Display function

- When the self-diagnostic function is activated, the information display displays the DTC stored in the memory.
- The DTC consists of the following codes and numbers:
  - — Supplier code (indicates manufacturer)
  - — Part number (indicates malfunctioning part)
  - — Error code (indicates malfunction description)
- Refer to the Service Section for the display method.

Supplier code	Supplier name
1	SANYO Automedia
2	Panasonic
3	Clarion
4	Pioneer



EPU920ZS2008

Parts number	Parts name
00	Cassette deck (lower module)
03	CD player (upper module)
05	CD changer (external)
06	CD changer (upper module)
07	MD player (lower module)
09	Base unit
10	CAN communication line
16	CAN communication line
17	CAN communication line
18	CAN communication line
19	CAN communication line
21	Audio cover
22	CD changer (upper module)

Error code	Malfunction description
01	Internal mechanism error
02	Servo mechanism error
03	Mechanism stuck
04	Tape malfunction
07	Disc reading error
08	Blank media
10	BUS line (communication line) error
11	CAN line (communication line) error
12	CAN line (communication line) error
17	CAN line (communication line) error (center panel)
18	CAN line (communication line) error (center panel)
19	CAN line (communication line) error (center panel)
20	Insufficient power supply

Error code	Malfunction description
21	Amplifier related circuit
22	Tuner error
30	High temperature

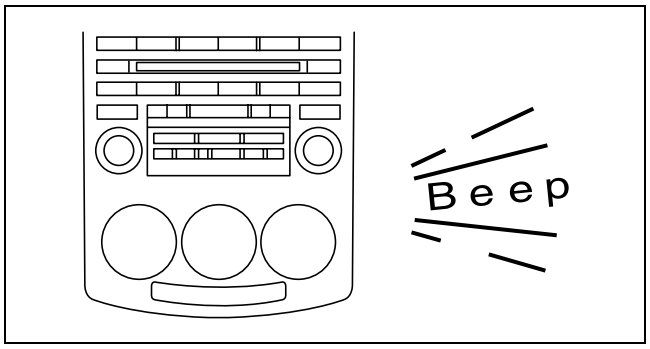
Screen display		Malfunction location
DTC	Output signal	
09: Er22	—	Base unit (peripheral circuit for tuner)
09: Er20	—	Power supply circuit to base unit
00: Er10	—	Cassette deck communication circuit system
03: Er10	—	CD player communication circuit system
05: Er10	—	CD changer (external) communication circuit system
06: Er10	—	CD changer (upper module) communication circuit system
07: Er10	—	MD player communication circuit system
03: Er01	—	CD player system
03: Er02	CHECK CD	CD player system
03: Er07	CHECK CD	CD player system
00: Er01	—	Cassette deck system
00: Er03	—	Cassette deck system
00: Er04	CHECK TAPE	Cassette tape system
06: Er01	—	CD changer (upper module) system
06: Er02	CHECK CD	CD changer (upper module) system
06: Er07	CHECK CD	CD changer (upper module) system
07: Er01	—	MD player system
07: Er02	CHECK MD	MD player system
07: Er07	CHECK MD	MD player system
07: Er08	CHECK MD	MD system
10: Er01	—	MP3 applicable CD player system
10: Er02	CHECK CD	MP3 applicable CD player system
no Er	—	No DTCs stored

Diagnostic Assist Function

- The diagnostic assist function displays the operating condition of the following functions (components) and forces them to operate in order to examine whether they are malfunctioning or not.
- For the start procedure of each mode, refer to the Service Section.

Switch

- The diagnostic assist function sounds the buzzer when the switches are pressed to check their operating condition.



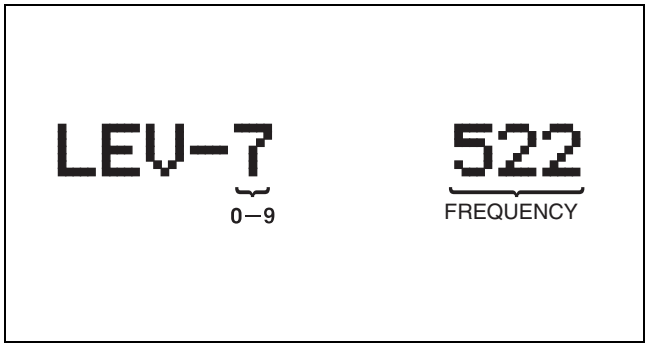
CPJ920ZNB006

Speaker

- The diagnostic assist function outputs sound to the speakers in the following order to determine the operating condition of the speakers and wiring harnesses between the base unit and each speaker.
  1. Left front door speaker and tweeter
  2. Right front door speaker and tweeter
  3. Right rear speaker
  4. Left rear speaker

Radio

- The diagnostic assist function displays the radio reception condition in 10 levels (0-9) to assist in determining the condition of the antenna, antenna feeders, and base unit (tuner).



EPU920ZS2007

CONTROLLER AREA NETWORK (CAN) OUTLINE

EPU092066900S06

- The center panel unit sends and receives data to and from other modules via the CAN system (MS-CAN). Refer to Section 09 for a detailed explanation of the CAN system.

Data sent

- Temperature unit
- INFO switch status

Data received

- Ambient temperature
- A/C status display request
- Temperature unit
- Vehicle speed
- Ignition key position
- Drive information system data

FRONT DOOR SPEAKER CONSTRUCTION

EPU092066961S01

- Located in the front door trim.

REAR SPEAKER CONSTRUCTION

EPU092066961S02

- Located in the trunk side trim.

TWEETER CONSTRUCTION

EPU092068966S01

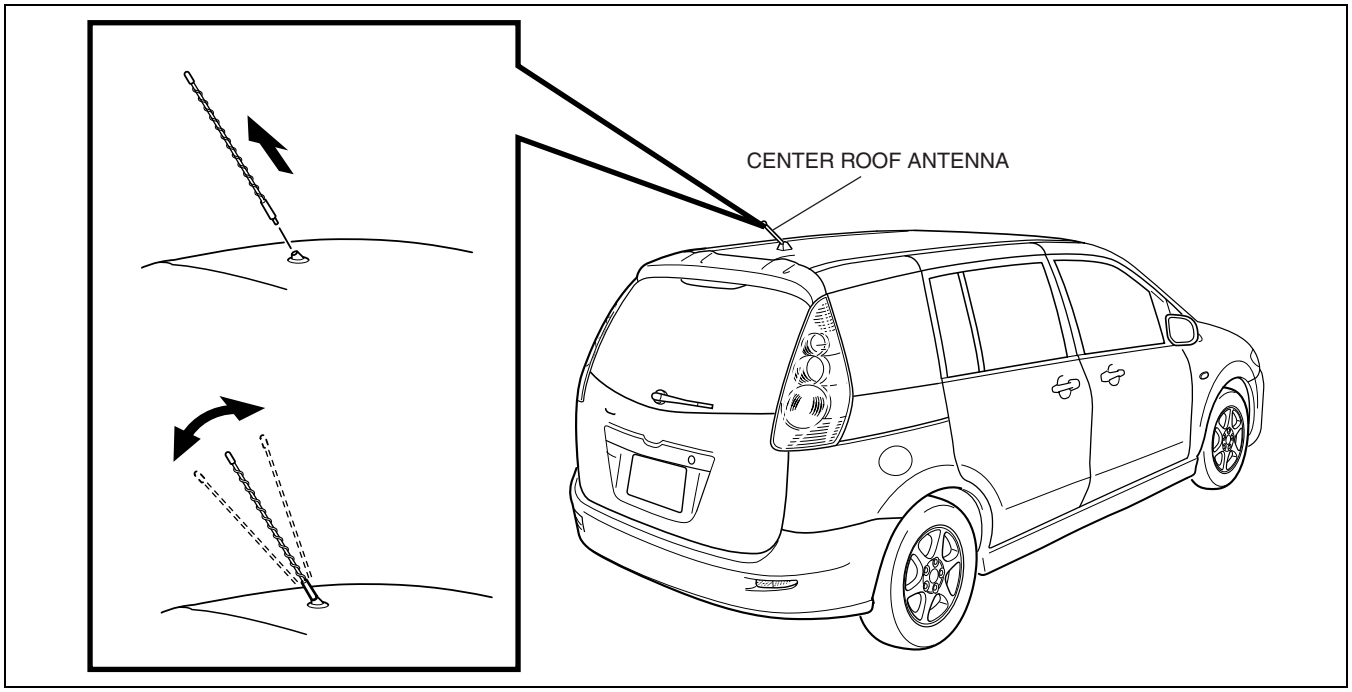
- Tweeters (high-frequency speaker) are installed in the front door inner garnishes (right and left), providing wide-range sound.

ANTENNA CONSTRUCTION

EPU092066939S01

Center Roof Antenna

- For improved convenience, the center roof antenna is removable.
- A flexible antenna mast with a built-in spring is used to prevent deformation.



EPU920ZS2009

AUDIO CONTROL SWITCH OUTLINE

EPU092000148S01

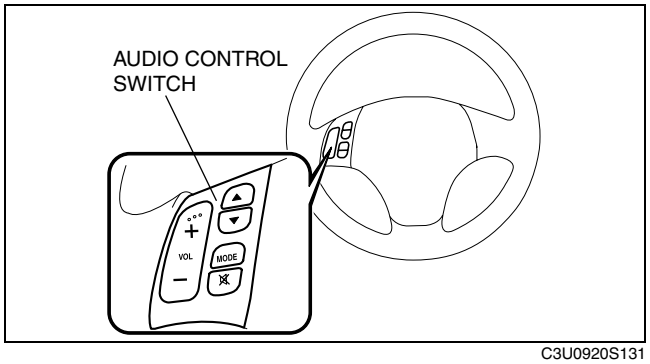
- A remote control for the audio system, with simplified design for easy operation, has been adopted.

AUDIO CONTROL SWITCH CONSTRUCTION/OPERATION

EPU092000148S02

Construction

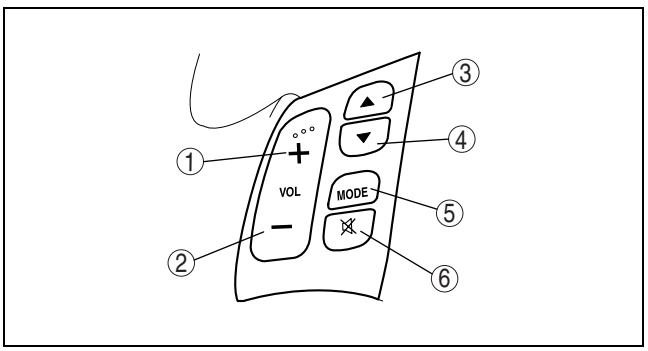
- The audio control switch is located on the steering wheel.



C3U0920S131

Operation

No.	Button (component)	Function
1	Volume button (+)	Volume up
2	Volume button (-)	Volume down
3	AUTO scan button	Selects radio stations
	AUTO track button	Changes tracks
4	Preset button	Selects the preset button
5	Mode button	Selects the audio mode (AM→FM1→FM2→Cassette tape/MD→CD/CD changer)
6	Mute button	Mute



CHU0920S007

CAR-NAVIGATION SYSTEM OUTLINE

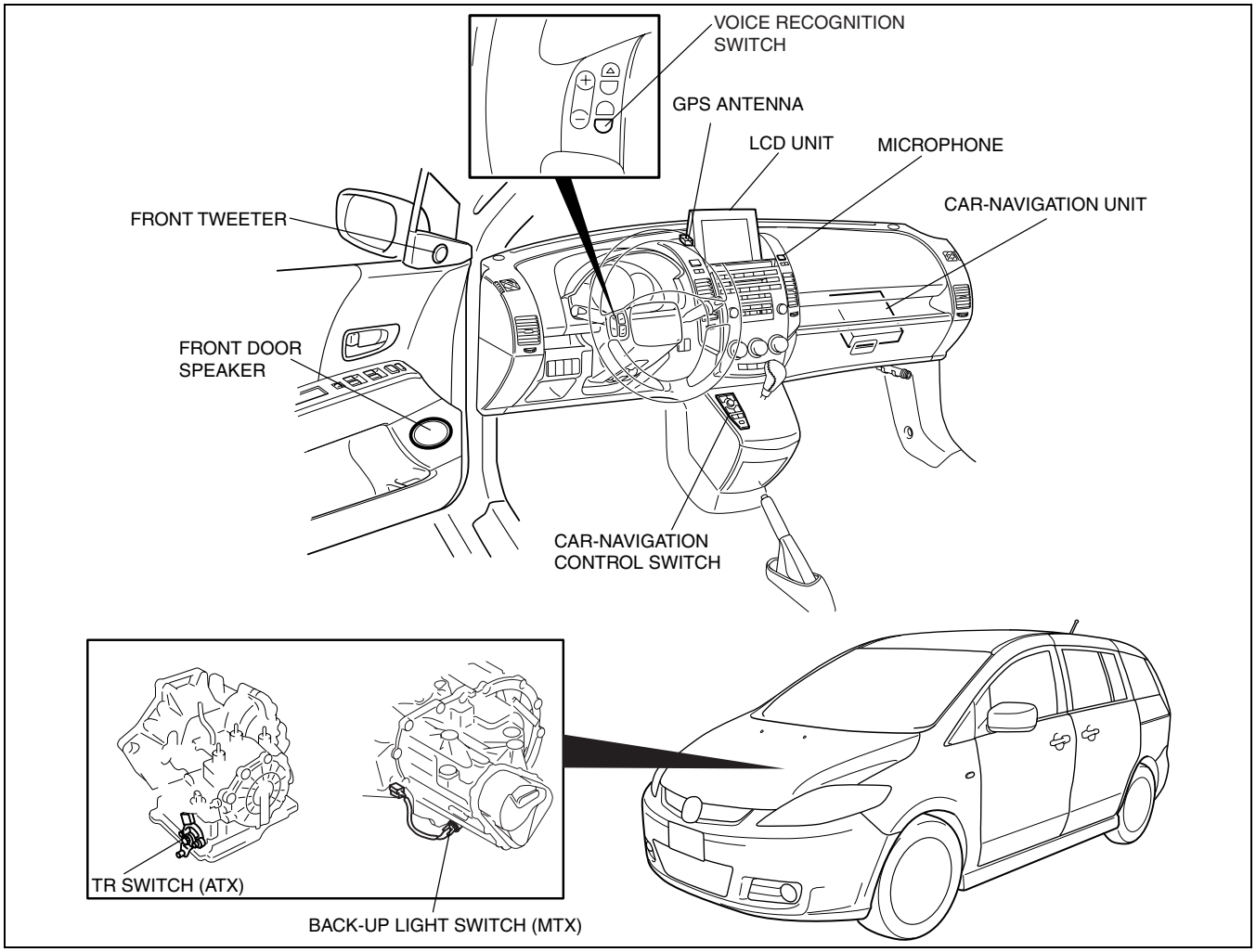
EPU092066000S01

- A 7 inch wide, pop-up LCD (*TFT) has been adopted to improve marketability.
- A hybrid in car-navigation system and map-matching function has been adopted to improve accuracy of vehicle position.
- A voice recognition function has been adopted.
- A remote control with an infrared transmitter has been adopted to improve operational ability. (UK specs. only)
- The languages and voices available for use with the car-navigation unit include English (U.S.A), English (UK), French, German, Dutch, Spanish, Portuguese, Swedish, Danish, Norwegian, Finnish, and Italian. However, the language used in this manual is in **English only**.

*TFT: Thin Film Transistor

CAR-NAVIGATION SYSTEM STRUCTURAL VIEW

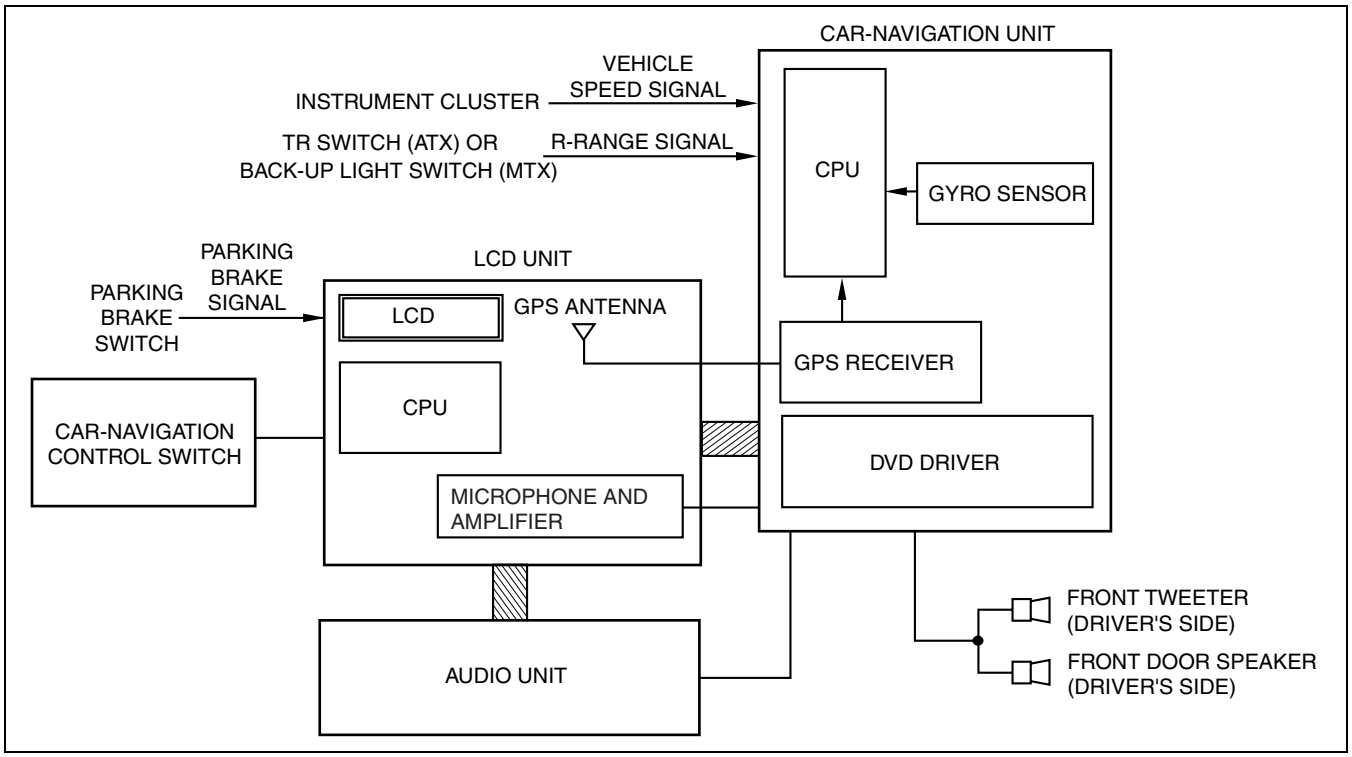
EPU092066000S02



EPU920ZS2010

CAR-NAVIGATION SYSTEM BLOCK DIAGRAM

EPU092066000S03



EPU920ZS2011

09–20

CAR-NAVIGATION SYSTEM SPECIFICATIONS

EPU092066000S04

Car-navigation Unit

Item		Specification
Unit type		Stand alone
Rated voltage	(V)	12
ROM type		DVD-ROM
Voice guidance output power	(W)	5

LCD Unit

Item			Specification
Unit type			Pop-up
Rated voltage		(V)	12
Display (for car-navigation system)	Size	(inch)	7 (wide)
	Type		TFT (Thin Film Transistor); Full-color

Speaker

- Refer to audio system. (See 09–20–3 AUDIO SYSTEM SPECIFICATIONS.)

COMPONENT PART AND FUNCTION

EPU092066000S05

Item	Function
Car-navigation unit	• Reads the data (map, voice and other) from the DVD-ROM. • Calculates and displays vehicle position from various signals. • Calculates the route to the destination. • Navigates the driver to the destination using the map screen and/or voice. **Note** • DVD audio and video are not supported by this system. • This unit does not support all Video CD and CD formats.
LCD unit	• Displays the screen (menus, maps and other screens) by remote control operation.
GPS antenna	• Receives GPS signal from satellites.

Gyro sensor (inside of the car-navigation unit)	• Sends yaw-rate signal to the CPU in the car-navigation unit.
TR switch (ATX) or back-up light switch (MTX)	• Sends R-range or reverse signal to the car-navigation unit.
Instrument cluster	• Sends vehicle speed signal to the car-navigation unit.
Front door speaker and tweeter (driver side)	• Outputs voice and audio sound.
DVD-ROM (inside of the car-navigation unit)	• Contains map information data of each country. • Contains voice data used to guide the route. • Contains route information data to search for the route.
Voice recognition switch	• Set the voice recognition function activate/deactivate
Car-navigation control switch	• Changes display screens, settings and other functions by button operation.

CAR-NAVIGATION UNIT OUTLINE

EPU092066902S01

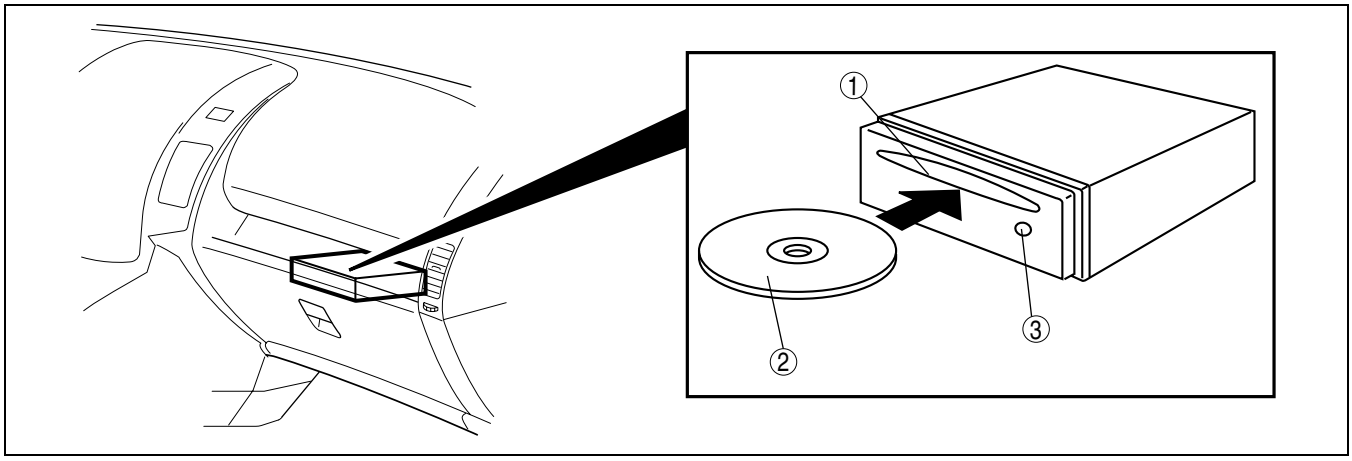
- Using exterior signal input and DVD-ROM information, this unit detects vehicle position, provides destination route guidance, and displays color maps.

CAR-NAVIGATION UNIT CONSTRUCTION

EPU092066902S02

Structure

- The car-navigation unit is located in the glove compartment.
- An eject button, to eject the DVD-ROM from the loading slot, is included in the unit.
- A gyro sensor which detects vehicle cornering angle is built into the unit.

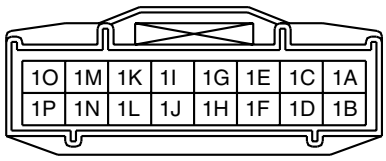


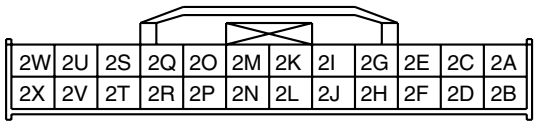
DPE920ZNB003

1	DVD-ROM loading slot
2	DVD-ROM

3	Eject button

Terminal Layout and Signals

Terminal		Signals
		16-pin connector
	1A	GND
	1B	B+
	1C	–
	1D	ACC
	1E	–
	1F	–
	1G	–
	1H	Vehicle speed
	1I	–
	1J	–
	1K	–
	1L	R-range
	1M	Front speaker output (-)
	1N	Front speaker output (+)
	1O	Front speaker input (-)
	1P	Front speaker input (+)

Terminal		Signals
		24-pin connector
	2A	–
	2B	–
	2C	–
	2D	–
	2E	–
	2F	–
	2G	–
	2H	–
	2I	–
	2J	–
	2K	–
	2L	–
	2M	–
	2N	Monitor serial input
	2O	Shield GND
	2P	Monitor serial output
	2Q	Shield GND
	2R	Video (composit sync)
	2S	–
	2T	Video (B)
	2U	Video GND
	2V	Video (G)
	2W	–
	2X	Video (R)

Terminal		Signal
		1-pin connector
	4A	GPS antenna input

Terminal		Signal
		1-pin connector
4A	6A	GND

AUTONOMOUS NAVIGATION OPERATION

EPU092066902S03

- The navigation unit detects the position of the vehicle from a cumulative calculation of the vehicle's direction and travelled distance based on the processing of direction data obtained from the gyro sensor and vehicle speed signals obtained from the instrument cluster.
- Even when GPS satellite reception is not available, accurate detection of vehicle's position is still possible.
- Signals from GPS satellites are used partially for detecting direction data.

GYRO SENSOR FUNCTION

EPU092066902S04

- The gyro sensor is located in the navigation unit. The sensor converts yaw rate, which is one of the inputs used in calculating the vehicle direction of travel from the vehicle cornering angle, into electrical signals. It then sends these signals to the navigation unit.

GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OUTLINE

EPU092066902S05

- GPS is a navigation system developed by the U.S. Department of Defence. The system has GPS satellites orbiting the earth at an altitude of approximately 21,000 km {13,000 miles}.
- There are at least five satellites over any point 24 hours a day.
- The navigation unit receives radio signals from these satellites and determines a vehicle's position.

GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OPERATION

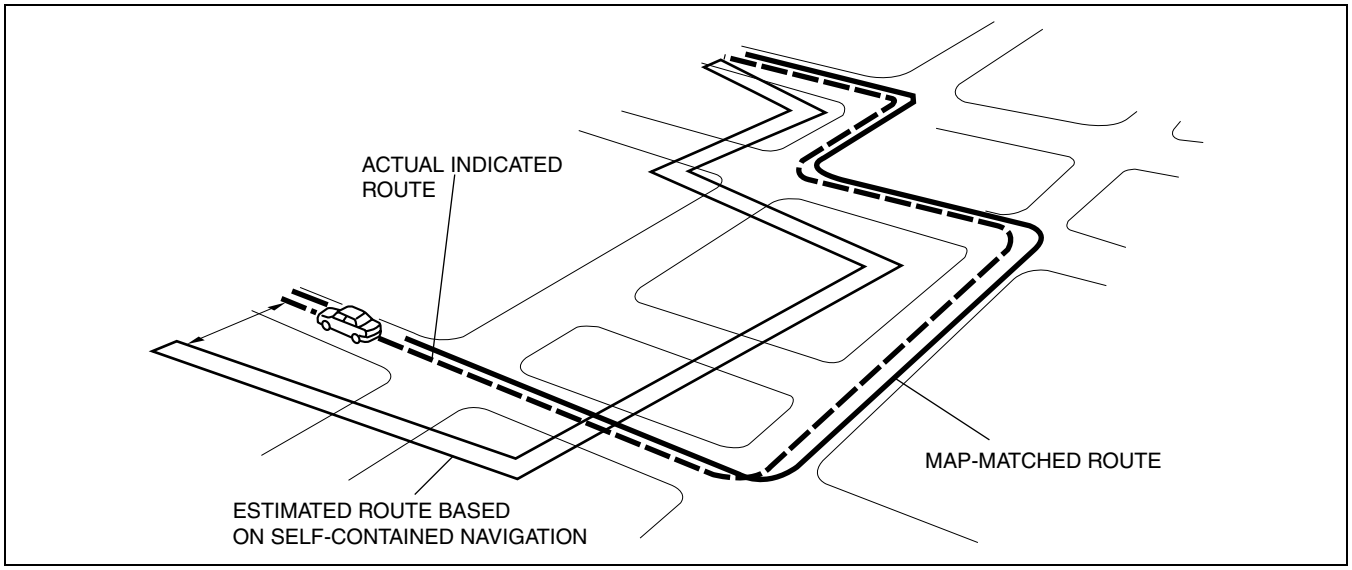
EPU092066902S06

- When using the navigation system for the first time after purchase or for the first time after a long period during which it was not used, it may take about 5—15 min. until the current position is measured. Also, even during normal use, it may take about 2—3 min. for measurement.
- The GPS antenna may be unable to receive GPS satellite signals when a vehicle passes through tunnels, valleys between tall buildings, or in the mountains.
- Placing an object above the GPS antenna may prevent the navigation unit from taking measurements.
- When GPS measurement conditions are bad, the navigation unit may be unable to compute dimensions or correct to the proper position.
- The position measurement error for GPS information can be reduced by reception conditions, the time band, and by deliberate reduction in satellite accuracy by the United States Department of Defence. Also, under the following conditions, interference with satellite signals may make it temporally impossible to receive signals from GPS satellites.
  - — When receiving monitor channel 56 (UHF)
  - — When an automobile phone or cellular phone is used near the GPS antenna
- The navigation unit can locate absolute position only when the vehicle is in motion. Therefore, the navigation unit does not correct direction when the vehicle is not moving.
- The navigation unit computes three positions (latitude, longitude, and altitude) using radio signals from four or more satellites, called three-dimensional positioning. The more GPS satellite signals received, the more accurate the three-dimensional positioning is performed. The navigation unit can receive a maximum of eight satellite signals to compute a vehicle's position.
- If only three satellite signals can be received, the navigation unit uses two positions (latitude and longitude) and the altitude calculated while in three-dimensional positioning to compute a vehicle's position. This is called two-dimensional positioning.
- There can be as much as a 30-m +/- factor in the position detection system, even using the three-dimensional positioning, which is highly accurate.
- The position detection system is affected by positions of the GPS satellites which send signals.

MAP MATCHING OUTLINE

EPU092066902S07

- This function compares the route shape the vehicle is travelling to map data using the GPS satellite signals, and corrects the vehicle's position to the most appropriate road on the map data.



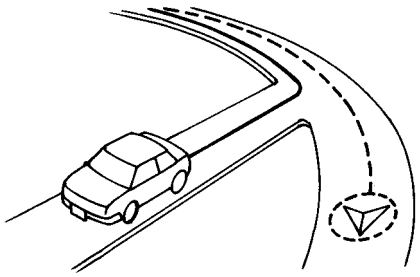
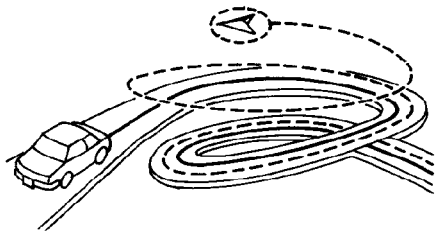
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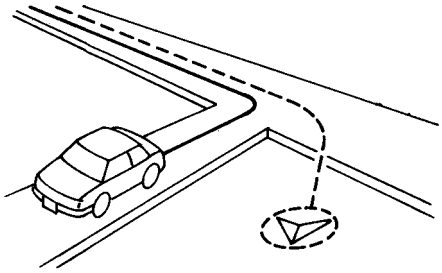
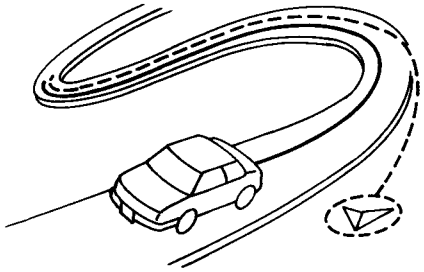
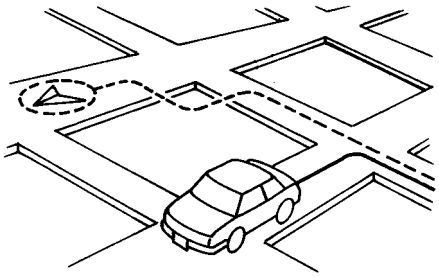
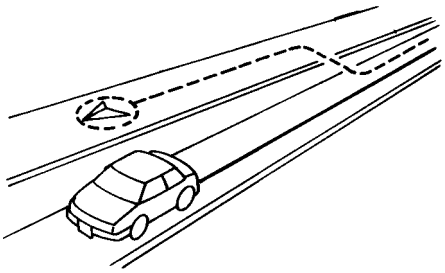
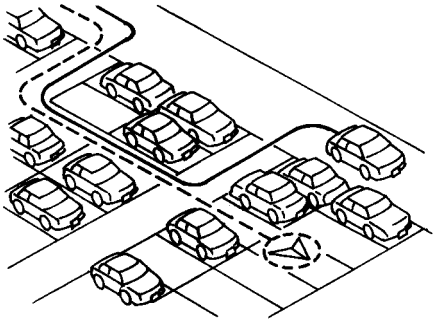
MAP MATCHING OPERATION

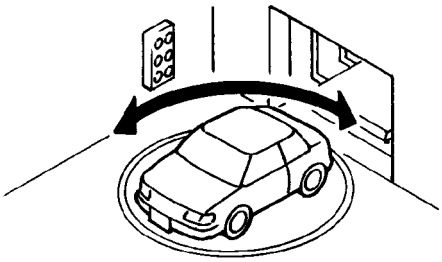
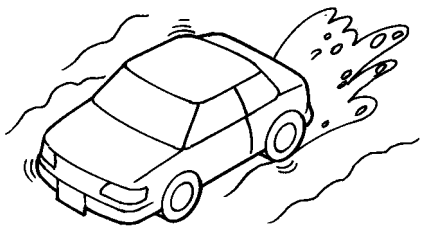
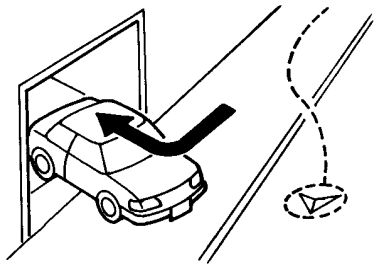
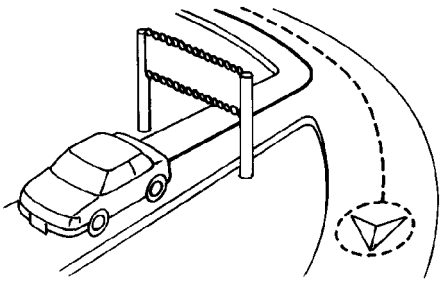
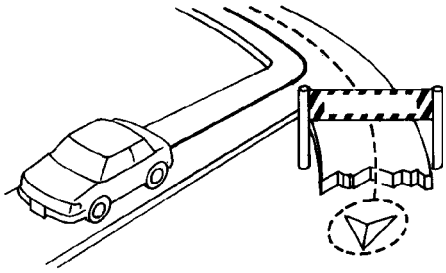
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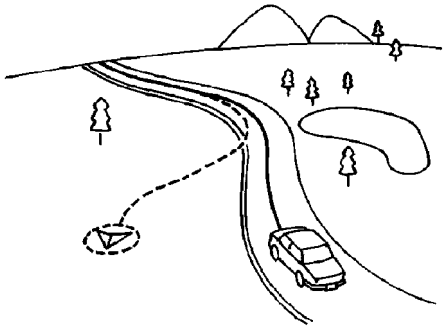
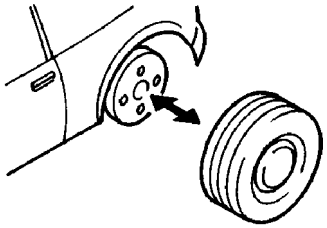
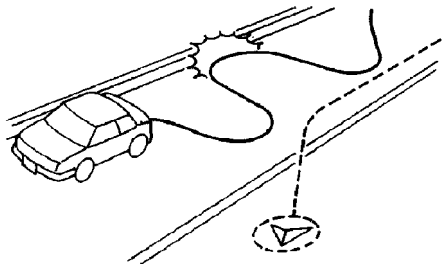
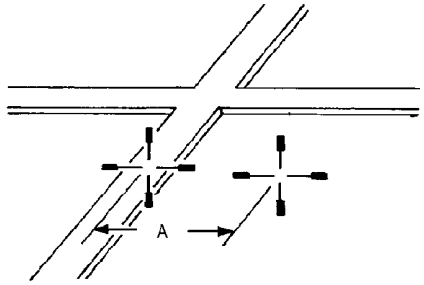
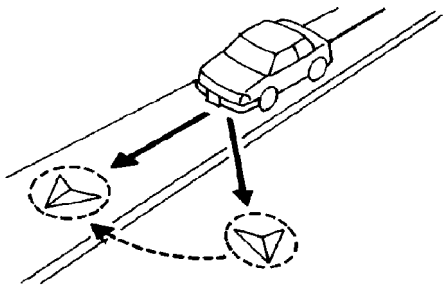
Map Matching Remarks

- The map matching function proposes route correction on an order of priority other than the currently indicated route. Therefore, when the navigation unit detects travelling speed or progressive direction errors, it could mistake the order of priority and fail to correct the route.
- Due to the system operation principles, the map matching function may be unable to determine which route a vehicle is taking when there are similar roads around the vehicle, and may not correct the vehicle's position until it can find a particular route.
- While driving on a road that does not exist in the map data or when the actual vehicle's position is far away from the position indicated by the vehicle locator mark, map matching will not be performed.
- Under the following driving conditions and GPS satellite conditions, the vehicle locator mark may deviate from the actual position of the vehicle. This does not indicate any breakdown in the system and if driving continues for a while, the current position will be corrected automatically.

Cause (Condition)	Driving condition
	• At a Y-shaped fork in the road where the roads separate gradually, the vehicle locator mark may be displayed on the wrong road.
	• If the vehicle makes continuous, large turns, for example on a loop structure, the vehicle locator mark may go off the road altogether.

Cause (Condition)	Driving condition
	• After driving for a long distance in a straight line or through gentle curves, if the vehicle turns a corner, the vehicle locator mark may be displayed on the wrong road.
	• On a zigzag road, the vehicle locator mark may go off the road.
	• If the roads form a grid, the vehicle locator mark may go off the road.
	• If there are parallel roads nearby, for example motorways and service roads, the vehicle locator mark may go off the road.
	• If driving in an area where roads are not available on the map, the vehicle locator mark may deviate from the correct position when the vehicle returns to the road. Also, when you turn or go back and forth repeatedly, the vehicle locator mark may not line up correctly with the road.

Cause (Condition)	Driving condition
	• If the vehicle rotates on a turntable, the navigation system may have difficulty returning the vehicle locator mark to the road correctly.
	• On slippery roads; for example, snow and ice-covered roads, wet roads, gravel roads, the vehicle locator mark may deviate from the correct road.
	• If the vehicle turns on an embankment; for example, at a parking garage entrance, on slope or banked roads, the vehicle locator mark may go off the road.
	• If driving on a new road not registered in the map data, the navigation system may incorrectly match the vehicle's position with a nearby road and when the vehicle returns to a road available in the map data, the vehicle locator mark may be off the correct road.
	• If the road registered in the map data and the actual road configuration differ, the vehicle locator mark may be off the correct road.

Cause (Condition)	Driving condition
	• For regions where there is no detailed map, the navigation system compares regions where there are detailed maps and configuration is sometimes not expressed correctly. Also, because few minor roads are registered, when the vehicle drives on a road not available in the map data, the vehicle locator mark may go off the correct road.
	• If the vehicle has tire chains, the distance travelled is not correctly detected and the vehicle locator mark may go off the correct road.
	• If the vehicle moves erratically, for example spinning wheels, the vehicle locator mark may go off the correct road.
	• In locations such as cities where there are a lot of roads, if the setting accuracy is poor when the vehicle's position is moved, the navigation system may be unable to find the correct road and accuracy may drop.
	• If the vehicle's position is moved and the vehicle direction does not match, the accuracy may drop afterwards.

LCD UNIT OUTLINE

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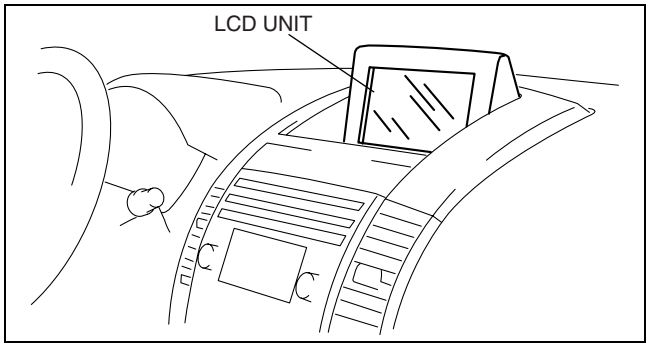
- The LCD display navigational information based on signals from the car-navigation unit.
- The LCD unit senses the user operations from the car-navigation control switch and sends a signal to the car-navigation unit.

LCD UNIT CONSTRUCTION

EPU092066901S02

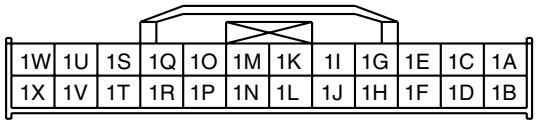
Structural View

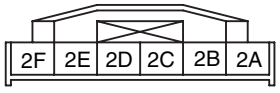
- Located at the center of the dashboard.



EPU920ZS2015

Terminal Layout and Signal

Terminal		Signal
		24-pin connector
	1A	Video (B)
	1B	Video (G)
	1C	Video (composite sync)
	1D	Video (R)
	1E	Video GND
	1F	Video GND
	1G	Shield GND
	1H	–
	1I	Monitor serial output
	1J	Shield GND
	1K	Monitor serial input
	1L	–
	1M	Rear cam
	1N	–
	1O	ACC
	1P	GND
	1Q	B+
	1R	Parking brake signal
	1S	Shield GND
	1T	–
	1U	UART2
	1V	Illumination (+)
	1W	UART1
	1X	Illumination (-)

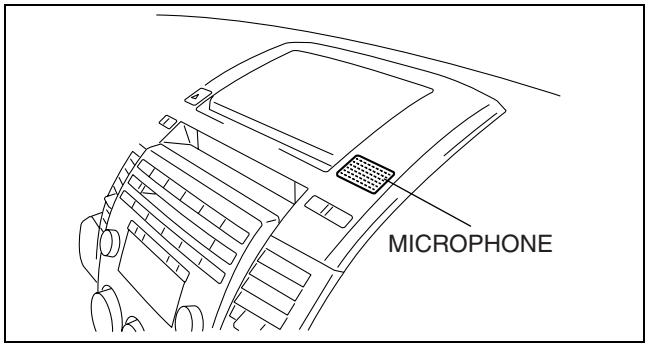
Terminal		Signal
		6-pin connector
	2A	Power
	2B	GND
	2C	Illumination
	2D	—
	2E	Remote data
	2F	Shield GND

Terminal		Signal
		1-pin connector
	3A	GND

MICROPHONE CONSTRUCTION/OPERATION

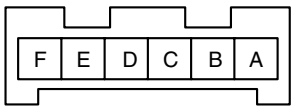
EPU092000175S02

- Located at the center of the LCD unit.
- Recognize the voice entry.



EPU920ZS2021

Terminal Layout and Signals

Terminal		Signals
		6-pin connector
	A	Mic (+)
	B	Mic (-)
	C	Mic power
	D	GND
	E	Mic sense
	F	–

CAR-NAVIGATION CONTROL SWITCH OUTLINE

EPU092066921S01

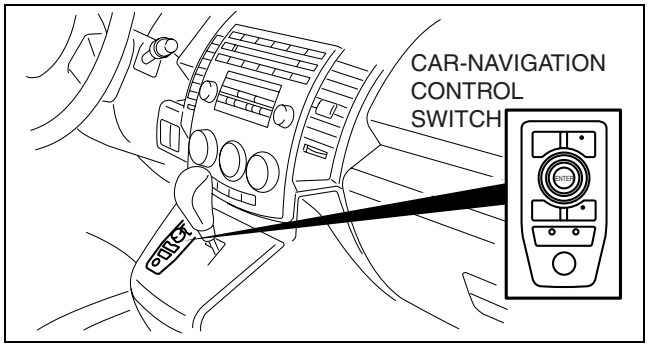
- A remote control for the car-navigation system, with simplified design for easy operation, has been adopted.

CAR-NAVIGATION CONTROL SWITCH CONSTRUCTION/OPERATION

EPU092066921S02

Construction

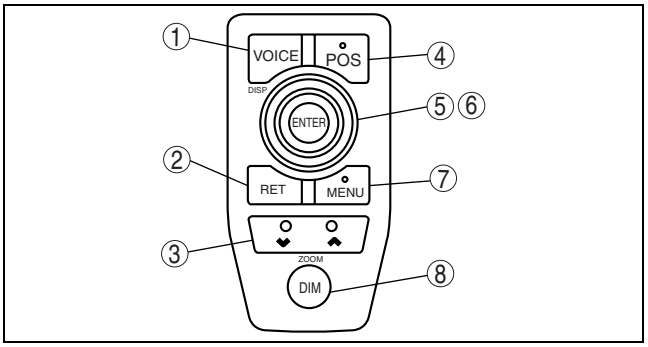
- The car-navigation control switch is located on the console.



EPU920ZS2022

Operation

No.	Button (component)	Function
1	[VOICE] button	• Initiates vocal guidance for route maneuvers. • Adjusts the display.
2	[RET] button	Returns to the previous screen.
3	[ZOOM] button	Changes the map scale.
4	[POS (Position)] button	Displays the current position.
5	Joystick	Selects items by tilting it up, down, right and left.
6	[ENTER] button	Executes a selected item.
7	[MENU] button	Selects menus.
8	[DIM] button	Cancel the night mode.



DPE920ZNB007

NAVIGATION FUNCTION

EPU092066000S06

Outline

- A vehicle's position is measured by a hybrid method of autonomous navigation (using yaw-rate signals from the gyro sensor and vehicle speed signals from the instrument cluster) and GPS navigation (using signals from GPS satellites). Accurate detection of the vehicle's position is possible based on the adoption of a map-matching function which specifies the vehicle's position as compared with the map data read from the DVD-ROM and the vehicle's position measured from autonomous navigation and GPS navigation.
- Guidance to destination is provided via display of the recommended route on the map screen, as well as voice messaging guidance at intersections and points of divergence.
- Based on inputted signals and information on the DVD-ROM, the following features are available:
  - — Destination can be selected based on address, POI (Point of Interest), postcode, memory point, home, preset destination, junction, motorway Ent/Exit, coordinates, map or previous destination.
  - — Route information is available in map, turn list, turn arrow, enlarged junction diagram, motorway information mode.
  - — Voice guidance and menus are available in twelve languages.
  - — A map screen that displays maps in thirteen steps with scales from 50 m to 256 km {1/32 mile to 128mile}.
  - — A map screen that displays routes according to Search condition and route preferences.

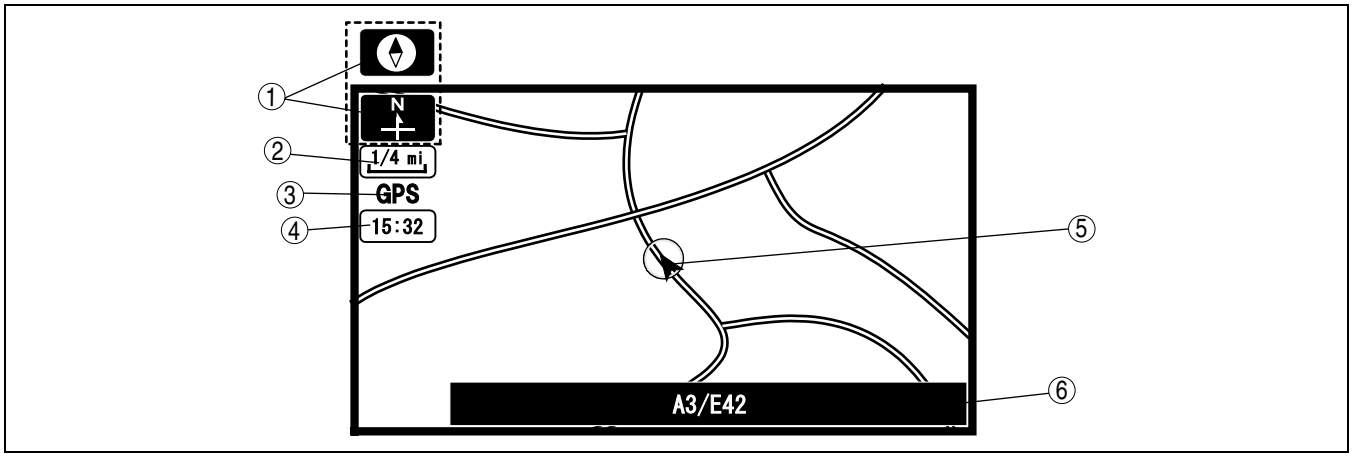
    Search condition

    Quick: The route with the quickest time will be used.
    Altern.: The alternative route will be used.
    Short: The route with the shortest distance.

    Route preferences

    Allow Major roads
    Allow toll road
    Allow restricted road
    Allow ferry
    Allow car train

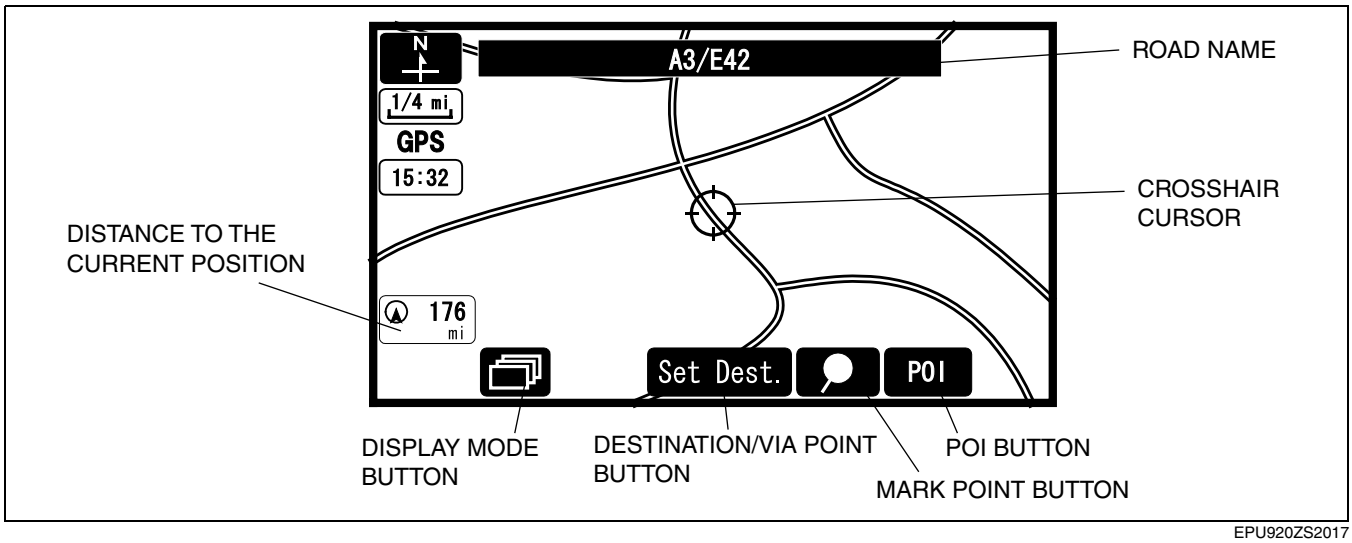
Map Screen Selection
Current position map
- The location of the vehicle and surrounding area are shown.



EPU920ZS2016

No.	Contents	Description
1	Map orientation	**North up** • Geographic north is up. **Head up** • The direction you are heading is up.
2	Map scale	The map can be displayed in 9 steps with scale from 50 m to 256 km {1/32 mile to 128 mile}
3	GPS reception indicator	Illuminates when receiving signals from 3 or more satellites.
4	Clock	Clock will be displayed when you set up clock on navigation set up on.
5	Vehicle position	Shows the current position and direction of the vehicle.
6	Road name	Shows the name of the road you are currently driving on.

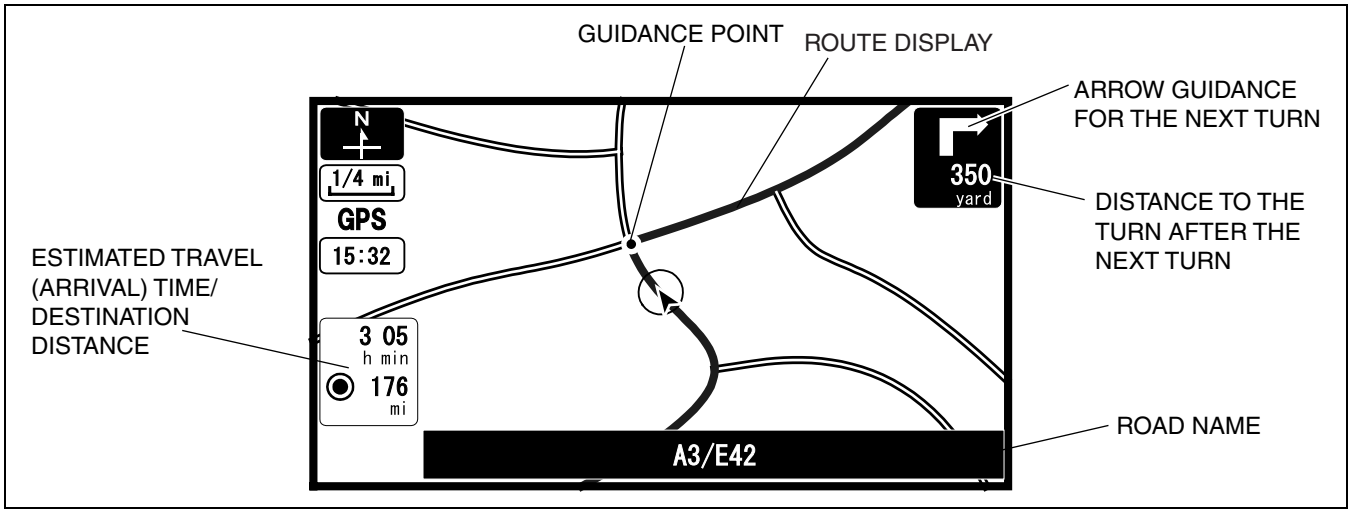
Scroll map mode
- The scroll map is displayed when operating the joystick on the current position map.
- This map can be scrolled with the crosshair cursor.



EPU920ZS2017

Guide mode

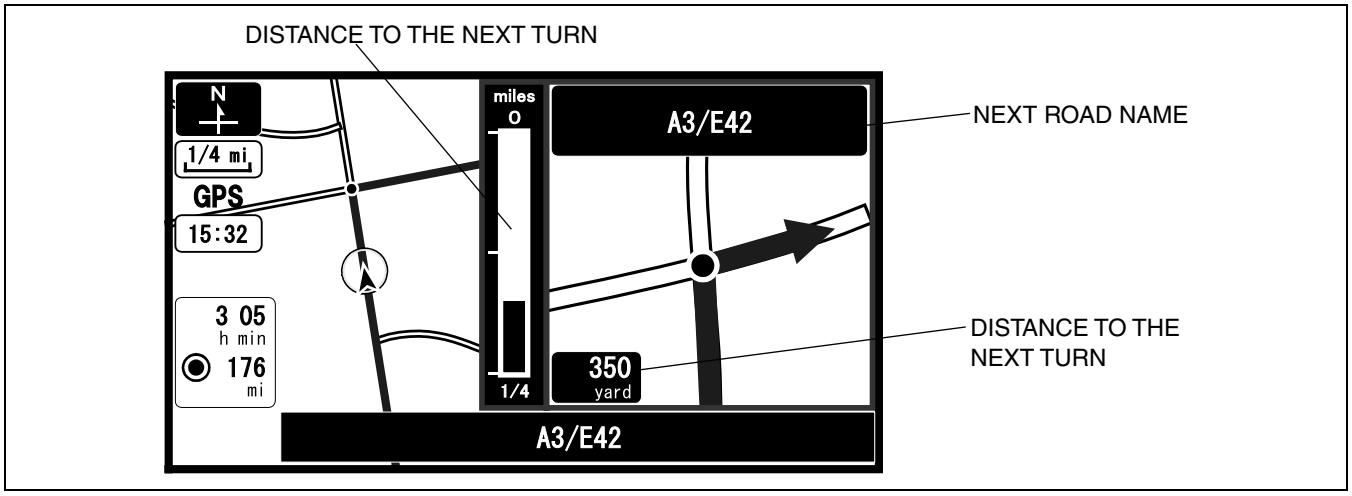
- Displays an enlarged view of the road using an arrow to indicate destination, and also displays route and destination guidance information. (While in route guidance.)



EPU920ZS2018

Intersection zoom map

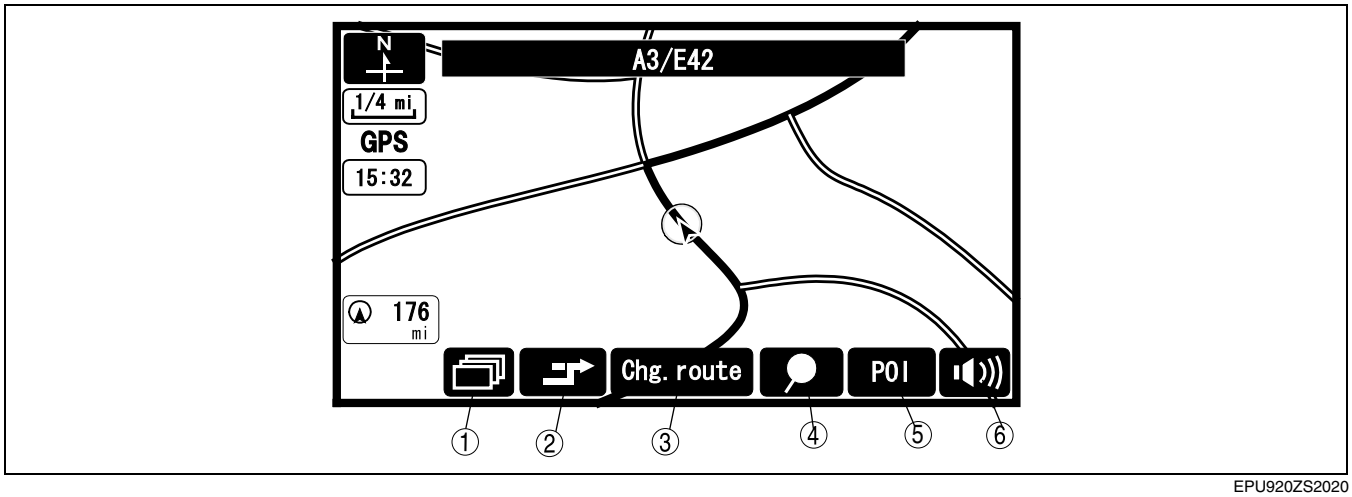
- An enlarged map is displayed when approaching a roundabout or intersection. (While in route guidance.) Activated by selecting Guidance Screen (On) in setup mode.



EPU920ZS2019

Pop Up Menu

- Pop up menu appears when pressing the [ENTER] button.
- The following items are displayed on the pop up menu. The actual displayed items vary according to the selected map, guidance, and other factors.



EPU920ZS2020

No.	Contents	Description
1	Display configuration	The following items can be selected. • single or dual map • Turn list • Turn arrow • Enlarged junction diagram • Motor way information
2	Detour	Searches for detour.
3	Change route	Changes route search settings.
4	Store memory point	Stores markers on the map.
5	POI (Point of Interest) display	Displays POI on the map.
6	Volume	Adjusts volume of voice guidance.

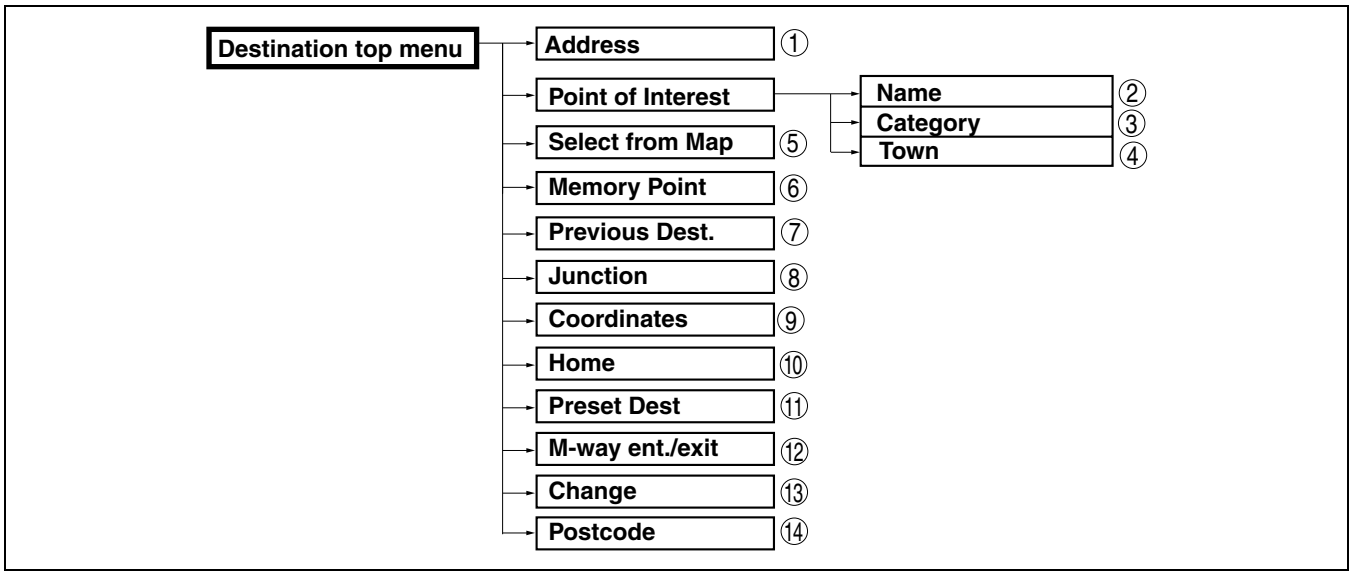
Destination Setting Function

Outline

- The following instructions explain how destinations can be chosen and set.

Note

- A destination can be set to where the crosshair cursor indicates by selecting the Destination option of the scroll map mode pop-menu.

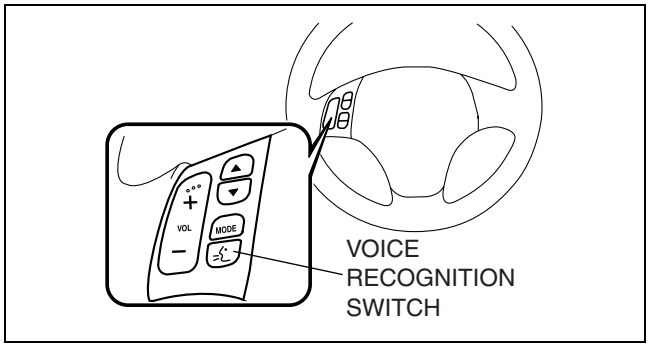


DPE920ZNB013

No.	Contents
1	Sets destination by inputting address.
2	Sets destination by inputting POI name.
3	Sets destination by selecting POI category, inputting target name and selecting POI.
4	Sets destination by selecting POI category, inputting city name and selecting POI.
5	Sets destination by moving the crosshair cursor to the destination when in scroll map mode.
6	Sets destination from a list of points stored by the user.
7	Sets destination from a list of recent destinations.
8	Sets destination by selecting junction name.
9	Sets destination by inputting coordinates.
10	Sets destination to home.
11	Sets destination to preset destination point.
12	Sets destination by selecting M-way ent./exit.
13	Changes search area.
14	Sets destination by inputting postal code.

Voice Recognition Function

- Voice control can be carried out by simply pressing voice recognition switch and speaking voice command into the microphone.



EPU920ZS2023

Voice recognition command

Note

Read notes listed below to have voice recognition recognize your voice properly.

- Speak a voice command clearly.
- Keep yourself in a safe driving position. Do not face or approach the microphone to speak a voice command into it.
- Voice recognition may fail in recognizing your command due to a tone of your voice. In such cases, change the tone by speaking more loudly and clearly, etc.
- Keep inside the vehicle quite when speaking a voice command. Your command may be disturbed by noises made by people, blinkers, the horn, and vehicle's vibration etc, and noise from outside the vehicle.
- Use the language you selected in voice recognition.

- The following voice commands can be used with voice recognition function.

Shortcut Commands

[Show] Current (Position/Location)
[Show] Map
Repeat [Voice] [Guidance]
Cancel

( ) : Indicates the commands to be the object of "/"
[ ] : Recognizes without uttering the command in "[ ]"
/ : Recognizes when uttering either commands before and after "/"

Map Operation Commands

Zoom In
Zoom Out
Zoom In Maximum
Zoom Out Maximum
Right Map Zoom In
Right Map Zoom Out
Right Map (Zoom In Maximum/Minimum Scale)
Right Map (Zoom Out Maximum/Maximum Scale)
[Change to/Show] North up [Mode]
[Change to/Show] Heading up [Mode]
[Change] Map Direction
Right Map [Show] North up [Mode]
Right Map [Show] Heading up [Mode]
Right Map [Change] Map Direction
[Show/Change to] Dual Map [Mode]
[Show/Change to] Single Map [Mode]
(Store/Mark) [This point]

( ) : Indicates the commands to be the object of "/"
[ ] : Recognizes without uttering the command in "[ ]"
/ : Recognizes when uttering either commands before and after "/"

POI Display Commands

Petrol Station/Petrol
Parking/Car Park/Multi storey Car Park/Car Park
Town Centre/City centre
Town hall
Exhibition centre/Convention Centre
Community centre/Civic Centre
University/Higher Education/College
Hospital
Park/Park & Recreation/Recreation/Amusement Park
Bowling centre/Bowling alley
Casino
Cinema
Golf course
Historical Monument
Ice Skating rink/Ice rink
Museum
Music club
Ski resort/Skiing
Sports centre/Sports Complex/Stadium
Theatre
Tourist attraction
Tourist information
Winery/Vineyard
Restaurant/I'm Hungry/Show Restaurant
Chinese Restaurant/Chinese Food
Fast Food/Fast Food Restaurant
French Restaurant/French Food
Italian Restaurant/Italian Food
Japanese Restaurant/Japanese Food
Other Restaurant/Other Food
Shopping centre/Shops
Airport
Bus station
Ferry port/Ferries
Hotel
Park & Ride/Rest Area
Car Rental
Motorway service
Railway station/Underground Station/Train Station
POI Off

( ) : Indicates the commands to be the object of “/”
[ ] : Recognizes without uttering the command in “[ ]”
/ : Recognizes when uttering either commands before and after “/”

Destination Operation Commands

[Go] Home
Enter Destination
Add to way point
[Go to/Previous] Starting Point
[Go to] Previous Destination
[Go to] Preset Destination [Number] 1
[Go to] Preset Destination [Number] 2
[Go to] Preset Destination [Number] 3
[Go to] Preset Destination [Number] 4
[Go to] Preset Destination [Number] 5
Cancel

( ) : Indicates the commands to be the object of "/"
[ ] : Recognizes without uttering the command in "[ ]"
/ : Recognizes when uttering either commands before and after "/"

Guidance Commands

Louder
Softer
[Show] (Whole/Entire) Route [Map]
[Show] Next Way Point [Map]
Show First Way Point [Map]
Show Second Way Point [Map]
Show Third Way Point [Map]
Show Fourth Way Point [Map]
Show Fifth Way Point [Map]
Show Destination [Map]
(Delete/Cancel) Next Way Point
Yes
No
(Delete/Cancel) Destination
(Delete/Cancel) All Way Points and Destination
Voice guidance OFF
Voice guidance ON
Quick
Alternative
Short
Detour
Detour Entire Route
[Change to] Arrow (Guide/Guidance)
[Change to] Turn List (Guide/Guidance)
[Change to] Motorway (Guide/Guidance)
[Change to] Crossroads (Guide/Guidance)
Display Commands
Display [set] day [mode]
Display [set] night [mode]
Display [set] auto [mode]

( ) : Indicates the commands to be the object of "/"
[ ] : Recognizes without uttering the command in "[ ]"
/ : Recognizes when uttering either commands before and after "/"

09–21 POWER SYSTEMS

POWER SYSTEMS OUTLINE. 09–21–1

POWER SYSTEMS STRUCTURAL VIEW 09–21–1

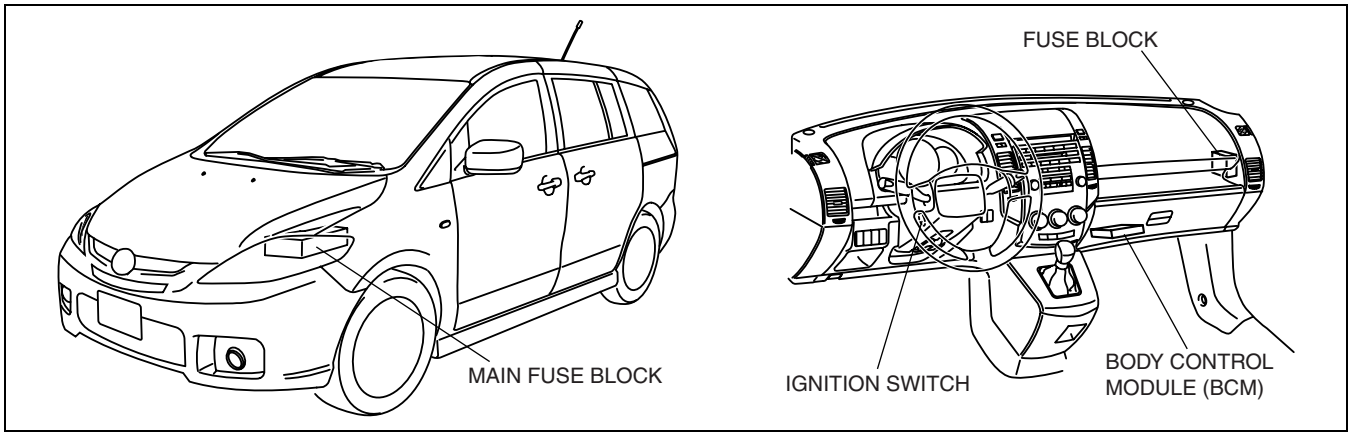
POWER SYSTEMS OUTLINE

EPU092100200S01

- All relays and fuses are located in the main fuse block, fuse block and body control module (BCM).
- The keyless switch is built into the ignition switch.

POWER SYSTEMS STRUCTURAL VIEW

EPU092100200S02



EPU921ZS3001

09–22 INSTRUMENTATION/DRIVER INFO.

INSTRUMENT CLUSTER OUTLINE 09–22–1
INSTRUMENT CLUSTER SPECIFICATIONS 09–22–2
INSTRUMENT CLUSTER STRUCTURAL VIEW 09–22–3
Meter And Gauge 09–22–3
Warning And Indicator Light 09–22–4
INSTRUMENT CLUSTER SYSTEM WIRING DIAGRAM 09–22–5
INPUT/OUTPUT CHECK MODE OUTLINE 09–22–6
INPUT/OUTPUT CHECK MODE OPERATION 09–22–6
Operation procedure 09–22–6
Input circuit check 09–22–7
Individual circuit check 09–22–7
PID/Data Monitor and Record 09–22–8
LIGHTS-ON REMINDER WARNING ALARM OUTLINE 09–22–8
LIGHTS-ON REMINDER WARNING ALARM CONSTRUCTION/OPERATION 09–22–8
System Wiring Diagram 09–22–8
Operation 09–22–8
SEAT BELT WARNING ALARM OUTLINE 09–22–8
SEAT BELT WARNING ALARM CONSTRUCTION/OPERATION 09–22–9
System Wiring Diagram 09–22–9
Operation 09–22–9
KEY REMINDER WARNING ALARM OUTLINE 09–22–9
KEY REMINDER WARNING ALARM CONSTRUCTION/OPERATION 09–22–9
System Wiring Diagram 09–22–9
Operation 09–22–9
TURN AND HAZARD INDICATOR ALARM OUTLINE 09–22–10
TURN AND HAZARD INDICATOR ALARM CONSTRUCTION/OPERATION 09–22–10
System Wiring Diagram 09–22–10
Operation 09–22–10
SPEEDOMETER CONTROL OUTLINE 09–22–10
SPEEDOMETER CONTROL CONSTRUCTION/OPERATION 09–22–10
System Wiring Diagram 09–22–10
Operation 09–22–10
TACHOMETER CONTROL OUTLINE 09–22–11
TACHOMETER CONTROL CONSTRUCTION/OPERATION 09–22–11
System Wiring Diagram 09–22–11
Operation 09–22–11
FUEL GAUGE CONTROL OUTLINE 09–22–11
FUEL GAUGE CONTROL CONSTRUCTION/OPERATION 09–22–11
System Wiring Diagram 09–22–11
Operation 09–22–11
WATER TEMPERATURE GAUGE CONTROL OUTLINE 09–22–12
WATER TEMPERATURE GAUGE ONTROL CONSTRUCTION/OPERATION 09–22–12
System Wiring Diagram 09–22–12
Operation 09–22–12
INFORMATION DISPLAY FUNCTION 09–22–12
INFORMATION DISPLAY SYSTEM WIRING DIAGRAM 09–22–13
INFORMATION DISPLAY CONSTRUCTION/OPERATION 09–22–13
Display Function 09–22–13
Clock Function 09–22–14
Input/output Check Function 09–22–14
HORN CONSTRUCTION 09–22–15

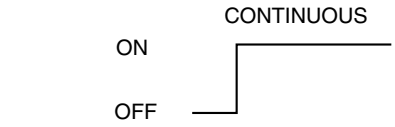
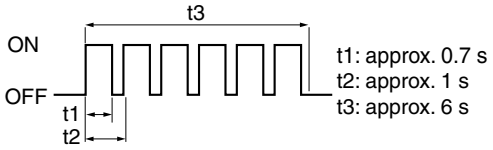
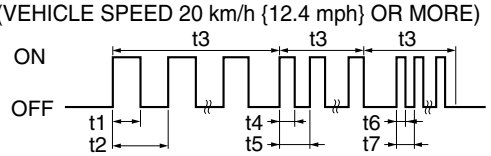
INSTRUMENT CLUSTER OUTLINE

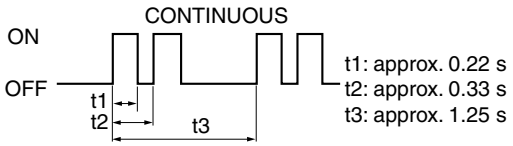
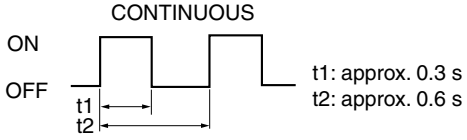
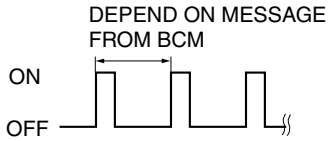
EPU092255430S01

- The CAN system has been adopted for the control signals of the input/output communication circuit of the meters, gauges and warning and indicator lights. (See 09–40–6 CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE.)
- LEDs have been adopted for warning and indicator lights installed on the instrument cluster.
- The information display, which includes the clock, audio system, and A/C system displays, has been placed in the center of the instrument panel. It also includes the drive information system, depending on the vehicle grade.
- A trumpet-type horn with spiral, resonant pipes, has been adopted.

INSTRUMENT CLUSTER SPECIFICATIONS

EPU092255430S02

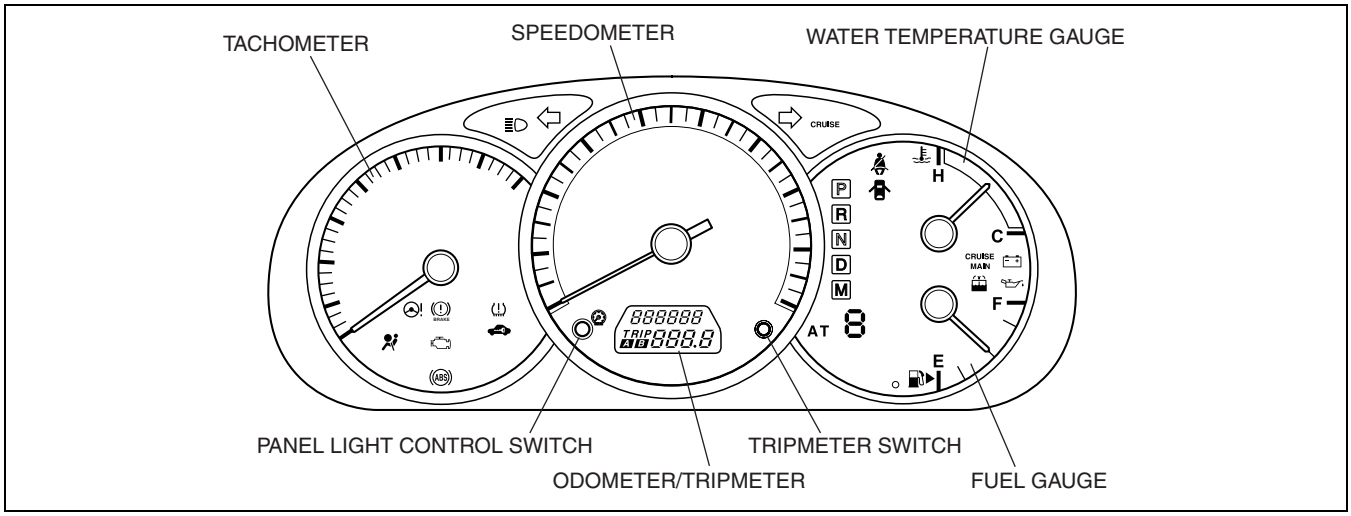
Item			Specification
Speedometer	Meter type		Stepping motor type
	Indication range (mph {km/h})		0—143 {0—230}
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage (V)		DC 12
Tachometer	Meter type		Stepping motor type
	Indication range (rpm)		0—8,000
	Red zone (rpm)		6,500—8,000
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage (V)		DC 12
Fuel gauge	Meter type		Stepping motor type (Reset-to-zero type)
	Input signal communication system		Conventional communication system
	Input signal source		Fuel gauge sender unit
	Rated voltage (V)		DC 12
Water temperature gauge	Meter type		Stepping motor type (Medium range stabilized type)
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage (V)		DC 12
Odometer/ Tripmeter	Display		LCD
	Indication digits		Odometer: 6 digits, Tripmeter: 4 digits
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage (V)		DC 12
Warning alarms	Sound frequency (Hz)		1,800—2,600
	Output sound pressure level (dB)		73.5—81.5
	Lights-on reminder warning alarm	Sound frequency (Hz)	1,900
		Sound cycle	
	Seat belt warning alarm	Sound frequency (Hz)	2,400
		Sound cycle	WHEN IGNITION SWITCH TURNED ON  WHILE VEHICLE DRIVING (VEHICLE SPEED 20 km/h {12.4 mph} OR MORE)  t1: approx. 0.25 s t2: approx. 0.50 s t3: approx. 31.0 s t4: approx. 0.10 s t5: approx. 0.20 s t6: approx. 0.05 s t7: approx. 0.10 s

Item			Specification
Warning alarms	Key reminder warning alarm	Sound frequency (Hz)	1,800
		Sound cycle	
	Tire pressure warning alarm	Sound frequency (Hz)	2,600
		Sound cycle	
Indicator alarm	Output sound pressure level (dB)		54.5
	Turn and hazard indicator alarm	Sound cycle	

INSTRUMENT CLUSTER STRUCTURAL VIEW

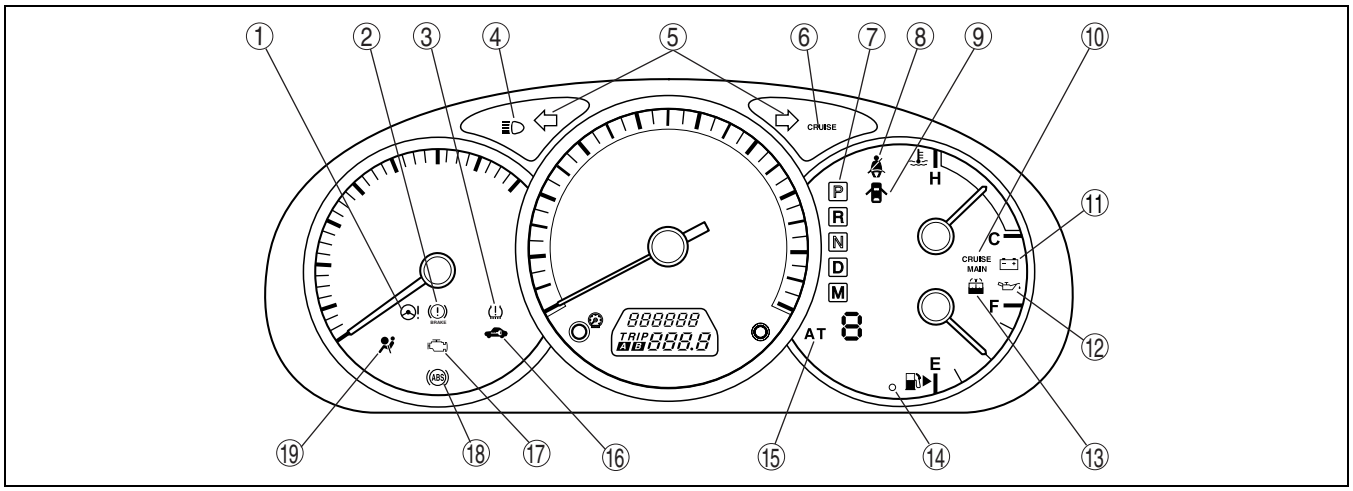
EPU092255430S03

Meter And Gauge



EPU922ZS3002

Warning And Indicator Light



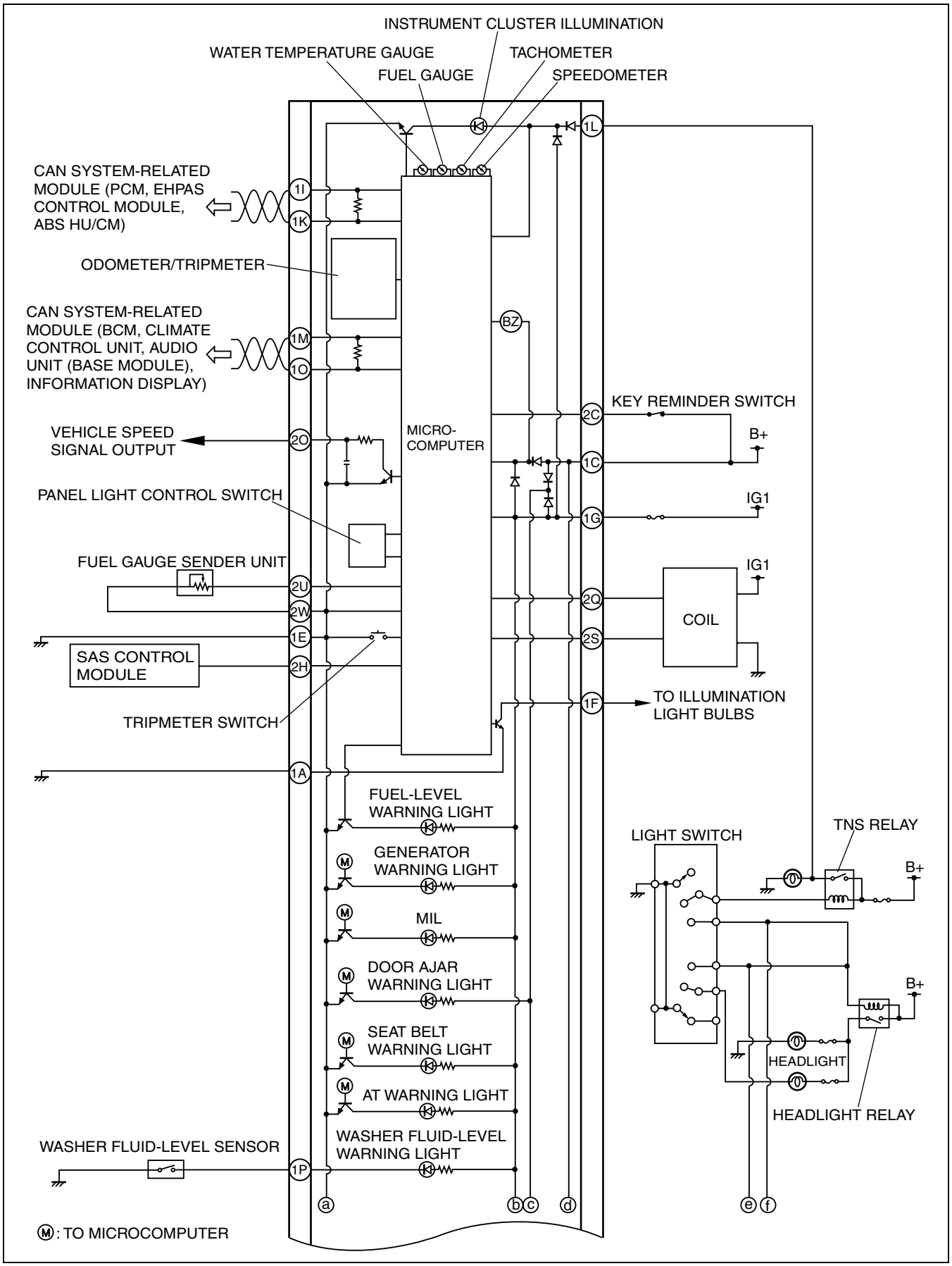
EPU922ZS3003

×: Applicable

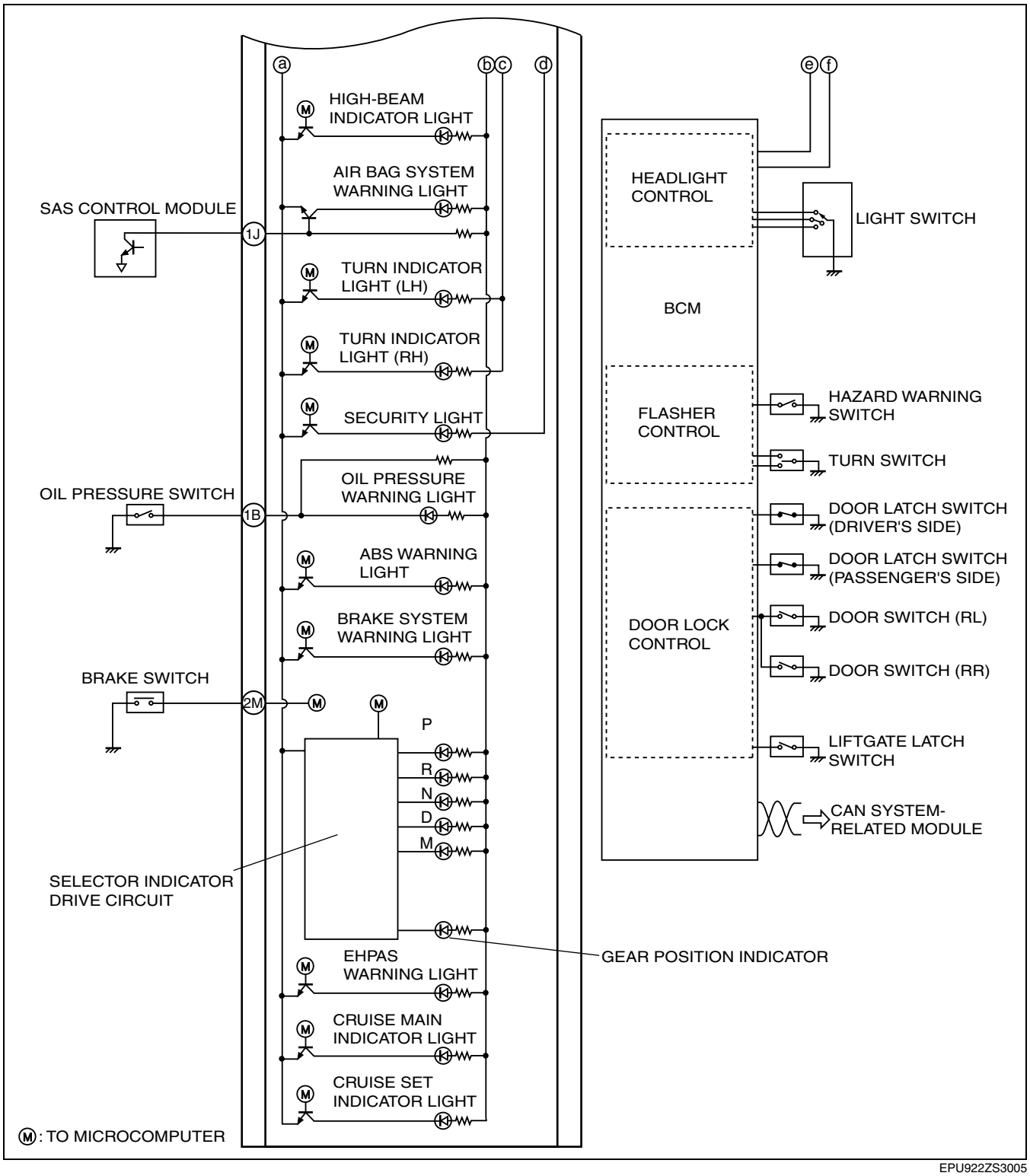
No.	Warning and indicator light	Input signal source	CAN system	Note
1	EHPAS warning light	EHPAS control module	×	—
2	Brake system warning light	ABS HU/CM	×	—
3	Tire pressure warning light	TPMS control module	×	—
4	High-beam indicator light	BCM	×	—
5	Turn indicator light	BCM	×	—
6	Cruise set indicator light	PCM	×	With cruise control system
7	Selector indicator light	PCM	×	ATX
8	Seat belt warning light	Buckle switch	—	—
9	Door ajar warning light	BCM	×	—
10	Cruise main indicator light	PCM	×	With cruise control system
11	Generator warning light	PCM	×	—
12	Oil pressure warning light	Oil pressure switch	—	—
13	Washer fluid level warning light	Washer fluid level sensor	—	—
14	Fuel-level warning light	Fuel gauge sender unit	—	—
15	AT warning light	PCM	×	ATX
16	Security light	—	—	—
17	MIL	PCM	×	—
18	ABS warning light	ABS HU/CM	×	—
19	Air bag system warning light	SAS control module	—	—

INSTRUMENT CLUSTER SYSTEM WIRING DIAGRAM

EPU092255430S04



EPU922ZS3004



EPU922ZS3005

INPUT/OUTPUT CHECK MODE OUTLINE

EPU092255430S05

- The microcomputer built into instrument cluster detects the quality of input signals and individual parts.
- Input/output check mode has both input circuit inspection and individual part inspection functions.

INPUT/OUTPUT CHECK MODE OPERATION

EPU092255430S06

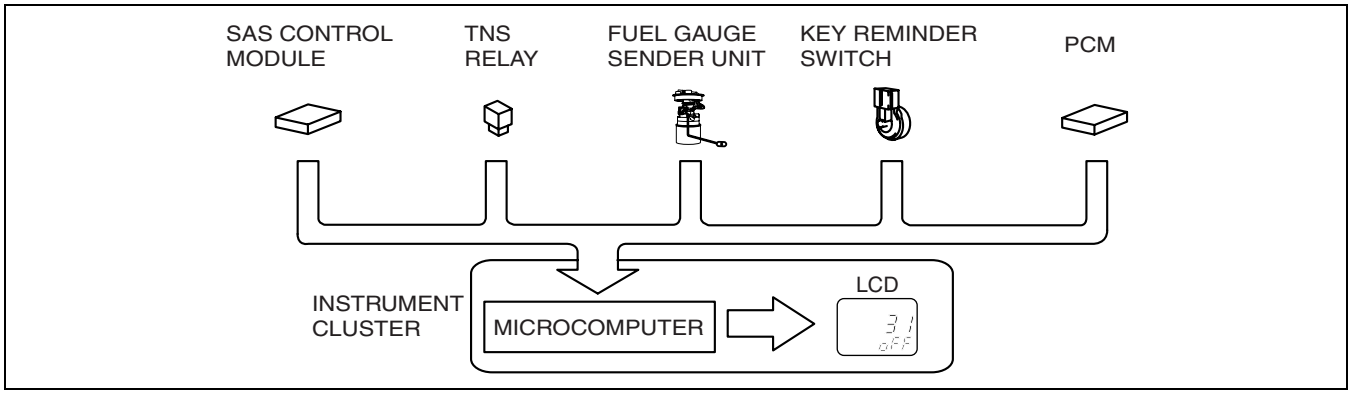
Operation procedure

- Refer to Mazda5 Workshop Manual.

Input circuit check

- When the parts listed in the chart are operated and signal is output to the instrument cluster, the built-in microcomputer determines the operability of the input circuit based on that signal.

Check code	Parts sending input signal
01	SAS control module
08	TNS relay
22	Fuel gauge sender unit
31	Key reminder switch (built into the ignition switch or steering lock unit)
59	Fuel system signal

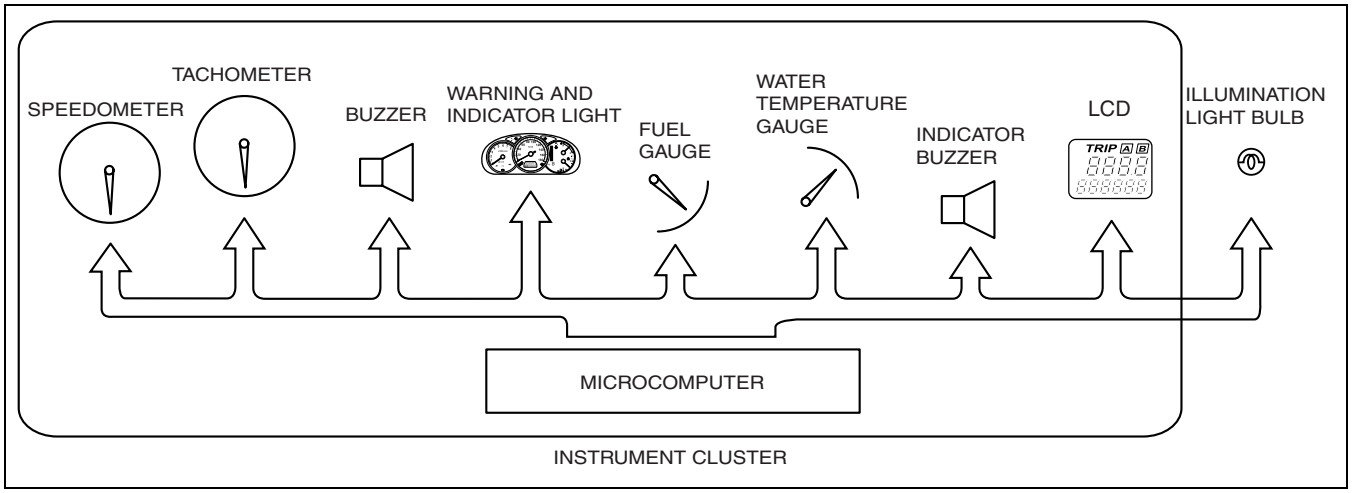


EPU922ZS3006

Individual circuit check

- By operating the parts listed in the chart, the built-in microcomputer determines the operability of the individual parts.

Check code	Parts sending input signal
12	Speedometer
13	Tachometer
14	Buzzer
16	Fuel-level warning light
23	Fuel gauge
25	Water temperature gauge
26	LCD, warning and indicator light
32	Indicator buzzer
57	Panel light control



EPU922ZS3007

PID/Data Monitor and Record

- The PID/data monitoring items for the instrument cluster is as shown in following the table:

Monitor item table

—: Not applicable

Monitor item	Input-output signal/part name	Unit/State		Terminal
CCNT_HE	Number of continuous DTCs	—		—
ECT_GAUGE	Water temperature gauge	°F	°C	1I, 1K
NUMKEYS	Number of key ID numbers registered with the vehicle	—		—
ODO COUNT	Odometer	m		1I, 1K
SPDOMETER	Speedometer	MPH	KPH	
TACH	Tachometer	RPM		

LIGHTS-ON REMINDER WARNING ALARM OUTLINE

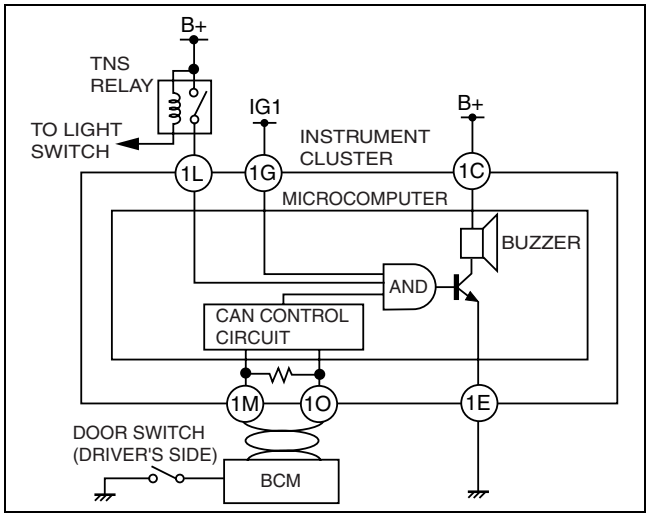
EPU092255430S07

- Warns the driver that the headlights or TNS are on when the driver-side door is opened.

LIGHTS-ON REMINDER WARNING ALARM CONSTRUCTION/OPERATION

EPU092255430S08

System Wiring Diagram



EPU922ZS3008

Operation

- The buzzer in the instrument cluster sounds continuously when all the following three conditions are met:
  - — The ignition switch is in the LOCK or ACC position.
  - — The headlight switch is in the TNS or headlight position.
  - — The driver-side door is open (driver-side door switch is on).

SEAT BELT WARNING ALARM OUTLINE

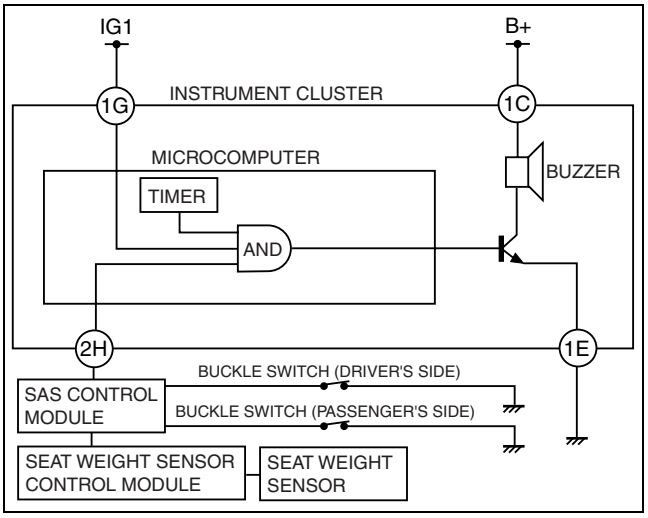
EPU092255430S09

- Warns the driver that the seat belt (driver-side or passenger-side) is unfastened.

SEAT BELT WARNING ALARM CONSTRUCTION/OPERATION

EPU092255430S10

System Wiring Diagram



EPU922ZS3009

Operation

- The buzzer in the instrument cluster sounds for **6 s** when all the following two conditions are met:
  - — After the ignition switch is turned to ON position.
  - — The seat belt (driver-side) is unfastened (buckle switch is off).
- The buzzer in the instrument cluster sounds for **93 s** when all the following two conditions are met:
  - — The seat belt (driver-side or passenger-side) is unfastened (driver-side: buckle switch is off, passenger-side: buckle switch is off and seat weight sensor detects passenger).
  - — The vehicle speed is **20 km/h {12.4 mph} or more**.

09–22

KEY REMINDER WARNING ALARM OUTLINE

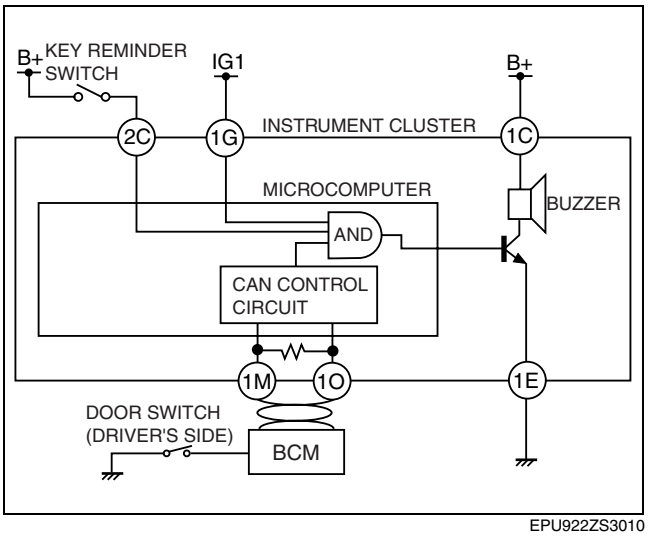
EPU092255430S11

- Warns the driver that the key is in the steering lock when the driver-side door is opened.

KEY REMINDER WARNING ALARM CONSTRUCTION/OPERATION

EPU092255430S12

System Wiring Diagram



EPU922ZS3010

Operation

- The buzzer in the instrument cluster sounds when all the following three conditions are met:
  - — The ignition switch is in the LOCK or ACC position.
  - — The key is in the steering lock (key reminder switch is on).
  - — The driver-side door is open (driver-side door switch is on).

TURN AND HAZARD INDICATOR ALARM OUTLINE

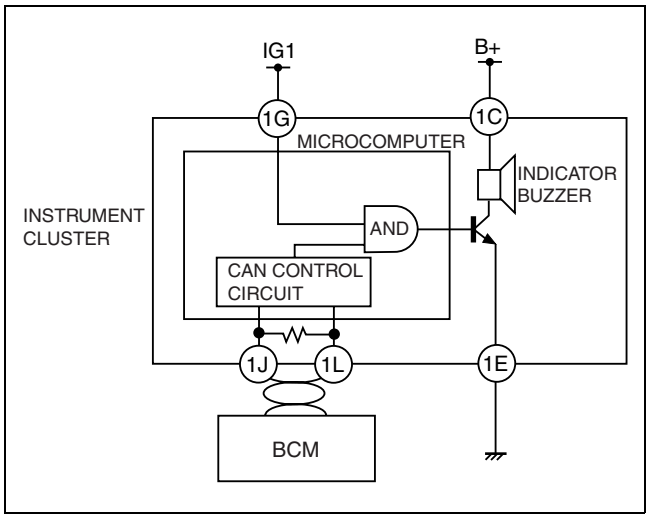
EPU092255430S13

- The indicator buzzer sounds when the turn indicator flashes.

TURN AND HAZARD INDICATOR ALARM CONSTRUCTION/OPERATION

EPU092255430S14

System Wiring Diagram



EPU922ZS3011

Operation

- The turn and hazard signal sent from the BCM via the CAN system is input to the microcomputer in the instrument cluster. The microcomputer sends an output signal to the turn indicator light and the indicator buzzer.

SPEEDOMETER CONTROL OUTLINE

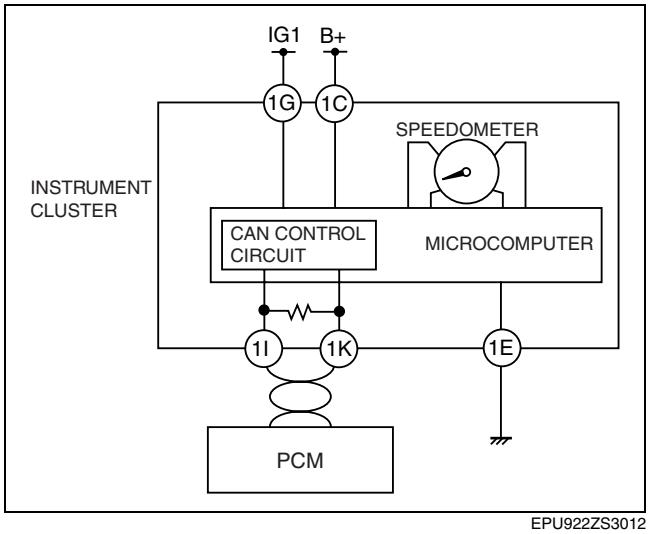
EPU092255430S15

- The vehicle speed signal is output from the PCM to the microcomputer in the instrument cluster.

SPEEDOMETER CONTROL CONSTRUCTION/OPERATION

EPU092255430S16

System Wiring Diagram



EPU922ZS3012

Operation

- The vehicle speed signal sent from the PCM via the CAN system is input to the microcomputer in the instrument cluster. The microcomputer calculates the current vehicle speed based on the vehicle speed signal, and sends an output signal to the speedometer.

TACHOMETER CONTROL OUTLINE

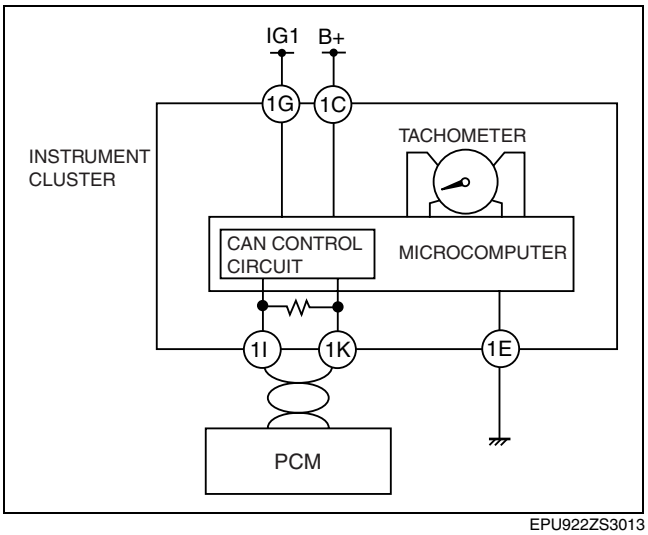
EPU092255430S17

- The engine speed signal is output from the PCM to the microcomputer in the instrument cluster.

TACHOMETER CONTROL CONSTRUCTION/OPERATION

EPU092255430S18

System Wiring Diagram



EPU922ZS3013

Operation

- The engine speed signal sent from the PCM via the CAN system is input to the microcomputer in the instrument cluster. The microcomputer calculates the current engine speed based on the engine speed signal, and sends an output signal to the tachometer.

09–22

FUEL GAUGE CONTROL OUTLINE

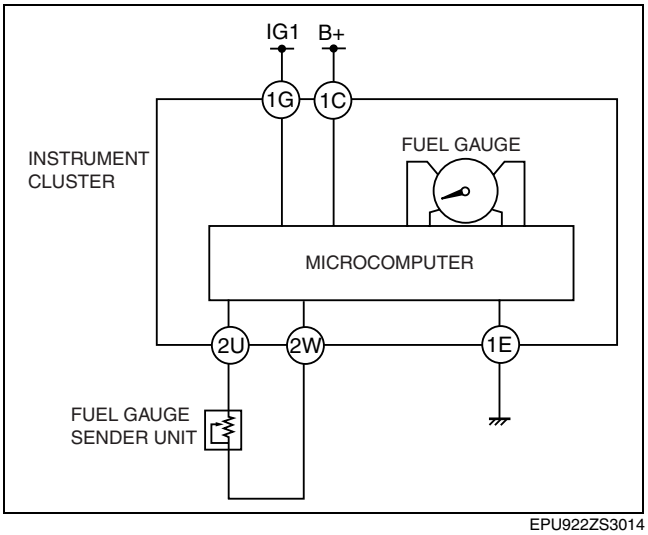
EPU092255430S19

- The fuel level signal is output from the fuel gauge sender unit to the microcomputer in the instrument cluster. Fuel gauge variation caused by fluctuating fuel level when cornering or driving on a slope, is reduced by microcomputer control.

FUEL GAUGE CONTROL CONSTRUCTION/OPERATION

EPU092255430S20

System Wiring Diagram



EPU922ZS3014

Operation

- A resistance according to fuel level is sent from the fuel gauge sender unit to the microcomputer. The microcomputer calculates the average resistance within a specified time, and sends the output signal to the fuel gauge based on the calculated value.

WATER TEMPERATURE GAUGE CONTROL OUTLINE

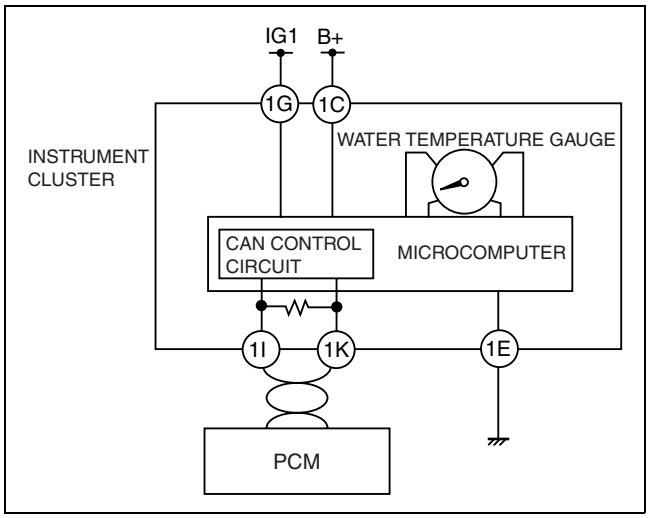
EPU092255430S21

- The engine coolant temperature signal is output from the PCM to the microcomputer in the instrument cluster.

WATER TEMPERATURE GAUGE CONTROL CONSTRUCTION/OPERATION

EPU092255430S22

System Wiring Diagram



EPU922ZS3015

Operation

- The engine coolant temperature signal sent from the PCM via the CAN system is input to the microcomputer in the instrument cluster. The microcomputer calculates the current engine coolant temperature based on the engine coolant temperature signal, and sends an output signal to the water temperature gauge.

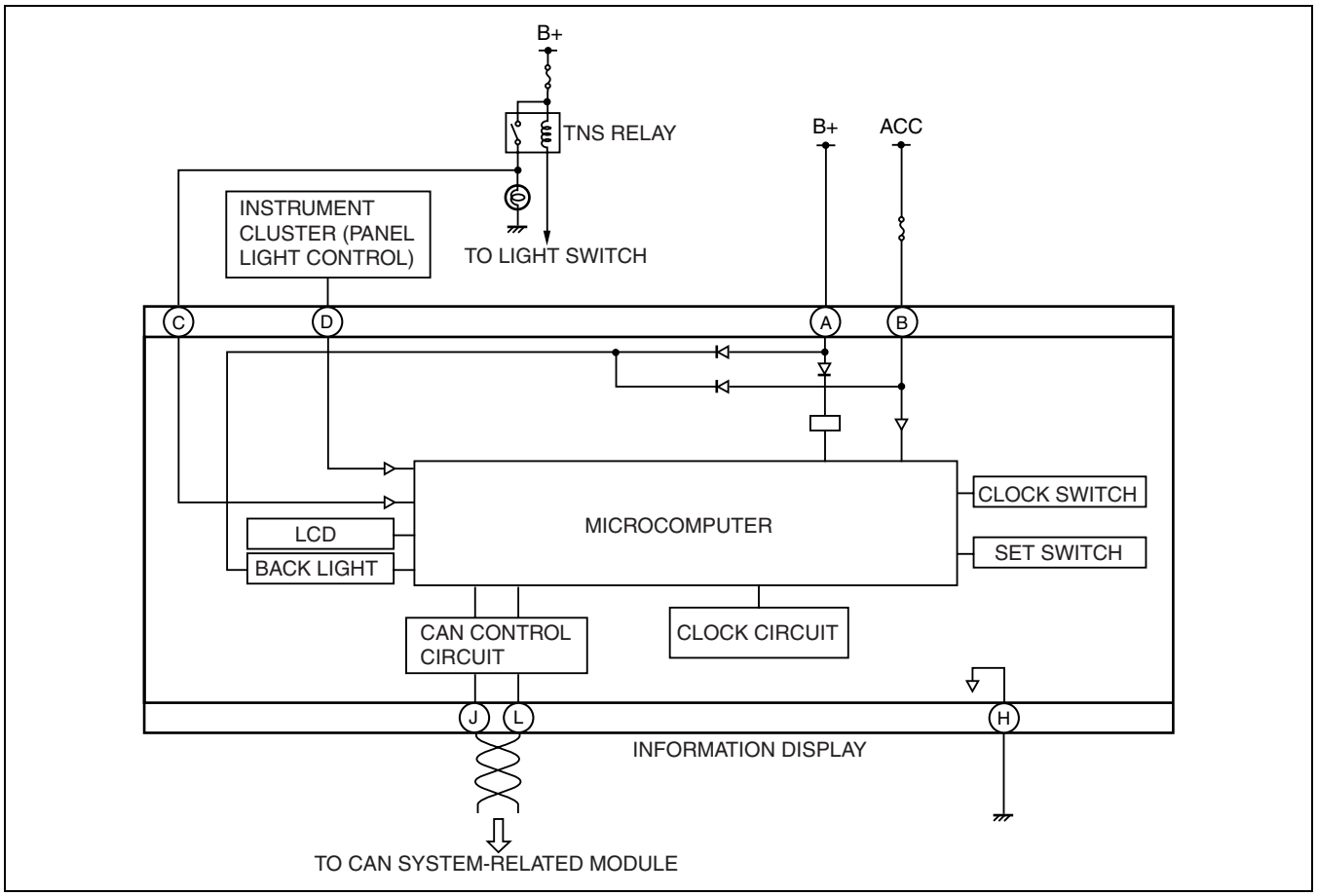
INFORMATION DISPLAY FUNCTION

EPU092255000S01

- The information display has the following functions:
  - — Display function
  - — Clock function
  - — Input/output check function

INFORMATION DISPLAY SYSTEM WIRING DIAGRAM

EPU092255000S02



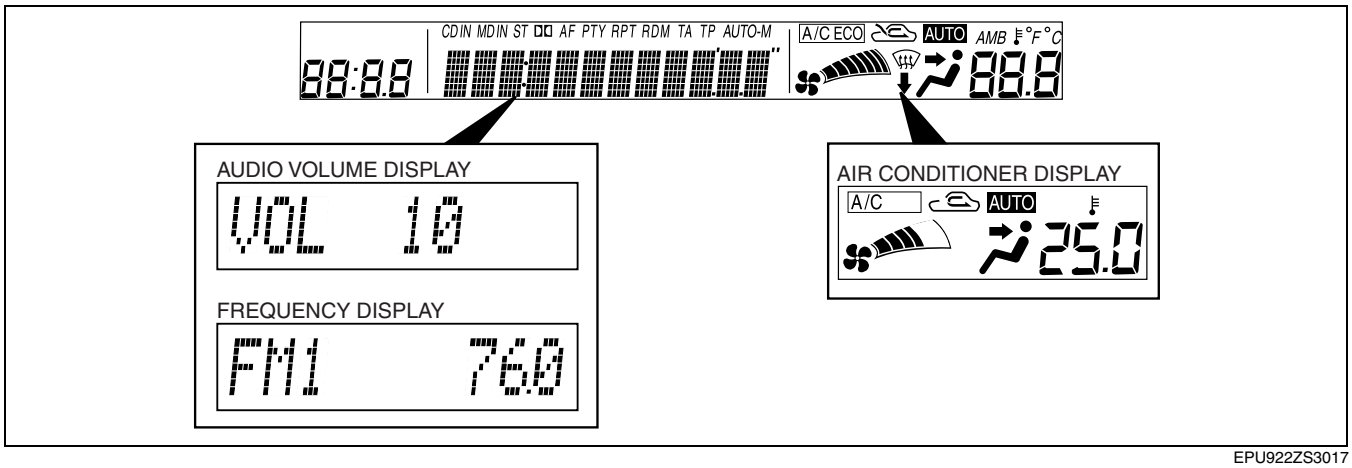
EPU922ZS3016

INFORMATION DISPLAY CONSTRUCTION/OPERATION

EPU092255000S03

Display Function

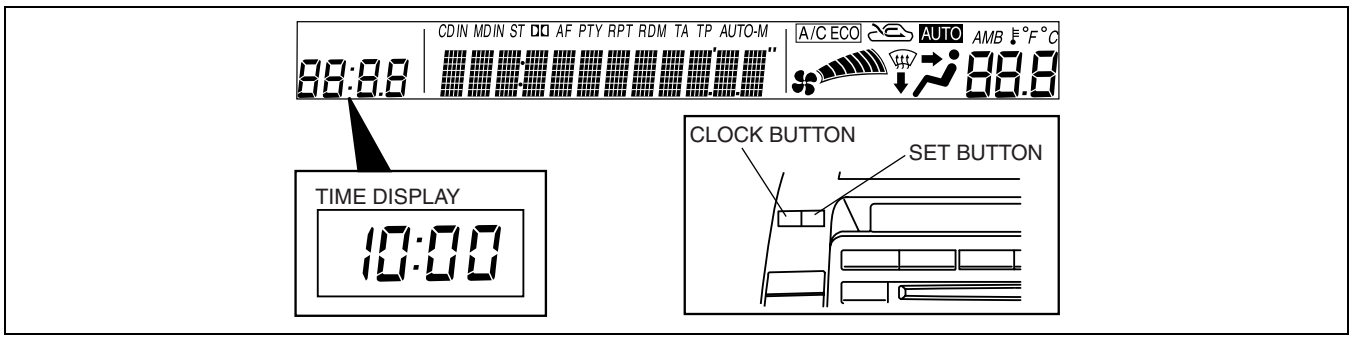
- Displays information for the audio system (such as volume and frequency) and air conditioner system (such as air flow volume, set temperature, and mode) based on the signals from the audio unit and the climate control module.



EPU922ZS3017

Clock Function

- A clock is integrated.
- Time can be adjusted with the buttons on the left side of the information display.



EPU922ZS3018

Input/output Check Function

- An input/output check function has been adopted which performs signal input to the display and examines the LCD according to the micro-computer built into the information display.

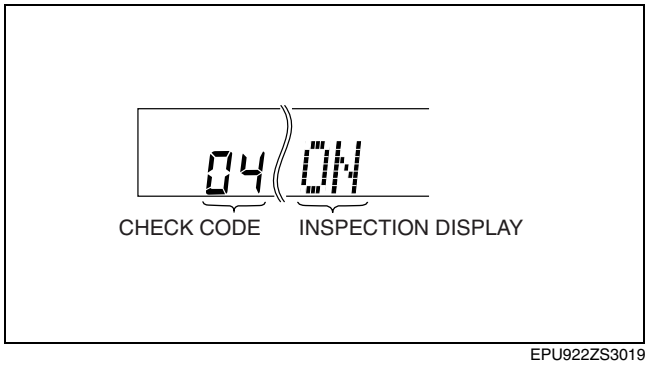
Check code

- When the signal output part indicated in the table below is activated, the micro-computer performs self-diagnosis of the signal input to the information display. Also, inspection of segments and dots is possible by illuminating the entire LCD.

Check code	Signal output part	Malfunction location
01	Information display	CAN system communication error
02	• Audio unit • Climate control module • Instrument cluster	Communication error to signal output part
03	LCD	—
04	TNS relay	• TNS relay • BCM • TNS signal wiring harness
05	—	—

Check code display

- The check code and inspection display are displayed in the LCD clock and audio display areas.

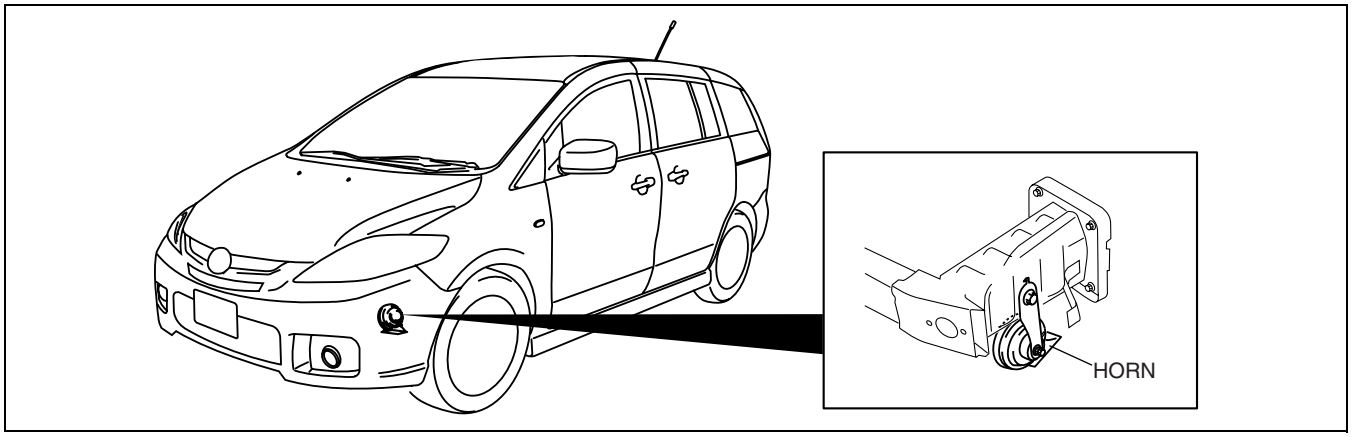


EPU922ZS3019

HORN CONSTRUCTION

EPU092266790S01

- A trumpet-type horn with spiral-shaped resonant pipes has been adopted.



EPU922ZS3020

09–40 CONTROL SYSTEM

BODY CONTROL MODULE (BCM) OUTLINE 09–40–1
BODY CONTROL MODULE (BCM) STRUCTURAL VIEW 09–40–1
BODY CONTROL MODULE (BCM) WIRING DIAGRAM 09–40–2
ON-BOARD DIAGNOSTIC FUNCTION [BODY CONTROL MODULE (BCM)] . . 09–40–5
Malfunction Detection Function **09–40–5**
PID/Data Monitor Function. **09–40–6**
CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE 09–40–6
CAN SYSTEM STRUCTURAL VIEW 09–40–7
CAN SYSTEM WIRING DIAGRAM 09–40–7
CAN SYSTEM DESCRIPTION 09–40–8
Mechanism of CAN System-Related Module **09–40–8**
Twisted Pair **09–40–8**
Time Division Multiplex **09–40–9**
Vehicle CAN System **09–40–9**
CAN Signal-Chart (HS-CAN) **09–40–10**
CAN Signal-Chart (MS-CAN) **09–40–11**
On-Board Diagnostic Function **09–40–11**

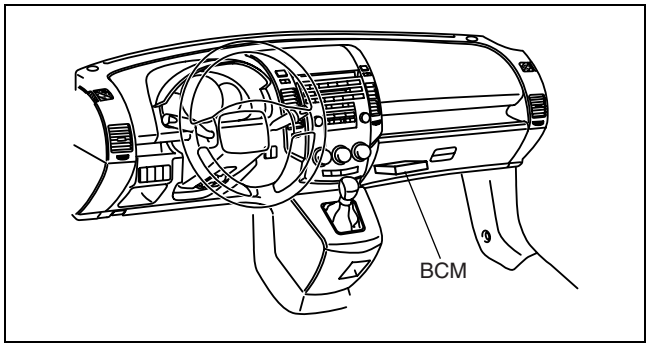
BODY CONTROL MODULE (BCM) OUTLINE

EPU094000200S01

- The following relays are built into the BCM:
  - — Windshield wiper relay
  - — Windshield wiper HI relay
  - — Door lock/unlock relays
- The BCM controls the following systems:
  - — Lighting system
  - — Wiper/washer system
  - — Power door lock system
  - — Keyless entry system
  - — Rear window defroster system

BODY CONTROL MODULE (BCM) STRUCTURAL VIEW

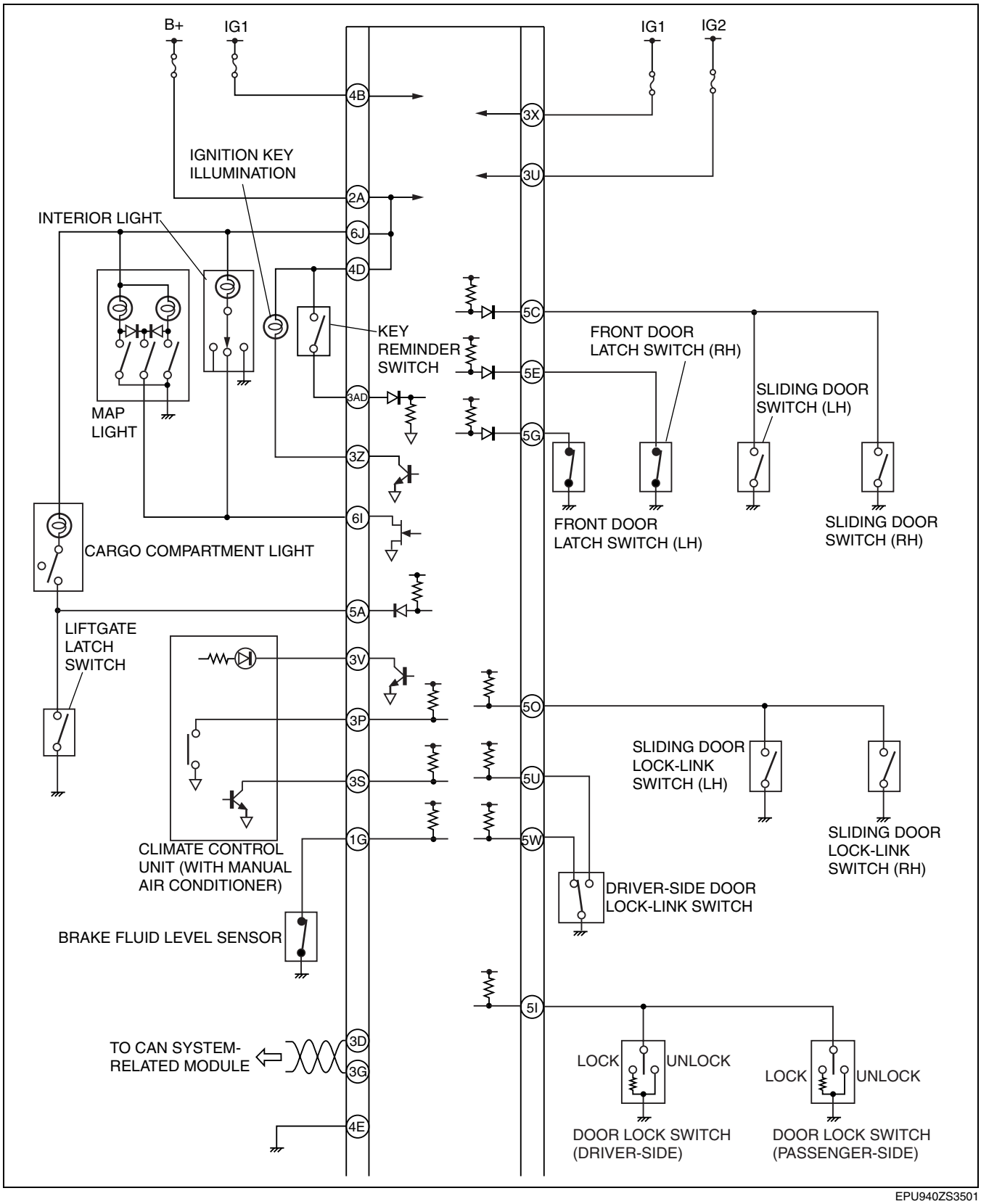
EPU094000200S02



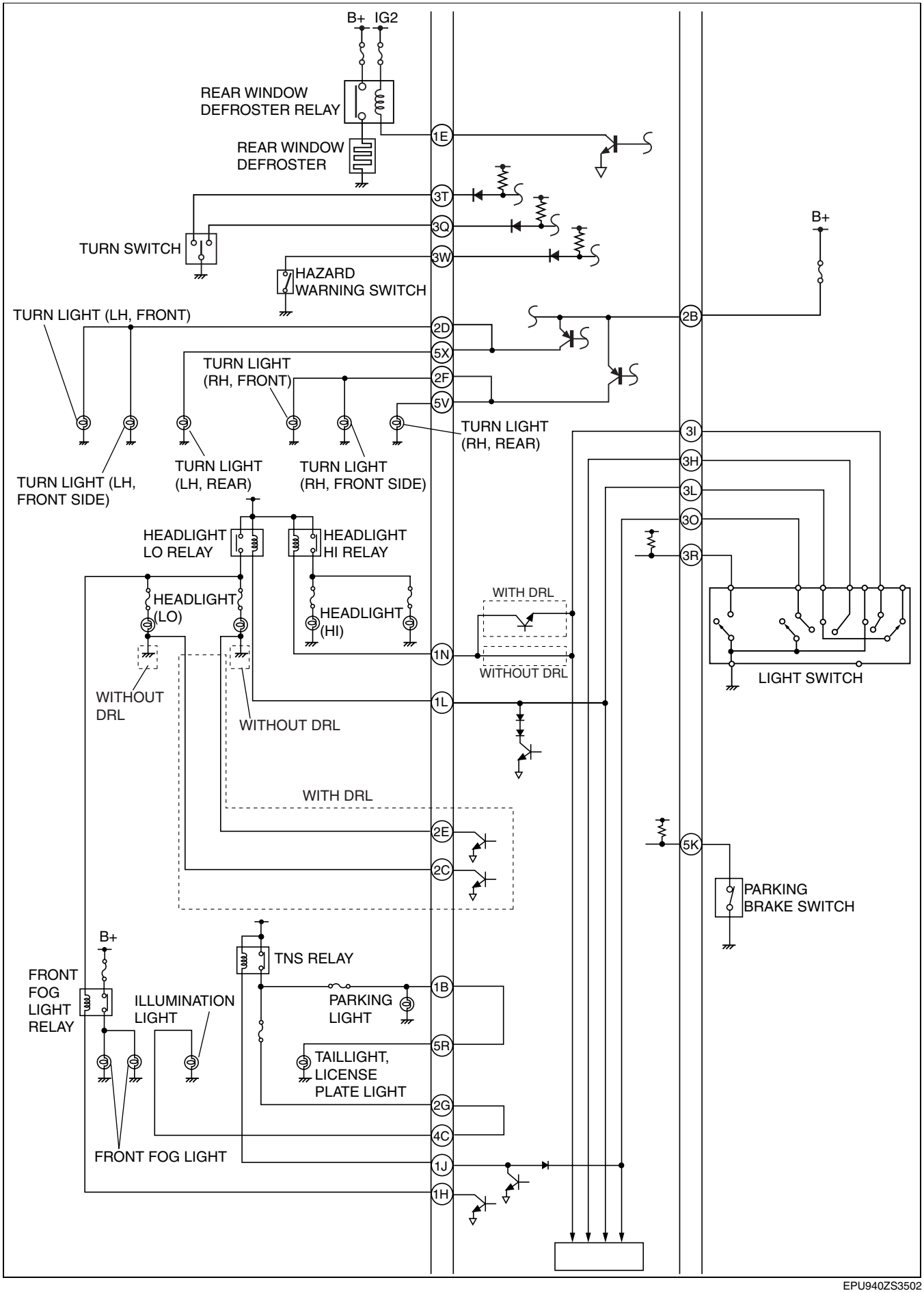
DPE940ZT1001

BODY CONTROL MODULE (BCM) WIRING DIAGRAM

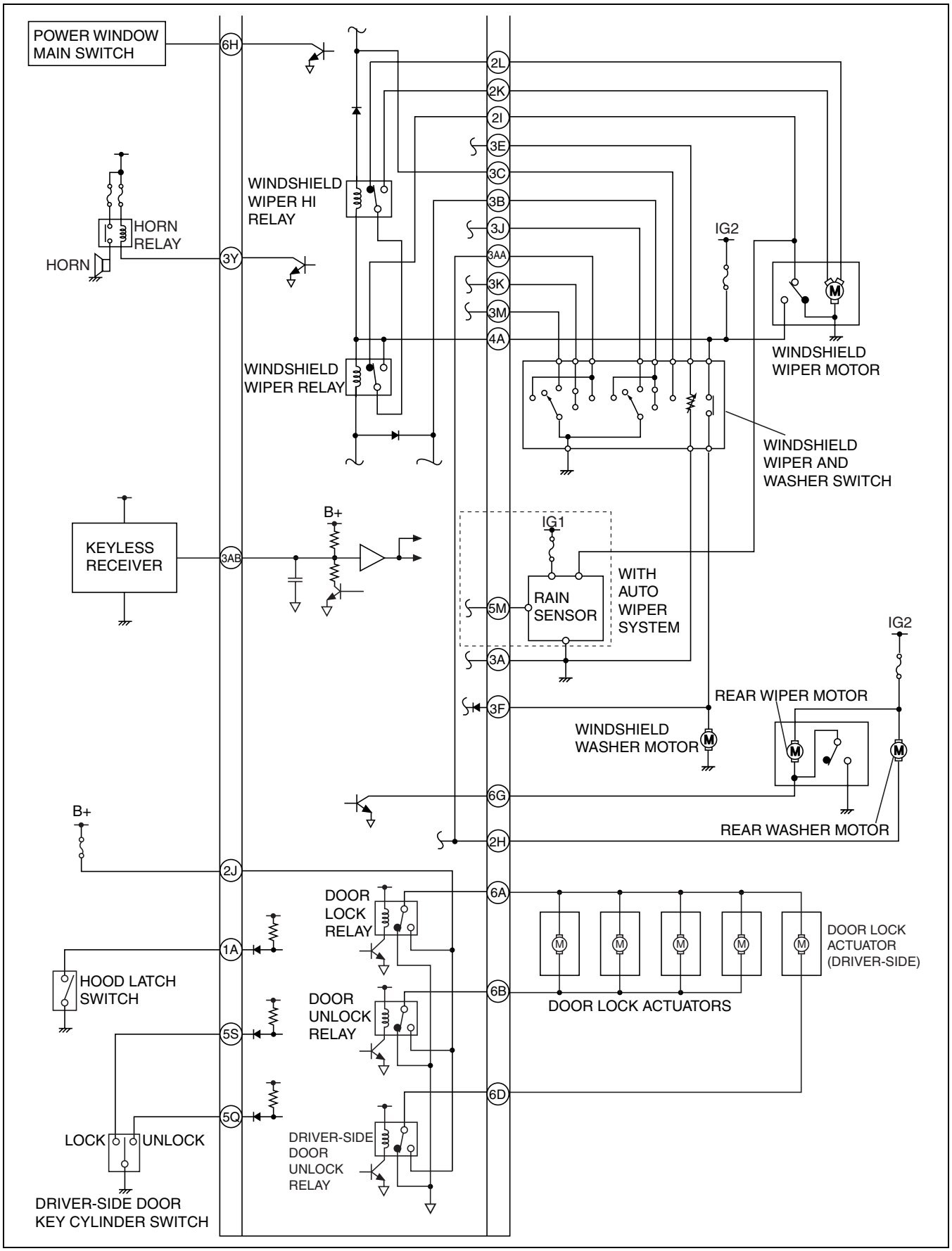
EPU094000200S03



EPU940ZS3501



EPU940ZS3502



EPU940ZS3503

ON-BOARD DIAGNOSTIC FUNCTION [BODY CONTROL MODULE (BCM)]

EPU094000200S04

- The on-board diagnostic system consists of a malfunction detection system that detects abnormalities in input/output signals, a data monitor function that reads out specified input/output signals.
- The data link connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis and detecting/repair into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the WDS or equivalent to the DLC-2.
- In addition to DTC read-out, the WDS or equivalent is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor function, providing enhanced malfunction diagnosis and improved serviceability.

Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the BCM.

DTC table

DTC No.	Description	Detection condition
B1014	Rain sensor error	Rain sensor internal malfunction
B1311	Unlock switch circuit open	Open circuit in wiring harness between BCM and sliding door lock-link switch (unlock signal)
B1317	Battery voltage high	Input voltage from the battery is excessively high
B1318	Battery voltage low	Input voltage from the battery is excessively low
B1320	Driver door ajar circuit open	Open circuit in wiring harness between BCM and front door latch switch (driver-side)
B1328	Passenger door ajar circuit open	Open circuit in wiring harness between BCM and front door latch switch (passenger-side)
B1342	ECU is faulted	BCM microcomputer malfunction
B1345	Heated backlite input circuit short to ground	Short to GND in wiring harness between BCM and climate control unit (rear window defroster switch)
B1447	Wiper park sense circuit open	Open circuit in wiring harness between BCM and windshield wiper motor (autostop switch)
B1472	Headlight on switch input circuit short to ground	Short to GND in wiring harness between BCM and light switch (low beam)
B1506	Turn signal switch circuit short to ground	Short to GND in wiring harness between BCM and turn switch
B1570	Headlight high beam switch input circuit short to ground	Short to GND in wiring harness between BCM and light switch (high beam)
B1572	Sliding door ajar circuit open	Open circuit in wiring harness between BCM and sliding door switch
B1614	Rear wiper interval switch input circuit short to ground	Short to GND in wiring harness between BCM and rear wiper and washer switch (INT)
B1696	Auto light switch input circuit short to ground	Short to GND in wiring harness between BCM and light switch (AUTO)
B1798	Position lights switch (TNS) input circuit short to ground	Short to GND in wiring harness between BCM and light switch (TNS)
B1873	Hazard switch input circuit short to ground	Short to GND in wiring harness between BCM and hazard warning switch
B2114	Front washer switch input circuit short to battery	Short to power supply in wiring harness between BCM and windshield wiper and washer switch (front washer)
B2175	A/C request switch circuit short to ground	Short to GND in wiring harness between BCM and climate control unit (A/C ON request)
B2180	Front wiper switch (slow) circuit short to ground	Short to GND in wiring harness between BCM and windshield wiper and washer switch (low)
B2181	Front wiper switch (high) circuit short to ground	Short to GND in wiring harness between BCM and windshield wiper and washer switch (high)
B2218	Door lock switch circuit short to ground	Short to GND in wiring harness between BCM and door lock switches
B2259	Intermittent wiper circuit short to ground	Short to GND in wiring harness between BCM and windshield wiper and washer switch (INT or AUTO)
B2479	Park brake switch circuit open	Open circuit in wiring harness between BCM and parking brake switch
B2574	Driver door lock switch short to ground	Short to GND in wiring harness between BCM and driver-side door lock-link switch
B2721	Liftgate ajar output short to ground	Short to GND in wiring harness between BCM and liftgate latch switch
U2030	Rain sensor communication fault	Communication error to rain sensor

PID/Data Monitor Function

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the BCM and reading them out in real-time.

PID/data monitor item	Unit/Condition (Tester display)	Input/output part	BCM terminal
ACSW	On/Off	Climate control unit (A/C switch)	3S
AUTOLMP	On/Off	Light switch (AUTO)	3H
BRK_FLUID	LOW/NORMAL	Brake fluid level sensor	1G
C_LOCK_SW	LOCK/OFF	Door lock switches (lock)	5I
C_UNLK_SW	UNLOCK/OFF	Door lock switches (unlock)	
CCNT_GE	—	DTC	—
DD_LOCK	LOCK/UNLOCK	Driver-side door lock-link switch	5U, 5W
HAZARD	On/Off	Hazard warning switch	3W
HBEAMSW	On/Off	Light switch (high beam)	3I
HEADLAMP	On/Off	Light switch (low beam)	3L
LF_AJAR	OPEN/CLOSE	Front door latch switch (LH)	5G
PARK_SW	On/Off	Light switch (TNS)	3O
PRK_BRK	On/Off	Parking brake switch	5K
RDEF_SW	On/Off	Climate control unit (rear window defroster switch)	3P
REAR_AJAR	OPEN/CLOSE	Sliding door switch	5C
RF_AJAR	OPEN/CLOSE	Front door latch switch (RH)	5E
T_AJAR	OPEN/CLOSE	Liftgate latch switch	5A
TURN_SW_L	On/Off	Turn switch (LH)	3T
TURN_SW_R	On/Off	Turn switch (RH)	3Q
WASH_FRT	On/Off	Windshield wiper and washer switch (washer)	3F
WPFAST_FRT	On/Off	Windshield wiper and washer switch (high)	3C
WPINT_FRT	On/Off	Windshield wiper and washer switch (INT or AUTO)	3J
WPINT_REAR	On/Off	Rear wiper and washer switch (INT)	3M
WPRPRKSTS	On/Off	Windshield wiper motor (auto stop switch)	2I
WP_SW_FRT	On/Off	Windshield wiper and washer switch (low)	3B

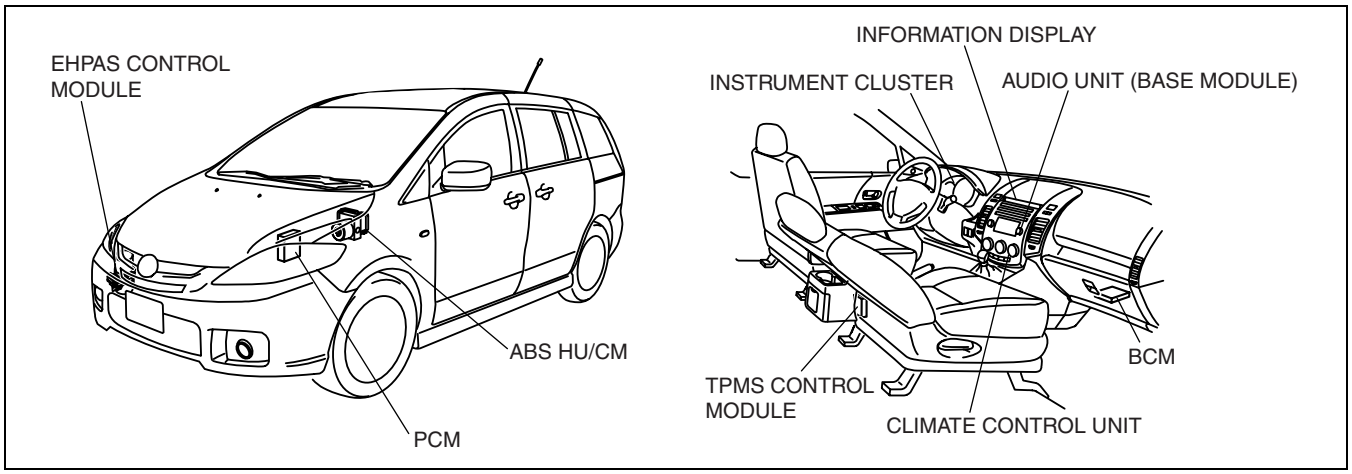
CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE

EPU094055430S01

- Due to the simplification of the wiring harness, a CAN system for transmission of multiplex input/output signals among electrical modules has been adopted.
- Twisted-pair wiring is used for connections between the following modules. (Each electrical module hereafter referred to as a CAN system-related module):
  - — PCM
  - — EHPAS control module
  - — ABS HU/CM
  - — TPMS control module
  - — Instrument cluster
  - — BCM
  - — Climate control unit
  - — Information display
  - — Audio unit (base module)
- With an on-board diagnostic function included for each multiplex module, display of DTCs using the WDS or equivalent has improved serviceability.

CAN SYSTEM STRUCTURAL VIEW

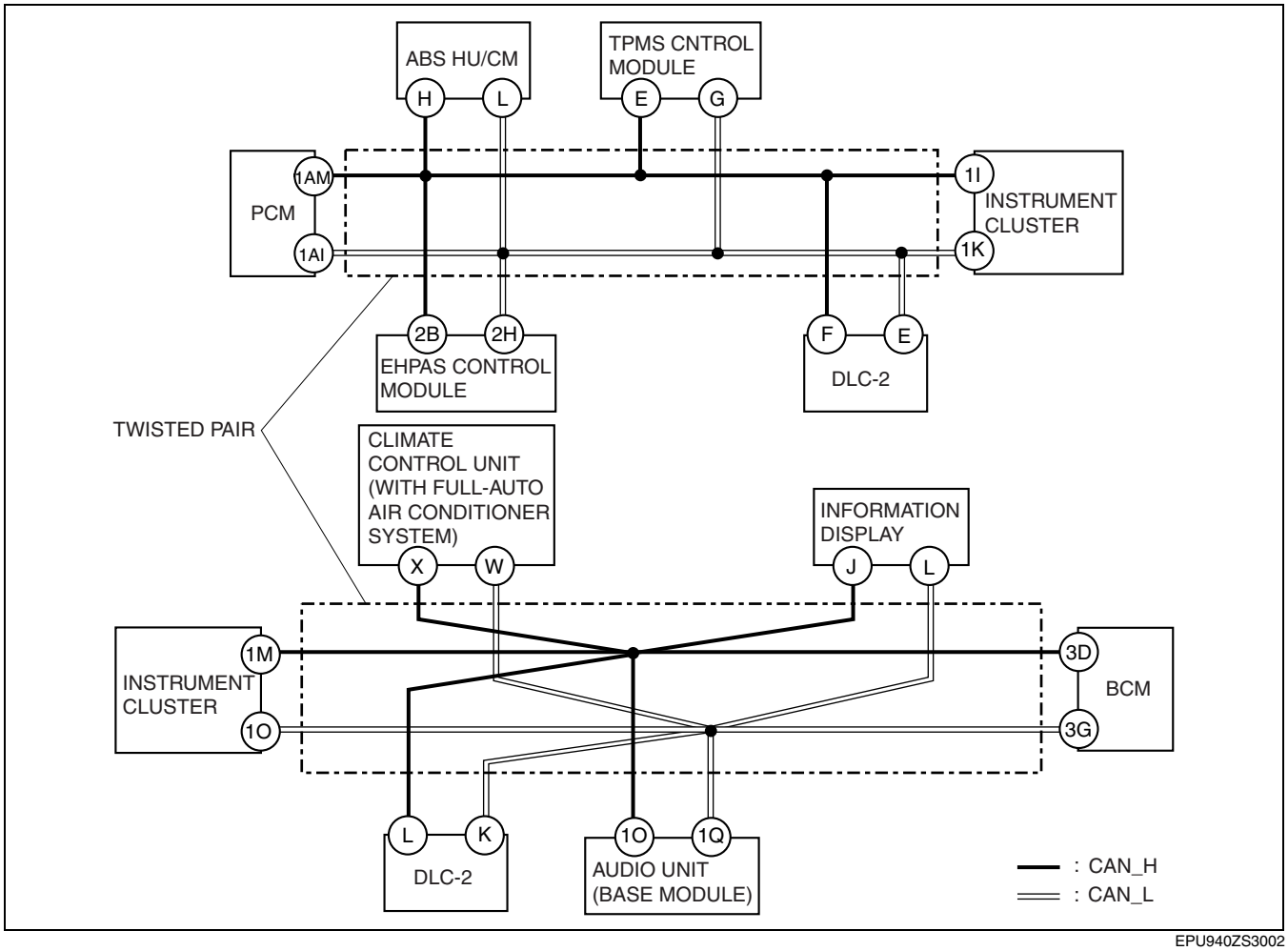
EPU094055430S02



EPU940ZS3001

CAN SYSTEM WIRING DIAGRAM

EPU094055430S03



EPU940ZS3002

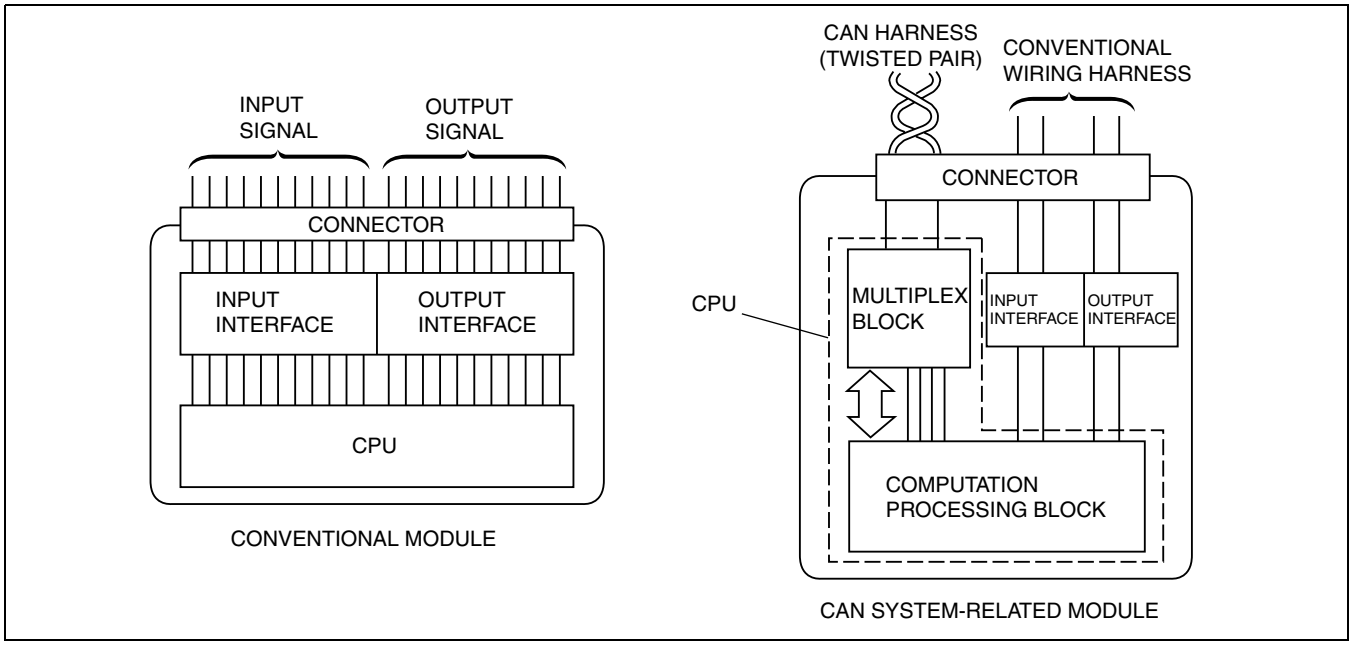
CAN SYSTEM DESCRIPTION

EPU094055430S04

Mechanism of CAN System-Related Module

- A CAN system-related module is composed of an electrical circuit, CPU, and input/output interface.
- The size of the module has been reduced due to the elimination of the bulky, superfluous, input/output interface in the conventional type of electrical module.
- The CPU (multiplex block) controls all signals exchanged on the CAN harness.
- Communication with non-multiplex parts is carried out by conventional input/output interface.
- The functions of each component are shown below.

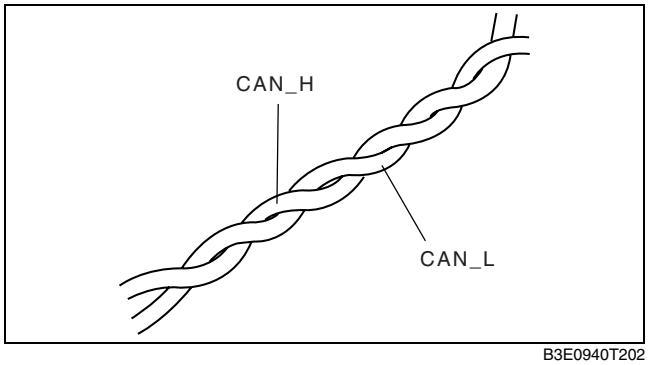
Component		Function
Electrical circuit		Supplies power to CPU and vicinity, and to input/output interface.
CPU	Computation processing block	Control function has been expanded, and when transmission is necessary, transmitted data is stored in a multiplex block. If a multiplex block receives a request to read stored data, transmitted data is read from the multiplex block.
	Multiplex block	Transmits data received from bus line to computation processing block. In addition, sends transmitted data stored from computation processing block to bus line.
Input/Output interface		Electrically converts information signals from switches to, be input to CPU, and signals output from CPU for operating actuator or indicator lights.



C3U0940S006

Twisted Pair

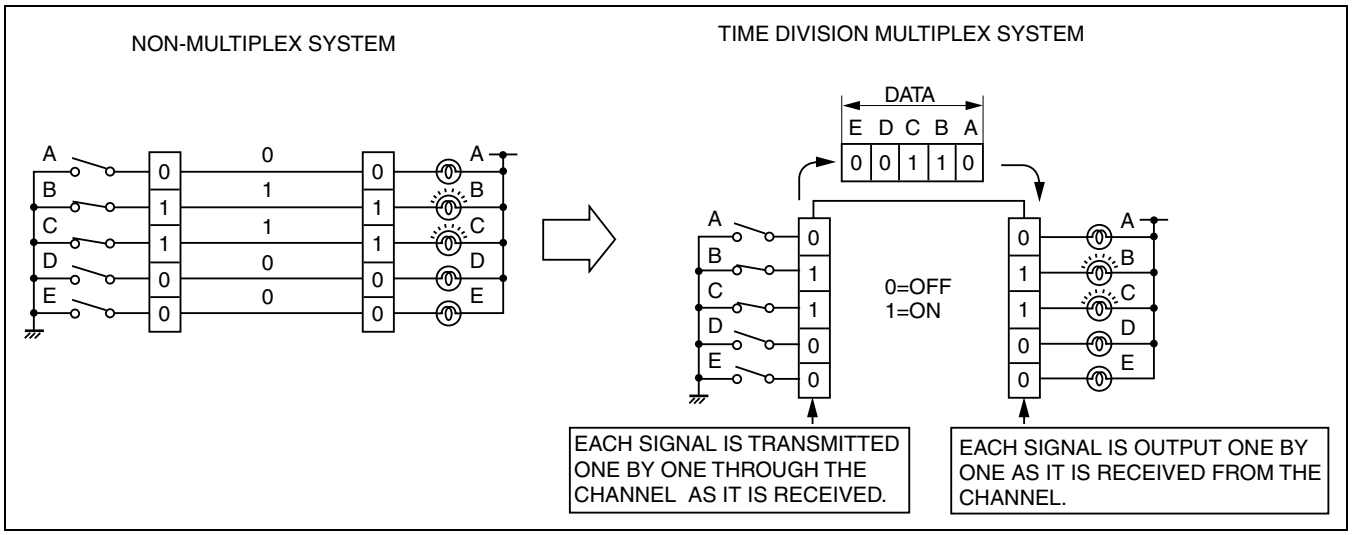
- The multichannel use two spirally twisted wires called a twisted pair, and each wire, CAN_L and CAN_H, has its own special function.
- Both bus lines are opposite phase voltage. This allows for minimal noise being emitted and makes if difficult for noise interference to be received.



B3E0940T202

Time Division Multiplex

- For information exchange between electrical modules in a conventional system, a wire connection was necessary for each information signal. However, by sending the different signal at varying times over one channel, it is possible to send a large amount of information via a small harness.
- In the conventional, non-multiplex system, in order to control the illumination of the five bulbs, one switch and one channel was necessary for each bulb. For bulbs B and C to illuminate, switches B and C must be ON and electricity must flow through the channel. With the time multiplex system, this can be done through one channel. The channel is comprised of five data signal transmitters which transmit either a “0” or “1” signal to indicate whether a bulb turns ON or OFF. For example, to illuminate bulbs B and C, transmitters B and C transmit a “1” and transmitters A, D, and E transmit a “0”. When the receiver receives these signal, bulbs B and C illuminate.

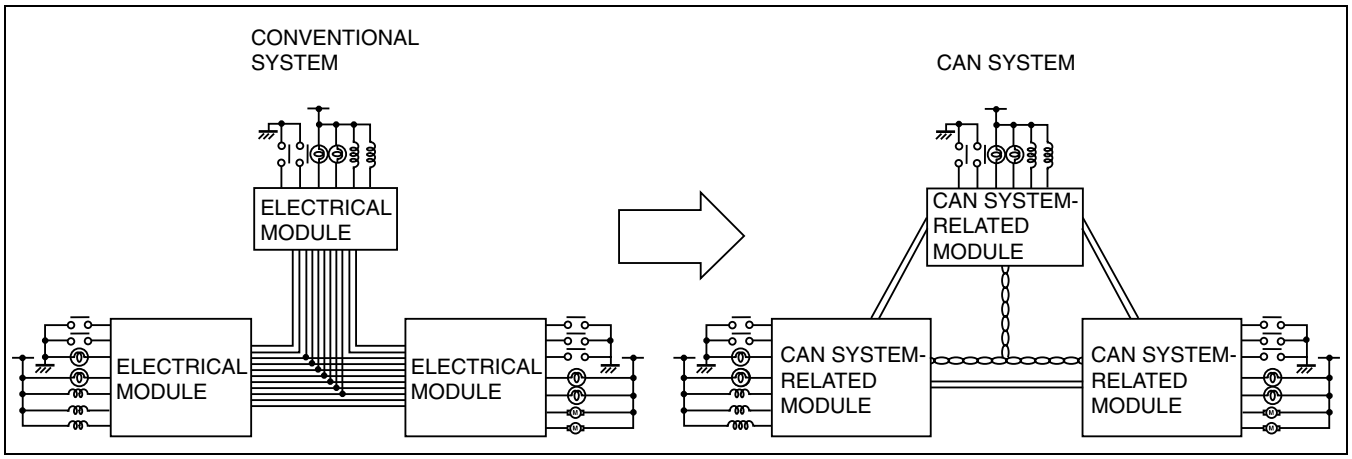


C3U0940S007

09–40

Vehicle CAN System

- By rearranging the multiple signal, common information between the CAN system-related modules is transmitted and received through the multichannel.
- The signal transmitted by one CAN system-related module is sent through the multichannel to all the CAN system-related modules, but only the concerned module (s) receives the signal and performs the appropriate operation (ex. light illumination, fan operation).



A6A8111T006

CAN Signal-Chart (HS-CAN)

OUT: Output (sends signal)
IN: Input (receives signal)

Signal	Multiplex module				
	PCM	EHPAS control module	ABS HU/CM	TPMS control module	Instrument cluster
Engine speed	OUT	IN	IN	–	IN
Vehicle speed	OUT	IN	–	IN	IN
ATX gear position/selector lever position (ATX)	OUT	IN	–	–	IN
Neutral switch position (MTX)	OUT	IN	–	–	–
Brake pedal position	IN	–	–	–	OUT
Tire circumference (front/rear)	OUT	–	IN	–	–
	IN		OUT		
Desired gear/change lever position	OUT	–	IN	–	–
TCC status (ATX)	OUT	–	–	IN	–
Immobilizer-related information	OUT	–	–	–	IN
	IN				OUT
AT warning light on request (ATX)	OUT	–	–	–	IN
Engine coolant temperature	OUT	–	–	–	IN
Travelled distance	OUT	–	–	–	IN
Fuel injection amount	OUT	–	–	–	IN
MIL on request	OUT	–	–	–	IN
Generator warning light on request	OUT	–	–	–	IN
Cruise main/set indicator light on request	OUT	–	–	–	IN
Steering angle	–	OUT	–	–	–
EHPAS control module malfunction	–	OUT	–	–	IN
Brake system status (EBD/ABS)	IN	–	OUT	–	–
Wheel speed (LF, RF, LR, RR)	IN	–	OUT	–	–
Brake system warning light on request	–	–	OUT	–	IN
ABS warning light on request	–	–	OUT	–	IN
Tire pressure warning light and alarm on request	–	–	–	OUT	IN
Fuel tank level	IN	–	–	–	OUT
A/C on request	IN	–	–	–	OUT
Transaxle in reverse position	IN	–	–	–	OUT
Parking brake position	–	IN	–	–	OUT

CAN Signal-Chart (MS-CAN)

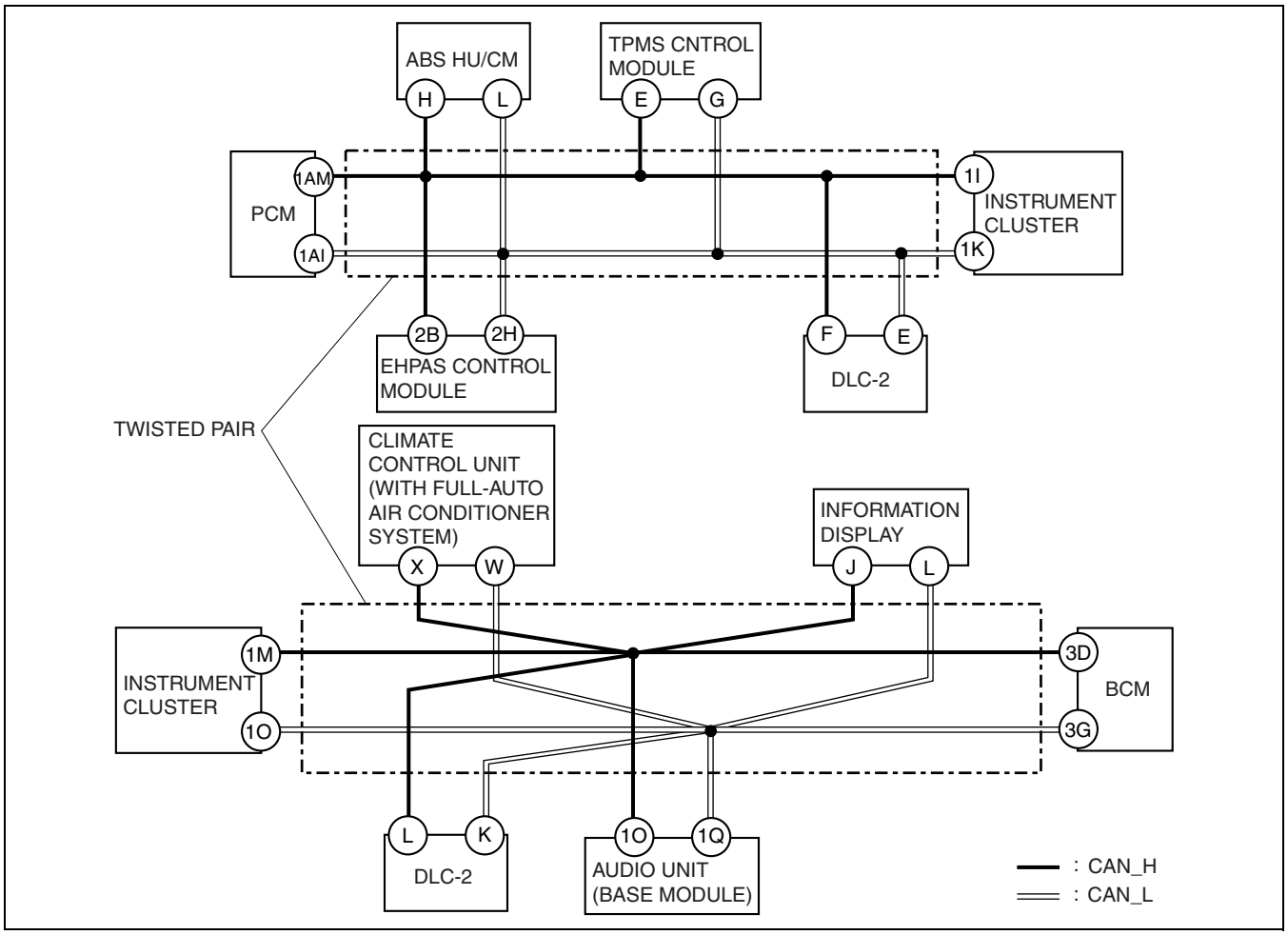
OUT: Output (sends signal)
IN: Input (receives signal)

Signal	Multiplex module				
	Body control module (BCM)	Climate control unit	Information display	Audio unit (base module)	Instrument cluster
Front wiper status	OUT	IN	–	–	–
TNS status	OUT	IN	–	–	–
Door lock status	OUT	–	–	–	IN
Turn indicator light on request	OUT	–	–	–	IN
Security light on request	OUT	–	–	–	IN
Alarm on request	OUT	–	–	–	IN
Each door status	OUT	–	–	–	IN
Brake fluid level	OUT	–	–	–	IN
High-beam indicator light on request	OUT	–	–	–	IN
Parking brake position	OUT	–	–	–	IN
Rear window defroster on request	IN	OUT	–	–	–
	OUT	IN			
A/C on request	IN	OUT	–	–	–
	OUT	–			IN
Ambient temperature	IN	OUT	–	–	–
A/C status display request	–	OUT	IN	–	–
Temperature unit	–	OUT	IN	–	–
	IN	–	–		OUT
Audio status display request	–	–	IN	OUT	–
Engine speed	IN	–	–	–	OUT
Vehicle speed	IN	IN	IN	IN	OUT
Engine coolant temperature	–	IN	IN	–	OUT
Ignition key position	–	IN	IN	IN	OUT
Drive information system data	–	–	IN	–	OUT

On-Board Diagnostic Function

- The on-board diagnostic function is incorporated into the following module:
  - — PCM
  - — ABS HU/CM
  - — EHPAS control module
  - — TPMS control module
  - — Body control module (BCM)
  - — Climate control unit
  - — Information display
  - — Audio unit (base module)
  - — Instrument cluster
- This function can narrow down CAN system malfunction locations.
- The on-board diagnostic function consists of the following functions.
  - — Failure detection function, which detects DTCs malfunctions in CAN system-related parts.
  - — Memory function, which stores detected.
  - — Self-malfunction diagnostic function, which indicates system malfunctions using DTCs and warning lights.
- Using the WDS or equivalent, DTCs can be read out and deleted.
- The CAN system has a fail-safe function. When a malfunction occurs in CAN system, the transmission module sends a warning signal and the receiving module illuminates the warning light.

Block diagram



EPU940ZS3002

Failure detection function

- The failure detection function in each CAN system-related module detects malfunctions in input/output signals.
- This function outputs the DTC for the detected malfunction to the DLC-2, and also sends the detected result to the memory function and fail-safe function.

Fail-safe function

- When the failure detection function determines that there is a malfunction, the fail-safe function illuminates a warning light to inform the driver of the malfunction.

Memory function

- The memory function stores the DTC for the malfunction of input/output signals for related parts, as determined by the failure detection function.

Self-malfunction diagnostic function

- The self-malfunction diagnostic function determines that there is a malfunction, and outputs a signal, as a DTC, to the DLC-2. The DTC can be read out using the WDS or equivalent.

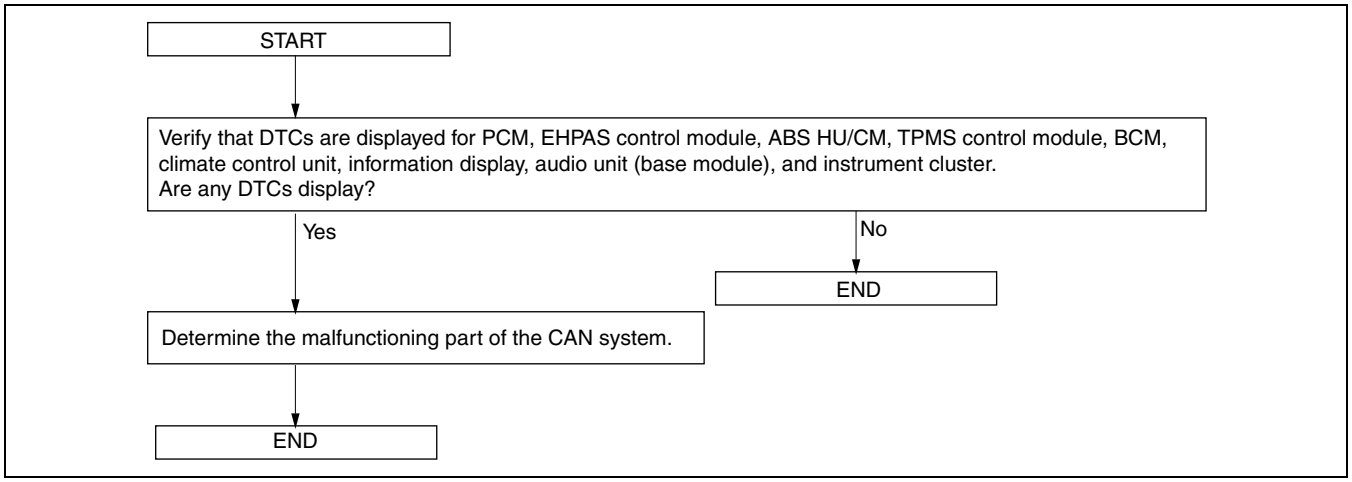
DTC table

DTC	Malfunction location	DTC output module
U0073	CAN system communication error	• PCM • EHPAS control module • Instrument cluster • BCM
U0100	Communication error to PCM	• EHPAS control module • Instrument cluster • BCM
U0121	Communication error to ABS HU/CM	• PCM • Instrument cluster
U0127	Communication error to TPMS control module	Instrument cluster
U0131	Communication error to EHPAS control module	Instrument cluster
U0140	Communication error to BCM	• Instrument cluster • Climate control unit
U0155	Communication error to instrument cluster	• PCM • Climate control unit • BCM
U0164	Communication error to climate control unit	• BCM • Information display
U0181	Communication error to instrument cluster	Information display
U0184	Communication error to audio unit (base module)	• Instrument cluster • Climate control unit • Information display
U0516	CAN system communication error	• TPMS control module • Climate control unit
U1900	Communication error to PCM	• ABS HU/CM • TPMS control module
U2012	CAN system communication error	ABS HU/CM
U2023	Abnormal message from PCM	EHPAS control module
U2516	CAN system communication error	• Instrument cluster • Information display
16: Er12	CAN system communication error	Audio unit (base module)
17: Er11	Communication error to instrument cluster	
18: Er11	Communication error to BCM	
19: Er11	Communication error to climate control unit	

Narrowing down malfunction locations

- The on-board diagnostic function, by verifying the detected DTC information from each module, can narrow down a CAN system malfunction location. Refer to the self-malfunction diagnostic function for detailed information regarding DTCs. (See09–40–12 Self-malfunction diagnostic function.)

Flowchart

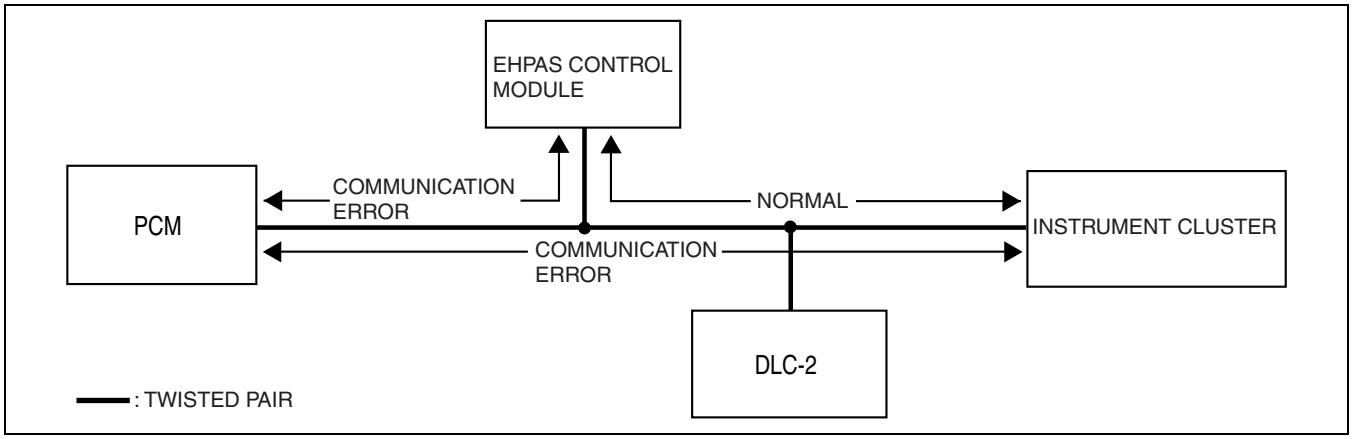


EPU940ZS3003

Example (PCM-related communication error)

1. DTCs for the PCM, ABS HU/CM, EHPAS control module and instrument cluster can be verified using the WDS or equivalent.

Module	Displayed DTC	Probable malfunction location
PCM	U0073	PCM-related CAN system malfunction
	U0121	Communication error between PCM and DSC HU/CM
	U0155	Communication error between PCM and instrument cluster
EHPAS control module	U0100	Communication error between EHPAS control module and PCM
Instrument cluster	U0100	Communication error between instrument cluster and PCM



EPU940ZS3004

2. If there is a communication error between the instrument cluster and PCM, even if the communication between the EHPAS control module and the instrument cluster is normal, it is probable that there is a malfunction in the PCM or PCM-related wiring harnesses.