2007 Mazda CX-9 Service Highlights

FOREWORD

This manual contains on-vehicle service and/or diagnosis procedures for the Mazda CX-9.

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.

Mazda Motor Corporation reserves the right to alter the specifications and contents of this manual without obligation or advance notice.

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.

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VEHICLE IDENTIFICATION NUMBERS (VIN)

JM3 TB28C✻7# 100001—
JM3 TB28Y✻7# 100001—
JM3 TB38C✻7# 100001—
JM3 TB38Y✻7# 100001—

RELATED MATERIALS

Material Name	MNAO Part No.	Mazda Material No.
2007 Mazda CX-9 Workshop Manual	9999–95–003B–07	1890–1U–06L
Automatic Transaxle and Transfer Workshop Manual AW6A-EL AW6AX-EL	9999–95–0AW6–07	1874–1U–06B
2007 Mazda CX-9 Bodyshop Manual	9999–95–007F–07	3424–1U–06L
2007 Mazda CX-9 Wiring Diagram	9999–95–009G–07	5681–1U–06K

GENERAL INFORMATION

00 SECTION

00-00 GENERAL INFORMATION

AIM OF DEVELOPMENT

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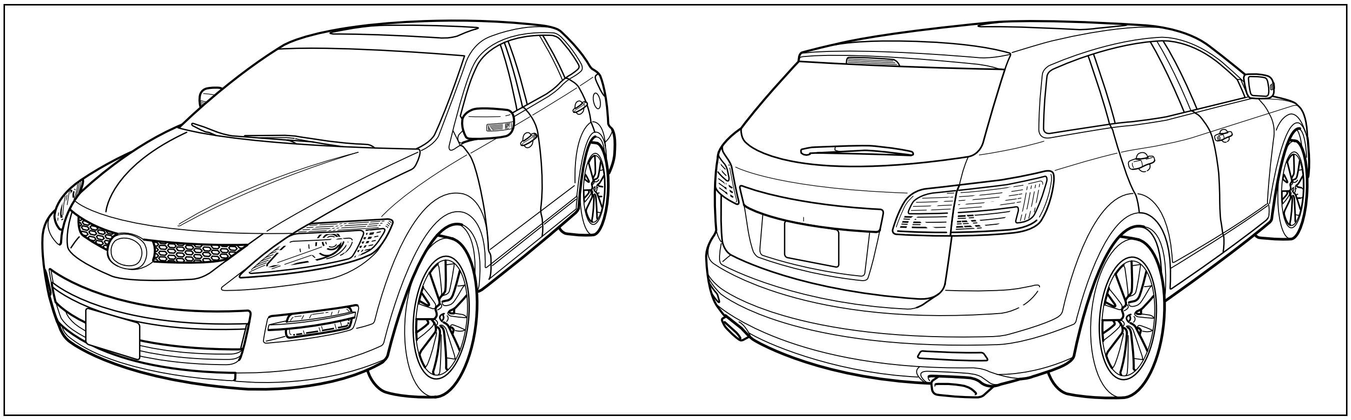
Product Concept

- A stylish, 3-row, on-road SUV with advanced functionality inheriting Mazda DNA.
- A new generation SUV providing emotional appeal and a high quality design/driving performance as a Mazda brand.
- A multi-passenger SUV that completely casts aside the negative images of a minivan (“Soccer-Mom” vehicle).
  — An emotional/sporty design and handling which fully supports Mazda DNA, surpassing conventional 3-row SUVs.
  — A design and craftsmanship with a sense of prestige that equals or surpasses premium brands.
  — An outstanding ease of use supporting a variety of busy, family lifestyles.
  — New safety features, and a safety feel responding to SUV customer expectations.

External View



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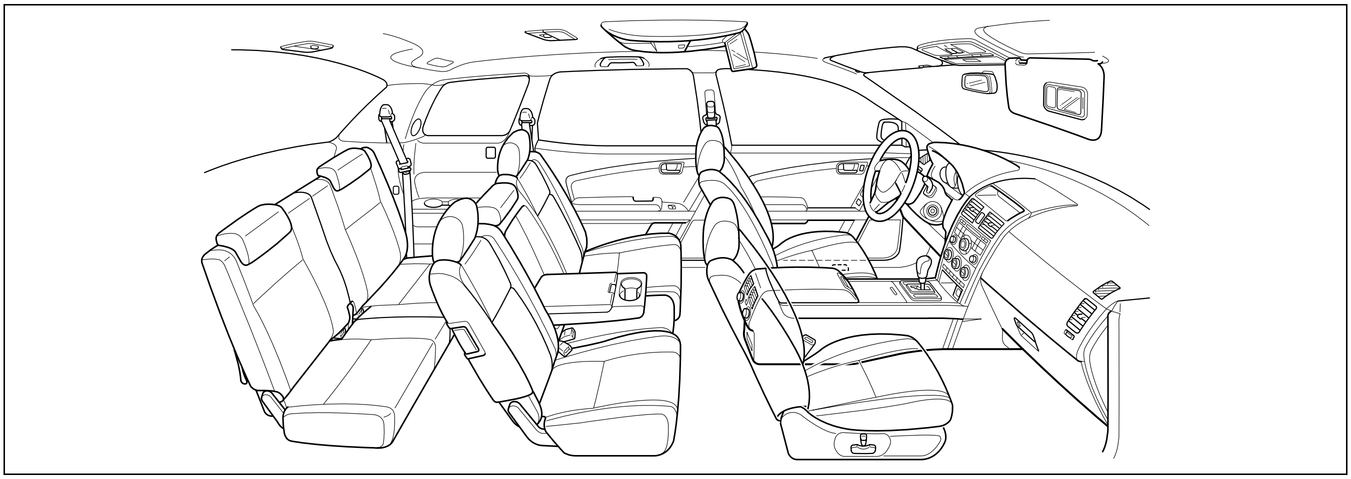
Vehicle Outline

Exterior design

- Sporty and smart styling with an athletic high quality.

Interior design

- Spacious legroom in the second and third-row seats.
- A storage space with a high quality feel and utility.
- Safety assured feel of the large-sized panel from the center panel to the console.



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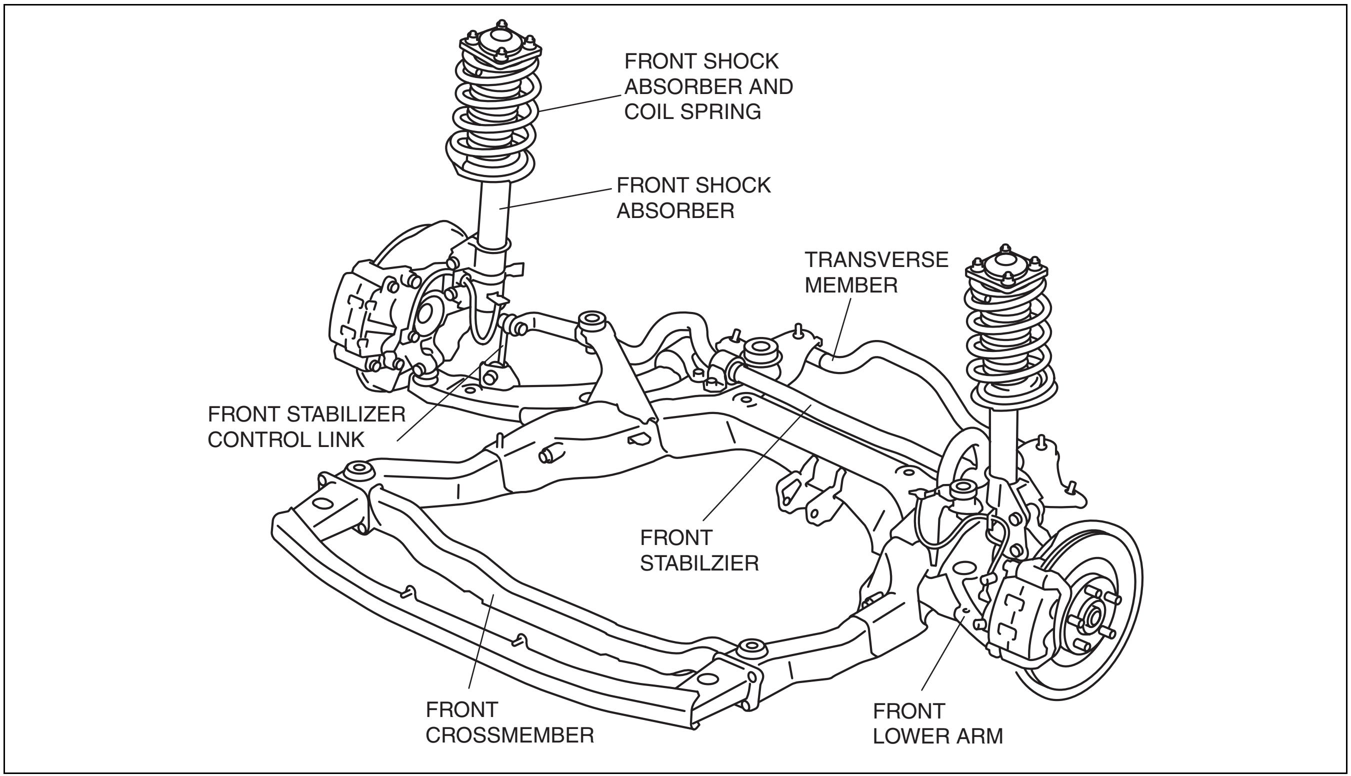
Engine

- Engine block
  - — Variable valve timing that optimally adjusts valve timing in accordance with driving conditions has been adopted.
  - — An aluminum-alloy cylinder head and cylinder block have been adopted.
  - — Shimless tappets have been adopted to minimize friction losses, thereby contributing to improved fuel economy.
  - — An auto-tensioner that automatically adjusts the belt to compensate for stretching has been adopted to minimize maintenance requirements.
- Intake, exhaust, control
  - — Weight reduction has been achieved due to a hard-plastic dynamic chamber.
  - — Maximum torque is achieved at all engine speeds due to the adoption of a variable valve timing system that controls intake valve timing in accordance with driving conditions to attain highly efficient air charging.
  - — An electronic throttle valve has been adopted resulting in precise intake air control.

Suspension

- Front suspension
  - — A strut-type front suspension has been adopted.
  - — Due to the tight connection of the six-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.



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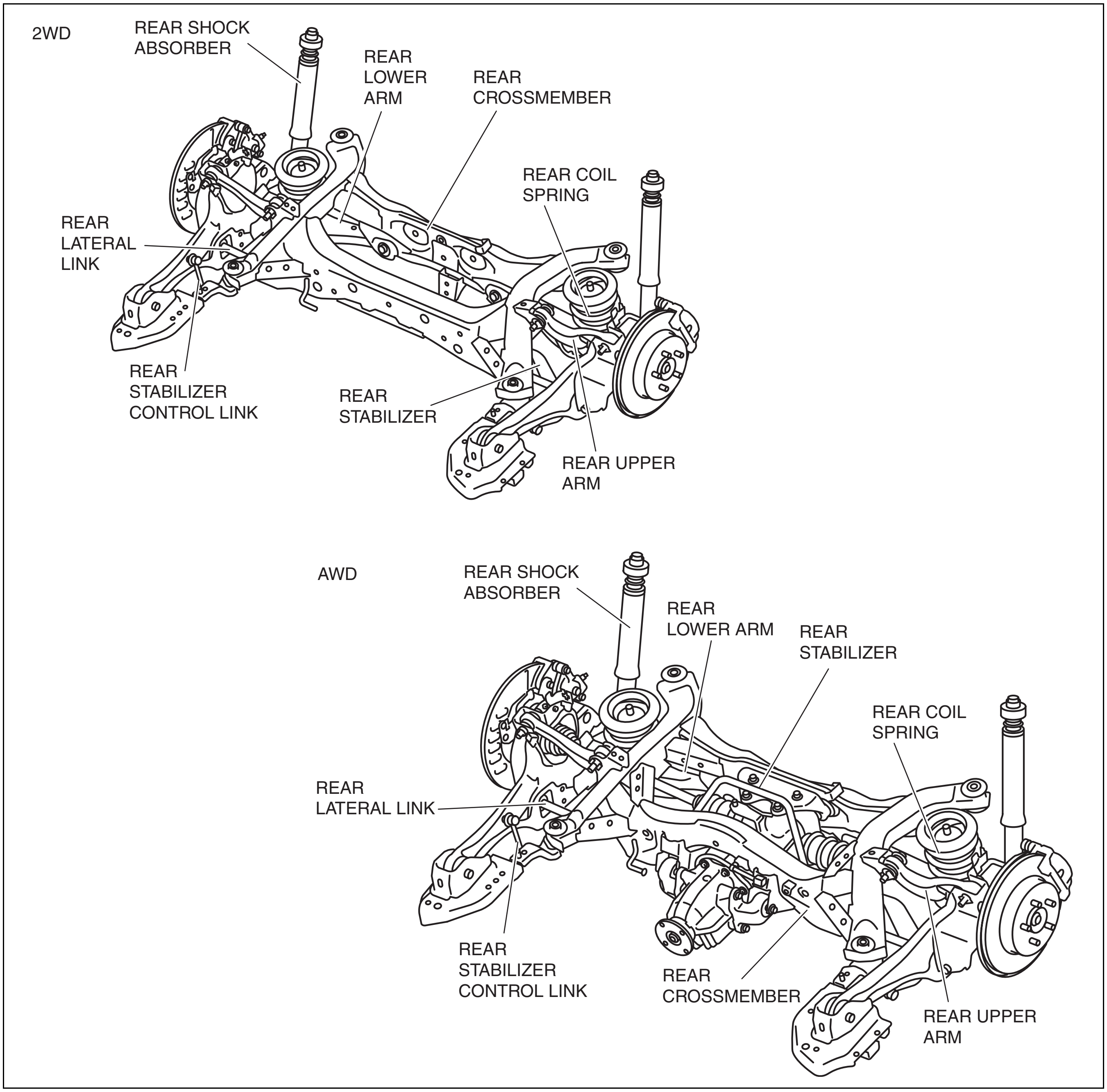
- Rear suspension
  - — An E-type multi-link rear suspension has been adopted.
  - — Link layout has been optimized to control the rear wheel alignment appropriately against the external force.
  - — A wider luggage compartment is ensured due to the separated positioning of the shock absorber and coil 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.
  - — Setting the trailing links at the front in a higher installation position controls nose dive during braking and has improved handling stability. As a result, tire road-hold has been improved, and excellent cornering performance and handling stability has been realized.



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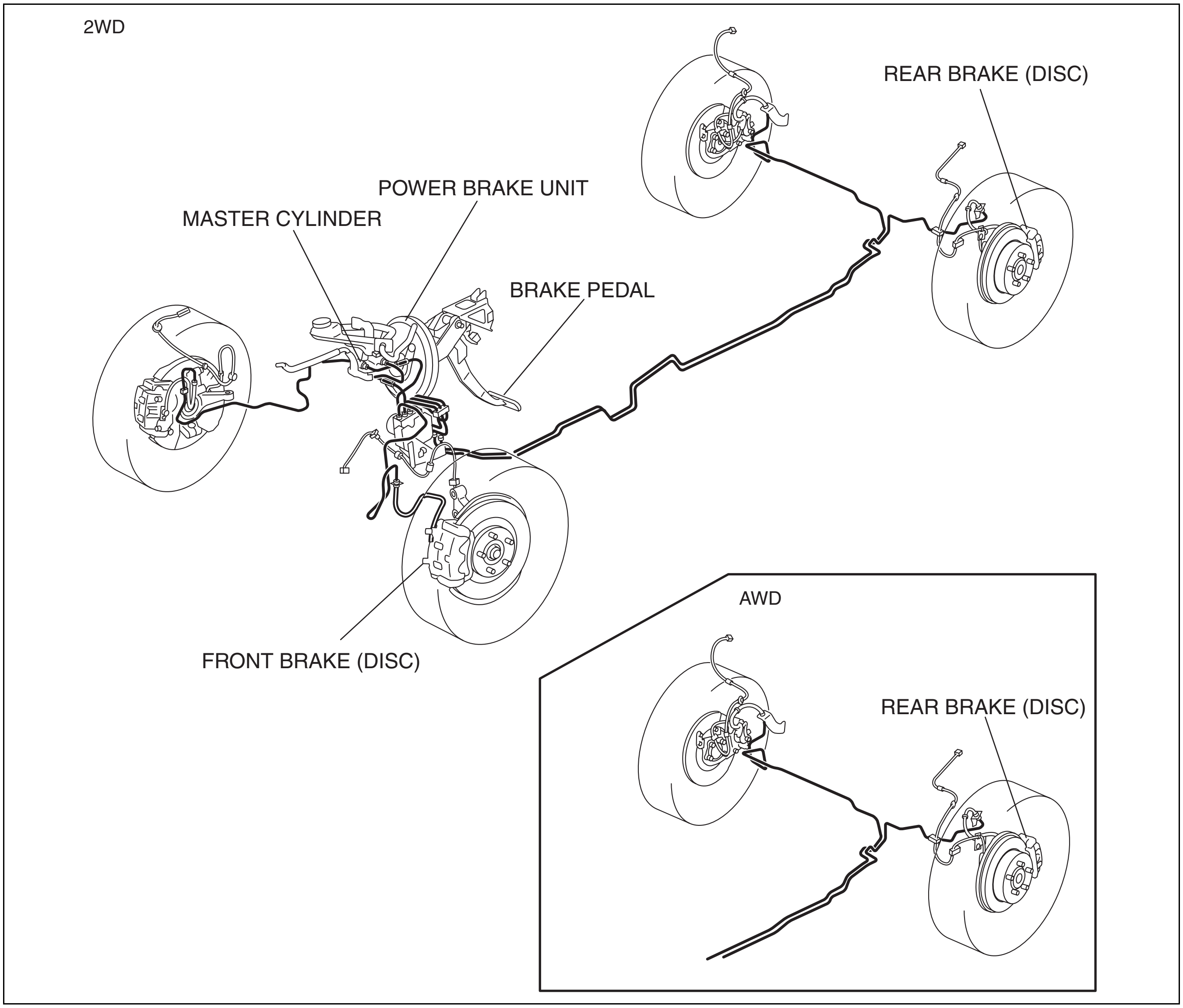
Brakes

- 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 has been adopted, improving braking force.
- High rigidity, 2-piston front brake calipers have been adopted on the front brakes for improved braking performance.
- Large diameter, ventilated discs have been adopted on the front and rear disc brakes for improved braking force.



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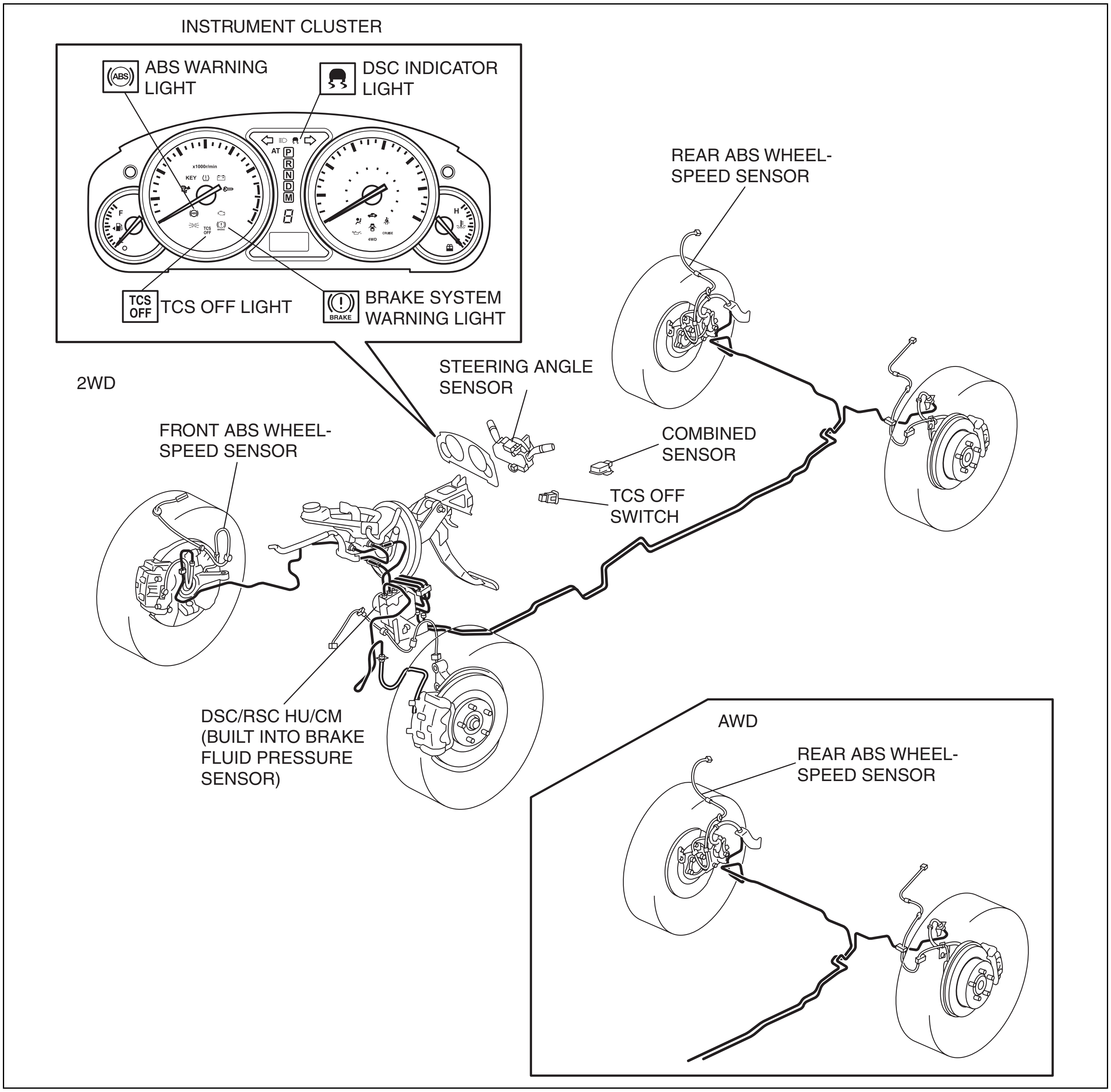
Dynamic stability control (DSC)/Roll stability control (RSC)

- The DSC/RSC HU/CM, integrating both the hydraulic unit (HU) and control module (CM), has been adopted, resulting in a size and weight reduction.
- A combined sensor, integrating both the yaw rate sensor, roll rate sensor, forward-G sensor and lateral-G sensor, has been adopted, improving serviceability.



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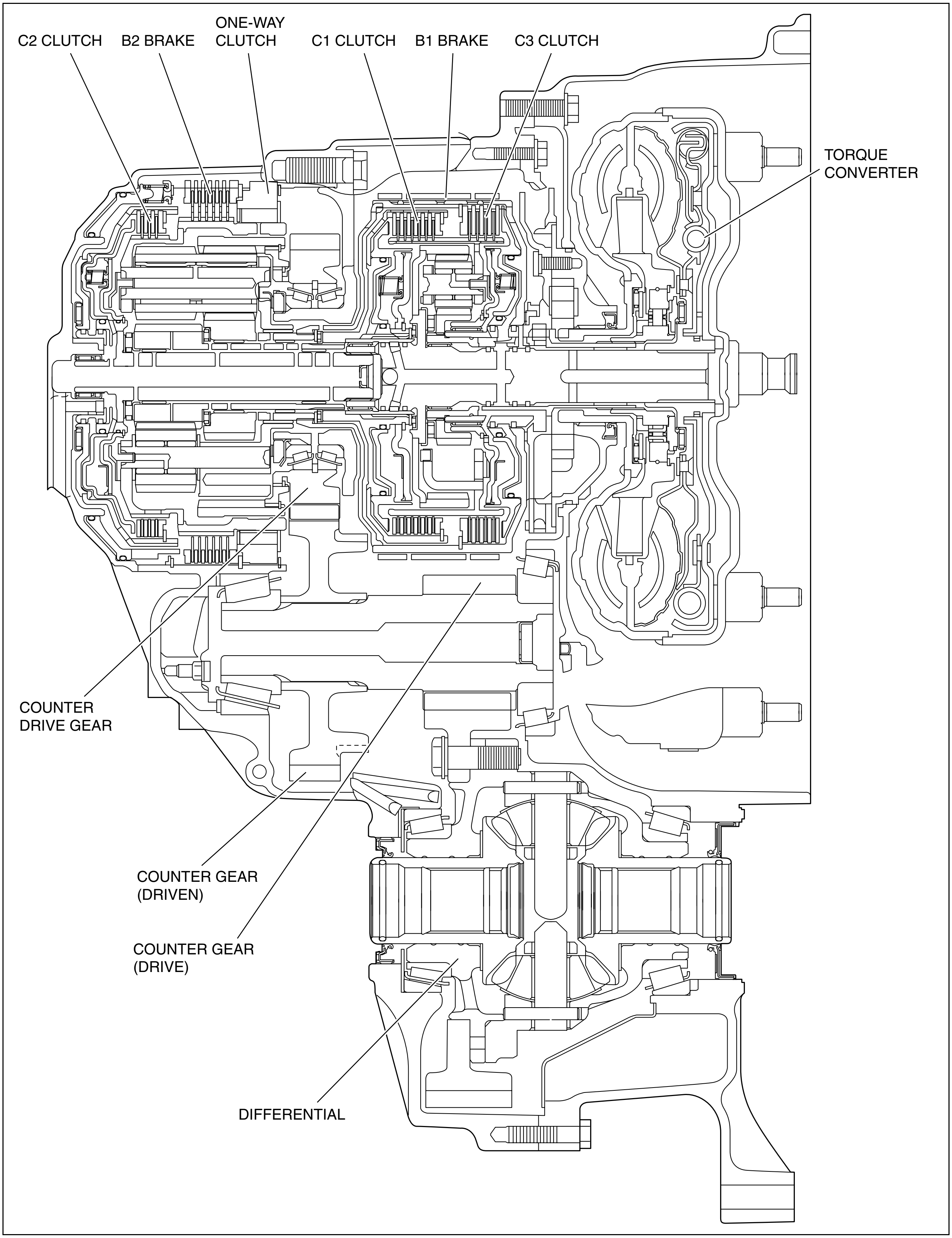
Automatic transaxle

- The AW6A(X)-EL automatic transaxle is a compact, lightweight, next-generation electronically controlled FF 6-speed automatic transaxle that employs a Ravigneaux-type planetary gear. It employs a high-precision clutch hydraulic control system for smooth, highly responsive gear shift feel.



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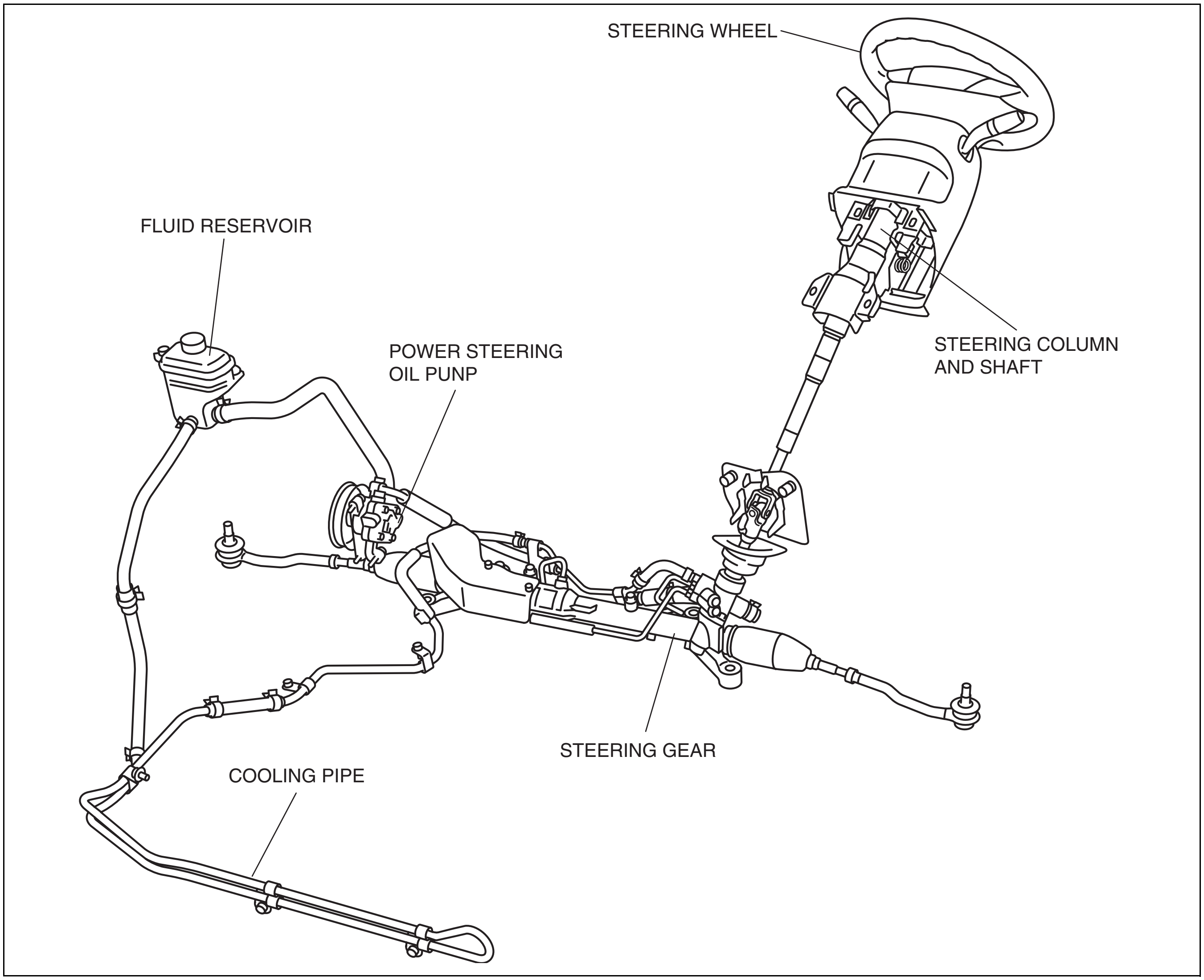
Power Steering

- With the adoption of an engine speed sensing power steering mechanism, handling stability has been improved.
- With the adoption, for all vehicles, of a steering column with a tilt mechanism, operability has been improved.
- With the adoption of a steering shaft with an energy absorbing mechanism, safety has been improved.



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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.
- 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.

VEHICLE IDENTIFICATION NUMBER (VIN) CODE

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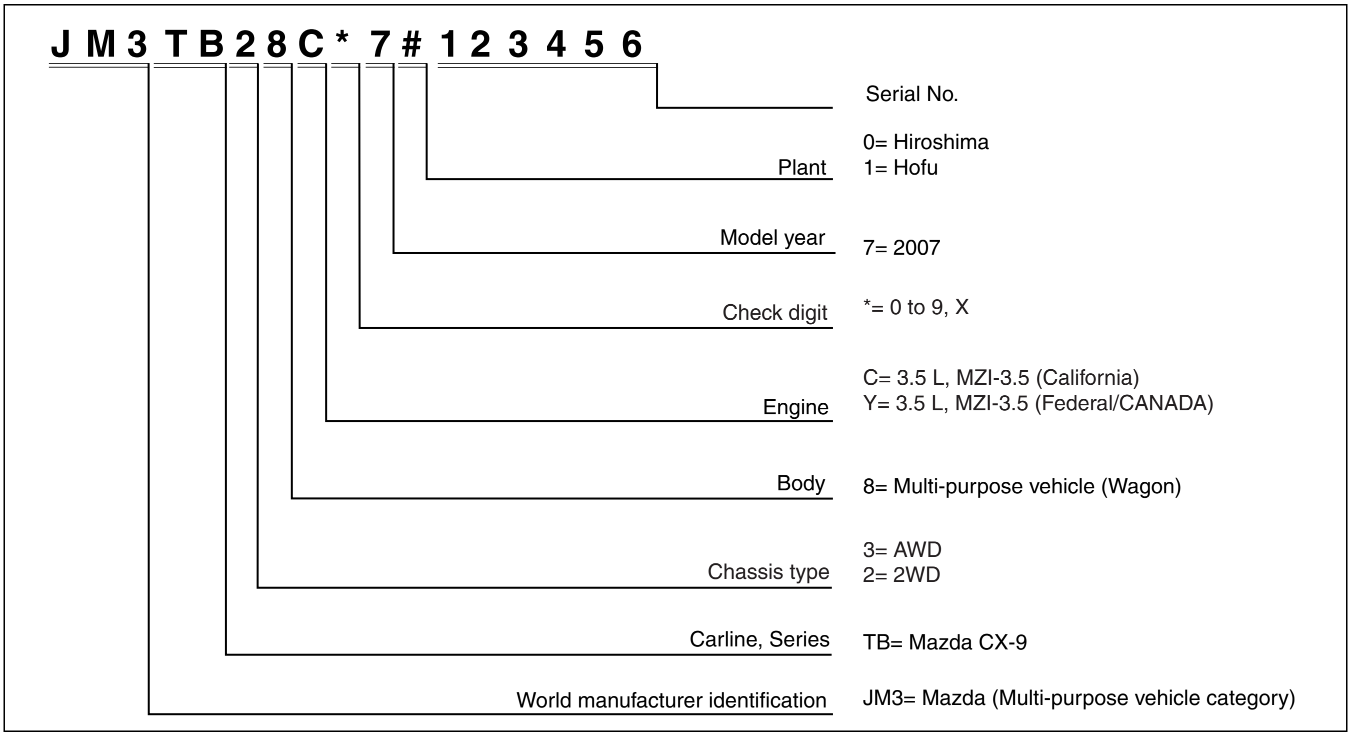

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VEHICLE IDENTIFICATION NUMBER (VIN)

id000000100300

JM3 TB28C*7# 100001—
JM3 TB28Y*7# 100001—
JM3 TB38C*7# 100001—
JM3 TB38Y*7# 100001—

UNITS

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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.

SAE STANDARDS

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- In accordance with new regulations, SAE (Society of Automotive Engineers) standard names and abbreviations are now used in this manual. The table below lists the names and abbreviations that have been used in Mazda manuals up to now and their SAE equivalents.

SAE Standard Abbreviation	SAE Standard Name	Remark
AP	Accelerator Pedal	
APP	Accelerator Pedal Position	
ACL	Air Cleaner	
A/C	Air Conditioning	
BARO	Barometric Pressure	
B+	Battery Positive Voltage	
CMP sensor	Camshaft Position Sensor	
CAC	Charge Air Cooler	
CLS	Closed Loop System	
CTP	Closed Throttle Position	
CPP	Clutch Pedal Position	
CIS	Continuous Fuel Injection System	
CKP sensor	Crankshaft Position Sensor	
DLC	Data Link Connector	
DTM	Diagnostic Test Mode	#1
DTC	Diagnostic Test Code(s)	
DI	Distributor Ignition	
DLI	Distributorless Ignition	
EI	Electronic Ignition	#2
ECT	Engine Coolant Temperature	
EM	Engine Modification	
EVAP	Evaporative Emission	
EGR	Exhaust Gas Recirculation	
FC	Fan Control	
FF	Flexible Fuel	
4GR	Fourth Gear	
GEN	Generator	
GND	Ground	
HO2S	Heated Oxygen Sensor	With heater
IAC	Idle Air Control	
IAT	Intake Air Temperature	
KS	Knock Sensor	
MIL	Malfunction Indicator Lamp	

SAE Standard Abbreviation	SAE Standard Name	Remark
MAP	Manifold Absolute Pressure	
MAF sensor	Mass Air Flow Sensor	
MFL	Multiport Fuel Injection	
OBD	On-board Diagnostic System	
OL	Open Loop	
OC	Oxidation Catalytic Converter	
O2S	Oxygen sensor	
PNP	Park/Neutral Position	
PSP	Power Steering Pressure	
PCM	Powertrain Control Module	#3
PAIR	Pulsed Secondary Air Injection	Pulsed injection
AIR	Secondary Air Injection	Injection with air pump
SAPV	Secondary Air Pulse Valve	
SFI	Sequential Multiport Fuel Injection	
3GR	Third Gear	
TWC	Three Way Catalytic Converter	
TB	Throttle Body	
TP sensor	Throttle Position Sensor	
TCC	Torque Converter Clutch	
TCM	Transmission (Transaxle) Control Module	
TR	Transmission (Transaxle) Range	
TC	Turbocharger	
VSS	Vehicle Speed Sensor	
VR	Voltage Regulator	
VAF sensor	Volume Air Flow Sensor	
WU-TWC	Warm Up Three Way Catalytic Converter	#4
WOP	Wide Open Throttle	

#1: Diagnostic trouble codes depend on the diagnostic test mode.
#2: Controlled by the PCM
#3: Device that controls engine and powertrain
#4: Directly connected to exhaust manifold

ENGINE

01 SECTION

01-00 OUTLINE [MZI-3.5]

ENGINE ABBREVIATIONS [MZI-3.5]

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ABDC	After Bottom Dead Center
ABS	Antilock Brake System
ATDC	After Top Dead Center
ATF	Automatic Transaxle Fluid
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
EBD	Electronic Brakeforce Distribution
EX	Exhaust
FFD	Freeze Frame Data

HU	Hydraulic Unit
IN	Intake
KOEO	Key On Engine Off
KOER	Key On Engine Running
M	Motor
LF	Left Front
LR	Left Rear
OCV	Oil Control Valve
PCV	Positive Crankcase Ventilation
RF	Right Front
RR	Right Rear
SEI	Single Electronic Ignition
SST	Special Service Tool
TDC	Top Dead Center

ENGINE FEATURES [MZI-3.5]

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On-board Diagnostic

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

Mechanical

Improved engine performance	• Variable valve timing mechanism adopted
Weight reduction	• Aluminum-alloy adopted for mainframe parts (cylinder head and block)
Reduced vibration and noise	• Aluminum-alloy cylinder head adopted • Crankshaft pulley with torsional damper adopted • Pendulum-type engine mounts adopted
Improved serviceability	• Drive belt auto tensioner adopted • Timing chain adopted

Lubrication

Reduced noise	• Aluminum alloy oil pan adopted
Improved lubricity	• Trochoid gear type oil pump adopted • Water-cooled type oil cooler adopted

Cooling System

Improved reliability	• Degassing type coolant reserve tank adopted
Reduced weight	• Down-flow type radiator with aluminum core and plastic tank adopted
Miniaturization	• Built-in type water pump adopted
Reduced engine noise and vibration	• Electric cooling fans 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 noise reduction	• Resonance chamber adopted

Fuel System

Reduction of evaporative gas	• Returnless fuel system adopted

Emission System

Improved exhaust gas purification	• Catalytic converter system adopted

Charging System

Reduced operation noise	• Generator with two delta connection type stator coils adopted

Ignition System

Improved reliability	• Independent ignition control system with distributorless ignition coils adopted
Improved durability	• Spark plugs with platinum-tipped center electrode adopted

Starting System

Improved startability	• Reduction type starter adopted

Control System

Improved driveability	• Drive-by-wire control adopted • Fuel injection control adopted • Fuel pump control adopted
Improved emission performance	• Variable valve timing control adopted
Improved fuel economy	• HO2S heater control adopted
Wiring harness simplification	• CAN adopted

ENGINE SPECIFICATION [MZI-3.5]

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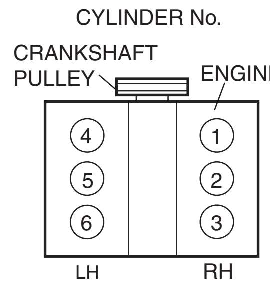
Specification

Item				Specification
MECHANICAL				
Type				Gasoline, 4-cycle
Cylinder arrangement and number				60° V configuration, 6 - cylinder
Combustion chamber				Pentroof
Valve system				DOHC, timing chain driven, 24 valves
Displacement			(ml {cc, cu in})	3,496 {3,496, 213.3}
Bore × stroke			(mm {in})	92.5 × 86.7 {3.64 × 3.41}
Compression ratio				10.3:1
Valve clearance	(mm {in})	IN		0.150—0.250 {0.00591—0.00984} [Engine cold]
		EX		0.300—0.400 {0.0119—0.0157} [Engine cold]
LUBRICATION SYSTEM				
Type				Force-fed type
Oil pressure (reference value) [oil temperature: 93.3 °C {200 °F}]			(kPa {kgf/cm^2, psi} [rpm])	310—621 {3.17—6.33, 45.0—90.0} [2,000]
Oil pump	Type			Trochoid gear type
Oil cooler	Type			Water-cooled
Oil filter	Type			Full-flow, paper element
Oil capacity (approx. quantity)	Oil replacement		(L {US qt, Imp qt})	4.7 {5.0, 4.2}
	Oil and oil filter replacement		(L {US qt, Imp qt})	5.2 {5.5, 4.6}
COOLING SYSTEM				
Type				Water-cooled, Electromotive
Coolant capacity (approx. quantity)			(L {US qt, Imp qt})	Without Towing Package: 11.1 {11.7, 9.77} With Towing Package: 11.7 {12.4, 10.3}
Water pump	Type			Centrifugal, timing chain-driven
Thermostat	Type			Wax, bottom-bypass
	Opening temperature		(°C {°F})	79.5—83.3 {175.2—181.9}
	Full-open temperature		(°C {°F})	94.5 {202.1}
	Full-open lift		(mm {in})	More than 8.1 {0.32}
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			No.1: 5, No.2: 7
	Outer diameter		(mm {in})	360 {14.2}
	Fan motor output		(W)	Without Towing Package: 160 With Towing Package: 240
FUEL SYSTEM				
Injector		Type		Hi-ohmic
		Type of fuel delivery		Top-feed
		Type of drive		Voltage
Fuel pump		Type		Electric
Fuel tank	Capacity		(L {US gal, Imp gal})	76.0 {20.1, 16.7}
Fuel	Type			87 [(R+M)/2 method] or above (91 RON or above)
EMISSION SYSTEM				
Catalyst		Type		WU-TWC (monolith)
EVAP control system		Type		Charcoal canister type
PCV system		Type		Closed type

Item		Specification
CHARGING SYSTEM		
Battery	Voltage (V)	12
	Type and capacity (5-hour rate) (A·h)	80D26L (55)
Generator	Output (V-A)	12-110
	Regulated voltage	Controlled by PCM
	Diagnosis function	
IGNITION SYSTEM		
Ignition system	Type	SEI (Single Electronic Ignition)
	Spark advance	Electronic
	Firing order	1-4-2-5-3-6 
Spark plug	Type	ZZJ1 18 110
STARTING SYSTEM		
Starter	Type	Coaxial reduction
	Output (kW)	1.6
CONTROL SYSTEM		
PSP switch	Type	Hydraulic pressure
CHT sensor	Type	Thermistor
MAF sensor	Type	Hot-wire
IAT sensor (Inside MAF sensor)	Type	Thermistor
TP sensor	Type	Potentiometer type
CKP sensor	Type	Pickup type
CMP sensor	Type	Pickup type
HO2S	Type	Zirconia element (Stoichiometric air/fuel ratio sensor)

Engine oil specification

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

01-02 ON-BOARD DIAGNOSTIC [MZI-3.5]

ON-BOARD DIAGNOSTIC OUTLINE[MZI-3.5]

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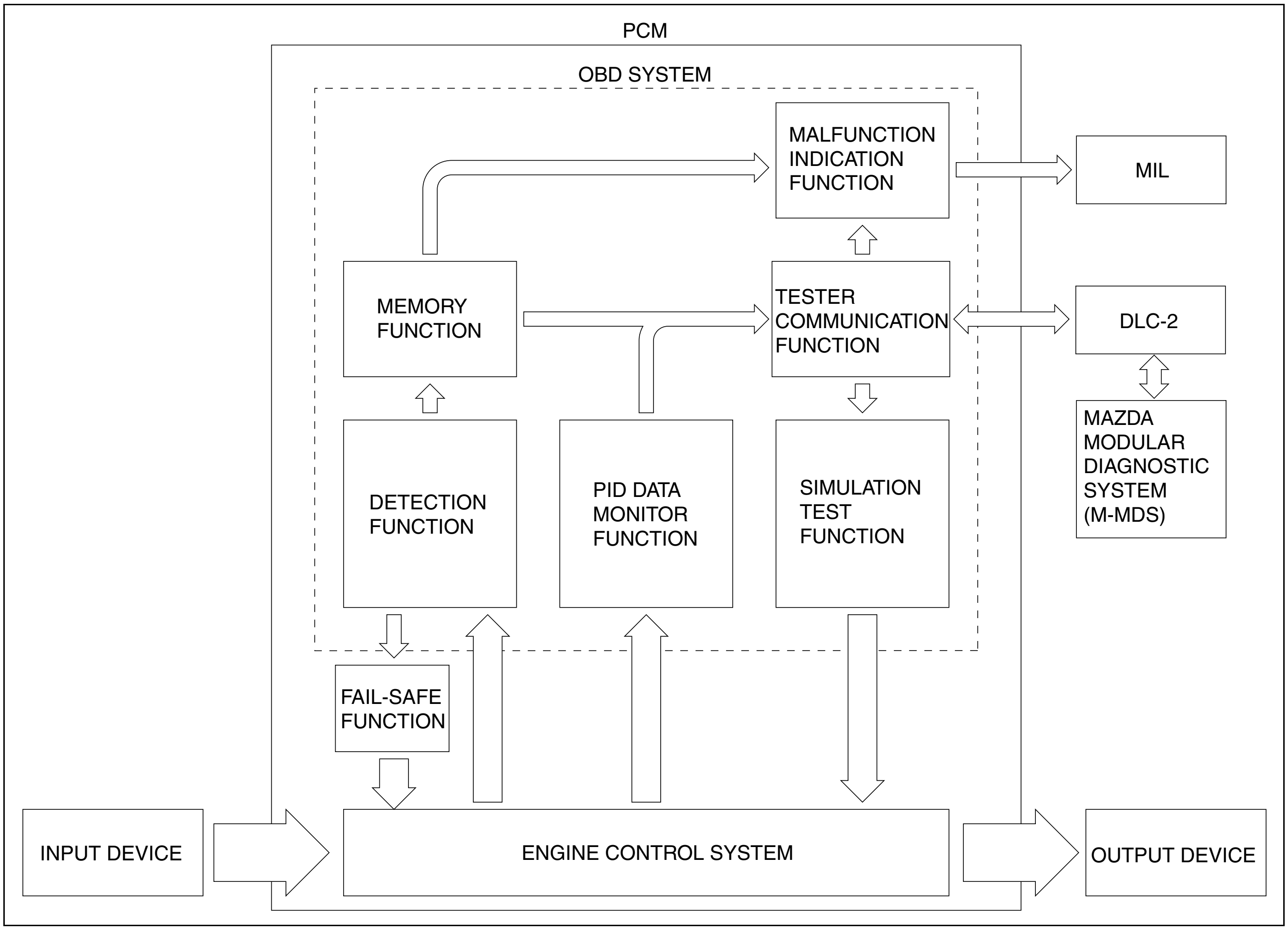
Features

Satisfies emission regulation	• An on-board diagnostic (OBD) system consisting of the following functions has been adopted: — Malfunction detection function — PID/data monitor function — Simulation function — External diagnostic unit communication function — Malfunction display function — Diagnostic data memory function • Malfunction indicator lamp (MIL) adopted • Data link connector-2 (DLC-2) adopted

Block Diagram



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ON-BOARD DIAGNOSTIC SYSTEM TEST MODE[MZI-3.5]

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- 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 08	On-board device control (simulation test, active command mode)
Mode 09	Request vehicle information

OBD-II Diagnostic Data Monitor (Mode 01)

PID data monitor

- The PID data monitor items are shown below.

PID data monitor table

Full names	Condition/unit	
Ambient air temperature	°C	
Absolute load value	%	
Accelerator pedal position (sensor No.1)	%	
Accelerator pedal position (sensor No.2)	%	
Accelerator pedal position (sensor No.3)	%	
Barometric pressure	kPa	
Catalytic converter temperature (RH)	°C	
Catalytic converter temperature (LH)	°C	
Catalyst efficiency monitor complete	—	
Catalyst efficiency monitor enabled	—	
Catalyst efficiency monitor evaluated	—	
Catalyst efficiency monitor supported	—	
Comprehensive components monitor complete	—	
Comprehensive components monitor enabled	—	
Comprehensive components monitor evaluated	—	
Comprehensive components monitor supported	—	
Distance since DTCs cleared	km	miles
Number of DTCs detected	—	
Engine coolant temperature	°C	
Theoretical air/fuel ratio coefficient to calculate target air/fuel ratio	%	
Purge solenoid valve control signal	%	
Evaporative emission system monitor complete	—	
Evaporative emission system monitor enabled	—	
Evaporative emission system monitor evaluated	—	
Evaporative emission system monitor supported	—	
Evaporative emission system vapor pressure	Pa	
Fuel level input	%	
Fuel system loop status (RH)	Refer to list below.	
Fuel system loop status (LH)	Refer to list below.	
Fuel system monitor complete	—	
Fuel system monitor enabled	—	
Fuel system monitor evaluated	—	
Fuel system monitor supported	—	
Intake air temperature	°C	
Long term fuel trim (RH)	%	
Long term fuel trim (LH)	%	
Calculated engine load	%	
Mass air flow rate	g/s	

Full names	Condition/unit	
Malfunction indicator lamp	—	
Distance travelled while MIL is activated	km	miles
Misfire detection monitor complete	—	
Misfire detection monitor enabled	—	
Misfire detection monitor evaluated	—	
Misfire detection monitor supported	—	
Front HO2S (RH)	V	
Rear HO2S (RH)	V	
Front HO2S (LH)	V	
Rear HO2S (LH)	V	
HO2S heater monitor complete	—	
HO2S heater monitor enabled	—	
HO2S heater monitor evaluated	—	
HO2S heater monitor supported	—	
HO2S monitor complete	—	
HO2S monitor enabled	—	
HO2S monitor evaluated	—	
HO2S monitor supported	—	
OBD requirement according to vehicle design	—	
Engine speed	rpm	
Run time	s	
Short term fuel trim (RH)	%	
Short term fuel trim (LH)	%	
Front short term fuel trim (RH)	%	
Front short term fuel trim (LH)	%	
Spark advance requested	°	
Throttle actuator control signal	%	
Absolute throttle position	%	
TP (sensor No.2)	%	
Relative throttle position	%	
Control module voltage	V	
Vehicle speed	km/h	mph
Number of warm-ups since DTCs cleared	—	

Meaning of fuel system loop status

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

OBD-II Freeze Frame Data (Mode 02)

- The Freeze Frame Data monitor items are shown below.

Freeze Frame Data monitor table

Full names	Condition/unit	
Ambient air temperature	°C	
Accelerator pedal position (sensor No.1)	%	
Accelerator pedal position (sensor No.2)	%	
Accelerator pedal position (sensor No.3)	%	
Engine coolant temperature	°C	
Fuel rail pressure	kPa	
Fuel system loop status (RH)	Refer to list below.	
Fuel system loop status (LH)	Refer to list below.	
Long term fuel trim (RH)	%	
Long term fuel trim (LH)	%	
Calculated load value	%	
Manifold absolute pressure	kPa	
Engine speed	rpm	
Run time	s	
Short term fuel trim (RH)	%	
Short term fuel trim (LH)	%	
Spark advance	°	
Absolute throttle position	%	
Vehicle speed	km/h	mph

Meaning of fuel system loop status

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

OBD-II Diagnostic Trouble Code (Mode 03)

- The DTCs are shown below.

DTC No.	Condition	MIL	DC
B1342	PCM malfunction	OFF	—
P0010	CMP actuator circuit open (RH)	ON	2
P0011	CMP timing over-advanced (RH)	ON	2
P0012	CMP timing over-retarded (RH)	ON	2
P0016	CKP-CMP sensor (RH) correlation	ON	2
P0018	CKP-CMP sensor (LH) correlation	ON	2
P0020	CMP actuator circuit open (LH)	ON	2
P0021	CMP timing over-advanced (LH)	ON	2
P0022	CMP timing over-retarded (LH)	ON	2
P0040	Front HO2S (LH/RH) signals swapped	OFF	1
P0041	Rear HO2S (LH/RH) signals swapped	OFF	1
P0053	Front HO2S (RH) heater resistance	ON	2
P0054	Rear HO2S (RH) heater resistance	ON	2
P0059	Front HO2S (LH) heater resistance	ON	2
P0060	Rear HO2S (LH) heater resistance	ON	2
P0068	MAP/MAF-throttle position correlation	ON	2
P0102	MAF circuit low input	ON	2
P0103	MAF circuit high input	ON	2
P0104	MAF circuit intermittent/erratic	OFF	1
P0111	IAT sensor circuit range/performance	ON	2
P0112	IAT sensor circuit low input	ON	2
P0113	IAT sensor circuit high input	ON	2
P0114	IAT sensor Intermittent/erratic	OFF	1

DTC No.	Condition	MIL	DC
P0116	CHT sensor circuit range/performance	ON	2
P0119	CHT sensor circuit intermittent/erratic	OFF	1
P0122	TP sensor No.1 circuit low input	ON	2
P0123	TP sensor No.1 circuit high input	ON	2
P0128	Coolant thermostat (coolant temp below thermostat regulating temperature)	ON	2
P0132	Front HO2S (RH) circuit high voltage	ON	2
P0133	Front HO2S (RH) circuit slow response	ON	2
P0135	Front HO2S (RH) heater circuit	ON	2
P0138	Rear HO2S (RH) circuit high voltage	ON	2
P0139	Rear HO2S (RH) circuit slow response	ON	2
P0141	Rear HO2S (RH) heater circuit	ON	2
P0148	Fuel delivery error	OFF	1
P0152	Front HO2S (LH) circuit high voltage	ON	2
P0153	Front HO2S (LH) circuit slow response	ON	2
P0155	Front HO2S (LH) heater circuit	ON	2
P0158	Rear HO2S (LH) circuit high voltage	ON	2
P0159	Rear HO2S (LH) circuit slow response	ON	2
P0161	Rear HO2S (LH) heater circuit	ON	2
P0171	System too lean (RH)	ON	2
P0172	System too rich (RH)	ON	2
P0174	System too lean (LH)	ON	2
P0175	System too rich (LH)	ON	2
P0201	Injector circuit/open—cylinder No.1	ON	2
P0202	Injector circuit/open—cylinder No.2	ON	2
P0203	Injector circuit/open—cylinder No.3	ON	2
P0204	Injector circuit/open—cylinder No.4	ON	2
P0205	Injector circuit/open—cylinder No.5	ON	2
P0206	Injector circuit/open—cylinder No.6	ON	2
P0222	TP sensor No.2 circuit low input	ON	2
P0223	TP sensor No.2 circuit high input	ON	2
P0230	FP primary circuit	OFF	1
P0231	FP secondary circuit low	OFF	1
P0232	FP secondary circuit high	OFF	1
P0297	Vehicle over speed condition	OFF	1
P0300	Random misfire detected	ON	1
P0301	Cylinder No.1 misfire detected	ON	1
P0302	Cylinder No.2 misfire detected	ON	1
P0303	Cylinder No.3 misfire detected	ON	1
P0304	Cylinder No.4 misfire detected	ON	1
P0305	Cylinder No.5 misfire detected	ON	1
P0306	Cylinder No.6 misfire detected	ON	1
P0315	CKP system variation not learned	ON	2
P0316	Misfire detected on startup (first 1000 revolutions)	OFF	1
P0320	Ignition/distributor engine speed input circuit	ON	2
P0325	KS circuit (RH)	OFF	1
P0330	KS circuit (LH)	OFF	1
P0340	CMP sensor (RH) circuit	ON	2
P0344	CMP sensor (RH) circuit intermittent	ON	2
P0345	CMP sensor (LH) circuit	ON	2
P0349	CMP sensor (LH) circuit intermittent	ON	2
P0351	Ignition coil No.1 primary/secondary circuit	ON	2
P0352	Ignition coil No.2 primary/secondary circuit	ON	2
P0353	Ignition coil No.3 primary/secondary circuit	ON	2
P0354	Ignition coil No.4 primary/secondary circuit	ON	2

DTC No.	Condition	MIL	DC
P0355	Ignition coil No.5 primary/secondary circuit	ON	2
P0356	Ignition coil No.6 primary/secondary circuit	ON	2
P0420	Catalyst system efficiency below threshold (RH)	ON	2
P0430	Catalyst system efficiency below threshold (LH)	ON	2
P0442	Evaporative emission system leak detected (small leak)	ON	2
P0443	Purge solenoid valve circuit	ON	2
P0446	CV solenoid valve control circuit	ON	2
P0451	Fuel tank pressure sensor range/performance	ON	2
P0452	Fuel tank pressure sensor low input	ON	2
P0453	Fuel tank pressure sensor high input	ON	2
P0454	Fuel tank pressure sensor intermittent	ON	2
P0455	Evaporative emission system leak detected (gross leak/no flow)	ON	2
P0456	Evaporative emission system leak detected (very small leak)	ON	1
P0457	Evaporative emission system leak detected (fuel cap loose/off)	OFF[*1]	1
P0460	Fuel level sensor circuit	ON	2
P0461	Fuel gauge sender unit range/performance problem	ON	2
P0462	Fuel gauge sender unit circuit low input	ON	2
P0463	Fuel gauge sender unit circuit high input	ON	2
P0480	Fan control circuit	OFF	1
P0505	Idle speed control system problem	OFF	1
P0506	IAC system RPM lower than expected	ON	2
P0507	IAC system RPM higher than expected	ON	2
P050E	Cold start engine exhaust temperature out of range	ON	2
P053A	PCV valve heater control circuit/open	OFF	1
P0579	Cruise control multi-function input circuit range/performance	OFF	1
P0581	Cruise control multi-function input circuit high	OFF	1
P0600	Serial communication link	OFF	1
P0602	PCM programming error	ON	2
P0603	PCM keep alive memory (KAM) error	ON	2
P0604	Internal control module random access memory (RAM) error	ON	2
P0605	PCM read only memory (ROM) error	ON	2
P0606	ECM/PCM processor	ON	2
P0607	Control module performance	ON	2
P060A	Internal control module monitoring processor performance	OFF	1
P060B	Internal control module A/D processing performance	ON	2
P060C	Internal control module main processor performance	ON	2
P0610	Control module vehicle options error	ON	2
P061B	Internal control module torque calculation performance	ON	2
P061C	Internal control module engine RPM performance	ON	2
P061D	Internal control module engine air mass performance	ON	2
P061F	Internal control module throttle actuator controller performance	ON	2
P0620	Generator control circuit	OFF	1
P0625	Generator field terminal circuit low	OFF	1
P0626	Generator field terminal circuit high	OFF	1
P0642	Sensor reference voltage circuit low	ON	2
P0643	Sensor reference voltage circuit high	ON	2
P0645	A/C relay control circuit	OFF	1
P0685	ECM/PCM power relay control circuit/open	OFF	1
P0689	ECM/PCM power relay sense circuit low	OFF	1
P0690	ECM/PCM power relay sense circuit high	OFF	1
P1000	OBD II systems readiness test not complete	OFF	1
P1001	KOER not able to complete, KOER aborted	OFF	1

DTC No.	Condition	MIL	DC
P1101	MAF sensor out of self-test range	OFF	1
P1127	Exhaust temperature out of range, HO2S tests not completed	OFF	1
P115E	Throttle actuator control throttle body air flow trim at max limit	OFF	1
P1260	Theft detected, vehicle immobilized	OFF	1
P1285	Cylinder head over temperature condition	OFF	1
P1288	CHT sensor out of self-test range	OFF	1
P1289	CHT sensor circuit high input	ON	2
P1290	CHT sensor circuit low input	ON	2
P1299	Cylinder head over temperature protection active	ON	1
P1336	CKP/CMP sensor range/performance	ON	2
P1397	System voltage out of self-test range	OFF	1
P1450	Unable to bleed up fuel tank vacuum	ON	2
P145E	PCV heater control circuit	OFF	1
P1464	A/C demand out of self-test range	OFF	1
P1500	Vehicle speed signal	OFF	1
P1501	Vehicle speed sensor (VSS) out of self-test range	OFF	1
P1633	Keep alive power voltage too low	ON	1
P1635	Tire/axle out of acceptable range	OFF	1
P1639	Vehicle ID block corrupted, not programmed	ON	2
P1650	PSP switch out of self-test range	OFF	1
P1674	Control module software corrupted	OFF	1
P1703	Brake switch out of self-test range	OFF	1
P2100	Throttle actuator circuit open	OFF	1
P2101	Throttle actuator circuit range/performance	ON	2
P2104	Throttle actuator control system - forced idle	ON	2
P2105	Throttle actuator control system - forced engine shutdown	OFF	1
P2107	Throttle actuator control module processor	ON	2
P2110	Throttle actuator control system - forced limited RPM	ON	2
P2111	Throttle actuator control system - stuck open	ON	2
P2112	Throttle actuator control system - stuck closed	ON	2
P2121	APP sensor No.1 circuit range/performance	OFF	1
P2122	APP sensor No.1 circuit low input	OFF	1
P2123	APP sensor No.1 circuit high input	OFF	1
P2126	APP sensor No.2 circuit range/performance	OFF	1
P2127	APP sensor No.2 circuit low input	OFF	1
P2128	APP sensor No.2 circuit high input	OFF	1
P2131	APP sensor No.3 circuit range/performance	OFF	1
P2132	APP sensor No.3 circuit low input	OFF	1
P2133	APP sensor No.3 circuit high input	OFF	1
P2135	TP sensor No.1/No.2 voltage correlation	ON	2
P2195	Front HO2S (RH) signal stuck lean	ON	2
P2196	Front HO2S (RH) signal stuck rich	ON	2
P2197	Front HO2S (LH) signal stuck lean	ON	2
P2198	Front HO2S (LH) signal stuck rich	ON	2
P2270	Rear HO2S (RH) signal stuck lean	ON	2
P2271	Rear HO2S (RH) signal stuck rich	ON	2
P2272	Rear HO2S (LH) signal stuck lean	ON	2
P2273	Rear HO2S (LH) signal stuck rich	ON	2
P260F	Evaporative emission system monitoring processor performance	ON	2

*1 : A warning light of a fuel cap illuminates.

OBD-II Diagnostic Monitoring System Test Results (Mode 06)

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

TEST ID	Description	Related system
10: 01: 01	Front HO2S (RH) switchpoint	HO2S
10: 01: 80	Front HO2S (RH) voltage amplitude	
10: 01: 81	Front HO2S (RH) heater current	
10: 05: 01	Front HO2S (LH) switchpoint	
10: 05: 80	Front HO2S (LH) voltage amplitude	
10: 05: 81	Front HO2S (LH) heater current	
10: 02: 01	Rear HO2S (RH) switchpoint	
10: 02: 81	Rear HO2S (RH) heater current	
10: 06: 01	Rear HO2S (LH) switchpoint	
10: 06: 81	Rear HO2S (LH) heater current	
10: 21: 80	HO2S (Front) and HO2S (Rear) switching time ratio	Catalyst
10: 22: 80		
10: 3A: 80	Phase 0 excessive vacuum limit	EVAP
10: 3A: 81	Phase 4 purge valve stuck open limit	
10: 3A: 82	Phase 0 gross leak limit	
10: 3B: 80	Phase 2 0.040" leak check vacuum bleedup and maximum 0.040" leak threshold	
10: A1: 80	Type A misfire rate (engine 200 rpm)	Misfire
10: A1: 81	Type B misfire rate (engine 1000 rpm)	
10: A1: 82	Highest misfire rate type A (engine 200 rpm)	
10: A1: 83	Highest misfire rate type B (engine 1000 rpm)	
10: A1: 84	Inferred catalyst mid-bed temperature	
10: A2: 0B	Cylinder No.1 average misfire counts for last 10 DC	
10: A2: 0C	Cylinder No.1 misfire counts for last/current DC	
10: A2: 80	Cylinder No.1 type A misfire rate (engine 200 rpm)	
10: A2: 81	Cylinder No.1 type B misfire rate (engine 1000 rpm)	
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: A3: 80	Cylinder No.2 type A misfire rate (engine 200 rpm)	
10: A3: 81	Cylinder No.2 type B misfire rate (engine 1000 rpm)	
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: A4: 80	Cylinder No.3 type A misfire rate (engine 200 rpm)	
10: A4: 81	Cylinder No.3 type B misfire rate (engine 1000 rpm)	
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: A5: 80	Cylinder No.4 type A misfire rate (engine 200 rpm)	
10: A5: 81	Cylinder No.4 type B misfire rate (engine 1000 rpm)	
10: A6: 0B	Cylinder No.5 average misfire counts for last 10 DC	
10: A6: 0C	Cylinder No.5 misfire counts for last/current DC	
10: A6: 80	Cylinder No.5 type A misfire rate (engine 200 rpm)	
10: A6: 81	Cylinder No.5 type B misfire rate (engine 1000 rpm)	
10: A7: 0B	Cylinder No.6 average misfire counts for last 10 DC	
10: A7: 0C	Cylinder No.6 misfire counts for last/current DC	
10: A7: 80	Cylinder No.6 type A misfire rate (engine 200 rpm)	
10: A7: 81	Cylinder No.6 type B misfire rate (engine 1000 rpm)	

ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION DETECTION FUNCTION[MZI-3.5]

id0102d1141900

Features

- If any malfunction develops in the engine control system, the PCM stores that malfunction as a DTC. Stored DTCs can be read-out using the Mazda Modular Diagnostic System (M-MDS).
- The malfunction detection function includes malfunction diagnosis and self-test functions.

Malfunction Diagnosis Function

- This function detects malfunctions that develop in the engine control system.
- When the malfunction conditions are consistent with the malfunction determination conditions preset in the PCM, the PCM determines that an engine control system malfunction has occurred and stores the corresponding DTC (s).

Comprehensive Component Monitor

- The Comprehensive Component Monitor (CCM) monitors for malfunctions in any powertrain electronic component or circuit that provides input or output signals to the PCM that can effect emissions and is not monitored by another system monitor. Inputs and outputs are, at a minimum, monitored for circuit continuity or specified range of values. Where feasible, inputs are also inspected for rationality, and outputs are inspected for proper functionality.
- CCM covers many components and circuits, and tests them in various ways depending on the hardware, function, and type of signal. For example, analog inputs such as throttle position or engine coolant temperature are typically inspected continuously for opens, shorts, and unspecified values. Some digital inputs such as brake switch on rationality inspection; inspecting if the input value makes sense at the current engine operating conditions. These types of tests require monitoring several components and can only be performed under appropriate test conditions.
- Outputs such as coil drivers are checked for open and short circuits by monitoring a feedback circuit or “dedicated IC chip” associated with the output. Other outputs such as relays, require additional feedback circuits to monitor the secondary side of the relay. Some outputs are also monitored for correct function by observing the reaction of the control system to a given change in the output command. Some tests can only be carried out under appropriate test conditions.
- The following is an example of some of the input and output components monitored by the CCM for OBD. The monitored components belong to a PCM supported subsystem.

  Inputs
  — Includes: CHT sensor, IAT sensor, MAF sensor, TP sensor, CKP sensor, CMP sensor, Fuel tank pressure sensor, refrigerant pressure switch (medium pressure)

  Outputs
  — Includes: Fuel pump, A/C relay, purge solenoid valve, CV solenoid valve, OCV
- The CCM is activated after the engine is started and is operating. A DTC is stored in the PCM memory and the MIL is illuminated if a malfunction is detected for two consecutive drive cycles. Many of the CCM monitor items are also performed during self-test.

Fuel System Monitor

- The fuel system monitor is an on-board function designed to monitor correction values for fuel injection control. The fuel control system uses fuel injection learning correction values stored in the PCM to compensate for deviations in fuel system components due to normal wear and aging. During fuel system feedback control, fuel injection control learns the corrections required to correct a “biased” rich or lean fuel system. These corrections are stored as fuel feedback correction coefficients. Fuel injection control has two correction methods: Long term and short term fuel corrections. Long term fuel correction uses the learning correction coefficient and short term fuel correction uses the fuel feedback correction coefficient. Inputs from the CHT, IAT, and MAF sensors are required to activate fuel injection control and perform fuel system monitor. Once activated, the fuel system monitor inspects if the fuel feedback and fuel learning correction coefficients exceed a specified limit. When a malfunction is detected as described below, the fuel system monitor stores a corresponding DTC.
  — The HO2S detects the presence of oxygen in the exhaust gas and provides the PCM with feedback indicating the air/fuel ratio.
  — A correction factor is added to the fuel injector pulse width calculation according to the long and short term fuel corrections as needed to compensate for deviations in the fuel system.
  — As the deviation from the stoichiometric air/fuel ratio becomes larger, air/fuel ratio control suffers and uncombusted gas in the exhaust increase. If the stoichiometric air/fuel ratio exceeds the specified limit and the fuel correction coefficient approaches the specified limit, the fuel system monitor stores DTCs as follows:
    - DTCs P0171 and P0174: Detection of a lean shift in fuel system operation
    - DTCs P0172 and P0175: Detection of a rich shift in fuel system operation
- The MIL is illuminated if a malfunction is detected during two consecutive drive cycles.

HO2S Monitor

- The HO2S monitor is an on-board diagnostic function designed to monitor the HO2S for malfunctions or deterioration that can affect emissions. The HO2S used for fuel injector control is monitored for proper output voltage. Inputs from the CHT, IAT, MAF and CKP sensors are required for HO2S monitor operation. The fuel system and misfire detection monitors must also have been performed successfully before the HO2S monitor is activated.
  — The HO2S detects the oxygen content in the exhaust gas and outputs voltage between 0—1.0 V. If the air fuel ratio is leaner than the stoichiometric air/fuel ratio (14.7: 1), the HO2S generates 0—0.45 V. If the air fuel ratio is richer than the stoichiometric air/fuel ratio (14.7: 1), the HO2S generates 0.45—1.0 V. The HO2S monitor evaluates the HO2S for proper operation.
  — The time between HO2S switches is monitored after the engine is started and during fuel system feedback conditions. Excessive time between switches or no switches since engine startup indicates a concern. Since a lack of switching can be caused by HO2S concerns or by shifts in the fuel system, DTCs are stored that provide additional information for this concern. Different DTCs indicate whether the sensor always indicates lean/disconnected (P2195 or P2197), or always indicates rich (P2196 or P2198). The HO2S signal is also monitored for high voltage, in excess of 1.1 V and stores a unique DTC (P0132 or P0152). An excess voltage condition is caused by a HO2S heater or battery power short to the HO2S signal line.
  — A functional test of the rear HO2S is done during normal vehicle operation. The peak rich and lean voltages are continuously monitored. Voltages that exceed the calibrated rich and lean thresholds indicate a functional sensor. If the voltages have not exceeded the thresholds after a long period of vehicle operation, the air/fuel ratio may be forced rich or lean in an attempt to get the rear sensor to switch. If the sensor does not exceed the rich and lean peak thresholds, a concern is indicated. The HO2S signal is also monitored for high voltage, in excess of 1.1 V and stores a unique DTC (P0138 or P0158). An excess voltage condition is caused by a HO2S heater or battery power short to the HO2S signal line.
  — The HO2S monitor DTCs can be categorized as follows:
    - P0040, P0041: Property failure
    - P0133, P0139, P0153, P0159: Slow response rate
    - P0053, P0054, P059, P0060: Heater circuit malfunction
    - P1127: Rear HO2S not running in on-demand self-test
    - P2195, P2196, P2197, P2198: HO2S lack of switching
    - P2270, P2272: HO2S lack of switching (sensor indicates lean)
    - P2271, P2273: HO2S lack of switching (sensor indicates rich)
- The MIL is illuminated if a malfunction is detected during two consecutive drive cycles.

Misfire Detection Monitor

- The misfire detection monitor is an on-board diagnostic function designed to detect engine misfire and identify in which cylinder the misfire has occurred. Misfire is defined as lack of combustion in a cylinder due to absence of spark, poor fuel metering, poor compression, or any other cause. The misfire detection monitor will only be enable when certain base engine conditions are first satisfied. Inputs from the CHT, IAT, MAF and CKP sensors are required for the monitor to be performed. The misfire detection monitor is also activated during the self-test.
  — The PCM synchronizes the ignition timing with crankshaft rotation signal from the CKP sensor. The crankshaft rotation signal is also the main signal used for determining which cylinder misfires.
  — The crankshaft rotation signal generated by the CKP sensor is derived from by sensing the passage of teeth on the crankshaft position wheel mounted on the end of the crankshaft.
  — This signal is input to the PCM and then used to calculate the time between crankshaft rotation signals, and also crankshaft rotation speed and acceleration. The power loss of each cylinder is determined by comparing the accelerations of each cylinder. When the power loss of a particular cylinder exceeds a specified value and other conditions are met, then that cylinder is determined to have misfired.
  Misfire type A
    - Upon detection of a serious misfire that could cause catalyst damage, the MIL flashes once per second during the misfire and a DTC is stored.
  Misfire type B
    - Upon detection of a misfire that could exceed the emission limits or cause the vehicle to fail an inspection and maintenance tailpipe emissions test, the MIL illuminates and a DTC is stored. DTC P0300 is stored in the case of a multiple cylinder misfire.
  — DTCs P0301, P0302, P0303, P0304, P0305, and P0306 are stored in case of an individual type A or type B single cylinder misfire.
  — DTC P0316 is stored if a type B threshold is exceeded during the first 1,000 revolutions after engine startup. This DTC is stored in addition to the normal P03xx DTC that indicates the misfiring cylinder.

Catalyst Efficiency Monitor

- The catalyst efficiency monitor uses an oxygen sensor before and after the catalyst to infer the HC efficiency based on the oxygen storage capacity of the catalyst. During monitor operation, the PCM calculates the length of the signal while the sensors are switching. Under normal fuel system feed back control conditions, high efficiency catalysts have significant oxygen storage. This makes the switching frequency of the rear HO2S very slow and reduces the amplitude, which provides for a shorter signal length. The front HO2S switches more frequently with greater amplitude, which provides for a longer signal length. As the catalyst efficiency deteriorates due to thermal and chemical deterioration, its ability to store oxygen declines. The rear HO2S signal begins to switch more rapidly with increasing amplitude and signal length, approaching the switching frequency, amplitude, and signal length of the front HO2S. The predominant failure mode for high-mileage catalysts is chemical deterioration (phosphorus deposits on the front brick of the catalyst), not thermal deterioration.
- Inputs from CHT, IAT, MAF, TP, CKP and vehicle speed sensors are required to enable the catalyst efficiency monitor.
- The DTCs associated with this test are DTC P0420 and P0430.
  Because an exponentially weighted moving average algorithm is used to determine a concern, up to 6 driving cycles may be required to illuminate the MIL during normal customer driving. If the PCM memory is reset or the battery is disconnected, a concern illuminates the MIL in 2 drive cycles.

Evaporative Emission (EVAP) Leak Check Monitor

- The EVAP leak check monitor is an on-board strategy designed to detect a leak from a hole (opening) equal to or greater than 0.508 mm (0.020 in) in the enhanced EVAP system. The correct functioning of the individual components of the enhanced EVAP system, as well as its ability to direct fuel vapor to the engine, is also examined. The EVAP leak check monitor relies on the individual components of the enhanced EVAP system to either allow a natural vacuum to occur in the fuel tank or apply engine vacuum to the fuel tank and then seal the entire enhanced EVAP system from the atmosphere. The fuel tank pressure is then monitored to determine the total vacuum lost (bleed-up) for a calibrated period of time. Inputs from the CHT sensor, IAT sensor, MAF sensor, vehicle speed, fuel level input and Fuel tank pressure sensor are required to enable the EVAP leak check monitor.
- During the EVAP leak check monitor repair verification drive cycle, clearing the continuous DTCs and resetting the emission monitors information in the PCM bypasses the minimum soak time required to complete the monitor. The EVAP leak check monitor does not run if the key is turned off after clearing the continuous DTCs and resetting the emission monitors information in the PCM. The EVAP leak check monitor does not run if a MAF sensor concern is present. The EVAP leak check monitor does not initiate until the HO2S monitor is complete.

Thermostat Monitor

- The thermostat monitor is designed to verify correct thermostat operation. This monitor is executed once per drive cycle and has a monitor run duration of 300—800 s. If a concern is present, P0128 is set and the MIL is illuminated.
- The monitor inspections the CHT sensor to warm up in a predictable manner when the engine is generating sufficient heat. A timer is initialized while the engine is at moderate load and the vehicle speed is above a calibrated limit. The target timer value is based on ambient air temperature at engine start-up. If the timer exceeds the target time and CHT has not warmed up to the target temperature, a concern is indicated.
- The test runs if the start-up intake air temperature is at, or below the target temperature.
  Inputs
  — Includes: CHT, IAT, engine LOAD (from MAF sensor), vehicle speed input

On-board Diagnostic System (OBD) Readiness Test

- Allows verification of whether or not the OBD items (monitor items) set in the PCM have been successfully completed.
- Fuel injection control, and CCM and non-CCM components, are constantly monitored since their status is constantly diagnosed.
- The status of intermittently monitored diagnostic items can be initiated by activating the initialization function for diagnostic data.

Self-test Function

- 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.
- When the self-test is activated, the PCM performs engine control system diagnosis. If any malfunction is detected as a result of the diagnosis, the applicable DTC is stored. Stored DTCs can be read-out using the Mazda Modular Diagnostic System (M-MDS).
- Using the self-test function, the present malfunction or a successful repair is readily confirmed. Refer to the self-test table for the corresponding DTCs.

KOEO (Key ON, Engine Off) Self-test

- The KOEO self-test, performed when the ignition switch is turned to the ON position and the engine is stopped, is designed to diagnose malfunctions related to DTCs applicable to this self-test function. A KOEO self-test begins when the connected the Mazda Modular Diagnostic System (M-MDS) sends an execute command to the PCM.

KOER (Key ON, Engine Running) Self-test

- The KOER, self-test performed when the ignition switch is turned to the ON position, the vehicle is stopped and the engine is idling, is designed to diagnose malfunctions related to DTCs applicable to this self-test function. A KOER self-test begins when the connected the Mazda Modular Diagnostic System (M-MDS) an execute command to the PCM.

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION[MZI-3.5]

id0102d1142100

Features

- PIDs that satisfy emission regulations are included.

Function

- Allows for monitoring emission-related data, such as input/output signals, PCM calculated values and system status.
- Items that can be monitored are shown below.

PID/Data Monitor Table
The Mazda Modular Diagnostic System (M-MDS)

PID Name	Description	Unit
AAT	Indicate the ambient air temperature	°C
AC_REQ	A/C request signal	Off/On
ACCS	A/C relay	Off/On
ALTF	Generator field coil control duty value	%
APP	Accelerator pedal position	%
APP1	APP sensor No.1	%
		V
APP2	APP sensor No.2	%
		V
APP3	APP sensor No.3	%
		V
ARPMDES	Target engine speed	RPM
AXLE	Axle ratio	—
BARO	Barometric pressure	Pa
BOO	Brake switch	Off/On
BPA	Brake pressure applied switch	Off/On
CATT11_DSD	Estimated catalytic converter temperature (RH)	°C
CATT21_DSD	Estimated catalytic converter temperature (LH)	°C
CHRGLP	Generator warning light	Off/On
CHT	CHT sensor	°C
		V
COLP	Refrigerant pressure switch (middle)	Off/On
DTCCNT	Number of DTCs detected	—
ECT	Engine coolant temperature	°C
EQ_RAT11_DSD	Desired equivalence ratio (lambda)	-
ETC_ACT	Electronic throttle control actual	°
ETC_DSD	Electronic throttle control desired	%
		°
EVAPCP	Purge solenoid valve duty value	%
EVAPCV	CV solenoid valve	Off/On
EVMV	Evaporative Emission Vapor Management valve	mA
FAN_DUTY	Cooling fan control	%
FLI	Fuel level	%
FP	Fuel pump relay	Off/On
FPM	Fuel pump monitor	Off/On
FTP	Fuel tank pressure sensor	V
FTP_H2O	Fuel tank pressure (inches of water column)	—
FUELSYS1	Fuel system loop status (RH)	OL/CL/OL-Drive/OL-Fault/CL-Fault
GENVDSD	Generator voltage desired	V
HTR11	Front HO2S heater (RH)	Off/On
HTR12	Rear HO2S heater (RH)	Off/On
HTR21	Front HO2S heater (LH)	Off/On
HTR22	Rear HO2S heater (LH)	Off/On

PID Name	Description	Unit
IAT	IAT sensor	°C
		V
INGEAR	Load/no load condition	Off/On
LOAD	Engine load	%
LONGFT1	Long term fuel trim (RH)	%
LONGFT2	Long term fuel trim (LH)	%
MAF	MAF sensor	g/s
		V
MFF_IAT	Intake air temperature at the time of misfire	°C
MFF_LOAD	Engine load at the time of misfire	%
MFF_RNTM	Engine running time at time of misfire	ms
MFF_RPM	Engine speed at the time of misfire	RPM
MFF_SOAK	Engine off soak time prior to misfire	ms
MFF_TP	Throttle position at the time of misfire	V
MFF_TRIP	Number of trips since the time of misfire	—
MFF_VSS	Vehicle speed at the time of misfire	KPH
MIL	Malfunction indicator lamp	Off/On
MIL_DIS	Travelled distance since the MIL illuminated	km
O2S11	Front HO2S (RH)	V
O2S12	Rear HO2S (RH)	V
O2S21	Front HO2S (LH)	V
O2S22	Rear HO2S (LH)	V
OCTANE	Octane of fuel	—
PCVHC	PCV valve heater control	%
PSP	Power steering pressure switch	Low/High
RO2FT1	Rear HO2S fuel trim (RH)	—
RO2FT2	Rear HO2S fuel trim (LH)	—
RPM	Engine speed	RPM
SC_CANCEL	Speed control cancel switch	Inactive / Active
SC_OFF	Cruise control OFF switch	Inactive / Active
SC_ON	Cruise control ON switch	Inactive / Active
SC_RES	Cruise resume switch	Inactive / Active
SC_SET-	Cruise coast switch	Inactive / Active
SC_SET+	Cruise set/acceleration switch	Inactive / Active
SCCS	Speed control command switch	V
SHRTFT1	Short term fuel trim (RH)	%
SHRTFT11	Front short term fuel trim (RH)	%
SHRTFT2	Short term fuel trim (LH)	%
SHRTFT21	Front short term fuel trim (LH)	%
SPARKADV	Ignition timing	°
SPKDUR_1	Spark duration of cylinder No.1	sec
SPKDUR_2	Spark duration of cylinder No.2	sec
SPKDUR_3	Spark duration of cylinder No.3	sec
SPKDUR_4	Spark duration of cylinder No.4	sec
SPKDUR_5	Spark duration of cylinder No.5	sec
SPKDUR_6	Spark duration of cylinder No.6	sec
SPRK_ACT	Actual ignition timing	°
TIRESIZE	Tire revolution per mile	-
TP REL	Relative throttle position	%
TP1	TP sensor No.1	%
		V
TP2	TP sensor No.2	%
		V
VPWR	Battery voltage	V

PID Name	Description	Unit
VSS	Vehicle speed	KPH
VT ACT1	Actual valve timing (RH)	°
VT ACT2	Actual valve timing (LH)	°
VT DIFF1	Difference between target and actual valve timing (RH)	°
VT DIFF2	Difference between target and actual valve timing (LH)	°
VT DUTY1	Oil control valve duty value (RH)	%
VT DUTY2	Oil control valve duty value (LH)	%

ON-BOARD DIAGNOSTIC SYSTEM SIMULATION FUNCTION[MZI-3.5]

id0102d1142200

Features

- Simulation items for output components are supported.

Function

- Output parts preset in the PCM can be operated regardless of PCM control status.
- The items that can be operated are as shown below.

Active command mode table

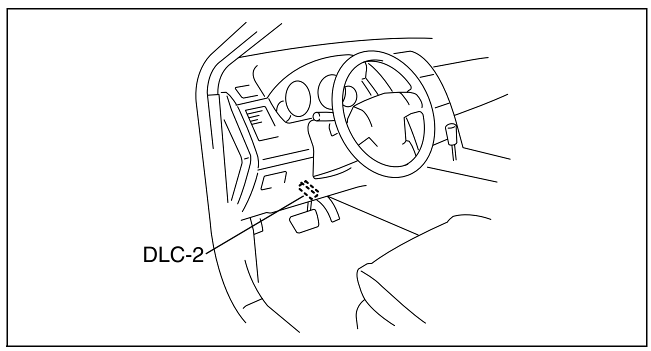
Item	Part operated	Unit/Operation
ARPMDES	Target engine speed	RPM
EVMV	Evaporative emission vapor management valve	mA
FP	Fuel pump relay	Off / On

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL DIAGNOSTIC UNIT COMMUNICATION FUNCTION[MZI-3.5]

id0102d1141800

Features

- The data link connector 2 (DLC-2) conforming to International Organization for Standardization (ISO) standards has been added.



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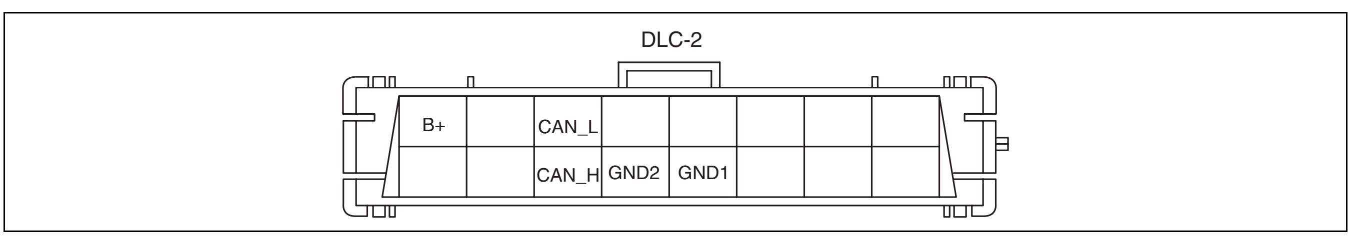
DLC-2

- Shape and terminal arrangement as stipulated by the ISO 15031-3 (SAE J1962) international standard has been adopted. A 16-pin terminal structure is used.



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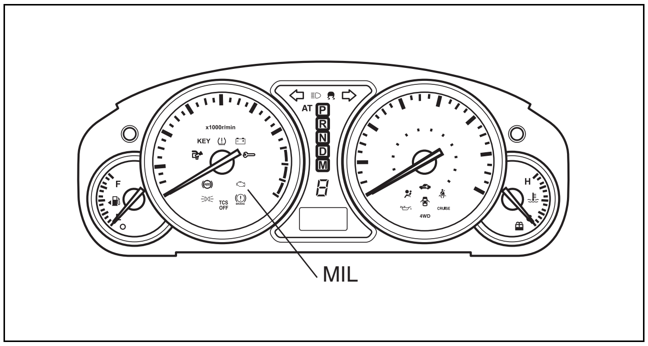
Terminal	Function
B+	Battery power supply terminal
CAN_L	Serial communication Lo terminal
CAN_H	Serial communication Hi terminal
GND1	Body GND terminal
GND2	Serial communication GND terminal

ON-BOARD DIAGNOSTIC SYSTEM MALFUNCTION DISPLAY FUNCTION[MZI-3.5]

id0102d1142000

Features

- The MIL has been adopted to alert the driver when a malfunction occurs in the engine control system.
- The MIL is built into the instrument cluster.



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Function

- When an engine control system malfunction occurs, a DTC is stored in the PCM at the same time the MIL illuminates.

ON-BOARD DIAGNOSTIC SYSTEM DIAGNOSTIC DATA MEMORY FUNCTION[MZI-3.5]

id0102d1141700

Features

- A diagnostic data memory function has been adopted for storing/clearing engine control system diagnostic data.

Memory Function

- The following diagnostic data can be stored in the PCM using the memory function:
  — DTC count
  — DTCs
  — Freeze frame data
  — On-board diagnostic system status
- A DTC is stored in the PCM when an engine control system malfunction occurs. This stored DTC can then be read-out using the Mazda Modular Diagnostic System (M-MDS) and is displayed as a five character code (PXXXX).
- The DTC is stored in or cleared from the PCM according to the drive cycle count setting.

Initialization Function

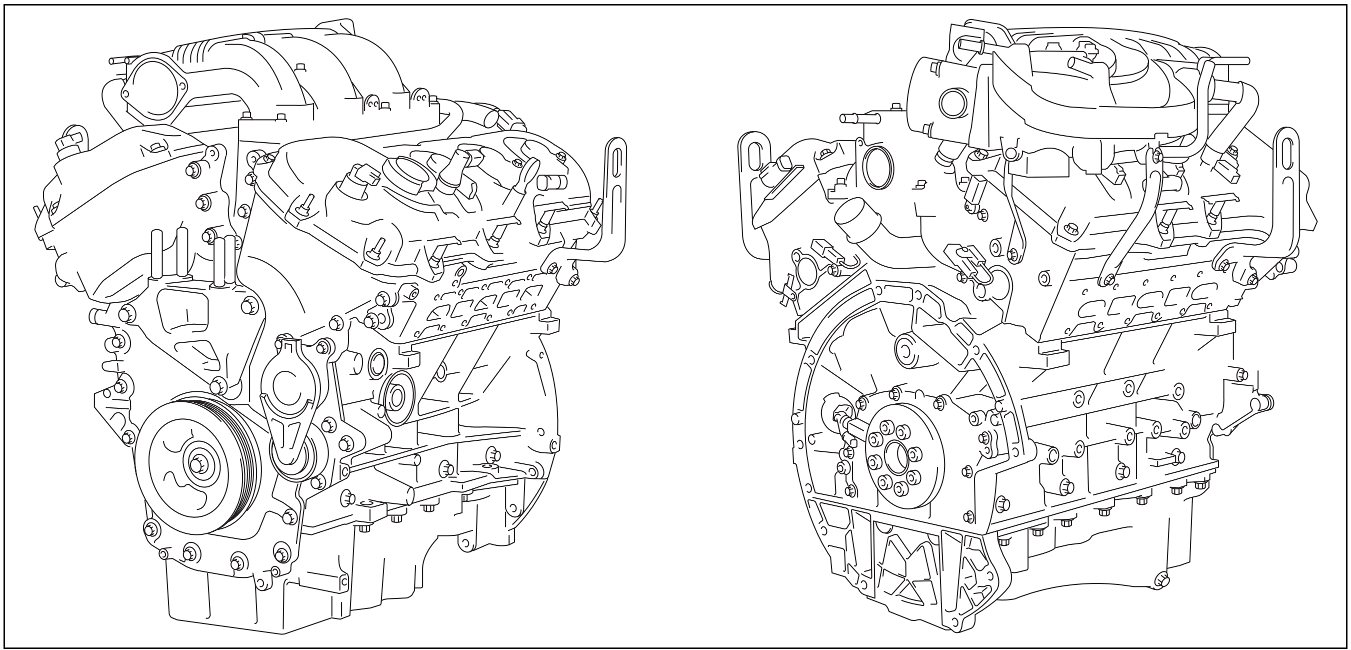
- Diagnostic data stored in the PCM can be cleared using the initialization function.

01-10 MECHANICAL [MZI-3.5]

01-10

ENGINE STRUCTURAL VIEW [MZI-3.5]

id0110c1119200



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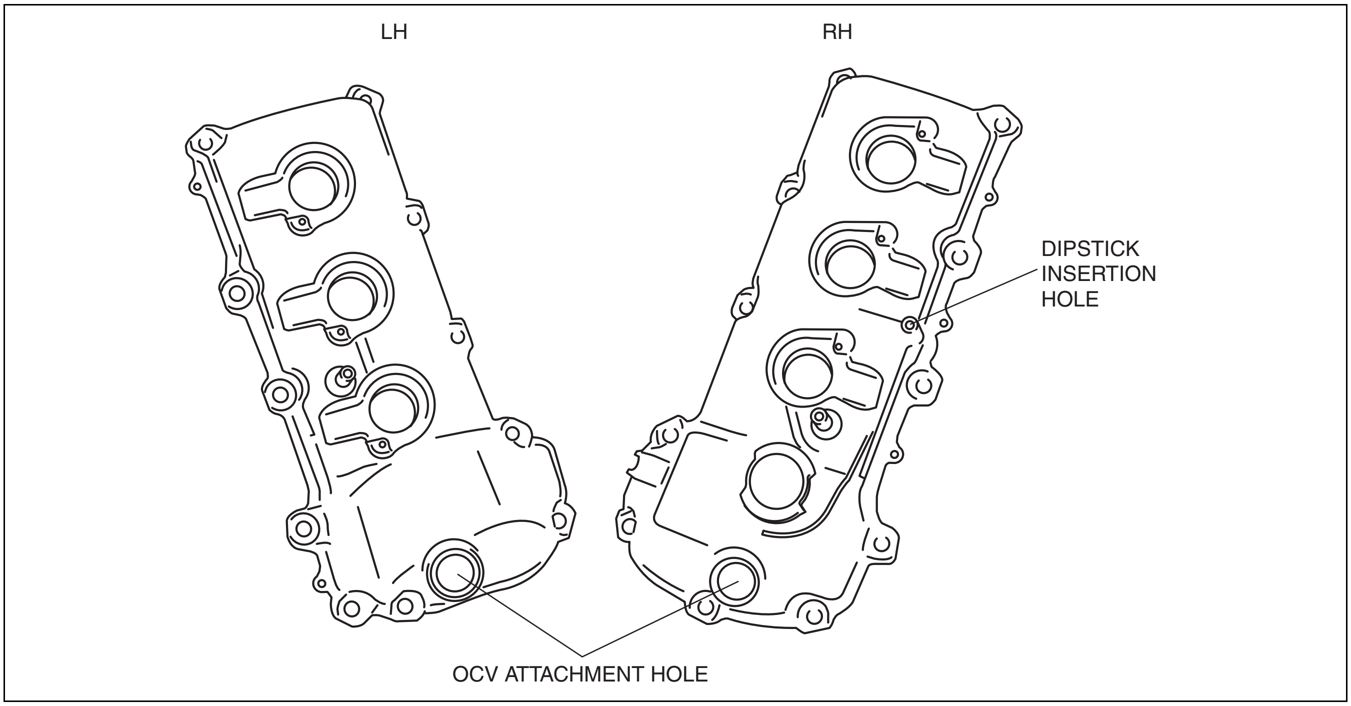
CYLINDER HEAD COVER CONSTRUCTION [MZI-3.5]

id0110c1100200

- The cylinder head cover is made of integrated aluminum alloy, which is lightweight.
- There are holes for installing the oil control valve (OCV).
- The cylinder head cover has been equipped with a dipstick insertion hole.



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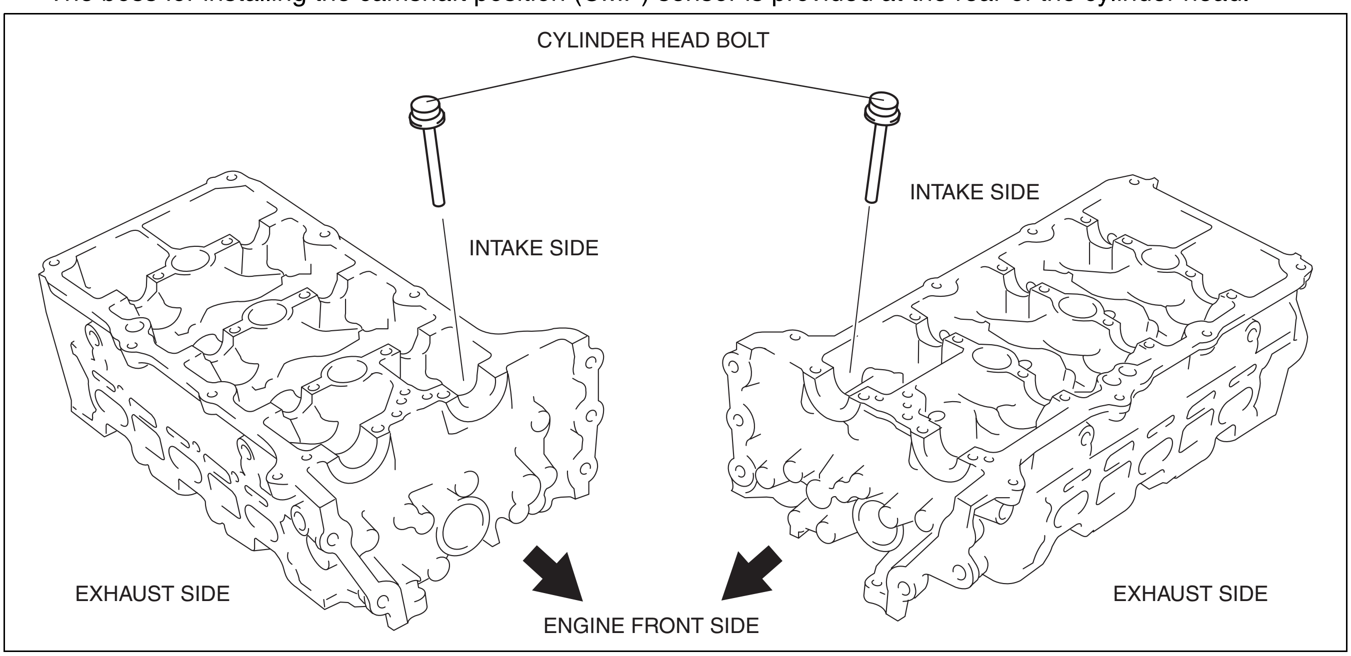
CYLINDER HEAD CONSTRUCTION [MZI-3.5]

id0110c1100300

- A high-heat conductive, lightweight aluminum alloy cylinder head has been adopted.
- Compact, pentroof-type combustion chambers have been adopted.
- Torque-to-yield cylinder head bolts have been adopted for the cylinder head bolts.
- The boss for installing the camshaft position (CMP) sensor is provided at the rear of the cylinder head.



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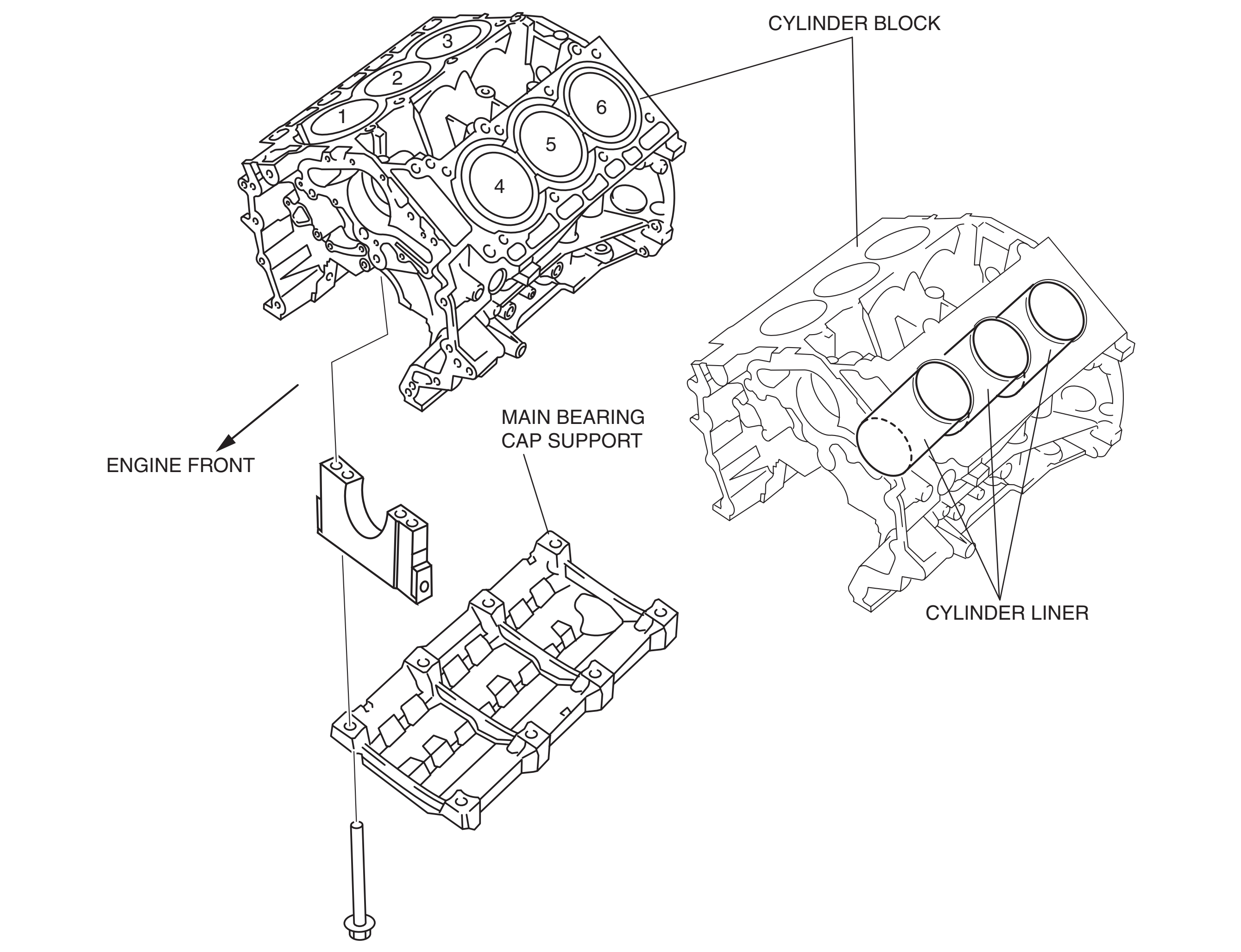
CYLINDER BLOCK CONSTRUCTION [MZI-3.5]

id0110c1100500

- Aluminum alloy has been adopted on the cylinder block, which consists of a cylinder block and a main bearing cap support.
- The cylinders are numbered 1, 2, 3 from the front along the right bank and 4, 5, 6 from the front along the left bank.
- The liner is cast into each cylinder.
- The main bearing cap support has been adopted to increase the rigidity.



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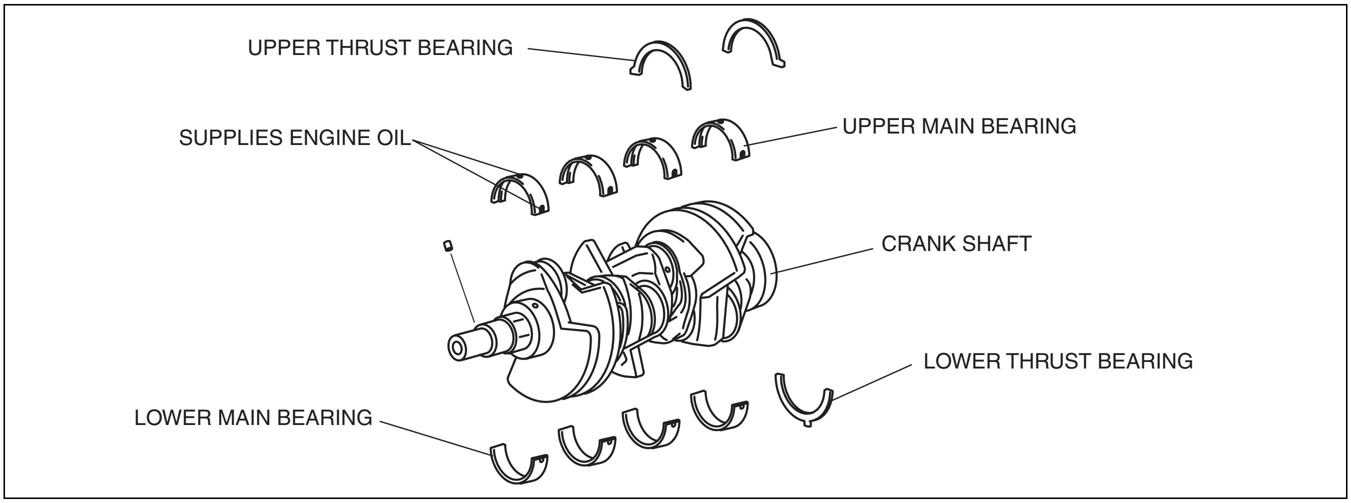
CRANKSHAFT, MAIN BEARING CONSTRUCTION [MZI-3.5]

id0110c1100800

- Consists of two upper thrust bearings and a lower thrust bearing.
- The crankshaft has internal oil passages for supplying oil to each journal.
- The internal surface of the upper main bearing has oil grooves and holes for oil lubrication.



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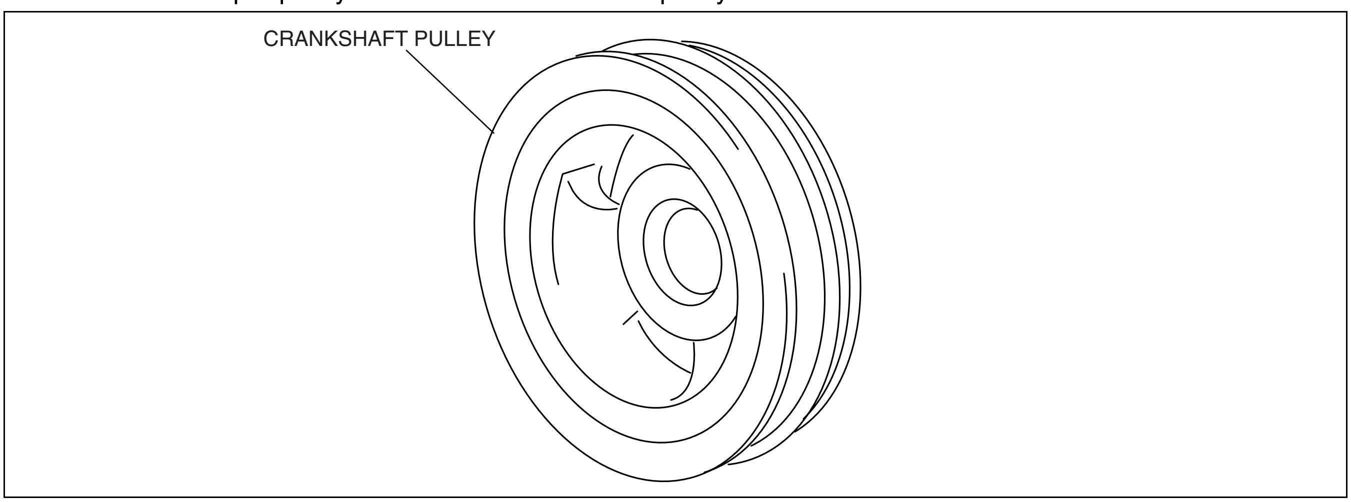
CRANKSHAFT PULLEY CONSTRUCTION [MZI-3.5]

id0110c1101800

- A torsional damper pulley is used for the crankshaft pulley to reduce noise and torsional vibration.



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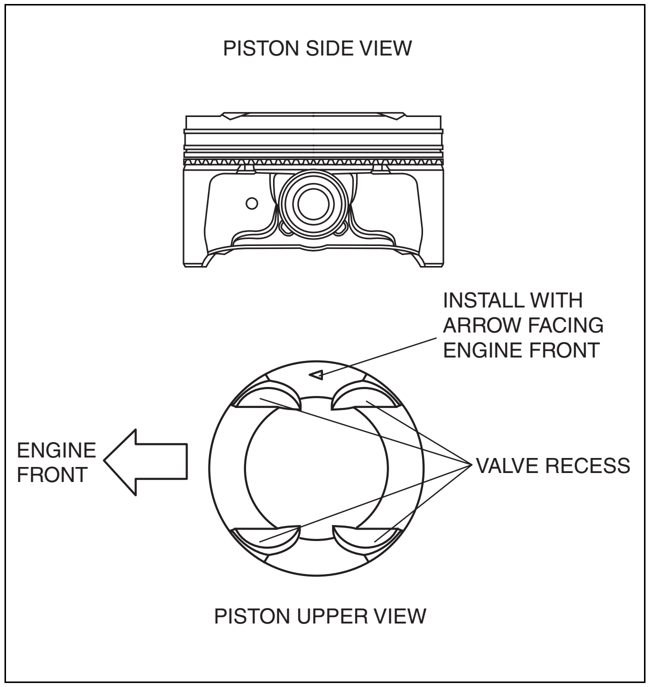
PISTON CONSTRUCTION [MZI-3.5]

id0110c1119600

Construction

- High-heat strengthened aluminum alloy has been adopted on the pistons for excellent thermal conductivity.
- A front mark has been adopted on the upper surface of the piston to prevent mis-assembly of the front/back.



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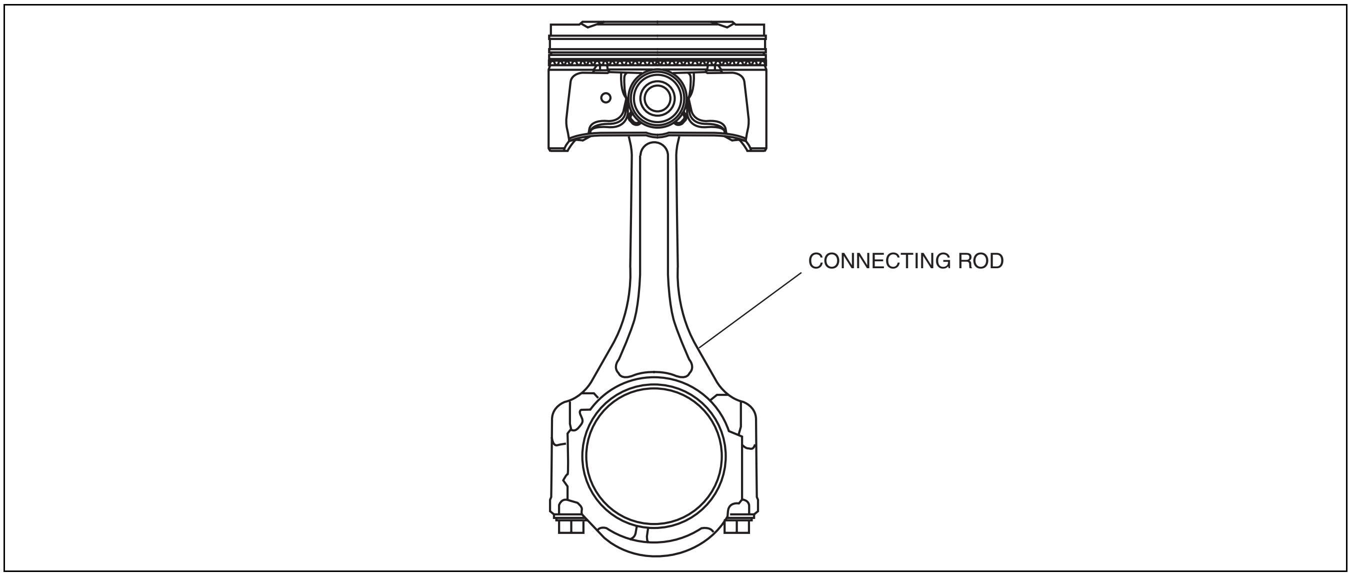
CONNECTING ROD CONSTRUCTION [MZI-3.5]

id0110c1119700

- Torque-to-yield bolts have been adopted for the connecting rod bolts.



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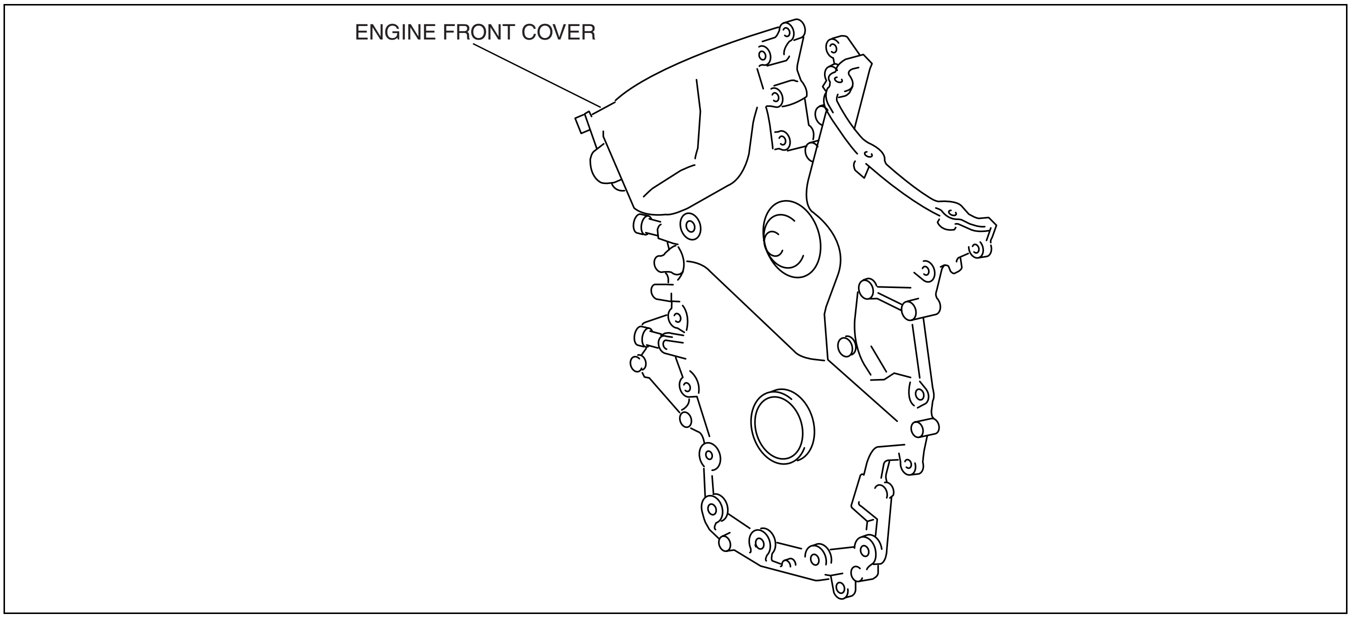
ENGINE FRONT COVER CONSTRUCTION [MZI-3.5]

id0110c1119100

- Aluminum alloy has been adopted on the engine front cover to weight reduction.



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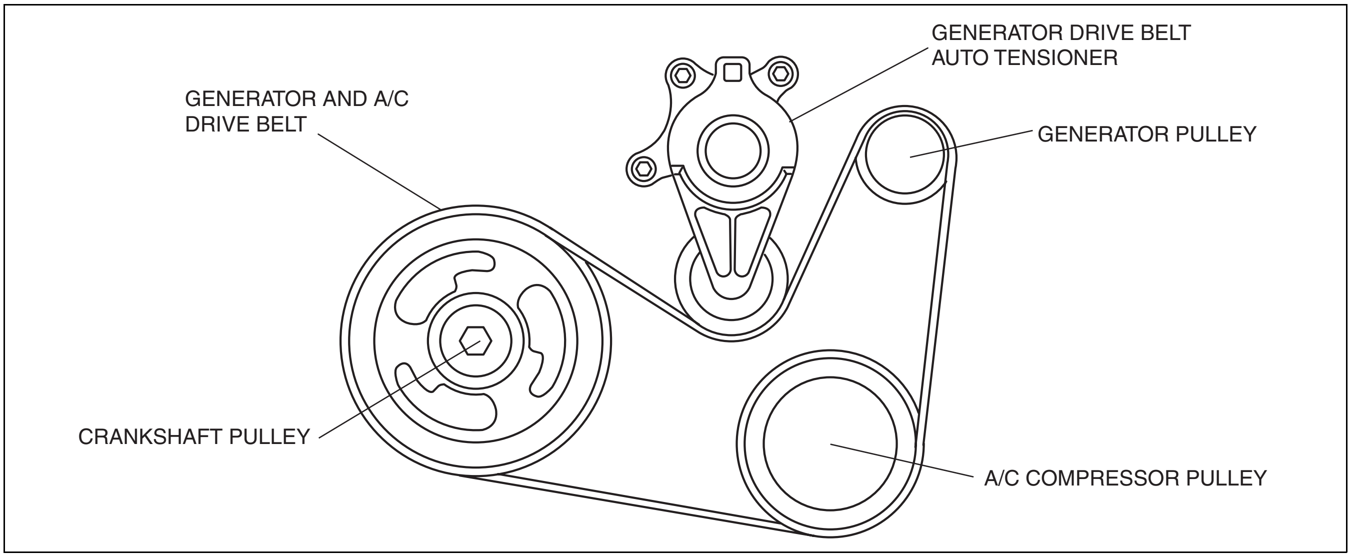
DRIVE BELT CONSTRUCTION [MZI-3.5]

id0110c1102500

Generator and A/C Drive Belt

- A V-ribbed drive belt is employed.
- A drive belt auto tensioner with an embedded coil spring has been adopted to automatically maintain optimal drive belt tension.



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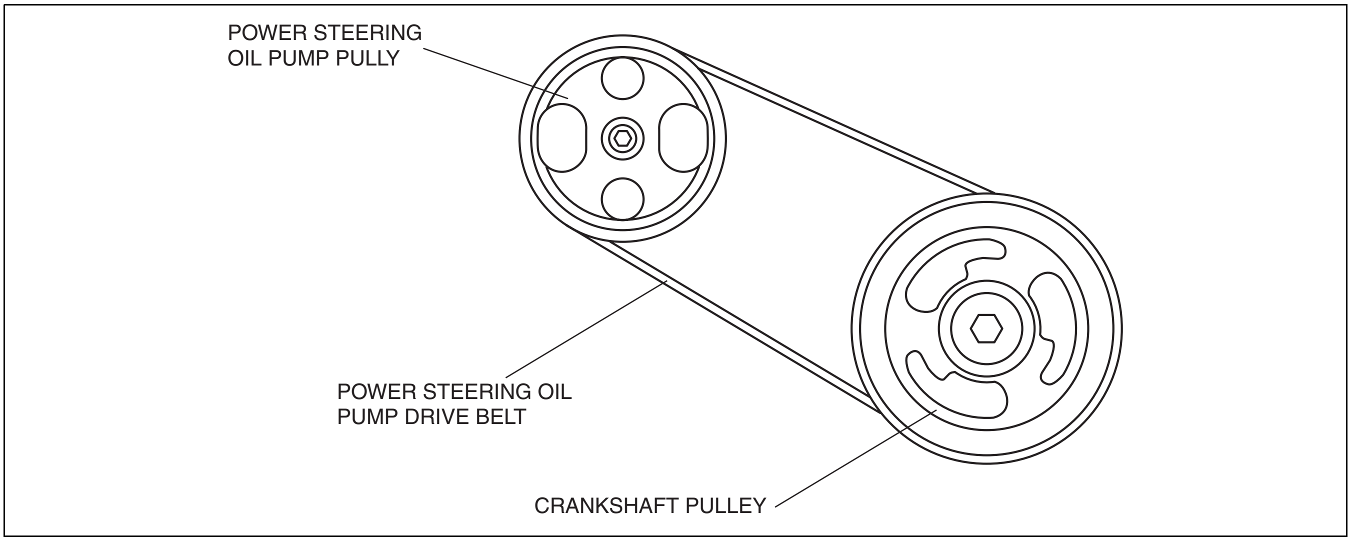
Power Steering Oil Pump Drive Belt

- A V-ribbed drive belt is employed.
- For the removal/installation of the power steering oil pump drive belt, rotate the crankshaft using the SST and remove/install.



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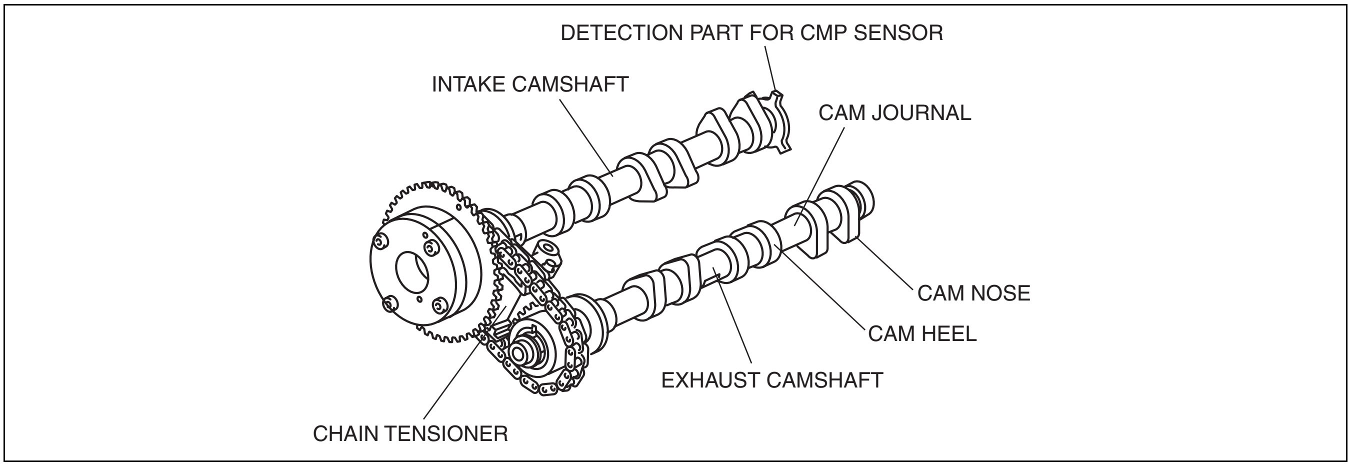
CAMSHAFT CONSTRUCTION [MZI-3.5]

id0110c1101300

- There is a camshaft sprocket positioning pin at the end of the camshaft, and a key groove in the camshaft sprocket. Mis-assembly can be prevented by aligning the positioning pin with the key groove when assembling.
- The detection unit for the camshaft position (CMP) sensor is at the intake port side camshaft.
- The groove for securing the No.1 cylinder TDC of the camshaft is provided at the top of the intake and exhaust camshaft.



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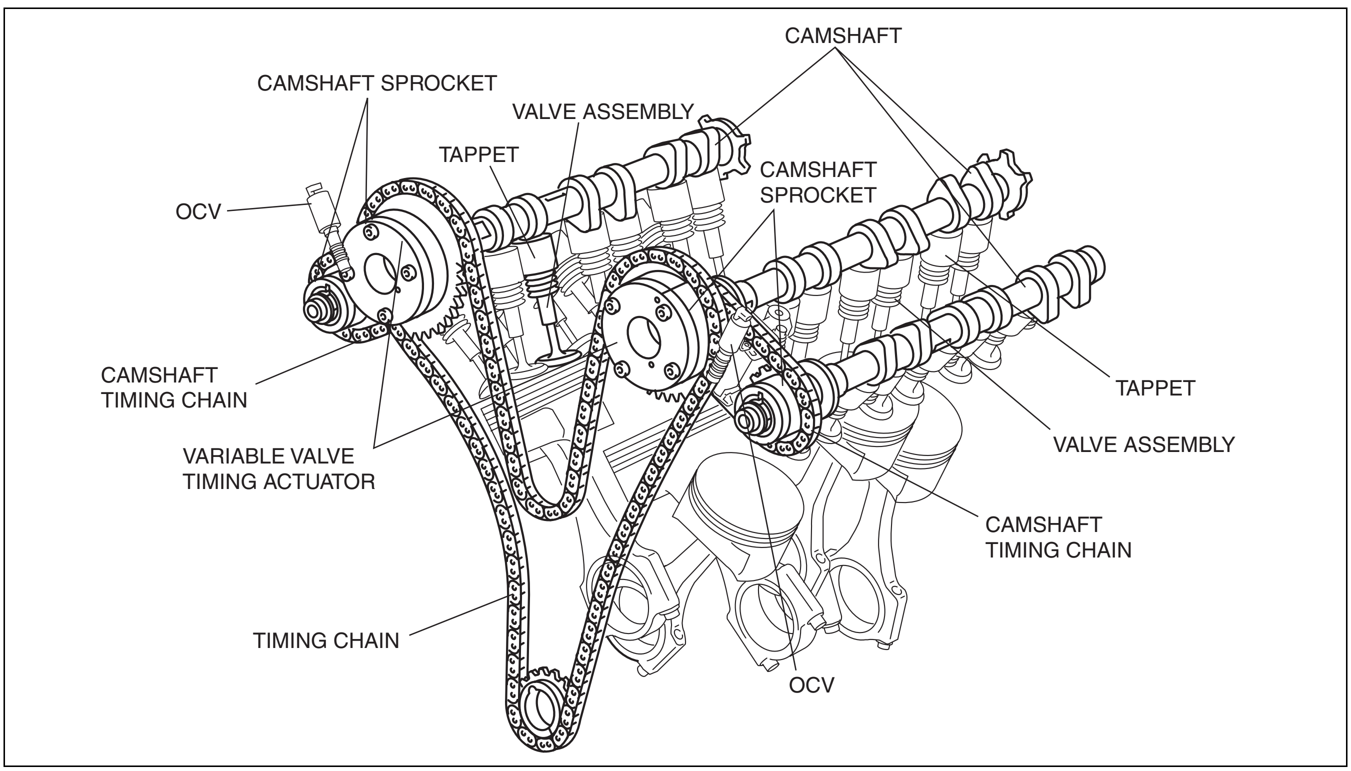
VALVE MECHANISM OUTLINE [MZI-3.5]

id0110c1120000

- There are two intake valves and two exhaust valves for each cylinder. There are a total of 24 valves which are directly driven by four camshafts.
- The variable valve timing mechanism has been adopted which insures the best valve timing according to the drive condition by constantly changing the phase of the intake valve side camshaft.

VALVE MECHANISM STRUCTURAL VIEW [MZI-3.5]

id0110c1120600



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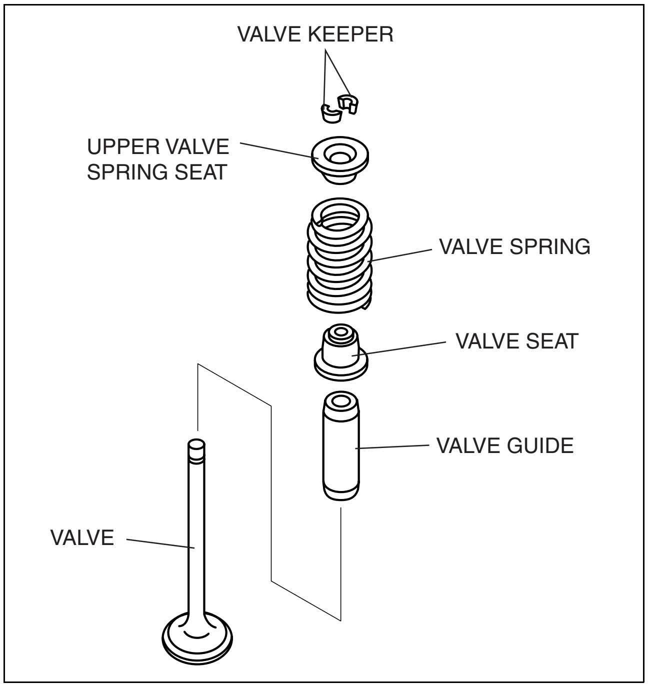
VALVE, VALVE SPRING, VALVE SEAL GUIDE CONSTRUCTION [MZI-3.5]

id0110c1120200

- Each cylinder has two intake valves and two exhaust valves, total of 4 valves.
- A valve seal integrated into the lower valve spring seat has been adopted for simplification and improved serviceability.



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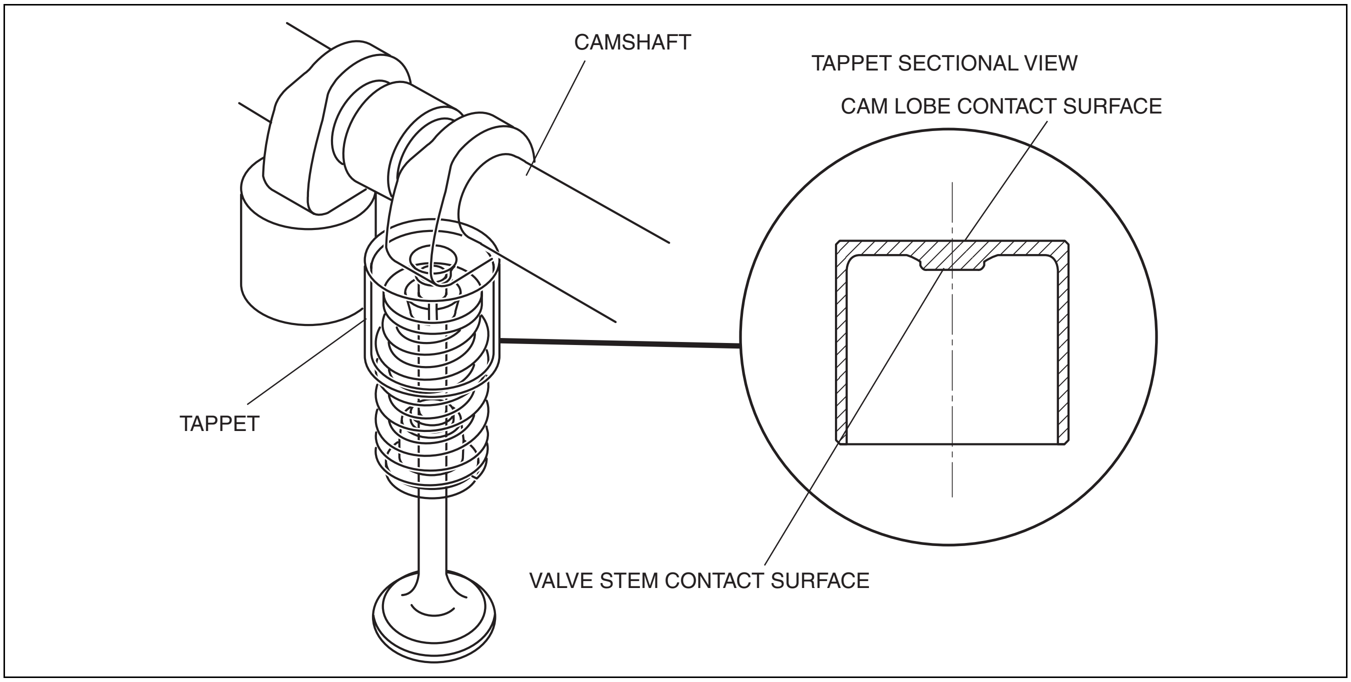
TAPPET CONSTRUCTION [MZI-3.5]

id0110c1102200

- Shimless tappets have been adopted. (Shim integrated with tappet.)
- The valve clearance can be adjusted by replacing the tappet.



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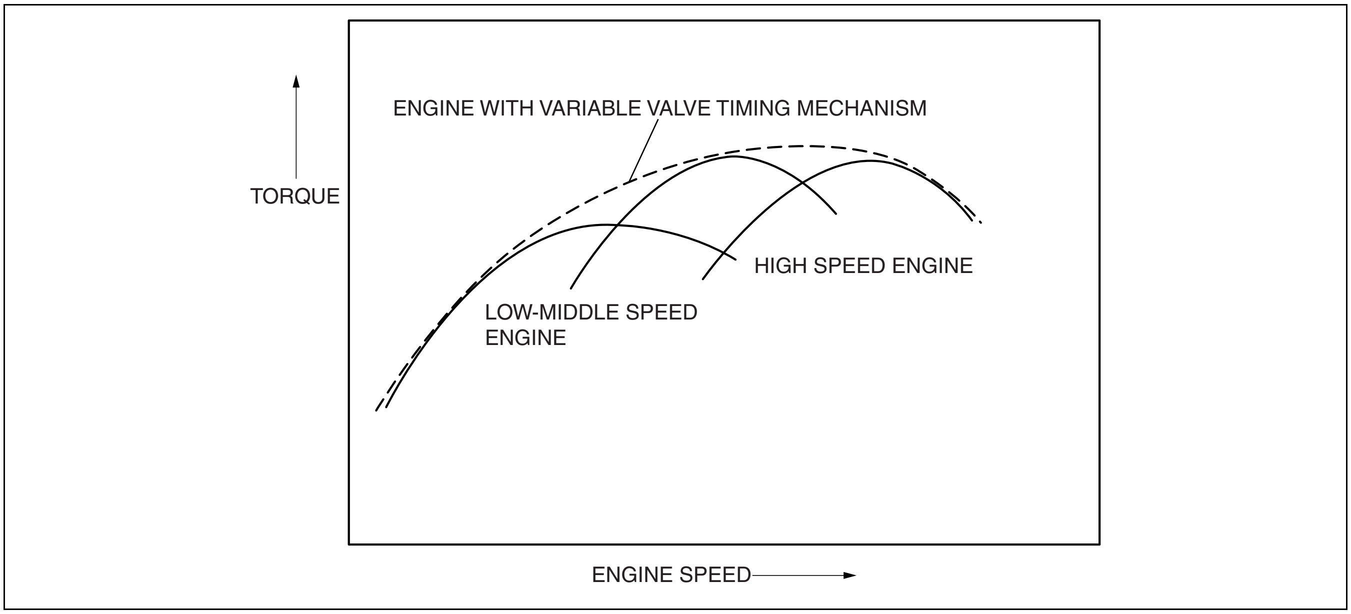
VARIABLE VALVE TIMING MECHANISM OUTLINE [MZI-3.5]

id0110c1101900

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



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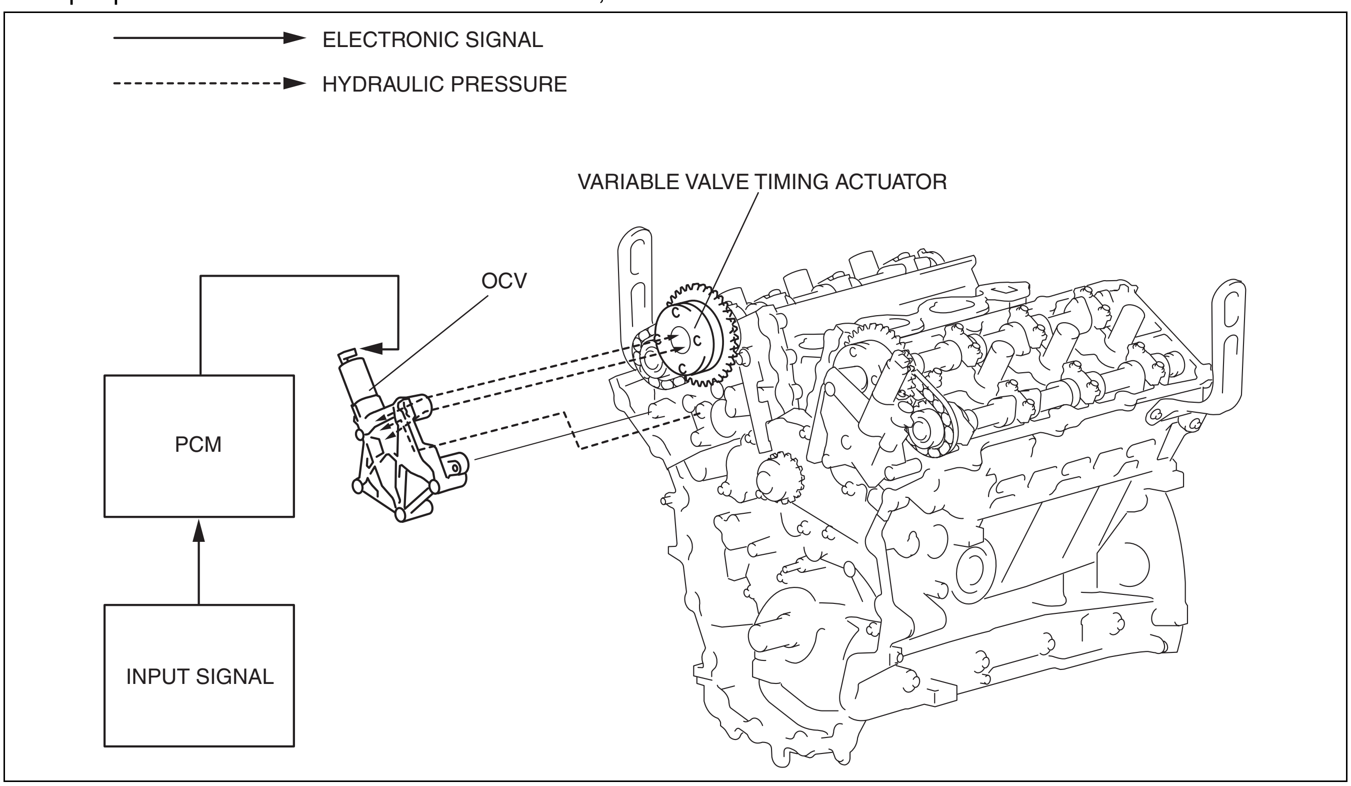
VARIABLE VALVE TIMING MECHANISM CONSTRUCTION/OPERATION [MZI-3.5]

id0110c1102000

Construction

- The variable valve timing mechanism consists of the variable valve timing actuator, oil control valve (OCV), input parts for vehicle conditions determination, and the PCM.



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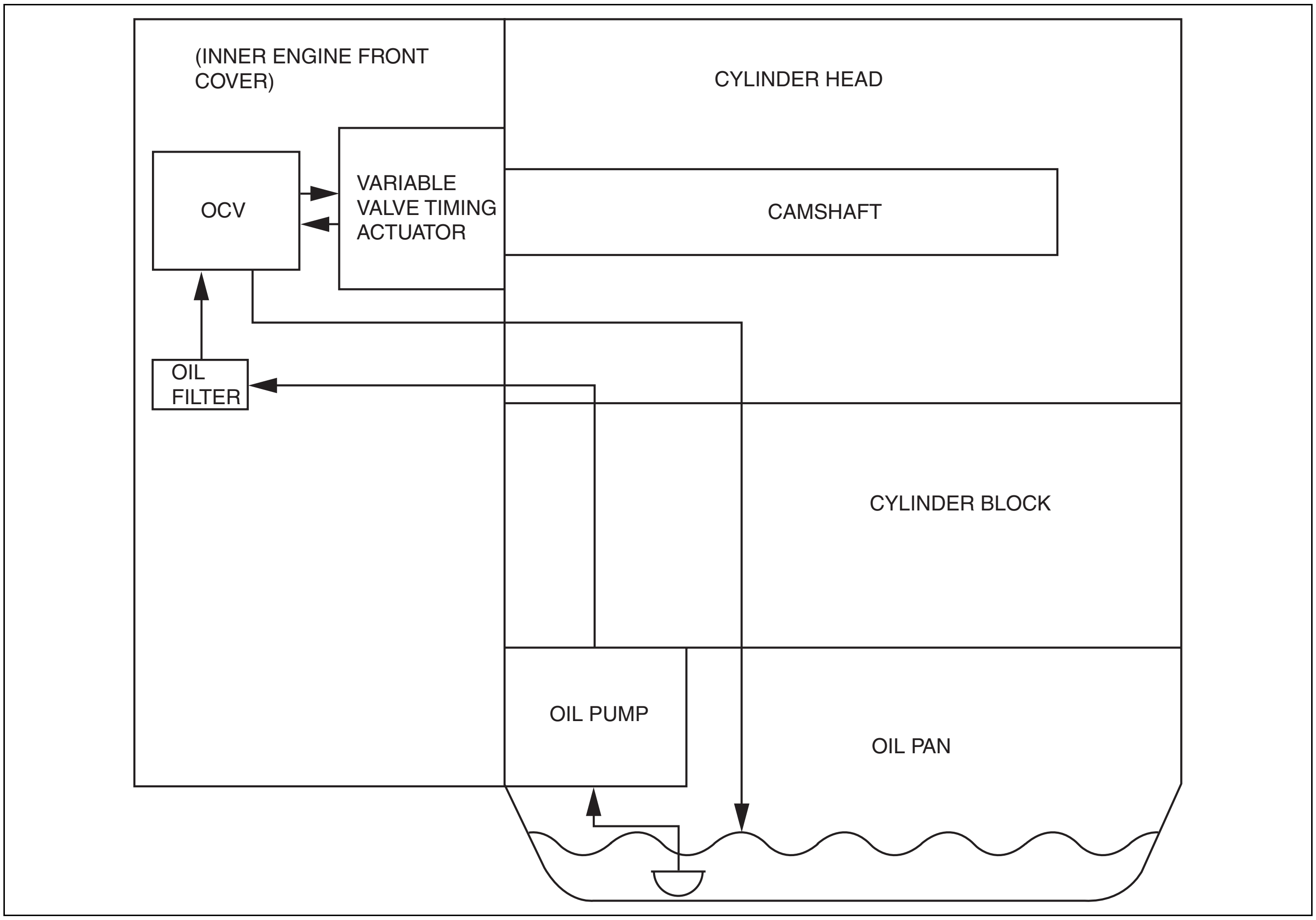
Hydraulic Pressure Flow Diagram



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Component and Function

Variable valve timing actuator	• Continuously modifies the phases of the intake camshaft and crankshaft at the forward end of the intake camshaft using hydraulic pressure from the oil control valve (OCV).
OCV	• Operated by current from the PCM. Switches the hydraulic oil passages to the variable valve timing actuator.
PCM	• Controls the OCV so that optimum valve timing is obtained according to engine operation conditions.

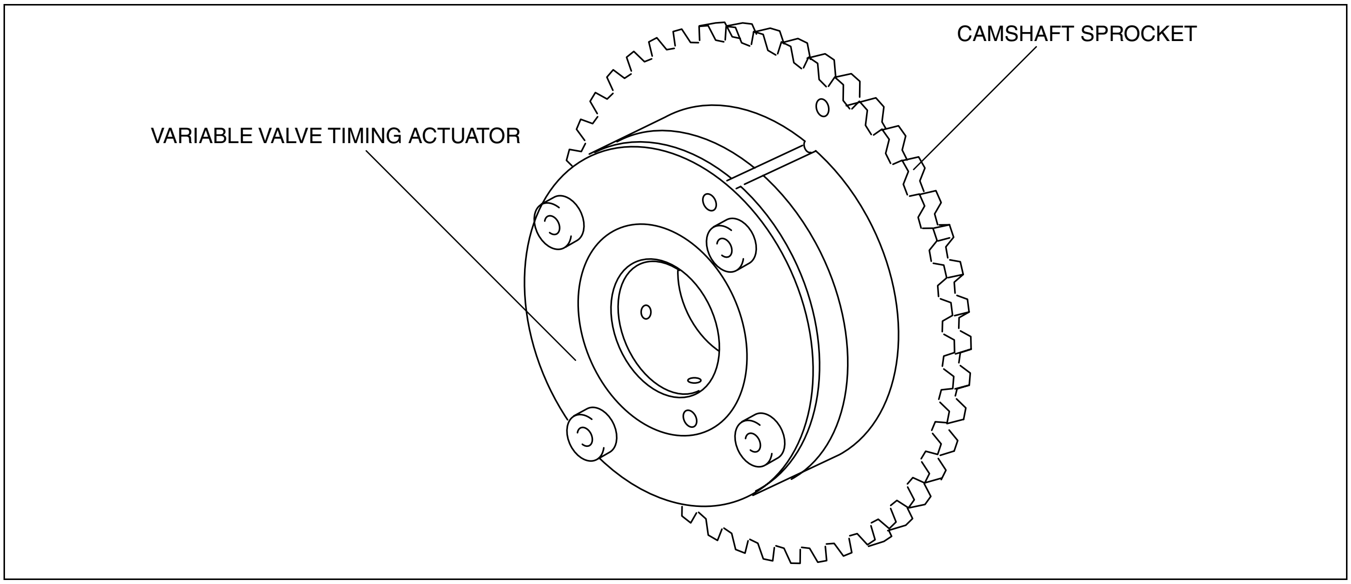
Operation

- Engine oil which is suctioned by the oil pump flows to the variable valve timing actuator via the oil control valve (OCV). The hydraulic pressure applied to the variable valve timing actuator is controlled by the OCV and the relative phase of the camshaft sprocket and camshaft is changed to optimize the valve timing depending on the engine operation conditions.

VARIABLE VALVE TIMING ACTUATOR CONSTRUCTION [MZI-3.5]

id0110c1102300

- The variable valve timing actuator is integrated (cannot be disassembled) with the intake camshaft sprocket.



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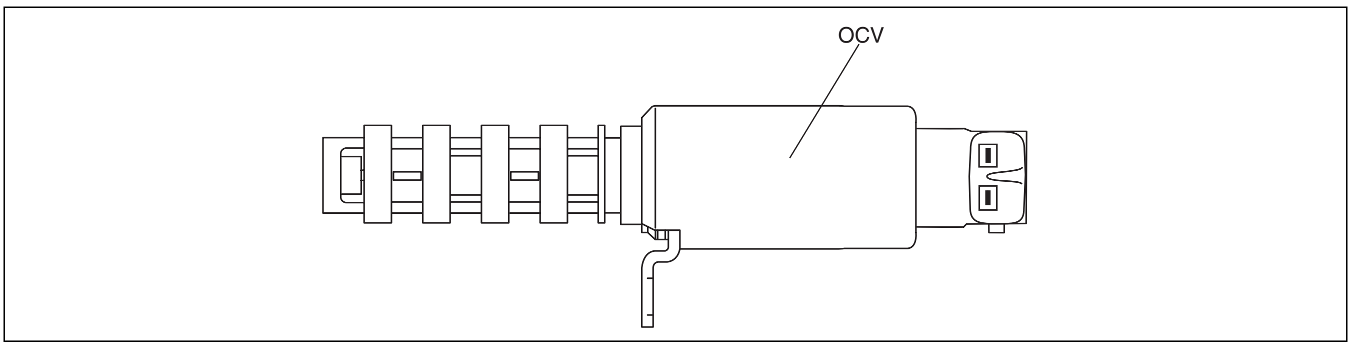
OIL CONTROL VALVE (OCV) OPERATION [MZI-3.5]

id0110c1103600

- The OCV changes the engine oil flow by moving the spool valve.



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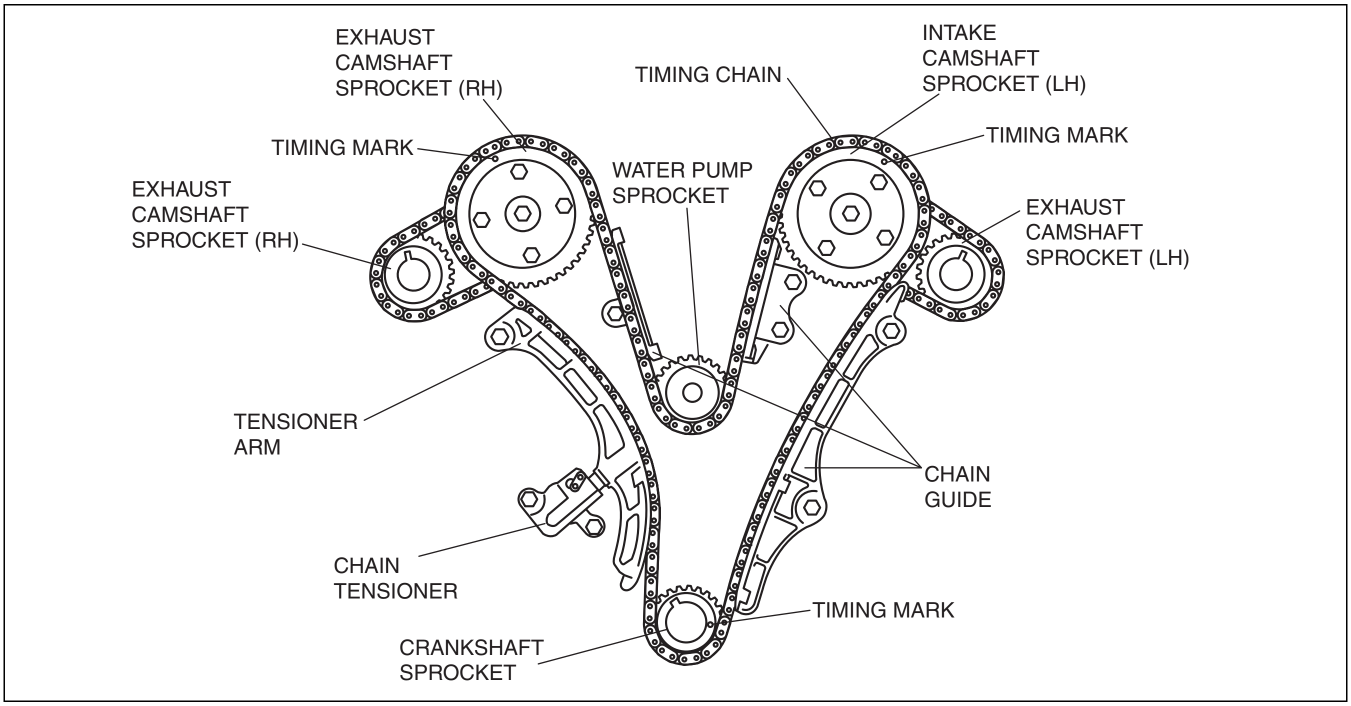
TIMING CHAIN, CHAIN TENSIONER CONSTRUCTION [MZI-3.5]

id0110c1101200

Timing Chain

- The timing chain tension is maintained constantly by the chain tensioner.
- The tension of the timing chain is constantly maintained using oil pressure and spring force in the chain tensioner.
- There is a timing mark on the surface of the intake camshaft sprocket on both banks, and on the surface of the crankshaft sprocket. Timing can be performed by assembling the timing chain based on these timing marks.



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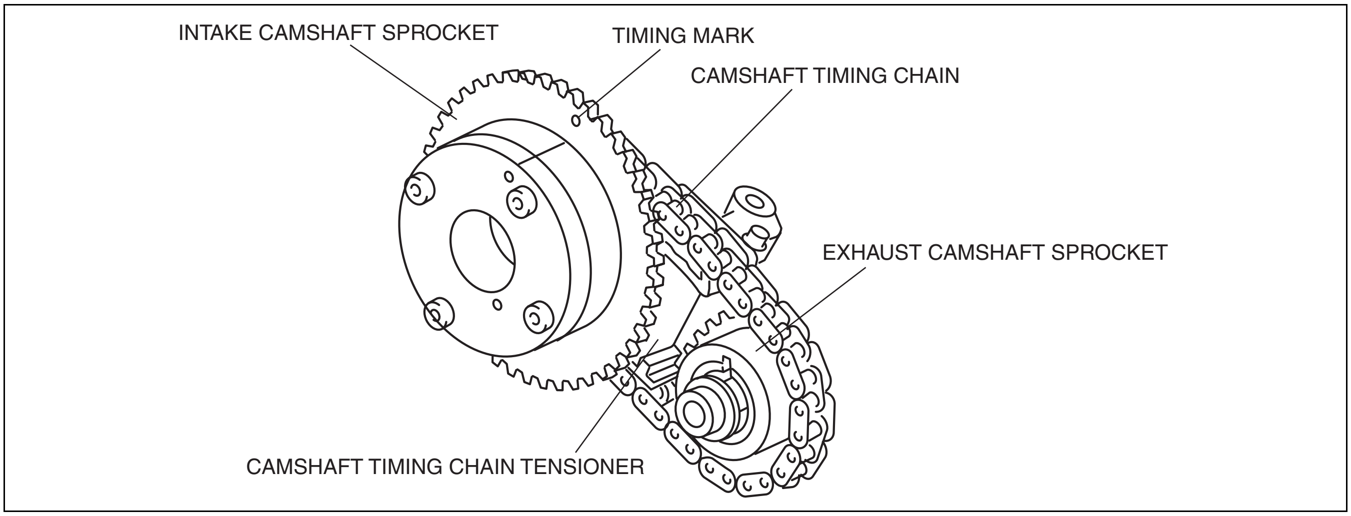
Camshaft Timing Chain

- The camshaft timing chain tensioner is positioned between the intake camshaft sprocket and exhaust camshaft sprocket.
- There is a timing mark on the underside of the intake camshaft sprocket on both banks, and on the surface of the exhaust camshaft sprocket on both banks. Timing can be performed by assembling the camshaft timing chain based on these timing marks.



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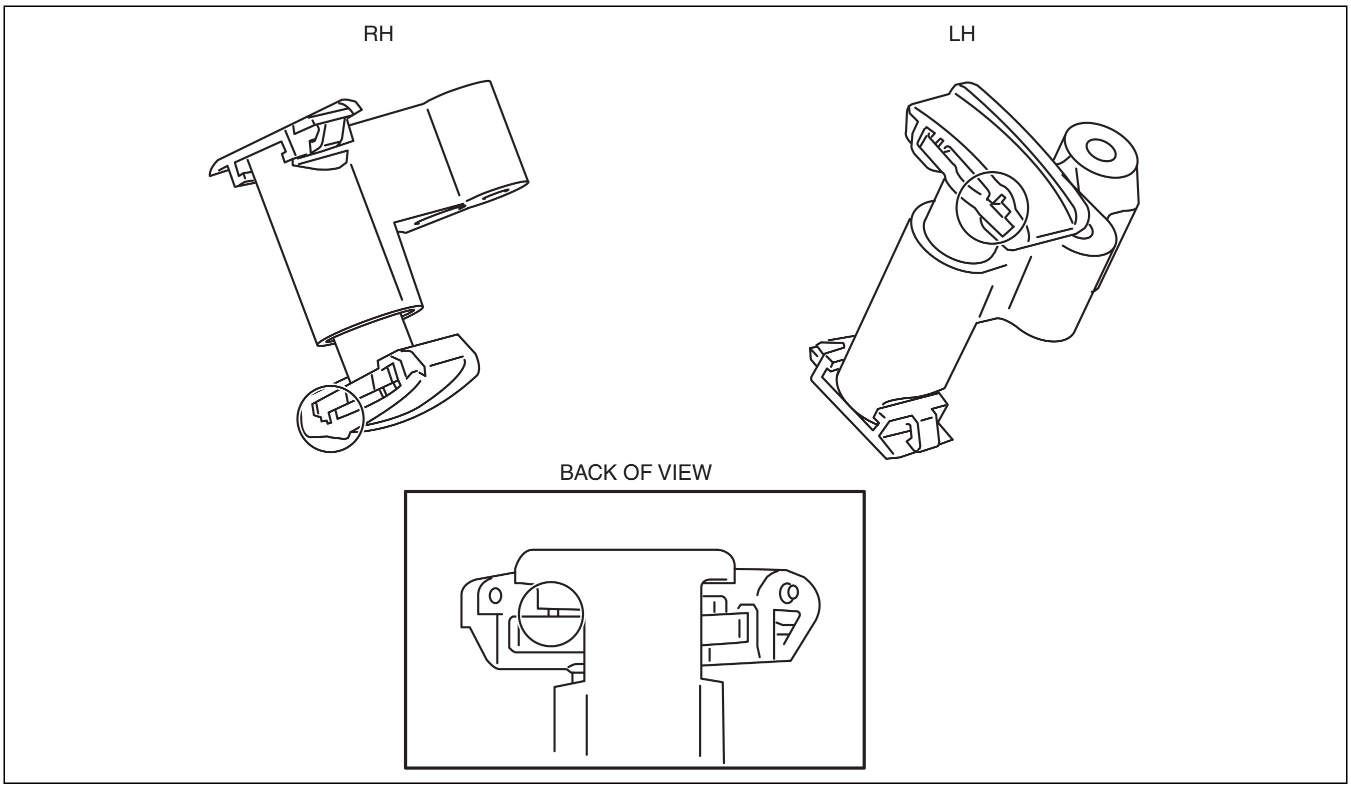
- To facilitate removal/installation of the camshaft timing chain, insert a clip or similar item into the hole of the camshaft timing chain tensioner to retain the timing chain tensioner force.



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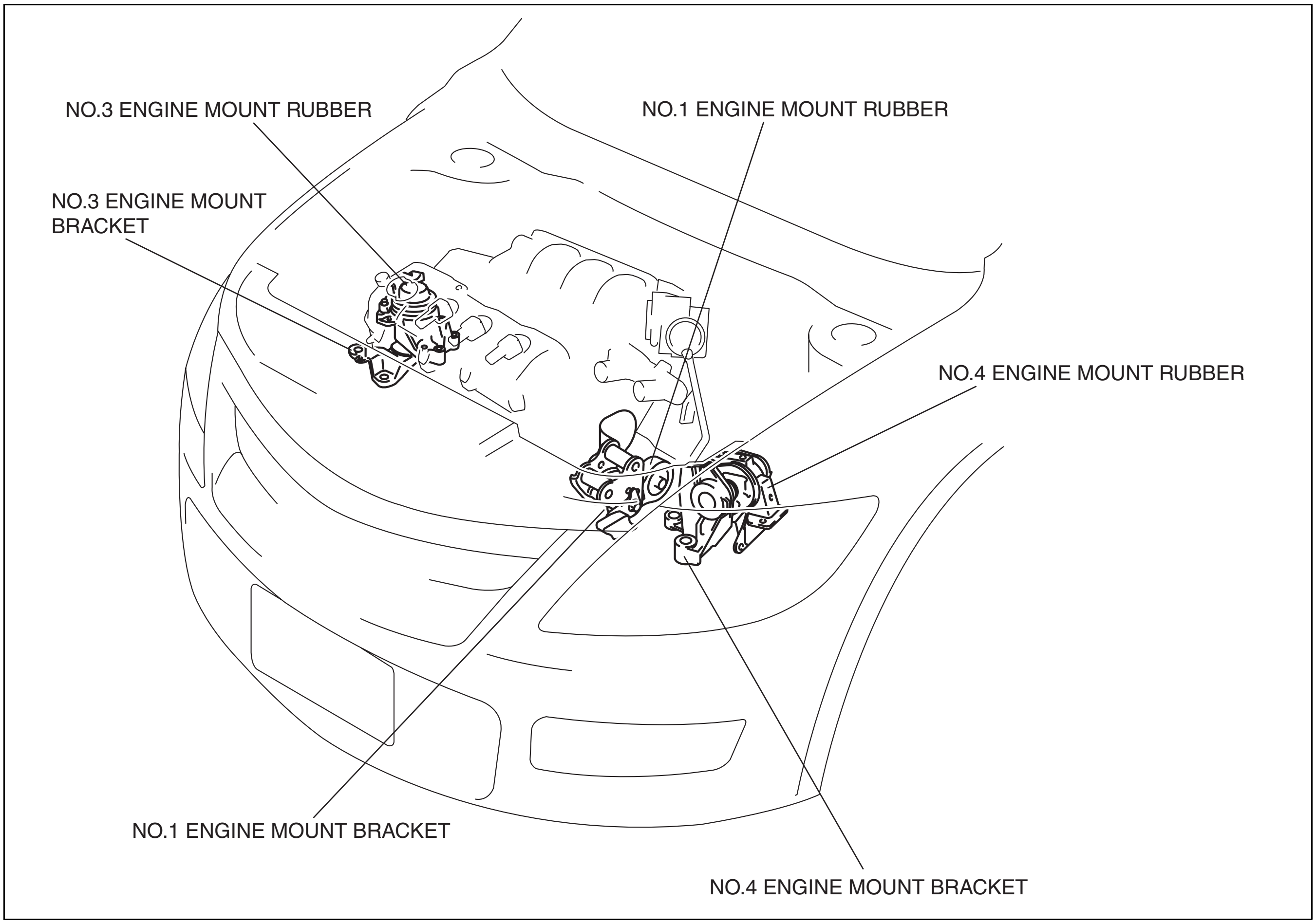
ENGINE MOUNT OUTLINE [MZI-3.5]

id0110c1101400

- The the engine mounting has a pendulum type layout, which reduces the noise in the cabin.
- The engine is supported at three points, and the structural parts of the engine mounts have been simplified.
- An oil-filled type No.3 engine mount rubber has been adopted to reduce noise in the cabin.



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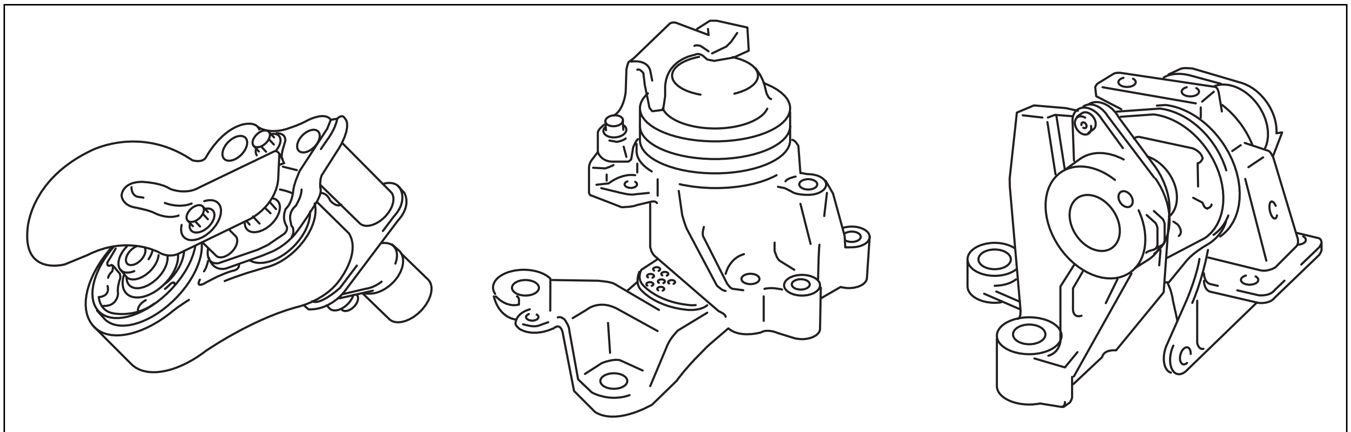
ENGINE MOUNT CONSTRUCTION [MZI-3.5]

id0110c1102600

- The surface of No.1 engine mount rubber is made of aluminum alloy. The torque rod structure regulates the conventional rubber function and the rotation from the power train, and it has a vibration isolator.
- The No.3 engine mount rubber is oil-filled for noise reduction and vibration isolation.
- The No.3 engine joint bracket is integrated with the aluminum alloy engine front cover.



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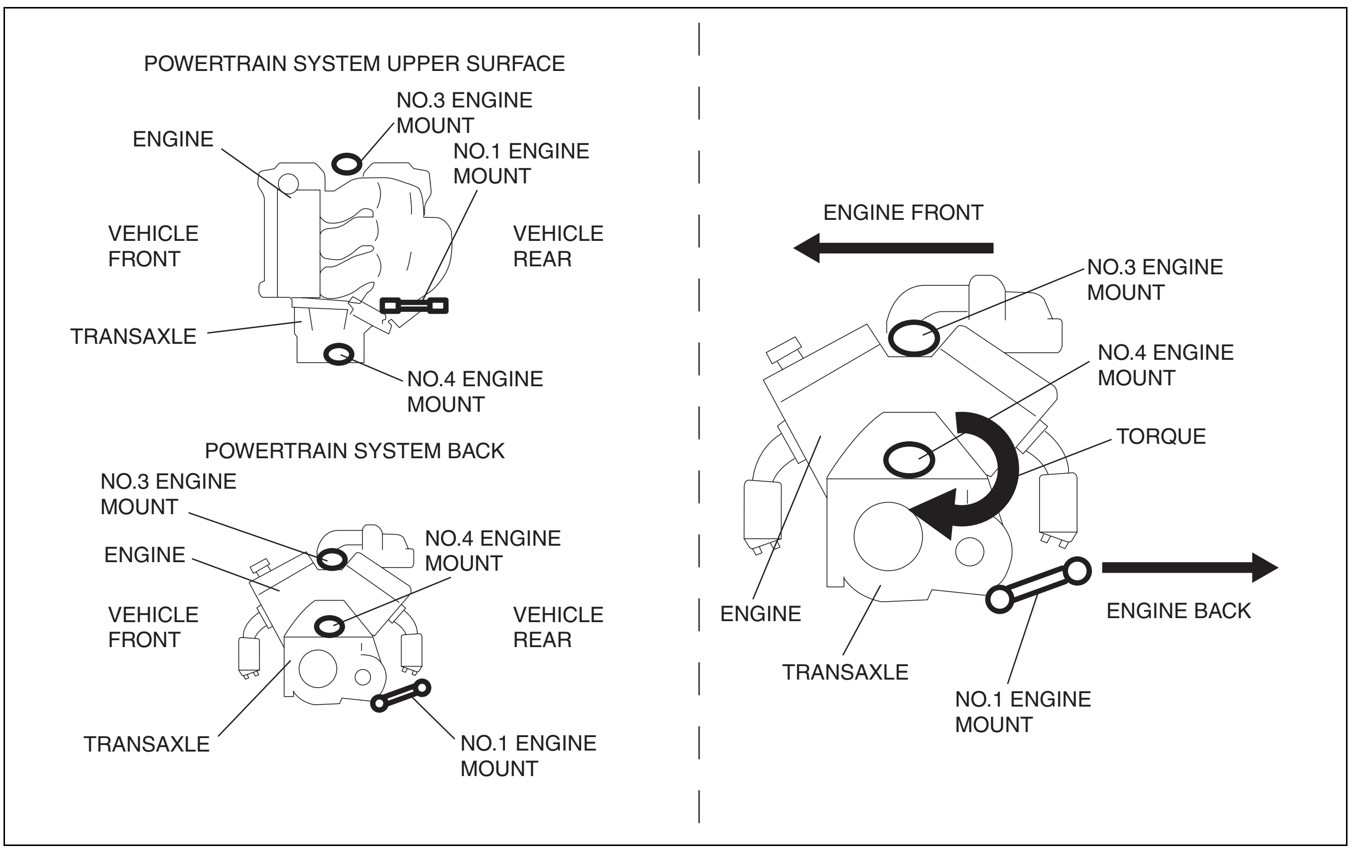
- The engine is supported at the following three points: front part of the engine (No.3 engine mount), one side of the transaxle (No.1 engine mount), and the rear upper part of the transaxle (No.4 engine mount). The supporting point at the side of the transaxle (No.1 engine mount) has been set at the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



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01-11 LUBRICATION [MZI-3.5]

LUBRICATION SYSTEM OUTLINE [MZI-3.5]

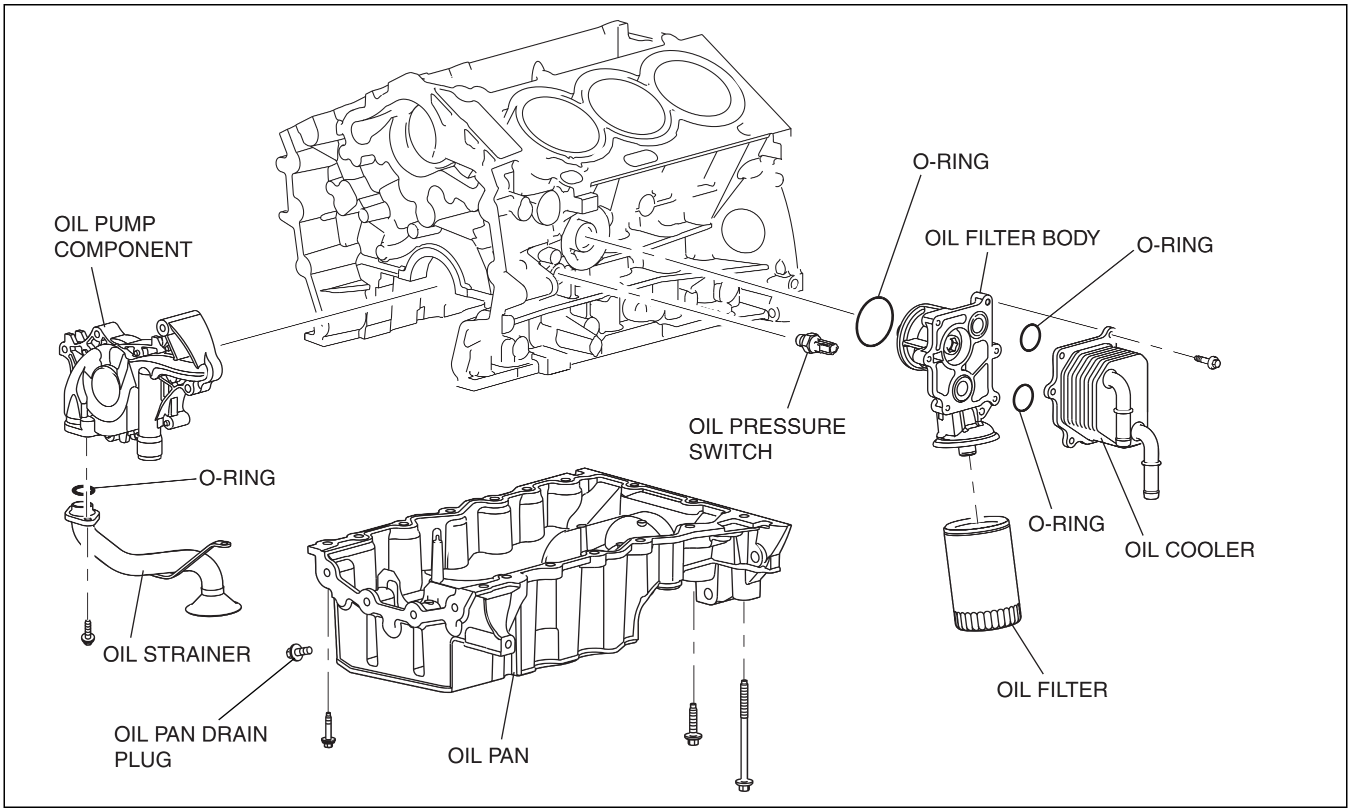
id0111e1100100

Features

Reduced noise	• Aluminum alloy oil pan adopted
Improved lubricity	• Trochoid gear type oil pump adopted • Water-cooled type oil cooler adopted

LUBRICATION SYSTEM STRUCTURAL VIEW [MZI-3.5]

id0111e1100200



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LUBRICATION SYSTEM FLOW DIAGRAM [MZI-3.5]

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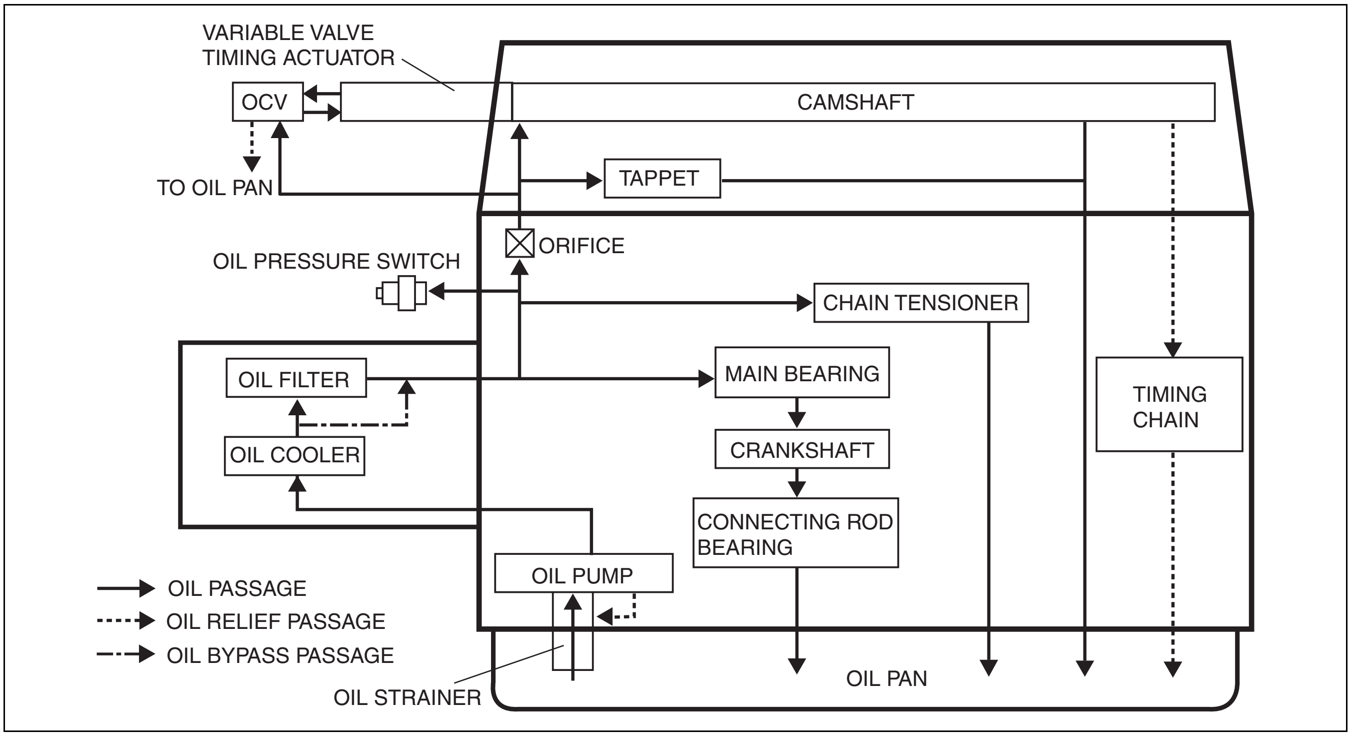

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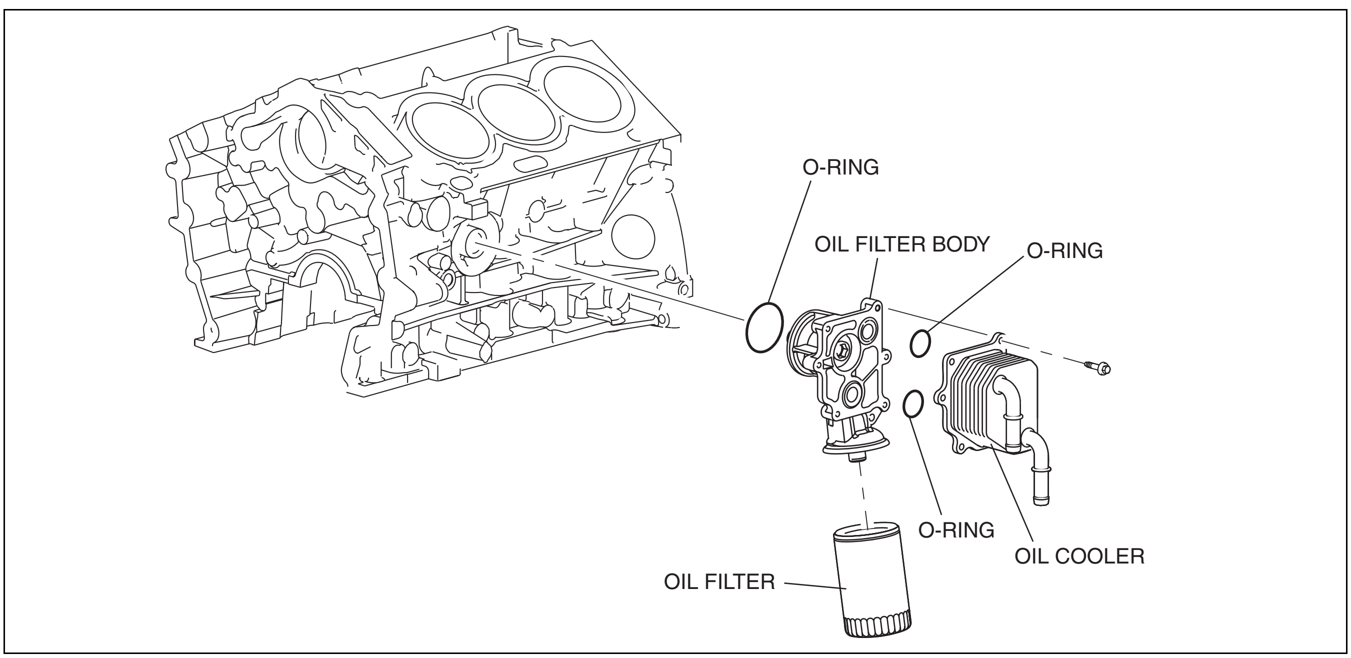
OIL FILTER, OIL COOLER CONSTRUCTION [MZI-3.5]

id0111e1118100

- The oil filter component is installed on the left surface (vehicle front) of the cylinder block.
- A full-flow paper element type oil filter has been adopted.
- A water-cooled type oil cooler has been adopted to reduce the engine oil degradation.



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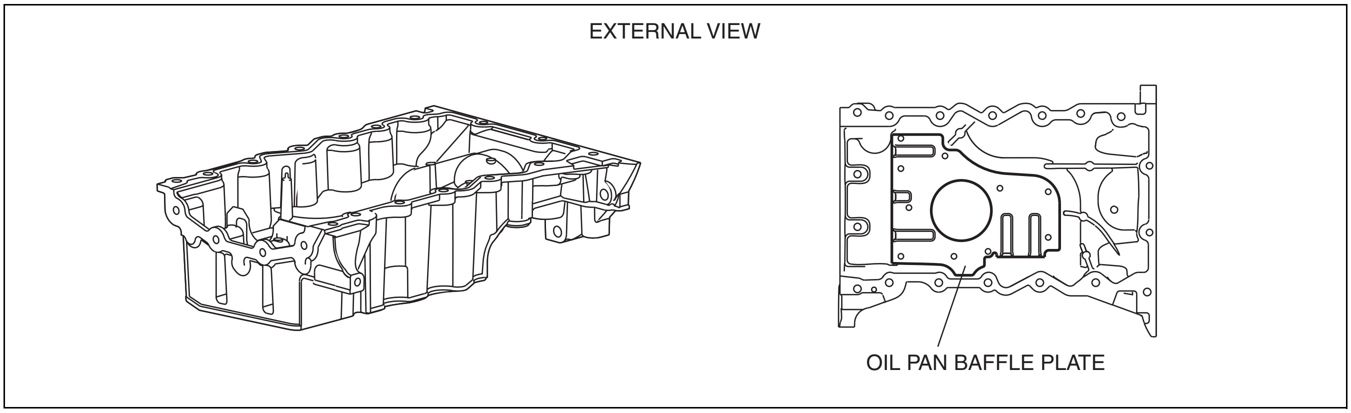
OIL PAN CONSTRUCTION [MZI-3.5]

id0111e1100400

- 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.



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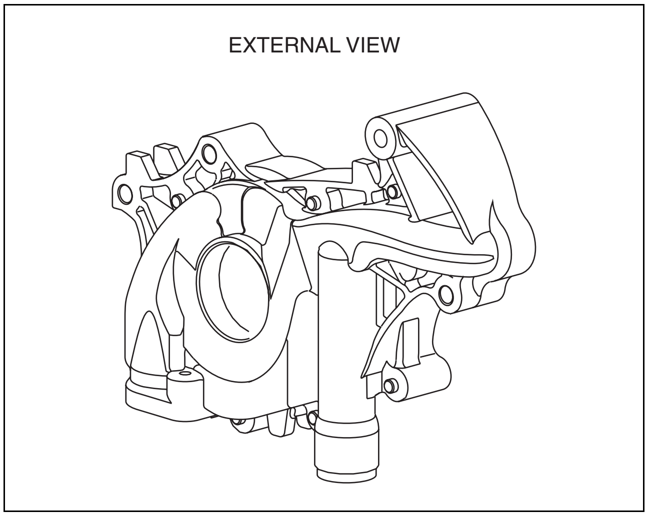
OIL PUMP CONSTRUCTION [MZI-3.5]

id0111e1100600

- The oil pump is directly driven by the crankshaft to reduce engine noise.
- A trochoid gear type oil pump has been adopted to ensure stable discharge function.
- The oil pump cannot be disassembled. If there is an oil pump malfunction, replace it as a single unit.
- The oil pump regulator, which adjusts the oil pressure, is built into the oil pump body.



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01-12 COOLING SYSTEM [MZI-3.5]

COOLING SYSTEM OUTLINE [MZI-3.5]

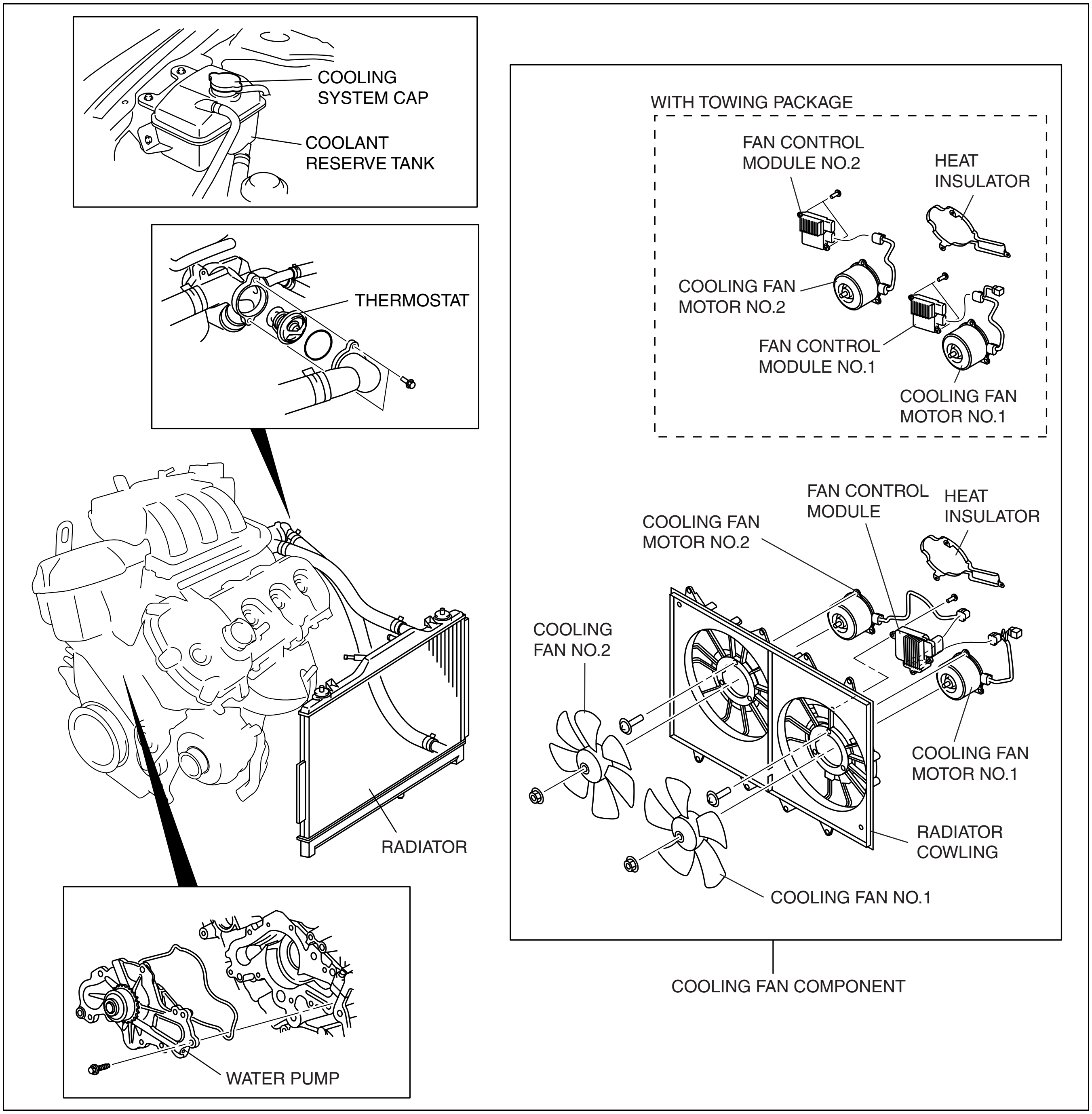
id0112d1100100

Features

Improved reliability	• Degassing type coolant reserve tank adopted
Reduced weight	• Down-flow type radiator with aluminum core and plastic tank adopted
Miniaturization	• Built-in type water pump adopted
Reduced engine noise and vibration	• Electric cooling fans 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 [MZI-3.5]

id0112d1100200



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COOLING SYSTEM FLOW DIAGRAM [MZI-3.5]

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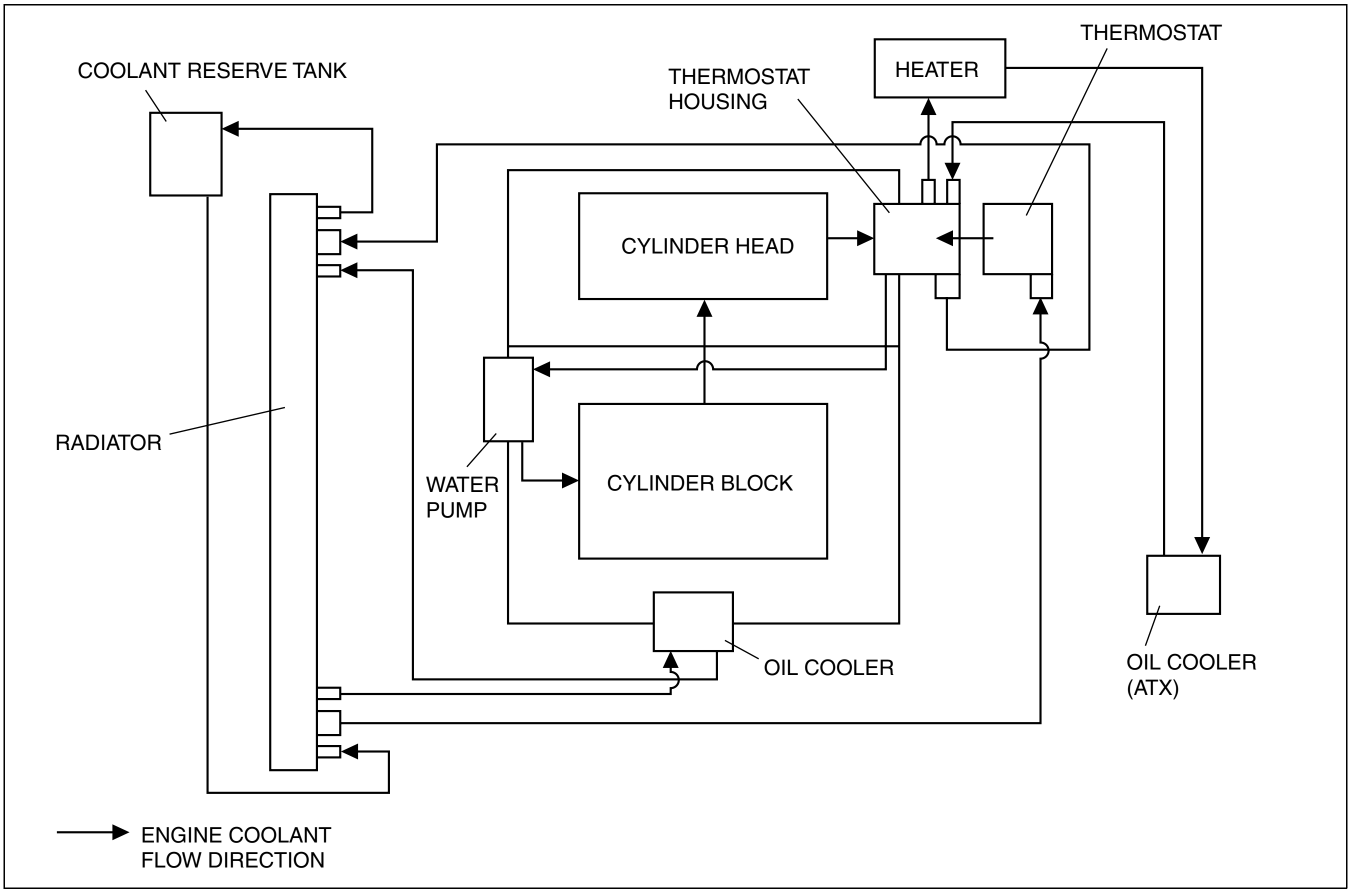

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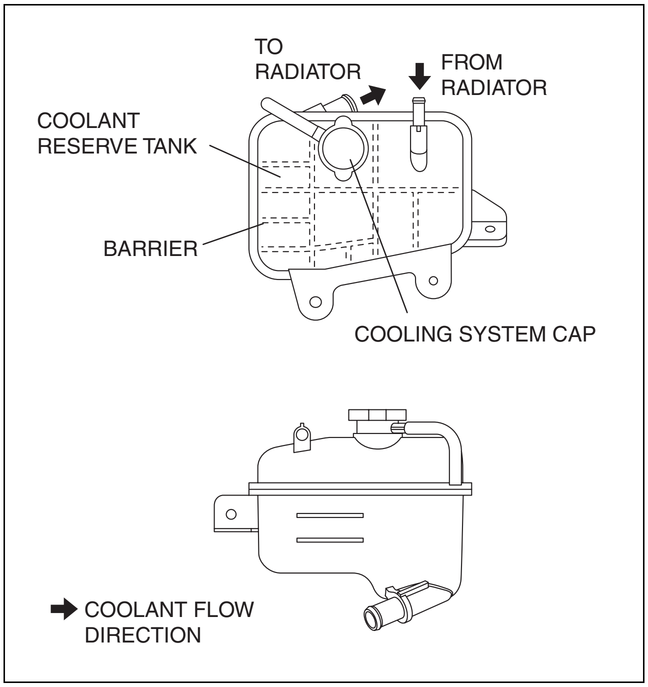
COOLING SYSTEM CAP, COOLANT RESERVE TANK CONSTRUCTION [MZI-3.5]

id0112d1142100

- A low-pressure type cap has been adopted for the cooling system. It is installed on the coolant reserve tank to improve serviceability when adding engine coolant and bleeding air.
- A degassing type coolant reserve tank has been adopted, to integrate the simple airtight sub-tank and the air/water separating tank, improving the air/water separating function. The integrated and large-size degassing tank consists of a labyrinth structure with internal barriers to lengthen the distance to the outlet and reduce the flow speed to lengthen the time the engine coolant has to accumulate, improving the air/water separation function.



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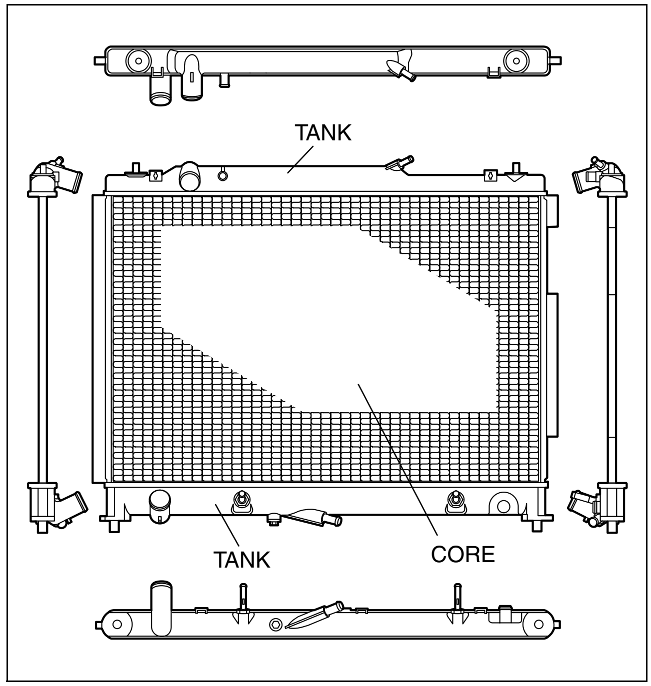
RADIATOR CONSTRUCTION [MZI-3.5]

id0112d1142000

- A corrugated fin type radiator has been adopted.
- The radiator tanks are made of plastic and the core is made of aluminum for weight reduction.
- The down-flow direction of water inside the radiator causes air to bleed from the cooling system easier.
- Four mounting rubbers are utilized to decrease vibration.
- The radiator has an ATF oil cooler in the lower radiator tank.



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THERMOSTAT CONSTRUCTION/OPERATION [MZI-3.5]

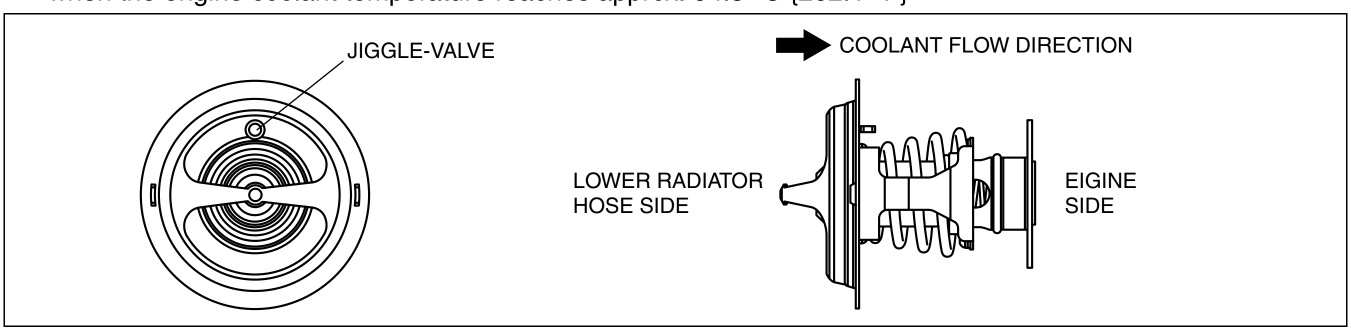
id0112d1100700

Construction

- A wax-type thermostat with a jiggle-valve has been adopted.
- Stainless steel has been adopted on the thermostat body for excellent corrosion resistance.

Operation

- When the engine coolant temperature reaches 79.5—83.3 °C {175.2—181.9 °F}, the valve starts opening to allow engine coolant to flow from the radiator stabilizing the engine coolant temperature. The valve fully opens when the engine coolant temperature reaches approx. 94.5 °C {202.1 °F}



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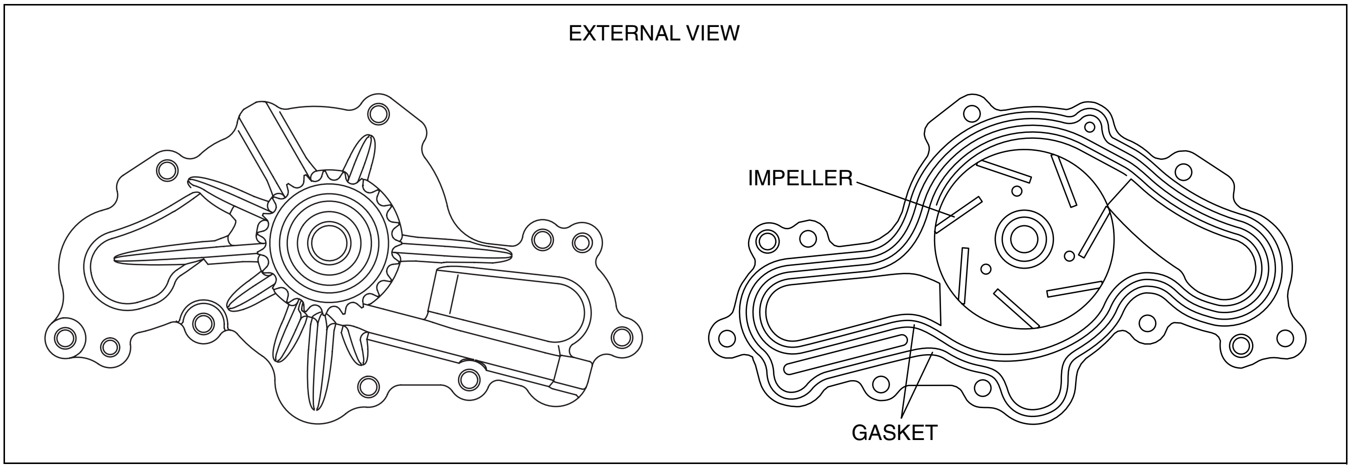
WATER PUMP CONSTRUCTION/OPERATION [MZI-3.5]

id0112d1100400

Construction

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



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Operation

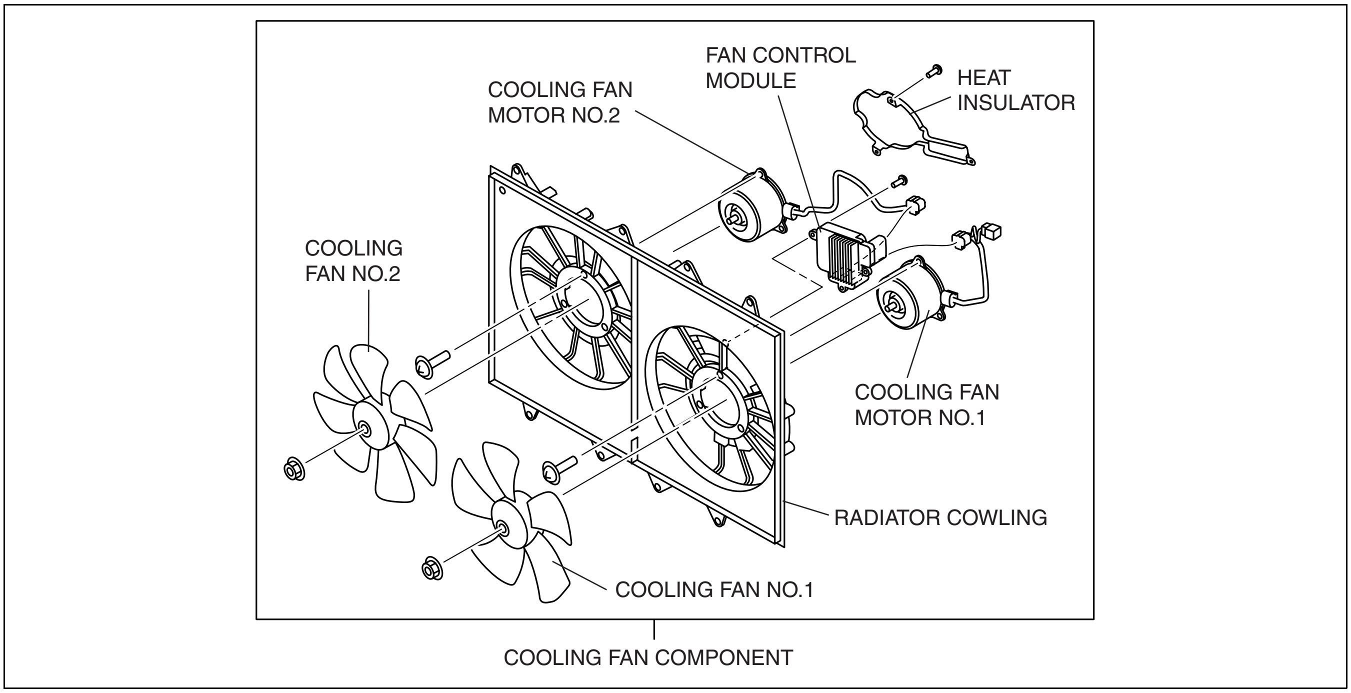
- The water pump is driven by the timing chain.

COOLING FAN COMPONENT CONSTRUCTION [MZI-3.5]

id0112d1100500

- The cooling fan component consists of the radiator cowling, cooling fans, cooling fan motors, and fan control module.
- Electric cooling fans No.1 and No.2, which operate according to the fan control signals sent from the PCM to the fan control module, have been adopted. Due to this, engine noise has been reduced and rapid engine warming-up is possible.
- The radiator cowling and cooling fans are made of plastic for weight reduction.

Without Towing Package



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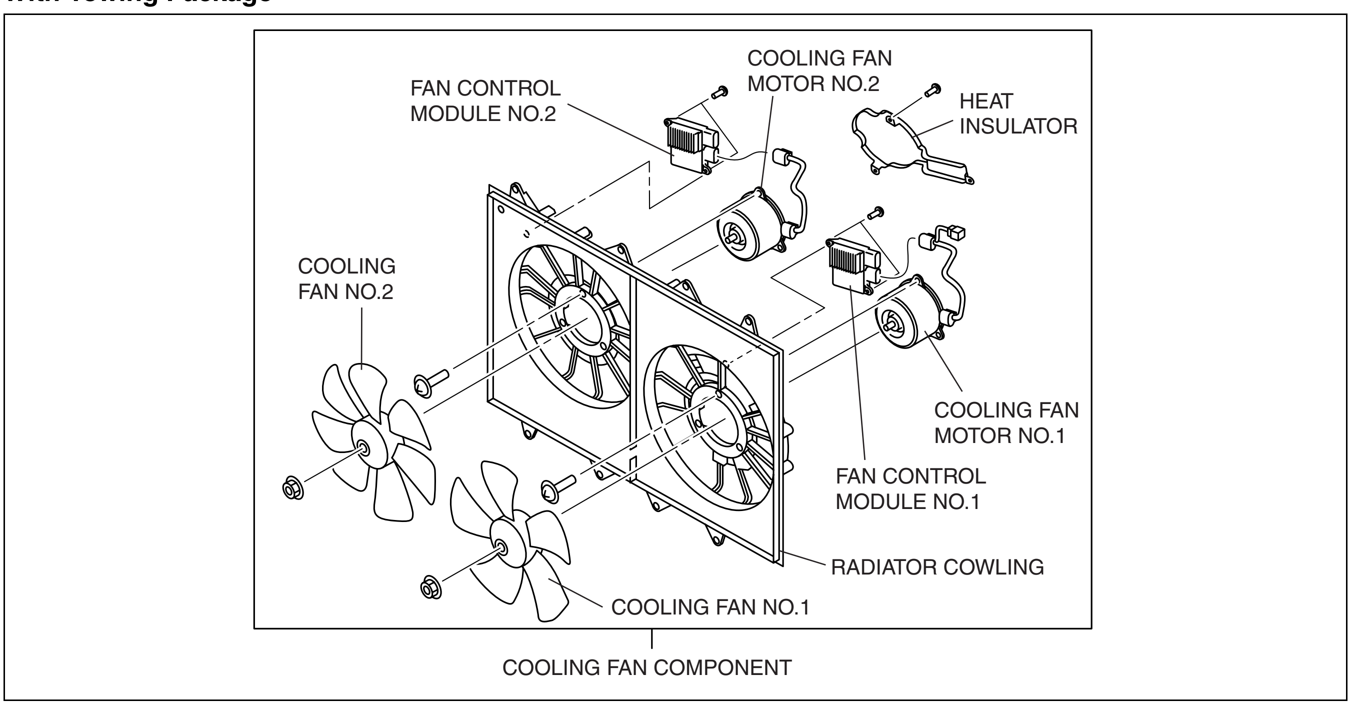
With Towing Package



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Cooling fan, cooling fan motor specification

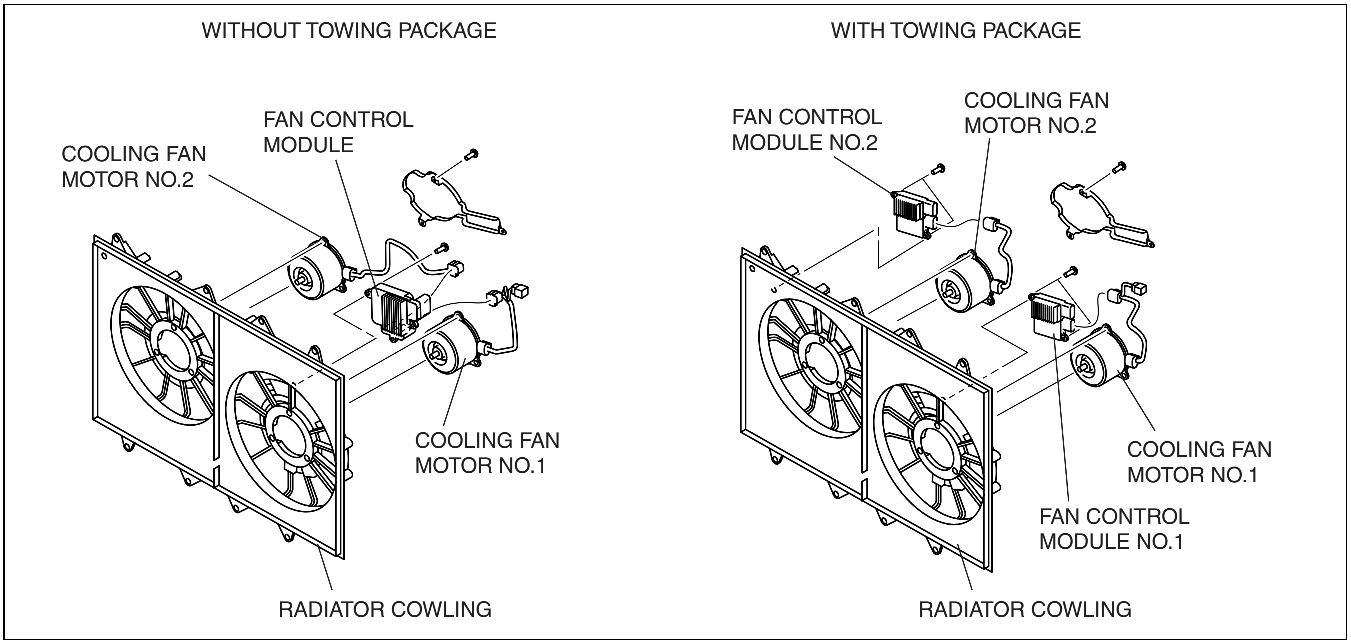
Item		Specification	
		No.1	No.2
Cooling fan	Number of blades	5	7
	Outer diameter (mm {in})	360 {14.2}	
Cooling fan motor output (W)		Without Towing Package: 160 With Towing Package: 240	

FAN CONTROL MODULE CONSTRUCTION/OPERATION [MZI-3.5]

id0112d1100600

Construction

- Fan control module is installed on the radiator cowling.



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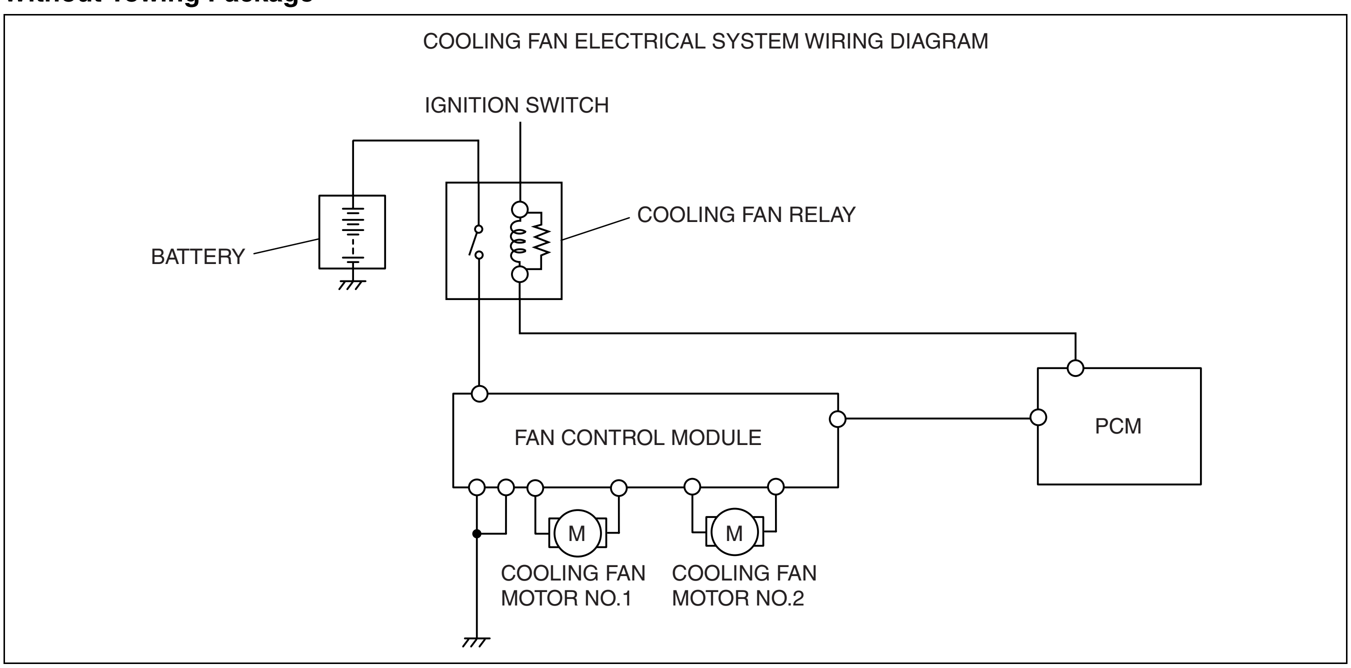
Operation

- The fan control module drives the each fan motors based on the cooling fan control signals sent by the PCM according to the following:
  — Engine coolant temperature
  — Vehicle speed
  — Whether refrigerant pressure switch (middle) 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.

Without Towing Package



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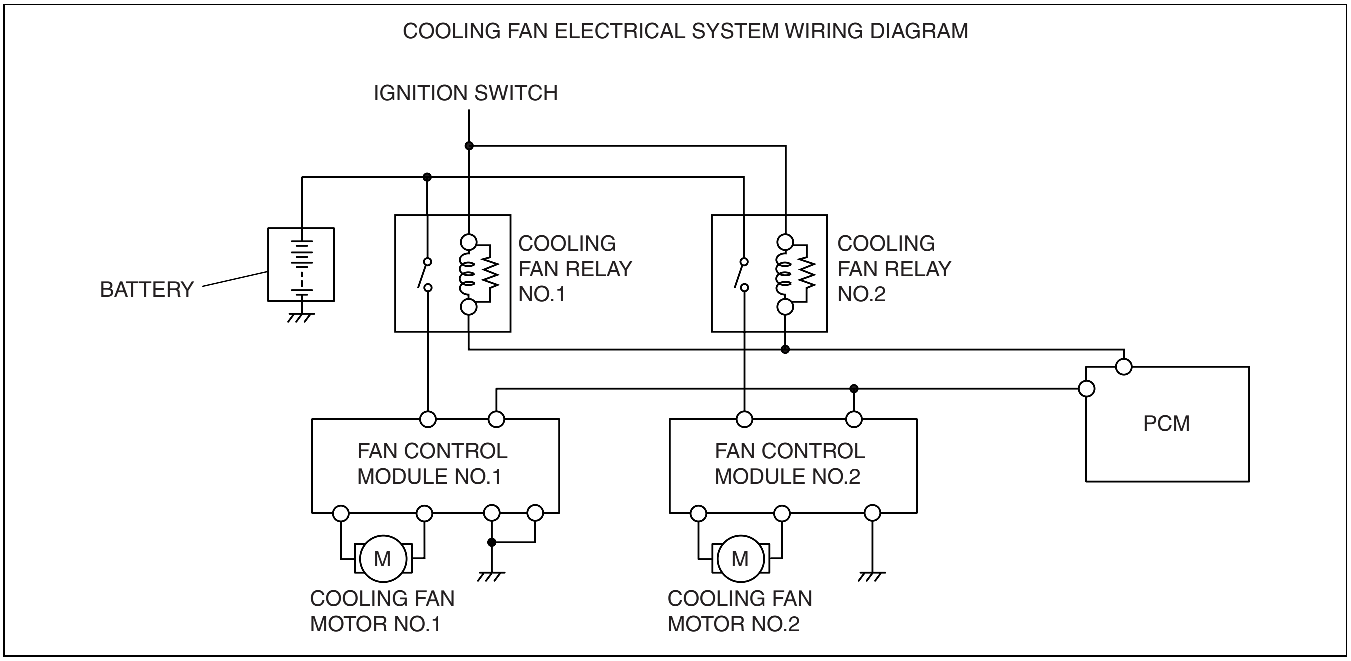
With Towing Package



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 stops running. (Without Towing Package)
   — 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. (With Towing Package)
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 [MZI-3.5]

INTAKE-AIR SYSTEM OUTLINE [MZI-3.5]

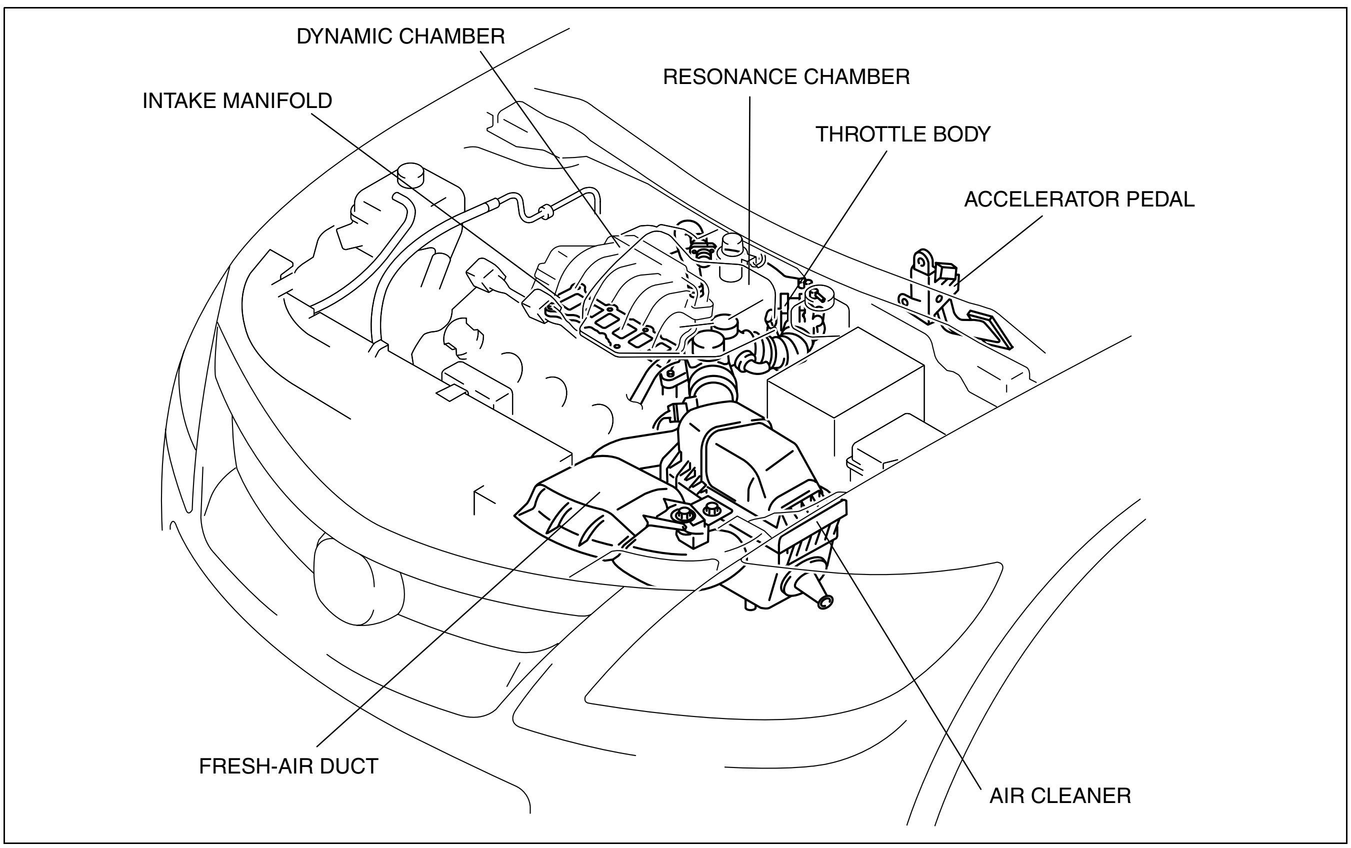
id0113c1100100

Features

Improved noise reduction	• Resonance chamber adopted

INTAKE-AIR SYSTEM STRUCTURAL VIEW [MZI-3.5]

id0113c1100200



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INTAKE-AIR SYSTEM FLOW DIAGRAM [MZI-3.5]

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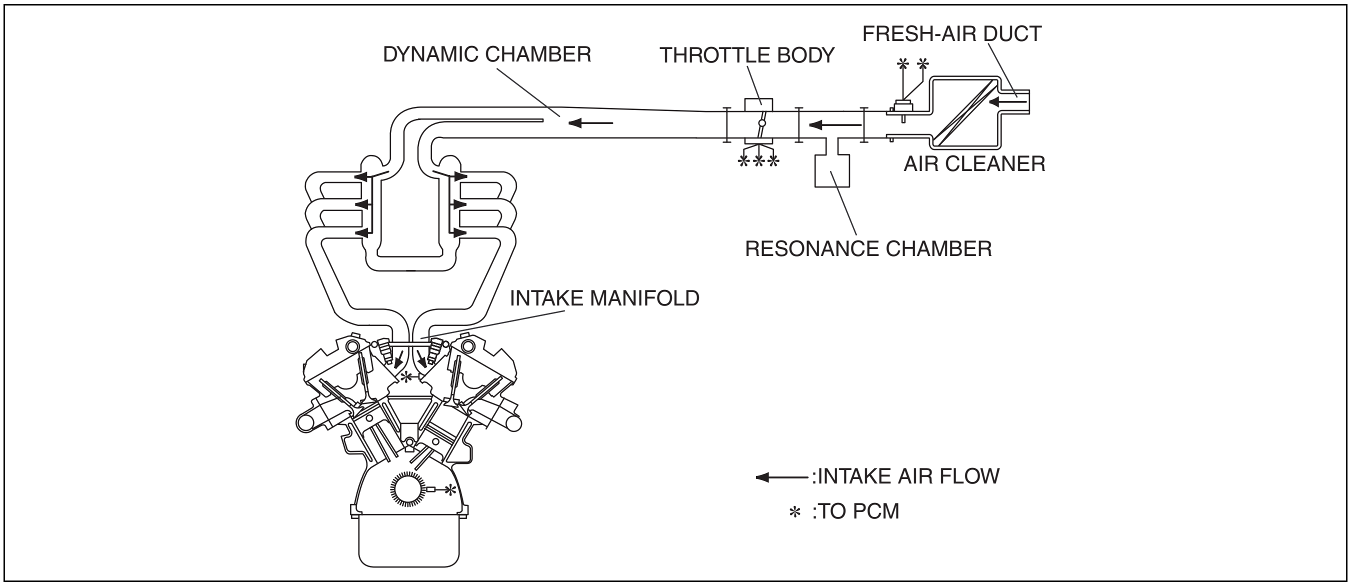

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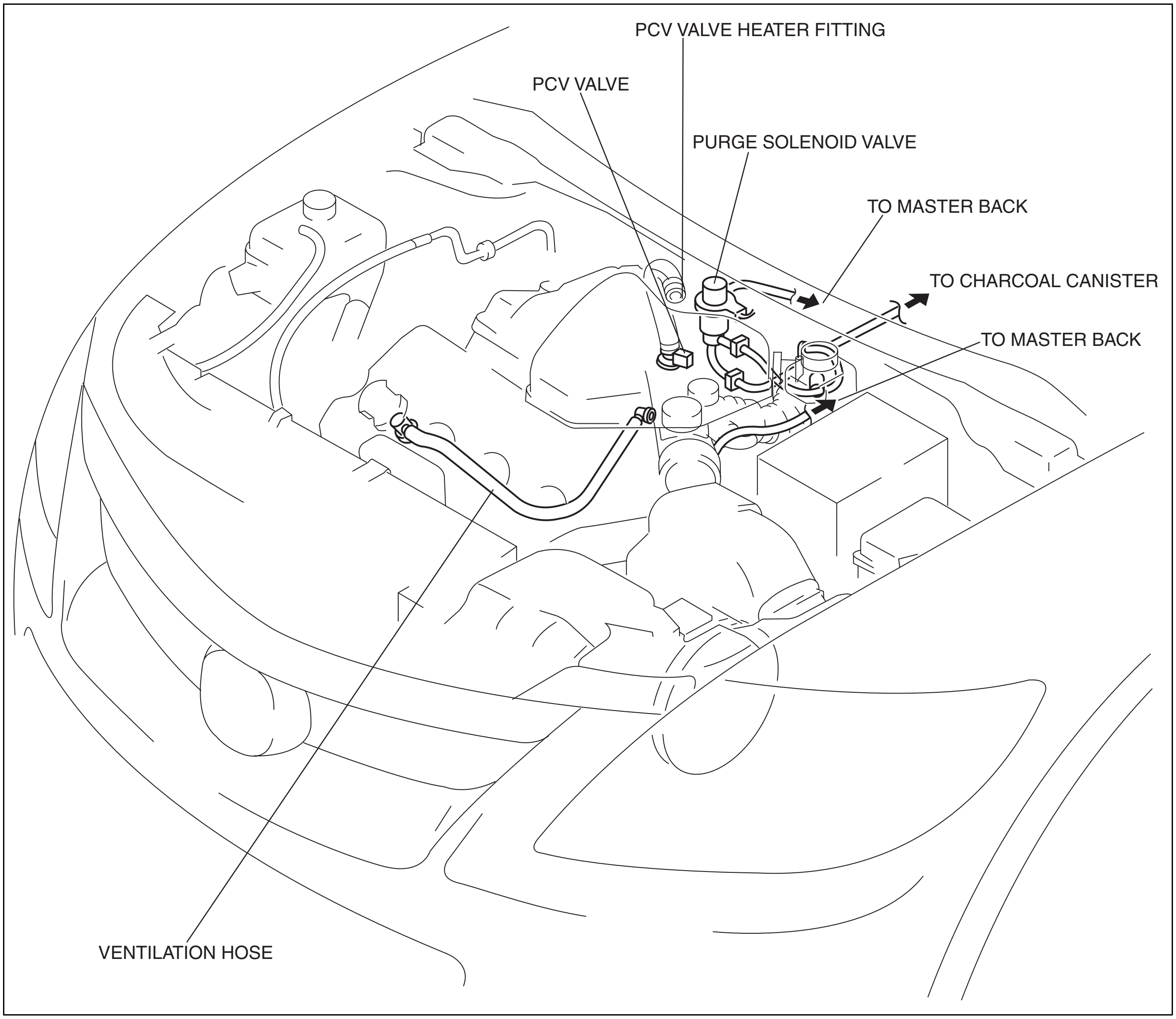
INTAKE-AIR SYSTEM VACUUM HOSE ROUTING DIAGRAM [MZI-3.5]

id0113c1106600



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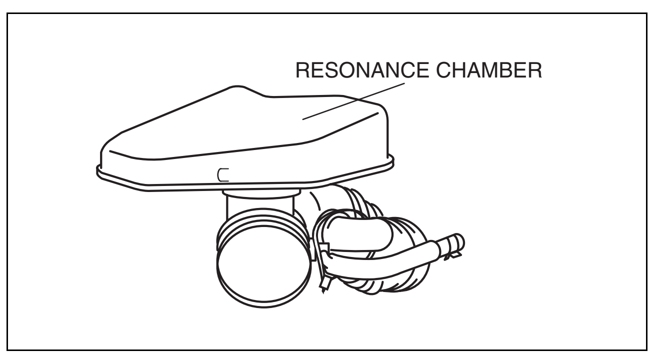
RESONANCE CHAMBER FUNCTION [MZI-3.5]

id0113c1100900

- Installed on air hose to reduce intake air noise.



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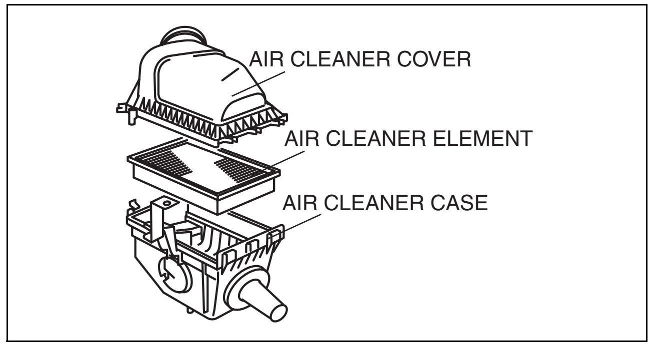
AIR CLEANER CONSTRUCTION [MZI-3.5]

id0113c1101400

Structure

- The air cleaner is composed of an air cleaner cover, air cleaner case, air cleaner element.
- A dry type air cleaner element has been adopted.



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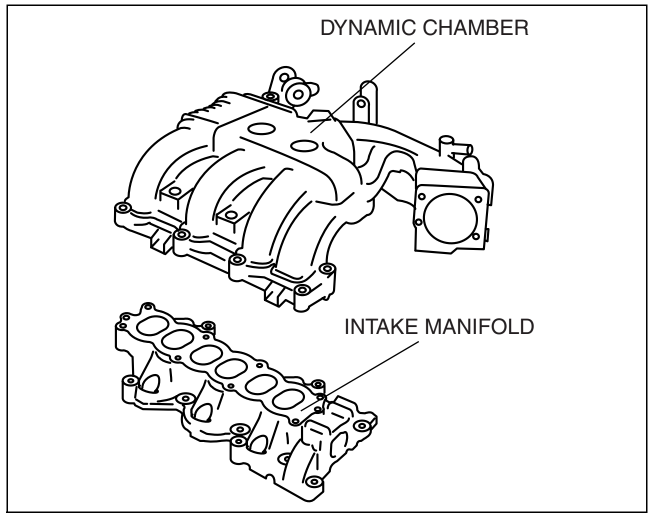
INTAKE MANIFOLD CONSTRUCTION [MZI-3.5]

id0113c1100800

- An intake manifold separated from the dynamic chamber has been adopted.



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THROTTLE BODY FUNCTION [MZI-3.5]

id0113c1101500

- An electronic throttle valve has been adopted which opens and closes the throttle valve with the actuator according to a signal from the PCM. It enables precise intake air control at all engine speed ranges.

THROTTLE BODY CONSTRUCTION [MZI-3.5]

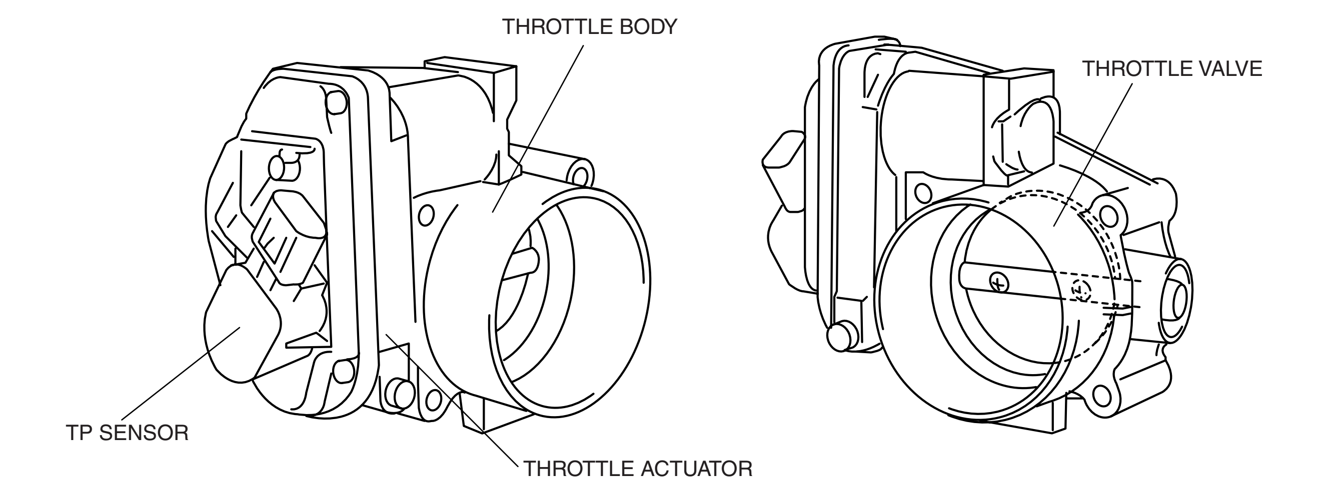
id0113c1147700

- 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 prevent the possible loss of PCM data and throttle body settings, the throttle body cannot be disassembled.

THROTTLE BODY OPERATION [MZI-3.5]

id0113c1147800

- The actuator is driven by a duty signal from the PCM.
- The throttle valve opening angle is input to the PCM by the TP sensor.
- The throttle body has a control spring. If a malfunction occurs and the actuator cannot be controlled, the throttle valve is maintained balanced at an opening angle of approx. 7—8 ° by the spring. Due to this, the required amount of air for vehicle operation is ensured.



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01-14 FUEL SYSTEM [MZI-3.5]

FUEL SYSTEM OUTLINE [MZI-3.5]

id0114d1100100

Features

Reduction of evaporative gas	• Returnless fuel system adopted

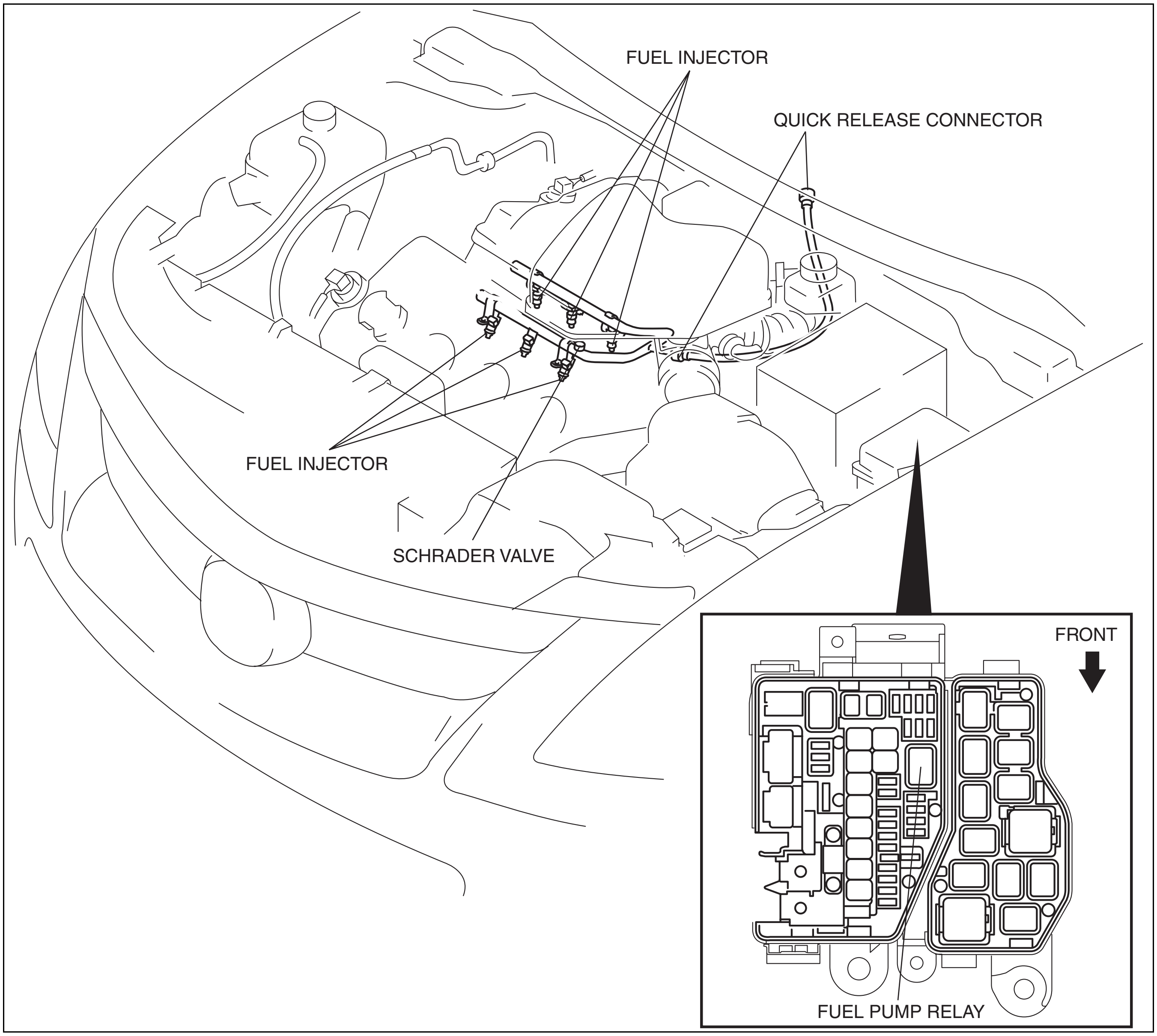
Specification

Item			Specification
Injector	Type		Hi-ohmic
	Type of fuel delivery		Top-feed
	Type of drive		Voltage
Fuel pump type			Electric
Fuel tank capacity		(L {US gal, Imp gal})	76.0 {20.1, 16.7}
Fuel type			87 [(R+M)/2 method] or above (91 RON or above)

FUEL SYSTEM STRUCTURAL VIEW [MZI-3.5]

id0114d1100200

Engine Compartment Side



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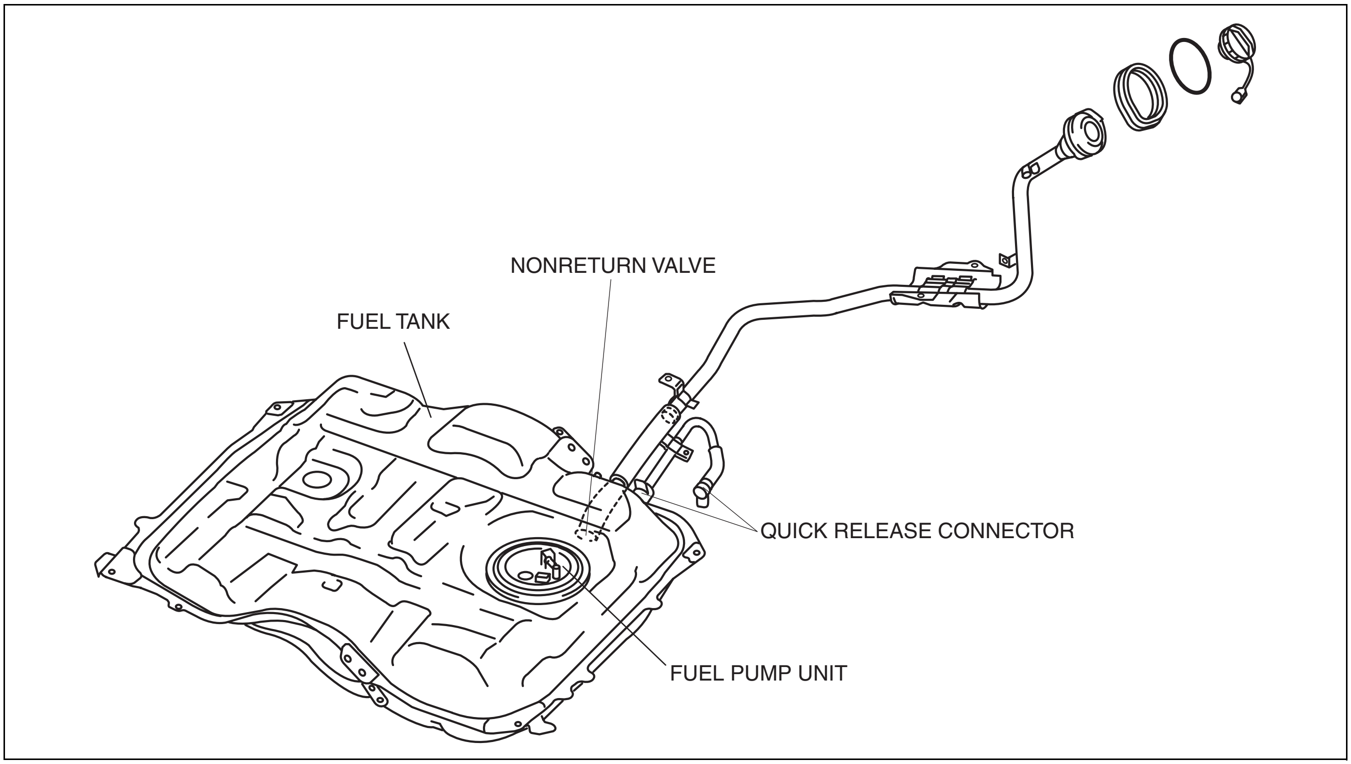
Fuel Tank Side
2WD



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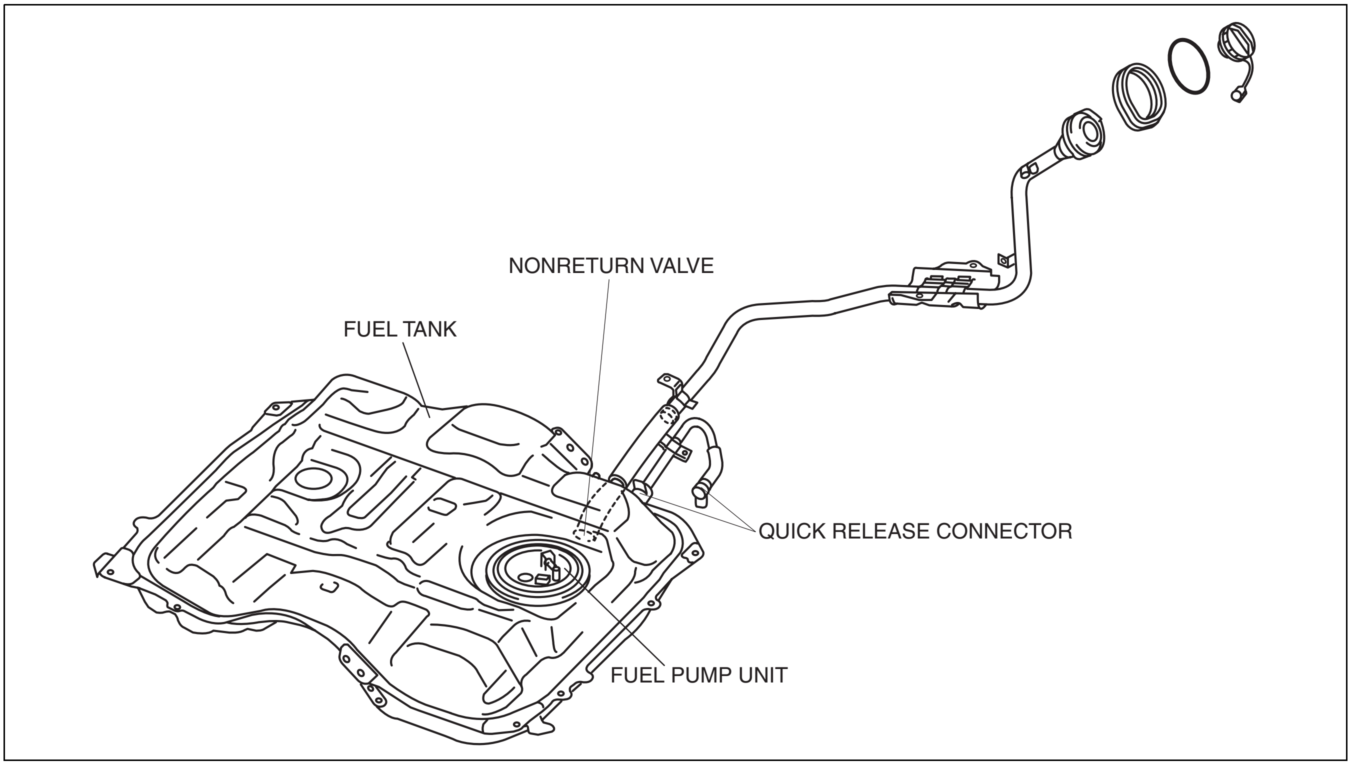
AWD



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FUEL SYSTEM FLOW DIAGRAM [MZI-3.5]

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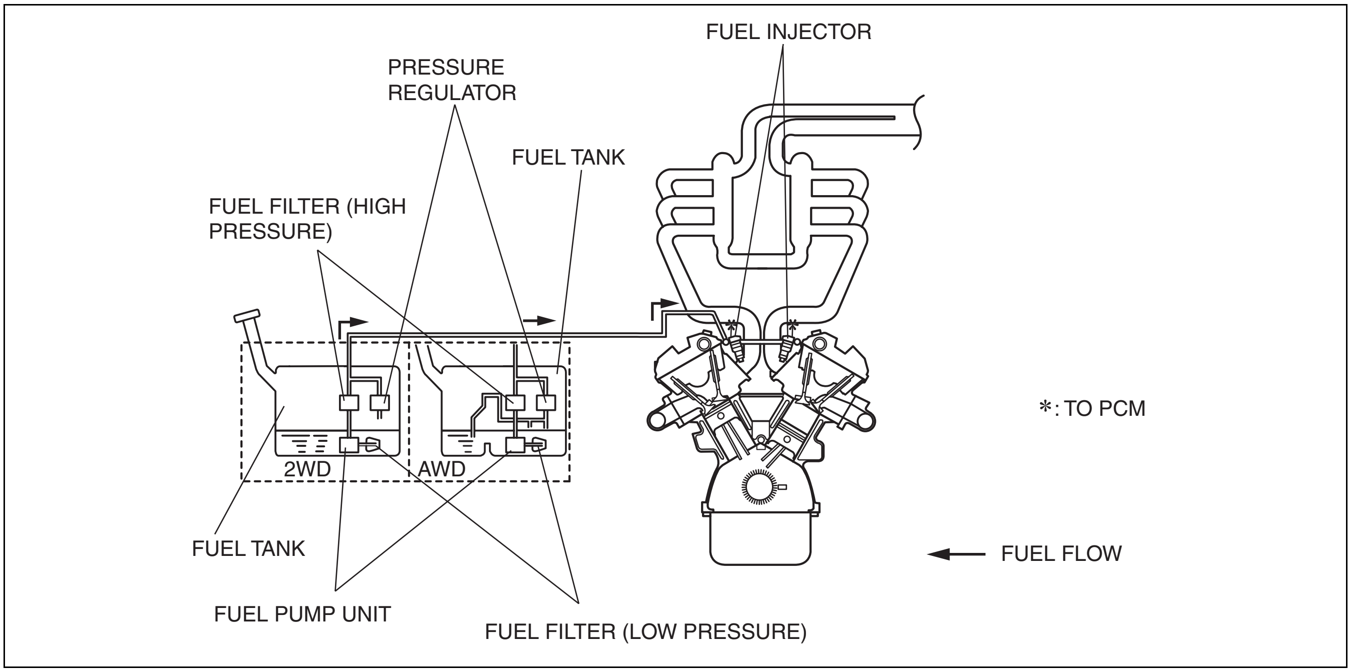

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RETURNLESS FUEL SYSTEM OUTLINE [MZI-3.5]

id0114d1101000

- 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.

RETURNLESS FUEL SYSTEM OPERATION [MZI-3.5]

id0114d1101100

- Fuel 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.

FUEL TANK CONSTRUCTION [MZI-3.5]

id0114d1101900

- Capacity is **76.0 L {20.1 US gal, 16.7 Imp gal}**.

NONRETURN VALVE FUNCTION [MZI-3.5]

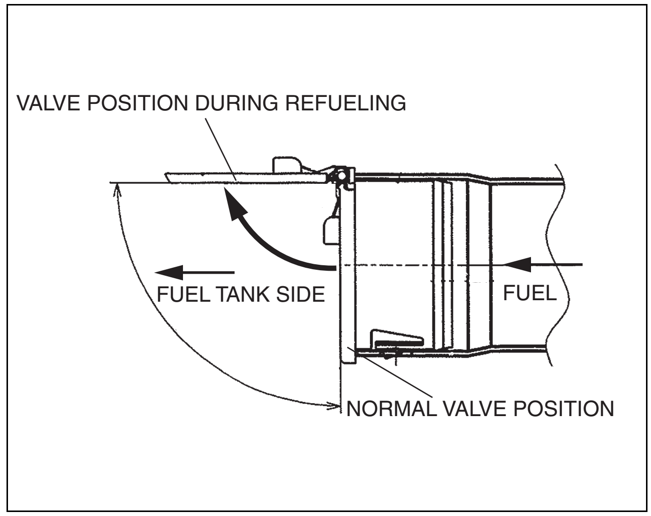
id0114d1102000

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

NONRETURN VALVE CONSTRUCTION/OPERATION [MZI-3.5]

id0114d1102100

- A single valve type has been adopted.
- 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.



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FUEL PUMP UNIT FUNCTION [MZI-3.5]

id0114d1101400

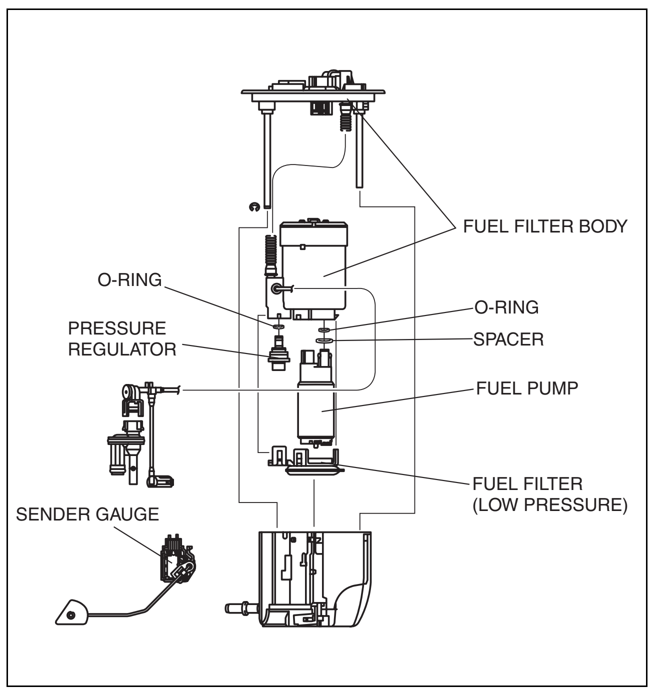
- A mechanical returnless fuel system has been adopted.
- The fuel pump siphons fuel from the fuel tank and pumps it to the fuel injectors.
- To prevent decreased engine output from a lack of fuel supply when the vehicle is turning, the fuel pump has been designed so the fuel supply always remains constant in the fuel reservoir cup.

FUEL PUMP UNIT CONSTRUCTION/OPERATION [MZI-3.5]

id0114d1101500

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.
- The fuel pump unit can be disassembled.
- 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 through the jet pump.



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Pressure Regulator

- Built into the fuel pump unit due to adoption of a mechanical returnless fuel system.
- Mainly consists of a spring, release valve and diaphragm.
- If fuel pressure exceeds the specified value, the release valve opens to discharge unnecessary fuel pressure.

QUICK RELEASE CONNECTOR (FUEL SYSTEM) FUNCTION [MZI-3.5]

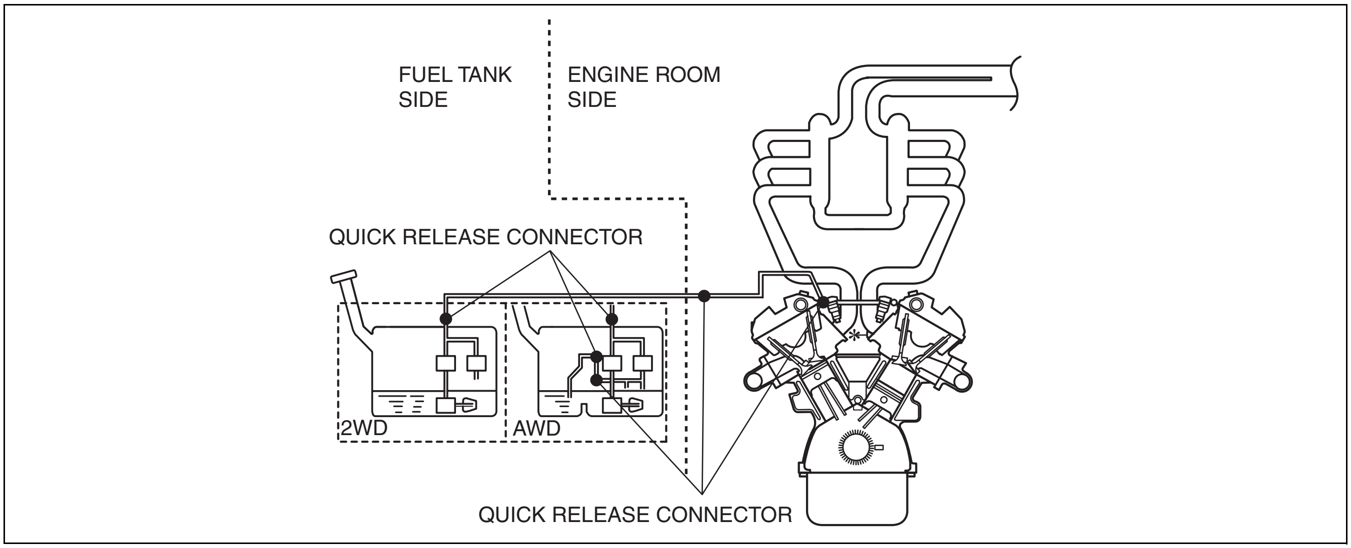
id0114d1151500

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

QUICK RELEASE CONNECTOR (FUEL SYSTEM) CONSTRUCTION/OPERATION [MZI-3.5]

id0114d1151400

Quick Release Connector Position



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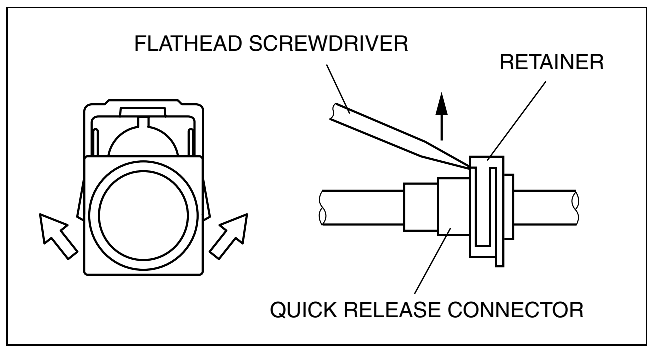
Construction

- An SST is not used with this type.
- Mainly consists of a retainer and O-ring. The quick release connector is integrated with the joint port and therefore cannot be disassembled.
- When the quick release connector is connected, the fuel pipe projection is locked at the clamp lock point. To release the quick connector lock for each type, follow the procedure in the order shown in each figure.



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FUEL INJECTOR FUNCTION [MZI-3.5]

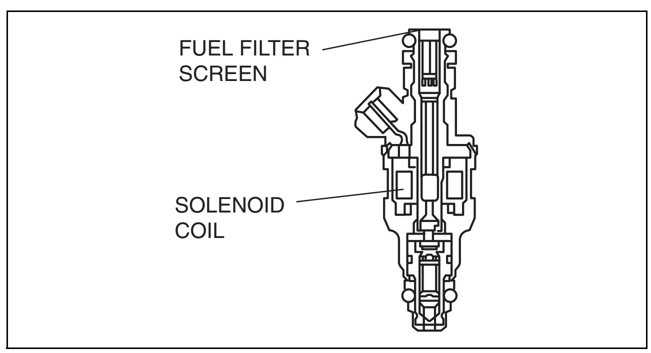
id0114d1101200

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

FUEL INJECTOR CONSTRUCTION/OPERATION [MZI-3.5]

id0114d1101300

- Installed on the intake manifold.
- Mainly consists of a coil, spring and valve.
- A signal is sent from the PCM causes excitation current to pass through the coil and thereby pull in the valve and fuel is injected.
- The amount of injection is determined by the open time of the valve (equal to the energization time of the coil).



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FUEL PUMP RELAY FUNCTION [MZI-3.5]

id0114d1100700

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

01-15 EXHAUST SYSTEM [MZI-3.5]

EXHAUST SYSTEM OUTLINE [MZI-3.5]

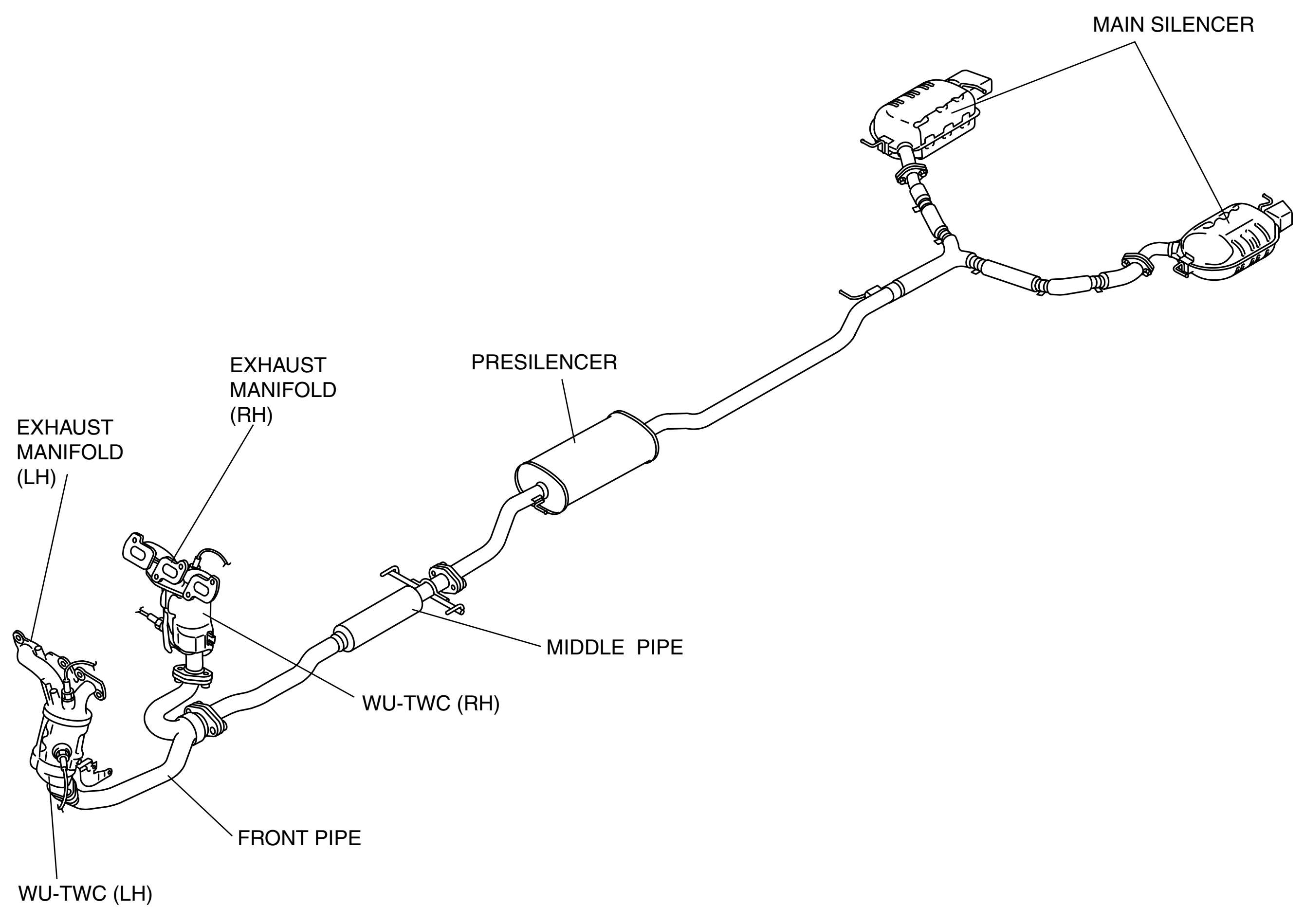
id0115d1125600

Features

- A flexible pipe of middle pipe has been adopted to reduce the engine vibration transmitted past the front pipe.

EXHAUST SYSTEM STRUCTURAL VIEW [MZI-3.5]

id0115d1100100



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01-16 EMISSION SYSTEM [MZI-3.5]

EMISSION SYSTEM OUTLINE [MZI-3.5]

id0116d1100100

Feature

Improved exhaust gas purification	• Catalytic converter system adopted

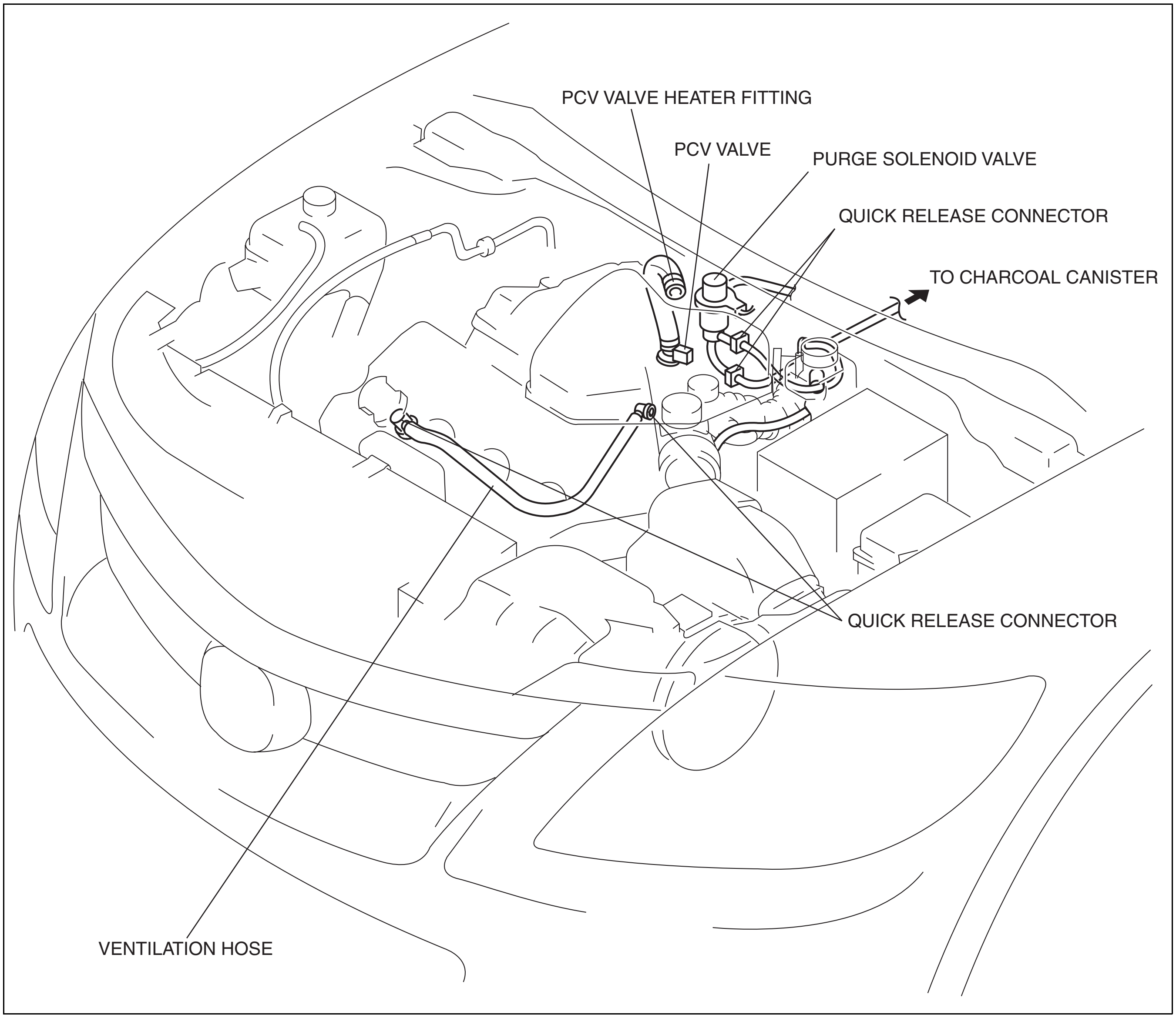
Specification

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

EMISSION SYSTEM STRUCTURAL VIEW [MZI-3.5]

id0116d1100200

Engine Compartment Side



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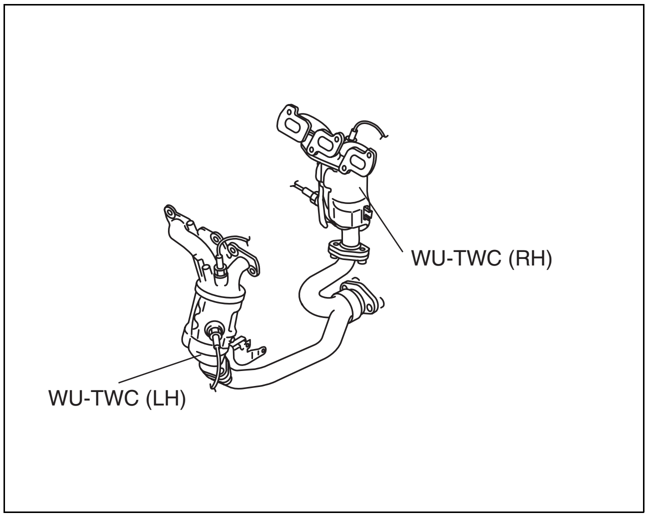
Exhaust System Side



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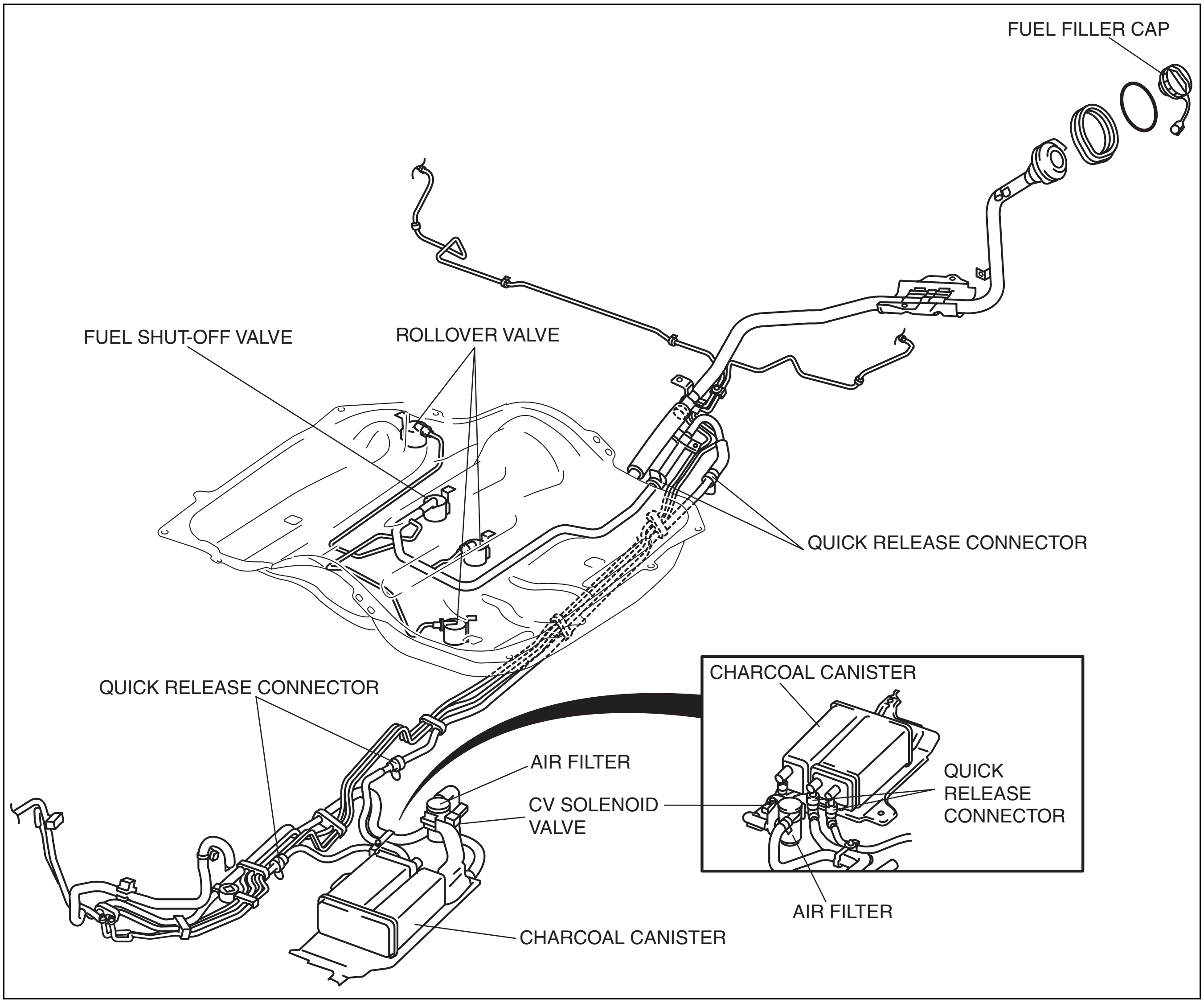
Fuel Tank Side
2WD



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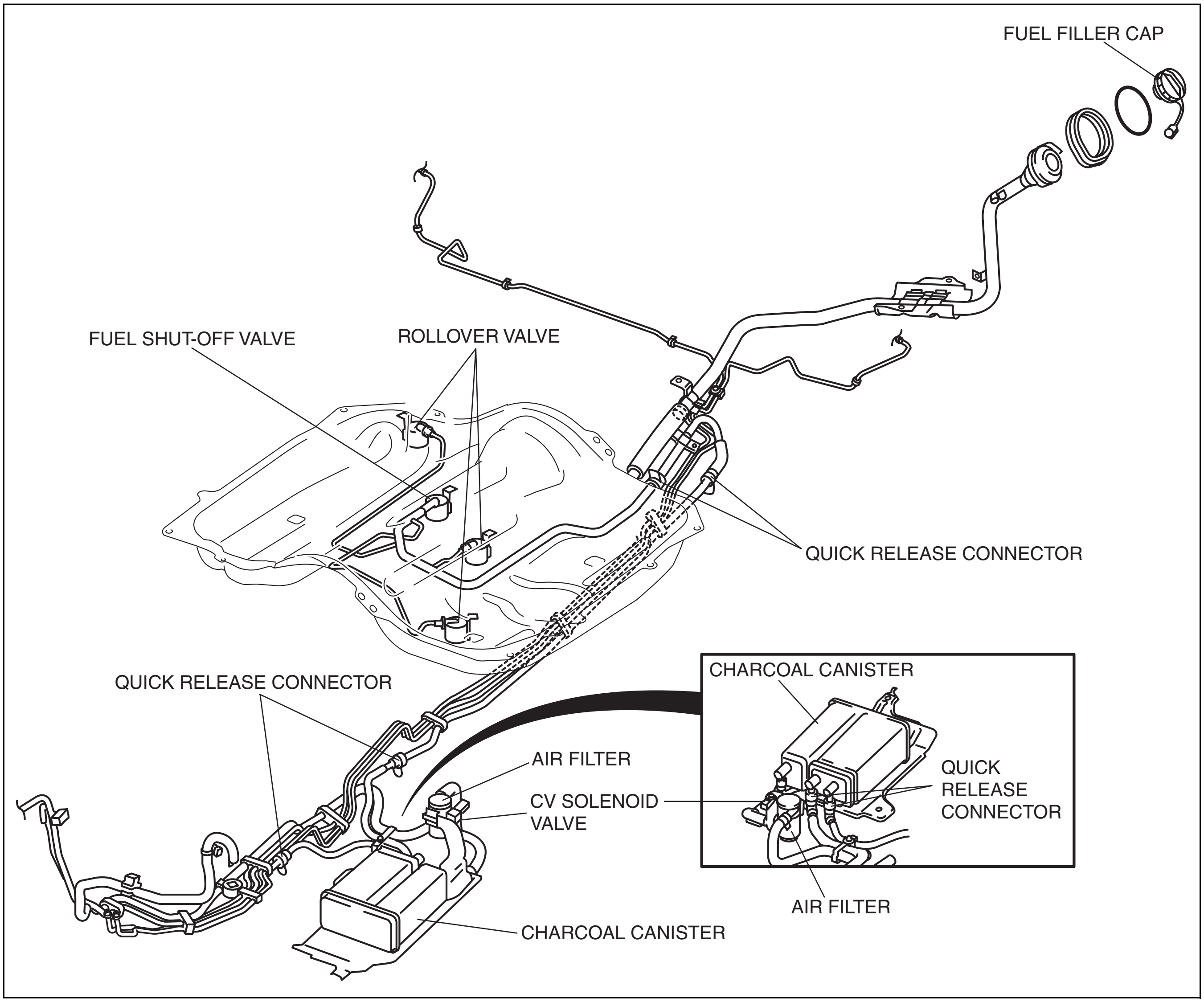
AWD



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EXHAUST PURIFICATION SYSTEM OUTLINE [MZI-3.5]

id0116d1100400

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.

CATALYTIC CONVERTER SYSTEM OUTLINE [MZI-3.5]

id0116d1101400

Feature

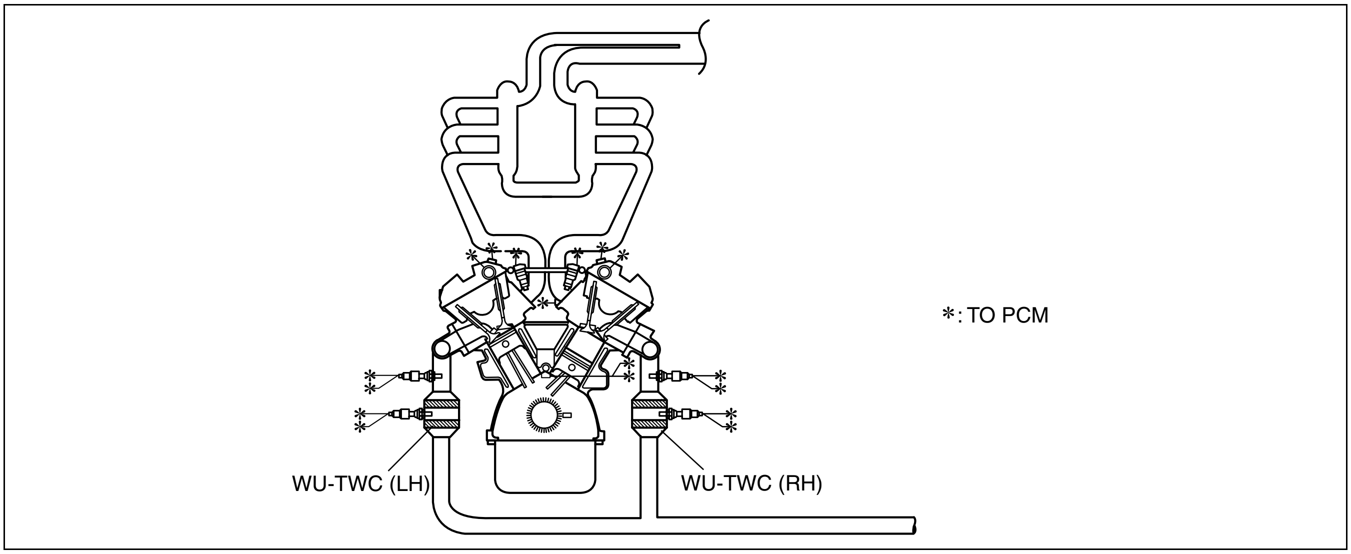
- Purifies contaminants in the exhaust gas by utilizing a chemical reaction in a three way catalytic converter.

CATALYTIC CONVERTER SYSTEM STRUCTURE [MZI-3.5]

id0116d1101500

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

System diagram



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CATALYTIC CONVERTER SYSTEM OPERATION [MZI-3.5]

id0116d1101600

- 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.
      $NO_X \rightarrow N_2 + O_2$

EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM OUTLINE [MZI-3.5]

id0116d1100800

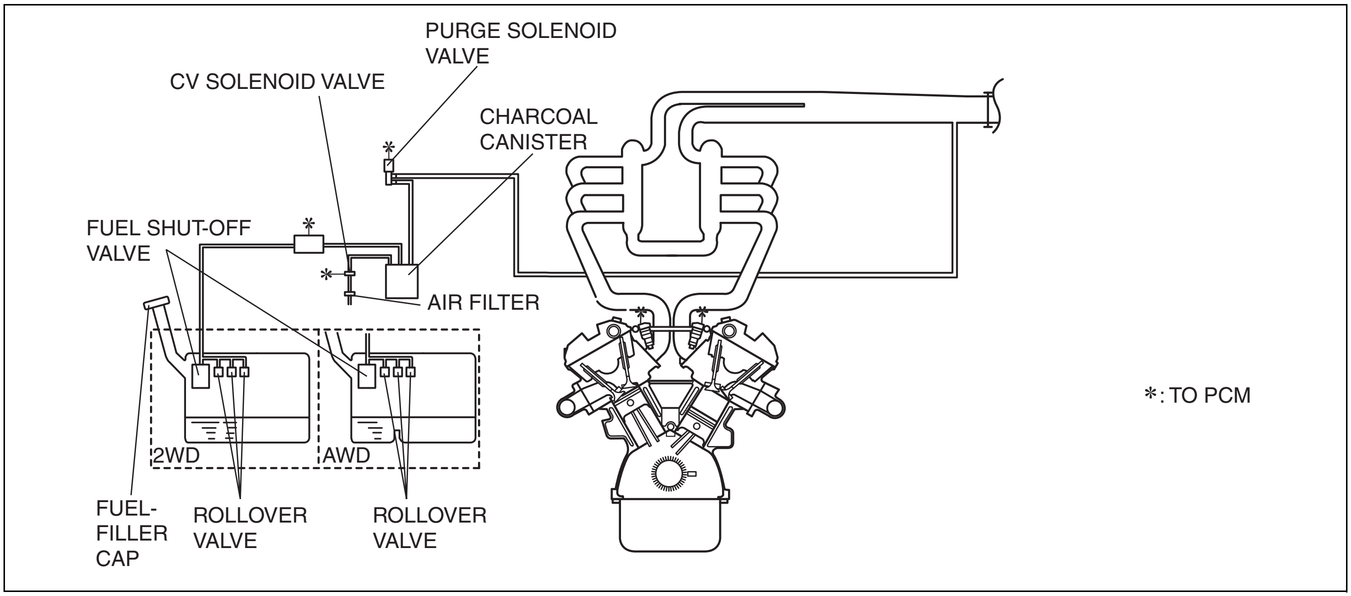
Features

- With the adoption of the charcoal canister, release of evaporative gas into the atmosphere has been prevented.
- A duty solenoid valve (purge control valve) has been adopted for optimum control according to engine operation conditions.

EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM STRUCTURE [MZI-3.5]

id0116d1100900

- Consists of a purge solenoid valve, charcoal canister, canister vent (CV) solenoid valve, air filter, rollover valve, fuel-filler cap and fuel shut-off valve.



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EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM OPERATION [MZI-3.5]

id0116d1101000

- When the engine is stopped, evaporative gas in the fuel tank flows out when the pressure increases and is absorbed by the charcoal canister.
- Evaporative gas that was absorbed by the charcoal canister passes through the solenoid valve together with air introduced from the charcoal canister when the engine is running, and is fed to the engine according to engine operation conditions.
- If the pressure in the fuel tank decreases, air is introduced from the charcoal canister through the rollover valve.

PURGE SOLENOID VALVE FUNCTION [MZI-3.5]

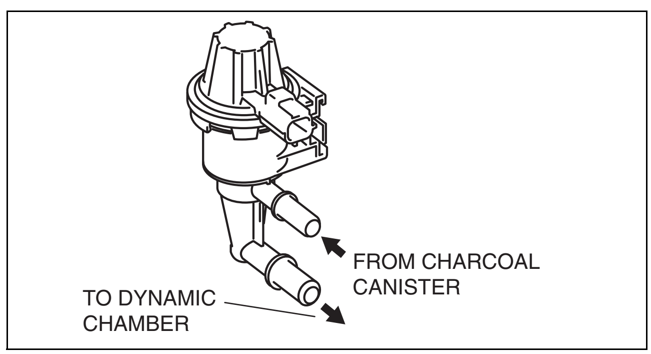
id0116d1102300

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

PURGE SOLENOID VALVE CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1102400

- Opens and closes the 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 dynamic chamber according to engine operation conditions.
- The passage between the ports opens when the PCM sent the signal, and evaporative gas is introduced to the intake air system according to intake manifold vacuum.



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POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OUTLINE [MZI-3.5]

id0116d1101100

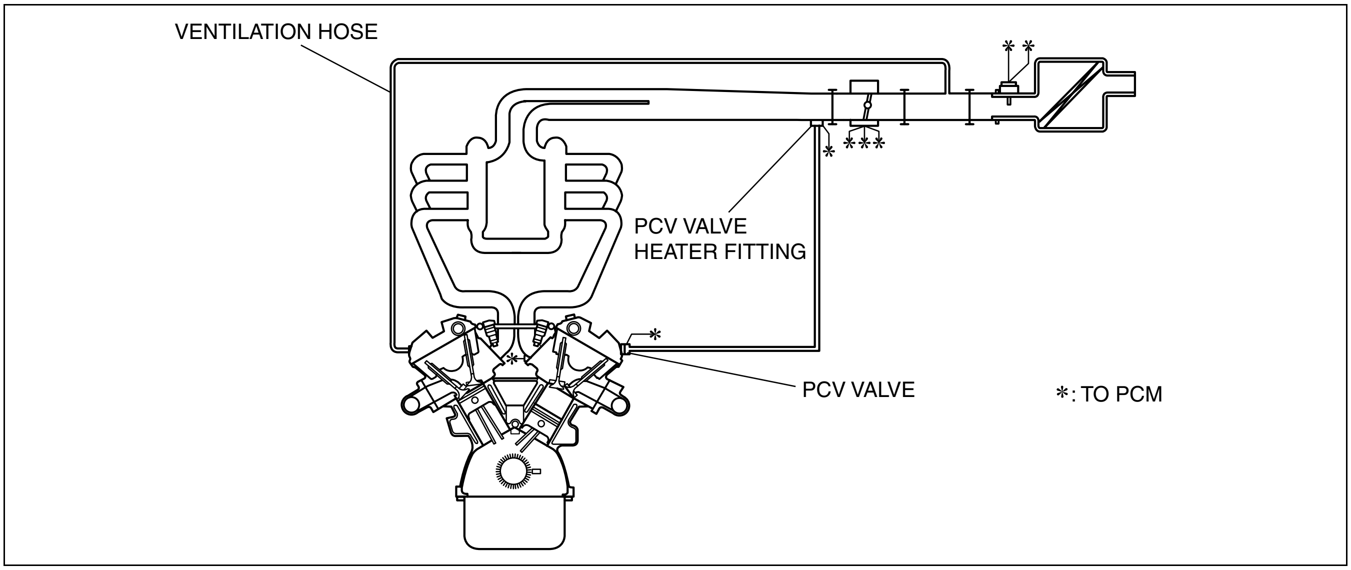
Feature

- A closed type PCV system has been adopted.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM STRUCTURE [MZI-3.5]

id0116d1101200

- Consists of a PCV valve, ventilation hose and PCV valve heater fitting.



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POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OPERATION [MZI-3.5]

id0116d1101300

- 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 [MZI-3.5]

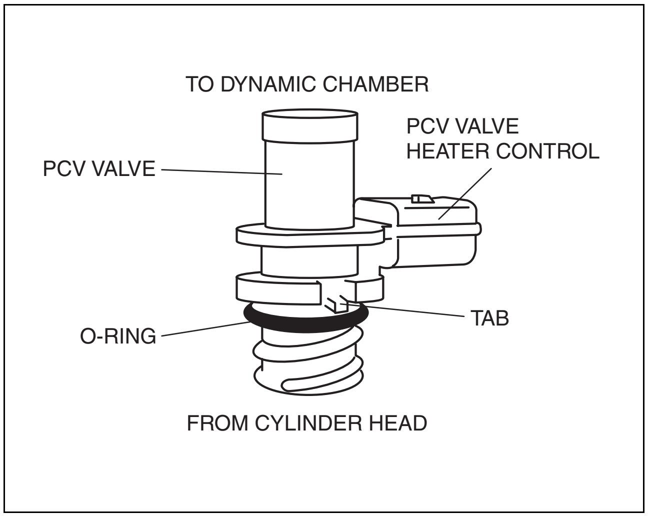
id0116d1101700

- 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 dynamic chamber during low load (when vacuum in the intake manifold is high) to ensure an optimum air/fuel ratio.
- Heater operates by the signal from PCM when IAT is low, and anti-icing is done.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1101800

- The PCV valve is installed on the cylinder head.
- Consists of a O-ring, 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.



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POSITIVE CRANKCASE VENTILATION (PCV) VALVE HEATER FITTING FUNCTION [MZI-3.5]

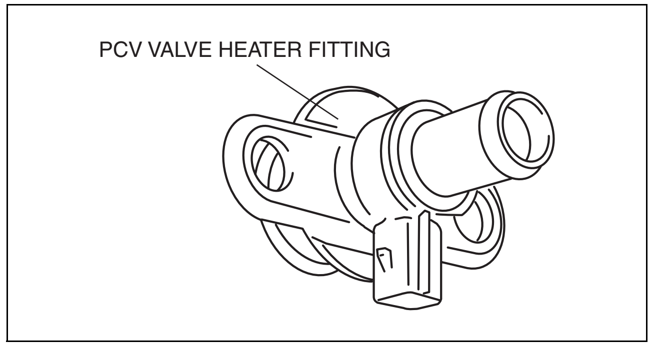
id0116d1105900

- Heater operates by the signal from PCM when IAT is low, and anti-icing is done.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE HEATER FITTING CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1105800

- Install on the dynamic chamber.



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CHARCOAL CANISTER FUNCTION [MZI-3.5]

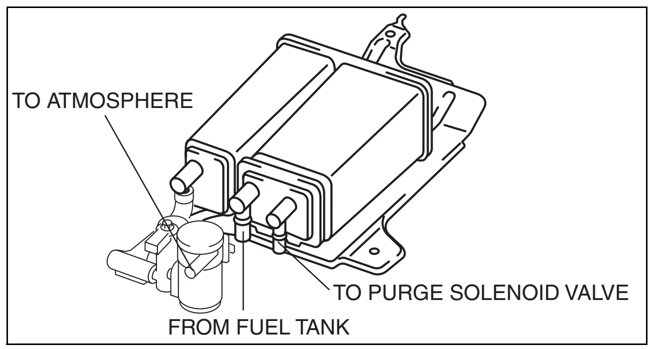
id0116d1101900

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

CHARCOAL CANISTER CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1102000

- 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.



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CANISTER VENT (CV) SOLENOID VALVE FUNCTION [MZI-3.5]

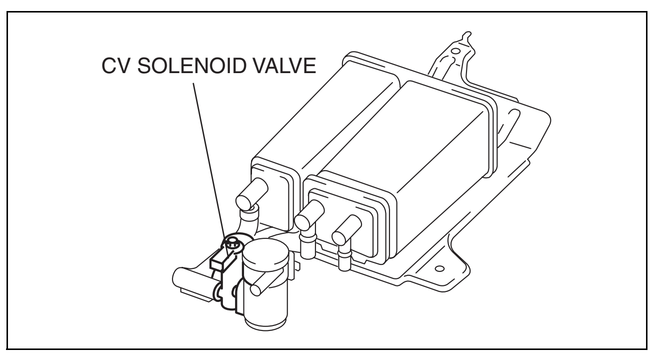
id0116d1190100

- Seals the atmosphere side of the charcoal canister during EVAP leak check monitoring.

CANISTER VENT (CV) SOLENOID VALVE CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1190200

- Equipped to the evaporative hose between the charcoal canister and air filter.



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AIR FILTER FUNCTION [MZI-3.5]

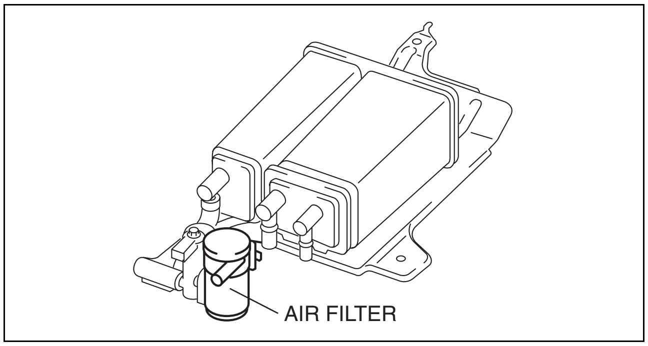
id0116d1102100

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

AIR FILTER CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1102200

- The air filter is located in the canister vent (CV) solenoid valve on the atmosphere side.



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FUEL SHUT-OFF VALVE FUNCTION [MZI-3.5]

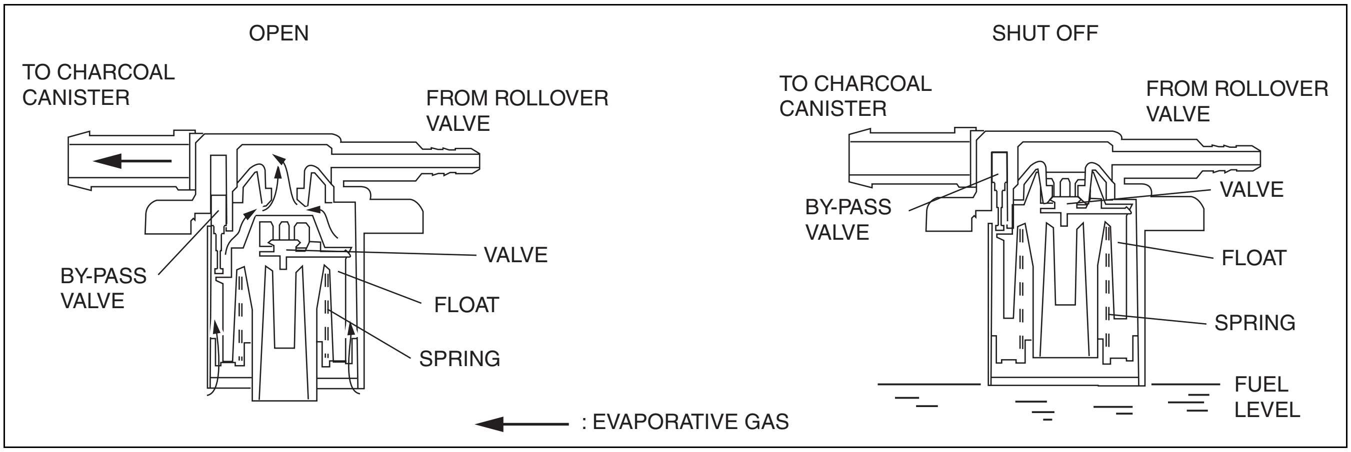
id0116d1150800

- 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 [MZI-3.5]

id0116d1150700

- The fuel shut-off valve is built into the fuel tank.
- The fuel shut-off valve mainly consists of a valve, float, spring, and by-pass valve.
- 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.



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ROLLOVER VALVE FUNCTION [MZI-3.5]

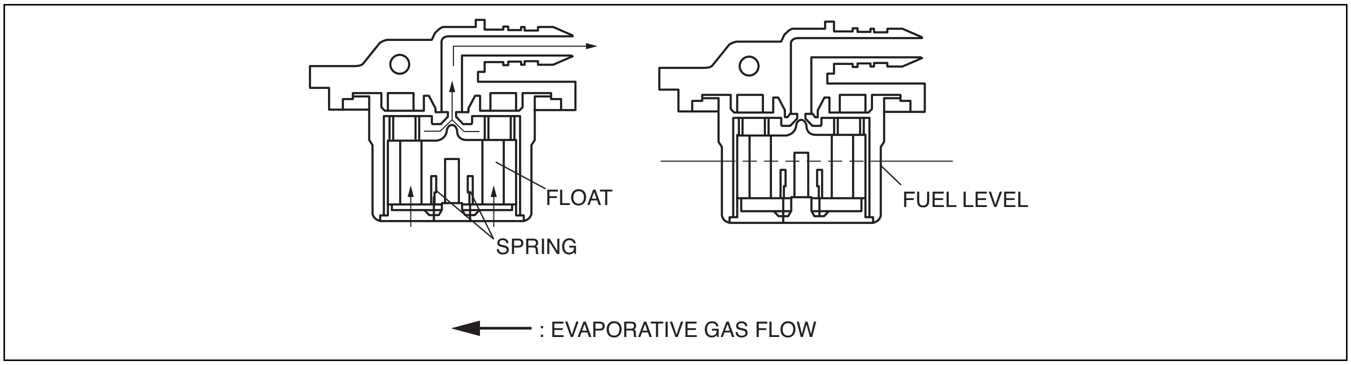
id0116d1102900

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

ROLLOVER VALVE CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1103000

- When the fuel flows into the rollover valve, the float (valve) closes the flow passage by relation of float weight, spring force and float floating force.



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QUICK RELEASE CONNECTOR (EMISSION SYSTEM) FUNCTION [MZI-3.5]

id0116d1152000

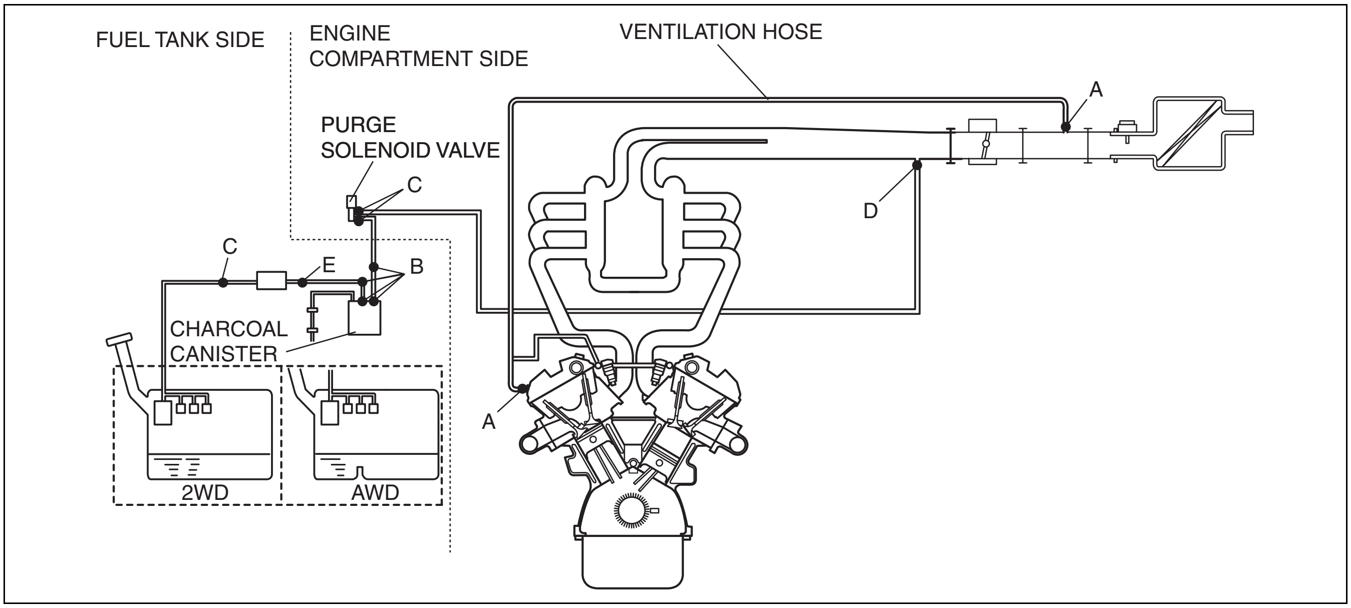
- Quick release connectors that can be easily connected/disconnected have been adopted to improve serviceability.

QUICK RELEASE CONNECTOR (EMISSION SYSTEM) CONSTRUCTION/OPERATION [MZI-3.5]

id0116d1152100

- There are five types of quick release connectors.

Quick Release Connector Type



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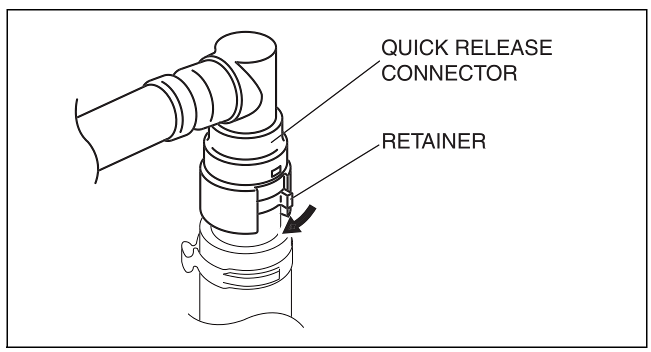
Type A Construction

- 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.



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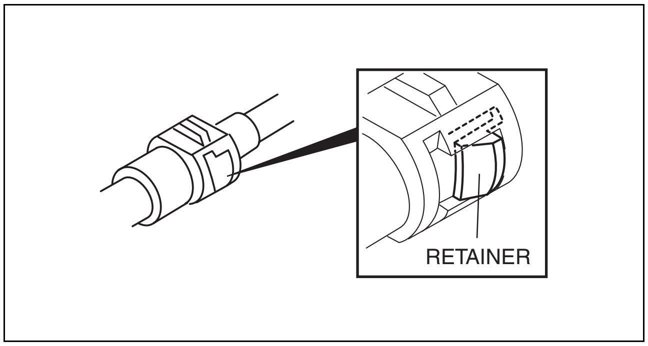
Type B Construction

- An SST is not used with this type.
- The connector can be disconnected by pinching the retainer tab pulling the connector.
- To connect the quick release connector properly, push it into the fuel pipe until a locking click sound is heard.



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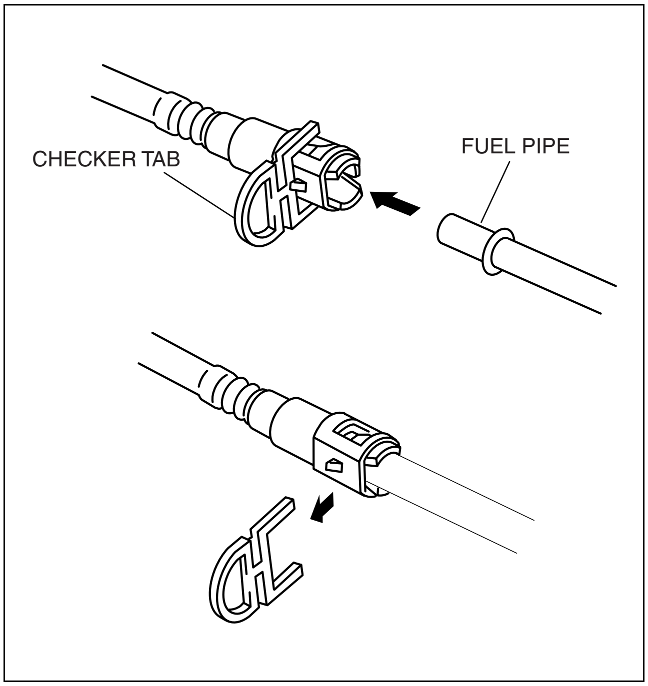
- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the fuel pipe, the lock is released and the checker tab comes off. Due to this, it can be verified that the quick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



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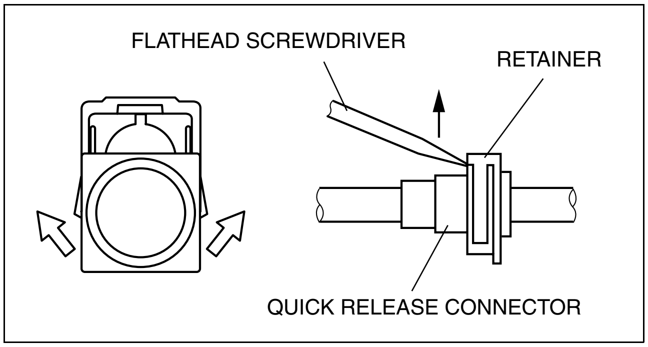
Type C Construction

- An SST is not used with this type.
- Mainly consists of a retainer and O-ring. The quick release connector is integrated with the joint port and therefore cannot be disassembled.
- When the quick release connector is connected, the fuel pipe projection is locked at the clamp lock point. To release the quick connector lock for each type, follow the procedure in the order shown in each figure.



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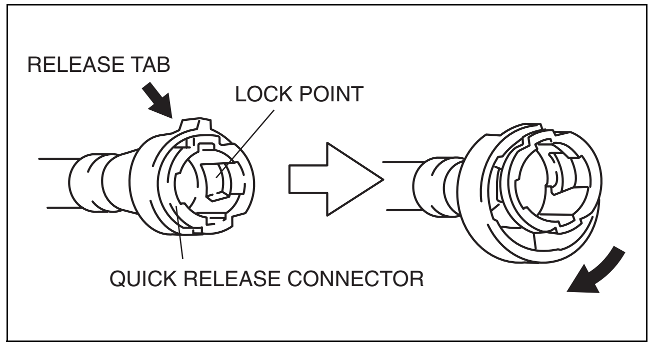
Type D Construction

- Used in the engine compartment.
- 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.



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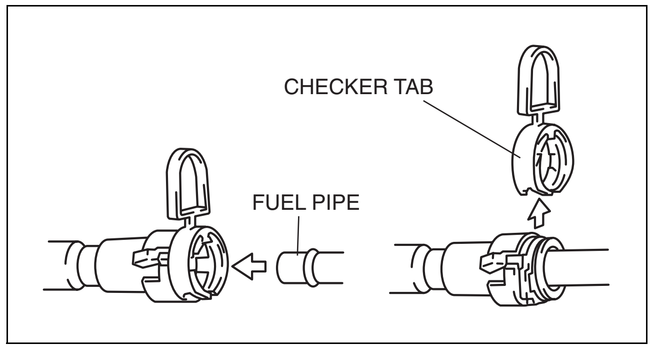
- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the fuel pipe, the lock is released and the checker tab comes off. Due to this, it can be verified that the quick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



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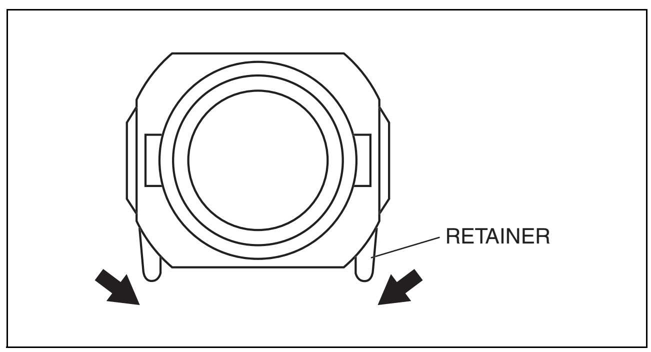
Type E Construction

- An SST is not used with this type.
- Mainly consists of a retainer and O-ring. The quick release connector is integrated with the joint port and therefore cannot be disassembled.
- When the quick release connector is connected, the fuel pipe projection is locked at the clamp lock point. To release the quick connector lock for each type, follow the procedure in the order shown in each figure.



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01-17 CHARGING SYSTEM [MZI-3.5]

CHARGING SYSTEM OUTLINE [MZI-3.5]

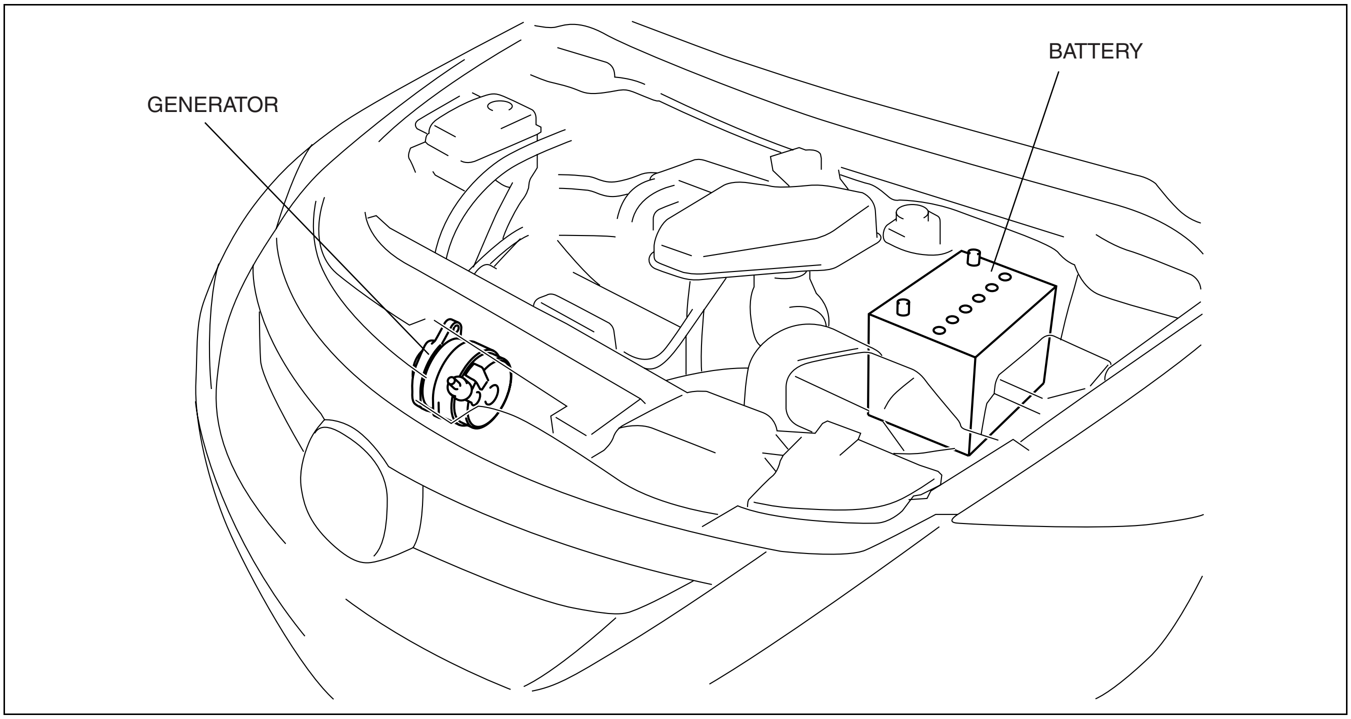
id0117d1102100

Features

Reduced operation noise	• Generator with two delta connection type stator coils adopted

CHARGING SYSTEM STRUCTURAL VIEW [MZI-3.5]

id0117d1102200



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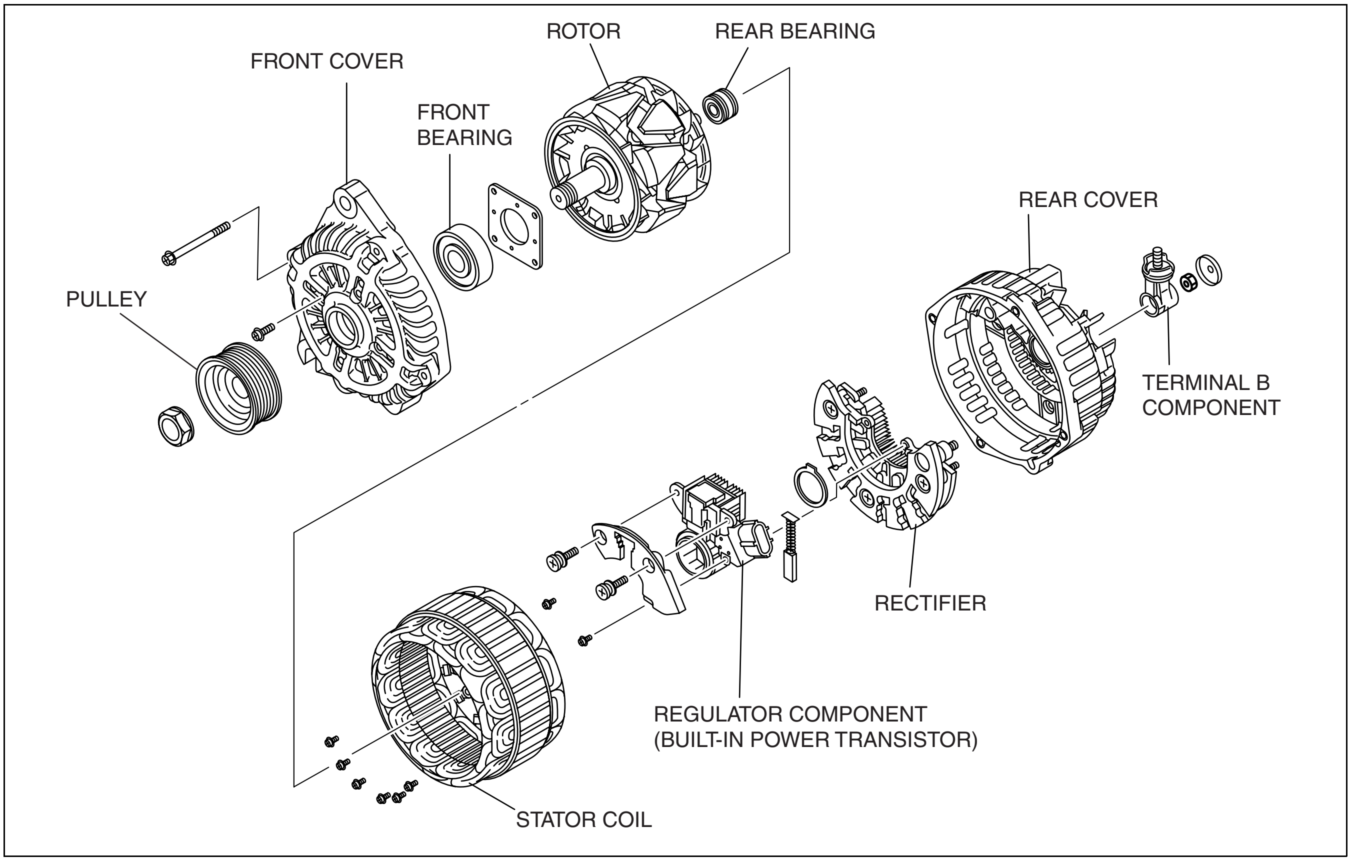
GENERATOR CONSTRUCTION [MZI-3.5]

id0117d1102300

- An IC regulator is built into the generator which determines the control voltage according to the duty signal sent from the PCM to generator, and controls output.
- Two delta connection type stator coils have been adopted.



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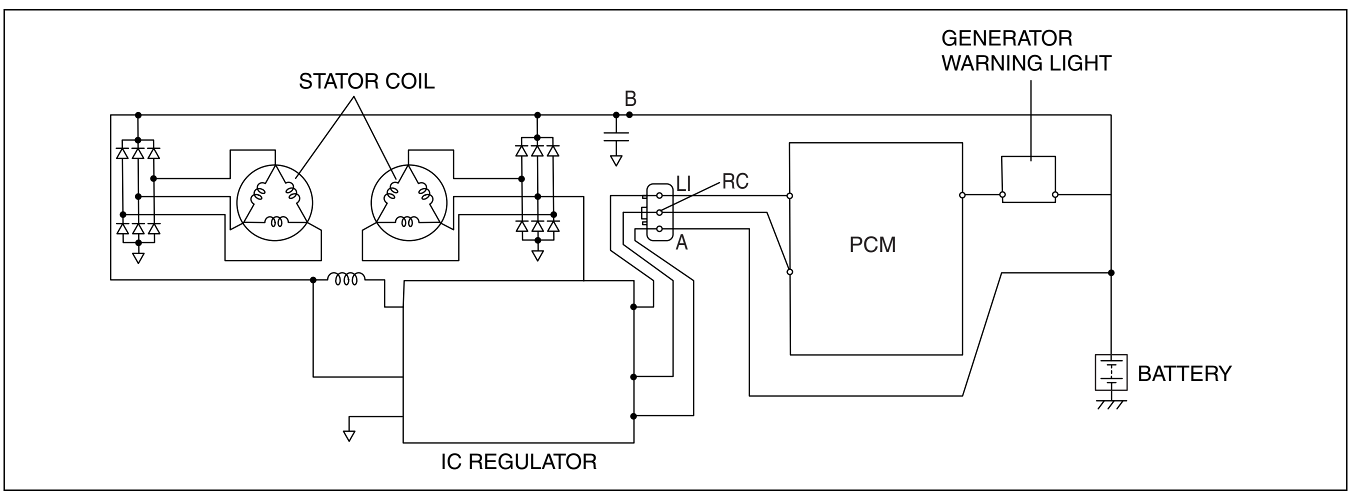

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Terminal B circuit

- Generator output is supplied to the battery from terminal B, and to each electronic device.

Terminal RC circuit

- The terminal RC circuit is the circuit where the duty signal (Generator Regulator Control (GENRC) signal) from the PCM is input to the IC regulator. The IC regulator control voltage is determined according to the GENRC signal.

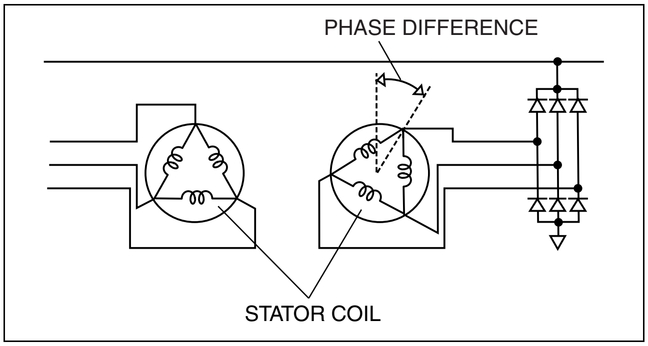
Terminal LI circuit

- The terminal LI circuit outputs the duty signal (Generator Load Input (GENLI) signal) of the field coil to the PCM. The GENLI signal is used as the feedback signal which corresponds to the GENRC signal input from the PCM. The PCM changes the duty value of the GENRC signal according to the GENLI signal. If the output is not normal, a 0 % duty value is output to the PCM which then illuminates the generator warning light.

Terminal A circuit

- Terminal A circuit is used to detect battery voltage. This voltage is used to determine generator output voltage. This circuit is used to supply current to the field coil (rotor). The amount of current supplied to the field coil (rotor) determines the generator output current.

- The phase difference in the circuit of the two stator coils causes the electromagnetic pull between the rotor and the stator to be eliminated logically. Due to this, electromagnetic vibration and generator operation noise (electromagnetic noise) have been reduced.
- The pulsation occurring through voltage rectifying is minimized, as a result, stable voltage output is supplied due to the adoption of two stator coils with the phase difference.



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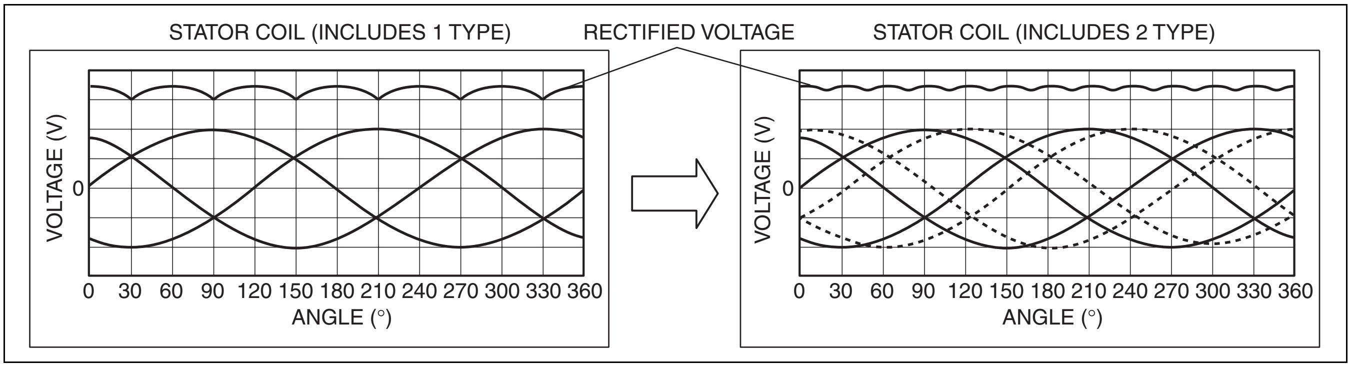

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01-18 IGNITION SYSTEM [MZI-3.5]

IGNITION SYSTEM OUTLINE [MZI-3.5]

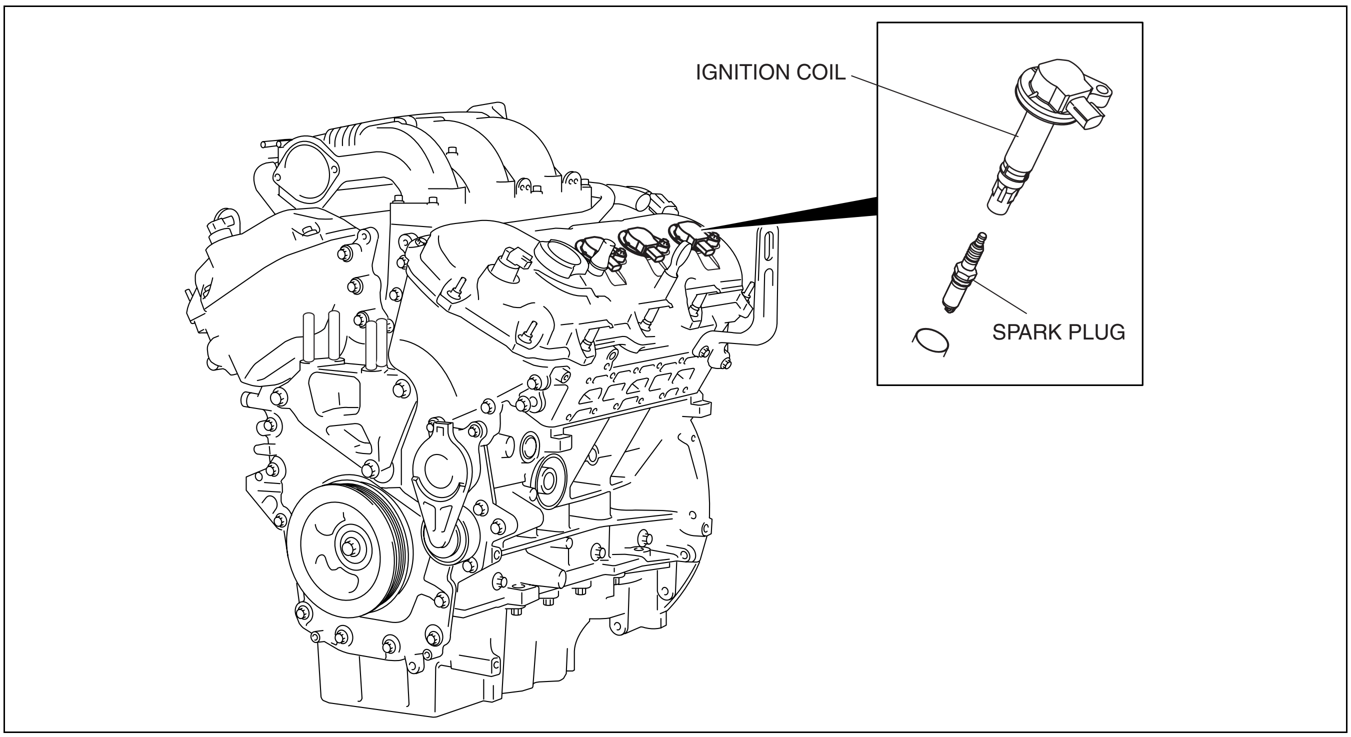
id0118c1100200

Features

Improved reliability	• Independent ignition control system with distributorless ignition coils adopted
Improved durability	• Spark plugs with platinum-tipped center electrode adopted

IGNITION SYSTEM STRUCTURAL VIEW [MZI-3.5]

id0118c1100100



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IGNITION COIL CONSTRUCTION/OPERATION [MZI-3.5]

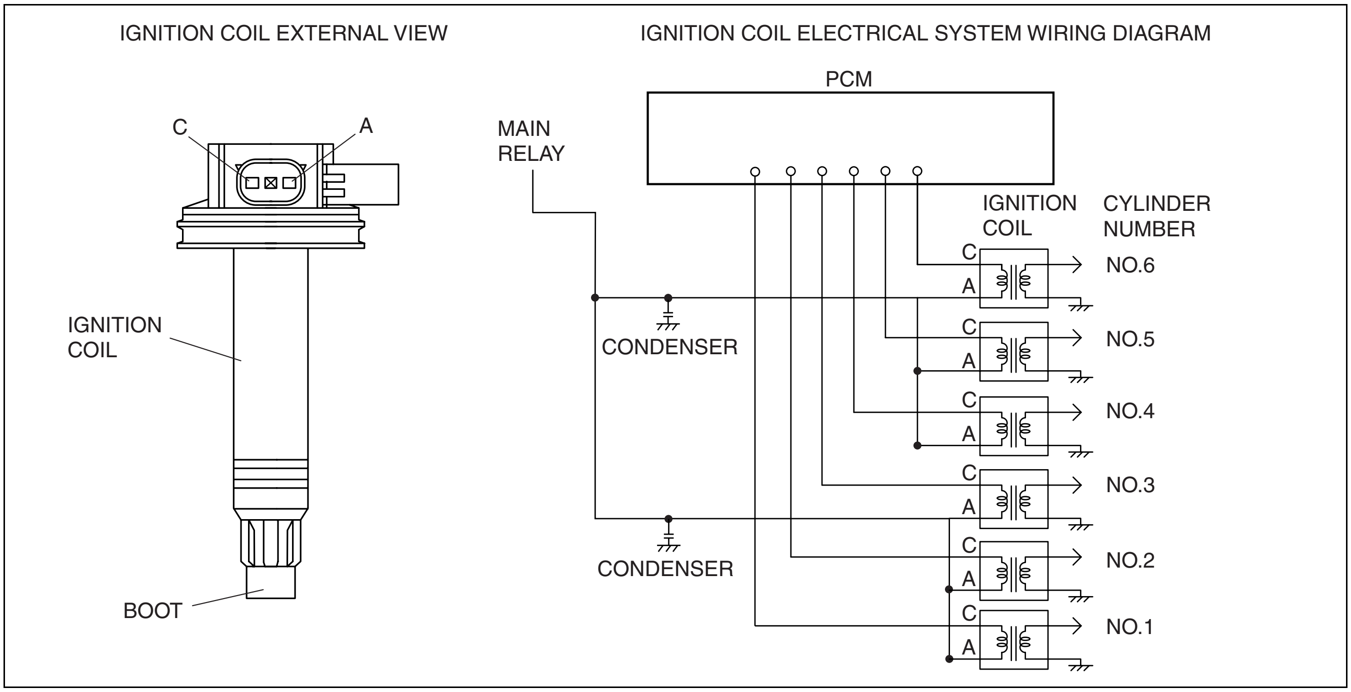
id0118c1100300

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.

Operation

- The firing timing of the coil is controlled by the PCM by means of a built-in igniter for optimum ignition timing control.



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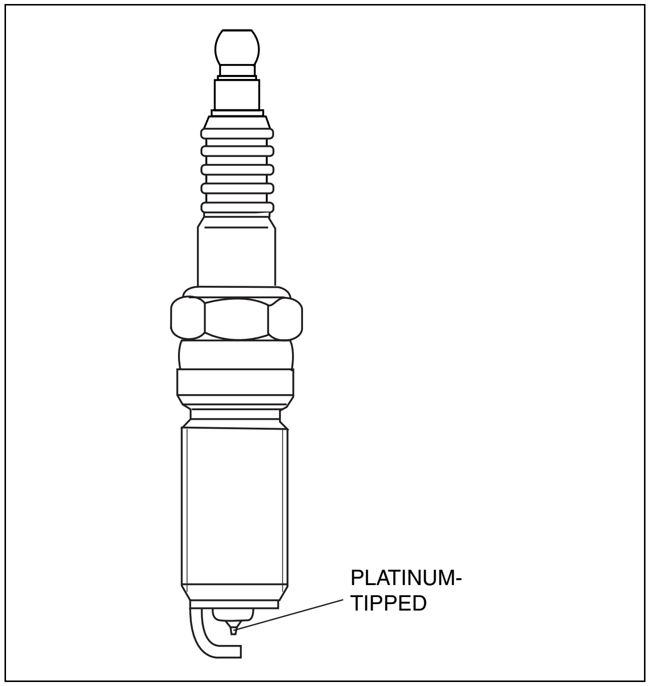
Terminal layout

Terminal	Signal
A	Power supply
C	Ignition coil control signal

SPARK PLUG CONSTRUCTION [MZI-3.5]

id0118c1100400

- Spark plugs with platinum-tipped center electrode have been adopted for longer life.



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01-19 STARTING SYSTEM [MZI-3.5]

STARTING SYSTEM OUTLINE [MZI-3.5]

id0119c1100200

Features

Improved startability	• Reduction type starter adopted

STARTING SYSTEM STRUCTURAL VIEW [MZI-3.5]

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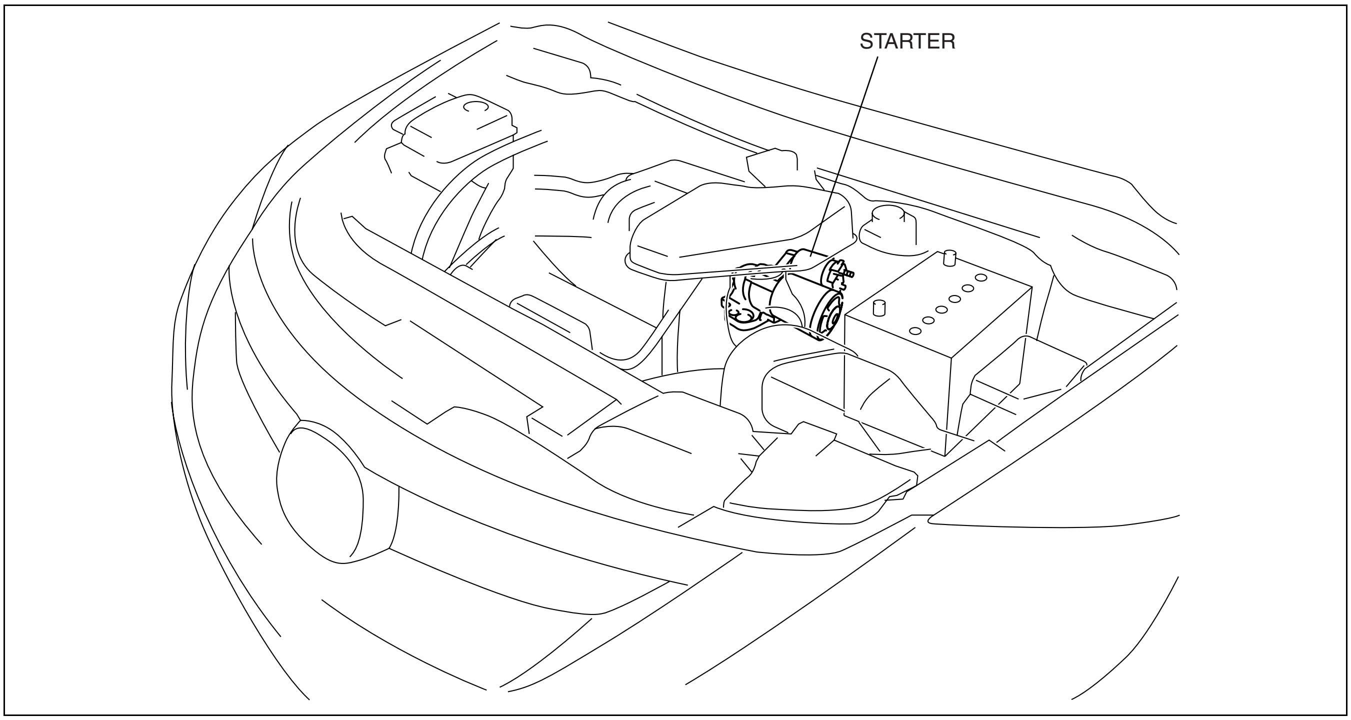

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STARTER CONSTRUCTION [MZI-3.5]

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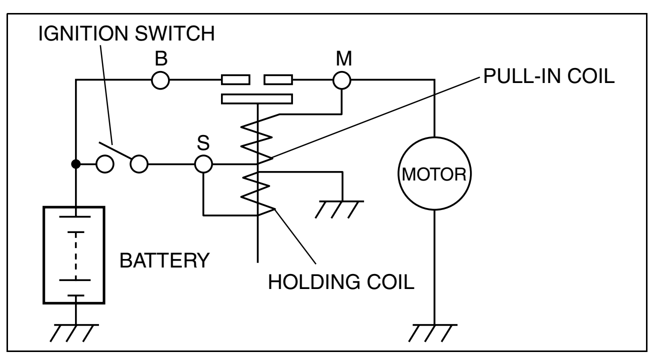
- A high torque coaxial reduction type starter has been adopted.



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01-20 CRUISE CONTROL SYSTEM [MZI-3.5]

CRUISE CONTROL SYSTEM OUTLINE [MZI-3.5]

id0120c1100100

- The cruise control system enables driving at a constant speed by setting the vehicle speed with the cruise control switch instead of operating the accelerator pedal.
- The PCM controls the throttle valve actuator to maintain the vehicle at a constant speed.

Component and function

Component		Function		Installation location
RSC(CAN communication: Vehicle speed signal)		The vehicle speed signal is sent to the PCM from either the RSC.		Engine compartment
Cruise control switch	ON/ OFF	ON	The cruise control system main switch. The cruise control system goes into stand-by with the operation of the switch.	Steering wheel
		OFF	The cruise control system main switch. The cruise control system is turned off with the operation of the switch.	
	SET+/ SET-	SET+	If the switch is pressed upward when the vehicle speed exceeds 24km/h {15 mph} with the system in stand-by, the vehicle speed at the point when the switch is pressed upward is stored in the PCM and the system initiates the cruise control.	
			The PCM controls acceleration by the pressing of the switch upward (tap-up operation) or when the switch is continuously pressed upward during cruise control.	
		SET-	If the switch is pressed downward when the vehicle speed exceeds 24km/h {15 mph} with the system in stand-by, the vehicle speed at the point when the switch is pressed downward is stored in the PCM and the system initiates the cruise control.	
			The PCM controls deceleration by the pressing of the switch downward (tap-down operation) or when the switch is continuously pressed downward during cruise control.	
	RESUME	RESUME	If the switch is pressed when the vehicle speed exceeds 24km/h {15 mph} with the system in stand-by and the previous pre-set vehicle speed stored in the PCM, the system initiates the cruise control so that the vehicle speed is the pre-set vehicle speed stored in the PCM.	
	CANCEL	CANCEL	If the CANCEL switch is pressed during cruise control, the cruise control system goes into stand-by (Pre-set vehicle speed is stored).	
Btake switch		Depressing the brake pedal during cruise control switches the cruise control system to standby status.		Brake pedal
TCM/CAN communication:gear signal)		If the following operation is performed during cruise control, the cruise control system goes into stand-by (Pre-set vehicle speed is stored). • The selector lever is shifted from the D range to the N position.		Engine compartment
Parking brake switch		If the parking brake is operated during cruise control, the cruise control system goes into stand-by (Pre-set vehicle speed is stored).		Parking brake pedal
PCM		The cruise control system is executed or stopped according to the cruise control switch signals. The throttle valve actuator is operated so that the vehicle speed is the pre-set vehicle speed during cruise control system.		Engine compartment
Throttle valve actuator		The duty signal sent from the PCM adjusts the throttle valve opening angle.		Throttle body
Cruise main indicator light (Amber)		This illuminates light while the cruise control system is in control status.		Instrument cluster
Cruise set indicator light (Green)		This illuminates light while the cruise control system is in control status.		

CRUISE CONTROL SYSTEM STRUCTURAL VIEW [MZI-3.5]

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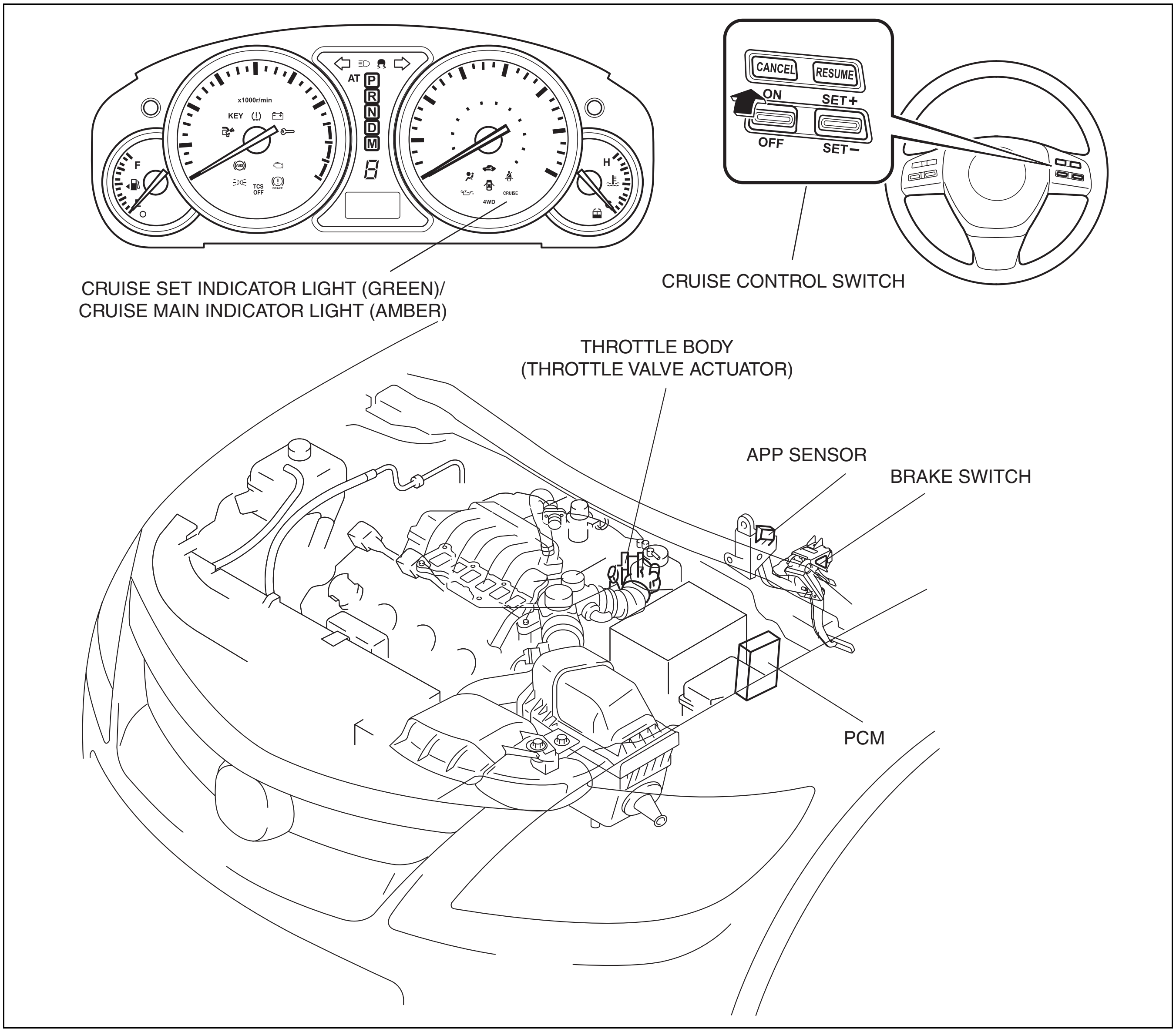

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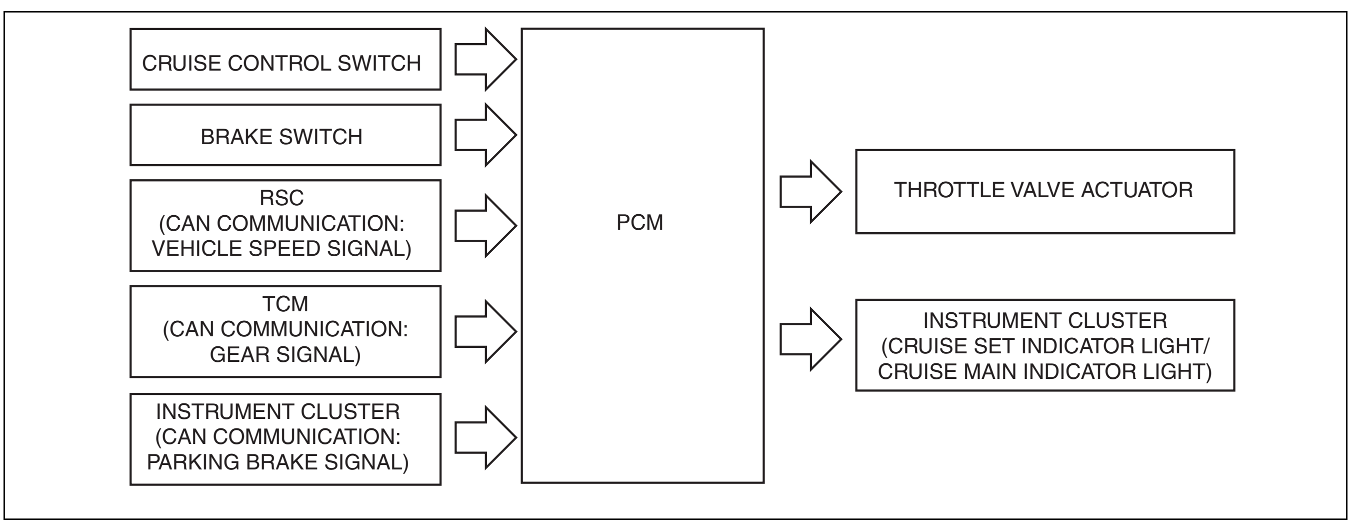
CRUISE CONTROL SYSTEM BLOCK DIAGRAM [MZI-3.5]

id0120c1100300



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01-40 CONTROL SYSTEM [MZI-3.5]

ENGINE CONTROL SYSTEM OUTLINE [MZI-3.5]

id0140c1100100

Features

Improved driveability	• Drive-by-wire control adopted • Fuel injection control adopted • Fuel pump control adopted
Improved emission performance	• Variable valve timing control adopted
Improved fuel economy	• HO2S heater control adopted
Wiring harness simplification	• CAN adopted

Specification

Item	Specification
PSP switch	Hydraulic pressure
CHT sensor	Thermistor
MAF sensor	Hot-wire
IAT sensor (Inside MAF sensor)	Thermistor
TP sensor	Potentiometer type
CKP sensor	Pickup type
CMP sensor	Pickup type
HO2S	Zirconia element (Stoichiometric air/fuel ratio sensor)

ENGINE CONTROL SYSTEM STRUCTURAL VIEW [MZI-3.5]

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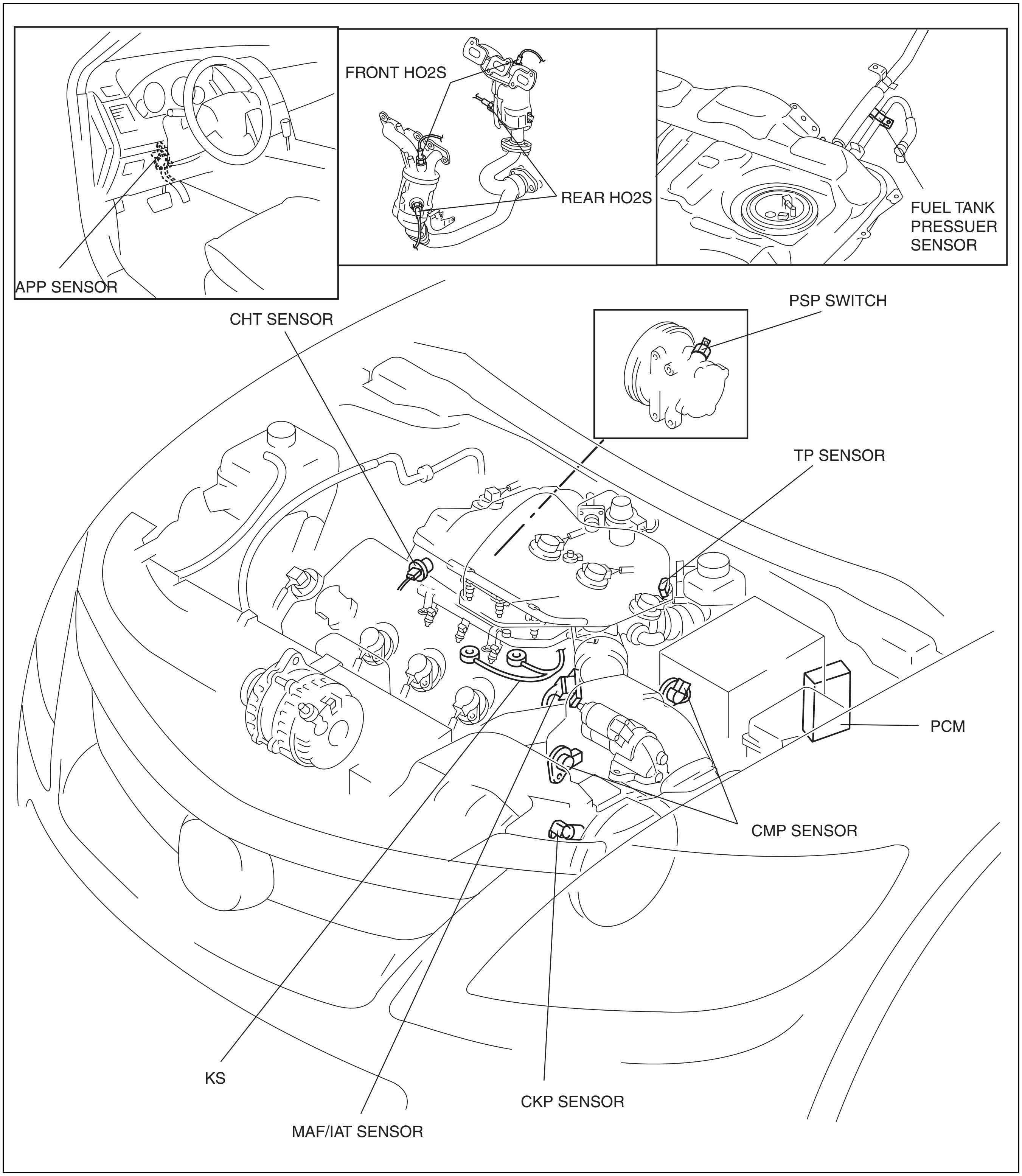

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ENGINE CONTROL SYSTEM DIAGRAM [MZI-3.5]

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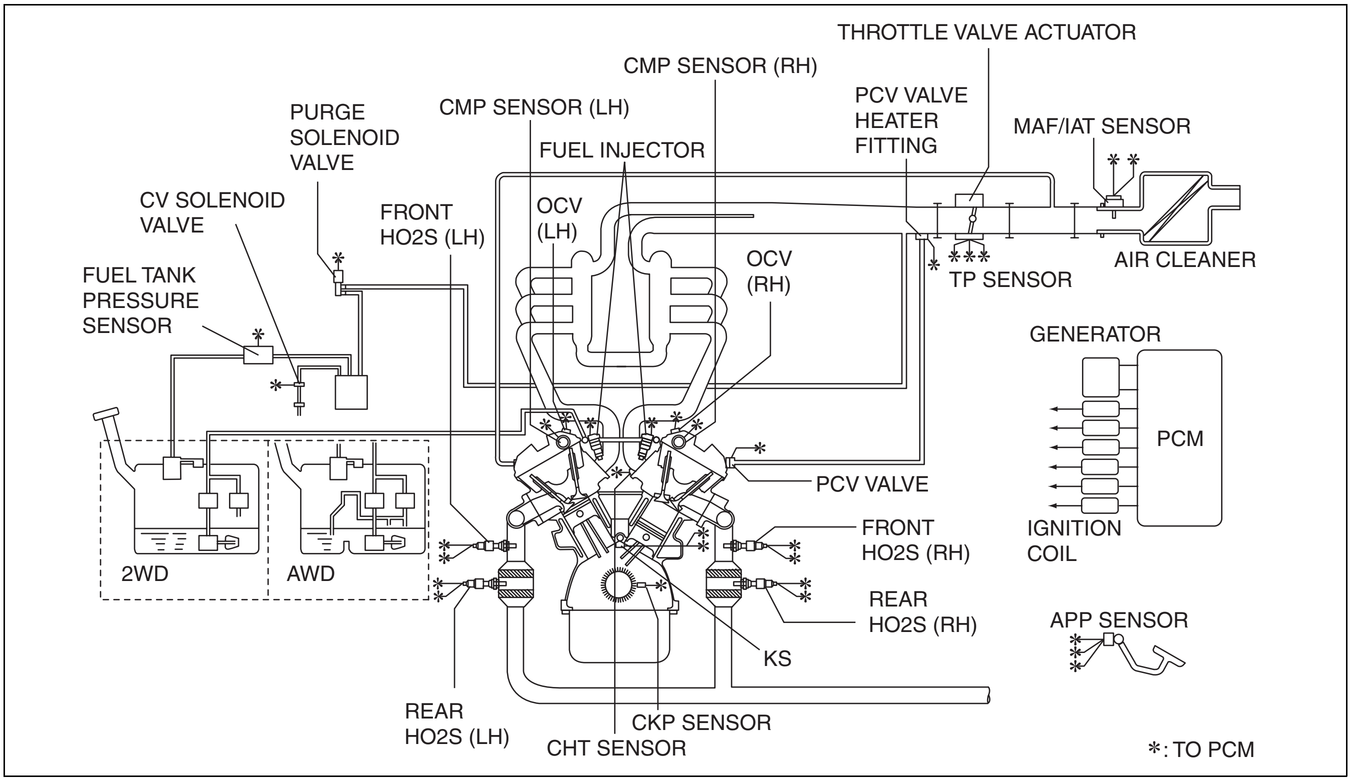

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ELECTRICAL FAN CONTROL OUTLINE [MZI-3.5]

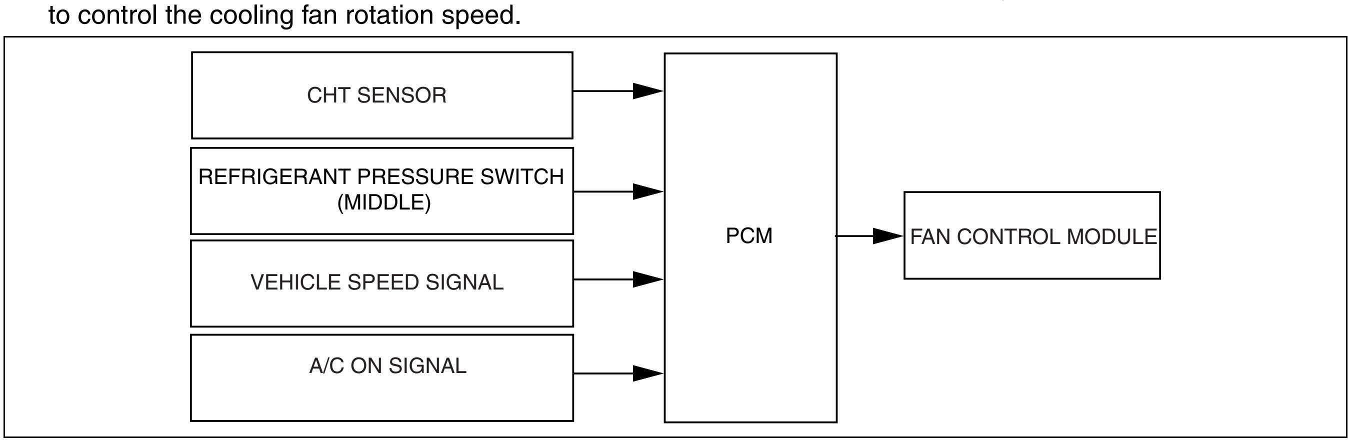
id0140c1103800

- 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 [MZI-3.5]

id0140c1103900

- 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.



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ELECTRICAL FAN CONTROL OPERATION [MZI-3.5]

id0140c1104000

Without Towing Package

- 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 less than 96°C {205°F}.
70—30 %	• Engine coolant temperature is 96—106°C {205—223°F}.
0 %	• Engine coolant temperature is more than 106°C {223°F}.

Refrigerant pressure control

PCM output duty ratio	Engine operation conditions
44 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is on.
53 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is off. — Vehicle speed is 70 km/h {43 mph} or less.
100 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is off. — Vehicle speed is 70 km/h {43 mph} or more.

With Towing Package

- 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 less than 96°C {205°F}.
70—25 %	• Engine coolant temperature is 96—106°C {205—223°F}.
0 %	• Engine coolant temperature is more than 106°C {223°F}.

Refrigerant pressure control

PCM output duty ratio	Engine operation conditions
45 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is on.
52 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is off. — Vehicle speed is 70 km/h {43 mph} or less.
100 %	• When all of the following conditions are met: — A/C is on. — Refrigerant pressure switch (medium pressure) is off. — Vehicle speed is 70 km/h {43 mph} or more.

PCM FUNCTION [MZI-3.5]

id0140c1105300

Function List

- The control descriptions are as shown below.

Function	Description
Drive-by wire control	The drive-by-wire control calculates the optimum target throttle valve opening angle at all ranges of engine speeds and controls the throttle valve actuator.
Variable valve timing control	Changes the intake valve timing according to engine operation conditions.
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).
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.
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.
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.
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.
PCV valve heater control	Operates the PCV valve heater and PCV valve heater fitting when the intake air temperature is low.
CAN	Used for communication with CAN related module and DLC-2.

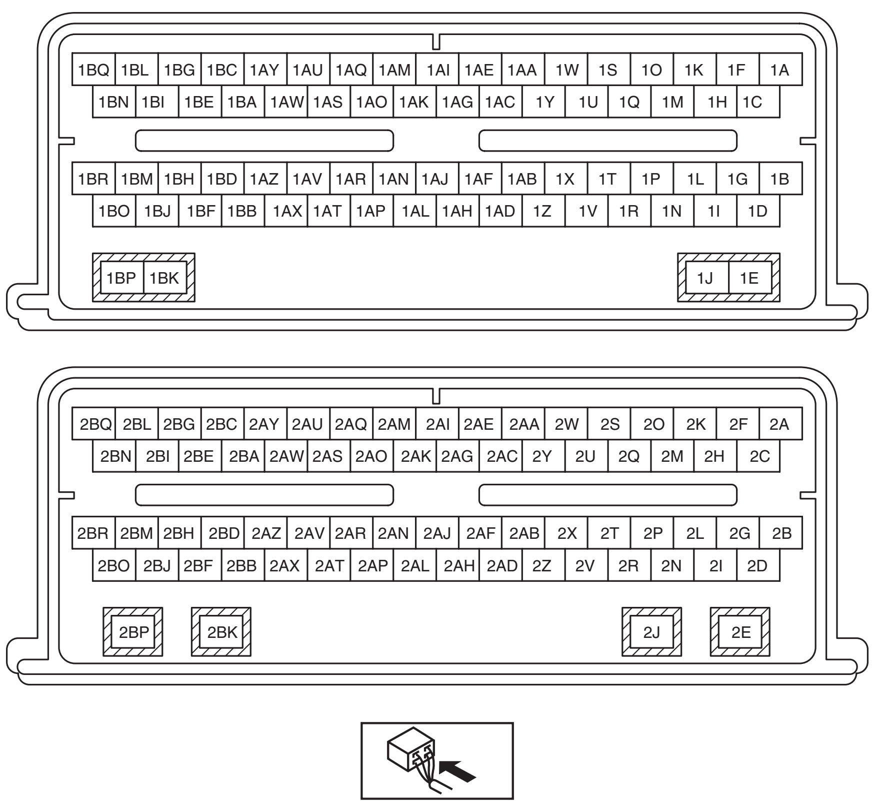
PCM CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1105400

Structure

- A 140-pin (two-block) PCM connector has been adopted.

PCM
WIRING HARNESS-SIDE CONNECTOR



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POWER STEERING PRESSURE (PSP) SWITCH FUNCTION [MZI-3.5]

id0140c1174500

- The PSP switch monitors the hydraulic pressure within the power steering system.

POWER STEERING PRESSURE (PSP) SWITCH CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1174600

- The PSP switch is a normally closed switch that opens as the hydraulic pressure increases.
- The PCM provides a low current voltage on the PSP circuit.
- The PCM uses the input signal from the PSP switch to compensate for additional loads on the engine by adjusting the idle RPM and preventing engine stall during parking maneuvers. Also, the PSP switch signals the PCM to adjust the transmission electronic pressure control (EPC) pressure during increased engine load, for example, during parking maneuvers.

INTAKE AIR TEMPERATURE (IAT) SENSOR FUNCTION [MZI-3.5]

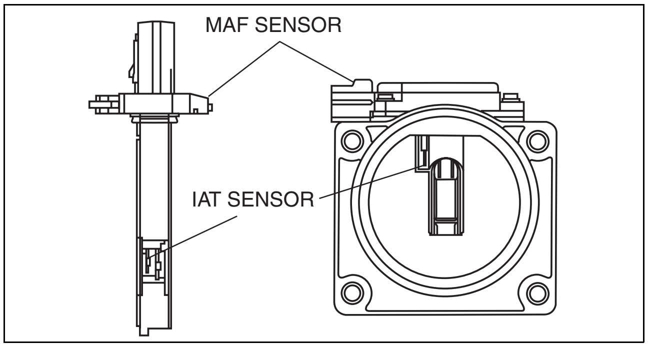
id0140c1178200

- Detects intake air temperature.

INTAKE AIR TEMPERATURE (IAT) SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1178100

- The IAT sensor is built into the MAF sensor.
- The IAT sensor is a thermistor device in which resistance changes with temperature.



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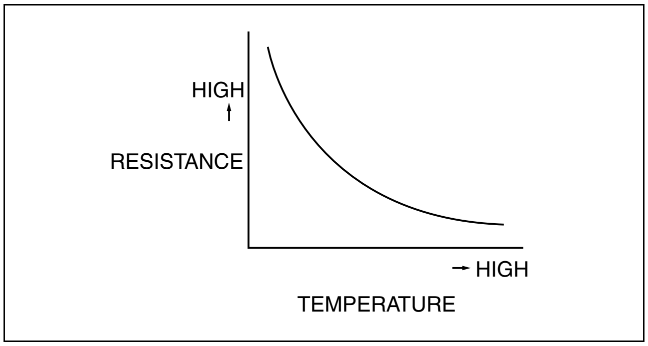
- The electrical resistance of the thermistor decreases as the temperature increases, and the resistance increases as the temperature decreases.



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ACCELERATOR PEDAL POSITION (APP) SENSOR FUNCTION [MZI-3.5]

id0140c1174700

- The APP sensor is an input to the powertrain control module (PCM) and is used to determine the torque demand.

ACCELERATOR PEDAL POSITION (APP) SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1174800

- There are 3 pedal position signals in the sensor.
- APP sensor No.1 has a negative slope (increasing angle, decreasing voltage) and APP sensor No.2 and APP sensor No.3 both have apositive slope (increasing angle, increasing voltage).

KNOCK SENSOR (KS) FUNCTION [MZI-3.5]

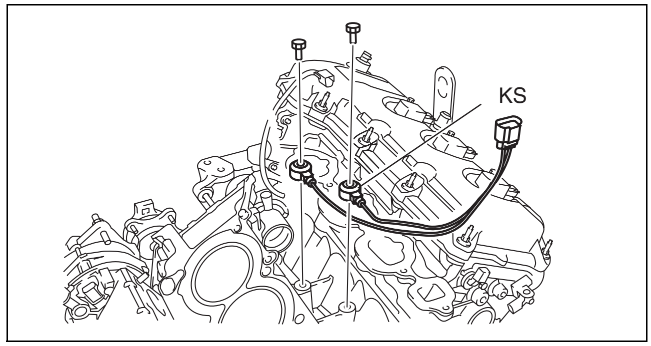
id0140c1174100

- Detects abnormal combustion in the engine.

KNOCK SENSOR (KS) CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1174200

- The KS is the sensor on the engine which converts engine vibration to an electrical signal.
- The PCM uses this signal to determine the presence of engine knock and to retard spark timing.
- Two KS have been adopted.



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MASS AIR FLOW (MAF) SENSOR FUNCTION [MZI-3.5]

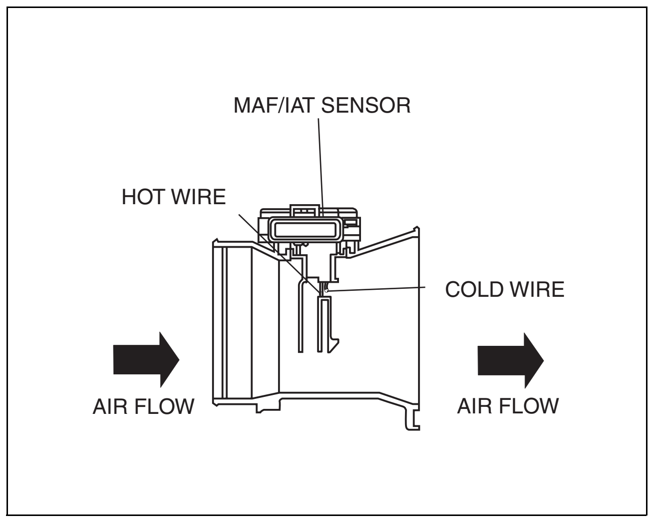
id0140c1176800

- Detects intake air amount (mass airflow amount).

MASS AIR FLOW (MAF) SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1176700

- Incorporates the IAT sensor.
- The MAF sensor uses a hot wire sensing element to measure the amount of air entering the engine.
- Air passing over the hot wire causes it to cool.
- This hot wire is maintained at 200°C (392°F) above the ambient temperature as measured by a constant cold wire.
- The current required to maintain the temperature of the hot wire is proportional to the mass air flow.



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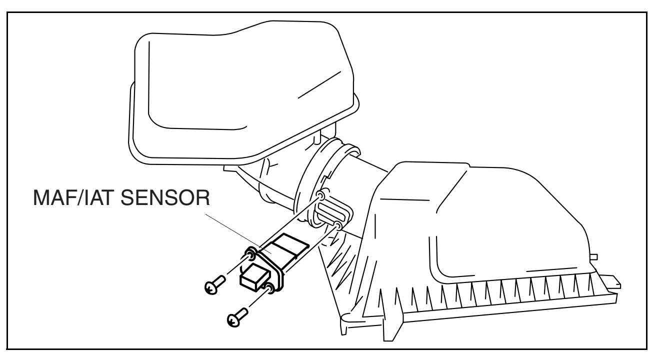
- The MAF sensor then outputs an analog voltage signal to the PCM proportional to the intake air mass.



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CRANKSHAFT POSITION (CKP) SENSOR FUNCTION [MZI-3.5]

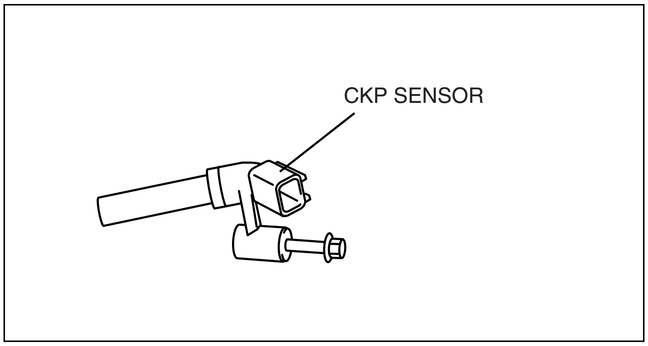
id0140c1177400

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

CRANKSHAFT POSITION (CKP) SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1177300

- By monitoring the crankshaft mounted pulse wheel, the CKP is the primary sensor for ignition information to the PCM.
- By monitoring the pulse wheel, the CKP sensor signal indicates the crankshaft position and speed information to the PCM. By monitoring the missing tooth, the CKP sensor is also able to identify piston travel in order to synchronize the ignition system and provide a way of tracking the angular position of the crankshaft relative to a fixed reference for the CKP sensor configuration.
- The PCM also uses the CKP signal to determine if a misfire has occurred by measuring rapid decelerations between teeth.



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CAMSHAFT POSITION (CMP) SENSOR FUNCTION [MZI-3.5]

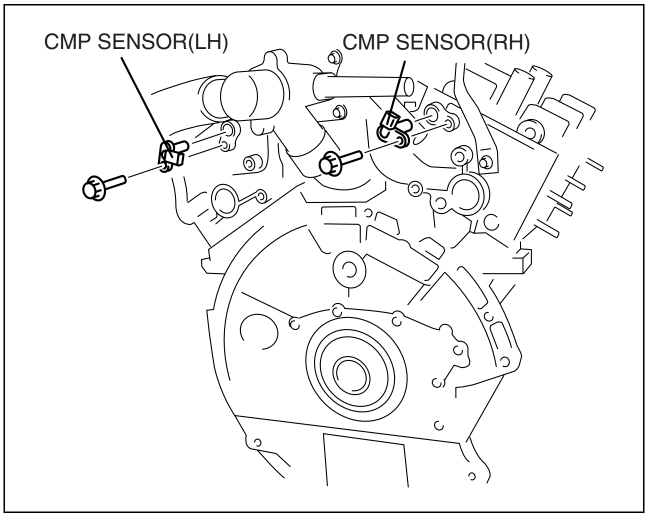
id0140c1177600

- The CMP sensor detects the position of the camshaft.

CAMSHAFT POSITION (CMP) SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1177500

- The CMP sensor identifies when piston No.1 is on its compression stroke.
- A signal is then sent to the PCM and used for synchronizing the sequential firing of the fuel injectors.
- Coil-on-plug ignition applications use the CMP signal to select the correct ignition coil to fire.
- Vehicles with 2 CMP sensors are equipped with variable camshaft timing.
- The CMP sensors use the second sensor to identify the position of the camshaft (LH) as an input to the PCM.



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HEATED OXYGEN SENSOR (HO2S) FUNCTION [MZI-3.5]

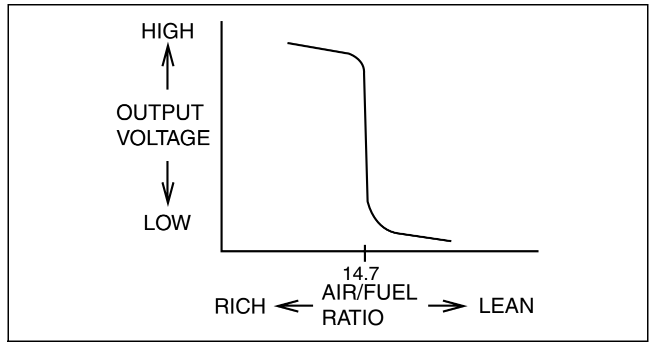
id0140c1178300

- Detects the oxygen concentration in the exhaust gas.
- A heater has been adopted to stabilize oxygen concentration detection even when the exhaust gas temperature is low.

HEATED OXYGEN SENSOR (HO2S) CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1178400

- Installed in front of the catalytic converter.
- The built-in heater promotes activation of the heated oxygen sensor at engine start (when exhaust gas is at low temperature).
- A zirconium element is used on the sensor. When there is a difference between the oxygen concentration on either side of the element, electromotive force is generated by the movement of oxygen ions (atmospheric air on the inner side of the zirconium element, exhaust gas on the outer side). The electromotive force changes significantly at the boundary of the stoichiometric air/fuel ratio (A/ F=14.7). The PCM inputs 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.



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- When the temperature of the zirconium element is low, electromotive force is not generated so the element is heated by a built-in heater, promoting the oxygen sensor activation. Due to this, the sensor is efficiently activated even immediately after cold-engine start, and a stable sensor output can be obtained.

THROTTLE POSITION (TP) SENSOR FUNCTION [MZI-3.5]

id0140c1178600

- Detects the throttle valve opening angle.

THROTTLE POSITION (TP) SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1178500

- The TP sensor is a rotary potentiometer sensor that provides a signal to the PCM that is linearly proportional to the throttle plate/shaft position.
- The TP sensor is mounted on the throttle body.
- As the TP sensor is rotated by the throttle shaft, 4 operating conditions are determined by the PCM from the TP.
  The operating conditions
  — Closed throttle (includes idle or deceleration)
  — Part throttle (includes cruise or moderate acceleration)
  — Wide open throttle (includes maximum acceleration or de-choke on crank)
  — Throttle angle rate

CYLINDER HEAD TEMPERATURE (CHT) SENSOR FUNCTION [MZI-3.5]

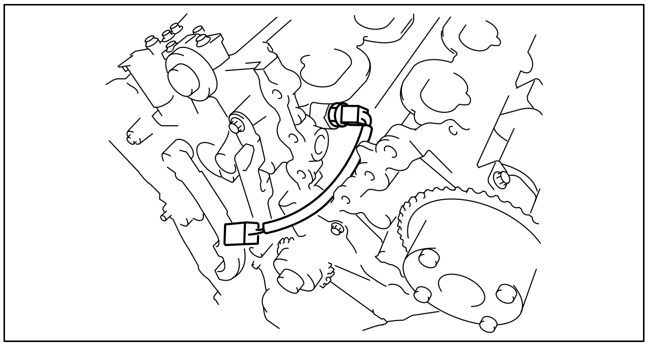
id0140c1205500

- Detects the cylinder head temperature.

CYLINDER HEAD TEMPERATURE (CHT) SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1205600

- The CHT sensor is Installed to the cylinder head.
- The CHT sensor is a thermistor device in which resistance changes with the temperature.
- The CHT sensor provides engine cylinder head temperature information, and the signal is used by the PCM to estimate the engine coolant temperature.
- The CHT sensor is a thermistor type sensor in which the resistance changes according to the cylinder head temperature.



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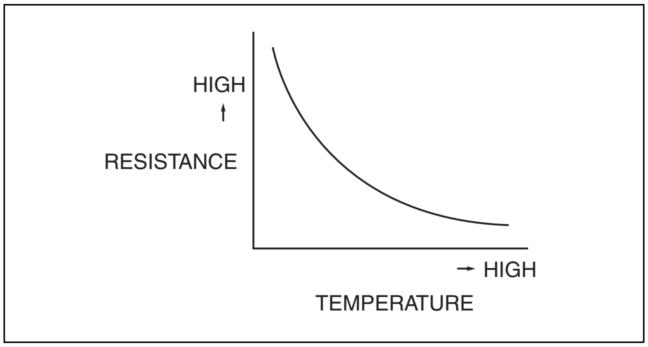
- The resistance decreases if the cylinder head temperature increases, and conversely increases if the cylinder head temperature decreases.



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FUEL TANK PRESSURE SENSOR FUNCTION [MZI-3.5]

id0140c1205700

- The fuel tank pressure sensor detects the fuel tank pressure.

FUEL TANK PRESSURE SENSOR CONSTRUCTION/OPERATION [MZI-3.5]

id0140c1205800

- The fuel tank pressure sensor is equipped to the evaporative hose between the fuel tank and charcoal canister.

SUSPENSION

02 SECTION

02-00 OUTLINE

SUSPENSION ABBREVIATIONS

id020000100100

AWD	All Wheel Drive
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
2WD	2-wheel Drive

SUSPENSION FEATURES

id020000100200

Improved rigidity and handling stability	• Strut type front suspension and E-type multi-link rear suspension adopted
Improved handling and riding comfort	• Six-point rubber mount system front crossmember adopted • Front shock absorber with large bore piston adopted • Front spring layout optimized • Separated input type front shock absorber mount adopted • Ball-type strut bearings adopted on the front strut upper mount
Enlarged trunk compartment	• Separated positioning of rear shock absorber and coil spring adopted
Improved marketability	• 20 inch wheel and tire adopted • 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

id020000100300

Suspension

<table>
<tr><th colspan="5" rowspan="2">Item</th><th colspan="2">Specification</th></tr>
<tr><th>2WD</th><th>AWD</th></tr>
<tr><td rowspan="12">Front suspension</td><td colspan="4">Type</td><td colspan="2">Strut type</td></tr>
<tr><td colspan="4">Spring type</td><td colspan="2">Coil spring</td></tr>
<tr><td colspan="4">Shock absorber type</td><td colspan="2">Low-pressure gas charged, cylindrical, double-acting</td></tr>
<tr><td rowspan="2">Stabilizer</td><td colspan="3">Type</td><td colspan="2">Torsion bar</td></tr>
<tr><td colspan="2">Diameter</td><td>(mm {in})</td><td>31 {1.22}</td><td>32 {1.25}</td></tr>
<tr><td rowspan="7">Wheel alignment (Unloaded*1)</td><td rowspan="2">Total toe-in</td><td>Tire [Tolerance ±4 {0.16}]</td><td>(mm {in})</td><td colspan="2">2 {0.08}</td></tr>
<tr><td colspan="2">Degree</td><td colspan="2">0°09′±18′</td></tr>
<tr><td colspan="2" rowspan="2">Maximum steering angle [Tolerance ±3°]</td><td>Inner</td><td colspan="2">38°00′</td></tr>
<tr><td>Outer</td><td colspan="2">32°00′</td></tr>
<tr><td colspan="3">Caster angle*2 (Reference) [Tolerance ±1°]</td><td>3°04′</td><td>3°05′</td></tr>
<tr><td colspan="3">Camber angle*2 (Reference) [Tolerance ±1°]</td><td colspan="2">-0°21′</td></tr>
<tr><td colspan="3">Steering axis inclination (Reference)</td><td colspan="2">11°35′</td></tr>
<tr><td rowspan="9">Rear suspension</td><td colspan="4">Type</td><td colspan="2">Multi-link</td></tr>
<tr><td colspan="4">Spring type</td><td colspan="2">Coil spring</td></tr>
<tr><td colspan="4">Shock absorber type</td><td colspan="2">Low-pressure gas charged, cylindrical, double-acting</td></tr>
<tr><td rowspan="2">Stabilizer</td><td colspan="3">Type</td><td colspan="2">Torsion bar</td></tr>
<tr><td colspan="2">Diameter</td><td>(mm {in})</td><td>16 {0.63}</td><td>18 {0.71}</td></tr>
<tr><td rowspan="4">Wheel alignment (Unloaded*1)</td><td rowspan="2">Total toe-in</td><td>Tire [Tolerance ±4 {0.16}]</td><td>(mm {in})</td><td colspan="2">2 {0.08}</td></tr>
<tr><td colspan="2">Degree</td><td colspan="2">0°09′±18′</td></tr>
<tr><td colspan="3">Camber angle*2 [Tolerance ±1°]</td><td>-0°32′</td><td>-0°33′</td></tr>
<tr><td colspan="3">Thrust angle [Tolerance ±48′]</td><td colspan="2">0°</td></tr>
</table>

*1 : Unloaded: Fuel tank is full. Engine coolant and engine oil are at specified level. Spare tire, jack and tools are in designated position.
*2 : Difference between left and right not exceed 1°30′.

Wheel and Tire

Standard tire

<table>
<tr><th colspan="3">Item</th><th colspan="2">Specification</th></tr>
<tr><td>Tire</td><td colspan="2">Size</td><td>P245/60R18 104H</td><td>P245/50R20 102V</td></tr>
<tr><td rowspan="4">Wheel</td><td colspan="2">Size</td><td>18 x 7 1/2J</td><td>20 x 7 1/2J</td></tr>
<tr><td colspan="2">Material</td><td colspan="2">Aluminum alloy</td></tr>
<tr><td>Offset</td><td>(mm {in})</td><td colspan="2">45 {1.8}</td></tr>
<tr><td>Pitch circle diameter</td><td>(mm {in})</td><td colspan="2">114.3 {4.50}</td></tr>
</table>

Temporary spare tire

Item			Specification
Tire	Size		T155/90D18
Wheel	Size		18 x 4T
	Material		Steel
	Offset	(mm {in})	40 {1.57}
	Pitch circle diameter	(mm {in})	114.3 {4.50}

02-02 ON-BOARD DIAGNOSTIC

02-02

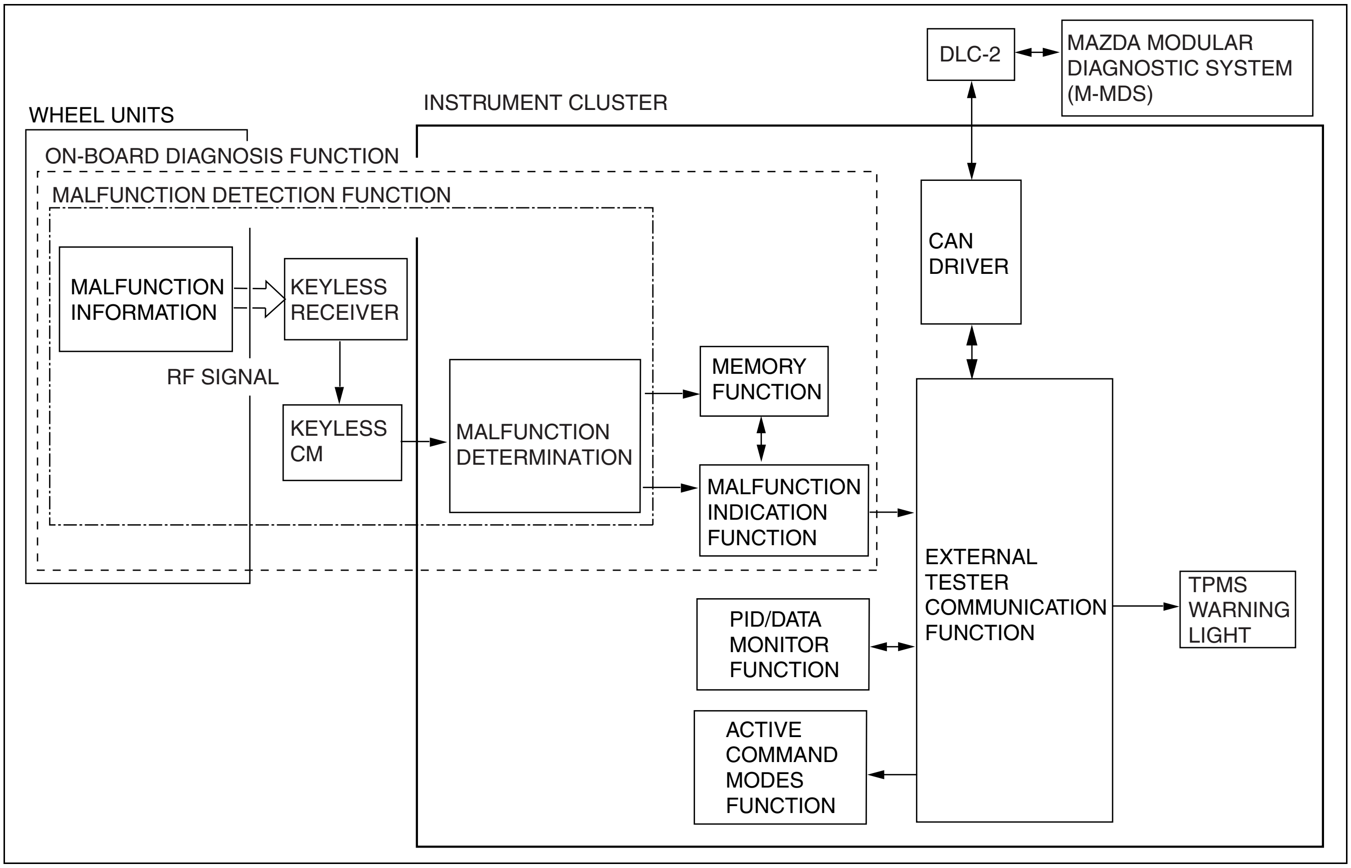
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE (TIRE PRESSURE MONITORING SYSTEM)

id020200100100

- 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 an active command modes function that execuse the wheel unit ID registration.
- 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 Mazda Modular Diagnostic System (M-MDS) to the DLC-2.
- In addition to DTC read-out, the Mazda Modular Diagnostic System (M-MDS) 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

With advanced keyless system



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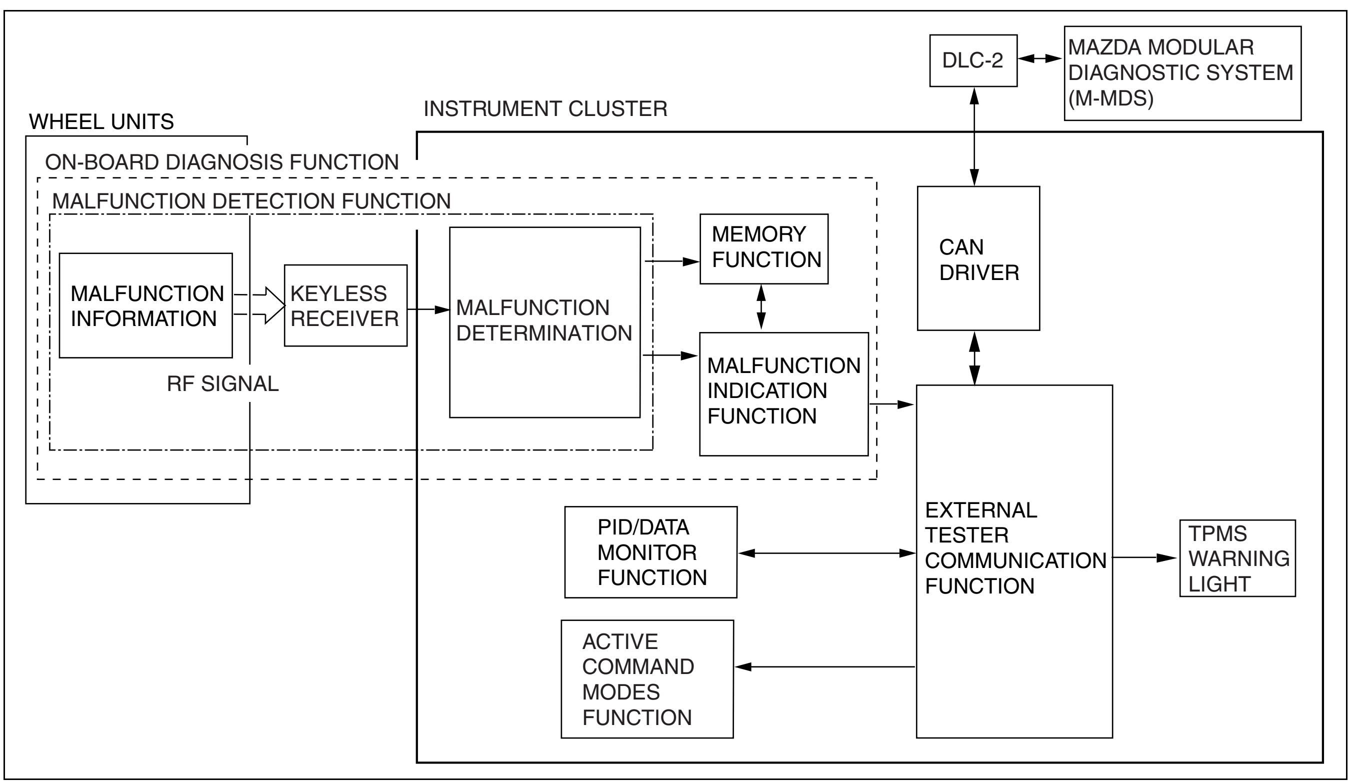
With keyless entry system



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ON-BOARD DIAGNOSTIC SYSTEM FUNCTION (TIRE PRESSURE MONITORING SYSTEM)

id020200100200

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 in 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.

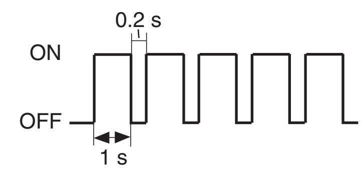
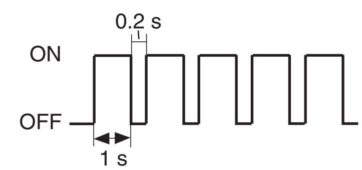
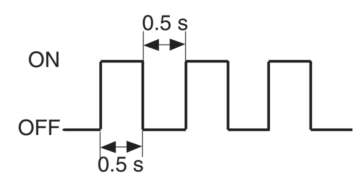
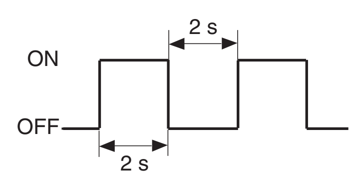
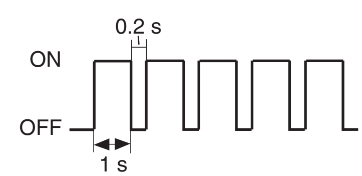
Malfunction Indication Function

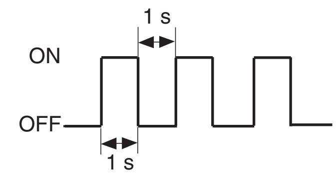
- When the malfunction detection function detects a malfunction, the TPMS warning light illuminates to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the CAN communication line. At the same time, malfunction detection results are sent to the memory 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 instrument cluster 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	TPMS warning light illumination condition	TPMS warning light illumination pattern
Instrument cluster	B1342	Illuminated	
Non-volatile memory failure	B2143	Illuminated	
System configuration malfunction	B2477	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	
Lost communication with keyless receiver	U0127	Illuminated	

Malfunction location	DTC	TPMS warning light illumination condition	TPMS warning light illumination pattern
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)

id020200100300

- 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 (Mazda Modular Diagnostic System (M-MDS))
AI_WU1_ID	Candidate wheel unit during registering wheel unit ID (wheel unit 1)	–
AI_WU2_ID	Candidate wheel unit during registering wheel unit ID (wheel unit 2)	–
AI_WU3_ID	Candidate wheel unit during registering wheel unit ID (wheel unit 3)	–
AI_WU4_ID	Candidate wheel unit during registering wheel unit ID (wheel unit 4)	–
AI_WU1_P	Tire pressure during registering wheel unit ID (wheel unit 1)	Pa, psi
AI_WU2_P	Tire pressure during registering wheel unit ID (wheel unit 2)	Pa, psi
AI_WU3_P	Tire pressure during registering wheel unit ID (wheel unit 3)	Pa, psi
AI_WU4_P	Tire pressure during registering wheel unit ID (wheel unit 4)	Pa, psi
FFD1_WU1_P	Freeze frame PID data1_tire pressure (wheel unit 1)	Pa, psi
FFD1_WU2_P	Freeze frame PID data1_tire pressure (wheel unit 2)	Pa, psi
FFD1_WU3_P	Freeze frame PID data1_tire pressure (wheel unit 3)	Pa, psi
FFD1_WU4_P	Freeze frame PID data2_tire pressure (wheel unit 4)	Pa, psi
FFD2_WU1_P	Freeze frame PID data2_tire pressure (wheel unit 1)	Pa, psi
FFD2_WU2_P	Freeze frame PID data2_tire pressure (wheel unit 2)	Pa, psi
FFD2_WU3_P	Freeze frame PID data2_tire pressure (wheel unit 3)	Pa, psi
FFD2_WU4_P	Freeze frame PID data2_tire pressure (wheel unit 4)	Pa, psi
FFD1_WU1_T	Freeze frame PID data1_tire temperature (wheel unit 1)	°C, °F
FFD1_WU2_T	Freeze frame PID data1_tire temperature (wheel unit 2)	°C, °F
FFD1_WU3_T	Freeze frame PID data1_tire temperature (wheel unit 3)	°C, °F
FFD1_WU4_T	Freeze frame PID data2_tire temperature (wheel unit 4)	°C, °F
FFD2_WU1_T	Freeze frame PID data2_tire temperature (wheel unit 1)	°C, °F
FFD2_WU2_T	Freeze frame PID data2_tire temperature (wheel unit 2)	°C, °F
FFD2_WU3_T	Freeze frame PID data2_tire temperature (wheel unit 3)	°C, °F
FFD2_WU4_T	Freeze frame PID data2_tire temperature (wheel unit 4)	°C, °F
FFD1_MLG	Freeze frame PID data1 mileage	m, mi (ft)
FFD2_MLG	Freeze frame PID data2 mileage	m, mi (ft)
FFD1_SPD	Freeze flame PID data1_speed	KPH, MPH
FFD2_SPD	Freeze flame PID data2_speed	KPH, MPH
IC_DTC_CNT	Number of continuous DTCs	–

PID name	Description (Input/output part)	Operation/unit (Mazda Modular Diagnostic System (M-MDS))
ID_WU1*	Registered wheel unit ID (Wheel unit 1)	–
ID_WU2*	Registered wheel unit ID (Wheel unit 2)	–
ID_WU3*	Registered wheel unit ID (Wheel unit 3)	–
ID_WU4*	Registered wheel unit ID (Wheel unit 4)	–
ID_LAST	Last received tire transmitter ID code value	–
WU1_P*	Tire pressure (wheel unit 1)	Pa, psi
WU2_P*	Tire pressure (wheel unit 2)	Pa, psi
WU3_P*	Tire pressure (wheel unit 3)	Pa, psi
WU4_P*	Tire pressure (wheel unit 4)	Pa, psi
WU1_T*	Tire temperature (wheel unit 1)	°C, °F
WU2_T*	Tire temperature (wheel unit 2)	°C, °F
WU3_T*	Tire temperature (wheel unit 3)	°C, °F
WU4_T*	Tire temperature (wheel unit 4)	°C, °F

* : 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 ID_LAST, and tire pressure and internal tire air temperature data are erased when the instrument cluster connector and the battery terminal are disconnected. If the instrument cluster 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 ACTIVE COMMAND MODES FUNCTION (TIRE PRESSURE MONITORING SYSTEM)

id020200100400

- The active command modes function is used for executing the wheel unit ID registration

Command name	Description	Operation	Operation condition
IDR_MODE	Wheel unit ID registration	Off/On	Ignition switch at ON

ON-BOARD DIAGNOSTIC SYSTEM FREEZE FRAME DATA MONITOR FUNCTION (TIRE PRESSURE MONITORING SYSTEM)

id020200100500

- The Freeze Frame Data monitor items are shown below.

Freeze frame data monitor table

PID name	Description	Operation/unit (Mazda Modular Diagnostic System (M-MDS))
FFD1_WU1_P	Freeze frame PID data1_tire pressure (wheel unit 1)	Pa, psi
FFD1_WU2_P	Freeze frame PID data1_tire pressure (wheel unit 2)	Pa, psi
FFD1_WU3_P	Freeze frame PID data1_tire pressure (wheel unit 3)	Pa, psi
FFD1_WU4_P	Freeze frame PID data1_tire pressure (wheel unit 4)	Pa, psi
FFD2_WU1_P	Freeze frame PID data2_tire pressure (wheel unit 1)	Pa, psi
FFD2_WU2_P	Freeze frame PID data2_tire pressure (wheel unit 2)	Pa, psi
FFD2_WU3_P	Freeze frame PID data2_tire pressure (wheel unit 3)	Pa, psi
FFD2_WU4_P	Freeze frame PID data2_tire pressure (wheel unit 4)	Pa, psi
FFD1_WU1_T	Freeze frame PID data1_tire temperature (wheel unit 1)	°C, °F
FFD1_WU2_T	Freeze frame PID data1_tire temperature (wheel unit 2)	°C, °F
FFD1_WU3_T	Freeze frame PID data1_tire temperature (wheel unit 3)	°C, °F
FFD1_WU4_T	Freeze frame PID data2_tire temperature (wheel unit 4)	°C, °F
FFD2_WU1_T	Freeze frame PID data2_tire temperature (wheel unit 1)	°C, °F
FFD2_WU2_T	Freeze frame PID data2_tire temperature (wheel unit 2)	°C, °F
FFD2_WU3_T	Freeze frame PID data2_tire temperature (wheel unit 3)	°C, °F
FFD2_WU4_T	Freeze frame PID data2_tire temperature (wheel unit 4)	°C, °F
FFD1_MLG	Freeze frame PID data1 mileage	m, mi (ft)
FFD2_MLG	Freeze frame PID data2 mileage	m, mi (ft)
FFD1_SPD	Freeze flame PID data1_speed	KPH, MPH
FFD2_SPD	Freeze flame PID data2_speed	KPH, MPH

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

id020200100600

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 instrument cluster and an external tester.

Connection and communication information

	External tester	
	Mazda Modular Diagnostic System (M-MDS)	
	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
Active command modes function	Input/output: CAN communication line	Serial communication

02-02

Serial Communication

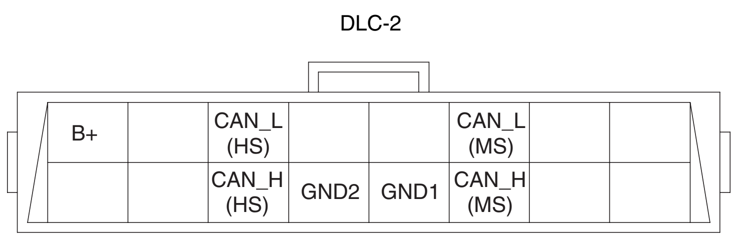
- Serial communication (synchronous communication) is a method of communication in which many pieces of information are sent and received instantaneously through a single wire.
- By connecting the Mazda Modular Diagnostic System (M-MDS) to DLC-2, diagnostic information can be sent and received between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

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
Active command modes function	Operation command signal for selected active command modes item	Wheel unit ID registration

DLC-2 CONSTRUCTION

id020200100700

- A DLC-2 connector conforming to ISO (International Organization for Standardization) 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.



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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 ground terminal
GND2	Serial communication ground terminal
B+	Battery power supply terminal

02-12 WHEEL AND TIRES

WHEELS AND TIRES OUTLINE

id021200100100

- 18 inch and 20 inch aluminum alloy wheel have been adopted.
- An adhesive-type balance weight is fastened on the outer side of the wheel. Since it is not visible from the styled side of the wheel, the design of the wheel is favored.
- In consideration of the environment, a balance weight made of steel has been adopted to reduce amount of lead used in the vehicle.

WHEELS AND TIRES STRUCTURAL VIEW

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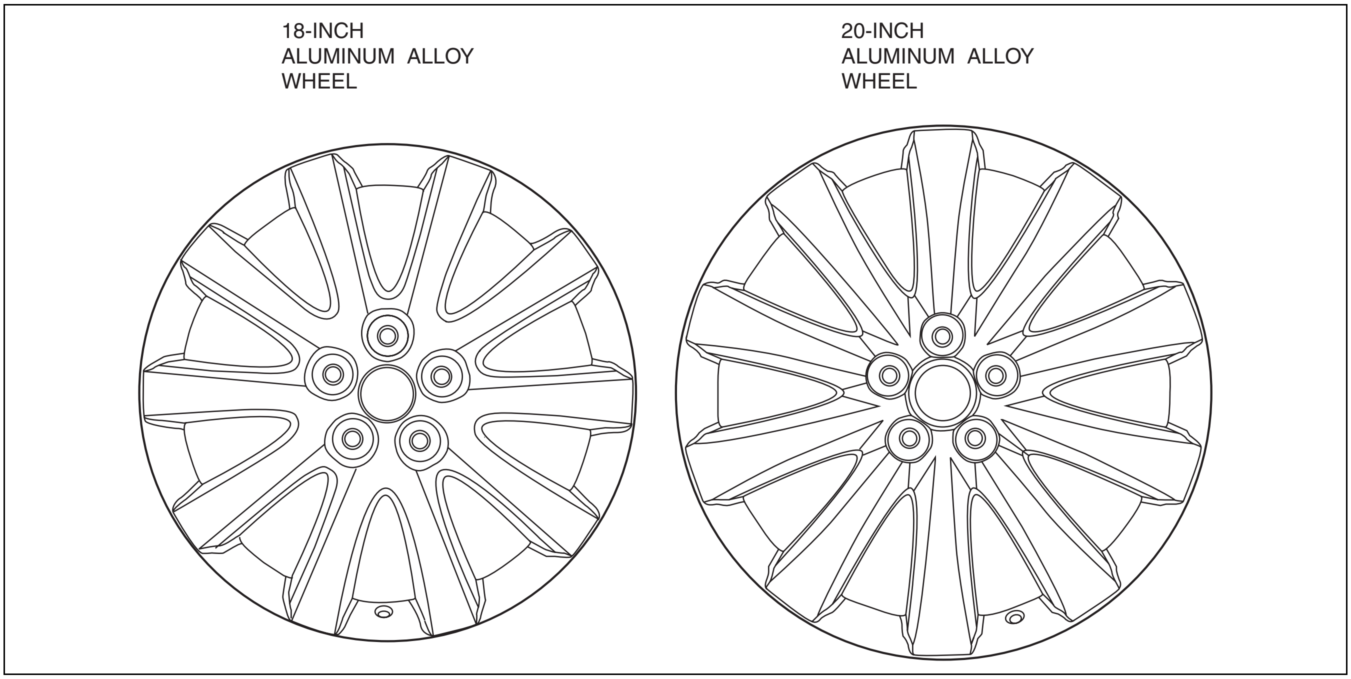

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TIRE PRESSURE MONITORING SYSTEM (TPMS) OUTLINE

id021200100400

- 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 there is an excessive drop in air pressure or a flat tire is detected.

Caution

- **Each wheel unit has its own preset identification code. If a system component is replaced, the system becomes inoperative since the instrument cluster 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**
  - **— Instrument cluster 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 {18 °F}**.

TIRE PRESSURE MONITORING SYSTEM (TPMS) STRUCTURAL VIEW

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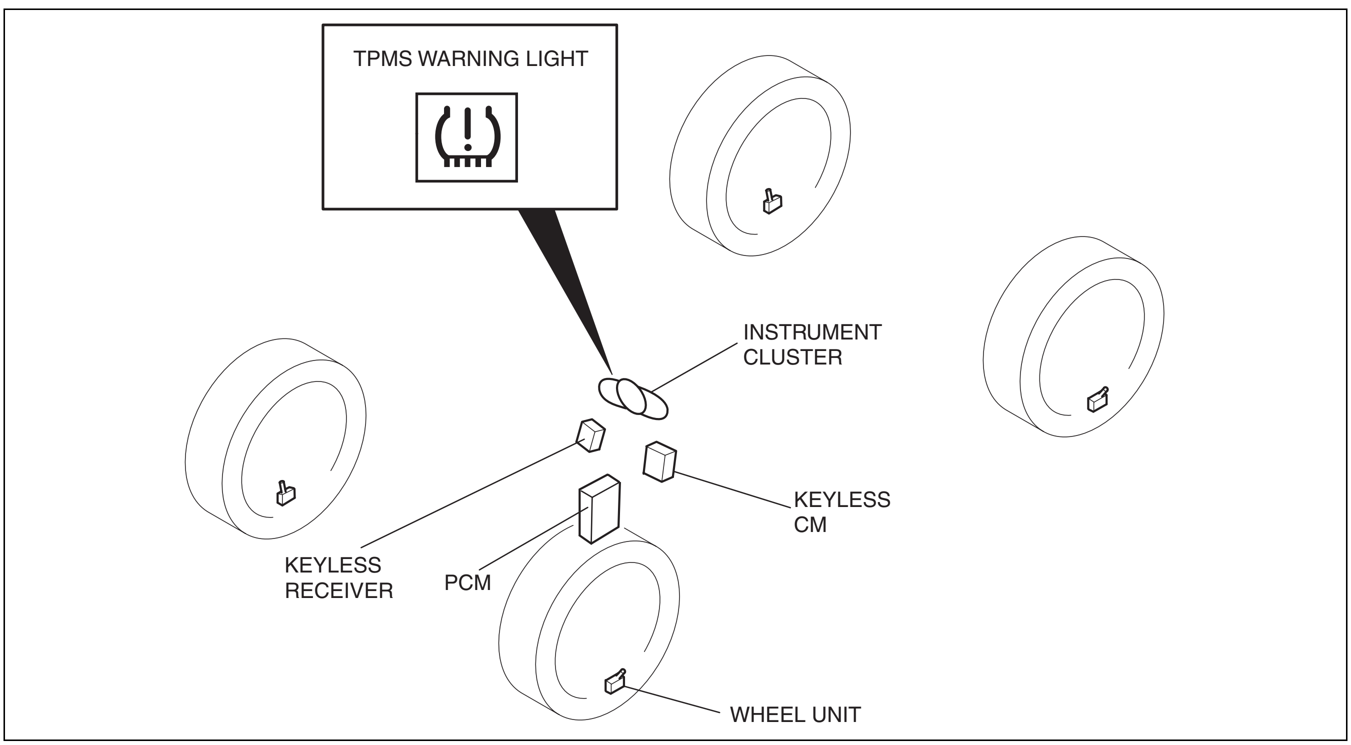

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TIRE PRESSURE MONITORING SYSTEM (TPMS) WIRING DIAGRAM

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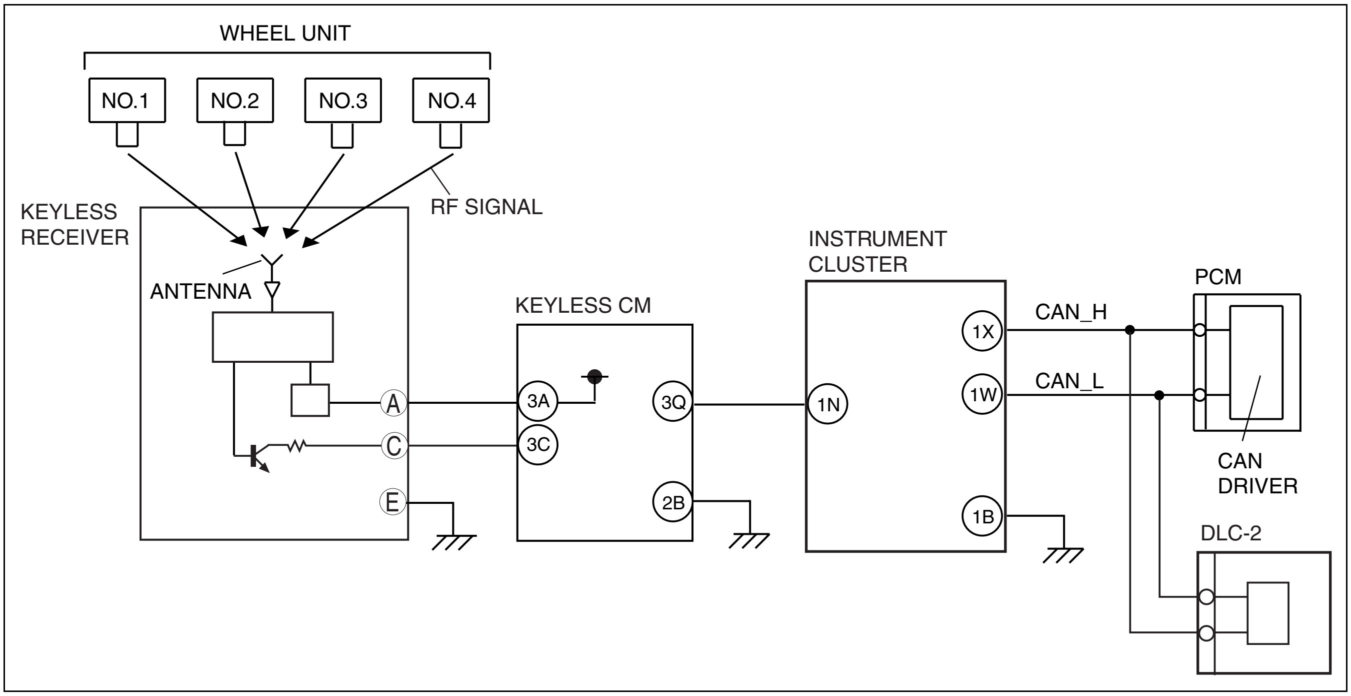
With Advanced Keyless System



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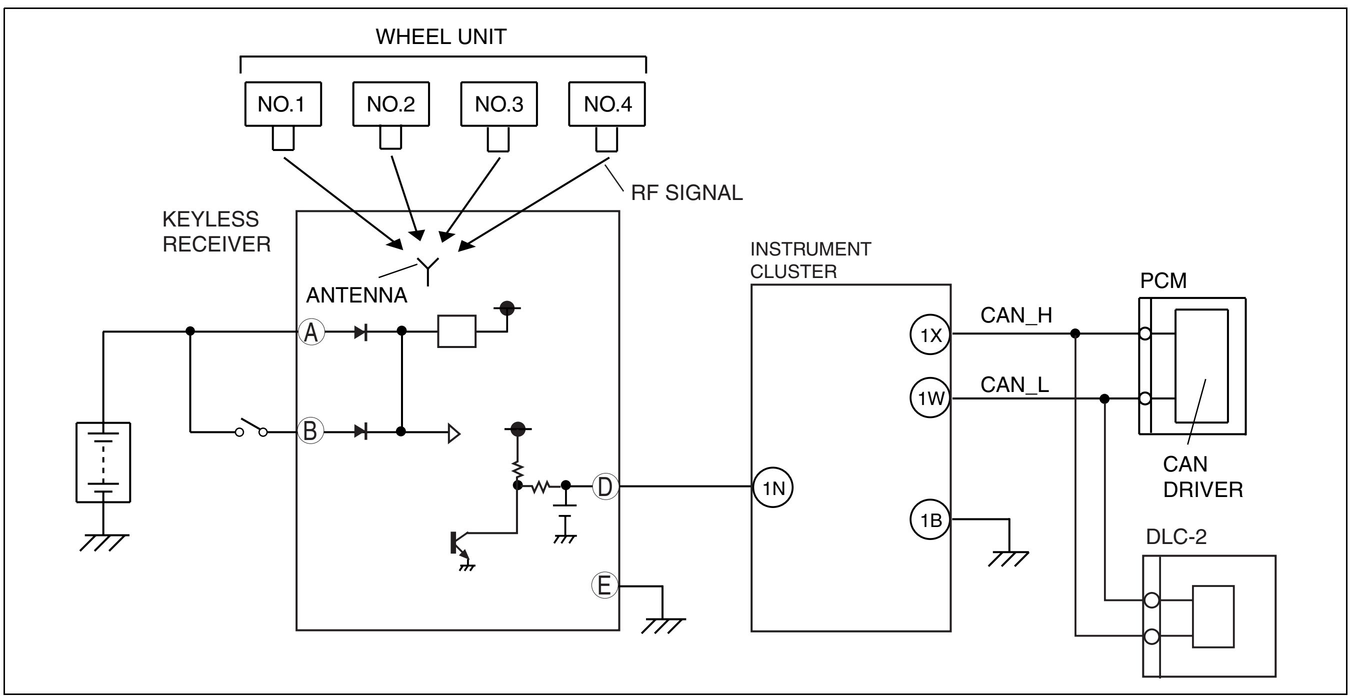
With Keyless Entry System



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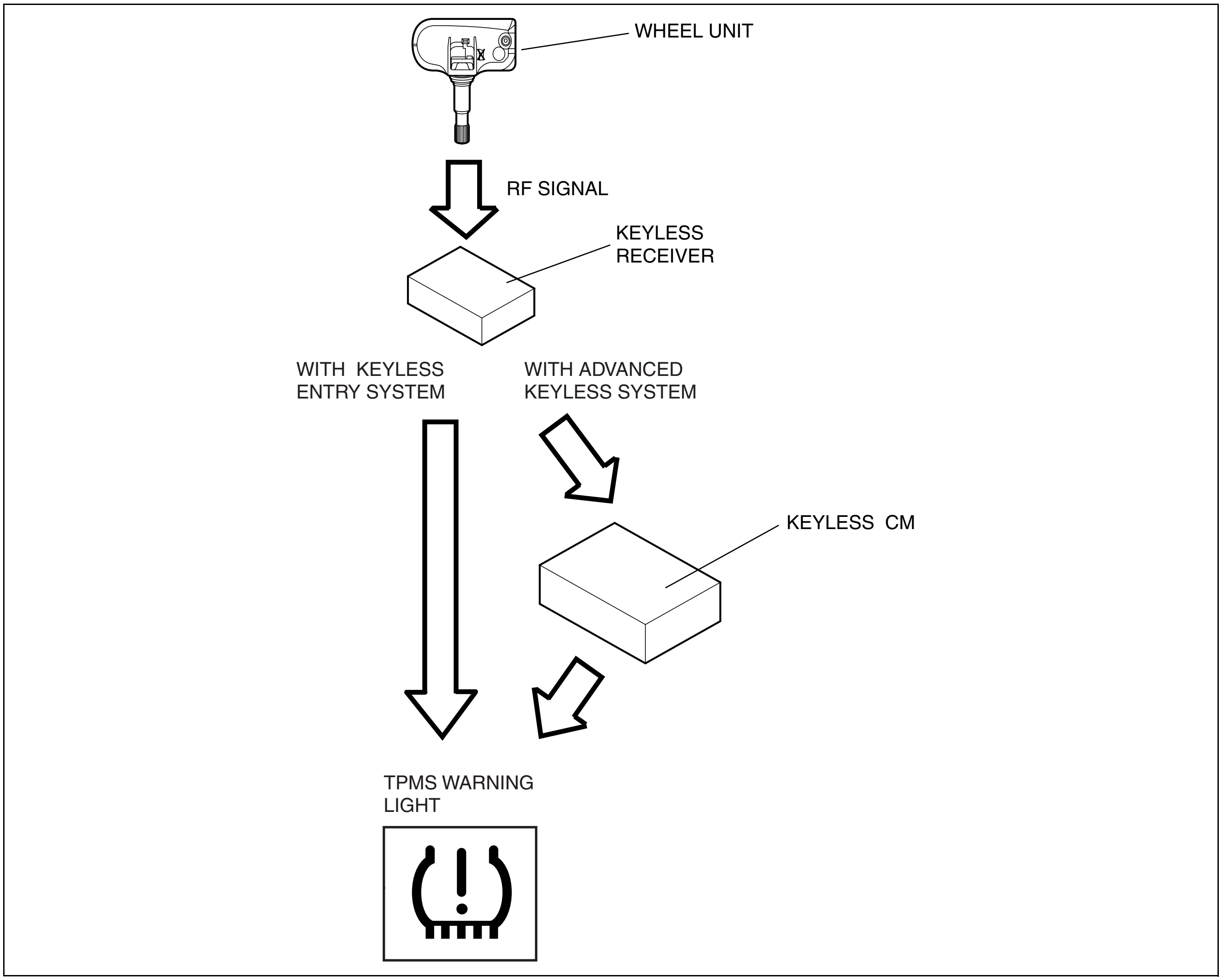
TIRE PRESSURE MONITORING SYSTEM (TPMS) CONSTRUCTION/OPERATION

id021200100700

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.



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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 keyless receiver receives these signals with a built-in antenna.
- With advanced keyless system: Signals received by the keyless receiver are transmitted to the instrument cluster via the keyless CM.
- With keyless entry system: Signals received by the keyless receiver are transmitted to the instrument cluster.
- The instrument cluster monitors the air pressure of each tire based on the tire data sent from each wheel unit. If the instrument cluster detects an excessive drop in air pressure or flat tire, the instrument cluster illuminates the TPMS warning light.

Component Parts/Function

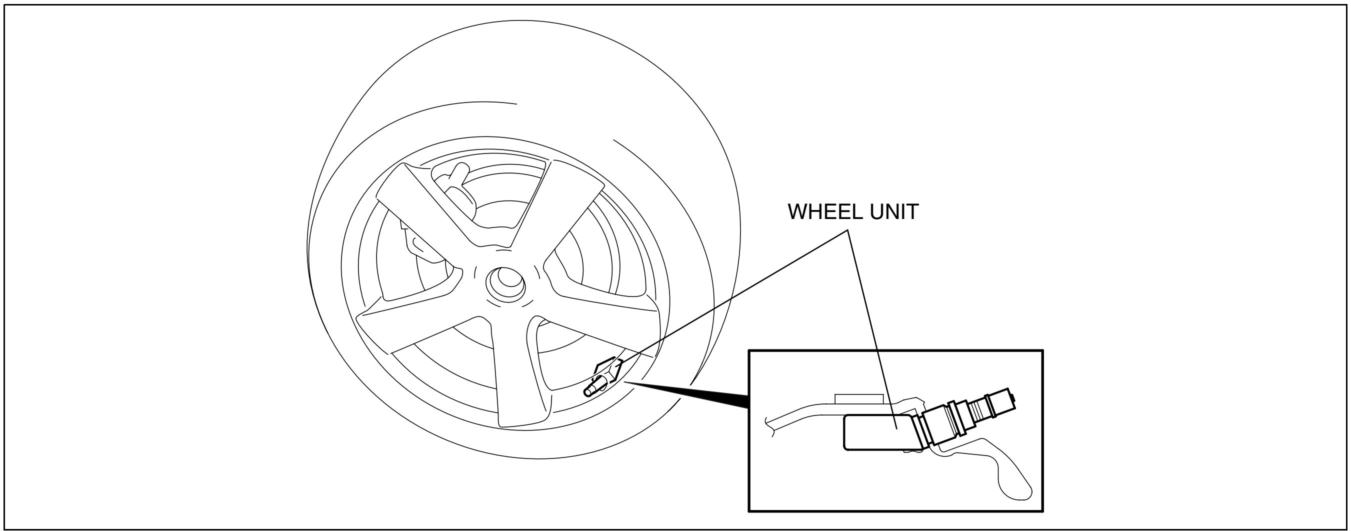
Part name		Function
Wheel unit		• Monitors air pressure, temperature, and acceleration of each tire, and sends RF signals. • Sends data if any abnormality is detected in the wheel unit.
Keyless receiver		• With advanced keyless system: Send the RF signals received from the wheel unit to the keyless CM. • With keyless entry system: Send the RF signals received from the wheel unit to the instrument cluster.
Keyless CM (with advanced keyless system)		• Receives data from the keyless receiver. • Sends data to the instrument cluster.
PCM	Vehicle speed signal	• Inputs vehicle speed signals to the instrument cluster via CAN communication.
Instrument cluster		• Receives data from keyless CM (with advanced keyless system) or keyless receiver (with keyless entry system) and monitor the air pressure of each wheel. If it determines from those signals that tire pressure is abnormal, it controls the TPMS warning light to alert the driver.
	TPMS warning light	• If the instrument cluster detects abnormal air pressure or any abnormality in the system, the light is illuminated to alert the driver.

WHEEL UNIT CONSTRUCTION/OPERATION

id021200100900

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.



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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 instrument cluster is replaced, the identification codes must be configured.

Sensing Function

- The sensing function periodically monitors the following data and sends it to the keyless receiver.
  - — Tire pressure
  - — Tire temperature
  - — Tire acceleration
  - — Voltage of the built-in battery
- Intervals of tire data monitoring and data transmission to the keyless receiver 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 keyless receiver.

TIRE PRESSURE MONITORING SYSTEM (TPMS) OPERATION

id021200101000

- The instrument cluster monitors the tire pressure of each tire and the wheel units for abnormalities using the received data. If any abnormality is found, it controls TPMS warning light to alert and notify the driver.
- The instrument cluster 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. If the pressure is determined to be too low, the instrument cluster alerts the driver via the TPMS warning light.

Identification Code Recognition Function

- Since the identification codes of wheel units mounted on the vehicle have been configured in the instrument cluster, the instrument cluster 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 signal. When the identification code does not agree, that signal data is ignored.

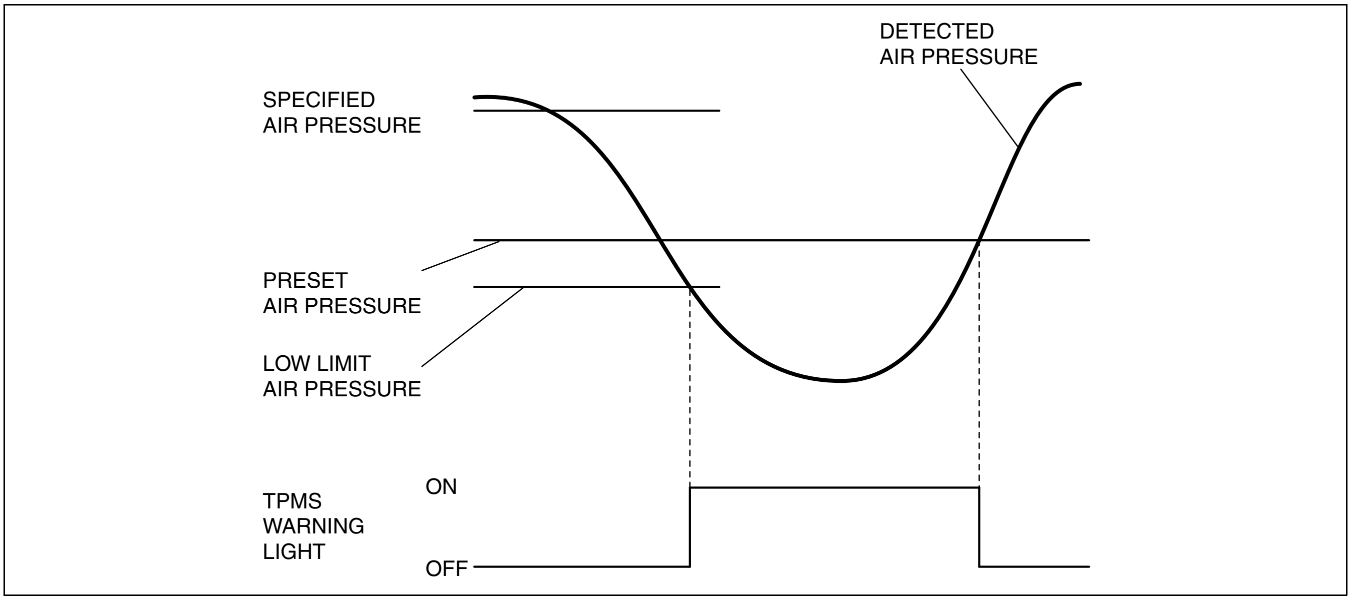
Tire Pressure Determination And Warning Function

- The instrument cluster determines the tire pressure status of each wheel by comparing tire pressure data received from the wheel units with the preset values in the instrument cluster.
- If a malfunction is detected in the received signals, the instrument cluster flashes the TPMS warning light to notify the driver of a tire malfunction.
- 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 is lower than the detection value configured in the instrument cluster, the instrument cluster 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 warning light is illuminated.
  — If low tire pressure is determined when the ignition is off, the instrument cluster performs an open-circuit check[*1] on the TPMS warning light after the ignition is turned on, and then illuminates the TPMS warning light.
- 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.



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TIRE PRESSURE MONITORING SYSTEM (TPMS) WARNING LIGHT CONSTRUCTION

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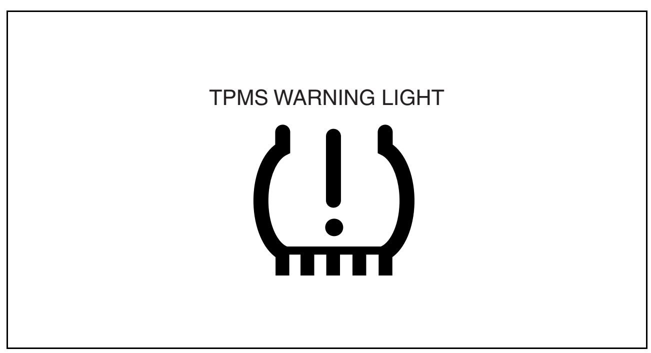
- The TPMS warning light is built into the instrument cluster.
- In the event of any abnormality in tire pressure or in the system, signals illuminate the warning light to alert the driver.



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CONTROLLER AREA NETWORK (CAN) OUTLINE

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- The instrument cluster receives information using the CAN system. See Section 09 for detailed information regarding the CAN system.

Received Information from PCM

- Vehicle speed

02-13 FRONT SUSPENSION

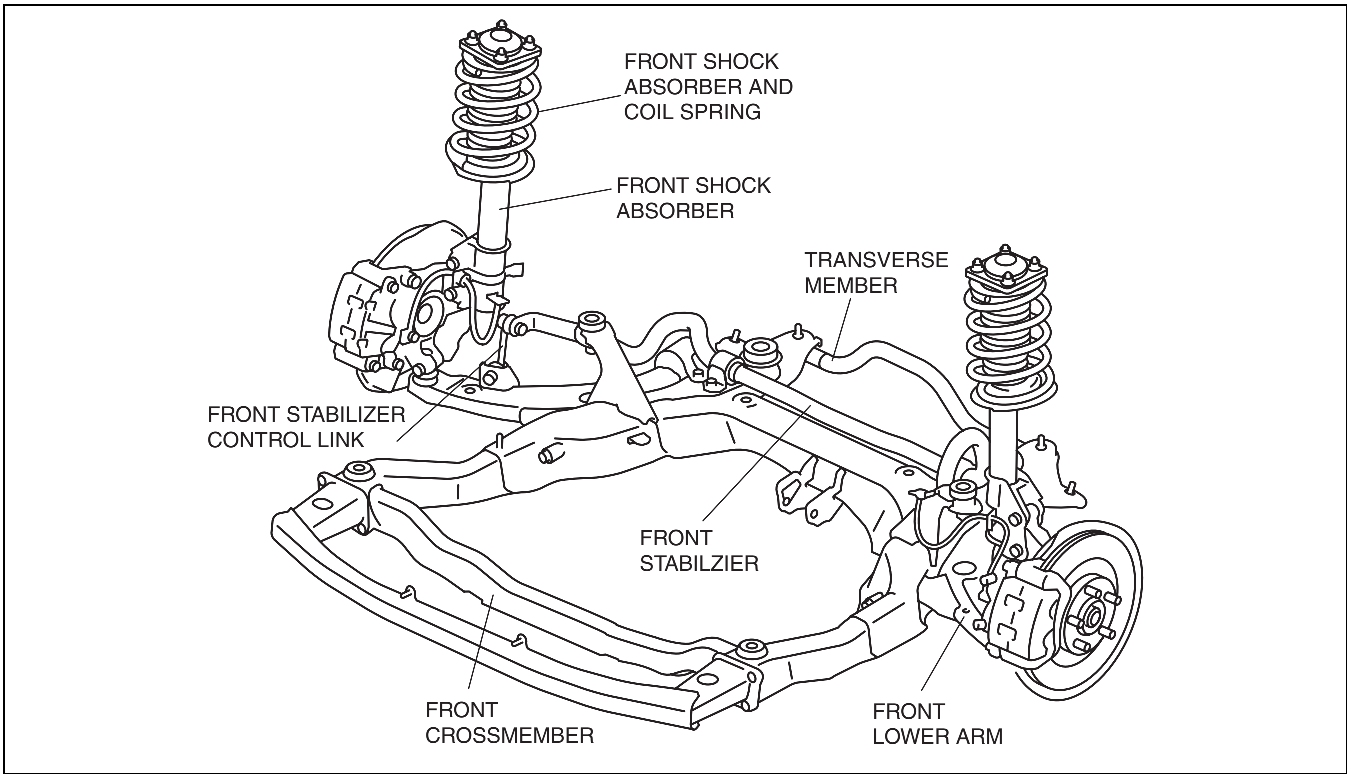
FRONT SUSPENSION OUTLINE

id021300100100

- A strut-type front suspension has been adopted.
- Due to the tight connection of the six-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

id021300100200



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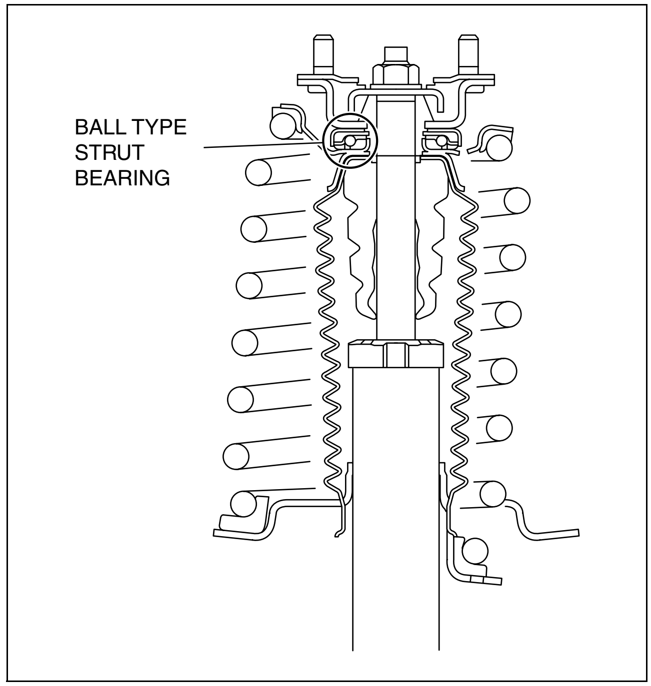
FRONT SHOCK ABSORBER CONSTRUCTION

id021300100500

- 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.
- To reduce shock absorber inner friction that occurs when lateral force acts on the shock absorbers, the coil springs have been optimally positioned.
- In addition, the adoption of ball bearings in the mount bearings has improved handling and ride comfort.



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FRONT CROSSMEMBER CONSTRUCTION

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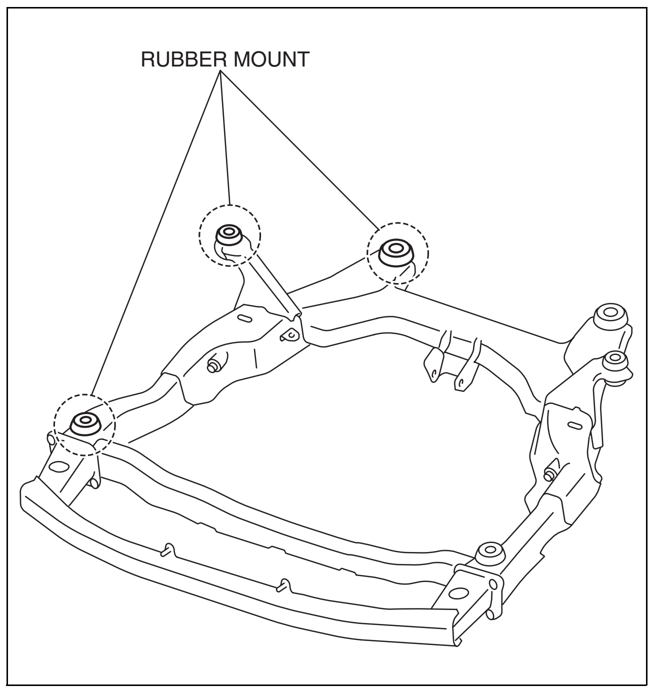
- A six-point rubber mount system has been adopted for the front crossmember. Due to this, the application of preload in the vertical direction has improved rigidity providing enhanced handling stability, and the utilization of horizontal flexibility has improved riding comfort.



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02-14 REAR SUSPENSION

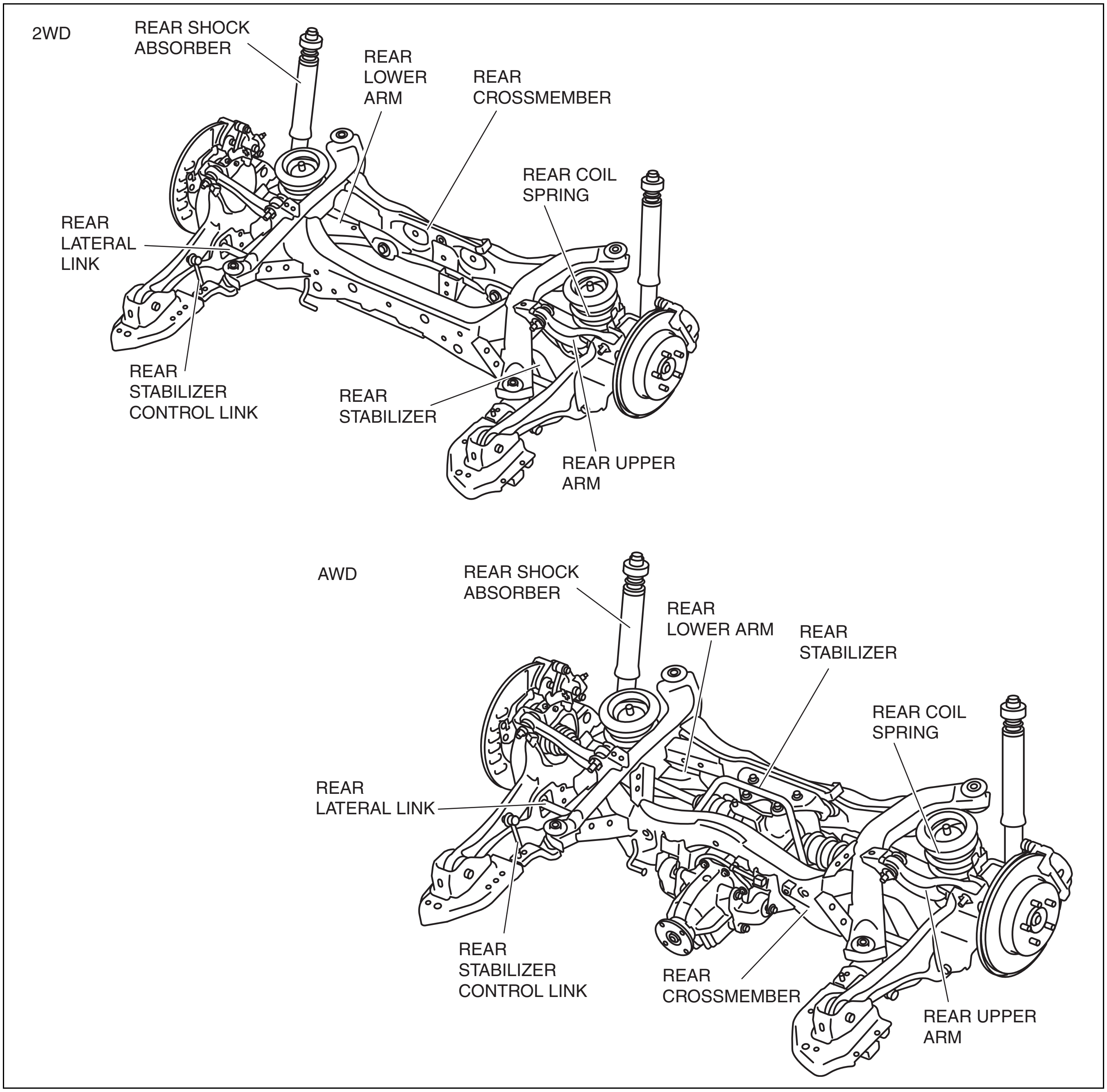
REAR SUSPENSION OUTLINE

id021400100100

- An E-type multi-link rear suspension has been adopted.
- Link layout has been optimized to control the rear wheel alignment appropriately against the external force.
- 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.
- Setting the trailing links at the front in a higher installation position controls nose dive during braking and has improved handling stability. As a result, tire road-hold has been improved, and excellent cornering performance and handling stability has been realized.

REAR SUSPENSION STRUCTURAL VIEW

id021400100200



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MULTI-LINK REAR SUSPENSION CONSTRUCTION

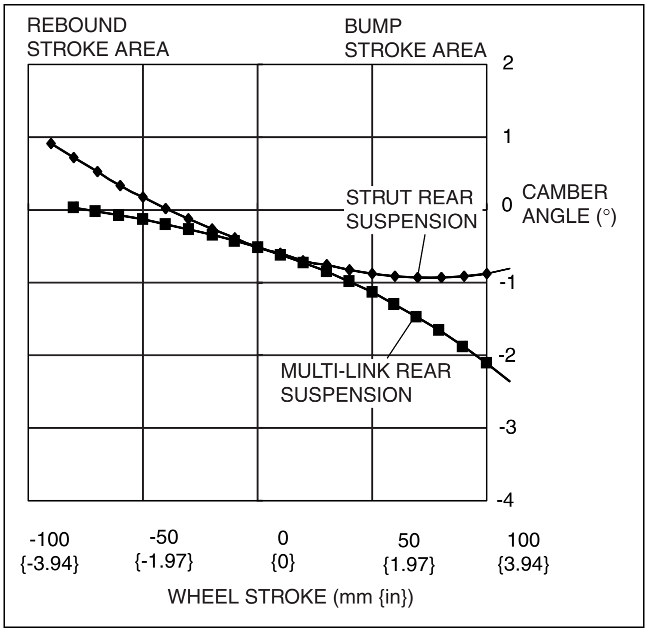
id021400100300

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



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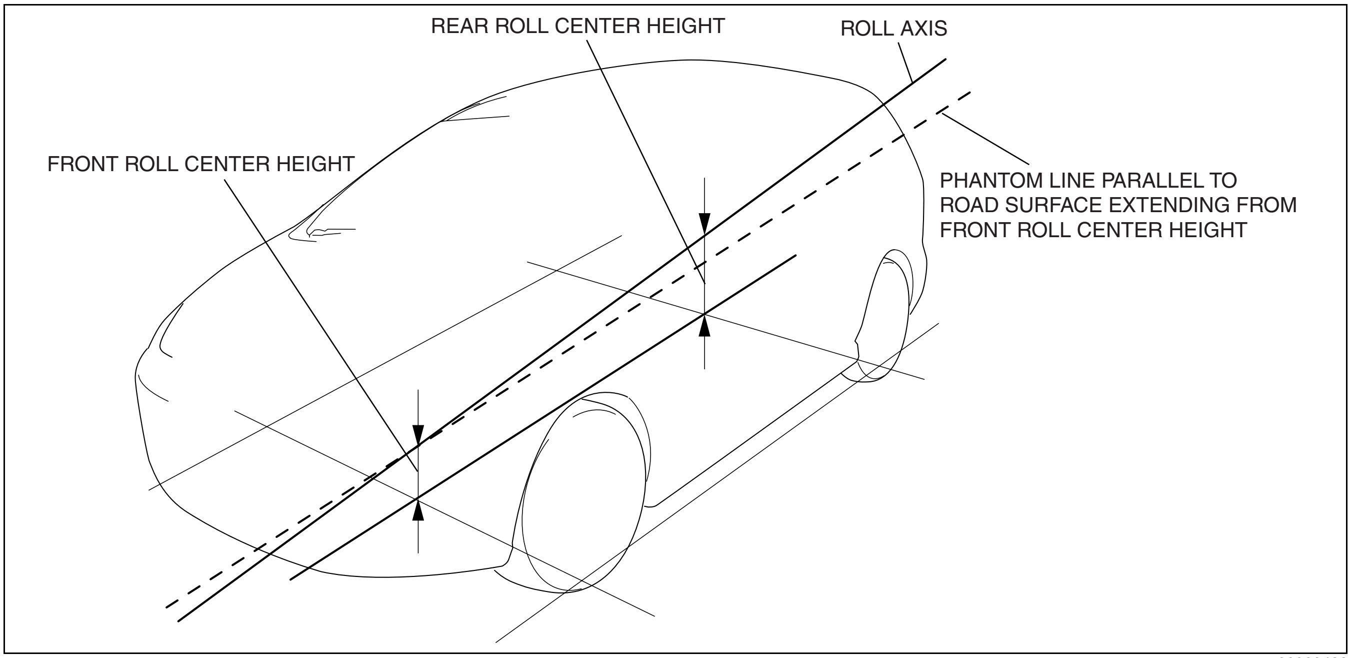
Optimized roll axis position

- 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.



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Improved roadholding

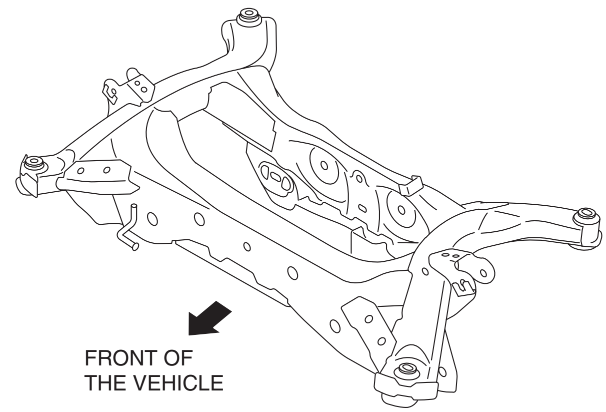
- The damper lever ratio has been set at approx. 1.2 to improve the efficiency of the shock absorber operation.
  — Damper lever ratio
  shock absorber stroke/wheel vertical stroke

REAR CROSSMEMBER CONSTRUCTION

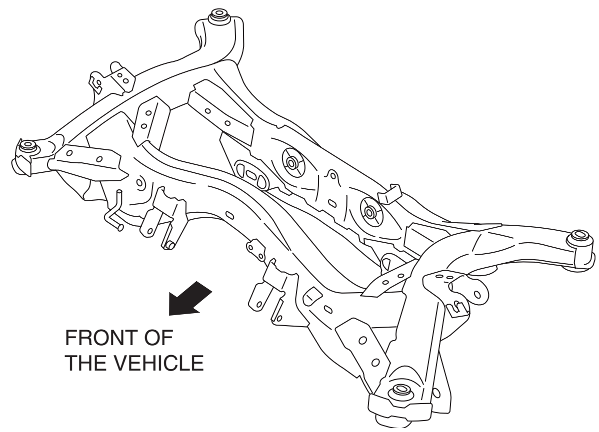
id021400100400

- 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 four points, ensuring high rigidity.

2WD



AWD



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DRIVELINE/AXLE

03 SECTION

03-00 OUTLINE

DRIVELINE/AXLE ABBREVIATIONS

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ABS	Antilock Brake System
AWD	All Wheel Drive
CAN	Controller Area Network
CM	Control Module
DSC	Dynamic Stability Control
HU	Hydraulic Unit
RSC	Roll Stability Control
2WD	2-wheel Drive

DRIVELINE/AXLE FEATURES

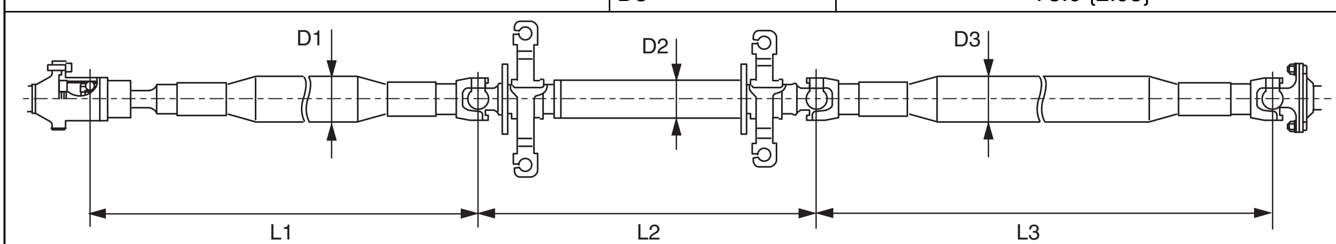
id030000100100

Improved driveability	• Bell-shaped constant velocity joint adopted for wheel-side joint of front and rear drive shaft • Tripod-shaped constant velocity joint adopted for differential-side joint of front drive shaft • Double offset-shaped constant velocity joint adopted for differential-side joint of rear drive shaft
Improved rigidity, reduced noise and vibration	• Characteristics of front drive shaft optimized • Constant velocity joint type rear drive shaft adopted (AWD) • 3-part, 4-joint type propeller shaft with middle shaft bearing has been adopted
Improved off-road mobility, handling stability and marketability	• Electronic AWD control system adopted
Size and weight reduction	• Rear differential with an integrated coupling component adopted • Aluminum differential carrier adopted
Improved serviceability	• Self diagnostic function adopted for electronic AWD control system • A maintenance-free transfer has been adopted

DRIVELINE/AXLE SPECIFICATIONS

id030000100200

Item			Specification
Front axle			
Bearing type			Angular ball bearing
Rear axle			
Bearing type			Angular ball bearing
Front drive shaft			
Front drive shaft joint type	Wheel side		Bell joint
	Differential side		Tripod joint
Front drive shaft diameter (mm {in})			LH: 27.0 {1.06} RH: 30.0 {1.18}
Joint shaft diameter (mm {in})			45.0 {1.77}
Rear drive shaft (AWD)			
Rear drive shaft joint type	Wheel side		Bell joint
	Differential side		Double offset joint
Rear drive shaft diameter (mm {in})			24.0 {0.94}
Rear differential (AWD)			
Rear and front wheel torque distribution unit			Electronic control coupling
Reduction gear			Hypoid gear
Differential gear			Straight bevel gear
Ring gear size (Inches)			7.35
Final gear ratio			2.928
Gears: Number of teeth		Drive pinion	14
		Ring gear	41
Differential oil	Type	Grade	API service GL-5
		Viscosity	SAE 80W-90
	Amount (Approximate quantity) (L {US qt, Imp qt})		1.0 {1.1, 0.9}
Propeller shaft (AWD)			
Length (mm {in})		L1	658.0 {25.91}
		L2	570.6 {22.46}
		L3	815.9 {32.12}
Outer diameter (mm {in})		D1	75.0 {2.95}
		D2	63.5 {2.50}
		D3	75.0 {2.95}



Joint type			Constant velocity joint and cross-shaped joint
Constant velocity joint			Double offset joint
Transfer (AWD)			
Transfer oil	Type	Grade	API service GL-5
		Viscosity	SAE 75W-140
	Oil capacity (approx. quantity) (L {US qt, Imp qt})		0.532 {0.562, 0.468}

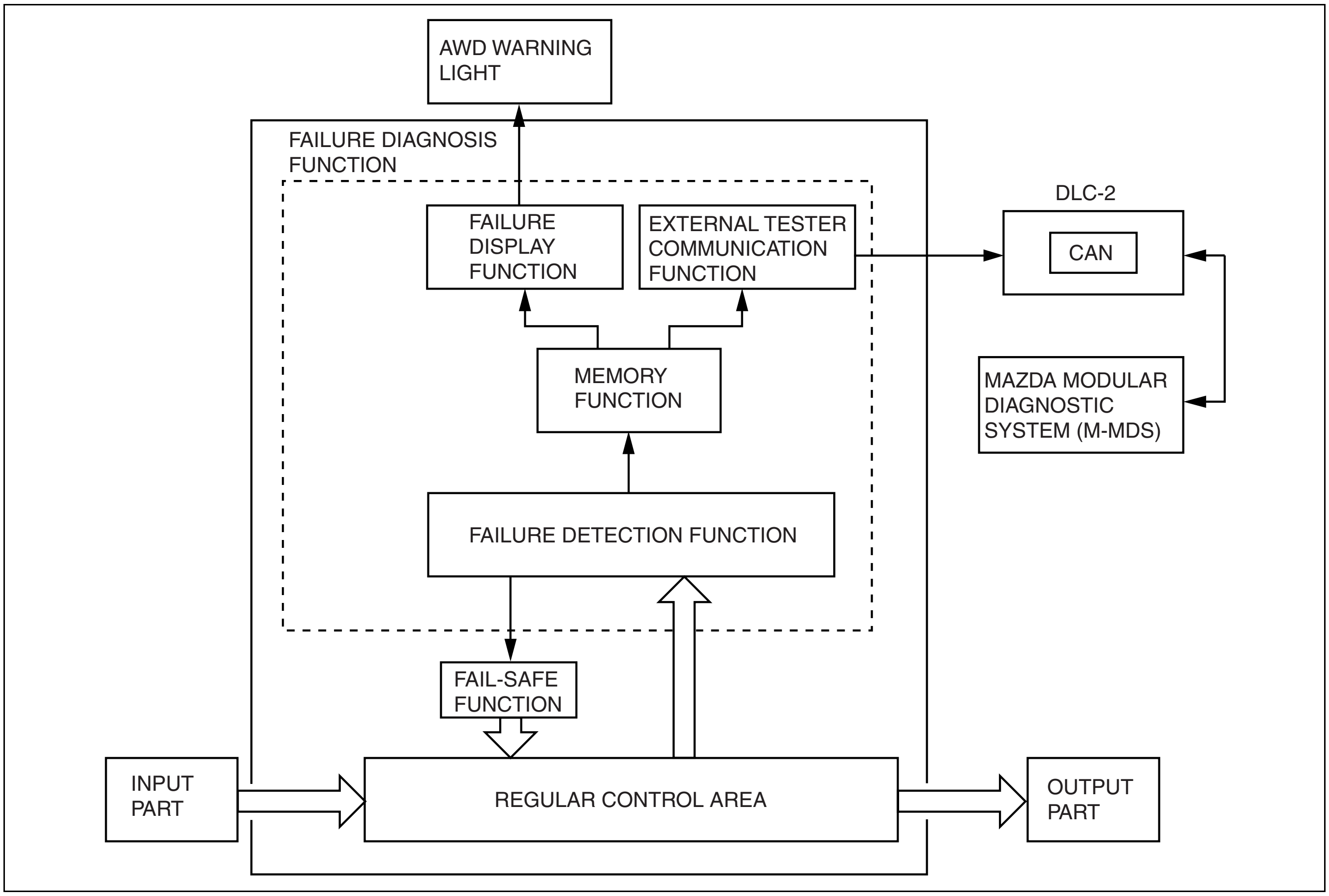
03-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC OUTLINE

id030200100100

- The on-board diagnostic function allows for detecting malfunctions in the input/output signals when the ignition key is at the ON position.
- The DLC-2, which combines the failure detection and detection maintenance connectors, has been adopted to improve serviceability. By connecting a Mazda Modular Diagnostic System (M-MDS) to the DLC-2, malfunction diagnosis can be carried out.
- Using a Mazda Modular Diagnostic System (M-MDS) DTCs can be retrieved or erased, depending on the screen display, thus improving serviceability.

Block Diagram



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Self-diagnostic Function

Failure detection function

- The failure detection function detects malfunctions in the input/output signal systems of the AWD CM and displays them when the ignition key is at the ON position.
- When the ignition key is turned to the ON position, the AWD CM system begins operation, and the AWD warning light illuminates for 3 seconds while the function checks for open circuits. At the same time the function monitors the condition of the power supply voltage and checks for internal malfunctions.
- Then, once the system is running, the function checks the operating conditions of the AWD solenoid and the differential oil temperature sensor at regular intervals to determine whether there is any malfunction.
- If any malfunction is detected during these diagnostic tests, the warning light illuminates according to the malfunction to alert the driver. Also, a DTC is output to DLC-2 via the CAN line. Also, at the same time the failure detection result is sent to the memory and fail-safe functions.

Memory function

- This function stores DTCs for malfunctions of the input/output signal systems as determined by the failure detection function. Once a DTC is stored, it is not cleared even if the input/output signal system malfunction returns to normal when the ignition key is turned to the LOCK position (engine OFF).
- Since DTCs are stored in the non-volatile memory inside the AWD CM, they are not cleared even if the battery is disconnected. Therefore, it is necessary to clear the memory when maintenance has been completed. For clearing DTCs, refer to the procedures in the Workshop Manual.

Fail-safe function

- When the failure detection function determines that there is a malfunction, the AWD warning light illuminates to alert the driver. At this time, the fail-safe function suspends control or takes other measures to ensure that driving stability is not lost.

X:Available

DTC	Malfunction location	AWD warning light condition	DTC stored in memory	Control condition
P1887	AWD solenoid circuit	Illuminated	X	Stop
P1888	Differential oil temperature sensor circuit	Illuminated	X	Stop
U0073	CAN system communication error	Illuminated	X	Stop
U0100	Communication error to PCM	Illuminated	X	Stop
U0101	Communication error to TCM	Illuminated	X	Stop
U0121	Communication error to DSC/RSC HU/CM	Illuminated	X	Stop
U0155	Communication error to instrument cluster	Illuminated	X	Stop

External Tester Communication Function

- This function allows for the storing and clearing of DTCs due to a communication link between the AWD CM and an external tester.

03-11 FRONT AXLE

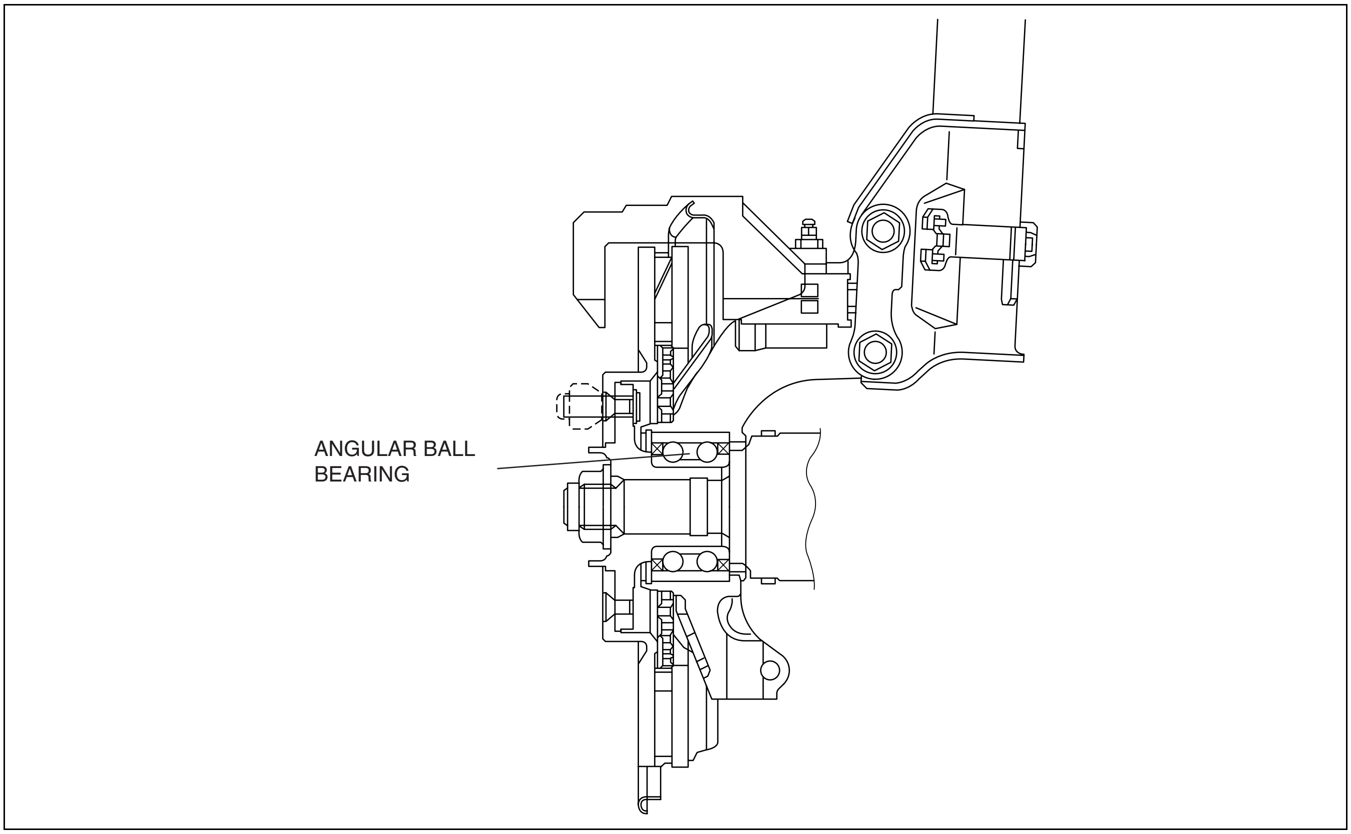
FRONT AXLE OUTLINE

id031100100100

- An angular ball bearing, with a low rotational resistance, has been adopted, improving driveability.
- A unit bearing that does not require pre-load setting has been adopted, improving serviceability.

FRONT AXLE CROSS-SECTIONAL VIEW

id031100100200



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03-12 REAR AXLE

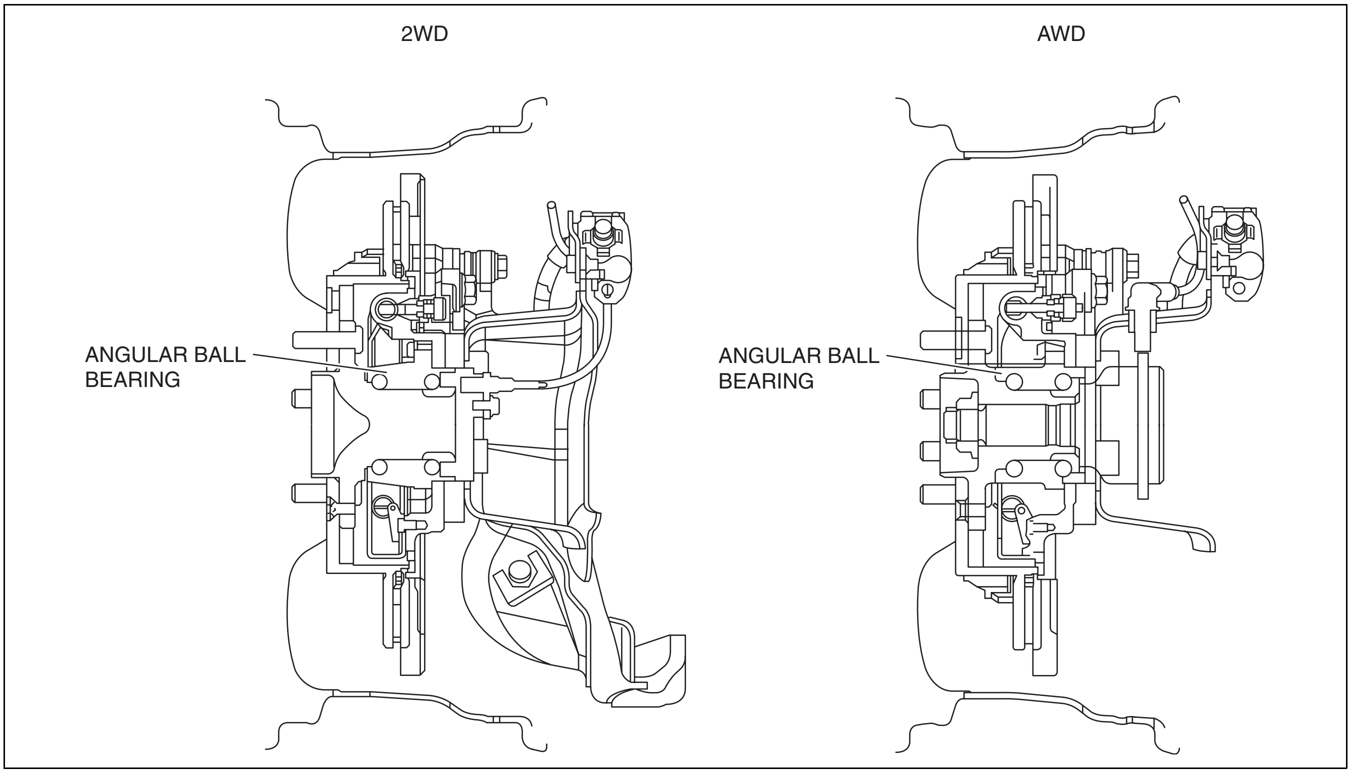
REAR AXLE OUTLINE

id031200100100

- An angular ball bearing, with a low rotational resistance, has been adopted, improving driveability.
- A unit bearing that does not require pre-load setting has been adopted, improving serviceability.

REAR AXLE CROSS-SECTIONAL VIEW

id031200100200



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03-13 DRIVE SHAFT

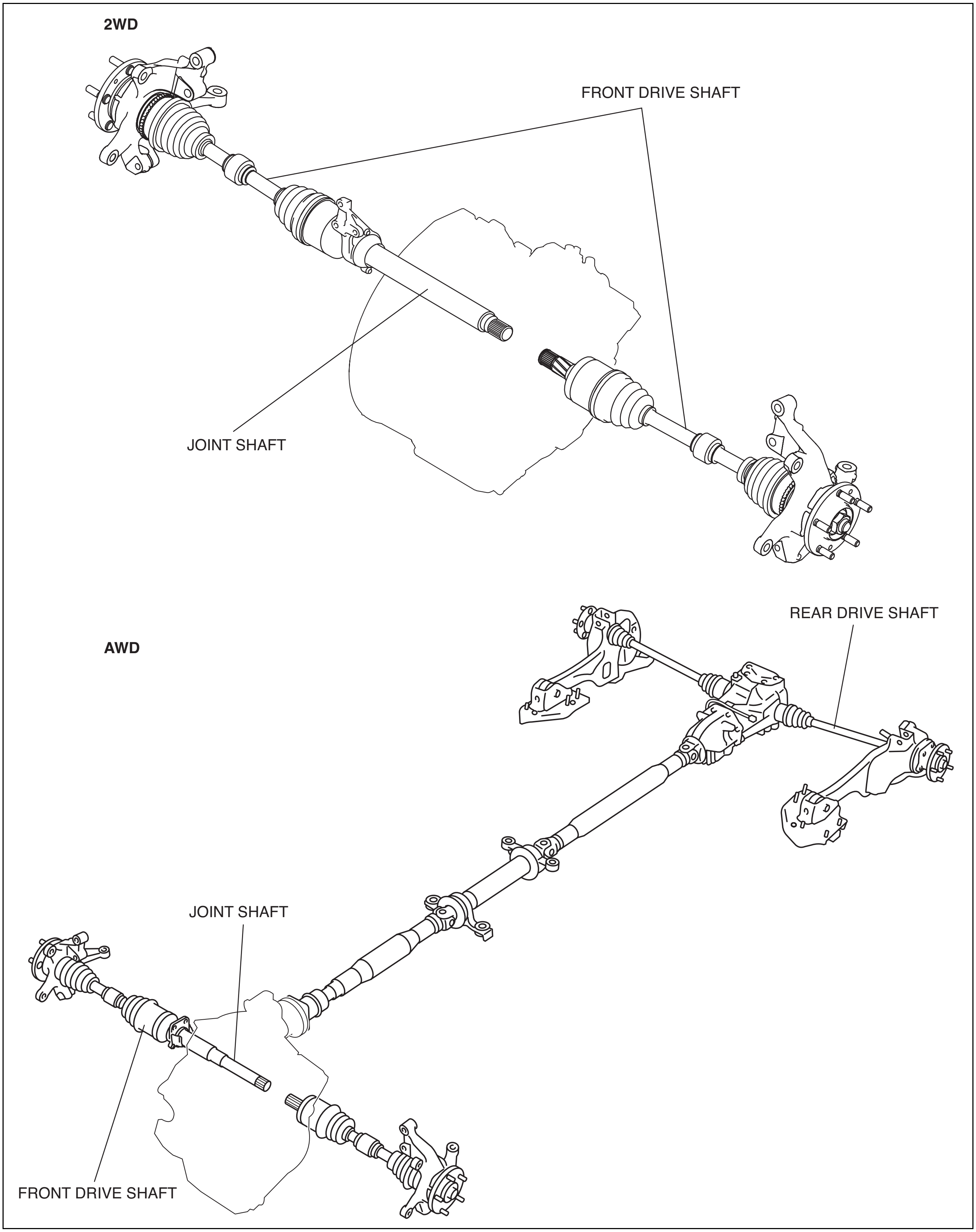
DRIVE SHAFT OUTLINE

id031300151600

- A large size front drive shaft and joint shaft has been adopted, improving driveability and reducing noise/vibration.
- A constant velocity joint system has been adopted for the rear drive shaft, improving driveability and reducing noise/vibration.

DRIVE SHAFT STRUCTURAL VIEW

id031300151700



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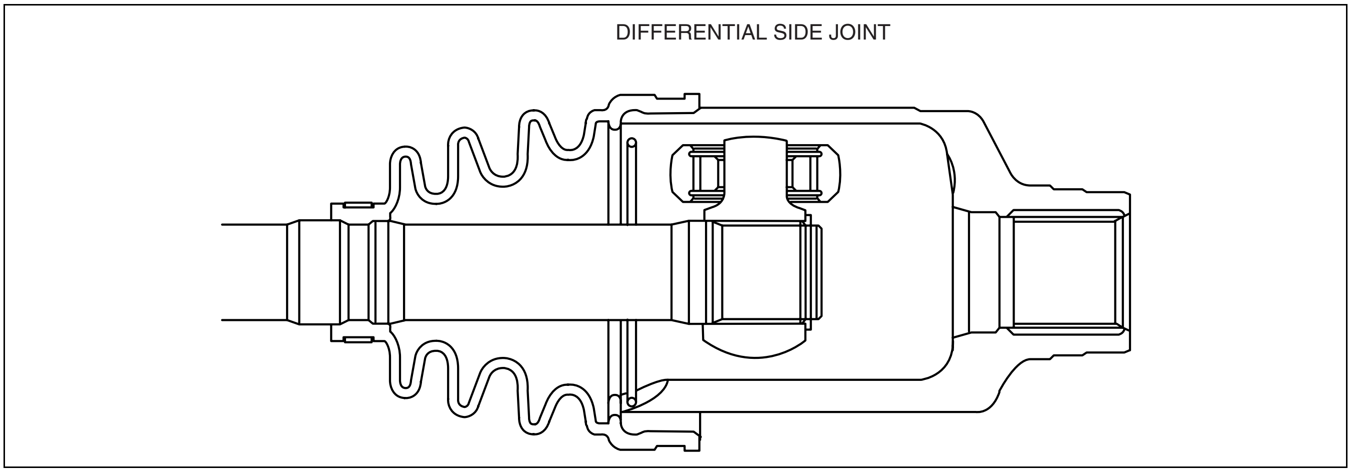
FRONT DRIVE SHAFT STRUCTURE

id031300101000

- A bell joint has been adopted for the wheel-side constant velocity joint, reducing vibration and noise.
- A tripod joint have been adopted for the differential side constant velocity joint to reduce booming noise during high-speed driving and vibration when idling.



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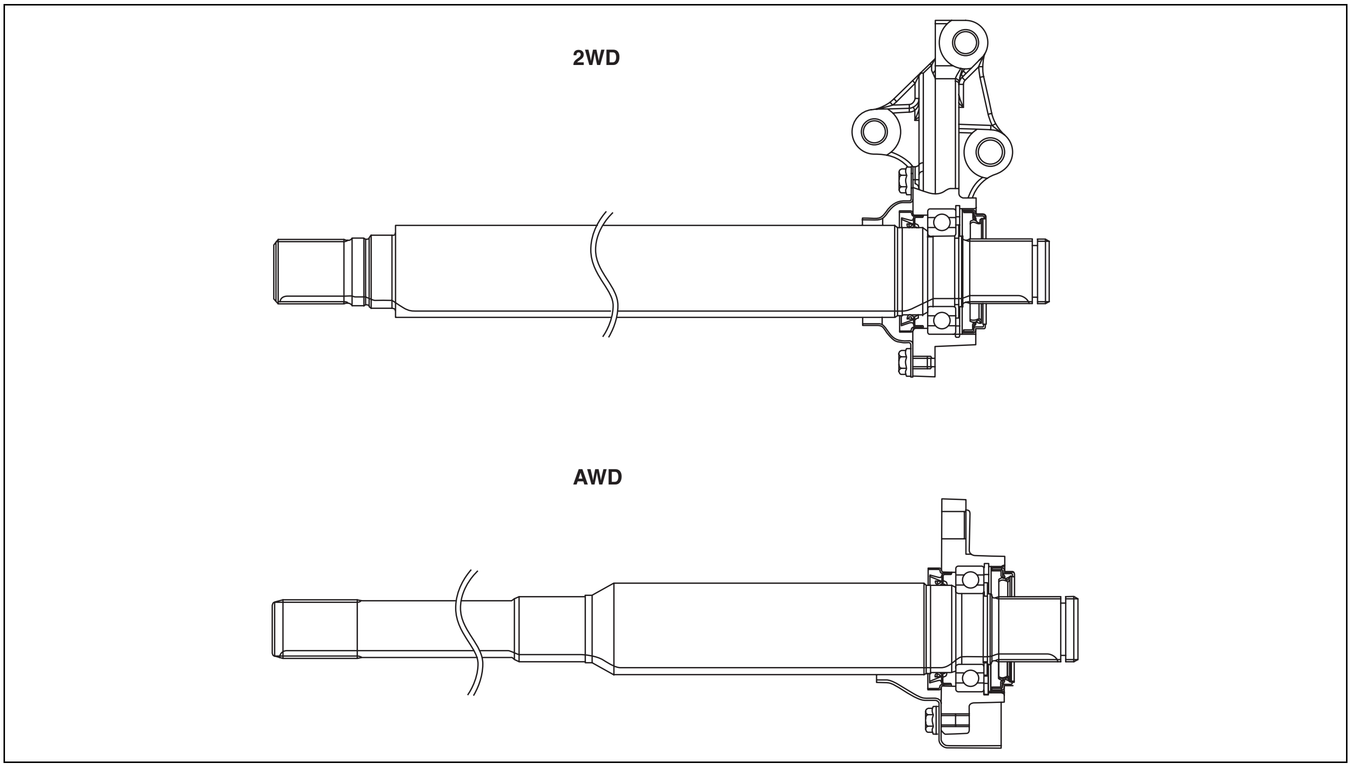
JOINT SHAFT OUTLINE

id031300100500

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.



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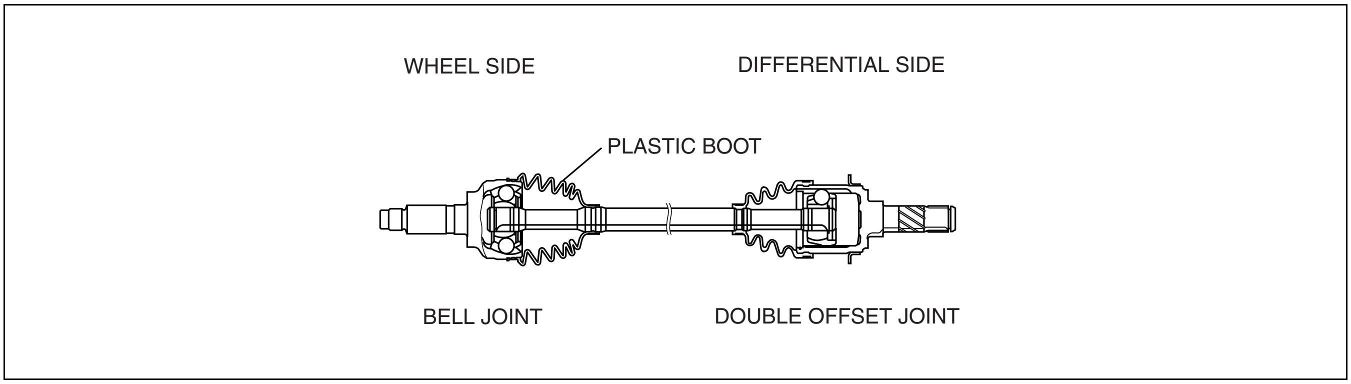
*Torque steer
The vehicle pulls to one side during acceleration from a standstill or normal acceleration due to a right-left difference in momentum created by engine torque.

REAR DRIVE SHAFT STRUCTURE

id031300100400

- Engine noise and vibration have been reduced due to adoption of a bell joint on the wheel side of the constant velocity joint.
- A low noise and vibration double offset joint with low slide resistance has been adopted for the differential side of the constant velocity joint. Due to this booming resonance at high speed is reduced.
- An extremely durable plastic has been adopted for the wheel side boot.



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03-14 DIFFERENTIAL

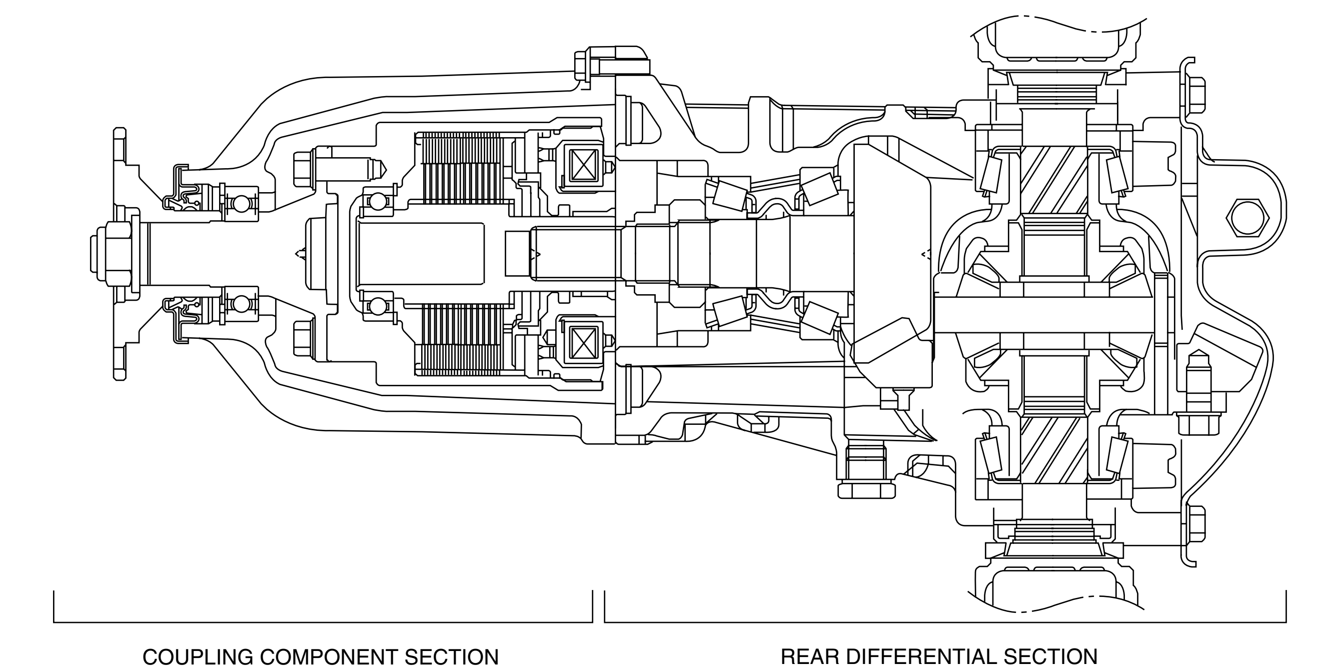
REAR DIFFERENTIAL OUTLINE

id031400100100

- A rear differential with an integrated coupling component has been adopted, reducing size and weight.
- An aluminum differential carrier has been adopted, reducing weight.

REAR DIFFERENTIAL CROSS-SECTIONAL VIEW

id031400100200



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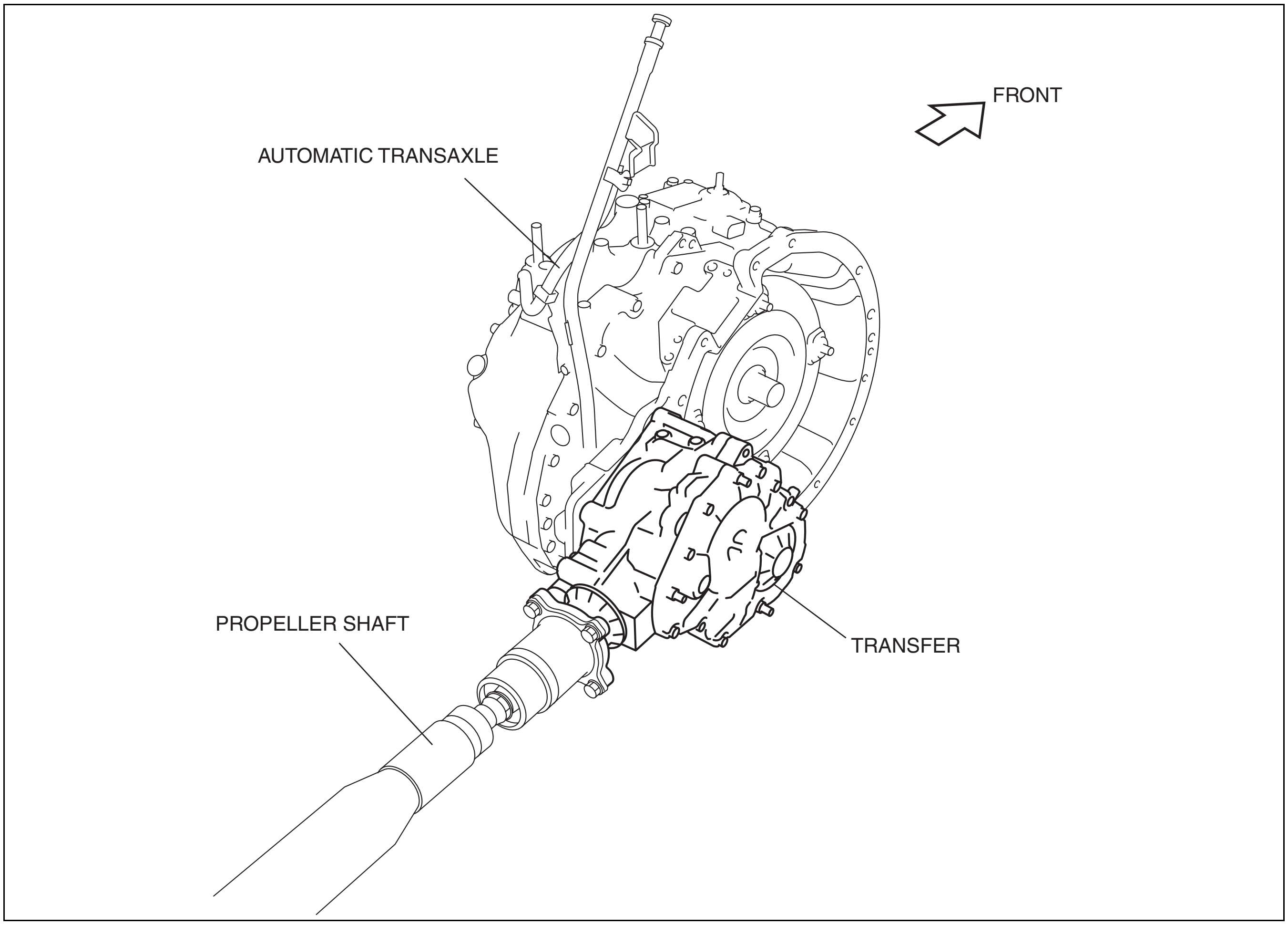
03-16 TRANSFER

TRANSFER STRUCTURAL VIEW

id031600100100



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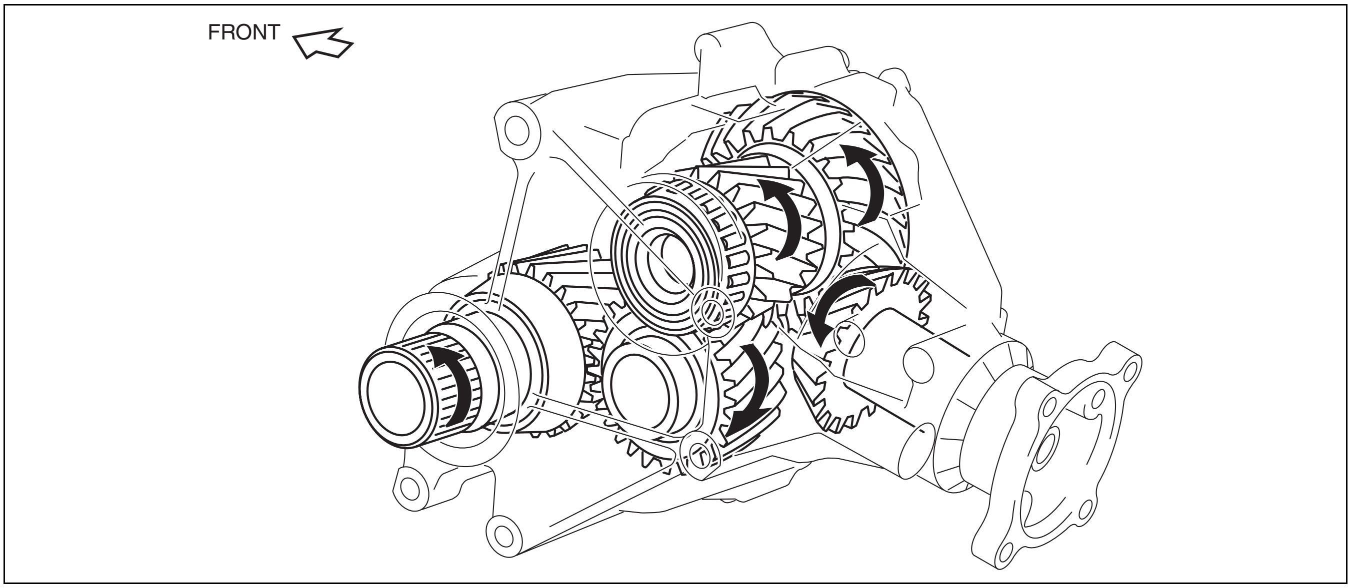
TRANSFER POWER FLOW

id031600100300



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03-19 ALL WHEEL DRIVE (AWD)

ALL-WHEEL DRIVE OUTLINE

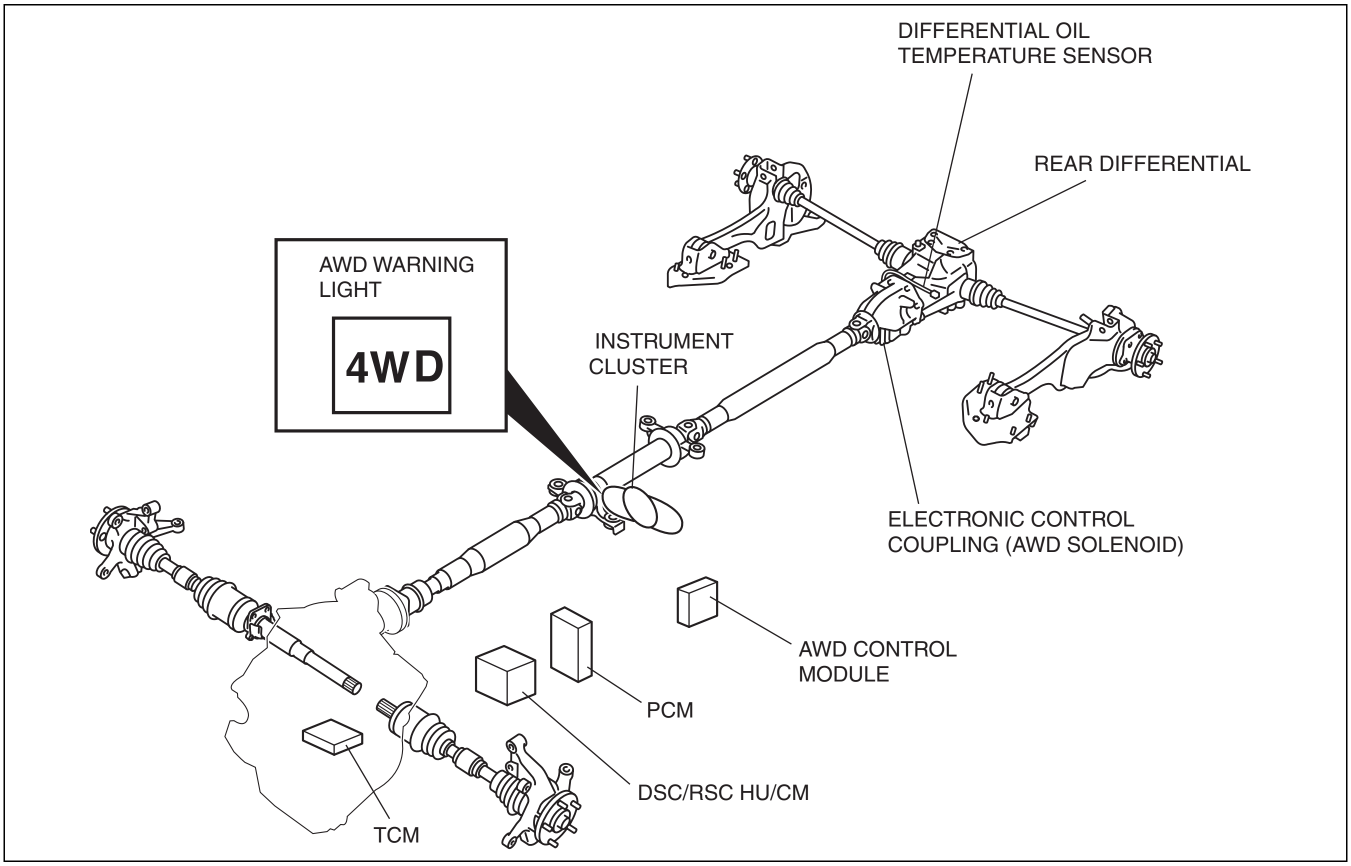
id031900100100

Electronic AWD Control System Outline

- The newly adopted electronic AWD control system automatically and optimally controls drive torque distribution for the front and rear wheels. Due to this off-road mobility and driving stability are improved.
- Based on the input signals from each sensor, the AWD control module (AWD CM) determines vehicle driving and road conditions, and controls output current to the electronic control coupling (AWD solenoid) inside the rear differential. This control allows for optimal distribution of the drive torque from the engine to the rear wheels.
- Also, the AWD CM automatically controls the AWD, greatly reducing the load on the driver and improving operability.

ALL-WHEEL DRIVE STRUCTURAL VIEW

id031900100200



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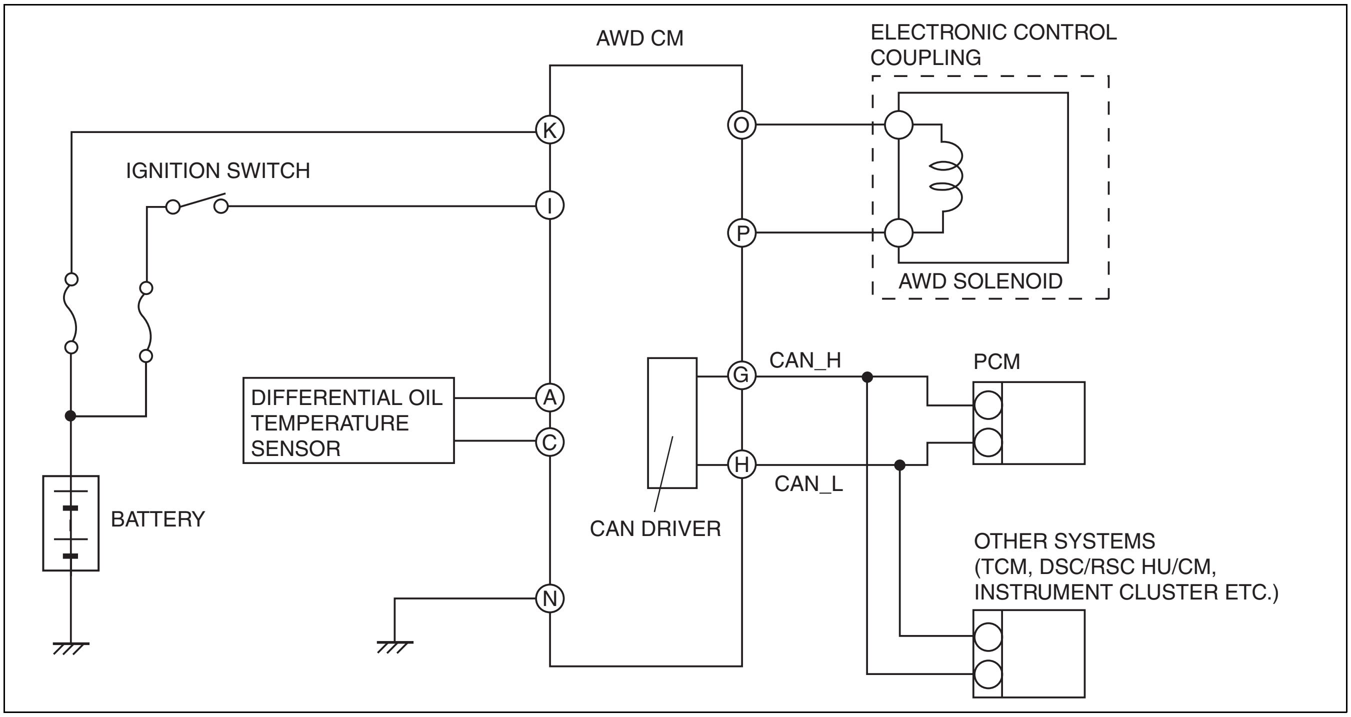
ALL-WHEEL DRIVE COMPONENTS AND FUNCTIONS

id031900100300

Part name	Function
Electronic control coupling (AWD solenoid)	• Based on a signal from the AWD CM, it operates the electromagnetic clutch and transmits drive torque to the rear wheels.
Differential oil temperature sensor	• Informs the AWD CM of the rear differential oil temperature.
AWD CM	• Controls operation of the electronic control coupling (AWD solenoid) based on signals input from the accelerator pedal opening angle, wheel speed, differential oil temperature and other sensors. • Outputs coupling control condition and AWD warning control information as a CAN signal. • Controls the on-board diagnostic system and the fail-safe system if there is a malfunction in the AWD system.
AWD warning light	• Illuminates or flashes to alert driver of a malfunction or control failure in the AWD system.
PCM	• Sends the accelerator pedal opening angle, engine speed signal and other signals, as CAN signals, to the AWD CM.
TCM	• Sends the gear position signal and other signals, as CAN signals, to the AWD CM.
DSC/RSC HU/CM	• Sends the four-wheel speed, DSC/RSC operating condition signal, steering wheel angle signal and other signals, as CAN signals, to the AWD CM. • Sends the coupling torque request signal, as a CAN signal, to the AWD CM.
Instrument cluster	• Sends the parking brake switch signal, as CAN signal, to the AWD CM.

ALL-WHEEL DRIVE SYSTEM DIAGRAM

id031900100400



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AWD SYSTEM CONTROL OUTLINE

id031900100500

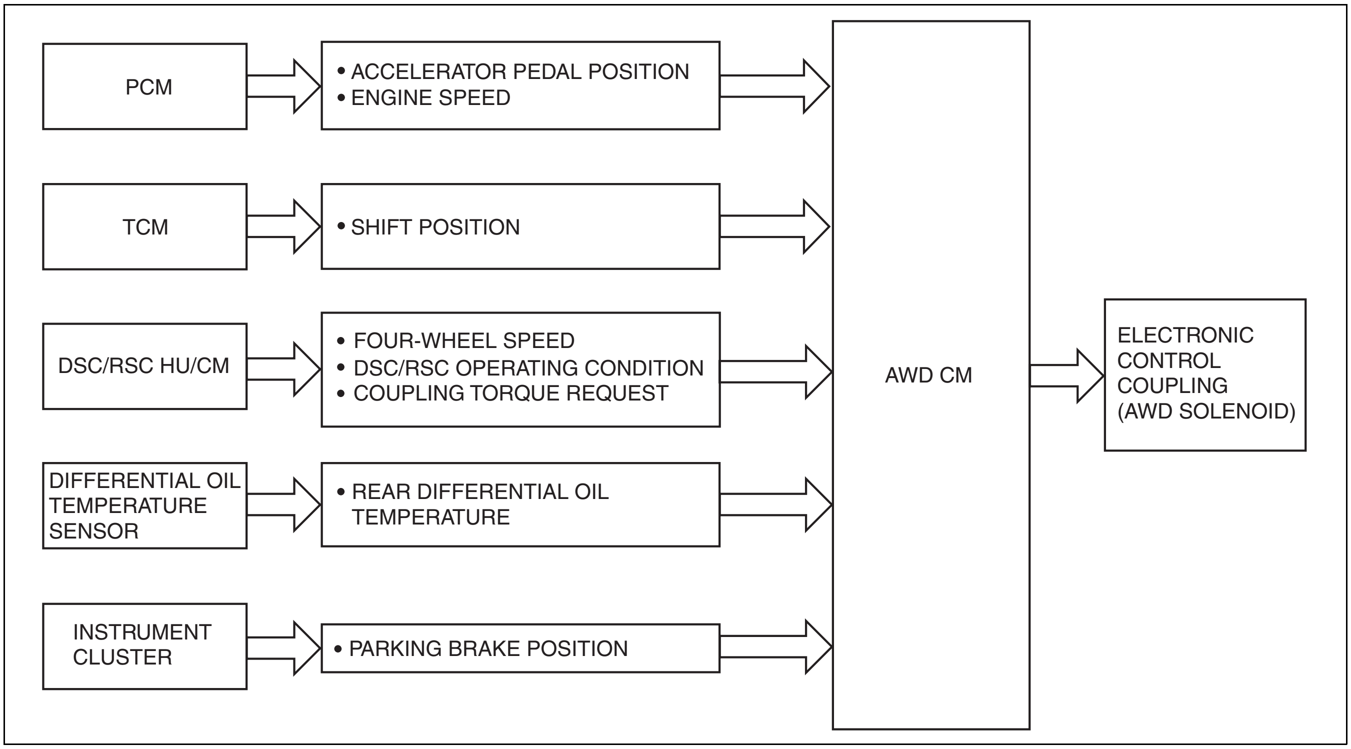
Features

- Based on the inputted signals listed below, the AWD CM calculates the optimal amount of torque distribution for the rear wheels and outputs a corresponding electric control current to the electronic control coupling (AWD solenoid).
- The module controls the current outputted to the AWD solenoid by changing the rate of the ON/OFF timing.

Signal output part	Signal name	Note
PCM	Accelerator pedal position Engine speed	Transmitted as a CAN signal
TCM	Shift position	
DSC/RSC HU/CM	Four-wheel speed DSC/RSC operating condition Coupling torque request	
Instrument cluster	Parking brake position	
Differential oil temperature sensor	Rear differential oil temperature	—

AWD SYSTEM CONTROL BLOCK DIAGRAM

id031900100600



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AWD SYSTEM CONTROL OPERATION

id031900100700

Normal Control

- When starting off or accelerating during straight-ahead driving, torque transmitted to the rear wheels is optimally controlled to ensure sufficient acceleration performance. Due to this, standing-start and acceleration performance is improved.
- If a parking brake signal input to the AWD CM indicates, the module controls the torque transmitted to the rear wheels.

Tight Cornering Control

- When the AWD CM determines, based on the four-wheel speed signal, that the vehicle is in tight cornering, it reduces the torque transmitted to the rear wheels to avoid tight corner braking characteristics.

Integrated DSC/RSC Control

- If a signal from the DSC/RSC HU/CM input to the AWD CM indicates that ABS control is activated, the module controls the torque transmitted to the rear wheels to prevent undue influence on ABS control.
- Also, when a coupling torque request signal is received from the DSC/RSC HU/CM, the module controls the torque transmitted to the rear wheels to match the amount of requested torque.

Other Control

- In case the rear differential oil temperature exceeds the specified amount, or when there is an unusually large variation in the rotation speed of the front and rear wheels (ex. when trying to get unstuck), control is temporarily suspended in order to protect the AWD system. When this occurs the AWD warning light flashes to indicate the situation to the driver.

CONTROLLER AREA NETWORK (CAN) OUTLINE

id031900100800

- The AWD CM transmits/receives information using the CAN system. See Section 09 for detailed information regarding the CAN system.

CONTROLLER AREA NETWORK (CAN) OPERATION

id031900100900

Transmitted Information

- Coupling torque
- AWD system condition (warning light information)

Received Information

- Four-wheel speed
- Accelerator pedal opening angle
- Engine speed
- DSC/RSC operating condition
- Shift position
- Coupling torque request

AWD CONTROL MODULE FUNCTION

id031900101000

- The AWD CM calculates the optimal amount of torque distribution for the rear wheels and outputs a corresponding electric current to the electronic control coupling (AWD solenoid). This calculation is based on the accelerator pedal angle, four-wheel speed, engine speed, and other related input signals, matched with the vehicle driving and road surface conditions.

Function table

Function name	Contents
AWD system control function	• Based on each input signal, the electronic control current sent to the electronic control coupling (AWD solenoid) is optimally controlled.
Diagnostic system	• If the self-diagnostic system detects a malfunction, the AWD warning light illuminates to alert the driver, and at the same time the system suspends control or performs other measures to prevent a loss of driving stability and protect the system. • The detected malfunction is stored as a DTC in the AWD CM.

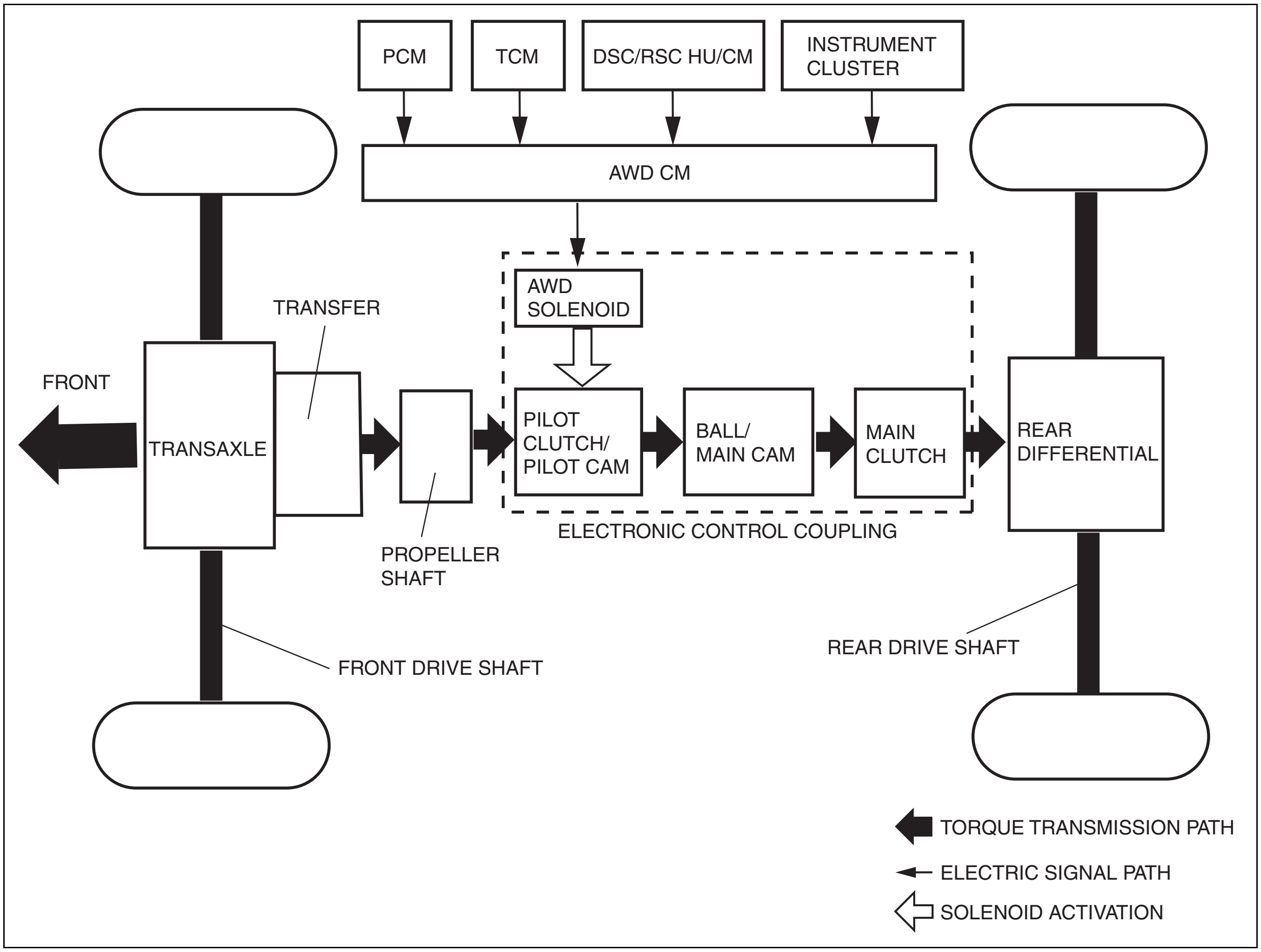
AWD CONTROL MODULE CONSTRUCTION

id031900101100

- The AWD CM is installed to the left of the dashboard. (Driver side)

AWD CONTROL MODULE BLOCK DIAGRAM

id031900101200



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AWD WARNING LIGHT CONSTRUCTION

id031900101300

- The AWD warning light is built into the instrument cluster.
- If the self-diagnostic function stores a DTC, the warning light illuminates to alert the driver of the malfunction. If system control is temporarily suspended due to the rear differential oil temperature becoming abnormally hot or similar cause, the warning light flashes to alert the driver.
- The AWD CM controls the operation of the warning light.

AWD WARNING LIGHT

ac9uun00000450

ELECTRONIC CONTROL COUPLING OUTLINE

id031900101400

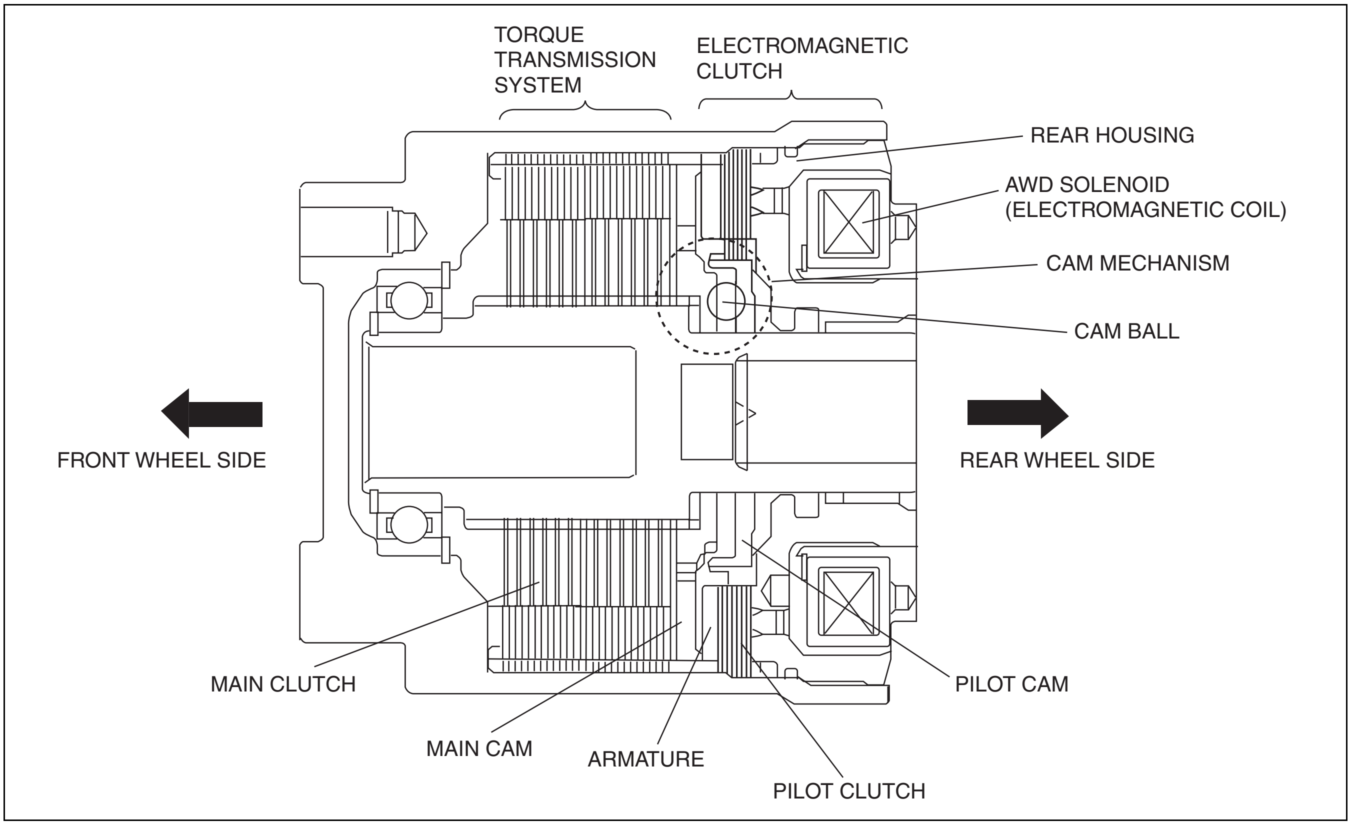
Features

- An electromagnetic clutch, which operates smoothly due to the lack influence from the front and rear wheel traction force, has been adopted for the electronic control coupling system.
- The construction of the coupling enables the torque formed by the pilot clutch to be amplified by the cam mechanism, thus allowing the main clutch to obtain a high degree of torque. Due to this, size and weight reduction of the component parts has been achieved.

ELECTRONIC CONTROL COUPLING CONSTRUCTION

id031900101500

- The electronic control coupling basically consists of an electromagnetic clutch, a cam mechanism and a torque transmission system.
- The electromagnetic clutch consists of a AWD solenoid (electromagnetic coil), rear-housing that forms a magnetic path, pilot clutch, and armature. The cam mechanism consists of a pilot cam, balls, and main cam. The torque transmission system consists of a main clutch and hydraulic oil (ATF).



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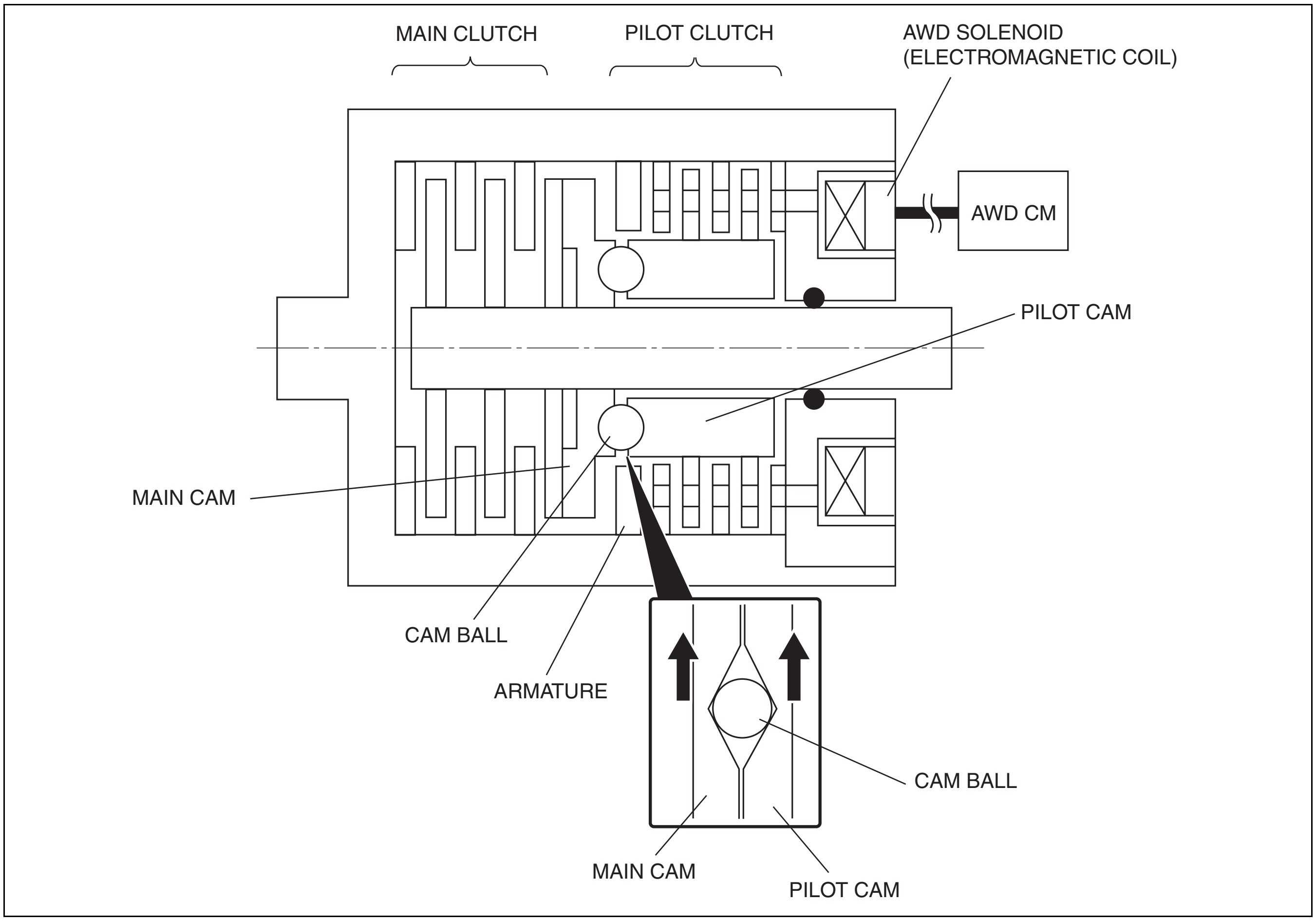
ELECTRONIC CONTROL COUPLING OPERATION

id031900101600

AWD Solenoid Control Current Is OFF

- When the AWD solenoid control current is OFF, no torque is generated in the pilot clutch because there is no current flowing to the AWD solenoid. At the same time, the pilot cam and the main cam rotate in the same direction via the balls, and the main cam does not exert any push force on the main clutch side. Therefore, the traction from the front wheels is not transmitted to the rear wheels.



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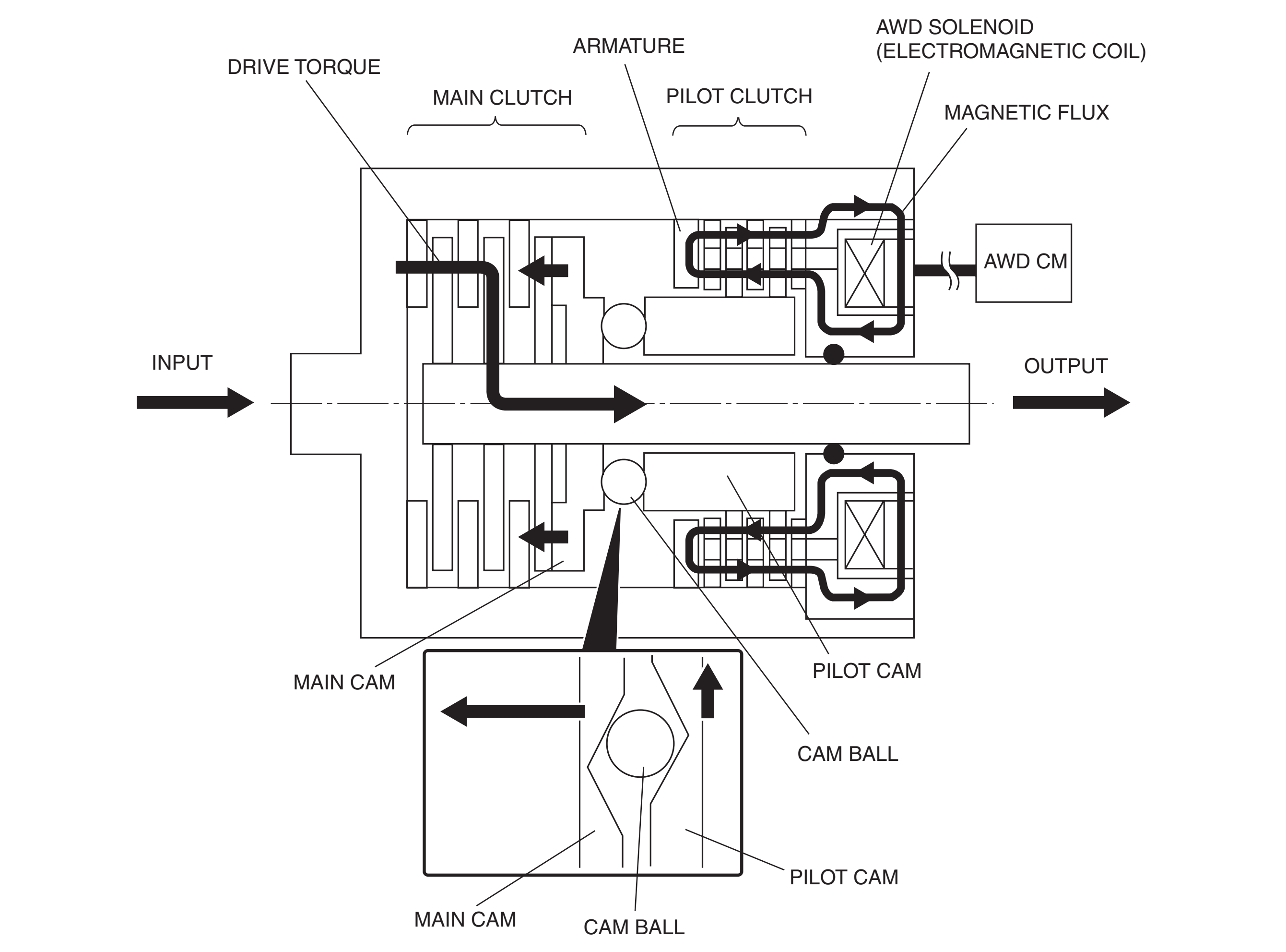
AWD Solenoid Control Current Is ON

- When the AWD solenoid control current is ON, current flows from the AWD CM to the AWD solenoid, and the coupling operates in the following manner.
  1. Magnetic flux forms at the electromagnetic coil of the AWD solenoid.
  2. Due to the magnetic flux in the armature, the pilot clutch is suctioned towards the magnetic coil side and made to engage. This causes frictional torque to generate in the pilot clutch.
  3. The torque is transmitted to the pilot cam, which is engaged with the pilot clutch.
  4. A rotational difference is created between the pilot cam and the main cam. Due to this relative torsion, the cam mechanism operates, transmitting torque from the pilot cam to the ball and then to the main cam. In this way, the push force exerted on the main clutch is amplified.
  5. As the main clutch engages, the drive torque from the front wheels is transmitted to the rear wheels.
- The amount of push force exerted on the main clutch by the main cam (that is, the strength of the drive torque transmitted to the rear wheels) changes in accordance with the proportion of the force acting upon the pilot cam, engaged with the pilot clutch. Therefore, by changing the periodicity of the electric current from the AWD CM to the AWD solenoid (ON/OFF rate of the AWD solenoid = force acting on the pilot cam), the module controls the transmission of drive torque to the rear wheels.

03-19



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DIFFERENTIAL OIL TEMPERATURE SENSOR FUNCTION

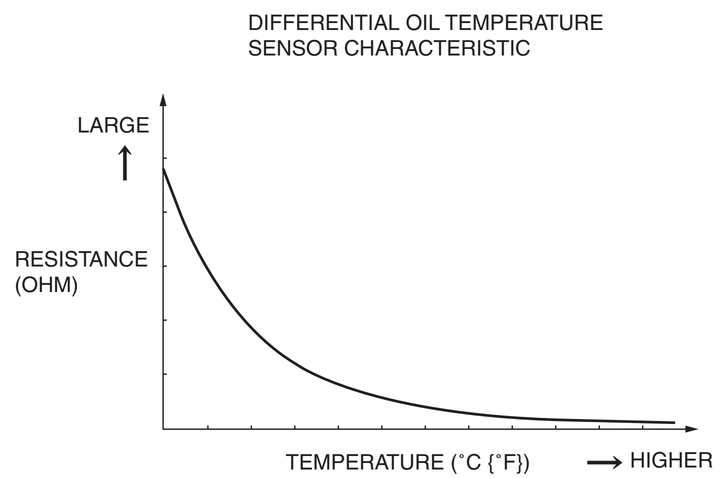
id031900101700

- The differential oil temperature sensor detects the rear differential oil temperature based on the resistance of the thermistor, and inputs it to the AWD CM.

DIFFERENTIAL OIL TEMPERATURE SENSOR CONSTRUCTION/OPERATION

id031900101800

- The differential oil temperature sensor is installed in the rear differential carrier.
- The differential oil temperature sensor uses a thermistor whose resistance changes according to changes in the rear differential oil temperature.
- The resistance grows smaller as the oil temperature rises and vice-versa, as shown.



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BRAKES

04 SECTION

04-00 OUTLINE

BRAKE ABBREVIATIONS

id040000100100

ABS	Antilock Brake System
AWD	All Wheel Drive
BCM	Body Control Module
CAN	Controller Area Network
CM	Control Module
DSC	Dynamic Stability Control
EBD	Electronic Brakeforce Distribution
HU	Hydraulic Unit
IG	Ignition
LF	Left Front
LR	Left Rear
OFF	Switch Off
ON	Switch On
PID	Parameter Identification
RF	Right Front
RR	Right Rear
RSC	Roll Stability Control
SW	Switch
TCS	Traction Control System
2WD	2-wheel Drive

BRAKE FEATURES

id040000100200

Improved safety	• Intrusion minimizing brake pedal adopted • Large power brake unit (10.5 inch) adopted • Electronic brakeforce distribution (EBD) control adopted • Electrical brake assist control has been adopted • Dynamic stability control (DSC)/Roll stability control (RSC) adopted
Improved braking force	• Large diameter front disc brakes adopted • Front brake caliper (two-piston type) adopted • Large diameter rear disc brakes adopted (Integrated with parking drum brake)
Improved serviceability	• Enhanced malfunction diagnosis system for use with Mazda Modular Diagnostic System (M-MDS) • Combined sensor integrating yaw rate, roll rate, longitudinal acceleration and lateral acceleration sensors adopted
Improved operability	• Foot-operated parking brake adopted
Size and weight reduction	• Integrated construction of the hydraulic unit (HU) and control module (CM) adopted for the DSC/RSC HU/CM
Improved brake pedal operability	• A master cylinder with smaller diameter long-stroke type has been adopted

BRAKE SPECIFICATIONS

id040000100300

Item		Specification
Brake pedal	Type	Suspended design
	Pedal lever ratio	2.9
	Max. stroke (mm {in})	130.5 {5.138}
Master cylinder	Type	Tandem
	Cylinder bore (mm {in})	22.2 {0.874}
Front brake (disc)	Type	Ventilated disc
	Cylinder bore (mm {in})	45.4 {1.79} × 2
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	6,000 × 12.0 {9.300 × 0.47}
	Disc plate dimensions (mm {in})	320 × 28 {12.6 × 1.1}
Rear brake (disc)	Type	Ventilated disc
	Cylinder bore (mm {in})	42.85 {1.687}
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	3,300 × 11 {5.115 × 0.43}
	Disc plate dimensions (mm {in})	325 × 18 {12.8 × 0.71}
Power brake unit	Type	Vacuum multiplier, single diaphragm
	Outer diameter (mm {in})	288 {11.3}
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)	Foot actuated type
	Drum brake type	Servo type
	Lining dimensions (area x thickness) (mm^2 x mm {in^2 x in})	4,700 × 3.4 {7.285 × 0.13}
	Drum inner diameter (mm {in})	190 {7.48}
	Play adjustment method	Manual-adjusting
Brake fluid	Type	SAE J1703, FMVSS 116 DOT-3

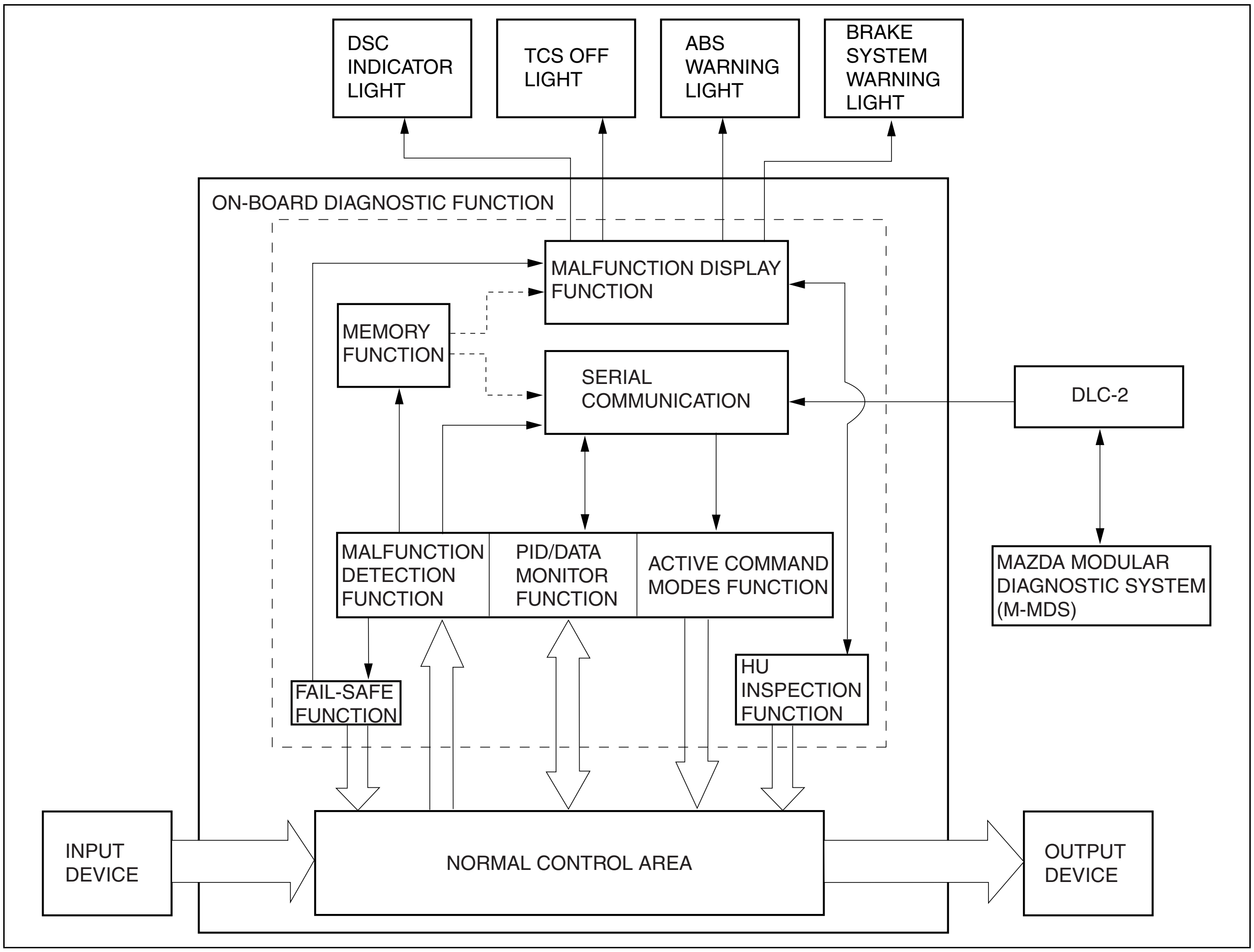
04-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE

id040200110000

- 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 simulation 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 Mazda Modular Diagnostic System (M-MDS) to the DLC-2.
- In addition to DTC read-out, the Mazda Modular Diagnostic System (M-MDS) is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor and simulation functions, providing enhanced malfunction diagnosis and improved serviceability.

Block Diagram



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ON-BOARD DIAGNOSTIC SYSTEM FUNCTION

id040200110300

Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM) when the ignition switch is at the switch on (ON) position.
- When the DSC/RSC HU/CM are started up, the following malfunction detections are performed.
  — The antilock brake system (ABS) and brake system warning lights, traction control system (TCS) switch off (OFF) and DSC indicator lights illuminate for **approx. 3 s** when the ignition switch is turned to the ON position. 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. 15 km/h {9.3 mph}** or more the pump motor is operated and malfunction diagnosis is performed again.
- 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 HS_CAN_H and HS_CAN_L of the DLC-2. At the same time, malfunction detection results are sent to the memory and fail-safe functions.

04-02

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 DSC/RSC HU/CM 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, each light illuminates to advise the driver. At this time, the fail-safe function controls the ABS, electronic brakeforce distribution (EBD), TCS, DSC and RSC as shown in the fail-safe function 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 number	Fail-safe function								
		Warning light illumination status				Control status				
		ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	TCS OFF light	ABS control	EBD Control	TCS control	DSC control	RSC control
Power supply system	B1317	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
Power supply system	B1318	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
DSC/RSC HU/CM system	B1342	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
DSC/RSC HU/CM system	B211B	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Pump motor, motor relay systems	C1095	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
Pump motor, motor relay systems	C1096	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
Valve relay system	C1115	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled

Malfunction location	DTC number	Fail-safe function								
		Warning light illumination status				Control status				
		ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	TCS OFF light	ABS control	EBD Control	TCS control	DSC control	RSC control
RF ABS wheel-speed sensor (open circuit) system	C1145	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
LF ABS wheel-speed sensor (open circuit) system	C1155	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
RR ABS wheel-speed sensor (open circuit) system	C1165	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
LR ABS wheel-speed sensor (open circuit) system	C1175	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
Valve relay system	C1185	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
LF outlet solenoid valve system	C1194	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
LF inlet solenoid valve system	C1198	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
RF outlet solenoid valve system	C1210	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
RF inlet solenoid valve system	C1214	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
ABS wheel-speed sensor system	C1222	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
LF ABS wheel-speed sensor/ABS sensor rotor system	C1233	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
RF ABS wheel-speed sensor/ABS sensor rotor system	C1234	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
RR ABS wheel-speed sensor/ABS sensor rotor system	C1235	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled

Malfunction location	DTC number	Fail-safe function								
		Warning light illumination status				Control status				
		ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	TCS OFF light	ABS control	EBD Control	TCS control	DSC control	RSC control
LR ABS wheel-speed sensor/ABS sensor rotor system	C1236	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
LR outlet solenoid valve system	C1242	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
RR outlet solenoid valve system	C1246	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
LR inlet solenoid valve system	C1250	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
RR inlet solenoid valve system	C1254	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
Steering angle sensor system	C1278	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system	C1279	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system	C1280	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system	C1281	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system	C1282	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Brake fluid pressure sensor system	C1288	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Steering angle sensor system	C1295	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Brake fluid level sensor system	C1327	Not illuminated	Illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
RF outlet solenoid valve coil system	C1329	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
LR outlet solenoid valve coil system	C1330	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
RR outlet solenoid valve coil system	C1331	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
LF outlet solenoid valve coil system	C1332	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled

Malfunction location	DTC number	Fail-safe function								
		Warning light illumination status				Control status				
		ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	TCS OFF light	ABS control	EBD Control	TCS control	DSC control	RSC control
LR inlet solenoid valve coil system	C1333	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
LF inlet solenoid valve coil system	C1334	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
RF inlet solenoid valve coil system	C1335	Illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
RR inlet solenoid valve coil system	C1336	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
RF traction control solenoid valve system	C1404	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
LF traction control solenoid valve system	C1410	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Brake switch system	C1446	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system	C1516	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled
Combined sensor system	C1517	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled
RF traction control solenoid valve coil system	C1527	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
LF traction control solenoid valve coil system	C1528	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
RF stability control solenoid valve coil system	C1530	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
LF stability control solenoid valve coil system	C1531	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
DSC/RSC HU/CM system	C1730	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled	Control disabled
RF stability control solenoid valve system	C1957	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
LF stability control solenoid valve system	C1958	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled

Malfunction location	DTC number	Fail-safe function								
		Warning light illumination status				Control status				
		ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	TCS OFF light	ABS control	EBD Control	TCS control	DSC control	RSC control
Combined sensor (Yaw rate sensor part) initial point correction error	C1963	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled
DSC/RSC sensor (abnormal initialization) system	C1991	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system	C2769	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled
Combined sensor system	C2770	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled
CAN system communicatio n error	U0073	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Communicati on error to PCM	U0100	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
Communicati on error to BCM	U0140	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Communicati on error to instrument cluster	U0155	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system (CAN2 line malfunction)	U1901	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled
Steering angle sensor system	U2023	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control disabled

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION

id040200110500

- The parameter identification (PID)/data monitor function is used for optionally selecting input/output signal monitor items preset in the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM) and reading them out in real-time.

PID/DATA Monitor Table

PID/data monitor item	Input/output part	Unit/Condition (Tester display)
ACCLMTR	Combined sensor	G
BOO_ABS	Brake switch	Off/On
CCNTABS	Number of continuous DTCs	—
LAT_ACCL	Combined sensor (lateral-G value)	G
MCYLI P	Brake fluid pressure sensor	MPa
PMP_MOTOR	Pump motor	Off/On
SHIFT_P	TCM	Off/On
PWR_RLY	Valve relay	Off/On
ROLL_RATE	Combined sensor	°/s
SWA_POS	Steering angle sensor	°
TCS_OFF_SW	TCS OFF switch	Off/On
V_LF_INL	LF inlet solenoid valve	Off/On
V_LF_OTL	LF outlet solenoid valve	Off/On
V_LR_INL	LR inlet solenoid valve	Off/On
V_LR_OTL	LR outlet solenoid valve	Off/On
V_RF_INL	RF inlet solenoid valve	Off/On
V_RF_OTL	RF outlet solenoid valve	Off/On
V_RR_INL	RR inlet solenoid valve	Off/On
V_RR_OTL	RR outlet solenoid valve	Off/On
V_STB_L	LH stability control solenoid valve	Off/On
V_STB_R	RH stability control solenoid valve	Off/On
V_TRC_L	LH traction control solenoid valve	Off/On
V_TRC_R	RH traction control solenoid valve	Off/On
WSPD_LF	ABS wheel-speed sensor (LF)	KPH, MPH
WSPD_LR	ABS wheel-speed sensor (LR)	KPH, MPH
WSPD_RF	ABS wheel-speed sensor (RF)	KPH, MPH
WSPD_RR	ABS wheel-speed sensor (RR)	KPH, MPH
YAW_RATE	Combined sensor (yaw rate value)	°/s

ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION

id040200110700

- The active command modes function is used for optionally selecting active command modes items of input/output parts preset in the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM), and to operate them regardless of CM control.
- To protect the hydraulic unit interior, operate output related parts for only **10 s or less** when using the active command modes function.

Active Command Modes Table

Command name	Output part name	Operation	Operation condition
PMP_MOTOR	Pump motor	Off/On	Ignition switch at ON
P_SIGNAL	TCM		
PWR_RLY	Valve relay		
SSR_INTL	DSC/RSC sensor (combined sensor, steering angle sensor)		
V_LF_INL	LF inlet solenoid valve		
V_LF_OTL	LF outlet solenoid valve		
V_LR_INL	LR inlet solenoid valve		
V_LR_OTL	LR outlet solenoid valve		
V_RF_INL	RF inlet solenoid valve		
V_RF_OTL	RF outlet solenoid valve		
V_RR_INL	RR inlet solenoid valve		
V_RR_OTL	RR outlet solenoid valve		
V_STB_L	LH stability control solenoid valve		
V_STB_R	RH stability control solenoid valve		
V_TRC_L	LH traction control solenoid valve		
V_TRC_R	RH traction control solenoid valve		

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION

id040200110900

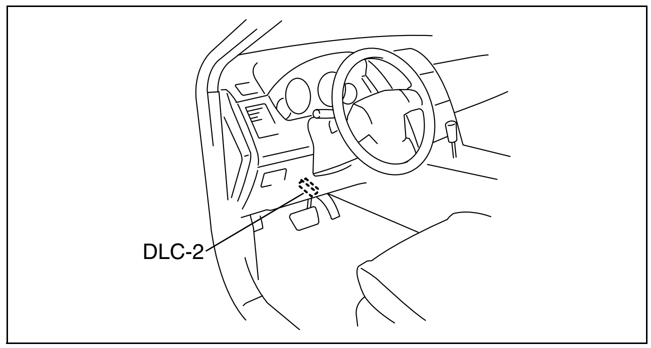
- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, and operation of input/output parts) between the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM) and an external tester.

Connections and Communication Contents

	External tester	
	Mazda Modular Diagnostic System (M-MDS)	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: HS_CAN_H, HS_CAN_L	Serial communication
PID/DATA monitor function	Input/output: HS_CAN_H, HS_CAN_L	Serial communication
Active command modes function	Input/output: HS_CAN_H, HS_CAN_L)	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 Mazda Modular Diagnostic System (M-MDS) to the DLC-2, diagnostic data can be sent and received between the Mazda Modular Diagnostic System (M-MDS) and the DSC/RSC HU/CM using the HS_CAN_H and HS_CAN_L terminals (within the DLC-2).
- The DSC/RSC HU/CM receives the command signals of the malfunction detection function, parameter identification (PID)/data monitor function, and the active command modes function from the Mazda Modular Diagnostic System (M-MDS), and sends DTCs and data regarding the operating condition and status of each input/output part to the Mazda Modular Diagnostic System (M-MDS).



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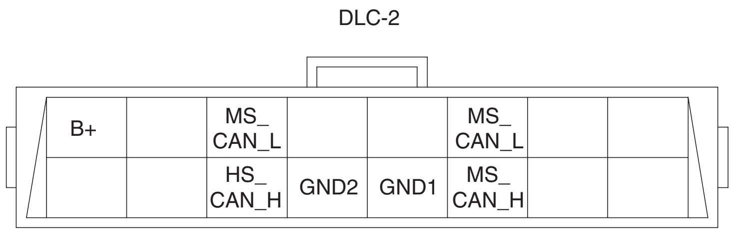
Diagnostic function name	Signal received	Signal sent
Malfunction detection function	DTC verification signal	DTC
PID/data monitor function	Command signal to read selected monitor item	Monitored data for requested monitor item
Active command modes function	Operation command signal for selected active command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

DLC-2 CONSTRUCTION

id040200111100

- 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 HS_CAN_H, HS_CAN_L, MS_CAN_H, MS_CAN_L, GND1, GND2 and B+ terminals.



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Terminal	Function
HS_CAN_L	Serial communication Lo terminal (HS)
HS_CAN_H	Serial communication Hi terminal (HS)
MS_CAN_L	Serial communication Lo terminal (MS)
MS_CAN_H	Serial communication Hi terminal (MS)
GND1	Body ground terminal
GND2	Serial communication ground terminal
B+	Battery power supply terminal

04-11 CONVENTIONAL BRAKE SYSTEM

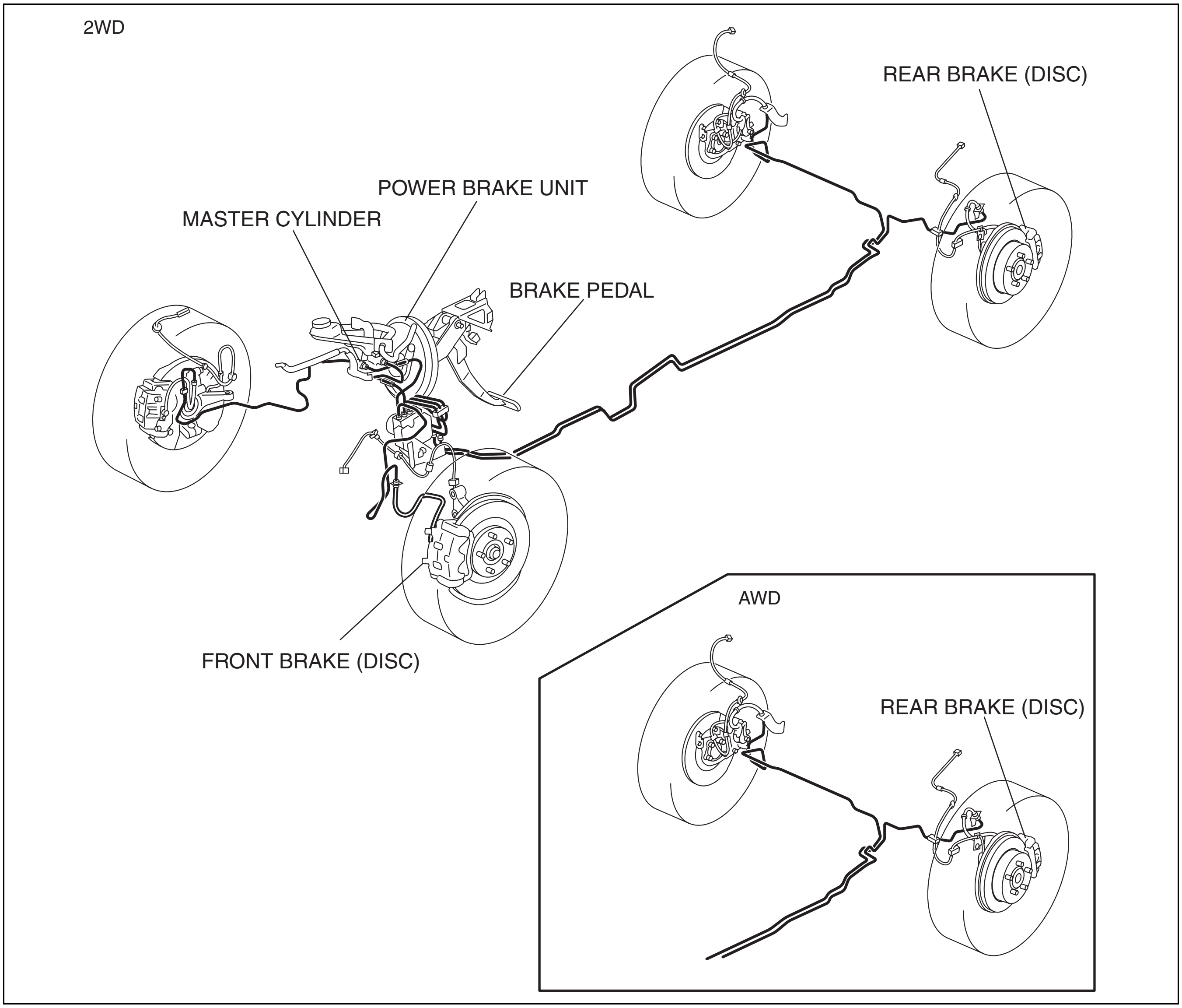
CONVENTIONAL BRAKE SYSTEM OUTLINE

id041100100100

- 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 has been adopted, improving braking force.
- High rigidity, 2-piston front brake calipers have been adopted on the front brakes for improved braking performance.
- Large diameter, ventilated discs have been adopted on the front and rear disc brakes for improved braking force.

CONVENTIONAL BRAKE SYSTEM STRUCTURAL VIEW

id041100100200



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INTRUSION-MINIMIZING BRAKE PEDAL FUNCTION

id041100100500

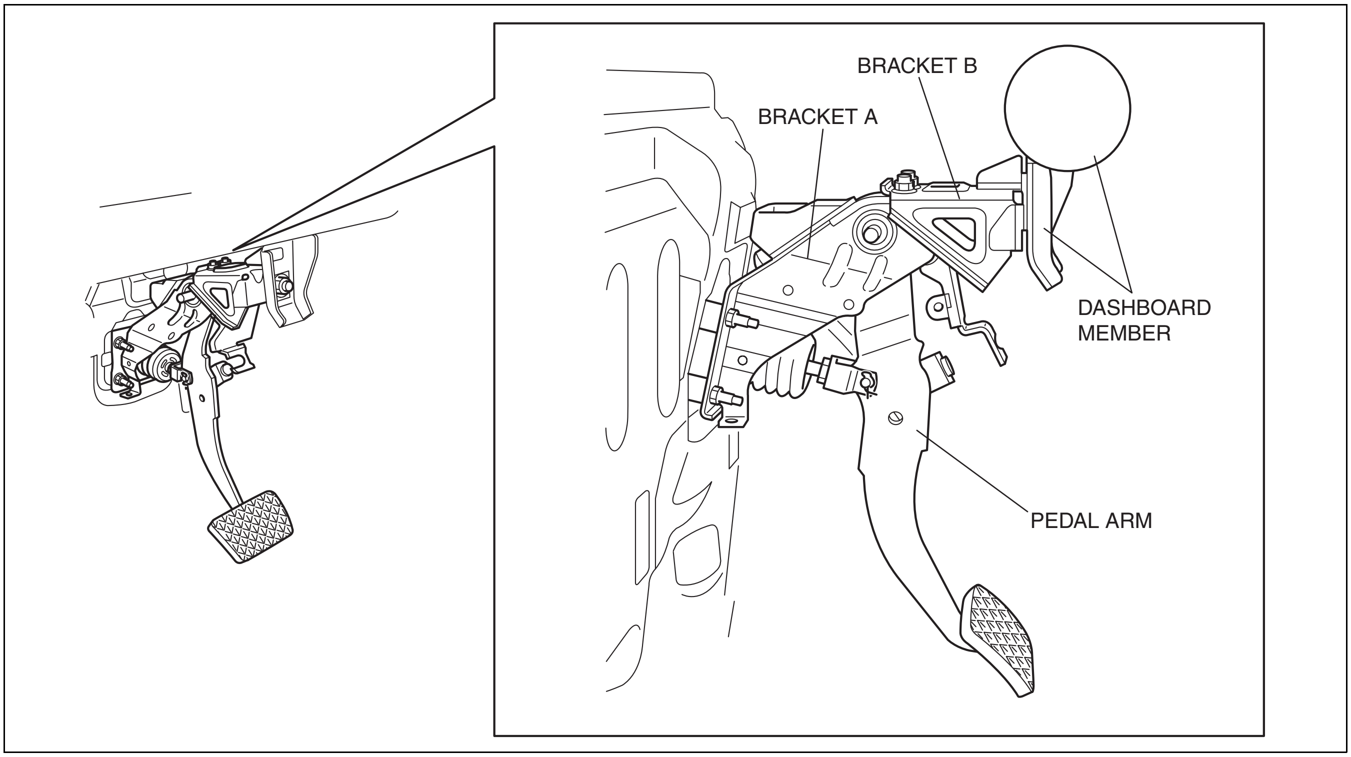
- An intrusion-minimizing brake pedal, which minimizes the amount of rearward pedal thrust in a frontal collision, has been adopted. Due to this, impact force to the lower body of the driver is softened.

INTRUSION-MINIMIZING BRAKE PEDAL CONSTRUCTION/OPERATION

id041100101000

Construction

- The intrusion minimizing brake pedal mechanism is structured to the brake pedal construction with the following parts.
  - — Pedal arm
  - — Bracket A
  - — Bracket B



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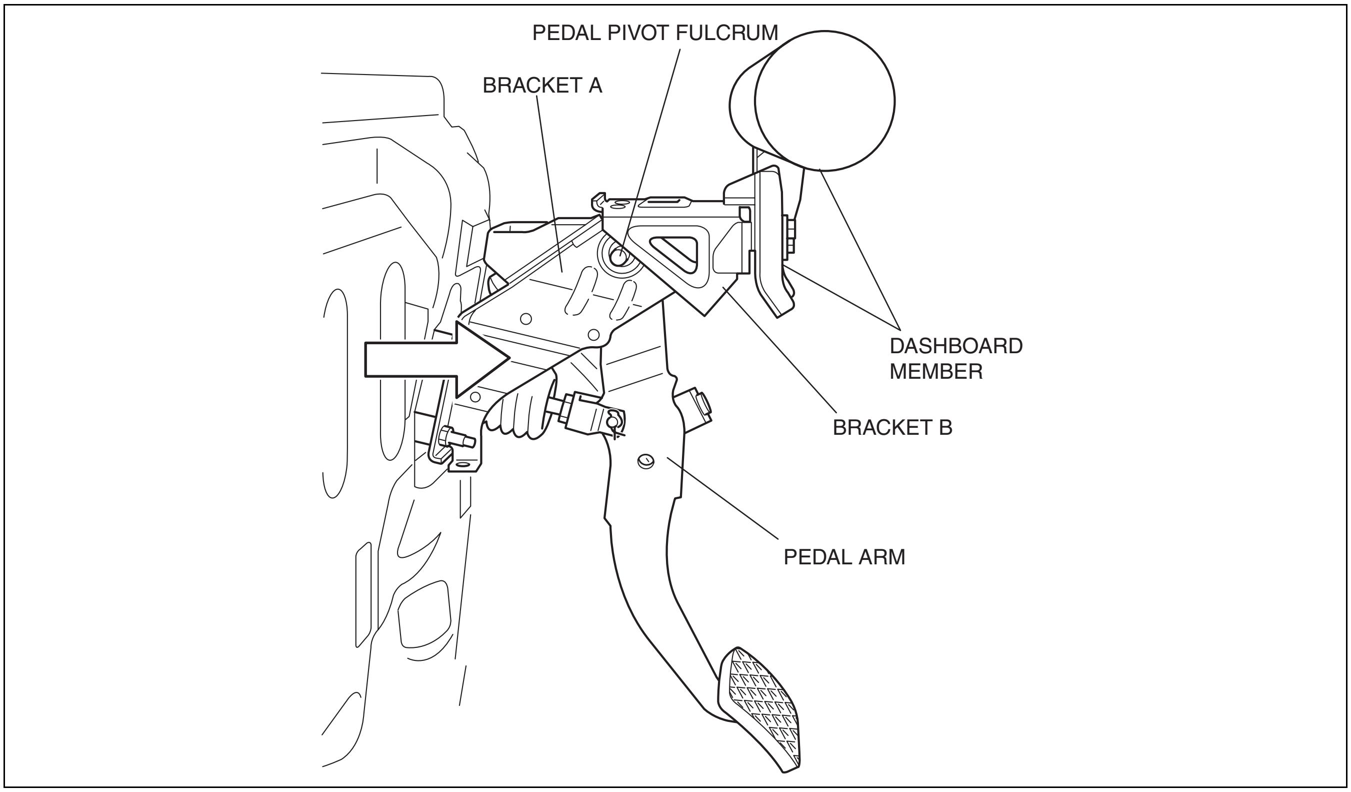
Operation

- In a frontal collision, the brake pedal is forced rearward by the movement of the engine and other parts.
- Bracket A, which is fixed to the body, detaches from bracket B, which is fixed to the dashboard member, allowing the pedal arm fulcrum to contact the incline of bracket B.



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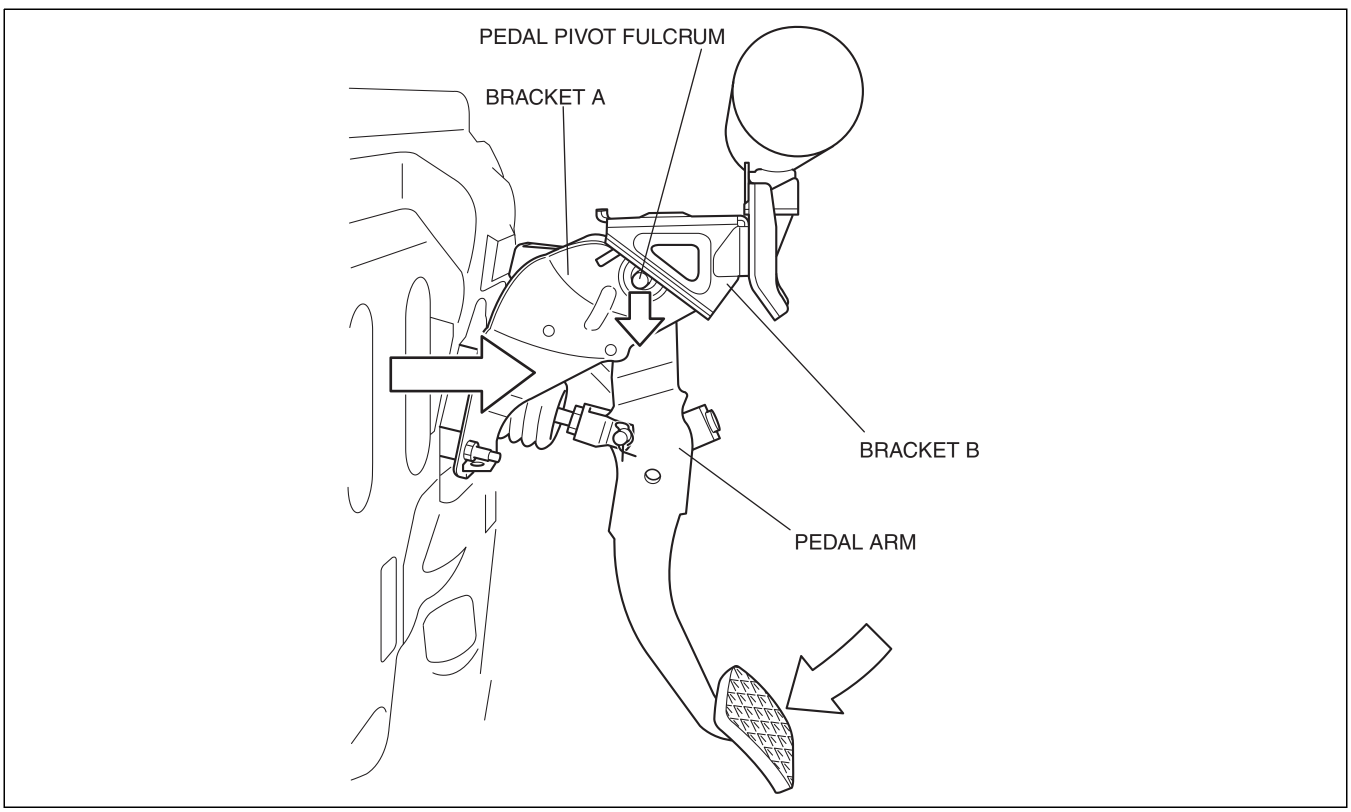
- As the amount of backward movement of the brake pedal increases, the pedal arm fulcrum point advances against the incline of bracket B, deforming bracket A.



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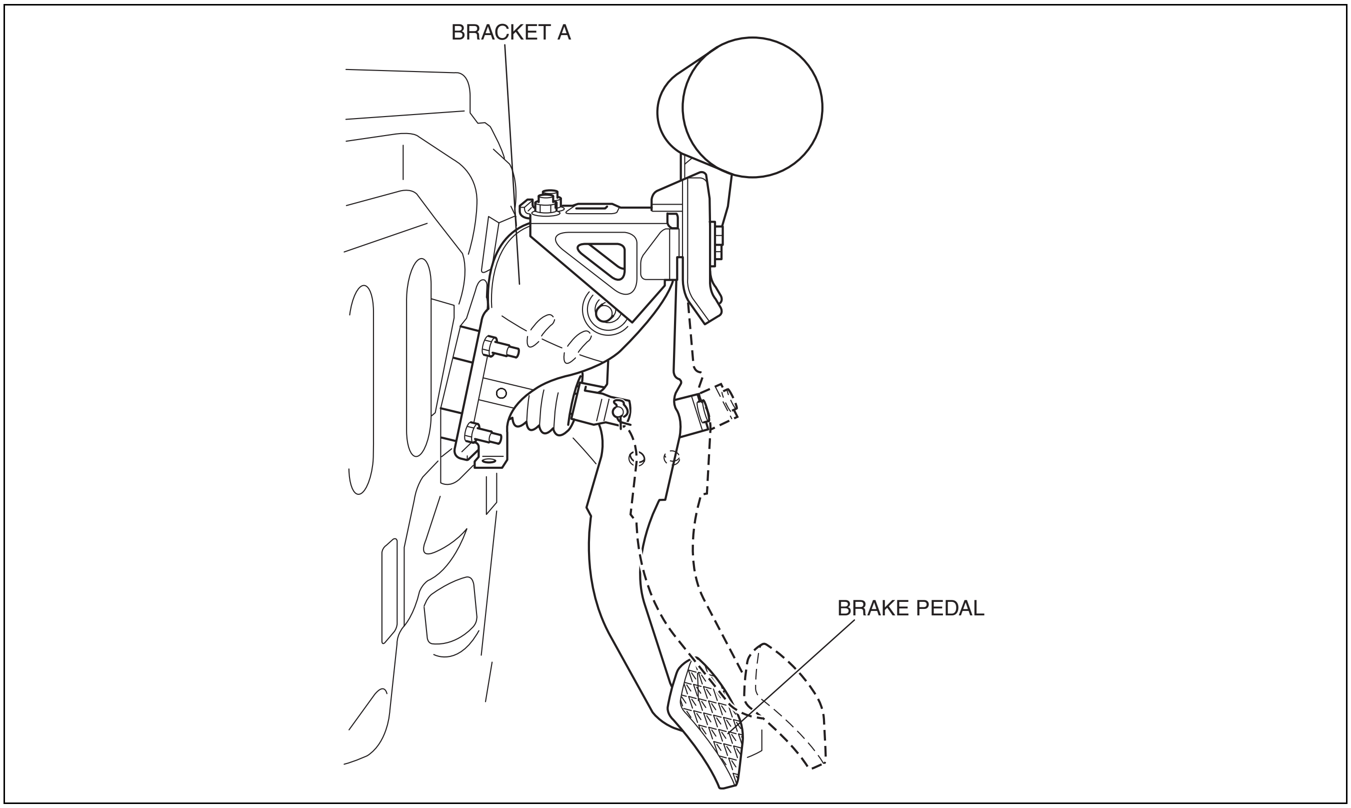
- The rearward movement of the brake pedal is prevented by the deformation of bracket A.



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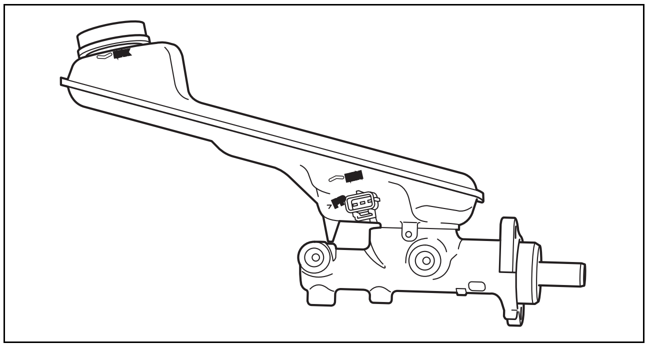
MASTER CYLINDER CONSTRUCTION

id041100100700

- 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.



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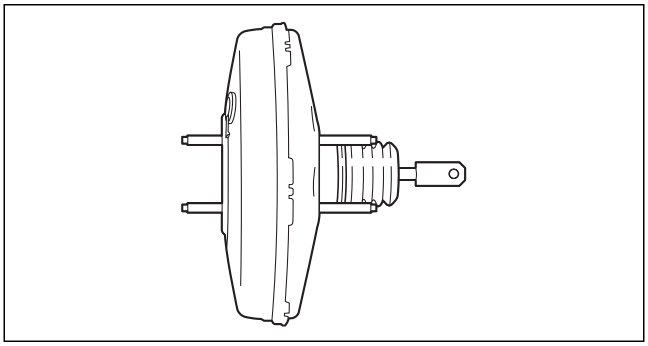
POWER BRAKE UNIT CONSTRUCTION

id041100101100

- A 10.5-inch, large diameter, single diaphragm type power brake unit has been adopted for all models, achieving compatibility between high braking performance and excellent brake feeling.



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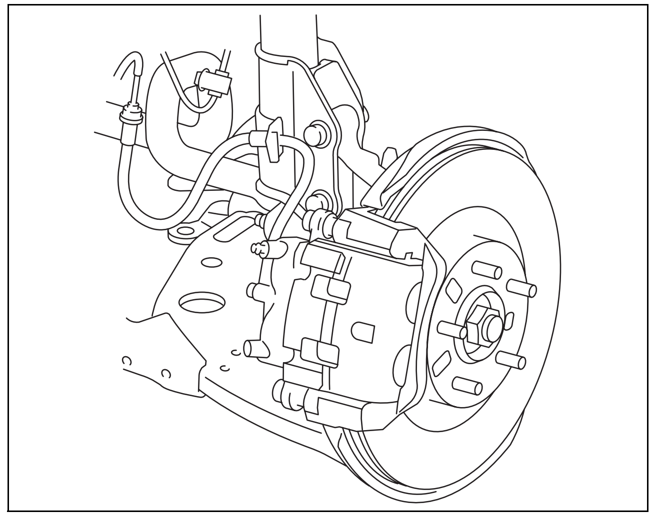
FRONT BRAKE (DISC) CONSTRUCTION

id041100100400

- A 17-inch brake, large diameter, ventilated disc type front brakes with a **320 mm {12.6 in}** diameter and a **28 mm {1.1 in}** thickness have been adopted, improving braking force and fade resistance.



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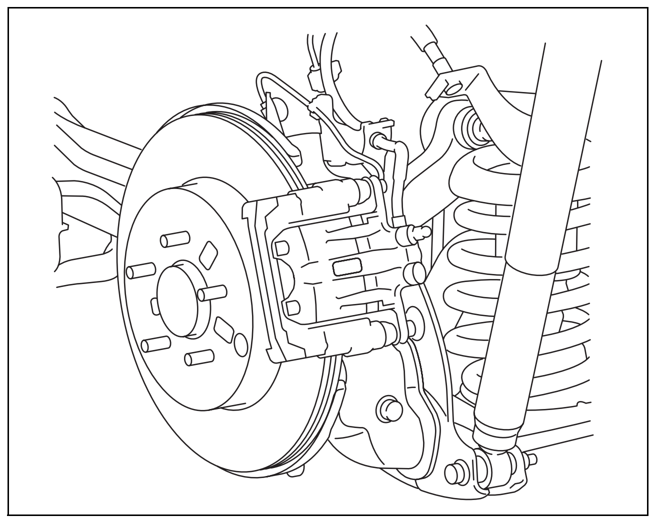
REAR BRAKE (DISC) CONSTRUCTION

id041100100300

- A 17-inch brake, large diameter, ventilated disc type rear brakes with a **325 mm {12.8 in}** diameter and **18 mm {0.71 in}** thickness have been adopted, improving braking force and fade resistance.
- In addition, the disc plate also serves as the parking drum.



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04-12 PARKING BRAKE SYSTEM

04-12

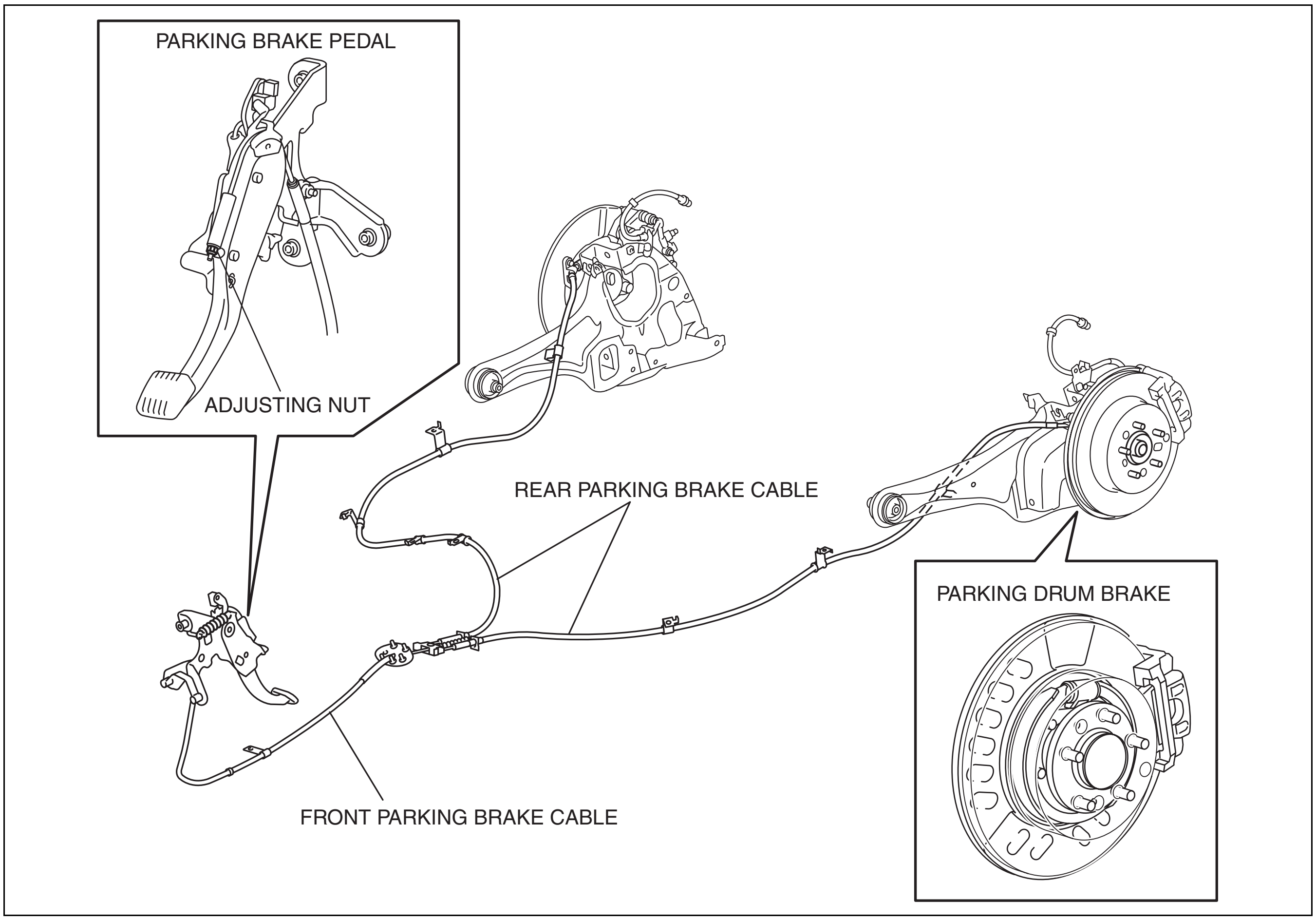
PARKING BRAKE SYSTEM OUTLINE

id041200100100

- A drum-in-disc type parking brake has been adopted for improved braking force of both the regular brakes and the parking brake, and improved reliability.
- Parking brake pedal adjustment can be performed more easily from the cabin interior realizing improved serviceability.

PARKING BRAKE SYSTEM STRUCTURAL VIEW

id041200100200



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PARKING BRAKE SYSTEM CONSTRUCTION/OPERATION

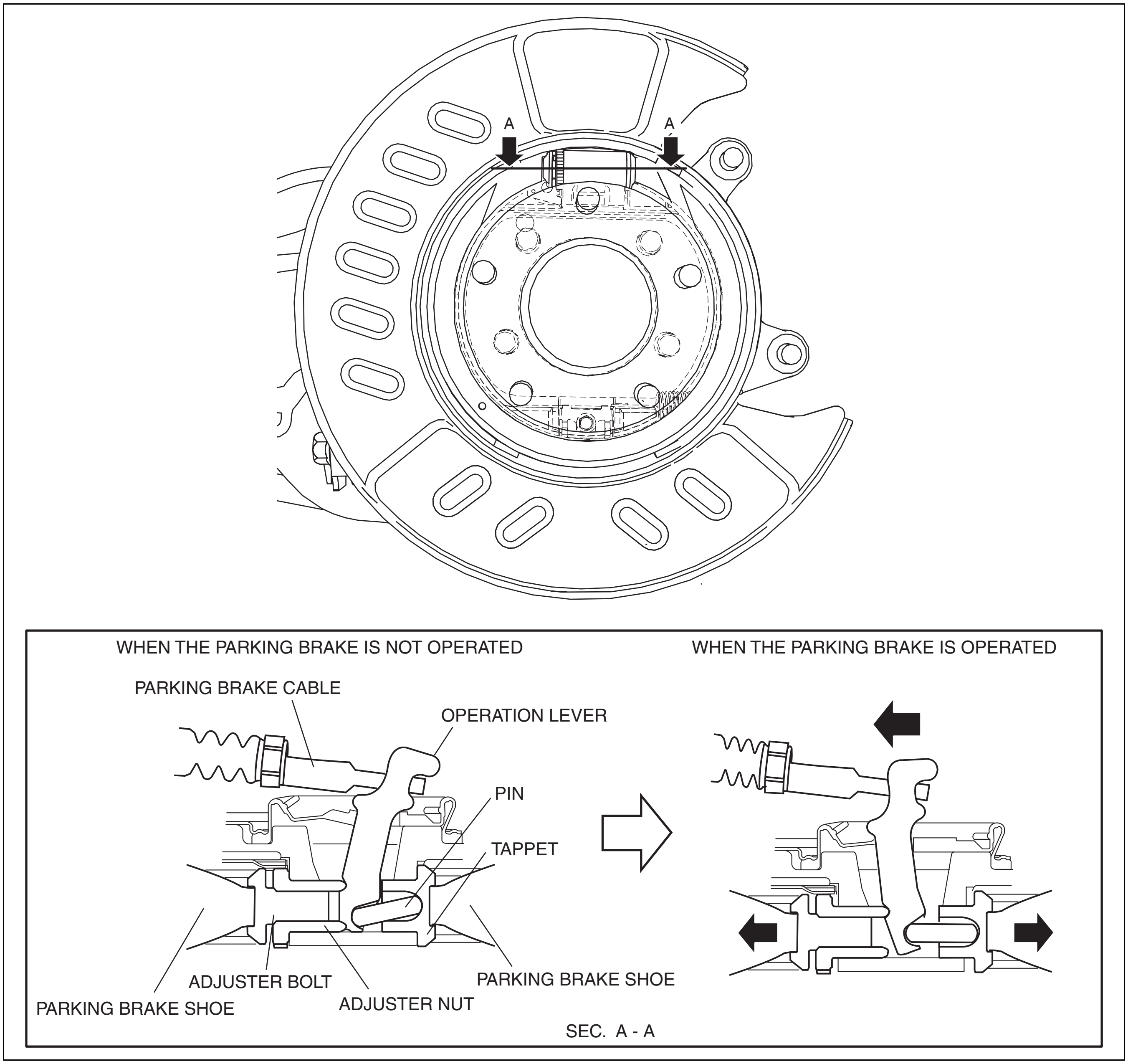
id041200100300

Construction

- The parking brake mechanism of vehicles with rear disc brakes mainly consists of a disc plate with parking drum function, parking brake shoe, and operation lever.

Operation

- By depressing the parking brake pedal, the operation lever is moved via the parking brake cable in the direction shown by the arrow in the figure. Due to the movement of the operation lever, the right and left adjusters press the parking brake shoes in the expansion direction. Due to this, the parking brake shoes press against the brake drum, applying braking force.
- When the parking brake is released, the force of the parking brake shoes returning to their original position is utilized.
- The parking brake shoe clearance is adjusted by the rotation of the adjuster screw.



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04-18 DYNAMIC STABILITY CONTROL/ROLL STABILITY CONTROL

DSC/RSC OUTLINE

id041800817600

- The dynamic stability control (DSC)/roll stability control (RSC) HU/CM, integrating both the hydraulic unit (HU) and control module (CM), has been adopted, resulting in a size and weight reduction.
- A combined sensor, integrating both the yaw rate sensor, roll rate sensor, forward-G sensor and lateral-G sensor, has been adopted, improving serviceability.
- An enhanced malfunction diagnosis system, used with the Mazda Modular Diagnostic System (M-MDS), has been adopted, improving serviceability.

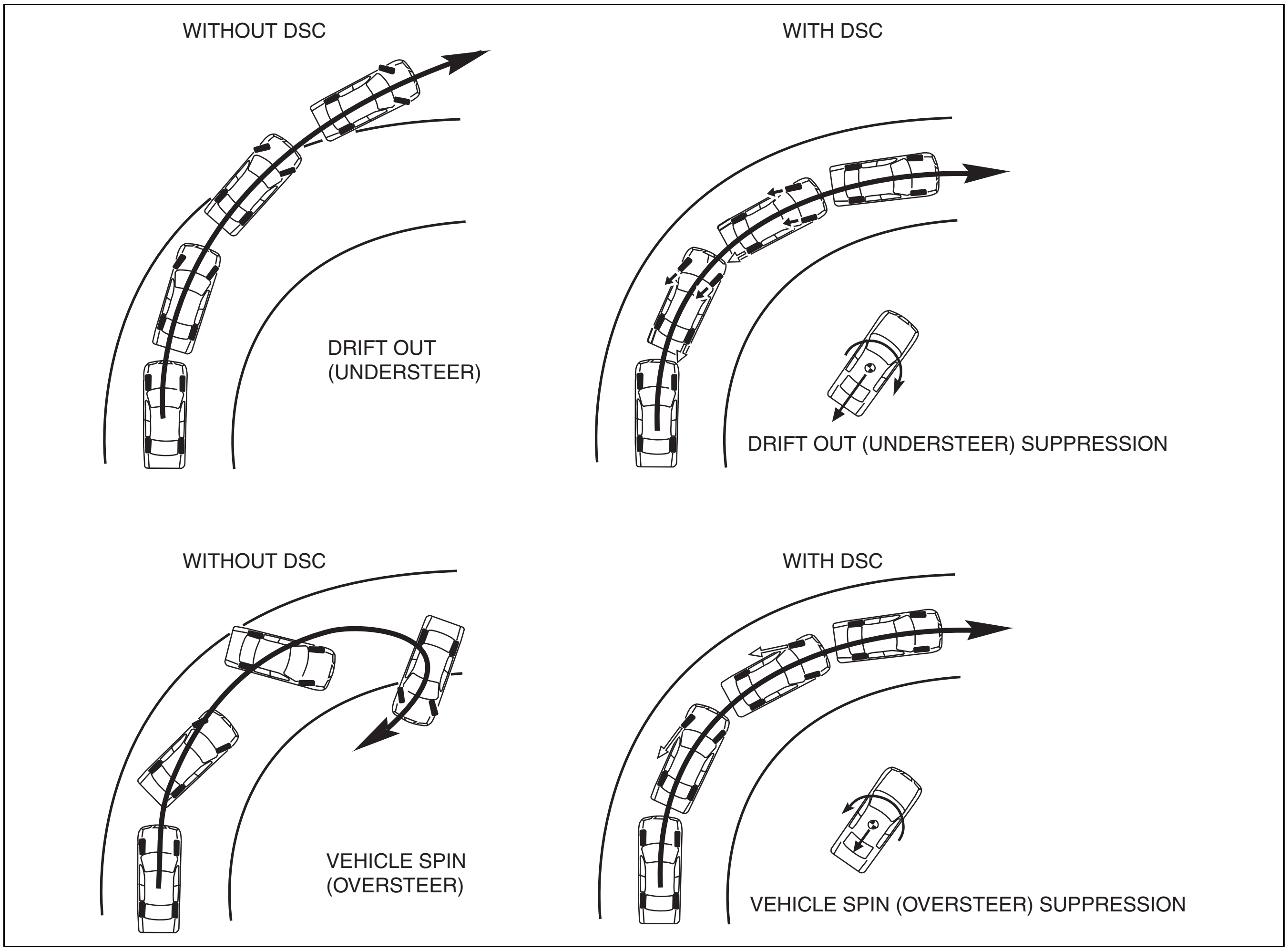
RSC Operation Outline

- The dynamic stability control (DSC)/roll stability control (RSC) system monitors the signal from the roll rate sensor and each sensor, and calculates if the vehicle may be approaching a situation where rollover is probable. When this occurs, the DSC/RSC system applies preemptive action.

DSC Operation Outline

- The antilock brake system (ABS) prevents wheel lock-up during braking. The traction control system (TCS) detects drive wheel spin due to the accelerator pedal being pressed too hard or similar causes and controls engine speed to suppress wheel spin. With these systems, safety is assured when driving or stopping.
- Additionally, sudden changes in vehicle attitude, due to evasive steering or road conditions, are controlled by the DSC. The DSC suppresses vehicle sideslip when driving due to vehicle spin (oversteer) or drift-out (understeer) by controlling braking and engine speed. At this time, the DSC indicator light illuminates to alert the driver that the DSC is operating due to a dangerous situation. As a result, the driver can calmly react and is provided leeway for the next maneuver, resulting in safe driving conditions.
- In this way the combination of DSC + ABS + TCS ensures driving, stopping and turning safety in all aspects.

Results Of DSC Operation



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Caution

- **While the DSC is a steering safety system, it does not improve normal steering function. Therefore, always drive carefully, even if the vehicle has DSC, and do not overestimate the DSC capability.**
- **The DSC and ABS will not operate normally under the following conditions:**
  - **— With tires that are not of the specified size, manufacturer or tread pattern, or not inflated according to specification**
  - **— With tires that have significant comparative wear variation**
  - **— With tire chains**

DSC/RSC STRUCTURAL VIEW

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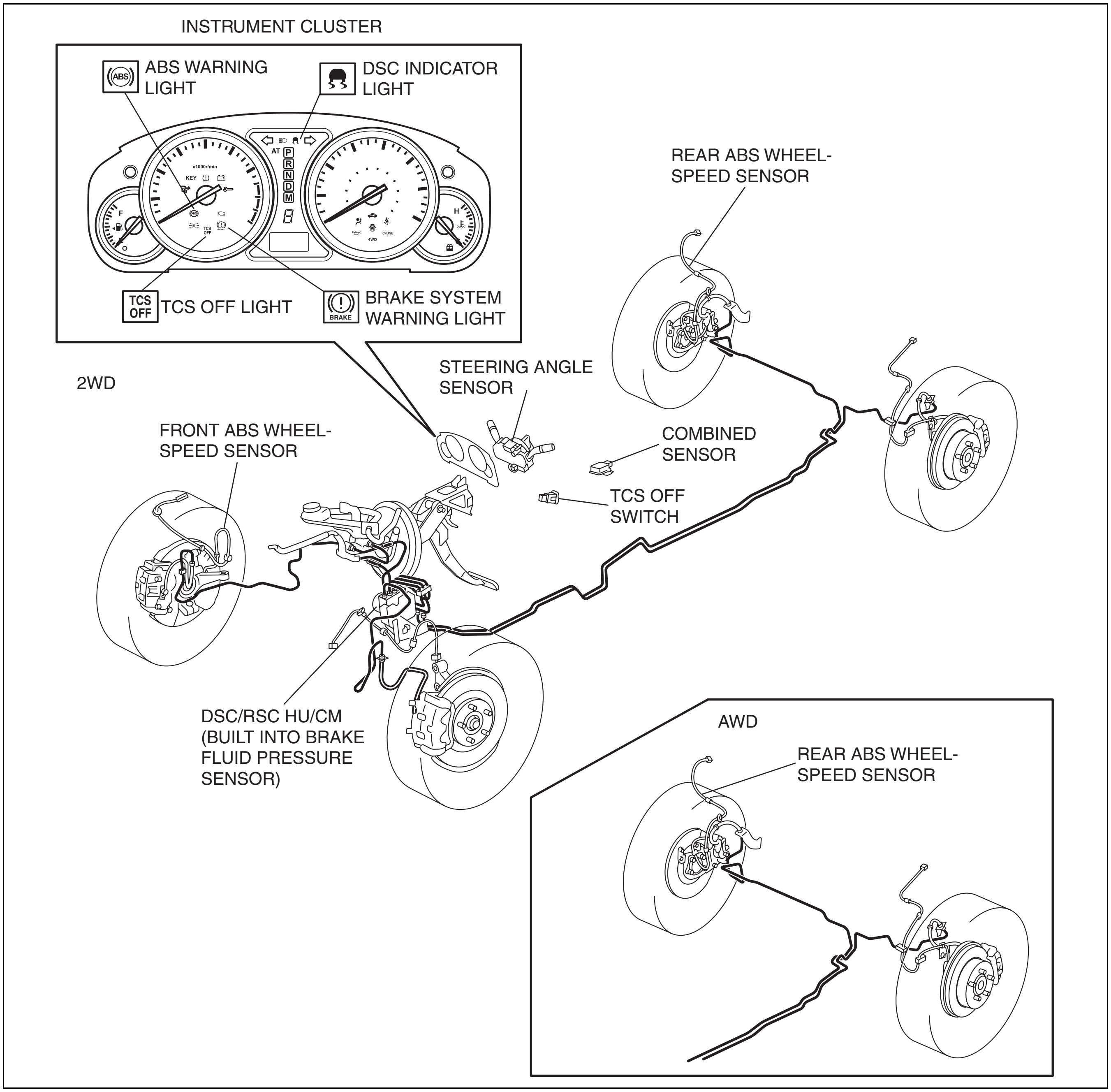

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DSC/RSC CONSTRUCTION

id041800817800

- The dynamic stability control (DSC)/roll stability control (RSC) system consists of the following parts. While each part has a regular function in other systems, only the function during DSC/RSC control is listed.

Part name	Function
DSC/RSC HU/CM	• Makes calculations using input signals from each sensor, controls brake fluid pressure to each wheel, and actuates each function (ABS, EBD, TCS, DSC and RSC) of the DSC/RSC system. • Outputs the torque reduction request signal, vehicle speed signal and DSC/RSC system warning control data via CAN lines. • Controls the on-board diagnostic system and fail-safe function when there is a malfunction in the DSC/RSC system.
PCM	• Controls engine output based on signals from the DSC/RSC HU/CM. • Transmits engine speed, tire and shift position data via CAN communication to the DSC/RSC HU/CM.
TCM	• Transmits gear/selector lever target position data via CAN communication to the DSC/ RSC HU/CM.
DSC indicator light	• Informs the driver that the RSC is operating. • Informs the driver that the DSC is operating (vehicle sideslip occurring). • Informs the driver that the TCS is operating (drive wheel is spinning).
TCS OFF switch	• Transmits driver intention to release engine TCS control to the DSC/RSC HU/CM.
TCS OFF light	• Informs driver that engine TCS control has been released due to TCS OFF switch operation.
ABS wheel-speed sensor	• Detects the rotation condition of each wheel and transmits it to the DSC/RSC HU/CM.
Combined sensor	• Detects the lateral-G (vehicle speed increase), forward-G (vehicle speed increase), yaw rate (vehicle turning angle) and roll rate (vehicle rolling angle) of the vehicle and transmits them to the DSC/RSC HU/CM.
Brake fluid pressure sensor (Builtinto DSC/RSC HU/CM)	• Detects the fluid pressure from the master cylinder and transmits it to the DSC/RSC HU/CM.
BCM	• Transmits the steering angle and steering angle sensor condition via CAN lines to the DSC/RSC HU/CM.

DSC/RSC SYSTEM WIRING DIAGRAM

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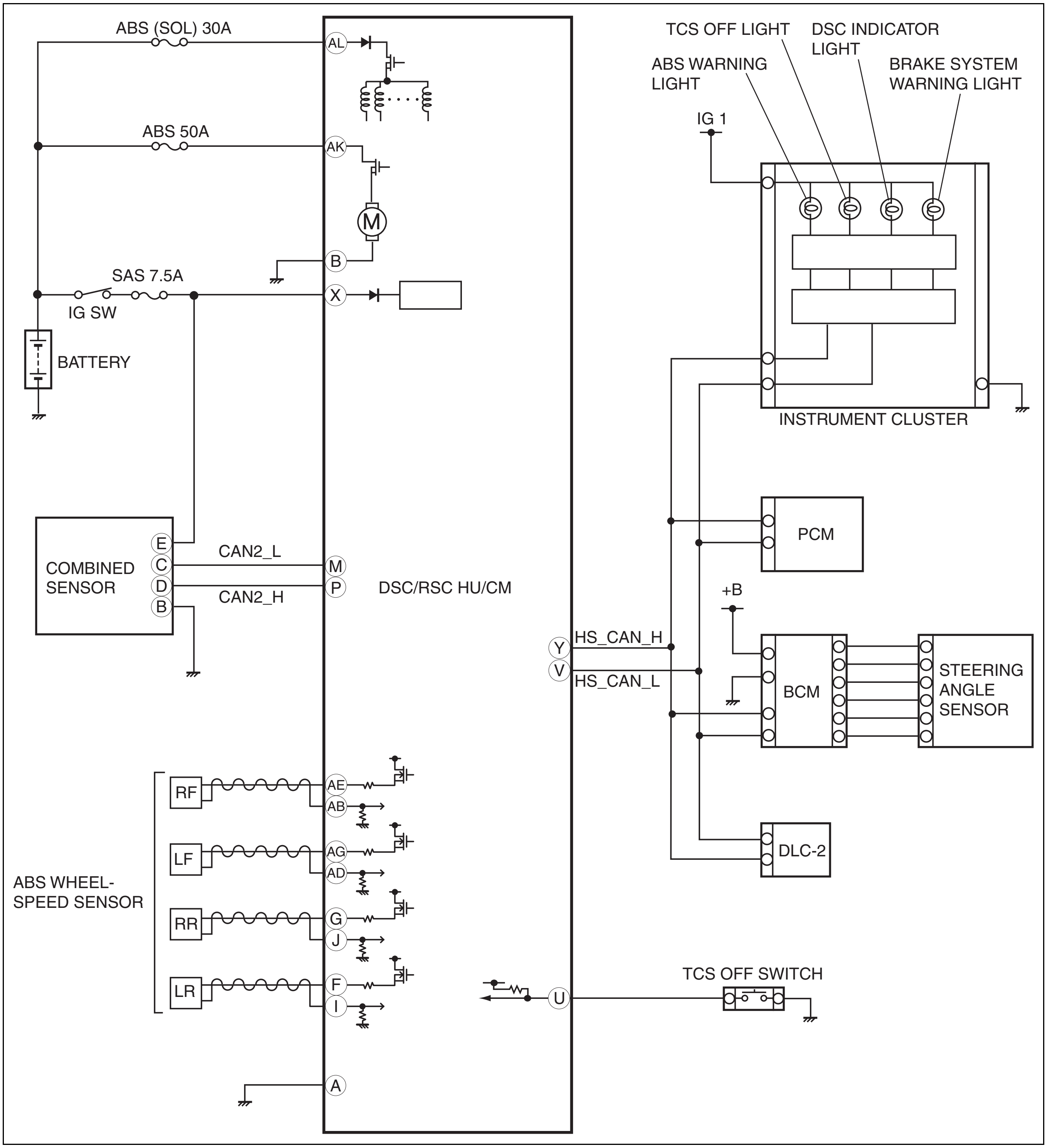

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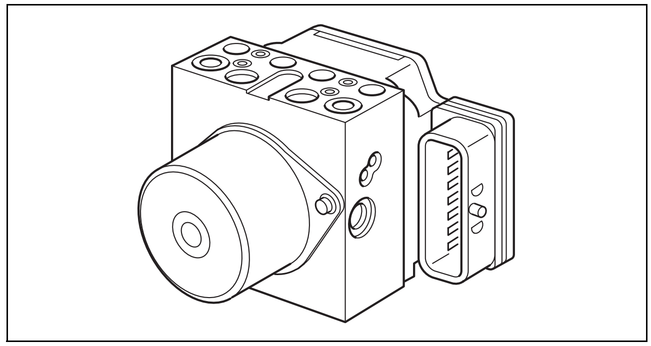
DSC/RSC HU/CM CONSTRUCTION

id041800818000

- A high reliability, reduced size and weight dynamic roll stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module CM, integrating both the DSC/RSC HU and the DSC/RSC CM, has been adopted.



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DSC/RSC HU PART FUNCTION

id041800818100

- According to dynamic stability control (DSC)/roll stability control (RSC) control module (CM) signals, the DSC/RSC hydraulic unit (HU) controls (on/off) each solenoid valve and the pump motor, adjusts fluid pressure in each caliper piston, and actuates each function (antilock brake system (ABS), electronic brakeforce distribution (EBD), traction control system (TCS), DSC and RSC) of the DSC/RSC system.

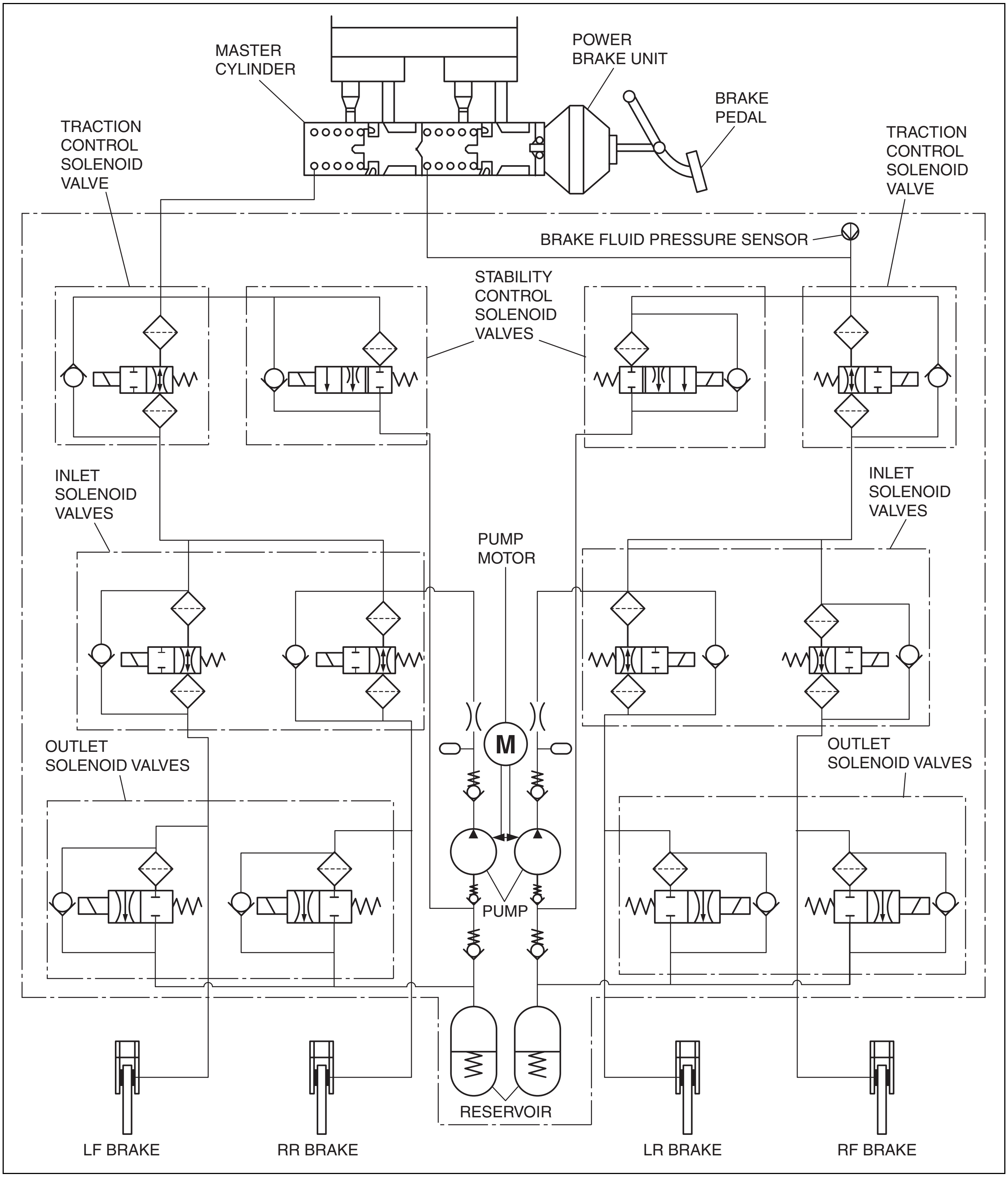
DSC/RSC HU PART CONSTRUCTION/OPERATION

id041800818200

Construction
Function of main component parts

Part name	Function
Inlet solenoid valve	• Adjusts the fluid pressure in each brake system according to DSC/RSC HU/CM signals.
Outlet solenoid valve	• Adjusts the fluid pressure in each brake system according to DSC/RSC HU/CM signals.
Stability control solenoid valve	• Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control and DSC control, RSC control.
Traction control solenoid valve	• Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control and DSC control, RSC control.
Reservoir	• Temporarily stores brake fluid from the caliper piston to ensure smooth pressure reduction during ABS and EBD control, TCS control and DSC control, RSC control.
Pump	• Returns the brake fluid stored in the reservoir to the master cylinder during ABS and DSC control, RSC control. • Increases brake fluid pressure and sends brake fluid to each caliper piston during TCS control and DSC control, RSC control.
Pump motor	• Operates the pump according to DSC/RSC HU/CM signals.

Hydraulic circuit diagram



Operation

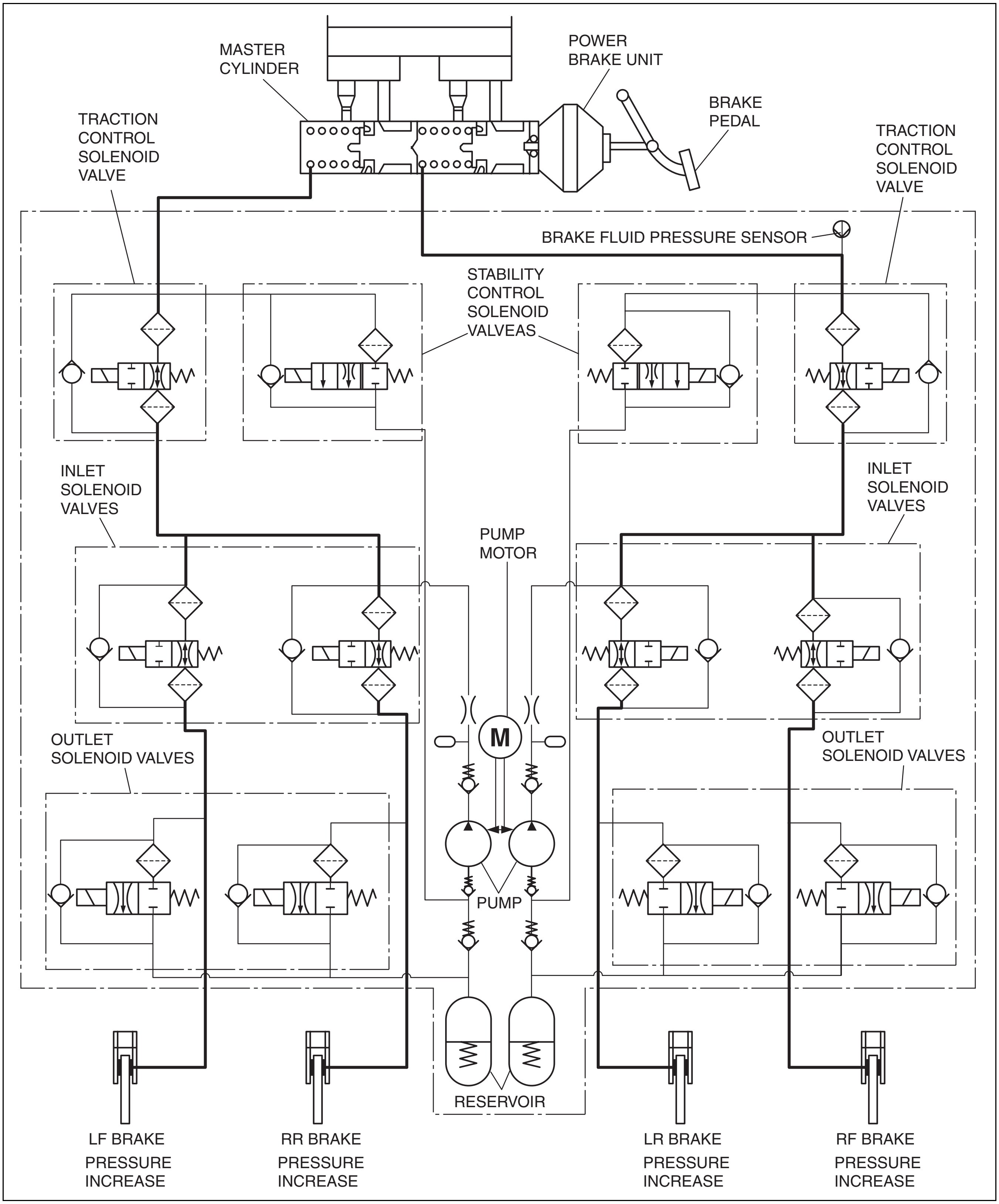
During normal braking

- 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 traction switch and inlet solenoid valves, and then to the caliper piston.

Solenoid valve operation table

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

Hydraulic circuit diagram



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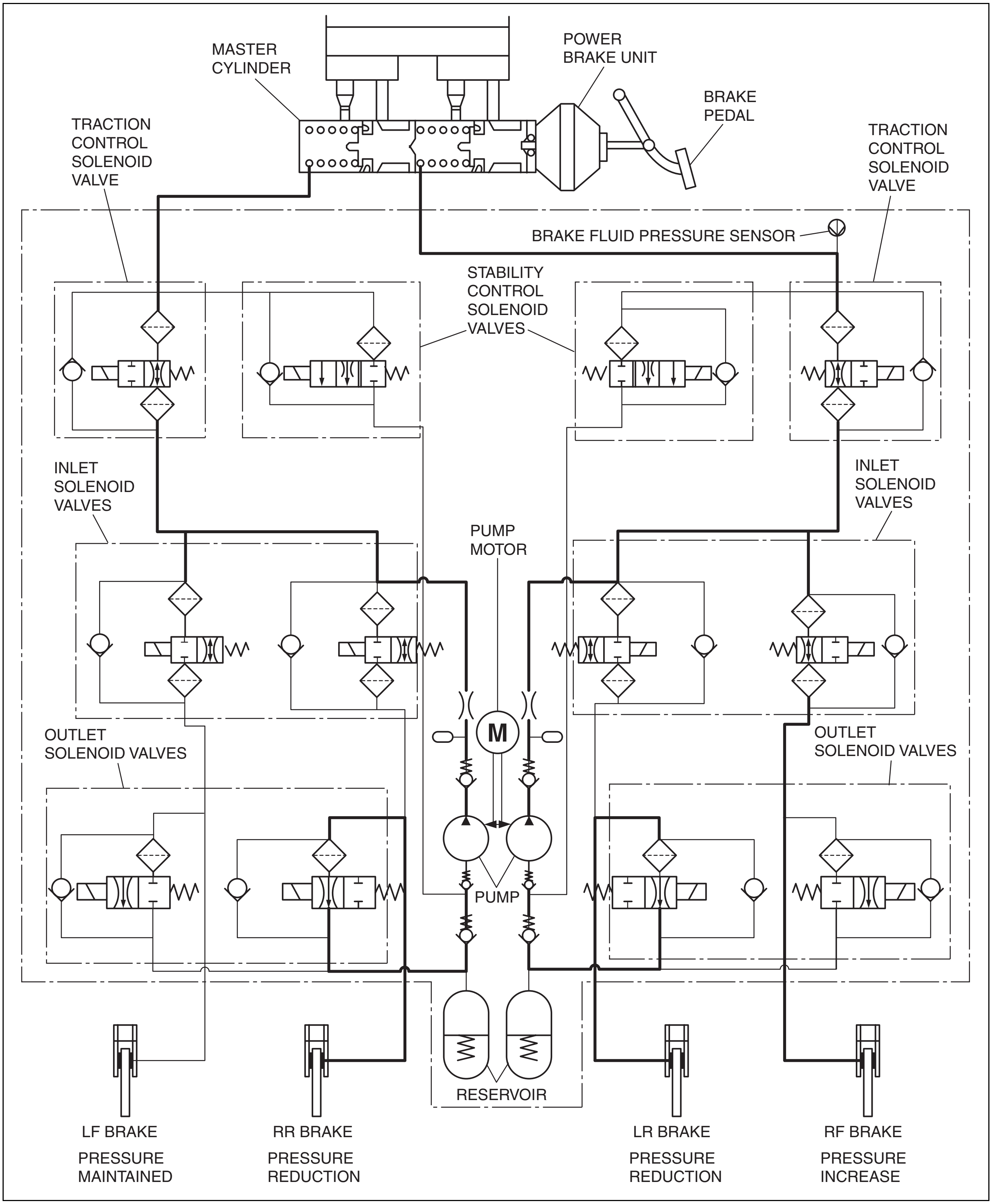
During ABS and EBD control

- During antilock brake system (ABS) and electronic brake force distribution (EBD) control, when wheel lock-up is about to occur, the traction switch and stability control solenoid valves are not energized, and the inlet and outlet solenoid valves are energized and controlled in three pressure modes (increase, reduction or maintain), 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 following figure shows these conditions: right front wheel pressure increased, left front wheel pressure maintained, and both rear wheels pressure decreased.)

Solenoid valve operation table

	Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
	LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
During Pressure increase mode	OFF (open)		OFF (closed)		OFF (open)				OFF (closed)				Stopped
During pressure maintain mode	OFF (open)		OFF (closed)		ON (closed)				OFF (closed)				Stopped
During pressure reduction mode	OFF (open)		OFF (closed)		ON (closed)				ON (open)				Operating

Hydraulic circuit diagram



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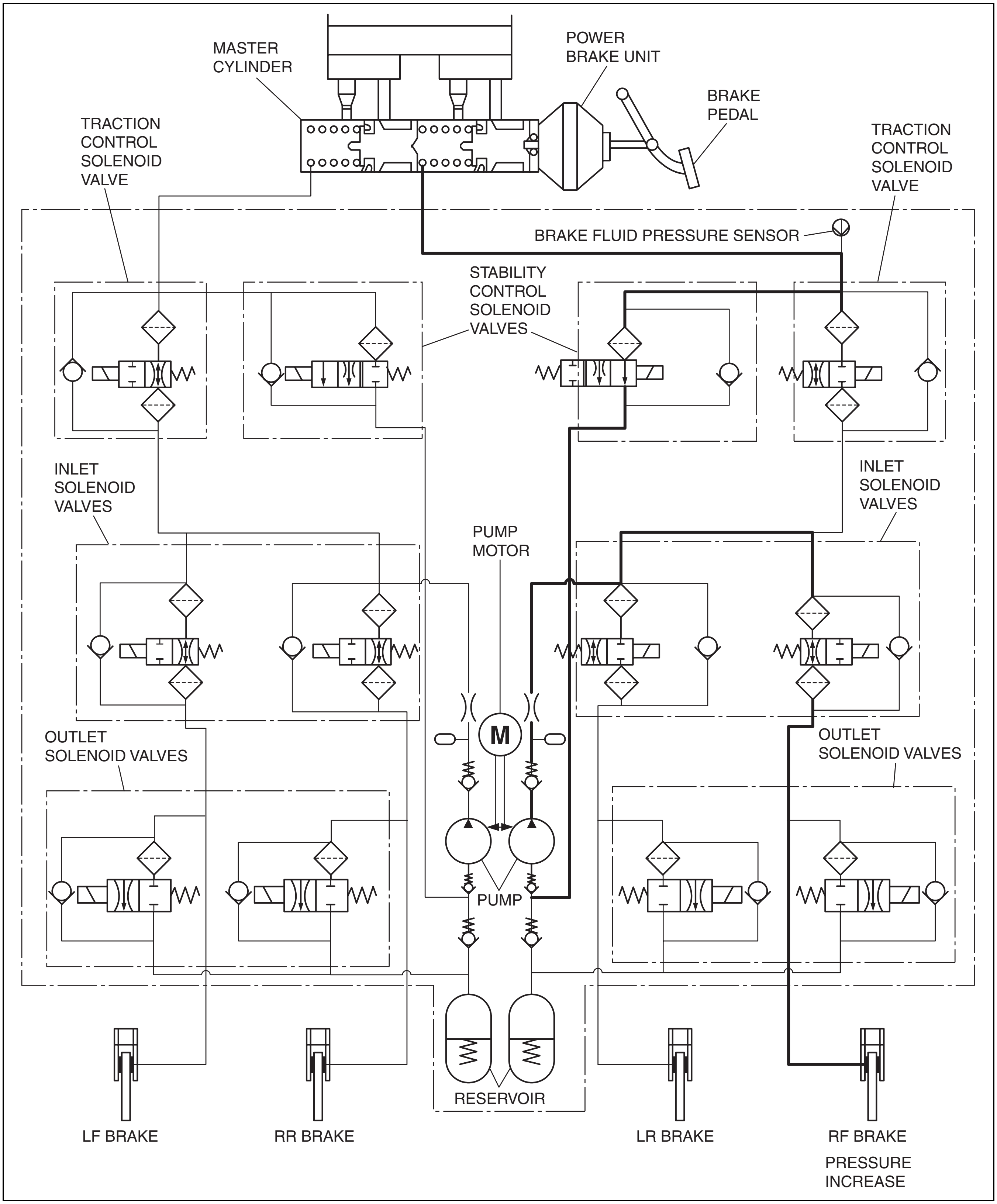
During DSC control (suppress oversteer tendency) and TCS control

- When a large oversteer tendency or driving wheel spin is determined, the traction control solenoid and stability control solenoid valves are energized, switching the hydraulic circuits. At the same time, the pump motor is actuated to operate the pump, thereby increasing pressure by supplying brake fluid pressure to the caliper piston of the outer front wheel or the slipping driving wheel. Also at this time, the inlet solenoid valve of the inner rear wheel is energized and the hydraulic circuit of this wheel is closed.
- After a pressure increase, brake fluid pressure is adjusted using the three pressure modes (reduction, maintain, increase) so that the target wheel speed is obtained. (The following figure shows a left turn, or control of right front wheel spin (during pressure increase mode).)

Solenoid valve operation table

<table>
<tr><th rowspan="2"></th><th colspan="2">Traction control solenoid valve</th><th colspan="2">Stability control solenoid valve</th><th colspan="4">Inlet solenoid valve</th><th colspan="4">Outlet solenoid valve</th><th rowspan="2">Pump motor, pump</th></tr>
<tr><th>LF—RR</th><th>RF—LR</th><th>LF—RR</th><th>RF—LR</th><th>LF</th><th>RF</th><th>LR</th><th>RR</th><th>LF</th><th>RF</th><th>LR</th><th>RR</th></tr>
<tr><td>During pressure increase mode</td><td colspan="2">ON (closed)</td><td>OFF (closed)</td><td>ON (open)</td><td>ON (closed)</td><td>OFF (open)</td><td>ON (closed)</td><td>OFF (open)</td><td colspan="4">OFF (closed)</td><td>Operating</td></tr>
<tr><td>During pressure maintain mode</td><td>OFF (open)</td><td>ON (closed)</td><td colspan="2">OFF (closed)</td><td>OFF (open)</td><td>ON (closed)</td><td>ON (closed)</td><td>OFF (open)</td><td colspan="4">OFF (closed)</td><td>Operating</td></tr>
<tr><td>During pressure reduction mode</td><td>OFF (open)</td><td>ON (closed)</td><td colspan="2">OFF (closed)</td><td>OFF (open)</td><td colspan="2">ON (closed)</td><td>OFF (open)</td><td>OFF (closed)</td><td>ON (open)</td><td>OFF (closed)</td><td>OFF (closed)</td><td>Operating</td></tr>
</table>

Hydraulic circuit diagram



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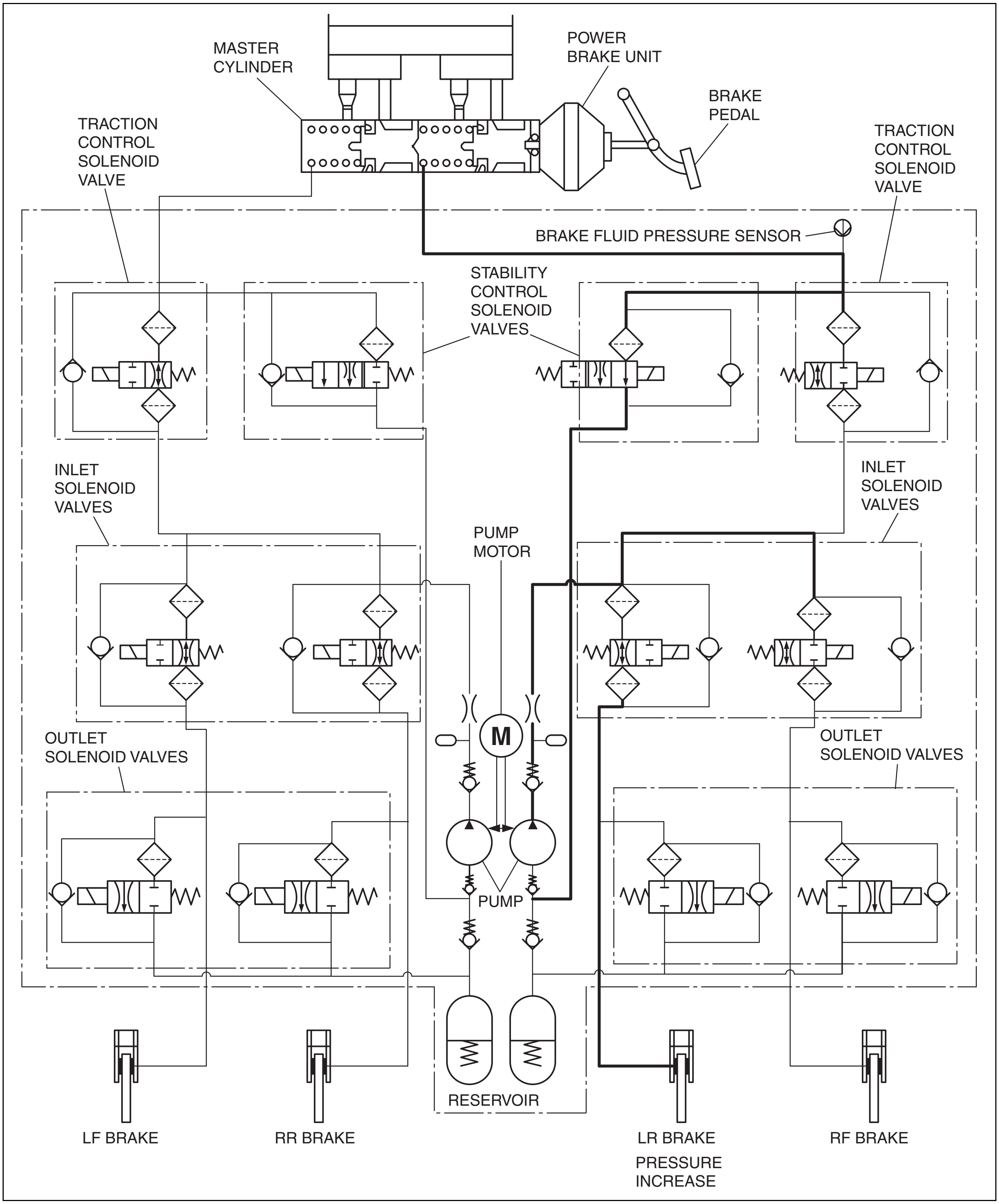
During DSC control (to suppress understeer tendency)

- When a large understeer tendency is determined, the traction control solenoid and stability control solenoid valves are energized, switching the hydraulic circuits. At the same time, the pump motor is actuated to operate the pump, supplying brake fluid pressure from the reservoir to the inner rear wheel cylinder. Also at this time, the pressure-retention solenoid valve of the outer front wheel is energized and the hydraulic circuit of this wheel is closed.
- After a pressure increase, brake fluid pressure is adjusted using the three pressure modes (reduction, maintain, increase) so that the target wheel speed is obtained. (The following figure shows control during a left turn during pressure increase mode.)

Solenoid valve operation table

<table>
<tr><th rowspan="2"></th><th colspan="2">Traction control solenoid valve</th><th colspan="2">Stability control solenoid valve</th><th colspan="4">Inlet solenoid valve</th><th colspan="4">Outlet solenoid valve</th><th rowspan="2">Pump motor, pump</th></tr>
<tr><th>LF—RR</th><th>RF—LR</th><th>LF—RR</th><th>RF—LR</th><th>LF</th><th>RF</th><th>LR</th><th>RR</th><th>LF</th><th>RF</th><th>LR</th><th>RR</th></tr>
<tr><td>During pressure increase mode</td><td colspan="2">ON (closed)</td><td>OFF (closed)</td><td>ON (open)</td><td>OFF (open)</td><td>ON (closed)</td><td colspan="2">OFF (open)</td><td colspan="4">OFF (closed)</td><td>Operating</td></tr>
<tr><td>During pressure maintain mode</td><td>OFF (open)</td><td>ON (closed)</td><td colspan="2">OFF (closed)</td><td>OFF (open)</td><td colspan="2">ON (closed)</td><td>OFF (open)</td><td colspan="4">OFF (closed)</td><td>Operating</td></tr>
<tr><td>During pressure reduction mode</td><td>OFF (open)</td><td>ON (closed)</td><td colspan="2">OFF (closed)</td><td>OFF (open)</td><td colspan="2">ON (closed)</td><td>OFF (open)</td><td colspan="2">OFF (closed)</td><td>ON (open)</td><td>OFF (closed)</td><td>Operating</td></tr>
</table>

Hydraulic circuit diagram



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DSC/RSC CM PART FUNCTION

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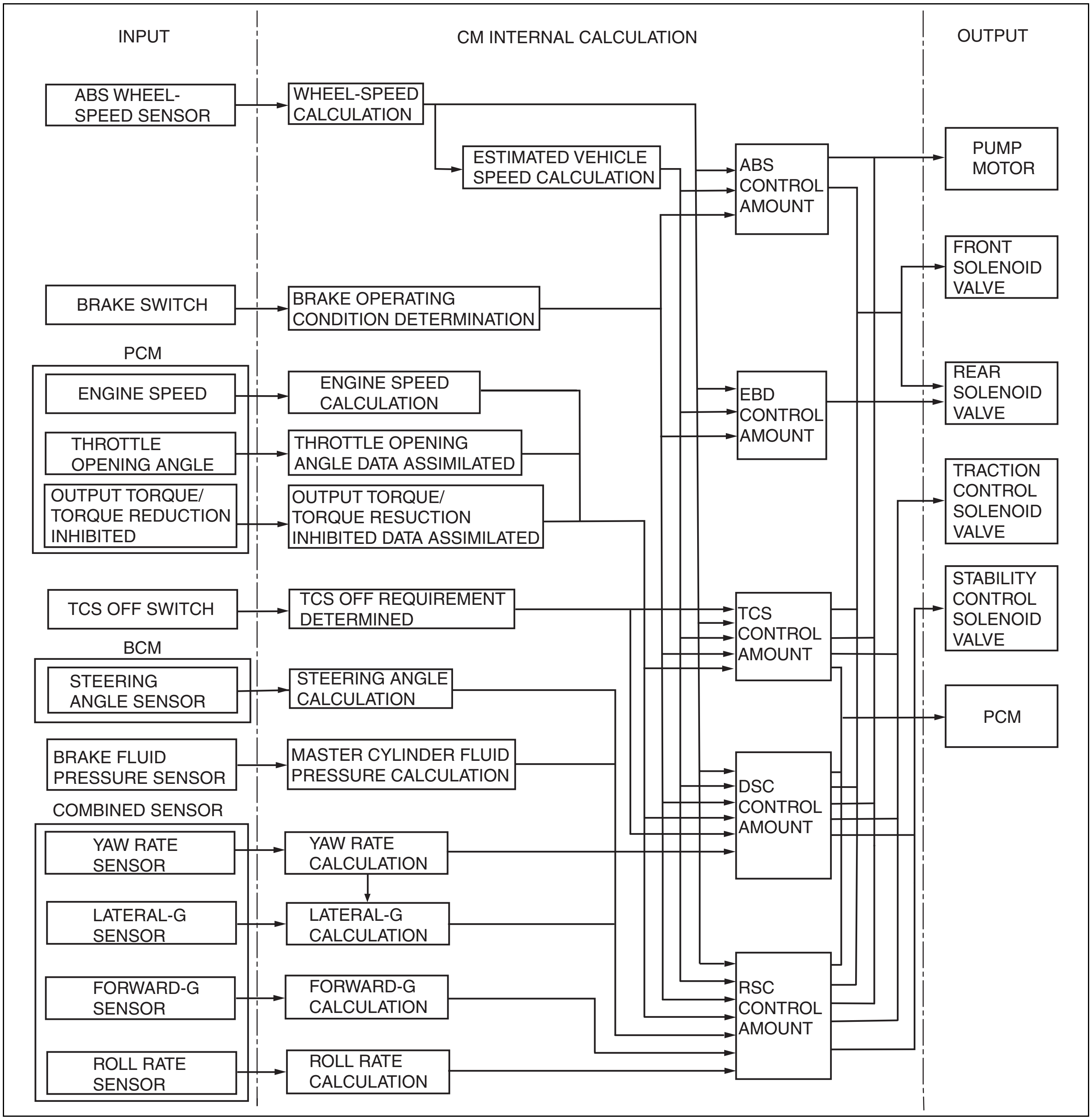
- The dynamic stability control (DSC)/roll stability control (RSC) control module (CM) makes calculations using signals input from each sensor, outputs a brake fluid pressure control signal to the DSC/RSC hydraulic unit (HU) to actuate DSC/RSC system functions and outputs an engine output control signal to the PCM.
- The DSC/RSC HU/CM controls the following functions:

Function Table

Function name	Contents
Antilock Brake System (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.
Traction Control System (TCS) control function	• Controls traction to within the road surface friction limit and according to road and driving conditions to improve starting and acceleration performance, and safety.
DSC control function	• Suppresses strong over-steer and under-steer tendencies when turning by controlling engine output and braking of each wheel to assure driving safety.
RSC control function	• Suppresses vehicle attitude due to overspeed during evasive steering or cornering by controlling engine speed and wheel braking to improve vehicle stability during cornering.
Brake assist function	• Controls the fluid of the wheel cylinder during emergency braking, provides increased fluid pressure to each wheels.
CAN signal function	• Transmits the wheel speed signal to the PCM using CAN communication.
On-board diagnostic system	• A function that allows important parts of the DSC/RSC control system to perform self-diagnosis. In case a malfunction occurs, the warning lights illuminate to alert the driver, and at the same time a DTC is stored in the DSC/RSC HU/CM. • When a malfunction is determined as a result of the on-board diagnosis test, system control is suspended or limited to prevent any dangerous situation while driving.

Block Diagram



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ABS CONTROL OUTLINE

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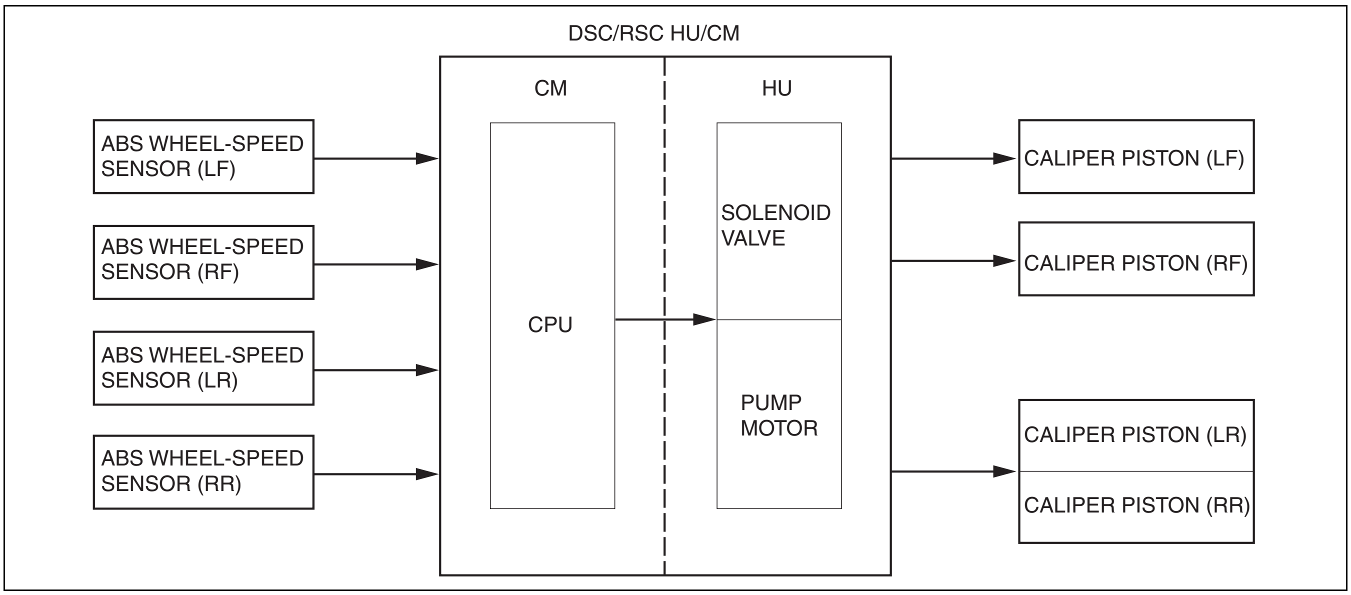
- Antilock brake system (ABS) control occurs when wheel slip is determined by the roll stability control (RSC) control module (CM) (based on the four ABS wheel-speed sensors). Then, the dynamic stability control (DSC)/ RSC hydraulic unit (HU) inlet and outlet solenoid valves are operated and brake fluid 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



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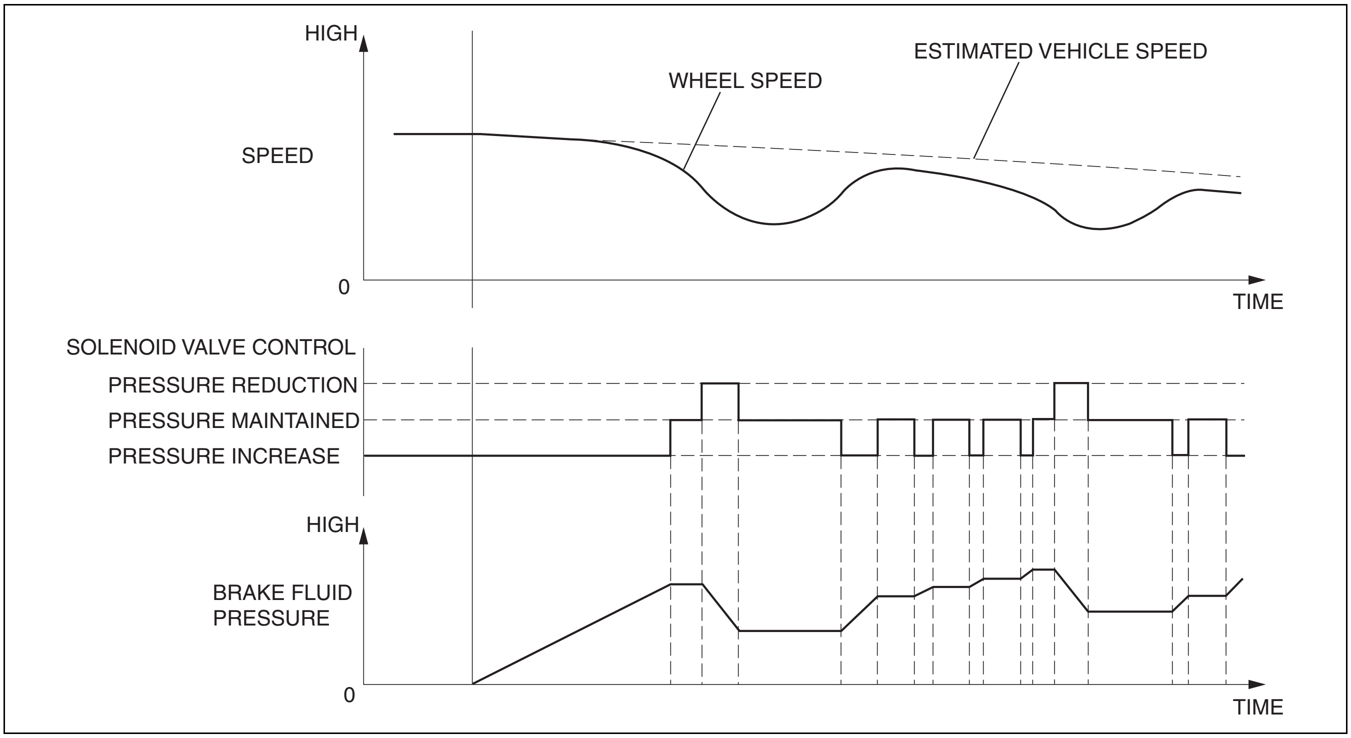
ABS CONTROL OPERATION

id041800818500

- When the dynamic stability control (DSC)/roll stability control (RSC) control module (CM) determines wheel slip conditions based on the signals from the antilock brake system (ABS) wheel-speed sensors during braking, the DSC/RSC CM operates the DSC/RSC hydraulic unit (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



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EBD CONTROL OUTLINE

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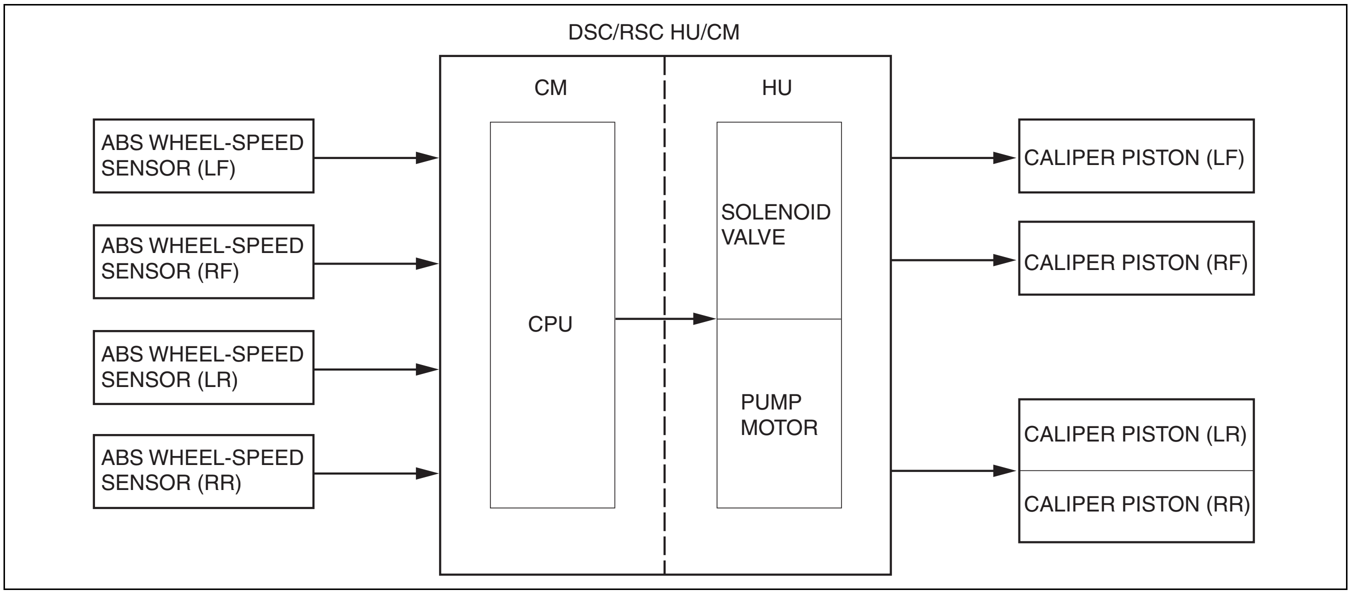
- Electronic brakeforce distribution (EBD) control uses the dynamic stability control (DSC)/roll stability control (RSC) system to control brake fluid pressure distribution to the rear wheels so that they do not lock-up prior to the front wheels during braking, thereby preventing the loss of handling stability.

Features

- 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



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EBD CONTROL OPERATION

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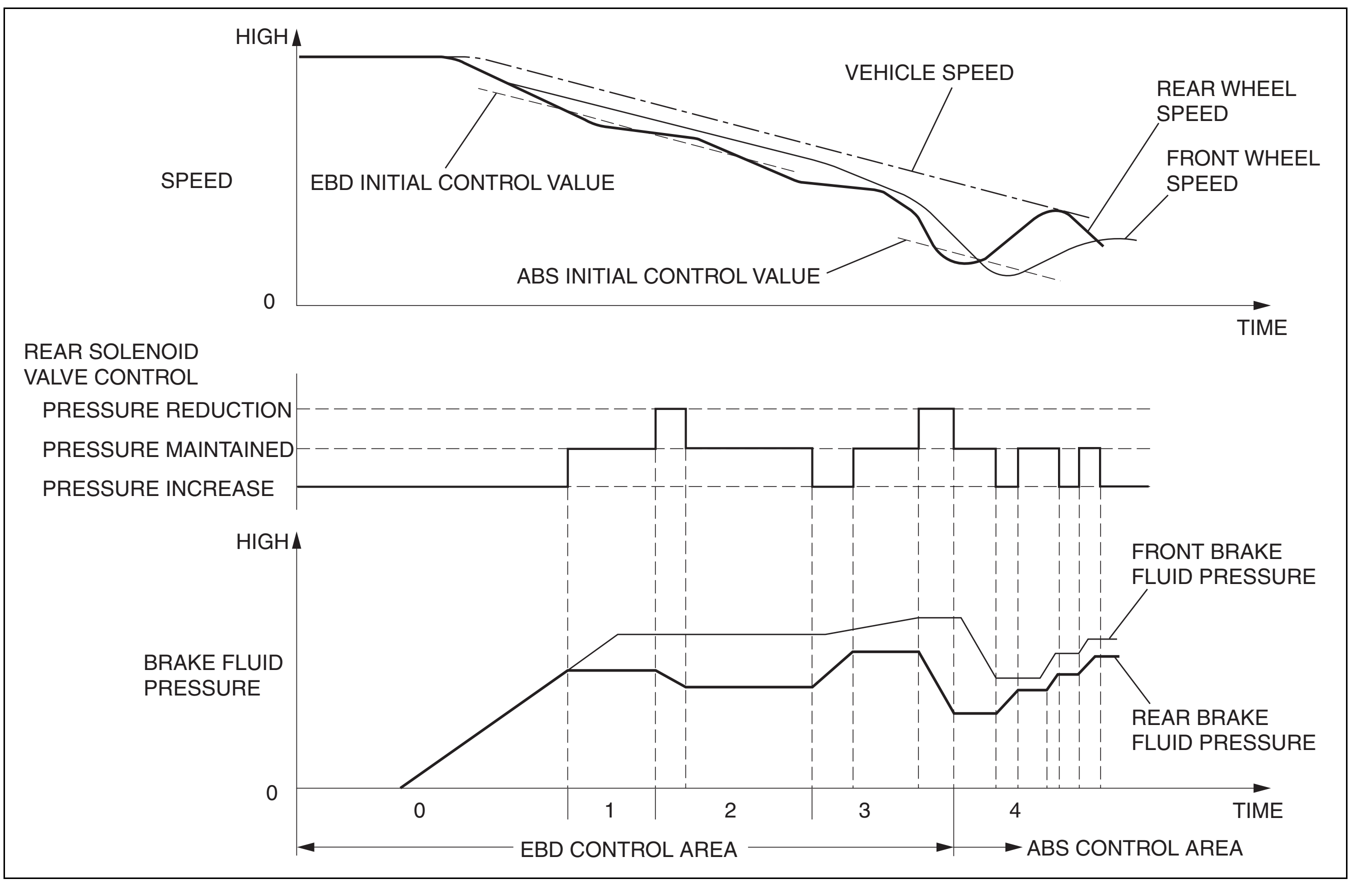
- Electronic brakeforce distribution (EBD) control detects the slip ratio between the front and rear wheels from the antilock brake system (ABS) wheel-speed sensor signals. If the slip ratio of the rear wheels as compared to the front wheels is larger than the fixed limit, the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (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 DSC/RSC 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.

Condition	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	Pressure reduction/ maintained	—
3	After EBD control, slip ratio is γ%	Control	Pressure increase/ maintained	—
4	wheel slip ratio is δ% or more	Control	Pressure reduction/ maintained/ increase	ABS control operates

α—δ:Specified value

Operating Condition Transition Diagram



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TCS CONTROL OUTLINE

id041800818900

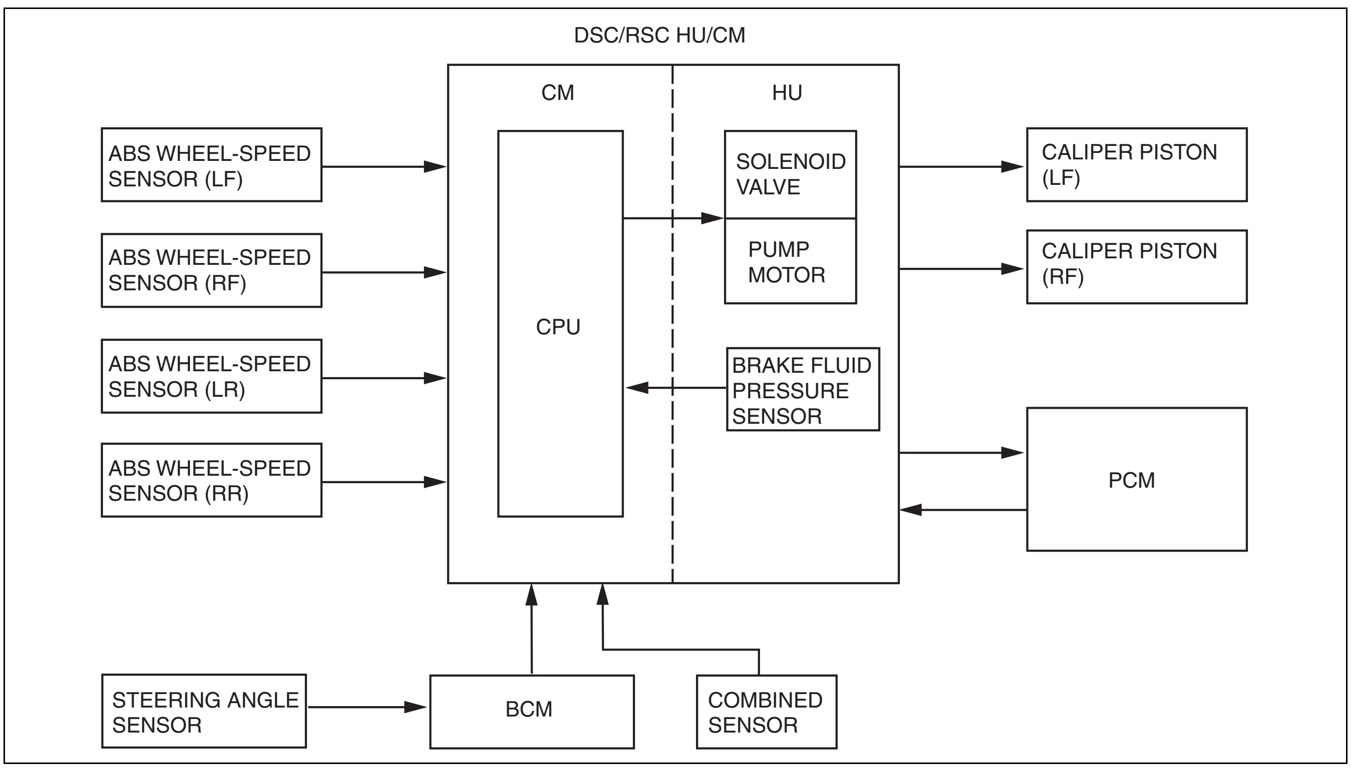
- The traction control system (TCS) control actuates torque reduction through engine control, as well as using brake control to control traction.

Note
- Engine control: Engine output is lowered by fuel cut and ignition timing control to reduce the traction, preventing driving wheel slip.
- Brake control: Brake fluid pressure from the hydraulic unit (HU) to the driving wheel that is slipping is increased, operating the brake and preventing driving wheel slip.

Features

- The left and right wheels are controlled at the same time by engine control. Therefore, when the road surface friction coefficients differ between the left and right wheels, proper torque reduction cannot be performed separately for each wheel. When this occurs, torque reduction is performed by independent left and right wheel brake control, providing more stable vehicle control.
- The TCS OFF switch allows the driver to optionally enable/disable the TCS control at the driver's discretion.
  — When both driving wheels are stuck, traction control according to the driver's operation can be performed by inhibiting the TCS control.
  — If the left and right driving wheel speeds are different when the TCS control is inhibited, brake control is performed. Due to this, the ability to free the vehicle when one of the driving wheels is stuck has been improved.
  — To ensure constant vehicle stability, the TCS control returns to normal operation automatically when the vehicle speed reaches the specification, even if the TCS control is inhibited by the TCS OFF switch.

Block Diagram



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TCS CONTROL OPERATION

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- Traction control system (TCS) control detects a slipping drive wheel using the following signals, sends a torque reduction request signal to the PCM and, at the same time, controls the solenoid valves and pump motor in the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM).
  — Vehicle wheel speed signals from the front and rear ABS wheel-speed sensors
  — Engine torque signal from the PCM
  — Steering angle signal from the body control module (BCM)
  — Yaw rate, roll rate, forward-G and lateral-G signals from the combined sensor
  — Fluid pressure signals from the brake fluid pressure sensors

DSC CONTROL OUTLINE

id041800819100

- While a vehicle normally turns safely in response to steering operation, there are instances when the limits of tire lateral grip is surpassed due to road surface conditions or vehicle speed, and the influence of evasive steering to avoid an accident or similar situations.
- Tires surpassing lateral grip exhibit one of the following conditions:
  — Strong oversteer tendency: The rear wheels are relatively losing their grip as compared to the front wheels
  — Strong understeer tendency: The front wheels are relatively losing their grip as compared to the rear wheels
- Dynamic stability control (DSC) operates at vehicle speeds of **10 km/h {6.2 mph}** or more in the conditions described above, controlling engine output and wheel braking to suppress oversteer and understeer tendencies.

Vehicle Condition Determination

- The vehicle speed, steering angle, lateral-G, forward-G and yaw rate are detected by the sensors and used in calculations by the DSC/roll stability control (RSC) hydraulic unit (HU)/control module (CM) to determine the vehicle condition. Then, depending on the difference between the target yaw rate, calculated with the values input from each sensor, and the value detected by the yaw rate sensor, an oversteer or understeer tendency can be determined.

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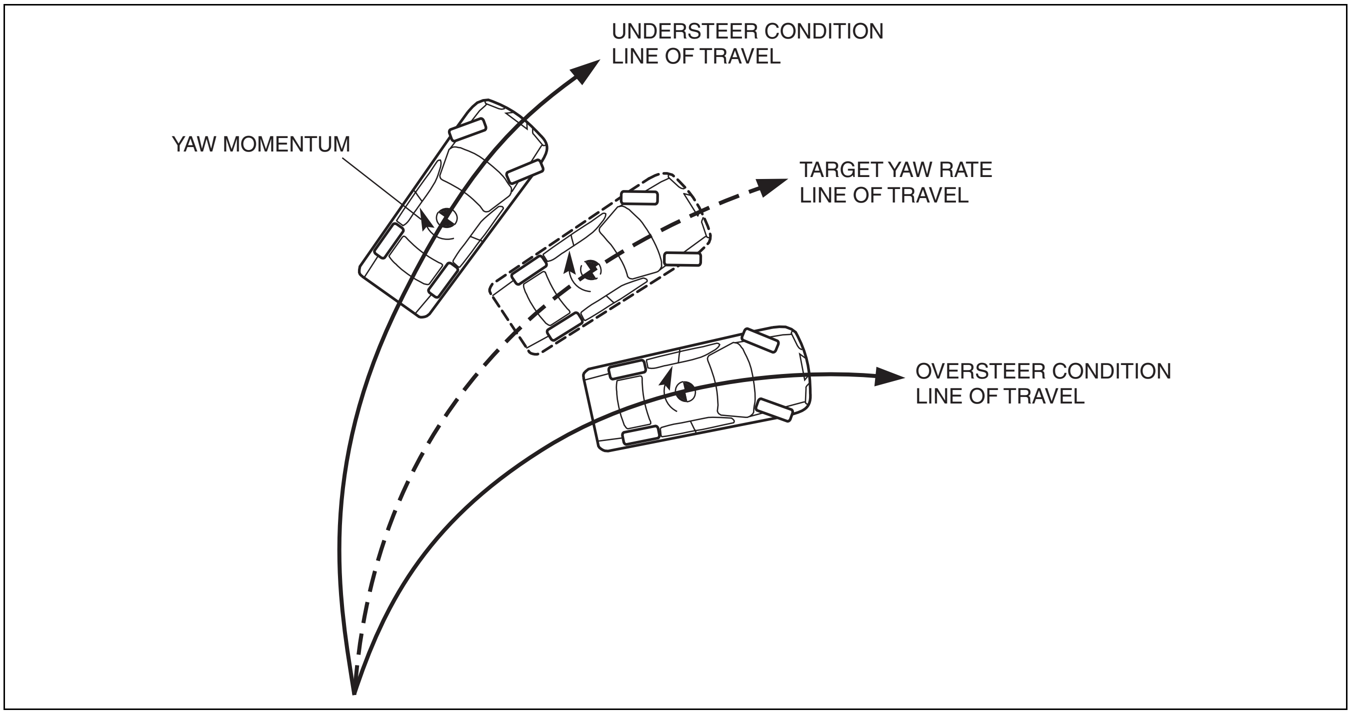

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Oversteer Tendency Determination

- When turning, if the actual vehicle yaw rate is larger than the target yaw rate (the yaw rate that should normally be formed as determined by the steering angle and vehicle speed), it means that the vehicle is in or about to be in a spin. Therefore the vehicle is determined to have an oversteer tendency.

Understeer Tendency Determination

- When turning, if the actual vehicle yaw rate is less than the target yaw rate (the yaw rate that should normally be formed as determined by the steering angle and vehicle speed), it means that the vehicle is not properly turning. Therefore the vehicle is determined to have an understeer tendency.

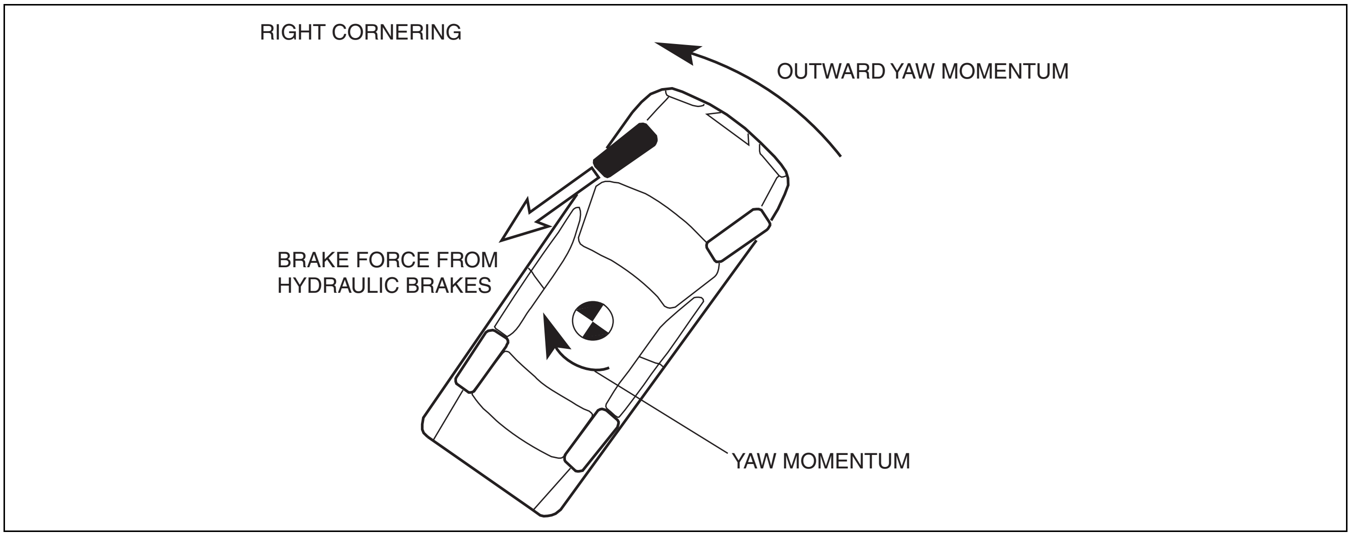
DSC CONTROL OPERATION

id041800819200

- When the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM) determines that the vehicle has a strong oversteer or understeer tendency, engine output is lowered and, at the same time, it suppresses the yaw moment by affecting the braking of the front or rear wheels to inhibit the oversteer or understeer tendency.

Oversteer Tendency Suppression

- When a large oversteer tendency is determined, braking is applied the outer front wheel according to the degree of the tendency. As a result, a yaw moment is formed towards the outer side of the vehicle and the oversteer tendency is suppressed.



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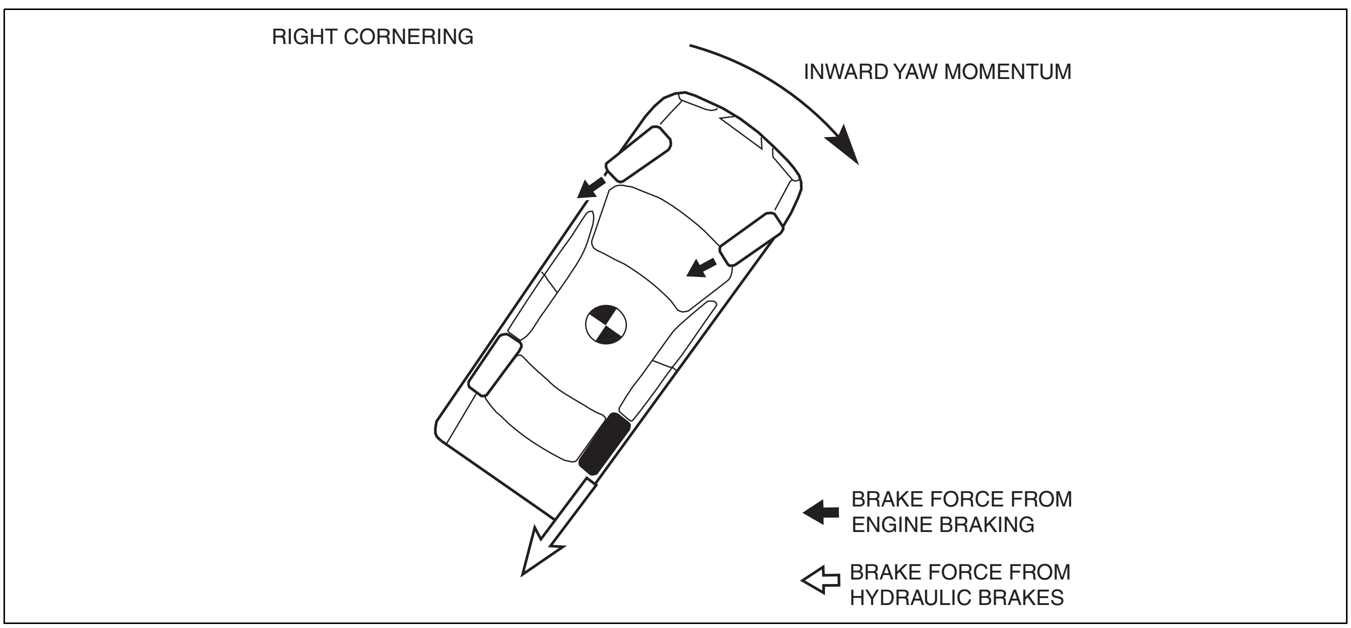
Understeer Tendency Suppression

- When a large understeer tendency is determined, engine output is controlled and braking is applied to the inner front wheel according to the degree of the tendency. As a result, a yaw moment is formed towards the inner side of the vehicle and the understeer tendency is suppressed.



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RSC CONTROL OUTLINE

id041800819300

- The dynamic stability control (DSC)/roll stability control (RSC) system monitors the signal from the roll rate sensor and each sensor, and calculates if the vehicle may be approaching a situation where rollover is probable. When this occurs, the DSC/RSC system applies preemptive action. When the DSC/RSC system is activated, it adjusts the braking force of specific wheels in response to the direct measurement of the vehicle roll motion. By adjusting the brake force, the DSC/RSC system can reduce cornering forces, reducing the total roll moment acting on the vehicle. The DSC/RSC system has the roll rate sensor located within the combined sensor and an additional program within the DSC/RSC control module (CM) to support the vehicle control during sudden steering operation. Information from the roll rate sensor is input into the DSC/RSC CM. The computer uses information from the antilock brake system (ABS) wheel-speed sensor (wheel speed), throttle position sensor (throttle valve opening angle), steering angle sensor (steering wheel angle, steering wheel rate of change), and combined sensor (longitudinal-G, lateral-G, yaw rate, roll rate). If the DSC/RSC CM determines from all these inputs that conditions exist for a potential rollover, the CM applies one or more brakes and reduces the engine torque to make the vehicle more stable.

CONTROLLER AREA NETWORK (CAN) OUTLINE

id041800819500

- The dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM) sends and receives data to and from other modules via the CAN system. Refer to Section 09 for a detailed explanation of the controller area network (CAN) system.

Data sent
- Brake system status
- Wheel speeds of all four wheels
- Torque reduction request
- Desired coupling torque

Data received
- Engine speed
- Accelerator pedal position
- Engine torque
- Torque reduction disabled
- Target gear position/selector lever position
- Steering angle
- Steering angle sensor status
- Brake switch
- Brake fluid level
- Parking brake position
- AWD system status
- Coupling torque inhibit

ABS WHEEL-SPEED SENSOR FUNCTION

id041800819600

- The Antilock brake system (ABS) wheel-speed sensor detects and transmits the rotation condition of each wheel to the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM).
- The signal from the ABS wheel-speed sensors is the primary signal for DSC/RSC HU/CM control.

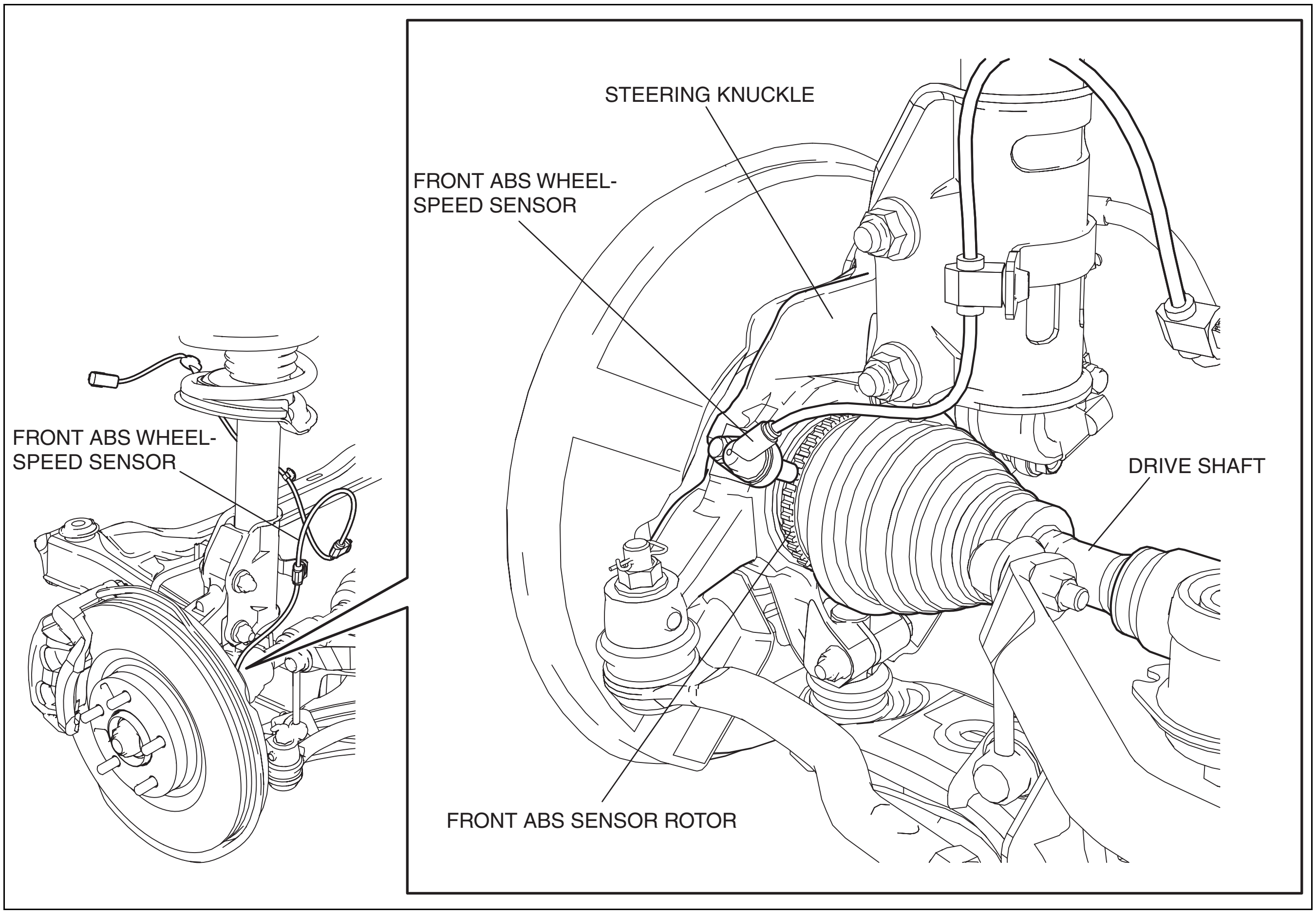
ABS WHEEL-SPEED SENSOR CONSTRUCTION/OPERATION

id041800819700

Construction

Front

- The front antilock brake system (ABS) wheel-speed sensor is installed on the steering knuckle and the rear ABS sensor rotor is integrated with the drive shaft. Therefore, if there is any malfunction on the front ABS sensor rotor, replace the drive shaft.



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Rear (2WD)

- The rear ABS wheel-speed sensor utilizes a semi-conductor element that contains an active drive circuit (MRelement*). The rear sensor is installed on the rear wheel hub.
- The rear 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 rear ABS sensor rotor, replace the wheel hub component.

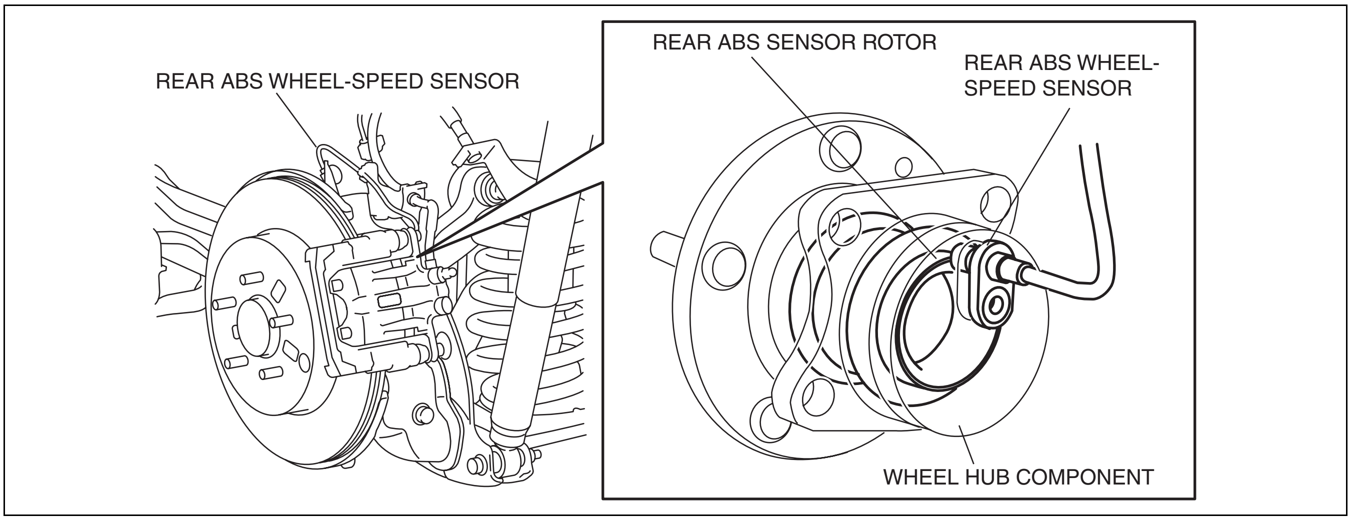
*: A magneto-resistive force means that an exterior magnetic field acts on the element, changing the resistance of the element.

Caution

- **When inspecting the ABS wheel-speed sensor, do not use a tester to inspect resistance. It impossible that the voltage from the tester could damage the semiconductor inside the ABS wheel speed sensor. Inspect using the parameter identification (PID) data monitor of the Mazda Modular Diagnostic System (M-MDS).**

Note

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



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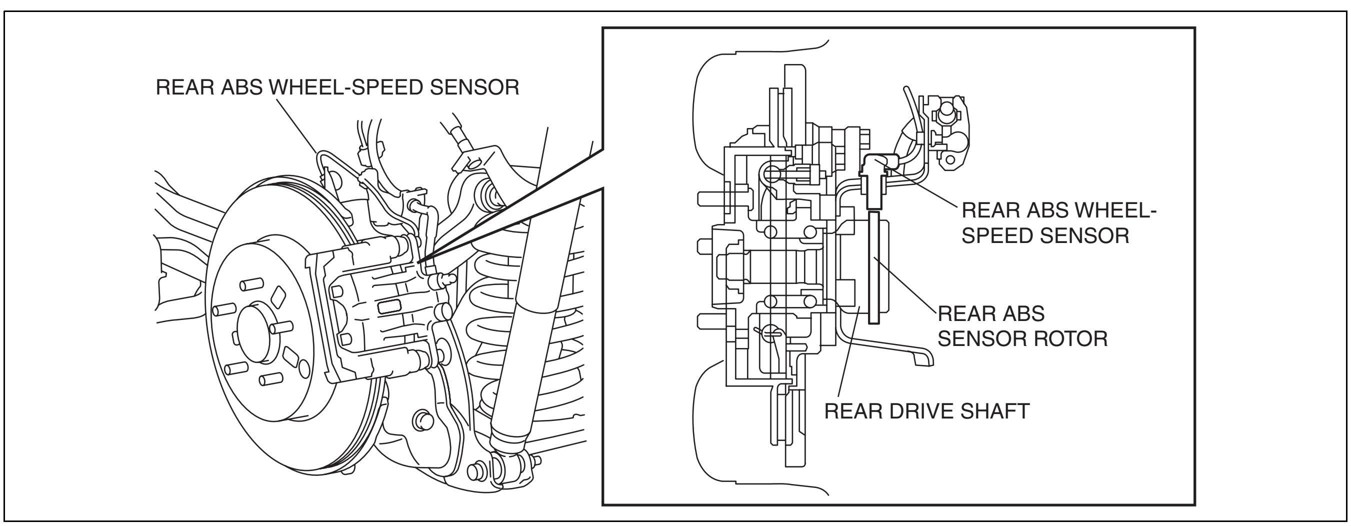
Rear (AWD)

- The rear ABS wheel-speed sensor is installed on the rear knuckle and the rear ABS sensor rotor is integrated with the rear drive shaft. Therefore, if there is any malfunction on the rear ABS sensor rotor, replace the rear drive shaft.



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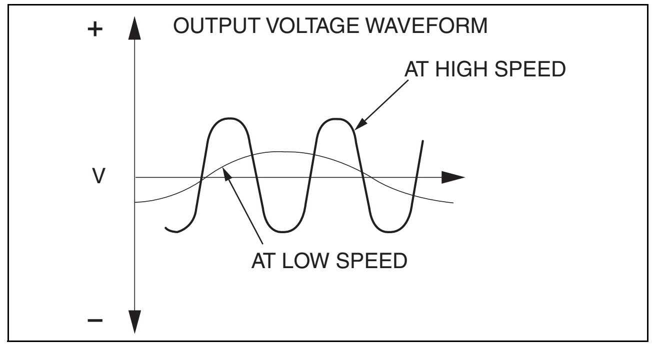
Operation

Front and rear (AWD)

- As the ABS sensor rotor rotates, magnetic flux formed from the permanent magnet varies and alternating current is formed with an electromagnetic conductor. Using this alternating current, rotation speed is expressed as a varying proportional cycle and from detection of this cycle the control module (CM) part of the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/CM can then detect the wheel rotation speed. While the structures of the front and rear ABS wheel-speed sensor differ, the operation is the same.



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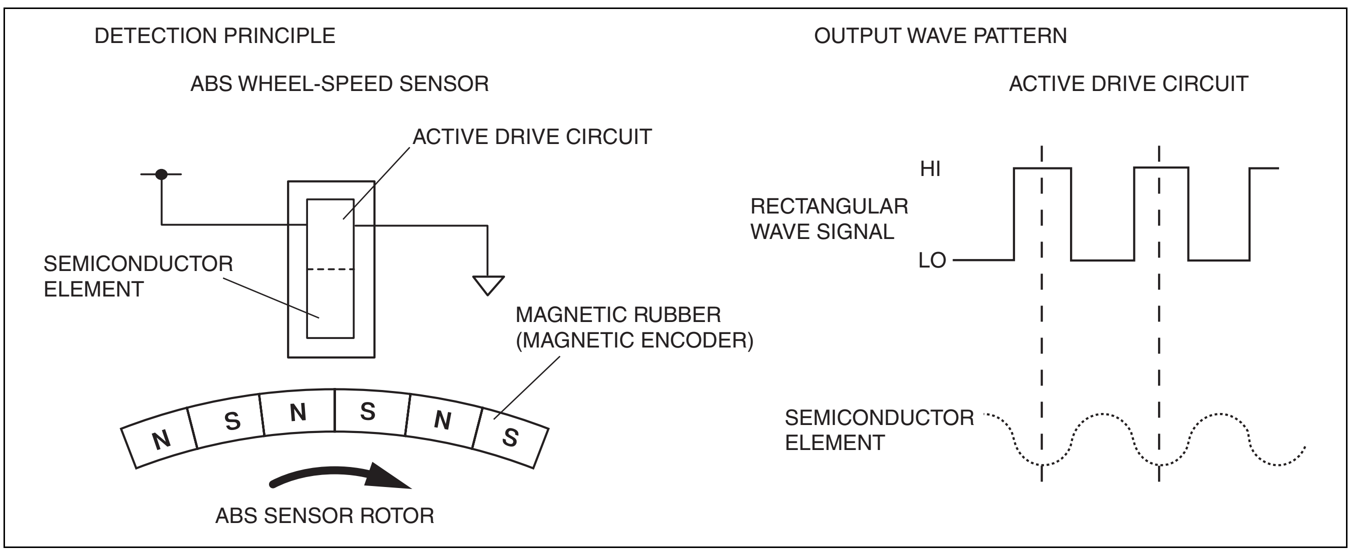
Rear (2WD)

- As the rear ABS sensor rotor rotates, the magnetic flux between the rear ABS wheel-speed sensor and the rear 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 DSC/RSC HU/CM.
- For every single rotation of the ABS sensor rotor, 44 rectangular wave pulse signals are output. The CM in the DSC/RSC HU/CM calculates the wheel speed from the periodicity of these pulses.



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COMBINED SENSOR FUNCTION

id041800819800

- A combined sensor, which integrates the yaw rate, roll rate, forward-G and lateral-G sensors, has been adopted.
- The combined sensor, located in the floor under the Second-row seat (RH), detects the vehicle yaw rate (vehicle turning angular speed), roll rate (vehicle rolling angular speed), forward-G and lateral-G, and transmits them to the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM).

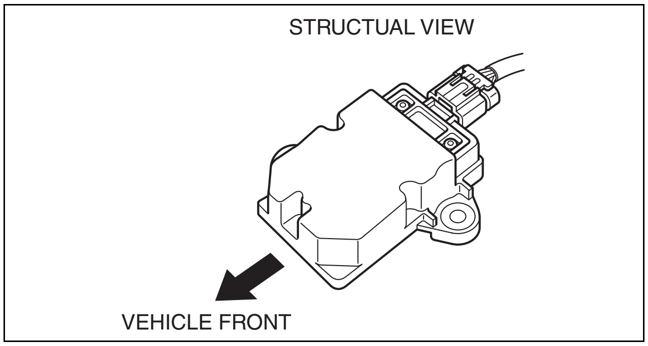
COMBINED SENSOR CONSTRUCTION/OPERATION

id041800819900

- The combined sensor, which integrates the yaw rate, roll rate, forward-G and lateral-G sensors, detects and calculates the vehicle yaw rate, roll rate, forward-G and lateral-G, and transmits this to the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM) via special controller area network (CAN) lines between the sensor and module.
- The yaw rate and roll rate sensor detects a Coriolis force created by, and in proportion to, the rotation speed of a gyroscope.
- The forward-G and lateral-G sensor detects an inertial force created by, and in proportion to, a G-force acting on a silicon detection component.

Note

- Coriolis force: When an object on a rotating disc attempts to move toward the center of the disc, force is produced at a right angle to the intended path of travel of the object. This results in the direction of movement being unchanged from its original point of departure, and the object does not reach the center. When looking at this effect from outside the disc, it appears as if a force is deflecting the object away from the center. This appearance of force is called a Coriolis force, and the object actually advances in a straight course.



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BRAKE FLUID PRESSURE SENSOR FUNCTION

id041800820000

- The brake fluid pressure sensor detects the fluid pressure from the master cylinder and transmits it to the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM).

BRAKE FLUID PRESSURE SENSOR CONSTRUCTION

id041800102100

- The brake fluid pressure sensor is integrated with the dynamic stability control (DSC)/roll stability control (RSC) hydraulic unit (HU)/control module (CM). Therefore if there is any malfunction of the brake fluid pressure sensor, replace the DSC/RSC HU/CM.

DSC INDICATOR LIGHT FUNCTION

id041800820100

- The DSC indicator light, built into the instrument cluster, informs the driver of the following vehicle conditions.
  — Roll stability control (RSC) is operating
  — Dynamic stability control (DSC) is operating (vehicle side-slip)
  — Traction control system (TCS) is operating (drive wheel slipping)

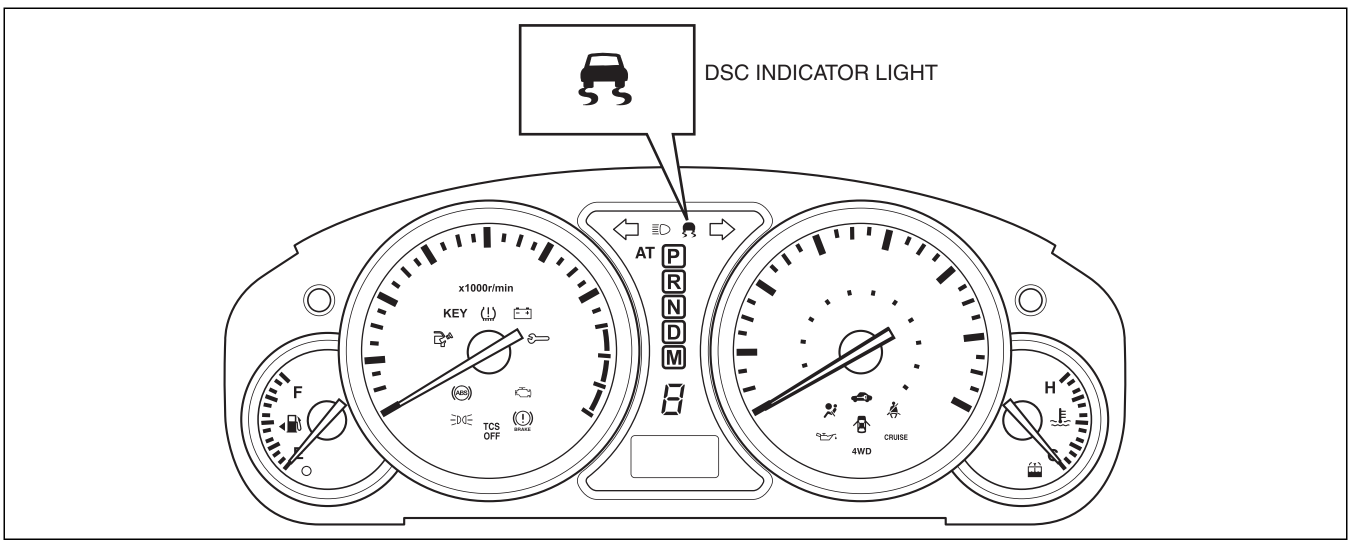
DSC INDICATOR LIGHT OPERATION

id041800820200

- When the dynamic stability control (DSC)/roll stability control (RSC) and controller area network (CAN) lines are normal, the DSC indicator light illuminates for **approx. 3 s** when the ignition switch is turned to the ON position to check the light function. When the system is malfunctioning, the DSC indicator light remains illuminated.
- When the RSC or DSC or traction control system (TCS) is operating (RSC/DSC/TCS has not been disabled by pressing the TCS OFF switch), the DSC indicator light operates as follows:

DSC Indicator Light Operation

Item	DSC indicator light condition
TCS, DSC, RSC not operating	Not illuminated
TCS operating	Flashes (**0.5 s intervals)**
DSC operating	
RSC operating	



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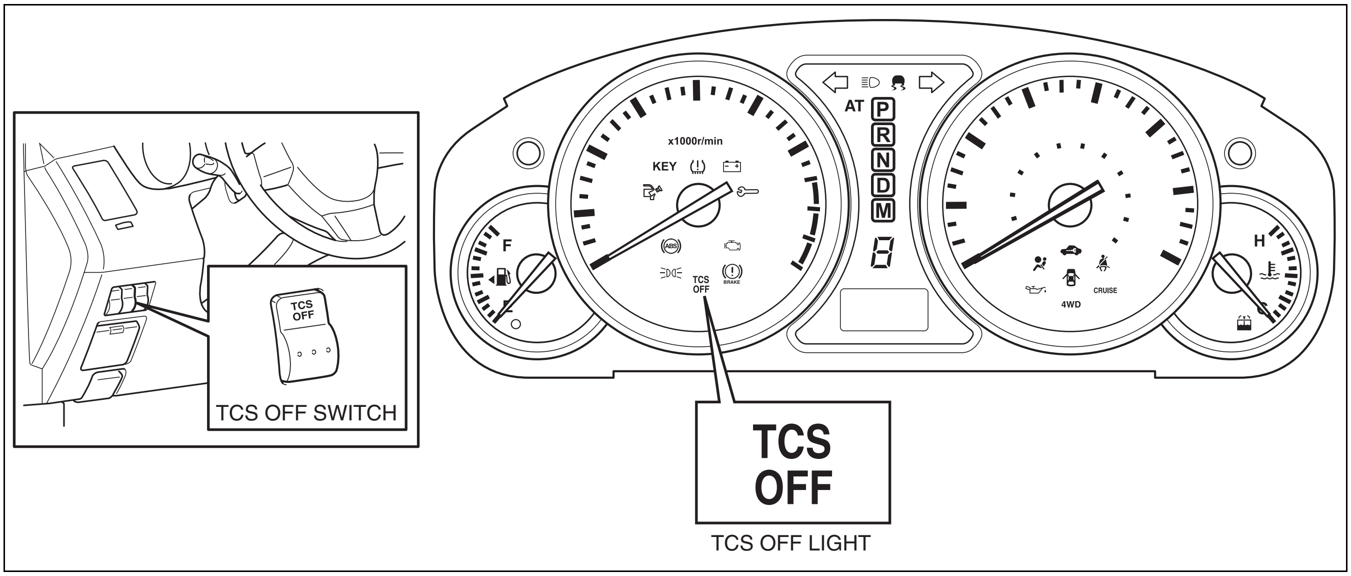
TCS OFF SWITCH, TCS OFF LIGHT FUNCTION

id041800820500

- The TCS OFF switch, located on the dashboard, allows for optionally enabling/disabling the TCS control at driver discretion.
- The TCS OFF light, built into the instrument cluster, informs the driver that TCS control has been disabled by operation of the TCS OFF switch.



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TCS OFF SWITCH, TCS OFF LIGHT OPERATION

id041800820600

- When the dynamic stability control (DSC)/roll stability control (RSC) system are functioning normally, the TCS OFF light illuminates for **approx. 3 s** when the ignition switch is turned to the ON position.
- When the TCS OFF switch is pressed to disable, the TCS control, the TCS OFF light illuminates.

Note
- To inhibit the TCS control, continue to press the TCS OFF switch until the TCS OFF light illuminates.
- When the vehicle speed is **15 km/h** or more, the TCS control cannot be disabled even if the TCS OFF switch is pressed.

- The TCS automatically becomes operable when the vehicle speed reaches **15 km/h** even if the TCS control has been disabled by pressing the TCS OFF switch. The TCS OFF light turns off simultaneously.
- The TCS OFF light illumination and RSC/DSC/TCS control conditions while operating the TCS OFF switch are as indicated in the table.

	TCS OFF light illumination conditions	RSC control conditions	DSC control conditions	TCS control conditions	
				Brake control	Engine control
TCS ON	Not illuminated	Permitted	Permitted	Permitted	Permitted
TCS OFF	Illuminated	Inhibited	Inhibited	Inhibited	Inhibited

- If the following occurs only for the TCS OFF light, a TCS OFF switch malfunction may have occurred. Refer to the Workshop Manual and inspect the TCS OFF switch.

Note
- The DSC/RSC HU/CM does not have a TCS OFF switch malfunction detection function. Therefore, a DTC is not stored and the fail-safe function does not operate.

— The TSC OFF light illuminates while driving even if the TCS OFF switch is not pressed.
— The TCS OFF light does not illuminate even if the TCS OFF switch is pressed at a vehicle speed of less than **15 km/h**.

TRANSMISSION/TRANSAXLE

05 SECTION

05-00 OUTLINE

TRANSMISSION/TRANSAXLE ABBREVIATIONS

id050000100100

AAS	Active Adaptive Shift
ABS	Antilock Brake System
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CHT	Cylinder Head Temperature
CM	Control Module
CPU	Central Processing Unit
DC	Drive Cycle
EC-AT	Electronically Controlled Automatic Transaxle
HU	Hydraulic Unit
PID	Parameter Identification
RAM	Random Access Memory
ROM	Read Only Memory
TFT	Transaxle Fluid Temperature
1GR	First Gear
2GR	Second Gear
3GR	Third Gear
4GR	Fourth Gear
5GR	Fifth Gear
6GR	Sixth Gear

TRANSMISSION/TRANSAXLE FEATURES

id050000100200

ATX [AW6A-EL, AW6AX-EL]	
Superior shift quality	• Self learning control has been adopted. • Centrifugal hydraulic pressure cancel clutch has been adopted. • Garage shift control has been adopted. • Engine-transaxle total control system has been adopted.
High efficiency	• Slip control system has been adopted.
Improved reliability	• The TR switch integral type TCM has been adopted.
Improved driveability	• A control feature for climbing/descending hills has been adopted, improving driveability when climbing/descending.
Improved marketability	• The Sport AT has been adopted.
Mis-shift prevention	• Reverse control has been adopted. • A key interlock system has been adopted. • A shift-lock system has been adopted.

AUTOMATIC TRANSAXLE SPECIFICATIONS

id050000100300

Item		Specifications
Transaxle type		**AW6A-EL, AW6AX-EL**
Gear ratio	1GR	4.148
	2GR	2.370
	3GR	1.555
	4GR	1.154
	5GR	0.859
	6GR	0.685
	Reverse	3.393
Final gear ratio		3.462
ATF	Type	JWS3309
	Capacity (approx. quantity) (L {US qt, Imp qt})	7.0 {7.4, 6.2}
Torque converter stall torque ratio		1.97
Hydraulic system (Number of drive/driven plates)	C1 clutch	7/7
	C2 clutch	4/4
	C3 clutch	4/4
	B2 brake	7/6
Band servo (mm {in})	Servo diameter (piston outer dia./retainer outer dia.)	61.3/66.0 {2.41/2.60}
Front planetary gear (Number of teeth)	Ring gear	81
	Sun gear	45
	Pinion gear	17
Rear planetary gear (Number of teeth)	Ring gear	72
	Middle sun gear	33
	Rear sun gear	27
	Long pinion gear	18
	Short pinion gear	17
Counter drive gear (Number of teeth)		50
Counter gear (Number of teeth)	Driven gear	51
	Drive gear	15
Ring gear (Number of teeth)		53

05-02 ON-BOARD DIAGNOSTIC [AW6A-EL, AW6AX-EL]

ON-BOARD DIAGNOSTIC (OBD) SYSTEM OUTLINE [AW6A-EL, AW6AX-EL]

id050211100100

- 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: controls the output device function and input value of the sensors/switches to ensure minimum vehicle drivability when a failure is detected.
  - — Memory function: stores the DTC when a failure is detected.
  - — PID data monitoring function: monitors the input/output signal and calculated value of the TCM and sends the monitoring data to the scan tool.
  - — Simulation function: Allows override operation of simulation items for input/output system parts preset in the TCM.

ON-BOARD DIAGNOSTIC (OBD) SYSTEM BLOCK DIAGRAM [AW6A-EL, AW6AX-EL]

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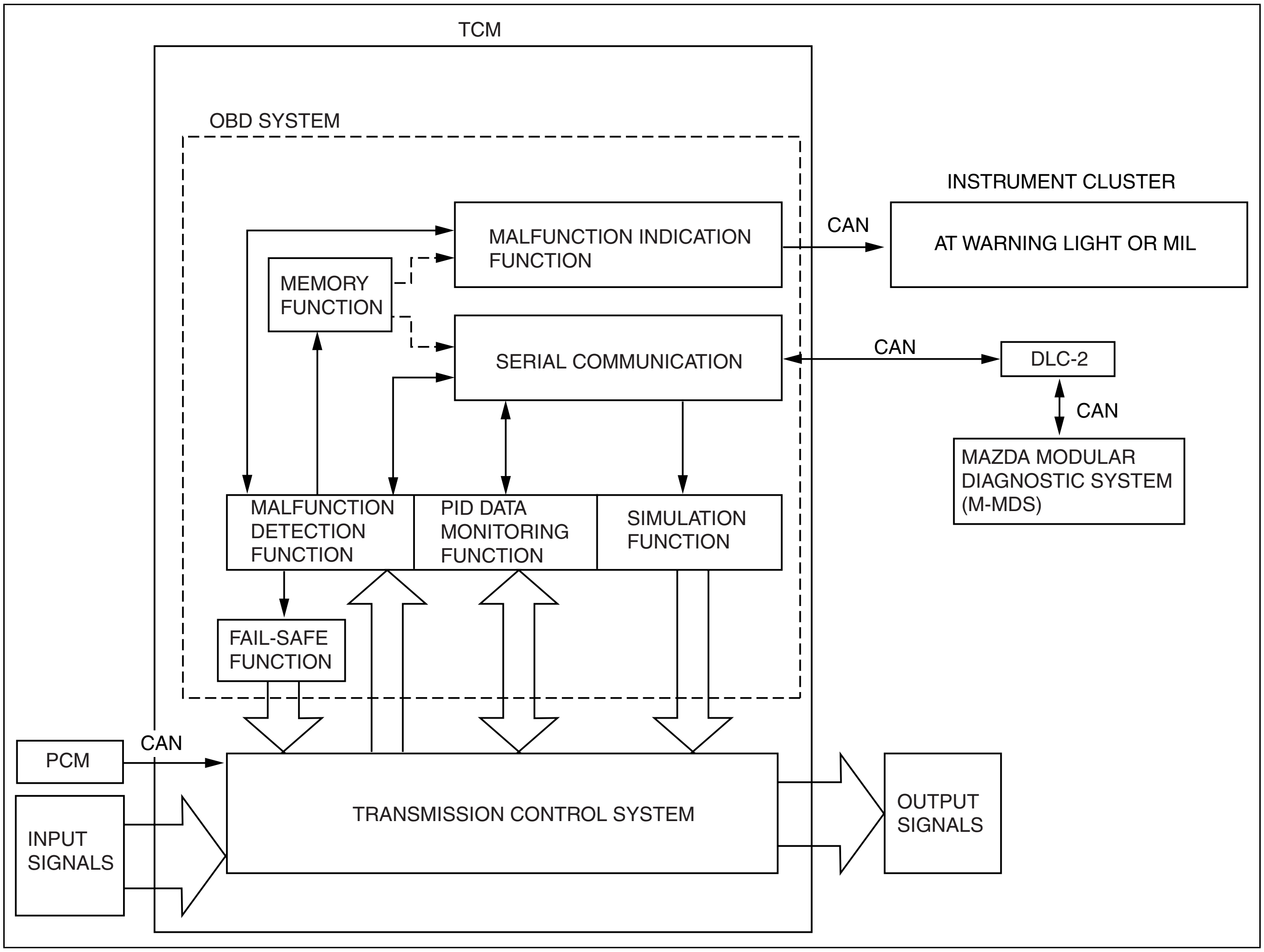

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MALFUNCTION DETECTION FUNCTION [AW6A-EL, AW6AX-EL]

id050211100300

Malfunction Detection Function

- In the malfunction detection function, the TCM detects malfunctions in the automatic transmission while driving.
- When vehicle driving conditions correspond with a preset malfunction detection condition, the TCM 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 Mazda Modular Diagnostic System (M-MDS) connected to the DLC-2.

DTC Table

DTC No.	Condition	MIL	AT warning light	DC	Monitor item	Memory function
P0220	Accelerator pedal position signal error	X	X	1	CCM	X
P0601	Flash ROM malfunction	X	X	1	CCM	X
P0603	EEPROM malfunction	X	X	1	–	X
P0604	RAM malfunction	X	X	1	CCM	X
P0706	Transaxle range (TR) switch circuit range/performance	X	X	1	Other	X
P0707	Transaxle range (TR) switch circuit low input	X	X	1	CCM	X
P0708	Transaxle range (TR) switch circuit high input	X	X	1	CCM	X
P0711	Transaxle fluid temperature (TFT) sensor malfunction (stuck)	X	X	1	CCM	X
P0712	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to ground)	X	X	1	CCM	X
P0713	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to power/open circuit)	X	X	1	CCM	X
P0717	Input/turbine speed sensor circuit malfunction (open circuit/short circuit)	X	X	1	CCM	X
P0722	Vehicle speed sensor (VSS) circuit malfunction (open circuit/ short circuit)	X	X	1	CCM	X
P0727	Engine speed signal error	X	X	1	CCM	X
P0729	Gear 6 incorrect (incorrect gear ratio detected)	X	X	1	CCM	X
P0730	Gear 1 and engine brake operation incorrect (incorrect gear ratio detected)	–	X	1	CCM	X
P0731	Gear 1 incorrect (incorrect gear ratio detected)	X	X	1	CCM	X
P0732	Gear 2 incorrect (incorrect gear ratio detected)	X	X	1	CCM	X
P0733	Gear 3 incorrect (incorrect gear ratio detected)	X	X	1	CCM	X
P0734	Gear 4 incorrect (incorrect gear ratio detected)	X	X	1	CCM	X
P0735	Gear 5 incorrect (incorrect gear ratio detected)	X	X	1	CCM	X
P0736	Gear reverse incorrect (incorrect gear ratio detected)	–	X	1	–	X
P0780	Valve control solenoid circuit malfunction (valve stuck)	–	X	1	CCM	X
P0817	Starter lock output signal circuit malfunction (open circuit/short circuit)	–	X	1	–	X
P0819	Manual switch/up switch/down switch circuit malfunction (open circuit/short circuit)	–	X	1	–	X
P0882	TCM B+ low	–	–	1	CCM	X
P0883	TCM B+ high	–	–	1	CCM	X
P0942	Valve control solenoid circuit malfunction at D range (valve stuck)	X	X	1	CCM	X
P0961	Line pressure control solenoid range/performance (stuck)	X	X	1	CCM	X
P0962	Line pressure control solenoid circuit malfunction (short to ground/open circuit)	X	X	1	CCM	X
P0963	Line pressure control solenoid circuit malfunction (short to power)	X	X	1	CCM	X
P0973	Shift solenoid A circuit malfunction (short to ground)	X	X	1	CCM	X
P0974	Shift solenoid A circuit malfunction (short to power/open circuit)	X	X	1	CCM	X
P0976	Shift solenoid B circuit malfunction (short to ground)	–	X	1	–	X
P0977	Shift solenoid B circuit malfunction (short to power/open circuit)	–	X	1	–	X
P0978	Shift solenoid C range/performance (stuck)	X	X	1	CCM	X
P0979	Shift solenoid C circuit malfunction (short to ground/open circuit)	X	X	1	CCM	X
P0980	Shift solenoid C circuit malfunction (short to power)	X	X	1	CCM	X

DTC No.	Condition	MIL	AT warning light	DC	Monitor item	Memory function
P0981	Shift solenoid D range/performance (stuck)	X	X	1	CCM	X
P0982	Shift solenoid D circuit malfunction (short to ground/open circuit)	X	X	1	CCM	X
P0983	Shift solenoid D circuit malfunction (short to power)	X	X	1	CCM	X
P0984	Shift solenoid E range/performance (stuck)	X	X	1	CCM	X
P0985	Shift solenoid E circuit malfunction (short to ground/open circuit)	X	X	1	CCM	X
P0986	Shift solenoid E circuit malfunction (short to power)	X	X	1	CCM	X
P0997	Shift solenoid F range/performance (stuck)	X	X	1	CCM	X
P0998	Shift solenoid F circuit malfunction (short to ground/open circuit)	X	X	1	CCM	X
P0999	Shift solenoid F circuit malfunction (short to power)	X	X	1	CCM	X
P1700	Valve control solenoid circuit malfunction at R range (valve stuck)	–	X	1	–	X
P1719	Engine torque signal error (inaccurate signal)	–	–	1	CCM	X
P1919	Engine coolant temperature signal error	–	–	1	CCM	X
P2544	Engine torque signal error (invalid signal)	X	X	1	CCM	X
P2757	Torque converter clutch (TCC) stuck off	X	X	1	CCM	X
P2758	Torque converter clutch (TCC) stuck on	X	X	1	CCM	X
P2762	TCC control solenoid range/performance (stuck)	X	X	1	CCM	X
P2763	TCC control solenoid circuit malfunction (short to power)	X	X	1	CCM	X
P2764	TCC control solenoid circuit malfunction (short to ground/open circuit)	X	X	1	CCM	X
U0073	CAN BUS OFF	X	X	1	CCM	X
U0100	TCM cannot receive any signals from PCM	X	X	1	CCM	X
U0121	TCM cannot receive any signals from DSC/RSC HU/CM	–	X	1	–	X
U0140	TCM cannot receive any signals from BCM	–	–	1	–	X
U0415	Invalid data received from DSC/RSC HU/CM (wheel speed)	–	–	1	–	X

MIL: Malfunction Indicator Lamp
DC: Drive Cycle
CCM: Comprehensive Component Monitor
X : Available
– : N/A

MEMORY FUNCTION [AW6A-EL, AW6AX-EL]

id050211100400

- 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 Mazda Modular Diagnostic System (M-MDS).

MALFUNCTION INDICATION FUNCTION [AW6A-EL, AW6AX-EL]

id050211100500

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

FAIL-SAFE FUNCTION [AW6A-EL, AW6AX-EL]

id050211100600

- 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 TCM control.

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0220	Accelerator pedal position signal error	• If the accelerator pedal position signal from the PCM, which is transmitted using the CAN communication, is invalid and the condition has continued for **500 ms or more**.	• Inhibits learning control • Inhibits TCC control • Inhibits TCC, slip control • inhibits adaptive shift control • Fixes the accelerator pedal position open signal at **18.8 %**	Enabled
P0601	Flash ROM malfunction	• Flash ROM (in TCM) internal circuit malfunction is detected.	• Emergency mode 1	Disabled
P0603	EEPROM malfunction	• Different numeric values for EEPRROM and RAM (in TCM) are detected.	• TCM uses the default value as the initial value for EEPROM	Enabled
P0604	RAM malfunction	• RAM (in TCM) read/write error is detected.	• Emergency mode 1	Disabled
P0706	Transaxle range (TR) switch circuit range/ performance	• TCM detects stuck TR switch when ignition switch is at ON position.	• Emergency mode 1 • Locks in D range, 3GR, if the counter drive gear (output) speed signal (VSS) is **0 rpm** • Locks start lock signal	Disabled
P0707	Transaxle range (TR) switch circuit low input	• TR switch position voltage input to TCM is **less than 0.127 V** when ignition switch is at ON position.	• Emergency mode 1 • Locks in D range, 3GR, if the counter drive gear (output) speed signal (VSS) is **0 rpm** • Locks start lock signal	Disabled
P0708	Transaxle range (TR) switch circuit high input	• TR switch position voltage input to TCM is **4.84 V or more** when ignition switch is at ON position.	• Emergency mode 1 • Locks in D range, 3GR, if the counter drive gear (output) speed signal (VSS) is **0 rpm** • Locks start lock signal	Disabled
P0711	Transaxle fluid temperature (TFT) sensor malfunction (stuck)	• Change in ATF temperature cannot be detected for **15 min or more** when driving in D range.	• Inhibits TCC control • Inhibits TCC, slip control • Inhibits self learning control • Fixes ATF temperature value at **80 °C {176 °F}**	Disabled
P0712	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to ground)	• TCM detects ATF temperature of **200 °C {392 °F} or more**.	• Inhibits TCC control • Inhibits TCC, slip control • Inhibits self learning control • Fixes ATF temperature value at **80 °C {176 °F}**	Disabled
P0713	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to power/open circuit)	• TCM detects ATF temperature of **less than -43 °C {-45.4 °F}** when engine is warmed-up and running.	• Inhibits TCC, slip control • Inhibits self learning control • Fixes ATF temperature value at **80 °C {176 °F}**	Disabled
P0717	Input/turbine speed sensor circuit malfunction (open circuit/short circuit)	• Turbine speed signal is not input during vehicle speed signal **24 pulse** period when driving in D range at **20 km/h {12 mph} or more**. • Normal turbine speed signal is not input.	• Emergency mode 1	Disabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0722	Vehicle speed sensor (VSS) circuit malfunction (open circuit/short circuit)	• Vehicle speed signal is not input during turbine speed signal **16 pulse** period when driving in D range at **20 km/h {12 mph} or more**. • Normal vehicle speed signal is not input.	• Changes source for output revolution calculation • Inhibits self learning control • Inhibits driver adaptive shift control	Enabled
P0727	Engine speed signal error	• If the engine speed signal from the PCM, which is transmitted using the CAN communication, is invalid and the condition has continued for **500 ms or more**.	• Emergency mode 1 • Fixes the engine speed signal at **7,000 rpm**	Enabled
P0729	Gear 6 incorrect (incorrect gear ratio detected)	• Incorrect gear ratio is detected when driving in D range, 6GR, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Emergency mode 2	Disabled
P0730	Gear 1and engine brake operation incorrect (incorrect gear ratio detected)	• Engine brake is detected to be not operating when driving in M range, 1GR, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Inhibits self learning control	Enabled
P0731	Gear 1 incorrect (incorrect gear ratio detected)	• Incorrect gear ratio is detected when driving in D range, 1GR, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Emergency mode 2	Disabled
P0732	Gear 2 incorrect (incorrect gear ratio detected)	• Incorrect gear ratio is detected when driving in D range, 2GR, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Emergency mode 2	Disabled
P0733	Gear 3 incorrect (incorrect gear ratio detected)	• Incorrect gear ratio is detected when driving in D range, 3GR, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Emergency mode 2	Disabled
P0734	Gear 4 incorrect (incorrect gear ratio detected)	• Incorrect gear ratio is detected when driving in D range, 4GR, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Emergency mode 2	Disabled
P0735	Gear 5 incorrect (incorrect gear ratio detected)	• Incorrect gear ratio is detected when driving in D range, 5GR, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Emergency mode 2	Disabled
P0736	Gear reverse incorrect (incorrect gear ratio detected)	• Incorrect gear ratio is detected when driving in R position, ATF temperature is **20 °C {68 °F} or more**, and accelerator opening angle is **10% or more**.	• Inhibits self learning control	Enabled
P0780	Valve control solenoid circuit malfunction (valve stuck)	• Irregular shift control detected when driving in D range, ATF temperature is **65 °C {149 °F} or more**, and counter drive gear (output) speed is **300 rpm or more**.	• Inhibits self learning control	Enabled
P0817	Starter lock output signal circuit malfunction (open circuit/short circuit)	• Any of the following conditions are met when ignition switch is at ON position: — **0 V** detected at TCM terminal A5 when in D range or R position — **12 V** detected at TCM terminal A5 when in P or N position	• Locks start lock signal	Enabled

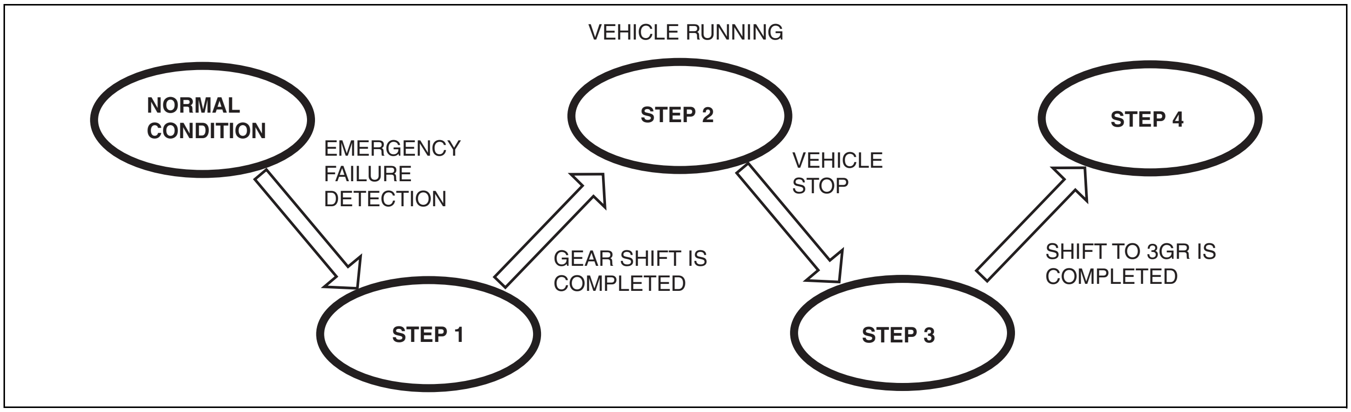
DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0819	Manual switch/up switch/ down switch circuit malfunction (open circuit/ short circuit)	• Any of the following conditions are detected for 10 s or more when engine is running: — **5 V** detected at TCM terminals A7 when in any position except D or M range. — **0 V** detected at TCM terminal A7 when **5 V** are input to TCM terminal A3 or A4.	• Inhibits manual mode control	Enabled
P0882	TCM B+ low	• Voltage of less than 9 V detected at TCM terminals A1 and A11 when engine is running.	• Emergency mode 1	Disabled
P0883	TCM B+ high	• Voltage of **18 V or more** detected at TCM terminals A1 and A11 when engine is running.	• Emergency mode 1	Disabled
P0942	Valve control solenoid circuit malfunction at D range (valve stuck)	• Difference between engine and turbine speeds of **less than 150 rpm** is detected when driving in D range and counter drive gear (output) speed is **500 rpm or less**.	• Emergency mode 1	Disabled
P0961	Line pressure control solenoid range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode 1	Disabled
P0962	Line pressure control solenoid circuit malfunction (short to ground/open circuit)	• Open or short circuit in line pressure control solenoid signal system (The solenoid circuit current value input to the TCM is continuously **less than 23 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0963	Line pressure control solenoid circuit malfunction (short to power)	• Short circuit in line pressure control solenoid signal system (The solenoid circuit current value input to the TCM is continuously **more than 1,333 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0973	Shift solenoid A circuit malfunction (short to ground)	• Short to ground in shift solenoid A signal system (The solenoid remains off continuously for **100 ms or more** even if the TCM sends a solenoid on command).	• Emergency mode 1	Disabled
P0974	Shift solenoid A circuit malfunction (short to power/open circuit)	• Open or short circuit in shift solenoid A signal system (The solenoid remains on continuously for **100 ms or more** even if the TCM sends a solenoid off command).	• Emergency mode 1	Disabled
P0976	Shift solenoid B circuit malfunction (short to ground)	• Short to ground in shift solenoid B signal system (The solenoid remains off continuously for **100 ms or more** even if the TCM sends a solenoid on command).	• Inhibits self learning control	Enabled
P0977	Shift solenoid B circuit malfunction (short to power/open circuit)	• Open or short circuit in shift solenoid B signal system (The solenoid remains on continuously for **100 ms or more** even if the TCM sends a solenoid off command).	• Inhibits self learning control	Enabled
P0978	Shift solenoid C range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode 1	Disabled
P0979	Shift solenoid C circuit malfunction (short to ground/open circuit)	• Open or short circuit in shift solenoid C signal system (The solenoid circuit current value input to the TCM is continuously **less than 23 mA** for **100 ms or more**).	• Emergency mode 1	Disabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0980	Shift solenoid C circuit malfunction (short to power)	• Short circuit in shift solenoid C signal system (The solenoid circuit current value input to the TCM is continuously **more than 1,333 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0981	Shift solenoid D range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode 1	Disabled
P0982	Shift solenoid D circuit malfunction (short to ground/open circuit)	• Open or short circuit in shift solenoid D signal system (The solenoid circuit current value input to the TCM is continuously **less than 23 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0983	Shift solenoid D circuit malfunction (short to power)	• Short circuit in shift solenoid D signal system (The solenoid circuit current value input to the TCM is continuously **more than 1,333 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0984	Shift solenoid E range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode 1	Disabled
P0985	Shift solenoid E circuit malfunction (short to ground/open circuit)	• Open or short circuit in shift solenoid E signal system (The solenoid circuit current value input to the TCM is continuously **less than 23 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0986	Shift solenoid E circuit malfunction (short to power)	• Short circuit in shift solenoid E signal system (The solenoid circuit current value input to the TCM is continuously **more than 1,333 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0997	Shift solenoid F range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode 1	Disabled
P0998	Shift solenoid F circuit malfunction (short to ground/open circuit)	• Open or short circuit in shift solenoid F signal system (The solenoid circuit current value input to the TCM is continuously **less than 23 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P0999	Shift solenoid F circuit malfunction (short to power)	• Short circuit in shift solenoid F signal system (The solenoid circuit current value input to the TCM is continuously **more than 1,333 mA** for **100 ms or more**).	• Emergency mode 1	Disabled
P1700	Valve control solenoid circuit malfunction at R range (valve stuck)	• When all of the following conditions are met while driving in R position and the counter drive gear (output} speed is **500 rpm or less**: — The difference between the engine and turbine shaft speeds is **less than 150 rpm** — The turbine shaft speed is more than the estimated turbine speed value, as derived from the counter drive gear (output) speed, plus **200 rpm**.	• Inhibits self learning control	Enabled
P1719	Engine torque signal error (inaccurate signal)	• With all of the following conditions met, if the engine torque signal from the PCM, which is transmitted using the CAN communication, is not normal and the condition has continued for **0.02 s or more**. — Engine speed: **500 rpm or more** — Accelerator pedal opening angle: **2 % or more**	• Performs control with the engine torque value of **1.2** • inhibits slope rate calculation • inhibits learning control	Enabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P1919	Engine coolant temperature signal error	• If the engine coolant temperature signal from the PCM, which is transmitted using the CAN communication, is invalid and the condition has continued for **500 ms or more**.	• inhibits TCC, slip control • Fixes the engine coolant temperature signal at **80 °C** {176 °F}	Enabled
P2544	Engine torque signal error (invalid signal)	• If the engine torque signal or engine torque-loss signal from the PCM, which is transmitted using the CAN communication, is invalid and the condition has continued for **500 ms or more**.	• Emergency mode 1 • Fixes the engine torque signal at the maximum	Enabled
P2757	Torque converter clutch (TCC) (stuck off)	• Difference of **100 rpm or more** between engine and counter drive gear (output) speeds is detected when driving in D range, engine speed is **less than 400 rpm**, TCC control solenoid is on, and ATF temperature is **20 °C {68 °F}**.	• Inhibits self learning control • Inhibits TCC control • Inhibits TCC, slip control	Disabled
P2758	Torque converter clutch (TCC) (stuck on)	• Difference of **less than 30 rpm** between engine and turbine speeds is detected when driving in D range, engine speed is **within 1,000—3,000 rpm**, TCC control solenoid is off, and ATF temperature is **20 °C {68 °F}**.	• Inhibits self learning control • Inhibits TCC control • Inhibits TCC, slip control • Inhibits driver adaptive shift control • Engine stall avoidance control (Engine braking is applied in 1GR when driving in D range, turbine speed is less than 1,000 rpm, and counter drive gear (output) speed is less than 420 rpm.)	Disabled
P2762	TCC control solenoid range/performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode 1	Disabled
P2763	TCC control solenoid circuit malfunction (short to power)	• Short circuit in TCC control solenoid signal system (when TCM monitors solenoid output voltage, voltage that differs from signal output by CPU in TCM is detected).	• Inhibits self learning control • Inhibits TCC control • Inhibits TCC, slip control • Inhibits driver adaptive shift control • Engine stall avoidance control (Engine braking is applied in 1GR when driving in D range, turbine speed is less than 1,000 rpm, and counter drive gear (output) is less than 420 rpm.)	Disabled
P2764	TCC control solenoid circuit malfunction (short to ground/open circuit)	• Open or short circuit in TCC control solenoid signal system (when TCM monitors solenoid output voltage, voltage that differs from signal output by CPU in TCM is detected).	• Inhibits TCC control • Inhibits TCC, slip control • Inhibits driver adaptive shift control	Disabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
U0073	CAN BUS OFF	• Bus off error is detected.	• Reactive shift look function • Emergency mode 1 • Fixes following signals as indicated: — Engine speed: **7,000 rpm** — Accelerator opening angle: **0%** — Engine torque: MAX — Idle: on — Kick down: off — Brake switch: on — Engine coolant temperature: **80 °C {176 °F}** — VSS used for all wheel speeds	Enabled
U0100	TCM cannot receive any signals from PCM	• Communication error is detected between TCM and PCM.	• Inhibits self learning control • Inhibits adaptive shift control • Reactive shift look function • Emergency mode 1 • Fixes following signals as indicated: — Engine speed: **7,000 rpm** — Accelerator opening angle: **0%** — Engine torque: MAX — Idle: on — Kick down: off — Brake switch: on — Engine coolant temperature: **80 °C {176 °F}**	Enabled
U0121	TCM cannot receive any signals from DSC/RSC HU/CM	• Communication error is detected between TCM and DSC/RSC HU/CM.	• Inhibits self learning control • Inhibits driver adaptive shift control • VSS used for all wheel speeds	Enabled
U0140	TCM cannot receive any signals from BCM	• Communication error detected between TCM and BCM.	• TCM considers that it is not equipped with DSC/ RSC	Enabled
U0415	Invalid data received from DSC/RSC HU/CM (wheel speed)	• Irregular input signals input from each wheel speed sensor.	• Inhibits cornering function • Inhibits self learning control • VSS used for all wheel speeds	Enabled

Emergency Mode 1



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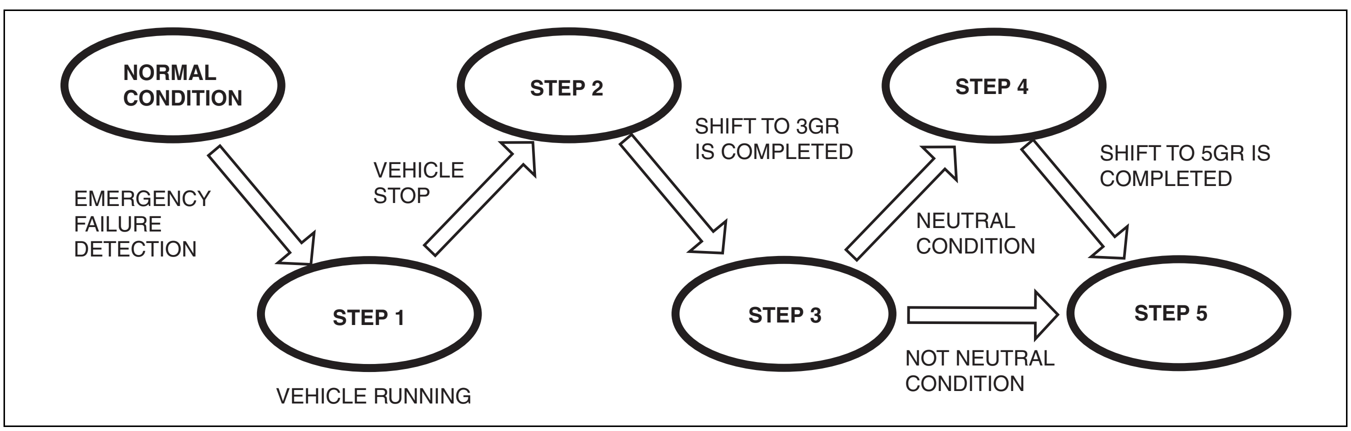
- Failure decided not by gear ratio or unusual shifting.

	Gear	Step1	Step2	Step3	Step4
Gear condition at failure detection	R	Shift solenoid F on	Maintain condition	Maintain condition	Solenoid cut
	1GR	Shift to 3GR*1	All solenoid output off	Maintain gear	
	2GR				
	3GR	Maintain gear*1			
	4GR			Shift to 3GR*2	
	5GR	Maintain gear			
	6GR				

*1 : In case of C1 clutch release failure, shift to 5GR.
*2 : In case of C2 clutch engagement failure, no shifting. But after shifting D→N→D, gear is 5GR.

Emergency Mode 2



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- Failure decided by gear ratio or unusual shifting.

	Gear	Step1	Step2	Step3	Step4	Step5
Gear condition at failure detection	R	Maintain condition	Maintain condition	Maintain condition	Maintain condition	Solenoid cut
	1GR	• Maintain gear • Inhibits TCC control	Shift to 3GR	• Maintain condition • Neutral detection	Shift to 5GR	
	2GR					
	3GR					
	4GR					
	5GR					
	6GR					

PARAMETER IDENTIFICATION (PID) DATA MONITORING FUNCTION [AW6A-EL, AW6AX-EL]

id050211100700

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

Monitor Item Table

–: N/A

Display on the tester	Definition	Unit/Condition	TCM terminal
BOO TCM	Brake switch	On/Off	–
DTCCNT	DTC count (includes those needing no action)	–	–
DWN SW	Down switch	On/Off	A4
ECT TCM	ECT	°C	–
FDPDTC	Freeze frame data	–	–
GEAR_RA	Gear ratio	–	–
GEAR_SEL	Calculated gear range in TCM	1st/2nd/3rd/4th/5th/6th	–
LPS	Pressure control solenoid	A	B1, B3
MNL SW	M range switch	On/Off	A7
OSS	Output shaft speed	RPM	B19, B20
PNP_TCM	Park/Neutral	Drive/Neutral	–
RPM TCM	Engine speed	RPM	–
SSC	Shift solenoid C	A	B10, B11
SSD	Shift solenoid D	A	B17, B18
SSE	Shift solenoid E	A	B14, B22
SSF	Shift solenoid F	A	B16, B21
TCCC	TCC control solenoid	A	B4, B9
TFT	ATF temperature	°C	B7, B8
TFTV	ATF temperature signal voltage	V	B7, B8
THOP	Throttle position	%	–
TR	TR switch	R/N/D/P	–
TRD	TR switch [D range]	On/Off	–
TRR	TR switch [R position]	On/Off	–
TSS	Input/turbine speed sensor	RPM	–
UP SW	Up switch	On/Off	A3
VSS	Vehicle speed	KPH, MPH	–

SIMULATION FUNCTION [AW6A-EL, AW6AX-EL]

id050211100800

- By using the Mazda Modular Diagnostic System (M-MDS), simulation items for input/output parts preset in the TCM can be optionally selected and operated regardless of TCM control conditions.

Simulation Item Table

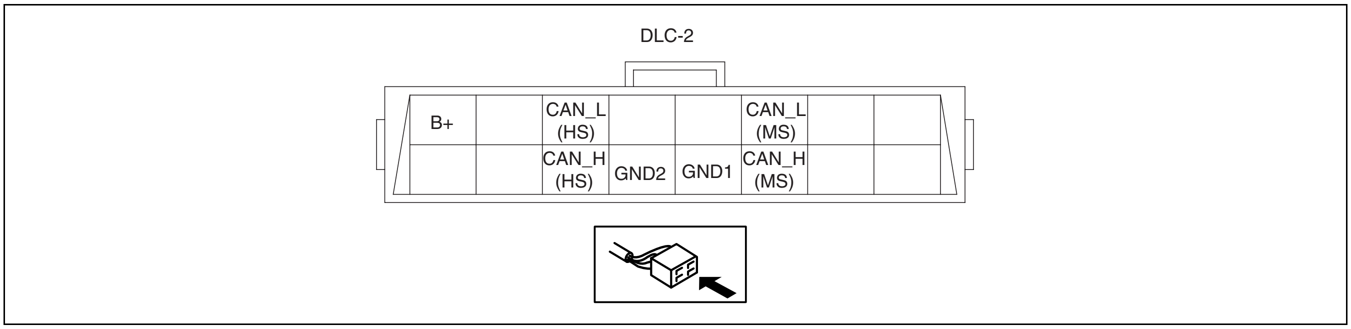
X: Available

Simulation item	Applicable component	Unit/Condition	Operation		TCM terminal
			IG ON	Idle	
LPS	Pressure control solenoid control signal in TCM	A	X	X	B1, B3
SSA	Shift solenoid A	On/Off	X	X	B5
SSB	Shift solenoid B	On/Off	X	X	B2
SSC	Shift solenoid C	A	X	X	B10, B11
SSD	Shift solenoid D	A	X	X	B17, B18
SSE	Shift solenoid E	A	X	X	B14, B22
SSF	Shift solenoid F	A	X	X	B16, B21
TCCC	TCC control solenoid	A	X	X	B4, B9

DLC-2 OUTLINE [AW6A-EL, AW6AX-EL]

id050211100900

- 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 B+, CAN_H (HS), CAN_L (HS), CAN_H (MS), CAN_L (MS), GND1 and GND2 terminals.



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Terminal	Function
B+	Battery power supply terminal
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 ground terminal
GND2	Serial communication ground terminal

05-17 AUTOMATIC TRANSAXLE [AW6A-EL, AW6AX-EL]

AUTOMATIC TRANSAXLE OUTLINE [AW6A-EL, AW6AX-EL]

id051723101700

- The AW6A (X) -EL automatic transaxle is a compact, lightweight, next-generation electronically controlled FF 6-speed automatic transaxle that employs a Ravigneaux-type planetary gear. It employs a high-precision clutch hydraulic control system for smooth, highly responsive gear shift feel.

AUTOMATIC TRANSAXLE FEATURES [AW6A-EL, AW6AX-EL]

id051723101800

Torque Converter Clutch (TCC) Control and Slip Control

- Based on output speed signals, signals from the PCM (engine speed and throttle opening) and vehicle speed, smooth TCC control is performed. Also, the slip rate is detected by adding input speed signals, and slip control is performed.

Self Learning Control

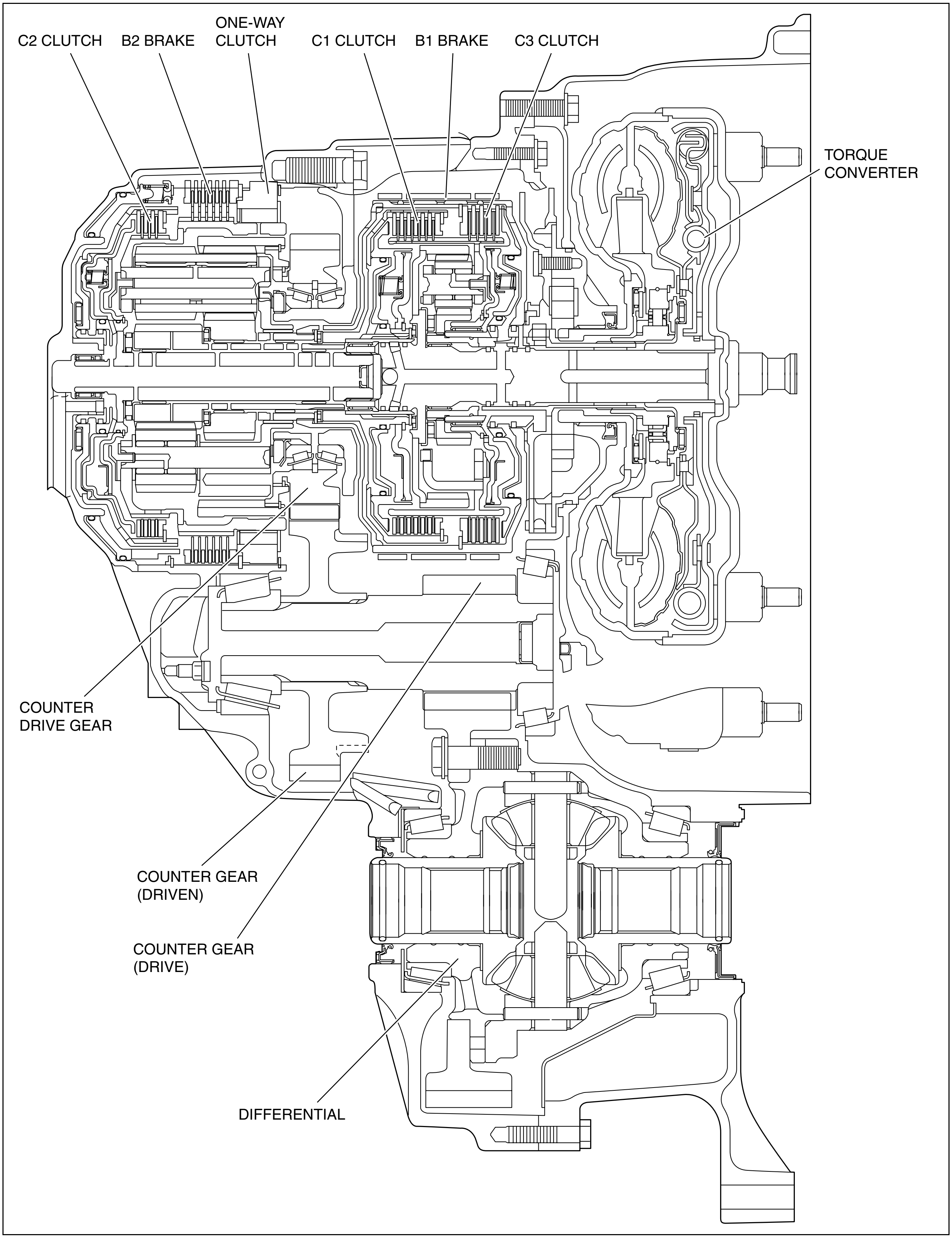
- Since TCM performs shift control learning and garage shift control learning, it provides smooth clutch engagement at gear shifting and smooth and delicate shifting while driving.

Manual Mode Shift Control

- By moving the selector lever from the “D range” into the manual shift position and shifting into + (up-shift) or – (down-shift), the driver can select the desired gear, enabling sporty driving that feels like a manual transaxle.

AUTOMATIC TRANSAXLE CROSS-SECTIONAL VIEW [AW6A-EL, AW6AX-EL]

id051723101900



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AUTOMATIC TRANSAXLE CONTROL SYSTEM WIRING DIAGRAM [AW6A-EL, AW6AX-EL]

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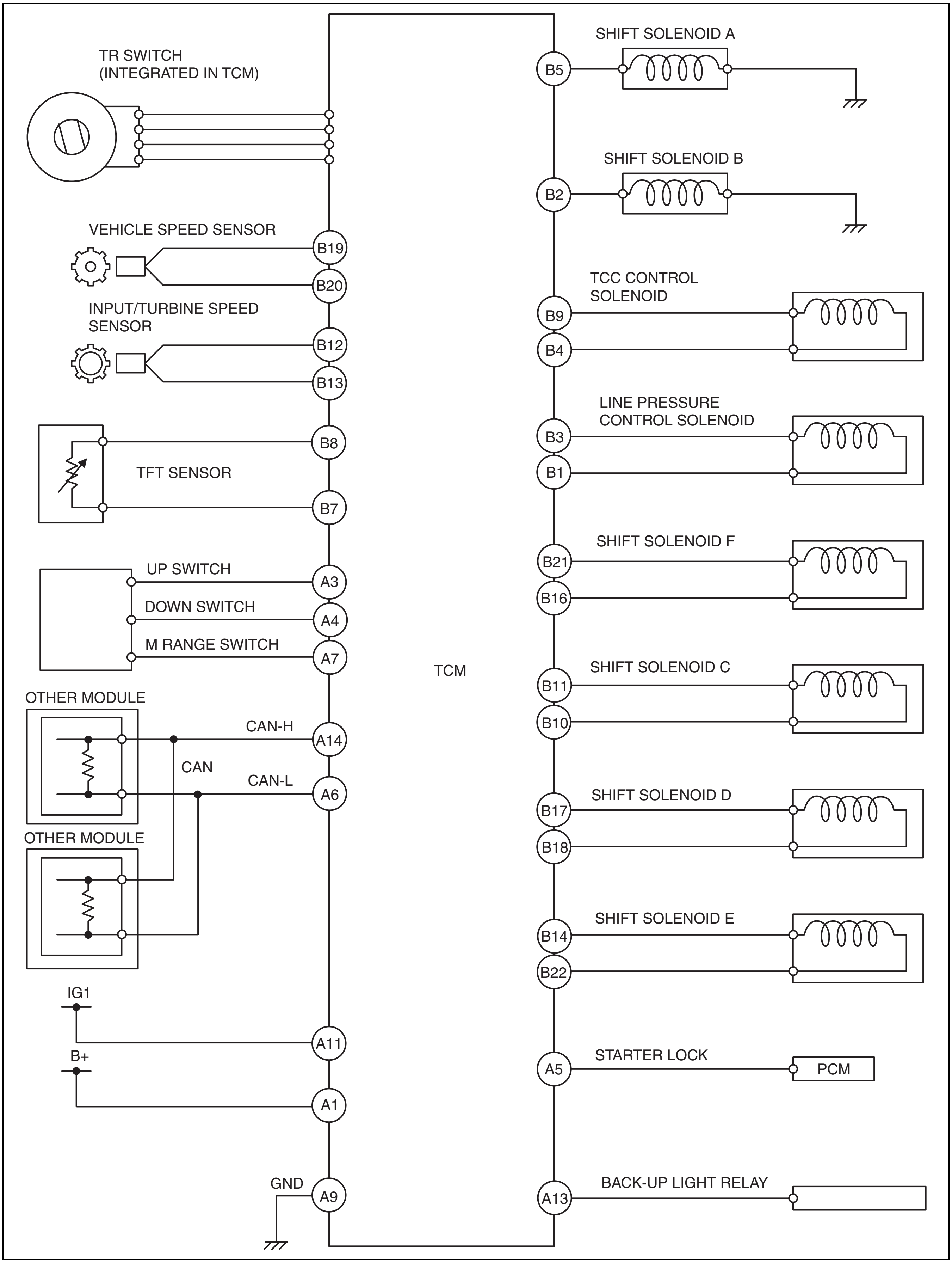

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EC-AT OPERATION CHART [AW6A-EL, AW6AX-EL]

id051723102100

				Shift pattern			Transaxle						Solenoid						
													3-way type		Linear type				
Position/Range	Mode	Gear position		Shift	TCC, Slip	Engine brake	C1 clutch	C2 clutch	C3 clutch	B1 brake	B2 brake	One-way clutch	Shift solenoid A	Shift solenoid B	Shift solenoid C	Shift solenoid D	Shift solenoid E	Shift solenoid F	TCC control solenoid
P	-	Neutral	-	-											○	○	○	○	
R	less than 11km/n {7mph}	Reverse	3.393	-					○		○				○	○		○	
	more than 11km/n {4mph}			-							○				○	○	○	○	
N	-	Neutral	-	-											○	○	○	○	
D	*1 AAS/ NORMAL	1GR	4.148	↕			○					○				○	○	○	
		2GR	2.370	↕			○			○						○	○		
		3GR	1.555	↕			○		○							○		○	
		4GR	1.154	↕			○	○									○	○	
		4GR TCC ON Slip ON *2		↕	○		○	○									○	○	○
		5GR	0.859	↕				○	○						○			○	
		5GR TCC ON Slip ON *2		↕	○			○	○						○			○	○
		6GR	0.685	↕				○		○					○		○		
		6GR TCC ON *3			○			○		○					○		○		○
M	MANUAL	1GR	4.148	↕ ⬍		○	○				○	○	○	○		○	○	○	
		2GR	2.370	↕ ⬍			○			○						○	○		
		3GR	1.555	↕ ⬍			○		○							○		○	
		4GR	1.154	↕ ⬍			○	○									○	○	
		5GR	0.859	↕ ⬍				○	○						○			○	
		6GR	0.685	↕ ⬍				○		○					○		○		
		6GR TCC ON			○			○		○					○		○		○

↕ : Automatic shift according to set speed and throttle opening angle

⬍ : Manual shift based on selector lever operation

*1 : Automatically switches between AAS and NORMAL modes according to accelerator pedal depressing speed

*2 : Performs slip operation in NORMAL mode

*3 : Performs TCC operation in NORMAL mode

○: Operating

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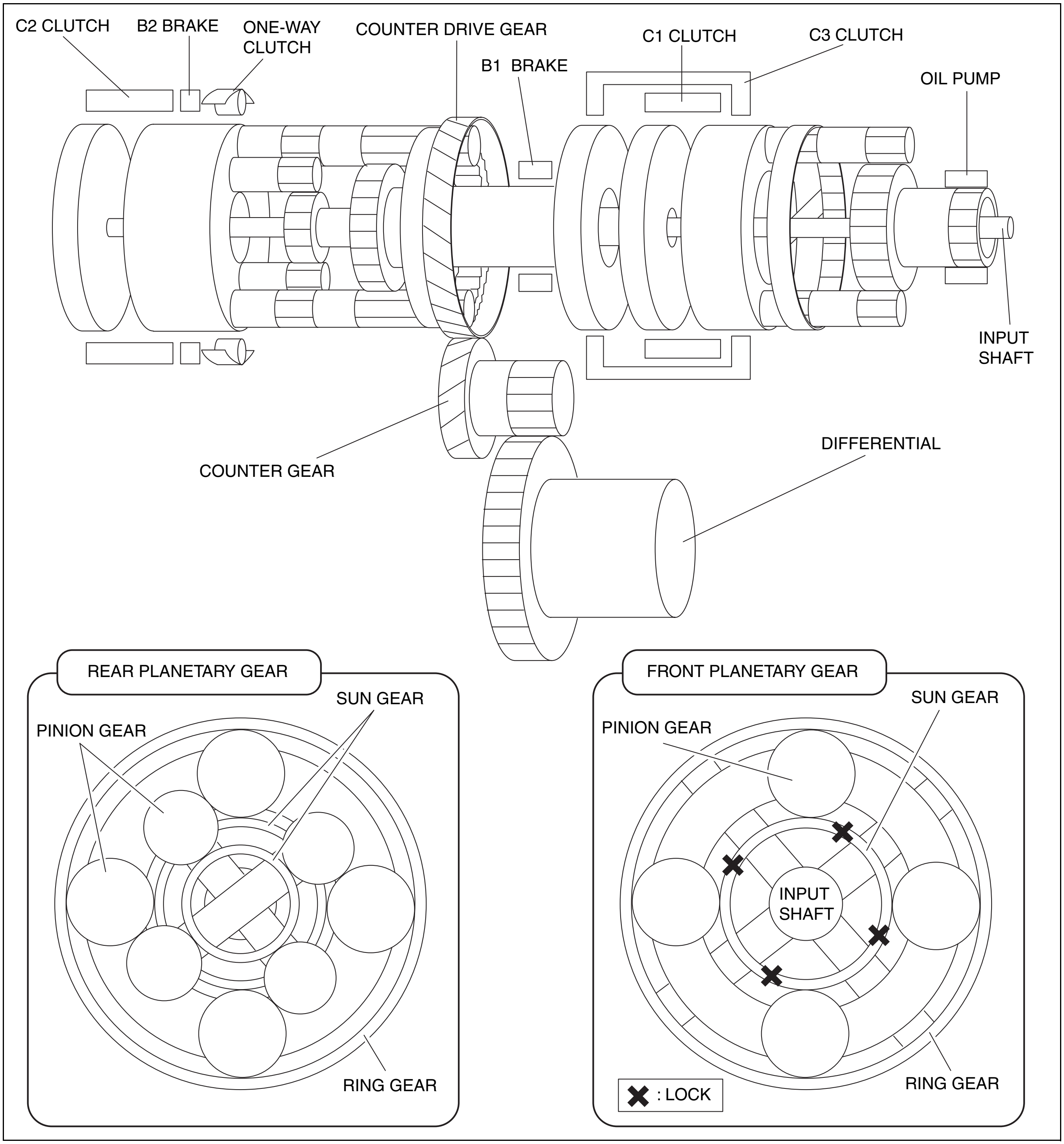
POWERFLOW STRUCTURE [AW6A-EL, AW6AX-EL]

id051723102200

Description of Components



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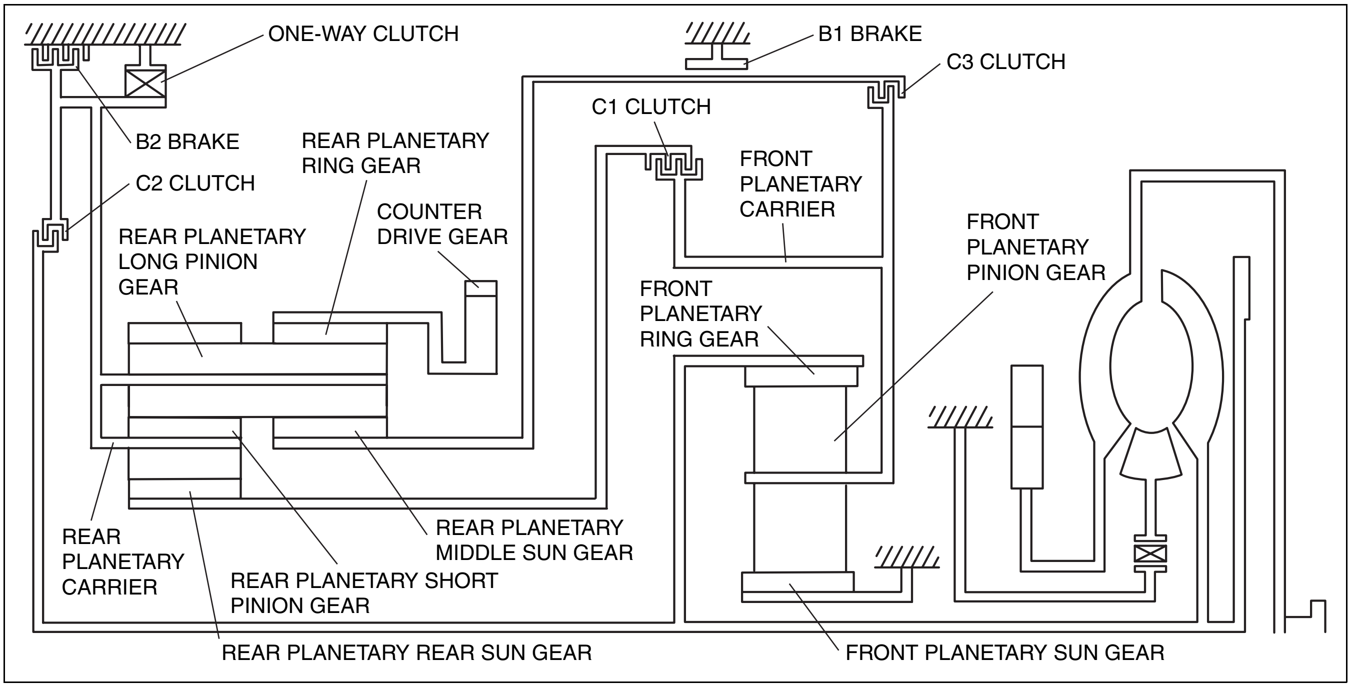
- The number of pinion gears differs depending on the engine displacement and vehicle.
  - Front: 5 pinions
  - Rear: 3 pinions



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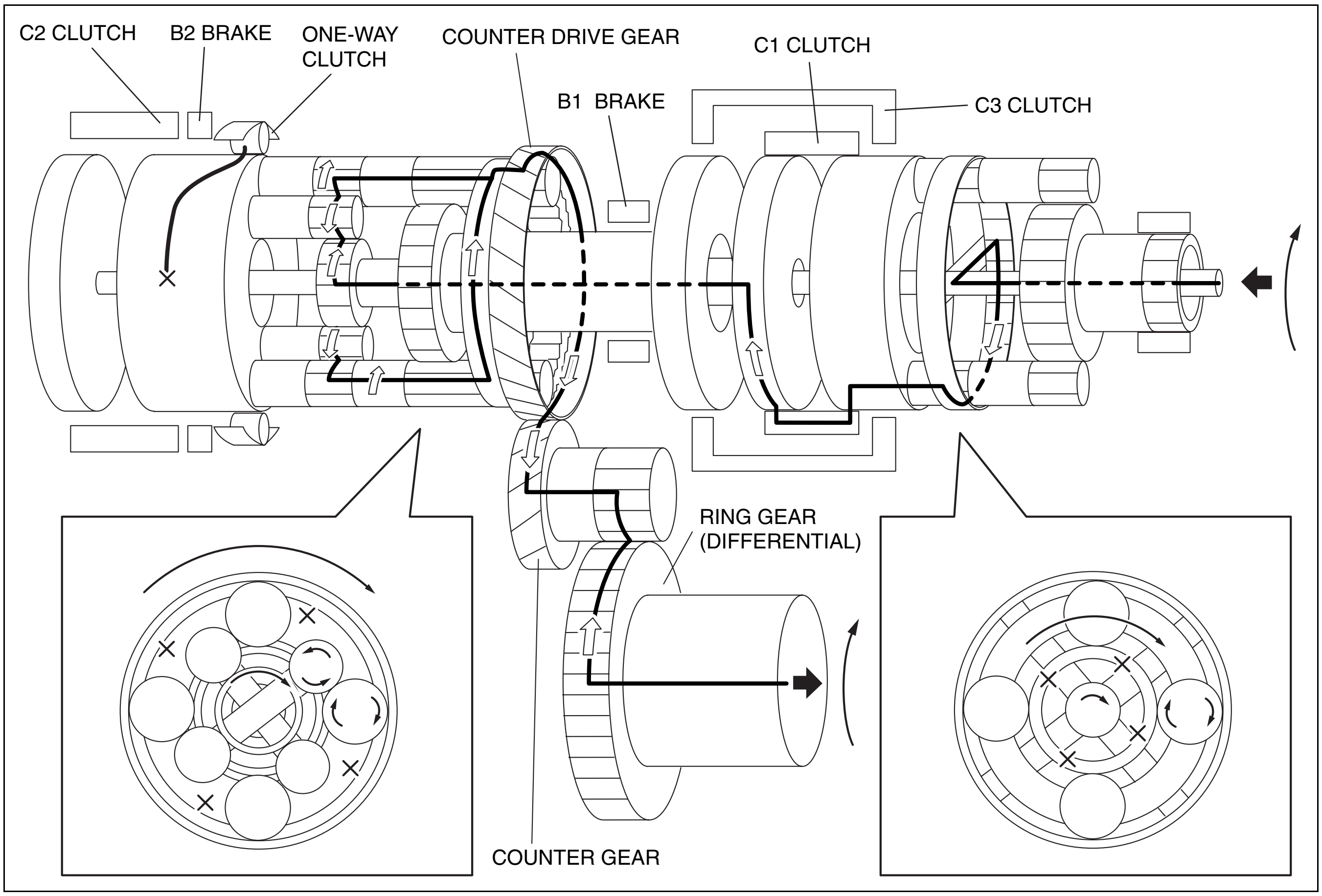
POWERFLOW OPERATION [AW6A-EL, AW6AX-EL]

id051723102300

List of operating components

Clutch / Brake	Operation
C1 clutch	• Connects front planetary carrier to rear planetary rear sun gear
C2 clutch	• Connects intermediate shaft to rear planetary carrier
C3 clutch	• Connects front planetary carrier to rear planetary middle sun gear
B1 brake	• Locks rear planetary middle sun gear
B2 brake	• Locks rear planetary carrier
One-way clutch	• Locks counterclockwise rotation of rear planetary carrier

1GR (D range)



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Power transmission pathway

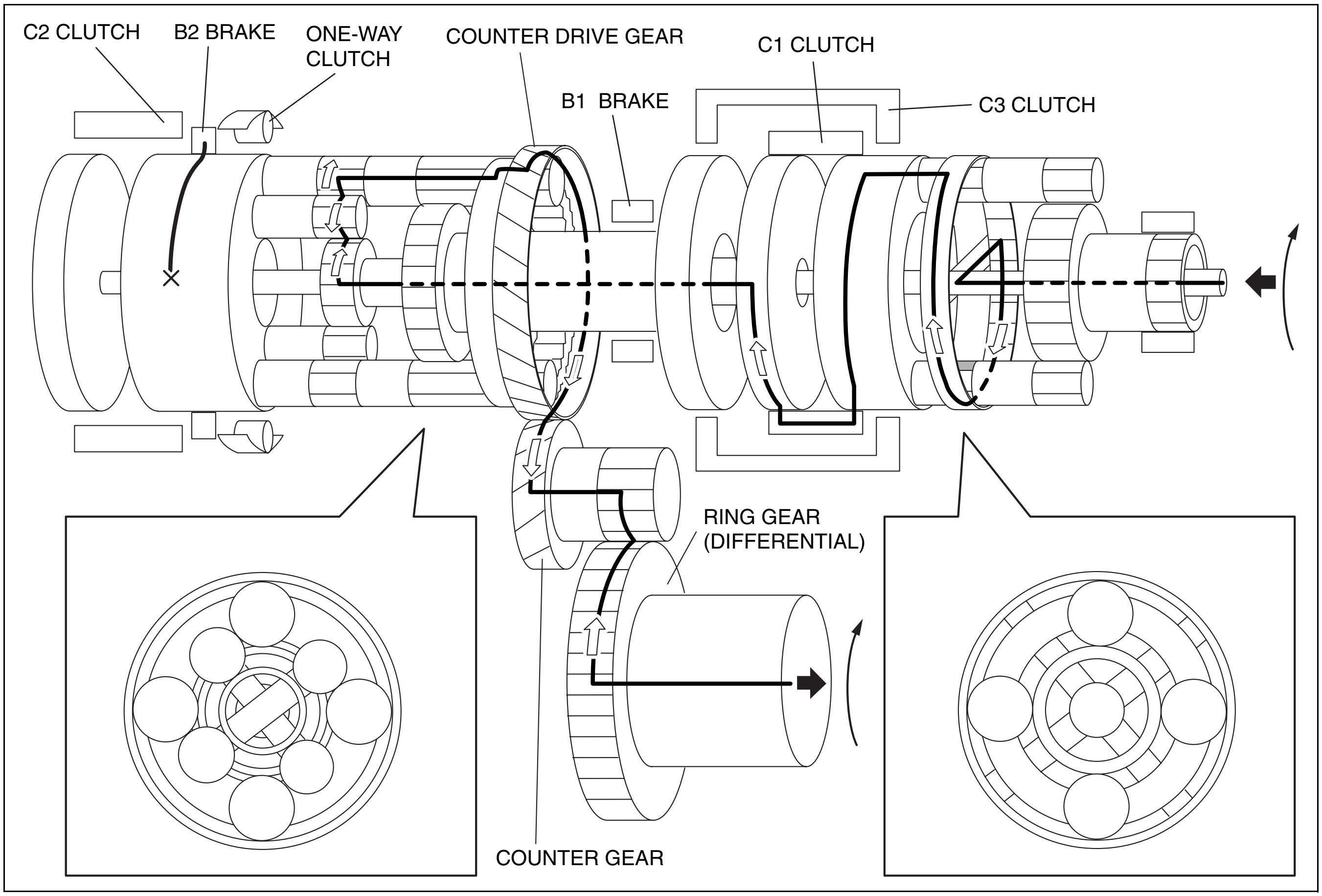
[Operating components: C1 clutch, One-way clutch]

- Operating components:
  C1 clutch, One-way clutch (counterclockwise rotation is locked), B2 brake (ON when engine brake is operating)

Planetary gear unit	Input, Locked, Output
Front	Input: Ring gear Locked: Sun gear Output: Carrier
Rear	Input: Rear sun gear Locked: Carrier Output: Ring gear

1. Input shaft (rotates clockwise) [same revolutions as the torque converter's turbine runner]
2. Front planetary ring gear (rotates clockwise) [same revolutions as the input shaft]
3. Front planetary pinion gear (rotates clockwise on its axis, orbits clockwise)
   [because the front planetary sun gear is locked by the oil pump, it is pressed against the front planetary ring gear and orbits the sun gear while rotating on its axis (because the front planetary ring gear has internal gears, the rotational direction does not change)]
4. Front planetary carrier (rotates clockwise)
   [reduction: same revolution as the front planetary pinion gear orbit revolution]
5. C1 clutch (rotates clockwise) [connects the front planetary carrier and the rear planetary rear sun gear]
6. Rear planetary rear sun gear (rotates clockwise) [same revolution as the front planetary carrier]
7. Rear planetary short pinion gear (rotates counterclockwise on its axis)
   [the rear planetary carrier tries to rotate counterclockwise, but the counterclockwise rotation is locked by one-way clutch.]
8. Rear planetary long pinion gear (rotates clockwise on its axis)
   [the rear planetary middle sun gear rotates counterclockwise (idling)]
9. Rear planetary ring gear (rotates clockwise)
   [the rear planetary ring gear is rotated by the rear planetary long pinion gear (because the rear planetary ring gear has internal gears, the rotational direction does not change)]
10. Counter drive gear (rotates clockwise)
    [because the rear planetary ring gear is installed on the counter drive gear, the rotational direction and the revolution are the same as the rear planetary ring gear]
11. Counter gear (rotates counterclockwise)
12. Differential ring gear (rotates clockwise)

1GR (M range)



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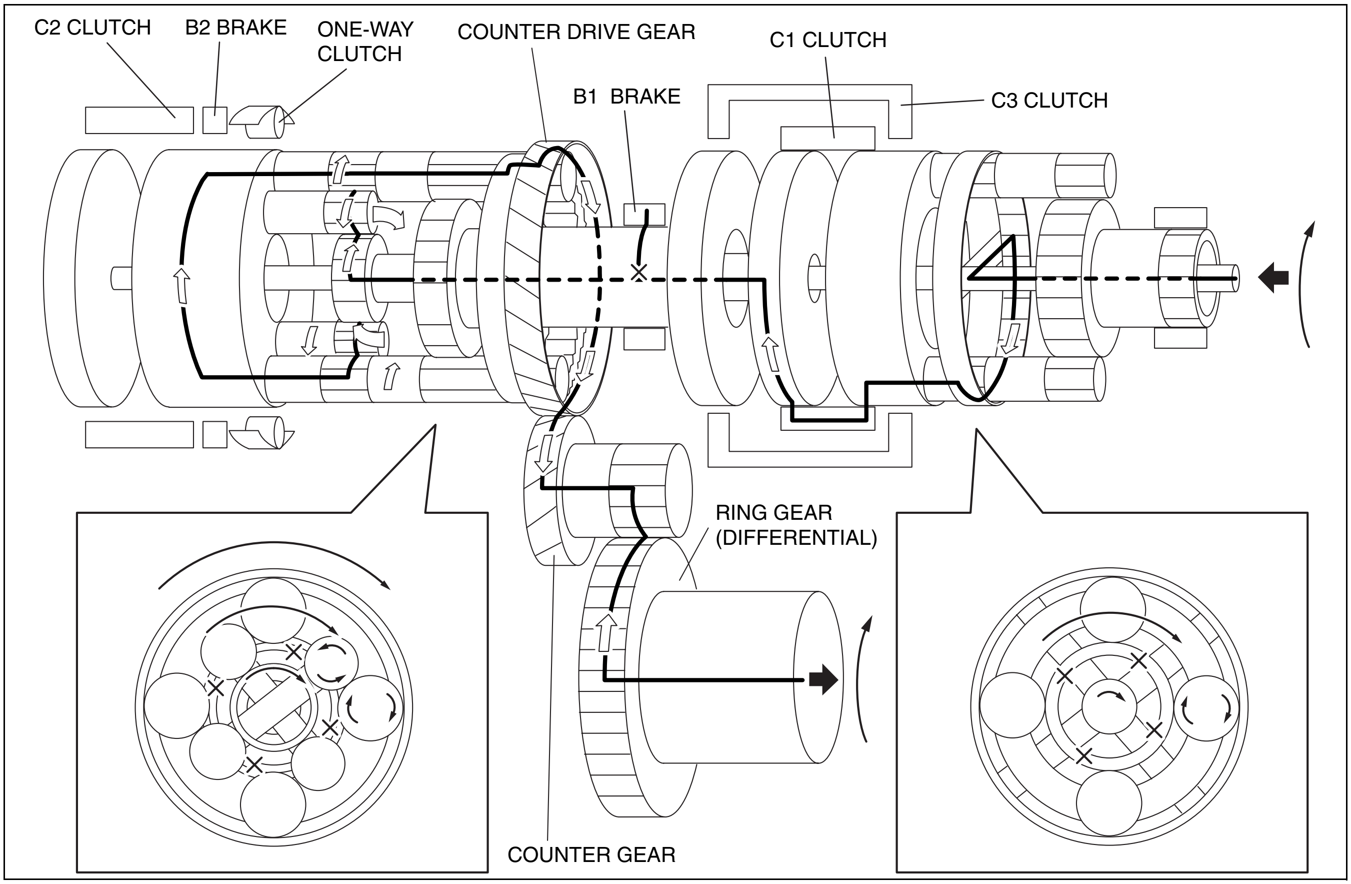
[Operating components: C1 clutch, B2 brake]

- When the engine brake is operating, driving force is transmitted from the tires. Because the rear planetary carrier, which is locked in its counterclockwise rotation by the one-way clutch, tries to rotate clockwise, B2 brake is turned ON and the rear planetary carrier is locked, and kinematic energy is transmitted from the tires to the engine.

2GR



acxuun00000622

Power transmission pathway
[Operating components: C1 clutch, B1 brake]

Planetary gear unit	Input, Locked, Output
Front	Input: Ring gear Locked: Sun gear Output: Carrier
Rear	Input: Rear Sun gear Locked: Middle Sun gear Output: Ring gear

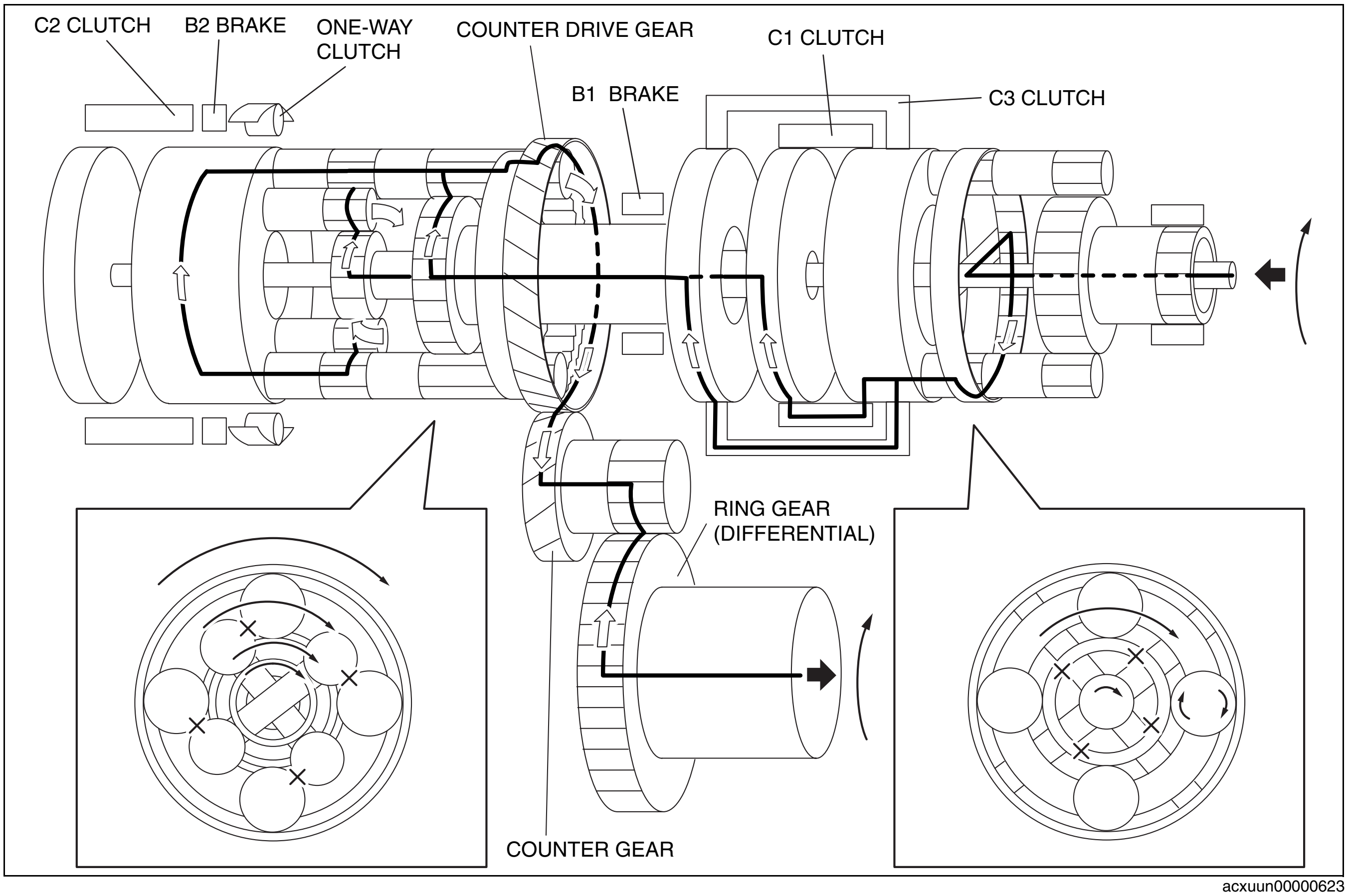
1. Input shaft (rotates clockwise) [same revolutions as the torque converter’s turbine runner]
2. Front planetary ring gear (rotates clockwise) [same revolution as the input shaft]
3. Front planetary pinion gear (rotates clockwise on its axis, orbits clockwise)
   [because the front planetary sun gear is locked by the oil pump, it is pressed against the front planetary ring gear and orbits the sun gear while rotating on its axis (because the front planetary ring gear has internal gears, the rotational direction does not change)]
4. Front planetary carrier (rotates clockwise)
   [reduction: same revolution as the front planetary pinion gear orbit revolution]
5. C1 clutch (rotates clockwise) [connects the front planetary carrier and the rear planetary rear sun gear]
6. Rear planetary rear sun gear (rotates clockwise) [same revolution as the front planetary carrier]
7. Rear planetary middle sun gear is locked by B1 brake
8. Rear planetary short pinion gear (rotates counterclockwise on its axis, orbits clockwise)
9. Rear planetary long pinion gear (rotates clockwise on its axis, orbits clockwise)
10. Rear planetary ring gear (rotates clockwise)
    [the rear planetary ring gear is rotated by the rear planetary long pinion gear (because the rear planetary ring gear has internal gears, the rotational direction does not change)]
11. Counter drive gear (rotates clockwise)
    [because the rear planetary ring gear is installed on the counter drive gear, the rotational direction and the revolution are the same as the rear planetary ring gear]
12. Counter gear (rotates counterclockwise)
13. Differential ring gear (rotates clockwise)

Engine brake

- When the engine brake is operating, driving force is transmitted from the tires.

05-17

3GR



Power transmission pathway
[Operating components: C1 clutch, C3 clutch]

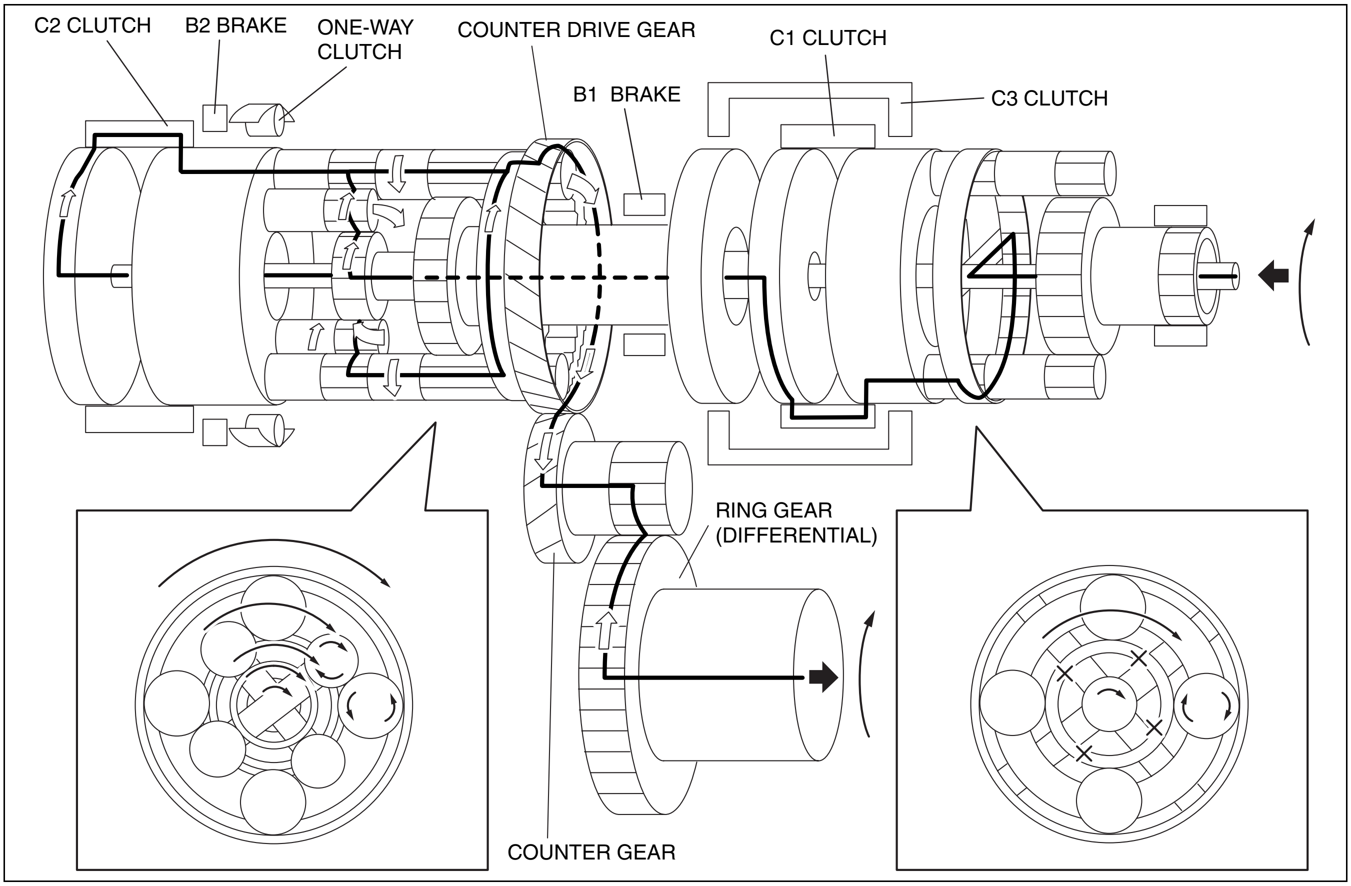
Planetary gear unit	Input, Locked, Output
Front	Input: Ring gear Locked: Sun gear Output: Carrier
Rear	Input: Rear Sun gear, Middle Sun gear Locked: - Output: Ring gear

1. Input shaft (rotates clockwise) [same revolution as the torque converter's turbine runner]
2. Front planetary ring gear (rotates clockwise) [same revolution as the input shaft]
3. Front planetary pinion gear (rotates clockwise on its axis, orbits clockwise)
   [because the front planetary sun gear is locked by the oil pump, it is pressed against the front planetary ring gear and orbits the sun gear while rotating on its axis (because the front planetary ring gear has internal gears, the rotational direction does not change)]
4. Front planetary carrier (rotates clockwise)
   [reduction: same revolution as the front planetary pinion gear orbit revolution]
5. C1 clutch (rotates clockwise) [connects the front planetary carrier and the rear planetary rear sun gear]
6. C3 clutch (rotates clockwise) [connects the front planetary carrier and the rear planetary middle sun gear]
7. Rear planetary gear component (rotates clockwise)
   [because the rear planetary short pinion gear and the rear planetary long pinion gear are engaged, both the pinion gears are locked due to the difference in the rotational directions, and kinematic energy of the rear planetary sun gear and rear planetary middle sun gear is transmitted to the rear planetary ring gear]
8. Rear planetary ring gear (rotates clockwise) [same revolution as the rear planetary carrier]
9. Counter drive gear (rotates clockwise)
   [because the rear planetary ring gear is installed on the counter drive gear, the rotational direction and the revolution are same as the rear planetary ring gear]
10. Counter gear (rotates counterclockwise)
11. Differential ring gear (rotates clockwise)

Engine brake

- When the engine brake is operating, driving force is transmitted from the tires.

4GR



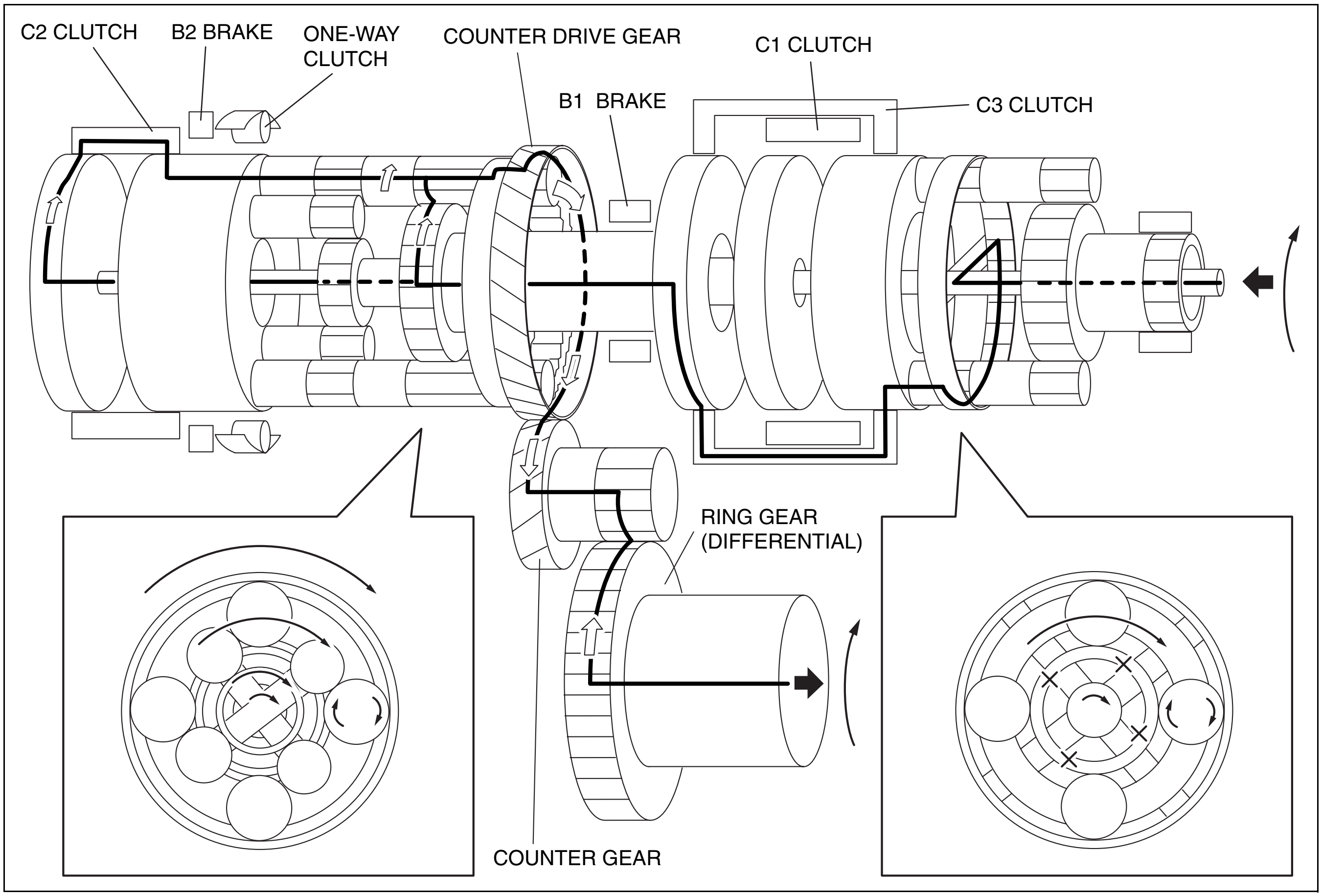
Power transmission pathway
[Operating components: C1 clutch, C2 clutch]

Planetary gear unit	Input, Locked, Output
Front	Input: Ring gear Locked: Sun gear Output: Carrier
Rear	Input: Rear Sun gear, Carrier Locked: - Output: Ring gear

1. Input shaft (rotates clockwise) [same revolution as the torque converter’s turbine runner]
2. Front planetary ring gear (rotates clockwise) [same revolution as the input shaft]
3. Front planetary pinion gear (rotates clockwise on its axis, orbits clockwise)
   [because the front planetary sun gear is locked by the oil pump, it is pressed against the front planetary ring gear and orbits the sun gear while rotating on its axis (because the front planetary ring gear has internal gears, the rotational direction does not change)]
4. Front planetary carrier (rotates clockwise)
   [reduction: same revolution as the front planetary pinion gear orbit revolution]
5. C1 clutch (rotates clockwise) [connects the front planetary carrier and the rear planetary rear sun gear]
6. Intermediate shaft (rotates clockwise) [same revolution as the input shaft]
7. C2 clutch (rotates clockwise) [same revolution as the intermediate shaft]
8. Rear planetary carrier (rotates clockwise) [same revolution as the intermediate shaft]
9. Rear planetary short pinion gear (rotates clockwise on its axis, orbits clockwise)
   [because the rear planetary carrier rotates faster than the rear planetary sun gear]
10. Rear planetary long pinion gear (rotates counterclockwise on its axis, orbits clockwise)
11. Rear planetary ring gear (rotates clockwise)
    [because the rear planetary long pinion gear’s rotation is subtracted from the rear planetary carrier revolution, the rear planetary ring gear revolution is slower than those of the rear planetary carrier]
12. Counter drive gear (rotates clockwise)
    [because the rear planetary ring gear is installed on the counter drive gear, the rotational direction and the revolution is the same as the rear planetary ring gear]
13. Counter gear (rotates counterclockwise)
14. Differential ring gear (rotates clockwise)

Engine brake
- When the engine brake is operating, driving force is transmitted from the tires.

5GR



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Power transmission pathway
[Operating components: C2 clutch, C3 clutch]

Planetary gear unit	Input, Locked, Output
Front	Input: Ring gear Locked: Sun gear Output: Carrier
Rear	Input: Carrier, Middle Sun gear Locked: - Output: Ring gear

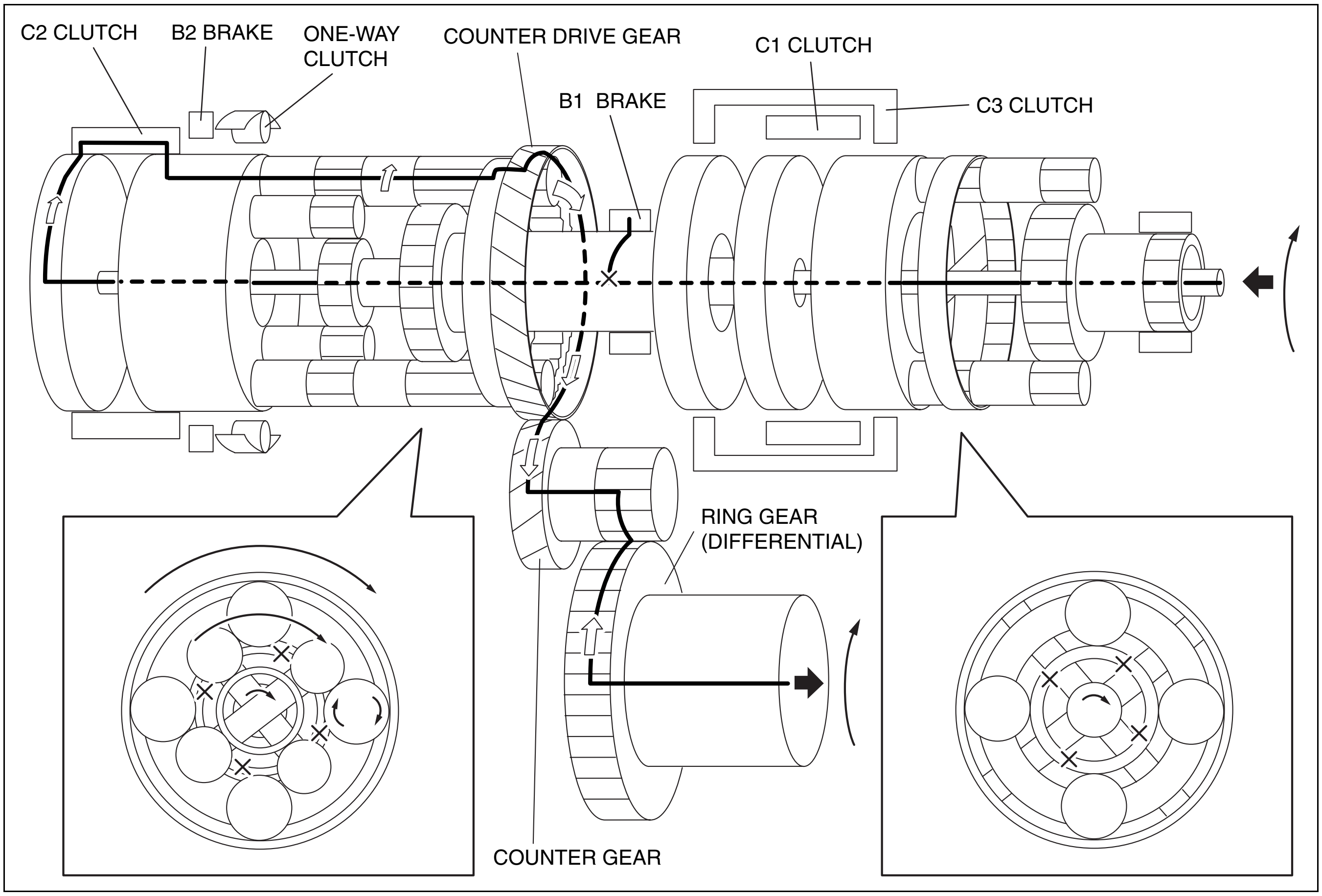
1. Input shaft (rotates clockwise) [same revolutions as torque converter's turbine runner]
2. Front planetary ring gear (rotates clockwise) [same revolution as the input shaft]
3. Front planetary pinion gear (rotates clockwise on its axis, orbits clockwise)
   [because the front planetary sun gear is locked by the oil pump, it is pressed against the front planetary ring gear and orbits the sun gear while rotating on its axis (because the front planetary ring gear has internal gears, the rotational direction does not change)]
4. Front planetary carrier (rotates clockwise)
   [reduction: same revolution as the front planetary pinion gear orbit revolution]
5. C3 clutch (rotates clockwise) [connects the front planetary carrier and the rear planetary middle sun gear]
6. Rear planetary middle sun gear (rotates clockwise)
   [same revolution as C3 clutch (decelerates by the front planetary gear, so the revolutions are slower than the input shaft)]
7. Intermediate shaft (rotates clockwise) [same revolution as the input shaft]
8. C2 clutch (rotates clockwise) [same revolution as the intermediate shaft]
9. Rear planetary carrier (rotates clockwise) [same revolutions as intermediate shaft]

10. Rear planetary long pinion gear (rotates clockwise on its axis, orbits clockwise)
[because the rear planetary carrier rotates faster than the rear planetary middle sun gear, the rear planetary middle pinion gear is pushed out by the speed difference, and orbits clockwise while rotating clockwise on its axis.]
11. Rear planetary ring gear (rotates clockwise)
[because the rear planetary long pinion gear's rotation is added to the rear planetary carrier revolutions, rear planetary ring gear revolution is faster than those of the rear planetary carrier]
12. Counter drive gear (rotates clockwise)
[because the rear planetary ring gear is installed on the counter drive gear, the rotational direction and revolution is the same as the rear planetary ring gear]
13. Counter gear (rotates counterclockwise)
14. Differential ring gear (rotates clockwise)

Engine brake

- When the engine brake is operating, driving force is transmitted from the tires.

6GR



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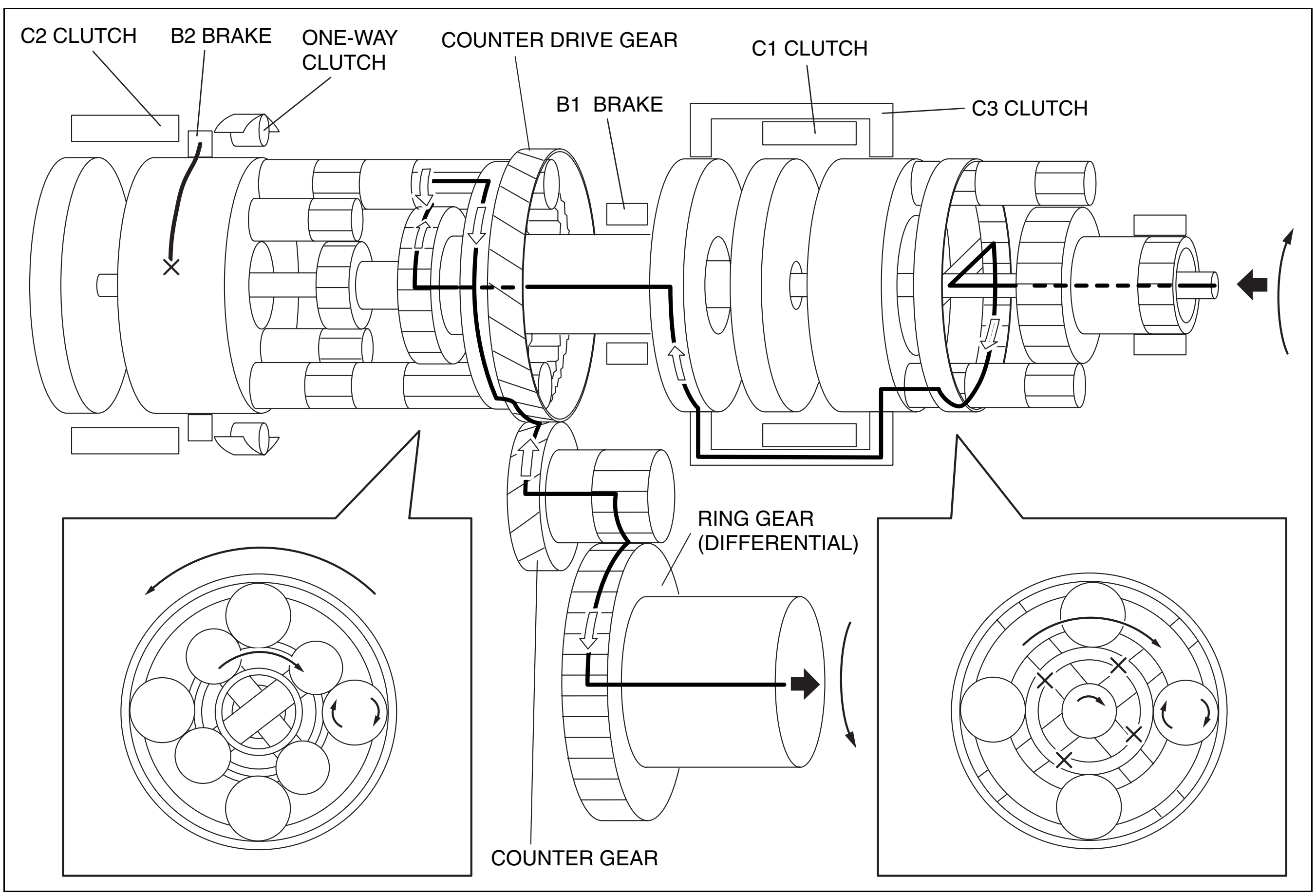
Power transmission pathway
[Operating components: B1 brake, C2 clutch]

Planetary gear unit	Input, Locked, Output
Front	-
Rear	Input: Carrier Locked: Middle Sun gear Output: Ring gear

1. Input shaft (rotates clockwise) [same revolution as the torque converter's turbine runner]
2. Intermediate shaft (rotates clockwise) [same revolution as the torque converter's turbine runner]
3. B1 brake [locks the rear planetary middle sun gear]
4. C2 clutch [connects the intermediate shaft and the rear planetary carrier]
5. Rear planetary carrier (rotates clockwise) [same revolution as the intermediate shaft]
6. Rear planetary long pinion gear (rotates clockwise on its axis, orbits clockwise) [because the rear planetary middle sun gear is locked, it is always in a speed increasing condition]
7. Rear planetary ring gear (rotates clockwise) [because the rear planetary long pinion gear's rotation is added to the rear planetary carrier revolution, the rear planetary ring gear revolution is faster than those of the rear planetary carrier]
8. Counter drive gear (rotates clockwise) [because the rear planetary ring gear is installed on the counter drive gear, the rotational direction and revolution are the same as the rear planetary ring gear]
9. Counter gear (rotates counterclockwise)
10. Differential ring gear (rotates clockwise)

Engine brake
- When the engine brake is operating, driving force is transmitted from the tires.

R position



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Power transmission pathway
[Operating components: C3 clutch, B2 brake]

Planetary gear unit	Input, Locked, Output
Front	Input: Ring gear Locked: Sun gear Output: Carrier
Rear	Input: Middle Sun gear Locked: Carrier Output: Ring gear

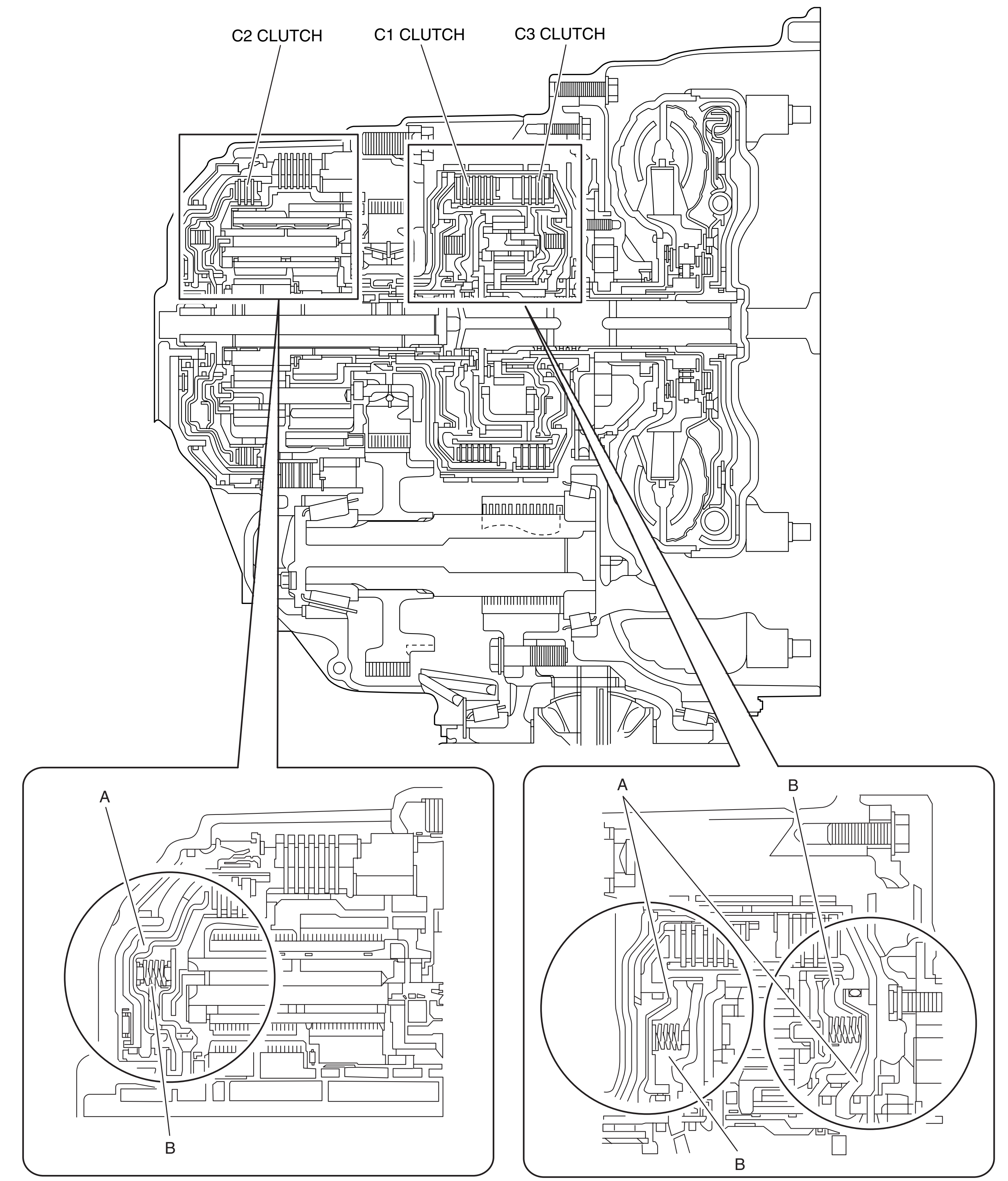
1. Input shaft (rotates clockwise) [same revolution as the torque converter's turbine runner]
2. Front planetary ring gear (rotates clockwise) [same revolution as the input shaft]
3. Front planetary pinion gear (rotates clockwise on its axis, orbits clockwise)
   [because the front planetary sun gear is locked by the oil pump, it is pressed against the front planetary ring gear and orbits the sun gear while rotating on its axis (because the front planetary ring gear has internal gears, the rotational direction does not change)]
4. Front planetary carrier (rotates clockwise)
   [reduction: same revolution as the front planetary pinion gear orbit revolution]
5. C3 clutch (rotates clockwise) [connects the front planetary carrier and the rear planetary middle sun gear]
6. Rear planetary middle sun gear (rotates clockwise)
   [same revolutions as the C3 clutch (rotates slower than the input shaft)]
7. B2 brake [locks the rear planetary carrier]
8. Rear planetary long pinion gear (rotates counterclockwise)
9. Rear planetary ring gear (rotates counterclockwise)
   [the rear planetary ring gear is rotated by the rear planetary long pinion gear (because the rear planetary ring gear has internal gears, the rotational direction does not change)]
10. Counter drive gear (rotates counterclockwise)
    [because the rear planetary ring gear is installed on the counter drive gear, the rotational direction and revolution are the same as the rear planetary ring gear]
11. Counter gear (rotates clockwise)
12. Differential ring gear (rotates counterclockwise)

Engine brake
- When the engine brake is operating, driving force is transmitted from the tires.

CENTRIFUGAL HYDRAULIC PRESSURE CANCEL CLUTCH OUTLINE [AW6A-EL, AW6AX-EL]

id051723102400

- When the rotation of the clutch rises, centrifugal force operates on the oil inside the clutch, hydraulic pressure rises, and the clutch is engaged at an earlier timing. Because of this, a difference arises in rotation between the input shaft and the output shaft, and shift shock may occur. To solve this, an additional chamber has been provided opposite the piston hydraulic pressure chamber. This causes centrifugal hydraulic pressure to operate in the opposite direction with the same force as the piston, counteracting that pressure.



A : PISTON HYDRAULIC PRESSURE CHAMBER
B : CENTRIFUGAL HYDRAULIC PRESSURE CANCEL CHAMBER

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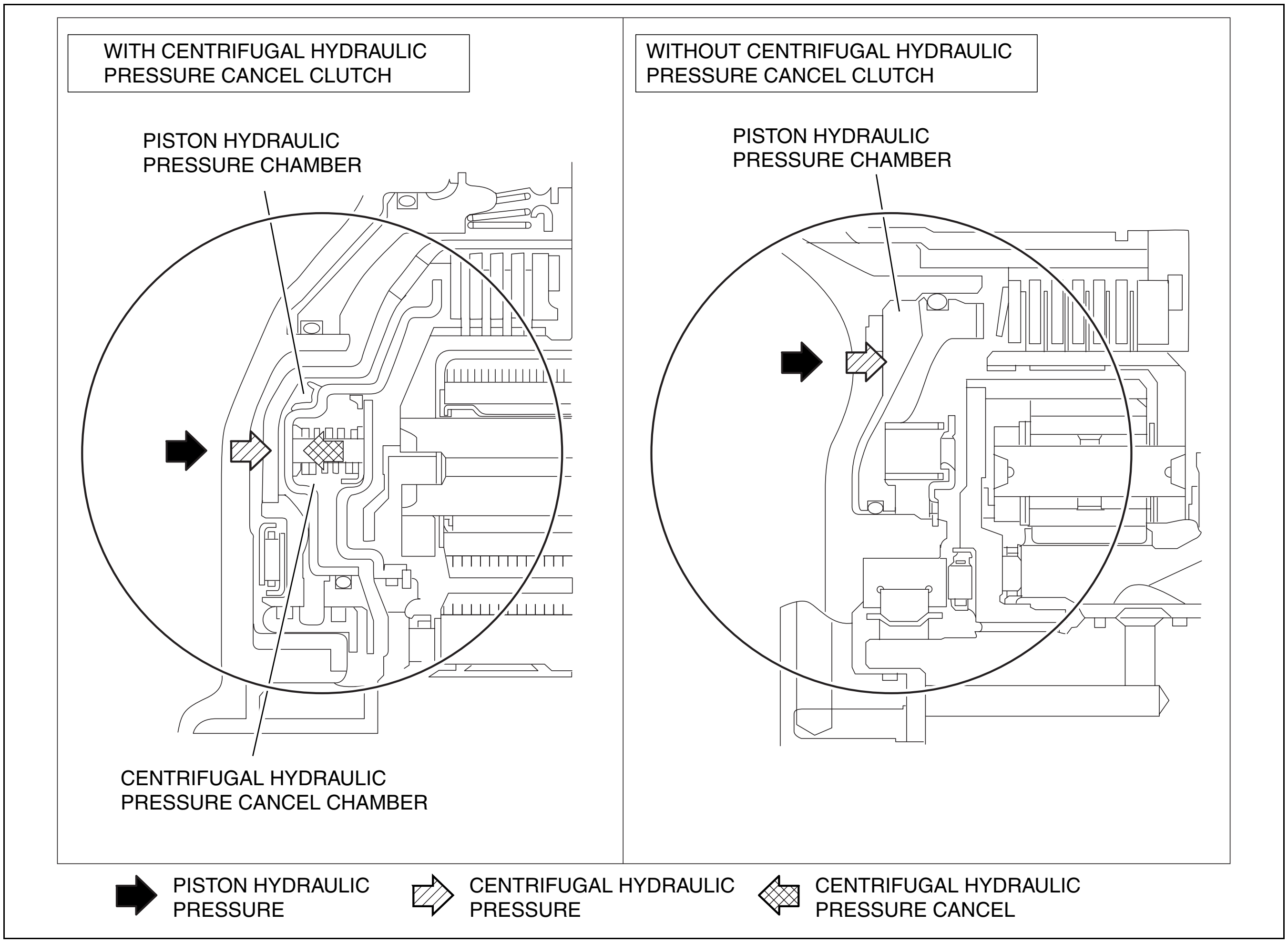

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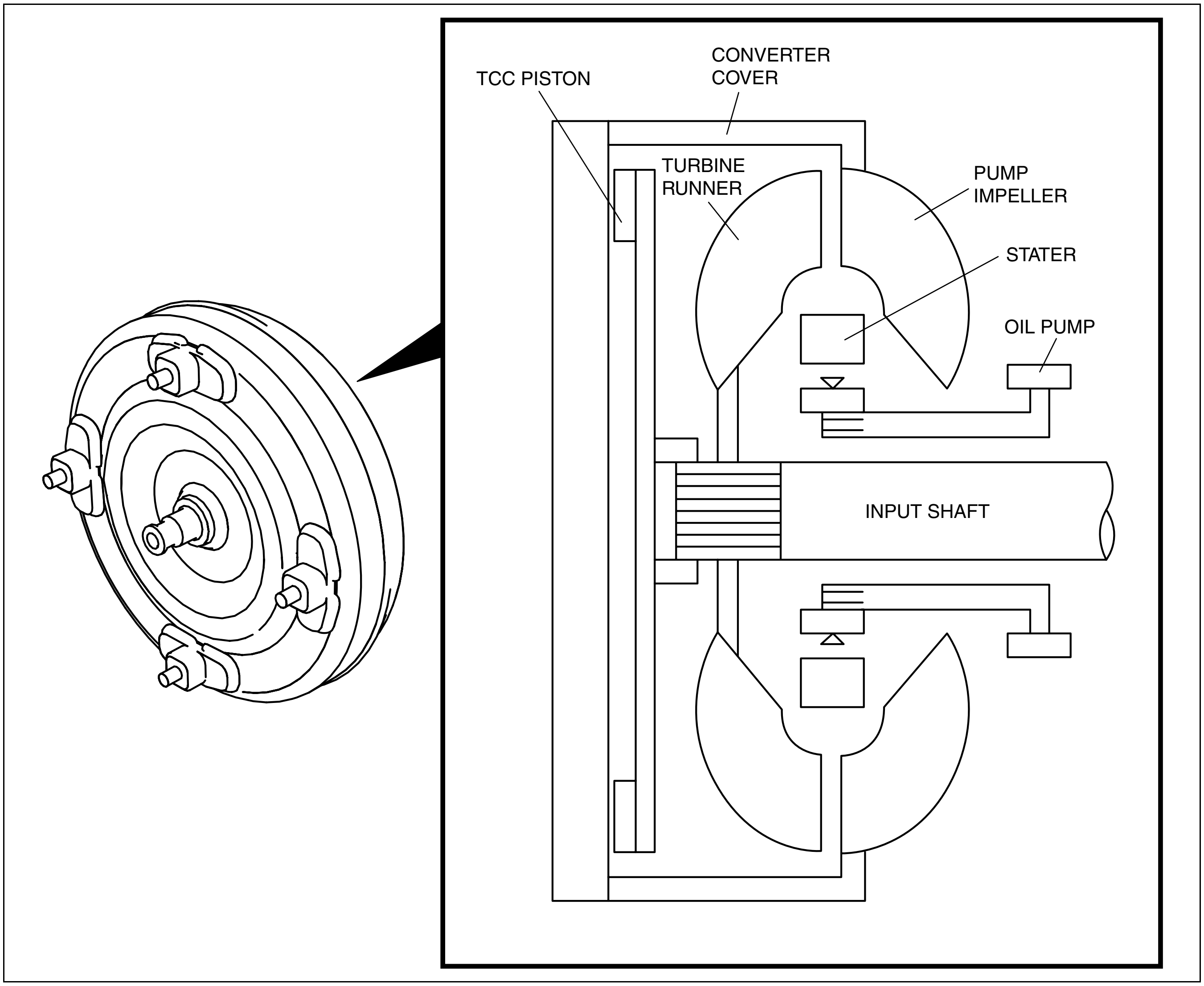
TORQUE CONVERTER OUTLINE [AW6A-EL, AW6AX-EL]

id051723100700

- The torque converter is composed of the converter cover, pump impeller, turbine runner, stator, one-way clutch, and TCC. The torque converter transmits and amplifies torque by means of the ATF inside it. In addition, the use of the TCC is intended to improve fuel economy as a direct coupling between the engine and automatic transaxle.



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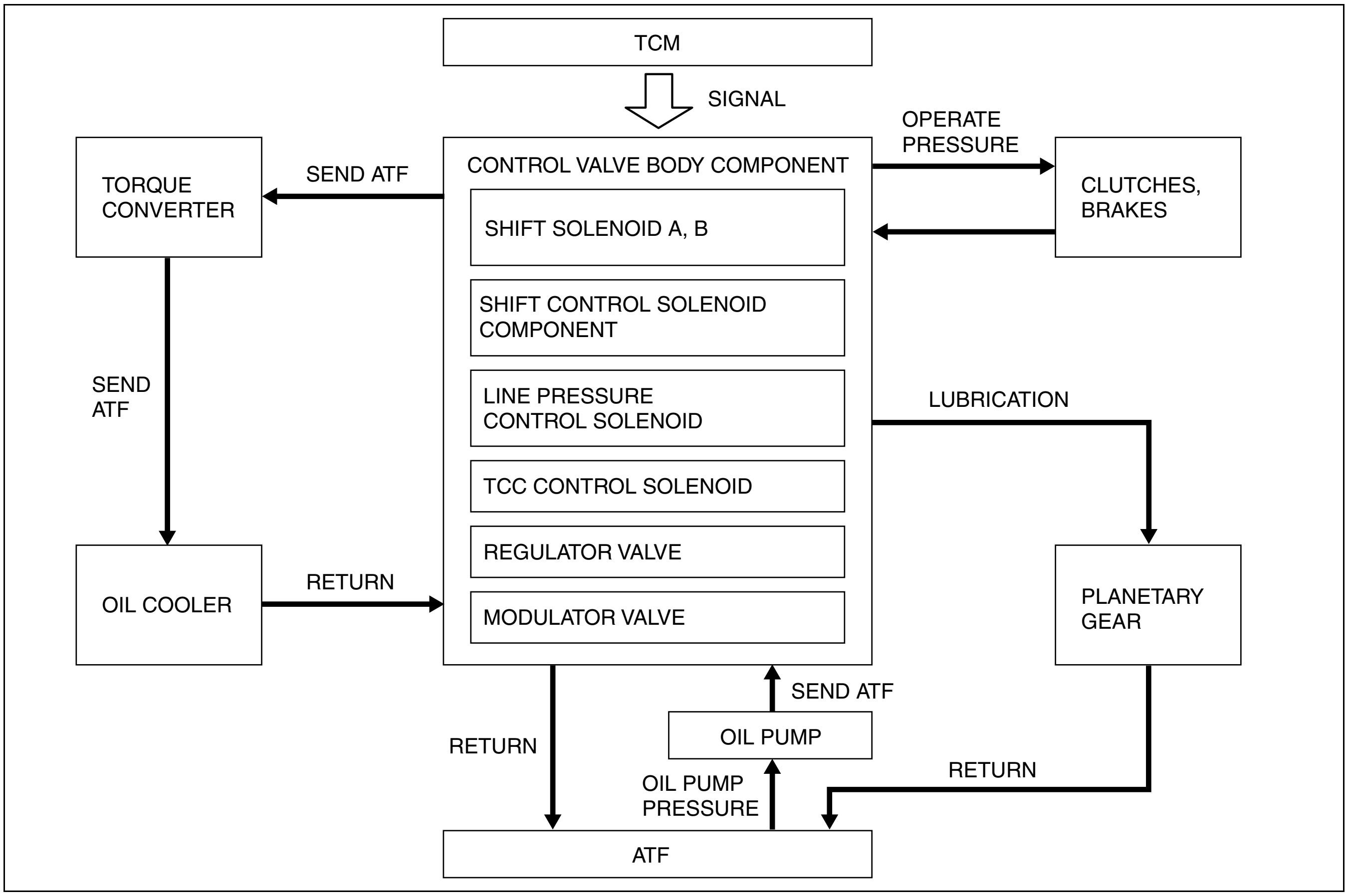
CONTROL VALVE BODY COMPONENT OUTLINE [AW6A-EL, AW6AX-EL]

id051723101600

- The control valve body supplys oil by switching the oil circuit for the hydraulic pressure generated by the oil pump. Based on the control signal from the TCM, the solenoid valves are activated to control the hydraulic pressure to the clutch and brakes, performing gear shift and TCC. In addition, an appropriate amount of oil is supplied to the torque converter, planetary gears and lubricating parts.



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ELECTRONIC CONTROL SYSTEM CONSTRUCTION [AW6A-EL, AW6AX-EL]

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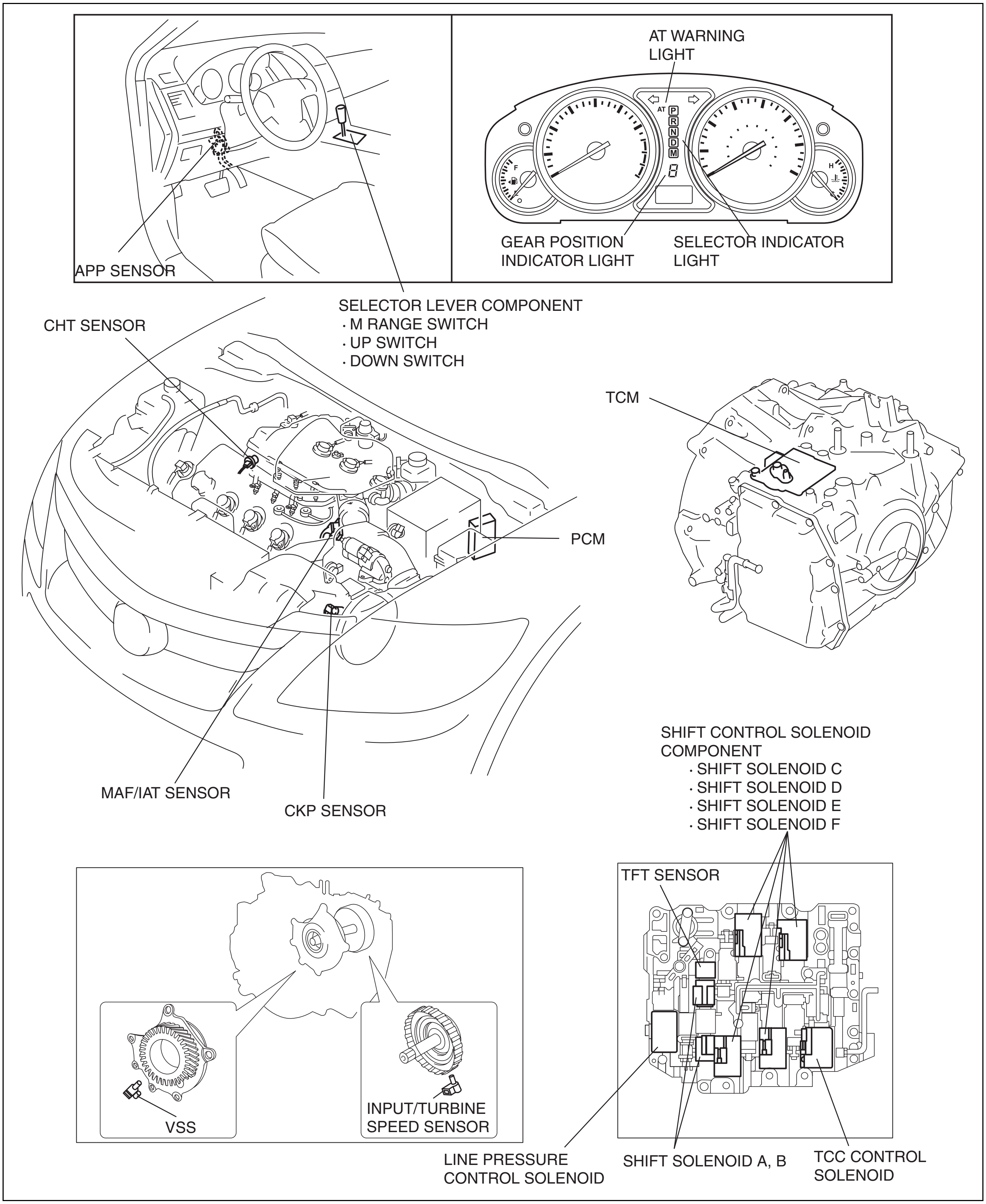

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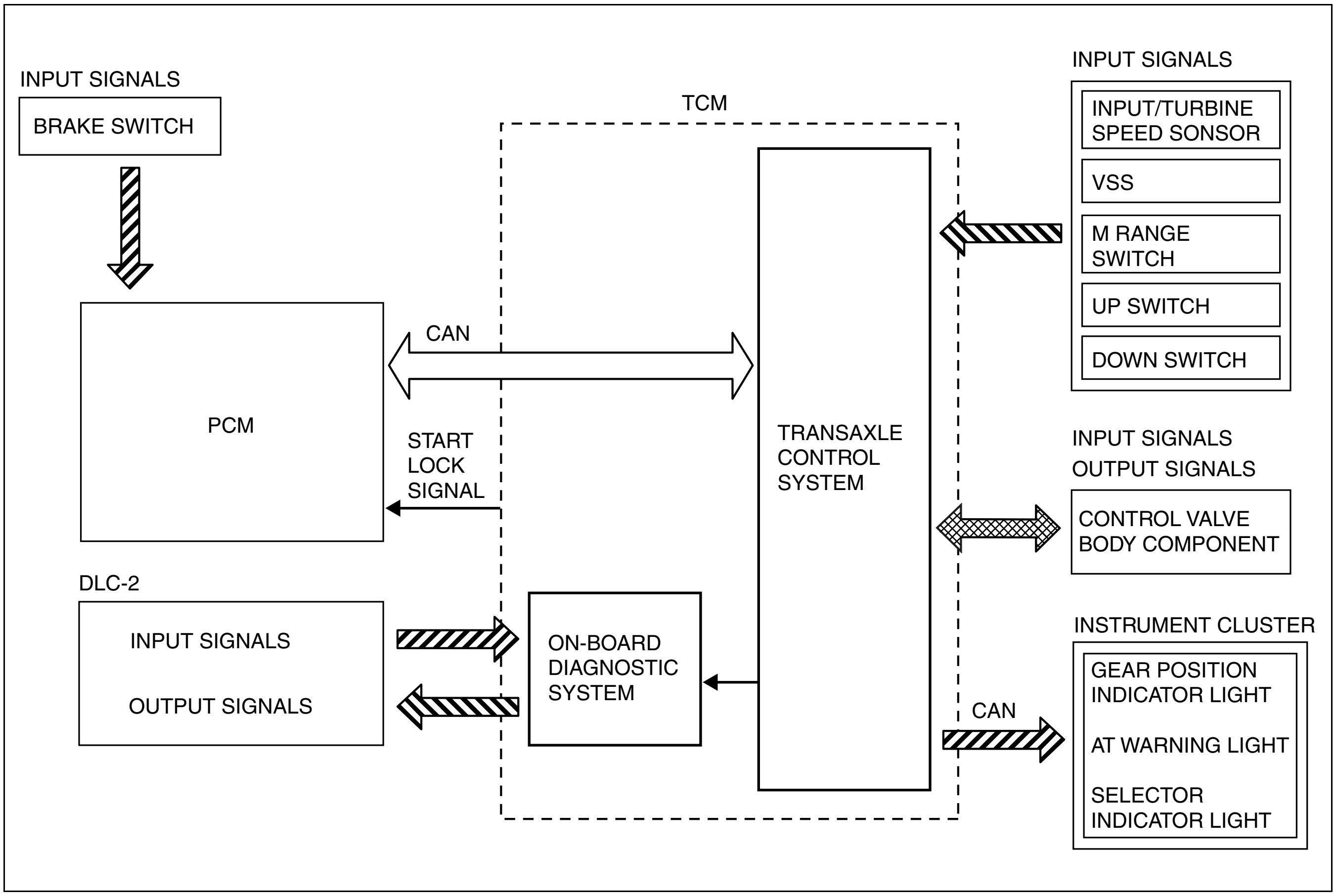
ELECTRONIC CONTROL SYSTEM BLOCK DIAGRAM [AW6A-EL, AW6AX-EL]

id051723100200

- Based on signals from the sensors, the system controls gear shift and TCC and performs clutch hydraulic control to achieve smooth gear shifting characteristics.



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ELECTRONIC CONTROL ITEMS AND CONTENTS [AW6A-EL, AW6AX-EL]

id051723100300

Item	Content
Driver adaptive shift control	• In D range, automatically switches between NORMAL, AAS, HIGH TEMP, CRUISE CONTROL, DOWN-SLOPE, UP-SLOPE, COLD modes according to specific conditions.
Manual mode shift control	• Shifts to selected gear position by manual shifting of the selector lever forward and back.
TCC, slip control	• According to preset TCC point, performs TCC operation via smooth TCC. • Slip control, by sliding the TCC when TCC is in the off range, extends the TCC range to low vehicle speeds.
Garage shift control	• Regulated oil pressure is supplied to the clutch when the selector lever is moved from N to D or from N to R, after the engine started.
Reverse control	• If the selector lever is moved from N to R while the vehicle is traveling and the transaxle shifts into reverse, TCM inhibits the transaxle from shifting into reverse while traveling.
Engine-transaxle total control	• Optimally controls engine output torque when shifting. • Operates optimal clutch engagement pressure corresponding to engine output torque.
On-board diagnostic system	• Detects and/or memorizes failure of input/output part and transaxle condition.

COMPONENT DESCRIPTIONS (ELECTRONIC CONTROL) [AW6A-EL, AW6AX-EL]

id051723100400

<table>
<tr><th colspan="3">Part name</th><th>Function</th></tr>
<tr><td rowspan="12">Input system</td><td colspan="2">M range switch</td><td>• Selects driving modes (M range) and changes driving patterns.</td></tr>
<tr><td colspan="2">Up switch</td><td>• Detects shift up request.</td></tr>
<tr><td colspan="2">Down switch</td><td>• Detects shift down request.</td></tr>
<tr><td colspan="2">TR switch</td><td>• Detects selector lever ranges/positions.</td></tr>
<tr><td colspan="2">APP sensor</td><td>• Detects the accelerator pedal depressing amount.</td></tr>
<tr><td colspan="2">Input/turbine speed sensor</td><td>• Detects the C2 clutch drum (input) revolution speed.</td></tr>
<tr><td colspan="2">VSS</td><td>• Detects the counter drive gear (output) revolution speed.</td></tr>
<tr><td colspan="2">Brake switch</td><td>• Detects the use of service brake.</td></tr>
<tr><td colspan="2">TFT sensor</td><td>• Detects the ATF temperature.</td></tr>
<tr><td colspan="2">CHT sensor</td><td>• Detects the engine cylinder head temperature. The PCM calculates the engine coolant temperature based on the signal.</td></tr>
<tr><td colspan="2">CKP sensor</td><td>• Detects the engine revolution speed.</td></tr>
<tr><td colspan="2">MAF sensor</td><td>• Detects the intake air amount.</td></tr>
<tr><td rowspan="10">Output system</td><td rowspan="6">Linear type</td><td>Line pressure control solenoid</td><td>• Adjusts the line pressure.</td></tr>
<tr><td>Shift solenoid C</td><td>• Controls the clutch engagement pressure.</td></tr>
<tr><td>Shift solenoid D</td><td>• Controls the clutch engagement pressure.</td></tr>
<tr><td>Shift solenoid E</td><td>• Controls the clutch engagement pressure.</td></tr>
<tr><td>Shift solenoid F</td><td>• Controls the clutch engagement pressure.</td></tr>
<tr><td>TCC control solenoid</td><td>• Controls the TCC and slip hydraulic pressure.</td></tr>
<tr><td rowspan="2">3-way type</td><td>Shift solenoid A</td><td>• Controls the clutch engagement pressure.</td></tr>
<tr><td>Shift solenoid B</td><td>• Controls the clutch engagement pressure.</td></tr>
<tr><td colspan="2">AT warning light</td><td>• Illuminates when failure is detected by diagnosis function.</td></tr>
<tr><td colspan="2">Speedometer signal</td><td>• Outputs the vehicle speed signal to speedometer.</td></tr>
</table>

INPUT/OUTPUT SIGNAL AND RELATED CONTROLS [AW6A-EL, AW6AX-EL]

id051723100500

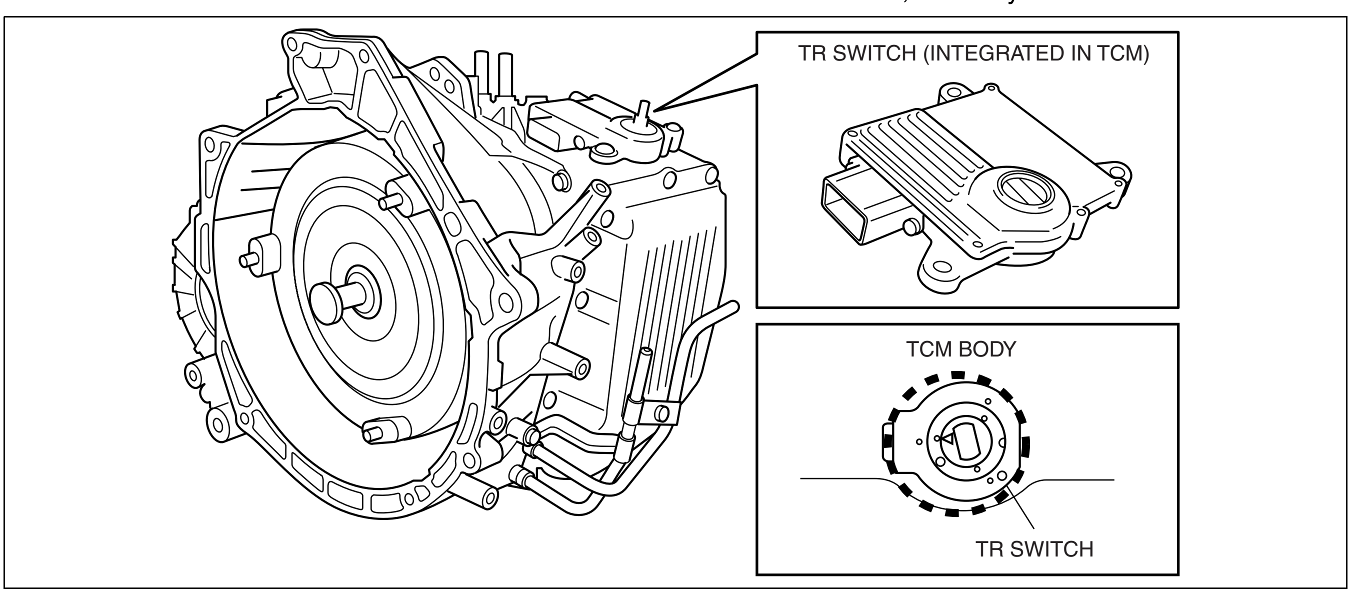
Component	Control item							
	Automatic gear shift control	Driver adaptive shift control	Manual mode shift control	TCC, slip control	Garage shift control	Reverse control	Engine-transaxle total control	On-board diagnostic function
Input								
M range switch		X	X					
Up switch		X	X					
Down switch		X	X					
TR switch	X	X			X	X		
APP sensor	X	X		X				X
Input/turbine speed sensor	X	X		X	X	X		X
VSS	X	X	X	X	X	X		X
Brake switch	X	X		X				
TFT sensor	X	X		X				X
CHT sensor		X		X				X
CKP sensor		X		X			X	X
MAF sensor		X					X	X
Output								
Line pressure control solenoid	X	X	X	X				X
Shift solenoid C	X	X	X		X			X
Shift solenoid D	X	X	X					X
Shift solenoid E	X	X	X		X	X		X
Shift solenoid F	X	X	X					X
TCC control solenoid	X	X	X	X				X
Shift solenoid A	X	X	X					X
Shift solenoid B	X	X	X					X
AT warning light	X	X	X					X

X : Available

TRANSAXLE RANGE (TR) SWITCH OUTLINE [AW6A-EL, AW6AX-EL]

id051723100800

- The adoption of the integrated TCM has the following advantages:
  — It allows the number of parts to be decreased (the wiring harness can be simplified).
  — Because there is no harness circuit between the TCM and TR switch, reliability is enhanced.



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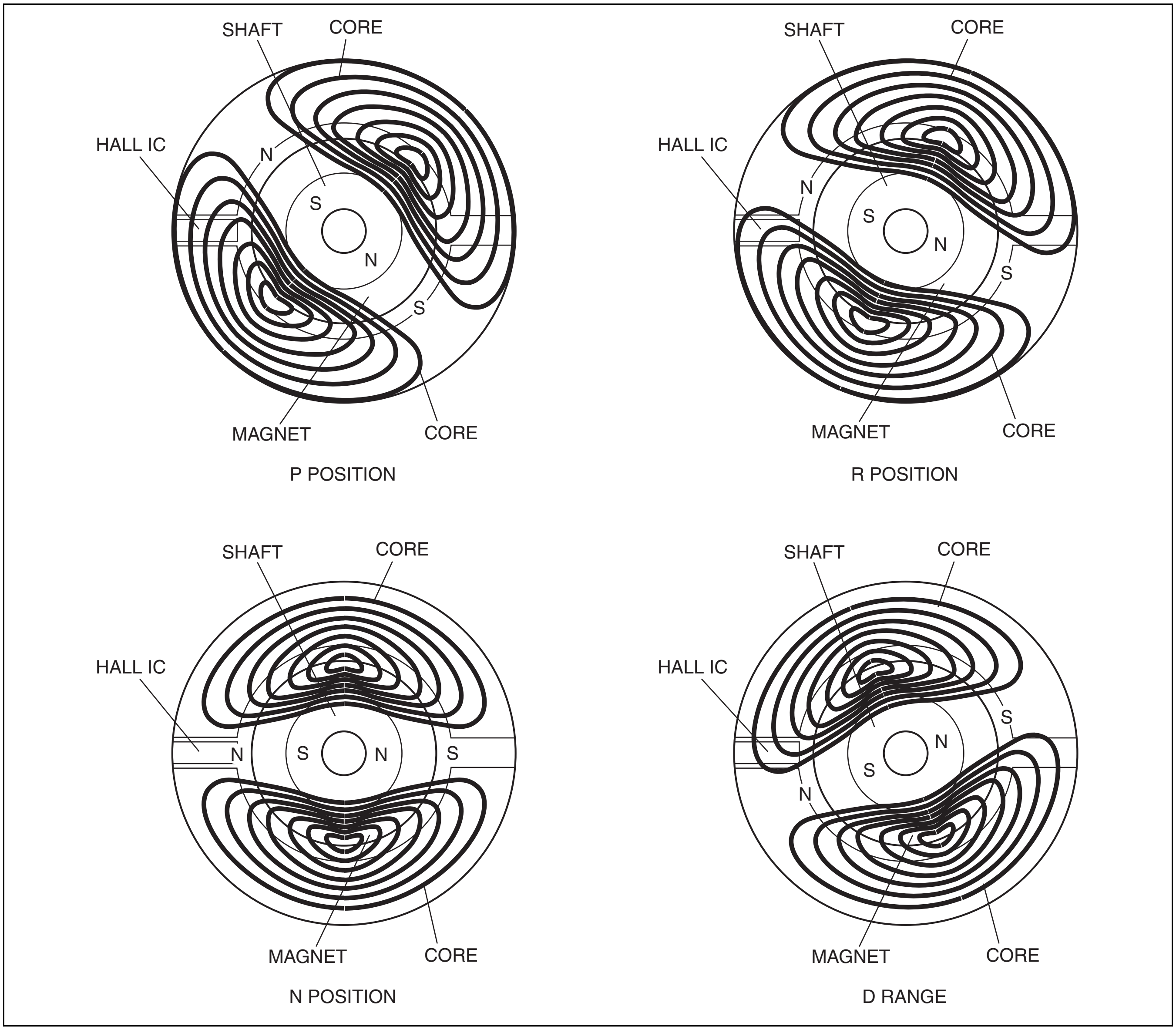
TRANSAXLE RANGE (TR) SWITCH OPERATION [AW6A-EL, AW6AX-EL]

id051723100900

- A non-contact type TR switch has been adopted in the TCM. The TR switch detects shift position by using the Hall Effect, which outputs specified voltage according to the shift position (P, R, N, D). The magnet position in the TR switch changes when moving the selector lever, enabling the Hall IC to convert magnetic field strength into an electrical signal according to the shift position. Compared to the contact type switch, the non-contact type switch does not have contact points and is very compact. This makes it possible to integrate it with the TCM, improving reliability and durability.
  - — The Hall Effect:
    - If magnetic flux is applied perpendicularly to electric current flowing into a conductor or semiconductor, a potential difference, called Hall voltage, is generated perpendicularly in both the electric current and magnetic flux. This phenomenon is called the “Hall Effect”.
  - — Hall IC:
    - A Hall IC is an electronic part that uses impetus caused by potential difference when a magnetic field is generated.



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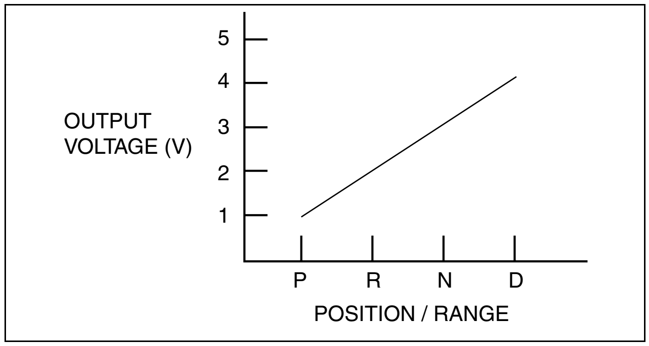

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TCM OUTLINE [AW6A-EL, AW6AX-EL]

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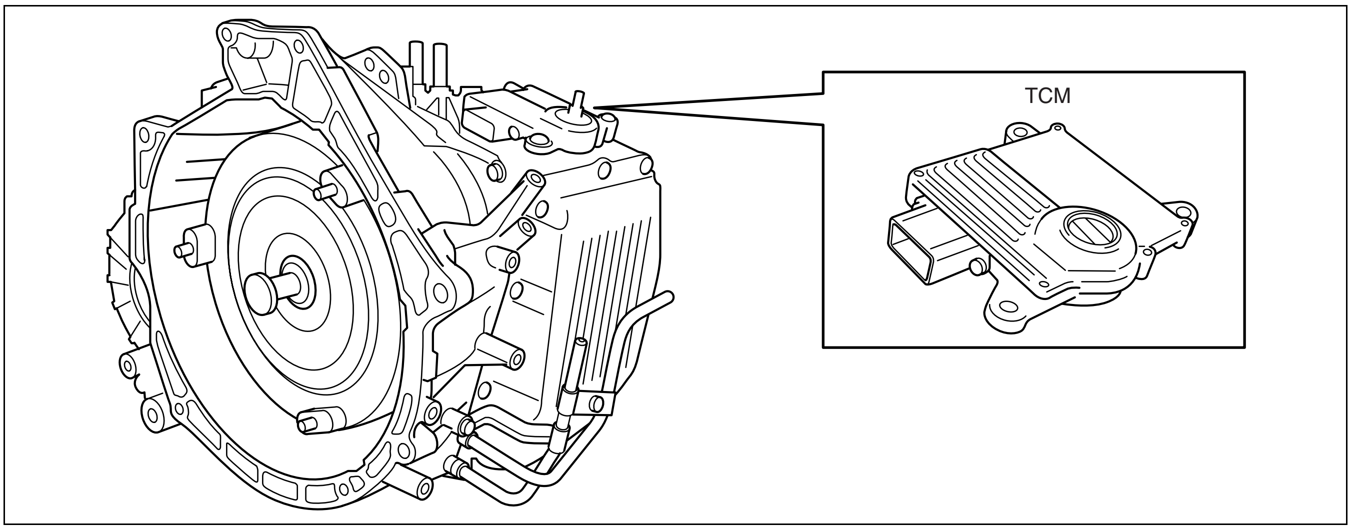
- TR switch function is installed as one part of TCM. Shift range is calculated by TCM reading output voltage from TR switch installed to the TCM itself.



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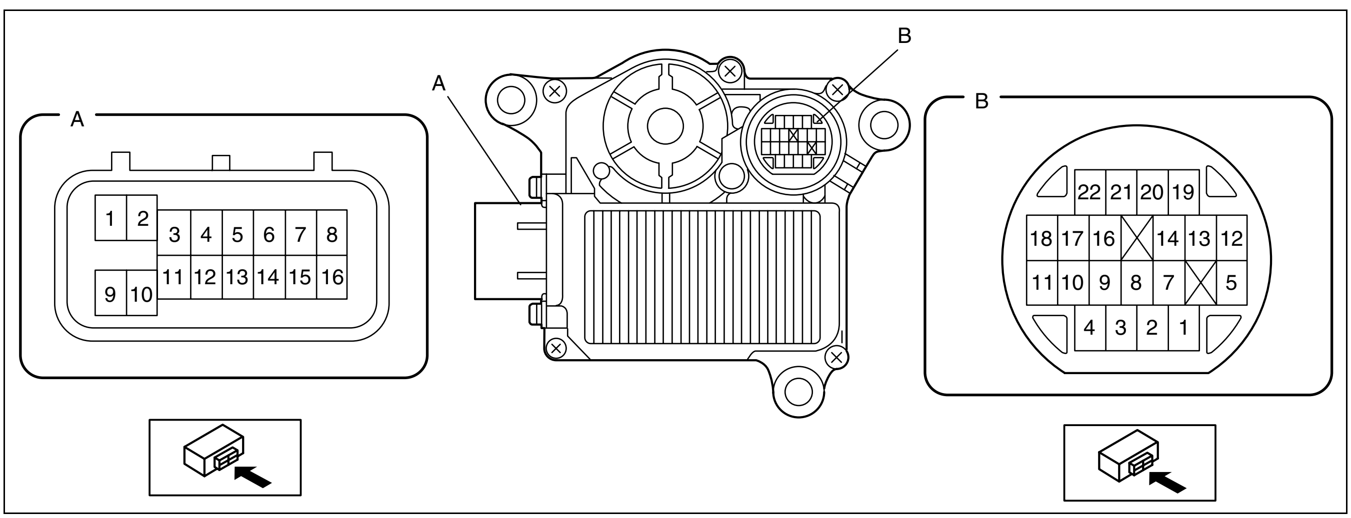
TCM Terminals



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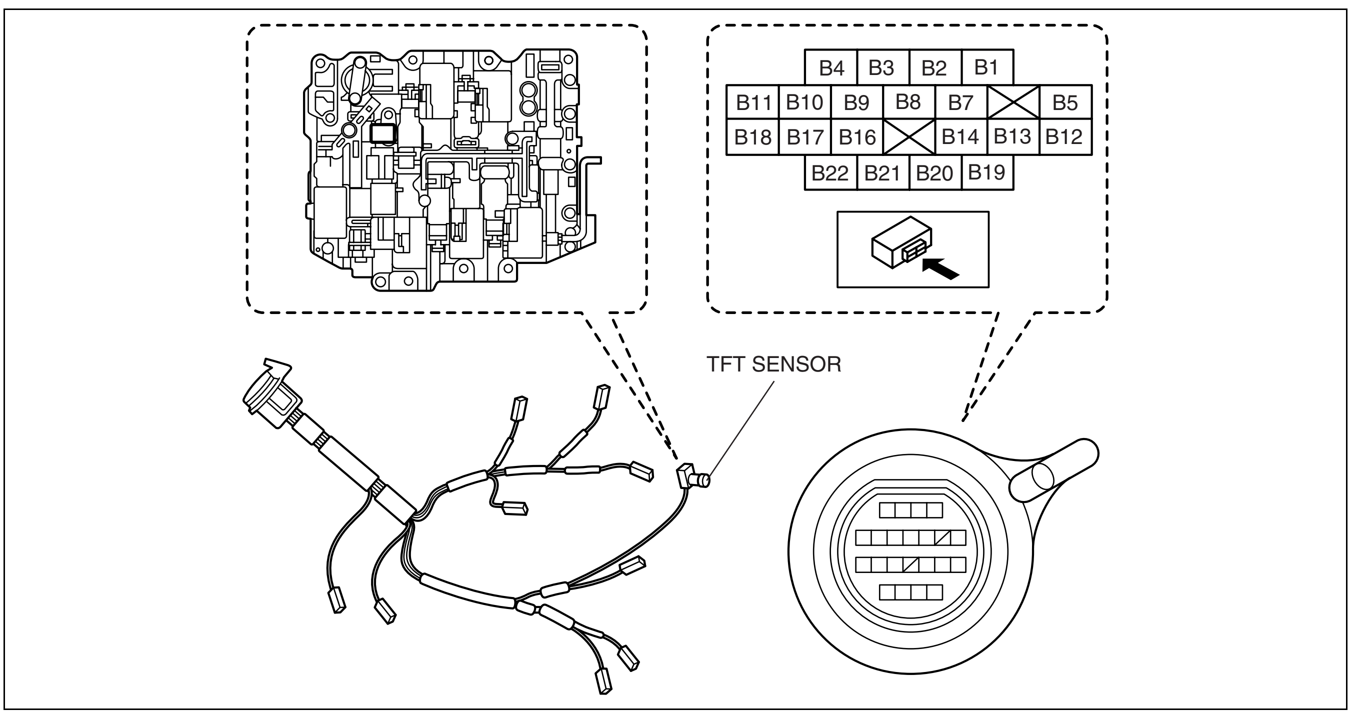
Terminal No.	Signal	Terminal No.	Signal
A1	B+	B1	Line pressure control solenoid (–)
A2	Blank	B2	Shift solenoid B
A3	Manual up	B3	Line pressure control solenoid (+)

Terminal No.	Signal	Terminal No.	Signal
A4	Manual down	B4	TCC control solenoid (–)
A5	Start lock	B5	Shift solenoid A
A6	CAN_L	B6	Blank
A7	M range	B7	TFT sensor (–)
A8	Blank	B8	TFT sensor (+)
A9	TCM GND	B9	TCC control solenoid (+)
A10	Blank	B10	Shift solenoid C (–)
A11	IGI	B11	Shift solenoid C (+)
A12	Blank	B12	Input/turbine speed sensor (+)
A13	Back-up light relay	B13	Input/turbine speed sensor (–)
A14	CAN_H	B14	Shift solenoid E (+)
A15	Blank	B15	Blank
A16	Blank	B16	Shift solenoid F (–)
—	—	B17	Shift solenoid D (+)
—	—	B18	Shift solenoid D (–)
—	—	B19	VSS (+)
—	—	B20	VSS (–)
—	—	B21	Shift solenoid F (+)
—	—	B22	Shift solenoid E (–)

COUPLER COMPONENT (TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR) OUTLINE [AW6A-EL, AW6AX-EL]

id051723101000

- The coupler component are installed on the transaxle case as the grouped connectors of the TFT sensor, input/turbine speed sensor, VSS and solenoids.
- The TFT sensor, which is integrated with the coupler component, is installed on the front valve body. It directly detects the TFT within the hydraulic pressure control circuit and transmits a signal based on that temperature to the TCM. Through this, it controls gear shift, TCC and slip in response to changes in TFT for smooth shifting across wide TFT zones.



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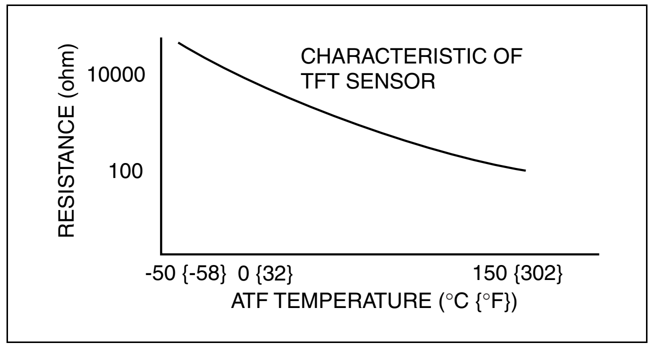
Terminal No.	Signal
B1	Line pressure control solenoid (–)
B2	Shift solenoid B
B3	Line pressure control solenoid (+)
B4	TCC control solenoid (–)
B5	Shift solenoid A
B6	—
B7	TFT sensor (–)
B8	TFT sensor (+)
B9	TCC control solenoid (+)
B10	Shift solenoid C (–)
B11	Shift solenoid C (+)

Terminal No.	Signal
B12	Input/turbine speed sensor (+)
B13	Input/turbine speed sensor (–)
B14	Shift solenoid E (+)
B15	—
B16	Shift solenoid F (–)
B17	Shift solenoid D (+)
B18	Shift solenoid D (–)
B19	VSS (+)
B20	VSS (–)
B21	Shift solenoid F (+)
B22	Shift solenoid E (–)



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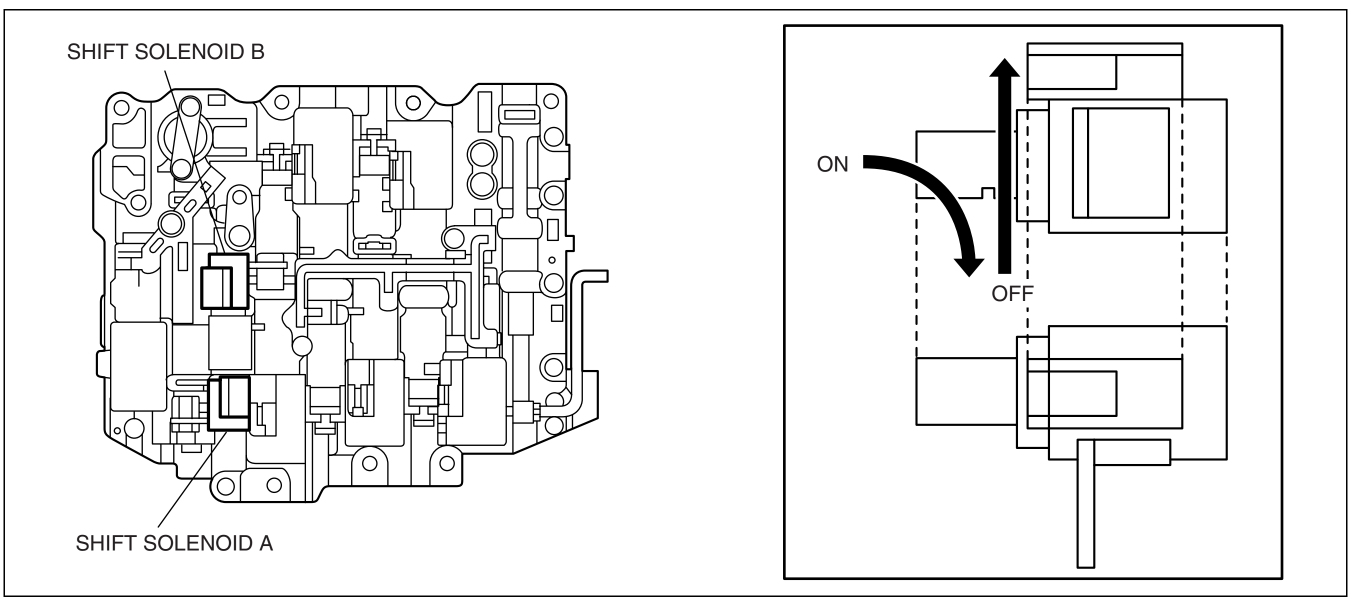
SHIFT SOLENOID A, B OUTLINE [AW6A-EL, AW6AX-EL]

id051723101100

- Shift solenoid A, B is installed on the front valve body. The solenoids turn ON and OFF in response to signals output from the TCM. According to the ON or OFF status of shift solenoid A or shift solenoid B, the 1st gear engine brake operates or the gear shifts into change. As a fail-safe function, if any shift solenoid abnormality occurs, the TCM will disable the current to the solenoids.



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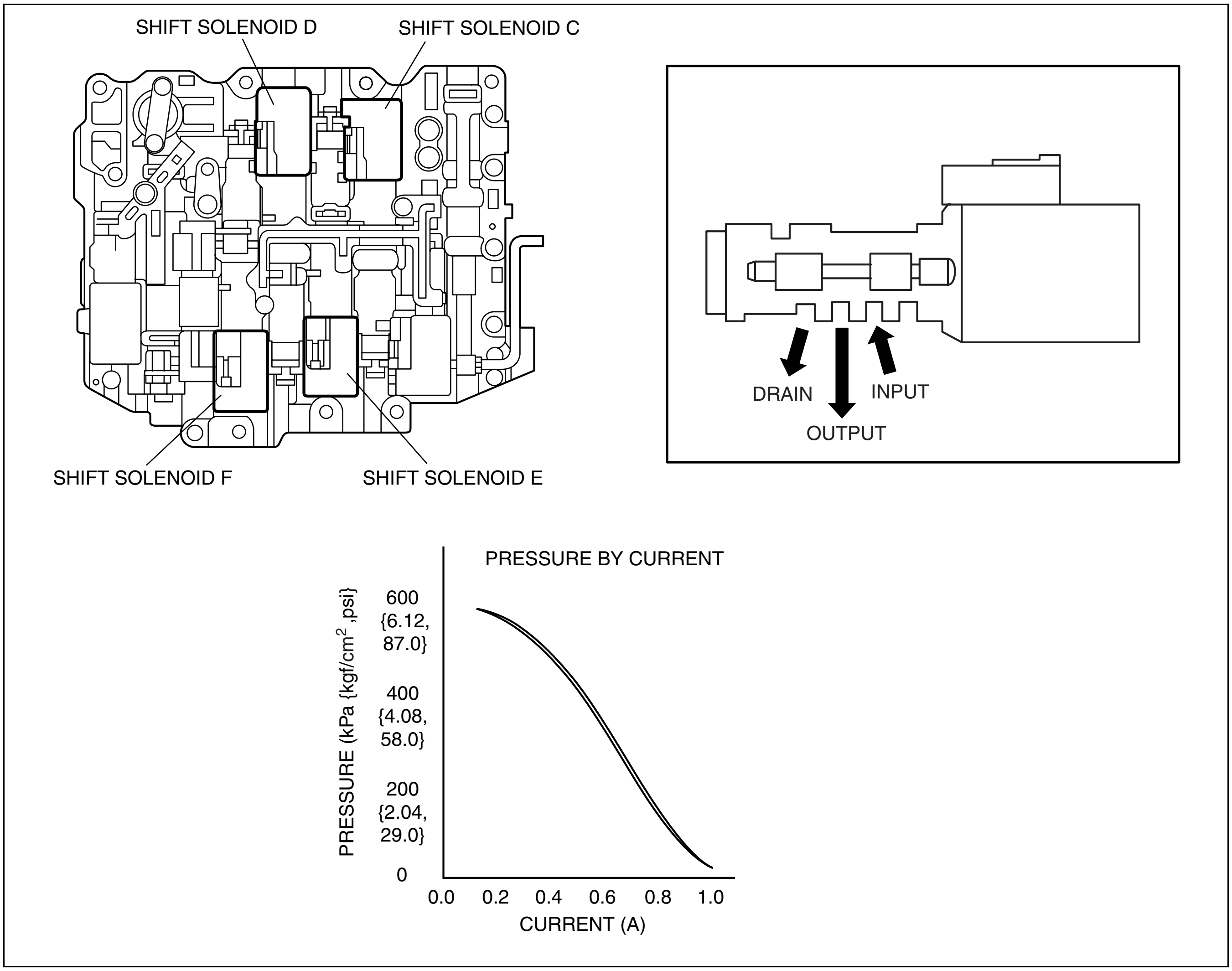
SHIFT CONTROL SOLENOID COMPONENT OUTLINE [AW6A-EL, AW6AX-EL]

id051723101200

- The shift control solenoid component is installed on the front valve body. The solenoids linearly control hydraulic pressure in response to signals output from the TCM. Through this, it controls hydraulic pressure to the clutch (C1 clutch, C2 clutch, C3 clutch) and brakes (B1 brake) for smooth shifting. According to each shift control solenoid component, the transaxle shifts from 1st gear into 6th gear and vice versa. As a fail-safe function, if any shift control solenoid component abnormality occurs, the TCM will disable the current to the solenoids.



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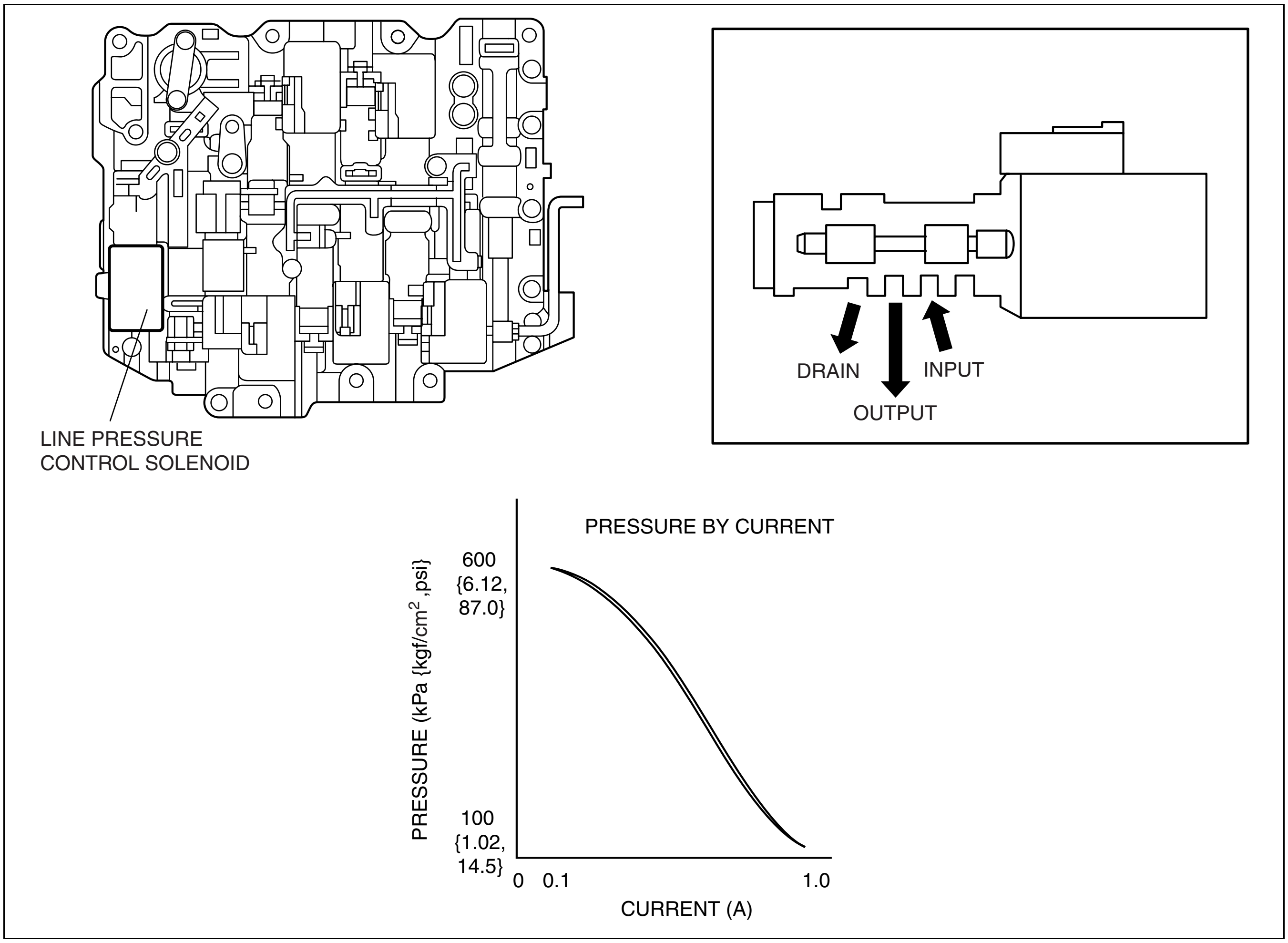
LINE PRESSURE CONTROL SOLENOID OUTLINE [AW6A-EL, AW6AX-EL]

id051723101300

- Line pressure control solenoid is installed on the front valve body. In accordance with the value decided in the TCM based on throttle opening signal and engine torque, line hydraulic pressure is controlled by linearly changing the comparable throttle pressure. Through this, it controls operating hydraulic pressure to the clutch and brakes for smooth shifting. As a fail-safe function, if any line pressure control solenoid abnormality occurs, the TCM will disable the current to the line pressure control solenoid. (The line pressure is maximized, if the line pressure control solenoid current is disabled when any abnormality of line pressure control solenoid other than valve stick occurs.)



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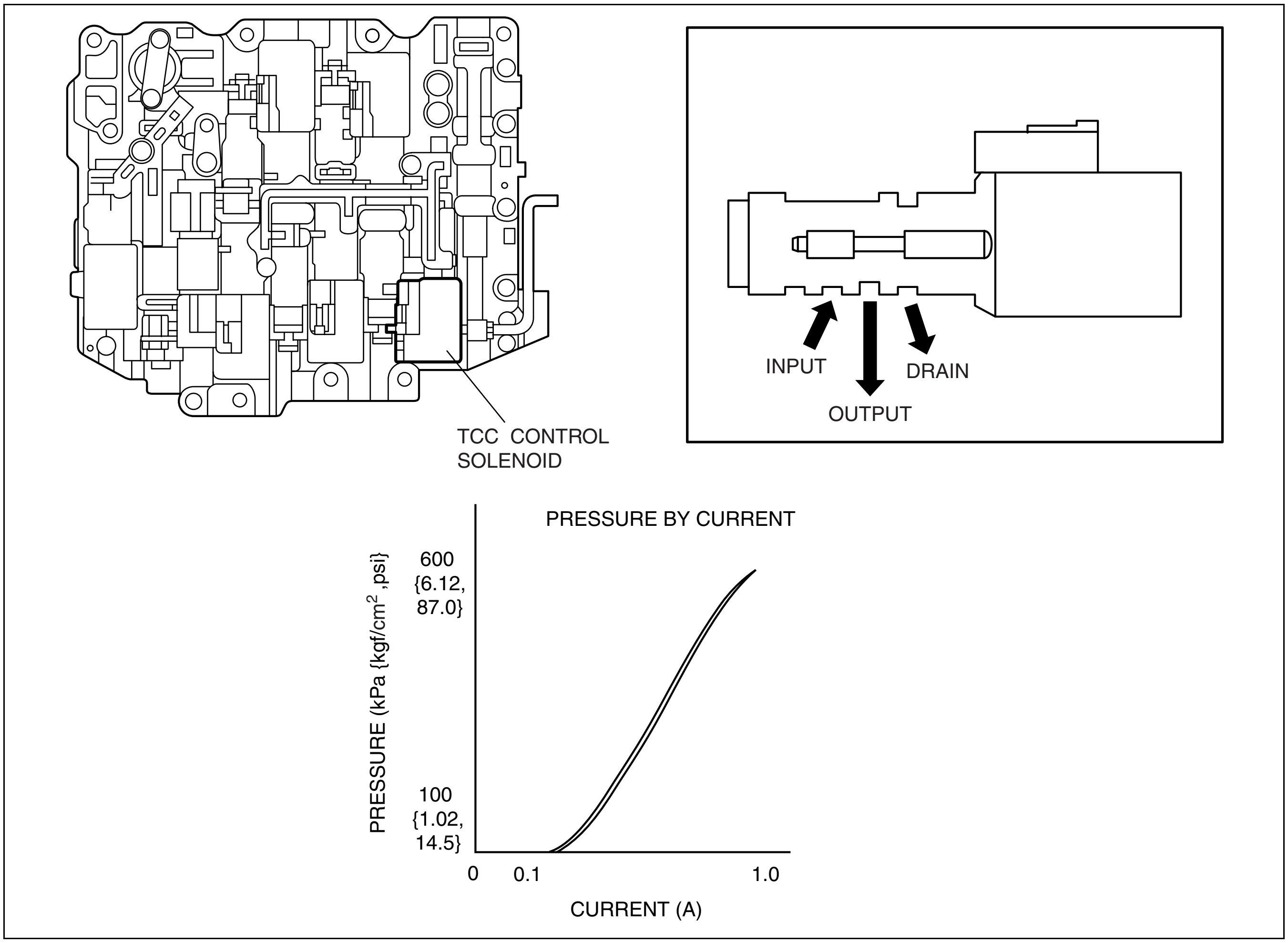
TORQUE CONVERTER CLUTCH (TCC) CONTROL SOLENOID OUTLINE [AW6A-EL, AW6AX-EL]

id051723101400

- The TCC control solenoid is installed on the front valve body. Based on engine speed, throttle opening degree signals, input/turbine speed sensor signals and vehicle speed sensor (VSS) signals, it linearly controls TCC hydraulic pressure. Through this, TCC and slip are controlled. As a fail-safe function, if any TCC control solenoid abnormality occurs, the TCM will disable the current to the solenoid.



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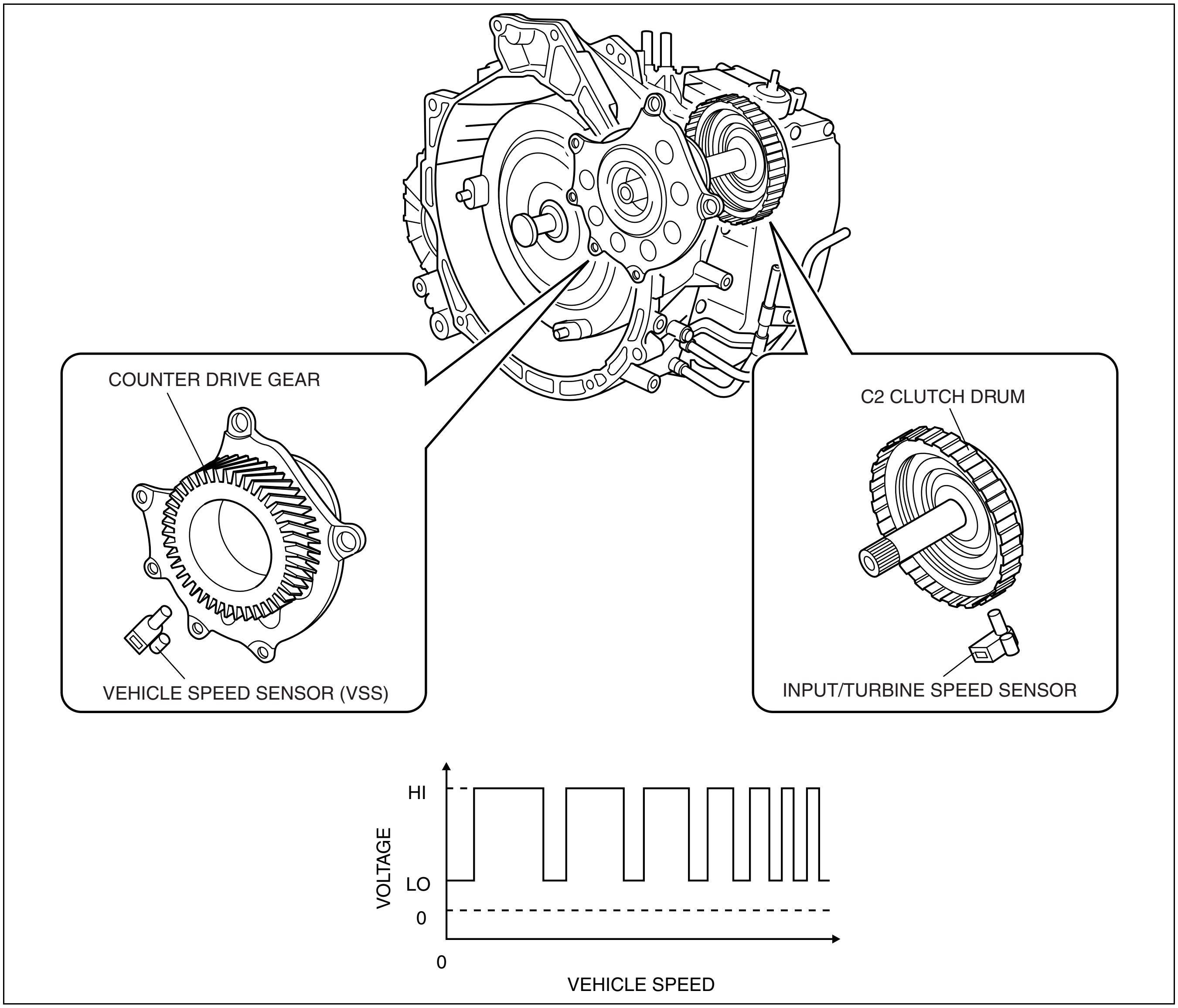
INPUT/TURBINE SPEED SENSOR, VEHICLE SPEED SENSOR (VSS) OUTLINE [AW6A-EL, AW6AX-EL]

id051723101500

- The speed sensors are installed in the transaxle case. Input/turbine speed sensor detects revolutions of the intermediate shaft's C2 clutch drum as input shaft revolutions. Vehicle speed sensor (VSS) detects the counter drive gear as output shaft revolutions. These signals are transmitted to the TCM. Based on those signals, the TCM controls engine torque, shift timing, and TCC.



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AUTOMATIC GEAR SHIFT CONTROL OUTLINE [AW6A-EL, AW6AX-EL]

id051723102500

- In automatic gear shift control, based on each gear shift pattern, shift solenoid A and shift solenoid B turn on or off and shift solenoid C, shift solenoid D, shift solenoid E, and shift solenoid F are operated linearly according to information that includes vehicle speed, the degree to which the accelerator is open, and brake signals.

DRIVER ADAPTIVE SHIFT CONTROL OUTLINE [AW6A-EL, AW6AX-EL]

id051723102600

- The AW6A (X) -EL automatic transaxle does not have a driving mode selection switch that allows drivers to select a mode themselves. The vehicle is ordinarily in NORMAL mode. However, when specific conditions are met, the TCM selects a shifting pattern appropriate to driving conditions from all of the shifting patterns and switches automatically.

Mode	Description
NORMAL	• Used during normal driving.
AAS	• In this mode, shift point and TCC point settings are higher than in the normal driving condition for generating high engine speed and output.
MANUAL	(See 05-17-35 MANUAL MODE SHIFT CONTROL OUTLINE [AW6A-EL, AW6AX-EL].)
HIGH TEMP	• When ATF temperature becomes too high, this mode activates TCC at an earlier timing to stop the temperature rise and lower the temperature.
CRUISE CONTROL	• When cruise control is ON, gears are fixed to perform smooth driving.
DOWN-SLOPE	• When the vehicle is driven down a slope, the TCM detects the gradient based on the signal from the PCM and the engine speed, and switches the drive mode to DOWN-SLOPE mode. Due to this, load on the brakes is reduced.
UP-SLOPE	• When driving up a slope, TCM detects an up-slope based on the engine control unit signal and output speed. TCM switches to UP-SLOPE mode to prevent driving force drop.
COLD	• TCM detects that the engine is cold based on the signal (ECT signal) from the PCM when the ignition switch is on. TCM switches to cold mode to improve warm-up performance.

Active Adaptive Shift (AAS) Mode

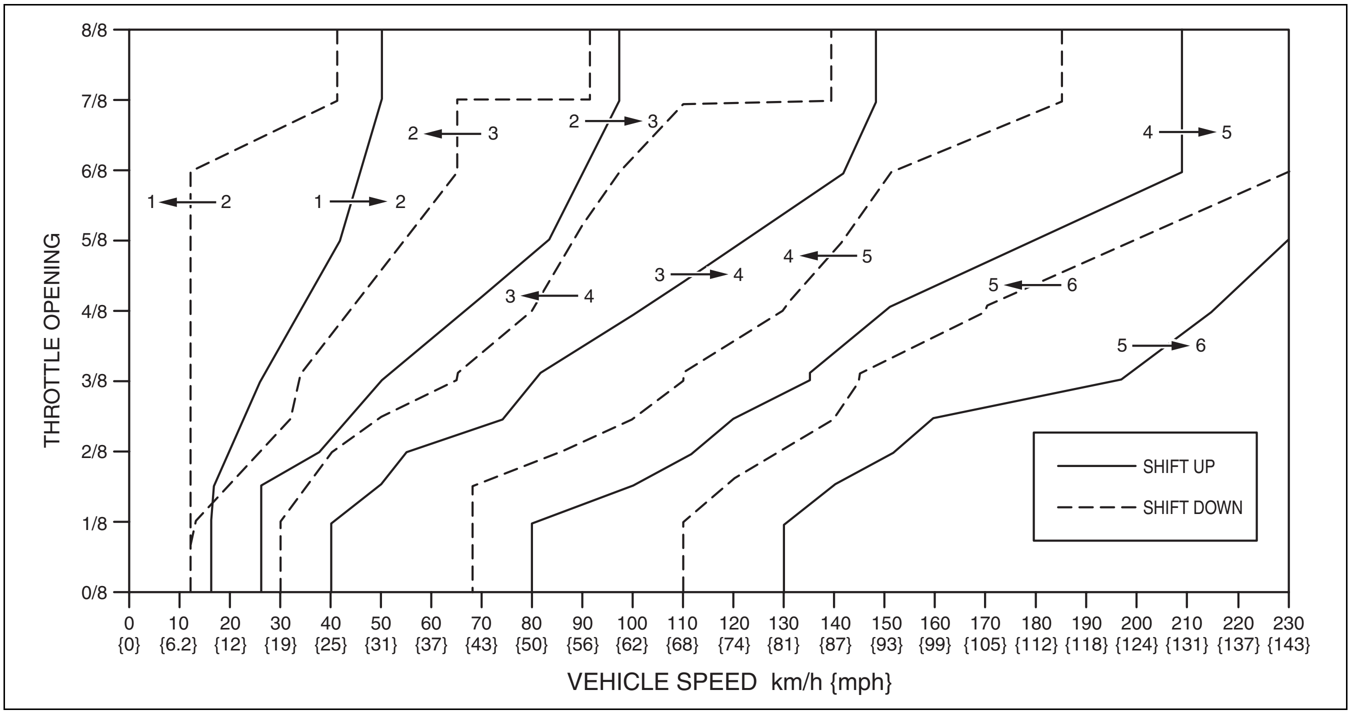
- When certain conditions are met, AAS mode is automatically selected from normal mode. In AAS mode, the shift point is set higher than the normal shift point so that high-engine speed, high-output conditions are available.
- AAS mode is canceled when the vehicle speed remains constant (stable vehicle behavior).

Conditions for switching to active adaptive shift (AAS) mode

- The accelerator pedal is depressed fully to accelerate rapidly while driving in D range.
- Rapid acceleration or deceleration continues for a certain period of time while driving in D range.

Shift control in active adaptive shift (AAS) mode

- Shift control is performed according to the shift pattern in AAS mode.
- When the driver releases the accelerator pedal fully and rapidly, the gear position is maintained at the position before accelerator pedal was released. Due to this, re-acceleration and vehicle control performance have been improved. If the accelerator pedal is released slowly, the gears shift up according to the shift pattern.
- While cornering the vehicle, the gear position is maintained at the position before the vehicle was cornered to facilitate re-acceleration after the corner. The gears do not shift up if the accelerator pedal is depressed fully while cornering the vehicle.



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Forced cancellation of active adaptive shift (AAS) mode

- AAS mode is forcibly cancelled under the following conditions:
  - — The vehicle speed in the cruise control system is reset.
  - — The selector lever is shifted to M range while driving in D range.

MANUAL MODE SHIFT CONTROL OUTLINE [AW6A-EL, AW6AX-EL]

id051723102700

- By moving the selector lever from the “D range” into the manual shift position and shifting into + (up-shift) or – (down-shift), the driver can select the desired gear, enabling sporty driving that feels like a manual transaxle. However, the TCM automatically performs upshifting to downshifting if vehicle speed decreases, and TCC control.

MANUAL MODE SHIFT CONTROL OPERATION [AW6A-EL, AW6AX-EL]

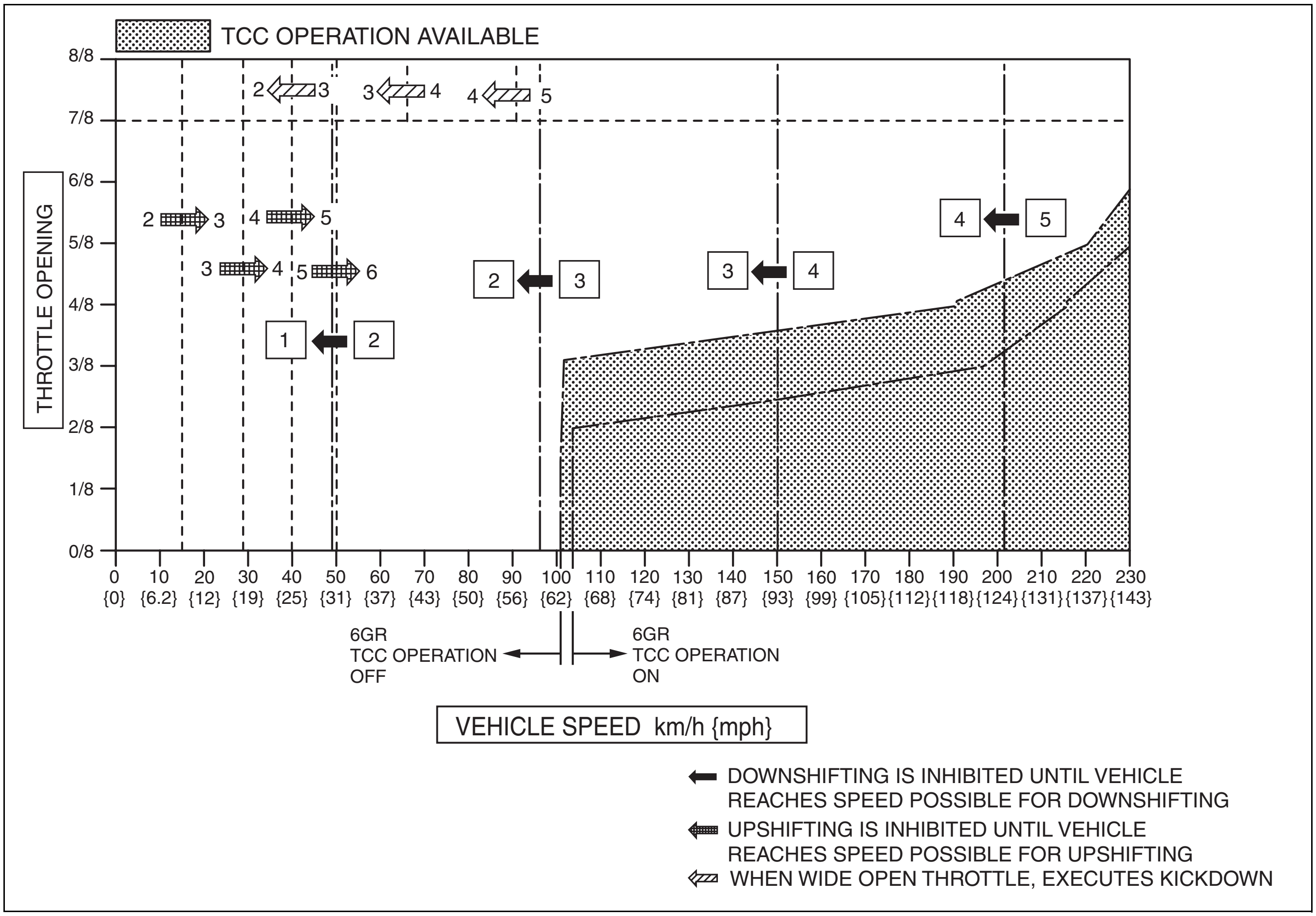
id051723102800

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 TCM 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 TCM.
  — The TCM, triggered by the up-shift command signal, carries out shifting by outputting an operation signal to the shift control solenoid.
- 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 TCM.
  — The TCM, triggered by the down-shift command signal, carries out shifting by outputting an operation signal to the shift control solenoid if the vehicle speed is less than the set speed and the gear position is 2GR or above.
- The TCM utilizes a specialized M range automatic shift diagram. Due to this, restriction of manual shift demand and automatic control of downshifting or upshifting is carried out, reducing load on the ATX, preventing engine over-rev and ensuring drive stability.
- If the engine speed reaches the excessive speed fuel cut zone while the shift lever is in the M range, the fuel cut and supply occur repeatedly. Moreover, if the engine speed is not lowered, the engine speed is lowered by a forced shift up of the gear to protect the engine.

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	• Selector indicator “M” light and gear position indicator light flash to alert driver
3GR→4GR up-shift command at low speed		
4GR→5GR up-shift command at low speed		
5GR→6GR up-shift command at low speed		
6GR→5GR 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
5GR→4GR down-shift command, above set speed		
4GR→3GR down-shift command, above set speed		
3GR→2GR down-shift command, above set speed		
2GR→1GR down-shift command, above set speed		
In 6GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 6GR to 5GR	–
In 5GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 5GR to 4GR	
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	
In 2GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 2GR to 1GR	
Wide open throttle at 85—95 km/h {53—58 mph} in 5GR	• To improve acceleration performance, 5GR to 4GR kickdown occurs	–
Wide open throttle at 60—70 km/h {38—43 mph} in 4GR	• To improve acceleration performance, 4GR to 3GR kickdown occurs	
Wide open throttle at 36—44 km/h {23—27 mph} in 3GR	• To improve acceleration performance, 3GR to 2GR kickdown occurs	

Shift Diagram



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AT WARNING LIGHT FUNCTION [AW6A-EL, AW6AX-EL]

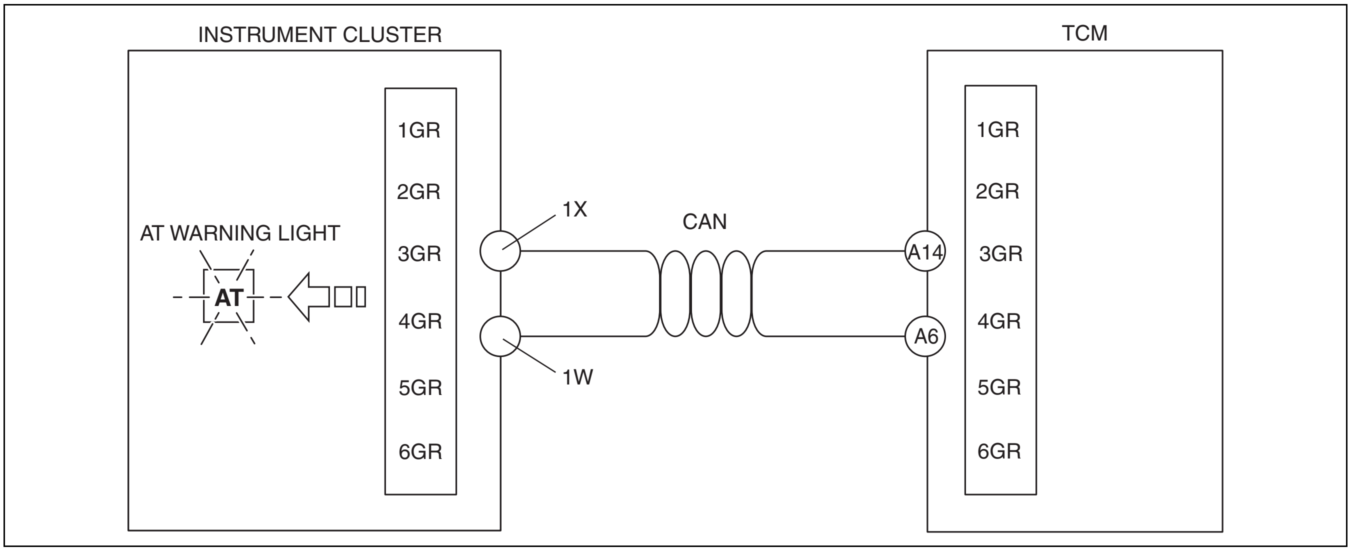
id051723102900

- The AT warning light illuminates to alert the driver of a malfunction in the automatic transaxle.

AT WARNING LIGHT CONSTRUCTION/OPERATION [AW6A-EL, AW6AX-EL]

id051723103000

- 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 TCM via CAN communication.
- The TCM sends a warning signal to the instrument cluster via CAN communication when it detects a malfunction.



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SELECTOR INDICATOR LIGHT FUNCTION [AW6A-EL, AW6AX-EL]

id051723103100

- 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 [AW6A-EL, AW6AX-EL]

id051723103200

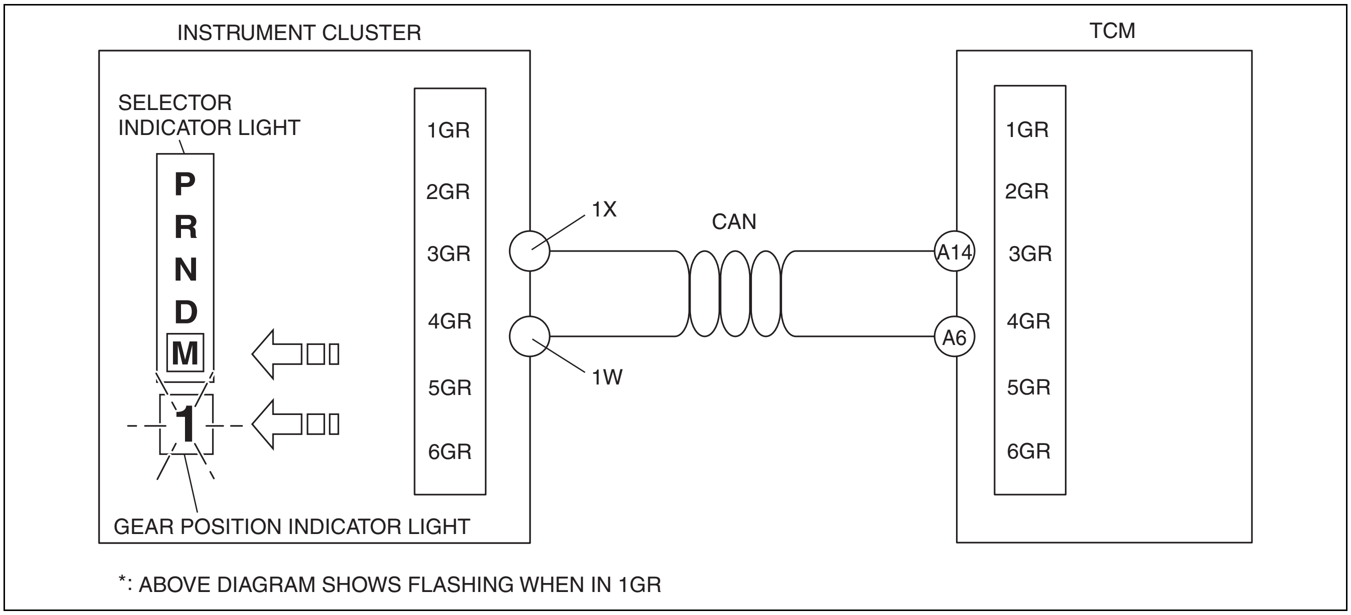
Construction

- The selector indicator light is built into the instrument cluster.
- When in the P, R, N or D range, the TCM detects the selector lever position based on an analog signal from the TR switch. When in the M range, the TCM 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 TCM 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 TCM 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, M5, M6) are reversed to off and on signals respectively.
- Based on a combination of input signals from the TCM, 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.



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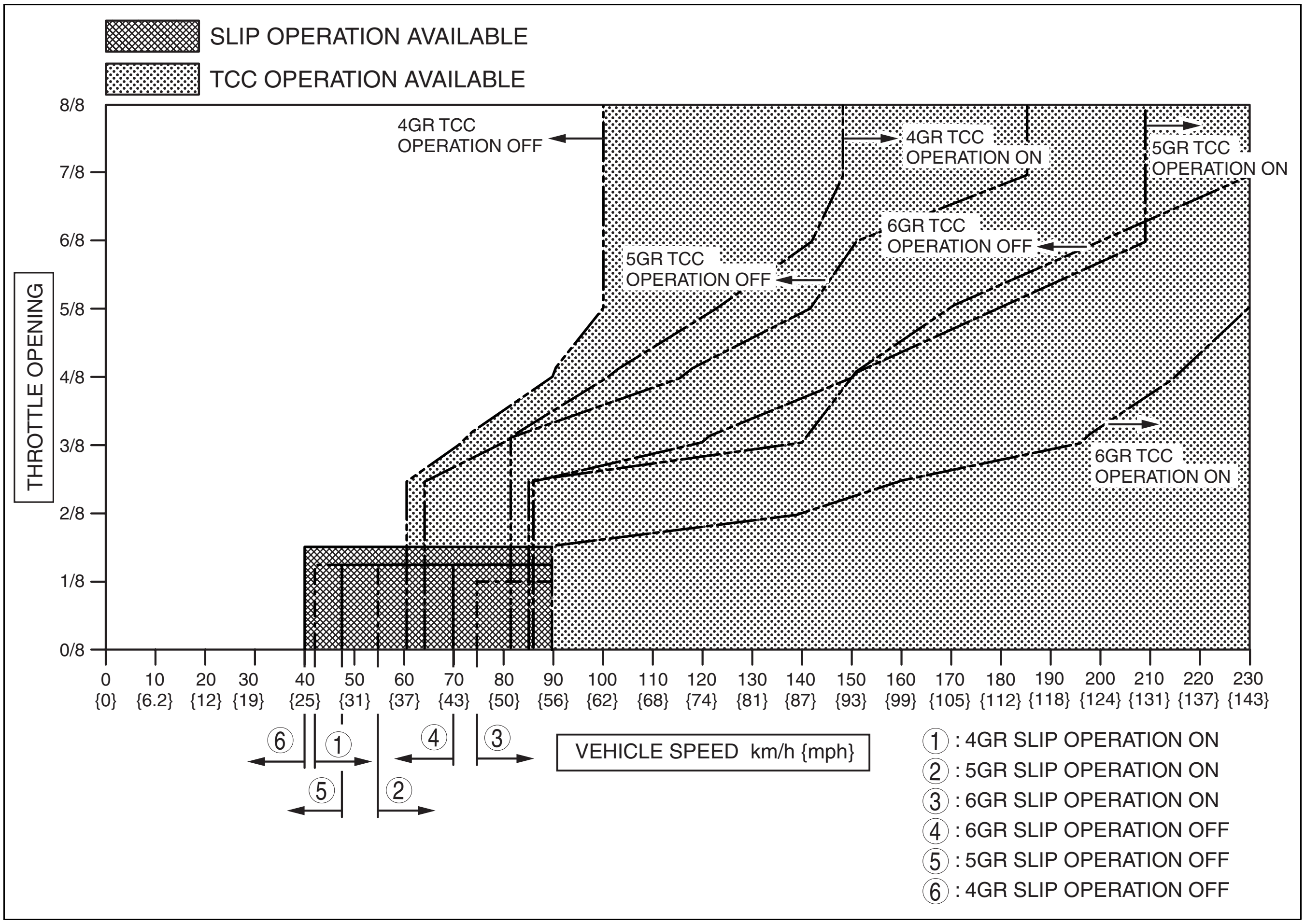
TCC, SLIP CONTROL OUTLINE [AW6A-EL, AW6AX-EL]

id051723103300

- Based on output speed signals, signals from the PCM (engine speed and throttle opening) and vehicle speed, smooth TCC control is performed through linear control of the TCC control solenoid. Also, the slip rate is detected by adding input speed signals and slip control is performed.

2WD



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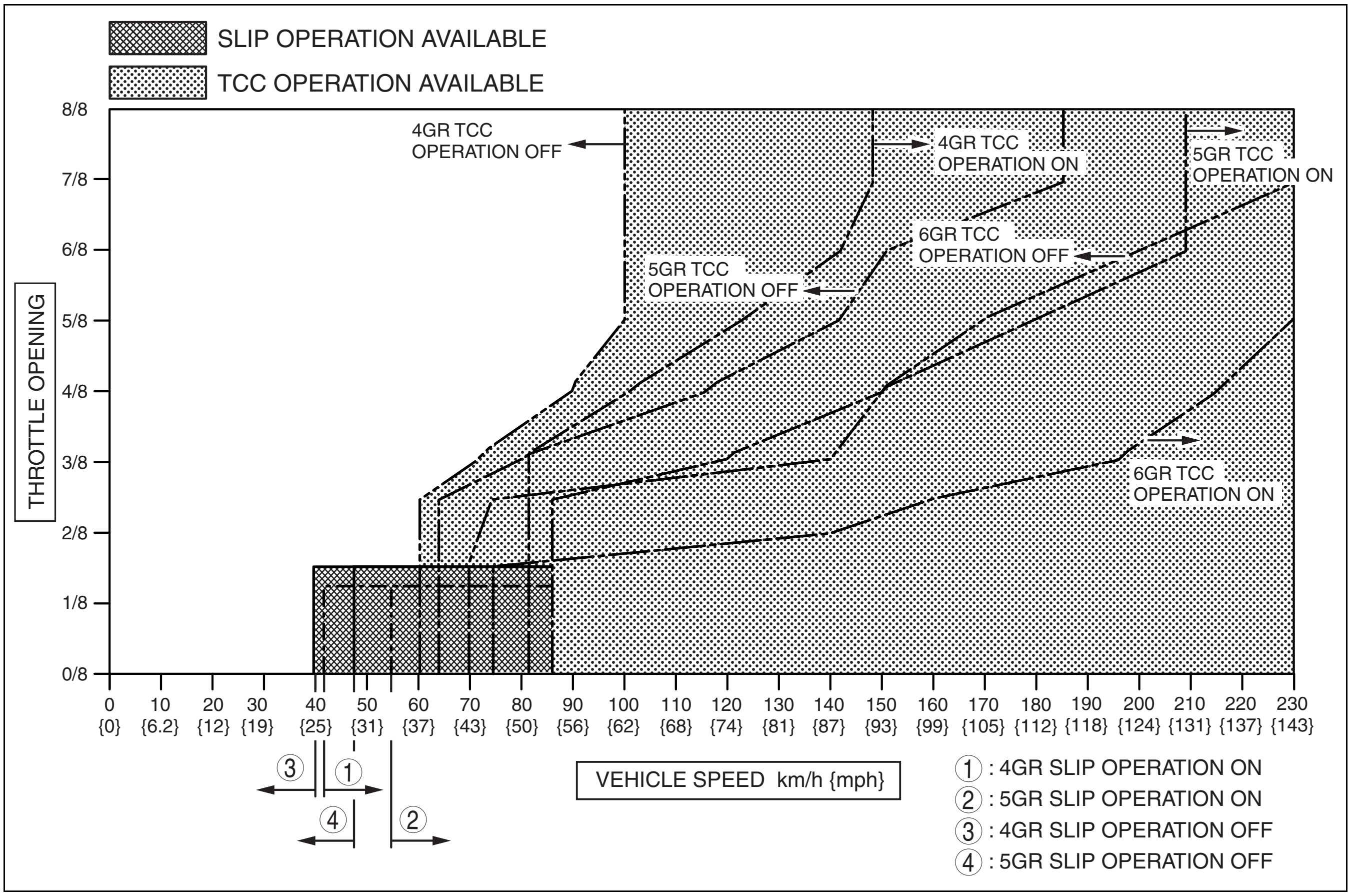
4WD



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- Slip control, by sliding the TCC piston when TCC is in the OFF range, extends the TCC range to low vehicle speeds. This suppresses a rise in engine speed and increases transmission efficiency, improving fuel economy. At the same time, through the sliding of the TCC piston, engine vibration can be absorbed by the torque converter. (However, this assumes that ATF JWS3309 is used.)

Control	Description
TCC control	• Control is performed using a TCC control solenoid. The TCC control solenoid is linearly turned ON and OFF, the TCC clutch inside the torque converter is operated, and the pump impeller and turbine runner are connected. Through this, the engine and the automatic transaxle are coupled and engine output is connected directly to the automatic transaxle, eliminating transmission loss and enhancing fuel economy.
Slip control	• Control is performed using a TCC control solenoid. The TCC control solenoid is linearly turned ON and OFF and the TCC piston within the torque converter is operated outside of the TCC range. The TCC piston slides without being in a completely coupled condition, increasing transmission efficiency and enhancing fuel economy. However, because the sliding of the TCC piston places a load on the ATF, it is assumed that ATF JWS3309 is used.

ENGINE-TRANSAXLE TOTAL CONTROL OPERATION [AW6A-EL, AW6AX-EL]

id051723103400

- When shifting between N-D and N-R, and when the transmission shifts between 1-6, the TCM outputs an engine torque request signal to the PCM, thereby cutting the inertia torque increase caused by shifting in order to provide smooth shifting characteristics.
- Furthermore, clutch-to-clutch control performs engine torque control to ensure that engine output does not exceed the proscribed upper limit even when the accelerator pedal is depressed suddenly in order to prevent air blasts from the engine (due to torque interruption) when shifting.

GARAGE SHIFT CONTROL OUTLINE [AW6A-EL, AW6AX-EL]

id051723103500

- When the selector lever is moved from N to D or from N to R, after the engine is started, shift solenoid C and shift solenoid E are used for the oil pressure required by C1 clutch or C3 clutch and appropriately regulated oil pressure is supplied to the clutch, engaging smoothly without shock.

Note

- When the engine is cold, the first piston stroke resistance becomes large, creating a time lag for shift operation. In order to reduce the time lag, control is not performed.
- By controlling the oil pressure according to the piston stroke, smooth engagement without shock becomes possible.

REVERSE CONTROL OUTLINE [AW6A-EL, AW6AX-EL]

id051723103600

- If the selector lever is moved from N to R while the vehicle is traveling and the transaxle shifts into reverse, the wheels may be locked, which is extremely dangerous. In order to avoid this, TCM inhibits the transaxle from shifting into reverse while traveling.

Note

- Even when the selector lever is moved from N to R, the transaxle does not shift into reverse if the vehicle speed is **10 km/h {6 mph} or more.**
- When this control is activated, the C3 clutch is released without operating the shift solenoid E so that the transaxle does not shift into reverse.
- Reverse control takes precedence over N-R shift control.

SELF-DIAGNOSIS FUNCTION OUTLINE [AW6A-EL, AW6AX-EL]

id051723103700

- The TCM monitors the communication status of each sensor, electronic component and PCM including the PCM. If any malfunction should occur, the TCM functions to warn the driver and stores the malfunction as a diagnosis code.
  — If any malfunction should occur in the automatic transaxle, the TCM will cause warning light to light up in order to inform the driver of the malfunction.
  — The TCM stores the malfunction as a diagnosis code.
  — The diagnosis code and TCM data can be inspected by connecting the Mazda Modular Diagnostic System (M-MDS).
- Deleting the diagnosis codes and initializing the learned values can be performed only with the Mazda Modular Diagnostic System (M-MDS).

FAIL-SAFE OUTLINE [AW6A-EL, AW6AX-EL]

id051723103800

- With the fail-safe function, if any malfunction should occur in the automatic transaxle system, the TCM will output a control signal, and control will be performed to make travelling a minimum distance possible. If shift solenoid malfunction, the TCM will cancel the output of control signals to the solenoid. If this happens, automatic transaxle gear shifting will be controlled by oil pressure circuits only and the gears will shift as shown in the chart below.

Shift position	Gear position
R	Reverse
D, M	3rd gear (5th gear in case of shift solenoid C malfunction)

N POSITION LEARNING FUNCTION [AW6A-EL, AW6AX-EL]

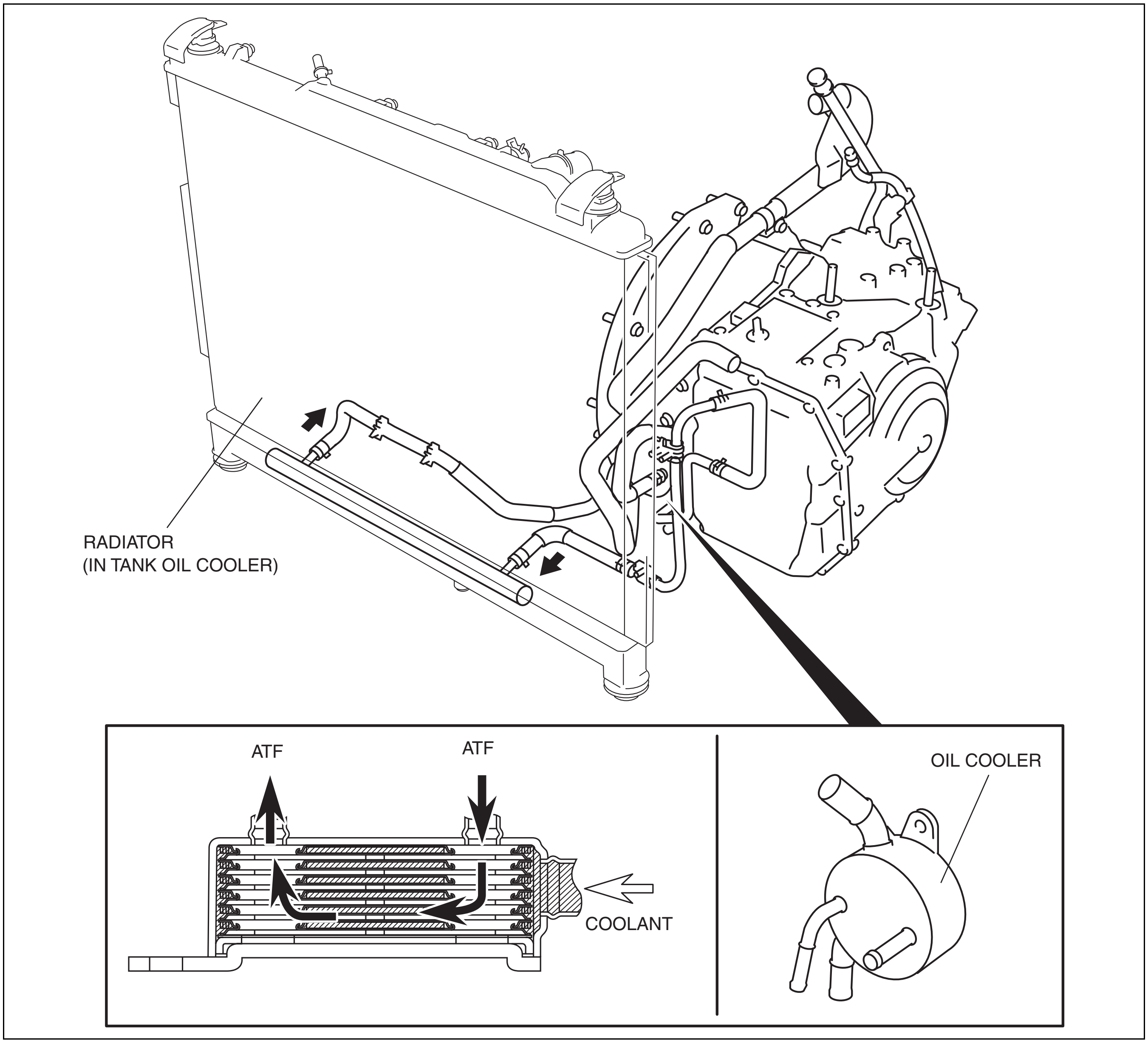
id051723103900

- The AW6A (X) -EL automatic transaxle has the “neutral position learning” function. For the neutral position learning procedure, refer to the CX-7 Workshop Manual.

COOLING SYSTEM OUTLINE [AW6A-EL, AW6AX-EL]

id051723104000

- A water-cooling type ATX oil cooler has been adopted and is installed in the radiator. The oil cooler cools the heated ATF in the ATX.
- A water-cooled type ATX oil cooler installed to the converter housing has been adopted.
- The water-cooled type 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)
- 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.



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05-18 AUTOMATIC TRANSAXLE SHIFT MECHANISM

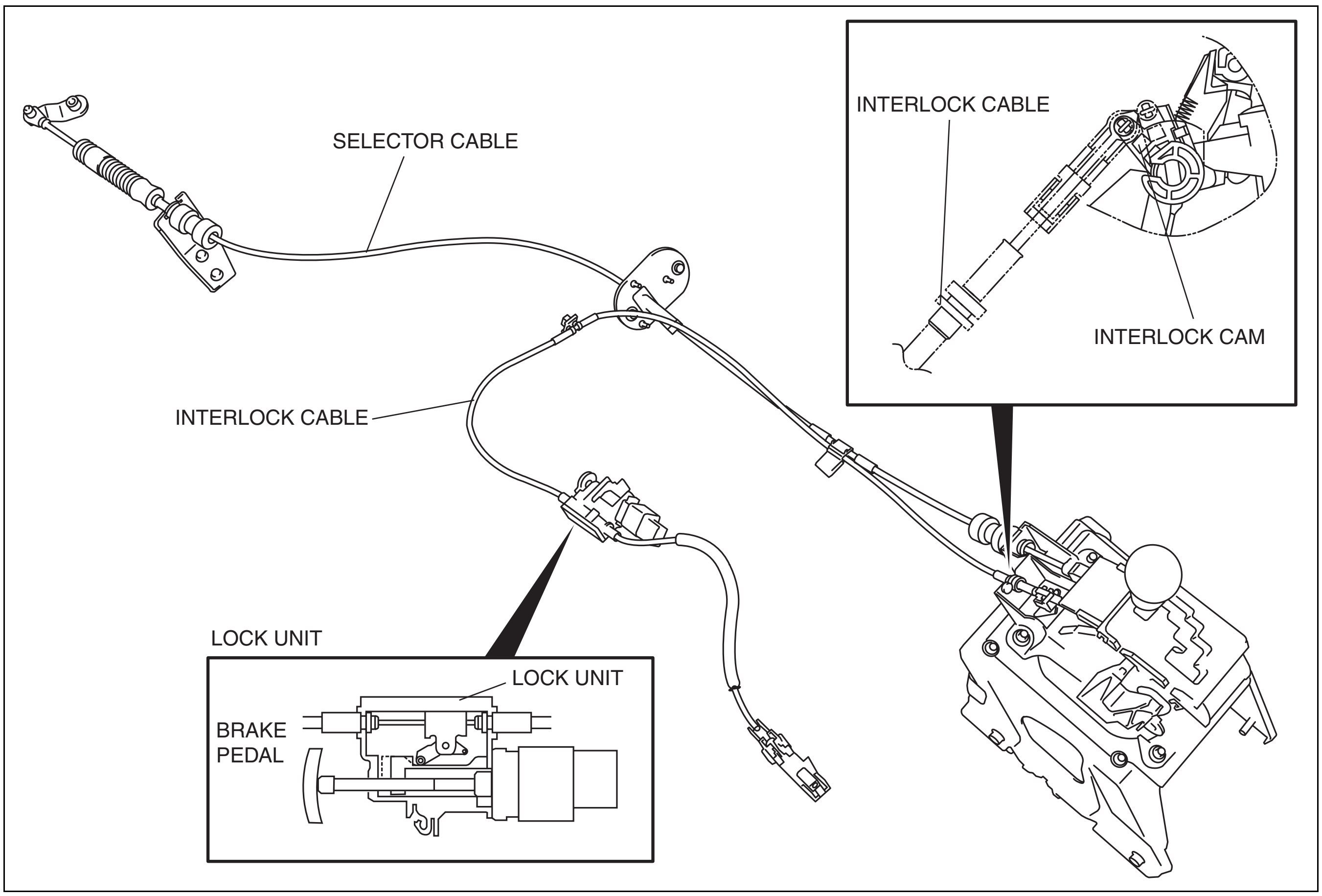
AUTOMATIC TRANSAXLE SHIFT MECHANISM OUTLINE

id051800100100

- The sport AT type shift mechanism has been adopted.
- To prevent inadvertent selection of the wrong gear, a key interlock device and a shift-lock device have been adopted.

AUTOMATIC TRANSAXLE SHIFT MECHANISM STRUCTURAL VIEW

id051800100200



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SELECTOR LEVER OUTLINE

id051800100300

- Operability has been improved due to the short stroke feature of the selector lever.
- Stable, secure shifting has been achieved along with reduced lever looseness and rattling due to the optimization of shift characteristics.

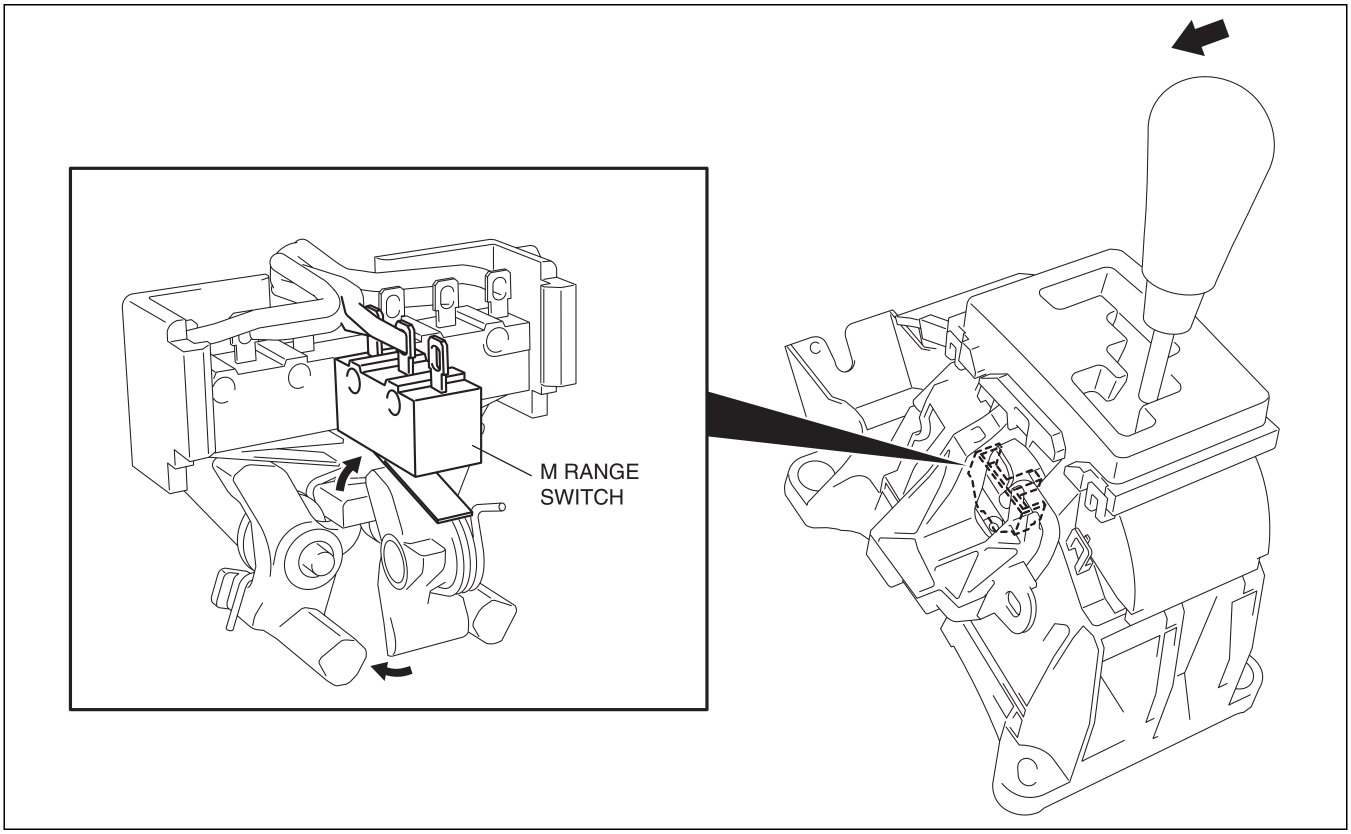
SELECTOR LEVER STRUCTURE

id051800100400

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 TCM.



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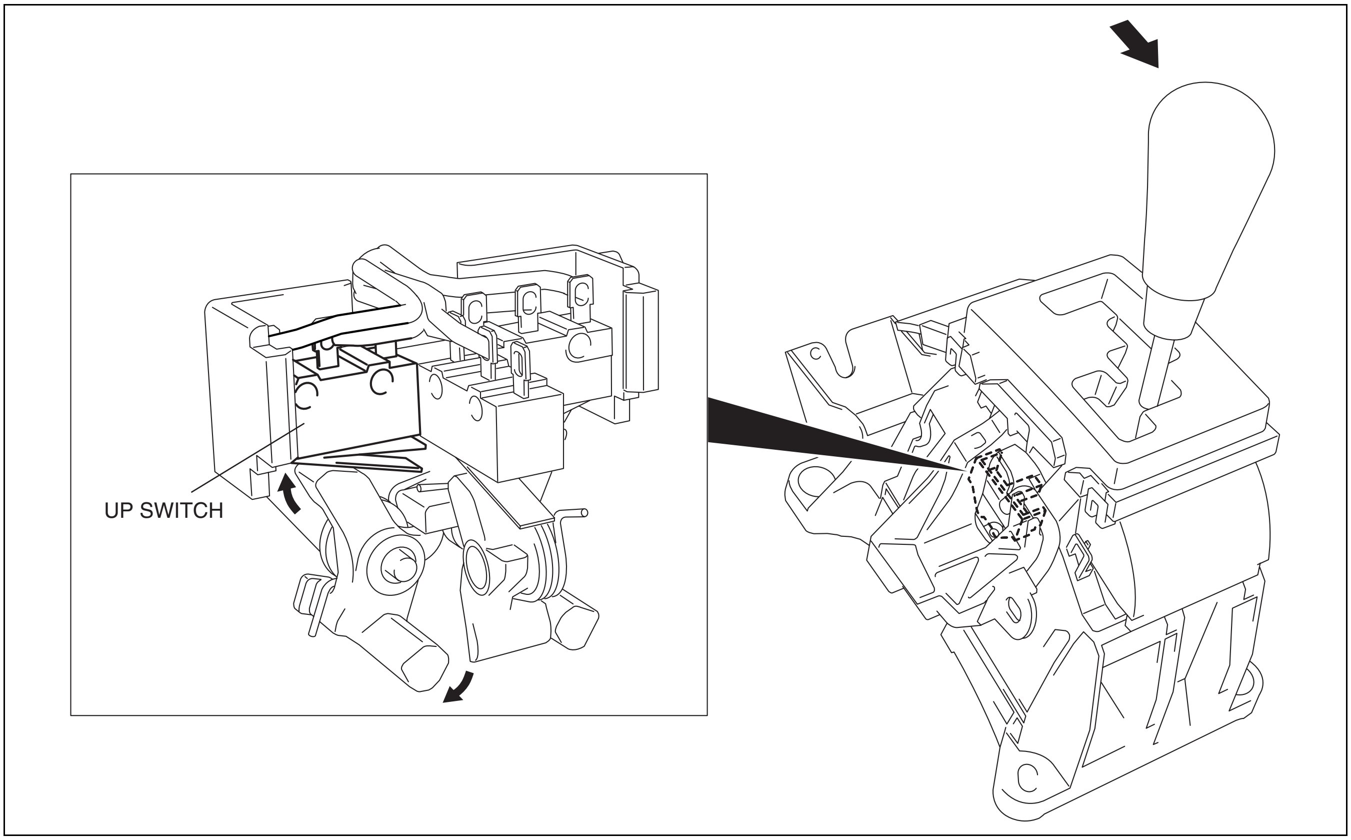
Operation

- 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 TCM.

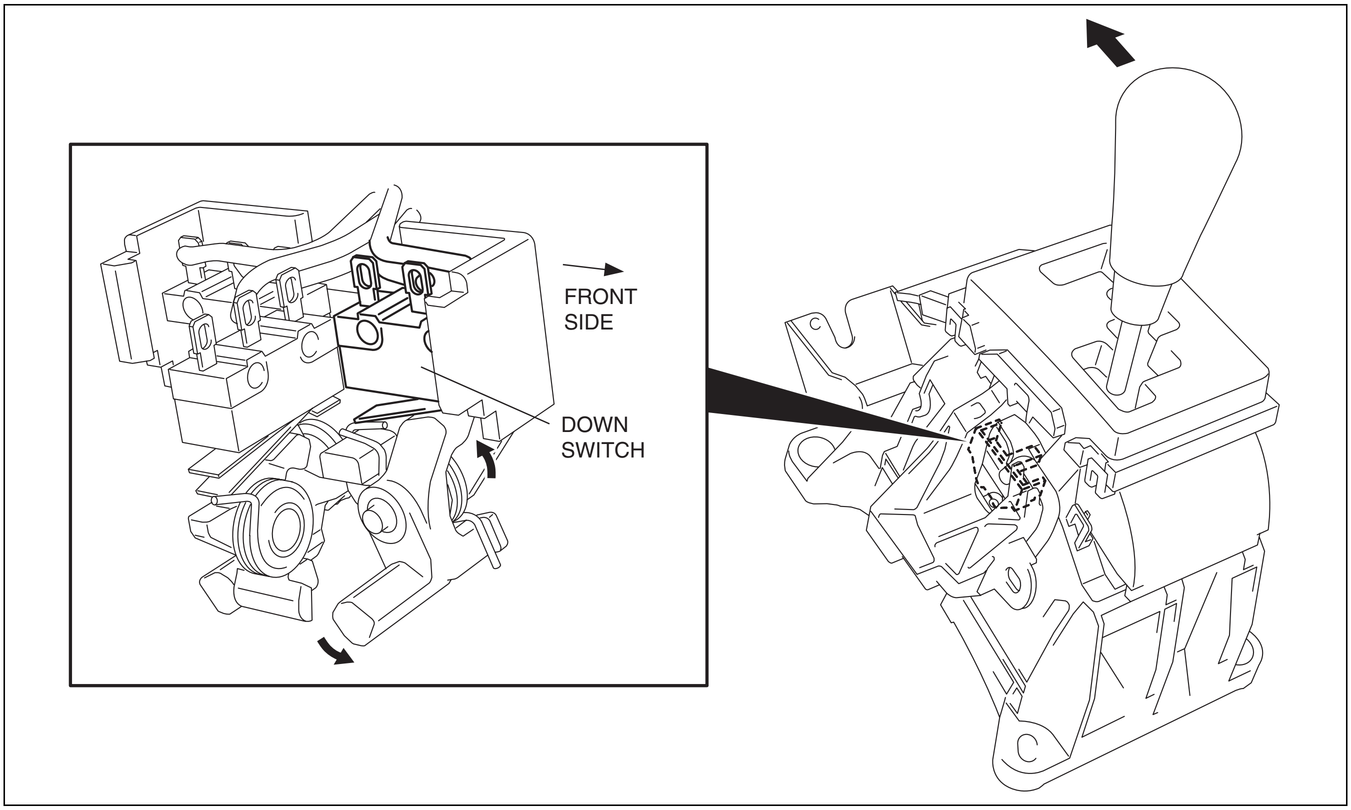


Operation
- The up switch is an on/off type switch that turns on when the selector lever is in the M range (+) side position.

Down Switch

Outline

- The down switch detects a down-shift operation in the M range and sends a down-shift request signal to the TCM.



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Operation

- The down switch is an on/off type switch that turns on when the selector lever is in the M range (–) side position.

SHIFT LOCK SYSTEM OUTLINE

id051800100700

- To make operation smoother and to simplify internal construction, the shift lock system directly determines movement of the slider block with the slider pin.
- The shift lock unit consists of the interlock cable, interlock cam, and lock unit.

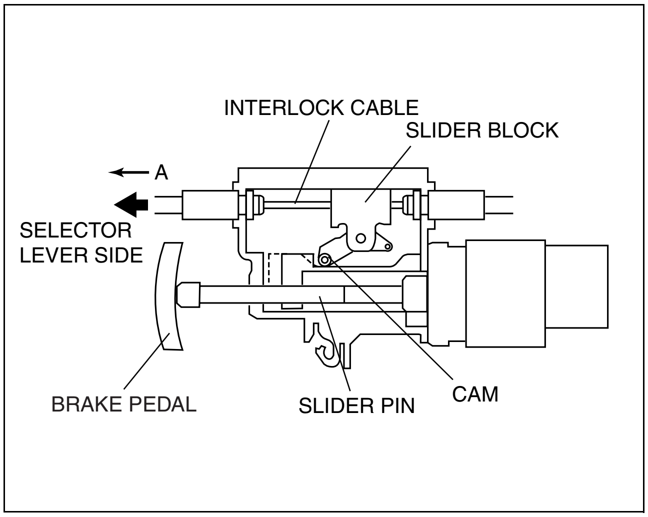
SHIFT-LOCK SYSTEM OPERATION

id051800100800

The selector lever can be shifted from P position only when the following conditions are satisfied.

- The brake pedal is depressed.

1. When the brake pedal is not depressed, the slider pin is pressed into the position shown below by the brake pedal. Thus the slider block is inhibited from moving in direction A via the cam. In this condition, the interlock cable and interlock cam are locked, and the guide pin on the shift lever does not move out of the position. Thus the select lever cannot be shifted to other than P position.



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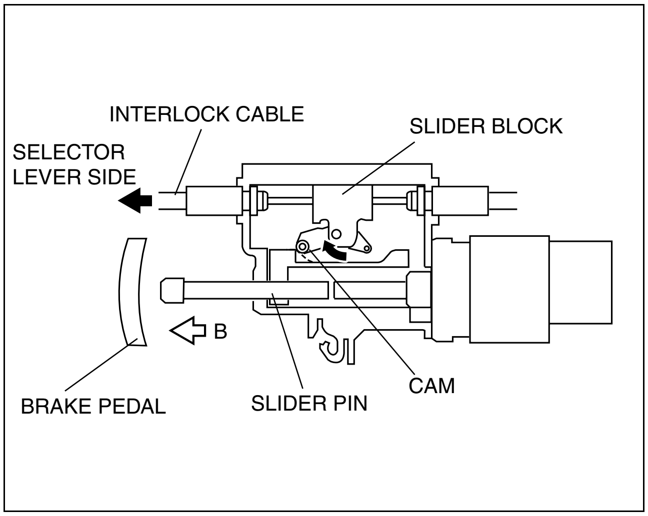
2. When the brake pedal is depressed, the slider pin moves freely in direction B. The slider block also starts to move freely. The interlock cable and interlock cam are not locked, thus shifting out of P position becomes possible.



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KEY INTERLOCK SYSTEM OUTLINE

id051800100500

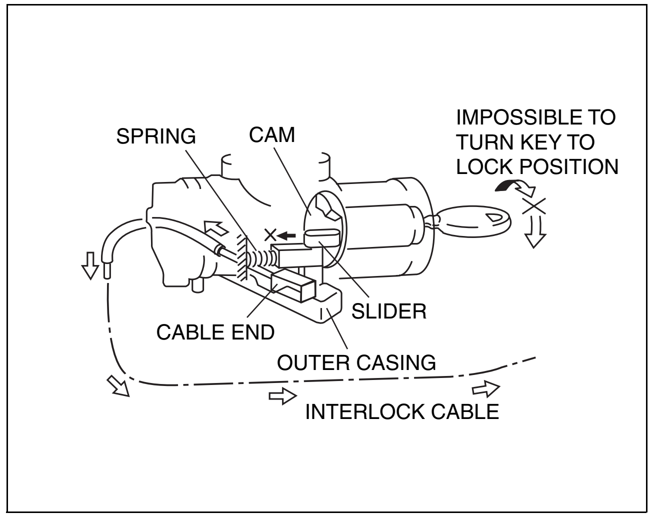
- The key interlock system, which is composed of the interlock cable and steering lock, prevents the ignition switch from being removed when the selector lever is in any position other than the P range. (The ignition switch cannot be turned to the LOCK position.)

KEY INTERLOCK SYSTEM OPERATION

id051800100600

Positions other than P position (Key interlock is operating)

- When the selector lever is in a position or range other than P position, the cable end is set at the key-locked position. When the engine is switched off and an attempt is made to turn the ignition switch to the LOCK position, turning of the cam is restricted by the slider because the cable end pushes the slider to the cam side, and the ignition switch cannot be turned to LOCK.



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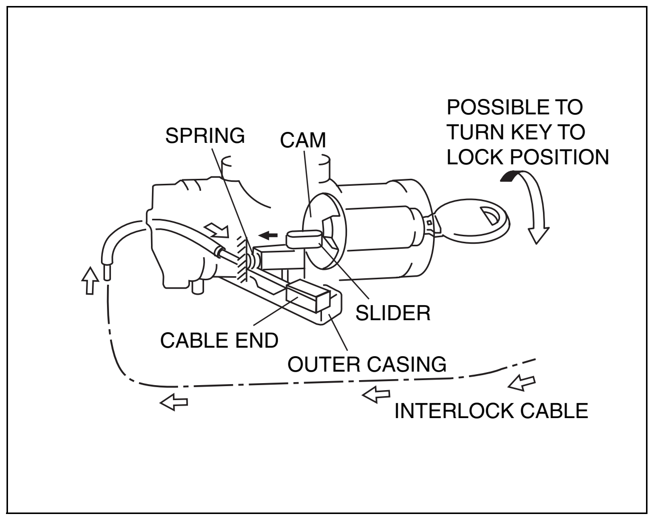
P Position (Key interlock is not operating)

- When the selector lever is in P position, the cable end is at the key-unlocked position, and because the slider does not restrict movement of the cam, the ignition switch can be turned to LOCK.



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STEERING

06 SECTION

06-00 OUTLINE

STEERING ABBREVIATION

id060000100100

ATF	Automatic Transaxle Fluid

STEERING FEATURES

id060000100200

Improved operability	• Steering shaft with tilt/telescope mechanism adopted
Improved safety in collision	• Steering shaft with energy absorbing system adopted
Improved handling stability	• A steering gear mount on the gear housing side adopted

STEERING SPECIFICATIONS

id060000100300

Item				Specifications
Steering wheel	Outer diameter		(mm {in})	372 {14.8}
	Lock-to-lock		(turns)	3.1
Steering gear and linkage	Type			Rack-and-pinion
	Rack stroke		(mm {in})	164.2 {6.465}
Steering column and shaft	Shaft type			Collapsible
	Joint type			2-cross joint
	Amount of tilt		(mm {in})	45 {1.8}
	Amount of telescope		(mm {in})	50 {2.0}
Power steering system	Power assist type			Engine speed sensing
	Power steering fluid	Type		ATF M-III, M-V or equivalent (e.g. Dexron®II)
		Fluid capacity* (approximate quantity) (L {US qt, Imp qt})		1.27 {1.34, 1.11}

* : When reservoir tank is at maximum volume

06-14 POWER STEERING

POWER STEERING OUTLINE

id061400100100

- With the adoption of an engine speed sensing power steering mechanism, handling stability has been improved.
- With the adoption, for all vehicles, of a steering column with a tilt/telescope mechanism, operability has been improved.
- With the adoption of a steering shaft with an energy absorbing mechanism, safety has been improved.

06-14

POWER STEERING STRUCTURAL VIEW

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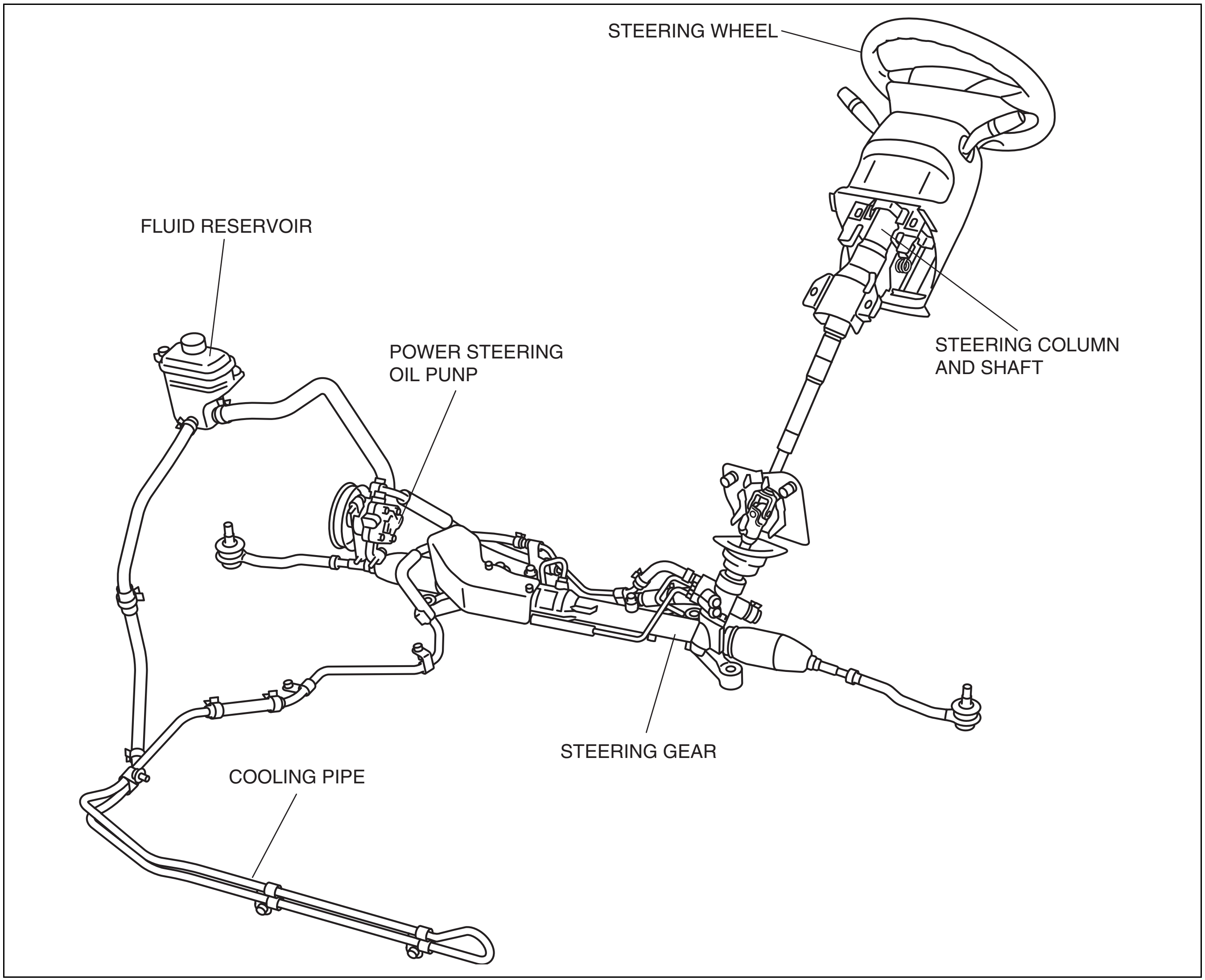

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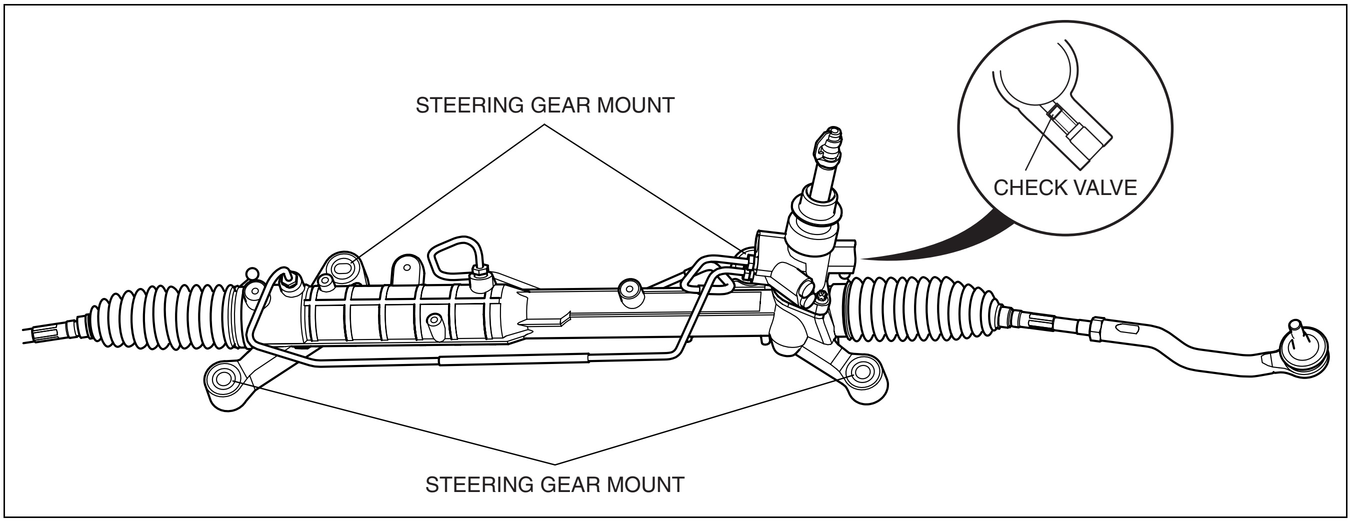
STEERING GEAR AND LINKAGE CONSTRUCTION

id061400100600

- 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 and gear housing, improving response and steering stability.
- A check valve equipped to the power steering fluid intake port (pressure side) prevents the power steering fluid from flowing back as a result of road surface resistance. Due to this, kickback from the road surface is reduced.



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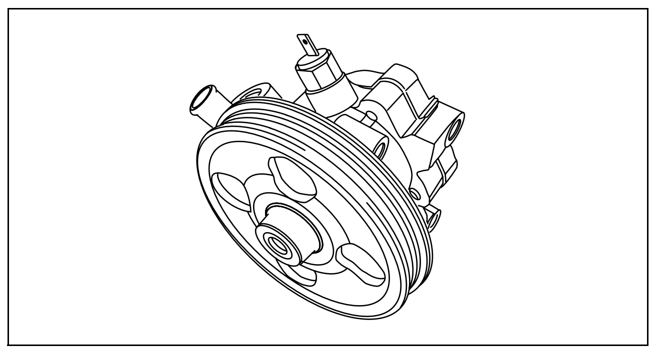
POWER STEERING OIL PUMP CONSTRUCTION

id061400100500

- A size and weight-reduced vane-type oil pump has been adopted.



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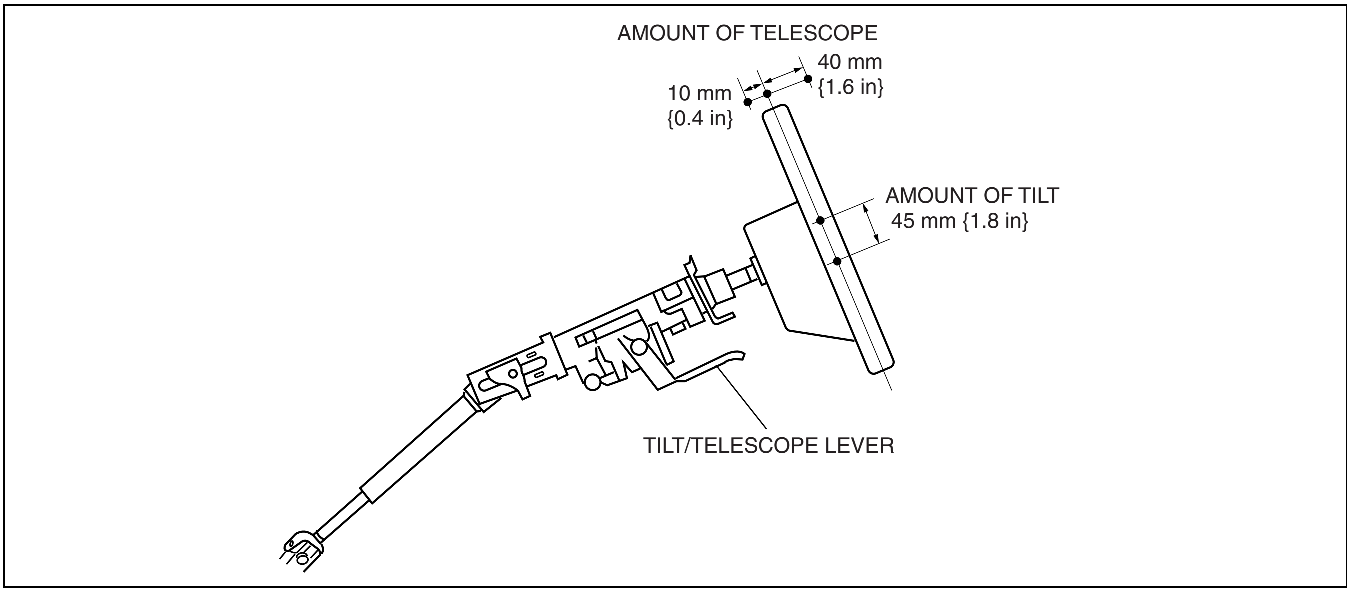
STEERING SHAFT CONSTRUCTION

id061400100300

- Due to the adoption of a tilt/telescope mechanism for the steering shaft on all vehicles, operability has been improved.
- The tilt/telescope mechanism has a movement range of **45 mm {1.8 in} (tilt) / 50 mm {2.0 in}** (telescope) and can be adjusted, without steps, to anywhere in this range.



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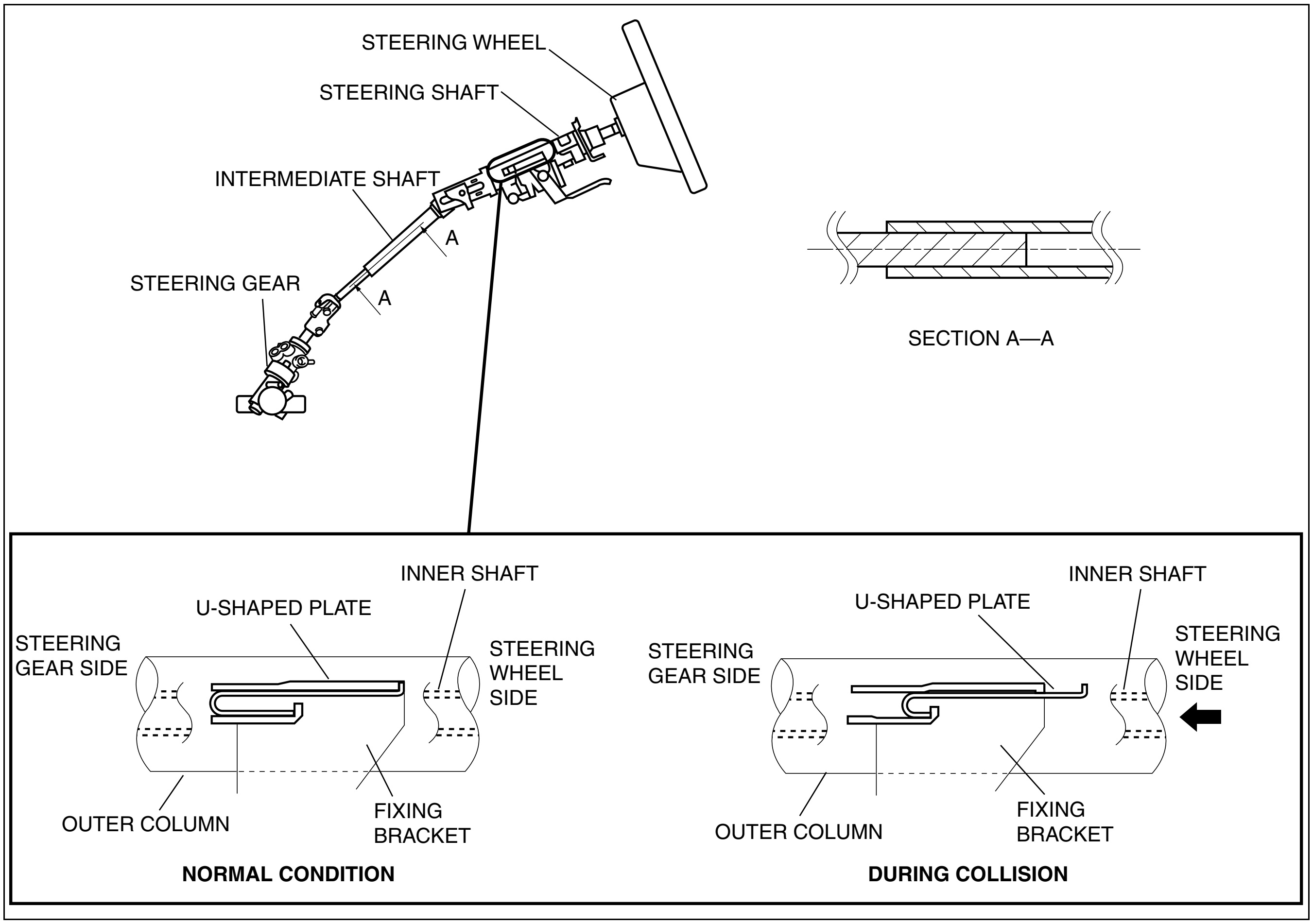
ENERGY ABSORBING SYSTEM DISCRIPTION

id061400102000

Structure and Operation

- The steering gear is joined to the steering shaft through the intermediate shaft.
- In a collision, the intermediate shaft is crushed as the steering gear moves rearward, thereby absorbing the impact.
- If the driver's body hits the steering wheel, the force applied to the steering wheel is transmitted through the inner shaft, outer column, and fixing bracket. As a result, the fixing bracket is disengaged from the dashboard, and the whole steering shaft will move forward. At this moment, the U-shaped plate, which is fixed to the dashboard at one end and held by the fixing bracket at the other, will deform and absorb the impact.



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HEATER, VENTILATION & AIR CONDITIONING (HVAC)

07 SECTION

07-00 OUTLINE

HVAC ABBREVIATION

id070000100100

07-00

A/C	Air Conditioning
B+	Battery Positive Voltage
BCM	Body Control Module
CPU	Central Processing Unit
DTC	Diagnostic Trouble Code
DEF	DEFroster
ECT	Engine Coolant Temperature
GND	Ground
HI	High
IG	Ignition
LED	Light Emitting Diode

LH	Left Hand
LO	Low
M	Motor
MAX	Maximum
MOS FET	Metal Oxide Semiconductor Field Effect Transistor
PCM	Powertrain Control Module
REC	Recirculate
RH	Right Hand
SW	Switch
TNS	Tail Number Side

HVAC FEATURES

id070000100200

Reduced weight	• Integrated A/C unit adopted
Improved air conditioning performance	• Sub-cooling system to multi-flow condenser adopted
Improved comfort	• Air filter adopted • DUAL switch adopted • Rear control switch adopted

HVAC SPECIFICATIONS

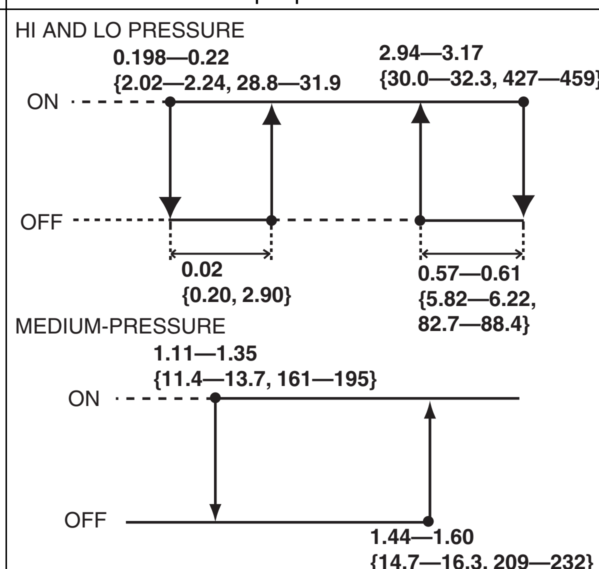
id070000100300

Basic System

Item				Specification FRONT	Specification REAR
Heating capacity			(kW {kcal/h})	5.250 {4,515}	2.0 {1,720}
Cooling capacity			(kW {kcal/h})	4.360 {3,749}	1.290 {1,109}
Refrigerant	Type			R-134a	
Refrigerant	Regular amount (approx. quantity)		(g {oz})	660—710 {23.3—25.0}	
A/C compressor	Type			Swash plate	
A/C compressor	Discharge capacity		(ml {cc, fl oz})	214.7 {214.7, 7.26}	
A/C compressor	Max. allowable speed		(rpm)	6,000	
A/C compressor	Lube oil	Type		DENSO OIL8	
A/C compressor	Lube oil	Sealed volume (approx. quantity)	(ml {cc, fl oz})	160 {160, 5.41}	
Condenser	Type			Multiflow (sub-cooling type)	
Condenser	Radiated heat		(kW {kcal/h})	9.0 {7,740}	
Condenser	Receiver/drier capacity		(ml {cc, fl oz})	280 {280, 9.46}	
Condenser	Desiccant			XH-9	
Expansion valve	Type			External equalizing type	External equalizing type
Evaporator	Type			Double-tank drawn cup	Double-tank drawn cup

Control System

Item			Specification FRONT	Specification REAR
Airflow volume (during heater operation)	Blower motor	(m^3/h)	330	120
Electricity consumption (during heater operation)	Blower motor	(W)	220	130
Airflow volume (during air conditioner operation)	Blower motor	(m^3/h)	515	240
Electricity consumption (during air conditioner operation)	Blower motor	(W)	250	130
Electricity consumption (during air conditioner operation)	Magnetic clutch	(W)	35	
Magnetic clutch clearance (approx. quantity)		(mm {in})	0.35—0.60 {0.014—0.024}	
Fan type	Blower motor		Sirocco fan	Sirocco fan
Refrigerant pressure switch	Type		Triple-pressure	
Refrigerant pressure switch	Operating pressure	(MPa {kgf/cm^2, psi})		



Item		Specification	
		FRONT	REAR
Sensor	Solar radiation sensor	Photodiode	
	Ambient temperature sensor	Thermistor	
	Cabin temperature sensor	Thermistor	Thermistor
	Evaporator temperature sensor	Thermistor	Thermistor
Actuator	Air intake actuator	Sliding contact type	
	Air mix actuator	Potentiometer type	Potentiometer type
	Airflow mode actuator	Potentiometer type	Potentiometer type

07-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC FUNCTION OUTLINE

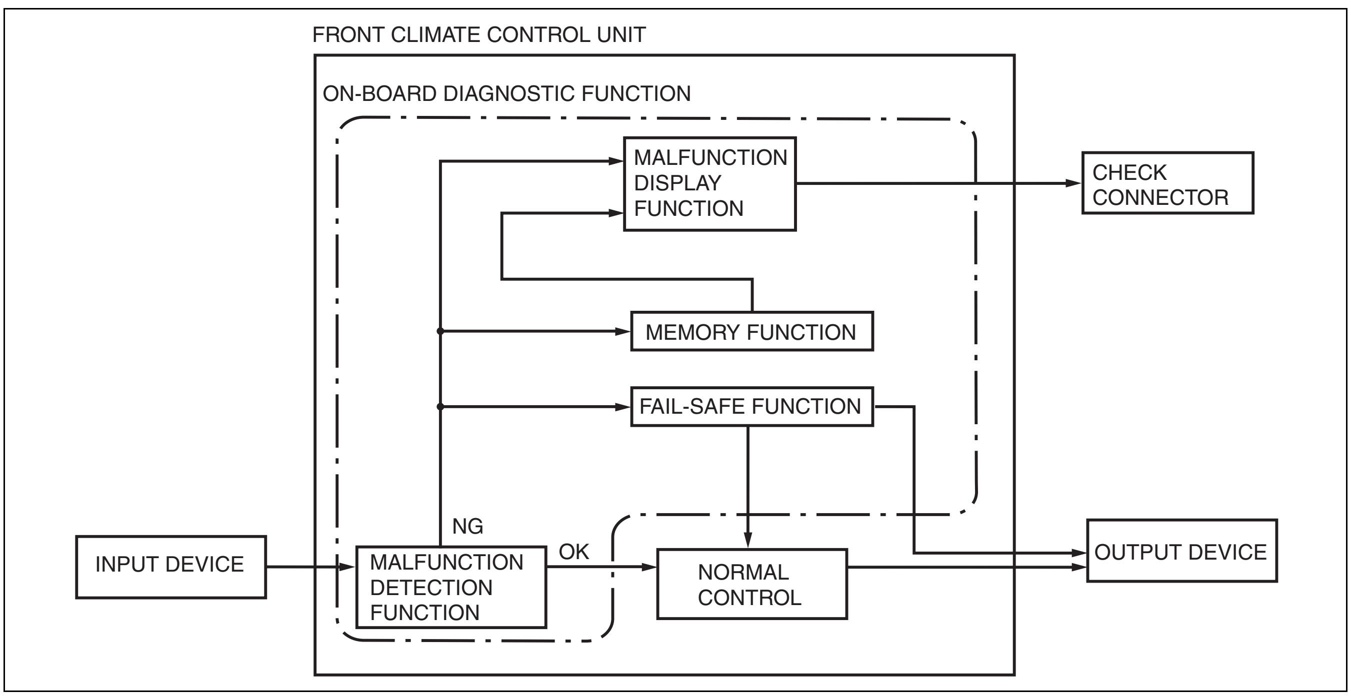
id070200100100

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 GND to the check connector.

ON-BOARD DIAGNOSTIC FUNCTION BLOCK DIAGRAM

id070200100200



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ON-BOARD DIAGNOSTIC FUNCTION

id070200100300

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 check connector 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
Cabin temperature sensor	Cabin temperature sensor input value is fixed at **25 °C {77 °F}**.	←
Ambient temperature sensor	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 **0 W/m^2**.	←
Engine coolant temperature sensor	Engine coolant temperature sensor input value is fixed at **80 °C {176 °F}**.	←
Rear airflow volume control (Rear control switch on)	Until a malfunction is detected, perform manual control using the normal value that was last detected. During malfunction determination, the rear airflow amount is controlled based on the rear target temperature calculated from the set temperature of the rear temperature setting dial.	←
Rear airflow temperature control (Rear control switch on)	Until a malfunction is detected, perform control using the normal value that was last detected. During malfunction determination, the rear temperature setting is controlled at **22 °C {72 °F}**	←
Air mix actuator (potentiometer)	Air mix actuator drive signal is stopped right when the malfunction is determined.	←
Airflow mode actuator (potentiometer)	Airflow mode actuator drive signal is stopped right when the malfunction is determined.	←
Air mix actuator (motor lock)	Air mix actuator drive signal is stopped right when the malfunction is determined.	After the IG SW is at ON, the air mix actuator drive signal is again output normally.
Airflow mode actuator (motor lock)	Airflow mode actuator drive signal is stopped right when the malfunction is determined.	After the IG SW is at ON, the airflow mode actuator drive signal is again output normally.

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.
- To clear stored malfunction information, press the front climate control unit AUTO switch and REC switch simultaneously during past malfunction display mode.

Display Function

- Function for outputting present or past malfunction to the information display as DTCs.

Present Malfunction Display Mode

- Presently occurring malfunctions (open/short circuits) are detected and the DTCs are indicated on the information display.

DTC Table

No.	Output pattern	Malfunction location	Detected condition	Memory function
02	02	Solar radiation sensor (present malfunction)	Solar radiation sensor (RH) circuit short	-
04	04		Solar radiation sensor (LH) circuit short	-
06	06	Cabin temperature sensor (present malfunction)	Cabin temperature sensor circuit open/short circuit	-
10	10	Front evaporator temperature sensor (present malfunction)	Front evaporator temperature sensor circuit open/short circuit	-
12	12	Front ambient temperature sensor (present malfunction)	Front ambient temperature sensor circuit open/short circuit	-
18	18	Driver-side front air mix actuator (potentiometer) (present malfunction)	Driver-side front air mix actuator (potentiometer) circuit open/short circuit	-
21	21	Front airflow mode actuator (potentiometer) (present malfunction)	Front airflow mode actuator (potentiometer) circuit open/ short circuit	-
37	37	Passenger-side front air mix actuator (potentiometer) (present malfunction)	Passenger- side front air mix actuator (potentiometer) circuit open/short circuit	-
74	74	Rear climate control unit set airflow volume communication system (present malfunction)	Between front climate control unit and rear climate control unit set airflow volume communication circuit open/short circuit	-
75	75	Rear climate control unit set temperature communication system (present malfunction)	Between front climate control unit and rear climate control unit set temperature communication circuit open/short circuit	-
76	76	Rear air mix actuator (potentiometer) (present malfunction)	Rear air mix actuator (potentiometer) circuit open/short circuit	-
78	78	Rear evaporator temperature sensor (present malfunction)	Rear evaporator temperature sensor circuit open/short circuit	-
85	85	Rear airflow mode actuator (potentiometer) (present malfunction)	Rear airflow mode actuator (potentiometer) circuit open/ short circuit	-

07-02

Past Malfunction Display Mode

- Past occurrence of sensor and other input circuit malfunctions (open/short circuits) are stored and the DTCs indicated on the table are displayed on the information display. Once a past malfunction has been stored and after malfunctioning part has been repaired, the past malfunction will continue to remain in the memory. Therefore, after repairing, clear the past malfunction from the memory.
- To clear stored past malfunction information, press the front climate control unit AUTO switch and REC switch simultaneously during past malfunction display mode.

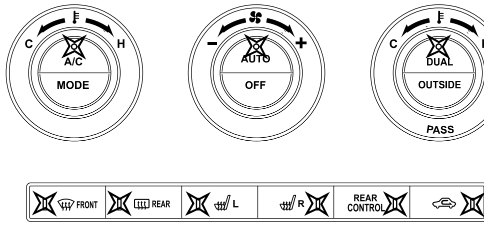
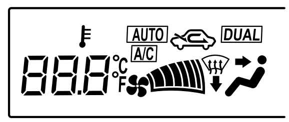
DTC Table

No.	Output pattern	Malfunction location	Detected condition	Memory function
07	07	Cabin temperature sensor (past malfunction)	When an open/short has occured in the cabin temperature sensor circuit **1 time or more** in the past	X
11	11	Front evaporator temperature sensor (past malfunction)	When an open/short has occured in the front evaporator temperature sensor circuit **1 time or more** in the past	X
13	13	Ambient temperature sensor (past malfunction)	When an open/short has occured in the ambient temperature sensor circuit **1 time or more** in the past	X
19	19	Driver-side front air mix actuator (potentiometer) (past malfunction)	When an open/short has occured in the driver-side front air mix actuator (potentiometer) circuit **1 time or more** in the past	X

No.	Output pattern	Malfunction location	Detected condition	Memory function
22	22	Front airflow mode actuator (potentiometer) (past malfunction)	When an open/short has occured in the front airflow mode actuator (potentiometer) circuit **1 time or more** in the past	X
38	38	Passenger-side front air mix actuator (potentiometer) (past malfunction)	When an open/short has occured in the passenger-side front air mix actuator (potentiometer) circuit **1 time or more** in the past	X
58	58	Driver-side front air mix actuator (motor lock) (past malfunction)	When motor lock has occured in the driver-side front air mix actuator circuit **1 time or more** in the past	X
59	59	Front airflow mode actuator (motor lock) (past malfunction)	When motor lock has occured in the front airflow mode actuator circuit **1 time or more** in the past	X
61	61	Passenger-side front air mix actuator (motor lock) (past malfunction)	When motor lock has occured in the passenger-side front air mix actuator circuit **1 time or more** in the past	X
77	77	Rear air mix actuator (potentiometer) (past malfunction)	When an open/short has occured in the rear air mix actuator (potentiometer) circuit **1 time or more** in the past	X
79	79	Rear evaporator temperature sensor (past malfunction)	When an open/short has occured in the rear evaporator temperature sensor circuit **1 time or more** in the past	X
86	86	Rear airflow mode actuator (potentiometer) (past malfunction)	When an open/short has occured in the rear airflow mode actuator (potentiometer) circuit **1 time or more** in the past	X
95	95	Rear air mix actuator (motor lock) (past malfunction)	When motor lock has occured in the rear air mix actuator circuit **1 time or more** in the past	X
96	96	Rear airflow mode actuator (motor lock) (past malfunction)	When motor lock has occured in the rear airflow mode actuator circuit **1 time or more** in the past	X

A/C Operation Check Mode

- The front 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.

Step	Target part	Operation condition	Monitor display*
1	Front climate control unit		Entire illumination of climate control display
	Information display		
2	Blower motor	FRONT OFF → 1ST → 2ND → 3RD → 4TH → 5TH → 6TH → 7TH REAR OFF → 1ST → 3RD → 6TH → 11TH → 13TH → 15TH	01
3	Air mix door	FRONT/REAR 0 % → 50 % → 100 % → 50 %	20.0 (0%) 20.5 (50%) 21.0 (100%) 20.5 (50%)
4	Airflow mode door	FRONT VENT → BI-LEVEL → HEAT → HEAT/DEF → DEFROSTER REAR VENT → BI-LEVEL → HEAT	03
5	Air intake door A/C compressor	FRESH ⇔ REC ON ⇔ OFF	04

* : Shown on the information display (at the set temperature display) according to each step.

07-11 BASIC SYSTEM

BASIC SYSTEM OUTLINE

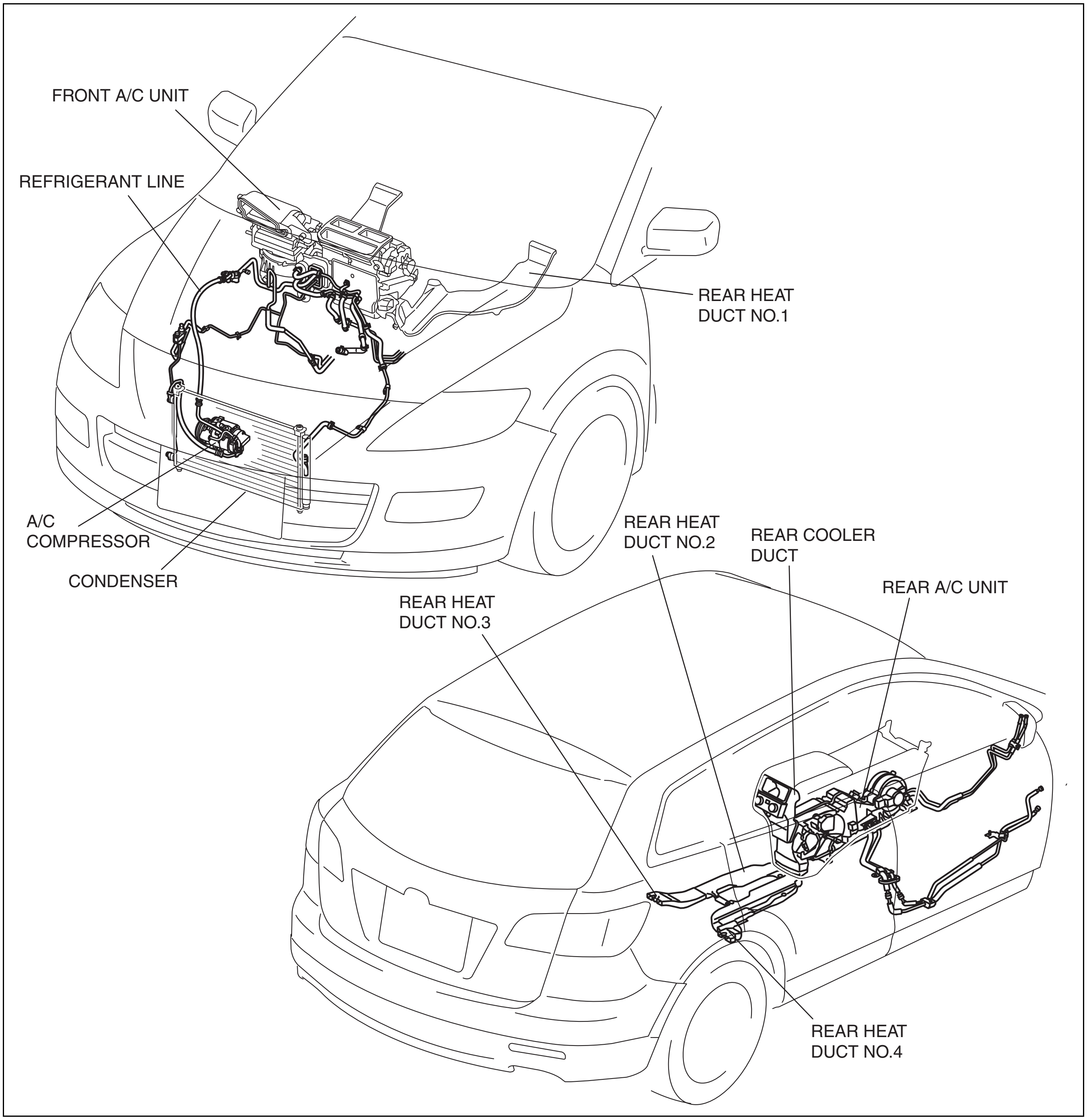
id071100100100

Reduced weight	• Integrated A/C unit adopted
Improved air conditioning performance	• Sub-cooling system to multi-flow condenser adopted
Improved comfort	• Air filter adopted

BASIC SYSTEM STRUCTURAL VIEW

id071100100200

Structural View



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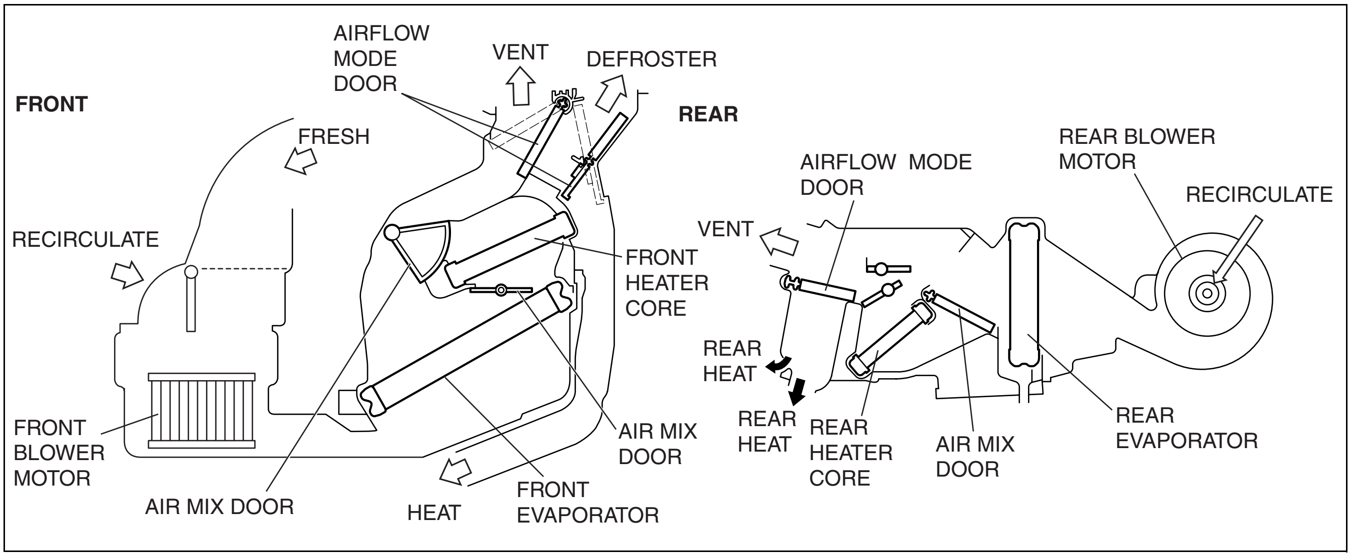
Flow Diagram
Ventilation system



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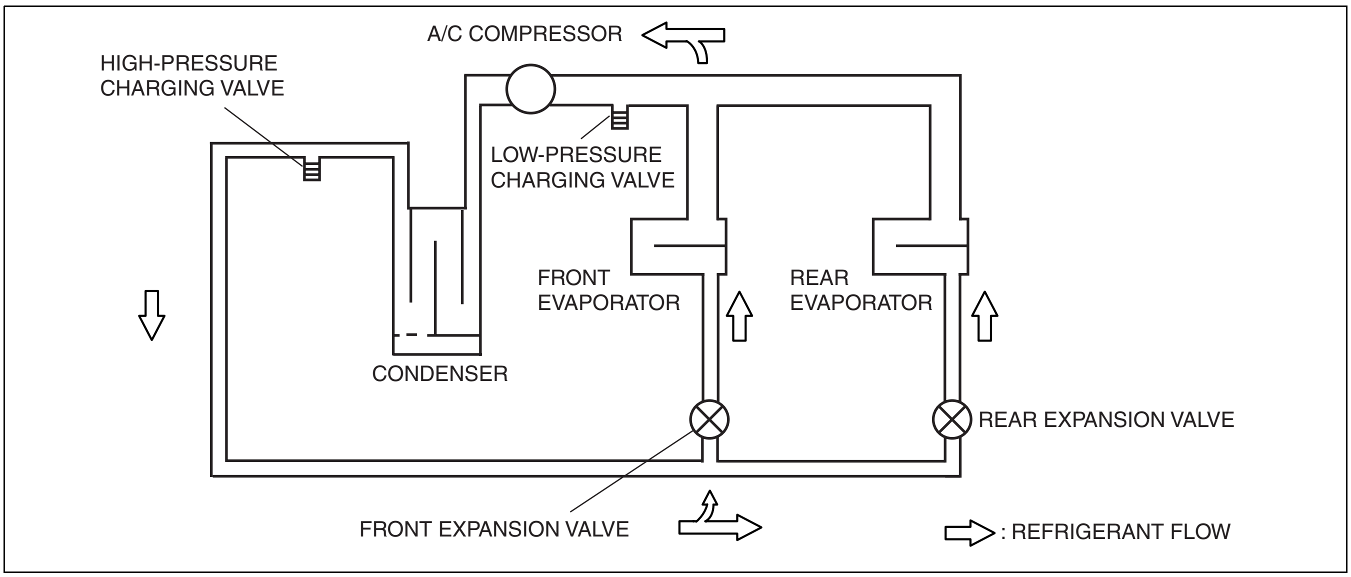
Refrigerant system



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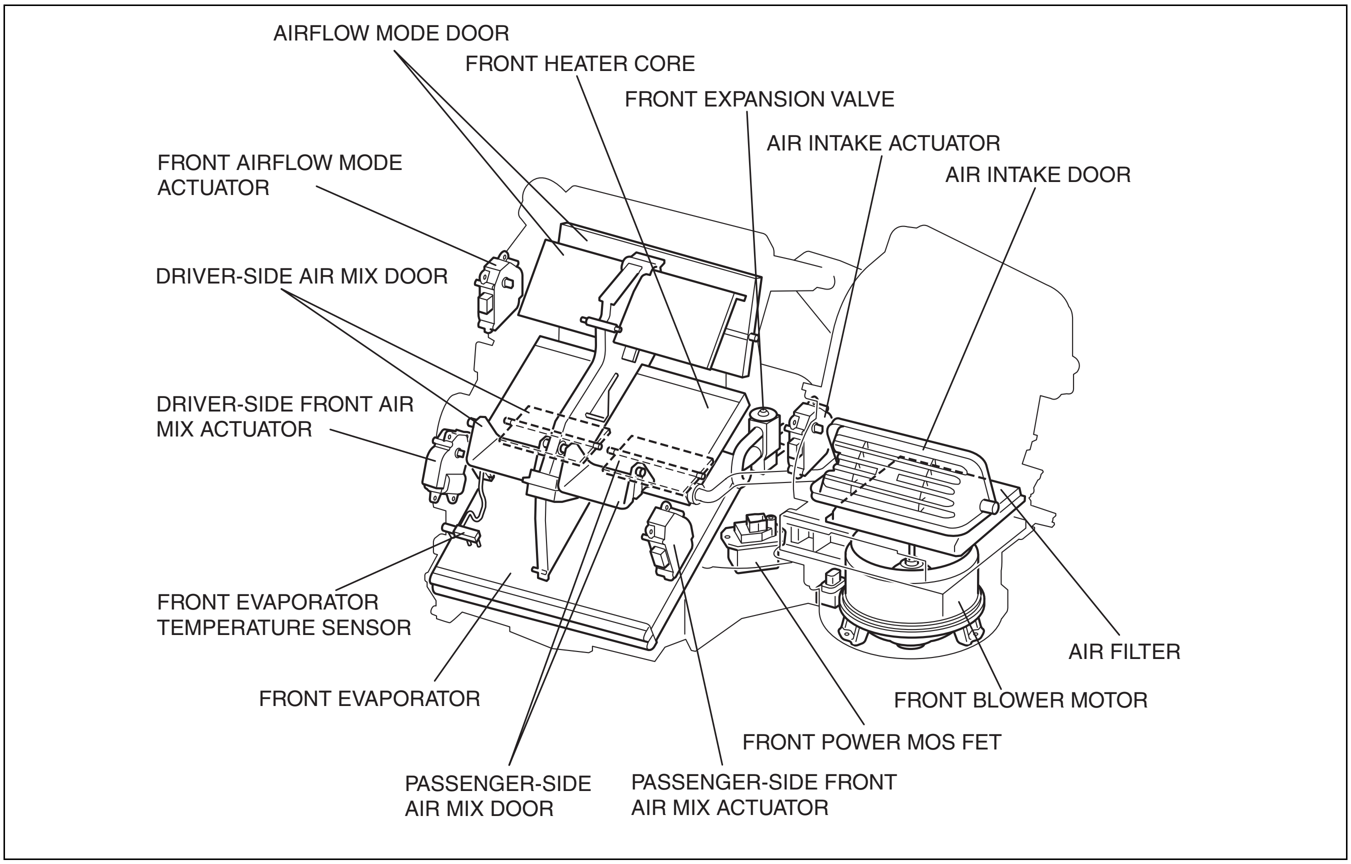
FRONT A/C UNIT CONSTRUCTION/OPERATION

id071100101000

Construction

- Consists of the following parts:
  - — Front blower motor
  - — Air intake actuator
  - — Air intake door
  - — Front evaporator
  - — Front heater core
  - — Driver-side front air mix actuator
  - — Passenger-side front air mix actuator
  - — Front airflow mode actuator
  - — Front expansion valve
  - — Air filter
  - — Front power MOS FET
  - — Front evaporator temperature sensor
  - — Air mix door
  - — Airflow mode door



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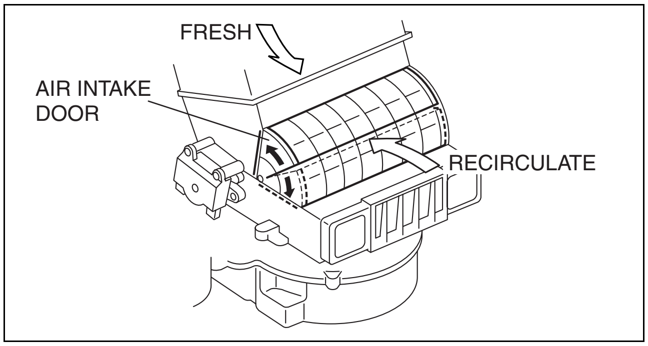
Operation

Air intake door operation

- The air intake door move to FRESH or RECIRCULATE position, depending on the position of the REC switch. As a result, air intake mode changes.



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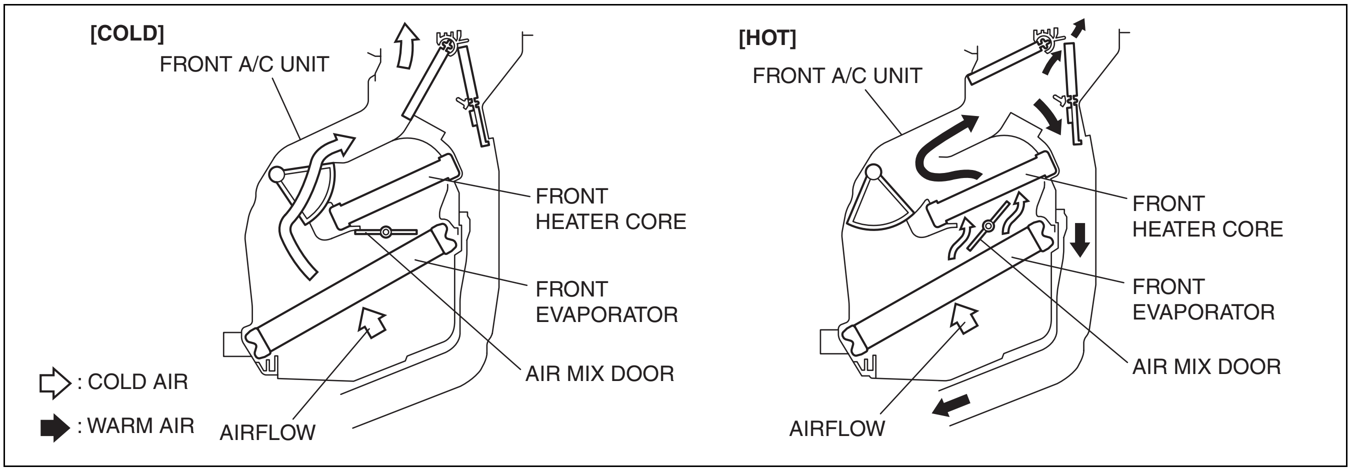
Air mix door operation

- 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.
- When the DUAL switch is on, an operation signal is sent to each actuator to change the air mix door opening angle according to the operation of the driver and passenger temperature setting dials.



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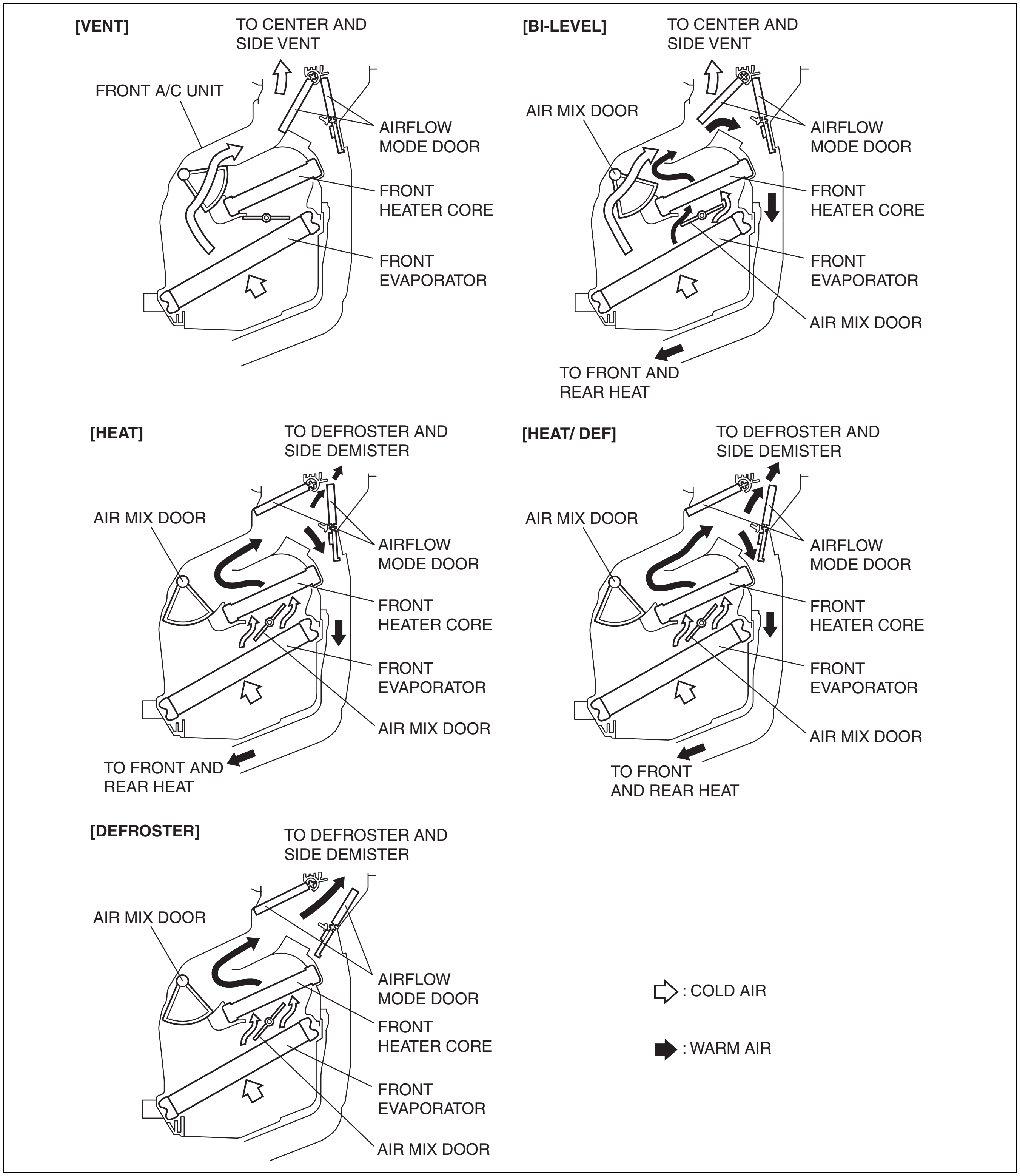
07-11

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.



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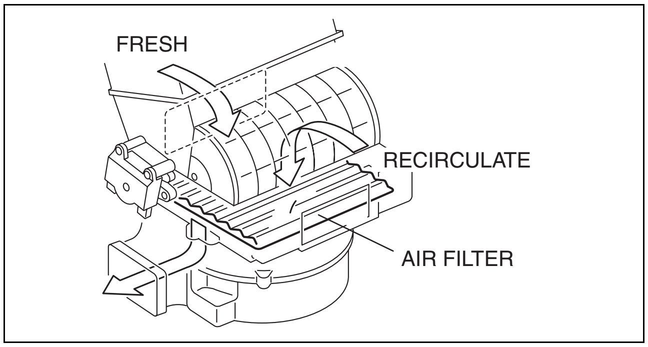
AIRFLOW MODE	AIRFLOW RATE (%)									
	VENT				HEAT		DEFROSTER			
	DRIVER SIDE		PASSENGER SIDE		FRONT	REAR	DRIVER SIDE		PASSENGER SIDE	
	SIDE	CENTER	CENTER	SIDE			SIDE	CENTER	CENTER	SIDE
VENT	25	25	25	25	—	—	—	—	—	—
BI-LEVEL	13.75	13.75	13.75	13.75	31.5	13.5	—	—	—	—

AIRFLOW MODE	AIRFLOW RATE (%)									
	VENT				HEAT		DEFROSTER			
	DRIVER SIDE		PASSENGER SIDE		FRONT	REAR	DRIVER SIDE		PASSENGER SIDE	
	SIDE	CENTER	CENTER	SIDE			SIDE	CENTER	CENTER	SIDE
HEAT	—	—	—	—	56	24	3	7	7	3
HEAT/DEF	—	—	—	—	31.5	13.5	8.25	19.25	19.25	8.25
DEFROSTER	—	—	—	—	—	—	15	35	35	15

AIR FILTER FUNCTION

id071100100500

- An air filter that can removes pollen and dust has been adopted.
- The air filter cannot be reused and must be replaced periodically.



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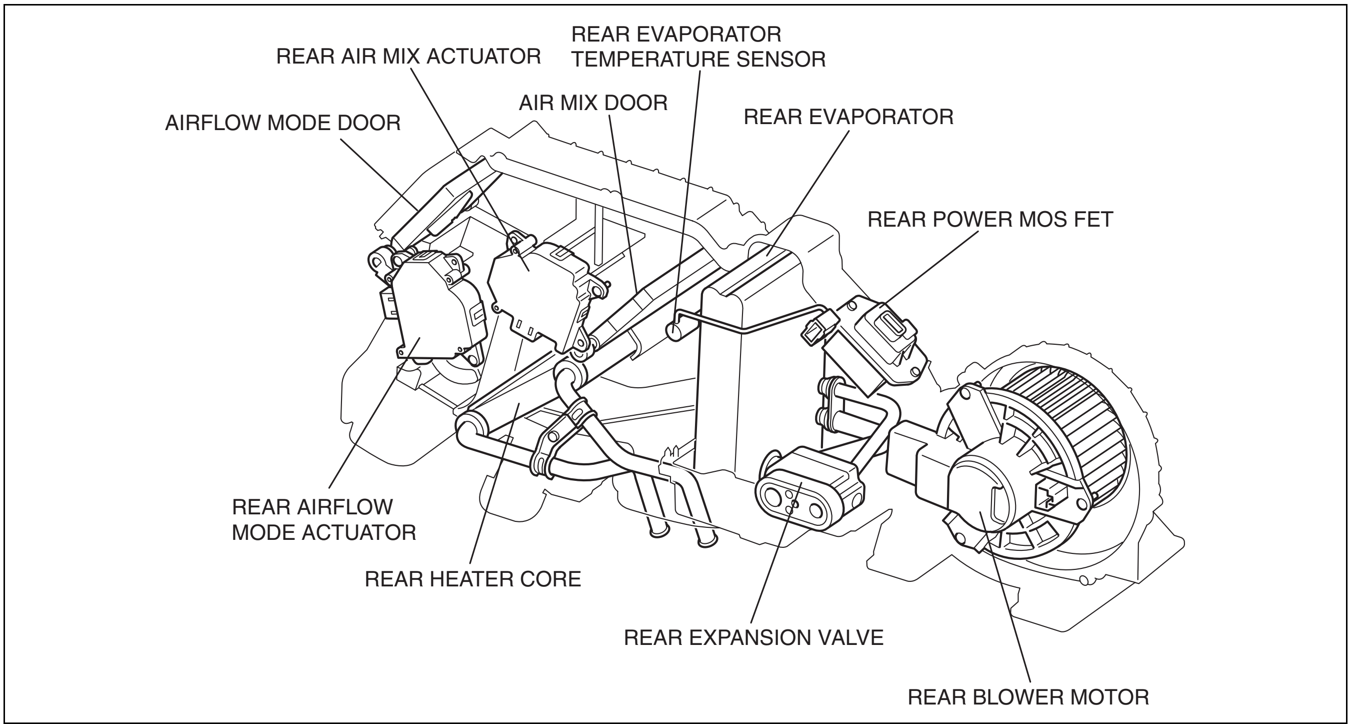
REAR A/C UNIT CONSTRUCTION/OPERATION

id071100100900

- Consists of the following parts:
  - — Rear blower motor
  - — Rear evaporator
  - — Rear heater core
  - — Rear air mix actuator
  - — Rear airflow mode actuator
  - — Rear expansion valve
  - — Rear power MOS FET
  - — Air mix door
  - — Airflow mode door



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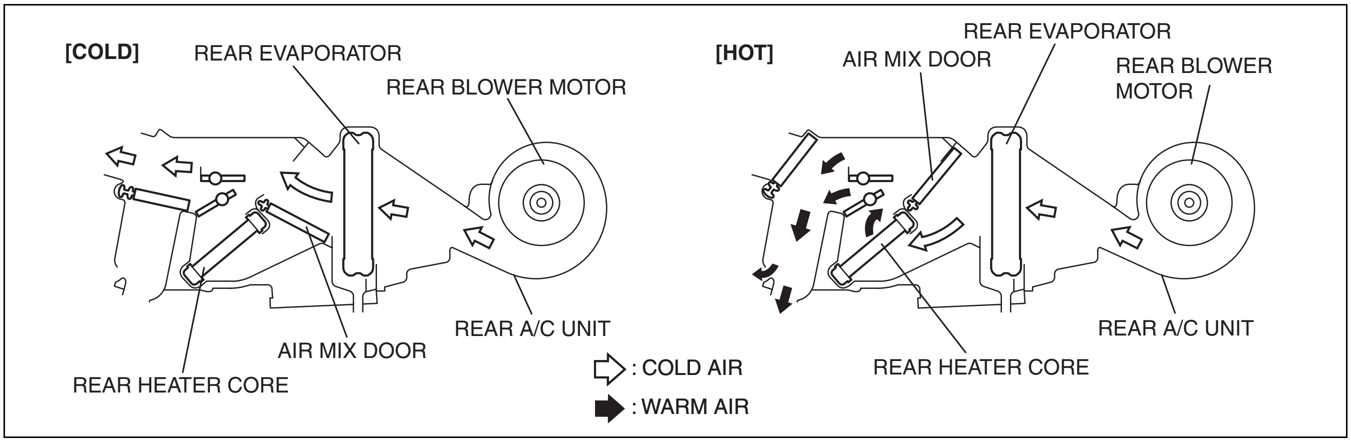
Air Mix Door Operation

- The air mix door moves to HOT or COLD position, using the air mix actuator. As a result, airflow distribution changes, and airflow temperature is controlled.



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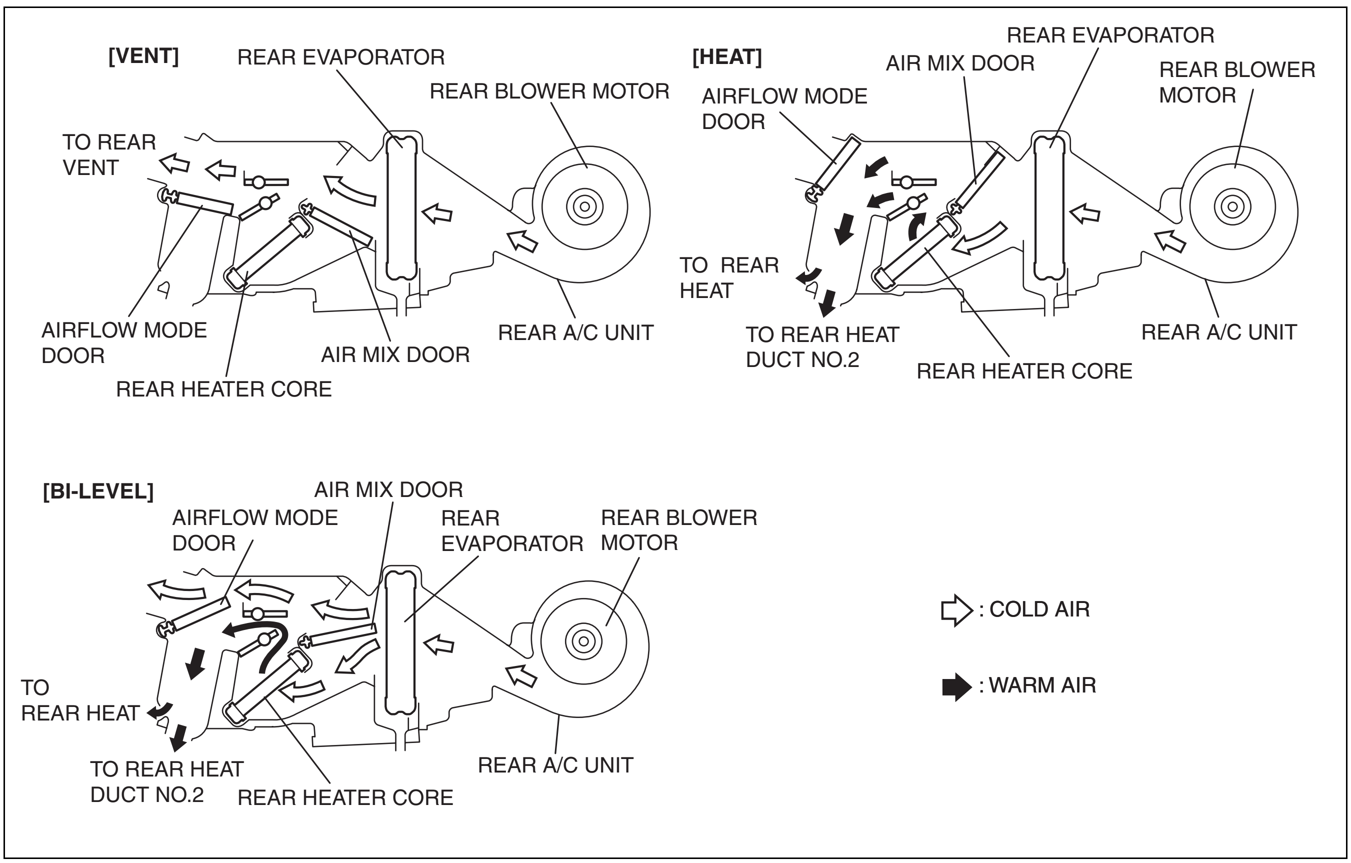
Airflow Mode Door Operation

- The airflow mode doors, installed in the rear A/C unit control VENT, BI-LEVEL, or HEAT position, using the airflow mode actuator. As a result, airflow mode changes.



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Airflow distribution

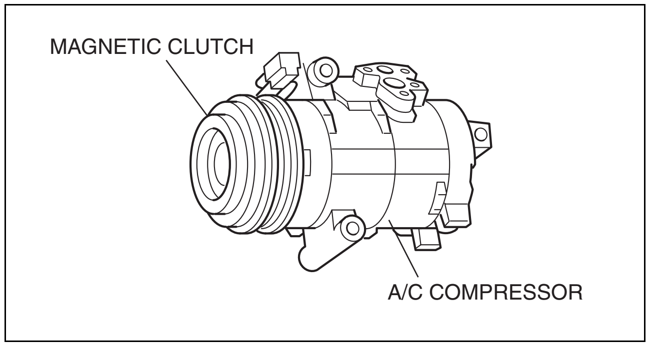
Airflow mode	Distribution (%)	
	Rear vent	Rear heat
VENT	100	0
BI-LEVEL	50	50
HEAT	0	100

A/C COMPRESSOR CONSTRUCTION

id071100100600

Construction

- Consists of the following parts:
  - — A/C compressor
  - — Magnetic clutch



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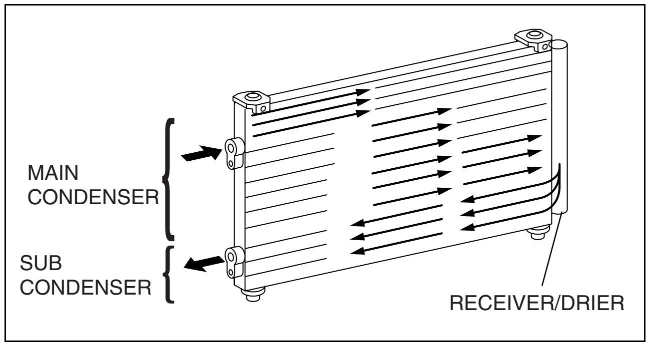
CONDENSER CONSTRUCTION

id071100100800

- 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.



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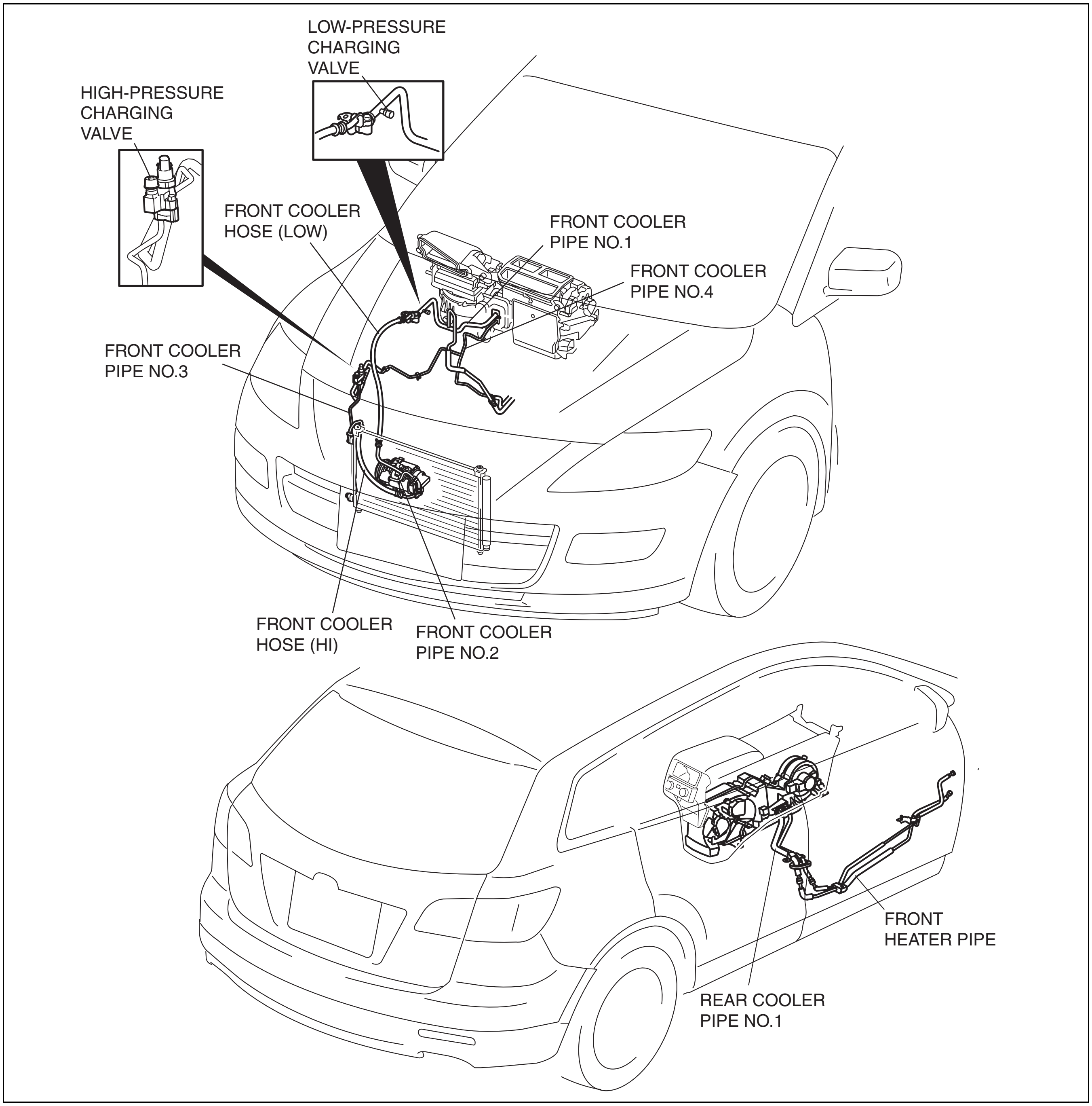
REFRIGERANT LINE CONSTRUCTION

id071100100700

- 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 front cooler pipe No.4 and a low-pressure charging valve is located on the front cooler pipe No.1.



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07-40 CONTROL SYSTEM

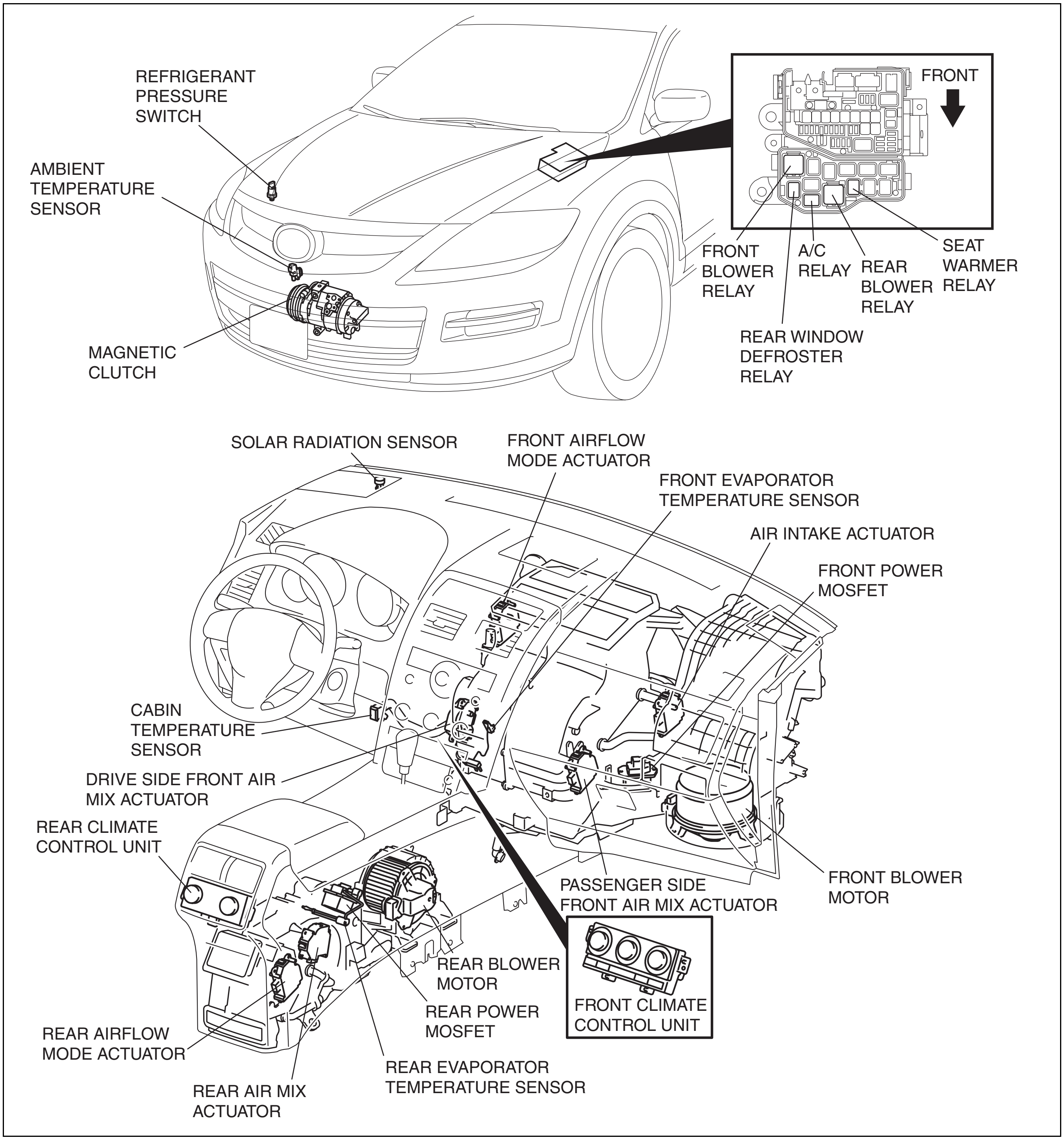
CONTROL SYSTEM OUTLINE

id074000100100

Improved comfort	• A DUAL switch has been adopted with which different temperature settings are possible for the driver and passenger sides • A rear fully-automatic air conditioner for rear seat passengers has been adopted in the console • A rear control switch has been adopted which enables rear A/C operation and the verification of operation conditions using the rear climate control unit.

CONTROL SYSTEM STRUCTURAL VIEW

id074000100200



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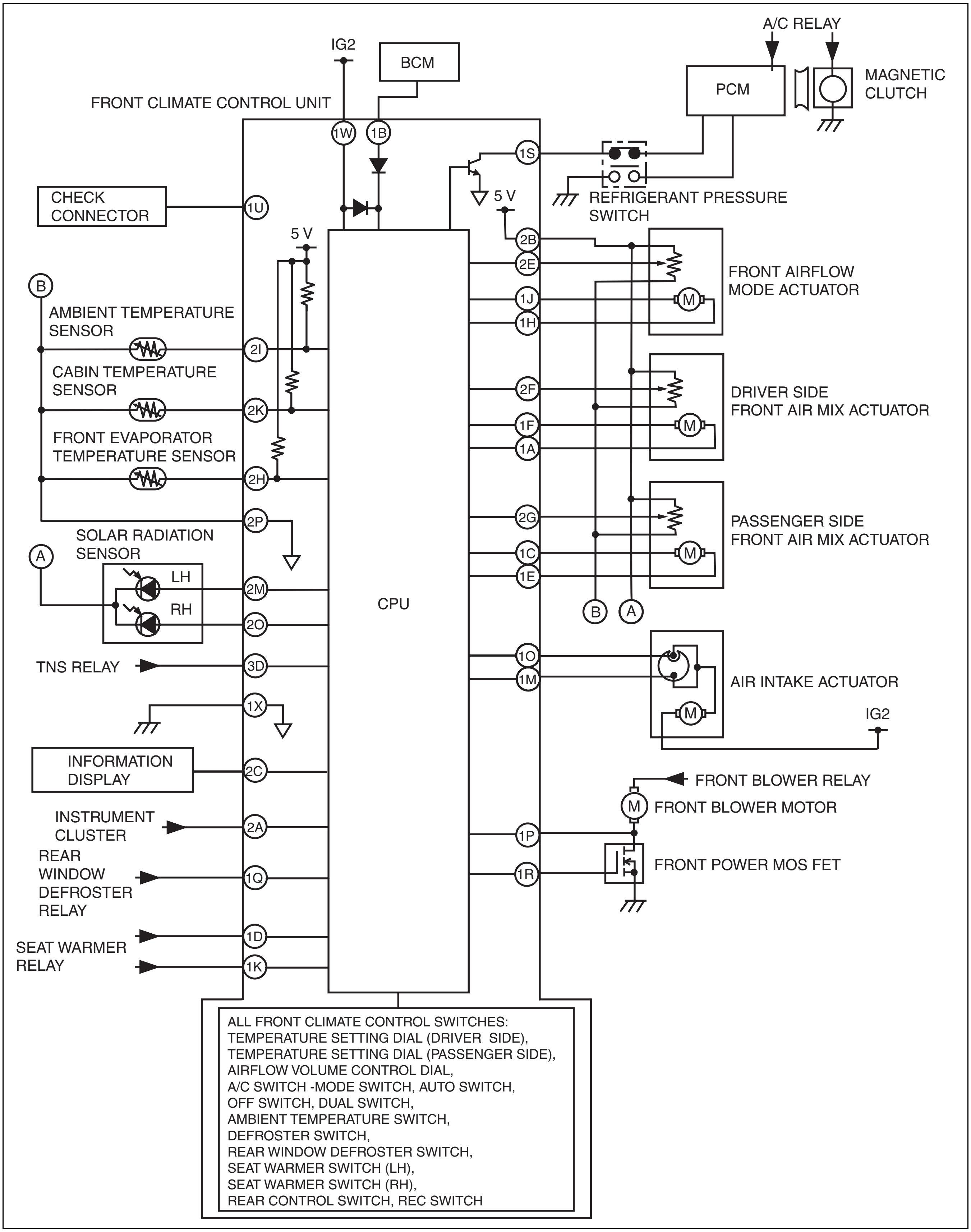
CONTROL SYSTEM WIRING DIAGRAM

id074000100400

Front



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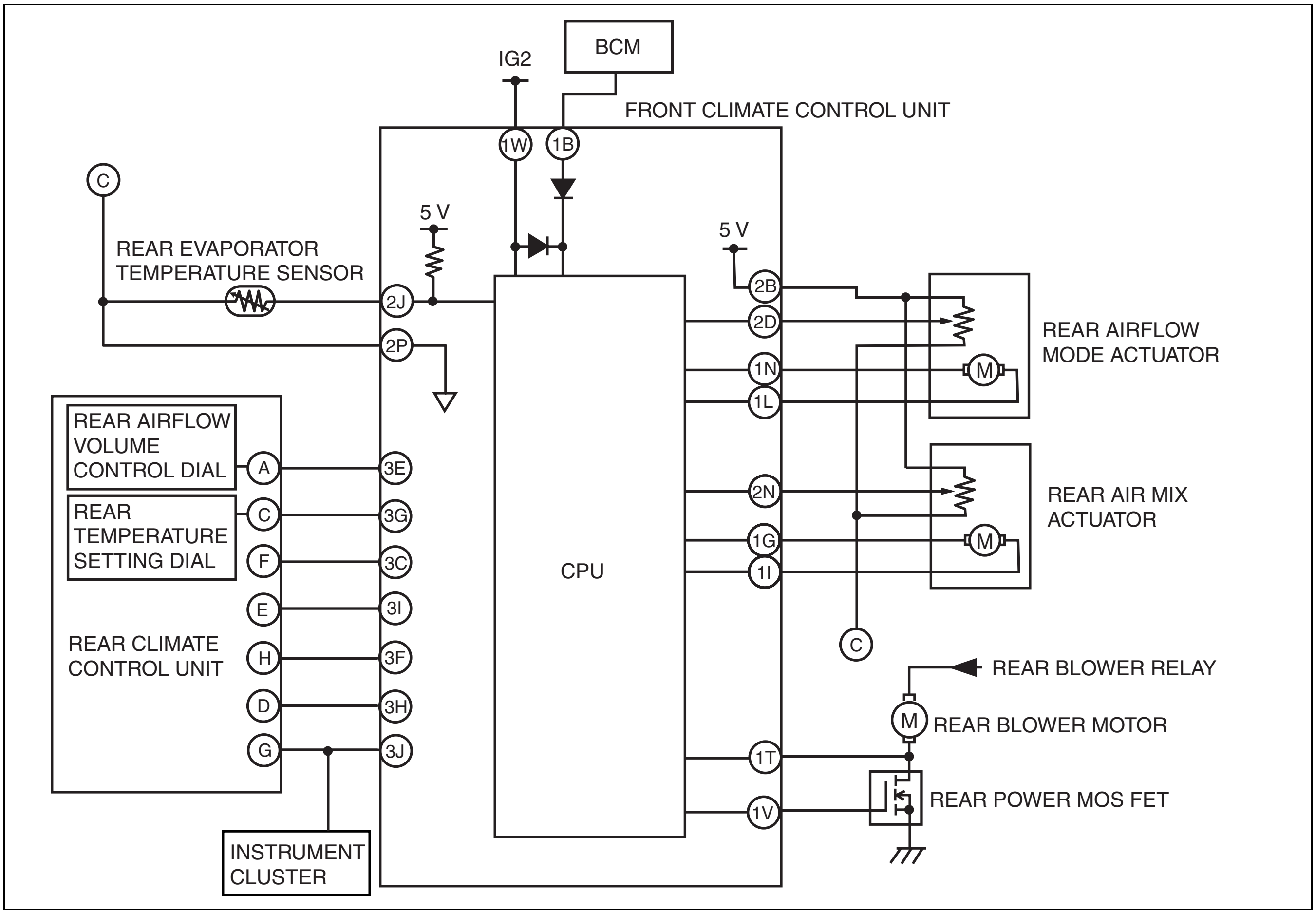
Rear



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AIR INTAKE ACTUATOR CONSTRUCTION

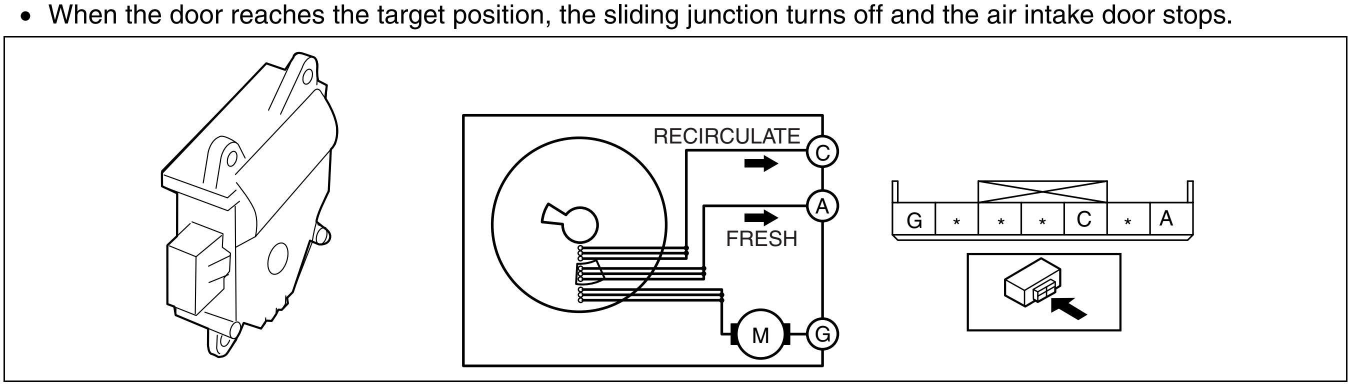
id074000101700

Construction

- Moves the air intake door based on the signals from the front climate control unit to switch between REC and FRESH.
- A sliding contact type has been adopted.

Operation

- Based on the signals from the front climate control unit, the motor in the air intake actuator operates to move the air intake door to the target position.
- When the door reaches the target position, the sliding junction turns off and the air intake door stops.



ac9uun00000215

FRONT AIR MIX ACTUATOR CONSTRUCTION

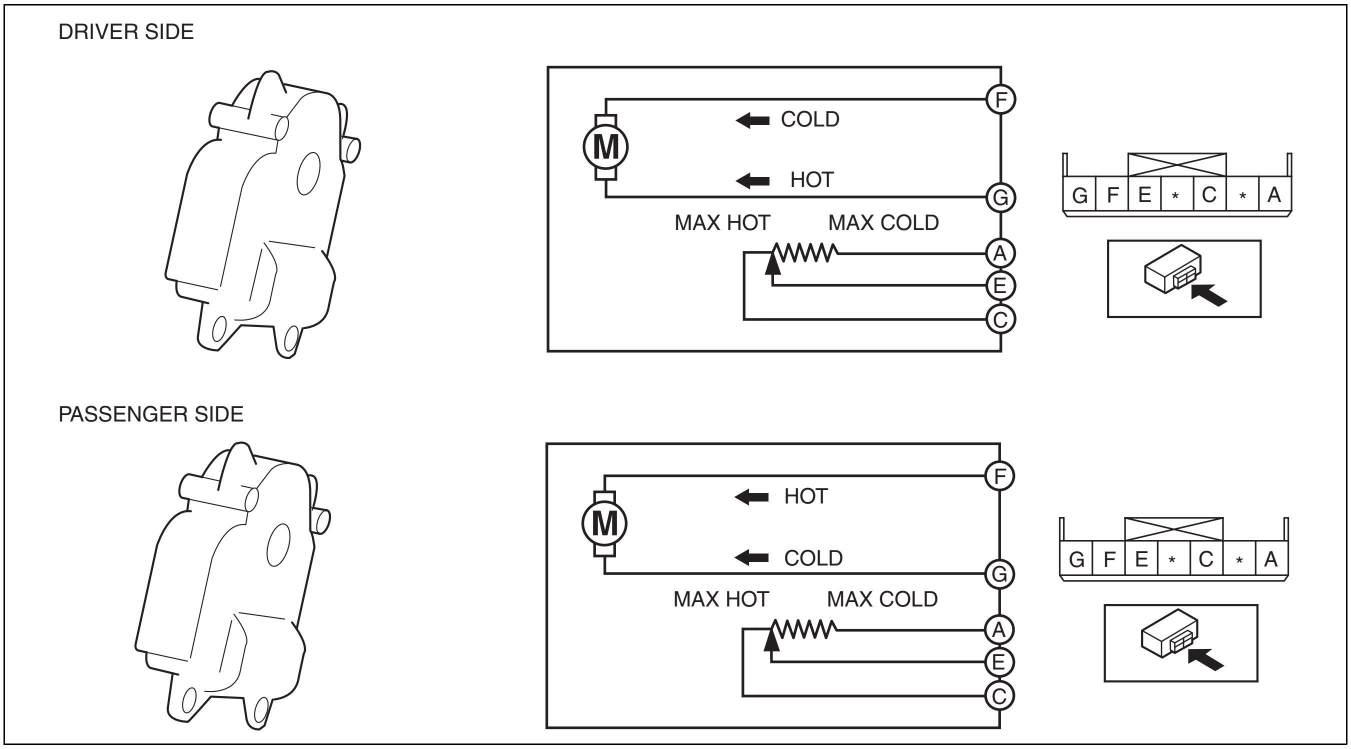
id074000106100

Construction

- Installed to both the driver and passenger sides.
- Opens/closes the air mix door based on the signals from the front climate control unit to adjust the temperature.
- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

Operation

- The front climate control unit compares the voltage detected by the potentiometer in the front air mix actuator with the target voltage.
- Operates the motor in the front air mix actuator until the detected voltage and the target voltage are equal.



ac9uun00000520

REAR AIR MIX ACTUATOR CONSTRUCTION

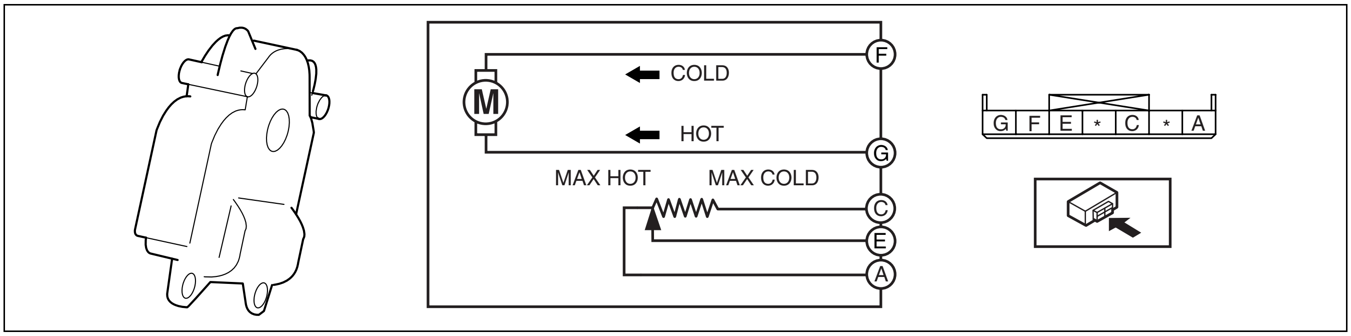
id074000106200

Construction

- Opens/closes the air mix door based on the signals from the front climate control unit to adjust the temperature.
- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

Operation

- The front climate control unit compares the voltage detected by the potentiometer in the rear air mix actuator with the target voltage.
- Operates the motor in the rear air mix actuator until the detected voltage and the target voltage are equal.



ac9uun00000217

FRONT AIRFLOW MODE ACTUATOR CONSTRUCTION

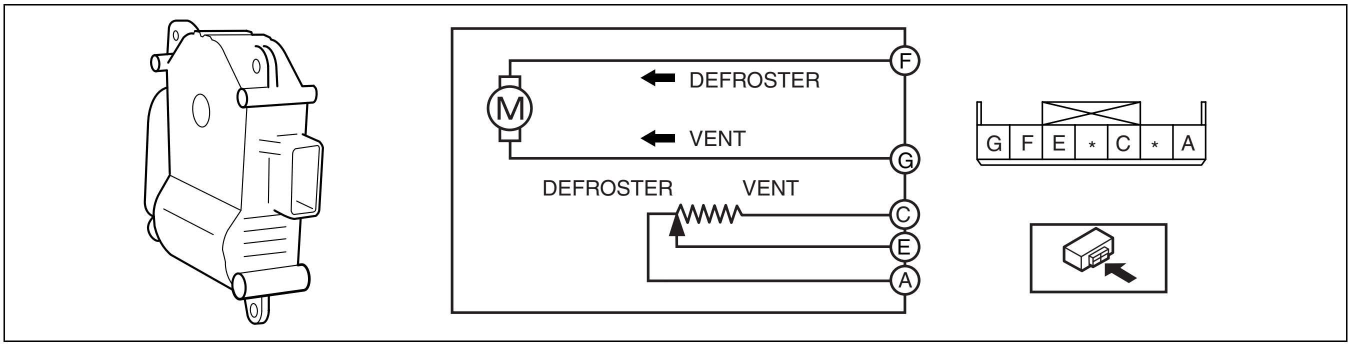
id074000105200

Construction

- Opens/closes the mode door based on the signals from the front climate control unit to switch the air vents.
- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

Operation

- The front climate control unit compares the voltage detected by the potentiometer in the front airflow actuator with the target voltage.
- Operates the motor in the front airflow actuator until the detected voltage and the target voltage are equal.



ac9uun00000218

REAR AIRFLOW MODE ACTUATOR CONSTRUCTION

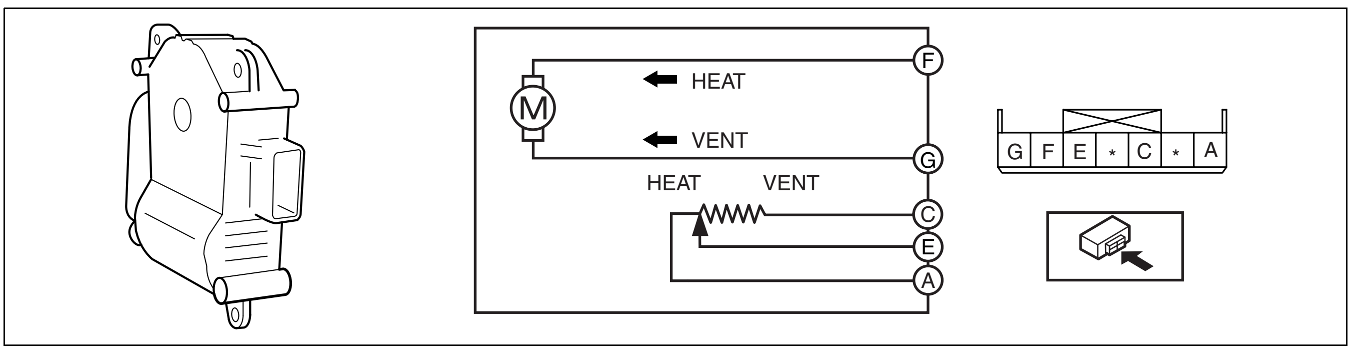
id074000105300

Construction

- Opens/closes the mode door based on the signals from the front climate control unit to switch the air vents.
- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

Operation

- The front climate control unit compares the voltage detected by the potentiometer in the rear airflow actuator with the target voltage.
- Operates the motor in the rear airflow actuator until the detected voltage and the target voltage are equal.

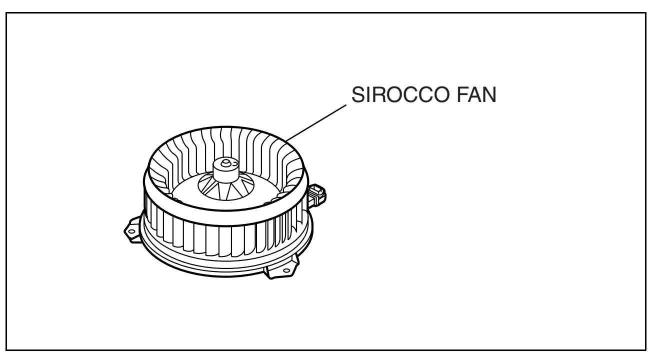


ac9uun00000219

FRONT BLOWER MOTOR CONSTRUCTION

id074000105400

- A sirocco fan has been adopted.

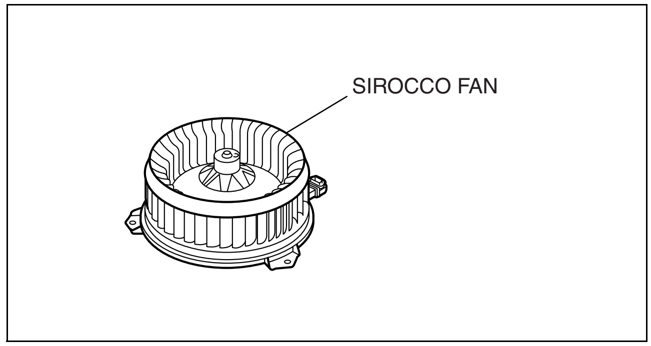


am8rrn00000294

REAR BLOWER MOTOR CONSTRUCTION

id074000105900

- A sirocco fan has been adopted.



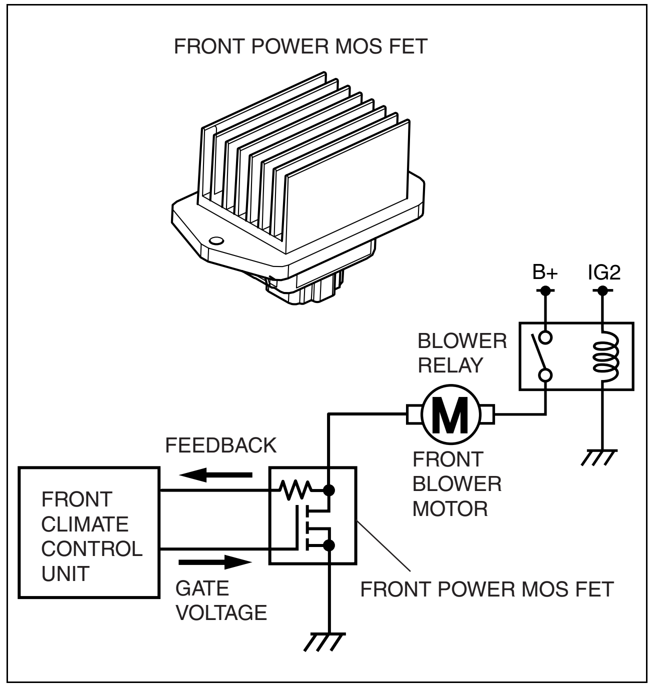
am8rrn00000294

FRONT POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (POWER MOS FET) CONSTRUCTION

id074000104800

Function

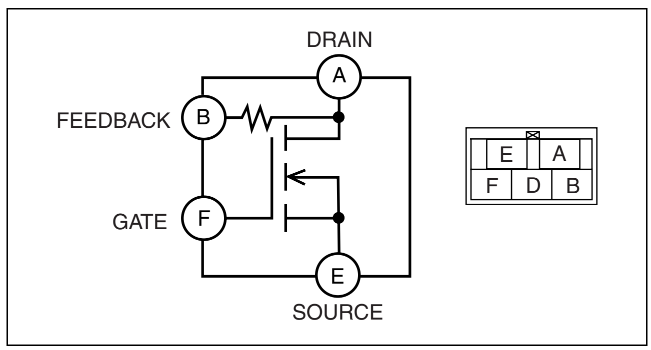
- Controls the supply voltage to the front blower motor according to the gate voltage sent from the front climate control unit and adjusts the rotation speed (airflow volume).



am8rrn00000318

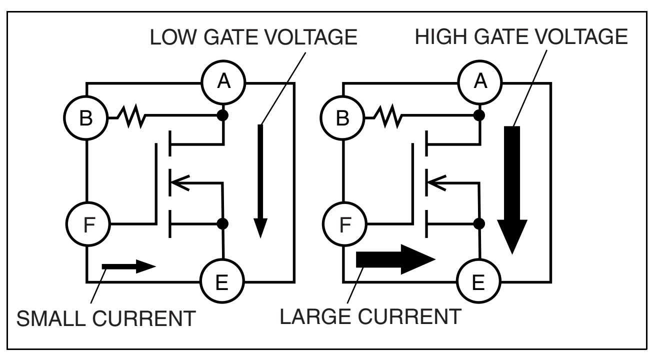
Construction/Operation

- There are four electrodes: source, gate, drain and feedback electrodes.
- The resistance between terminals A and E (between drain and source) changes according to the voltage (gate voltage) applied to terminal F (gate).



am8rrn00000319

- When the gate voltage increases, the resistance between terminals A and E decreases, allowing the current to flow easily.



am8rrn00000320

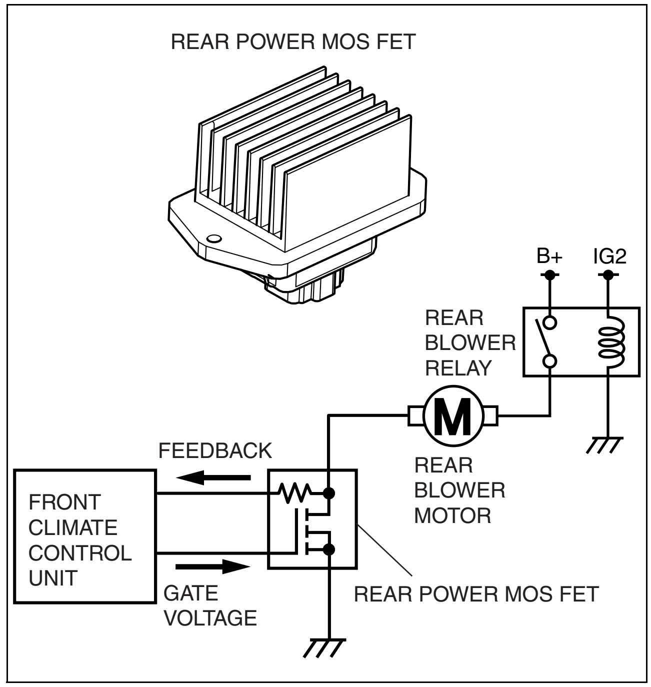
07-40

REAR POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (POWER MOS FET) CONSTRUCTION

id074000104900

Function

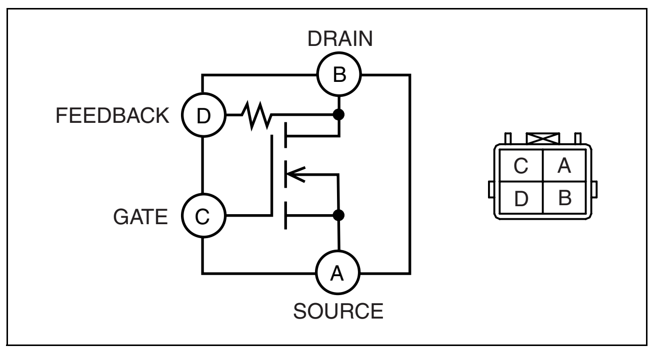
- Controls the supply voltage to the rear blower motor according to the gate voltage sent from the front climate control unit and adjusts the rotation speed (airflow volume).



am8rrn00000321

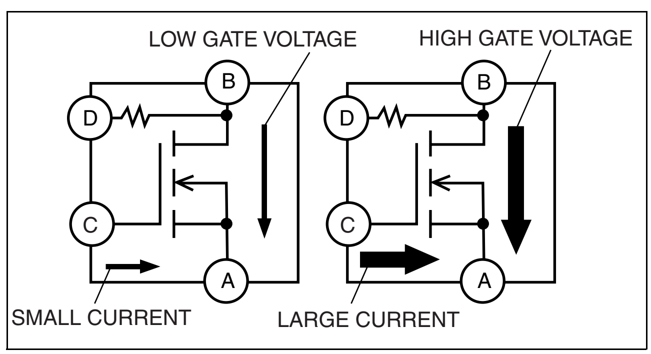
Construction/Operation

- There are four electrodes: source, gate, drain and feedback electrodes.
- The resistance between terminals B and A (between drain and source) changes according to the voltage (gate voltage) applied to terminal C (gate).



am8rrn00000322

- When the gate voltage increases, the resistance between terminals B and A decreases, allowing the current to flow easily.

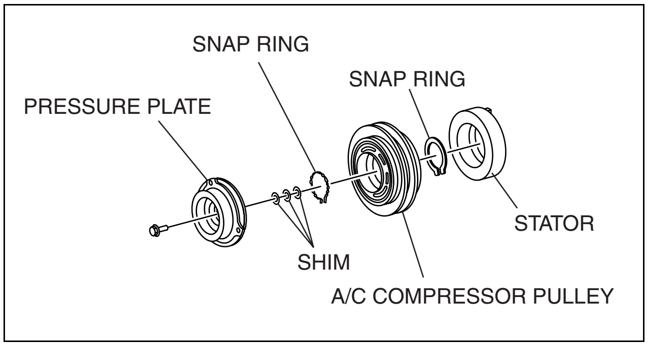


am8rrn00000323

MAGNETIC CLUTCH CONSTRUCTION

id074000101300

- Consists of the following parts:
  — Pressure plate
  — Shim
  — Snap ring
  — A/C compressor pulley
  — Stator



am8rrn00000317

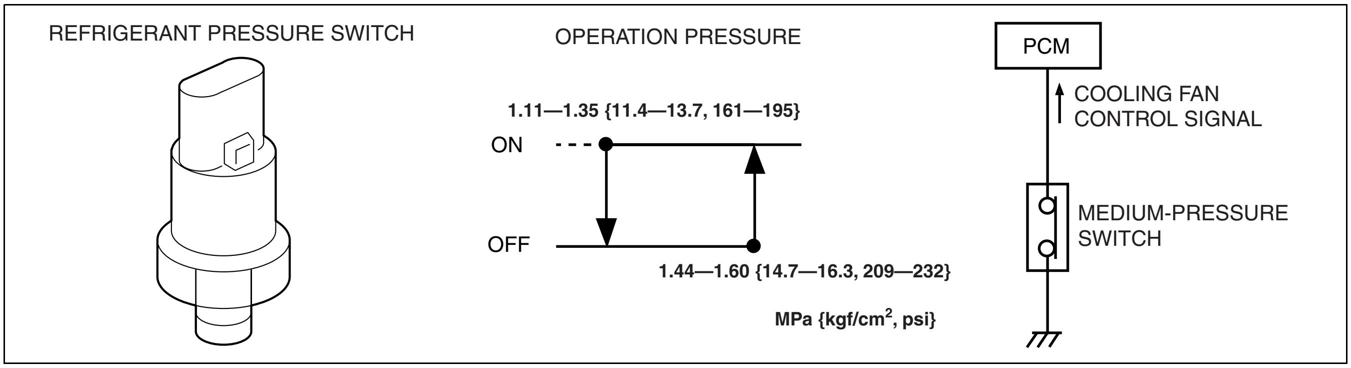
REFRIGERANT PRESSURE SWITCH CONSTRUCTION

id074000103700

- 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 reaches **approx. 1.44 MPa {14.7 kgf·cm^2, 209 psi} or more**, the contact turns on, and a cooling fan control signal is sent to the PCM.



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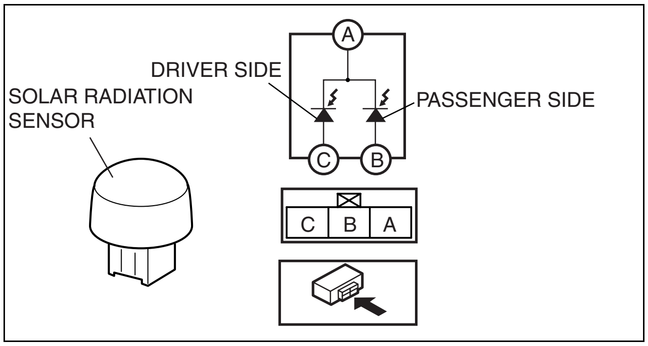
SOLAR RADIATION SENSOR CONSTRUCTION

id074000103800

- A photo diode (light-receiving diode) has been adopted.
- There are two photodiodes in each sensor and each of them sends signals from the driver and passenger-side to the front climate control unit.



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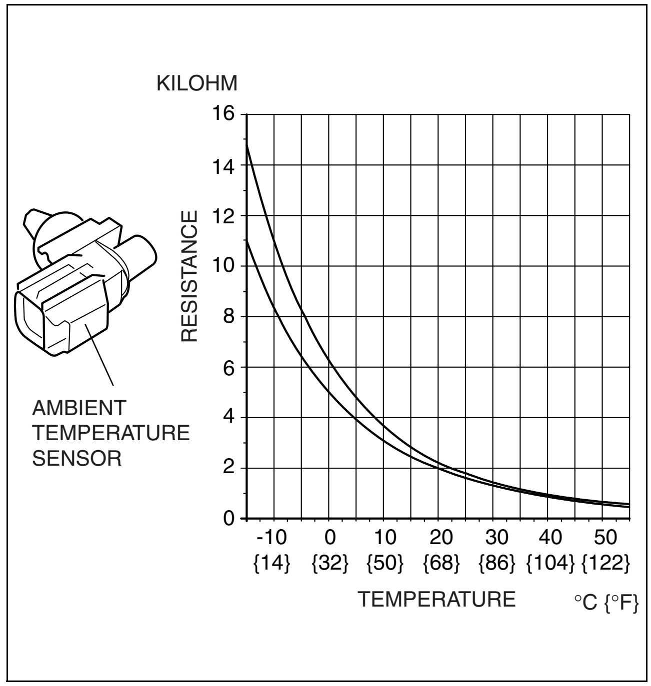
AMBIENT TEMPERATURE SENSOR CONSTRUCTION

id074000104000

- A thermistor type has been adopted.



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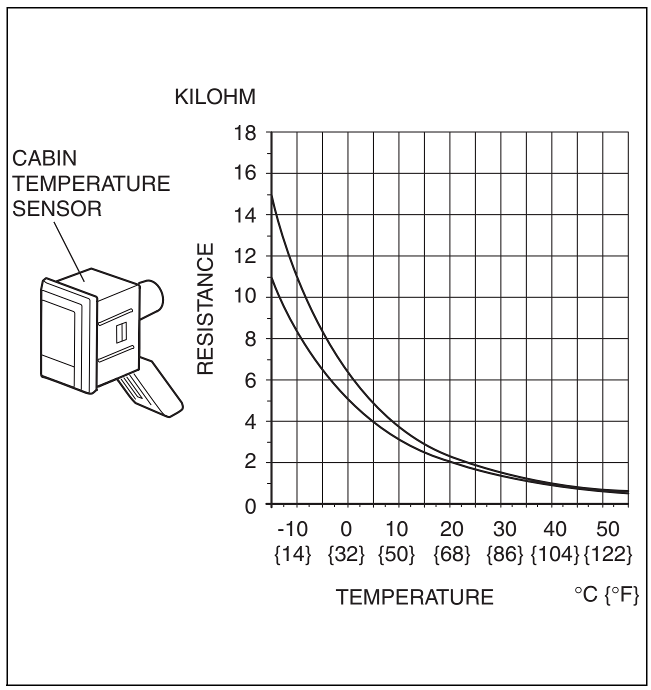
CABIN TEMPERATURE SENSOR CONSTRUCTION

id074000107100

- A thermistor has been adopted.

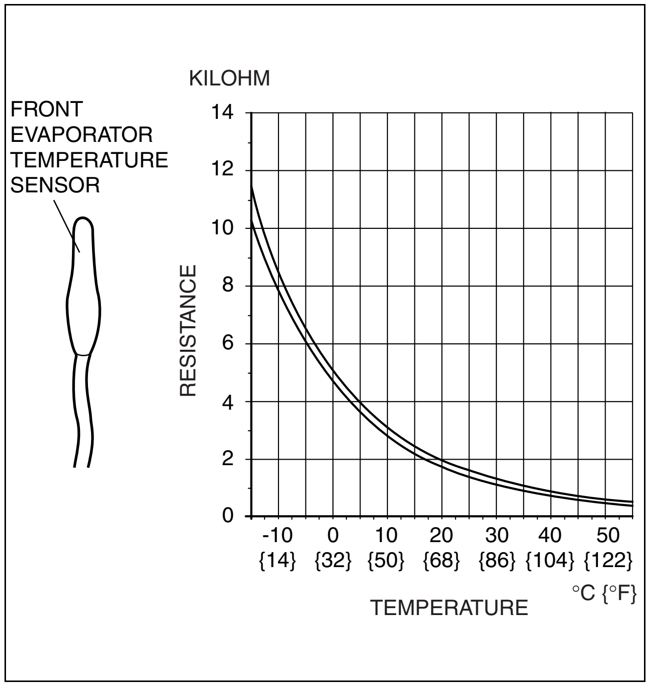


ac9uun00000542

FRONT EVAPORATOR TEMPERATURE SENSOR CONSTRUCTION

id074000105000

- A thermistor type has been adopted.

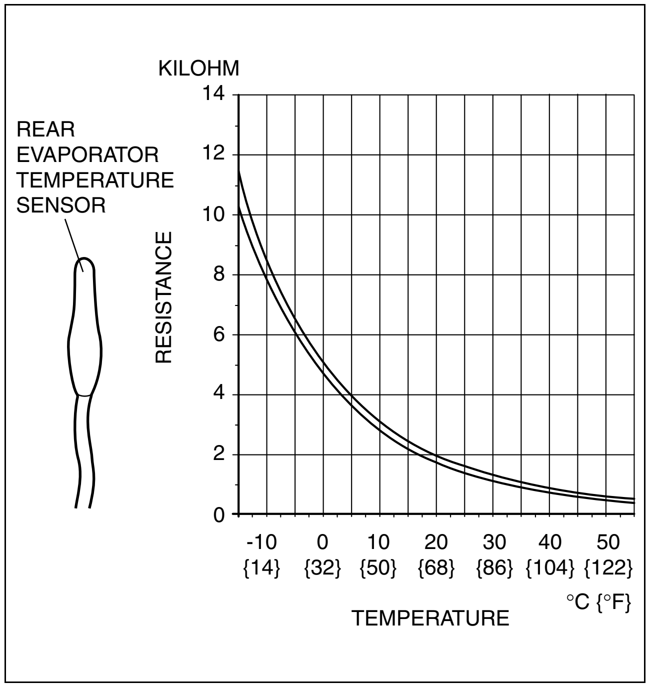


ac9uun00000223

REAR EVAPORATOR TEMPERATURE SENSOR CONSTRUCTION

id074000105100

- A thermistor type has been adopted.

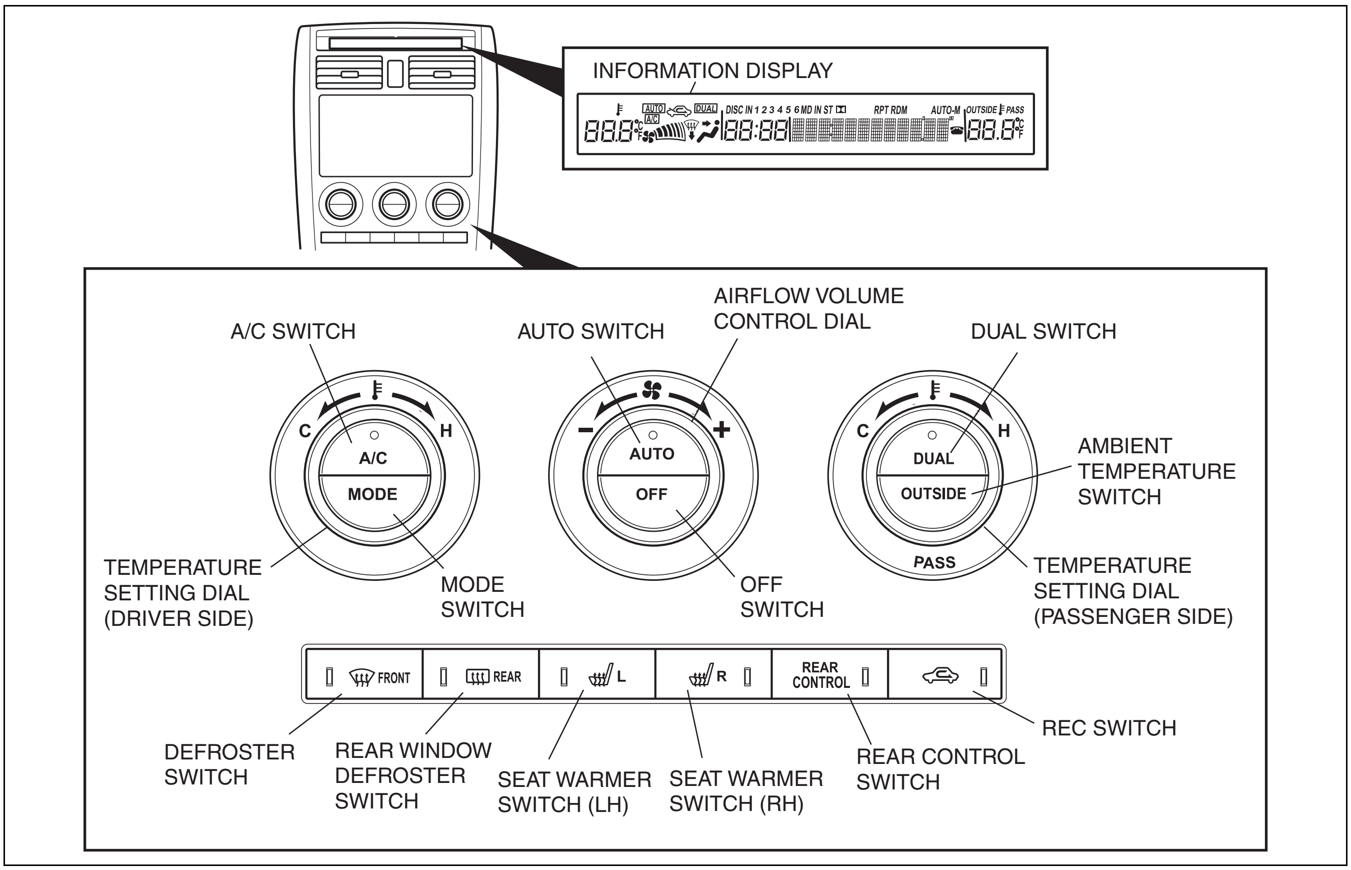


ac9uun00000224

FRONT CLIMATE CONTROL UNIT CONSTRUCTION

id074000105500

- A logic-type climate control unit is used with the full-auto air conditioner.
- The operation condition is displayed in the information display.
- When the DUAL switch is on, the airflow temperature for each side can be set using the driver and passenger-side temperature setting dials. If the DUAL switch is operated during the defroster mode, the mode does not change to the DUAL mode.
- When the ambient temperature switch is pressed, ambient temperature is displayed in the information display.
- When the ambient temperature switch is pressed approx. 3 s or more, the temperature setting display in the information display changes from °C to °F.
- When the rear control switch is on, the rear A/C can be operated using the rear climate control unit. When the rear control switch is off, the rear A/C is controlled based on the set temperature which has been set using the driver-side temperature setting dial on the front climate control unit.
- A seat warmer switch is integrated. (See 09-13-1 SEAT OUTLINE.)
- The rear window defroster switch is integrated. (See 09-12-1 REAR WINDOW DEFROSTER SYSTEM OUTLINE.)



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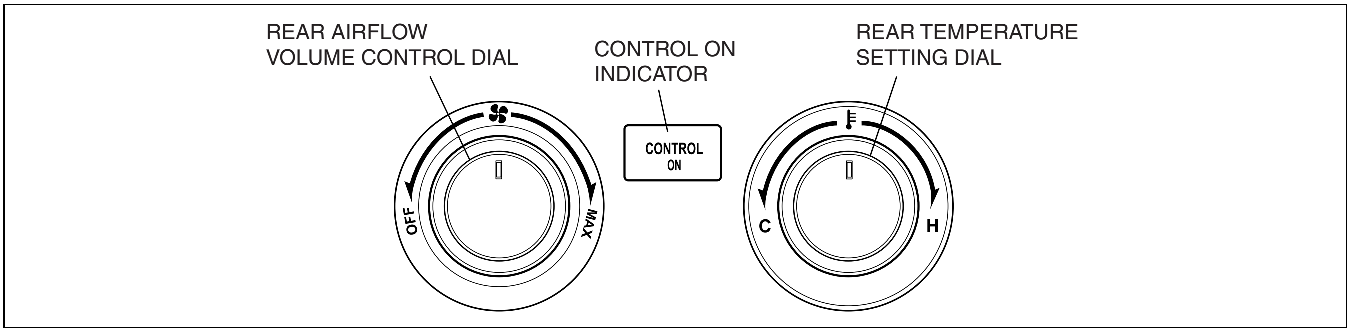
REAR CLIMATE CONTROL UNIT CONSTRUCTION

id074000106000

- Installed to the console panel.
- When the rear control switch on the front climate control unit is on, the control indicator on the rear climate control unit is illuminated, and the rear A/C can be operated using the rear climate control unit.
- When the rear control switch on the front climate control unit is on, the LED on the outside of the dial on the rear climate control unit illuminates, and the airflow amount and set temperature for the rear are displayed.
- When the rear control switch on the front climate control unit is off, the rear A/C is controlled based on the set temperature which has been set using the driver-side temperature setting dial on the front climate control unit. The operation condition of the rear A/C is not displayed.



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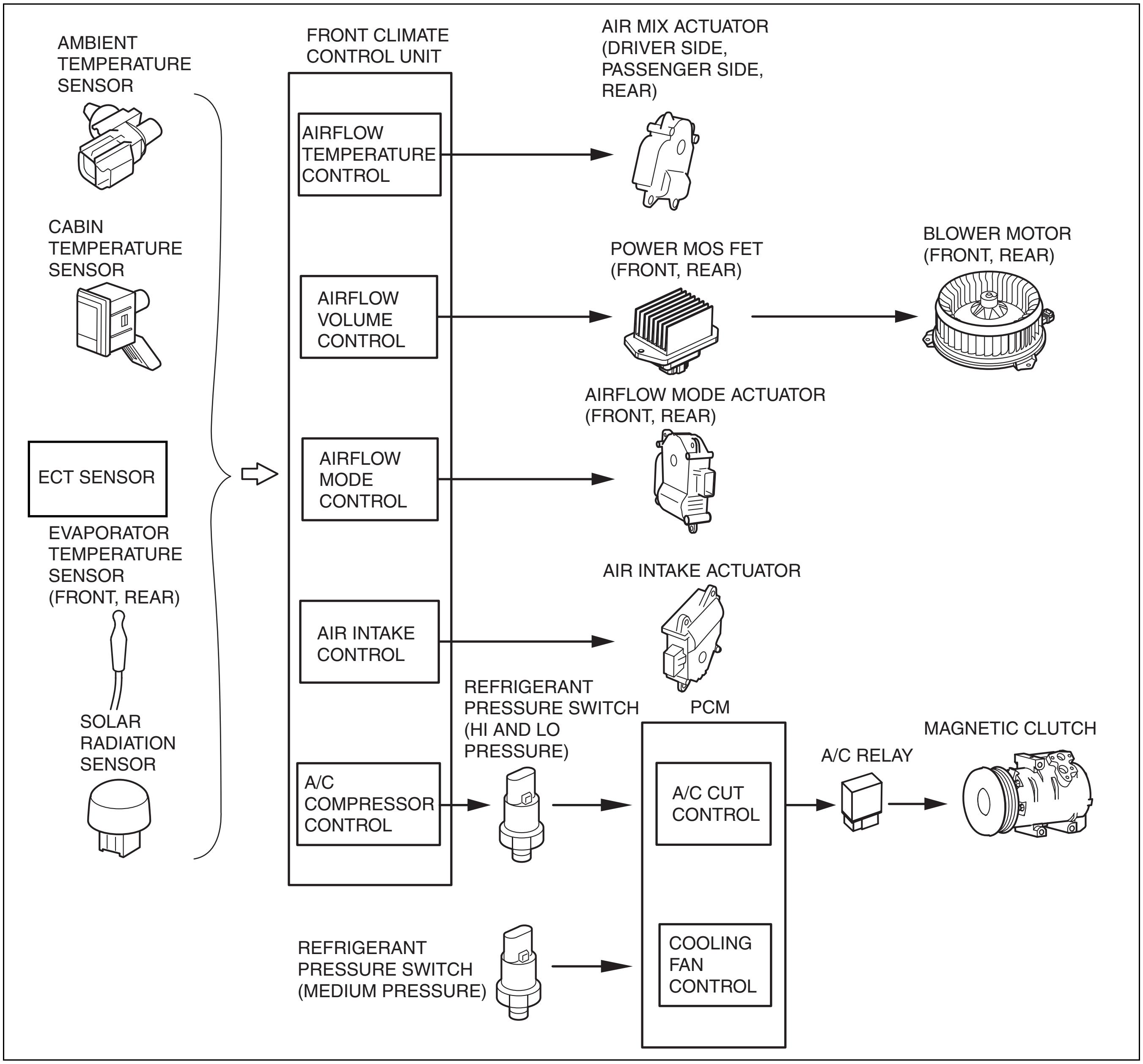
FULL-AUTO AIR CONDITIONER FUNCTION

id074000100600

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 (front climate control unit).



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Control Table

- The full-auto air conditioner system functions based on the five basic types of controls and two supplementary functions.

×:Possible
-:Not possible

Basic control	Control description	Correction control	Front	Rear
Airflow temperature control	Airflow temperature automatic control	MAX HOT and MAX COLD correction	×	×
		Air mix actuator opening angle correction	×	×
Airflow volume control	Airflow volume automatic control	Warm-up correction	×	×
		Mild start correction	×	×
		MAX HOT and MAX COLD correction	×	×
		Defroster correction	×	-
		Solar radiation correction	×	-
	Airflow volume manual control	Defroster correction	×	-
Airflow mode control	Airflow mode automatic control	Warm-up correction	×	-
		MAX HOT and MAX COLD correction	×	×
	Airflow mode manual control	—	×	-
Air intake control	Air intake automatic control	MAX HOT and MAX COLD correction	×	-
		Defroster correction	×	-
	Air intake manual control	Defroster correction	×	-
A/C compressor control	A/C compressor automatic control	MAX HOT and MAX COLD correction	×	-
		Defroster correction	×	-
	A/C compressor manual control	Defroster correction	×	-

Supplementary function
Fail-safe function
On-board diagnostic function

Control Type Transition by Switch Operation (Front)
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						
					1	2	3	4	5	6	7
OFF switch		Automatic control	OFF	OFF	OFF						
AUTO switch		Automatic control	Automatic control	*6	*6						
Fan switch	+	Automatic control	Manual control*2	Manual control*7	2	3	4	5	6	7	7
	-	Automatic control	Manual control*3	Manual control*8	1	1	2	3	4	5	6
MODE switch		Automatic control	Automatic control	*5	No change						
DEFROSTER switch		Automatic control	Defroster correction	*5	Defroster correction						
A/C switch		Automatic control	Automatic control	No change	No change						
REC switch		Automatic control	Automatic control	No change	No change						
Driver-side temperature setting dial*1	15.0	MAX COLD	MAX HI	No change	No change						
	15.5—31.5	Automatic control	Automatic control	No change	No change						
	32.0	MAX HOT	AUTO HI*4	No change	No change						
Passenger-side temperature setting dial*1	15.0	Automatic control	MAX HI	No change	No change						
	15.5—31.5	Automatic control	Automatic control	No change	No change						
	32.0	Automatic control	AUTO HI*4	No change	No change						
DUAL switch		Automatic control	*6	No change	No change						

*1 : Adjusted up or down in increments of 0.5 within a range of 15.0—32.0.
*2 : Increases to the manual voltage that is closest to the auto voltage.

*3 : Decreases to the manual voltage that is closest to the auto voltage.
*4 : Warm-up 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.
*6 : MAX HOT and MAX COLD correction takes precedence.
*7 : Increases to the manual voltage that is closest to the defroster correction voltage.
*8 : Decreases to the manual voltage that is closest to the defroster correction voltage.

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	No change*2	FRESH	No change	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 → *2	Automatic control*3	No change*3	Automatic control*6	No change*6
DEFROSTER switch		DEFROSTER	DEFROSTER*2	Defroster correction	Defroster correction*2	Defroster correction	Defroster correction
A/C switch		Automatic control	No change	Automatic control	No change	A/C→OFF OFF→A/C*4	A/C→OFF OFF→A/C*4
REC/FRESH switch		Automatic control	No change	FRESH→REC REC→FRESH *5	FRESH→REC REC→FRESH *5	Automatic control	No change
Driver-side temperature setting dial*1	15.0	Automatic control	No change	Automatic control	No change	Automatic control	No change
	15.5—31.5	Automatic control	No change	Automatic control	No change	Automatic control	No change
	32.0	Automatic control	No change	Automatic control	No change	Automatic control	No change
Passenger-side temperature setting dial*1	15.0	Automatic control	No change	Automatic control	No change	Automatic control	No change
	15.5—31.5	Automatic control	No change	Automatic control	No change	Automatic control	No change
	32.0	Automatic control	No change	Automatic control	No change	Automatic control	No change
DUAL switch		Automatic control	No change	Automatic control	No change	Automatic control	No change

*1 : Adjusted up or down in increments of 0.5 within a range of 15.0—32.0.
*2 : Returns to condition prior to defroster operation.
*3 : FRESH during HEAT, HEAT/DEF
*4 : A/C is set at ON during DEFROSTER, HEAT/DEF, HEAT. Switches only to the A/C display.
*5 : Set at FRESH during DEFROSTER, HEAT/DEF
*6 : A/C ON during HEAT, HEAT/DEF

Control Type Transition by Switch Operation (Rear)
Airflow temperature control, airflow volume control

<table>
<tr><th colspan="3" rowspan="3">Operation switch</th><th>Airflow temperature control</th><th colspan="2">Airflow volume control</th><th>Airflow mode control</th></tr>
<tr><th>Control prior to switch operation</th><th colspan="2">Control prior to switch operation</th><th>Control prior to switch operation</th></tr>
<tr><th>Automatic control</th><th>Automatic control</th><th>Manual control</th><th>Automatic control</th></tr>
<tr><td rowspan="5">REAR</td><td colspan="2">Fan switch OFF</td><td>Automatic control</td><td>-</td><td>OFF</td><td>Fixed at mode before turned OFF</td></tr>
<tr><td colspan="2">Fan switch</td><td>Automatic control</td><td>-</td><td>*2</td><td>Automatic control</td></tr>
<tr><td rowspan="3">Temperature setting dial*1</td><td>MAX COLD</td><td>MAX COLD</td><td>-</td><td>No change</td><td>Automatic</td></tr>
<tr><td>Middle</td><td>Automatic control</td><td>-</td><td>No change</td><td>Automatic</td></tr>
<tr><td>MAX HOT</td><td>MAX HOT</td><td>-</td><td>No change</td><td>Automatic</td></tr>
<tr><td rowspan="9">FRONT</td><td colspan="2">OFF switch</td><td>Automatic control</td><td>OFF</td><td>OFF</td><td>Fixed at mode before turned OFF</td></tr>
<tr><td colspan="2">AUTO switch*6</td><td>Automatic control</td><td>Automatic control</td><td>No change</td><td>Automatic control</td></tr>
<tr><td colspan="2">Fan switch</td><td>Automatic control</td><td>Automatic control</td><td>No change</td><td>Automatic control</td></tr>
<tr><td colspan="2">DEFROSTER switch</td><td>Automatic control</td><td>Automatic control</td><td>No change</td><td>Automatic control</td></tr>
<tr><td rowspan="3">Temperature setting dial*1, 6</td><td>15.0</td><td>MAX COLD</td><td>MAX HI</td><td>No change</td><td>Automatic control</td></tr>
<tr><td>15.5—31.5</td><td>Automatic control</td><td>Automatic control</td><td>No change</td><td>Automatic control</td></tr>
<tr><td>32.0</td><td>MAX HOT</td><td>AUTO HI*4</td><td>No change</td><td>Automatic control</td></tr>
<tr><td colspan="2">Rear control switch: ON</td><td>Automatic control</td><td>*2</td><td>-</td><td>Automatic control</td></tr>
<tr><td colspan="2">Rear control switch: OFF</td><td>*3,*5</td><td>-</td><td>*5</td><td>Automatic control</td></tr>
</table>

*1 : Adjusted up or down in increments of 0.5 within a range of 15.0—32.0.
*2 : Set to the rear airflow volume control dial position.
*3 : Set to the driver-side temperature setting dial position.
*4 : Warm-up correction takes precedence.
*5 : MAX HOT and MAX COLD correction takes precedence.
*6 : Operable only when the rear control switch is on and the control indicator is illuminated.

TARGET TEMPERATURE OUTLINE

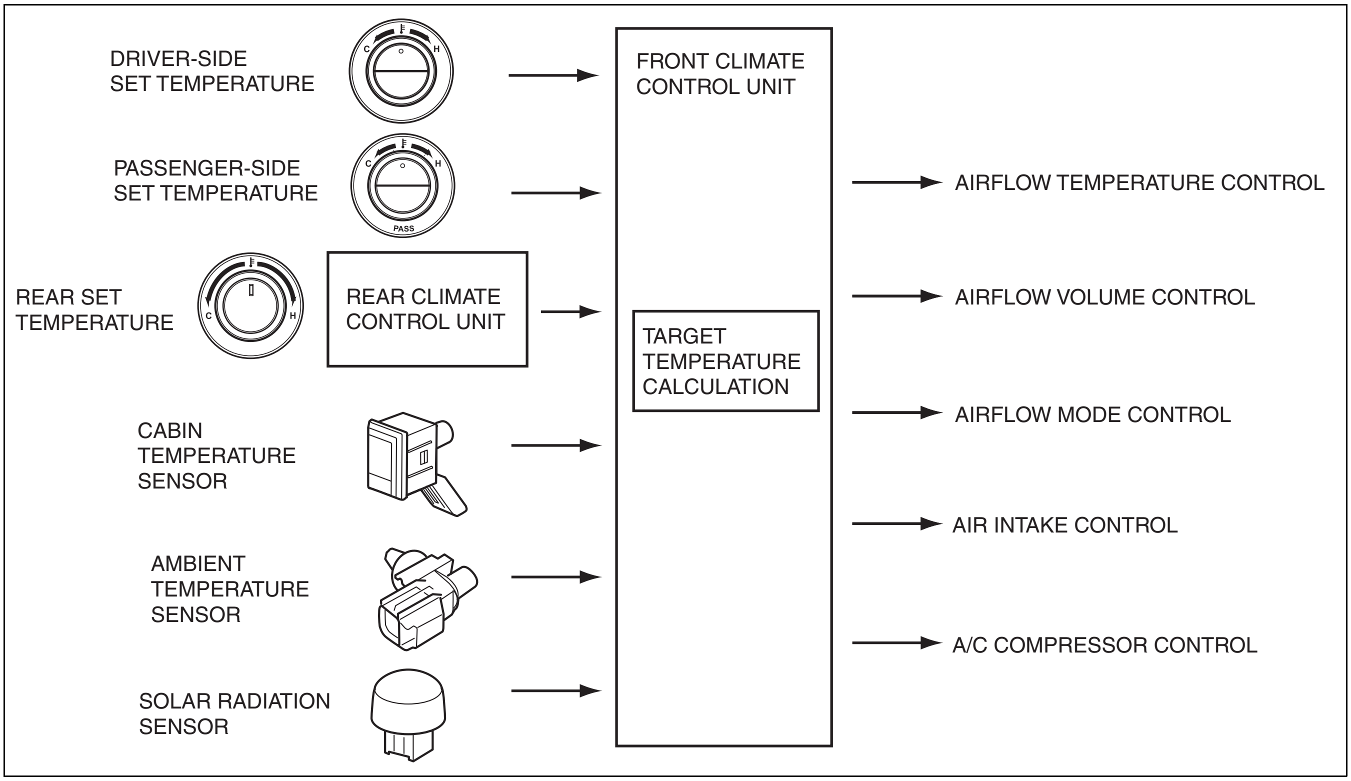
id074000105800

Features

- The front climate control unit calculates the target temperature (temperature to stabilize set temperature) based on input from each sensor and the temperature control dial to control each actuator, the blower motor and A/C compressor.

TARGET TEMPERATURE BLOCK DIAGRAM

id074000105600



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TARGET TEMPERATURE OPERATION

id074000105700

Target Temperature Calculation

- The target temperature is calculated using the following formula based on input from the cabin temperature sensor, the ambient temperature sensor (Correction is added according to vehicle speed.) and the solar radiation sensor, in addition to the temperature set by the climate control unit.

Front (driver side)
Front target temperature = (K_1 x (driver-side set temperature + K_2)) - (K_3 x cabin temperature) - (K_4 x ambient temperature) - (K_5 x (C_1 x (solar radiation temperature (LH) + solar radiation temperature (RH)))) + C_2 + C_3

K_1-K_5:Control coefficient
C_1-C_3:Correction coefficient

Front (passenger side)
Front target temperature = (K_1 x (passenger-side set temperature + K_2)) - (K_3 x cabin temperature) - (K_4 x ambient temperature) - (K_5 x ((1 - C_1) x (solar radiation temperature (LH) + solar radiation temperature (RH)))) + C_2 + C_3

K_1-K_5:Control coefficient
C_1-C_3:Correction coefficient

Rear (Rear control switch off)
Rear target temperature = (K_1 x (driver-side set temperature + K_2)) - (K_3 x cabin temperature) - (K_4 x ambient temperature) - (K_5 x (1/2 (solar radiation temperature (LH) + solar radiation temperature (RH))) + C

K_1-K_5:Rear control coefficient
C : Correction coefficient

Rear (Rear control switch on)
Rear target temperature = (K_1 x (rear set temperature + K_2)) - (K_3 x cabin temperature) - (K_4 x ambient temperature) - (K_5 x (1/2 (solar radiation temperature (LH) + solar radiation temperature (RH))) + C_1 + C_2

K_1-K_5:Rear control coefficient
C_1-C_2:Correction coefficient

AIRFLOW TEMPERATURE CONTROL OUTLINE

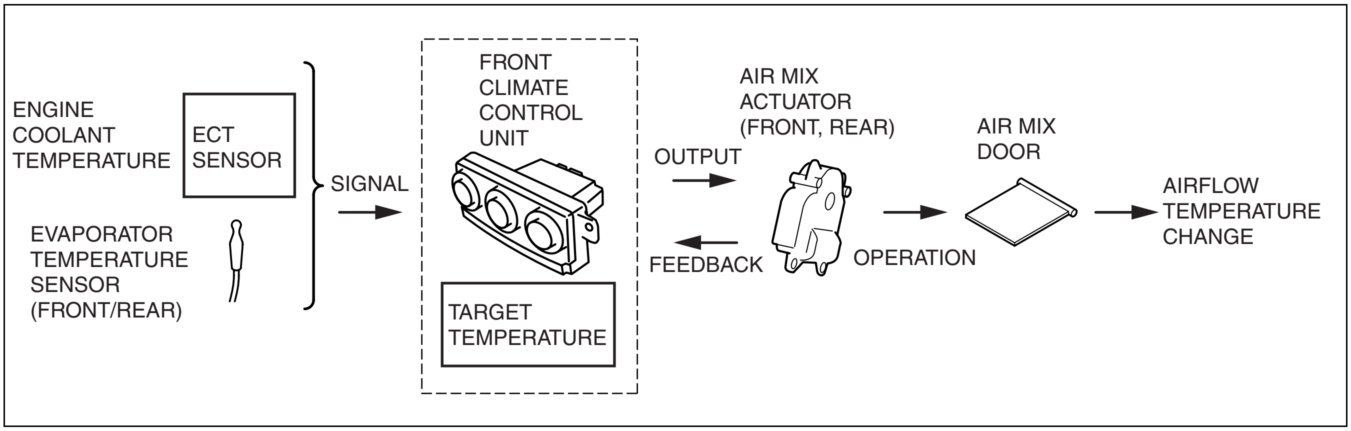
id074000102100

Features

- The airflow temperature is constantly controlled automatically. The front climate control unit controls the airflow temperature via the front air mix actuator or rear air mix actuator.

AIRFLOW TEMPERATURE CONTROL SYSTEM DIAGRAM

id074000102200



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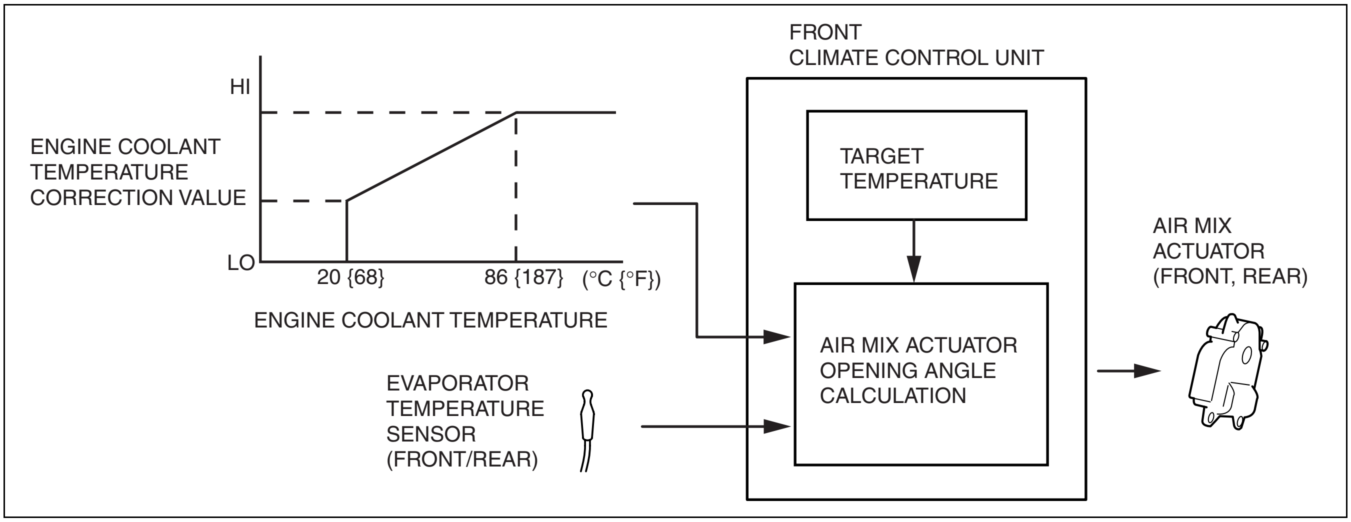
AIRFLOW TEMPERATURE CONTROL OPERATION

id074000102300

Airflow Temperature Automatic Control

- The front climate control unit calculates the air mix actuator (front/rear) opening angle (airflow temperature) by adding the correction input from the ECT sensor and evaporator temperature sensor (front/rear) to the target temperature that was calculated based on the set temperature and input from each sensor, operating the actuator.



ac9uun00000228

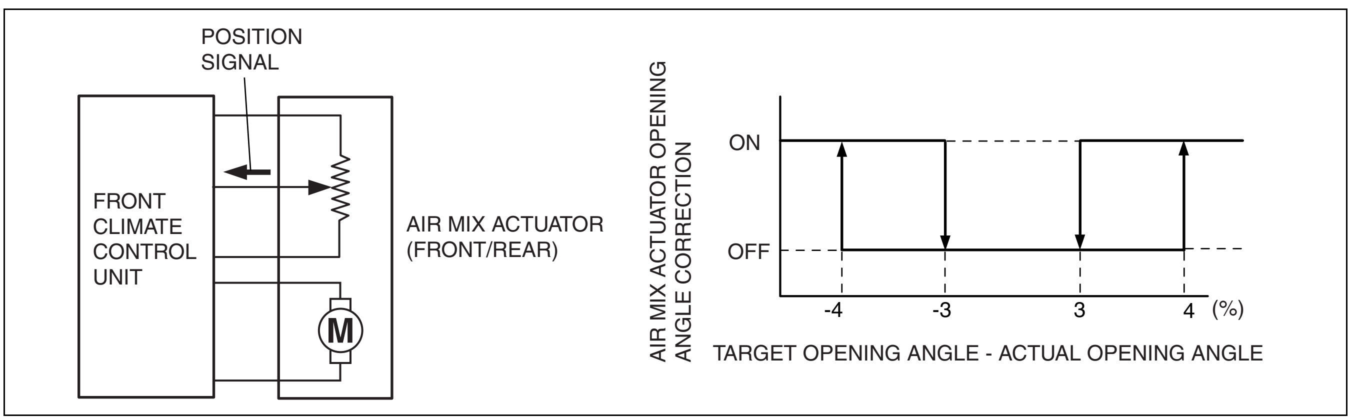
Correction

MAX HOT and MAX COLD correction

- When the temperature is set to **32.0**, the air mix actuator (front/rear) opening angle is fixed at fully open and when set to **15.0**, it is fixed at fully closed.

Air mix actuator opening angle correction

- The climate control unit maintains the actuator at the opening angle calculated based on the position signal from the potentiometer inside the air mix actuator (front/rear).



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AIRFLOW VOLUME CONTROL OUTLINE

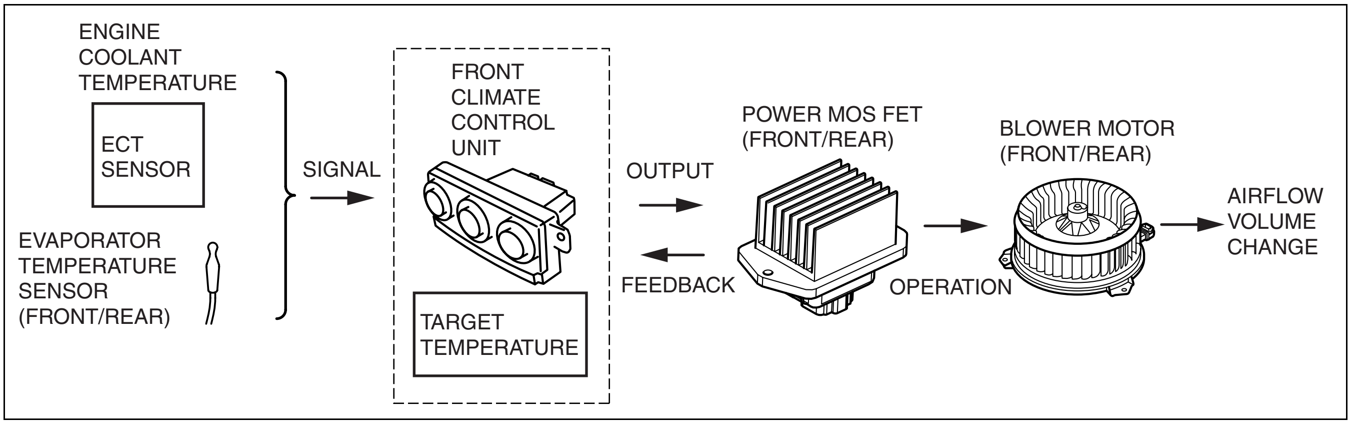
id074000102400

Features

- Consists of the airflow volume automatic and manual controls with the front climate control unit controlling the airflow volume (blower motor applied voltage) via the front power MOS FET or rear power MOS FET.

AIRFLOW VOLUME CONTROL SYSTEM DIAGRAM

id074000102500



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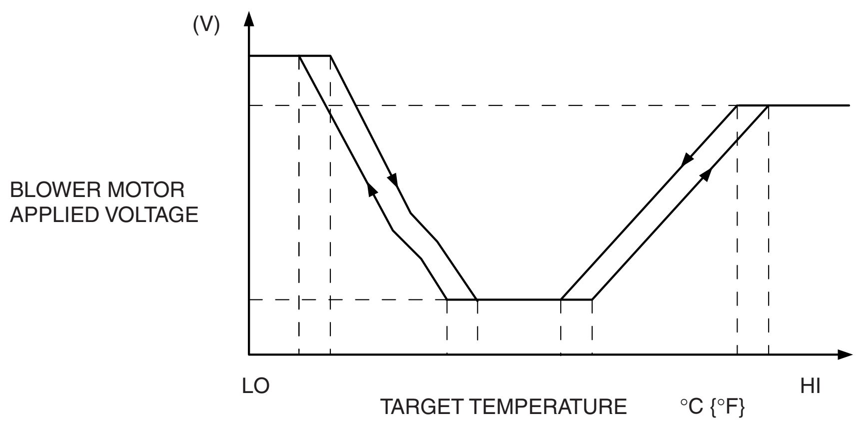
AIRFLOW VOLUME CONTROL OPERATION

id074000102600

Airflow Volume Automatic Control

- The front climate control unit calculates the applied voltage to the blower motor based on the input from the target temperature, ECT sensor and evaporator temperature sensor (front/rear), and outputs the drive signal to the power MOS FET (front/rear). However, the warm-up correction, mild start correction, MAX HOT and MAX COLD correction and defroster correction take precedence under the operation conditions of the warm-up correction, mild start correction, MAX HOT and MAX COLD correction and defroster correction.



am8rrn00000275

- Switches the front blower motor applied voltage in 31 steps when the front power MOS FET is on. The front blower motor applied voltage is as follows:

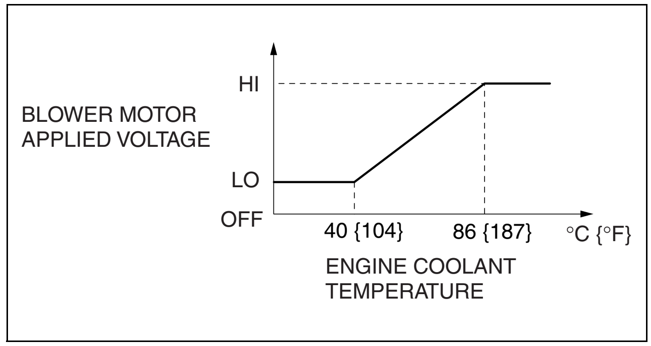
Fan level	Front blower motor applied voltage
1	3.41 V
2	3.73 V
3	4.05 V
4	4.37 V
5	4.69 V
6	5.01 V
7	5.33 V
8	5.65 V
9	5.97 V
10	6.29 V
11	6.61 V
12	6.93 V
13	7.25 V
14	7.57 V
15	7.89 V
16	8.21 V

Fan level	Front blower motor applied voltage
17	8.53 V
18	8.85 V
19	9.17 V
20	9.49 V
21	9.81 V
22	10.13 V
23	10.45 V
24	10.77 V
25	11.09 V
26	11.41 V
27	11.73 V
28	12.05 V
29	12.37 V
30	12.69 V
31 (MAX HI)	V_B

07-40

Correction

Warm-up correction

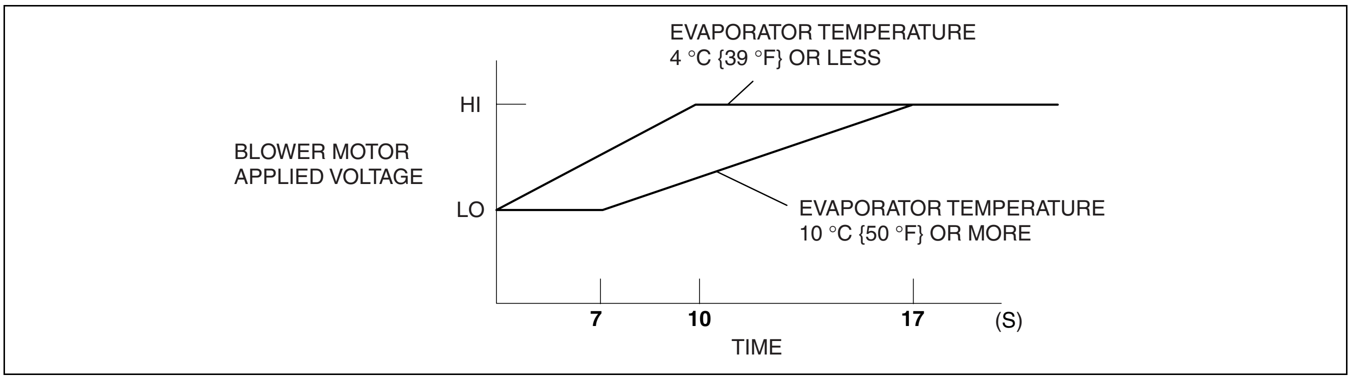


ac9uun00000238

- 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 when the target temperature is low, and the airflow mode is in any mode other than VENT mode.

Mild start correction

- Limits blower motor applied voltage (front/rear) for **17 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 airflow is in any mode other than VENT or BI-LEVEL, A/C mode is OFF, or temperature of air passing through evaporator is low.



ac9uun00000239

MAX HOT and MAX COLD correction

- When the set temperature is at **32.0**, the blower motor applied voltage (front/rear) is fixed at AUTO-HI, and when the set temperature is at **15.0**, the blower motor applied voltage (front/rear) is fixed at MAX-HI. However, MAX HOT correction is not performed during warm-up correction.

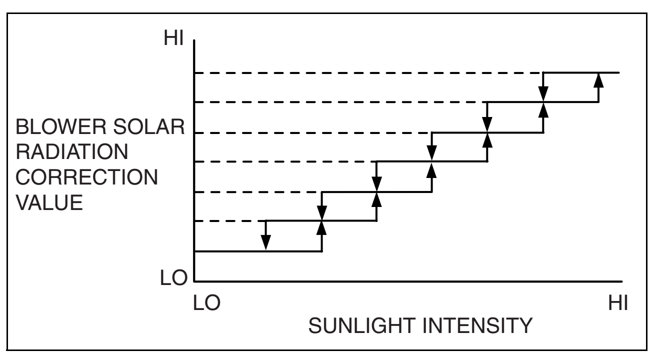
Correction name	Set temperature	Front blower motor applied voltage	Rear blower motor applied voltage
MAX HOT correction	32.0	AUTO-HI	AUTO-HI
MAX COLD correction	15.0	MAX-HI	MAX-HI

Defroster correction

- To improve defrosting of the windows, a correction (**+2 V**) is added to the front blower motor applied voltage when the defroster switch is turned on.

Solar radiation correction

- When the airflow mode is in VENT or BI-LEVEL, a correction is added to the airflow volume according to the amount of solar radiation.



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Airflow Volume Manual Control

- The blower motor applied voltage (airflow volume) can be switched in seven (front) / fifteen (rear) steps with the fan switch.

Front

Fan switch	Blower motor applied voltage
1st	3.41 V
2nd	5.01 V
3rd	6.61 V
4th	8.21 V
5th	9.81 V
6th	11.41 V
7th	V_B

Rear

Fan switch	Blower motor applied voltage
1st	3.41 V
2nd	3.88 V
3rd	4.35 V
4th	4.82 V
5th	5.29 V
6th	5.76 V
7th	6.23 V
8th	6.70 V
9th	7.17 V
10th	7.64 V
11th	8.11 V
12th	8.58 V
13th	9.05 V
14th	9.52 V
15th	10.0 V

AIRFLOW MODE CONTROL OUTLINE

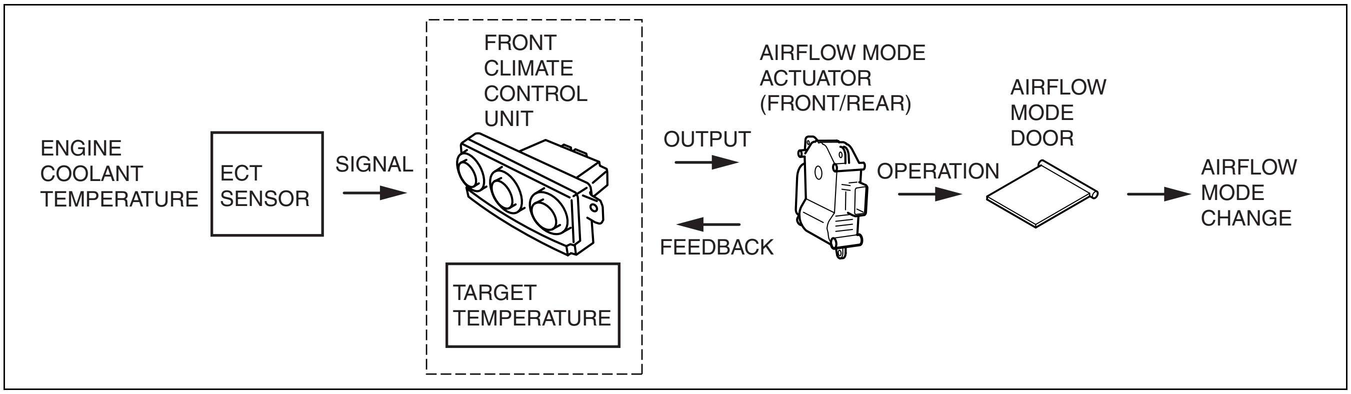
id074000102700

Features

- Consists of the airflow mode automatic and manual controls with the front climate control unit controlling the airflow mode via the front airflow mode actuator or rear airflow mode actuator.

AIRFLOW MODE CONTROL SYSTEM DIAGRAM

id074000102800



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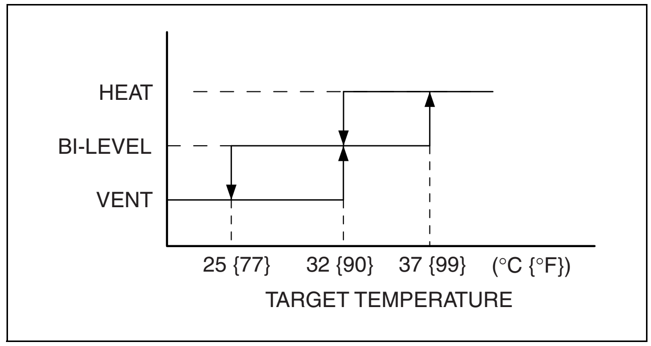
AIRFLOW MODE CONTROL OPERATION

id074000102900

Airflow Mode Automatic Control

Front

- The front climate control unit determines the front mode actuator opening angle based on the target temperature.



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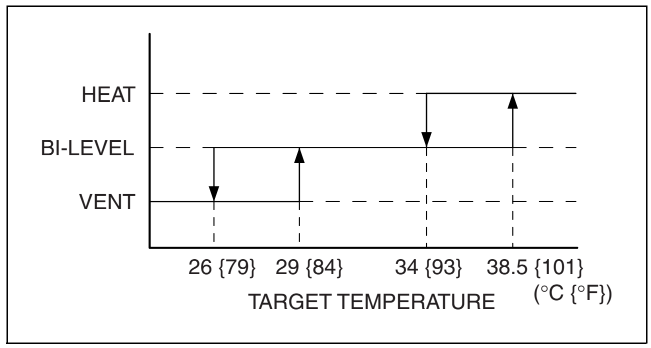
Rear

- When the rear control switch is off, the rear airflow mode control determines the rear mode actuator opening angle using the target temperature for the rear which is calculated by the front climate control unit based on the set temperature which has been set using the driver-side temperature setting dial.
- When the rear control switch is on, the rear airflow mode control determines the rear mode actuator opening angle using the rear target temperature which is calculated by the front climate control unit based on the set temperature which has been set using the rear temperature setting dial.



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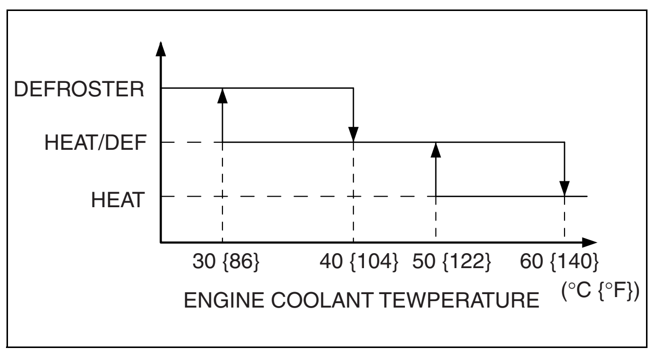
Correction

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.



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MAX HOT and MAX COLD correction

Front

- When the set temperature is at **32.0 or 15.0**, the airflow mode is set as shown in the table.

TEMPERATURE CONTROL DIAL		AIRFLOW MODE
DRIVER SIDE	PASSENGER SIDE	
15.0	15.0	VENT
15.0	EXCEPT 15.0, 32.0	VENT
EXCEPT 15.0, 32.0	15.0	VENT
15.0	32.0	BI-LEVEL
32.0	15.0	BI-LEVEL
32.0	EXCEPT 15.0, 32.0	HEAT
EXCEPT 15.0, 32.0	32.0	HEAT
32.0	32.0	HEAT

Rear

- The airflow mode is fixed in heat with the set temperature of **32.0** (MAX HOT), and in vent with **15.0** (MAX COLD).

Airflow Mode Manual Control

- The airflow modes can be switched by operating the airflow mode selector switch and the front defroster switch.

FRONT	VENT, BI-LEVEL, HEAT, HEAT/DEF, DEFROSTER

AIR INTAKE CONTROL OUTLINE

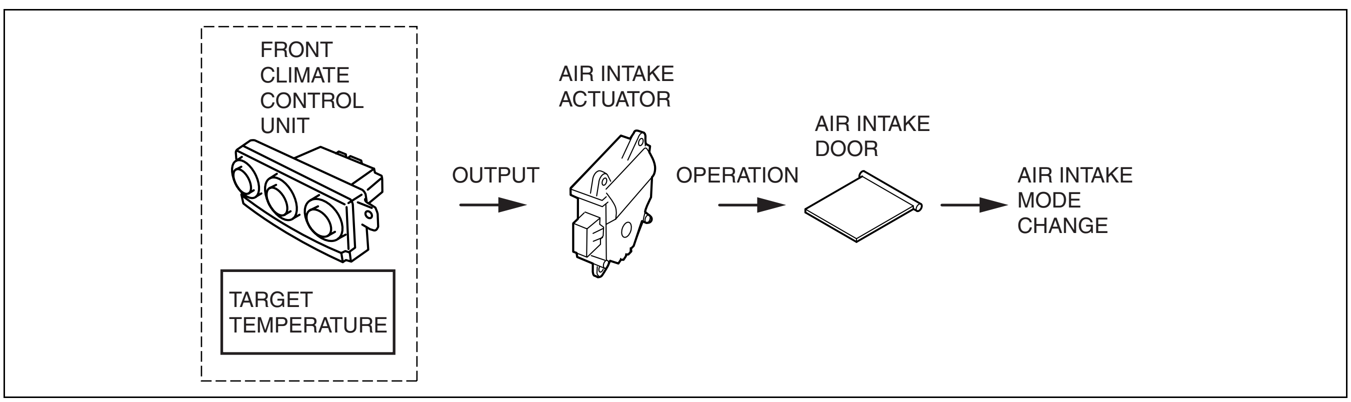
id074000103300

Features

- Consists of the air intake automatic and manual controls with the front climate control unit controlling the air intake mode via the air intake actuator.

AIR INTAKE CONTROL SYSTEM DIAGRAM

id074000103400



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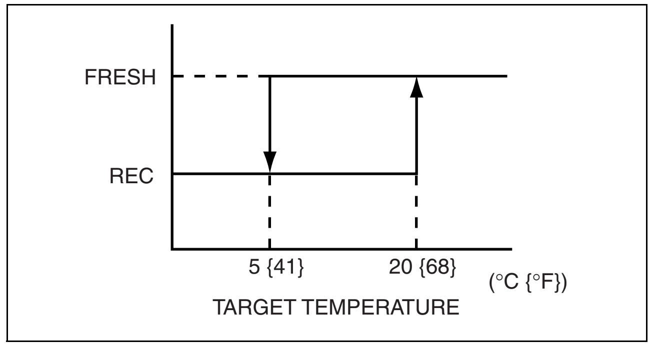
AIR INTAKE CONTROL OPERATION

id074000103500

Air Intake Automatic Control

- The front climate control unit calculates the air intake actuator opening angle (air intake mode) based on the target temperature operating the actuator.



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Correction

MAX HOT and MAX COLD correction

- When the set temperature is at **32.0 or 15.0**, the air intake is set as shown in the table.

TEMPERATURE CONTROL DIAL		AIR INTAKE MODE
DRIVER SIDE	PASSENGER SIDE	
15.0	15.0	REC
15.0	EXCEPT 15.0, 32.0	REC
EXCEPT 15.0, 32.0	15.0	REC
32.0	EXCEPT 15.0, 32.0	FRESH
EXCEPT 15.0, 32.0	32.0	FRESH
15.0	32.0	FRESH
32.0	15.0	FRESH
32.0	32.0	FRESH

Defroster correction

- When the defroster switch is turned on or the airflow mode is switched to HEAT/DEF or HEAT mode, the air intake mode switches to fresh air to improve defrosting. If the air intake mode is switched to fresh air when the airflow mode is in HEAT mode, the air intake can be switched to recirculate manually.

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

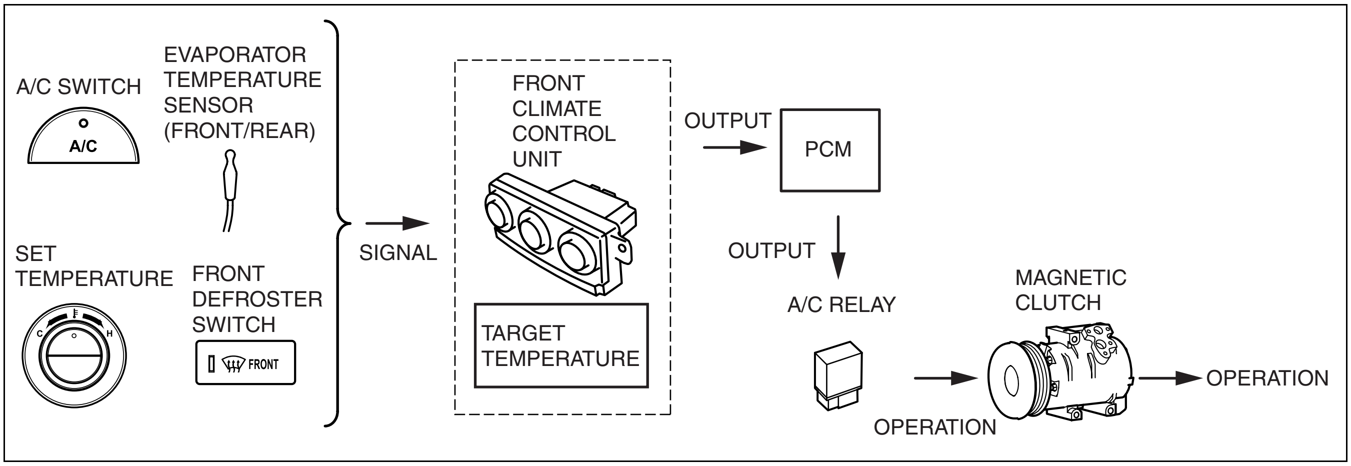
id074000103000

Features

- Consists of the A/C compressor automatic and manual controls with the front climate control unit outputting the A/C signal to the PCM to control the A/C compressor.

A/C COMPRESSOR CONTROL SYSTEM DIAGRAM

id074000103100



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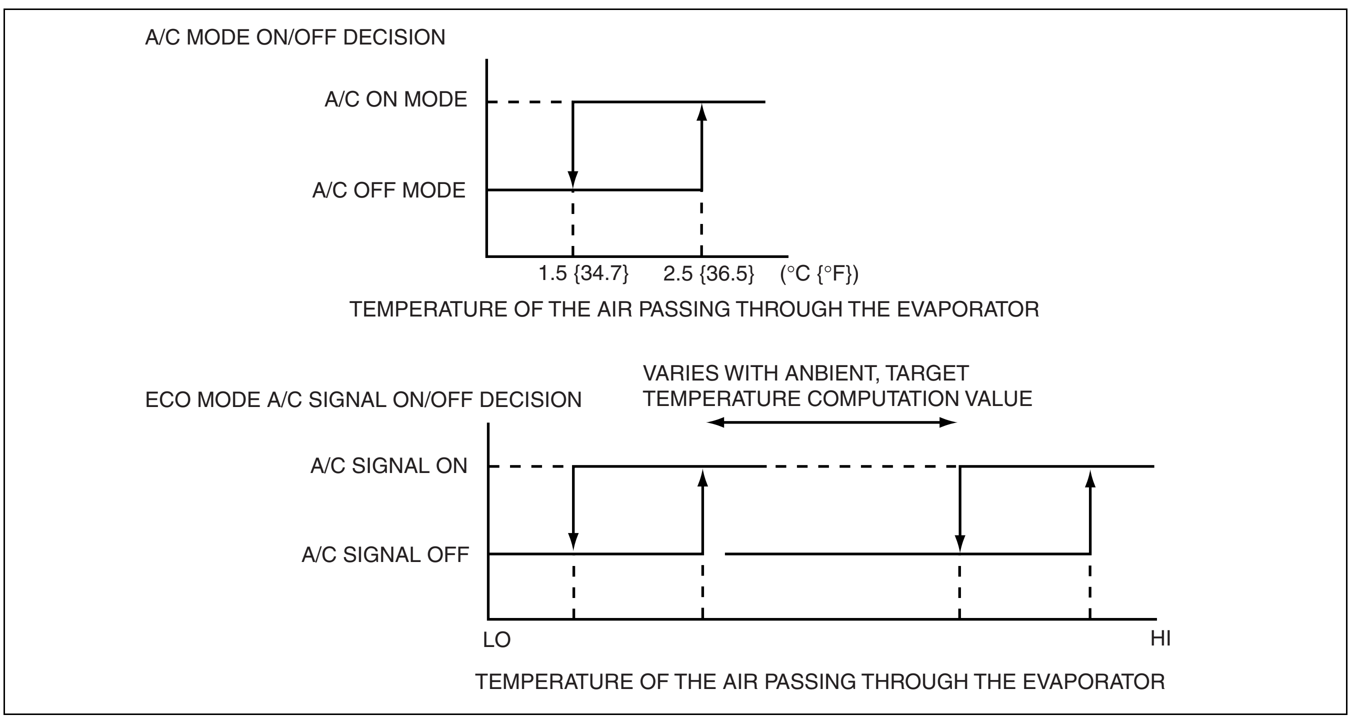
A/C COMPRESSOR CONTROL OPERATION

id074000103200

A/C Compressor Automatic Control

- The front climate control unit switches modes between the A/C mode and ECO mode based on the input signal from evaporator temperature sensor and ambient temperature sensor.
- In A/C mode, the A/C signal (magnetic clutch) is turned on/off according to the temperature of the air passing through the evaporator. The temperature of the air passing through the evaporator at which the A/C signal turns off is determined by the ambient temperature calculation value that is calculated based on the ambient temperature, target temperature. By setting the A/C signal off temperature low when strong cooling performance is needed, such as when the ambient temperature is high, and setting it high in other conditions, cooling comfort and fuel economy during A/C operation are improved.



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Correction

Defroster correction

- When the defroster switch is turned on or the airflow mode is switched to HEAT/DEF or HEAT mode, the system is fixed in A/C mode to improve defrosting.

MAX COLD correction

- When the set temperature is at **32.0 or 15.0**, the A/C operation mode set as shown in the table.

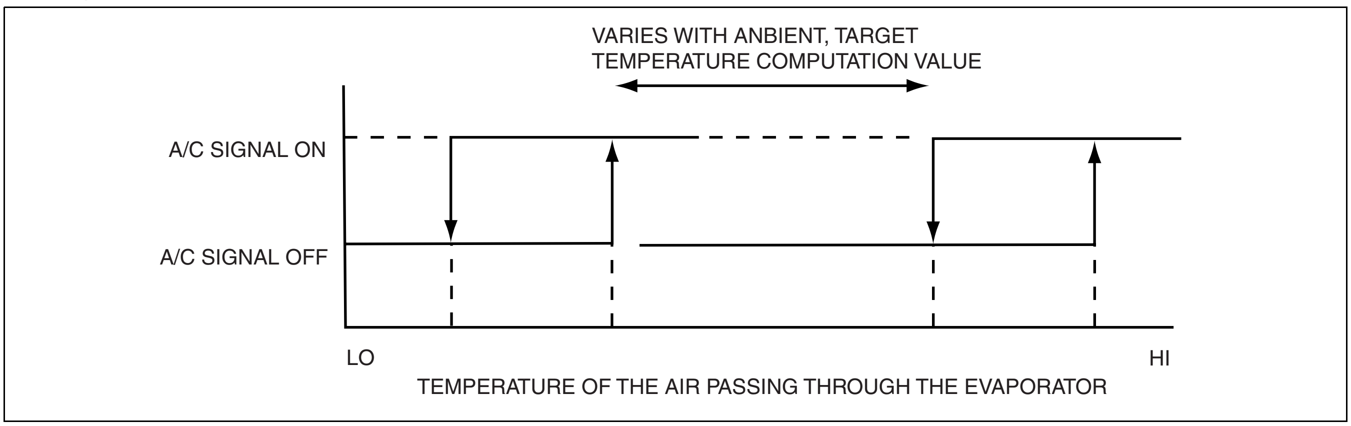
TEMPERATURE CONTROL DIAL		OPERATION MODE
DRIVER SIDE	PASSENGER SIDE	
15.0	15.0	A/C MODE
15.0	EXCEPT 15.0, 32.0	A/C MODE
EXCEPT 15.0, 32.0	15.0	A/C MODE
15.0	32.0	A/C MODE
32.0	15.0	A/C MODE
32.0	EXCEPT 15.0, 32.0	ECO MODE
EXCEPT 15.0, 32.0	32.0	ECO MODE
32.0	32.0	OFF

A/C Compressor Manual Control

- A/C ON (ECO mode) or OFF mode is selected by operating the A/C switch.

A/C mode		Operation condition
A/C ON mode	ECO mode (A/C display)	Fixed in ECO mode.
A/C OFF mode (No display)		Fixed in A/C OFF mode.

A/C signal ON/OFF determination in A/C ON (ECO mode)



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RESTRAINTS

08
SECTION

08-00 OUTLINE

RESTRAINTS ABBREVIATIONS

id080000100100

ALR	Automatic Locking Retractor
CAN	Controller Area Network
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
ELR	Emergency Locking Retractor
GND	Ground
IG	Ignition
LED	Light Emitting Diode
LH	Left Hand
PAD	Passenger Air Bag Deactivation
PID	Parameter Identification
RH	Right Hand
SAS	Sophisticated Air Bag Sensor
SST	Special Service Tool

RESTRAINTS FEATURES

id080000100200

Improved safety	• A two-step deployment control has been adopted to the front air bag system (driver and passenger side) deployment control. • A curtain air bag module has been adopted. • A side air bag module has been adopted. • A pre-tensioner seat belt has been adopted. • A rollover control has been adopted. • Three-point seat belt with the following functions for front seat passengers adopted — ELR (Emergency Locking Retractor: emergency locking mechanism) — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism) (passenger side only) — Pre-tensioner seat belt (See 08-10-18 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 operation • Three-point seat belt with the following functions for second-row seat passengers adopted — ELR — ALR (left and right side only) • Three-point seat belt with the following functions for third-row seat passengers adopted — ELR

08-02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC FUNCTION OUTLINE

id080200100100

- 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 Mazda Modular Diagnostic System (M-MDS), 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

id080200100500

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.

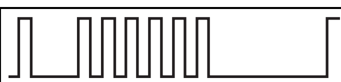
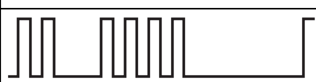
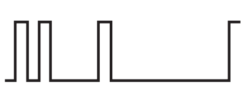
Memory function

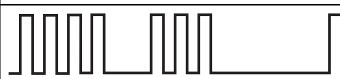
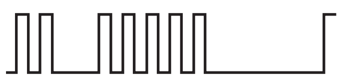
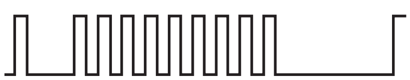
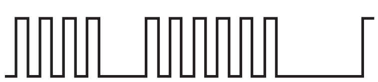
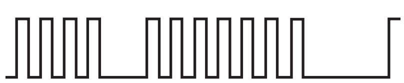
- Stores malfunctions in the air bag system-related parts detected by the malfunction detection function, and the stored malfunction contents are not cleared even if the ignition switch is turned to the LOCK position or the negative battery cable is disconnection.

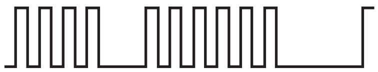
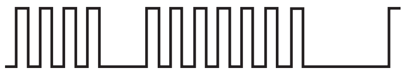
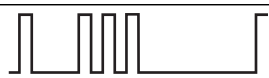
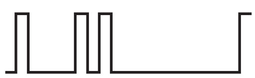
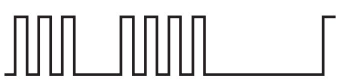
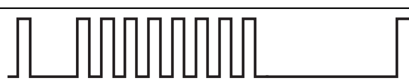
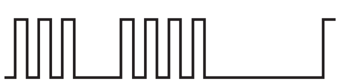
Display function

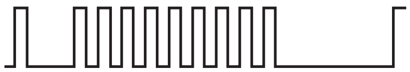
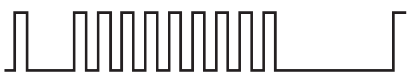
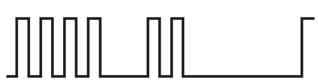
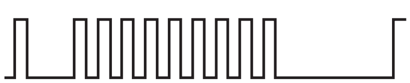
- When the malfunction detection function detects a malfunction, the air bag system warning light illuminates to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the K-Line.

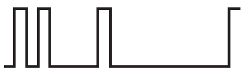
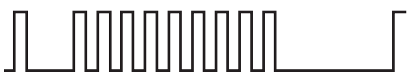
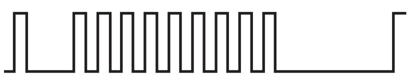
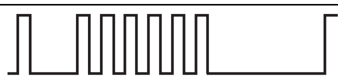
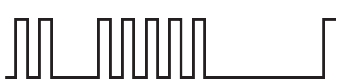
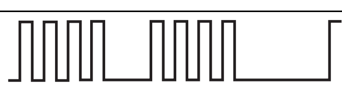
DTC table

DTC				System malfunction location
Mazda Modular Diagnostic System (M-MDS) display	Air bag system warning light			
	Flashing pattern		Prior ity ranki ng	
B1013	16		20	Seat weight sensor calibration error
B1046	24		19	Driver-side curtain air bag module and other air bag module circuits short
B1047	22		17	Driver-side side air bag module and other air bag module circuits short
B1048	21		12	Passenger-side air bag module (inflator No.1) and other air bag module circuits short

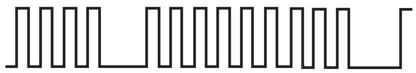
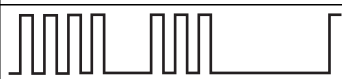
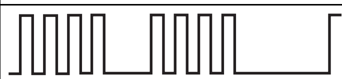
DTC				
Mazda Modular Diagnostic System (M-MDS) display	Air bag system warning light			System malfunction location
	Flashing pattern		Priority ranking	
B1049	34		14	Passenger-side pre-tensioner seat belt and other air bag module circuits short
B104B	43		8	Driver-side side air bag sensor No. 1 and other sensor circuits short to power supply
B104C	44		7	Passenger-side side air bag sensor No.1 and other sensor circuits short to power supply
B104D	42		11	Crash zone sensor and other sensor circuits short to power supply
B104E	43		8	Driver-side side air bag sensor No.1 circuit open or short
B104F	44		7	Passenger-side side air bag sensor No.1 (internal circuit abnormal)
B1050				Passenger-side side air bag sensor No.1 circuit open or short
B1051	43		8	Driver-side side air bag sensor No.1 (internal circuit abnormal)
B1054	33		15	Driver-side pre-tensioner seat belt and other air bag module circuits short
B1055	23		16	Passenger-side side air bag module and other air bag module circuits short
B1056	25		18	Passenger-side curtain air bag module and other air bag module circuits short
B1057	19		13	Driver-side air bag module (inflator No.1) and other air bag module circuits short
B1058				Driver-side air bag module (inflator No.2) and other air bag module circuits short
B1059	21		12	Passenger-side air bag module (inflator No.2) and other air bag module circuits short
B105A	-	Continuously illuminated	1	SAS control module activation (deployment) control frequency error
B105B	46		10	Driver-side side air bag sensor No. 2 and other sensor circuits short to power supply
B105F	47		9	Passenger-side side air bag sensor No. 2 and other sensor circuits short to power supply
B110C	46		10	Driver-side side air bag sensor No. 2 circuit open or short

DTC				
Mazda Modular Diagnostic System (M-MDS) display	Air bag system warning light			System malfunction location
	Flashing pattern		Priority ranking	
B110D	47		9	Passenger-side side air bag sensor No. 2 circuit open or short
B110E	46		10	Driver-side side air bag sensor No. 2 assembly incorrect
B110F	47		9	Passenger-side side air bag sensor No. 2 assembly incorrect
B1144	46		10	Driver-side side air bag sensor No. 2 (internal circuit abnormal)
B1145				Driver-side side air bag sensor No. 2 (communication error)
B1146	47		9	Passenger-side side air bag sensor No. 2 (internal circuit abnormal)
B1147				Passenger-side side air bag sensor No. 2 (communication error)
B1231	13		3	SAS control module activation (deployment) control freeze
B1317	-	Continuously illuminated	1	SAS control module power supply voltage increases (16.1 V or more)
B1318				SAS control module power supply voltage decreases (less than 8 V)
B1342	12		2	SAS control module (internal circuit abnormal)
	-	Continuously illuminated	1	
B1868	-	-	1	Air bag system warning light malfunction
B1877	33		15	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		14	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		21	Passenger air bag deactivation (PAD) indicator circuit open or short to body ground
B1885	33		15	Driver-side pre-tensioner seat belt circuit resistance low
B1886	34		14	Passenger-side pre-tensioner seat belt circuit resistance low

DTC				
Mazda Modular Diagnostic System (M-MDS) display	Air bag system warning light			System malfunction location
	Flashing pattern		Priority ranking	
B1890	18		21	Passenger air bag deactivation (PAD) indicator circuit short to power supply
B1916	19		13	Driver-side air bag module (inflator No.1) circuit short to power supply
B1921	-	Continuously illuminated	1	Air bag diagnostic monitor ground circuit open
B1925	21		12	Passenger-side air bag module (inflator No.1) circuit short to power supply
B1932	19		13	Driver-side air bag module (inflator No.1) circuit resistance high
B1933	21		12	Passenger-side air bag module (inflator No.1) circuit resistance high
B1934	19		13	Driver-side air bag module (inflator No.1) circuit resistance low
B1935	21		12	Passenger-side air bag module (inflator No.1) circuit resistance low
B1936	19		13	Driver-side air bag module (inflator No.1) circuit short to body ground
B1938	21		12	Passenger-side air bag module (inflator No.1) circuit short to body ground
B1992	22		17	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		16	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		11	Crash zone sensor (internal circuit abnormal)
B2227				Crash zone sensor (communication error)
B2228	19		13	Driver-side air bag module (inflator No.2) circuit short to body ground

DTC				System malfunction location
Mazda Modular Diagnostic System (M-MDS) display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B2229	21		12	Passenger-side air bag module (inflator No.2) circuit short to body ground
B2230	19		13	Driver-side air bag module (inflator No.2) circuit short to power supply
B2231	21		12	Passenger-side air bag module (inflator No.2) circuit short to power supply
B2232	19		13	Driver-side air bag module (inflator No.2) circuit resistance high
B2233	21		12	Passenger-side air bag module (inflator No.2) circuit resistance high
B2234	19		13	Driver-side air bag module (inflator No.2) circuit resistance low
B2235	21		12	Passenger-side air bag module (inflator No.2) circuit resistance low
B2290	16		20	Seat weight sensor signal malfunction
B2477	54		6	Configuration error
B2773	24		19	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		18	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
B2855	42		11	Crash zone sensor circuit short
B2856				Crash zone sensor system communication data error
B2886	44		7	Passenger-side side air bag sensor No. 1 assembly incorrect

08-02

DTC				System malfunction location
Mazda Modular Diagnostic System (M-MDS) display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B2887	43		8	Driver-side side air bag sensor No. 1 assembly incorrect
C1946	49		22	Seat track position sensor circuit open
C1947				Seat track position sensor circuit short to body ground
C1948				Seat track position sensor circuit resistance not within specification
C1981				Seat track position sensor circuit malfunction
C1982				Seat track position sensor circuit short to power supply
U2017	43		8	Driver-side side air bag sensor No. 1 (communication error)
U2018	44		7	Passenger-side side air bag sensor No. 1 (communication error)
U0073	14		4	CAN system communication error
U0100	-	-	1	Communication error to PCM
U0155				Communication error to instrument cluster

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 Mazda Modular Diagnostic System (M-MDS) is used to read out PID/data monitor information.

PID/data monitor table

PID name (definition)	Operation Condition (Reference)	Unit/Condition	Terminal
BUCKLE_D	Driver-side buckle switch status	Unbuckled/Buckled	2W
BUCKLE_P	Passenger-side buckle switch status	Unbuckled/Buckled	2C
CCNT_RCM	Number of continuous DTCs	—	—
CRSH_RC	Number of detected collisions	—	—
DTC_CLR_ST*1	OCS DTC cleared state	Starting/Normal End/ In Process/OCS Fault	2AJ
IGN_V	IG1 voltage	V	1D
OCS_CAL_ST*2	Seat weight sensor calibration status	Starting/Normal End/ Commanding/NG (Voltage)/ NG (Weight)/Timeout/ In Process/OCS Fault	2AJ
OCS_SYS_ST*1	Seat weight sensor status	Empty/SMALL/ Indeterminate/LARGE/ Invalid	2AJ
OCSFLT_CAL	Passenger sensing system calibration status	OK/FAULT	2AJ
OCSFLT_COM	Passenger sensing system communication status	OK/FAULT	2AJ
OCSFLT_L	Passenger sensing system (LH) malfunction status	OK/FAULT	2AJ
OCSFLT_MDL	Passenger sensing system control module malfunction status	OK/FAULT	2AJ
OCSFLT_R	Passenger sensing system (RH) malfunction status	OK/FAULT	2AJ
PS_WEIGHT	Seat weight sensor measured weight of passenger	kg	2AJ
PSAB_DepSt	Passenger-side air bag module deployment status	Inactive/Active	2AJ
RES_AB_D	Driver-side air bag module (inflator No.1) resistance	ohm	1I, 1M
RES_AB_P	Passenger-side air bag module (inflator No.1) resistance	ohm	1J, 1N
RES_AB2_D	Driver-side air bag module (inflator No.2) resistance	ohm	1Q, 1U
RES_AB2_P	Passenger-side air bag module (inflator No.2) resistance	ohm	1R, 1V
RES_CAB_D	Driver-side curtain air bag module resistance	ohm	2AG, 2AK
RES_CAB_P	Passenger-side curtain air bag module resistance	ohm	2AH, 2AL
RES_PT_D	Driver-side pre-tensioner seat belt resistance	ohm	2N, 2J
RES_PT_P	Passenger-side pre-tensioner seat belt resistance	ohm	2A, 2E
RES_SAB_D	Driver-side side air bag module resistance	ohm	2B, 2F
RES_SAB_P	Passenger-side side air bag module resistance	ohm	2I, 2M
TRAK_SW	Seat track position sensor state	Forward/Rearward	2AB, 2AF

*1 : Used during seat weight sensor calibration setting. Not necessary for diagnostic.

*2 : When the calibration error is displayed, the error can be cleared by turning the ignition switch to the LOCK position.

08-10 AIR BAG SYSTEM

AIR BAG SYSTEM OUTLINE

id081000100100

- 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. • A rollover control has been adopted which operates (deploys) the curtain air bag module and pre-tensioner seat belts during a vehicle rollover. • Recognizes actually equipped air bag module or pre-tensioner seat belt 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 seat belt deployment operation. (See 08-10-6 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 passenger of the deployment standby status of the passenger-side air bag module, passenger-side side air bag module, and passenger-side pre-tensioner seat belt.
Air bag system warning light	• LED has been adopted.
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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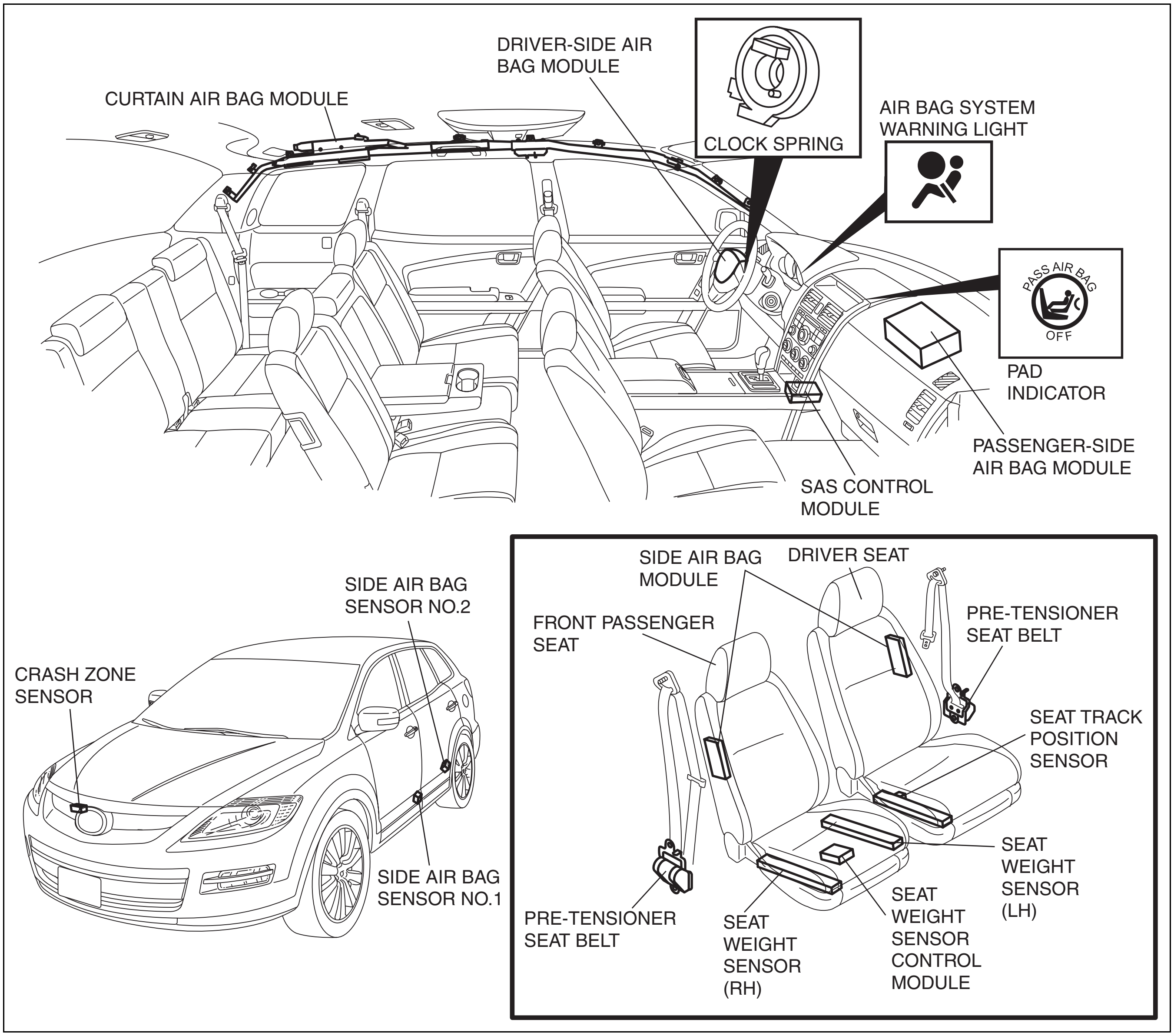

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AIR BAG SYSTEM WIRING DIAGRAM

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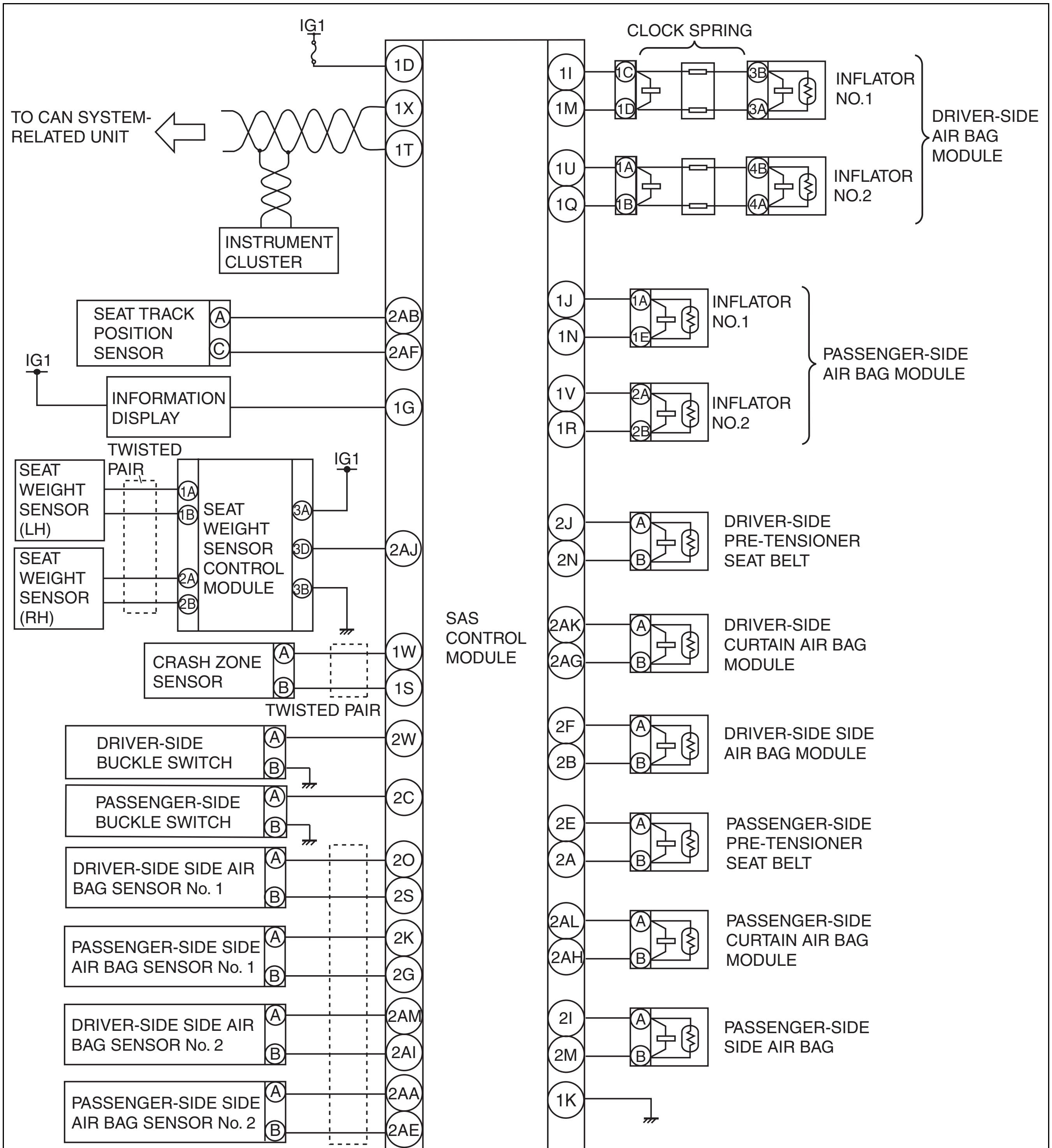

2AK	2AG	2AC	2Y	2U	2Q	2M	2I	2E	2A
2AL	2AH	2AD	2Z	2V	2R	2N	2J	2F	2B
2AM	2AI	2AE	2AA	2W	2S	2O	2K	2G	2C
2AN	2AJ	2AF	2AB	2X	2T	2P	2L	2H	2D

1U	1Q	1M	1I	1E	1A
1V	1R	1N	1J	1F	1B
1W	1S	1O	1K	1G	1C
1X	1T	1P	1L	1H	1D

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SAS CONTROL MODULE FUNCTION

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Sensing Function

- crash, angular rate, and low-G sensors are built into the SAS control module.
- If the degree of impact detected by the crash zone sensor and the crash sensor built into the SAS control module exceeds the set value during a frontal collision to the vehicle, the SAS control module sends an operation (deployment) signal to the air bag module and the pre-tensioner seat belts.
- If the degree of impact detected by side air bag sensor No. 1 or No. 2 and the crash sensor built into the SAS control module exceeds the set value during a side collision to the vehicle, the SAS control module sends an operation (deployment) signal to the side air bag module and curtain air bag module.
- During vehicle rollover, the rollover determination is performed based on the results detected by the angular rate and low-G sensors built into the SAS control module.

Backup Power Supply Function

- The backup power supply function enables the condenser to discharge and supply power to assure air bag system operation/deployment properly for a specified time even if the power supply to the SAS control module is cut due to a collision.

Configuration Function

- Identifies the variation of the air bag module installed to the vehicle when replacing the SAS control module with a new one.
- If the air bag module installed to the vehicle and the module identified by the SAS control module differ, a DTC is displayed.
- Refer to the Workshop Manual for the configuration setting procedure.

SAS CONTROL MODULE CONSTRUCTION/OPERATION

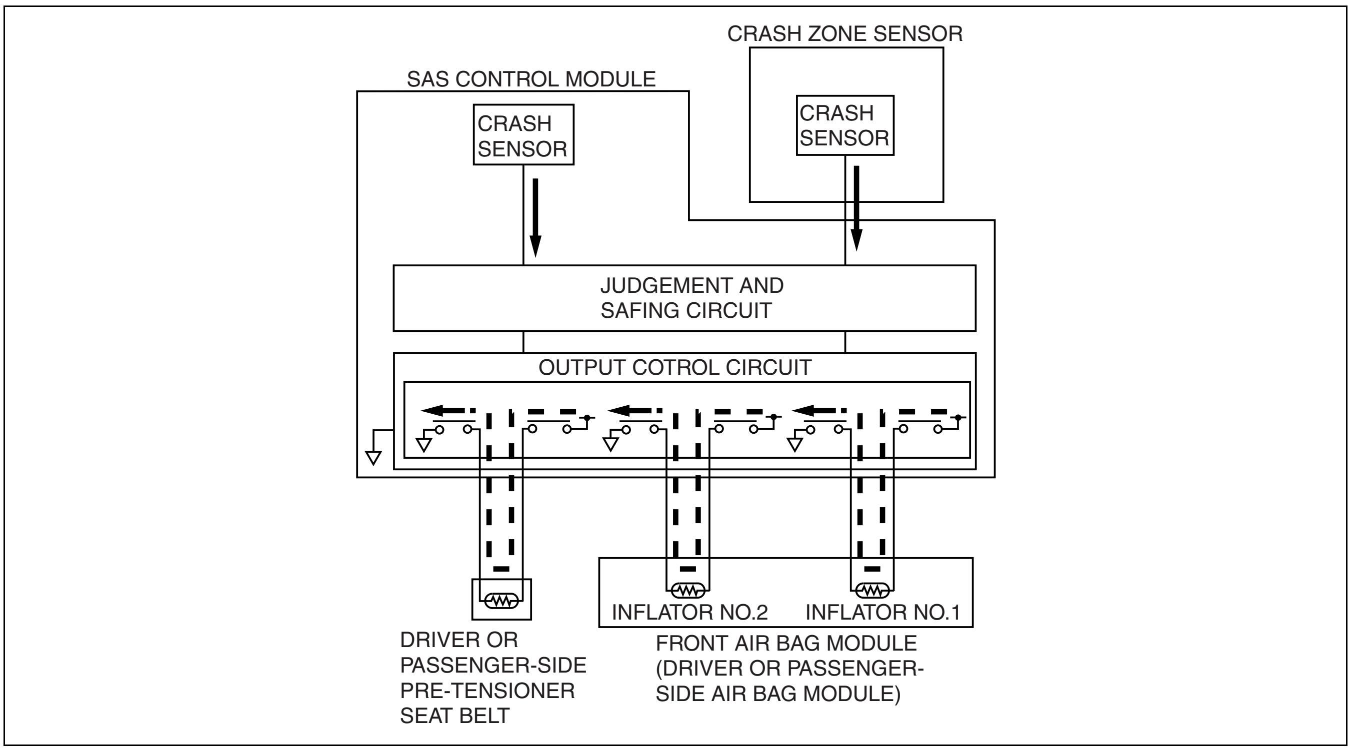
id081000101100

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.



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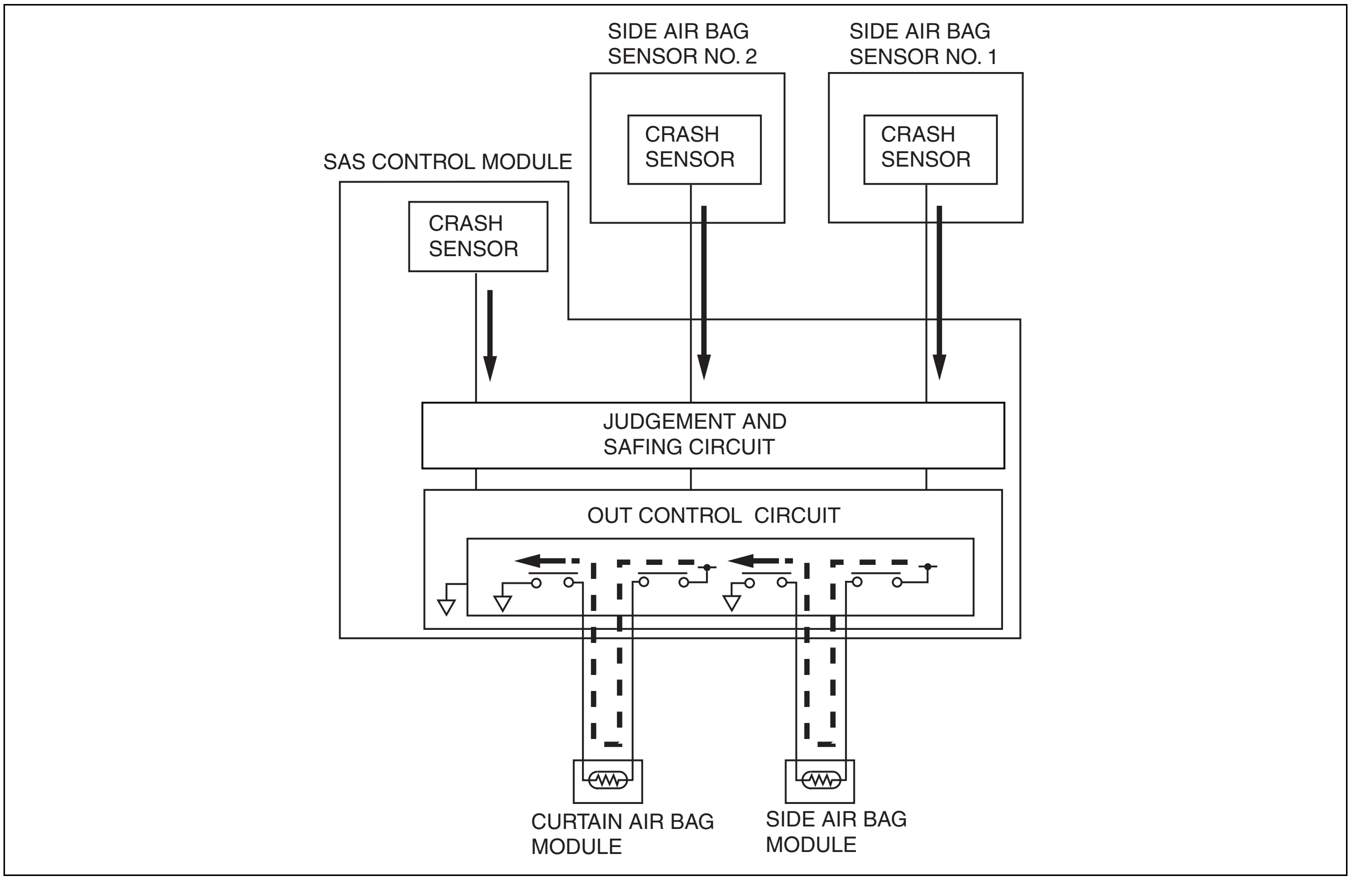
Side Air Bag System

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 three 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.



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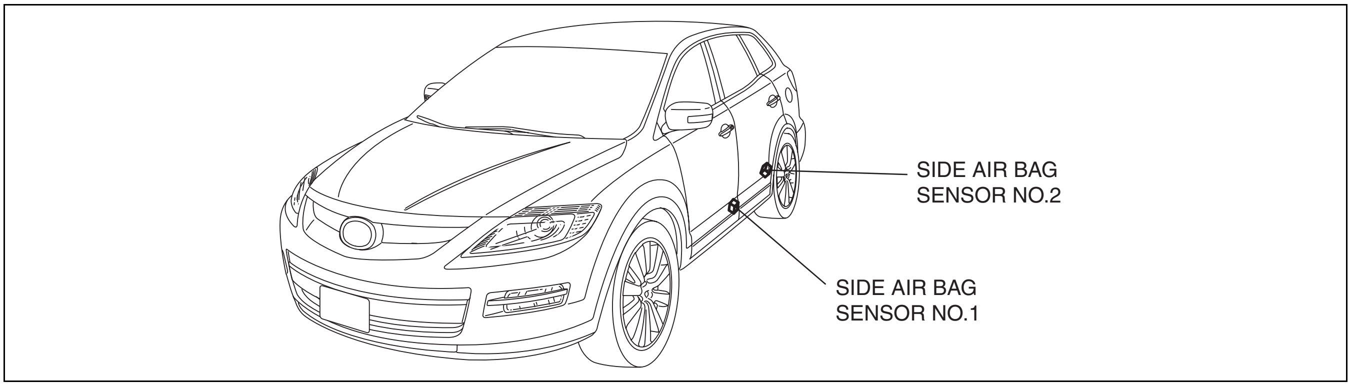
Side Air Bag Sensor System

- 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)



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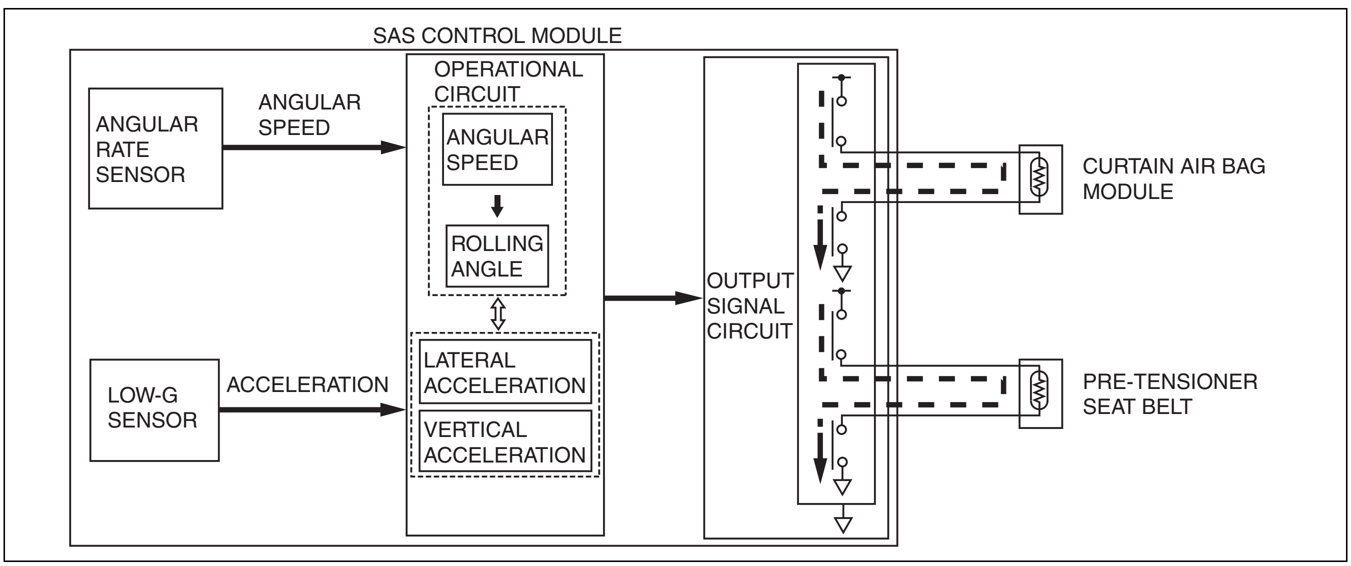
08-10

Rollover Control

1. When the vehicle starts to rollover, the angular rate sensor in the SAS control module detects the vehicle rolling angle speed, and the low-G sensor in the SAS control module detects lateral and vertical accelerations.
2. When the angular speed detected by the angular rate sensor exceeds the specification, an initial rollover condition is determined and the operational circuit calculates the rolling angle based on the angular speed detected by the angular rate sensor.
3. When the rollover control operation conditions of angular speed and rolling angle are met and the vehicle is determined to be in a rollover condition based on the acceleration detected by the low-G sensor, an electronic signal is output to the output signal circuit.
4. The output signal circuit completes an ignition circuit, and an operation (deployment) signal is sent to the air bag module and pre-tensioner seat belts indicated in the table below.

×:Possible
-:Not possible

Position	Determined result	Front seat belt	Front air bag module operation (deployment)	Side air bag module operation (deployment)	Curtain air bag module operation (deployment)	Pre-tensioner seat belt operation (deployment)
Driver side	-	Fastened	-	-	×	×
		Unfastened	-	-	×	×
Passenger side	Adult	Fastened	-	-	×	×
		Unfastened	-	-	×	×
	Child (including child-restraint seat)	Fastened	-	-	×	-
		Unfastened	-	-	×	-
	Empty	Fastened	-	-	×	-
		Unfastened	-	-	×	-



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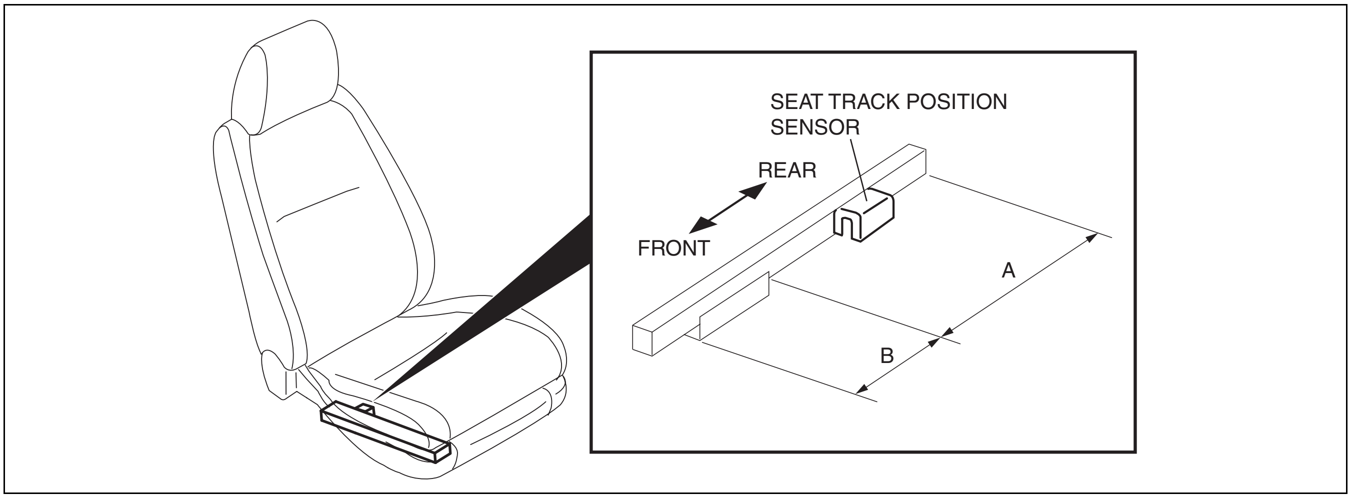
Seat Position Matching Deployment Control

- 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	Driver-side 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



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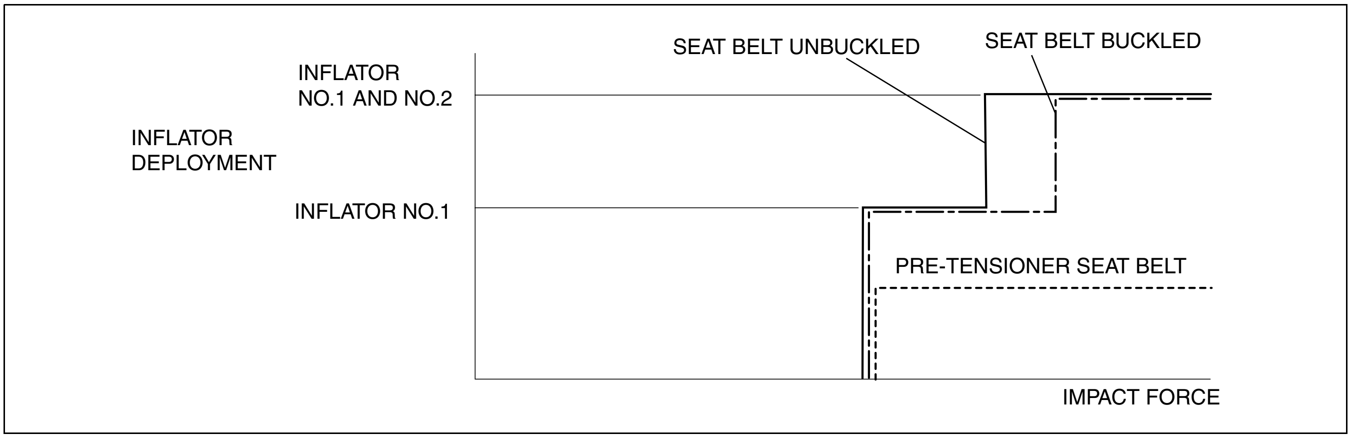
Seat Belt Buckled/Unbuckled Condition Matching (Deployment) Control

- 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). 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) of the air bag modules, the corresponding air bag will deploy if either one of the front seat belts is unbuckled.



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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

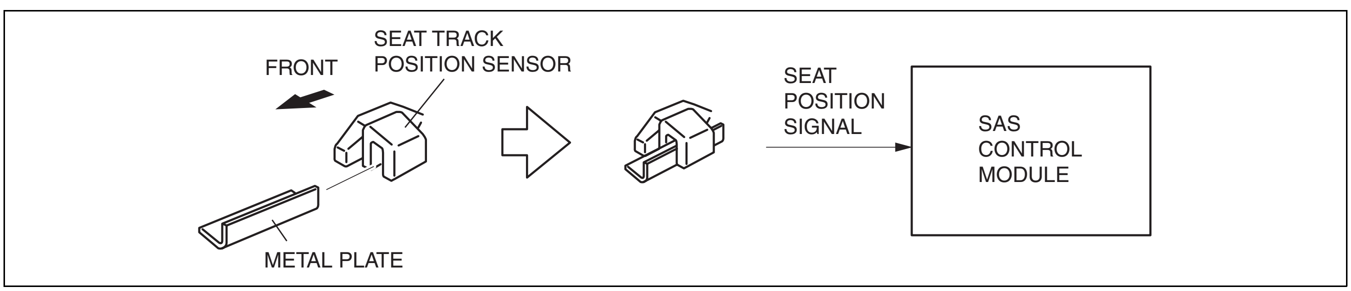
id081000101200

- 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

id081000101300

- 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.



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PASSENGER SENSING SYSTEM OUTLINE

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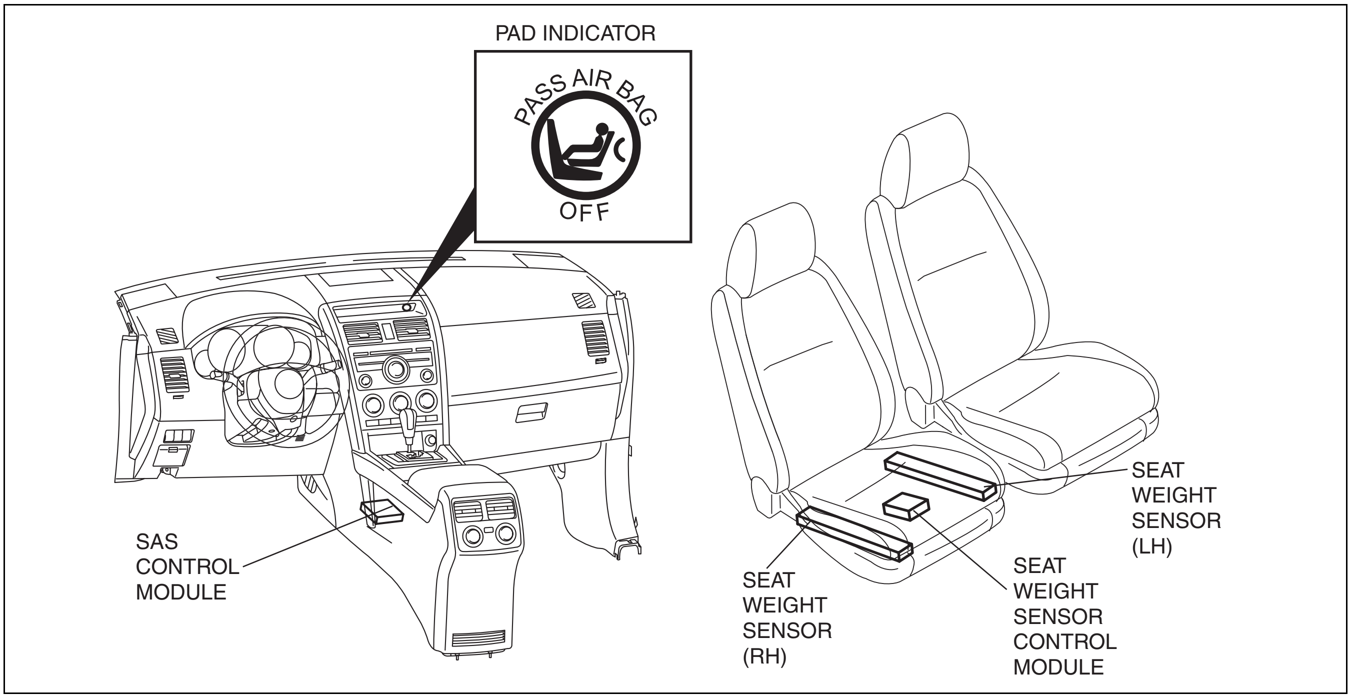
- Measures the total seated weight on the passenger-side seat, determines whether there is an adult or child (including a child-restraint seat), or that it is empty, and then controls operation (deployment) or non-operation (non-deployment) of the passenger-side air bag module and pre-tensioner seat belt.

PASSENGER SENSING SYSTEM CONSTRUCTION

id081000101500

- 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 (information display), and SAS control module installed in the console.



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PASSENGER SENSING SYSTEM OPERATION

id081000101600

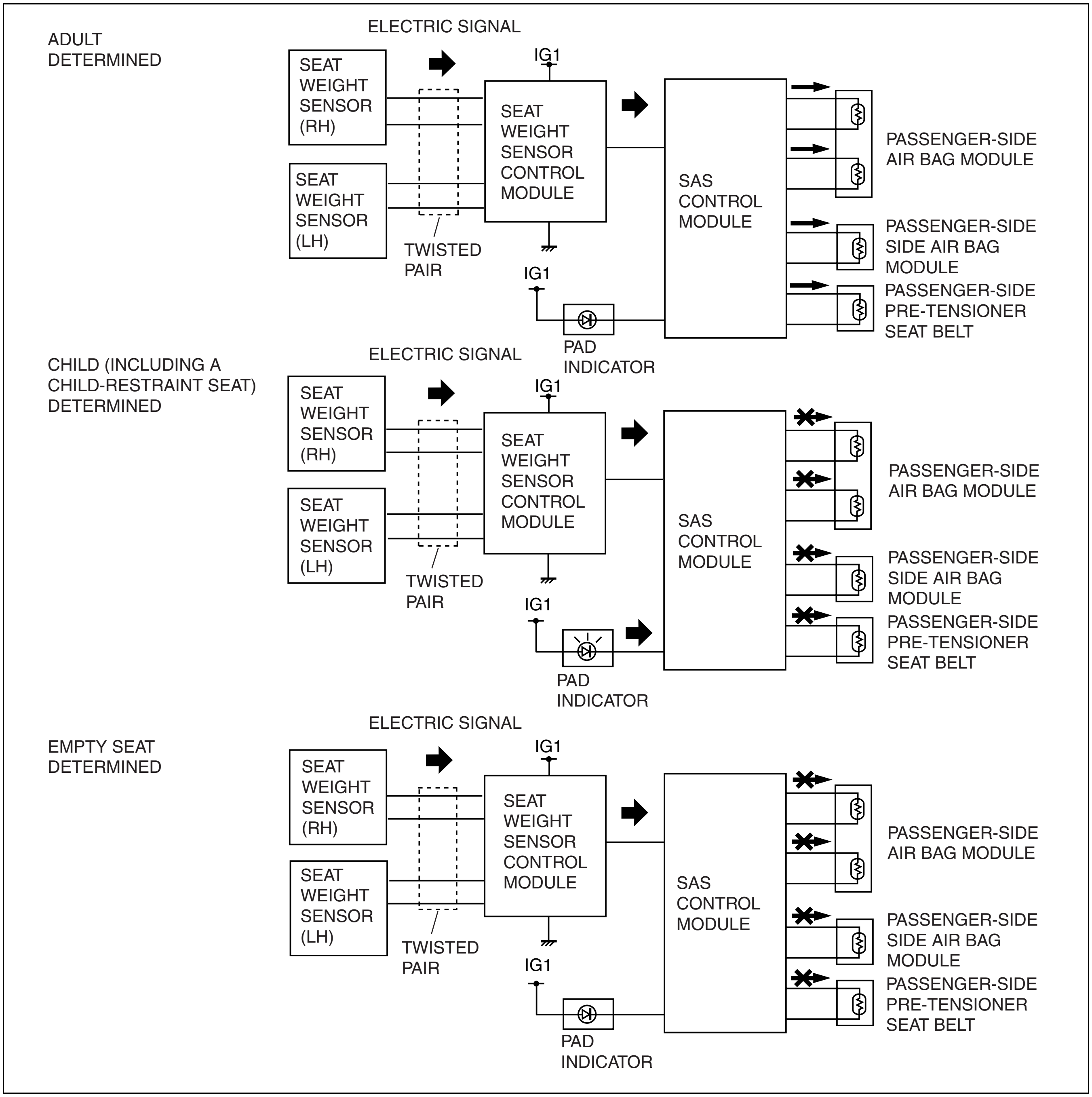
1. The load on the passenger-side front seat is converted into an electric signal by the strain gauge built into the seat weight sensor, and this signal is sent to the seat weight sensor control module.
2. The electronic signals from the two seat weight sensor are used for calculation by the seat weight 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}.



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Caution

- **If any of the following work is performed, perform the seat weight sensor calibration using the mazda modular diagnostic system (M-MDS).**
  - **— 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 mazda modular diagnostic system (M-MDS).**
  - **— Removal of the passenger-side seat**
  - **— Loosening and retightening of passenger-seat fixing bolts**
  - **— Or, the vehicle is involved in a collision**

DRIVER-SIDE AIR BAG MODULE FUNCTION

id081000100800

- 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.

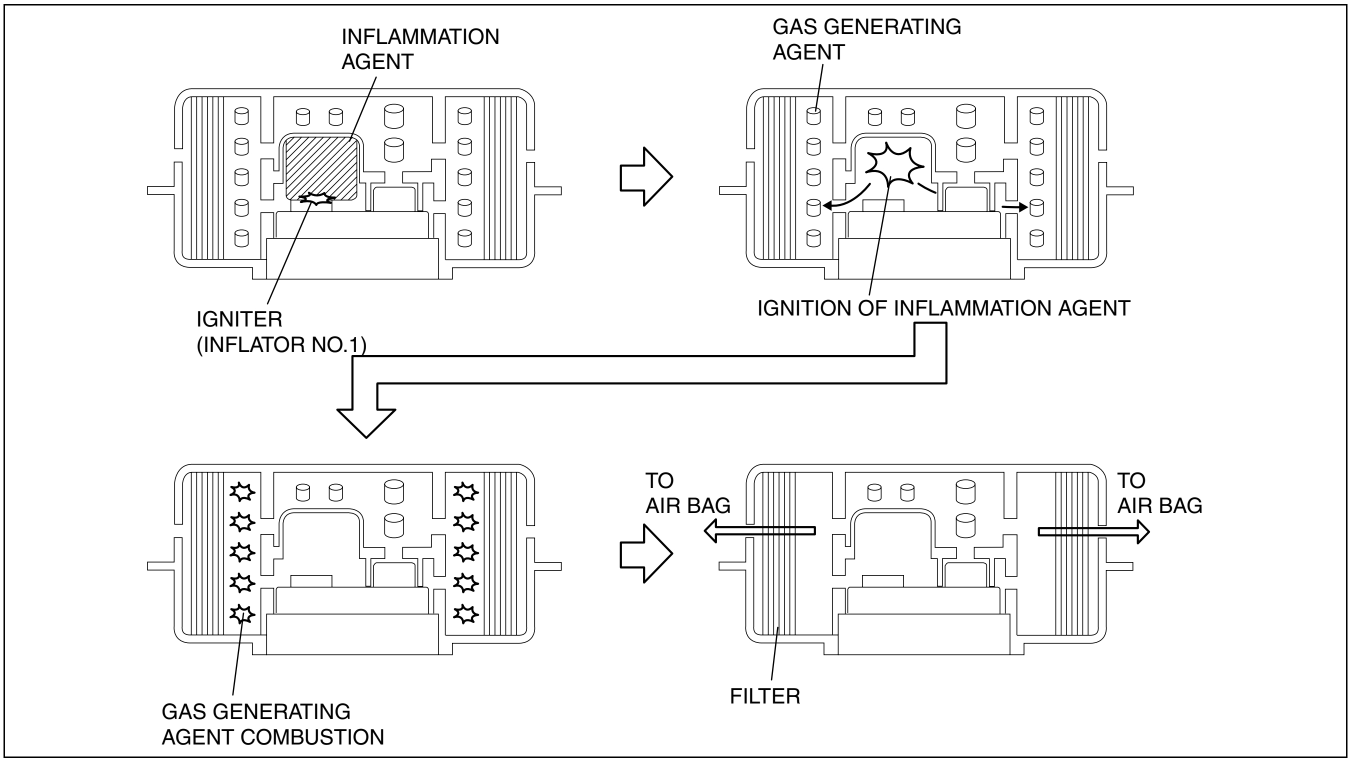
DRIVER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

id081000100900

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.



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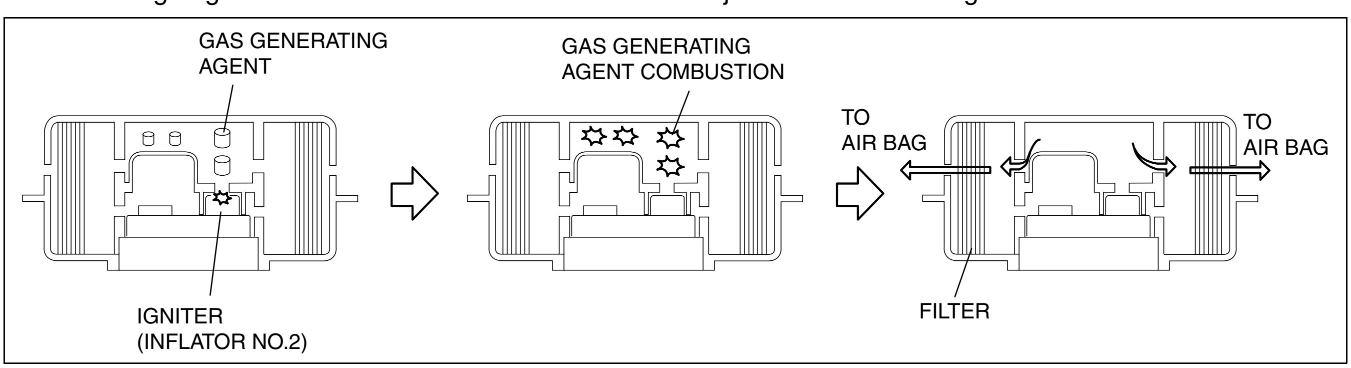
Inflator No.2

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.



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PASSENGER-SIDE AIR BAG MODULE FUNCTION

id081000101700

Outline

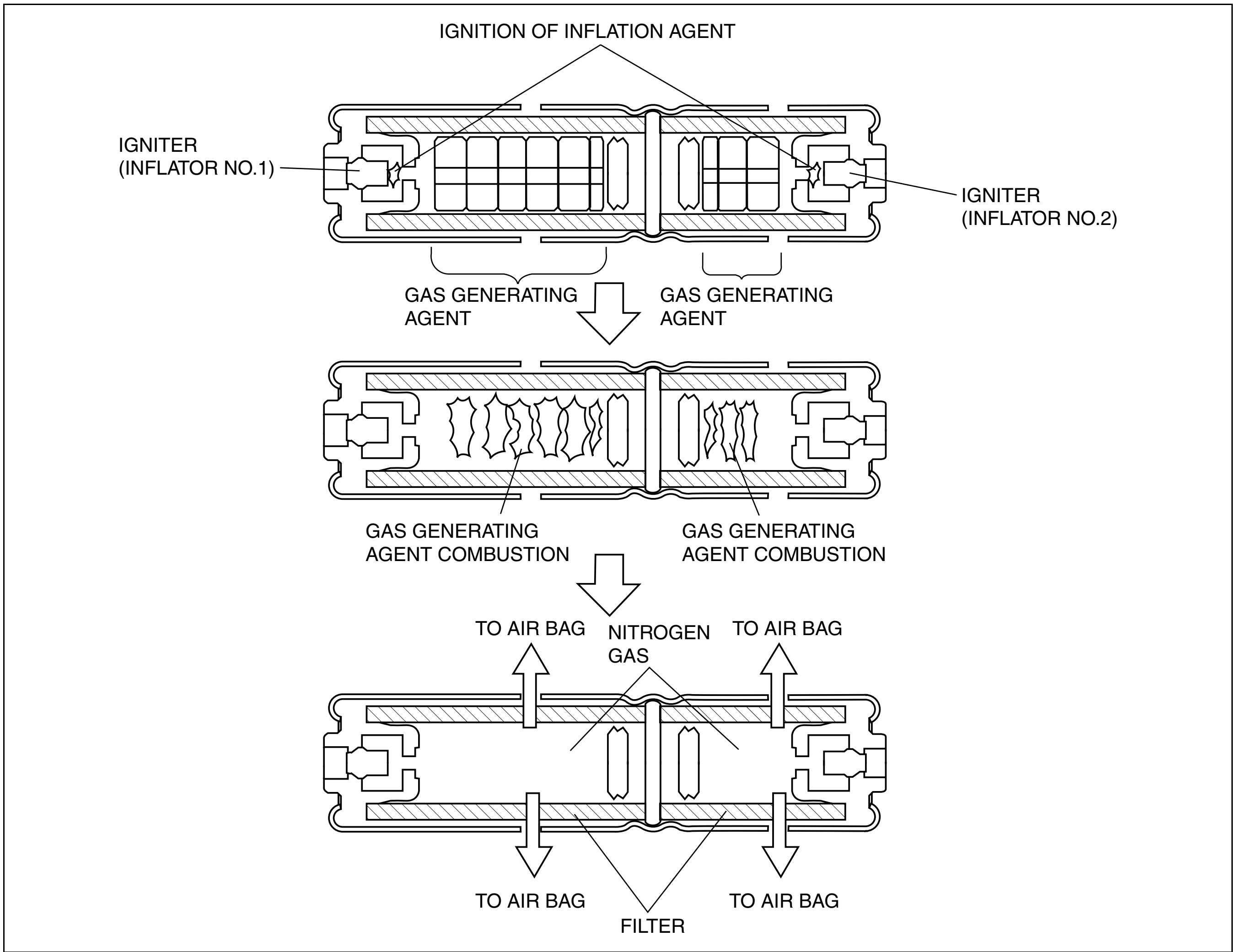
- A dual inflator, divided into inflator No.1 and inflator No.2, has been adopted in accordance with the front air bag system 2-step deployment control.

PASSENGER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

id081000101800

Inflator Operation

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 ignition of the inflation agent causes the combustion of an agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter, and the filtrate is injected into the air bag.



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08-10

SIDE AIR BAG MODULE FUNCTION

id081000100400

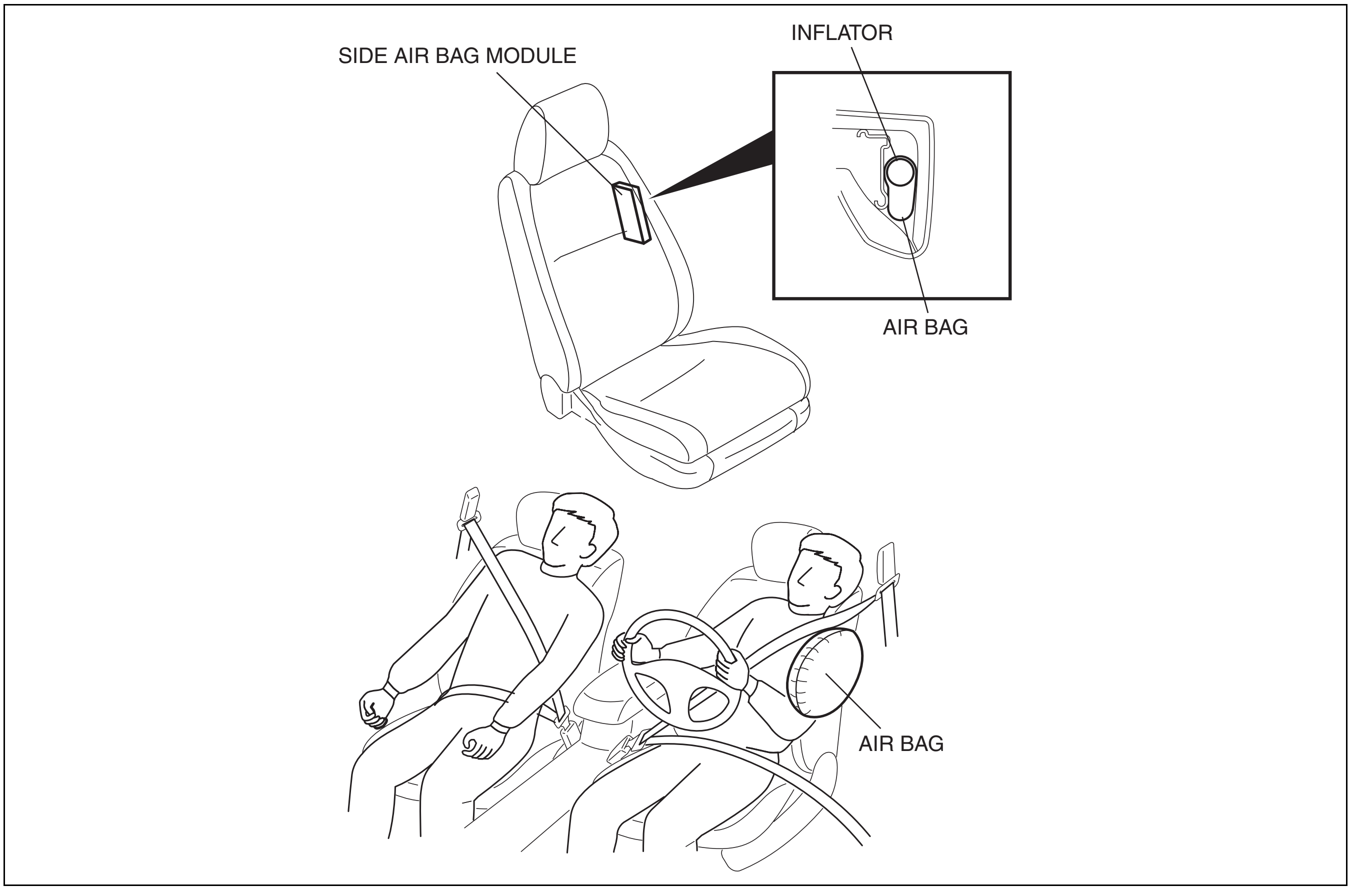
- During a collision to the side of the vehicle, the air bag operates (deploys) after receiving an operation signal from the SAS control module, defusing impact to the chest area of the driver and front passenger.
- Operates in conjunction with the curtain air bag module.

SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

id081000100500

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.



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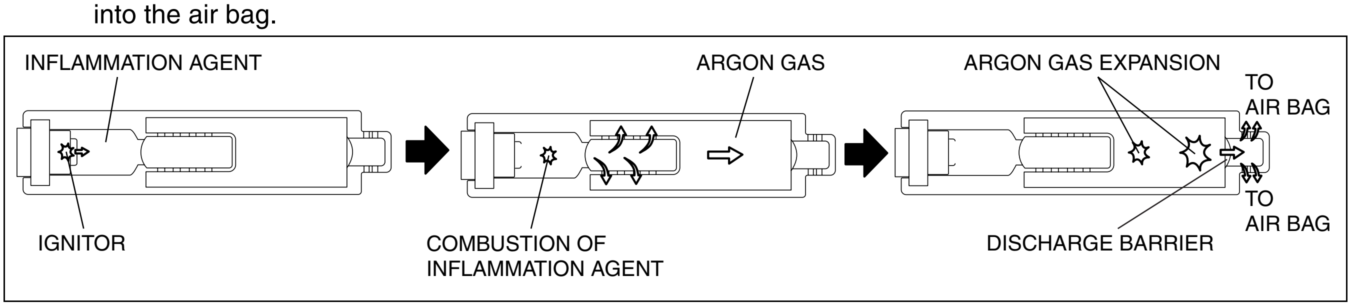
- The inflator operates in the following order:
  1. The igniter built into the inflator begins to build up heat when the operation (deployment) signal is sent from the SAS control module. The inflammation agent is ignited by the build up of heat in the igniter.
  2. The argon gas expands due to the heat of the ignited inflammation agent.
  3. The expanding argon gas breaks the discharge barrier, is cooled and filtered by the filter, and then injected into the air bag.



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CURTAIN AIR BAG MODULE FUNCTION

id081000100600

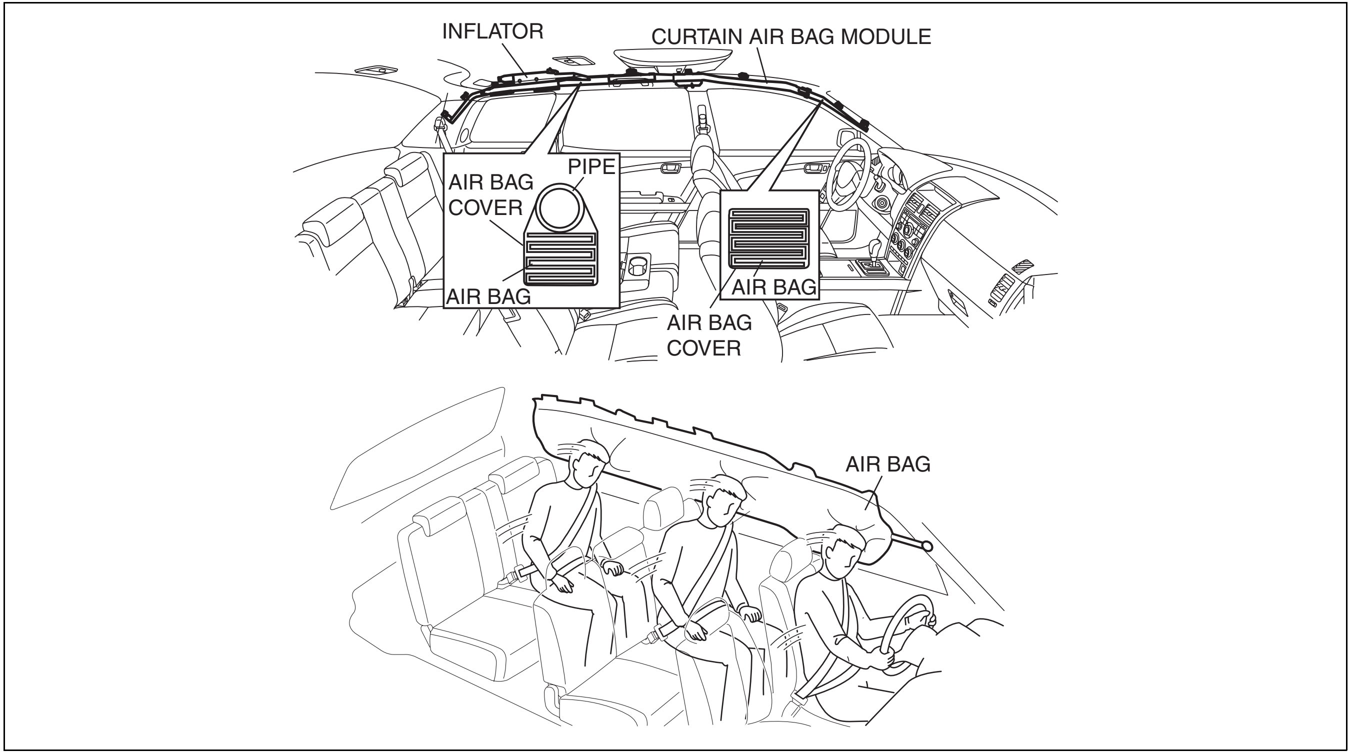
- During a lateral collision to the vehicle, the air bag operates (deploys) after receiving an operation signal from the SAS control module, defusing impact to the side of the head of the driver and other passengers (passenger-side and rear outboard-seated passenger).

CURTAIN AIR BAG MODULE CONSTRUCTION/OPERATION

id081000100700

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 operates (deploys), the A-pillar trim and headliner are spread apart by gas generated from the inflator, inflating the air bag and maintaining the gas reserve for **approx. 6 s**.
- A stored-type inflator has been adopted instead of using an ignition agent in the inflator.



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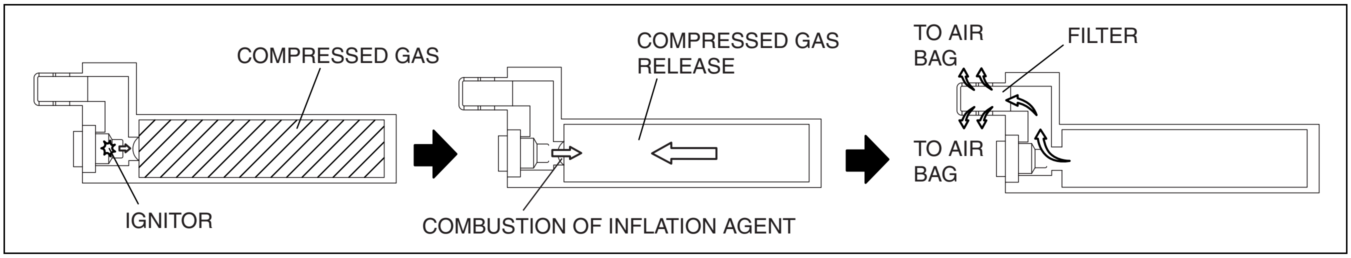
Operation

Inflator operation

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.



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08-10

PRE-TENSIONER SEAT BELT FUNCTION

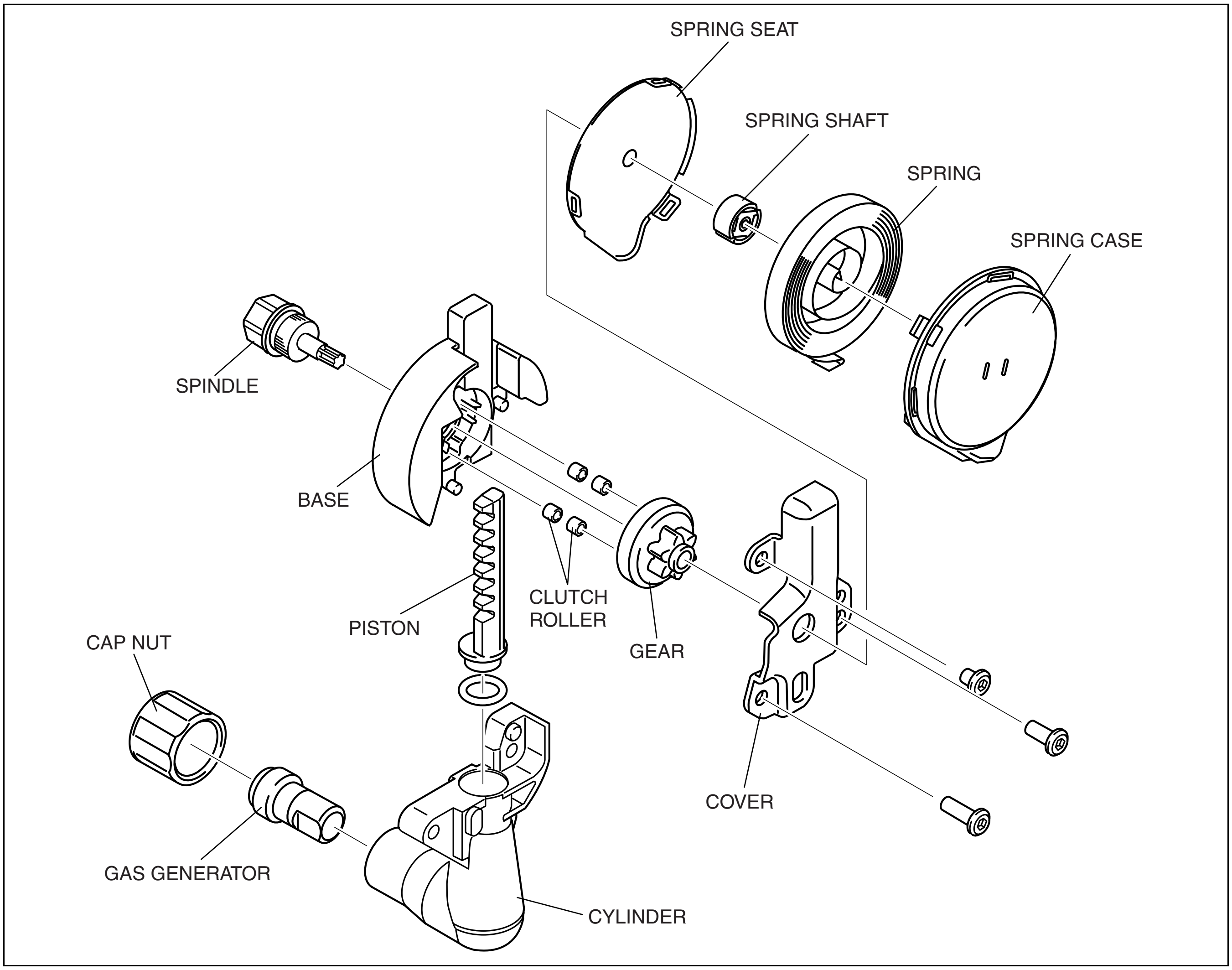
id081000101900

- When a vehicle is involved in a frontal or frontal offset collision and the front seat belts are buckled, the pre-tensioner seat belt system receives an operation signal from the SAS control module, retracting and tightening the belt webbing instantly on the driver and front passenger restraints.

PRE-TENSIONER SEAT BELT CONSTRUCTION/OPERATION

id081000102000

Construction



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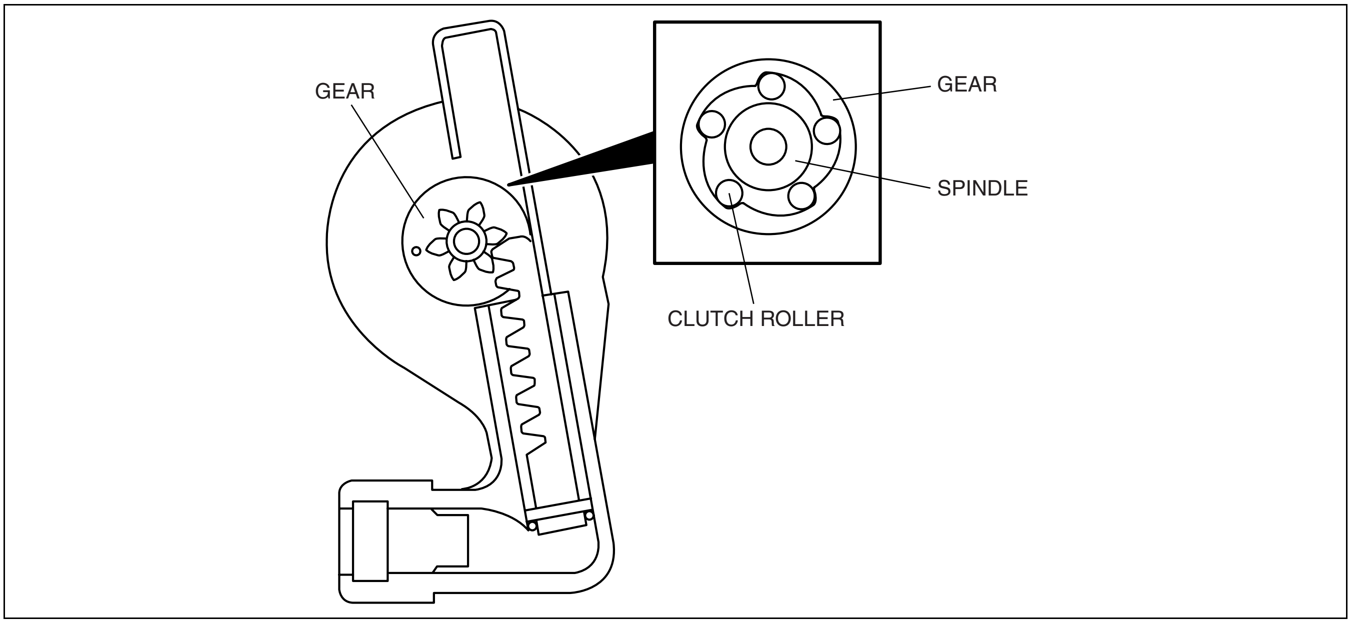
Operation

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.



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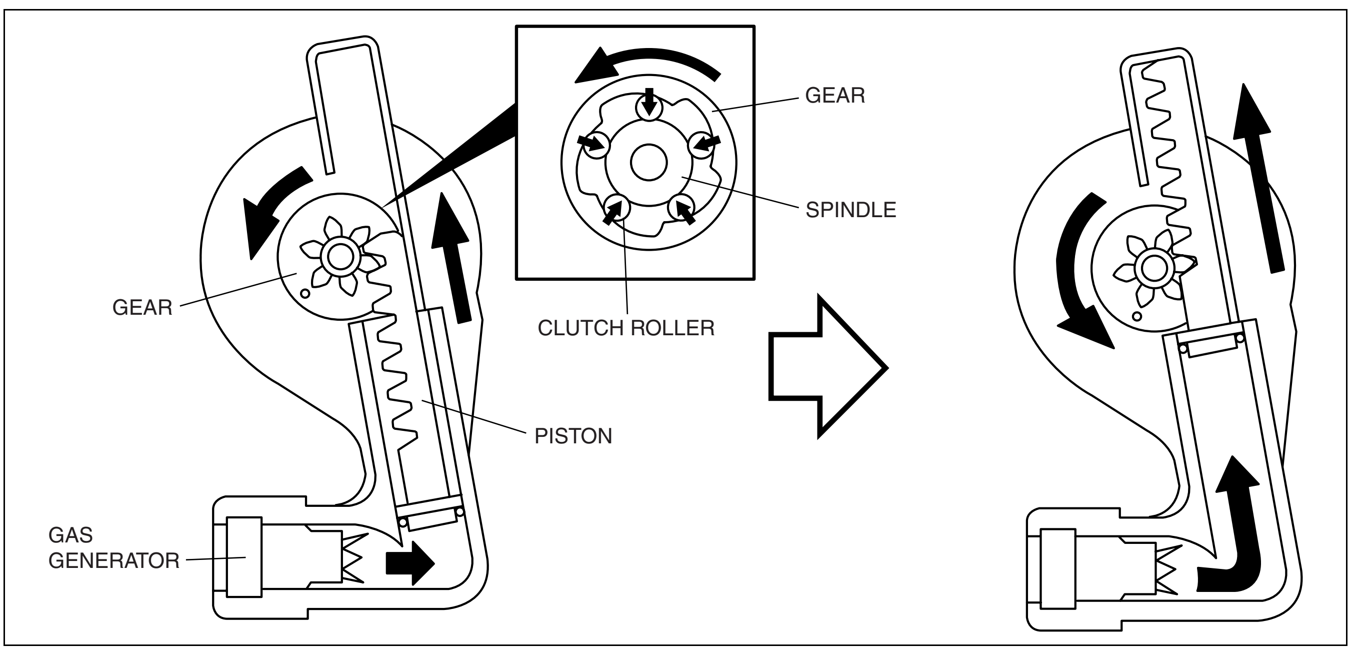
Seat Belt Pretensioners Operating

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.



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08-11 SEAT BELT

SEAT BELT OUTLINE

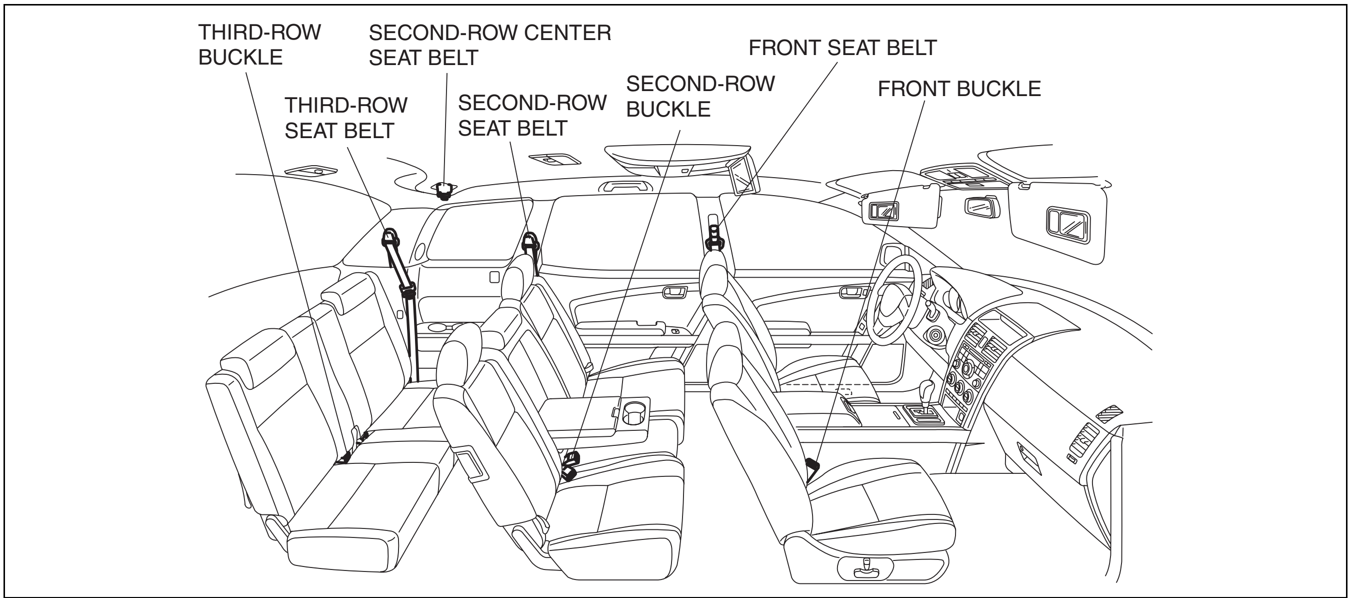
id081100100400

Features

Improved safety	• Three-point seat belt with the following functions for front seat passengers adopted — ELR (Emergency Locking Retractor: emergency locking mechanism) — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism) (passenger side only) — Pre-tensioner seat belt (See 08-10-18 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 operation • Three-point seat belt with the following functions for second-row seat passengers adopted — ELR — ALR (left and right side only) • Three-point seat belt with the following functions for third-row seat passengers adopted — ELR — ALR

SEAT BELT STRUCTURAL VIEW

id081100100500



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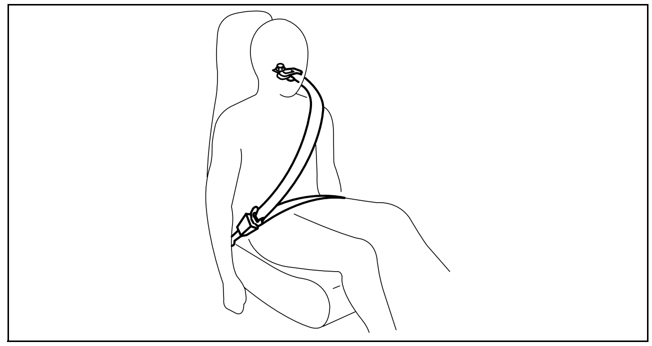
LOAD LIMITER RETRACTOR CONSTRUCTION/OPERATION

id081100100300

1. Initial state



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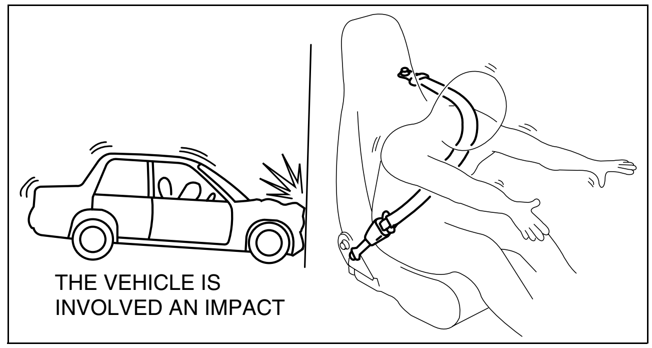
2. Pre-tensioner and ELR operation
   When the vehicle has been subjected to an impact, the pre-tensioner or ELR activates, locking the belt and securing the passenger's body.



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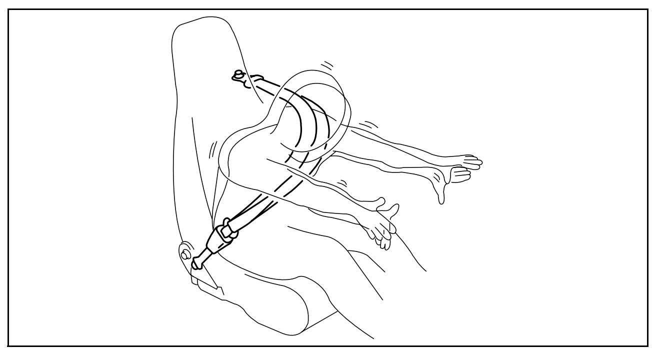
3. Load limiter operation
   After locking, if the force of impact transferred to the belt is strong enough to cause injury to the chest of the occupant, an adequate amount of belt is released to absorb the load applied to the chest.



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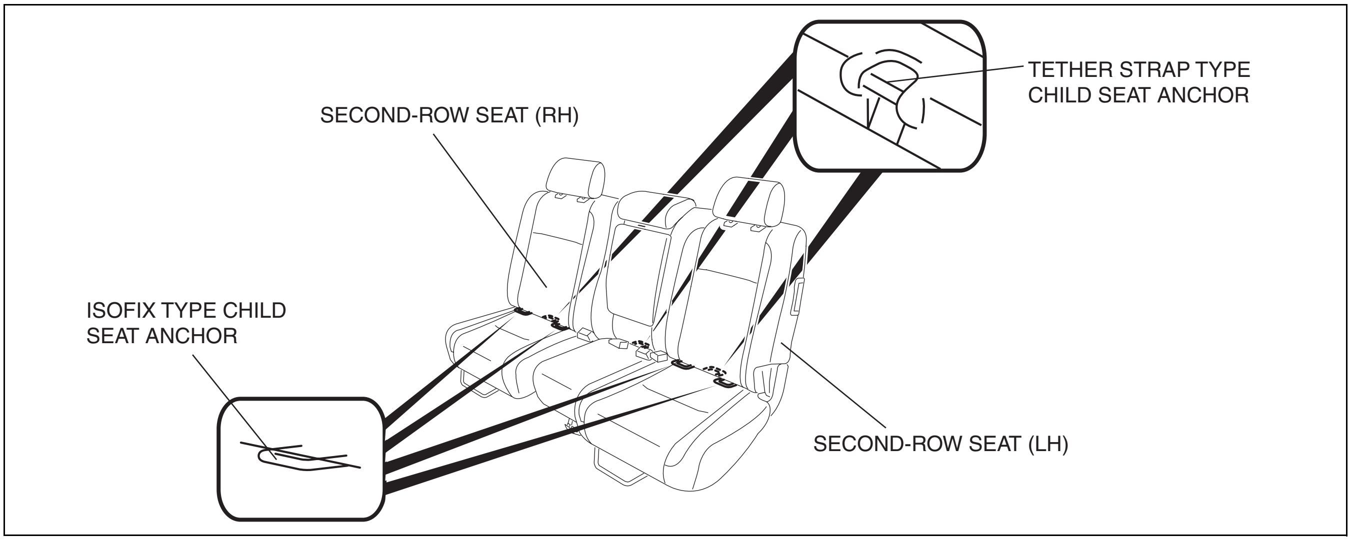
CHILD RESTRAINT SEAT ANCHOR CONSTRUCTION

id081100100200

- ISOFIX anchors for securing an ISOFIX child-restraint seat are set on the left and right sides of the second-row seats.

Caution

- **The 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.**



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BODY & ACCESSORIES

09
SECTION

09-00 OUTLINE

BODY AND ACCESSORIES ABBREVIATIONS

id090000100100

ACC	Accessories
ALC	Auto Level Control
ATX	Automatic Transaxle
AWD	All Wheel Drive
BCM	Body Control Module
CAN	Controller Area Network
CM	Control Module
CPU	Central Processing Unit
DLC	Data Link Connector
DSC	Dynamic Stability Control
DTC	Diagnostic Trouble Code
DRL	Daytime running light
ECT	Engine Coolant Temperature
GND	Ground
GPS	Global Positioning System
HF/TEL	Hands-Free Telephone
HI	High
IC	Integrated Circuits
IG	Ignition
INT	Intermittent
LCD	Liquid Crystal Display
LED	Light Emitting Diode

LF	Left Front
LH	Left Hand
LO	Low
LR	Left Rear
M	Motor
OFF	Switch Off
ON	Switch On
PCM	Powertrain Control Module
PID	Parameter Identification
PLG	Power Liftgate
PTC	Positive Temperature Coefficient
P/W CM	Power Window Control Module
RES	Rear Entertainment System
RF	Right Front
RH	Right Hand
RR	Right Rear
RSC	Roll Stability Control
SAS	Sophisticated Air Bag Sensor
SW	Switch
TCM	Transaxle Control Module
TNS	Tail Number Side Lights
TPMS	Tire Pressure Monitoring System

BODY AND ACCESSORIES FEATURES

id090000100300

Improved marketability	• Power liftgate (PLG) adopted • Auto-open/close function adopted for front power windows • Power door lock system adopted • Advanced keyless entry & start system adopted • 3D Black-out gauges have been adopted • Rear entertainment system (RES) adopted • Console indirect illumination adopted • Door pocket indirect illumination adopted • Seat warmer adopted for the front seats • Lumbar support adopted for the driver seat • Power seat adopted for the front seats • Seat position memory function adopted
Improved convenience	• Auto light system adopted • Headlight leveling system adopted • Auto wiper system adopted • Car-navigation system adopted • Rear view monitor adopted • Hands-free telephone (HF/TEL) system adopted
Improved safety	• Triple-H structure adopted
Improved security	• Immobilizer system adopted • Theft-deterrent system adopted
Improved visibility	• Discharge headlight (low-beam) that illuminate a wide area adopted • LEDs adopted for the brake/taillights • LEDs adopted for the high-mount brake light • Built-in front side turn light adopted for outer mirror
Wiring harness simplification	• Controller area network (CAN) system adopted
System simplification	• Body control module adopted • Auto light/wiper control module adopted

09-10 BODY PANELS

BODY PANEL OUTLINE

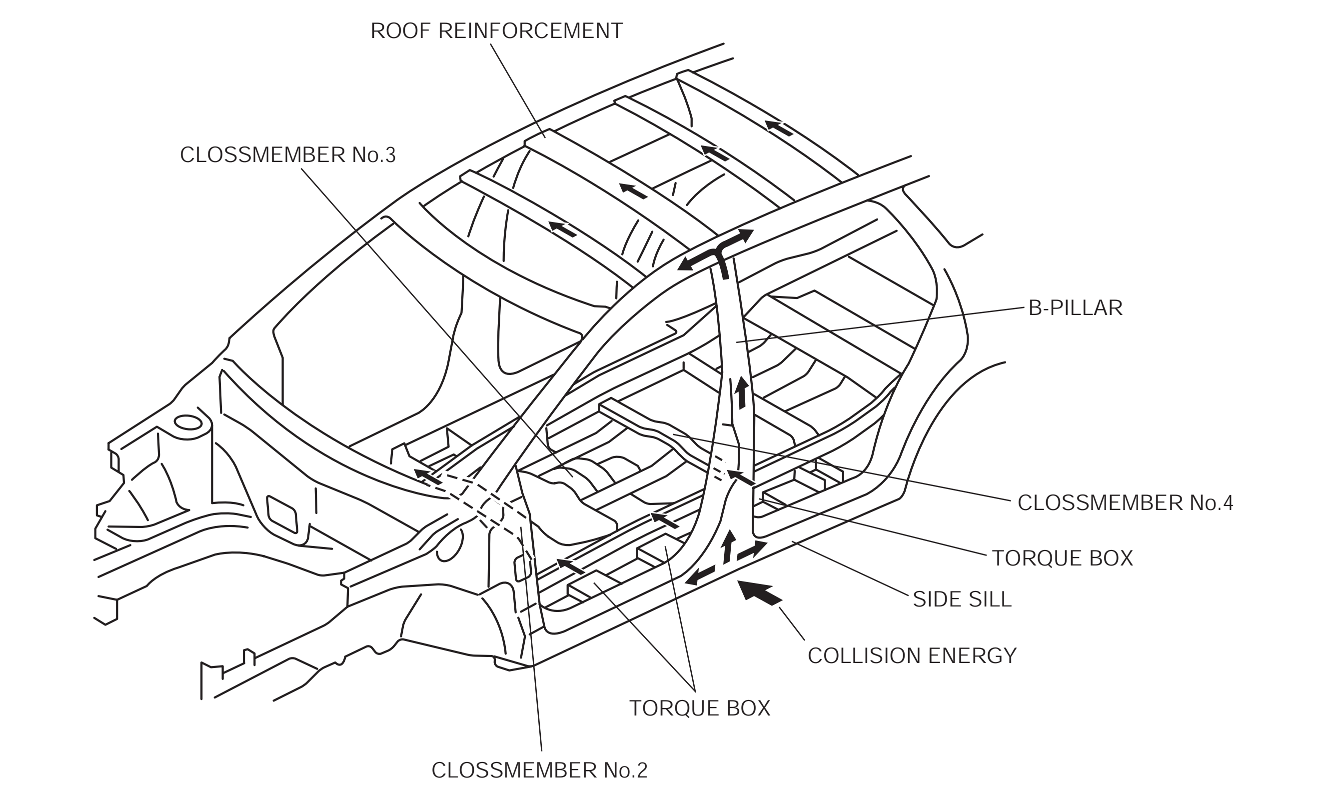
id091000100200

- 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

id091000100700

- An impact dispersing three-fork structure that disperses a collision impact into three directions has been adopted.
- 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.



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09-10

09-11 DOORS AND LIFTGATE

DOORS AND LIFTGATE OUTLINE

id091100101200

Features

Improved marketability	• Door modules with integrated front door and rear door internal parts have been adopted. • A power liftgate (PLG) system has been adopted.
Improved safety	• A rigid side impact bar has been adopted for each front door and rear door. • Shock-absorbing pad adopted

DOORS AND LIFTGATE STRUCTURAL VIEW

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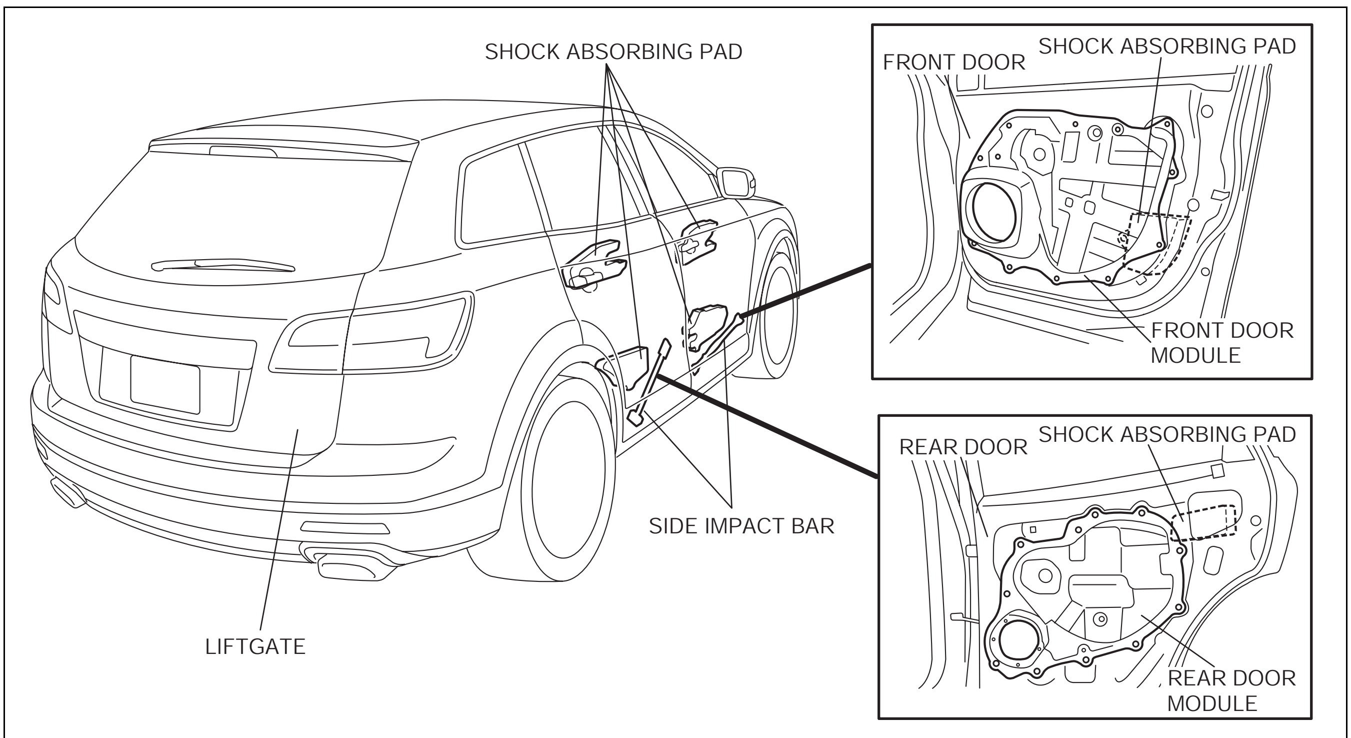

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DOOR CONSTRUCTION

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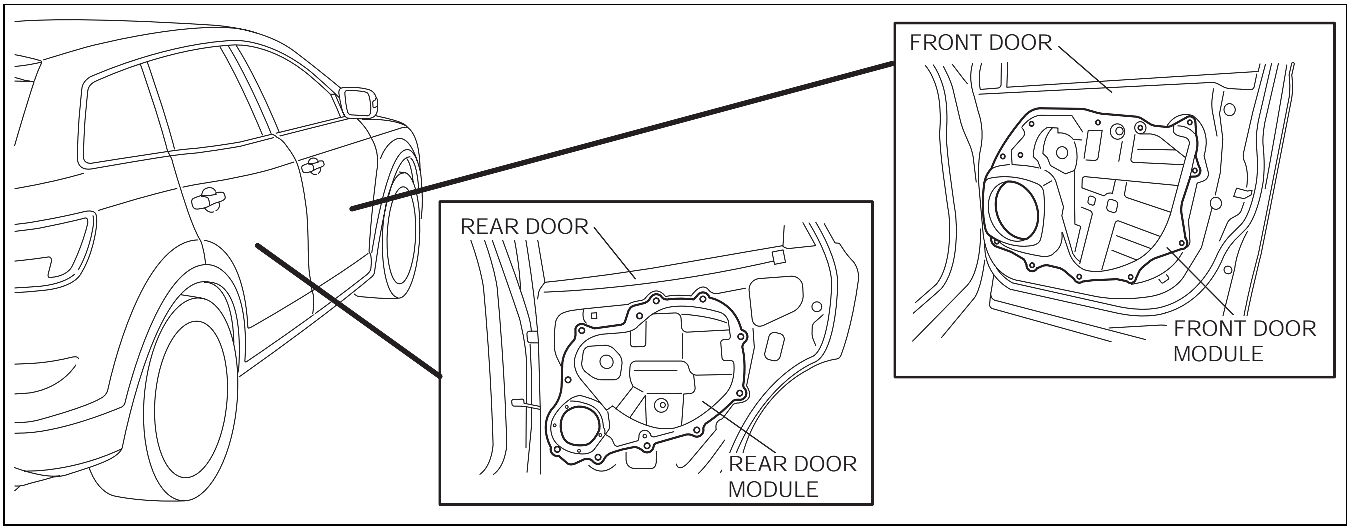
- The internal parts of the door have been integrated into a door module.



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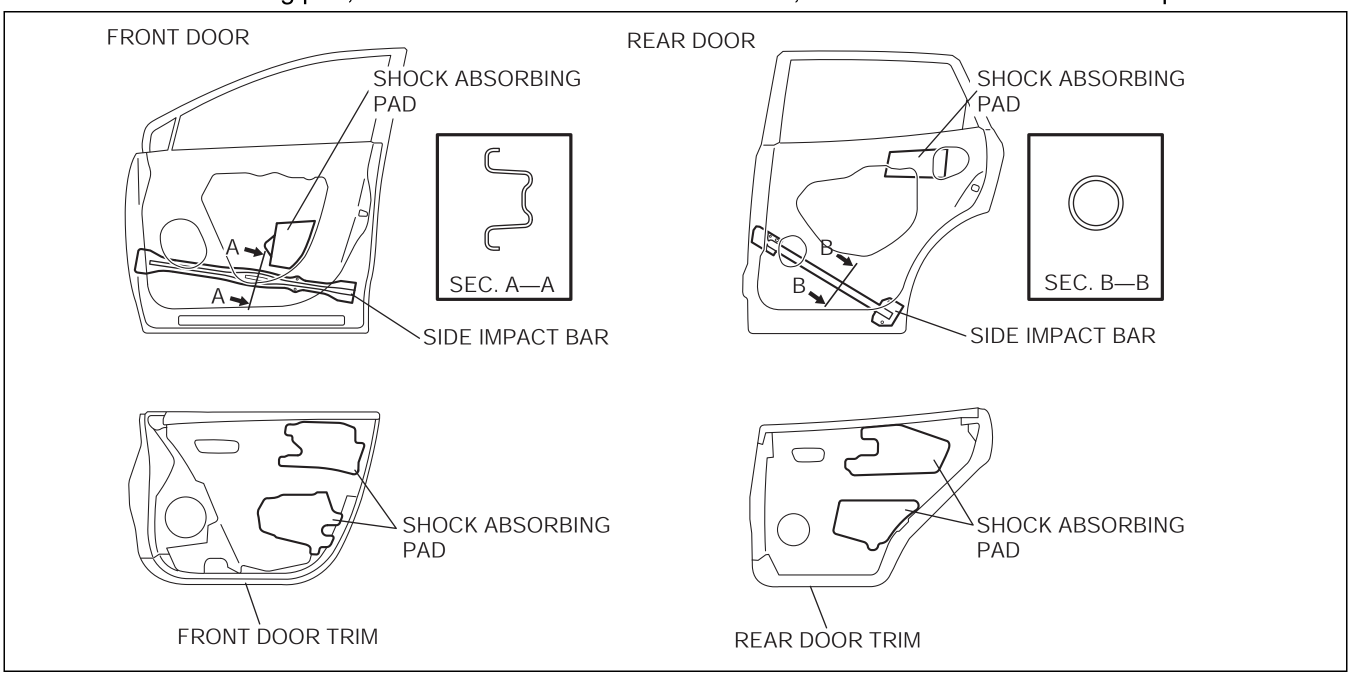
- A corrugated side impact bar and cylindrical side impact bar have been adopted to improve rigidity in case of collision.
- The side impact bars, located on the door, prevents the door from deforming inward by dispersing the impact to the floor in case of a side-impact collision.
- The shock absorbing pad, located inside the door trim and door, functions to soften collision impact.



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POWER LIFTGATE (PLG) SYSTEM OUTLINE

id091100104600

- An automatic open/close power liftgate system has been adopted.
- The PLG system has the following functions.
  — Auto open/close function
  — Manual open/close function
  — Fail-safe function
  — Malfunction detection function
- A buzzer sounds when the PLG is operating and if a malfunction is detected.
- An auto closure mechanism has been adopted on the liftgate latch and lock actuator which performs automatic closing from the latch release/ajar condition during opening/closing in auto/manual.

POWER LIFTGATE (PLG) SYSTEM CONSTRUCTION

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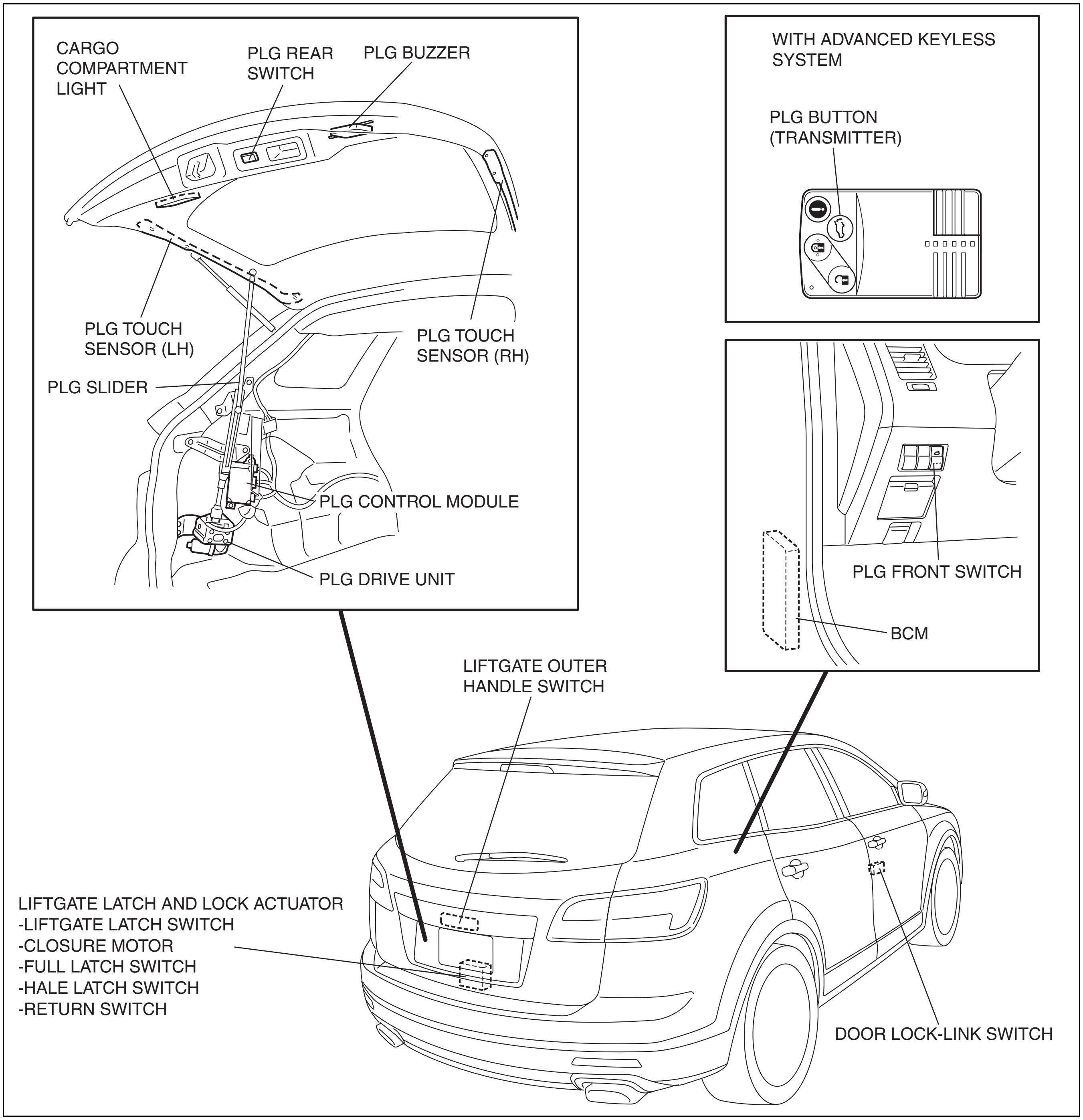

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POWER LIFTGATE (PLG) SYSTEM WIRING DIAGRAM

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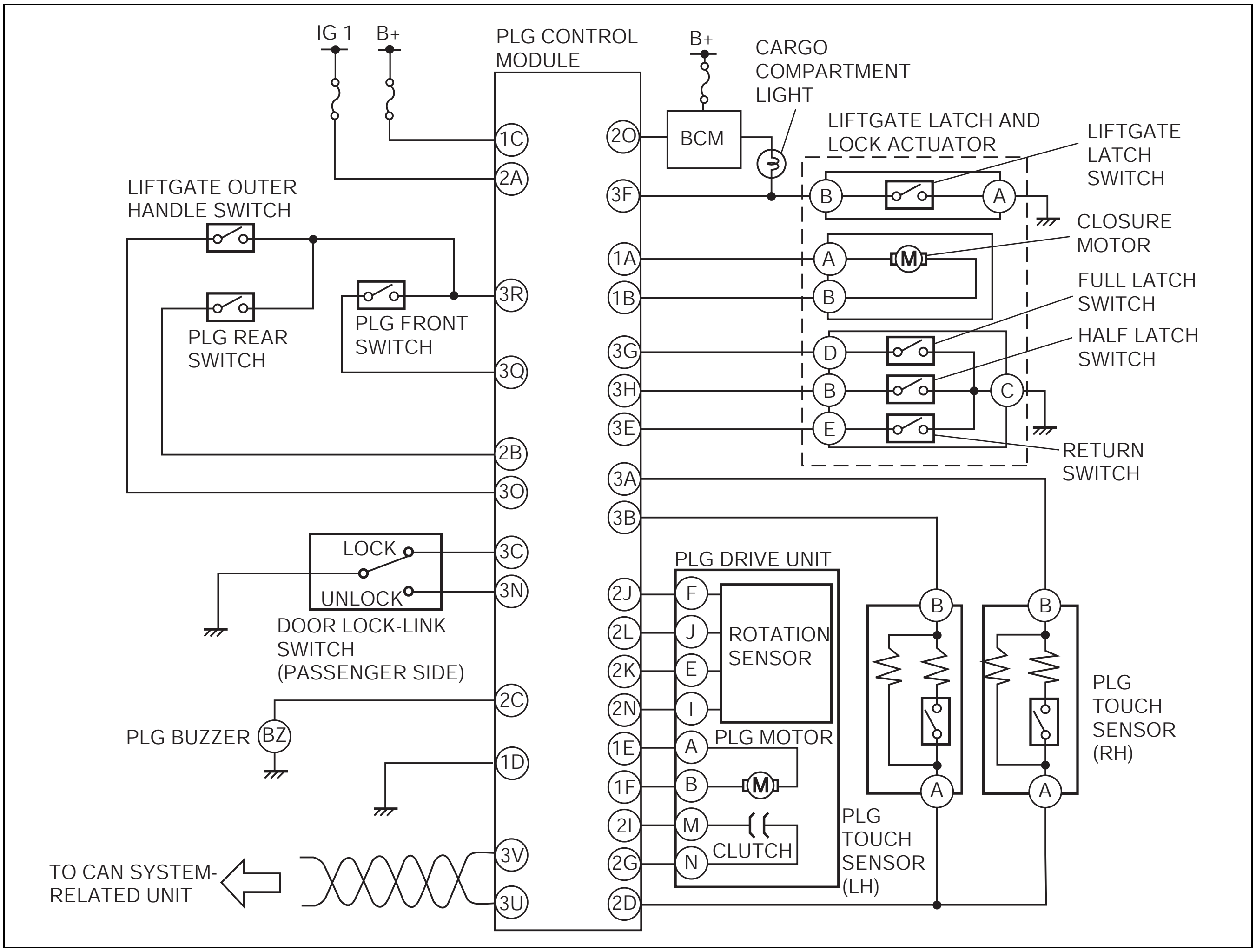

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POWER LIFTGATE (PLG) SYSTEM OPERATION

id091100105100

Operation Conditions

1. If all of the conditions indicated in the table below are met, each operation commences.

When the ignition switch is at ON

Operating items	Liftgate conditions	Operation conditions						Switch operated	Switch operation result
		Shift position	Speed of car	Supply voltage	Liftgate lock condition	PLG touch sensor (*1)	Latch condition (*2)		
Auto open	Fully-close or half-open	P position	Under 3 km/h {1.86 mph}	Over 10.5 V	Unlock	OFF	Neutral and fully closed position	PLG front switch	Liftgate auto open
								PLG rear switch	Operating is not allowed
								Transmitter	Operating is not allowed
Auto close	Fully-open	P position	Under 3 km/h {1.86 mph}	Over 10.5 V	Unlock	OFF	Neutral and fully opened position	PLG front switch	Liftgate auto close
								PLG rear switch	Liftgate auto close
								Transmitter	Operating is not allowed
Manual open	Fully-close or half-open	P position	Under 3 km/h {1.86 mph}	—	Unlock	—	—	Liftgate outer handle	Liftgate manual open
	—						Neutral and fully closed position		

When the ignition switch is at LOCK

Operating items	Liftgate conditions	Operation conditions						Operating switch	Operations
		Shift position	Speed of car	Supply voltage	Liftgate lock condition	PLG touch sensor (*1)	Latch condition (*2)		
Auto open	Fully-close or half-open	—	—	Over 10.5 V	Unlock	OFF	Neutral and fully closed position	PLG front switch	Liftgate auto open
								PLG rear switch	Operating is not allowed
								Transmitter	Liftgate auto open
Auto close	Fully-open	—	—	Over 10.5 V	—	OFF	Neutral and fully opened position	PLG front switch	Liftgate auto close
								PLG rear switch	Liftgate auto close
								Transmitter	Liftgate auto close
Manual open	Fully-close or half-open	—	—	—	Unlock	—	—	Liftgate outer handle	Liftgate manual open
	—						Neutral and fully closed position		

- (*1) OFF = No obstruction is detected, ON = Obstruction is detected.
- (*2) Latch condition.

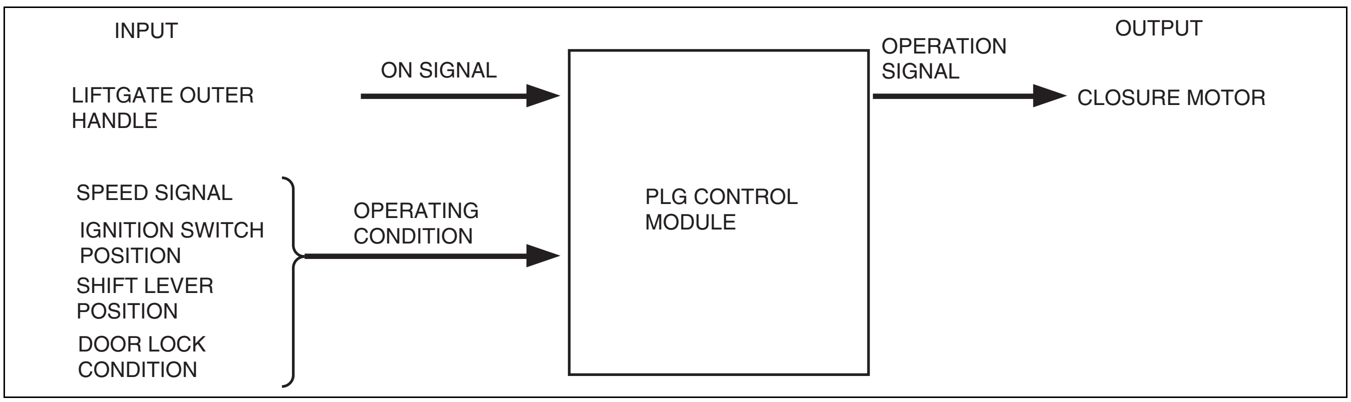
	HALF LATCH SWITCH	FULL LATCH SWITCH	RETURN SWITCH
Neutral and fully closed position	ON	ON	OFF
Neutral and fully opened position	OFF	—	OFF

- ON/OFF shows the condition of contact point of SW.
- HALF LATCH SWITCH: Contact point at ON when half lock/full lock.
- FULL LATCH SWITCH: Contact point at ON when full lock.
- RETURN SWITCH: Contact point at ON when closure motor is in operation.

Manual open/close Operation

Note
- Operation conditions vary depending on the vehicle conditions (Such as ignition switch, shift lever position). Refer to the operation conditions.

Manual open
1. By operating the liftgate outer handle while the liftgate is closed, the liftgate outer handle switch turns on and a signal is sent to the PLG control module.
2. When the PLG control module receives the signal, the operation conditions are confirmed, and if the conditions are met, a motor operation signal is sent to the closure motor.
3. The closure motor rotates in the direction to open the liftgate and releases the latch.
4. After the latch is released, the liftgate can be opened manually.



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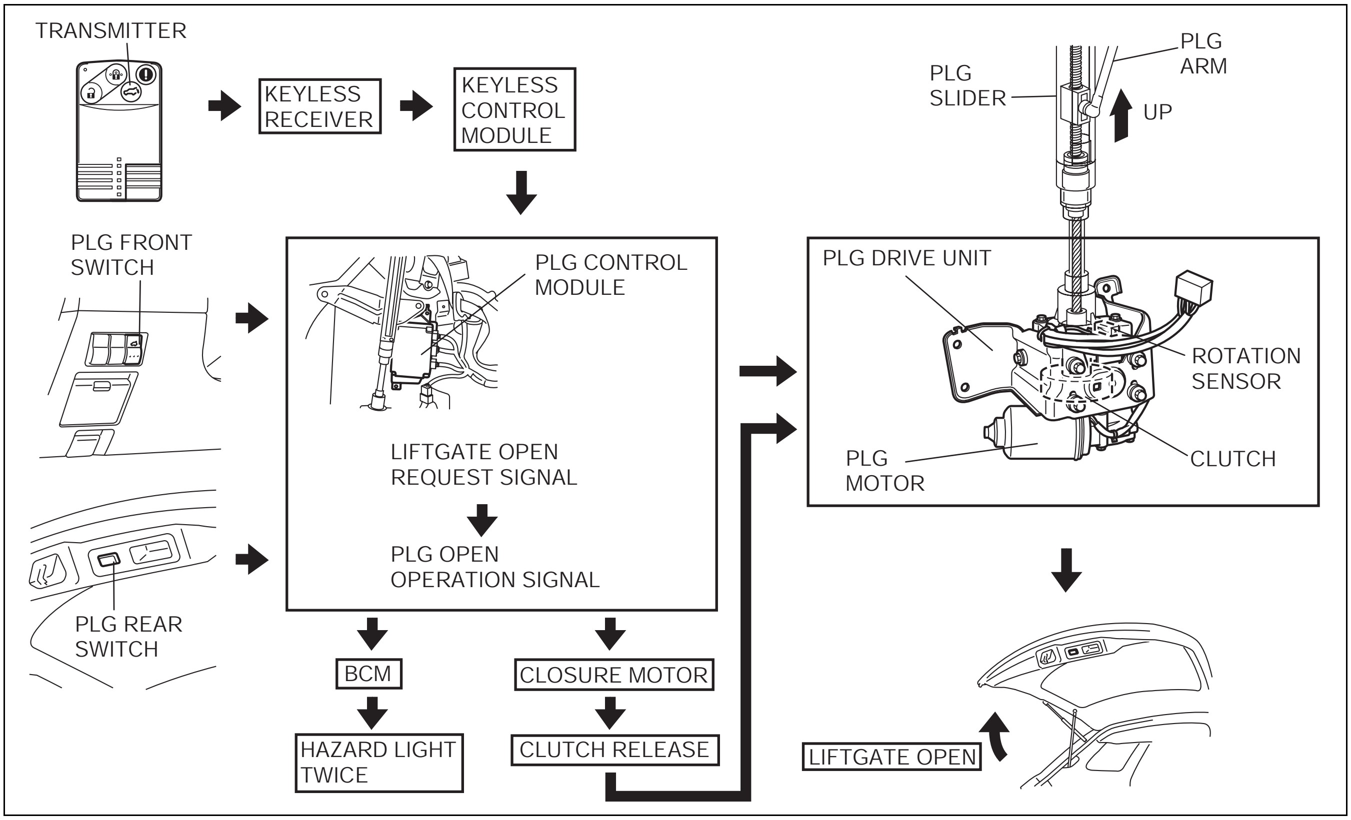
Manual close
1. The liftgate can be closed manually in the same way as the previous liftgate.
2. If the door is ajar, the half-latch switch turns off, and a signal is sent to the PLG control module.
3. The PLG control module sends a motor operation signal to the closure motor.
4. The closure motor rotates in the direction to close the liftgate, and the liftgate closes. The motor operates until a full-latch switch off signal is input.

Auto Open Operation
Auto open operation using the PLG front switch or transmitter operation
1. While the liftgate is closed, a liftgate-open request signal is sent from the PLG front switch or the transmitter to the PLG control module.
2. The PLG control module verifies the operation conditions after receiving the signal, and if the conditions are met, a buzzer sound is activated and a signal is sent to the BCM simultaneously to flash the hazard warning lights 2 times and to commence the open operation.
3. The PLG control module sends a motor operation signal to the closure motor to release the latch.
4. When the latch is released, the clutch in the PLG drive unit is engaged, and the PLG motor operates in the open direction.
5. The PLG control module counts the pulse signals from the rotation sensor in the PLG drive unit to detect the liftgate speed. By detecting the speed, the PLG motor output is adjusted so that the liftgate opens smoothly at a constant speed.
6. The PLG control module releases the clutch in the PLG drive unit when the counted pulse signals approach the fully open position.

Auto close operation using the PLG front switch, PLG rear switch or transmitter operation

1. While the liftgate is open, a liftgate-close request signal is sent from the PLG front switch, PLG rear switch or the transmitter to the PLG control module.
2. The PLG control module verifies the operation conditions after receiving the signal, and if the conditions are met, a buzzer sound is activated and a signal is sent to the BCM simultaneously to flash the hazard warning lights 2 times and to commence the close operation.



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3. The PLG control module counts the pulse signals from the rotation sensor in the PLG drive unit to detect the liftgate speed and opening angle. By detecting the speed, the PLG motor output is adjusted so that the liftgate closes smoothly at a constant speed.
4. When the liftgate approaches the fully closed position, the half-latch switch turns off, and closure motor operates in the close direction. After this, the PLG motor stops and the clutch is released.
5. The closure motor rotates in the direction to close the liftgate, and the liftgate closes. The motor operates until a full-latch switch off signal is input.

Emergency peration/stop

Reverse operation

- If any of the following conditions are met during auto open/close operation, the buzzer sounds and the liftgate reverses its direction of operation.
  — The liftgate outer handle switch, PLG front switch, PLG rear switch, or the transmitter (PLG button) are operated
  — A touch sensor is activated and it is determined that an object is obstructing
  — There is no change in the rotation sensor pulse signal other than the fully open/closed positions, and it is determined that an object is obstructing.

Emergency stop

- If any of the following conditions are met during auto open operation, the buzzer sounds and the liftgate stops immediately.
  — The power supply voltage is less than 8 V
  — A malfunction is detected in the rotation sensor, Over-current in PLG motor, PLG motor failure and ECU failure.
- If any of the following conditions are met during auto close operation the liftgate stops immediately.
  — The power supply voltage is less than 8 V
  — A malfunction is detected in the rotation sensor, touch sensor, half-latch switch, or the full-latch switch, Over-current in PLG motor, PLG motor failure and ECU failure.
- Insertion, turning over repetition.

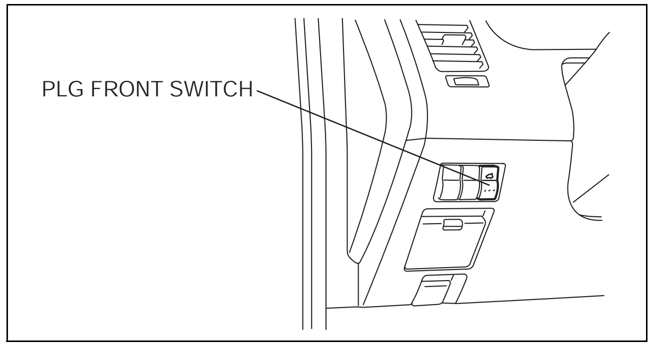
Vehicle moves during auto operation or CAN system malfunction occurs

- If the vehicle speed is 3 km/h or more during auto open operation, the operation is reversed and auto close operates until the liftgate is fully closed.
- If the vehicle speed is 3 km/h or more during auto close operation, the auto close operation continues until the liftgate is fully closed.

POWER LIFTGATE (PLG) FRONT SWITCH CONSTRUCTION/OPERATION

id091100104000

- The PLG front switch is installed to the instrument panel on the driver's side.



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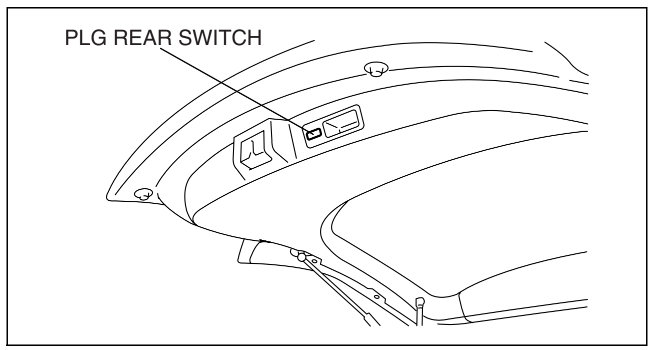
POWER LIFTGATE (PLG) REAR SWITCH CONSTRUCTION/OPERATION

id091100105500

- The PLG rear switch is installed to the liftgate.



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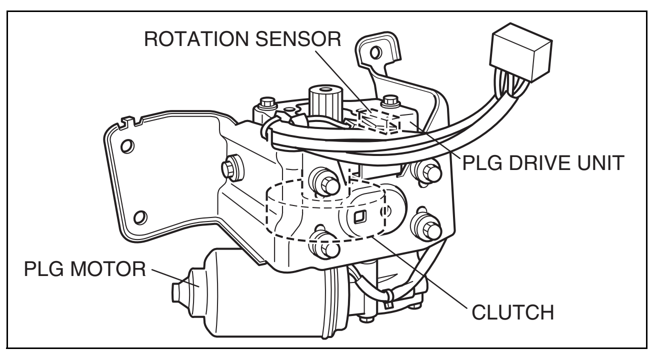
POWER LIFTGATE (PLG) DRIVE UNIT OUTLINE

id091100104700

- The PLG drive unit consists of the following parts.
  — PLG motor
  — Rotation sensor
  — Clutch



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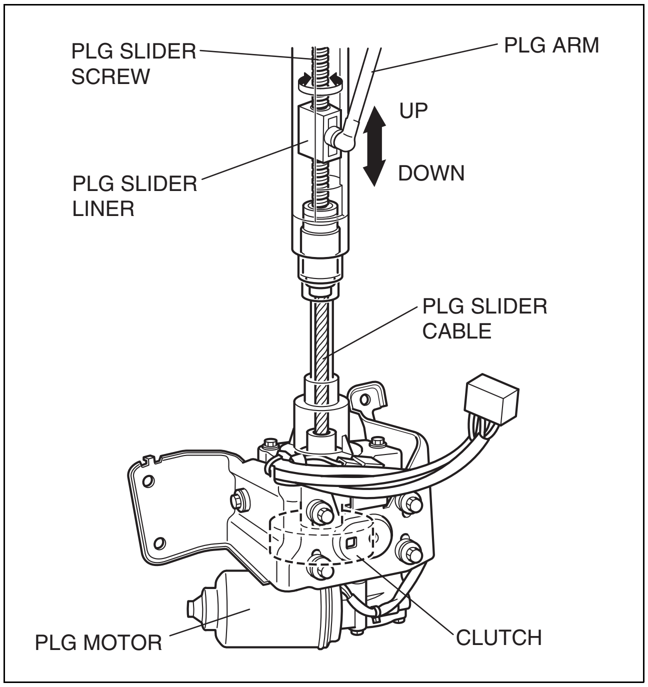
POWER LIFTGATE (PLG) DRIVE UNIT CONSTRUCTION/OPERATION

id091100104200

PLG Motor

- Transmit the power of PLG motor via the CLUTCH to rotate the PLG slider cable.
- PLG slider screws gets linked and wheels when the PLG slider cable wheels, and then engages with the PLG slider liner and the PLG slider liner moves up and down.



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Rotation Sensor

- The PLG motor's drive condition is converted into a pulse signal and transmitted to the PLG control module.
- If the pulse signal during open/close is interrupted, it is determined that there is an obstruction and the PLG control module reverses the PLG motor.
- The open/close speed is calculated based on the pulse. The PLG motor output is adjusted by comparing the target speed that is set for each liftgate position with the pulse as a base. Based on this, the liftgate open/close operation is performed smoothly.

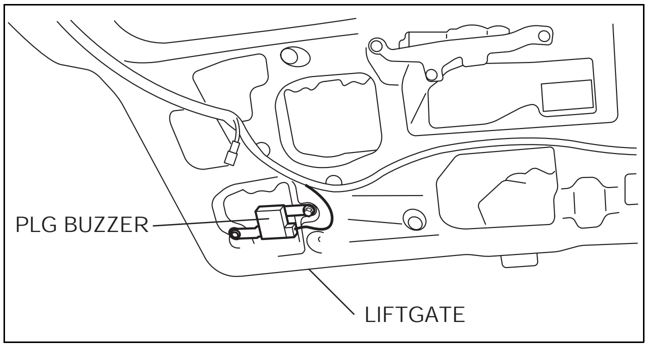
Clutch

- The clutch is normally released. The clutch is only engaged when the PLG system operates to transmit the PLG motor operating force. The clutch engagement/release is performed based on the reception of the signal from the PLG control module.

POWER LIFTGATE (PLG) BUZZER CONSTRUCTION/OPERATION

id091100104300

- The PLG buzzer is installed inside the liftgate.
- The buzzer sounds after receiving an operation signal from the PLG control module.



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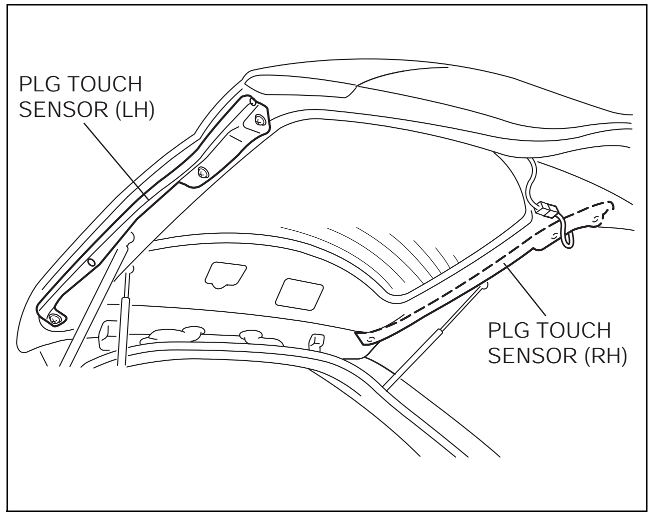
POWER LIFTGATE (PLG) TOUCH SENSOR CONSTRUCTION/OPERATION

id091100104400

- The PLG touch sensors are installed on the left and right sides of the liftgate.
- If pressure is applied to the sensor area, the resistance in the sensor area changes. This change in resistance is detected by the PLG control module and it is determined that an object is obstructing.



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POWER LIFTGATE (PLG) CONTROL MODULE FUNCTION

id091100103700

- A fail-safe function is adopted which reverses the operation or stops it if an abnormal signal is detected from any part.
- A self-diagnostic function has been adopted which can verify the failed parts and malfunction.

POWER LIFTGATE (PLG) CONTROL MODULE CONSTRUCTION/OPERATION

id091100104500

Fail-safe Function

- The PLG control module monitors each input/output part, and if a malfunction is detected, performs the following actions.

Item	Detection Condition	Action after detection	Auto operation return
Rotation sensor malfunction	• Pulse signal A fixed at high or low is detected • Pulse signal B fixed at high or low is detected • Abnormal pulse count detected • Reverse direction pulse detected for operation direction	Auto operation stop (Clutch off)	Liftgate closed
Damper damage	After auto open operation or emergency stop (Clutch off), a sudden pulse in the close direction is detected	Auto close operation	Liftgate closed
PLG motor over-current	Over-current in PLG motor	Auto operation stop (Clutch off)	Liftgate closed or open
Continuous reverse	• Switch is operated continuously • Continuous obstruction detected	Auto operation stop (Clutch off)	Liftgate closed or open
PLG motor failure	PLG motor GND fault detection	Auto operation stop (Clutch off)	Liftgate fully closed
ECU failure	PLG motor FET ON fault detection	Auto operation stop (Clutch off)	Liftgate fully closed

ON-BOAD DIAGNOSTIC OUTLINE

id091100104800

- Self-diagnosis functions include the failure detection that comprehensively detects the failure of PLG system-related parts, and memory function that memorizes the detected failure, and the data monitor function that retrieves a particular input and output signal.
- You can retrieve and delete service codes and monitor data by using Mazda Modular Diagnostic System (M-MDS).

ON-BOAD DIAGNOSTIC PID DATE MONITOR FUNCTION

id091100103800

Self-diagnosis Function

Malfunction detection function

- Detects overall malfunctions in the PLG system-related parts.

Memory function

- Stores malfunctions in the PLG 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 disconnected.

DTC table

DTC Mazda Modular Diagnostic System (M-MDS) DISPLAY	SYSTEM MALFUNCTION LOCATION
B1311	Unlock switch circuit open
B1318	Power supply voltage decreases
B1342	PLG control module internal malfunction
B241A	PLG touch sensor circuit malfunction
B266A	Rotation sensor circuit malfunction
B266B	Rotation sensor A circuit malfunction
B266C	Rotation sensor B circuit malfunction
B266E	Rotation sensor malfunction
B267A	Half latch switch circuit malfunction
B267B	Full latch switch circuit malfunction
B267C	Return switch circuit malfunction
B2699	PLG touch sensor (LH) circuit malfunction
B2700	PLG touch sensor (RH) circuit malfunction
B2701	PLG touch sensor (LH) circuit malfunction
B2702	PLG touch sensor (RH) circuit malfunction
B2821	Closure motor circuit malfunction
B2936	PLG motor circuit malfunction
B2937	PLG motor circuit malfunction
B2939	Clutch circuit malfunction
U0073	Unit communication error
U0100	Communication error to PCM
U0101	Communication error to TCM
U0140	Communication error to BCM
U0155	Communication error to instrument cluster
U0214	Communication error to keyless control module

PID/DATA Monitor Function

- The data monitor function is used for optionally selecting input/output signal monitor items preset in the PLG and reading them out in real-time.
- Use the Mazda Modular Diagnostic System (M-MDS) to read the PID/data monitor.

PID/DATA monitor table

NAME (DEFINITION)	DATA CONTENTS	UNIT/OPERATION	TERMINAL
DTC_CNT	Number of continuous DTCs	—	—
LAT_FULL	Liftgate latch and lock actuator (full latch switch)	Off / On	3G
LAT_HALF	(Liftgate latch and lock actuator (half latch switch)	Off / On	3H
LAT_RTN	Liftgate latch and lock actuator (return switch)	Off / On	3E
MTR_CLS_CL	Closure motor (CLOSE)	Off / On	1A
MTR_CLS_OP	Closure motor (OPEN)	Off / On	1B
MTR_PLG_C	PLG motor current	A	1E, 1F
MTR_PLG_CL	PLG motor (CLOSE)	Off / On	1F
MTR_PLG_OP	PLG motor (OPEN)	Off / On	1E
PWR_IG1	Ignition 1 (IG1) electric source	Off / On	2A
SW_CCL	Liftgate latch switch	Off / On	3F
SW_MAIN	PLG front switch	Off / On	3Q
SW_SUB	PLG rear switch	Off / On	2B
TCH_L_FLT	PLG touch sensor (LH) failure	OK / Fault	3B
TCH_L_ST	PLG touch sensor (LH) condition	Off / On	3B
TCH_L_V	PLG touch sensor (LH) voltage	V	3B
TCH_R_FLT	PLG touch sensor (RH) failure	OK / Fault	3A
TCH_R_ST	PLG touch sensor (RH) condition	Off / On	3A
TCH_R_V	PLG touch sensor (RH) voltage	V	3A
VPWR	Module supply voltage	V	2O

09-12 GLASS/WINDOWS/MIRRORS

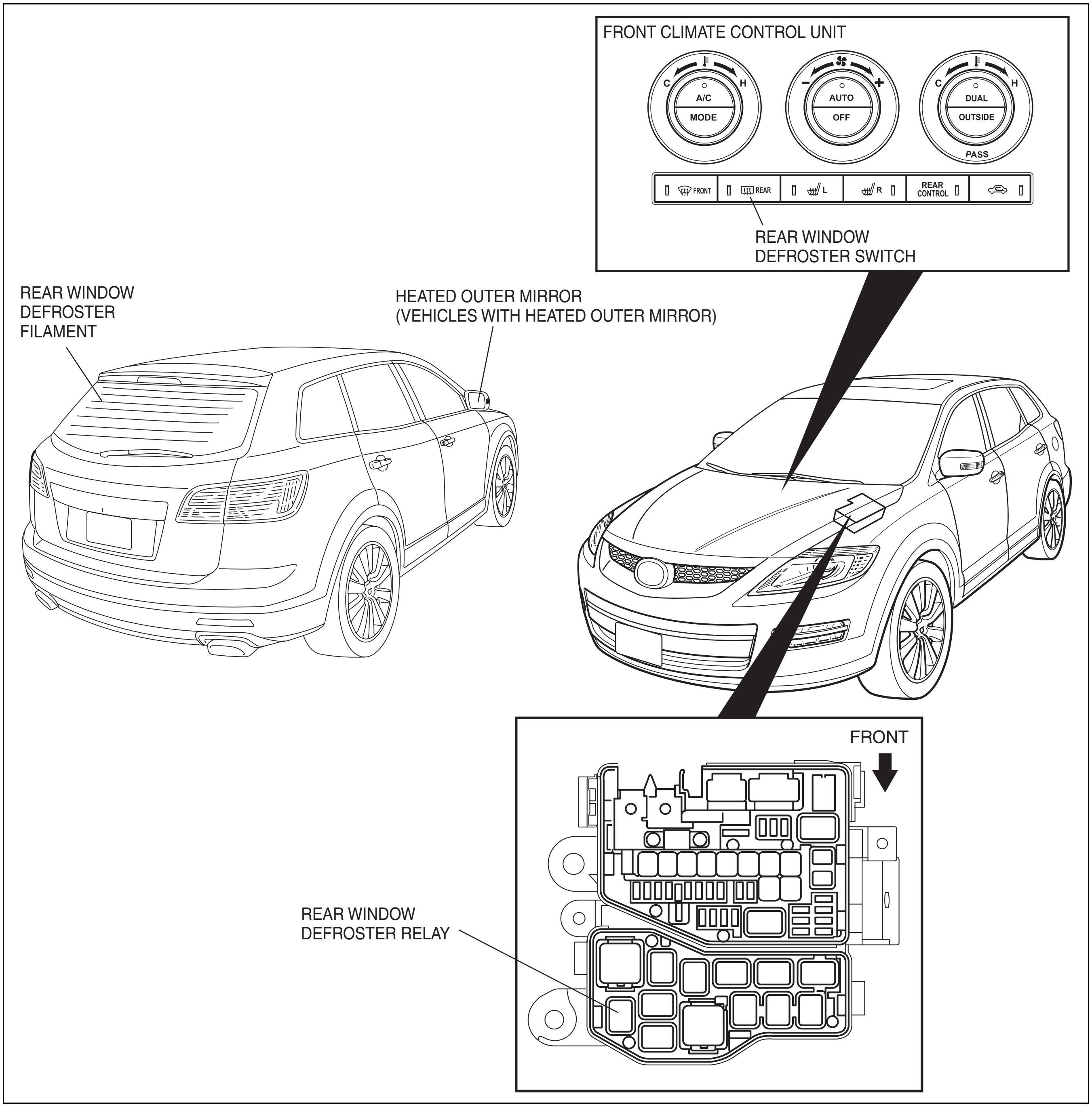
REAR WINDOW DEFROSTER SYSTEM OUTLINE

id091200100400

Improved visibility	• Rear window defroster adopted • Heated outer mirror adopted (Vehicles with heated outer mirror)

REAR WINDOW DEFROSTER SYSTEM STRUCTURAL VIEW

id091200100500



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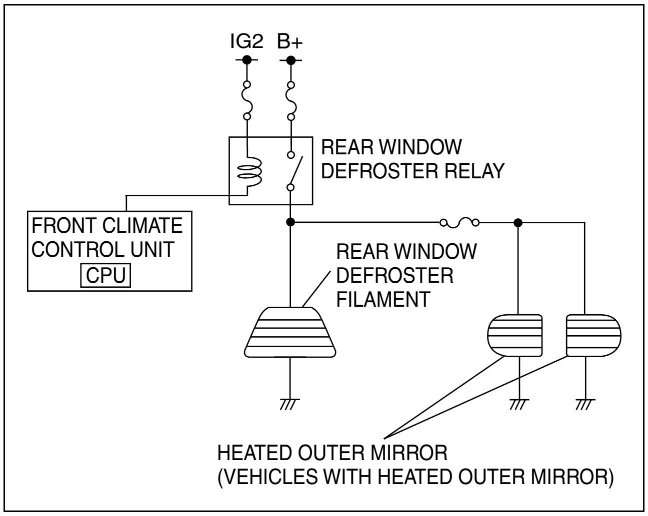
REAR WINDOW DEFROSTER SYSTEM WIRING DIAGRAM

id091200101200

- The rear defroster and the left and right heated outer mirrors (Vehicles witch heated outer mirrors) operate by turning the rear defroster switch on.
- The rear defroster and the heated outer mirrors (Vehicles witch heated outer mirrors) operate as follows:
  1. A signal is input to the microcomputer in the climate control unit when the rear defroster switch is turned on.
  2. The microcomputer in the front climate control unit turns on the rear defroster relay to operate the rear defroster and the heated outer mirrors (Vehicles witch heated outer mirrors).
  3. After 15-17 min have elapsed from the time the rear defroster switch was turned on, the timer control of the microcomputer in the climate control unit automatically turns off the rear defroster relay to stop the operation of the rear defroster and the heated outer mirrors (Vehicles witch heated outer mirrors).



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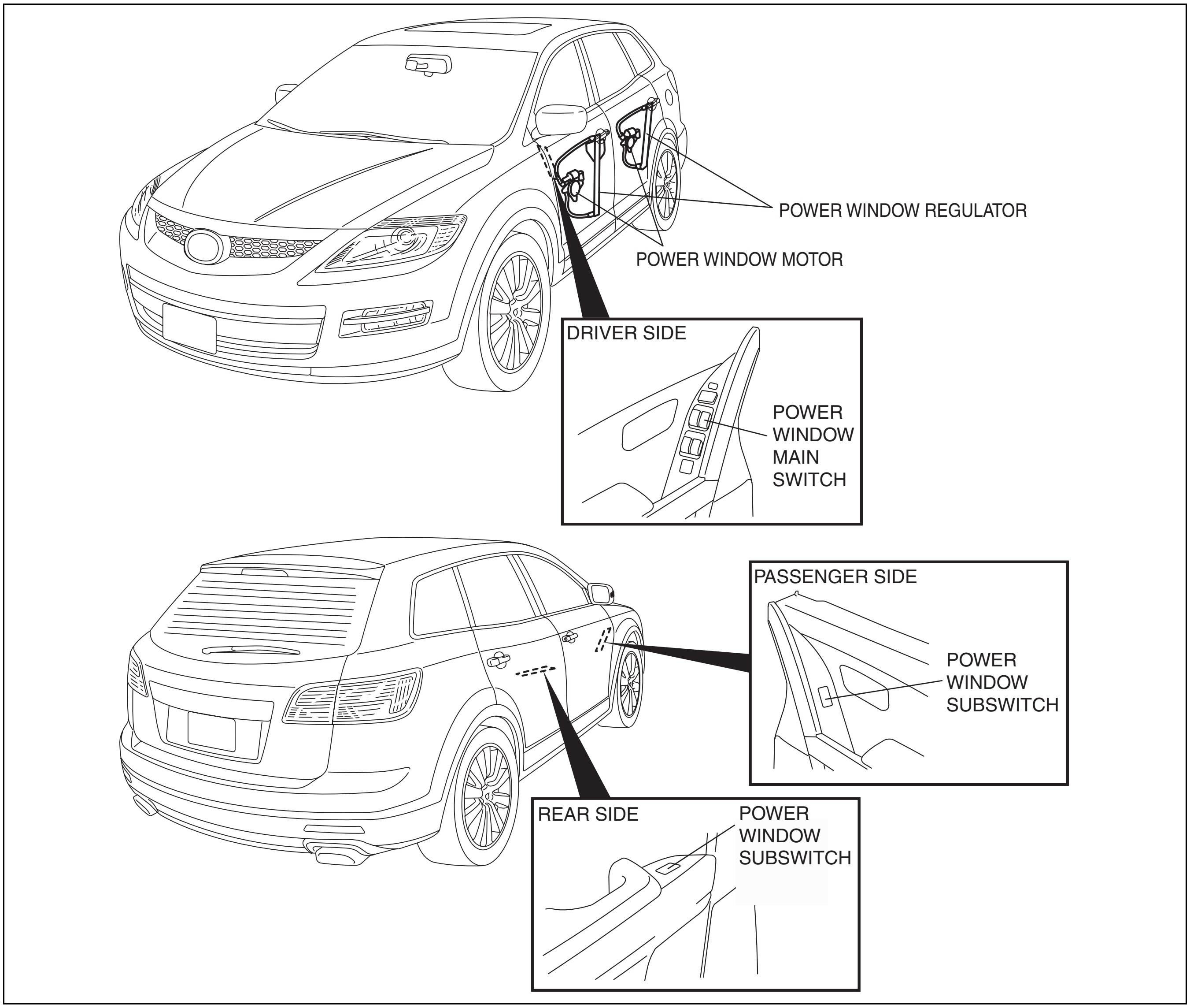
POWER WINDOW SYSTEM OUTLINE

id091200100100

- The power window system has the following functions.
  — Auto-open/close function
  — Auto reverse pinch protection function
  — Two-step down function
  — Ignition off timer function
  — Fail-safe function

POWER WINDOW SYSTEM STRUCTURAL VIEW

id091200100200



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POWER WINDOW SYSTEM WIRING DIAGRAM

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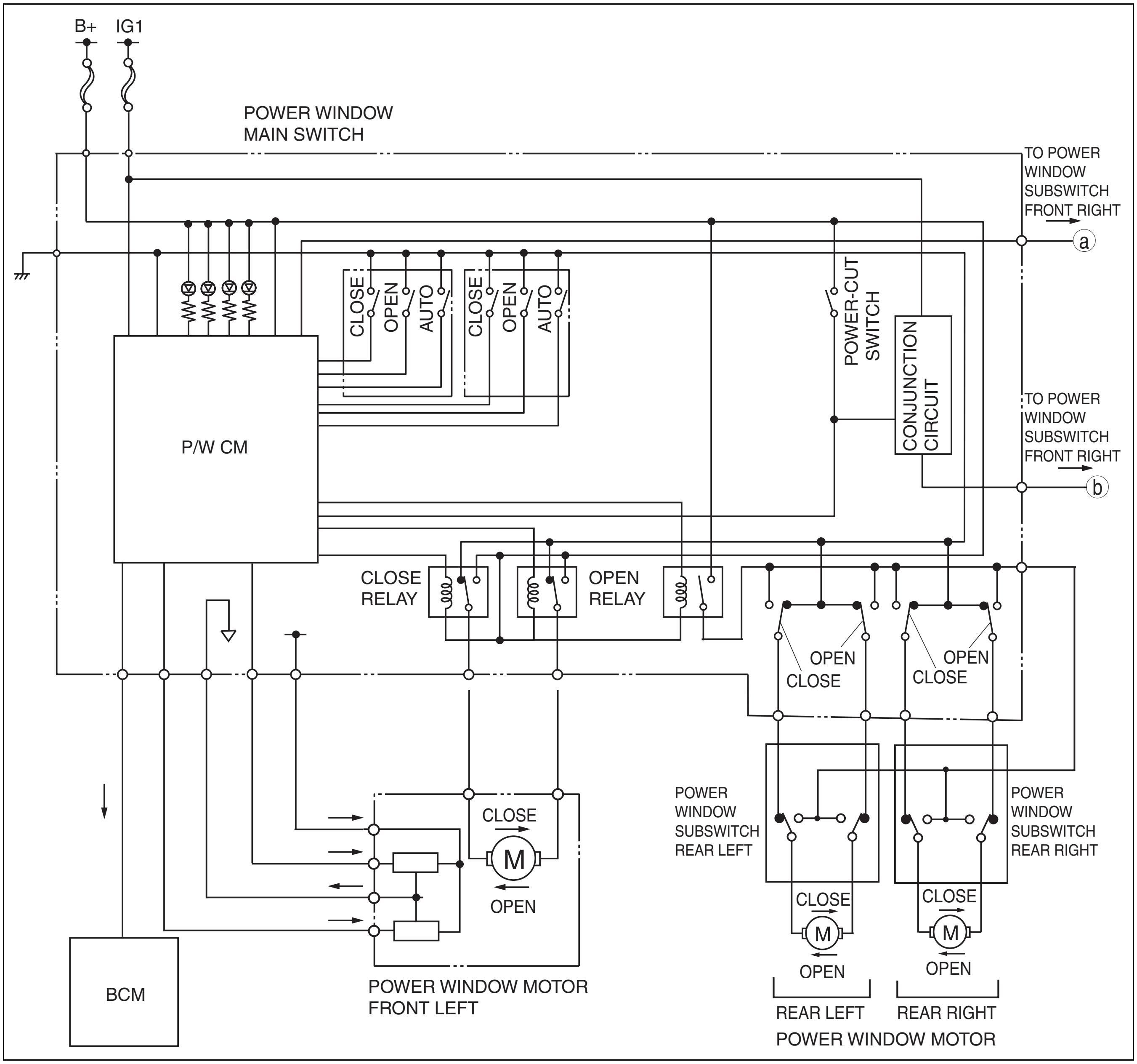

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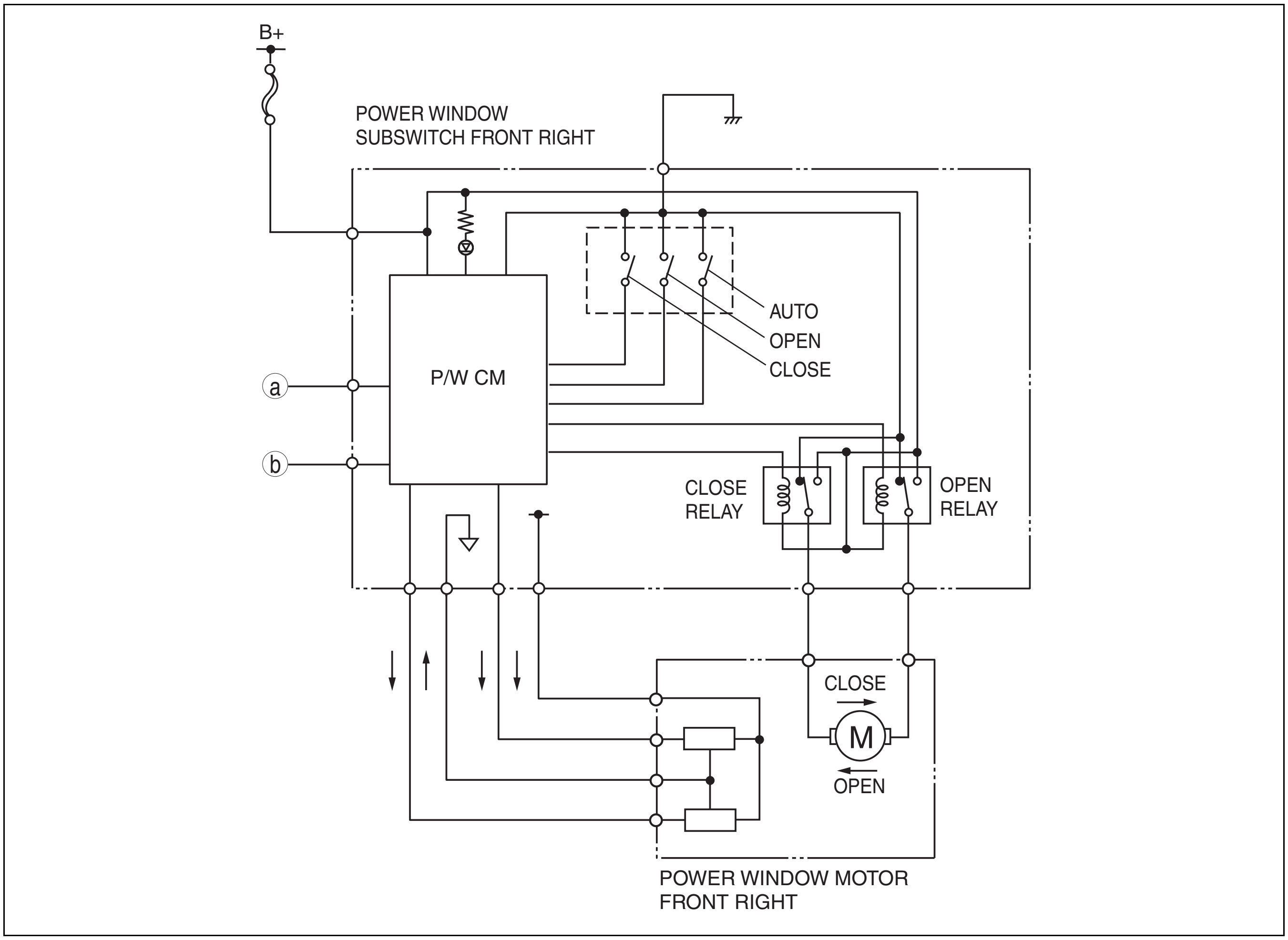

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POWER WINDOW SYSTEM OPERATION

id091200101100

Manual Open/Close Function

- The window opens/closes according to the down (push) or up (pull) operation of the power window main switches and the power window subswitches.

Auto-Open/Close Function (Front windows)

- The front windows automatically moves to a fully-opened or closed position when the power window main switches or the power window subswitche is operated two times, either down (push) or up (pull).
- If the following operations have been performed, initial setting is reset, and auto up/down and two-step down operation are disabled. Therefore, performing initial setting is necessary.
  - — Negative battery cable disconnected or power window system power supply fuse removed. (perform initial setting for the switches of all seats.)
  - — Power window switch connector disconnected. (Perform initial setting for the switch connected with the connector.)
  - — Prolonged open/close operation of the power window main or sub switches causes the circuit breaker to activate and automatic operation is disabled.
- The driver-side power window initialization procedure can be performed only using the power window main switch.
- The passenger-side power window initialization procedure can be performed using the power window main switch and subswitch (Passenger side).
- If the power window initialization procedure is not completed, the power window (Driver and passenger sides) does not operate automatically. Each power window can be operated only in manual operation.

Auto Reverse Pinch Protection Function (Front windows)

- If any object is pinched in the window during auto-close operation, the window automatically opens approx. 200 mm {7.9 in}.

Two-step Down Function

- If a switch is lightly pushed (manual open operation) when the window is completely closed, the window lowers a set distance. (Initial setting is approx. 30 mm {1.2 in}.)
- If the manual open operation is performed with the two-step down function enabled, the window will always stop momentarily. (This is not a malfunction.)
- The set distance the window goes down can be changed. (Within a range of approx. 20-100 mm {0.79-3.9 in}.)
- The two-step down function can be disabled. (Initial setting is enabled)
- If the operation of the auto open/close, manual close or window obstruction is detected during two-step down function operation, these other operations are given priority.
- Does not function during IG OFF Timer operation.

Ignition Off Timer Function

- Allows operation of the driver's power window for approx. 40 s after the ignition switch has been turned from the ACC to the LOCK position.However, when the front door is opened/closed during IG OFF timer, the function stops.

Fail-safe Function

- The power window system is switched to fail-safe mode to prevent a malfunction when the P/W CM detects a malfunction in the pulse signal (Hall IC).

Detection condition	IG switch ON	IG switch OFF	Recovery items
Hall effect switch 1 (for jam-safe and window position detection) operation malfunction • During up/down movement, Hall effect switch 2 pulse detected but Hall effect switch 1 pulse not detected	Automatic operation prohibited	Automatic and manual operation prohibited	During up movement, pulse signals for Hall effect switches 1 and 2 detected normally, and fully closed position return/non-return ranges redetected
Hall effect switch 2 (for window movement direction detection) operation malfunction • During up/down movement, Hall effect switch 1 pulse detected but Hall effect switch 2 pulse not detected			
Pulse signal malfunction detected (Inversion of input signals of or large phase deviation between, Hall effect switch 1 and 2.) • During up/down movement, difference detected between the direction signals from Hall effect switches 1 and 2, and actual direction			
Non-return range downturn malfunction • During up movement, the signal input from Hall effect switch 1 higher than the position stored in the P/W main switch			
Hall effect switches 1 and 2 operation malfunction • Hall effect switches 1 and 2 pulse signal not detected after down movement initiated from the fully closed position			

EXTERIOR OPEN/CLOSE FUNCTION OUTLINE

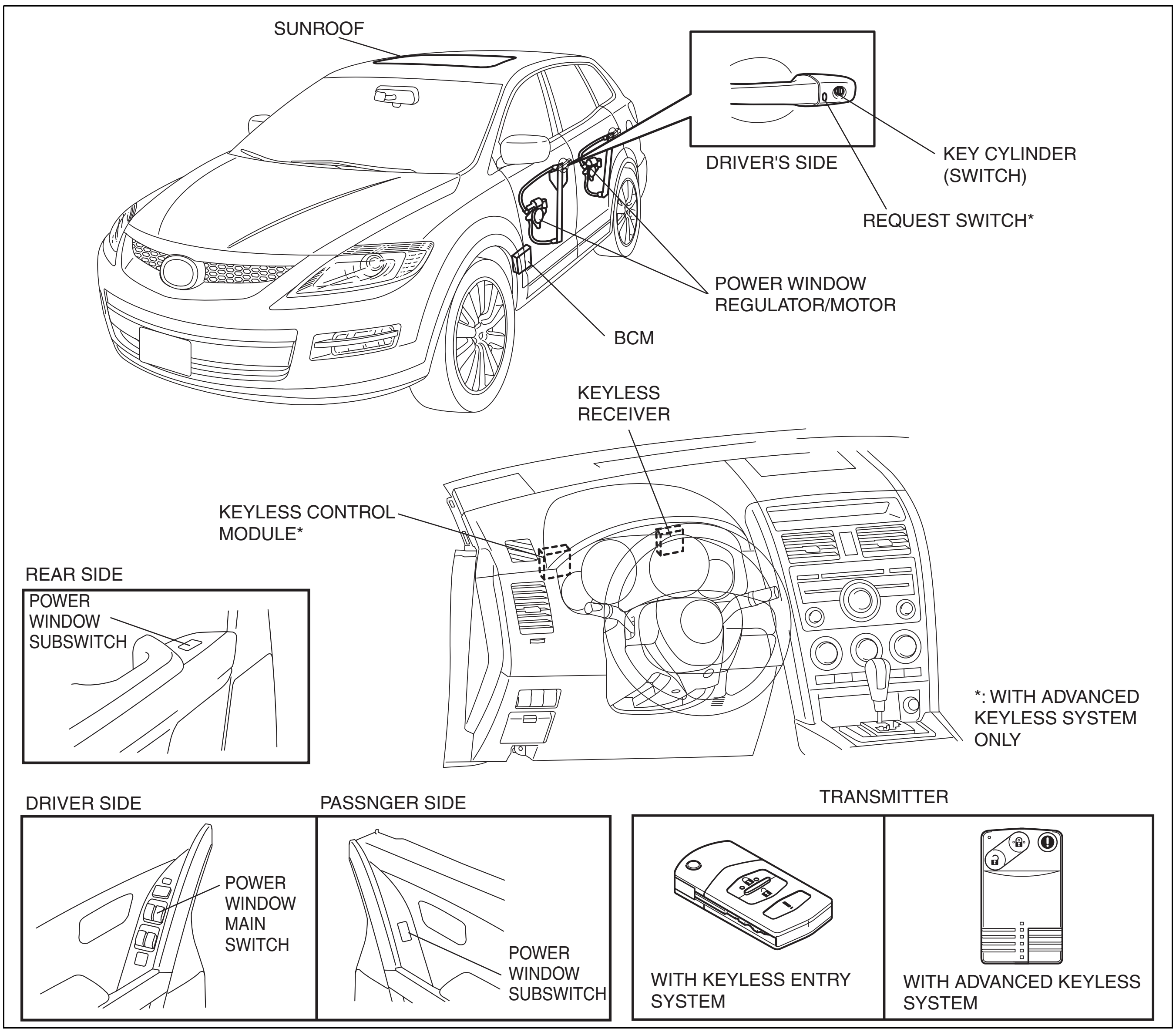
id091200102000

- A exterior open/close function has been adopted so that the power window system and sunroof can be operated from outside the vehicle.
- This system can operate in conjunction with the following:
  — Transmitter (open operation only)
  — Driver-side door key cylinder
  — Driver-side request switch (with advanced keyless system, close operation only)
- An automatic reverse function operates if the door glass is obstructed during close operation.

Operation item	Open operation	Close operation (Manual close)
Transmitter	(Manual open) UNLOCK button operation (press once, then press again within 1.5 s and hold)	—
Driver-side key cylinder	(Automatic open) UNLOCK operation (hold approx. 2.2 s or more)	LOCK operation (hold, approx. 1.5 s or more)
Request switch (With advanced keyless system)	—	Long press, approx. 1.5 s or more

EXTERIOR OPEN/CLOSE FUNCTION STRUCTURAL VIEW

id091200102100



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EXTERIOR OPEN/CLOSE FUNCTION BLOCK DIAGRAM

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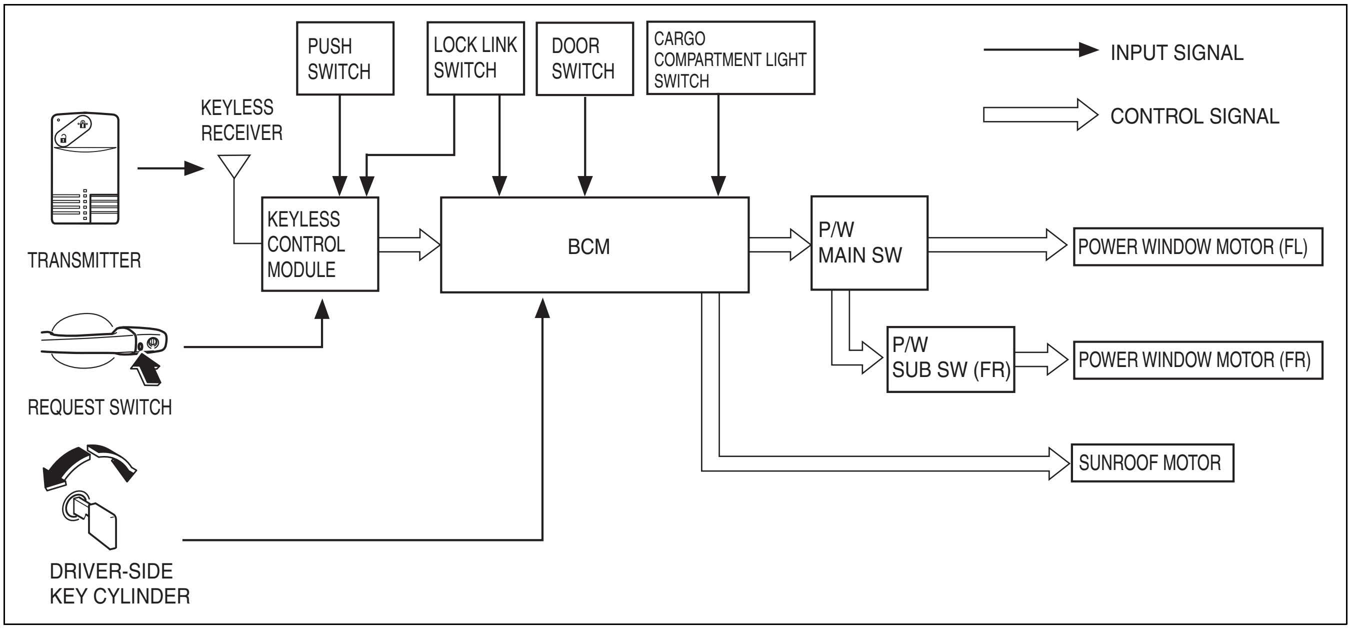
With Advanced Keyless System



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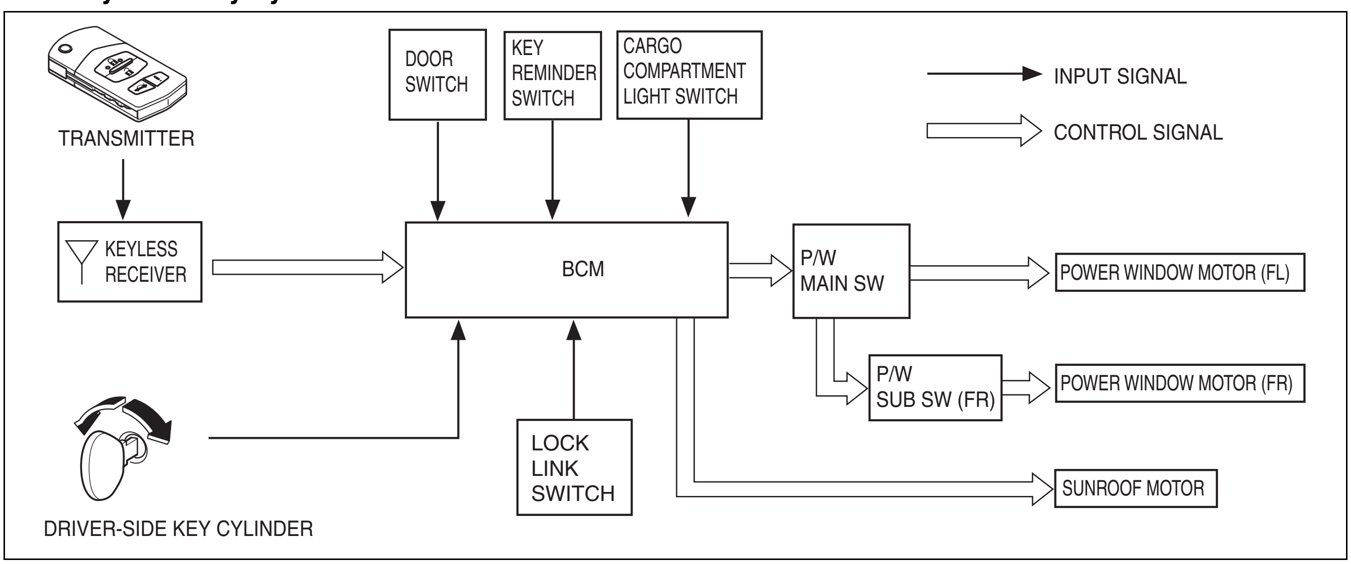
With Keyless Entry System



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EXTERIOR OPEN/CLOSE FUNCTION OPERATION

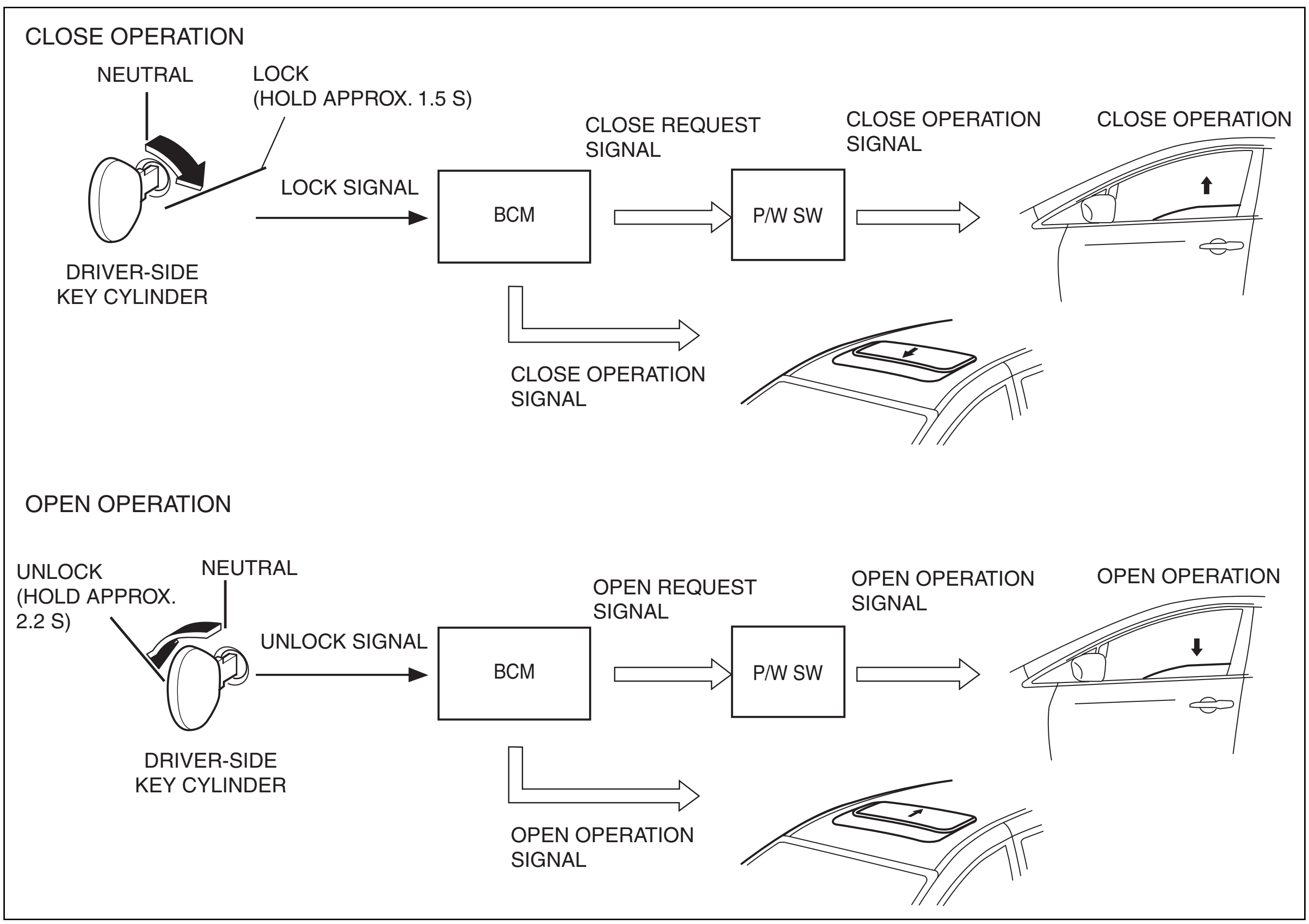
id091200102300

- With the system, front door glass and sunroof can open/close in conjunction with the LOCK/UNLOCK operation of the driver-side key cylinder, transmitter, and request switch (with advanced keyless system).
- During IG OFF timer operation (power window system operates approx. 40 s after IG OFF), the power window switch operation has priority over the exterior open/close function.
- Automatic reverse operation has priority when the door glass is obstructed during close operation.
- The BCM sends the signal requiring the open/close operation to the power window control unit (power window main switch) based on the signals input from the switches.
  The BCM also sends the open/close operation signal to the sunroof motor based on the signals input from the switches, and operates the sunroof.
- The power window control unit (power window main switch) sends open/close operation signal to the power window motor based on the required signal, and operates the door glass.

Open/Close Function/Operation in Conjunction with Key Operation

- Insert the key into the driver-side door key cylinder, hold in the LOCK or UNLOCK position for approx. 1.5 s (LOCK)/2.2 s (UNLOCK) or more to open/close the door glass and the sunroof.
- When the door glass or the sunroof is open; if the key is held in the LOCK position for approx. 1.5 s or more, the glasses perform manual close operation. When the key is returned to the neutral position, the operation stops.
- When the door glass or the sunroof is not fully open; if the key is held in the UNLOCK position for approx. 2.2 s or more, the glasses perform automatic open operation, and fully open the glasses. When the key is operated again[*1] during the automatic open operation, it stays in that position.

*1 : The operation direction can be either the LOCK/UNLOCK. Also, the holding time is not factored.



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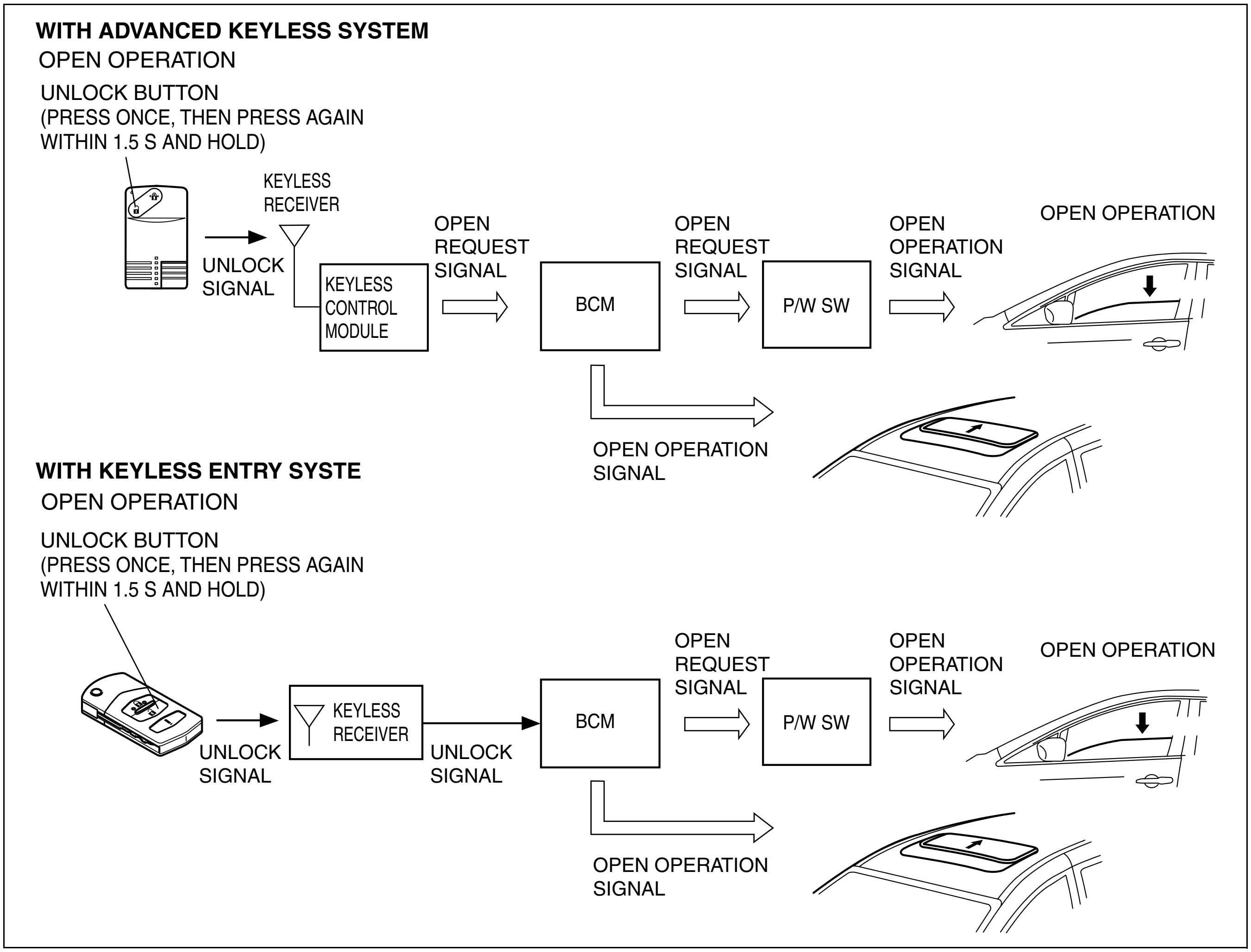
Open Function/Operation in Conjunction with Transmitter

- When the door glass or the sunroof is not fully open, press the UNLOCK button once, then press again within 1.5 s and hold the button pressed, and the glasses perform manual open operation. If the UNLOCK button is released, manual open operation stops in that position.



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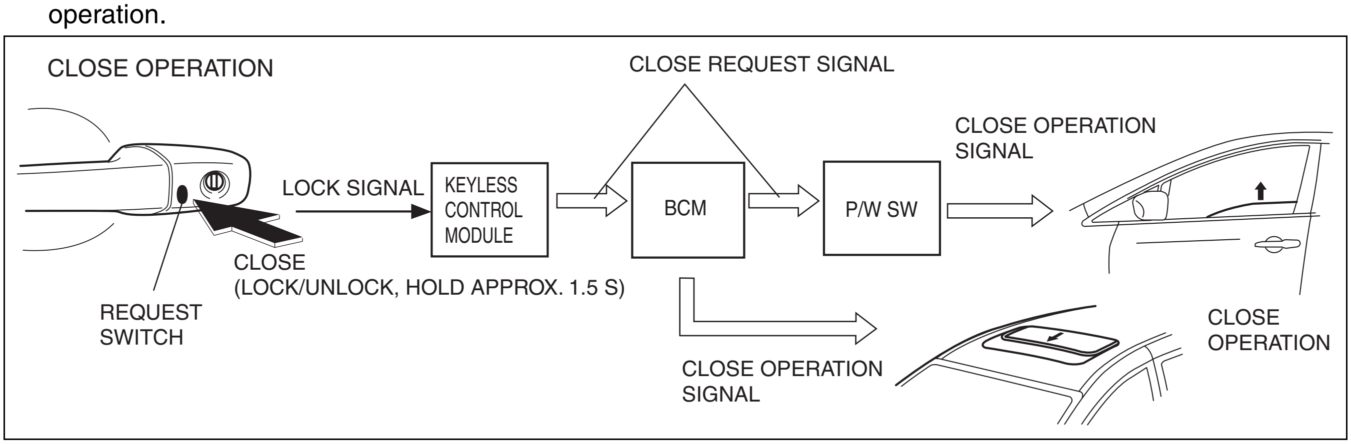
Close Function/Operation in Conjunction with Request Switch

- If the driver-side request switch is operated and held for approx. 1.5 s or more while the card key (transmitter) is within the reception area and the door glass or the sunroof is open, the glasses perform manual close operation. When the switch is released, the operation stops.
- During the operation, when the open/close function in conjunction with the key operation is performed, or the open/close function in conjunction with the transmitter is performed, these functions have priority over the operation.



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Operation Prohibition/Stop Condition

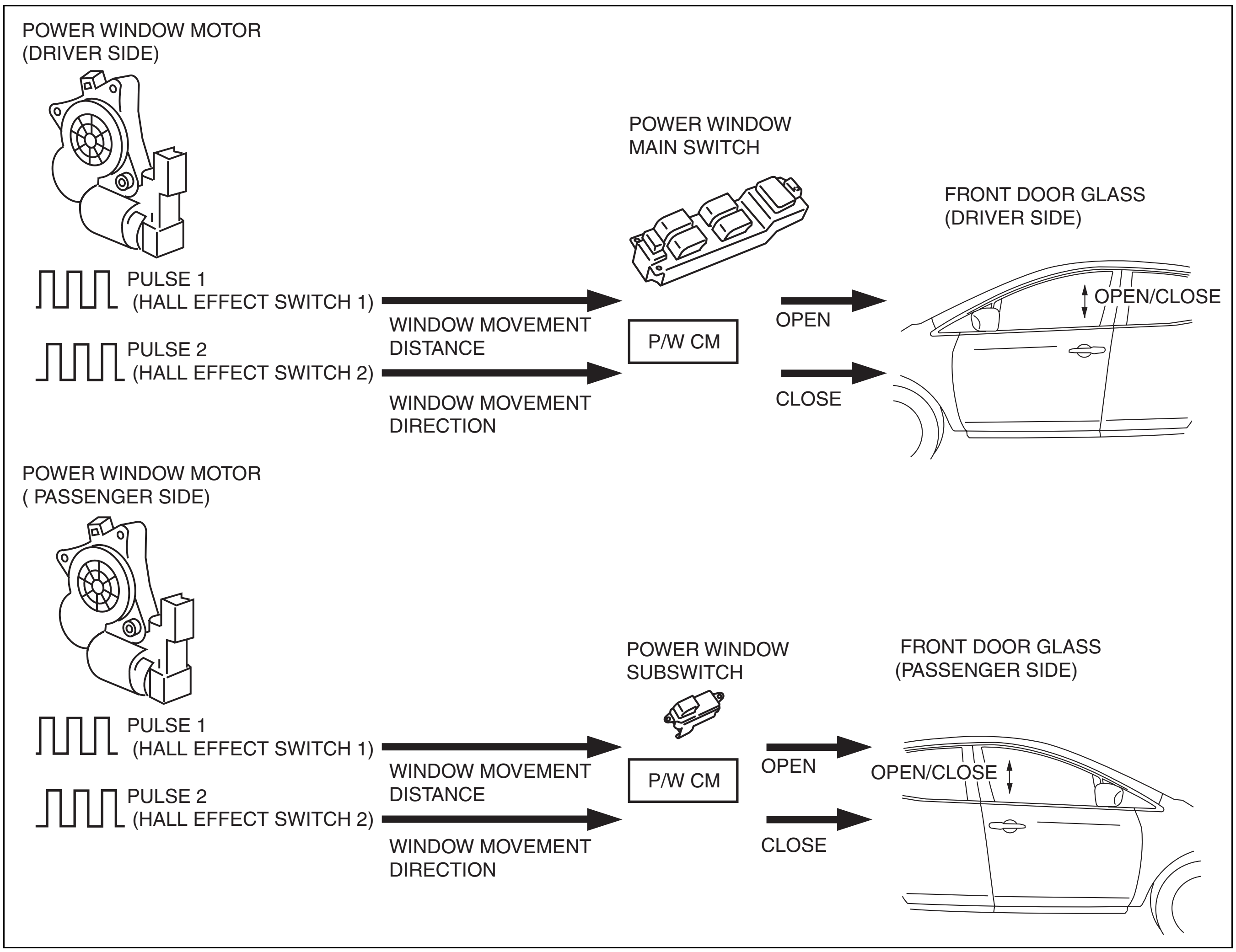
- When the following conditions are met before the operation, the exterior open/close function does not operate. Also, if the conditions are met during the operation, the operation stops.
  - — Either door/liftgate is open (when the door switch or cargo compartment light switch is ON)
  - — The key is inserted in the steering lock (when the keyless switch is ON)
  - — The push switch is pressed in or the start knob (ignition switch) is in a position other than the LOCK (with advanced keyless system)
  - — The transmitter is not in the reception area

POWER WINDOW SWITCH CONSTRUCTION

id091200101300

- Manual-open/close can be performed for all door glasses by operation of the power window main switches.
- Manual-open/close can be performed for each specific window by operation of the switches at the all door glasses.
- Auto-open/close can be performed for front windows by operation of the power window main switches.
- By locking the power cut switch, operation of the power window main switches for each door glasses and the power window subswitches is inhibited.
- A built-in P/W CM (power window control module) controls the power window system control based on the pulse signals from the power window motor.
- The position and movement direction of the window is stored at the time of vehicle delivery. Due to this, the initial position setting must be performed after performing any of the following procedures:
  - — Disconnecting the negative battery cable.
  - — Removing the power window system power supply fuse.
  - — Disconnecting the power window switch connector.

Block Diagram



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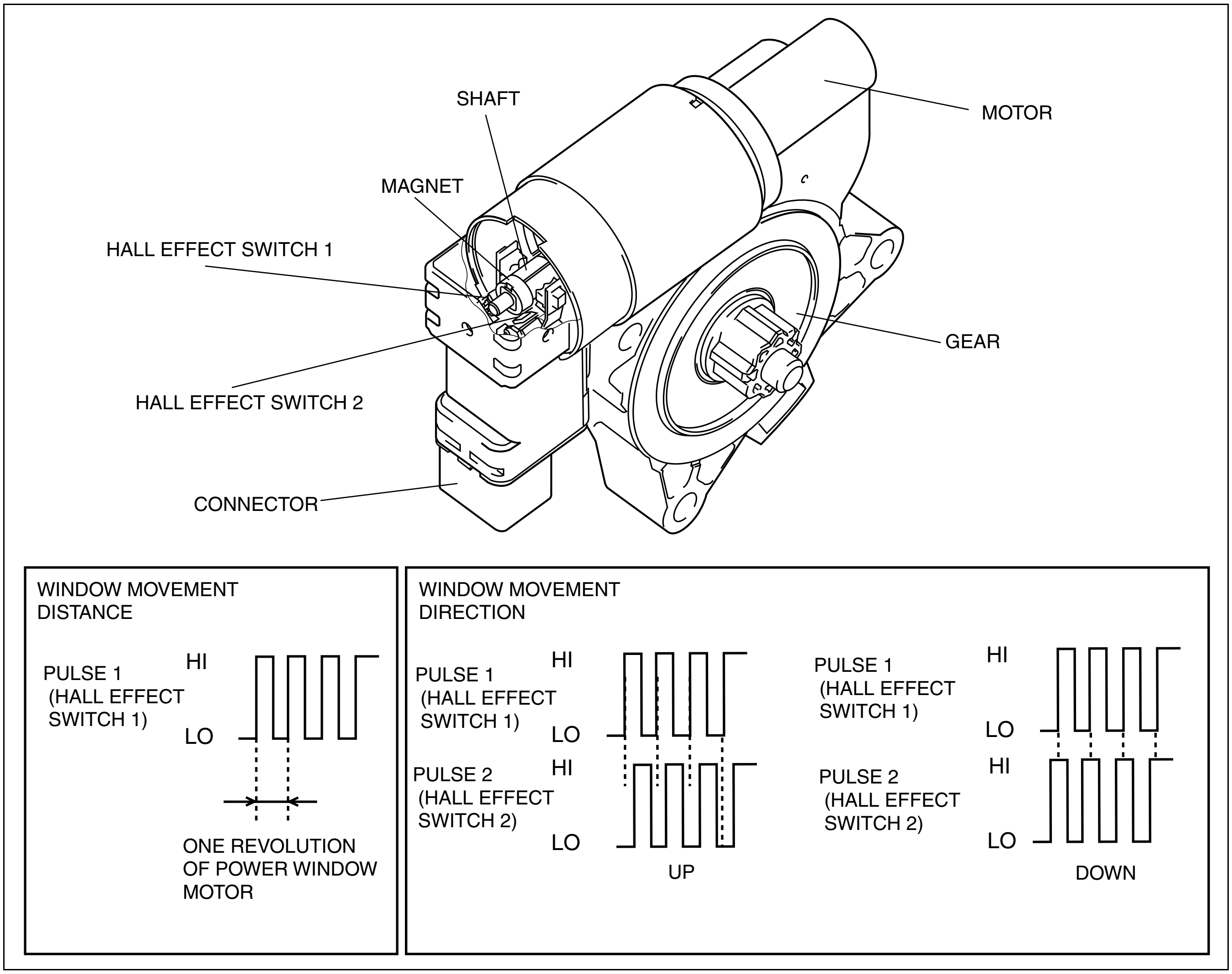
POWER WINDOW MOTOR CONSTRUCTION

id091200101400

- Consists of a motor, connector, and gear.
- Two Hall effect switches are located in the connector.
- The Hall effect switch utilizes magnets set on a rotating axis to detect the motor rotation, and outputs a synchronized pulse to the power window main switch.
- Hall effect switch 1 outputs one pulse cycle for each rotation of the power window motor axle and the power window main switch detects motor rotation speed from this.
- Hall effect switch 2 outputs pulse corresponding to motor rotation in the same manner as Hall effect switch 1. The high and low pulse points of Hall effect switches 1 and 2 are different during opening and closing because the phase difference shifts by 90°, allowing the power window main switch to detect the rotational direction of the power window motor.



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POWER OUTER MIRROR OUTLINE

id091200100700

Improved convenience	• Power outer mirror (mirror glass adjusting function) adopted
Improved visibility	• Heated outer mirror adopted (See 09-12-3 REAR WINDOW DEFROSTER SYSTEM WIRING DIAGRAM.)

09-12

POWER OUTER MIRROR STRUCTURAL VIEW

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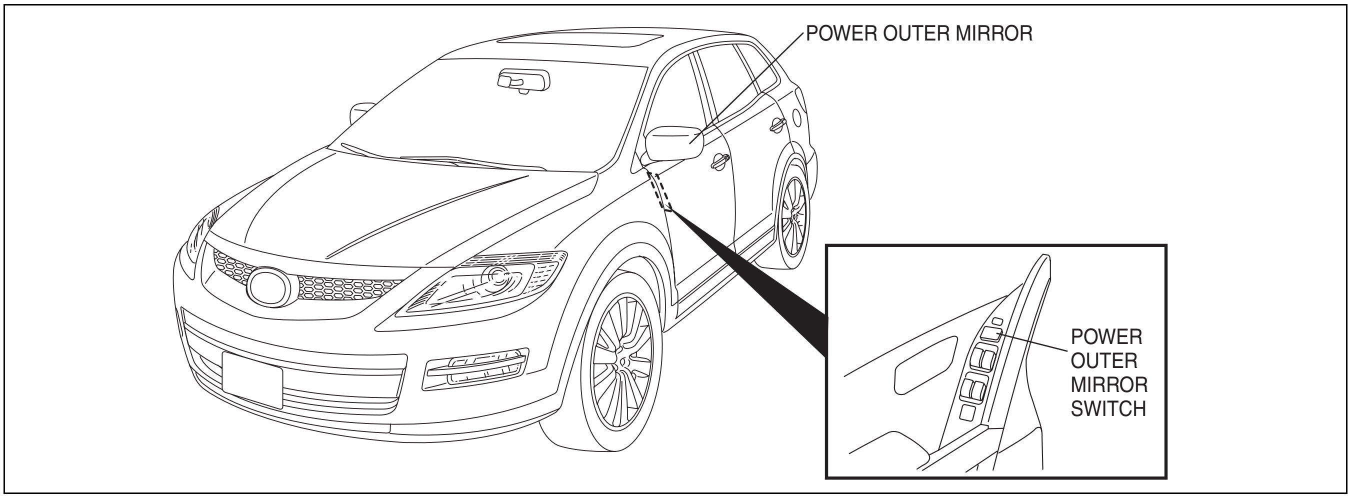

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POWER OUTER MIRROR SYSTEM WIRING DIAGRAM

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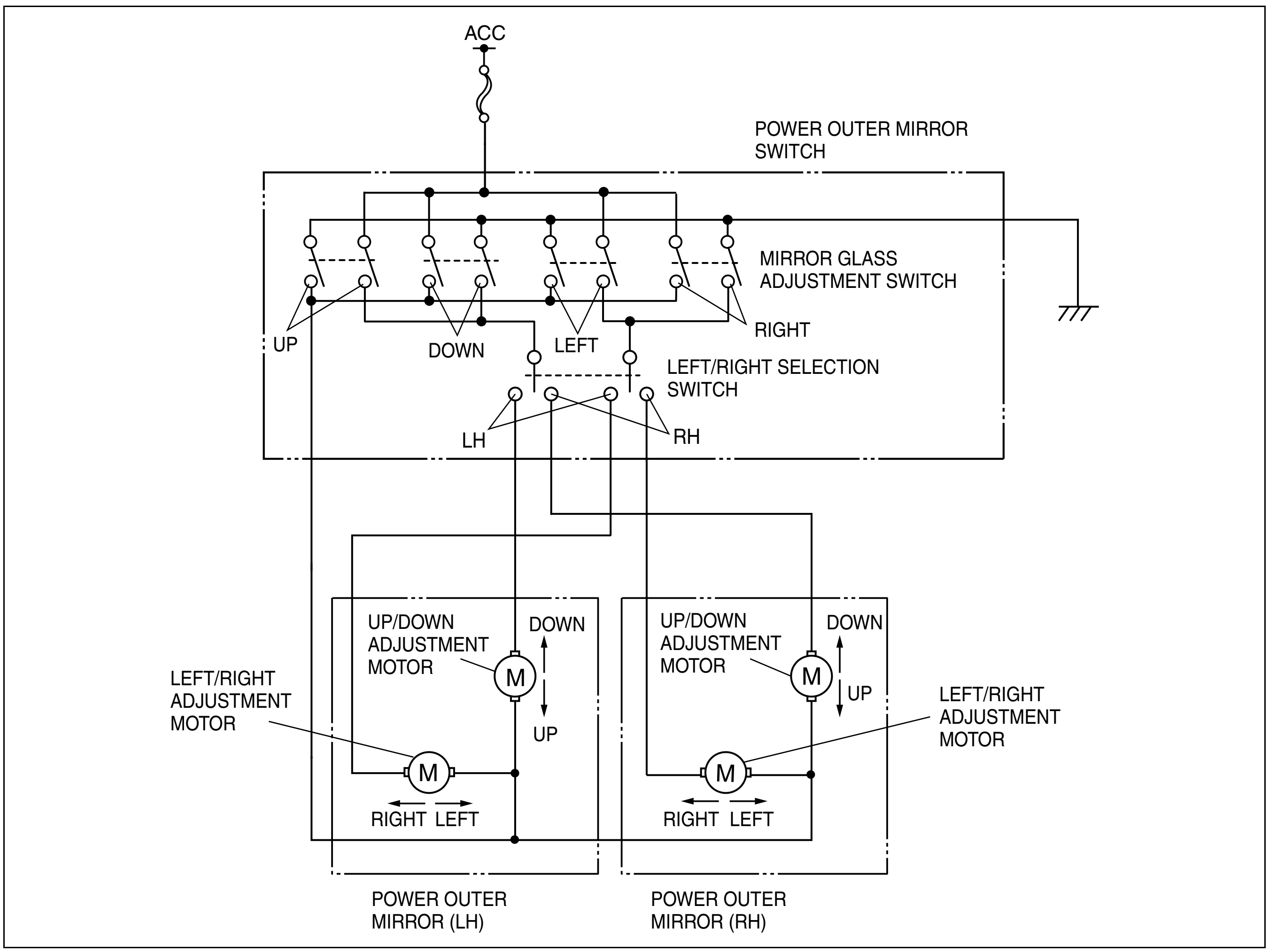

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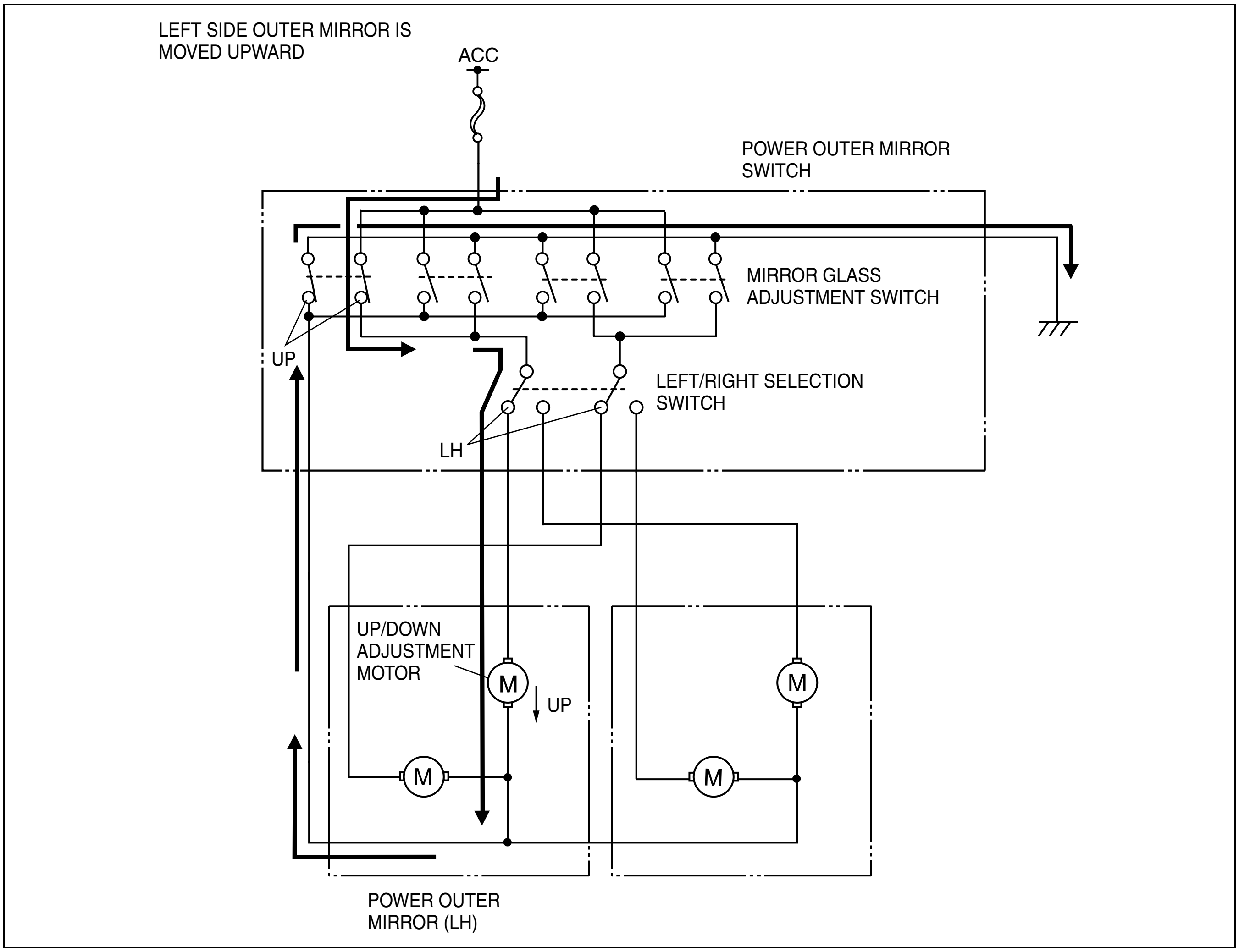
POWER OUTER MIRROR OPERATION

id091200101000

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.



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09-13 SEATS

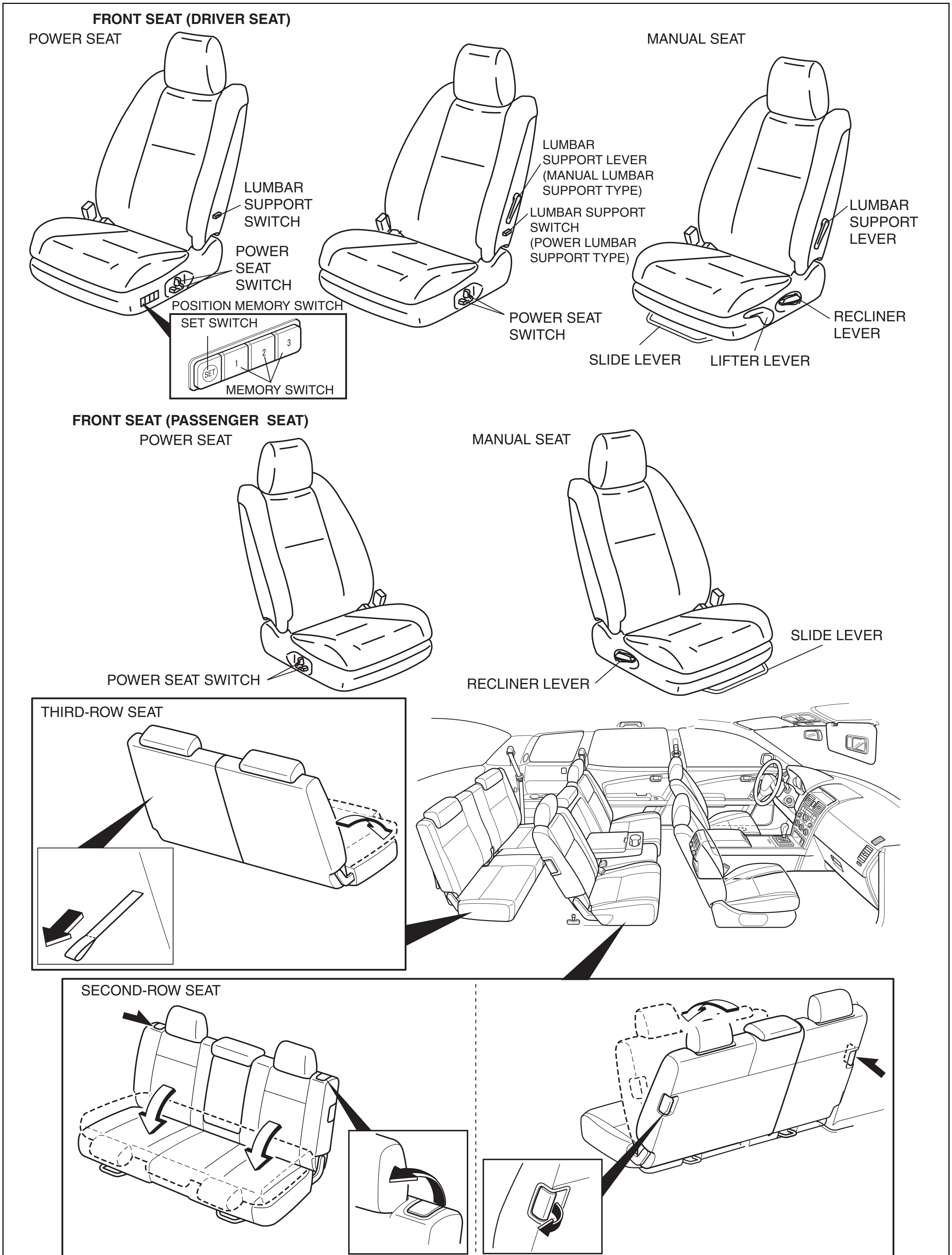
SEAT OUTLINE

id091300100100

Improved marketability	• Power seat has been adopted for the front seats. • Lumbar support has been adopted for the driver's seat. • Seat warmer has been adopted for the front seats.(Leather seat only) • Seat automatically slides to the seat position programmed in the position memory control module by operating the memory switch or unlocking the door using the transmitter.
Improved safety	• Built-in side air bag has been adopted for the front seats.

SEATS STRUCTURAL VIEW

id091300100300



ac9uun00000545

SEAT SPECIFICATION

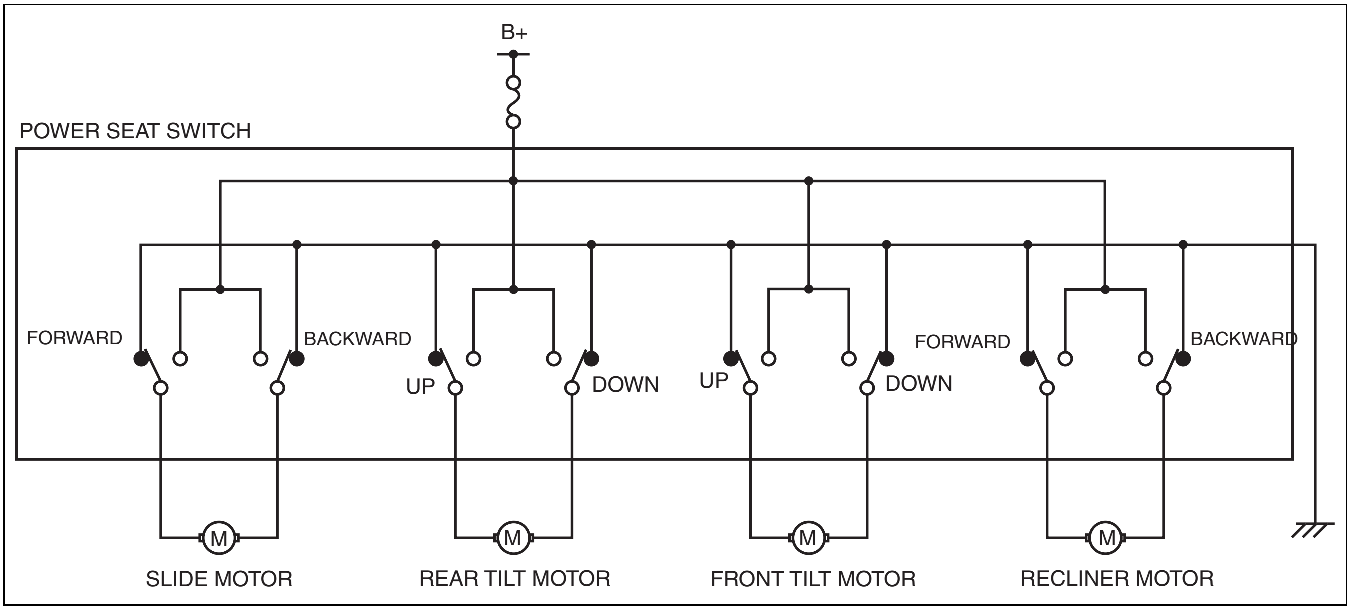
id091300100200

<table>
<tr><th>Item</th><th colspan="3">Function</th></tr>
<tr><td rowspan="22">Front seat</td><td rowspan="12">Drive seat</td><td rowspan="7">Power seat</td><td>Seat position memory (vehicles with seat position memory)</td></tr>
<tr><td>Recliner</td></tr>
<tr><td>Slide</td></tr>
<tr><td>Cushion lifter</td></tr>
<tr><td>Lumbar support (Power or manual)</td></tr>
<tr><td>Seat warmer</td></tr>
<tr><td>Seat track position sensor
(See 08-10-10 SEAT TRACK POSITION SENSOR FUNCTION.)</td></tr>
<tr><td rowspan="5">Manual seat</td><td>Recliner</td></tr>
<tr><td>Slide</td></tr>
<tr><td>Cushion lifter</td></tr>
<tr><td>Lumbar support lever</td></tr>
<tr><td>Seat track position sensor
(See 08-10-10 SEAT TRACK POSITION SENSOR FUNCTION.)</td></tr>
<tr><td rowspan="10">Passenger seat</td><td rowspan="5">Power seat</td><td>Recliner</td></tr>
<tr><td>Slide</td></tr>
<tr><td>Seat warmer</td></tr>
<tr><td>Seat weight sensor
(See 08-10-10 PASSENGER SENSING SYSTEM OUTLINE.)</td></tr>
<tr><td>Seat weight sensor control module
(See 08-10-10 PASSENGER SENSING SYSTEM OUTLINE.)</td></tr>
<tr><td rowspan="4">Manual seat</td><td>Recliner</td></tr>
<tr><td>Slide</td></tr>
<tr><td>Seat weight sensor
(See 08-10-10 PASSENGER SENSING SYSTEM OUTLINE.)</td></tr>
<tr><td>Seat weight sensor control module
(See 08-10-10 PASSENGER SENSING SYSTEM OUTLINE.)</td></tr>
<tr><td rowspan="4" colspan="3">Second-row seat</td><td>Recliner</td></tr>
<tr><td>Slide</td></tr>
<tr><td>Fold-down (6:4)</td></tr>
<tr><td>Armrest</td></tr>
<tr><td colspan="3">Third-row seat</td><td>Fold-down (5:5)</td></tr>
</table>

POWER SEAT SYSTEM WIRING DIAGRAM

id091300100400

Driver Seat



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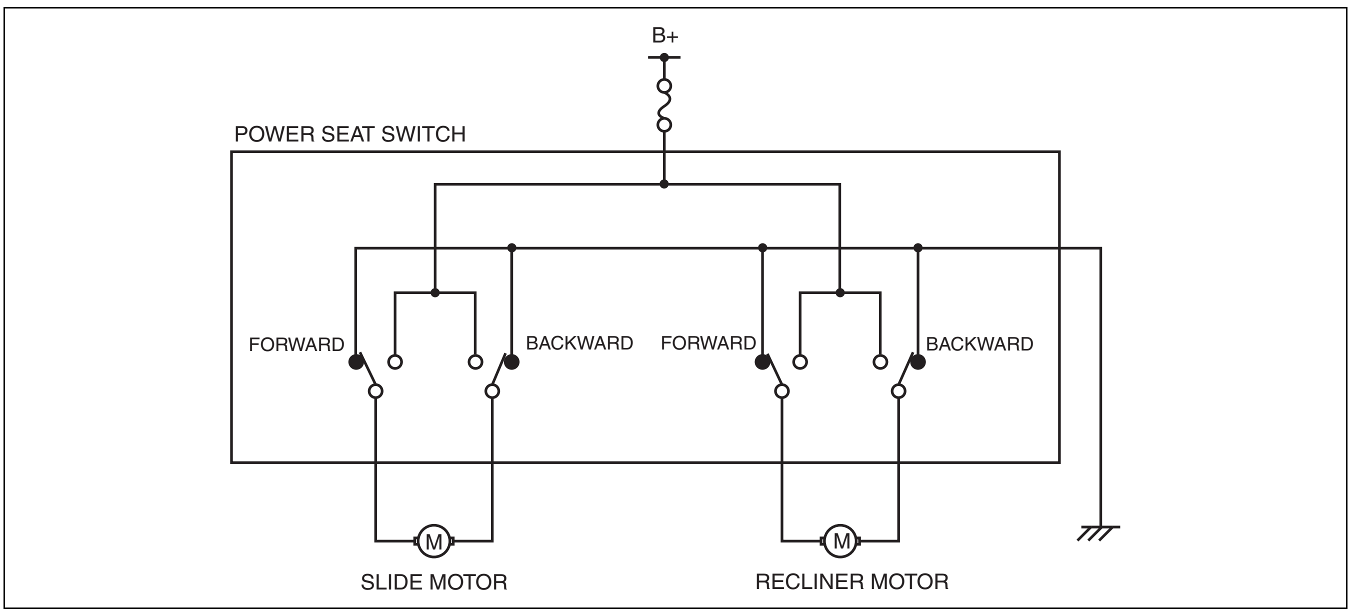
Passenger Seat



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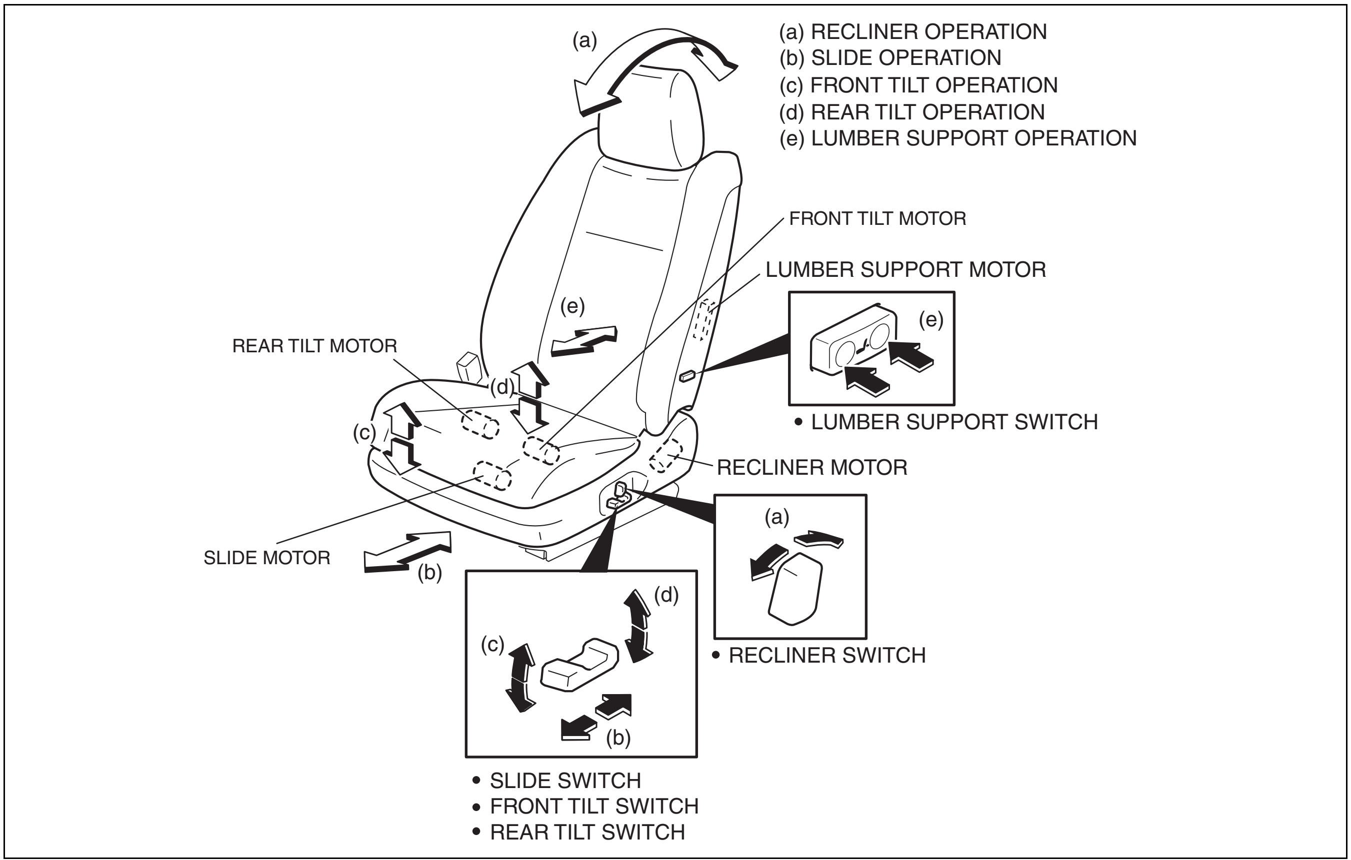
POWER SEAT CONSTRUCTION/OPERATION

id091300100500

- The following motors are built into the seat:
  — Slide motor
  — Recliner motor
  — Front tilt motor
  — Rear tilt motor
  — Lumber support motor
- The slide, front tilt and rear tilt switches are all operated by use of a single switch knob.



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SEAT POSITION MEMORY FUNCTION OUTLINE

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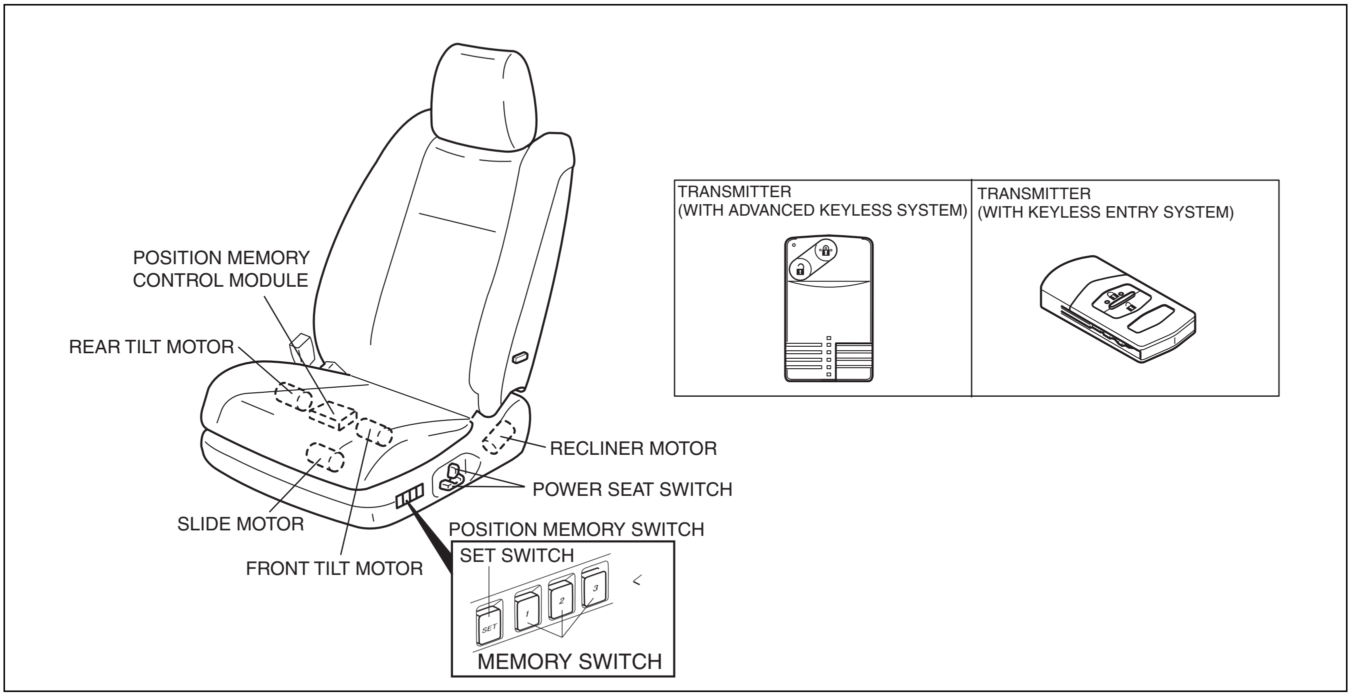
- Seat automatically slides to the seat position programmed in the position memory control module by operating the memory switch or unlocking the door using the transmitter.

SEAT POSITION MEMORY STRUCTURAL VIEW

id091300200300



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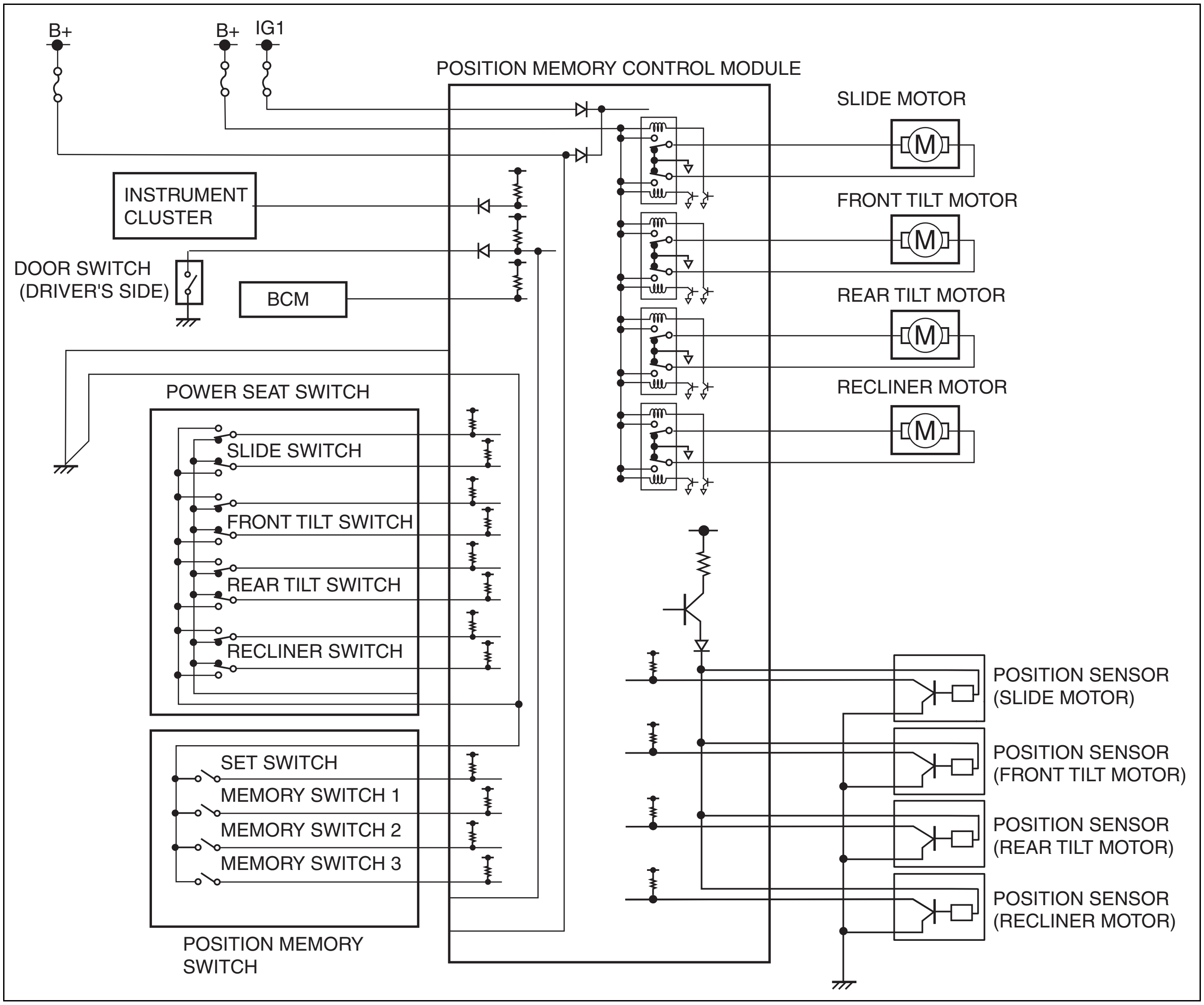
SEAT POSITION MEMORY WIRING DIAGRAM

id091300200200



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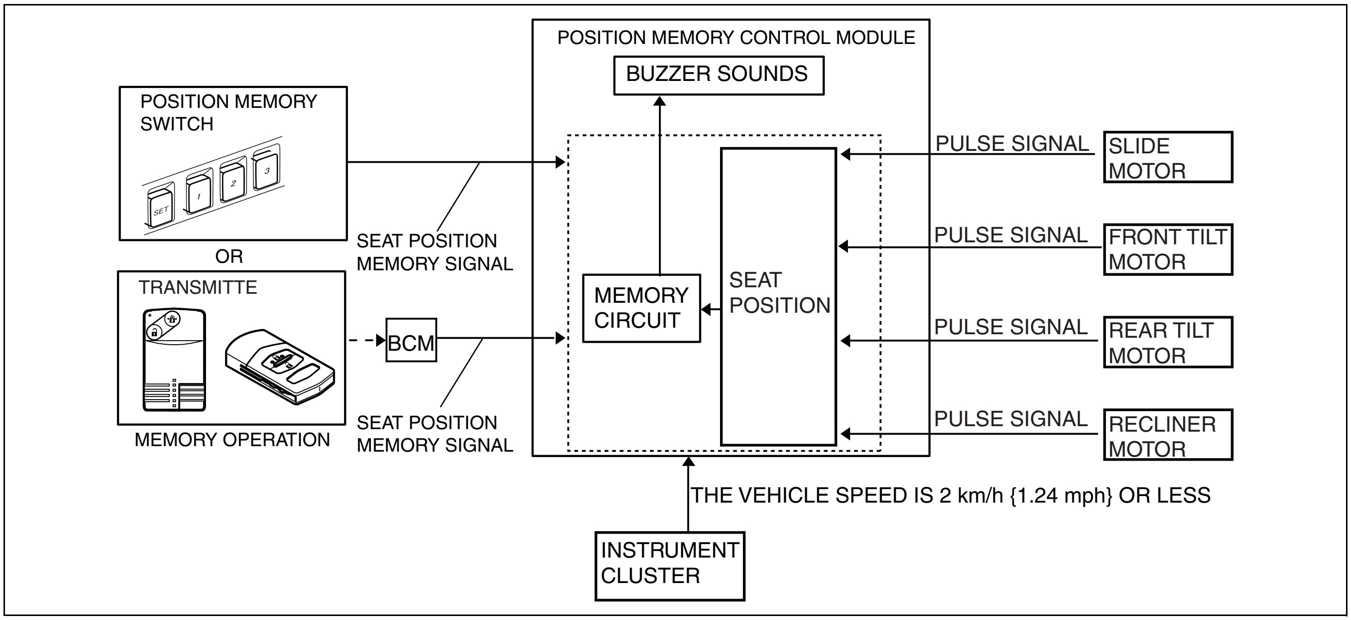
SEAT POSITION MEMORY OPERATION

id091300200600

Seat Position Memory Operation

1. A seat position memory signal is input to the seat memory control module when memory operations are performed using the transmitter or seat memory switch.
2. When the seat memory control module receives a signal, the operation conditions are confirmed, and if the conditions are met, pulse signals from each motor are input to the memory circuit as seat positions.
3. When a seat position is input to the memory circuit, the buzzer sounds and the seat position memory operation is finished.



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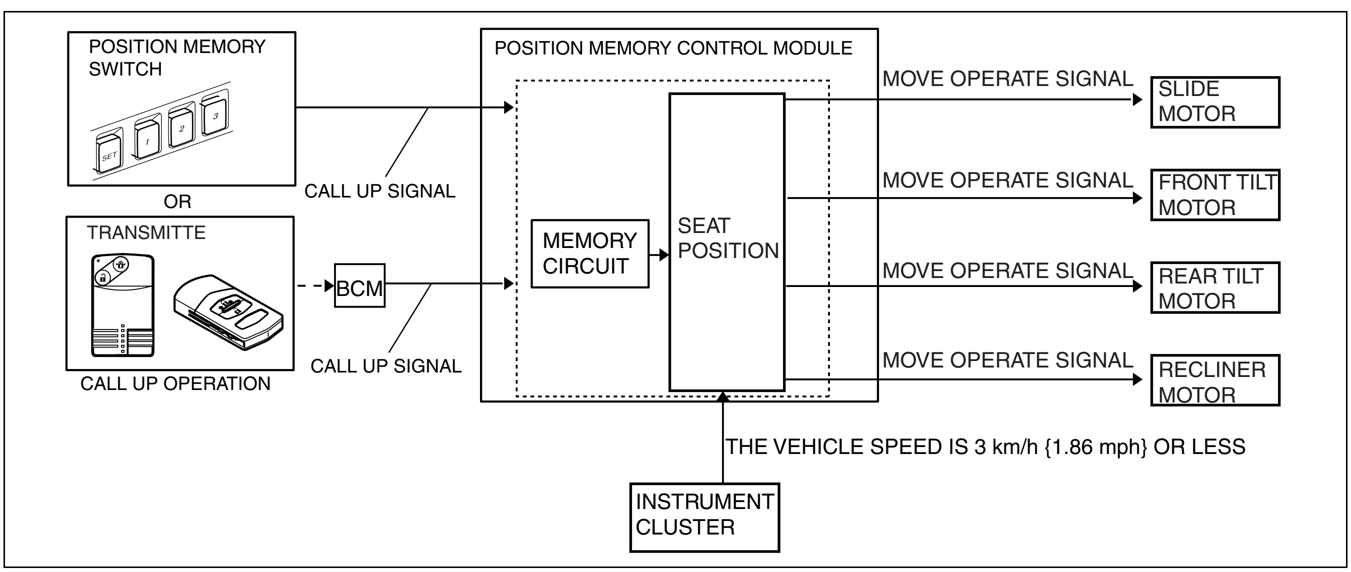
Seat Position Auto Call Up Operation

1. A seat position call up signal is input to the seat memory control module when an auto call up operation is performed using the transmitter or the seat memory switch.
2. When the seat memory control module receives the signal, the operation conditions are confirmed, and if the conditions are met, the applicable seat position is called up from the memory circuit to operate each motor and move the seat to the applicable position.



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SEAT POSITION MEMORY CONTROL MODULE FUNCTION

id091300200700

Seat Position Detection Function

- Position memory control module detects the motor position (seat position) according to the pulse signal from the position sensors installed to each motor.

Seat Position Memory Function

- The position memory control module records the positions of the transmitter and the memory switch of the seat. A maximum of nine seat positions combining the transmitter and the memory switch can be recorded. The number of seat positions the transmitter and the memory switch are each able to record is as follows:
  — Transmitter: Maximum of 6 positions
  — Memory switch: Maximum of 3 positions
- Programming of the seat position is possible according to the following procedures.

  Seat position switch
  1. Slide the seat manually to the desired position.
  2. Press the set switch while pressing memory switches 1, 2, or 3.
  3. Buzzer sounds and the seat position is programmed.

  Transmitter
  1. Slide the seat manually to the desired position.
  2. Press the UNLOCK button on the transmitter while pressing the set switch.
  3. Buzzer sounds and seat position is programmed.

  Note
  - Memory operation is possible when all of the following three conditions are met.
    — Memory call up operation has not been performed.
    — Manual operation has not been performed.
    — When the vehicle is stopped (vehicle speed 2 km/h [1.24 mph] or less).

- Memory is reprogrammed when the seat position is added to the memory switch which has already been programmed.
- If the negative battery cable is disconnected and 5 s or more have elapsed, all of the seat position memory will be erased.

Memory Call Up Function (Memory Switch)

- Call up operation is performed which slides the seat to the programmed seat position by the memory switch operation.

Auto call up

- If the following conditions are met, the seat position is automatically called up by the memory switch operation.
  — Door is open (door switch on).
  — Seat position has been programmed by memory switch.
  — Memory switch and set switch are off.
  — Ignition switch is in the LOCK position.
  — When the vehicle is stopped (vehicle speed 2 km/h [1.24 mph] or less).

  Note
  - Auto call up continues when the door is closed (door switch off) or the ignition switch is turned to the ON position during the auto call up.
  - Auto call up is cancelled when any of the following conditions are met during the auto call up.
    — Manual operation using the power seat switch has been operated
    — Memory switch or set switch has been operated
    — LOCK/UNLOCK operation has been performed using the transmitter with the ignition switch in the LOCK position.
    — While driving (vehicle speed 2 km/h [1.24 mph] or more).

Manual call up

- When the following conditions are met, the call up operation is performed only while the memory switch is being operated.
  — Door is closed (door switch off) or the ignition switch is in the ON position.
  — Seat position has been programmed.
  — Memory switch and set switch are off.
  — When the vehicle is stopped (vehicle speed 2 km/h [1.24 mph] or less).

Note

- Auto call up is cancelled when any of the following conditions are met during the manual call up.
  — Memory switch operation has stopped.
  — Manual operation using the power seat switch has been performed.
  — LOCK/UNLOCK operation has been performed using the transmitter with the ignition switch in the LOCK position.
  — While driving (vehicle speed 2 km/h [1.24 mph] or more).

Memory Call Up Function (Transmitter)

- If the door is opened within approx. 40 ±10 s after the doors are unlocked using the transmitter, the call up operation is performed and the seat moves to the position programmed in the transmitter.
- Seat position is automatically called up when the following conditions are met.
  — Seat position has been programmed by transmitter.
  — Ignition switch is in the LOCK position.
  — Memory switch and set switch are off.
  — When the vehicle is stopped (vehicle speed 2 km/h [1.24 mph] or less).

Note

- Auto call up continues when the door is closed (door switch off) or the ignition switch is turned to the ON position during the auto call up.
- Auto call up is cancelled if any of the following conditions are met during the auto call up.
  — Manual operation using the power seat switch has been performed.
  — Memory switch or the set switch has been operated.
  — LOCK/UNLOCK operation using the transmitter has been performed with the ignition switch in the LOCK position.
  — While driving (vehicle speed 2 km/h [1.24 mph] or more)

09-14A SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

SECURITY AND LOCKS OUTLINE [ADVANCED KEYLESS SYSTEM]

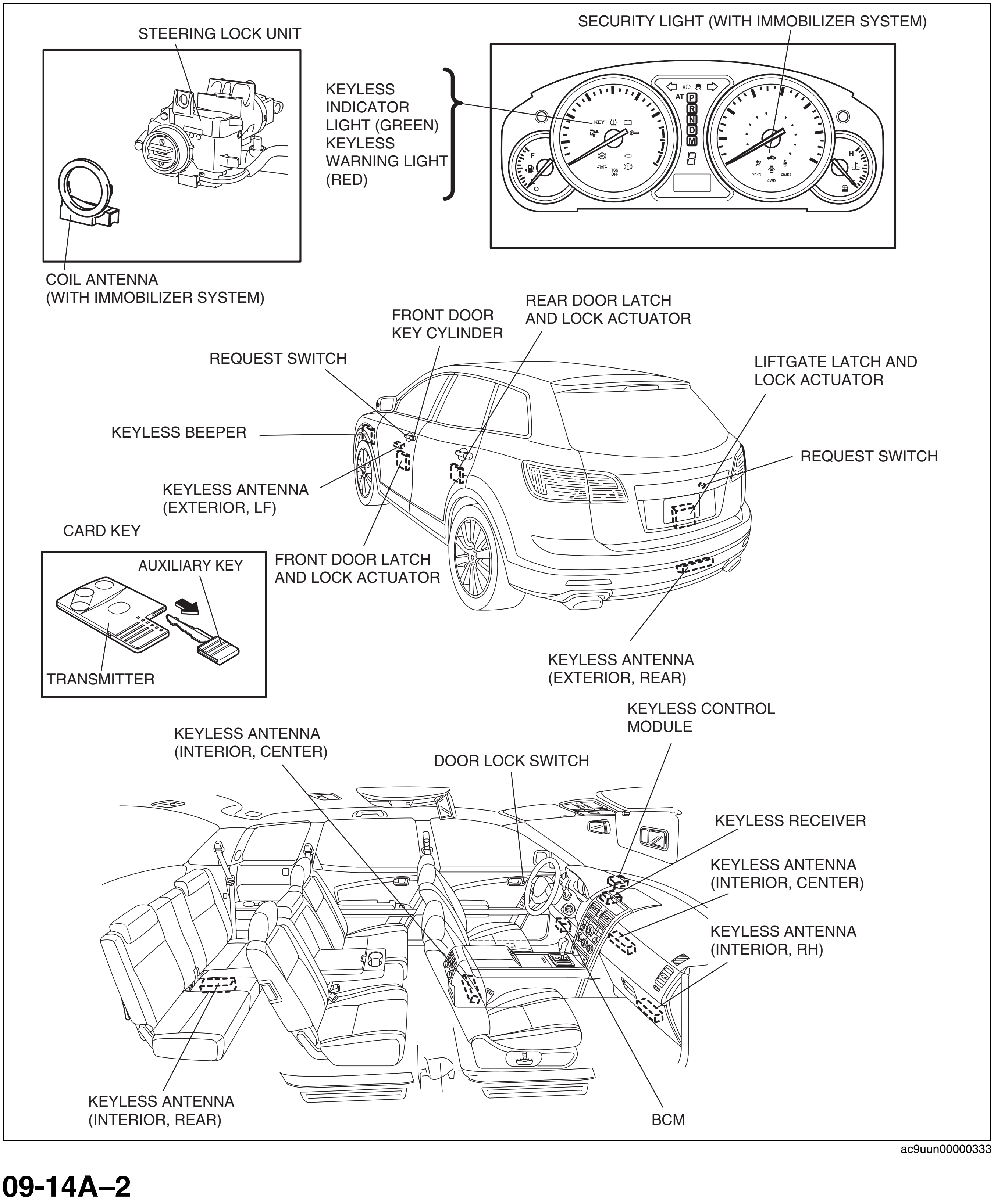
id0914b1100100

Features

Improved marketability	• Power door lock system adopted • Advanced keyless entry and start system adopted
Improved theft-deterrence	• Theft-deterrent system adopted • Immobilizer system adopted

SECURITY AND LOCKS STRUCTURAL VIEW [ADVANCED KEYLESS SYSTEM]

id0914b1100200



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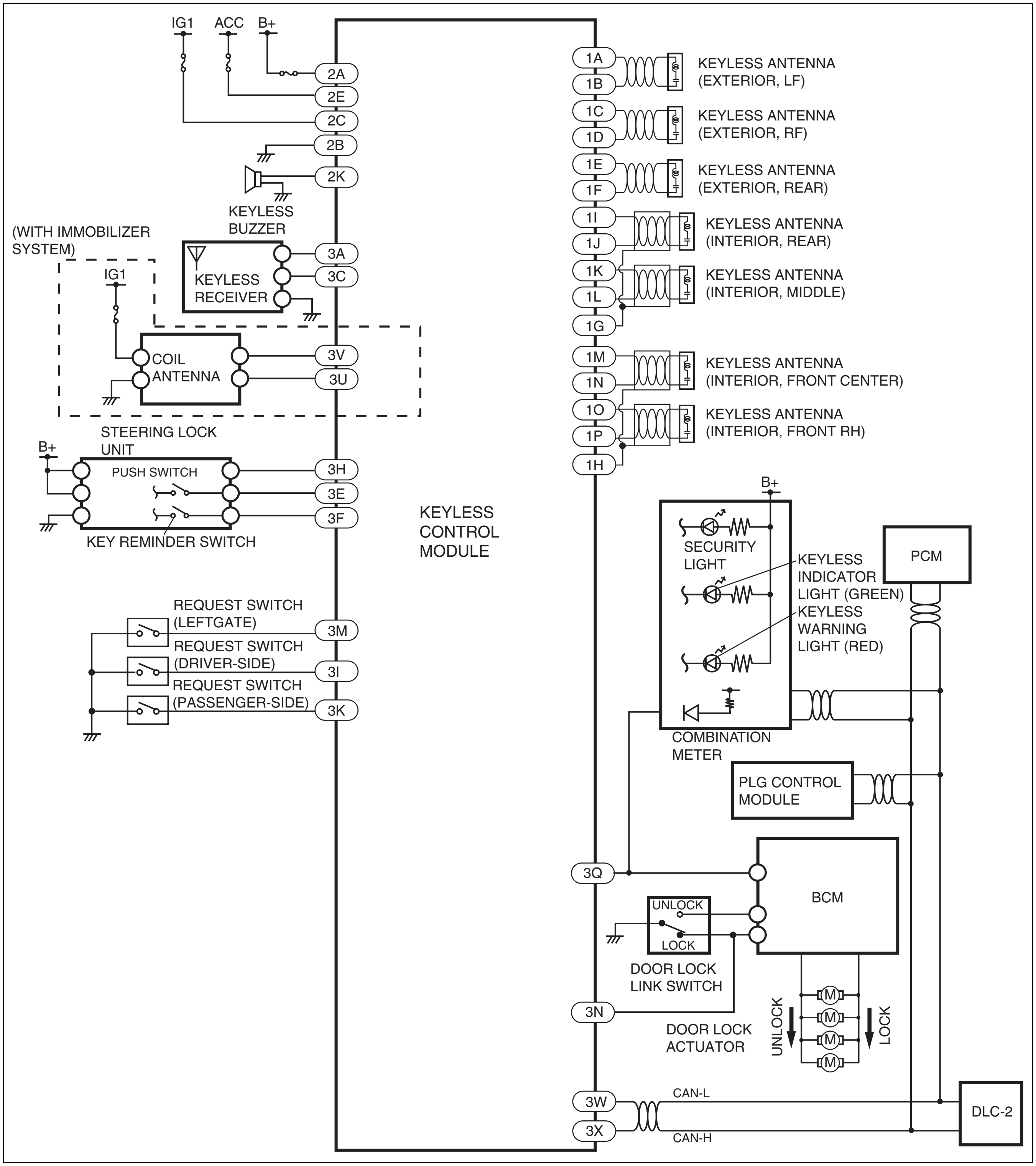
SECURITY AND LOCKS SYSTEM WIRING DIAGRAM [ADVANCED KEYLESS SYSTEM]

id0914b1100300



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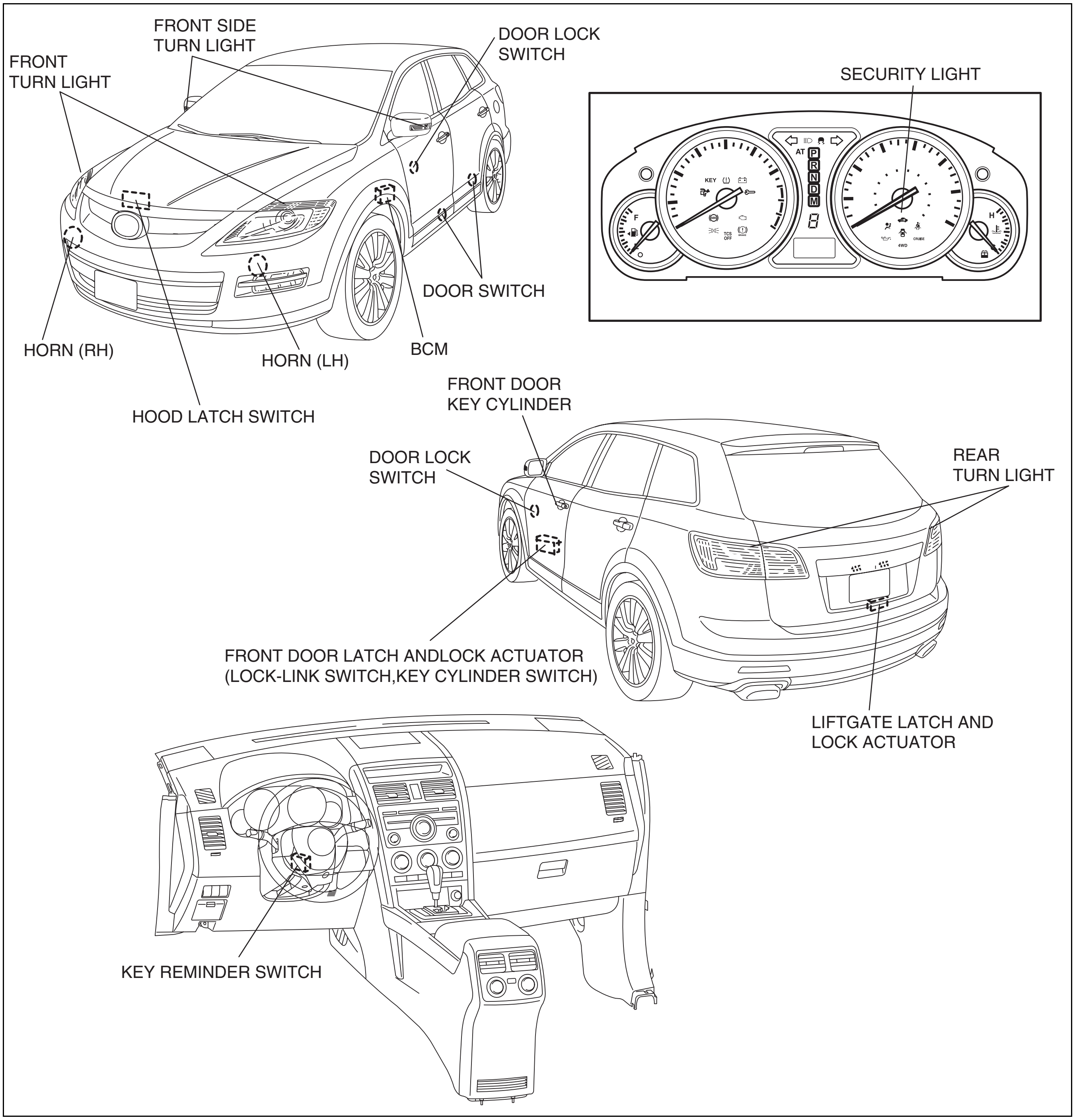
THEFT-DETERRENT SYSTEM OUTLINE [ADVANCED KEYLESS SYSTEM]

id0914b1100500

- The theft-deterrent system includes sound and light alarms that activate when the hood, the 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 and turned to unlock or the transmitter unlock button is pressed, the alarms stop.

THEFT-DETERRENT SYSTEM STRUCTURAL VIEW [ADVANCED KEYLESS SYSTEM]

id0914b1100600



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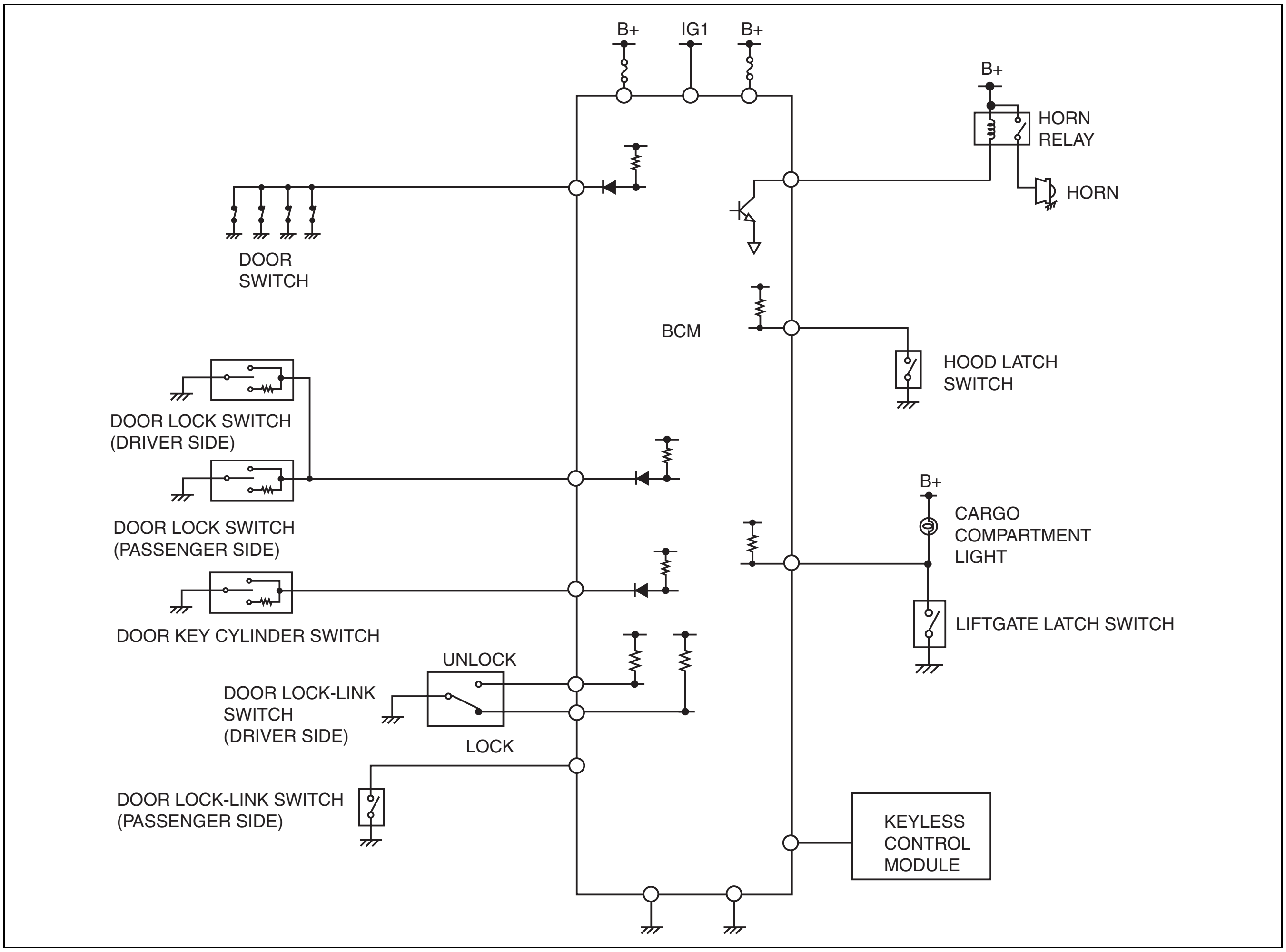
THEFT-DETERRENT SYSTEM WIRING DIAGRAM [ADVANCED KEYLESS SYSTEM]

id0914b1100700



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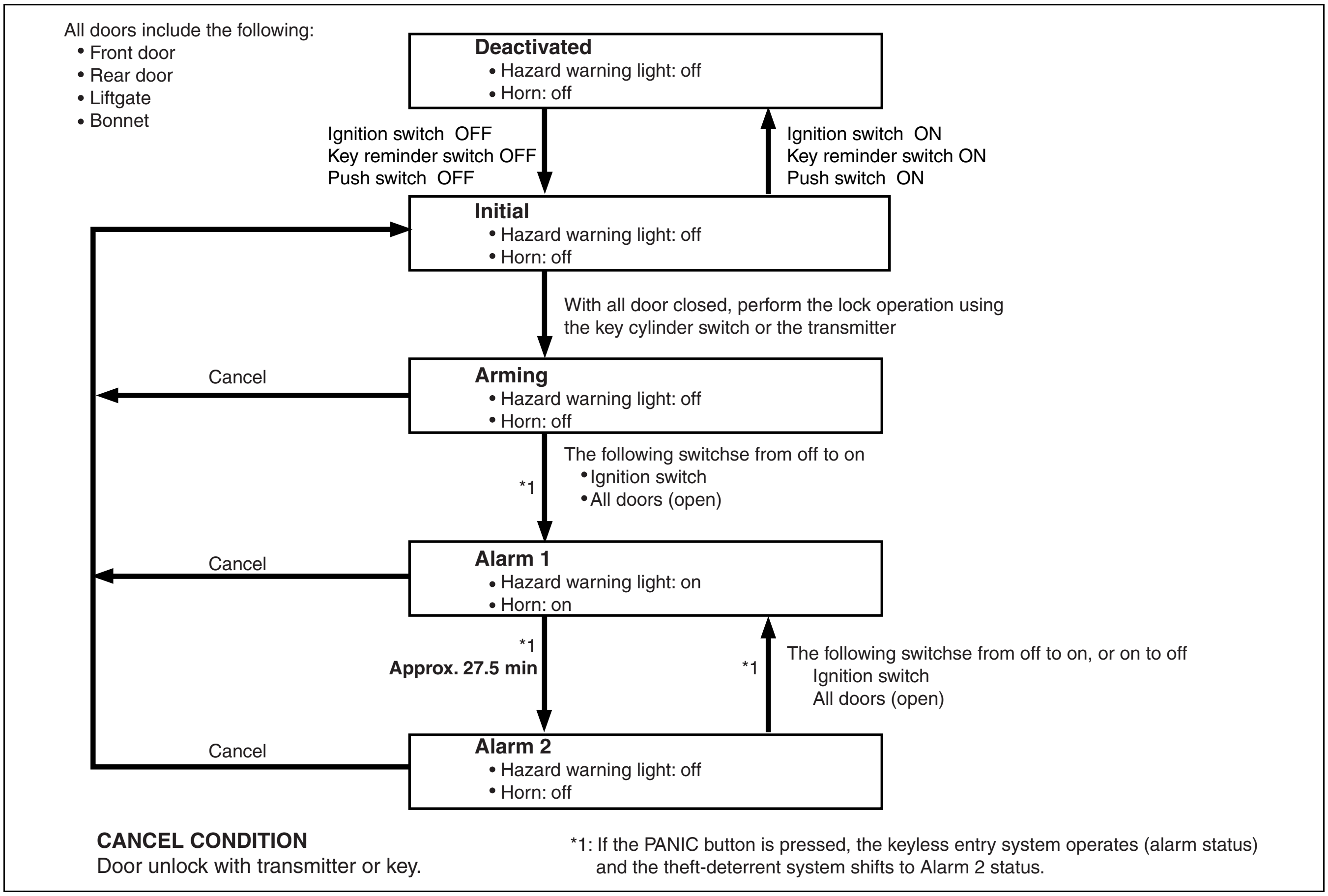
THEFT-DETERRENT SYSTEM OPERATION [ADVANCED KEYLESS SYSTEM]

id0914b1100800

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 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.	• With any door open, the doors will not lock with the transmitter and the theft-deterrent system will not arm • The liftgate can be opened with the key or the transmitter even when the system is armed. The alarm will not come on and the system will remain armed. *1: If the hood or the liftgate is open, the doors will lock but the alarm will not arm until the hood or liftgate is closed.
Arming cancel	Arming can be canceled by either of the following operations: • Unlock any doors using the transmitter or key. • Insert the key into the steering lock and turn the ignition switch to ON position.	• Hazard warning lights flash two times.	-
Alarm	The alarm triggers with each of the following operations: • Forcing open a door, the hood, or the liftgate. • Unlock any doors without using the transmitter or key. • Open a door, the hood or the liftgate by operating an door lock switch, the hood release lever or the liftgate opener switch. • Ignition switch turned to ON position using incorrect key.	• Hazard warning lights flash. • Horn sounds.	• The alarm continues for approx. 27.5 min, then stops.
Alarm cancel	Alarm can be canceled by either of the following operations: • Door unlock with transmitter or key. • liftgate open with transmitter or key.	-	-

System flowchart



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POWER DOOR LOCK SYSTEM OUTLINE [ADVANCED KEYLESS SYSTEM]

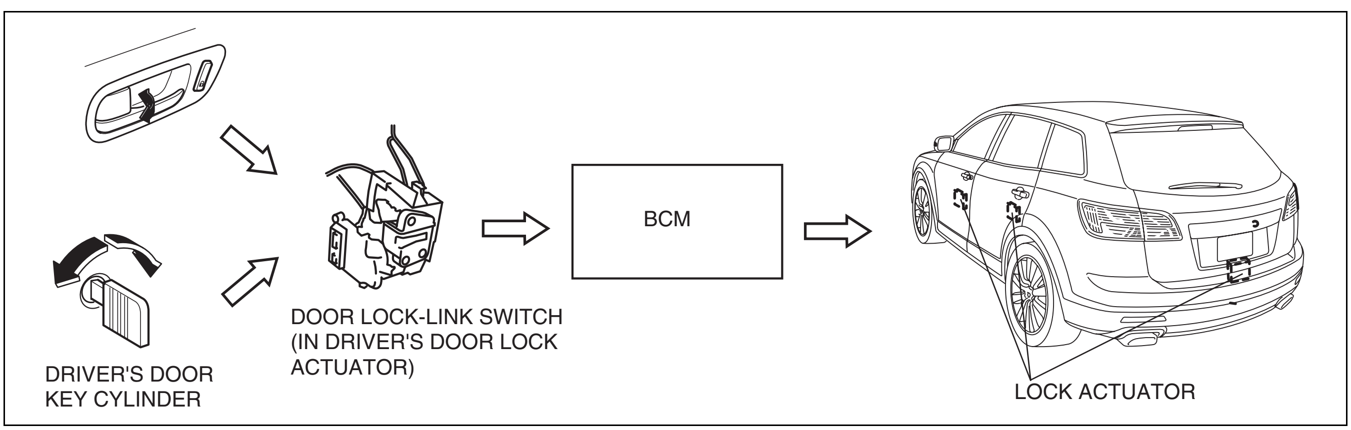
id0914b1100900

- A door lock knob interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door lock knob.
- A door key interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door key cylinder.

POWER DOOR LOCK SYSTEM OPERATION [ADVANCED KEYLESS SYSTEM]

id0914b1101000

- When the driver's door is locked/unlocked with the driver's door lock knob or key cylinder, the door lock-link switch in the door lock actuator is locked/unlocked via the rod.
- The BCM activates each lock actuator to lock/unlock according to the lock/unlock signal from the door lock-link switch.



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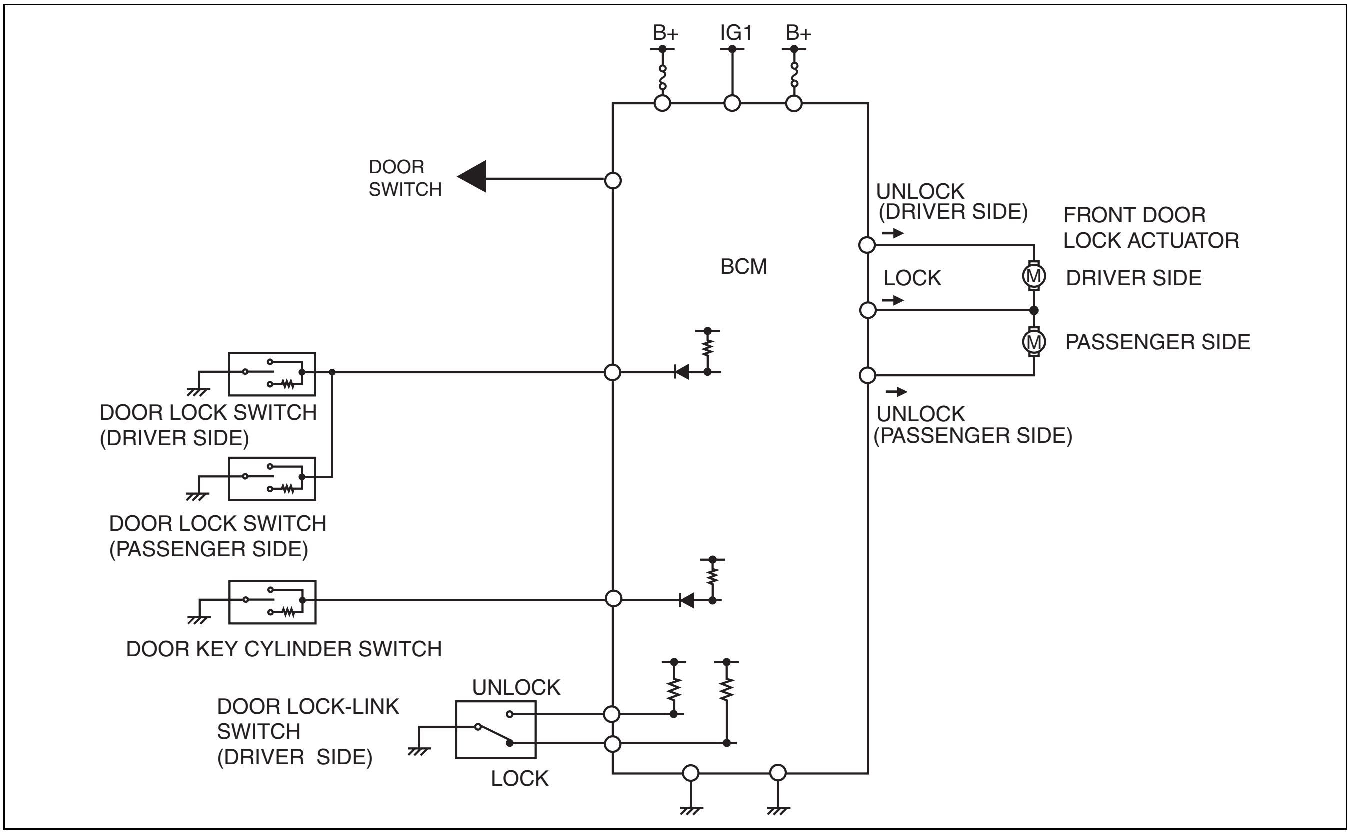
POWER DOOR LOCK SYSTEM WIRING DIAGRAM [ADVANCED KEYLESS SYSTEM]

id0914b1101300



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KEYLESS ENTRY SYSTEM OUTLINE [ADVANCED KEYLESS SYSTEM]

id0914b1101400

- An advanced keyless system has been adopted that enables the driver to start the engine or lock/unlock the doors without operating the key or transmitter (card key) by carrying the card key that has been programmed to the vehicle.
- The doors also can be locked/unlocked by operating the key (auxiliary key) or transmitter (card key).
- The answer-back function has been adopted where the hazard warning light flashes and a beeping sound confirms that the doors are locked/unlocked. Also, the advanced keyless entry system indicates activation by a beeper sound.
- A warning and guidance function has been adopted that promotes correction if the system is operated improperly, and uses the indicator light in the instrument cluster, a beeper sound, and the keyless beeper from behind passenger compartment.
- A customize function that switches the activation/deactivation of each function has been adopted.
- A rolling code type transmitter (card key) has been adopted to prevent theft by radiowave interception.
- To prevent improper operation while the vehicle is moving, the doors cannot be locked/unlocked by operating the transmitter (card key) or request switch when the start knob is in any position except LOCK.

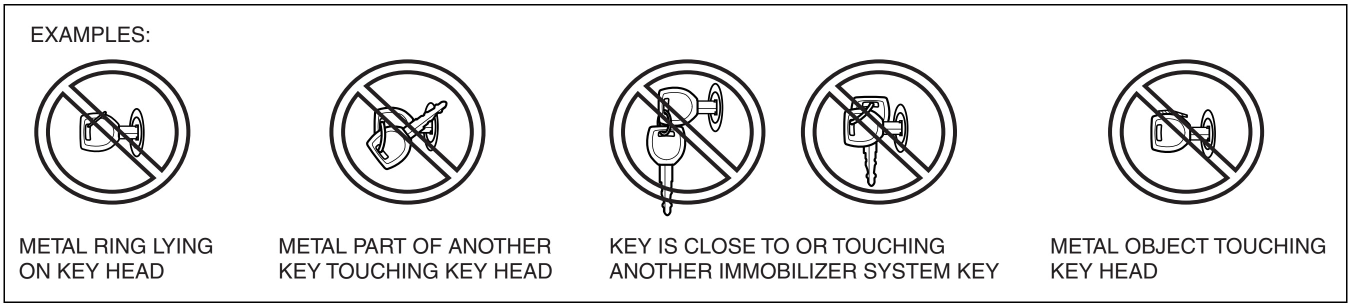
IMMOBILIZER SYSTEM OUTLINE [ADVANCED KEYLESS SYSTEM]

id0914b1101700

- 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 and prevents it from being started in any other manner (such as with an unregistered key or by starter relay short).
- The immobilizer system consists of the key (built-in transponder), coil antenna, keyless control module, PCM, and security light (in the instrument cluster).
- Ignition 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).
- The immobilizer system operates automatically when the ignition switch is turned to the LOCK or ACC position. When this occurs, the security light flashes repeatedly 0.1 s every 2 s.
- In order to start the engine, the immobilizer system must be made inoperable using a key previously registered with the vehicle. No special operation is required to release the immobilizer system but rather the vehicle is started similar to vehicles without the system: the ignition switch is turned from the LOCK or ACC position to the ON or START position and the release operation begins automatically. The engine can only be started after the key, keyless control module and PCM successfully perform their parts of the verification procedure. For details, refer to “09-14A-11 IMMOBILIZER SYSTEM OPERATION [ADVANCED KEYLESS SYSTEM]”.
- If the immobilizer system is not released due to a malfunction or verification failure, the security light in the instrument cluster displays a DTC. At the same time, DTCs are stored respectively in the PCM and keyless control module. The stored DTCs can be verified using the Mazda Modular Diagnostic System (M-MDS). Repair the malfunctioning part using the verified DTCs. For details, refer to “09-14A-13 ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION [ADVANCED KEYLESS SYSTEM]”.
- The immobilizer system cannot be deactivated.

Caution

- **The immobilizer system must be reset using the Mazda Modular Diagnostic System (M-MDS) after performing any of the following: “Replacement of all the keys (steering lock replacement or similar procedure)”, “Keyless control module replacement”, “PCM replacement” and “Keyless control module and PCM replacement”. Moreover, when performing “Replacement of all the keys” or “Keyless control module replacement”, two or more keys usable with the immobilizer system must be readied. For details, refer to Workshop Manual.**
- **Two or more key ID numbers must be registered for the engine to start. For key ID number registration, refer the Workshop ManualSection 09-14, “IMMOBILIZER SYSTEM COMPONENT REPLACEMENT/KEY ADDITION AND CLEARING”.**
- **A maximum of eight key ID numbers can be registered for one vehicle. The PID/data monitor function can be used to verify the number of key ID numbers registered for a single vehicle. For details refer to Workshop Manual.**
- **The following conditions may cause poor signal communication between the key and vehicle, resulting in the engine not starting or a key registration error. Do not perform key registration under the following conditions:**
  - **— If any of the following items are touching or near the key head.**
    - **Spare keys**
    - **Keys for other vehicles equipped with an immobilizer system**
    - **Any metallic object**
    - **Any electronic device, or any credit or other cards with magnetic strips**



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IMMOBILIZER SYSTEM STRUCTURAL VIEW [ADVANCED KEYLESS SYSTEM]

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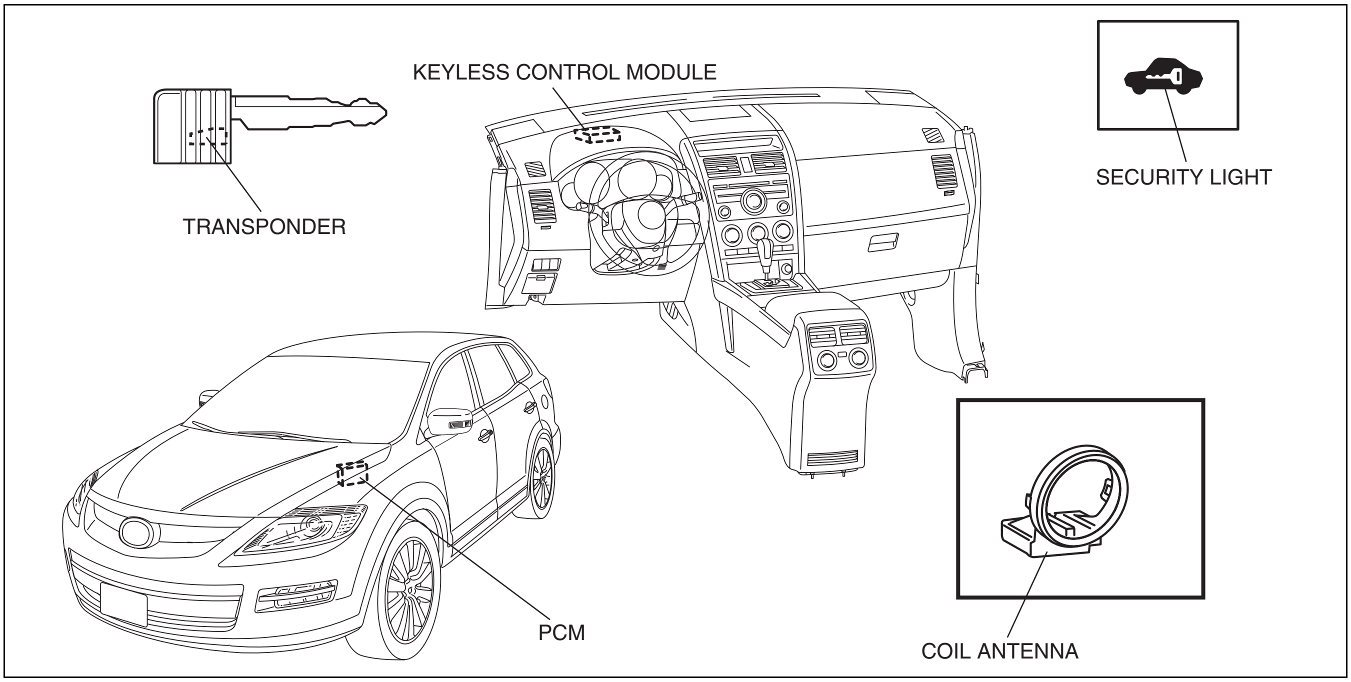

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IMMOBILIZER SYSTEM WIRING DIAGRAM [ADVANCED KEYLESS SYSTEM]

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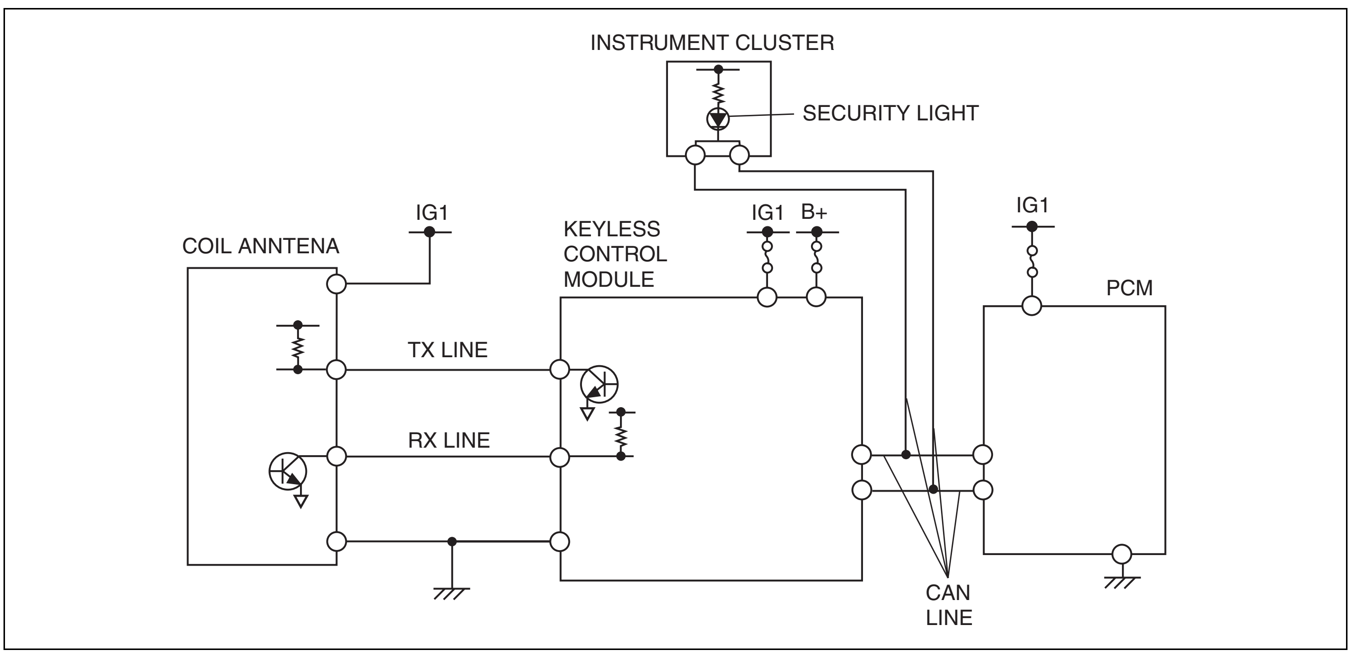

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IMMOBILIZER SYSTEM OPERATION [ADVANCED KEYLESS SYSTEM]

id0914b1102000

Immobilizer System Release Operation

The ignition switch is turned from the LOCK (ACC) to the ON (START) position. (Security light illuminates.)

↓

(1) The keyless control module 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 keyless control module via the coil.

↓

(3) The keyless control module verifies consistency between the received key ID number and the previously registered key ID numbers.

UNSATISFACTORY RESULT → Engine starting is not permitted.

SATISFACTORY RESULT ↓

(4) The keyless control module makes a calculation using received data B and compares it with sent data A.

UNSATISFACTORY RESULT → Engine starting is not permitted.

SATISFACTORY RESULT ↓

(5) The keyless control module requests data for verification from the PCM.

↓

(6) The PCM sends data C* to the keyless control module.

↓

(7) The keyless control module 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.

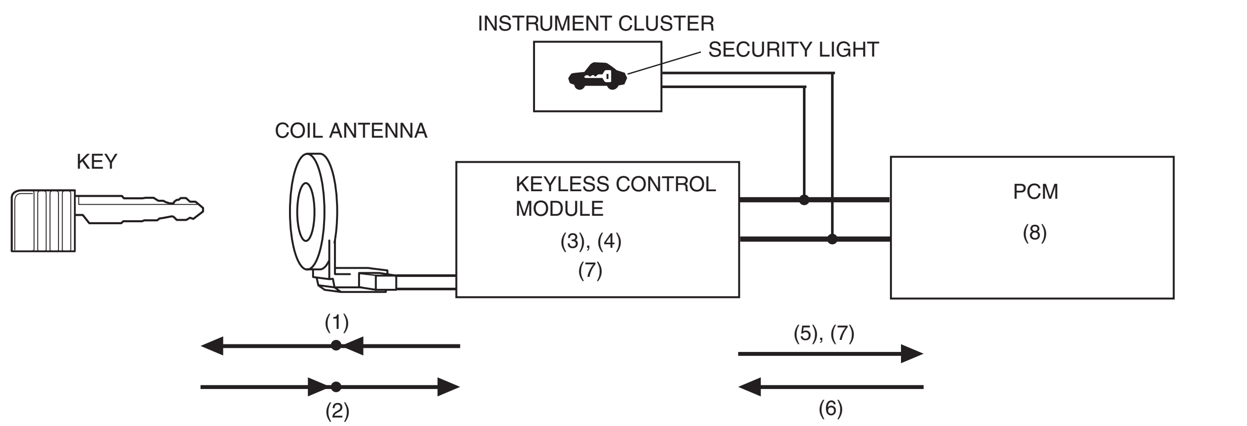
UNSATISFACTORY RESULT → Engine starting is not permitted.

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



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ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) MALFUNCTION DIAGNOSIS FUNCTION [ADVANCED KEYLESS SYSTEM]

id0914b1102100

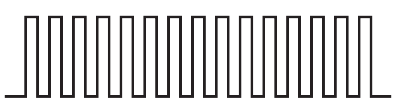
- The immobilizer system is provided with a malfunction diagnosis function.
- Malfunction diagnosis of the immobilizer system occurs automatically when the ignition switch is turned from the LOCK (ACC) to the ON (START) position.
- If the results of the malfunction diagnosis show a malfunction in the immobilizer system, the security light displays a DTC. At the same time, DTCs are stored in the PCM and keyless control module. The stored DTCs can be verified using the Mazda Modular Diagnostic System (M-MDS).

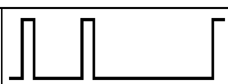
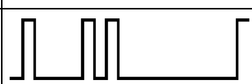
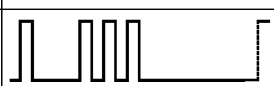
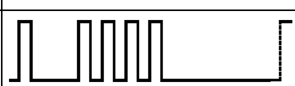
Caution
- **Always use the Mazda Modular Diagnostic System (M-MDS) to verify DTCs even if the security light display a DTC. If the security light itself has a malfunction, it is possible that a DTC may not be properly displayed. There are certain DTCs which can only be verified using the Mazda Modular Diagnostic System (M-MDS), not the security light.**
- **DTCs for the immobilizer system that are stored in the keyless control module and PCM are cleared when the ignition switch is turned from the ON to the LOCK (ACC) position.**

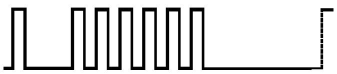
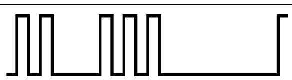
Note
- If two or more malfunctions are detected as a result of malfunction diagnosis, only the DTC with the lowest number of those detected will be displayed by the security light. However, multiple DTCs are stored at the same time.
- If two or more immobilizer system DTCs are verified, first repair 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
ILLUMINATED  GOES OUT	11, 12, 13, 14, 15, 16
ILLUMINATED  GOES OUT	21, 22, 23

DTC				Detected condition
Security light flashing pattern		Mazda Modular Diagnostic System (M-MDS) display		
		Keyless control module	PCM	
11		B1681	P1260	No detected communication with the coil antenna.
12		B2103	P1260	Coil antenna malfunction
13		B1600	P1260	The key ID number data cannot be read.
		B2431	P1260	Key ID number registration error.
14		B1602	P1260	The keyless control module cannot read key ID number data normally.

DTC				Detected condition
Security light flashing pattern		Mazda Modular Diagnostic System (M-MDS) display		
		Keyless control module	PCM	
15		B1601	P1260	The keyless control module has detected unregistered key ID number.
16		U2510	P1260	Communication error between the keyless control module and the PCM (mismatched conditions)
21		B1213	P1260	Only one key ID number is registered.
22		B2141	P1260	Communication error between the keyless control module and the PCM (data transfer error)
23		B2139	P1260	ID number data in the PCM and the keyless control module do not match.
Not illuminated		B1342	-	Keyless control module malfunction

ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION [ADVANCED KEYLESS SYSTEM]

id0914b1102200

- The following items can be verified:
  — Number of continuous DTCs
  — Number of key ID numbers registered with the vehicle
- Use the Mazda Modular Diagnostic System (M-MDS) to read the PID/data monitor.

PID/Data Monitor Table

PID name (definition)	Detected condition
NUMKEY (Number of key ID numbers registered with the vehicle)	Number of key ID numbers registered: 0—8

IMMOBILIZER SYSTEM COMPONENT REPLACEMENT/KEY ADDITION AND CLEARING OUTLINE [ADVANCED KEYLESS SYSTEM]

id0914b1102300

- When performing the following procedures, the immobilizer resetting procedure using the Mazda Modular Diagnostic System (M-MDS) must also always be performed: “Keyless control module replacement”, “PCM replacement”, “Keyless control module and PCM joint replacement”, “Key ID number clearing”. The engine will not start unless all work is performed using the Mazda Modular Diagnostic System (M-MDS).
- When replacing any of the immobilizer system component parts, adding/erasing keys or performing other functions, refer to the following table. For repair procedures, refer to the Workshop Manual Section 09-14.

Situation	Items neccesary to perform procedure (always have these ready before beginning the procedure)	Cautionary notes
Making a spare key when the customer has two or more keys that can start the engine. Or registering an additional key.	• Keys for registration	• If “Customer Spare Key Programming Disable” has previously been performed using the Mazda Modular Diagnostic System (M-MDS), the Mazda Modular Diagnostic System (M-MDS) must be used to register an additional key.
Making a spare key when the customer has one key that can start the engine or no keys. Or registering an additional key.	• Keys for registration • Mazda Modular Diagnostic System (M-MDS)	–
Clearing previously registered key ID numbers.	• Keys for registration (two or more keys) • Mazda Modular Diagnostic System (M-MDS)	• All key ID numbers registered in the vehicle are cleared. • Unless keys are re-registered after clearing the key ID numbers, the engine cannot be started. Before beginning the procedure, verify that the customer has turned in all of the keys for the vehicle. • Unless two or more keys are registered after clearing the key ID numbers, the engine cannot be started. • The keys (two or more keys) readied before beginning the procedure do not have to be new keys. Any key that is capable of starting the engine before beginning the procedure can be used.
Replacing all keys. (When replacing the steering lock or similar procedure)	• New keys (two or more keys) • Mazda Modular Diagnostic System (M-MDS)	• Since the steering lock is replaced, keys used before replacement become unusable. Have two new keys or more ready before beginning the procedure. • Unless keys are registered after replacing the steering lock, the engine cannot be started.
Changing the method for registering additional keys. (Method for registering other keys using two keys that can start the engine is disabled.)	• Mazda Modular Diagnostic System (M-MDS)	• After performing this procedure, additional keys can only be registered using the Mazda Modular Diagnostic System (M-MDS). • The setting can be changed to the original using the Mazda Modular Diagnostic System (M-MDS).
Changing the method for registering additional keys. (Method for registering other keys using two keys that can start the engine is enabled.)	• Mazda Modular Diagnostic System (M-MDS)	• This is the default setting on new vehicles.
Replacing the keyless control module only.	• New keyless control module • Keys for registration (two or more keys) • Mazda Modular Diagnostic System (M-MDS)	• Unless keys are re-registered after replacement, the engine cannot be started. Before beginning the procedure, verify that the customer has turned in all of the keys for the vehicle. • Unless two or more keys are registered after replacement, the engine cannot be started. • The keys (two or more keys) readied before beginning the procedure do not have to be new keys. Any key that is capable of starting the engine before beginning the procedure can be used.

Situation	Items neccesary to perform procedure (always have these ready before beginning the procedure)	Cautionary notes
Replacing the PCM only.	• New PCM • Mazda Modular Diagnostic System (M-MDS)	-
Replacing the PCM and keyless control module.	• New PCM • New keyless control module • Keys for registration (two or more keys) • Mazda Modular Diagnostic System (M-MDS)	• Unless keys are re-registered after replacement, the engine cannot be started. Before beginning the procedure, verify that the customer has turned in all of the keys for the vehicle. • Unless two or more keys are registered after replacement, the engine cannot be started. • The keys (two or more keys) readied before beginning the procedure do not have to be new keys. Any key that is capable of starting the engine before beginning the procedure can be used.
Replacing the coil antenna.	• New coil antenna	• It is not neccessary to reset the immobilizer system.
Replacing the instrument cluster.	• New instrument cluster	• It is not neccessary to reset the immobilizer system.

KEYLESS ENTRY SYSTEM OPERATION [ADVANCED KEYLESS SYSTEM]

id0914b1102600

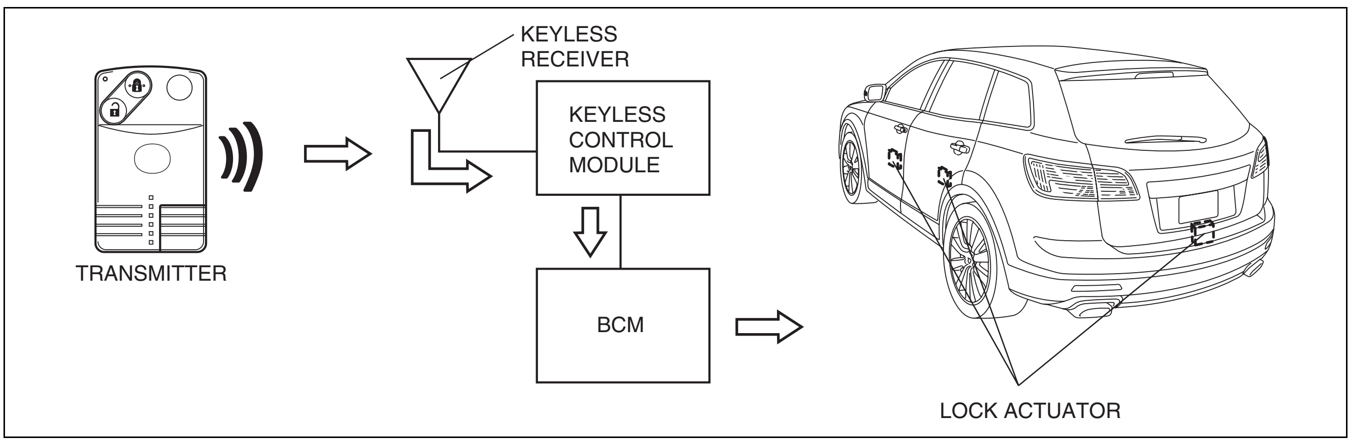
Normal Keyless Entry Function

Lock/unlock

Note

- If any of the following conditions are met, the doors cannot be locked by operating the transmitter (card key).
  - — The auxiliary key is inserted in the ignition key cylinder.
  - — The start knob is not in the LOCK position.
  - — The start knob is being pressed.
  - — Any door is open.
- If any of the following conditions are met, the doors cannot be unlocked by operating the transmitter (card key).
  - — The auxiliary key is inserted in the ignition key cylinder.
  - — The start knob is not in the LOCK position.
  - — The start knob is being pressed.

1. When the transmitter (card key) is operated, the card key sends ID data and rolling code. They are received by the keyless receiver and sent to the keyless control module.
2. When the keyless control module receives a lock/unlock signal from the transmitter (card key) and verifies the ID, the signal is sent to the all lock actuators activate to lock/unlock.
3. The keyless control module operates the hazard warning lights flash to flash according to lock/unlock signal from the transmitter (card key).
   - — When the LOCK button is pressed, the hazard warning lights flash once.
   - — When the UNLOCK button is operated, the hazard warning lights flash twice.



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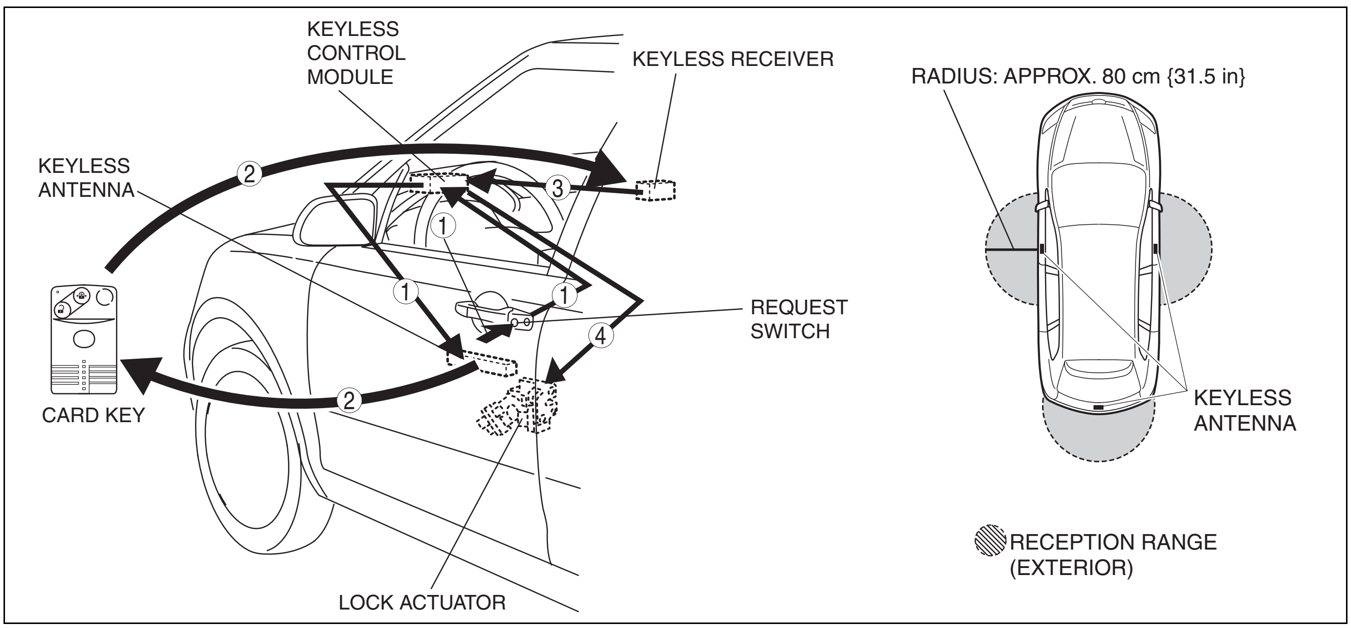
Advanced Keyless Entry Function
Door lock/unlock

Note
- If any of the following conditions are not met, the doors cannot be locked by operating the request switch.
  — The card key is not inside the vehicle.
  — All doors and trunk lid are closed.
  — The auxiliary key is not inserted in the ignition key cylinder.
  — The start knob is in the LOCK position and not being pressed.
  — The card key is within the reception range outside the vehicle.
- If any of the following conditions are not met, the doors cannot be unlocked by operating the request switch.
  — The auxiliary key is not inserted in the ignition key cylinder.
  — The start knob is in the LOCK position and not being pressed.
  — The card key is within the reception range outside the vehicle.

1. When a request switch is pressed, the keyless control module sends a request signal from the keyless antenna. The request signal is sent to the area around the door that the request switch is pressed, and the signal is sent to the cabin area.
2. When the card key receives a request signal, the card key sends back ID data.
3. The ID data is received at the keyless receiver, and sent to the keyless control module.
4. When the ID data is verified by the keyless control module and the card key is determined to be outside the vehicle, a signal is sent to the BCM and all the lock actuators are activated to lock/unlock.
5. The keyless control module operates the hazard warning light to flash via the BCM.Allso, the keyless control module operates the keyless beeper at the same time.
   — When the doors are locked, the hazard warning lights flash once.
   — When the doors are unlocked, the hazard warning lights flash twice.



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Auto re-lock function
- The auto re-lock function automatically locks the doors if any of the following operations are performed within approx. 30 s after the UNLOCK button of the card key is pressed, or after the request switch is pressed to unlock the doors.
  — A door or the trunk lid is opened.
  — The auxiliary key is inserted in the ignition key cylinder.
  — The start knob is pressed.
  — The transmitter (card key) is operated. (If the UNLOCK button is pressed, the timer is reset.)
  — A request switch is operated.

Out-of-area (reception area) autolock function

- When all doors are closed and the driver is out of the reception area carrying the card key, the doors are automatically locked. (Initial setting is OFF.)

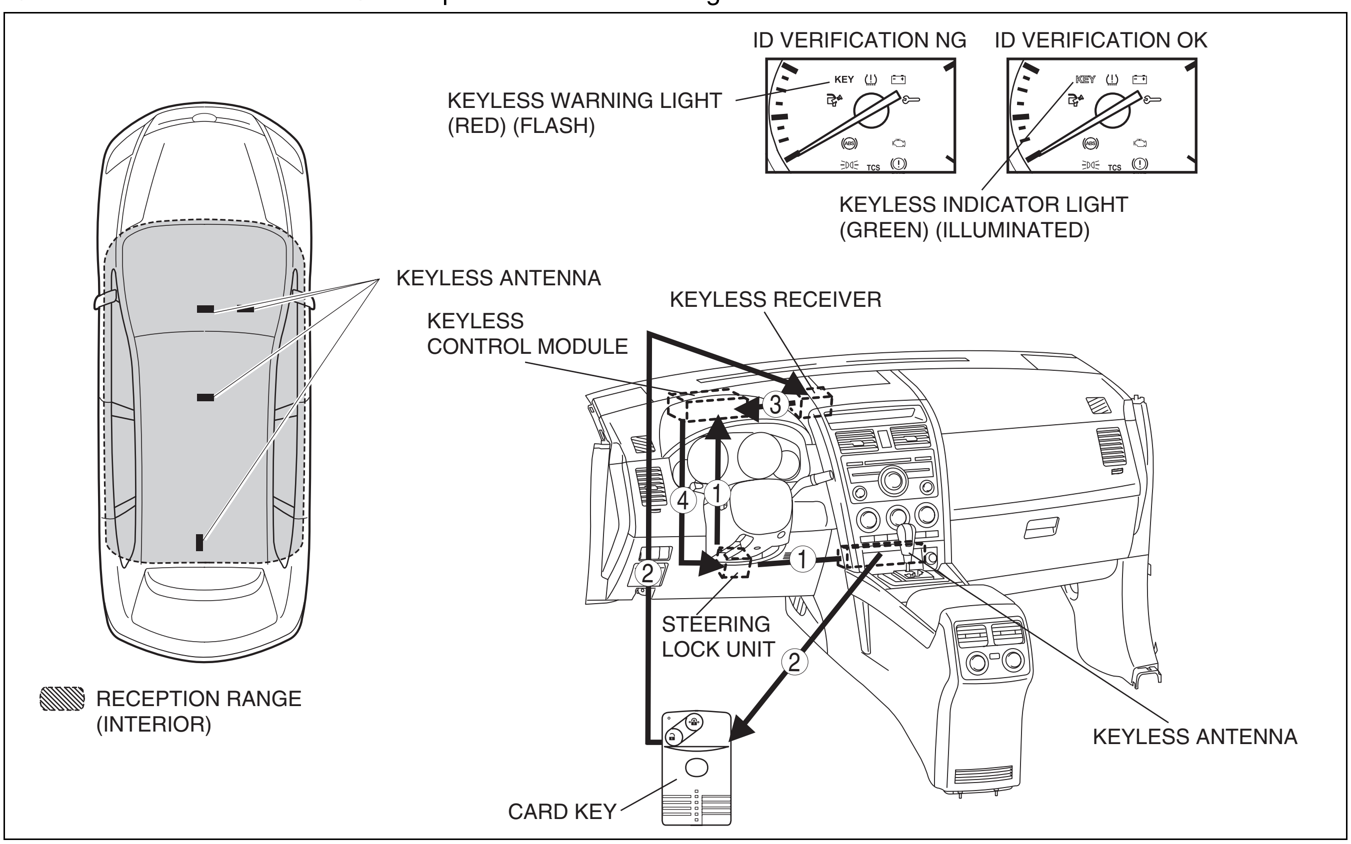
1. When all the following conditions are met and all doors are closed after any door or the trunk lid is open, the keyless beeper sound is heard and the function starts operation. (The doors are not locked at this time.)
   — The card key is not inside the vehicle.
   — The card key is within the reception area outside the vehicle.
   — The auxiliary key is not inserted in the ignition key cylinder.
   — The start knob is in the LOCK position, and not being pressed.
2. After the operation has started, the card key is monitored within the reception area by the keyless antenna. After about 2 s from where the card key has been determined to be out of the reception area, all lock actuators activate to lock. If approx. 30 s have passed since the operation started, the doors also locks regardless of whether the card key is within or out of the reception area.
3. The hazard warning light flashes once and keyless beep spund will be heard once at the same time the door locks.

ADVANCED KEYLESS START FUNCTION OPERATION [ADVANCED KEYLESS SYSTEM]

id0914b1102700

- The advanced start function activates to start the engine by operating the start knob, and not by inserting the key but by the driver carrying the card key while in the vehicle.

1. When the start knob is pressed, the keyless control module sends a request signal from the keyless antennas (interior).
2. The card key receives the request signal, and sends back ID data.
3. The ID data is received by the keyless receiver, and sent to the keyless control module.
4. When the ID data is verified by the keyless control module and the card key is determined to be inside the vehicle, the start knob of the steering lock unit is released. The keyless indicator light (green) in the instrument cluster illuminates at the same time to indicate that the start knob is operable.
   — If the ID verification is not acceptable (for reasons such as an unprogrammed card key, or card key battery depletion or transmitter interference), the start knob is not released and the keyless warning light (red) illuminates to indicate that the start knob is inoperable.
   — For vehicles with the immobilizer system, ID verification is performed when the start knob is turned to the ON position, and if the verification is acceptable, permission is given to start the engine.
5. Turn the start knob to the START position to start the engine.



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WARNING/GUIDANCE FUNCTION OPERATION [ADVANCED KEYLESS SYSTEM]

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- If the system is operated improperly, it warns the driver using the indicator light in the instrument cluster, beeper sound, and keyless beeper in the trunk compartment.
- The operation condition of the advanced keyless system is indicated by the indicator light and beeper sound to guide user's operation.

Item		Operation condition	Keyless beeper (outside the vehicle)	Instrument cluster		
				Buzzer (Interior)	Keyless warning light (red)	Keyless indicator light (green)
Warning	Start knob not in LOCK warning	Driver's door is open with start knob in ACC position	–	Continuous	Flashes	–
	Card key out of vehicle warning*1	Card key cannot be detected inside vehicle with driver's door open and start knob not in LOCK position	–	Continuous	Flashes*2	–
		Card key cannot be detected inside vehicle with all doors closed and start knob not in LOCK position	Sounds 6 times	—	Flashes*3	–
		Card key cannot be detected inside vehicle with start knob not in LOCK position and under any condition other than above	–	—	Flashes*2	–
	Card key left in vehicle warning	Door/trunk lid is open with proper card key inside vehicle and another card key carried	Continuous for 10 s	–	–	–
	Door lock inoperable warning	Request switch is pressed with card key carried and a door open or start knob not in LOCK position	Sounds 6 times	–	–	–
	Battery voltage low indication	Card key battery voltage depleted	–	–	–	Flashes (Approx. 30 s after IG OFF)
Guidance	Start knob operable guidance	Start knob is operable (lock released) when it is pressed	–	–	–	On (Max. 3 s)
	Start knob inoperable guidance	Start knob is inoperable (locked) when it is pressed	–	–	Flashes	–
	Lock/unlock answer back	Doors are locked/unlocked with normal/advanced keyless entry function	Locked: Once Unlocked: Twice	–	–	–

*1 : If the start knob is turned to the LOCK position with the card key out of the vehicle, the start knob is inoperable (the engine cannot be restarted). For vehicles with the immobilizer system, the engine cannot be restarted by turning the start knob from the ACC position to the START position even though the start knob has not been turned to the LOCK position.
*2 : Stops flashing and goes out if the card key is detected inside the vehicle.
*3 : Stops flashing and goes out if the card key is detected inside the vehicle and door is opened.

CUSTOMIZE FUNCTION OUTLINE [ADVANCED KEYLESS SYSTEM]

id0914b1102900

- The settings of the following functions, and warning and guidance functions for the advanced keyless entry system can be turned ON/OFF optionally.
- The Mazda Modular Diagnostic System (M-MDS) is necessary for settings. Refer to the Workshop Manual for the detailed setting procedure.

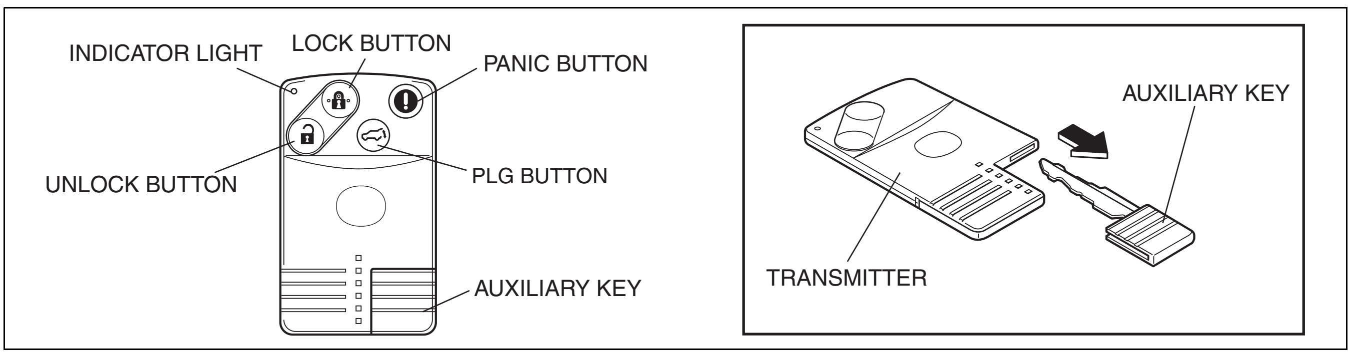
Note
- Window will not roll up when auto-lock function is enable.

Function name	M-MDS	Initial setting
Auto lock function (Out-of-area type)	Auto Lock	OFF
Keyless beeper answer back	Answer Back buzzer	OFF
Battery voltage low indication	Low Battery Warning	ON

CARD KEY (TRANSMITTER) CONSTRUCTION/OPERATION [ADVANCED KEYLESS SYSTEM]

id0914b1103200

- A card-type transmitter that is thin and convenient to carry has been adopted.
- A maximum of six transmitters can be programmed for one vehicle.
- A built-in operation indicator light illuminates according to LOCK/UNLOCK button operation and request signal from the vehicle.
- In case the transmitter is inoperable due to battery depletion, the doors can be locked/unlocked and the engine can be started using the auxiliary key.
- A transponder is built into the auxiliary key for vehicles with the immobilizer system.



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KEYLESS ANTENNA CONSTRUCTION/OPERATION [ADVANCED KEYLESS SYSTEM]

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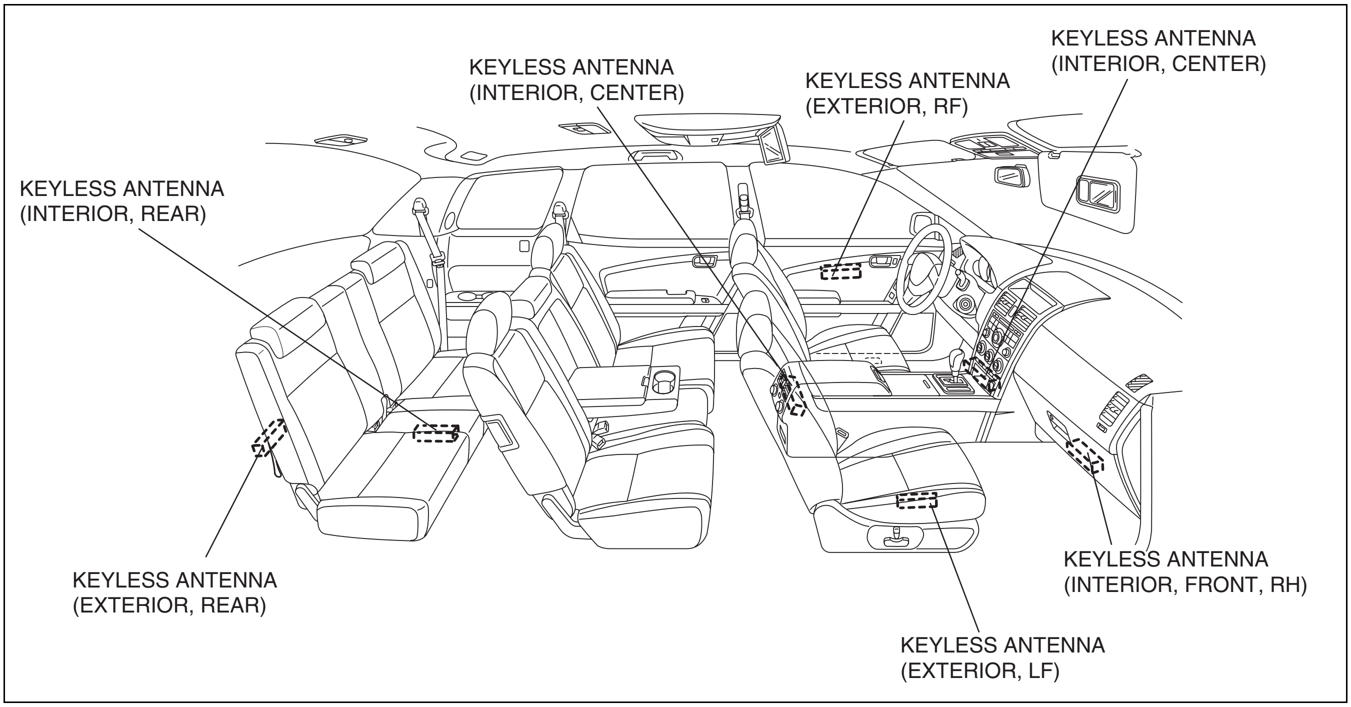
- Consists of the antennas for request signal output (7 locations).
- Operated by the keyless control module, the keyless antennas send request signals to produce the reception areas inside and outside the vehicle.
- The keyless antennas built-into the front doors can output signals to both inside or outside the vehicle, and change the level of the radiowave (output to inside or outside the vehicle) according to operation conditions.
- The keyless control module locates the card key by determining the antenna which is receiving the signal the strongest.



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REQUEST SWITCH CONSTRUCTION [ADVANCED KEYLESS SYSTEM]

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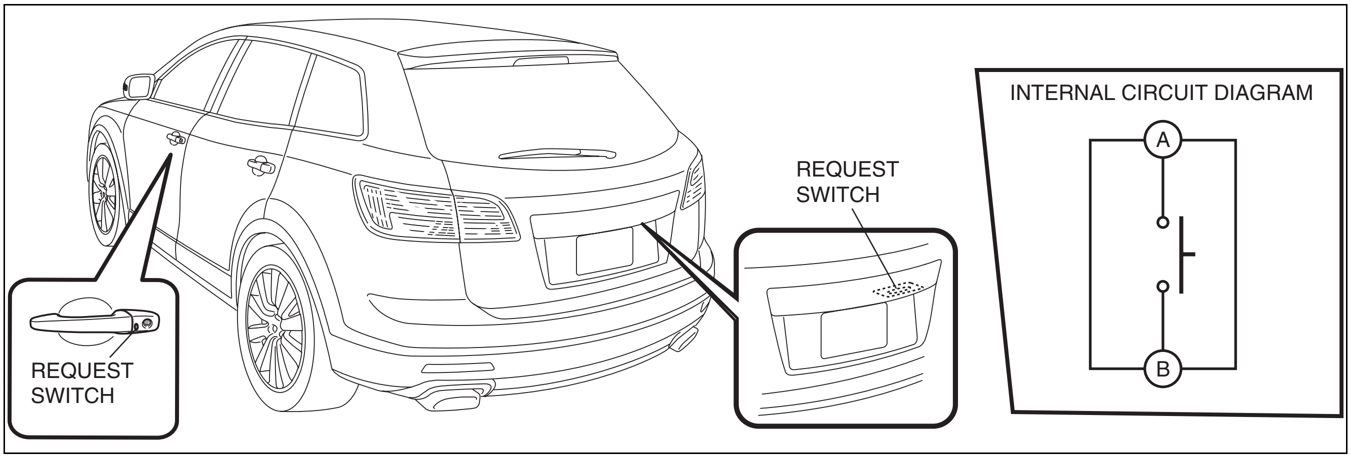
- Installed on both doors and liftgate.



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ON-BOARD DIAGNOSYS SYSTEM OUTLINE (KEYLESS ENTRY SYSTEM) [ADVANCED KEYLESS SYSTEM]

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Special Features

- The keyless entry system has an on-board diagnostic function to facilitate system diagnosis.
- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the keyless entry system-related parts; a memory function, which stores detected DTCs; a display function, which indicates system malfunctions by DTC display; and a PID/data monitoring function, which reads out specific input/output signals.
- Using the Mazda Modular Diagnostic System (M-MDS), DTCs can be read out and cleared, and the PID/data monitoring function can be activated.

ON-BOARD DIAGNOSYS SYSTEM PID DATA/MONITOR FUNCTION OPERATION (KEYLESS ENTRY SYSTEM) [ADVANCED KEYLESS SYSTEM]

id0914b1103100

On-board Diagnostic Function

Malfunction detection function

- Detects overall malfunctions in the keyless entry system-related parts.

Display function

- If any malfunction is detected, the keyless warning light (red) in the instrument cluster illuminates to inform the driver of a system malfunction.

Memory function

- Stores malfunctions in the keyless entry 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 disconnected.

DTC table

DTC Mazda Modular Diagnostic System (M-MDS) display	System malfunction location
B1342	Keyless control module internal malfunction
B1134	Unprogrammed card key
B2477	Configuration error
B1317	Keyless control module power supply voltage increases.
B1318	Keyless control module power supply voltage decreases
B2170	Push switch (Steering lock unit)
B1126	Steering lock unit internal malfunction
U0236	Steering lock unit communication system
B1093	Steering lock unit communication error
U0214	Keyless receiver
B1133	Keyless antenna (exterior, RF)
B1132	Keyless antenna (exterior, LF)
B1128	Keyless antenna (Interior, rear)
B1131	Keyless antenna (exterior, rear)
B1129	Keyless antenna (Interior, middle)
B112A	Keyless antenna (Interior, front)
U0323	Communication error to instrument cluster
U0100	Communication error to PCM
U0073	Control module communication error
U2023	Error signal from CAN related module
B1681*	No detected communication with the coil antenna.
B2103*	Coil malfunction
B1213*	Only one key ID number is programmed.

* : Vehicles with immobilizer system

PID/data monitor function

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the keyless control module and reading them out in real-time.
- Use the Mazda Modular Diagnostic System (M-MDS) to read the PID/data monitor.

PID/data monitor table

PID name (definition)	Data contents	Unit/ Operation	Terminal
DTC_CNT	Number of continuous DTCs	–	–
RPM	Engine speed	RPM	3W, 3X
VSS	Vehicle speed	KPH	3W, 3X
VPWR	Supply voltage	V	2A
NUMCARD	Number of programmed card keys	–	–
NUMKEY*	Number of programmed key ID numbers	–	–
DRSW_D	Door switch (driver's door)	CLOSE/ OPEN	3Q
DRSW_ALL	Door switch (except driver's door)	CLOSE/ OPEN	3Q
REQ_SW_P	Request switch (right side door)	On/Off	3K
REQ_SW_D	Request switch (left side door)	On/Off	3I
REQ_SW_BK	Request switch (liftgate)	On/Off	3M
LOCK_SW_D	Door lock-link switch (driver's side)	On/Off	3N
IMMOBI	Immobilizer system equipped or not	On*/Off	–
TR/LG_SW	Trunk compartment light switch	CLOSE/ OPEN	
IG_KEY_IN	Key reminder switch	Key-In/Key-Out	3F
IG_SW_ST	Ignition switch (Push switch)	Pushed/Not Pushed	3E
BUZZER	Keyless beeper	On/Off	2K
PWR_IG1	Power supply (IG1)	On/Off	2C
PWR_ACC	Power supply (ACC)	On/Off	2E

* : Vehicles with immobilizer system

Simulation Function

- The simulation function is used for optionally selecting simulation items of output parts preset in the keyless control module, and to operate them regardless of control.

ACTIVE COMMAND MODE TABLE

Command name	Output part name	Unit/ Operation	Terminal
BZR_OUT	Keyless beeper	On/Off	2K
BZR_INN	Interior buzzer (Instrument cluster)	On/Off	3W, 3X
LNP_RED	Keyless warning light (red)	On/Off	3W, 3X
LNP_GREEN	Keyless indicator light (green)	On/Off	3W, 3X
DR_LOCK	All doors lock	Off/Lock	3Q
DR_UNLOCK	All doors unlock	Off/Unlock	3Q

AUXILIARY KEY CONSTRUCTION [ADVANCED KEYLESS SYSTEM]

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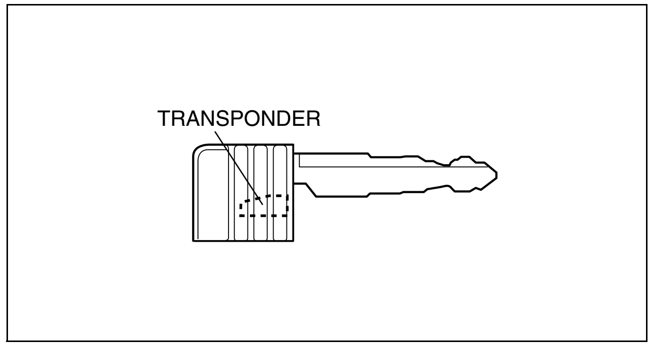
- Keys for use with the immobilizer system have an electronic communication device (transponder) built into the key head that retains specific electronic codes (key ID number).



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COIL ANTENNA CONSTRUCTION [ADVANCED KEYLESS SYSTEM]

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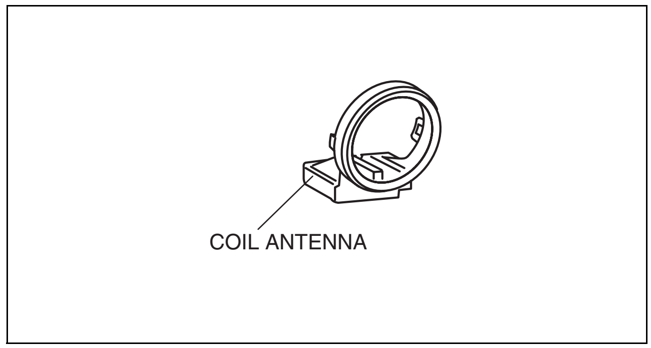
- Installed on the steering lock.
- Forms a magnetic field near the steering lock and receives the key signal.
- Demodulates the received key signal and outputs the signal to the keyless control module.



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SECURITY LIGHT CONSTRUCTION/OPERATION [ADVANCED KEYLESS SYSTEM]

id0914b1105700

Construction

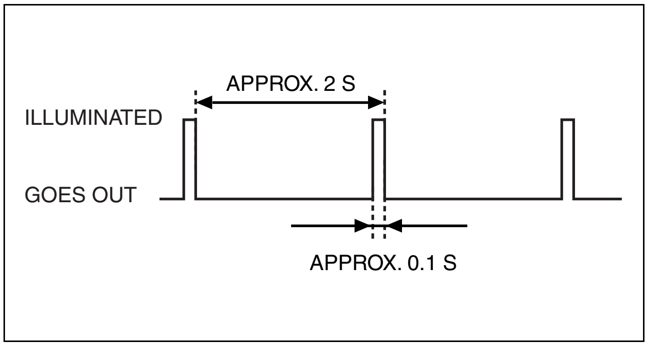
- Allows visual confirmation of immobilizer system operation.
- If any malfunction is detected in the immobilizer system, the malfunction location can be verified by the security light illumination/flashing pattern.

Caution

- **Always use the Mazda Modular Diagnostic System (M-MDS) or equivalent to verify DTCs even if the security light indicates a DTC. If the security light itself has a malfunction, a DTC may not be indicated properly.**

Operation

- When the immobilizer system is operating, the security light flashes repeatedly 0.1 s every approx. 2 s.



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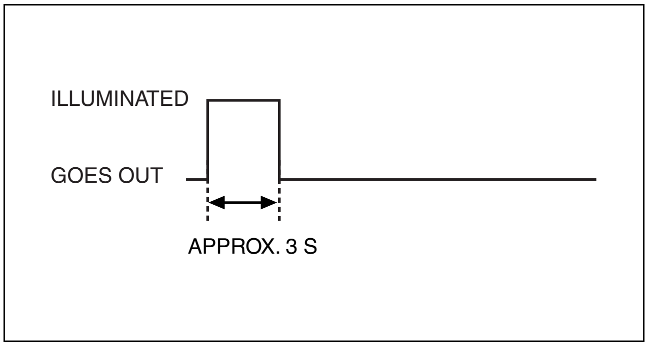
- When the immobilizer system is deactivated normally, the security light illuminates for approx. 3 s and then goes out when the start knob is turned to the ON position.



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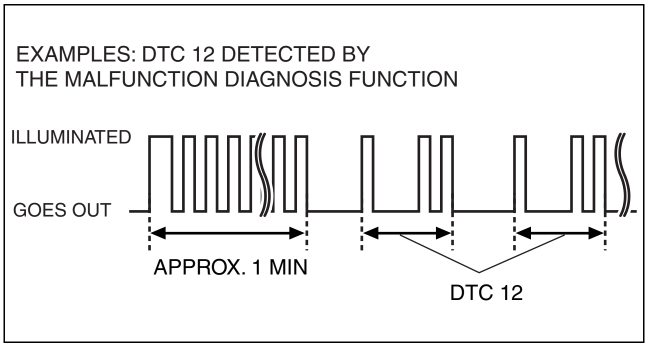
- If the immobilizer system is not deactivated normally (malfunction detected by the malfunction diagnosis function), the security light indicates a DTC. When the start knob is turned to the ON position, the security light flashes or illuminates for 1 min in the following pattern:
  — DTC 11—16: Flashes
  — DTC 21, 22, 23: On

Note

- The security light indicates the DTC 10 times.
- If multiple DTCs that can be confirmed only the DTC with the lowest number of those detected will be indicated by the security light.



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KEYLESS BEEPER CONSTRUCTION [ADVANCED KEYLESS SYSTEM]

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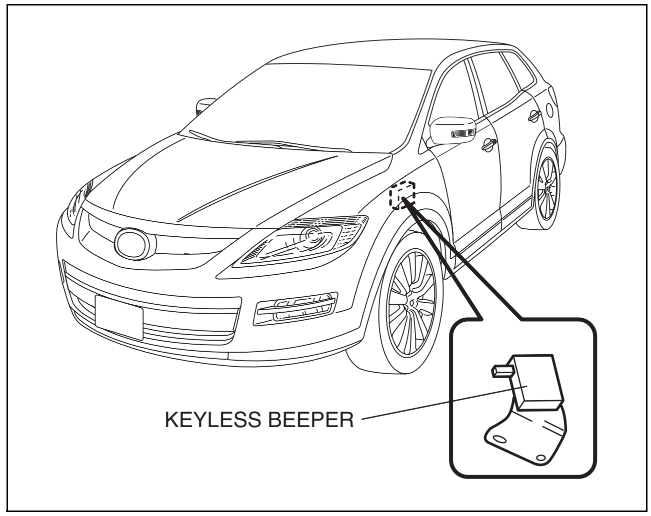
- Installed on the front fender pane.



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09-14B SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

SECURITY AND LOCKS OUTLINE [KEYLESS ENTRY SYSTEM]

id0914b3100100

Features

Improved marketability	• Power door lock system adopted • Keyless entry system adopted
Improved theft-deterrence	• Theft-deterrent system adopted • Immobilizer system adopted

SECURITY AND LOCKS STRUCTURAL VIEW [KEYLESS ENTRY SYSTEM]

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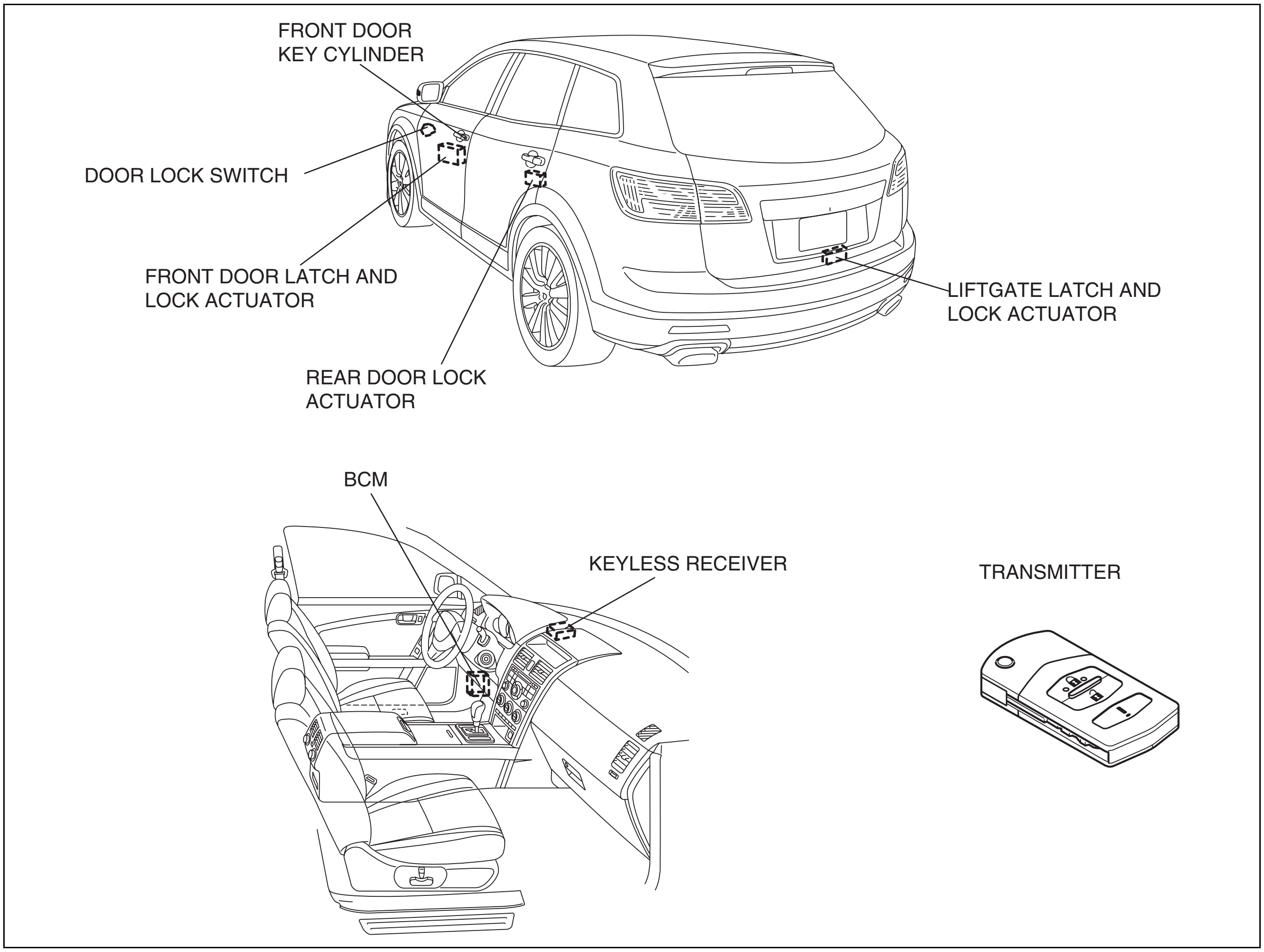

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SECURITY AND LOCKS SYSTEM WIRING DIAGRAM [KEYLESS ENTRY SYSTEM]

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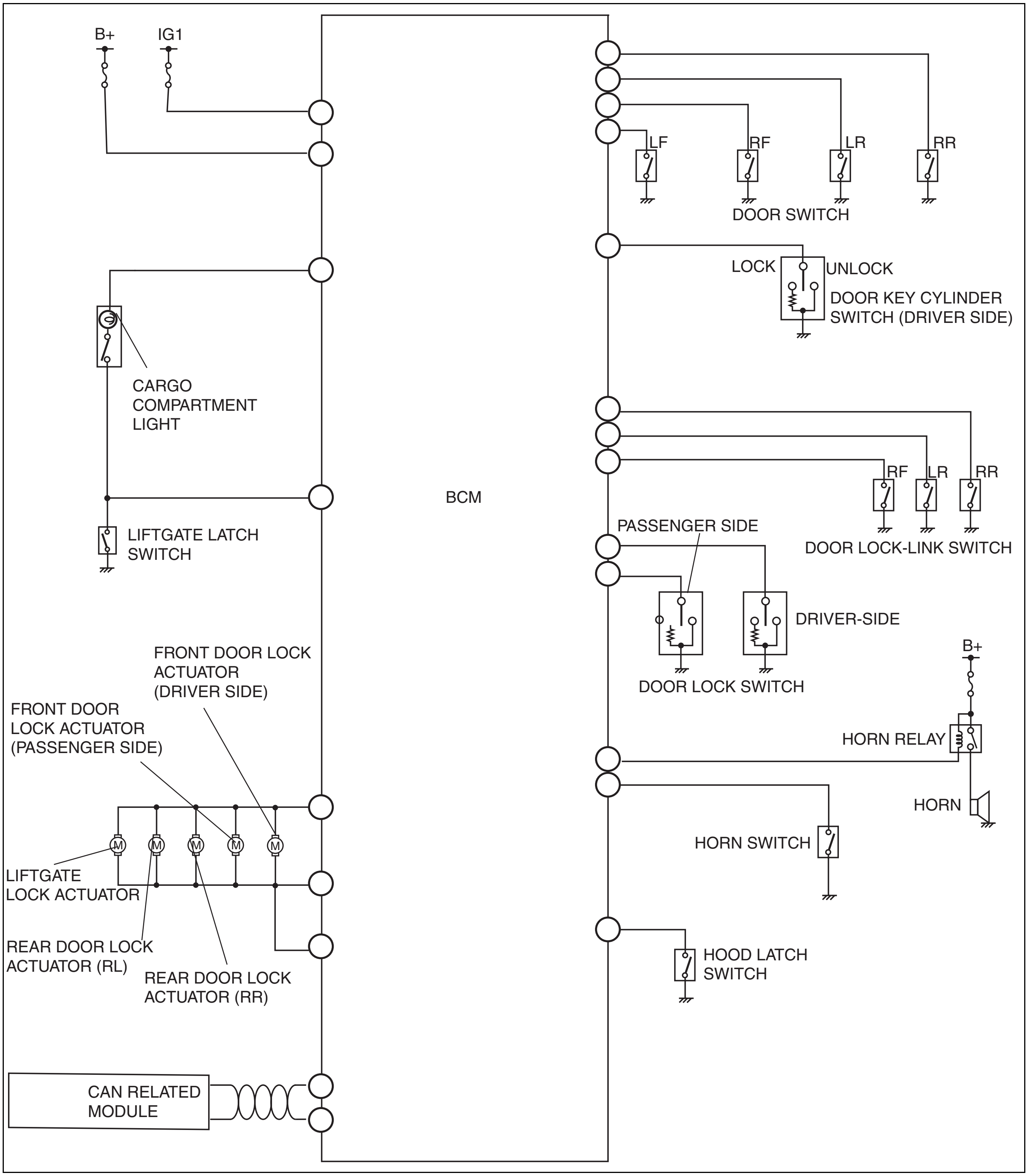

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THEFT-DETERRENT SYSTEM OUTLINE [KEYLESS ENTRY SYSTEM]

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- The theft-deterrent system includes sound and light alarms that activate when the hood, the 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 and turned to unlock or the transmitter unlock button is pressed, the alarms stop.

THEFT-DETERRENT SYSTEM STRUCTURAL VIEW [KEYLESS ENTRY SYSTEM]

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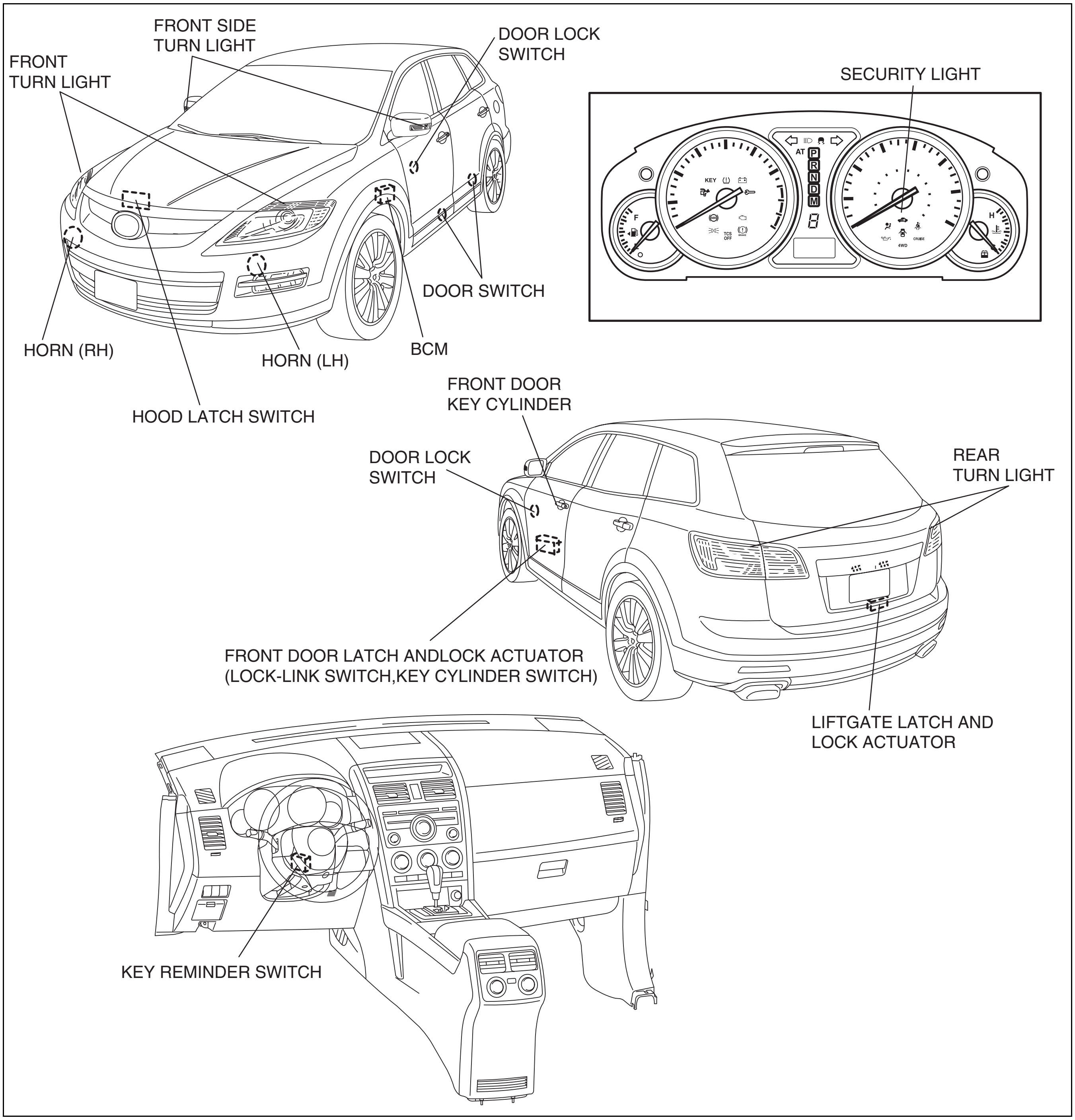

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THEFT-DETERRENT SYSTEM WIRING DIAGRAM [KEYLESS ENTRY SYSTEM]

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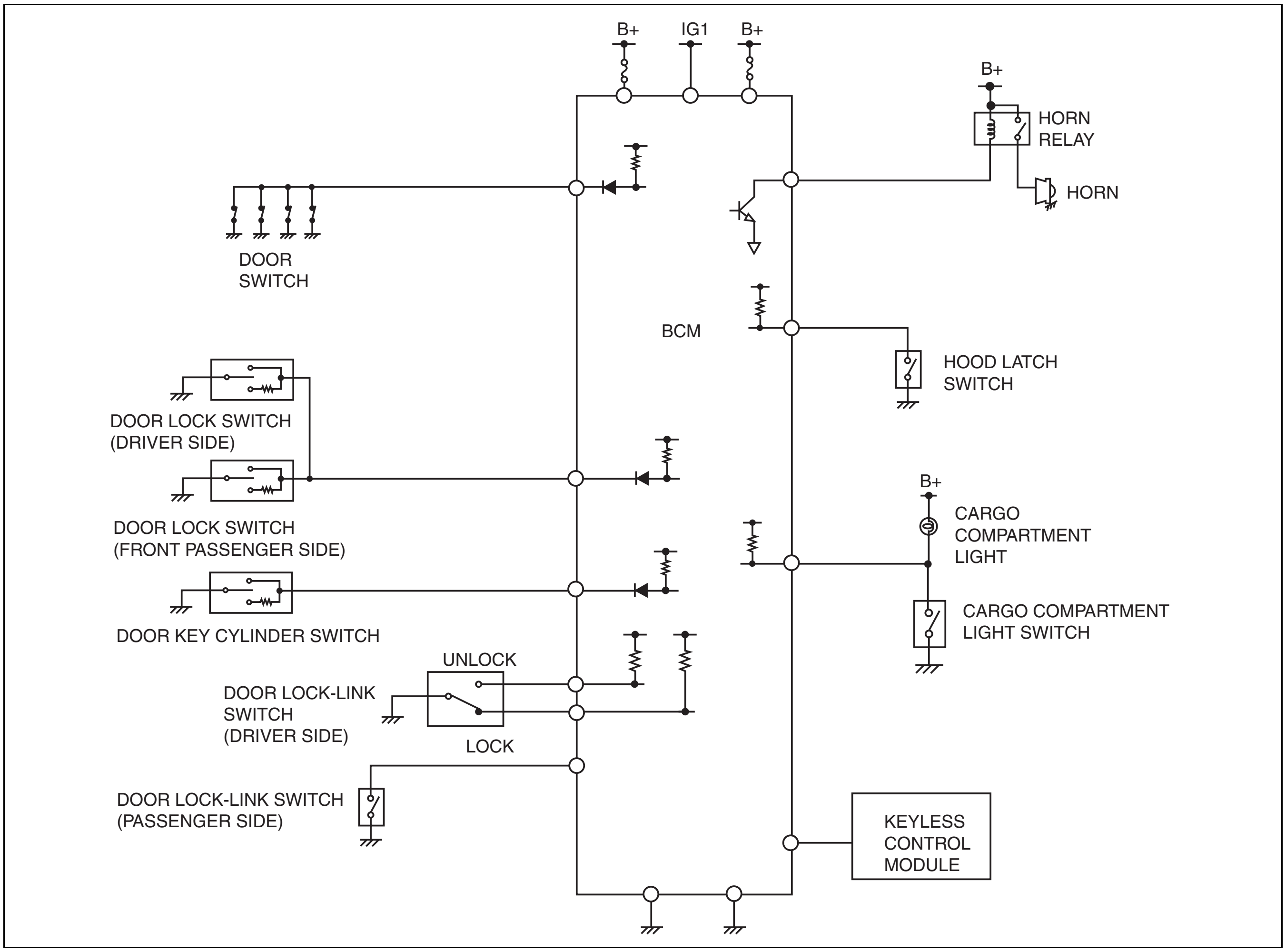

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THEFT-DETERRENT SYSTEM OPERATION [KEYLESS ENTRY SYSTEM]

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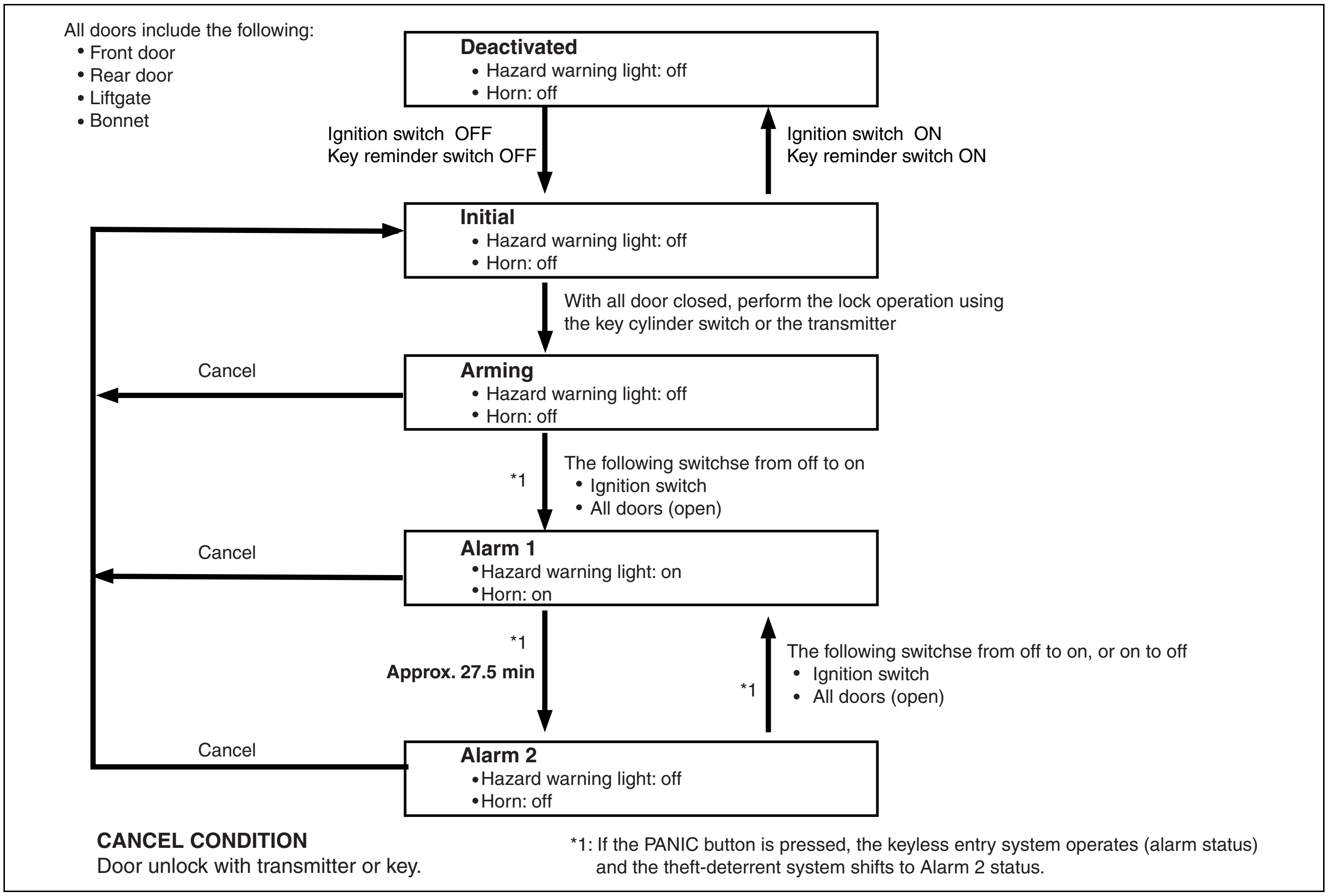
Item	Action	Confirmation	Note
Arming	The theft-deterrent system can be armed by performing the following operations: 1. Turn the ignition switch to ON, then to LOCK position. 2. Remove the key from the steering lock. 3. Perform the following: • Close all doors. • Close the liftgate. • Close the hood. 4. Lock all doors.[*1]	• Hazard warning lights flash once.	• With any door open, the doors will not lock with the transmitter and the theft-deterrent system will not arm • The liftgate can be opened with the key or the transmitter even when the system is armed. The alarm will not come on and the system will remain armed. [*1]: If the hood or the liftgate is open, the doors will lock but the alarm will not arm until the hood or liftgate is closed.
Arming cancel	Arming can be canceled by either of the following operations: • Unlock any doors using the transmitter or key. • Insert the key into the steering lock and turn the ignition switch to ON position.	• Hazard warning lights flash two times.	-
Alarm	The alarm triggers with each of the following operations: • Forcing open a door, the hood, or the liftgate. • Unlock any doors without using the transmitter or key. • Open a door, the hood or the liftgate by operating an door lock switch, the hood release lever or the liftgate opener switch. • Ignition switch turned to ON position using incorrect key.	• Hazard warning lights flash. • Horn sounds.	• The alarm continues for approx. 2.5 min, then stops.
Alarm cancel	Alarm can be canceled by either of the following operations: • Door unlock with transmitter or key. • liftgate open with transmitter or key.	-	-

System flowchart



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09-14B

POWER DOOR LOCK SYSTEM OUTLINE [KEYLESS ENTRY SYSTEM]

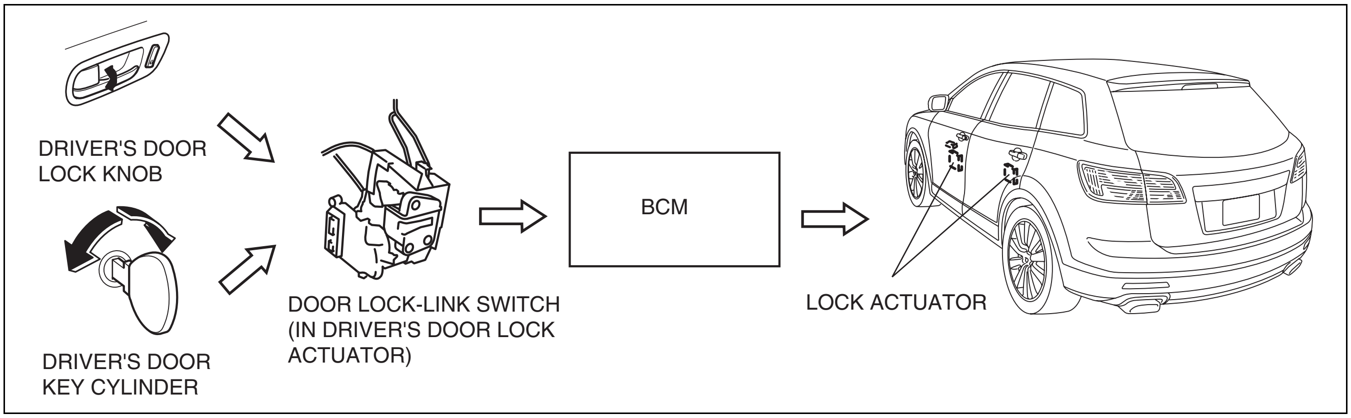
id0914b3100900

- A door lock knob interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door lock knob.
- A door key interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door key cylinder.

POWER DOOR LOCK SYSTEM OPERATION [KEYLESS ENTRY SYSTEM]

id0914b3101000

- When the driver's door is locked/unlocked with the driver's door lock knob or key cylinder, the door lock-link switch in the door lock actuator is locked/unlocked via the rod.
- The BCM activates each lock actuator to lock/unlock according to the lock/unlock signal from the door lock-link switch.



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POWER DOOR LOCK SYSTEM WIRING DIAGRAM [KEYLESS ENTRY SYSTEM]

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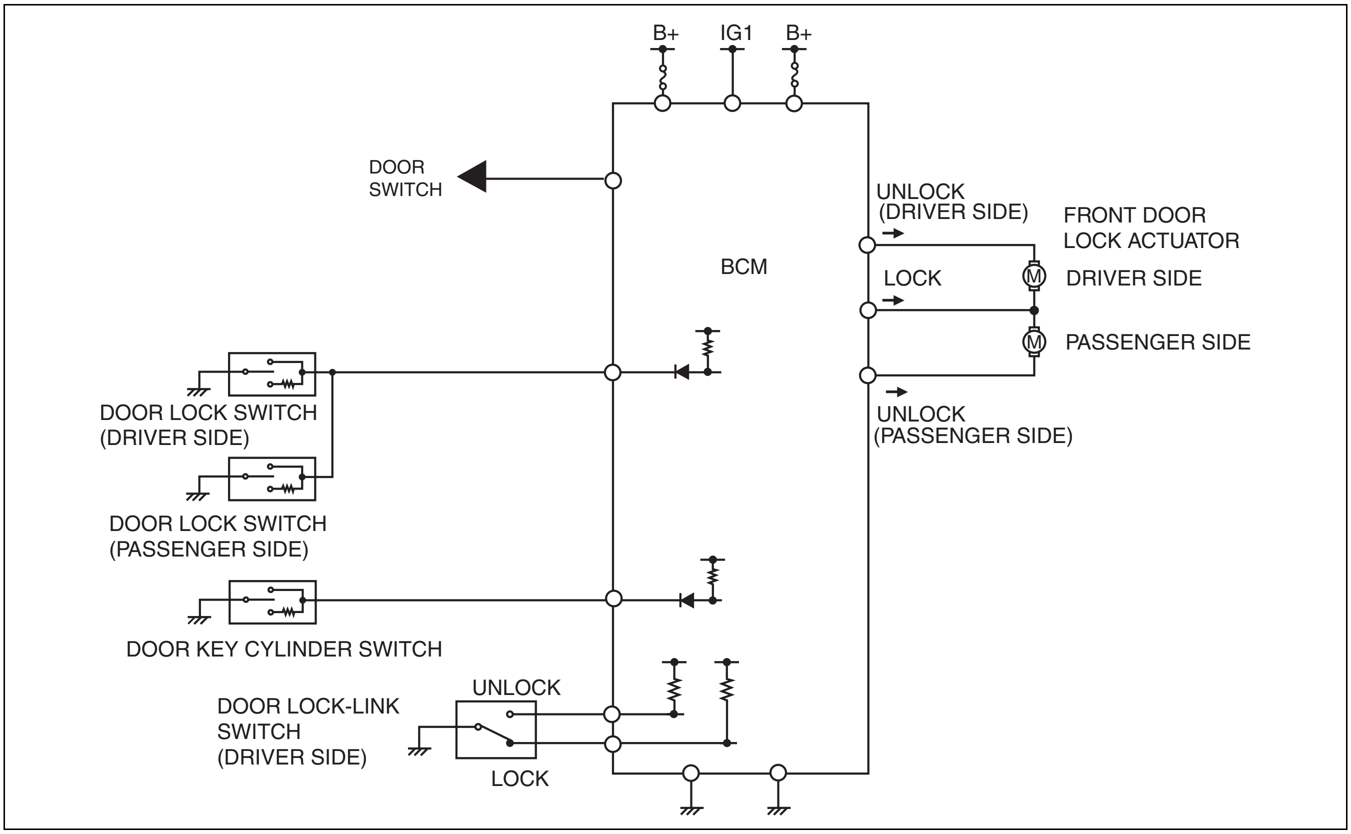

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KEYLESS ENTRY SYSTEM OUTLINE [KEYLESS ENTRY SYSTEM]

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- The doors also can be locked/unlocked by operating the key or transmitter.
- The answer-back function has been adopted where the hazard warning light flashes confirms that the doors are locked/unlocked.
- A rolling code type transmitter has been adopted to prevent theft by radiowave interception.
- To prevent improper operation while the vehicle is moving, the doors cannot be locked/unlocked by operating the transmitter when the ignition switch is in any position except LOCK.

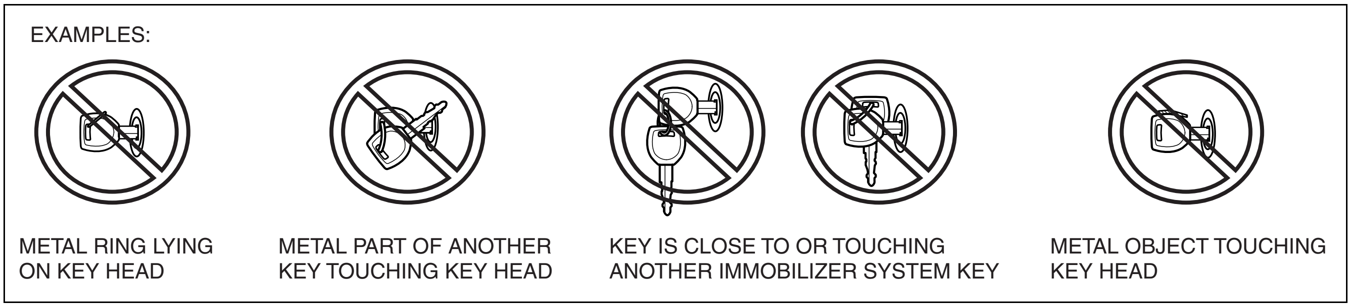
IMMOBILIZER SYSTEM OUTLINE [KEYLESS ENTRY SYSTEM]

id0914b3101700

- 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 and prevents it from being started in any other manner (such as with an unregistered key or by starter relay short).
- The immobilizer system consists of the key (built-in transponder), coil antenna, keyless control module, PCM, and security light (in the instrument cluster).
- Ignition 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).
- The immobilizer system operates automatically when the ignition switch is turned to the LOCK or ACC position. When this occurs, the security light flashes repeatedly 0.1 s every 2 s.
- In order to start the engine, the immobilizer system must be made inoperable using a key previously registered with the vehicle. No special operation is required to release the immobilizer system but rather the vehicle is started similar to vehicles without the system: the ignition switch is turned from the LOCK or ACC position to the ON or START position and the release operation begins automatically. The engine can only be started after the key, keyless control module and PCM successfully perform their parts of the verification procedure. For details, refer to “09-14A-11 IMMOBILIZER SYSTEM OPERATION [ADVANCED KEYLESS SYSTEM]”.
- If the immobilizer system is not released due to a malfunction or verification failure, the security light in the instrument cluster displays a DTC. At the same time, DTCs are stored respectively in the PCM and keyless control module. The stored DTCs can be verified using the Mazda Modular Diagnostic System (M-MDS). Repair the malfunctioning part using the verified DTCs. For details, refer to “09-14A-13 ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION [ADVANCED KEYLESS SYSTEM]”.
- The immobilizer system cannot be deactivated.

Caution

- **The immobilizer system must be reset using the Mazda Modular Diagnostic System (M-MDS) after performing any of the following: “Replacement of all the keys (steering lock replacement or similar procedure)”, “Keyless control module replacement”, “PCM replacement” and “Keyless control module and PCM replacement”. Moreover, when performing “Replacement of all the keys” or “Keyless control module replacement”, two or more keys usable with the immobilizer system must be readied. For details, refer to Workshop Manual.**
- **Two or more key ID numbers must be registered for the engine to start. For key ID number registration, refer the Workshop ManualSection 09-14, “IMMOBILIZER SYSTEM COMPONENT REPLACEMENT/KEY ADDITION AND CLEARING”.**
- **A maximum of eight key ID numbers can be registered for one vehicle. The PID/data monitor function can be used to verify the number of key ID numbers registered for a single vehicle. For details refer to Workshop Manual.**
- **The following conditions may cause poor signal communication between the key and vehicle, resulting in the engine not starting or a key registration error. Do not perform key registration under the following conditions:**
  - **— If any of the following items are touching or near the key head.**
    - **Spare keys**
    - **Keys for other vehicles equipped with an immobilizer system**
    - **Any metallic object**
    - **Any electronic device, or any credit or other cards with magnetic strips**



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09-14B

IMMOBILIZER SYSTEM STRUCTURAL VIEW [KEYLESS ENTRY SYSTEM]

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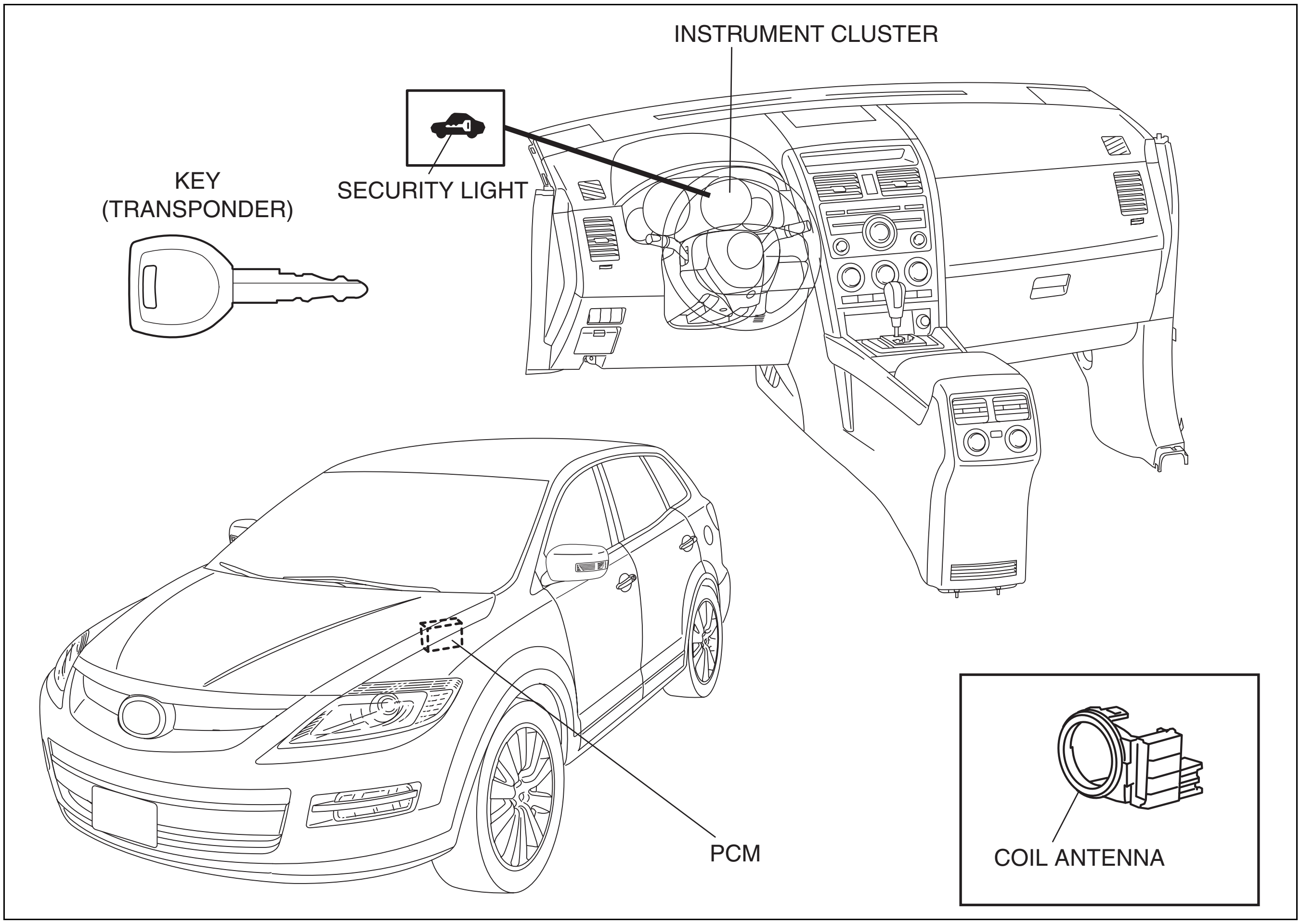

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IMMOBILIZER SYSTEM WIRING DIAGRAM [KEYLESS ENTRY SYSTEM]

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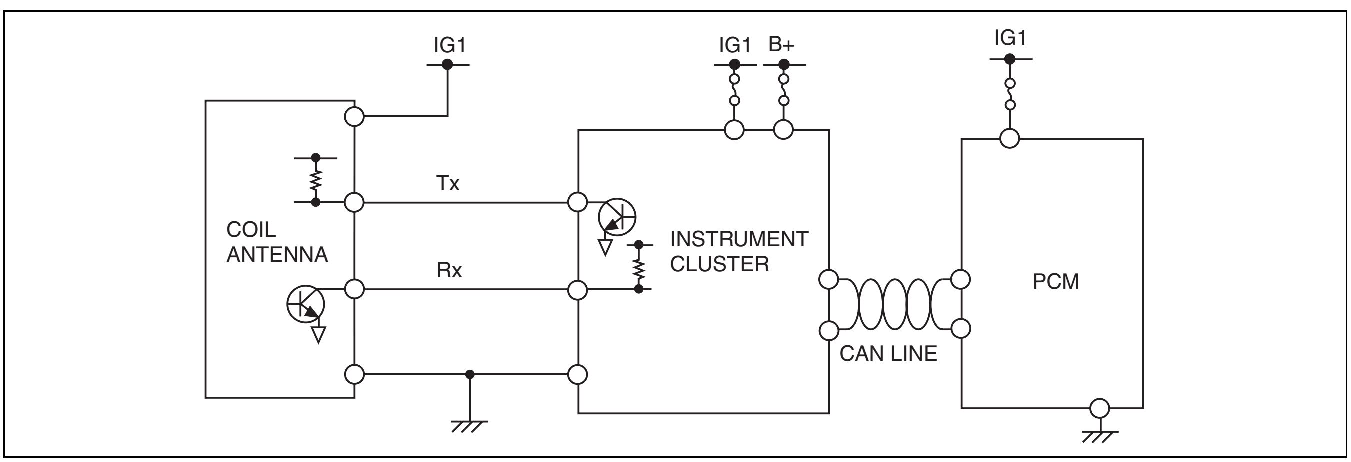

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ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION [KEYLESS ENTRY SYSTEM]

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- The following items can be verified:
  — Number of key ID numbers registered with the vehicle
- Use the Mazda Modular Diagnostic System (M-MDS) to read the PID/data monitor.

PID/Data Monitor Table

PID name (definition)	Detected condition
IC_NUMKEYS (Number of key ID numbers registered in the instrument cluster)	Number of key ID numbers registered: 0—8

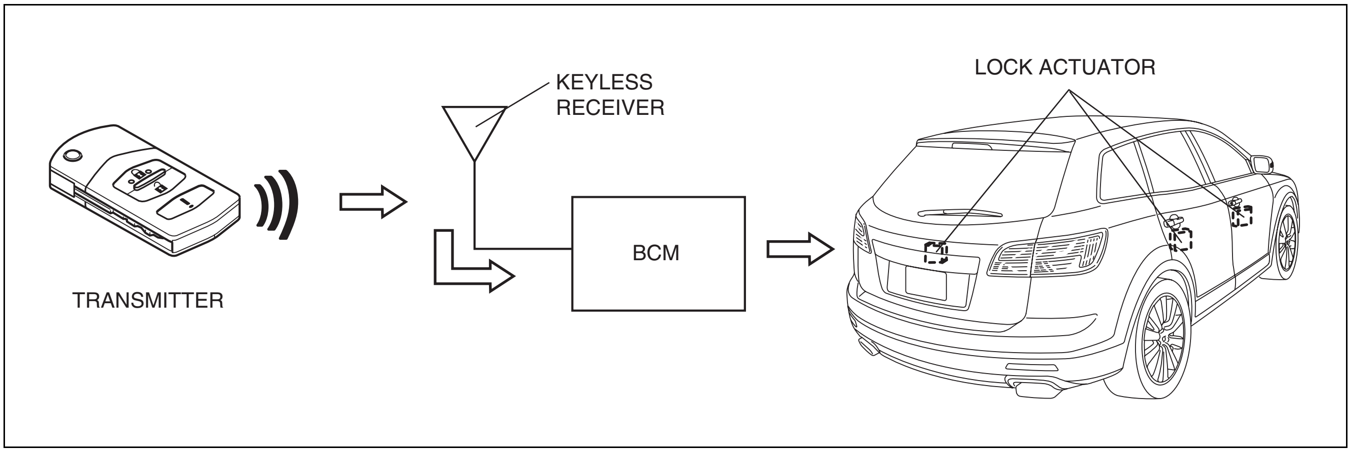
KEYLESS ENTRY SYSTEM OPERATION [KEYLESS ENTRY SYSTEM]

id0914b3102600

Lock/unlock

Note
- If any of the following conditions are met, the doors cannot be locked by operating the transmitter.
  — The key is inserted in the ignition key cylinder.
  — The ignition switch is not in the LOCK position.
  — Any door is open.
- If any of the following conditions are met, the doors cannot be unlocked by operating the transmitter.
  — The key is inserted in the ignition key cylinder.
  — The ignition switch is not in the LOCK position.

1. When the transmitter is operated, the transmitter sends ID data and rolling code. They are received by the keyless receiver and sent to the BCM.
2. When the BCM receives a lock/unlock signal from the transmitter and verifies the ID, the signal is sent to the all lock actuators activate to lock/unlock.
3. The BCM operates the hazard warning lights flash to flash according to lock/unlock signal from the transmitter.
   — When the LOCK button is pressed, the hazard warning lights flash once.
   — When the UNLOCK button is operated, the hazard warning lights flash twice.



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TRANSMITTER (RETRACTABLE KEY TYPE) STRUCTURAL VIEW [KEYLESS ENTRY SYSTEM]

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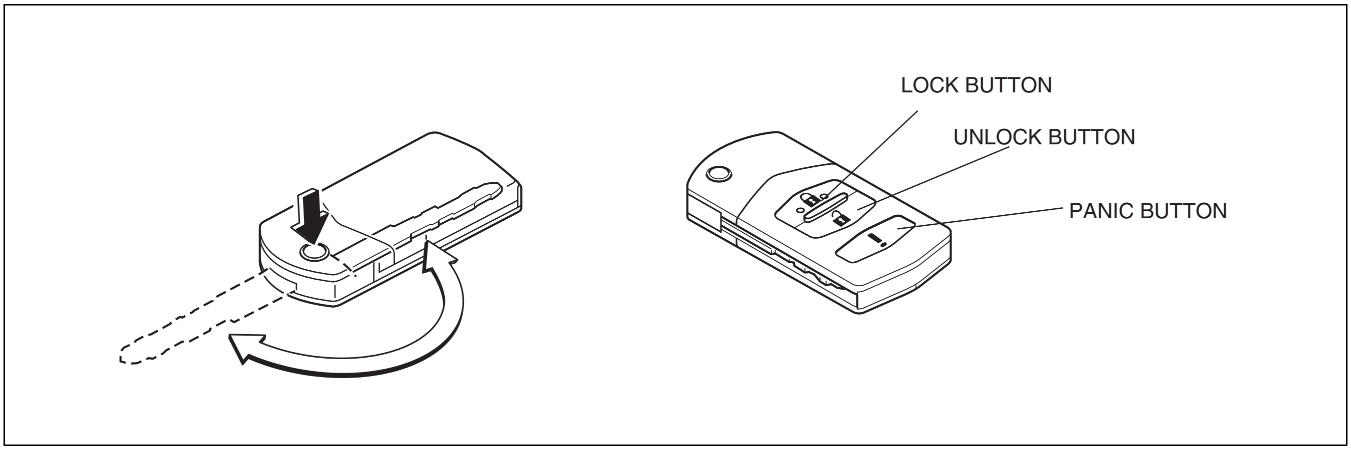

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IMMOBILIZER SYSTEM CONSTRUCTION/OPERATION [KEYLESS ENTRY SYSTEM]

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- When a key is inserted into the key cylinder and turn the ignition switch to ON, the key ID number of the key and the key ID number registered in the instrument cluster 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 using the received data from 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 → Engine starting is not permitted.

SATISFACTORY RESULT ↓

(4) The instrument cluster makes a calculation using received data B and compares it with sent data A.

UNSATISFACTORY RESULT → Engine starting is not permitted.

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.

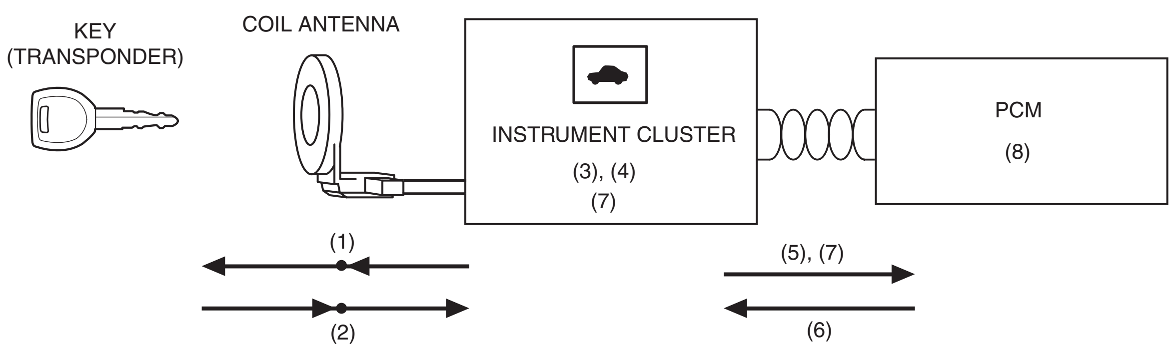
UNSATISFACTORY RESULT → Engine starting is not permitted.

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.



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Immobilizer System Setting

- The immobilizer system can be set so that only the Mazda Modular Diagnostic System (M-MDS) or equivalent must be used to perform system procedures. When using the Mazda Modular Diagnostic System (M-MDS) or equivalent, first security access must be requested. Obtain security access permission according the Mazda Modular Diagnostic System (M-MDS) or equivalent screen and then perform system procedures.

Mazda Modular Diagnostic System (M-MDS) 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 Mazda Modular Diagnostic System (M-MDS) 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 immobililizer 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 CX-9 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 Mazda Modular Diagnostic System (M-MDS) or equivalent
Key clearing	The registered key ID number can only be cleared using the Mazda Modular Diagnostic System (M-MDS) or equivalent. When clearing a key ID number using the Mazda Modular Diagnostic System (M-MDS) or equivalent, all key ID numbers are cleared.
PCM replacement	• Parameter reset must be performed.
Instrument cluster replacement	• Parameter reset must be performed. • The key ID numbers for all keys that were being used must be registered using the Mazda Modular Diagnostic System (M-MDS) or equivalent. Two or more keys must be registered.
Coil antenna replacement	Resetting of the immobilizer system does not need to be performed.

09-15 SUNROOF

SLIDING SUNROOF OUTLINE

id091500100100

- An electric sunroof with tilt mechanism has been adopted.
- A deflector has been adopted, reducing throbbing noise.
- A system control using pulse sensors (hall effect switches) has been adopted for system simplification.
- A sunroof motor with an integrated control unit has been adopted.
- An IG OFF timer function has been adopted.
- An exterior open/close function has been adopted. (See 09-12-7 EXTERIOR OPEN/CLOSE FUNCTION OUTLINE.)

SUNROOF SPECIFICATION

id091500100200

Item	Specification
Slide system	Inner slide
Opening measurement (mm {in})	281 × 740 {11.1 × 29.1}
Tilt-up amount (mm {in})	24.6—28.6 {0.96—1.12}
Opening/closing time (s)	Slide: 3.0—6.0, Tilt: 0.3—1.3

SLIDING SUNROOF STRUCTURAL VIEW

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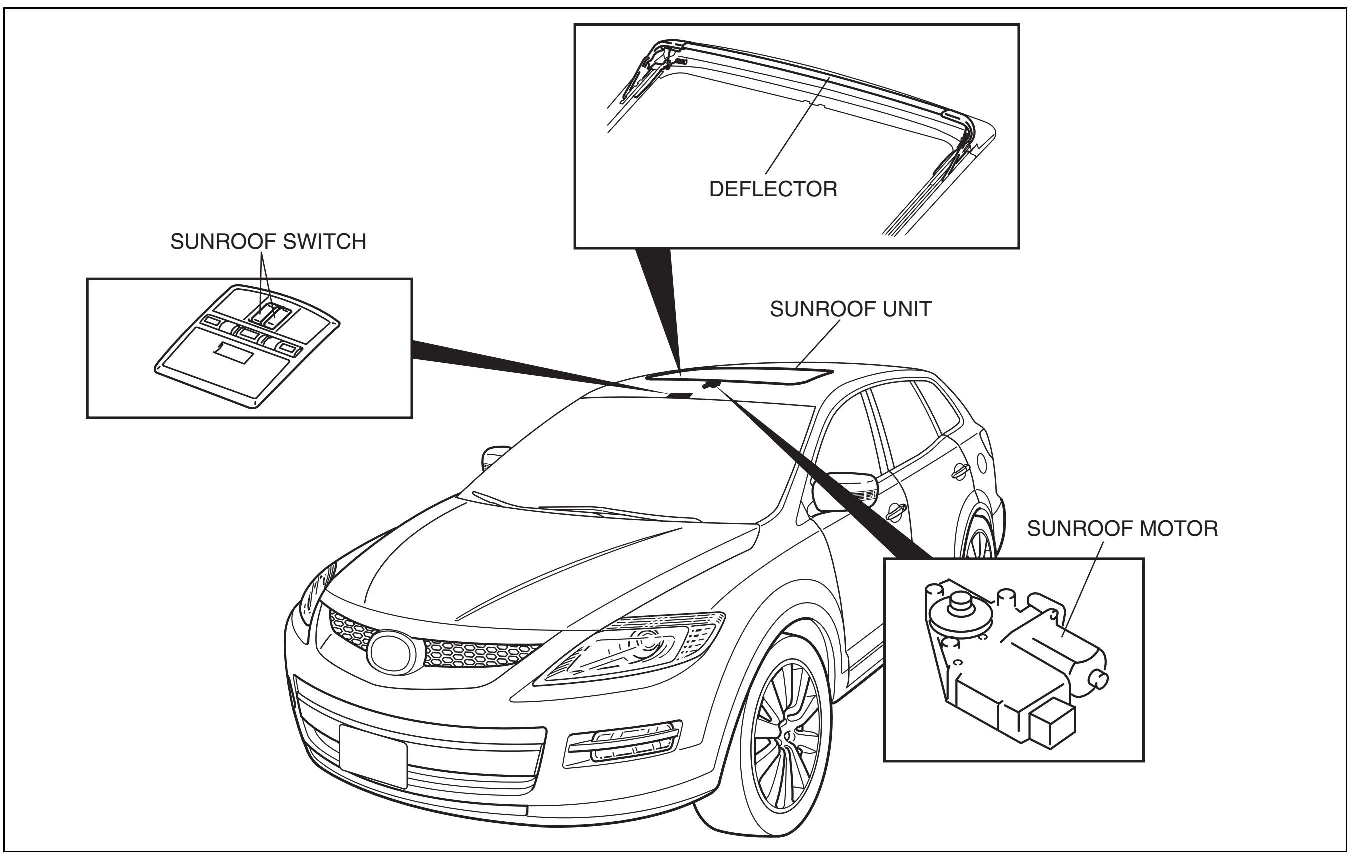

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SLIDING SUNROOF SYSTEM WIRING DIAGRAM

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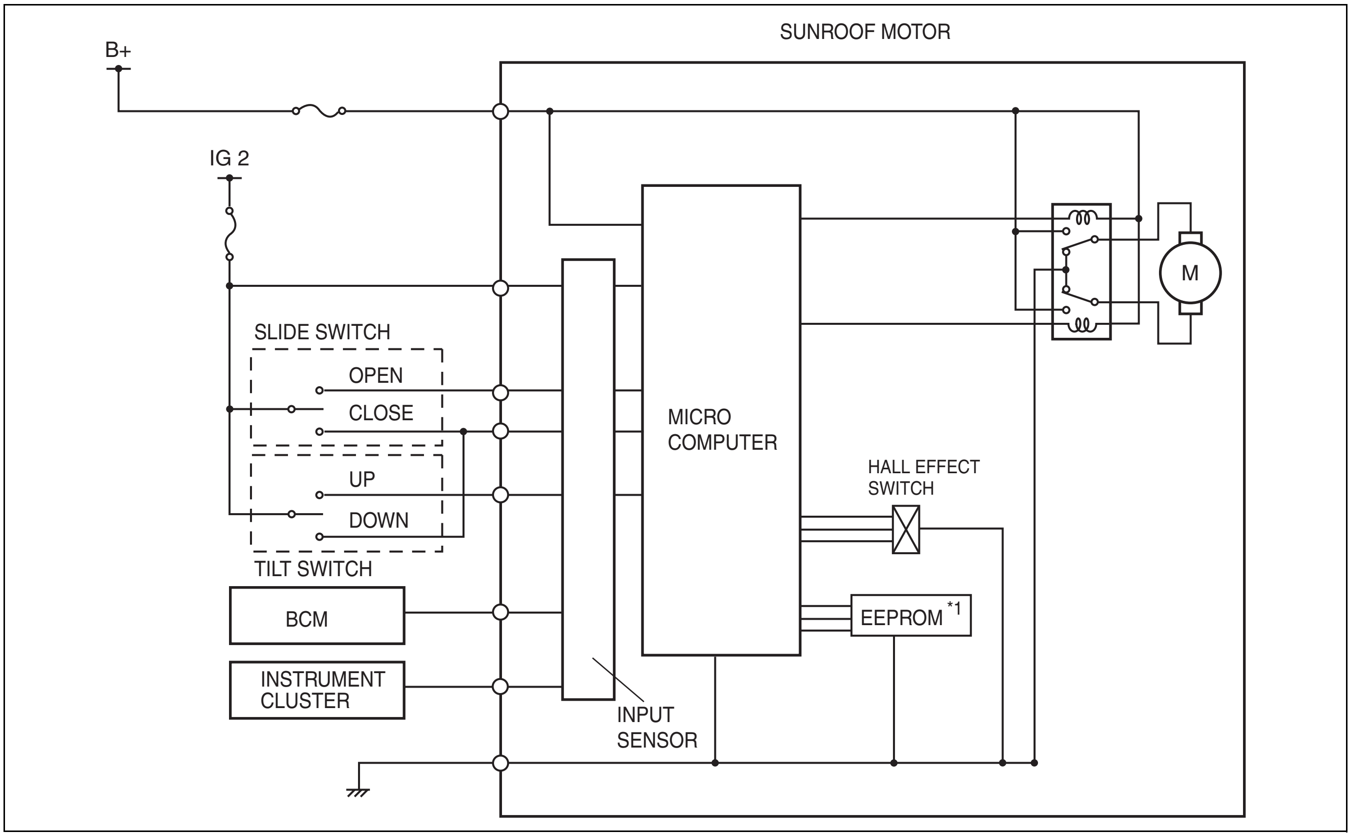

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*1 : Electronically Erasable and Programmable Read Only Memory

SLIDING SUNROOF OPERATION

id091500100500

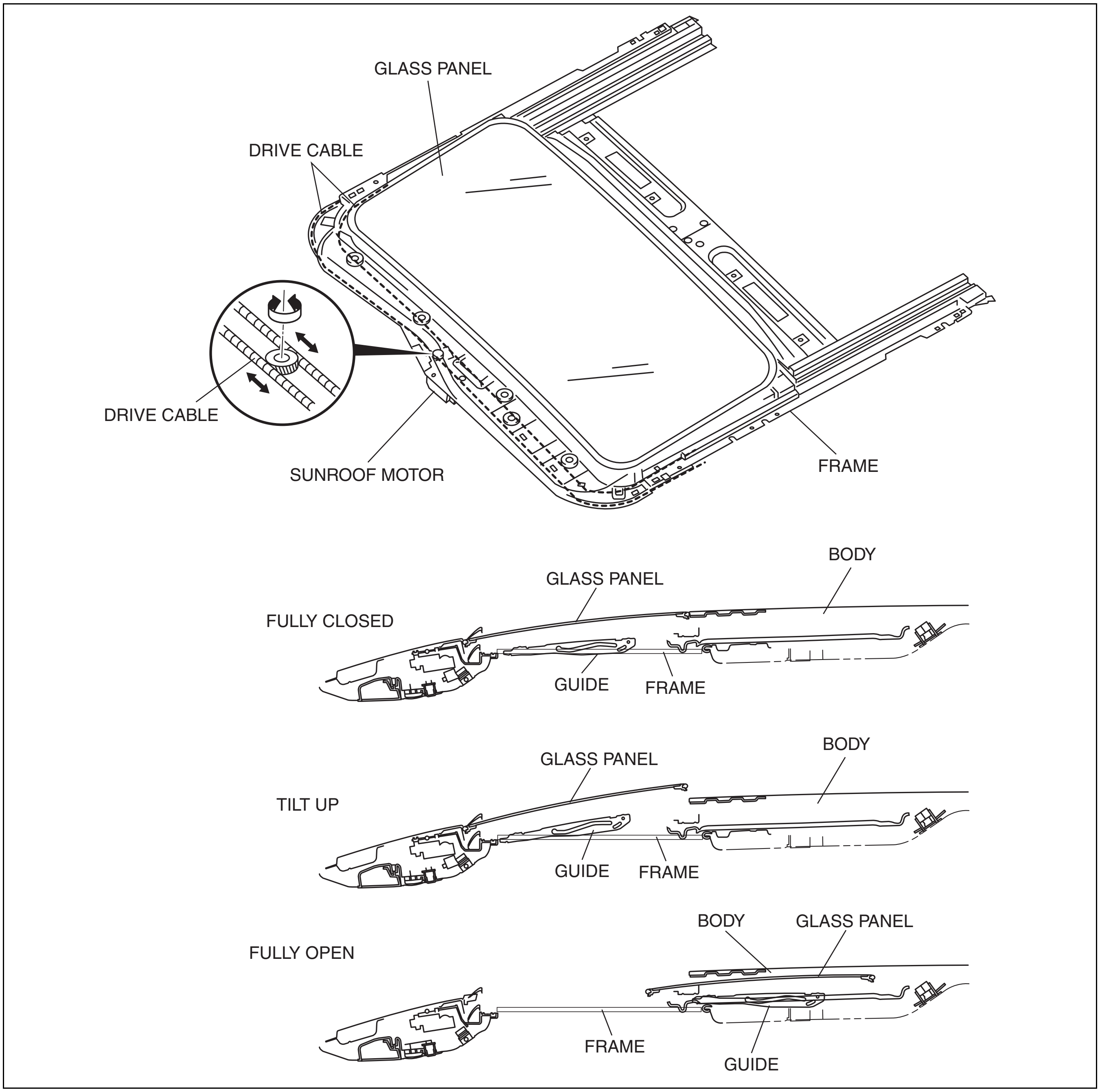
- The glass panel opens/closes using tilting and sliding operations.
- When the ignition switch is at the ON position, the sunroof operates by use of the sunroof switches.
- When the ignition switch is in the ON position, the sunroof operates automatically using a one-touch operation of the slide open/close and tilt up/down switches.
- When the ignition switch is in the LOCK or ACC position, the slide-open and tilt-up switches operate automatically, and the slide-close and tilt-down switches operate manually for 45 s or less until the front door opens. (IG OFF timer function)
- 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	Detection conditions	Fail-safe status		Cancel condition
		Motor is stopped	Motor is operating	
Obstruction detection	Obstruction load of 100 N {10.2 kgf·m,73.8 ft·lbf} or more	—	Reverse operation • Reverses to the full-tilt position when detected during tilt-down operation. • Moves 200 mm {7.87 in} in the open direction (to fully open position if sunroof opens within 200 mm {7.87 in}) when detected during slide-close operation.	Reverse operation completed
Low voltage detection	Approx. 8 V or less voltage detected	Operation prohibited	Operation continued	Voltage is within the guaranteed operation voltage
Over-voltage detection	Approx. 18 V or more voltage detected	Operation prohibited	Operation stopped → Operation prohibited	Voltage is within the guaranteed operation voltage
Pulse sensor error	One side of the pulse cannot be detected	—	Operation stopped Switches to the starting point, non-set conditions	Sensor signal returned to normal
Improper roof position	Pulse sensor output is at the overflow value or more, or at the underflow value or less (Only occurs when the glass is moved forcibly to the full-tilt position or to the position exceeding the full-open position.)	Switches to the starting point, non-set conditions	—	Initialization of the roof position completed
EEPROM error	Reading error of the roof position data preset in the EEPROM when the operation is started	Operation prohibited	—	EEPROM is read normally
Microcomputer overdrive	Watchdog timer clear signal does not input from the microcomputer	Operation prohibited	Operation stopped → Operation prohibited	Normal operation is started after the microcomputer power-on reset
Element breakage affecting closing operation	—	Operation prohibited	Operation stopped → Operation prohibited	Does not recover from operation prohibition

SUNROOF UNIT CONSTRUCTION/OPERATION

id091500100600

- 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.



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09-16 EXTERIOR TRIM

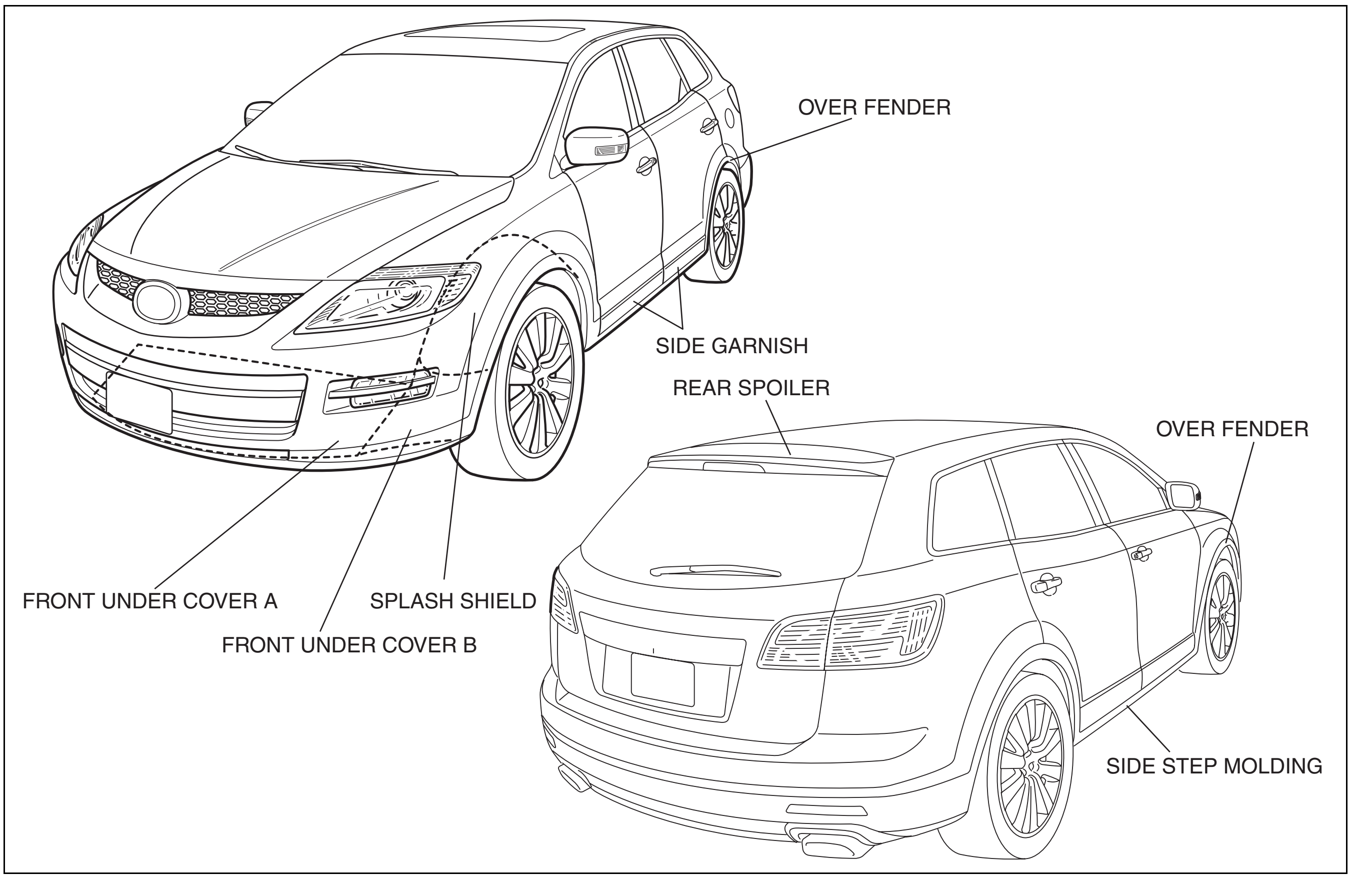
EXTERIOR TRIM OUTLINE

id091600100100

- Side step molding has been adopted.
- Side garnish has been adopted.
- Rear spoiler has been adopted.
- Over fender has been adopted.
- Front under cover A has been adopted.
- Front under cover B has been adopted.
- Splash shield has been adopted.

EXTERIOR TRIM STRUCTURAL VIEW

id091600100200



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09-17 INTERIOR TRIM

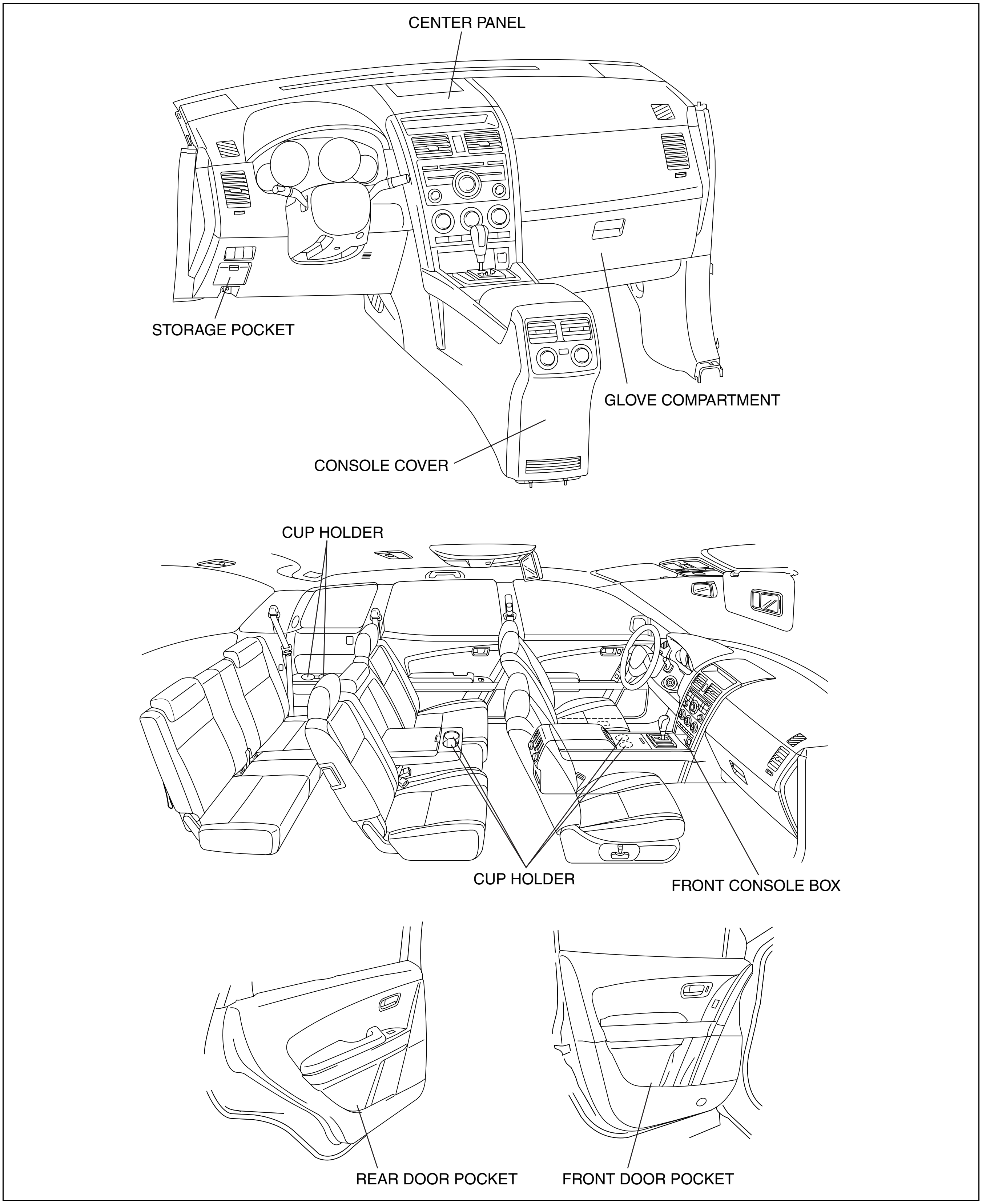
INTERIOR TRIM OUTLINE

id091700100100

- The center panel with front climate control units, is located at the center of the dashboard. This improves functionality and gives a unified appearance.
- A console cover integrated with rear climate control units and ventilator grilles has been adopted.
- Various storage spaces have been added.

INTERIOR TRIM STRUCTURAL VIEW

id091700100200



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09-18 LIGHTING SYSTEMS

LIGHTING SYSTEMS OUTLINE

id091800100100

Improved marketability	• A headlight with built-in front turn light, parking light and front side marker light has been adopted for design improvement. • Projector type headlights (low-beam) have been adopted. • Front fog lights have been adopted. (Located in front bumper) • Console Indirect illumination adopted • Door pocket Indirect illumination adopted
Improved convenience	• Headlight leveling system adopted • Auto light system adopted • Auto light-off system adopted
Improved visibility	• LEDs have been adopted for the high-mount brake light. • LEDs have been adopted for the brake/taillights. • Built-in front side turn light has been adopted for outer mirror. • 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.
System simplification	• An auto light/wiper control module has been adopted in which the auto light, auto wiper, DRL, and auto light-off systems are consolidated.

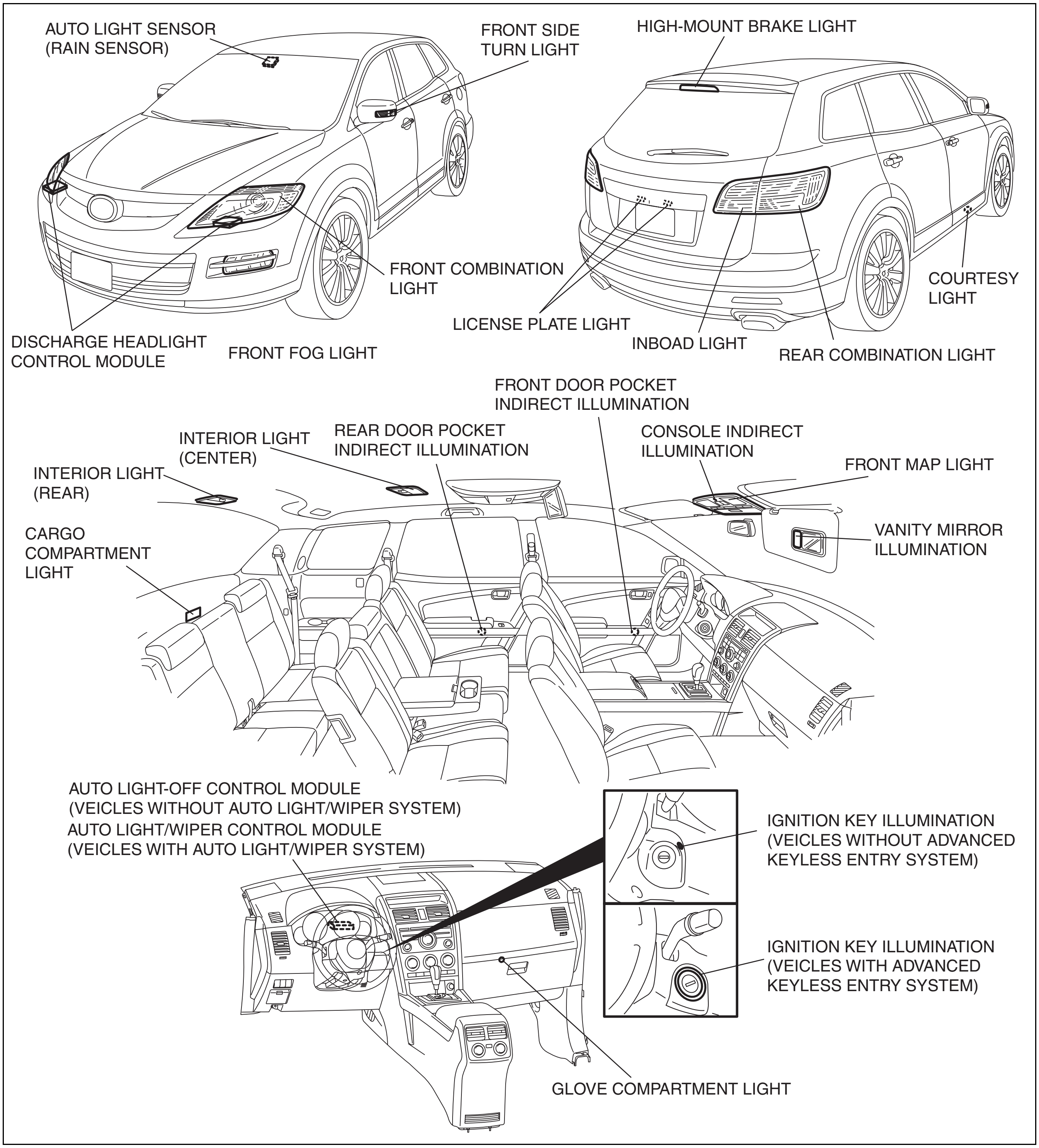
LIGHTING SYSTEMS SPECIFICATION

id091800100200

Item			Specifications (W) × number
Exterior light bulb capacity	Headlight bulb (high-beam)		60 × 2
	Headlight bulb (low-beam)	Discharge headlight bulb	35 × 2
		Halogen headlight bulb	55 × 2
	Front turn light bulb		27 × 2
	Parking/front side marker light bulb		5 × 2
	Front fog light bulb		51 × 2
	Front side turn light (LED)		2.26 × 2
	Brake/taillight (LED)		5.4/0.7× 2
	Rear turn light bulb		21 × 2
	Rear side marker light bulb		5 × 2
	Back-up light bulb		21 × 2
	Taillight bulb		3.8 × 2
	License plate light bulb		5 × 2
	High-mount brake light (LED)		2.4 × 1
Interior light bulb capacity	Front map light bulb		8 × 2
	Center interior light bulb		10 × 1
	Rear interior light bulb		10 × 1
	Cargo compartment light bulb		10 × 1
	Courtesy light bulb		5 × 2
	Vanity mirror illumination bulb		2 × 2
	Glove compartment light bulb		1.7 × 1
	Ignition key illumination bulb		1.4 × 1

LIGHTING SYSTEMS STRUCTURAL VIEW

id091800100300



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FRONT COMBINATION LIGHT CONSTRUCTION

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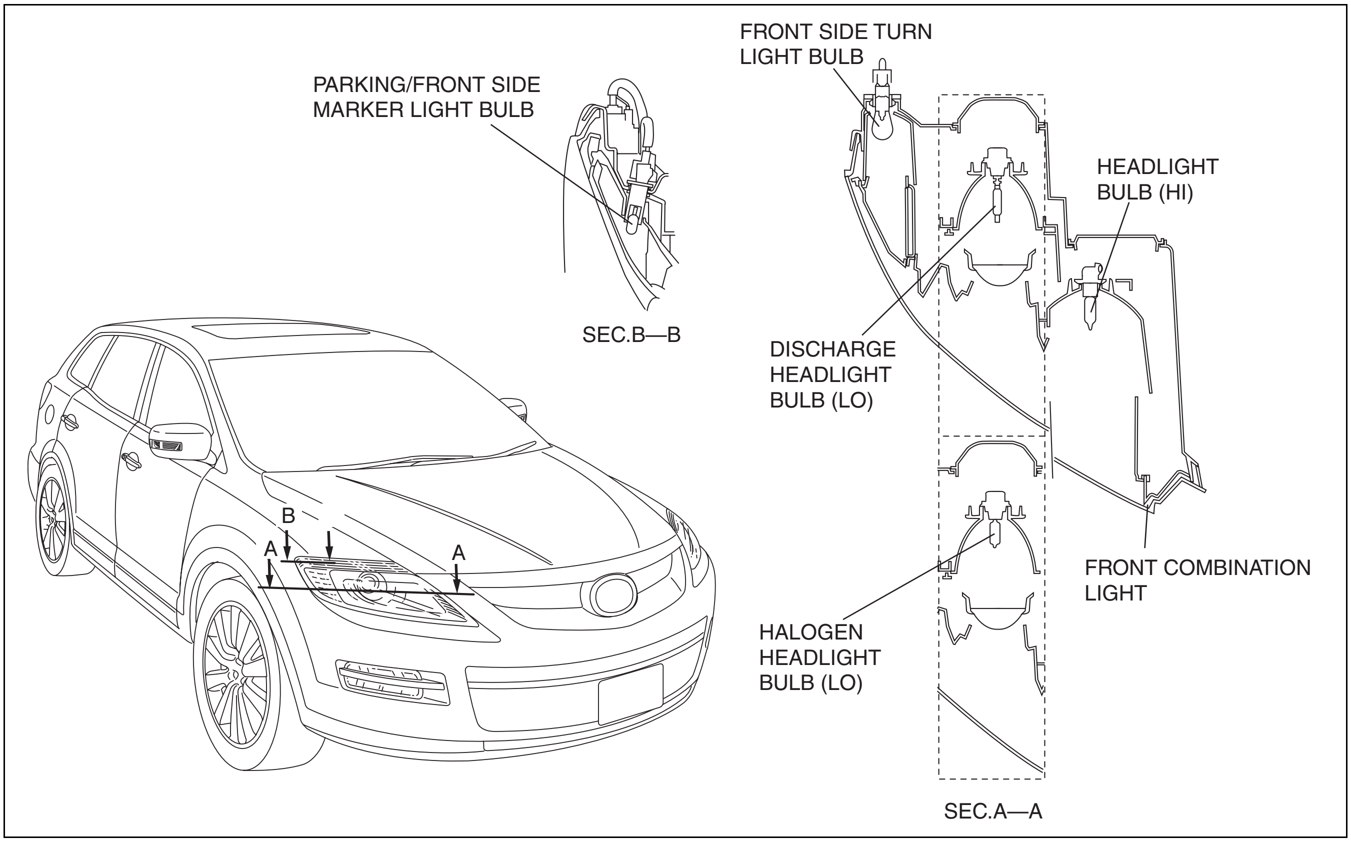
- A headlight with built-in front turn light, parking/front side marker light and front side turn light has been adopted for design improvement.
- Projector type headlights have been adopted.



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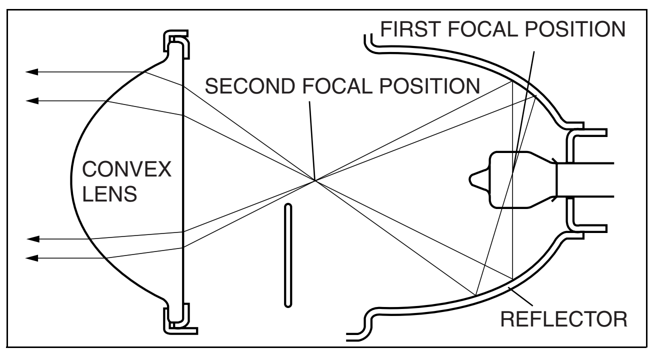
Projector-type Headlight

- Light emitted from the first focal point is projected off the reflector, gathered at the second focal point, and output through the convex lens.



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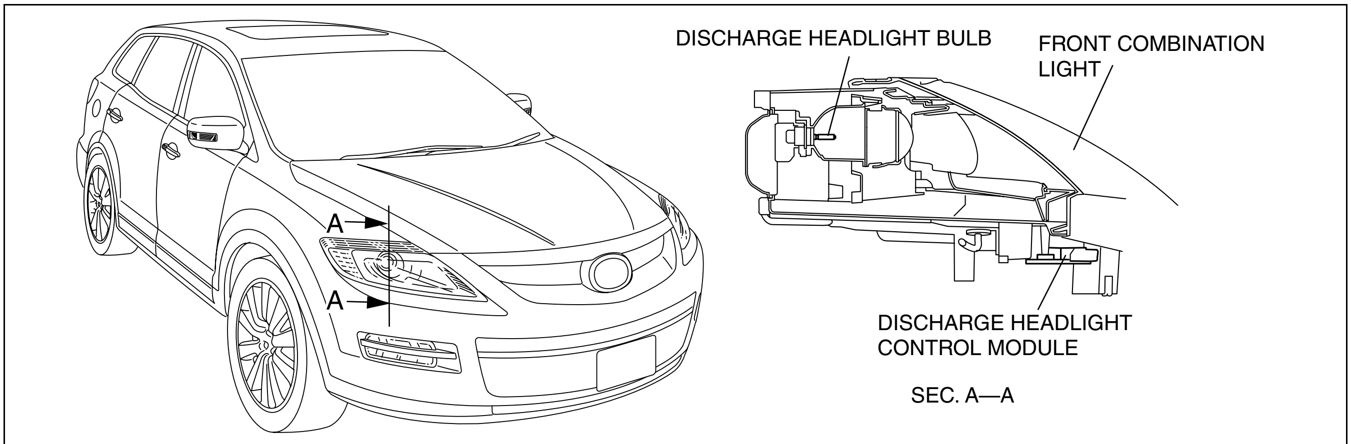
DISCHARGE HEADLIGHT OUTLINE

id091800103600

- Compared with the current model, the illumination area is wider. Moreover, due to projection of white light with a hue similar to sunlight, night visibility while driving has been improved.
- The gas discharge bulb is efficient with low power consumption and high luminosity.

DISCHARGE HEADLIGHT STRUCTURAL VIEW

id091800103700



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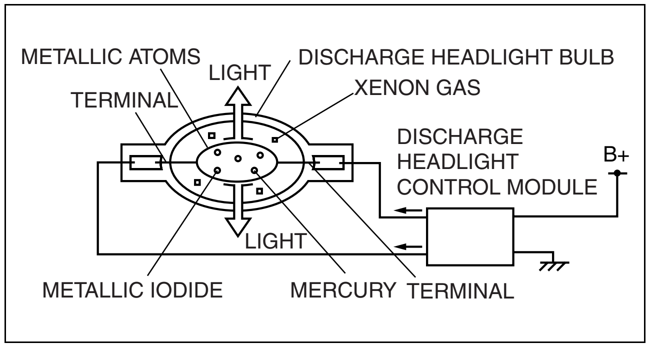
DISCHARGE HEADLIGHT OPERATION

id091800103500

1. A high voltage pulse (alternating current approx. 25,000 V) traveling from the discharge headlight control module is applied between both discharge headlight bulb terminals, energizing the xenon gas in the bulb.
2. Due to the energizing of the xenon gas, the temperature of the discharge headlight bulb interior increases, vaporizing the mercury and discharging an arc.
3. Due to the mercury and discharging the arc, the temperature of the discharge headlight bulb interior increases further, metallic iodide is vaporized and separated, and metallic atoms are discharged, producing light.



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DISCHARGE HEADLIGHT CONTROL MODULE FUNCTION

id091800103400

- Controls the amount of electrical current while the discharge headlights are on to maintain optimum brightness together with lighting stability.
- The failure detection functions are as follows:
  - — Abnormal input detection function
  - — Abnormal output detection function

Abnormal Input Detection Function

- If the discharge headlight control module input voltage (**9—16 V**) fails to maintain operational voltage (except for the drop in voltage immediately after the headlights are turned on), the discharge headlight control module turns off the headlights for protection and to prevent partial operation.
- The discharge headlight control module turns the headlights back on at resumption of normal operational voltage.

Abnormal Output Detection Function

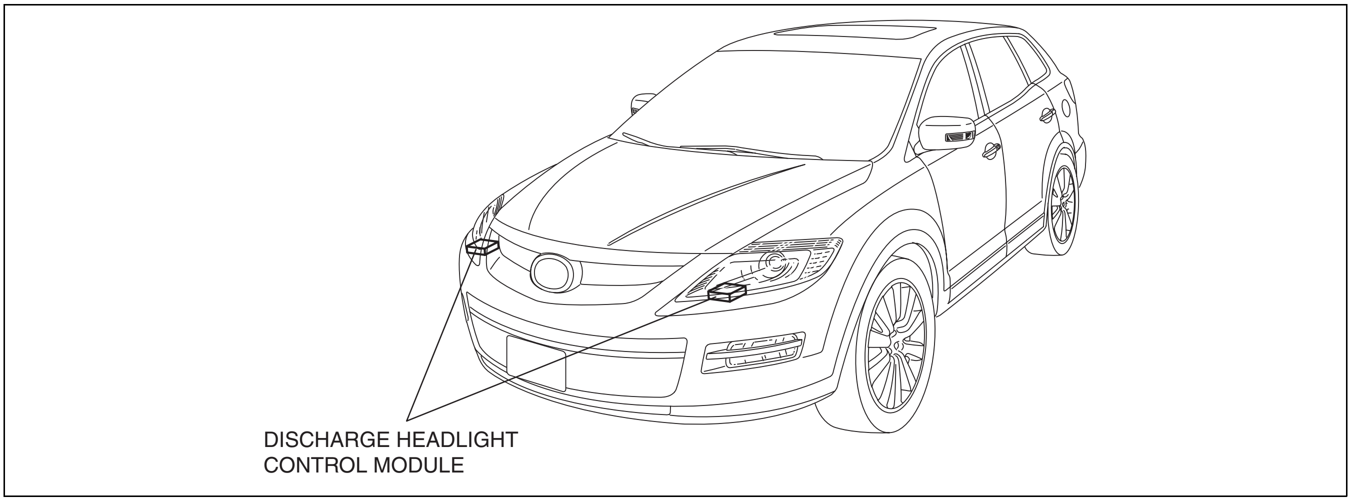
- If there is an abnormality in the output system (detects an open or GND short circuit in harness), the discharge headlight control module turns off the headlights for protection and to prevent partial operation errors.
- If the discharge headlight control module turns off the headlights due to an abnormality in the output system, the discharge headlight control module will maintain them in the off condition until the light switch is turned again from off to on.

DISCHARGE HEADLIGHT CONTROL MODULE CONSTRUCTION/OPERATION

id091800103300

Warning
- **Incorrect servicing of the discharge headlights could result in electrical shock. Before servicing the discharge headlights, always refer to the discharge headlight service warnings. (See CX-9 Workshop Manual.)**

- Built into the headlight and installed on the headlight lower side.



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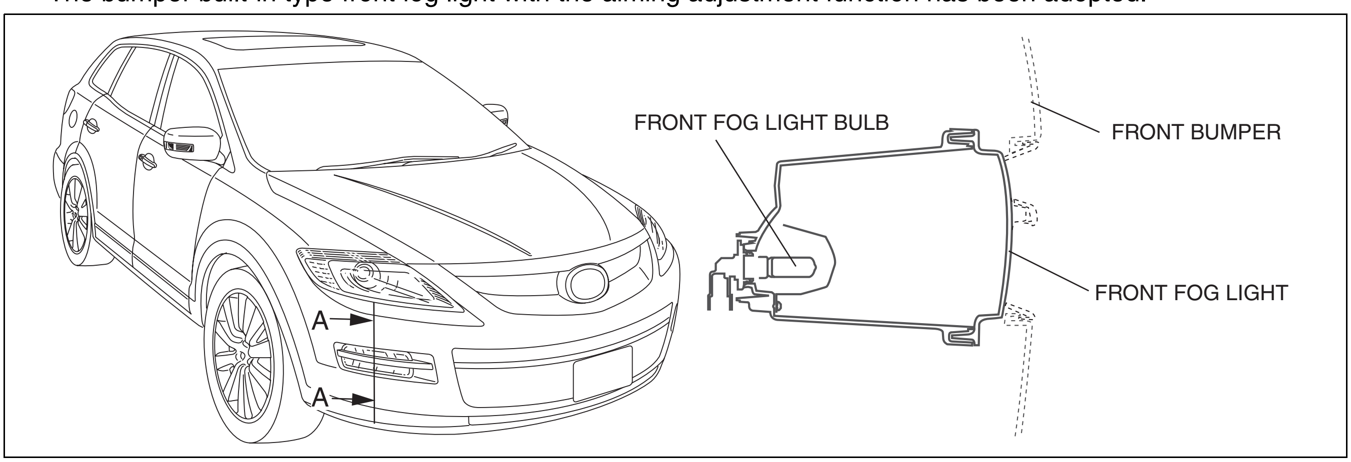
- Switches the direct current from the battery to alternating current (**25,000 V**) and optimally controls the current supply output to the bulb.

FRONT FOG LIGHT CONSTRUCTION

id091800105900

- The bumper built-in type front fog light with the aiming adjustment function has been adopted.



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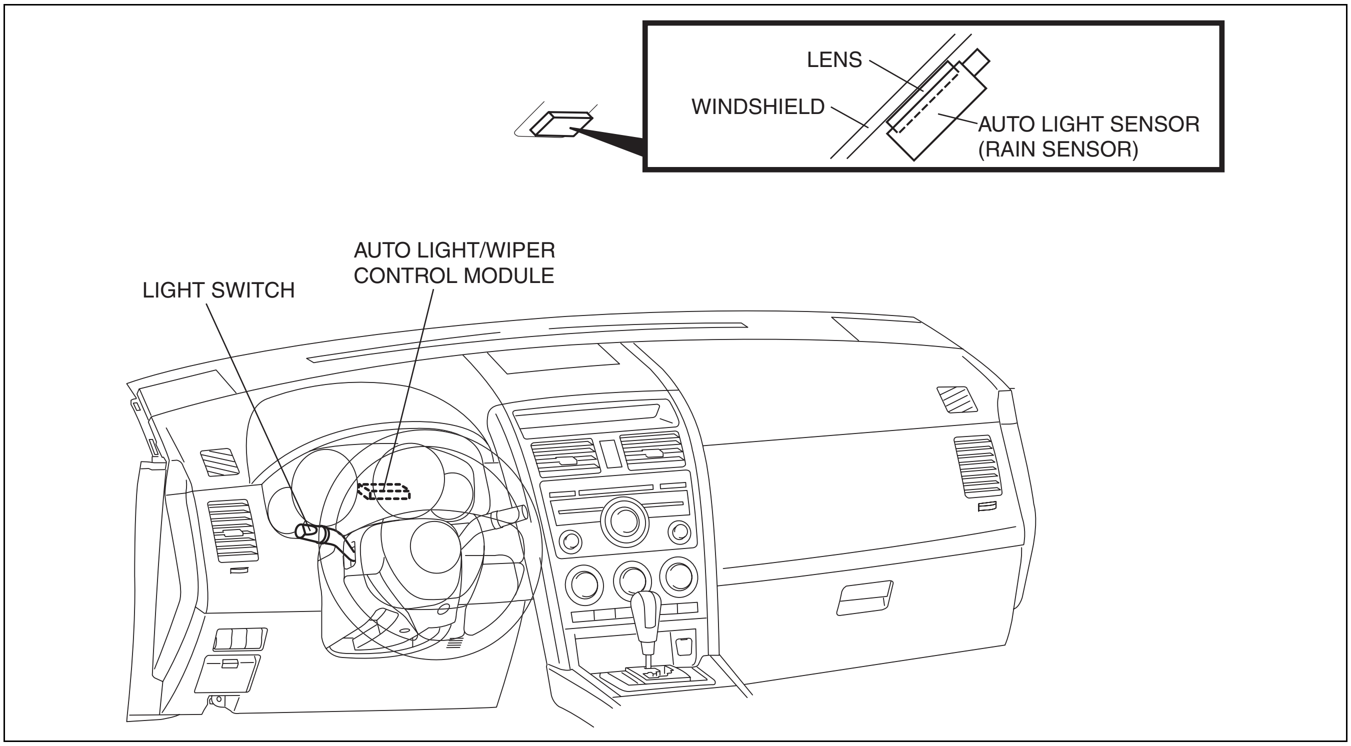
AUTO LIGHT SYSTEM OUTLINE

id091800101800

- An auto light system that automatically illuminates and turns off the headlights in any situation according to the level of light outside of the vehicle has been adopted.
- An auto light/wiper control module has been adopted in which the auto light, auto wiper, DRL, and auto light-off systems are consolidated.

AUTO LIGHT SYSTEM STRUCTURAL VIEW

id091800101900



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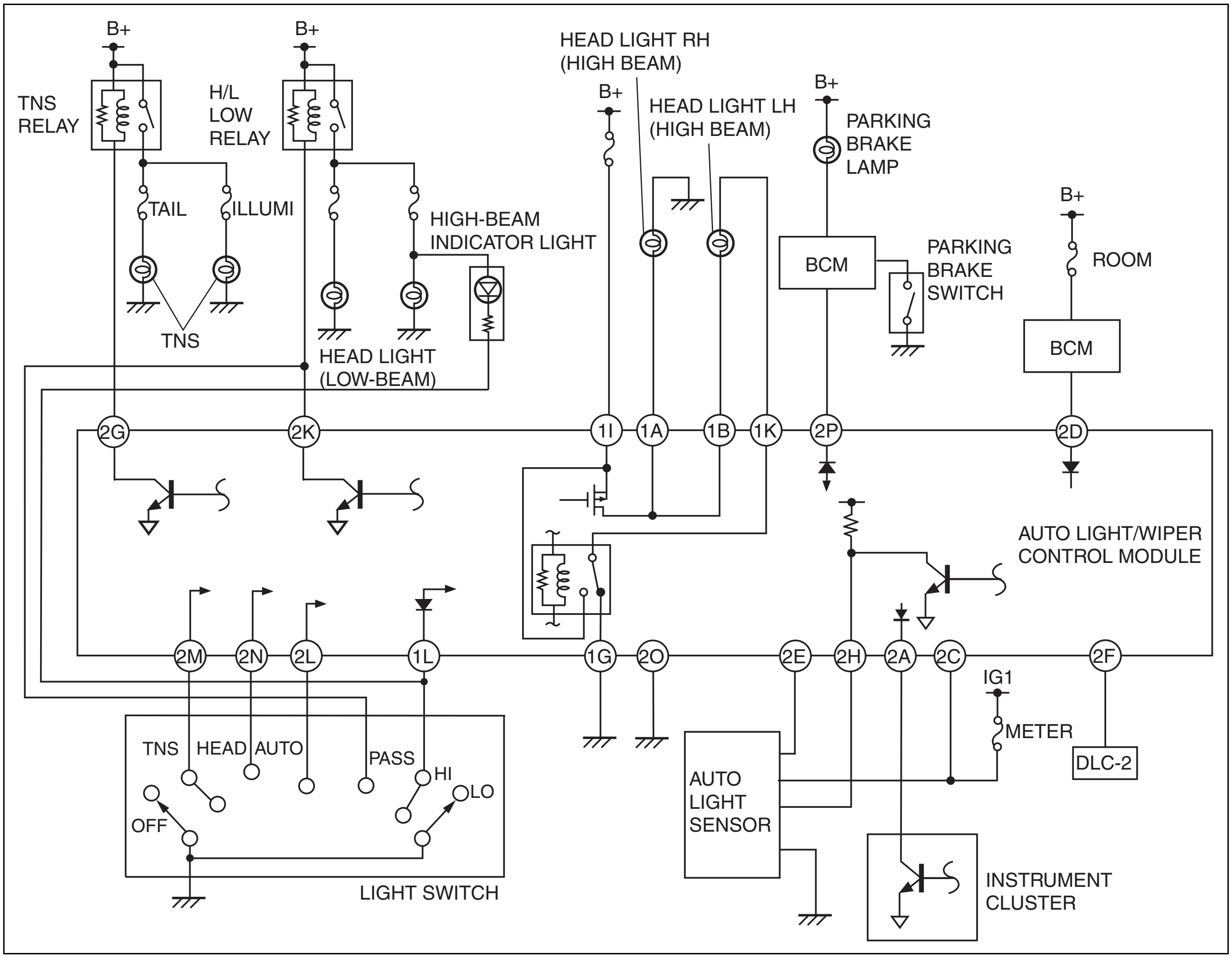
AUTO LIGHT SYSTEM WIRING DIAGRAM

id091800102000

Vehicles With DRL



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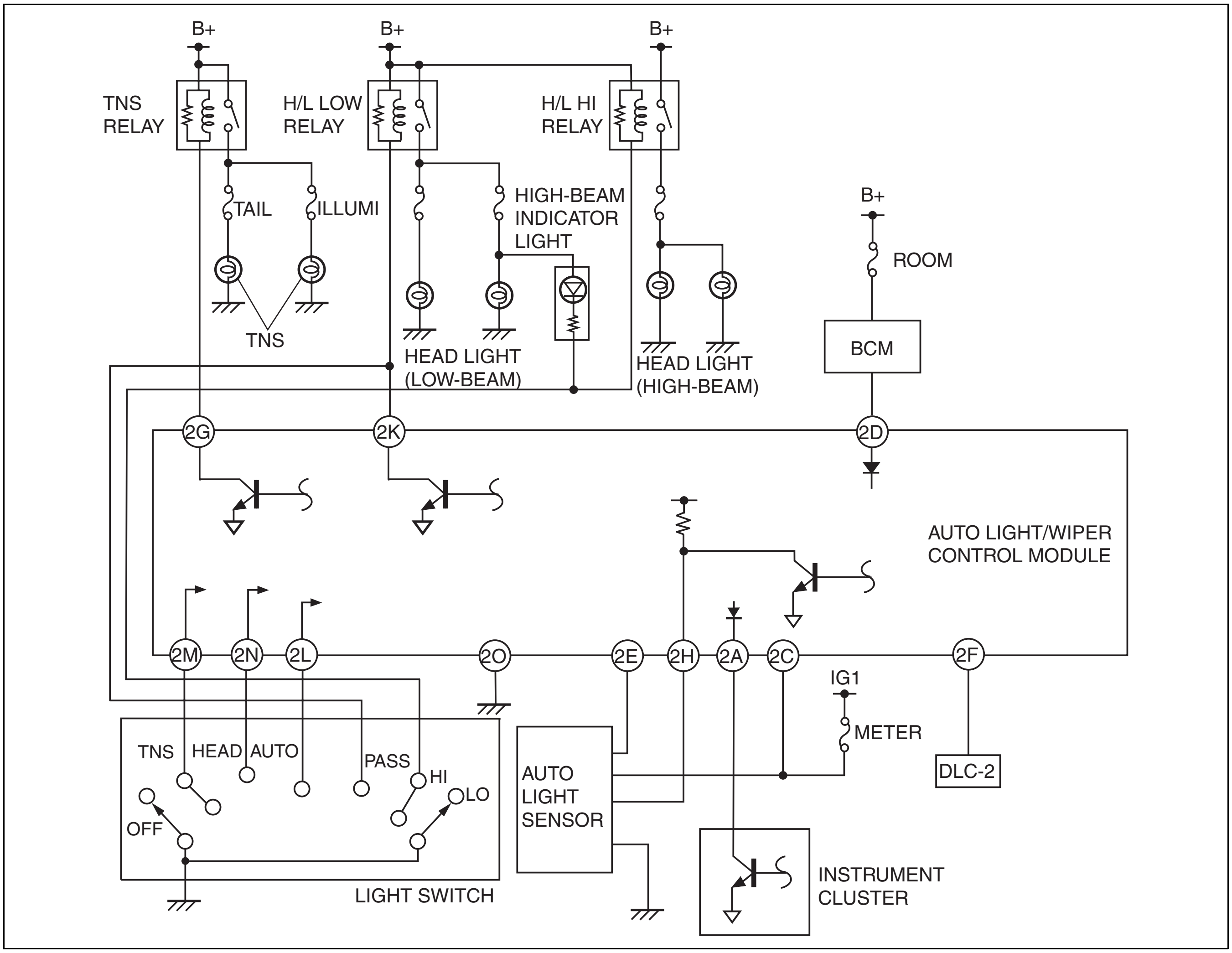
Vehicles Without DRL



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AUTO LIGHT SYSTEM OPERATION

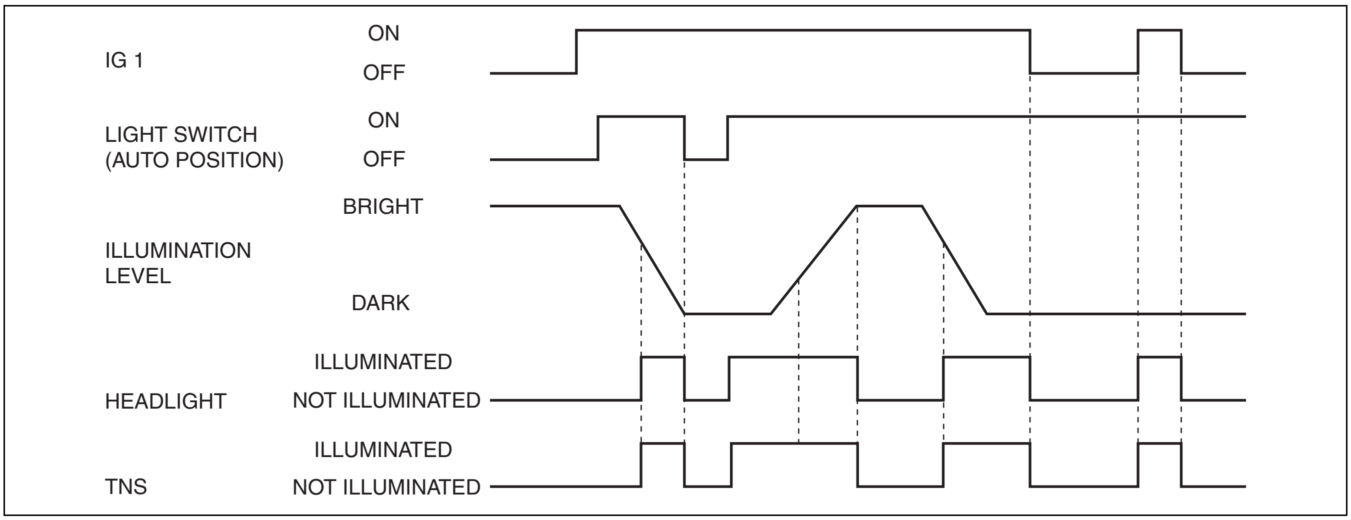
id091800102100

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 headlight and TNS turn off under the following conditions:
  — The forward and upward illumination level sensors detect **approx. 4000 lux or more for approx. 1.0 s**.
  — The ignition switch is off.
  — The light switch is in the OFF position.



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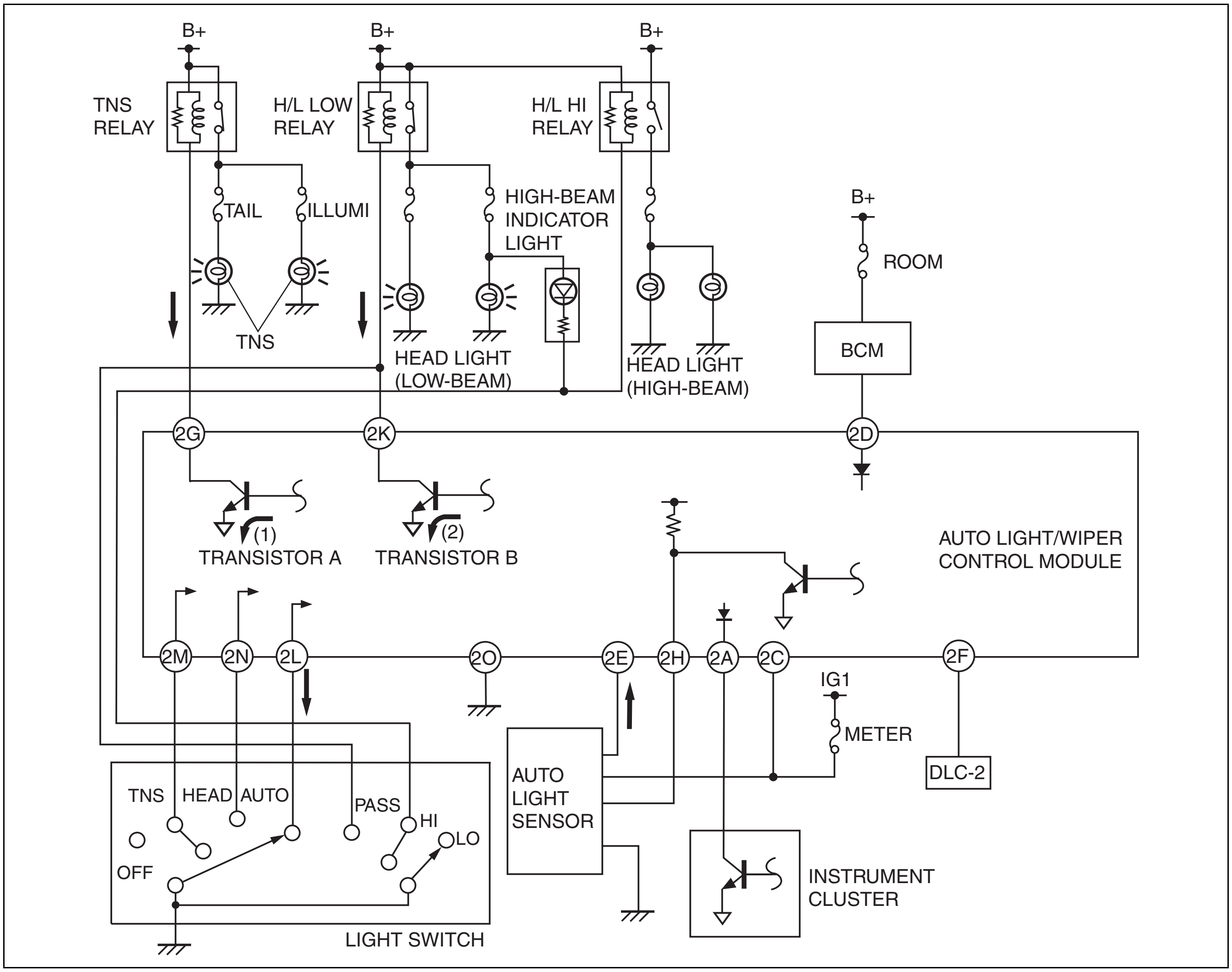
Illumination operation

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, the headlight and TNS illumination control signal is sent to the auto light/wiper control module.
3. The microcomputer in the auto light/wiper control module receives the control signal and sends current (1) to transistor A, causing the transistor A to turn on.
4. When transistor A turns on, the TNS relay also turn on. At the same time, the TNS illuminate.
5. The microcomputer in the auto light/wiper control module receives the control signal and sends current (2) to transistor B, causing the transistor B to turn on.
6. When transistor B turns on, the headlight relay (LO) also turns on. At the same time, the headlights (low-beam) illuminate.



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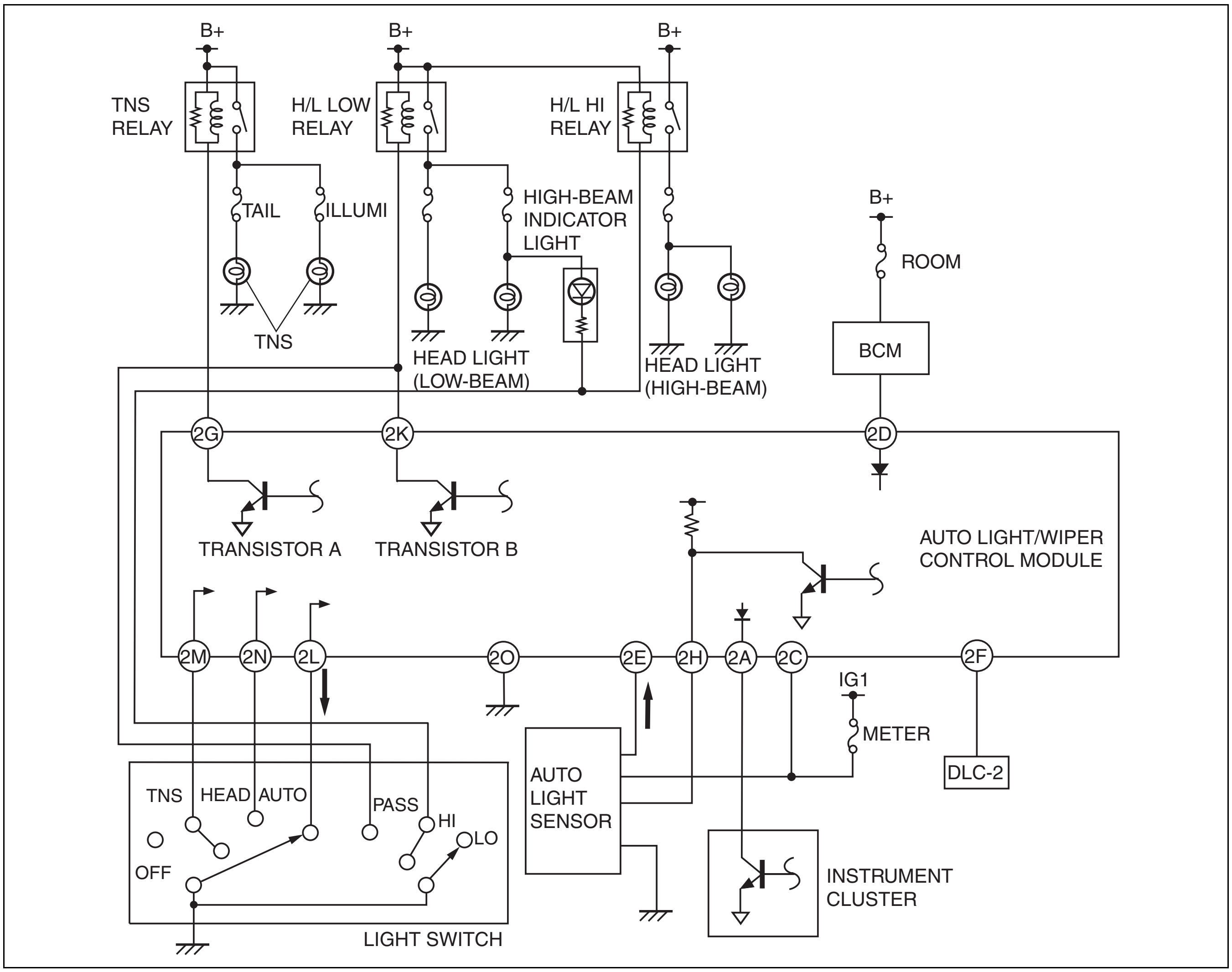
Lights off operation

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 1.0 s** in front of and above the vehicle, the headlight and TNS off control signal is sent to the auto light/wiper control module.
3. The microcomputer in the auto light/wiper control module receives the control signal and turns off the current to transistor A, causing the TNS relay to also turn off.
4. When the TNS relay turns off, the TNS also turns off.
5. The microcomputer in the auto light/wiper control module receives the control signal and turns off the current to transistor B, causing the headlight relay (LO) to also turn off.
6. When the headlight relay (LO) turns off, the headlights (low-beam) also turn off.



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Fail-Safe Function

- When a auto light sensor malfunction or a communication error between the auto light sensor and auto light/ wiper control module is detected, the auto light/wiper control module initiates controls as indicated in the fail safe function table.

Fail-Safe Function Table

Malfunctions	Fail-safe function		Recovery items
	Before operation	After operation	
• auto light sensor error • auto light sensor communication error	Headlight illuminated	Maintains headlights on	• Ignition switch lock position • When a auto light sensor malfunction is cleared • When communication is restored • When the light switch is in a position other than AUTO
	TNS illuminated	Maintains TNS on	
	Off	Maintains turn-off	

AUTO LIGHT SENSOR FUNCTION

id091800102200

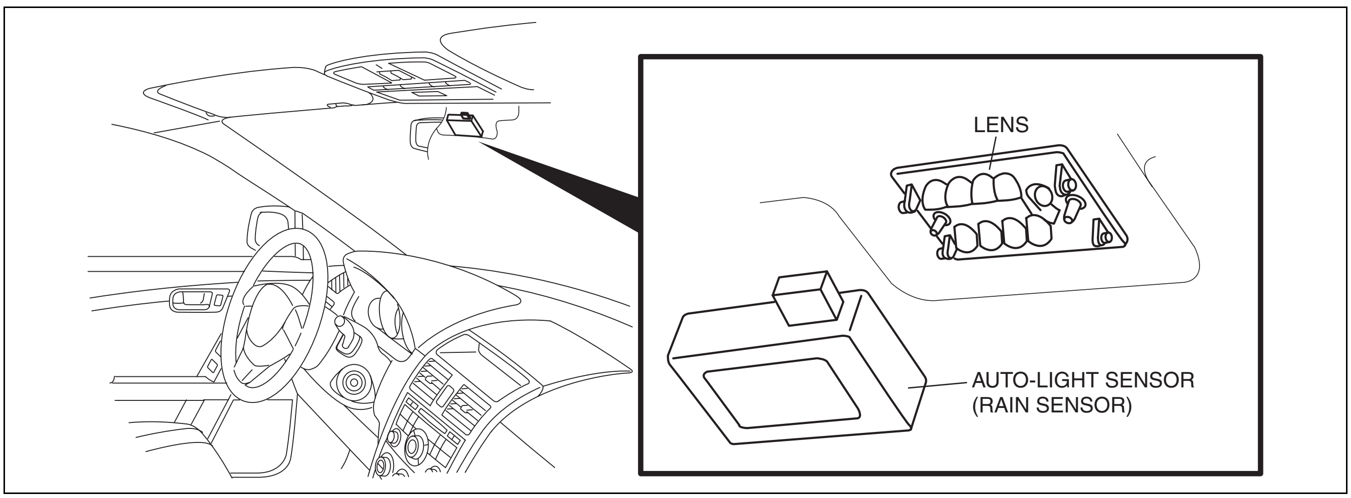
- The auto light sensor contains upward and forward illumination sensors which detect the level of illumination above and in front of the vehicle respectively.
- If the forward illumination level sensor detects a bright level of illumination in front of the vehicle and the upward illumination level sensor 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

id091800102300

Caution
- **In the following cases, the auto light sensor cannot detect the illumination level correctly which could cause an auto light malfunction:**
  - **— A sticker or label is adhered to the windshield above the auto light sensor.**
  - **— The windshield is dirty above the auto light sensor.**

- The auto light sensor is installed to the lens which is installed to top center area of the windshield



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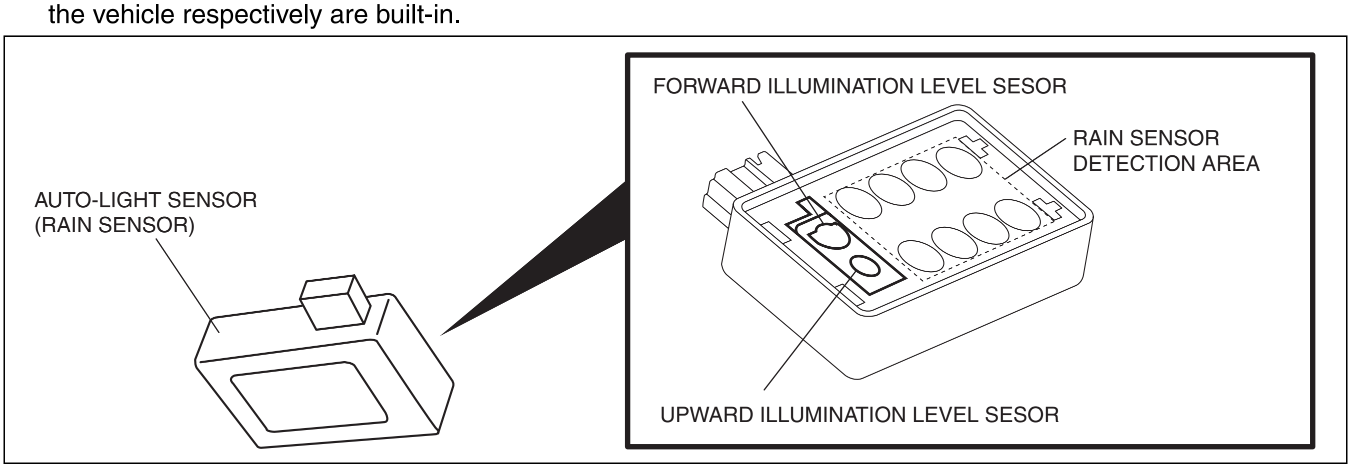
- The auto light sensor is integrated with the rain sensor as a single unit.
- The upward and forward illumination level sensors which detect the level of illumination above and in front of the vehicle respectively are built-in.



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Function Description

Illumination level adjustment function
- The illumination level sensitivity can be switched between two levels using the M-MDS.

On-board diagnostic function
- If there is any malfunction in the auto light sensor, the auto light/wiper control module is informed of the malfunction and a DTC is detected.

AUTO LIGHT-OFF SYSTEM OUTLINE

id091800105000

- The auto light/wiper control module has an auto light-off timer function.
- The auto light/wiper control module has been adopted in which the auto light, auto wiper, DRL, and auto light-off systems are consolidated.

AUTO LIGHT-OFF SYSTEM OPERATION

id091800106200

Operation

- When the following conditions are satisfied, the auto light/wiper control module turns on the lights and activates the built-in timer. When the specified time has passed, the lights go off.

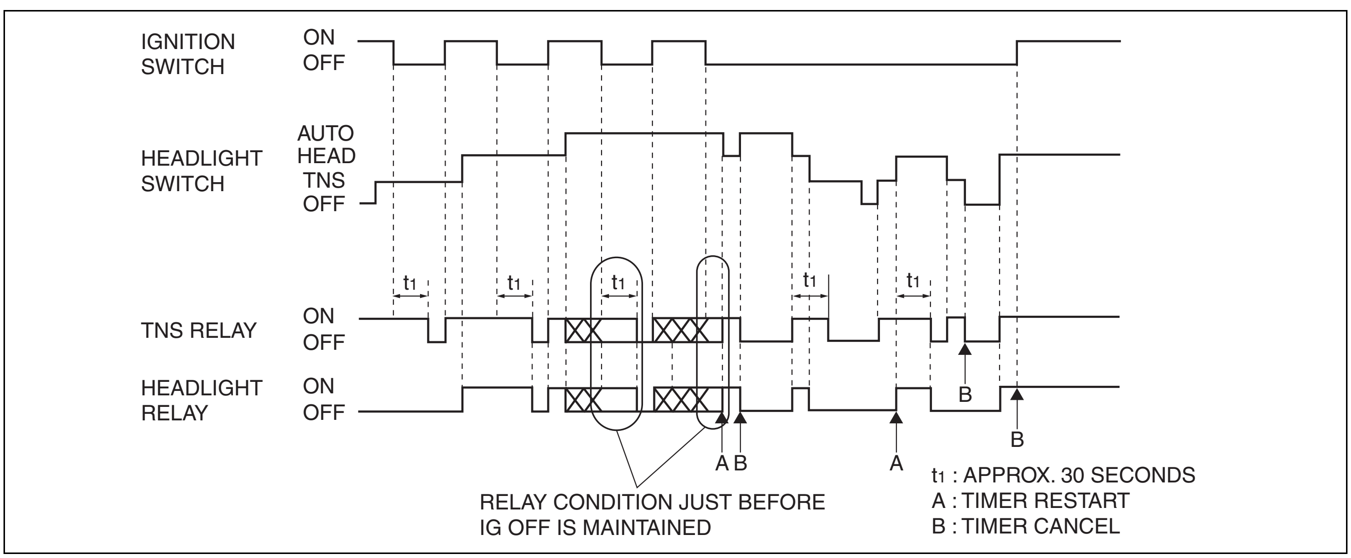
Condition before operation	Operation condition	Illumination time
• Ignition switch is at ON position. • Headlight switch is at TNS or headlight position. • Headlight switch is in AUTO position and auto light system is operating. (Vehicles with auto light system)	Ignition switch is turned to LOCK or ACC position.	Approx. 30 seconds
• Ignition switch is at LOCK or ACC position.	Headlight switch is turned to TNS or headlight position.	
• Headlight switch is at TNS position and timer is operating. • Headlight switch is at AUTO position and timer is operating. (Vehicles with auto light system)	Headlight switch is turned to headlight position.	

- The timer is canceled according to the following conditions, and then the system operates as follows:

Cancel condition	Auto light-off system operation
Ignition switch is turned to ON position.	• When headlight switch is at TNS position, TNS relay turns on. • When headlight switch is at headlight position, headlight relay and TNS relay turns on.
Headlight switch is turned off.	TNS and headlight relays turn off.
Headlight switch is turned AUTO position. (Vehicles with auto light system)	TNS and headlight relays turn off.

- The lights turn on when the ignition switch is at the ON position and the headlight switch is at the TNS or headlight position, even if the auto light/wiper control module is malfunctioning.

Timing Chart



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AUTO LIGHT-OFF SYSTEM WIRING DIAGRAM

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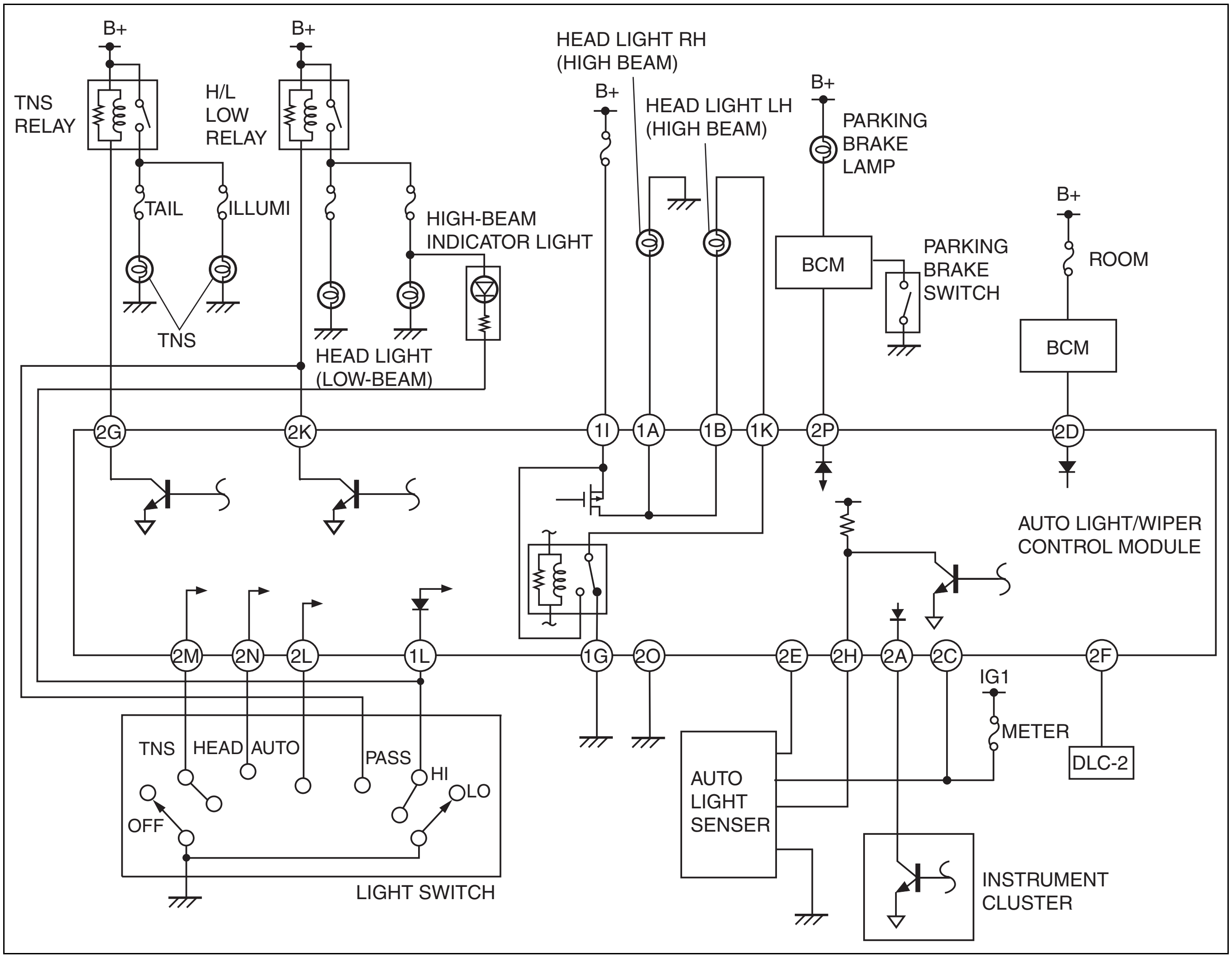
Auto Light/wiper Control Module
Vehicles with DRL



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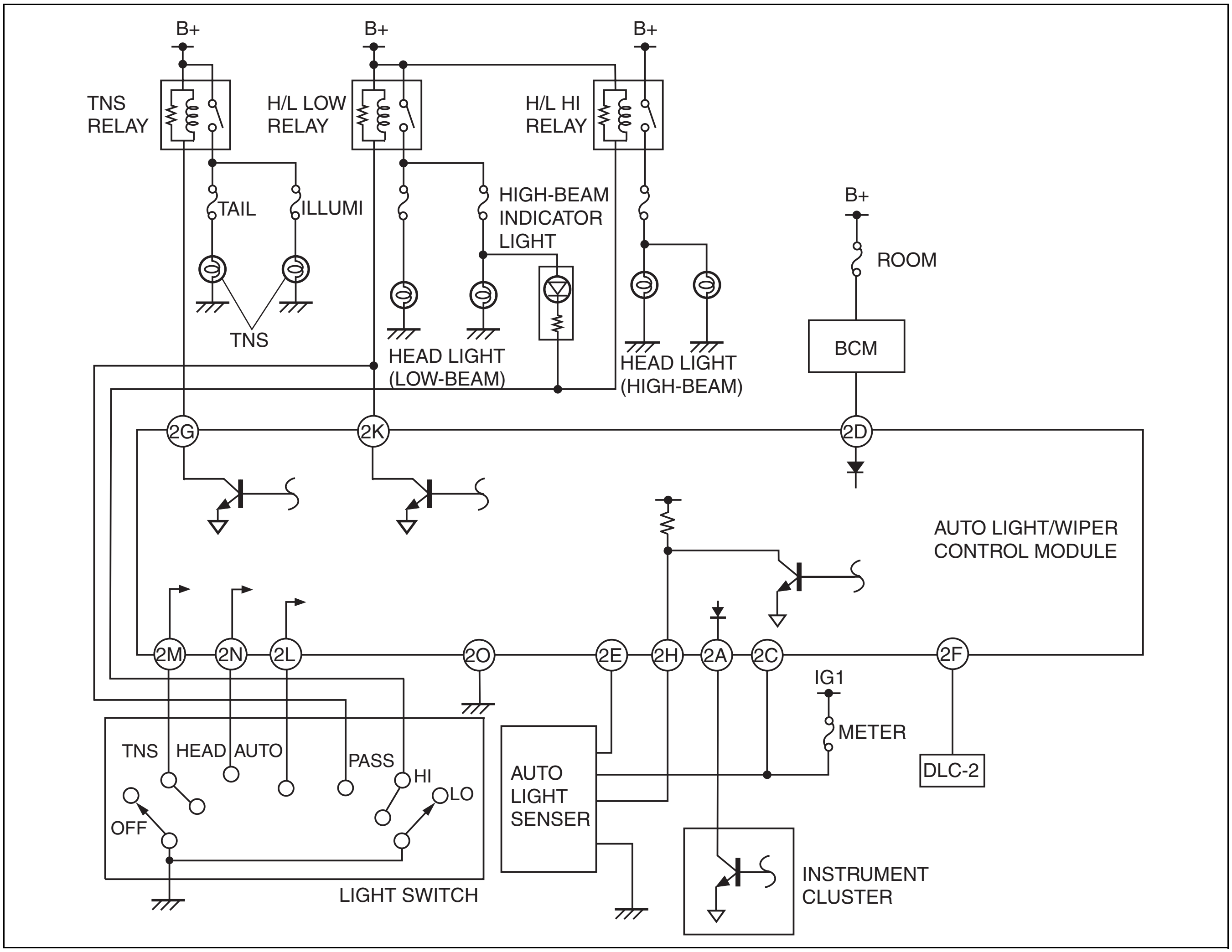
Vehicles without DRL



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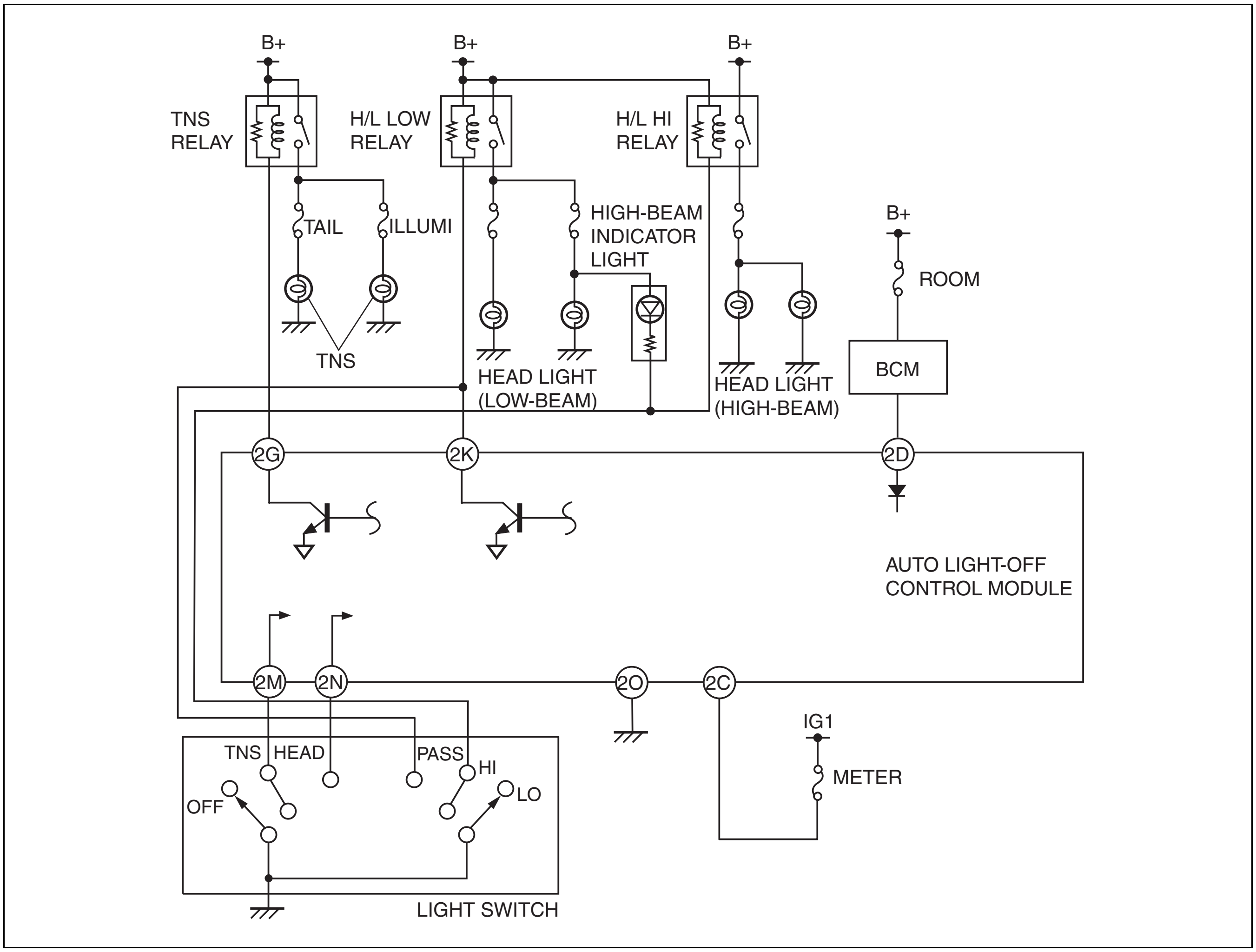
Auto Light-off Control Module



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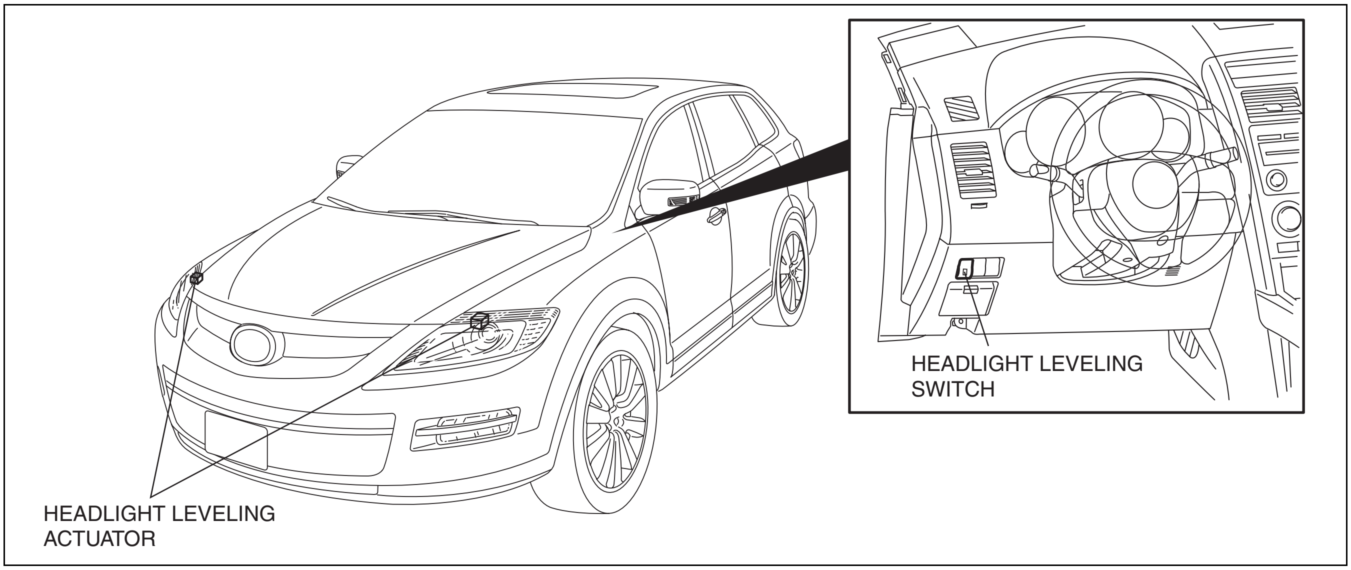
HEADLIGHT LEVELING SYSTEM OUTLINE

id091800102700

- A headlight leveling system providing freely adjustable headlight (low-beam) beam angle has been adopted.
- The headlight optical axis can be freely adjusted by setting the headlight leveling switch between 0-3 ("0" is the maximum upward angle, "3" is the maximum downward angle).

HEADLIGHT LEVELING SYSTEM STRUCTURAL VIEW

id091800102400



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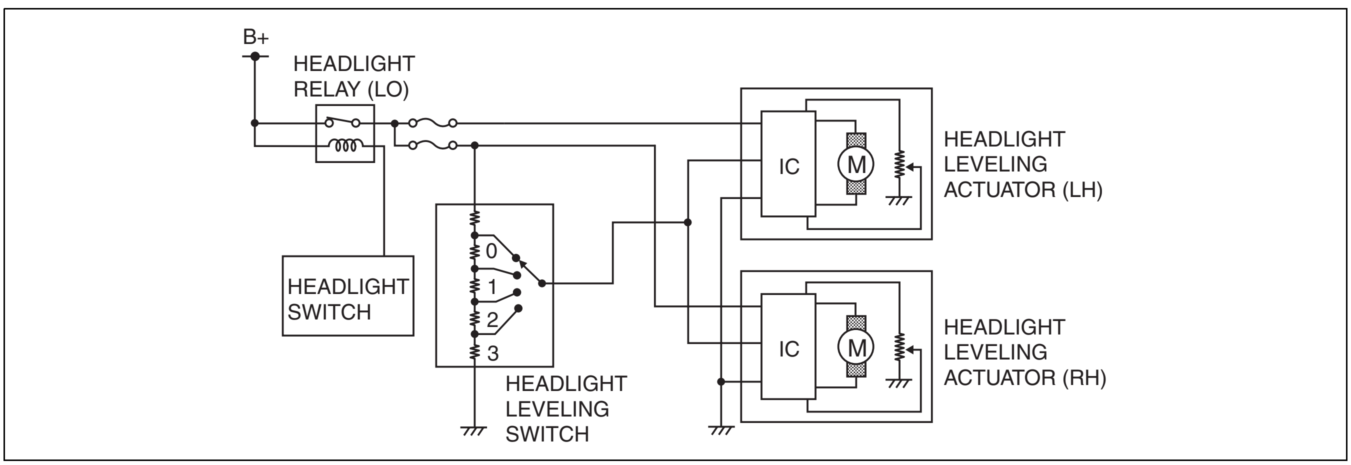
HEADLIGHT LEVELING SYSTEM DIAGRAM

id091800102500



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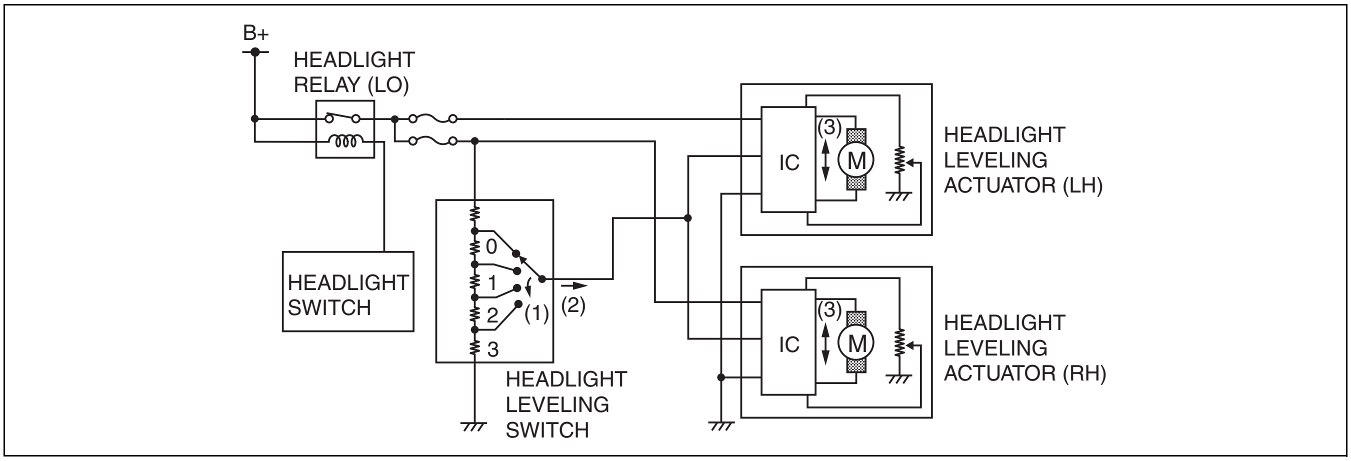
HEADLIGHT LEVELING SYSTEM OPERATION

id091800102600

1. The headlight leveling switch is adjusted.
2. A headlight leveling switch position signal is output to the headlight leveling actuator.
3. The motor inside the headlight leveling actuator operates, moving the headlight reflector angle upward or downward, and the headlight beam is adjusted accordingly.



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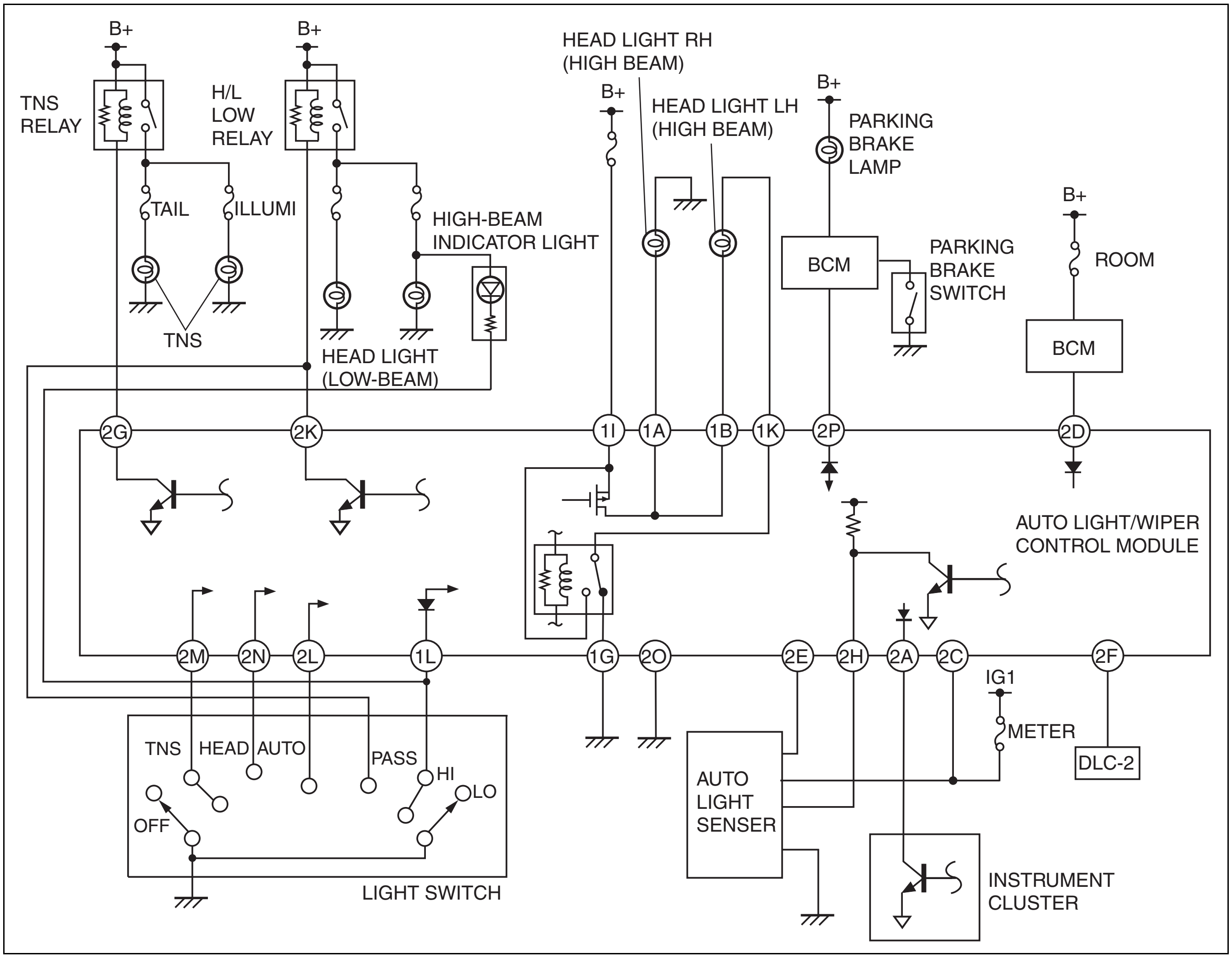
DRL (DAYTIME RUNNING LIGHT) SYSTEM OUTLINE

id091800106100

- The DRL system automatically operates the high-beam headlights when the ignition switch is turned to the ON position and the parking brake is released.
- An auto light/wiper control module has been adopted in which the auto light, auto wiper, DRL, and auto light-off systems are consolidated.

DRL (DAYTIME RUNNING LIGHT) SYSTEM WIRING DIAGRAM

id091800109500



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DRL (DAYTIME RUNNING LIGHT) SYSTEM OPERATION

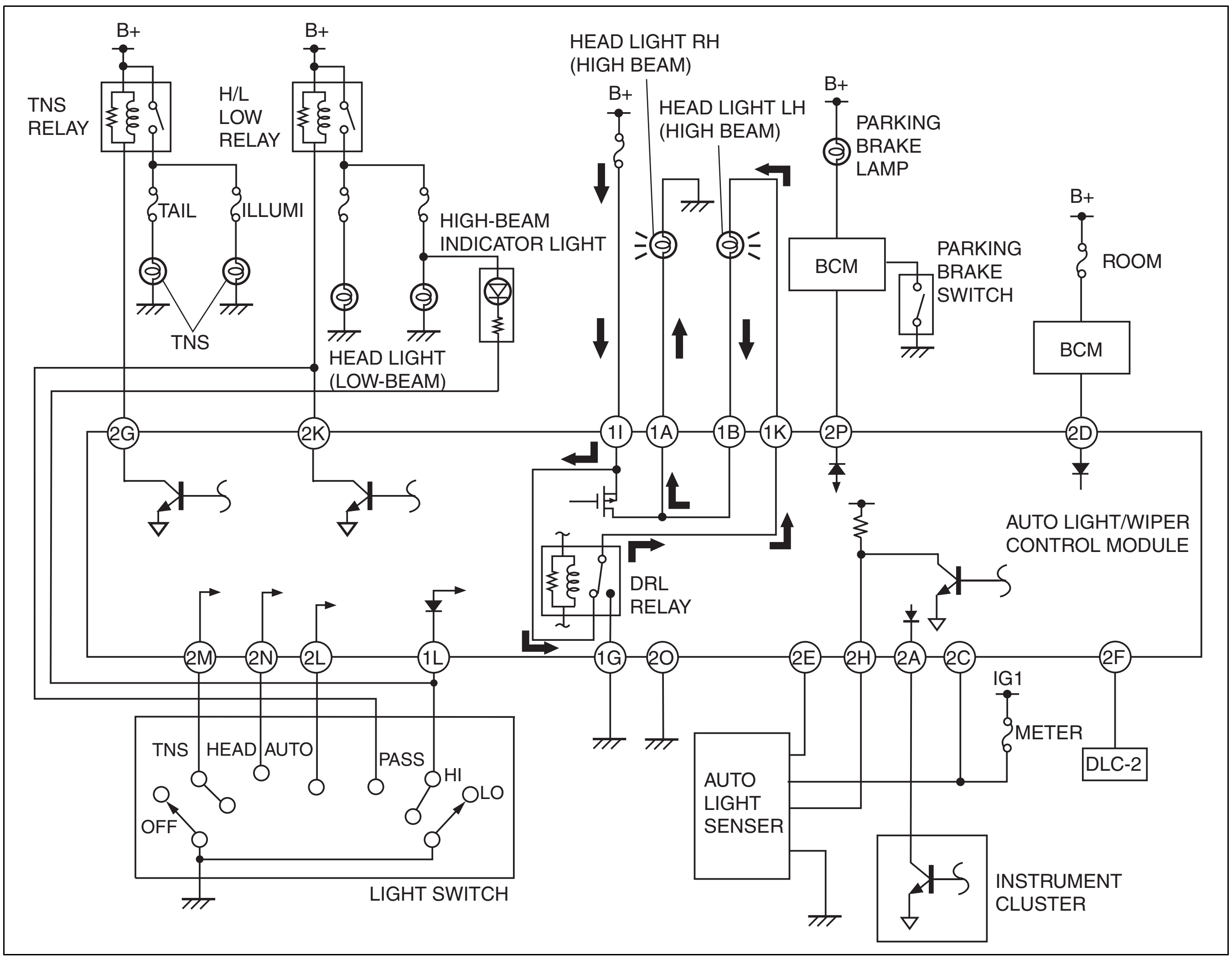
id091800109600

Operation Condition

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	OFF	-	Illuminates (DRL)	-
				-	Illuminates (DRL)	-
	ON			-	-	-
				-	-	-
	-	Headlight (LO)		Illuminates	-	Illuminates
		Headlight (HI)		Illuminates	Illuminates	-
-	-	-	ON	Illuminates	Illuminates	-

Illumination Operation

1. When the DRL operation conditions are met, the current flows and the DRL relay turns on.
2. When the DRL relay turns on, the current flows to the headlight high beam (LH) and then to the headlight high beam (RH) to turn on the headlight high beams at 50 % dim.



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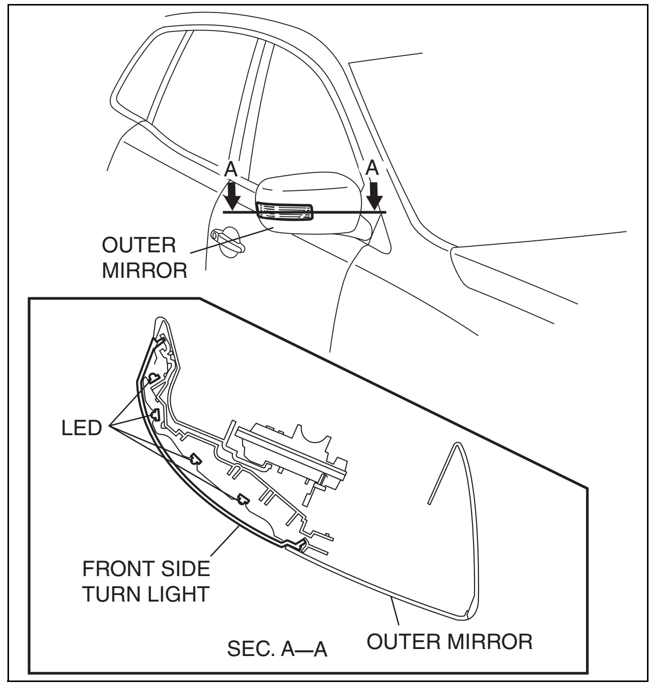
FRONT SIDE TURN LIGHT CONSTRUCTION

id091800107000

- Built-in front side turn light has been adopted for outer mirror.



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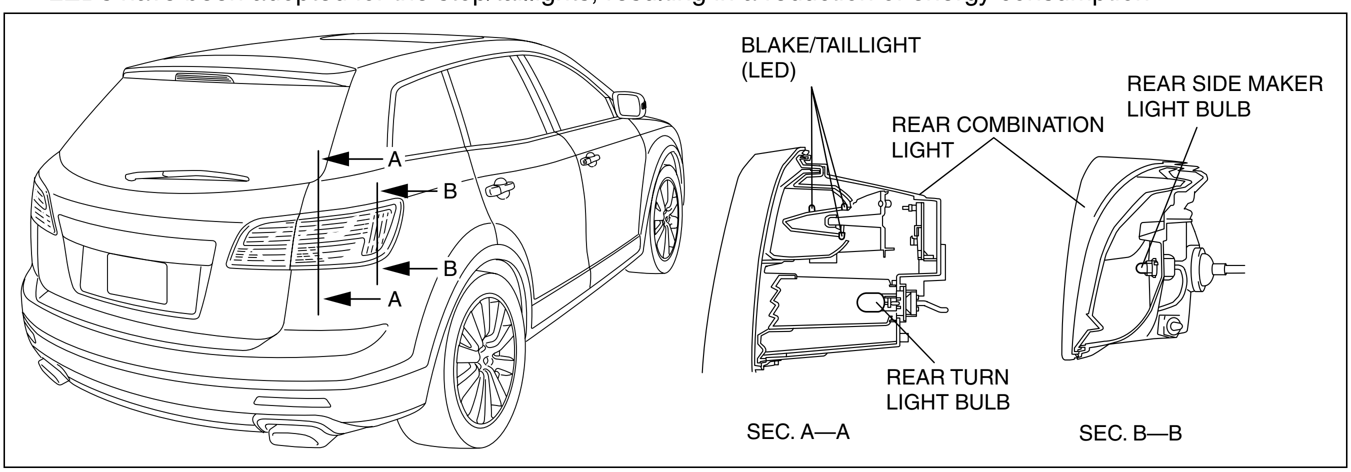
REAR COMBINATION LIGHT CONSTRUCTION

id091800100800

- LEDs have been adopted for the stop/taillights, resulting in a reduction of energy consumption.



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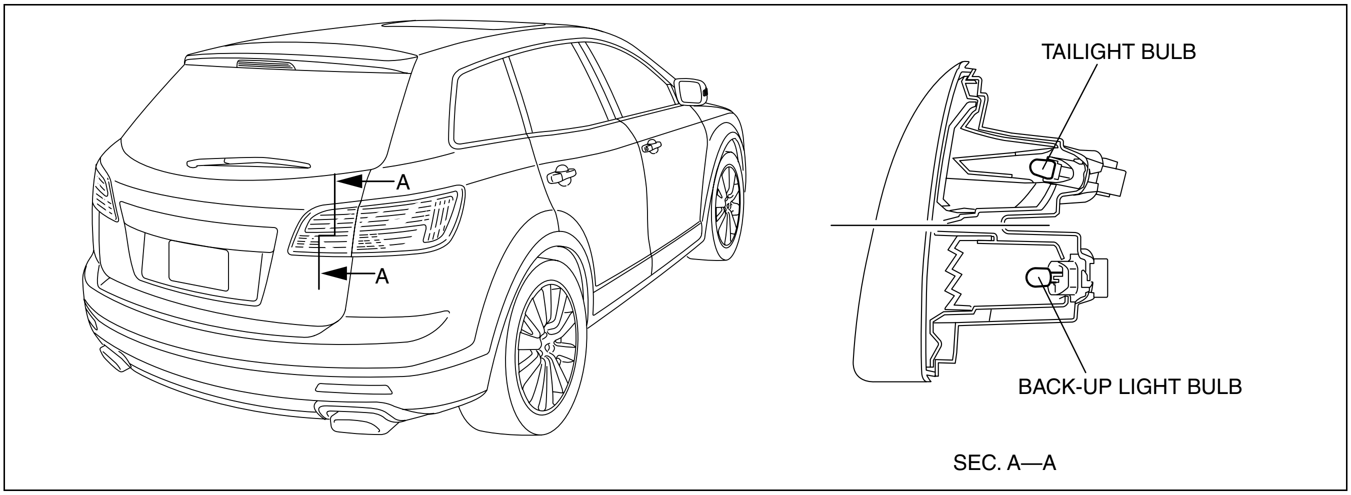
INBOARD LIGHT CONSTRUCTION

id091800110000

- A step reflector that diffuses and reflects the light of the inboard light bulbs, has been adopted. A flat, uncut lens has been adopted to control illumination distribution.



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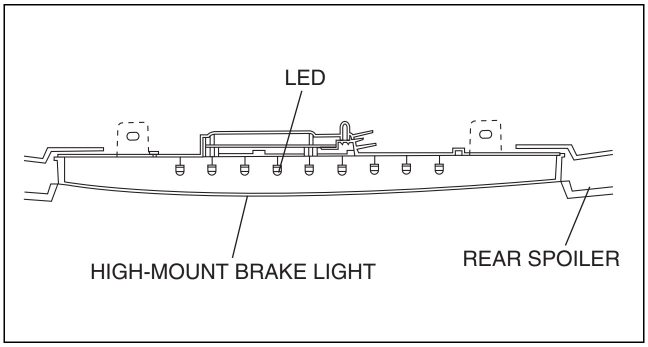
HIGH-MOUNT BRAKE LIGHT CONSTRUCTION

id091800101500

- Installed to the rear spoiler with the connecting screws.
- Using LED has resulted in reduced energy consumption.



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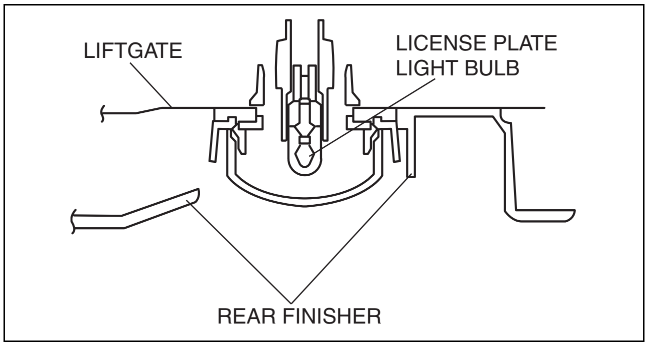
LICENSE PLATE LIGHT CONSTRUCTION

id091800100900

- Installed to the liftgate with the connecting tabs



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INTERIOR LIGHTING SYSTEM CONSTRUCTION

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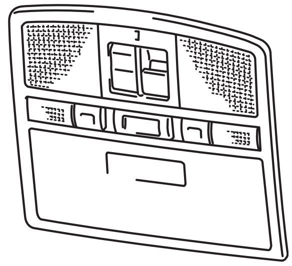
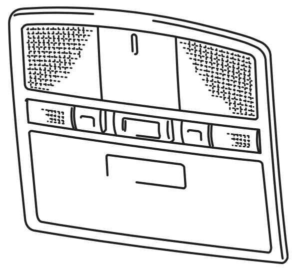
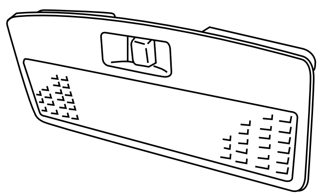
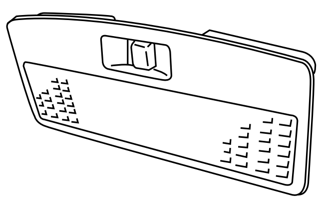
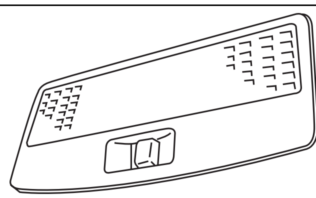
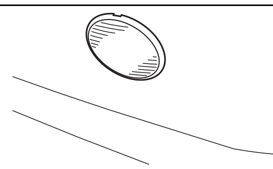
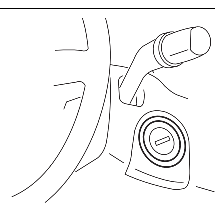
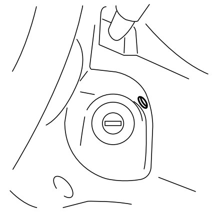
- The map and interior lights settings are controlled by the interior light control system.

×: Equipped
-: Not equipped

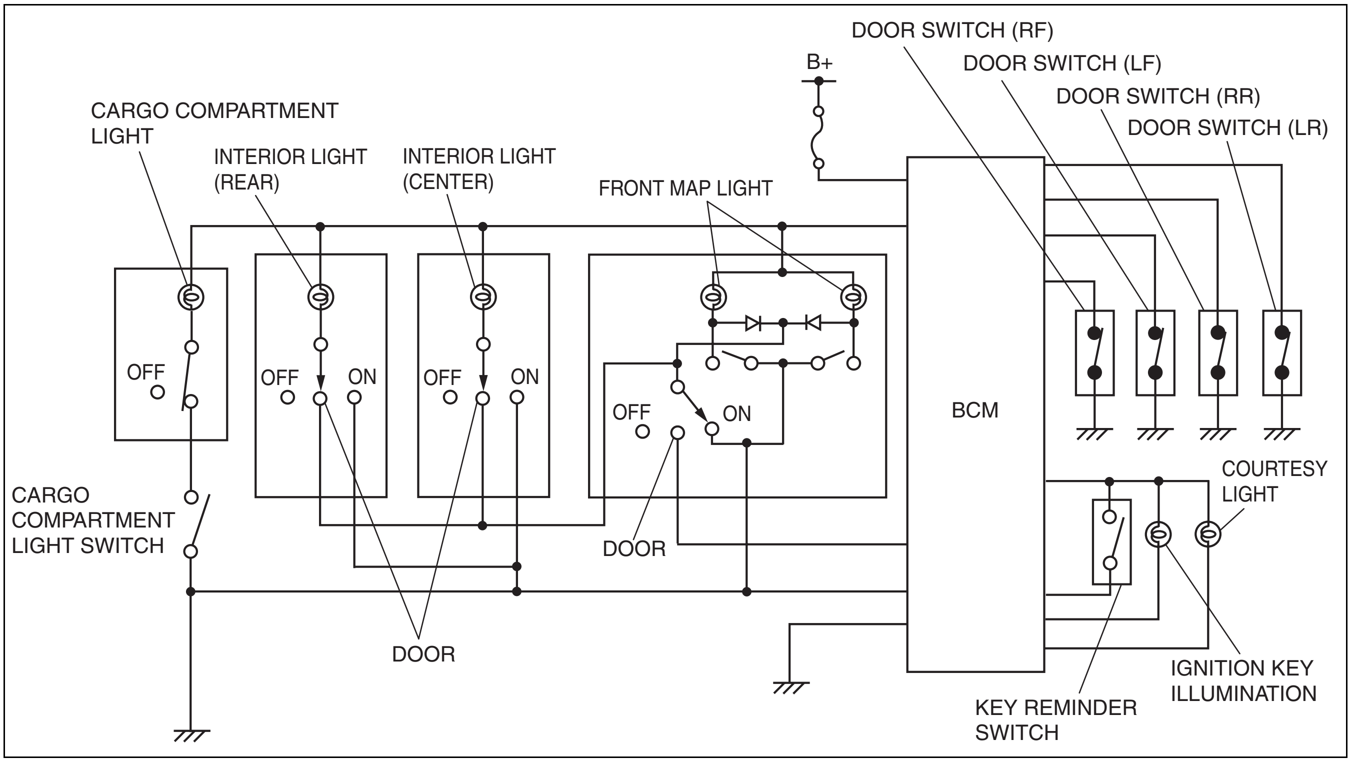
Type		Installation position	Interior light control system	Roof
Front map light		Front	×	Sunroof
			×	Normal roof
Interior light		Center	×	Both
		Rear	×	Both
Cargo compartment light		Cargo compartment	-	Both
Courtesy light		Front door trim	×	Both
Ignition key illumination (With advanced keyless entry system)		Ignition switch	×	-

Type		Installation position	Interior light control system	Roof
Ignition key illumination (With keyless entry system)		Lower column cover	×	-

ROOM LIGHT CONTROL SYSTEM FUNCTION

id091800101100

- 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.



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09-18

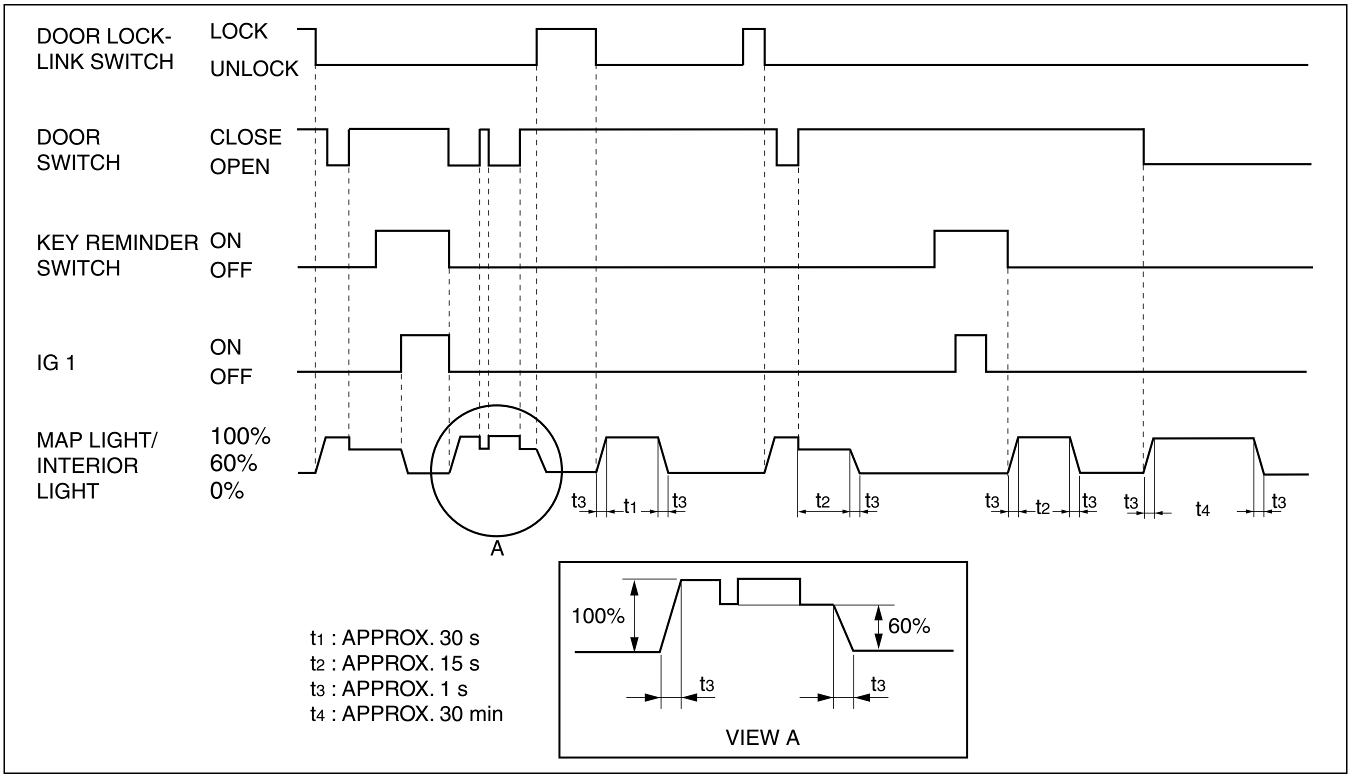
ROOM LIGHT CONTROL SYSTEM OPERATION

id091800101200

<table>
<tr><th rowspan="2">Conditions before operation
(Conditions which must be satisfied)</th><th rowspan="2">Operation condition</th><th colspan="2">Interior light</th><th rowspan="2">Cancel condition
(When any condition satisfied)</th></tr>
<tr><th>Illumination time</th><th>Brightness</th></tr>
<tr><td>• Turn the ignition switch to the LOCK or ACC position.
• All doors are closed.
(All door switches off)</td><td>Any door open.
(Any door switch on)</td><td>Approx. 30 min</td><td>100 %</td><td>• All doors are closed except liftgate.
(All door switches off)
• After illumination time.*1</td></tr>
<tr><td>• Key extracted from steering lock.
(Key reminder switch is off.)
• All doors are closed.
(All door switches off)
• Driver's door lock knob is locked.
(Door lock-link switch is in lock position.)</td><td>Driver's door lock knob is unlocked.
(Door lock-link switch is in unlock position.)</td><td>Approx. 30 s</td><td>100 %</td><td>• Turn the ignition switch to the ON position.
• Any door open.
(Any door switch on)
• Driver's door lock knob is locked.
(Door lock-link switch is in lock position.)
• After illumination time.</td></tr>
<tr><td>• Key inserted into steering lock.
(Key reminder switch is on.)
• All doors are closed.
(All door switches off)</td><td>Key extracted from steering lock.
(Key reminder switch is off.)</td><td>Approx. 15 s</td><td>100 %</td><td>• Turn the ignition switch to the ON position.
• Any door open.
(Any door switch on)
• Driver's door lock knob is locked.
(Door lock-link switch is in lock position.)
• After illumination time.</td></tr>
<tr><td>• Turn the ignition switch to the LOCK or ACC position.
• Any door is open.
(Any door switches on)
• Driver's door lock knob is unlocked.
(Door lock-link switch is in unlock position.)</td><td>All doors are closed.
(All door switches off)</td><td>Approx. 15 s</td><td>60 %</td><td>• Turn the ignition switch to the ON position.
• Any door open.
(Any door switch on)
• Driver's door lock knob is locked.
(Door lock-link switch is in lock position.)
• After illumination time.</td></tr>
</table>

*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 switches are off, any door switch is on)
- After all doors are closed, then ignition switch is at the ON position. (Ignition switch ON)

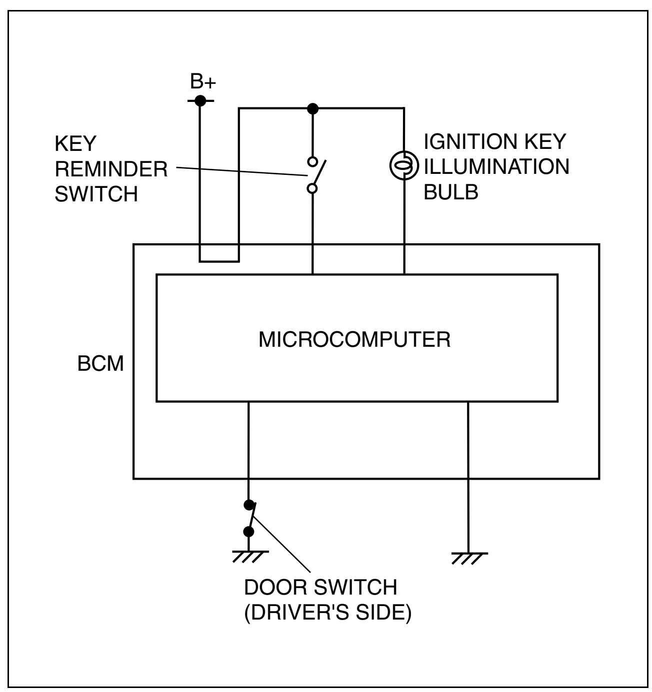


am8rrn00000200

IGNITION KEY ILLUMINATION FUNCTION

id091800101300

- 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.



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IGNITION KEY ILLUMINATION OPERATION

id091800101400

Illumination Condition

- The ignition key illumination glows under all of the following conditions:
  - — Driver-side door is open. (Driver-side door switch is on.)
  - — Ignition switch is in the LOCK or ACC position. (Ignition switch 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 Iswitch is off).
  - — Ignition switch is in the ON position. (Ignition switch 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 switch is on)

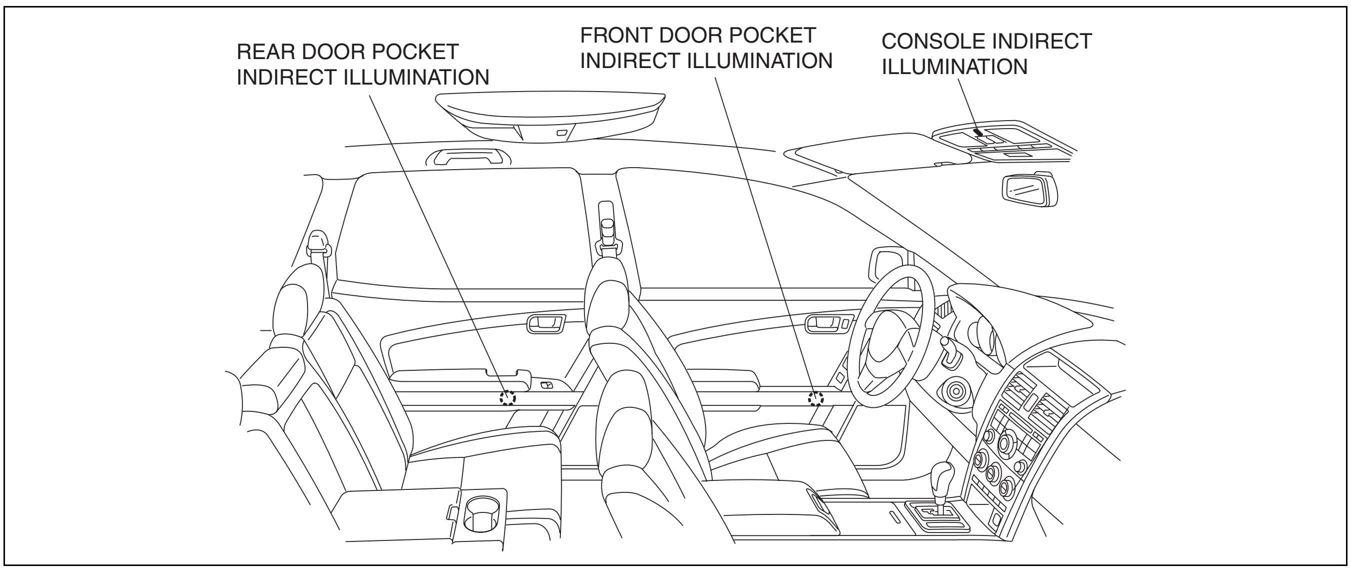
INDIRECT ILLUMINATION OUTLINE

id091800105400

- Indirect illumination has been adopted which illuminates in conjunction with TNS to light the area around the console.
- Indirect illumination has been adopted which illuminates in conjunction with TNS to light the area around the door pocket.

INDIRECT ILLUMINATION STRUCTURAL VIEW

id091800105500



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09-19 WIPER/WASHER SYSTEM

WIPER/WASHER OUTLINE

id091900100100

Improved convenience	• Auto wiper system adopted which enables fully automatic windshield wiper operation
System simplification	• An auto light/wiper control module has been adopted in which the auto light, auto wiper, DRL, and auto light-off systems are consolidated.

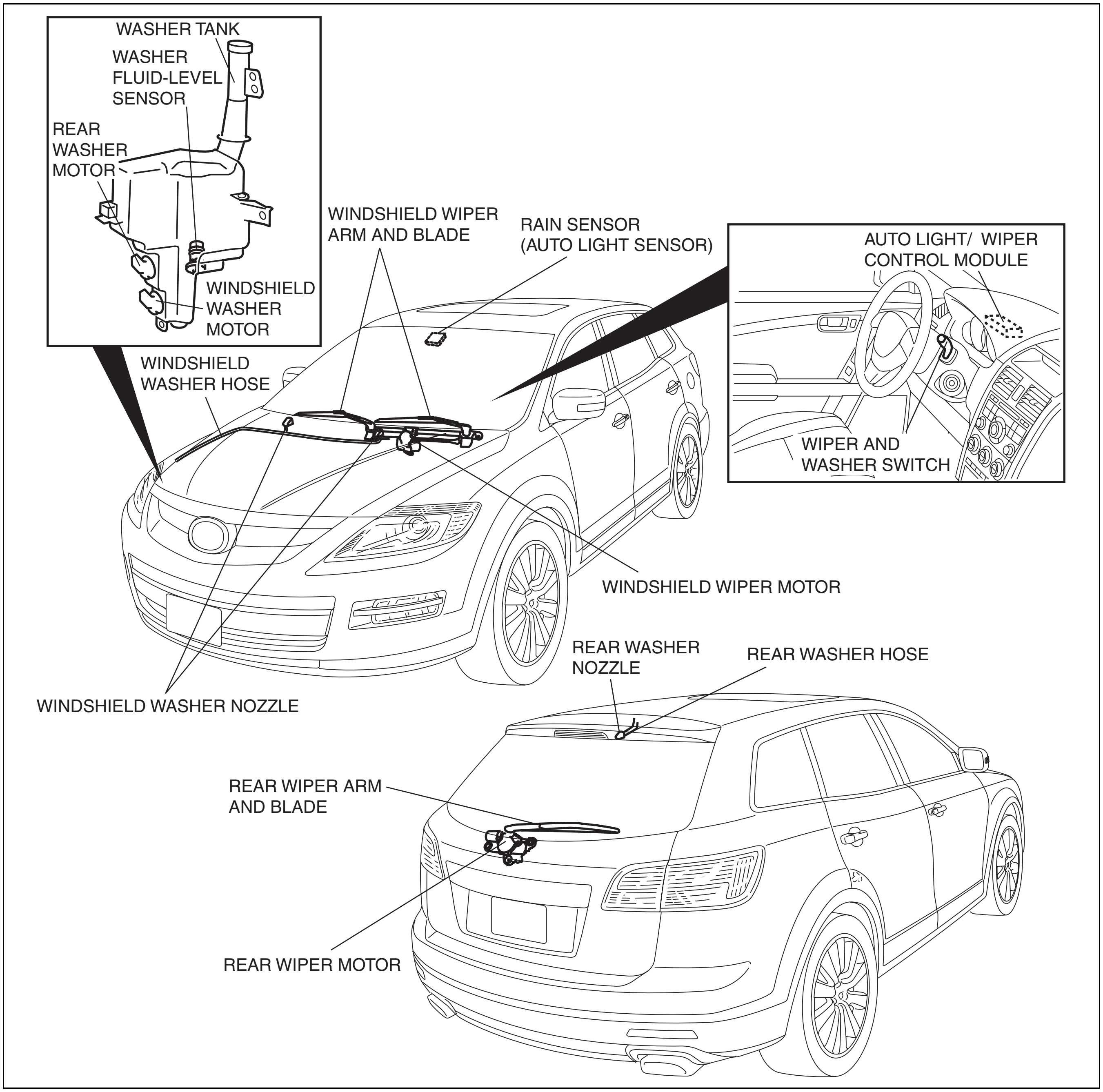
WASHER TANK SPECIFICATION

id091900100200

Washer tank capacity	4.5 L {4.8 US qt, 4.0 Imp qt}

WIPER/WASHER SYSTEM STRUCTURAL VIEW

id091900100300



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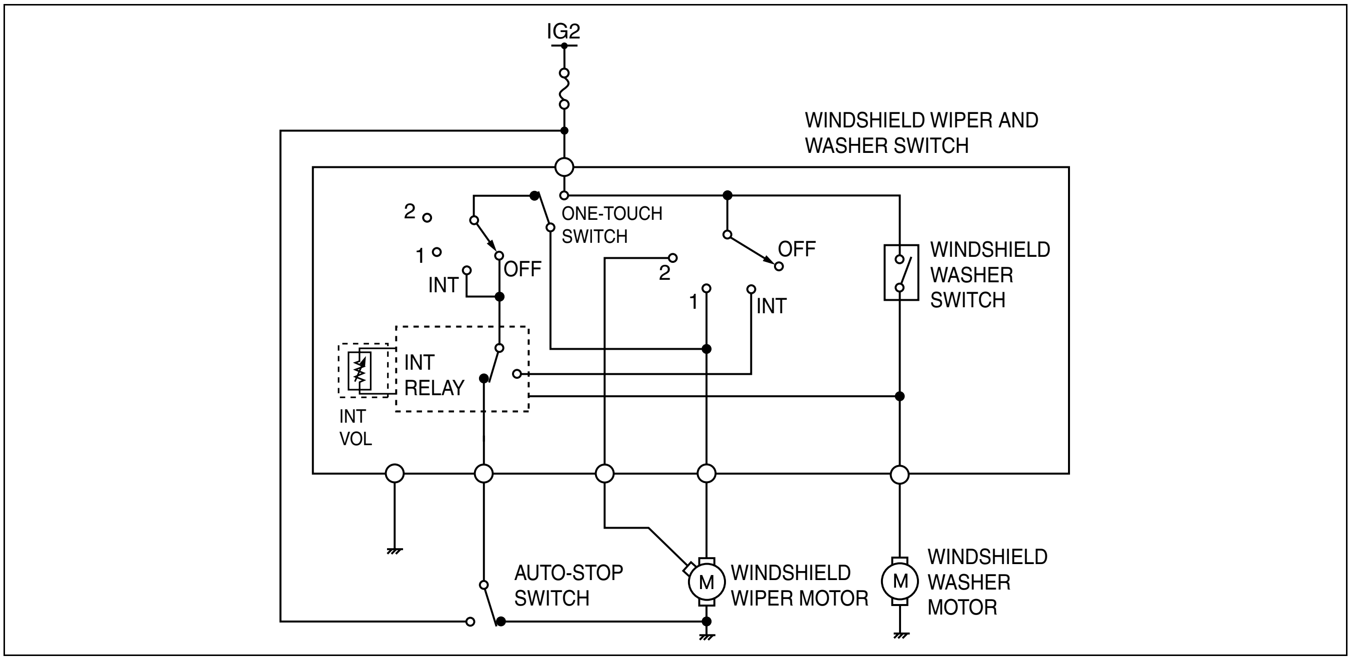
WINDSHIELD WIPER SYSTEM OUTLINE

id091900100400

- 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

id091900100500



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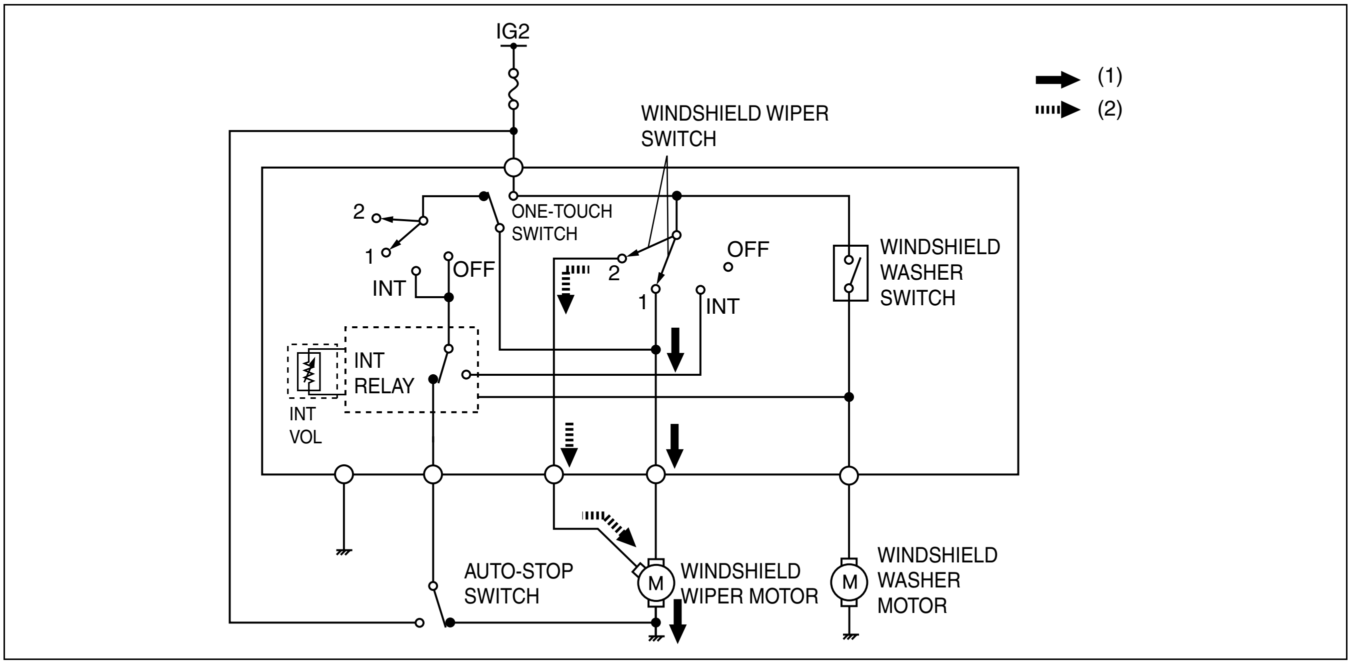
WINDSHIELD WIPER SYSTEM OPERATION

id091900100600

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.

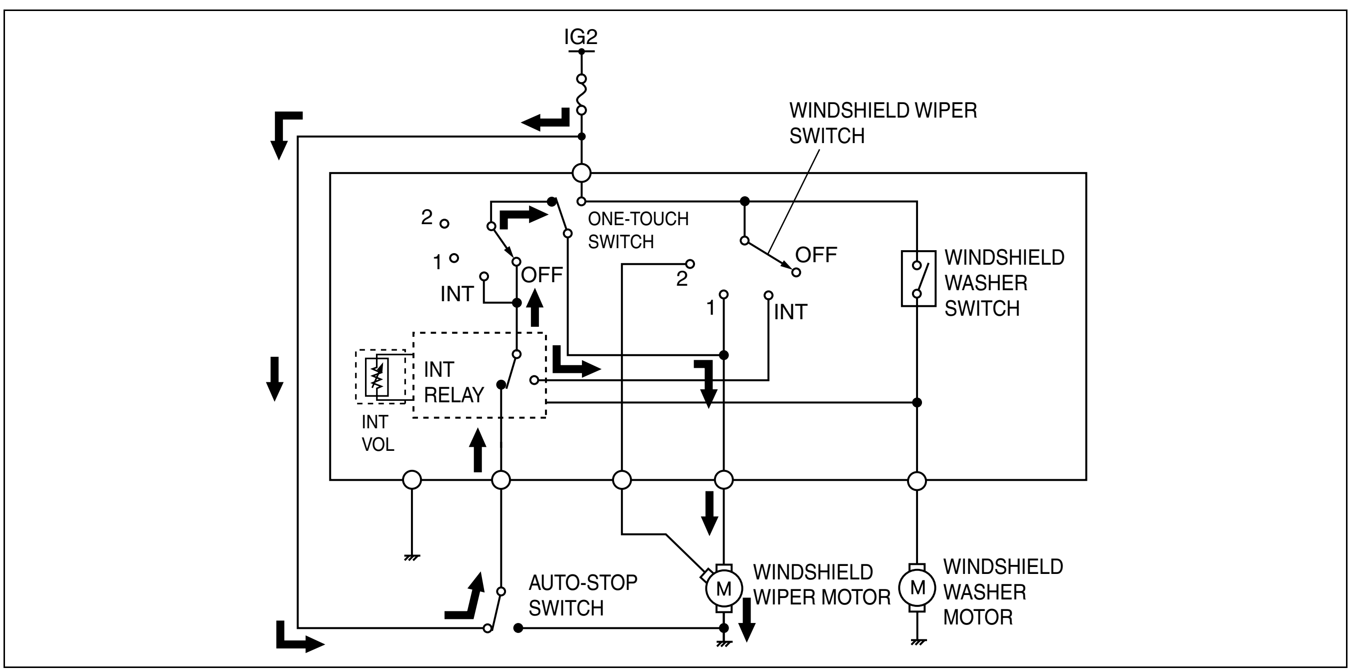


acxuun00000407

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.



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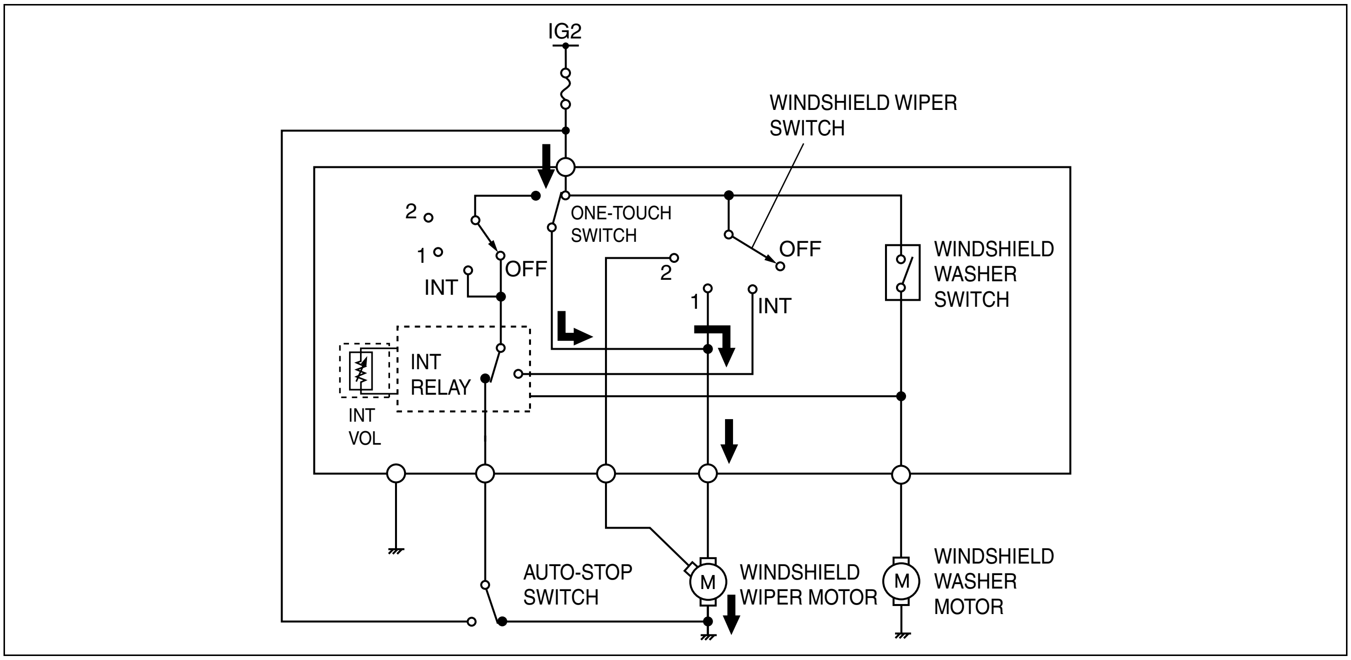
One-touch Wiper Operation

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.



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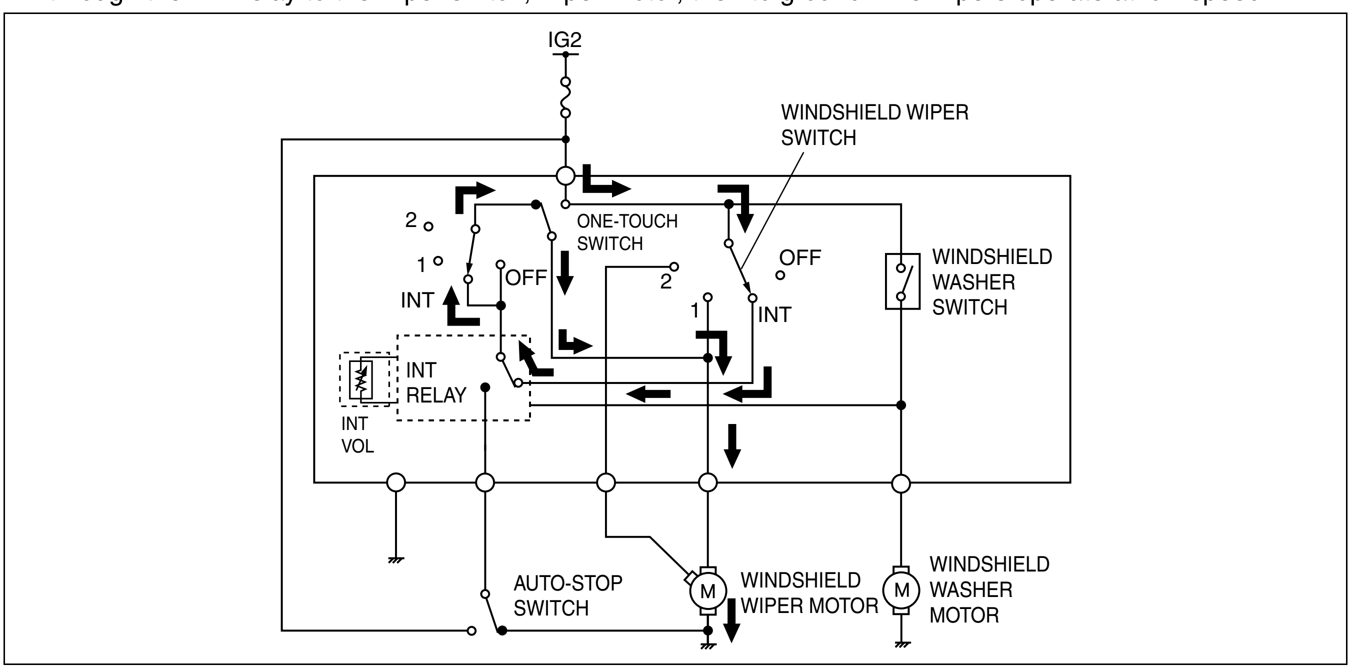
2. The windshield wipers operate at low speed while the windshield wiper lever is pulled up. When the windshield wiper lever is released, the wipers stop in the park position due to the autostop operation.

Intermittent Wiper Operation

1. When the wiper switch moves to the INT position, the intermittent wiper (INT) relay turns on, and current flows through the INT relay to the wiper switch, wiper motor, then to ground. The wipers operate at low speed.



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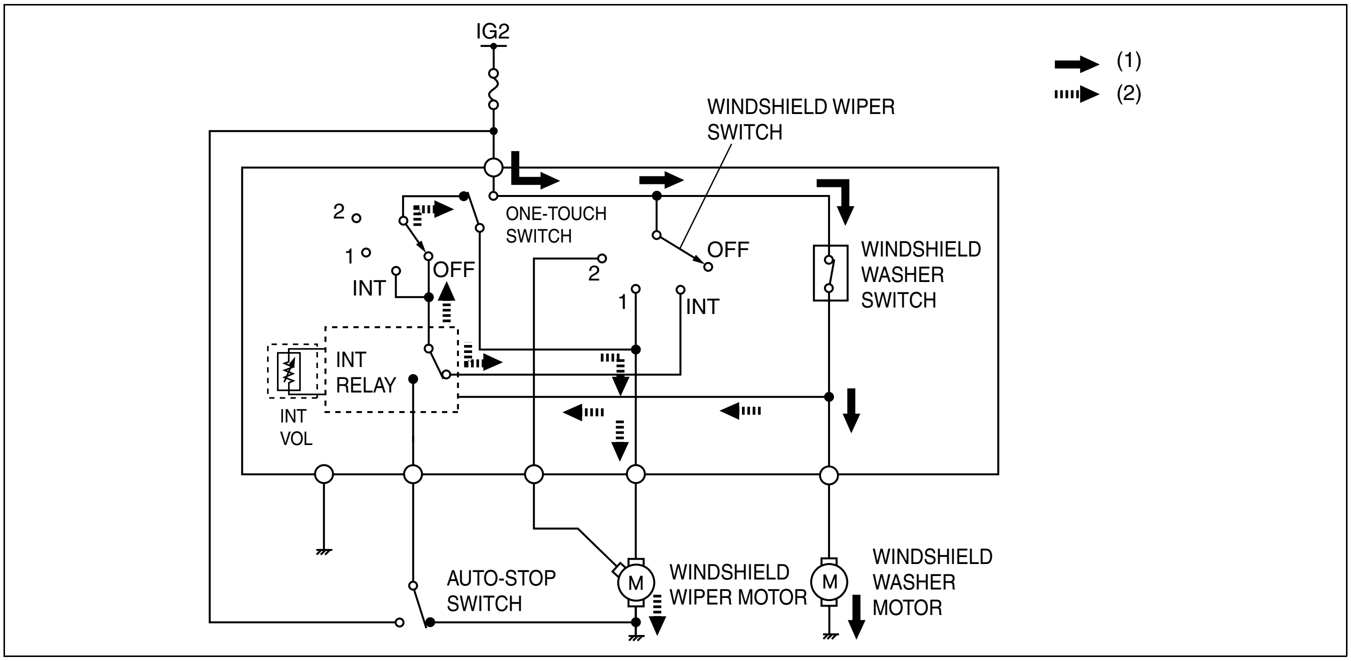
2. When the preset period of time has passed, the INT relay turns off. The current stops flowing through the wiper motor. The autostop function activates, and the wipers stop at the park position. Cycling through this sequence of operations, the wipers operate at specified intervals.
3. The windshield 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.



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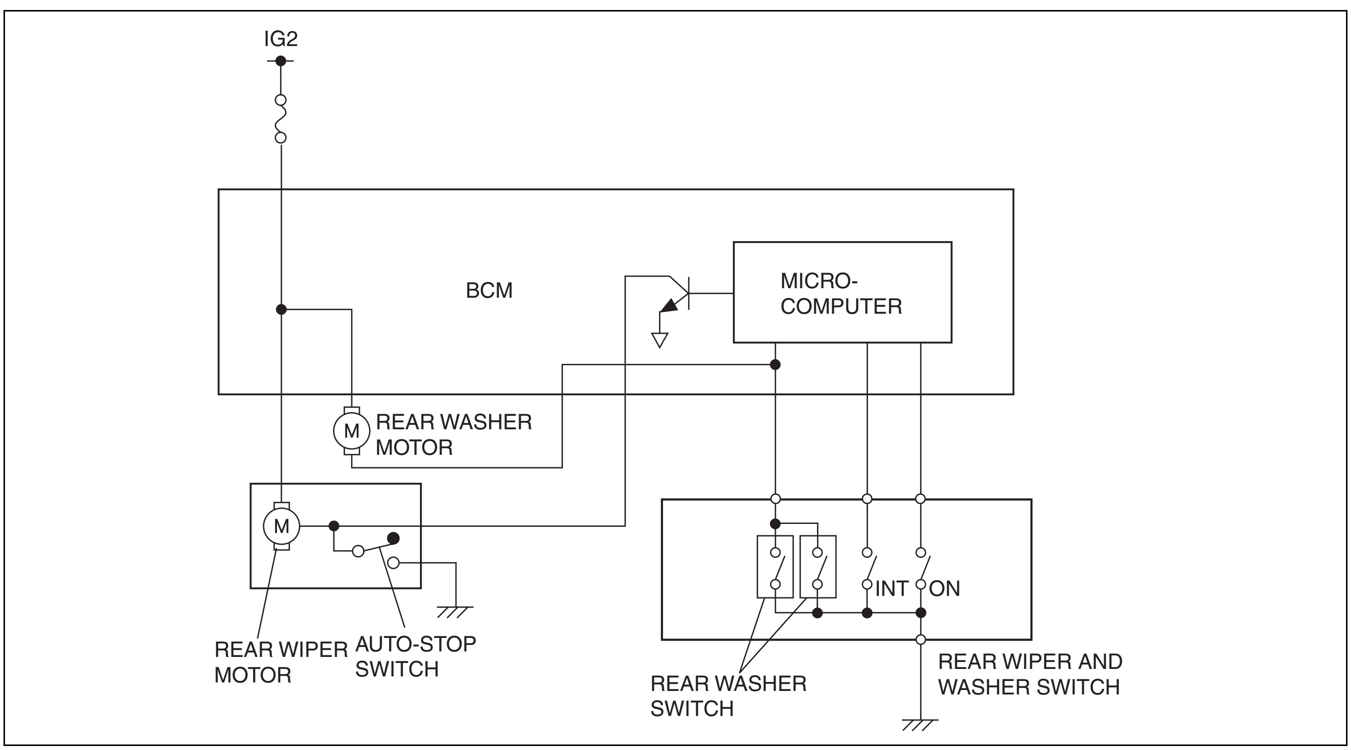
REAR WIPER SYSTEM OUTLINE

id091900100700

- The rear wiper system has auto-stop function, intermittent function, and synchronized washer and wiper function.

REAR WIPER SYSTEM WIRING DIAGRAM

id091900100800



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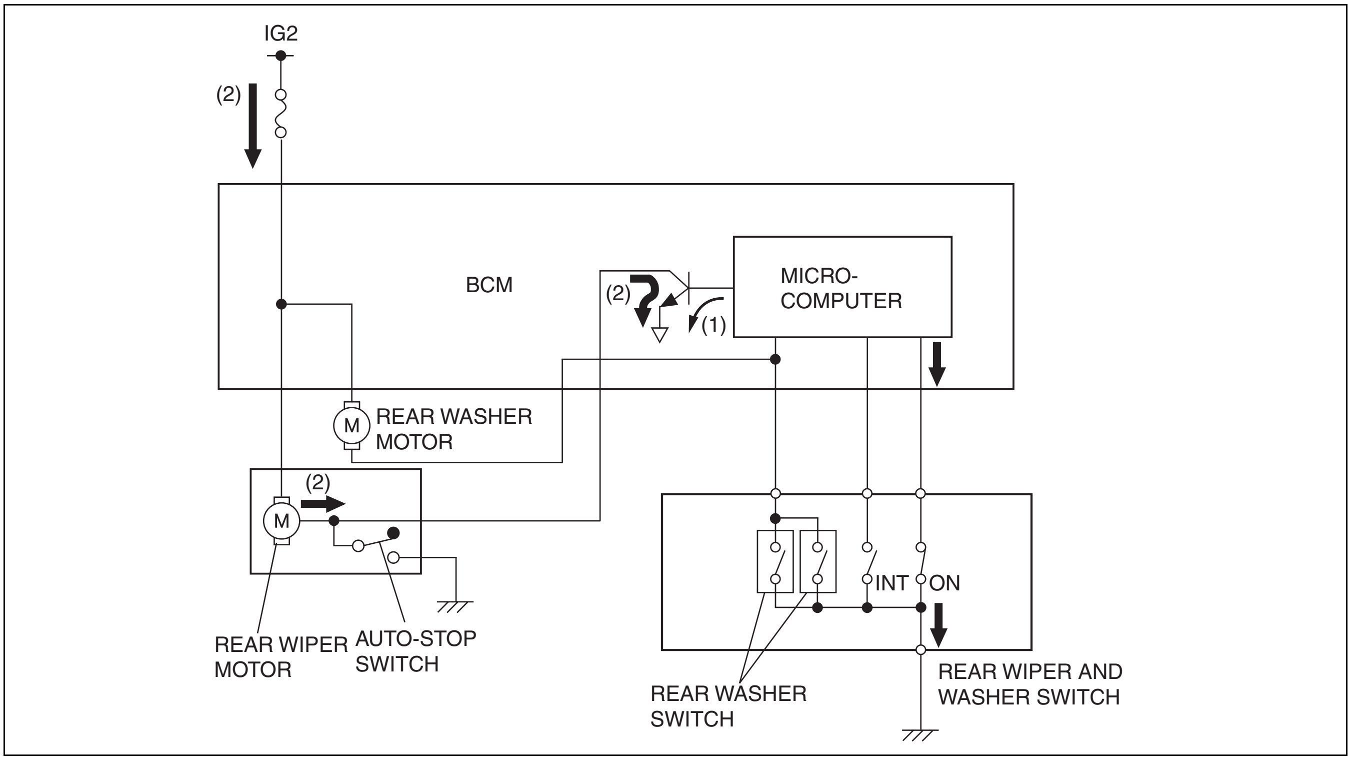
REAR WIPER SYSTEM OPERATION

id091900100900

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.



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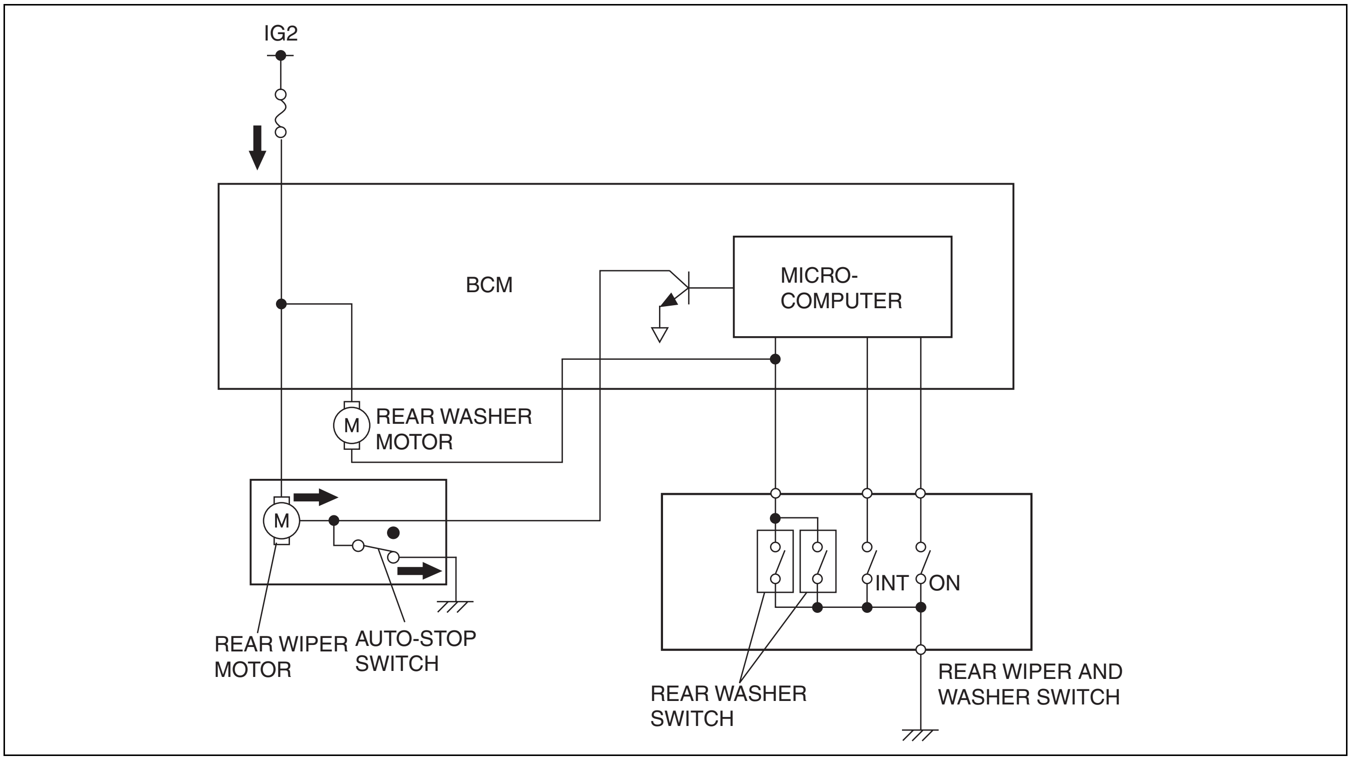
Autostop Operation

- 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.



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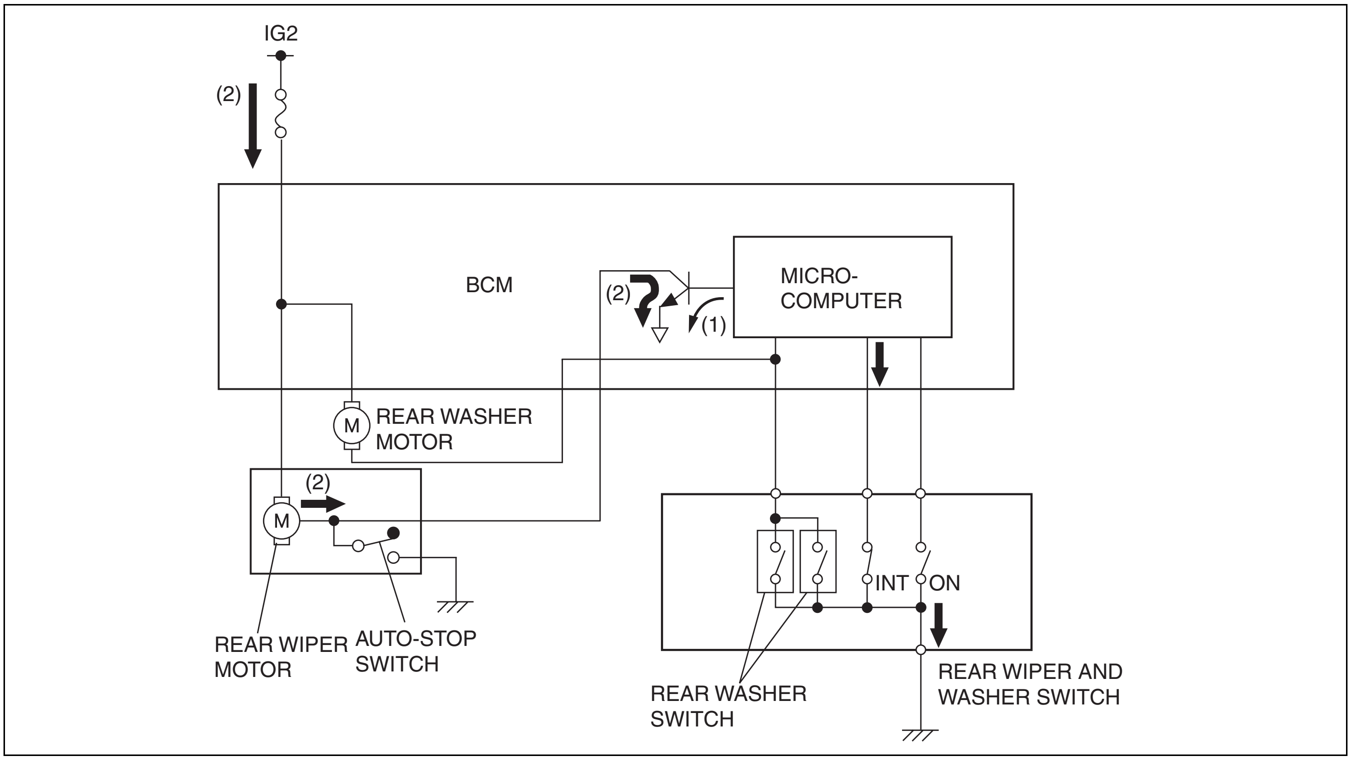
Intermittent Wiper Operation

- 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.



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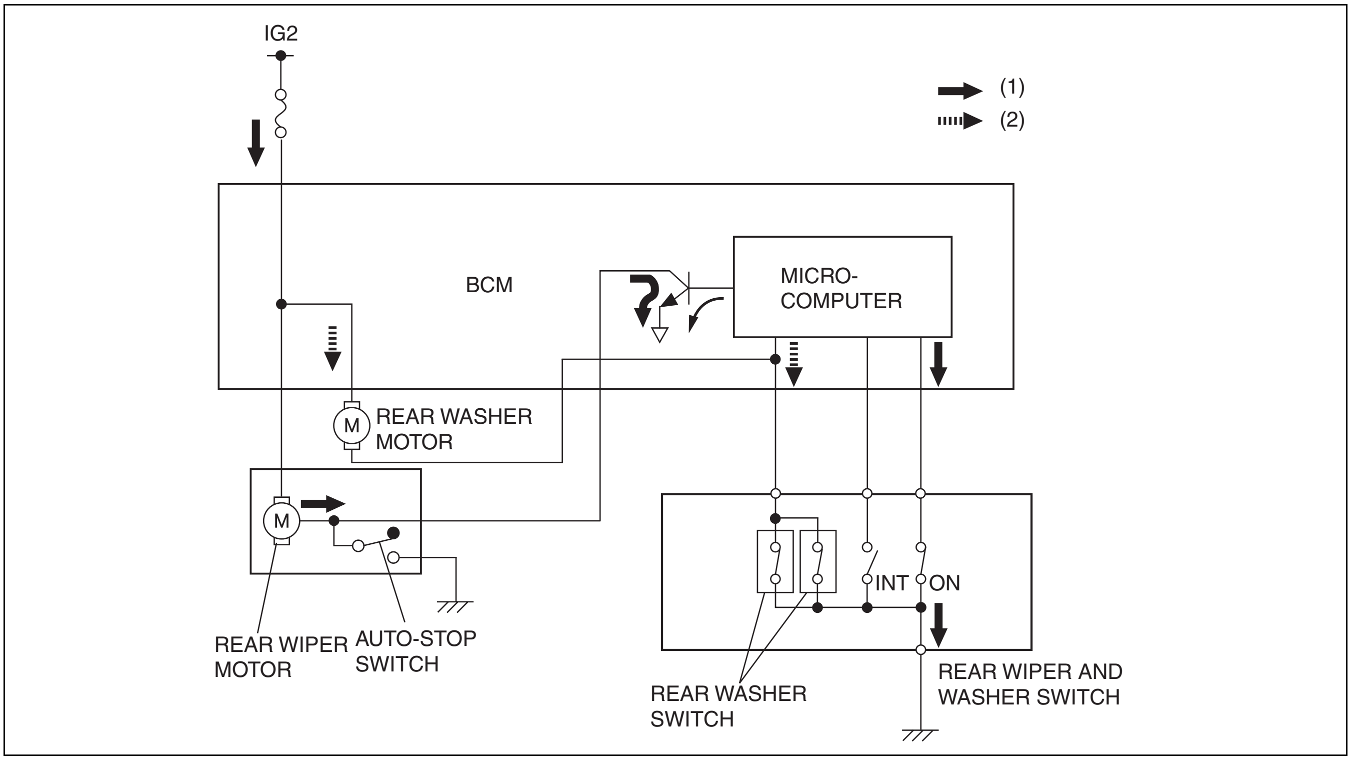
Synchronized Washer And Wiper Operation

- 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.



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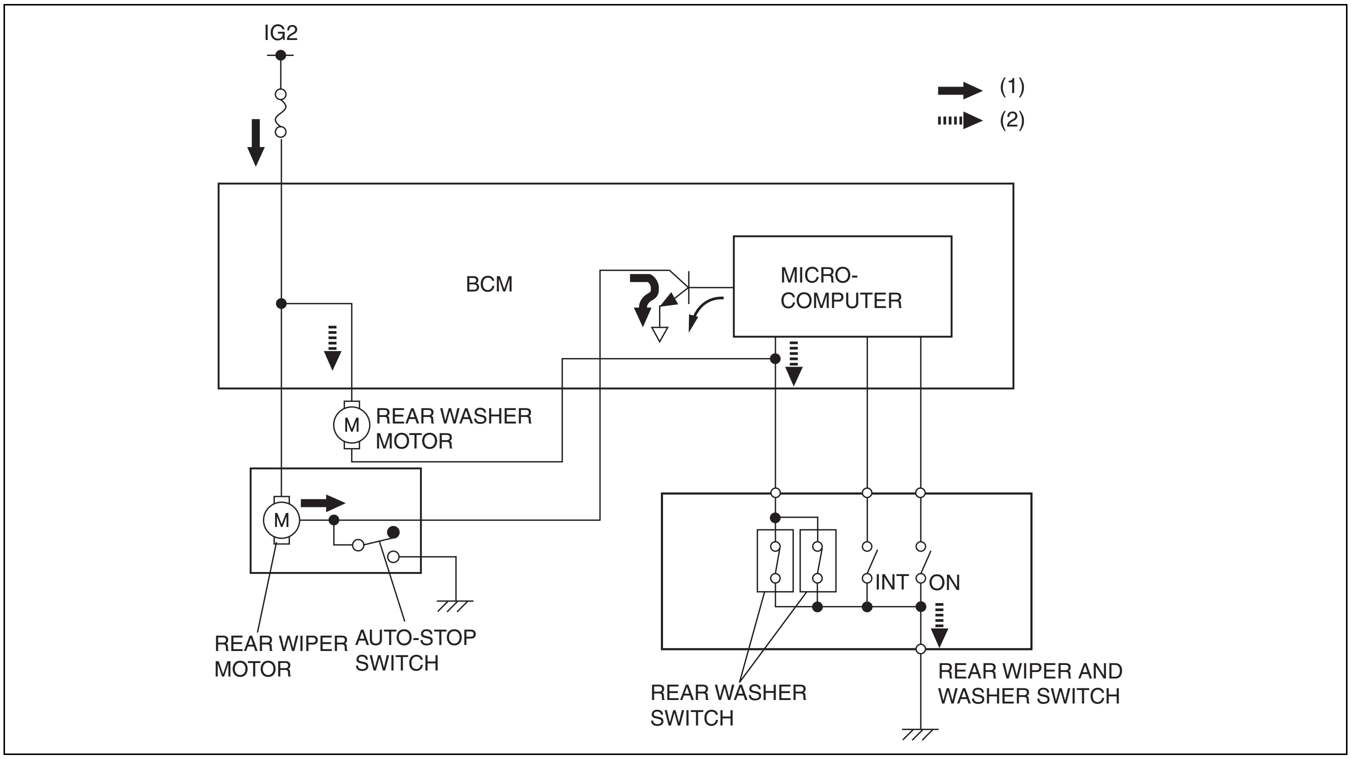
09-19

- 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.



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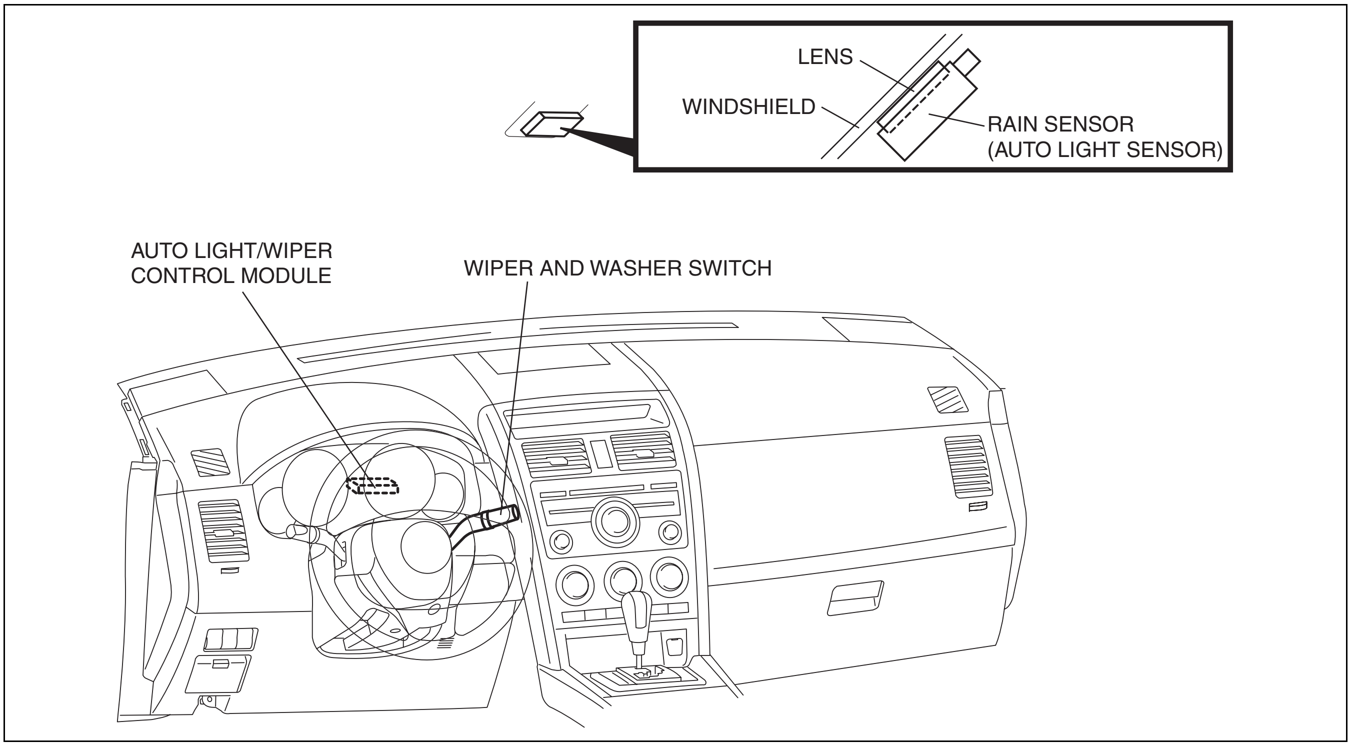
AUTO WIPER SYSTEM OUTLINE

id091900101000

- 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.
- An auto light/wiper control module has been adopted in which the auto light, auto wiper, DRL, and auto light-off systems are consolidated.

AUTO WIPER SYSTEM STRUCTURAL VIEW

id091900101100



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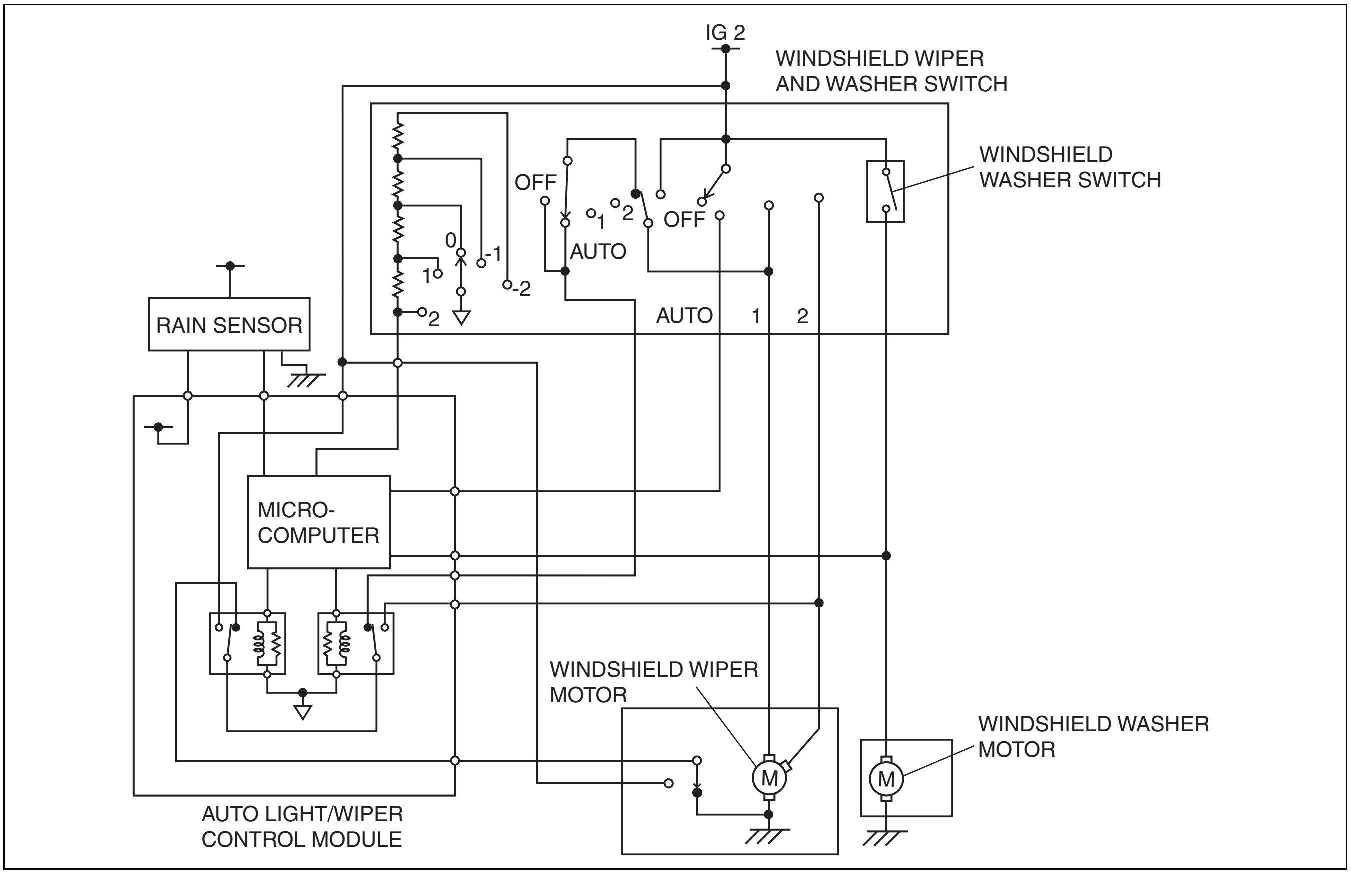
AUTO WIPER SYSTEM WIRING DIAGRAM

id091900101200



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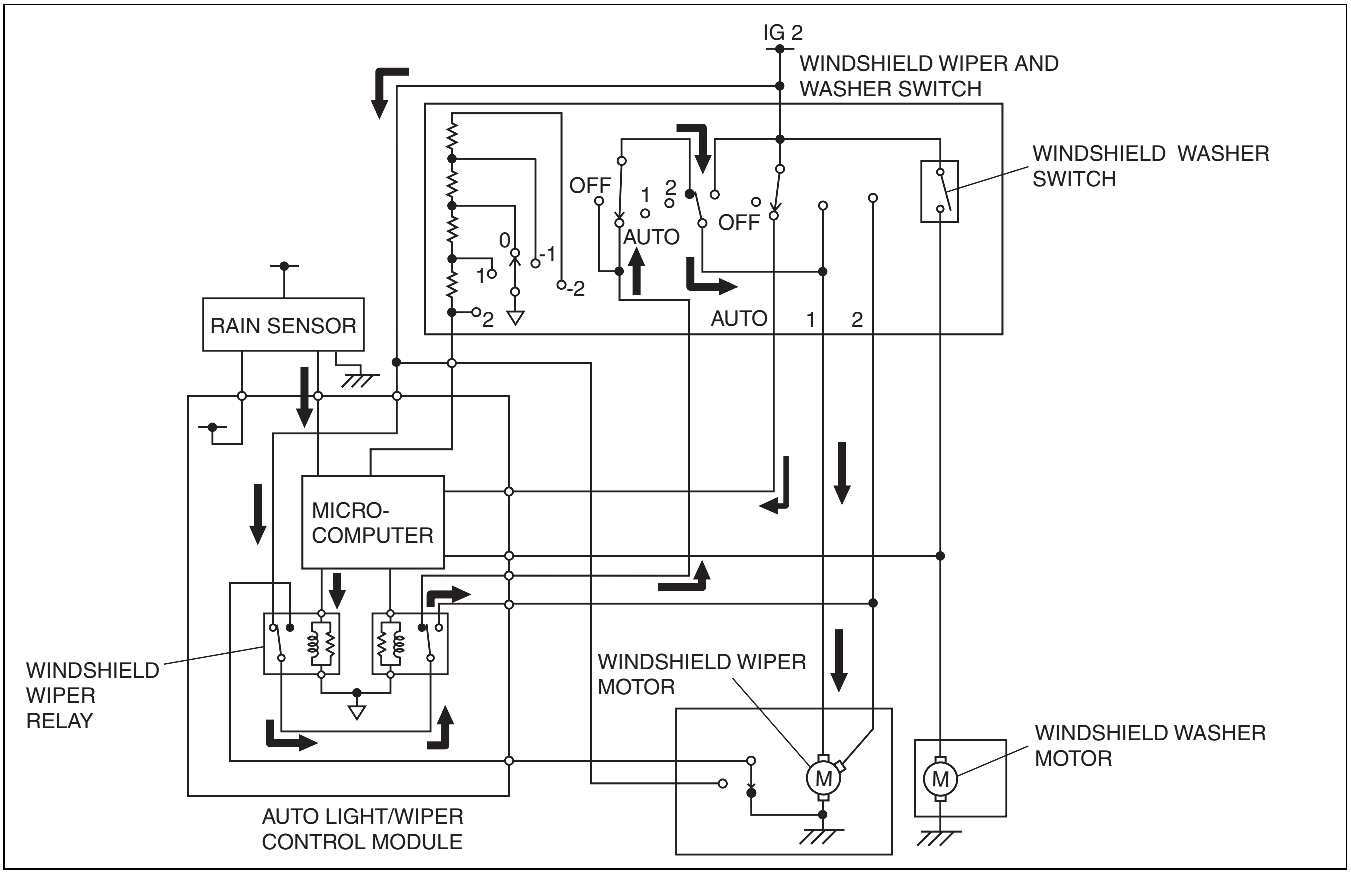
AUTO WIPER SYSTEM OPERATION

id091900101300

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 auto light/wiper control module as a windshield wiper operation control signal.
3. When the microcomputer in the auto light/wiper control module receives the control signal, the wiper relay turns 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.



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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 specific 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.

Fail-Safe Function

- When a rain sensor malfunction or a communication error between the rain sensor and auto light/wiper control module is detected, the auto light/wiper control module initiates controls as indicated in the fail safe function table.

Fail-Safe Function Table

Malfunctions	Fail-safe function		Recovery items
	Before operation	After operation	
• Rain sensor error • Rain sensor communication error	High speed operation	Maintains high speed operation	• Ignition switch lock position • When a rain sensor malfunction is cleared • When communication is restored • When the wiper and washer switch is in a position other than AUTO
	Low speed operation	Maintains low speed operation	
	Intermittent operation	Intermittent operation according to the sensitivity setting	
	Off	Maintains turn-off	

RAIN SENSOR FUNCTION

id091900101400

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.
- 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.
  — If the windshield is dirty, turn the wiper and washer switch to the 1 or 2 position to operate the windshield wipers. Or, remove dirt from the windshield before operating the auto wiper.
- 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.

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.

Note

- The optional rain sensor re-initialization can be performed using the specified procedure.
  — For the re-initialization method, refer to the Workshop Manual. (See CX-9 Workshop Manual.)

On-board Diagnostic Function

- If there is any malfunction in the rain sensor, the auto light/wiper control module is informed of the malfunction and a DTC is detected.

RAIN SENSOR CONSTRUCTION/OPERATION

id091900101500

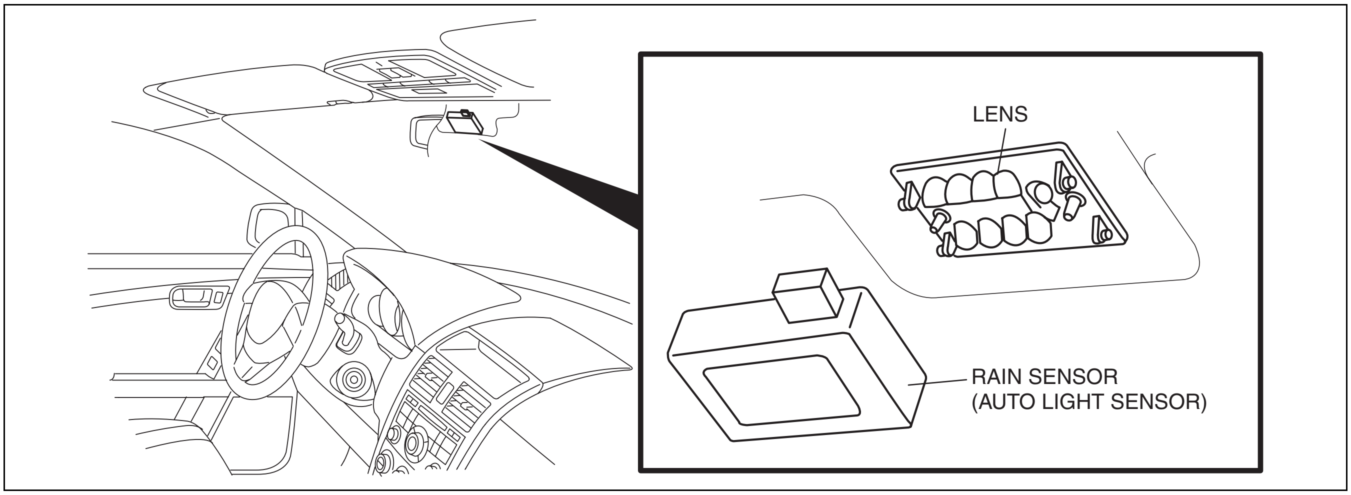
Warning

- **If vehicle servicing such as car washing is performed with the ignition switch turned to the ON position, and the wiper and washer switch is in the AUTO position, the windshield wipers may operate automatically. Always turn the ignition switch, and the wiper and washer switch off before performing servicing such as the car washing; otherwise a pinched hand or fingers could result in injury or a wiper system malfunction.**

Caution

- **In the following cases, the rain sensor cannot detect the rainfall amount correctly which could cause a windshield wiper malfunction:**
  - **— A sticker or label is adhered to the windshield above the rain sensor.**
  - **— The windshield is dirty above the rain sensor.**

- The rain sensor is installed to the lens which is installed to top center area of the windshield.



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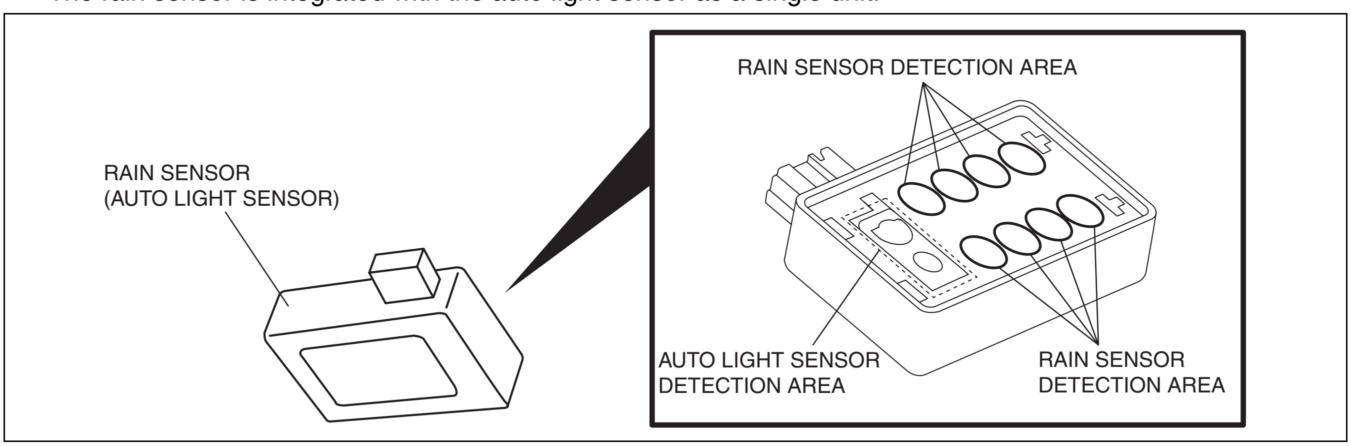
- The rain sensor is integrated with the auto light sensor as a single unit.



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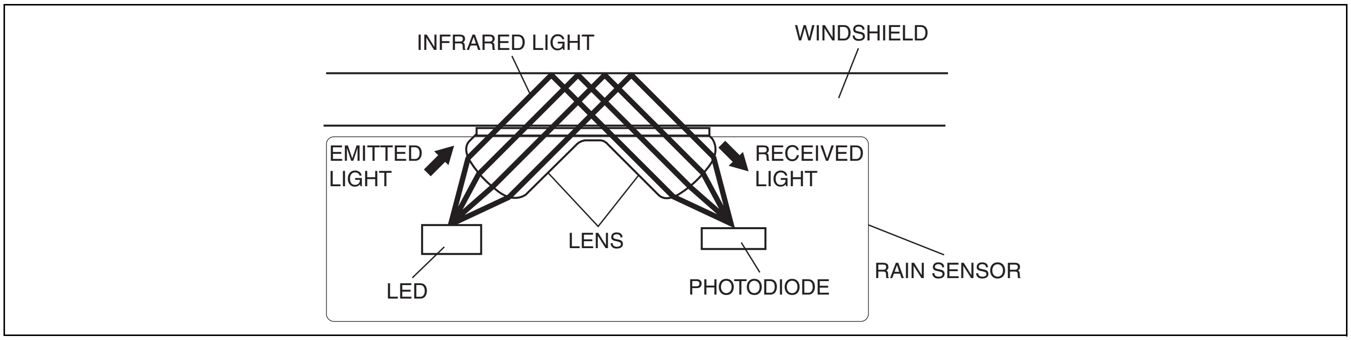
Operation With No Rainfall Contacting Windshield

1. Infrared light is emitted from the LED in the rain sensor towards the windshield.
2. The emitted infrared light passes through the lens and is reflected off the windshield.
3. The infrared light reflected off the windshield is received by the photodiode in the rain 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 auto light/ wiper control module.



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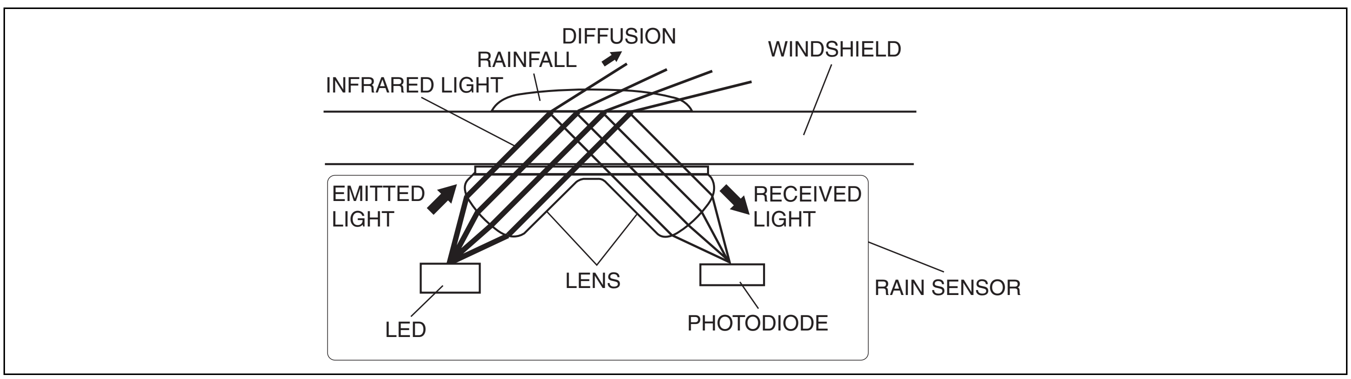
Operation With Rainfall Contacting Windshield

1. Infrared light is emitted from the LED in the rain sensor towards the windshield.
2. Emitted infrared light passing through the lens 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 rain 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 auto light/ wiper control module.

09-19



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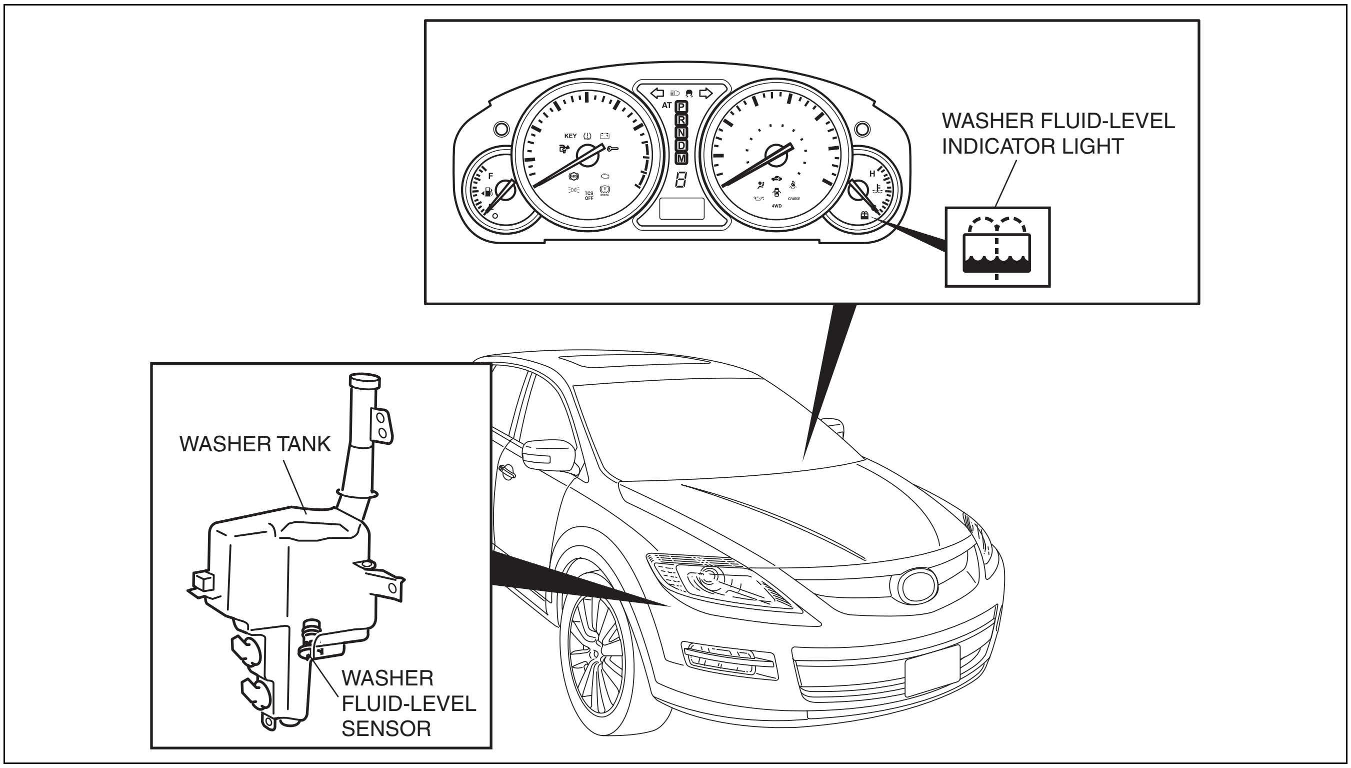
WASHER FLUID-LEVEL SENSOR FUNCTION

id091900101600

- Warns the driver that the washer fluid-level is low.



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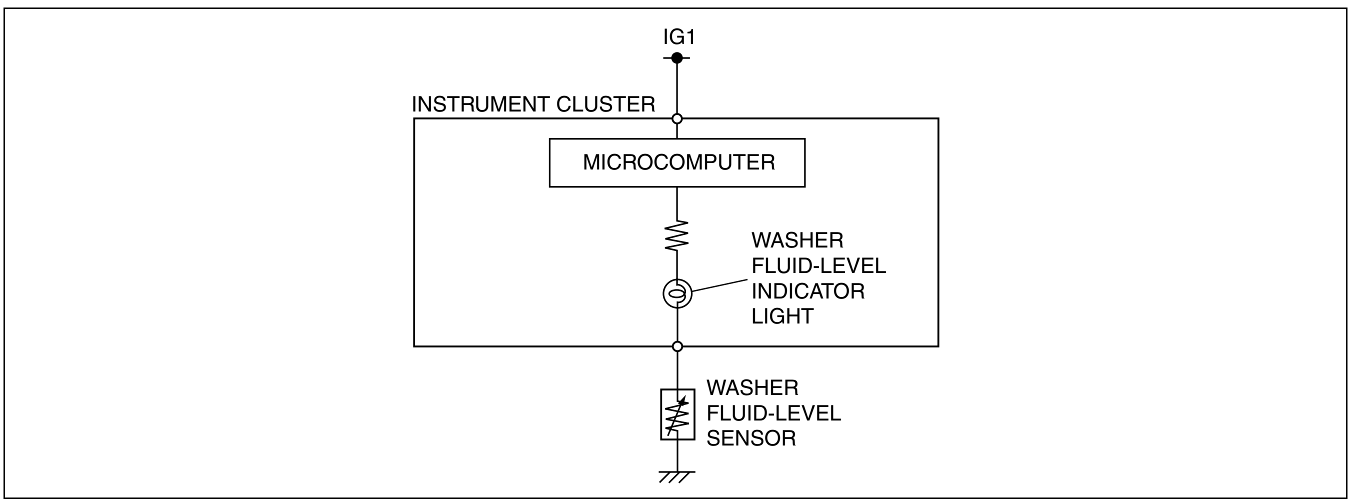

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09-20 ENTERTAINMENT

ENTERTAINMENT OUTLINE

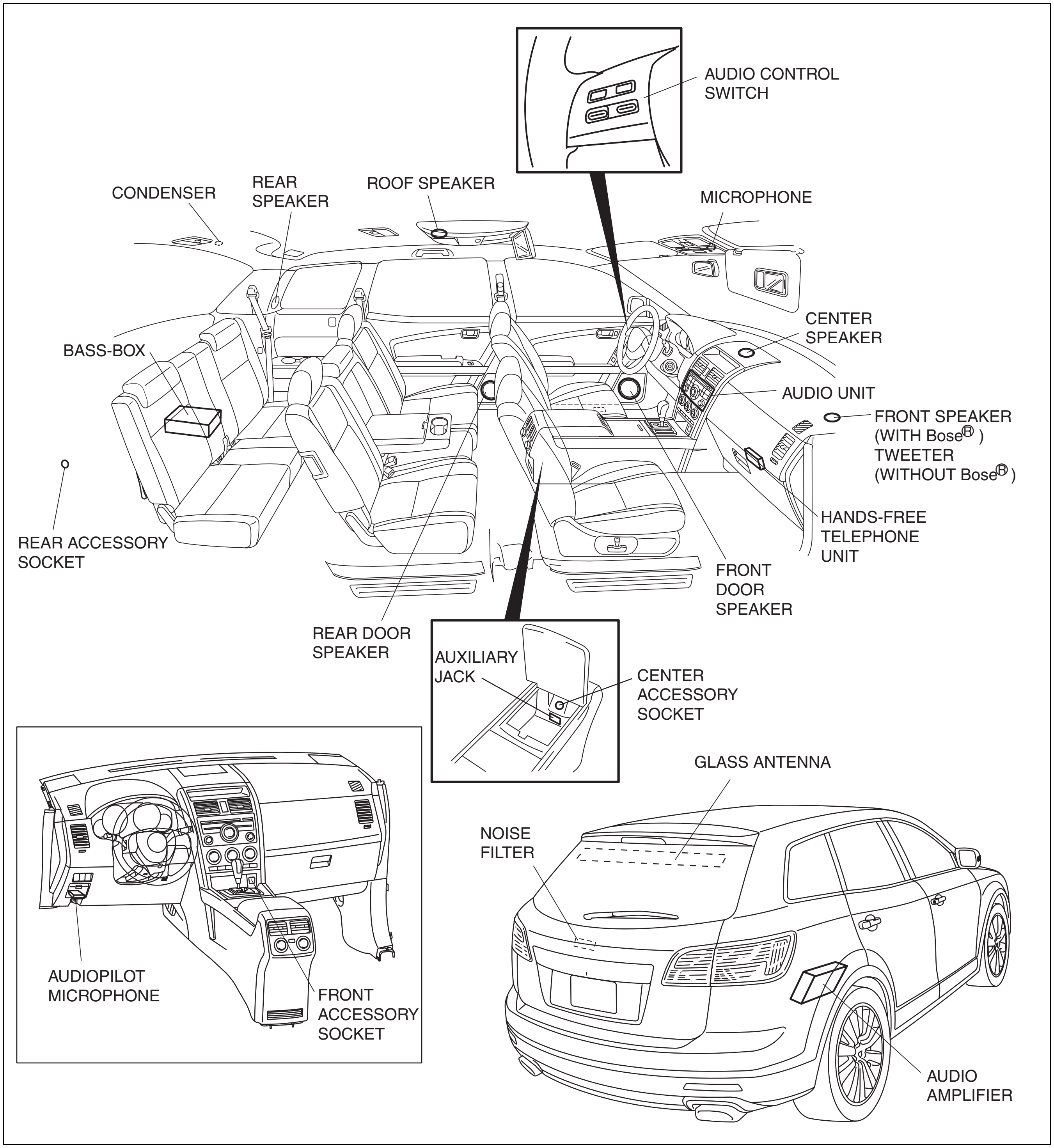
id092000100100

- The audio system consists of the following parts and systems:
  Type A
  — Standard audio unit (with ALC function)
  — 6 speakers
  Type B
  — Standard audio unit
  — Bose® sound system (with AudioPilot*2 and Centerpoint*2 function)
  — 10 speakers
  Type C
  — Standard audio unit
  — Bose® sound system (with AudioPilot, Centerpoint, and 5.1 ch discrete surround sound)
  — RES
  — 11 speakers
  Type D
  — Touch panel type audio unit
  — Bose® sound system (with AudioPilot Centerpoint function)
  — Car-navigation system
  — 10 speakers
  Type E
  — Touch panel type audio unit
  — Bose® sound system (with AudioPilot Centerpoint and 5.1 ch discrete surround sound)
  — Car-navigation system
  — RES
  — 11 speakers
- The following speakers have been adopted (11 speakers*1):
  — Front door speaker
  — Rear door speaker
  — Front speaker*1/Tweeter*1
  — Rear speaker*1
  — Center speaker*1
  — Roof speaker*1
  — Bass-box*1
- An HF/TEL system in which mobile telephones can be used while driving has been adopted.*1
- Rear view monitor has been adopted.
- An audio control switch is equipped on the steering wheel for audio operation.
- A glass antenna has been adopted.

*1 : May or may not be equipped, depends on the vehicle grade.
*2 : “AudioPilot” and “Centerpoint” are registered trademarks of Bose® Corporation.

AUDIO SYSTEM STRUCTURAL VIEW

id092000100200



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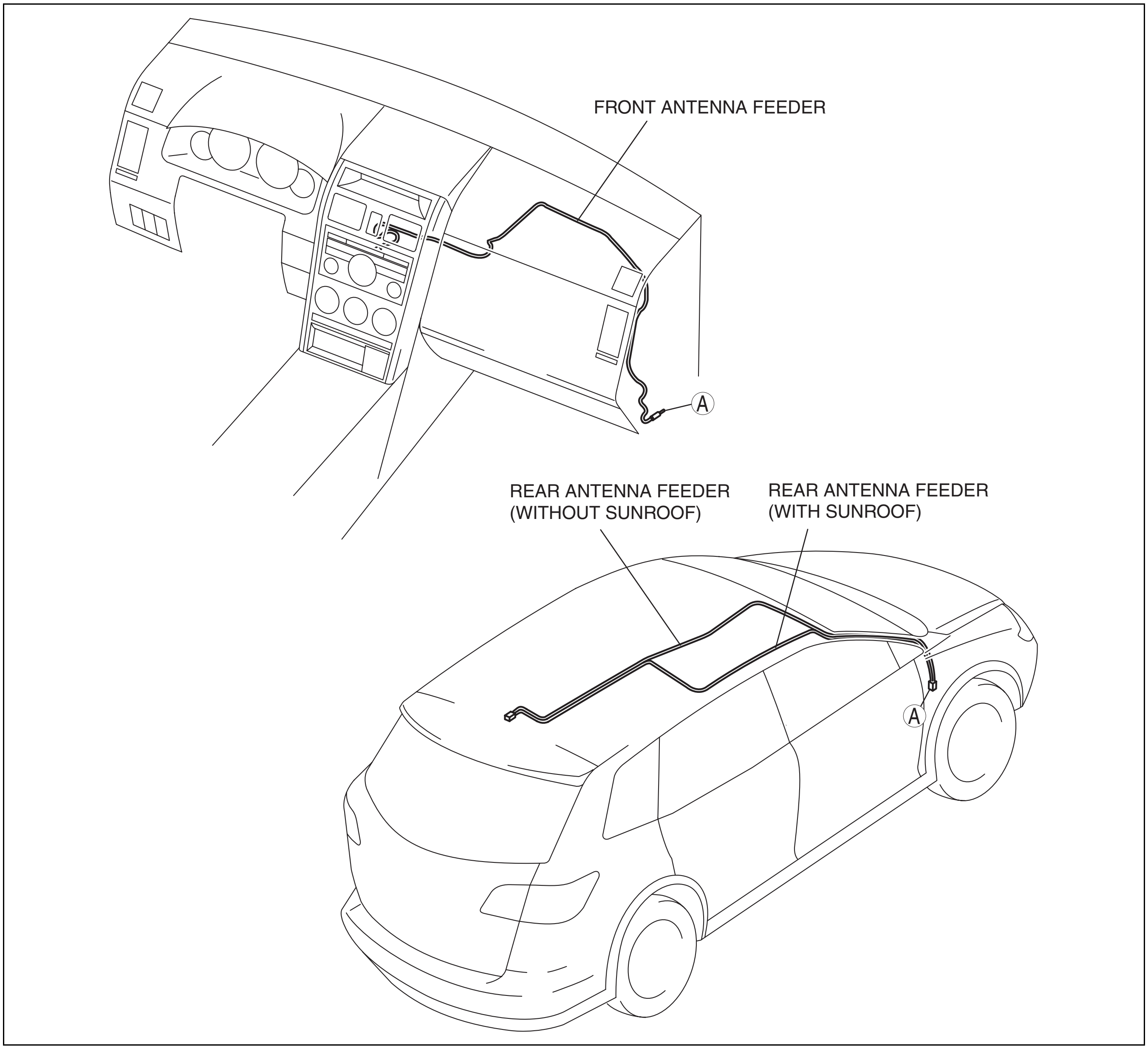

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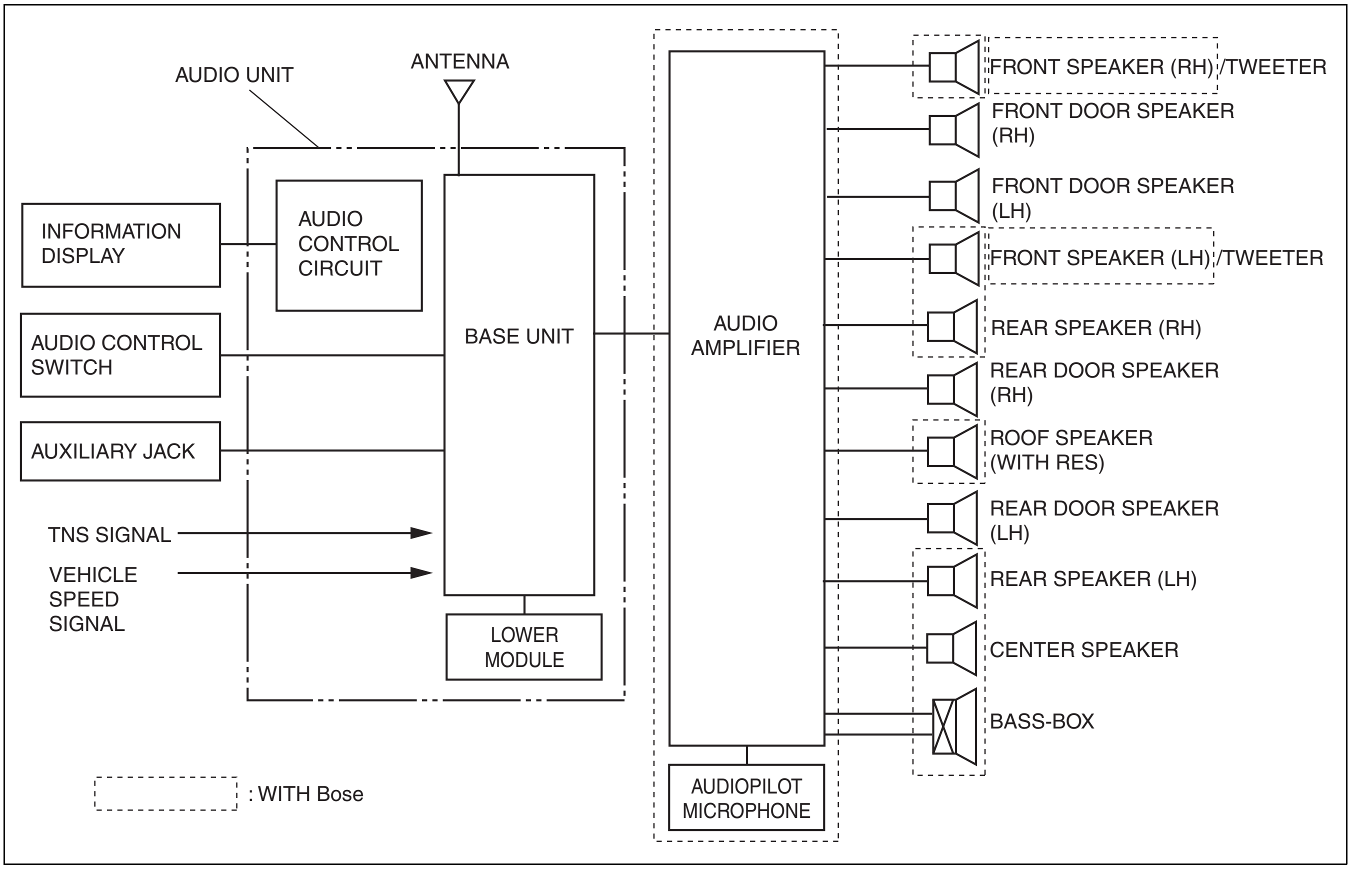
AUDIO SYSTEM BLOCK DIAGRAM

id092000100300



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AUDIO SYSTEM SPECIFICATIONS

id092000100400

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)	With Bose®: 296 (External type audio amplifier) Without : 25×4
Output impedance		(ohm)	4

Speaker

Item		Specification					
		Without Bose®		With Bose®			
		Front door speaker / Rear door speaker	Tweeter	Front door speaker	Rear door speaker	Front speaker / Rear speaker / Center speaker / Roof speaker	Bass-box
Maximum input	(W)	25	25	37	37	18.5	74
Impedance	(ohm)	4	4	2	2	3.6	1
Size	(mm {in})	140×190 {5.5×7.5}	30 {1.2}	230 {9}	165 {6.5}	80 {3}	370×420×150 {14.5×16.5×6}

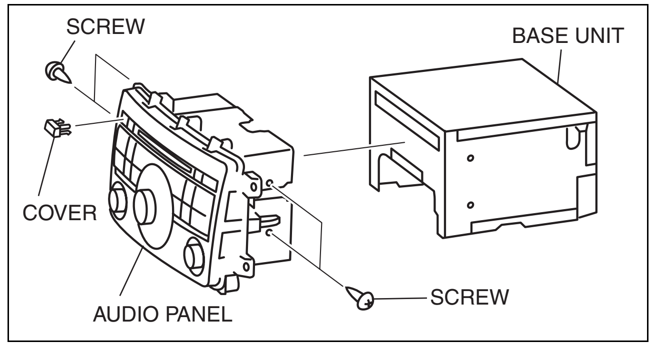
AUDIO UNIT CONSTRUCTION/OPERATION

id092000101600

Standard Audio

Structural view

- The audio unit is composed of the audio panel and the base unit.



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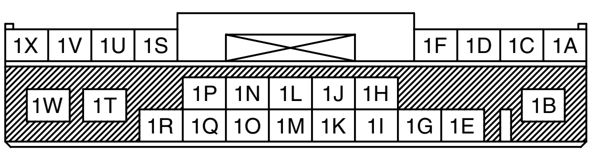
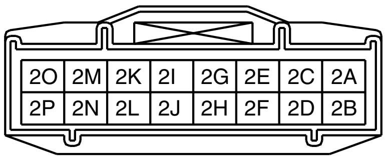
Terminal Layout and Signal



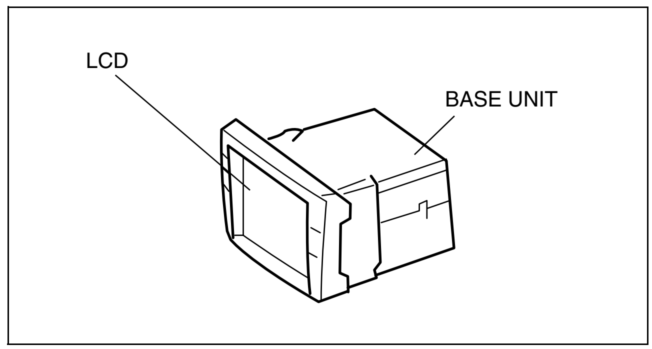
Terminal	Signal
1A	Left front door speaker (+)
1B	B+ (Power back up)
1C	Front door speaker (–)
1D	Right front door speaker (+)
1E	Illumination (+)
1F	Right front door speaker (–)
1G	Illumination (–)
1H	Antenna
1I	Vehicle speed signal*1
1J	AMP control*2
1K	UART-1
1L	Dimmer cancel
1M	UART-2
1N	Audio control 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 (–)

*1 : Vehicles without Bose®
*2 : Vehicles with Bose®

Terminal		Signal
	2A	Power ground
	2B	TEL (+)
	2C	Input signal RH (+)
	2D	Input signal RH (–)
	2E	Input signal LH (+)
	2F	Input signal LH (–)
	2G	Signal ground
	2H	TEXT DATA
	2I	TEXT CLK
	2J	TEL (–)
	2K	BUS (–)
	2L	BUS (+)
	2M	RES/AUX CONT
	2N	—
	2O	ACC
	2P	B+

Touch Panel Type Audio
Structural view

- The audio unit is composed of the LCD and base unit.



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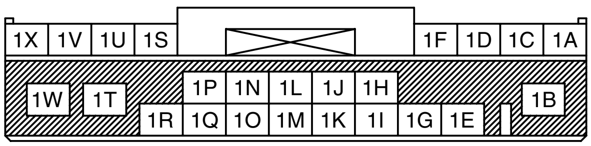
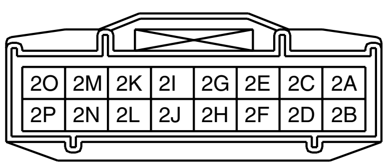
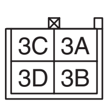
Terminal Layout and Signal



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	Vehicle speed signal
1J	AMP control
1K	Parking brake signal
1L	Dimmer cancel signal
1M	R range signal
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	Power ground
2B	TEL (+)
2C	Input signal RH (+)
2D	Input signal RH (-)
2E	Input signal LH (+)
2F	Input signal LH (-)
2G	Signal ground
2H	TEXT DATA
2I	TEXT CLK
2J	TEL (–)
2K	BUS (–)
2L	BUS (+)
2M	RES/AUX CONT
2N	—
2O	ACC
2P	B+



Terminal	Signal
3A	VCC
3B	Ground
3C	Camera in
3D	Video ground

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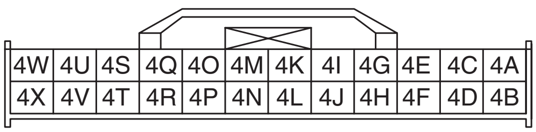
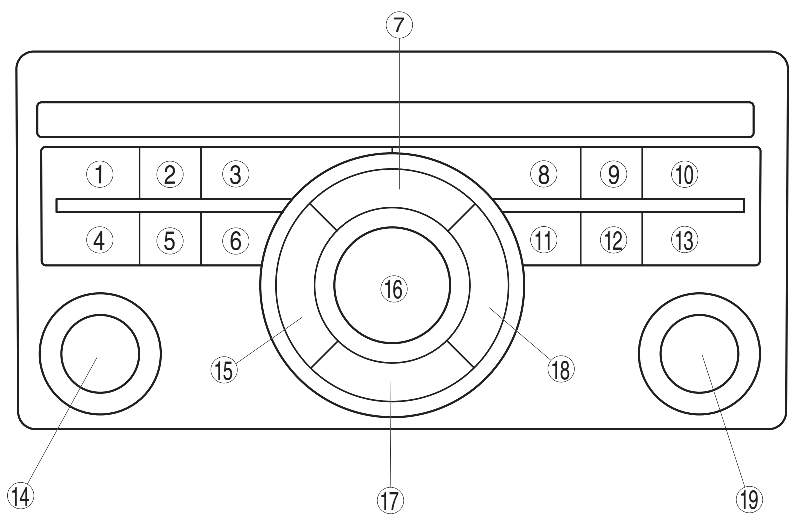


Terminal	Signal
4A	—
4B	—
4C	Phone switch
4D	Digital ground
4E	UART-1
4F	—
4G	—
4H	—
4I	UART-2
4J	—
4K	SYNC-RGB
4L	—
4M	—
4N	—
4O	B-RGB
4P	—
4Q	G-RGB
4R	—
4S	R-RGB
4T	—
4U	RGB/SYNC ground
4V	—
4W	—
4X	—

Button Location
Standard audio



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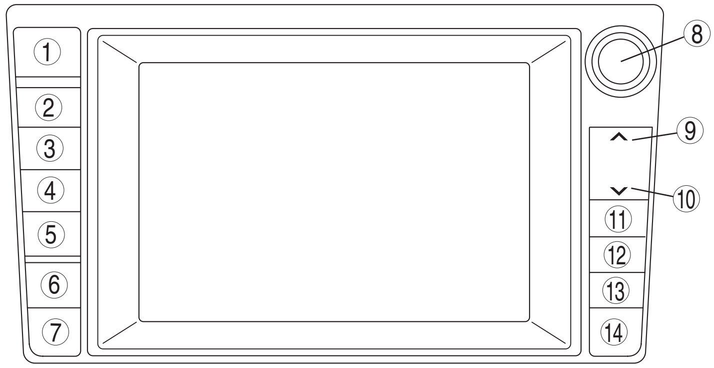
1	TRACK/SEEK button (up)
2	RPT button
3	SCAN button
4	TRACK/SEEK button (down)
5	CLK button
6	SET button
7	FM/AM button
8	Preset button “1”
9	Preset button “2”
10	Preset button “3”

11	Preset button “4”
12	Preset button “5”
13	Preset button “6”
14	TUNE/AUTO-M button
15	CD button
16	POWER button
17	MEDIA button
18	SAT button
19	AUDIO CONT button

Touch panel type audio



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1	LOAD/EJECT button
2	NAVI button
3	MENU button
4	RTN button
5	DISP button
6	AUDIO button
7	SCAN button

8	POWER button
9	TUNE/SEEK/TRACK button (up)
10	TUNE/SEEK/TRACK button (down)
11	FM/AM button
12	SAT button
13	CD button
14	MEDIA button

AUTO LEVEL CONTROL (ALC) FUNCTION

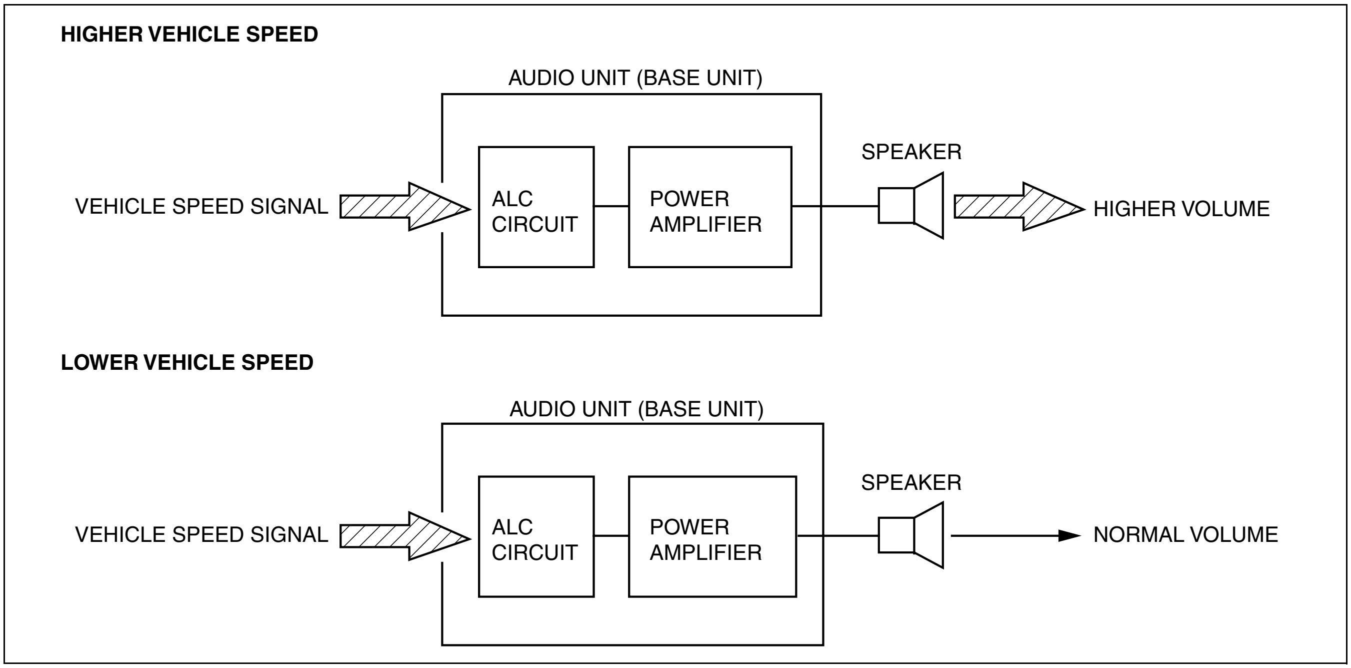
id092000106900

- Adjusts the audio volume so that the sound is balanced against wind and road noise while driving.

AUTO LEVEL CONTROL (ALC) OPERATION

id092000106800

- The audio unit changes the volume automatically based on the vehicle speed signal sent from the instrument cluster.



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- 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

AUDIOPILOT OUTLINE

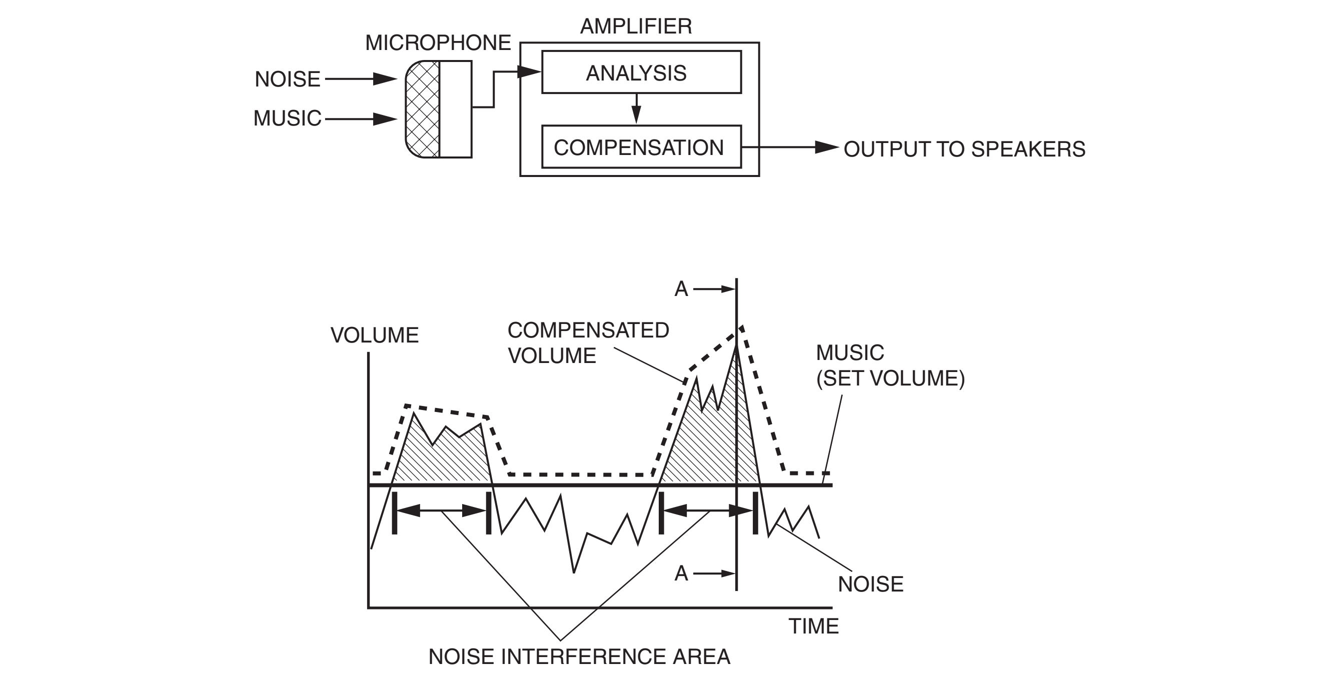
id092000107000

- Measures the driving noise level inside the vehicle with a specialized microphone, and the amplifier adjusts the volume in accordance with the degree of noise masking the music component. Due to this, passengers can enjoy music at a constantly perceived volume level regardless of the noise level.

AUDIOPILOT CONSTRUCTION/OPERATION

id092000107100

- A microphone is installed on the lower panel.
- The amplifier separates the sound inside the vehicle, measured with a microphone, into music and noise, and compares the noise and music levels at each frequency. Then, volume compensation is performed for frequency bands where the noise is determined to interfere with the music.



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ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [AUDIO AMPLIFIER]

id0920001018a3

- The on-board diagnostic system has a self-diagnostic function to help technicians locate malfunctions.

Self-diagnostic Function

Malfunction detection function

- The malfunction detection function detects malfunctions occurring in the audio amplifier.

Memory function

- The memory function detects a malfunction, changes it to a DTC, and stores it in the memory.
- 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 on-board diagnostic function has started, DTCs stored by the memory function are output to the DLC-2.

DTC table

DTC No.	Description	Detection condition
B2477	Audio amplifier configuration error	If there is any malfunction in the configuration data.

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [AUDIO (STANDARD AUDIO)]

id0920001018a6

- The on-board diagnostic system has a self-diagnostic function and diagnostic assist function to help technicians locate malfunctions.

Self-diagnostic Function

Malfunction detection function

- The malfunction detection function detects malfunctions occurring in the system.

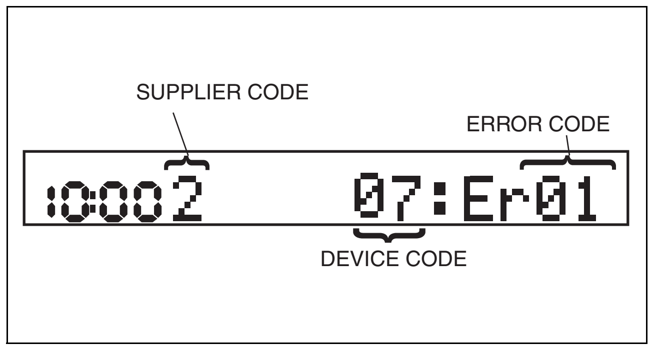
Memory function

- 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:
  — Supplier code (indicates manufacturer)
  — Device code (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



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Device code	Parts name
00	Cassette deck
03	CD player
05	CD changer (external)
06	CD changer
09	Base unit
10	MP3 applicable CD player
11	Sirius unit
16	CAN system
17	CAN communication line
21	Audio panel
22	MP3 applicable CD changer

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	Incorrect Combination
18	Incorrect Combination
19	Communication line
20	Insufficient power supply
21	Amplifier related circuit
22	Tuner error

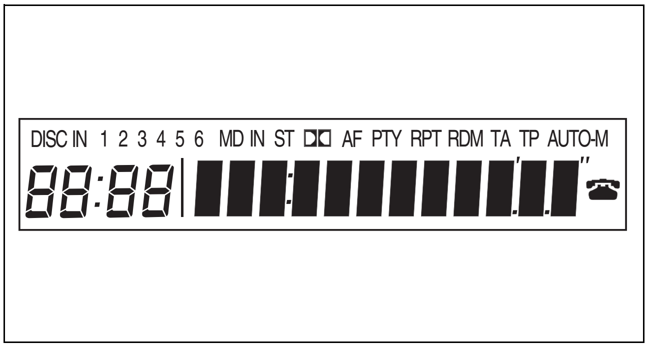
Screen display		Malfunction location
DTC	Output signal	
09: Er20	—	Power supply circuit to base unit
09: Er21	—	Base unit (peripheral circuit for power amplifier)
09: Er22	—	Base unit (peripheral circuit for tuner)
11: Er01	—	Sirius unit
11: Er03	—	Sirius unit
11: Er10	—	Sirius unit—Base unit communication line
16: Er12	—	CAN system
21: Er17	—	Audio cover system
21: Er18	—	Audio cover system
21: Er19	—	Audio cover system
22: Er01	—	MP3 applicable CD changer system
22: Er02	—	MP3 applicable CD changer system
22: Er07	—	MP3 applicable CD changer system
22: Er10	—	MP3 applicable CD changer communication circuit system
no Err	—	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.

Information display

- The diagnostic assist function illuminates all characters in the information display to check for truncated or faint characters.



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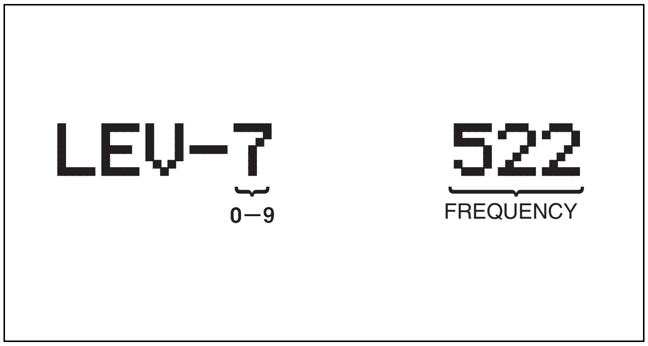
09-20

Speaker

- The diagnostic assist function outputs sound to the speakers in the specified order to determine the operating condition of the speakers and wiring harnesses between the base unit and each 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).



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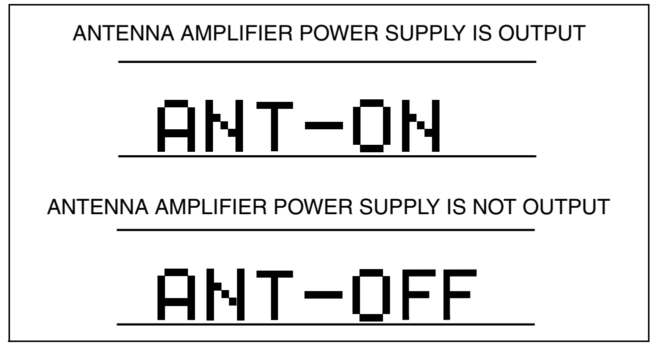
Antenna control condition

- The diagnostic assist function displays the output state of the antenna amplifier power supply to determine the condition of the antenna amplifier, base unit, and wiring harness between the base unit and antenna amplifier.



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ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [AUDIO (TOUCH PANEL TYPE AUDIO)]

id0920001018a7

- The on-board diagnostic system has a self-diagnostic function and diagnostic assist function to help technicians locate malfunctions.

Self-diagnostic Function

Malfunction detection function

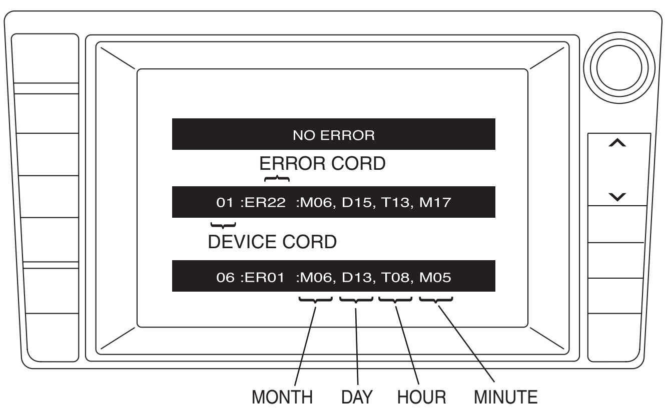
- The malfunction detection function detects malfunctions occurring in the system.

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 twenty DTCs. If another malfunction is detected when twenty 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.
- An error history in which 30 days have elapsed from the occurrence is automatically erased.

Display function

- When the self-diagnostic function is activated, DTCs and the time when errors occur which have been stored by the memory function and displayed on the audio panel screen.
- The DTC consists of the following codes and numbers:
  — Error code (indicates malfunction description)
  — Device code (indicates malfunctioning part)
  — Time information (indicates date and time when malfunction occurred)
- Refer to the Service Section for the display method.



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Device code	Parts name
09	Base unit
11	Sirius unit
16	CAN communication line
21	Audio panel
22	MP3 applicable CD changer
23	Audio amplifier
24	Audio panel (Touch panel type)
25	Car-navigation unit

Error code	Malfunction description
01	Internal mechanism error
02	Servo mechanism error
03	Mechanism stuck
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

Error code	Malfunction description
20	Insufficient power supply
21	Amplifier related circuit
22	Tuner error

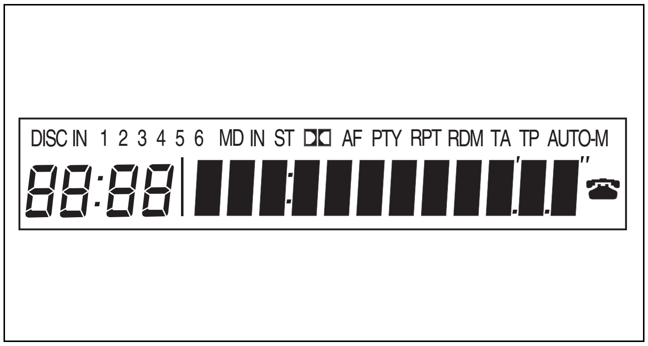
Screen display		Malfunction location
DTC	Output signal	
03: Er01	—	CD player system
03: Er02	CHECK CD	CD player system
03: Er07	CHECK CD	CD player system
03: Er10	—	CD player communication circuit system
05: Er01	—	CD changer (external) system
05: Er07	CHECK CD	CD changer (external) system
05: Er10	—	CD changer (external) communication circuit system
06: Er01	—	CD changer system
06: Er02	CHECK CD	CD changer system
06: Er07	CHECK CD	CD changer system
06: Er10	—	CD changer communication circuit system
09: Er20	—	Power supply circuit to base unit
09: Er21	—	Base unit (peripheral circuit for power amplifier)
09: Er22	—	Base unit (peripheral circuit for tuner)
10: Er01	—	MP3 applicable CD player system
10: Er02	CHECK CD	MP3 applicable CD player system
10: Er07	CHECK CD	MP3 applicable CD player system
10: Er10	—	MP3 applicable CD player communication circuit system
11: Er01	—	Sirius unit
11: Er03	—	Sirius unit
11: Er10	—	Sirius unit—Base unit communication line
16: Er12	—	CAN system
17: Er11	—	CAN system
21: Er17	—	Audio panel system
21: Er18	—	Audio panel system
21: Er19	—	Audio panel system
22: Er01	—	MP3 applicable CD changer system
22: Er02	—	MP3 applicable CD changer system
22: Er07	—	MP3 applicable CD changer system
22: Er10	—	MP3 applicable CD changer communication circuit system
23: Er03	—	Audio amplifier
23: Er11	—	Audio amplifier
23: Er23	—	Audio amplifier
24: Er01	—	Audio panel open/close mechanism
24: Er19	—	Connectors between base unit and audio panel
25: Er10	—	Car-navigation unit
no Err	—	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.

Information display

- The diagnostic assist function illuminates all characters in the information display to check for truncated or faint characters.



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Audio panel screen

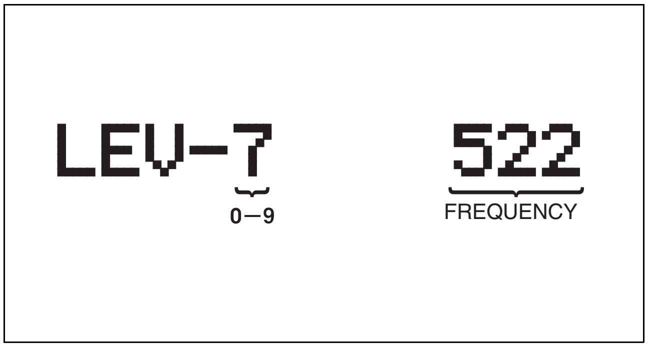
- Switches the display color in the specified order and examines the audio panel.

Speaker

- The diagnostic assist function outputs sound to the speakers in the specified order to determine the operating condition of the speakers and wiring harnesses between the base unit and each 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).



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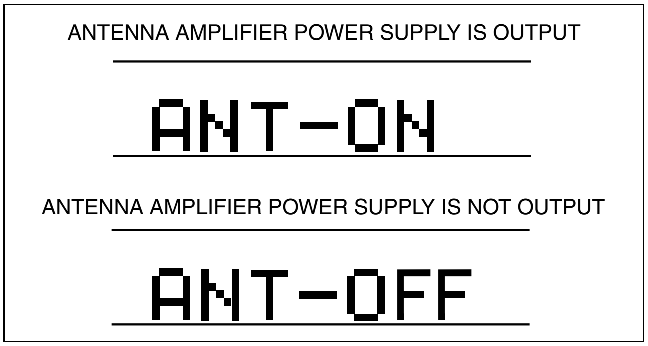
Antenna control condition

- The diagnostic assist function displays the output state of the antenna amplifier power supply to determine the condition of the antenna amplifier, base unit, and wiring harness between the base unit and antenna amplifier.



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09-20

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION [HANDS-FREE TELEPHONE (HF/TEL) SYSTEM]

id0920001018a8

- The on-board diagnostic system has a self-diagnostic function and diagnostic assist function to help technicians locate malfunctions.
- In the on-board diagnostic test mode, present malfunctions are indicated on the information display as DTCs. (For the touch panel type audio unit, present malfunctions are indicated on the audio display.)

Self-diagnostic Function

Malfunction detection function

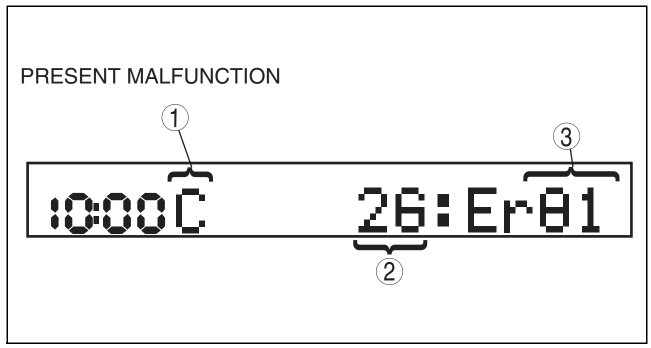
- The malfunction detection function detects malfunctions occurring in the HF/TEL system.

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:
  - — Malfunction type
  - — Device code (indicates malfunctioning part)
  - — Error code (indicates malfunction description)
- Refer to the Service Section for the display method.

Standard audio

1	Malfunction type • C: Present malfunction
2	Device code • 26: HF/TEL unit
3	Error code



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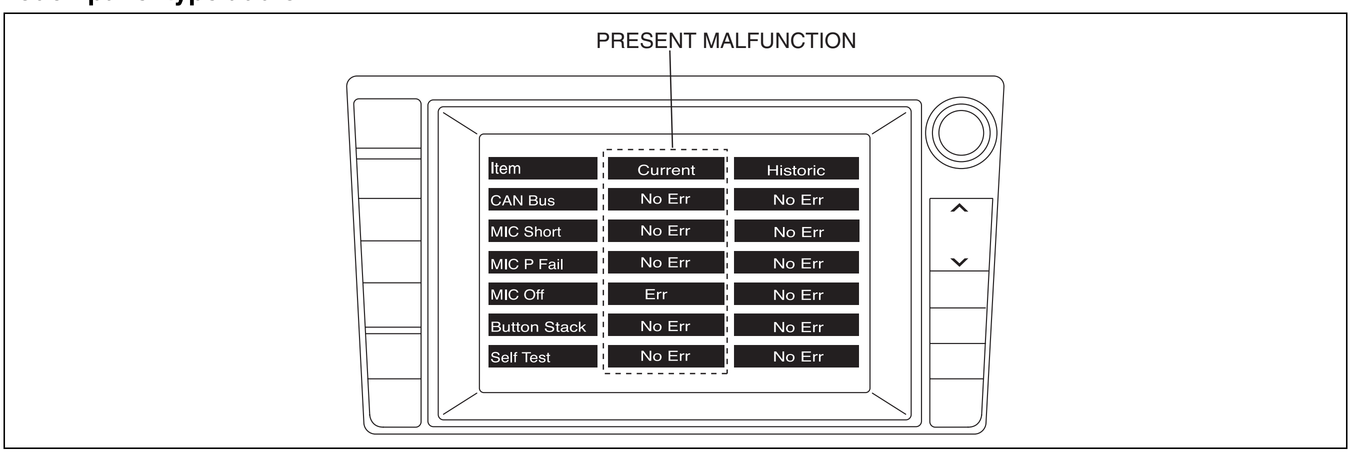
Touch panel type audio



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DTC table

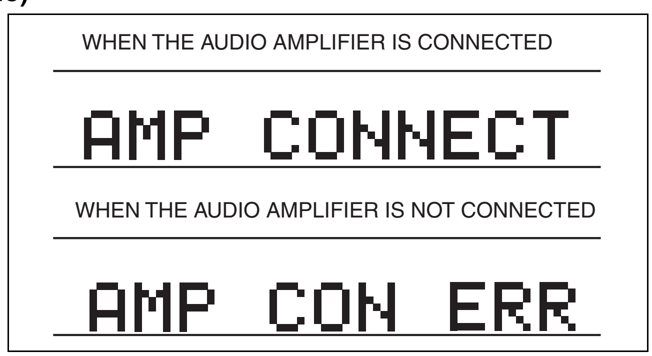
Screen display		Detection condition	Possible cause/inspection
DTC (Standard audio)	Item (Touch panel type audio)		
26: Er81	CAN Bus	—	CAN system malfunction
26: Er82	MIC Short	Short to power supply in wiring harness between microphone (Input signal) and HF/TEL unit	Wring harness between microphone (Input signal) and HF/TEL unit
26: Er83	MIC P Fail	Short to GND/power supply in microphone power supply circuit	Wring harness between microphone (Input signal) and HF/TEL unit
26: Er84	MIC Off	Any of the following is detected: • The microphone power supply circuit is not connected. • Open circuit in the microphone input circuit • Microphone input circuit short to body ground	Poor contact in the microphone or hands-free telephone unit (HF/TEL unit) connector
26: Er85	Button Stack	Hands-free telephone switch (HF/TEL switch) malfunction	Poor contact in the hands-free telephone switch or hands-free telephone unit (HF/TEL unit) connector
26: Er86	Self Test	HF/TEL unit malfunction	HF/TEL unit malfunction
no Err	—	No DTCs stored	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.

Audio amplifier connection (With touch panel type audio)

- Displays the audio amplifier connection status on the information display and examines the audio amplifier, wiring harness, and connector.



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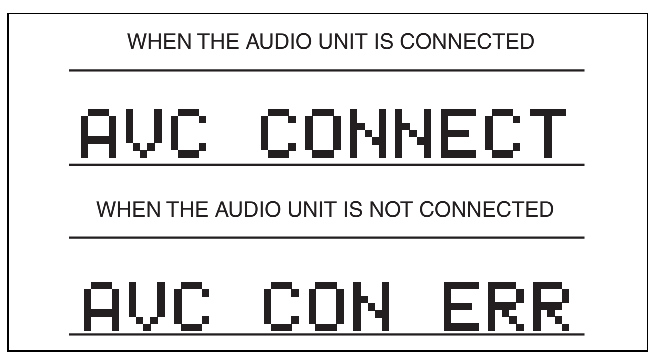
Audio unit connection (With touch panel type audio)

- Displays the audio unit connection status on the information display and examines the audio unit, wiring harness, and connector.



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Connection condition verification (With standard audio)
- Displays the connection status on the information display and examines the HF/TEL system-related unit, wiring harness, and connector.

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Password reset
- Operate the switch and reset the password.

ac9uun00000512

CONTROLLER AREA NETWORK (CAN) OUTLINE
id092000101900

- The audio 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
- Audio status display request
- Audio system-related information
- Hands-free telephone system-related information
- RES-related information
- Vehicle speed
- Ignition key position
- Buttons status
- Drive information system data

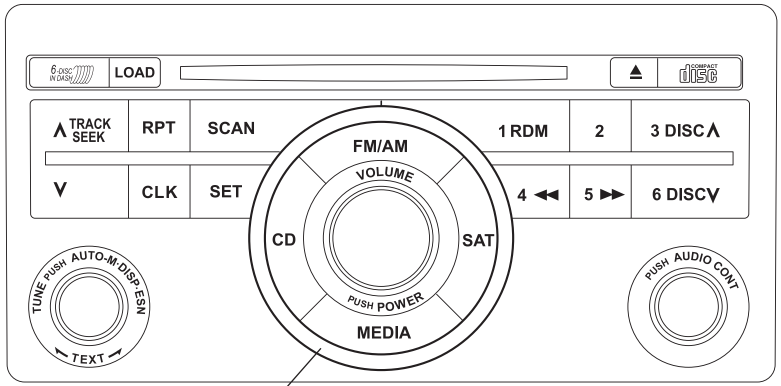
Data received
- Audio system-related information
- Hands-free telephone system-related information
- Beep sound request

ACTION ILLUMINATION OUTLINE
id092000108000

- LED lights are installed inside the outer ring around the FM/AM, SAT, MEDIA, and CD buttons on the audio unit.
- When any of the following operations is performed, the audio unit illuminates the LED lights in eight patterns while changing the brightness of the LED lights.
  — Turning the ignition switch to the ACC or LOCK position with the audio unit on
  — Turning the audio unit on or off
  — Pressing the TRACK/SEEK button (up)/(down)
  — Pressing the SCAN button
  — Registration using the preset buttons
  — Pressing the CD button
  — Volume adjustment
  — Pressing/releasing the Fast-forward button
  — Pressing/releasing the Rewind button
  — Pressing the SAT button

ACTION ILLUMINATION STRUCTURAL VIEW

id092000108100



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SPEAKER CONSTRUCTION

id092000107900

Front Door Speaker

- Located in the front door trim.

Rear Door Speaker

- Located in the rear door trim.

Tweeter (without Bose®)

- Tweeters (speaker for high sound) are installed the upper part of the dashboard, providing wide-range sound.

Front Speaker (with Bose®)

- The front speakers (speakers for middle and upper register sound range) have been installed to the upper part of the dashboard, improving the sound quality and output.

Rear Speaker (with Bose®)

- The rear speakers (speakers for middle and upper register sound range) have been installed to the D-pillar, improving the sound quality and output.

Center Speaker (with Bose®)

- The center speaker (speaker for middle and upper register sound range) has been installed to the center of the dashboard, improving the sound quality and output.

Roof Speaker (with RES)

- The roof speaker (speaker for middle and upper register sound range) has been installed to the center of the top ceiling, improving the sound quality and output.

Bass-box (with Bose®)

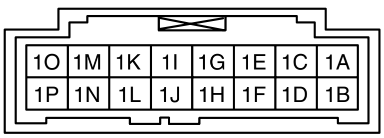
- A Bose® Bass-box producing rich, deep bass sounds has been adopted and is installed next to the spare tire storage area.

AUDIO AMPLIFIER CONSTRUCTION

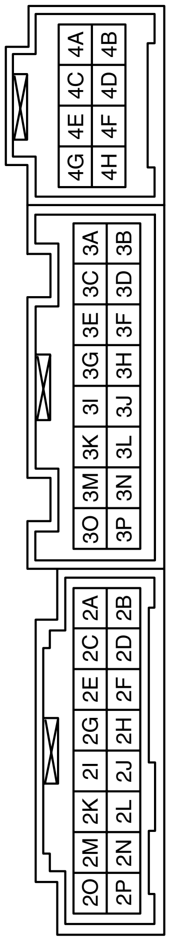
id092000819300

- Positioned under the trunk side trim (RH).
- Converts music signals (analog voltage waveform) from the audio unit to digital signals, then amplifies and outputs them.

Terminal Layout and Signal



Terminal	Signal
1A	—
1B	PHONE input (-)
1C	—
1D	PHONE input (+)
1E	DVD LFE CH6 input (-)
1F	DVD C CH5 input (-)
1G	DVD LFE CH6 input (+)
1H	DVD C CH5 input (+)
1I	DVD SR CH4 input (-)
1J	DVD SL CH3 input (-)
1K	DVD SR CH4 input (+)
1L	DVD SL CH3 input (+)
1M	DVD R CH2 input (-)
1N	DVD L CH1 input (-)
1O	DVD R CH2 input (+)
1P	DVD L CH1 input (+)



Terminal	Signal
2A	—
2B	NAVI INT
2C	VNC SHIELD
2D	—
2E	AudioPilot MIC input (-)
2F	AudioPilot MIC input (+)
2G	NAVI input (-)
2H	NAVI input (+)
2I	R CH2 input (-)
2J	L CH1 input (-)
2K	R CH2 input (+)
2L	L CH1 input (+)
2M	—
2N	SW B+
2O	—
2P	—
3A	Front speaker output LH (-) (CH7-)
3B	Front speaker output LH (+) (CH7+)
3C	Rear door speaker output RH (+) (CH4+)
3D	Front speaker output RH (+) (CH8+)
3E	Rear door speaker output RH (-) (CH4-)
3F	Front speaker output RH (-) (CH8-)
3G	Rear door speaker output LH (-) (CH3-)
3H	Center speaker output (+) (CH9+)
3I	Rear door speaker output LH (+) (CH3+)
3J	Center speaker output (-) (CH9-)
3K	Front door speaker output RH (+) (CH2+)
3L	Front door speaker output LH (+) (CH1+)
3M	Front door speaker output RH (-) (CH2-)
3N	Front door speaker output LH (-) (CH1-)
3O	CAN H
3P	CAN L
4A	B+
4B	GND
4C	Rear speaker output RH (-) (CH6-)
4D	Rear speaker output RH (+) (CH6+)
4E	Rear speaker output (-) (CH5-)
4F	Roof speaker output (-) (CH10-)
4G	Rear speaker output (+) (CH5+)
4H	Roof speaker output (+) (CH10+)

AUDIO AMPLIFIER FUNCTION

id092000819200

- The 5.1-channel surround audio source output from the RES unit is distributed among each speaker and bass-box to output realistic sounding audio. Due to this, the acoustic experience of a live theater can be reproduced faithfully.

Centerpoint Function

- The 2-channel (left and right) audio signals are converted to simulated 5-channel in the audio amplifier and output to each speaker. Due to this, surround sound can be enjoyed with the source from a 2-channel recorded CD.

5.1ch Discrete Surround Sound (Front Seat-optimized And Rear Seat-optimized Modes)

- Balanced surround sound can be enjoyed anywhere in the vehicle by selecting front seat-optimized or rear seat-optimized modes.

ANTENNA CONSTRUCTION

id092000103200

Glass Antenna

- A glass antenna with high noise resistance has been adopted inside the rear window glass.

AUDIO CONTROL SWITCH OUTLINE

id092000100500

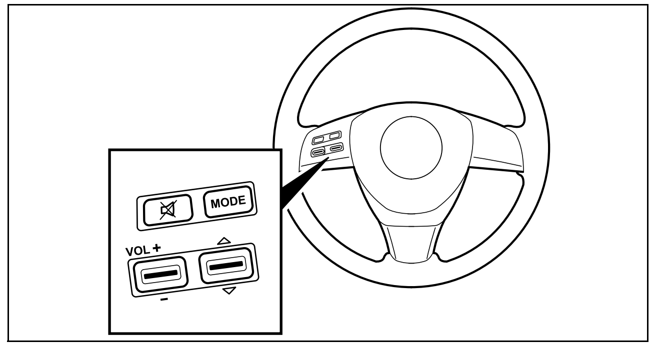
- A remote control for the audio system, with simplified design for easy operation, has been adopted.

AUDIO CONTROL SWITCH CONSTRUCTION/OPERATION

id092000100600

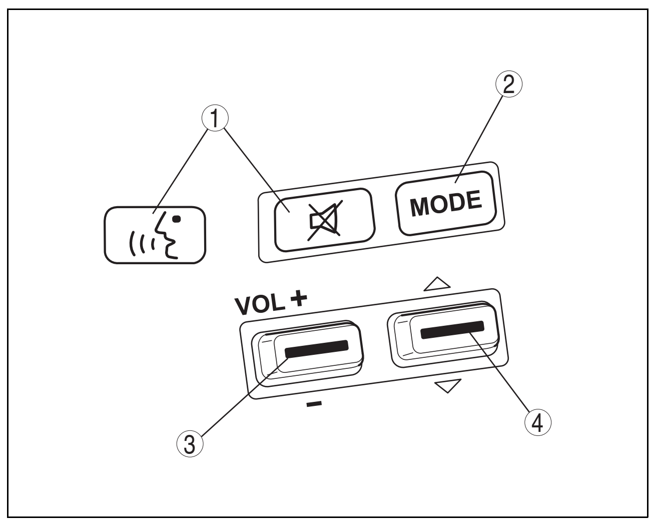
Construction

- The audio control switch is located on the steering wheel.



ampjjn00000337

Operation



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No.	Button (component)	Function
1	Mute button	Mute
	Voice recognition switch	Voice recognition function ON/OFF (with car-navigation system)
2	Mode button	Selects the audio mode (FM1→FM2→AM→CD→MD→SAT1→SAT2→SAT3→RSE→AUX)*
3	Volume switch	Volume up/down
4	SEEK switch	Selects radio stations

* : It is only switched to the mode which has been connected.

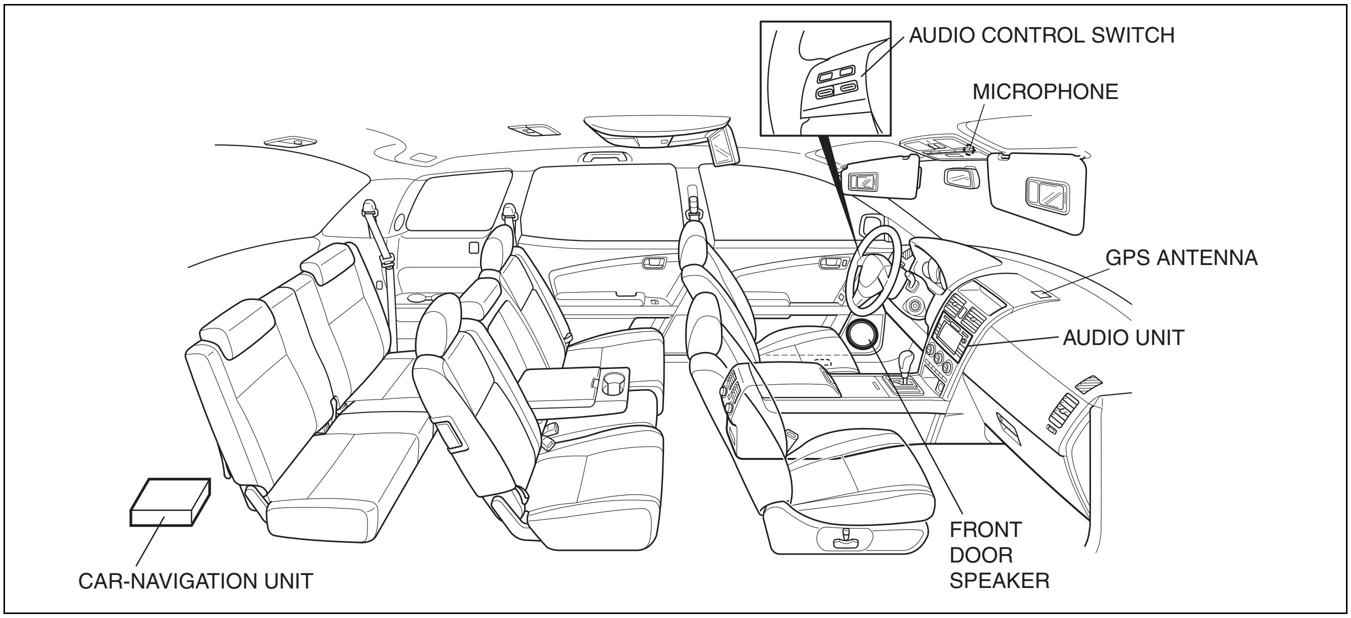
CAR-NAVIGATION SYSTEM OUTLINE

id092000100800

- A touch panel has been adopted to the car-navigation system that can be operated by touching the on-screen buttons.
- 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.
- The languages and voices available for use with the car-navigation unit include English, French, Spanish. However, the language used in this manual is in **English only.**

CAR-NAVIGATION SYSTEM STRUCTURAL VIEW

id092000100900



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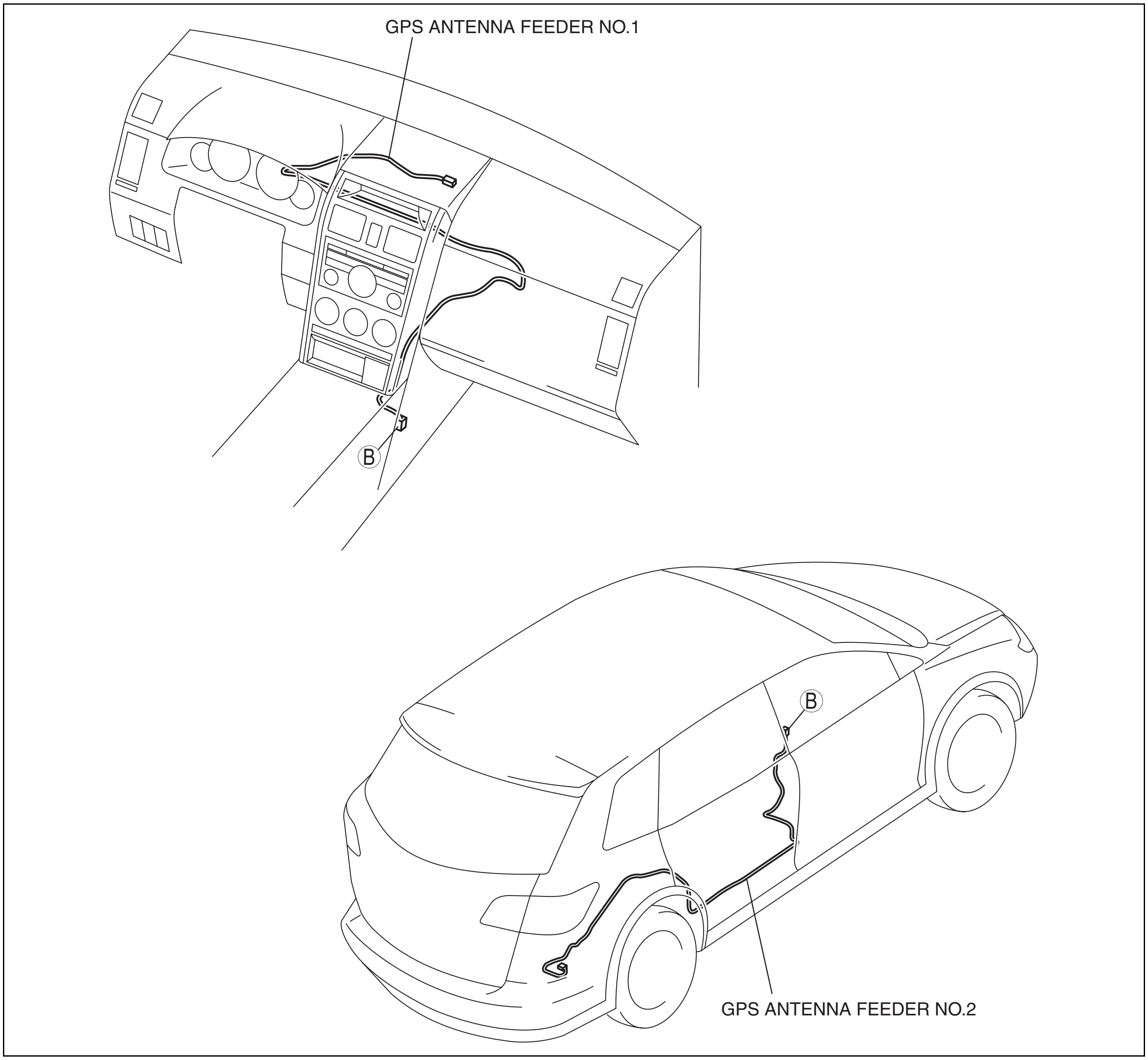

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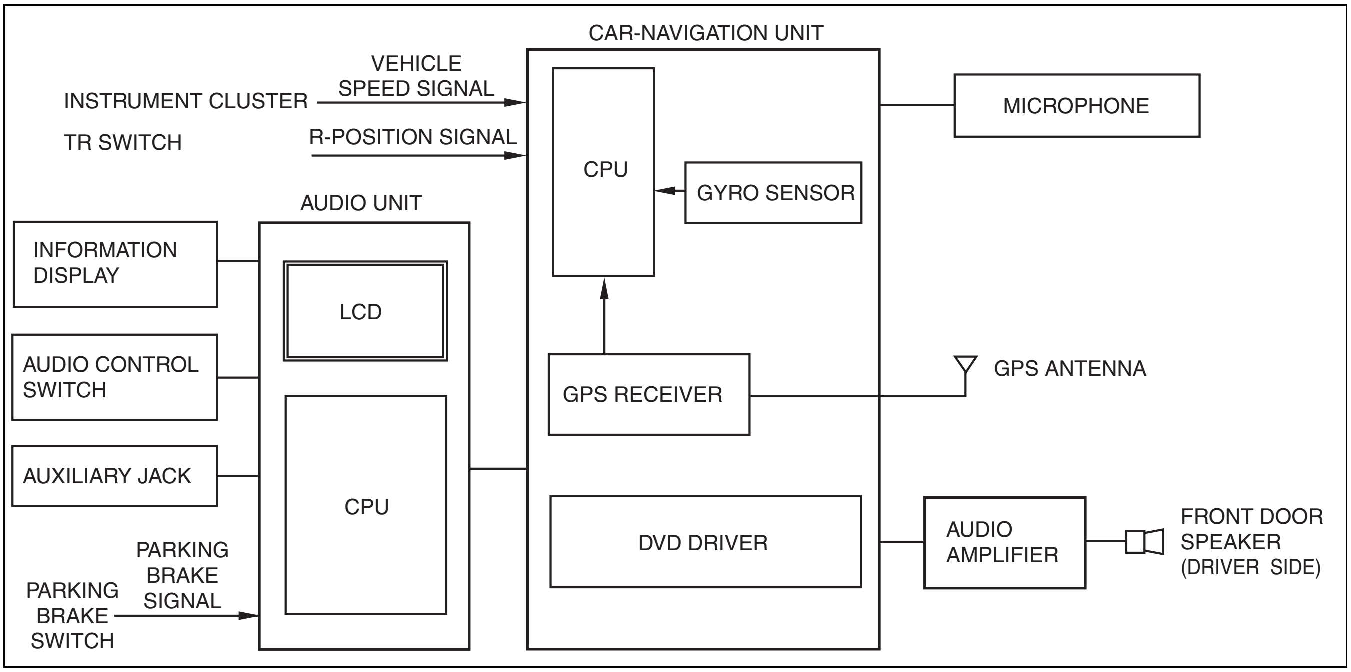
CAR-NAVIGATION SYSTEM BLOCK DIAGRAM

id092000101000



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CAR-NAVIGATION SYSTEM SPECIFICATIONS

id092000101100

Car-navigation Unit

Item	Specification
Unit type	Stand alone
Rated voltage (V)	12
ROM type	DVD-ROM
Voice guidance output power (W)	5

Audio Unit

Item		Specification
Unit type		Fixed
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 09-20-6 AUDIO SYSTEM SPECIFICATIONS.)

COMPONENT PART AND FUNCTION

id092000101200

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.
Audio unit (Touch panel type)	• Displays the screen (menus, maps and other screens) by touch 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	• 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 (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

NAVIGATION FUNCTION

id092000101300

Outline

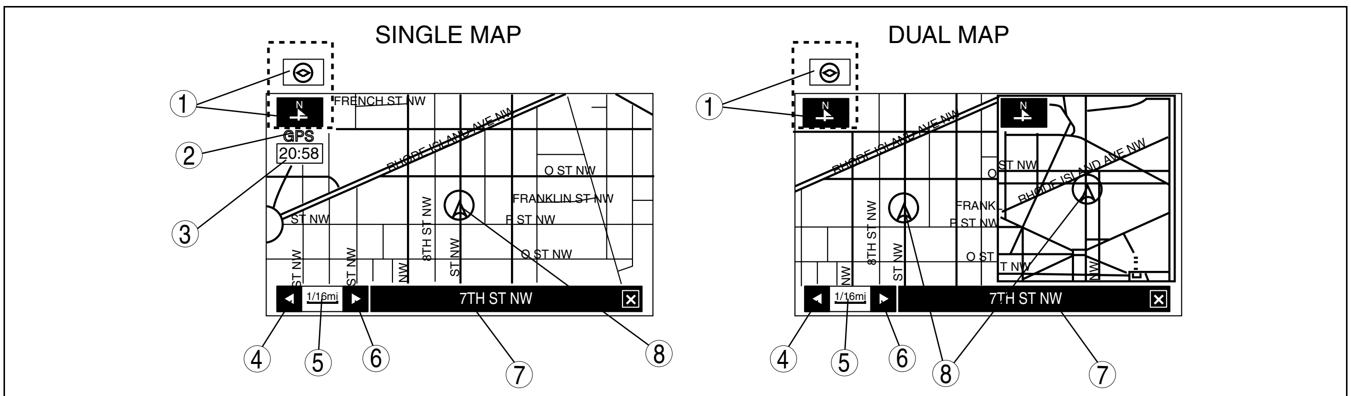
- A vehicle's position is measured by a hybrid method of autonomous navigation (using yaw-rate signals from the gyro sensor and vehicle speed signals from the instrument cluster) and GPS navigation (using signals from GPS satellites). Accurate detection of the vehicle's position is possible based on 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), emergency, memory point, home, preset destination, intersection, freeway on/off ramp, coordinates, map or previous destination.
  — Route information is available in map, turn list, turn arrow, enlarged junction diagram, freeway information mode.
  — Voice guidance and menus are available in three 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 (info) 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

09-20

Map Screen Selection

Current position map

- The location of the vehicle and surrounding area are shown.



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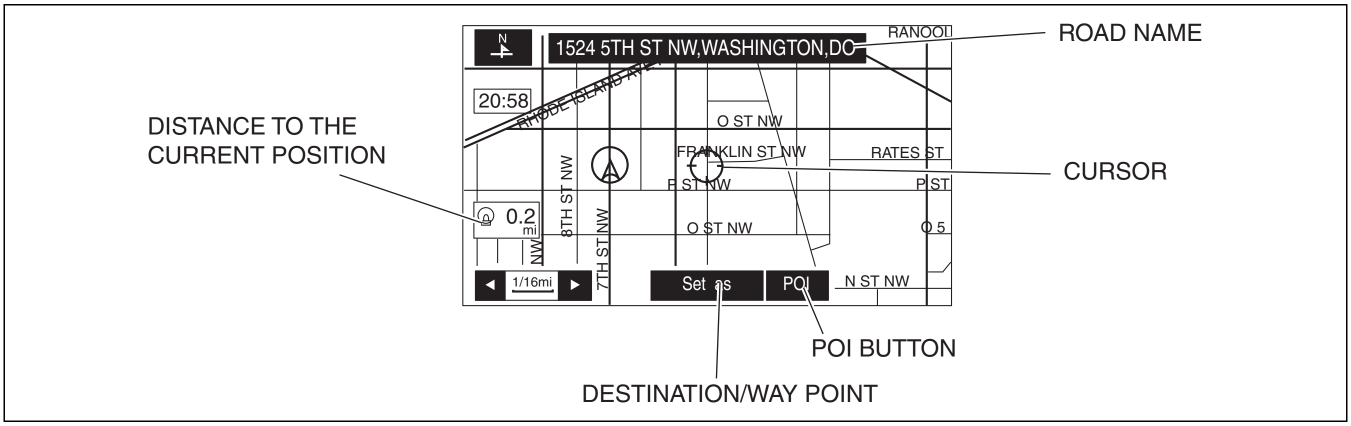
No.	Contents	Description
1	Map orientation	**North up** • Geographic north is up. **Head up** • The direction you are heading is up.
2	GPS reception indicator	Illuminates when receiving signals from 3 or more satellites.
3	Clock	Clock will be displayed when you set up clock on navigation set up on.
4	Zoom in button	Enlarges the map. (more detail)
5	Map scale	The map can be displayed in 13 steps with scale from 50 m to 256 km {1/32 mile to 128 mile}
6	Zoom out button	Reduces the map.
7	Road name	Shows the name of the road you are currently driving on.
8	Vehicle position	Shows the current position and direction of the vehicle.

Scroll map mode

- This map can be scrolled with the cursor.



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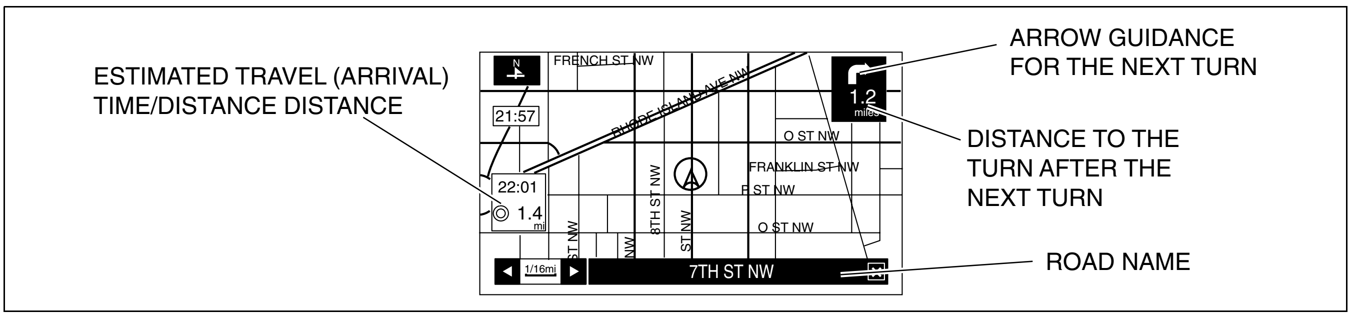
Guide mode

- 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.)



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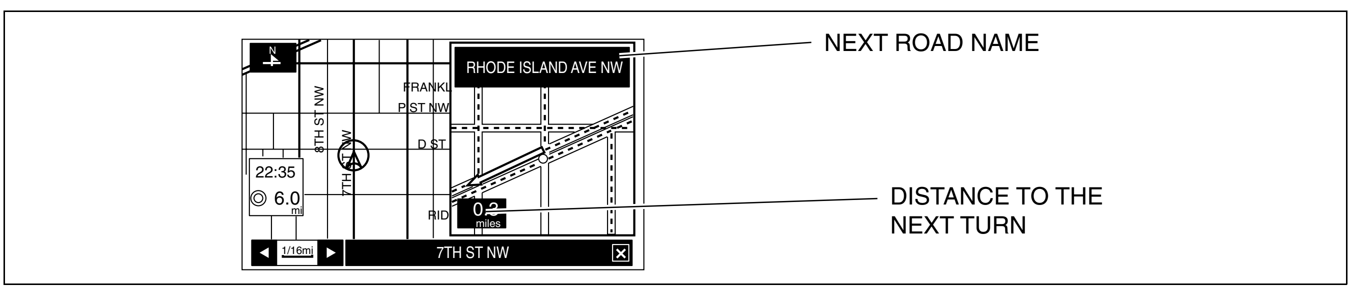
Intersection zoom map

- An enlarged map is displayed when approaching a fork or intersection. (While in route guidance.) Activated by selecting Guidance Screen (On) in setup mode.



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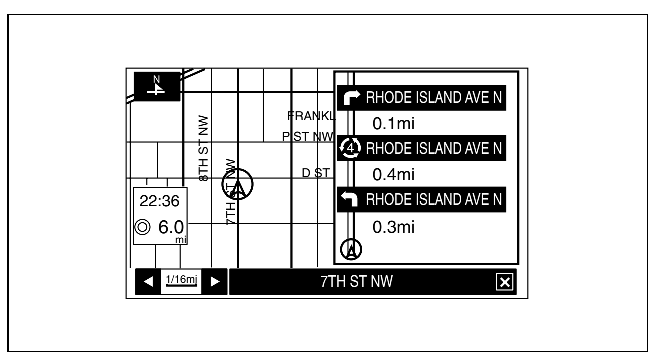
Turn list

- While using route guidance, the directions for the next intersection where you have to turn are shown as turn list.



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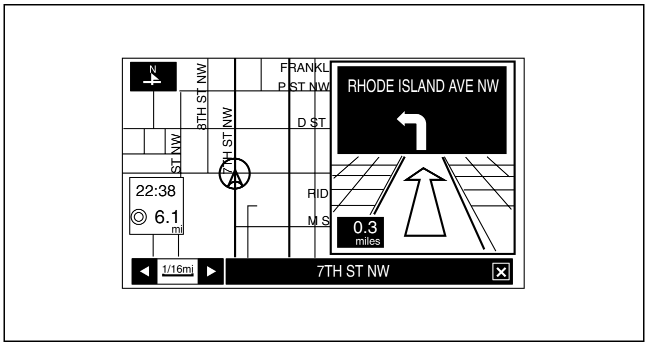
Turn arrow

- While using route guidance, the directions for the next intersection where you have to turn are shown as turn arrow.



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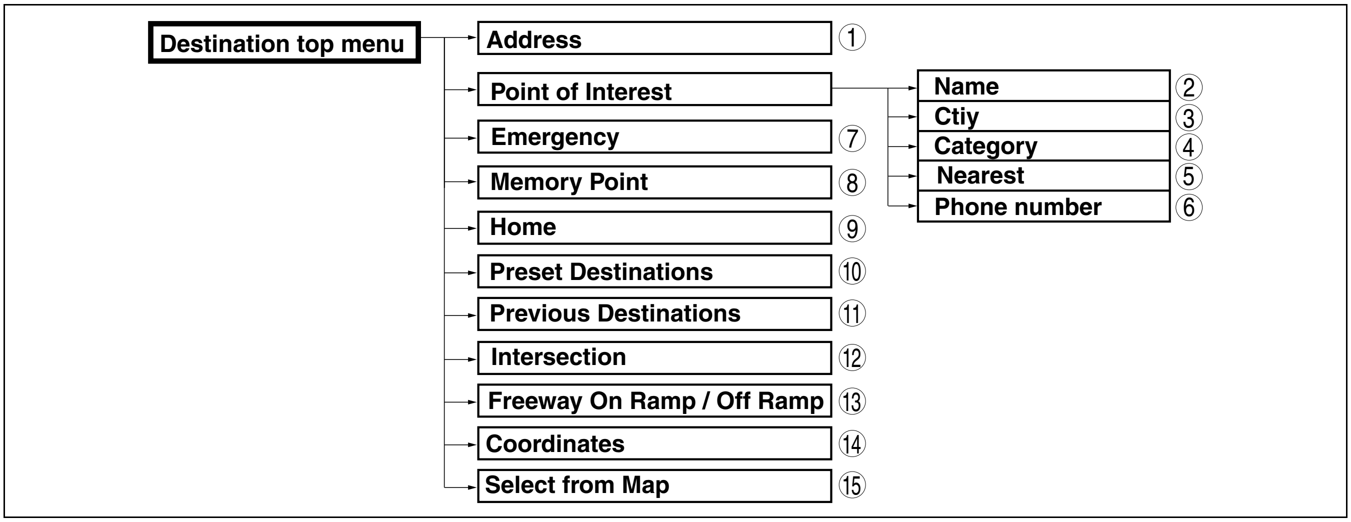
Destination Setting Function

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.



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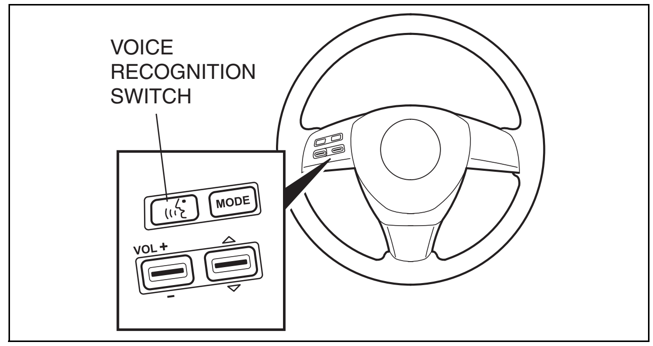
No.	Contents
1	Sets destination by inputting address.
2	Sets destination by inputting POI name.
3	Sets destination by selecting POI city, inputting city name and selecting POI.
4	Sets destination by selecting POI category, inputting target name and selecting POI.
5	Sets destination by inputting POI nearest facility.
6	Sets destination by selecting POI phone number, inputting phone number and selecting POI.
7	• Sets destination from a list of police station or hospital. (When stopped) • Sets destination to the nearest police station or hospital automatically. (When driving)
8	Sets destination from a list of points stored by the user.
9	Sets destination to home.
10	Sets destination to preset destination point.
11	Sets destination from a list of recent destinations.
12	Sets destination by selecting intersection name.
13	Sets destination by selecting Freeway On Ramp / Off Ramp.
14	Sets destination by inputting coordinates.
15	Sets destination by moving the crosshair cursor to the destination when in scroll map mode.

Voice Recognition Function

- Voice control can be carried out by simply pressing voice recognition switch and speaking voice command into the microphone.



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CAR-NAVIGATION UNIT OUTLINE

id092000102200

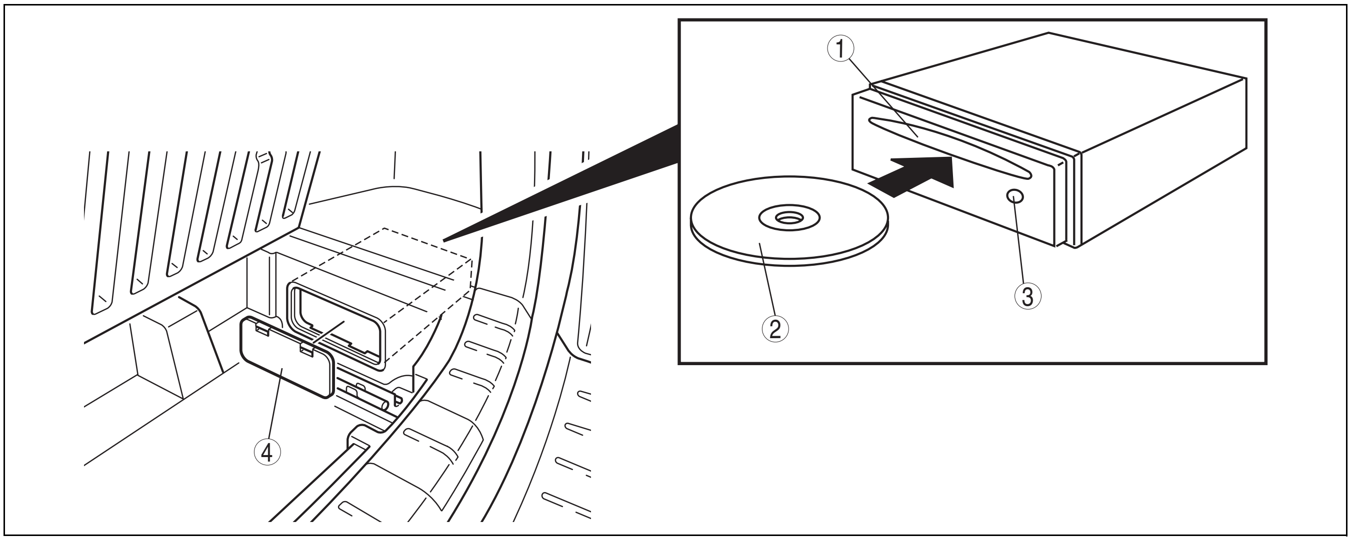
- Using exterior signal input and DVD-ROM information, this unit detects vehicle position, provides destination route guidance, and displays color maps.

CAR-NAVIGATION UNIT CONSTRUCTION

id092000102300

Structure

- The car-navigation unit is located on the right side of the trunk box under the trunk board.
- 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.



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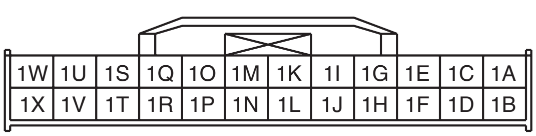
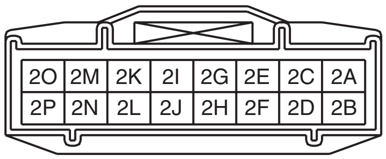
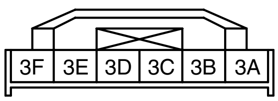
1	DVD-ROM loading slot		3	Eject button
2	DVD-ROM		4	Cover

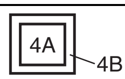
Terminal Layout and Signals



Terminal		Signals: 24-pin connector
	1A	–
	1B	–
	1C	–
	1D	–
	1E	–
	1F	–
	1G	–
	1H	–
	1I	–
	1J	–
	1K	–
	1L	–
	1M	–
	1N	Monitor serial input
	1O	Shield GND
	1P	Monitor serial input 2
	1Q	Shield GND
	1R	Video (composit sync)
	1S	–
	1T	Video (B)
	1U	Video GND
	1V	Video (G)
	1W	–
	1X	Video (R)

Terminal		Signals
		16-pin connector
	2A	GND
	2B	B+
	2C	–
	2D	ACC
	2E	PRF SP IN (-)
	2F	MUTE
	2G	PRF SP IN (+)
	2H	Vehicle speed
	2I	PRF SP OUT (-)
	2J	–
	2K	PRF SP OUT (+)
	2L	R-range
	2M	Front speaker output (-)
	2N	Front speaker output (+)
	2O	Front speaker input (-)
	2P	Front speaker input (+)

Terminal		Signals
		6-pin connector
	3A	MIC+
	3B	MIC-
	3C	MIC B+
	3D	GND
	3E	MIC SENSE
	3F	–

Terminal		Signal
		1-pin connector
	4A	GPS antenna input
	4B	GND

AUTONOMOUS NAVIGATION OPERATION

id092000102400

- 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

id092000102500

- 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

id092000102600

- 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

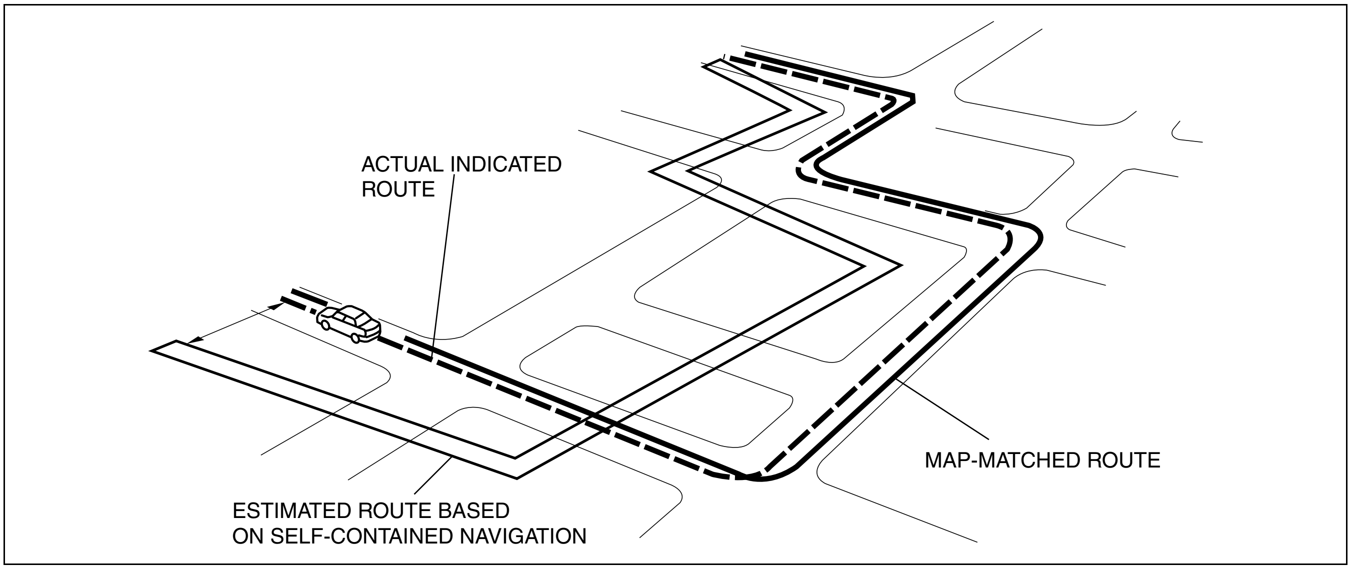
id092000102700

- 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

id092000102800

- 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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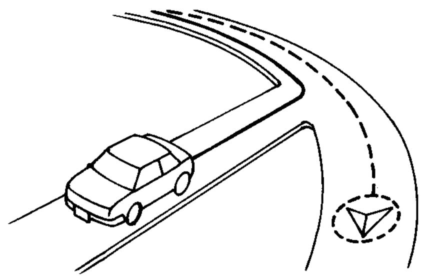
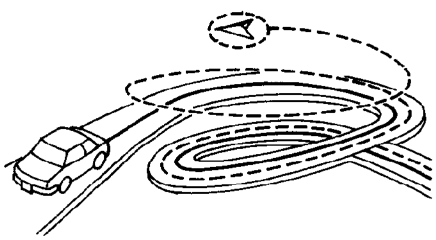
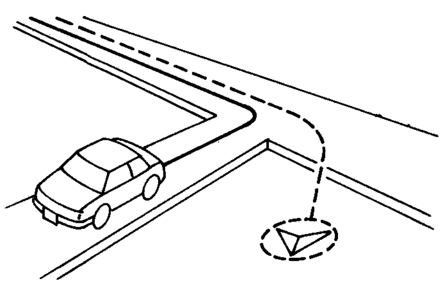
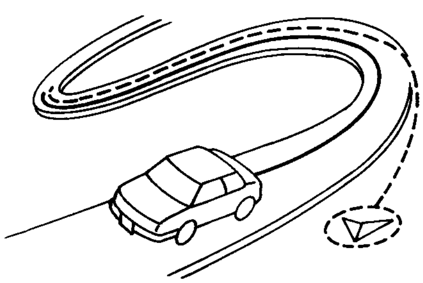
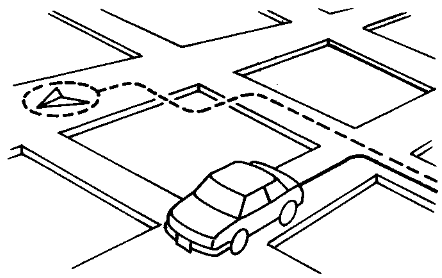
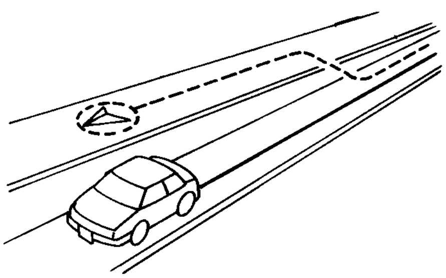
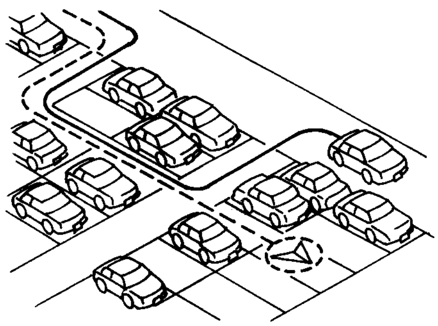
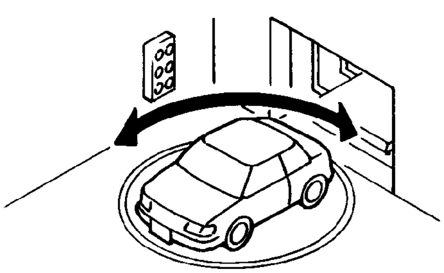
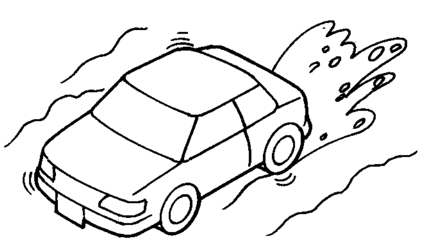
MAP MATCHING OPERATION

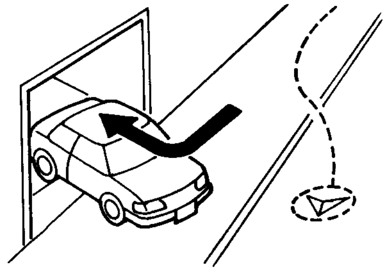
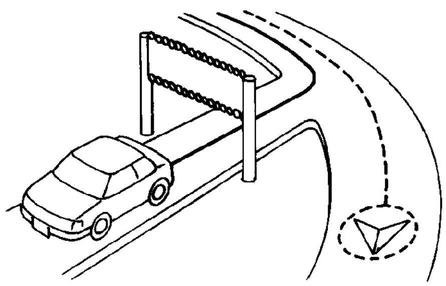
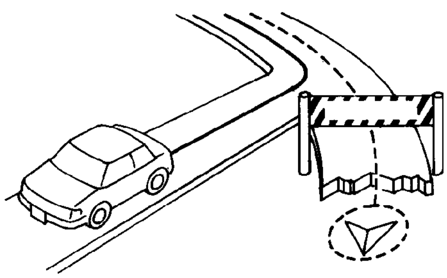
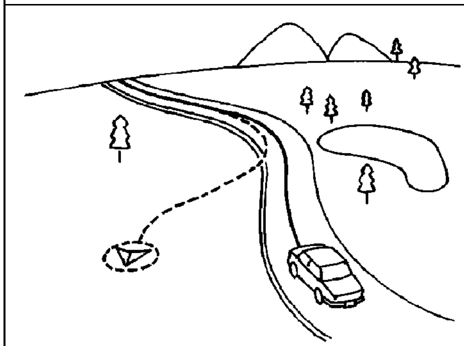
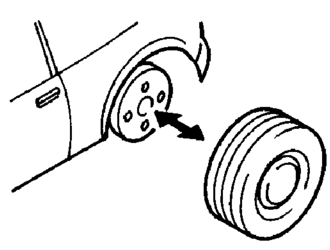
id092000102900

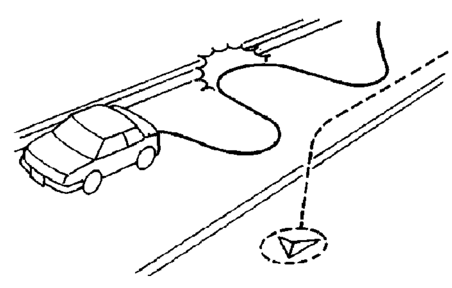
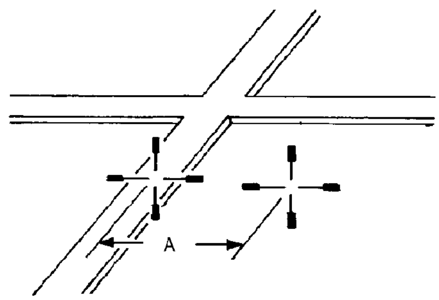
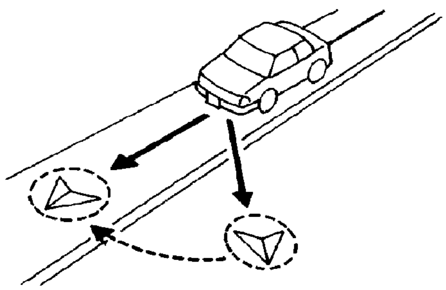
Map Matching Remarks

- 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.
	• 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.

Cause (Condition)	Driving condition
	• 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.
	• 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.

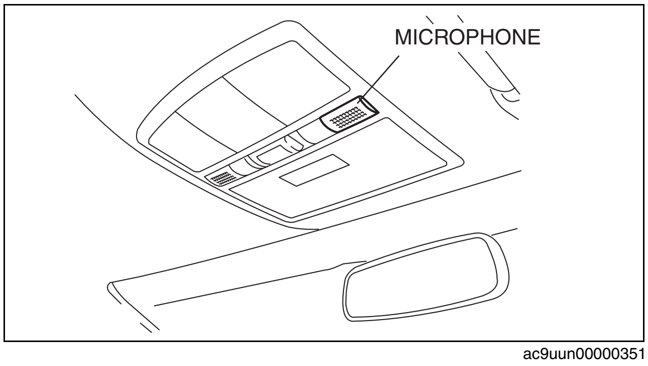
Cause (Condition)	Driving condition
	• If the vehicle turns on an embankment; for example, at a parking garage entrance, on slope or banked roads, the vehicle locator mark may go off the road.
	• If driving on a new road not registered in the map data, the navigation system may incorrectly match the 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.
	• 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.

Cause (Condition)	Driving condition
	• 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.

MICROPHONE CONSTRUCTION/OPERATION

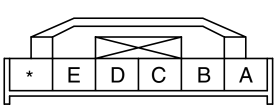
id092000100700

- Located in the map light.
- Recognize the voice entry.



ac9uun00000351

Terminal Layout and Signals

Terminal		Signals
		6-pin connector
	A	Mic (+)
	B	Mic (-)
	C	Mic power
	D	GND
	E	Mic sense
	F	–

REAR VIEW MONITOR OUTLINE

id092000104500

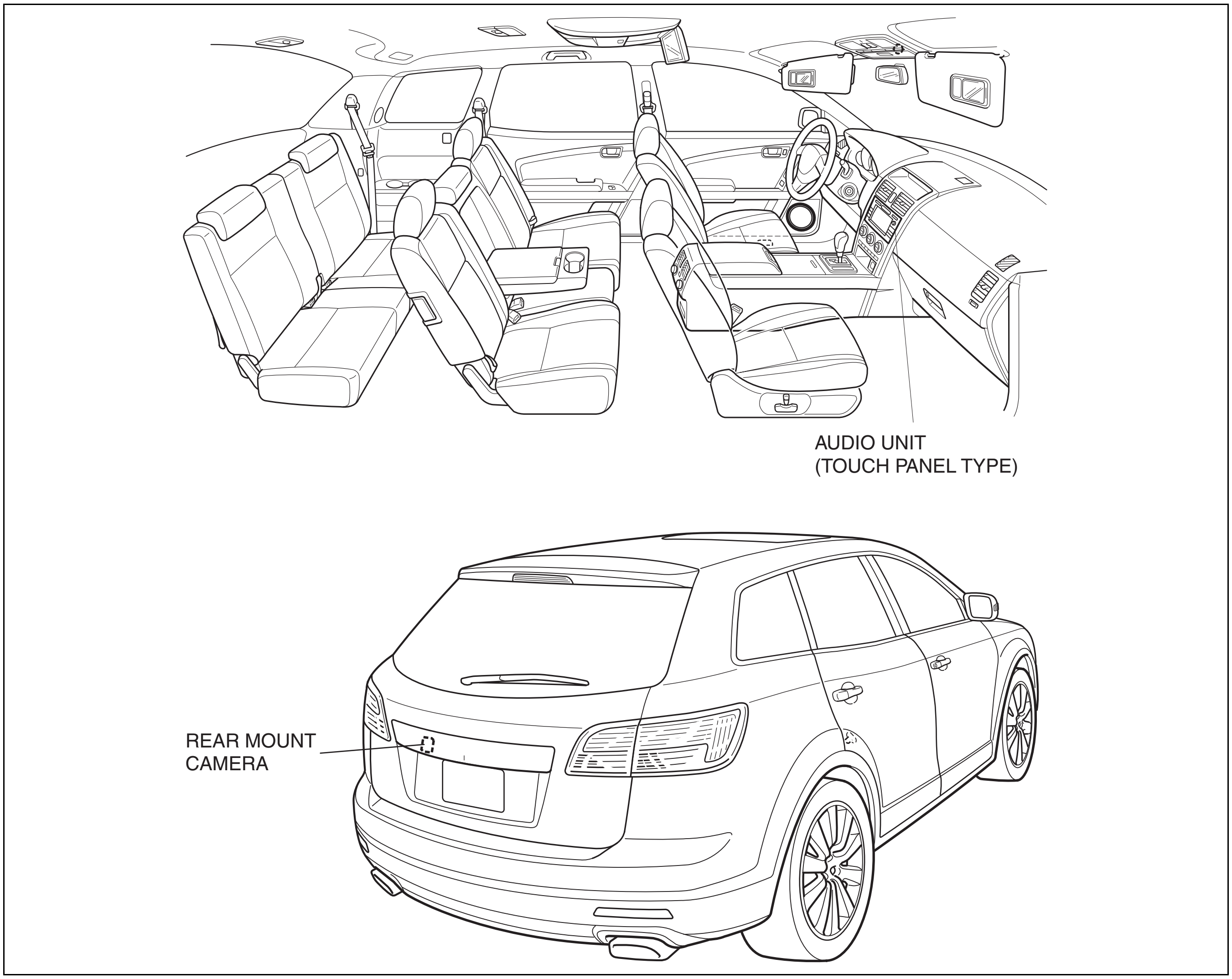
- The rear view monitor is a visual assist system when reversing the vehicle.

Caution

- **The rear view monitor is only a visual assist device when reversing the vehicle. The images on the screen may be different from the actual conditions. Always drive carefully confirming the safety of the rear and surrounding conditions by looking directly with your eyes.**
  Reversing the vehicle by only looking at the screen may cause an accident or collision with an object.

REAR VIEW MONITOR STRUCTURAL VIEW

id092000104600



ac9uun00000309

REAR MOUNT CAMERA FUNCTION

id092000109900

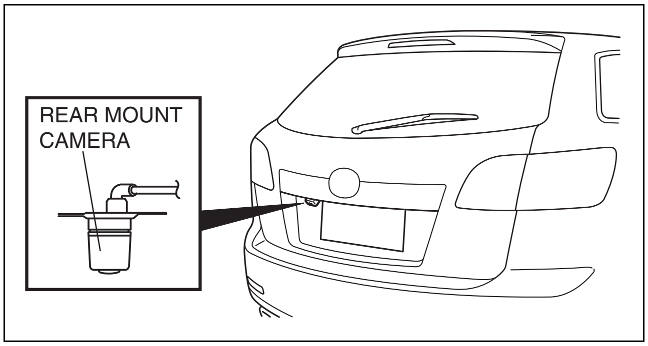
- The rear mount camera shoots color pictures of the rear condition of the vehicle and outputs the image signal to the audio unit (Touch panel type).

REAR MOUNT CAMERA CONSTRUCTION/OPERATION

id092000109800

- The rear mount camera is located in the liftgate.
- Super wide angle lens that can shoot a broad spectrum has been combined with a small (1/4 in.) color CCD*1 camera which has a high-sensitivity CCD image element.

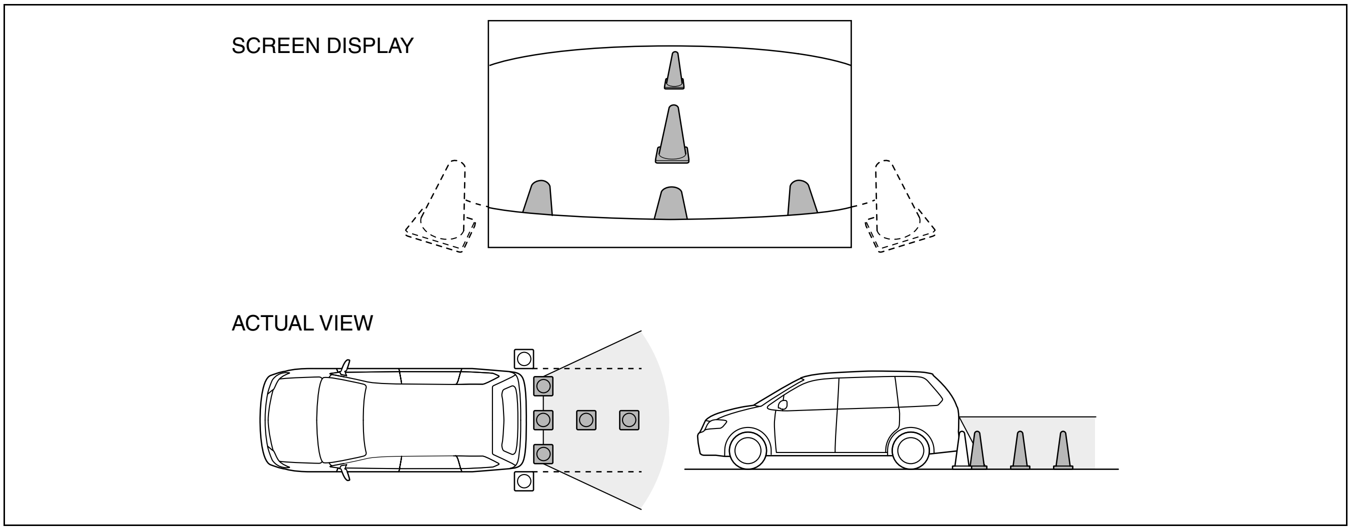
*1 : Charge Coupled Device



ac9uun00000433

Displayable Range

- The displayable range varies depending on the vehicle and road conditions.
- The displayable range is limited. Objects under the bumper or around the bumper ends cannot be displayed.
- The distance appearing in the displayed image is different from the actual distance because the rear mount camera is equipped with a specific lens.



acxuun00000358

- It may be difficult to see the display under the following conditions; however, it does not indicate a malfunction:
  — In darkened areas.
  — When the temperature around the lens is high/low.
  — When the camera is wet such as on a rainy day or during period of high humidity.
  — When foreign material such as mud is stuck around the camera.
  — When the camera lens reflects sunlight or headlight beams.
- If the camera picks up a high-intensity light such as sunlight reflected off the vehicle body, a bright belt (light line) may appear on the display (Smear phenomenon).

09-20

REAR ENTERTAINMENT SYSTEM (RES) OUTLINE

id092000808400

Outline

- The rear entertainment system (RES) has a 9.0-inch wide LCD, as well as DVD video, video CD, audio CD, and MP3 CD playback function.
- The RES is equipped with input terminals for video picture and audio sound, and AV equipment such as a video game player or a video camera can be connected and displayed on the LCD.
- Sound/music being played by the RES can be heard from the vehicle speakers.
- Audio output from the RES unit can be heard using the infrared cordless headphones provided with the vehicle.
- Operate the RES with the remote controller except for disc insertion/ejection.
- An audio amplifier has been adopted which supports 5.1ch audio source.

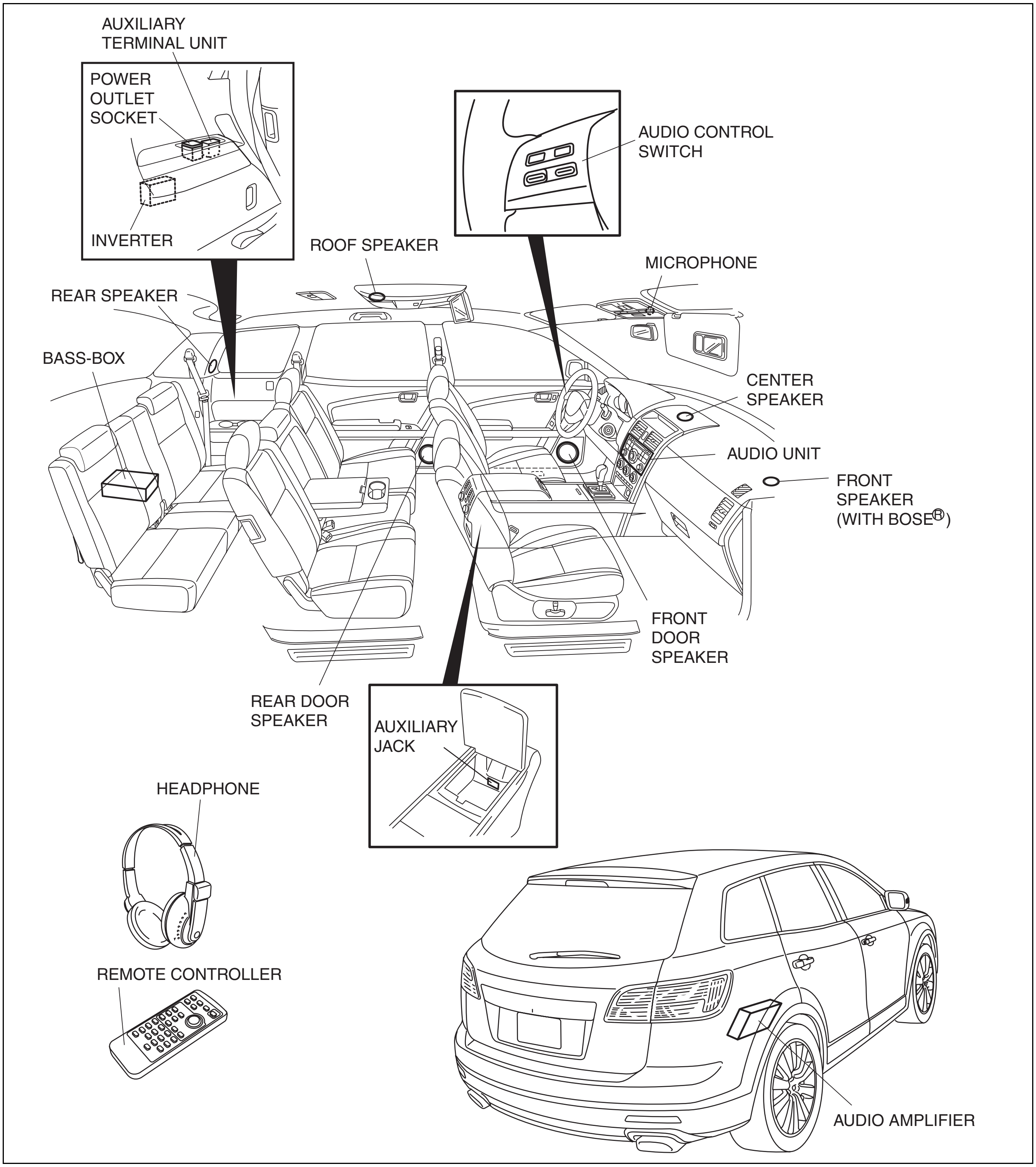
Specifications

RES unit

Item		Specification
Rated voltage (V)		12
Display	Size (inch)	9
	Type	TFT (Thin Film Transistor); Full-color

REAR ENTERTAINMENT SYSTEM (RES) STRUCTURAL VIEW

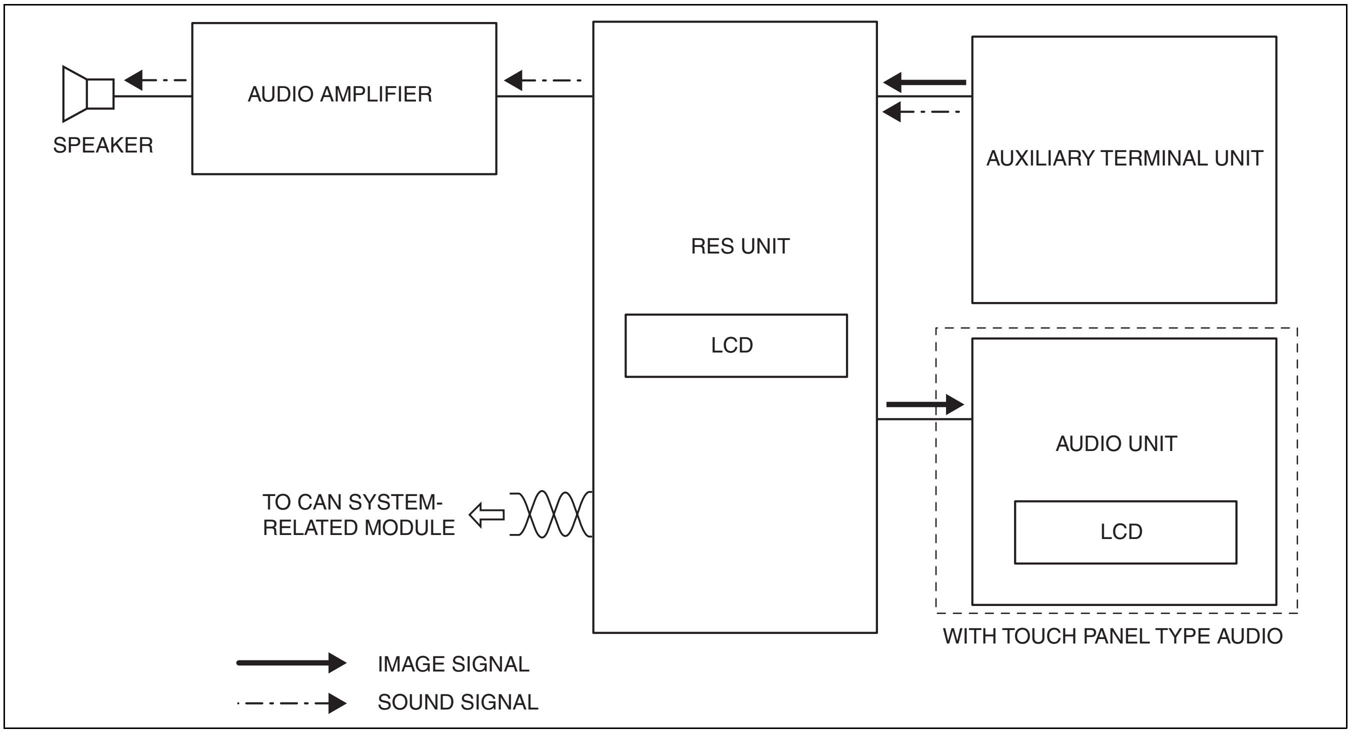
id092000808500



ac9uun00000356

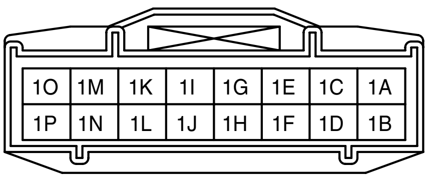
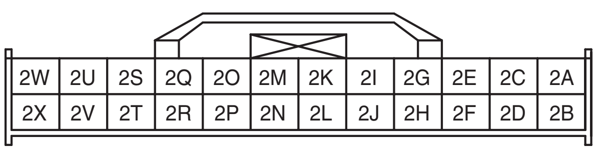
REAR ENTERTAINMENT SYSTEM (RES) BLOCK DIAGRAM

id092000808600



ac9uun00000499

Terminal Layout and Signal
RES unit

<table>
<tr><th colspan="2">Terminal</th><th>Signal</th></tr>
<tr><td rowspan="16"></td><td>1A</td><td>+B</td></tr>
<tr><td>1B</td><td>—</td></tr>
<tr><td>1C</td><td>ACC</td></tr>
<tr><td>1D</td><td>—</td></tr>
<tr><td>1E</td><td>TNS</td></tr>
<tr><td>1F</td><td>—</td></tr>
<tr><td>1G</td><td>CAN (-)</td></tr>
<tr><td>1H</td><td>—</td></tr>
<tr><td>1I</td><td>CAN (+)</td></tr>
<tr><td>1J</td><td>—</td></tr>
<tr><td>1K</td><td>—</td></tr>
<tr><td>1L</td><td>—</td></tr>
<tr><td>1M</td><td>—</td></tr>
<tr><td>1N</td><td>—</td></tr>
<tr><td>1O</td><td>—</td></tr>
<tr><td>1P</td><td>GND</td></tr>
<tr><td rowspan="24"></td><td>2A</td><td>Audio output FL (+)</td></tr>
<tr><td>2B</td><td>GND</td></tr>
<tr><td>2C</td><td>Audio output FL (-)</td></tr>
<tr><td>2D</td><td>Video input from AUX</td></tr>
<tr><td>2E</td><td>Audio output FR (+)</td></tr>
<tr><td>2F</td><td>Video input GND</td></tr>
<tr><td>2G</td><td>Audio output FR (-)</td></tr>
<tr><td>2H</td><td>Audio input Lch</td></tr>
<tr><td>2I</td><td>Audio output RL (+)</td></tr>
<tr><td>2J</td><td>Audio input Rch</td></tr>
<tr><td>2K</td><td>Audio output RL (-)</td></tr>
<tr><td>2L</td><td>Audio GND</td></tr>
<tr><td>2M</td><td>Audio output RR (+)</td></tr>
<tr><td>2N</td><td>—</td></tr>
<tr><td>2O</td><td>Audio output RR (-)</td></tr>
<tr><td>2P</td><td>—</td></tr>
<tr><td>2Q</td><td>Audio output C (+)</td></tr>
<tr><td>2R</td><td>—</td></tr>
<tr><td>2S</td><td>Audio output C (-)</td></tr>
<tr><td>2T</td><td>—</td></tr>
<tr><td>2U</td><td>Audio output SW (+)</td></tr>
<tr><td>2V</td><td>—</td></tr>
<tr><td>2W</td><td>Audio output SW (-)</td></tr>
<tr><td>2X</td><td>—</td></tr>
</table>

REAR ENTERTAINMENT SYSTEM (RES) FUNCTION

id092000808700

DVD/CD Play Function

- Following discs can be played.

  DVD video*1 and DVD audio*2

  — 12 cm {5 in} or 8 cm {3 in} size

  — NTSC*3 (National Television Standards Committee) recorded type

  — Region code must include “1” or “ALL”

  video CD, audio CD, CD-R, CD-RW, DVD-R, DVD-RW, dts CD

  — 12 cm {5 in} or 8 cm {3 in} size

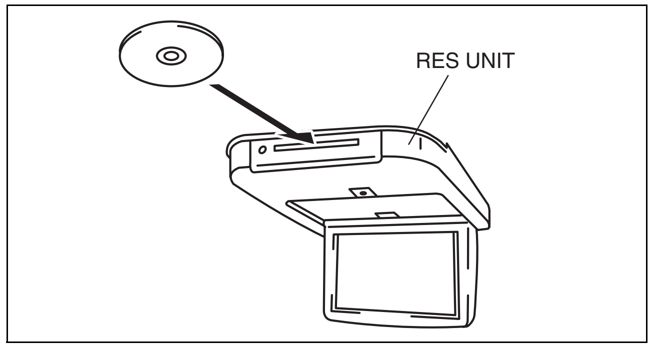
  — Playback control function supported

  — MP3 recorded type

*1 : Audio from the headphones is not produced when dts audio is selected.
*2 : Becomes stereo playback.
*3 : Short for National Television Standards Committee. The name of the committee which formulates specifications for terrestrial analog color television broadcasting.

Note

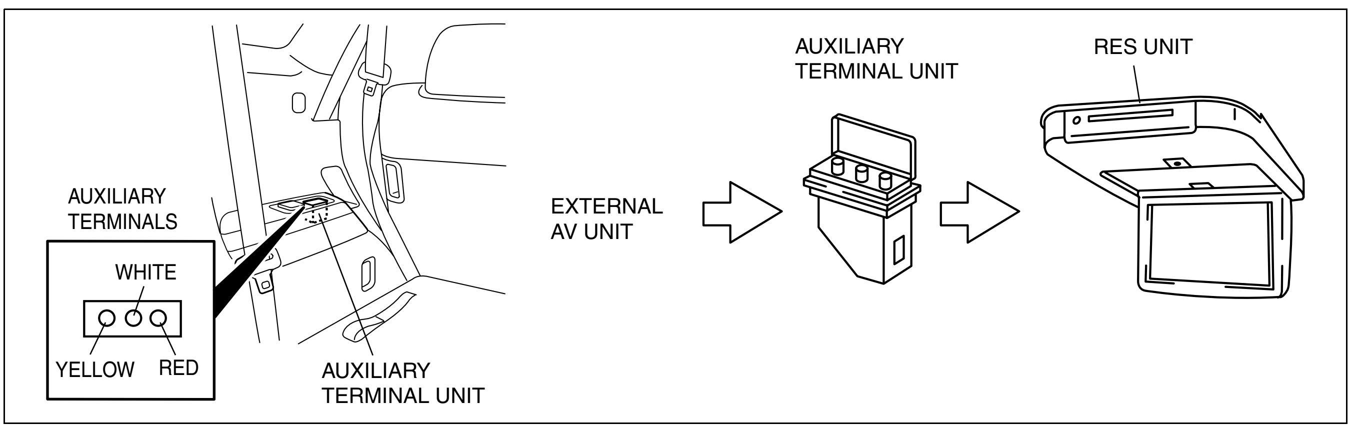
- Following discs cannot be played.
  - — Discs not including “1” or “ALL” in region code.
  - — Discs recorded in the other than NTSC (e.g. PAL or SECAM).
  - — DVD-ROM/RAM, DVD+RW, CD-ROM, CDV, CD-G, CVD, VSD, SVCD, SACD, photo CD, HD DVD, Blu-ray Disc, non-conventional discs (e.g. heart-shaped), and partially transparent.
- Discs recorded in CD-TEXT.



ac9uun00000401

Auxiliary Input Function

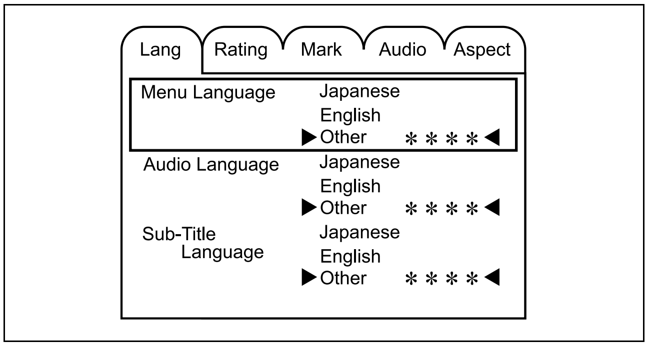
- In AUX mode, AV equipment such as a video game player or a video camera can be used be connecting the image and sound leads to auxiliary terminals.



ac9uun00000402

Initial Setting Function

- Following items can be set in the initial setting mode.
  — Lang: Sound and subtitle setting
  — Rating: Parental lock setting
  — Mark: On-screen mark, angle mark and mode priority setting
  — Audio: Audio DRC setting
  — Aspect: Not available



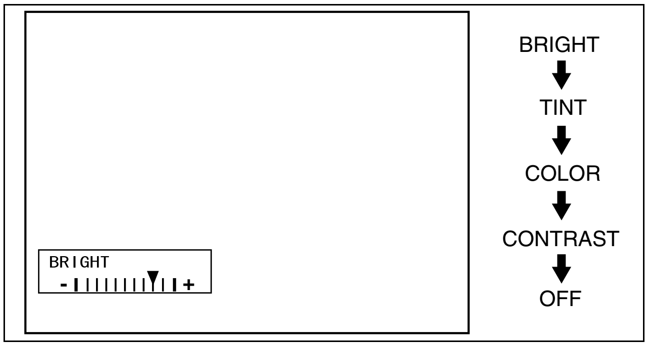
ac9uun00000256

Picture Adjustment Function

- Following items can be set in the picture adjustment mode.
  — BRIGHT: Brightness
  — TINT: Color shade
  — COLOR: Color density
  — CONTRAST: Contrast

Note

- If the picture adjustment mode is on and no operation has been done for approx. 5 s, the mode is cancelled automatically.

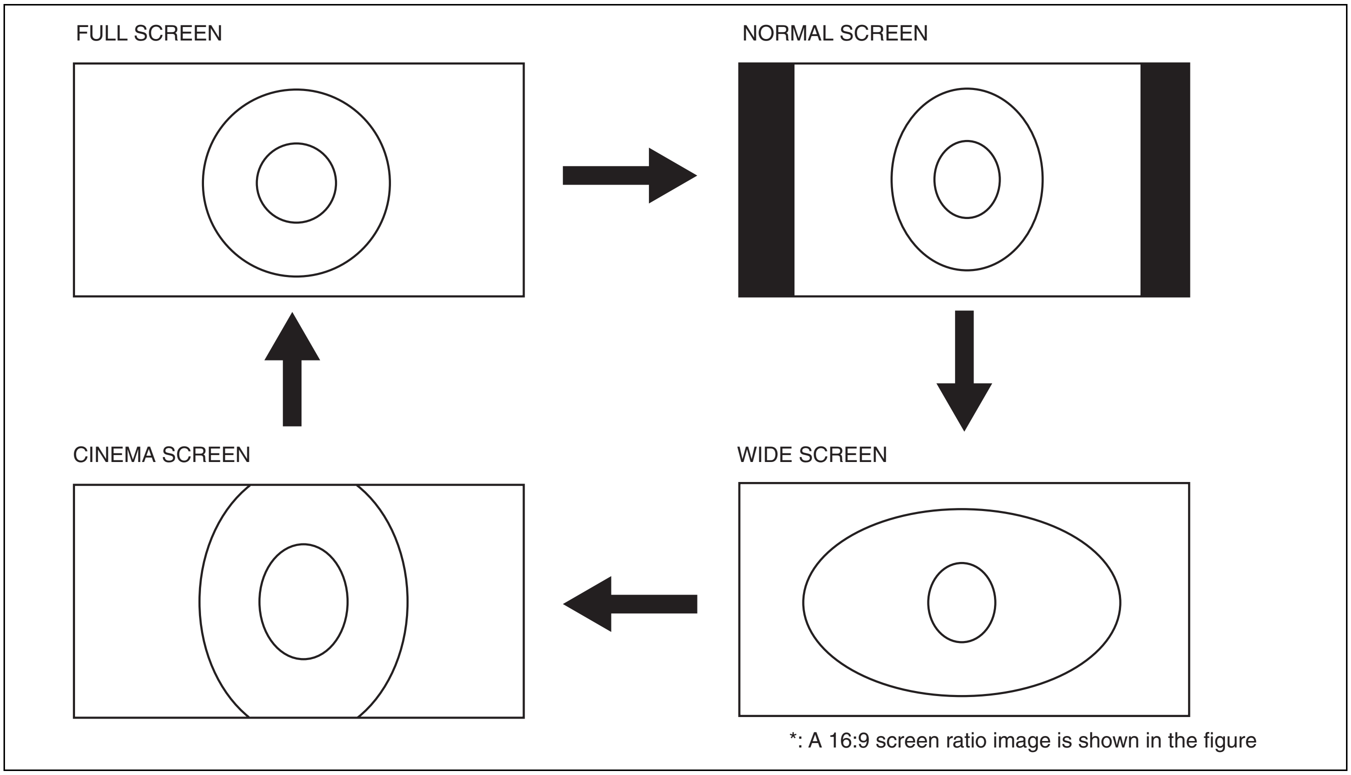


ampjjn00000249

09-20

Screen Size Setting Function

- The size of screen can be changed.
- The screen size changes in the order of Full Normal Wide Cinema each time the DISPLAY MODE button is pressed.



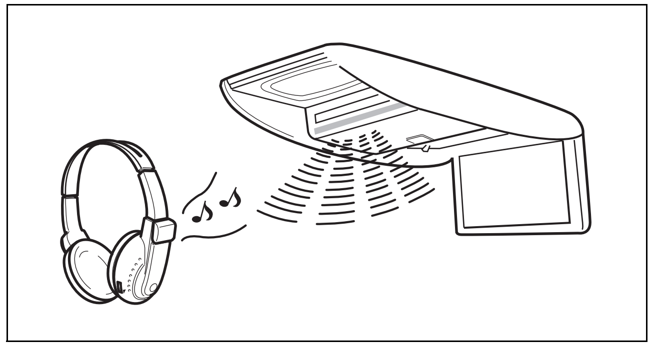
ac9uun00000318

Display Open/Close Detection Function

- If the display is closed while the power is on, it automatically turns off.

Wireless Sound Output Function

- The RES unit converts playback or externally input audio signals to infrared light and outputs them. As a result, audio output from the RES unit can be heard using the infrared cordless headphones provided with the vehicle.



ac9uun00000331

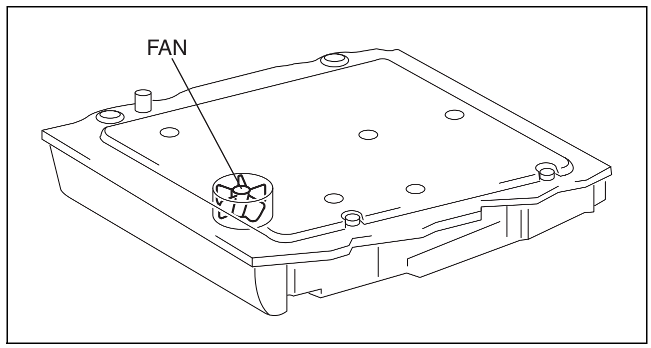
Abnormal Temperature Detection and Protection Function

- The RES unit stops operation if the temperature surrounding the DVD/CD player and the display is the specified value or more to prevent miss-operation of parts or to protect parts. The operation resumes when the ambient temperature is the specified value or less.

Part	Operation stop temperature	Operation resume temperature
DVD/CD player	Approx. 88 °C {190 °F}	Approx. 70 °C {158 °F}
Display	Approx. 95 °C {203 °F}	Approx. 85 °C {185 °F}

Fun Control Function

- If the internal temperature of the RES unit increases to 50 °C {122 °F} or more, the fan in the RES unit operates to lower the temperature.
- If the temperature decreases to approx. 40 °C {104 °F} or less, the fan stops.



ac9uun00000332

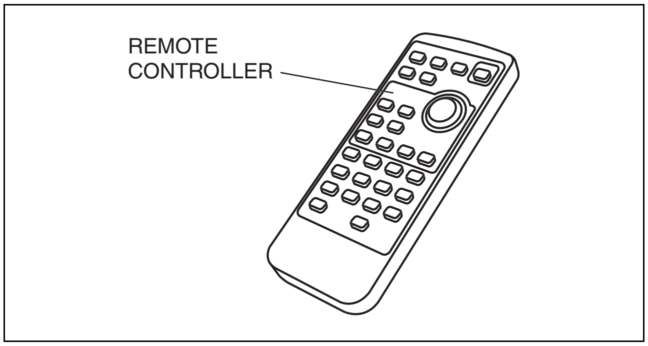
Low Voltage Detection and Protection Function

- If the ACC voltage lowers to approx. 9.5 V or less, the operation stops after “BATTERY ERROR” is displayed on the screen to prevent a system miss-operation.

REMOTE CONTROLLER CONSTRUCTION

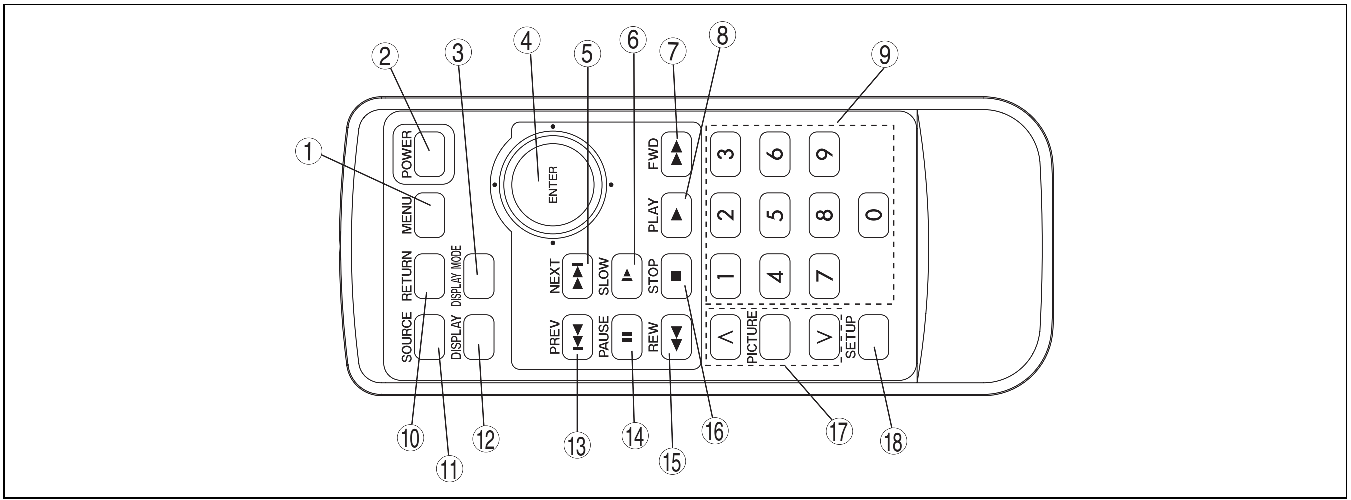
id092000808800

- A remote controller for RES has been adopted.
- Operate the remote controller with it pointed to the disk slot or display cover of the RES unit.



ac9uun00000348

Buttons Function



ac9uun00000349

1	MENU button
2	POWER button
3	DISPLAY MODE button
4	ENTER/Set button
5	SKIP button (Next)
6	Slow playback button
7	Fast-forward button
8	Start playback button
9	Number keys

10	RETURN (Back) button
11	SOURCE button
12	DISPLAY button
13	SKIP button (Prev)
14	PAUSE button
15	Reverse button
16	STOP button
17	Picture adjust button
18	SET UP button

AUXILIARY TERMINAL UNIT CONSTRUCTION

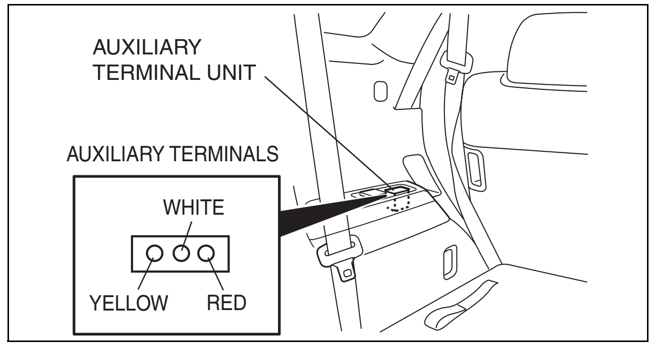
id092000819400

Outline

- Image/audio input signals are output to the RES unit by connecting an on-market, external AV unit.

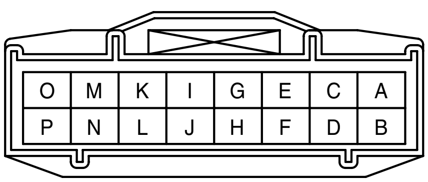
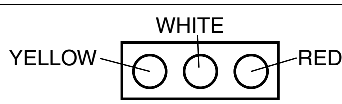
Construction

- Located on the trunk side trim (LH).
- Auxiliary terminals are equipped on the upper part of the unit.



ac9uun00000396

Terminal layout and signal

Terminal		Signal
	A	AUX Video
	B	Video GND
	C	AUX Audio LH
	D	Audio GND
	E	AUX Audio RH
	F	—
	G	—
	H	—
	I	—
	J	—
	K	—
	L	—
	M	—
	N	—
	O	—
	P	—
	Yellow	Video input
	White	Audio input (LH)
	Red	Audio input (RH)

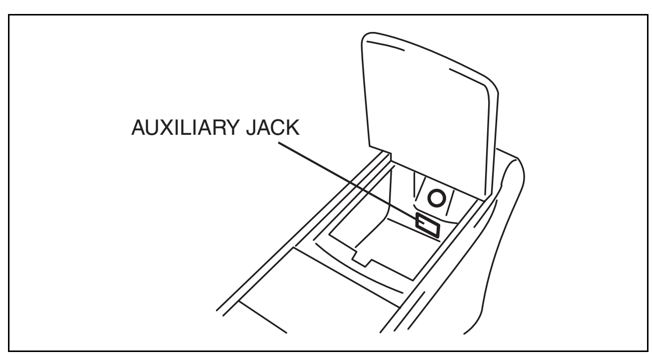
AUXILIARY JACK CONSTRUCTION/OPERATION

id092000110000

Outline

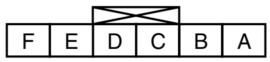
- Portable audio units or other similar products on the market can be connected to the Auxiliary jack to listen to music or audio over the vehicle's speakers.

Structural View



ac9uun00000312

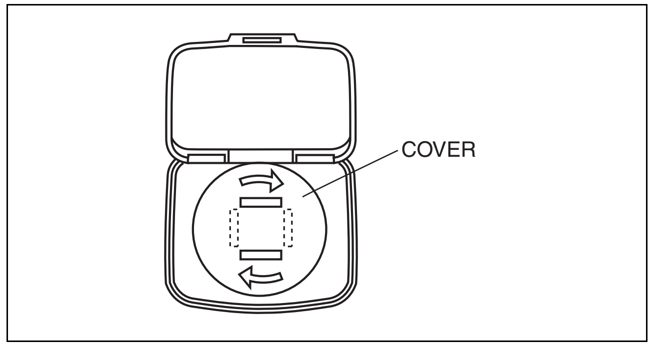
Terminal layout and signal

Terminal		Signal
	A	-
	B	-
	C	Sound LH
	D	Audio GND
	E	Sound RH
	F	AUX DET

POWER SUPPLY SOCKET (AC 115 V) CONSTRUCTION

id092000808300

- There is a rotating cover at the plug-in area of the socket designed to prevent penetration of dust and dirt.



ac9uun00000319

INVERTER FUNCTION

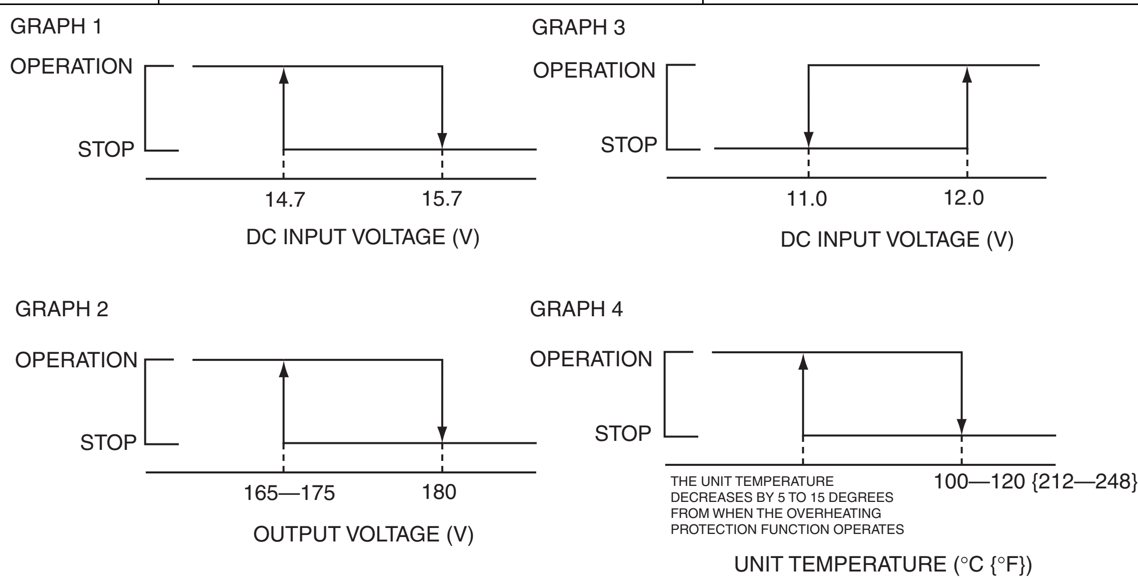
id092000809000

Fail-safe function

- If a malfunction is detected by the malfunction detection function, the inverter is stopped immediately to prevent an operation malfunction of the inverter and malfunction of output parts.

Fail-safe table

Item	Malfunction Detection Condition	Recovery Condition*1
Over-voltage protection function (Input voltage)	The input voltage is 15.7 V or more (See: Graph 1).	The input voltage is 14.7 V or less.
Over-voltage protection function (Output terminal)	The output voltage is 180 V or more (See: Graph 2).	The output voltage is between 165-175 V or less.
Low voltage protection function (Input voltage)	The input voltage of 11.0 V or less continues for 2 s or more (See: Graph 3).	The input voltage is 12.0 V or more.
Excess-current protection function	The input current is 12 A or more.	The input current of 12 A or less continues for 30 s or more.
Electric power protection function	The current is restricted if the electric power is 101 W or more. (Stops immediately if the current restriction control continues for 10 s or more.)	Electric power of 100 W or less continues for 30 s or more.
Overheating protection function	The inverter unit is overheated at between 100-120 degree or more (See: Graph 4).	The unit temperature decreases by 5 to 15 degrees from when the overheating protection function operates.
Output short-circuit protection function	The AC output line is short circuited.	30 s or more has elapsed since the short circuit in the AC output line has been repaired.



*1 : Returns to normal operation by turning the ignition switch from the LOCK to ON position when the recovery conditions are met.

INVERTER CONSTRUCTION/OPERATION

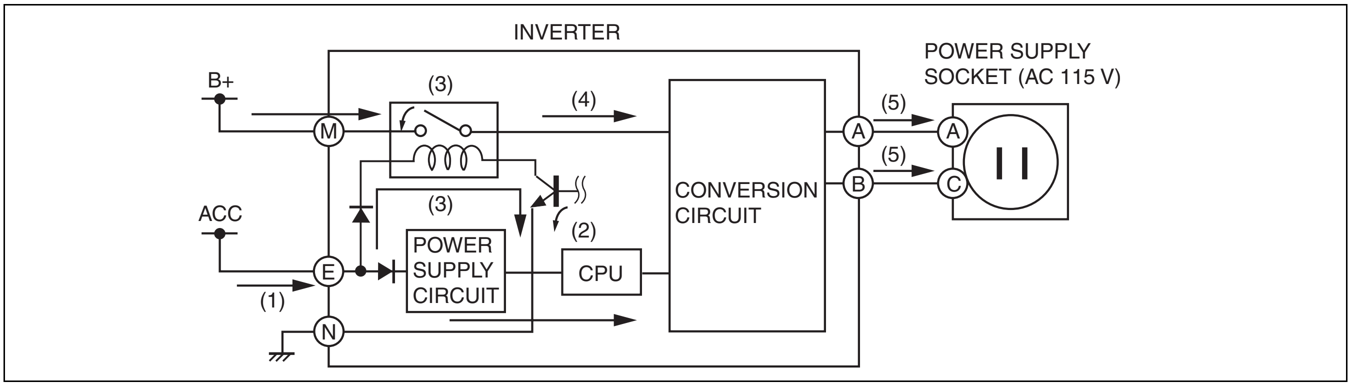
id092000808900

Outline

- DC 12 V voltage from the battery is converted to AC 115 V and supplied to the power supply socket (AC 115 V)

Operation

1. When the ignition switch is turned to the ACC or ON position, current flows to the terminal E of the inverter.
2. Current passes through the circuit to turn the transistor on.
3. The current flows to the relay coil to turn on the relay.
4. Current (DC 12 V) from the battery flows to the converter circuit through the relay from the terminal M of the inverter.
5. The converted current is supplied to the power supply socket (AC 115 V) from the inverter terminals A and B.



ac9uun00000425

HANDS-FREE TELEPHONE (HF/TEL) SYSTEM OUTLINE

id092000819800

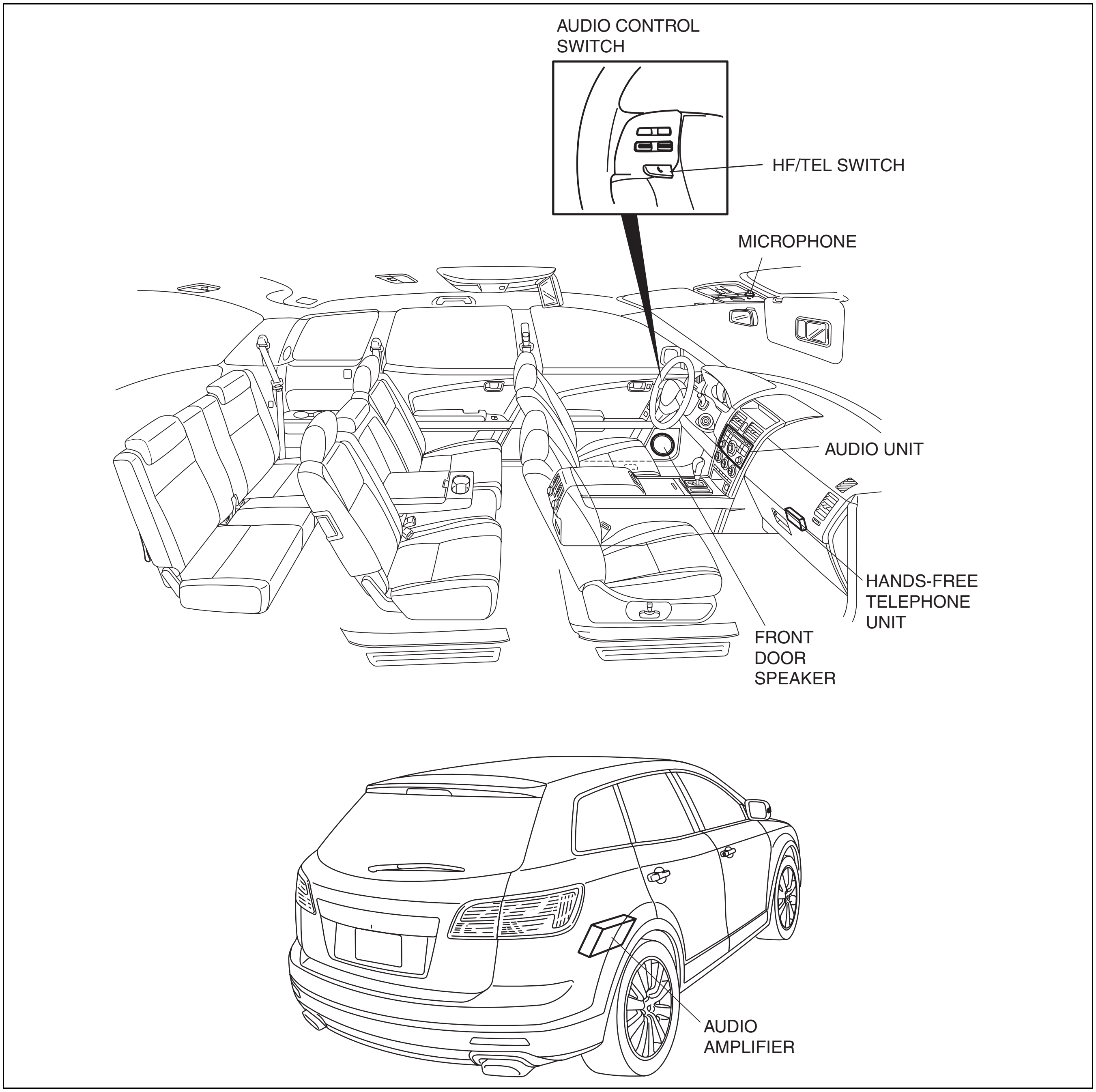
- Calls can be made without operating the cellular phone*1 directly by using the voice recognition, which allows the user to concentrate on driving.
- If the cellular phone has been programmed, Bluetooth*2 is connected automatically each time the ignition switch is turned to the ACC or ON position.
- A voice recognition microphone and a speaker are used for conversation exchange.

*1 : A Bluetooth applicable cellular phone is required separately as the communication device.

*2 : Radio communication technology in which sound and data are transferred by connecting wireless cellular phones or personal computers.

HANDS-FREE TELEPHONE (HF/TEL) SYSTEM STRUCTURAL VIEW

id092000819700



ac9uun00000500

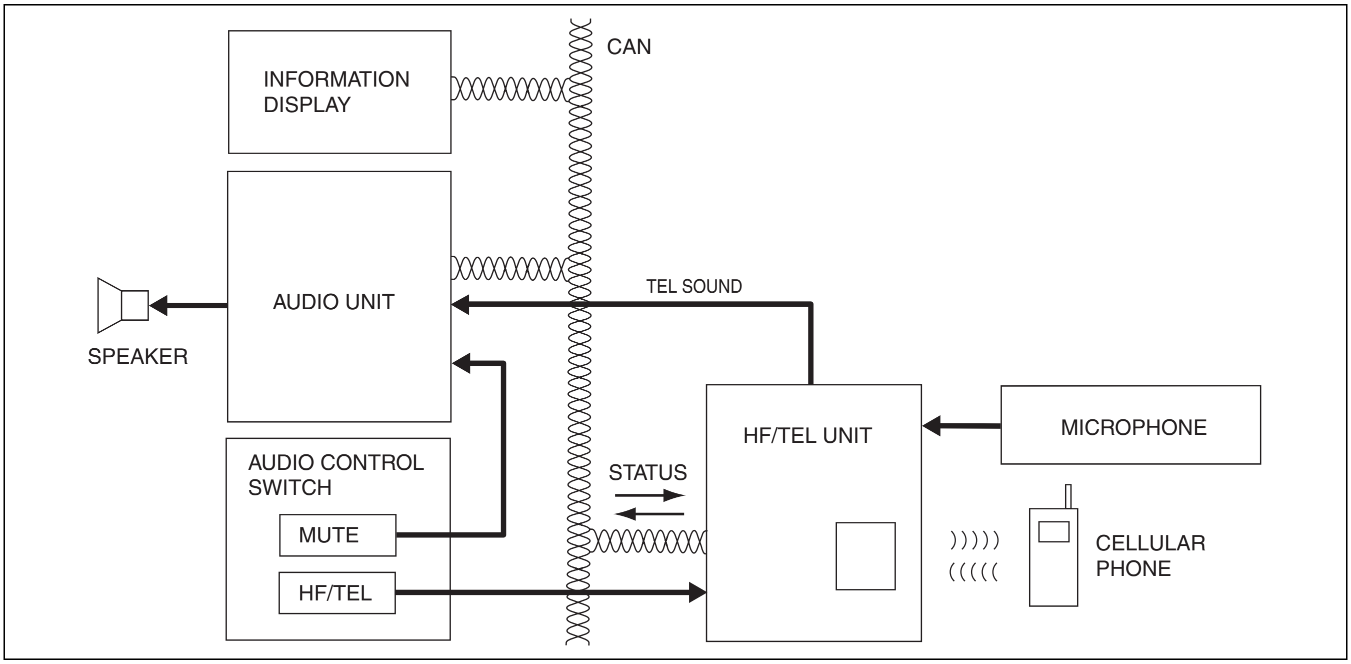
Component part and Function

Item	Function
HF/TEL unit	• Possesses a voice recognition function to identify voice input from the microphone. • Outputs the call voice and voice guidance via the audio unit or audio amplifier. • Communicates with a cellular phone using Bluetooth. • Call-out, incoming call, and telephone number registration are controlled. The status signals are sent to the information display and audio unit via CAN.
Microphone	• The user voice is sent to the HF/TEL unit as electric signals.
Information display	• Each operation status of the HF/TEL unit is displayed by the character data.
Audio unit	• Bluetooth connection status, radio wave strength, roaming, and remaining battery level are displayed. (Touch panel type only) • Audio playback is canceled when the HF/TEL system is activated such as during an incoming call. • The call recipient voice and voice guidance are output to the speaker. (Without Bose®)
Audio amplifier	• The call recipient voice and voice guidance are output to the speaker. (With Bose®)
Front door speaker (driver side)	• The call recipient voice and voice guidance are output.
HF/TEL switch	• Used for activating the HF/TEL system and initiating/terminating calls.
Car-navigation unit	• The car-navigation system's voice recognition is cancelled while the HF/TEL system is activated.

HANDS-FREE TELEPHONE (HF/TEL) SYSTEM BLOCK DIAGRAM

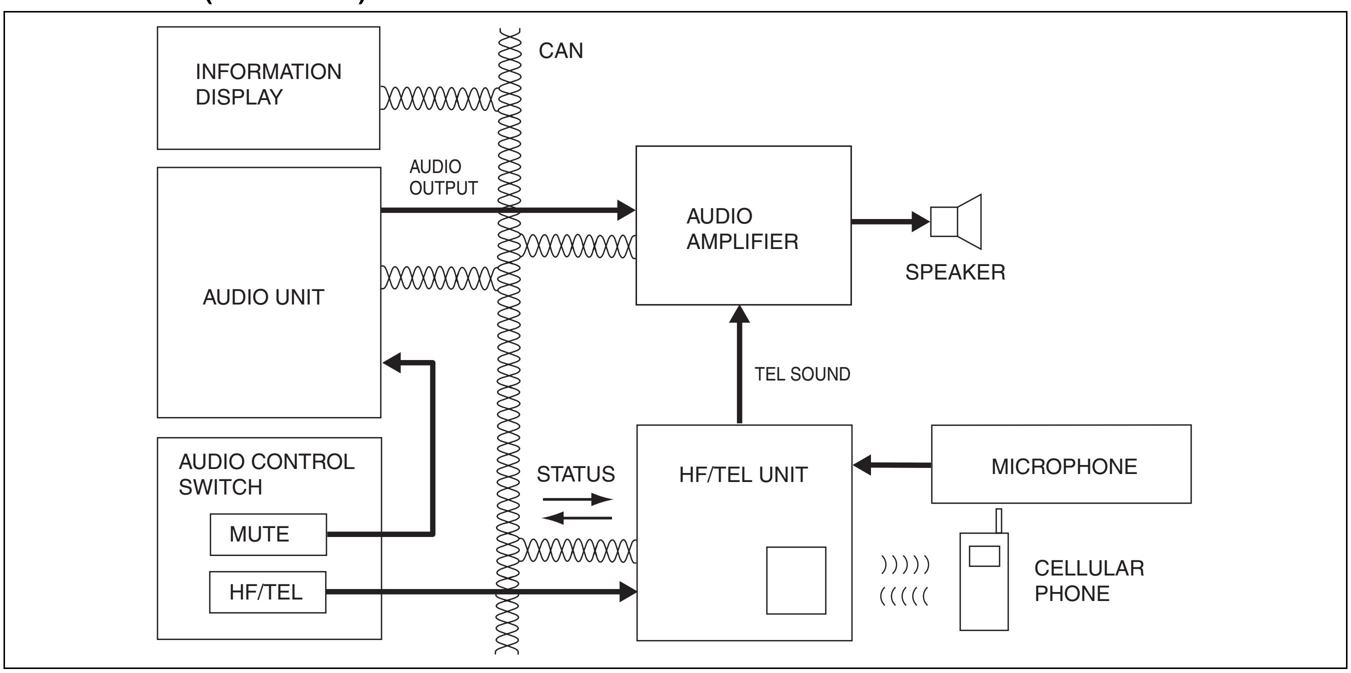
id092000819500

Standard audio (without Bose®)



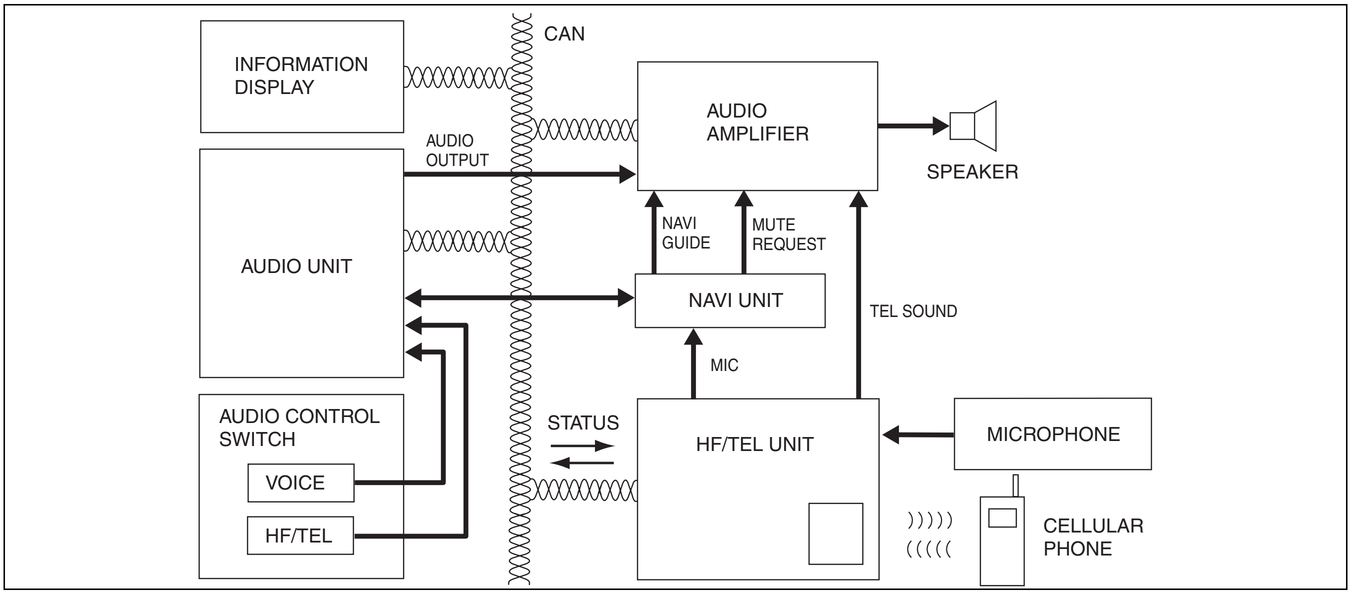
ac9uun00000501

Standard audio (with Bose®)



ac9uun00000502

Touch panel type audio



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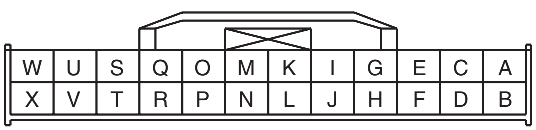
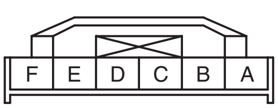
Terminal Layout and Signal
HF/TEL unit

Terminal		Signal
	A	MIC output (+)
	B	MIC input (+)
	C	MIC output (-)
	D	MIC input (-)
	E	MIC output shield
	F	MIC input shield
	G	Audio output (+)
	H	Audio output (-)
	I	–
	J	MIC SENSE
	K	Audio control switch input
	L	Audio output shield
	M	–
	N	–
	O	–
	P	–
	Q	CAN (+)
	R	CAN (-)
	S	–
	T	GND
	U	MIC B+
	V	–
	W	ACC
	X	B+

MIcrophone

Terminal		Signal
	A	MIC+
	B	MIC-
	C	MIC B+
	D	GND
	E	MIC SENSE
	F	–

HANDS-FREE TELEPHONE (HF/TEL) SYSTEM FUNCTION

id092000819600

- The following functions have been adopted.
- Operates by voice recognition and the HF/TEL switch. Refer to the user's instructions for the operation method.

Function			Outline
Callout	Callout using telephone number		Call is made by the user calling out the telephone number.
	Callout using telephone book		Call is made by a calling out the name of a person whose telephone number has been registered in the telephone book in advance.
	Redialing		Redialing a telephone number previously dialed.
	Emergency calls		Calls the emergency “911” number.
Incoming call	Receiving calls		• Notifies the users that their cellular phone is being called immediately after the incoming call is detected. • Call is initiated.
	Call rejection		Calls are rejected.
Active call	Mute		Input from the microphone is interrupted during the call.
	Transfer		Switches a standard call using a cellular phone to a call using a hands-free phone.
	Multiple calls	Call interrupt	• An additional incoming call can be received during the current one. In this case, the first call is interrupted. • Call interrupt can be refused.
		Switching calls	• Press the HF/TEL switch to switch the call. — HF/TEL switch (short press): The current call is put on hold. — HF/TEL switch (long press): The current call is terminated.
Telephone book	Registration		• Registers telephone numbers to the telephone book in the HF/TEL unit. • 32 names can be programmed for each language. • The telephone numbers of four places (home, work, mobile, pager) can be programmed under one name.
	Edit		Correct/change the registered data.
	Clear		Clears a single registered data or collectively.
	View		Guides the registered data sequentially using voice.
Device pairing/ selection	Pairing		• A maximum of seven Bluetooth applicable cellular phones can be paired. • Connection priority ranking and four-digit PIN numbers must be input during pairing.
	Changing pairing contents		Changes the pairing name and priority ranking of the paired devices.
	Clear		Clear the device paired by each device or collectively.
	View		Guides the pairedmed devices sequentially using voice.
Setting	Language setting		language used for voice recognition, voice guidance, and display can be selected from three languages (English, French, and Spanish).
	Password setting/cancellation		• Password can be set. • If a password is set, the HF/TEL system does not operate until it is input.
	Confirmation prompt setting		• Confirms using voice guidance before executing the operation indicated by the user. • When it is set to on, confirmation guidance is skipped.
	Volume		Adjusts the call and voice guidance volumes.
Other	HF/TEL system stop		Stops the HF/TEL system operation.
	Voice training		• Learns features of the voice/pronunciation of the person making the call and improves voice recognition. • Voice training for up to two people can be done for each language.
	Help		• When “Help” is called out, the system switches to this function at any step. • Guides all executable voice commands.
Diagnosis system			The on-board diagnostic system has a self-diagnostic function and diagnostic assist function to help technicians locate malfunctions.

09-21 POWER SYSTEMS

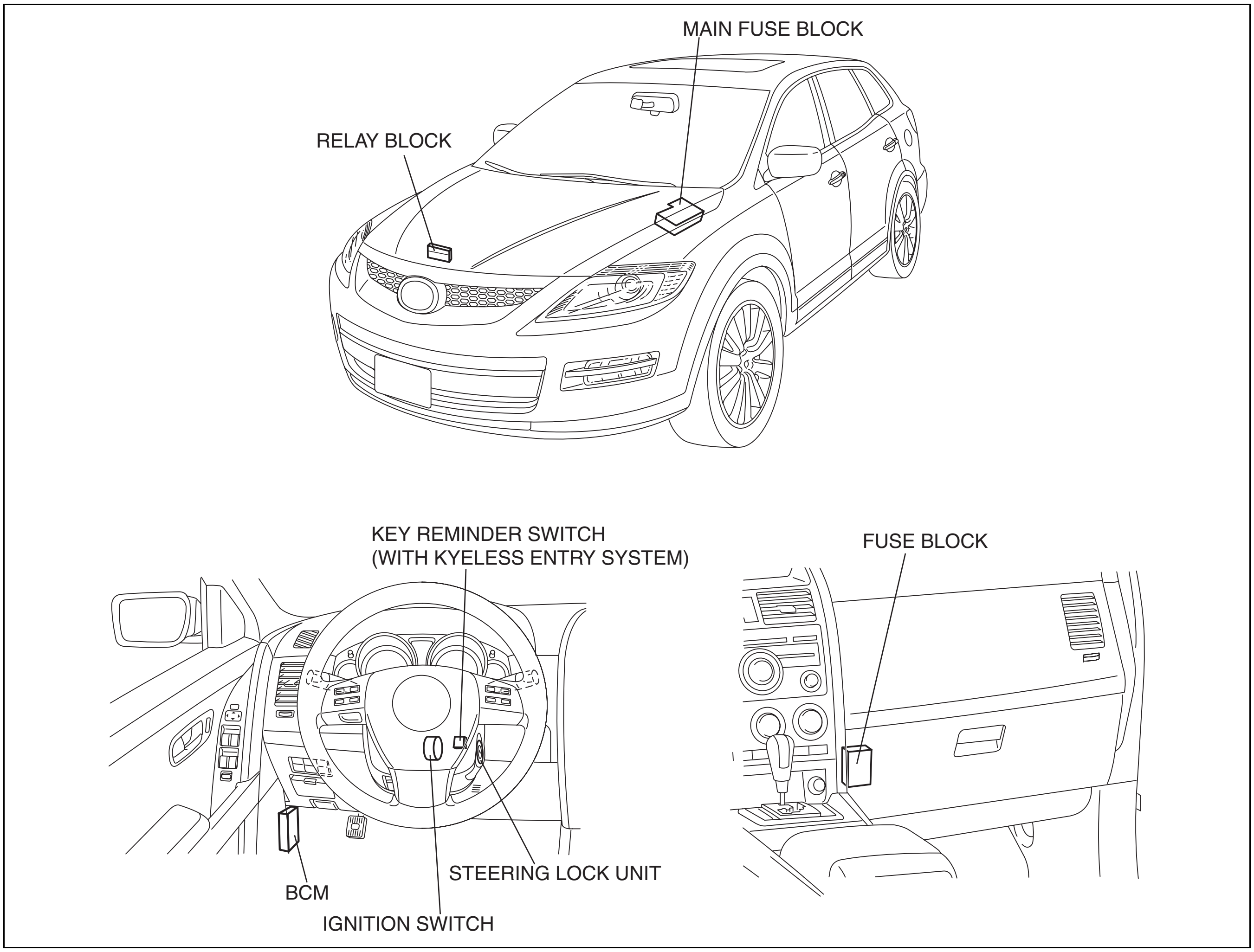
POWER SYSTEMS OUTLINE

id092100100100

- All relays and fuses are located in the main fuse block, fuse block, relay block and body control module (BCM).
- The key reminder switch for the advanced keyless entry system is built into the steering lock unit.

POWER SYSTEMS STRUCTURAL VIEW

id092100100200



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09-22 INSTRUMENTATION/DRIVER INFO.

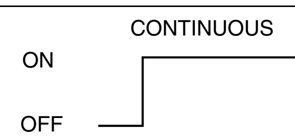
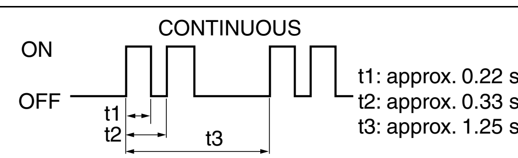
INSTRUMENT CLUSTER OUTLINE

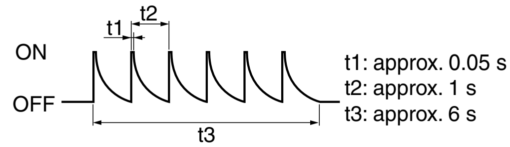
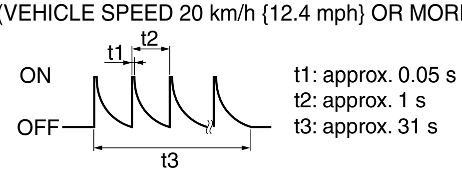
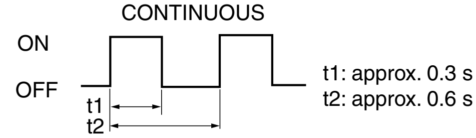
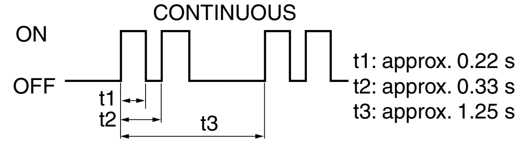
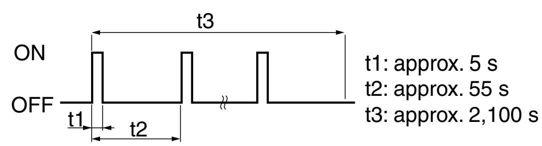
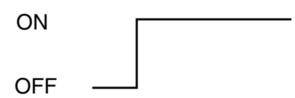
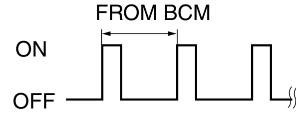
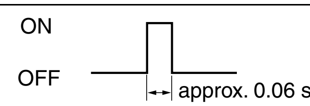
id092200100200

- 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 09-40-1 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, A/C system, and hands-free telephone 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

id092200101100

Item			Specification
Speedometer	Meter type		Stepping motor type
	Indication range	(mph {km/h})	0—140 {0—220}
	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 •Fuel gauge sender sub-unit (AWD)
	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
Clock accuracy (Reference value)*		(s/day)	-1.5—1.5
Warning/indicator alarms			
Sound frequency		(Hz)	1,000—2,600
Output sound pressure level		(dB)	60.0—75.0
Lights-on reminder warning alarm	Sound frequency	(Hz)	1,900
	Sound cycle		
Key reminder warning alarm	Sound frequency	(Hz)	1,800
	Sound cycle		

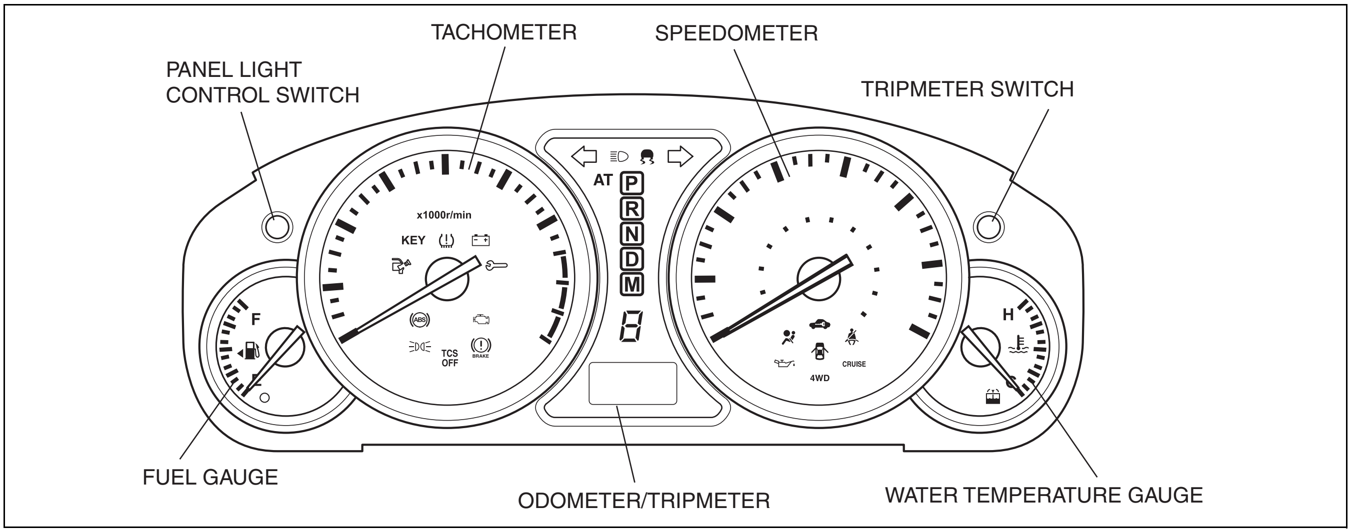
Item		Specification
Seat belt warning alarm	Sound frequency (Hz)	1,000
	Sound cycle	WHEN IGNITION SWITCH TURNED ON  WHILE VEHICLE DRIVING (VEHICLE SPEED 20 km/h {12.4 mph} OR MORE) 
Tire pressure warning alarm	Sound frequency (Hz)	2,600
	Sound cycle	CONTINUOUS 
Advanced keyless entry system warning alarm	Sound frequency (Hz)	1,800
	Sound cycle	CONTINUOUS 
Air bag system warning alarm	Sound frequency (Hz)	2,200
	Sound cycle	
Parking brake reminder warning alarm	Sound frequency (Hz)	2,000
	Sound cycle	CONTINUOUS 
Turn and hazard indicator alarm	Sound frequency (Hz)	1,700—1,800
	Sound cycle	DEPEND ON MESSAGE FROM BCM 
Panel light control indicator alarm	Sound frequency (Hz)	1,900
	Sound cycle	

* : If the clock accuracy varies largely from the reference value, battery deterioration or an information display malfunction may have occurred.

INSTRUMENT CLUSTER STRUCTURAL VIEW

id092200101200

Meter and Gauge



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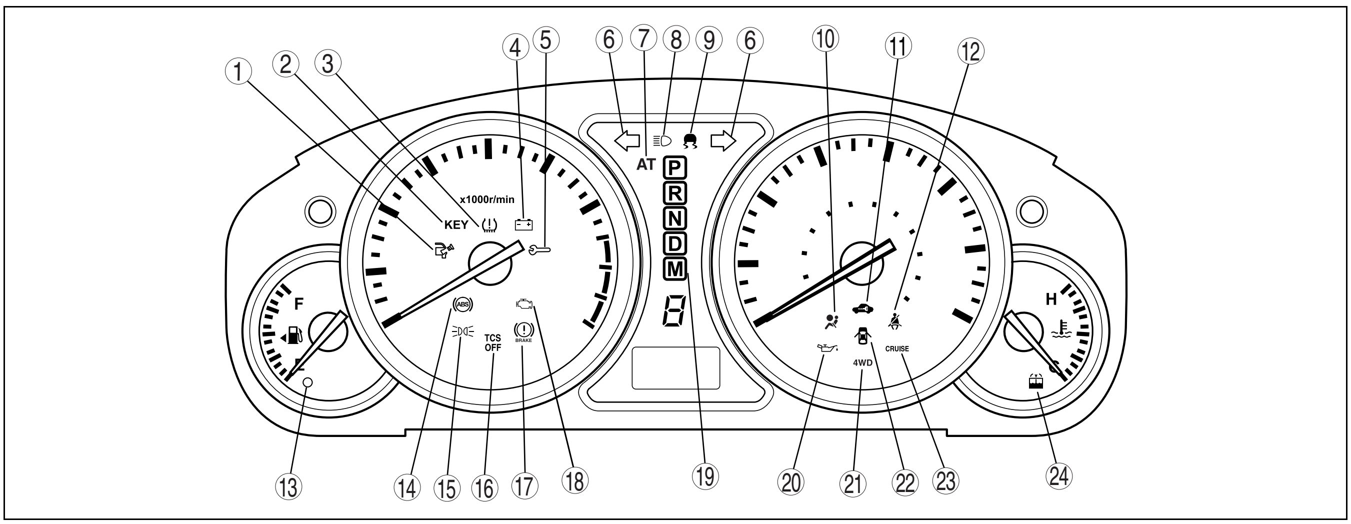
Warning and Indicator Light



ac9uun00000138

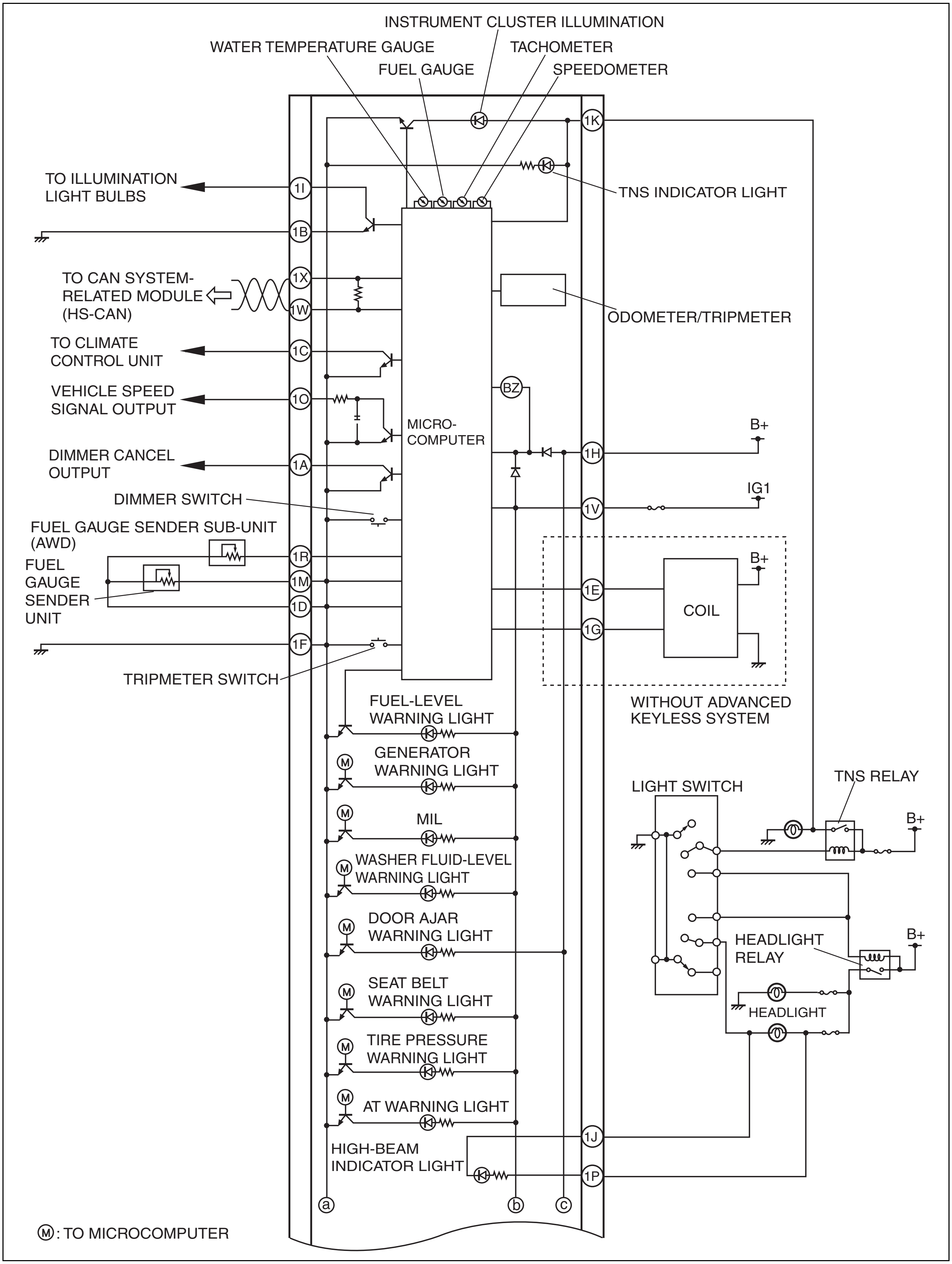
×: Applicable

No.	Warning and indicator light	Input signal source	CAN system	Note
1	Fuel cap warning light	PCM	×	—
2	Keyless indicator light (green)	Keyless control module	×	With advanced keyless system
	Keyless warning light (red)			
3	Tire pressure warning light	Instrument cluster	—	With TPMS
4	Generator warning light	PCM	×	—
5	Electronic throttle control (ETC) warning light	PCM	×	—
6	Turn indicator light	BCM	×	—
7	AT warning light	TCM	×	—
8	High-beam indicator light	Headlight (HI)	—	—
9	DSC indicator light	DSC/RSC HU/CM	×	—
10	Air bag system warning light	SAS control module	×	—
11	Security light	• PCM (Without advanced keyless system) • Keyless control module (With advanced keyless system)	×	—
12	Seat belt warning light	SAS control module	×	—

No.	Warning and indicator light	Input signal source	CAN system	Note
13	Fuel-level warning light	Fuel gauge sender unit	—	—
14	ABS warning light	DSC/RSC HU/CM	×	—
15	TNS indicator light	TNS relay	—	—
16	TCS OFF light	DSC/RSC HU/CM	×	—
17	Brake system warning light	• DSC/RSC HU/CM • BCM	×	—
18	MIL	PCM	×	—
19	Selector indicator light	TCM	×	—
20	Oil pressure warning light	BCM	×	—
21	AWD warning light	AWD control module	×	AWD
22	Door ajar warning light	BCM	×	—
23	Cruise main indicator light (amber)	PCM	×	With cruise control system
	Cruise set indicator light (green)			
24	Washer fluid level warning light	BCM	×	—

INSTRUMENT CLUSTER SYSTEM WIRING DIAGRAM

id092200101300



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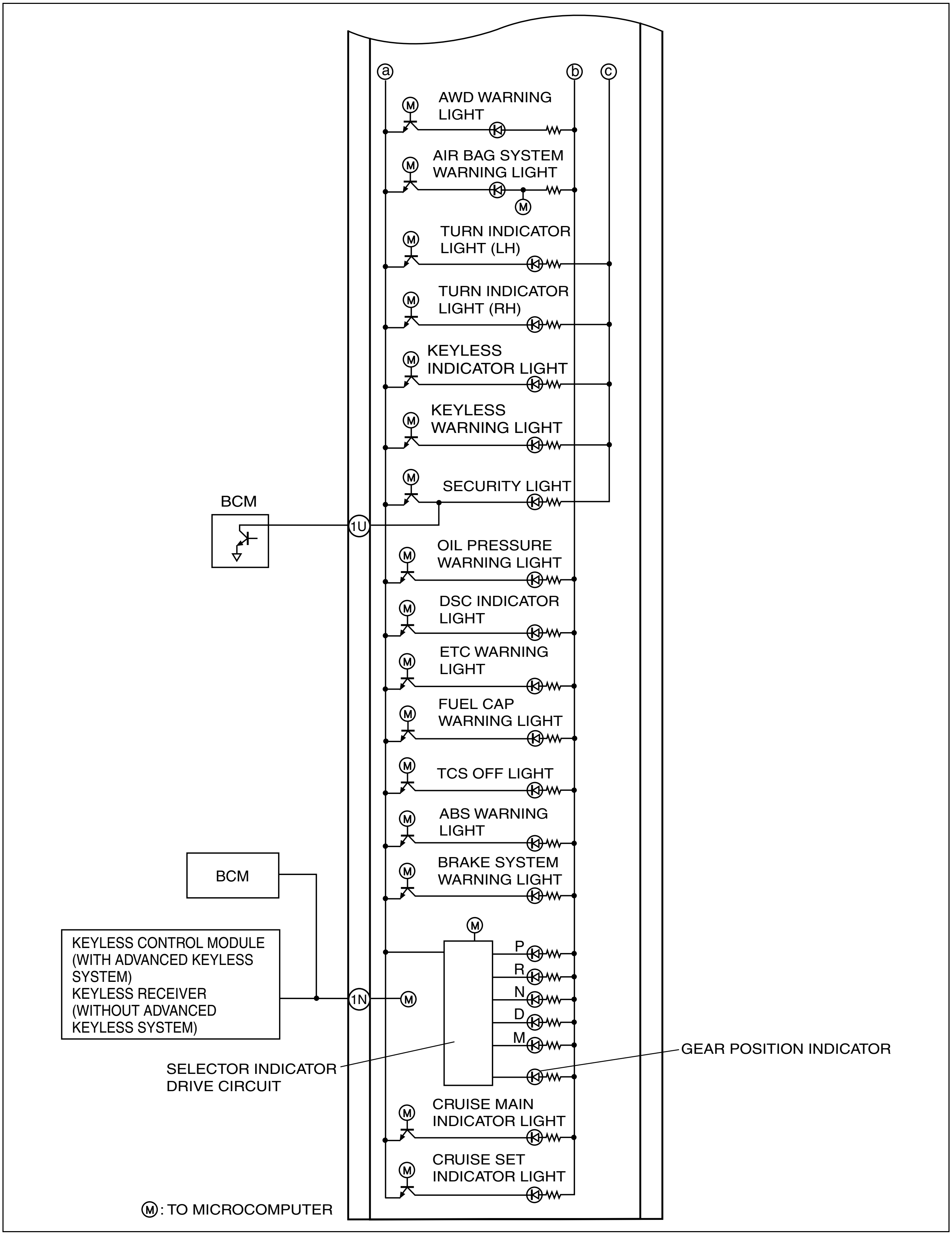

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09-22

LIGHTS-ON REMINDER WARNING ALARM OUTLINE

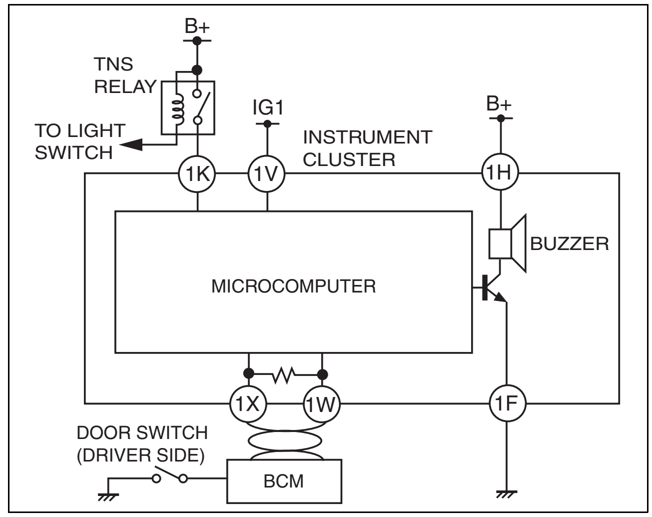
id092200101700

- Warns the driver that the headlights or TNS are on when the driver-side door is opened.

LIGHTS-ON REMINDER WARNING ALARM CONSTRUCTION/OPERATION

id092200101600

System Wiring Diagram



ac9uun00000183

Operation

- The buzzer in the instrument cluster sounds continuously when all the following three conditions are met:
  — The ignition switch is in the LOCK position.
  — The headlight switch is in the TNS or headlight position.
  — The driver-side door is open (driver-side door switch is on).

KEY REMINDER WARNING ALARM OUTLINE

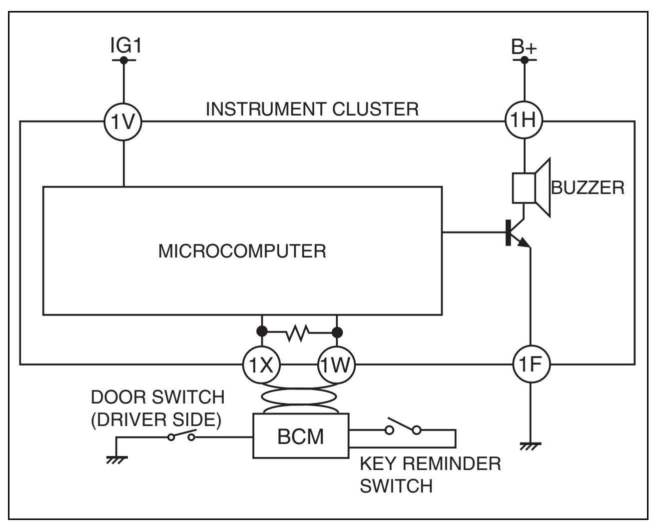
id092200101500

- Warns the driver that the key is in the steering lock when the driver-side door is opened.

KEY REMINDER WARNING ALARM CONSTRUCTION/OPERATION

id092200101400

System Wiring Diagram



ac9uun00000184

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).

SEAT BELT WARNING ALARM OUTLINE

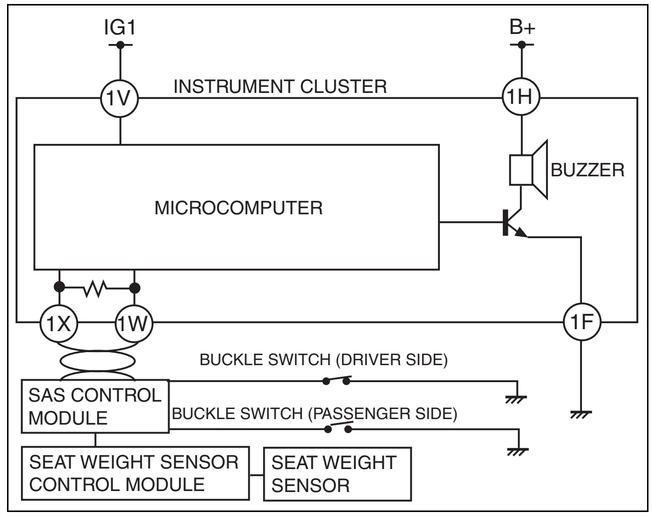
id092200101900

- Warns the driver that the seat belt (driver side or passenger side) is unfastened.

SEAT BELT WARNING ALARM CONSTRUCTION/OPERATION

id092200101800

System Wiring Diagram



ac9uun00000185

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 on).
- 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 on, fronr passenger side: buckle switch is on and seat weight sensor detects passenger).
  - — The vehicle speed is **20 km/h {12.4 mph} or more**.

PARKING BRAKE REMINDER WARNING ALARM OUTLINE

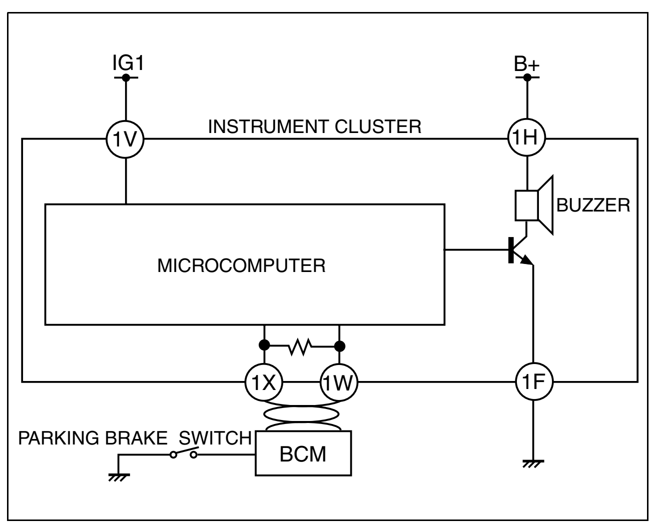
id092200102900

- Warns the driver that the vehicle is being driven with the parking brake applied.

PARKING BRAKE REMINDER WARNING ALARM CONSTRUCTION/OPERATION

id092200103000

System Wiring Diagram



ac9uun00000186

Operation

- The buzzer in the instrument cluster sounds continuously when all the following two conditions are met:
  - — Parking brake has not been released (parking brake switch is on).
  - — The vehicle speed is **5 km/h {3.1 mph} or more**.

TURN AND HAZARD INDICATOR ALARM OUTLINE

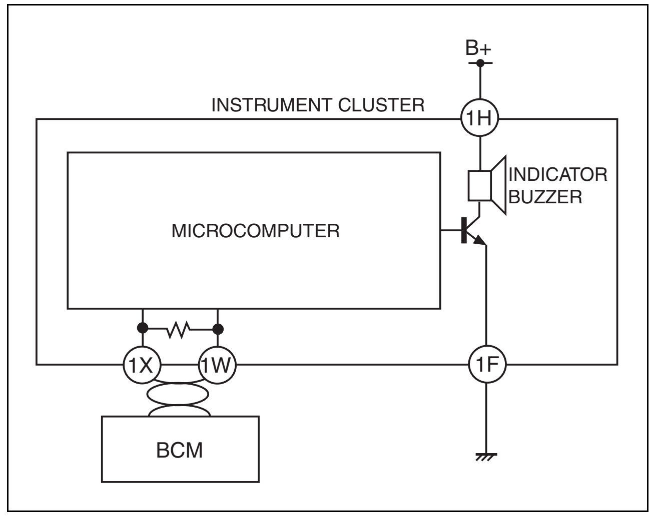
id092200102500

- The indicator buzzer sounds when the turn indicator flashes.

TURN AND HAZARD INDICATOR ALARM CONSTRUCTION/OPERATION

id092200102400

System Wiring Diagram



ac9uun00000187

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

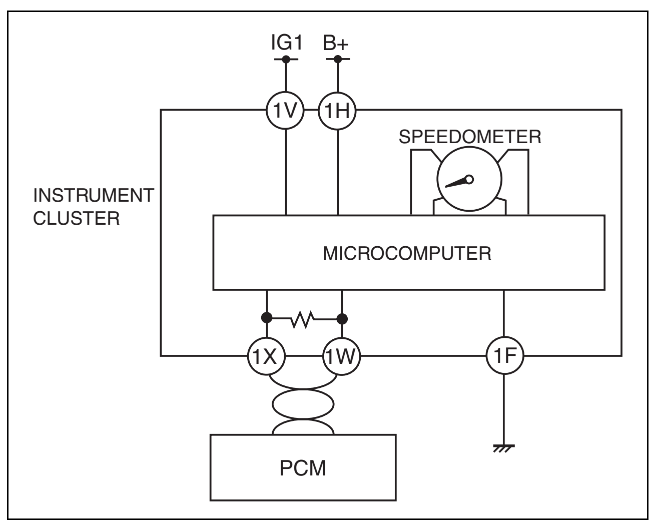
id092200102100

- The vehicle speed signal is output from the PCM to the microcomputer in the instrument cluster.

SPEEDOMETER CONTROL CONSTRUCTION/OPERATION

id092200102000

System Wiring Diagram



ac9uun00000188

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

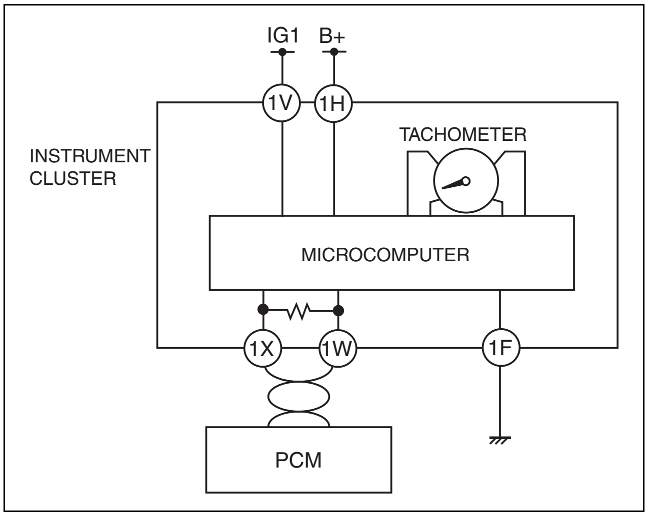
id092200102300

- The engine speed signal is output from the PCM to the microcomputer in the instrument cluster.

TACHOMETER CONTROL CONSTRUCTION/OPERATION

id092200102200

System Wiring Diagram



ac9uun00000189

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.

FUEL GAUGE CONTROL OUTLINE

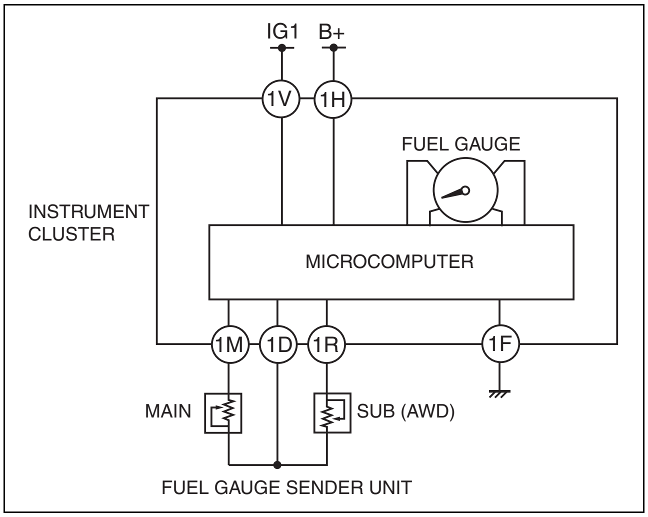
id092200100800

- 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

id092200100700

System Wiring Diagram



ac9uun00000190

Operation

- A resistance according to fuel level is sent from the gauge sender unit to the microcomputer.
- A Fuel injection amount is sent from the PCM via the CAN system to the microcomputer.
- The microcomputer calculates the average resistance and Fuel injection amount within a specified time, and sends the output signal to the fuel gauge based on the calculated value.

WATER TEMPERATURE GAUGE CONTROL OUTLINE

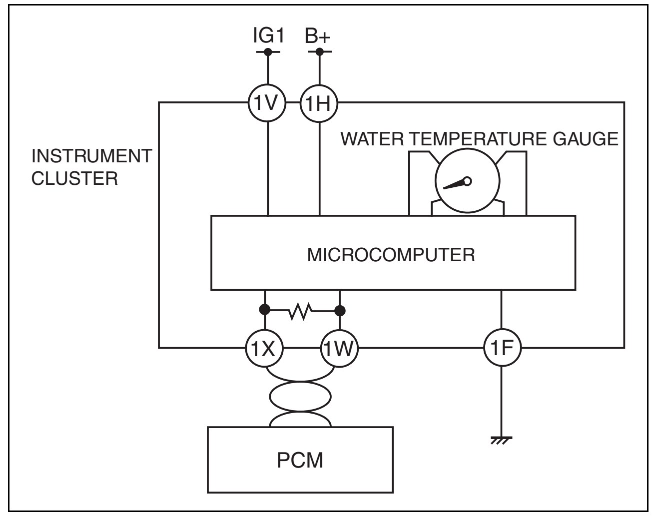
id092200102700

- The engine coolant temperature signal is output from the PCM to the microcomputer in the instrument cluster.

WATER TEMPERATURE GAUGE CONTROL CONSTRUCTION/OPERATION

id092200102600

System Wiring Diagram



ac9uun00000191

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.

BURNT OUT BULB CHECK FUNCTION OUTLINE

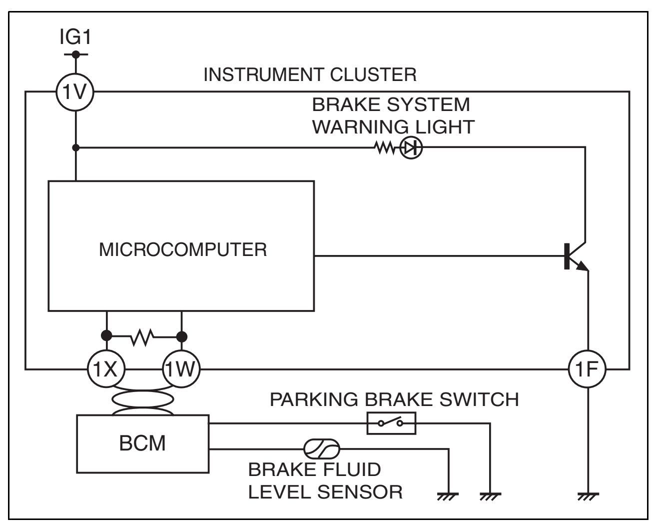
id092200103100

- The microcomputer in the instrument cluster illuminates the brake system warning light when the ignition switch is in the ON position. Due to this, the brake system warning light function can be inspected for a burnt out bulb.

BURNT OUT BULB CHECK FUNCTION CONSTRUCTION/OPERATION

id092200103200

System Wiring Diagram



ac9uun00000192

Operation

- The microcomputer in the instrument cluster illuminates the brake system warning light for **approx. 3 s** and then turns it off when the ignition switch is turned to the ON position. (When the parking brake switch or the brake fluid level sensor is on, the brake system warning light remains illuminated.)

ON-BOARD DIAGNOSTIC OUTLINE

id092200103300

- If a malfunction occurs in the system, a malfunction detection function is equipped to record the malfunction as a DTC. Recorded DTCs can be read by the Mazda Modular Diagnostic System (M-MDS).
- The diagnostic system records the DTC while also storing the control status of the related instrument cluster as freeze frame data.
- An input/output check function has been adopted that examines input signals to the instrument cluster and individual parts via the micro computer built into the instrument cluster.
- A PID/data monitor function is equipped in the instrument cluster.
- When configuring, the odometer (total traveled distance data) data from the previous instrument cluster can be transferred to the new instrument cluster.

ON-BOARD DIAGNOSTIC OPERATION

id092200103400

Malfunction Detection Function

- If a malfunction occurs in the input/output signals, other units or the CAN system, it is recorded as a DTC. Recorded DTCs can be read by the Mazda Modular Diagnostic System (M-MDS).

DTC table

×: Applicable

DTC	Malfunction location	Freeze frame data
B1202	Fuel gauge sender unit circuit malfunction (open circuit)	—
B1204	Fuel gauge sender unit circuit malfunction (short to GND)	—
B1342	Instrument cluster malfunction	—
B2477	Configuration error	—
U0073	CAN system communication error	—
U0100	Communication error to PCM	×
U0101	Communication error to TCM	×
U0114	Communication error to AWD control module	×
U0121	Communication error to DSC/RSC HU/CM	×
U0140	Communication error to BCM	×
U0151	Communication error to SAS control module	×
U0214	Communication error to keyless control module	×
U2023	Abnormal message from other module	×
U2064	Warning light illumination request signal from other modules	×

Freeze Frame Data

- When a DTC is recorded, the related instrument cluster control status is stored. This recorded data is freeze frame data. Freeze frame data availability for each DTC is indicated in the DTC table.
- The freeze frame data recorded range contains 4 types of data (FFD1 to FFD4), with the most recent data being FFD1.
  - — Determine which unit is thought to be malfunctioning based on the warning light illumination, meters and gauges records recorded in the freeze frame data, and perform malfunction diagnosis.
  - — Even for malfunctions that are not currently occurring, analysis of the period (traveled distance) and malfunction status (warning light, gauges, meters control status, type of malfunction) of past malfunction occurrence can be done from the freeze frame data.
- The recorded freeze frame data can be read by the Mazda Modular Diagnostic System (M-MDS).
- The items recorded as freeze frame data are as follows:

Freeze frame data	Unit	Note
Malfunction type	—	• Communication errors of other units • Abnormal messages from the PCM • Warning light illumination request signal from other units

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Freeze frame data	Unit	Note
Illuminated warning light	—	Target warning light: • Air bag system warning light • Generator warning light • MIL • Oil pressure warning light • DSC indicator light • ABS warning light • Brake system warning light • AT warning light • AWD warning light • Keyless warning light
Meter, gauge control status	—	Target meter, gauge: • Speedometer • Tachometer • Water temperature gauge
Traveled distance after DTC recorded	km	Only the last four digits are recorded
DTC cleared flag	Cleared/Not cleared	The freeze frame data will not be cleared even if the DTC data is cleared. If a DTC is cleared, a DTC cleared flag 'Cleared' is recorded with the corresponding freeze frame data.

DTCs and recorded freeze frame data

- The unit thought to be malfunctioning can be inferred from the content of the freeze frame data.
- The traveled distance at the time of the DTC and the DTC cleared flag are also recorded in the DTC.
- To avoid false diagnosis, verify whether the warning lights, meters or gauges are normal using the input/output check mode.

Warning light illumination request signal from other modules (U2064)

×: Applicable

Freeze frame data		Warning light illumination request unit					
		PCM	TCM	DSC/RSC HU/CM	Keyless control module	AWD control module	SAS control module
Illuminated warning light	Air bag system warning light	—	—	—	—	—	×
	Generator warning light	×	—	—	—	—	—
	MIL	×	—	—	—	—	—
	Oil pressure warning light	—	—	—	—	—	—
	DSC indicator light	—	—	—	—	—	—
	ABS warning light	—	—	×	—	—	—
	Brake system warning light	—	—	×	—	—	—
	AT warning light	—	×	—	—	—	—
	AWD warning light	—	—	—	—	×	—
	Keyless warning light	—	—	—	×	—	—
Meter, gauge control status	Speedometer	—	—	—	—	—	—
	Tachometer	—	—	—	—	—	—
	Water temperature gauge	—	—	—	—	—	—

- The freeze frame data will be recorded after the warning light illumination request has continued for **3 s or more**. However, it will not be recorded under the following situations.
  — Illumination request for a burnt out bulb check is received
  — The instrument cluster power supply voltage is **10 V or less**
  — During the period of **twenty seconds** after the instrument cluster power supply voltage goes from **10 V or less** to **10 V or more**.
  — Engine speed is **500 rpm or less** (Engine warning light and generator warning light only)
- If several warning light illumination requests are received, they will be recorded in one freeze frame data.

Communication errors of other units (U0100, U0101, U0114, U0121, U0140, U0151, U0214)

×: Applicable

Freeze frame data		Unit that communication error occurs						
		PCM (U0100)	TCM (U0101)	DSC/RSC HU/CM (U0121)	BCM (U0140)	Keyless control module (U0214)	AWD control module (U0114)	SAS control module (U0151)
Illuminated warning light	Air bag system warning light	—	—	—	—	—	—	×
	Generator warning light	×*1	—	—	—	—	—	—
	MIL	×*1	—	—	—	—	—	—
	Oil pressure warning light	—	—	—	×	—	—	—
	DSC indicator light	—	—	×*2	—	—	—	—
	ABS warning light	—	—	×	—	—	—	—
	Brake system warning light	—	—	×	×	—	—	—
	AT warning light	—	×	—	—	—	—	—
	AWD warning light	—	—	—	—	—	×	—
	Keyless warning light	—	—	—	—	×	—	—
Meter, gauge control status	Speedometer	×	—	—	—	—	—	—
	Tachometer	×	—	—	—	—	—	—
	Water temperature gauge	×*1	—	—	—	—	—	—

*1 : Can be recorded based on the PCM communication error status.
*2 : Can be recorded based on the DSC/RSC HU/CM communication error status.

- The speedometer and the tachometer initiate fail-safe control (Indicates the 0) **1 s** from the occurrence of a communication error.
- The water temperature gauge initiates a fail safe control (Indicates the position at IG OFF) **5 s** from the occurrence of a communication error.
- If several communication errors are detected at the same time, the control status of several illuminated warning lights, meters or gauges are recorded in one freeze frame data.
- Perform malfunction diagnosis of communication errors following the on-board diagnostic system [Multi-communication system].

Abnormal messages from other module (U2023)

×: Applicable

Freeze frame data		PCM	Keyless control module	SAS control module
Illuminated warning light	Air bag system warning light	—	—	×
	Generator warning light	—	—	—
	MIL	—	—	—
	Oil pressure warning light	×	—	—
	DSC indicator light	—	—	—
	ABS warning light	—	—	—
	Brake system warning light	—	—	—
	AT warning light	—	—	—
	AWD warning light	—	—	—
	Keyless warning light	—	×	—
Meter, gauge control status	Speedometer	×	—	—
	Tachometer	×	—	—
	Water temperature gauge	×	—	—

- If several malfunction signals are received at the same time, the control status of several meters and gauges are stored in one freeze frame data.

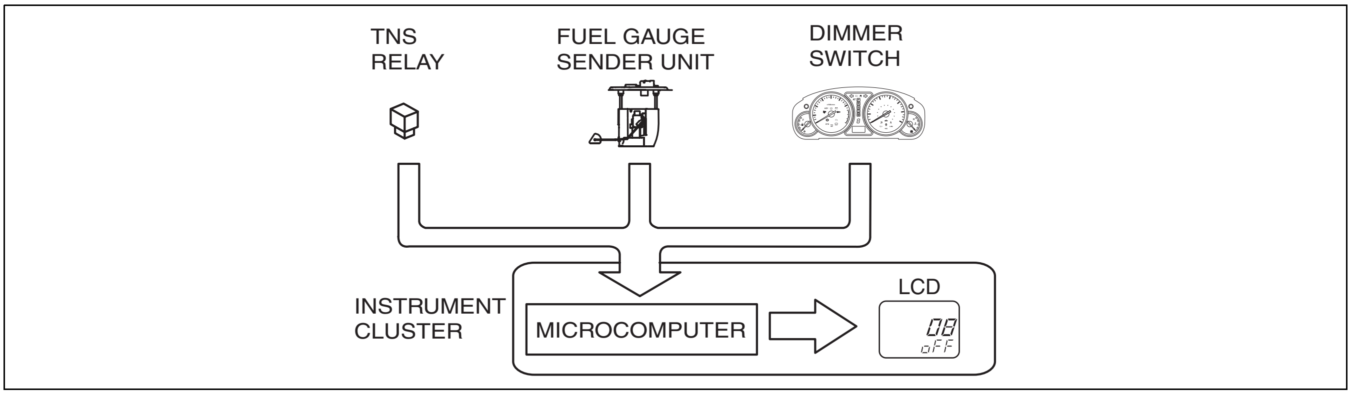
Input/Output Check Mode
Operation procedure

- Refer to the 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
08	TNS relay
22	Fuel gauge sender unit
55	Dimmer switch



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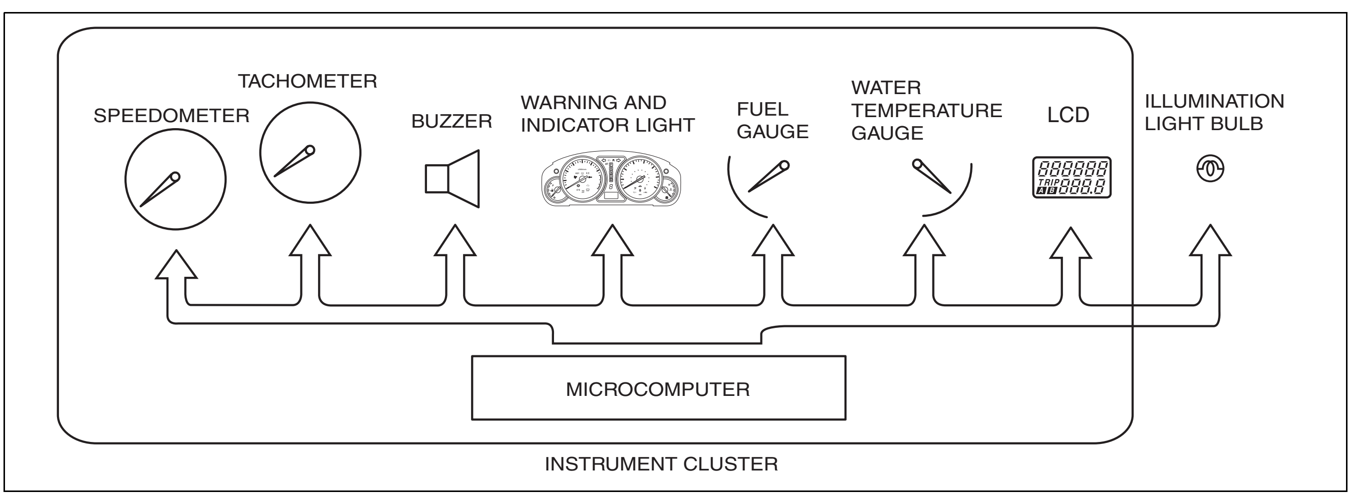
Individual circuit check

- 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	Odometer/tripmeter (LCD) Warning and indicator light
57	Panel light control



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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
IC_DTC_CNT	Number of continuous DTCs	—	—
IC_ECT	Water temperature gauge	°C	1X, 1W
IC_NUMKEYS	Number of key ID numbers registered with the vehicle	—	—
IC_ODO_CNT	Odometer	m	1X, 1W
IC_SPDMTR	Speedometer	KPH	
IC_TACHO	Tachometer	RPM	

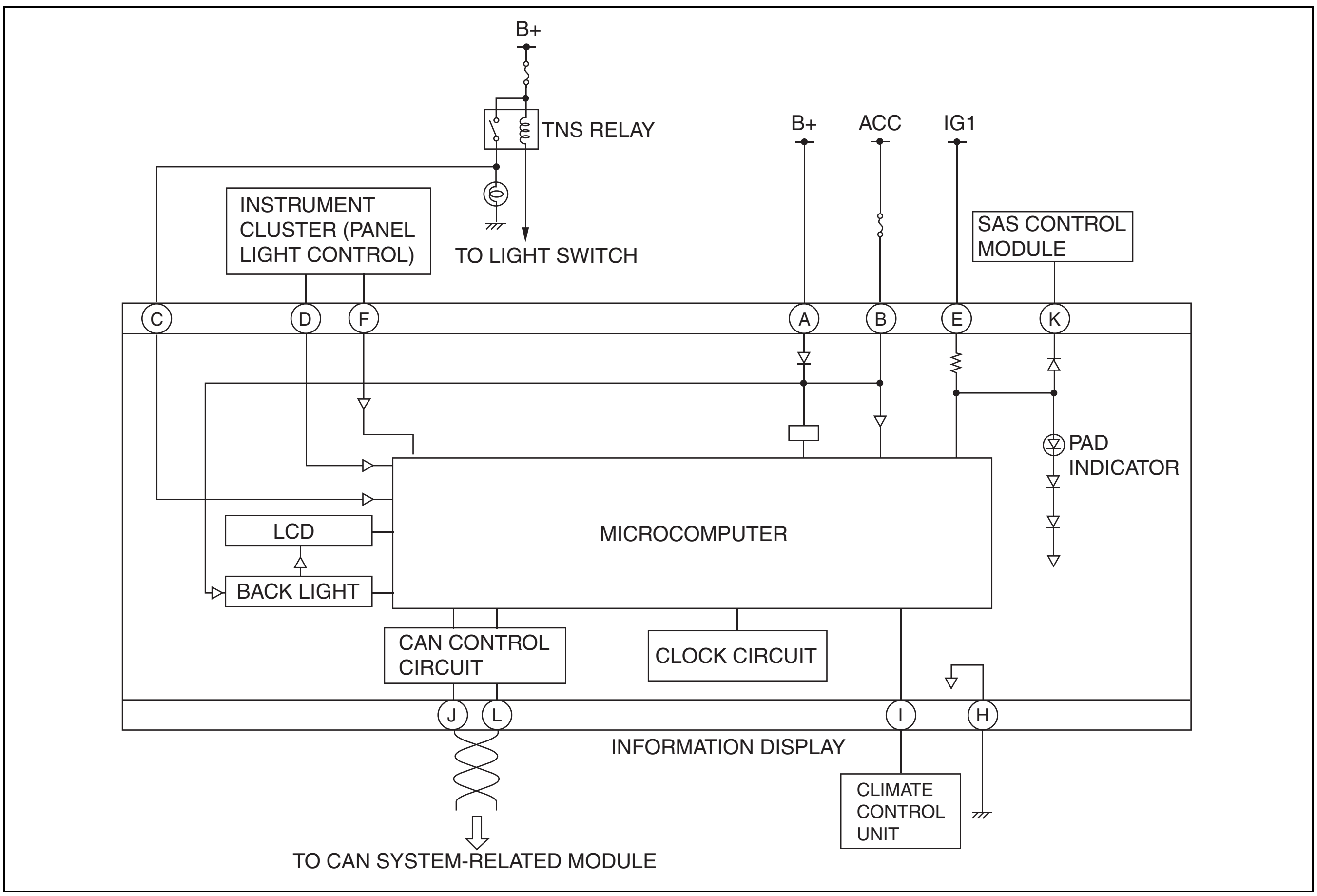
INFORMATION DISPLAY FUNCTION

id092200100500

- The information display has the following functions:
  - — Display function
  - — Clock function
  - — Input/output check function

INFORMATION DISPLAY SYSTEM WIRING DIAGRAM

id092200100600



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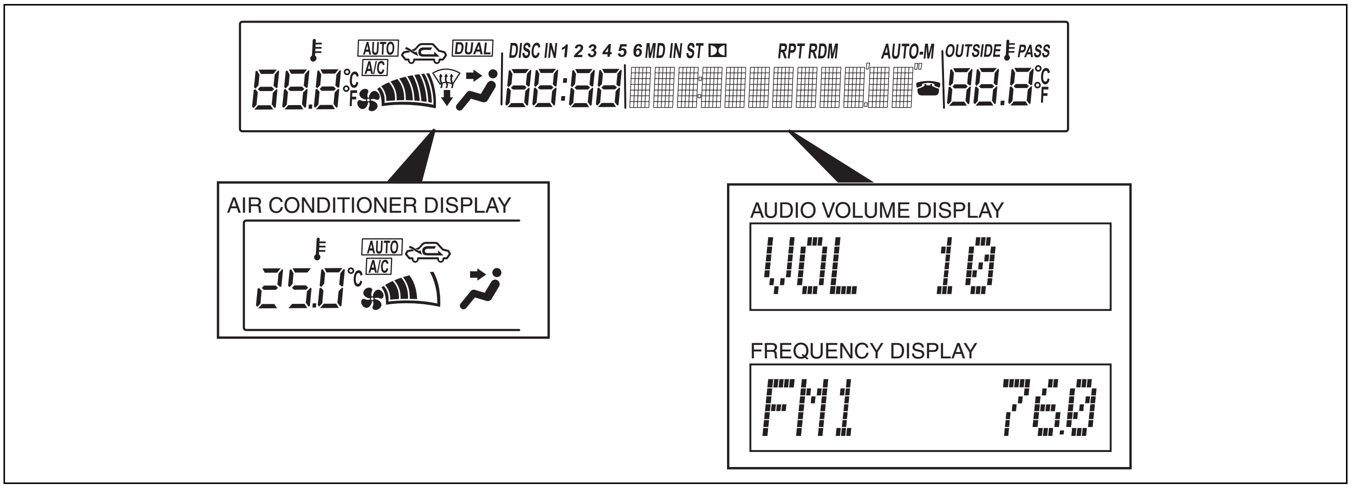
INFORMATION DISPLAY CONSTRUCTION/OPERATION

id092200100400

Display Function

- Displays information for the audio system (such as volume and frequency), air conditioner system (such as air flow volume, set temperature, and mode), and hands-free telephone system based on the signals from the audio unit, the climate control module, and the hands-free telephone unit.



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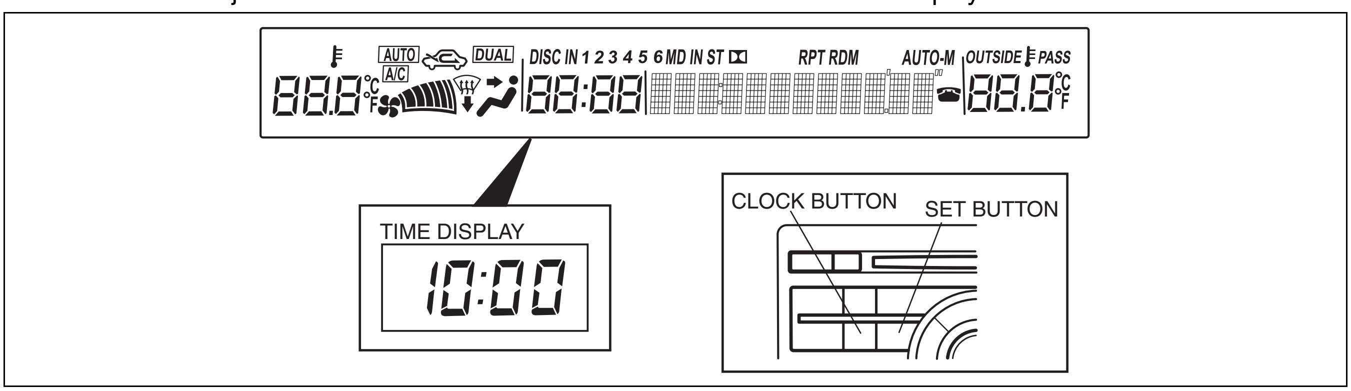
Clock Function

- A clock is integrated.
- Time can be adjusted with the buttons on the left side of the information display.



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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.

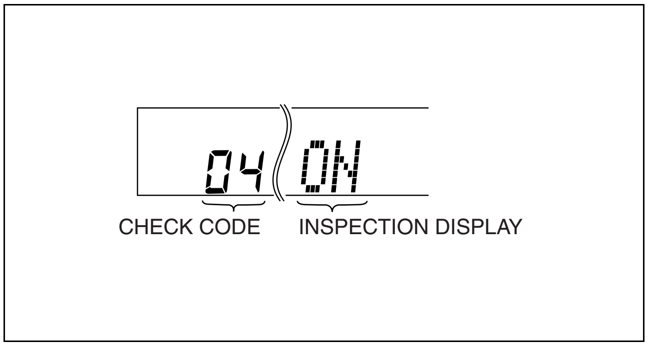
Check code

- 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	Communication error to signal output part
04	TNS relay	• TNS relay • TNS signal wiring harness
06	Ignition switch	Ignition switch
07	Dimmer cancel switch (Instrument cluster)	• Instrument cluster • Related wiring harness
—	LCD	—

Check code display

- The check code and inspection display are displayed in the LCD clock and audio display areas.



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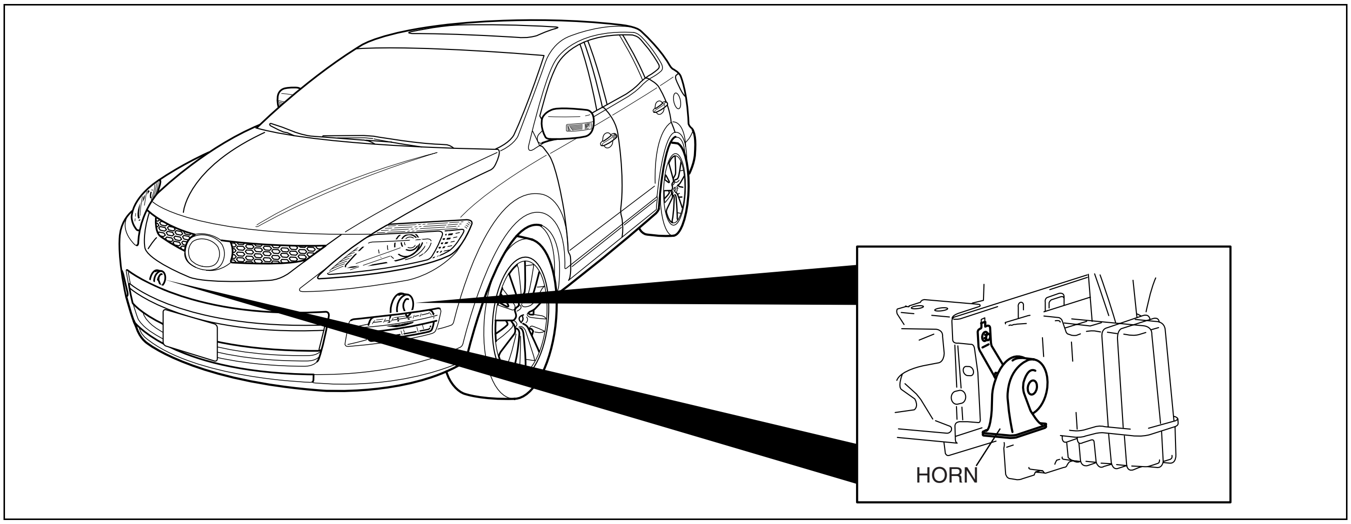
HORN CONSTRUCTION

id092200102800

- A trumpet-type horn with spiral-shaped resonant pipes has been adopted.



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09-40 CONTROL SYSTEM

CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE

id094000101300

- 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
  - — TCM
  - — DSC/RSC HU/CM
  - — BCM
  - — AWD control module
  - — PLG control module
  - — SAS control module
  - — Keyless control module
  - — Instrument cluster
  - — Audio unit (base module)
  - — Audio amplifier
  - — RES unit
  - — Hands-free telephone unit
  - — Information display
  - — Engine off natural vacuum (Engine-off-natural-vacuum is integrated in the PCM)
- With an on-board diagnostic function included for each multiplex module, display of DTCs using the Mazda Modular Diagnostic System (M-MDS) has improved serviceability.

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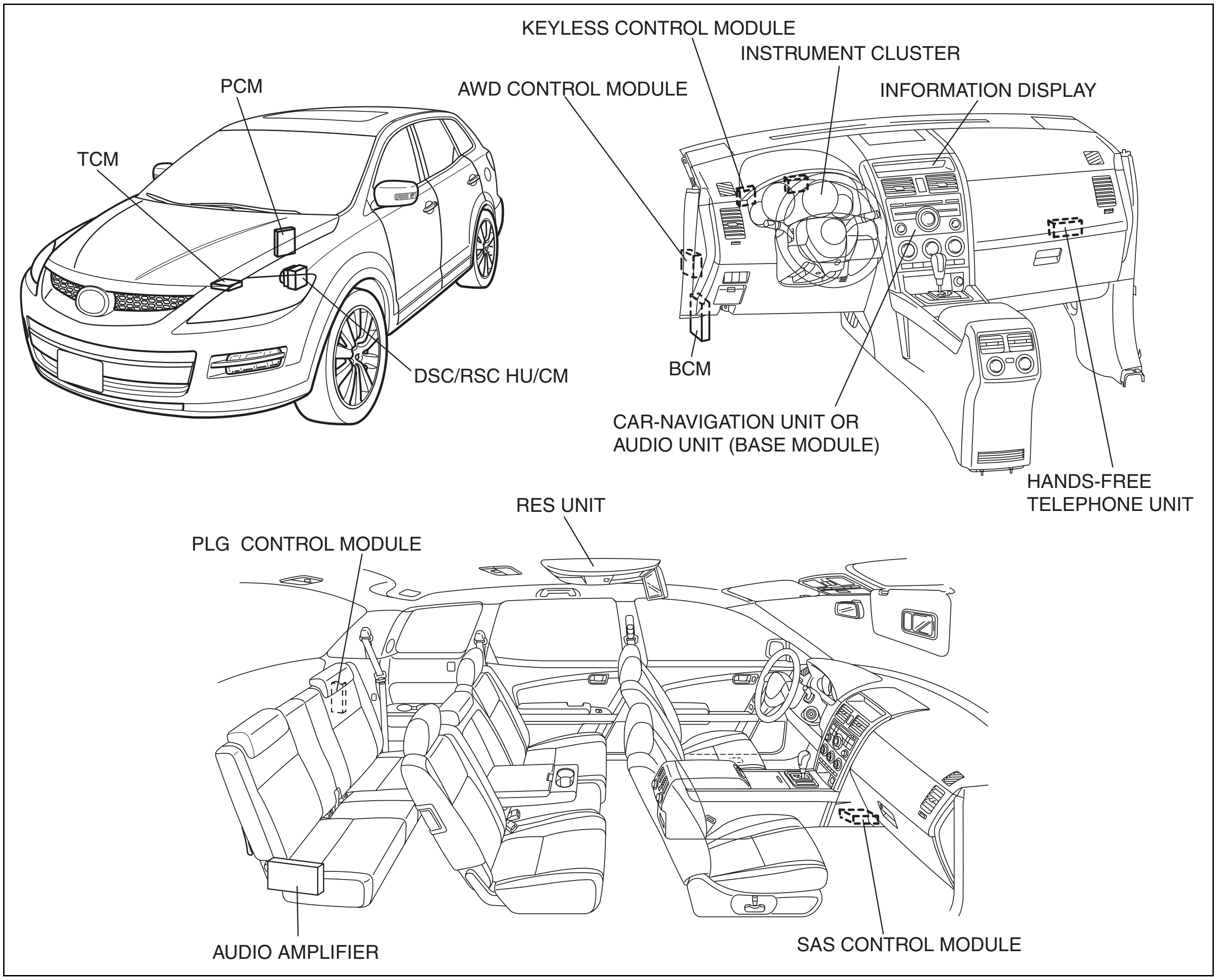
CAN SYSTEM STRUCTURAL VIEW

id094000101100



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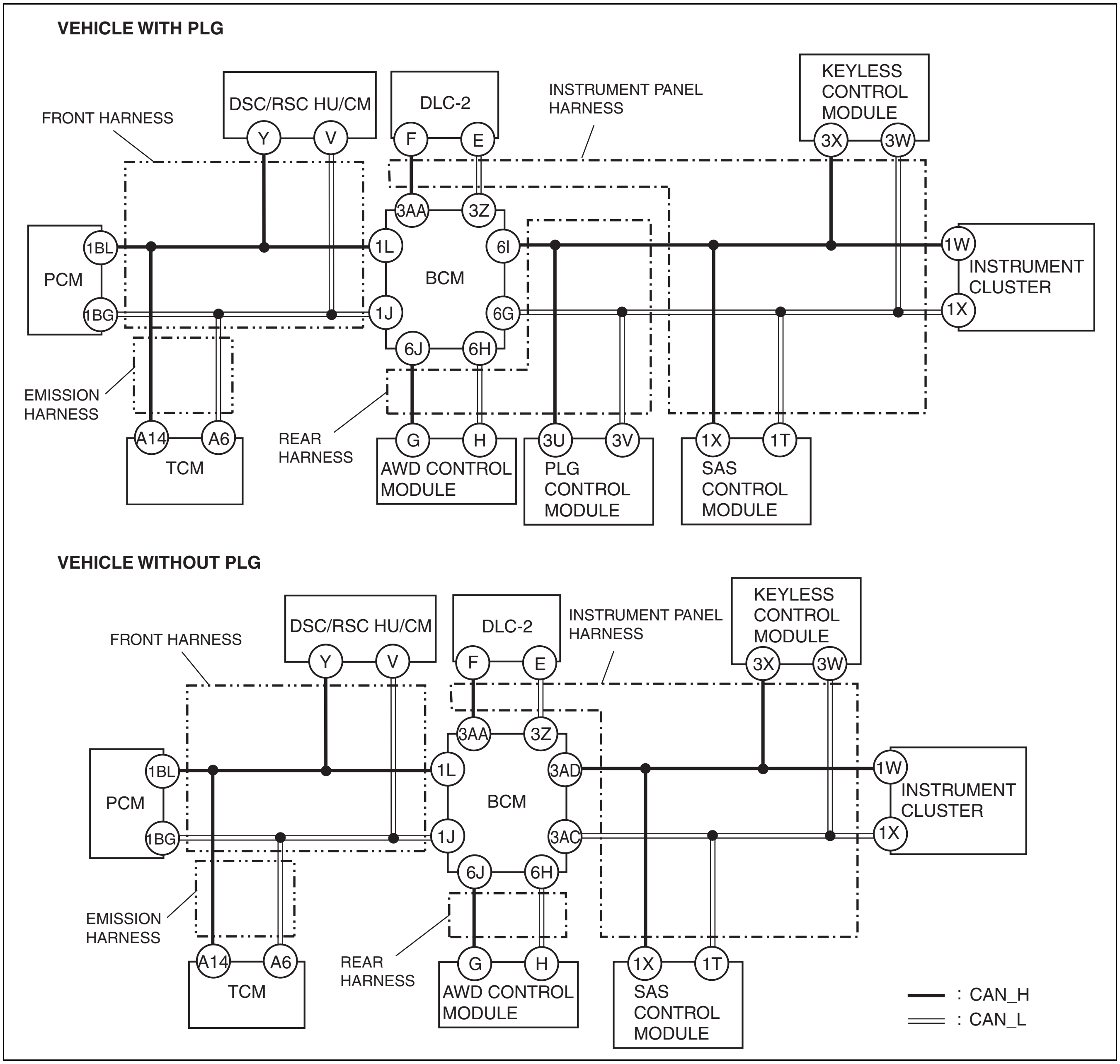
CAN SYSTEM WIRING DIAGRAM

id094000101200

HS-CAN



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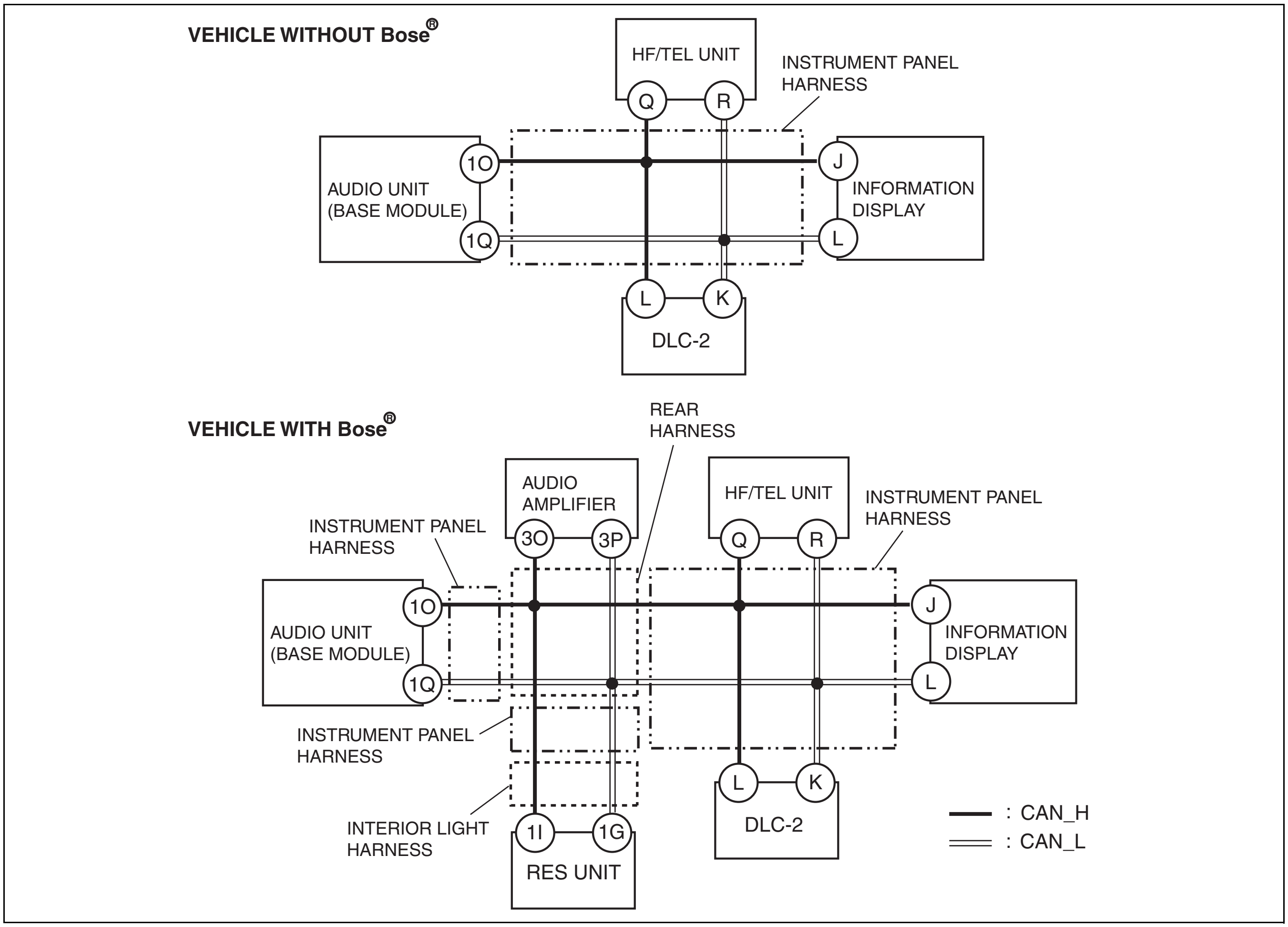
MS-CAN



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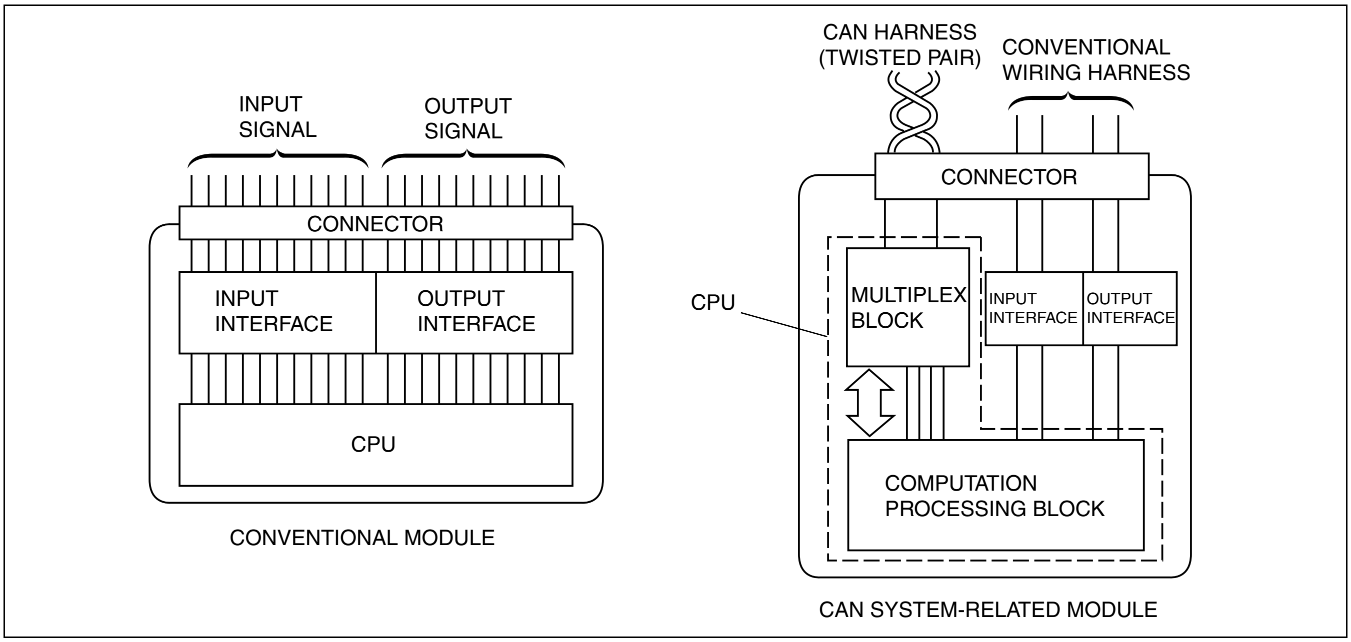
CAN SYSTEM DESCRIPTION

id094000101000

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.



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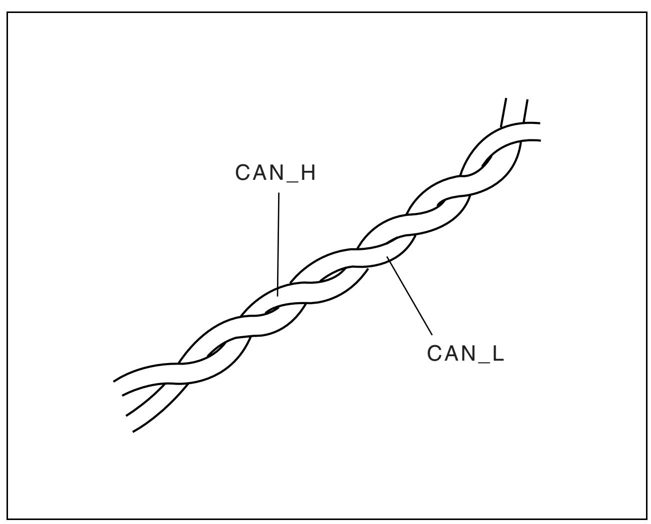
Twisted Pair

- 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.



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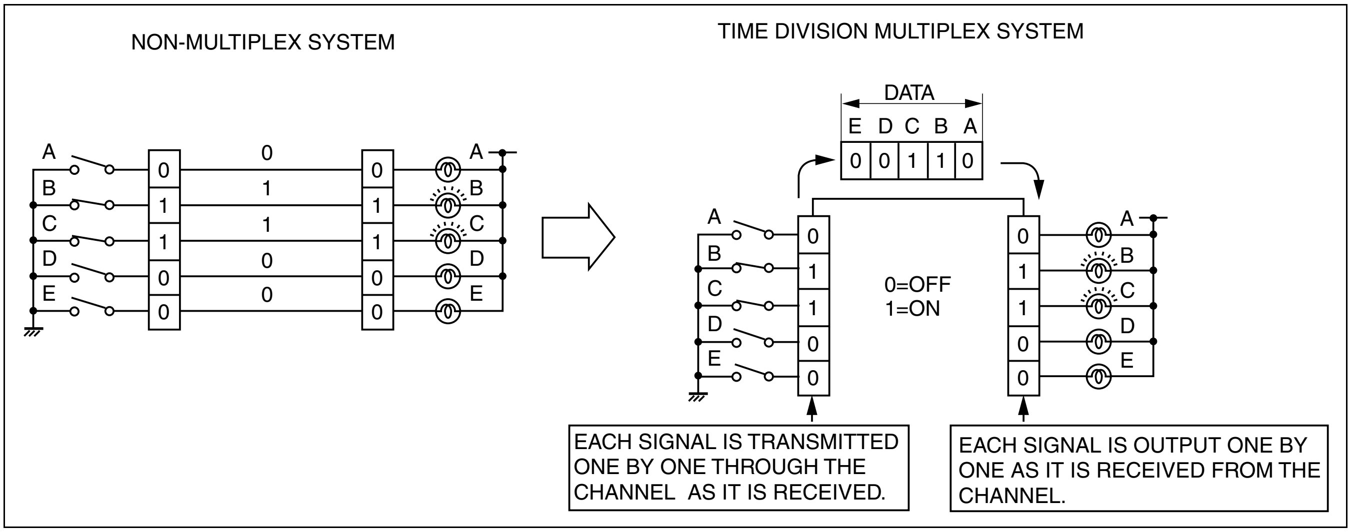
Time Division Multiplex

- 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.



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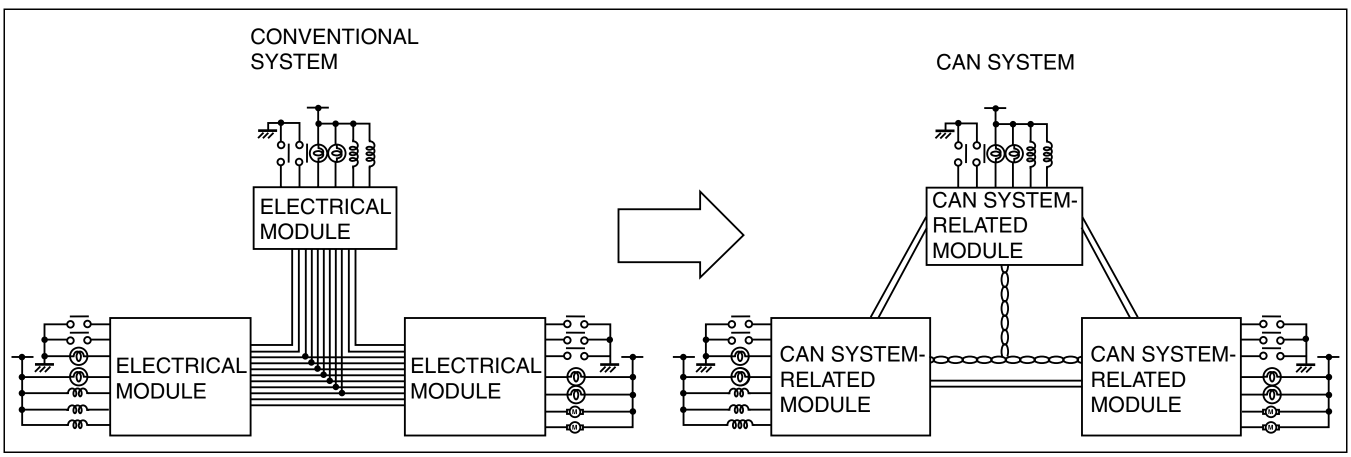
Vehicle CAN System

- 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).



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CAN Signal-Chart (HS-CAN)

OUT: Output (sends signal)
IN: Input (receives signal)

Signal	Multiplex module									
	PCM	TCM	DSC/ RSC HU/CM	BCM	AWD control module	PLG control modul e	SAS control module	Keyless control module	Instrume nt cluster	Engine -off- natural - vacuu m
Immobilizer-related information	OUT	–	–	–	–	–	–	IN	IN	–
	IN	–	–	–	–	–	–	OUT	–	–
Engine torque	OUT	IN	–	–	–	–	–	–	–	–
Engine load	OUT	IN	–	–	–	–	–	–	–	–
Engine torque	OUT	–	IN	–	–	–	–	–	–	–
	OUT	IN	–	–	–	–	–	–	–	–
Brake switch	OUT	–	IN	–	–	–	–	–	–	–
Malfunction of evaporative emission control system-related information	OUT	–	–	–	–	–	–	–	–	IN
	IN	–	–	–	–	–	–	–	–	OUT
FUEL_FLOW	OUT	–	–	–	–	–	–	–	IN	–
MIL on request	OUT	–	–	–	–	–	–	–	IN	–
	IN	OUT	–	–	–	–	–	–	–	–
Cruise control system-related information	OUT	–	–	–	–	–	–	–	IN	–
	OUT	–	IN	–	–	–	–	–	IN	–
ETC warning light on request	OUT	–	–	–	–	–	–	–	IN	–
Electronic throttle control (ETC) status	OUT	–	–	–	–	–	–	–	IN	–
Generator warning light on request	OUT	–	–	–	–	–	–	–	IN	–
Fuel cap warning light on request	OUT	–	–	–	–	–	–	–	IN	–
Intake air temperature	OUT	–	IN	–	–	–	–	–	–	–
Engine coolant temperature	OUT	IN	–	–	–	–	–	–	–	–
ATX gear position/ selector lever position	OUT	–	IN	–	–	–	–	–	–	–
Steering angle/steering angle sensor status	–	–	IN	OUT	–	–	–	–	–	–
Door switch status (LF, RF, LR, RR, liftgate)	–	–	IN	OUT	–	–	–	–	IN	–
Key reminder switch status	–	–	–	OUT	–	–	–	–	IN	–
Turn indicator light on request	–	–	–	OUT	–	–	–	–	IN	–
Turn indicator light on request	–	–	–	OUT	–	–	–	–	IN	–
Brake fluid level	–	–	–	OUT	–	–	–	–	IN	–
Oil pressure switch status	–	–	–	OUT	–	–	–	–	IN	–
Washer fluid level sensor status	–	–	–	OUT	–	–	–	–	IN	–
Door lock status	–	–	–	OUT	–	IN	–	–	–	–
Torque down request	IN	OUT	–	–	–	–	–	–	–	–
ATF temperature	IN	OUT	–	–	–	–	–	–	–	–
ATX gear position/ selector lever position	–	OUT	–	–	–	–	–	–	IN	–
Travelled distance	–	OUT	–	–	–	–	–	–	IN	–

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Signal	Multiplex module									
	PCM	**TCM**	**DSC/ RSC HU/CM**	**BCM**	**AWD control module**	**PLG control module**	**SAS control module**	**Keyless control module**	**Instrument cluster**	**Engine-off-natural-vacuum**
Brake fluid pressure	–	IN	OUT	–	–	–	–	–	–	–
Torque down request	IN	–	OUT	–	–	–	–	–	–	–
Brake system status (EBD/ABS/DSC/RSC)	–	IN	OUT	–	–	–	–	–	–	–
	IN	IN	OUT	–	–	–	–	–	–	–
	IN	–	OUT	–	–	–	–	–	–	–
	–	–	OUT	–	–	–	–	–	IN	–
Wheel speed (LF, RF, LR, RR)	IN	IN	OUT	IN	IN	IN	–	–	–	–
	IN	IN	OUT	IN	IN	–	–	–	–	–
Brake system warning light on request	–	–	OUT	–	–	–	–	–	IN	–
ABS warning light on request	–	–	OUT	–	–	–	–	–	IN	–
Tire circumference (front/ rear)	IN	–	OUT	–	–	–	–	–	–	–
DSC indicator light on request	–	–	OUT	–	–	–	–	–	IN	–
TCS OFF light on request	–	–	OUT	–	–	–	–	–	IN	–
Security light on request	–	–	–	–	–	–	–	OUT	IN	–
Keyless warning buzzer on request	–	–	–	–	–	–	–	OUT	IN	–
Keyless indicator light on request	–	–	–	–	–	–	–	OUT	IN	–
Keyless warning light on request	–	–	–	–	–	–	–	OUT	–	–
PLG operation request	–	–	–	–	–	IN	–	OUT	–	–
	–	–	–	IN	–	OUT	–	–	–	–
	–	–	–	IN	–	OUT	–	IN	IN	–
Buckle switch status	–	–	–	–	–	–	OUT	–	IN	–
Passenger sensing system status	–	–	–	–	–	–	OUT	–	IN	–
Air bag system warning light on request	–	–	–	–	–	–	OUT	–	IN	–
	–	–	–	–	–	–	IN	–	OUT	–
Air bag system warning buzzer on status	–	–	–	–	–	–	OUT	–	IN	–
AWD system status	–	–	IN	–	OUT	–	–	–	–	–
	–	–	–	–	OUT	–	–	–	IN	–
Fuel tank level	IN	–	–	–	–	–	–	–	OUT	IN
	IN	–	–	–	–	–	–	–	OUT	–
Brake fluid level	–	–	IN	–	–	–	–	–	OUT	–
Parking brake switch status	IN	–	IN	–	IN	–	–	–	OUT	–
Ignition key position	IN	–	IN	–	–	–	–	–	OUT	–

CAN Signal-Chart (MS-CAN)

OUT: Output (sends signal)
IN: Input (receives signal)

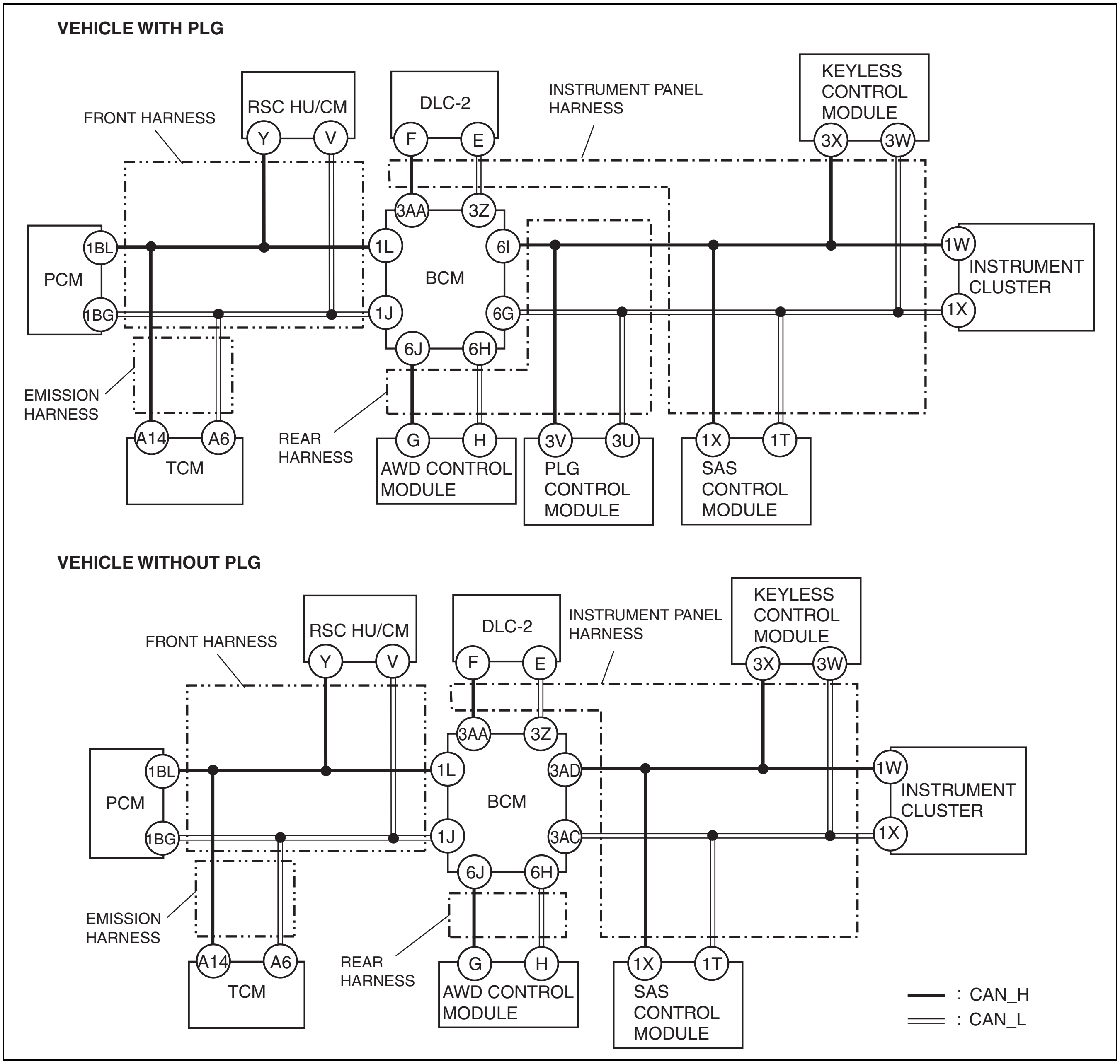
Signal	Multiplex module				
	Audio unit (base module)	Audio amplifier	RES unit	Hands-free telephone unit	Information display
Hands-free telephone system-related information	IN	–	–	OUT	–
	OUT	–	–	IN	–
Audio status display request	OUT	–	–	–	IN
Ignition key position	OUT	–	–	–	IN
Drive information system data	OUT	–	–	–	IN
Buttons status	OUT	–	–	–	IN
Vehicle speed	OUT	IN	–	IN	–
Audio system-related information	OUT	IN	–	–	–
	IN	OUT	IN	IN	–
RES-related information	OUT	–	IN	–	–
Beep sound request	IN	IN	–	–	OUT

On-Board Diagnostic Function

- The on-board diagnostic function is incorporated into the following module:
  - — PCM
  - — TCM
  - — DSC/RSC HU/CM
  - — AWD control module
  - — BCM
  - — PLG control module
  - — SAS control module
  - — Keyless control module
  - — Instrument cluster
  - — Audio unit (base module)
  - — Audio amplifier
  - — RES unit
  - — Hands-free telephone unit
  - — Information display
  - — Engine off natural vacuum (Engin-off-natural-vacuum is integrated in the PCM)
- 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 Mazda Modular Diagnostic System (M-MDS), 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

HS-CAN



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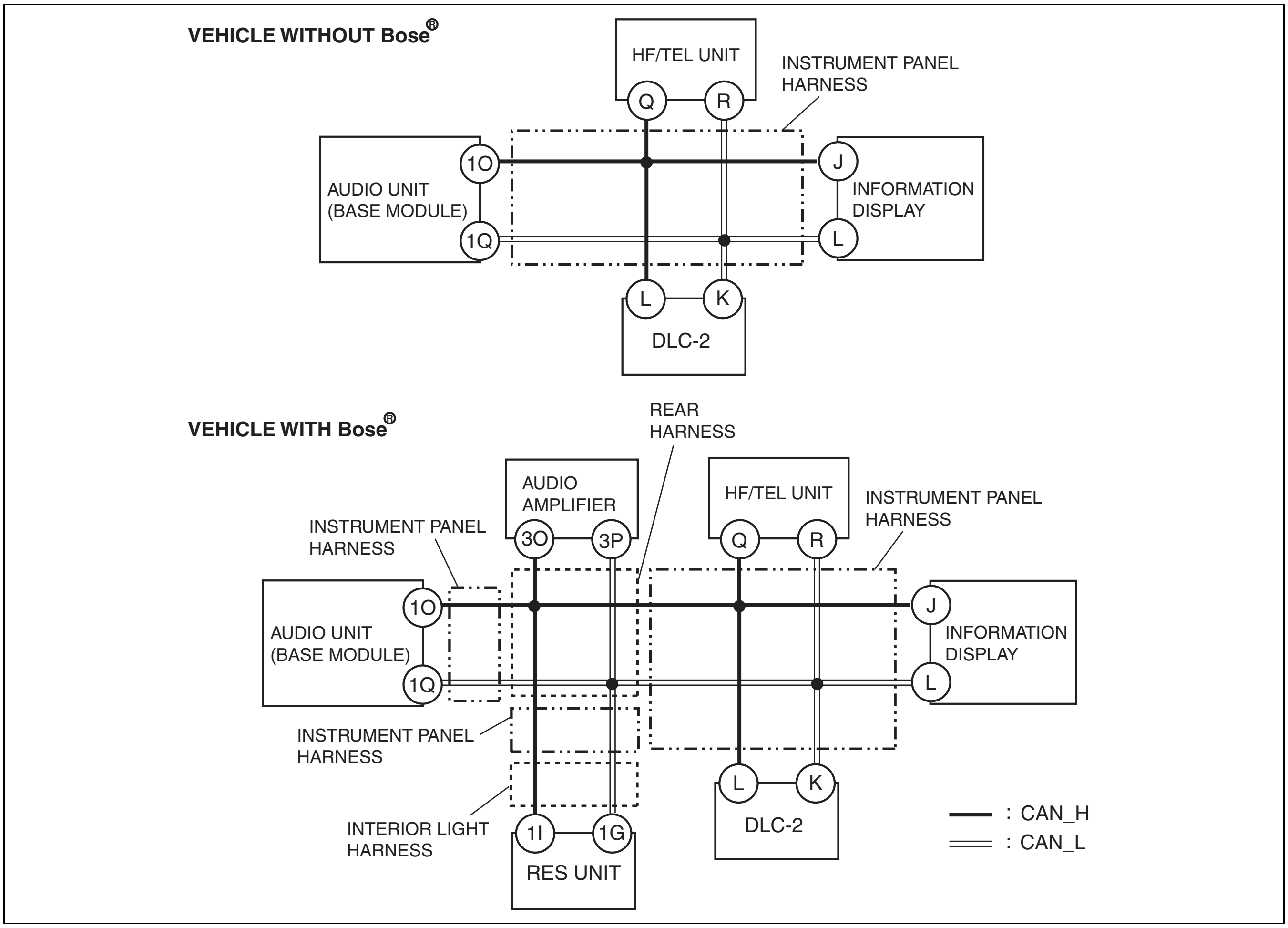
MS-CAN



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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 Mazda Modular Diagnostic System (M-MDS).

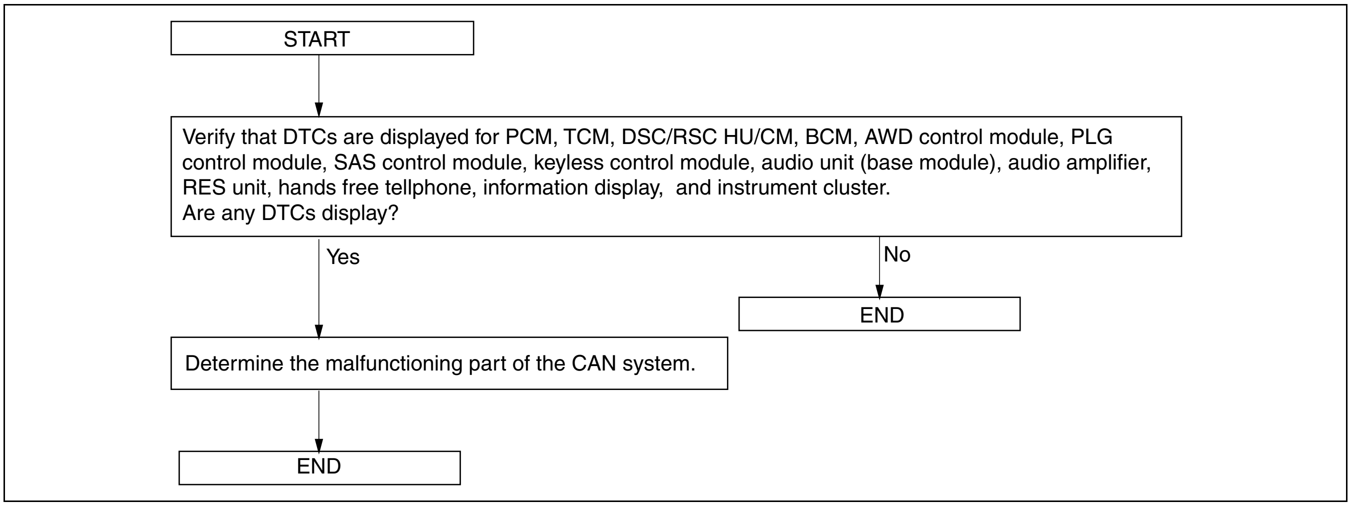
DTC table

DTC	Malfunction location	DTC output module
U0073	CAN system communication error	• TCM • DSC/RSC HU/CM • BCM • AWD control module • PLG control module • SAS control module • Keyless control module • Instrument cluster
U0100	Communication error to PCM	• TCM • DSC/RSC HU/CM • AWD control module • PLG control module • SAS control module • Keyless control module • Instrument cluster
U0101	Communication error to TCM	• PCM • AWD control module • PLG control module • Instrument cluster
U0114	Communication error to AWD control module	• Instrument cluster
U0121	Communication error to DSC/RSC HU/CM	• TCM • AWD control module • Instrument cluster
U0129	Communication error to DSC/RSC HU/CM	• PCM
U0140	Communication error to BCM	• TCM • DSC/RSC HU/CM • PLG control module • Keyless control module • Instrument cluster
U0151	Communication error to SAS control module	Instrument cluster
U0155	Communication error to instrument cluster	• PCM • DSC/RSC HU/CM • AWD control module • PLG control module • SAS control module
U0184	Communication error to audio unit (Base module)	Information display
U0214	Communication error to keyless control module	• PLG control module • Instrument cluster
U0300	Internal control module software incompatibility	PCM
U0323	Communication error to instrument cluster	Keyless control module
U0415	Abnormal message from DSC/RSC HU/CM	TCM
U2023	Abnormal message from other modules	• DSC/RSC HU/CM • Keyless control module • Instrument cluster
U2510	Communication error to PCM	Instrument cluster
U2516	CAN system communication error	Information display
23:Er11	Communication error to audio amplifier	Audio unit (Base module, Touch panel type)
26:Er81	CAN system communication error	HF/TEL unit (Standard type)
CAN Bus	CAN system communication error	HF/TEL unit (Touch panel type)

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. (See 09-40-11 Self-malfunction diagnostic function.)

Flowchart



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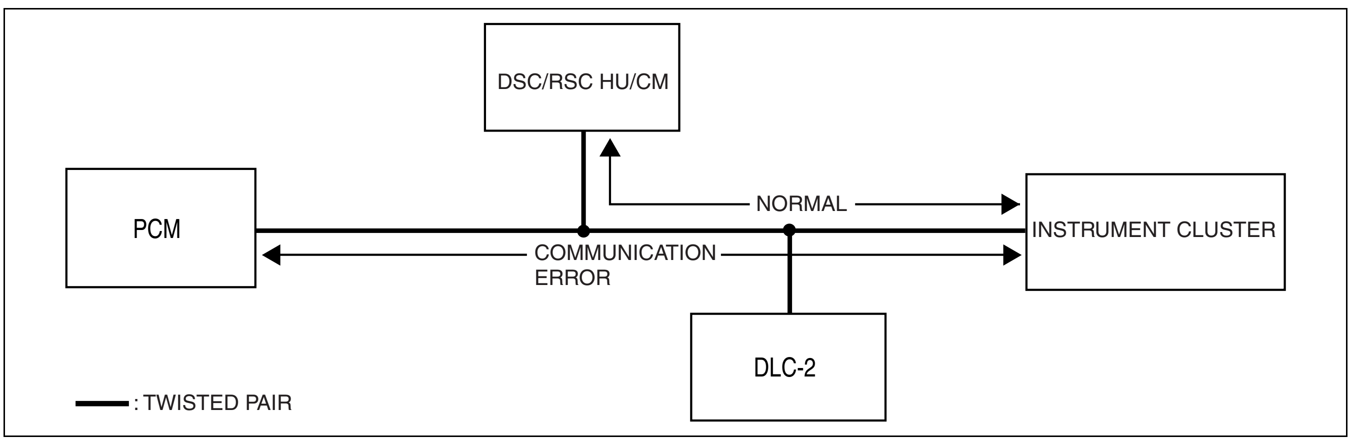
Example (PCM-related communication error)

1. DTCs for the PCM, DSC/RSC HU/CM and instrument cluster can be verified using the Mazda Modular Diagnostic System (M-MDS).

Module	Displayed DTC	Probable malfunction location
PCM	U0155	Communication error between PCM and instrument cluster
DSC/RSC HU/CM	–	–
Instrument cluster	U0100	Communication error between instrument cluster and PCM



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2. If there is a communication error between the instrument cluster and PCM, even if the communication between the DSC/RSC HU/CM and the instrument cluster is normal, it is probable that there is a malfunction in the PCM or PCM-related wiring harnesses.

BODY CONTROL MODULE (BCM) OUTLINE

id094000101400

- The following relays are built into the BCM:
  — Door lock/unlock relays
- The BCM controls the following systems:
  — Interior lighting system
  — Turn and hazard system
  — Rear wiper/washer system
  — Power door lock system
  — Keyless entry system
  — Steering angle detection

BODY CONTROL MODULE (BCM) STRUCTURAL VIEW

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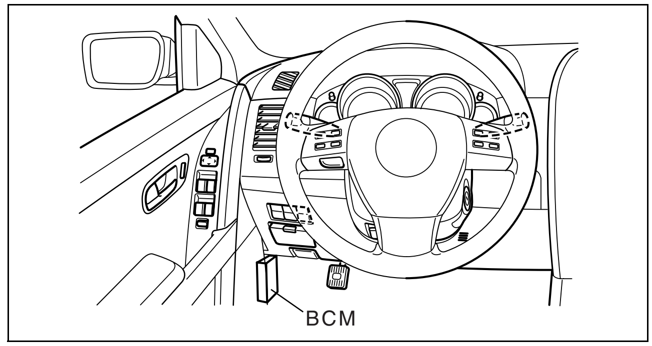

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BODY CONTROL MODULE (BCM) WIRING DIAGRAM

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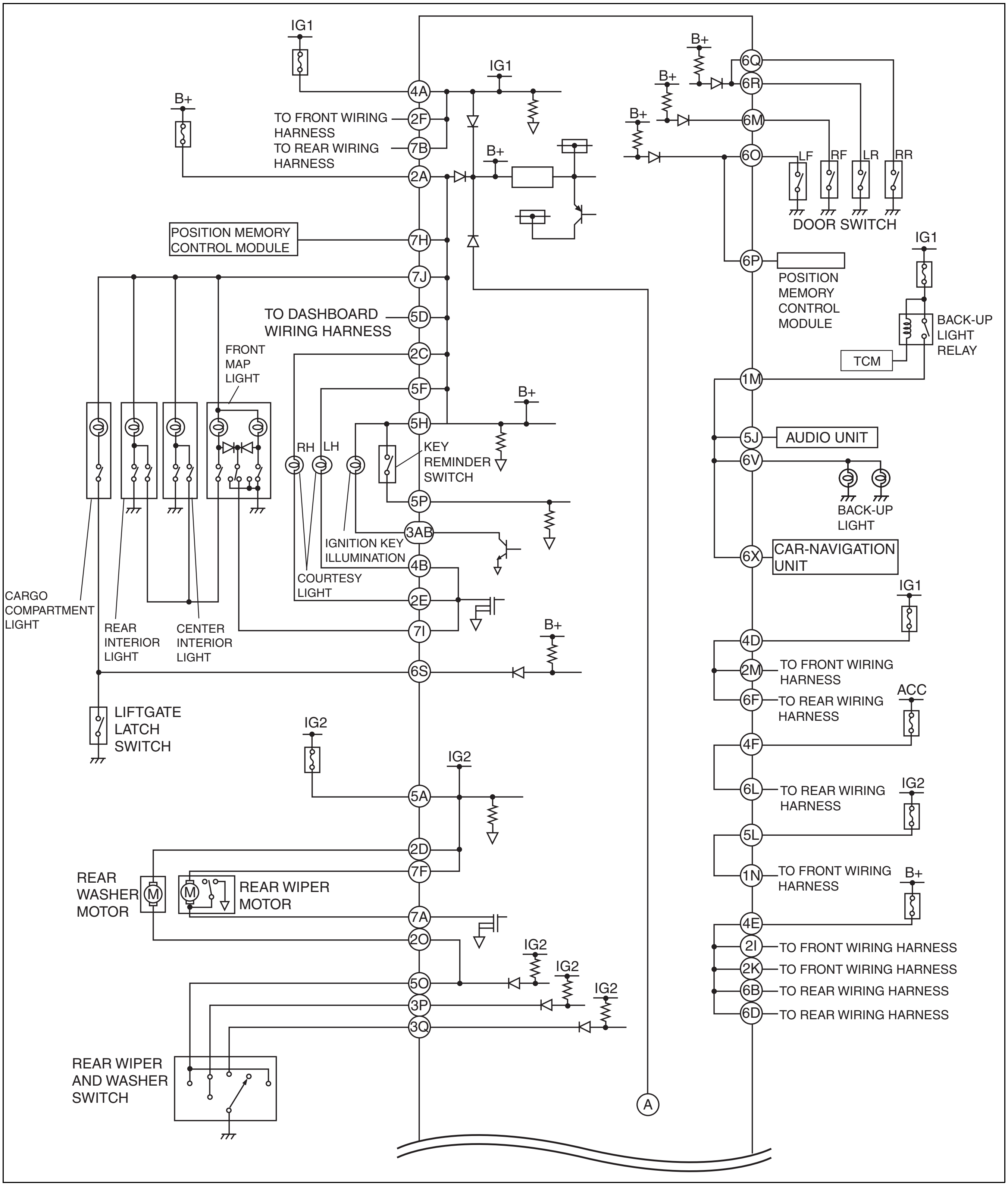

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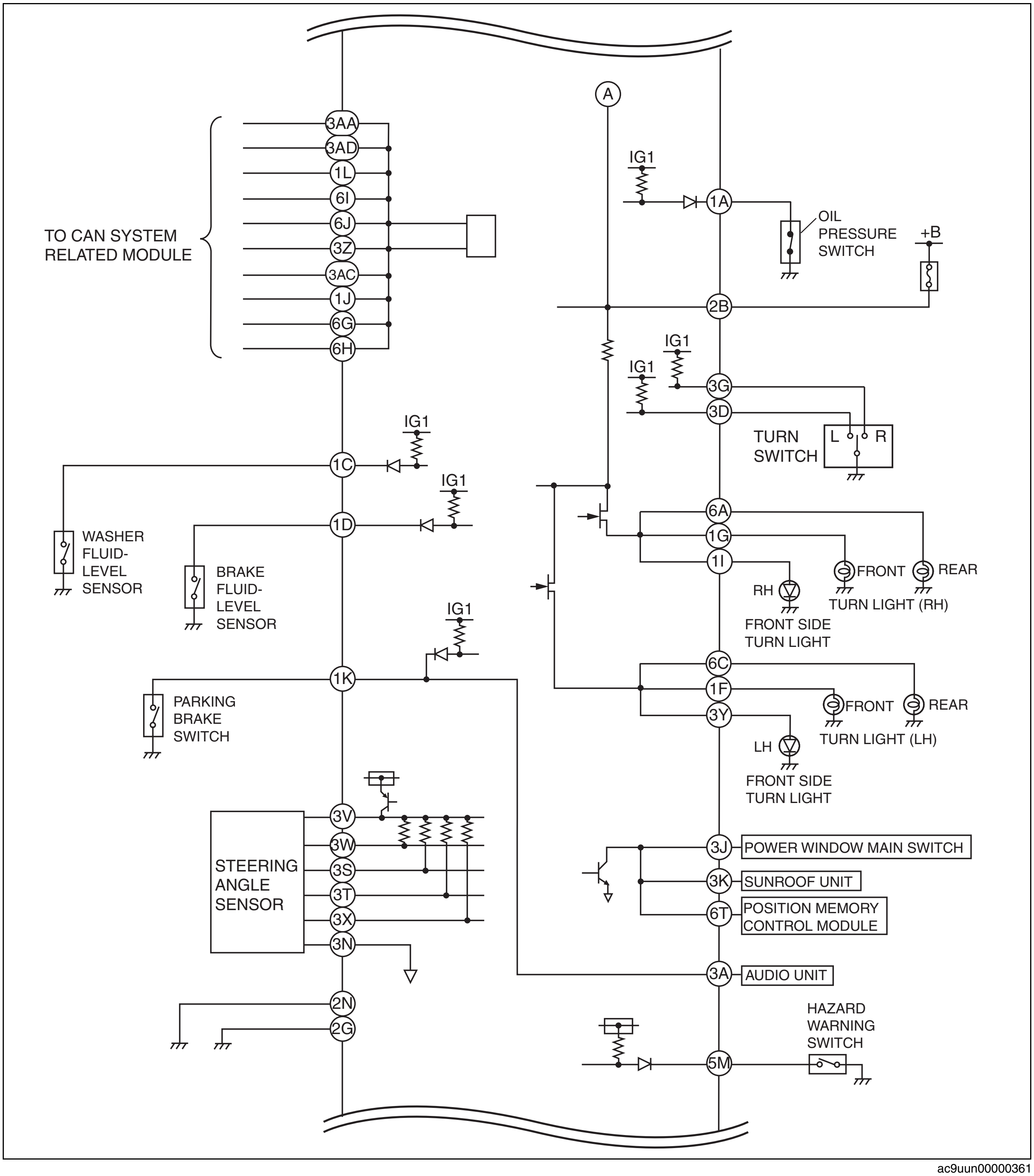
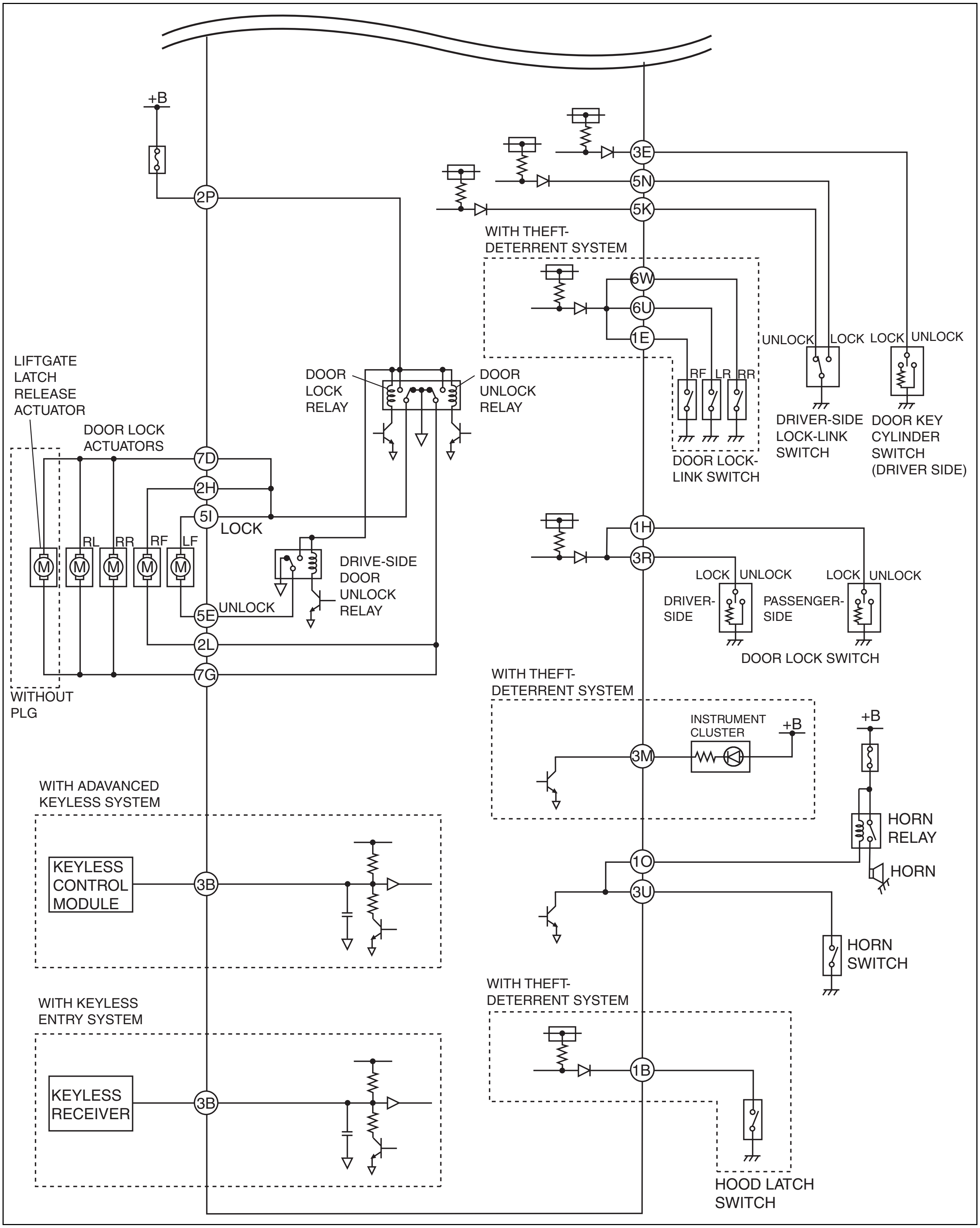


3AA
3AD
1L
6I
6J
3Z
3AC
1J
6G
6H
TO CAN SYSTEM RELATED MODULE
A
IG1
1A
OIL PRESSURE SWITCH
+B
2B
IG1
IG1
3G
3D
TURN SWITCH
L
R
IG1
1C
IG1
1D
WASHER FLUID-LEVEL SENSOR
BRAKE FLUID-LEVEL SENSOR
6A
1G
1I
FRONT
REAR
RH
TURN LIGHT (RH)
FRONT SIDE TURN LIGHT
IG1
1K
PARKING BRAKE SWITCH
6C
1F
3Y
FRONT
REAR
LH
TURN LIGHT (LH)
FRONT SIDE TURN LIGHT
STEERING ANGLE SENSOR
3V
3W
3S
3T
3X
3N
3J
POWER WINDOW MAIN SWITCH
3K
SUNROOF UNIT
6T
POSITION MEMORY CONTROL MODULE
3A
AUDIO UNIT
2N
2G
HAZARD WARNING SWITCH
5M
ac9uun00000361


+B
2P
3E
5N
5K
WITH THEFT-DETERRENT SYSTEM
6W
6U
1E
UNLOCK
LOCK
LOCK
UNLOCK
RF
LR
RR
DRIVER-SIDE LOCK-LINK SWITCH
DOOR KEY CYLINDER SWITCH (DRIVER SIDE)
DOOR LOCK-LINK SWITCH
LIFTGATE LATCH RELEASE ACTUATOR
DOOR LOCK RELAY
DOOR UNLOCK RELAY
DOOR LOCK ACTUATORS
7D
2H
5I
LOCK
RL
RR
RF
LF
M
DRIVE-SIDE DOOR UNLOCK RELAY
5E
UNLOCK
2L
7G
WITHOUT PLG
1H
3R
LOCK
UNLOCK
LOCK
UNLOCK
DRIVER-SIDE
PASSENGER-SIDE
DOOR LOCK SWITCH
WITH THEFT-DETERRENT SYSTEM
INSTRUMENT CLUSTER
+B
3M
+B
HORN RELAY
HORN
1O
3U
HORN SWITCH
WITH ADAVANCED KEYLESS SYSTEM
KEYLESS CONTROL MODULE
3B
WITH KEYLESS ENTRY SYSTEM
KEYLESS RECEIVER
3B
WITH THEFT-DETERRENT SYSTEM
1B
HOOD LATCH SWITCH
ac9uun00000362

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STEERING ANGLE DETECTION FUNCTION

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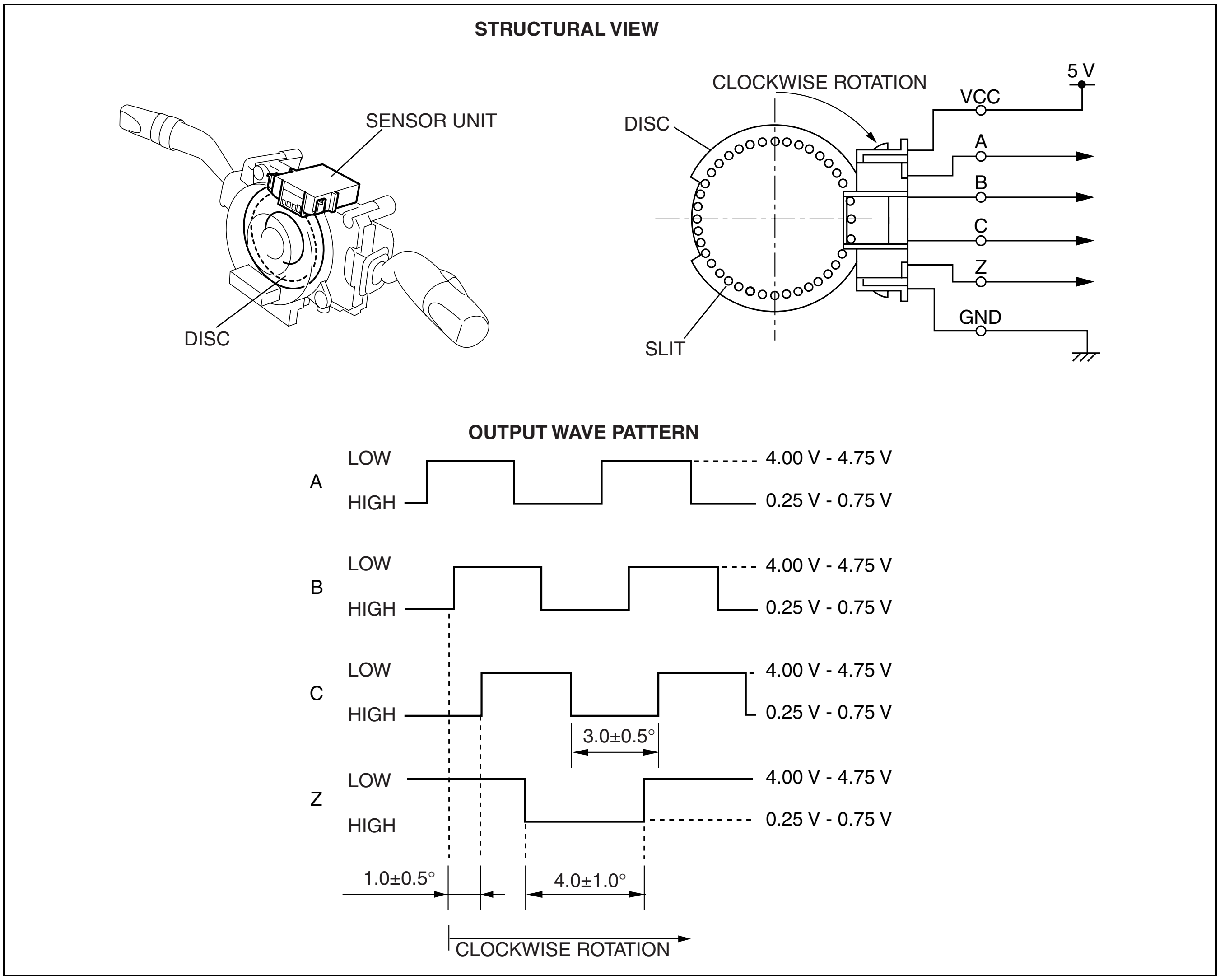
- The steering angle is calculated based on the signal from the steering angle sensor and sent to other units via CAN.

Steering Angle Sensor

- The steering angle sensor, located on the combination switch, detects the steering angle and the neutral position, and transmits them to the BCM.

Note

- The steering angle reference point stored in the BCM is cleared in the following cases. Perform the steering angle sensor initialization referring to the Workshop Manual.
  - — Negative battery cable disconnected
  - — Steering angle sensor connector disconnected
  - — Fuse (ROOM) removed
  - — Wiring harness between battery and BCM disconnected



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Sleep Control

- When determination is made with all of the following conditions met and no occupants in the vehicle, the BCM initiates sleep control and controls power consumption.
  - — Ignition switch is in the LOCK position
  - — **Fifteen hours** have elapsed since the ignition switch was in the LOCK position
- If any one of the following operations is performed, the BCM returns to normal control.
  - — Ignition switch is turned to the ON position.
  - — The key is inserted in the steering lock.
  - — A door or the liftgate is opened
  - — The steering wheel is operated
- During sleep control, the power supply voltage to the steering angle sensor becomes intermittent to control power consumption.

Note

- If sudden maneuvering is performed during slip control, the steering angle reference point stored in the BCM could be cleared. Perform the steering angle sensor initialization referring to the Workshop Manual.

ON-BOARD DIAGNOSTIC FUNCTION

id094000101700

- 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 Mazda Modular Diagnostic System (M-MDS) to the DLC-2.
- In addition to DTC read-out, the Mazda Modular Diagnostic System (M-MDS) 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
B1317	Battery voltage high	Input voltage from the battery is excessively high
B1318	Battery voltage low	Input voltage from the battery is excessively low
B1322	Driver door ajar circuit short to ground	Short to GND in wiring harness between BCM and front door switch (driver side)
B1330	Passenger door ajar circuit short to ground	Short to GND in wiring harness between BCM and front door latch switch (passenger side)
B1342	BCM internal malfunction	BCM microcomputer malfunction
B1502	Turn signal left circuit short to ground	Short to GND in wiring harness between BCM and turn switch (LH)
B1506	Turn signal right circuit short to ground	Short to GND in wiring harness between BCM and turn switch (RH)
B1520	Hood switch circuit open	Open circuit in wiring harness between BCM and hood latch switch
B1566	Door ajar circuit short to ground	Short to GND in wiring harness between BCM and rear door switches
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)
B1873	Hazard switch input circuit short to ground	Short to GND in wiring harness between BCM and hazard warning switch
B2218	Door lock switch circuit short to ground	Short to GND in wiring harness between BCM and door lock switches
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
B2982	Parking brake switch circuit open	Open circuit in wiring harness between BCM and parking brake switch
C1189	Brake fluid level sensor input short to ground	Short to GND in wiring harness between BCM and brake fluid level sensor
C1284	Oil pressure switch circuit failure	Open circuit in wiring harness between BCM and oil pressure switch
C1295	Steering wheel angle sensor internal fault	BCM detects steering angle sensor internal abnormality (signal overflow)
C1307	Steering wheel angle sensor encoder ring defective	BCM detects steering angle sensor internal abnormality (signal jump)
C1441	Steering phase A circuit signal is not sensed	Open circuit in wiring harness between BCM and steering angle sensor
C1442	Steering phase B circuit signal is not sensed	Open circuit in wiring harness between BCM and steering angle sensor
C1443	Steering phase A circuit short to ground	Short to GND in wiring harness between BCM and steering angle sensor
C1444	Steering phase B circuit short to ground	Short to GND in wiring harness between BCM and steering angle sensor
C144A	Steering phase C circuit short to ground	Short to GND in wiring harness between BCM and steering angle sensor
C144B	Steering phase Z circuit short to ground	Short to GND in wiring harness between BCM and steering angle sensor

DTC No.	Description	Detection condition
C144C	Steering phase C circuit signal is not sensed	Open circuit in wiring harness between BCM and steering angle sensor
C144D	Steering phase Z circuit signal is not sensed	Open circuit in wiring harness between BCM and steering angle sensor
C1937	Steering wheel angle sensor offset failure	BCM lost steering angle initialization position
U0073	CAN system communication error	BCM or twisted pair malfunction

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
CCNT_GE	—	Perform the DTC inspection.	—
HOOD_SW	OPEN/CLOSE	Hood latch switch **Note** • "CLOSE" is displayed on vehicles with the theft-deterrent system.	1B
T_GATE_SW	OPEN/CLOSE	Liftgate latch switch	6S
DRSW_REAR	OPEN/CLOSE	Rear door switch	6Q, 6R
DRSW_RF	OPEN/CLOSE	Front door latch switch (RH)	6M
DRSW_LF	OPEN/CLOSE	Front door latch switch (LH)	6O
HAZARD	On/Off	Hazard warning switch	5M
RWASH_SW	On/Off	Rear washer switch	5O
PRK_BRK	On/Off	Parking brake switch	1K
WPINT_REAR	On/Off	Rear wiper and washer switch (INT)	3Q
TURN_SW_R	On/Off	Turn switch (RH)	3G
TURN_SW_L	On/Off	Turn switch (LH)	3D
LLSW_D	LOCK/UNLOCK	Driver-side door lock-link switch	5K, 5N
CLS_LOCK	LOCK/Off	Door lock switches (lock)	1H, 3R
BRK_FLUID	Low/Normal	Brake fluid level sensor	1D