2004 Mazda RX-8 Service Highlights

FOREWORD

This Service Highlights is intended for use by service training personnel of Authorized Mazda Dealers.

All the contents of this manual, including drawings and specifications, are the latest available at the time of printing.

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.

CONTENTS

PRINTED IN U.S.A., MARCH 2003
Form No. 3378–1U–03C
Part No. 9999–95–102F–04

GENERAL INFORMATION

00
SECTION

00–00 GENERAL INFORMATION

AIM OF DEVELOPMENT

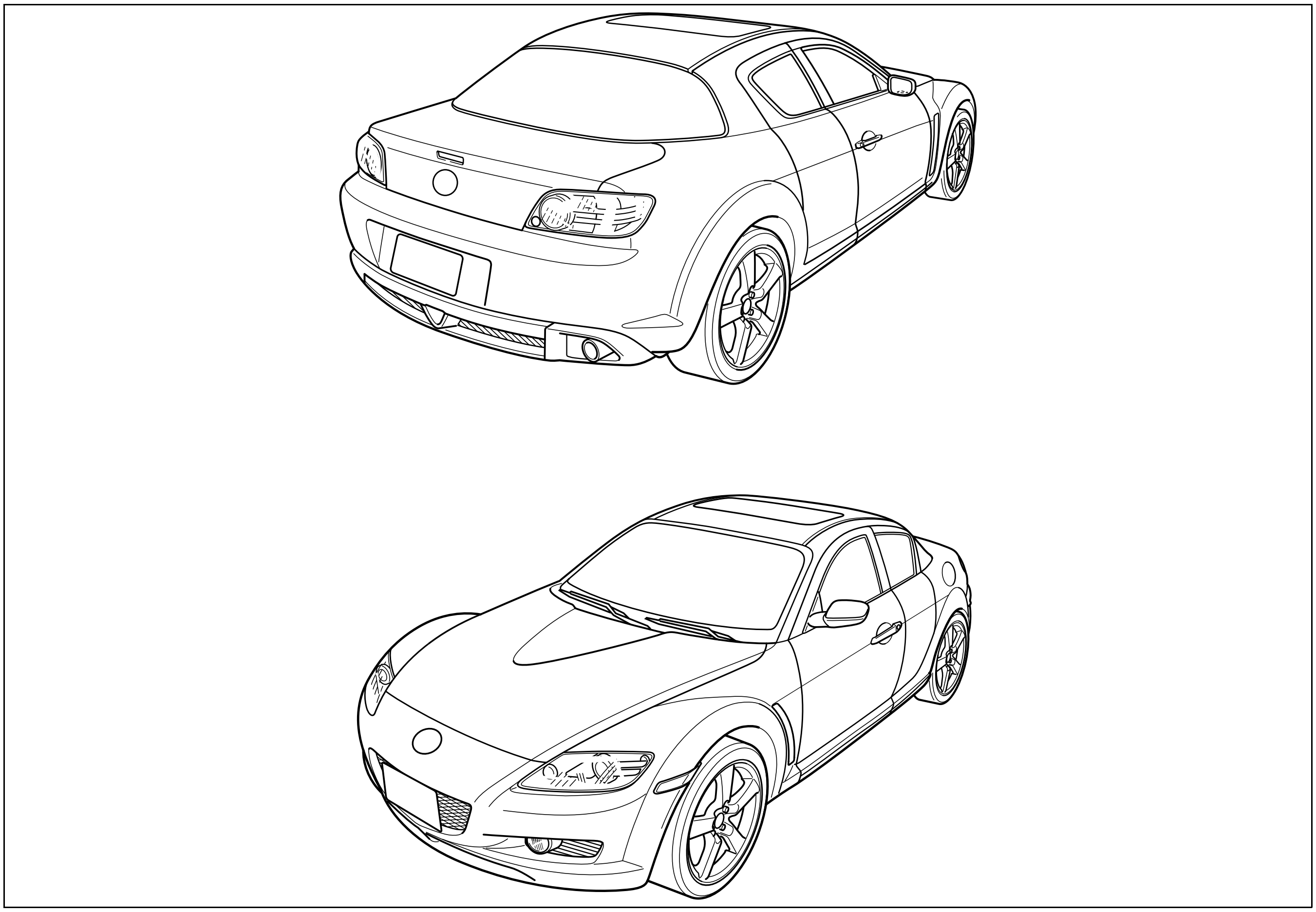
CHU000000022S01

New Model Concept

"New four-door, four-passenger sports car"

- The Mazda RX-8 is an entirely new concept in a state-of-the-art sports car, combining unique sports-car styling and excellent driving performance, together with the comfort and practicality of a four-door, four-passenger layout.

External view



CHU0000S003

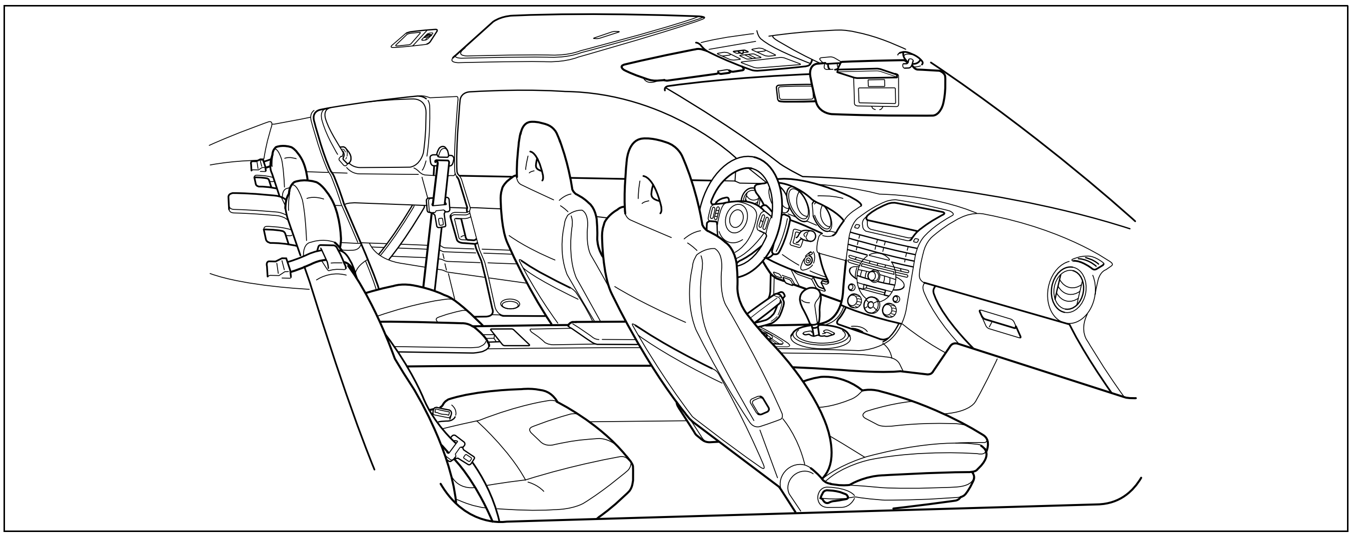
Outline

Exterior design

- The dynamic styling, from front to back and along the body sides, creates a sense of "motion".
- A compact cabin supported by pronounced overfenders, lowers the visual center of gravity, emphasizing a sense of "stability".
- A pared-down body shape and a boldly contoured form gives the Mazda RX-8 an aggressive appearance.

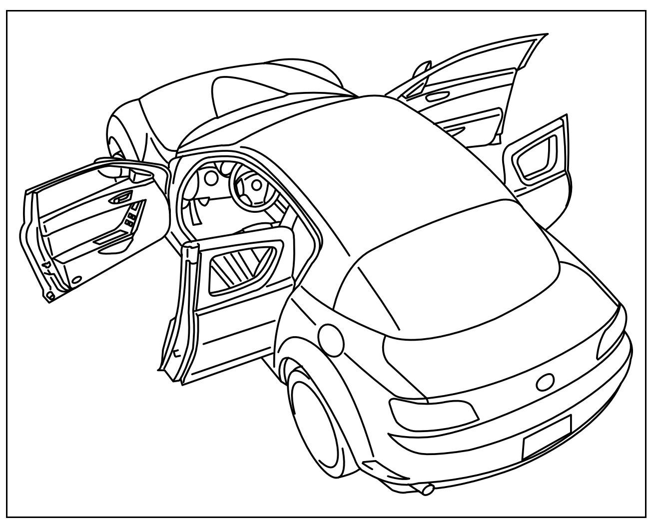
Interior design

- Modern, high-quality design
  - — Vibrant styling from the dashboard to the rear.
  - — Tight and compact dashboard emphasizes lightness and sophistication by adopting new textures, coloring, and metallic-look materials that add to its unique style.
  - — Rotor-motif shift-lever knob and sunvisors employing mesh texturing demonstrate the value and attention to detail.
- Comfortable interior
  - — Front and rear console boxes with cup holders.
  - — Door pockets are provided for road maps or a small bag.
  - — Sunvisors are equipped with illuminated vanity mirrors.
  - — Premium audio system with nine BOSE speakers is available, offering an acoustic space of high quality.



CHU0000S018

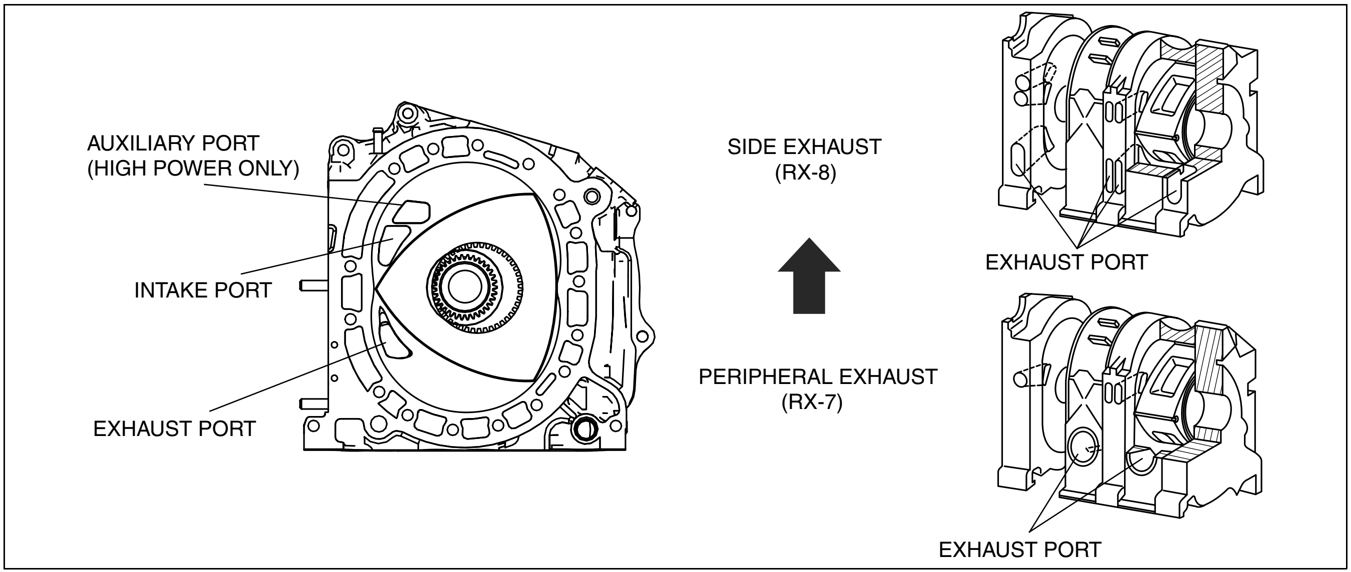
- Center pillarless freestyle doors providing unhindered access to the cabin have been adopted.
- Trunk compartment with a practical capacity
  - — A storage capacity of approx. 290 L {306 US qt, 255 Imp qt}, sufficient for two golf bags or two size-67 Samsonite suitcases, has been realized by lowering the floor thanks to the emergency puncture repair kit which requires no spare tire.



CHU0000S017

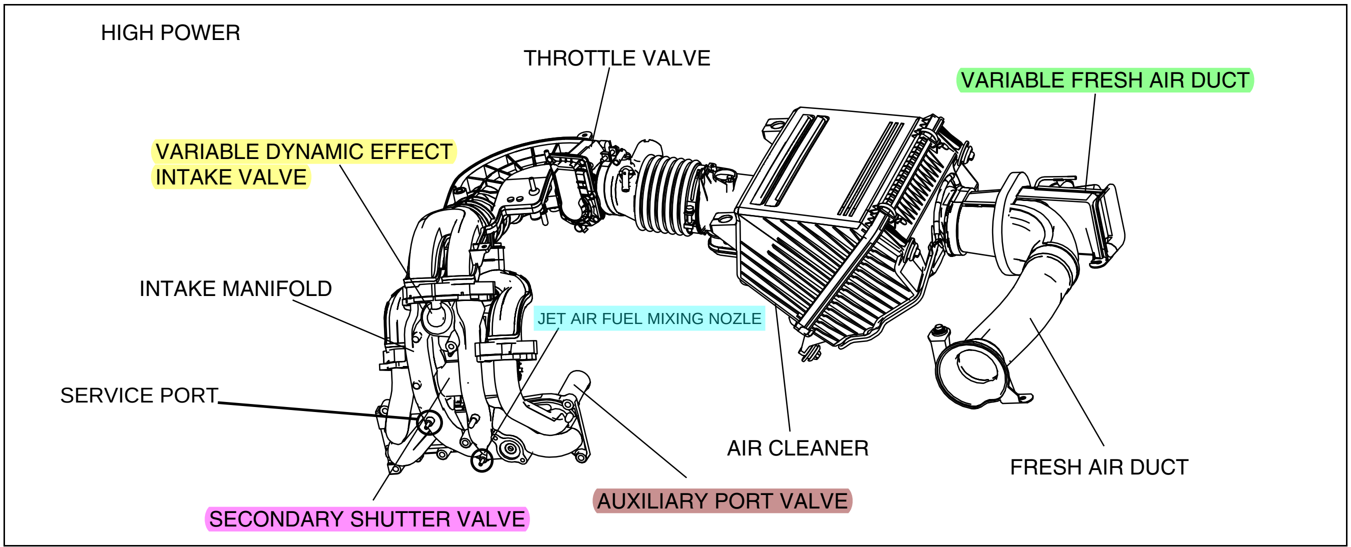
Engine - the "RENESIS" - a new-generation rotary engine

- Engine
  - 13B-multi side port (MSP) (High power and Standard power), new-generation rotary engine has been adopted.
  - Side exhaust system has been adopted by transferring the exhaust ports from the rotor housing to the side housing.
  - The intake port area has been in increased by 30% over previous rotary engines. This results in reduced intake resistance and increased air flow which makes more power.
  - Cut-off seals have been provided between the oil seals and the side seals of the rotors, preventing combustion gas from flowing into the intake air process.
  - Keystone-shaped (wedge-shaped) side seals have been adopted for increased sealing performance.
  - Ribs in the side housing and rotors have been decreased in thickness and weight while maintaining high rigidity.
  - Spark plugs with iridium tips have been adopted for improved heat resistance and durability.
  - Flank cuts on the corners of the rotors provide improved exhaust efficiency by delaying the exhaust-port closing timing.



CHU0000S020

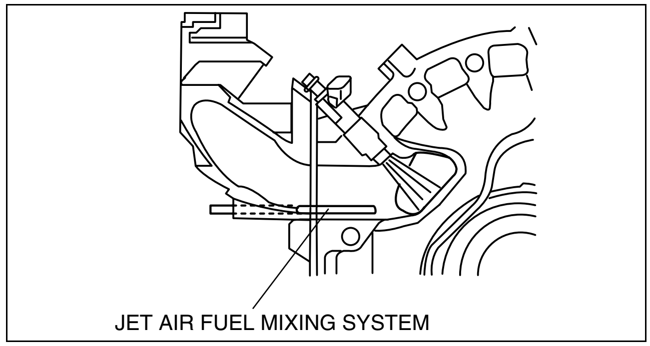
- Intake and control
  - Sequential dynamic air intake system (S-DAIS) has been adopted, realizing powerful output at high engine speed provides a wide-range of torque in the low and medium-speed ranges through full use of air intake pulsating unique to the rotary engine.
  - Large, low-resistance air cleaner and variable fresh air duct (VFAD) (High power only) have been adopted.



CHU0000S013

— Three injectors per rotor have been provided on the High power model (2 per rotor for Standard power). Together with the electronically controlled (drive-by-wire) throttle valves and the 32-bit powertrain control module (PCM), the injector arrangement has realized fine control of the air-fuel ratio and reduced response time.

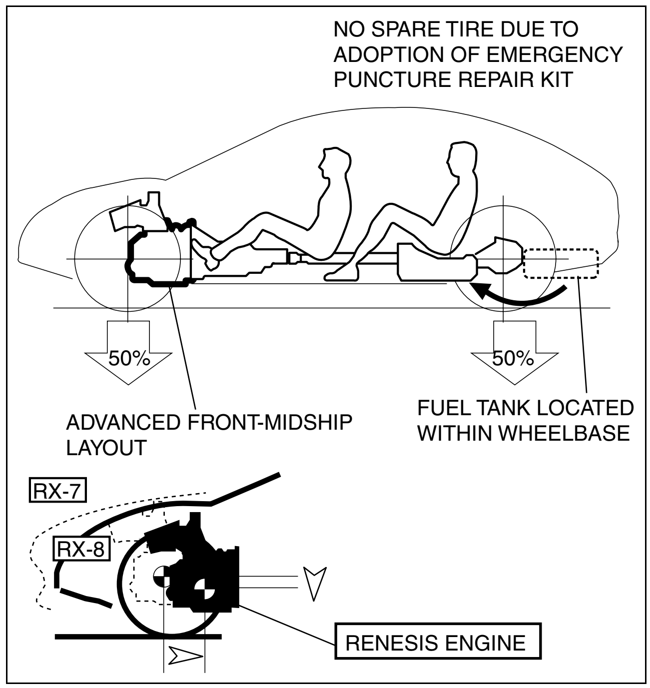
— New jet air fuel mixing system that promotes atomization, vaporization, and mixing of fuel has been adopted on the intake port unique to the rotary engine, realizing improved combustion and reduced fuel consumption.



CHU0000S014

Advanced front-midship layout

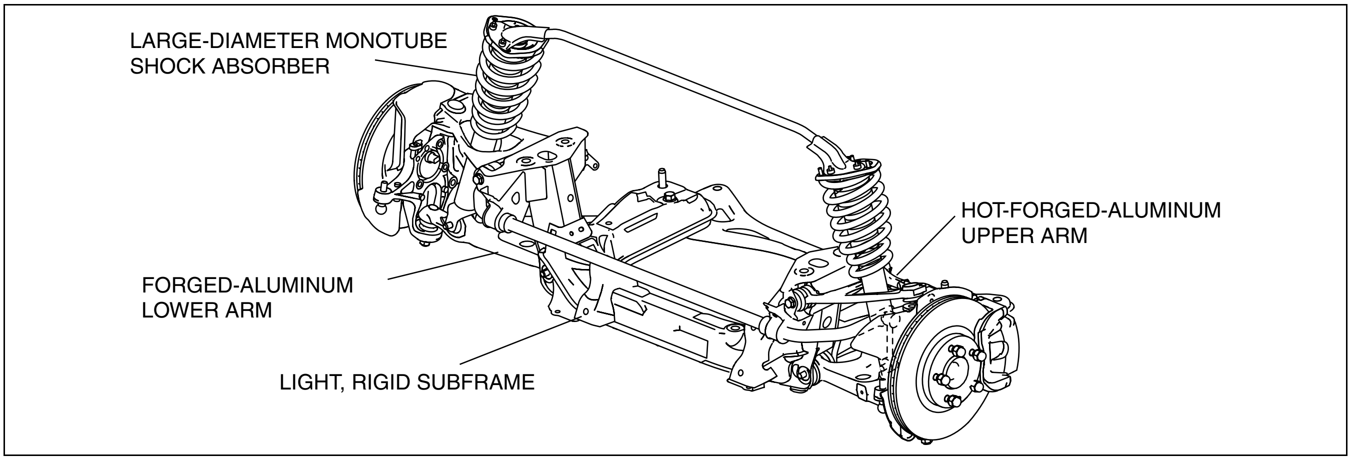
- Combination of state-of-the-art technologies such as a compact rotary engine, a thin engine oil pan, a forward-located air intake system, a compact air-conditioning unit, has produced a small and light powerplant package.
- Adoption of an advanced front-midship layout, saddle-shaped plastic fuel tank, and an emergency puncture repair kit requiring no spare tire has realized a 50-50 front/rear weight distribution, minimal yaw-inertia moment, and high roll-rigidity.



CHU0000S002

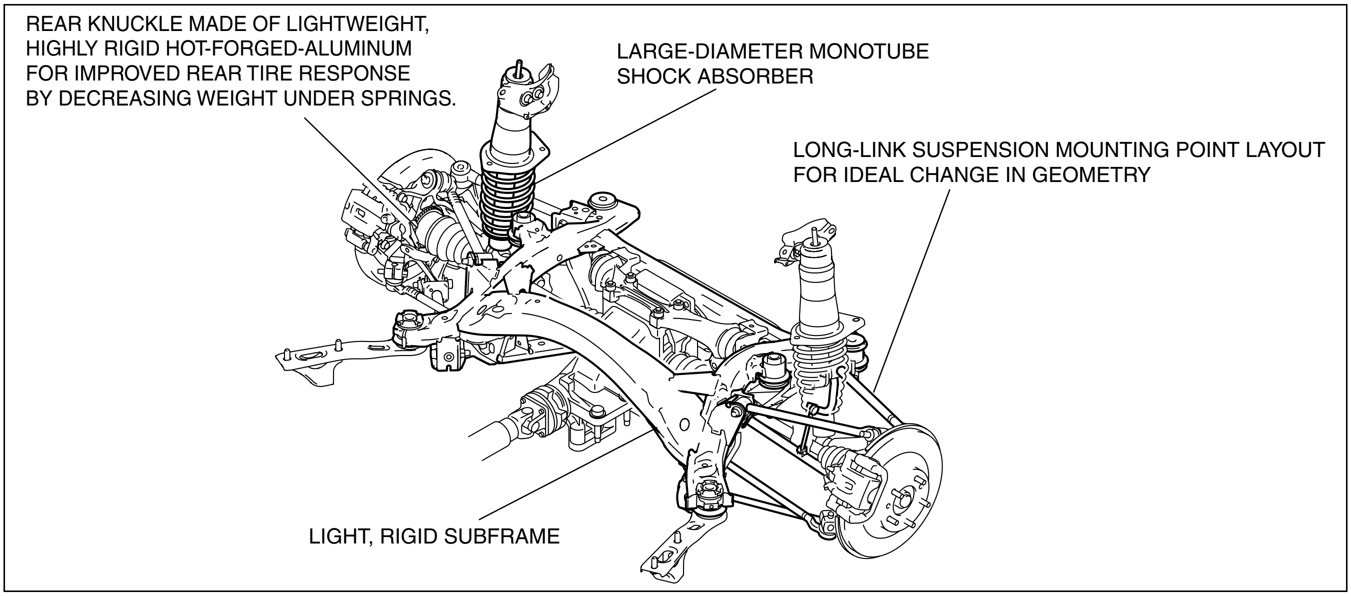
Suspension and steering

- Tire pressure monitoring system
  — The tire pressure monitoring system (TPMS) has been adopted to assist the driver in understanding the tire status to improve the safety.
- Front suspension
  — Newly developed, in-wheel type double-wishbone suspension has been adopted.
  — Relatively long arms promote linear alignment changes during bounce and rebound, realizing excellent controllability at the vehicle handling limits in diverse road and driving conditions.



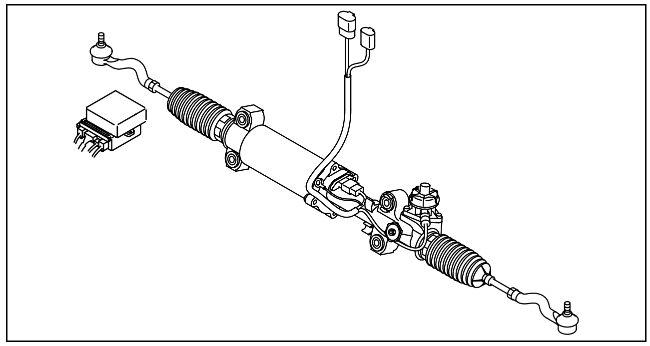
CHU0000S007

- Rear suspension
  — Multi-link suspension employing five links per wheel has been adopted.
  — Excellent handling stability, ride comfort, and road noise performance have been realized by optimizing each link arrangement in consideration of geometry and compliance in order to maintain the optimum tire contact area at any time in the optimal condition against external forces during driving.



CHU0000S008

- Electric power steering (Rack assist type)
  - To provide the driver with appropriate road feel, the power steering system employs computer controlled power assistance characteristic based on vehicle speed and a rack assist mechanism with a motor installed on the same axis as the rack.



CHU0000S009

Brake

- Large-diameter, 17-inch type front brakes have been adopted on sport-suspension vehicles for consistent stopping power.
- 16-inch type front brakes have been adopted on standard-suspension vehicles.
- 16-inch type rear brakes have been adopted on both for sport and standard-suspension vehicles.

Transmission

- Manual transmission
  - Cross-ratio six-speed manual transmission has been adopted on the 13B-MSP (High power).
- Automatic transmission (13B-MSP (Standard power))
  - Four-speed sport automatic transmission has been adopted that can be shifted up/down by operating the one-touch steering-wheel-mounted switches.
  - Shift patterns have been adopted that optimize the frequently used operating positions of N-D and manual modes by reducing the shift-lever stroke.

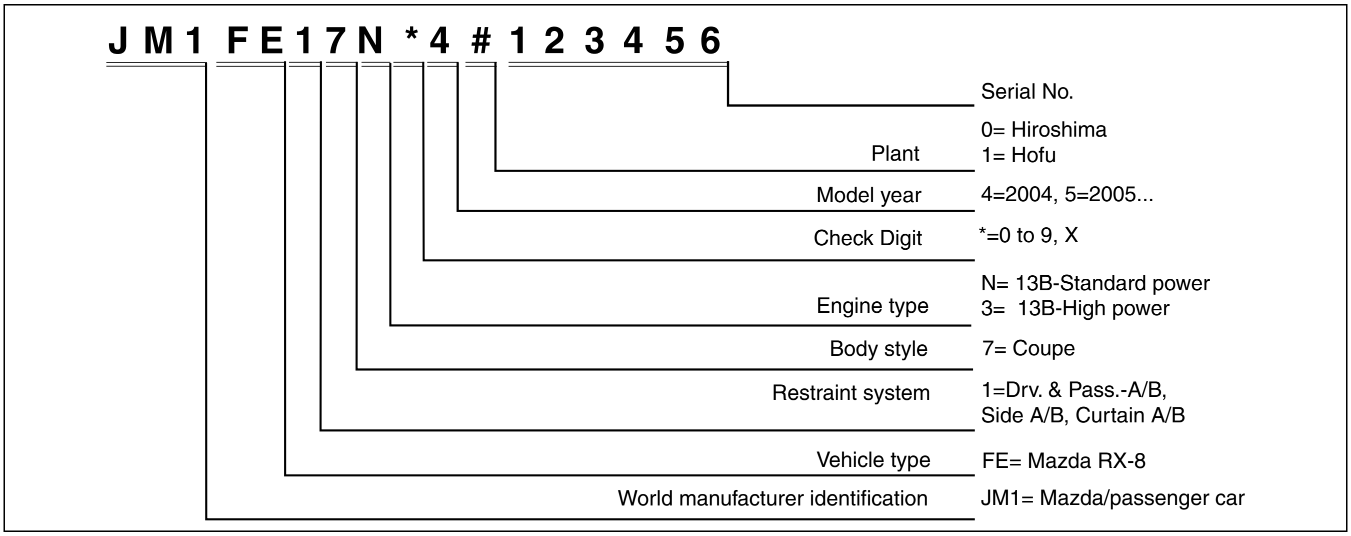
Safety

- Lightweight and highly rigid safe body structure developed uniquely for the Mazda RX-8 has achieved high international standards of crash safety.
- Reinforcement with high strength has been installed on the area equivalent to the center pillar on the rear doors, realizing strength nearly equal to that of a center pillar of a standard sedan.
- 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.
- Curtain air bags have been adopted that deploy and cover the front and rear windows and protect the heads of front and rear passengers.
- Side air bags effective in protecting the upper abdomen of passengers have been adopted and installed in the outboard sides of the front seat backs.
- Pre-tensioner and load limiter mechanisms have been adopted for the front seat belts.
- Intrusion minimizing mechanism has been adopted for the brake pedal.
- ISO-FIX anchors and tether straps have been adopted for installing child restraint systems on the rear seats.
- Aluminum hood with a shock-absorbing cone structure has been adopted in consideration of pedestrian protection.

HOW TO USE THIS MANUAL

CHU000000001S02

Vehicle Identification Number (VIN) Code



CHU0000S001

UNITS

CHU000000002S01

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 STANDARD

CHU000000003S01

- 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		Remark	SAE Standard		Remark
Abbreviation	Name		Abbreviation	Name	
AP	Accelerator Pedal		MAP	Manifold Absolute Pressure	
APP	Accelerator Pedal Position		MAF	Mass Air Flow	
ACL	Air Cleaner		MAF sensor	Mass Air Flow Sensor	
A/C	Air Conditioning		MFL	Multiport Fuel Injection	
A/F	Air Fuel Ratio		OBD	On-board Diagnostic System	
BARO	Barometric Pressure		OL	Open Loop	
B+	Battery Positive Voltage		OC	Oxidation Catalytic Converter	
CMP sensor	Camshaft Position Sensor		O2S	Oxygen Sensor	
LOAD	Calculated Load Value		PNP	Park/Neutral Position	
CAC	Charge Air Cooler		PID	Parameter Identification	
CLS	Closed Loop System		PSP	Power Steering Pressure	
CTP	Closed Throttle Position		PCM	Powertrain Control Module	#3
CPP	Clutch Pedal Position		PAIR	Pulsed Secondary Air Injection	Pulsed injection
CIS	Continuous Fuel Injection System				
CKP sensor	Crankshaft Position Sensor		AIR	Secondary Air Injection	Injection with air pump
DLC	Data Link Connector				
DTM	Diagnostic Test Mode	#1			
DTC	Diagnostic Trouble Code(s)		SAPV	Secondary Air Pulse Valve	
DI	Distributor Ignition		SFI	Sequential Multiport Fuel Injection	
DLI	Distributorless Ignition				
EI	Electronic Ignition	#2	3GR	Third Gear	
ECT	Engine Coolant Temperature		TWC	Three Way Catalytic Converter	
EM	Engine Modification		TB	Throttle Body	
EVAP	Evaporative Emission		TP	Throttle Position	
EGR	Exhaust Gas Recirculation		TP sensor	Throttle Position Sensor	
FC	Fan Control		TCC	Torque Converter Clutch	
FF	Flexible Fuel		TCM	Transmission (Transaxle) Control Module	
4GR	Fourth Gear				
GEN	Generator		TR	Transmission (Transaxle) Range	
GND	Ground		TC	Turbocharger	
HO2S	Heated Oxygen Sensor	With heater	VSS	Vehicle Speed Sensor	
			VR	Voltage Regulator	
IAC	Idle Air Control		VAF sensor	Volume Air Flow Sensor	
IAT	Intake Air Temperature		WU-TWC	Warm Up Three Way Catalytic Converter	#4
KS	Knock Sensor				
MIL	Malfunction Indicator Lamp		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

ENGINE ABBREVIATIONS

CHU010002000S01

A/C	Air Conditioner
API	American Petroleum Institute
APV	Auxiliary Port Valve
AT	Automatic Transmission
ATDC	After Top Dead Center
ABDC	After Bottom Dead Center
BBDC	Before Bottom Dead Center
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
DC	Drive Cycle
DLI	Distributorless Ignition
F/P	Fuel Pump
FP1	Front Primary 1
FP2	Front Primary 2
FS	Front Secondary
HI	High
IC	Integrated Circuit
IG	Ignition
KAM	Keep Alive Memory
KOEO	Key On Engine Off
KOER	Key On Engine Running

L/F	Leading Front
LF	Left Front
LH	Left Hand
LO	Low
L/R	Leading Rear
LR	Left Rear
MSP	Multi Side Port
MT	Manual Transmission
RH	Right Hand
RP1	Rear Primary 1
RP2	Rear Primary 2
RR	Right Rear
RS	Rear Secondary
SAE	Society of Automotive Engineers
SST	Special Service Tool
SSV	Secondary Shutter Valve
SW	Switch
T/F	Trailing Front
T/R	Trailing Rear
VDI	Variable Dynamic Effect Intake
VFAD	Variable Fresh Air Duct
WDS	Worldwide Diagnostic System

ENGINE FEATURES

CHU010002000S02

Improved power performance	• A side intake and exhaust port system adopted • 2-piece apex seals adopted • Keystone shaped side seals adopted • Cut-off seal adopted • A lightweight flywheel adopted
Improved driving performance	• Advanced front mid-ship layout adopted • Drive-by-wire system, which opens and closes throttle valve by throttle actuator, adopted
Improved engine torque and output	• Sequential dynamic air intake system (S-DAIS) adopted
Improved startability	• A reduction type starter adopted
Reduced weight	• Thin walls on the side housings adopted • Lightweight rotors adopted • Aluminum rotor housings adopted • Aluminum engine mount brackets adopted • A compact oil filter adopted • A thin oil pan made of steel adopted • An oil strainer made of plastic adopted • A down flow type radiator with aluminum core and plastic tank adopted
Miniaturization	• A regulatorless generator with built-in power transistor adopted • A built-in type water pump adopted
Improved fuel economy	• Bathtub shaped combustion chambers adopted • By-pass valve in the eccentric shaft adopted • Anti-wet port adopted
Improved idle fuel economy	• Jet air fuel mixing system adopted
Reduced engine noise and vibration	• Oil-filled engine mount rubber adopted • A cooling fan with electric motor adopted
Improved reliability	• A degassing type coolant reserve tank adopted • An independent ignition control system with distributorless ignition coil adopted • A battery duct adopted
Improved durability	• A spark plug with an iridium tip adopted
Improved lubricity	• A two-rotor type trochoid oil pump adopted • An electric type metering oil pump adopted
Improved safety	• A starter interlock switch adopted (MT)
Improved serviceability	• Nylon tubes adopted for fuel hoses in the engine compartment and around the fuel tank, and quick release connectors adopted for joints
Wiring harness simplification	• Controller area network (CAN) adopted
Reduction of evaporative gas	• Returnless fuel system adopted • Evaporative purge control adopted
Improved exhaust purification	• Secondary air injection (AIR) system with electric secondary air injection (AIR) pump adopted • TWC system adopted

ENGINE SPECIFICATIONS

CHU010002000S03

Item		Specifications	
		13B-MSP (Standard power)	**13B-MSP (High power)**
MECHANICAL			
Engine type		Rotary	
Rotor arrangement and number		In-line 2-rotor, longitudinal	
Combustion chamber type		Bathtub	
Displacement	(ml {cc, cu in})	654 {654, 40.0}×2	
Compression ratio		10.0	
Compression pressure	(kPa {kgf/cm^2, psi} [rpm])	830 {8.5, 120}[250]	

OUTLINE

<table>
<tr><th colspan="5" rowspan="2">Item</th><th colspan="2">Specifications</th></tr>
<tr><th>13B-MSP (Standard power)</th><th>13B-MSP (High power)</th></tr>
<tr><td rowspan="8">Port timing</td><td rowspan="6">IN</td><td rowspan="3">Open</td><td>Primary port</td><td rowspan="3">ATDC</td><td colspan="2">3°</td></tr>
<tr><td>Secondary port</td><td colspan="2">12°</td></tr>
<tr><td>Auxiliary port</td><td>–</td><td>38°</td></tr>
<tr><td rowspan="3">Close</td><td>Primary port</td><td rowspan="3">ABDC</td><td>60°</td><td>65°</td></tr>
<tr><td>Secondary port</td><td>45°</td><td>36°</td></tr>
<tr><td>Auxiliary port</td><td>–</td><td>80°</td></tr>
<tr><td rowspan="2">EX</td><td colspan="2">Open</td><td>BBDC</td><td>40°</td><td>50°</td></tr>
<tr><td colspan="2">Close</td><td>BTDC</td><td colspan="2">3°</td></tr>
<tr><td colspan="7">LUBRICATION SYSTEM</td></tr>
<tr><td colspan="5">Type</td><td colspan="2">Force-fed type</td></tr>
<tr><td rowspan="2">Oil pump</td><td colspan="4">Type</td><td colspan="2">Trochoid gear</td></tr>
<tr><td colspan="4">Relief valve opening pressure (approx. quantity) (kPa {kgf/cm^2, psi})</td><td colspan="2">441—490 {4.5—5.0, 64.0—71.0}</td></tr>
<tr><td rowspan="2">Oil filter</td><td colspan="4">Type</td><td colspan="2">Full-flow</td></tr>
<tr><td colspan="4">Relief valve opening pressure (approx. quantity) (kPa {kgf/cm^2, psi})</td><td colspan="2">78—118 {0.8—1.2, 11.4—17.1}</td></tr>
<tr><td colspan="5">Oil pressure (approx. quantity) [oil temperature 100°C {212°F}] (kPa {kgf/cm^2, psi} [rpm])</td><td colspan="2">350 {3.57, 50.8} [3,000]</td></tr>
<tr><td colspan="3" rowspan="4">Oil capacity (approx. quantity) (L {US qt, Imp qt})</td><td colspan="2">Oil replacement</td><td colspan="2">3.3 {3.5, 2.9}</td></tr>
<tr><td colspan="2">Oil and oil filter replacement</td><td colspan="2">3.5 {3.7, 3.1}</td></tr>
<tr><td colspan="2">Engine overhaul</td><td colspan="2">4.7 {5.0, 4.1}</td></tr>
<tr><td colspan="2">Total (dry engine)</td><td>5.8 {6.1, 5.1}</td><td>6.7 {7.1, 5.9}</td></tr>
<tr><td colspan="3" rowspan="3">Recommended oil</td><td colspan="2">API service</td><td colspan="2">SL</td></tr>
<tr><td colspan="2">SAE viscosity</td><td colspan="2">5W–20</td></tr>
<tr><td colspan="2">ILSAC</td><td colspan="2">GF–3</td></tr>
<tr><td colspan="7">COOLING SYSTEM</td></tr>
<tr><td colspan="5">Type</td><td colspan="2">Water-cooled, forced circulation</td></tr>
<tr><td colspan="5">Coolant capacity (L {US qt, Imp qt})</td><td colspan="2">9.8 {10.4, 8.6}</td></tr>
<tr><td colspan="5">Water pump</td><td colspan="2">Centrifugal, V-ribbed belt-driven</td></tr>
<tr><td rowspan="4">Thermostat</td><td colspan="4">Type</td><td colspan="2">Wax</td></tr>
<tr><td colspan="4">Opening temperature (°C {F°})</td><td colspan="2">80—84 {176—183}</td></tr>
<tr><td colspan="4">Full-open temperature (°C {F°})</td><td colspan="2">95 {203}</td></tr>
<tr><td colspan="4">Full-open lift (mm {in})</td><td colspan="2">8.5 {0.33} or more</td></tr>
<tr><td>Radiator</td><td colspan="4">Type</td><td colspan="2">Corrugated fin</td></tr>
<tr><td colspan="2">Cooling system cap</td><td colspan="3">Cap valve opening pressure (kPa {kgf/cm^2, psi})</td><td colspan="2">73.3—103.3 {0.748—1.053, 10.63—14.98}</td></tr>
<tr><td colspan="3" rowspan="3">Cooling fan</td><td colspan="2">Type</td><td colspan="2">Electronic</td></tr>
<tr><td colspan="2">Number of blades</td><td colspan="2">Cooling fan No.1: 5,
Cooling fan No.2: 7</td></tr>
<tr><td colspan="2">Outer diameter (mm {in})</td><td colspan="2">300 {11.8}</td></tr>
<tr><td colspan="7">FUEL SYSTEM</td></tr>
<tr><td colspan="3" rowspan="3">Injector</td><td colspan="2">Type</td><td colspan="2">Multiple hole design</td></tr>
<tr><td colspan="2">Type of fuel delivery</td><td colspan="2">Top-feed</td></tr>
<tr><td colspan="2">Type of drive</td><td colspan="2">Electronic</td></tr>
<tr><td colspan="5">Pressure regulator control pressure (kPa {kgf/cm^2, psi})</td><td colspan="2">Approx. 390 {3.98, 56.6}</td></tr>
<tr><td colspan="5">Fuel pump type</td><td colspan="2">Electric</td></tr>
<tr><td colspan="5">Fuel tank capacity (approx. quantity) (L {US gal, Imp gal})</td><td colspan="2">60 {15.9, 13.2}</td></tr>
<tr><td colspan="5">Fuel type</td><td colspan="2">Unleaded premium (unleaded high-octane) gasoline</td></tr>
<tr><td colspan="7">EMISSION SYSTEM</td></tr>
<tr><td colspan="5">AIR system</td><td colspan="2">Air pump, air control valve</td></tr>
<tr><td colspan="5">Catalyst type</td><td colspan="2">Three-way catalyst (monolithic)</td></tr>
<tr><td colspan="5">EVAP control system</td><td colspan="2">Canister design</td></tr>
</table>

OUTLINE

<table>
<tr><th colspan="4" rowspan="2">Item</th><th colspan="2">Specifications</th></tr>
<tr><th>13B-MSP
(Standard power)</th><th>13B-MSP
(High power)</th></tr>
<tr><td colspan="4">PCV system</td><td colspan="2">Closed design</td></tr>
<tr><td colspan="6">CHARGING SYSTEM</td></tr>
<tr><td rowspan="2">Battery</td><td colspan="3">Voltage (V)</td><td colspan="2">12</td></tr>
<tr><td colspan="3">Type and capacity
(5 hour rate) (A·h)</td><td colspan="2">50D20L (40)*1, 55D23L (48)*2
75D23L (52)*3, 75D26L (52)*3</td></tr>
<tr><td rowspan="3">Generator</td><td colspan="3">Out-put (V–A)</td><td colspan="2">12—100</td></tr>
<tr><td colspan="3">Regulated voltage (V)</td><td colspan="2" rowspan="2">Controlled by PCM</td></tr>
<tr><td colspan="3">Self diagnosis function</td></tr>
<tr><td colspan="6">IGNITION SYSTEM</td></tr>
<tr><td colspan="2" rowspan="3">Ignition system</td><td colspan="2">Type</td><td colspan="2">Distributorless ignition (DLI)</td></tr>
<tr><td colspan="2">Spark advance</td><td colspan="2">Electric</td></tr>
<tr><td colspan="2">Firing order</td><td colspan="2">When idling:T/F-L/F-T/R-L/R
Except for idling: L/F-T/F-L/R-T/R
(Independent ignition control)</td></tr>
<tr><td rowspan="2">Spark plug</td><td rowspan="2">Type</td><td rowspan="2">NGK</td><td>Leading side</td><td colspan="2">RE7A-L*4, (RE6A-L)*5</td></tr>
<tr><td>Trailing side</td><td colspan="2">RE9B-T*4</td></tr>
<tr><td colspan="6">STARTING SYSTEM</td></tr>
<tr><td colspan="2" rowspan="2">Starter</td><td colspan="2">Type</td><td colspan="2">Coaxial reduction</td></tr>
<tr><td colspan="2">Output (kW)</td><td colspan="2">AT: 1.8, MT: 1.4</td></tr>
<tr><td colspan="6">CONTROL SYSTEM</td></tr>
<tr><td colspan="4">Neutral switch (MT)</td><td colspan="2">ON/OFF</td></tr>
<tr><td colspan="4">CPP switch (MT)</td><td colspan="2">ON/OFF</td></tr>
<tr><td colspan="4">SSV switch</td><td colspan="2">ON/OFF</td></tr>
<tr><td colspan="4">APV position sensor</td><td>–</td><td>Hall element</td></tr>
<tr><td colspan="4">ECT sensor</td><td colspan="2">Thermistor</td></tr>
<tr><td colspan="4">IAT sensor</td><td colspan="2">Thermistor</td></tr>
<tr><td colspan="4">TP sensor</td><td colspan="2">Hall element</td></tr>
<tr><td colspan="4">APP sensor</td><td colspan="2">Hall element</td></tr>
<tr><td colspan="4">MAF sensor (Inside MAF)</td><td colspan="2">Hot-wire</td></tr>
<tr><td colspan="4">Front HO2S</td><td colspan="2">Zirconia element (all range air/fuel ratio sensor)</td></tr>
<tr><td colspan="4">Rear HO2S</td><td colspan="2">Zirconia element (Stoichiometric air/fuel ratio sensor)</td></tr>
<tr><td colspan="4">BARO sensor</td><td colspan="2">Piezoelectric element</td></tr>
<tr><td colspan="4">KS</td><td colspan="2">Piezoelectric element</td></tr>
<tr><td colspan="4">Eccentric shaft position sensor</td><td colspan="2">Magnetic pickup</td></tr>
<tr><td colspan="4">Metering oil pump switch</td><td colspan="2">ON/OFF</td></tr>
<tr><td colspan="4">Brake switch</td><td colspan="2">ON/OFF</td></tr>
<tr><td colspan="4">Throttle valve actuator</td><td colspan="2">DC motor</td></tr>
<tr><td colspan="4">APV motor</td><td>–</td><td>DC motor</td></tr>
<tr><td colspan="4">Fuel injector (primary 1)</td><td colspan="2">Multiple hole type (12 holes)</td></tr>
<tr><td colspan="4">Fuel injector (secondary)</td><td colspan="2">Multiple hole type (4 holes)</td></tr>
<tr><td colspan="4">Fuel injector (primary 2)</td><td>–</td><td>Multiple hole type
(4 holes)</td></tr>
<tr><td colspan="4">Stepping motor (in metering oil pump)</td><td colspan="2">Stepping motor</td></tr>
</table>

*1 : MT
*2 : AT
*3 : Cold area
*4 : Standard equipment
*5 : Hot type plug: Available only for customers who often drive their car at very low speed which causes the plugs to foul easily.

01–02 ON-BOARD DIAGNOSTIC

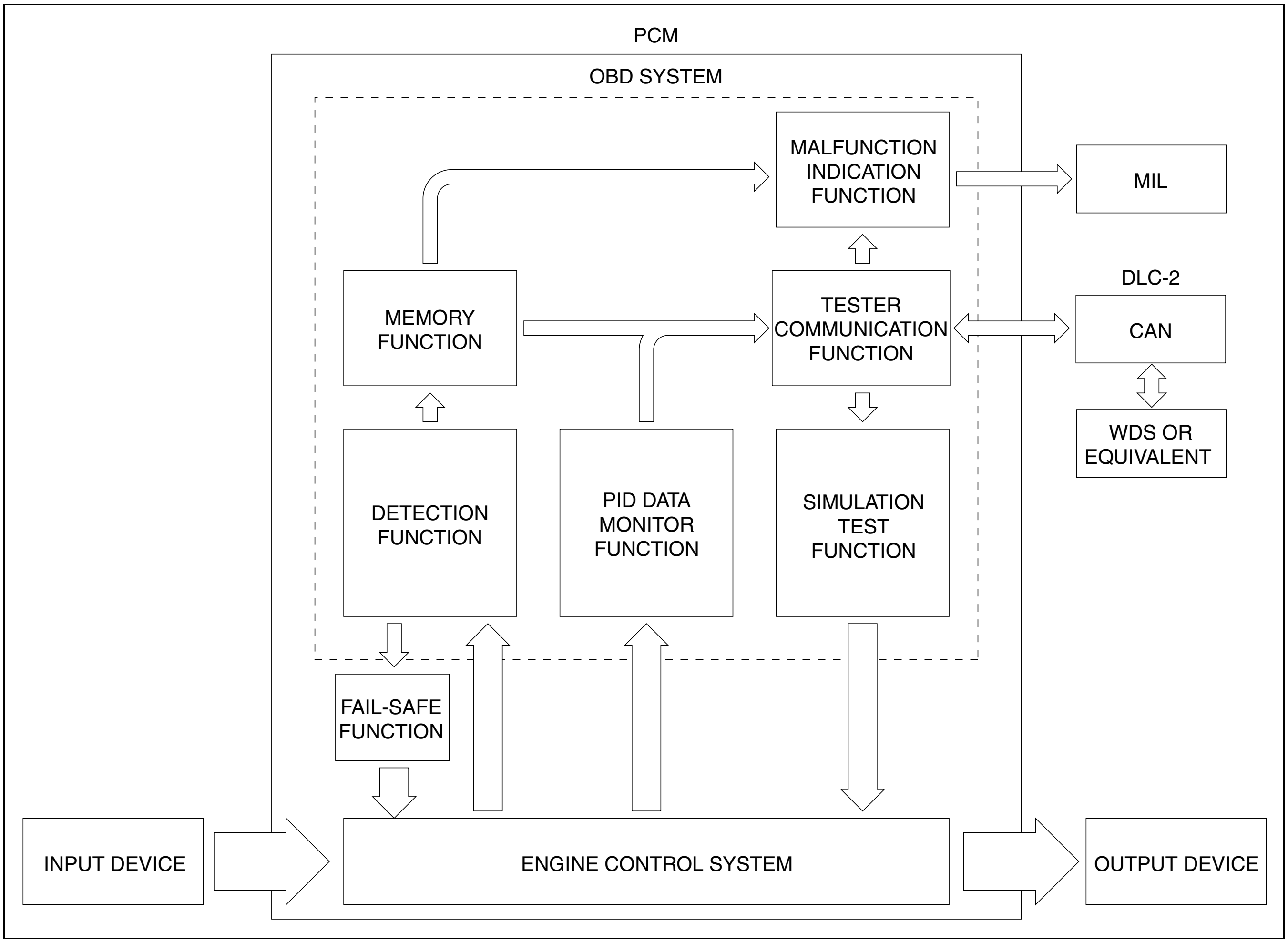
ON-BOARD DIAGNOSTIC OUTLINE

CHU010200102S01

Features

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

Block Diagram



CHU0102S001

DIAGNOSTIC TEST MODE

CHU010200102S02

- 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

Sending Diagnostic Data

PID data monitor

- The PID data monitor items are shown below.

PID data monitor table

—: Not applicable

Full names	Unit	
Fuel system loop status	Refer to list below.	
LOAD	%	
ECT	°C	°F
Short term fuel trim	%	
Long term fuel trim	%	
Engine speed	rpm	
Vehicle speed	km/h	mph
Spark advance	°	
IAT	°C	°F
MAF	g/s	
Absolute TP	%	
AIR control status	—	
O2S location	—	
Input voltage from rear HO2S	V	
Target A/F fuel trim	%	
OBD requirement according to vehicle design	—	
Time since engine start	s	
Distance travelled while MIL is activated	km	miles
Purge solenoid valve control signal	%	
Fuel tank level	%	
Number of warm-ups since DTCs cleared	—	
Distance travelled since DTCs cleared	km	miles
BARO	kPa	
Lambda	—	
Front HO2S output current	mA	
Estimated catalyst converter temperature	°C	°F
PCM power supply voltage	V	
Absolute load value	%	
Relative TP	%	
TP from TP sensor No.2	%	
APP from APP sensor No.1	%	
APP from APP sensor No.2	%	
Throttle actuator control signal	%	

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.

On-board system readiness test
- The items supported by the on-board system readiness test are shown below.
  Continuous monitoring system
  — HO2S heater
  — Thermostat
  — Fuel system
  — Misfire
  — CCM
  Intermittent monitoring system
  — HO2S
  — AIR system
  — Catalyst
  — EVAP system

Sending Freeze Frame Data
- The Freeze Frame Data monitor items are shown below.

Freeze Frame Data monitor table

—: Not applicable

Full names	Unit	
DTC that caused required Freeze Frame Data storage	—	
Fuel system loop status	Refer to list below.	
LOAD	%	
ECT	°C	°F
Short term fuel trim	%	
Long term fuel trim	%	
Engine speed	rpm	
Vehicle speed	km/h	mph
Spark advance	°	
IAT	°C	°F
MAF	g/s	
Absolute TP	%	
AIR control status	—	
Time since engine start	s	
Purge solenoid valve control signal	%	
Fuel tank level	%	
Number of warm-ups since DTCs cleared	—	
Distance travelled since DTCs cleared	km	miles
BARO	kPa	
Estimated catalyst converter temperature	°C	°F
PCM power supply voltage	V	
Lambda	—	
Absolute load value	%	
Relative TP	%	
TP from TP sensor No.2	%	
APP from APP sensor No.1	%	
APP from APP sensor No.2	%	
Throttle actuator control signal	%	

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.

Sending Emission-related Malfunction Code

- The DTCs are shown below.

DTC table

×: Applicable
—: Not applicable

DTC No.	Condition	MIL	DC	Monitor item*	Memory function
P0030	Front HO2S heater control circuit problem	ON	2	HO2S heater	×
P0031	Front HO2S heater control circuit low	ON	2	HO2S heater	×
P0032	Front HO2S heater control circuit high	ON	2	HO2S heater	×
P0037	Rear HO2S heater control circuit low	ON	2	HO2S heater	×
P0038	Rear HO2S heater control circuit high	ON	2	HO2S heater	×
P0076	VDI solenoid valve control circuit low	OFF	2	CCM	×
P0077	VDI solenoid valve control circuit high	OFF	2	CCM	×
P0101	MAF sensor circuit range/performance problem	ON	2	CCM	×
P0102	MAF sensor circuit low input	ON	1	CCM	×
P0103	MAF sensor circuit high input	ON	1	CCM	×
P0107	BARO sensor circuit low input	ON	1	CCM	×
P0108	BARO sensor circuit high input	ON	1	CCM	×
P0111	IAT sensor circuit range/performance problem	ON	2	CCM	×
P0112	IAT sensor circuit low input	ON	1	CCM	×
P0113	IAT sensor circuit high input	ON	1	CCM	×
P0117	ECT sensor circuit low input	ON	1	CCM	×
P0118	ECT sensor circuit high input	ON	1	CCM	×
P0122	TP sensor No.1 circuit low input	ON	1	CCM	×
P0123	TP sensor No.1 circuit high input	ON	1	CCM	×
P0125	Insufficient coolant temperature for closed loop fuel control	ON	2	CCM	×
P0126	Insufficient coolant temperature for stable operation	ON	2	Thermostat	×
P0128	Coolant thermostat problem	ON	2	Thermostat	×
P0130	Front HO2S circuit problem	ON	2	HO2S	×
P0131	Front HO2S circuit low voltage	ON	2	HO2S	×
P0132	Front HO2S circuit high voltage	ON	2	HO2S	×
P0133	Front HO2S circuit slow response	ON	2	HO2S	×
P0138	Rear HO2S circuit high voltage	ON	2	HO2S	×
P0139	Rear HO2S circuit slow response	ON	2	HO2S	×
P0171	System too lean	ON	2	Fuel system	×
P0172	System too rich	ON	2	Fuel system	×
P0222	TP sensor No.2 circuit low input	ON	1	CCM	×
P0223	TP sensor No.2 circuit high input	ON	1	CCM	×
P0300	Random misfire detected	Flash/ON	1 or 2	Misfire	×
P0301	Front rotor misfire detected	Flash/ON	1 or 2	Misfire	×
P0302	Rear rotor misfire detected	Flash/ON	1 or 2	Misfire	×
P0327	KS circuit low input	ON	1	CCM	×
P0328	KS circuit high input	ON	1	CCM	×
P0335	Eccentric shaft position sensor circuit problem	ON	1	CCM	×
P0336	Eccentric shaft position sensor circuit range/performance problem	ON	1	CCM	×
P0410	AIR system problem	ON	2	AIR system	×
P0420	Catalyst system efficiency below threshold	ON	2	Catalyst	×
P0441	EVAP system incorrect purge flow	ON	2	EVAP system	×

DTC No.	Condition	MIL	DC	Monitor item*	Memory function
P0442	EVAP system leak detected (small leak)	ON	2	EVAP system	×
P0443	Purge solenoid valve circuit problem	ON	2	CCM	×
P0446	EVAP system vent control circuit problem	ON	2	EVAP system	×
P0455	EVAP system leak detected (large leak)	ON	2	EVAP system	×
P0456	EVAP system leak detected (very small leak)	ON	2	EVAP system	×
P0461	Fuel gauge sender unit circuit range/performance problem	ON	2	CCM	×
P0462	Fuel gauge sender unit circuit low input	ON	2	CCM	×
P0463	Fuel gauge sender unit circuit high input	ON	2	CCM	×
P0480	Cooling fan No.1 control circuit problem	OFF	2	Other	×
P0481	Cooling fan No.2 control circuit problem	OFF	2	Other	×
P0500	VSS circuit problem	ON	2	CCM	×
P0505	Idle air control system problem	OFF	—	—	—
P0506	Idle air control system RPM lower than expected	ON	2	CCM	×
P0507	Idle air control system RPM higher than expected	ON	2	CCM	×
P0562	System voltage low (KAM)	ON	1	CCM	×
P0564	Cruise control switch input circuit problem	OFF	1	Other	×
P0571	Brake switch input circuit problem	OFF	1	Other	×
P0601	PCM memory check sum error	ON	1	CCM	×
P0602	PCM programming error	ON	1	CCM	×
P0604	PCM random access memory error	ON	1	CCM	×
P0610	PCM vehicle options error	ON	1	CCM	×
P0638	Throttle actuator control circuit range/performance problem	ON	1	CCM	×
P0661	SSV solenoid valve control circuit low	ON	2	CCM	×
P0662	SSV solenoid valve control circuit high	ON	2	CCM	×
P0703	Brake switch No.1 input circuit problem	ON	2	CCM	×
P0704	CPP switch input circuit problem	ON	2	CCM	×
P0850	Neutral switch input circuit problem	ON	2	CCM	×
P1260	Immobilizer system problem	OFF	1	Other	—
P1574	TP sensor output incongruent	ON	1	CCM	×
P1577	APP sensor output incongruent	ON	1	CCM	×
P1686	Metering oil pump control circuit low flow side problem	ON	1	Other	×
P1687	Metering oil pump control circuit high flow side problem	ON	1	Other	×
P1688	Metering oil pump control circuit initial check problem	ON	1	Other	×
P2004	APV stuck open	ON	2	CCM	×
P2006	APV motor control circuit IC problem	ON	2	CCM	×
P2008	APV motor control circuit/open	ON	2	CCM	×
P2017	APV position sensor circuit problem	ON	2	CCM	×
P2070	SSV stuck open	ON	2	CCM	×
P2096	Target A/F feedback system too lean	ON	2	Fuel system	×
P2097	Target A/F feedback system too rich	ON	2	Fuel system	×
P2101	Drive-by-wire relay control circuit problem	ON	1	CCM	×
P2106	Throttle actuator control system-forced limited power	ON	1	CCM	×
P2107	Throttle actuator control module processor error	ON	1	CCM	×
P2108	Throttle actuator control module performance error	ON	1	CCM	×
P2109	TP sensor minimum stop range/performance problem	ON	1	CCM	×
P2112	Throttle actuator control system range/performance problem	ON	1	CCM	×
P2119	Throttle actuator control throttle body range/performance problem	ON	2	CCM	×
P2122	APP sensor No.1 circuit low input	ON	1	CCM	×
P2123	APP sensor No.1 circuit high input	ON	1	CCM	×
P2127	APP sensor No.2 circuit low input	ON	1	CCM	×
P2128	APP sensor No.2 circuit high input	ON	1	CCM	×
P2135	TP sensor No.1/No.2 voltage correlation problem	ON	1	CCM	×

DTC No.	Condition	MIL	DC	Monitor item*	Memory function
P2136	TP sensor No.1/No.3 voltage correlation problem	ON	1	CCM	×
P2138	APP sensor No.1/No.2 voltage correlation problem	ON	1	CCM	×
P2195	Front HO2S signal stuck lean	ON	2	HO2S	×
P2196	Front HO2S signal stuck rich	ON	2	HO2S	×
P2257	AIR pump relay control circuit low	ON	2	CCM	×
P2258	AIR pump relay control circuit high	ON	2	CCM	×
P2259	AIR solenoid valve control circuit low	ON	2	CCM	×
P2260	AIR solenoid valve control circuit high	ON	2	CCM	×
P2270	Rear HO2S signal stuck lean	ON	2	HO2S	×
P2271	Rear HO2S signal stuck rich	ON	2	HO2S	×
P2401	EVAP system leak detection pump control circuit low	ON	2	EVAP system	×
P2402	EVAP system leak detection pump control circuit high	ON	2	EVAP system	×
P2404	EVAP system leak detection pump sense circuit range/ performance problem	ON	2	EVAP system	×
P2405	EVAP system leak detection pump sense circuit low	ON	2	EVAP system	×
P2406	EVAP system leak detection pump sense circuit high	ON	2	EVAP system	×
P2407	EVAP system leak detection pump sense circuit intermittent/ erratic problem	ON	2	EVAP system	×
P2502	Charging system voltage problem	OFF	1	Other	×
P2503	Charging system voltage low	OFF	1	Other	×
P2504	Charging system voltage high	OFF	1	Other	×

* : Indicates the applicable item in On-Board System Readiness Test defined by CARB.

Sending Intermittent Monitoring System Test Results

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

Test ID	Description	Related system
10:01:80	Response lean to rich	HO2S (front HO2S)
10:01:81	Response rich to lean	
10:02:01	Rich to lean sensor threshold voltage	HO2S (rear HO2S)
10:02:03	Low sensor voltage for switch time calculation	
10:02:04	High sensor voltage for switch time calculation	
10:02:05	Rich to lean sensor switching time	
10:21:80	Front and rear HO2S switching time ratio	Catalyst
10:3A:80	Large leak check	EVAP system
10:3B:80	Small leak check	
10:3C:80	Very small leak check	
10:3D:80	Purge flow monitor	
10:71:80	Secondary airflow test	AIR system
10:E1:80	Heat radiation ratio	Thermostat
10:E1:81	ECT	

Sending Continuous Monitoring System Test Results

- These appear when a problem is detected in a monitored system.

1-drive cycle type

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

2-drive cycle type

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

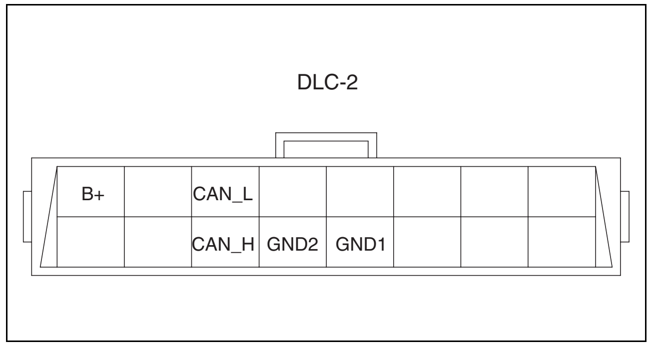
On-board Device Control

- This mode allows the technicians to operate the EVAP system leak detection pump.

DLC-2 Outline

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

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



CHU0102S002

DTC DETECTION LOGIC AND CONDITIONS

CHU010200102S03

P0030 Front HO2S heater control circuit problem

- The PCM monitors the front HO2S impedance when under the front HO2S heater control for 200 s. If the impedance is more than 44 ohms, the PCM determines that there is a front HO2S heater control circuit problem.

P0031 Front HO2S heater control circuit low

- The PCM monitors the front HO2S heater control voltage when the PCM turns the front HO2S heater off. If the control voltage exceeds 25 % of the battery voltage, the PCM determines that the front HO2S heater control circuit voltage is low.

P0032 Front HO2S heater control circuit high

- The PCM monitors the front HO2S heater control voltage when the PCM turns the front HO2S heater on. If the control voltage is less than 25 % of the battery voltage, the PCM determines that the front HO2S heater control circuit voltage is high.

P0037 Rear HO2S heater control circuit low

- The PCM monitors the rear HO2S heater control voltage when the PCM turns the rear HO2S heater off. If the control voltage exceeds 25 % of the battery voltage, the PCM determines that the rear HO2S heater control circuit voltage is low.

P0038 Rear HO2S heater control circuit high

- The PCM monitors the rear HO2S heater control voltage when the PCM turns the rear HO2S heater on. If the control voltage is less than 57 % of the battery voltage, the PCM determines that the rear HO2S heater control circuit voltage is high.

P0076 VDI solenoid valve control circuit low

- The PCM monitors the VDI solenoid valve control voltage when the PCM turns the VDI solenoid valve off. If the control voltage is low, the PCM determines that the VDI solenoid valve control circuit voltage is low.

P0077 VDI solenoid valve control circuit high

- The PCM monitors the VDI solenoid valve control voltage when the PCM turns the VDI solenoid valve on. If the control voltage is high, the PCM determines that the VDI solenoid valve control circuit voltage is high.

P0101 MAF sensor circuit range/performance problem

- The PCM compares the actual MAF amount with the expected MAF amount when the engine is running.
  — If the throttle opening angle is more than 50 % and the MAF amount is less than 5 g/s {0.66 lb/min}, the PCM determines that there is a MAF sensor circuit range/performance problem.
  — If the ECT is more than 70 °C {158 °F}, the engine speed is less than 2,000 rpm and the MAF amount is more than 130 g/s {17.20 lb/min} (MT) 110 g/s {14.55 lb/min} (AT), the PCM determines that there is a MAF sensor circuit range/performance problem.

P0102 MAF sensor circuit low input

- The PCM monitors the input voltage from the MAF sensor when the engine is running. If the input voltage is less than 0.5 V, the PCM determines that the MAF sensor circuit input voltage is low.

P0103 MAF sensor circuit high input
- The PCM monitors the input voltage from the MAF sensor when the engine is running. If the input voltage is more than 5.0 V, the PCM determines that the MAF sensor circuit input voltage is high.

P0107 BARO sensor circuit low input
- The PCM monitors the input voltage from the BARO sensor when the engine is running. If the input voltage is less than 0.2 V, the PCM determines that the BARO sensor circuit input voltage is low.

P0108 BARO sensor circuit high input
- The PCM monitors the input voltage from the BARO sensor when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the BARO sensor circuit input voltage is high.

P0111 IAT sensor circuit range/performance problem
- The PCM compares the IAT with the ECT when the engine is running. If the IAT is higher than the ECT by 40 °C {104 °F}, the PCM determines that there is an IAT sensor circuit range/performance problem.

P0112 IAT sensor circuit low input
- The PCM monitors the input voltage from the IAT sensor when the engine is running. If the input voltage is less than 0.1 V, the PCM determines that the IAT sensor circuit input voltage is low.

P0113 IAT sensor circuit high input
- The PCM monitors the input voltage from the IAT sensor when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the IAT sensor circuit input voltage is high.

P0117 ECT sensor circuit low input
- The PCM monitors the input voltage from the ECT sensor when the engine is running. If the input voltage is less than 0.2 V, the PCM determines that the ECT sensor circuit input voltage is low.

P0118 ECT sensor circuit high input
- The PCM monitors the input voltage from the ECT sensor when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the ECT sensor circuit input voltage is high.

P0122 TP sensor No.1 circuit low input
- The PCM monitors the input voltage from the TP sensor No.1 when the engine is running. If the input voltage is less than 0.3 V, the PCM determines that the TP sensor No.1 circuit input voltage is low.

P0123 TP sensor No.1 circuit high input
- The PCM monitors the input voltage from the TP sensor No.1 when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the TP sensor No.1 circuit input voltage is high.

P0125 Insufficient coolant temperature for closed loop fuel control
- The PCM monitors the ECT after cold engine start. If the ECT does not reach the specification in a certain period, the PCM determines that the coolant temperature for closed loop fuel control is insufficient.

P0126 Insufficient coolant temperature for stable operation
- The PCM monitors the ECT after the engine start for a certain period. If the the ECT never exceeds 71 °C {160 °F} when the following conditions are met, the PCM determines that the coolant thermostat is stuck open.

  MONITORING CONDITIONS
  — Soak time: more than 6 hour
  — IAT: more than –10 °C {14 °F}
  — Vehicle speed: more than 10 km/h {6.2 mph}
  — LOAD: more than 21.9 %

P0128 Coolant thermostat problem
- The PCM calculates the radiator heat radiation ratio while the following conditions are met. If the calculated value exceeds the threshold, the PCM determines that the coolant thermostat is stuck open.

  MONITORING CONDITIONS
  — Soak time: more than 6 hour
  — IAT: more than –10 °C {14 °F}
  — ECT at engine start: less than 35 °C {95 °F}
  — Vehicle speed: more than 40 km/h {24.9 mph}

P0130 Front HO2S circuit problem
- The PCM monitors the front HO2S impedance when under the front HO2S heater control. If the impedance is more than 500 ohms, the PCM determines that there is a front HO2S circuit problem.

P0131 Front HO2S circuit low voltage
- The PCM monitors the input voltage from the front HO2S and the front HO2S output current when the engine is running. If the input voltage is less than 1.8 V or the output current is less than -5 mA, the PCM determines that the front HO2S circuit voltage is low.

P0132 Front HO2S circuit high voltage
- The PCM monitors the input voltage from the front HO2S and the front HO2S output current when the engine is running. If the input voltage is more than 3.8 V or the output current is more than 5 mA, the PCM determines that the front HO2S circuit voltage is high.

P0133 Front HO2S circuit slow response
- The PCM monitors the front HO2S output current and short term fuel trim (SHRTFT) when the following conditions are met. If the output current response is lower than that expected from the fuel trim, the PCM determines that the front HO2S circuit response is slow.

MONITORING CONDITION

— Front HO2S heater monitor: Completed
— Fuel system loop status: Closed loop fuel control
— Engine speed: 2,000—3,500 rpm
— LOAD: 30.0—50.0 %

P0138 Rear HO2S circuit high voltage

- The PCM monitors the input voltage from the rear HO2S when the engine is running. If the input voltage is more than 1.2 V, the PCM determines that the rear HO2S circuit voltage is high.

P0139 Rear HO2S circuit slow response

- The PCM monitors the rear HO2S inversion cycle period, lean-to-rich response time and rich-to-lean response time when under the open loop fuel control (fuel cut off control). If the average response time is more than the specification, the PCM determines that the rear HO2S circuit response is slow.

P0171 System too lean

- The PCM monitors the short term fuel trim (SHRTFT) and long term fuel trim (LONGFT) when under closed loop fuel control. If the fuel trim is more than the specification, the PCM determines that the system is too lean.

P0172 System too rich

- The PCM monitors the short term fuel trim (SHRTFT) and long term fuel trim (LONGFT) when under closed loop fuel control. If the fuel trim is less than the specification, the PCM determines that the system is too rich.

P0222 TP sensor No.2 circuit low input

- The PCM monitors the input voltage from the TP sensor No.2 when the engine is running. If the input voltage is less than 0.7 V, the PCM determines that the TP sensor No.2 circuit input voltage is low.

P0223 TP sensor No.2 circuit high input

- The PCM monitors the input voltage from the TP sensor No.2 when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the TP sensor No.2 circuit input voltage is high.

P0300 Random misfire detected

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

P0301 Front rotor misfire detected

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

P0302 Rear rotor misfire detected

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

P0327 KS circuit low input

- The PCM monitors the input voltage from the KS when the engine is running. If the input voltage is less than 1.2 V, the PCM determines that the KS circuit input voltage is low.

P0328 KS circuit high input

- The PCM monitors the input voltage from the KS when the engine is running. If the input voltage is more than 4.0 V, the PCM determines that the KS circuit input voltage is high.

P0335 Eccentric shaft position sensor circuit problem

- The PCM monitors the input signal from the eccentric shaft position sensor when the mass intake airflow amount is more than 2 g/s {0.26 lb/min}. If the input signal is not input, the PCM determines that there is a eccentric shaft position sensor circuit malfunction.

P0336 Eccentric shaft position sensor circuit range/performance problem

- The PCM monitors the input signal from the eccentric shaft position sensor when the engine is running. If the input signal is not the proper pulse number, the PCM determines that there is a eccentric shaft position sensor circuit range/performance problem.

P0410 AIR system problem
- The PCM monitors the front HO2S output current when the AIR control is operating. If the output current is less than the specification, the PCM determines that there is an AIR system problem.

P0420 Catalyst system efficiency below threshold
- The PCM monitors the input voltage from the rear HO2S and the front HO2S output current when the following conditions are met. If the input voltage change is extremely large compared to the output current change, the PCM determines that the catalyst system has deteriorated.
  MONITORING CONDITION
  — ECT: more than 70 °C {158 °F}
  — Catalyst converter temperature: more than 400 °C {752 °F}
  — Engine speed: 1,500—3,500 rpm
  — LOAD: 20—50% (maximum calculated load value varies depending on engine speed.)
  — Time with purge control system does not operate: more than 20 s

P0441 EVAP system incorrect purge flow
- The PCM monitors the purge line vacuum, when the following conditions are met. If the vacuum between the charcoal canister and the intake manifold does not reach the specification, the PCM determines that the EVAP system purge flow is incorrect.
  MONITORING CONDITION
  — Vehicle speed: 25—49 km/h {16—30 mph}
  — Engine speed: 1,200—3,000 rpm
  — Throttle valve opening angle: 0—31.7 % (changes by engine speed)

P0442 EVAP system leak detected (small leak)
- The PCM monitors the pump load current (EVAP line pressure) when the specified period has passed after EVAP system is sealed when the following conditions are met. If the pump load current does not reach the reference current value within the specified period, the PCM determines that the EVAP system has small leak.
  MONITORING CONDITION
  — BARO: more than 72 kPa {542 mmHg, 21.33 inHg}
  — IAT: 5—40 °C {41—104 °F}
  — Fuel tank level: 15—85 %
  — Battery voltage: 11.0—14.6 V
  — Ignition switch: OFF

P0443 Purge solenoid valve circuit problem
- The PCM monitors the purge solenoid valve control voltage when the PCM turns the purge solenoid valve off. If the control voltage is less than 5.8 V, the PCM determines that the purge solenoid valve control circuit voltage is low.
- The PCM monitors the purge solenoid valve control voltage when the PCM turns the purge solenoid valve on. If the control voltage is more than 11.5 V, the PCM determines that the purge solenoid valve control circuit voltage is high.

P0446 EVAP system vent control circuit problem
- The PCM monitors pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the decrease in pump load current is less than the specification after the reference current value has been obtained, the PCM determines change over valve in EVAP system leak detection pump has a malfunction.

P0455 EVAP system leak detected (large leak)
- The PCM monitors the pump load current (EVAP line pressure) when the specified period has passed after EVAP system is sealed when the following conditions are met. If the pump load current does not reach the reference current value within the specified period, the PCM determines that the EVAP system has large leak.
  MONITORING CONDITION
  — BARO: more than 72 kPa {542 mmHg, 21.33 inHg}
  — IAT: 5—40 °C {41—104 °F}
  — Fuel tank level: 15—85 %
  — Battery voltage: 11.0—14.6 V
  — Ignition switch: OFF

P0456 EVAP system leak detected (very small leak)
- The PCM monitors the pump load current (EVAP line pressure) when a specified period has passed after EVAP system is sealed after ignition switch is turned OFF. If the pump load current does not reach the reference load value or rate of the load increase lower than specified within a specified period, the PCM determines that the EVAP system has a very small leak.
  MONITORING CONDITION
  — BARO: more than 72 kPa {542 mmHg, 21.33 inHg}
  — IAT: 5—40 °C {41—104 °F}
  — Fuel tank level: 15—85 %
  — Battery voltage: 11.0—14.6 V
  — Ignition switch: OFF

P0461 Fuel gauge sender unit circuit range/performance problem
- The PCM monitors the fuel tank level difference before and after the PCM-calculated fuel consumption has reached more than 21 L {22.2 US qt, 18.5 Imp qt}. If the difference is less than 5 %, the PCM determines that there is a fuel gauge sender unit circuit range/performance problem.

P0462 Fuel gauge sender unit circuit low input
- The PCM monitors the fuel tank level and input voltage from the fuel gauge sender unit when the engine is running. If the input voltage is less than 2.5 V and fuel tank level is full, the PCM determines that the fuel gauge sender unit circuit input voltage is low.

P0463 Fuel gauge sender unit circuit high input
- The PCM monitors the fuel tank level and input voltage from the fuel gauge sender unit when the engine is running. If the input voltage is more than 2.5 V and fuel tank level is empty, the PCM determines that the fuel gauge sender unit circuit input voltage is high.

P0480 Cooling fan No.1 control circuit problem
- The PCM monitors the cooling fan relay No.1 control voltage when the PCM turns the cooling fan relay No.1 off. If the control voltage is low, the PCM determines that the cooling fan No.1 control circuit voltage is low.
- The PCM monitors the cooling fan relay No.1 control voltage when the PCM turns the cooling fan relay No.1 on. If the control voltage is high, the PCM determines that the cooling fan No.1 control circuit voltage is high.

P0481 Cooling fan No.2 control circuit problem
- The PCM monitors the cooling fan relay No.2 control voltage when the PCM turns the cooling fan relay No.2 off. If the control voltage is low, the PCM determines that the cooling fan No.2 control circuit voltage is low.
- The PCM monitors the cooling fan relay No.2 control voltage when the PCM turns the cooling fan relay No.2 on. If the control voltage is high, the PCM determines that the cooling fan No.2 control circuit voltage is high.

P0500 VSS circuit problem
- The PCM monitors the input signal from the vehicle speed sensor when the following conditions are met. If the input signal is less than 3.7 km/h {2.3 mph}, the PCM determines that there is a VSS circuit malfunction.
  MONITORING CONDITION
  — Shift lever position: gear is not in neutral position
  — Engine speed: more than 2,500 rpm
  — LOAD: more than 40.0 %

P0505 Idle air control system problem
- The PCM cannot control idle speed at the target idle speed during the self-test.

P0506 Idle air control system RPM lower than expected
- The PCM compares the actual idle speed with the target idle speed when the engine is running. If the actual idle speed is lower than targeted by 100 rpm, the PCM determines that the idle air control system RPM is lower than expected.

P0507 Idle air control system RPM higher than expected
- The PCM compares the actual idle speed with the target idle speed when the engine is running. If the actual idle speed is higher than targeted by 200 rpm, the PCM determines that the idle air control system RPM is higher than expected.

P0562 System voltage low (KAM)
- The PCM monitors the battery voltage when the engine is running. If the voltage is less than 2.5 V, the PCM determines that the system voltage is low.

P0564 Cruise control switch input circuit problem
- The PCM monitors the input voltage from the cruise control switch when the engine is running. If the input voltage is less than 3.0 V for more than 2 min, the PCM determines that there is a cruise control switch input circuit problem.

P0571 Brake switch input circuit problem
- The PCM monitors the input signal from brake switch No.1 and brake switch No.2 when the engine is running. If the both input signals remain on or off, the PCM determines that there is a brake switch input circuit problem.

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

P0602 PCM programming error
- No configuration data in the PCM.

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

P0610 PCM vehicle options error
- PCM data configuration error.

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

P0661 SSV solenoid valve control circuit low
- The PCM monitors the SSV solenoid valve control voltage when the PCM turns the SSV solenoid valve off. If the control voltage is less than 5.8 V, the PCM determines that the SSV solenoid valve control circuit voltage is low.

P0662 SSV solenoid valve control circuit high
- The PCM monitors the SSV solenoid valve control voltage when the PCM turns the SSV solenoid valve on. If the control voltage is more than 11.5 V, the PCM determines that the SSV solenoid valve control circuit voltage is high.

P0703 Brake switch No.1 input circuit problem
- The PCM monitors the input signal from the brake switch No.2 when the following conditions are met. If the input signal does not change while alternately accelerating and decelerating 8 times, the PCM determines that there is a brake switch No.2 input circuit malfunction.
  MONITORING CONDITION
  — Vehicle speed: decelerating more than 30 km/h {19 mph} to 0 km/h {0 mph}
  — Deceleration: more than 4 km/h {2 mph} per s

P0704 CPP switch input circuit problem
- The PCM monitors the input signal from the CPP switch when the vehicle speed is more than 30 km/h {19 mph}. If the input signal does not change while alternately accelerating and decelerating 10 times, the PCM determines that there is a CPP switch input circuit malfunction.

P0850 Neutral switch input circuit problem
- The PCM monitors the input signal from the neutral switch when the vehicle is running. If the input signal does not change while alternately running more than 30 km/h {19 mph} 8 times, the PCM determines that there is a neutral switch input circuit malfunction.

P1260 Immobilizer system problem
- The keyless control module detects an immobilizer system malfunction.

P1574 TP sensor output incongruent
- The PCM compares the TP from TP sensor No.1 with the TP from TP sensor No.2 when the engine is running. If the difference is more than the specification, the PCM determines that the TP sensor outputs are incongruent.

P1577 APP sensor output incongruent
- The PCM compares the APP from APP sensor No.1 with the APP from APP sensor No.2 when the engine is running. If the difference is more than the specification, the PCM determines that the APP sensor outputs are incongruent.

P1686 Metering oil pump control circuit low flow side problem
- The PCM monitors the input signal from the metering oil pump switch when the metering oil pump stepping motor is more than the standard step. If the input signal is off, the PCM determines that the metering oil pump control circuit has a problem on the low flow side.

P1687 Metering oil pump control circuit high flow side problem
- The PCM monitors the input signal from the metering oil pump switch when the metering oil pump stepping motor is less than the standard step. If the input signal is on, the PCM determines that the metering oil pump control circuit has a problem on the high flow side.

P1688 Metering oil pump control circuit initial check problem
- The PCM monitors the input signal from the metering oil pump switch when the metering oil pump stepping motor initial check is operating. If the input signal is on, the PCM determines that there is a metering oil pump control circuit initial check problem.

P2004 APV stuck open
- The PCM monitors the input voltage from the APV position sensor when the PCM turns the APV motor off. If the input voltage is more than 1.4 V, the PCM determines that the APV is stuck open.

P2006 APV motor control circuit IC problem
- APV motor control IC error.

P2008 APV motor control circuit/open
- The PCM monitors the APV motor control current when the engine is running. If the control current is less than 0.1 A or more than 10 A, the PCM determines that there is an APV motor control open circuit.

P2017 APV position sensor circuit problem
- The PCM monitors the input voltage from the APV position sensor when the engine is running. If the input voltage is less than 0.2 V, the PCM determines that the APV position sensor circuit input voltage is low.
- The PCM monitors the input voltage from the APV position sensor when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the APV position sensor circuit input voltage is high.

P2070 SSV stuck open
- The PCM monitors the input signal from the SSV switch when the PCM turns the SSV solenoid valve on. If the input signal is on, the PCM determines that the SSV is stuck open.

P2096 Target A/F feedback system too lean
- The PCM monitors the target A/F fuel trim when under the target A/F feedback control. If the fuel trim is more than the specification, the PCM determines that the target A/F feedback system is too lean.

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

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

P2106 Throttle actuator control system-forced limited power
- The PCM monitors the throttle actuator control current when the ignition switch is on. If the control current is less than 8 A or more than 11 A, the PCM determines that the throttle actuator control system is under forced limited power.

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

P2108 Throttle actuator control module performance error
- Throttle actuator control module internal communication error.

P2109 TP sensor minimum stop range/performance problem
- The PCM monitors the minimum TP when the closed TP learning is completed. If the TP is less than 11.5 % or more than 24.3 %, the PCM determines that there is a TP sensor minimum stop range/performance problem.

P2112 Throttle actuator control system range/performance problem
- The PCM monitors the throttle actuator control duty ratio when the engine is running. If the duty ratio is more than 95 %, the PCM determines that there is a throttle actuator control system range/performance problem.

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

P2122 APP sensor No.1 circuit low input
- The PCM monitors the input voltage from the APP sensor No.1 when the engine is running. If the input voltage is less than 0.3 V, the PCM determines that the APP sensor No.1 circuit input voltage is low.

P2123 APP sensor No.1 circuit high input
- The PCM monitors the input voltage from the APP sensor No.1 when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the APP sensor No.1 circuit input voltage is high.

P2127 APP sensor No.2 circuit low input
- The PCM monitors the input voltage from the APP sensor No.2 when the engine is running. If the input voltage is less than 0.3 V, the PCM determines that the APP sensor No.2 circuit input voltage is low.

P2128 APP sensor No.2 circuit high input
- The PCM monitors the input voltage from the APP sensor No.2 when the engine is running. If the input voltage is more than 4.8 V, the PCM determines that the APP sensor No.2 circuit input voltage is high.

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

P2136 TP sensor No.1/No.3 voltage correlation problem
- The PCM compares the input voltage from TP sensor No.1 with the input voltage from TP sensor No.3 (calculation value in PCM) when the engine is running. If the difference is more than the specification, the PCM determines that there is a TP sensor No.1/No.3 voltage correlation problem.

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

P2195 Front HO2S signal stuck lean
- The PCM monitors the front HO2S output current when the following conditions are met. If the average output current is more than 1.2 A for 25 s, the PCM determines that the front HO2S signal remains lean.

  MONITORING CONDITION
  - — ECT: more than 70 °C {158 °F}
  - — Engine speed: 1,000—3,200 rpm
  - — MAF amount: 6—80 g/s {0.80—10.58 lb/min}
  - — Target A/F feedback system status: feedback control
  - — Input voltage from the rear HO2S: more than 0.7 V

P2196 Front HO2S signal stuck rich

- The PCM monitors the front HO2S output current when the following conditions are met. If the average output current is less than 0.8 A for 25 s, the PCM determines that the front HO2S signal remains rich.
  MONITORING CONDITION
  — ECT: more than 70 °C {158 °F}
  — Engine speed: 1,000—3,200 rpm
  — MAF amount: 6—80 g/s {0.80—10.58 lb/min}
  — Target A/F feedback system status: feedback control
  — Input voltage from the rear HO2S: less than 0.2 V

P2257 AIR pump relay control circuit low

- The PCM monitors the AIR pump relay control voltage when the AIR pump is not operating. If the control voltage is less than 5.8 V, the PCM determines that the AIR pump relay control circuit voltage is low.

P2258 AIR pump relay control circuit high

- The PCM monitors the AIR pump relay control voltage when the AIR pump is operating. If the control voltage is more than 11.5 V, the PCM determines that the AIR pump relay control circuit voltage is high.

P2259 AIR solenoid valve control circuit low

- The PCM monitors the AIR solenoid valve control voltage when the AIR pump is not operating. If the control voltage is less than 5.8 V, the PCM determines that the AIR solenoid valve control circuit voltage is low.

P2260 AIR solenoid valve control circuit high

- The PCM monitors the AIR solenoid valve control voltage when the AIR pump is operating. If the control voltage is more than 11.5 V, the PCM determines that the AIR solenoid valve control circuit voltage is high.

P2270 Rear HO2S signal stuck lean

- The PCM monitors the input voltage from the rear HO2S when the following conditions are met. If the input voltage is more than 0.9 V for 40 s, the PCM determines that the rear HO2S signal remains lean.
  MONITORING CONDITION
  — ECT: more than 70 °C {158 °F}
  — Engine speed: more than 1,500 rpm
  — MAF amount: more than 10 g/s {1.32 lb/min}
  — Short term fuel trim: -20—20 %
  — Long term fuel trim: -15—15 %
  — Target A/F feedback system status: feedback control

P2271 Rear HO2S signal stuck rich

- The PCM monitors the input voltage from the rear HO2S when the following conditions are met. If the input voltage is less than 0.4 V for 40 s, the PCM determines that the rear HO2S signal remains rich.
  MONITORING CONDITION
  — ECT: more than 70 °C {158 °F}
  — Engine speed: more than 1,500 rpm
  — MAF amount: more than 10 g/s {1.32 lb/min}
  — Short term fuel trim: -20—20 %
  — Long term fuel trim: -15—15 %
  — Target A/F feedback system status: feedback control

P2401 EVAP system leak detection pump control circuit low

- The PCM monitors the pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the pump load current is less than the specification, the PCM determines that the EVAP system leak detection pump control circuit voltage is low.

P2402 EVAP system leak detection pump control circuit high

- The PCM monitors the pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the pump load current is more than the specification, the PCM determines that the EVAP system leak detection pump control circuit voltage is high.

P2404 EVAP system leak detection pump sense circuit range/performance problem

- The PCM monitors the pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the time in which the pump load current reaches the reference current value is not within the specification after the PCM obtains the reference current value, the PCM determines that there is an EVAP system leak detection pump sense circuit range/performance problem.

P2405 EVAP system leak detection pump sense circuit low

- The PCM monitors the pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the pump load current is less than the specification while the PCM obtains the reference current value, the PCM determines that the EVAP system leak detection pump sense circuit voltage is low.

P2406 EVAP system leak detection pump sense circuit high

- The PCM monitors the pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the pump load current is more than the specification while the PCM obtains the reference current value, the PCM determines that the EVAP system leak detection pump sense circuit voltage is high.

P2407 EVAP system leak detection pump sense circuit intermittent/erratic problem
- The PCM monitors the pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the change in pump load current is more than the specification while the PCM obtains the reference current value 28 times, the PCM determines that there is an EVAP system leak detection pump sense circuit intermittent/erratic problem.
- The PCM monitors the pump load current (EVAP line pressure) when the evaporative leak monitor is operating. If the pump load current is kept less than the maximum pump load current after the PCM obtains the reference current value 28 times, the PCM determines that there is an EVAP system leak detection pump sense circuit intermittent/erratic problem.

P2502 Charging system voltage problem
- The PCM monitors the generator output voltage and the battery voltage when the engine is running. If the generator output voltage is more than 16.9 V and the battery voltage is less than 10.9 V, the PCM determines that there is a charging system voltage malfunction.

P2503 Charging system voltage low
- The PCM monitors the generator output voltage when the engine is running. If the generator output voltage is less than 8.5 V while the PCM needs more than 19.5 A from the generator, the PCM determines that the charging system voltage is low.

P2504 Charging system voltage high
- The PCM monitors the generator output voltage and the battery voltage when the engine is running. If the generator output voltage is more than 18.4 V or the battery voltage is more than 15.9 V, the PCM determines that the charging system voltage is high.

KOEO/KOER SELF-TEST

CHU010200102S04

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

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

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

KOEO/KOER self-test table

×: Applicable
—: Not applicable

DTC No.	Condition	Test condition	
		KOEO	KOER
P0030	Front HO2S heater control circuit problem	—	×
P0031	Front HO2S heater control circuit low	—	×
P0032	Front HO2S heater control circuit high	—	×
P0037	Rear HO2S heater control circuit low	—	×
P0038	Rear HO2S heater control circuit high	—	×
P0076	VDI solenoid valve control circuit low	×	×
P0077	VDI solenoid valve control circuit high	×	×
P0101	MAF sensor circuit range/performance problem	—	—
P0102	MAF sensor circuit low input	×	×
P0103	MAF sensor circuit high input	×	×
P0107	BARO sensor circuit low input	×	×
P0108	BARO sensor circuit high input	×	×
P0111	IAT sensor circuit range/performance problem	—	—
P0112	IAT sensor circuit low input	×	×

DTC No.	Condition	Test condition	
		KOEO	KOER
P0113	IAT sensor circuit high input	×	×
P0117	ECT sensor circuit low input	×	×
P0118	ECT sensor circuit high input	×	×
P0122	TP sensor No.1 circuit low input	×	×
P0123	TP sensor No.1 circuit high input	×	×
P0125	Insufficient coolant temperature for closed loop fuel control	—	—
P0126	Insufficient coolant temperature for stable operation	—	—
P0128	Coolant thermostat problem	—	—
P0130	Front HO2S circuit problem	—	×
P0131	Front HO2S circuit low voltage	—	×
P0132	Front HO2S circuit high voltage	—	×
P0133	Front HO2S circuit slow response	—	—
P0138	Rear HO2S circuit high voltage	—	×
P0139	Rear HO2S circuit slow response	—	×
P0171	System too lean	—	×
P0172	System too rich	—	×
P0222	TP sensor No.2 circuit low input	×	×
P0223	TP sensor No.2 circuit high input	×	×
P0300	Random misfire detected	—	—
P0301	Front rotor misfire detected	—	—
P0302	Rear rotor misfire detected	—	—
P0327	KS circuit low input	×	×
P0328	KS circuit high input	×	×
P0335	Eccentric shaft position sensor circuit problem	—	—
P0336	Eccentric shaft position sensor circuit range/performance problem	—	×
P0410	AIR system problem	—	×
P0420	Catalyst system efficiency below threshold	—	—
P0441	EVAP system incorrect purge flow	—	×
P0442	EVAP system leak detected (small leak)	—	×
P0443	Purge solenoid valve circuit problem	—	×
P0446	EVAP system vent control circuit problem	—	×
P0455	EVAP system leak detected (large leak)	—	—
P0456	EVAP system leak detected (very small leak)	—	×
P0461	Fuel gauge sender unit circuit range/performance problem	—	—
P0462	Fuel gauge sender unit circuit low input	×	×
P0463	Fuel gauge sender unit circuit high input	×	×
P0480	Cooling fan No.1 control circuit problem	×	×
P0481	Cooling fan No.2 control circuit problem	×	×
P0500	VSS circuit problem	—	—
P0505	Idle air control system problem	—	×
P0506	Idle air control system RPM lower than expected	—	—
P0507	Idle air control system RPM higher than expected	—	—
P0562	System voltage low (KAM)	×	×
P0564	Cruise control switch input circuit problem	×	×
P0571	Brake switch input circuit problem	×	×
P0601	PCM memory check sum error	×	×
P0602	PCM programming error	×	×
P0604	PCM random access memory error	×	×
P0610	PCM vehicle options error	×	×
P0638	Throttle actuator control circuit range/performance problem	—	—
P0661	SSV solenoid valve control circuit low	×	×
P0662	SSV solenoid valve control circuit high	×	×
P0703	Brake switch No.1 input circuit problem	—	—

DTC No.	Condition	Test condition	
		KOEO	KOER
P0704	CPP switch input circuit problem	—	—
P0850	Neutral switch input circuit problem	—	—
P1260	Immobilizer system problem	×	—
P1574	TP sensor output incongruent	×	×
P1577	APP sensor output incongruent	×	×
P1686	Metering oil pump control circuit low flow side problem	—	×
P1687	Metering oil pump control circuit high flow side problem	—	×
P1688	Metering oil pump control circuit initial check problem	—	×
P2004	APV stuck open	×	×
P2006	APV motor control circuit IC problem	—	—
P2008	APV motor control circuit/open	×	×
P2017	APV position sensor circuit problem	×	×
P2070	SSV stuck open	×	×
P2096	Target A/F feedback system too lean	—	×
P2097	Target A/F feedback system too rich	—	×
P2101	Drive-by-wire relay control circuit problem	—	—
P2106	Throttle actuator control system-forced limited power	—	—
P2107	Throttle actuator control module processor error	×	×
P2108	Throttle actuator control module performance error	—	—
P2109	TP sensor minimum stop range/performance problem	—	—
P2112	Throttle actuator control system range/performance problem	—	—
P2119	Throttle actuator control throttle body range/performance problem	×	×
P2122	APP sensor No.1 circuit low input	×	×
P2123	APP sensor No.1 circuit high input	×	×
P2127	APP sensor No.2 circuit low input	×	×
P2128	APP sensor No.2 circuit high input	×	×
P2135	TP sensor No.1/No.2 voltage correlation problem	×	×
P2136	TP sensor No.1/No.3 voltage correlation problem	×	×
P2138	APP sensor No.1/No.2 voltage correlation problem	×	×
P2195	Front HO2S signal stuck lean	—	×
P2196	Front HO2S signal stuck rich	—	×
P2257	AIR pump relay control circuit low	×	×
P2258	AIR pump relay control circuit high	×	×
P2259	AIR solenoid valve control circuit low	×	×
P2260	AIR solenoid valve control circuit high	×	×
P2270	Rear HO2S signal stuck lean	—	×
P2271	Rear HO2S signal stuck rich	—	×
P2401	EVAP system leak detection pump control circuit low	×	×
P2402	EVAP system leak detection pump control circuit high	×	×
P2404	EVAP system leak detection pump sense circuit range/performance problem	—	—
P2405	EVAP system leak detection pump sense circuit low	×	×
P2406	EVAP system leak detection pump sense circuit high	×	×
P2407	EVAP system leak detection pump sense circuit intermittent/erratic problem	×	×
P2502	Charging system voltage problem	—	×
P2503	Charging system voltage low	—	×
P2504	Charging system voltage high	—	×

PID/DATA MONITOR AND RECORD

CHU010200102S05

- The PID/DATA monitor items are shown below.

PID/DATA monitor item table

—: Not applicable

Item	Definition	Unit/Condition			PCM terminal
ACCS	A/C relay control signal in PCM	On/Off			5AA
ACSW	Input signal from A/C switch	On/Off			4W
AIP RLY	AIR pump relay control signal in PCM	On/Off			4O
ALTF	Generator field coil control signal in PCM	%			2I
ALTT V	Input voltage from generator	V			2T
APP	APP	%			5C, 5F
APP1	APP from APP sensor No.1	%			5F
	Input voltage from APP sensor No.1	V			
APP2	APP from APP sensor No.2	%			5C
	Input voltage from APP sensor No.2	V			
APV	APV motor control signal in PCM	Opening/Closing			3G, 3J
APV_POS	Input voltage from APV position sensor	V			3B
ARPMDES	Target engine speed	RPM			—
B+	Input voltage from battery	V			5I
BARO	BARO	kPa	Bar	psi	5S
	Input voltage from BARO sensor	V			
BOO	Input signal from brake switch No.2	On/Off			4P
CATT11_DSD	Estimated catalyst converter temperature	°C	°F		—
CHRGLP	Generator warning light control signal in PCM	On/Off			—
COLP	Input signal from refrigerant pressure switch (medium-pressure)	On/Off			4Z
CPP	Input signal from CPP switch	On/Off			4F
CPP/PNP	Input signal from neutral switch	Drive/Neutral			2O
DEI	VDI solenoid valve control signal in PCM	On/Off			1W
DTCCNT	DTC count (includes those needing no action)	—			—
ECT	ECT	°C	°F		2K
	Input voltage from ECT sensor	V			
ECT_DES	Estimated ECT	°C	°F		—
EQ_RAT11	Lambda	—			2B
ETC_ACT	Throttle valve opening angle	°			1J, 1M
ETC_DSD	Target throttle valve position	%			—
	Target throttle valve opening angle	°			
EVAPCP	Purge solenoid valve control signal in PCM	%			2P
FAN1	Cooling fan relay No.1 control signal in PCM	On/Off			5X
FAN2	Cooling fan relay No.2 control signal in PCM	On/Off			5AD
FDPDTC	Pending code that caused Freeze Frame Data storage	—			—
FLI	Fuel tank level	%			—
FP	Fuel pump relay control signal in PCM	On/Off			5P
FPRR	Fuel pump speed control relay control signal in PCM	On/Off			4M
FUELPW	Fuel injection duration in PCM	ms			2J, 2M
FUELSYS	Fuel system loop status	OL/CL/OL Drive/ OL Fault/CL Fault			—
GENVDSD	Target generator voltage	V			—
HTR11	Front HO2S heater control signal in PCM	On/Off			1V
HTR12	Rear HO2S heater control signal in PCM	On/Off			2A
IAC	Throttle actuator control signal in PCM	%			1B, 1C
IASV	VFAD solenoid valve control signal in PCM	On/Off			5Z
IAT	IAT	°C	°F		5K
	Input voltage from IAT sensor	V			
INGEAR	In gear	On/Off			—
IVS	Idle validation	Idle/Off Idle			1J, 1M
KNOCKR	Spark retard value to prevent knocking	°			1T

Item	Definition	Unit/Condition		PCM terminal
LOAD	LOAD	%		—
LONGFT1	Long term fuel trim	%		—
MAF	MAF	g/s		5N
	Input voltage from MAF sensor	V		
MIL	MIL control signal in PCM	On/Off		—
MIL_DIS	Distance travelled while MIL is activated	km	mile	—
MOP_POS	Metering oil pump control status	—		2V, 2W, 2Y, 2AB
MOP_SW	Input signal from metering oil pump switch	On/Off		2N
O2S11	Front HO2S output current	mA		2B
O2S12	Input voltage from rear HO2S	V		2Q
PACNTV	AIR solenoid valve control signal in PCM	On/Off		1O
PCM_T	Input voltage from PCM temperature sensor	V		—
PREDELI	Delivery mode	On/Off		—
RO2FT1	Target A/F feedback system status	—		—
RPM	Engine speed	RPM		—
SC_SET	Cruise indicator light control signal in PCM	On/Off		—
SCCS	Input voltage from cruise control switch	V		5V
SELTESTDTC	DTC count by KOEO/KOER self-test	—		—
SHRTFT1	Short term fuel trim	%		—
SHRTFT12	Target A/F fuel trim	%		—
SPARK-L	Spark advance (L/F) in PCM	°		2AA
SPARK-T	Spark advance (T/F) in PCM	°		2AD
SSV	SSV solenoid valve control signal in PCM	On/Off		1L
test	Test mode	On/Off		—
TIRESIZE	Tire revolution per mile	—		—
TP	Input voltage from TP sensor	V		1J, 1M
TP REL	Relative TP	%		1J, 1M
TP1	TP from TP sensor No.1	%		1J
	Input voltage from TP sensor No.1	V		
TP2	TP from TP sensor No.2	%		1M
	Input voltage from TP sensor No.2	V		
TPCT	Minimum input voltage from TP sensor at throttle closing	V		1J, 1M
VSS	Vehicle speed	KPH	MPH	—

SIMULATION TEST

CHU010200102S06

- The simulation items are shown below.

Simulation item table

×: Applicable
—: Not applicable

Item	Applicable component	Unit/condition	Test condition		PCM terminal
			KOEO	KOER	
ACCS	A/C relay	On/Off	×	×	5AA
AIP RLY	AIR pump relay	On/Off	×	×	4O
ALTF	Generator (field coil)	%	—	×	2I
APV	APV motor	On/Off	×	×	3G, 3J
ARPMDES	Target engine speed	RPM	×	×	—
DEI	VDI solenoid valve	On/Off	×	×	1W
ETC_DSD	Target throttle valve opening angle	°	×	×	—
EVAPCP	Purge solenoid valve	%	×	×	2P
FAN1	Cooling fan relay No.1	On/Off	×	×	5X
FAN2	Cooling fan relay No.2	On/Off	×	×	5AD
FP	Fuel pump relay	On/Off	×	×	5P
FPRR	Fuel pump speed control relay	On/Off	×	×	4M
FUELPW1	Fuel injector (FP1, RP1)	%	—	×	2J, 2M
GENVDSD	Target generator voltage	V	—	×	—
HTR12	Rear HO2S heater	On/Off	×	×	2A
IASV	VFAD solenoid valve	On/Off	×	×	5Z
MOP_POS	Metering oil pump	—	×	×	2V, 2W, 2Y, 2AB
PACNTV	AIR solenoid valve	On/Off	×	×	1O
PREDELI	Delivery mode	On/Off	×	×	—
SSV	SSV solenoid valve	On/Off	×	×	1L
test	Test mode	On/Off	×	×	—

01–10 MECHANICAL

MECHANICAL OUTLINE

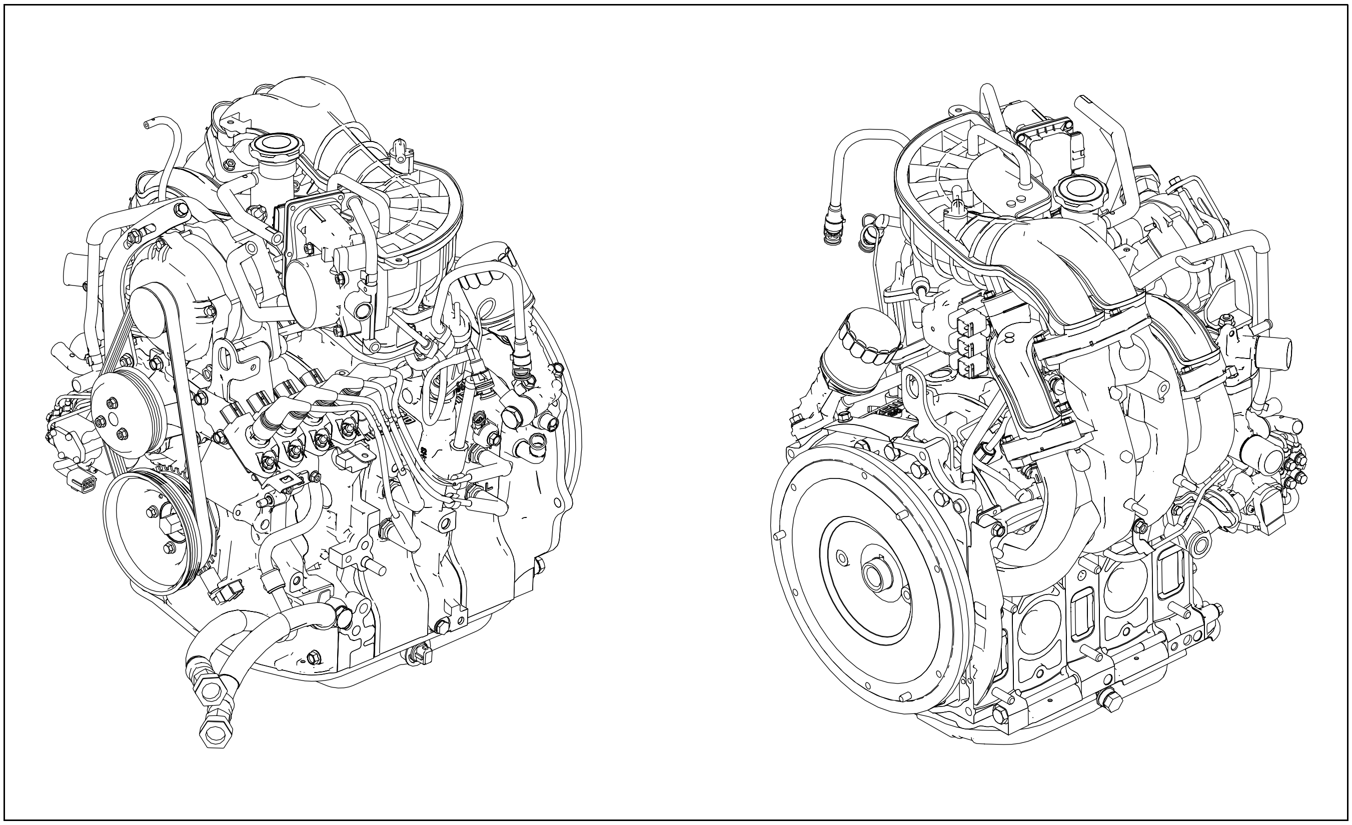
Features

CHU011001001S01

Improved power performance	• A side intake and exhaust port system adopted. • 2-piece apex seals adopted. • Keystone shaped side seals adopted. • Cut-off seal adopted. • A lightweight flywheel adopted.
Reduced weight	• Thin walls on the side housings adopted. • Lightweight rotors adopted. • Aluminum rotor housings adopted. • Aluminum engine mount brackets adopted.
Improved driving performance	• Advanced front-midship layout adopted.
Reduced engine noise and vibration	• Oil-filled engine mount rubber adopted.
Improved fuel economy	• Bathtub shaped combustion chambers adopted. • By-pass valve in the eccentric shaft adopted. • Anti-wet port adopted.

ENGINE STRUCTURAL VIEW

CHU011001001S02

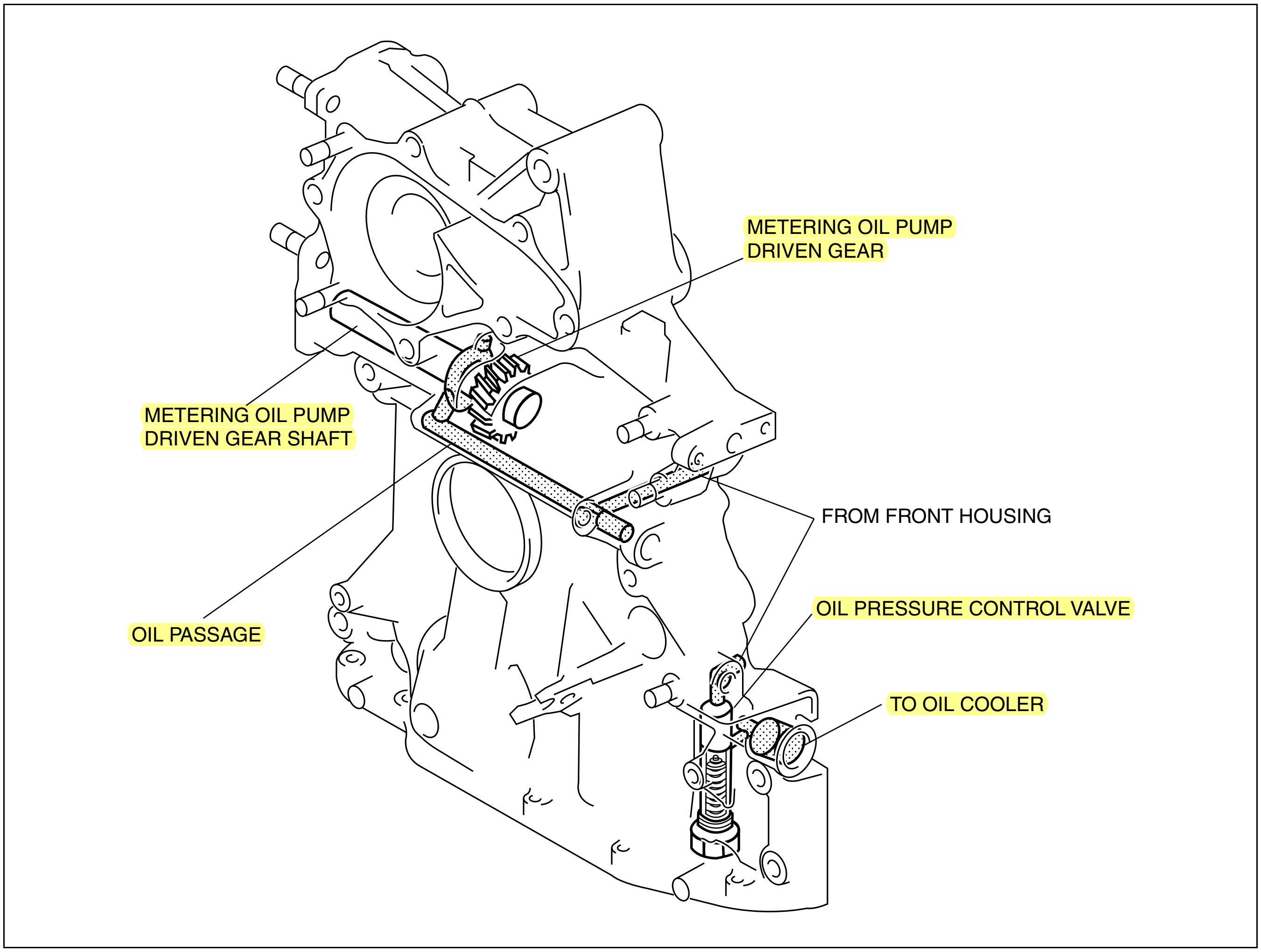


BHJ0110N002

ENGINE FRONT COVER CONSTRUCTION

CHU011010908S01

- The lightweight, aluminum alloy engine front cover includes a metering oil pump driven gear shaft, metering oil pump driven gear and oil cooler with a hydraulic pressure adjusted oil pressure control valve. An internal oil passage for a metering type oil pump has also been added.

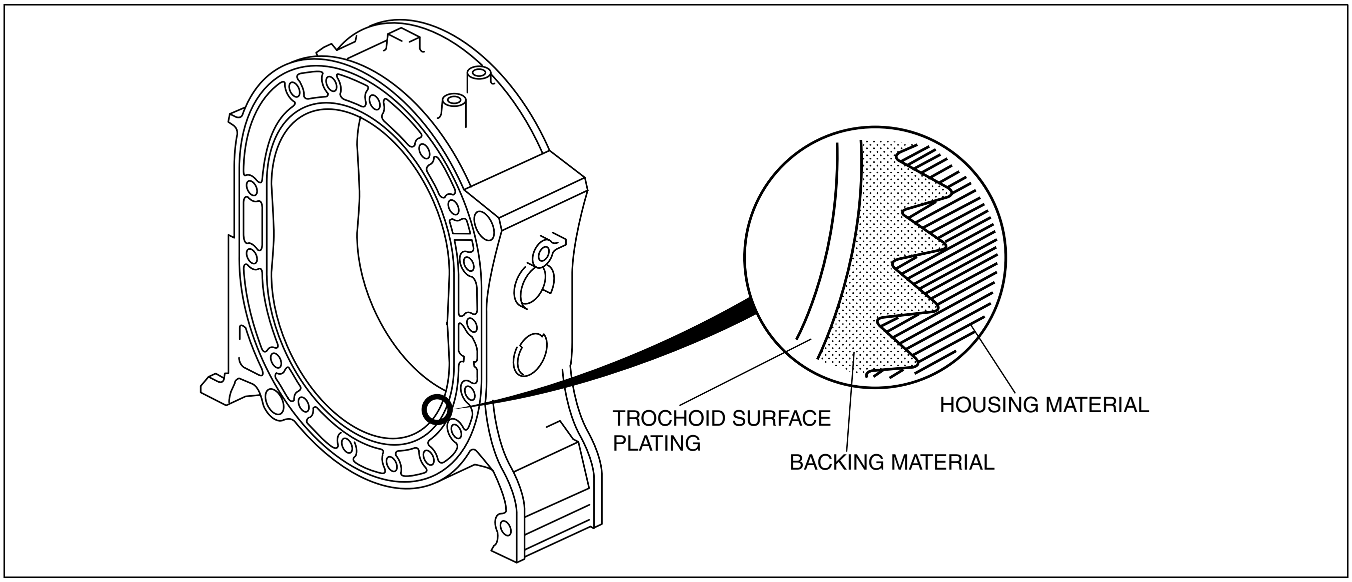


CHU0110S003

ROTOR HOUSING CONSTRUCTION

CHU011010908S02

- Based on the SIP (Sheetmetal Insert Process) production method utilizing special steel on the inner surface and casting aluminum around the steel circumference, the rotor housings employ the benefits of both the lightweight feature of aluminum together with the excellent strength of steel. By the addition of MCP (Micro Channel Porous) chromium plating to the inner trochoid surface, fine grooves have been made in the surface of the chromium plating for improved oil retention.
- A fluorocarbon resin coating has been added to the trochoid surface for improved initial break-in.

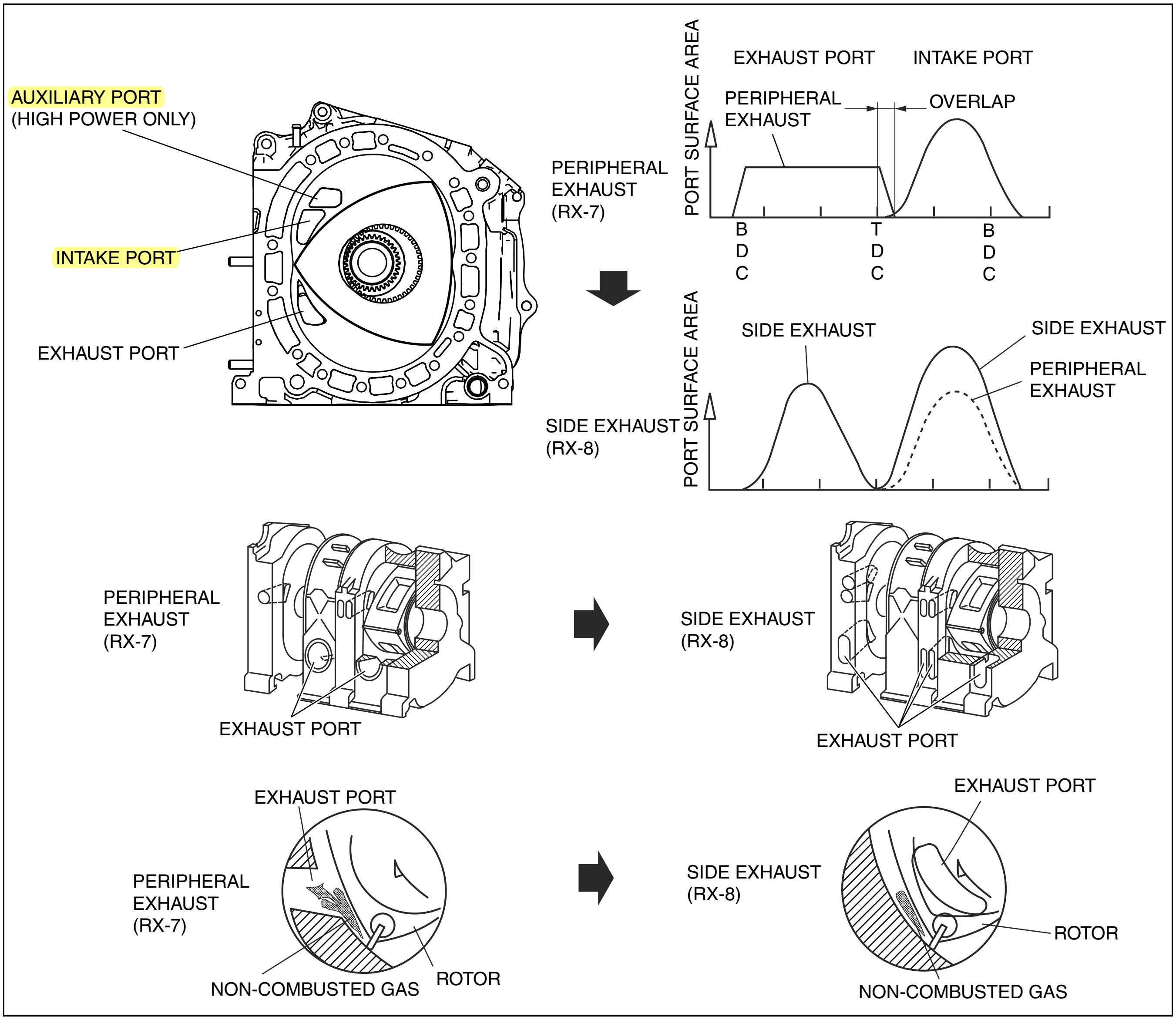


CHJ0110S006

SIDE HOUSING OUTLINE

CHU011010908S03

- With the adoption of a side intake and exhaust port system, the exhaust ports have been moved from the rotor housing to the side housing.
- Intake and exhaust port overlap has been eliminated on the side intake and exhaust port system by way of independently set intake and exhaust port size configurations. As a result, stable combustion is achieved due to the combustion gas not flowing into the intake process.
- With 2 exhaust ports per rotor, the current exhaust ports have approximately 2 times the exhaust port surface area compared with the previous ports. Because of this, open-timing on the exhaust ports can be retarded while maintaining sufficient port size. Therefore, the expansion process period has been increased, improving heat efficiency and resulting in high engine output with reduced fuel consumption.
- Intake air resistance has been largely reduced by the approximate 30% expansion of the intake port surface area compared with the previous ports. By retarding the close-timing of the intake ports, intake air volume has been increased for higher engine output.
- With the adoption of side exhaust ports, non-combusted gas, which used to be swept by the apex seals, is sent to the next combustion process for re-combustion, resulting in reduced exhaust from non-combusted gas.



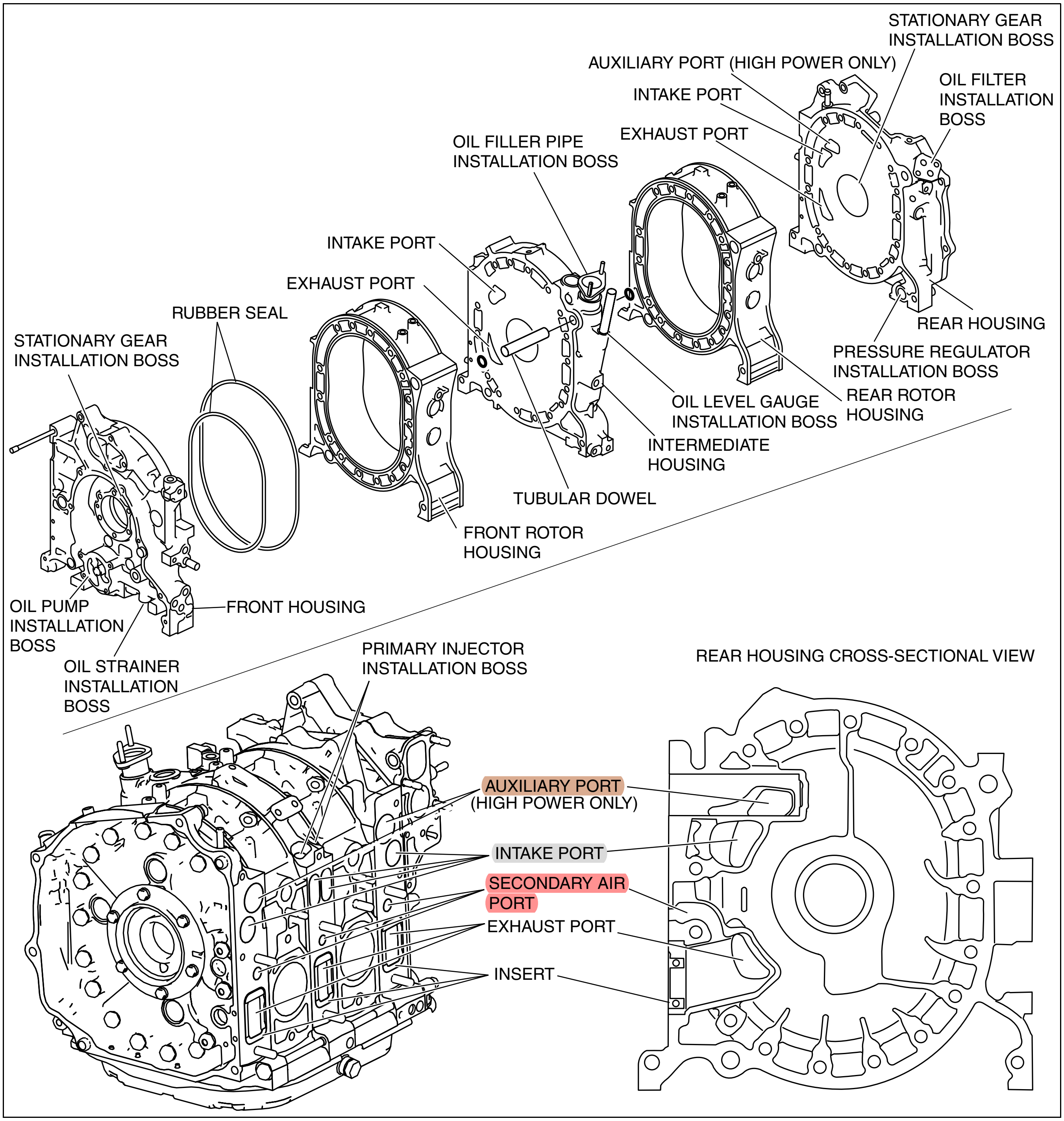
CHJ0110S004

SIDE HOUSING CONSTRUCTION

CHU011010908S04

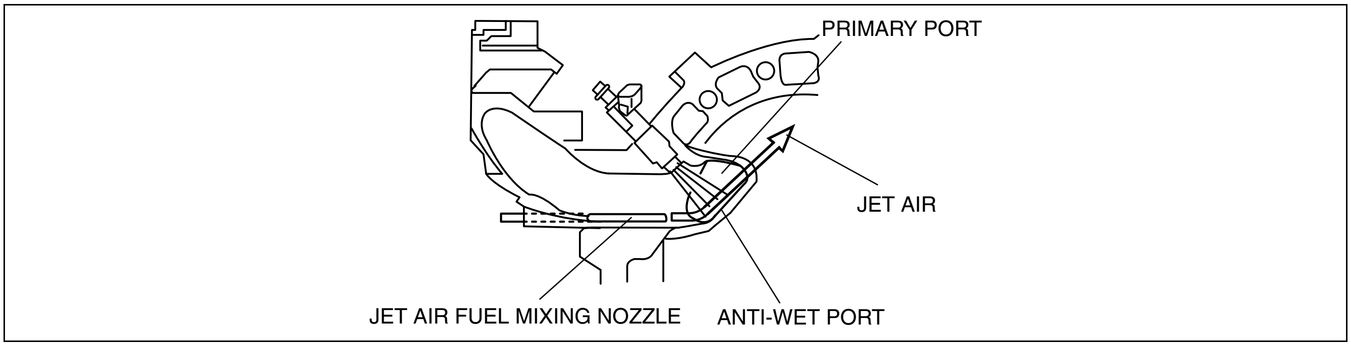
- To speed catalytic activation during cold-engine start, inserts have been installed in each exhaust port to maintain the higher temperatures. Above each exhaust port is a secondary air port, which sends secondary air close to the combustion chamber.
- The housing forms the engine outer core with the intermediate housing positioned between the two rotor housings, which are further enclosed by front and rear housings. The components of the housing are positioned precisely using tubular dowel pins.

- On the front and rear housings are the installation bosses for the stationary gears that regulate the rotational movement of the rotors supporting the eccentric shaft.
- On the front housing are the bosses for installing the oil pump and the oil strainer.
- On the intermediate housing are the bosses for the primary injectors, which are placed near the combustion chambers for semi-direct injection. There are also additional bosses for the oil level gauge and the oil filler pipe.
- On the rear housing are the bosses for installing the oil filter and the oil pressure regulator.
- The special cast iron side housings are processed with soft-nitriding for improved wear resistance of the rotor friction surfaces. Wall thickness in each area of the side housings has been reduced for weight reduction.
- Each of the housings are sealed together with rubber seals at the inner and outer circumferences of the water jacket surrounding the rotor friction surface.



CHJ0110S005

- The anti-wet port with a projection is located on the bottom edge of the primary port. With the anti-wet port, jet air from the jet air fuel mixing nozzle, located at the primary port outlet of the intake manifold, flows upward, and atomization is accelerated under low load when air intake velocity is slow. At the same time, air current is formed so that the air-fuel mixture flows to the spark plugs. As a result, stable combustion is obtained.

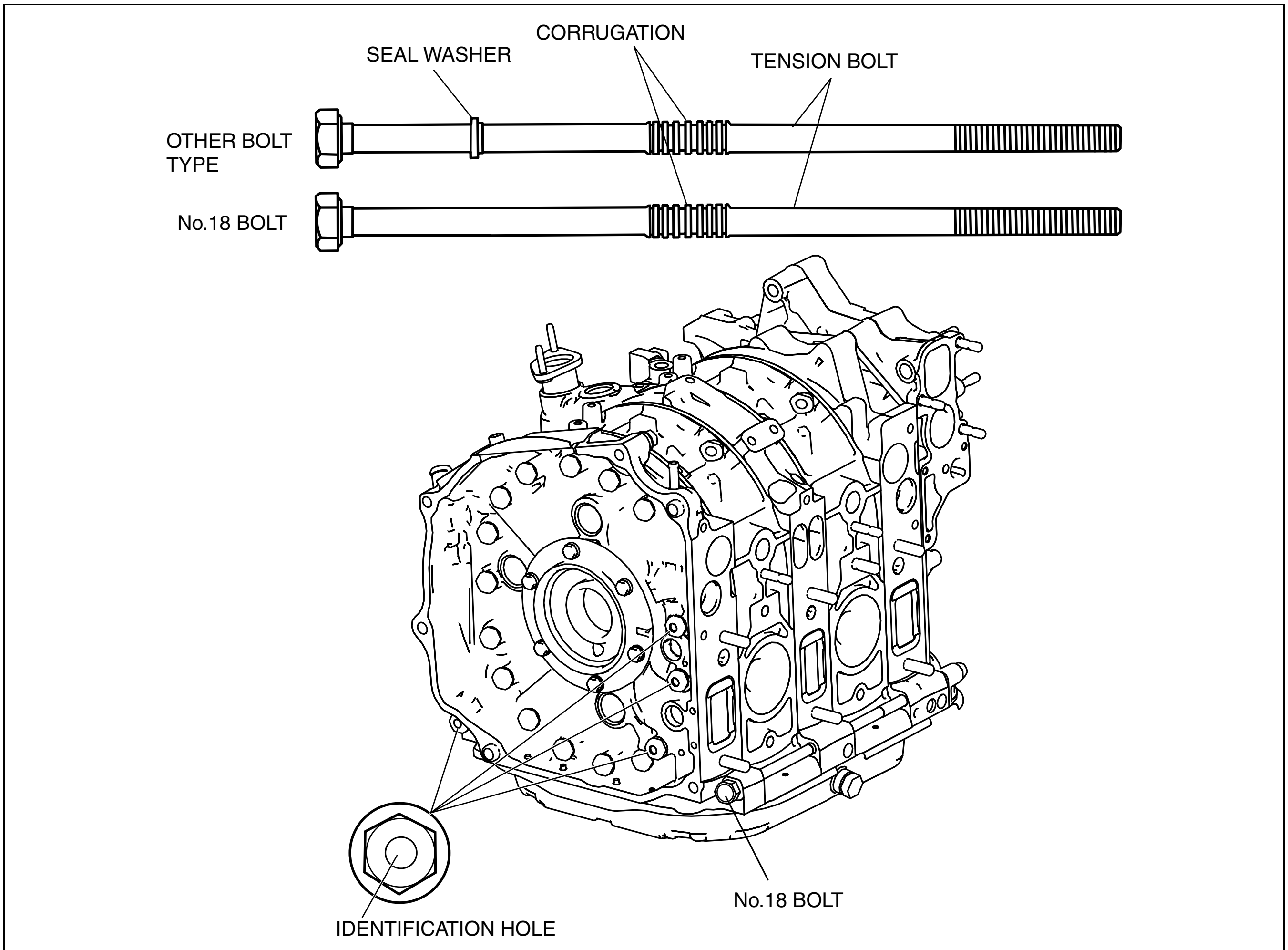


CHJ0110S022

TENSION BOLT CONSTRUCTION

CHU011010908S05

- The tension bolts, pointed from the rear to the front housing, are tightened to fix the housings.
- Corrugation at the center of the tension bolts prevents resonance.
- There are two types of tension bolt lengths, with the longer bolts having a hole in the bolt head for differentiating between the two types of lengths.

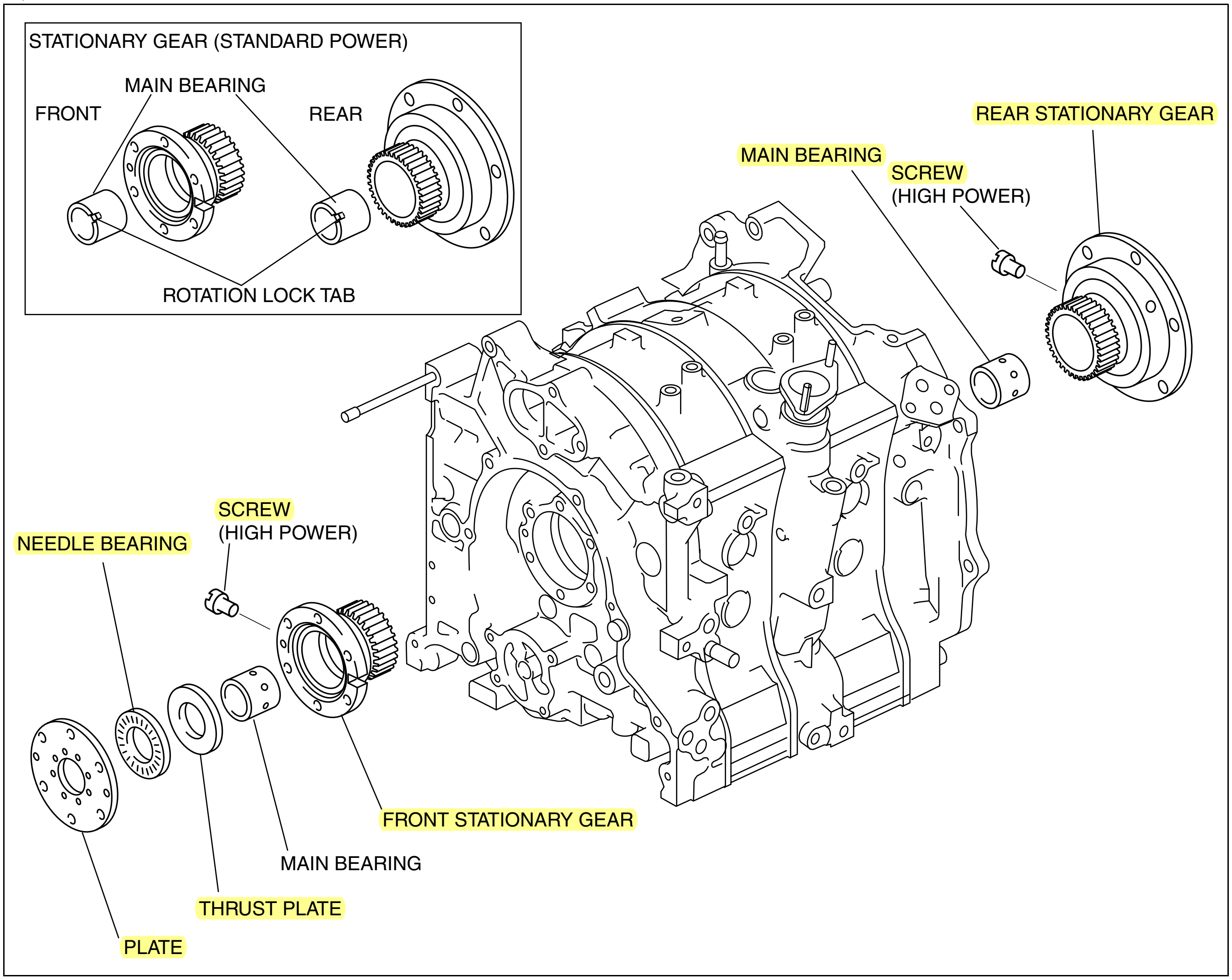


CHJ0110S007

STATIONARY GEAR CONSTRUCTION

CHU011010908S06

- The special steel used for the stationary gear is processed with ion nitriding for improved strengthening against fatigue on the tooth surfaces.
- The main bearing is pressed into the stationary gear. Rotation lock of this bearing is done with a screw for the high power and a rotation lock tab for the standard power.
- A needle bearing and thrust plate have been assembled in the front stationary gear for regulation of the eccentric shaft end play.

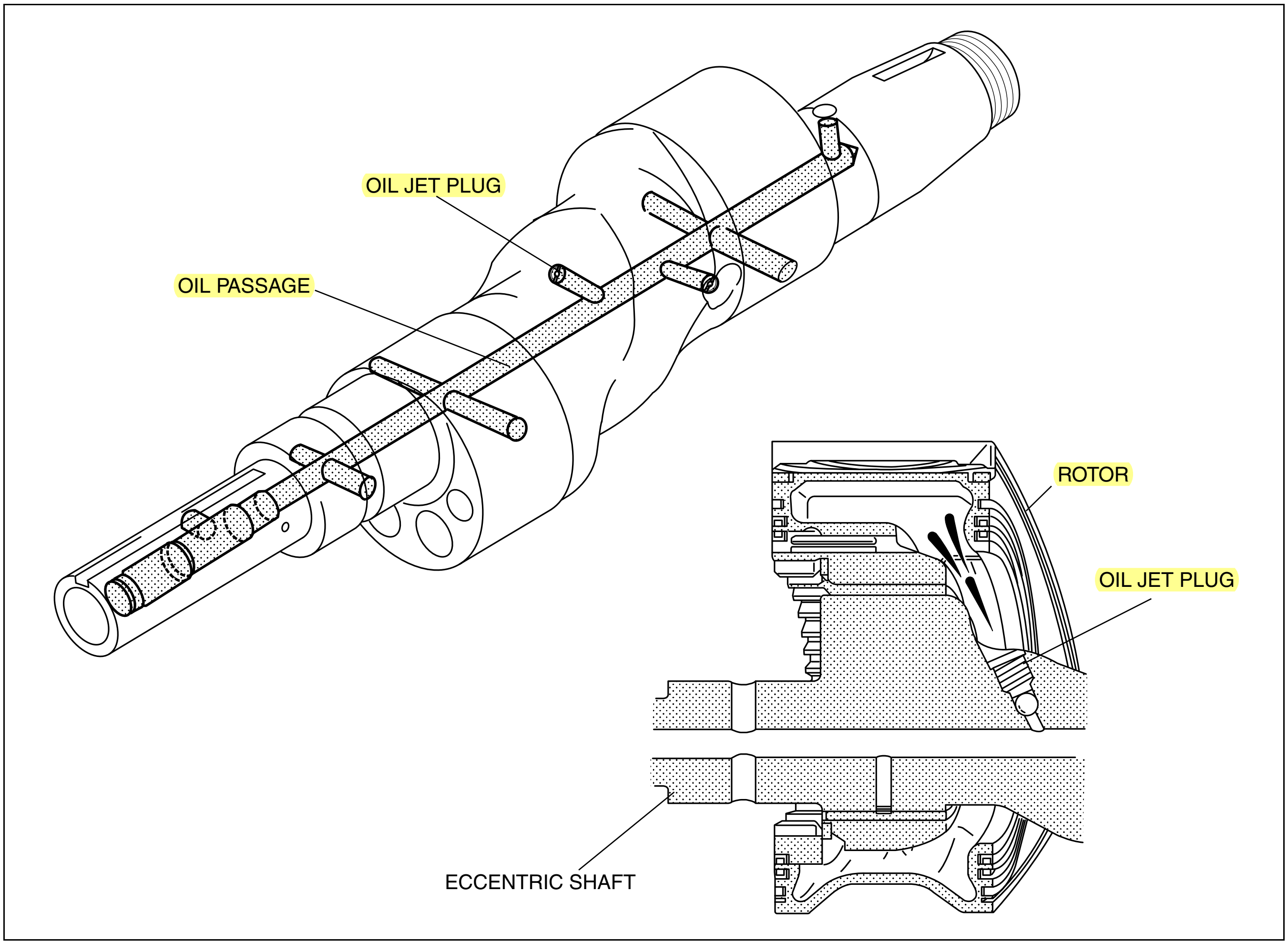


CHJ0110S008

ECCENTRIC SHAFT CONSTRUCTION

CHU011011901S01

- The highly durable, forged carbon steel eccentric shaft is processed with induction hardening for improved wear resistance.
- The oil passage supplying lubrication for each journal and the rotor cooling oil jet plugs, runs from the front end of the eccentric shaft to the rear main journal.
- The rotor cooling oil jet plugs inject oil into the rotor interior.

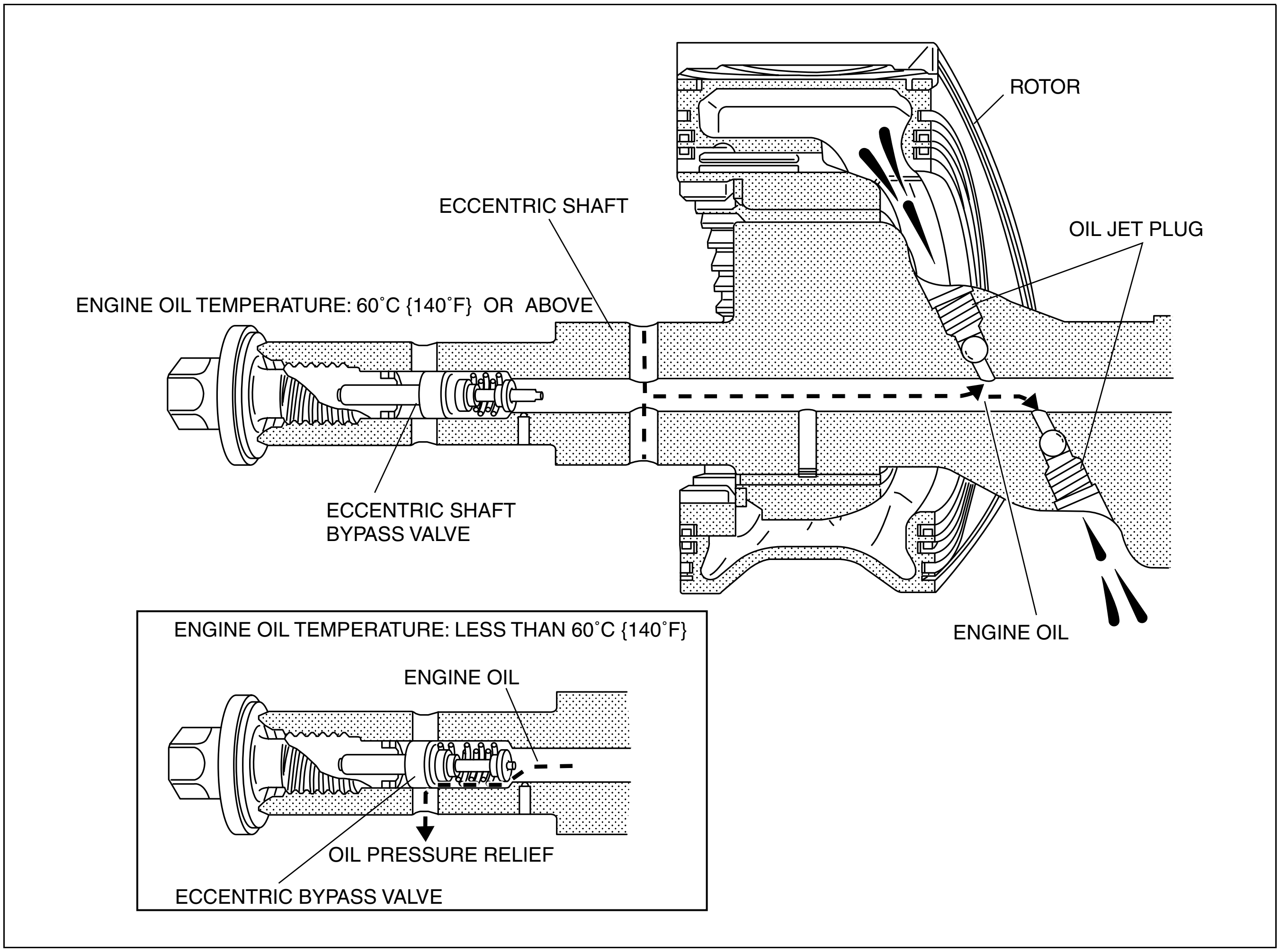


CHJ0110S009

ECCENTRIC SHAFT BYPASS VALVE CONSTRUCTION

CHU011011901S02

- An eccentric shaft bypass valve has been adopted to shorten the engine warm up period. The eccentric shaft bypass valve allows engine oil in the oil passage to escape at cold-engine start, maintaining a pressure in the eccentric shaft that prohibits injection of rotor cooling engine oil from the oil jet plugs until the engine is warmed up.



CHJ0110S010

BALANCE WEIGHT, COUNTERWEIGHT (AT), FLYWHEEL (MT) OUTLINE

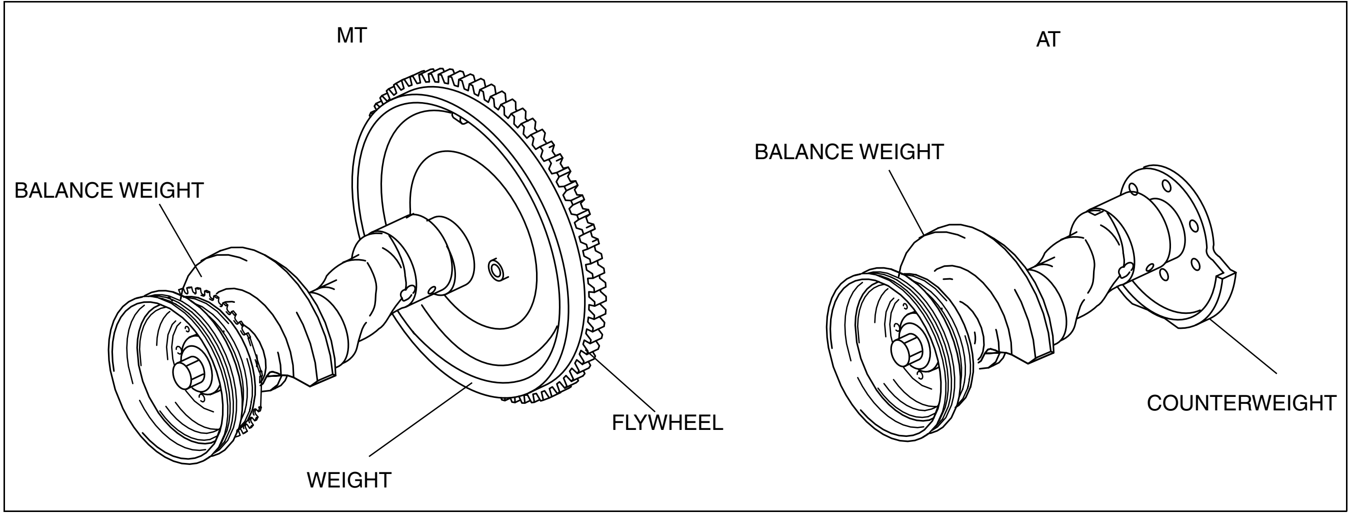
CHU011011901S03

- The flywheel is approximately 20% lighter than the previous flywheel for improved engine response.

BALANCE WEIGHT, COUNTERWEIGHT (AT), FLYWHEEL (MT) CONSTRUCTION

CHU011011901S04

- A balance weight and a counterweight (AT) have been installed to prevent dynamic unbalance.
- For MT, a weight has been added to perimeter of the flywheel to obtain the same balancing effect as the counterweight on AT.
- The weight of balance weights for both MT and AT changes in accordance with the difference in rotation-related mass of the transmission that is employed.



CHJ0110S011

ROTOR OUTLINE

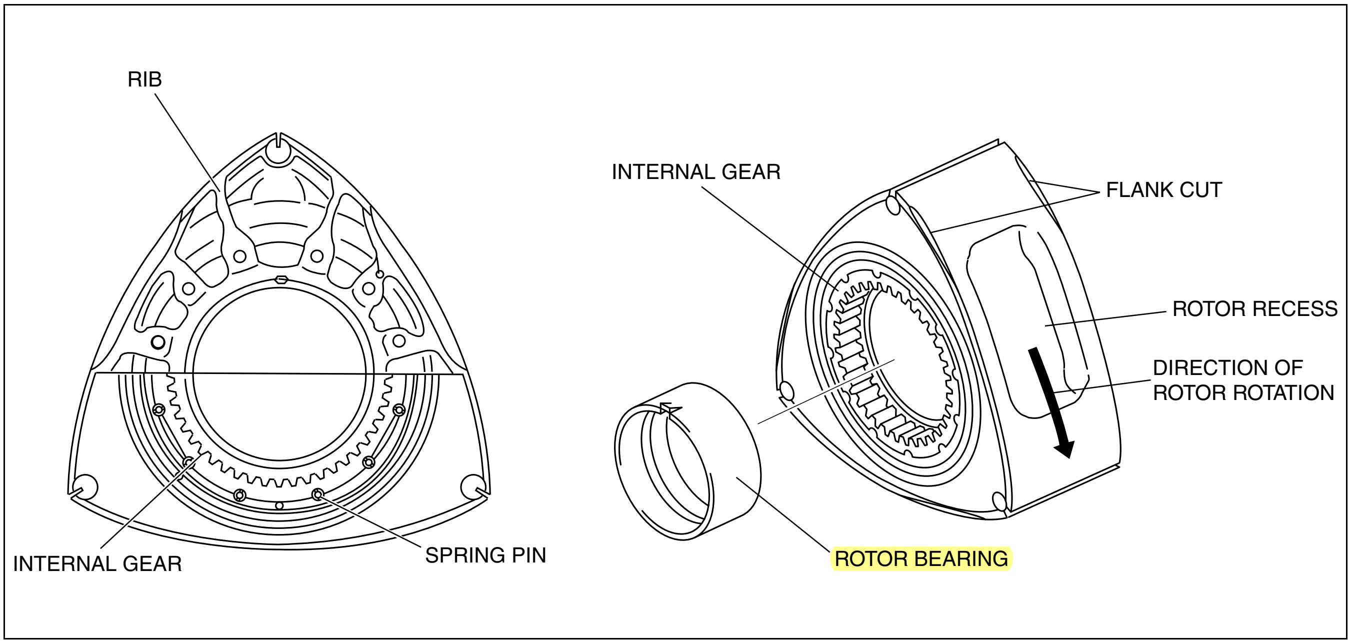
CHU011011910S01

- Lightweight rotors have been adopted that correspond to the high-speed rotation for improved engine response.

ROTOR CONSTRUCTION

CHU011011910S02

- The special cast iron rotors have a hollow interior structure.
- Reduction in rotor weight has been achieved by reducing the thickness of the ribs in the rotor interior.
- The outer surfaces of the rotor include rotor recesses that serve as the combustion chambers. (Bathtub shape)
- A rotor bearing has been installed to the interior wall of the central axial area because the wall rubs against the eccentric shaft.
- Flank cuts are located at the corners of the rotor to delay exhaust closing timing by approx. 15 degrees, improving exhaust efficiency.

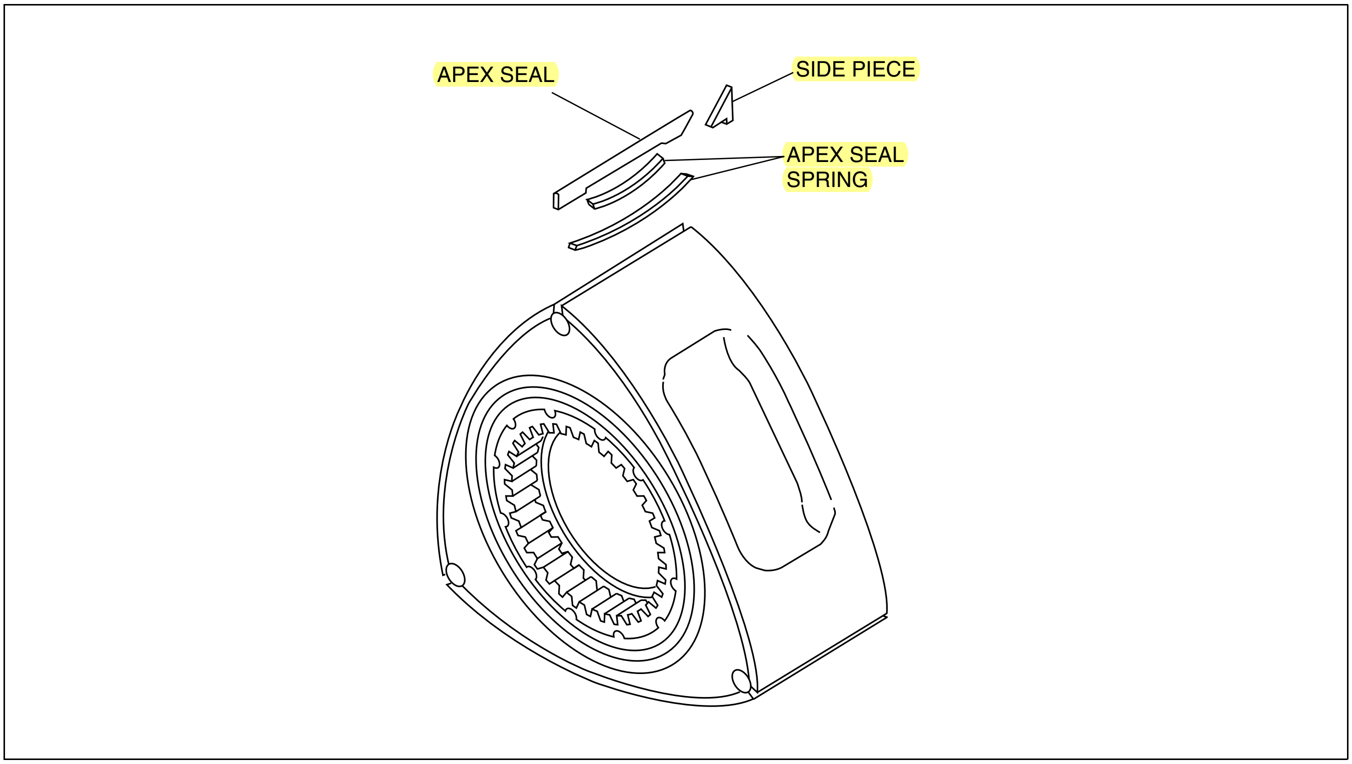


CHJ0110S012

APEX SEAL CONSTRUCTION

CHU011011910S03

- The special iron cast apex seals have been electronic beam processed to improve abrasion resistance on the trochoid friction surface.
- The apex seal is comprised of two parts including a side piece set on the sharp end of an apex seal. The apex seals maintain a gas seal while sweeping the trochoid surface by the combined force of the apex seal springs and centrifugal force of the rotor rotation.

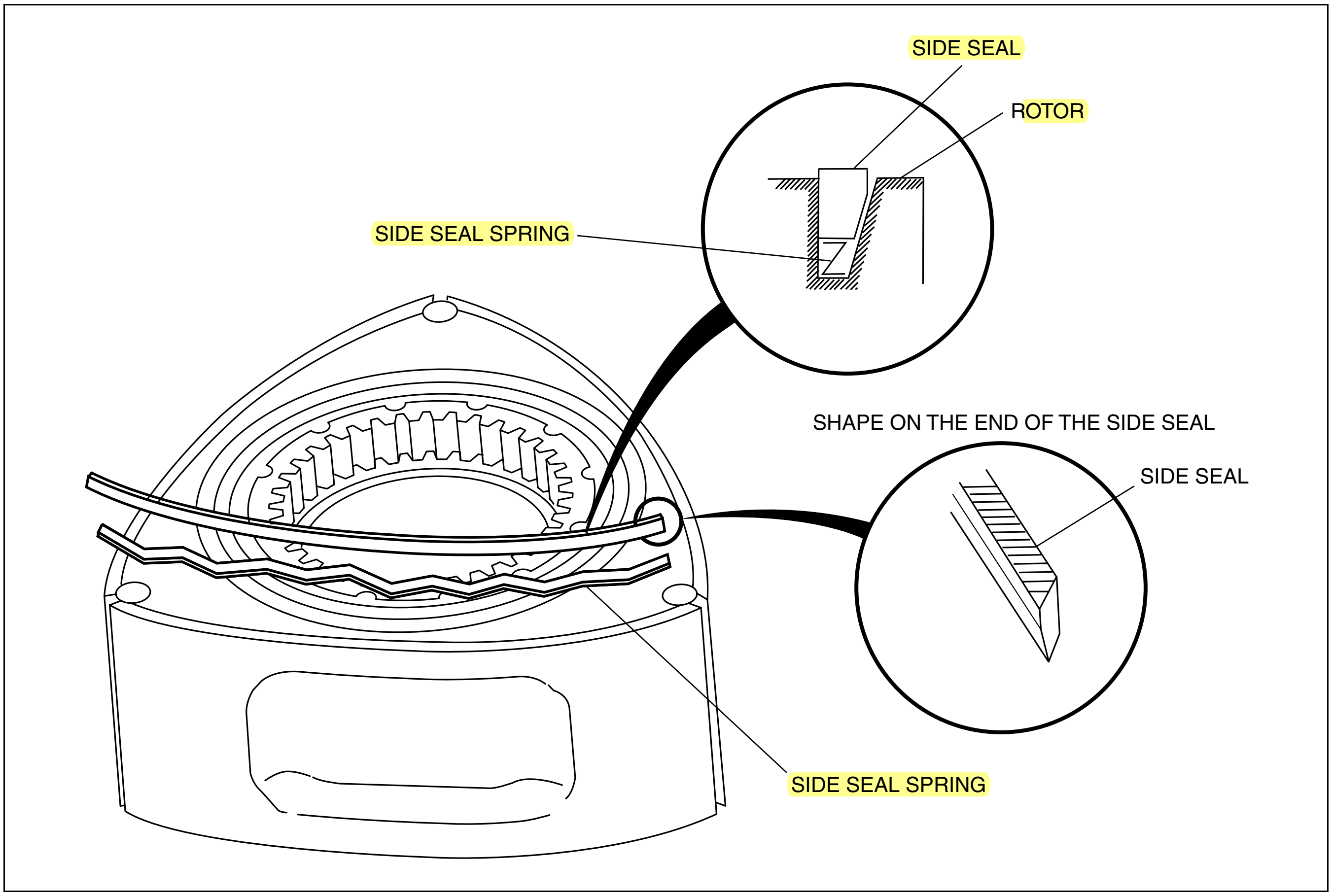


CHJ0110S013

SIDE SEAL CONSTRUCTION

CHU011011910S04

- The iron sintering system side seals maintain a gas seal while sweeping the side housing by the force of the side seal springs.
- With the adoption of keystone-shaped (bulged shape) side seals, scraping and removal of carbon that collects in the side seal grooves has been improved. At the same time, gas sealing performance on the friction surface and seal performance have been strengthened.

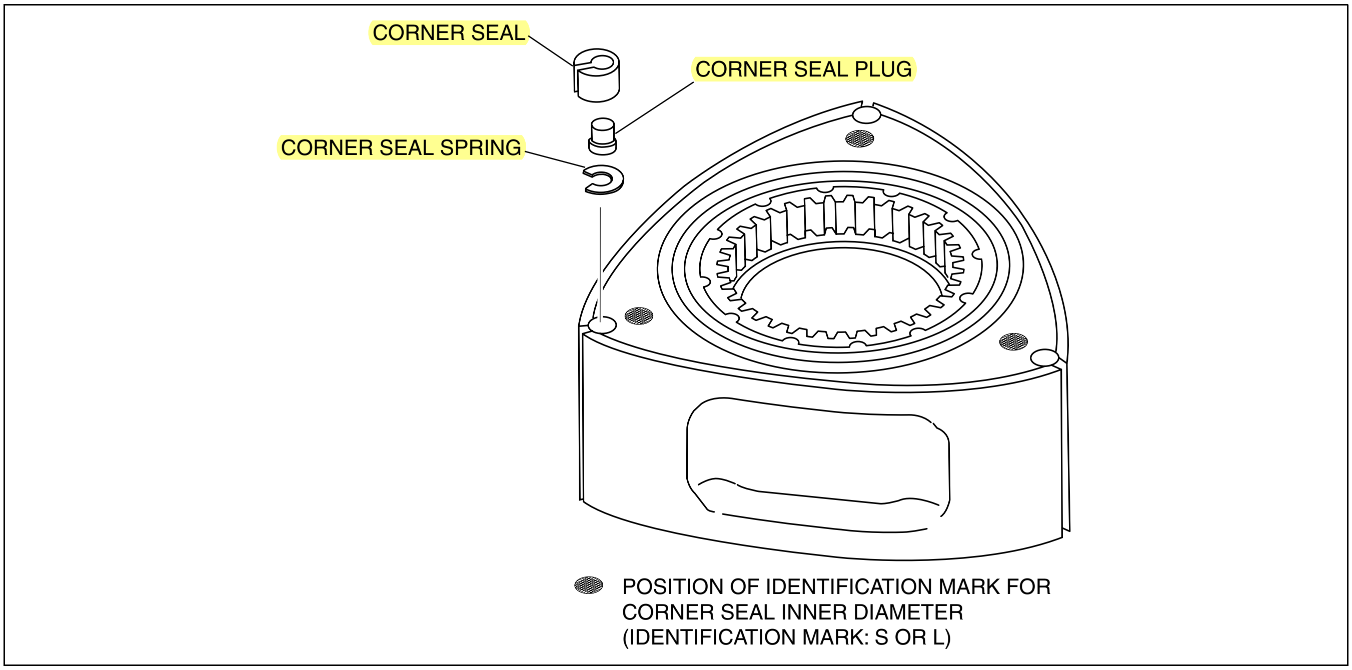


CHJ0110S014

CORNER SEAL CONSTRUCTION

CHU011011910S05

- The special cast iron corner seals maintain a gas seal while sweeping the side housing by the force of the corner seal springs. In addition, the chrome plating on perimeter side of the corner seals has reduced wear on the rotor installation holes.
- There are two types of corner seal diameters to match the inner diameters of the corner seal installation holes on the rotor. To aid in the selection of the type of corner seal to be used when replacing corner seals, identification marks have been provided on the rotor.

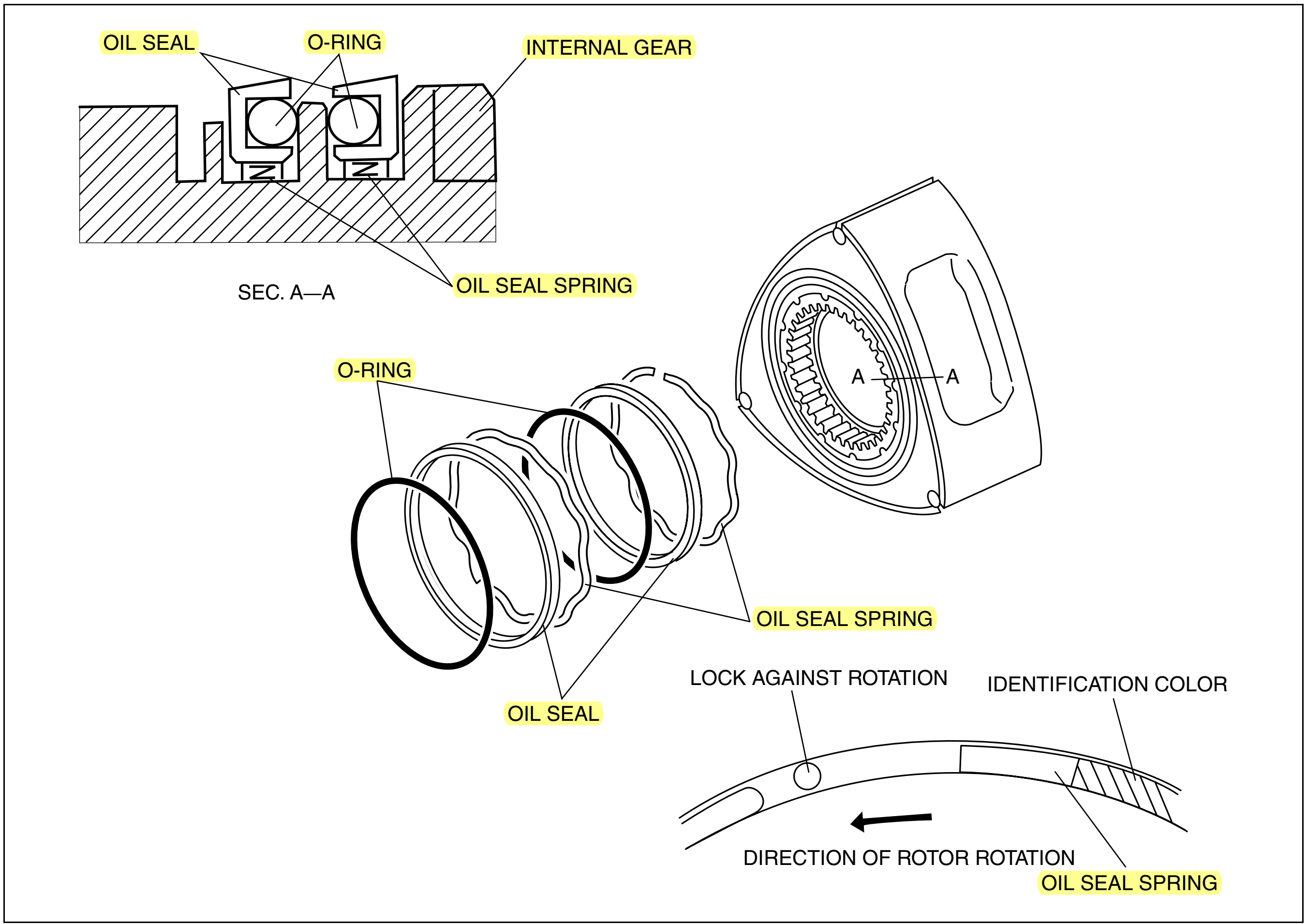


CHJ0110S015

OIL SEAL CONSTRUCTION

CHU011011910S06

- To prevent the oil that is supplied to the inner rotor for cooling and for lubrication of the bearings from leaking into the combustion chambers from the side surfaces, two oil seals have been added to each side of the rotor.
- The tapered lips press against the housing friction surface to perform oil sweeping and have employed hard-chrome plating for improved wear resistance.
- The addition of oil seal springs between the oil seals and the rotor maintain a oil seal against the side housing friction surface. Colored marks for identification of the spring have been added on the oil seal spring.



CHJ0110S016

CUT-OFF SEAL OUTLINE

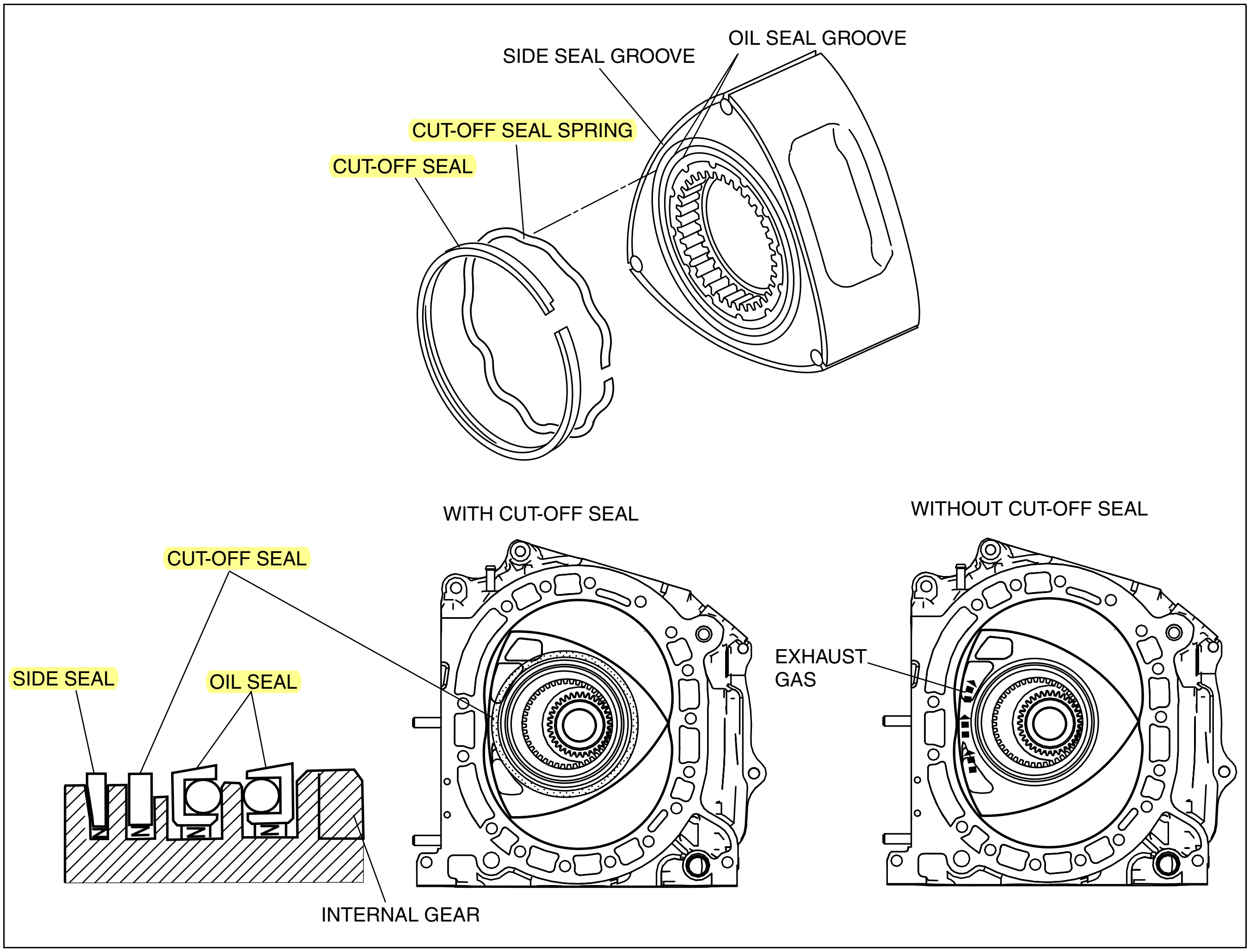
CHU011011910S07

- New seals have been adopted in accordance with the side exhaust port system for improved combustion stability.

CUT-OFF SEAL CONSTRUCTION

CHU011011910S08

- The zero-overlap side exhaust port system has structurally reduced the mixing of exhaust gas in the intake air process. When the position of the rotor is at top dead center (TDC) of exhaust, the intake ports and exhaust ports are closed by the side surfaces of the rotor. However, exhaust gas flows into the intake air port passing through the minute gap between the rotor and the side housing. To prevent this, exhaust gas has been blocked from flowing into the intake air process by a cut-off seal set between the oil seal and side seal.
- A gas seal is maintained against the housing friction surface by the addition of a spring between the cut-off seal and the rotor.

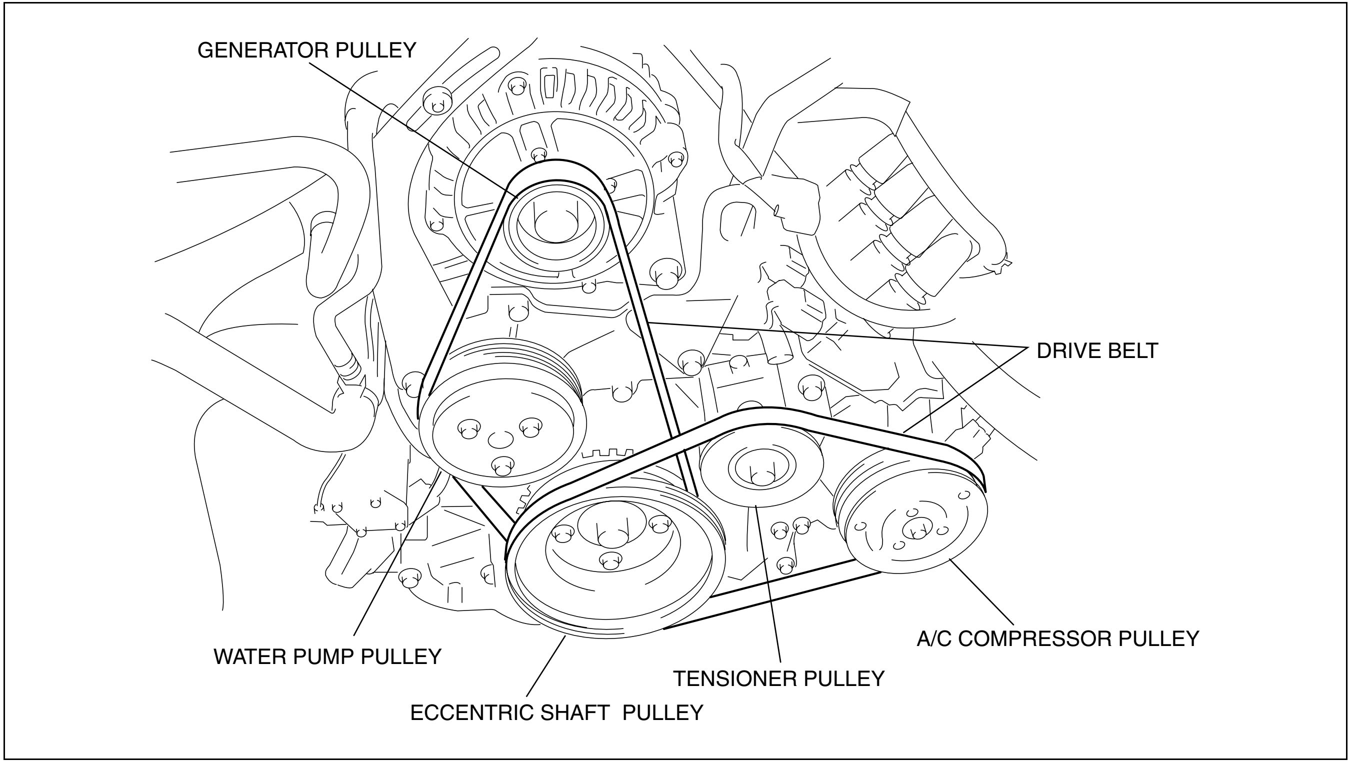


CHJ0110S017

DRIVE BELT CONSTRUCTION

CHU011015800S01

- The V-ribbed drive belts are composed of two belts, one that drives the generator and the water pump, and another that drives the A/C compressor. Serviceability has been improved from this simple layout based on the motorization of the air pump and P/S pump that were formerly driven by drive belts.

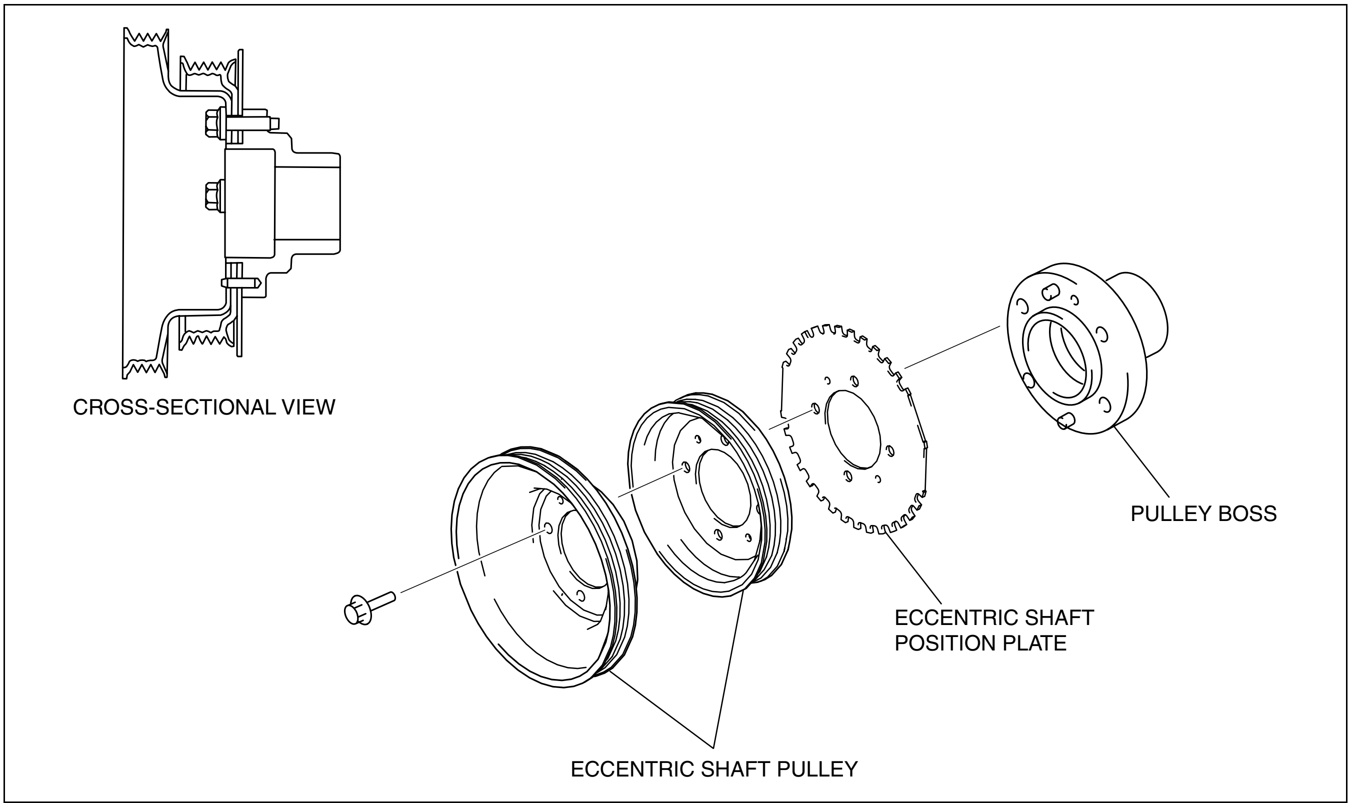


CHJ0110S018

ECCENTRIC SHAFT PULLEY DESCRIPTION

CHU011011400S01

- The eccentric shaft pulleys are made of carbon steel and are installed to the eccentric shaft through the pulley boss.

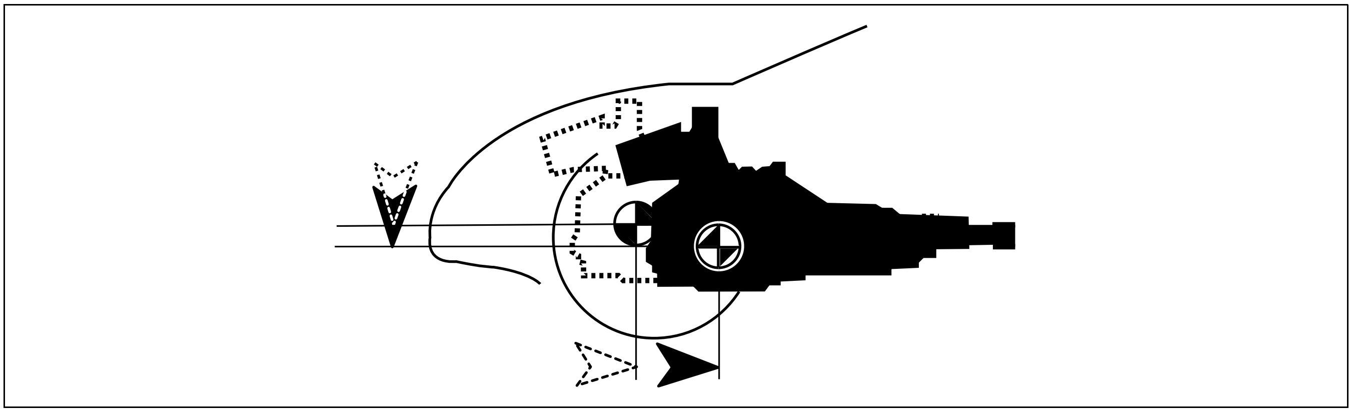


CHJ0110S019

ENGINE MOUNT OUTLINE

CHU011039000S01

- With the adoption of a naturally aspirated engine, an ideal engine layout (advanced front-midship layout) has been realized by the engine being positioned approximately 60 mm {2.36 in} further rearward and approximately 39 mm {1.54 in} further downward than the previous engine. This has been made possible by reducing the height the oil pan and placing intake air related parts at the front of the engine.

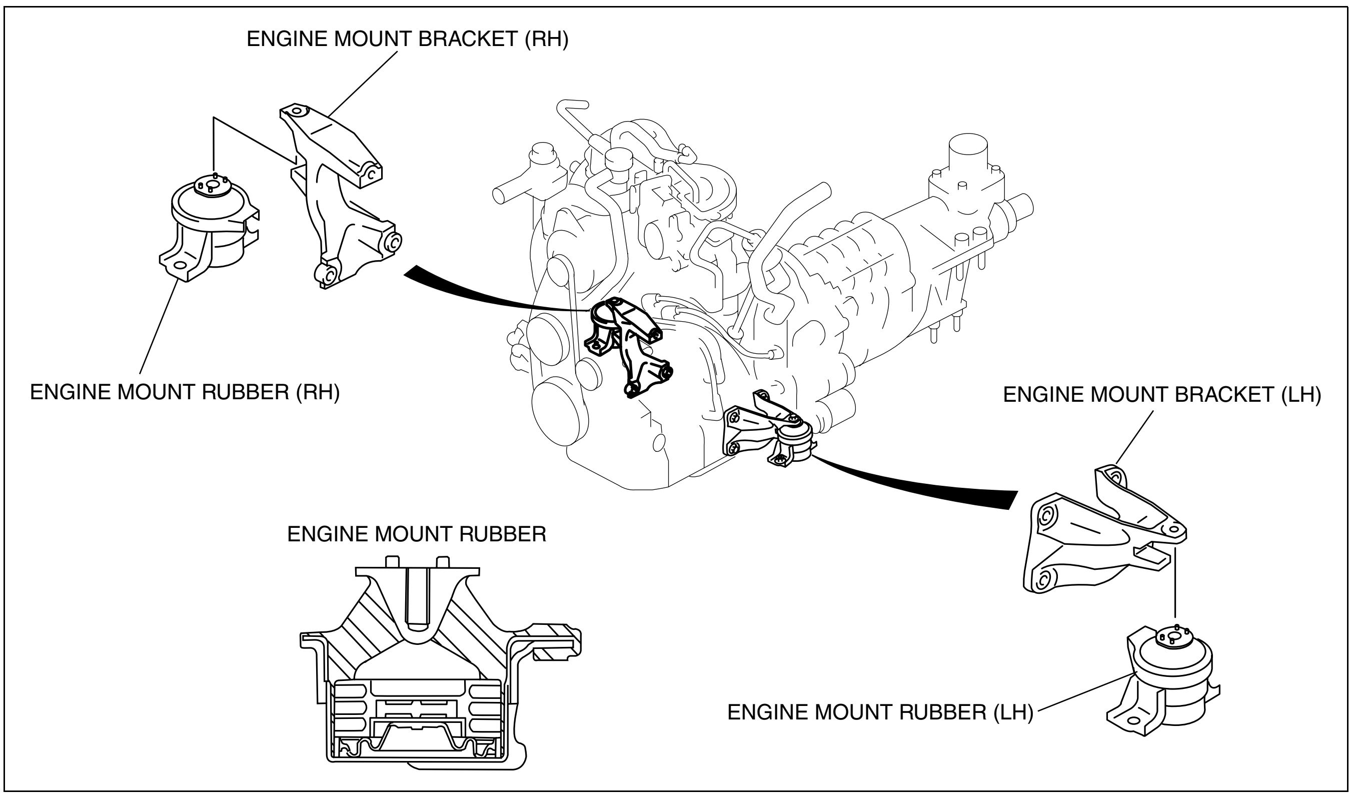


BHJ0110N022

ENGINE MOUNT CONSTRUCTION

CHU011039000S02

- The use of mount rubber to support areas under the engine where there is less vibration as well as oil-filled mount rubber has reduced engine vibration.
- With the adoption of aluminum engine mount brackets, weight reduction have been achieved.



CHJ0110S021

01–11 LUBRICATION

LUBRICATION SYSTEM OUTLINE

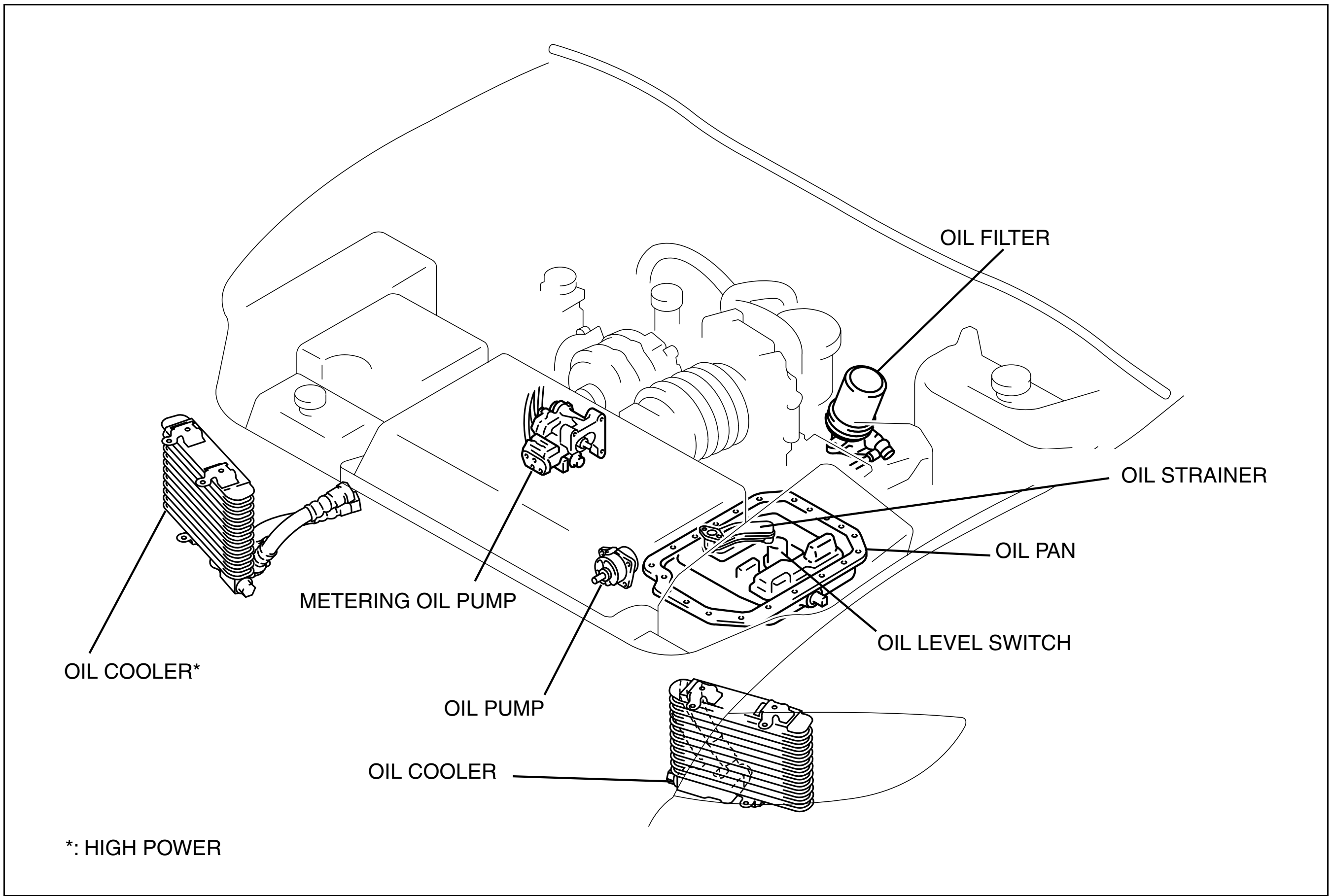
CHU011101008S01

Features

Reduced weight	• A compact oil filter adopted • An oil strainer made of plastic adopted • A thin oil pan made of steel adopted
Improved lubricity	• A two-rotor type trochoid oil pump adopted • An electric type metering oil pump adopted

LUBRICATION STRUCTURAL VIEW

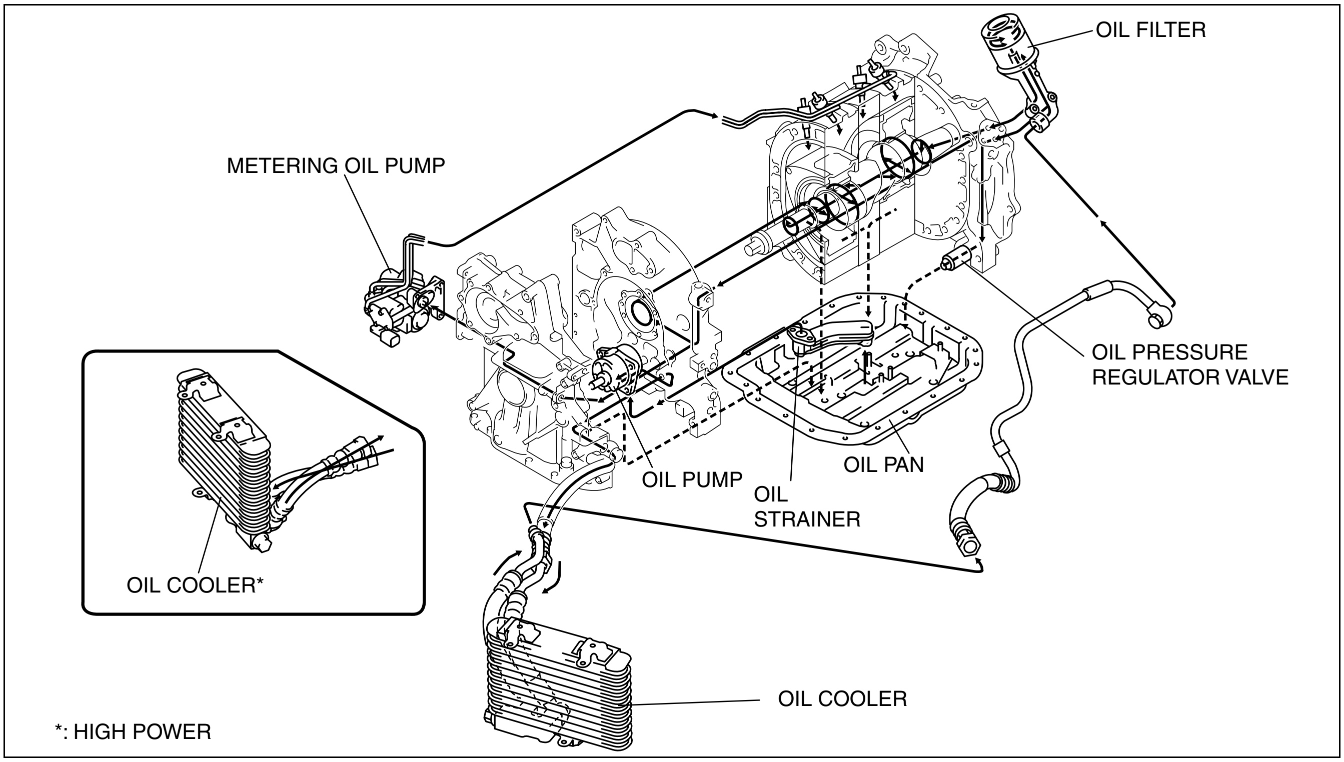
CHU011101008S02



CHU0111S001

LUBRICATION SYSTEM FLOW CHART

CHU011101008S03



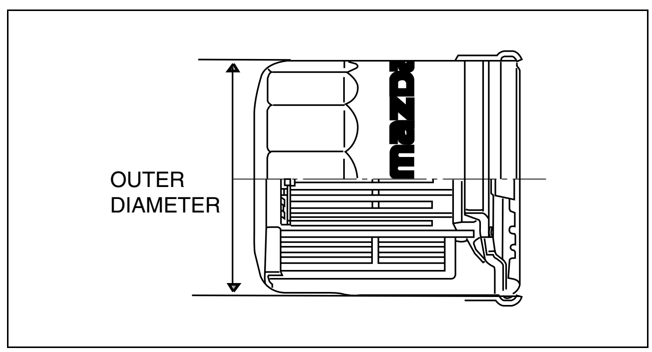
CHU0111S002

OIL FILTER CONSTRUCTION

CHU011101008S04

- A full-flow type oil filter, one with an outer diameter of 65 mm {2.56 in} (Denso*), or another with a diameter of 68 mm {2.68 in} (Tokyo Roki) have been adopted. The oil filter manufacturer (Denso or Tokyo Roki) is indicated on the label of the filter.

* : Used on assembly line

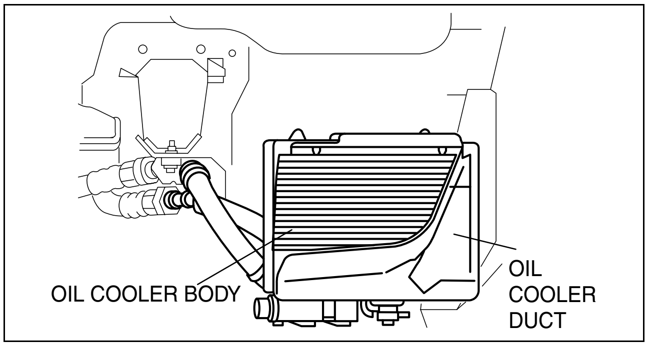


CHU0111S020

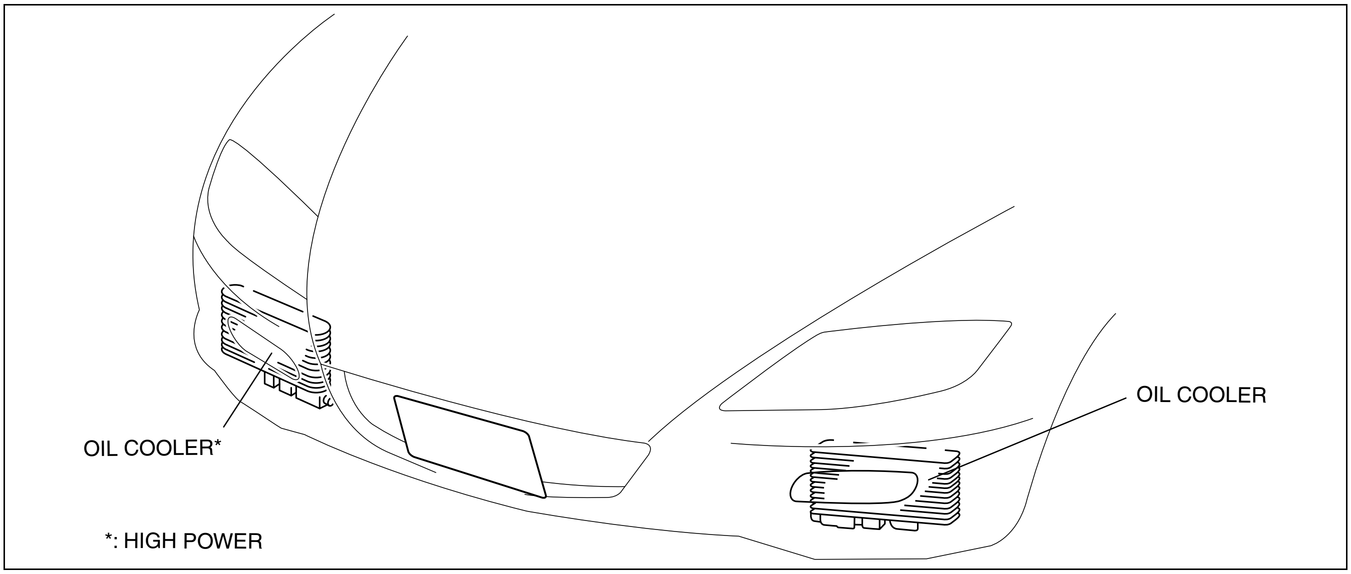
OIL COOLER CONSTRUCTION

CHU011110040S01

- A large-sized, air-cooled type oil cooler has been adopted to handle the heat load resulting from the high engine output.
- The oil cooler component is composed of an oil cooler body made of aluminum, and an oil cooler duct made of rubber.



CHU0111S009

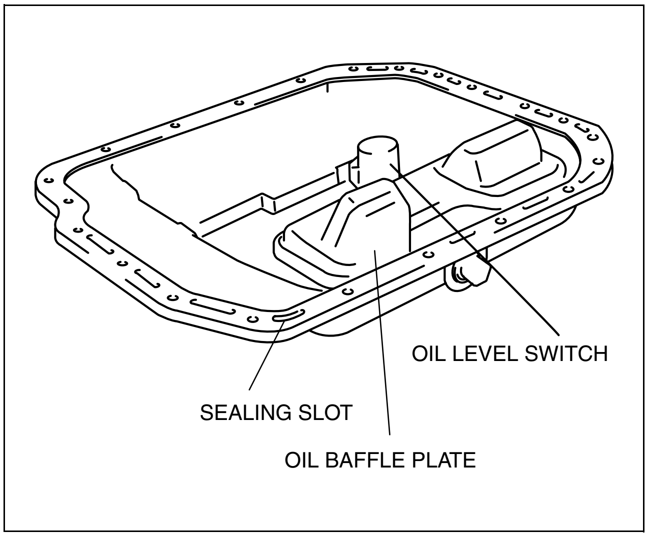


CHU0111S007

OIL PAN CONSTRUCTION

CHU011110040S02

- A thin oil pan made of steel has been adopted to lower the engine height.
- An oil baffle plate has been adopted inside the oil pan to stabilize engine oil slosh or aeration when the vehicle rolls and to prevent air suction in the oil strainer.
- An oil level switch has been adopted on the center of the oil pan. A low oil level warning light in the instrument cluster illuminates when the oil level is below the specified amount.
- An oil level switch inputs directly to the PCM. The PCM has an anti slosh circuit similar to the fuel level sensor. The PCM turns on the low oil level warning light.
- A silicon sealant with excellent sealing qualities has been adopted. Also, sealing slots have been adopted on the oil pan attachment side to improve sealing performance.

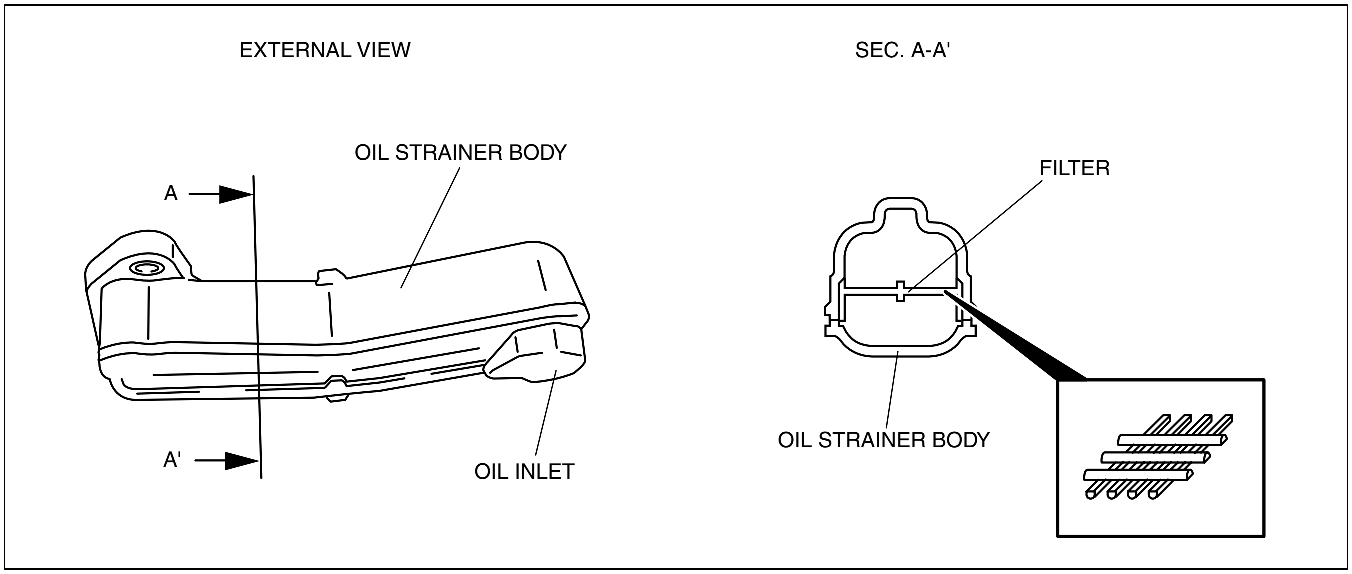


CHU0111S004

OIL STRAINER CONSTRUCTION

CHU011101008S05

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

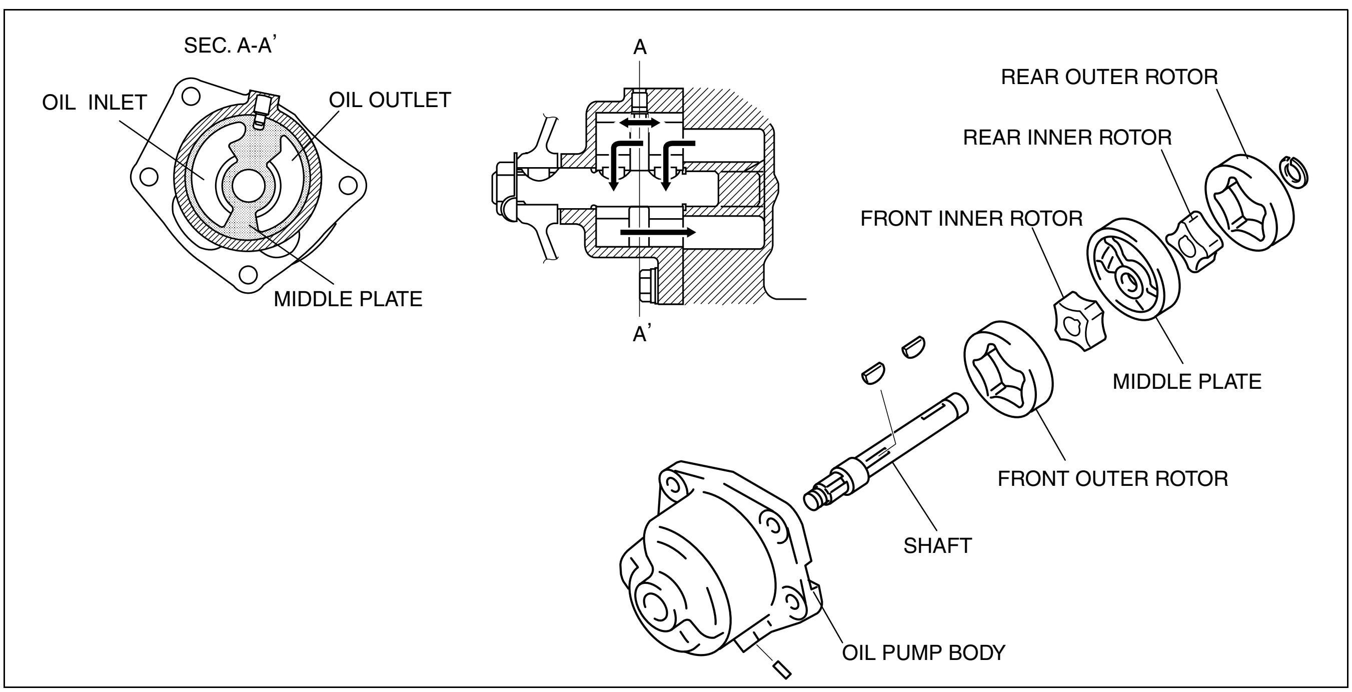


CHU0111S005

OIL PUMP CONSTRUCTION

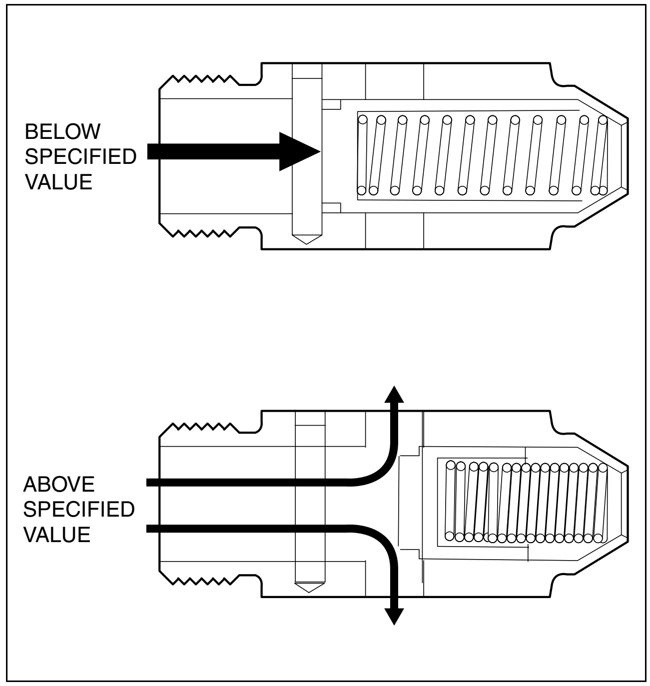
CHU011101008S06

- A trochoid type oil pump has been adopted.
- A two-rotor type oil pump has been adopted for improved oil discharging ability and downsizing. It is also beneficial for reducing discharging pulsation.
- An efficient, compact 4-lobe epitrochoid and 5-flank inner envelope type gear has been adopted for the oil pump.
- The oil pump consists of oil pump body, shaft, front outer rotor, front inner rotor, middle plate, rear inner rotor, and rear outer rotor.



CHU0111S011

- An oil pressure regulator has been adopted on the rear side housing to release oil when the oil pressure is 538—638 kPa {5.5—6.5 kgf/cm^2, 78.0—92.5 psi} or more.



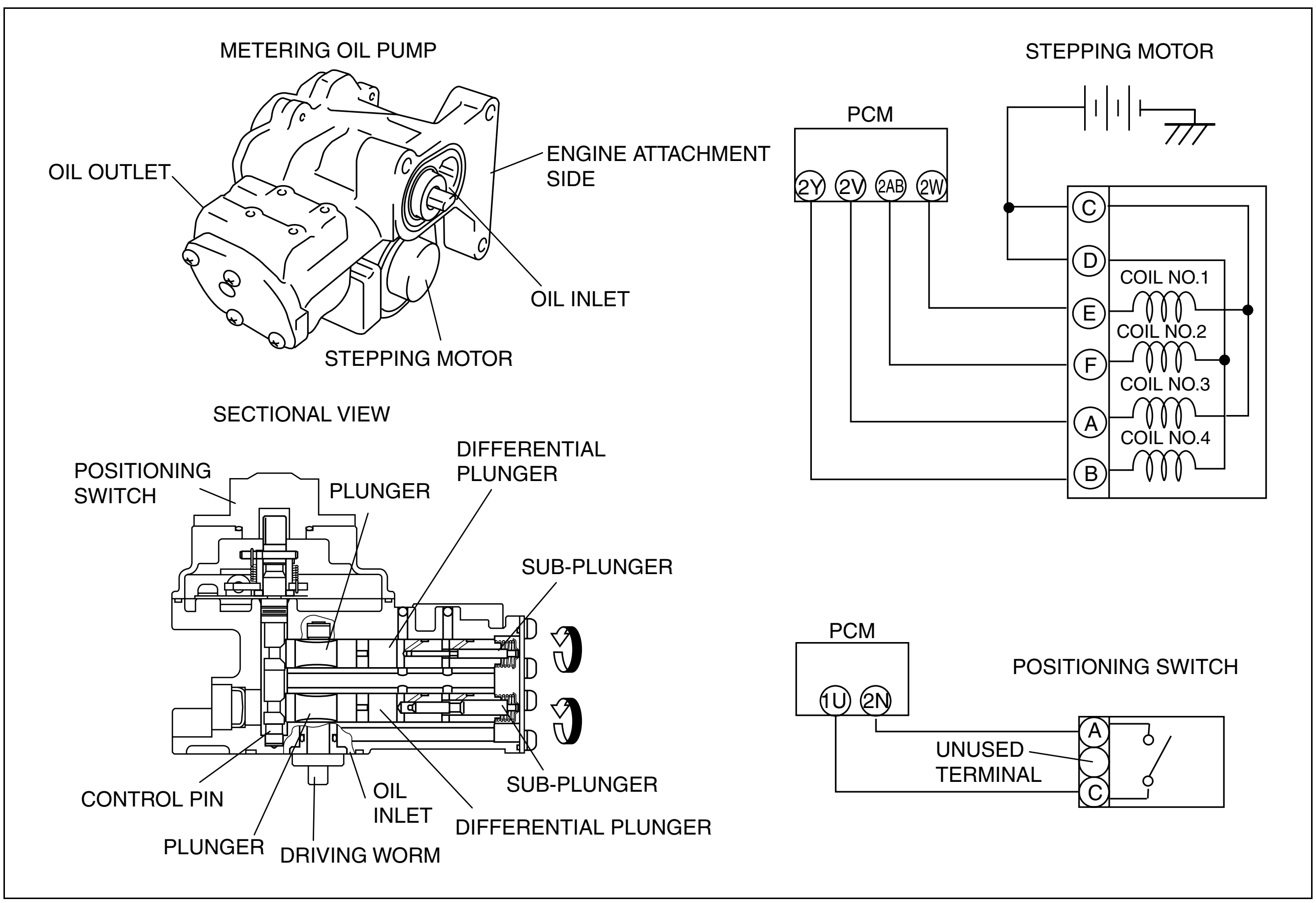
CHU0111S015

METERING OIL PUMP CONSTRUCTION/OPERATION

CHU011101008S07

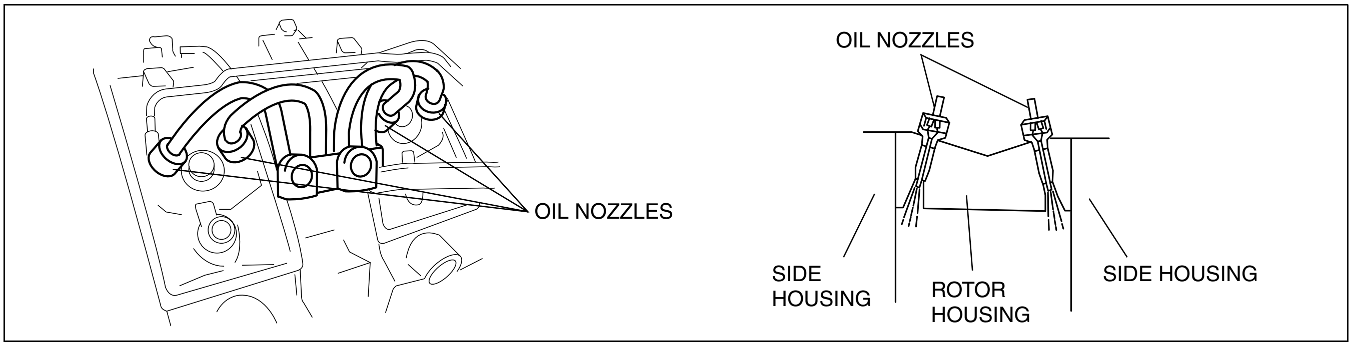
Construction

- An electric metering oil pump has been adopted to reduce oil consumption by controlling the amount of oil discharged.
- The electric metering oil pump is controlled by the PCM.
- The PCM sends a pulse signal controlling the amount of oil discharged to the metering oil pump according to the engine rotation, engine coolant temperature, and the amount of intake air.



CHU0111S013

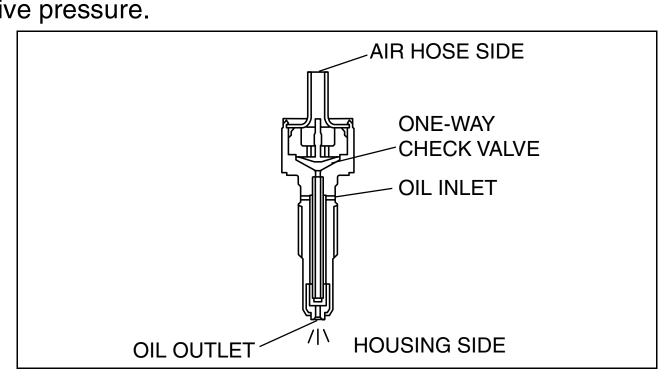
- Two oil nozzles are adopted on each rotor in order to improve lubrication in the side housing and side seal in accordance with the adoption of the side exhaust system. They are tilted toward the side housing to inject oil directly to the side housing.



CHU0111S016

Operation

- The oil discharging mechanism consists of the plunger and differential plunger driven by the driving worm. The driving worm is driven by the eccentric shaft through the driven gear.
- The amount of oil discharged is controlled by change in the stroke of the plunger and the rotation of the control pin attached to the stepping motor according to the signal from the PCM.
- The operation of the stepping motor is monitored by the positioning switch and it ensures the optimum amount of oil discharge according to the driving condition.
- The oil nozzle receives the barometric pressure from the air hose to prevent the negative pressure from the engine being applied to the oil inlet. Also, a one-way check valve has been adopted to prevent oil from flowing out of the air hose side when the engine is under positive pressure.



CHU0111S008

Fail-safe function

- Fail-safe function operates when the engine senses a failure in the stepping motor and the positioning switch.
- When the fail-safe function operates, the PCM keeps the control pin at the minimum stroke position and the oil supply is only in proportion to the engine rotation rate. Thus, the minimum amount of oil at each engine rotation rate is supplied.
- Normal driving is possible when the amount of the oil required by the engine is within the minimum oil discharge.
- When the amount of the oil required by the engine is more than the minimum oil discharge, fuel injection is restricted, increased engine rotation is suppressed, and seizure of each seal inside the engine is prevented.

01–12 COOLING SYSTEM

COOLING SYSTEM OUTLINE

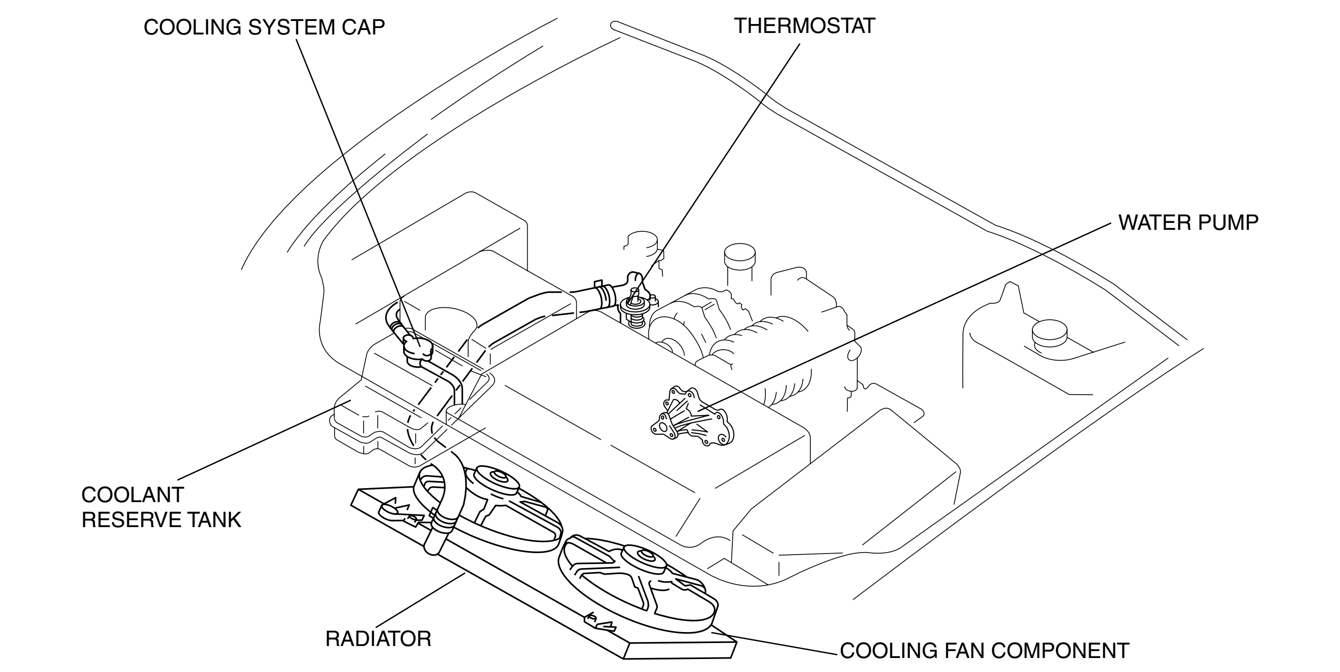
CHU011201008S01

Features

Improved reliability	• A degassing type coolant reserve tank adopted
Reduced weight	• A down flow type radiator with aluminum core and plastic tank adopted
Miniaturization	• A built-in type water pump adopted
Reduced engine noise and vibration	• A cooling fan with electric motor adopted

COOLING SYSTEM STRUCTURAL VIEW

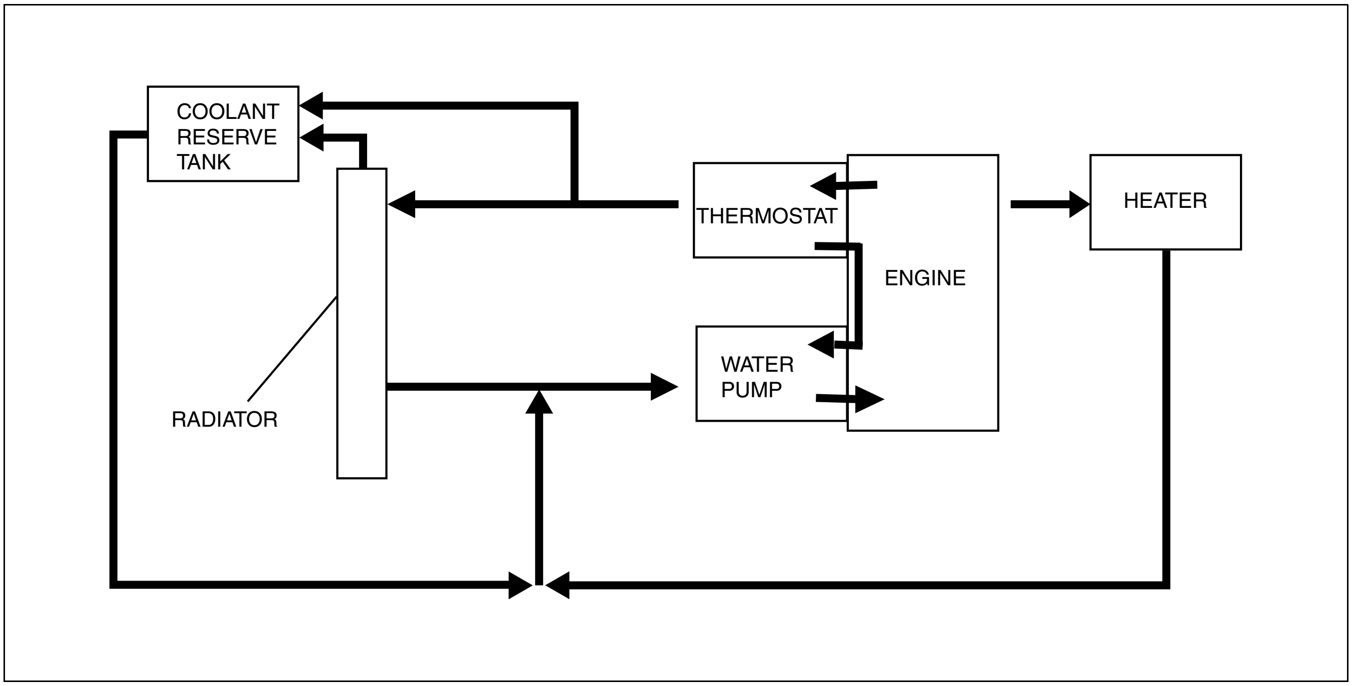
CHU011201008S02



CHU0112S002

COOLING SYSTEM FLOW CHART

CHU011201008S03

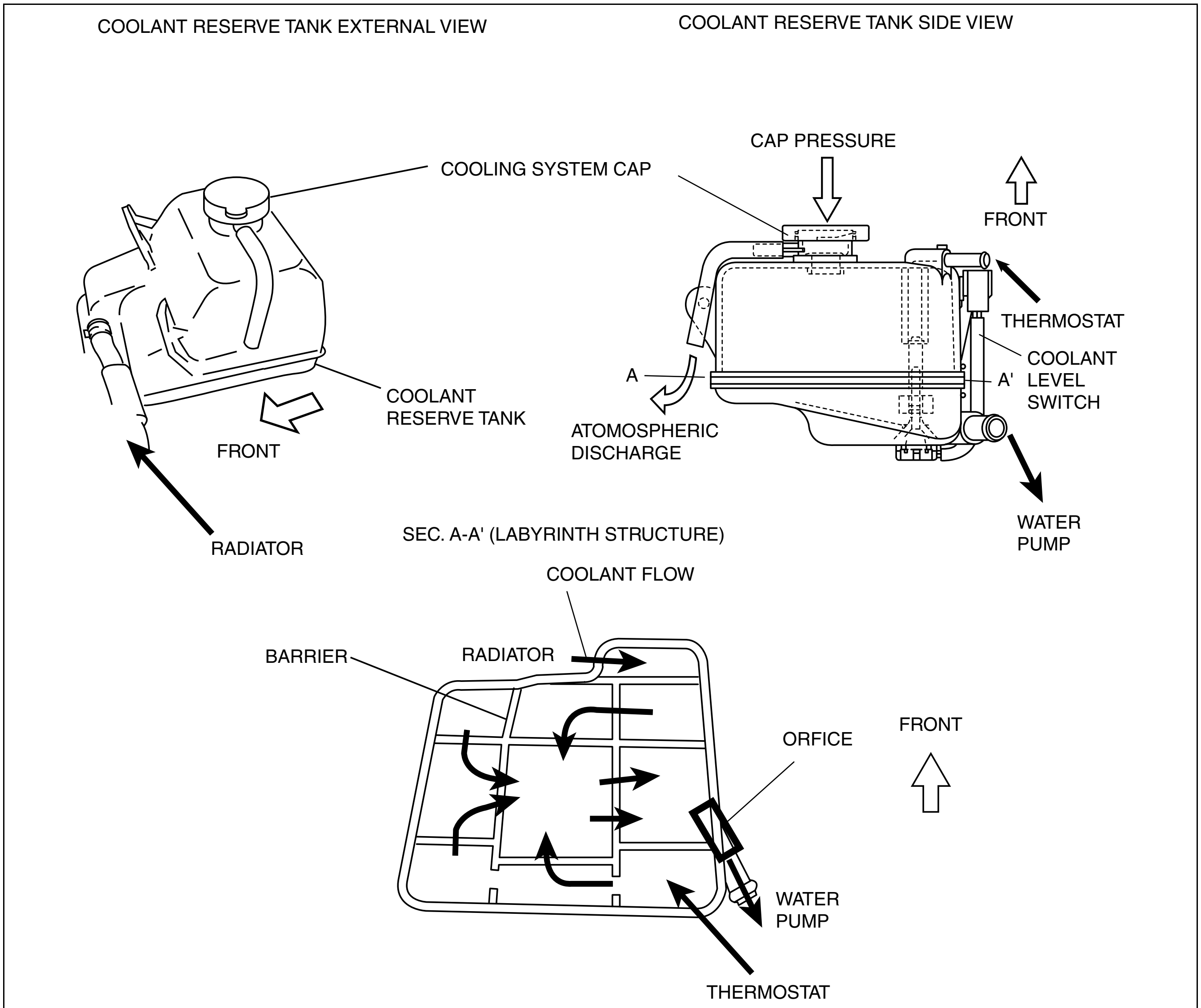


CHU0112S001

COOLING SYSTEM CAP, COOLANT RESERVE TANK CONSTRUCTION

CHU011201008S04

- A low-pressure type cap has been adopted for the cooling system cap. 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.
- An orifice has been adopted inside the coolant reserve outlet hose. The orifice minimizes the inner tube space and controls the engine coolant amount to stabilize the engine coolant pressure properly when the engine output is high.
- A coolant level switch has been adopted on the side of the coolant reserve tank. A warning light in the instrument cluster illuminates when the engine coolant is below the specified amount.

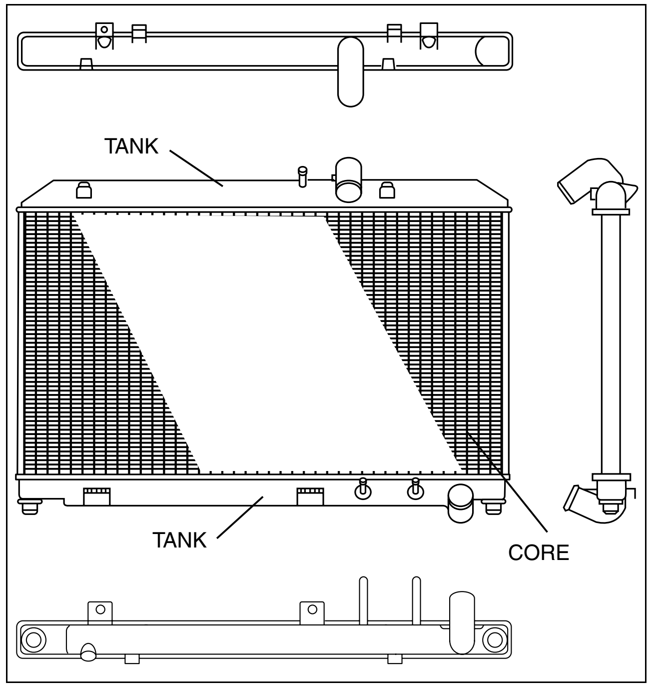


CHU0112S007

RADIATOR CONSTRUCTION

CHU011201008S05

- 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 rubber-insulated mounting brackets are utilized to decrease vibration.
- To improve both the cooling ability and the sporty design, the radiator is designed to tilt forward to reduce the height and to take in the air from the inlet installed under the bumper.



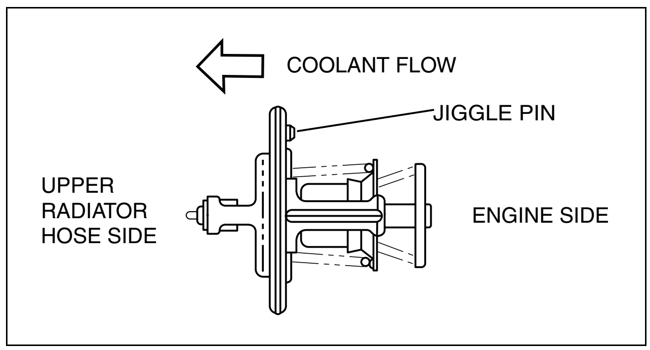
CHU0112S005

THERMOSTAT CONSTRUCTION/OPERATION

CHU011201008S06

Construction

- A wax-type thermostat with a jiggle-pin has been adopted. The thermostat body is made of stainless steel with excellent corrosion resistance.



CHU0112S003

Operation

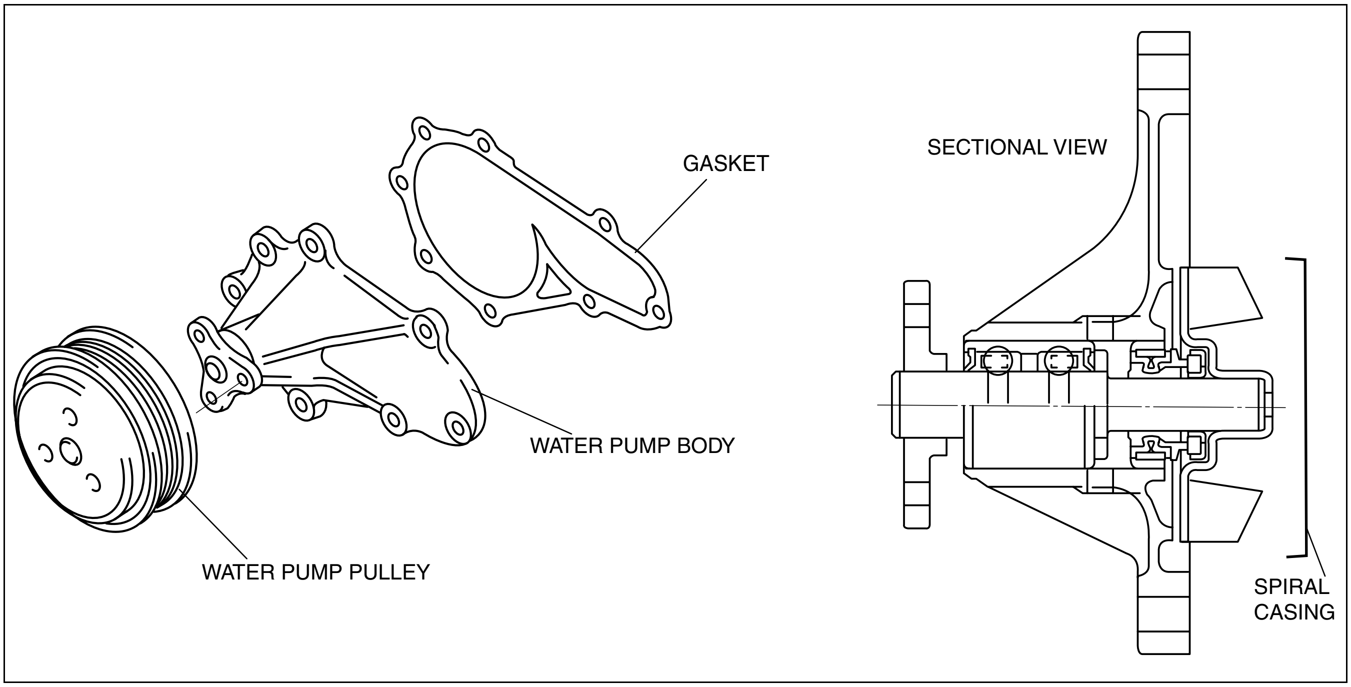
- When the engine coolant temperature is below 80°C {176°F}, the valve closes and lets the engine coolant circulate inside the engine to improve engine warming performance. When the engine coolant temperature is between 80 °C {176°F} to 84 °C {183°F}, the thermostat begins to open the valve and engine coolant flows to the radiator to stabilize engine coolant temperature.

WATER PUMP CONSTRUCTION/OPERATION

CHU011201008S07

Construction

- The water pump is composed of a steel water pump pulley, a water pump body made of aluminum alloy, and the gasket. The spiral casing is built into the front cover for weight reduction.



CHU0112S004

Operation

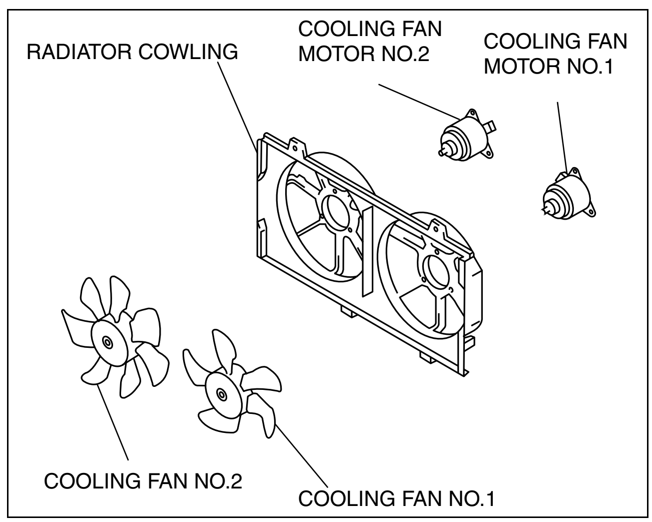
- The water pump is driven by the drive pulley.

COOLING FAN, COOLING FAN MOTOR, RADIATOR COWLING CONSTRUCTION/OPERATION

CHU011201008S08

Construction

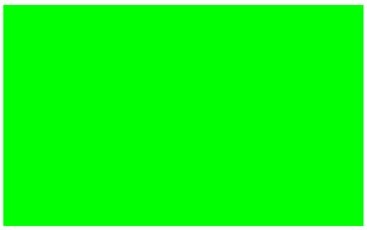
- Plastic cooling fans and radiator cowling have been adopted for weight reduction.
- Both cooling fans and cooling fan motors are attached to the radiator cowling.
- An electric motor type cooling fans operated by a fan control signal from the PCM has been adopted.



BHJ0112N006

Operation

- Cooling fans No.1 and No.2 operate simultaneously according to the engine coolant temperature and whether the A/C is on or off. Two- stage control has been adopted to the cooling fan with high and low speed rotation allowing noise reduction and power savings. (See 01–40–37 ELECTRICAL FAN CONTROL OPERATION.)



01–13 INTAKE-AIR SYSTEM

INTAKE-AIR SYSTEM OUTLINE

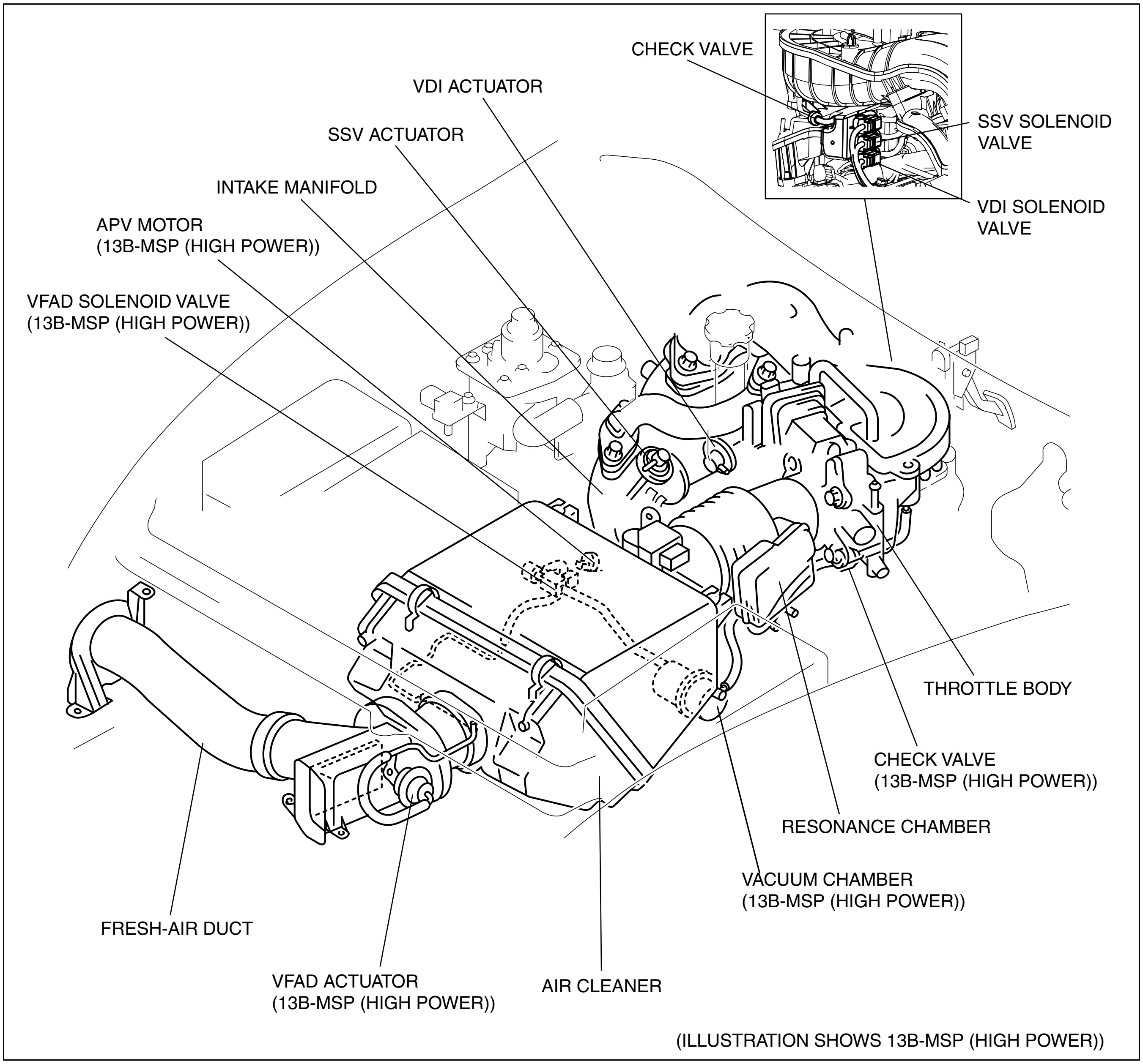
CHU011300113S01

Features

Improved engine controllability	• Drive-by-wire system, which opens and closes throttle valve by throttle actuator, adopted
Improved engine output	• Sequential dynamic air intake system (S-DAIS) adopted
Improved idle fuel economy	• Jet air fuel mixing system adopted

INTAKE-AIR SYSTEM STRUCTURAL VIEW

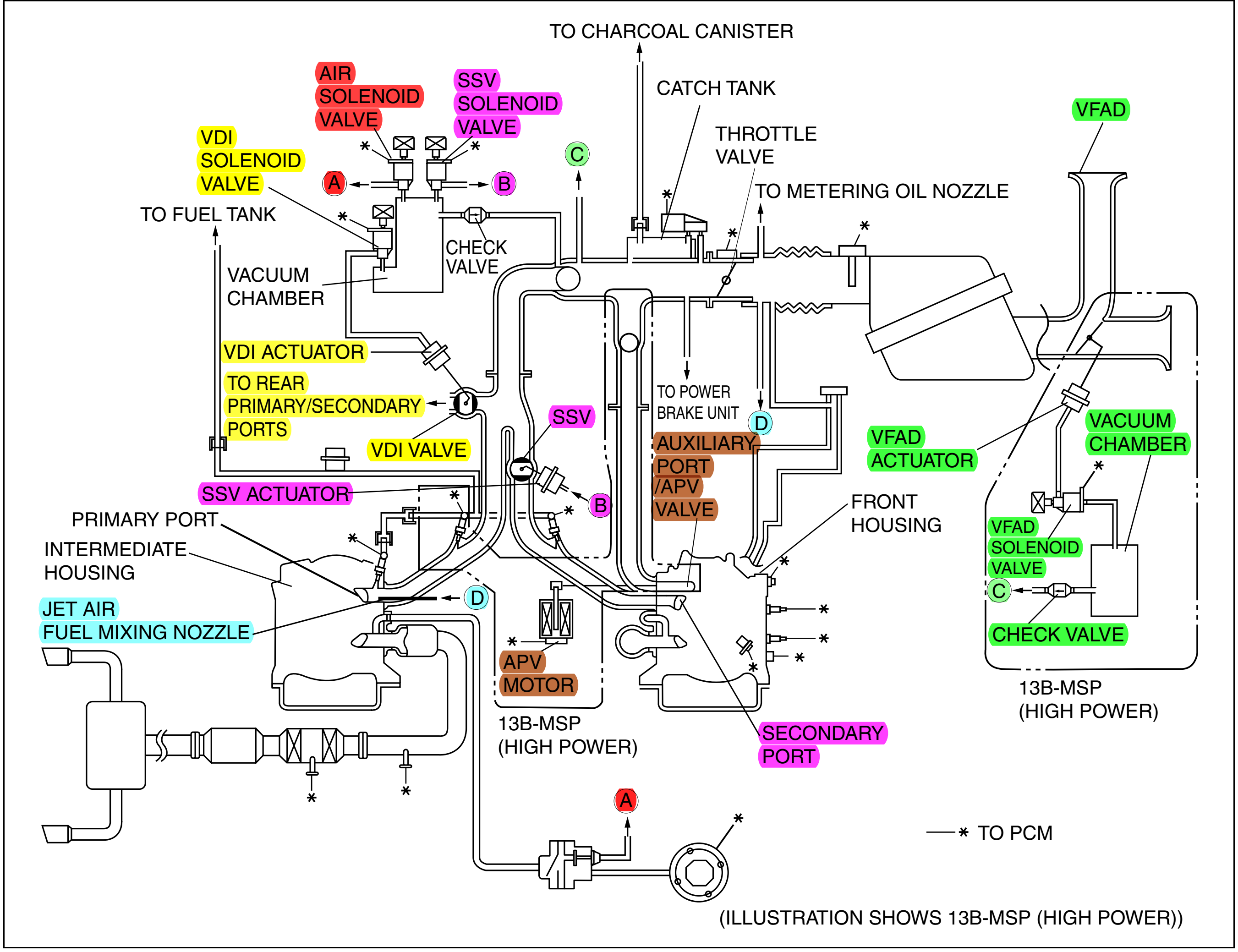
CHU011300113S02



CHU0113S001

INTAKE-AIR SYSTEM DIAGRAM

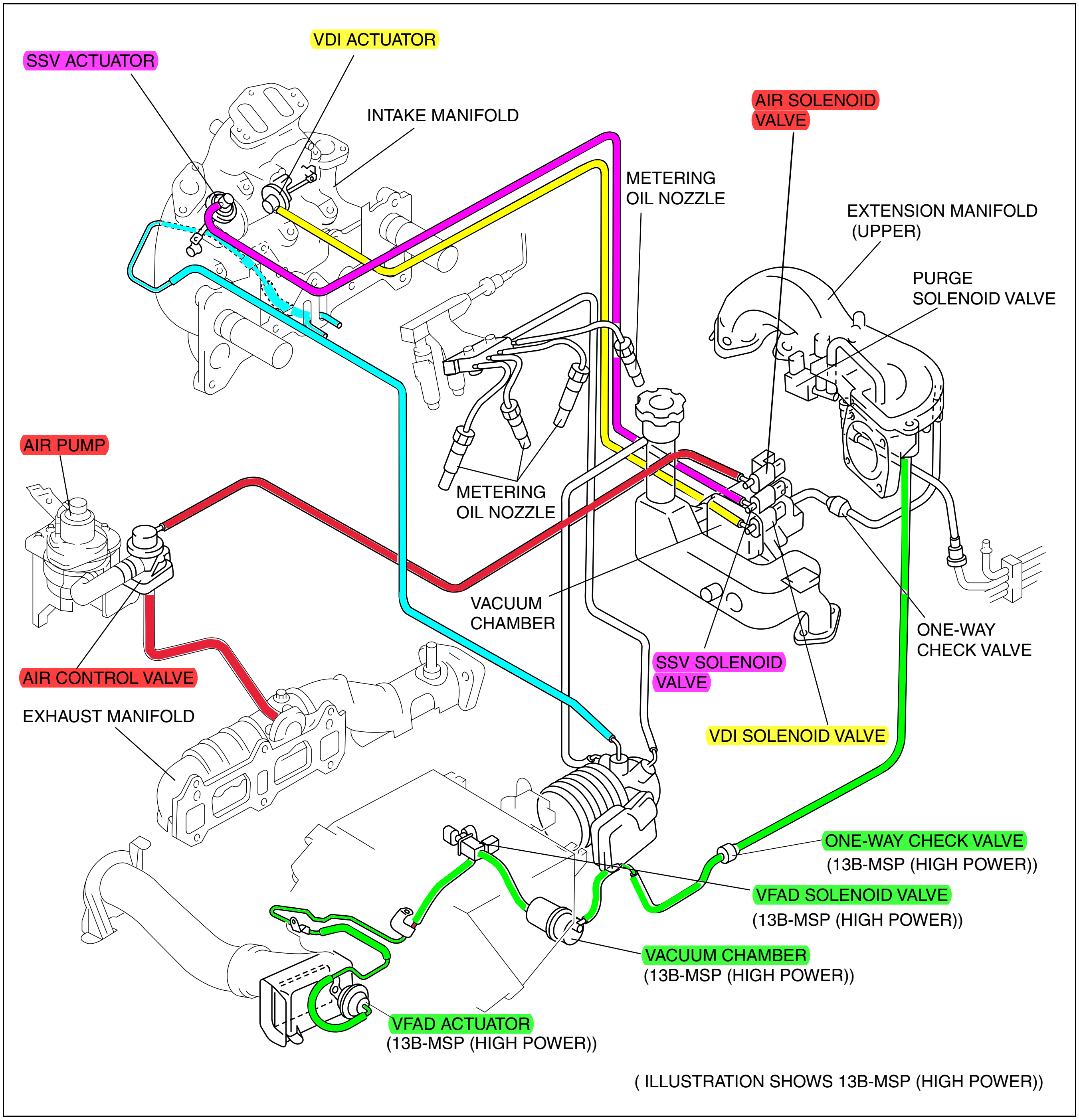
CHU011300113S03



CHU0113W001

INTAKE-AIR SYSTEM HOSE ROUTING DIAGRAM

CHU011300113S04



CHU0113W002

FRESH-AIR DUCT FUNCTION

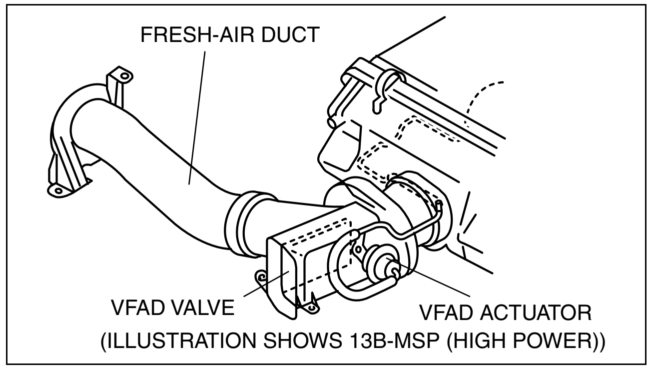
CHU011313200S01

- Channels air to the air cleaner.
- For 13B-MSP (High Power), the VFAD valve has been adopted, improving torque and output at the medium-high speed range.

FRESH-AIR DUCT CONSTRUCTION

CHU011313200S02

- Composed of the fresh-air duct, VFAD actuator (13B-MSP (High Power)), and VFAD valve (13B-MSP (High Power)).



CHU0113S004

AIR CLEANER FUNCTION

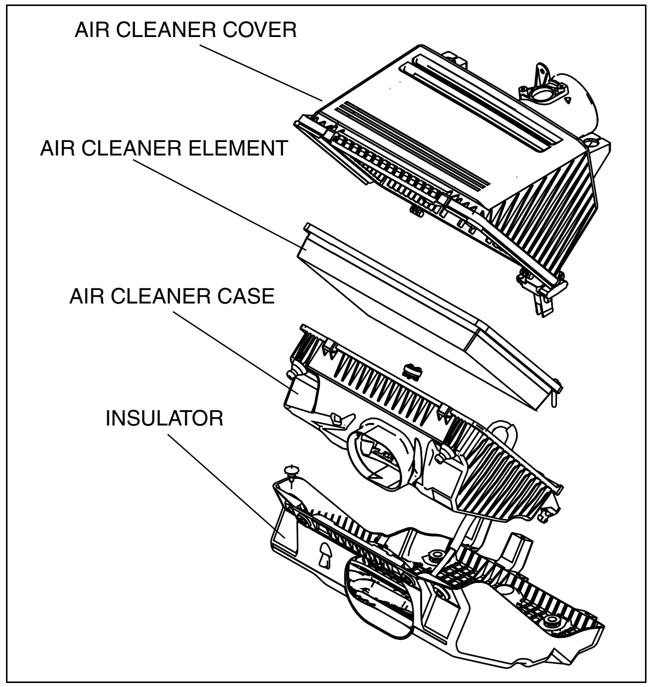
CHU011313300S01

- A large-size air cleaner has been adopted, reducing air intake noise and intake resistance.

AIR CLEANER CONSTRUCTION

CHU011313300S02

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



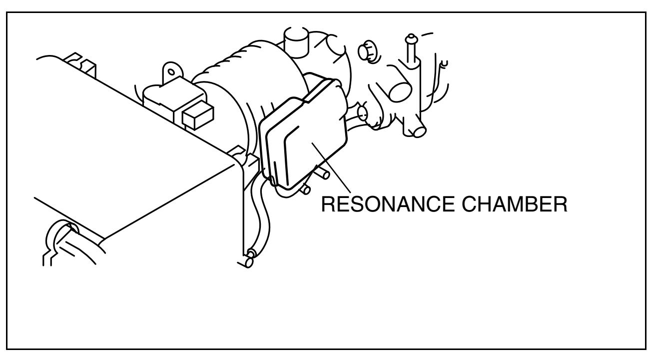
CHU0113S005

RESONANCE CHAMBER FUNCTION

CHU011300100S01

Features

- Installed to the air hose to reduce air intake noise.

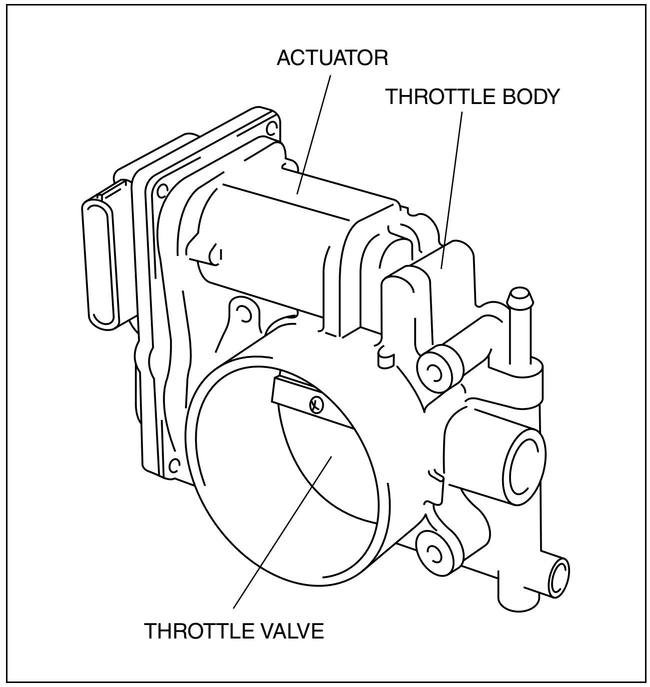


CHU0113S006

THROTTLE BODY FUNCTION

CHU011313640S01

- 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.



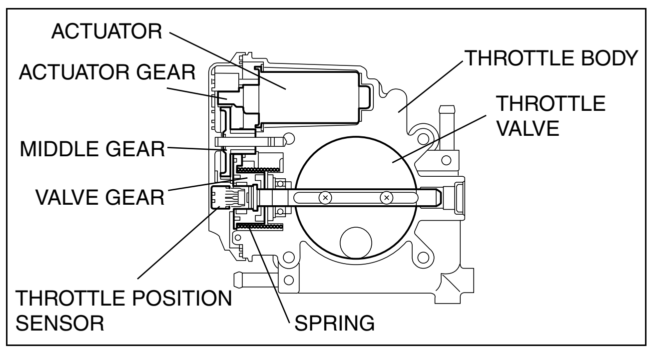
CHU0113S007

THROTTLE BODY CONSTRUCTION/OPERATION

CHU011313640S02

Construction

- The throttle body construction is as shown in the figure.



CHU0113S008

Operation

- The actuator is driven by a duty signal from the PCM. This driving force is transmitted to the actuator gear, middle gear, and valve gear, and the throttle valve opens.
- Conversely, to close the throttle valve, the actuator is reversed by an opposite signal from the PCM, and the throttle valve closes.
- The throttle valve opening angle is input to the PCM by the TP sensor.
- The throttle valve 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 5° by the spring. Due to this, the required amount of air for vehicle operation is ensured.

INTAKE MANIFOLD FUNCTION

CHU011313100S01

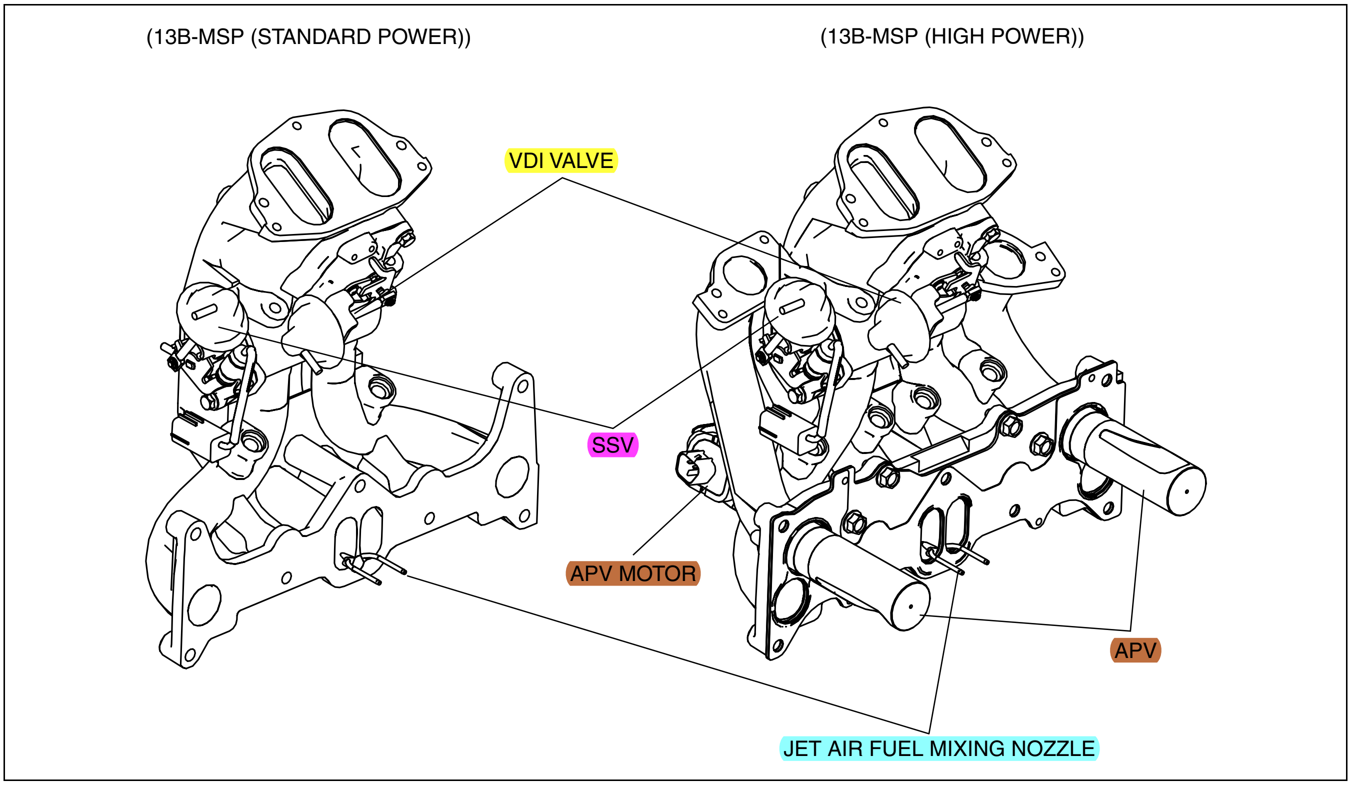
- Integrates the SSV, VDI valve, and APV (13B-MSP (High Power)) which are switched according to the engine speed and fuel amount required by the engine. Due to this, torque and output in all driving ranges are improved.

INTAKE MANIFOLD CONSTRUCTION

CHU011313100S02

Construction

- Composed of the SSV, VDI valve, APV (13B-MSP (High Power)), APV motor (13B-MSP (High Power)), jet air fuel mixing nozzles, and body.



CHU0113S009

SEQUENTIAL DYNAMIC AIR INTAKE SYSTEM (S-DAIS) OUTLINE

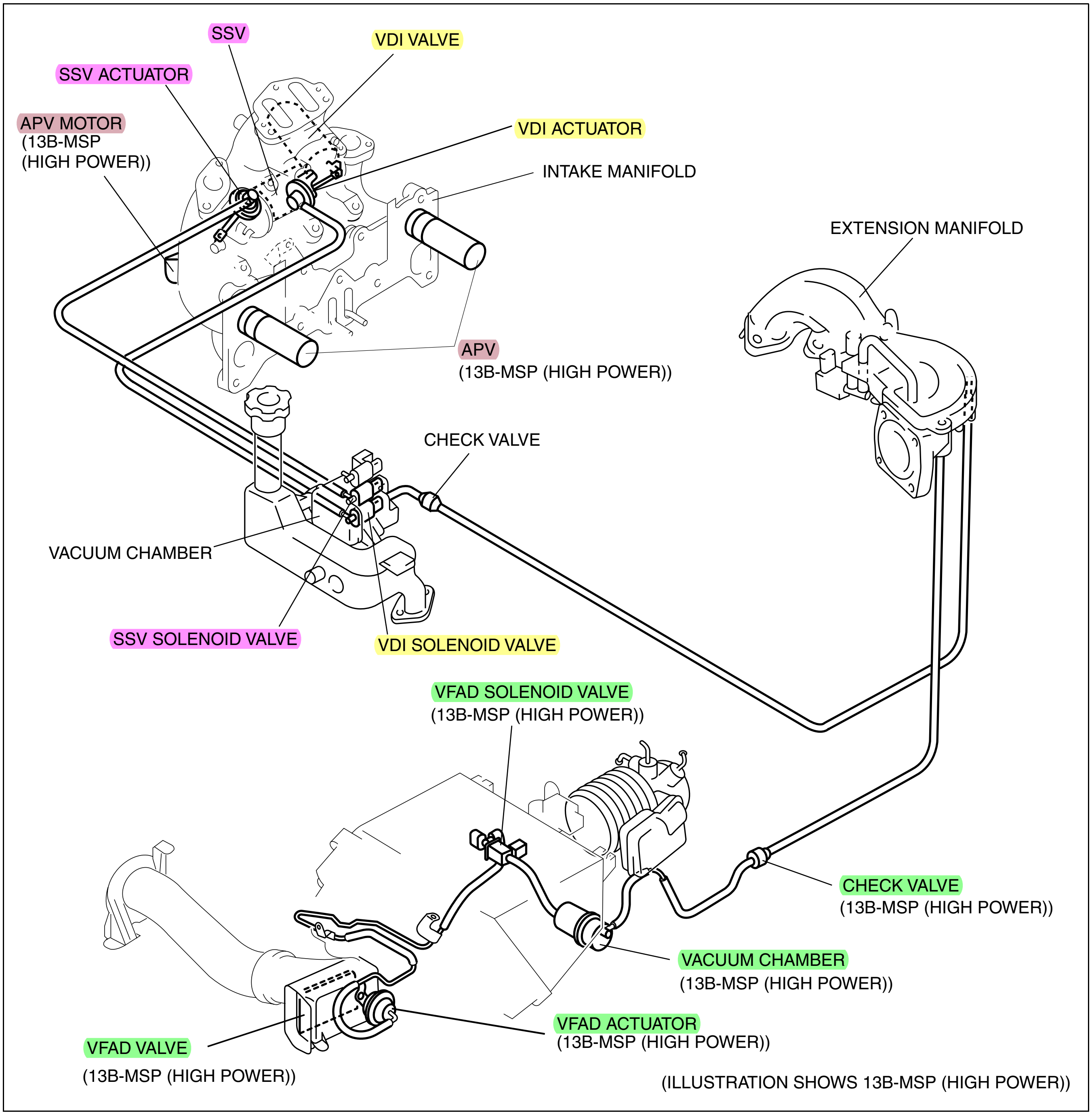
CHU011300113S05

- The S-DAIS increases intake air amount and combustion efficiency by controlling the size of the intake ports and the air length in the intake pipes according to engine condition. By a combination of the S-DAIS and side intake and exhaust port configuration, high torque and high output are obtained at a wide range of engine speeds from low to high.
- For a description of S-DAIS control, refer to S-DAIS control (See 01–40–14 SEQUENTIAL DYNAMIC AIR INTAKE SYSTEM (S-DAIS) CONTROL OUTLINE.).

SEQUENTIAL DYNAMIC AIR INTAKE SYSTEM (S-DAIS) STRUCTURE

CHU011300113S06

- The S-DAIS is composed of the SSV, VDI valve, and VFAD valve (13B-MSP (High Power)) which are opened and closed by intake manifold vacuum or BARO, and the APV (13B-MSP (High Power)) which is opened and closed by motor drive.



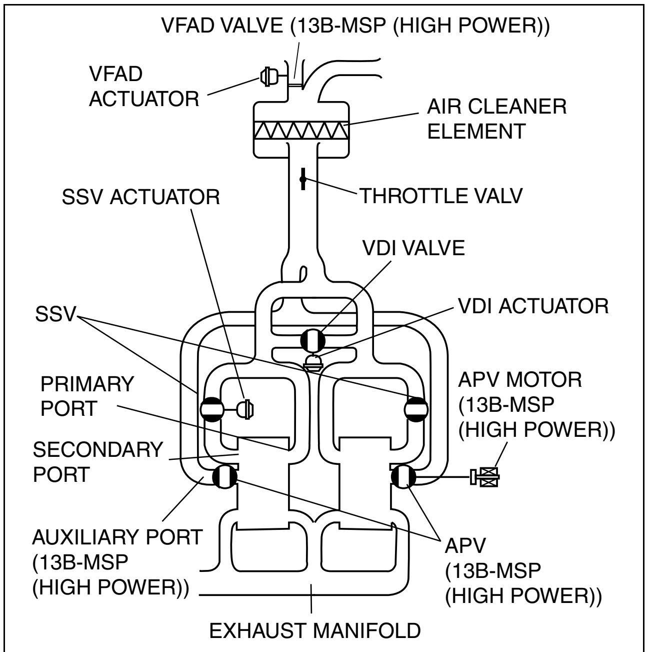
CHU0113S010

SEQUENTIAL DYNAMIC AIR-INTAKE SYSTEM (S-DAIS) OPERATION

CHU011300113S07

Operation Outline

- To increase intake air amount and combustion efficiency, the S-DAIS controls the size of the intake ports and the air length in the intake pipes by opening or closing the SSV, VDI valve, APV (13B-MSP (High Power)), and VFAD valve (13B-MSP (High Power)) according to engine speed and load condition.



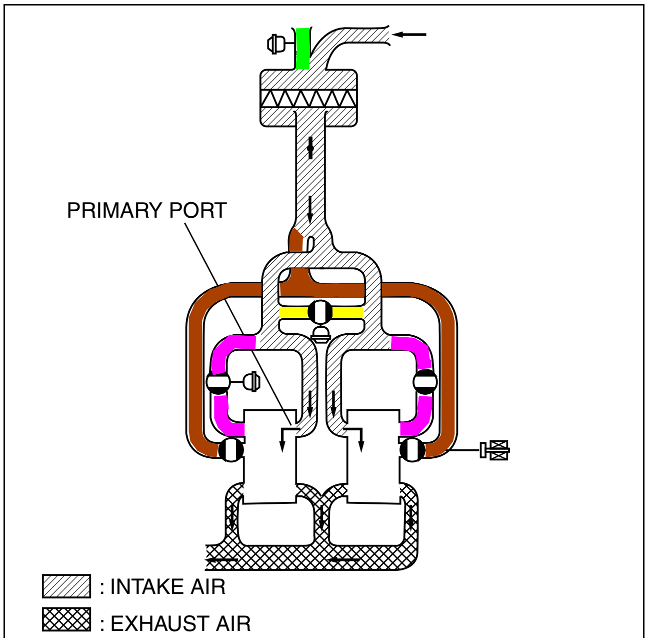
(ILLUSTRATION SHOWS 13B-MSP (HIGH POWER))

CHU0113S011

Operation

Low-speed range

- At the low-speed range, the secondary and auxiliary ports close, and a high velocity intake air amount is fed from only the primary port. Due to this, better combustion efficiency is obtained by the improved fuel atomization, producing high torque output.

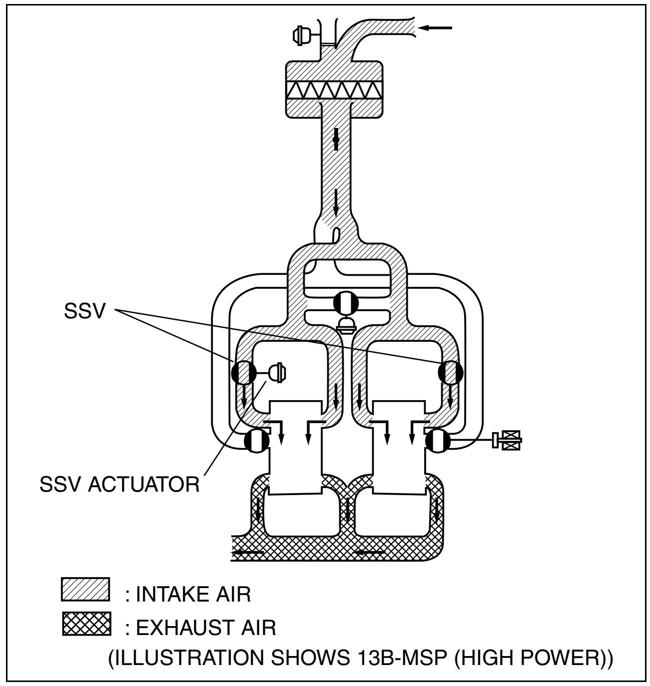


(ILLUSTRATION SHOWS 13B-MSP (HIGH POWER))

CHU0113S012

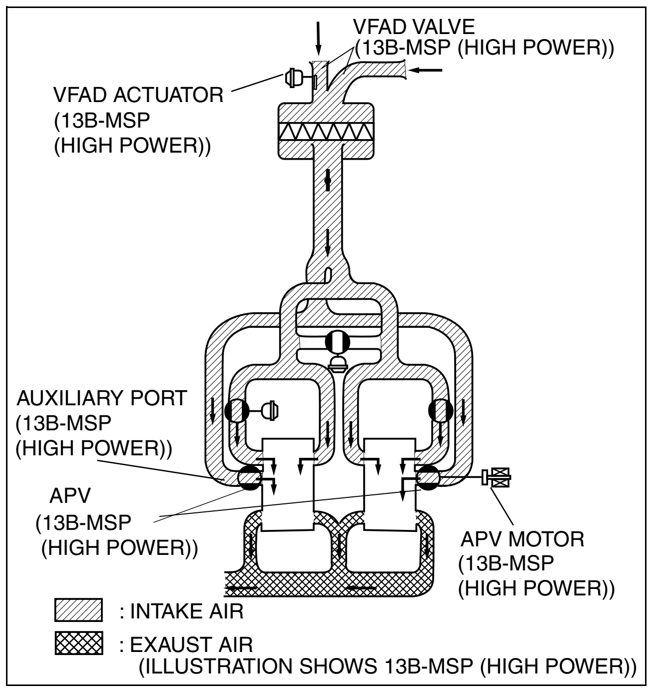
Medium-speed range
- When the engine speed reaches the medium range, the SSV opens and intake air from the secondary port begins. Due to this, the intake air amount increases, improving torque at the engine medium-speed range.

Medium-to-high-speed range
- When the engine speed reaches the medium-to-high range, the VFAD and APV open.
- When the VFAD valve (13B-MSP (High Power)) opens, intake air resistance is reduced by the shortening of air length in the fresh-air duct pipe.



CHU0113S013

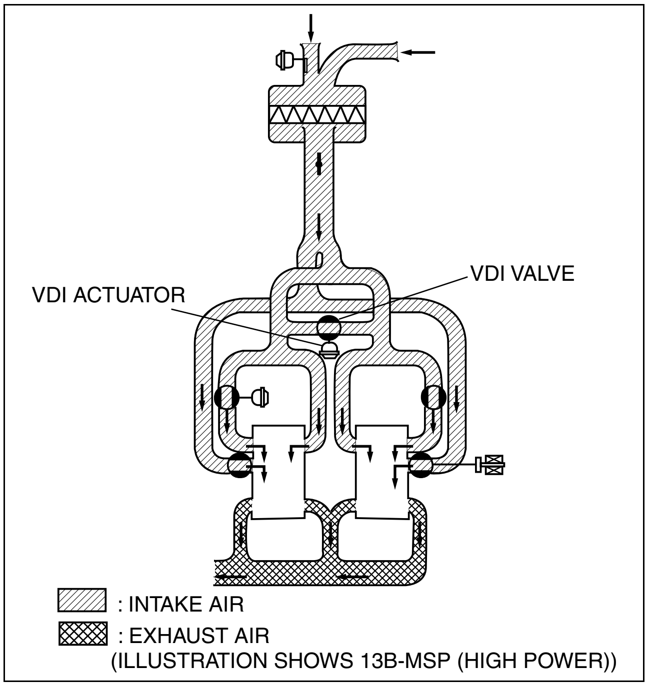
- When the APV (13B-MSP (High Power)) opens, air from all intake ports is fed, improving torque at the medium-to-high-speed range.



CHU0113S014

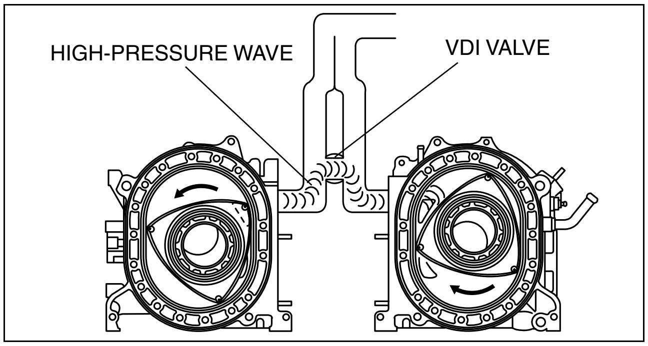
High-speed range

- When the engine speed reaches the high range, the VDI valve opens, and the actual length of the intake air in the pipe is shortened to efficiently provide dynamic air charging effect.



CHU0113S016

- When the intake ports are shut abruptly, the intake air does not stop due to the inertia effect and it becomes compressed and highly pressurized. This pressurized air becomes a reflected high-pressure wave that pressurizes the intake air in the rotor chambers. This is dynamic air charging pressurization. The intake air amount is increased by the dynamic air charging effect, improving torque at the high-speed range.



CHU0113S015

SECONDARY SHUTTER VALVE (SSV) SOLENOID VALVE FUNCTION

CHU011318740S01

- Switches pressure (intake manifold vacuum or BARO) applied to the SSV actuator according to a signal from the PCM.

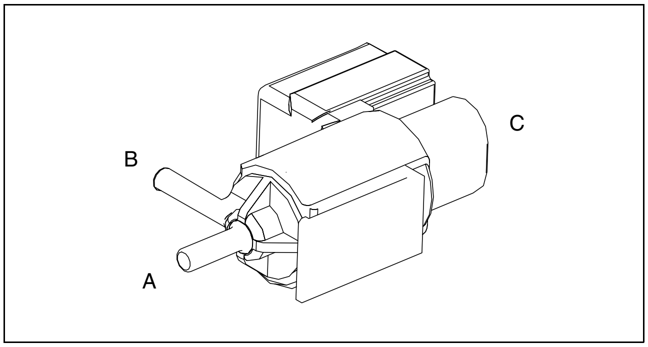
SECONDARY SHUTTER VALVE (SSV) SOLENOID VALVE CONSTRUCTION/OPERATION

CHU011318740S02

- Composed of a solenoid coil, spring, plunger, and filter.

  Energized
  - When the solenoid coil is energized, the plunger is pulled back. Pulling the plunger back opens the passage between ports A and B. Due to this, intake manifold vacuum is applied to the actuator.

  De-energized
  - Passage of port A is closed by the reaction force of the spring, and the passage between ports B and C is opened. Due to this, BARO is applied to the actuator.



CHU0113S017

SECONDARY SHUTTER VALVE (SSV) ACTUATOR FUNCTION

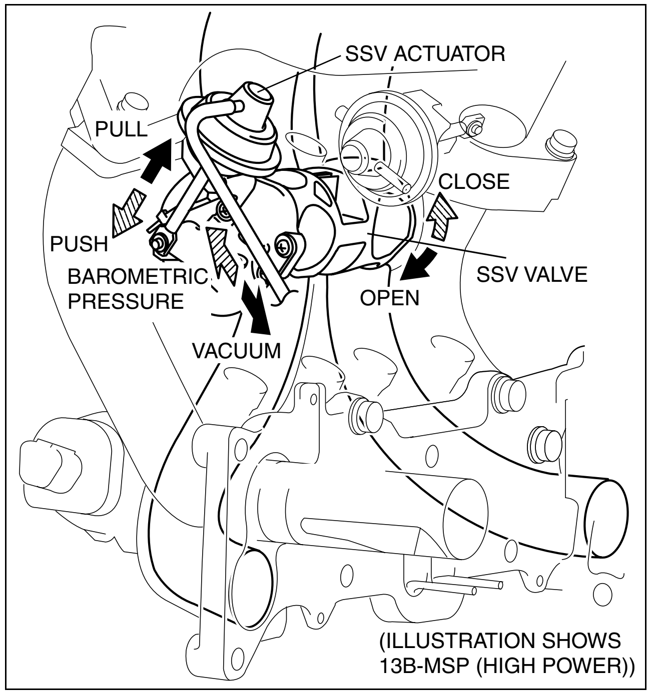
CHU011320130S01

- Opens and closes the SSV.

SECONDARY SHUTTER VALVE (SSV) ACTUATOR CONSTRUCTION/OPERATION

CHU011320130S02

- A diaphragm design has been adopted.
- Normally, the rod is pushed by the force of the spring, closing the SSV. When intake manifold vacuum is applied to the diaphragm chamber, the rod is pulled, opening the SSV.



CHU0113S018

VARIABLE FRESH AIR DUCT (VFAD) SOLENOID VALVE FUNCTION (13B-MSP (HIGH POWER))

CHU011318740S03

- Switches pressure (intake manifold vacuum or BARO) applied to the VFAD actuator according to a signal from the PCM.

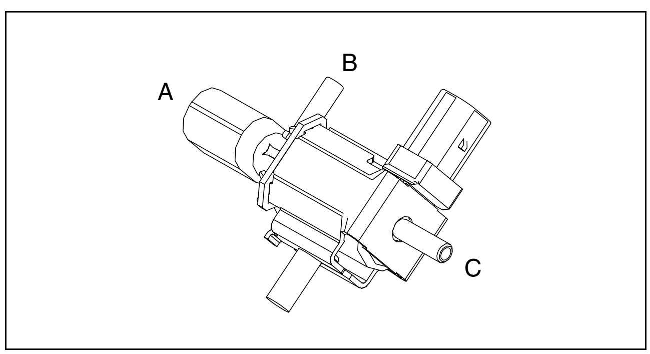
VARIABLE FRESH AIR DUCT (VFAD) SOLENOID VALVE CONSTRUCTION/OPERATION (13B-MSP (HIGH POWER))

CHU011318740S04

- Composed of a solenoid coil, spring, plunger, and filter.

  Energized
  - When the solenoid coil is energized, the plunger is pulled back. Pulling the plunger back opens the passage between ports A and B. Due to this, BARO is applied to the actuator.

  De-energized
  - Passage of port A is closed by the reaction force of the spring, and the passage between ports B and C is opened. Due to this, intake manifold vacuum is applied to the actuator.



CHU0113S019

VARIABLE FRESH AIR DUCT (VFAD) ACTUATOR FUNCTION (13B-MSP (HIGH POWER))

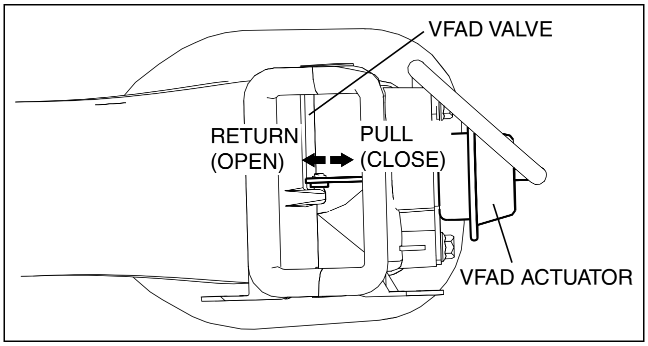
CHU011320130S03

- Opens and closes the VFAD valve.

VARIABLE FRESH AIR DUCT (VFAD) ACTUATOR CONSTRUCTION/OPERATION (13B-MSP (HIGH POWER))

CHU011320130S04

- A diaphragm design has been adopted.
- Normally, the rod is pushed by the force of the spring, opening the VFAD valve. When intake manifold vacuum is applied to the diaphragm chamber, the rod is pulled, closing the VFAD valve.



CHU0113S020

VARIABLE DYNAMIC EFFECT INTAKE-AIR (VDI) SOLENOID VALVE FUNCTION

CHU011318740S05

- Switches pressure (intake manifold vacuum or BARO) applied to the VDI actuator according to a signal from the PCM.

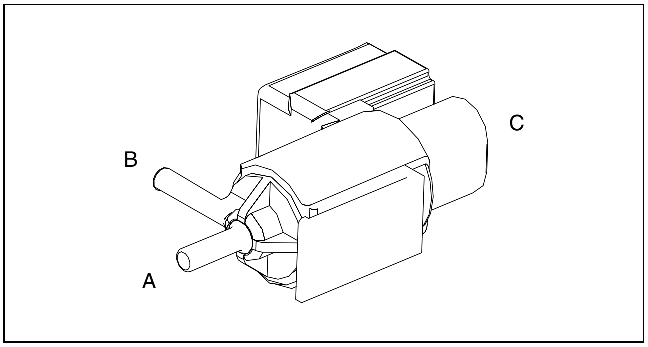
VARIABLE DYNAMIC EFFECT INTAKE-AIR (VDI) SOLENOID VALVE CONSTRUCTION/OPERATION

CHU011318740S06

- Composed of a solenoid coil, spring, plunger, and filter.

  Energized
  - When the solenoid coil is energized, the plunger is pulled back. Pulling the plunger back opens the passage between ports A and B. Due to this, intake manifold vacuum is applied to the actuator.

  De-energized
  - Passage of port A is closed by the reaction force of the spring, and the passage between ports B and C is opened. Due to this, BARO is applied to the actuator.



CHU0113S017

VARIABLE DYNAMIC EFFECT INTAKE-AIR (VDI) ACTUATOR FUNCTION

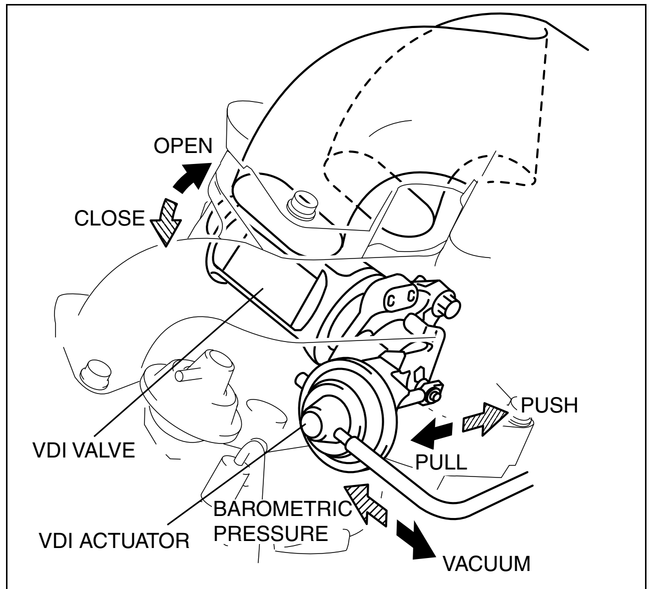
CHU011320130S05

- Opens and closes the VDI valve.

VARIABLE DYNAMIC EFFECT INTAKE-AIR (VDI) ACTUATOR CONSTRUCTION/OPERATION

CHU011320130S06

- A diaphragm design has been adopted.
- Normally, the rod is pushed by the force of the spring, closing the VDI valve. When intake manifold vacuum is applied to the diaphragm chamber, the rod is pulled, opening the VDI valve.



(ILLUSTRATION SHOWS 13B-MSP (HIGH POWER))

CHU0113S021

AUXILIARY PORT VALVE (APV) MOTOR FUNCTION (13B-MSP (HIGH POWER))

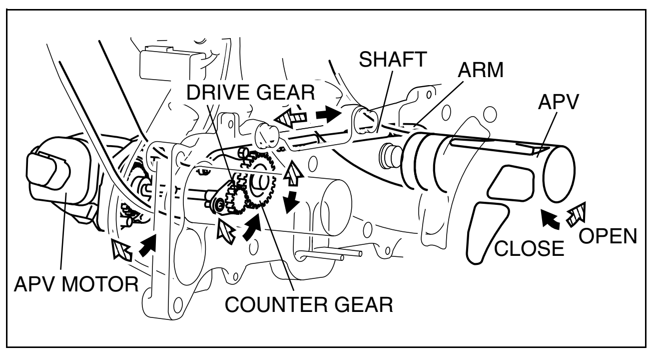
CHU011320130S07

- Drives the APV motor to open or close the APV according to a signal from the PCM.

AUXILIARY PORT VALVE (APV) MOTOR CONSTRUCTION/OPERATION (13B-MSP (HIGH POWER))

CHU011320130S08

- The position sensor is built into the APV motor.
- The motor is driven according to an operation signal from the PCM.
- The motor driving force is transmitted to the drive gear, counter gear, shaft, and arm, thereby opening or closing the APV.



CHU0113S022

CHECK VALVE FUNCTION

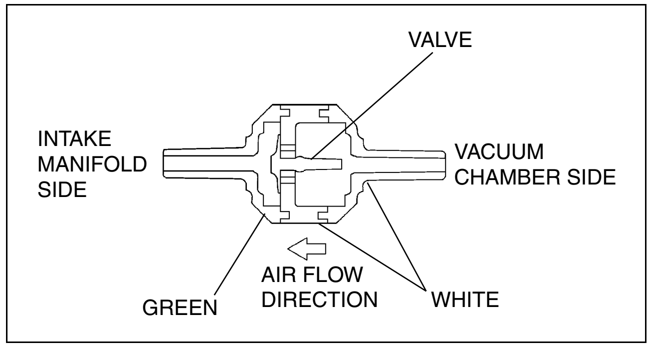
CHU011342910S01

- A one-way check valve has been adopted, allowing intake manifold vacuum to be applied to the vacuum chamber.

CHECK VALVE CONSTRUCTION/OPERATION

CHU011342910S02

- Composed of the main body and valve.
- Air can only flow from the vacuum chamber to the intake manifold.



CHU0113S023

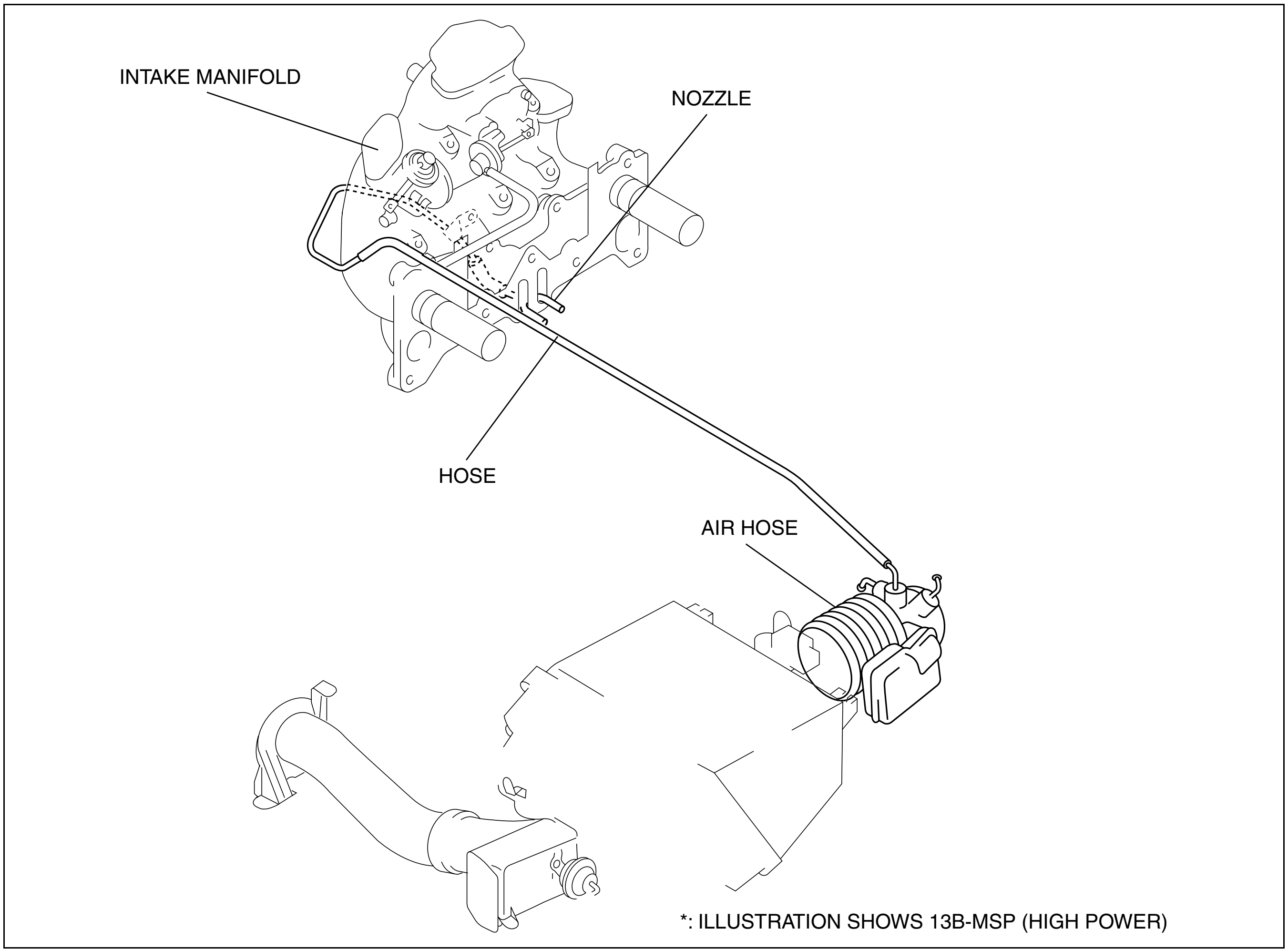
JET AIR FUEL MIXING SYSTEM OUTLINE

CHU011300113S08

- This system flows jet air (high-velocity air) into the primary port.
- Jet air is injected from the nozzle installed to the intake manifold, to blow off fuel adhering to the surface of the intake port.
- A projection (anti-wet port) is provided on the bottom edge of the intake port. With this projection, air current is formed so that the air-fuel mixture blown off by jet air flows to the intake port efficiently, and ideal air-fuel mixture is obtained.
- The air/fuel ratio is lean due to the facilitation of a slow air intake velocity and low load fuel mixture. As a result, fuel economy is improved.

JET AIR FUEL MIXING SYSTEM CONSTRUCTION

CHU011300113S09



*: ILLUSTRATION SHOWS 13B-MSP (HIGH POWER)

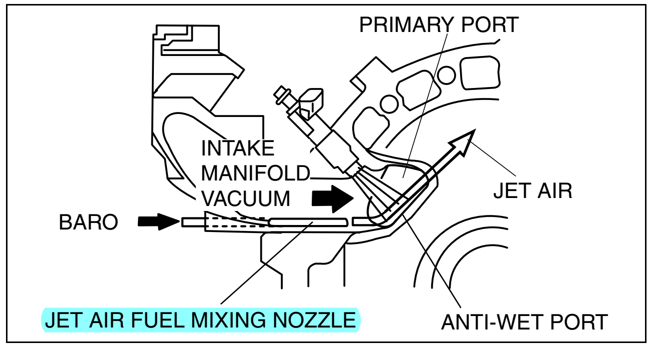
CHU0113S024

01–13

JET AIR FUEL MIXING SYSTEM OPERATION

CHU011300113S10

- The nozzle is installed on the primary port outlet of the intake manifold. BARO is fed to the nozzle from upstream of the throttle valve with the hose.
- Under low load, jet air is injected from the nozzle due to the difference in pressure in the primary port and nozzle.
- This jet air flows along the surface of the intake port, and blows off fuel adhering to the surface of the intake port. In order to change the direction of the air-fuel mixture flow upward, a guide (anti-wet port) with a step is provided on the bottom of the intake port outlet. As a result, atomization is accelerated under low load when air intake velocity is slow, and air current is formed so that the air-fuel mixture flows to the intake port.



CHU0113S025

01–14 FUEL SYSTEM

FUEL SYSTEM OUTLINE

CHU011401006S01

Features

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

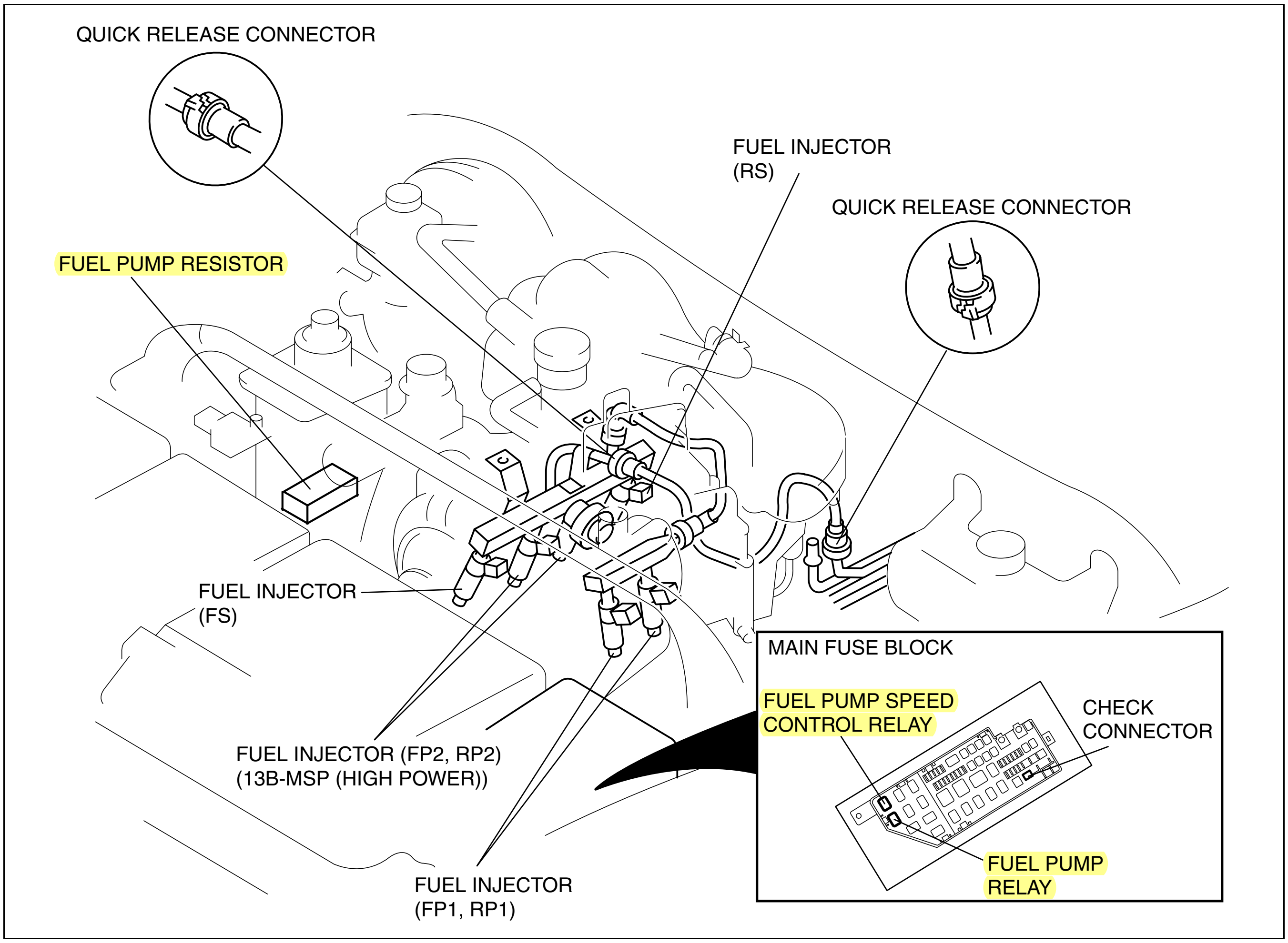
Specification

Item		Specification
Injector	Type	Multiple hole design
	Type of fuel delivery	Top-feed
	Type of drive	Electronic
Pressure regulator control pressure	(kPa {kgf/cm^2, psi})	Approx. 390 {3.98, 56.6}
Fuel pump type		Electric
Fuel tank capacity	(L {US gal, Imp gal})	60 {15.9, 13.2}
Fuel type		Unleaded premium (unleaded high-octane) gasoline

FUEL SYSTEM STRUCTURAL VIEW

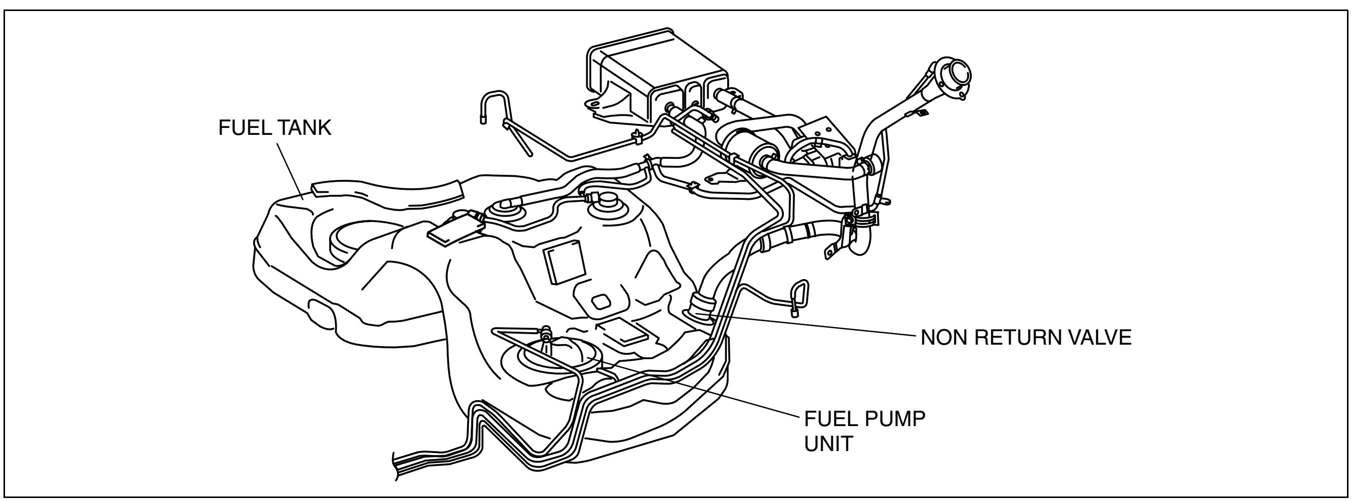
CHU011401006S02

Engine Room Side



CHU0114S001

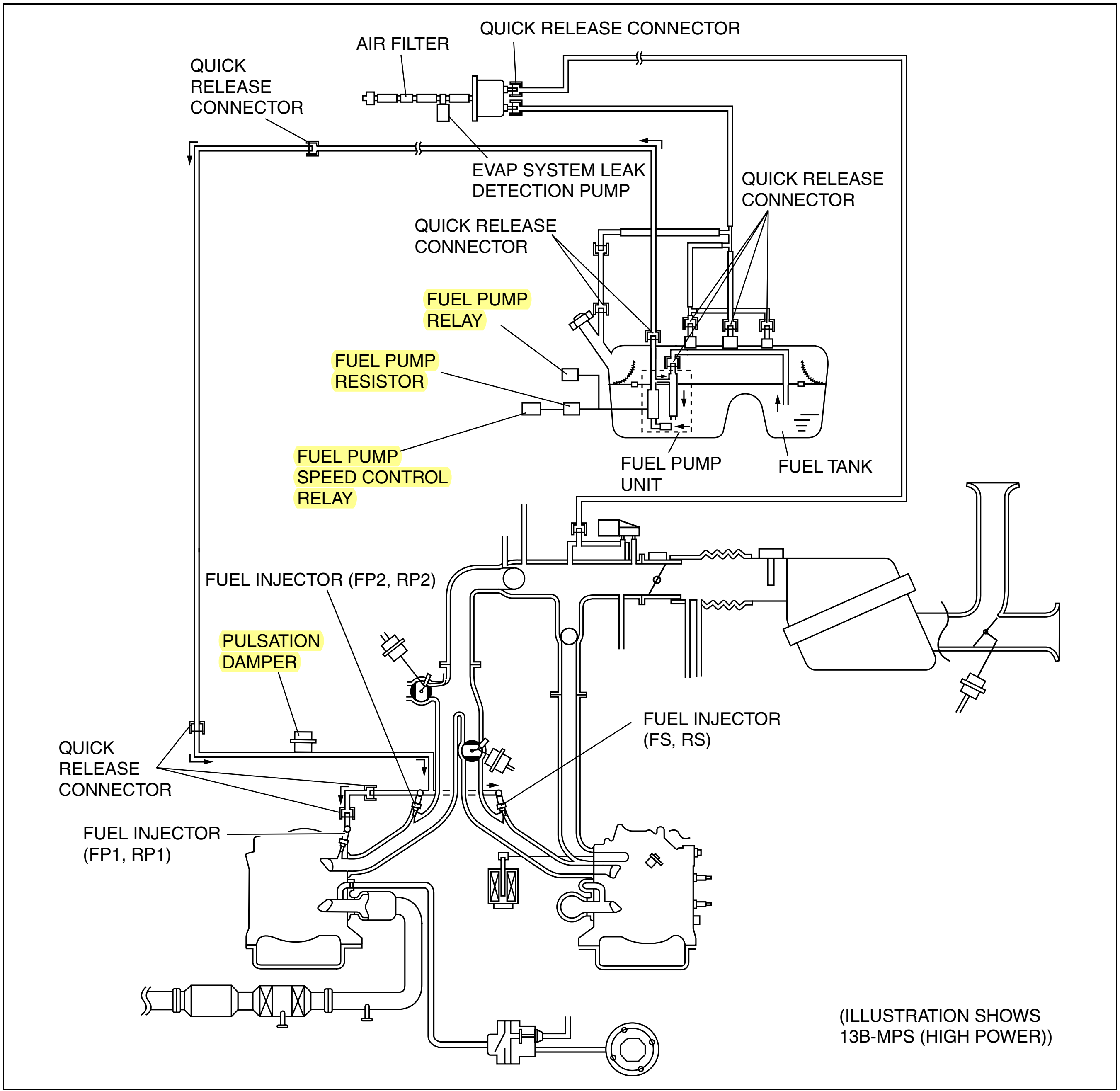
Fuel Tank Side



CHU0114S002

FUEL SYSTEM DIAGRAM

CHU011401006S03



CHU0114S003

FUEL TANK CONSTRUCTION

CHU011442110S01

- Fuel tank capacity is **60 L {15.9 US gal, 13.2 Imp gal}**.
- Includes two rollover valves, and the fuel shut-off valve that is press-fitted in the evaporative hose above the fuel tank. For the fuel shut-off valve and the rollover valves, refer to EMISSION SYSTEM. (See 01–16–10 FUEL SHUT-OFF VALVE FUNCTION, 01–16–11 FUEL SHUT-OFF VALVE CONSTRUCTION/OPERATION, 01–16–11 ROLLOVER VALVE FUNCTION, 01–16–12 ROLLOVER VALVE CONSTRUCTION/OPERATION.)
- Made of hard plastic for weight reduction.

NONRETURN VALVE FUNCTION

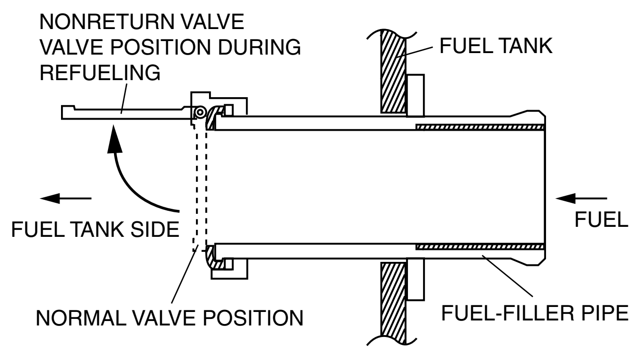
CHU011442270S01

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

NONRETURN VALVE CONSTRUCTION/OPERATION

CHU011442270S02

- A single valve type has been adopted.



CHU0114S014

- The nonreturn valve cannot be removed because it is fixed to the fuel-filler pipe in the fuel tank.
- Under normal conditions, this valve is closed as shown by the dotted line. When refueling, it opens to the position shown by the solid line due to the flow of fuel. When refueling is finished, the valve returns to the normal valve position due to spring force.

RETURNLESS FUEL SYSTEM OUTLINE

CHU011413350S01

Features

- 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 tank temperature. Due to this, formation of evaporative gas produced by a rise in fuel temperature is suppressed.
- The pressure regulator is built into the fuel pump unit in the fuel tank.

RETURNLESS FUEL SYSTEM OPERATION

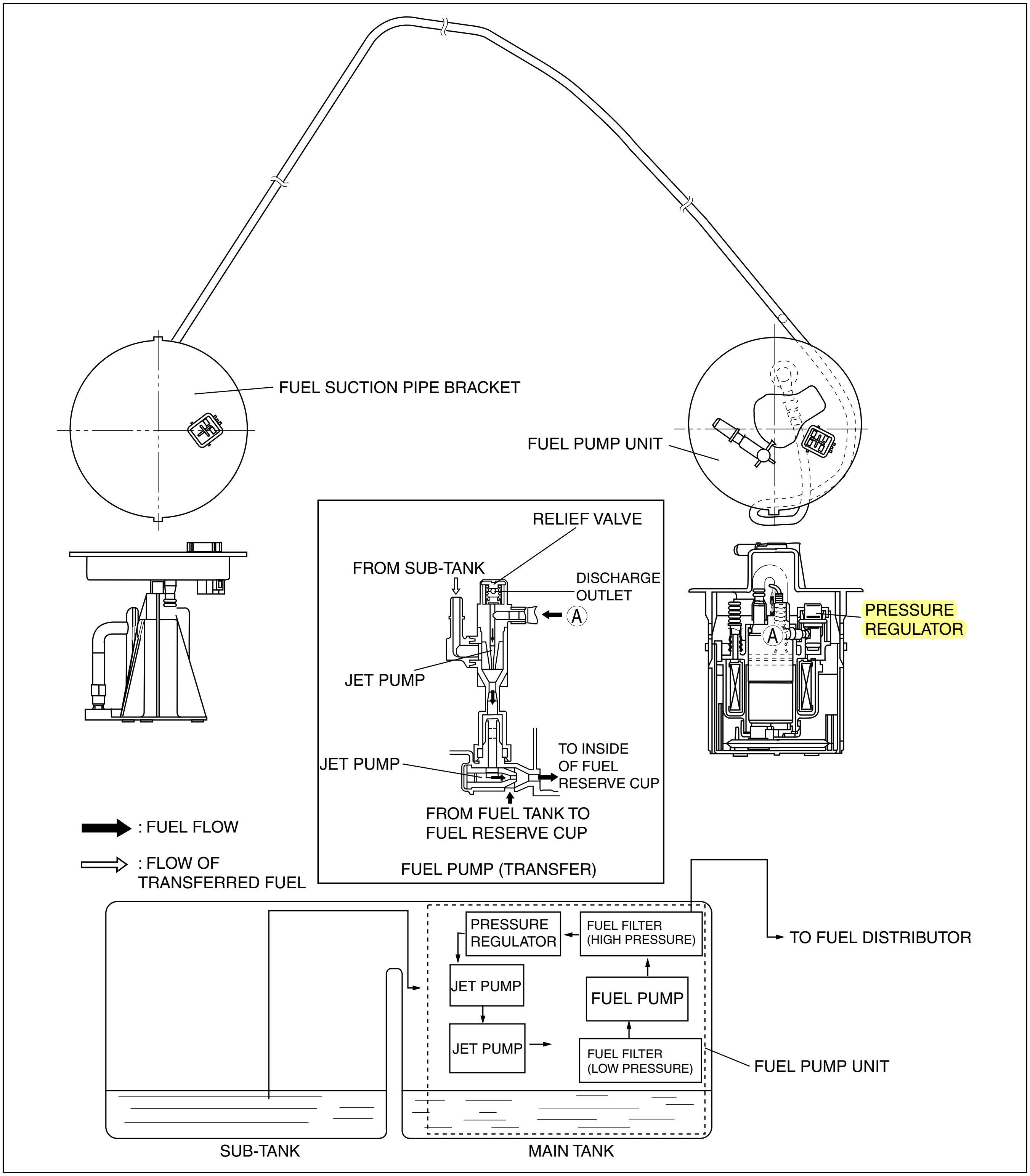
CHU011413350S02

- Fuel in the fuel tank is pumped out through the fuel filter (low-pressure side) by the fuel pump, filtered by the fuel filter (high-pressure side), and then compressed to a specified pressure by the pressure regulator. The pressurized fuel passes through the pulsation damper and is sent to the fuel injector.
- The pressure regulator pressurizes fuel to **approx. 390 kPa {3.98 kgf/cm^2, 56.6 psi}**. If the pressure exceeds the **approx. 390 kPa {3.98 kgf/cm^2, 56.6 psi}**, the pressure regulator valve in the fuel pump unit opens to allow fuel to flow to the fuel tank.

FUEL PUMP UNIT FUNCTION

CHU011413350S03

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



CHU0114S012

FUEL PUMP UNIT CONSTRUCTION/OPERATION

CHU011413350S04

Fuel Pump Unit

- Mainly consists of a fuel filter (high-pressure), pressure regulator, fuel pump, fuel reserve cup, fuel filter (low-pressure), and fuel pump (transfer).
- 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, located on top of the fuel tank, can be removed and installed through the service hole in the bottom of the rear seat.
- The fuel pump unit cannot 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 or the fuel tank through the jet pump.
- A venturi, located in the path of fuel returning from the pressure regulator, creates negative pressure that is used to transfer fuel from the reserve to the main tank.
- If return fuel pressure exceeds the specified value, the relief valve discharges return fuel into the fuel pump unit without passing it through the venturi. Due to this, return fuel pressure is maintained below the specified value.

Pressure Regulator

- Built into the fuel pump unit due to adoption of a returnless fuel system.
- Cannot be removed because it is integrated with the fuel pump unit.
- Mainly consists of a spring, release valve and diaphragm.
- Pressurizes fuel discharged by the fuel pump to **approx. 390 kPa {3.98 kgf/cm^2, 56.6 psi}** with the spring, diaphragm and release valve, and then pumps it to the fuel distributor.
- If fuel pressure exceeds **approx. 390 kPa {3.98 kgf/cm^2, 56.6 psi}**, the release valve opens to discharge unnecessary fuel pressure.

QUICK RELEASE CONNECTOR FUNCTION

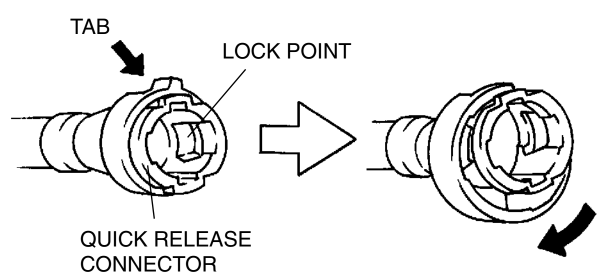
CHU011442692S01

- Quick release connectors that can be connected/disconnected without an **SST** have been adopted to improve serviceability.

QUICK RELEASE CONNECTOR CONSTRUCTION/OPERATION

CHU011442692S02

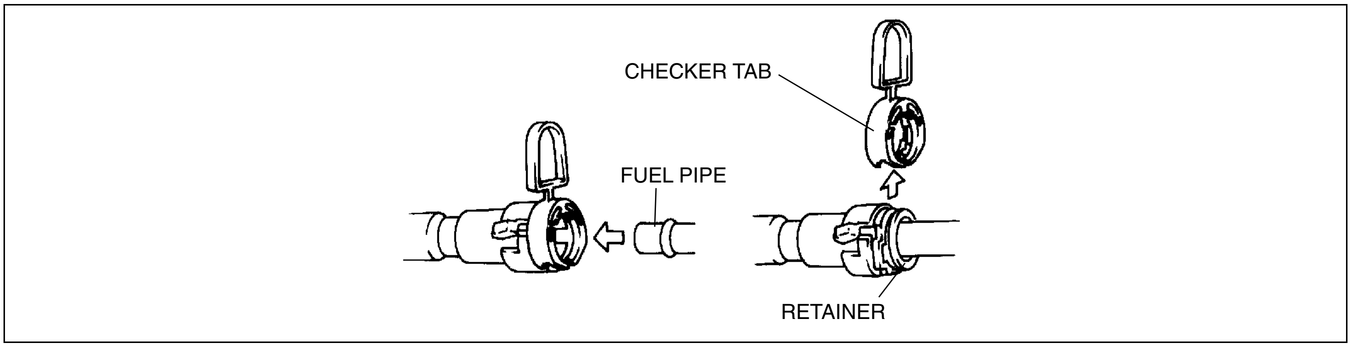
- Mainly consists of a retainer and O-ring. The quick release connector is integrated with the fuel hose and therefore cannot be disassembled.
- When the quick release connector is connected, the fuel pipe projection is locked at the clamp lock point. If the clamp release tab is pushed to expand the clamp, the lock point is released allowing the fuel pipe to be disconnected.



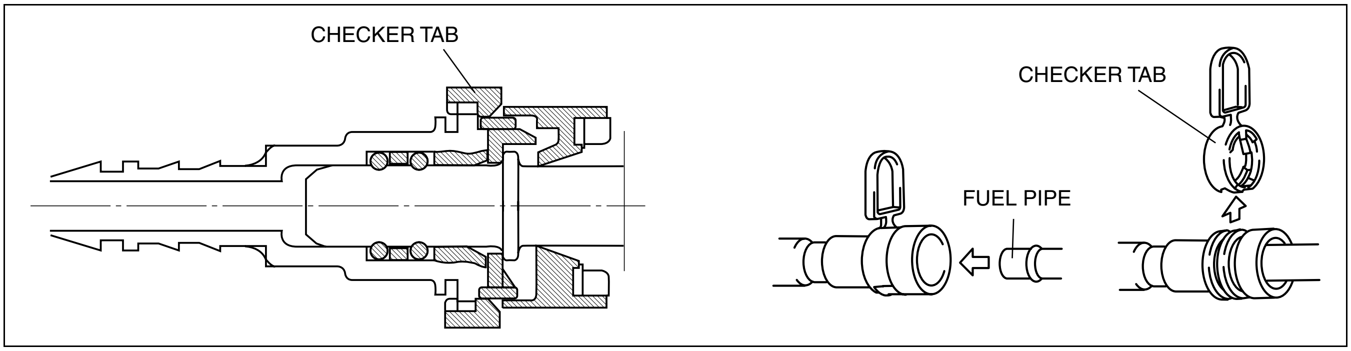
CHU0114S008

- To connect the quick release connector properly, push it into the fuel pipe until a locking click sound is heard.

- New quick release connectors excluding those for the fuel suction pipe, fuel shut-off valve and rollover valve are fitted with a checker tab that prevents improper fit. This checker tab cannot be removed under normal conditions. 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.



CHU0114S009



CHU0114S010

PULSATION DAMPER FUNCTION

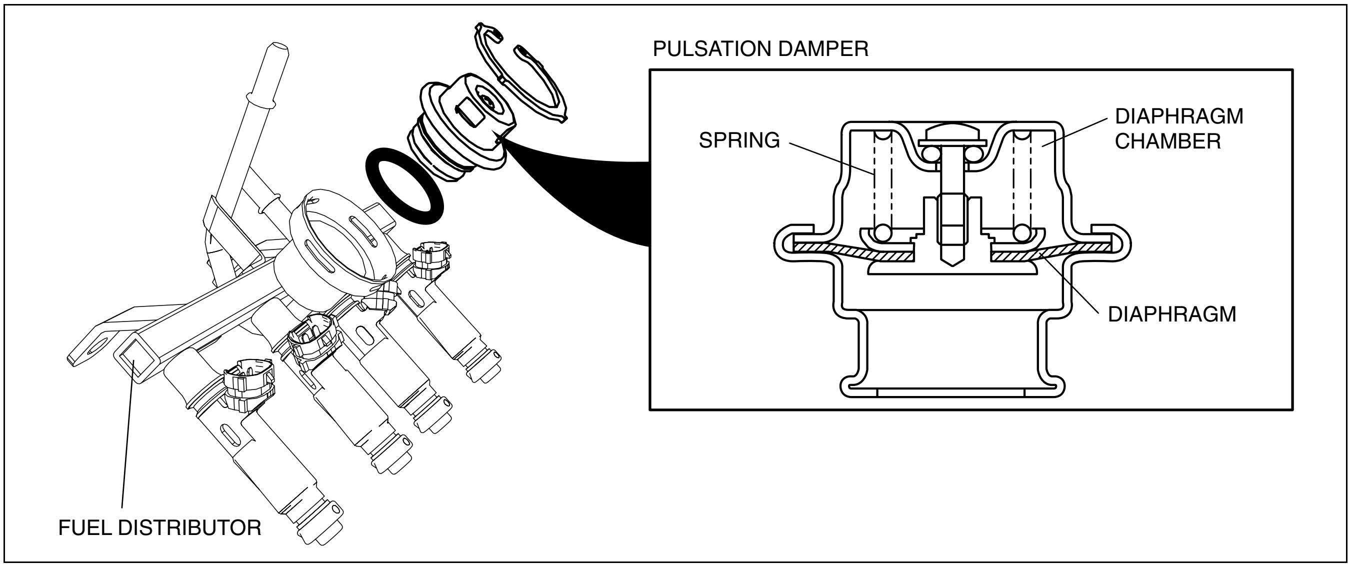
CHU011420180S01

- Reduces pulsation of pressurized fuel between the fuel filter (high-pressure) and the fuel injector.

PULSATION DAMPER CONSTRUCTION/OPERATION

CHU011420180S02

- Installed to the fuel distributor.
- Mainly consists of a diaphragm and spring.
- Uses spring force in the diaphragm chamber to reduce fuel pressure pulsation produced just after fuel injection by the fuel injector.



CHU0114S011

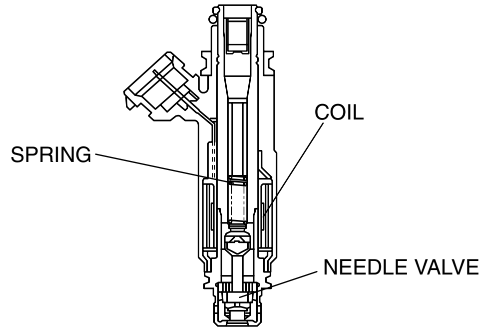
FUEL INJECTOR FUNCTION

CHU011413250S01

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

FUEL INJECTOR CONSTRUCTION/OPERATION

CHU011413250S02



CHU0114S004

Fuel Injector (FP1, RP1)

- Installed on the intermediate housing at an angle of **approx. 45°**, and injects fuel near the intake port opening.
- Mainly consists of a coil, spring and needle valve.
- Fuel injector with 12 injection holes and injection angle of **approx. 30°** adopted to enhance fuel injection vaporization.
- When a PCM signal is sent, exciting current passes through the coil, pulling in the needle valve and injecting fuel.
- The amount of injection is determined by the open time of the needle valve, i.e. the energization time of the coil.

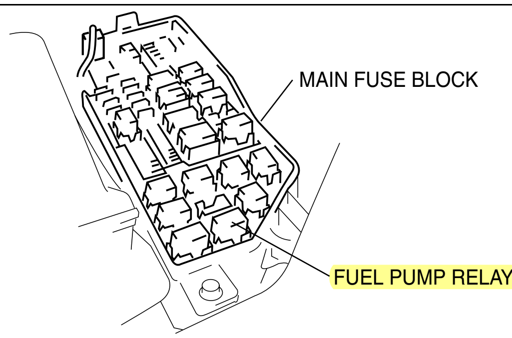
Fuel Injector (FP2, RP2, FS, RS)

- Installed on the intake manifold.
- Mainly consists of a coil, spring, and needle valve.
- Injects fuel into the intake manifold at an angle of **approx. 19°**, so that the fuel is drawn into the housing together with intake air.
- When a PCM signal is sent, exciting current passes through the coil, pulling in the needle valve and injecting fuel.
- The amount of injection is determined by the open time of the needle valve, i.e. the energization time of the coil.

FUEL PUMP RELAY FUNCTION

CHU011413350S05

- Controls the fuel pump on/off according to control signals from the PCM.
- For fuel pump relay control, refer to CONTROL SYSTEM, FUEL PUMP CONTROL. (See 01–40–23 FUEL PUMP CONTROL OUTLINE, 01–40–24 FUEL PUMP CONTROL BLOCK DIAGRAM, 01–40–24 FUEL PUMP CONTROL OPERATION.)
- Supplies voltage to the fuel pump via the fuel pump resistor when the fuel pump speed control relay is off.

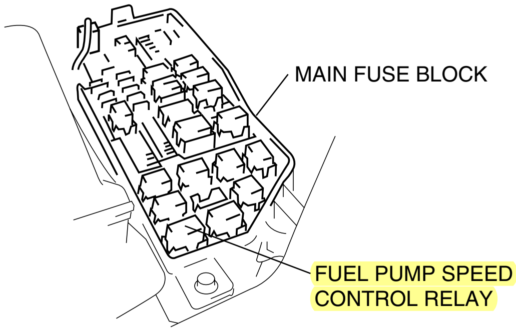


CHU0114W001

FUEL PUMP SPEED CONTROL RELAY FUNCTION

CHU011413350S06

- Supplies power to the fuel pump according to control signals from the PCM.
- For fuel pump speed control, refer to CONTROL SYSTEM, FUEL PUMP SPEED CONTROL. (See 01–40–23 FUEL PUMP CONTROL OUTLINE, 01–40–24 FUEL PUMP CONTROL BLOCK DIAGRAM, 01–40–24 FUEL PUMP CONTROL OPERATION.)

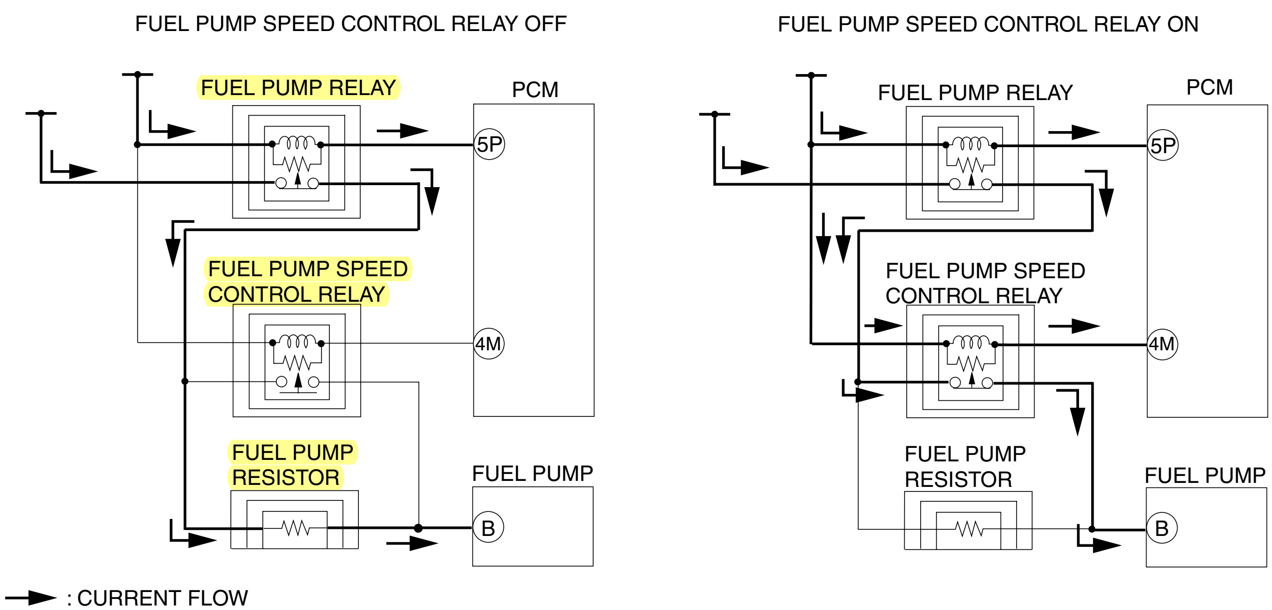


CHU0114W012

FUEL PUMP SPEED CONTROL RELAY OPERATION

CHU011413350S07

- Reduces voltage by routing it through the fuel pump resistor to protect the fuel pump when required fuel amount is low due to low engine speed.

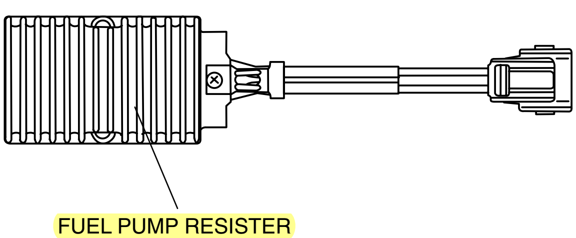


CHU0114S013

FUEL PUMP RESISTOR FUNCTION

CHU011413350S08

- Supplies voltage to the fuel pump via the fuel pump resistor to protect the fuel pump when the injection amount is low (when engine speed is low).
- A fuel pump resistor with a resistance of **0.304—0.336 ohms** has been adopted.



CHU0114S007

01–15 EXHAUST SYSTEM

EXHAUST SYSTEM OUTLINE

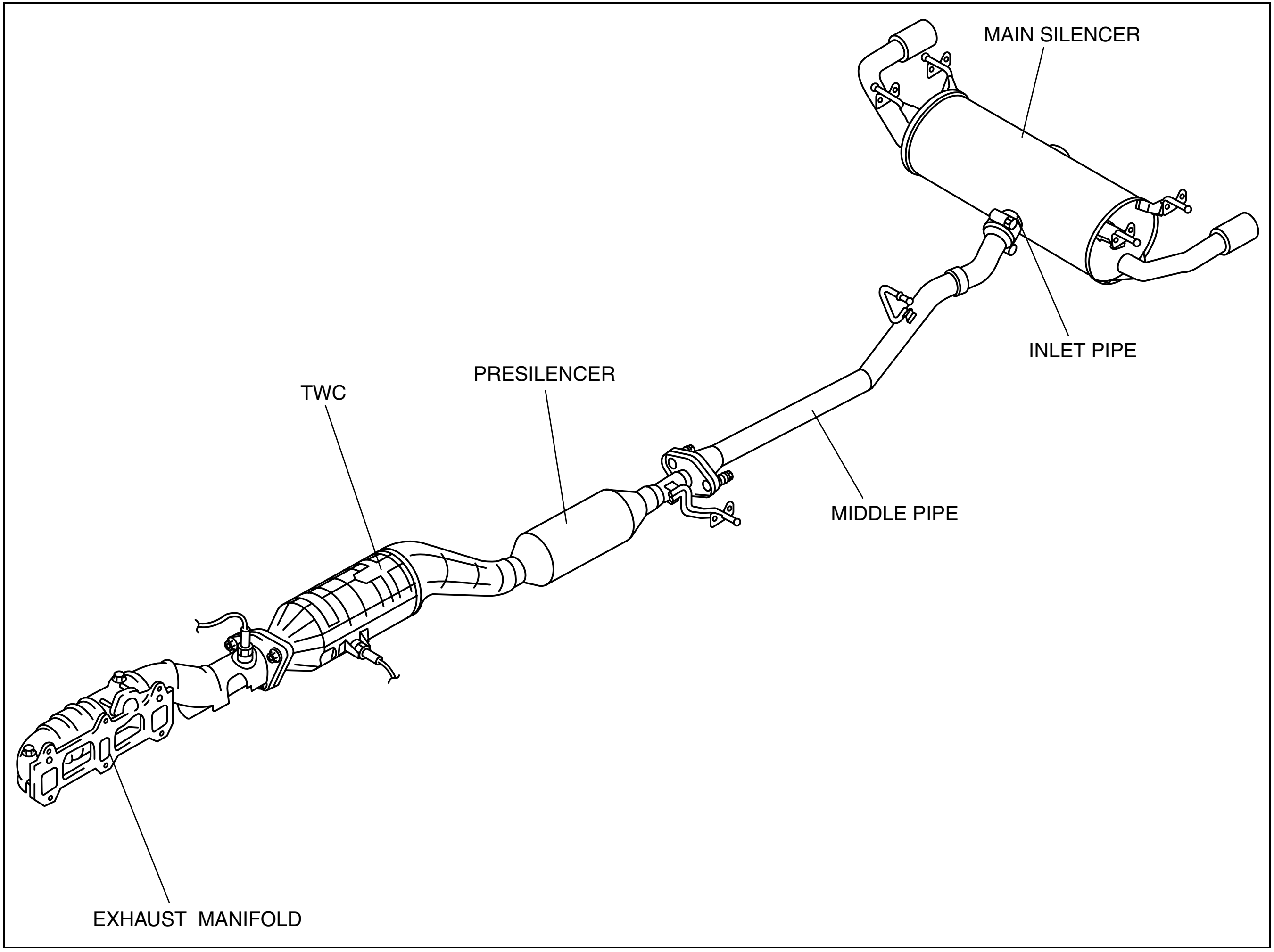
CHU011540000S01

Features

- The exhaust system (including the exhaust manifold) has been laid out as straight as possible in order to achieve smooth flow of exhaust gas and maintain high power output. Additionally, a large-bore exhaust pipe and a high-capacity main silencer with an inlet pipe that passes through the center of the main silencer body have been adopted to reduce exhaust resistance.
- Double wall piping has been adopted for the exhaust manifold to prevent lowering of exhaust gas temperature and facilitates rapid catalyzer activation after cold engine starting for improved exhaust purification.

EXHAUST SYSTEM STRUCTURAL VIEW

CHU011540000S02



CHU0115S001

01–16 EMISSION SYSTEM

EMISSION SYSTEM OUTLINE

CHU011601007S01

Features

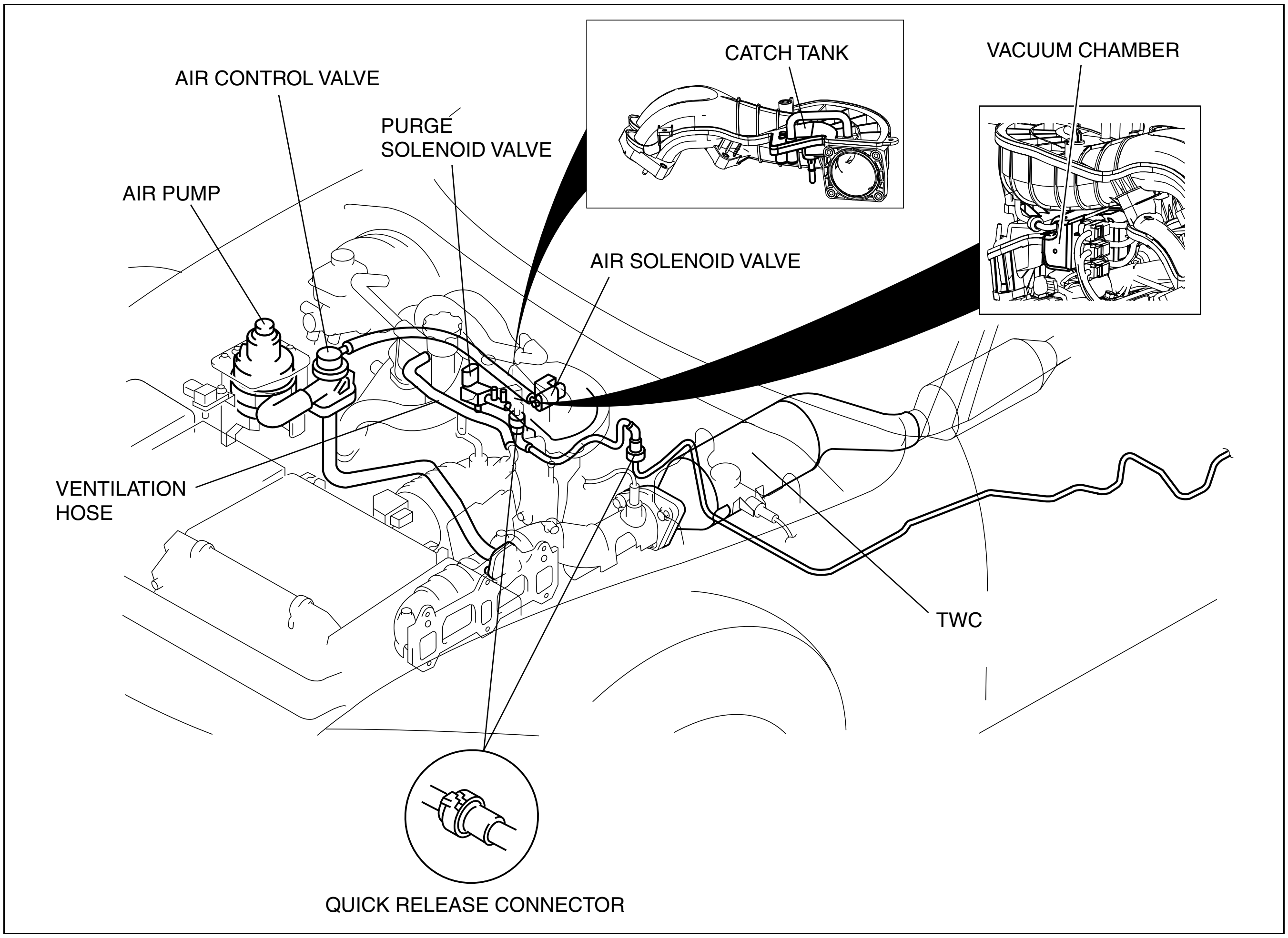
Improved exhaust purification	• Secondary air injection (AIR) system with electric Secondary air injection (AIR) pump adopted • Catalytic converter system adopted

Specification

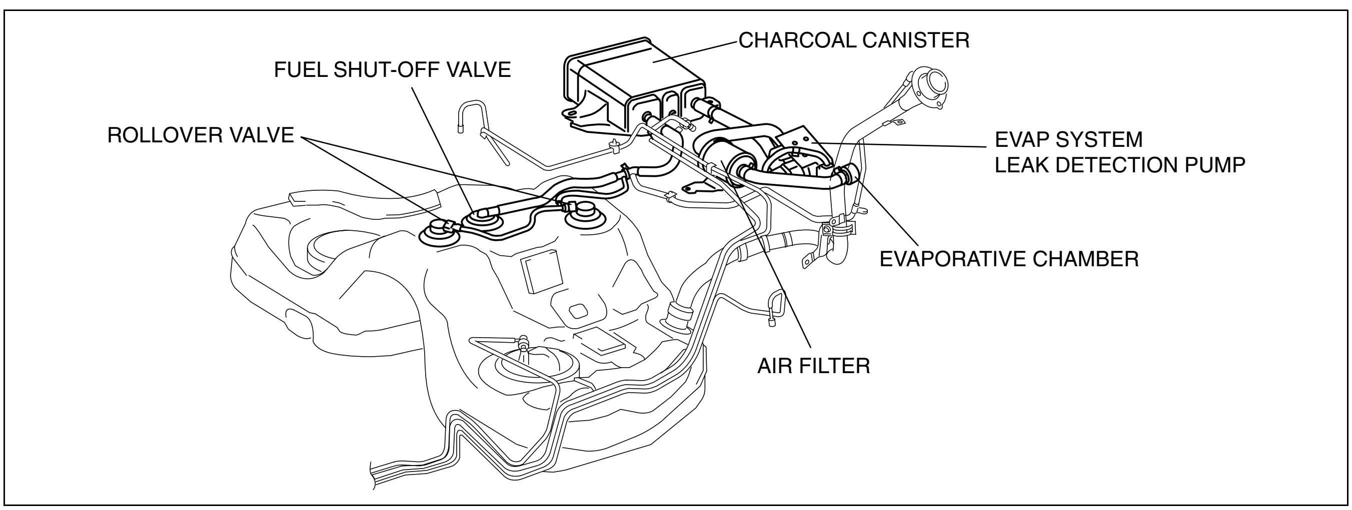
Item	Specification
Secondary air injection (AIR) system	Air pump, air control valve
Catalyst type	Three-way catalyst (monolithic)
Evaporative emission (EVAP) control system	Canister design
Positive crankcase ventilation (PCV) system	Closed design

EMISSION SYSTEM STRUCTURAL VIEW

CHU011601007S02



CHU0116S001



CHU0116S002

CATALYTIC CONVERTER SYSTEM OUTLINE

CHU011620500S01

Features

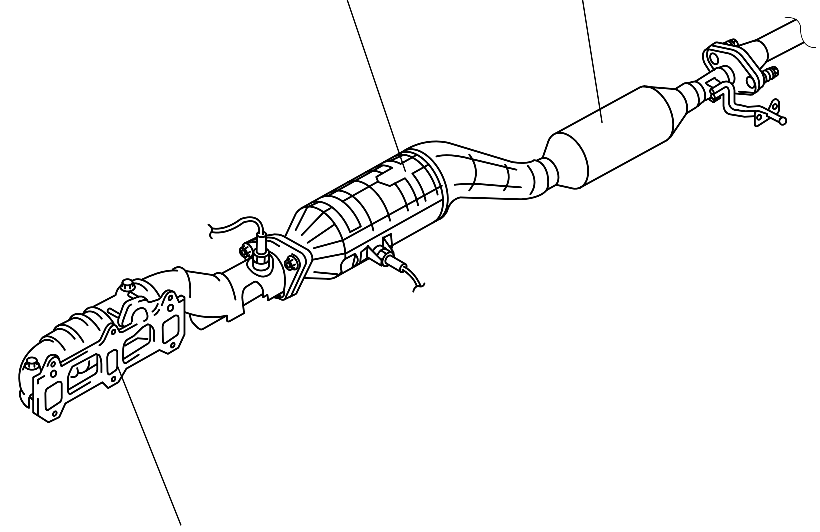
- Purifies toxic substances in exhaust gas by utilizing the chemical reaction process of the three-way catalyst.

CATALYTIC CONVERTER SYSTEM STRUCTURE

CHU011620500S02

- The catalytic converter consists of a three-way catalyst and insulator.
- A **3.01 L {3.18 US qt, 2.65 Imp qt}** capacity catalytic converter with a three-way platinum-palladium-rhodium based catalyst has been adopted.

System Diagram



CHU0116S003

01–16

CATALYTIC CONVERTER SYSTEM OPERATION

CHU011620500S03

- Toxic substances (HC, CO, NO_X) in exhaust gas are purified by oxidization and reduction while passing through the catalytic converter.
  - — Oxidation
    - Combines toxic HC and CO with oxygen to produce non-toxic carbon dioxide and water.
      $O_2 + HC + CO \rightarrow CO_2 + H_2O$
  - — Reduction
    - Converts toxic NO_X (nitrogen oxides) into non-toxic nitrogen and oxygen. Part of the oxygen produced in this process is used for oxidation.
      $NO_X \rightarrow N_2 + O_2$

SECONDARY AIR INJECTION (AIR) SYSTEM OUTLINE

CHU011600116S01

Features

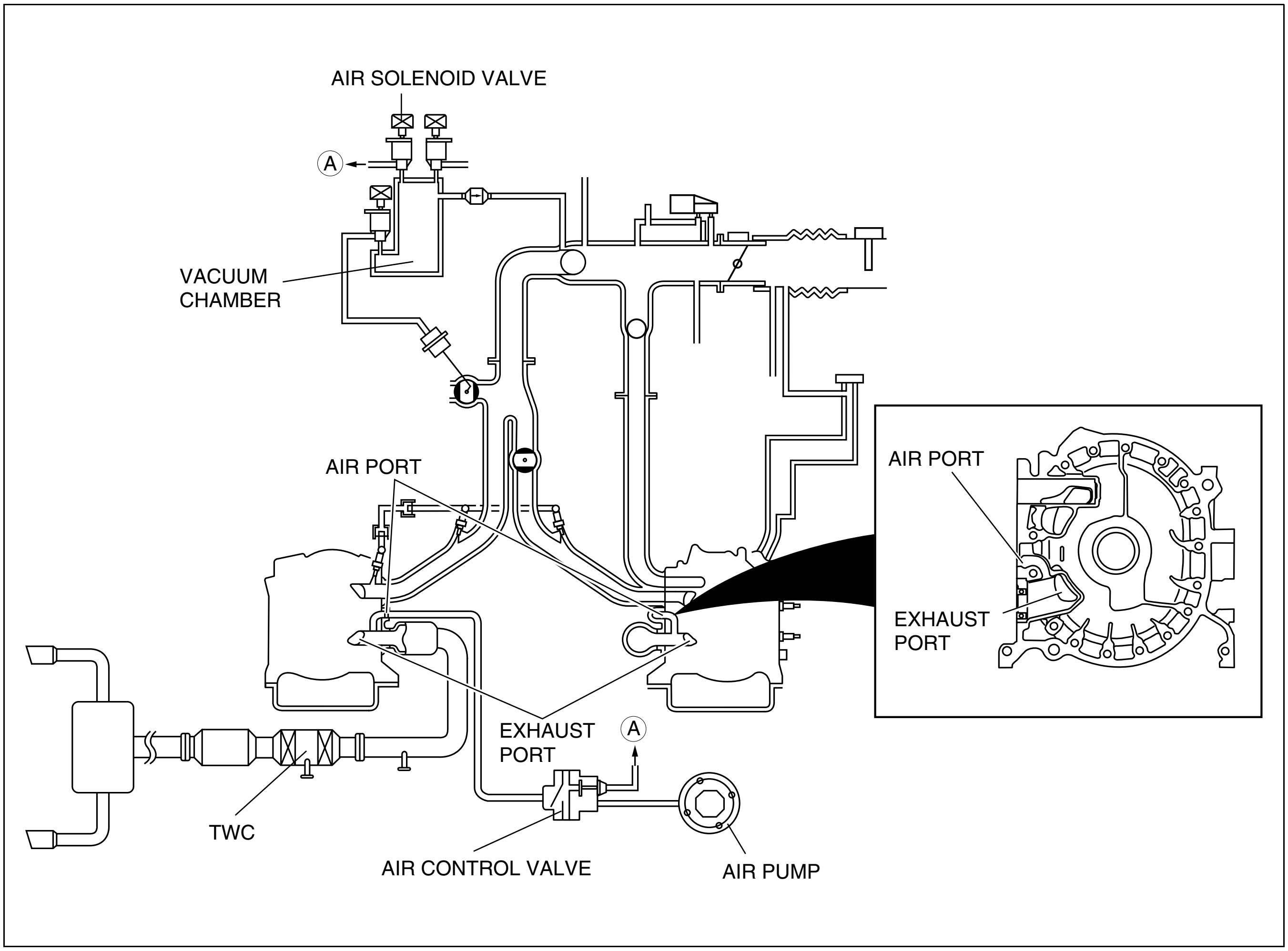
- Supplies secondary air discharged by the AIR pump to the exhaust ports.
- Rapid activation of the catalytic converter system is achieved by sending secondary air to the exhaust ports and causing it to react with unburnt gas to raise exhaust gas temperature.

SECONDARY AIR INJECTION (AIR) SYSTEM CONSTRUCTION/OPERATION

CHU011600116S02

- The AIR system is controlled by the PCM.
- If the engine is started when the conditions for actuating the AIR system are satisfied, the AIR pump operates, pumping air to the AIR control valve. At this point, the PCM turns on the AIR solenoid valve, causing negative pressure in the vacuum chamber to open the AIR control valve. Due to this, the air pumped by the AIR pump is passed through the secondary air ports and introduced into the exhaust ports in the side housing as secondary air. The secondary air reacts with unburnt gas discharged from the rotor housing thereby raising exhaust gas temperature and enhancing catalyst activation. When the AIR pump stops, the AIR solenoid valve turns off, closing the AIR control valve and preventing the reverse flow of exhaust gas from the exhaust ports to the AIR pump.
- The AIR pump only operates for a short period after a cold start. (Except extreme cold engine starts)

System Diagram



CHU0116S004

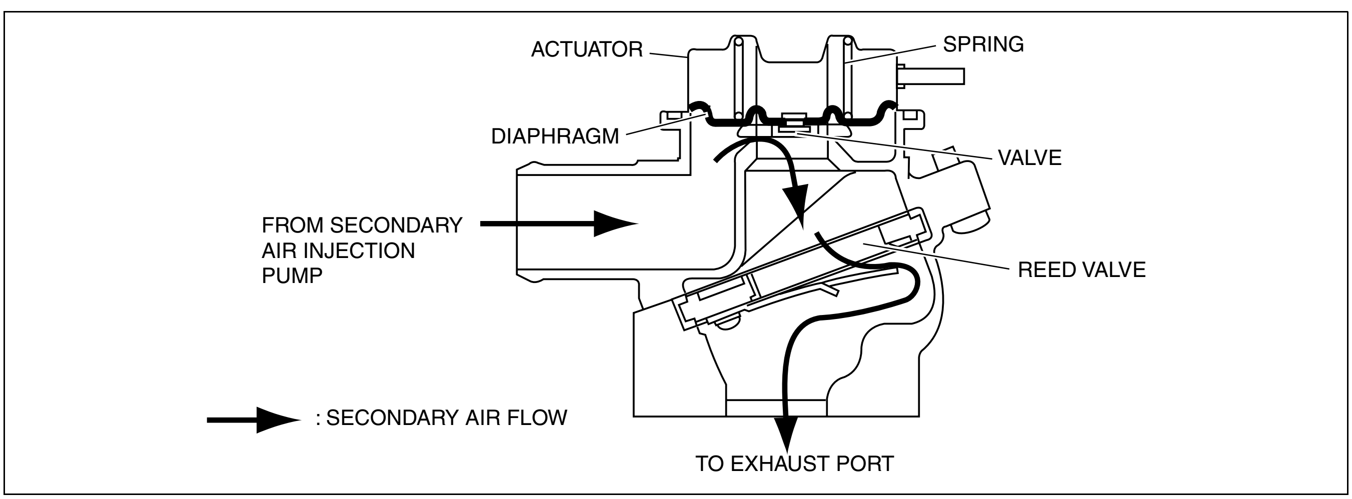
SECONDARY AIR INJECTION (AIR) CONTROL VALVE FUNCTION

CHU011613990S01

- Opens/closes the path of air sent from the AIR pump to the exhaust ports.

SECONDARY AIR INJECTION (AIR) CONTROL VALVE CONSTRUCTION/OPERATION

CHU011613990S02



CHU0116S005

- Mainly consists of an actuator and reed valve.
- When the AIR solenoid valve is turned on, negative pressure is applied to the actuator diaphragm, opening the inner valve and sending the air from the AIR pump to the exhaust ports.

- When the AIR solenoid valve is turned off, atmospheric air forms in the actuator and the valve is closed by spring force, thereby blocking the path.
- The reed valve provided in the AIR control valve prevents reverse flow of exhaust gas and protects the AIR pump.

SECONDARY AIR INJECTION (AIR) SOLENOID VALVE FUNCTION

CHU011618740S01

- Switches the path of intake manifold negative pressure between the vacuum chamber and the AIR control valve.

SECONDARY AIR INJECTION (AIR) SOLENOID VALVE CONSTRUCTION/OPERATION

CHU011618740S02

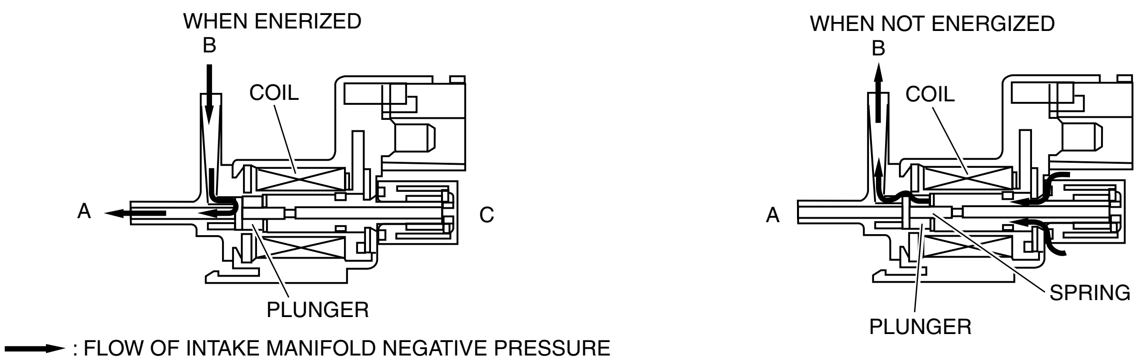
- Mainly consists of a coil, spring, plunger, and filter.

When Energized
  - The solenoid coil becomes an electromagnet and pulls in the plunger. This opens an airflow path between ports A and B, applying intake manifold negative pressure to the actuator of the AIR control valve.

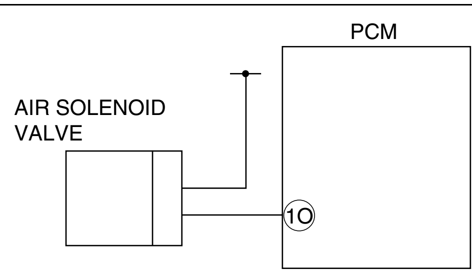
When Not Energized
  - The path of intake manifold negative pressure is closed, and the path between B and C is opened, causing the actuator of the AIR control valve to be open to the atmosphere.

○—○ : Airflow

Condition	Vacuum chamber (A)	Actuator (B)	Atmosphere (C)
When energized	○——	——○	
When not energized		○——	——○



CHU0116S009



CHU0116S010

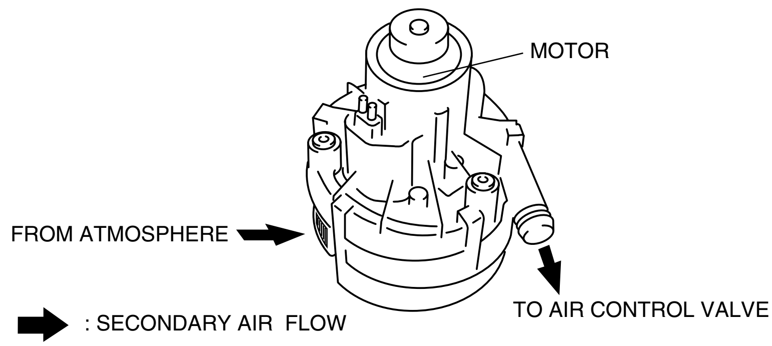
SECONDARY AIR INJECTION (AIR) PUMP FUNCTION

CHU011613811S01

- Pressurizes outside air and discharges secondary air.
- Secondary air from the AIR pump is pumped to the exhaust ports through the AIR control valve.

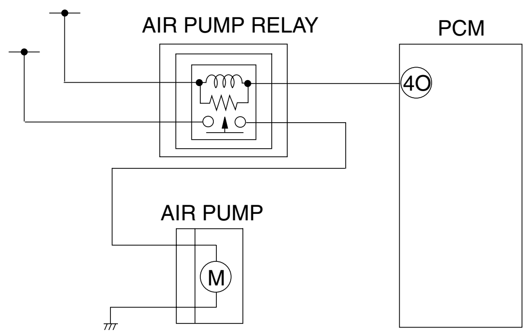
SECONDARY AIR INJECTION (AIR) PUMP CONSTRUCTION/OPERATION

CHU011613811S02

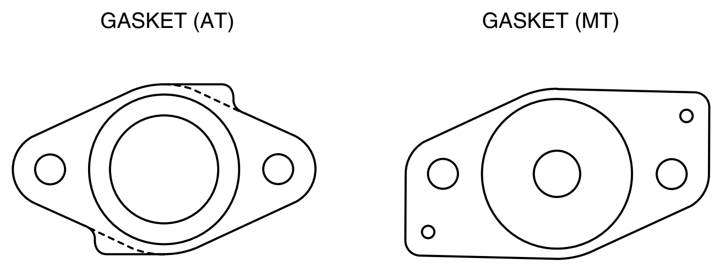


CHU0116S007

- Mainly consists of a DC motor and fan.
- When the AIR pump relay is turned on due to a PCM signal, the motor drives the pump fan to discharge secondary air.



CHU0116S018



CHU0116S022

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OUTLINE

CHU011613890S01

Features

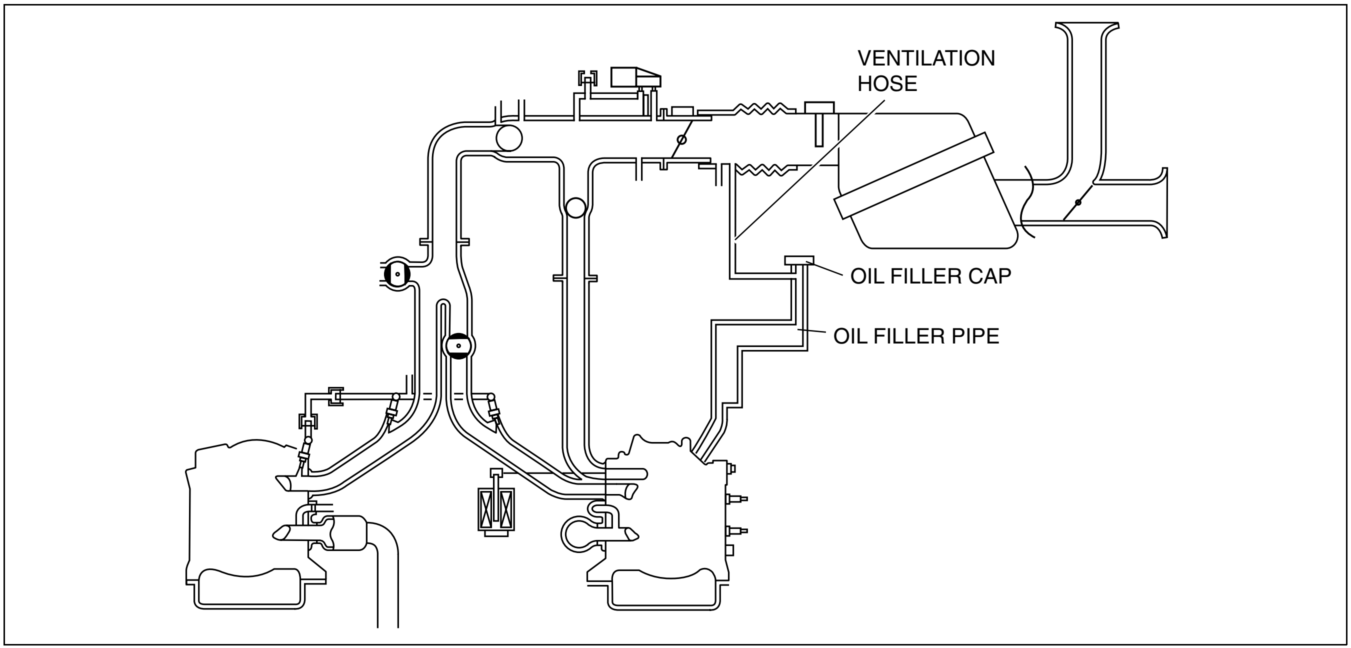
- A closed system has been adopted.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM STRUCTURE

CHU011613890S02

- A ventilation hose to the oil filler pipe is provided to send blowby gas to the extension manifold (upper). The gas is then introduced into the intake port together with intake air and recombusted.

System Diagram



CHU0116S008

POSITIVE CRANKCASE VENTILATION (PCV) VALVE OPERATION

CHU011613890S03

- Forces blowby gas (unburnt gas) that contains CO, HC, and other noxious gas from the rotor housing into the intake-air system for combustion in the combustion chamber in order to prevent discharge of blowby gas into the atmosphere.

EVAPORATIVE EMISSIONS (EVAP) CONTROL SYSTEM OUTLINE

CHU011601074S01

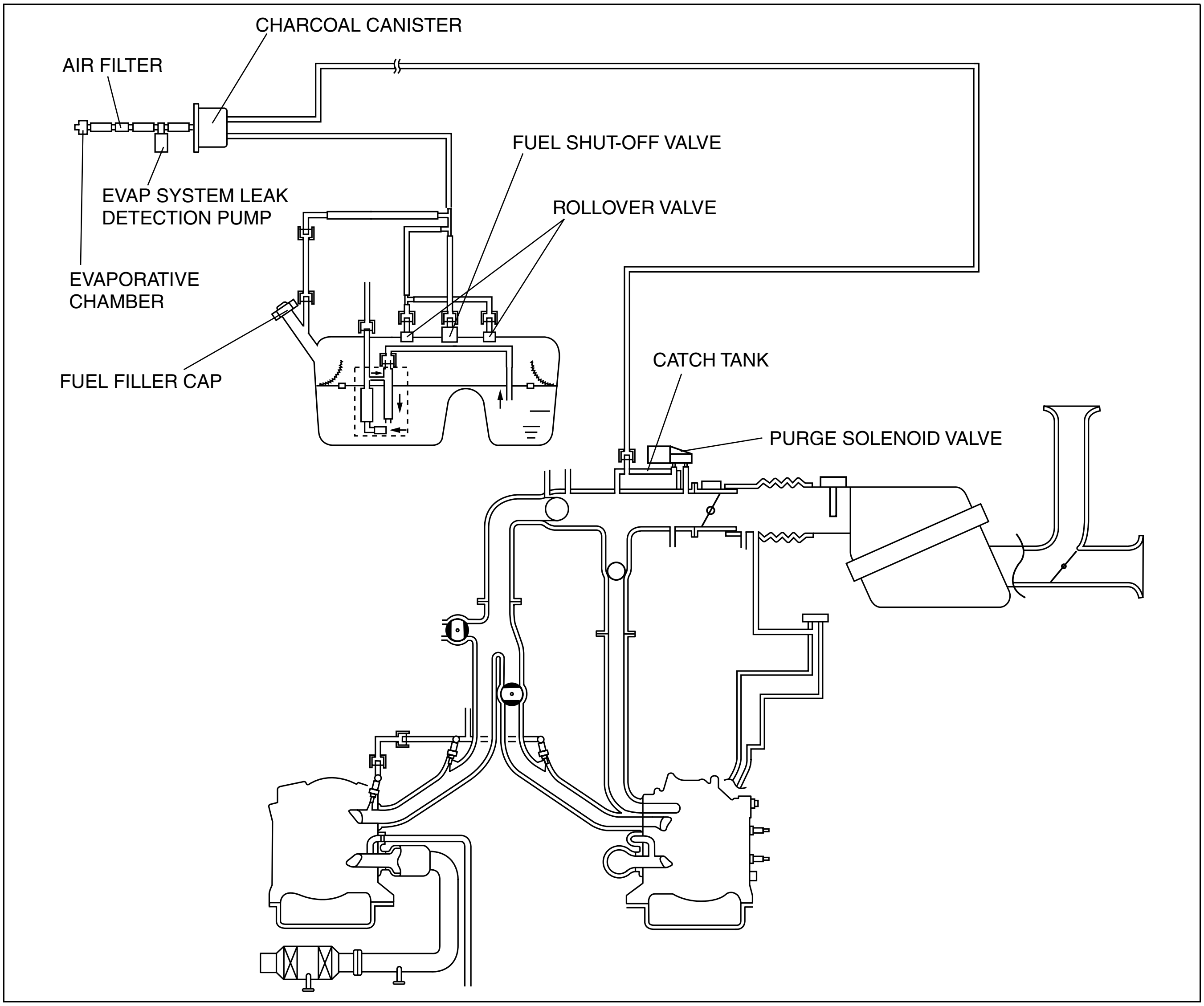
Features

- A canister design has been adopted to prevent discharge of evaporative gas into the atmosphere.
- A duty solenoid (purge solenoid valve) has been adopted to provide optimum control according to engine conditions.
- For evaporative purge control, refer to ENGINE CONTROL SYSTEM, EVAPORATIVE PURGE CONTROL. (See 01–40–30 EVAPORATIVE PURGE CONTROL OUTLINE, 01–40–30 EVAPORATIVE PURGE CONTROL BLOCK DIAGRAM, 01–40–31 EVAPORATIVE PURGE CONTROL OPERATION.)

EVAPORATIVE EMISSIONS (EVAP) CONTROL SYSTEM STRUCTURE

CHU011601074S02

- Consists of a purge solenoid valve, charcoal canister, catch tank, evaporative chamber, rollover valves, fuel shut-off valve, EVAP system leak detection pump, air filter, and fuel-filler cap.



CHU0116S011

EVAPORATIVE EMISSIONS (EVAP) CONTROL SYSTEM OPERATION

CHU011601074S03

- When the engine is stopped, evaporative gas in the fuel tank flows from the fuel tank as pressure rises, and is absorbed by the charcoal canister. Additionally, liquefied evaporative gas is stored in the catch tank.
- When the engine is running, evaporative gas absorbed by the charcoal canister together with air drawn from the atmospheric air port in the charcoal canister passes through the purge solenoid valve and is then inducted into the engine in an amount appropriate to engine condition.
- If negative pressure in the fuel tank rises, air is drawn from the charcoal canister atmospheric air port via the rollover valves. If the atmospheric air port in the charcoal canister becomes clogged, this malfunction causes negative pressure in the fuel tank to rise, applying a load to the fuel tank, and the negative pressure valve in the fuel-filler cap opens to draw air into the fuel tank.

PURGE SOLENOID VALVE FUNCTION

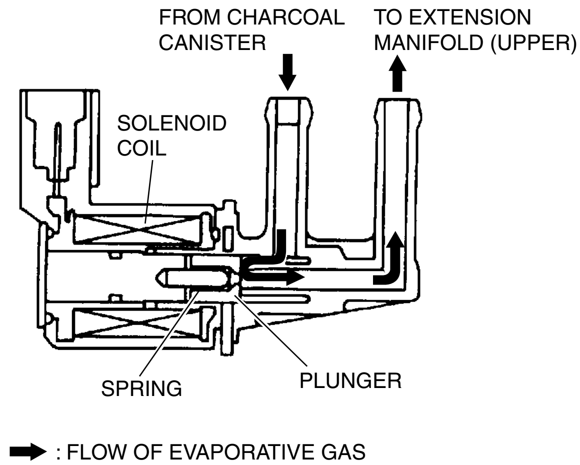
CHU011618740S03

- Adjusts the amount of evaporative gas drawn into the intake-air system.

PURGE SOLENOID VALVE CONSTRUCTION/OPERATION

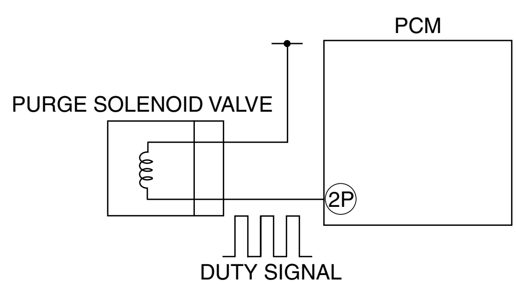
CHU011618740S04

- Installed to the catch tank integrated with the extension manifold (upper).



CHU0116S012

- Mainly consists of a solenoid coil, spring, and a plunger.
- Opens and closes the solenoid valve path according to purge solenoid valve control signals (duty signals) from the PCM in order to adjust the amount of evaporative gas sent to the extension manifold (upper) in accordance with engine conditions.
- When the PCM signal is given to the solenoid coil, it energizes and becomes an electromagnet, pulling in the plunger. This opens a path between ports, and evaporative gas is drawn into the intake-air system by intake manifold negative pressure.



CHU0116S013

CATCH TANK FUNCTION

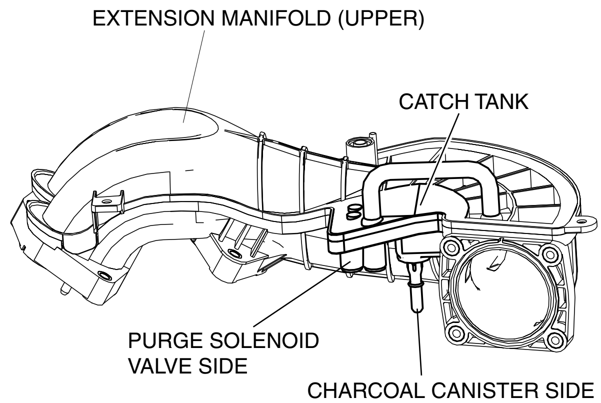
CHU011613978S01

- The catch tank stores liquefied evaporative gas in order to prevent an overly rich air-fuel ratio caused by the introduction of this gas in the intake-air system.

CATCH TANK CONSTRUCTION/OPERATION

CHU011613978S02

- Integrated with the extension manifold (upper) and cannot be disassembled.



CHU0116S014

- Evaporative gas between the purge solenoid valve and the charcoal canister is liquefied while being transferred to the extension manifold (upper) due to a decrease in temperature and other factors. The catch tank holds such liquefied evaporative gas (gasoline).
- Liquefied evaporative gas is held in the catch tank and not supplied to the extension manifold (upper). This prevents an overly rich air-fuel ratio.

CHARCOAL CANISTER FUNCTION

CHU011613970S01

- A canister filled with activated charcoal that absorbs evaporative gas temporarily.

CHARCOAL CANISTER CONSTRUCTION/OPERATION

CHU011613970S02

- A charcoal canister contains activated carbon.

EVAPORATIVE CHAMBER FUNCTION

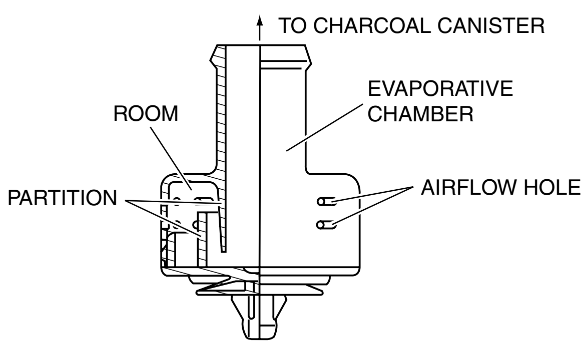
CHU011613988S01

- Prevents flooding of the charcoal canister hose that opens to the atmosphere.

EVAPORATIVE CHAMBER CONSTRUCTION/OPERATION

CHU011613988S02

- Installed into the rear crossmember.



CHU0116S016

- A small section with partitions is located in the evaporative chamber. These partitions protect the charcoal canister by preventing flooding as atmospheric air enters from the airflow holes.

FUEL SHUT-OFF VALVE FUNCTION

CHU011642990S01

- 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, it is possible that, due to the built-up pressure caused by evaporative emissions in the fuel tank, the fuel could overflow. The shut-off valve closes to prevent such a fuel overflow.

FUEL SHUT-OFF VALVE CONSTRUCTION/OPERATION

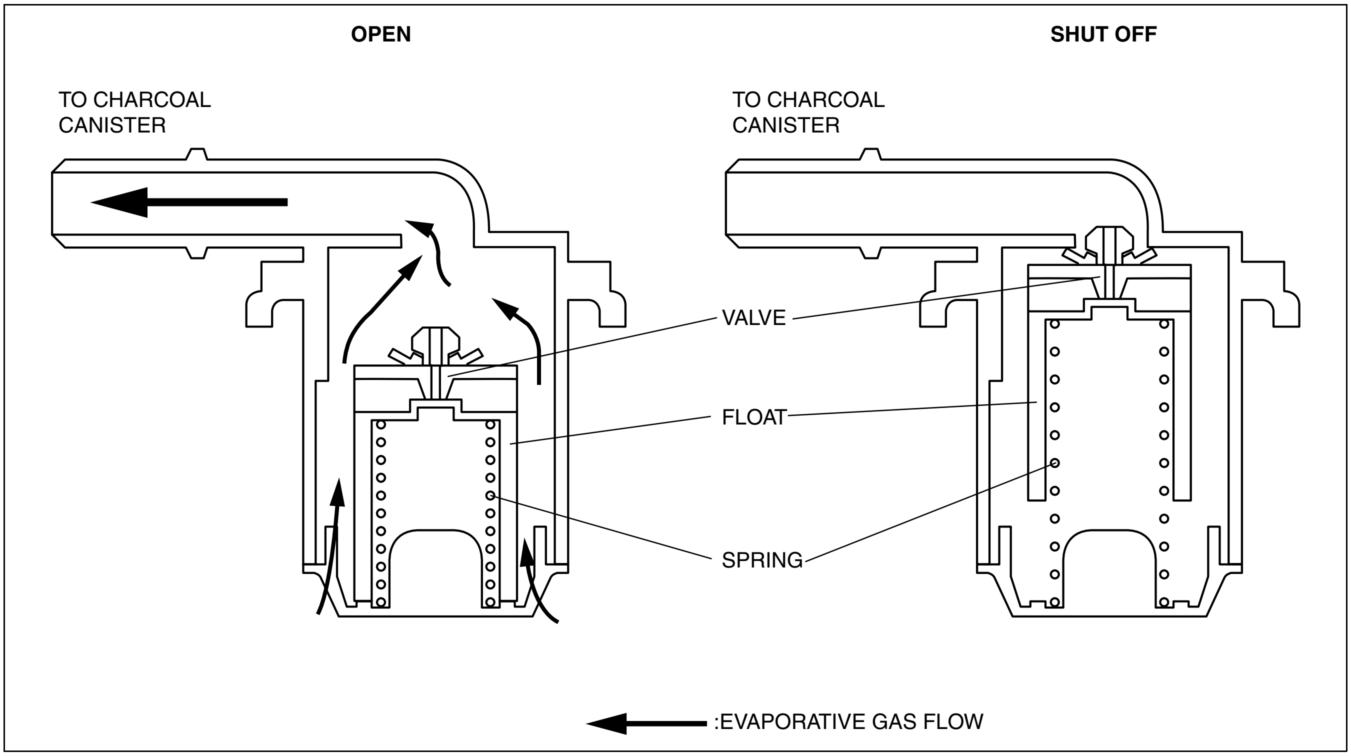
CHU011642990S02

Construction

- Since the shut-off valve is press-fit to the top of the fuel tank, it cannot be disassembled.
- The shut-off valve mainly consists of a valve, float, spring, and by-pass valve.

Operation

- 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 pressure.
- The float rises during refueling, locks after refueling is completed, and returns to the original position by its own weight when the fuel level decreases. Due to this, the evaporative emissions in the fuel tank can be released through the charcoal canister.



CHU0116S020

ROLLOVER VALVE FUNCTION

CHU011642720S01

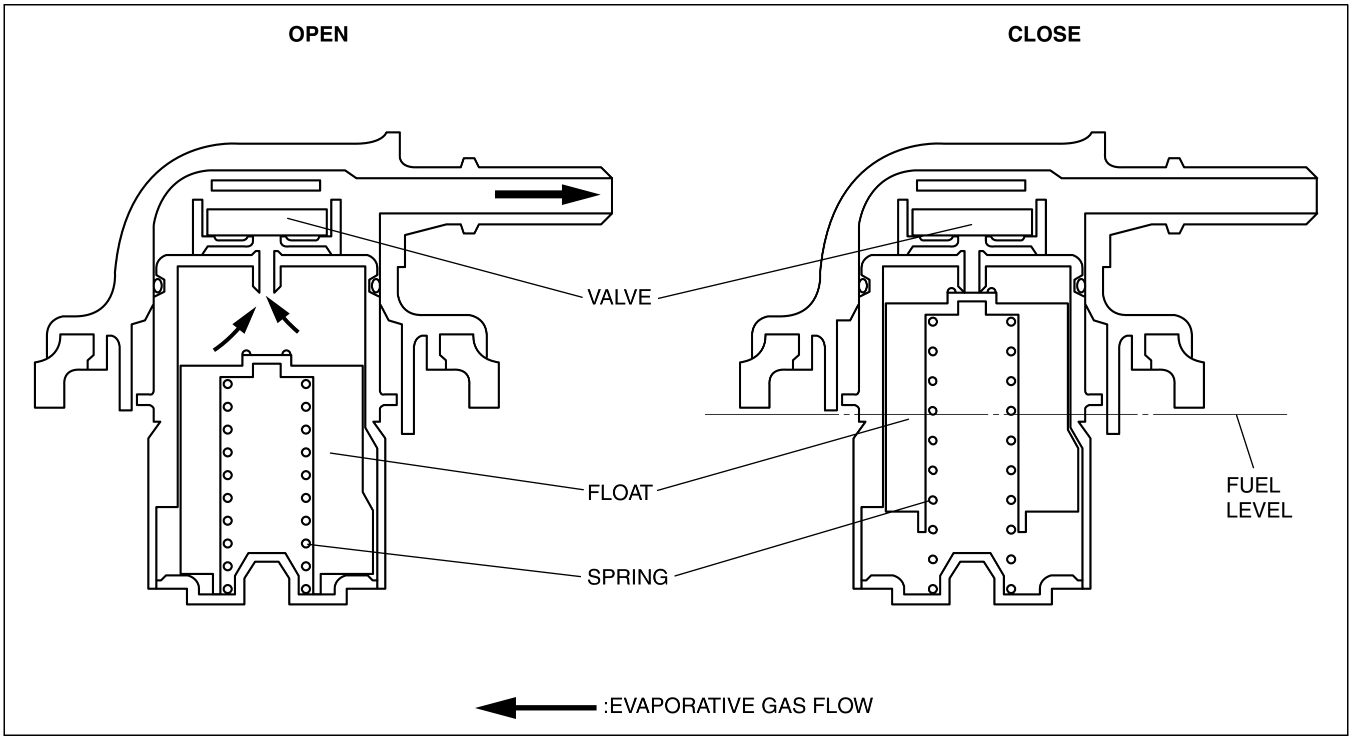
Function

- The rollover valve prevents fuel from flowing to the charcoal canister during tight turns, vehicle rollover or when the fuel tank is full.

ROLLOVER VALVE CONSTRUCTION/OPERATION

CHU011642720S02

- The rollover valves are welded in two locations in the evaporative gas path on the top of the fuel tank and cannot be removed/installed.



CHU0116S021

- The rollover valve mainly consists of a float and spring.
- When the float is saturated with fuel, the float (valve) closes to shut the sealing surface of the path due to the weight of the float, spring force, and flotation relationship.

EVAP SYSTEM LEAK DETECTION PUMP DESCRIPTION

CHU011618743S01

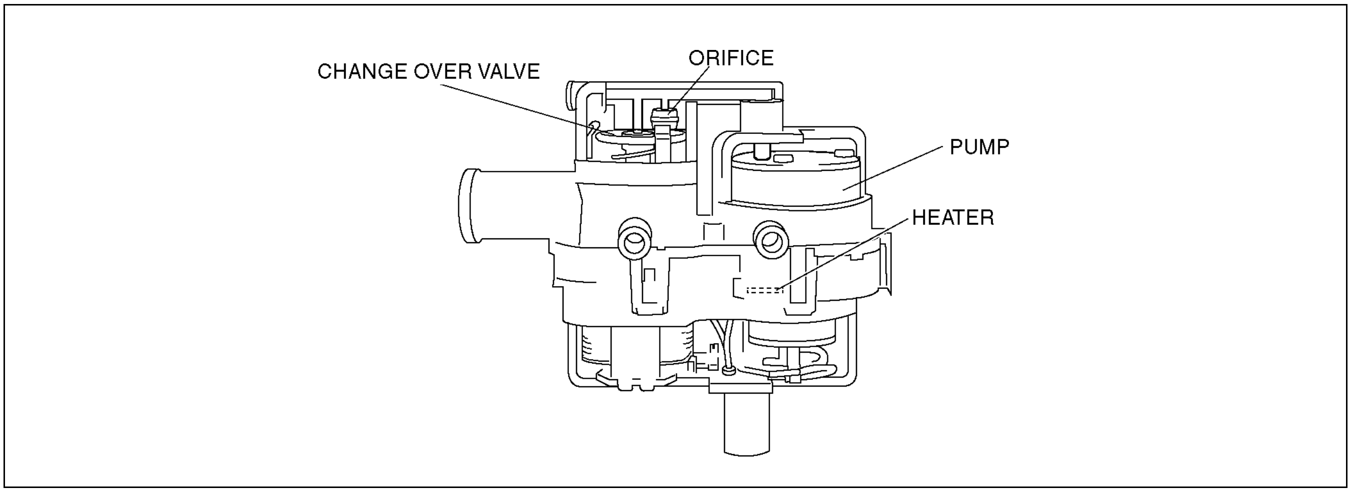
Function

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

Structure

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

01–16

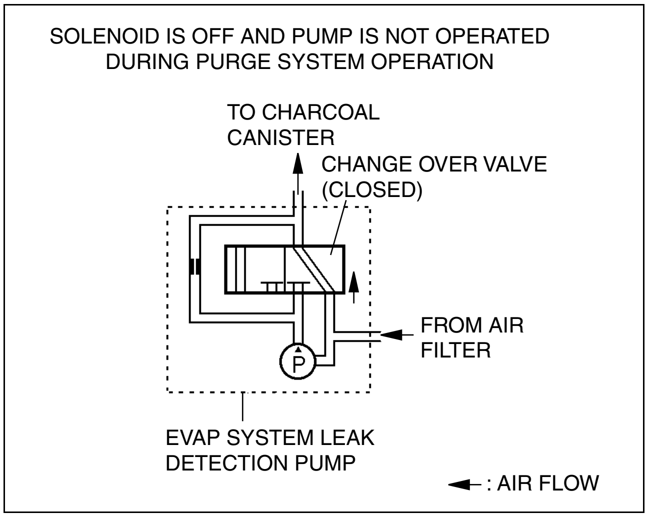


B6U0116S028

Operation

Evaporative system monitor is not operated

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

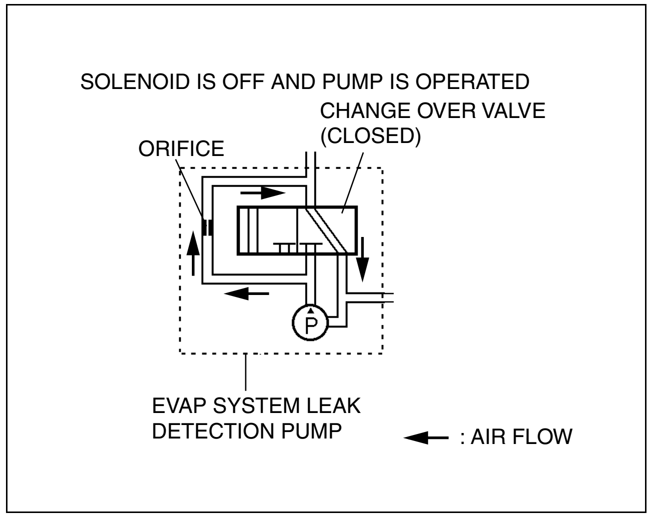


B6U0116S017

Evaporative system monitor is operated
When obtaining the reference current value

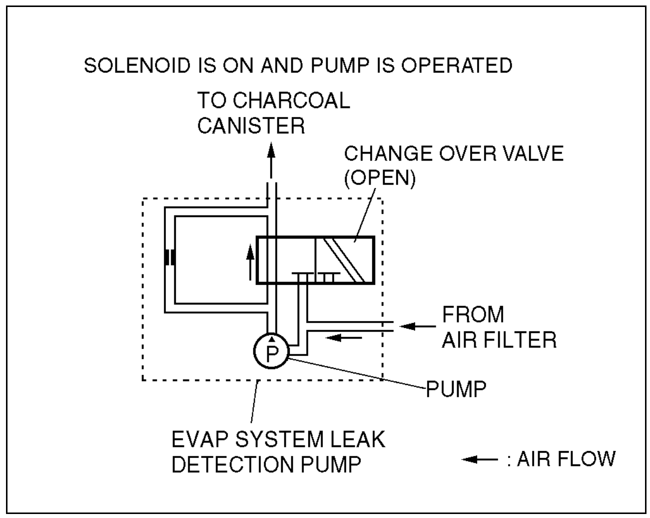
- Air is sent from the pump to the orifice.

Small leak and very small leak determination



B6U0116S018

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



B6U0116S029

AIR FILTER DESCRIPTION

CHU011613988S03

Function

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

Structure

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

01–17 CHARGING SYSTEM

CHARGING SYSTEM OUTLINE

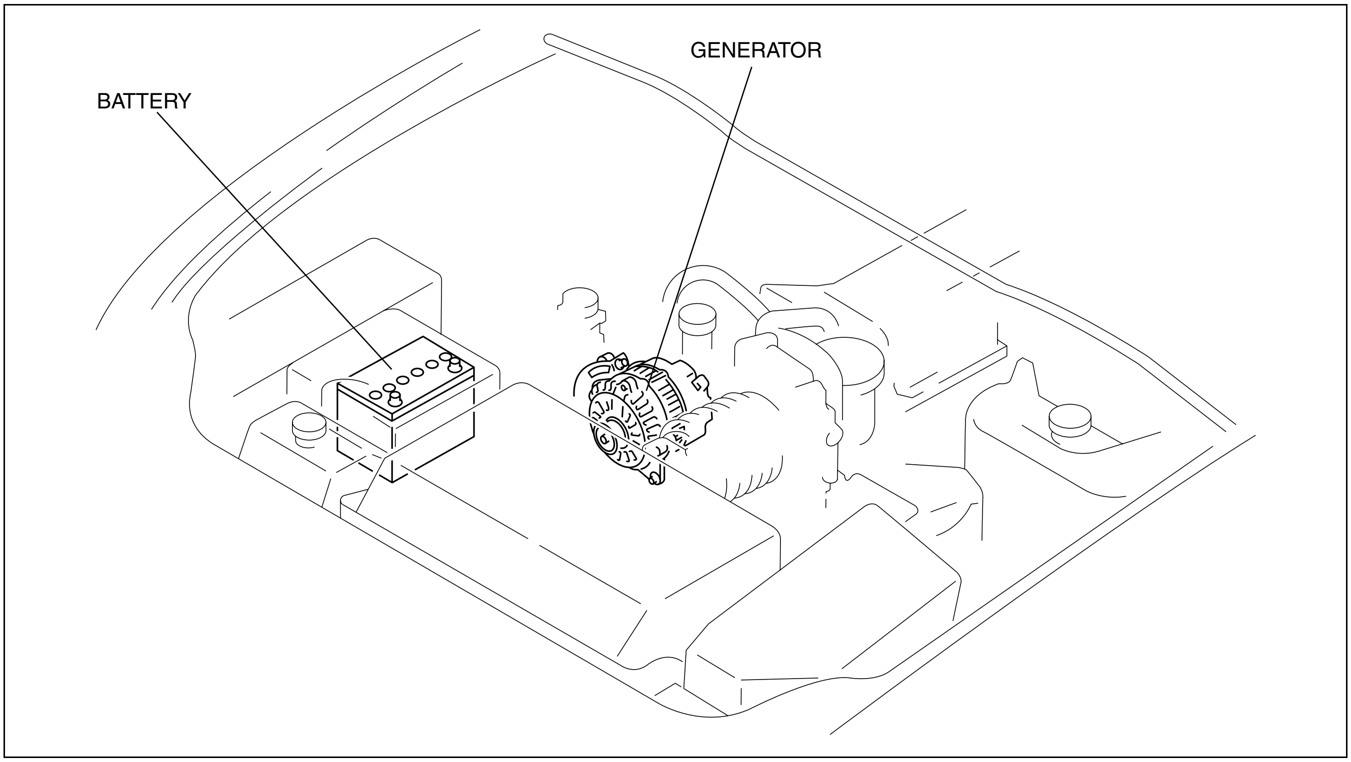
CHU011701008S01

Features

Improved reliability	• A battery duct adopted
Miniaturization	• A regulatorless generator with built-in power transistor adopted

CHARGING SYSTEM STRUCTURAL VIEW

CHU011701008S02

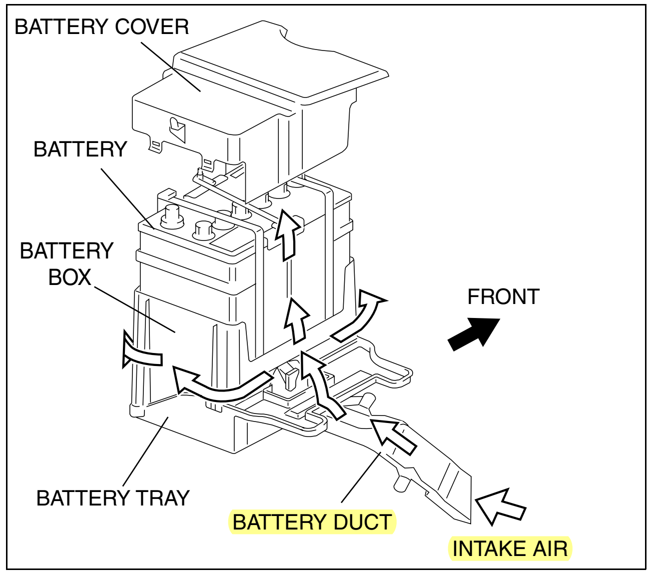


CHU0117S001

BATTERY CONSTRUCTION

CHU011701008S03

- Air that passes through the battery duct when the vehicle is moving is used to cool the battery, improving reliability.

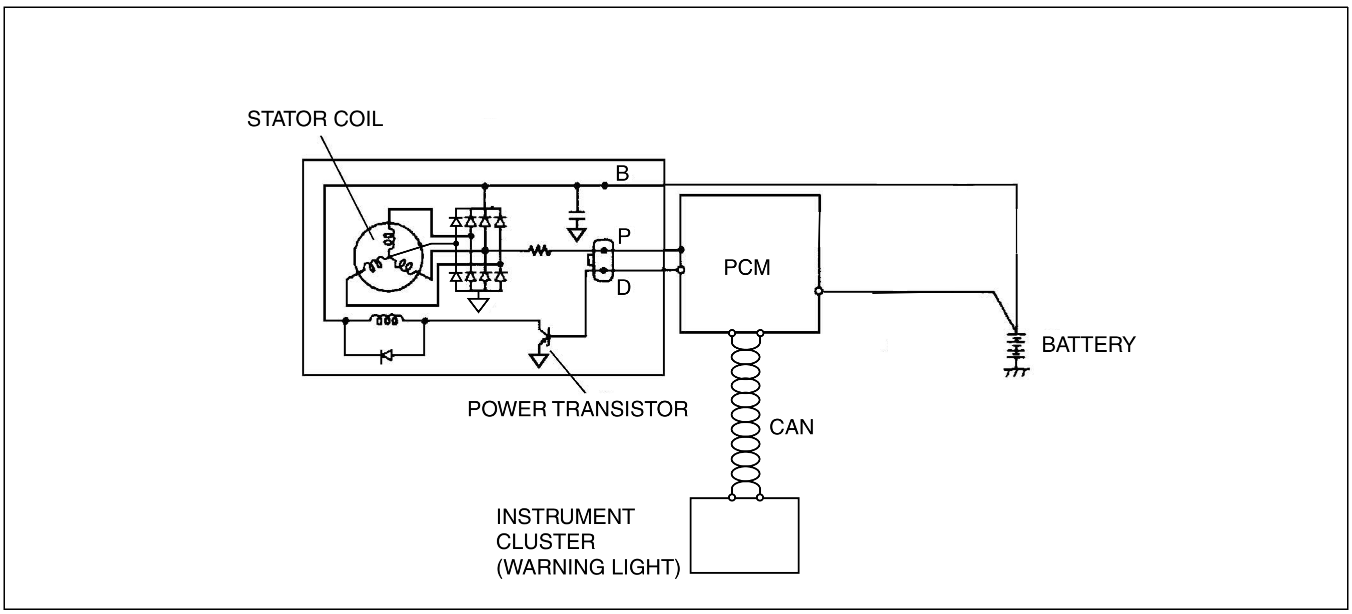


CHU0117S002

GENERATOR CONSTRUCTION

CHU011701008S04

- The voltage regulator has been eliminated, and generator control is carried out by the PCM.



CHU0117S003

01–18 IGNITION SYSTEM

IGNITION SYSTEM OUTLINE

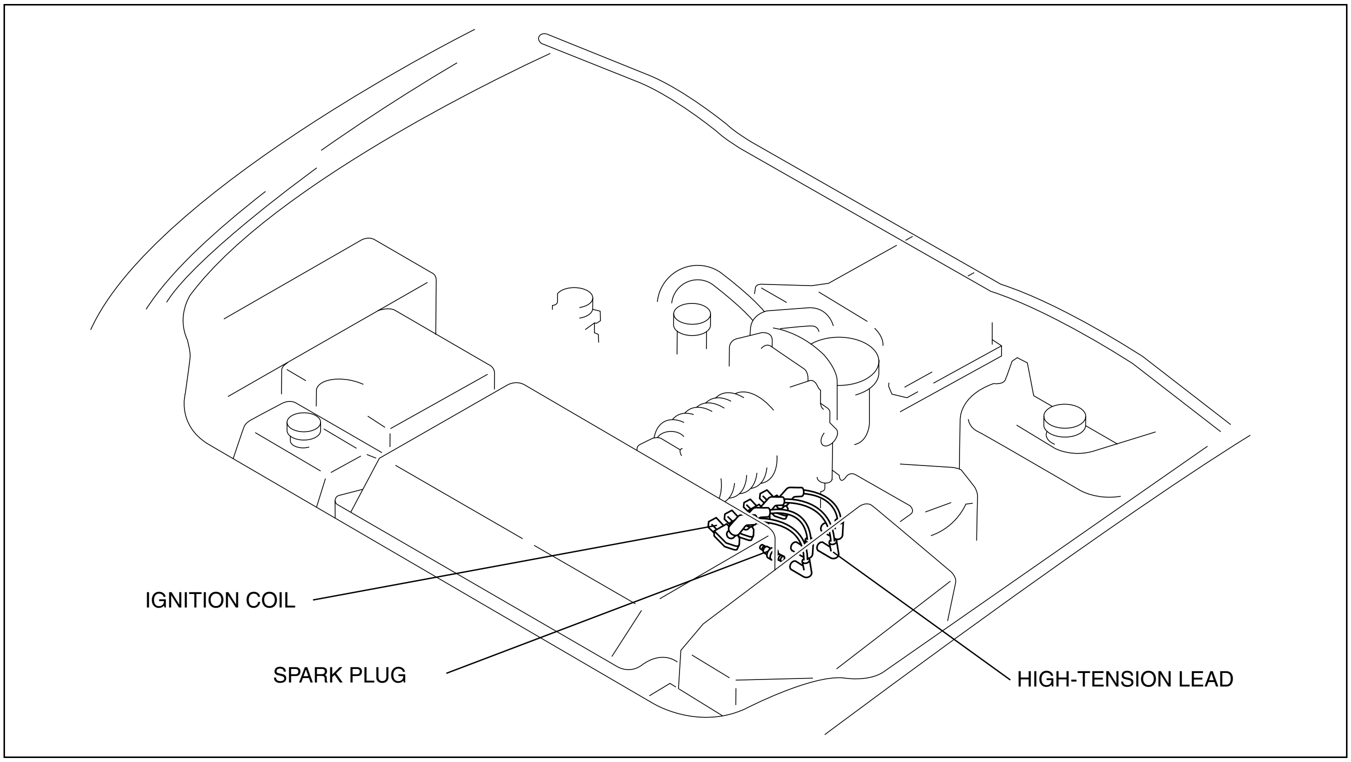
CHU011801008S01

Features

Improved reliability	• An independent ignition control system with distributorless ignition coil adopted
Improved durability	• A spark plug with an iridium tip adopted

IGNITION SYSTEM STRUCTURAL VIEW

CHU011801008S02



CHU0118S001

IGNITION COIL CONSTRUCTION/OPERATION

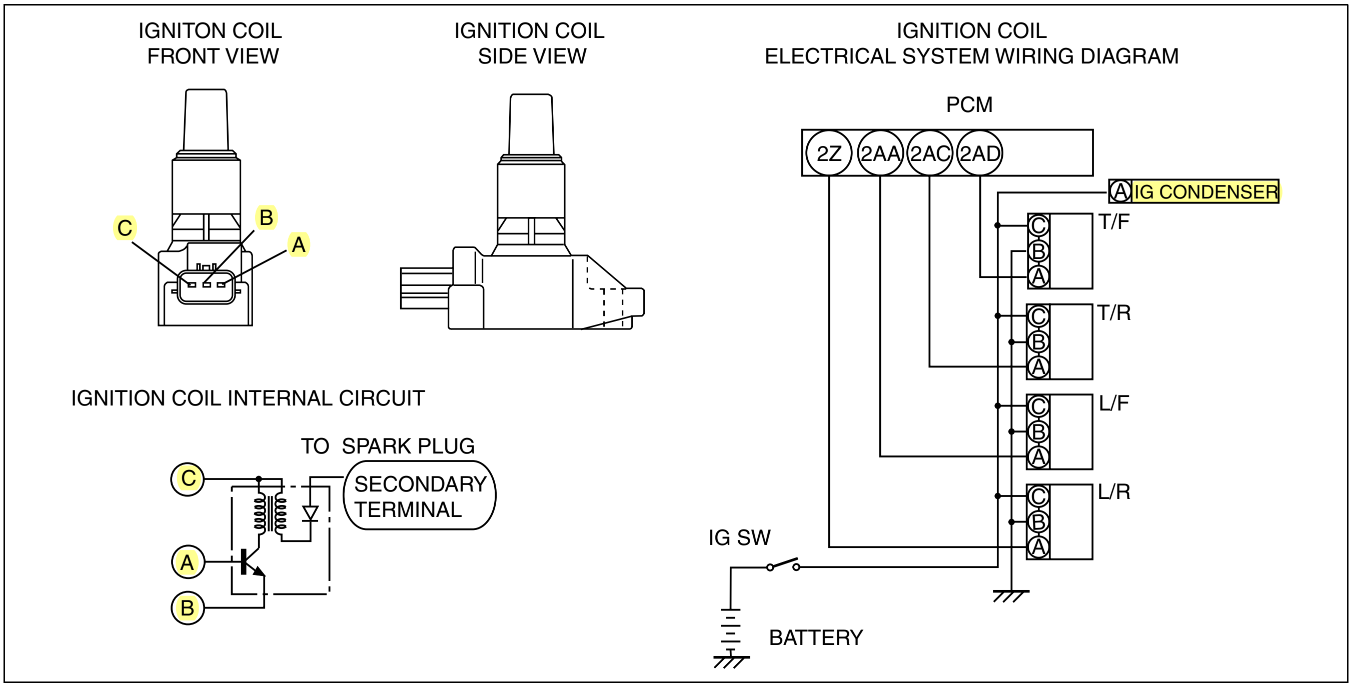
CHU011801008S03

Construction

- Distributorless ignition coils have been adopted, and two ignition coils are installed each on both the trailing and leading sides. By adopting the distributorless ignition coil, the distributor has been eliminated in order to simplify the parts of the ignition system, and also to prevent voltage reduction occurring between the parts improving firing efficiency.
- Independent firing control has been adopted to eliminate firing without spark, increasing firing energy.

Operation

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



CHU0118S004

Terminal layout

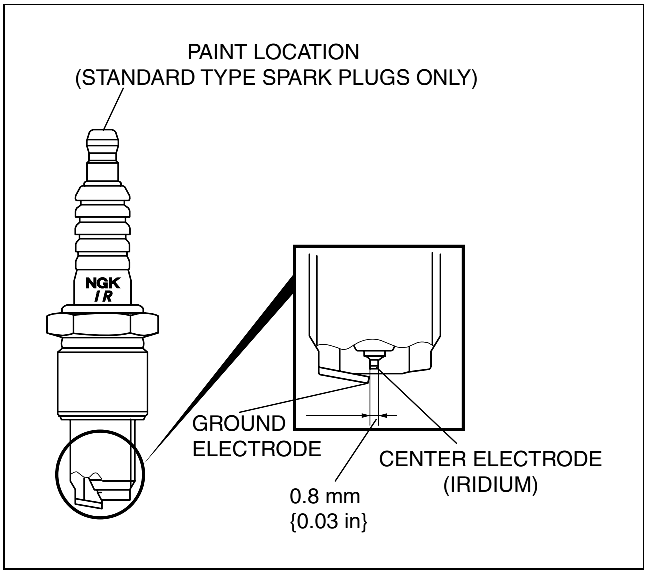
Terminal		Signal
3 terminals	A	Ignition coil control signal
	B	Ground
	C	Ignition coil power supply

01–18

SPARK PLUG CONSTRUCTION

CHU011801008S04

- Iridium-tipped spark plugs have been adopted on both trailing and leading sides to improve durability.
- A center electrode with a thick insulator and extremely thin tip (diameter of 0.8 mm {0.03 in}) and small single-ground electrode have been adopted to stabilize firing under a thin fuel-air mixture. At the same time, high-heat resistance has been improved by decreasing the temperature of the electrode and the insulator.
- Spark plugs with an internal resister have been adopted to remove noise caused by the ignition system. The effect of which prevents ignition noise from mixing with the audio system.
- White paint (leading side), blue paint (trailing side) is on the the spark plugs to prevent mis-installation. (Standard type spark plugs only.)



CHU0118S005

Specification

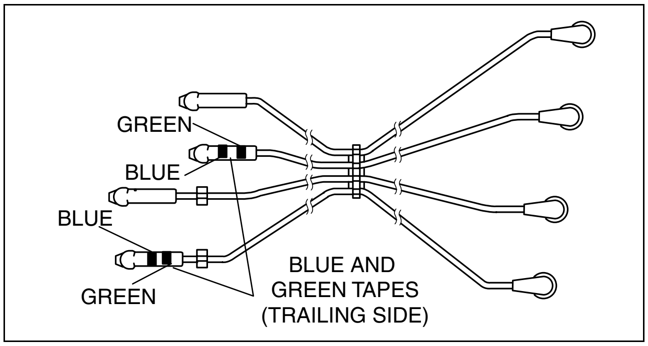
Item			Specification
Type	NGK	Leading side	RE7A-L*1 (RE6A-L)*2
		Trailing side	RE9B-T*1

*1 : Standard equipment
*2 : Hot type plug: Available only for customers who often drive their car at very low speed which causes the plugs to foul easily.

HIGH-TENSION LEAD CONSTRUCTION

CHU011801008S05

- Blue and green tapes are on the trailing side of the plug caps to prevent mis-installation.



CHU0118S006

01–19 STARTING SYSTEM

STARTING SYSTEM OUTLINE

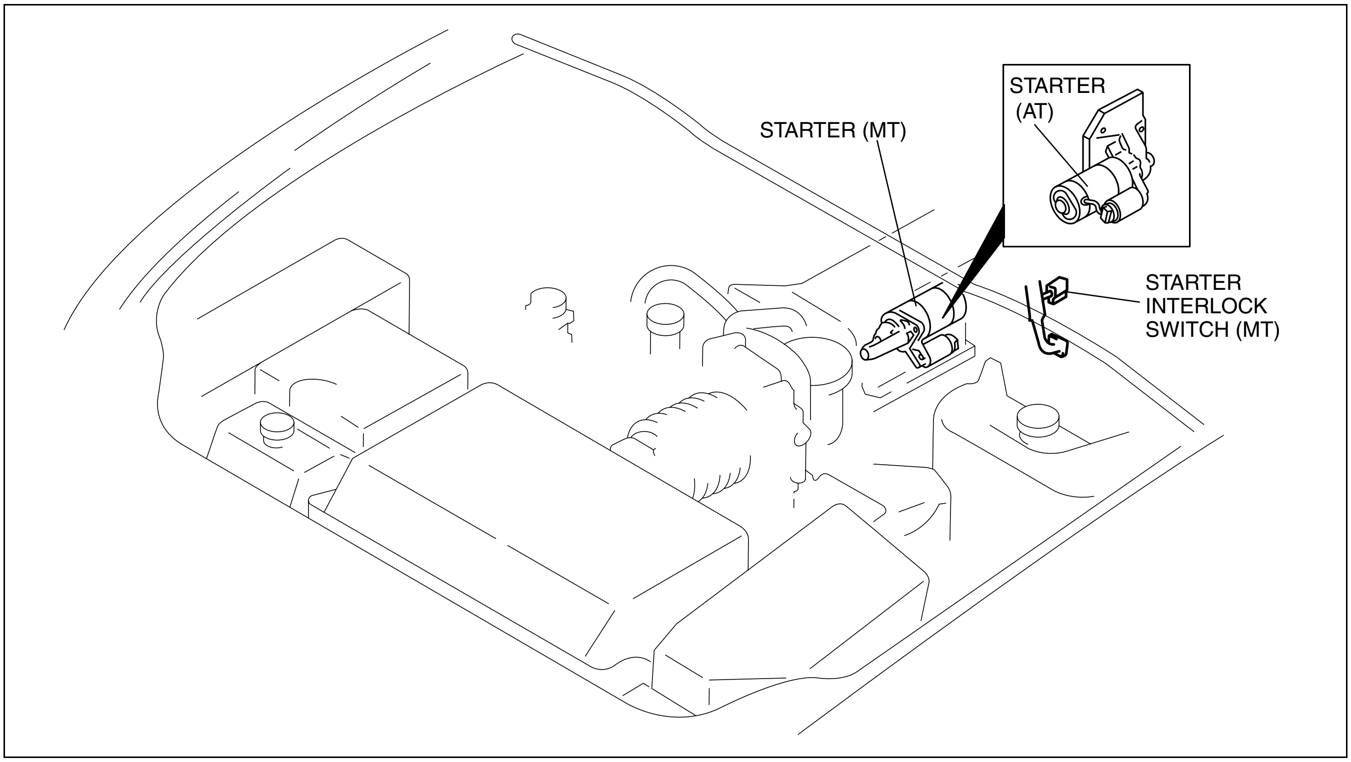
CHU011901008S01

Features

Improved startability	• A reduction type starter adopted
Improved safety	• A starter interlock switch adopted (MT)

STARTING SYSTEM STRUCTURAL VIEW

CHU011901008S02

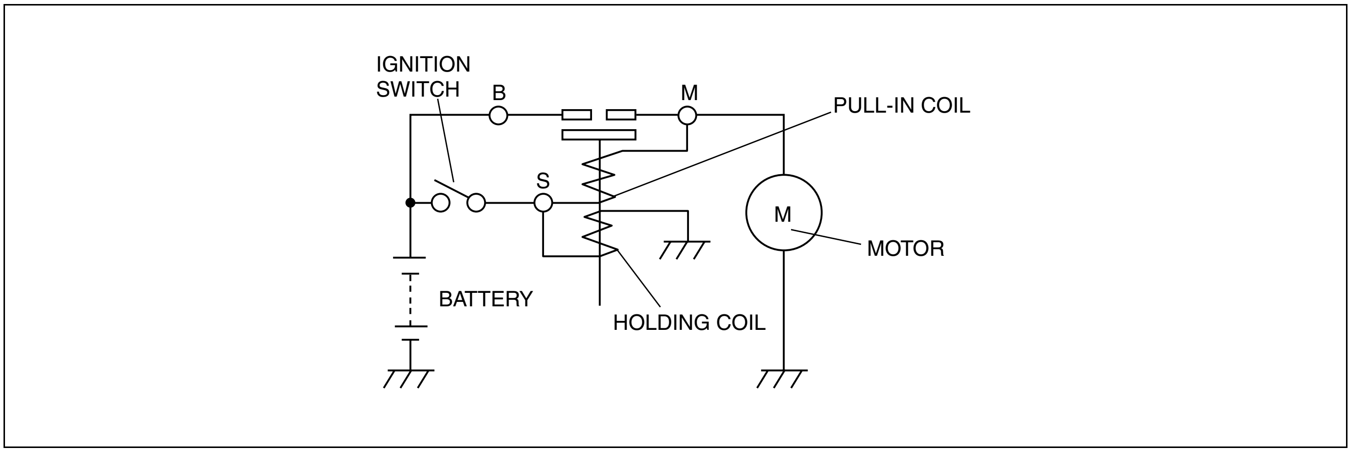


CHU0119S001

STARTER CONSTRUCTION

CHU011918400S01

- High torque coaxial reduction type starter has been adopted.



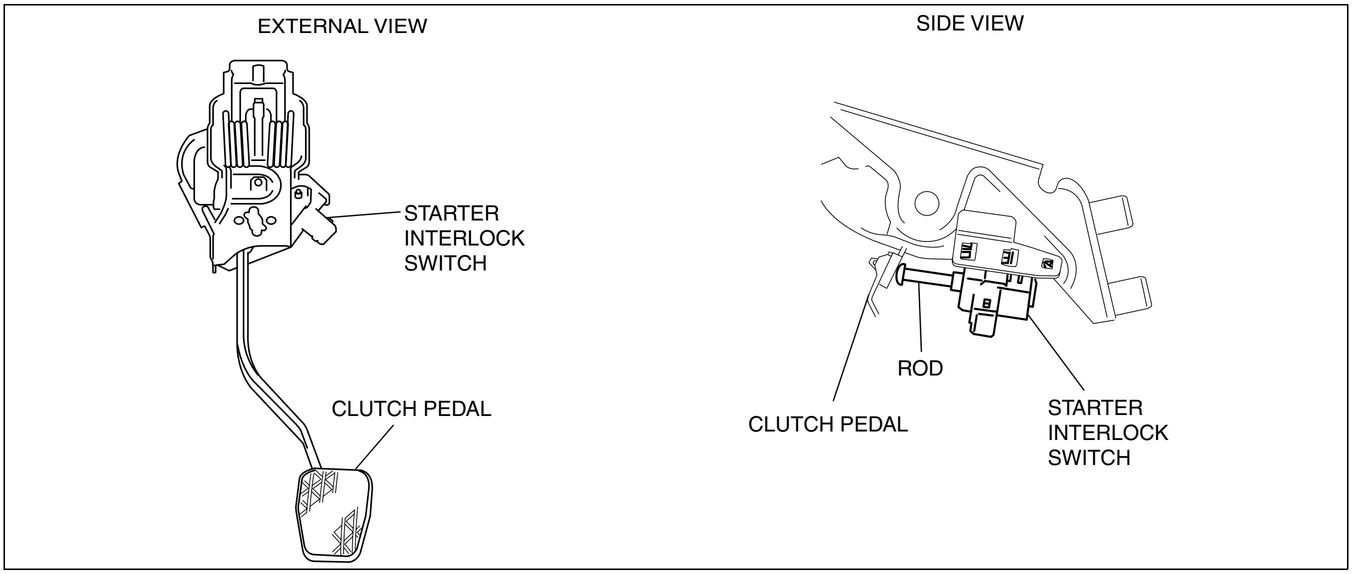
CHU0119S002

STARTER INTERLOCK SWITCH (MT) CONSTRUCTION/OPERATION

CHU011918400S02

Construction

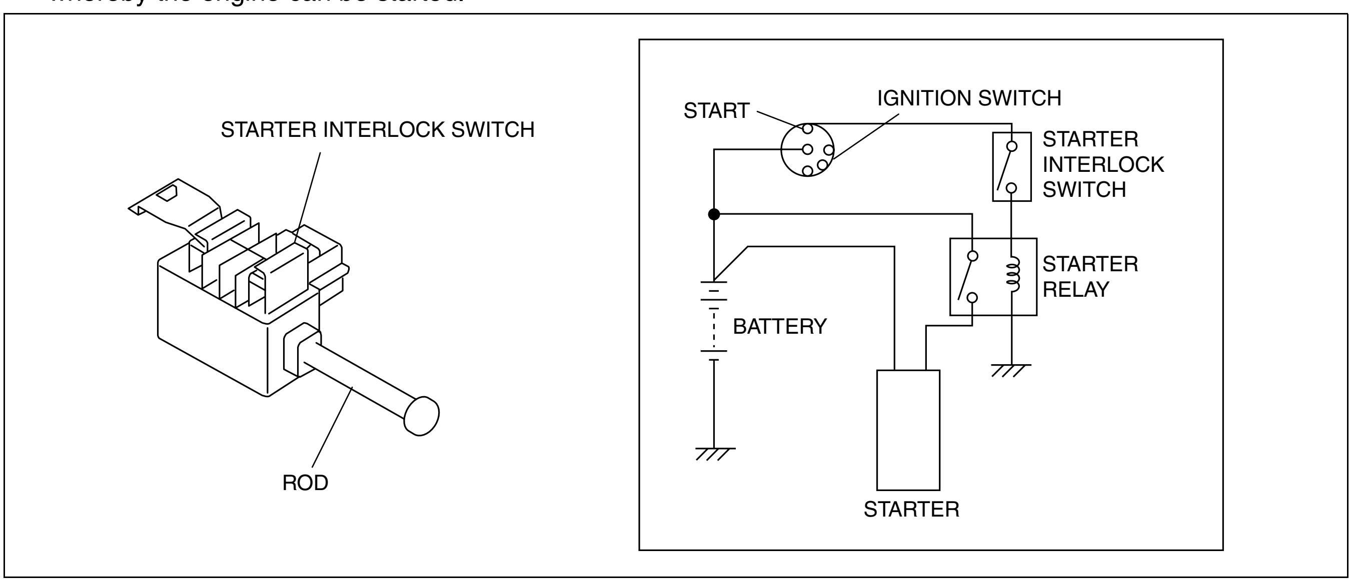
- The starter interlock switch mechanism prevents vehicle surge when the engine is started, enhancing the safety. The engine cannot be started unless the clutch is depressed.
- The mechanism is provided with a starter interlock switch on the circuit between the ignition switch and the starter.



CHU0119S003

Operation

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



CHU0119S004

01–20 CRUISE CONTROL SYSTEM

CRUISE CONTROL SYSTEM OUTLINE

CHU012001011S01

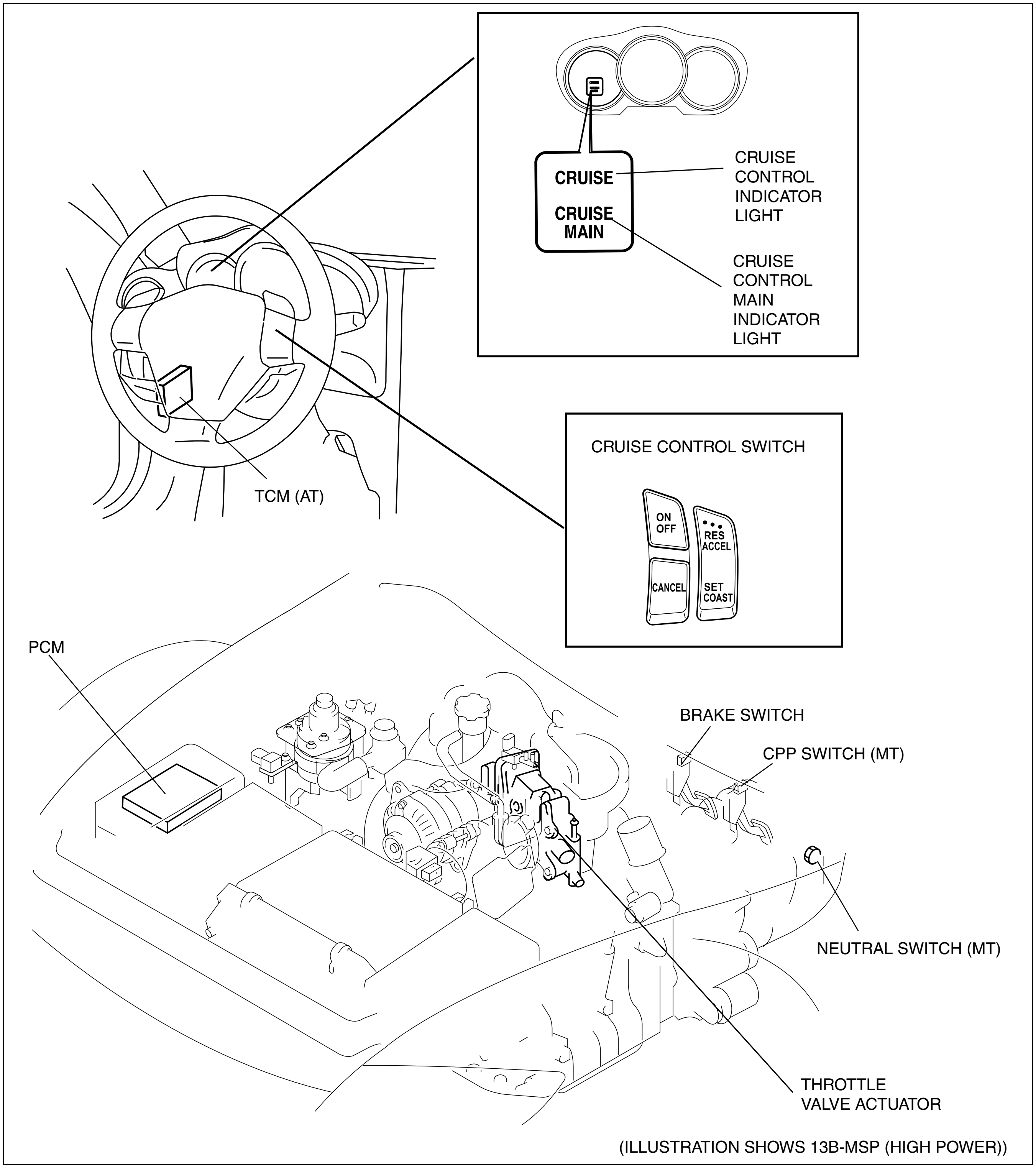
- The cruise control system enables driving at a constant speed by setting vehicle speed with the cruise control switch instead of operating the AP.
- The PCM controls the throttle valve actuator to maintain the vehicle at a constant speed.
- For the control of the cruise control system, refer to the drive-by wire control. (See 01–40–12 DRIVE-BY-WIRE CONTROL OPERATION.)

Component and function

<table>
<tr><th colspan="2">Component</th><th colspan="2">Function</th><th>Installation location</th></tr>
<tr><td colspan="2">• ABS HU/CM (CAN communication: Vehicle speed signal)
• DSC HU/CM (CAN communication: Vehicle speed signal)</td><td colspan="2">The vehicle speed signal is sent to the PCM from either the ABS HU/CM or the DSC HU/CM.</td><td>Engine compartment</td></tr>
<tr><td rowspan="6">Cruise control switch</td><td>ON/OFF</td><td>ON/OFF</td><td>This is the main switch of the cruise control system. Turning the ON/OFF switch to on switches the cruise control system to standby status.</td><td rowspan="6">Steering wheel</td></tr>
<tr><td rowspan="2">SET/COAST</td><td>SET</td><td>When the vehicle speed exceeds 27 km/h {16.7 mph} during normal driving (cruise control system is in standby status) and the SET/COAST switch is released after it is pressed, the PCM stores the vehicle speed at the time of the switch is released and the cruise control begins.</td></tr>
<tr><td>COAST</td><td>Tapping the SET/COAST switch (tap-down operation) or continuously pressing it during cruise control decreases the set vehicle speed.</td></tr>
<tr><td rowspan="2">RES/ACCEL</td><td>RES</td><td>If the RES/ACCEL switch is pressed while the cruise control is in standby status (PCM has stored a set vehicle speed) and the vehicle speed exceeds 27 km/h {16.7 mph} during normal driving, the cruise control system activates to control the vehicle speed to the set vehicle speed.</td></tr>
<tr><td>ACCEL</td><td>Tapping the RES/ACCEL switch (tap-up operation) or continuously pressing it during cruise control increases the set vehicle speed.</td></tr>
<tr><td>CANCEL</td><td>CANCEL</td><td>Pressing the CANCEL switch during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).</td></tr>
<tr><td colspan="2">Brake switch</td><td colspan="2">Depressing the brake pedal during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).</td><td>Brake pedal</td></tr>
<tr><td colspan="2">CPP switch (MT)</td><td colspan="2">Depressing the clutch pedal during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).</td><td>Clutch pedal</td></tr>
<tr><td colspan="2">Neutral switch (MT)</td><td colspan="2">Shifting to neutral during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).</td><td>Manual transmission</td></tr>
<tr><td colspan="2">TCM (AT) (CAN communication: Neutral signal)</td><td colspan="2">Changing the selector lever from the D range to the N position during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).</td><td>Automatic transmission</td></tr>
<tr><td colspan="2">PCM</td><td colspan="2">• The cruise control system activates or stops based on the cruise control switch ON/OFF signal.
• The cruise control duty signal, which is based on each input signal, is sent to the throttle valve actuator.</td><td>Engine compartment</td></tr>
<tr><td colspan="2">Throttle valve actuator</td><td colspan="2">The duty signal sent from the PCM adjusts the throttle valve opening angle.</td><td>Throttle body</td></tr>
<tr><td colspan="2">Cruise control main indicator light</td><td colspan="2">This illuminates while the cruise control system is in standby or control status.</td><td rowspan="2">Instrument cluster</td></tr>
<tr><td colspan="2">Cruise control indicator light</td><td colspan="2">This illuminates while the cruise control system is in control status.</td></tr>
</table>

CRUISE CONTROL SYSTEM STRUCTURAL VIEW

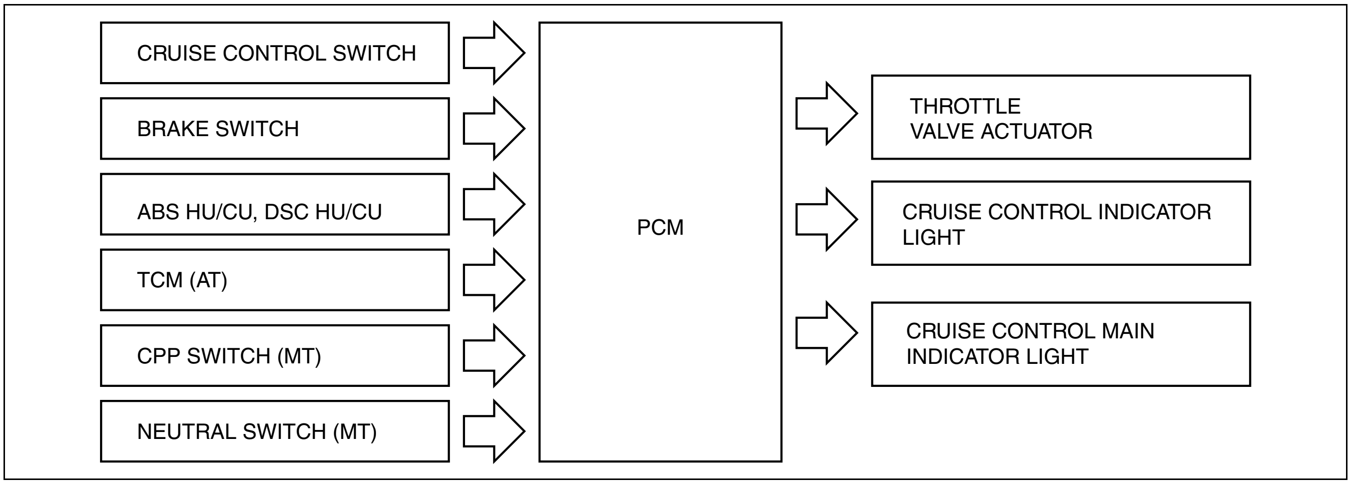
CHU012001011S02



CHU0120S001

CRUISE CONTROL SYSTEM BLOCK DIAGRAM

CHU012001011S03



CHU0120S002

01–40 CONTROL SYSTEM

ENGINE CONTROL SYSTEM OUTLINE

CHU014000140S01

Features

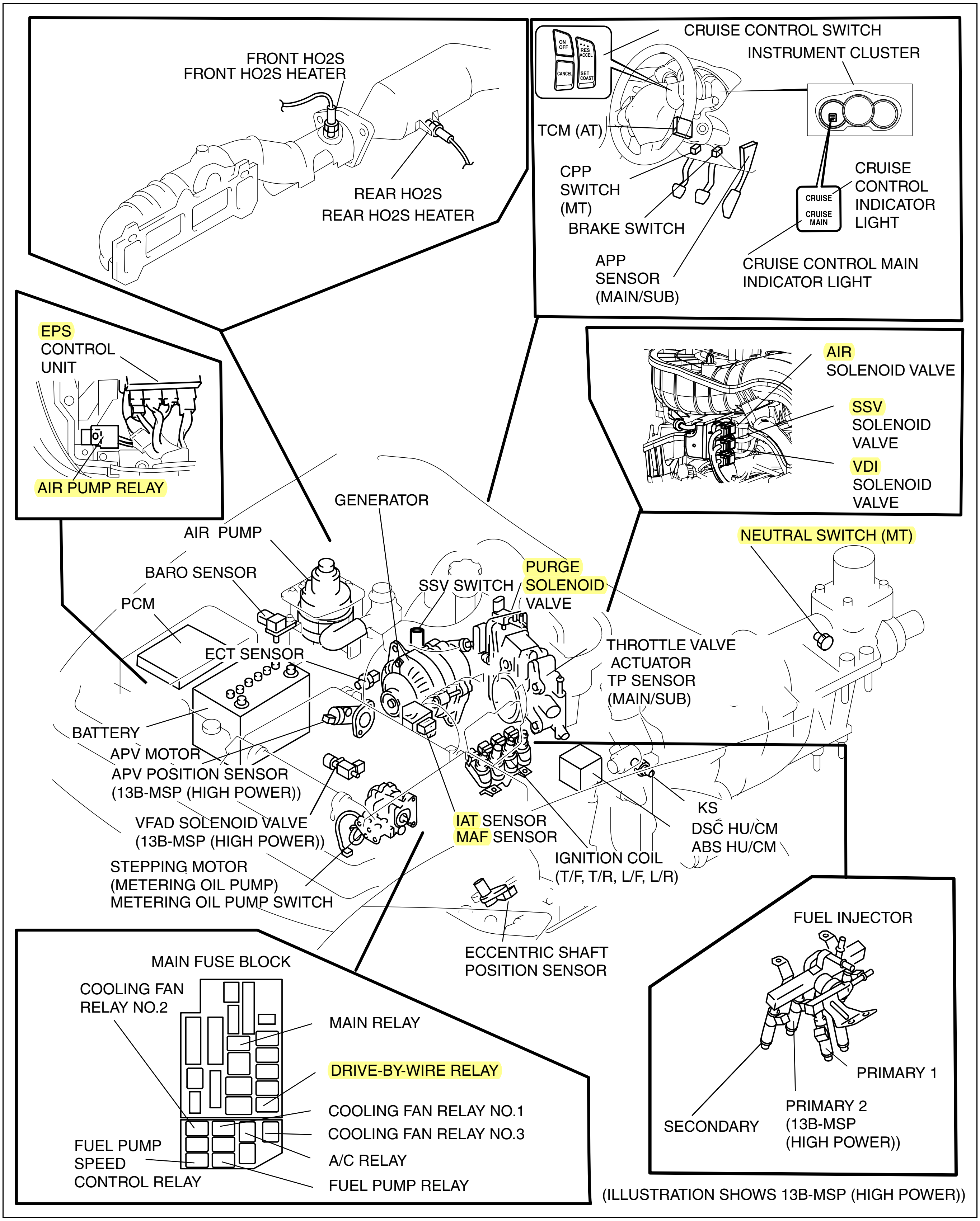
Improved driveability	• Drive-by-wire control adopted
Improved engine torque and output	• Sequential dynamic air intake system (S-DAIS) adopted
Wiring harness simplification	• Controller area network (CAN) adopted

Specification

Item	Specification
Neutral switch (MT)	ON/OFF
CPP switch (MT)	ON/OFF
SSV switch	ON/OFF
APV position sensor (13B-MSP (High Power))	Hall element
ECT sensor	Thermistor
IAT sensor (Inside MAF)	Thermistor
TP sensor	Hall element
APP sensor	Hall element
MAF sensor	Hot-wire
Front HO2S	Zirconia element (Wide-range air/fuel ratio sensor)
Rear HO2S	Zirconia element (Stoichiometric air/fuel ratio sensor)
BARO sensor	Piezoelectric element
KS	Piezoelectric element
Eccentric shaft position sensor	Magnetic pickup
Metering oil pump switch	ON/OFF
Brake switch	ON/OFF
Throttle valve actuator	DC motor
APV motor (13B-MSP (High Power))	DC motor
Fuel injector (primary 1)	Multiple hole type (12 holes)
Fuel injector (secondary)	Multiple hole type (4 holes)
Fuel injector (primary 2) (13B-MSP (High Power))	Multiple hole type (4 holes)
Stepping motor (in metering oil pump)	Stepping motor

ENGINE CONTROL SYSTEM STRUCTURAL VIEW

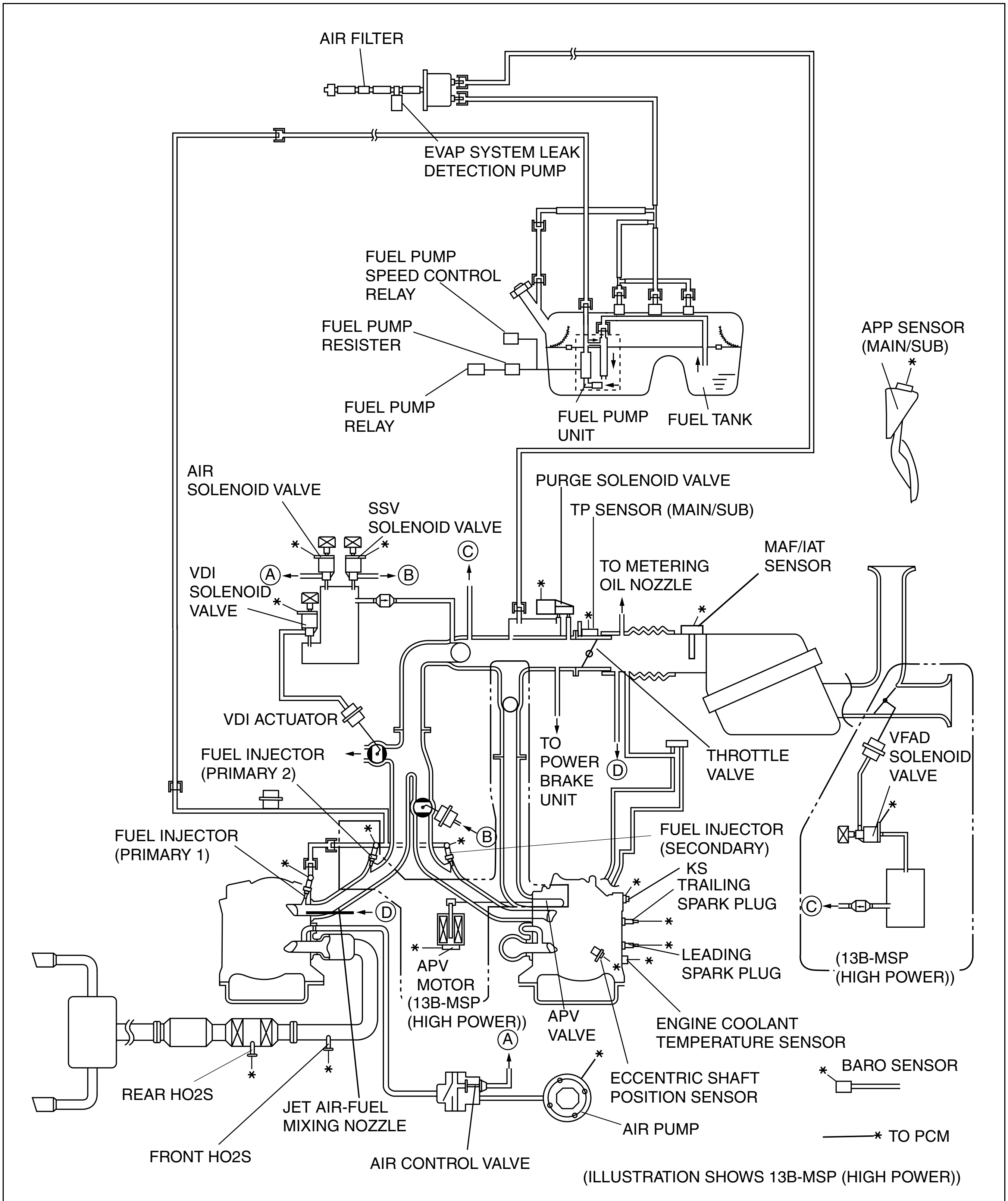
CHU014000140S02



CHU0140S001

ENGINE CONTROL SYSTEM DIAGRAM

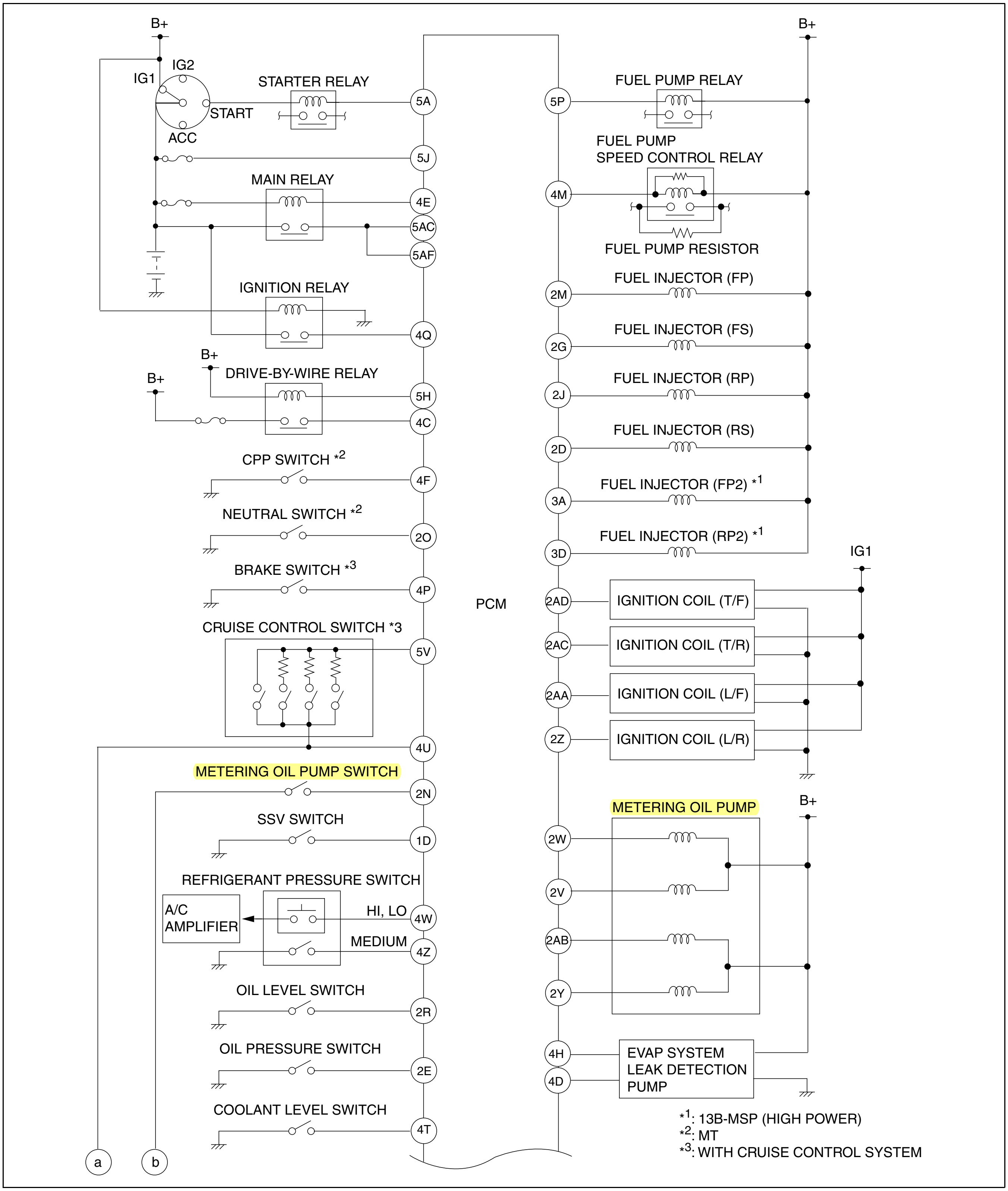
CHU014000140S03



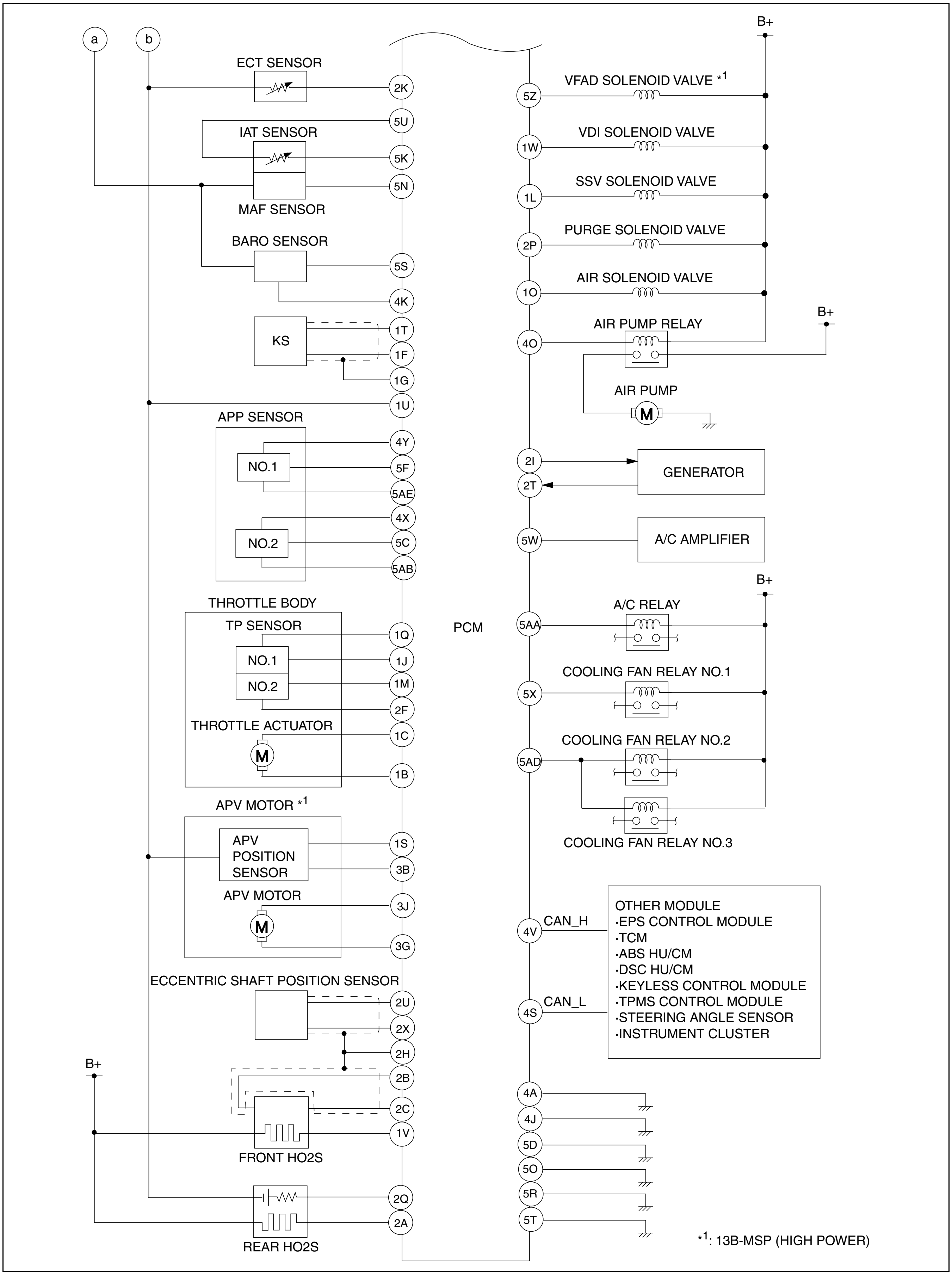
CHU0140S002

ENGINE CONTROL SYSTEM WIRING DIAGRAM

CHU014000140S04



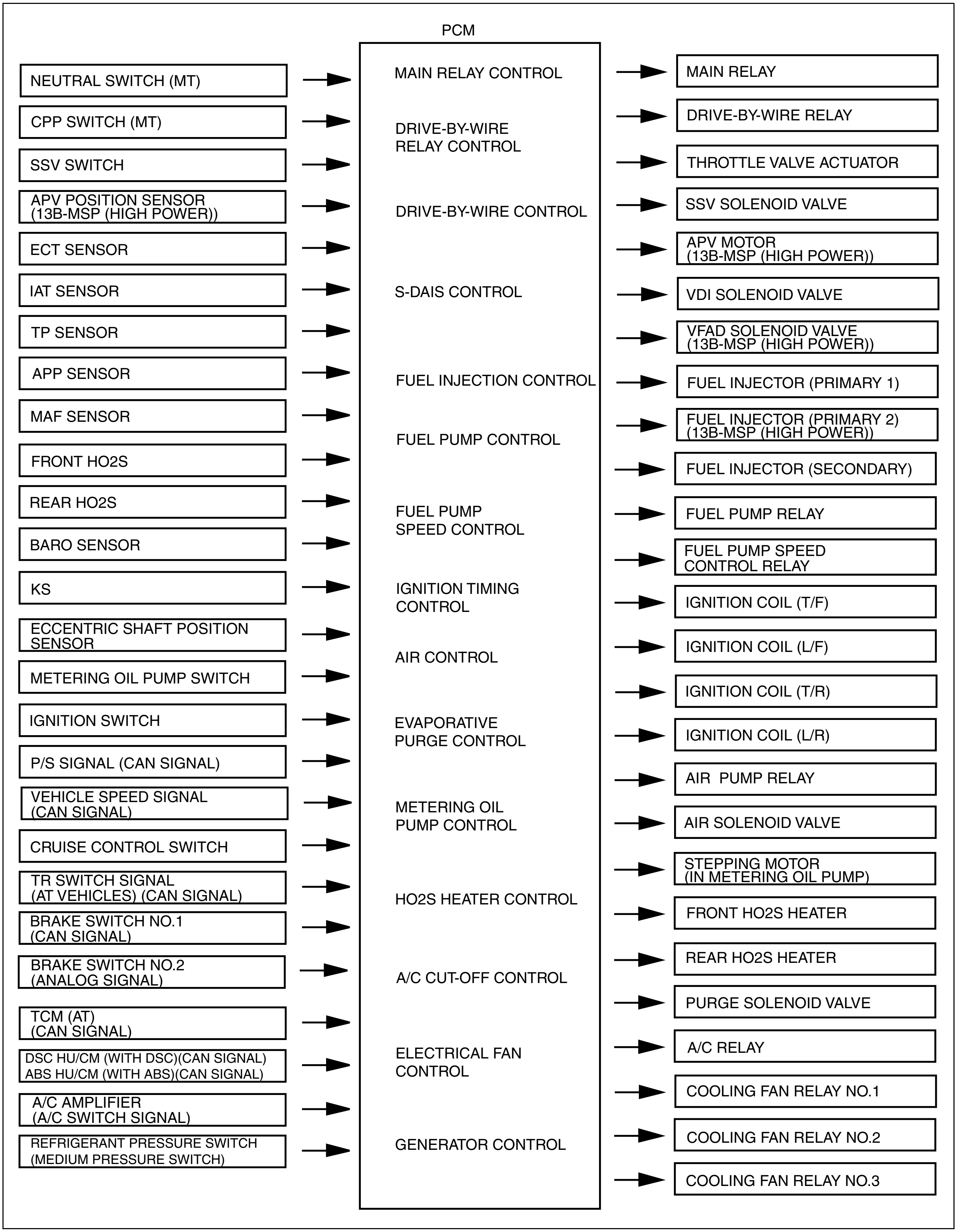
CHU0140S085



CHU0140S086

ENGINE CONTROL SYSTEM BLOCK DIAGRAM

CHU014000140S05



CHU0140S005

ENGINE CONTROL SYSTEM RELATION CHART

CHU014000140S06

- Each control system and their related input and output parts are as follows.

x: Applied

ITEM	MAIN RELAY CONTROL	DRIVE-BY-WIRE RELAY CONTROL	DRIVE-BY-WIRE CONTROL	S-DAIS CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	FUEL PUMP SPEED CONTROL	ELECTRIC SPARK ADVANCE CONTROL	AIR CONTROL	EVAPORATIVE PURGE CONTROL	METERING OIL PUMP CONTROL	HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	ELECTRICAL FAN CONTROL	GENERATOR CONTROL	CONTROLLER AREA NETWORK
INPUT																
NEUTRAL SWITCH (MT)			X					X								
CPP SWITCH (MT)			X					X								
SSV SWITCH					X		X									
ECT SENSOR			X	X	X		X	X	X	X	X	X	X	X	X	
IAT SENSOR			X	X	X		X	X	X	X	X	X		X	X	
TP SENSOR			X	X	X		X	X					X			
APP SENSOR			X		X			X					X			
MAF SENSOR			X	X	X		X	X				X				
FRONT HO2S					X		X									
REAR HO2S					X		X									
BARO SENSOR				X	X		X			X	X	X				
KS					X			X								
ECCENTRIC SHAFT POSITION SENSOR			X	X	X	X	X	X		X	X	X			X	
METERING OIL PUMP SWITCH											X					
BATTERY POSITIVE VOLTAGE					X		X					X			X	
IGNITION SWITCH	X	X	X		X	X					X	X		X		
P/S SIGNAL (CAN SIGNAL)			X													X
VEHICLE SPEED SIGNAL (CAN SIGNAL)			X		X			X					X		X	X
CRUISE CONTROL SWITCH			X													
TR SWITCH (CAN SIGNAL)			X	X												X
BRAKE SWITCH NO.1 (CAN SIGNAL)			X												X	X
BRAKE SWITCH NO.2 (ANALOG SIGNAL)			X													
TCM (AT) (CAN SIGNAL)			X		X			X							X	X
DSC HU/CM (CAN SIGNAL)			X		X			X								X
A/C AMPLIFIER (A/C SWITCH)					X			X						X	X	
REFRIGERANT PRESSURE SWITCH (MEDIUM PRESSURE SWITCH)			X											X		
GENERATOR (TERMINAL P: STATOR COIL)			X												X	
OUTPUT																
MAIN RELAY	X															
DRIVE-BY-WIRE RELAY		X														
THROTTLE VALVE ACTUATOR			X													
SSV SOLENOID VALVE				X												
APV MOTOR				X												
VDI SOLENOID VALVE				X												
VFAD SOLENOID VALVE				X												
FUEL INJECTOR (PRIMARY 1)					X											
FUEL INJECTOR (SECONDARY)					X											
FUEL INJECTOR (PRIMARY 2)					X											
FUEL PUMP RELAY						X										
FUEL PUMP SPEED CONTROL RELAY							X									
IGNITION COIL (T/F)								X								
IGNITION COIL (L/F)								X								
IGNITION COIL (T/R)								X								
IGNITION COIL (L/R)								X								
AIR PUMP RELAY									X							
AIR SOLENOID VALVE									X							
PURGE SOLENOID VALVE										X						
STEPPING MOTOR (INTEGRATED IN METERING OIL PUMP)											X					
FRONT HO2S HEATER												X				
REAR HO2S HEATER												X				
A/C RELAY													X			
COOLING FAN RELAY NO.1														X		
COOLING FAN RELAY NO.2														X		
COOLING FAN RELAY NO.3														X		
GENERATOR (TERMINAL D: FIELD COIL)															X	

CHU0140S006

MAIN RELAY CONTROL OUTLINE

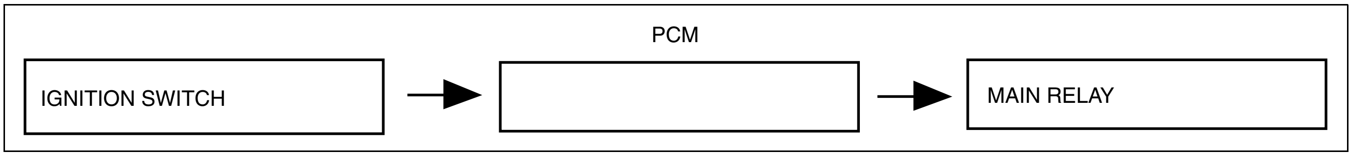
CHU014000140S07

- When the ignition switch is turned to the ON position, the main relay turns on.
- When the ignition switch is turned from on to off, the main relay turns on for a few minutes to activate the fully-closed throttle learning function of the drive-by-wire control, the ignition switch off function of the metering oil pump control, the after-cleaning function of the electrical fan control, and EVAP system leak detection function of the EVAP control system.

MAIN RELAY CONTROL BLOCK DIAGRAM

CHU014000140S08

- The PCM controls the main relay on/off, based on commands from the ignition switch or the controls.



CHU0140S007

MAIN RELAY CONTROL OPERATION

CHU014000140S09

- When the ignition switch is turned to the ON position, the main relay turns on and power is supplied to sensors and devices.
- When the ignition switch is turned from on to off, a main relay on command signal is received the main relay turns on and the following actions take place:
  1. Throttle valve control: Fully closed throttle learning function (See 01–40–12 DRIVE-BY-WIRE CONTROL OPERATION.)
  2. Ignition switch off function of the metering oil pump control (See 01–40–32 METERING OIL PUMP CONTROL OPERATION.)
  3. After-cooling function of the electrical fan control (See 01–40–37 ELECTRICAL FAN CONTROL OPERATION.)
  4. EVAP system leak detection function of the EVAP control system (See 01–16–7 EVAPORATIVE EMISSIONS (EVAP) CONTROL SYSTEM OUTLINE.)
- When the on request signal from the controls stop, the main relay turns off.

DRIVE-BY-WIRE CONTROL OUTLINE

CHU014000140S10

- 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.
- The drive-by-wire control includes idle speed control, accelerator control, traction control, cruise control, and vehicle speed limiter.

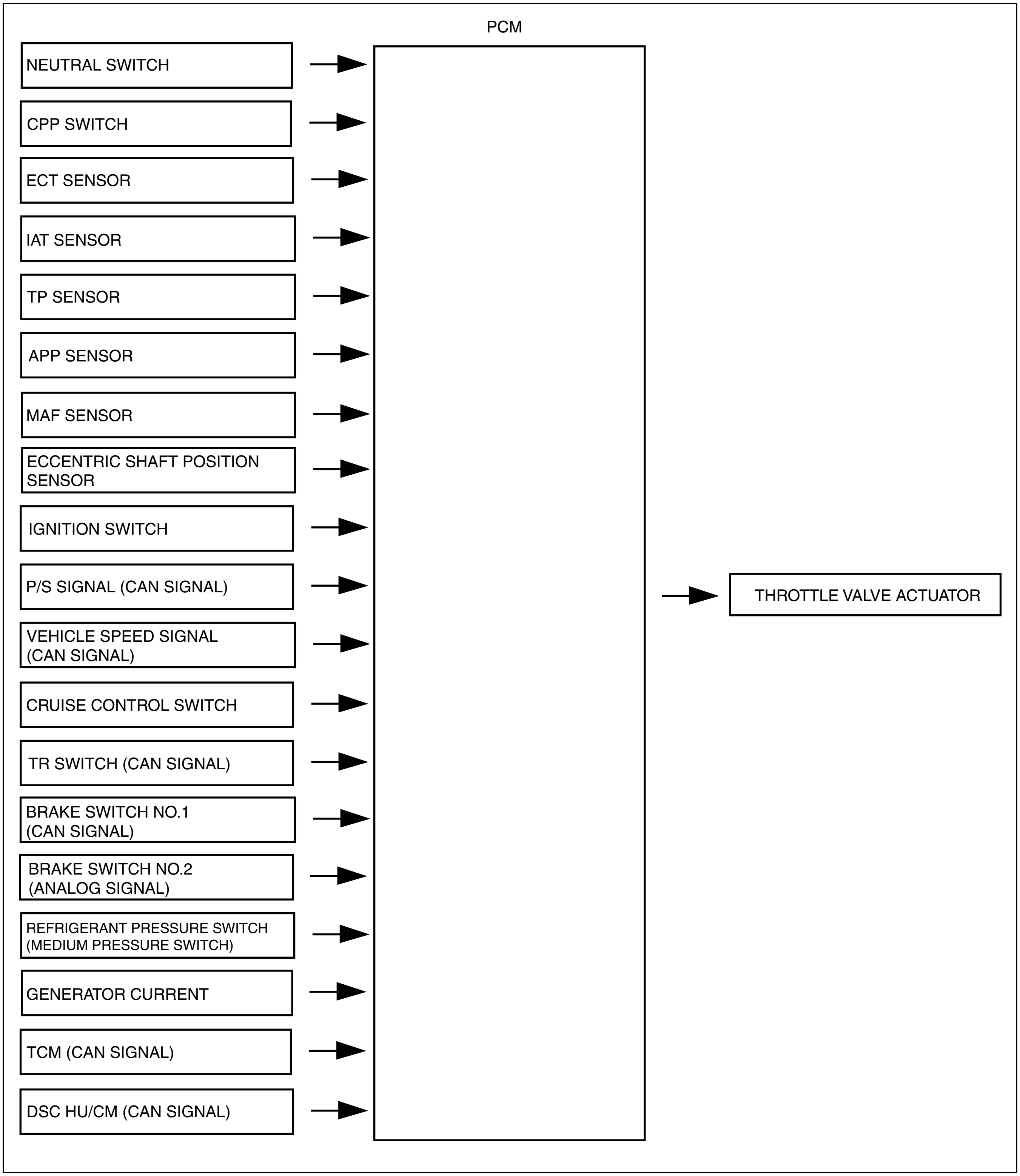
Control List

Control name	Control Outline
Idle speed control	• Controls the throttle valve opening angle during idling so that the idle speed is at the target idle speed.
Accelerator control	• Controls the throttle valve opening angle according to the amount of AP depression. Has a fully-closed throttle learning function for consistent setting of the optimum throttle opening angle according to changes due to age deterioration.
Traction control	• Controls the throttle valve opening angle by torque up/down request signals from the DSC HU/CM and TCM (AT).
Cruise control	• Sets the vehicle speed by operation of the cruise control switch and controls the throttle valve opening angle so that it becomes close to the set vehicle speed.
Vehicle speed limiter (AT)	• Controls the throttle valve opening angle to lower the vehicle speed when it exceeds 200 km/h {124.3 mph}.

DRIVE-BY-WIRE CONTROL BLOCK DIAGRAM

CHU014000140S11

- The PCM calculates a throttle valve opening angle matching the engine operation conditions from the following input signals and sends a duty signal to the throttle valve actuator.



CHU0140S008

DRIVE-BY-WIRE CONTROL OPERATION

CHU014000140S12

Idle Speed Control

- Controls the throttle valve opening angle so that it is close to the target idle speed calculated by the PCM.
- The PCM calculates the target throttle opening angle by adding each type of correction to the basic duty value which is the basis of the throttle valve opening angle, and then sends a duty signal to the throttle valve actuator. The basic duty value is determined by the target engine speed.
- Each type of correction is as follows.

Correction

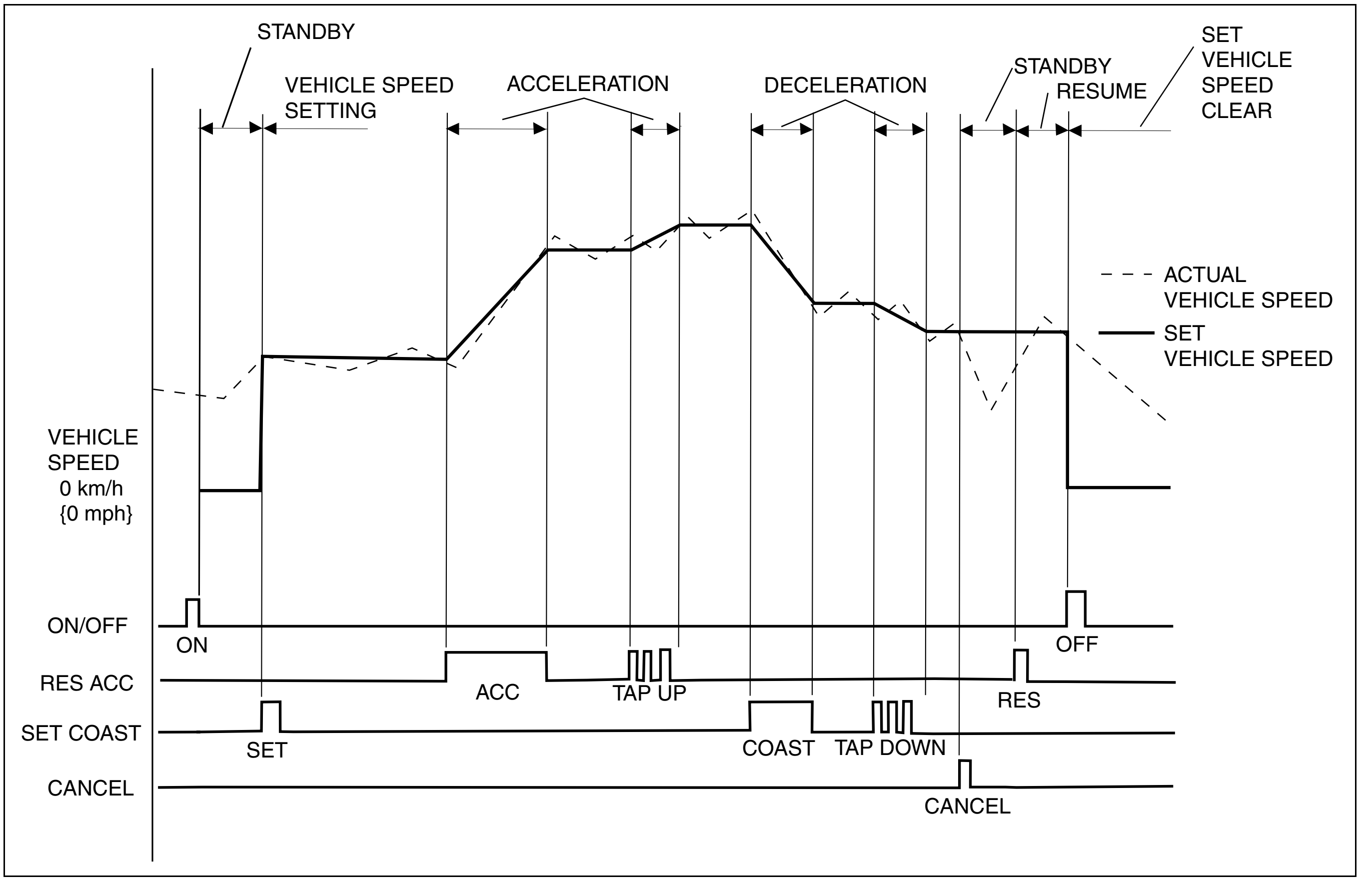
Correction	Purpose	Condition	Amount of Correction
Water temperature correction	Corrects changes in engine friction resistance based on changes in engine temperature.	Determines correction amount based on ECT.	Correction amount decreases as ECT increases.
Correction at engine start	Prevents idle speed dropping off after engine start.	Directly after cranking and engine-start.	Correction amount increases as ECT decreases.
Feedback correction	Performs feedback control so that idle speed is close to the target idle speed.	• Executes feedback conditions when all of the following conditions are met: — Vehicle stopped — AP fully closed	• Correction amount decreases when the idle speed is higher than the target idle speed. • Correction amount increases when the idle speed is lower than the target idle speed.
Learning correction	Corrects air flow amount changes from changes in the engine due to aged deterioration such as engine friction resistance and air leakage from the throttle valve.	Determined by the amount of feedback correction when external load correction and purge control stop.	Learning correction executed when upper or lower limit of feedback correction exceeds the fixed value.
Purge correction	Increase in air from purge control is subtracted from the target throttle opening angle. Increases throttle valve opening angle to prevent rotation fluctuation from changes in air/fuel ratio when purge concentration is high.	Determined by the purge flow amount and purge concentration when purge control is executed.	• Correction amount decreases as purge flow amount increases. • Correction amount increases as purge flow concentration increases.
Load correction when vehicle accelerates from idle (MT)	Prevents engine speed drop after vehicle accelerates from idle.	At acceleration from idle	The amount of correction increases as the idle speed depression amount increases.
External load correction	• Prevents engine speed drop when the A/C and electrical load are operating. • Prevents engine speed revving when the A/C and electrical load are off.	• When any of the following signals are input: — A/C amplifier (A/C switch) — Refrigerant pressure switch (medium-pressure switch) — Generator current value	Correction amount increases as external load increases.
Fast idle up correction	Rapidly activates the catalytic converter after cold-engine start.	Synchronizes fast idle correction for electric spark control. (See 01–40–28 ELECTRIC SPARK ADVANCE CONTROL OPERATION.)	Correction amount increases as the ignition timing retard for the fast idling correction of the ignition timing control advances.

Accelerator Control

- Controls the throttle valve opening angle through control of the throttle valve actuator, according to the amount of AP depression.
- The PCM controls the throttle valve actuator so that the actual throttle valve opening angle is close to the target throttle valve opening angle.
- The final throttle valve opening angle is determined by the sum of the target throttle opening angle during idling and the target throttle valve opening angle during regular driving.
- The target throttle valve opening angle during regular driving is determined based on the transmission gear position, the amount of AP depression and the engine speed. If the target throttle opening angle is at the fixed value or less during regular driving, the PCM switches to idle speed control.
- The PCM sets the throttle valve to the fully-closed position when the ignition switch is on or off and executes the idle position learning function to learn the throttle valve position. Due to this, changes in the throttle valve opening angle due to age deterioration are corrected.
- When the ignition switch is off, a main relay on request is output and the fully-closed learning function is executed. (See 01–40–10 MAIN RELAY CONTROL OPERATION.)

Traction Control
- The PCM calculates the target throttle valve opening angle by the torque up/down request signal from the DSC HU/CM and TCM and the engine speed.

Cruise Control
- Calculates the throttle valve opening angle based on the deviation of the actual vehicle speed from the set vehicle speed which was set with the cruise control switch and sends a duty signal to the throttle valve actuator.
- The PCM controls the actual vehicle speed so that it is close to the set vehicle speed.



CHU0140S077

- The cruise control includes the cruise control operation condition and the cruise control stop condition.

Cruise control operation condition
- When all of the following conditions are met, execution of the cruise control system is enabled (cruise control standby status).
  — Cruise control main switch: ON
  — Vehicle speed: Exceeds 27 km/h {16.8 mph}

Cruise control stop condition
- When any of the following conditions are met even while in cruise control, the PCM stops the cruise control and clears the set vehicle speed.
  — Ignition switch: OFF
  — Cruise control main switch: OFF
  — Cruise control related DTCs (P0564, P0571) detected
- When any of the following conditions are met even while in cruise control, the PCM stops the cruise control while storing the set vehicle speed.
  — Cancel switch: ON
  — Neutral switch (MT) or CPP switch (MT): ON
  — Inhibitor switch (AT) P/N position switch: ON
  — Vehicle speed: Less than 22.5 km/h {13.9 mph}
  — Brake switch: ON
  — The actual vehicle speed is 15 km/h {9.3 mph} or more lower than the set vehicle speed during cruise control (ascending).
  — Condition where actual vehicle speed is 15 km/h {9.3 mph} or more lower than the set vehicle speed continues for 60 s or more even when the RESUME/ACCEL switch is on.

Cruise control function

- The cruise control includes accelerating, coasting, resume, tap-down, tap-up and downshift functions (AT).

Function List

Function	Contents
Accelerating	• When any of the following conditions are met while driving in cruise control and when the RESUME/ ACCEL switch is continuously pressed, the PCM gradually increases the set vehicle speed. — Except during resume operation — The RESUME/ACCEL switch is on one time or more during resume operation.
Coasting	• When the SET/COAST switch is continuously pressed, the PCM gradually decreases the set vehicle speed.
Resume	• When the RESUME/ACCEL switch signal is input to the PCM during regular driving (cruise control is stopped) and the previously set vehicle speed is stored in the PCM, the PCM sets the set vehicle speed to the previously set vehicle speed and begins control.
Tap down	• When all of the following conditions are met while driving in cruise control, the PCM decreases the set vehicle speed by 1.6 km/h {1 mph} and controls the throttle valve actuator. — During cruise control — RESUME/ACCEL switch off — The RESUME/ACCEL switch switches from off to on — When actual vehicle speed is lower (set vehicle speed –2 km/h {-1.2 mph})
Tap-up	• When all of the following conditions are met, the PCM increases the set vehicle speed by 1.6 km/h {1 mph} and controls the throttle valve actuator so that the vehicle speed is close to the set vehicle speed. — During cruise control — The RESUME/ACCEL switch switches from off to on
Downshift (AT)	• When the following conditions are met, a downshift signal is sent to the TCM via CAN. — RESUME/ACCEL switch on — Target vehicle acceleration is not reached

Vehicle Speed Limiter (AT)

- When the actual vehicle speed exceeds 200 km/h {124.3 mph}, the vehicle speed limiter controls the throttle valve actuator so that vehicle speed is maintained at 200 km/h {124.3 mph} or less. It also reduces shock when the vehicle speed reaches 200 km/h {124.3 mph} and prevents rapid temperature increase of the catalytic converter during high speed.

DRIVE-BY-WIRE RELAY CONTROL OUTLINE

CHU014000140S13

- Supplies power to the drive-by-wire control.

DRIVE-BY-WIRE RELAY CONTROL OPERATION

CHU014000140S14

- When the main relay is on, the drive-by-wire relay also turns on. (See 01–40–10 MAIN RELAY CONTROL OPERATION.)

SEQUENTIAL DYNAMIC AIR INTAKE SYSTEM (S-DAIS) CONTROL OUTLINE

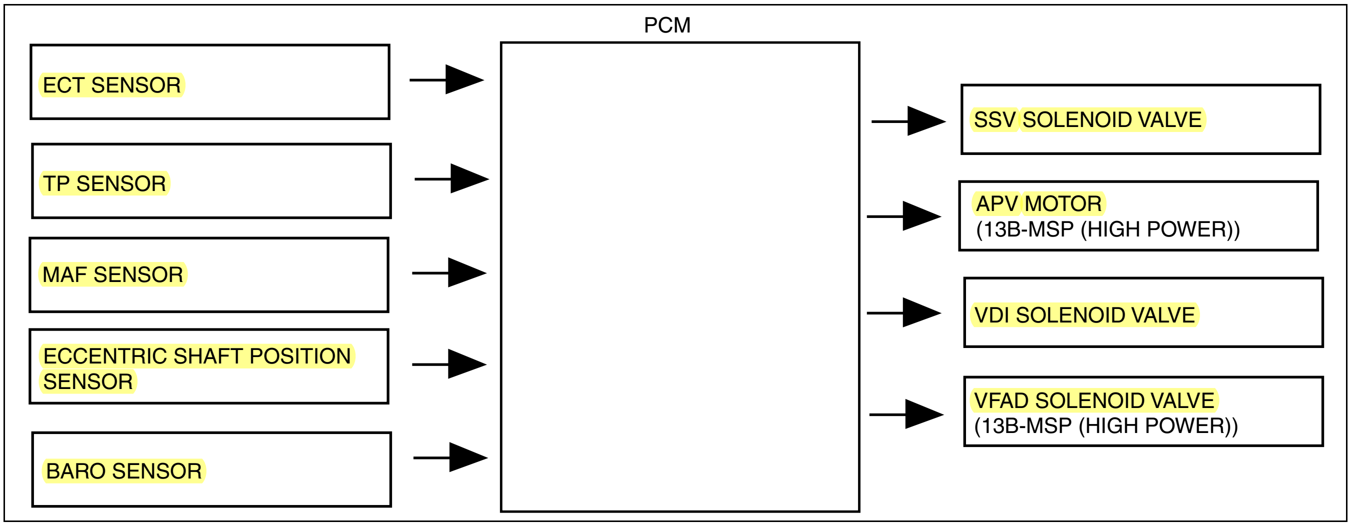
CHU014000140S15

- Operates the SSV solenoid valve, the APV motor (13B-MSP (High Power)), the VDI solenoid valve, and the VFAD solenoid valve (13B-MSP (High Power)) according to the engine speed range. As a result, torque and output at all engine speed ranges have been improved.

SEQUENTIAL DYNAMIC AIR INTAKE SYSTEM (S-DAIS) CONTROL BLOCK DIAGRAM

CHU014000140S16

- The PCM determines the engine conditions based on each input signal and sends signals to the SSV solenoid valve, the APV motor (13B-MSP (High Power)), the VDI solenoid valve, and the VFAD solenoid valve (13B-MSP (High Power)).



CHU0140S010

SEQUENTIAL DYNAMIC AIR INTAKE SYSTEM (S-DAIS) CONTROL OPERATION

CHU014000140S17

Operation Outline

- Operates the SSV solenoid valve, the APV motor (13B-MSP (High Power)), the VFAD solenoid valve (13B-MSP (High Power)), and the VDI solenoid valve according to the engine speed range.

Operation list

Engine speed range and operation conditions for each valve

On: Energization, Off: Non-energization, Open: Valve opens, Closed: Valve closes

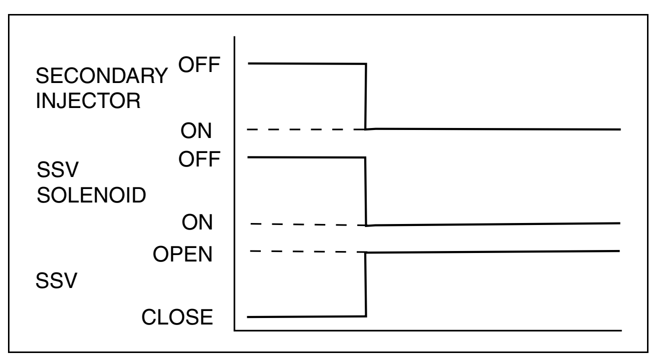
Item		Engine speed range			
		Low speed	Medium speed	Medium-high speed	High speed
SSV	Solenoid valve	OFF	ON (Secondary injector is operating)		
	Valve	Closed	Open		
VFAD	Solenoid valve	OFF		ON (Approx. 5,500 rpm or more)	
	Valve	Closed		Open	
APV	Motor	OFF		ON (Approx. 6,250 rpm or more)	
	Valve	Closed		Open	
VDI	Solenoid valve	OFF			ON [*1][*2]
	Valve	Closed			Open

[*1]: 13B-MSP (Standard Power): Approx. 5,800 rpm or more
[*2]: 13B-MSP (High Power): Approx. 7,300 rpm or more

Operation

SSV solenoid valve

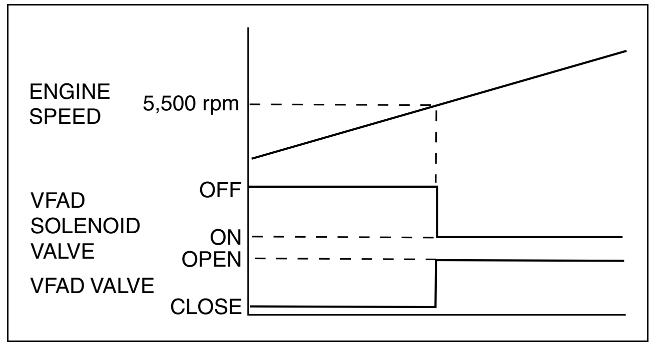
- Turns on at the same time as the injection timing of the secondary injector. Due to this, the intake manifold vacuum is fed to the SSV actuator allowing intake air from secondary port which is opened by the SSV valve.



CHU0140S011

VFAD solenoid valve (13B-MSP (High Power))

- At an engine speed of less than 5,500 rpm, the VFAD solenoid valve turns off and feeds intake manifold vacuum to the actuator (valve closes).
- At an engine speed of Approx. 5,500 rpm or more, the VFAD solenoid valve turns on and feeds BARO to the actuator (valve opens).



CHU0140S015

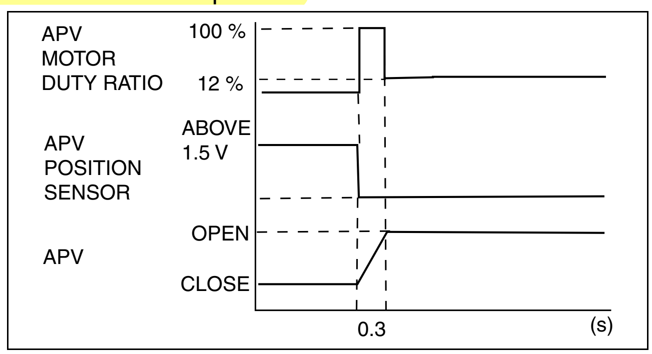
APV motor (13B-MSP (High Power))

- When the following conditions are met, a duty signal is sent to the APV motor, the APV gradually opens. If an APV-open condition is not met, a minus duty signal is sent to the APV motor, reversing the motor and closing the APV.

  APV-open condition

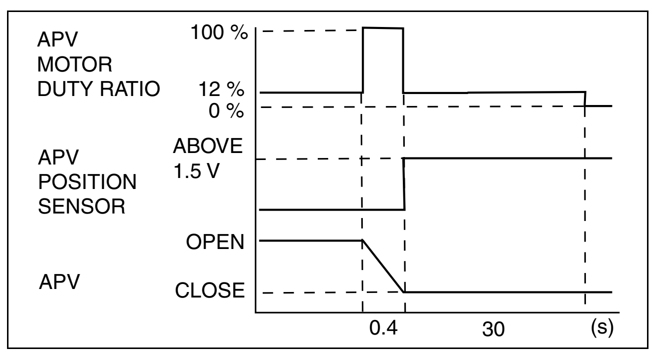
  — Engine speed: Approx. 6,250 rpm or more

  — ECT: Approx. 20°C {68°F} or more
- The APV motor has a built-in APV position sensor that monitors the APV position.
- The duty ratio and the operation time when the APV valve is open are as shown in the figure.
- When the opening conditions are not met, the APV sends a reverse duty signal while the APV opens.



CHU0140S012

- The duty ratio and the operation time when the APV closes are as shown in the figure.



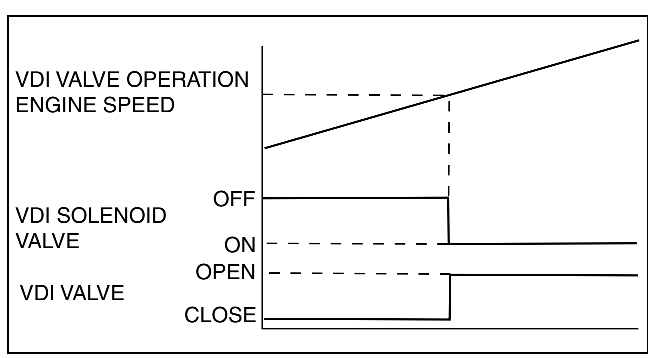
CHU0140S013

VDI solenoid valve

- At a VDI valve operation engine speed or more, the VDI solenoid valve turns on and feeds intake manifold vacuum to the actuator (valve opens).

  VDI valve operation engine speed

  - **13B-MSP (Standard Power): Approx. 5,800 rpm or more**
  - **13B-MSP (High Power): Approx. 7,300 rpm or more**



CHU0140S014

FUEL INJECTION CONTROL OUTLINE

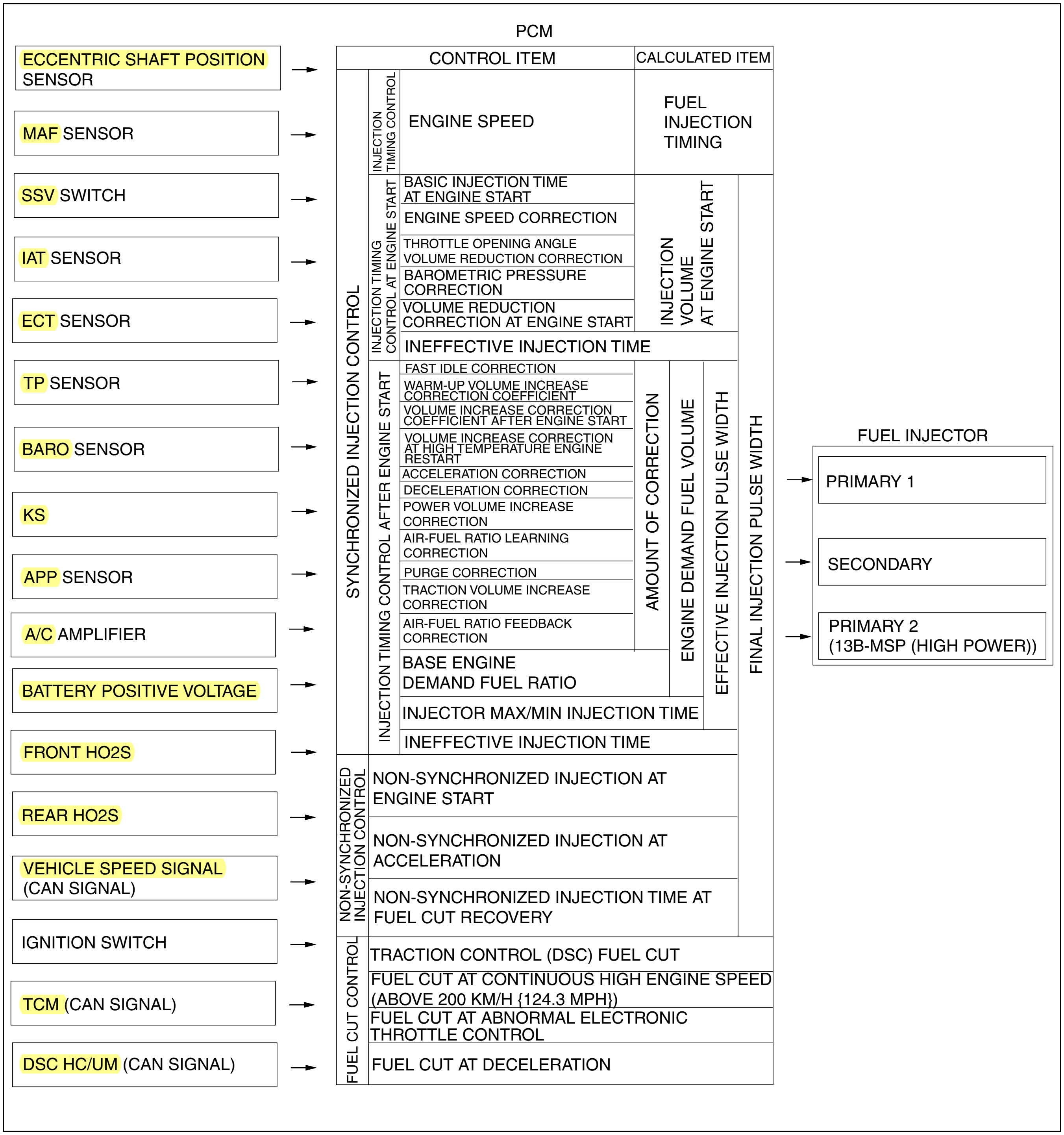
CHU014000140S18

- The fuel injection control includes the following:
  — synchronized injection control, which performs fuel injection at the rotor intake stroke according to designated timing.
  — non-synchronized injection control, which performs fuel injection only when fuel injection conditions are met regardless of rotor intake stroke.
  — Fuel cut control, which temporarily stops fuel injection.
- There are primary, secondary and primary 2 (13B-MSP (High Power)) fuel injectors, and the injection timing and injection amount varies according to the engine speed range. Due to this, the optimum amount of fuel injection is controlled at all ranges.

FUEL INJECTION CONTROL BLOCK DIAGRAM

CHU014000140S19

- The PCM determines the engine operation conditions based on input signals and operates the injectors to inject fuel with the optimum fuel injection timing and fuel injection time (fuel injection amount).



CHU0140S016

FUEL INJECTION CONTROL OPERATION

CHU014000140S20

Fuel Injection Timing

- The PCM calculates the optimum fuel injection timing according to the engine operation conditions and operates the injectors.
- The fuel injection timing is controlled at engine start and after engine start.
- At engine start (engine speed is within 500 rpm), fuel injection timing control at engine start is performed and after determining that the engine has started (engine speed is 500 rpm or more), injection timing control after engine start is performed.

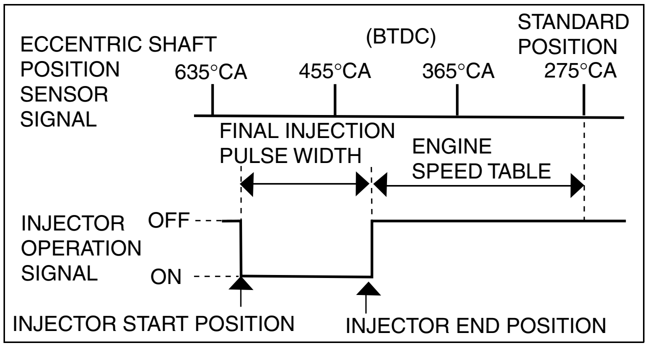
Fuel injection timing at engine start

— The injection timing at engine start operates for a period until engine start has been determined and injects at BTDC 455°CA (crank angle position).

Fuel injection timing after engine start

— The injection start position of the fuel injection timing after engine start is determined by the injection end position and the final injection pulse width (injection time).

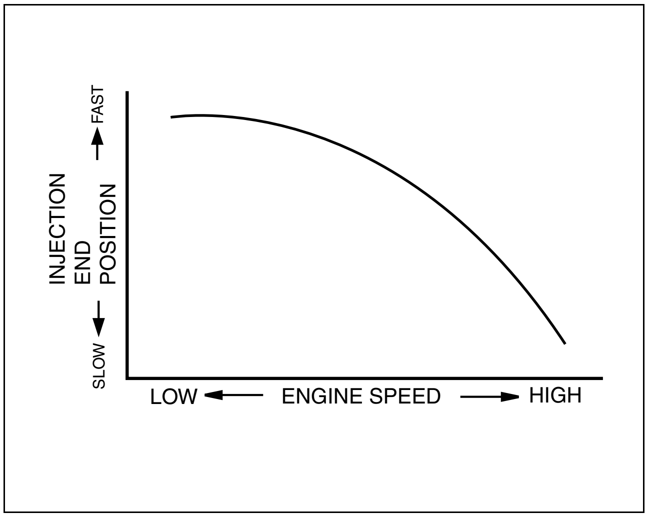
— The injection start position is calculated by: (Injection start position = BTDC 275°CA + Injection end position + Final injection pulse width).



CHU0140S018

— The injection end position is determined by the engine speed. (The higher the engine speed the lower the fuel injection timing.)

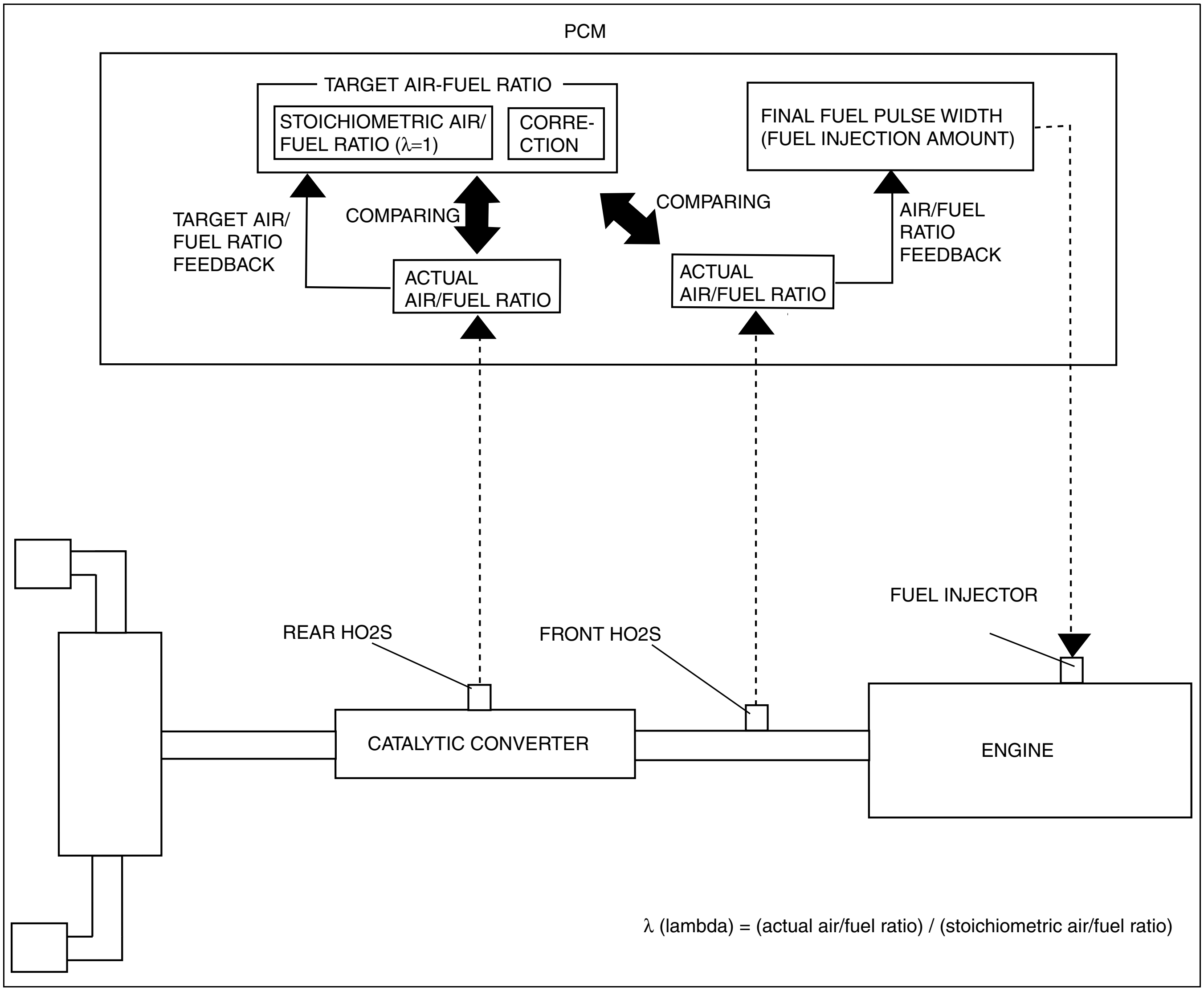
Engine speed table



CHU0140S017

Air/fuel Ratio Control

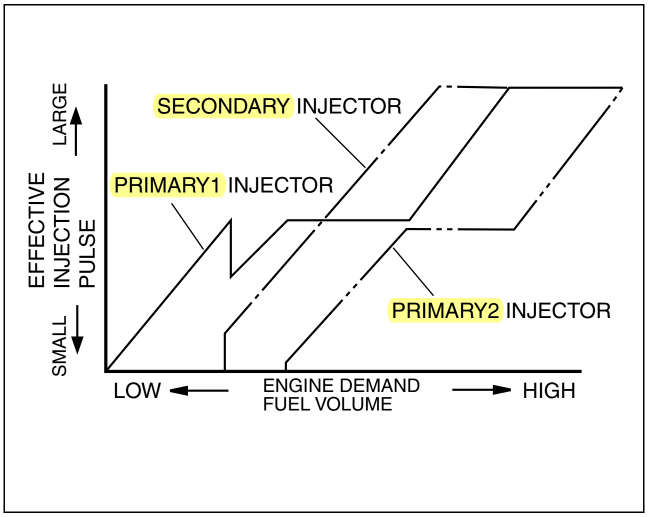
- Controls the fuel injection amount so that the actual air/fuel ratio is close to the target air/fuel ratio, to boost purification of the catalytic converter.
- air/fuel ratio feedback and target air/fuel ratio feedback are adopted for precise control of the air/fuel ratio.
- The air/fuel ratio feedback compares the air/fuel ratio in the exhaust manifold detected by the front HO2S and the target air/fuel, and feeds back the air/fuel ratio difference to the final fuel pulse width (fuel injection amount).
- The target air/fuel ratio feedback compares the air/fuel ratio in the catalytic converter detected by the rear HO2S with the target air/fuel ratio and feeds back the air/fuel ratio difference to the stoichiometric air/fuel ratio (λ = 1). Due to this, the optimum target air/fuel ratio is determined.
- Repeats feedback to the target air/fuel ratio and final fuel pulse width (fuel injection amount), and by constantly calculating the optimum target air/fuel ratio and final fuel pulse width, purification of the catalytic converter at a high level has been achieved.



CHU0140S082

Fuel Injection Distribution Control

- There are primary 1, secondary and primary 2 (13B-MSP (High Power)) injectors, and they independently control fuel injection amount and timing according to the amount of fuel demand from the engine.
- The amount of fuel demand from the engine is determined by each correction of the charging efficiency and injection time after engine start.
- When the amount of fuel demand from the engine is low, only the primary 1 injectors inject fuel. When the amount of fuel demand from the engine increases, fuel injection in the order of secondary injector and primary 2 injector (13B-MSP (High Power)) begin injection.



CHU0140S019

Synchronized Injection Control

- The synchronized injection control performs fuel injection according to each timing that has been determined by the intake stroke of the rotors.
- The synchronized injection control includes fuel injection control at engine start and fuel injection control after engine start. Synchronized injection control performs fuel injection based on injection time (final injection pulse width) and fuel injection timing demanded by each rotor.

Injection time at start

- Calculated by adding the engine speed correction to the basic injection time at engine start, the throttle valve opening angle correction, the BARO correction, and the volume decrease correction at engine start, and then the final injection pulse width is calculated by adding the ineffective injection time to the injection time at engine start.
- Basic injection time at engine start is determined based on ECT and shortens as the ECT increases.
- Ineffective injection time is determined according to battery voltage and lengthens as battery voltage becomes lower.

Correction	Condition	Amount of Correction
Engine speed correction	Determines correction amount based on engine speed.	• Correction amount lengthens as the engine speed increases.
Throttle valve opening angle correction	Determines correction amount based on throttle valve opening angle.	• Correction amount shortens as the throttle valve opening angle increases.
BARO correction	Determines correction amount based on BARO sensor.	• Correction amount lengthens (time) as the BARO increases.
Volume decrease correction at engine start	Determines correction amount based on ECT and engine speed at engine start.	• After starter is on for approx. 1 s and any one of the following conditions are met, injection time gradually decreases: — ECT at fixed value or more — Engine speed at target engine speed or more — Approx. 5 s of cranking time elapsed

Injection time after engine start

- The injection time after engine start is calculated from the charging efficiency, ineffective injection time and each type of correction.

  Charging efficiency

  — The charging efficiency is the ratio of intake air amount that is actually taken in relation to the maximum air charging amount (mass) of the operation chamber. This value becomes larger in proportion to the increase in engine load.

Ineffective injection time

— Ineffective injection time at engine start is determined according to the battery voltage and lengthens as the battery voltage becomes lower.

Each type of correction

— Includes the following corrections:

Fast idle correction

- Determines the correction amount when the secondary air injection system operates to rapidly heat the catalytic converter. The correction amount is determined by estimating the air amount that is sent from the secondary air injection pump based on the BARO, battery positive voltage, IAT, charging efficiency and the engine speed, and by calculating the target air/fuel ratio.

Warm-up volume increase correction coefficient

- At cold-engine start, warm-up is accelerated by advanced vaporization and atomization. The warm-up volume increase correction coefficient is determined by the ECT, water temperature at engine start, charging efficiency, and the engine speed.

Volume increase correction coefficient after start coefficient

- The volume increase correction coefficient after engine start coefficient is determined by the ECT and IAT at engine start, the time elapsed, and fuel-cut conditions after engine start.

High temperature volume increase correction at engine restart

- At high temperature engine restart, increased fuel volume correction is performed to prevent fluctuations in idle speed based on the occurrence of vapor in the fuel pipe. The correction amount is determined by the IAT and the ECT.

Acceleration correction

- Improves engine response during acceleration. The correction amount is determined by the rate of charging efficiency increase, throttle valve opening angle, engine speed, volume increase after engine start, time after engine start, and the ECT.

Deceleration correction

- Stops afterburn within the ranges fuel cut does not operate during deceleration. The correction amount is determined by the rate of charging efficiency decrease, throttle valve opening angle, engine speed, volume increase after engine start, time after engine start, and the ECT.

Power increase correction

- Volume increase correction is performed to improve output during high load and to inhibit overheating of the catalytic converter. The correction amount is determined by the throttle opening angle, charging efficiency, engine speed, volume increase after engine start, ECT, gear position (MT: determined by engine speed and vehicle speed, AT: determined by signal from the TCM), and BARO.

Fuel learning correction

- Learns the difference between the target air/fuel ratio and the actual air/fuel ratio (front HO2S).

Purge correction

- Performs volume decrease correction of the fuel amount for the portion of evaporative fuel inflowing from the charcoal canister. The correction amount is determined by calculating the fuel amount inflowing from the charcoal canister caused by the amount of change in air/fuel ratio feedback during activation of the evaporative purge control.

Traction volume increase correction

- Ignition timing is retarded by the torque down request signal from the DSC HU/CM and TCM. The volume increase correction is performed to prevent the increase of combustion temperature due to the ignition timing retard, which causes the combustion temperature to increase resulting in overheating of the catalytic converter.

Fuel feedback correction

- Detects the air/fuel ratio in the exhaust manifold at the front HO2S and feeds back to the final injection pulse width (final fuel injection amount).
- Fuel feedback begins when all of the following conditions are met:
  ECT is 40°C {104°F} or more.
  After the engine has started and 3—100 s have elapsed (time period after engine-start lengthens as ECT becomes lower).
  -Power volume increase correction
  -During fuel cut recovery, non synchronized injection control stops.
  -Traction correction retard stops.
  -Fast idle correction stops.
  -Charging efficiency is 78% or less or engine speed is 1,100 rpm or less.
  -During activation of front HO2S.

Non-synchronized Injection Control

- The non-synchronized injection control allows fuel injection when fuel injection conditions are met, regardless of the position of the eccentric shaft.
- The non-synchronized injection control includes non-synchronized injection control at engine start, acceleration, idle, and fuel cut recovery.

Control name	Purpose	Injection condition
Non-synchronized injection control at engine start	Improves engine startability.	• Performs non-synchronized fuel injection at engine start until determining the engine has been started (engine speed 500 rpm or more). • Injection pulse width at engine start is calculated by adding the injection amount at engine start calculated from the following signals to the ineffective injection time: — ECT — Engine speed — Throttle valve opening angle — BARO
Non-synchronized injection control at acceleration	Prevents acceleration hesitation and lean air/fuel ratio due to delay of fuel injection during sudden acceleration.	• Performs non-synchronized fuel injection when the amount of throttle valve change is at the fixed value or more for both rotors simultaneously. • Injection pulse width is calculated from the following signals: — Charging efficiency — Throttle valve opening angle — Engine speed — ECT
Non-synchronized injection control at fuel cut recovery	Prevents engine hesitation and lean air/fuel ratio due to the delay of fuel injection during fuel cut recovery.	• Performs non-synchronized fuel injection during fuel cut recovery. • Injection time is determined by ECT.

Fuel Cut Control

- The fuel cut control stops fuel injection when the fuel cut conditions are met.
- The fuel cut control includes traction fuel cut control, continuous fuel cut control during high engine speed, fuel cut control during drive-by-wire abnormality, fuel cut control during deceleration and dechoke control.

Control name	Purpose	Fuel cut condition
Traction fuel cut control	Lowers engine torque based on the torque down request from DSC HU/CM and TCM.	Performs fuel cut based on torque down request from DSC HU/CM and TCM.
Continuous speed fuel cut control during high engine speed	Prevents overheating of the catalytic converter.	Performs fuel cut during continuous high engine speed while vehicle is stopped.
Fuel cut control during drive-by-wire abnormality	When there is a malfunction in the drive-by-wire, fuel cut is activated and excess increase in engine speed is prevented.	When there is an abnormality in the drive-by-wire (when related DTCs are stored in PCM), performs fuel cut only on the front rotor.
Fuel cut control during deceleration	Prevents overheating of the catalytic converter due to misfire for improved fuel economy. Performs fuel cut on one rotor for reduced deceleration shock.	Performs fuel cut on one rotor when the throttle valve is open during deceleration. Performs fuel cut on both front and rear rotors when throttle valve is fully closed.
Dechoke control	Scavenges operation chambers to improve engine startability if the spark plugs are smoldered.	Performs dechoke control when the throttle valve opening angle is 50° or more.

FUEL PUMP CONTROL OUTLINE

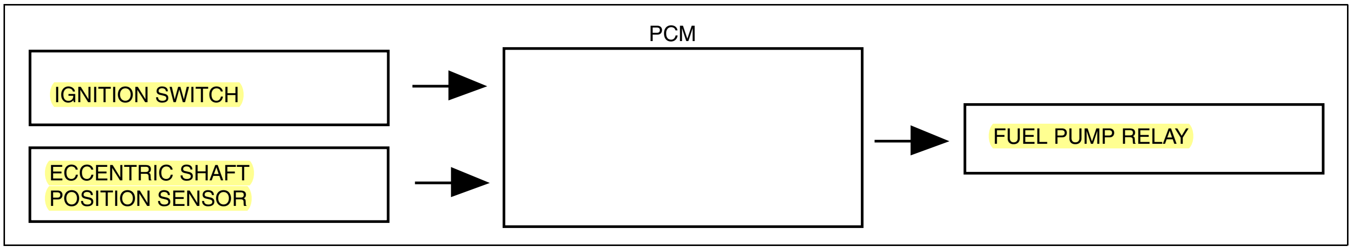
CHU014000140S21

- When the eccentric shaft position sensor signal is input to the PCM, the fuel pump relay turns on and the fuel pump operates.
- When input from the eccentric shaft position sensor signal stops, the fuel pump relay turns off and the fuel pump turns off.
- For improved startability when the ignition switch is turned from off to on, the fuel pump is operated for several seconds. Due to this, fuel pressure increases rapidly for improved startability.

FUEL PUMP CONTROL BLOCK DIAGRAM

CHU014000140S22

- The PCM determines the engine starting condition based on each input signal and controls the fuel pump relay on/off.



CHU0140S020

FUEL PUMP CONTROL OPERATION

CHU014000140S23

Operation condition

- When the ignition switch is turned from off to on, the fuel pump relay turns on for approx. 1 s.

Note

- When the ignition switch is turned from off to on, the operation sound of the fuel pump unit can be heard, but this does not indicate an abnormality.

- During cranking (ignition switch: START), the fuel pump relay turns on for approx. 1 s.
- After the engine starts (ignition switch: ON), the fuel pump relay turns on repeatedly each time an input signal from the eccentric shaft position sensor is input. Due to this, the fuel pump relay remains on.
- When the engine stalls (ignition switch: ON) and the input signal from the eccentric shaft position sensor stops, the fuel pump relay turns on for approx. 2 s, and then turns off.

FUEL PUMP SPEED CONTROL OUTLINE

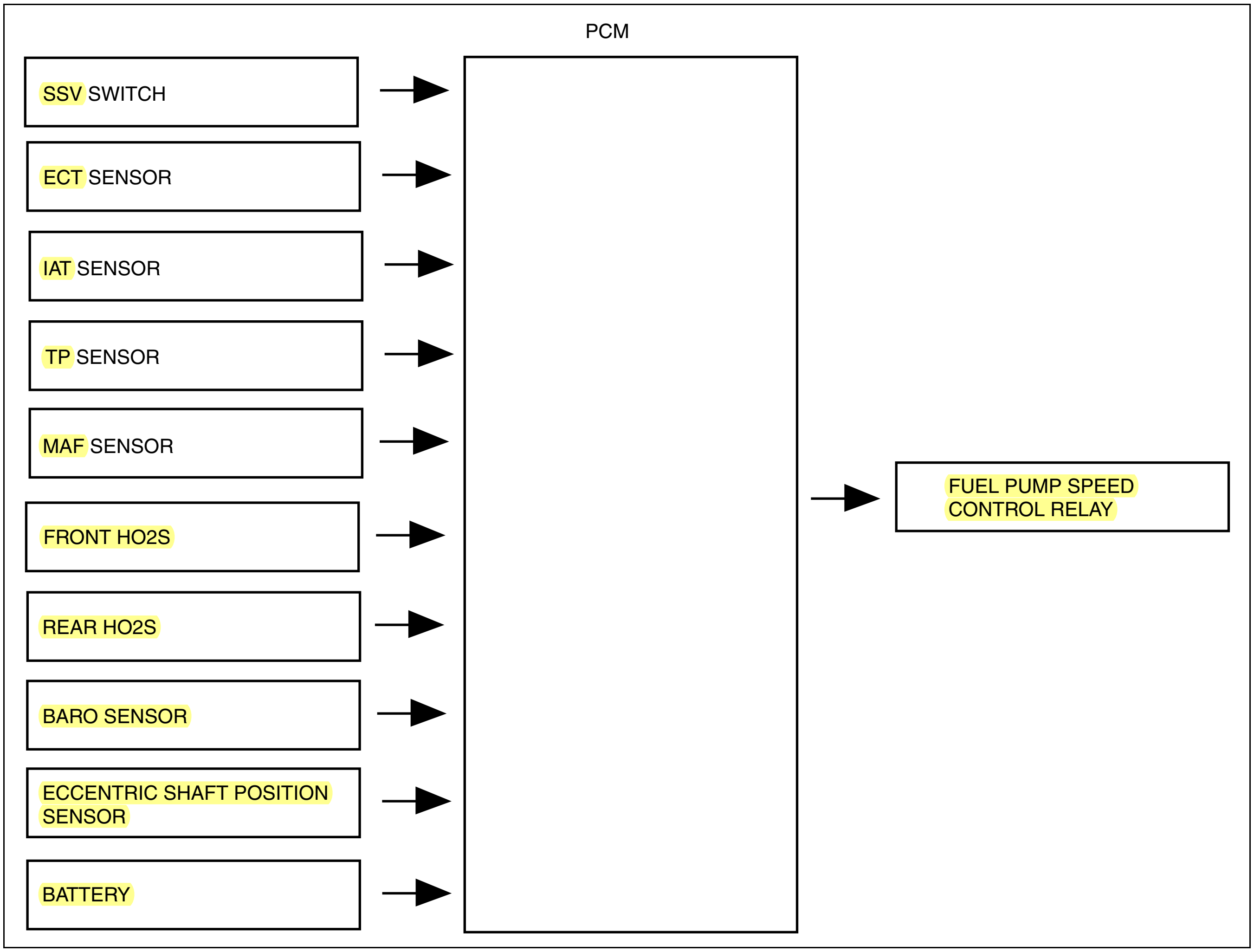
CHU014000140S24

- The fuel pump speed control turns the fuel pump speed control relay on/off according to the required fuel amount, switching between two fuel pump speed levels.
- Excess load on the fuel pump is reduced by control of the fuel pump speed. Due to this, reliability has been improved as well as an assured delivery of the optimum fuel amount according to the engine conditions.

FUEL PUMP SPEED CONTROL BLOCK DIAGRAM

CHU014000140S25

- The PCM compares the fuel injection amount with the required fuel amount based on input signals and controls the fuel pump speed control relay on/off.



CHU0140S021

01–40

FUEL PUMP SPEED CONTROL OPERATION

CHU014000140S26

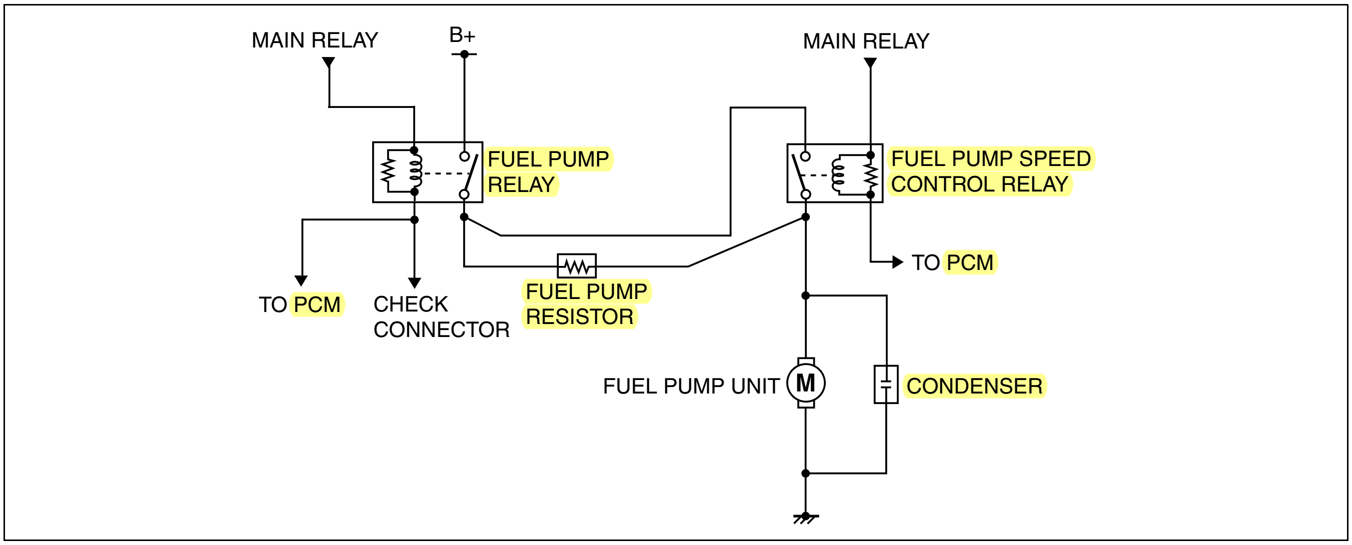
- Controls the fuel pump speed control relay according to the fuel amount required by the engine.
- The required fuel amount is determined by the engine speed, battery positive voltage and the ECT.
- When the required fuel amount exceeds the fixed amount, the PCM turns the fuel pump speed control relay on.
- The circuit driving the fuel pump switches by the fuel pump speed control relay turning on or off.

When Fuel Pump Speed Control Relay Off

— Electric current flows from the fuel pump relay to the fuel pump through the fuel pump resistor. Excess load on the fuel pump is reduced because voltage to the fuel pump is reduced by the fuel pump resistor.

When Fuel Pump Speed Control Relay On

— Electric current flows from the fuel pump relay to the fuel pump through the fuel pump speed control relay. Voltage to the fuel pump flows from the battery because the voltage does not flow through the fuel pump resistor. Due to this, the fuel delivery amount increases by the increase of fuel pump drive force.



CHU0140S083

Operation Conditions

During cranking

- During cranking, the fuel pump turns on for improved startability.

At low engine speed

- As less fuel is required, the fuel pump speed control relay is turned off.

At high engine speed

- At high engine speed, the fuel pump speed control relay turns on because the required fuel amount increases.

ELECTRIC SPARK ADVANCE CONTROL OUTLINE

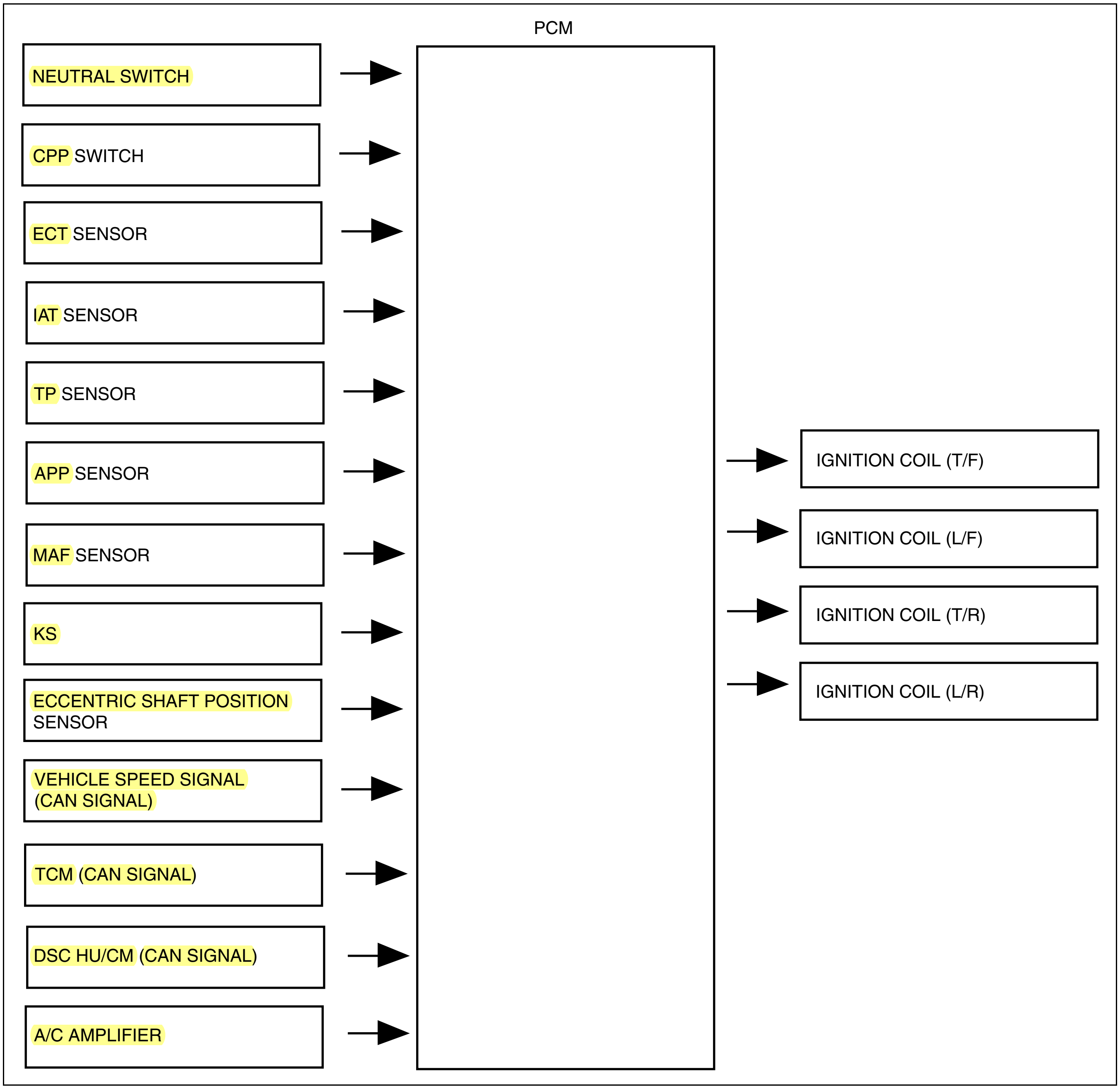
CHU014000140S27

- Controls optimum ignition timing according to engine operation conditions.
- The PCM determines the engine conditions based on the input signal from the sensors and calculates the optimum ignition timing.
- Independent ignition coils are available for each spark plug.

ELECTRIC SPARK ADVANCE CONTROL BLOCK DIAGRAM

CHU014000140S28

- The PCM calculates the optimum ignition timing based on the engine conditions and sends an ignition signal to the ignition coils.



CHU0140S022

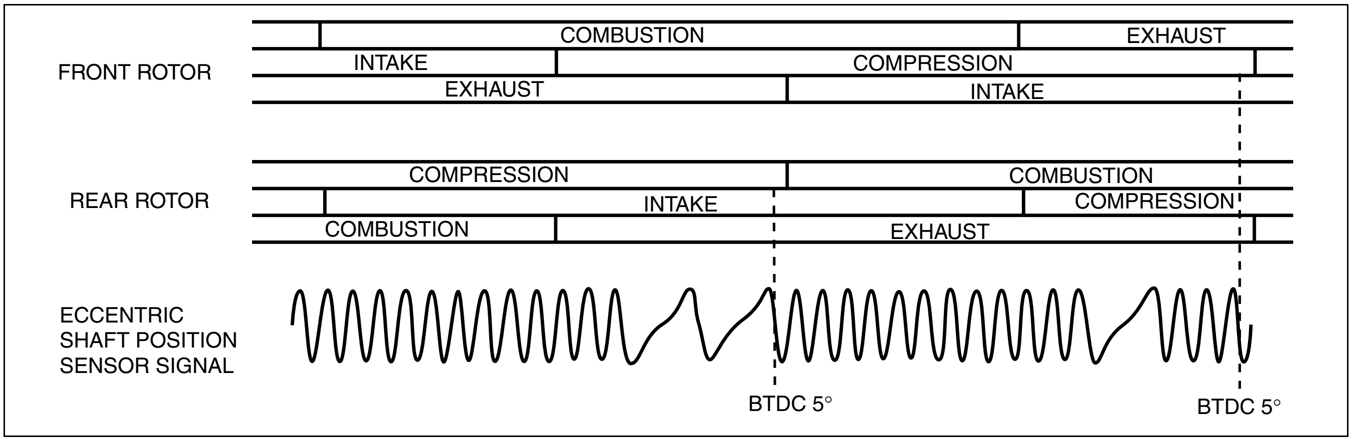
ELECTRIC SPARK ADVANCE CONTROL OPERATION

CHU014000140S29

Ignition Method

- The PCM controls fixed ignition and regular ignition according to the engine operation conditions.

Ignition Method	Ignition timing
Fixed ignition	Ignition fixed at BTDC 5°
Regular ignition	Appropriate ignition for engine operation conditions based on input signals.

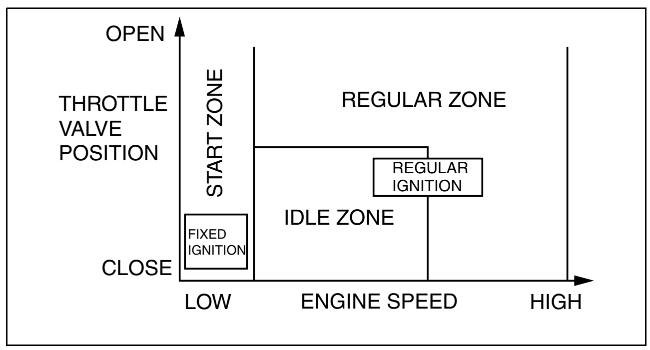


CHU0140S023

Determination of Ignition Timing

Control Zone Divisions

- The PCM divides the full range of ignition control into control zones and determines the ignition timing from each control zone according to engine speed and throttle valve opening angle to perform optimum ignition control at the full range of engine operating conditions.



CHU0140S024

Ignition Method	Zone	Condition	Ignition timing
Fixed ignition	Start zone	• Engine speed 500 rpm or less • When MAF sensor has a malfunction.	Fixed ignition
Regular ignition	Idle zone	When the AP is fully closed (during idle).	Determined by addition of each type of correction to the basic spark advance.
	Regular zone	During engine operation other than start zone and idle zone	Determined by addition of each type of correction to the basic spark advance.

Fixed Ignition

- At engine start, fixed ignition is performed at BTDC 5° until the engine speed reaches 500 rpm or more, due to ignition timing control difficulty from changes such as low battery positive voltage from start operation and fluctuations in engine speed.

Regular Ignition

- The PCM determines the optimum final ignition timing, adding each type of spark advance correction to the base spark advance, ECT spark advance correction, and the IAT spark advance correction.

Basic spark advance

- The basic spark advance becomes the basis for the ignition timing control.
- The basic spark advance amount is determined by the engine speed, charging efficiency and the ECT.

ECT spark advance correction

- Corrects other than during idling.
- Stabilizes combustion by correction of ignition timing in consideration of friction loss when the engine is at a low temperature.
- The correction amount is determined by the ECT and charging efficiency, and increases as the ECT decreases.

IAT spark advance correction

- Corrects ignition timing according to the IAT.
- The correction amount is determined by the IAT, idling condition and charging efficiency, and increases as the IAT decreases.

Types of spark advance correction

- Spark advance correction is as follows:

  Knock feedback correction
  - When knocking is detected, ignition timing is retarded, stabilizing the combustion condition.

  Idling stabilization correction
  - Correction stabilizes engine speed during idling. The correction amount is determined by the actual engine speed and the average engine speed.

  Fast idle correction
  - At cold-engine start, the correction is performed to accelerate secondary air response (reburn), decrease unburnt gas, and rapidly activate the catalytic converter.

  Low temperature correction
  - Performs spark advance correction of ignition timing to stabilize combustion during low temperature. Low temperature correction performs advance of ignition timing when ECT is less than 90°C {194°F} and the AP is depressed, and is determined by ECT, charging efficiency and engine speed.

  Acceleration correction
  - Performs retard correction of ignition timing to prevent knocking at acceleration from a standstill. Correction amount is determined by the amount of throttle valve change, the charging efficiency and the ECT.

  Fuel cut recovery correction
  - Performs retard correction of ignition timing during recovery from deceleration fuel cut to prevent shock during fuel cut recovery. Correction amount is determined by idling condition, A/C condition and engine speed.

  Surging correction
  - Performs spark retard correction due to acceleration vibration to stabilize acceleration. Correction amount is determined by the engine speed and the amount of engine speed change.

  Acceleration shock correction
  - Gradually restores ignition timing after it is retarded for a fixed period of time to inhibit shock during acceleration.

  A/C off correction
  - The retard correction is performed to prevent engine speed fluctuation due to load decrease when the A/C switch is off. The correction amount is determined by the engine speed and the charging efficiency, and decreases as the engine speed and the charging efficiency are high.

  Traction correction
  - The spark timing is retarded following a torque down request from the DSC HU/CM and TCM, reducing engine torque.

SECONDARY AIR INJECTION (AIR) CONTROL OUTLINE

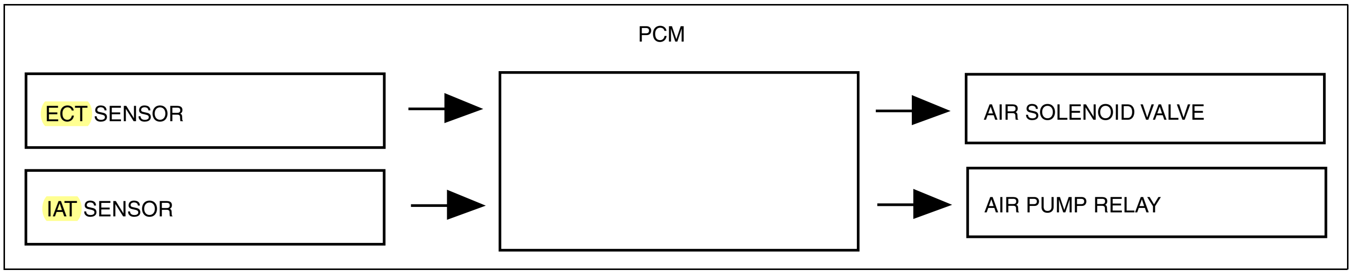
CHU014000140S30

- The AIR control activates the catalytic converter rapidly at cold-engine start.
- The PCM controls the AIR pump relay and the AIR solenoid valve.
- After the catalytic converter reaches the activation temperature, AIR control stops.
- For the construction and operation of the AIR system, refer to the emission system and AIR system. (See 01–16–3 SECONDARY AIR INJECTION (AIR) SYSTEM OUTLINE.)

SECONDARY AIR INJECTION (AIR) CONTROL BLOCK DIAGRAM

CHU014000140S31

- The PCM determines the engine conditions based on input signals and sends an operation signal to the AIR solenoid valve and the AIR pump relay.



CHU0140S025

SECONDARY AIR INJECTION (AIR) CONTROL OPERATION

CHU014000140S32

Outline

- The AIR relay supplies power to the AIR pump and drives the pump.
- The AIR solenoid valve opens and closes the valve switching to feed intake manifold vacuum and barometric pressure which is fed to the actuator in the AIR control valve.
- At cold-engine start, the AIR solenoid valve switches for vacuum feed, and opens the AIR control valve. The AIR pump relay also turns on, driving the AIR pump and sending air to the exhaust port through the AIR control valve. As a result, the unburnt gas in the air and exhaust gas are mixed and it recombusts to activate the catalytic converter rapidly.

Operation

- At cold-engine start and when the catalytic converter temperature is low, the AIR pump relay turns on to drive the AIR pump. When the AIR pump relay turns on, an on signal is also sent to the AIR solenoid valve simultaneously.
- The ignition timing, the fuel injection amount and the throttle valve opening angle are controlled intentionally so that the air mixes with the exhaust gas easily, and the secondary air amount corresponding to the unburnt gas amount is discharged for rapid and complete reburn.

EVAPORATIVE PURGE CONTROL OUTLINE

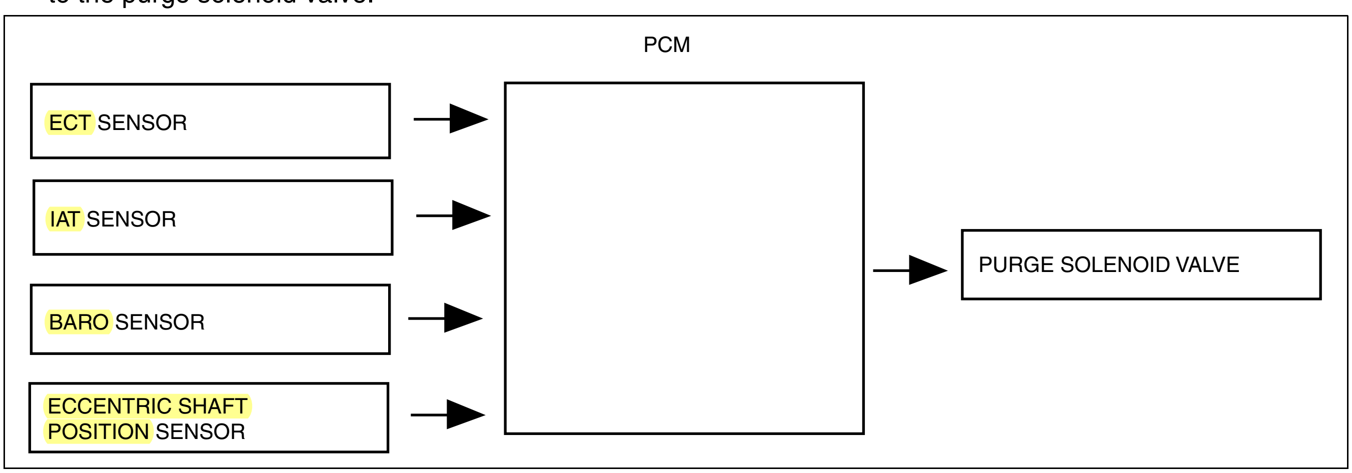
CHU014000140S33

- The purge solenoid valve operates according to the engine operation conditions, controlling the optimum air/fuel ratio while feeding evaporative gas to the intake air passage and inhibiting its atmospheric release.

EVAPORATIVE PURGE CONTROL BLOCK DIAGRAM

CHU014000140S34

- The PCM determines the engine conditions based on input signals and sends an operation signal (duty signal) to the purge solenoid valve.



CHU0140S026

EVAPORATIVE PURGE CONTROL OPERATION

CHU014000140S35

Evaporative Purge Control Execution Condition

- When the following conditions are met, the evaporative purge control sends a duty signal to the purge solenoid valve.
  — During fuel injection control feedback
  — Fuel system and MAF sensor are normal
  — Approx. 30 s have elapsed since engine start
  — ECT is 60°C {140°F} or more

Determination of Purge Solenoid Valve Energization Period

- The duty ratio of the duty signal (ratio of on time per 1 cycle) is calculated based on the amount of purge flow and the differential pressures of the injectors. The amount of purge flow is determined by the estimated intake air passage pressure and barometric pressure calculated by the engine speed and charging efficiency. The differential pressure of the injectors is determined by the BARO and the estimated intake air passage pressure.

METERING OIL PUMP CONTROL OUTLINE

CHU014000140S36

- Controls the amount of plunger stroke which determines the amount of oil delivery through the stepping motor according to the engine operation conditions.
- The plunger opens and closes by the stepping motor in the metering oil pump.
- The PCM determines the target step number of the stepping motor from input signals for engine speed, charging efficiency and ECT, and sends an operation signal to the stepping motor. For the construction and operation of the metering oil pump, refer to metering oil pump construction/operation. (See 01–11–5 METERING OIL PUMP CONSTRUCTION/OPERATION.)
- The metering oil pump control includes the energization off function, the initial-set function, the normal drive function, the ignition switch off function, the monitor function, and the fail-safe function.

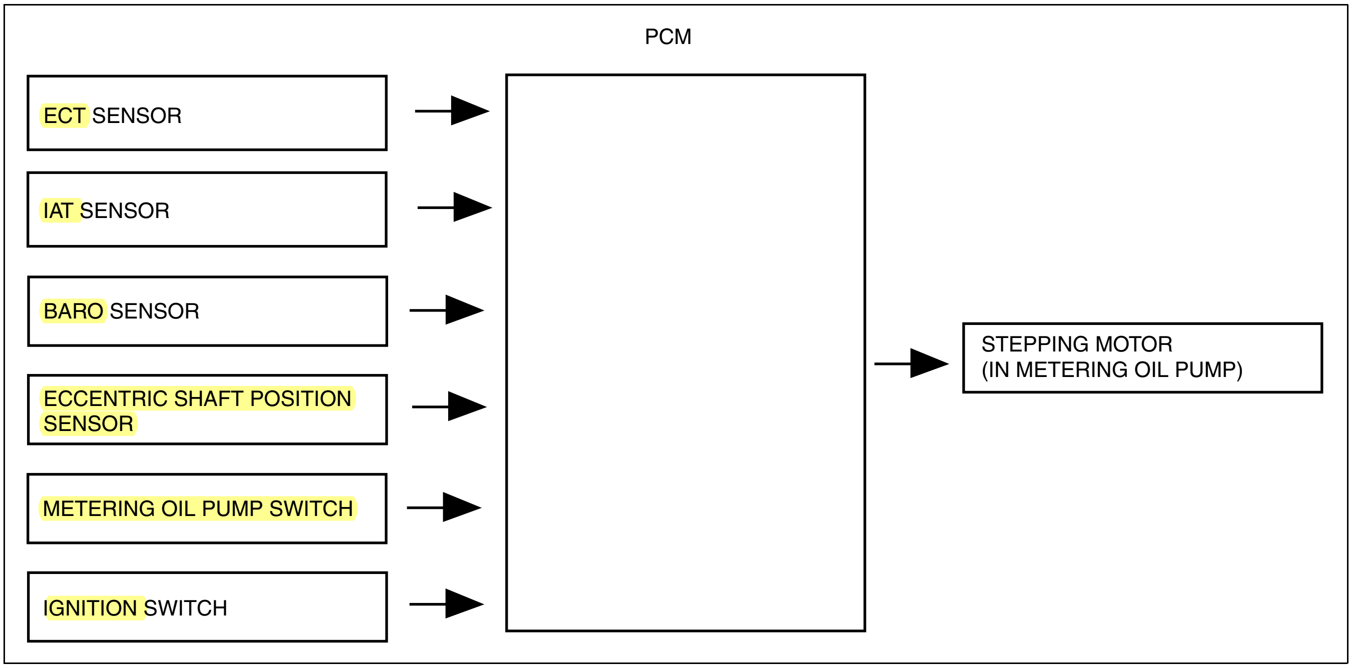
Function List

Function	Purpose
Energization off function	Stops control at engine off, lowering the battery current consumption.
Initial-set function	Detects the 0-step position and sets to the reference position for regular drive.
Regular drive function	Control to calculated target step based on engine operation conditions.
Ignition switch off function	Shortens operation time of initial-set function.
Monitor function	Verifies that the target step and the actual step correspond.
Fail-safe function	Controls engine output to protect the engine if a malfunction in the metering oil pump system occurs.

METERING OIL PUMP CONTROL BLOCK DIAGRAM

CHU014000140S37

- The PCM calculates the optimum amount of oil delivery (stepping motor step number) by determining the engine operation conditions based on each input signal, and sends an operation signal to the stepping motor (inside the metering oil pump).



CHU0140S027

METERING OIL PUMP CONTROL OPERATION

CHU014000140S38

Outline

- The PCM changes the amount of stroke of the plunger by controlling the amount of stepping motor rotation (step number), adjusting the amount of oil delivery.
- The stepping motor operates by the combination of coils No.1—No.4, according to the stepping motor step number.

Example of energization condition for each coil and step number

On: Energization, Off: Non-energization

Step number	0	1	2	3	4	5	6	7	8	9	10	30	52
Coil No.1 (PCM terminal 2W)	On	On	Off	Off	On	On	Off	Off	On	On	Off	Off	On
Coil No.2 (PCM terminal 2AB)	Off	On	On	Off	Off	On	On	Off	Off	On	On	On	Off
Coil No.3 (PCM terminal 2V)	Off	Off	On	On	Off	Off	On	On	Off	Off	On	On	Off
Coil No.4 (PCM terminal 2Y)	On	Off	Off	On	On	Off	Off	On	On	Off	Off	Off	On

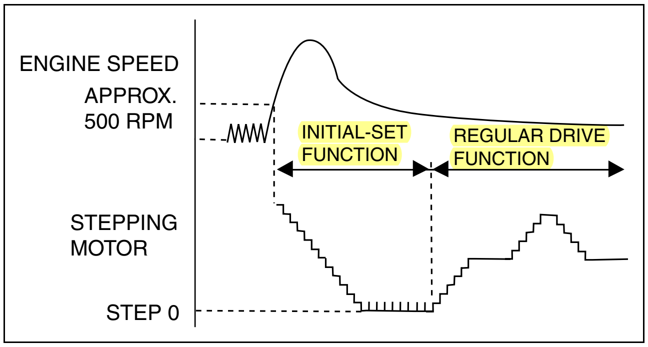
- The energization condition of stepping motor coils No.1—No.4 can be verified by verifying the step number based on the WDS data monitor function PID (MOP POS).

Energization Off Function

- When the ignition switch is turned to the ON position and the engine is stopped, current flow to stepping motor coils No.1—No.4 is stopped, saving on battery consumption.

Initial-set Function

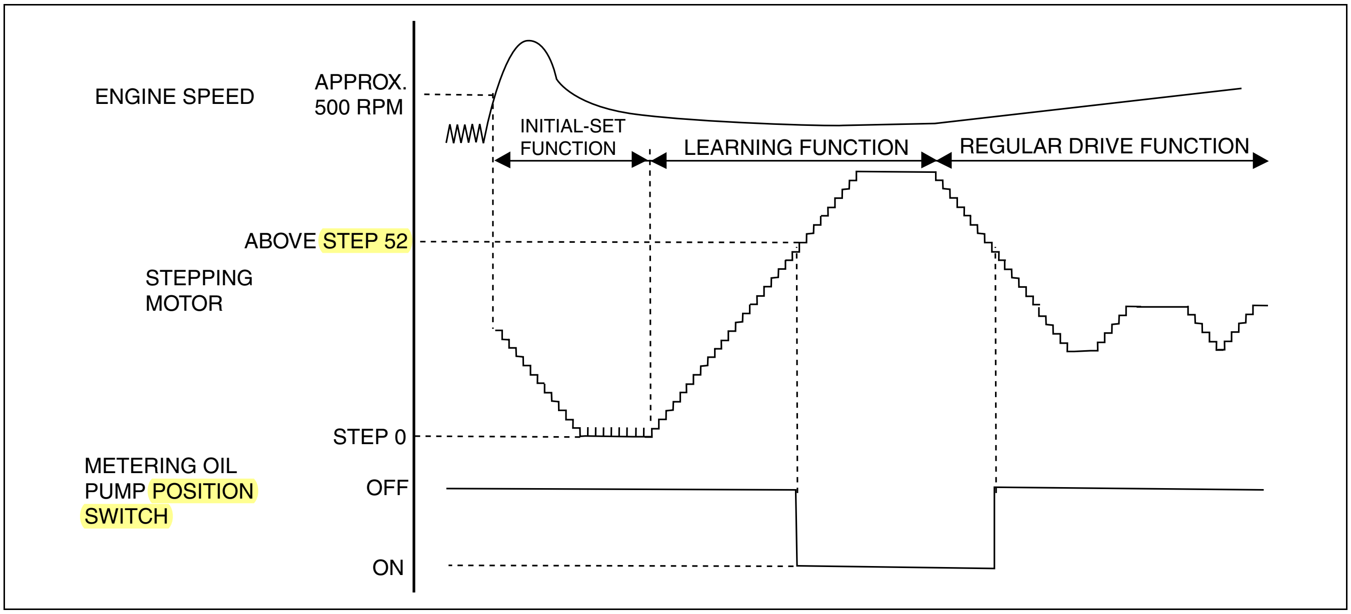
- Reverses the stepping motor 60 steps at engine start, and detects the 0-step position.
- The 0-step position becomes the reference for the regular drive function.



CHU0140S028

Monitor Function

- When the following conditions are met and after the initial-set function is completed, the monitor function activates.
  - — Ignition switch at ON for 12th time.
  - — When the battery terminals are connected.
- The PCM monitors the stepping motor position when the position switch is on. The monitor method is as follows:
  - — The stepping motor is rotated 60 steps clockwise from the 0-step position after the initial-set function, the step number is counted until the position switch turns on.
- The position switch is on above step 52. However, if the on position for the position switch is not detected above step 52, a malfunction of the stepping motor is determined and the fail-safe function is activated.



CHU0140S029

Fail-safe Function

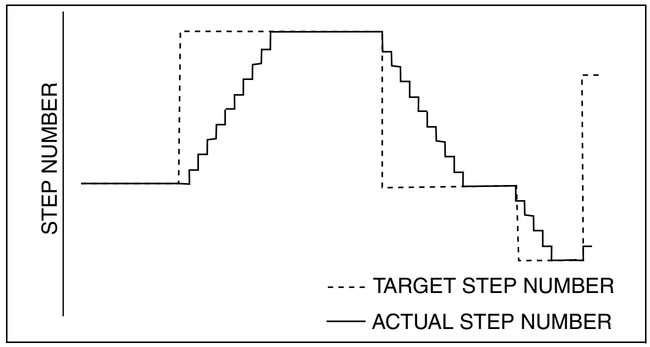
- When the stepping motor is determined to be malfunctioning by the monitor function, the fail-safe function is activated.
- The fail-safe function controls fuel injection time, ignition timing, the target step for the stepping motor as indicated in the table below, and controls engine output to protect the engine. Due to this, burning of engine seals is prevented.
- Ineffective injection time is determined according to battery voltage and lengthens as battery voltage becomes lower.

Fail-safe for each control

Control	Fail-safe	
Fuel injection control (pulse width at last injection)	At engine start	Regular control
	When the throttle opening angle exceeds 13%.	4.50 ms + ineffective injection time
	Other	2.65 ms + ineffective injection time
Ignition timing control (ignition timing)	Leading side	Fixed at 4.88°CA
	Trailing side	
Metering oil pump control (Step number)	Stepping motor fixed at step 7	

Regular Drive Function

- The PCM always calculates the optimum target step number according to the engine operation conditions, and controls the stepping motor step number so that it is close to the actual step number in reference to the target.
- If the actual step number is less than the target step number, the amount of stroke of the plunger is increased by increasing the stepping motor step number, which increases the amount of oil delivered. If the actual step number is larger than the target step number, the stepping motor step number is lowered, the amount of stroke of the plunger is reduced, and the amount of oil delivery is reduced. (See 01–11–5 METERING OIL PUMP CONSTRUCTION/OPERATION.)



CHU0140S030

Ignition Switch Off Function

- After the ignition switch is turned off, the PCM sets the target step to step 0 and when the actual step reaches 0, control of the metering oil pump ends.
- After the ignition switch is turned off, a main relay ON request is output and the ignition switch off function operates. (See 01–40–10 MAIN RELAY CONTROL OPERATION.)

HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL OUTLINE

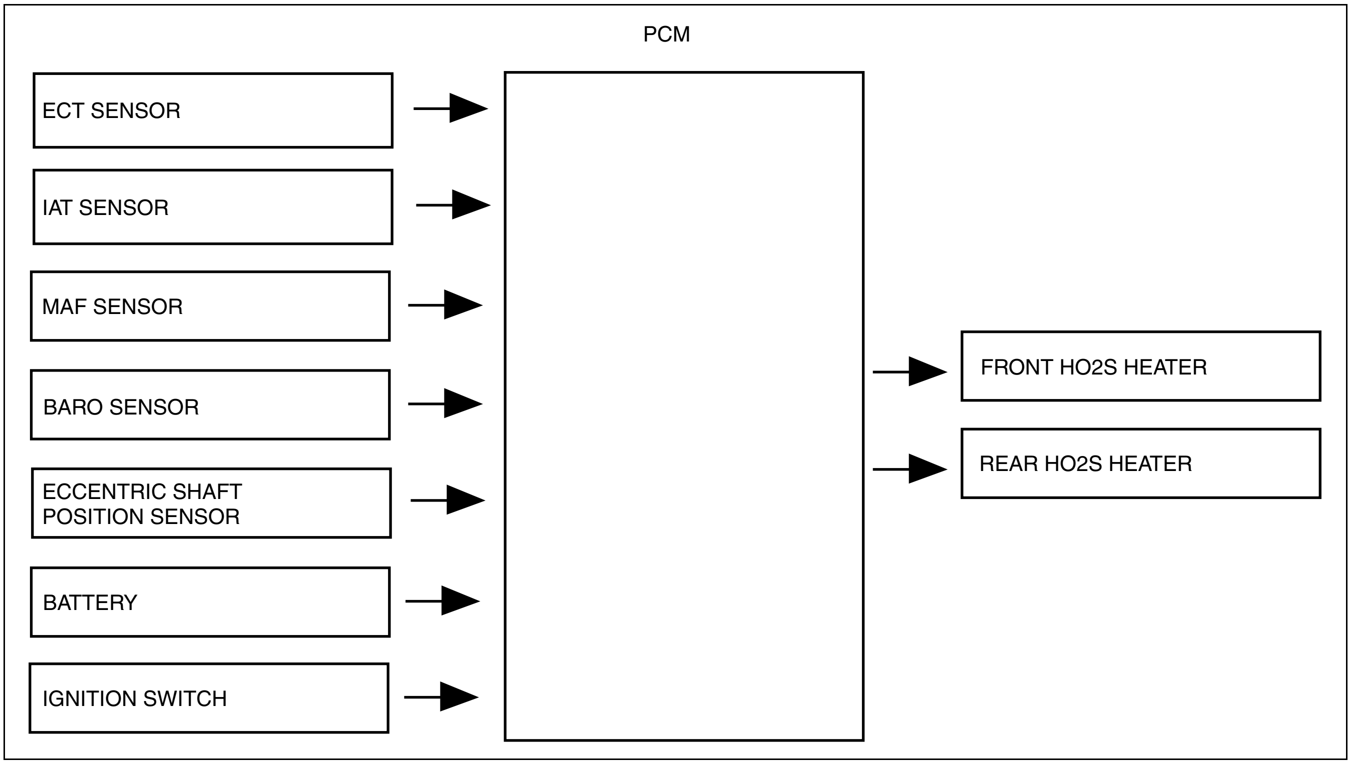
CHU014000140S39

- Stabilized oxygen concentrations, even when the exhaust gas temperature is low, are detected by controlling of the HO2S, enabling feedback control of the fuel injection control even during cold-engine starting, improving emission performance when cold.
- When the exhaust gas temperature is high, the HO2S is protected from sharp rises in its temperature by stopping energization to the O2S heater.
- Emission performance improvement and protection of the HO2S have both been achieved by the duty control of the front and rear HO2S according to the engine operation conditions (exhaust gas temperature).

HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL BLOCK DIAGRAM

CHU014000140S40

- The PCM determines the engine conditions based on input signals and sends an operation signal to the front or rear HO2S.



CHU0140S031

HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL OPERATION

CHU014000140S41

Operation Conditions

- The PCM operates the HO2S when the following conditions are met.

HO2S	Activation condition	Drive signal
Front	• After engine start • After the engine has started and a fixed period of time has elapsed (the elapsed time period after the engine starts is determined by ECT). • ECT is 5°C {41°F} or more. • Battery positive voltage is 9 V or more and less than 16 V. • MAF sensor is normal (no DTC is stored in PCM).	• The PCM outputs a duty signal. • The element temperature is measured by the impedance of the HO2S and a duty ratio is determined.
Rear	• Starter is off • After engine start • After the engine has started and a fixed period of time has elapsed (the time period after the engine starts lenghtens if the ECT falls below 0°C {32°F}. • ECT is 10°C {50°F} or more. • Battery positive voltage is 9 V or more and less than 16 V. • Charging efficiency is the fixed value or less, or during fuel cut.	• The PCM outputs a duty signal. However the duty signal is either 100% or 0%.

A/C CUT-OFF CONTROL OUTLINE

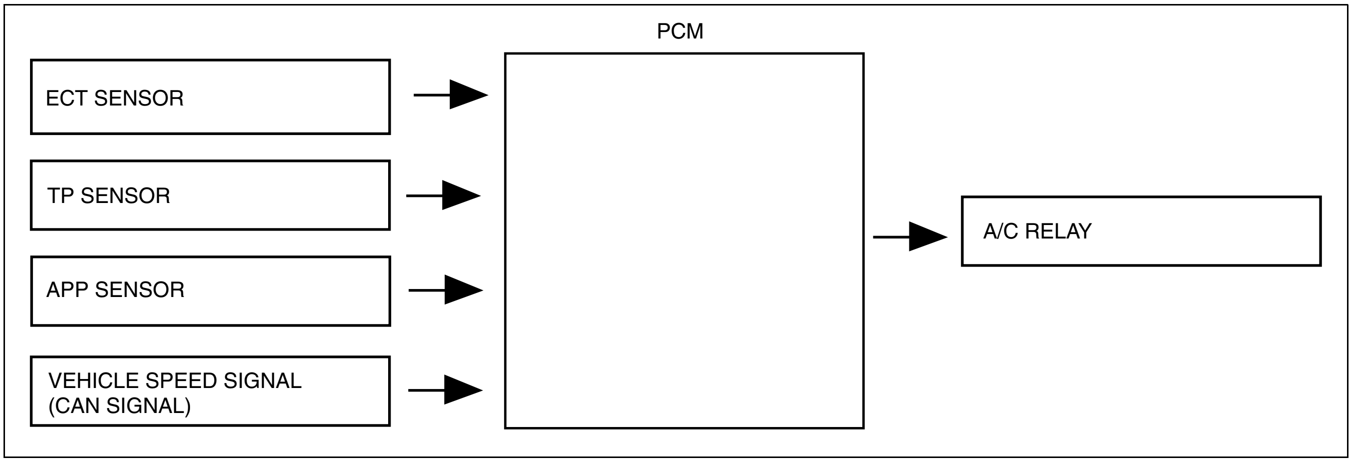
CHU014000140S42

- The current application (energize/de-energize) to the A/C relay (magnetic clutch) is controlled according to the engine operation conditions to prevent deterioration of engine performance, damage to the engine, and deterioration of the A/C function.

A/C CUT-OFF CONTROL BLOCK DIAGRAM

CHU014000140S43

- The PCM determines the engine conditions based on signals from the various input parts and sends an on/off control signal to the A/C relay.



CHU0140S032

A/C CUT-OFF CONTROL OPERATION

CHU014000140S44

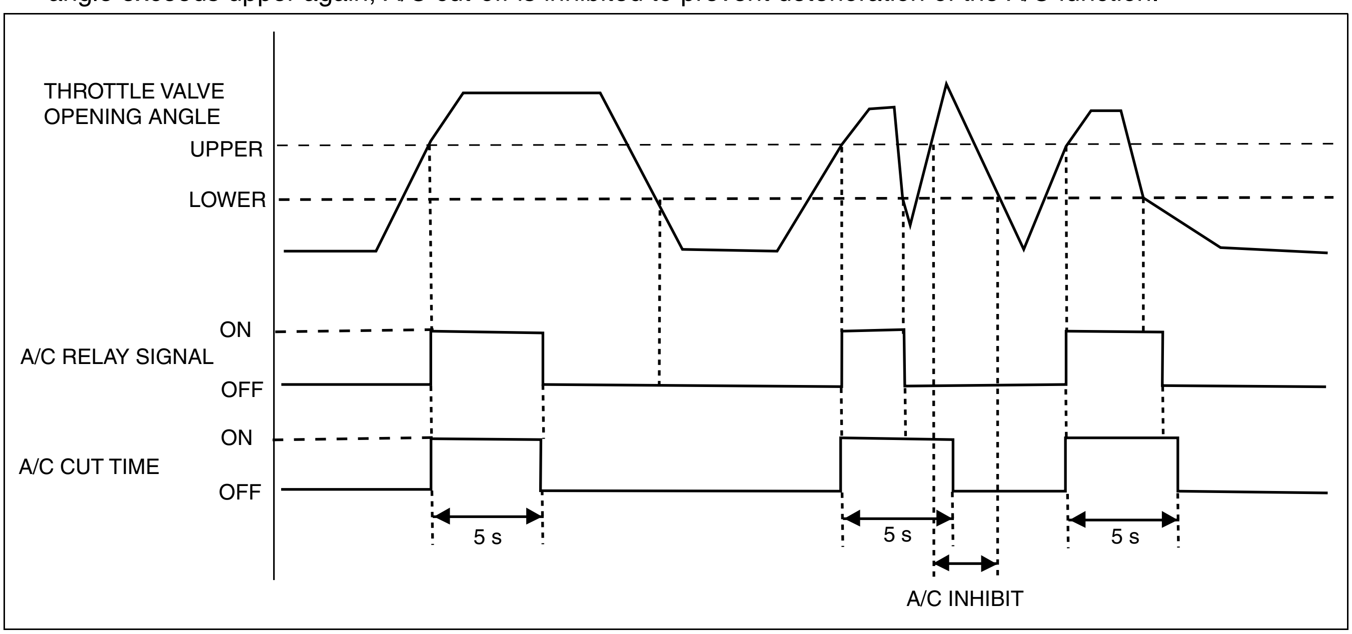
Operation

- The A/C cut-off control includes the following: A/C cut-off at wide throttle valve opening angle and A/C cut-off at standing start acceleration.

A/C Cut-off at Wide Throttle Valve Opening Angle

Operation condition

- When the throttle valve opening angle exceeds upper, A/C cut-off is activated for approx. 5 s to improve acceleration performance.
- When the throttle valve opening angle is lower or less, A/C cut-off ends.
- When A/C cut-off at wide throttle valve opening angle ends within approx. 5 s and the throttle valve opening angle exceeds upper again, A/C cut-off is inhibited to prevent deterioration of the A/C function.



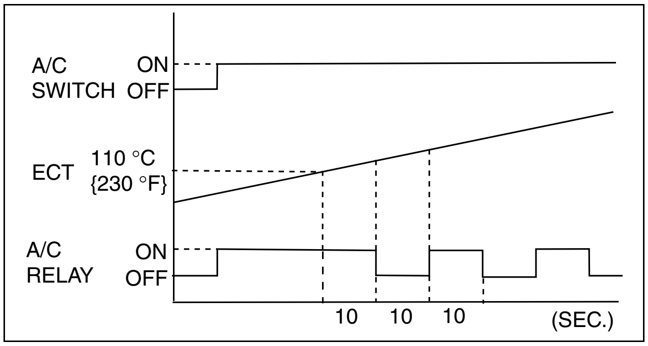
CHU0140S033

A/C Cut-off at Standing Start Acceleration

- When accelerated from a standing start, A/C cut-off is activated.

A/C Cut-off at High ECT

- When the ECT exceeds 110 °C {230°F} during the A/C operation, the A/C relay alternately turns on and off approx. every 10 s to protect the engine and to prevent deterioration of the A/C function.



CHU0140S078

ELECTRICAL FAN CONTROL OUTLINE

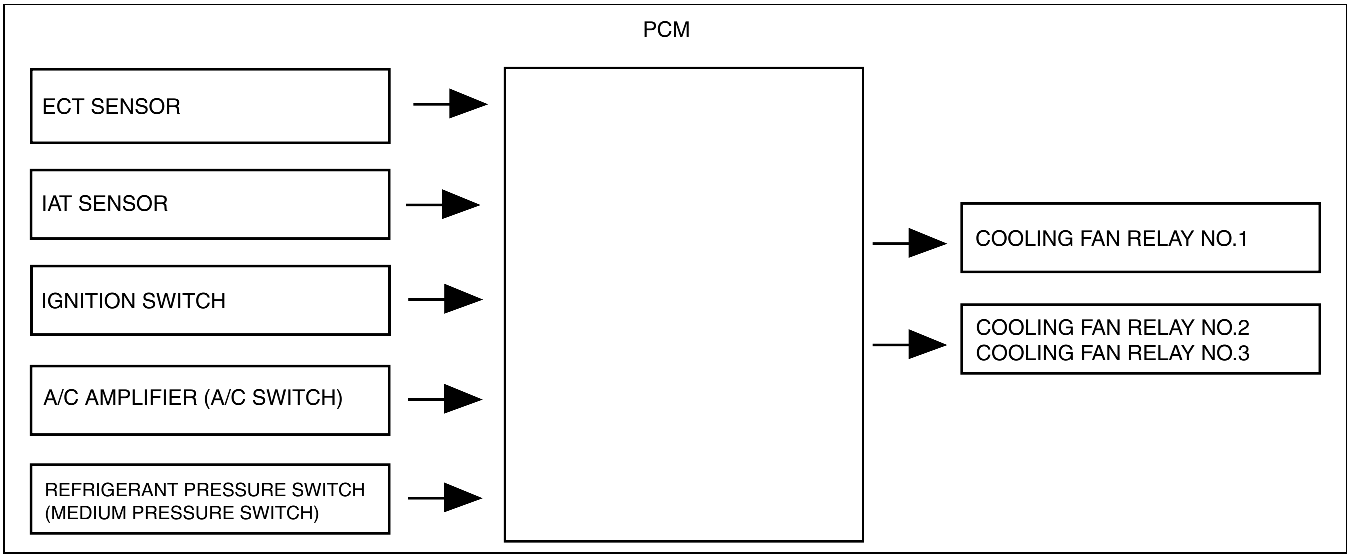
CHU014000140S45

- Cooling fan relays No.1, No.2, and No.3 turn on and off to control operation timing and rotation speed of the cooling fan motor according to the engine conditions. Due to this, the radiator and condenser are cooled efficiently, preventing overheating and overcooling.
- The electrical fan control includes the regular-driving cooling function and the after-cooling function.
- The regular-driving cooling function operates according to the engine conditions during the engine operation.
- The after-cooling function operates when the vehicle has stopped at high engine temperature (ignition switch off).
- After the ignition switch is turned off, a main relay on request is sent to operate the after-cooling function. (See 01–40–10 MAIN RELAY CONTROL OPERATION.)

ELECTRICAL FAN CONTROL BLOCK DIAGRAM

CHU014000140S46

- The PCM determines the engine conditions based on input signals and sends an on/off signal to cooling fan relay No.1 or No.2/No.3.



CHU0140S035

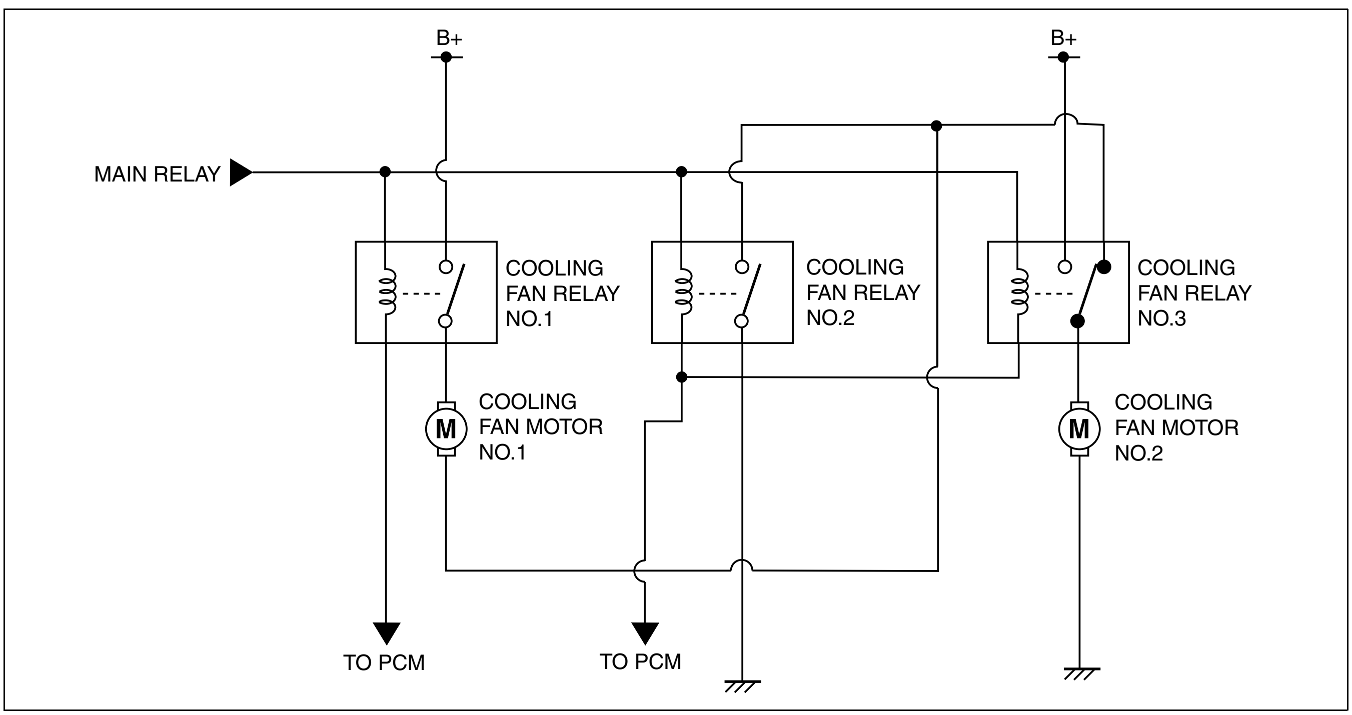
ELECTRICAL FAN CONTROL OPERATION

CHU014000140S47

- When the operation conditions are met for each function, the PCM sends an operation signal to cooling fan relay No.1 or No.2/No.3 to operate the cooling fan motors.
- The rotation speed of the cooling fan motor is switched between two levels according to a combination of the cooling fan relays.
- When only cooling fan relay No.1 is on, the rotation speed is low and when in addition to No.1, No.2 and No.3 are on, rotation speed is high.

Operation Conditions

Function	Operation condition	Cooling fan motor		Cooling fan relay	
		No.1	No.2	No.1	No.2/No.3
Regular-driving cooling	ECT: Less than 97°C {206.6°F}	Stop		OFF	OFF
	ECT: 97°C {206.6°F} or more	Low speed rotation		ON	OFF
	• When all the following conditions are met: — ECT: 97°C {206.6°F} or more — During fuel cut at deceleration	Low speed rotation		ON	OFF
	A/C amplifier (A/C switch): ON	Low speed rotation		ON	OFF
	ECT: 101°C {213.8°F} or more	High speed rotation		ON	
	• When all the following conditions are met: — ECT: 101°C {213.8°F} or less — A/C amplifier (A/C switch): ON — Refrigerant pressure switch (medium-pressure switch): ON	High speed rotation		ON	
After-cooling	• When all the following conditions are met: — Ignition switch: OFF — Drive-by-wire relay: OFF — Metering oil pump: Other than during ignition switch off mode — Engine compartment temperature high.	High speed rotation		ON	
	• When all the following conditions are met: — Ignition switch: OFF — Drive-by-wire relay: OFF — Metering oil pump: Other than during ignition switch off mode — ECT: 110°C {230°F} or more	High speed rotation		ON	
Forced drive	During test mode (during test mode with WDS) when the AP is depressed.	High speed rotation		ON	
Fail safe	When a failure occurs in the ECT sensor.	High speed rotation		ON	



CHU0140S036

GENERATOR CONTROL OUTLINE

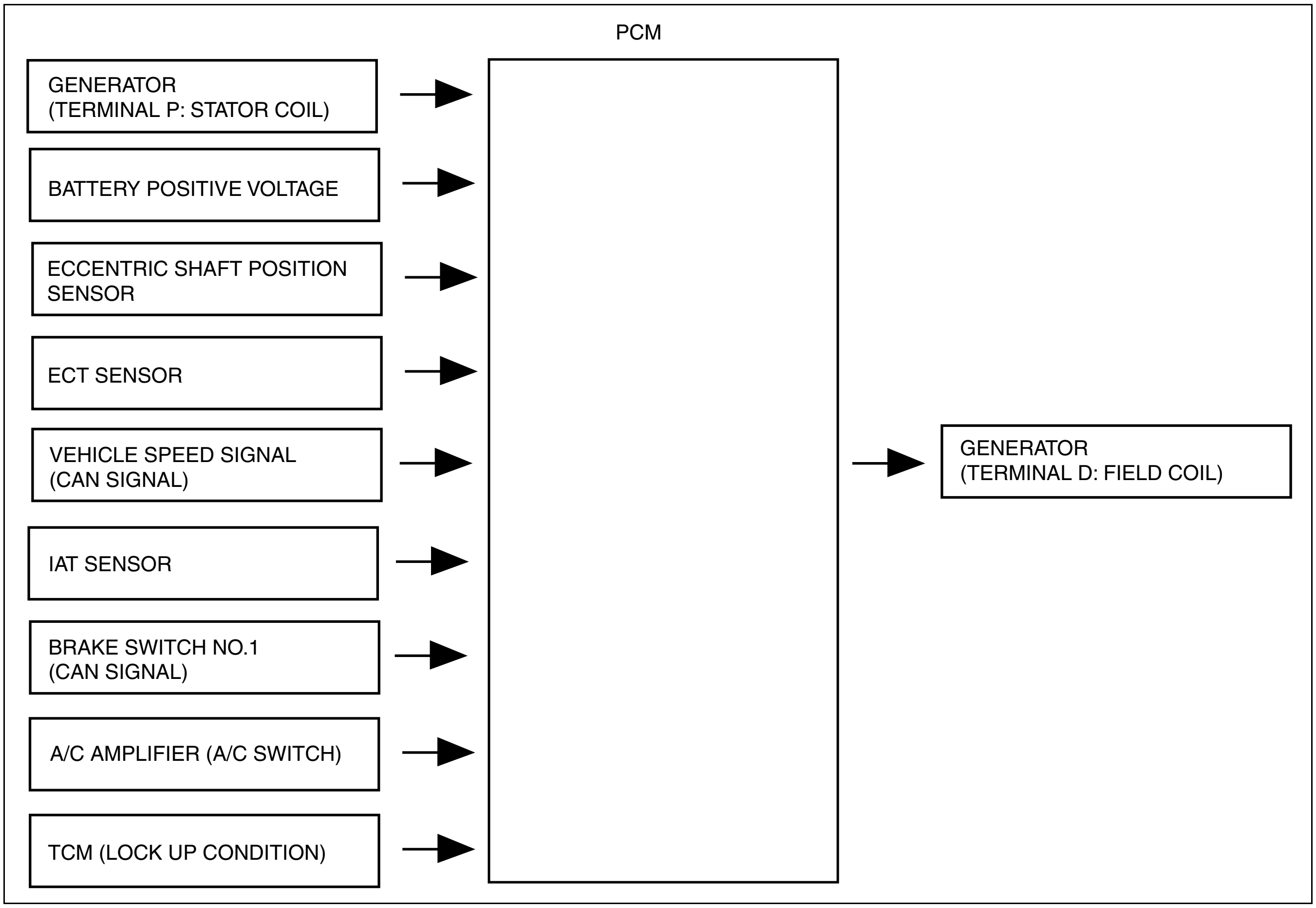
CHU014000140S48

- Generator output is optimized according to the engine operation and electrical load conditions, ensuring idling stability and anti-load performance.

GENERATOR CONTROL BLOCK DIAGRAM

CHU014000140S49

- The PCM determines the engine operation and electrical load conditions based on input signals, and controls energization time of the generator field coil.

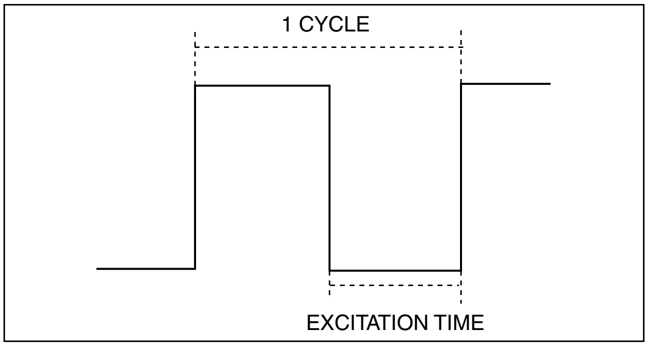


CHU0140S037

GENERATOR CONTROL OPERATION

CHU014000140S50

Determination of Field Coil Excitation Time



CHU0140S073

- The PCM increases or decreases the field coil excitation current by sending a duty signal to the power transistor built into the generator.
- The PCM changes the duty ratio of the duty signal to change the energization time of the power transistor. As a result, field coil excitation current is changed. For example, when the battery positive voltage drops, the duty ratio of the duty signal sent to the power transistor is larger, increasing the field coil excitation current.

Control

- In order to maintain the optimum battery positive voltage, the PCM calculates the target generator current (target output current) and target excitation current according to the generator rotation speed at that time.
- The generator rotation speed is calculated based on the ratio between the generator pulley and eccentric shaft pulley, and the engine speed.
- The target output current is calculated from the difference obtained by comparison between present battery positive voltage and target battery positive voltage (regulated voltage), calculated based on the IAT, engine speed, and vehicle speed.
- When an electrical load is applied, power consumption increases and the battery positive voltage drops, increasing the target engine speed at idling.

CONTROLLER AREA NETWORK (CAN) OUTLINE

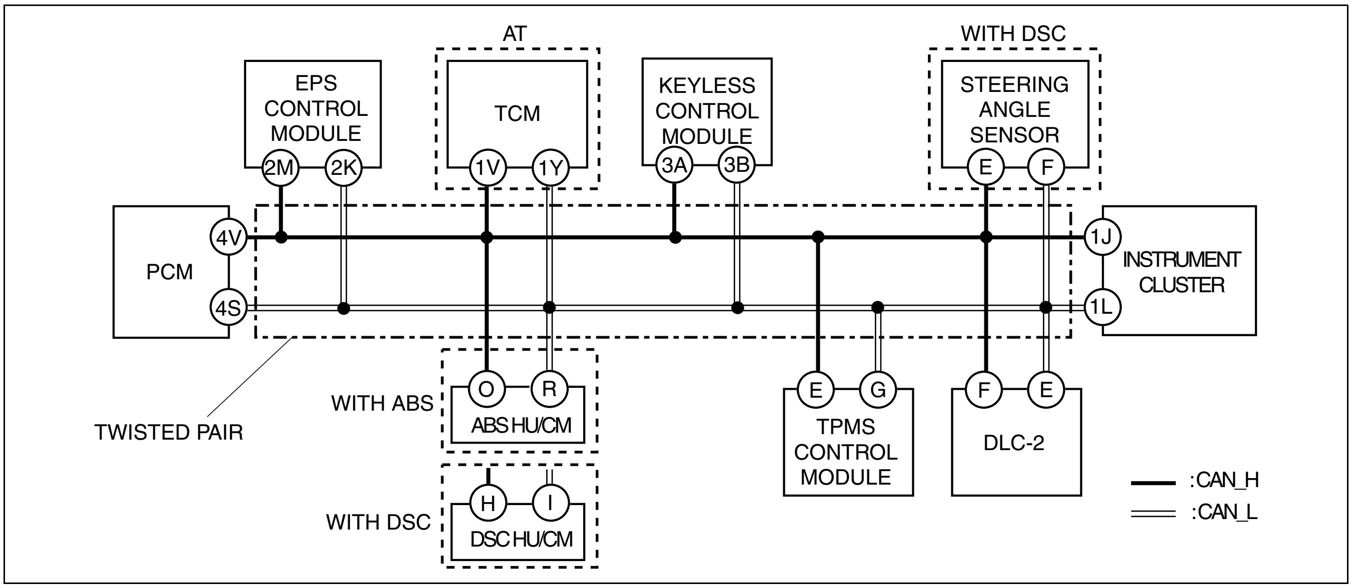
CHU014000140S51

- Used for communication with the EPS control module, TCM (AT), keyless control module, instrument cluster, ABS HU/CM or DSC HU/CM and TPMS control module.
- By the adoption of the CAN, wiring between the PCM and other units has been simplified.

CONTROLLER AREA NETWORK (CAN) SYSTEM WIRING DIAGRAM

CHU014000140S52

- The PCM performs communication of vehicle information with the EPS control module, TCM (AT), keyless control module, instrument cluster, ABS HU/CM or DSC HU/CM, TPMS control module and DLC-2.



CHU0140S088

CONTROLLER AREA NETWORK (CAN) OPERATION

CHU014000140S53

- The PCM communicates the following vehicle information with the EPS control module, TCM (AT), keyless control module, steering angle sensor, instrument cluster, ABS HU/CM or DSC HU/CM, TPMS control module via CAN line.

CAN Signal-Chart (Between PCM and other units)

OUT: Output (sends signal)
IN: Input (receives signal)

Signal	Multiplex module							
	PCM	EPS control module	TCM (AT)	ABS HU/CM / DSC HU/CM	Keyless control module	TPMS control module	Steering angle sensor	Instrument cluster
Immobilizer-related information	OUT	–	–	–	IN	–	–	–
	IN	–	–	–	OUT	–	–	–
Engine speed	OUT	IN	IN	– / IN	IN	– / IN	–	IN
Vehicle speed	OUT	IN	–	–	–	IN	–	IN
	IN	–	OUT	–	–	–	–	–
Throttle valve opening angle	OUT	–	IN	– / IN	–	–	–	–

Signal	Multiplex module							
	PCM	EPS control module	TCM (AT)	ABS HU/CM DSC HU/CM	Keyless control module	TPMS control module	Steering angle sensor	Instrument cluster
Engine coolant temperature	OUT	–	IN	–	–	–	–	IN
Engine torque	OUT	–	IN	– IN	–	–	–	IN
Torque reduction disable	OUT	–	IN	– IN	–	IN	–	–
Travelled distance	OUT	–	–	–	–	–	–	IN
Fuel injection amount	OUT	–	–	–	–	–	–	IN
Engine oil pressure	OUT	–	–	–	–	–	–	IN
Engine oil level	OUT	–	–	–	–	–	–	IN
Engine coolant level	OUT	–	–	–	–	–	–	IN
Fuel pump status	OUT	–	–	–	–	–	–	IN
MIL on request	OUT	–	–	–	–	–	–	IN
	IN	–	OUT	–	–	–	–	–
Generator warning light on request	OUT	–	–	–	–	–	–	IN
Transmission/axle specifications	OUT	–	–	– IN	–	–	–	–
Tire size	OUT	–	–	IN	–	–	–	–
Cruise control main indicator light on request	OUT	–	IN	–	–	–	–	IN
Cruise control indicator light on request	OUT	–	IN	–	–	–	–	IN
Downshift request	OUT	–	IN	–	–	–	–	–
Idle speed increase request	IN	OUT	OUT	–	–	–	–	–
Ignition switch off time	IN	–	–	–	OUT	–	–	–
Target torque	IN	–	OUT	–	–	–	–	–
Torque upper limit	IN	–	OUT	–	–	–	–	–
Turbine shaft speed	IN	–	OUT	–	–	–	–	–
Target gear position/ selector lever position	IN	–	OUT	– IN	–	–	–	IN
Gear ratio	IN	–	OUT	–	–	–	–	–
Brake system status: ABS/EBD EBD/ABS/DSC	IN	IN	IN	OUT OUT	–	–	–	IN
Torque down request	IN	–	OUT	– OUT	–	–	–	–
Wheel speed (LF, RF, LR, RR)	IN	–	–	OUT	–	–	–	–
Wheel speed status (LF, RF, LR, RR)	IN	–	–	OUT	–	–	–	–
Fuel tank level	IN	–	–	–	–	–	–	OUT

PCM FUNCTION

CHU014018880S01

Function List

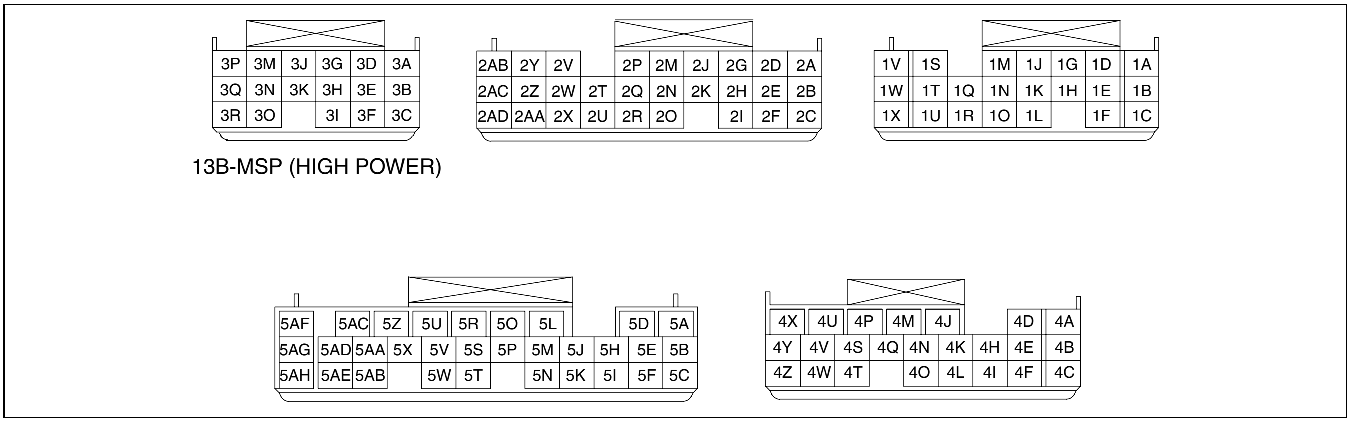
- The control descriptions are as shown below.

Function	Description
Main relay control	Turns on the main relay according to requests from the controls, even when the ignition switch is off.
Drive-by-wire control	Controls the drive-by-wire actuator to obtain the optimum throttle valve opening angle according to the engine operation conditions.
Drive-by-wire relay control	Controls the drive-by-wire relay according to the ignition switch signal.
Sequential dynamic air intake system (S-DAIS) control	Controls the VFAD solenoid valve (13B-MSP (High Power)), SSV solenoid valve, VDI solenoid valve, and APV motor (13B-MSP (High Power)) according to the engine speed condition.
Fuel injection control	Calculates the optimum fuel injection amount according to the engine conditions, and controls injection time and injection timing of the injector.
Fuel pump control	Controls the fuel pump relay according to the eccentric shaft position sensor signal.
Fuel pump speed control	Controls fuel pump speed control relay according to the fuel amount required by the engine.
Ignition timing control	Controls timing of the energization applied to the ignition coils according to the engine conditions.
Secondary air injection control	Controls the secondary air injection solenoid valve and secondary air injection pump relay at startup with the cold engine.
Metering oil pump control	Controls the stepping motor in the metering oil pump according to the engine conditions.
Evaporative purge control	Controls the purge solenoid valve according to the driving condition.
Heated oxygen sensor heater control	Controls the heated oxygen sensor heater when cold.
A/C cut-off control	Controls the A/C relay according to the driving condition.
Electrical fan control	Controls the cooling fan relays No.1 and No.2/No.3 according to the engine conditions.
Generator control	Controls the energization applied to the generator field coil according to the engine operation and electrical load conditions.
Controller area network	Communicates with the instrument cluster, ABS HU/CM or DSC HU/CM, EPS control module, keyless control module, steering angle sensor TPMS control module and TCM via the CAN.

PCM CONSTRUCTION/OPERATION

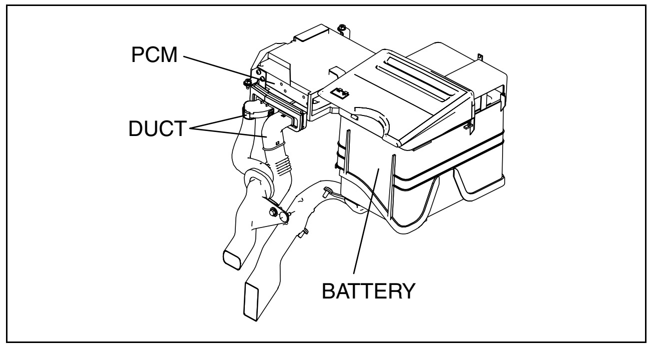
CHU014018880S02

- Located in front area of the engine compartment.
- 122-pin connector (13B-MSP (High Power)) or 105-pin connector (13B-MSP (Standard Power)) is used for the PCM.



CHU0140S079

- The fresh air induction duct has been installed to cool the PCM. During regular driving, fresh air is induced by wind that blows against the vehicle as it is running. When the PCM temperature is high and the vehicle has stopped, the cooling fan operates, inducing additional fresh air.



CHU0140S040

NEUTRAL SWITCH FUNCTION (MT)

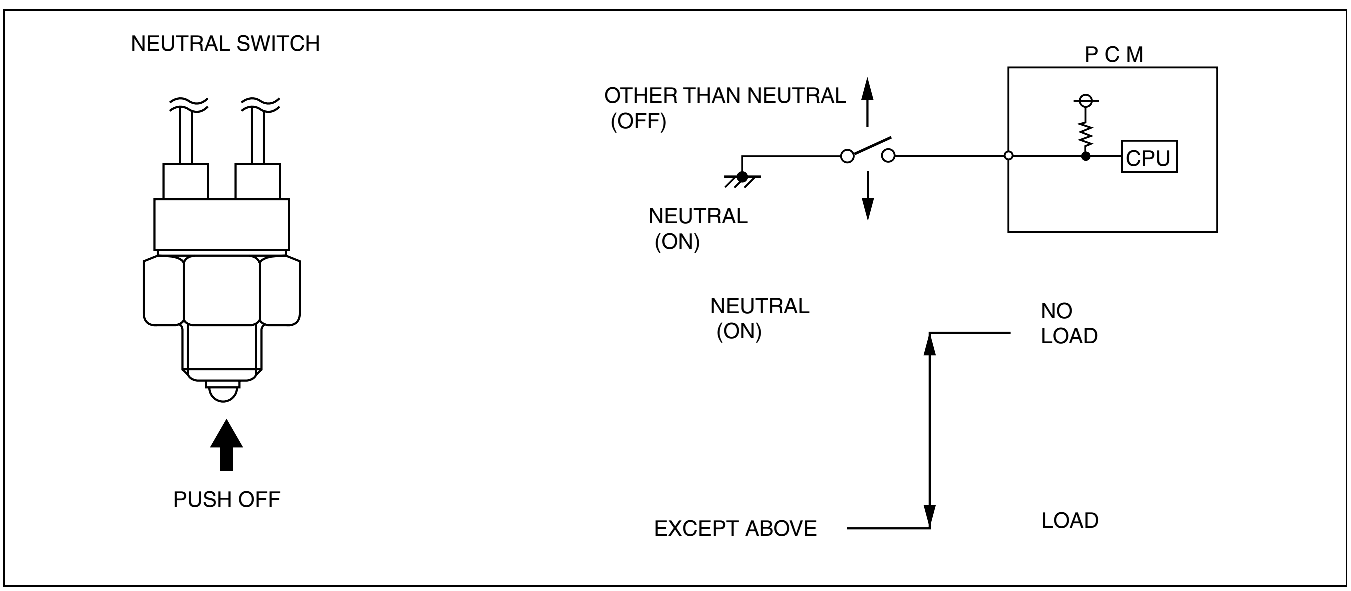
CHU014017640S01

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

NEUTRAL SWITCH CONSTRUCTION/OPERATION (MT)

CHU014017640S02

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



CHU0140S042

CLUTCH PEDAL POSITION (CPP) SWITCH FUNCTION (MT)

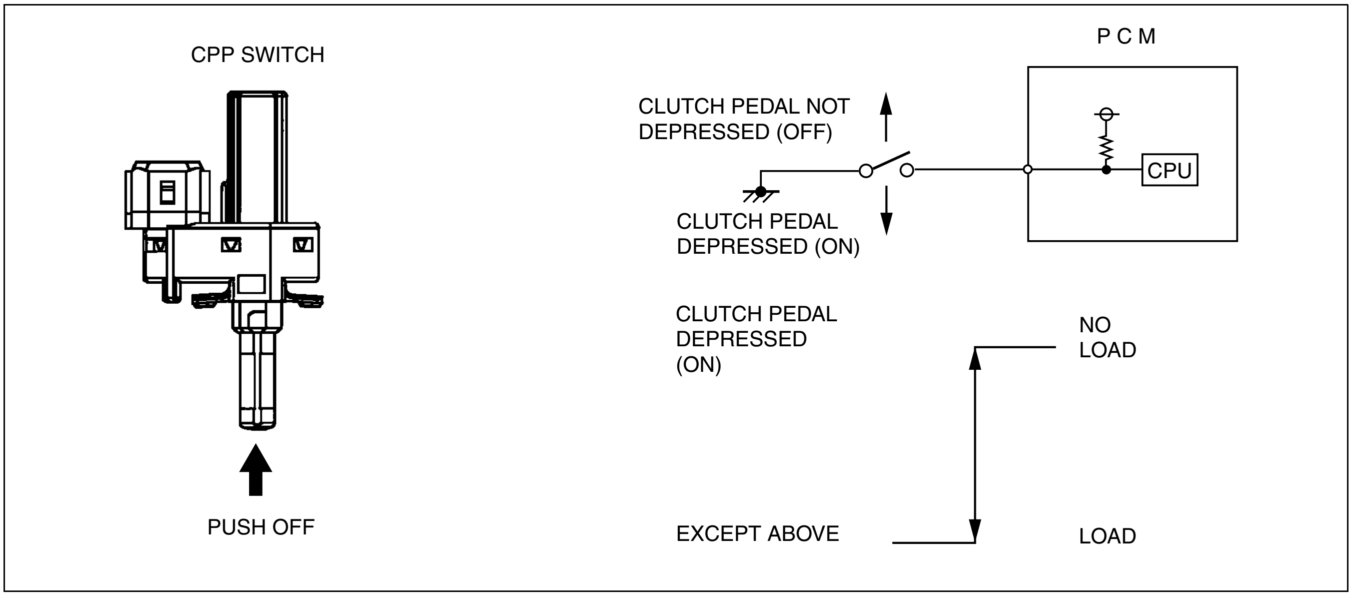
CHU014018990S01

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

CLUTCH PEDAL POSITION (CPP) SWITCH CONSTRUCTION/OPERATION (MT)

CHU014018660S01

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



CHU0140S043

SECONDARY SHUTTER VALVE (SSV) SWITCH FUNCTION

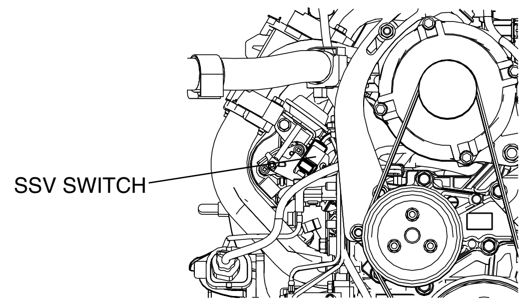
CHU014018990S02

- Detects whether the SSV is open or closed.

SECONDARY SHUTTER VALVE (SSV) SWITCH CONSTRUCTION/OPERATION

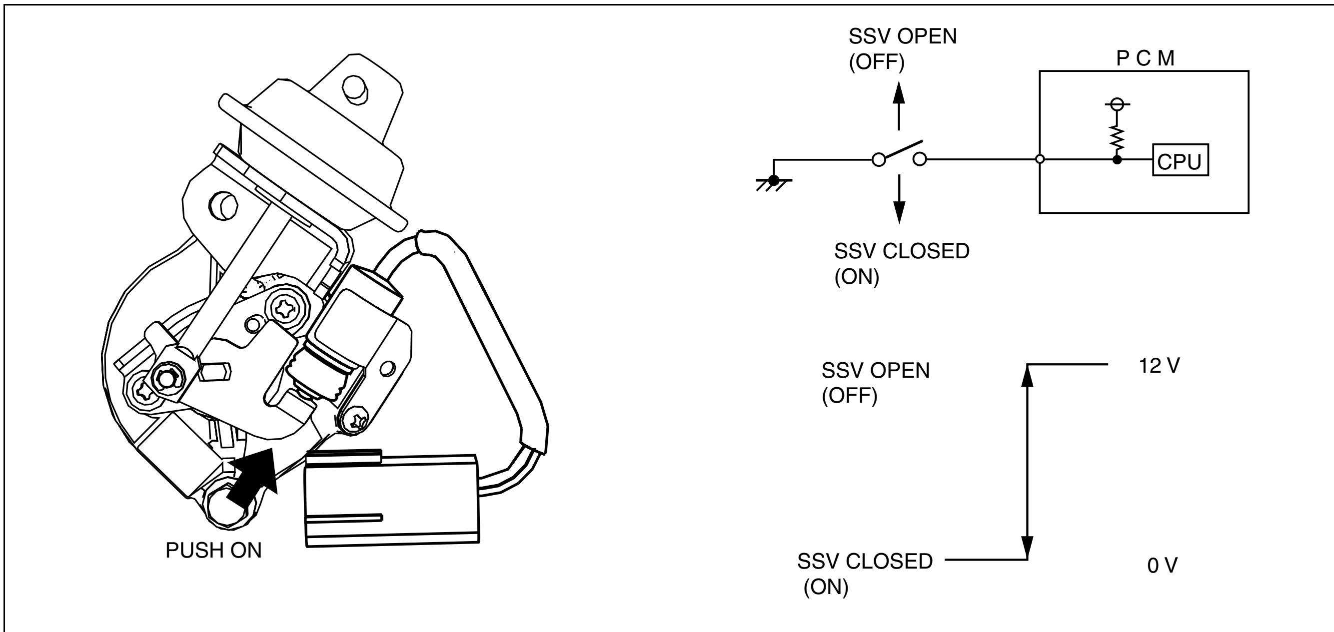
CHU014018660S02

- The SSV switch is installed on the position close to the SSV actuator.
- When the SSV is closed, the SSV switch contact closes (ON) and the PCM detects a voltage of 0 V. When the SSV is open, the SSV switch contact opens (OFF) and the PCM detects a voltage of 12 V.



(ILLUSTRATION SHOWS 13B-MSP (HIGH POWER))

CHU0140S044



CHU0140S045

AUXILIARY PORT VALVE (APV) POSITION SENSOR FUNCTION

CHU014018990S03

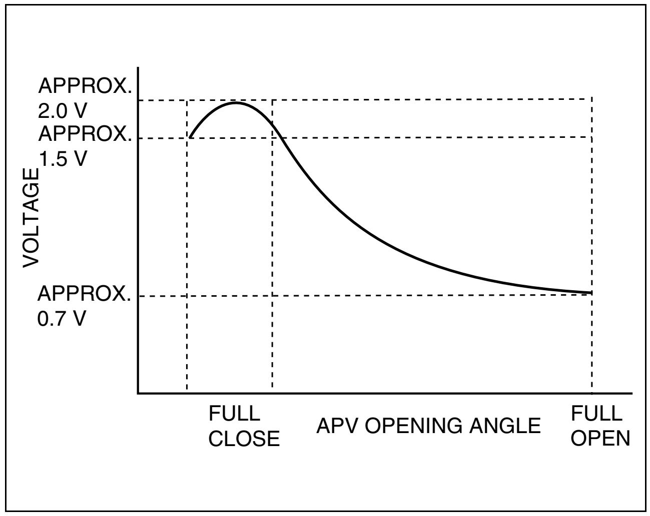
- The APV position sensor detects the APV fully-closed position to monitor the APV motor operation condition.

AUXILIARY PORT VALVE (APV) POSITION SENSOR CONSTRUCTION/OPERATION

CHU014018660S03

- The APV position sensor is built into the APV motor.
- The Hall element, used for the sensor, detects the APV fully-closed position and sends a voltage signal to the PCM.
- When the APV closes, the APV position sensor outputs a voltage of 1.5 V or more.

APV Position Sensor Voltage Characteristics



CHU0140S046

ENGINE COOLANT TEMPERATURE (ECT) SENSOR FUNCTION

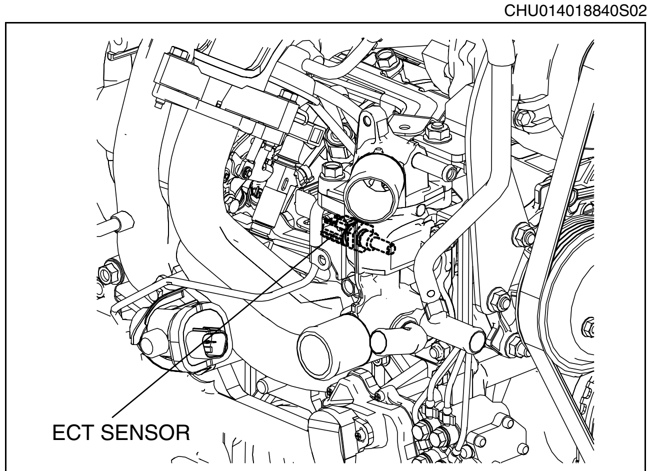
CHU014018840S01

- Detects the ECT.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR CONSTRUCTION/OPERATION

CHU014018840S02

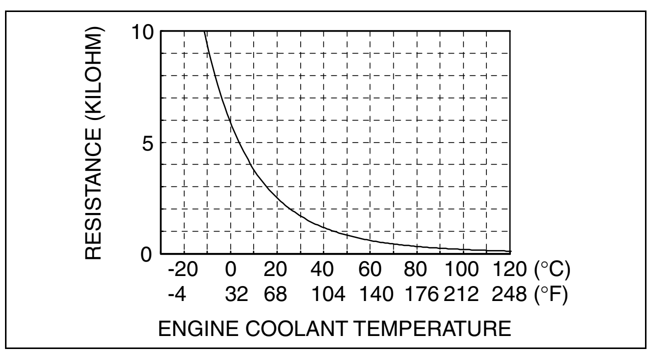
- Installed on the thermostat case.
- A thermistor type is used and the resistance changes according to the ECT.
- As shown in the characteristics graph, when the ECT is high, the resistance is small, and when the ECT is low, the resistance is large.



(ILLUSTRATION SHOWS 13B-MSP (HIGH POWER))

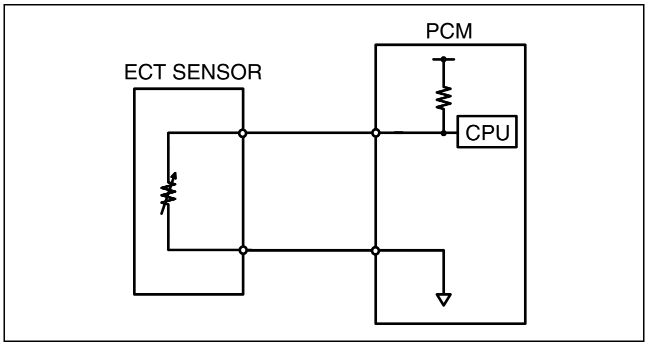
CHU0140S047

ECT Sensor Characteristics



CHU0140S048

System Diagram



CHU0140S049

INTAKE AIR TEMPERATURE (IAT) SENSOR FUNCTION

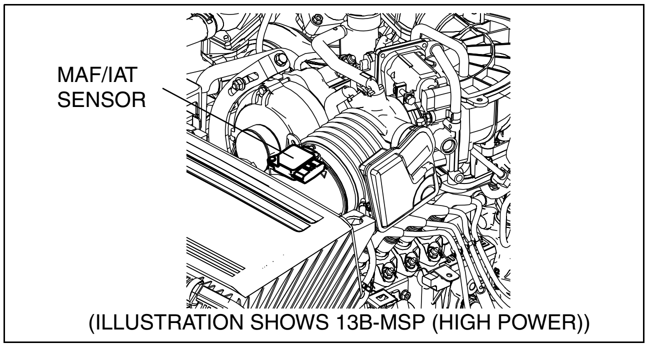
CHU014018840S03

- Detects the IAT.

INTAKE AIR TEMPERATURE (IAT) SENSOR CONSTRUCTION/OPERATION

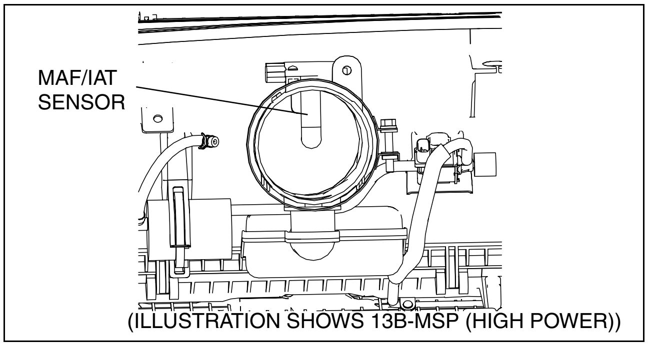
CHU014018840S04

- Installed on the air hose.



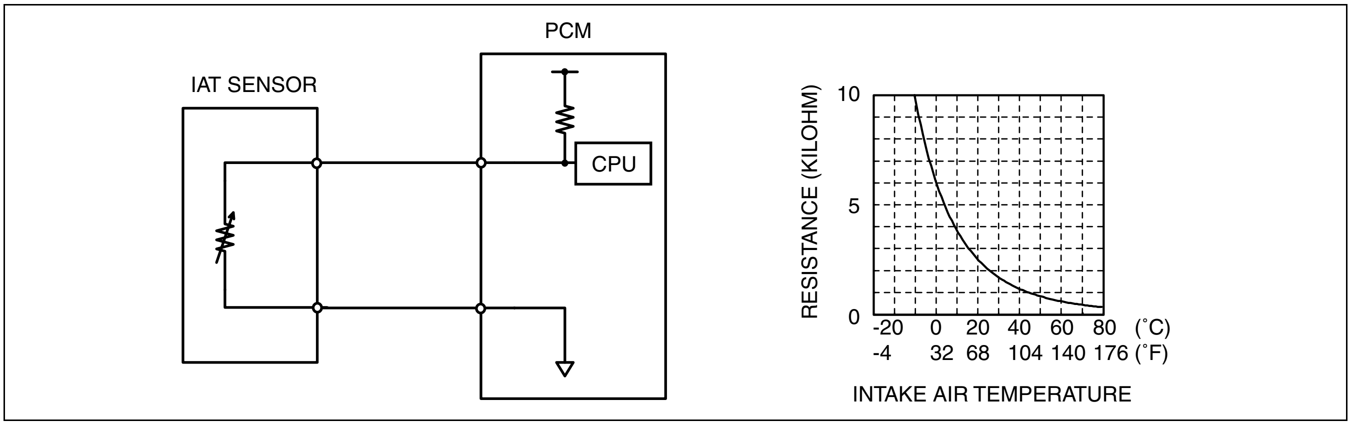
CHU0140S050

- Built into the MAF sensor.
- A thermistor type is used and the resistance changes according to the IAT.
- As shown in the characteristics graph, when the IAT is high, the resistance is low, and when the IAT is low, the resistance is high.



CHU0140S051

IAT Sensor Characteristics



CHU0140S052

THROTTLE POSITION (TP) SENSOR FUNCTION

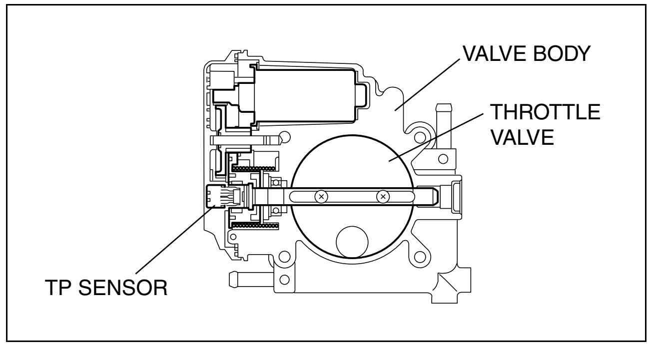
CHU014018910S01

- Detects the throttle valve opening angle.

THROTTLE POSITION (TP) SENSOR CONSTRUCTION/OPERATION

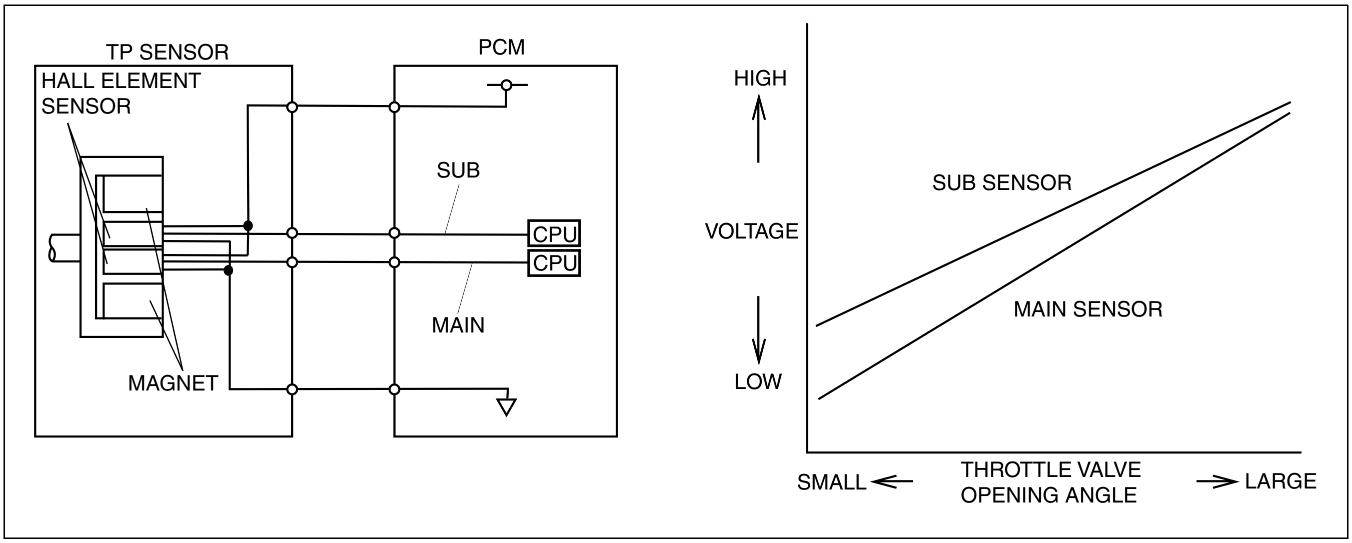
CHU014018910S02

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



CHU0140S053

TP Sensor Voltage Characteristics



CHU0140S055

ACCELERATOR PEDAL POSITION (APP) SENSOR FUNCTION

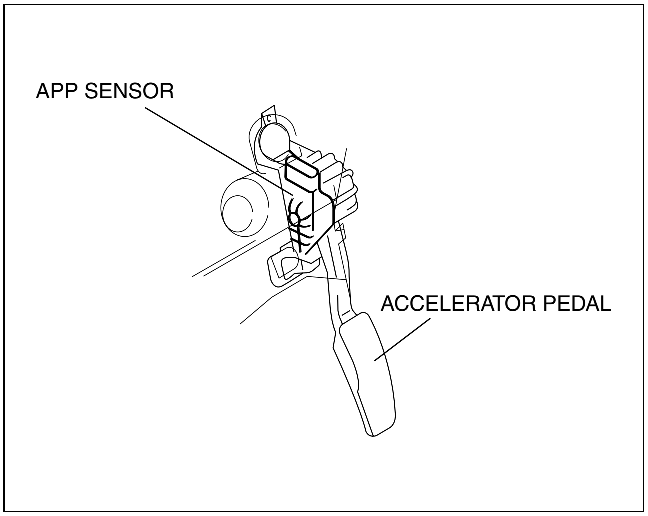
CHU014041600S01

- Detects how much the AP is depressed.

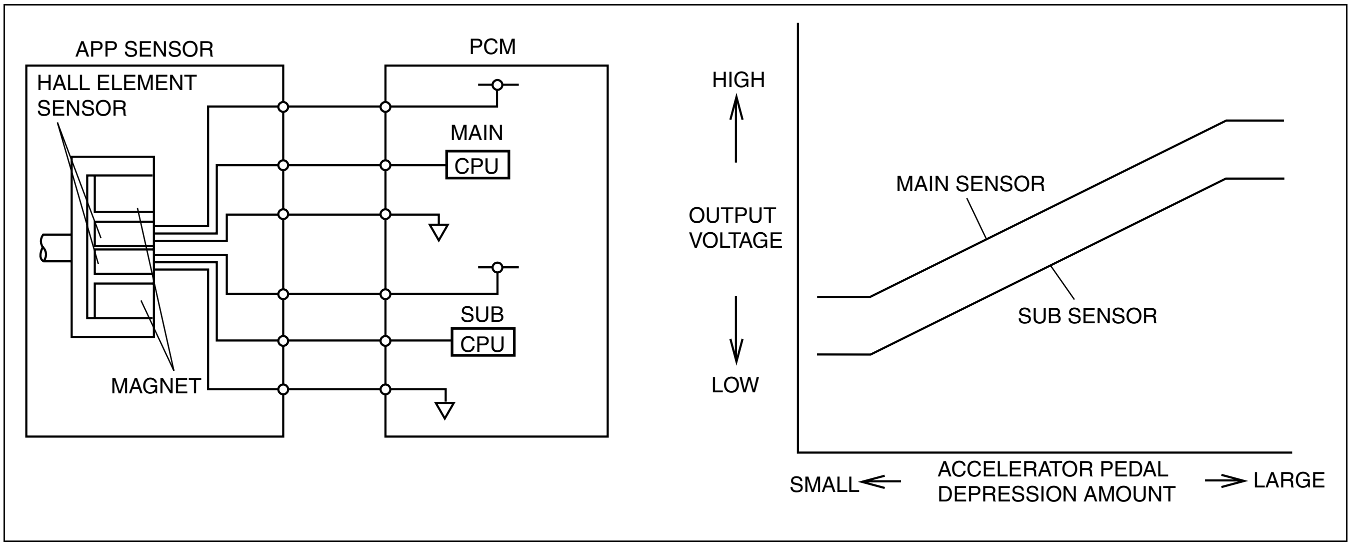
ACCELERATOR PEDAL POSITION (APP) SENSOR CONSTRUCTION/OPERATION

CHU014041600S02

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



CHU0140S056



CHU0140S057

MASS AIR FLOW (MAF) SENSOR FUNCTION

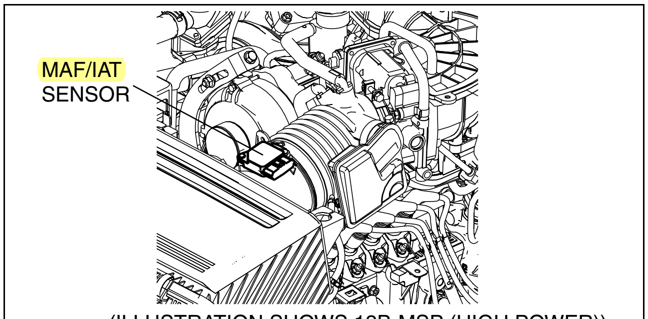
CHU014013215S01

- Detects the intake air amount (mass airflow amount).

MASS AIR FLOW (MAF) SENSOR CONSTRUCTION/OPERATION

CHU014013215S02

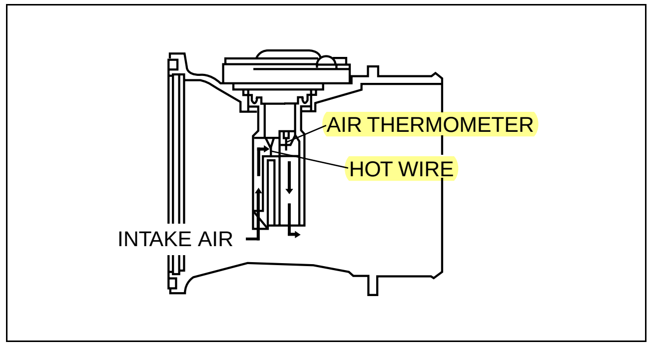
- Installed on the air hose.



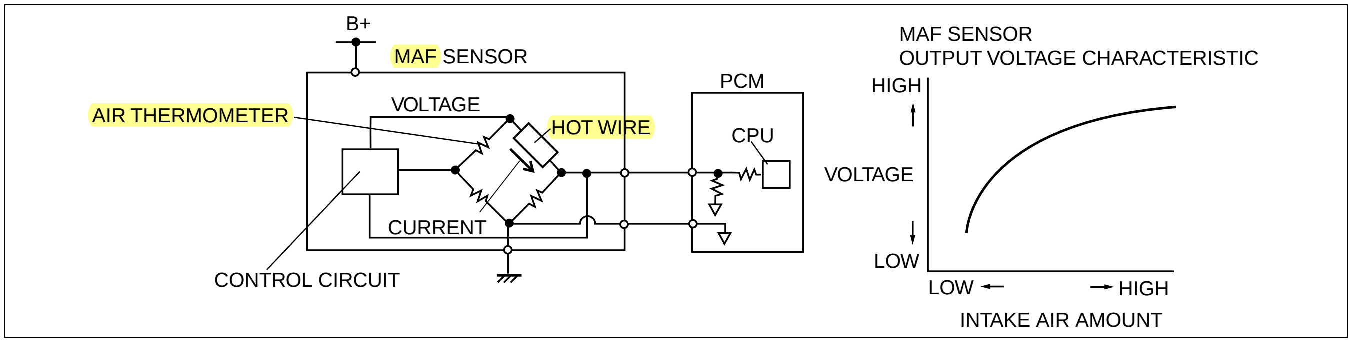
(ILLUSTRATION SHOWS 13B-MSP (HIGH POWER))

CHU0140S058

- Built into the intake air temperature IAT sensor.
- Converts the mass intake airflow amount into a voltage.
- When the heating element is placed in the air, the heat is dissipated by the air cooling the heating element. If there is a large volume of air circulating around the heating element, the amount of heat that is dissipated increases. This heat transfer utilizes the voltage which is changed by the heat transfer phenomenon.



CHU0140S080



CHU0140S081

FRONT HEATED OXYGEN SENSOR (HO2S) FUNCTION

CHU014018860S01

- The wide-range air/fuel ratio sensor, which can linearly detect the oxygen concentration (air/fuel ratio of the air-fuel mixture) in the exhaust gas in all ranges, from lean to rich, is used on the front HO2S.
- A heater has been adopted on the front HO2S, allowing stable detection of the oxygen concentration even when the exhaust gas temperature is low.

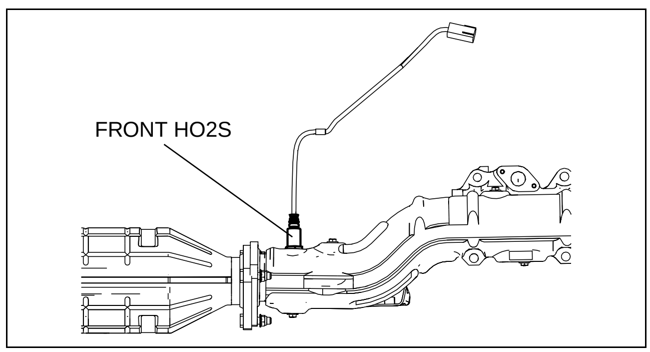
FRONT HEATED OXYGEN SENSOR (HO2S) CONSTRUCTION/OPERATION

CHU014018860S02

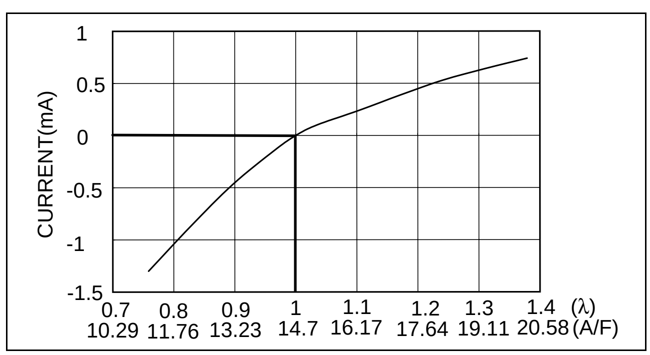
- Installed on the exhaust manifold.
- The wide-range air/fuel ratio sensor is a pump cell type sensor, using both the oxygen concentration cell action and oxygen pump cell action, and can detect the oxygen concentration (air/fuel ratio of the air-fuel mixture) in the exhaust gas in all ranges, from lean to rich.
- A heater is built into the sensor to facilitate the activation of the HO2S at engine startup (when the exhaust gas temperature is low).

Operation

- The wide-range air/fuel ratio sensor converts the oxygen concentration in the exhaust gas into a current value, and sends the value to the PCM.
- The PCM calculates the λ (lambda) value of the air-fuel mixture based on the received current value.
- (λ (lambda)) = (actual air/fuel ratio)/(stoichiometric air/fuel ratio)



CHU0140S061



CHU0140S074

REAR HEATED OXYGEN SENSOR (HO2S) FUNCTION

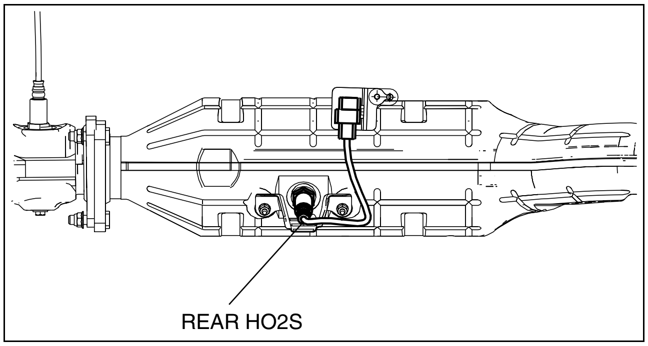
CHU014018860S03

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

REAR HEATED OXYGEN SENSOR (HO2S) CONSTRUCTION/OPERATION

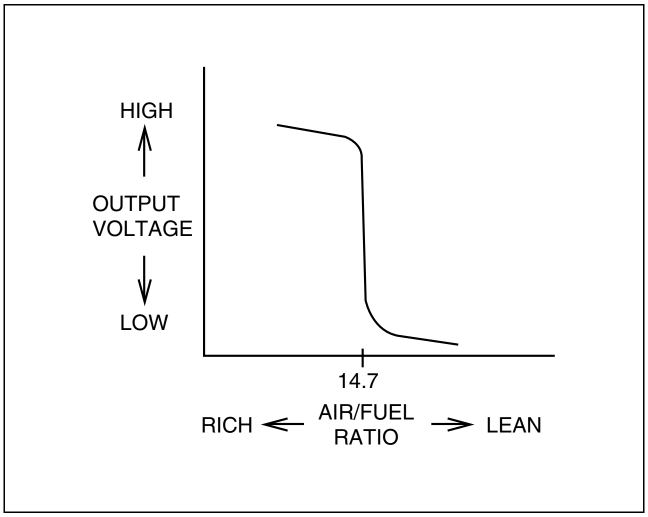
CHU014018860S04

- Installed on the catalytic converter.
- A heater is built into the sensor to facilitate the activation of the HO2S at engine startup (when the exhaust gas temperature is low).
- A zirconium element is used on the sensor. When there is a difference between the oxygen concentration inside and outside the element, electromotive force is generated by the movement of oxygen ions (inside of the zirconium element: atmosphere, outside: exhaust gas). The electromotive force changes significantly at the boundary of the stoichiometric air/fuel ratio (A/F=14.7). The PCM receives the voltage generated from the HO2S directly, and increases or decreases the fuel injection amount by the fuel injection control so that it is close to the stoichiometric air/fuel ratio.



CHU0140S063

- When the temperature of the zirconium element is low, electromotive force is not generated. Therefore the HO2S is heated by a built-in heater, facilitating the oxygen sensor activation. Due to this, the sensor is efficiently activated even immediately after cold-engine startup, and a stable sensor output can be obtained.



CHU0140S075

BAROMETRIC PRESSURE (BARO) SENSOR FUNCTION

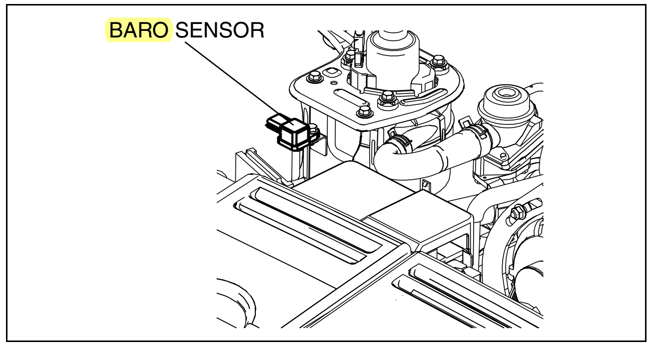
CHU014018210S01

- Detects the BARO.

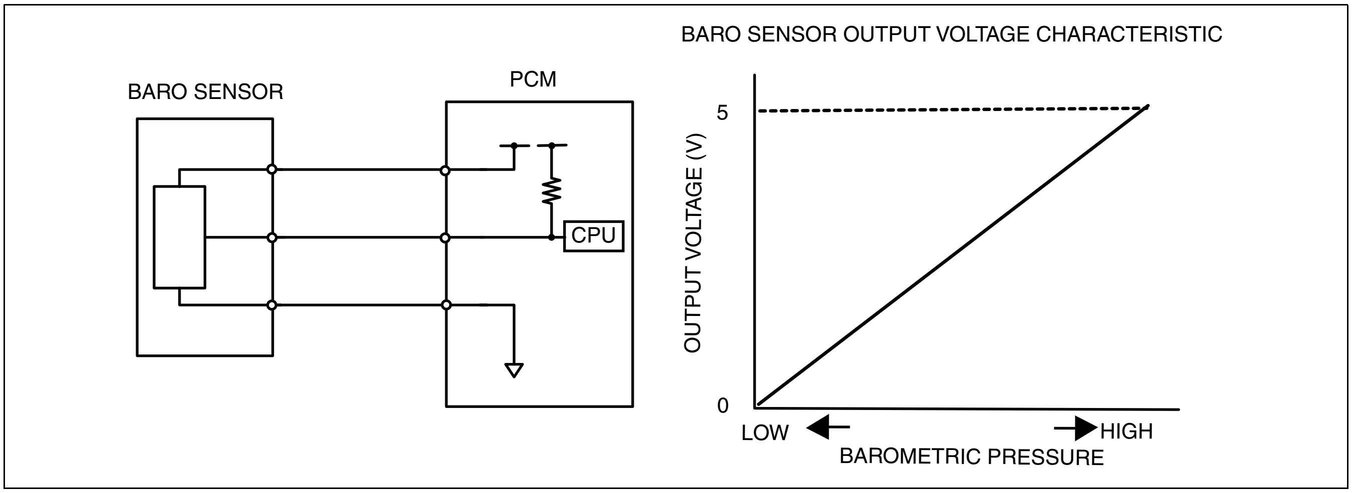
BAROMETRIC PRESSURE (BARO) SENSOR CONSTRUCTION/OPERATION

CHU014018210S02

- The BARO sensor is installed on the secondary air injection pump bracket.
- The piezoelectric element is enclosed in the sensor and the electric potential difference changes as the BARO drops. The output voltage lowers as the BARO drops.



CHU0140S066



CHU0140S076

KNOCK SENSOR (KS) FUNCTION

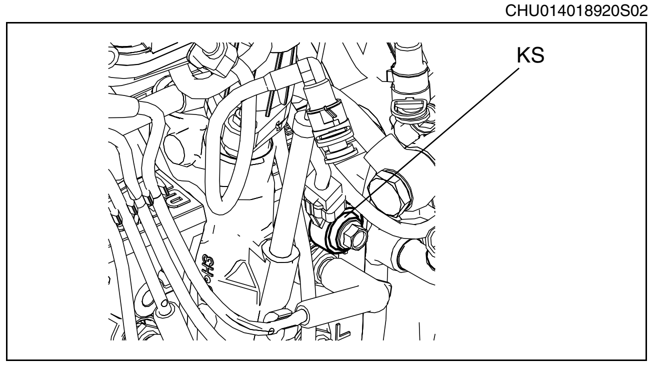
CHU014018920S01

- Detects knocking.

KNOCK SENSOR (KS) CONSTRUCTION/OPERATION

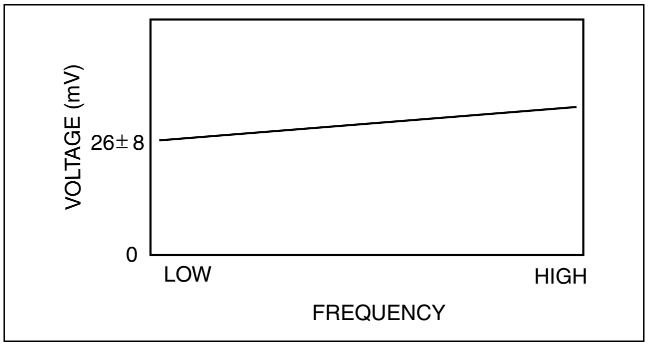
CHU014018920S02

- Installed on the left of the rear rotor housing (plug hole side).
- Converts knocking vibration into a voltage value using the piezoelectric effect of the semi-conductor, and sends the value to the PCM.
- The piezoelectric effect is a phenomenon in which a difference in electric potential is produced on the surface of a piezoelectric element by the application of tensile load or pressure from a certain direction. Tensile load and pressure applied to the KS originates from cylinder block vibration caused by abnormal combustion in the engine. The difference in electric potential, which results from the strain by the vibration, is sent to the PCM as a knocking signal.



CHU0140S068

KS Characteristic (When 1G applied)



CHU0140S089

ECCENTRIC SHAFT POSITION SENSOR FUNCTION

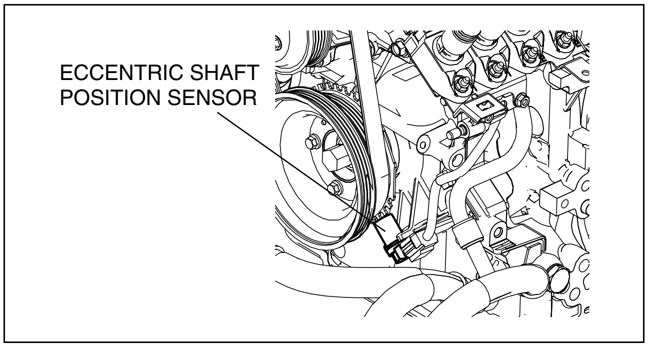
CHU014018221S01

- Detects the rotation pulse of the eccentric shaft position plate as an eccentric shaft angle signal.

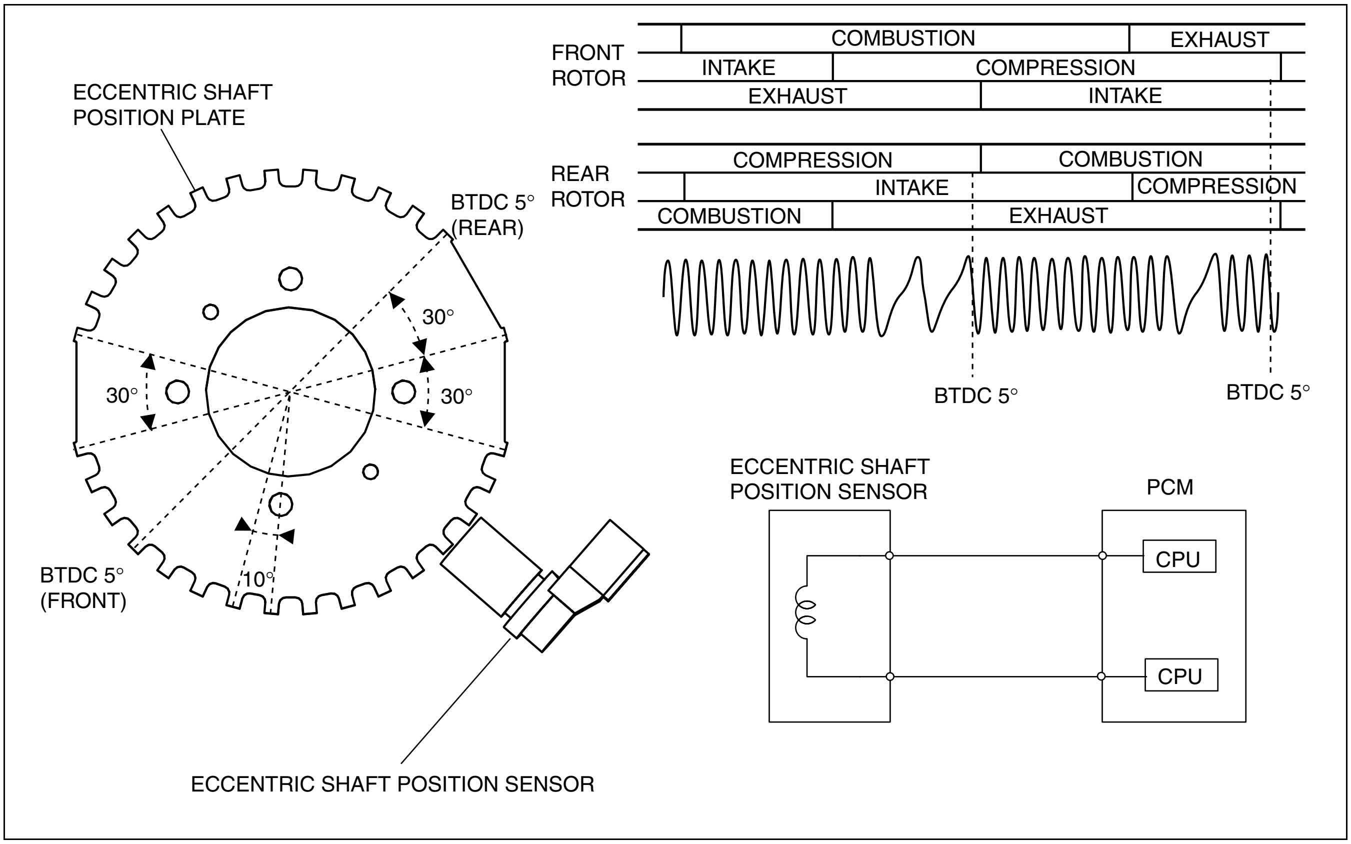
ECCENTRIC SHAFT POSITION SENSOR CONSTRUCTION/OPERATION

CHU014018221S02

- Installed on the front housing.
- The sensor pulse wheel has 30 teeth and 3 areas with no teeth.
- The angle between two notches is 10°, and the angle between two notches where there are no teeth is 30°.
- Sends the change in the amount of magnetic flux density detected at the magnet pickup coil in the eccentric shaft position sensor to the PCM as a voltage value.
- When the eccentric shaft position sensor is removed, installed, or replaced, magnetic flux of the magnet pickup coil will be disturbed, if magnetic material such as iron powder adheres to the sensor, resulting in abnormal sensor output, which may adversely affect the engine control.



CHU0140S069



CHU0140S070

METERING OIL PUMP SWITCH FUNCTION

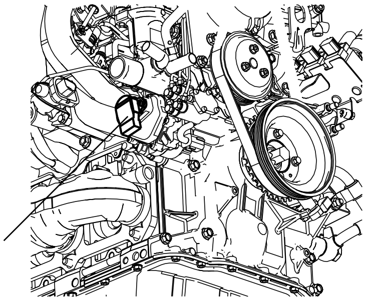
CHU014018990S04

- Detects the fully-open position of the stepping motor when the learning function of the metering oil pump is performed.
- Turns on when the stepping motor is at step 52 or more.

METERING OIL PUMP SWITCH CONSTRUCTION/OPERATION

CHU014018660S04

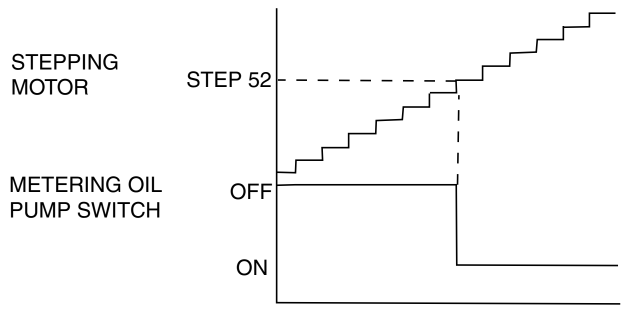
- The metering oil pump switch is installed on the metering oil pump.



(ILLUSTRATION SHOWS 13B-MSP (HIGH POWER))

CHU0140S071

- The metering oil pump switch turns on when the stepping motor is at step 52 or more.
- For a description of the learning function, refer to the learning function of the metering oil pump control. (See01–40–32 METERING OIL PUMP CONTROL OPERATION.)



CHU0140S072

SUSPENSION

02 SECTION

02–00 OUTLINE

SUSPENSION ABBREVIATIONS

CHU020001013S01

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

SUSPENSION FEATURES

CHU020001013S02

Improved rigidity and handling stability	• In-wheel-type double-wishbone front suspension adopted • Front crossmember with integrated side members adopted • Front suspension tower bar adopted • Front upper arm of liquid-forged aluminum and front lower arm of forged aluminum adopted • Damper lever ratio of rear shock absorbers set at approx. 1.0
Improved handling performance and riding comfort	• Rear crossmember with a six-point rubber-mounting system adopted • Zero-stopper-clearance bushings adopted • Roll axis position optimized • Gas-filled monotube shock absorbers with large-diameter pistons adopted for the front and rear • Layout of links and shock absorbers optimized
Enlarged trunk compartment	• Emergency puncture repair kit adopted (No spare tire) • Rear coil springs placed below floor level
Improved marketability	• Adhesive-type balance weights adopted
Environmental consideration	• Steel balance weights adopted to reduce the use of lead
Tire condition maintenance assistance	• Tire pressure monitoring system (TPMS) adopted

SUSPENSION SPECIFICATIONS

CHU020001013S03

Suspension

Item					Specification	
					Standard suspension	Sport suspension
Front suspension	Type				Double-wishbone	
	Spring type				Coil spring	
	Shock absorber type				Monotube type: High-pressure gas charged, cylindrical, double-acting	
	Stabilizer	Type			Torsion bar	
		Diameter		(mm {in})	25.4 {1.00}	26.5 {1.04}
	Wheel alignment (Unloaded*)	Total toe-in	Tire [Tolerance ±4 {0.15}]	(mm {in})	2 {0.08}	
			Rim inner	(mm {in})	1.2±2.5 {0.05±0.09}	1.4±2.8 {0.06±0.11}
				Degree	0°11′±21′	
		Maximum steering angle [Tolerance ±3°]		Inner	38°41′	38°36′
				Outer	33°15′	33°07′
		Caster angle (Reference) [Tolerance ±45′]			6°06′	6°15′
		Camber angle (Reference) [Tolerance ±45′]			0°04′	-0°06′
		Steering axis inclination (Reference)			10°52′	11°02′
Rear suspension	Type				Multi-link	
	Spring type				Coil spring	
	Shock absorber type				Monotube type: High-pressure gas charged, cylindrical, double-acting	
	Stabilizer	Type			Torsion bar	
		Diameter		(mm {in})	15.9 {0.626}	
	Wheel alignment (Unloaded*)	Total toe-in	Tire [Tolerance ±4 {0.15}]	(mm {in})	3 {0.12}	
			Rim inner	(mm {in})	1.9±2.5 {0.075±0.098}	2.1±2.8 {0.083±0.110}
				Degree	0°16′±20′	
		Camber angle [Tolerance ±45′]			-0°56′	-1°07′

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

Wheel and Tire

Item			Specification	
Tire	Size		225/55R16 94V	225/45R18 91W
Wheel	Size		16 x 7 1/2JJ	18 x 8JJ
	Material		Aluminum alloy	
	Offset	(mm {in})	50 {2.0}	
	Pitch circle diameter	(mm {in})	114.3 {4.50}	

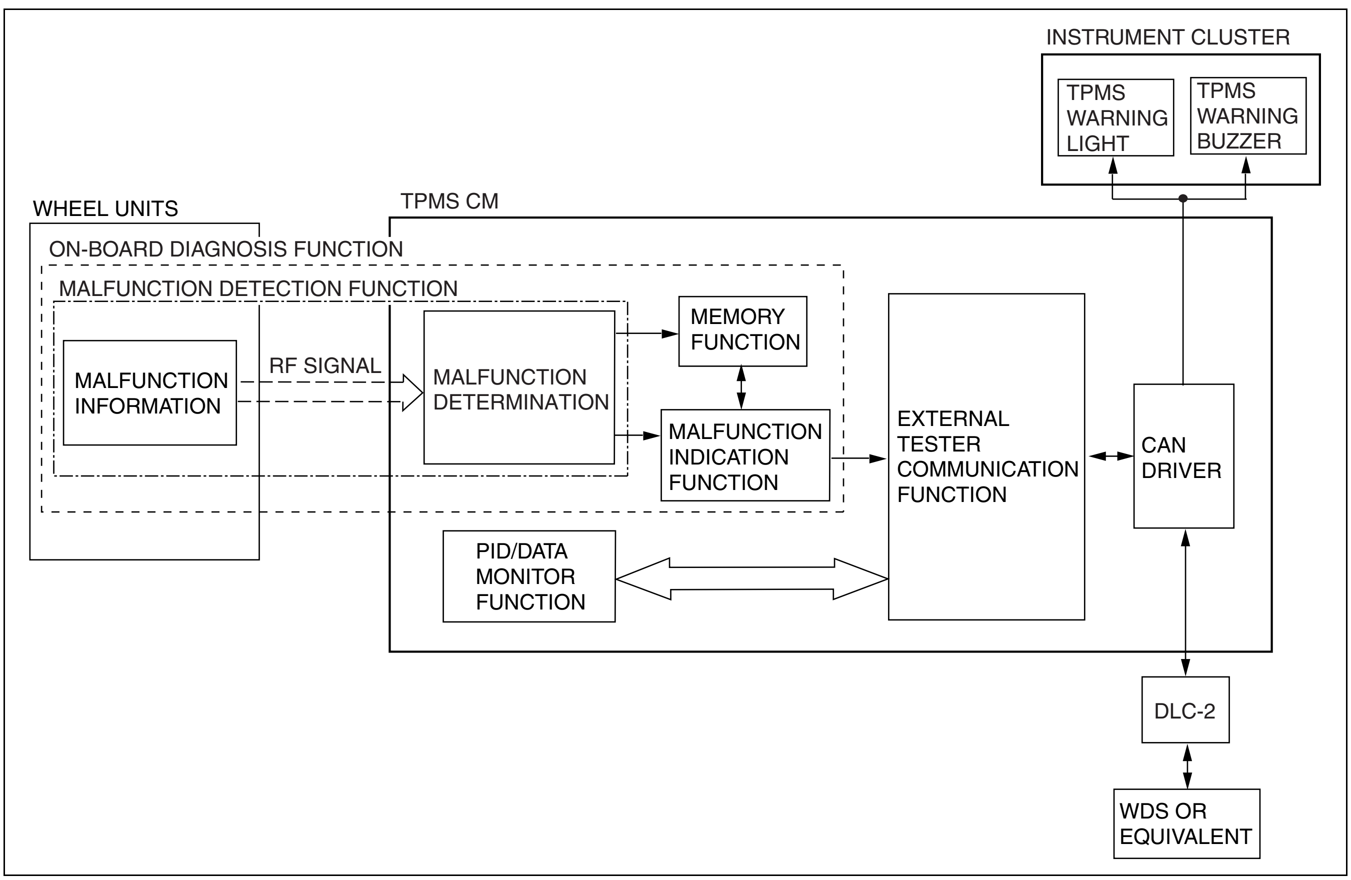
02–02 ON-BOARD DIAGNOSTIC

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

CHU020237020S01

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

Block Diagram



CHU0202S001

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

CHU020237020S02

Malfunction Detection Function

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

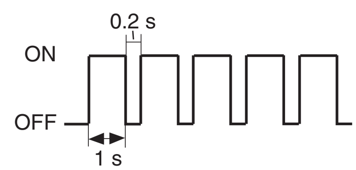
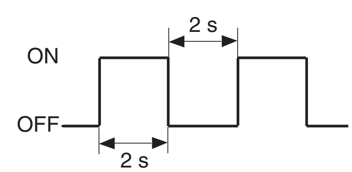
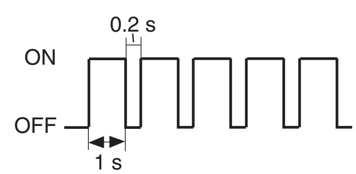
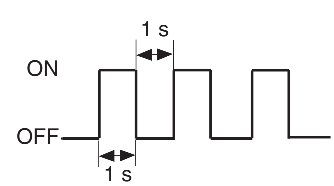
Malfunction Display Function

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

Memory Function

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

DTC TABLE

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

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

CHU020237020S03

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

PID/DATA monitor table

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

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

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

CHU020237020S04

External Tester Communication Function

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

Connection and communication information

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

Serial Communication

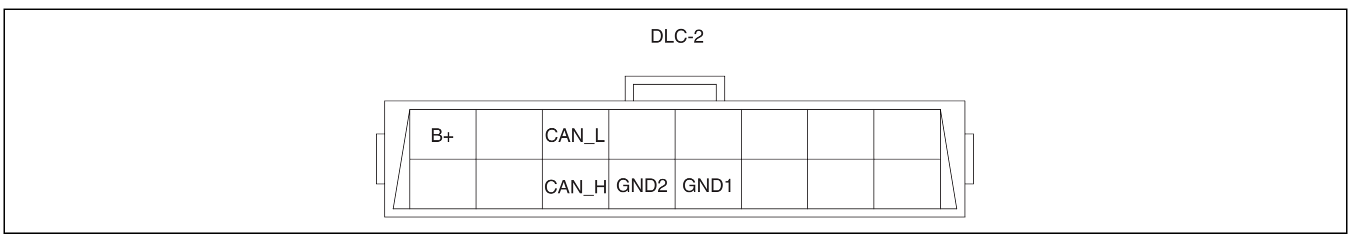
- Serial communication (synchronous communication) is a method of communication in which many pieces of information are sent and received instantaneously through a single wire.
- By connecting the WDS or equivalent to DLC-2, diagnostic information can be sent and received between the WDS or equivalent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

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

DLC-2 CONSTRUCTION

CHU020237020S05

- 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, CAN_L, GND1, GND2 and B+ terminals.



CHU0602S002

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

02–12 WHEEL AND TIRES

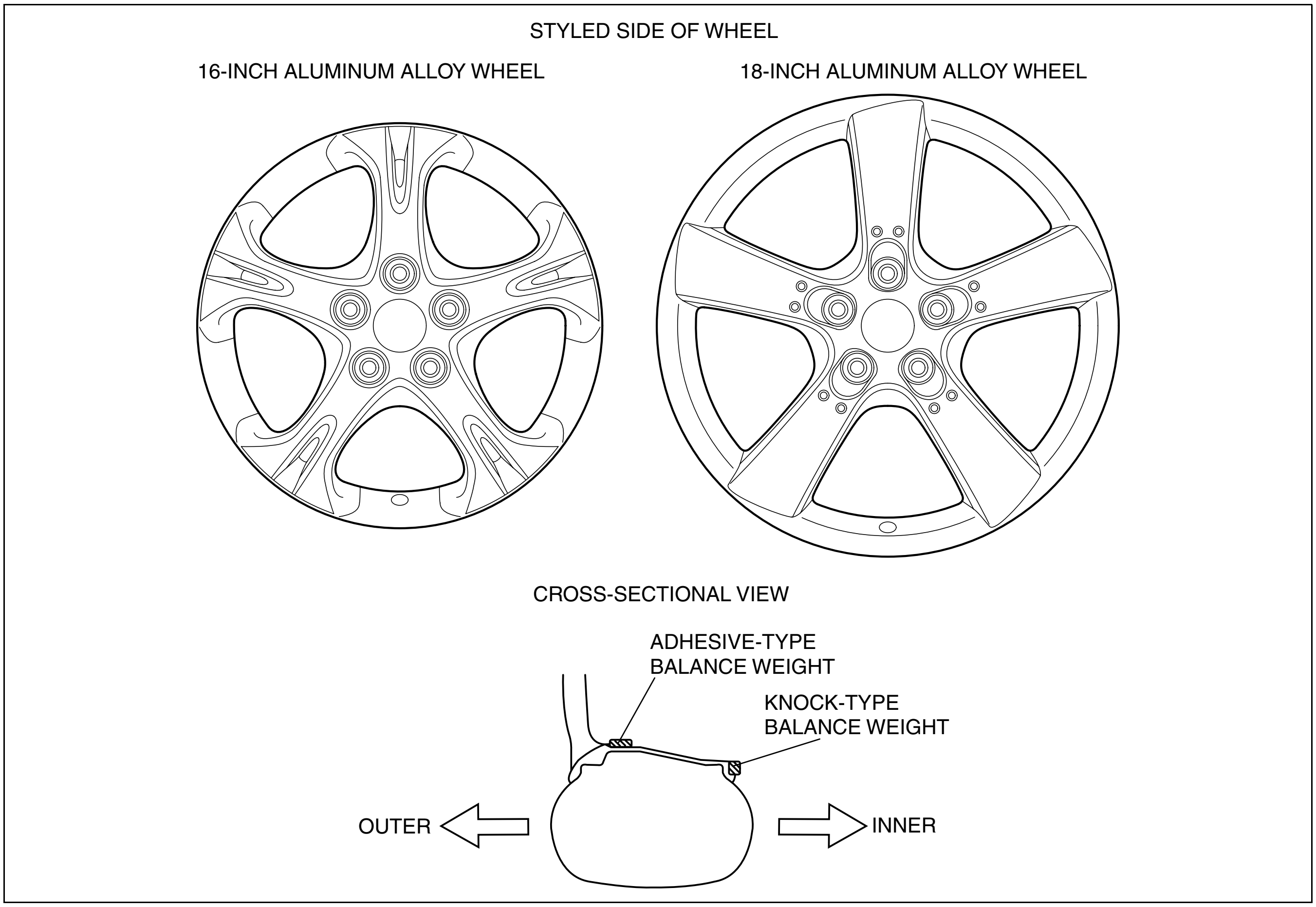
WHEELS AND TIRES OUTLINE

CHU021201014S01

- A 16-inch aluminum alloy wheel is equipped for the standard suspension, and an 18-inch aluminum alloy wheel is equipped for the sport suspension.
- 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

CHU021201014S02

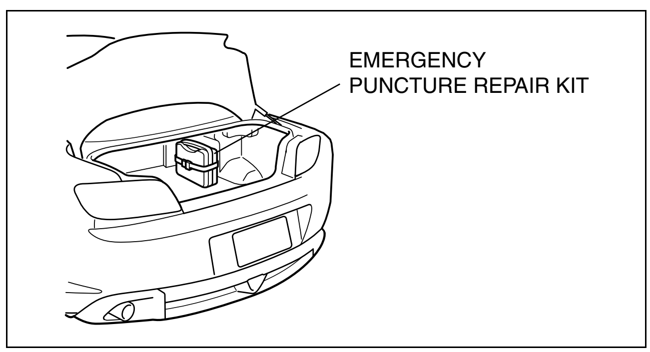


CHU0212S007

PUNCTURE REPAIR KIT OUTLINE

CHU021237100S01

- An emergency puncture repair kit has been provided for all models instead of a temporary spare tire. This kit enables temporary repair of a puncture without tire removal.
- The emergency puncture repair kit is located in the trunk compartment and includes the following:
  — Repair agent
  — Repair agent filler hose
  — Air compressor
  — Tire valve core
  — Tire valve core tool
  — Instruction manual
  — Speed limit label
  — Filled tire indication label
- The accessory socket (12V DC) is used as an input power source for the air compressor and the compressor plug includes a 10 A fuse.



CHU0212S008

Note

- The expiration date of the repair agent is printed on the repair agent bottle. Do not use the repair agent if it has passed the expiration date.
- Dispose of repair agent according to local waste disposal law.
- The repair agent consists of the following ingredients:
  — Deproteinized natural rubber latex
  — Emulsified adhesive resin
  — Propylene glycol

TIRE PRESSURE MONITORING SYSTEM (TPMS) OUTLINE

CHU021237020S01

- 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 air pressure higher than a specified value is detected.

Caution

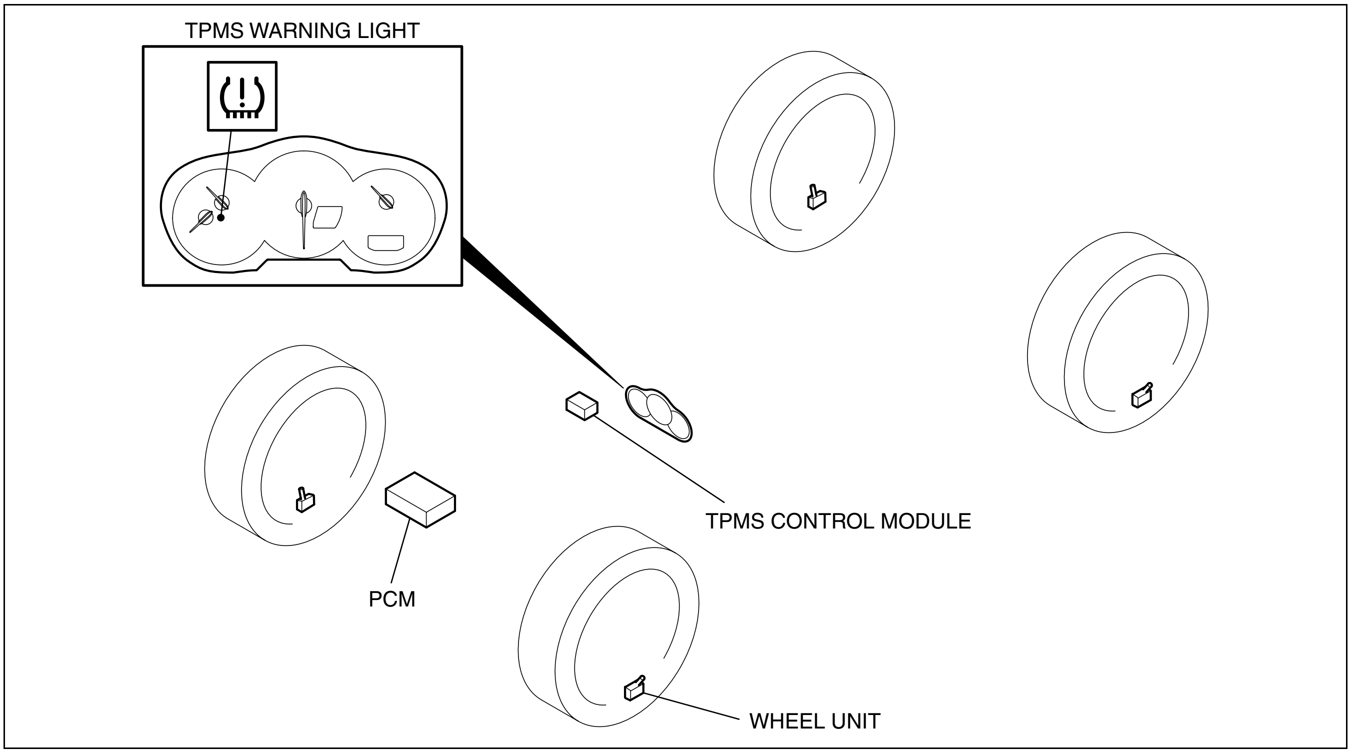
- **Each wheel unit has its own preset identification code. If a system component is replaced, the system becomes inoperative since the TPMS control module cannot recognize the identification codes. Therefore, be sure to configure the identification codes of wheel units when any of the following items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

Note

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

TIRE PRESSURE MONITORING SYSTEM (TPMS) STRUCTURAL VIEW

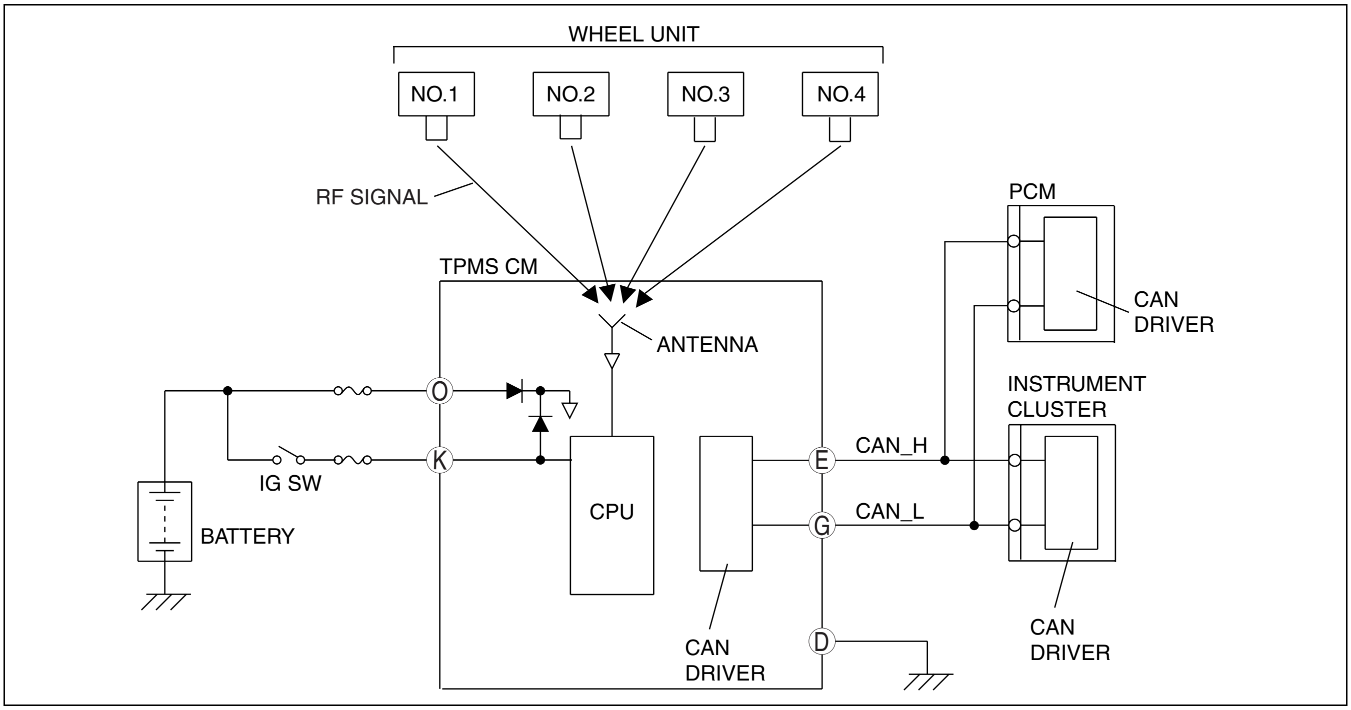
CHU021237020S03



CHU0212S001

TIRE PRESSURE MONITORING SYSTEM (TPMS) WIRING DIAGRAM

CHU021237020S04



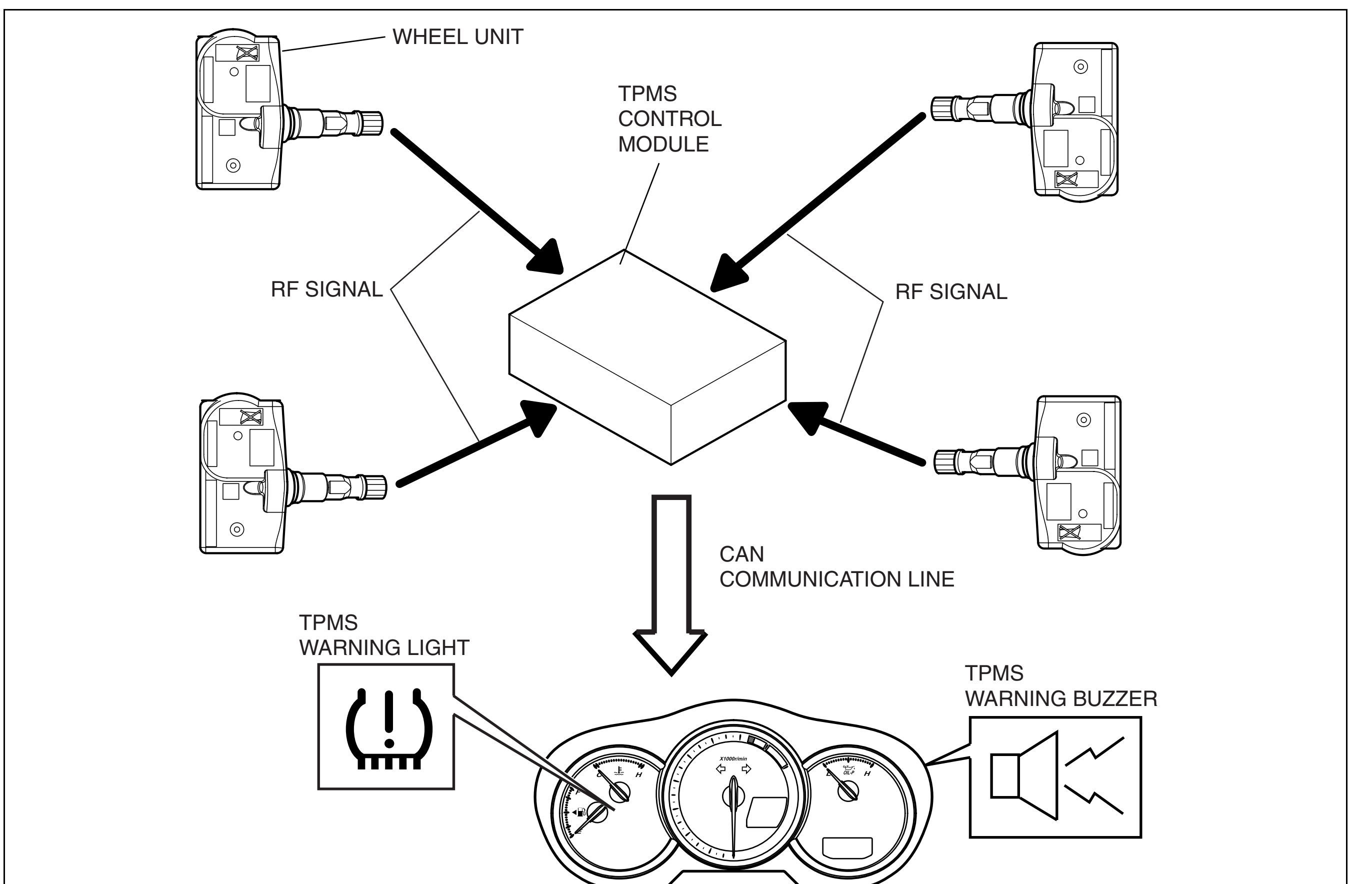
CHU0202W001

TIRE PRESSURE MONITORING SYSTEM (TPMS) CONSTRUCTION/OPERATION

CHU021237020S05

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.



CHU0212S009

Operation

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

Component Parts/Function

02–12

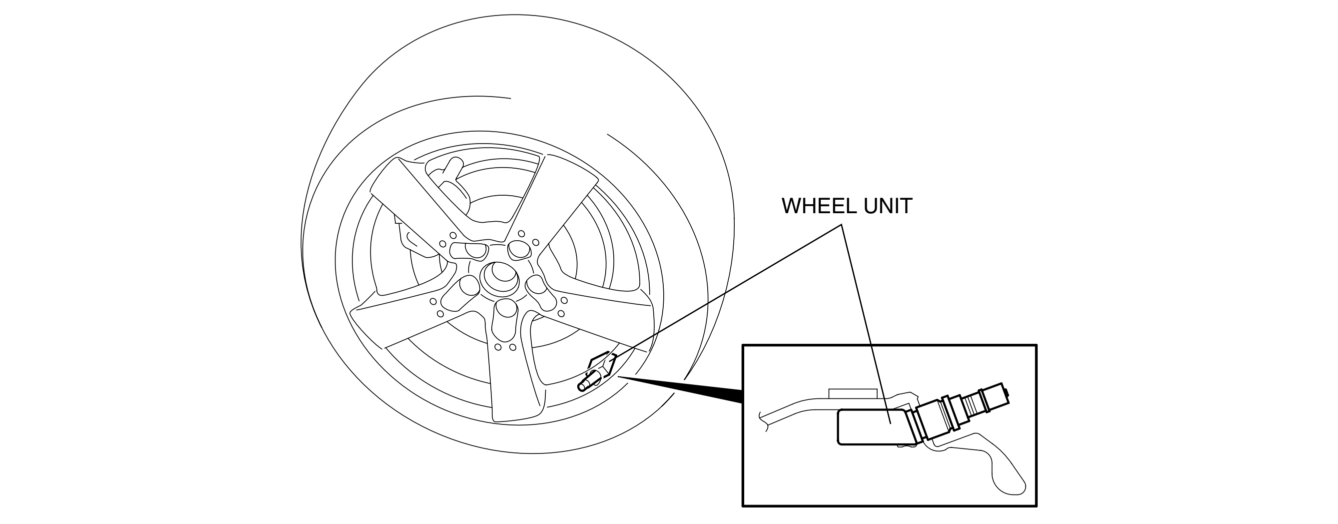
Part name		Function
Wheel unit		• Monitors air pressure, temperature, and acceleration of each tire, and sends RF signals. • Sends data if any abnormality is detected in the wheel unit.
TPMS control module		• Receives RF signals from the wheel units and monitors the air pressure of each tire. If it determines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

WHEEL UNIT CONSTRUCTION/OPERATION

CHU021237140S01

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.



CHU0212S002

Operation

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

Sensing Function

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

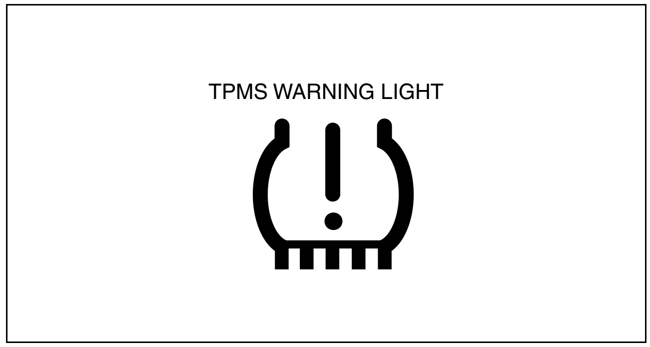
Self-diagnostic Function

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

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

CHU021237140S02

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



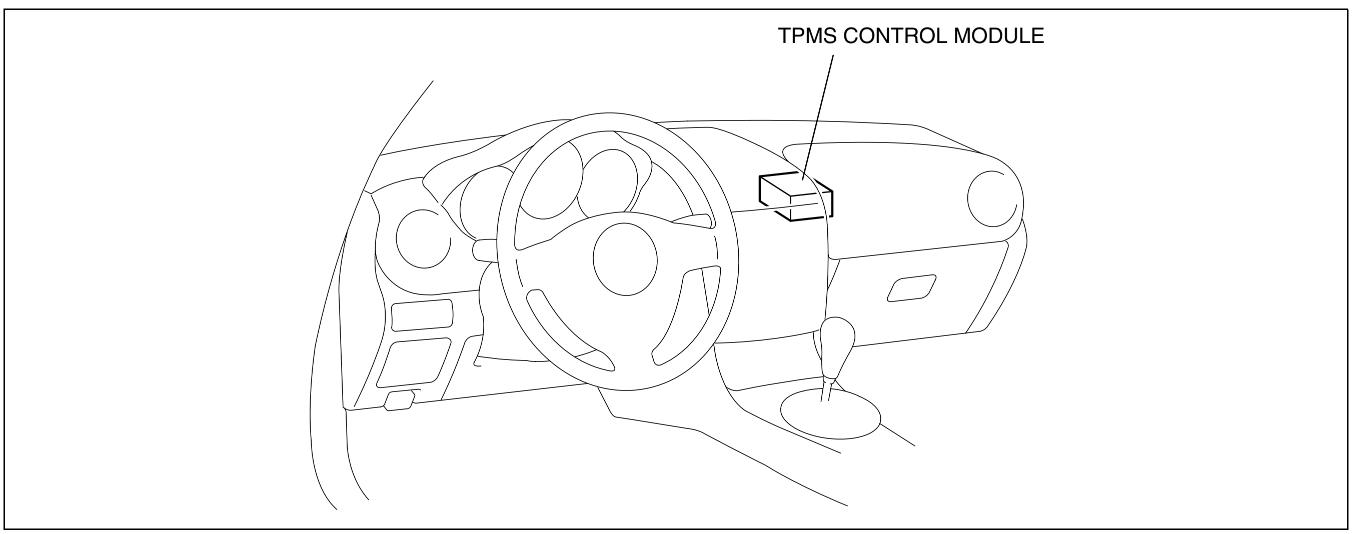
CHU0212S010

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

CHU021267502S01

Construction

- The TPMS control module is installed in the upper part of the instrument cluster.



CHU0212S003

Operation

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

Function list

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

Identification code recognition function

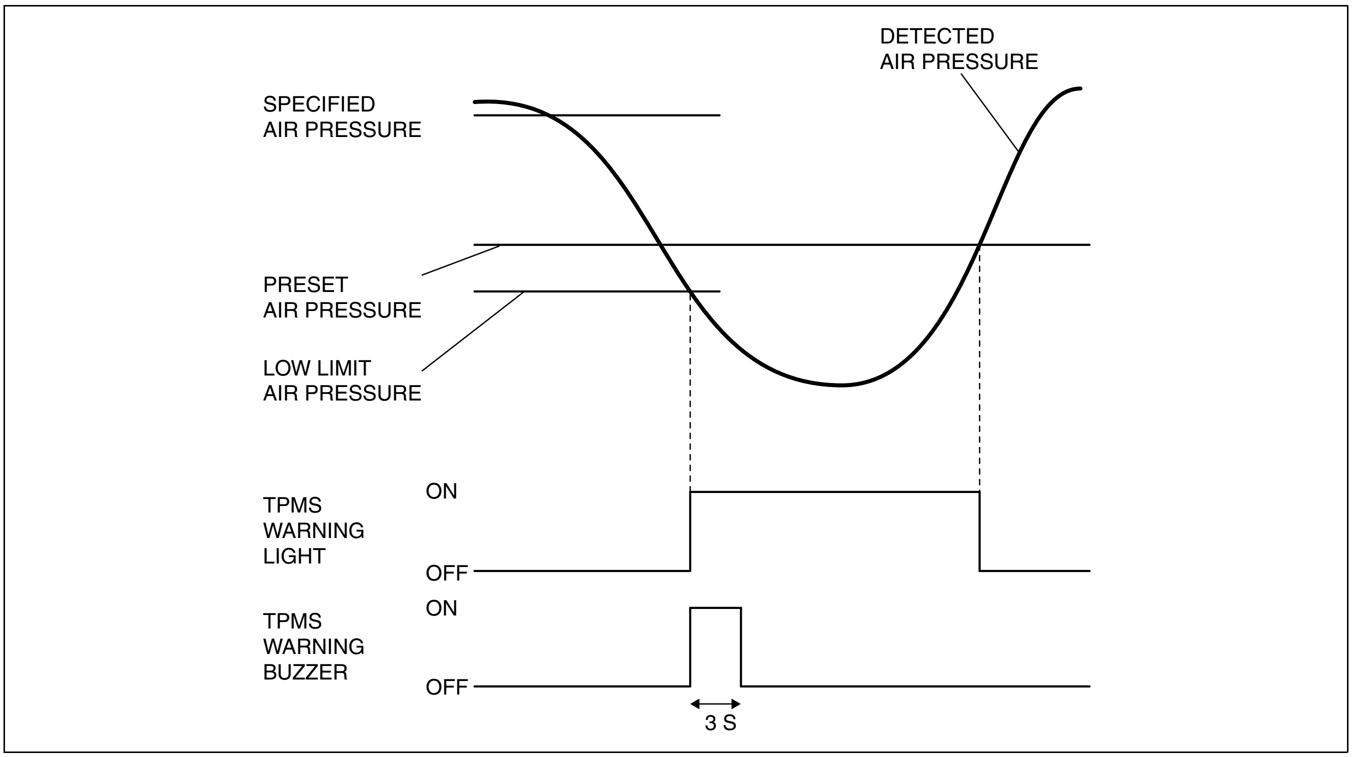
- Since the identification codes of wheel units mounted on the vehicle have been configured in the TPMS control module, the module can verify the identification codes sent from the wheel units against the configured identification codes.
- When the received identification code agrees with the configured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

Tire pressure determination and warning function

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

Low-pressure determination

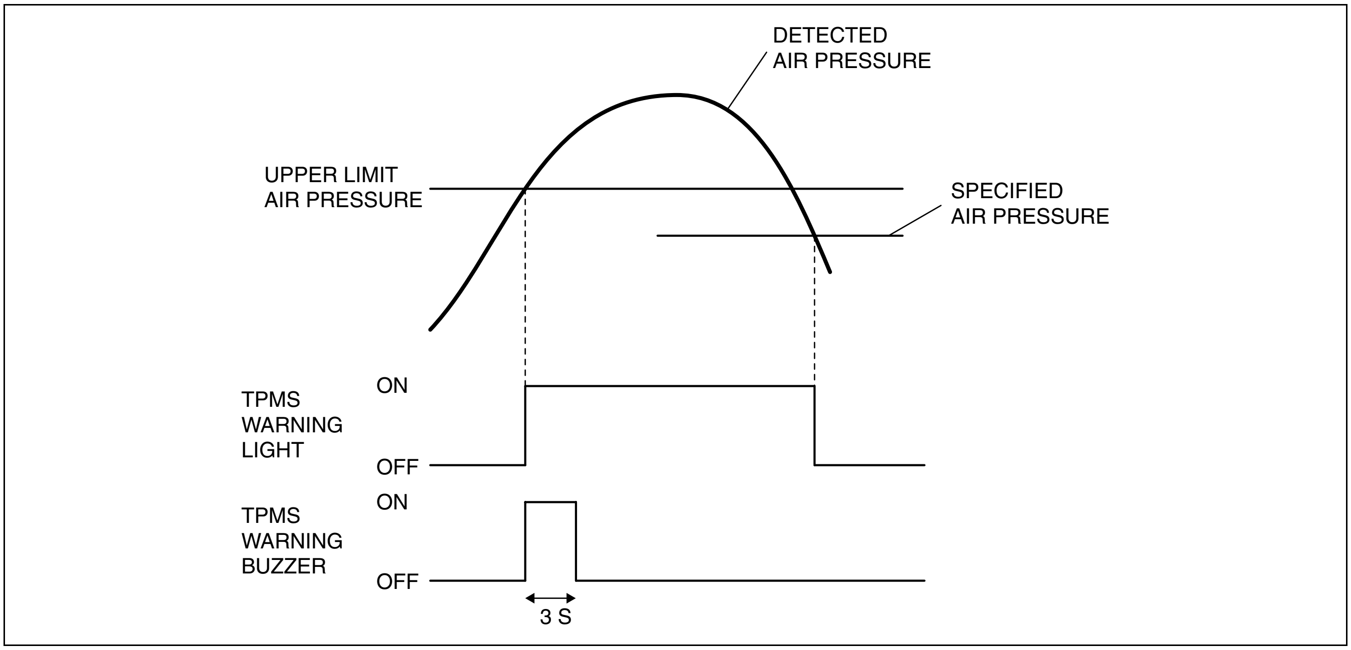
- When tire pressure data sent from a wheel unit is lower than the detection value configured in the TPMS control module, the module determines that the tire for that wheel unit has low tire pressure.
  — If low tire pressure is determined when the ignition is on, the TPMS control module illuminates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



CHU0212S004

High-pressure determination

- When tire pressure data sent from the wheel unit exceeds the upper limit, the module determines that the tire for that wheel unit has high tire pressure.
  — If high tire pressure is determined when the ignition is on, the TPMS control module illuminates the TPMS warning light built into the instrument cluster and sounds the TPMS warning buzzer for **3 s** to alert the driver.
  — If high tire pressure is determined when the ignition is off, the module performs an open-circuit check*1 on the TPMS warning light after the ignition is turned on, and then illuminates the TPMS warning light and sounds the TPMS warning buzzer for **3 s** to alert the driver.
- A high-pressure determination is cleared if tire pressure data from the applicable wheel unit is lower than the specified recovery value.
  — If the determination is cleared when the ignition is on, the TPMS control module turns off the TPMS warning light.
  — If the determination is cleared 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 off 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.



CHU0212S005

CONTROLLER AREA NETWORK (CAN) OUTLINE

CHU021267502S02

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

Transmitted Information

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

Received Information from PCM

- Vehicle speed

02–13 FRONT SUSPENSION

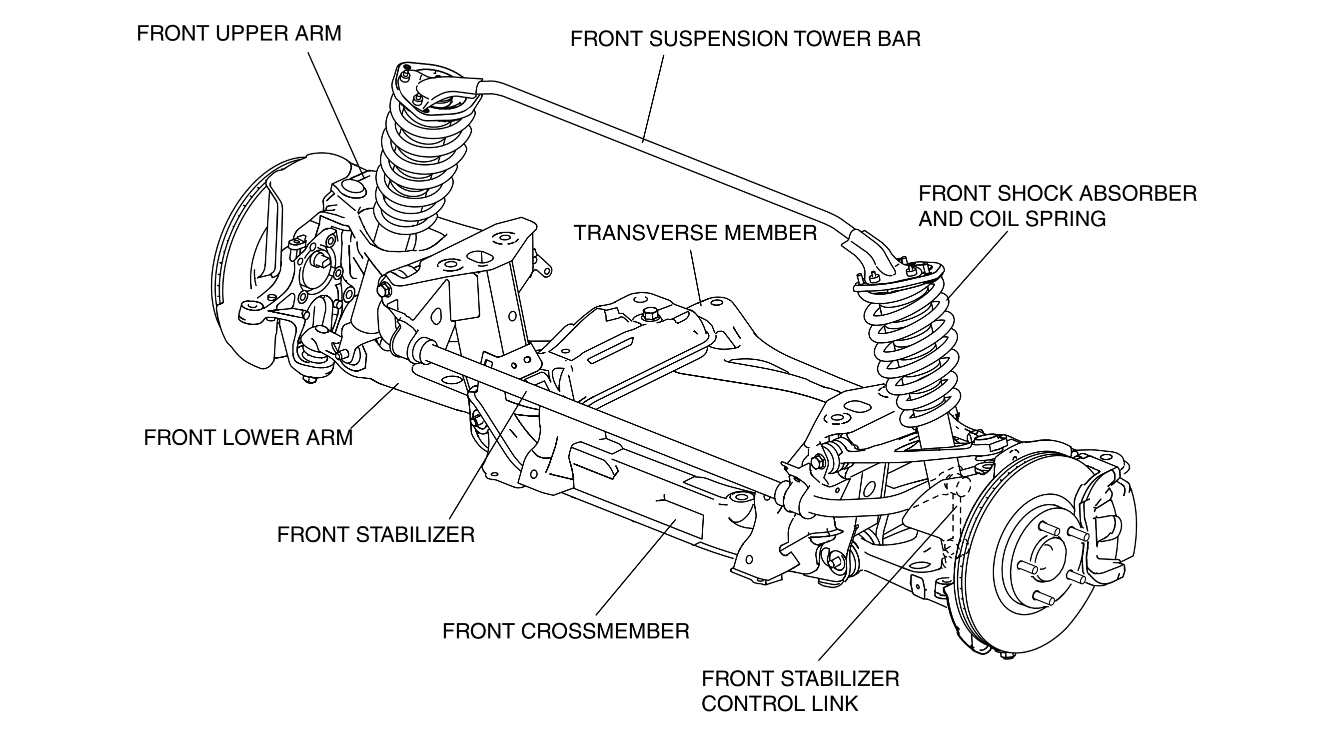
FRONT SUSPENSION OUTLINE

CHU021301015S01

- A newly developed in-wheel-type double-wishbone suspension has been adopted to take full advantage of the low bonnet line enabled by the optimized engine layout.
- The front upper arm and the front lower arm have been lengthened and attached to the highly rigid front crossmember to allow for linear alignment changes during jounce and rebound of the front wheels. Due to this, roadholding and handling performance have been improved.

FRONT SUSPENSION STRUCTURAL VIEW

CHU021301015S02



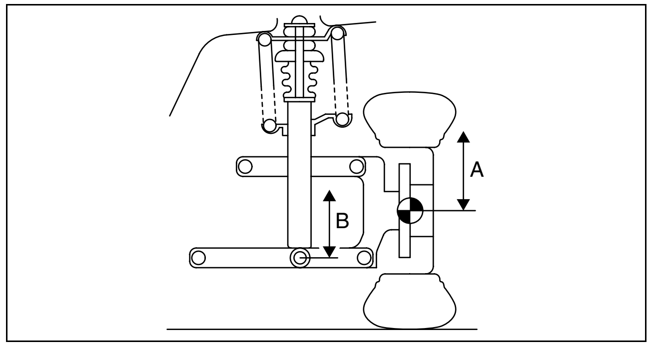
CHU0213S001

DOUBLE WISHBONE FRONT SUSPENSION CONSTRUCTION

CHU021301015S03

Improved roadholding

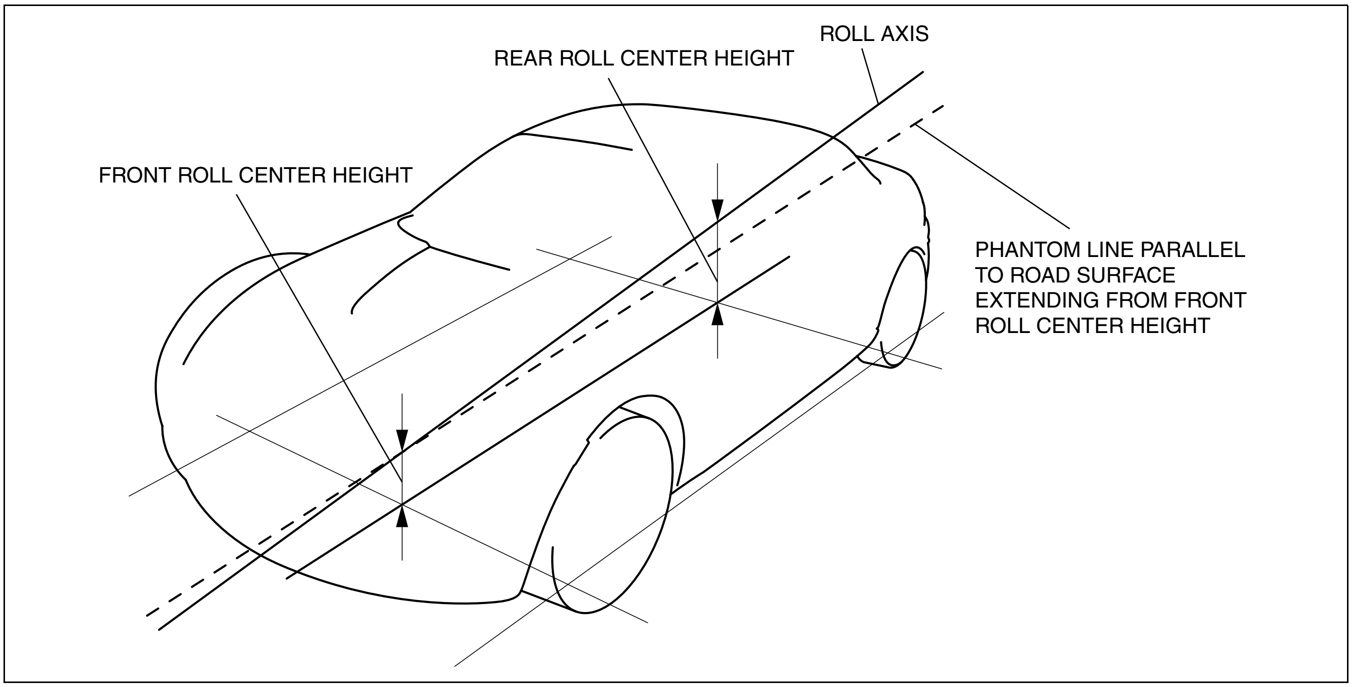
- The heightened damper lever ratio has improved the efficiency of shock absorber operation.
  — Damper lever ratio:
  shock absorber stroke (B)/wheel vertical stroke (A)
  — The heightened damper lever ratio has made it possible to provide a damping force even during minute strokes. As a result, excellent roadholding is exhibited in a variety of driving conditions.



BHJ0213N002

Optimized roll axis position

- The height of the front roll center is set lower than the rear.
- Change of roll center height in response to a change in wheel stroke has been suppressed in order to improve roll linearity and convergence.

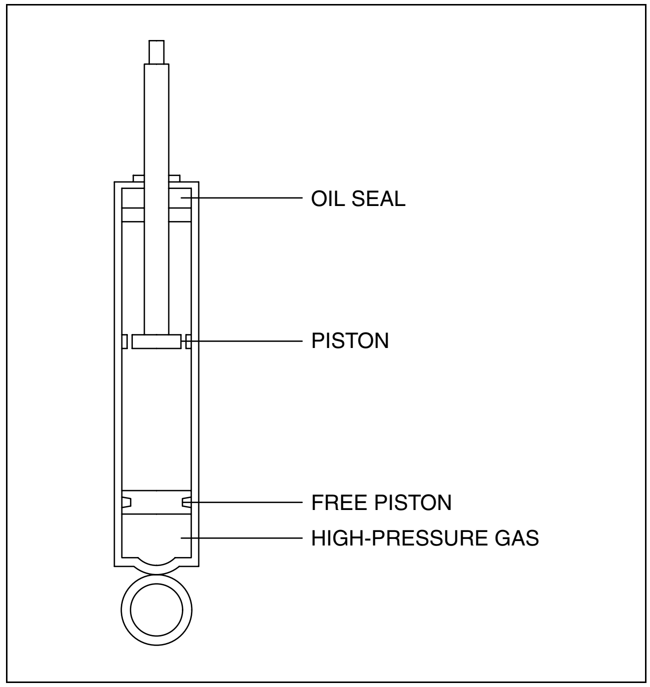


CHU0213S002

FRONT SHOCK ABSORBER CONSTRUCTION

CHU021334700S01

- The high-pressure gas-filled monotube shock absorber minimizes cavitation and provides stable damping force even during hard driving.
  — The large-diameter piston ensures superior response during minute strokes, providing consistent damping force and stroke feeling.
  — The enlarged piston port area also contributes to the improvement of riding comfort.

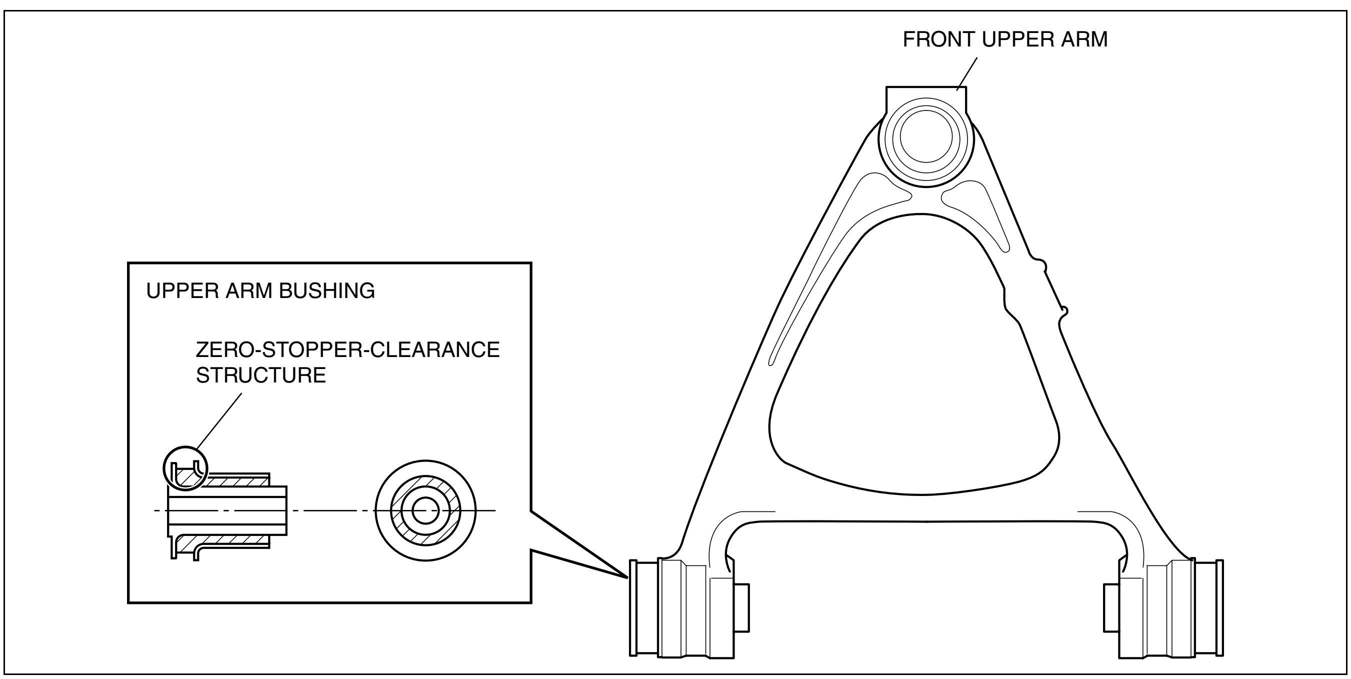


CHU0213S005

FRONT UPPER ARM CONSTRUCTION

CHU021334200S01

- The front upper arm is made of liquid-forged aluminum for improved rigidity and weight reduction.
- Newly developed zero-stopper-clearance rubber bushings have been adopted for where the upper arm attaches to the front crossmember.
  — The stopper sleeve, integrated with the inner pipe, protrudes slightly.
  — This structure suppresses forward-backward movement caused by external forces acting on the arm.
  — It also enables linear spring characteristics of the bushings from an early stage, thereby optimizing control over changes in vehicle behavior.

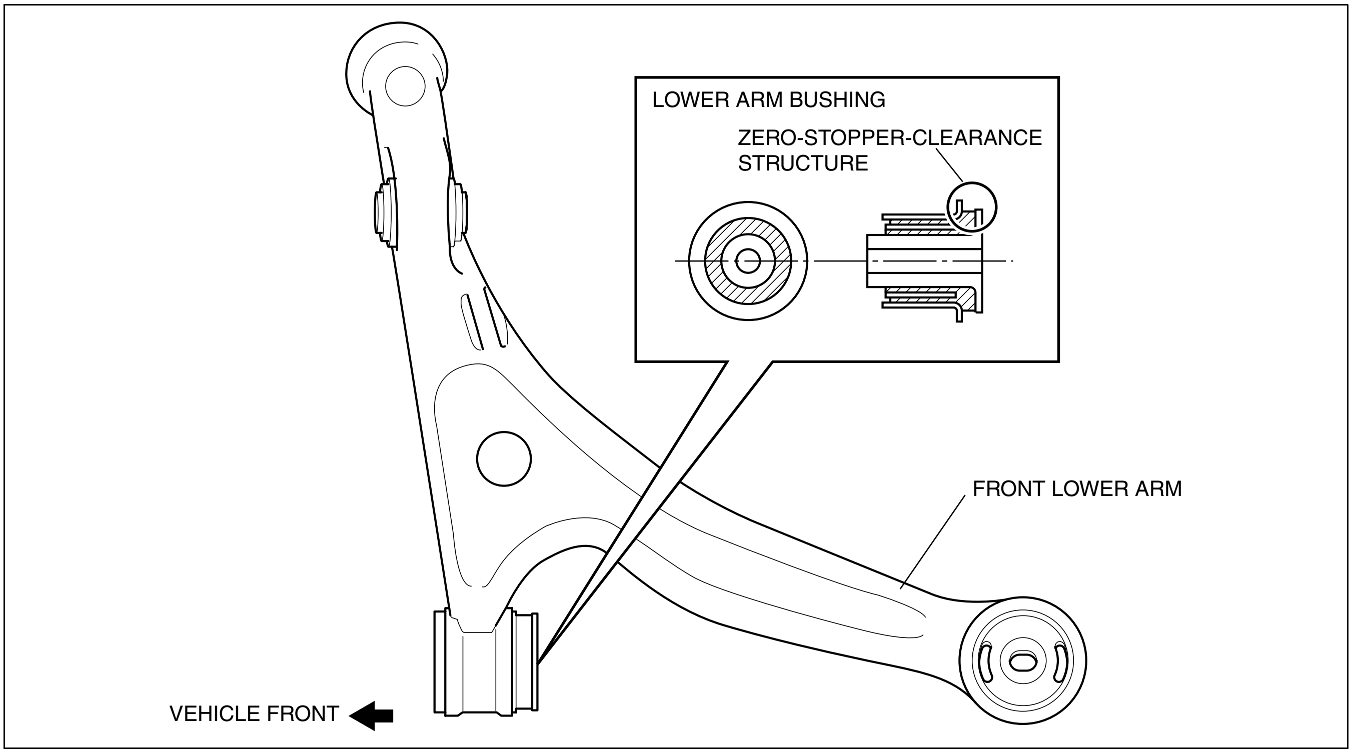


CHU0213S003

FRONT LOWER ARM CONSTRUCTION

CHU021334300S01

- The front lower arm is made of forged aluminum for rigidity and weight reduction.
- As with the front upper arm, the zero-stopper-clearance bushings optimize control over changes in vehicle behavior.

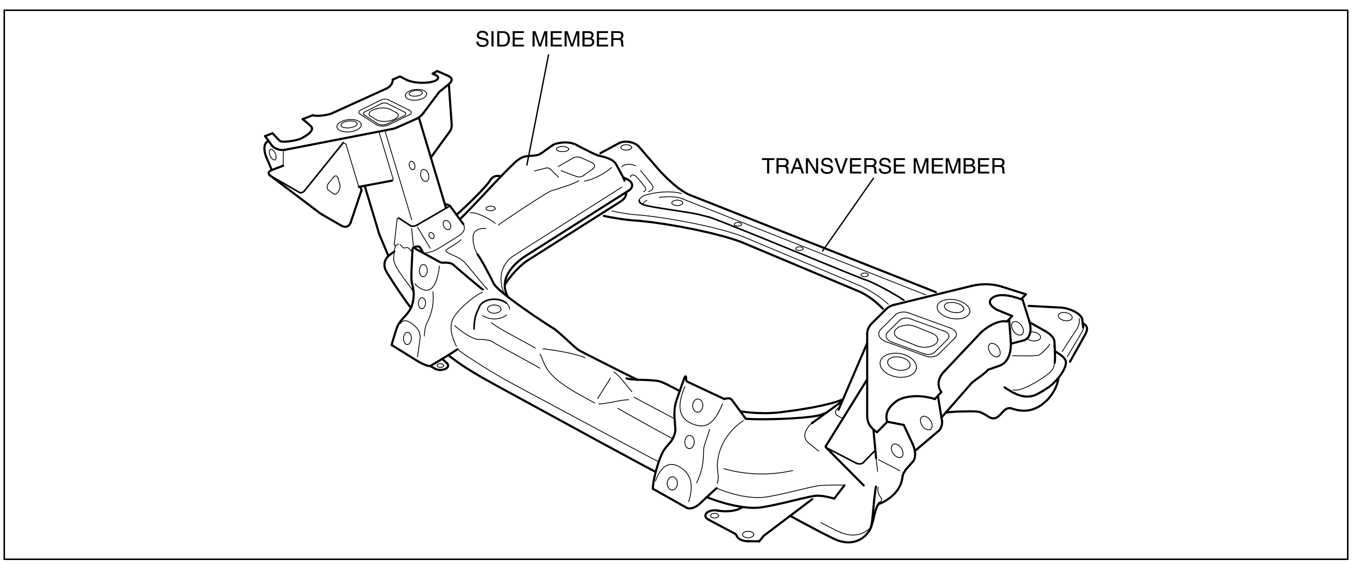


CHU0213S004

FRONT CROSSMEMBER CONSTRUCTION

CHU021334800S01

- A lightweight, highly rigid front crossmember with integrated side members has been adopted.
- The transverse member is attached to the back of the front crossmember to create a highly rigid square construction.
- This front crossmember component is rigidly mounted to the vehicle body at eight points, providing an extremely large amount of suspension support stiffness and alignment precision.



CHU0213S006

02–14 REAR SUSPENSION

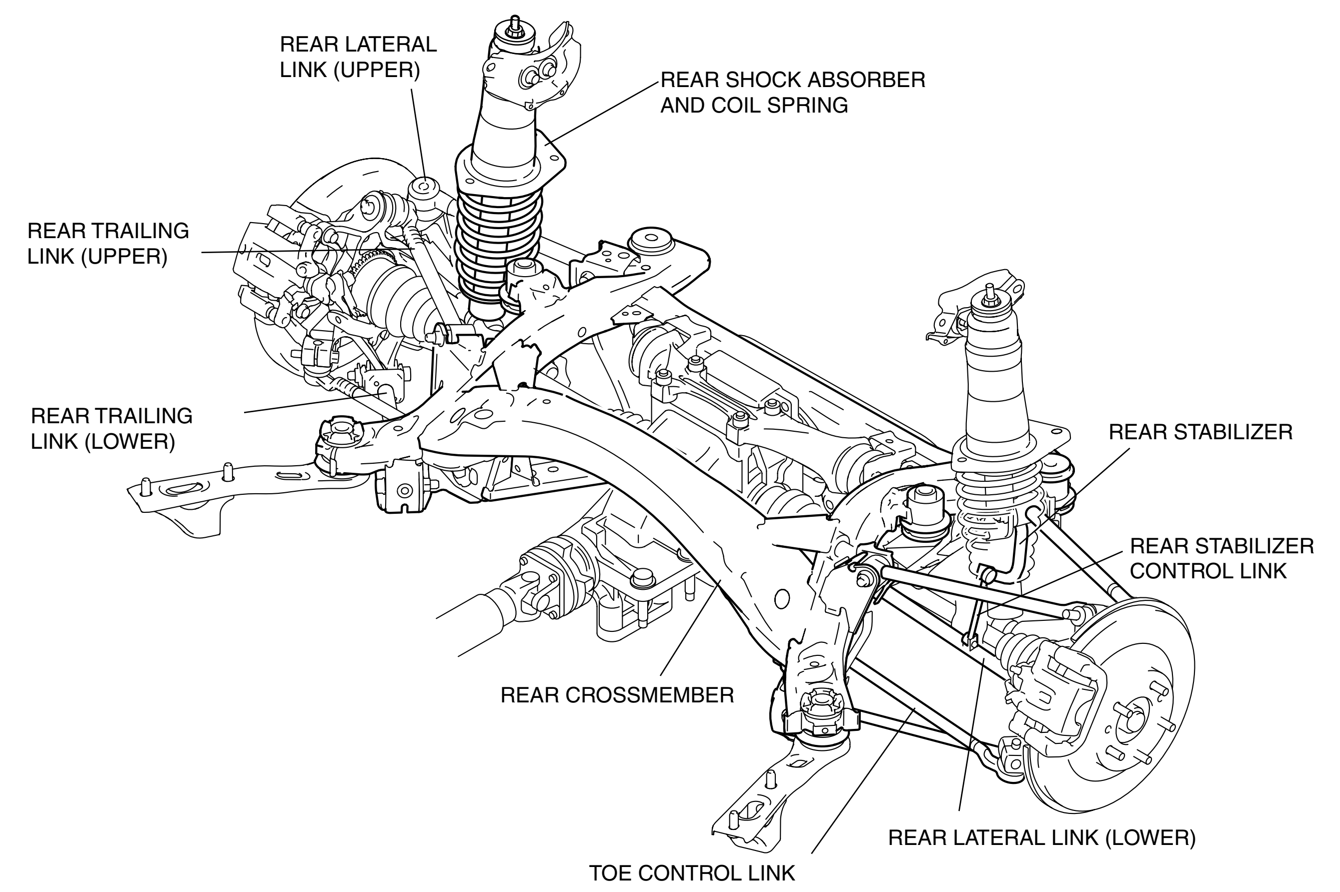
REAR SUSPENSION OUTLINE

CHU021401016S01

- A multi-link suspension composed of five links has been adopted.
- The links have been lengthened and optimally positioned. Due to this, they constantly provide ideal geometry to respond to external forces applied during driving, improving handling stability and riding comfort, and reducing road noise.

REAR SUSPENSION STRUCTURAL VIEW

CHU021401016S02



CHU0214S001

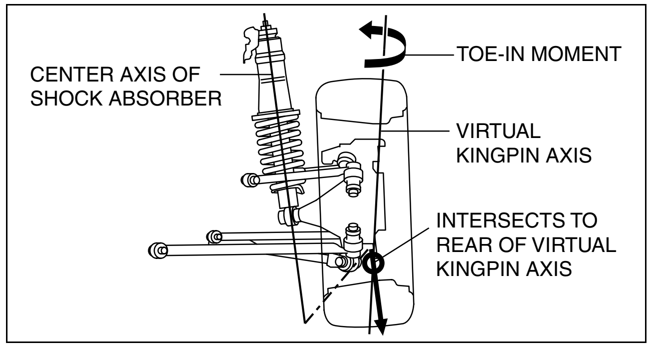
MULTI-LINK REAR SUSPENSION CONSTRUCTION

CHU021401016S03

Optimized Link and Shock Absorber Layout

Compliance toe control

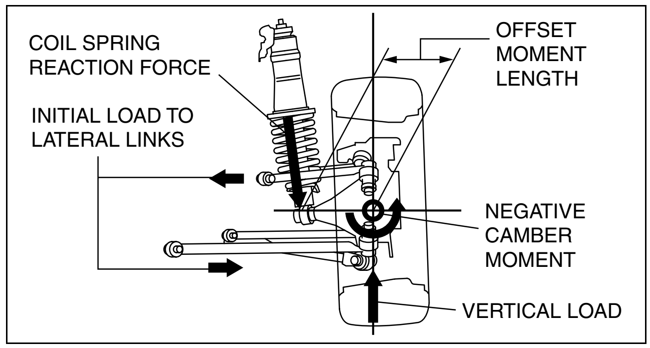
- The suspension system layout is such that the center axis line of the shock absorber intersects to the outside and rear of the virtual kingpin axis. This layout ensures that the toe-in moment is constantly produced around the virtual kingpin axis of the rear wheels. Due to this, the rear wheels constantly and securely provide a high level of gripping power.



CHU0214S002

Compliance camber control

- Initial load in the negative camber direction is applied to the rear lateral links (upper/lower). Because of this, the bushings anchoring the rear lateral links (upper/lower) to the rear crossmember are constantly pressed toward the rear lateral links. As a result, the central, non-sensitive region of the bushing is not used, thereby minimizing delayed steering response and suppressing parasitic (unnecessary) wheel movement in response to external disturbances.



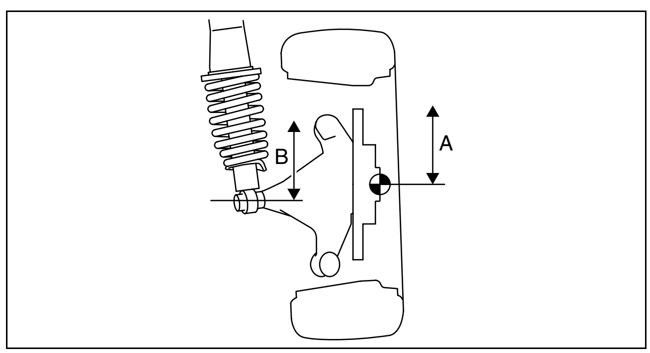
CHU0214S003

Elongated links

- Elongated upper and lower rear lateral links have been adopted. They reduce torsion applied to the bushings on the rear crossmember side during jounce and rebound of the rear wheels, providing smooth link behavior.

Improved Roadholding

- The damper lever ratio has been set at approx. 1 to improve the efficiency of shock absorber operation.
  - — Damper lever ratio:
    shock absorber stroke (B)/wheel vertical stroke (A)
  - — A layout with the damper lever ratio close to 1 makes it possible to provide a damping force even during minute strokes. As result, excellent roadholding is exhibited in a variety of driving conditions.



BHJ0214N005

REAR SHOCK ABSORBER CONSTRUCTION

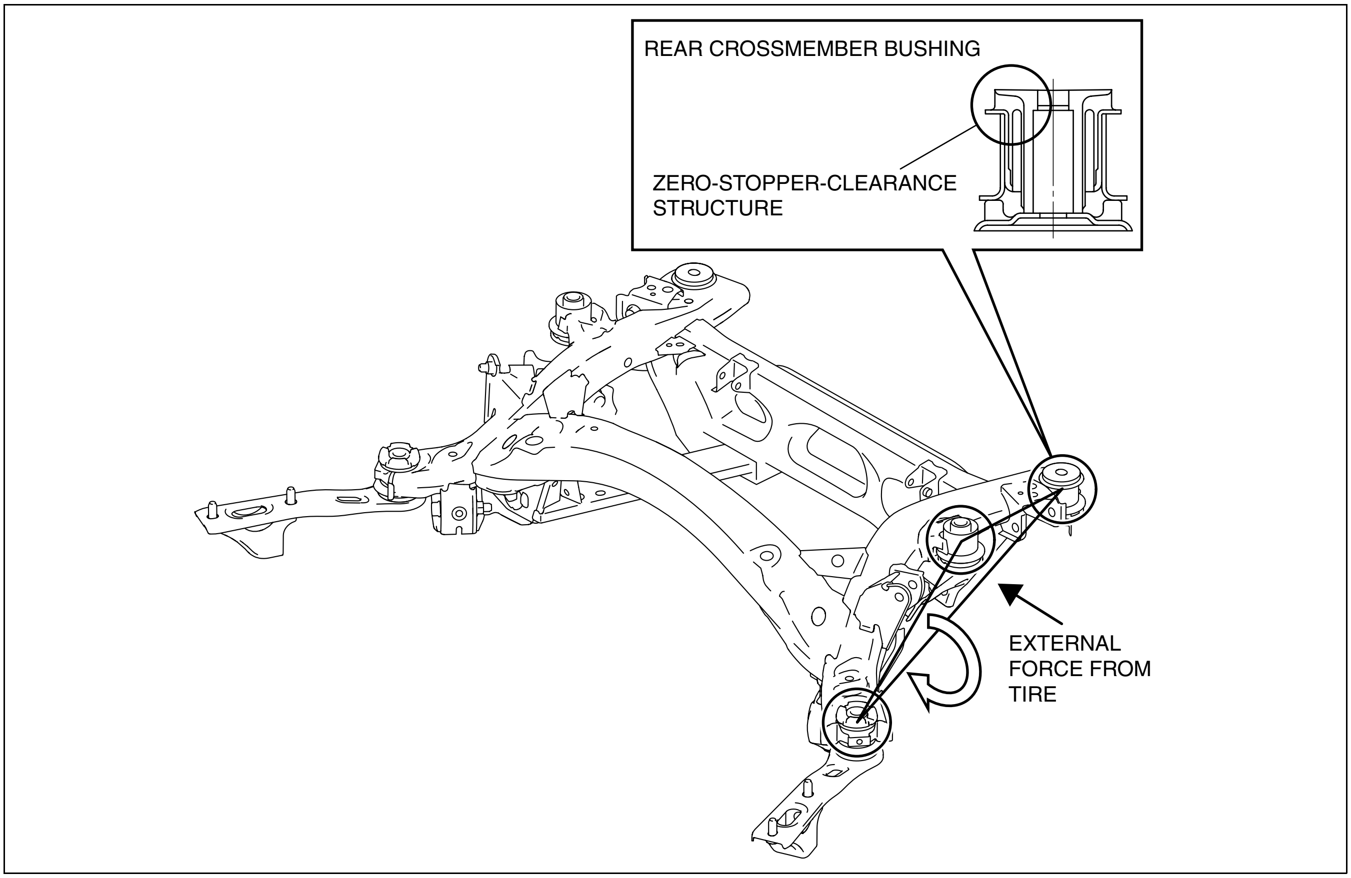
CHU021428700S01

- As with the front shock absorber, a high-pressure gas-filled monotube shock absorber has been adopted.
- Placement of the rear coil springs below floor level reduces lateral spring force on the damper rods and thereby minimizes friction.
- This layout also contributes to an enlarged trunk compartment space.

REAR CROSSMEMBER CONSTRUCTION

CHU021428400S01

- Adoption of a six-point rubber-mounting system rear crossmember ensures link support stiffness and isolates vibration improving riding comfort and reducing road noise.
- Zero-stopper-clearance rubber bushings are installed at three points (the front, middle, and rear) of the crossmembers, six locations in total, so that they form a three-dimensional triangle.



CHU0214S004

- This construction provides the following benefits:
  — Suppresses rear crossmember turning when lateral forces are applied, ensuring high camber stiffness.
  — Bushing characteristics can be softened.
  — Suppresses vibrations transmitted to the vehicle body.

DRIVELINE/AXLE

03 SECTION

03–00 OUTLINE

DRIVELINE/AXLE ABBREVIATIONS

CHU030001018S03

AT	Automatic Transmission
LSD	Limited Slip Differential
MT	Manual Transmission

DRIVELINE/AXLE FEATURES

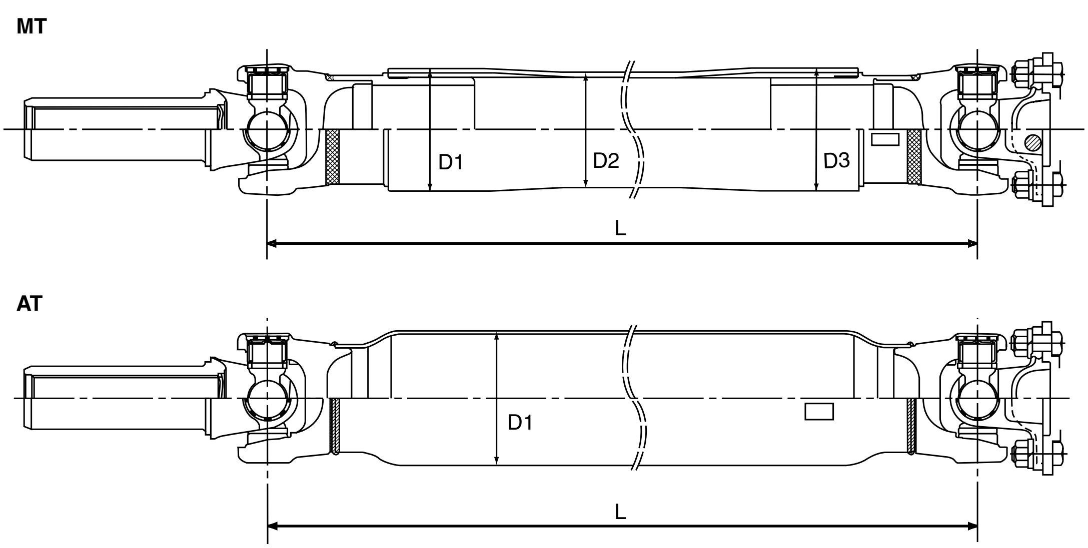
CHU030001018S01

Improved driveability	• Double angular ball bearings with low rotational resistance adopted for the front and rear axles • Bell-shaped constant velocity joint adopted for the axle-side joint of the rear drive shaft • Tripod-shaped constant velocity joint adopted for the differential-side joint of the rear drive shaft • Super-LSD adopted (with LSD) • Carbon construction propeller shaft adopted (MT)
Reduced vibration and noise	• Bell-shaped constant velocity joint adopted for the axle-side joint of the rear drive shaft • Tripod-shaped constant velocity joint adopted for the differential-side joint of the rear drive shaft • Straight-line layout adopted for the propeller shaft to avoid formation of a crease angle with the universal joint
Improved reliability	• Crimped fixing type universal joint adopted for the propeller shaft
Improved serviceability	• Unit bearings that require no preload adjustment adopted for the front and rear wheels
Weight reduction	• Aluminum alloy adopted for the differential rear cover

DRIVELINE/AXLE SPECIFICATIONS

CHU030001018S02

Item			Specification (MT)	Specification (AT)
Transmission type			**MT**	**AT**
Front axle				
Bearing type			Angular ball bearing	
Rear axle				
Bearing type			Angular ball bearing	
Rear drive shaft				
Joint type	Wheel side		Bell joint	
	Differential side		Tripod joint	
Shaft diameter (mm {in})			Left side: 31.0 {1.22} (Maximum diameter) 27.0 {1.06} (Minimum diameter) Right side: 34.0 {1.34} (Maximum diameter) 27.0 {1.06} (Minimum diameter)	Left side: 25.0 {0.98} Right side: 25.8 {1.02}
Rear differential				
Reduction gear type			Hypoid gear	
Differential gear type			Straight bevel gear	
Ring gear size (inch)			8	
Reduction ratio			4.444	
Number of gear teeth	Drive pinion		9	
	Ring gear		40	
Differential oil	Type	Grade	API service GL-5	
		Viscosity	SAE 90	
	Capacity (approx. quantity) (L {US qt, Imp qt})		1.3 {1.4, 1.1}	
Propeller shaft				
Length (mm {in})		L	1,078 {42.44}	
Diameter (mm {in})		D1	76 {3.0}	82.6 {3.25}
		D2	71.5 {2.81}	—
		D3	76 {3.0}	—



03–11 FRONT AXLE

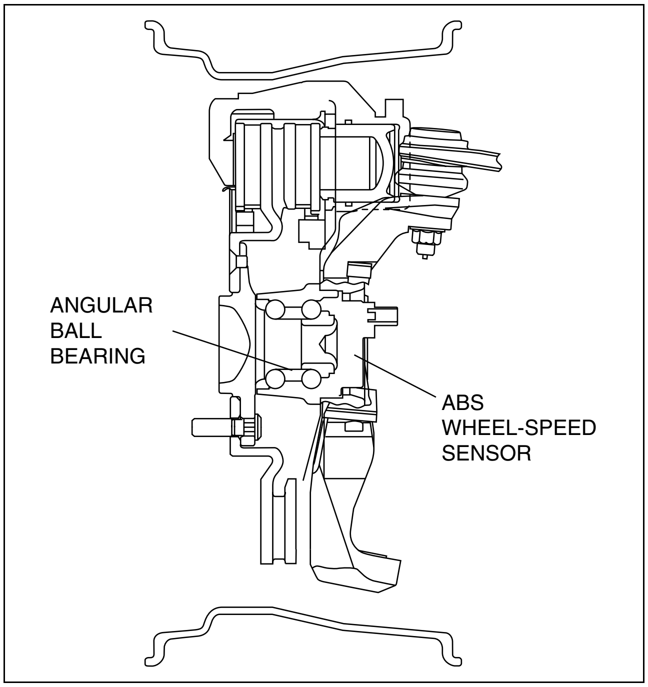
FRONT AXLE OUTLINE

CHU031104000S01

- For the front axle wheel bearing, unit-design angular ball bearings with low rotational resistance have been adopted. Due to this, driveability and serviceability have been improved.
- The wheel hub component is integrated with the ABS wheel-speed sensor, improving reliability.

FRONT AXLE CROSS-SECTIONAL VIEW

CHU031104000S02



CHU0311S001

03–12 REAR AXLE

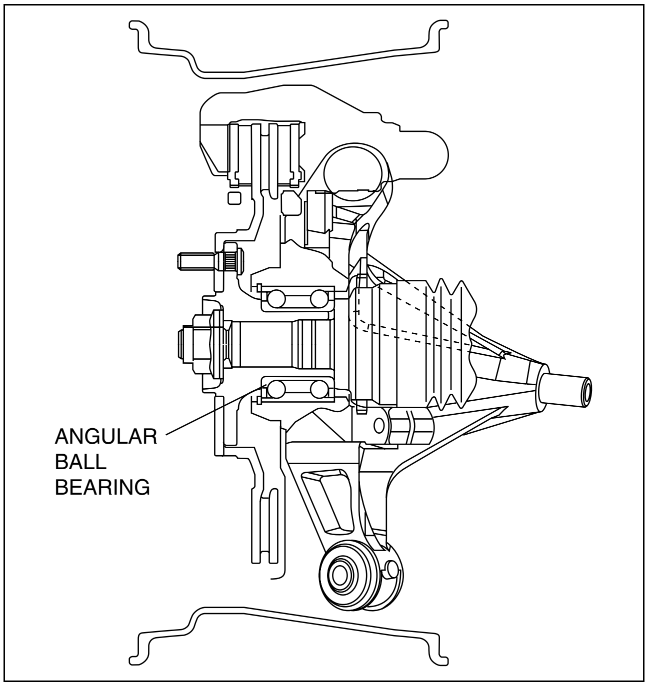
REAR AXLE OUTLINE

CHU031205000S01

- As with the front axle, unit-design angular ball bearings have been adopted, improving driveability and serviceability.

REAR AXLE CROSS-SECTIONAL VIEW

CHU031205000S02



CHU0312S001

03–13 DRIVE SHAFT

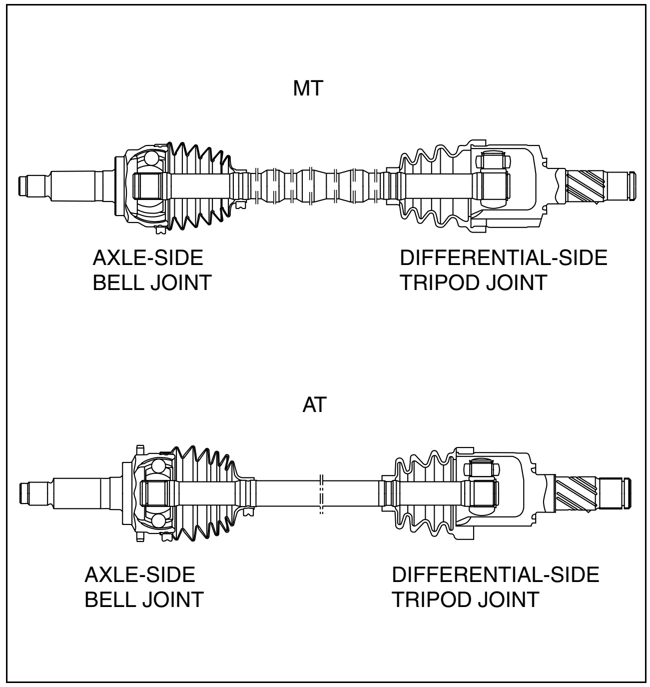
REAR DRIVE SHAFT OUTLINE

CHU031325600S01

- For the axle-side joint, a bell-shaped constant velocity joint has been adopted, reducing vibration and noise.
- For the differential-side joint, a tripod-shaped constant velocity joint has been adopted to reduce slide resistance, vibration and noise, as well as booming noise during high-speed driving.

REAR DRIVE SHAFT CROSS-SECTIONAL VIEW

CHU031325600S02



CHU0313S001

03–14 DIFFERENTIAL

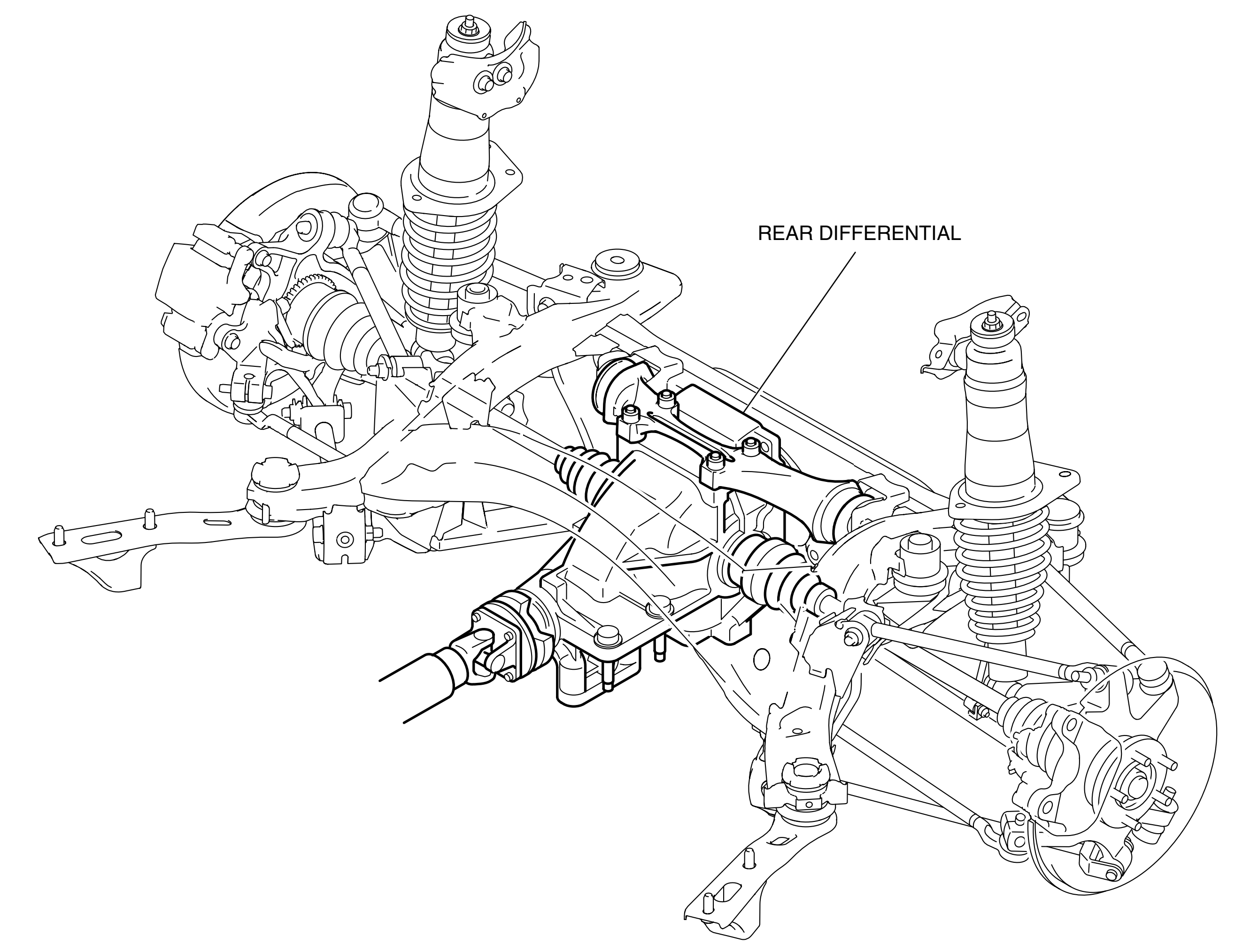
REAR DIFFERENTIAL OUTLINE

CHU031427100S01

- For vehicles with LSD, a super-LSD with a low torque bias ratio* has been adopted to improve performance when starting from a standstill, driving straight-ahead and response.
  *Torque bias ratio: When a wheel slips due to a low-traction surface, the LSD provides proportionally more torque to the opposite wheel. The torque bias ratio is the ratio of torque supplied to the right and left wheels in such cases, and represents the performance capability of the LSD.
- It is rigidly attached to the transmission with a power plant frame in order to enhance the feeling of direct drive when starting from a standstill and accelerating.
- A differential rear cover of aluminum alloy has been adopted for weight reduction.

REAR DIFFERENTIAL CONSTRUCTION

CHU031427100S02



CHU0314S001

SUPER-LSD OUTLINE

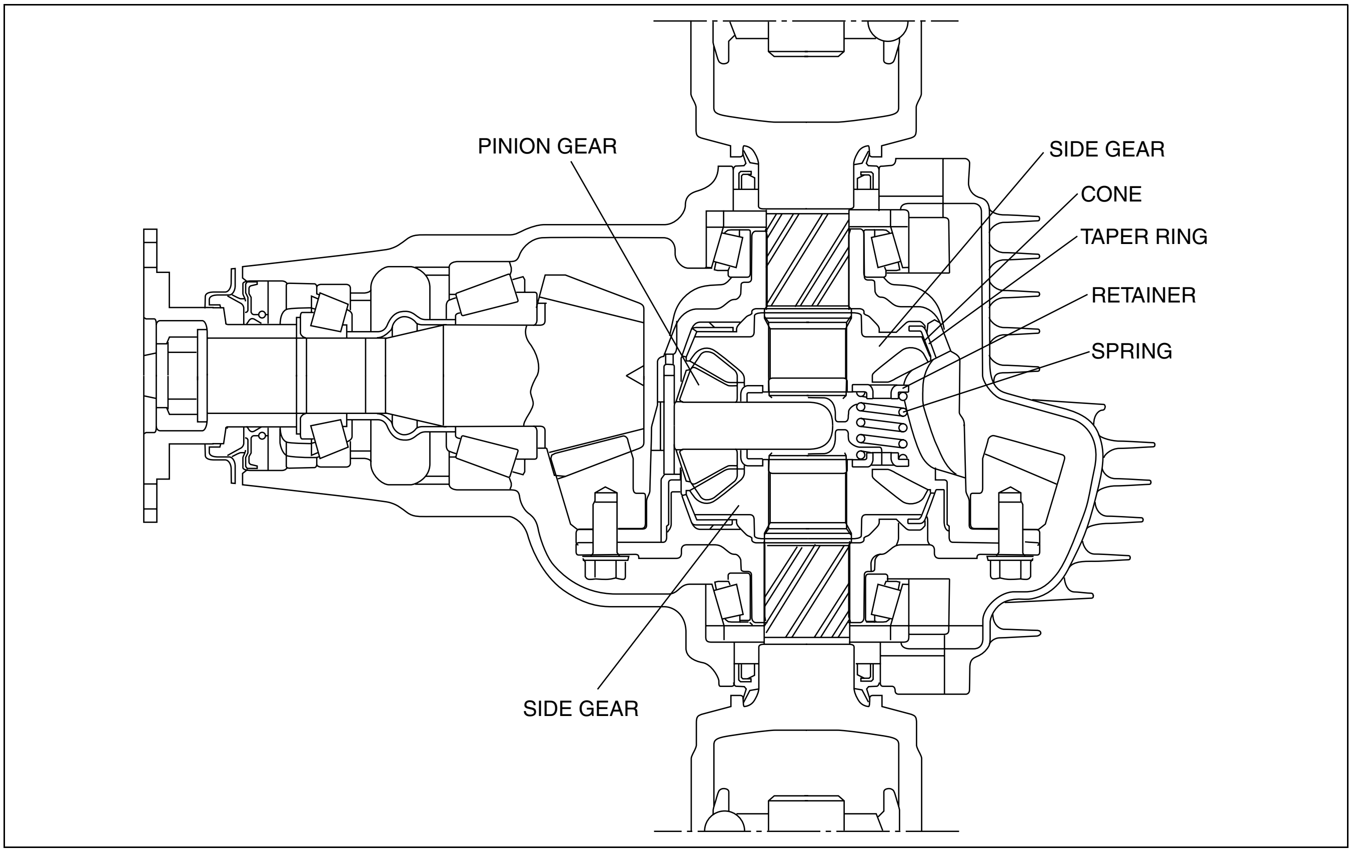
CHU031427100S03

- The super-LSD is a torque-sensing type that provides improved driving stability due to the following characteristics:
  — Low torque bias ratio provides improved controllability (torque bias ratio: 2.0)
  — Creation of initial torque provides improved starting from a standstill and acceleration/deceleration response, and driving straight-ahead (initial torque: 49 N·m {5.0 kgf·m, 36 ft·lbf})
  — Simplified construction provides weight reduction
- The gear case component of the super-LSD cannot be disassembled.

SUPER-LSD CONSTRUCTION

CHU031427100S04

- Inside the super-LSD, taper rings that are fixed to the differential gear case have been placed between the differential gear case and the side gears. Additionally, a cone is provided around the outer surface of the side gear.
- Springs and retainers are positioned between the right and left side gears to provide initial torque to the taper rings.



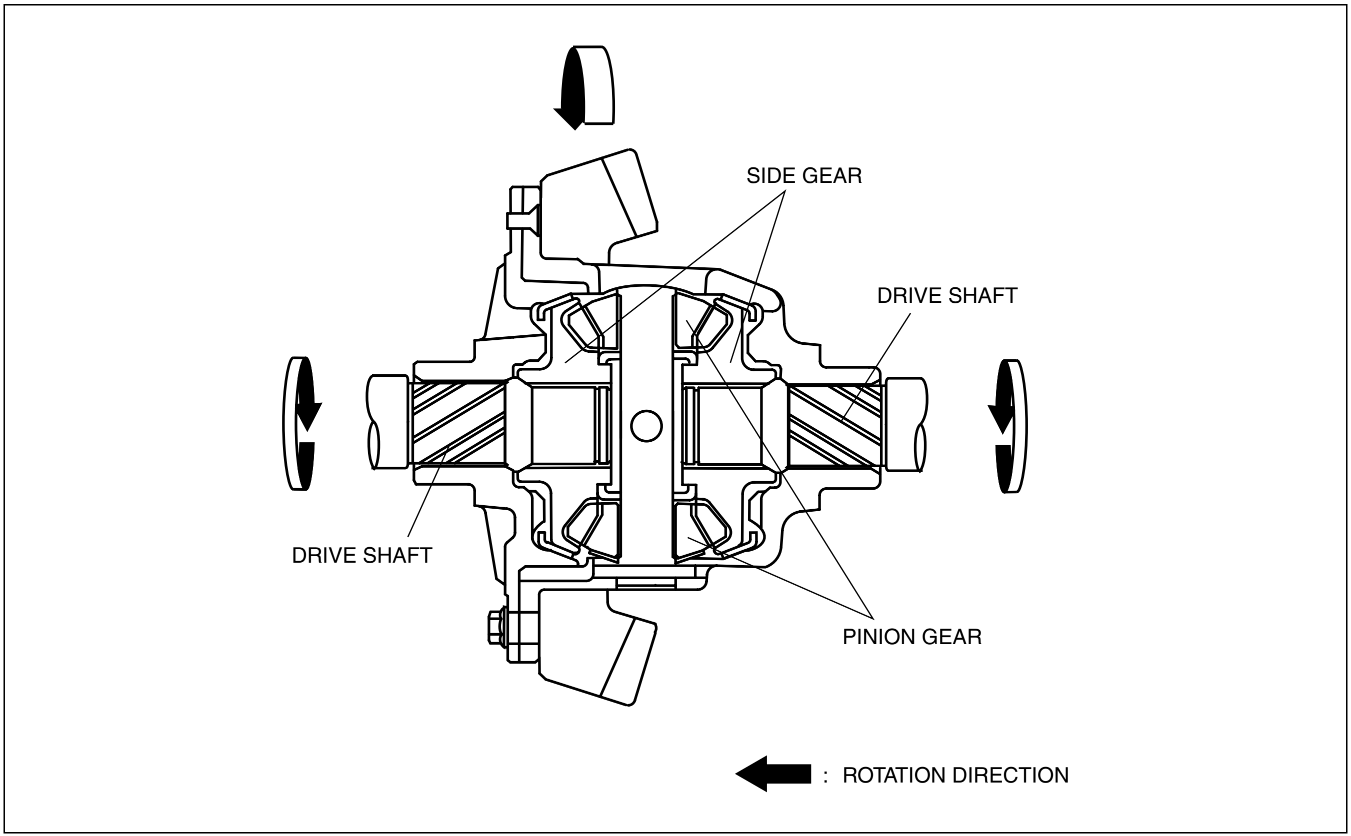
CHU0314S002

SUPER-LSD OPERATION

CHU031427100S05

Straight ahead driving

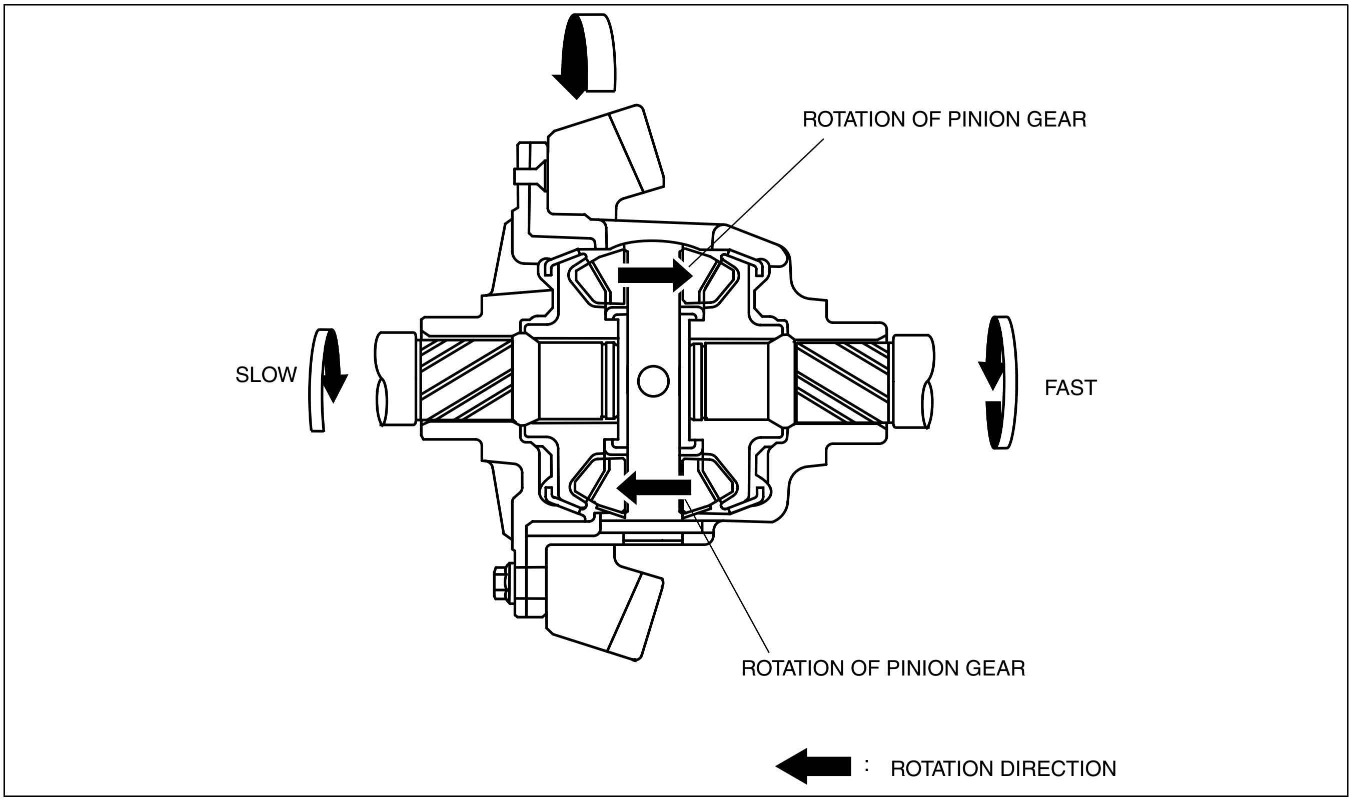
- When driving straight, the right and left side gears rotate at the same speed, and the pinion and side gears rotate together with the differential gear case. Input force from the ring gear is transmitted to the pinion gears via the gear case and to the drive shaft via the side gears. Due to this, a speed difference between right and left in the differential does not occur.



CHU0314S003

Differential operation

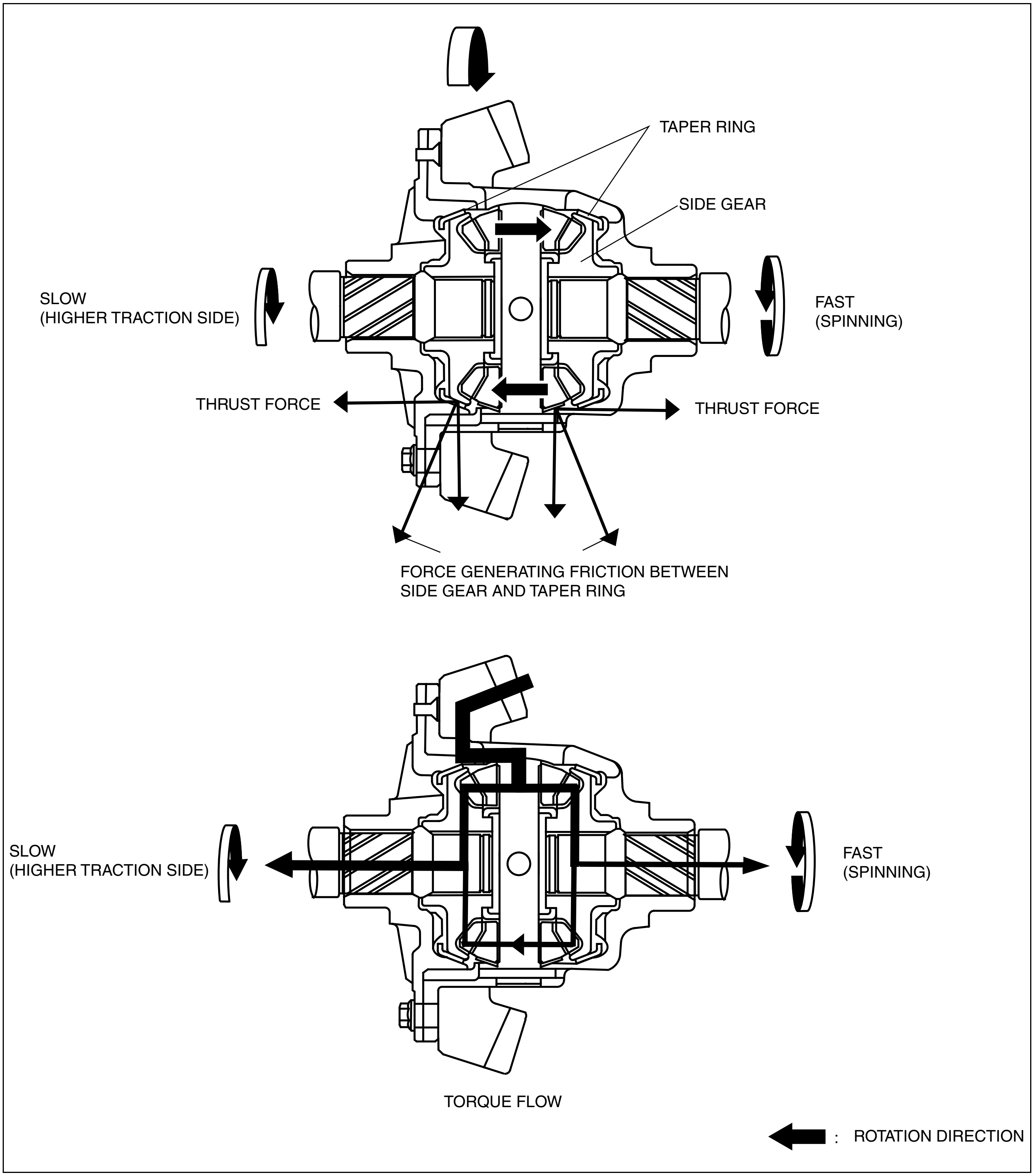
- If the rotation speed between the right and left wheels becomes different (during normal driving), the pinion gears rotate together while revolving around the center axle of the drive shaft, thereby absorbing the difference in rotation speed. This mechanism serves as a differential.



CHU0314S004

Limited-slip operation

- If the differential encounters a condition requiring limited-slip control such as wheel spin, thrust force acts on the side gears due to the reaction force from the meshing of the pinion and side gears. This thrust force presses the side gears against the taper ring, generating friction between the side gear cone and the taper ring and reducing the torque of the slipping wheel. The reduced torque is transmitted without change to the wheel with higher traction, and the limited slip differential function is provided. The torque transmitted to the wheel with higher traction is proportionate to the input torque of the ring gear.



CHU0314S005

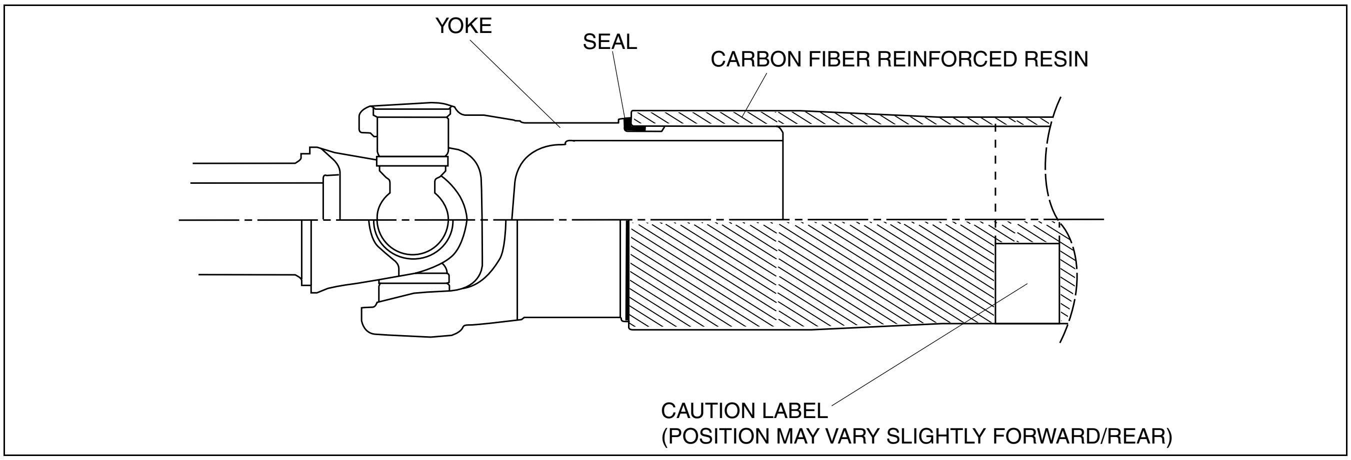
03–15 PROPELLER SHAFT

STRUCTURE

CHU031525002S01

- A one-piece, double-jointed propeller shaft has been adopted for all models. For MT vehicles, a lightweight propeller shaft, with a carbon fiber-reinforced resin pipe*, has been adopted. Due to this, oscillation is controlled and noise vibration and harshness have been greatly reduced over a wide range.
  Additionally, a weight reduction of approx. 3.7 kg {130 oz} has been achieved. (Compared to a two piece, steel-construction propeller shaft)
- Due to the elimination of crease angle in the universal joint together with an in-line layout when viewed from any angle for the powertrain (transmission, propeller shaft, and differential), booming noise has been suppressed, and vibration and harsh noise have been greatly reduced.
  A crimped-fixing method has been adopted for the universal joint.

* : Composite materials of an epoxy resin base reinforced with carbon fibers, whose winding angle has been adjusted, provides unit strength and resilience.



CHU0315N002

BRAKES

04
SECTION

04–00 OUTLINE

BRAKE ABBREVIATIONS

CHU040001021S03

ABS	Antilock Brake System
AT	Automatic Transmission
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
MT	Manual Transmission
PID	Parameter Identification
RF	Right Front
RR	Right Rear
SW	Switch
TCS	Traction Control System
WDS	Worldwide Diagnostic System

BRAKE FEATURES

CHU040001021S01

Improved safety	• Intrusion minimizing brake pedal adopted • Electronic brakeforce distribution (EBD) control adopted • ABS adopted • Dynamic stability control (DSC) adopted
Improved braking force	• Large diameter front disc brakes adopted • Large diameter rear disc brakes adopted • Large diameter power brake unit adopted
Improved serviceability	• Combined sensor integrating the yaw rate and lateral-G sensors adopted • Steering angle sensor that uses controller area network (CAN) adopted • Enhanced malfunction diagnosis system for use with WDS or equivalent
Improved operability	• Center lever type parking brake, adjustable from vehicle interior, adopted
Size and weight reduction	• Integrated construction of the hydraulic unit (HU) and control module (CM) adopted for the ABS HU/CM and DSC HU/CM • Integrated construction of the front wheel hub component and front ABS wheel-speed sensor adopted
Improved durability	• Plunger type master cylinder adopted

BRAKE SPECIFICATIONS

CHU040001021S02

Item		Specification
Brake pedal	Type	Suspended design
	Pedal lever ratio	2.8
	Max. stroke (mm {in})	140 {5.51}
Master cylinder	Type	Tandem (plunger type)
	Cylinder bore (mm {in})	22.22 {0.875}
Front brake (disc)	Type	Ventilated disc
	Cylinder bore (mm {in})	54.0 {2.13}
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	4,840 x 11 {7.744 x 0.43}
	Disc plate dimensions (outer diameter x thickness) (mm {in})	Standard suspension: 303 x 24 {11.9 x 0.94} Sport suspension: 323 x 24 {12.7 x 0.94}
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})	3,330 x 9 {5.328 x 0.4}
	Disc plate dimensions (outer diameter x thickness) (mm {in})	302 x 18 {11.9 x 0.71}
Power brake unit	Type	Vacuum multiplier Single diaphragm
	Outer diameter (mm {in})	274 {10.8}
Rear wheel braking force control device	Type	EBD (Electronic brakeforce distribution)
Parking brake	Type	Mechanical two-rear-wheel control
	Operation system	Center lever type
Brake fluid	Type	SAE J1703, FMVSS 116 DOT3

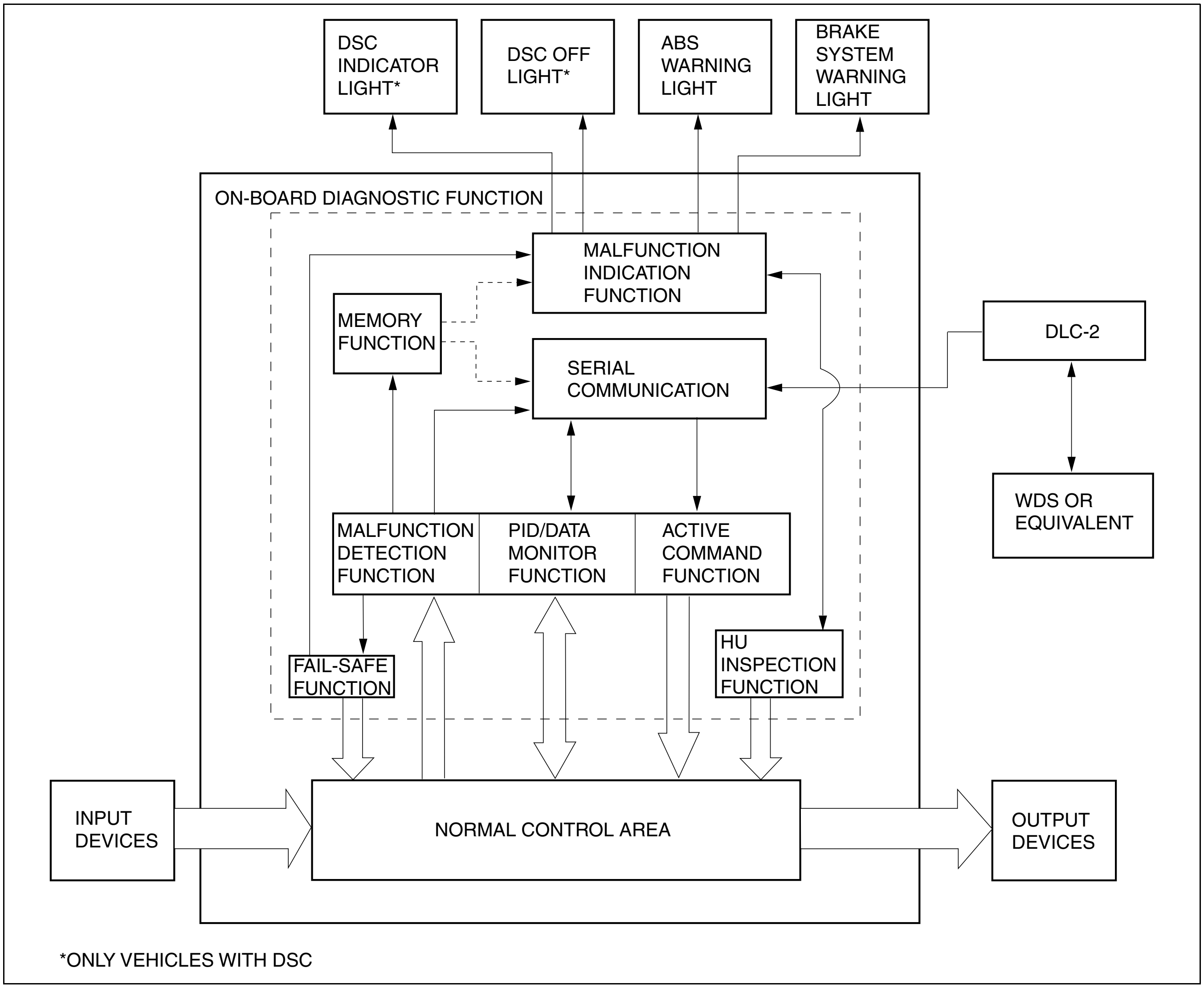
04–02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE (ABS, DYNAMIC STABILITY CONTROL)

CHU040243000S01

- 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 WDS or equivalent to the DLC-2.
- In addition to DTC read-out, the WDS or equivalent is used to clear DTCs using the display screen of the diagnostic tester, and to access the PID/data monitor and simulation functions, providing enhanced malfunction diagnosis and improved serviceability.

Block Diagram



CHU0402S001

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION (ABS, DYNAMIC STABILITY CONTROL)

CHU040243000S02

Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the ABS HU/CM (vehicles with ABS) or DSC HU/CM (vehicles with DSC) when the ignition switch is at the ON position.
- When the ABS HU/CM and DSC HU/CM are started up, the following malfunction detections are performed.

  ABS HU/CM

  — The ABS and brake system warning lights illuminate for **approx. 3 s** when the ignition switch is turned to the ON position to inspect for open circuits in the lights. At the same time, the fail-safe relay is operated, and the input/output signals of each part is monitored for malfunction diagnosis. After starting to drive, the first time the vehicle speed is **approx. 10 km/h {6.2 mph} or more** the pump motor is operated and malfunction diagnosis is performed again.

  DSC HU/CM

  — The ABS and brake system warning lights, DSC OFF and DSC indicator lights illuminate for **approx. 3 s** when the ignition switch is turned to the ON position to inspect for open circuits in the lights. At the same time, the fail-safe relay is operated, and the input/output signals of each part is monitored for malfunction diagnosis. After starting to drive, the first time the vehicle speed is **approx. 10 km/h {6.2 mph} or more** the pump motor is operated and malfunction diagnosis is performed again.
- 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 DLC-2 terminal KLN. At the same time, malfunction detection results are sent to the memory and fail-safe functions.

Memory Function

- The memory function stores DTCs of malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition switch has been turned off (LOCK position), even if the malfunctioning signal system has returned to normal.
- Since the ABS HU/CM or DSC 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, EBD, TCS* and DSC* as shown in the fail-safe function table.

*: Only vehicles with DSC

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 (Vehicles With ABS)

Malfunction location	DTC number	Fail-safe function			
		Warning light illumination status		Control status	
	WDS or equivalent display	ABS warning light	Brake system warning light (when parking brake is released)	ABS control	EBD control
Power supply system	B1318	Illuminated[*1]	Illuminated[*1]	Control enabled	Control enabled
ABS HU/CM system	B1342	Illuminated	Illuminated	Control disabled	Control disabled
ABS wheel-speed sensor system	C1145	Illuminated	Not illuminated[*2]	Control disabled	Control enabled[*3]
	C1148				
	C1155				
	C1158				
	C1165				
	C1168				
	C1175				
	C1178				
ABS wheel-speed sensor/ABS sensor rotor systems	C1233	Illuminated	Not illuminated[*4]	Control disabled	Control enabled[*5]
	C1234				
	C1235				
	C1236				
Solenoid valve system	C1194	Illuminated	Illuminated[*6]	Control disabled	Control disabled[*7]
	C1198				
	C1210				
	C1214				
	C1242				
	C1246				
	C1250				
	C1254				
ABS HU/CM internal pump system	C1140	Illuminated	Not illuminated	Control disabled	Control enabled
Solenoid valve, pump motor, ABS wheel speed sensor/ABS sensor rotor systems	C1510	Illuminated	Not illuminated[*2]	Control disabled	Control enabled[*3]
	C1511				
	C1512				
	C1513				
Fail-safe relay system	C1186	Illuminated	Illuminated	Control disabled	Control disabled
	C1266		Not illuminated		Control enabled

Malfunction location	DTC number	Fail-safe function			
		Warning light illumination status		Control status	
	WDS or equivalent display	ABS warning light	Brake system warning light (when parking brake is released)	ABS control	EBD control
Pump motor, motor relay systems	C1095	Illuminated	Not illuminated	Control disabled	Control enabled
	C1096				
CAN line system	U1900	Not illuminated	Not illuminated	Control enabled	Control enabled
	U2516			Control enabled	Control enabled

*1 : If the ignition voltage returns to normal, the light goes out.
*2 : Illuminates when either rear or both front wheels are abnormal.
*3 : Control disabled when both rear or both front wheels are abnormal.
*4 : Illuminates when either rear wheel is abnormal.
*5 : Control disabled when both rear wheels are abnormal.
*6 : Does not illuminate when either front wheel solenoid valve malfunctions (stuck off).
*7 : Control enabled when the front wheel pressure increase and the rear wheel pressure decrease solenoid valves malfunction (stuck off).

Fail-safe Function Malfunction Contents (Vehicles With DSC)

Malfunction location	DTC number	Fail-safe function							
		Warning light illumination status				Control status			
	WDS or equivalent Display	ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	DSC OFF light	ABS control	EBD Control	TCS control	DSC control
Power supply system	B1318	Illuminated *1	Not illuminated	Illuminated *1	Not illuminated	Control disabled *2	Control enabled	Control disabled *2	Control disabled *2
DSC HU/CM system	B1342	Illuminated	Illuminated	Illuminated	Illuminated	Control disabled	Control disabled	Control disabled	Control disabled
Brake switch signal system	B1484	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
	C1953								
DSC HU/CM configuration system	B2477	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
DSC OFF switch system	C1093	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled
Pump motor, motor relay systems	C1095	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
	C1096								
PCM communication system	C1119	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled	Control disabled
	C1134								
ABS wheel-speed sensor system	C1145	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
	C1155								
	C1165								
	C1175								
	C1233								
	C1234								
	C1235								
	C1236								

Malfunction location	DTC number WDS or equivalent Display	Fail-safe function: Warning light illumination status: ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	DSC OFF light	Control status: ABS control	EBD Control	TCS control	DSC control
ABS wheel-speed sensor/ ABS sensor rotor systems	C1148 C1158 C1168 C1178	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
ABS wheel-speed sensor (slip monitor) system	C1222	Illuminated	Illuminated	Illuminated	Not illuminated	Control disabled	Control disabled	Control disabled	Control disabled
Valve relay system	C1186 C1266	Illuminated	Illuminated	Illuminated	Not illuminated	Control disabled	Control disabled	Control disabled	Control disabled
Solenoid valve system	C1194 C1198 C1210 C1214 C1242 C1246 C1250 C1254 C1400 C1410 C1957 C1958	Illuminated	Illuminated	Illuminated	Not illuminated	Control disabled	Control disabled	Control disabled	Control disabled
Brake fluid pressure sensor system	C1288 C1290 C1440 C1730 C1954	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
Steering angle sensor system	C1295 C1306 C1307 C1937 C1938 C1956 C2778	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled	Control disabled
Combined sensor system	C1279 C1280 C1281 C1282 C1951 C1952 C1959 C2768	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled	Control disabled
Incorrect DSC HU/CM installed	C1805	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
DSC HU/CM control system	C1994	Illuminated *3	Not illuminated	Illuminated *3	Not illuminated	Control disabled *4	Control enabled	Control disabled *4	Control disabled *4

04–02

Malfunction location	DTC number	Fail-safe function							
		Warning light illumination status				Control status			
	WDS or equivalent Display	ABS warning light	Brake system warning light (when parking brake is released)	DSC indicator light	DSC OFF light	ABS control	EBD Control	TCS control	DSC control
CAN communication system	U1900	Not illuminated *5	Not illuminated	Illuminated	Illuminated	Control enabled *6	Control enabled	Control disabled	Control disabled
	U2516	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled

*1 : If the ignition voltage returns to normal, the light goes out.
*2 : If the ignition voltage returns to normal, control is enabled.
*3 : Light goes out if the malfunction is repaired.
*4 : Control enabled if the malfunction is repaired.
*5 : Illuminates if tire size data cannot be received.
*6 : Control is disabled if tire size data cannot be received.

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION (ABS, DYNAMIC STABILITY CONTROL)

CHU040243000S03

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

PID/DATA Monitor Table (Vehicles with ABS)

PID/data monitor item	Input/output part	Unit/Condition (Tester display)
ABS_LAMP	ABS warning light	On/Off
ABS_VOLT	Battery	V
ABSLF_I	LF inlet solenoid valve	On/Off
ABSLF_O	LF outlet solenoid valve	On/Off
ABSLR_I	LR inlet solenoid valve	On/Off
ABSLR_O	LR outlet solenoid valve	On/Off
ABSPMPRLY	Pump motor relay	On/Off
ABSRF_I	RF inlet solenoid valve	On/Off
ABSRF_O	RF outlet solenoid valve	On/Off
ABSRR_I	RR inlet solenoid valve	On/Off
ABSRR_O	RR outlet solenoid valve	On/Off
ABSVLVRLY	Valve control relay	On/Off
BOO_ABS	Brake switch	On/Off
BRAKE_LMP	Brake system warning light	On/Off
CCNTABS	Number of continuous DTCs	—
LF_WSPD	ABS wheel-speed sensor (LF)	KPH, MPH
LR_WSPD	ABS wheel-speed sensor (LR)	KPH, MPH
PMPSTAT	Pump motor	On/Off
RF_WSPD	ABS wheel-speed sensor (RF)	KPH, MPH
RR_WSPD	ABS wheel-speed sensor (RR)	KPH, MPH

PID/DATA Monitor Table (Vehicles with DSC)

PID/data monitor item	Input/output part	Unit/Condition (Tester display)
ABS_LAMP	ABS warning light	On/Off
ABS_VOLT	Battery	V
ABSLF_I	LF inlet solenoid valve	On/Off
ABSLF_O	LF outlet solenoid valve	On/Off
ABSLR_I	LR inlet solenoid valve	On/Off
ABSLR_O	LR outlet solenoid valve	On/Off
ABSRF_I	RF inlet solenoid valve	On/Off
ABSRF_O	RF outlet solenoid valve	On/Off
ABSRR_I	RR inlet solenoid valve	On/Off
ABSRR_O	RR outlet solenoid valve	On/Off
BOO_ABS	Brake switch	On/Off
BRAKE_LMP	Brake system warning light	On/Off
CCNTABS	Number of continuous DTCs	—
L_DSC O	LH stability control solenoid valve	On/Off
LAT ACC	Lateral-G sensor	G
LF_WSPD	ABS wheel-speed sensor (LF)	KPH, MPH
LR_WSPD	ABS wheel-speed sensor (LR)	KPH, MPH
MCYLIP	Brake fluid pressure sensor	kPa, psi, Bar
PMPSTAT	Pump motor	On/Off
R_DSC O	RH stability control solenoid valve	On/Off
RF_WSPD	ABS wheel-speed sensor (RF)	KPH, MPH
RPM	PCM (engine speed)	RPM
RR_WSPD	ABS wheel-speed sensor (RR)	KPH, MPH
SWA POS	Steering angle sensor	°
TC LVAL	LH traction switch solenoid valve	On/Off
TC RVAL	RH traction switch solenoid valve	On/Off
TPI	PCM (throttle opening angle)	%
YAW_RATE	Combined sensor	deg./s

ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION (ABS, DYNAMIC STABILITY CONTROL)

CHU040243000S04

- The active command modes function is used for optionally selecting active command modes items of input/output parts preset in the ABS HU/CM or DSC HU/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 (Vehicles with ABS)

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

Active Command Modes Table (Vehicles with DSC)

Command name	Output part name	Operation	Operation condition
LATACCEL	Combined sensor (lateral acceleration) initialization start-up	TRUE/FALSE	Ignition switch at ON
LF_DSC_V	LF stability control valve	On/Off	
LF_INLET	LF inlet solenoid valve		
LF_OUTLET	LF outlet solenoid valve		
LF_TC_VLV	LF traction control valve		
LR_INLET	LR inlet solenoid valve		
LR_OUTLET	LR outlet solenoid valve		
PMP_MOTOR	Pump motor		
RF_DSC_V	RF stability control valve		
RF_INLET	RF inlet solenoid valve		
RF_OUTLET	RF outlet solenoid valve		
RF_TC_VLV	RF traction control valve		
RR_INLET	RR inlet solenoid valve		
RR_OUTLET	RR outlet solenoid valve		
SAS_CAL	Steering angle sensor initialization start-up	TRUE/FALSE	
YAWRATE	Combined sensor (yaw rate) initialization start-up	On/Off	

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION (ABS, DYNAMIC STABILITY CONTROL)

CHU040243000S05

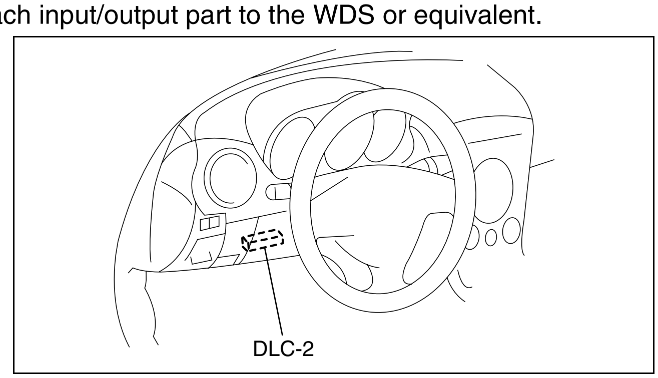
- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, and operation of input/output parts) between the ABS HU/CM or the DSC HU/CM and an external tester.

Connections and Communication Contents

	External tester	
	WDS or equivalent	
	Connection	Communication method
Self-diagnosis (malfunction detection) function	Input/output: KLN terminal	Serial communication
Data monitor function	Input/output: KLN terminal	Serial communication
Active command modes function	Input/output: KLN terminal	Serial communication

Serial communication

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



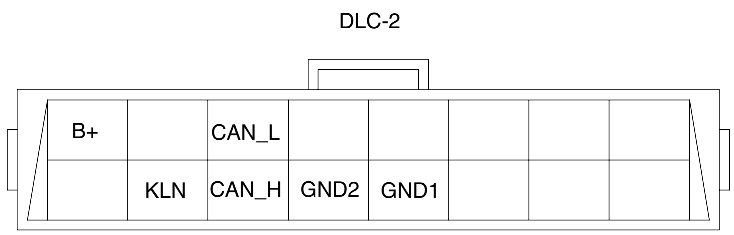
CHU0413W001

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

CHU040243000S06

- 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 KLN, CAN_H, CAN_L, GND1, GND2 and B+ terminals.



CHU0402S002

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

04–11 CONVENTIONAL BRAKE SYSTEM

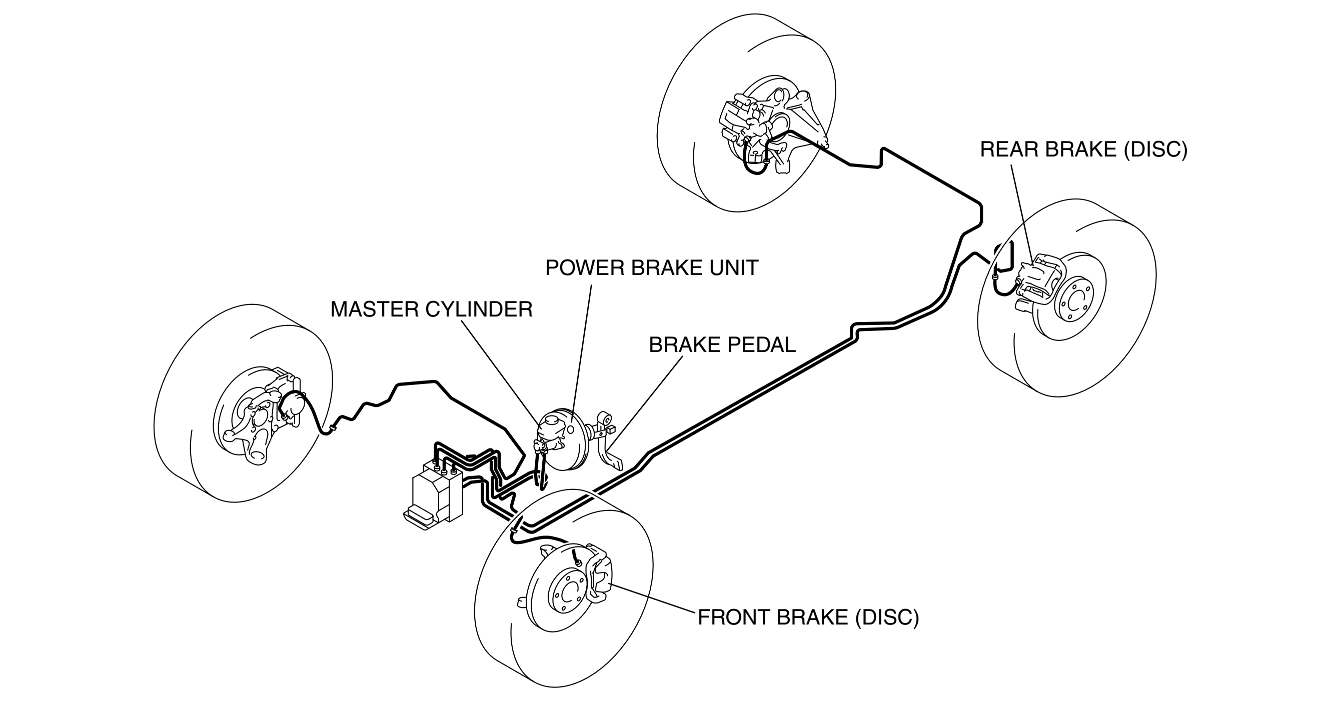
CONVENTIONAL BRAKE SYSTEM OUTLINE

CHU041101021S01

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

CONVENTIONAL BRAKE SYSTEM STRUCTURAL VIEW

CHU041101021S02



CHU0411S001

INTRUSION-MINIMIZING BRAKE PEDAL FUNCTION

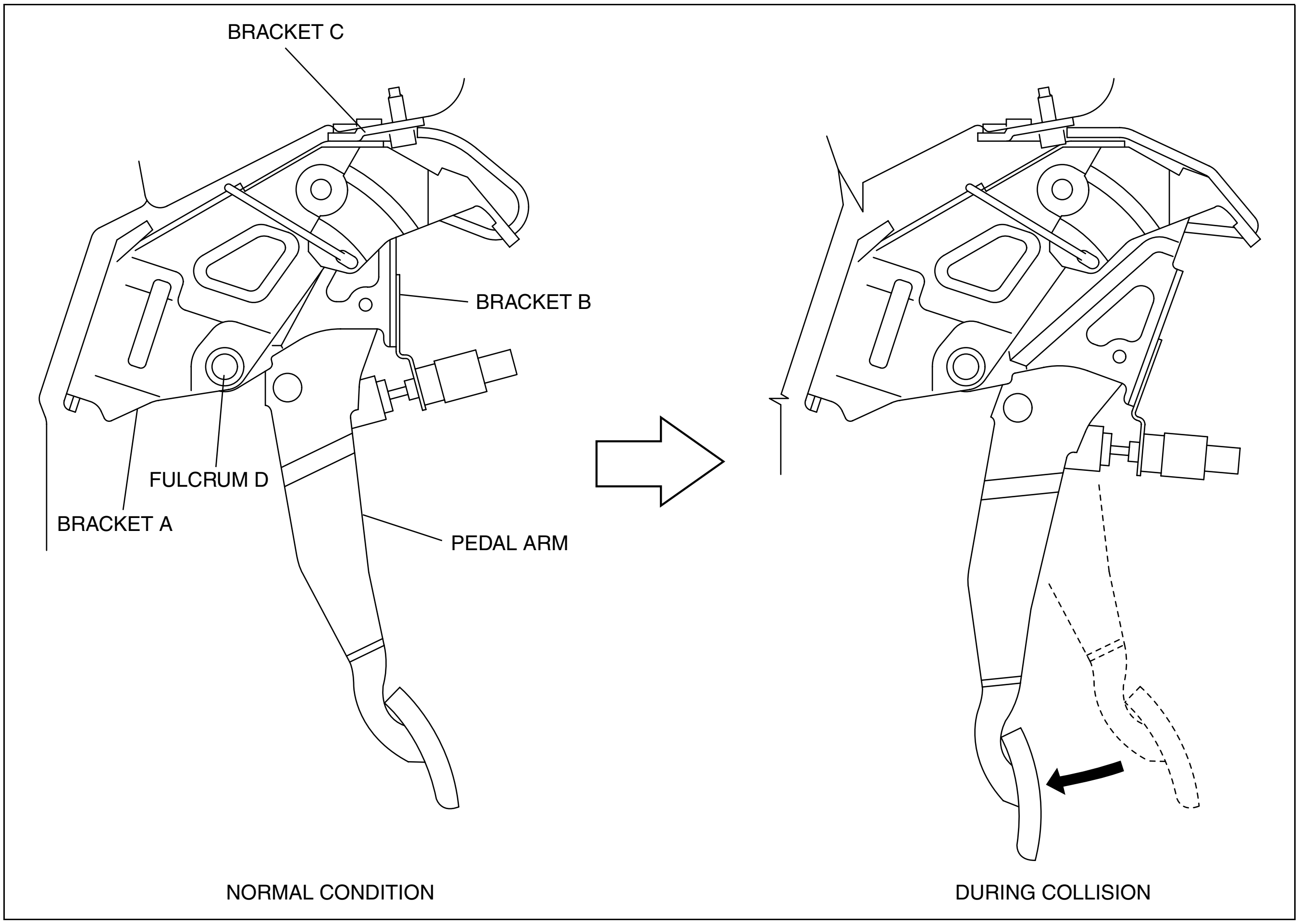
CHU041143300S01

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

INTRUSION-MINIMIZING BRAKE PEDAL OPERATION

CHU041143300S02

- In a frontal collision, the brake pedal is forced rearward by the movement of the engine and other parts.
- Brackets A and B break away from bracket C, which is fixed to the body.
- Bracket B is freed allowing it and the pedal arm to rotate together at pivot fulcrum D of bracket A, thereby preventing the rearward movement of the brake pedal.



CHU0411S002

MASTER CYLINDER CONSTRUCTION

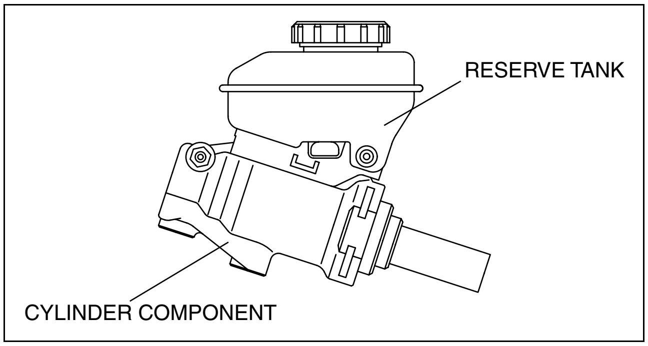
CHU041143400S01

- A plunger-type master cylinder with a **22.22 mm {0.875 in}** bore has been adopted, improving durability.

Note

- Plunger type: A system where the cups are fixed on the cylinder, and the piston slides through the inner perimeter of the cups.

- For vehicles with DSC, the master cylinder outlet pipe diameter has been increased, improving response during DSC operation.
- Except for the reservoir, 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.

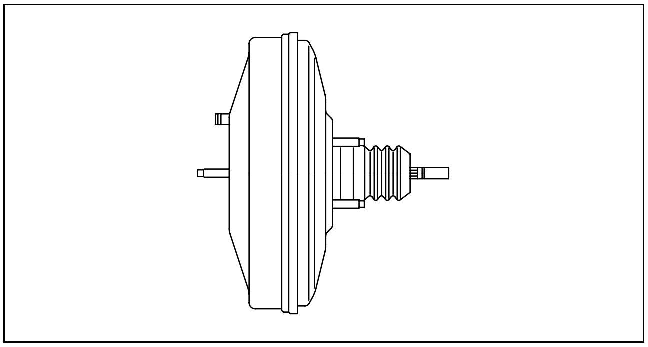


CHU0411S003

POWER BRAKE UNIT CONSTRUCTION

CHU041143800S01

- A 10-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.



CHU0411S004

FRONT BRAKE (DISC) CONSTRUCTION

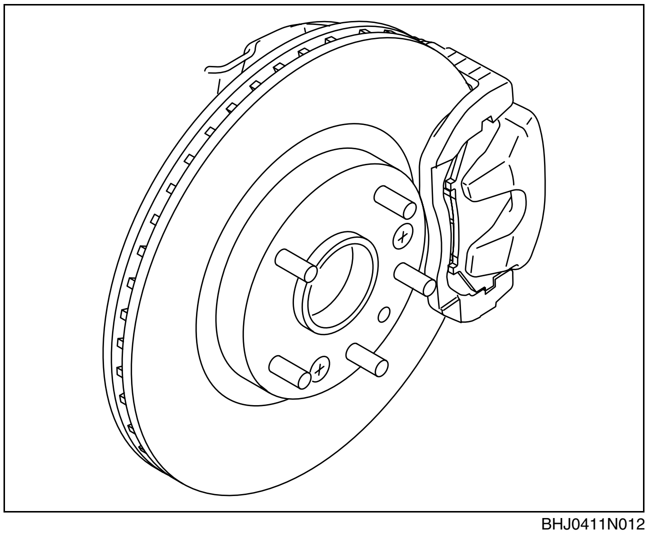
CHU041133980S01

Standard Suspension Specification Vehicles

- Ventilated disc type front brakes with a **303 mm {11.9 in}** diameter and **24 mm {0.94 in}** thickness have been adopted.

Sport Suspension Specification Vehicles

- Large diameter, ventilated disc type front brakes with a **323 mm {12.7 in}** diameter and **24 mm {0.94 in}** thickness have been adopted.
- The number of ribs in the ventilated plate have been increased, improving fade resistance.

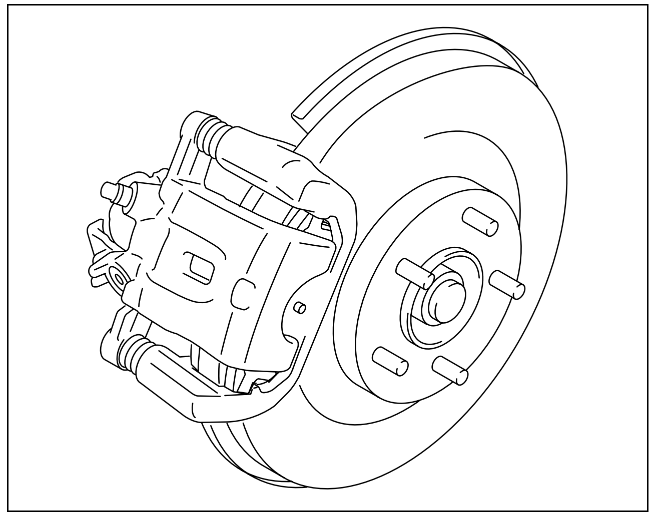


BHJ0411N012

REAR BRAKE (DISC) CONSTRUCTION

CHU041126980S01

- A large diameter, ventilated disc type rear brake with a **302 mm {11.9 in}** diameter and **18 mm {0.71 in}** thickness has been adopted for all models, improving braking force and fade resistance.



BHJ0411N013

04–12 PARKING BRAKE SYSTEM

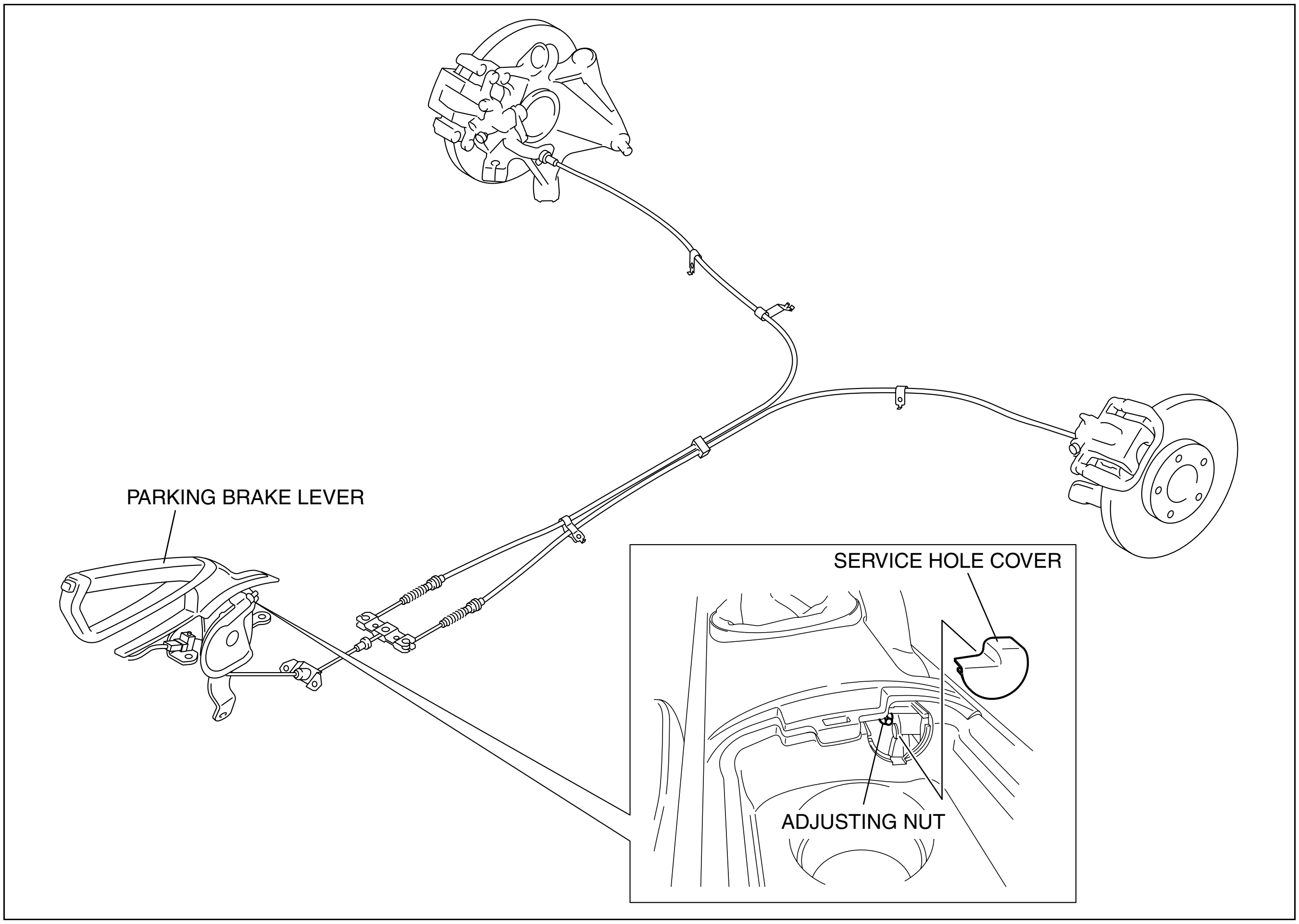
PARKING BRAKE SYSTEM OUTLINE

CHU041201022S01

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

PARKING BRAKE SYSTEM STRUCTURAL VIEW

CHU041201022S02



CHU0412S001

04–13 ANTILOCK BRAKE SYSTEM

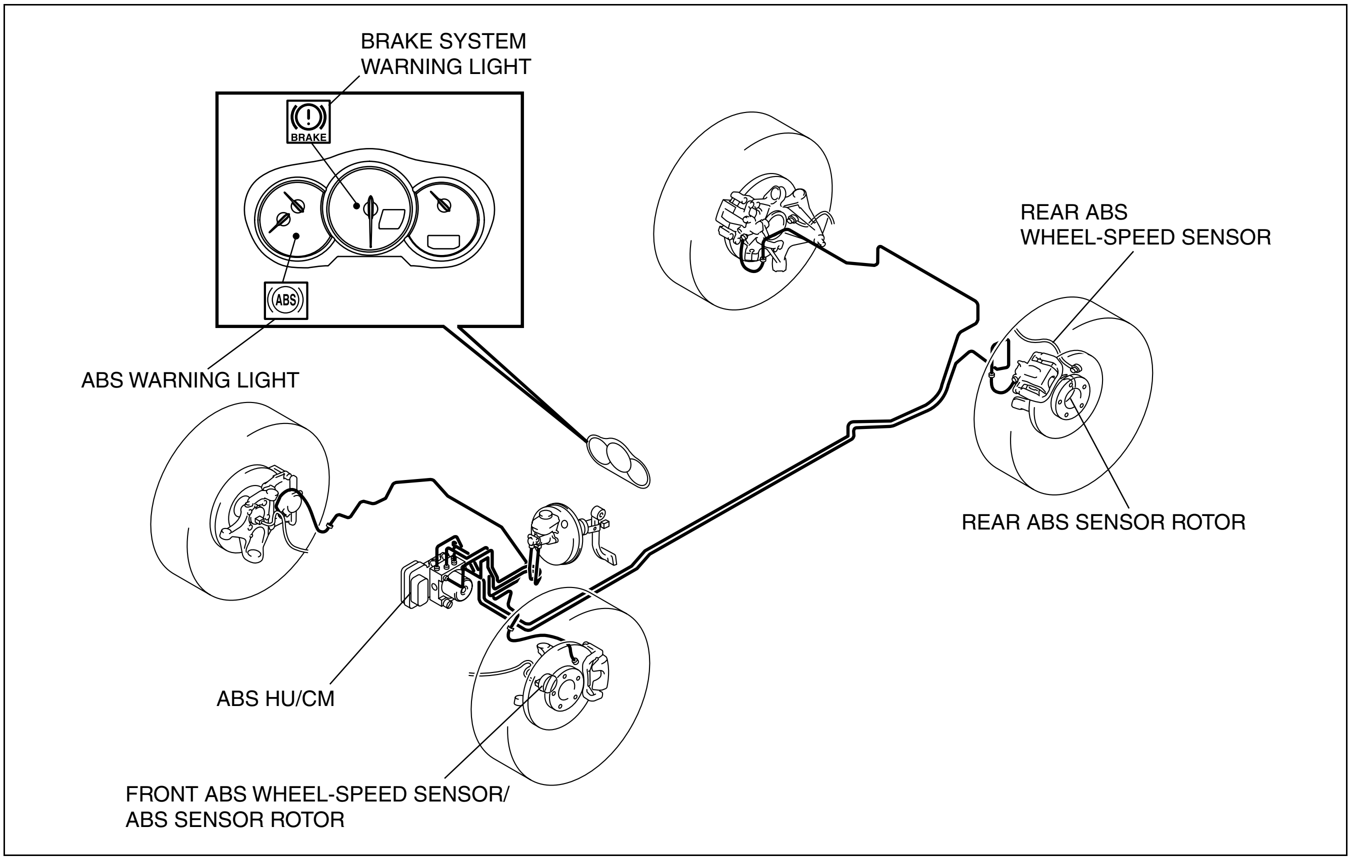
ABS OUTLINE

CHU041343000S01

- The ABS HU/CM, integrating both the hydraulic unit (HU) and control module (CM), has been adopted, resulting in size and weight reduction.
- A front wheel hub component with an integrated front ABS wheel-speed sensor has been adopted for improved reliability and size and weight reduction.
- Electronic brakeforce distribution (EBD) control has been adopted, resulting in improved safety and handling stability.

ABS STRUCTURAL VIEW

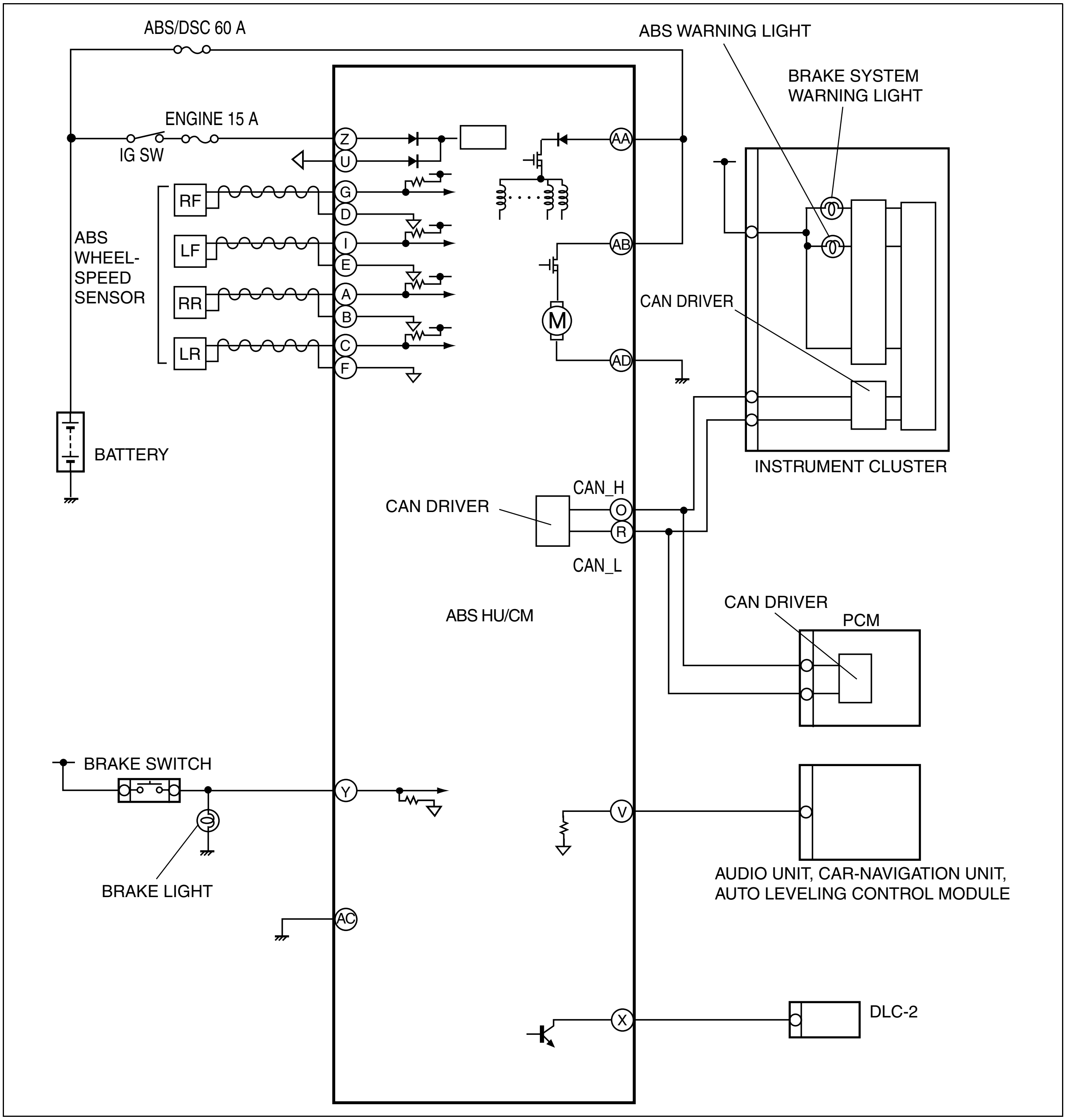
CHU041343000S02



CHU0413S001

ABS SYSTEM WIRING DIAGRAM

CHU041343000S03

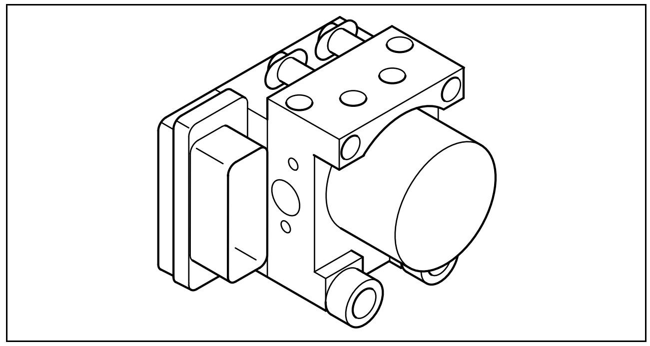


CHU0402W007

ABS HU/CM CONSTRUCTION

CHU041343750S01

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



BHJ0413N002

ABS HU PART FUNCTION

CHU041343750S02

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

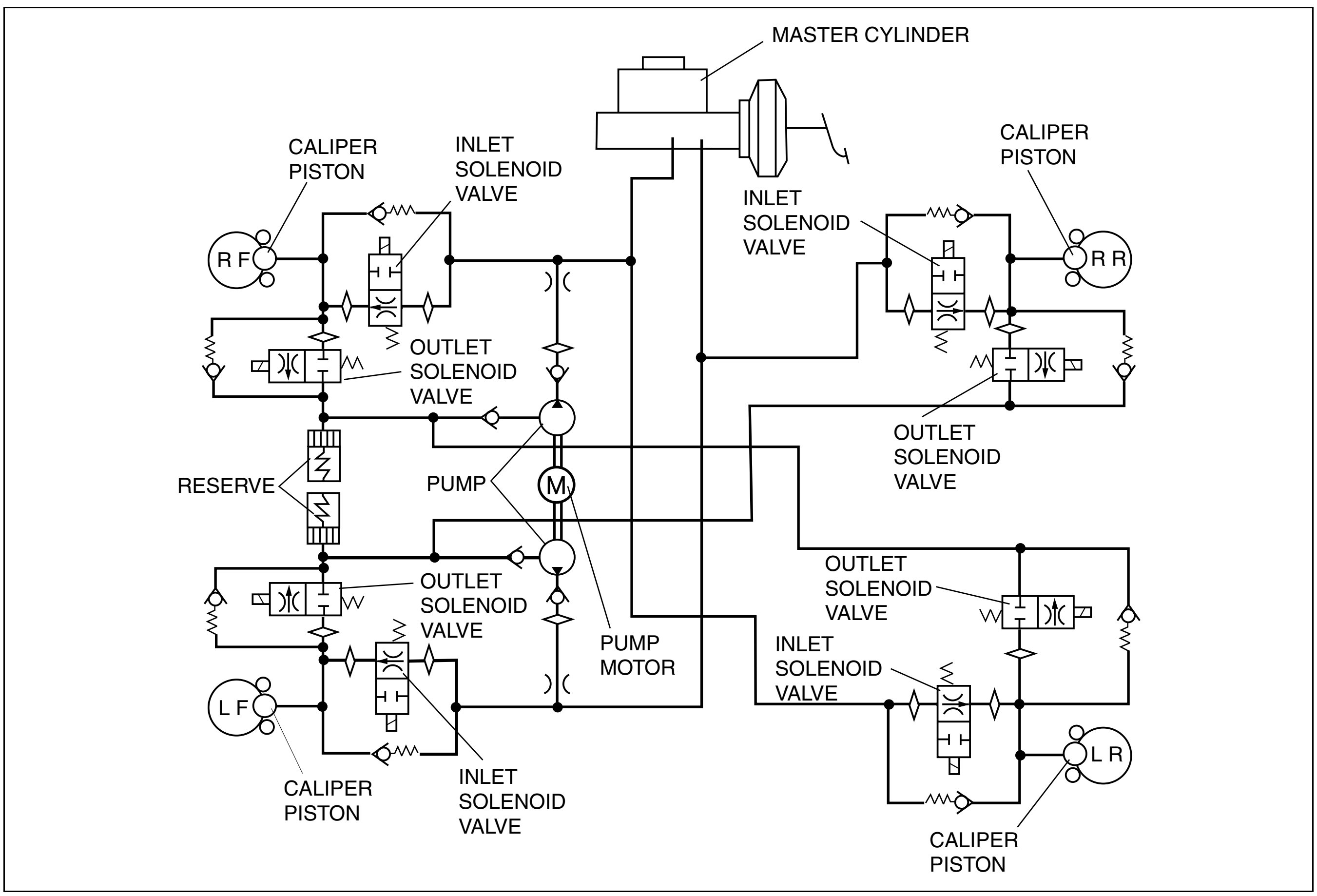
ABS HU PART CONSTRUCTION/OPERATION

CHU041343750S03

Structure

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

Hydraulic Circuit Diagram



CHU0413S005

Function Of Main Component Parts

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

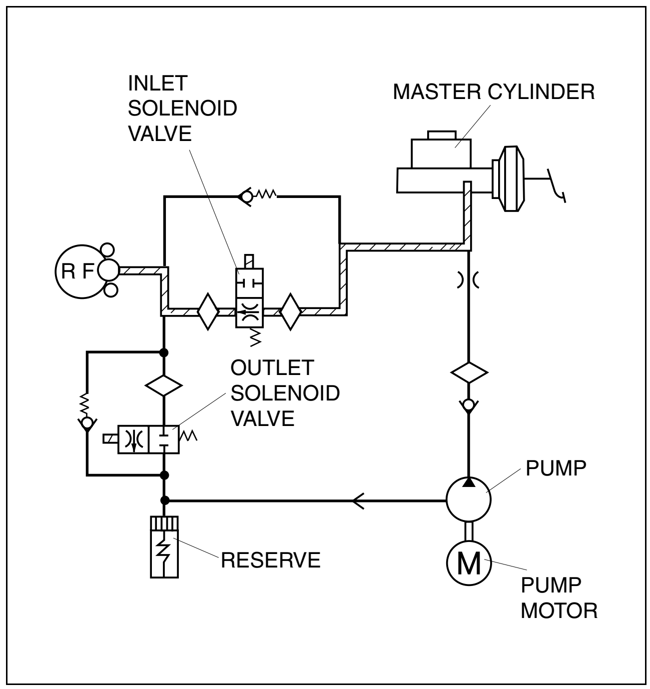
Operating

Normal braking or pressure increase mode

- During normal braking or pressure increase mode the inlet and outlet solenoid valves are not energized: the inlet solenoid valve is open and the outlet solenoid valve is closed. Brake fluid pressure from the master cylinder flows through the inlet solenoid valve and is transmitted to the caliper piston. At this time, the pump motor does not operate. (Description for single front wheel only)

Solenoid valve operation table

Inlet solenoid valve	Outlet solenoid valve	Pump motor, pump
OFF (open)	OFF (closed)	Stopped



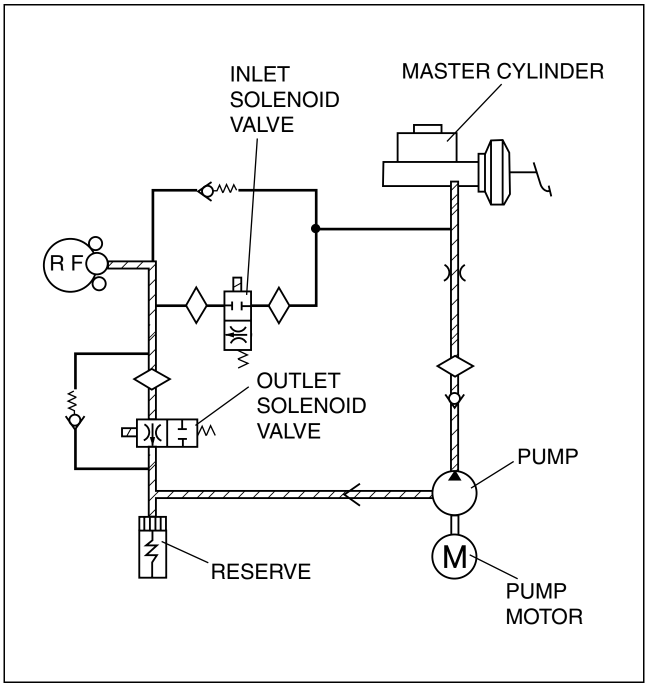
CHU0413S006

Pressure reduction mode

- During pressure reduction mode, when the wheels may possibly lock-up due to emergency braking or similar, the inlet solenoid valve closes and the outlet solenoid valve opens. The brake fluid being applied to the caliper piston flows out through the outlet solenoid valve into the reserve tank, thereby decreasing pressure. During this operation, the pump motor operates, returning the brake fluid stored in the reserve tank to the master cylinder. (Description for single front wheel only)

Solenoid valve operation table

Inlet solenoid valve	Outlet solenoid valve	Pump motor, pump
ON (closed)	ON (open)	Operating



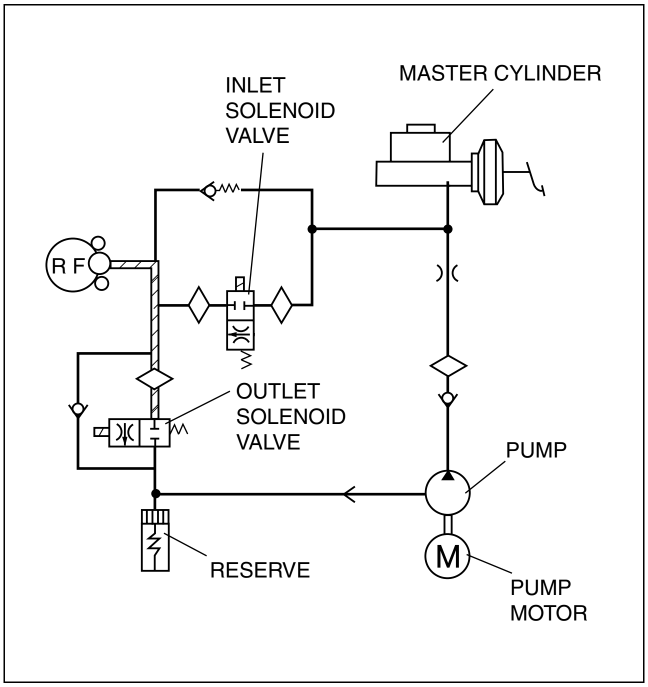
CHU0413S007

Pressure maintain mode

- During pressure maintain mode, both the inlet and outlet solenoid valves are closed. The path for the brake fluid being applied to the caliper piston is blocked and brake fluid pressure is maintained. (Description for single front wheel only)

Solenoid valve operation table

Inlet solenoid valve	Outlet solenoid valve	Pump motor, pump
ON (closed)	OFF (closed)	Stopped



CHU0413S008

ABS CM PART FUNCTION

CHU041343750S04

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

Function Table

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

ABS CONTROL OUTLINE

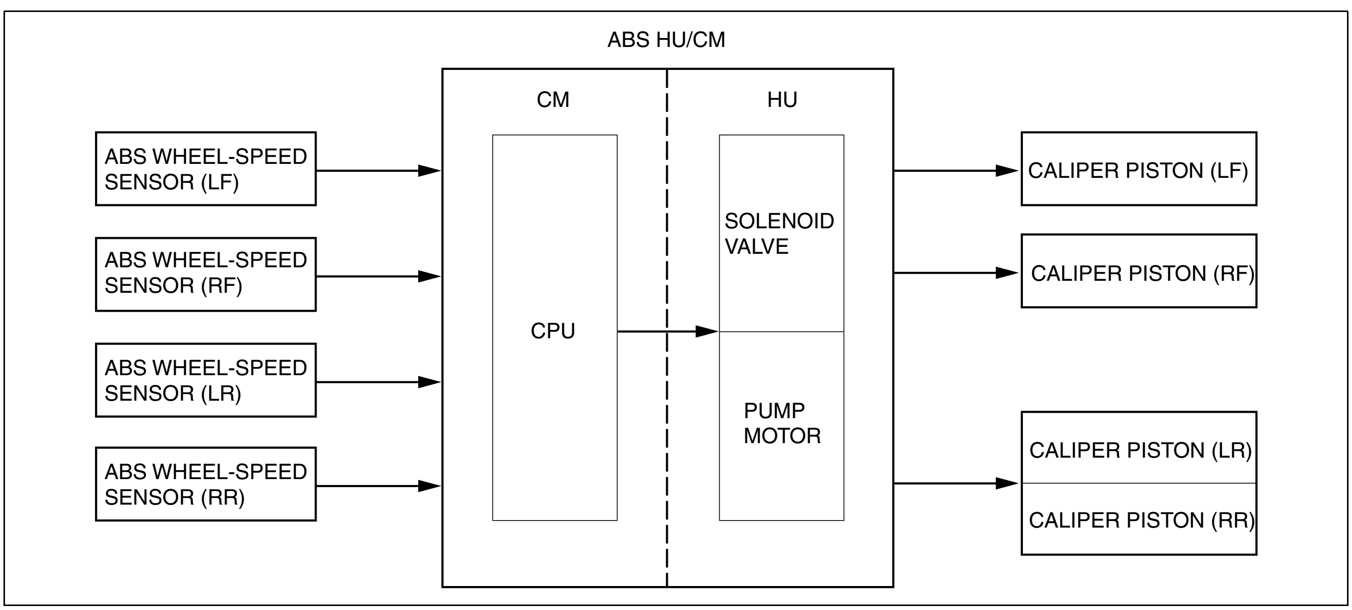
CHU041343750S05

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

Note

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

Block Diagram



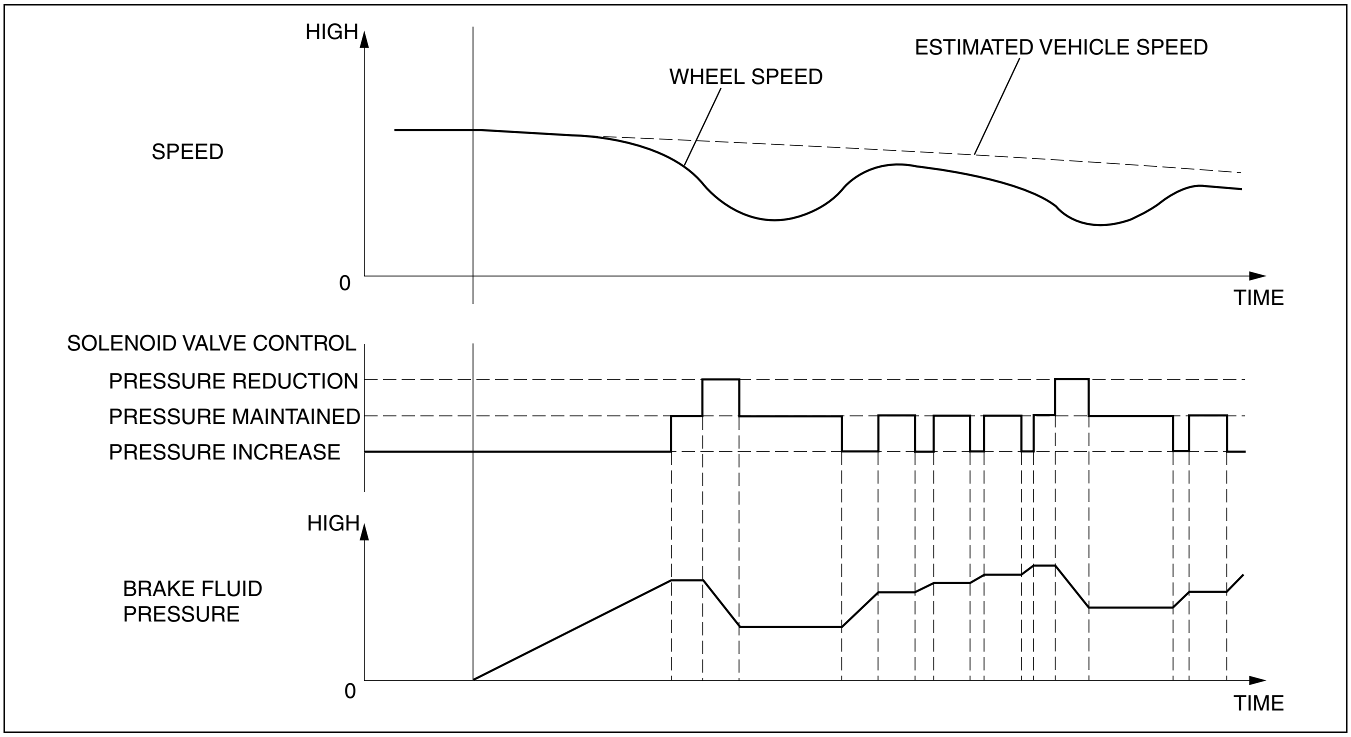
CHU0413S009

ABS CONTROL OPERATION

CHU041343750S06

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

Operating Condition Transition Diagram



CHU0413S010

EBD CONTROL OUTLINE

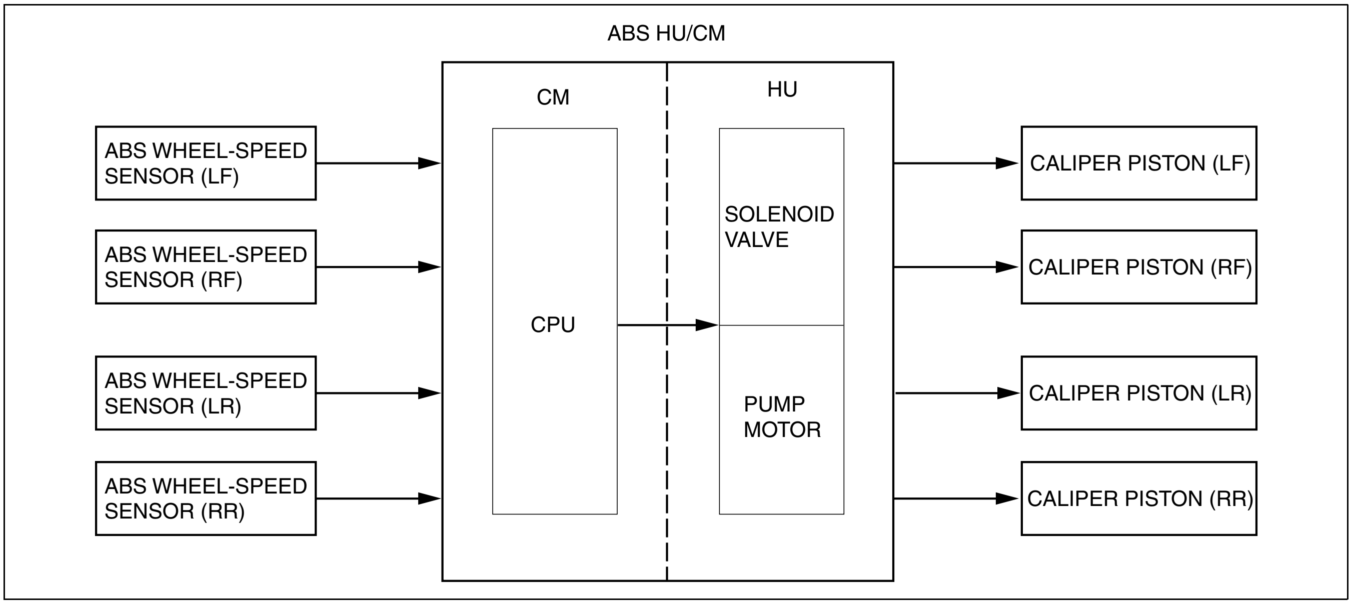
CHU041343750S07

- EBD control uses the ABS system to control brake fluid pressure distribution to the rear wheels so that they do not lock-up prior to the front wheels during braking, thereby preventing the loss of handling stability.

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



CHU0413S011

EBD CONTROL OPERATION

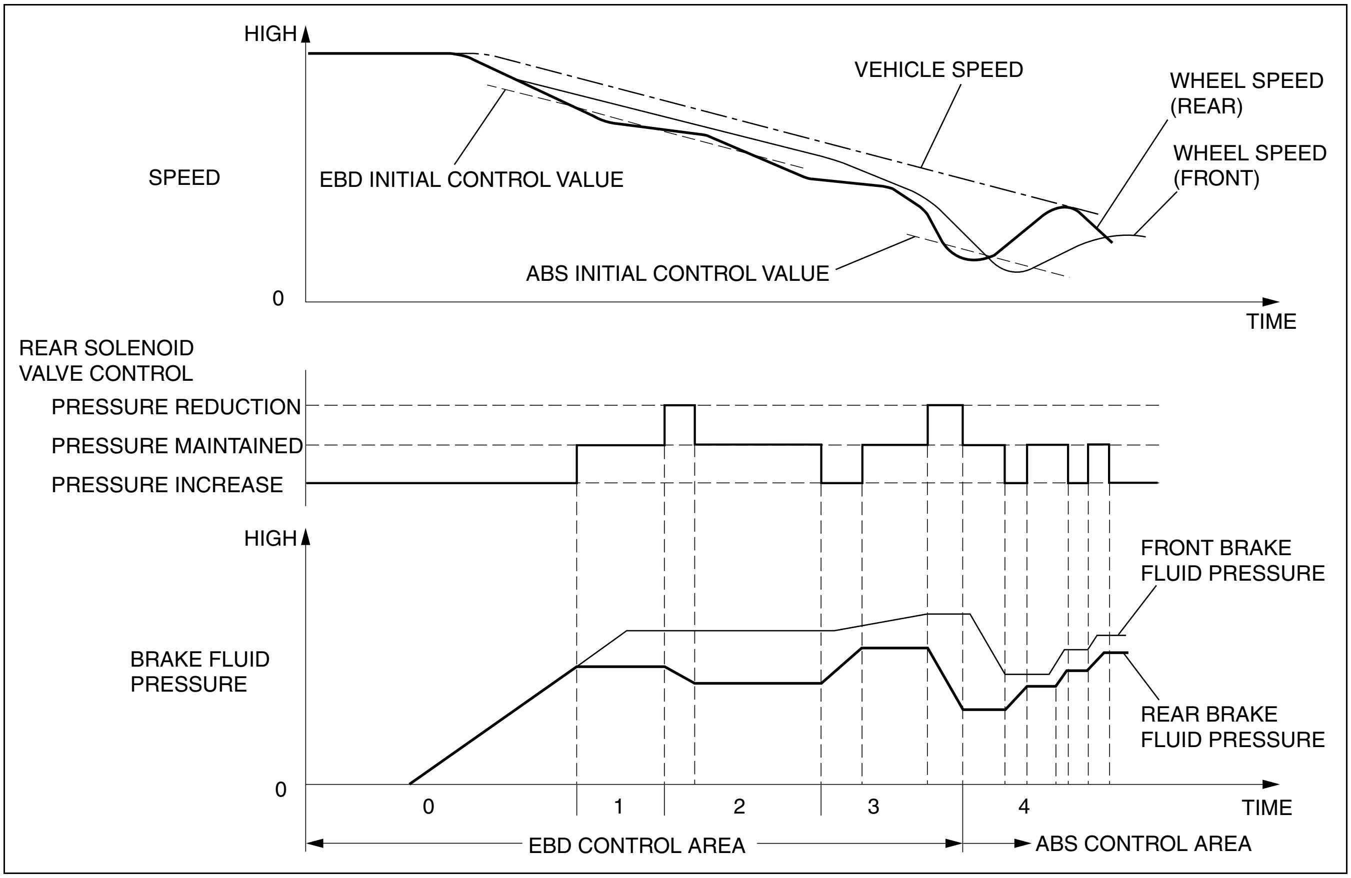
CHU041343750S08

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

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	Front wheel slip ratio is δ% or more	Control	Pressure reduction/ maintained/ increase	ABS control operates

α—δ: Specified value

Operating Condition Transition Diagram



CHU0413S012

CONTROLLER AREA NETWORK (CAN) OUTLINE

CHU041343000S04

- The ABS HU/CM sends and receives data to and from other modules via the CAN system. Refer to Section 09 for a detailed explanation of the CAN system.

Data sent

- Travelled distance
- Brake system condition
- Wheel speeds of all four wheels
- ABS wheel-speed sensor condition

Data received

- Tire size

ABS WHEEL-SPEED SENSOR FUNCTION

CHU041343720S01

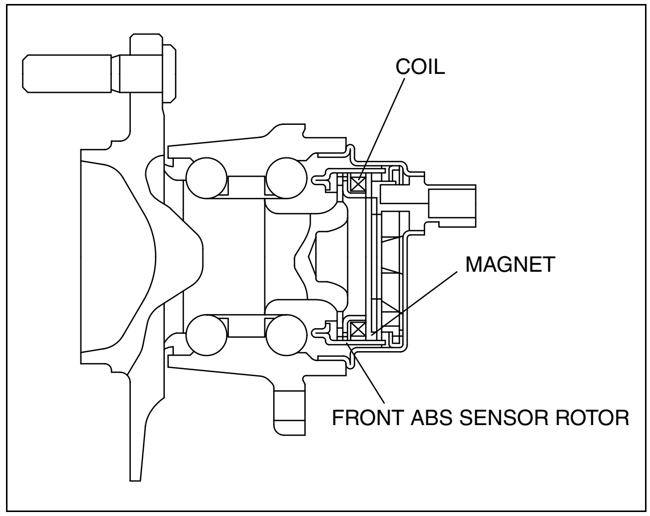
- The ABS wheel-speed sensor, which has a magnetic pick-up, transmits the rotation condition of each wheel to the ABS HU/CM.

ABS WHEEL-SPEED SENSOR CONSTRUCTION/OPERATION

CHU041343720S02

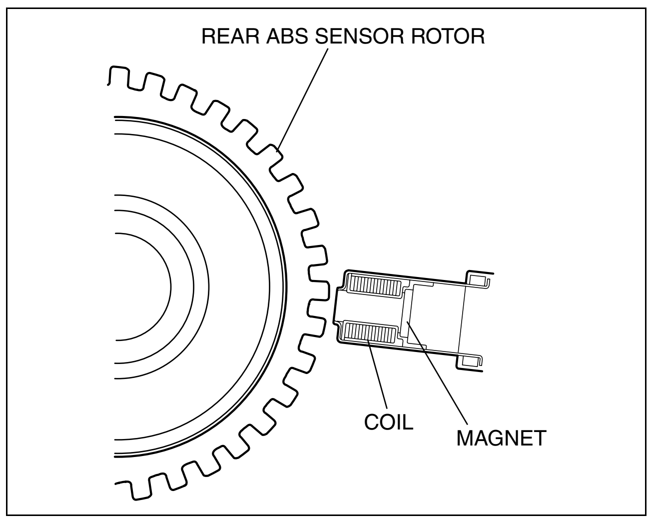
Structure

- The front ABS wheel-speed sensor and the front ABS sensor rotor are integrated with the front wheel hub and installed on the steering knuckle. Therefore, if there is any malfunction of the front ABS wheel-speed sensor, replace the front wheel hub component.



CHU0413S002

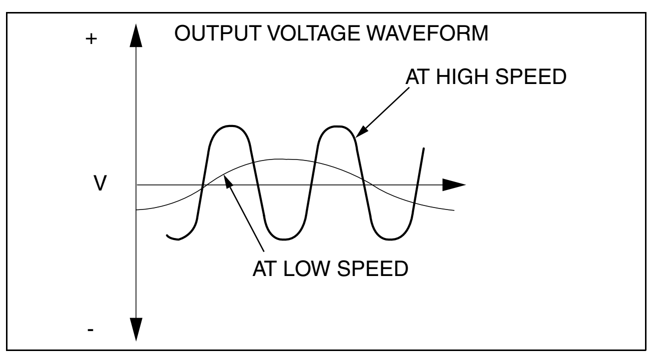
- The rear ABS wheel-speed sensor is installed on the rear knuckle and the rear ABS sensor rotor is integrated with the drive shaft. Therefore, if there is any malfunction of the rear ABS sensor rotor, replace the drive shaft.



CHU0413S003

Operation

- 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 CM part of the ABS 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.



CHU0413S004

04–15 DYNAMIC STABILITY CONTROL

DYNAMIC STABILITY CONTROL (DSC) OUTLINE

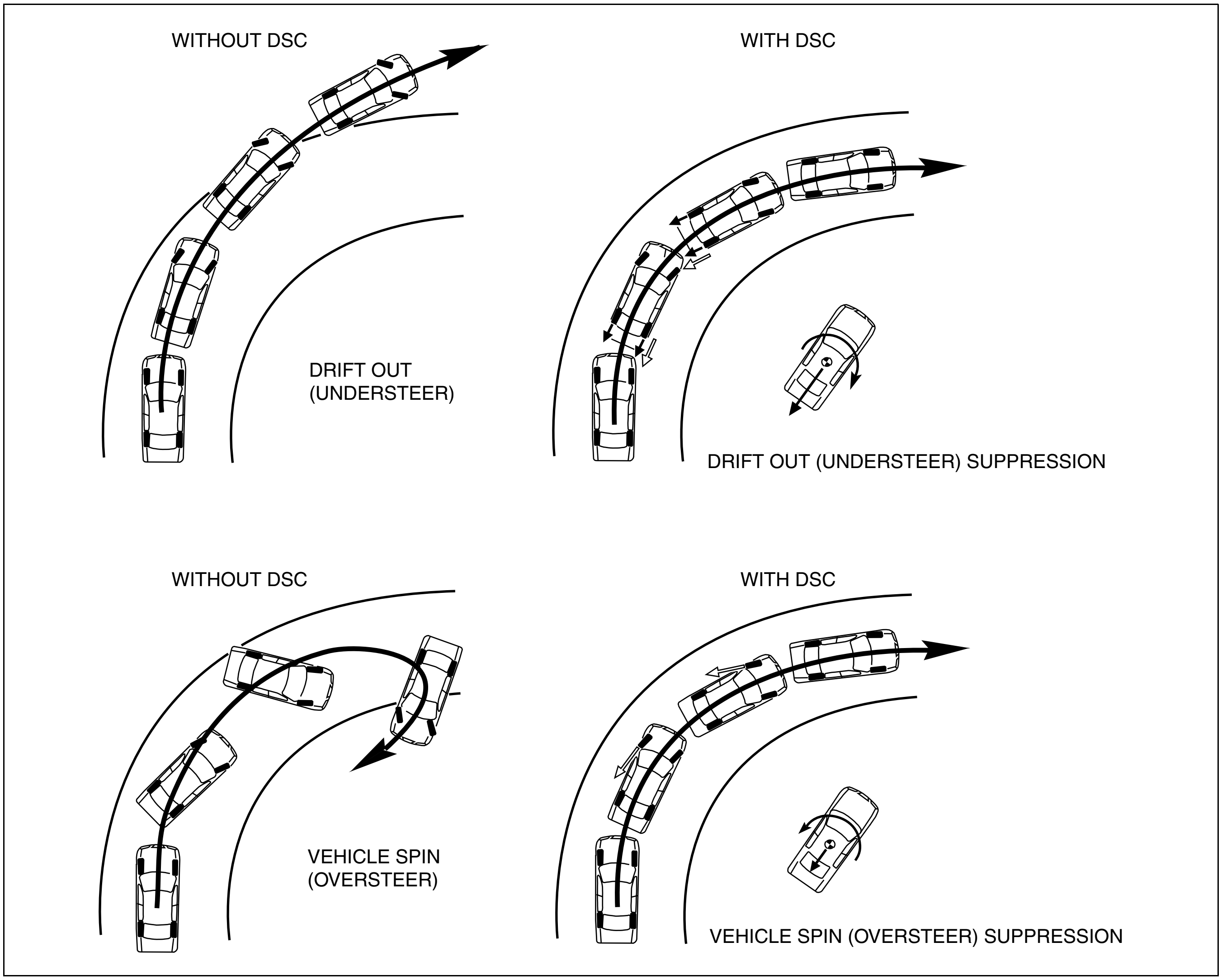
CHU041543000S01

- The DSC 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 and lateral-G sensor, has been adopted, improving serviceability.
- The controller area network (CAN) system has been adopted for the steering angle sensor, improving serviceability and reliability.
- An enhanced malfunction diagnosis system, used with the WDS, has been adopted, improving serviceability.

DSC Operation Outline

- The ABS prevents wheel lock-up during braking. The 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



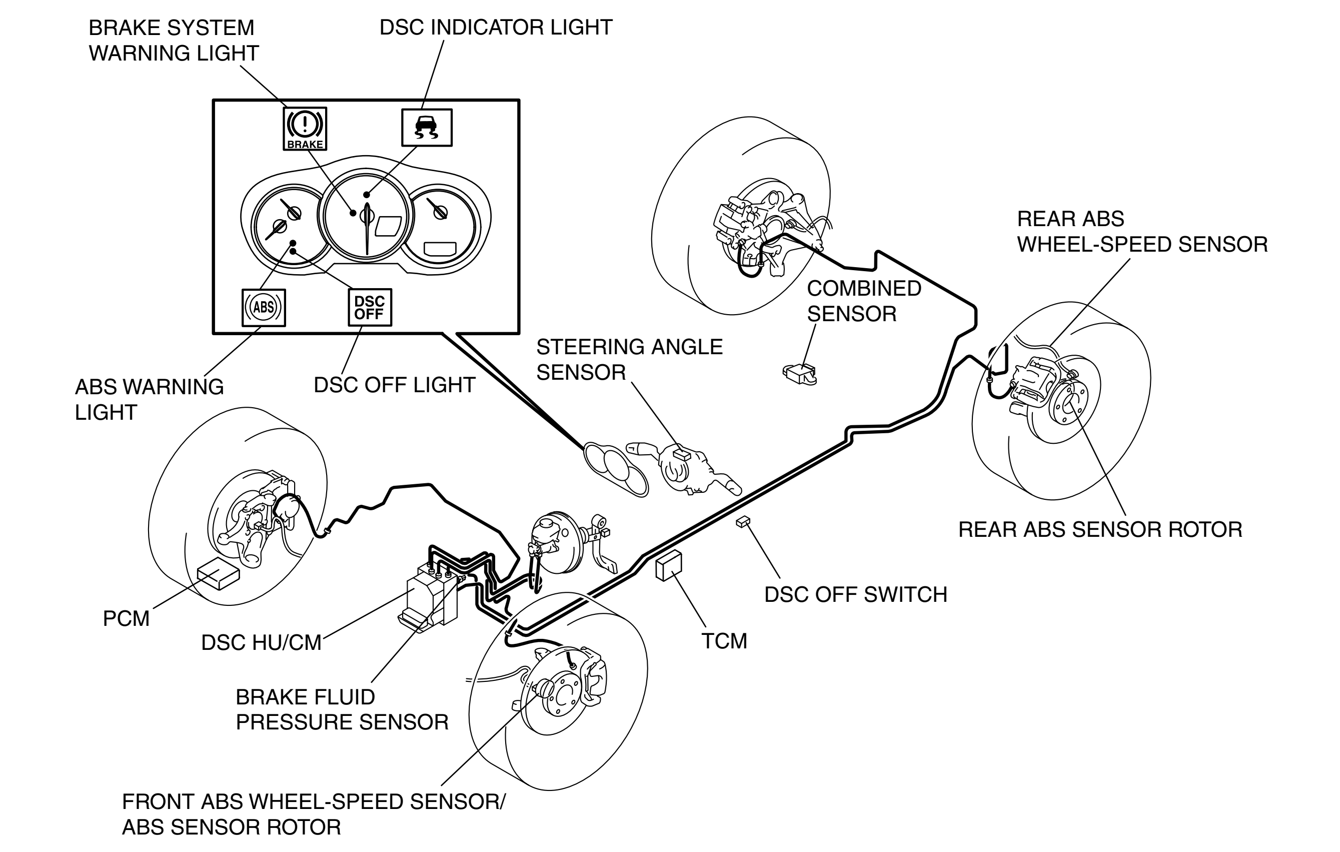
CHU0415S001

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**

DYNAMIC STABILITY CONTROL (DSC) STRUCTURAL VIEW

CHU041543000S02



CHU0415S002

04–15

DYNAMIC STABILITY CONTROL (DSC) CONSTRUCTION

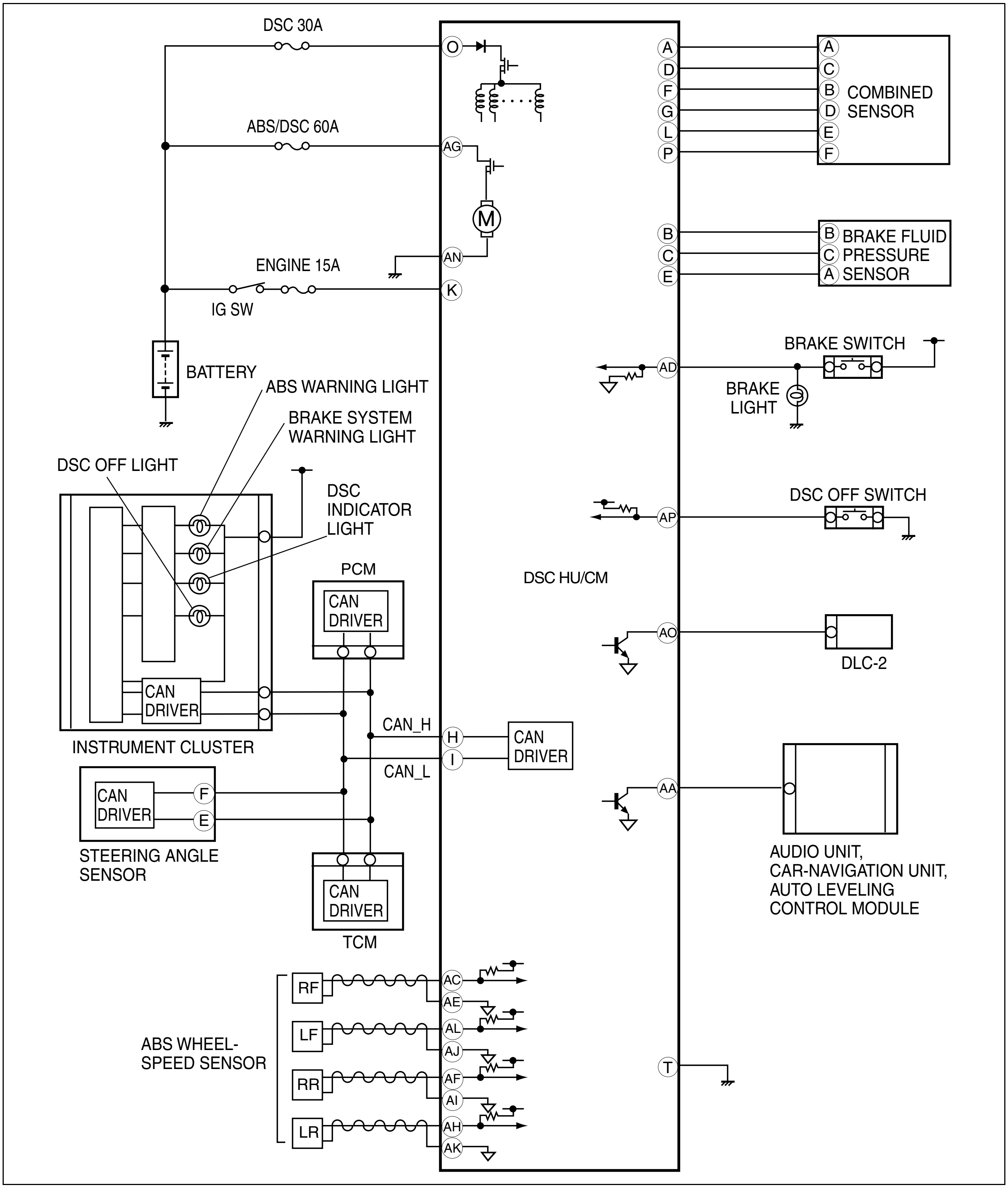
CHU041543000S03

- The DSC system consists of the following parts. While each part has a regular function in other systems, only the function during DSC control is listed.

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

DYNAMIC STABILITY CONTROL (DSC) SYSTEM WIRING DIAGRAM

CHU041543000S04

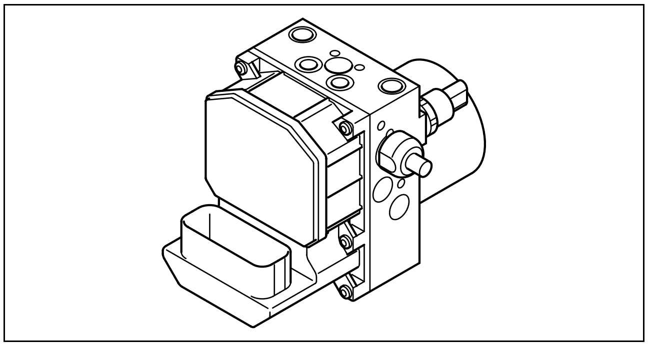


CHU0402W009

DSC HU/CM CONSTRUCTION

CHU041543750S01

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



BHJ0415N003

DSC HU PART FUNCTION

CHU041543750S02

- According to DSC CM signals, the DSC HU controls (on/off) each solenoid valve and the pump motor, adjusts fluid pressure in each caliper piston, and actuates each function (ABS, EBD (Electronic Brakeforce Distribution), TCS and DSC) of the DSC system.

DSC HU PART CONSTRUCTION/OPERATION

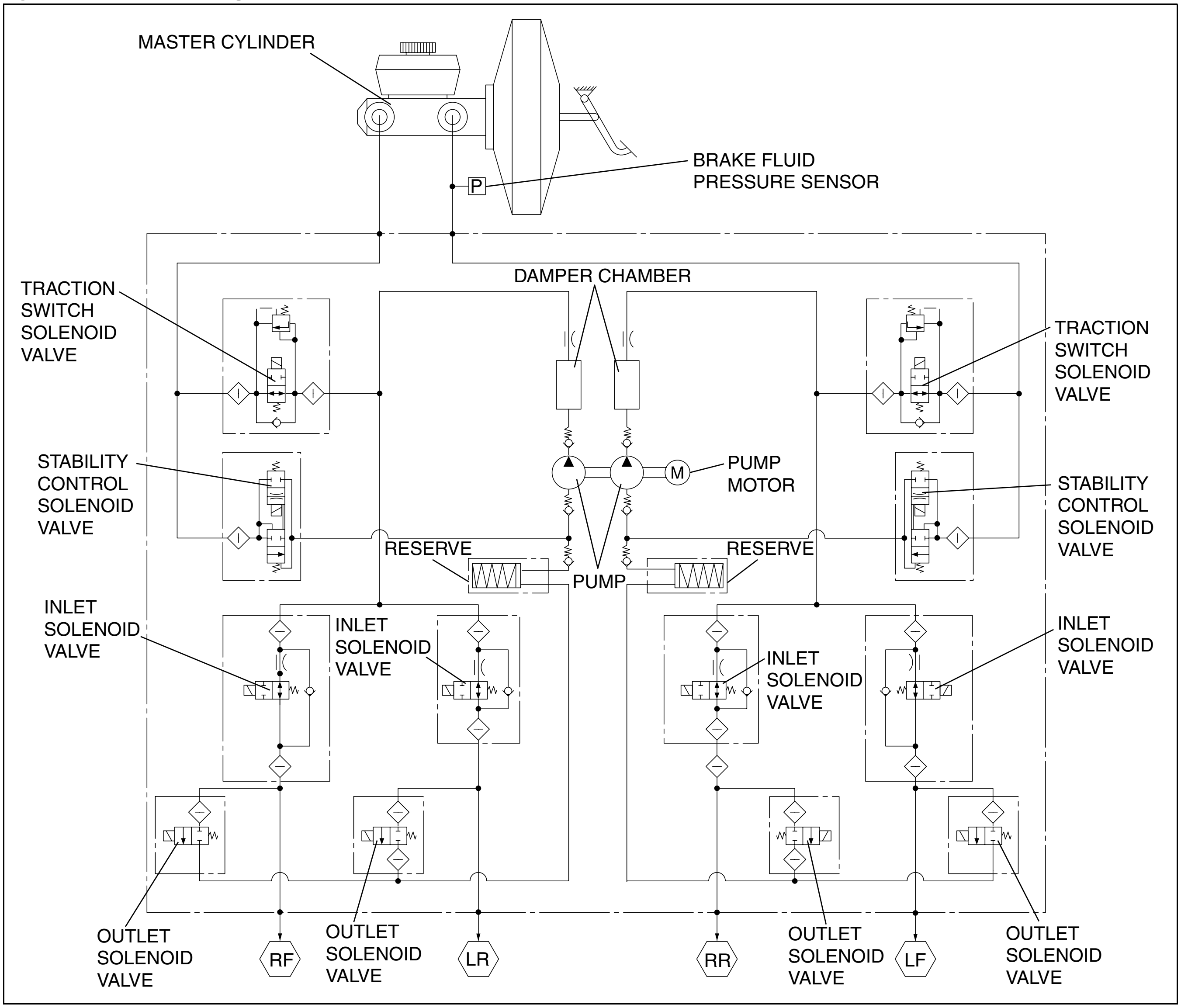
CHU041543750S03

Construction

Function Of Main Component Parts

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

Hydraulic Circuit Diagram



CHU0415S003

Operation

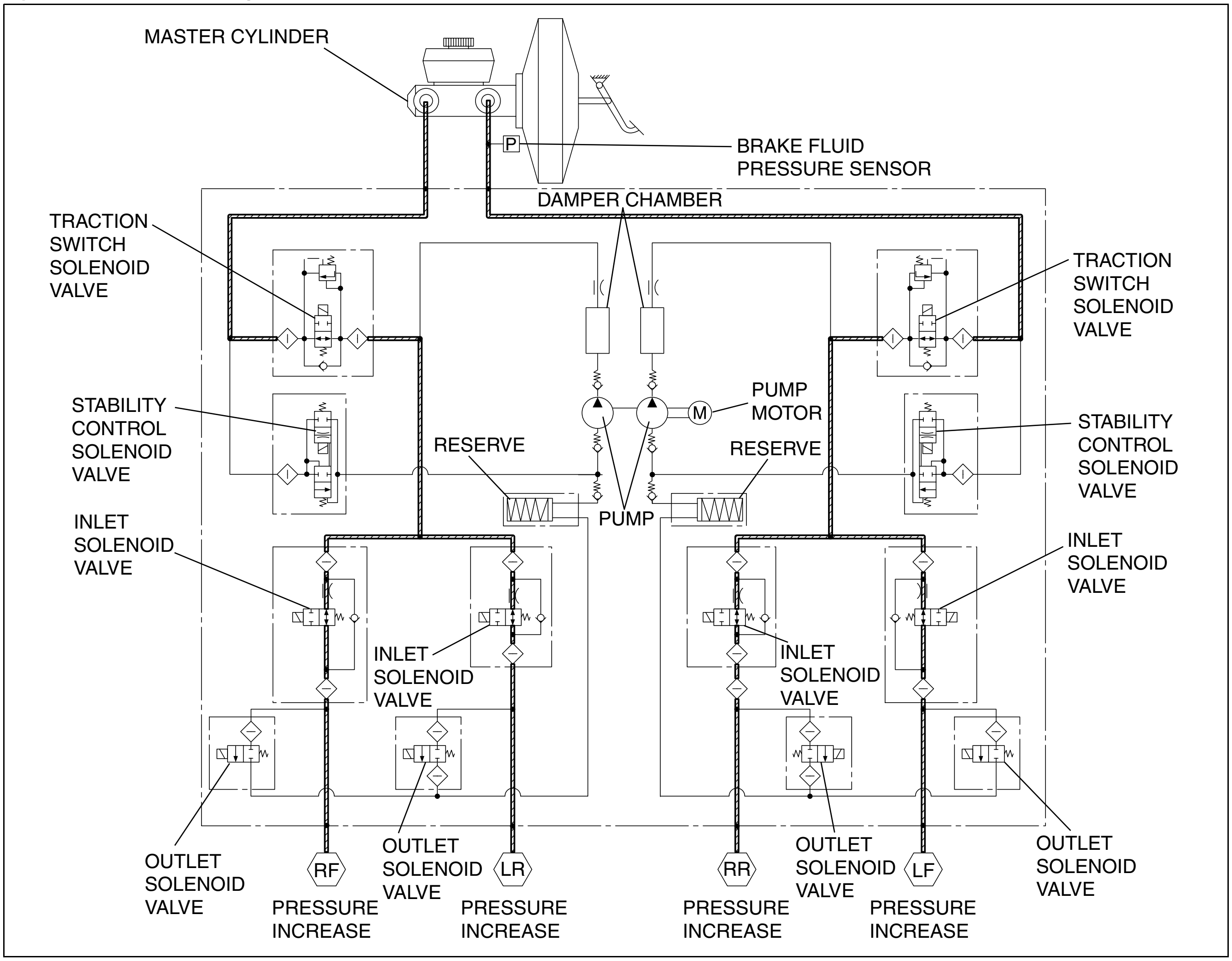
During normal braking

- 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 switch 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



CHU0415S004

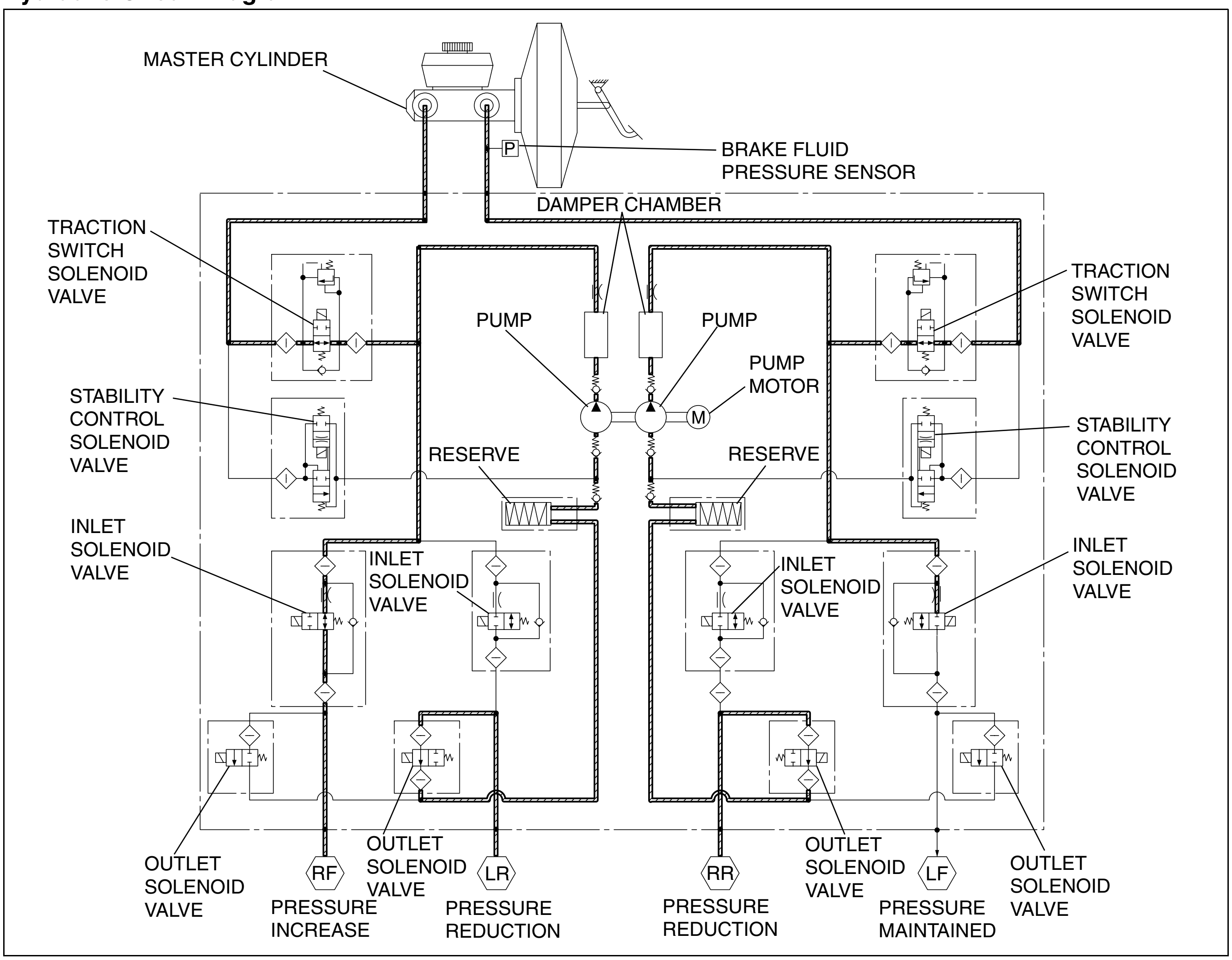
During ABS and EBD control

- During ABS and 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 switch 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



CHU0415S005

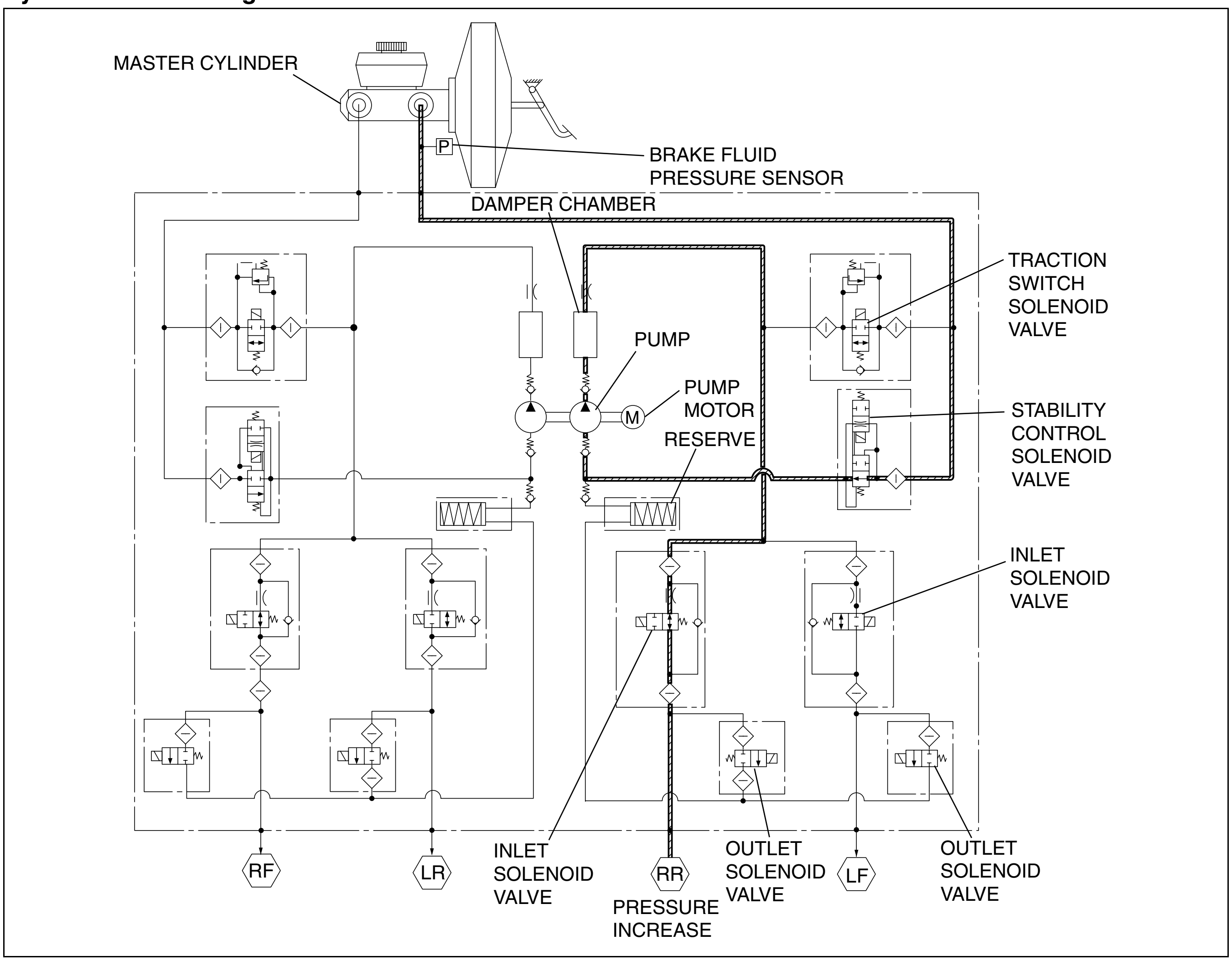
During DSC control (suppress oversteer tendency) and TCS control

- When a large oversteer tendency or driving wheel spin is determined, the traction switch and the 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 rear wheel spin (during pressure increase mode).)

Solenoid Valve Operation Table

	Traction switch 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	ON (closed)		ON (open)	ON (closed)	ON (closed)	OFF (open)	ON (closed)	OFF (open)	OFF (closed)				Operating
During pressure maintain mode	OFF (open)	OFF (closed)	OFF (closed)		OFF (open)	ON (closed)	OFF (closed)	ON (open)	OFF (closed)				Operating
During pressure reduction mode	OFF (open)	OFF (closed)	OFF (closed)		OFF (open)	ON (closed)	OFF (closed)	ON (open)	OFF (closed)	ON (open)	OFF (closed)	ON (open)	Operating

Hydraulic Circuit Diagram



CHU0415S006

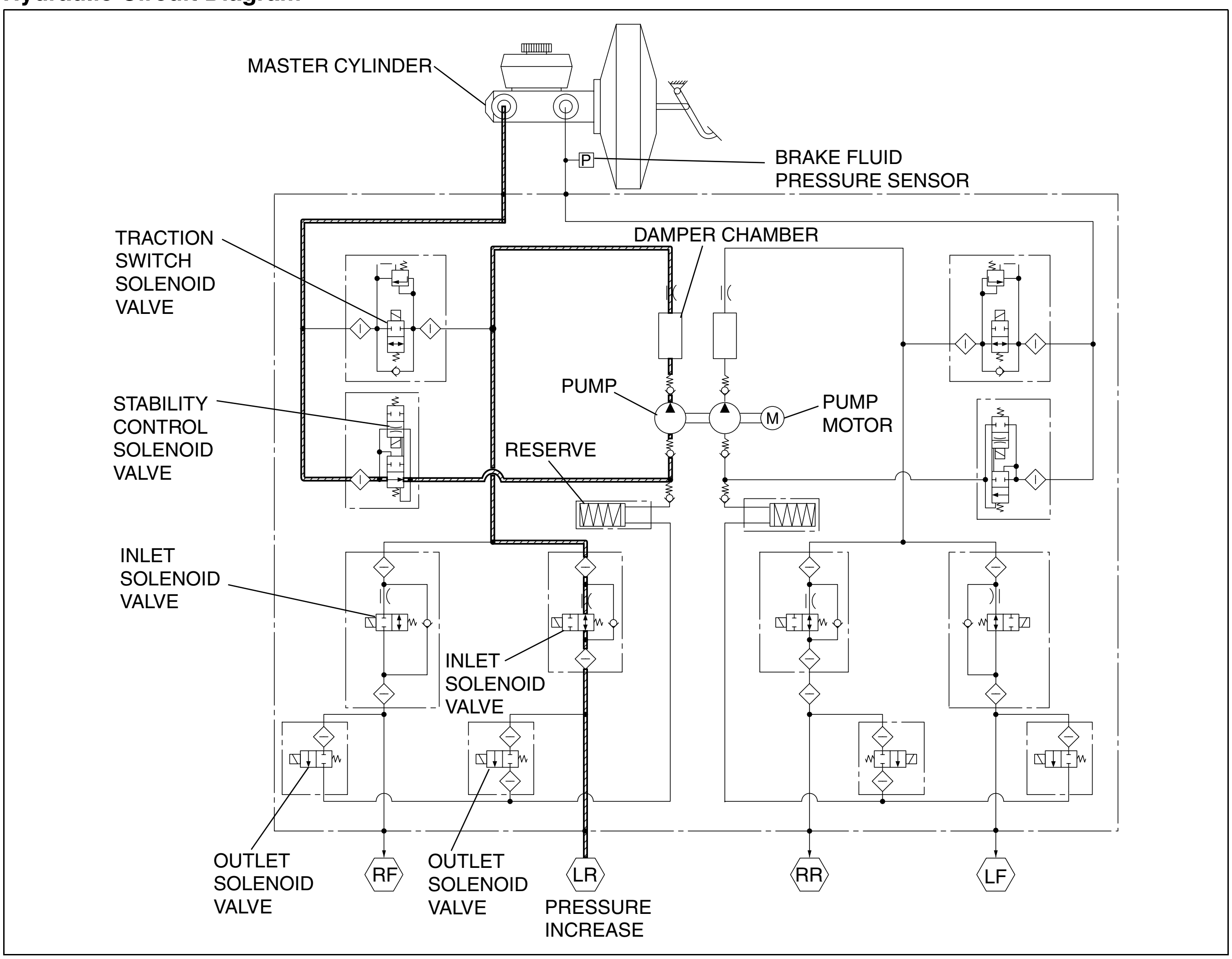
During DSC control (to suppress understeer tendency)

- When a large understeer tendency is determined, the traction switch and the 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 inlet 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

	Traction switch 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)	ON (closed)	OFF (closed)	ON (open)	OFF (open)	ON (closed)	OFF (open)		OFF (closed)				Operating
During pressure maintain mode	OFF (open)	OFF (closed)	OFF (closed)		OFF (open)	OFF (closed)	ON (open)	OFF (open)	OFF (closed)				Operating
During pressure reduction mode	OFF (open)	OFF (closed)	OFF (closed)		OFF (open)	OFF (closed)	ON (closed)	OFF (open)	OFF (closed)		ON (open)	OFF (closed)	Operating

Hydraulic Circuit Diagram



CHU0415S007

DSC CM PART FUNCTION

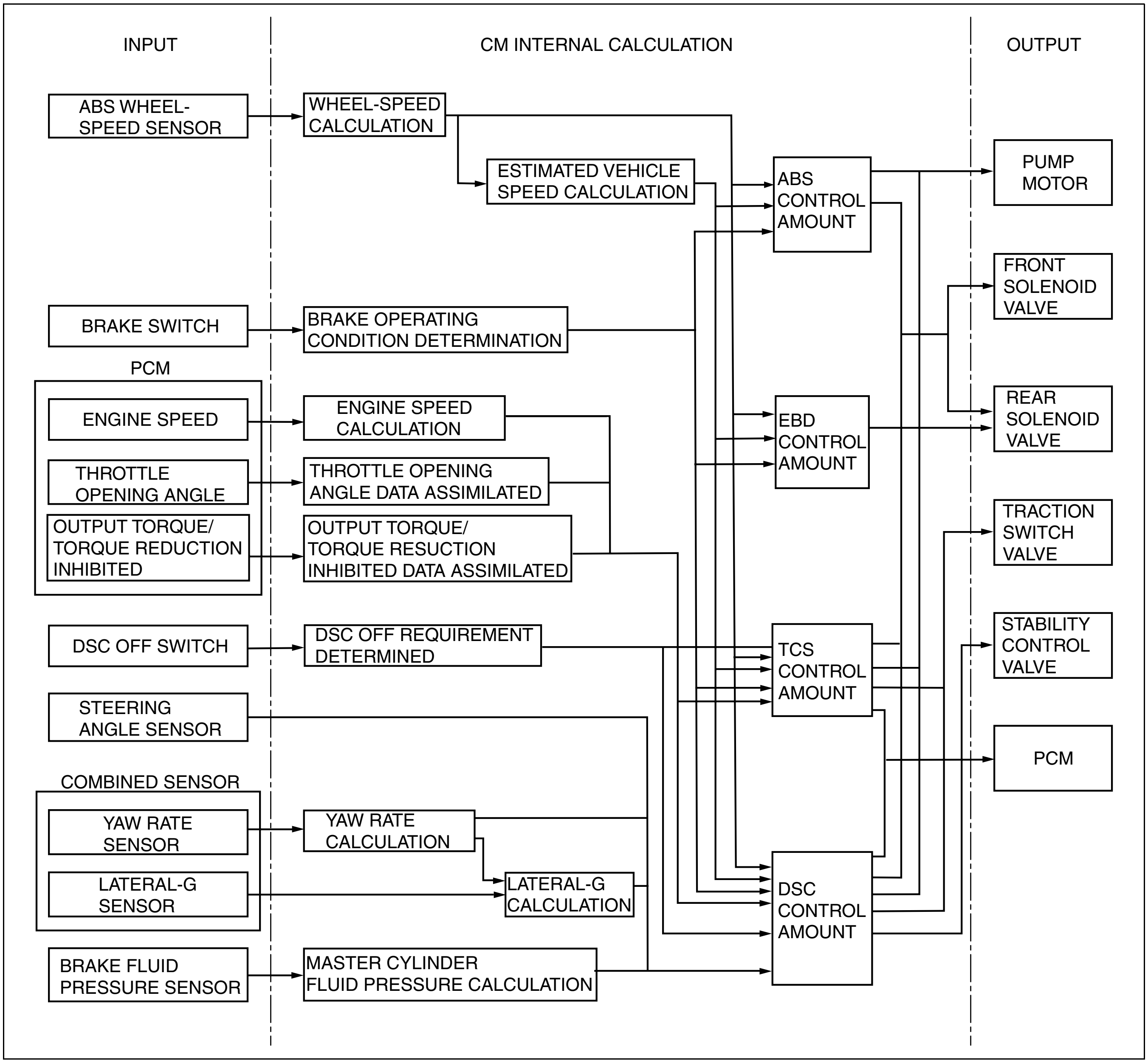
CHU041543750S04

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

Function Table

Function name	Contents
ABS control function	• Controls brake fluid pressure when braking to maintain directional stability, ensure steerability and reduce stopping distance.
EBD (Electronic Brakeforce Distribution) 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.
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.
Vehicle speed output function	• Outputs the value calculated using the ABS wheel-speed sensor signals as vehicle speed signal to the audio unit, car-navigation unit and the auto leveling control module. • Transmits the wheel speed signal to the PCM using CAN communication.
On-board diagnostic system	• A function that allows important parts of the DSC 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 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



CHU0415S008

ABS CONTROL FUNCTION

CHU041543750S05

- ABS control is basically the same as that for vehicles with ABS. However, fluid pressure in each wheel is under independent control in this system.

EBD CONTROL FUNCTION

CHU041543750S06

- EBD control has an independent control system for the front and rear wheels, as well as vehicles with ABS, which constantly and properly distributes brake fluid regardless of vehicle weight (number of passengers).

TCS CONTROL OUTLINE

CHU041543750S07

- TCS control actuates torque reduction through throttle, fuel cut and ignition timing control, as well as using brake control to control traction.

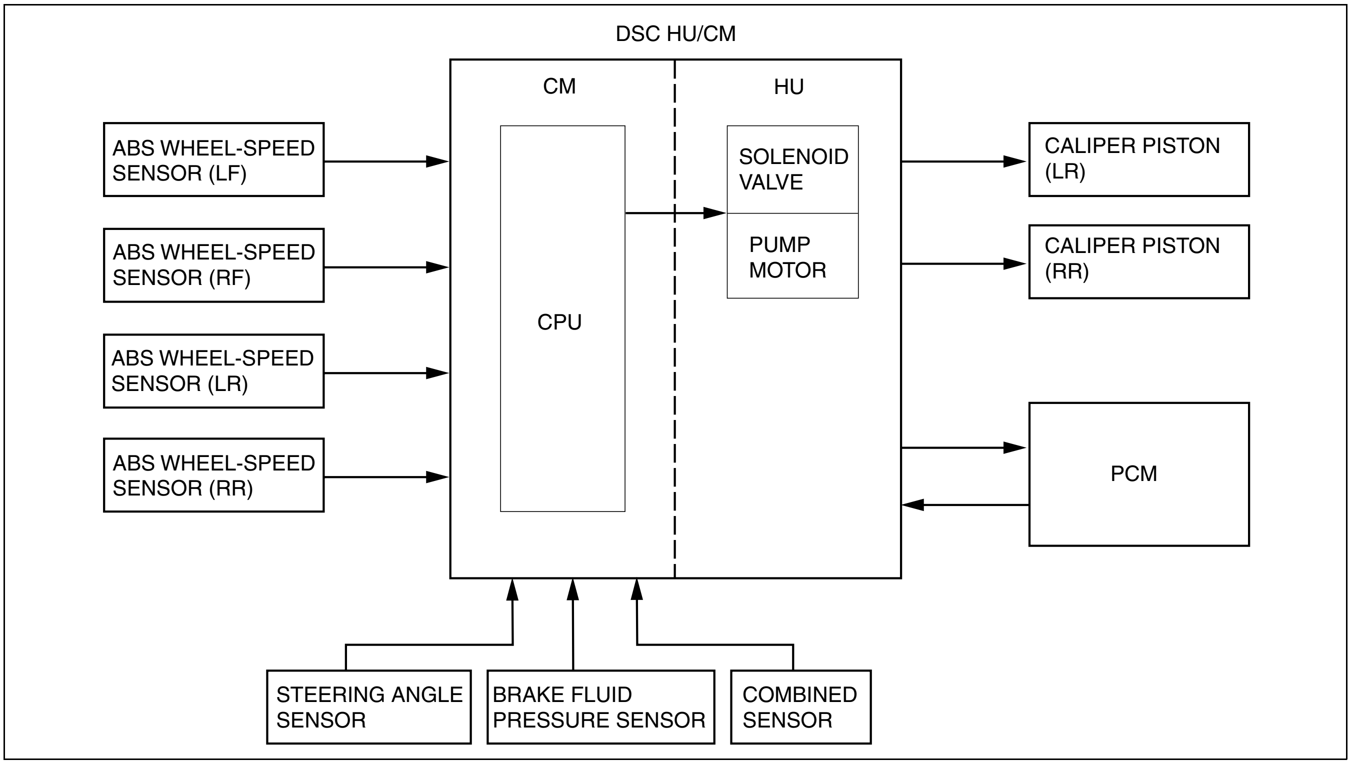
Note

- Brake control: Brake fluid pressure from the hydraulic unit to the slipping driving wheel is increased, operating the brake and preventing drive wheel slip.

Features

- The left and right wheels are controlled at the same time by throttle, fuel cut and ignition timing 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 much stable vehicle control.

Block Diagram



CHU0415S009

TCS CONTROL OPERATION

CHU041543750S08

- 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 DSC HU/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 steering angle sensor
  — Yaw rate and lateral-G signals from the combined sensor
  — Fluid pressure signals from the brake fluid pressure sensors

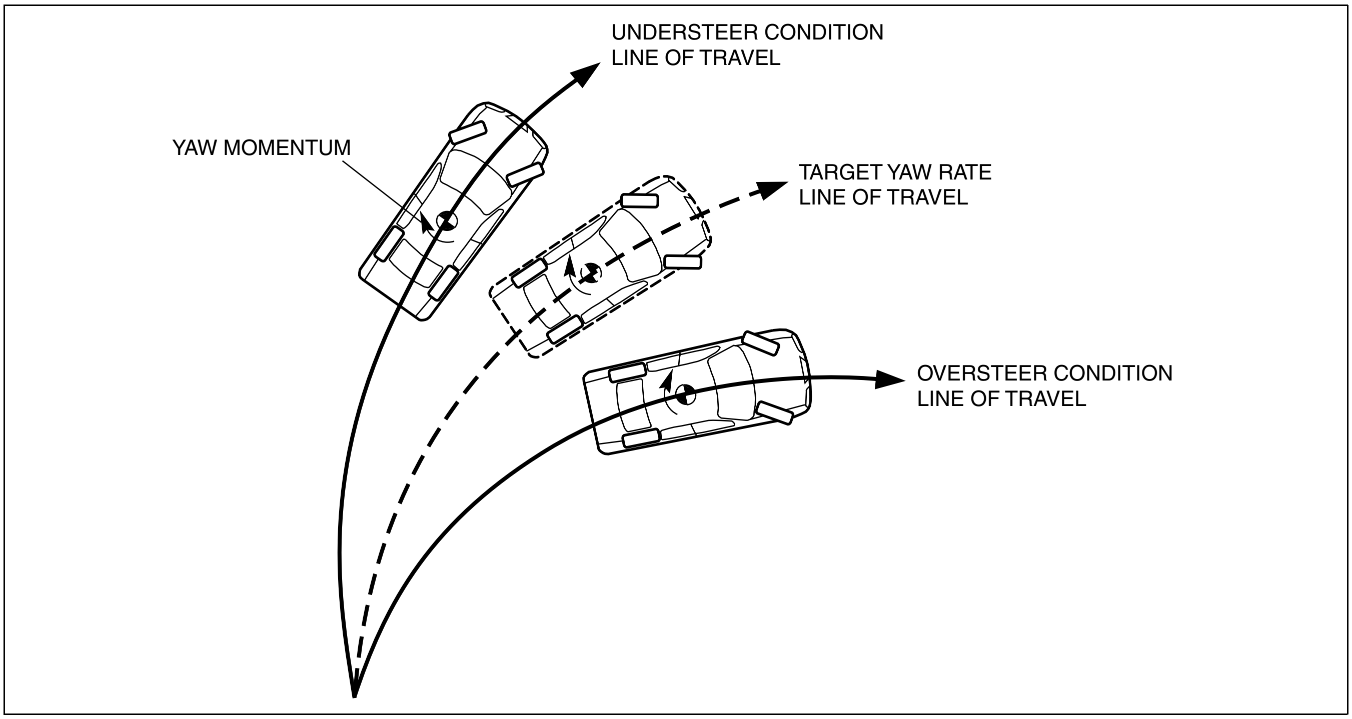
DSC CONTROL OUTLINE

CHU041543750S09

- 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
- 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 and yaw rate are detected by the sensors and used in calculations by the DSC HU/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.



CHU0415S010

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.

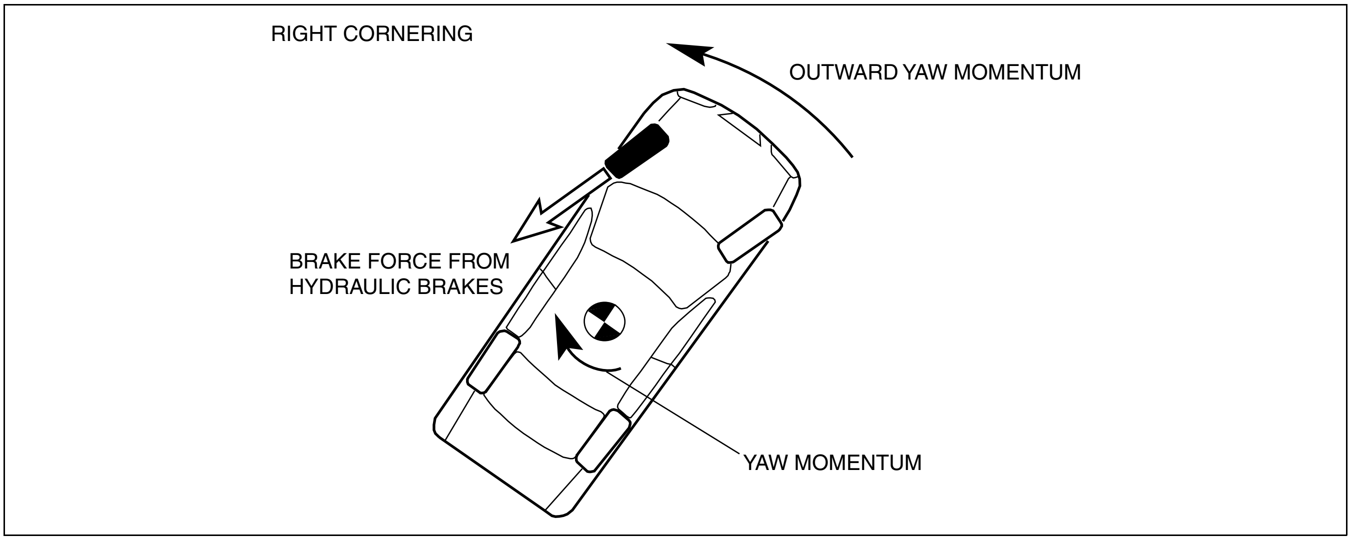
DSC CONTROL OPERATION

CHU041543750S10

- When the DSC HU/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

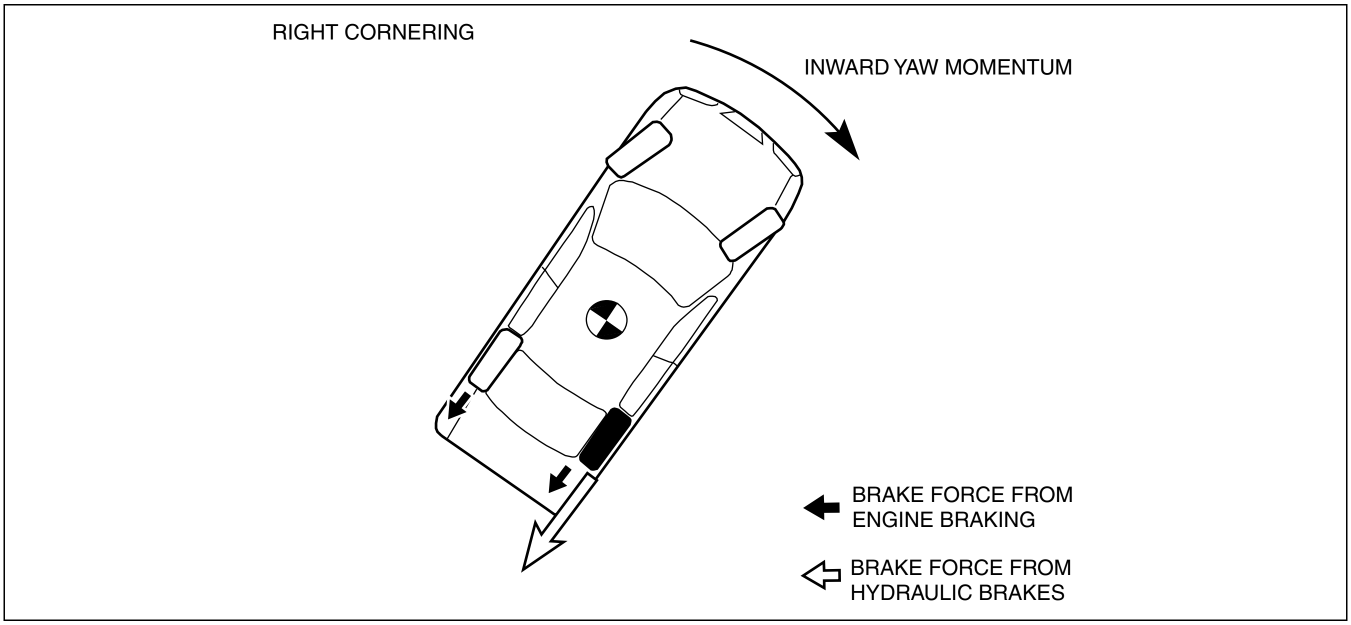
- When a large oversteer tendency is determined, braking is applied the outer front wheel according to the degree of the tendency. As a result, a yaw moment is formed towards the outer side of the vehicle and the oversteer tendency is suppressed.



CHU0415S016

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.



CHU0415S017

CONTROLLER AREA NETWORK (CAN) OUTLINE

CHU041543000S05

- The DSC HU/CM sends and receives data to and from other modules via the CAN system. Refer to Section 09 for a detailed explanation of the CAN system.

Data sent

- Travelled distance
- Brake system status
- Wheel speeds of all four wheels
- ABS wheel-speed sensor status
- Torque reduction request

Data received

- Engine speed
- Throttle valve opening angle
- Engine torque
- Torque reduction disabled
- Transmission/axle specifications
- Tire size
- Target gear position/selector lever position
- Steering angle
- Steering angle sensor status
- Parking brake position

ABS WHEEL-SPEED SENSOR FUNCTION

CHU041543720S01

- The ABS wheel-speed sensor, which has a magnetic pick-up, transmits the rotation condition of each wheel to the DSC HU/CM.

ABS WHEEL-SPEED SENSOR CONSTRUCTION/OPERATION

CHU041543720S02

- The construction and operation of the ABS wheel-speed sensor is the same as that of vehicles with ABS.

COMBINED SENSOR FUNCTION

CHU041543770S01

- A combined sensor, which integrates the yaw rate and lateral-G sensors, has been adopted.
- The combined sensor, located in the floor under the rear console, detects the vehicle yaw rate (vehicle turning angular speed) and lateral-G, and transmits them to the DSC HU/CM.

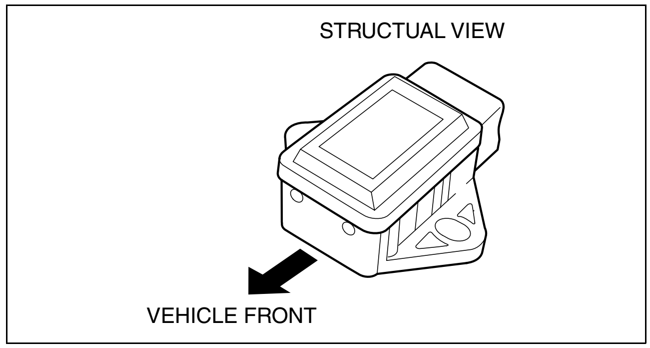
COMBINED SENSOR CONSTRUCTION/OPERATION

CHU041543770S02

- The combined sensor, with built-in yaw rate and lateral-G sensors, detects and calculates the vehicle yaw rate and lateral-G, converts them into voltage and transmits this to the DSC HU/CM.
- The output voltage characteristic for the combined sensor is **2.5 V** when the vehicle is standing still, and changes accordingly as yaw rate and lateral-G are formed.
- The yaw rate sensor detects a Coriolis force created by, and in proportion to, the rotation speed of a rotating tuning fork.
- The 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.



CHU0415S011

BRAKE FLUID PRESSURE SENSOR FUNCTION

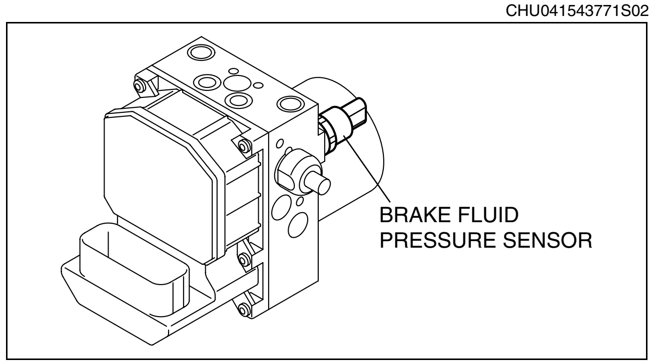
CHU041543771S01

- The brake fluid pressure sensor detects the fluid pressure from the master cylinder and transmits it to the DSC HU/CM.

BRAKE FLUID PRESSURE SENSOR CONSTRUCTION

CHU041543771S02

- The brake fluid pressure sensor is integrated with the DSC HU/CM. Therefore if there is any malfunction of the brake fluid pressure sensor, replace the DSC HU/CM.



CHU0415S012

STEERING ANGLE SENSOR FUNCTION

CHU041566120S01

- The steering angle sensor, located on the combination switch, detects the steering angle degree and the neutral position, and transmits these to the DSC HU/CM via CAN lines.

Warning

- **The following circumstances will cause the stored initialization value of the steering angle sensor to be cleared. This may possibly cause an accident due to the DSC becoming inoperative. Always refer to the Workshop Manual and properly perform the initialization procedure for the steering angle sensor so that the DSC operates properly.**
  - **— Negative battery cable disconnected**
  - **— Steering angle sensor connector disconnected**

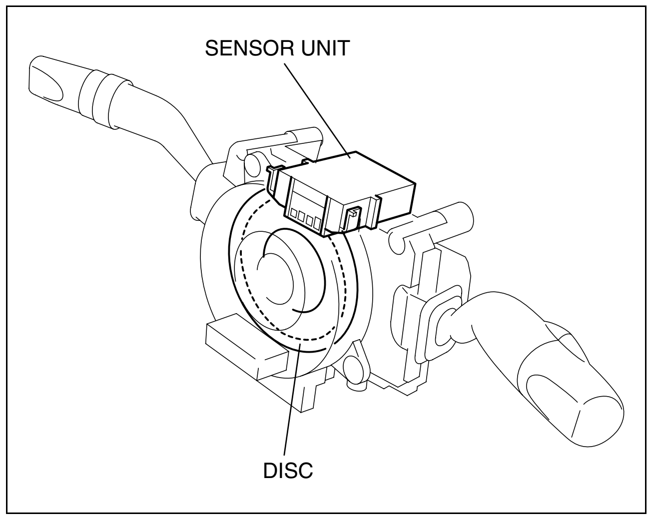
Note

- If the initialization procedure for the steering angle sensor has not been performed, when the ignition switch is turned to the ON position, the DSC indicator light illuminates and the DSC OFF light flashes to warn of a malfunction.

STEERING ANGLE SENSOR CONSTRUCTION

CHU041566120S02

- The steering angle sensor, integrated with the combination switch body, has a sensor unit straddling a disc that moves together with the steering mechanism. Therefore, if there is any malfunction of the steering angle sensor, replace the combination switch body.



CHU0415S015

DSC INDICATOR LIGHT FUNCTION

CHU041555430S01

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

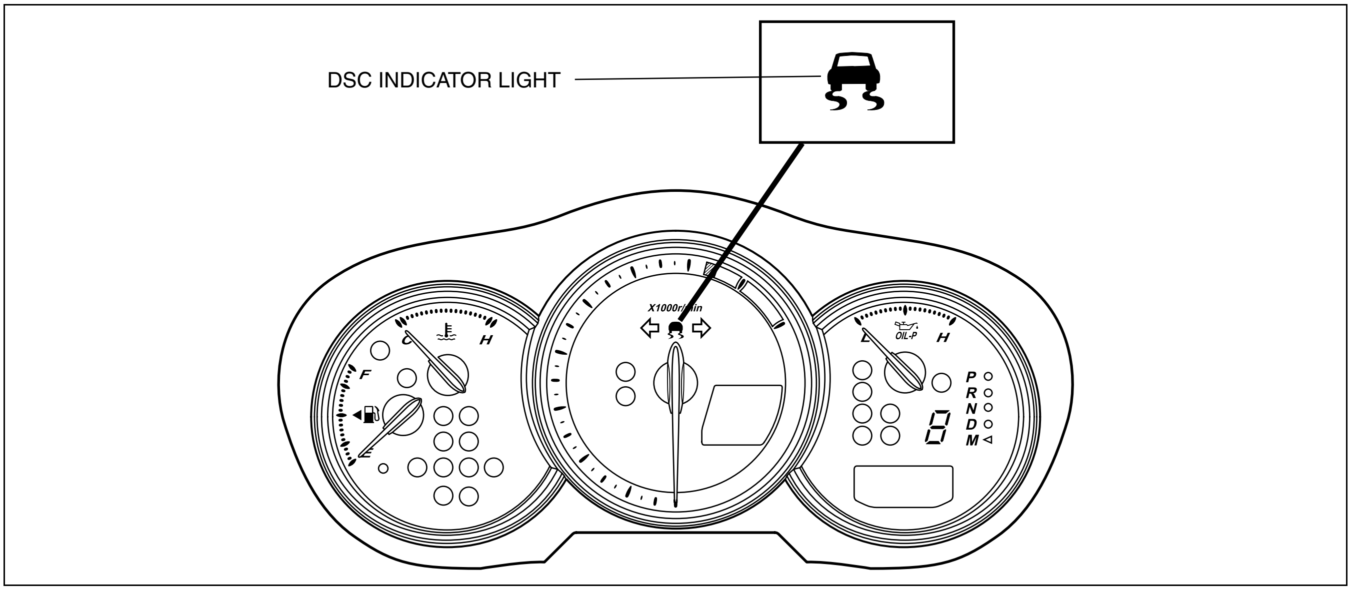
DSC INDICATOR LIGHT OPERATION

CHU041555430S02

- When the DSC and 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 DSC or TCS is operating (DSC has not been disabled by pressing the DSC OFF switch), the DSC indicator light operates as follows:

DSC Indicator Light Operation

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



CHU0415S013

DSC OFF SWITCH, DSC OFF LIGHT FUNCTION

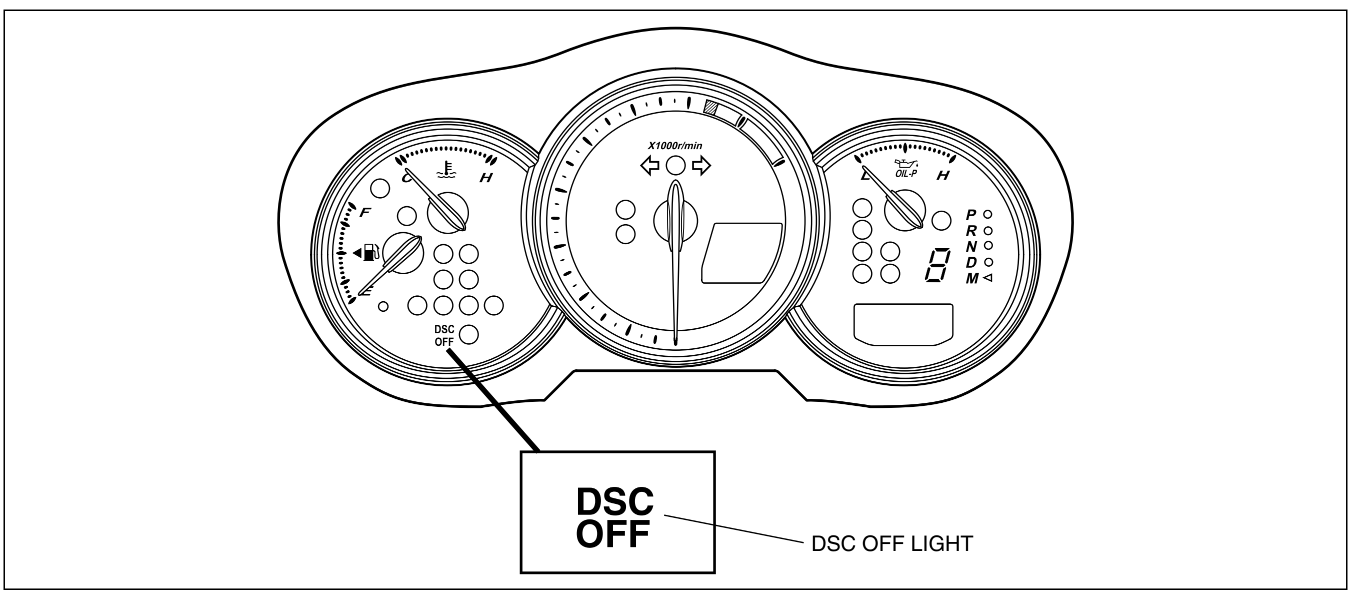
CHU041566410S01

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

DSC OFF SWITCH, DSC OFF LIGHT OPERATION

CHU041566410S02

- When the DSC OFF switch is pressed to disable DSC control, the DSC OFF light illuminates.



CHU0415S014

TRANSMISSION/TRANSAXLE

05 SECTION

05–00 OUTLINE

TRANSMISSION/TRANSAXLE ABBREVIATIONS

CHU050001030S01

ATF	Automatic Transmission Fluid
AT	Automatic Transmission
B+	Battery Positive Voltage
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CPU	Central Processing Unit
DC	Drive Cycle
DLC	Data Link Connector
DTC	Diagnostic Trouble Code (s)
EC-AT	Electronically Controlled Automatic Transmission
MIL	Malfunction Indicator Lamp
MT	Manual Transmission
NVH	Noise Vibration Harshness
O/D	Over Drive
OBD	On-Board Diagnostic
PCM	Powertrain Control Module
PID	Parameter Identification
PPF	Power Plant Frame
TCC	Torque Converter Clutch
TCM	Transmission Control Module
TFT	Transmission Fluid Temperature
TP	Throttle Position
TR	Transmission Range
VSS	Vehicle Speedometer Sensor
1GR	First Gear
2GR	Second Gear
3GR	Third Gear
4GR	Fourth Gear
5GR	Fifth Gear
6GR	Sixth Gear

TRANSMISSION/TRANSAXLE FEATURES

CHU050001030S02

CLUTCH	
Increased torque transmission capacity	• The clutch cover set load has been increased. • Torsional spring tension has been reduced to reduce NVH.
MT	
Improved operability	• A ball-type synchromesh mechanism has been adopted. • A triple synchronizer mechanism has been adopted for 1GR, 2GR and 3GR. • Bushings for the control rod have been adopted.
Improved driveability	• In order to obtain more power from the engine, the total gear ratio has been reduced in speed and set in a cross pattern. • To improve drivetrain rigidity, a closed section power plant frame (PPF) has been adopted.
Improved fuel economy	• Six-speed Y16M-D manual transmission has been adopted.
Improved marketability	• Six-speed Y16M-D manual transmission has been adopted.
Improved reliability	• A double engagement prevention mechanism (interlock mechanism) has been adopted.
Mis-shift prevention	• A reverse lockout mechanism has been adopted.
AT	
Superior shift quality	• Direct electronic shift control by duty-cycle solenoids has been adopted. • Feedback control system has been adopted. • Centrifugal balance clutch chamber has been adopted. • A plate-type clutch pack replaces the band brake in the 2-4 brake. • Shifting assist at high engine speeds has been achieved due to adoption of an engine-transmission total control system.
High efficiency, compactness, lightweight	• A miniature trochoid gear oil pump with torque converter direct drive has been adopted. • Due to complete electronic control of clutch engagement and release pressure, the forward one-way and overrunning clutches have been eliminated. • Due to the adoption of direct electronic clutch pressure control (direct electronic shift control), the accumulators have been eliminated.
Improved reliability, reduced NVH (noise, vibration, and harshness)	• A pleat type oil strainer with fine mesh has been adopted. • A highly rigid transmission case has been adopted.
Improved driveability	• To improve drivetrain rigidity, a closed section power plant frame (PPF) has been adopted. • A control feature for climbing/descending hills has been adopted, improving driveability when climbing/descending.
Improved marketability	• The Sport AT has been adopted. With this feature up and downshifting can be performed with either the shift control switch on the steering wheel or with the one-touch operation of the selector lever.

CLUTCH SPECIFICATIONS

CHU050001030S03

Item			Specifications
Clutch control			Hydraulic
Clutch cover	Spring type		Diaphragm
	Set load	(N {kgf, lbf})	6,470 {660, 1,455}
Clutch disc	Outer diameter	(mm {in})	236 {9.29}
	Inner diameter	(mm {in})	160 {6.30}
Clutch pedal	Type		Suspended
	Pedal ratio		5.7
	Full stroke	(mm {in})	130 {5.118}
Clutch master cylinder inner diameter		(mm {in})	15.87 {0.6248}
Clutch release cylinder inner diameter		(mm {in})	19.05 {0.7500}
Clutch fluid type			SAE J1703 or FMVSS 116 DOT-3

MANUAL TRANSMISSION SPECIFICATIONS

CHU050001030S04

Item			Specifications
Transmission type			Y16M-D
Transmission control			Floor-shift
Shift assist			Synchromesh
Gear ratio	1GR		3.760
	2GR		2.269
	3GR		1.645
	4GR		1.187
	5GR		1.000
	6GR		0.843
	Reverse		3.564
Oil	Grade		API service GL-4 or GL-5
	Viscosity	All season	SAE 75W-90
	Capacity (approx. quantity)	(L {US qt, Imp qt})	1.75 {1.85, 1.54}

MANUAL TRANSMISSION SHIFT MECHANISM SPECIFICATIONS

CHU050001030S05

Item	Specifications
Transmission control	Floor-shift
Operation system	Direct

AUTOMATIC TRANSMISSION SPECIFICATIONS

CHU050001030S06

Item		Specifications
Transmission type		RC4A-EL
Gear ratio	1GR	2.785
	2GR	1.545
	3GR	1.000
	4GR	0.694
	Reverse	2.272
ATF	Type	ATF M-III or equivalent (e.g. Dexron®III)
	Capacity (Approx. quantity) (L {US qt, Imp qt})	8.7 {9.2, 7.7}
Torque converter stall torque ratio		2.04:1
Hydraulic system (Number of drive/driven plates)	Low clutch	5/5
	High clutch	6/6
	Reverse clutch	2/2
	2-4 brake	4/4
	Low and reverse brake	4/5
Front planetary gear (Number of teeth)	Sun gear	33
	Pinion gear	21
	Internal gear	75
Rear planetary gear (Number of teeth)	Sun gear	42
	Pinion gear	17
	Internal gear	75

AUTOMATIC TRANSMISSION SHIFT MECHANISM SPECIFICATIONS

CHU050001030S07

Item	Specifications
Transmission control	Floor-shift
Operation system	Rod
Selector lever type	Sport AT

05–02 ON-BOARD DIAGNOSTIC

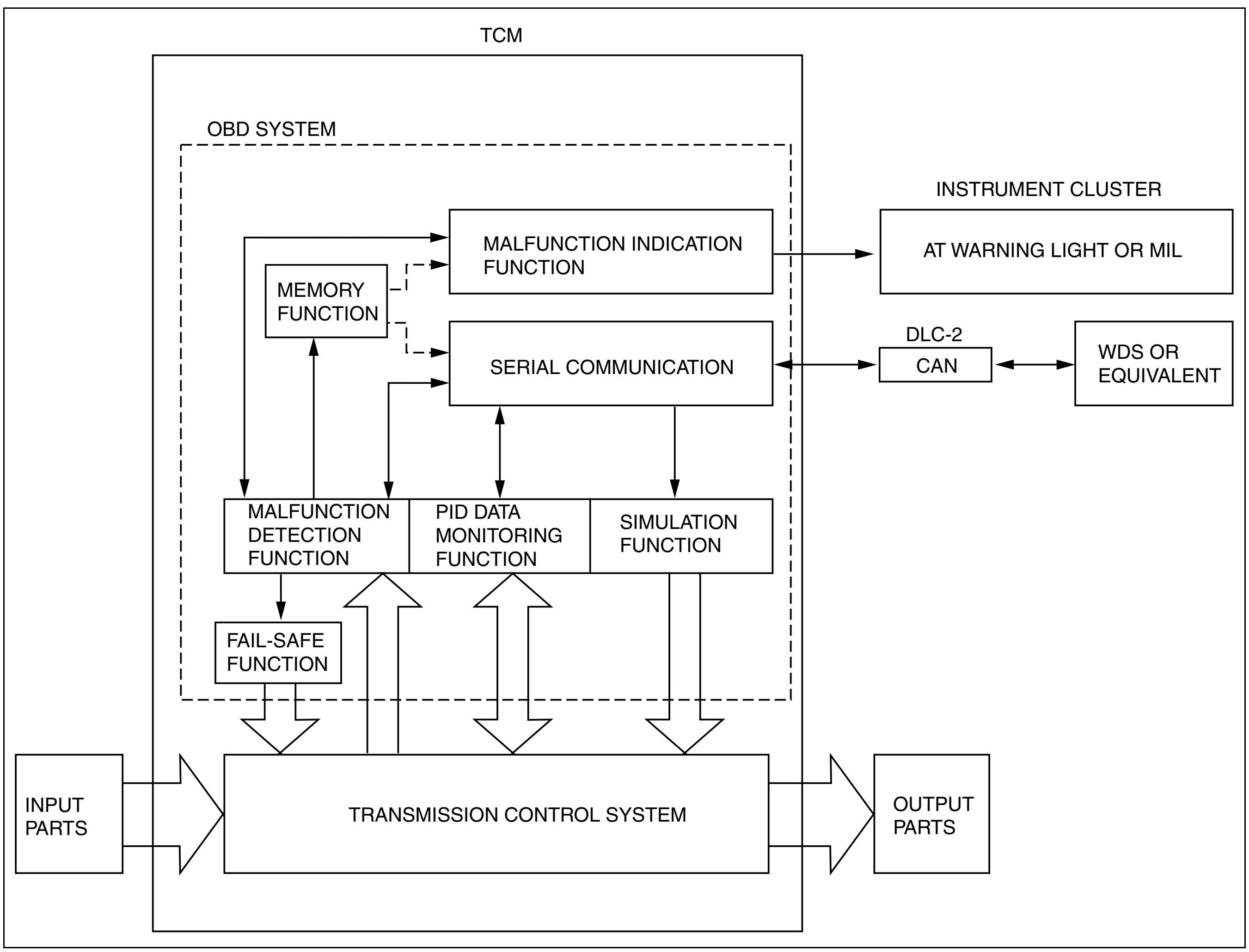
ON-BOARD DIAGNOSTIC (OBD) SYSTEM OUTLINE

CHU050201026S01

- The OBD system has the following functions:
  — Malfunction detection function: detects malfunctions of the input/output devices and system components of the AT.
  — Fail-safe function: fixes 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

CHU050201026S02



CHU0502S001

MALFUNCTION DETECTION FUNCTION

CHU050201026S03

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 WDS or equivalent connected to the DLC-2.

DTC Table

×: Available

DTC No.	Condition	MIL	AT warning light illuminated	DC	Monitor item	Memory function
P0705	Transmission range (TR) switch circuit malfunction (short to power supply)	ON	YES	2	CCM	×
P0706	Transmission range (TR) switch circuit malfunction (open circuit/short to ground)	ON	YES	2	CCM	×
P0707	M range switch, up switch or down switch circuit malfunction (open circuit/short to ground)	OFF	YES	1	CCM	×
P0708	Steering shift switch circuit malfunction (open circuit/short to ground)	OFF	YES	1	CCM	×
P0711	Transmission fluid temperature (TFT) sensor malfunction (stuck)	ON	NO	2	CCM	×
P0712	Transmission fluid temperature (TFT) sensor circuit malfunction (short to ground)	ON	YES	1	CCM	×
P0713	Transmission fluid temperature (TFT) sensor circuit malfunction (open circuit/short to power supply)	ON	YES	1	CCM	×
P0715	Turbine sensor circuit malfunction	ON	YES	1	CCM	×
P0720	Vehicle speed sensor (VSS) malfunction (open circuit/short to ground)	ON	YES	1	CCM	×
P0731	Gear 1 incorrect (incorrect gear ratio detected)	OFF	NO	1	CCM	×
P0732	Gear 2 incorrect (incorrect gear ratio detected)	OFF	NO	1	CCM	×
P0733	Gear 3 incorrect (incorrect gear ratio detected)	OFF	NO	1	CCM	×
P0734	Gear 4 incorrect (incorrect gear ratio detected)	OFF	NO	1	CCM	×
P0740	TCC system malfunction	ON	NO	2	CCM	×
P0743	Torque converter clutch (TCC) solenoid valve circuit malfunction (open circuit/short to ground or power supply)	ON	YES	1	CCM	×
P0748	Pressure control solenoid circuit malfunction (open circuit/short to ground or power supply)	OFF	YES	1	CCM	×
P0751	Shift solenoid A malfunction (stuck off)	ON	NO	2	CCM	×
P0753	Shift solenoid A circuit malfunction (open circuit/short to ground or power supply)	ON	YES	1	CCM	×
P0758	Shift solenoid F circuit malfunction (open circuit/short to ground or power supply)	ON	YES	1	CCM	×
P0761	Shift solenoid B malfunction (stuck off)	ON	NO	2	CCM	×
P0762	Shift solenoid B malfunction (stuck on)	ON	NO	2	CCM	×
P0763	Shift solenoid B circuit malfunction (open circuit/short to ground or power supply)	ON	YES	1	CCM	×
P0766	Shift solenoid C malfunction (stuck off)	ON	NO	2	CCM	×
P0767	Shift solenoid C malfunction (stuck on)	ON	NO	2	CCM	×
P0768	Shift solenoid C circuit malfunction (open circuit/short to ground or power supply)	ON	YES	1	CCM	×
P0841	Oil pressure switch B circuit malfunction	OFF	YES	2	CCM	×
P0846	Oil pressure switch C circuit malfunction	OFF	YES	2	CCM	×
P0871	Oil pressure switch F circuit malfunction	OFF	YES	2	CCM	×
P0882	TCM B+ low	ON	NO	1	CCM	×
P0960	GND return circuit malfunction	ON	YES	1	CCM	×
P1759	2-4 brake fail-safe valve malfunction	OFF	YES	2	CCM	×
P1764	Low and reverse brake fail-safe valve malfunction	OFF	YES	2	CCM	×

DTC No.	Condition	MIL	AT warning light illuminated	DC	Monitor item	Memory function
U0073	CAN bus off	OFF	NO	1	CCM	×
U0100	TCM cannot receive any signals from PCM	ON	YES	1	CCM	×

MIL: Malfunction Indicator Lamp
DC: Drive Cycle
CCM: Comprehensive Component Monitor

MEMORY FUNCTION

CHU050201026S04

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

MALFUNCTION INDICATION FUNCTION

CHU050201026S05

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

FAIL-SAFE FUNCTION

CHU050201026S06

- 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
P0705	Transmission range (TR) switch circuit malfunction (short to power supply)	• Two or more range signals are input from the TR switch for **12 s or more**.	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0706	Transmission range (TR) switch circuit malfunction (open circuit/short to ground)	• No range signal is input from the TR switch for **100 s or more**.	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0707	M range switch, up switch or down switch circuit malfunction (open circuit/ short to ground)	**M range switch circuit malfunction** • M range switch off with up or down switch on. • M range switch remains on for 10 s or more except in D range. **Up switch or down switch circuit malfunction** • When all of the following conditions are met: — M range switch off. — Except D range. — Up or down switch remains on for 10 s or more.	**M range switch circuit malfunction** • Inhibits manual mode **Up switch or down switch circuit malfunction** • Inhibits manual shifting using the up switch or down switch	Enabled
P0708	Steering shift switch circuit malfunction (open circuit/ short to ground)	• Signal from shift control switch is **0.5 V or less**, or **4.7 V or more** for **10 s or more**.	• Inhibits manual shifting using the steering shift switch	Enabled
P0711	Transmission fluid temperature (TFT) sensor malfunction (stuck)	• ATF temperature remains **20 °C {68 °F}** or less for **6.5 min or more**.	N/A	Enabled
P0712	Transmission fluid temperature (TFT) sensor circuit malfunction (short to ground)	• Signal from TFT sensor is **0.1 V or less** for **150 s or more**.	• Engine coolant temperature signal is used for shifting. • Feedback control disabled • Torque reduction control disabled • If the ECT has a malfunction, ATF temperature is controlled at **80 °C {176 °F}**	Enabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0713	Transmission fluid temperature (TFT) sensor circuit malfunction (open circuit/short to power supply)	• Vehicle speed is **20 km/h {12.4 mph} or more**, and signal from TFT sensor is **2.4 V or more** for **150 s or more**.	• Engine coolant temperature signal is used for shifting. • Feedback control disabled • Torque reduction control disabled • If the ECT has a malfunction, ATF temperature is controlled at **80 °C {176 °F}**	Enabled
P0715	Turbine sensor circuit malfunction	• The following condition is detected twice: — Turbine sensor signal is **300 rpm or less** while engine speed is **1,500 rpm or more** and vehicle speed is **40 km/h {25 mph} or more** in D range for **2 s or more**.	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0720	Vehicle speed sensor (VSS) malfunction (open circuit/short to ground)	• While driving in D range at a speed of **2,000 rpm or more** (**25.5 s or more** after shifting to D range), vehicle speed signal is **5 km/h {3 mph} or less** for **3.5 s or more**.	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0731	Gear 1 incorrect (incorrect gear ratio detected)	• TCM monitors the rotation ratio of the parking gear compared to reverse and high clutch drum when the following monitoring conditions are met. If the rotation ratio is **2.283 or less**, or **3.287 or more**, the TCM determines that there is malfunction. **Monitoring condition:** — **2 s or more** after shifting to D range — Vehicle speed **10 km/h {6 mph} or more** — Engine speed **1,000 rpm or more** — Turbine speed **400 rpm or more** — Ratio between engine speed and turbine speed **less than 1.1** — Throttle opening angle **12.5% or more** — Engine torque **80 N·m {8.2 kgf·m, 59 ft·lbf} or more** — ATF temperature **within 20—150 °C {68—302 °F}** — None of the following are present: DTC P0705, P0706, P0711, P0712, P0713, P0715, P0720, P0751, P0753, P0758, P0761, P0762, P0763, P0766, P0767, P0768, P0882, P0960, U0073, U0100.	N/A	Disabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0732	Gear 2 incorrect (incorrect gear ratio detected)	• TCM monitors the rotation ratio of the parking gear compared to reverse and high clutch drum when the following monitoring conditions are met. If the rotation ratio is **1.266 or less**, or **1.824 or more**, the TCM determines that there is malfunction. **Monitoring condition:** — **2 s or more** after shifting to D range — Vehicle speed **10 km/h {6 mph} or more** — Engine speed **1,000 rpm or more** — Turbine speed **1,000 rpm or more** — Ratio between engine speed and turbine speed **less than 1.1** — Throttle opening angle **12.5% or more** — Engine torque **65 N·m {6.6 kgf·m, 48 ft·lbf} or more** — ATF temperature **within 20—150 °C {68—302 °F}** — None of the following are present: DTC P0705, P0706, P0711, P0712, P0713, P0715, P0720, P0751, P0753, P0758, P0761, P0762, P0763, P0766, P0767, P0768, P0882, P0960, U0073, U0100.	N/A	Disabled
P0733	Gear 3 incorrect (incorrect gear ratio detected)	• TCM monitors the rotation ratio of the parking gear compared to reverse and high clutch drum when the following monitoring conditions are met. If the rotation ratio is **0.819 or less**, or **1.181 or more**, the TCM determines that there is malfunction. **Monitoring condition:** — **2 s or more** after shifting to D range — Vehicle speed **20 km/h {12 mph} or more** — Engine speed **1,000 rpm or more** — Turbine speed **1,000 rpm or more** — Ratio between engine speed and turbine speed **less than 1.1** — Throttle opening angle **12.5% or more** — Engine torque **50 N·m {5.1 kgf·m, 37 ft·lbf} or more** — ATF temperature **within 20—150 °C {68—302 °F}** — None of the following are present: DTC P0705, P0706, P0711, P0712, P0713, P0715, P0720, P0751, P0753, P0758, P0761, P0762, P0763, P0766, P0767, P0768, P0882, P0960, U0073, U0100.	N/A	Disabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0734	Gear 4 incorrect (incorrect gear ratio detected)	• TCM monitors the rotation ratio of the parking gear compared to reverse and high clutch drum when the following monitoring conditions are met. If the rotation ratio is **0.568 or less**, or **0.819 or more**, the TCM determines that there is malfunction. **Monitoring condition:** — **2 s or more** after shifting to D range — Vehicle speed **40 km/h {25 mph} or more**. — Engine speed **1,000 rpm or more** — Turbine speed **1,000 rpm or more** — Ratio between engine speed and turbine speed **less than 1.1** — Throttle opening angle **12.5% or more** — Engine torque **50 N·m {5.1 kgf·m, 37 ft·lbf} or more** — ATF temperature **within 20—150 °C {68—302 °F}** — None of the following are present: DTC P0705, P0706, P0711, P0712, P0713, P0715, P0720, P0751, P0753, P0758, P0761, P0762, P0763, P0766, P0767, P0768, P0882, P0960, U0073, U0100.	N/A	Disabled
P0740	Torque converter clutch (TCC) system malfunction	• Difference between the engine speed and turbine speed remains "vehicle speed/2+40" rpm or more for 10 s or more during TCC operation in 3GR or 4GR while driving.	N/A	Enabled
P0743	Torque converter clutch (TCC) solenoid valve circuit malfunction (open circuit/short to ground or power supply)	• Open or short circuit in TCC solenoid signal system (when the TCM monitors solenoid output voltage, voltage that differs from the ON/OFF signal output by CPU in TCM is detected)	• Stops operation of TCC solenoid valve (OFF).	Disabled
P0748	Pressure control solenoid circuit malfunction (open circuit/short to ground or power supply)	• Open or short circuit in pressure control solenoid signal system (when the TCM monitors solenoid output voltage, voltage that differs from the ON/OFF signal output by CPU in TCM is detected)	• Stops driving of pressure control solenoid valve (OFF).	Enabled
P0751	Shift solenoid A malfunction (stuck off)	• Large difference between actual gear ratio and gear ratio set in TCM	N/A	Enabled
P0753	Shift solenoid A circuit malfunction (open circuit/ short to ground or power supply)	• Open or short circuit in shift solenoid A signal system (when the TCM monitors solenoid output voltage, voltage that differs from the ON/OFF signal output by CPU in TCM is detected)	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0758	Shift solenoid F circuit malfunction (open circuit/ short to ground or power supply)	• Open or short circuit in shift solenoid F signal system (when the TCM monitors solenoid output voltage, the voltage that differs from the ON/OFF signal output by CPU in TCM is detected)	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0761	Shift solenoid B malfunction (stuck off)	• Large difference between actual gear ratio and gear ratio set in TCM	N/A	Enabled
P0762	Shift solenoid B malfunction (stuck on)	• Large difference between actual gear ratio and gear ratio set in TCM	N/A	Enabled

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0763	Shift solenoid B circuit malfunction (open circuit/ short to ground or power supply)	• Open or short circuit in shift solenoid B signal system (when the TCM monitors solenoid output voltage, voltage that differs from the ON/OFF signal output by CPU in TCM is detected).	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0766	Shift solenoid C malfunction (stuck off)	• Large difference between actual gear ratio and gear ratio set in TCM	N/A	Enabled
P0767	Shift solenoid C malfunction (stuck on)	• Large difference between actual gear ratio and gear ratio set in TCM	N/A	Enabled
P0768	Shift solenoid C circuit malfunction (open circuit/ short to ground or power supply)	• Open or short circuit in shift solenoid C signal system (when the TCM monitors solenoid output voltage, voltage that differs from the ON/OFF signal output by CPU in TCM is detected).	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P0841	Oil pressure switch B circuit malfunction	• When driving, hydraulic pressure should be generated in the 2-4 brake, but oil pressure switch B does not turn on. • When driving, hydraulic pressure should not be generated in the 2-4 brake, but oil pressure switch B does not turn off.	N/A	Disabled
P0846	Oil pressure switch C circuit malfunction	• When driving, hydraulic pressure should be generated in the high clutch, but oil pressure switch C does not turn on. • When driving, hydraulic pressure should not be generated in the high clutch, but oil pressure switch C does not turn off.	N/A	Disabled
P0871	Oil pressure switch F circuit malfunction	• When driving, hydraulic pressure should be generated in the low and reverse brake, but oil pressure switch F does not turn on. • When driving, hydraulic pressure should not be generated in the low and reverse brake, but oil pressure switch F does not turn off.	N/A	Disabled
P0882	TCM B+ low	• The TCM monitors the voltage of back-up battery positive terminal at TCM terminal 1A. If the TCM detects battery positive terminal voltage **4 V or less** for **100 s or more**, the TCM determines that the backup voltage circuit has malfunction.	N/A	Enabled
P0960	GND return circuit malfunction	• TCM detects an open circuit in the GND return signal line from the solenoid valve.	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled
P1759	2-4 brake fail-safe valve malfunction	• TCM detects 2-4 brake fail-safe valve malfunction.	N/A	Disabled
P1764	Low and reverse brake fail-safe valve malfunction	• TCM detects low and reverse brake fail-safe valve malfunction.	N/A	Disabled
U0073	CAN bus off	• CAN controller damaged.	• CAN communication is stopped	Disabled
U0100	TCM cannot receive any signals from the PCM	• TCM cannot receive any signals from the PCM.	• Driving restricted to 3GR • Stops operation of TCC solenoid valve (OFF).	Disabled

PARAMETER IDENTIFICATION (PID) DATA MONITORING FUNCTION

CHU050201026S07

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

Monitor Item Table

Display on the tester	Definition	Unit/Condition	TCM terminal
24B_Duty	Shift solenoid valve B (2-4 brake duty)	%	2S
BOO_TCM	Brake switch	ON/OFF	1G
CPP/PNP	TR switch (P/N range switch)	Drive/Neutral	1D, 2B
DTC_CNT	Number of DTCs detected	N/A	N/A
DWN SW	Down switch (manual mode)	ON/OFF	2D
ECT TCM	Engine coolant temperature	°C, °F	N/A
FDPDTC	Pending code causing FFD storage	N/A	N/A
GEAR	Calculated gear ratio in TCM	1st/2nd/3rd/4th	N/A
GEAR_RA	Calculated gear ratio in TCM	N/A	N/A
HC_Duty	Shift solenoid valve C (high clutch duty)	%	2V
LRB_Duty	Shift solenoid valve F (low and reverse brake duty)	%	2P
LU_Duty	TCC solenoid valve (TCC solenoid duty)	%	2W
MNL SW	M range switch	ON/OFF	1E
OP_SW_24B	Oil pressure switch B	ON/OFF	2A
OP_SW_HC	Oil pressure switch C	ON/OFF	2F
OP_SW_LRB	Oil pressure switch F	ON/OFF	2H
OSS	Vehicle speed sensor (output shaft speed signal)	rpm	2K
PCSV	Pressure control solenoid valve	ON/OFF	2X
RPM	Engine speed	rpm	N/A
TCCC	Shift solenoid valve A (low clutch duty)	%	2Y
TFT	ATF temperature	°C, °F	2J
TFTV	ATF temperature signal voltage	V	2J
THOP	Throttle position	%	N/A
TR	TR switch	R/N/D	2B, 2C, 2E
TRD	TR switch (D range switch)	ON/OFF	2E
TRR	TR switch (R range switch)	ON/OFF	2C
TSS	Turbine sensor	rpm	2G
UP SW	Up switch (manual mode)	ON/OFF	2I
VPWR	Battery voltage	V	1A, 2Z, 2AA
VSS	Vehicle speed	km/h, mph	N/A

SIMULATION FUNCTION

CHU050201026S08

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

Simulation Item Table

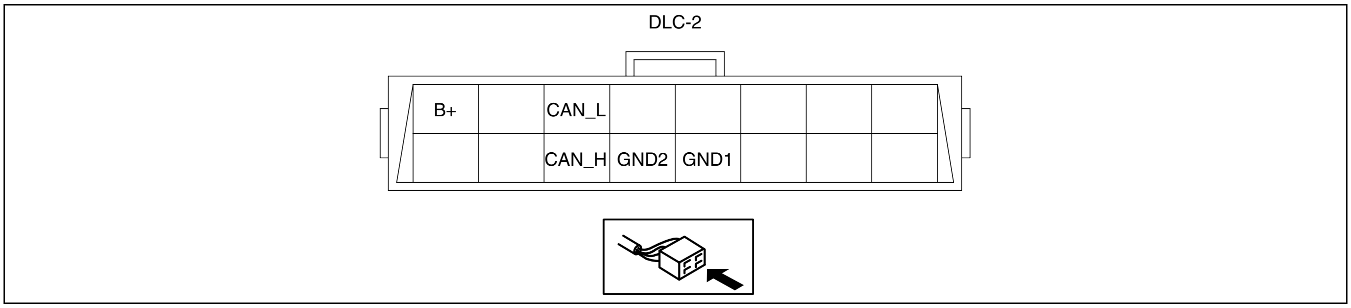
X: Available

Simulation item	Applicable component	Unit/Condition	Operation		TCM terminal
			IG ON	Idle	
24B_Duty	Shift solenoid valve B (2-4 brake duty)	%	X	X	2S
HC_Duty	Shift solenoid valve C (high clutch duty)	%	X	X	2V
LRB_Duty	Shift solenoid valve F (low and reverse brake duty)	%	X	X	2P
LU_Duty	TCC solenoid valve (TCC solenoid duty)	%	X	X	2W
PCSV	Pressure control solenoid valve	ON/OFF	X	X	2X
TCCC	Shift solenoid valve A (low clutch duty)	%	X	X	2Y

DLC-2 OUTLINE

CHU050201026S09

- The DLC-2 located in the drive compartment is a standard service connector as defined by OBD-II regulations.



CHU0502S002

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

05–10 CLUTCH

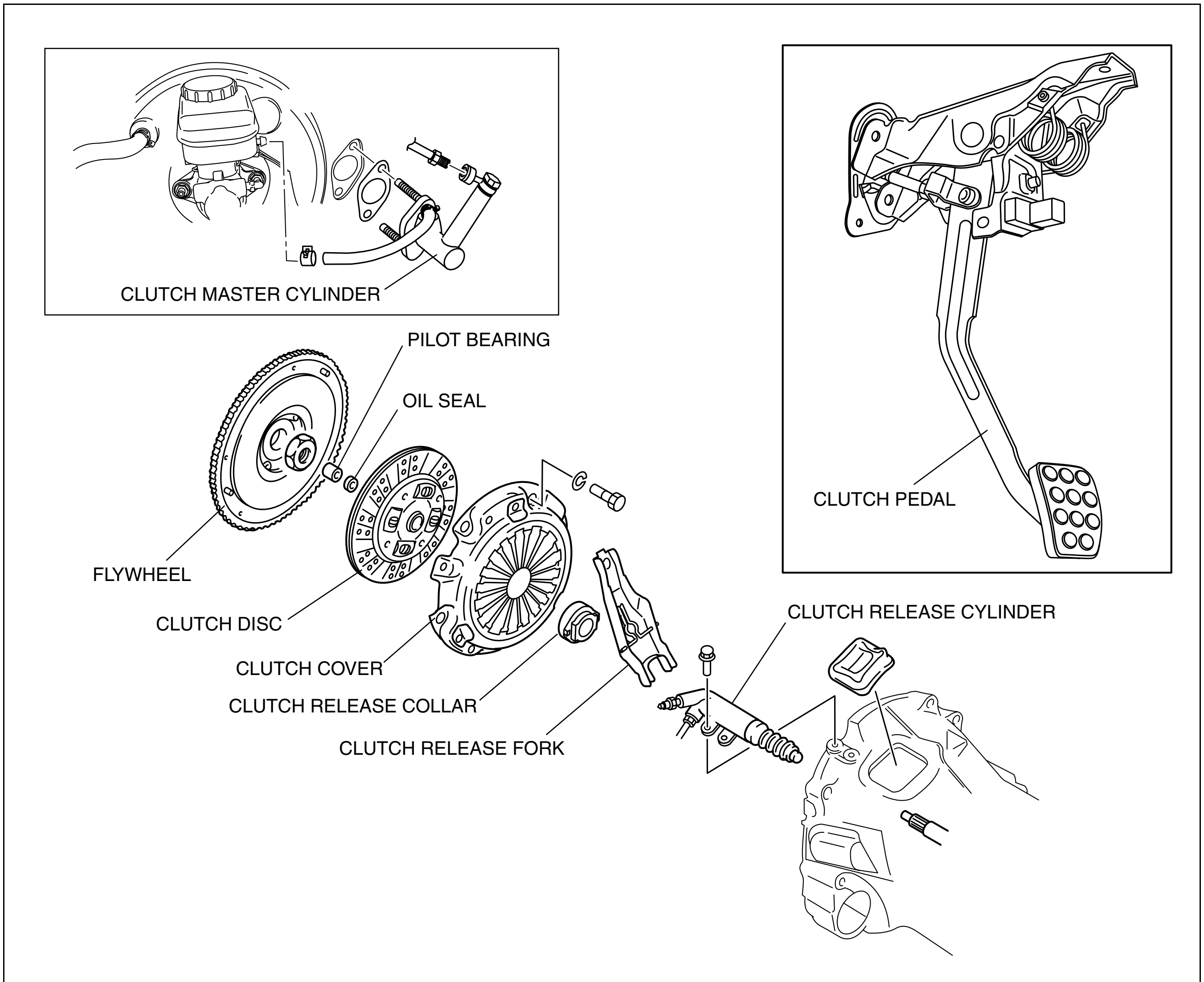
CLUTCH OUTLINE

CHU051001025S01

- A hydraulic clutch control mechanism is used.

CLUTCH STRUCTURAL VIEW

CHU051001025S02

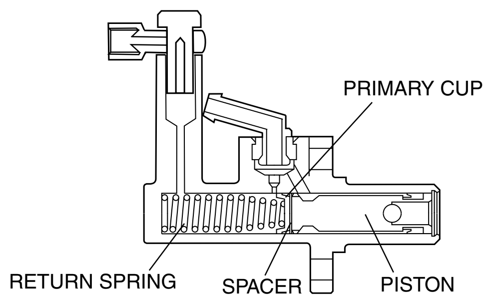


CHU0510N001

CLUTCH MASTER CYLINDER

CHU051001025S03

- The clutch master cylinder consists of a primary cup, spacer, piston, and a return spring.



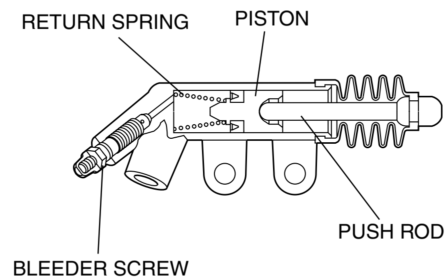
CHU0510T004

CLUTCH RELEASE CYLINDER

CHU051001025S04

STRUCTURE

- The clutch release cylinder consists of a return spring, piston, push rod and a bleeder screw for bleeding air.



CHU0510N003

- Due to spring pressure maintaining play between the push rod end and the release fork at zero, an automatic adjusting, maintenance-free design has been achieved.

05–11 MANUAL TRANSMISSION [Y16M-D]

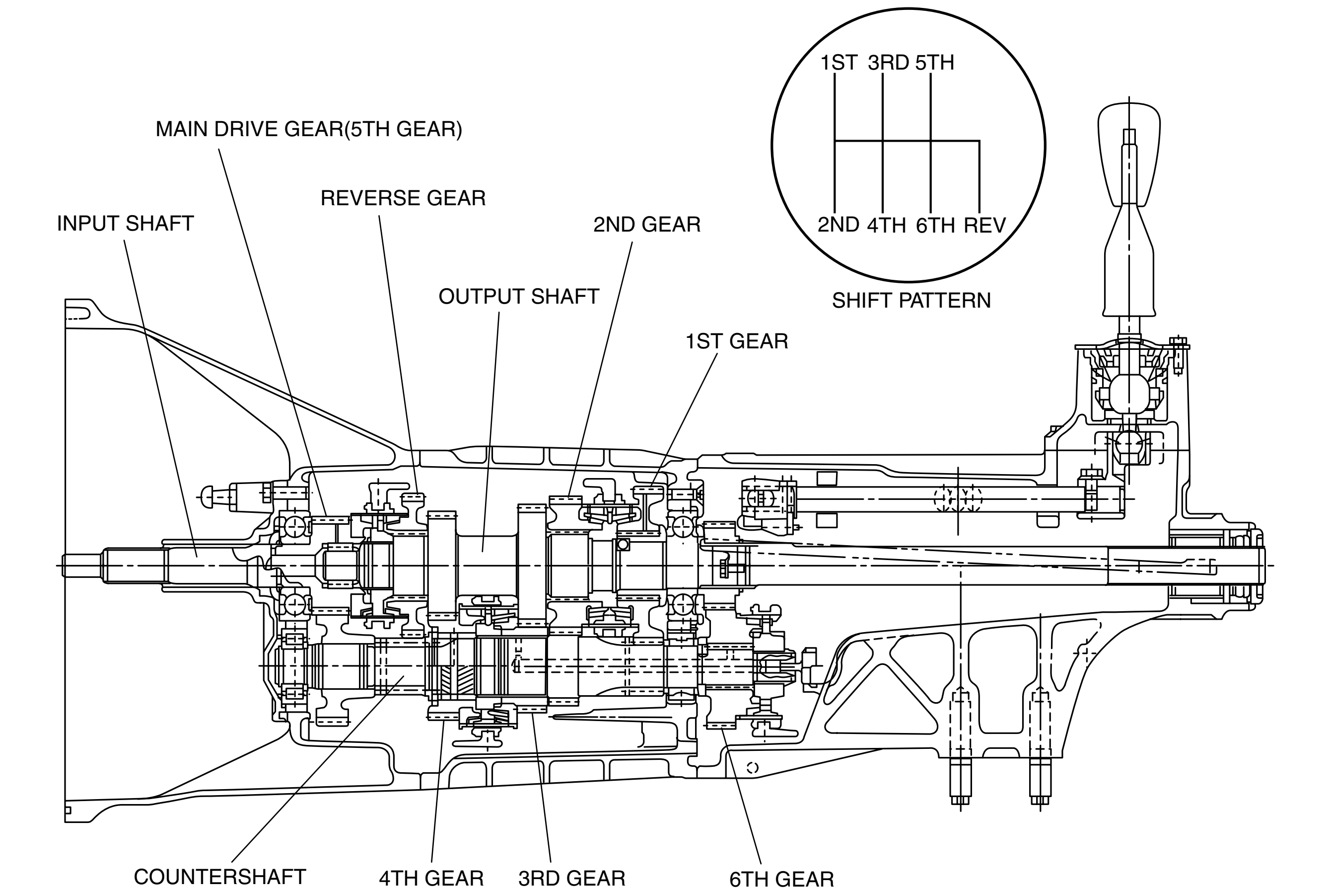
MANUAL TRANSMISSION OUTLINE

CHU051101025S01

- A triple synchronizer mechanism has been adopted for 1st, 2nd and 3rd gears.
- A guide plate type reverse lockout mechanism has been adopted.

MANUAL TRANSMISSION CROSS-SECTIONAL VIEW

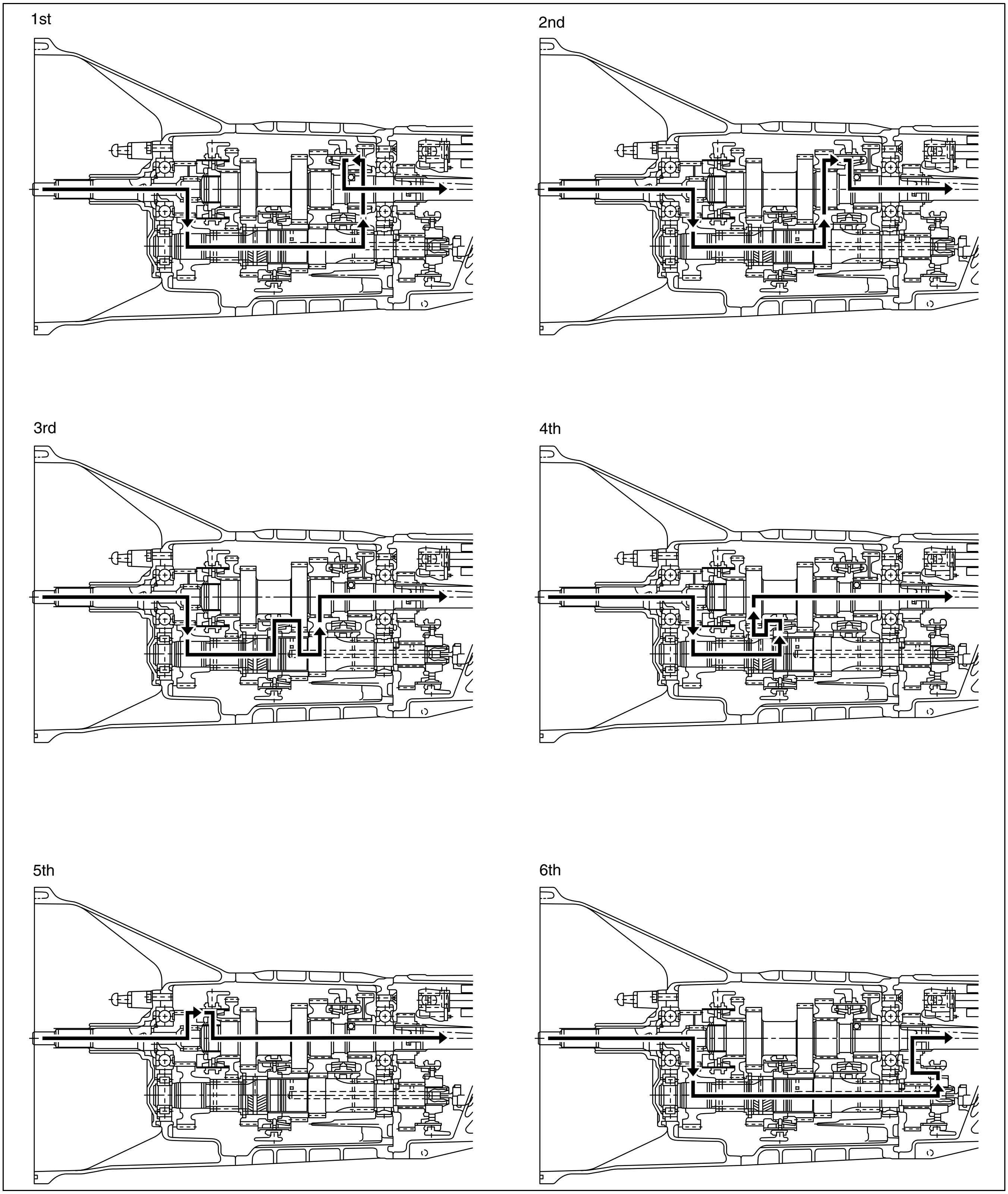
CHU051101025S02



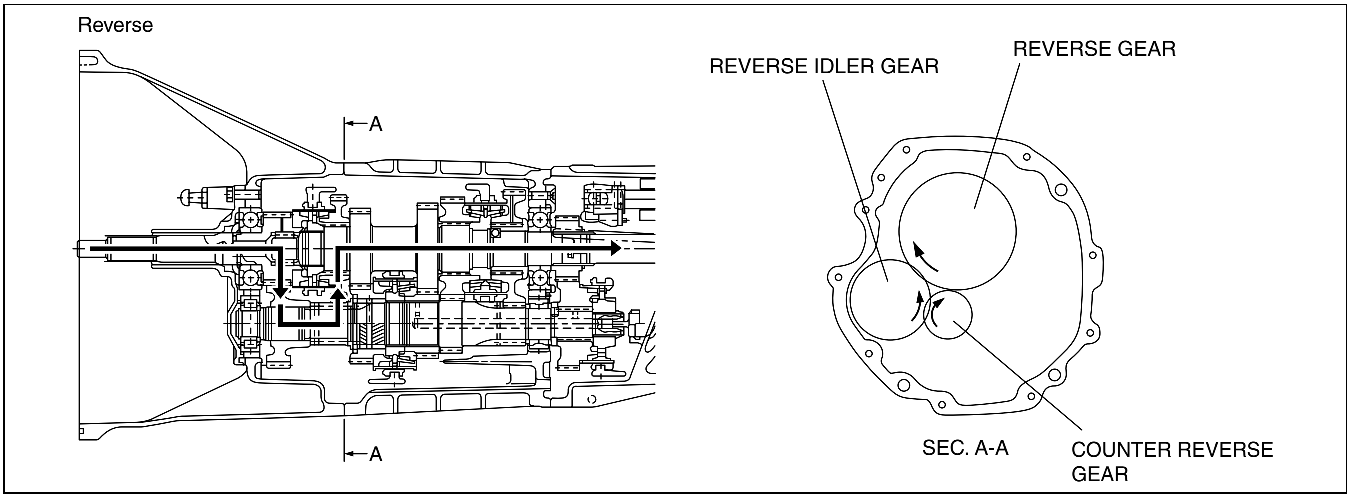
CHU0511S101

MANUAL TRANSMISSION POWER FLOW

CHU051101025S03



CHU0511S102



CHU0511S103

05–11

SYNCHRONIZER MECHANISM OUTLINE

CHU051101025S04

- A ball-type synchronizer mechanism is used in each gear.
- The ball-type synchronizer mechanism consists of a coil-type synchronizer key spring, synchronizer key, and ball. Use of these components in the clutch hub reduces the length of the manual transmission and makes the synchronizer mechanism more compact.

TRIPLE SYNCHRONIZER MECHANISM STRUCTURE

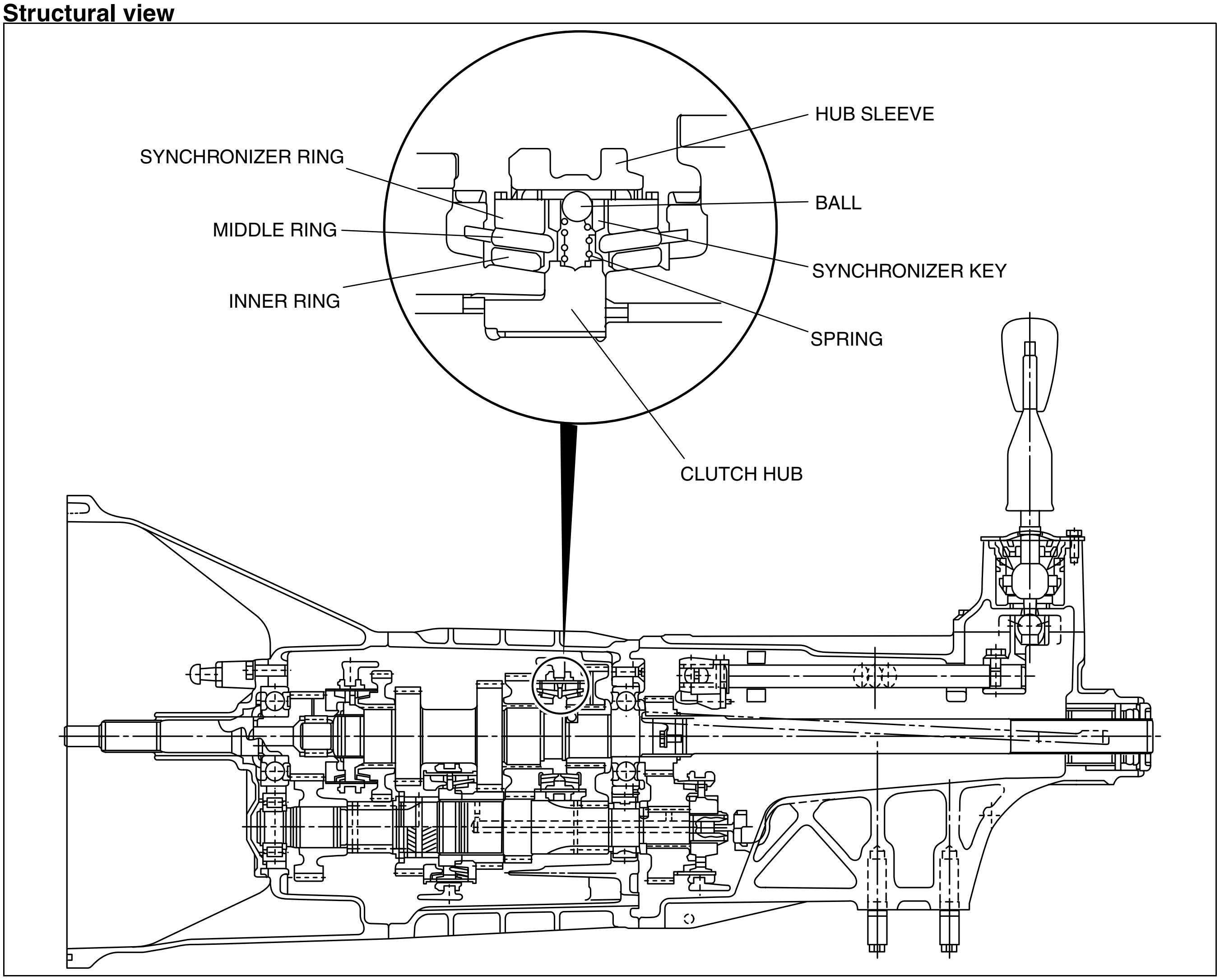
CHU051101025S05

Features

- A triple synchronizer mechanism using more rings than double synchronizer mechanism is used for the first, second and third gears to improve synchromesh capacity by increasing a friction surface area.
- The triple synchronizer mechanism consists of a synchronizer ring, middle ring, and inner ring.
- The gear side inner surface of the inner ring can also be used as a friction surface in the triple synchronizer mechanism. This provides a stronger synchronization force compared to the double cone synchronizer mechanism and reduces operation force and meshing time.

Structure

Structural view

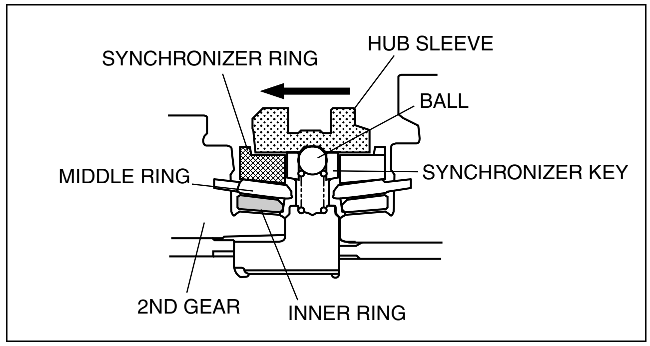


CHU0511S104

TRIPLE SYNCHRONIZER MECHANISM OPERATION

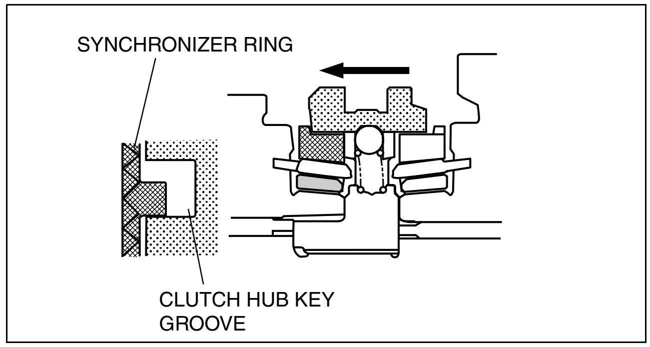
CHU051101025S06

1. As the hub sleeve moves leftward (in the direction of the arrow), the synchronizer key presses against the end of the synchronizer ring. As the hub sleeve continues moving leftward, the synchronizer key presses onto the synchronizer ring. The synchronizer ring presses onto the middle ring, the middle ring presses onto the inner ring, and the inner ring presses onto the second gear.



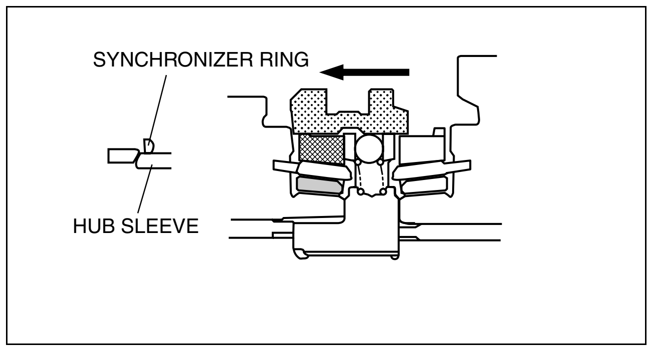
CHU0511S105

2. As the hub sleeve continues moving leftward, friction is produced along the friction surfaces of the synchronizer ring, middle ring, inner ring, and second gear, and the synchronizer ring rotates only an amount equivalent to the space in the key groove of the hub sleeve. As a result, the chamfers of the hub sleeve and the synchronizer ring become aligned. As the hub sleeve continues moving leftward, friction between each component becomes greater and the difference between the rotational speeds of the synchronizer ring, middle ring, inner ring, and second gear gradually disappears.



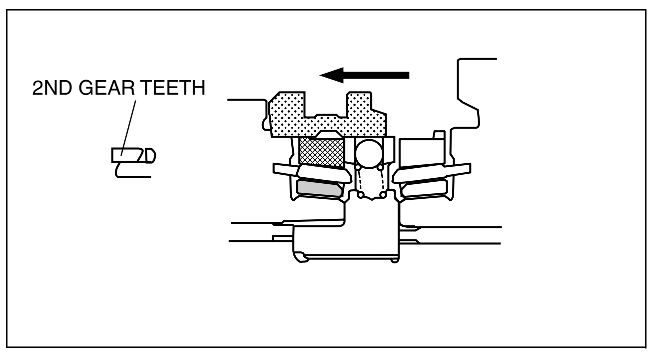
CHU0511S106

3. As the hub sleeve continues moving leftward, the difference between the rotational speeds of the second gear and the hub sleeve disappears, and synchronization is completed. When synchronization is completed, the hub sleeve rides over the ball and engages the synchronizer ring.



CHU0511S107

4. As the hub sleeve continues moving leftward, the hub sleeve then engages the synchro teeth to complete the shift.

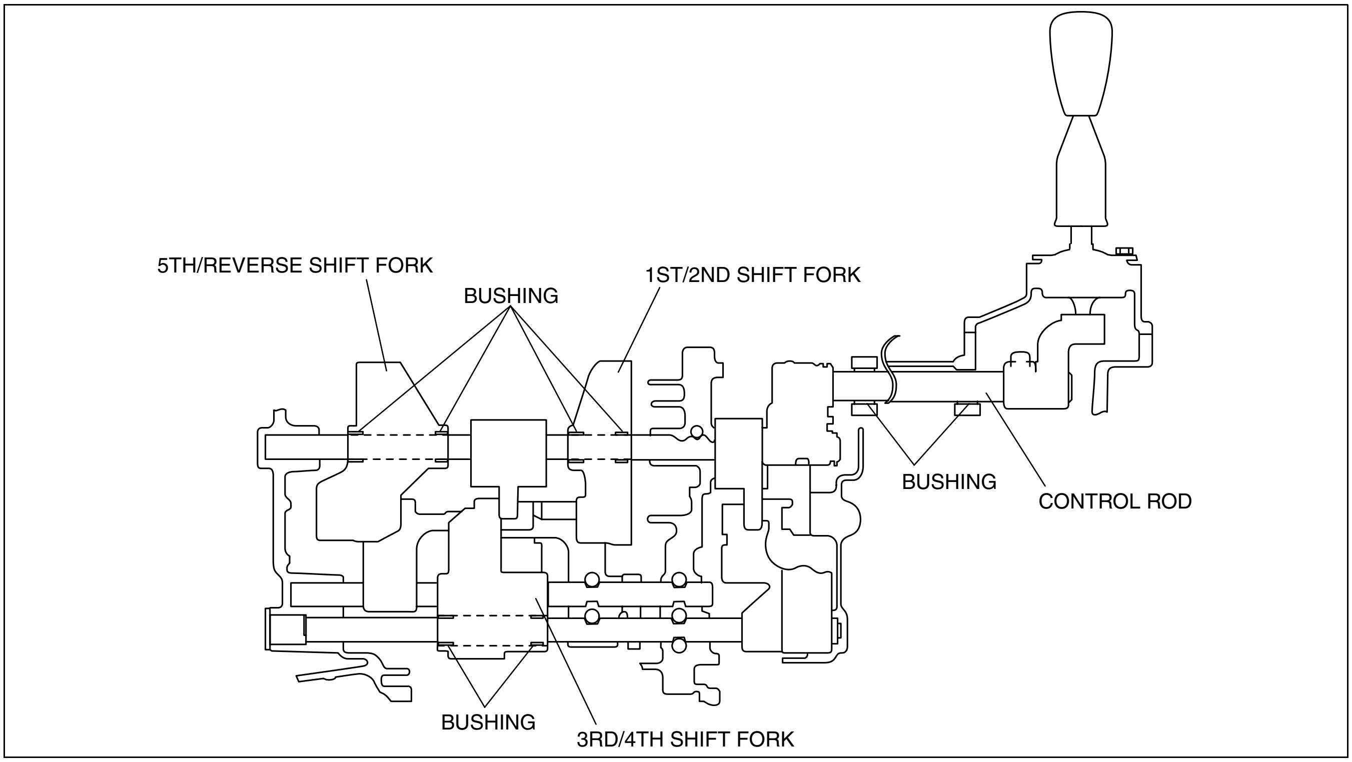


CHU0511S108

05–11

CONTROL ROD OPERATION

CHU051101025S07



CHU0511S109

- The control rod sliding section and the supports of each shift fork are equipped with a teflon bushing, which reduces sliding resistance during shifts and thus improves shift feeling.

SHIFT INTERLOCK MECHANISM FUNCTION

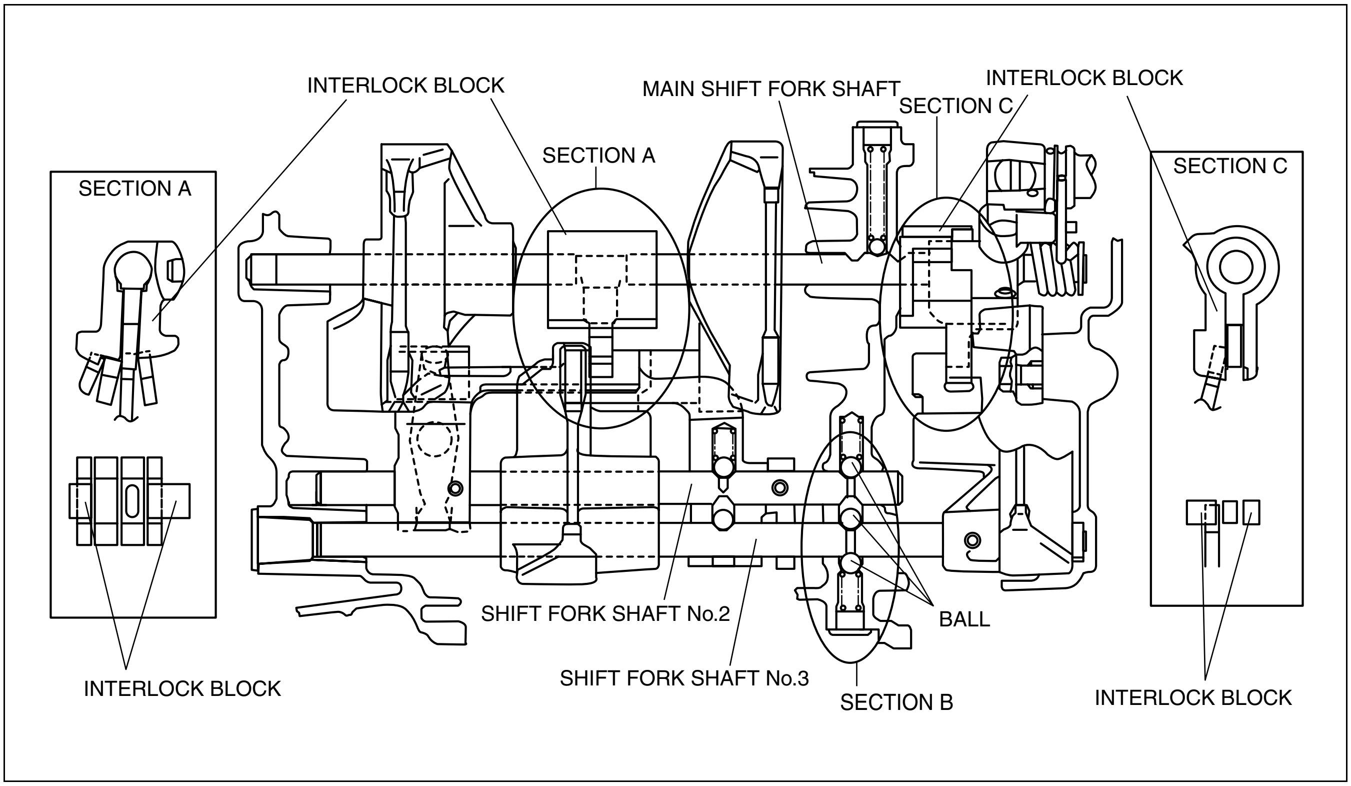
CHU051101025S08

- The shift interlock mechanism prevents double engagement. Two interlock blocks, which can only move in the selected direction, and a ball located between shift fork shafts No.2 and No.3 operate together to restrict the movement of the unselected shift forks, thereby ensuring reliability.

SHIFT INTERLOCK MECHANISM OPERATION

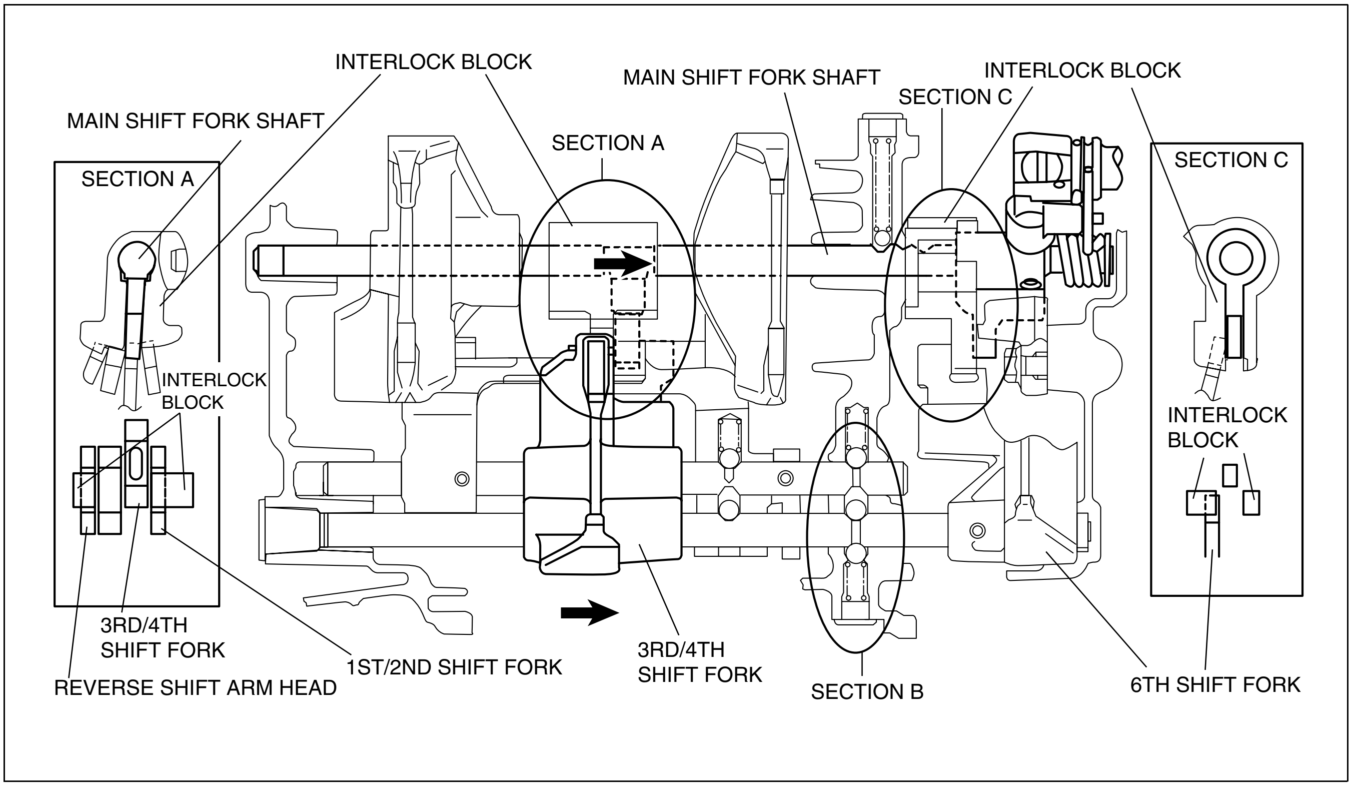
CHU051101025S09

In Neutral Position



CHU0511S110

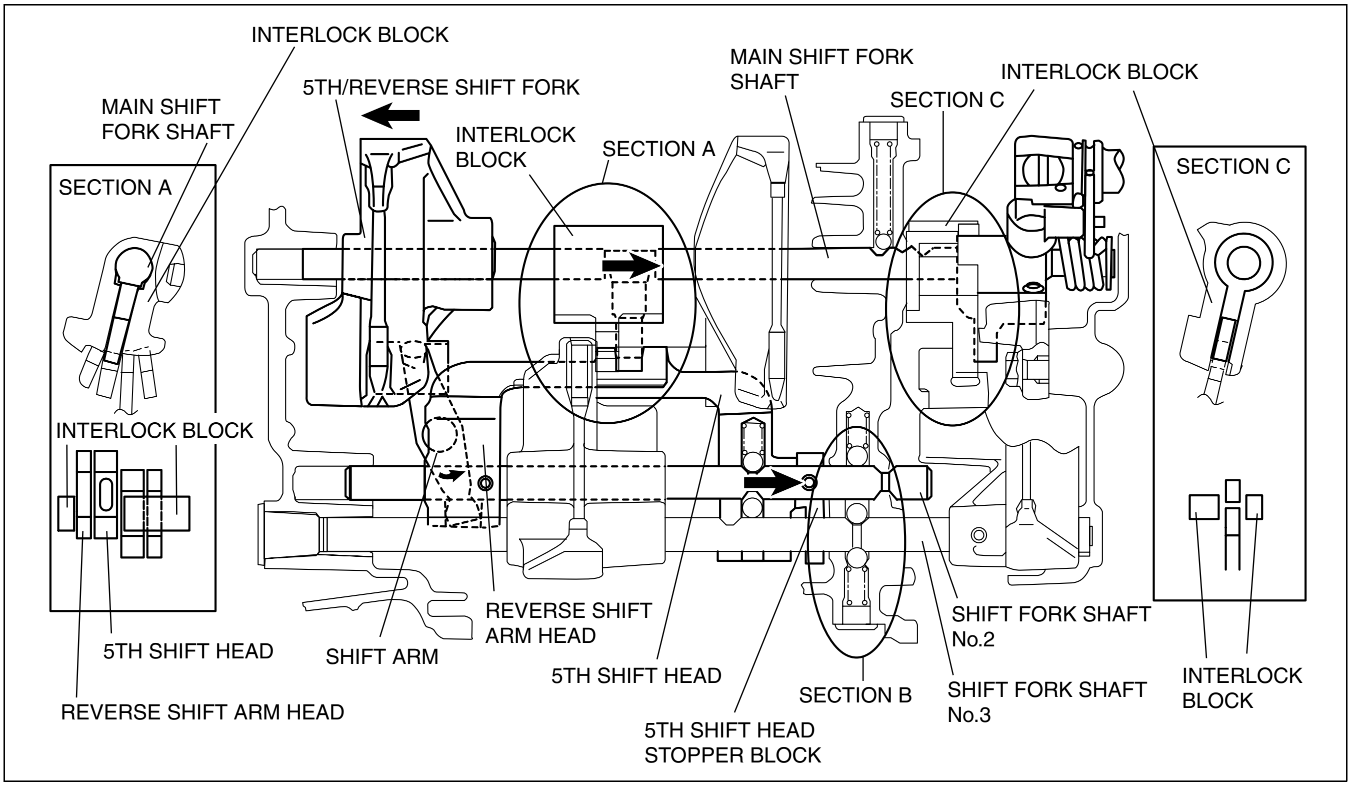
In 1st, 2nd, 3rd, and 4th Gear Positions Example: in 3rd gear position



CHU0511S111

- When the shift lever is shifted into third gear, the main shift fork shaft moves rightward (see figure) and moves the third/fourth shift fork in the same direction to complete the shift into third gear. At the same time, the first/second shift fork and the reverse shift arm head are held in neutral position by the interlock block in section A, and the sixth shift fork is also held in neutral position by the interlock block in section C. In this way, the unselected shift forks are locked to prevent double engagement.
- In the same way, when shifting into first, second, or fourth gears, the interlock blocks in section A and C restrict the movement of the unselected shift forks to prevent double engagement.

In 5th Gear Position

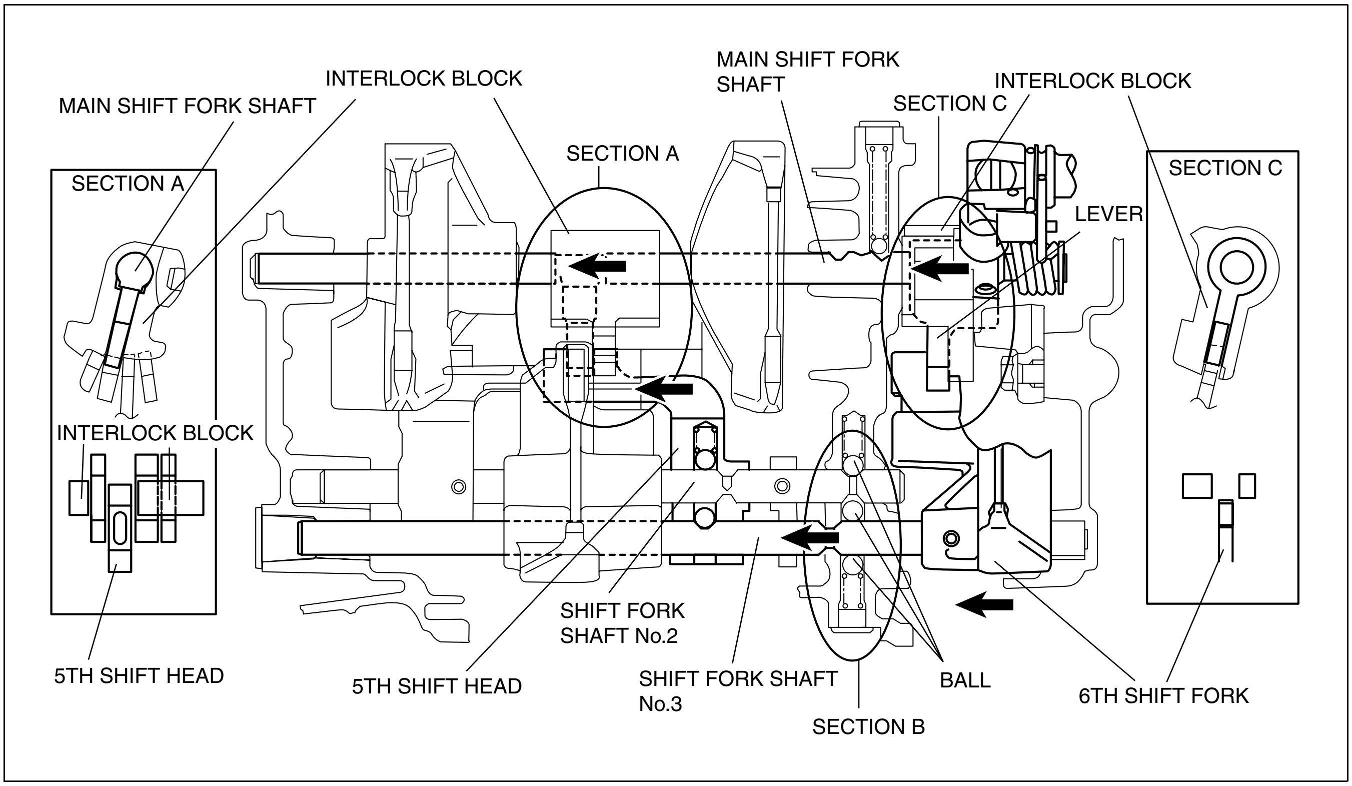


CHU0511S112

- When the shift lever is shifted into fifth gear, the main shift fork shaft moves rightward (see figure), which simultaneously moves the fifth shift head and the fifth shift head stopper block rightward. As the fifth shift head stopper block is fixed to shift fork shaft No.2 by a pin, the shift fork shaft moves when the shift head stopper block moves. Likewise, the reverse shift arm head, which is fixed to shift fork shaft No.2 by a pin, also moves rightward. As a result, the fifth/reverse shift fork moves leftward through the shift arm connected to the reverse shift arm head, thereby shifting the gear into fifth gear. At the same time, the interlock block in section A fixes the shift forks in neutral position except for the fifth shift and reverse shift arm heads. Also, shift fork shaft No.2, which is moved rightward by the fifth shift head, presses onto the ball which is out of the ridge to fix shift fork shaft No.3, thereby preventing double engagement during fifth gear shifting.

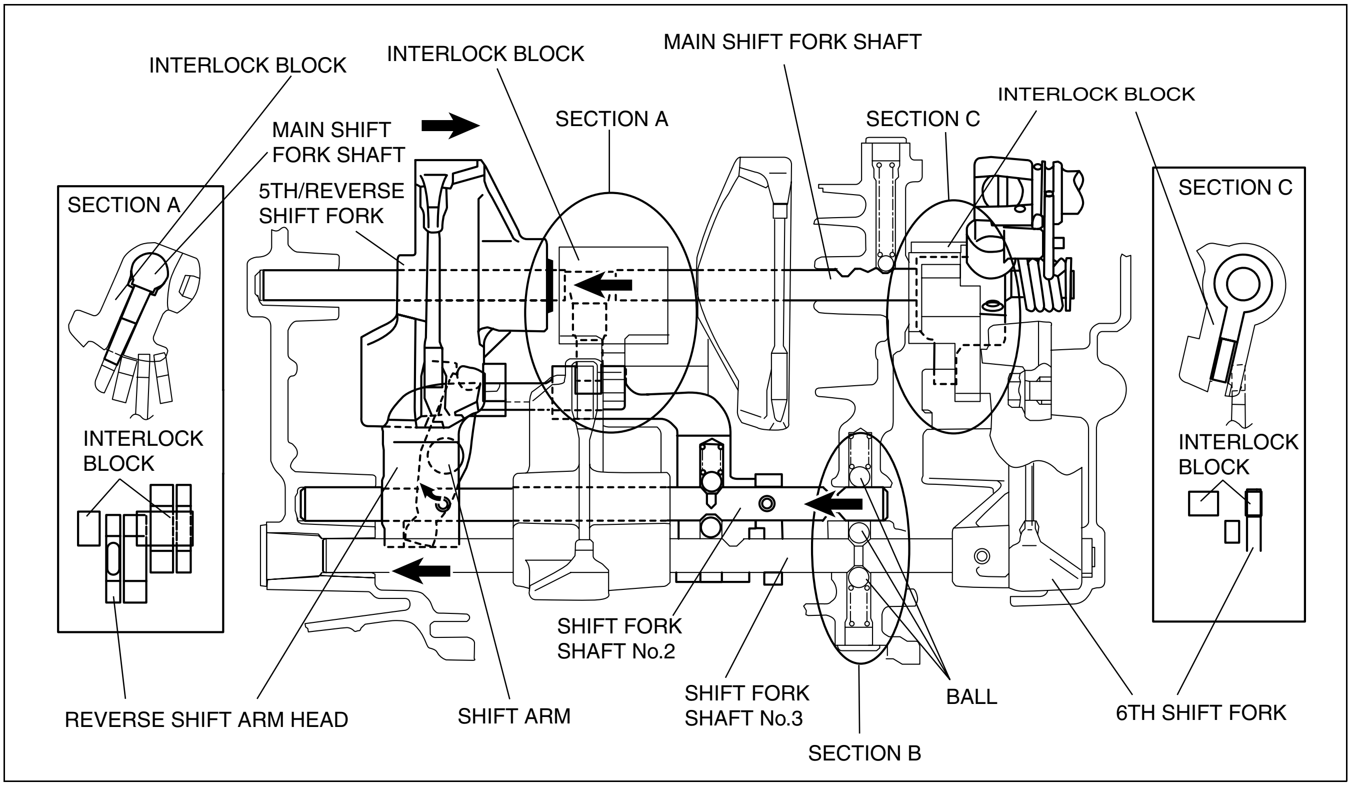
05–11

In 6th Gear Position



- When the shift lever is shifted into sixth gear, the main shift fork shaft and the lever in section C move leftward (see figure), which moves the sixth shift fork and shifts the gear into sixth gear. At the same time, the interlock block in section A fixes the shift fork in neutral position except for the fifth shift head. Also, shift fork shaft No.3, which is moved leftward by the sixth shift fork, presses onto the ball which is out of the ridge to fix shift fork shaft No.2, thereby preventing double engagement during sixth gear shifting. Additionally, during sixth gear shifting, the main shift fork shaft also moves the fifth shift head, but as shift fork shaft No.2 is fixed by the ball, the fifth shift head moves leftward on the top of the shaft by itself and is not directly affected by shift operation.

In Reverse Gear Position



CHU0511S114

- When the shift lever is shifted into reverse gear, the main shift fork shaft moves leftward (see figure), which moves the reverse shift arm head leftward. As a result, the fifth/reverse shift fork moves rightward through the shift arm connected to the reverse shift arm head, thereby shifting the gear into reverse. At the same time, the interlock blocks in sections A and C fix the shift forks in neutral position except for the fifth shift and reverse shift arm heads. Also, shift fork shaft No.2, which is moved leftward by the reverse shift arm head, presses onto the ball which is out of the ridge to fix shift fork shaft No.3, thereby preventing double engagement during reverse shifting.

REVERSE LOCKOUT MECHANISM FUNCTION

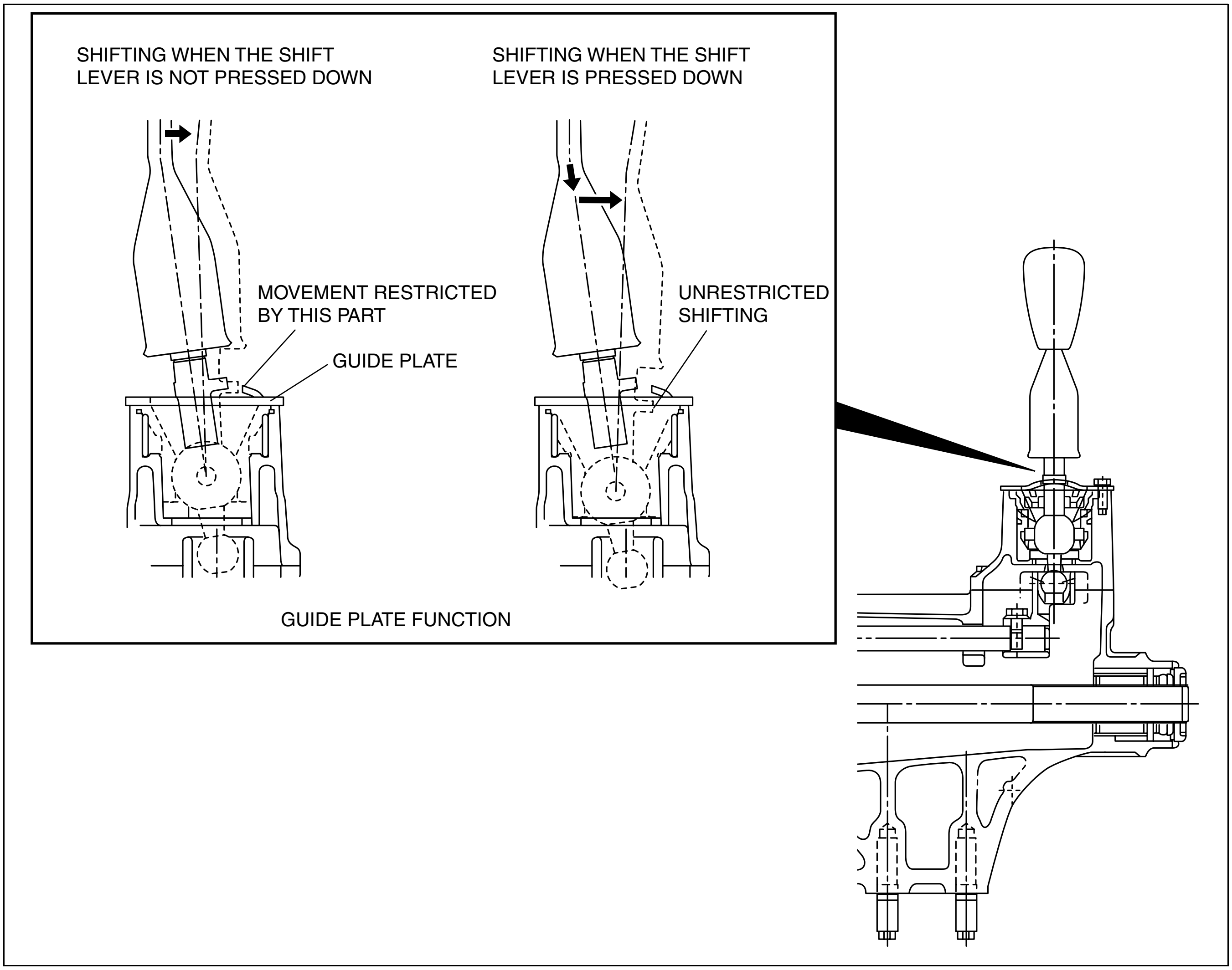
CHU051101025S10

- The reverse lockout mechanism prevents mis-shifting into reverse gear when shifting from 5th gear to 6th gear.

REVERSE LOCKOUT MECHANISM CONSTRUCTION/OPERATION

CHU051101025S11

- With the adoption of the reverse lockout mechanism, which utilizes a guide plate, reliability has been assured.
- A guide plate, attached to the extension housing, prevents accidental shifting into reverse when shifting from 5th to 6th gear by restricting the movement of the shift lever. When shifting into reverse, once the shift lever is pressed down and moved towards the reverse position, the projection on the lever goes under the guide plate, releasing the reverse shift restriction and allowing for shifting into reverse.



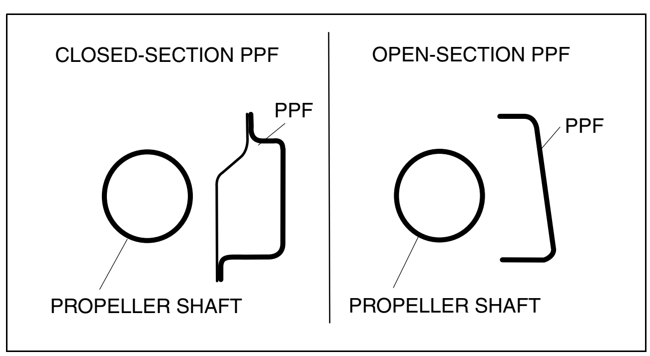
CHU0511S115

POWER PLANT FRAME (PPF) FUNCTION

CHU051101025S12

Features

- The power plant frame (PPF) maintains rigidity with a bracket installed between the transmission and the differential. Due to this the shift feeling is solid and a feeling of direct drive when starting from a standstill or accelerating is created.
- Also, due to the closed-section construction of the PPF, direct drive and response feeling have been improved.



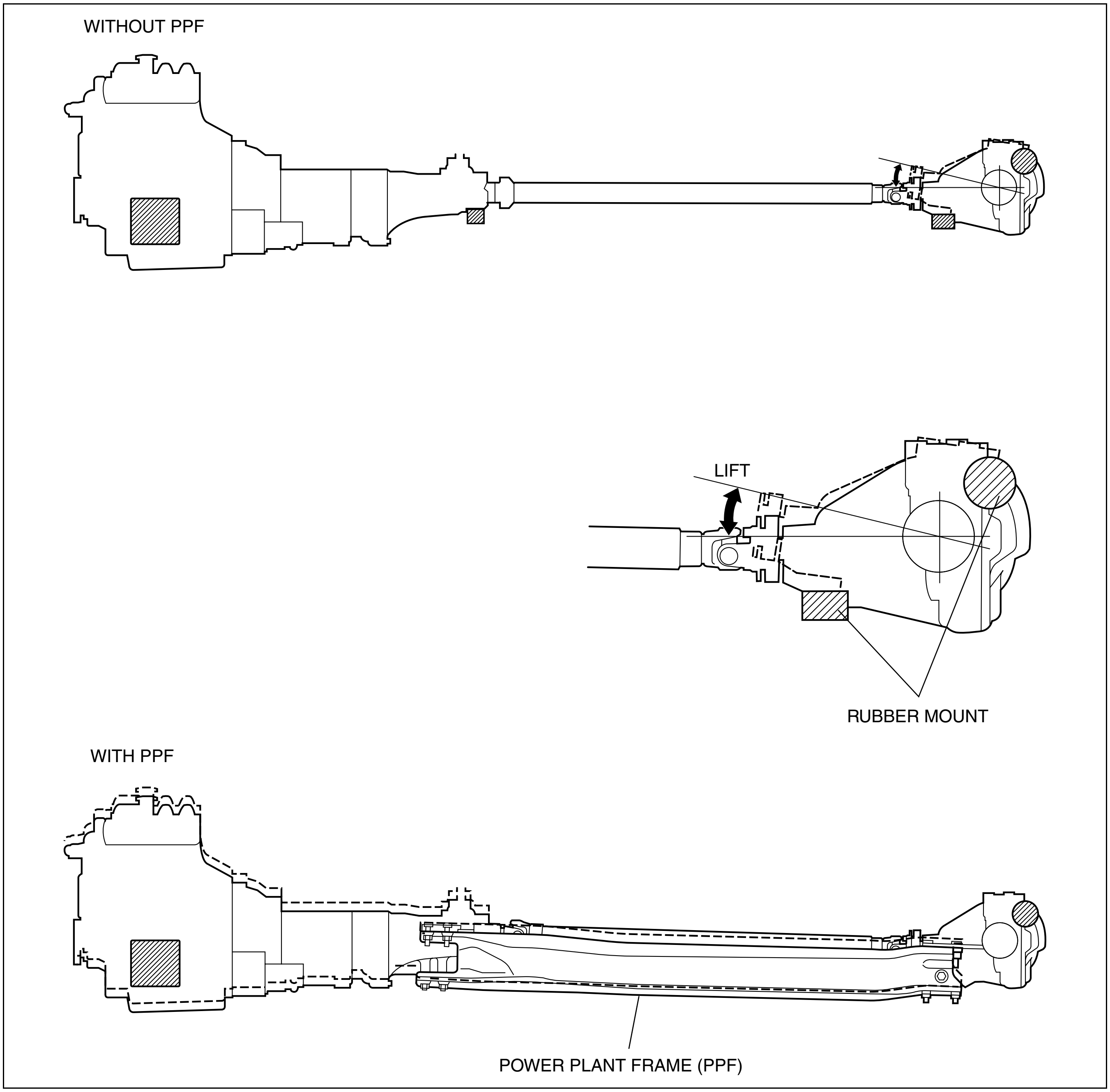
CHU0511S016

Without PPF

— In order to suppress vibration to the vehicle body, rubber mounts are used to connect the differential to the frame. When accelerating rapidly, the front part of the differential lifts upward which causes a time lag in the actual engine torque being transmitted to the tires and direct drive feeling is lost.

With PPF

— With PPF, the transmission and differential are joined in a single unit which, even though the differential can be separated from the body, time lag is lessened due to the near elimination of lift, creating a feeling of direct drive. Furthermore, shock and vibration during acceleration and deceleration is greatly reduced.



CHU0511S014

05–13 AUTOMATIC TRANSMISSION

AUTOMATIC TRANSMISSION OUTLINE

CHU051301030S01

- A newly developed RC4A-EL type electronically controlled automatic transmission with four-speeds and a torque converter clutch mechanism combining advanced electronic and mechanical technology has been adopted.
- The RC4A-EL type has been newly developed as an automatic transmission with state-of-the-art technology.
- In the RC4A-EL type automatic transmission, the part count has been greatly reduced to lessen size and weight. Also, a well-balanced powertrain mechanism with high reliability has been adopted to improve marketability.

Outline of operation

- The outline of the electronically-controlled automatic transmission is classified into three systems: the powertrain system (includes the torque converter mechanism), the hydraulic control system, and the electronic control system.

Powertrain system

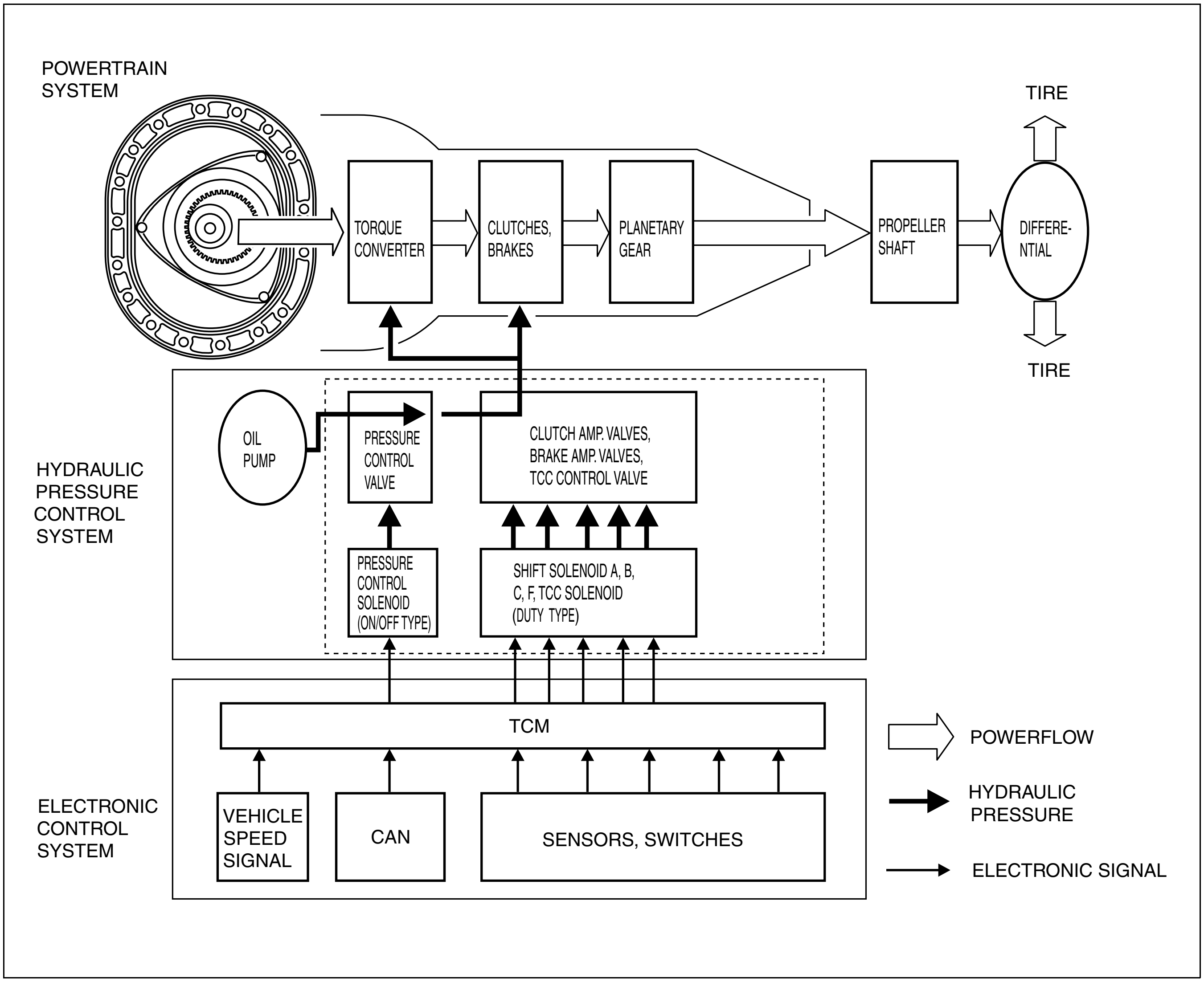
- Driving force from the engine is transmitted through the torque converter to the transmission.
- When the clutch and brakes are engaged by clutch pressure from the control valve, the planetary gear unit switches between fixed and input, and thus transmitted driving force is converted to optimum driving force.
- The converted driving force is transmitted to the propeller shaft, the differential, and the tires.

Hydraulic control system

- The solenoids operate, according to the signals from the TCM, to switch to high or low line pressure (depending on driving conditions) and regulate the clutch pressure.
- The on/off pressure control solenoid switches line pressure between high and low, duty cycle shift solenoids regulate clutch pressure, and duty cycle TCC solenoids control TCC.

Electronic control system

- The TCM sends signals that suit current driving conditions to the solenoids of the hydraulic control system, according to input signals from sensors and switches, and shifts gears.



CHU0513S003

05–13

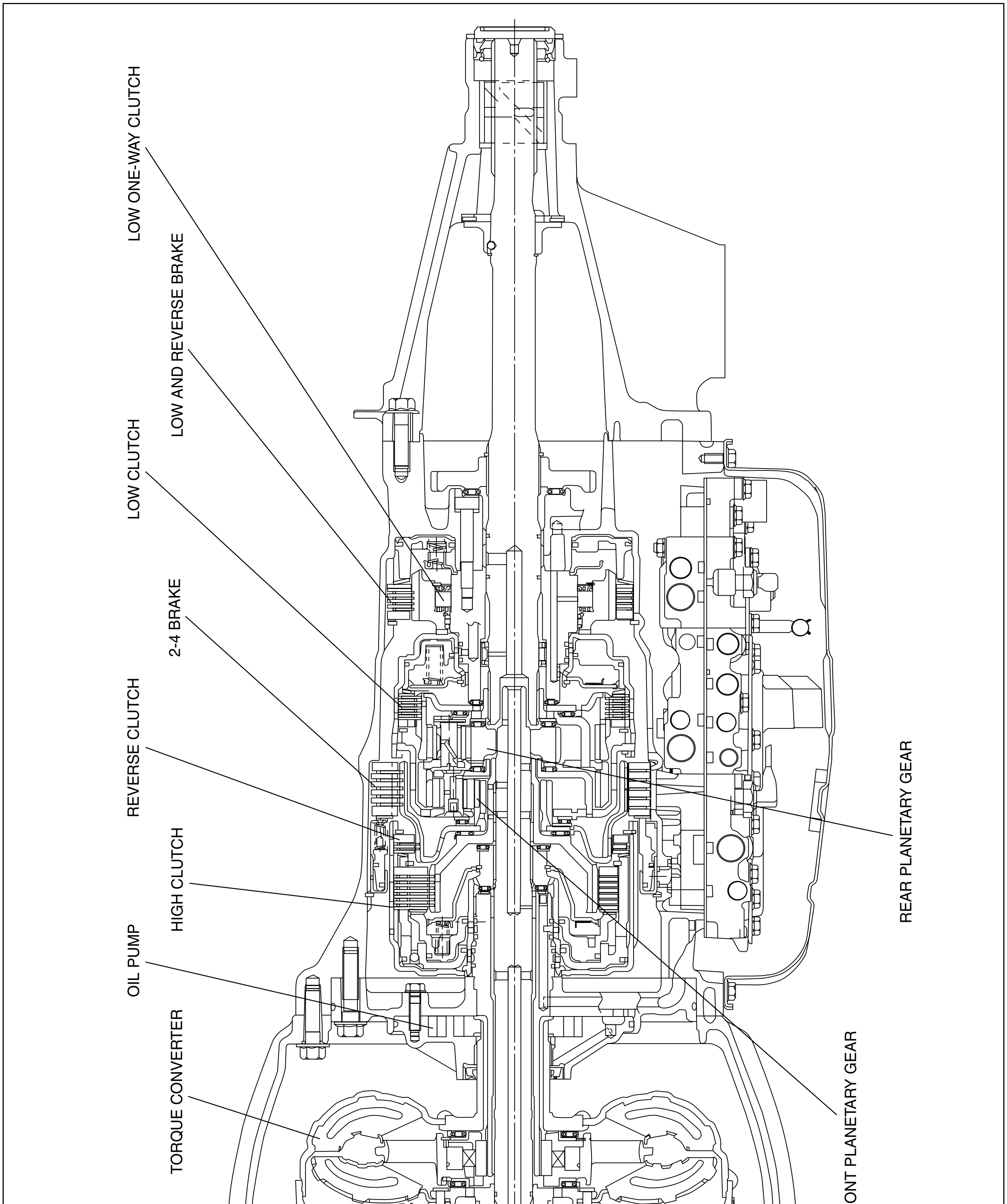
Position/Range	Mode	Gear position		Shift pattern: Shift	Shift pattern: TCC	Shift pattern: Engine brake	Transmission: Low clutch	Transmission: High clutch	Transmission: Reverse clutch	Transmission: 2-4 brake	Transmission: Low and reverse brake	Transmission: Low one-way clutch	Operation of solenoid valve: Shift solenoid A	Operation of solenoid valve: Shift solenoid B	Operation of solenoid valve: Shift solenoid C	Operation of solenoid valve: Shift solenoid F	Operation of solenoid valve: TCC solenoid	Operation of oil pressure switch: Oil pressure switch B	Operation of oil pressure switch: Oil pressure switch C	Operation of oil pressure switch: Oil pressure switch F
P	—	—	—	—										×	×	×				
R	—	Reverse	2.272	—		×			×		×			×	×					×
N	—	—	—	—										×	×	×				
D	NOMAL	1GR	2.785				×					⊗		×	×	×				
		2GR	1.545			×	×			×					×	×		×		
		3GR	1.000			×	×	×						×		×			×	
		3GR TCC ON	1.000		×	×	×	×						×		×	×		×	
		4GR	0.694			×		×		×			×			×		×	×	
		4GR TCC ON	0.694		×	×		×		×			×			×	×	×	×	
M	MANUAL	1GR	2.785			×	×				×			×	×					
		2GR	1.545			×	×			×					×	×		×		
		3GR	1.000			×	×	×						×		×			×	
		3GR TCC ON	1.000		×	×	×	×						×		×	×		×	
		4GR	0.694			×		×		×			×			×		×	×	
		4GR TCC ON	0.694		×	×		×		×			×			×	×	×	×	

↕: Automatic shift according to set speed and throttle opening angle
⬍: Manual shift based on selector lever or steering shift switch operation
⇡: Consective shift by tapping selector lever or steering shift switch two times in the downshift direction
×: Operating
⊗: Transmits the torque only when driving

CHU0513S004

AUTOMATIC TRANSMISSION CROSS-SECTIONAL VIEW

CHU051301030S02



CHU0513S001

AUTOMATIC TRANSMISSION ELECTRONIC CONTROL SYSTEM STRUCTURAL VIEW

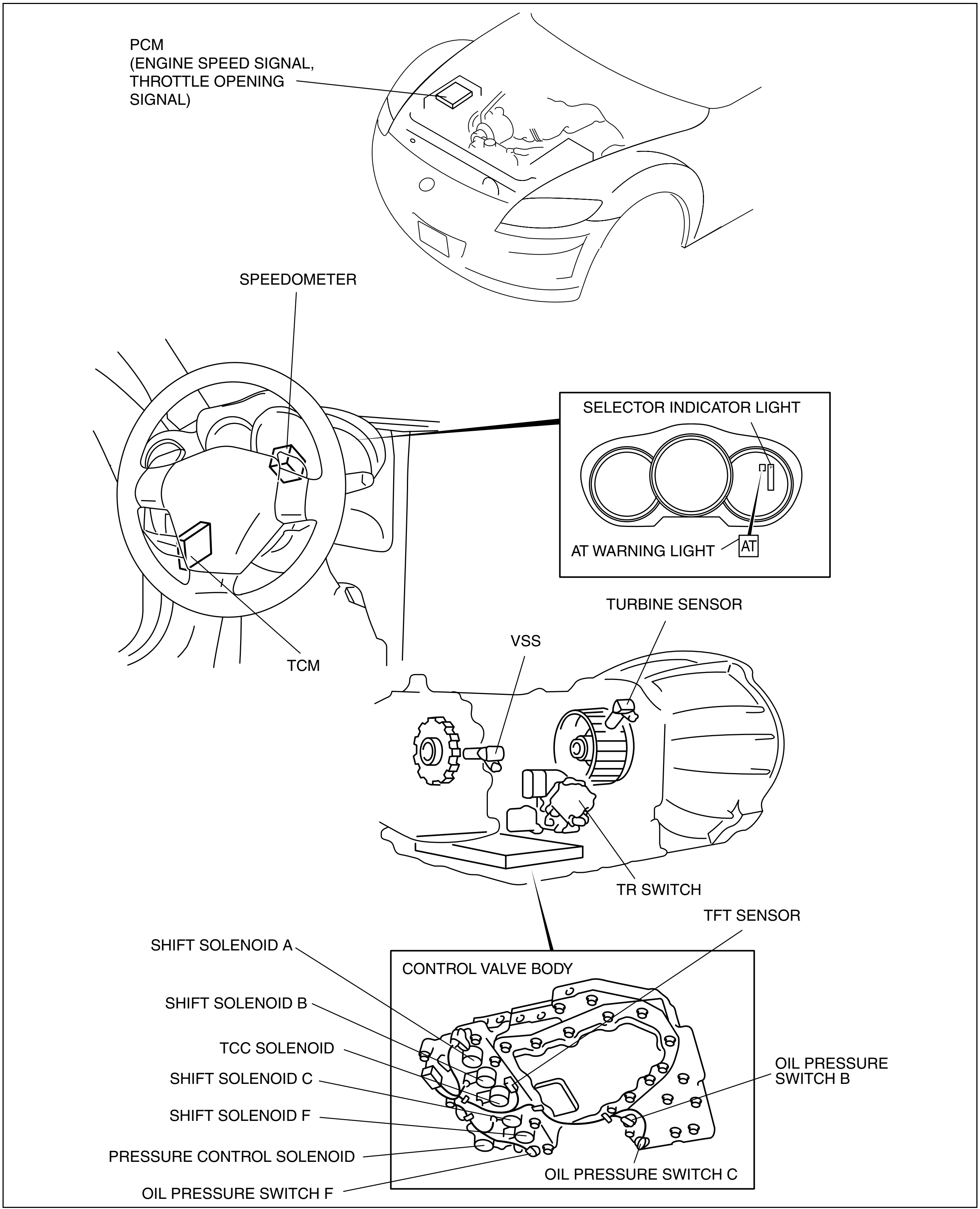
CHU051301030S03

Outline

Features

- A stand-alone TCM, used exclusively for transmission control, performs various controls such as up and downshifts, according to signals relayed from sensors and switches.
- Direct electronic shift control provides superior shift quality.
- A superior balance has been achieved between the quick shift response of a sports car and the mild shift quality of a luxury car.
- In particular, the response when downshifting in manual mode has been greatly heightened, resulting in a highly responsive and direct shift feeling.

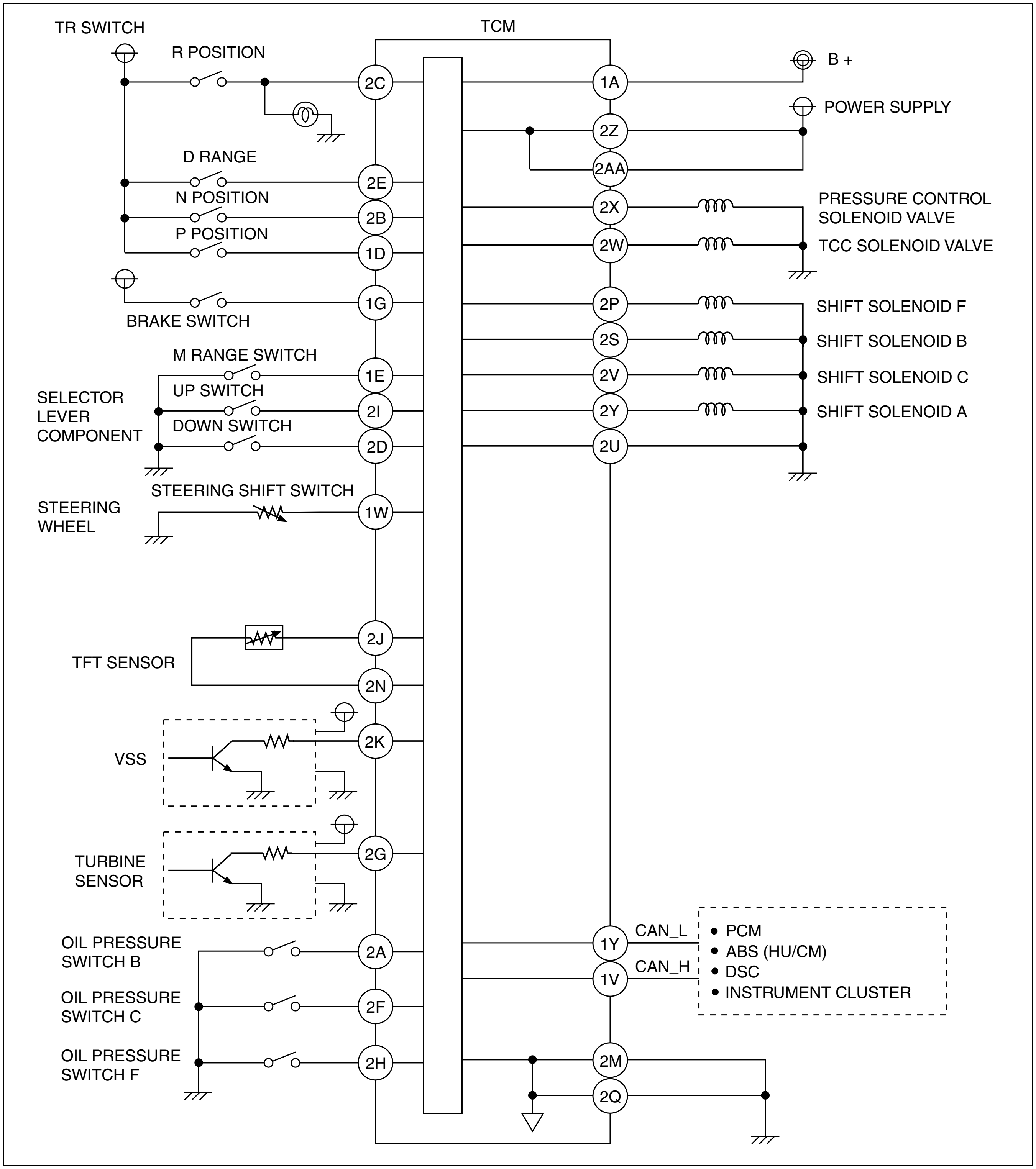
Structure
Structural view



CHU0513S046

AUTOMATIC TRANSMISSION CONTROL SYSTEM WIRING DIAGRAM

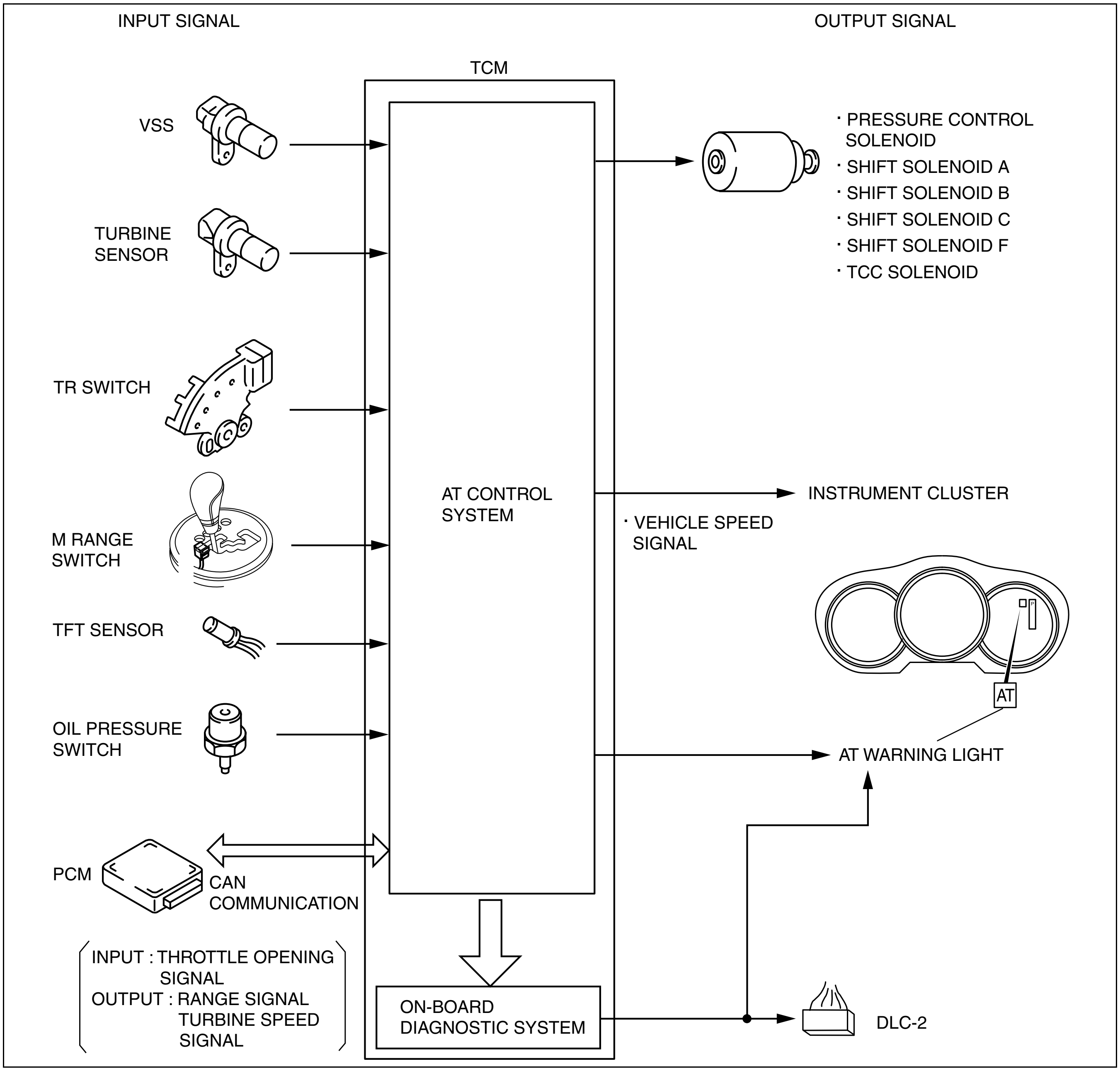
CHU051301030S04



CHU0513S002

AUTOMATIC TRANSMISSION BLOCK DIAGRAM

CHU051301030S05



CHU0513S062

Electronic Control Item and Contents

Control Item	Contents
Shift control	• Detects engine load and vehicle speed, and switches to optimum gear in accordance with preset shift program
Line pressure control	• Switches between high and low line pressure to suit engine load and vehicle speed, according to on/off pressure control valve solenoid
Direct electronic shift control	• Regulates clutch pressure to suit engine load and driving conditions, according to duty cycle solenoids (shift solenoids A, B, C, F) and amplifier valve of clutches, and electronically controls clutch engagement and release directly
Feedback control	• Performs real-time feedback correction for clutch engagement pressure to achieve target shifts • Corrects clutch engagement pressure and timing on drain side to compensate for changes in engine performance and changes in transmission
Engine-transmission total control	• Optimally controls engine output torque when shifting • Operates optimal clutch engagement pressure corresponding to engine output torque
TCC control	• Controls TCC smoothly by duty cycle TCC solenoid, in accordance with designated TCC points
Slope mode control	• Changes the shift point to prevent frequent shifting up/down when climbing hills
OBD system	• Parts essential for EC-AT control have a self-diagnosis function, which, in the event of trouble, illuminates the AT warning light to warn the driver, and stores the DTC in the TCM • If it is determined by self-diagnosis that trouble has occurred, the system performs controls to maintain drivability

Component Description (Electronic Control)

Part name			Function
Input system	VSS		• Detects output shaft revolution speed
	Turbine sensor		• Detects reverse and high clutch drum (input) revolution speed
	TR switch		• Detects selector lever ranges/positions
	M range switch		• Selects driving modes (M range) and changes driving patterns
	TFT sensor		• Detects ATF temperature
	Oil pressure switch B		• Detects pressure applied to 2-4 brake
	Oil pressure switch C		• Detects pressure applied to high clutch
	Oil pressure switch F		• Detects pressure applied to low and reverse brake
	Brake switch		• Detects the brake pedal depressed
	CAN communication	Throttle opening signal [*1]	• Input throttle opening angle from PCM
		Engine speed signal	• Input engine speed signal from PCM
		Engine torque signal	• Input engine torque signal from PCM
		Cruise control signal	• Detects cruise control is in use
		Engine coolant temperature signal	• Input engine coolant temperature signal from PCM
Output system	ON/OFF type	Pressure control solenoid	• Switches line pressure between high and low
	Duty type	Shift solenoid A	• Controls amplifier valve to regulate low clutch pressure
		Shift solenoid B	• Controls amplifier valve to regulate 2-4 brake pressure
		Shift solenoid C	• Controls amplifier valve to regulate high clutch pressure
		Shift solenoid F	• Controls amplifier valve to regulate low and reverse brake pressure
		TCC solenoid	• Controls TCC engagement and disengagement
	CAN communication	AT warning light	• Illuminates when failure is detected by diagnosis function
		Reduce torque signal	• Sends signals to the PCM during shifting
		Range signal	• Illuminates to selector indicator light
		Turbine speed signal	• Output turbine speed signal to PCM

[*1] : There are two throttle opening angle signals. One is based on the accelerator pedal opening angle and the other is based on the throttle valve opening angle.

AUTOMATIC TRANSMISSION DEVICE RELATIONSHIP CHART

CHU051301030S06

Component		Control item					
		Shift control	Line pressure control	Direct electronic shift control	Feedback control	TCC control	OBD system
Input							
VSS		X	X	X	X	X	X
Turbine sensor			X	X	X	X	X
M range switch		X	X	X		X	
TFT sensor		X	X	X	X	X	X
Oil pressure switch B				X	X		X
Oil pressure switch C				X	X		X
Oil pressure switch F				X	X		X
CAN communication	Throttle opening signal [*1]	X	X	X	X	X	X
	Engine speed signal			X	X	X	X
	Engine torque signal	X	X	X	X		X
	Brake switch	X				X	
	Cruise control signal	X		X			
	Engine coolant temperature signal	X				X	
Output							
ON/OFF type	Pressure control solenoid		X	X			X
Duty type	Shift solenoid A	X		X	X	X	X
	Shift solenoid B	X		X	X	X	X
	Shift solenoid C	X		X	X	X	X
	Shift solenoid F	X		X	X	X	X
	TCC solenoid	X				X	X
Speedometer signal							
CAN communication	AT warning light						X
	• Illuminates selector indicator light						
	Reduce torque signal			X	X		X
	Turbine speed signal			X			

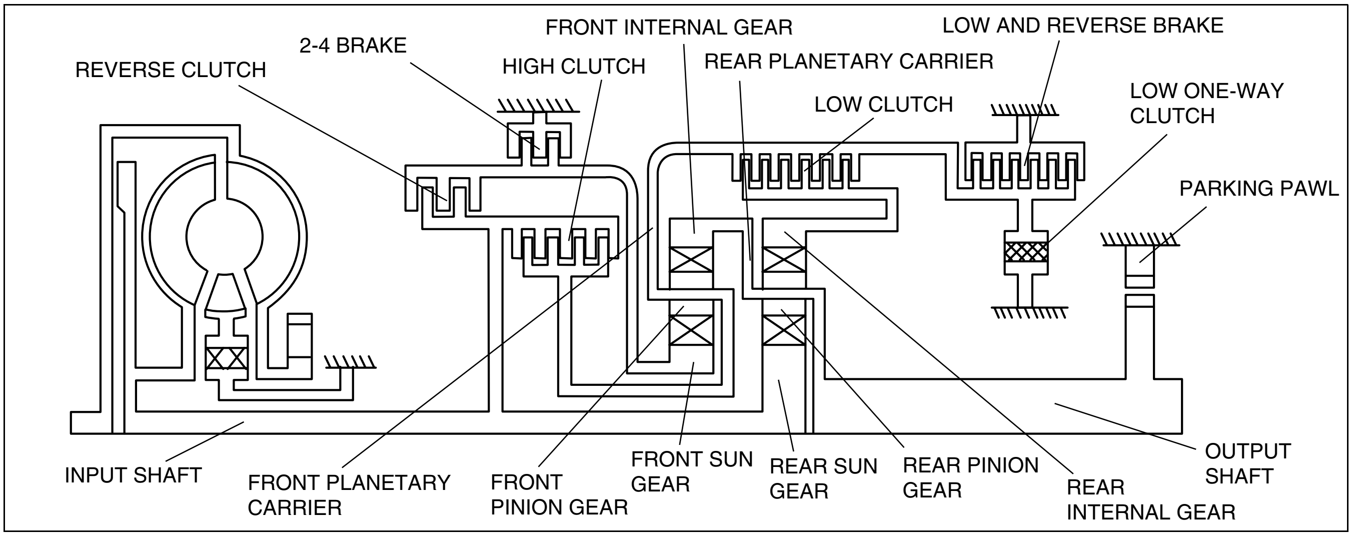
X : Available

*1 : There are two throttle opening angle signals. One is based on the accelerator pedal opening angle and the other is based on the throttle valve opening angle.

POWERTRAIN OUTLINE

CHU051301030S07

- In the powertrain system, hydraulic pressure is transmitted from the control valves to operate the clutches and brakes, and the planetary gear changes the gear ratio according to the vehicle driving condition.
- To improve shift quality, a plate-type clutch pack 2-4 brake, which has optimum control at low oil temperatures and is unaffected by changes over time, is used.
- A highly rigid transmission case has been adopted to reduce noise and vibration.
- The powertrain system of the RC4A-EL type consists of three pairs of clutches, two pairs of brakes, a one-way clutch, and two pairs of single type planetary gears.



CHU0513S005

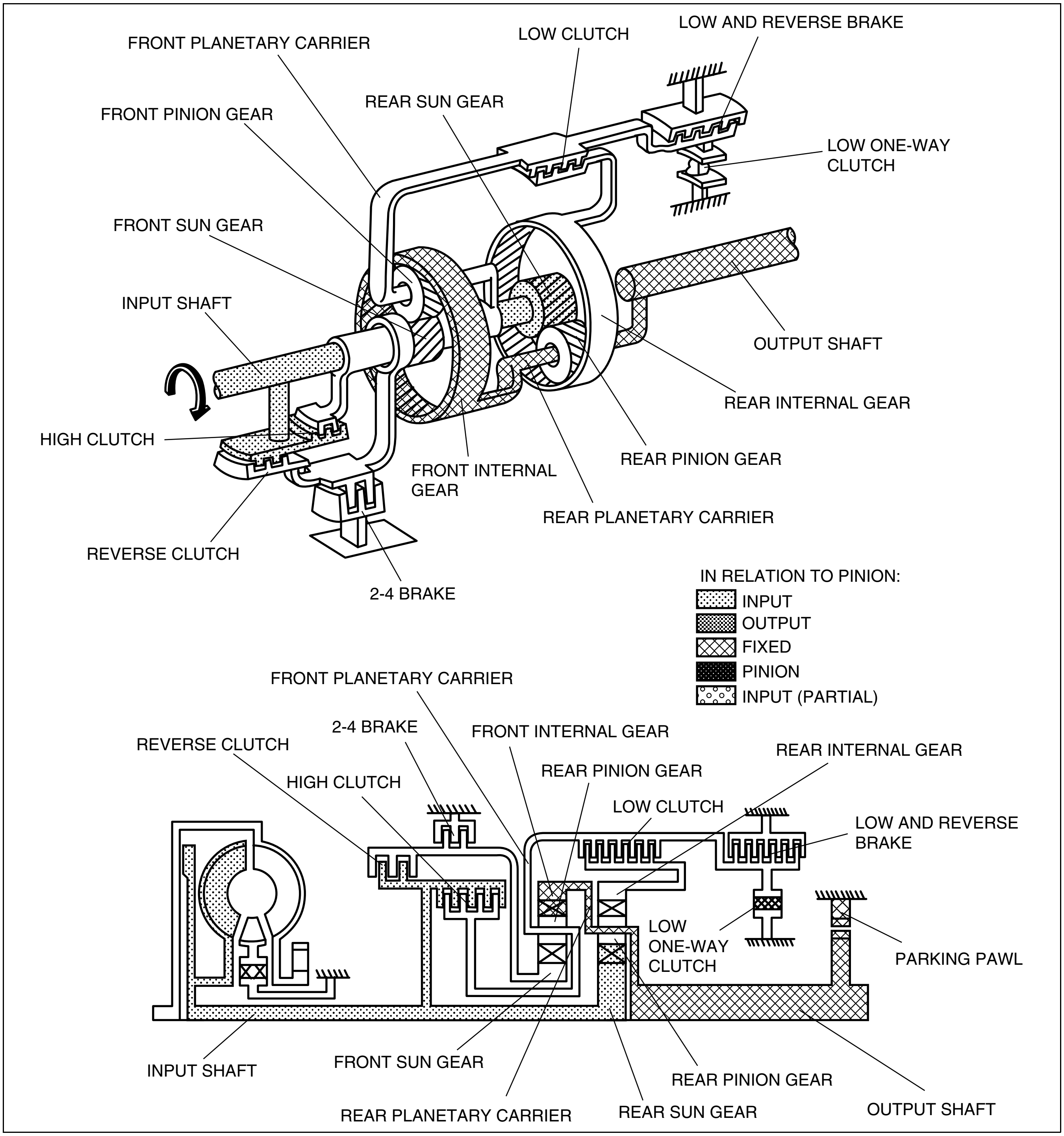
POWERTRAIN OPERATION

CHU051301030S08

Component description

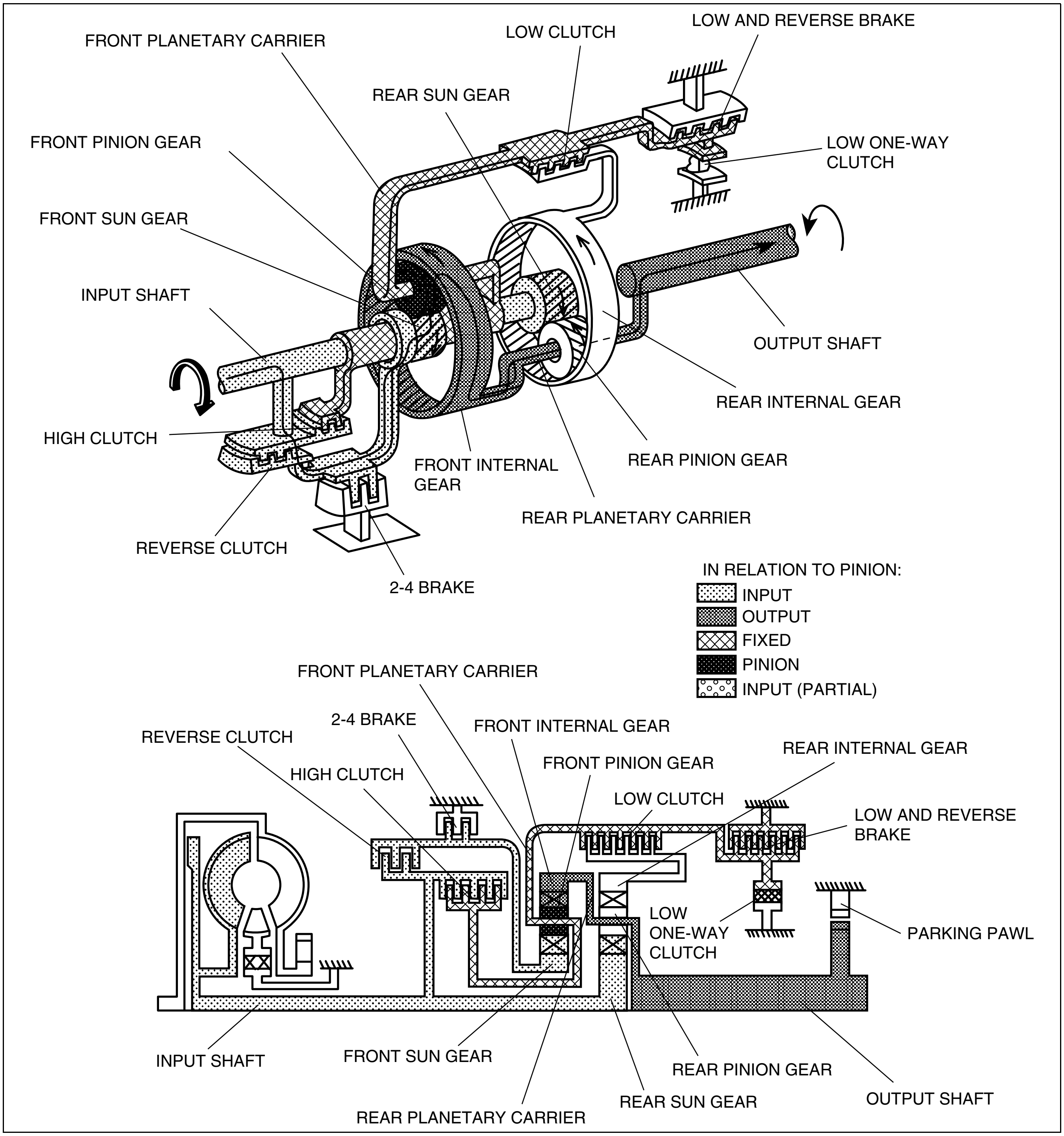
Component	Function
Low clutch	• Transmits rotation of low clutch drum to rear internal gear • Operates in 1GR, 2GR, or 3GR position
High clutch	• Transmits rotation of high clutch drum to front planetary carrier • Operates in 3GR or 4GR position
Reverse clutch	• Transmits rotation of reverse clutch drum to front sun gear • Operates when vehicle is reversing
2-4 brake	• Prevents rotation of front sun gear • Operates in 2GR or 4GR position
Low and reverse brake	• Prevents rotation of front planetary carrier • Operates when vehicle is reversing or in 1GR position (M range)
Low one-way clutch	• Locks clockwise rotation of front planetary carrier in 1GR position
Planetary gear	• The planetary gear functions as a transmission due to the engagement/disengagement of clutches and/or brakes, converts the transmitted driving force of the input shaft by multiplying/reducing torque or reversing power flow, and then transmitting it to the output shaft.

Power flow
P position



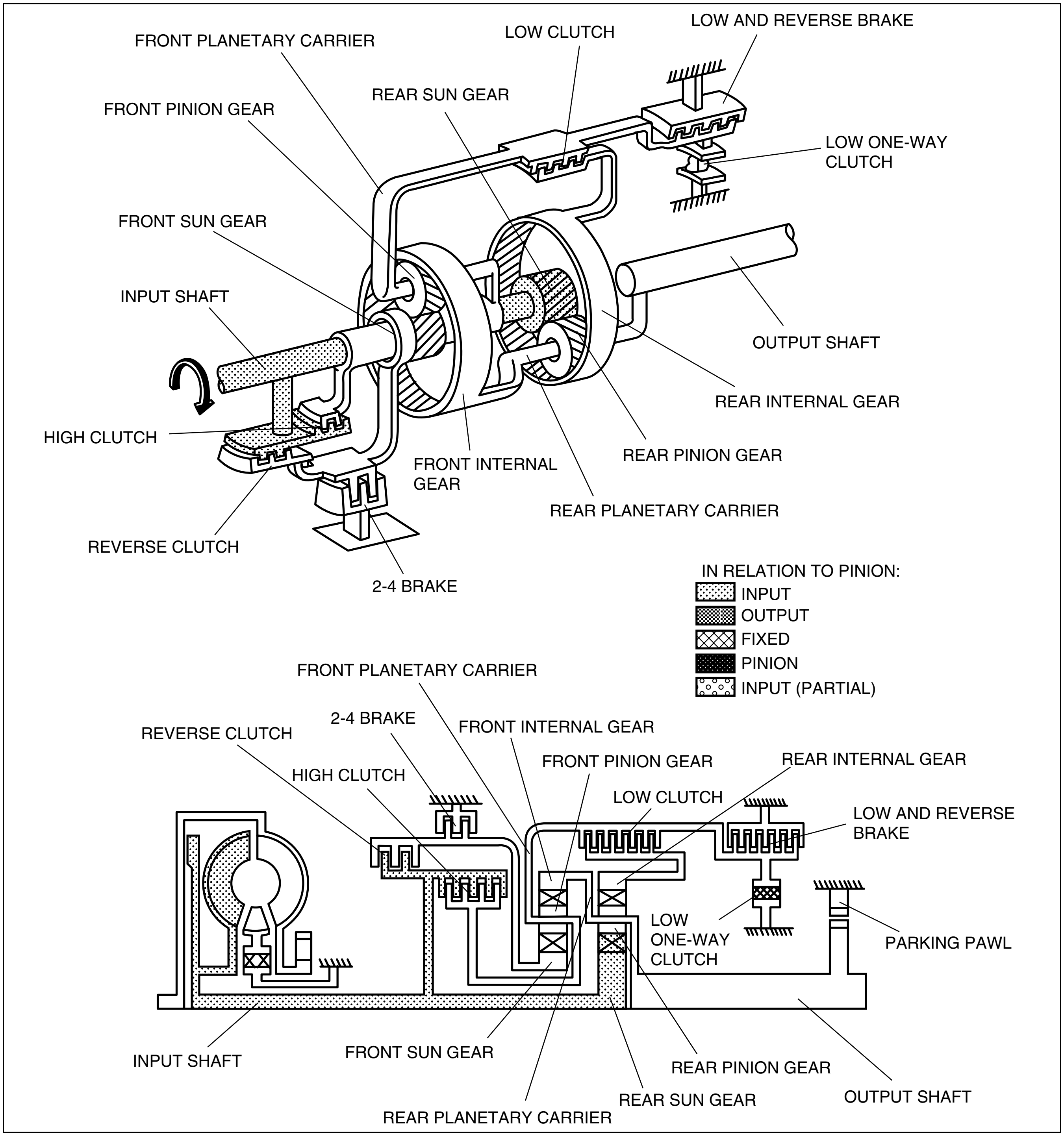
CHU0513S006

R position



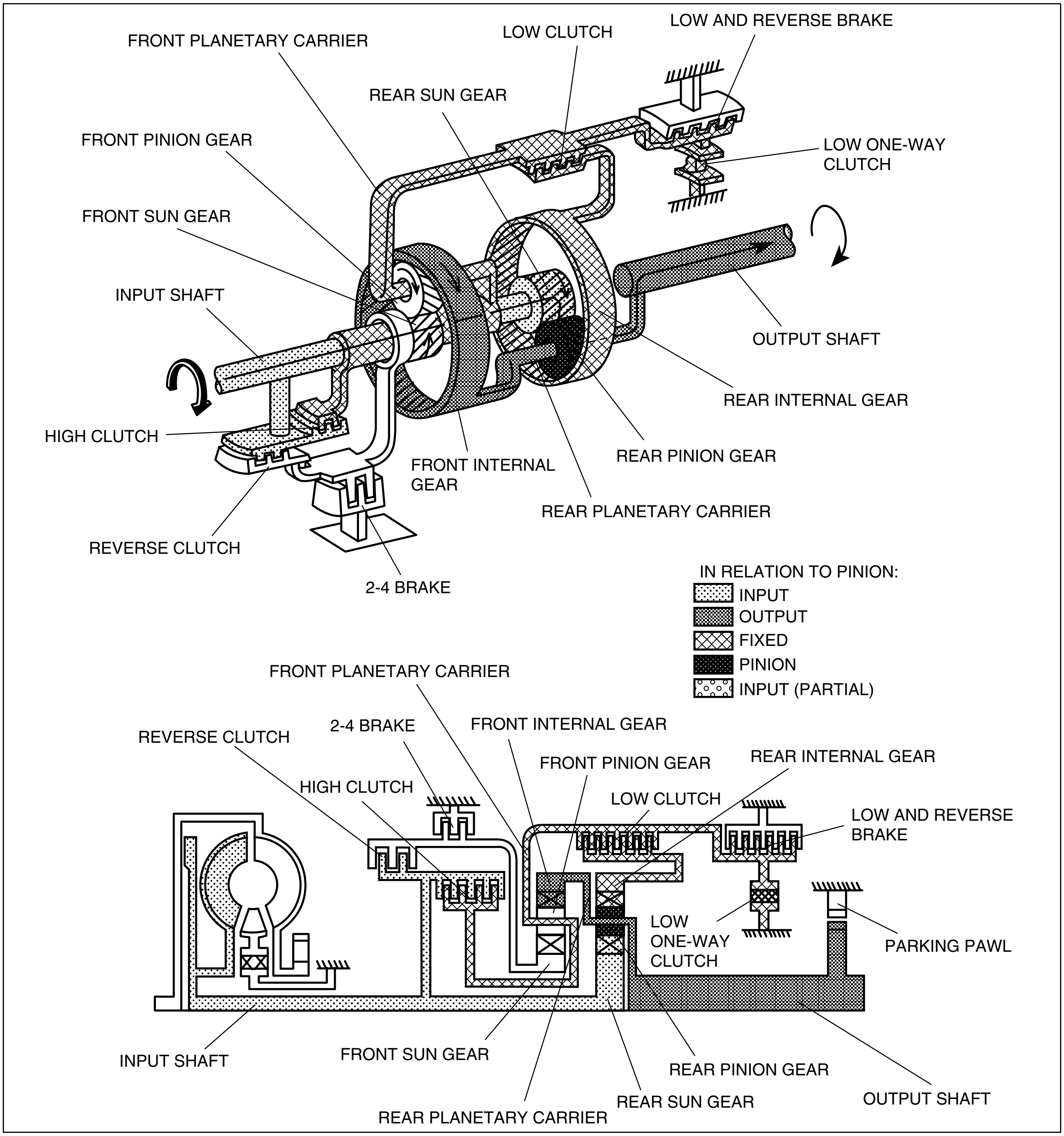
CHU0513S007

N position



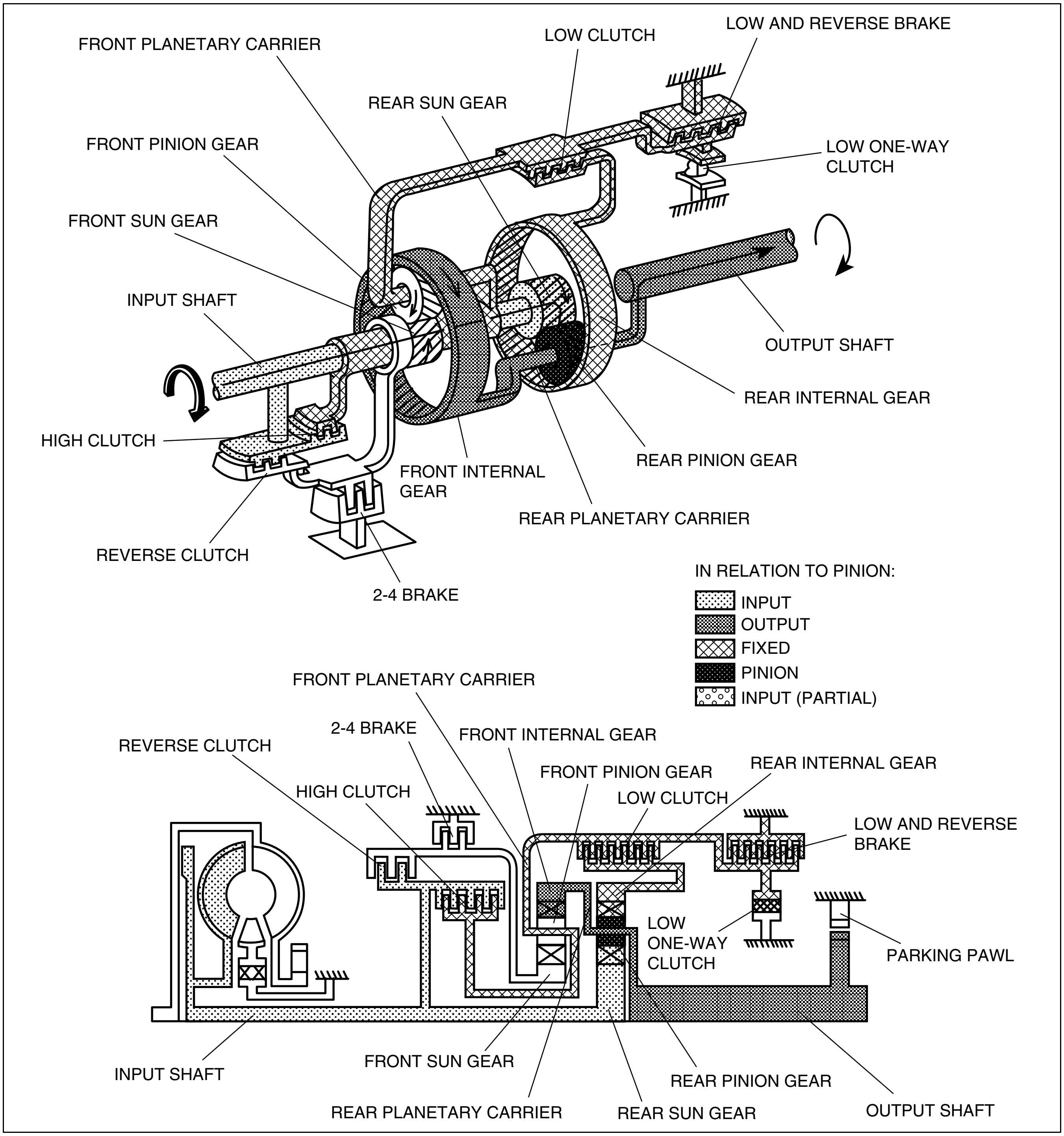
CHU0513S008

D range 1GR



CHU0513S009

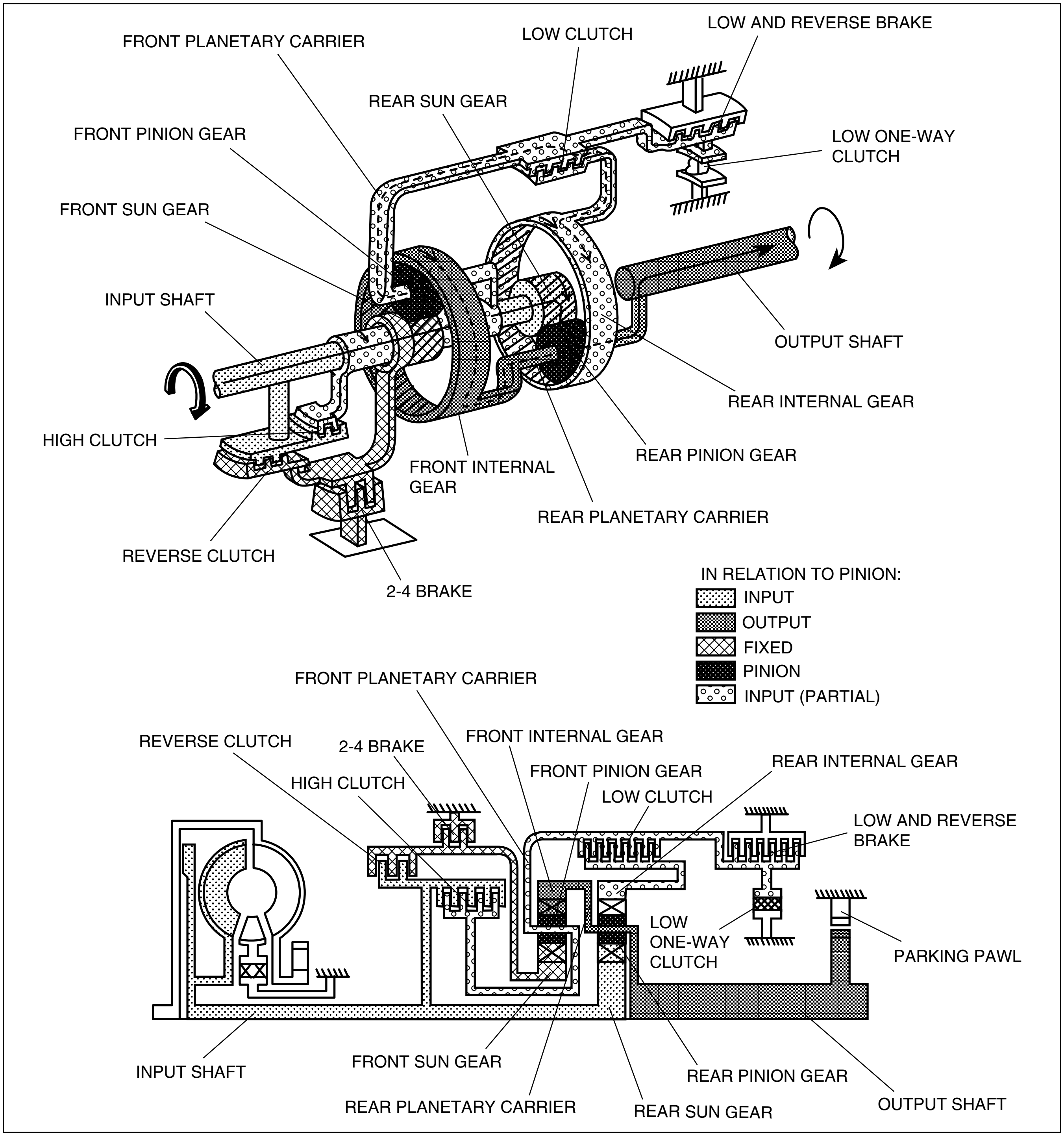
M range 1GR



CHU0513S010

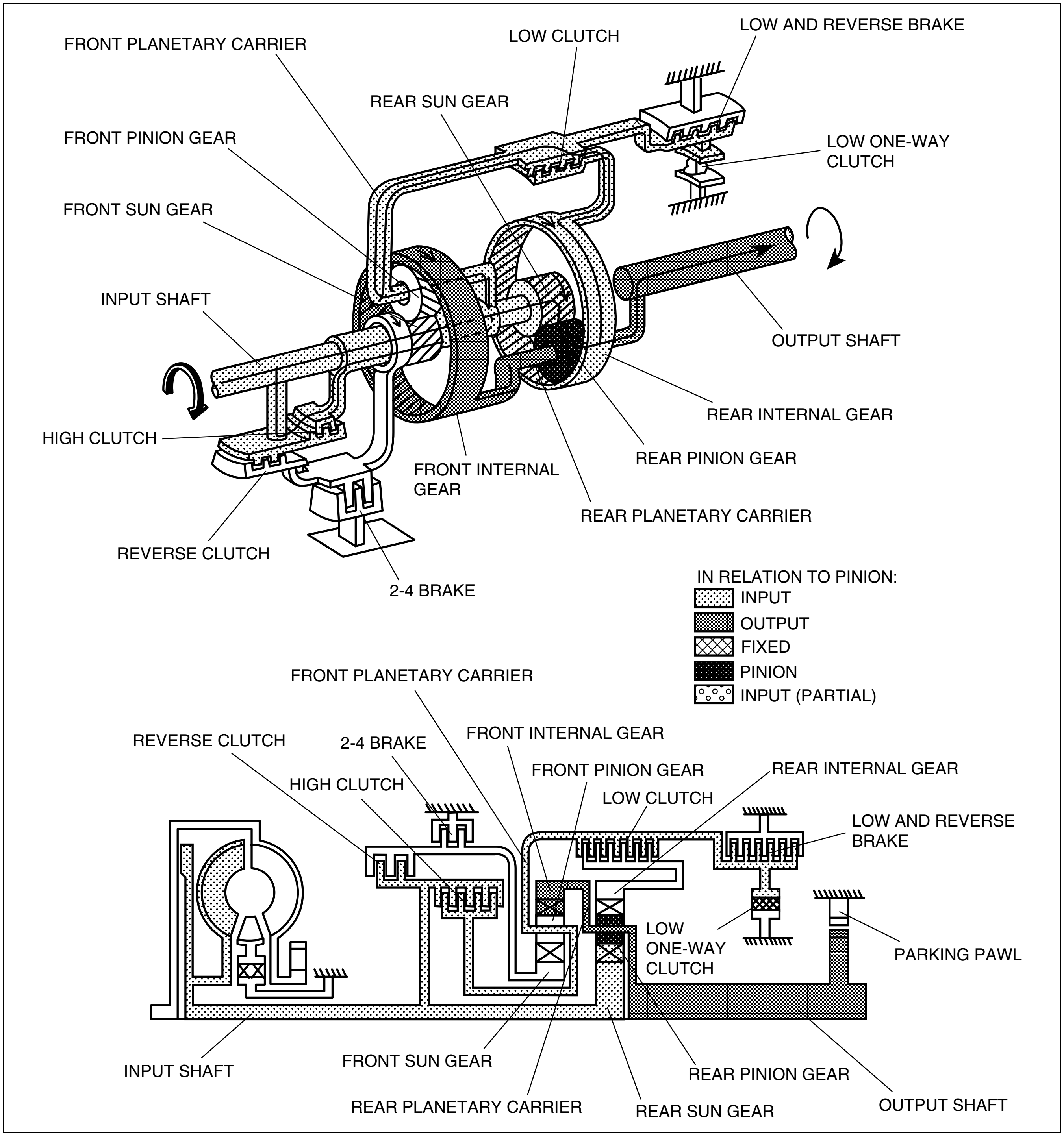
05–13

D, M range 2GR



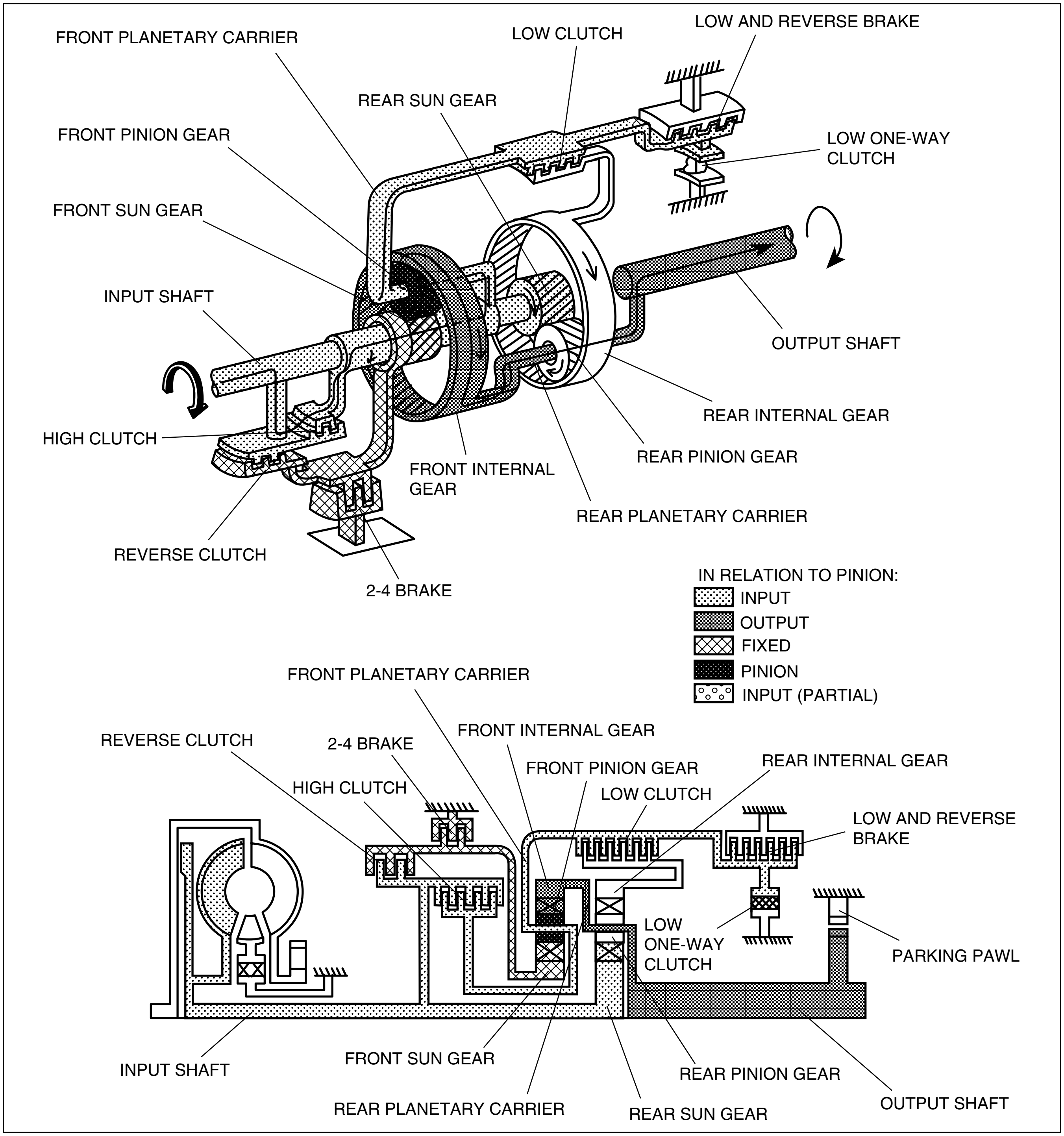
CHU0513S011

D, M range 3GR



CHU0513S012

D, M range 4GR

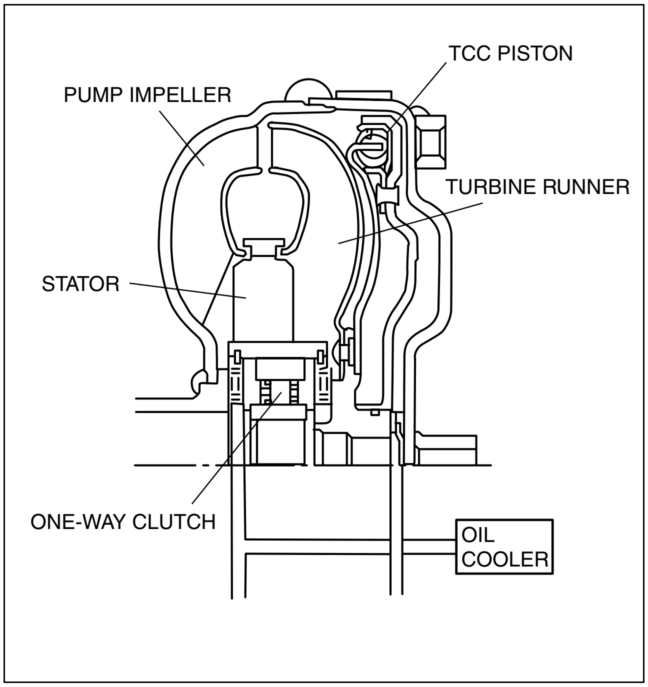


CHU0513S013

TORQUE CONVERTER OUTLINE

CHU051319100S01

- The RC4A-EL type torque converter adopts a TCC mechanism.
- The TCC mechanism mechanically engages the pump impeller and the turbine runner under certain conditions, and transmits the power, not through the fluid, but directly, preventing the slip loss of the torque converter.
- The torque converter has obtained sufficient transmission efficiency and torque converting ratio to match the output characteristics of the engine.

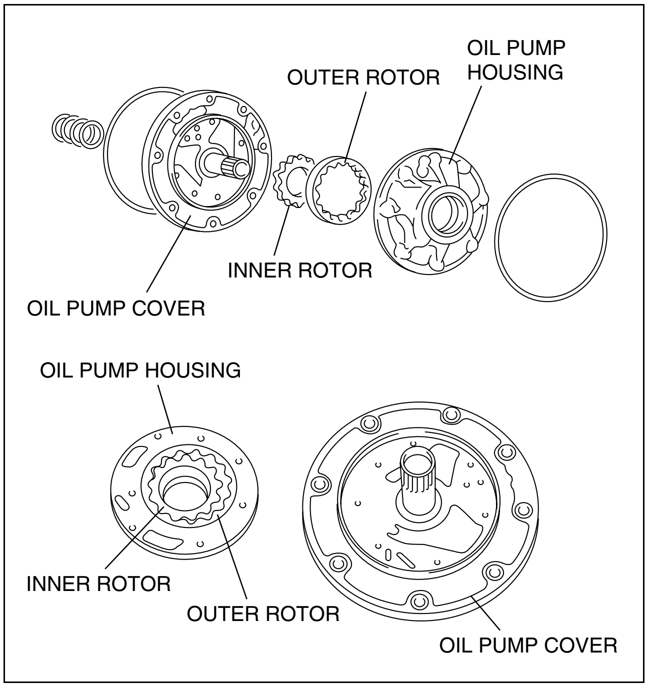


CHU0513S014

OIL PUMP FUNCTION

CHU051319220S01

- The lightweight, compact, quiet trochoid gear oil pump feeds oil to the torque converter, lubricates the powertrain, and feeds oil to the hydraulic control system.



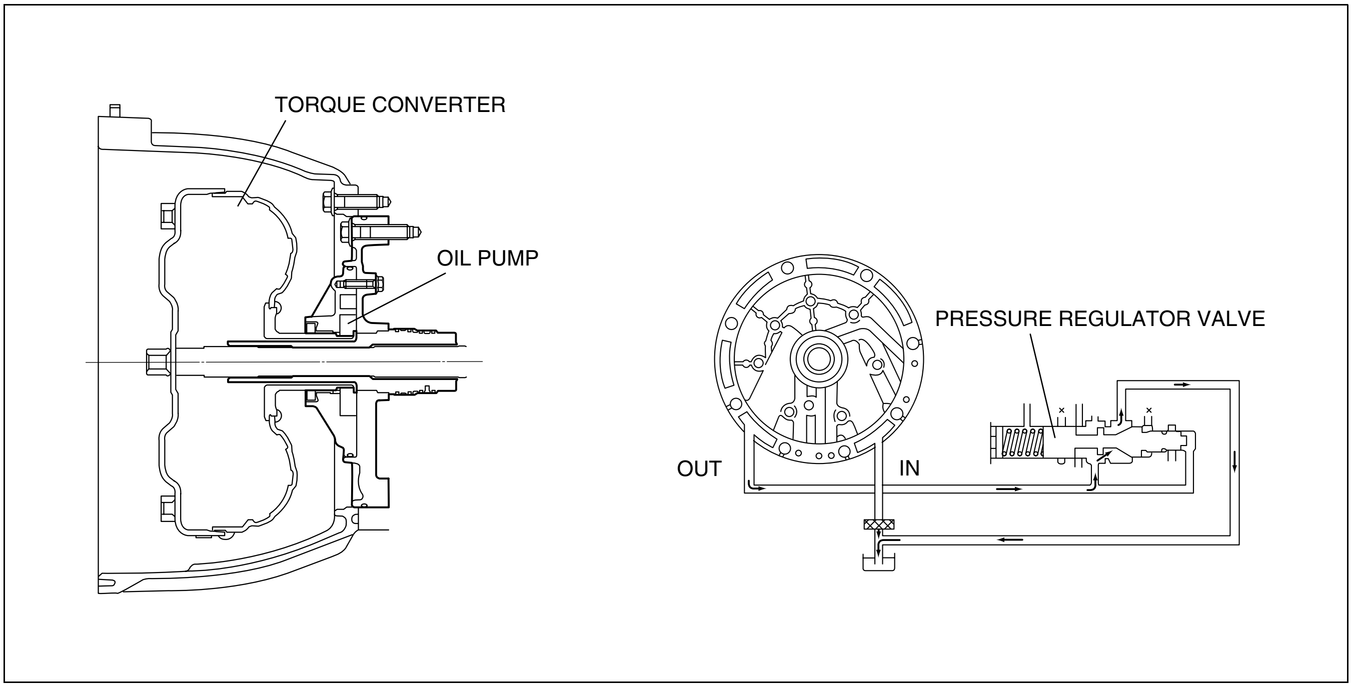
CHU0513S029

05–13

OIL PUMP CONSTRUCTION/OPERATION

CHU051319220S02

- The oil pump, mounted behind the torque converter, is driven directly by the torque converter.
- Inner and outer rotors are built into the pump housing in the oil pump.
- The inner rotor is driven by the torque converter in the same rotational direction as the engine.
- When the inner rotor in the oil pump rotates, ATF is drawn from the oil pan to the oil pump and then discharged to the pressure regulator valve.
- The amount of ATF discharged is proportional to the rotational speed of the torque converter.



CHU0513S030

CENTRIFUGAL BALANCE CLUTCH FUNCTION

CHU051301030S09

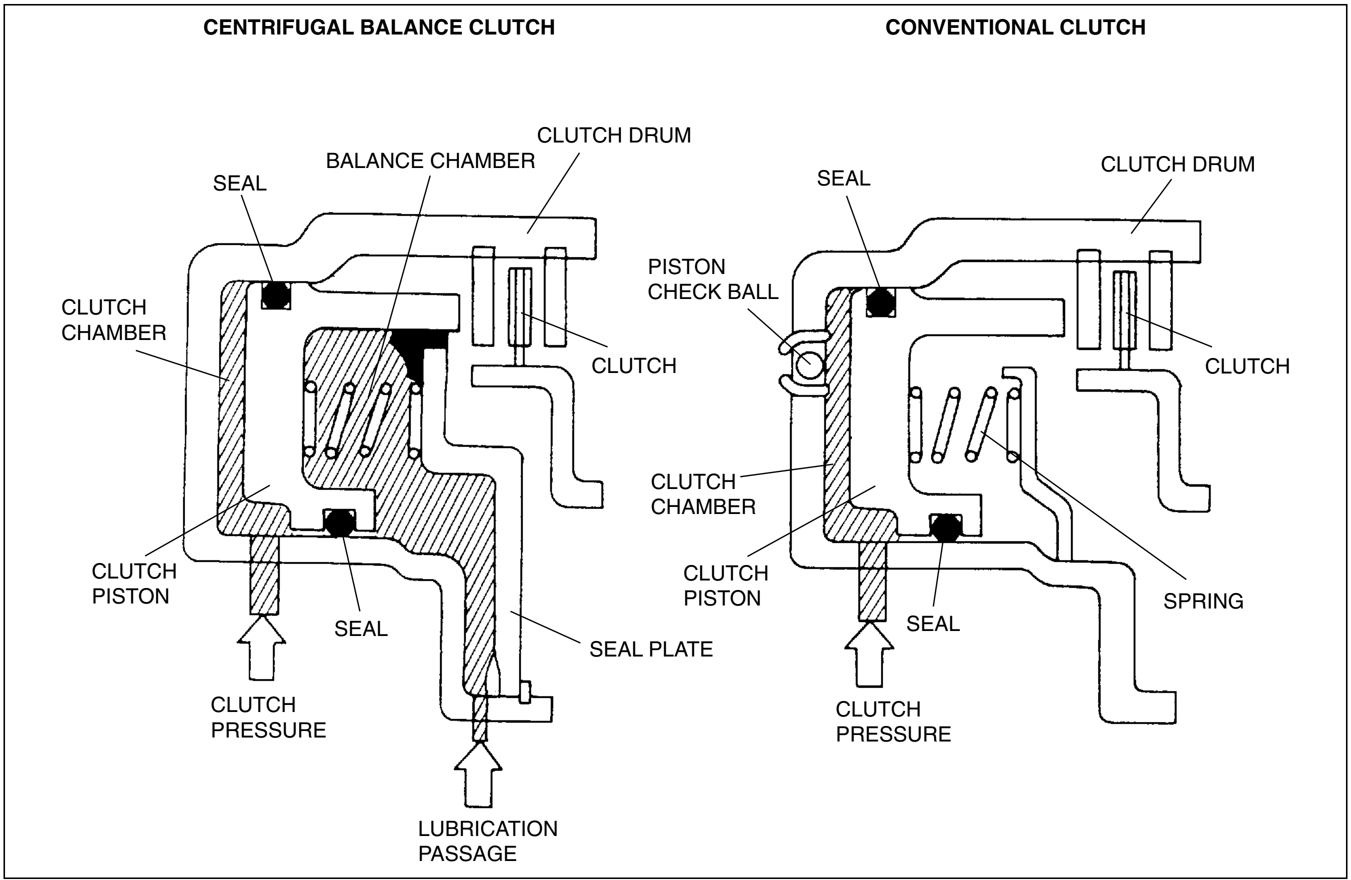
- The centrifugal balance clutch, which replaces the conventional piston check ball, cancels centrifugal oil pressure generated during clutch drum rotation to prevent the clutch drag-engagement and to stabilize piston pressure during full rotation.

CENTRIFUGAL BALANCE CLUTCH CONSTRUCTION/OPERATION

CHU051301030S10

Construction

- Centrifugal balance clutch chambers are installed opposite the clutch chambers in the low and high clutches. The centrifugal balance clutch chambers are constantly filled with ATF from an exclusive hydraulic passage of the oil pump.



AEA5710T025

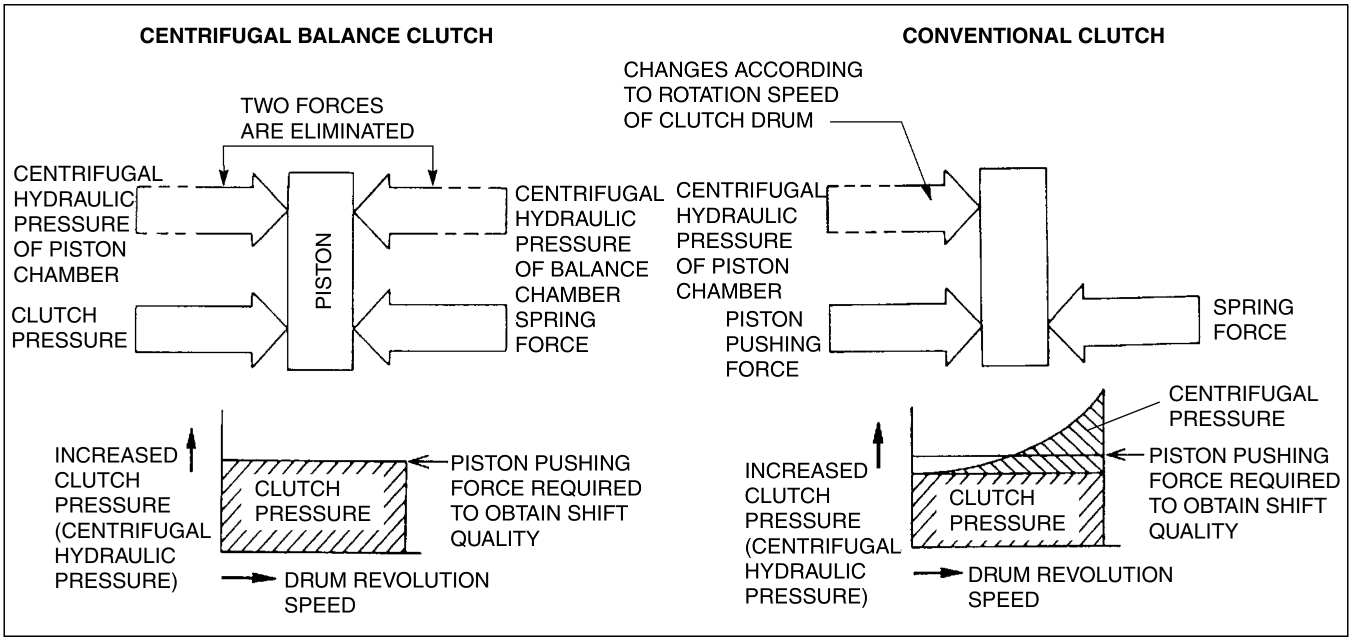
Operation

When clutch pressure not applied

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

When clutch pressure applied

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



CHU0513S201

CONTROL VALVE BODY STRUCTURE

CHU051321100S01

Features

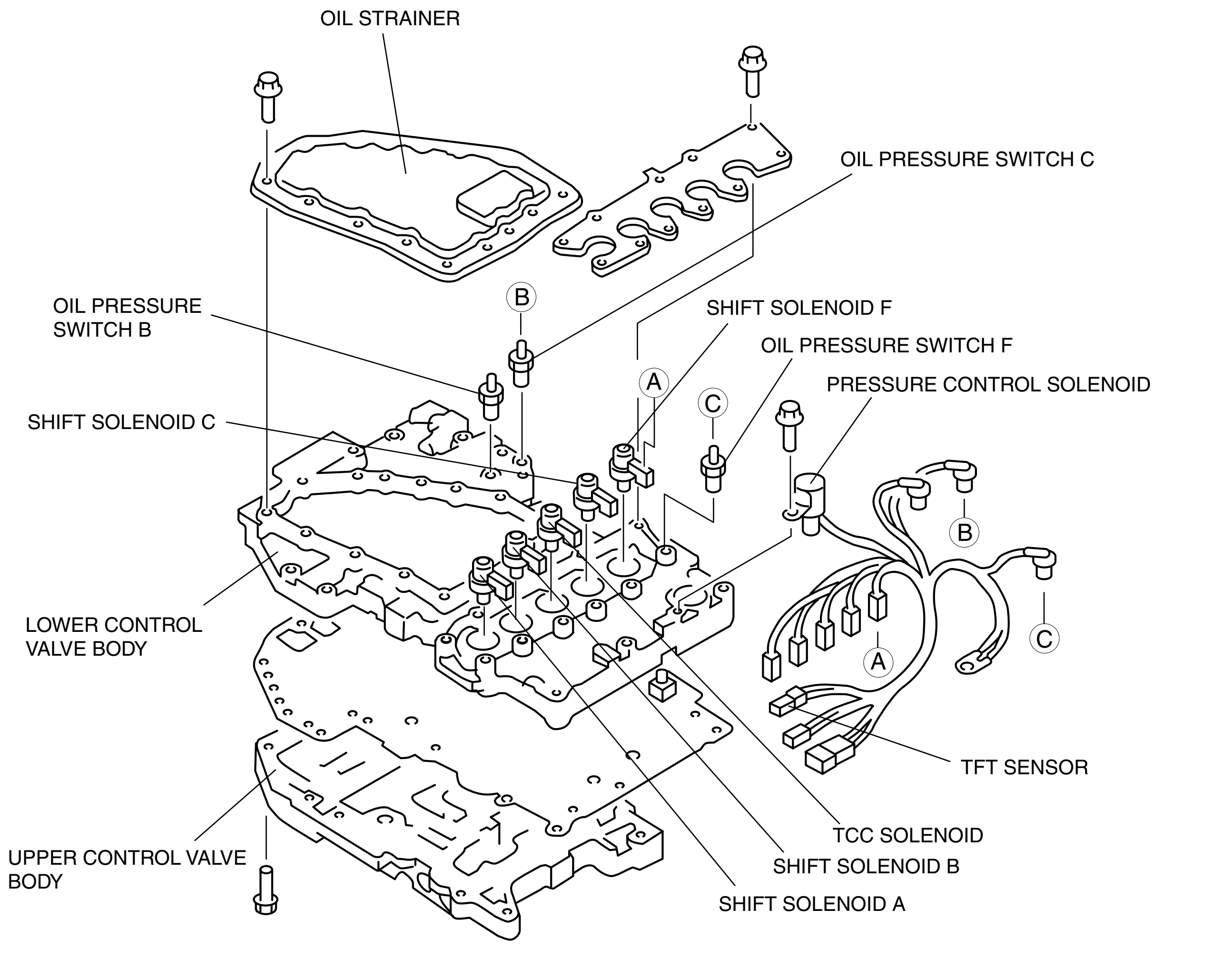
- Direct electronic shift control simplifies the hydraulic system, and at the same time, reduces the number of component parts and the size of the control valve body.
- A fine mesh pleat type oil strainer installed in the control valve body filters impurities.

Construction

- The control valve body consists of upper control and lower control valve bodies.
- All solenoids, oil pressure switches, and the TFT sensor are installed in the lower control valve body.

CONTROL VALVE BODY STRUCTURAL VIEW

CHU051321100S02

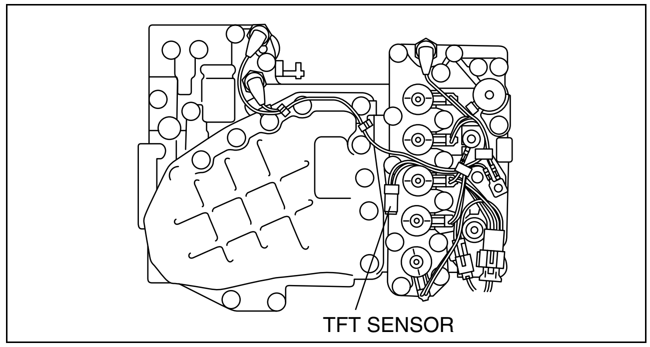


CHU0513S028

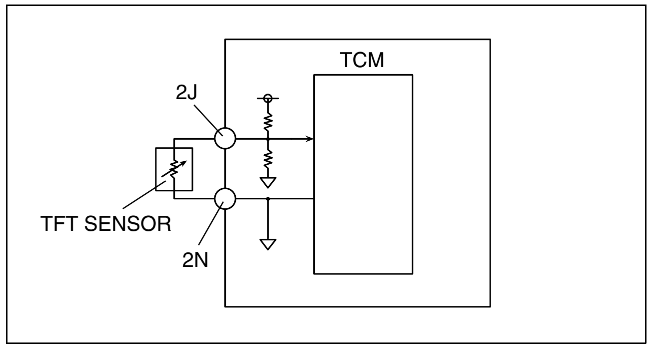
TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR FUNCTION

CHU051319010S01

- The TFT sensor detects the ATF temperature in the oil pan, and sends control signals to the TCM. The TCM controls the driving pattern selection and the torque converter clutch based on signals from the TFT sensor.



CHU0513S040

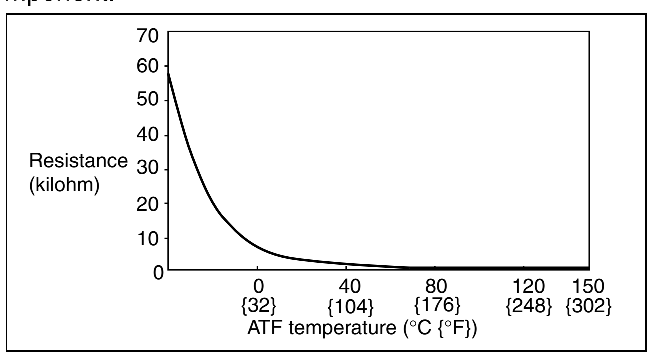


CHU0513S041

TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR CONSTRUCTION/OPERATION

CHU051319010S02

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



CHU0513W020

TURBINE SENSOR FUNCTION

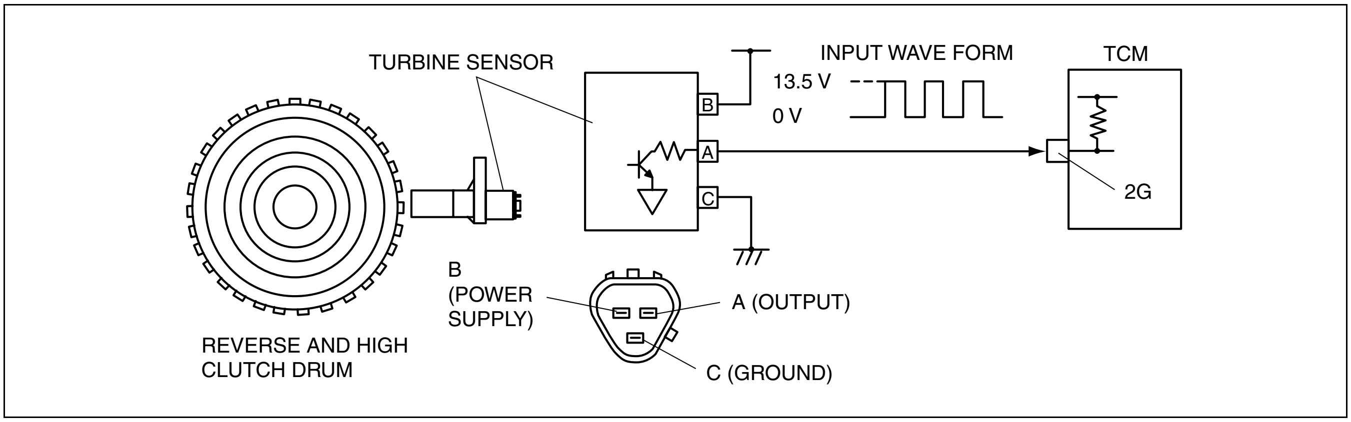
CHU051319010S03

- The turbine sensor is located in the transmission case with clearance between it and the reverse and high clutch drum, and detects the rotating speed of the input shaft (turbine).

TURBINE SENSOR CONSTRUCTION/OPERATION

CHU051319010S04

- The turbine sensor is a Hall element type. A 32-pulse signal is generated per rotation of the reverse and high clutch drum and the sensor sends this signal to the TCM.
- The TCM detects the shift start and end timing according to the signal from turbine sensor, and performs detailed control, improving shift quality.



CHU0513S049

VEHICLE SPEED SENSOR (VSS) FUNCTION

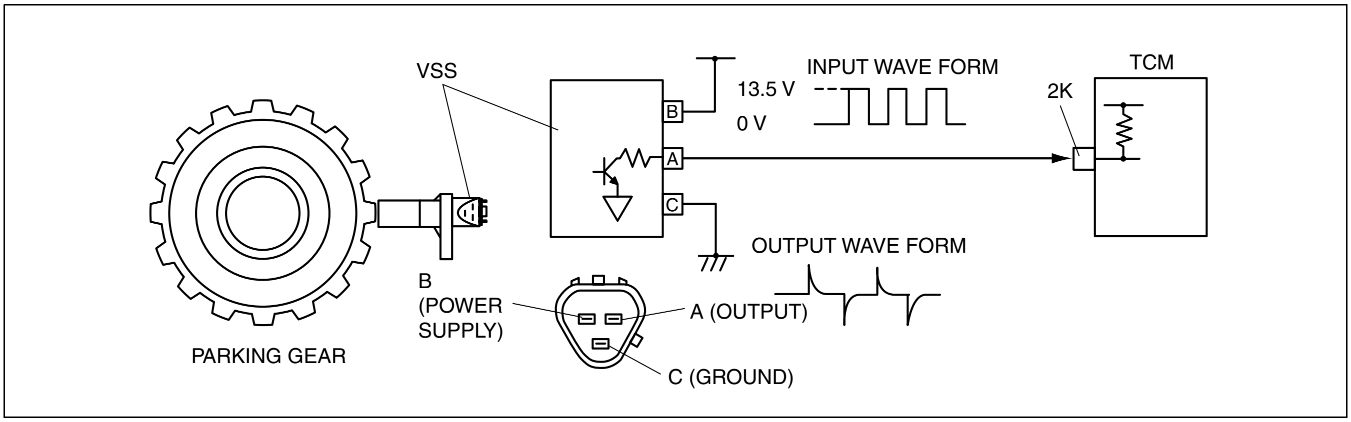
CHU051319010S05

- The VSS is located in the transmission case with clearance between it and top of the parking gear, and detects output shaft rotating speed.

VEHICLE SPEED SENSOR (VSS) CONSTRUCTION/OPERATION

CHU051319010S06

- The VSS is a Hall element type. A 16-pulse signal is generated per rotation of the parking gear and the VSS sends this signal to the TCM.
- The TCM performs EC-AT control based on the VSS and throttle position sensor signals.

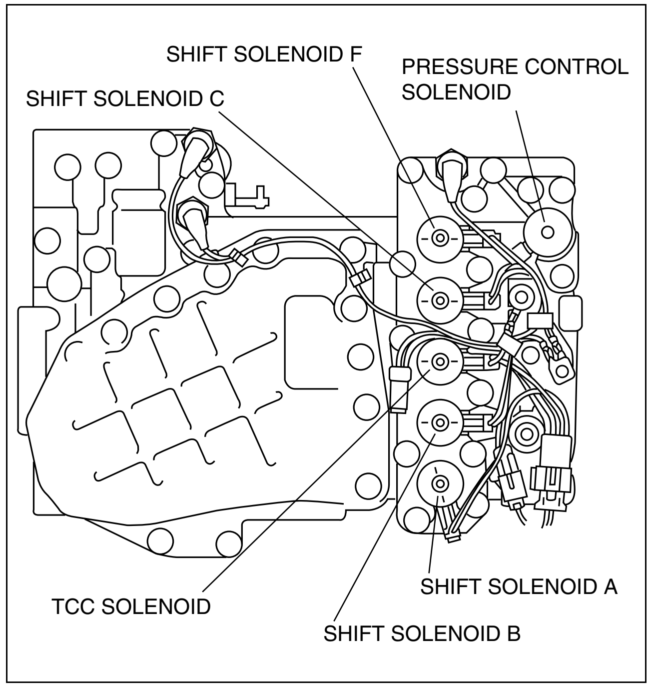


CHU0513S048

SOLENOID VALVE FUNCTION

CHU051321280S01

- All solenoid valves have superior responsiveness to hydraulic control.
- The solenoids have the following functions.



CHU0513S032

Function chart

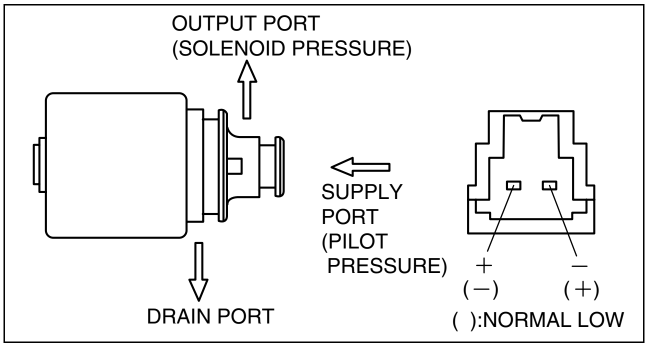
Solenoid	Type	Characteristics	Function	
Pressure control solenoid	ON/OFF	Normal high (Supplies solenoid pressure to pressure control valve)	Supplies or drains solenoid pressure depending on whether solenoid is energized or de-energized	Switches between high and low line pressure
Shift solenoid A	Repeats ON and OFF at 50 Hz (20 ms cycle); duty cycle type	Normal high (Supplies solenoid pressure to amplifier valve)	Controls supply and drainage of solenoid pressure, according to change in on-time ratio (0-100%) for one cycle	Controls amplifier valve, regulates low clutch pressure
Shift solenoid B				Controls amplifier valve, regulates 2-4 brake pressure
Shift solenoid C				Controls amplifier valve, regulates high clutch pressure
Shift solenoid F				Controls amplifier valve, regulates low and reverse brake pressure
TCC solenoid		Normal low (Drains solenoid pressure supplied to amplifier valve)		Controls TCC engagement and disengagement

SOLENOID VALVE CONSTRUCTION/OPERATION

CHU051321280S02

Construction

- The construction of all solenoids is the same, but the polarity of the positive and negative terminals is different.



CHU0513S033

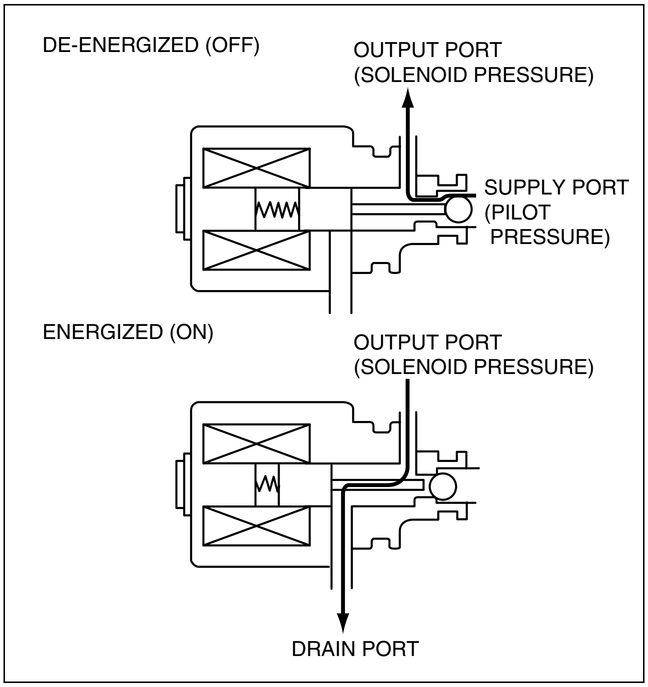
Operation

Normal high

- De-energized (OFF) or duty 0%
  - — Solenoid pressure is supplied to the output port because the output port (solenoid pressure) and the supply port (pilot pressure) connect in the solenoid.
- Energized (ON) or duty 100%
  - — Solenoid pressure is drained because the output port (solenoid pressure) and the drain port connect.

Normal low

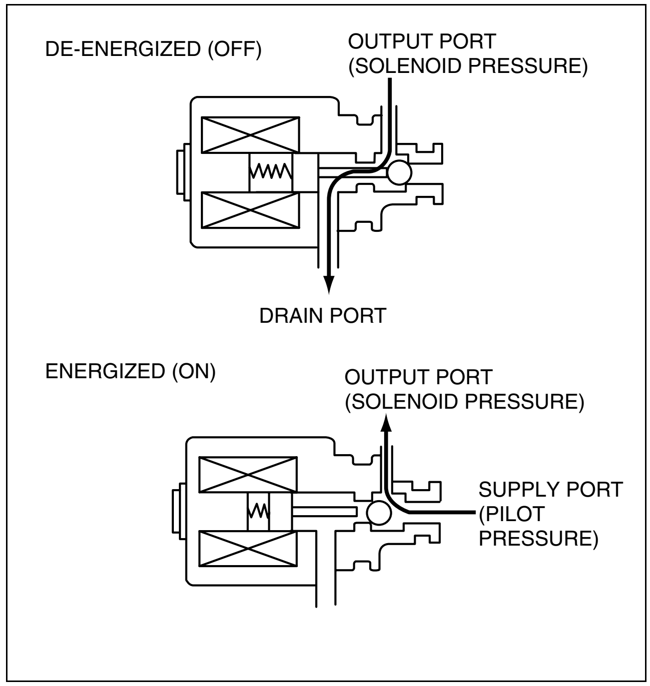
- De-energized (OFF) or duty 0%
  - — Solenoid pressure is drained because the output port (solenoid pressure) and the drain port connect in the solenoid.



CHU0513S034

05–13

- Energized (ON) or duty 100%
  — Solenoid pressure is supplied to the output port because the output port (solenoid pressure) and the supply port (pilot pressure) connect in the solenoid.



CHU0513S035

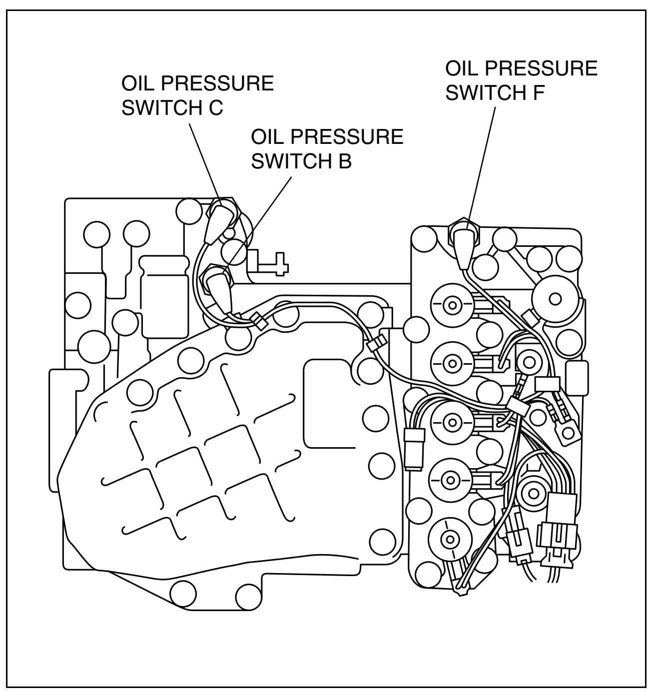
OIL PRESSURE SWITCH FUNCTION

CHU051321280S03

- The oil pressure switches detect pressure applied to the clutch and brakes, and send control signals to the TCM.
- The TCM controls clutch engagement based on these signals.
- The oil pressure switches have the following functions:

Function chart

Oil pressure switch	Function
Oil pressure switch B	Detects pressure applied to 2-4 brake
Oil pressure switch C	Detects pressure applied to high clutch
Oil pressure switch F	Detects pressure applied to low and reverse brake

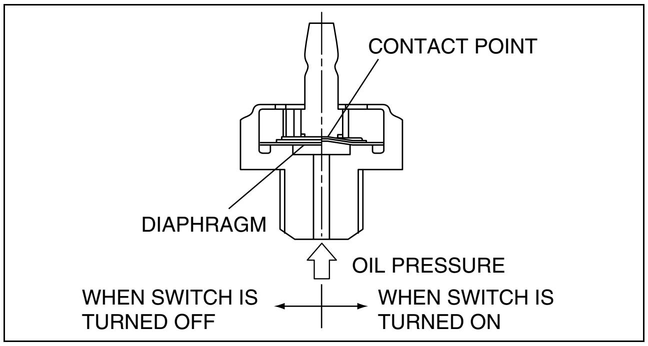


CHU0513S042

OIL PRESSURE SWITCH CONSTRUCTION/OPERATION

CHU051321280S04

- While clutch or brake pressure is applied, the oil pressure switches turn on when the oil pressure reaches the operating pressure of the switch, and turn off when the oil pressure is below the operating pressure of the switch.
- The oil pressure switches are mounted on the lower control valve.



CHU0513S043

CONTROLLER AREA NETWORK (CAN) OUTLINE

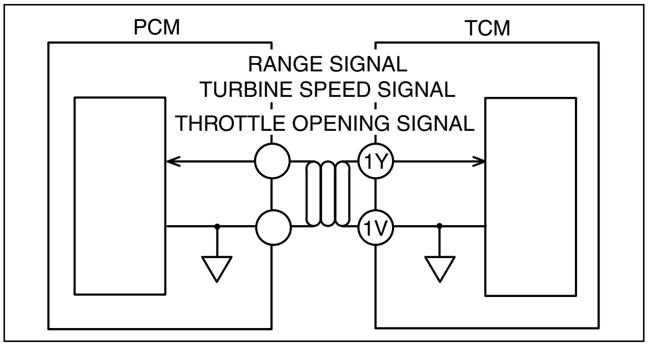
CHU051318901S01

- Information between the TCM and PCM is relayed by CAN communication.

CONTROLLER AREA NETWORK (CAN) CONSTRUCTION/OPERATION

CHU051318901S02

- Throttle opening signals are input from the PCM to the TCM, where shift and TCC are controlled, based on these signals.
- Range signals and turbine speed signals are output from the TCM to the PCM, where transmission load is determined, based on these signals, and idle speed is controlled.
- Information about abnormal signal communication is also relayed by CAN communication.



CHU0513S050

TRANSMISSION CONTROL MODULE (TCM) OUTLINE

CHU051318901S03

- The TCM controls automatic transmission operations. The TCM outputs control signals to the transmission according to the signals from other sensors and/or switches.
- In driving mode, there are five mode selections: NORMAL, POWER, MANUAL, cold engine coolant temperature, and slope. The TCM automatically selects the proper mode according to driving condition.

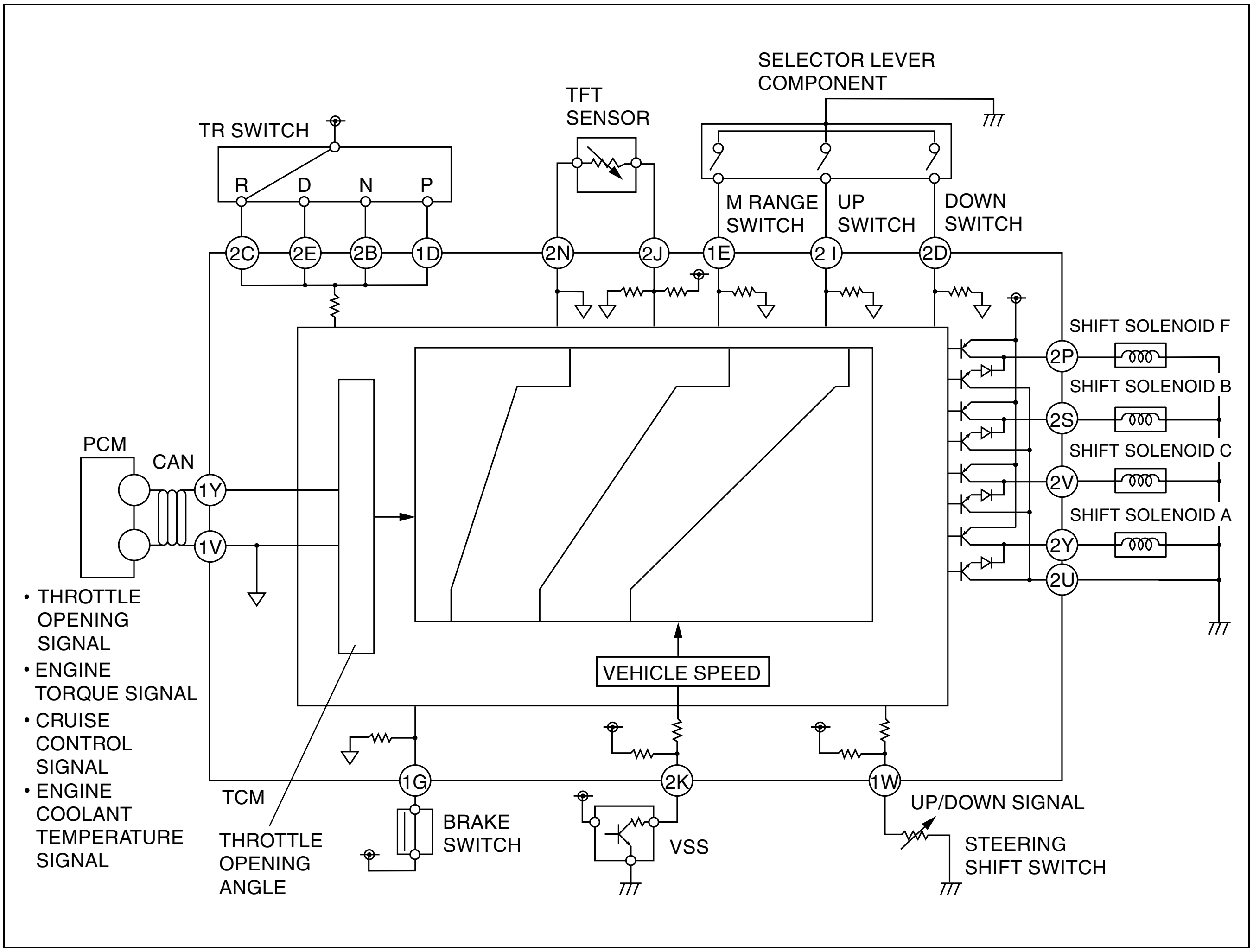
SHIFT CONTROL STRUCTURE

CHU051318901S04

Features

- The TCM selects and determines the shift diagram based on the results of the range and driving mode judgements. Then, based on the shift diagram, the TCM sends signals to the duty-cycle type solenoid valves and the ON/OFF type solenoid valves, according to the VSS and the throttle opening signals, to perform shifting.

Structure
System diagram



CHU0513S051

SHIFT CONTROL OPERATION

CHU051318901S05

Range determination

- Each range is determined by operating the selector lever, and switching on/off the switch in the TR switch internal circuit. The present range is detected according to the on/off signal of the switch.
- The following switches are built into the TR switch, and determine each range when the switch is on.
  P position switch
  R position switch
  N position switch
  D range switch

DRIVE MODE DETERMINATION OPERATION

CHU051318901S06

D range

- When the ATF temperature is high or low, the mode is automatically switched to each shift pattern: when the ATF temperature is high, the TCC point is shifted to the low speed side, and when the ATF temperature is low, 4GR is inhibited.

M range

- When the selector lever is shifted over from the D to M range position, the M range switch in the selector lever component turns on, sending a manual mode command signal to the TCM which activates the manual mode shift control.

LINE PRESSURE CONTROL STRUCTURE

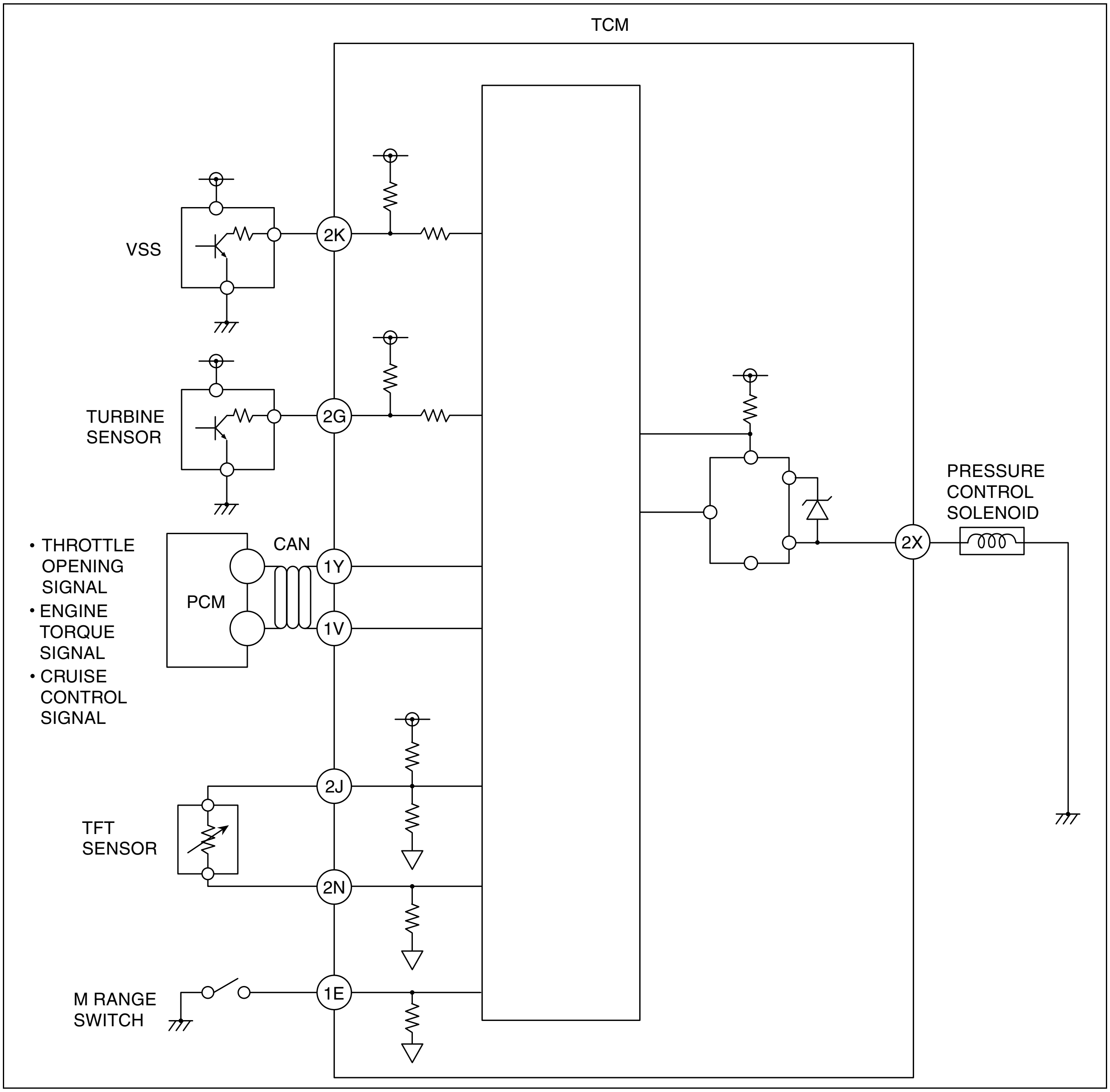
CHU051318901S07

Features

- With direct electronic shift control, clutch pressure is regulated by duty-cycle solenoids (shift solenoids A, B, C, F) and amplifier valves, and thus conventional continuously variable line pressure control does not occur. Instead, throttle opening angle, vehicle speed, ATF temperature, and TR switch signals drive on/off type pressure control solenoids, and switch line pressure to high or low pressure to suit engine load and vehicle speed.

Structure

System diagram

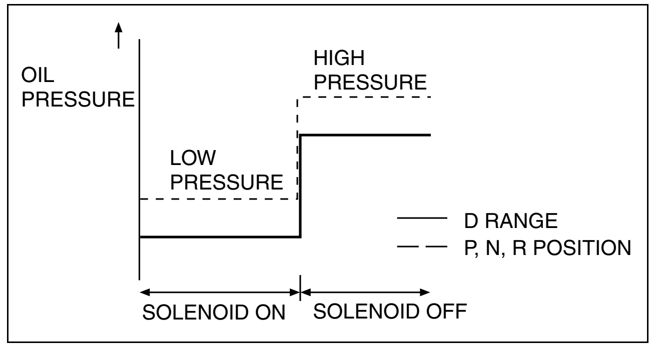


CHU0513S052

LINE PRESSURE CONTROL OPERATION

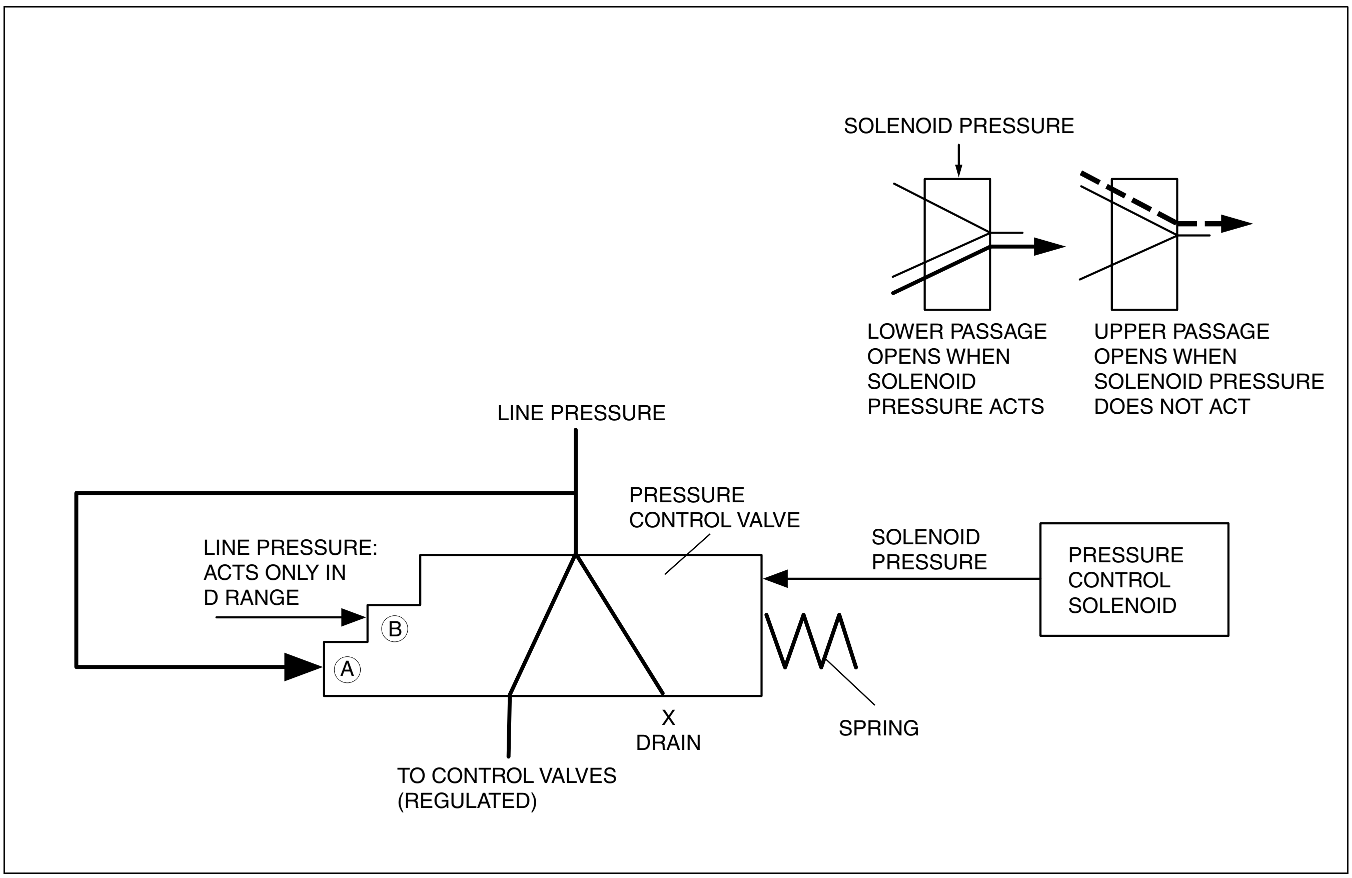
CHU051318901S08

- Line pressure switches to high or low pressure in accordance with line pressure switching pre-programmed in the TCM.
- If the pressure control solenoid valve is energized, line pressure switches to the low-pressure side; if the pressure control solenoid valve is de-energized, line pressure switches to the high-pressure side.



CHU0513S053

- Line pressure generated by the oil pump (discharge pressure) acts on the area marked A on the pressure control valve. It, however, does not act if the pressure control valve is turned on by a signal relayed from the TCM. Thus line pressure is regulated to match the spring force acting on the right side of the pressure control valve. If the pressure control solenoid turns off, solenoid pressure acts and line pressure is regulated to match the spring force and solenoid pressure acting on the right side of the pressure control valve. As a result, line pressure is decreased when the pressure control solenoid valve is on, and increased when it is off.
- Line pressure, which acts only in D, S, or L range, acts on the area marked B on the pressure control valve. Thus, the pressure control valve moves in the direction in which oil is drained, and line pressure is decreased by an amount equal to the surface area marked B.



CHU0513S054

DIRECT ELECTRONIC SHIFT CONTROL STRUCTURE

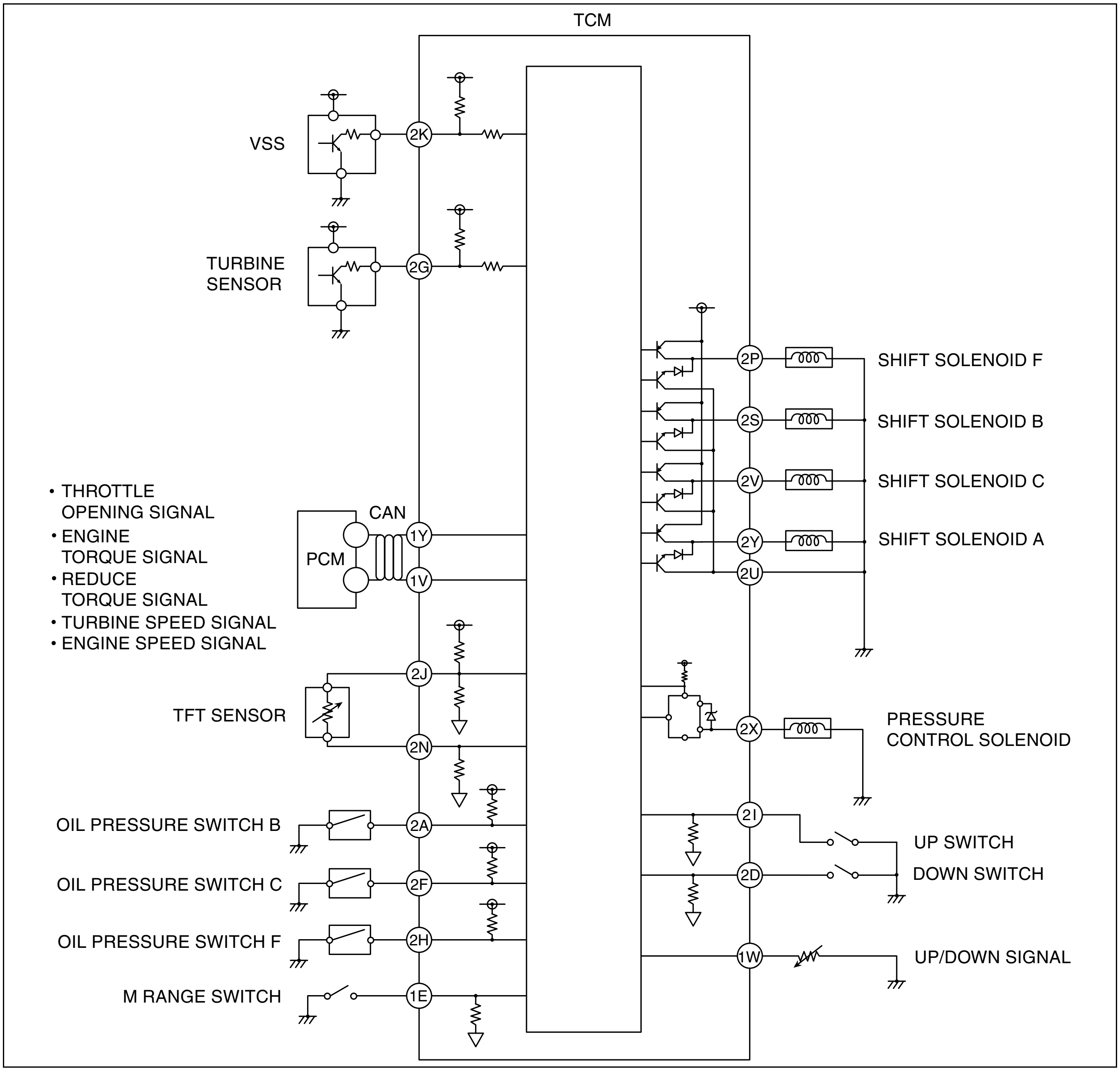
CHU051318901S09

Features

- According to signals from switches and sensors, direct electronic shift control drives the duty-cycle solenoid valves (shift solenoid valves A, B, C, F), regulates clutch pressure to suit engine load and vehicle speed, and electronically controls clutch pressure directly.
- As a result, minute hydraulic control is possible, unlike with conventional clutch engagement pressure control using an accumulator.
- Even for select lever operation, the TCM provides the optimum torque capacity of clutch to the engagement- and release-side clutches according to the transmission input torque (turbine torque).

Structure

System diagram

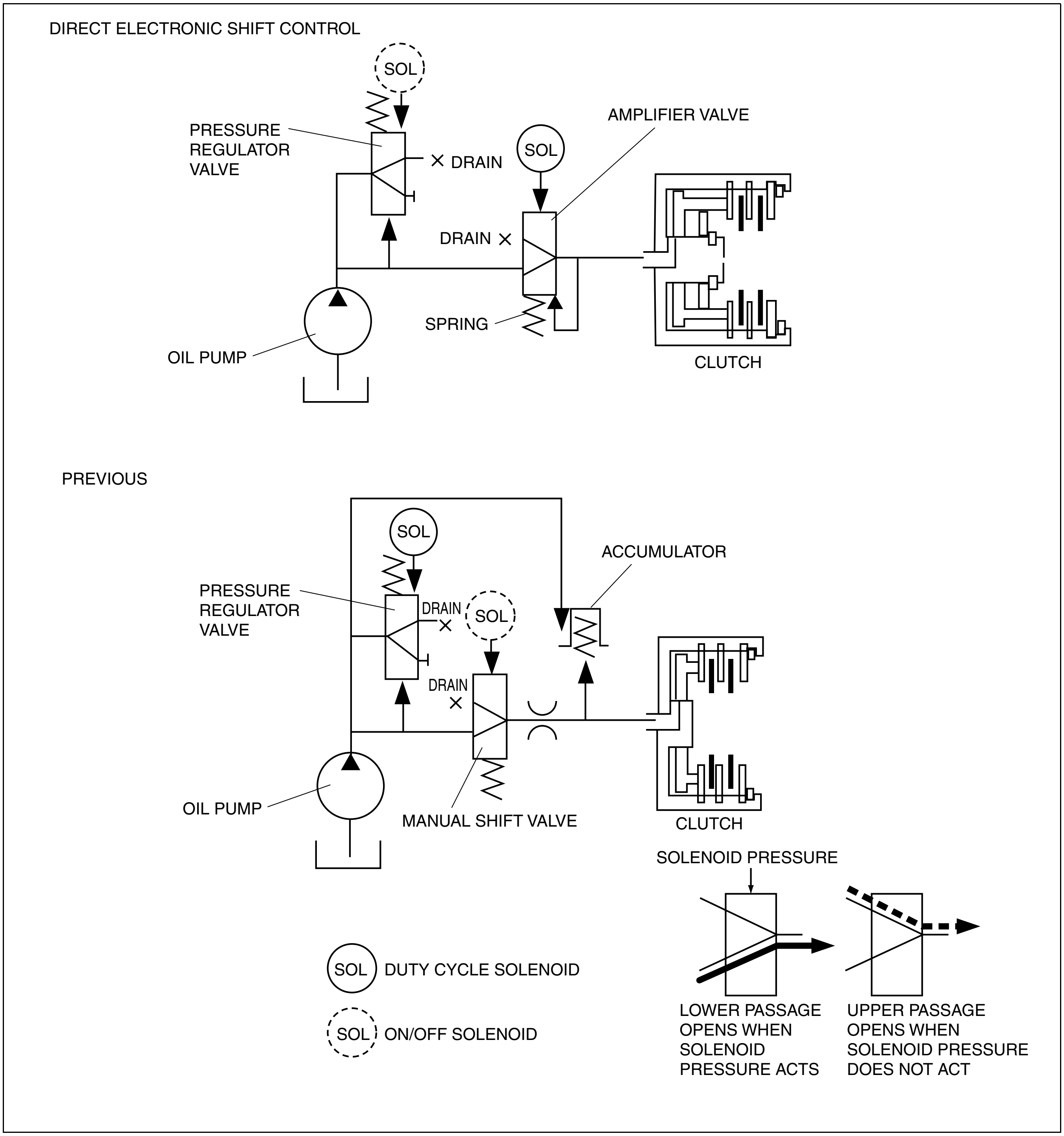


CHU0513S055

DIRECT ELECTRONIC SHIFT CONTROL OPERATION

CHU051318901S10

- In the previous system, line pressure passages are switched with a combination of on/off shift solenoids and shift valves to engage the clutch. In the new system, clutch pressure is regulated for each clutch and brake with a combination of duty cycle shift solenoids and amplifier valves.
- When shifting from 2GR→3GR, 3GR→4GR, 3GR→2GR, 4GR→3GR, engagement- and release-side clutch pressures are simultaneously controlled according to throttle opening angle and vehicle speed, as well as clutch pressure supply and extent of gear shift. As a result, the capacity of torque for both clutches can be regulated optimally during switching of clutch pressure (switching of engagement clutch) to prevent engine flare-up and dragging during shifting for smooth and responsive shifting.



CHU0513S056

AT WARNING LIGHT FUNCTION

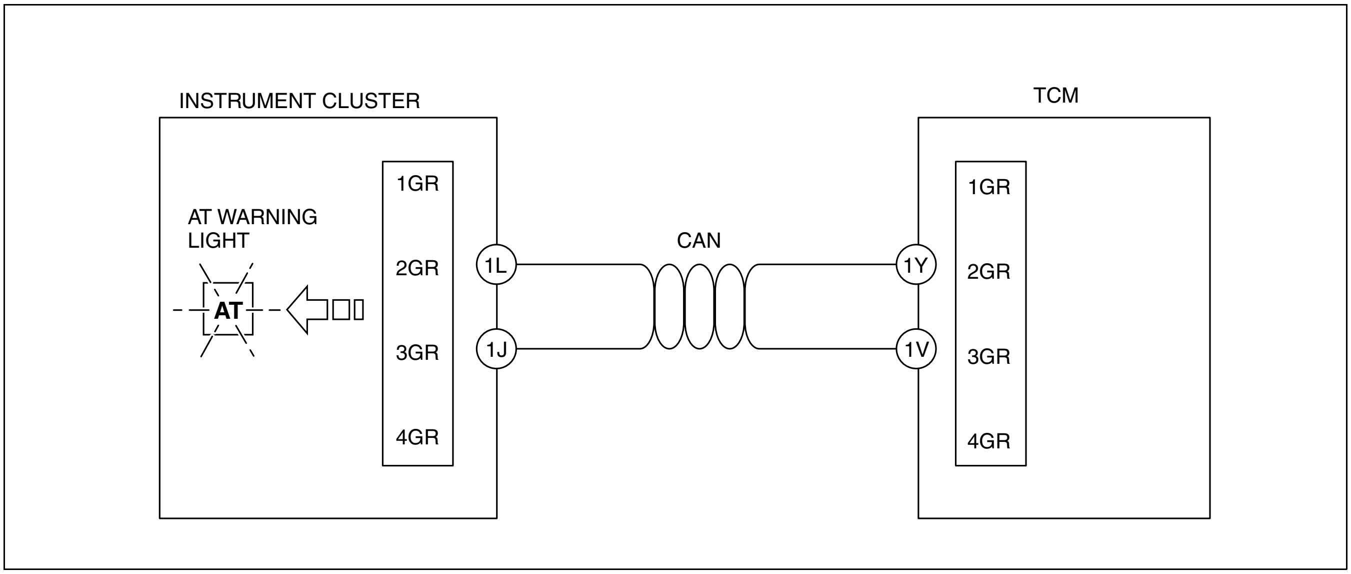
CHU051319010S07

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

AT WARNING LIGHT CONSTRUCTION/OPERATION

CHU051319010S08

- 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.



CHU0513S070

SELECTOR INDICATOR LIGHT FUNCTION

CHU051319010S09

- 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

CHU051319010S10

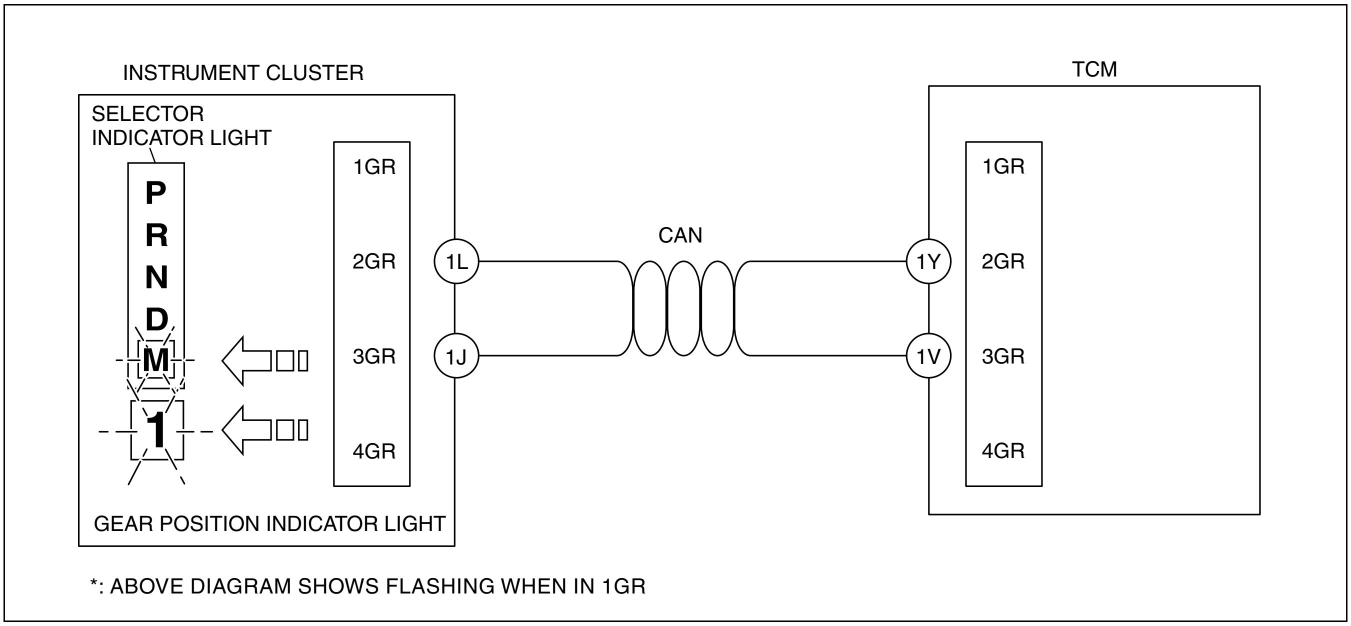
Construction

- 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.

Construction

Selector indicator “M” light and gear position indicator light flash

- When the driver’s shift operation is cancelled, the gear position indicator light and selector lever indicator “M” 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) are reversed to off and on signals respectively.
- Based on a combination of inputted 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.



CHU0513S103

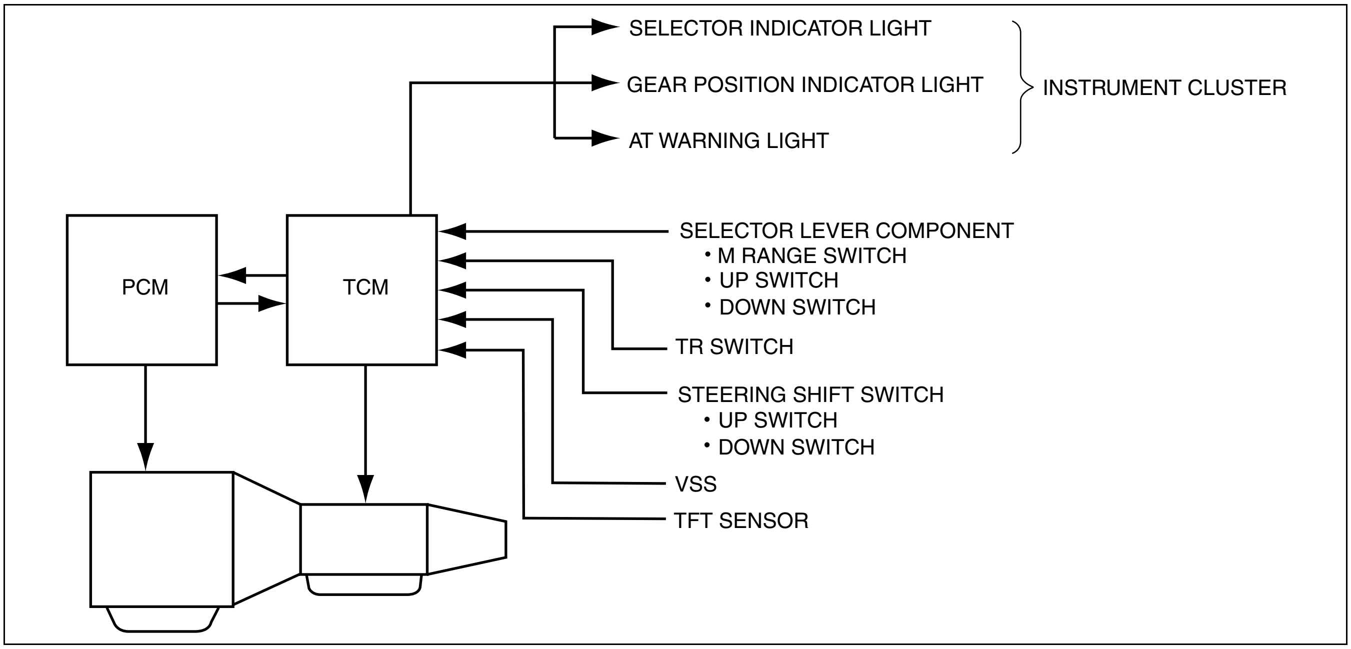
MANUAL MODE SHIFT CONTROL STRUCTURE

CHU051301030S11

Features

- The manual mode shift control is activated by moving the selector lever from the D to M range position (selector lever is shifted over toward driver side).
- Manual mode shift control with a manual shifting system allowing selection of gear positions by manual operation of the selector lever forward (–) and back (+) has been adopted. Moreover, engine braking for all gears in manual mode according to the gear ratio is available.
  - — Shifting between 1GR and 2GR when the vehicle is stopped is possible. Moreover, when shifting from the D to M range while driving, the same gear position is maintained.
  - — Consecutive shifting in the M range has been adopted. When shifting down from M range 4GR or 3GR, one gear can be skipped over by rapidly tapping the selector lever two times in the down-shift (–) direction.
- Selector lever position and gear position indicator lights, built into the instrument cluster, have been adopted. The gear position indicator light displays the selected gear position.
  - — The selector indicator light includes a selector lever position indicator that displays selector lever positions and, a gear position indicator light that displays gear positions.

Structure
System diagram



CHU0513S105

MANUAL MODE SHIFT CONTROL OPERATION

CHU051301030S12

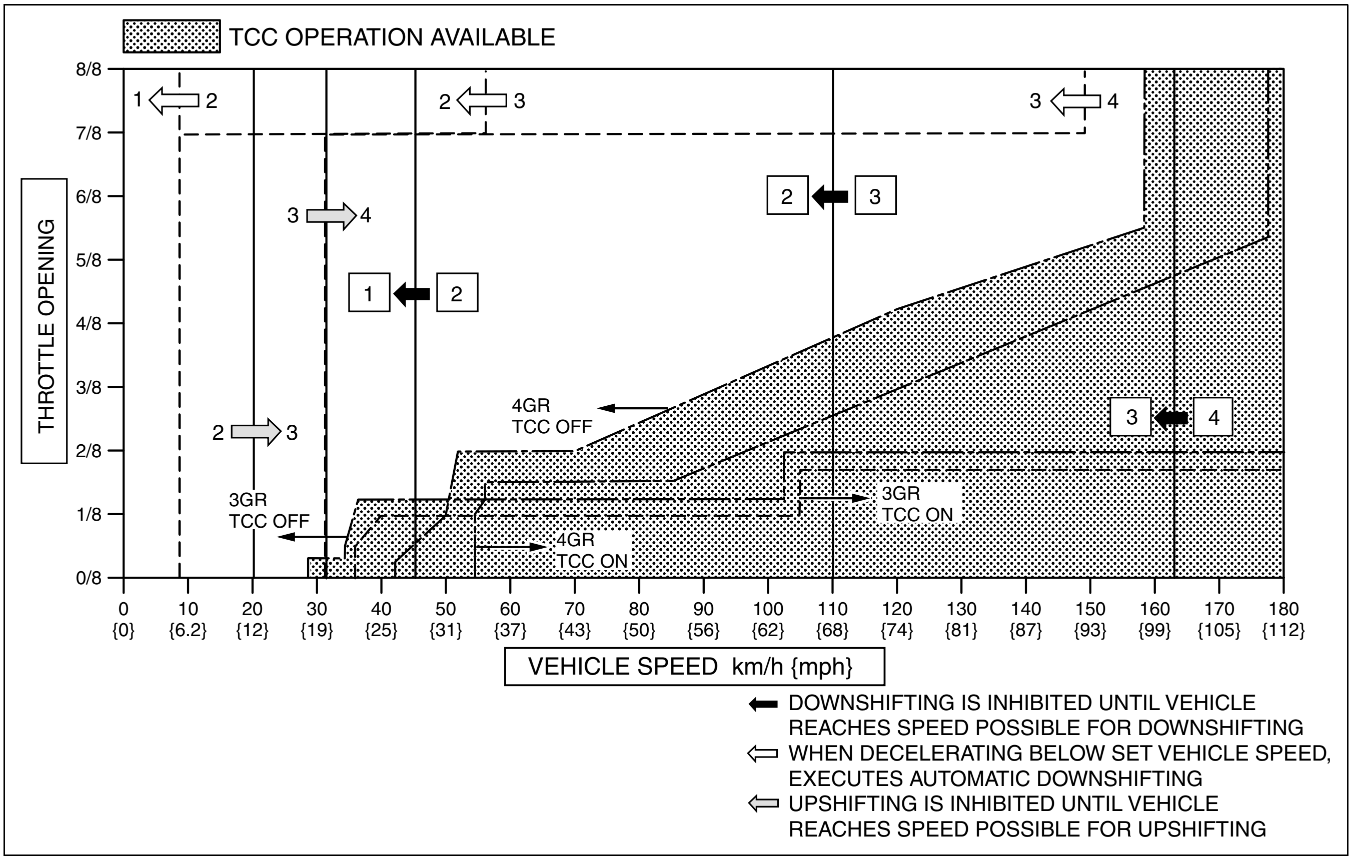
Manual mode shift

- 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 inputted to the TCM.
  — The TCM, triggered by the up-shift command signal, carries out shifting by outputting an operation signal to the shift solenoid if the ATF temperature is not low (for 3GR only), vehicle speed is higher than the set speed and the gear position is 3GR or lower.
- Conversely, when the selector lever is operated in the forward (–) direction, the down switch in the selector lever component turns on, and a down-shift command signal is inputted to the TCM.
  — The TCM, triggered by the down-shift command signal, carries out shifting by outputting an operation signal to the shift solenoid if the vehicle speed is less than the set speed and the gear position is 2GR or above.
- The up/down operation of the steering wheel shift switch is the same as the manual operation of the selector lever.
- The TCM utilizes a specialized M range automatic shift diagram. Due to this, restriction of manual shift demand and automatic control of downshifting is carried out, reducing load on the AT, preventing engine over-rev and ensuring drive stability.

Condition	Shift control	Note
2GR→3GR up-shift command at low speed	• To reduce load on the AT, 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		
3GR→4GR up-shift command, low ATF temperature	• To reduce load on the AT, upshifting to 4GR is inhibited	
4GR→3GR down-shift command, above set speed	• To prevent engine over-rev, downshifting is inhibited until vehicle reaches speed possible for downshifting	
3GR→2GR down-shift command, above set speed		
2GR→1GR down-shift command, above set speed		

Condition	Shift control	Note
In 4GR deceleration, speed goes below coast-down set speed (deceleration downshift)	• To assure drive stability, automatically downshifts from 4GR to 3GR.	—
In 3GR deceleration, speed goes below coast-down set speed (deceleration downshift)	• To assure drive stability, automatically downshifts from 3GR to 2GR and 3GR to 1GR.	
In 2GR deceleration, speed goes below coast-down set speed (deceleration downshift)	• To assure drive stability, automatically downshifts from 2GR to 1GR.	

Shift diagram



CHU0513S104

FEEDBACK CONTROL STRUCTURE

CHU051301030S13

Features

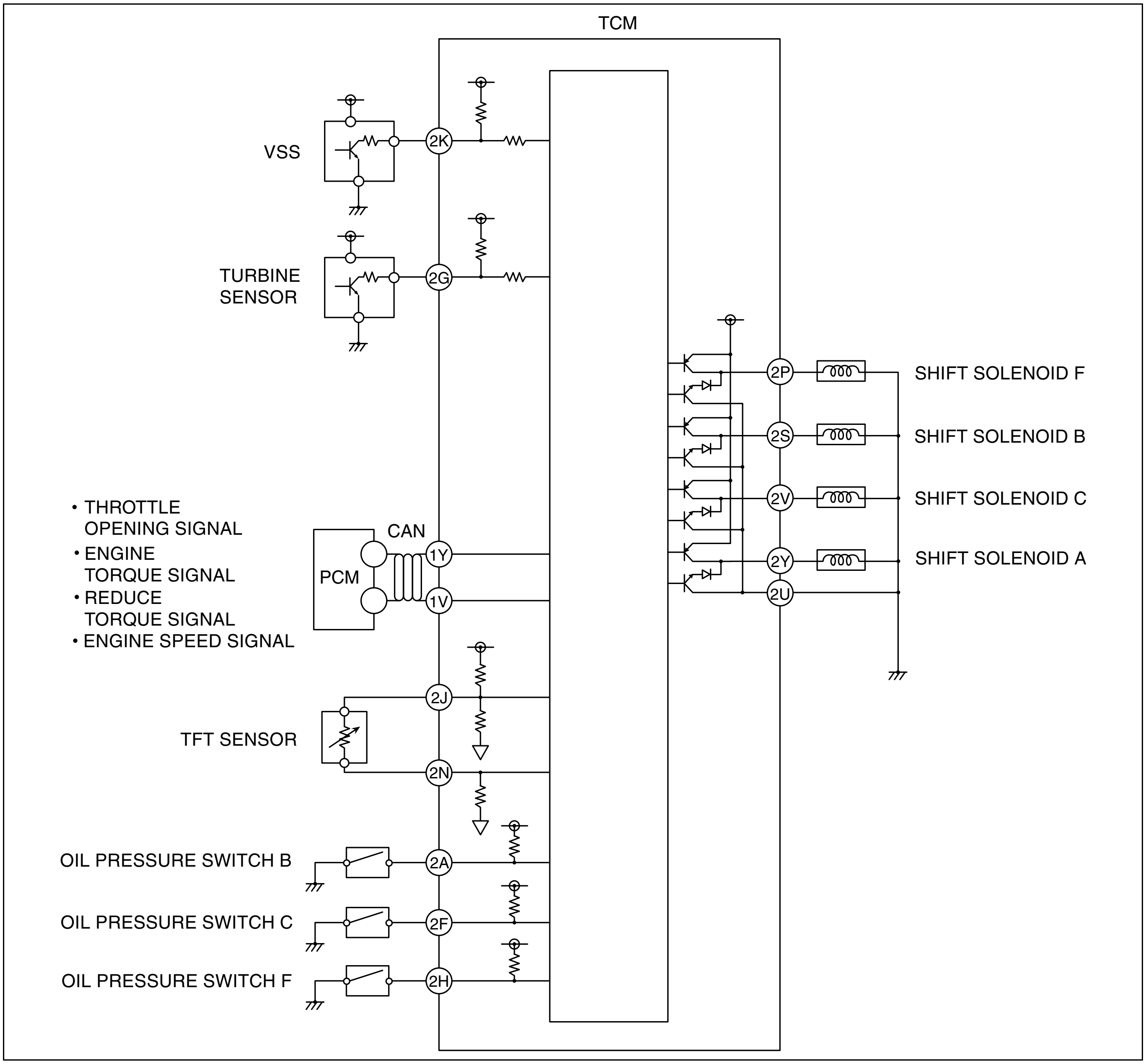
- During shift up with the accelerator pedal depressed, feedback control regulates the clutch pressure on the engagement and release sides, according to the throttle opening angle and vehicle speed. It also uses past gearshifts to optimize clutch pressure.

Note

- If the battery negative terminal is disconnected, feedback memory in the TCM will be erased, and thus gearshift shock may increase. The shock, however, will decrease gradually as the vehicle is driven.

Structure

System diagram



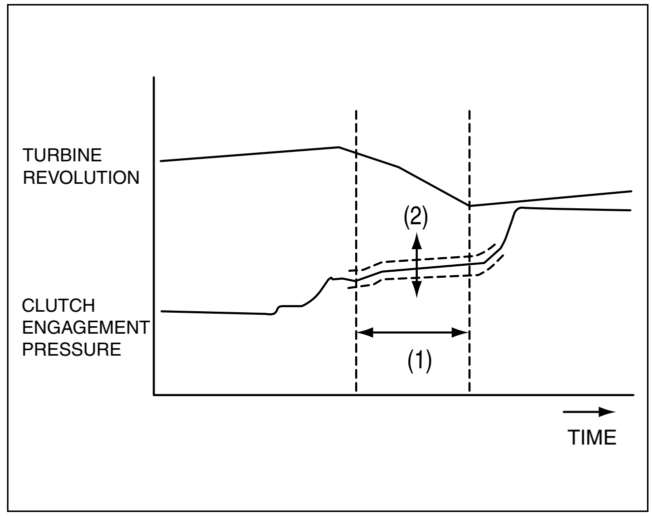
CHU0513S057

FEEDBACK CONTROL OPERATION

CHU051301030S14

Upshift clutch engagement pressure feedback

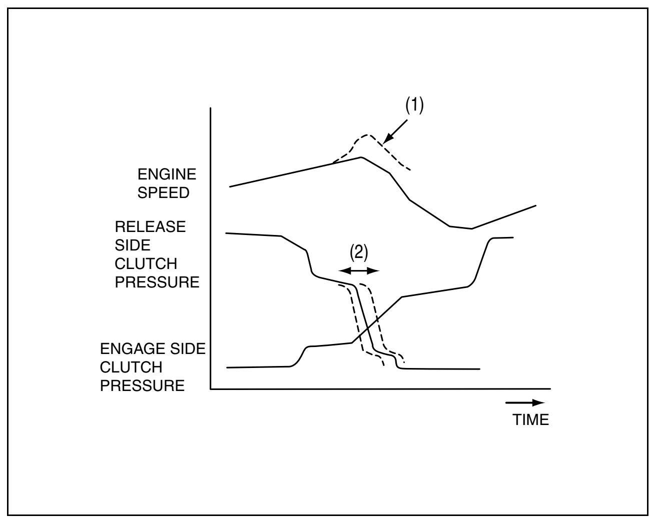
- Clutch pressure (2) is learned so that gear shift time (1) becomes a predetermined target value, and thus changes in performance and changes in the transmission over time are minimized based on past gear shift results.



CHU0513S058

Upshift timing feedback (release-side clutch pressure)

- Clutch pressure release timing on the release side (2) is learned so that the change in engine speed (1) is optimized, and thus clutch pressures on the engagement and release sides are optimized.



CHU0513S059

ENGINE-TRANSMISSION TOTAL CONTROL OUTLINE

CHU051301030S15

Features

- The clutch engagement pressure is maintained in an optimal range due to engine output control when downshifting to provide improved shift quality and assist shifting at high engine speeds.

Operation

- During downshifting, engine output torque variation is converted to signal form by the PCM, and input to the TCM, which optimally controls clutch engagement pressure accordingly.
- Smooth shifting is achieved at high engine speeds due to the effective reduction in engine output torque.

TORQUE CONVERTER CLUTCH (TCC) CONTROL STRUCTURE

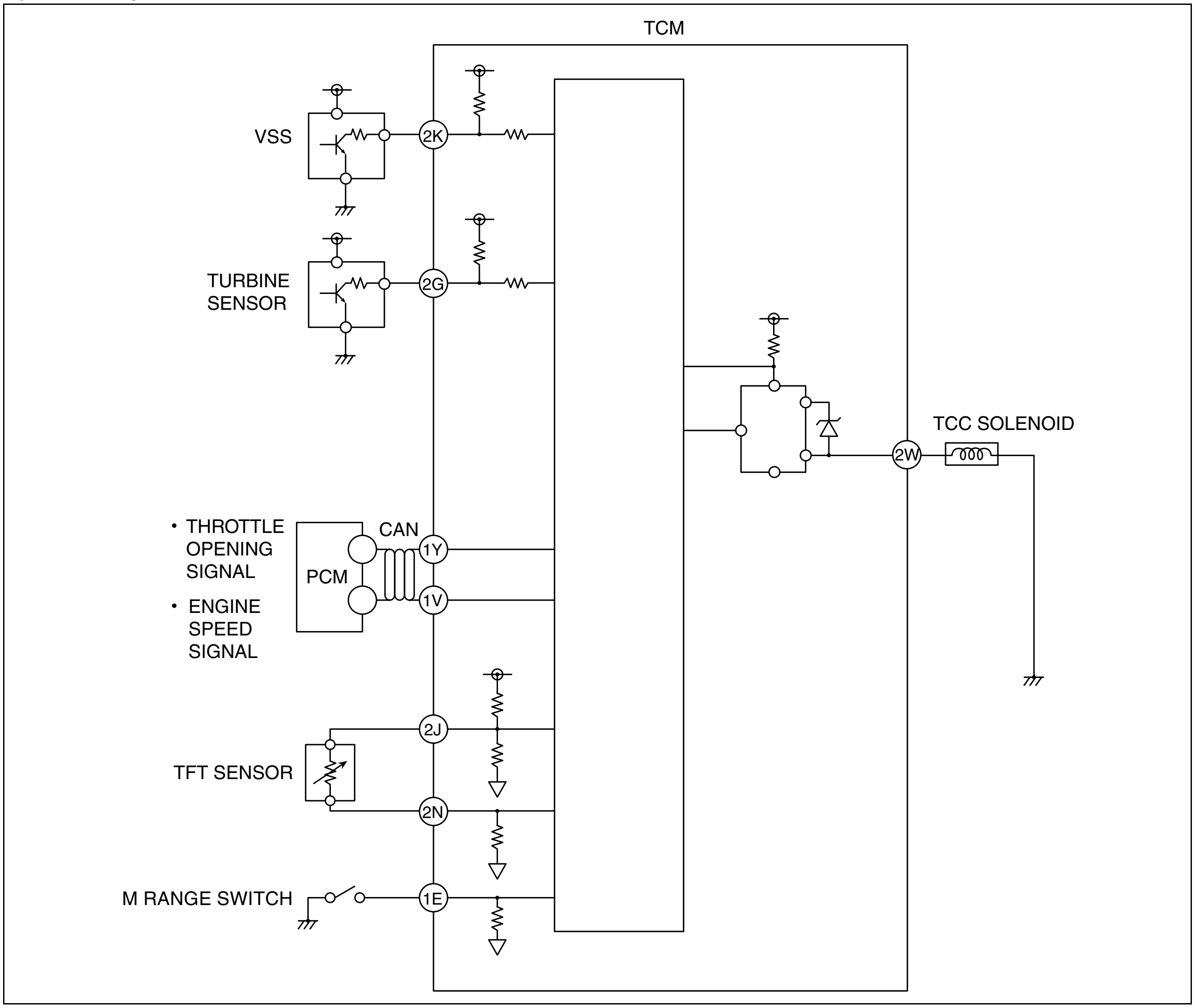
CHU051301030S16

Features

- The TCM selects the TCC schedule according to the gear selected by the transmission. Fifty Hz (20 ms cycle) on/off signals are relayed from the TCC schedule, VSS and throttle opening angle to the duty cycle TCC solenoid valve to control the TCC.

Structure

System diagram



CHU0513S060

TORQUE CONVERTER CLUTCH (TCC) OPERATION

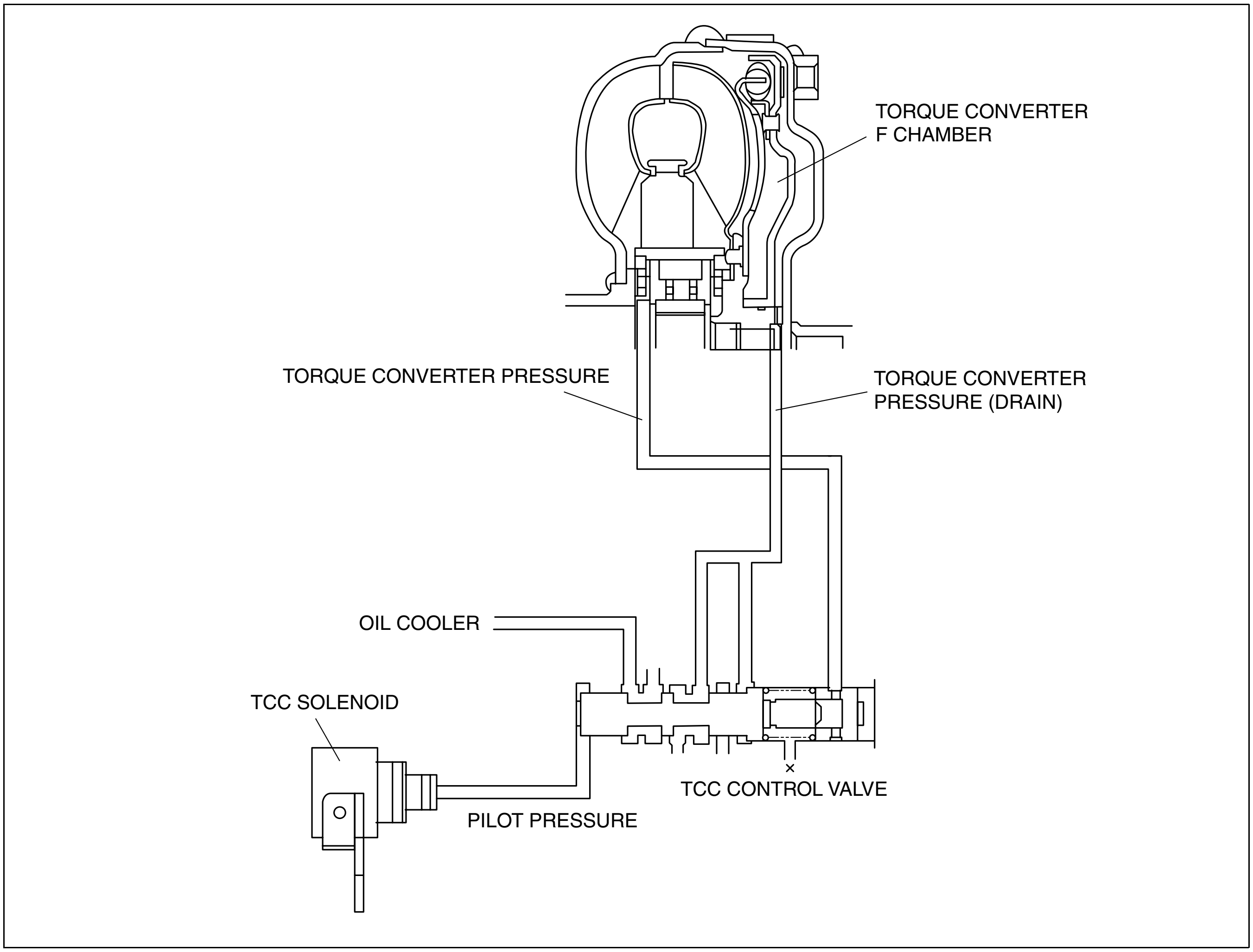
CHU051301030S17

TCC release

- The TCM stops driving the TCC solenoid (OFF) when TCC release is determined.

TCC engagement

- When the TCM determines TCC engagement, the TCM gradually increases the duty ratio energizing the TCC solenoid, and gradually drains the oil pressure in the torque converter F chamber.
- The TCC piston slowly presses against the converter cover, and the TCC engages smoothly.



CHU0513S061

Determination of TCC inhibition

- The TCC is inhibited when any of the following conditions are met.
  — ATF temperature is low.
  — Throttle valve is closed.
  — Failure is detected by diagnosis function.

SLOPE MODE CONTROL OUTLINE

CHU051301030S18

- Climbing or descending is determined based on the engine output torque and the vehicle acceleration, and the shift gear is controlled to realize smooth vehicle driving.

SLOPE MODE CONTROL OPERATION

CHU051301030S19

When climbing hill

- When the hill is steeper than a certain grade, unnecessary shift up is prevented by holding an appropriate shift gear.

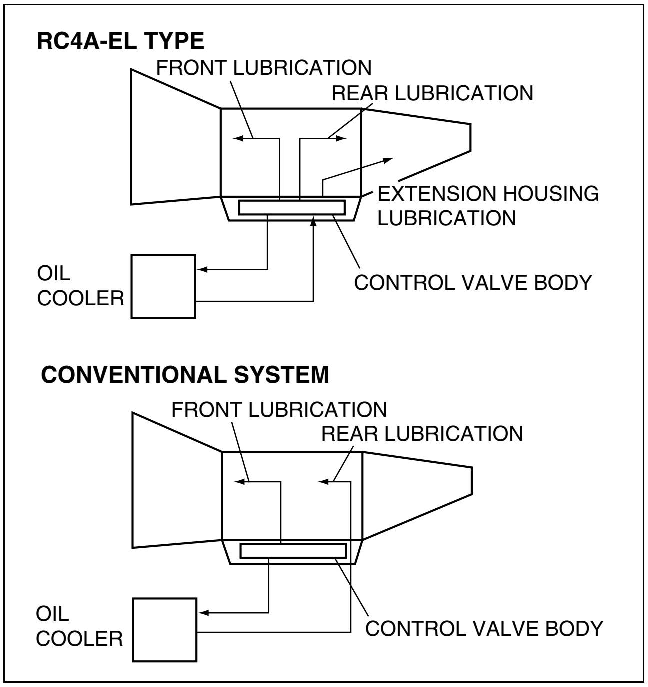
Descending hill

- When the descent is steeper than a certain grade and the brake switch is depressed, use of the brake pedal is reduced by shifting from 4GR to 3GR, or 3GR to 2GR and applying engine braking.

LUBRICATION SYSTEM OUTLINE

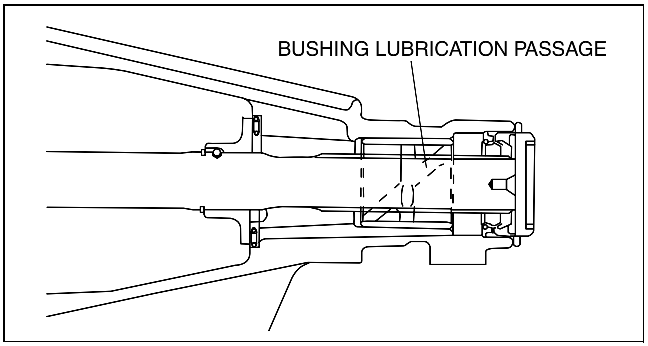
CHU051319900S01

- In the conventional system, the rear section is lubricated by ATF returning from the ATF oil cooler. In the new system, all parts are lubricated directly from the control valve.
- With this construction, the system is unaffected by the ATF oil cooler, and thus a steady amount of lubricant is supplied.



CHU0513S037

- A passage located in the rear of the extension housing supplies a steady amount of lubricant exclusively to the bushing.



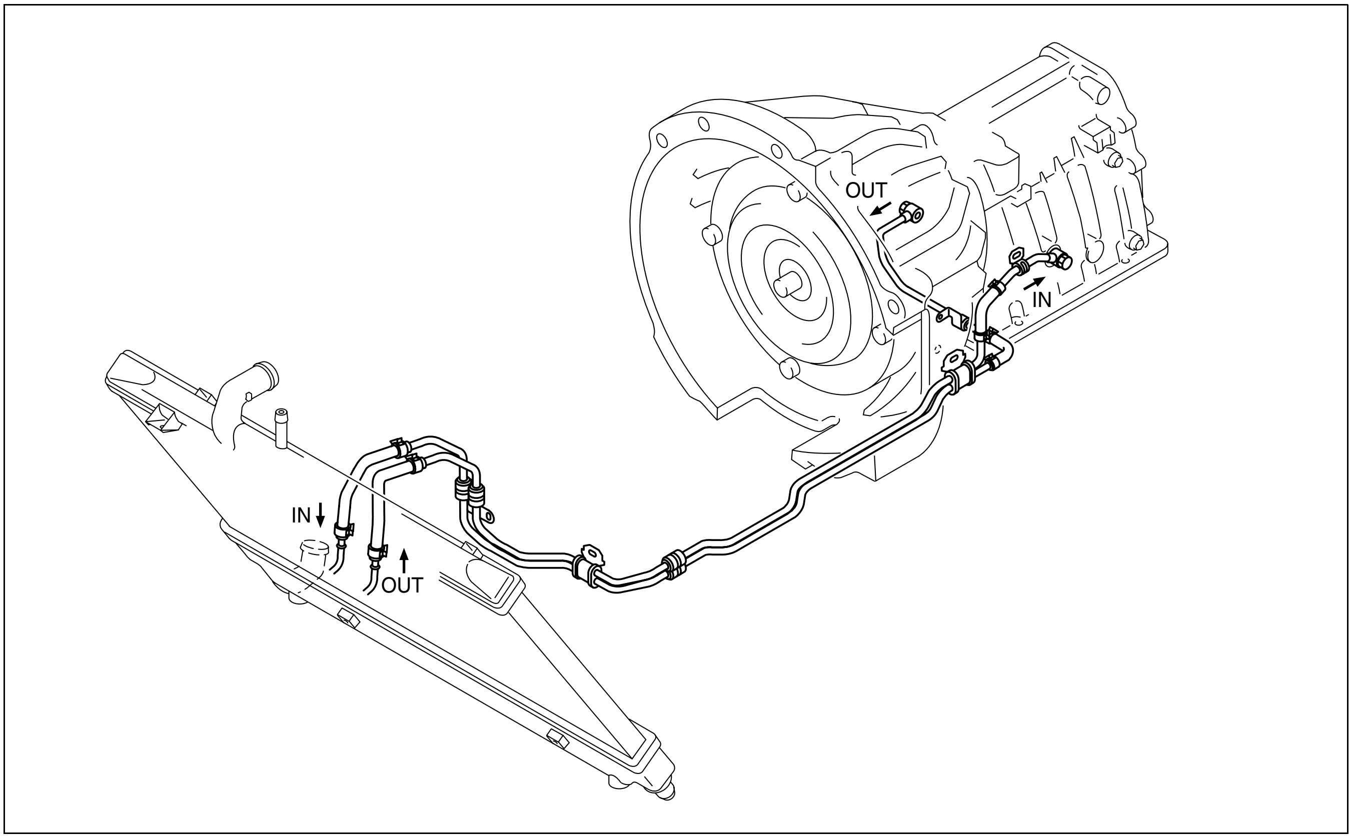
CHU0513S044

05–13

COOLING SYSTEM OUTLINE

CHU051319900S02

- A water-cooling type AT oil cooler is adopted and installed in the radiator. The oil cooler cools the ATF heated in the AT body.



BHJ0513N045

POWER PLANT FRAME (PPF) FUNCTION

CHU051319900S03

- The Power Plant Frame feature has been adopted for all models. For detailed information, refer to the Y16M-D manual transmission description. (See 05–11–12 POWER PLANT FRAME (PPF) FUNCTION.)

05–14 AUTOMATIC TRANSMISSION SHIFT MECHANISM

AUTOMATIC TRANSMISSION SHIFT MECHANISM OUTLINE

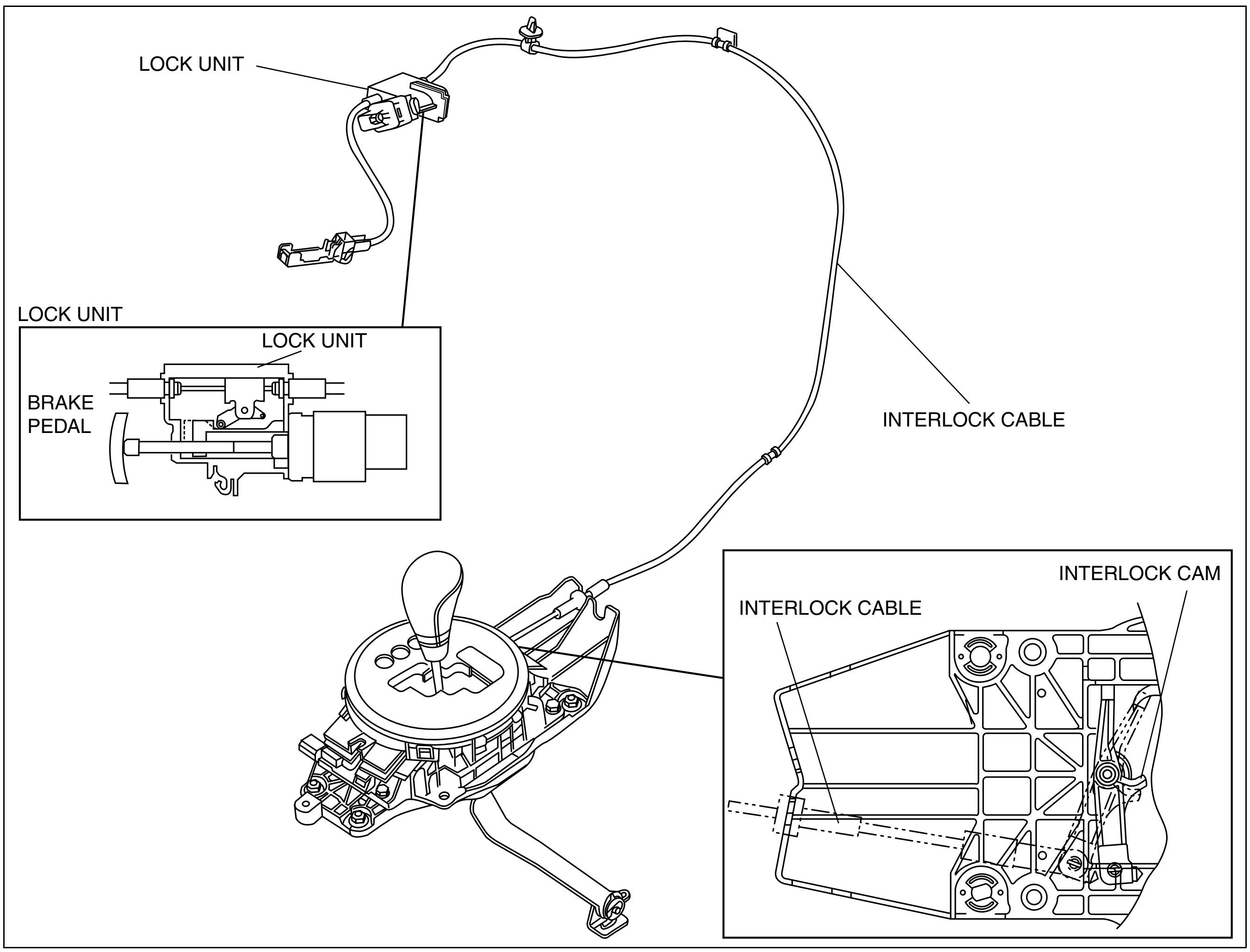
CHU051409000S01

05–14

- The mechanical type key interlock and shift-lock system is adopted.

AUTOMATIC TRANSMISSION SHIFT MECHANISM STRUCTURAL VIEW

CHU051409000S02



CHU0514S001

KEY INTERLOCK SYSTEM OUTLINE

CHU051409000S03

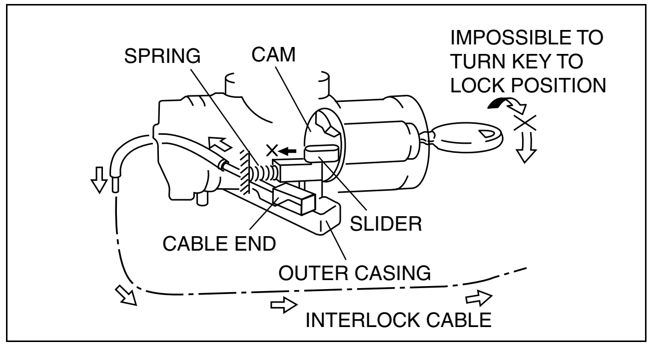
- The key interlock system, which is composed of the interlock cable and steering lock, prevents the ignition switch from being removed when the selector lever is in any position other than the P range. (The ignition switch cannot be turned to the LOCK position.)

KEY INTERLOCK SYSTEM OPERATION

CHU051409000S04

Positions other than P position (Key interlock is operating)

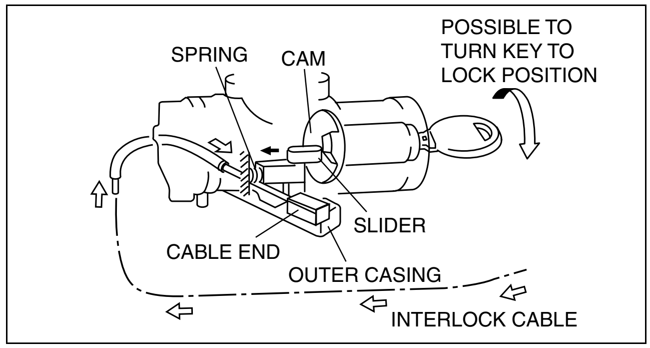
- When the selector lever is in a position or range other than P position, the cable end is set at the key-locked position. When the engine is switched off and an attempt is made to turn the ignition switch to the LOCK position, turning of the cam is restricted by the slider because the cable end pushes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



CHU0514S006

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.



CHU0514S007

SHIFT LOCK SYSTEM OUTLINE

CHU051430000S01

- 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.

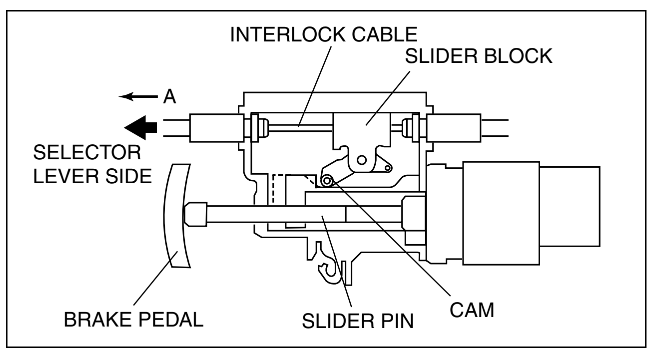
SHIFT-LOCK SYSTEM OPERATION

CHU051430000S02

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

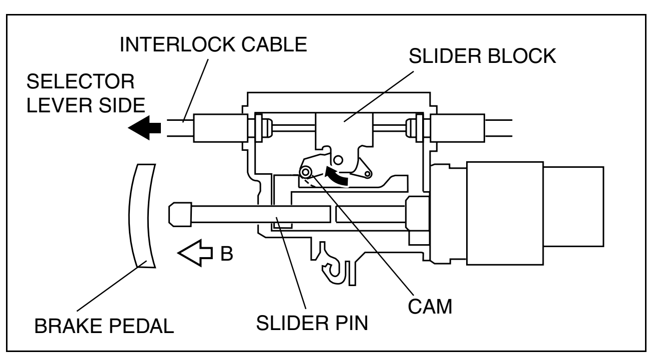
- The brake pedal is depressed.

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.



CHU0514S008

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.



CHU0514S009

SELECTOR LEVER OUTLINE

CHU051446010S01

- Operability has been improved due to the short stroke feature of the selector lever.
- Shift position has been optimized by the reduction of space achieved between the frequently utilized N and D ranges. Due to this optimization of shift position, a quick and sporty shift operation has been achieved while the sleek shift feeling of an AT is also maintained.

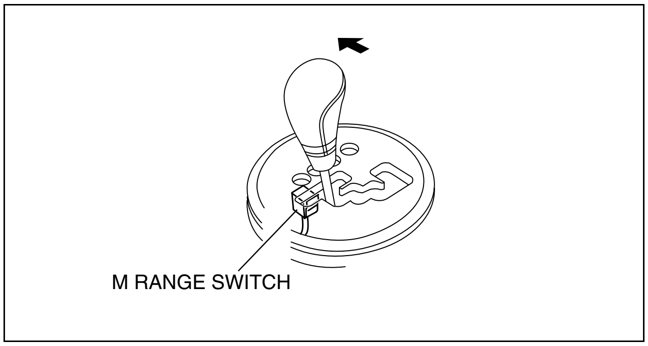
SELECTOR LEVER STRUCTURE

CHU051446010S02

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.



CHU0514S002

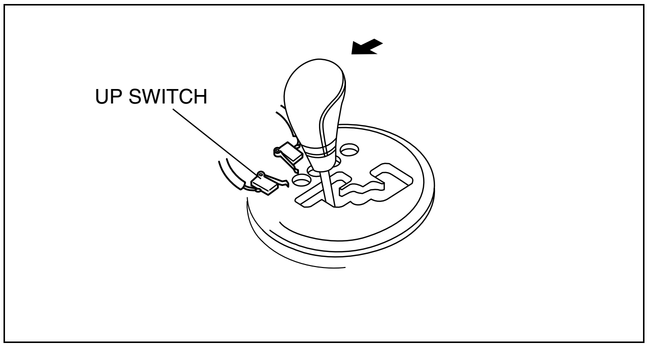
Operation

- 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.



CHU0514S003

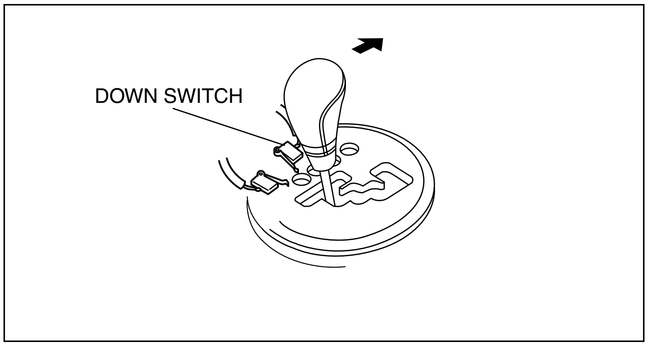
Operation

- 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.



CHU0514S004

Operation

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

STEERING SHIFT SWITCH FUNCTION

CHU051446010S03

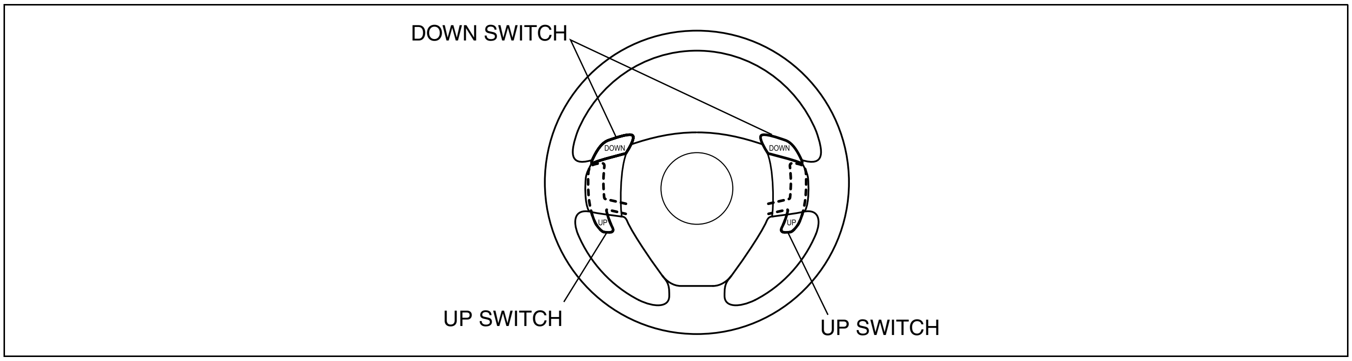
- When an up-shift or down-shift operation is detected in M range, an up-shift or down-shift request signal is sent to the TCM.

STEERING SHIFT SWITCH CONSTRUCTION/OPERATION

CHU051446010S04

Construction

- There is one pair of up and down switches on both the left and right sides of the steering wheel.
- The down switch is built into the audio control and cruise control switches. (For vehicles without cruise control, there is only a down switch.)

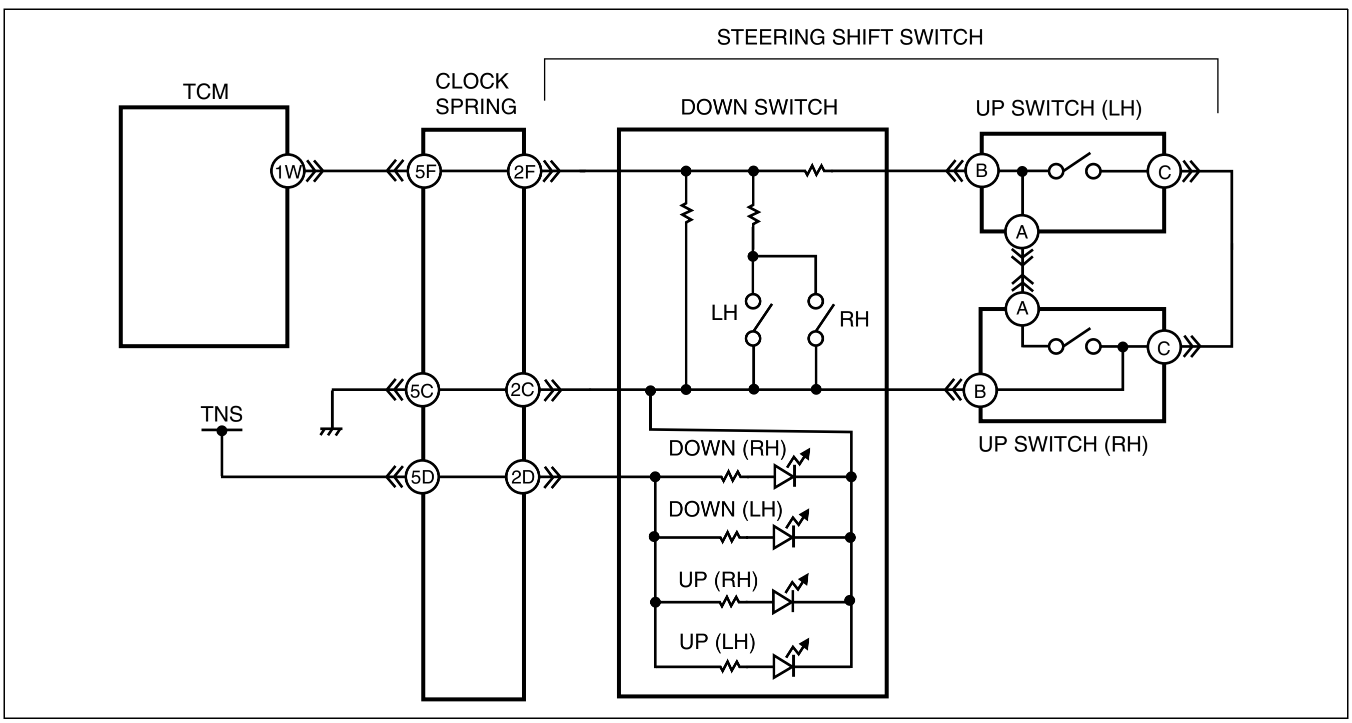


CHU0514S201

Operation

Sending of up/down-shift request signals

- The TCM detects an up/down-shift request signal according to the voltage applied to terminal 1W.
- When the up or down switch is operated, the resistor built into the down switch changes the voltage applied to TCM terminal 1W.
- The TCM controls upshifting or downshifting based on this change in voltage.



CHU0514S202

STEERING

06
SECTION

06–00 OUTLINE

STEERING ABBREVIATIONS

CHU060001034S03

ABS	Antilock Brake System
CAN	Controller Area Network
CM	Control Module
CPU	Central Processing Unit
DSC	Dynamic Stability Control
EPS	Electric Power Steering
HU	Hydraulic Unit
IG	Ignition
M	Motor
OFF	Switch Off
ON	Switch On
PID	Parameter Identification
SW	Switch
WDS	Worldwide Diagnostic System

STEERING FEATURES

CHU060001034S01

Improved handling Improved fuel economy Improved marketability	• Rack assist EPS (Electric Power Steering) adopted
Improved operability	• Steering shaft with a tilt mechanism adopted
Improved safety	• Steering shaft with an energy absorbing mechanism adopted
Improved serviceability	• Enhanced malfunction diagnosis system for use with WDS or equivalent

STEERING SPECIFICATIONS

CHU060001034S02

Item			Specification
Steering wheel	Outer diameter	(mm {in})	370 {14.6}
	Lock to lock	(turns)	2.99
Steering shaft	Shaft type		Collapsible design
	Coupling type		Cross-shaped joint design
	Tilt amount	(mm {in})	32 {1.3}
Steering gear and linkage	Type		Rack and pinion design
	Rack stroke	(mm {in})	79.0 {3.11} x 2
Power steering	Power assist system		Electric motor assist (rack assist type)

06–02 ON-BOARD DIAGNOSTIC

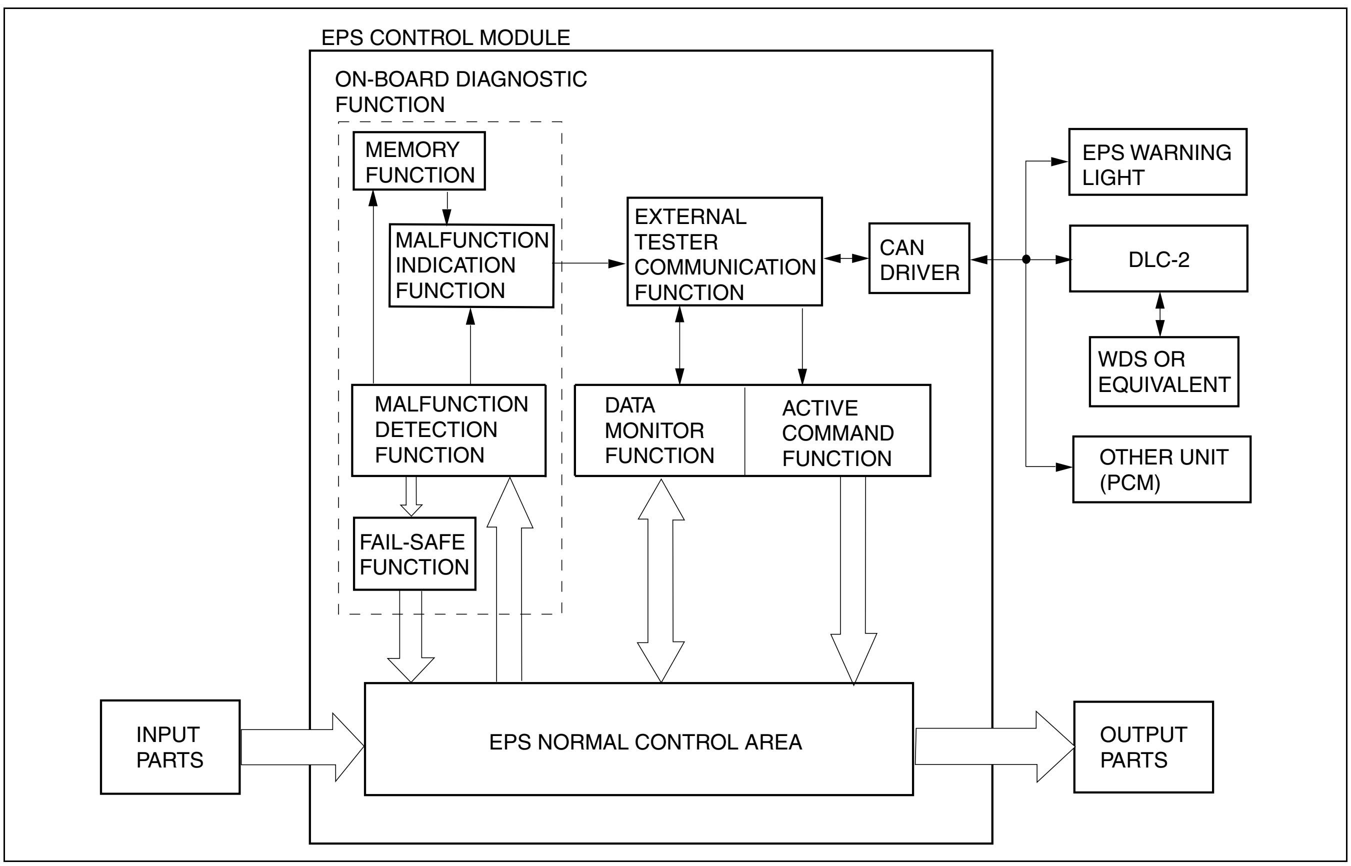
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE (ELECTRIC POWER STEERING)

CHU060201038S01

06–02

- 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 and is used to set the system to the neutral position.
- The Data Link Connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the WDS or equivalent to the DLC-2.
- In addition to DTC read-out, the WDS or equivalent is used to clear DTCs using the display screen of the diagnostic tester, and to access the data monitor and simulation functions, providing enhanced malfunction diagnosis and improved serviceability.

Block Diagram



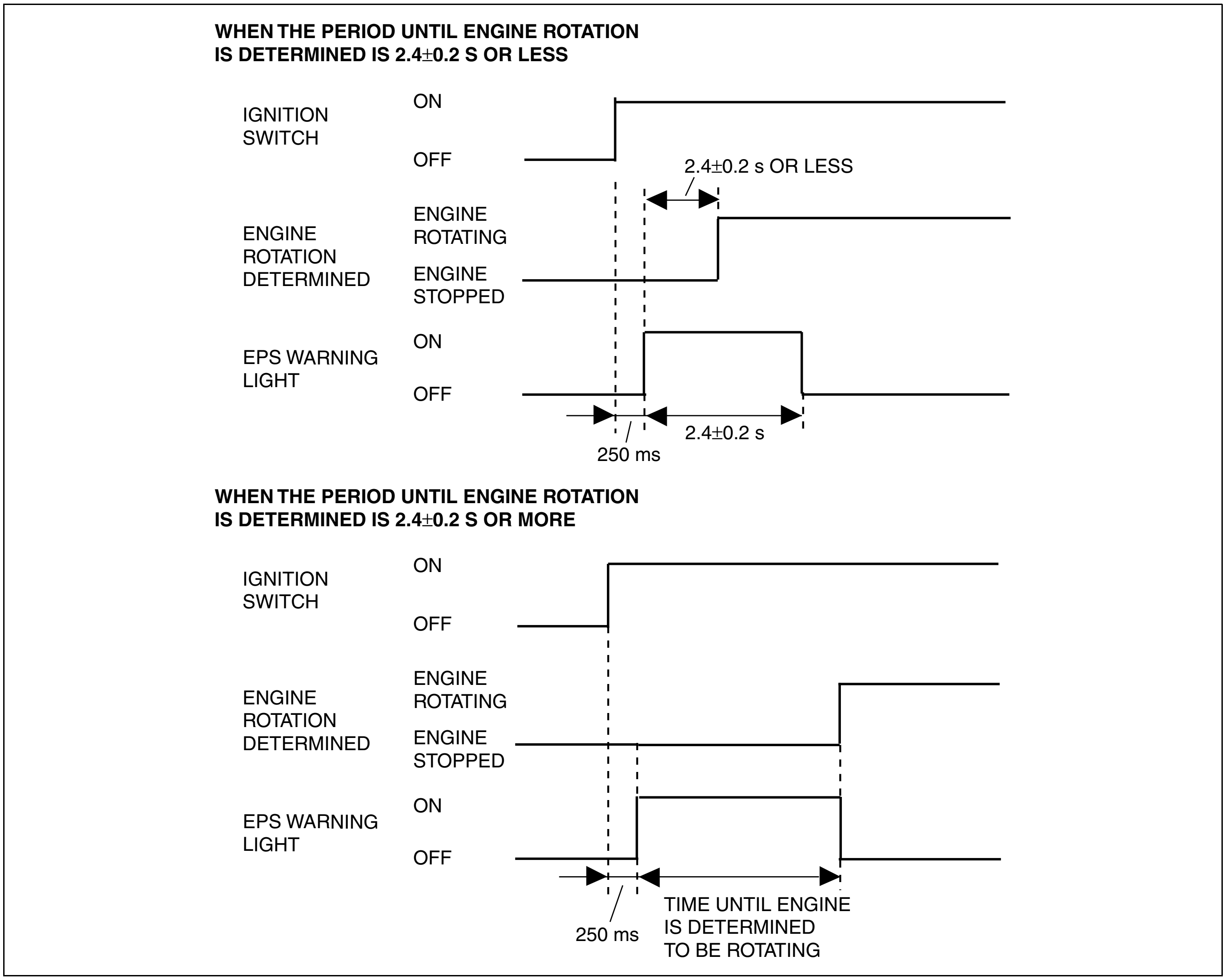
CHU0602S003

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION (ELECTRIC POWER STEERING)

CHU060201038S02

Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the EPS control module when the ignition switch is at the ON position or driving the vehicle.
- When the ignition switch is turned to the ON position, the EPS warning light illuminates as shown in the diagram to inspect for open circuits in the light.



CHU0602S100

Malfunction Display Function

- When the malfunction detection function detects a malfunction, the EPS 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 and fail-safe functions.

Memory Function

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

Fail-safe Function

- When the malfunction detection function determines a malfunction, the EPS warning light illuminates to advise the driver. At this time, the fail-safe function controls the system as shown in the DTC table.

DTC TABLE

System malfunction location	DTC	Fail-safe function	
		EPS warning light illumination status	Control status
Battery power supply	B1318	Illuminated	Control suspended
EPS control module	B1342	Illuminated	Control suspended
EPS system (neutral position setting not performed)	B2141	Illuminated	Control available
Torque sensor	B2278	Illuminated	Control suspended
EPS motor	C1099	Illuminated	Control suspended
CAN bus communication error	U0073	Illuminated*1	Control available*2
CAN communication error	U1900	Illuminated*1	Control available*2
CAN communication error	U2023	Illuminated*1	If there is an irregularity only in the vehicle speed data: Control available*2 If there is any other irregularity: Control available*3

*1 : Illuminates after switching to fail mode.
*2 : Switches to fail mode (controlled by assist torque to allow safe driving).
*3 : If a malfunction is detected in the engine speed signal before the engine is started, assist control is not started up.

ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION (ELECTRIC POWER STEERING)

CHU060201038S03

- The PID/data monitor function is used for optionally selecting input/output signal monitor items pre-set in the EPS control module and reading them out in real-time.

PID/DATA MONITOR TABLE

Command name (WDS or equivalent)	Input/output part name	Unit/operation (WDS or equivalent)
B+	Battery positive voltage	V
CCNT	DTC (amount detected)	—
EPS_MTR	EPS motor	A
EPSLAMP	EPS warning light	ON/OFF
RPM	Engine speed signal	RPM
TRQ_S_CORR	Torque sensor neutral position	NM
TRQ_SENS	Torque sensor	NM
VSS	Vehicle speed signal	KPH/MPH

ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODE FUNCTION (ELECTRIC POWER STEERING)

CHU060201038S04

- The EPS system can be set to the neutral position using the active command mode function.

Active command mode

Command name (WDS or equivalent)	Output part name	Operation	Operation condition
TRQ_S_CAL	EPS system (neutral position setting)	ON/OFF	Ignition switch at ON

ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION (ELECTRIC POWER STEERING)

CHU060201038S05

Outline

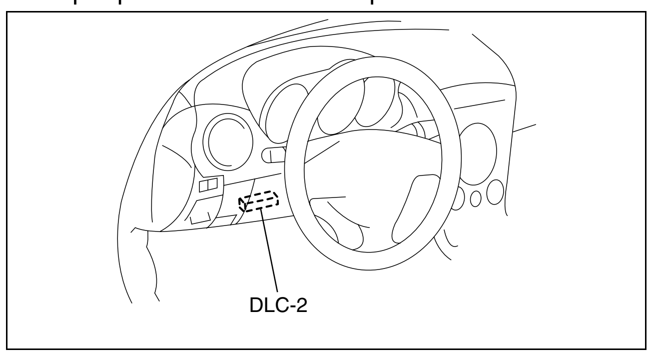
- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, and operation of input/output parts) between the EPS control module and an external tester.

Connections/Communication Contents

Item	External tester	
	WDS	
	Connection	Communication method
Self-diagnosis (malfunction detection) function	Input/output: CAN_H, CAN_L	Serial communication
PID/data monitor function		
Active command mode function		

Serial Communication

- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the WDS or equivalent to the DLC-2, diagnostic data can be sent and received between the WDS or equivalent and the EPS control module via CAN communication lines.
- The EPS control module receives the command signals of the malfunction detection function, PID/data monitor function, and the active command mode function from the WDS or equivalent, and sends DTCs and data regarding the operating condition and status of each input/output part to the WDS or equivalent.



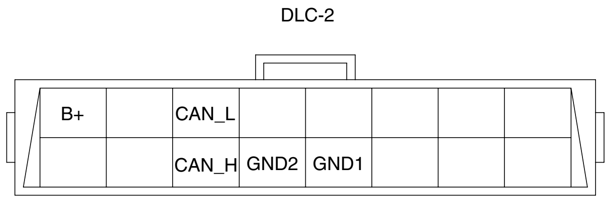
CHU0602S001

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 selected monitor item
Active command mode function	Operation command signal for selected active command item	Output part operation signal and system neutral position setting

DLC-2 CONSTRUCTION

CHU060201038S06

- 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, CAN_L, GND1, GND2 and B+ terminals.



CHU0602S002

Terminal	Function
CAN _L	Serial communication terminal (Lo)
CAN_H	Serial communication terminal (Hi)
GND1	Body GND terminal
GND2	Serial communication GND terminal
B+	Battery power supply terminal

06–13 ELECTRIC POWER STEERING (EPS)

ELECTRIC POWER STEERING (EPS) OUTLINE

CHU061301034S01

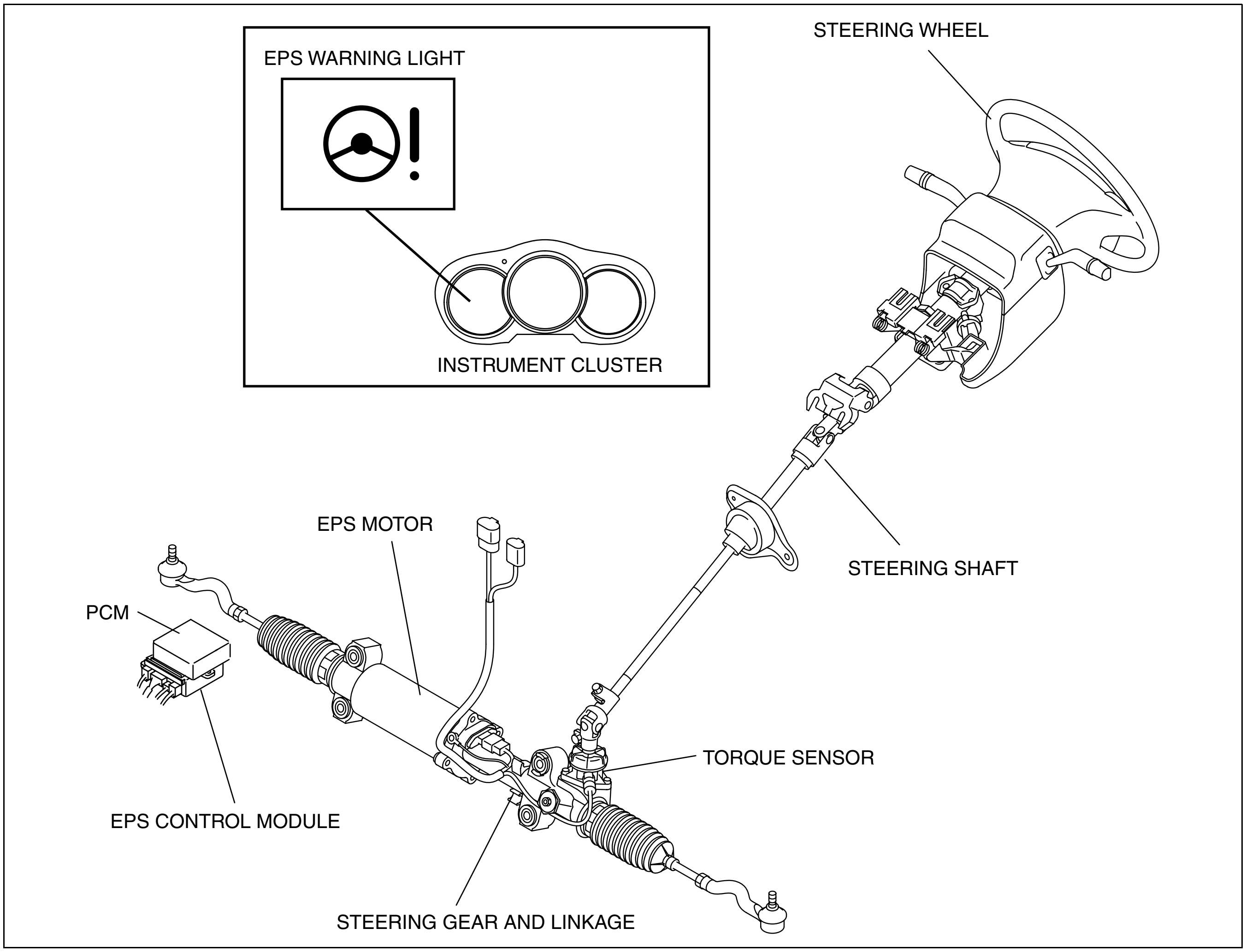
- Rack assist EPS (Electric Power Steering), with a direct-assist type rack, has been adopted for the steering rack on all models.
- EPS provides excellent steering feel and smooth handling from low to high speeds due to an electronic control system.
- Since the electric power assist system does not require a power steering oil pump, engine load has been reduced and fuel economy improved.

Caution

- **After performing the following work on the steering system, always set the EPS system to the neutral position to prevent system malfunction. Refer to the Workshop Manual for neutral position setting procedures.**
  - **— Replacing the steering gear and linkage**
  - **— Replacing the EPS control module**
  - **— Disconnecting the steering shaft joint (gear side)**

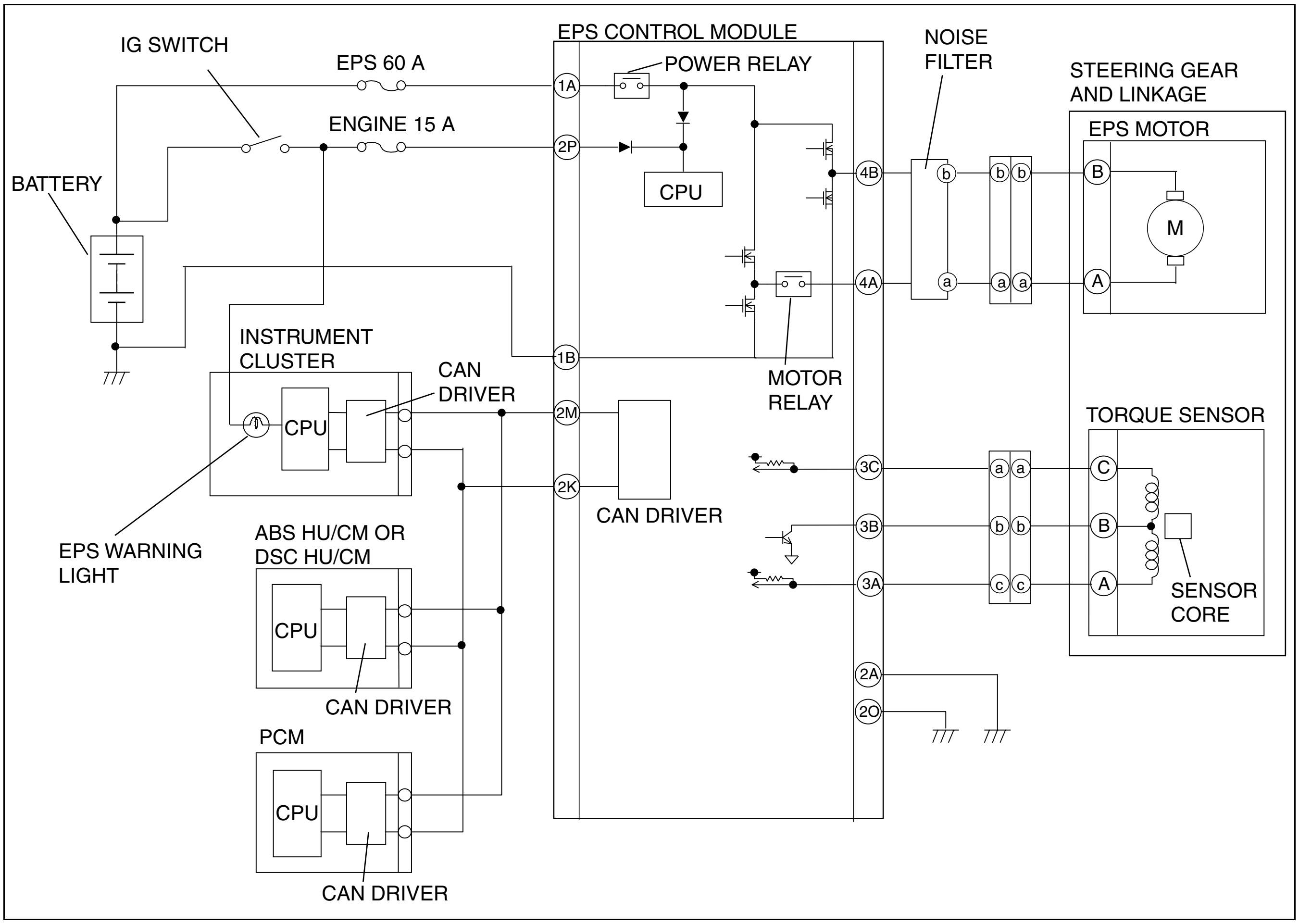
ELECTRIC POWER STEERING (EPS) STRUCTURAL VIEW

CHU061301034S02



ELECTRIC POWER STEERING (EPS) SYSTEM WIRING DIAGRAM

CHU061301034S03



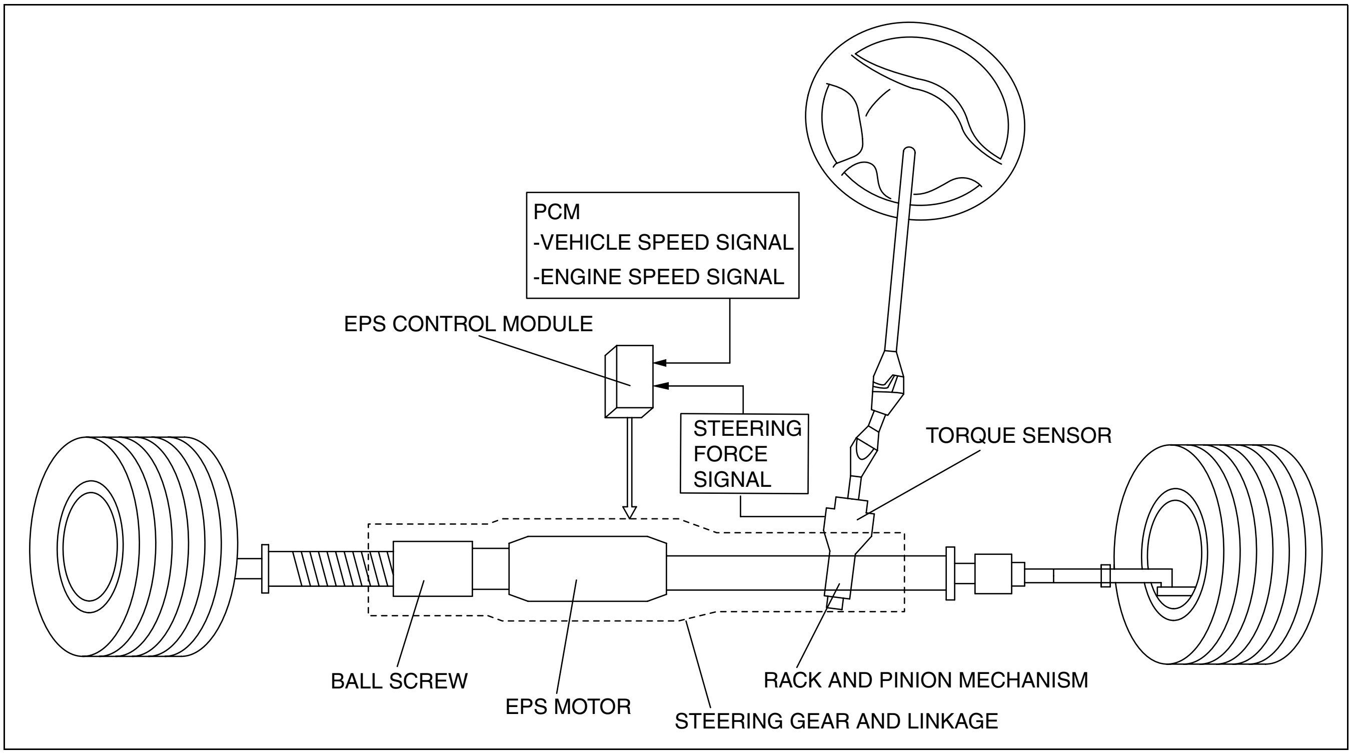
CHU0602S004

ELECTRIC POWER STEERING (EPS) CONSTRUCTION/OPERATION

CHU061301034S04

Construction

- The EPS (Electric Power Steering) consists mainly of manual steering and electric assist mechanisms, and a control system.
  - — Manual steering mechanism:
    Consists of the steering wheel, steering shaft, steering gear and linkage.
  - — Electric assist mechanism:
    Consists of the EPS motor and ball screw built into the steering gear and linkage.
  - — Control system:
    Consists of a torque sensor, and vehicle speed and engine speed signals input from the EPS control module and PCM.



CHU0613S002

Operation

- EPS assists the manual steering mechanism operation with the EPS motor, supplementing manual power during vehicle steering and reducing the load on the driver.

Manual Steering Mechanism Operation

- The steering input force, formed when the driver operates the steering wheel, is converted from a rotational movement to a linear movement by the rack and pinion mechanism of the steering gear and linkage. This linear movement is transmitted via the inner and outer ball joints to the steering knuckle and the tires are steered to the left or right.

Power Assist Mechanism Operation

- According to the steering action of the driver, the torque sensor detects the steering force for the road surface resistance and then inputs a steering force signal to the EPS control module. The EPS control module uses this steering force signal, correcting for vehicle speed and other conditions, to determine the proper power assist force.
- Based on the assist force determined by the EPS control module, the current from the motor drive circuit to the EPS motor is controlled to within the target current amount and the motor operates accordingly.
- The operating force generated by the EPS motor rotates the ball screw integrated with the motor and thereby assists the rack to turn axially. Due to this, the steering operation load on the driver is reduced.

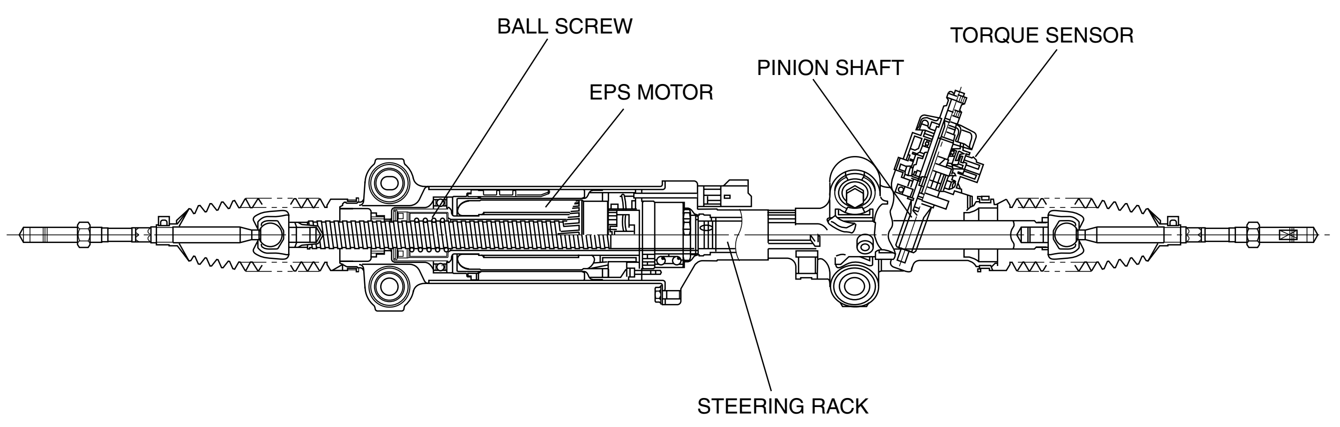
Function of Component Parts

Part name		Function
Steering gear and linkage	Torque sensor	• Detects the steering force signal and inputs it to the EPS control module.
	EPS motor	• Generates an assist force based on the control current from the EPS control module.
EPS control module		• Determines the control current for the EPS motor based on the steering force signal from the torque sensor, vehicle speed signal from the PCM and other signals. • Inputs an idle increase request signal to the PCM via CAN communication lines. • Controls the on-board diagnostic system and fail-safe function when an abnormality is detected in the EPS system.
PCM	Vehicle speed signal	• Inputs the vehicle speed signal to the EPS control module via CAN communication lines.
	Engine speed signal	• Inputs the engine speed signal to the EPS control module via CAN communication lines.
Instrument cluster	EPS warning light	• The light illuminates to inform the driver when a system malfunction is detected.

STEERING GEAR AND LINKAGE CONSTRUCTION

CHU061332960S01

- The steering gear and linkage consists of the steering rack, pinion shaft, EPS motor, ball screw and torque sensor.
- The steering rack, which has a threaded groove, is inserted through the center of the EPS motor. The rotation of the EPS motor (assist force) is transmitted via the balls inside the ball screw directly to the steering rack.
- The torque sensor, which detects the steering force, is installed on the pinion shaft.



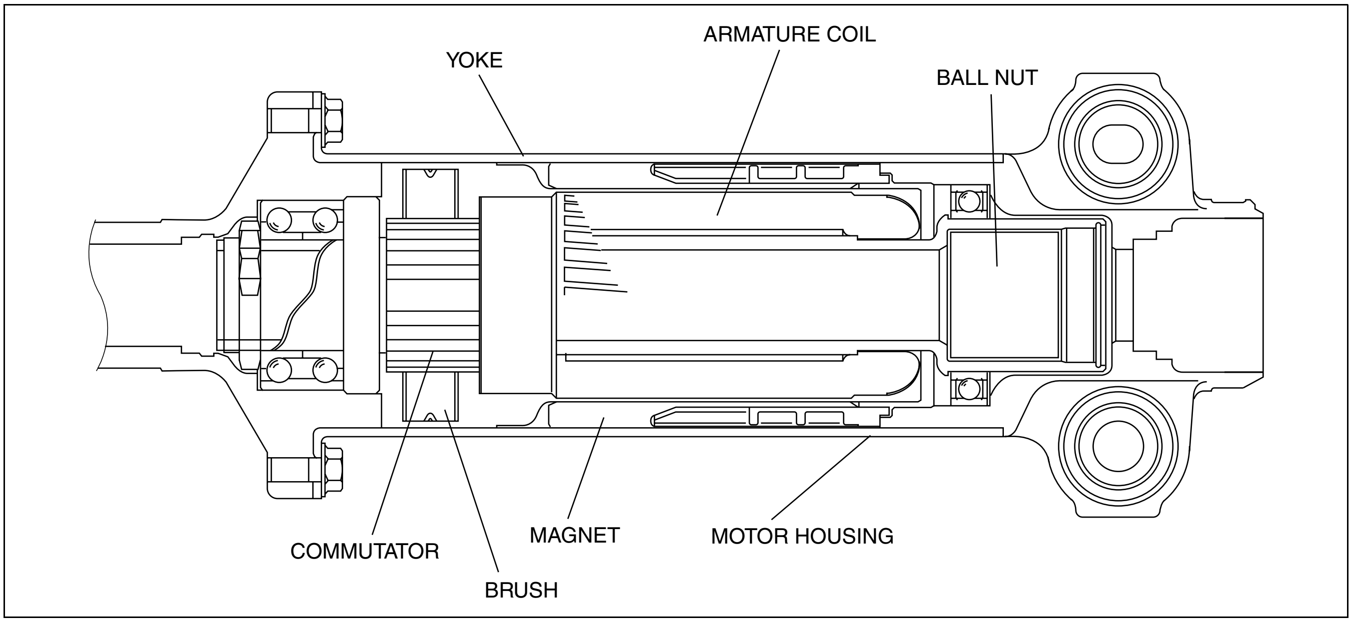
CHU0613S003

ELECTRIC POWER STEERING (EPS) MOTOR CONSTRUCTION/OPERATION

CHU061332960S02

Construction

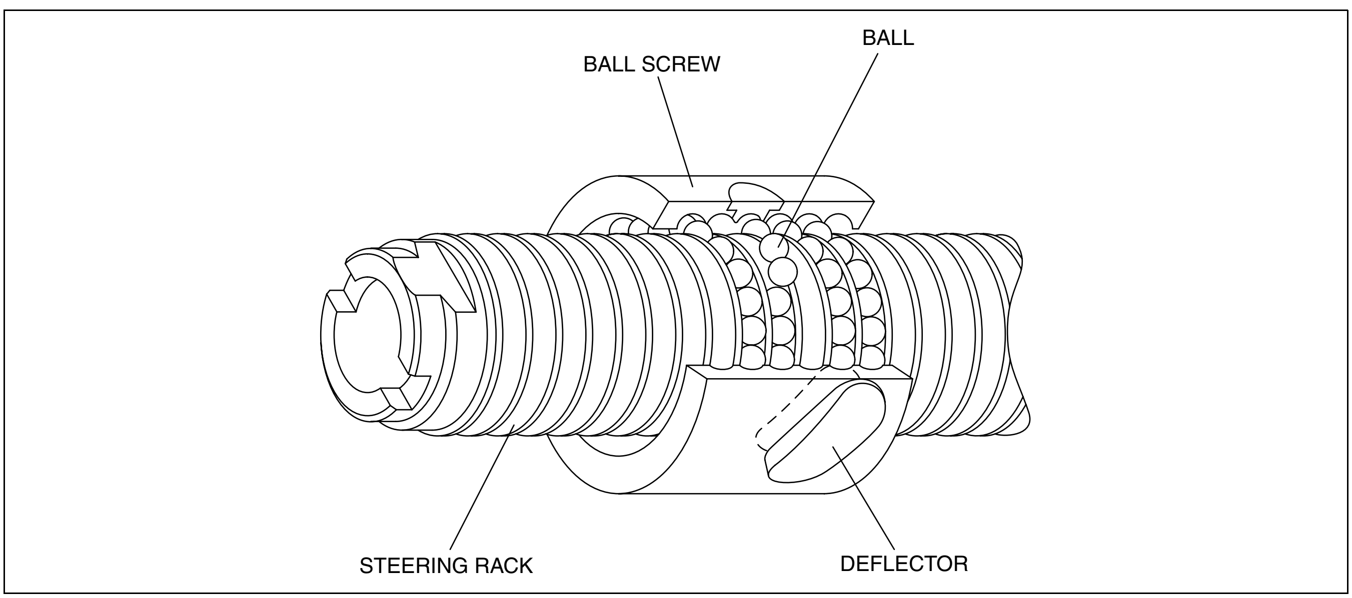
- The EPS motor is a direct current motor with a magnet fixed to the inner surface of the motor housing.
- The main structural parts are the armature coil (inserted through the steering rack), brush (where energization occurs), magnet and the ball screw.
- The armature coil moves together with the ball screw so that when the coil rotates so does the ball screw.



CHU0613S004

Operation

- The ball screw, positioned with the steering rack inserted through it, encloses balls that move in the threaded grooves between the rack and the ball screw. A deflector is attached to circulate the balls.
- When the EPS motor operates according to a control current from the EPS control module, the armature is rotated and the ball screw is rotated together with the armature. This causes the balls to roll and move along the threaded groove between the ball screw and the steering rack. The balls are continuously circulated by the ball screw deflector. Due to this, the rotational force of the EPS motor is converted via the balls into the axial direction movement of the steering rack and a highly effective means of transmission is achieved.



CHU0613S005

TORQUE SENSOR CONSTRUCTION/OPERATION

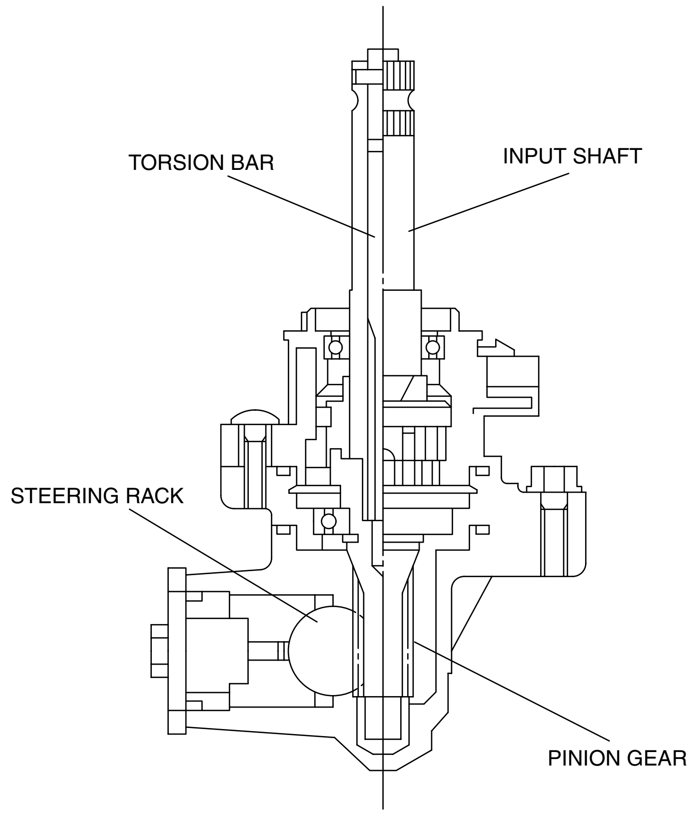
CHU061332960S03

Construction

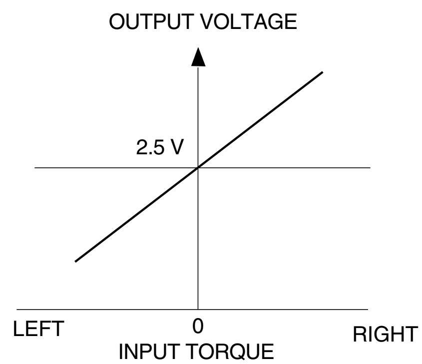
- The torque sensor, installed on the pinion shaft, detects the amount of road surface resistance (steering torque) and the steering direction, and inputs a corresponding signal to the EPS control module.

Operation

- The torsion bar within the pinion shaft is of double-construction with the steering shaft and steering gear sides joined together. Due to this, torsion forms on the torsion bar according to the steering force on the steering shaft side and the road surface resistance on the steering gear side. This torsion is converted to electrical signal based on variable inductance, and the amount of road surface resistance (steering torque) and the steering direction are detected.



TORQUE SENSOR CROSS-SECTIONAL VIEW



OUTPUT CHARACTERISTICS

CHU0613S006

ELECTRIC POWER STEERING (EPS) CONTROL MODULE CONSTRUCTION/OPERATION

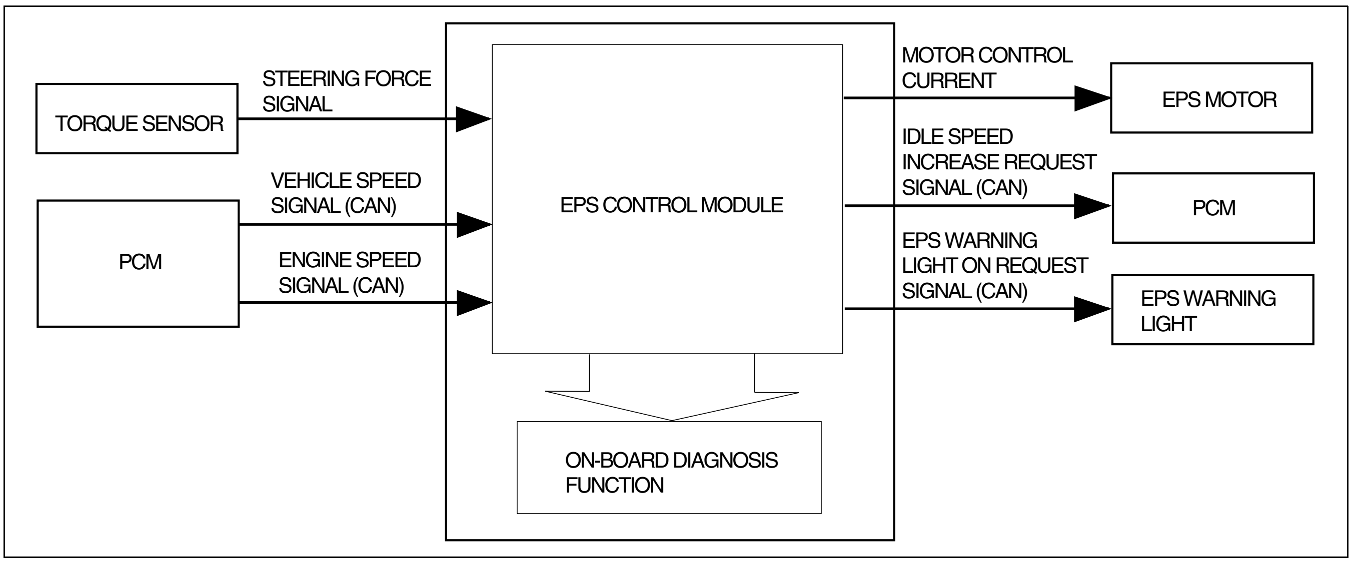
CHU061367880S01

Construction

- The EPS control module is located in the engine compartment, on the underside of the PCM.
- The module calculates the proper assist current based on the steering force signal from the torque sensor installed on the steering gear and linkage, and the vehicle and engine speed signals from the PCM using CAN communication line, and then outputs the control current to the EPS motor.

Function Table

Control items	Function
Motor current control	• Calculates the proper assist current based on the steering force, and vehicle and engine speeds, and outputs a control current to the EPS motor.
System overheating prevention control	• In order to prevent system overheating, motor current is controlled according to turning limit or motor output control.
Self-diagnosis function	• A function that allows important parts of the control system to perform self-diagnosis. In case a malfunction occurs, the EPS warning light illuminates to alert the driver, and at the same time a DTC is stored in the EPS control module. • As a result of the self-diagnosis, when a malfunction is determined, system control is suspended or limited to prevent any dangerous occurrence while driving.



CHU0613S014

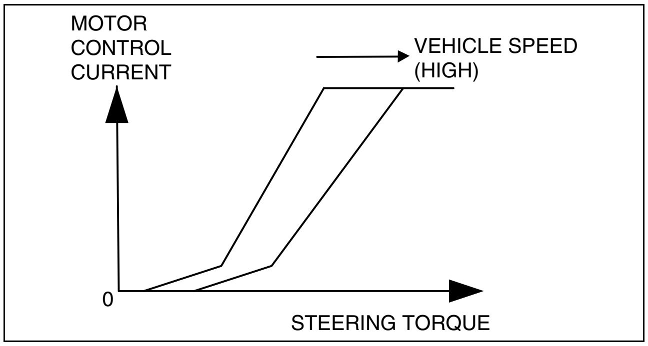
Operation

Motor current control

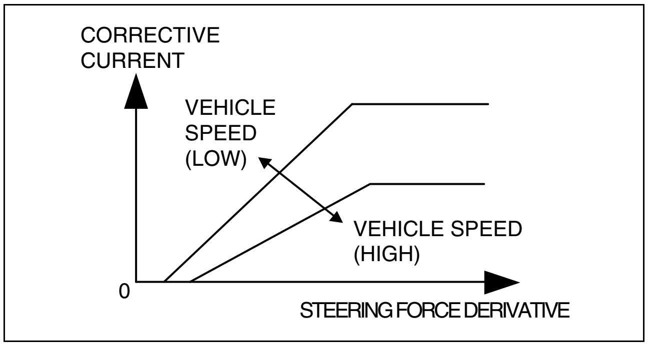
- The proper assist current is calculated based on the steering force signal from the torque sensor, and the vehicle and engine speed signals from the PCM, and then the control current is output to the EPS motor.
- Also, various control corrections are performed according to vehicle driving conditions.
  — Base current control
    - The base current is the fundamental current amount for driving the EPS motor and is calculated based on the steering force and vehicle speed signals.

  — Inertia correction control
    - The inertia correction control compensates for the influence caused by the motor body of revolution inertia (insufficient torque when starting, torque continuance when stopping). The correction current to the base current is either increased or decreased according to vehicle conditions.
    - Inertia correction control is calculated based on the steering force and vehicle speed signals, and the motor speed.

  — Damping correction control
    - The damping correction control reduces slight vibrations transmitted from the road surface (kickback) using the motor control current. The correction current to the base current is either increased or decreased according to vehicle conditions.
    - The damping correction control is calculated based on the steering force and vehicle speed signals, and the motor speed.



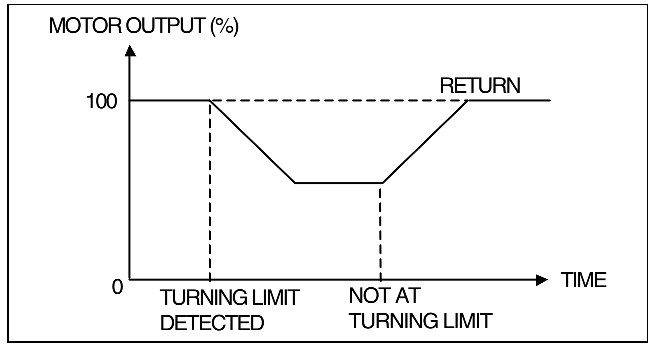
CHU0613S007



CHU0613S008

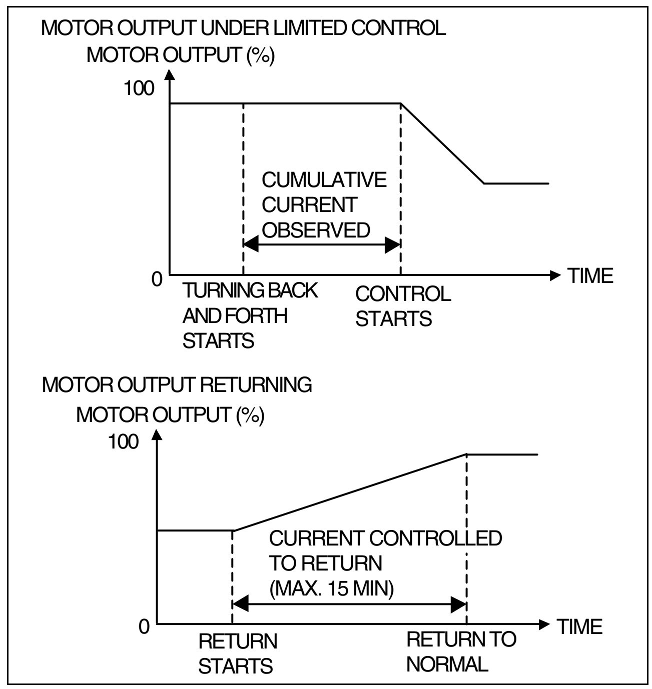
System overheating prevention control

- To prevent a malfunction of the system caused by overheating (due to motor over-speed or other factors), the steering mechanism turning limit and cumulative value of the motor current are detected and the current output to the EPS motor is controlled accordingly.
  — Turning limit control
    - The turning limit control detects the turning limit of the steering mechanism and when it is determined that the limit has been reached, current output to the EPS motor is reduced by approximately one-half.
    - Then, when it is determined that it is no longer at the turning limit, the motor current is returned to normal.



CHU0613S010

  — Motor output limit control
    - The motor output limit control detects the cumulative value of the current output to the motor, and if the steering mechanism is turned from lock to lock continuously (or similar repetitious operation), current output to the EPS motor is lowered.
    - The motor current will gradually return to normal after the steering torque is detected at **0 N·m {0 kgf·cm, 0 in·lbf}** or the ignition switch is turned off. A maximum of **15 min** is required to return to normal conditions.



CHU0613S011

CONTROLLER AREA NETWORK (CAN) OUTLINE

CHU061367880S02

- The EPS control module sends and receives data to and from other modules via the CAN. Refer to Section 09 for a detailed explanation of the CAN.

Transmitted information

- EPS warning light ON request
- Idle speed increase request

Received information

- Vehicle speed
- Engine speed

ENERGY ABSORBING SYSTEM CONSTRUCTION/OPERATION

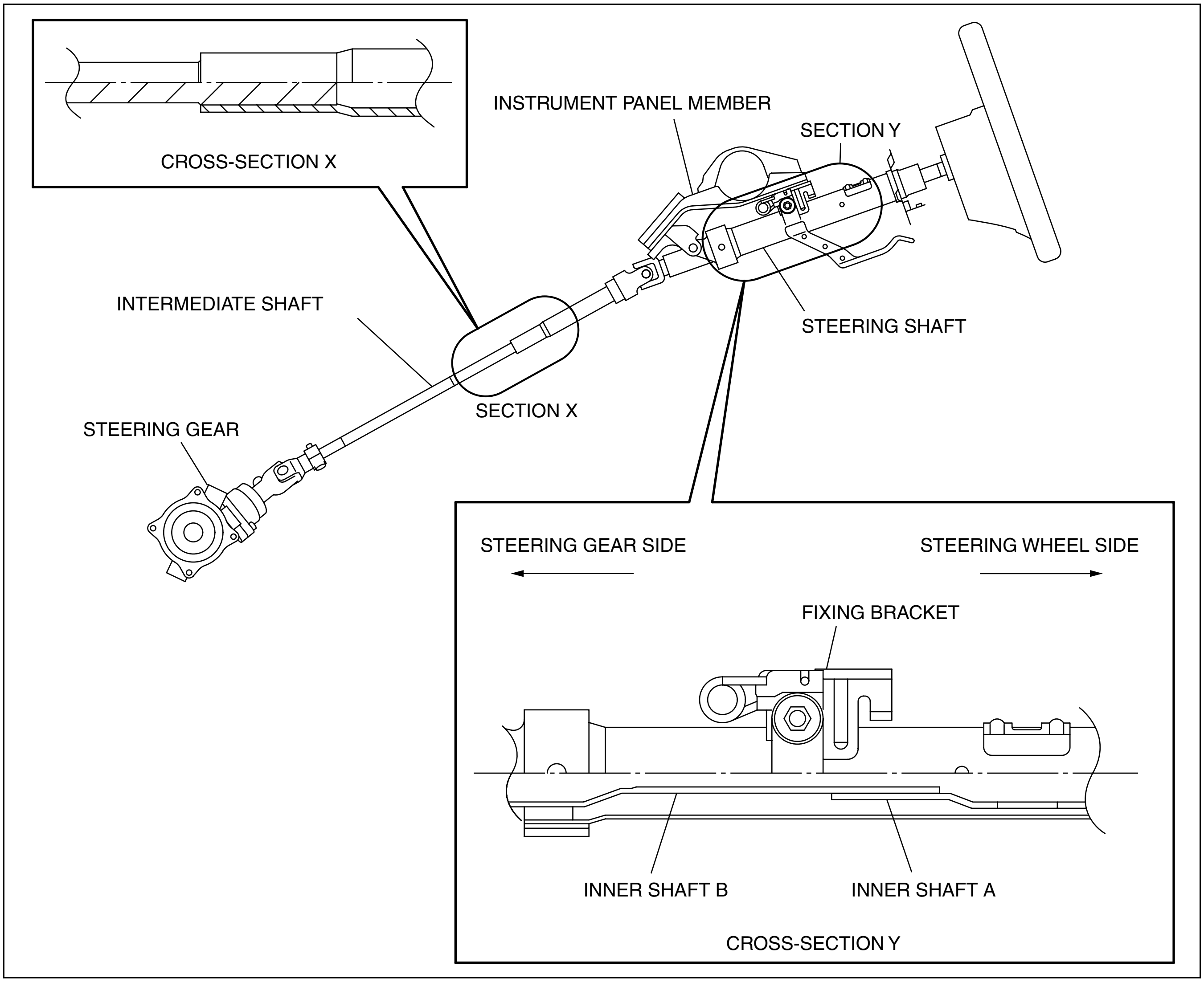
CHU061332010S01

Construction

- Due to impact absorbing mechanisms at two points on the steering shaft, when a collision occurs, the steering shaft effectively absorbs the impact energy that would be transmitted to the driver, thereby reducing injury.

Operation

- At the moment of a collision, the rearward collapse of the steering gear and linkage takes in the impact energy from the front (first stage impact), causing the intermediate shaft connecting the steering gear and linkage with the steering shaft to contract, thereby absorbing the impact energy. (Section X in the figure)
- Then, as the steering wheel contacts the body of the driver (second stage impact), the fixing bracket of the steering shaft comes off the dashboard member causing inner shafts A and B to contract, thereby absorbing the impact energy. (Section Y in the figure)



CHU0613S013

HEATER, VENTILATION & AIR CONDITIONING (HVAC)

07 SECTION

07–00 OUTLINE

HVAC ABBREVIATION

CHU070001038S01

A/C	Air Conditioning
B+	Battery Positive Voltage
CPU	Central Processing Unit
HI	High
IG	Ignition
LO	Low
M	Motor
MAX	Maximum
OFF	Switch Off
ON	Switch On
PCM	Powertrain Control Module
REC	Recirculate

HVAC FEATURES

CHU070001038S02

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

HVAC SPECIFICATIONS

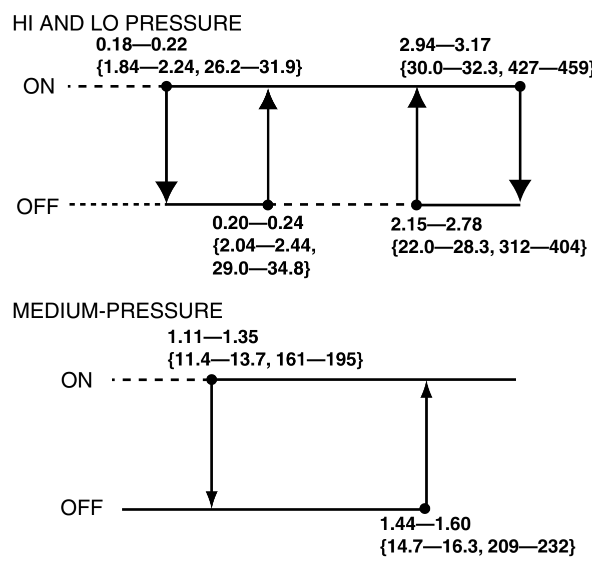
CHU070001038S03

Basic System

Item			Specification
Heating capacity (kW {kcal/h})			4.400 {3,784}
Cooling capacity (kW {kcal/h})			4.500 {3,870}
Refrigerant	Type		R-134a
	Regular amount (approx. quantity) (g {oz})		430 {15.2}
A/C compressor	Type		Scroll type
	Discharge capacity (ml {cc, fl oz})		60 {60, 2.03}
	Max. allowable speed (rpm)		9,000
	Lube oil	Type	DENSO OIL8
		Sealed volume (approx. quantity) (ml {cc, fl oz})	60 {60, 2.03}

Item			Specification
Condenser	Type		Multiflow (sub-cooling type)
	Radiated heat	(kW {kcal/h})	7.0 {6,020}
	Receiver/drier capacity	(ml {cc, fl oz})	190 {190, 6.42}
	Desiccant		XH-9
Expansion valve	Type		External pressure equalizer
Evaporator	Type		Double-tank drawn cup
Temperature control			Reheat full air mix type

Control System

Item			Specification
Airflow volume (during heater operation)	Blower motor	(m^3/h)	300
Electricity consumption (during heater operation)	Blower motor	(W)	220
Airflow volume (during air conditioner operation)	Blower motor	(m^3/h)	460
Electricity consumption (during air conditioner operation)	Blower motor	(W)	220
	Magnetic clutch	(W)	35
Magnetic clutch clearance		(mm {in})	0.20—0.45 {0.008—0.017}
Fan type	Blower motor		Sirocco fan
Refrigerant pressure switch	Type		Triple-pressure
	Operating pressure	(MPa {kgf/cm^2, psi})	
Sensor	Ambient temperature sensor		Thermistor
	Evaporator temperature sensor		
Actuator	Air intake actuator		Sliding contact type
	Air mix actuator		Potentiometer type
	Airflow mode actuator		

07–11 BASIC SYSTEM

BASIC SYSTEM OUTLINE

CHU071101040S01

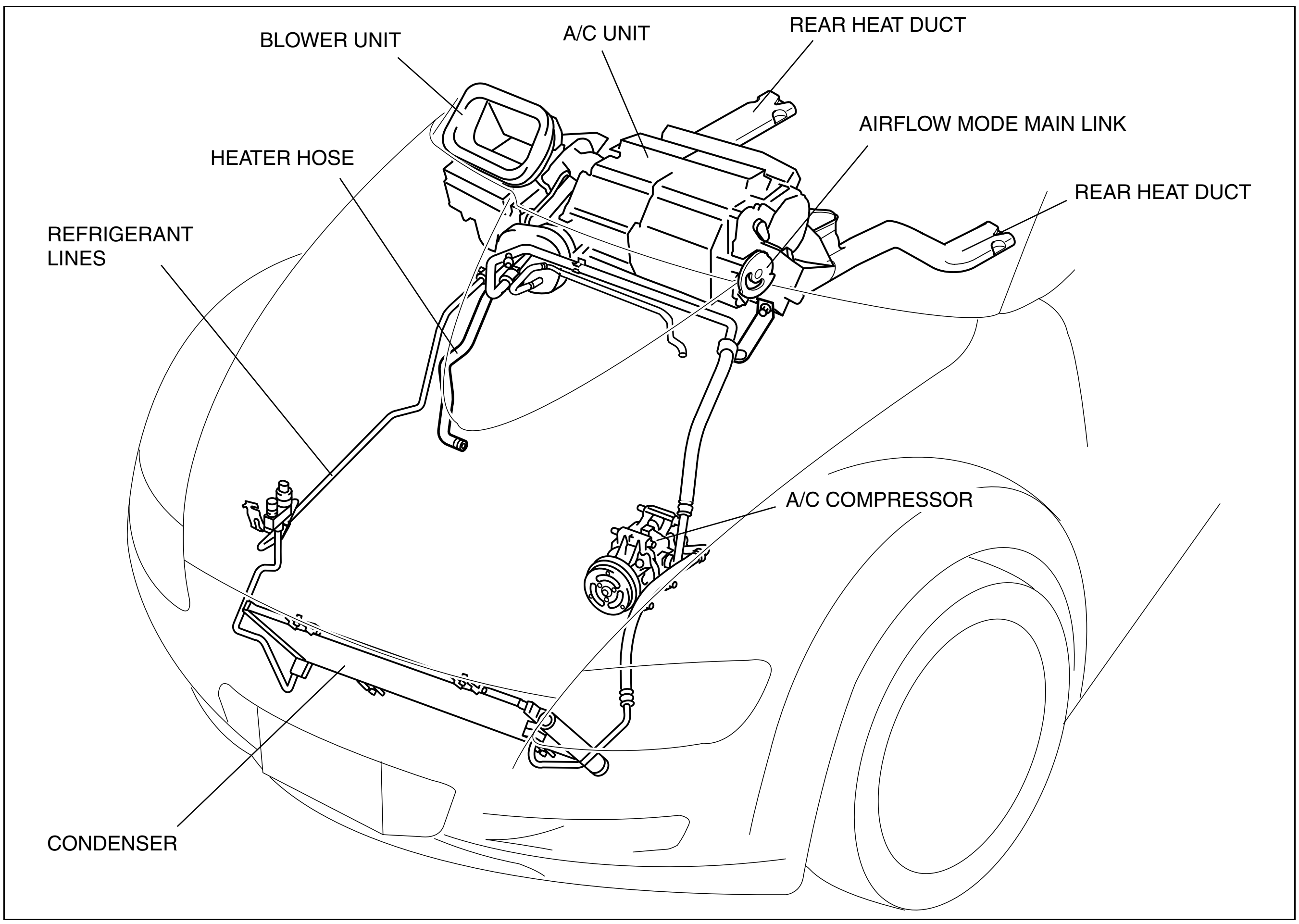
Reduced Weight
- A/C unit with integrated cooling and heater units adopted to reduce weight.

Improved Air Conditioning Performance
- Sub-cooling system with an integrated condenser and receiver/drier adopted to facilitate evaporator operation. This system also reduces the number of parts and the amount of refrigerant.

Improved Comfort
- Air filter, which cleans air flowing into passenger compartment, adopted.

BASIC SYSTEM STRUCTURAL VIEW

CHU071101040S02

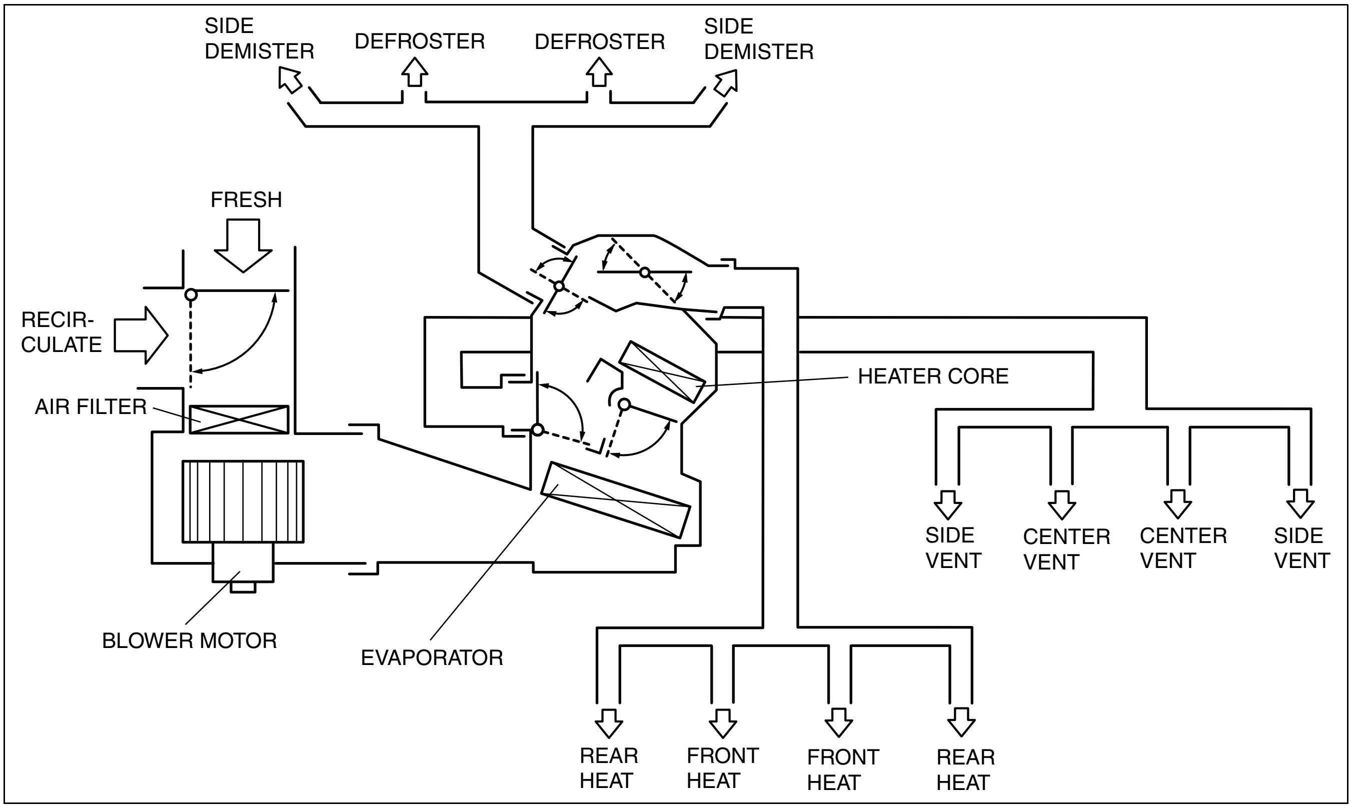


CHU0711S003

BASIC SYSTEM FLOW DIAGRAM

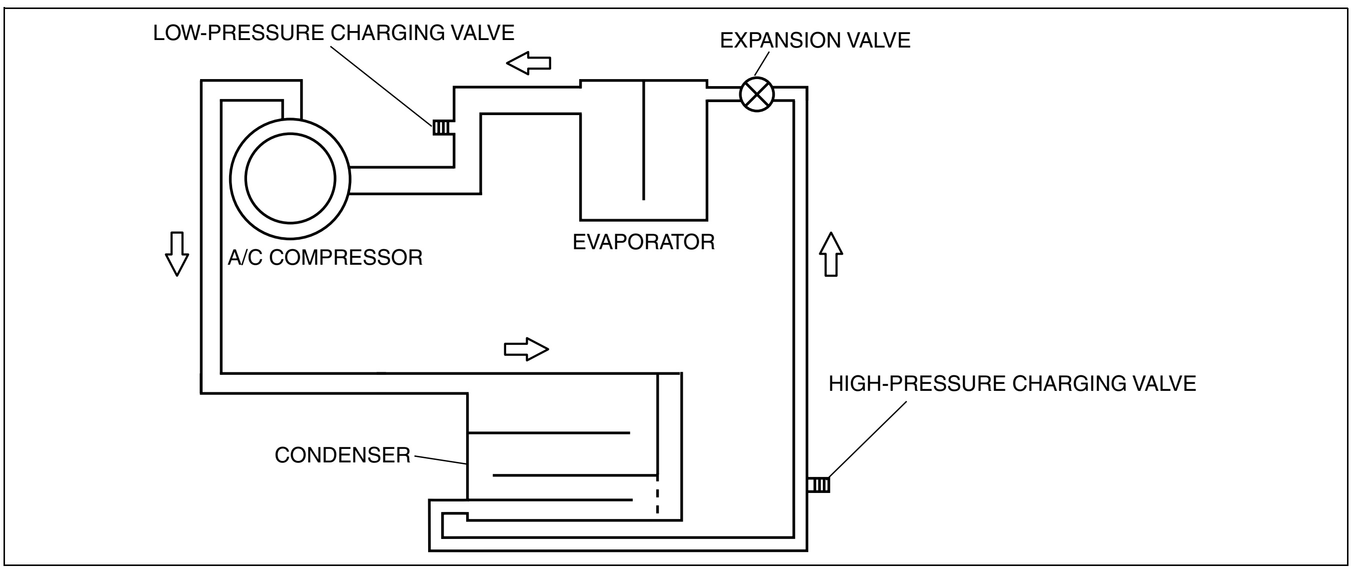
CHU071101040S03

VENTILATION SYSTEM



CHU0711S004

REFRIGERANT SYSTEM

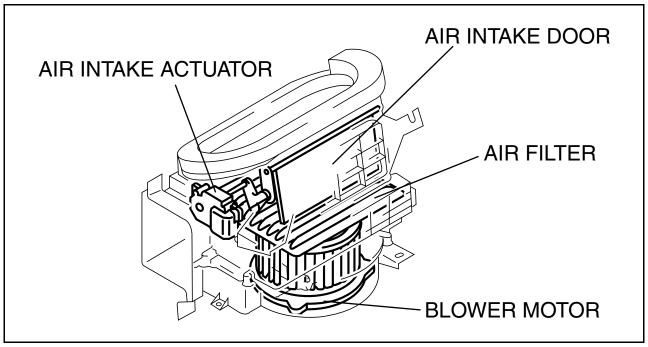


CHU0711S005

BLOWER UNIT CONSTRUCTION

CHU071113988S01

- Composed of the following parts:
  — Blower motor
  — Air intake door
  — Air intake actuator
  — Air filter

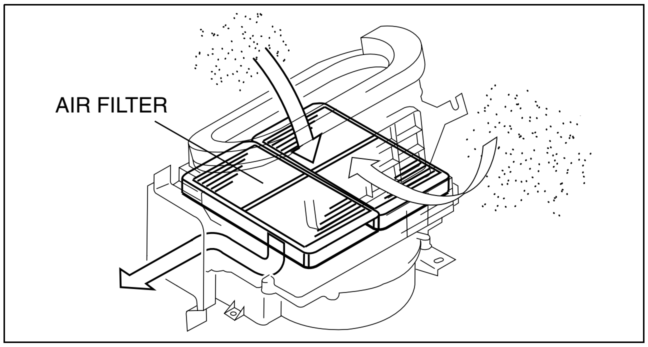


CHU0711S006

AIR FILTER FUNCTION

CHU071113988S02

- An air filter that can remove pollen and dust has been adopted.
- The air filter cannot be reused and must be replaced periodically. Even new air filters are gray, so be careful not to mistake the gray color for dirt.
- Air filter can be replaced easily.



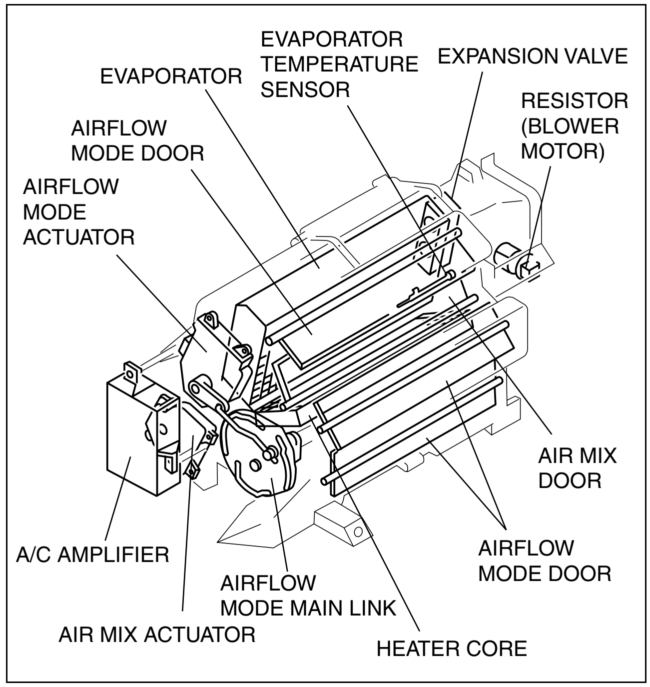
CHU0711S007

A/C UNIT CONSTRUCTION/OPERATION

CHU071161130S01

Construction

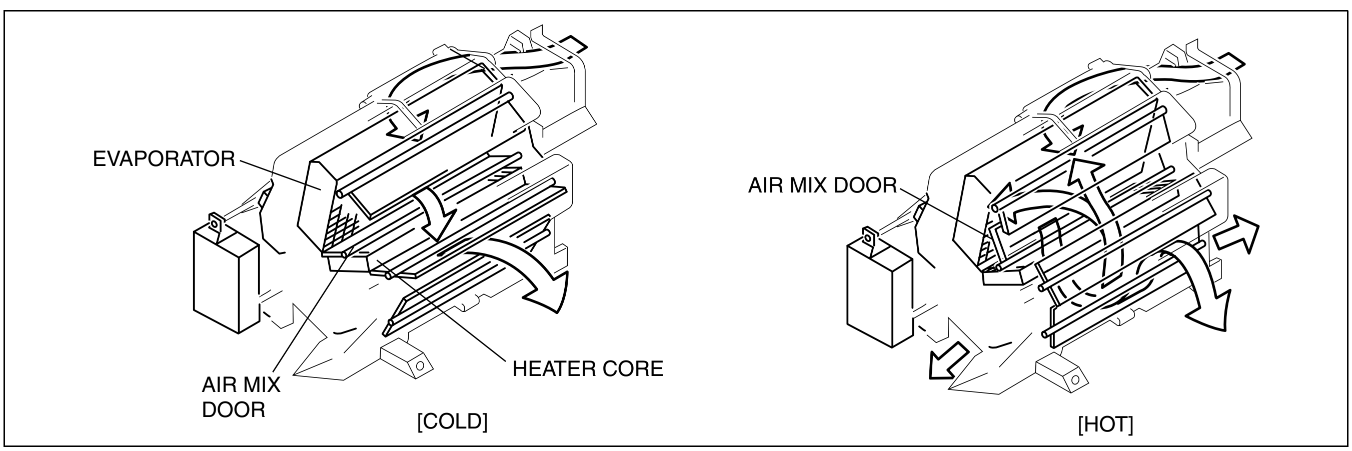
- An A/C unit with integrated cooling and heater units has been adopted.
  - — Evaporator
  - — Heater core
  - — Expansion valve
  - — Air mix door
  - — Airflow mode door
  - — Evaporator temperature sensor
  - — Resistor (blower motor)
  - — Air mix actuator
  - — Airflow mode actuator
  - — A/C amplifier



CHU0711S008

Air Mix Door Operation

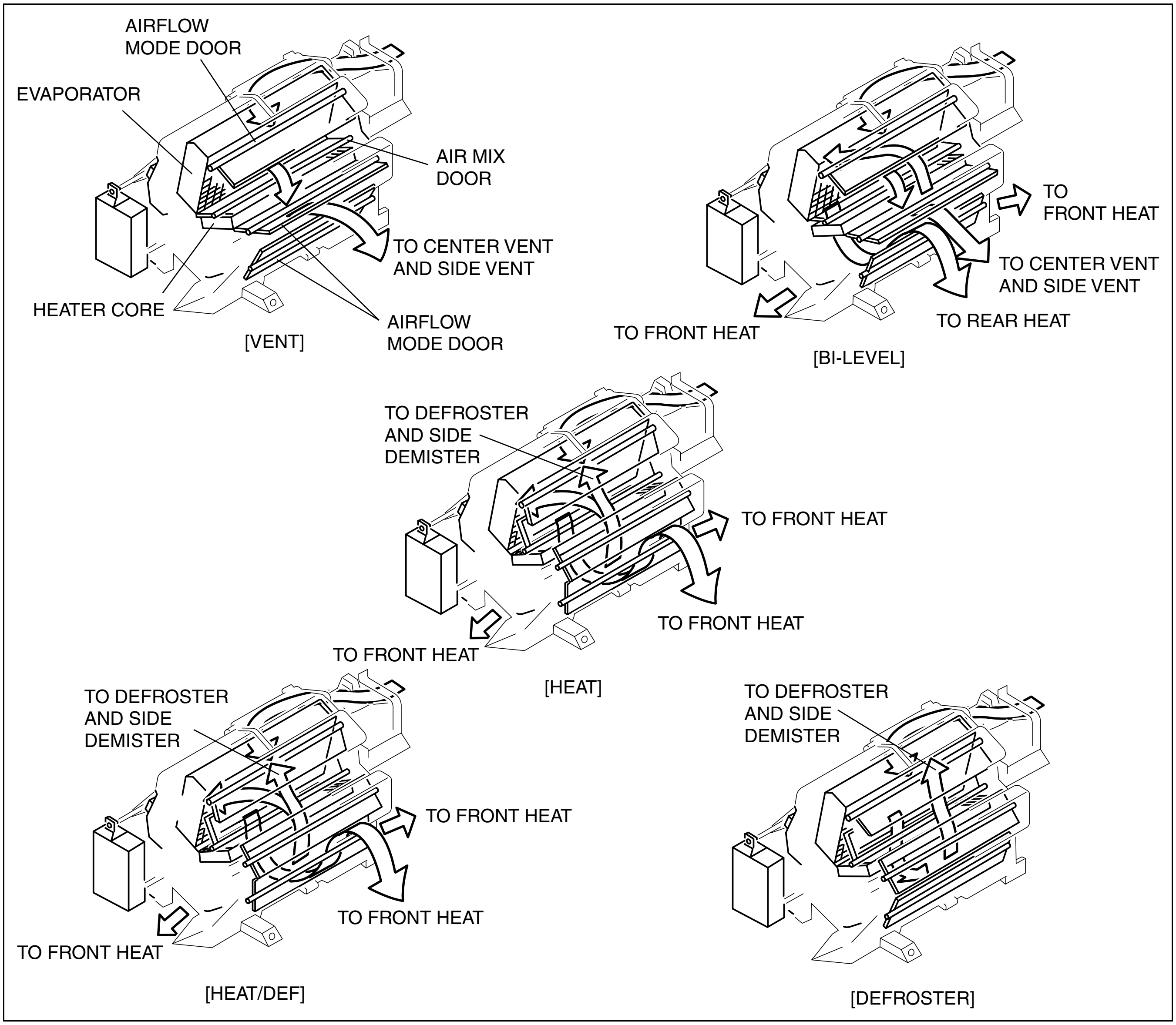
- The air mix door, installed in the A/C unit, controls HOT or COLD positions, depending on the position of the temperature control dial. As a result, the airflow distribution changes, and the airflow temperature is controlled.



CHU0711S009

Airflow Mode Door Operation

- The airflow mode doors move to the VENT, BI-LEVEL, HEAT, HEAT/DEF, or DEFROSTER position, depending on the position of the airflow mode selector switch. As a result, the airflow mode changes.



CHU0711S010

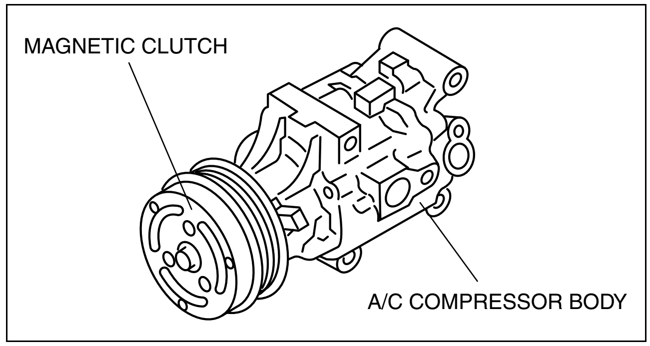
Airflow Distribution

AIRFLOW MODE	AIRFLOW RATE (%)											
	VENT				HEAT				DEFROSTER			
	DRIVER-SIDE		PASSENGER-SIDE		DRIVER-SIDE		PASSENGER-SIDE		DRIVER-SIDE		PASSENGER-SIDE	
	SIDE	CENTER	CENTER	SIDE	FRONT	REAR	FRONT	REAR	SIDE	CENTER	CENTER	SIDE
VENT	25	25	25	25	–	–	–	–	–	–	–	–
BI-LEVEL	12.5	12.5	12.5	12.5	16.25	8.75	16.25	8.75	–	–	–	–
HEAT	–	–	–	–	27	14.5	27	14.5	2	6.5	6.5	2
HEAT/DEF	–	–	–	–	16.25	8.75	16.25	8.75	6	19	19	6
DEFROSTER	–	–	–	–	–	–	–	–	12	38	38	12

A/C COMPRESSOR CONSTRUCTION

CHU071161480S01

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

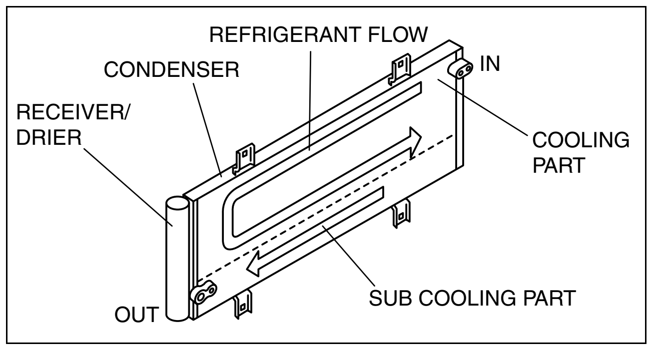


CHU0711S011

CONDENSER CONSTRUCTION

CHU071161480S02

- 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.

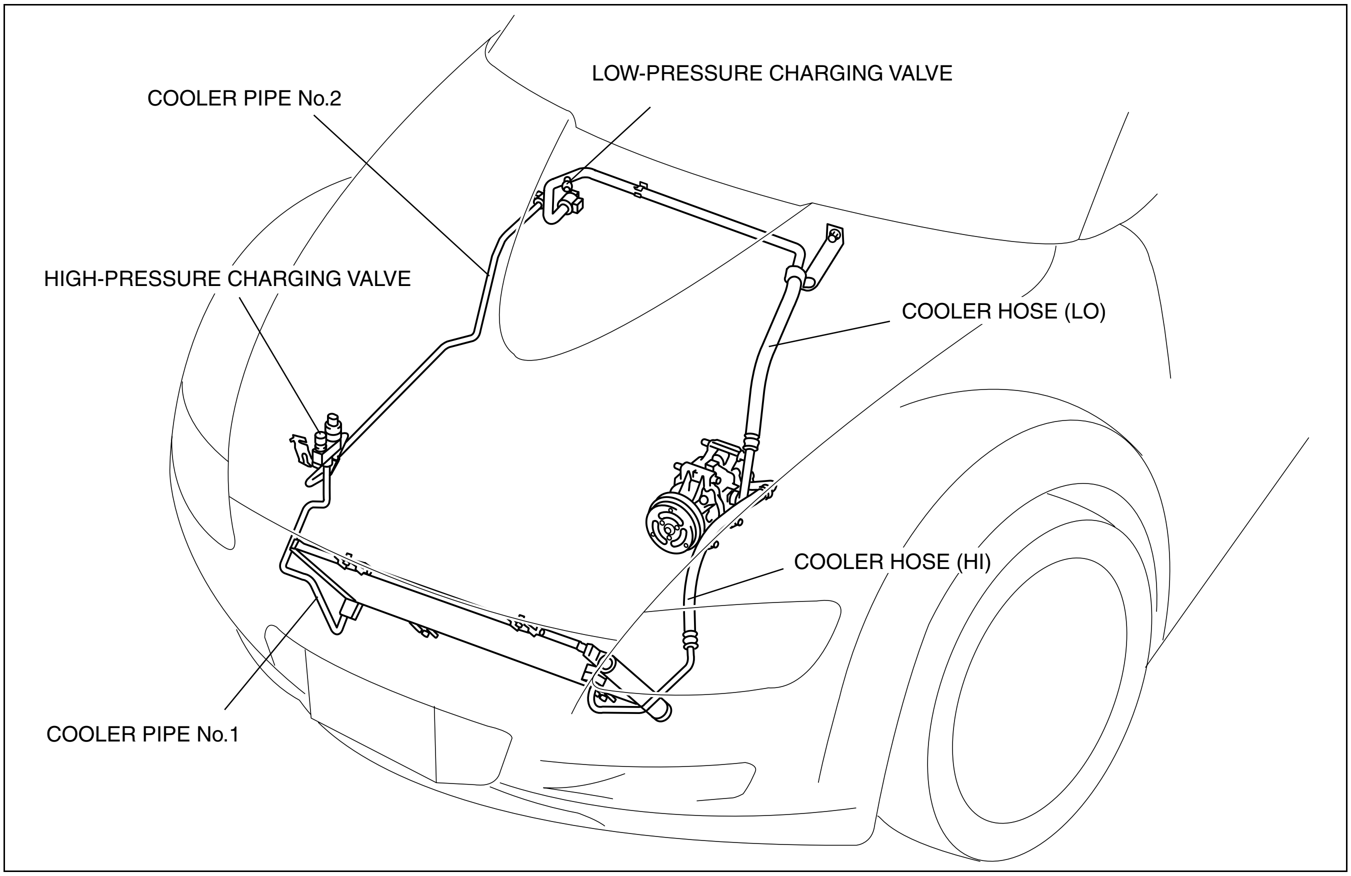


CHU0711S012

REFRIGERANT LINES CONSTRUCTION

CHU071161460S01

- Aluminum alloy has been adopted for the pipes of the refrigerant lines and rubber (flexible hoses) has been adopted for the hoses.
- A high-pressure charging valve is installed on cooler pipe No.2, and a low-pressure charging valve is installed on the cooler hose (LO).



CHU0711S013

07–40 CONTROL SYSTEM

CONTROL SYSTEM OUTLINE

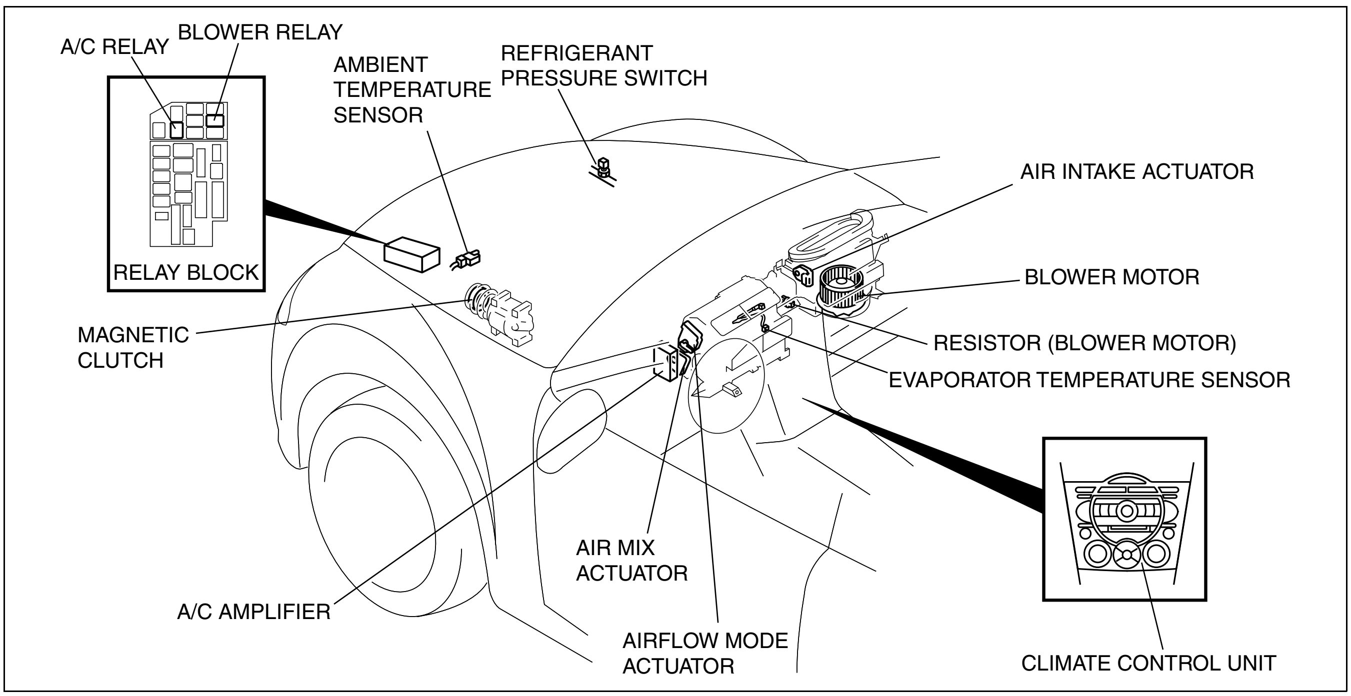
CHU074001040S01

Improved Marketability

- Logic-type manual air conditioner adopted.

CONTROL SYSTEM STRUCTURAL VIEW

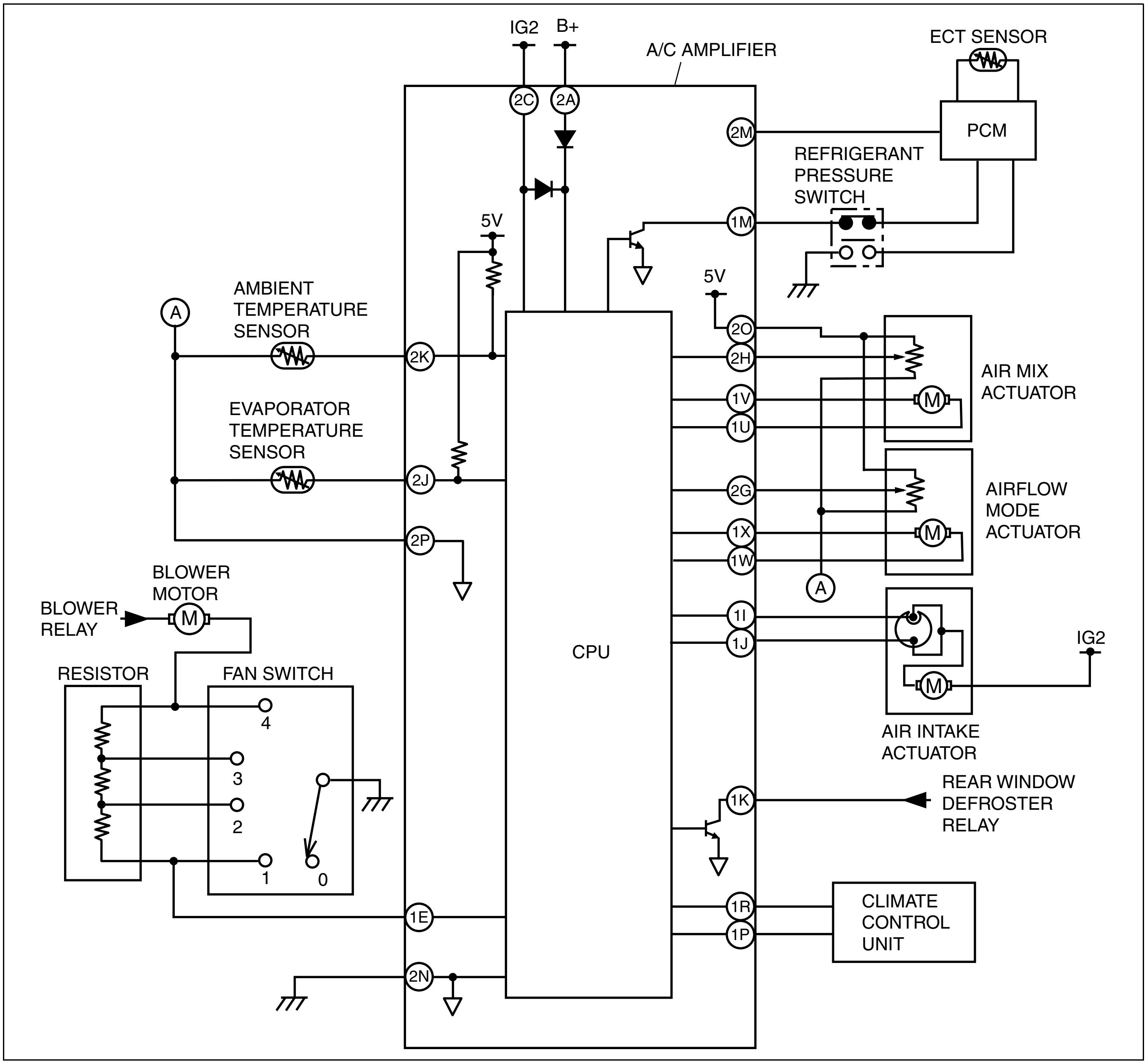
CHU074001040S02



CHU0740S001

CONTROL SYSTEM SYSTEM WIRING DIAGRAM

CHU074001040S03

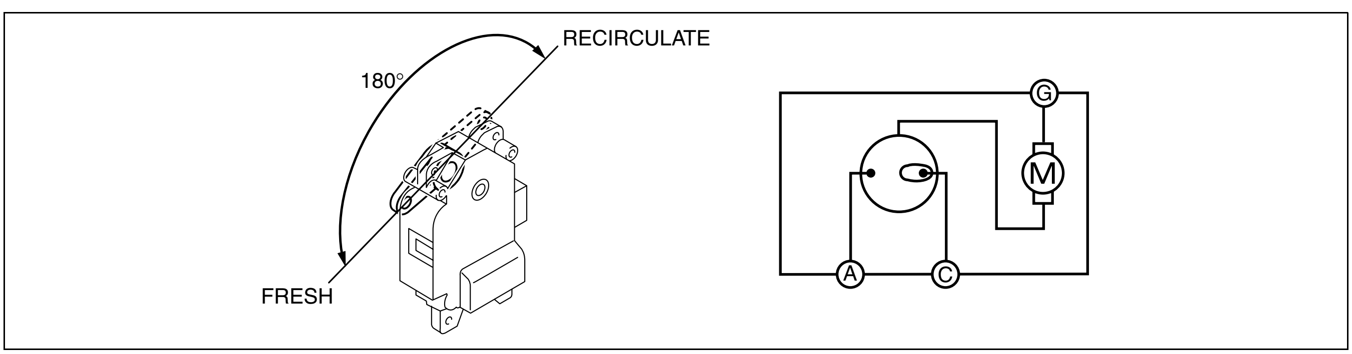


CHU0740S008

AIR INTAKE ACTUATOR CONSTRUCTION

CHU074061480S01

- A sliding contact type has been adopted.

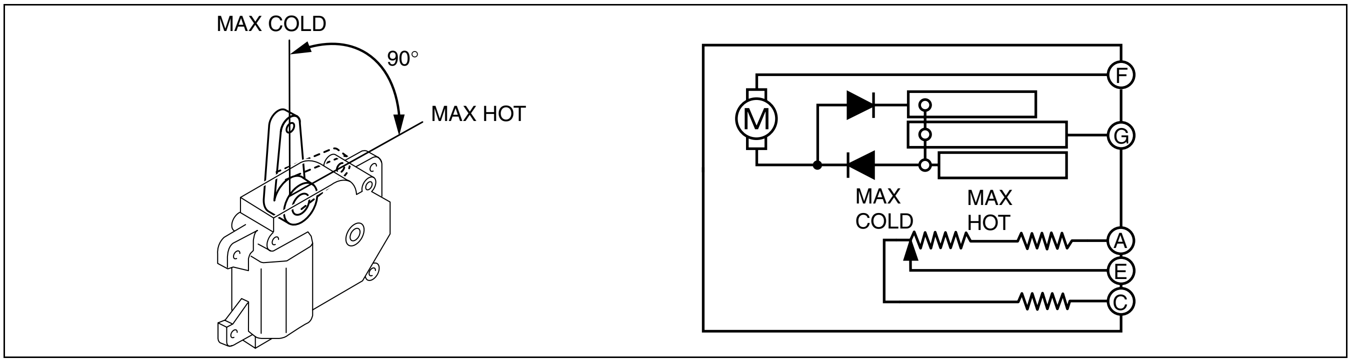


CHU0740S002

AIR MIX ACTUATOR CONSTRUCTION

CHU074061480S02

- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

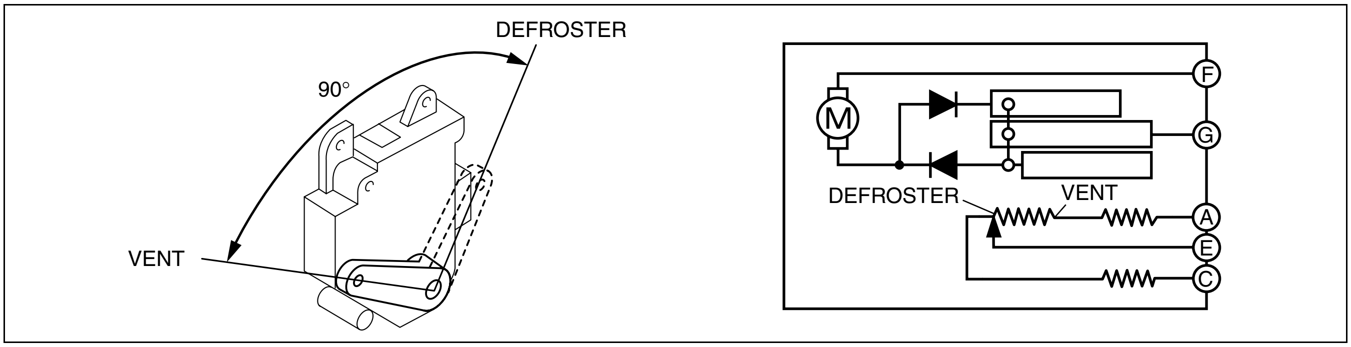


CHU0740S003

AIRFLOW MODE ACTUATOR CONSTRUCTION

CHU074061480S03

- A potentiometer type, which allows minute and smooth changes of the door position, has been adopted.

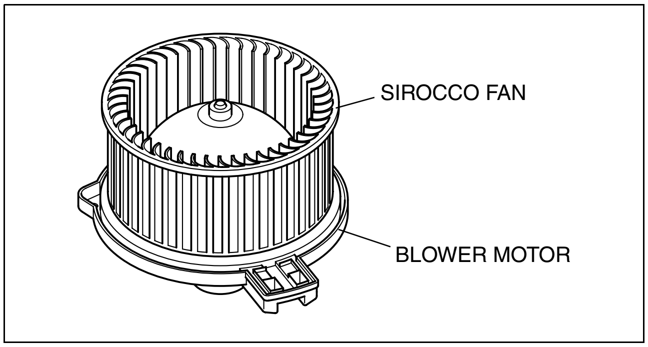


CHU0740S004

BLOWER MOTOR CONSTRUCTION

CHU074061480S04

- A sirocco fan has been adopted.



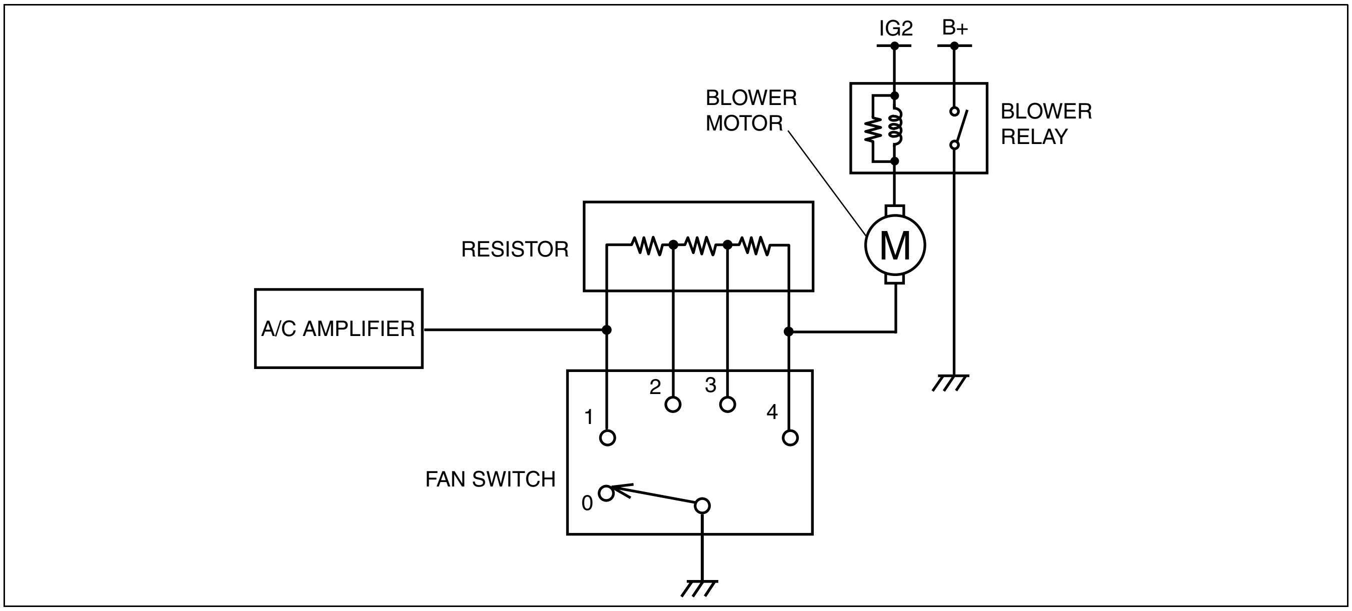
CHU0740S005

07–40

RESISTOR OPERATION

CHU074061480S05

- Changes the resistance value of the blower motor operation current based on fan switch operation to control the airflow volume.

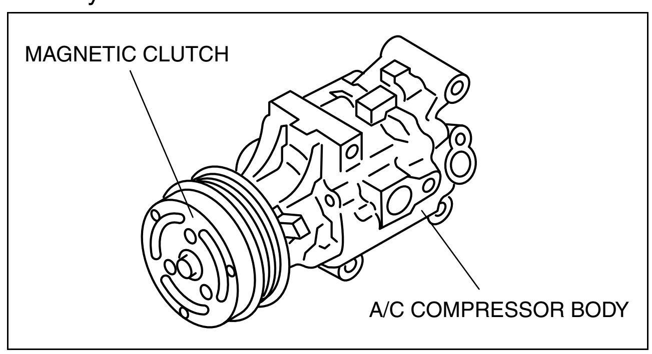


CHU0740S009

MAGNETIC CLUTCH CONSTRUCTION

CHU074061480S06

- Engages and disengages the A/C compressor body according to control signals from the PCM. When engaged, it transmits engine power to the A/C compressor body via the drive belt.

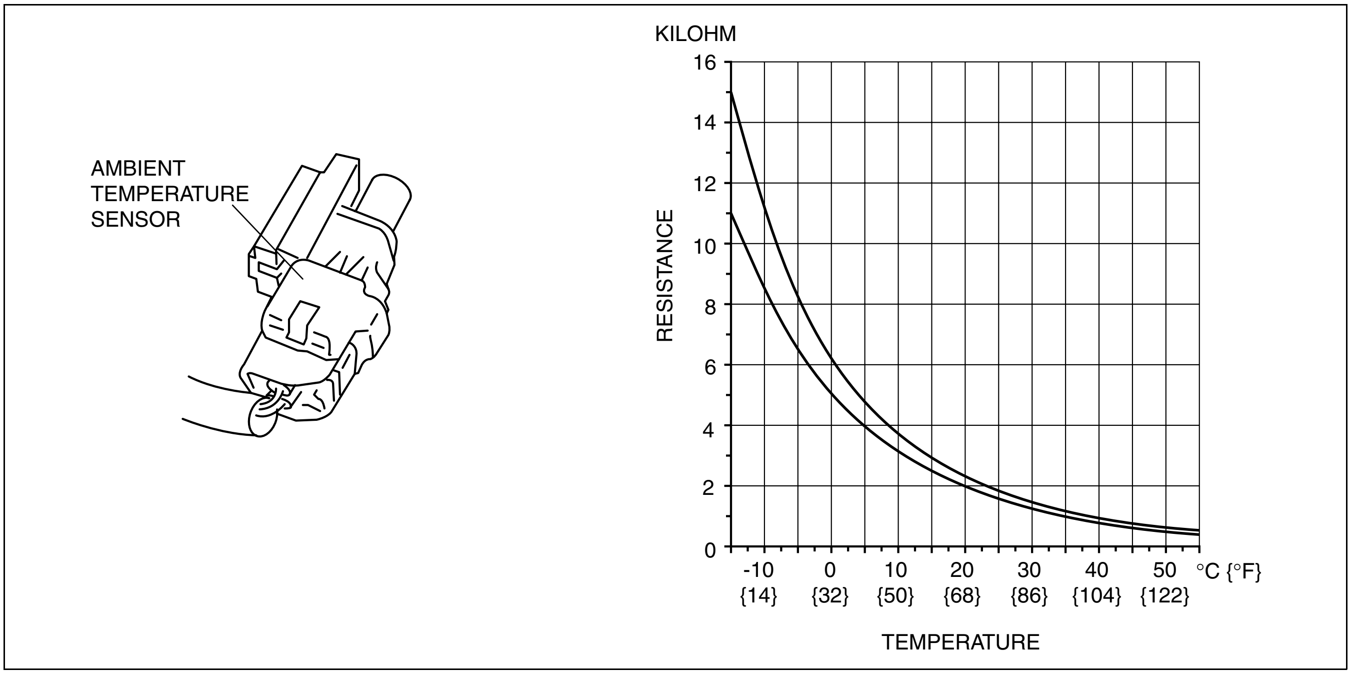


CHU0711S011

AMBIENT TEMPERATURE SENSOR CONSTRUCTION

CHU074061480S07

- A thermistor type has been adopted.

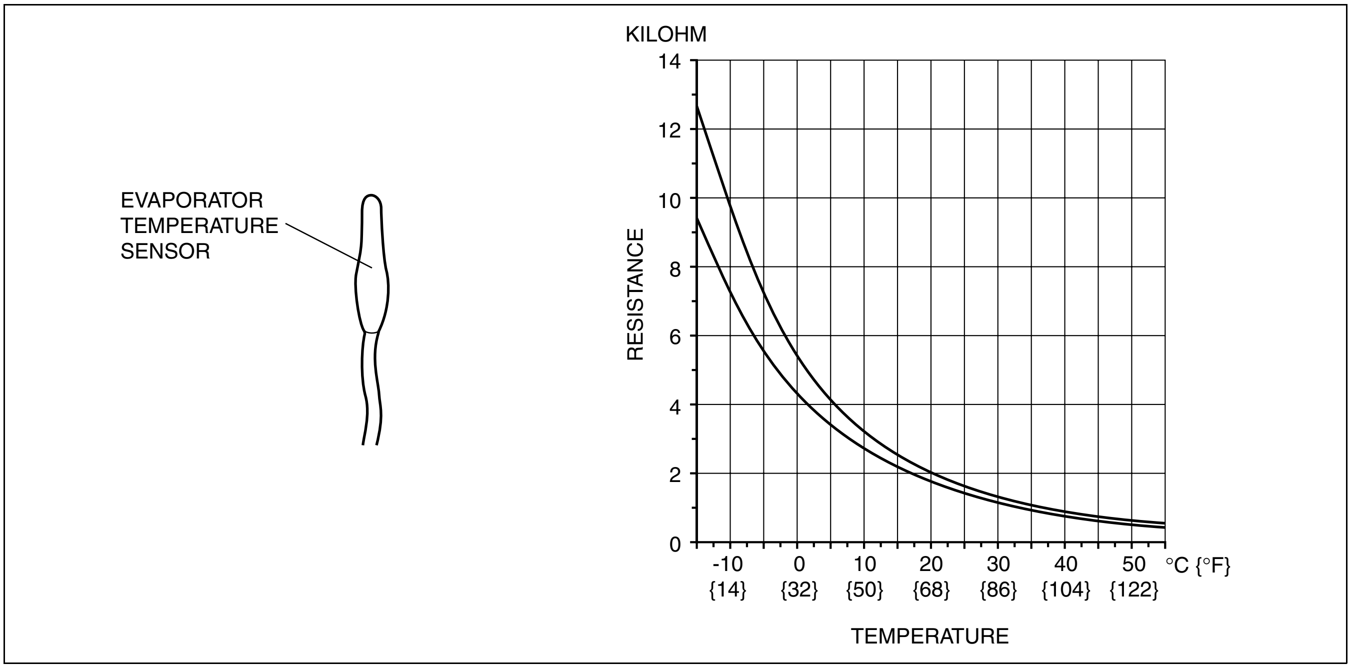


CHU0740S012

EVAPORATOR TEMPERATURE SENSOR CONSTRUCTION

CHU074061480S08

- A thermistor type has been adopted.



CHU0740S007

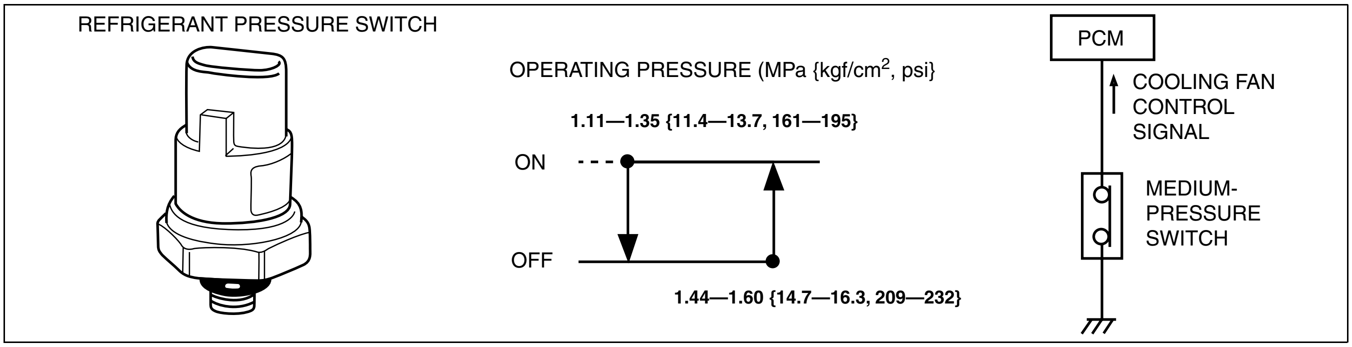
REFRIGERANT PRESSURE SWITCH CONSTRUCTION

CHU074061480S09

- A triple-pressure type has been adopted.
- The refrigerant pressure switch is composed of the high-pressure and low-pressure switches, which cut the A/C signal to protect the refrigeration cycle if pressure in the refrigeration cycle is too high or too low; and the medium-pressure switch, which sends an cooling fan control signal according to the operation load of the cooling fan.

Medium-pressure Switch

- When 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.
- When the PCM receives a cooling fan control signal while the A/C is on, it sends an operation signal to the cooling fan relay.

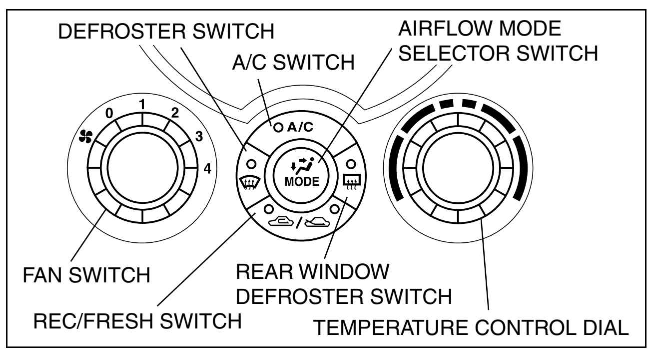


CHU0740S006

CLIMATE CONTROL UNIT CONSTRUCTION

CHU074013988S01

- Composed of the following parts:
  - — Fan switch
  - — Airflow mode selector switch
  - — REC/FRESH switch
  - — A/C switch
  - — Temperature control dial
  - — Defroster switch
  - — Rear window defroster switch

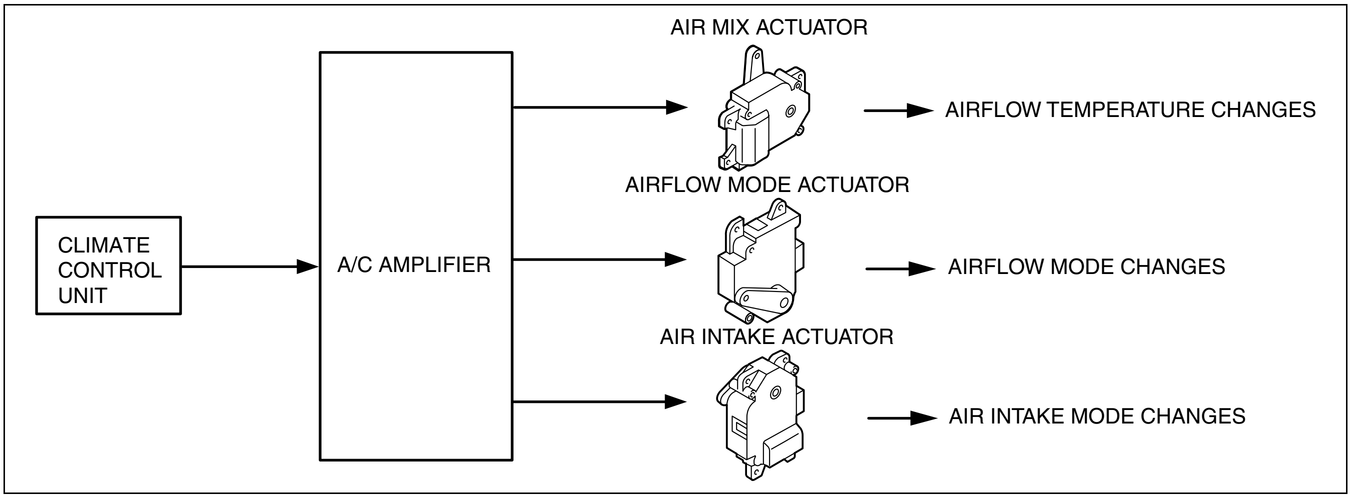


CHU0740S010

A/C AMPLIFIER FUNCTION

CHU074061480S10

- Receives signals from the climate control unit and sends operation control signals to the actuators.
- A/C amplifier has defroster control.



CHU0740S011

Defroster Control

- To improve defrosting when the climate control unit airflow mode selector switch is turned to HEAT/DEF or the defroster switch is on, the defroster control switches air intake to FRESH mode, and switches A/C to ON.

Airflow mode	Air intake mode (REC/FRESH switch pressed)	A/C ON/OFF (A/C switch pressed)	
		A/C	A/C illumination
VENT, BI-LEVEL, HEAT	RECIRCULATE⇔FRESH	OFF	OFF
		ON	ON
HEAT/DEF, DEFROSTER	FRESH	ON	ON⇔OFF

RESTRAINTS

08 SECTION

08–00 OUTLINE

RESTRAINTS ABBREVIATIONS

CHU080001045S01

ALR	Automatic Locking Retractor
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
ELR	Emergency Locking Retractor
GND	Ground
IG	Ignition
LED	Light Emitting Diode
LH	Left Hand
PID	Parameter Identification
RH	Right Hand
SAS	Sophisticated Air bag Sensor
SST	Special Service Tool
WDS	Worldwide Diagnostic System

RESTRAINTS FEATURES

CHU080001045S02

Improved safety	• A 2-step deployment control has been added 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.

08–02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC FUNCTION OUTLINE

CHU080201046S01

- The on-board diagnostic function consists of the following functions: a failure detection function, which detects malfunctions in the air bag system-related parts; a memory function, which stores detected DTCs; a self-diagnostic function, which indicates system malfunctions using DTCs; a PID/data monitoring function, which reads out specific input/output signals.
- Using the WDS or equivalent, DTCs can be read out and deleted, and the PID/data monitoring function can be activated.
- A fail-safe function, prevents the abrupt activation of the air bag module and the pre-tensioner seat belt in case of an air bag system malfunction.

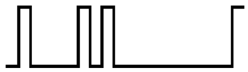
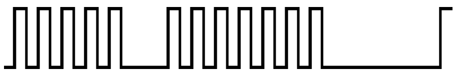
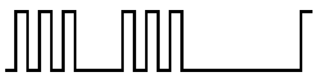
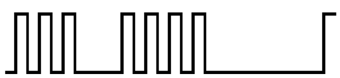
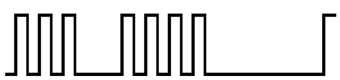
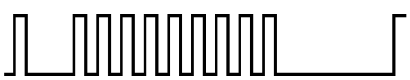
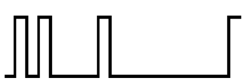
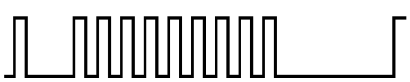
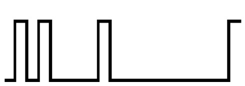
ON-BOARD DIAGNOSTIC FUNCTION FUNCTION

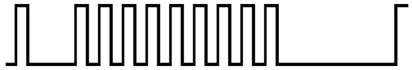
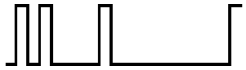
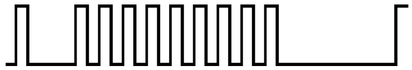
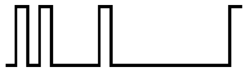
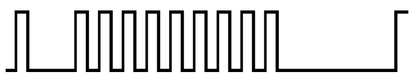
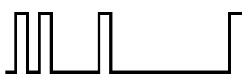
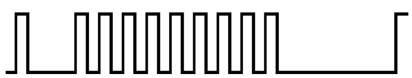
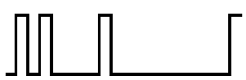
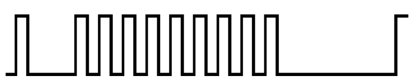
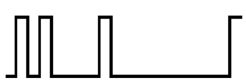
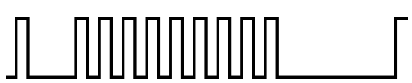
CHU080201046S02

Self-diagnostic Function

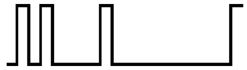
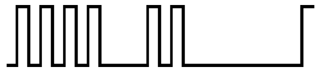
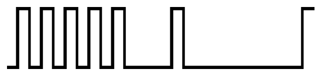
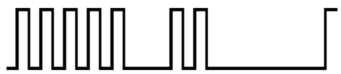
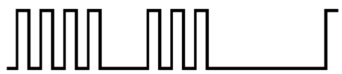
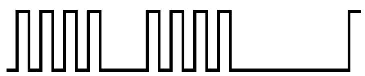
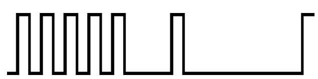
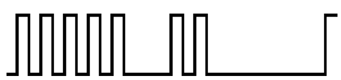
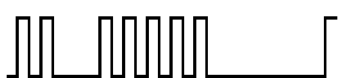
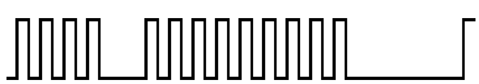
- The self-diagnostic function determines that there is a malfunction, outputs a signal, as a DTC, to the DLC-2, and at the same time, flashes the air bag system warning light to advise the driver of a malfunction.
- The air bag system warning light illuminates or flashes to indicate a single DTC according to the present malfunction. (If there is more than one present malfunction, only one DTC will be displayed according to the preset priority ranking.)
- The air bag system warning light will flash the DTC pattern for five cycles, and then will remain illuminated until the ignition switch is turned to the LOCK position.
- The self-diagnostic function consists of a present malfunction diagnostic and a past malfunction diagnostic.

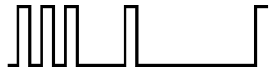
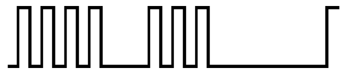
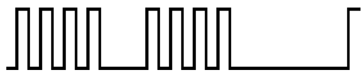
DTC table

DTC				
WDS display	Air bag system warning light			System malfunction location
	Flashing pattern		Priority ranking	
B1231	13		3	SAS control module activation (deployment) control freeze
B1342	12		2	SAS control module
	—	Continuously illuminated	1	SAS control module (DTC 12 detection circuit malfunction)
B1426	57		21	Seat belt warning light circuit short to power supply
B1427				Seat belt warning light circuit open
B1869	—	Continuously illuminated	1	Air bag system warning light circuit open
	—	Does not illuminate	—	Air bag system warning light circuit short to body ground
B1870	—	Continuously illuminated	1	Air bag system warning light circuit short to power supply
B1877	33		13	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		12	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
B1885	33		13	Driver-side pre-tensioner seat belt circuit resistance low
B1886	34		12	Passenger-side pre-tensioner seat belt circuit resistance low
B1913	19		11	Driver-side air bag module (inflator No.1) circuit short to body ground
	21		10	Passenger-side air bag module (inflator No.1) circuit short to body ground
B1916	19		11	Driver-side air bag module (inflator No.1) circuit short to power supply
B1921	14		4	Activation (deployment) inhibited due to configuration setting
B1925	21		10	Passenger-side air bag module (inflator No.1) circuit short to power supply

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1932	19		11	Driver-side air bag module (inflator No.1) circuit resistance high
B1933	21		10	Passenger-side air bag module (inflator No.1) circuit resistance high
B1934	19		11	Driver-side air bag module (inflator No.1) circuit resistance low
B1935	21		10	Passenger-side air bag module (inflator No.1) circuit resistance low
B1992	22		15	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		14	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
B2228	19		11	Driver-side air bag module (inflator No.2) circuit short to body ground
B2229	21		10	Passenger-side air bag module (inflator No.2) circuit short to body ground
B2230	19		11	Driver-side air bag module (inflator No.2) circuit short to power supply
B2231	21		10	Passenger-side air bag module (inflator No.2) circuit short to power supply
B2232	19		11	Driver-side air bag module (inflator No.2) circuit resistance high
B2233	21		10	Passenger-side air bag module (inflator No.2) circuit resistance high
B2234	19		11	Driver-side air bag module (inflator No.2) circuit resistance low

08–02

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B2235	21		10	Passenger-side air bag module (inflator No.2) circuit resistance low
B2296	42		9	Crash zone sensor (communication error, internal circuit abnormal)
B2434	51		18	Driver-side front buckle switch circuit short to ground
B2435				Driver-side front buckle switch circuit resistance not within specification
B2438	52		19	Passenger-side front buckle switch circuit short to ground
B2439				Passenger-side front buckle switch circuit resistance not within specification
B2444	43		8	Driver-side side air bag sensor (internal circuit abnormal)
B2445	44		7	Passenger-side side air bag sensor (internal circuit abnormal)
B2477	54		5	Configuration error
B2691	51		18	Driver-side front buckle switch circuit open or short to power supply
B2692	52		19	Passenger-side front buckle switch circuit open or short to power supply
B2773	24		17	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		16	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
C1947	49		20	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 open or short to power supply

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B2867	31		6	Poor connection of any SAS control module connectors
U2017	43		8	Driver-side side air bag sensor (communication error)
U2018	44		7	Passenger-side side air bag sensor (communication error)

PID/Data Monitoring Function

- By using the PID/data monitoring function, the monitored item of the input/output signal, as set on the SAS control module, can be freely selected and read out in real-time.
- The WDS or equivalent is used to read out PID/data monitor information.

PID/data monitor table

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
CCNT_RCM (Number of continuous DTCs)	—	• DTCs detected: 1—255 • No DTCs detected: 0	—
D_ABAGR2 (Driver-side air bag module (inflator No.2) resistance)	Ohms	Under any condition: 1.5—3.7 ohms	1G, 1J
D_CRSH_S (Driver-side side air bag sensor status)	OK/ COMM_FAIL/ INT_FAIL	• Sensor normal: OK • Sensor communication error: COMM_FAIL • Sensor internal circuit abnormal: INT_FAIL	2Z, 2AA
DABAGR (Driver-side air bag module (inflator No.1) resistance)	Ohms	Under any condition: 1.5—3.7 ohms	1S, 1V
D_PTENSFLT (Driver-side pre-tensioner seat belt circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Pre-tensioner seat belt circuit resistance low: SQ_LOWRES	2P, 2S
DR_BUKL (Driver-side buckle switch status)	Buckled/ Unbuckled	• Driver-side buckle switch on: Buckled • Driver-side buckle switch off: Unbuckled	2T
DR_CURTN (Driver-side curtain air bag module resistance)	Ohms	Under any condition: 1.4—3.2 ohms	2V, 2Y
DR_PTENS (Driver-side pre-tensioner seat belt resistance)	Ohms	Under any condition: 1.5—3.1 ohms	2P, 2S
DS_AB (Driver-side side air bag module resistance)	Ohms	Under any condition: 1.4—3.2 ohms	2M, 2O
DS_AB_ST (Driver-side side air bag module circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2M, 2O
DS_CURT_ST (Driver-side curtain air bag module circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2V, 2Y

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
DS1_STAT (Driver-side air bag module (inflator No.1) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1S, 1V
DS2_STAT (Driver-side air bag module (inflator No.2) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1G, 1J
DSB_P_ST (Driver-side pre-tensioner seat belt circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Pre-tensioner seat belt circuit resistance low: SQ_LOWRES	2P, 2S
FNT_CRSH_S (Crash zone sensor status)	OK/ COMM_FAIL/ INT_FAIL	• Sensor normal: OK • Sensor communication error: COMM_FAIL • Sensor internal circuit abnormal: INT_FAIL	1B, 1C
OD_D_CRSH (Driver-side side air bag sensor status)	OK/ COMM_FAIL/ INT_FAIL	• Sensor normal: OK • Sensor communication error: COMM_FAIL • Sensor internal circuit abnormal: INT_FAIL	2Z, 2AA
OD_D_CURT (Driver-side curtain air bag module circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2V, 2Y
OD_DAB1_ST (Driver-side air bag module (inflator No.1) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1S, 1V
OD_DAB2_ST (Driver-side air bag module (inflator No.2) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1G, 1J
OD_DSAB_ST (Driver-side side air bag module circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2M, 2O
OD_F_CRSH (Crash zone sensor status)	OK/ COMM_FAIL/ INT_FAIL	• Sensor normal: OK • Sensor communication error: COMM_FAIL • Sensor internal circuit abnormal: INT_FAIL	1B, 1C
OD_P_CRSH (Passenger-side side air bag sensor status)	OK/ COMM_FAIL/ INT_FAIL	• Sensor normal: OK • Sensor communication error: COMM_FAIL • Sensor internal circuit abnormal: INT_FAIL	2B, 2C
OD_P_CURT (Passenger-side curtain air bag module circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2A, 2D
OD_PAB1_ST (Passenger-side air bag module (inflator No.1) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1M, 1P
OD_PAB2_ST (Passenger-side air bag module (inflator No.2) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1A, 1D

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
OD_PSAB_ST (Passenger-side side air bag module circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2I, 2L
P_ABAGR2 (Passenger-side air bag module (inflator No.2) resistance)	Ohms	Under any condition: 1.4—2.9 ohms	1A, 1D
P_PTENSFLT (Passenger-side pre-tensioner seat belt circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Pre-tensioner seat belt circuit resistance low: SQ_LOWRES	2G, 2J
PABAGR (Passenger-side air bag module (inflator No.1) resistance)	Ohms	Under any condition: 1.4—2.9 ohms	1M, 1P
P_CRSH_S (Passenger-side side air bag sensor status)	OK/ COMM_FAIL/ INT_FAIL	• Sensor normal: OK • Sensor communication error: COMM_FAIL • Sensor internal circuit abnormal: INT_FAIL	2B, 2C
PS_AB (Passenger-side side air bag module resistance)	Ohms	Under any condition: 1.4—3.2 ohms	2I, 2L
PS_AB_ST (Passenger-side side air bag sensor circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2I, 2L
PS_BUKL (Passenger-side buckle switch status)	Buckled/ Unbuckled	• Passenger-side buckle switch on: Buckled • Passenger-side buckle switch off: Unbuckled	2H
PS_CURTN (Passenger-side curtain air bag module resistance)	Ohms	Under any condition: 1.4—3.2 ohms	2A, 2B
PS_CURT_ST (Passenger-side curtain air bag module circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	2A, 2D
PS_PTENS (Passenger-side pre-tensioner seat belt resistance)	Ohms	Under any condition: 1.5—3.1 ohms	2G, 2J
PS1_STAT (Passenger-side air bag module (inflator No.1) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1M, 1P
PS2_STAT (Passenger-side air bag module (inflator No.2) circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Air bag module circuit resistance low: SQ_LOWRES	1A, 1D
PSB_P_ST (Passenger-side pre-tensioner seat belt circuit status)	NORMAL/ OPEN/ SHRT_GND/ SHRT_B+/ SQ_LOWRES	• Related wiring harness normal: NORMAL • Related wiring harness circuit open: OPEN • Related wiring harness short to ground: SHRT_GND • Related wiring harness short to power supply: SHRT_B+ • Pre-tensioner seat belt circuit resistance low: SQ_LOWRES	2G, 2J
RCM_VOLT (IG1 voltage)	V	• Ignition switch is at ON: B+ • Other: 0	1W
TRAK_SW (Seat track position sensor state)	Forward/ Rearward	• Front seat front position: Forward • Front seat rear position: Rearward	2W, 2X

08–10 AIR BAG SYSTEM

AIR BAG SYSTEM OUTLINE

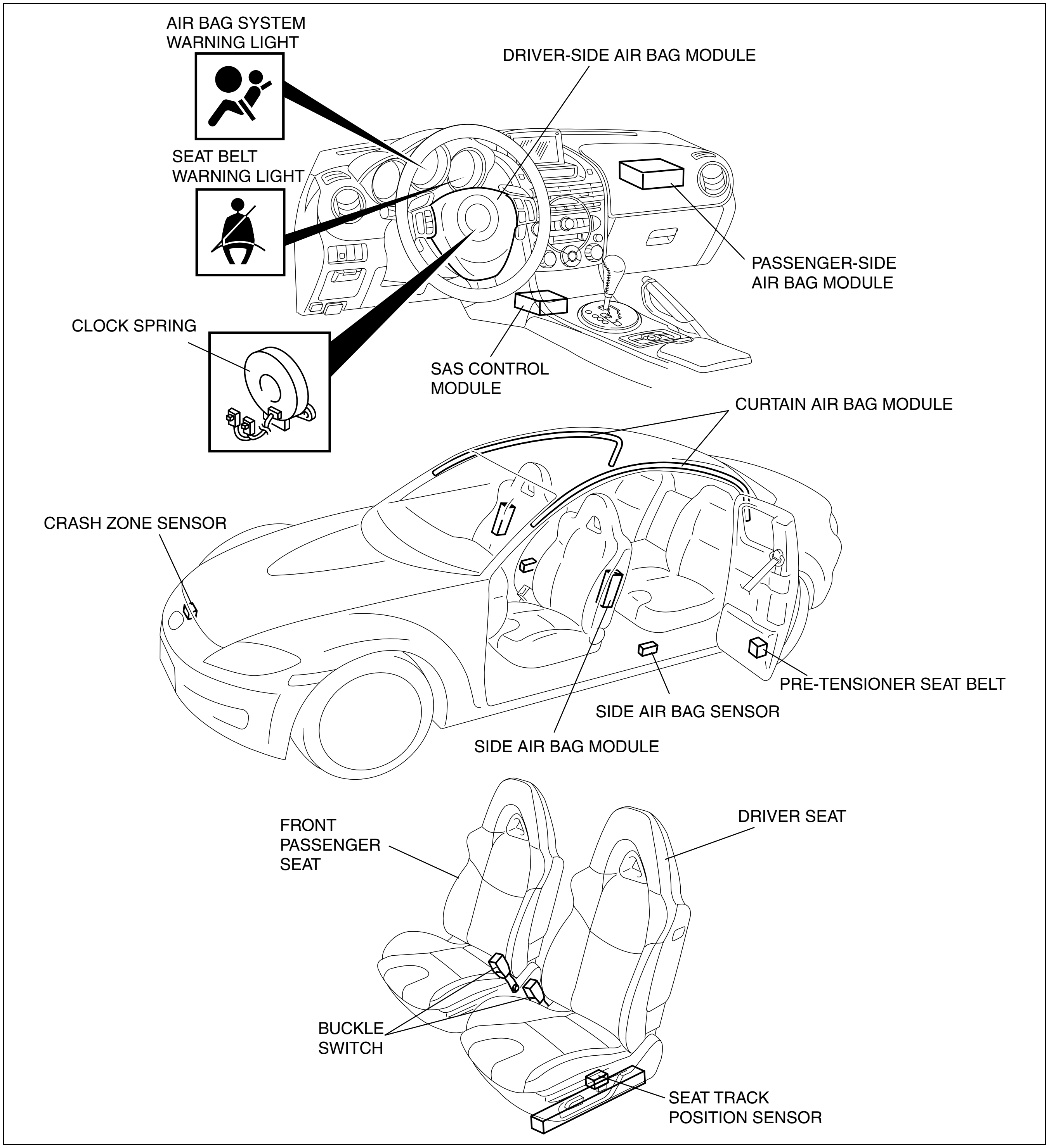
CHU081001046S01

- 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	• 2-step deployment control has been added to the front air bag system (driver and passenger-side) deployment control. • Recognizes actually equipped air bag module or pre-tensioner 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 08–10–4 SAS CONTROL MODULE CONSTRUCTION/OPERATION)
Side air bag sensor	
Driver-side air bag module	• Dual inflator, inflator 1 and inflator 2, has been adopted in accordance with the front air bag system 2-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	• Ball-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.
Buckle switch	• Detects the buckled/unbuckled condition of the front driver-side and passenger-side seat belts, and sends a corresponding signal to the SAS control module.
Air bag system warning light	• LED has been adopted.
Seat belt warning light	

AIR BAG SYSTEM STRUCTURAL VIEW

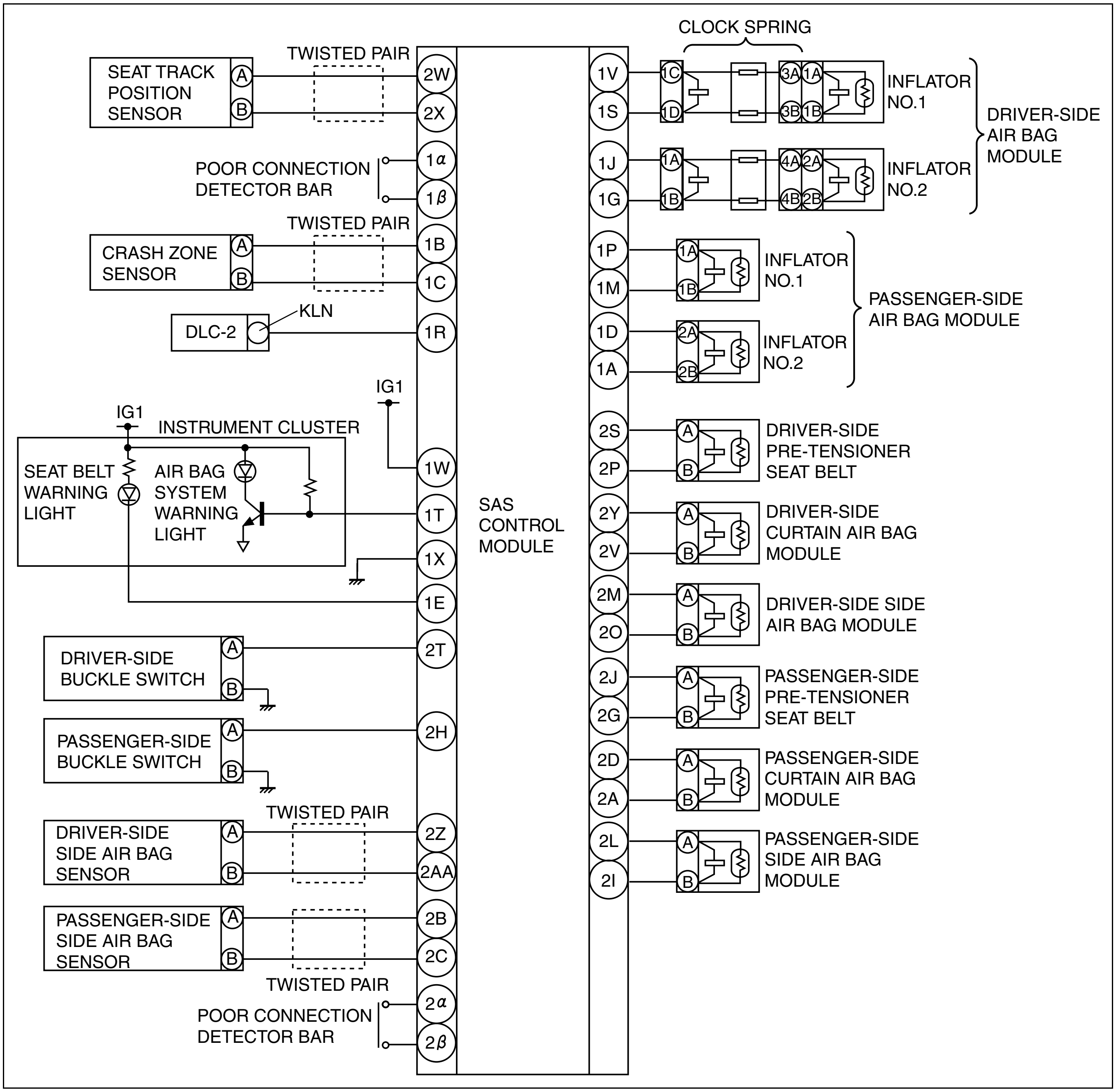
CHU081001046S02



CHU0810S001

AIR BAG SYSTEM WIRING DIAGRAM

CHU081001046S03



CHU0810S003

SAS CONTROL MODULE FUNCTION

CHU081057030S01

Outline

- A 2-step air bag deployment control system has been adopted. In case of a frontal or frontal offset collision, an optimal air bag deployment force is matched to the impact force. The inflators for the driver and passenger-side air bag modules have two tiers, and deploy at either a low or high rate, according to the force of the impact.

SAS CONTROL MODULE CONSTRUCTION/OPERATION

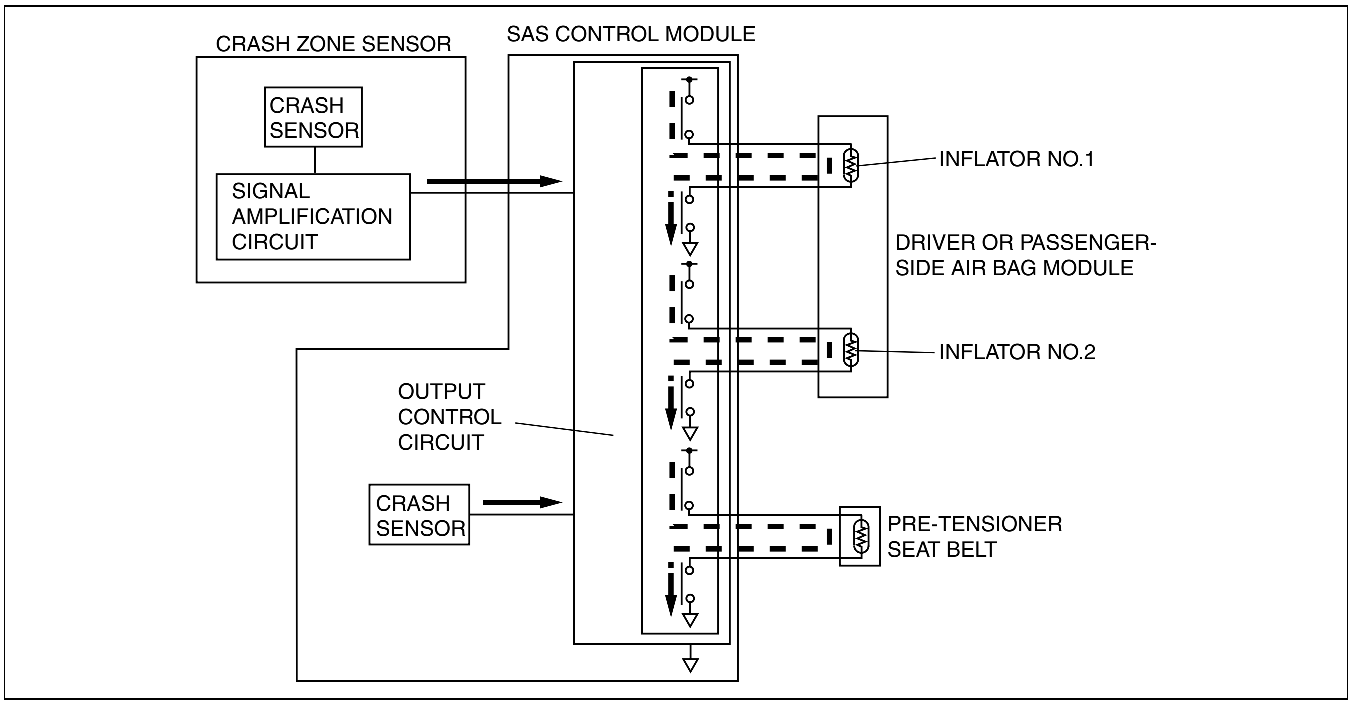
CHU081057030S03

Front Air Bag System (2-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 degree 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 degree 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 degree 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.	Degree 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.

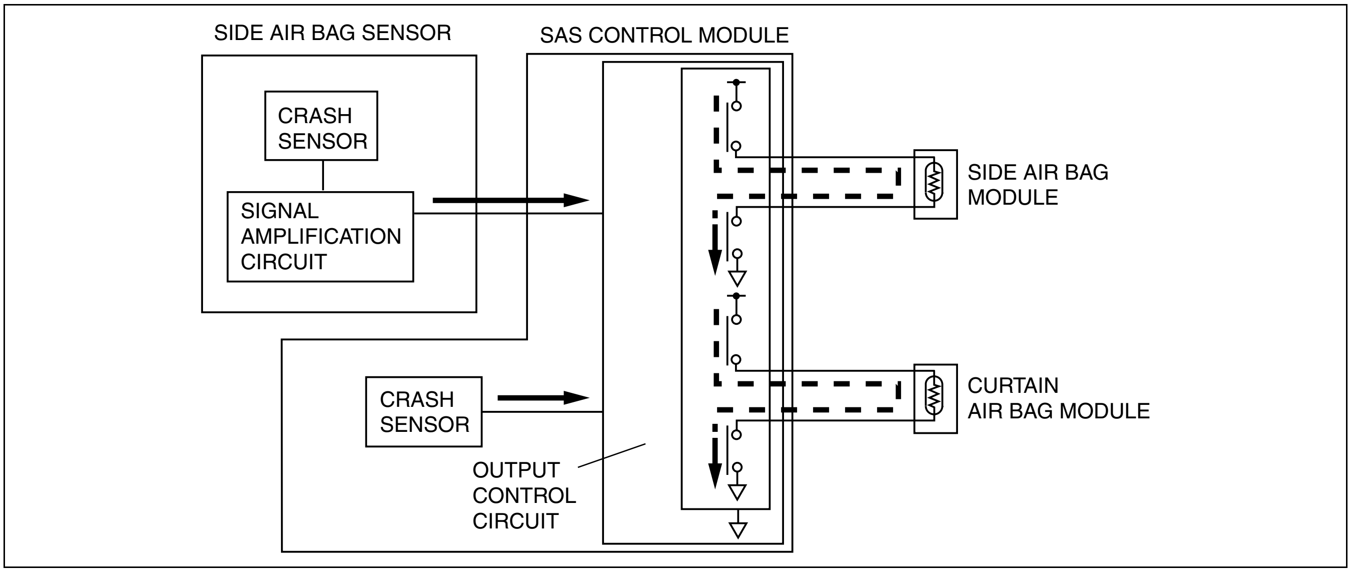
6. The SAS control module completes an ignition circuit for the pre-tensioner seat belts that is synchronized to the deployment of the driver and passenger-side air bag modules, and an operation signal is sent to the pre-tensioner seat belts.



B6U0810S005

Side air bag system

1. During a lateral collision to the vehicle, the crash sensors in the side air bag sensor and SAS control module detect the collision.
2. The degree 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 degree 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 degree 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.

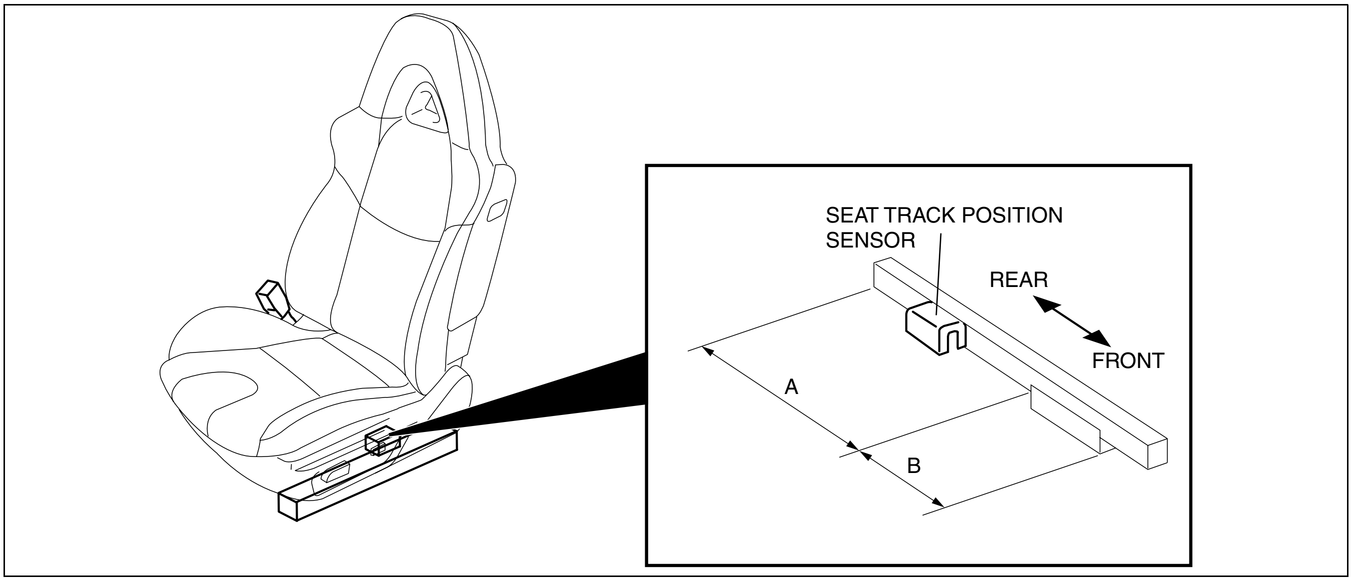


B6U0810S006

Seat Position Matching Deployment Control

- The SAS control module controls the air bag deployment operation pattern (deploying only inflator No.1 or both inflator No.1 and No.2) according to the seat track position of the driver's seat.
- The SAS control module detects the seat track position based on the seat position signal received from the seat track position sensor.
- When the driver's seat is in a forward position, the SAS control module deploys only inflator No.1 to lessen the air bag module deployment force.

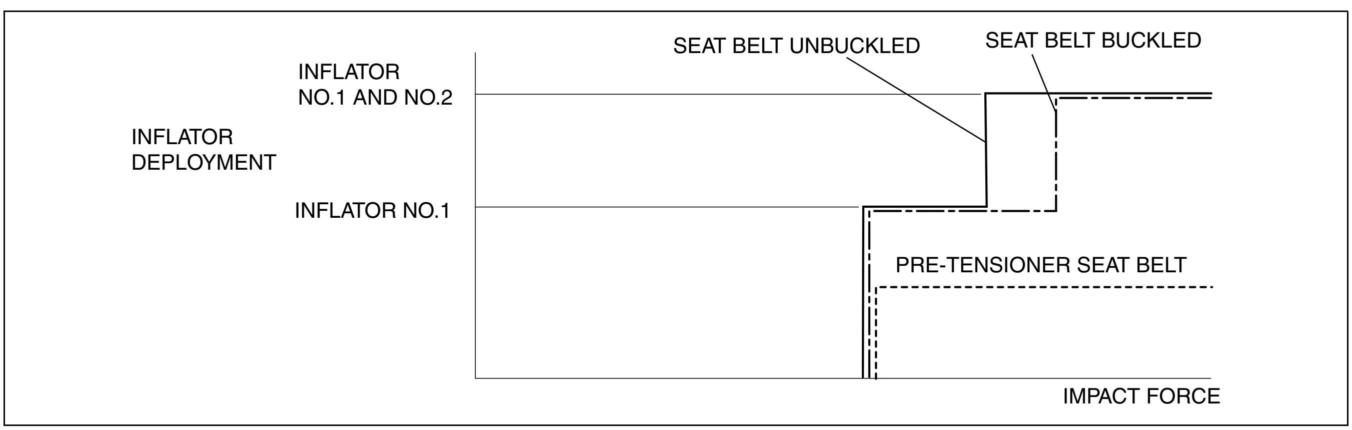
Seat position	Air bag module deployment control
A	Normal control (only inflator No.1 deploys or both inflator No.1 and No.2 deploy)
B	Only inflator No.1 deploys



CHU0810S002

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 seat-belt is unbuckled, it lowers the minimum specified value of the impact profile (speed) for high-output deployment (inflators No.1 and No.2 deploy simultaneously). This means that the SAS control module controls deployment so that in a collision with an impact profile which normally does not lead to high-output deployment (inflators No.1 and No.2 deploy simultaneously) of the air bag modules, the corresponding air bag will deploy if either one of the front seat belts is unbuckled.



CHU0810S020

SEAT TRACK POSITION SENSOR FUNCTION

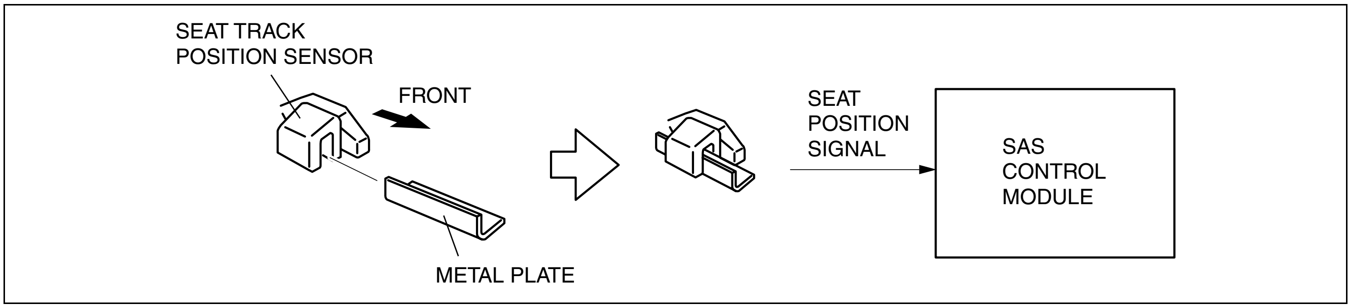
CHU081057030S02

- 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

CHU081057030S04

- The seat track position sensor consists of a Hall element (semi-conductor) and a magnet. The sensor converts the effect of the magnetic flux (produced by the magnet) on the Hall element, into an electrical signal.
- When the driver's seat is moved to a forward position, the metal plate installed near the front of the seat track passes through the groove in the seat track position sensor. When this occurs the magnetic flux of the sensor changes and that change is sent as an electrical signal to the SAS control module. The SAS control module receives this signal and determines that the driver's seat has been moved to a forward position.



CHU0810S004

DRIVER-SIDE AIR BAG MODULE FUNCTION

CHU081057010S01

Outline

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

DRIVER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

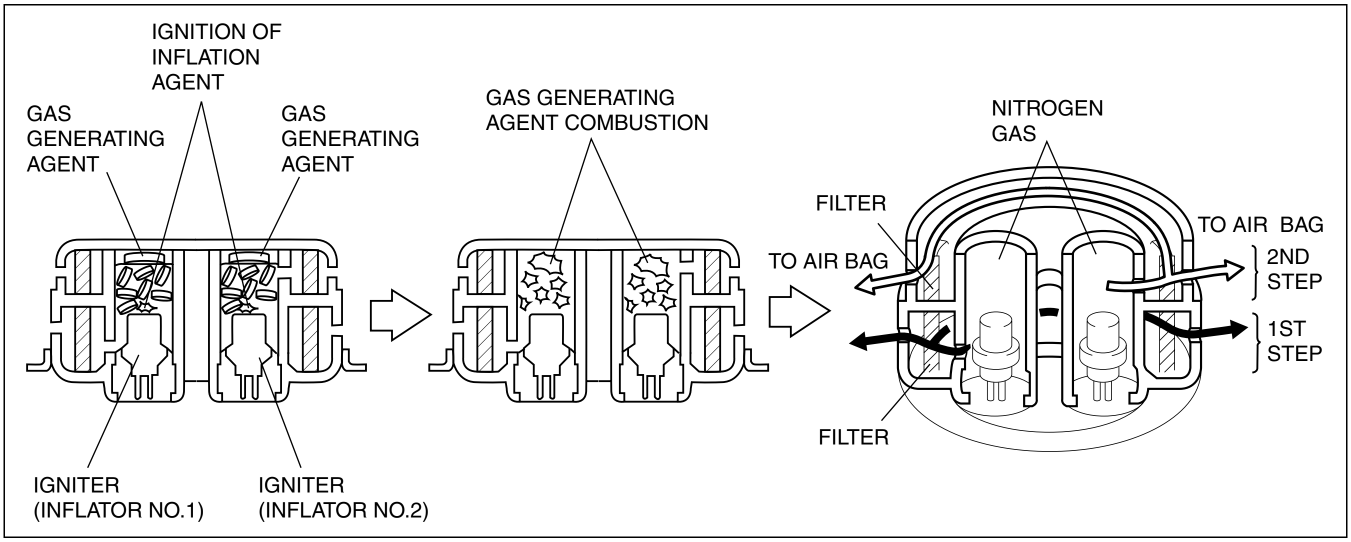
CHU081057010S02

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.

Note

- The gas injection outlets for the inflators are divided into two tiers. Gas from inflator No.1 is injected from the No.1 tier, and from the No.2 tier for inflator No.2.



CHU0810S220

PASSENGER-SIDE AIR BAG MODULE FUNCTION

CHU081057050S01

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.

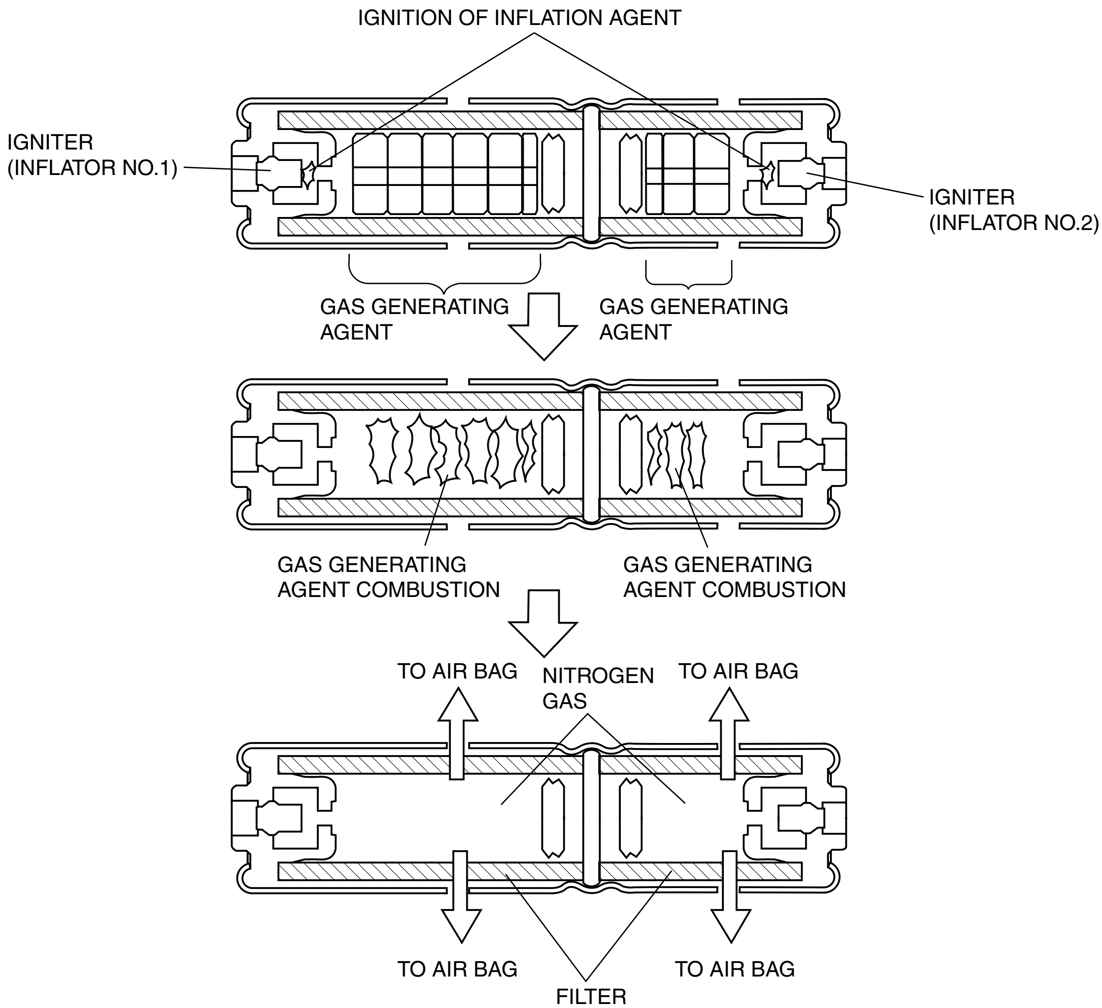
08–10

PASSENGER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

CHU081057050S02

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.



CHU0810S221

SIDE AIR BAG MODULE FUNCTION

CHU081000147S01

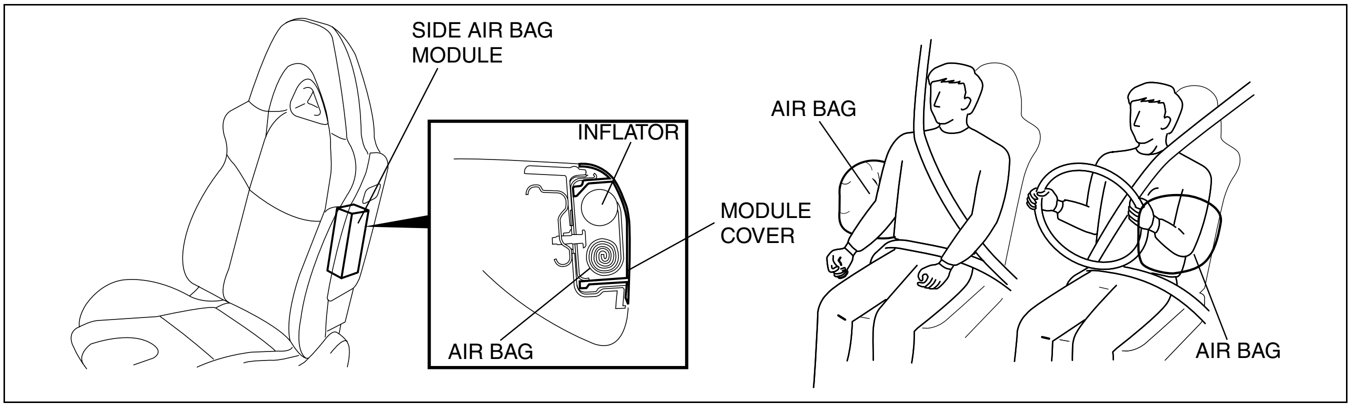
- During a collision to the side of the vehicle, the air bag operates (deploys) after receiving an operation signal from the SAS control module, defusing impact to the chest area of the driver and front passenger.

SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

CHU081000147S02

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, module cover and air bag.
- When an air bag deploys, the side air bag module cover is spread apart by the generation of argon gas from the inflator, inflating the air bag.



CHU0810S023

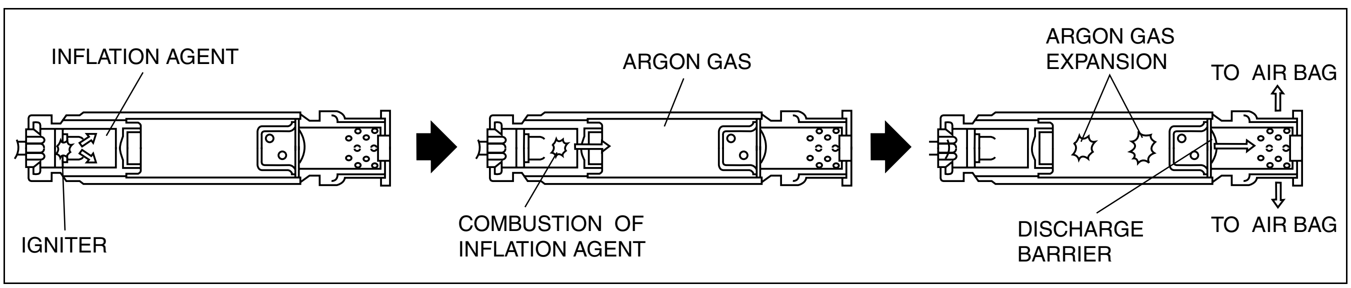
Operation

Air bag module deployment operation

- Refer to the SAS CONTROL MODULE DESCRIPTION, Air Bag Module and Pre-tensioner Seat Belt Deployment Operation. (See 08–10–4 SAS CONTROL MODULE CONSTRUCTION/OPERATION.)

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 argon gas expands due to the heat of the ignited inflation agent.
3. The expanding argon gas breaks the discharge barrier, is cooled and filtered by the filter, and then injected into the air bag.



CHU0810S222

CURTAIN AIR BAG MODULE FUNCTION

CHU081000171S01

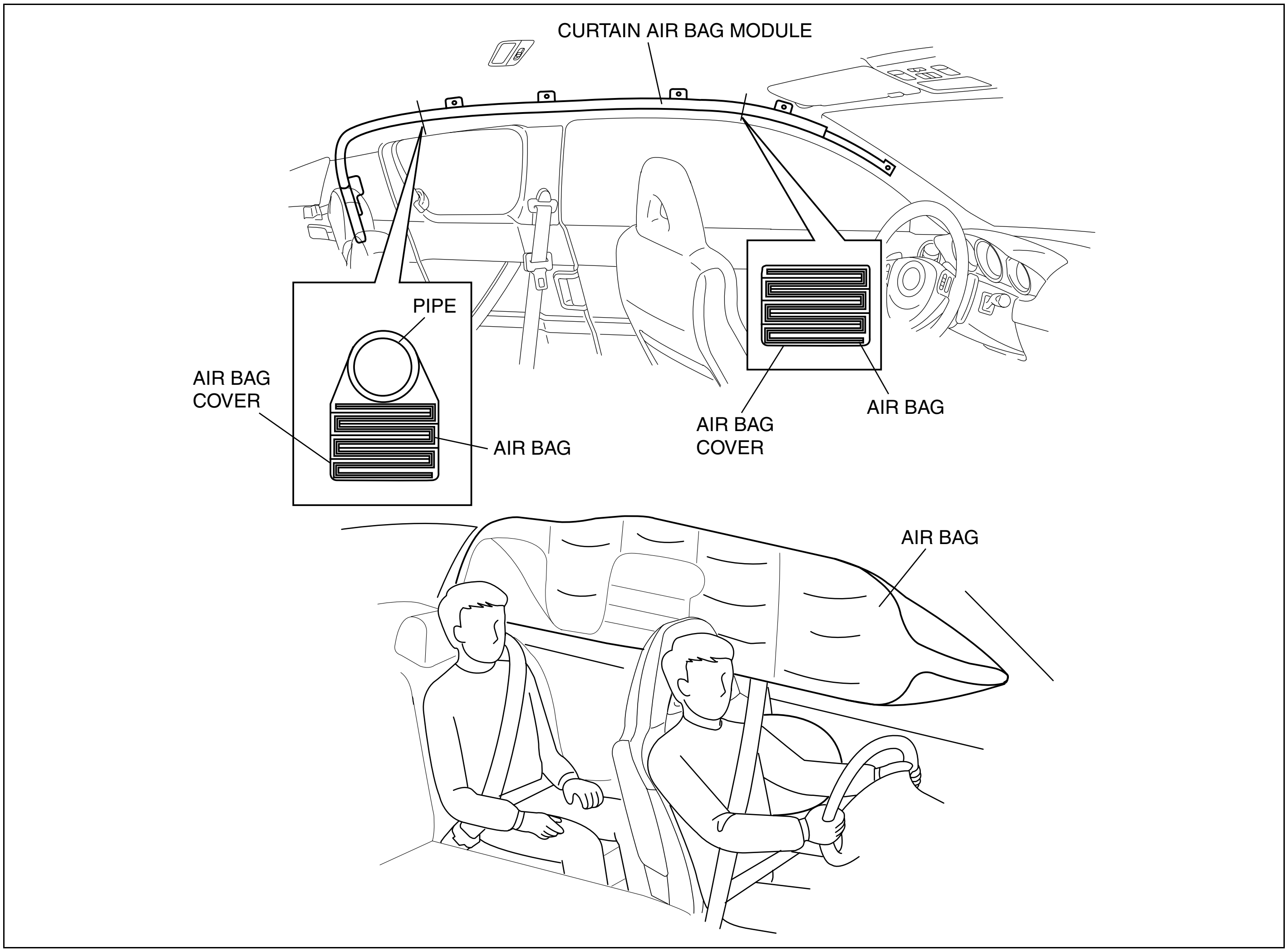
- During a lateral collision to the vehicle, the air bag operates (deploys) after receiving an operation signal from the SAS control module, defusing impact to the side of the head of the driver and other passengers (passenger-side and rear outboard-seated passenger).

CURTAIN AIR BAG MODULE CONSTRUCTION/OPERATION

CHU081000171S02

Construction

- The curtain air bag modules are equipped along the roof edge between the A and B pillars.
- The curtain air bag module is composed of the inflator, pipe, bag cover, and air bag.
- When the curtain air bag deploys, the A-pillar trim and headliner is spread apart by argon gas generated from the inflator, inflating the air bag.



CHU0810S104

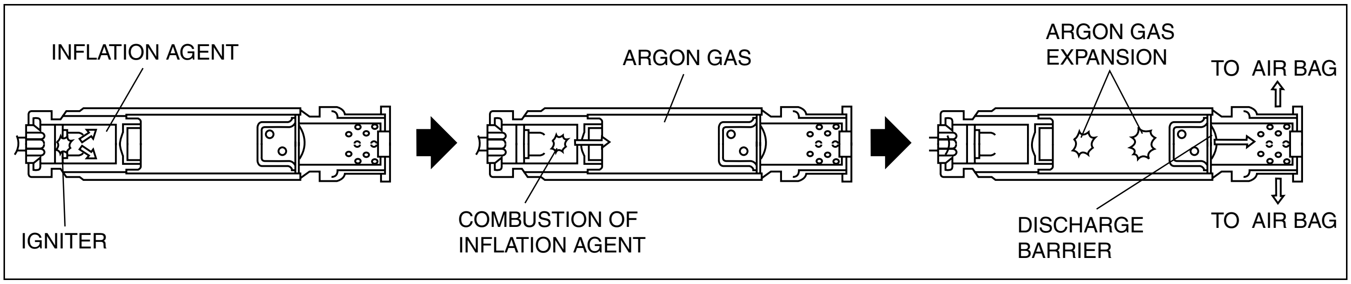
Operation

Air bag module deployment operation

- Refer to SAS CONTROL MODULE DESCRIPTION, Air Bag Module and Pre-tensioner Seat Belt Deployment Operation. (See 08–10–4 SAS CONTROL MODULE CONSTRUCTION/OPERATION.)

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 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.



CHU0810S302

PRE-TENSIONER SEAT BELT FUNCTION

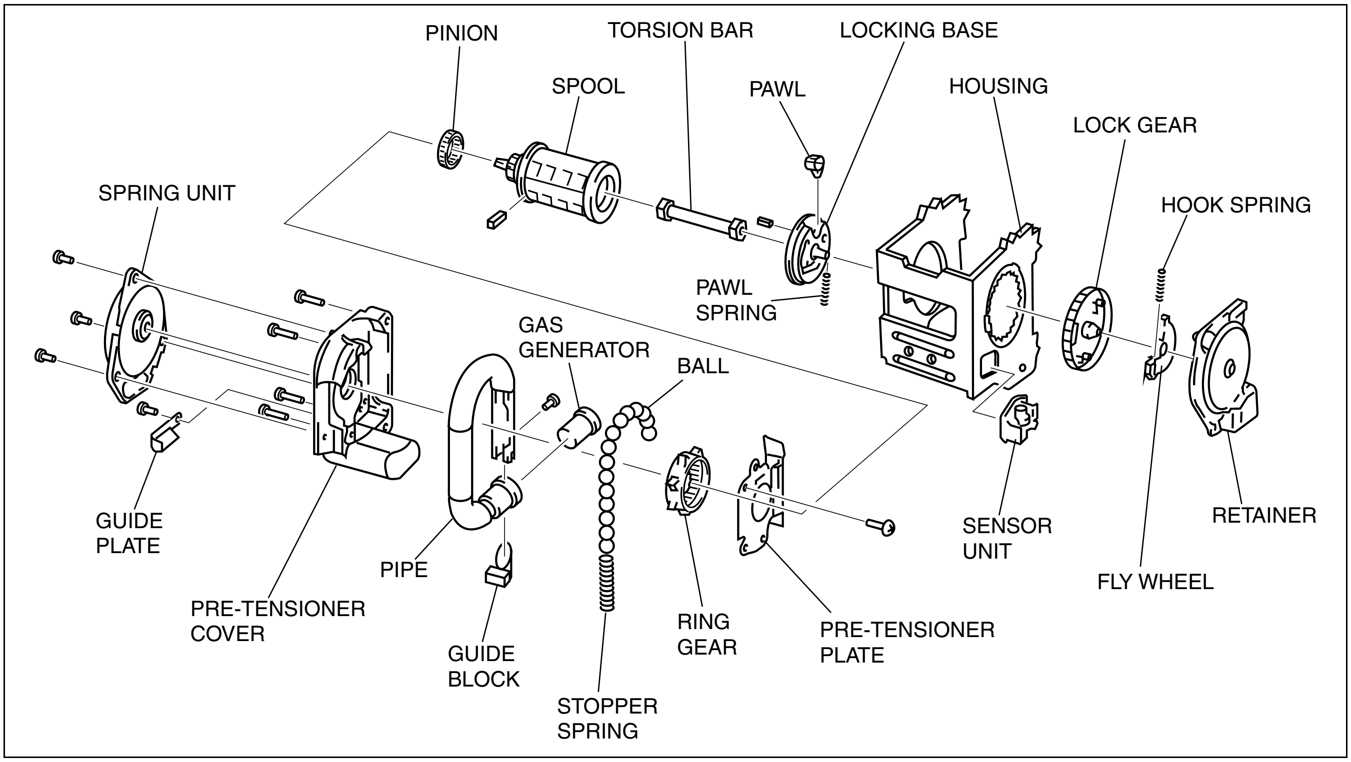
CHU081057630S01

- 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

CHU081057630S02

Construction

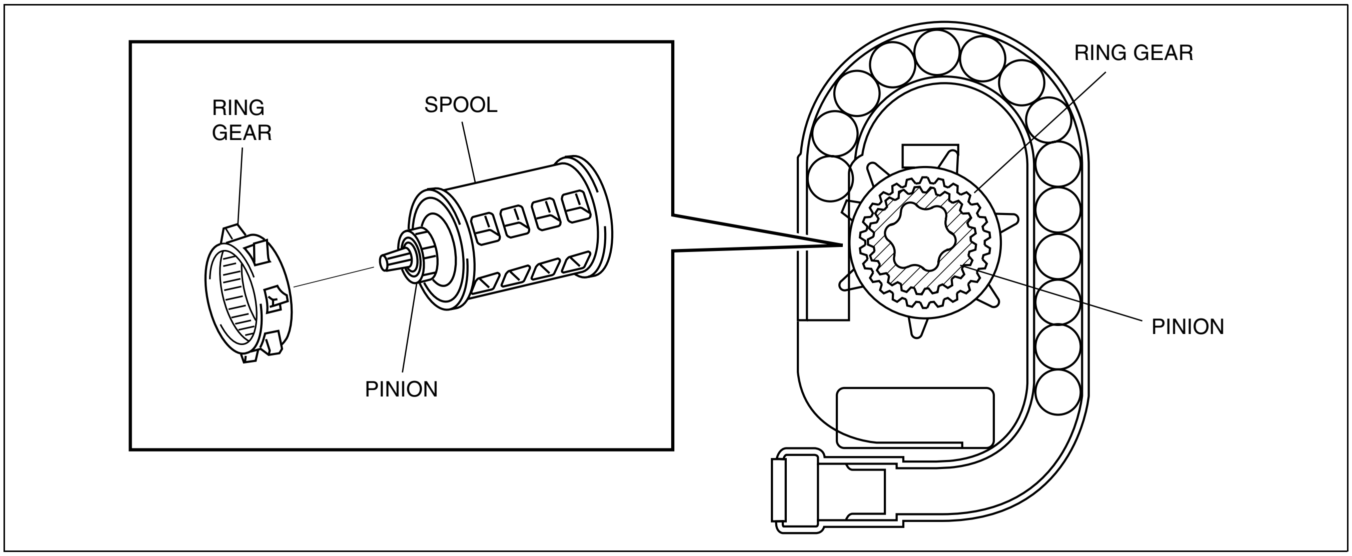


CHU0810S005

Operation

Before Activation (Normal Condition)

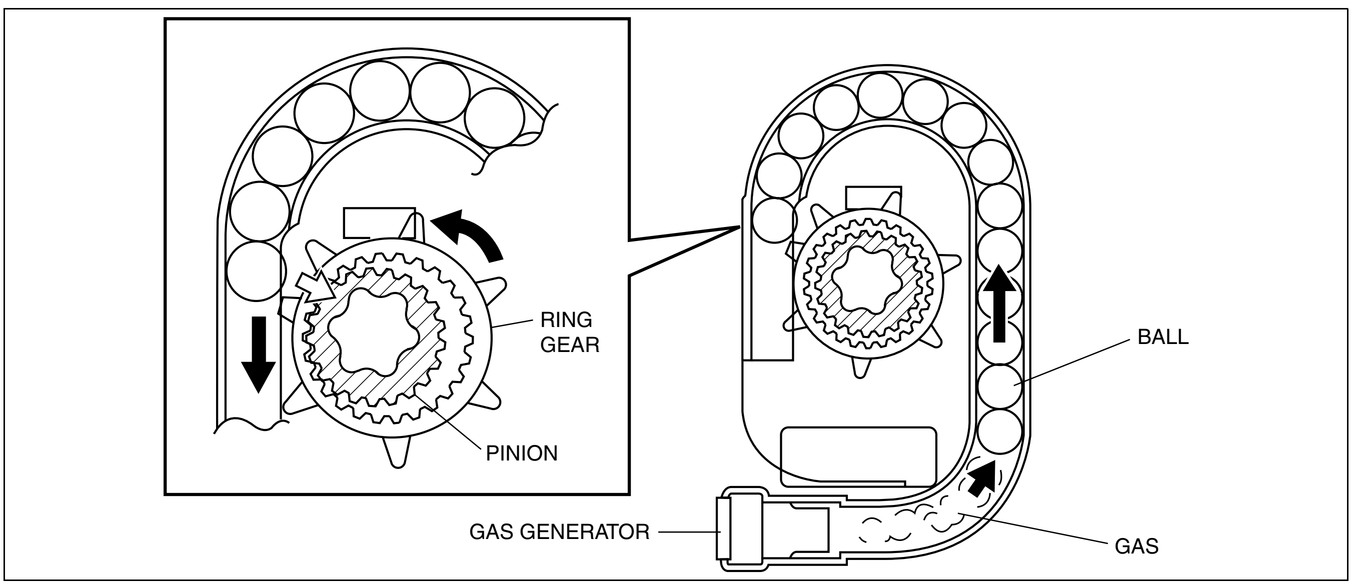
- The spool has a pinion on its end, which rotates with the spool when the belt webbing is retracted or withdrawn.
- There is a ring gear around the pinion. Because the pinion does not engage with the ring gear during normal operation, the ring gear does not rotate even when the belt webbing is retracted or withdrawn.



A6A8130T011

During Activation

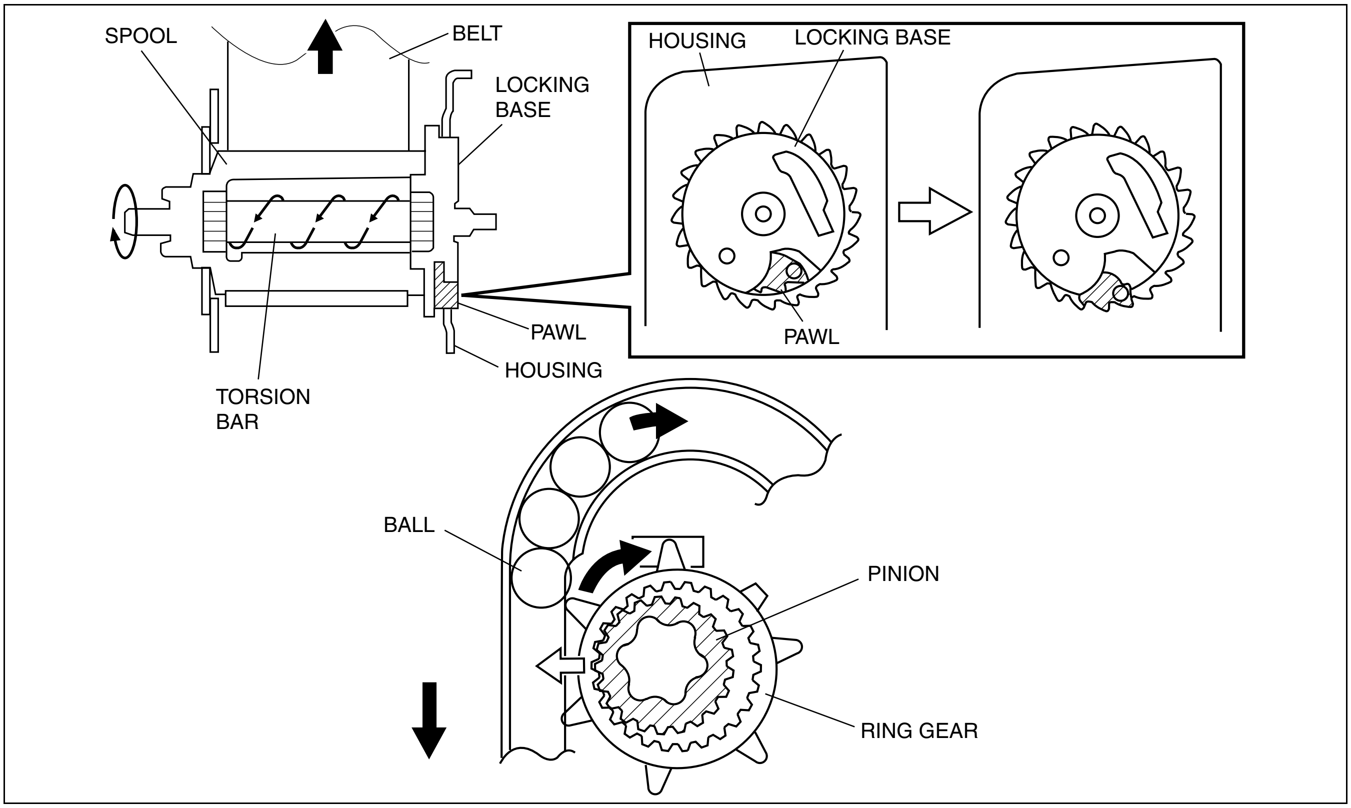
1. When the pre-tensioner seat belt system receives an operation signal from the SAS control module, gas is produced from each generator forcing up the balls in the tube.
2. The balls shift, pushing the ring gear toward the pinion. Due to this, the ring gear and pinion are engaged.
3. The shifting balls rotate the ring gear. The pinion, coupled with the rotation of the ring gear, rotates the spool in the direction of retraction. Thus the belt webbing is tightened.



A6A8130T012

After Activation

1. Directly after the activation of the pre-tensioner seat belt system and the application of a load to the seat belt in the direction of withdrawal, the ELR lock mechanism operates and the pawl engages the housing gear.
2. When a larger than specified load is applied to the seat belt with the locking base locked by the pawl, the torsion bar twists. Thus the spool rotates and the belt webbing is withdrawn.
3. Because the spool rotates in the direction of withdrawal, the ring gear pushes the balls back and the pinion is disengaged from the ring gear.



A6A8130T013

08–10

08–11 SEAT BELT

SEAT BELT OUTLINE

CHU081157100S01

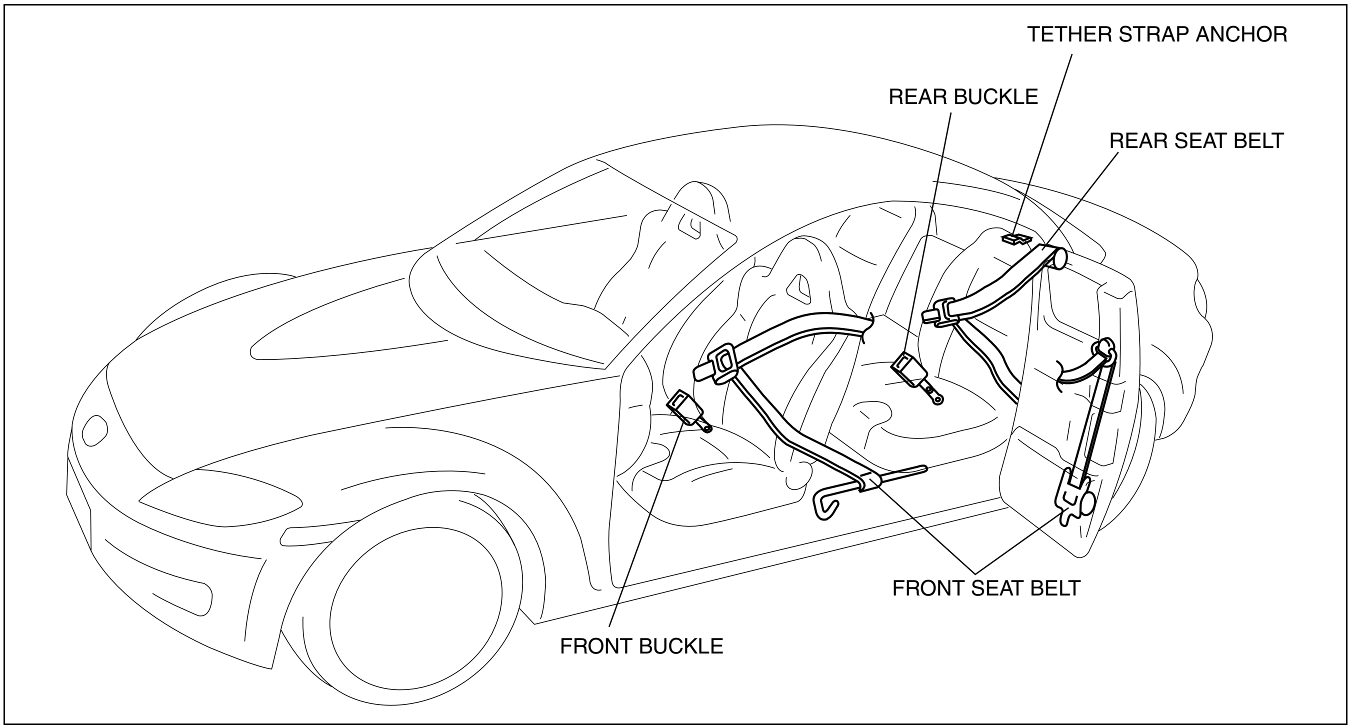
Features

Improved safety	• Three-point seat belt with the following functions for front seat passengers adopted — ELR (Emergency Locking Retractor: emergency locking mechanism) — Pre-tensioner (See 08–10–11 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 — Seat belt lock release, which releases the lock on the front seat belt when the rear door is opened to prevent interference. • Three-point seat belt with the following functions for rear seat passengers adopted — ELR — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism)

08–11

SEAT BELT STRUCTURAL VIEW

CHU081157100S02



CHU0811S001

SEAT BELT LOCK RELEASE OUTLINE

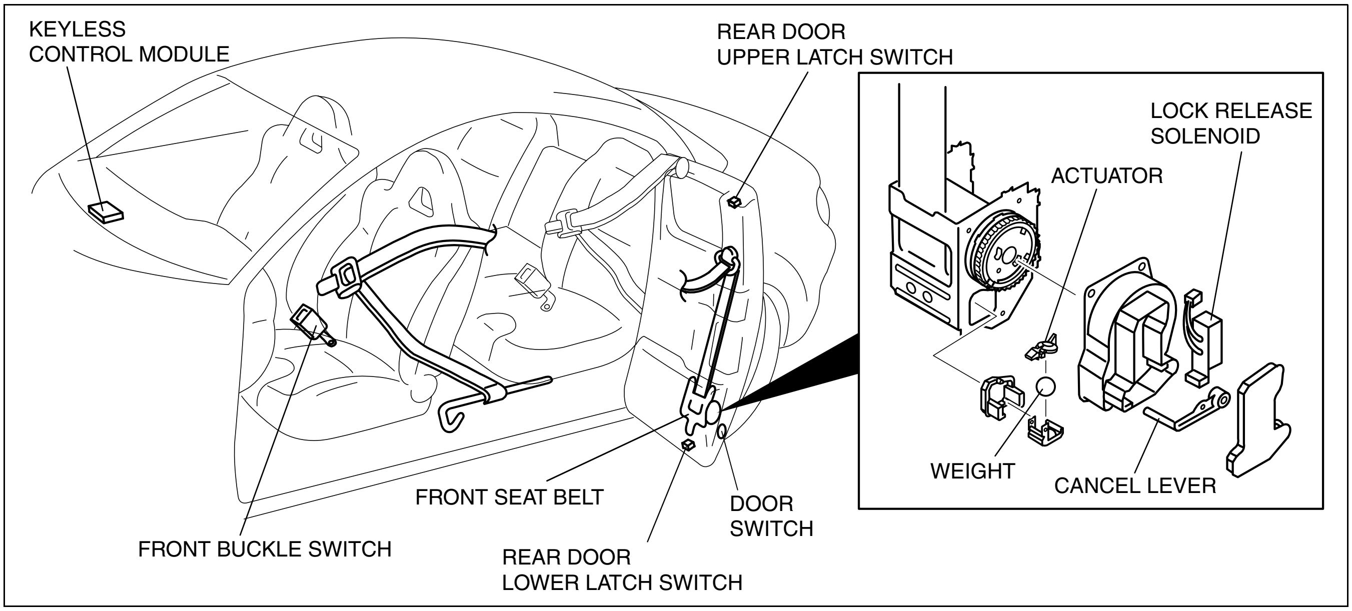
CHU081157100S04

Features

- A seat belt lock release function has been adopted on the front seat belts which are installed on the rear doors. This function releases the locks on the front seat belts when the rear doors open to prevent interference.

SEAT BELT LOCK RELEASE STRUCTURAL VIEW

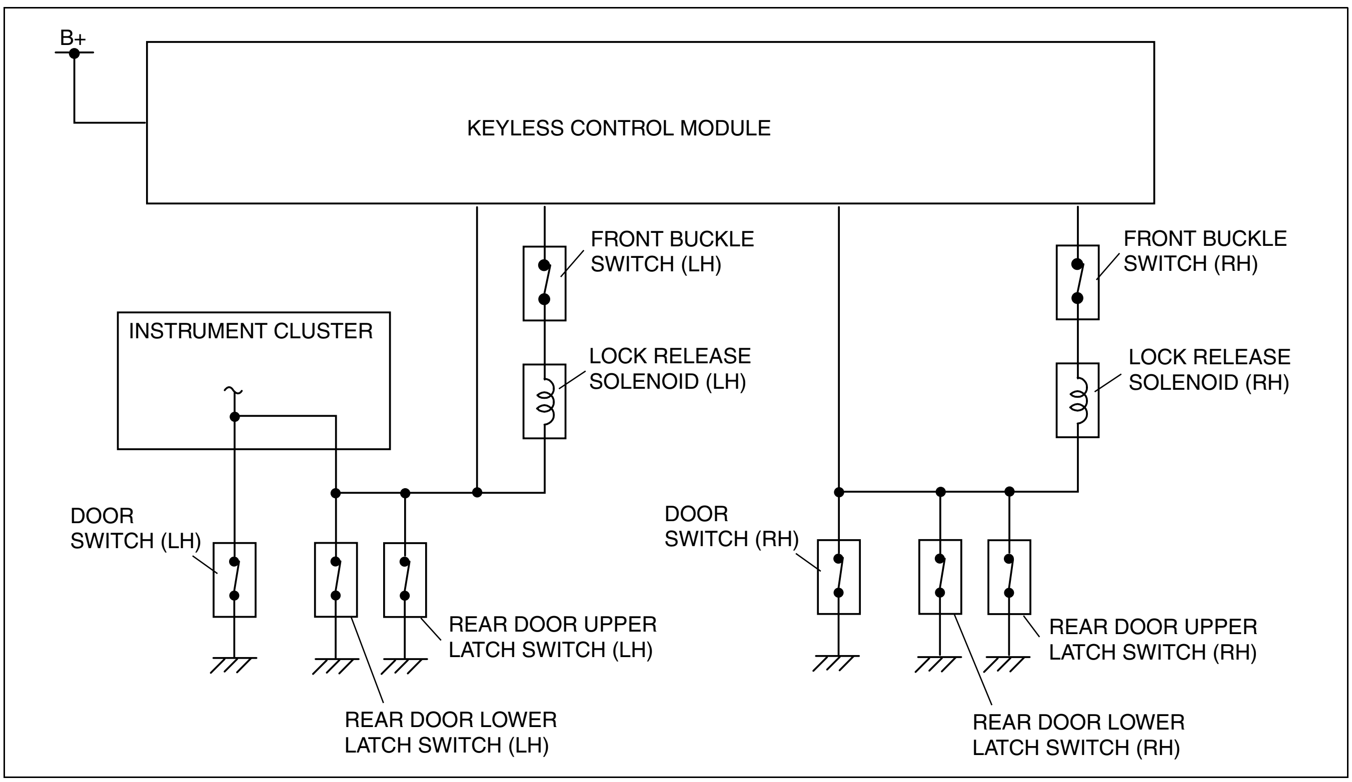
CHU081157100S05



CHU0811S002

SEAT BELT LOCK RELEASE SYSTEM DIAGRAM

CHU081157100S06

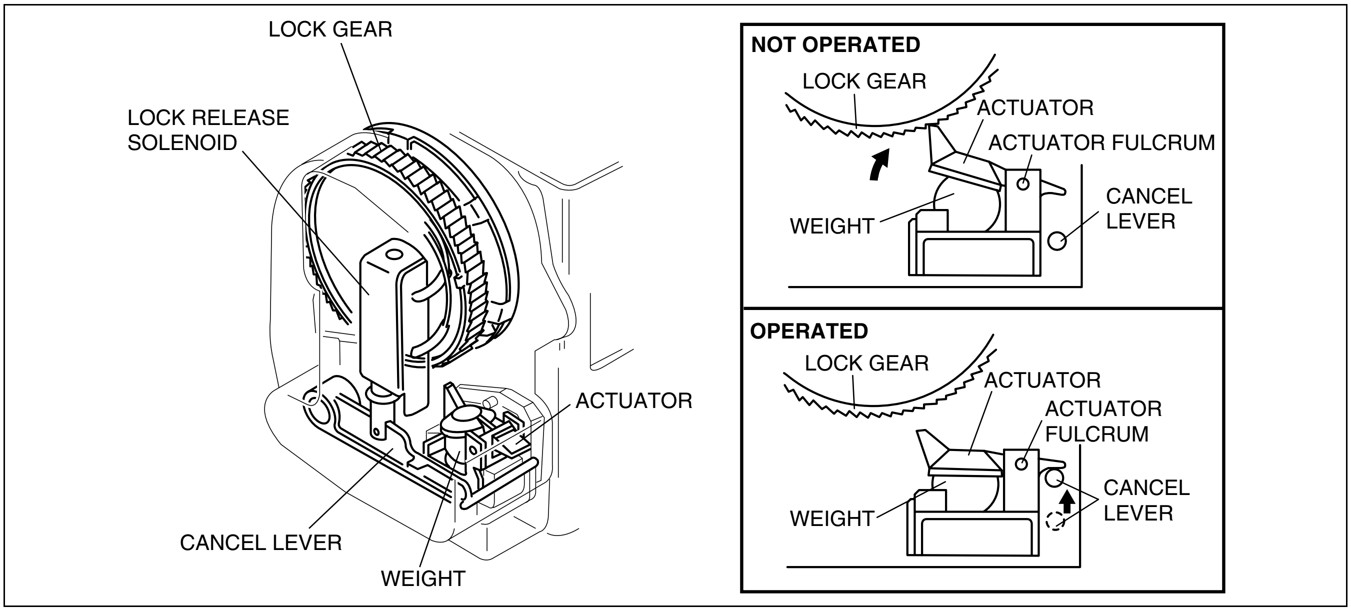


CHU0811S003

SEAT BELT LOCK RELEASE OPERATION

CHU081157100S07

- When the seat belt lock release function is not operated, the weight is under a no-load condition. When a sudden shock is applied to the vehicle, the weight moves to push the actuator upward. The actuator engages with a lock gear and stops its rotation (ELR condition). Due to this, the rotation direction of belt pull out is stopped.
- When a front seat belt is not in use, the lock release solenoid turns on, pulling the cancel lever upward, if a door is opened (during the seat belt lock release function operation). As a result, the actuator and weight are fixed in their positions. Due to this, the front seat belt pulls out smoothly.



CHU0811S006

Note

- The seat belt lock release function does not operate under the following conditions:
  - — When all doors are closed.
  - — When a front seat belt is in use.
  - — When one hour has elapsed with a door open.
  - — When the battery or ROOM 15 A fuse is removed.

08–11

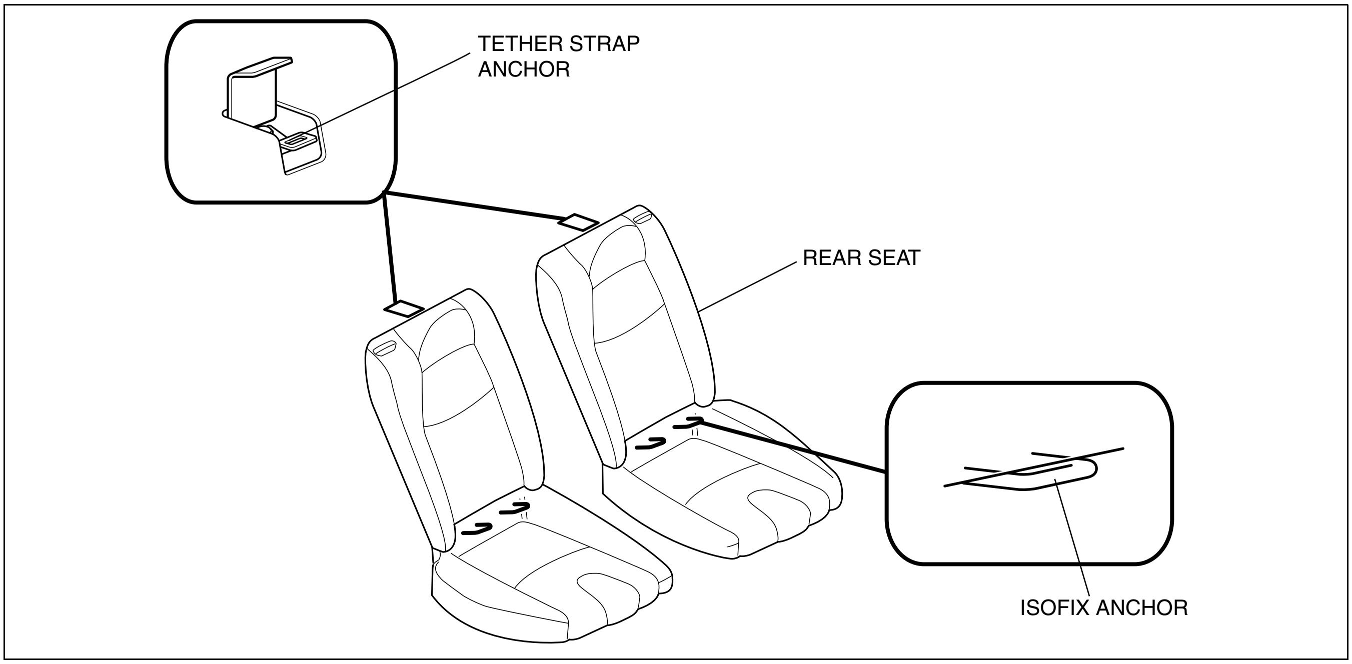
CHILD RESTRAINT SEAT ANCHOR CONSTRUCTION

CHU081101046S01

- ISOFIX anchors for securing an ISOFIX child restraint seat, and tether strap anchors have been adopted.

Caution

- **Installation procedure varies with the type of child restraint seat. When installing a child restraint seat, be sure to follow the prescribed procedure for each type.**



CHU0811S004

BODY & ACCESSORIES

09
SECTION

09–00 OUTLINE

BODY AND ACCESSORIES ABBREVIATIONS

CHU090001034S01

ABS	Antilock Brake System
A/C	Air Conditioner
ACC	Accessories
AT	Automatic Transmission
CAN	Controller Area Network
CM	Control Module
CPU	Central Processing Unit
DLC	Data Link Connector
DRL	Daytime Running Light
DSC	Dynamic Stability Control
DTC	Diagnostic Trouble Code
EBD	Electronic Brakeforce Distribution
GND	Ground
GPS	Global Positioning System
HI	High
HID	High Intensity Discharge
HU	Hydraulic Unit

IG	Ignition
INT	Intermittent
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LO	Low
M	Motor
MT	Manual Transmission
OFF	Switch Off
ON	Switch On
PATS	Passive Anti-theft System
PCM	Powertrain Control Module
PID	Parameter Identification
P/W CM	Power Window Control Module
SW	Switch
TNS	Tail Number Side Lights
WDS	Worldwide Diagnostic System

BODY AND ACCESSORIES FEATURES

CHU090001034S02

Design Improvement	• Pop-up type headlight cleaner adopted
Improved marketability	• Power window system adopted • Power outer mirror adopted • Power seat adopted • Power door lock system adopted • keyless entry system adopted
Improved convenience	• Car-navigation system adopted (If equipped)
Improved safety	• Triple-H structure adopted
Improved security	• Theft-deterrent system adopted • Immobilizer system adopted
Improved visibility	• Auto-dimming mirror adopted (If equipped) • Heated outer mirror adopted • Discharge headlight (HID) adopted • Headlight auto leveling system adopted
Improved serviceability	• Controller area network (CAN) system adopted

09–10 BODY PANELS

BODY PANEL OUTLINE

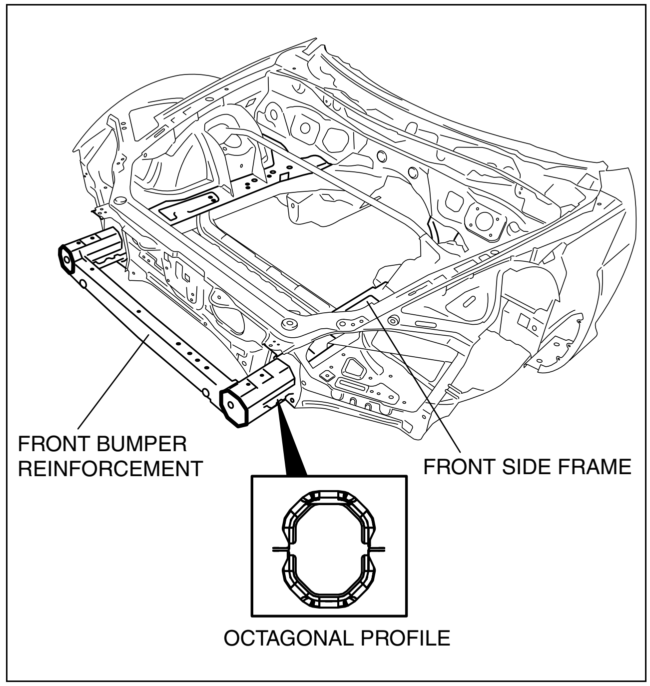
CHU091001084S01

- An H-shaped frame (triple-H structure) has been adopted.
- Aluminum hood with a shock-absorbing cone structure has been adopted.

CRUSH ZONE CONSTRUCTION

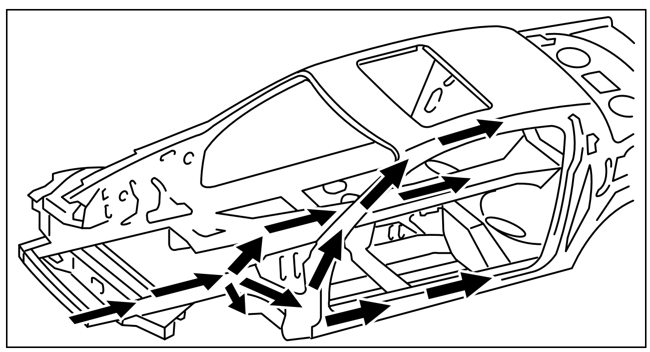
CHU091001084S02

- High-tensile-strength plates with an octagonal profile are used for the front bumper reinforcement and front side frames have been placed to absorb the impact force of a frontal collision.



CHU0910S003

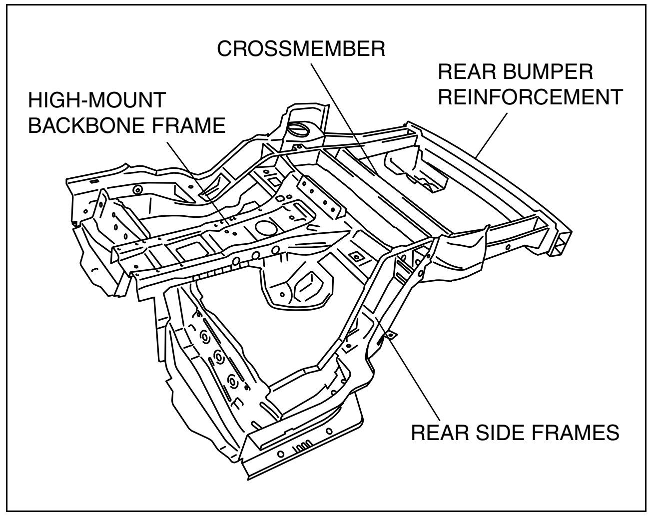
- A three-pronged structure, capable of dispersing impact force received by the front side frame in three directions, has been adopted. It also suppresses cabin deformation in offset frontal collisions.



BHJ0910N005

09–10

- A high-tensile-strength plate that is highly effective in absorbing force has been adopted for the large profile, straight-shaped rear side frame. Structural strength of the high-mount backbone frame and the crossmember rear side frame has been reinforced in order to disperse an impact to the fuel tank area and thereby suppress deformation.

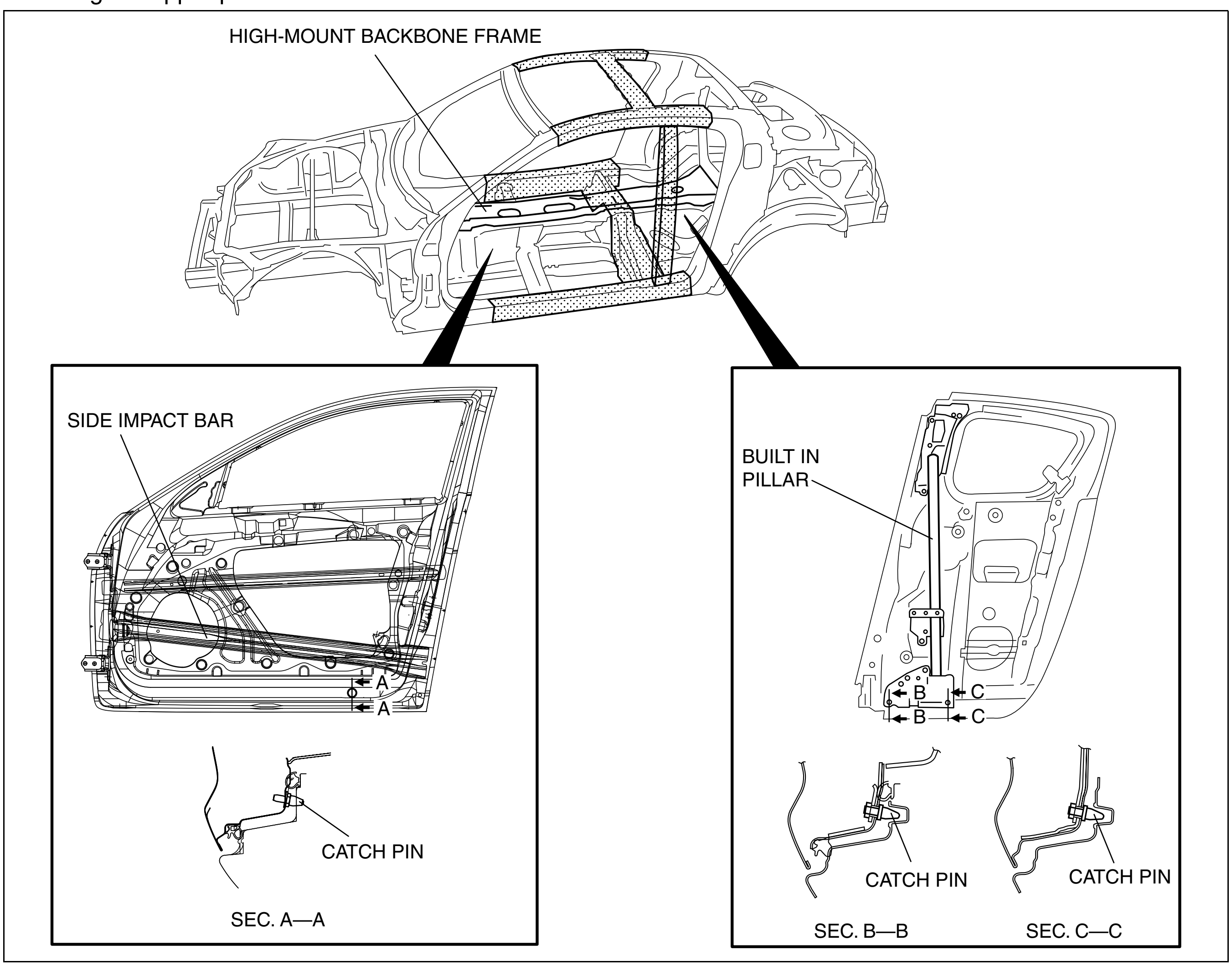


CHU0910S004

CABIN CONSTRUCTION

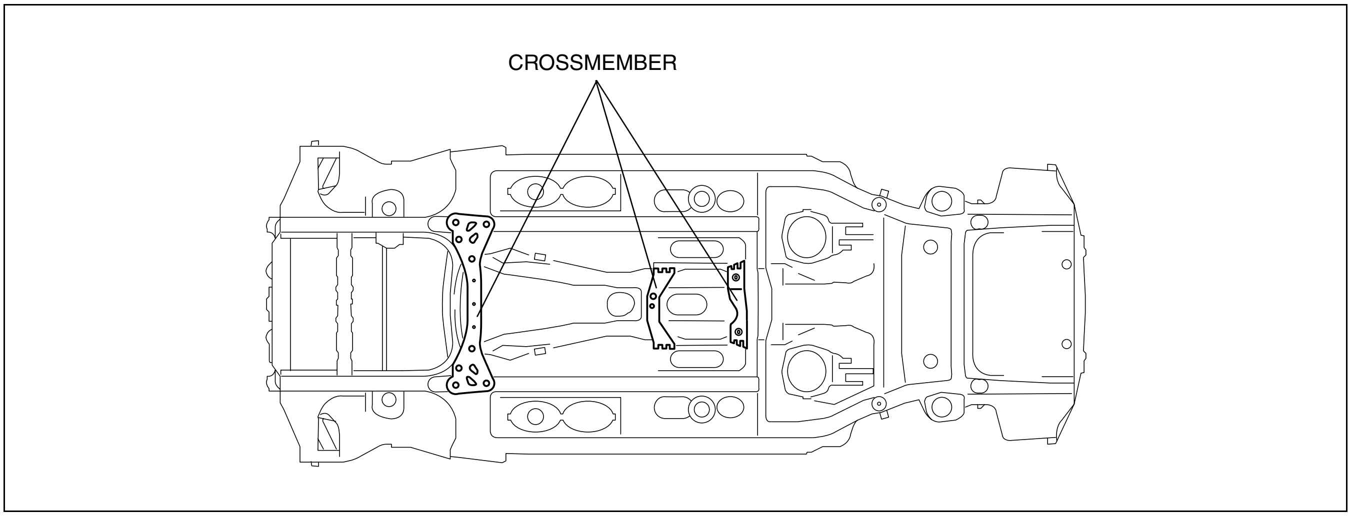
CHU091001084S03

- A triple-H construction has been adopted which provides a solid assembly, while being center pillar-less, due to the H-shaped structure of the floor, sides and roof.
- The solid coupling of the rear door locks (top and bottom) with the strikers on the body, together with the rear door built-in pillar provide structural strength equal to or better than that of a regular sedan.
- The side impact bar inside the front door is positioned to effectively disperse an impact throughout the body. Also, catch pins are installed to disperse impacts involving the doors throughout the side sill.
- Body rigidity has been improved due to the highly rigid, closed-section high-mount backbone frame located along the upper part of the transmission tunnel.



CHU0910S001

- Cabin distortion when driving has been suppressed due to the crossmembers, attached on each side of and crossing over the transmission tunnel. These also heighten the rigidity of the front seat supports and improve handling.

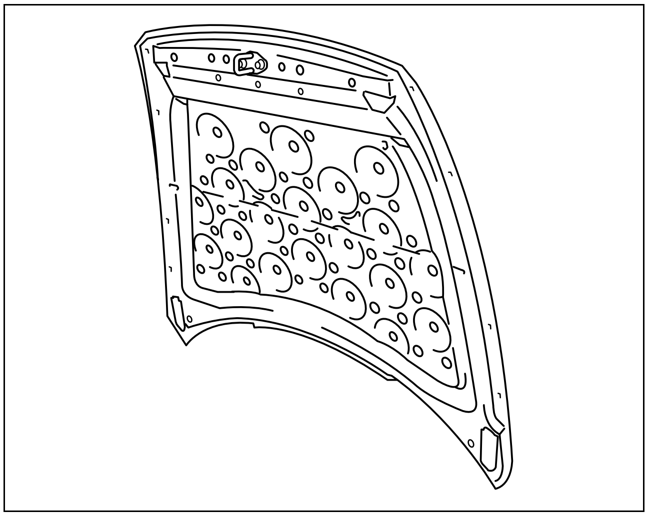


CHU0910S002

HOOD CONSTRUCTION

- An shock-absorbing cone structure has been adopted that consists of numerous dimples in the hood inner panel, reducing thickness while maintaining the energy absorption rate.

CHU091056601S01



BHJ0910N002

09–11 DOORS AND LIFTGATE

DOOR OUTLINE

CHU091158010S01

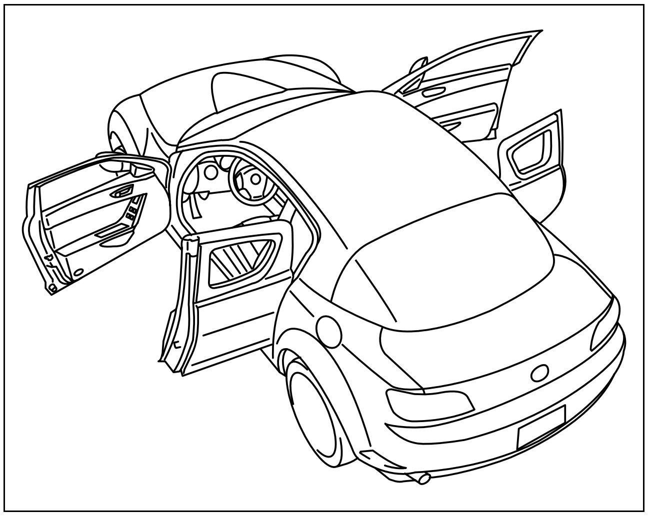
Features

Improved marketability	• Freestyle doors adopted • Door module that integrates interior parts adopted for front doors
Reduced weight	• Aluminum construction adopted for rear door
Improved safety	• Side impact bars adopted for front doors • Built-in pillars adopted for rear doors • Catch pins adopted

DOOR CONSTRUCTION

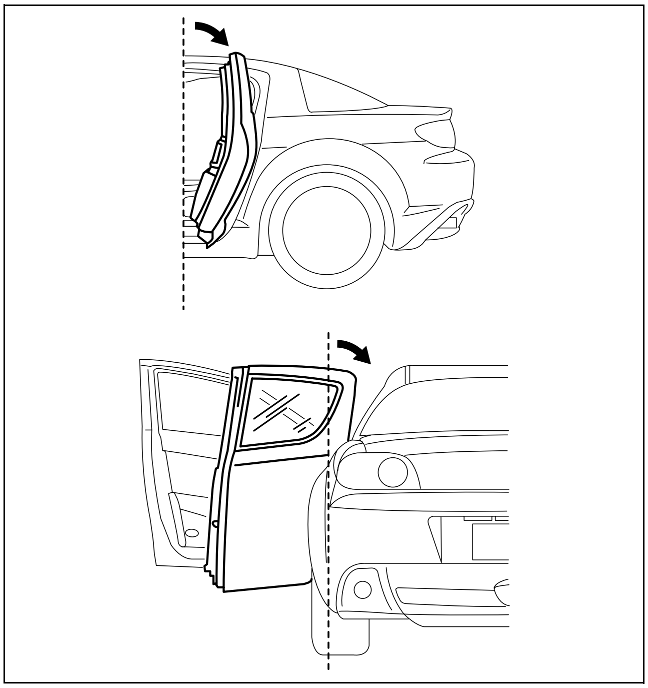
CHU091158010S02

- Freestyle doors have been adopted, allowing the rear doors to open outward from the center of the vehicle.
- The front doors can open up to 67% and the rear doors up to 80%, ensuring good access.



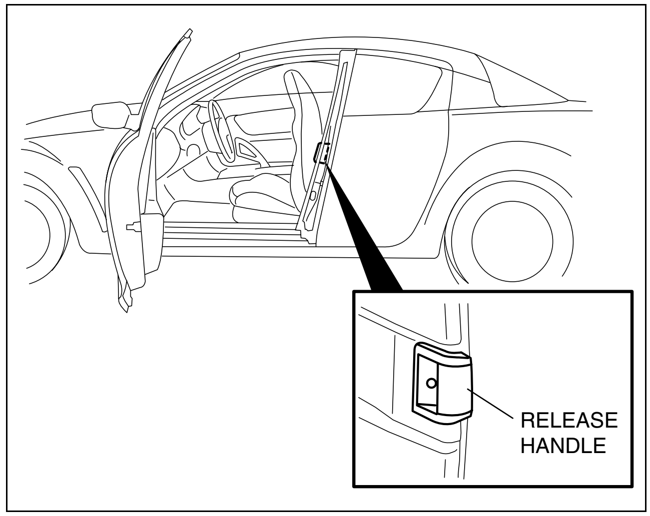
CHU0911S002

- The rear doors have been slanted towards the inner side and rear of the vehicle so they open at a slightly upward angle. This prevents the doors from interfering with each other when opening or closing and reduces the amount of force required for opening.



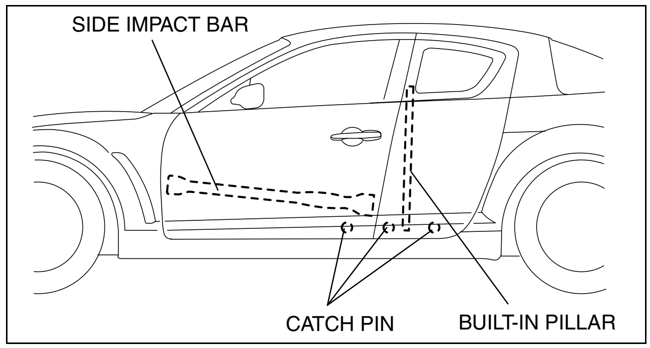
CHU0911S003

- A large-sized release handle located inside the rear door jamb is used to open the rear door. Due to this, a mechanism that keeps the rear door from opening if the front is not opened first has been adopted, and accidental opening is prevented.



CHU0911S004

- The following structural supports have been adopted in order to prevent cabin deformation in case of a side-impact collision. See (0910) for detailed descriptions.
  — Side impact bars in the front doors
  — Built-in pillar in the rear doors
  — Catch pins along the bottom edges of both the front and rear doors

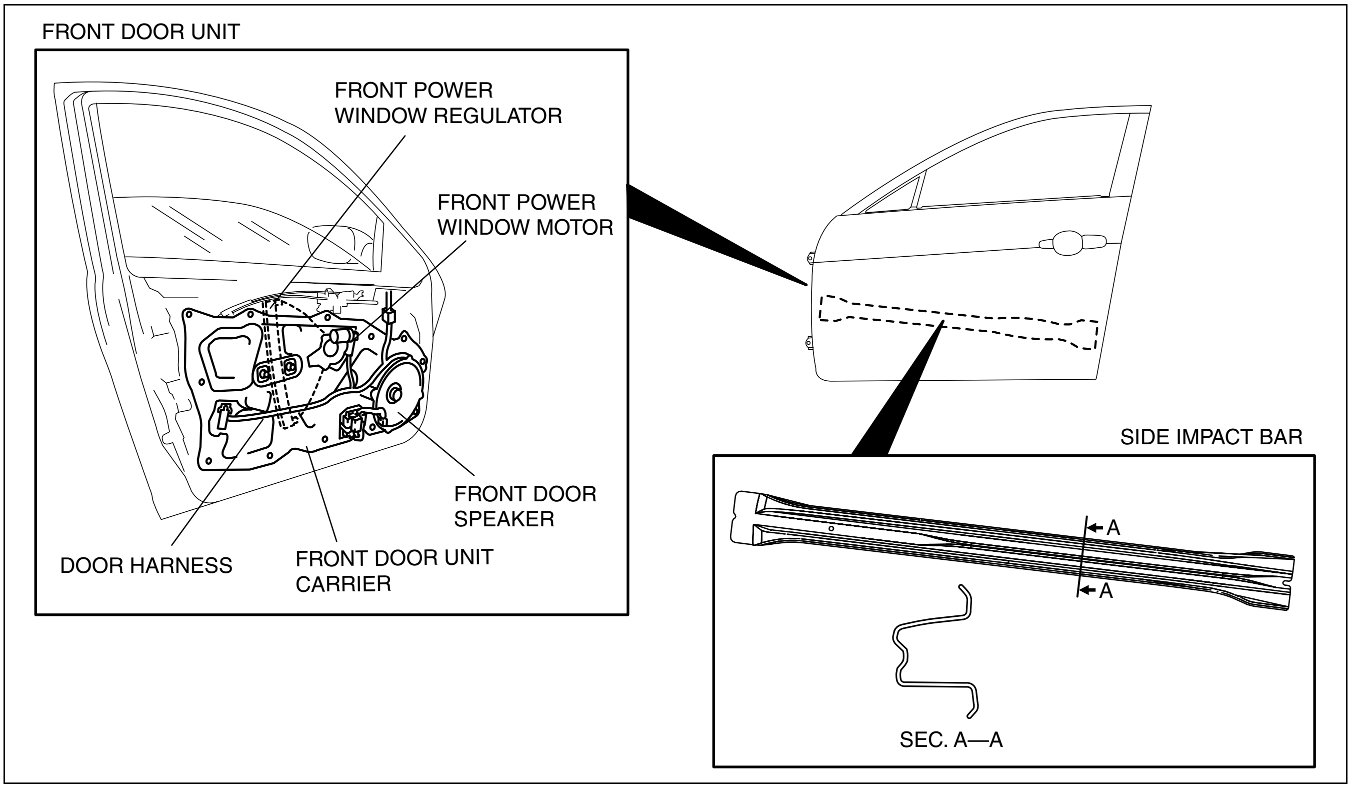


CHU0911S005

FRONT DOOR CONSTRUCTION

CHU091158010S03

- The inner construction of the door, including the power window regulator, door speaker, door harness and other parts, have been integrated into a single door unit.
- Due to the integrated door unit, weight reduction has been achieved for the whole door.
- Waterproofing of the inner door unit parts is achieved due to sectional design.
- Fiberglass reinforced plastics have been adopted for the door unit carrier to improve rigidity.
- A ripple-shaped side impact bar has been adopted to improve rigidity in case of collision.



CHU0911S001

09–11

09–12 GLASS/WINDOWS/MIRRORS

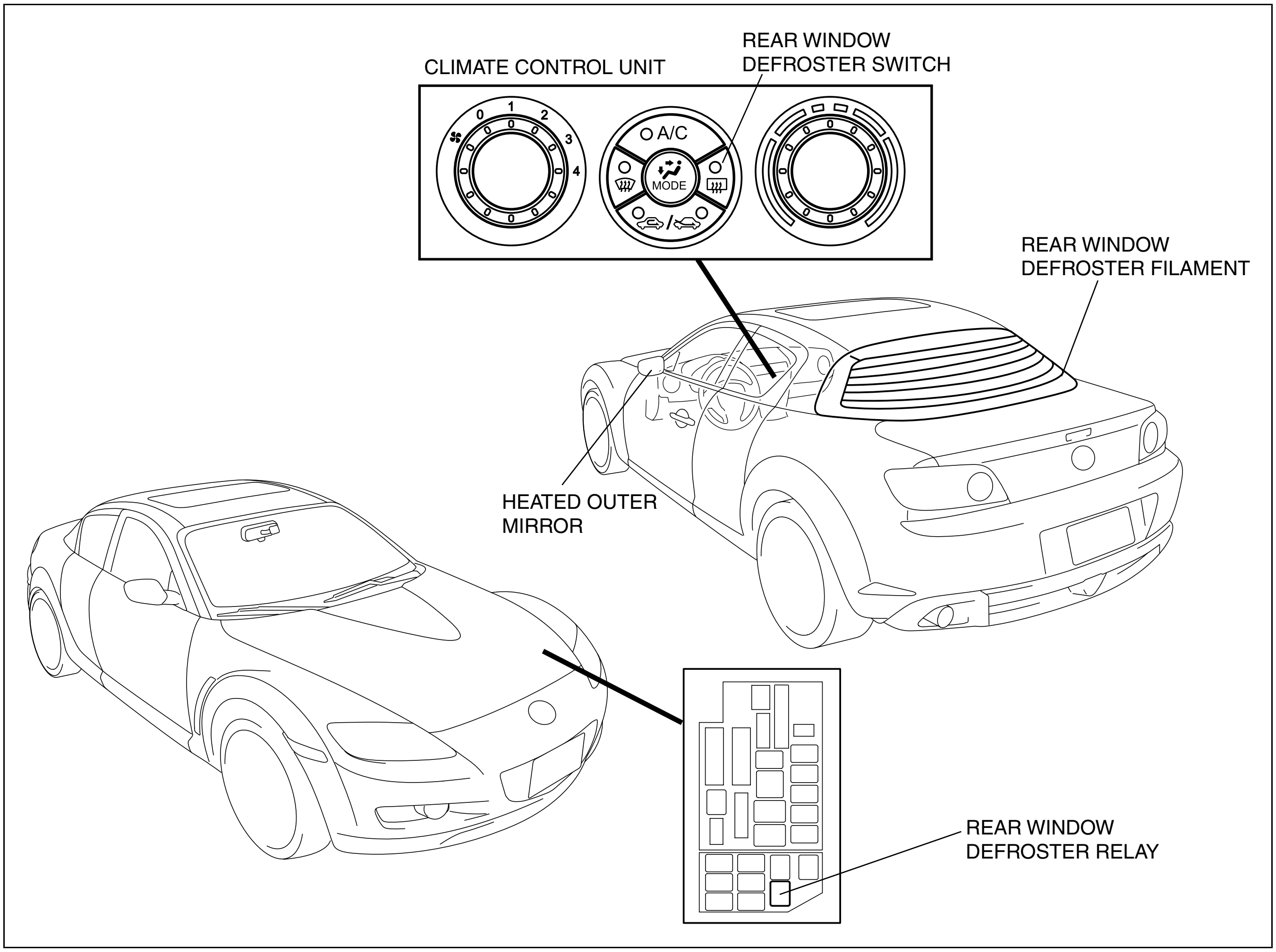
REAR WINDOW DEFROSTER SYSTEM OUTLINE

CHU091263000S01

- By heating the filament, fogging is cleared from the rear window and outer mirrors.

REAR WINDOW DEFROSTER SYSTEM STRUCTURAL VIEW

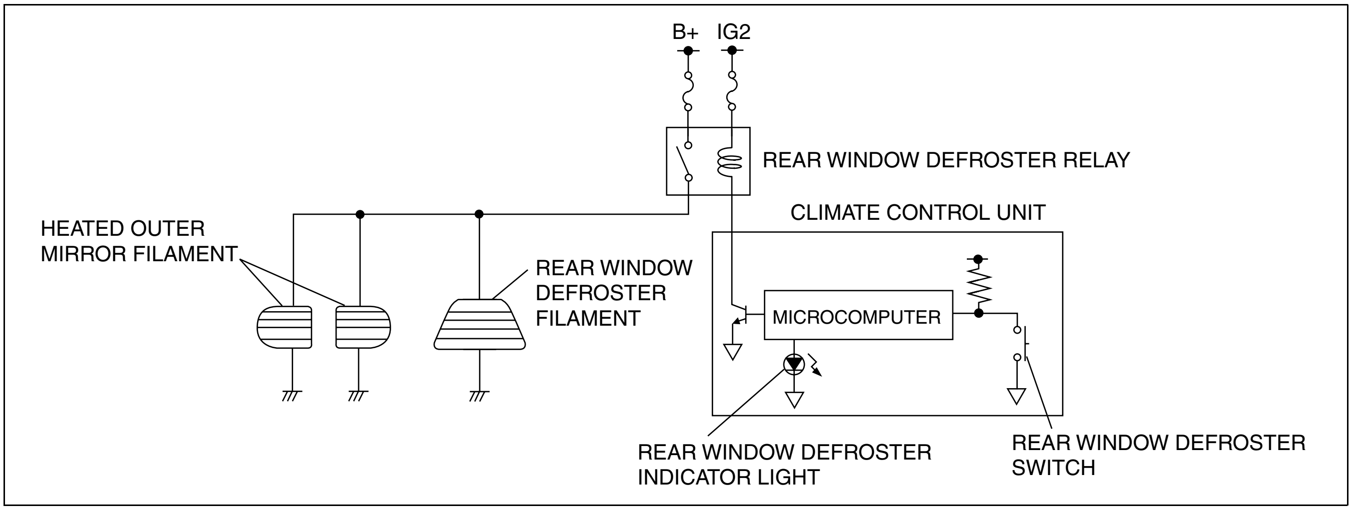
CHU091263000S02



CHU0912S003

REAR WINDOW DEFROSTER SYSTEM WIRING DIAGRAM

CHU091263000S03



CHU0912S007

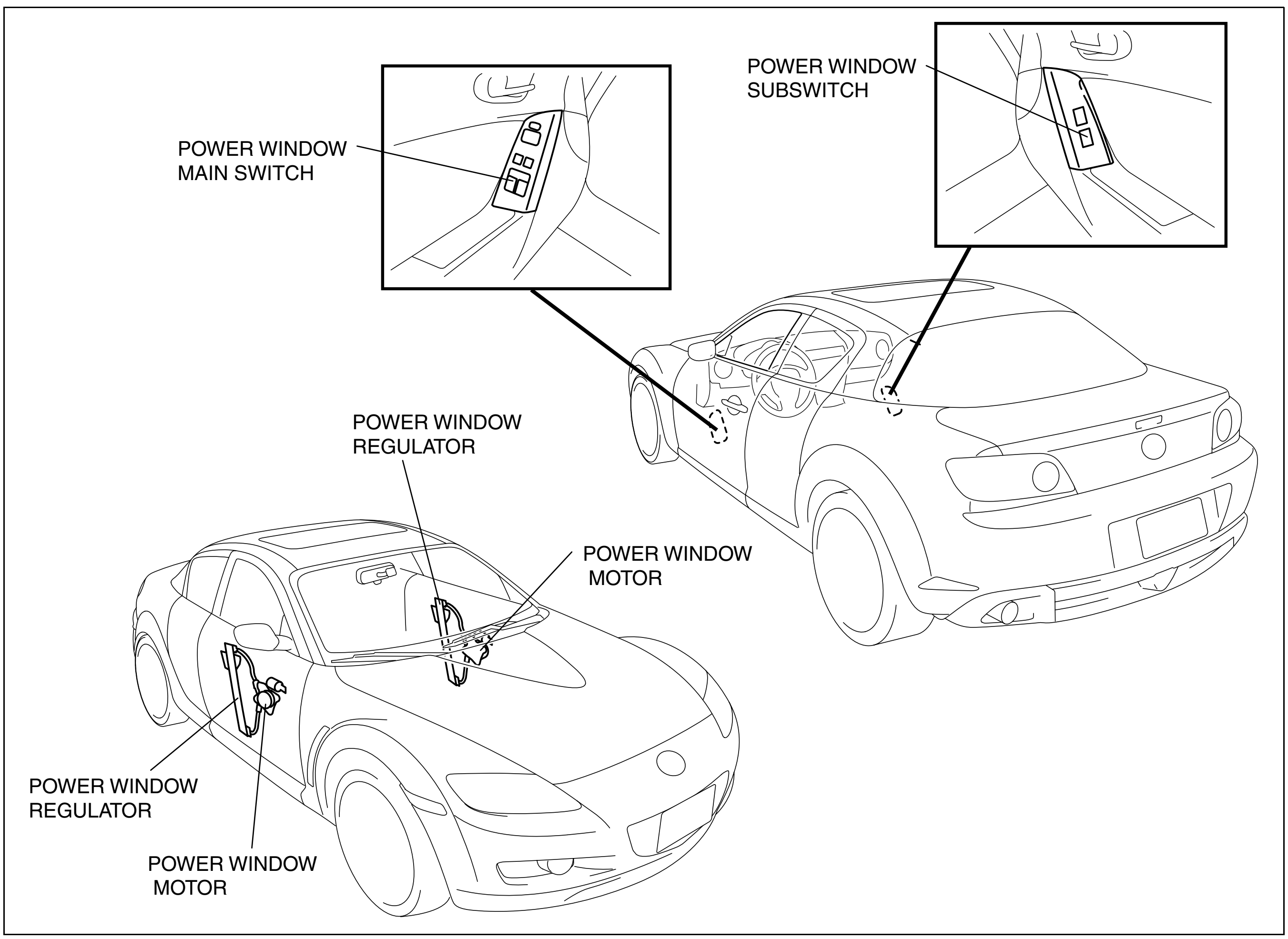
POWER WINDOW SYSTEM OUTLINE

CHU091258000S01

- The power window system has the following functions.
  - — Auto open function (driver's side)
  - — Power-cut function (driver's side)
  - — Manual open/close function
  - — IG OFF timer function (Cancelled when any door is opened.)

POWER WINDOW SYSTEM STRUCTURAL VIEW

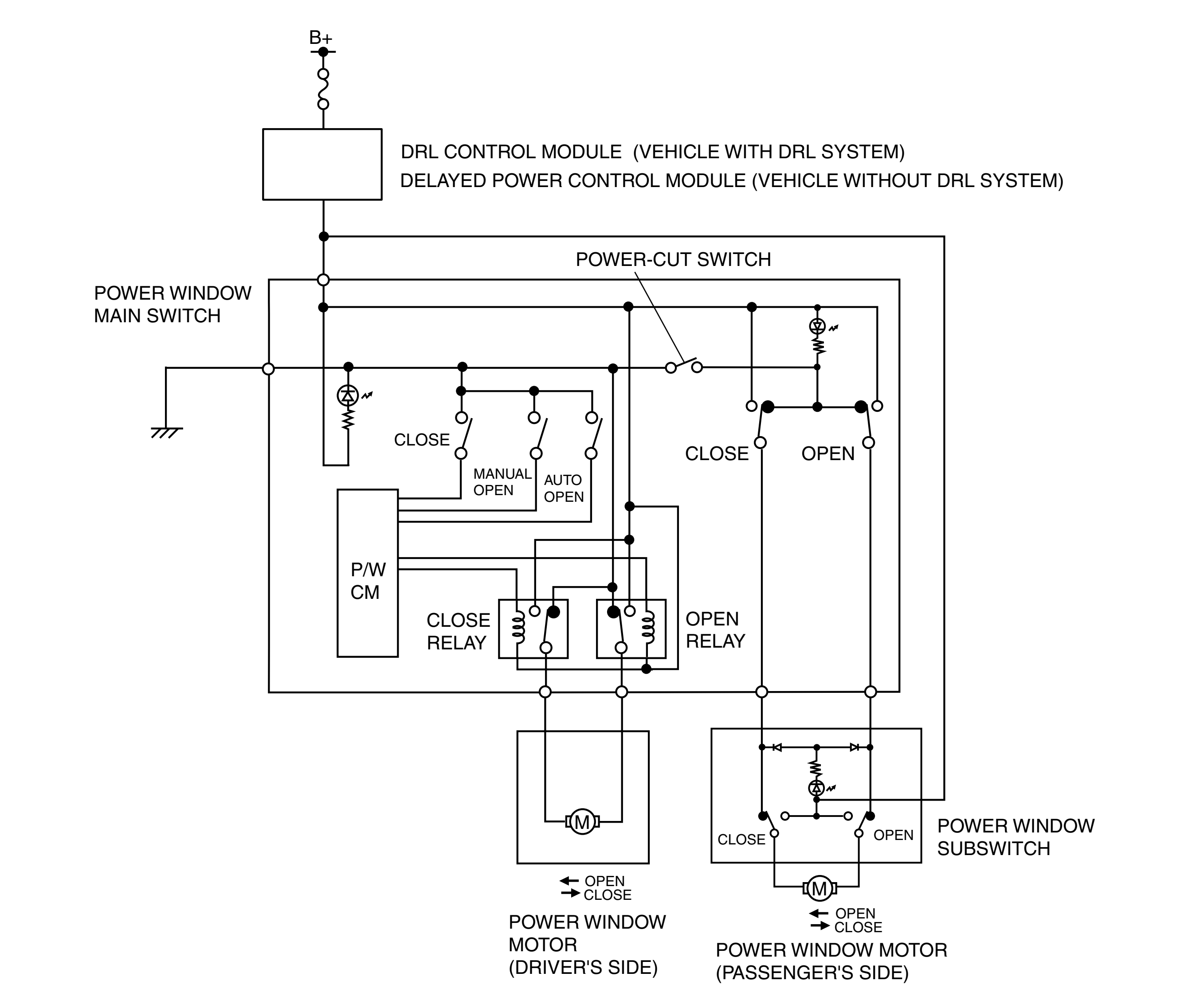
CHU091258000S02



CHU0912S001

POWER WINDOW SYSTEM WIRING DIAGRAM

CHU091258000S03



CHU0912S002

OUTER MIRROR OUTLINE

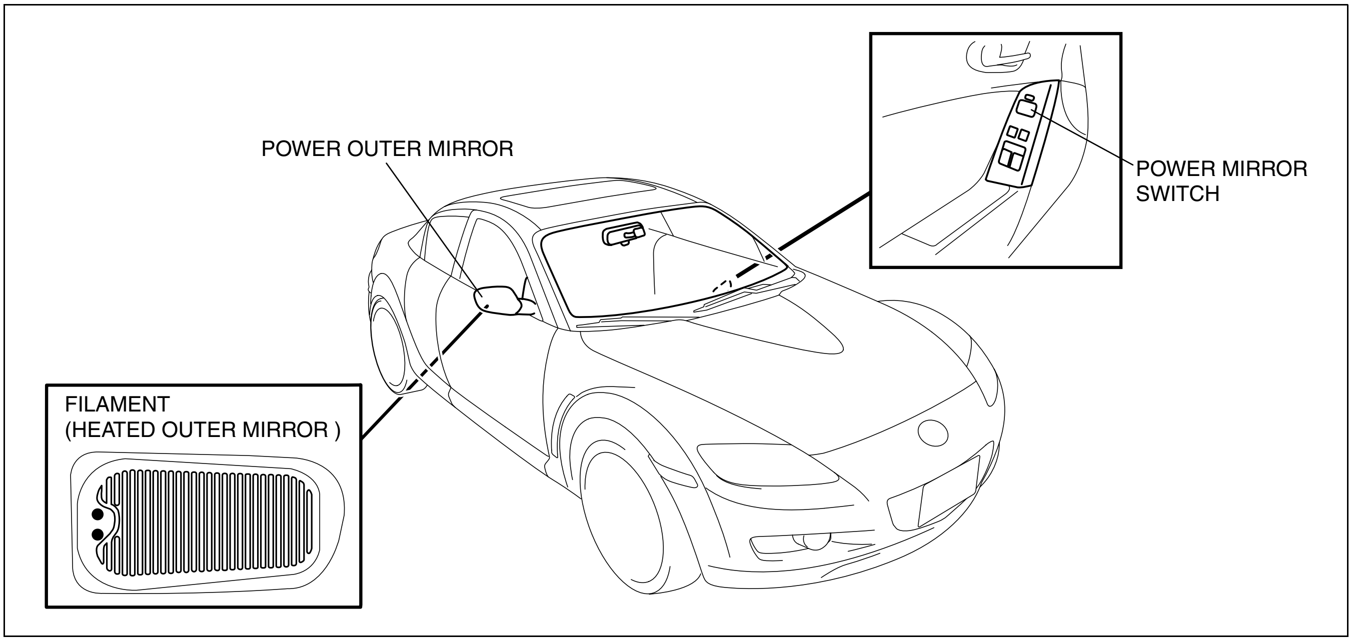
CHU091269100S01

- Power outer mirrors with automatically adjustable glass angle adopted.
- Heated outer mirrors adopted (operate when the rear defroster system is activated).

09–12

OUTER MIRROR STRUCTURAL VIEW

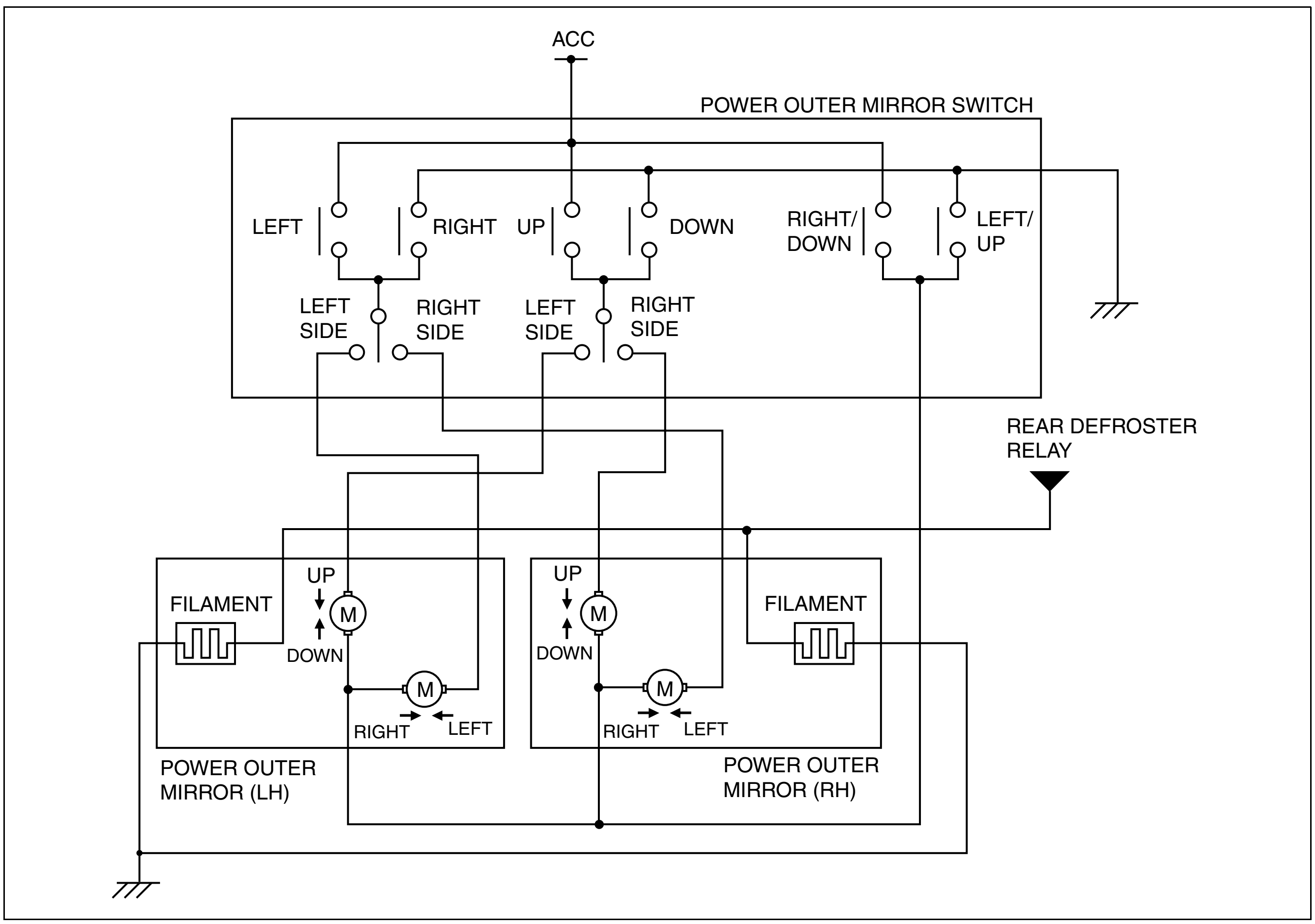
CHU091269100S02



CHU0912S004

POWER MIRROR SYSTEM WIRING DIAGRAM

CHU091269100S03



CHU0912S005

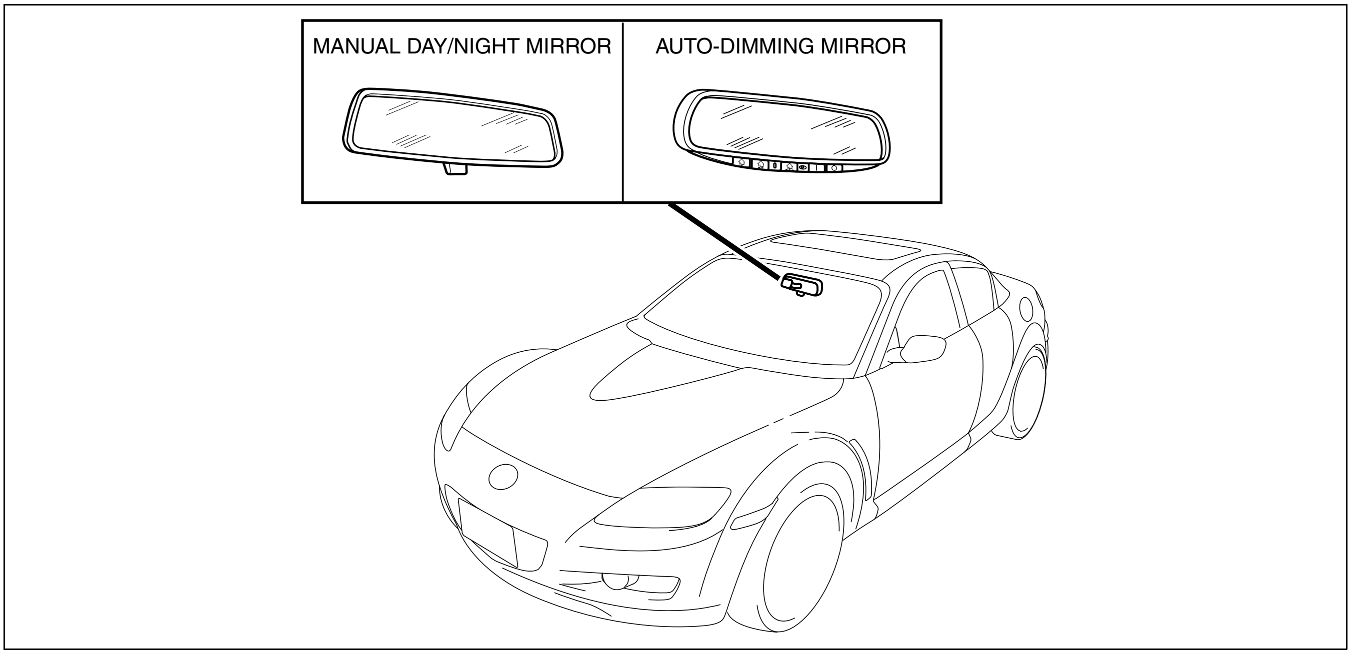
REARVIEW MIRROR OUTLINE

CHU091269220S01

- The auto-dimming mirror integrated HomeLink Wireless Control System has been adopted for improved safety.

REARVIEW MIRROR STRUCTURAL VIEW

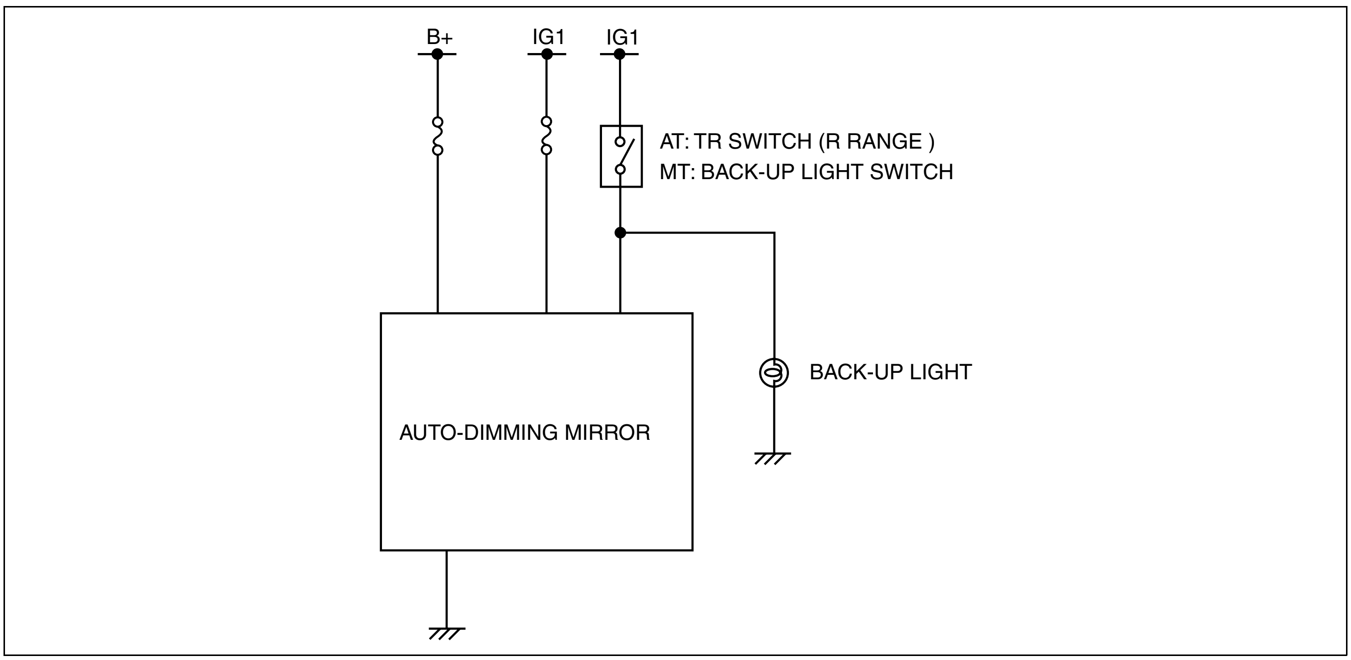
CHU091269220S02



CHU0912S006

REARVIEW MIRROR SYSTEM WIRING DIAGRAM

CHU091269220S03



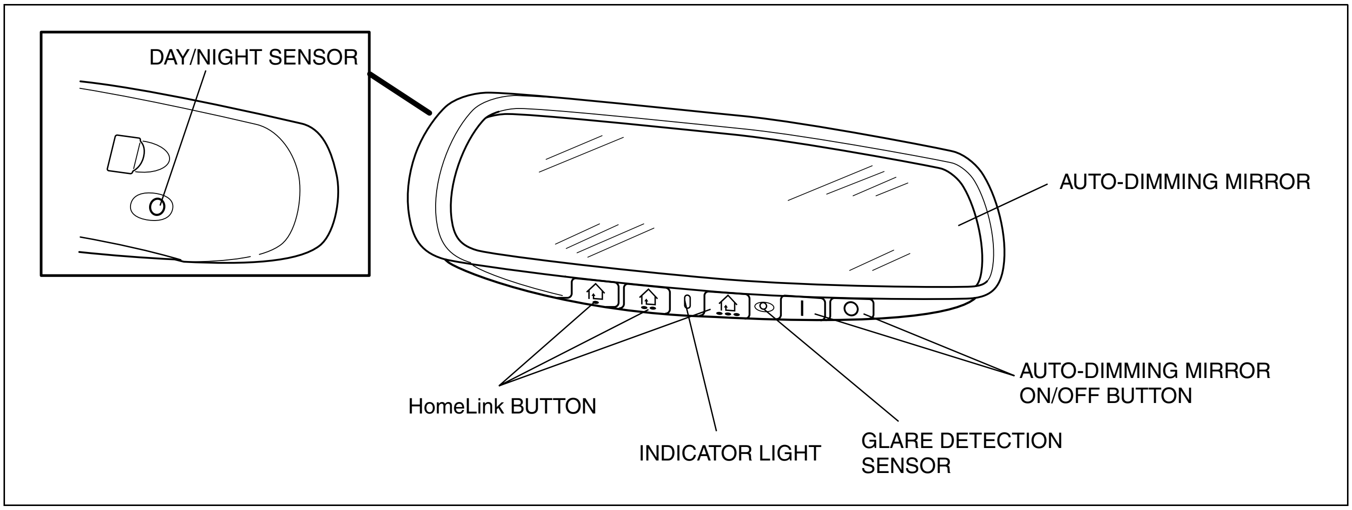
CHU0912S201

AUTO-DIMMIMG MIRROR CONSTRUCTION/OPERATION

CHU091269220S04

Function

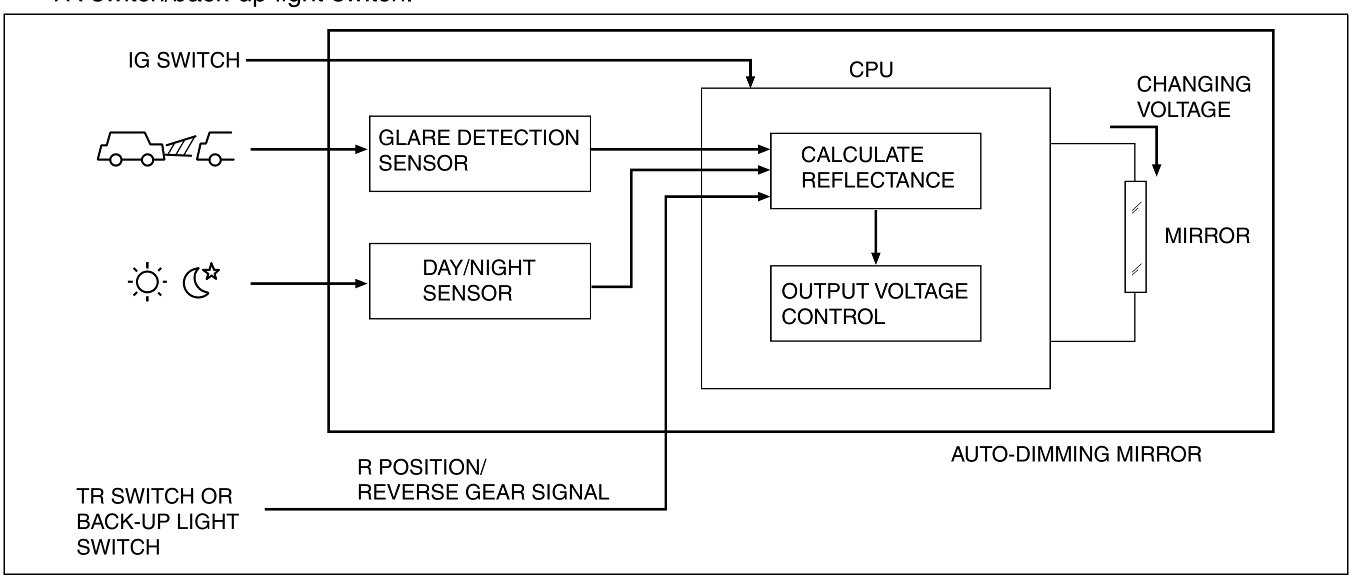
- The auto-dimming mirror automatically reduces glare from rear car headlights when the auto-dimming mirror on/off switch is turned on.
- The auto-dimming mirror comes with an integrated HomeLink Wireless Control System, which enables the programming of the mirror for activation of garage doors, electric gates, and home lighting. The auto-dimming mirror stores the codes from various existing transmitters.
- If the auto-dimming mirror is replaced, it is necessary to perform the HomeLink programming. Refer to the Owner's Manual for the procedure.



B6U0912S005

Operation

1. The day/night sensor detects the ambient brightness (A) and sends the signal to the CPU.
2. The glare detection sensor detects the amount of light from the rear (B) and sends the signal to the CPU.
3. The CPU compares A and B, and determines the reflectance of the mirror.
4. The CPU controls the reflectance of the mirror by changing the voltage.
5. The reflectance is determined to be high when the CPU receives the R position/reverse gear signal from the TR switch/back-up light switch.



CHU0912S202

09–13 SEATS

SEAT OUTLINE

CHU091357100S01

- Front seat with built-in side air bag adopted
- Cushion lifter adopted for the driver-side seat
- Power seat adopted for the driver-side seat

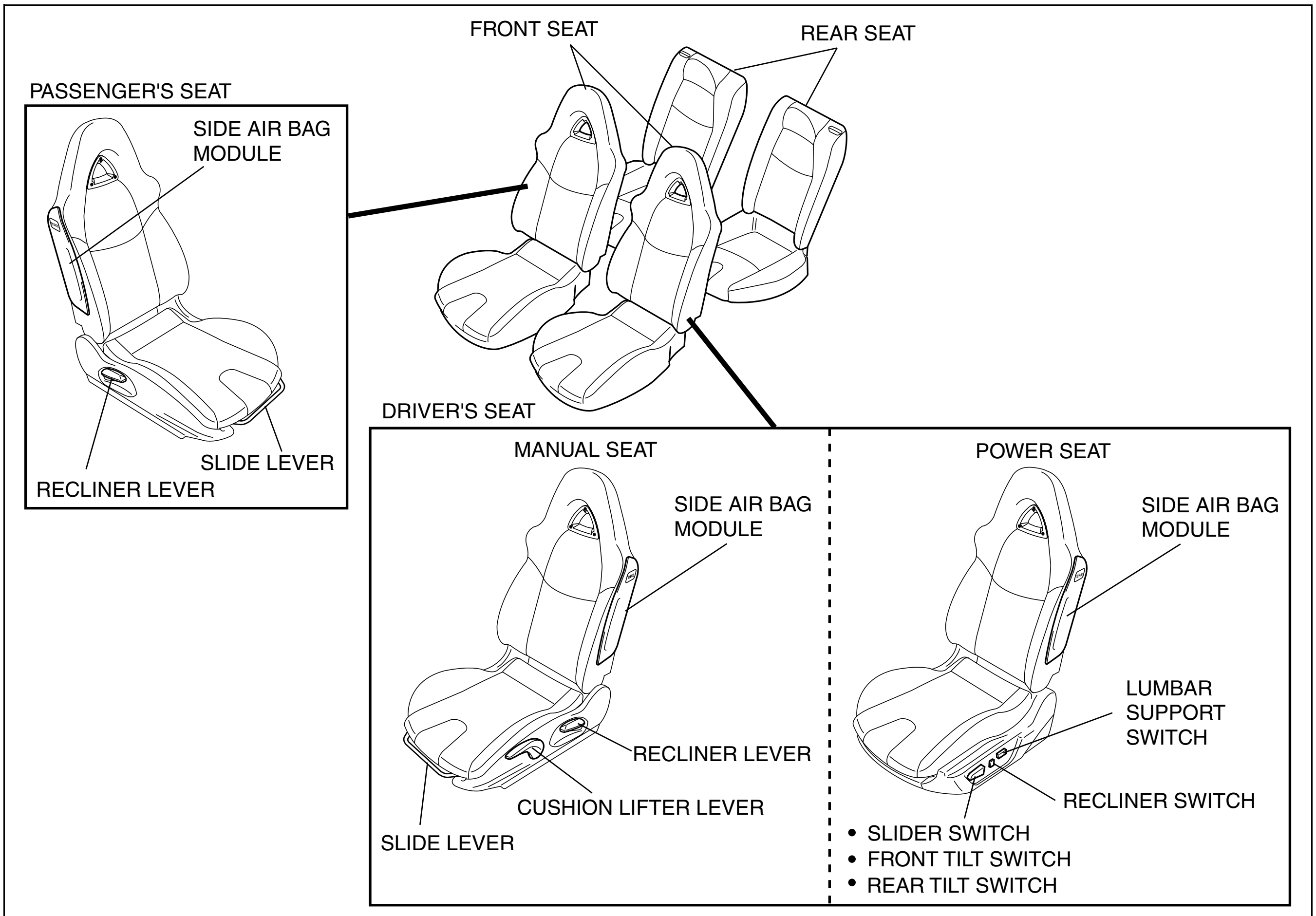
SEAT SPECIFICATION

CHU091357100S02

Item	Type	
Front seat	Manual seat	Recliner function
		Slide function
		Cushion lifter function (Driver-side seat only)
	Power seat	Recliner function
		Slide function
		Cushion lifter function
		Lumbar support function
Rear seat	Fixed	

SEAT STRUCTURAL VIEW

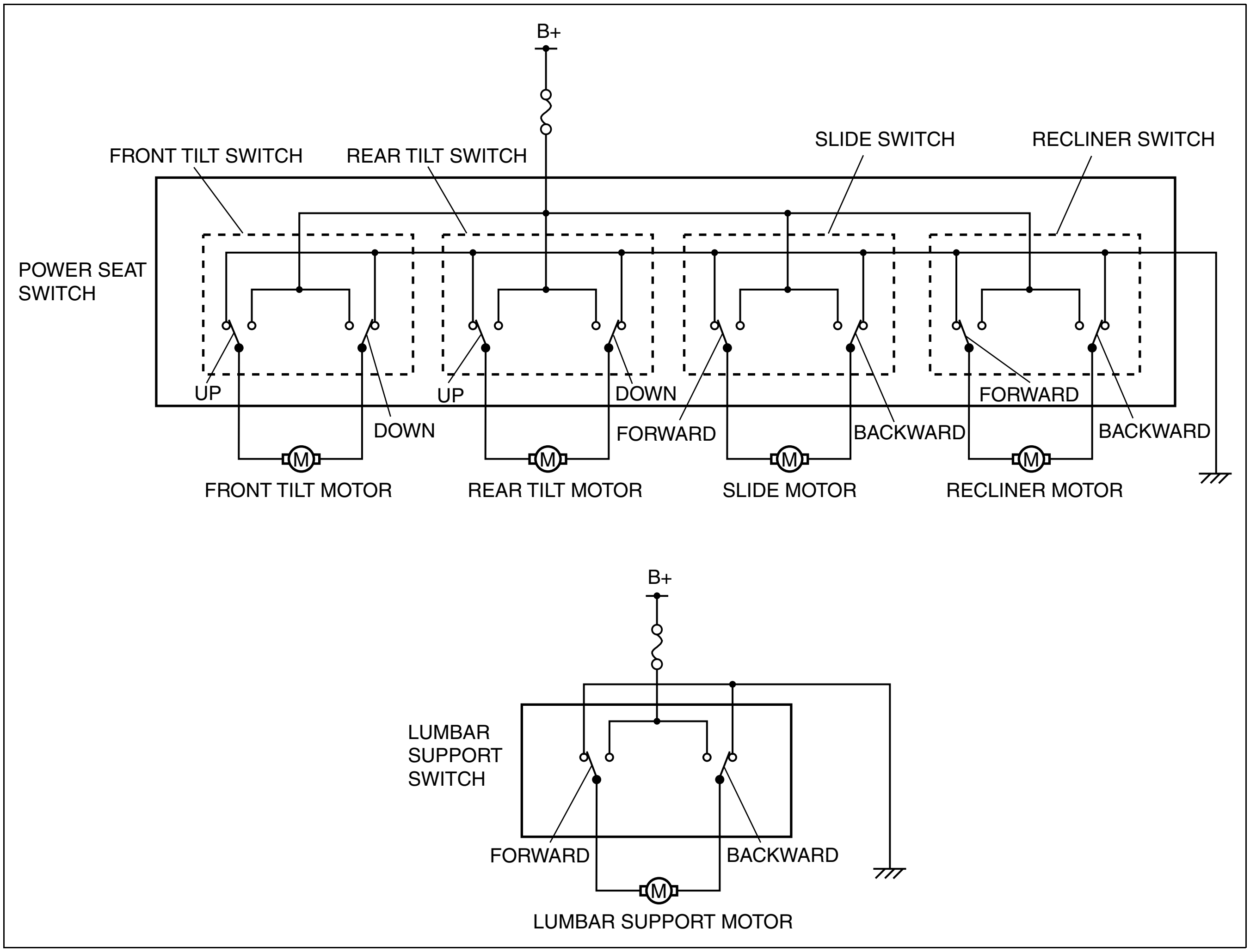
CHU091357100S03



CHU0913S101

POWER SEAT SYSTEM WIRING DIAGRAM

CHU091357101S01

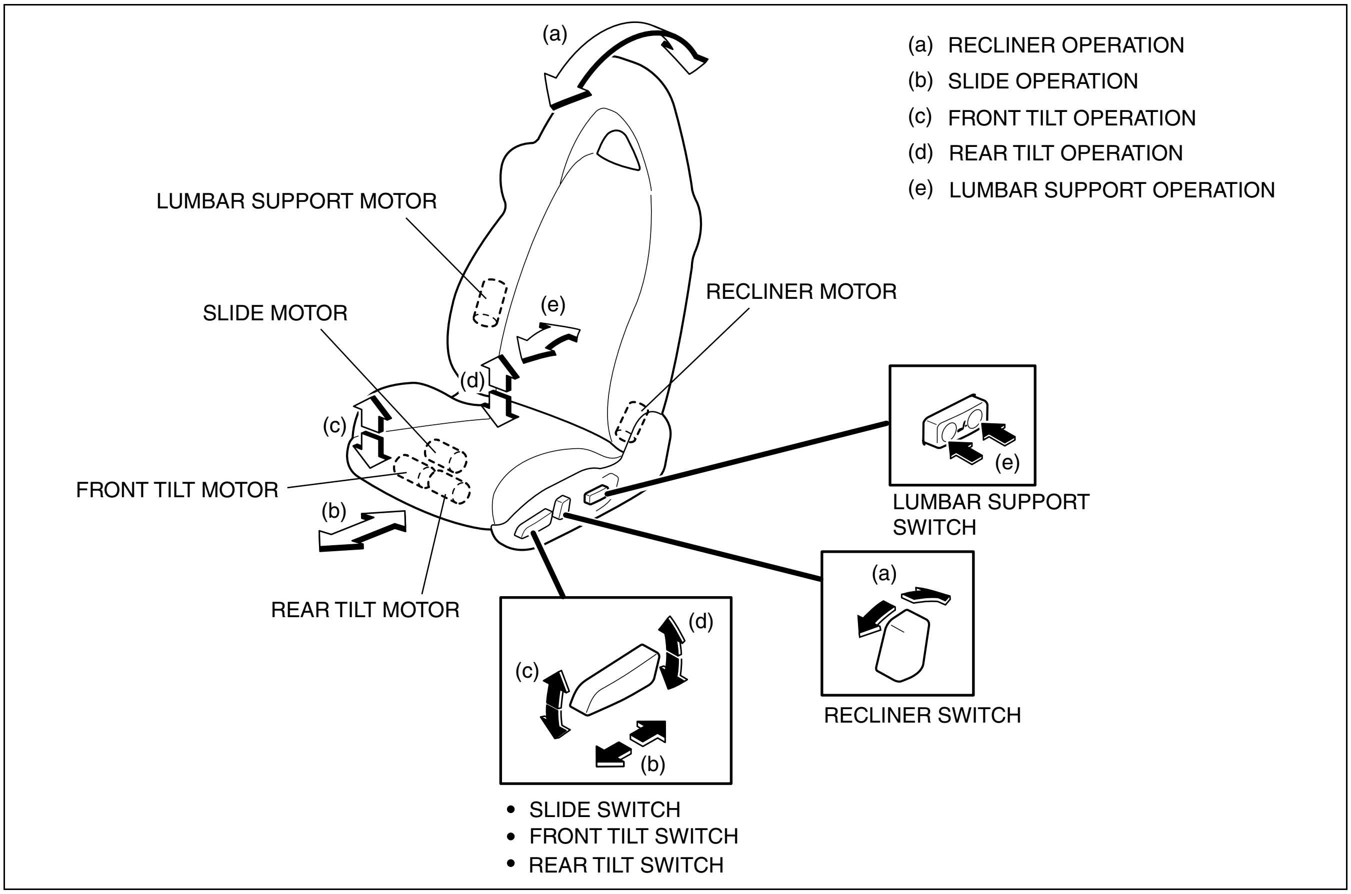


CHU0913S102

POWER SEAT CONSTRUCTION/OPERATION

CHU091357101S02

- The following motors are built into the seat:
  — Slide motor
  — Recliner motor
  — Front tilt motor
  — Rear tilt motor
  — Lumbar support motor
- The slide, front tilt and rear tilt switches are all operated by use of a single switch knob.



CHU0913S103

09–14 SECURITY AND LOCKS

SECURITY AND LOCKS OUTLINE

CHU091400001S01

Features

Improved marketability	• Power door lock system adopted • Keyless entry system adopted
Improved theft-deterrence	• Theft-deterrent system adopted • Immobilizer system adopted
Improved convenience	• Trunk lid opener switch adopted
Improved serviceability	• Control of following systems consolidated into the keyless control module: — Power door lock system — Keyless entry system — Interior light control — Theft-deterrent system — Immobilizer system

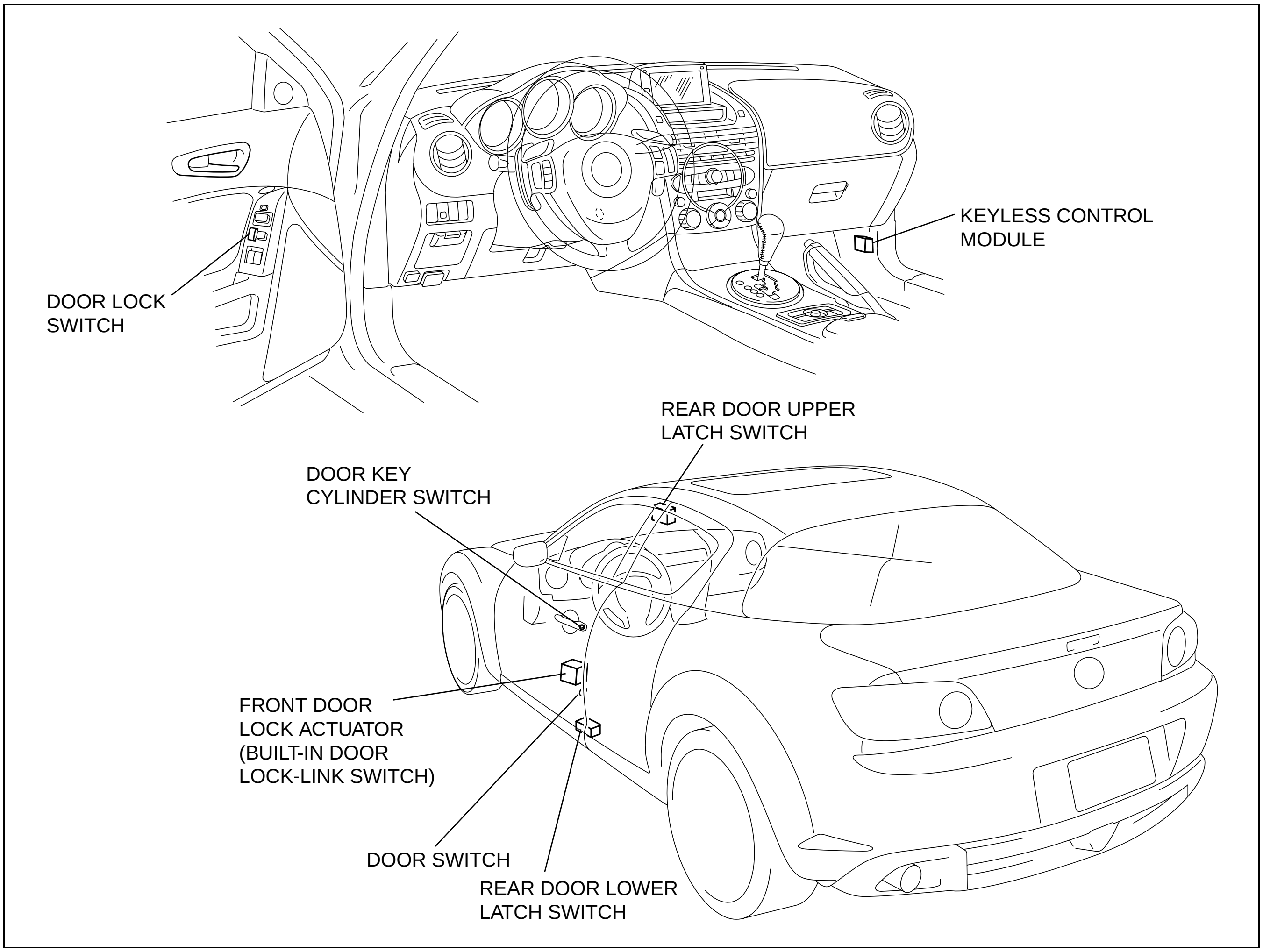
POWER DOOR LOCK SYSTEM OUTLINE

CHU091401090S01

- Operating the following will lock/unlock all doors.
  — Driver's-side door lock switch
  — Passenger's-side door lock switch
  — Door key cylinder
- When unlocking using the door key cylinder, operating one time will unlock the driver-side door and operating a second time will unlock the passenger-side door.

POWER DOOR LOCK SYSTEM STRUCTURAL VIEW

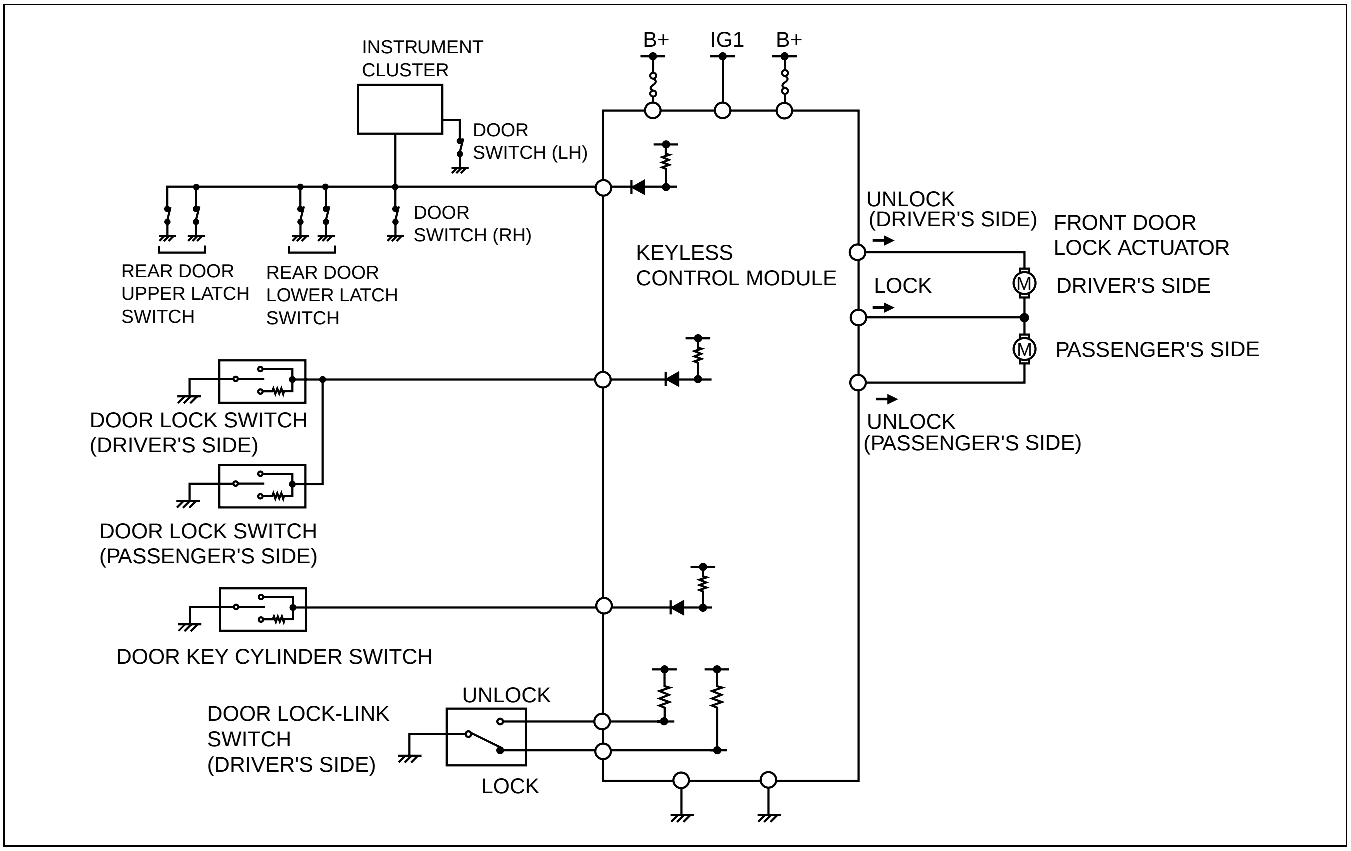
CHU091401090S02



CHU0914S207

POWER DOOR LOCK SYSTEM WIRING DIAGRAM

CHU091401090S03



CHU0914S205

KEYLESS ENTRY SYSTEM OUTLINE

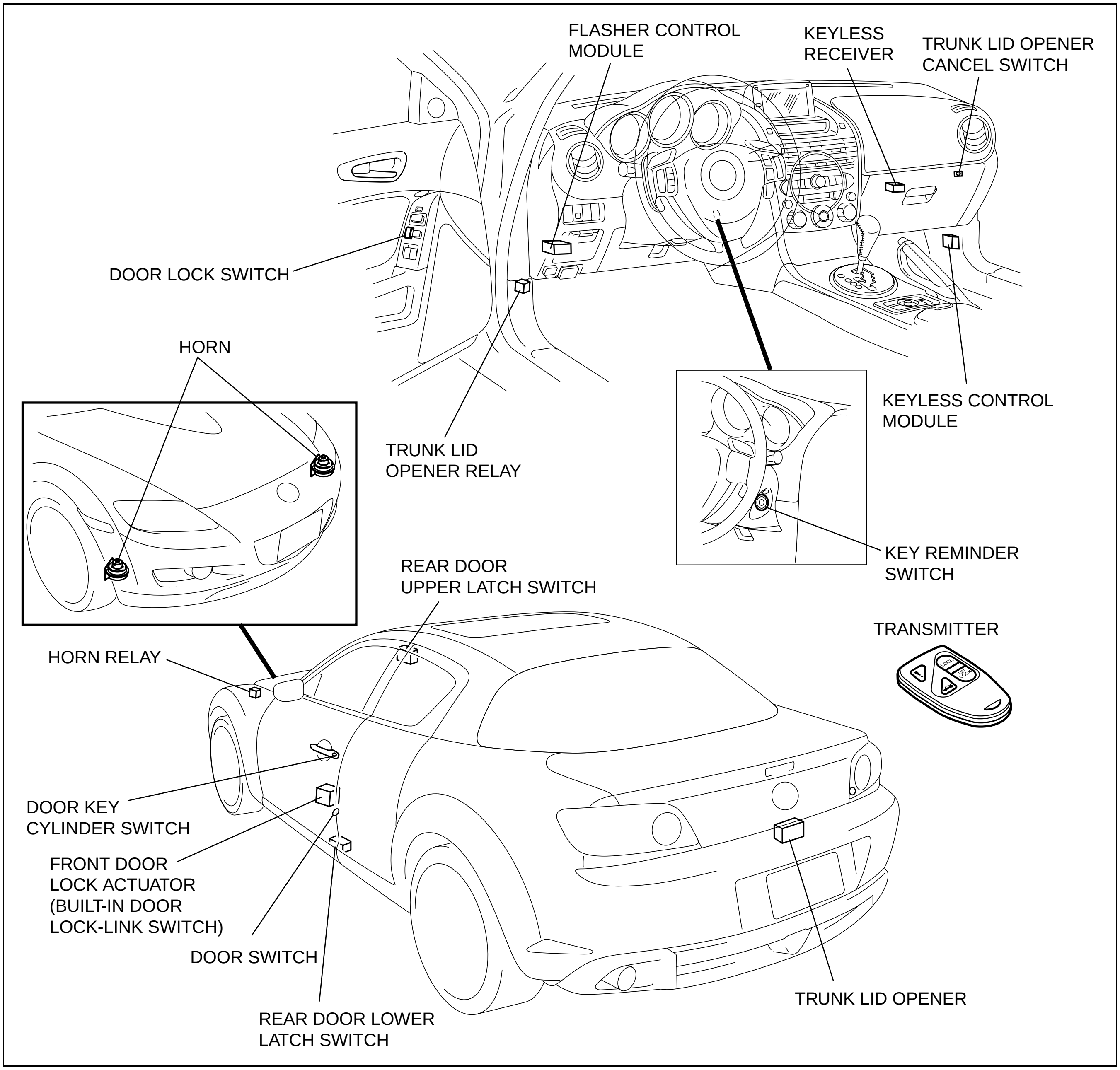
CHU091401090S04

- The following operations can be performed using the transmitter when away from the vehicle (approx. 2.5 m {8.2 ft}):
  - — Lock all doors (by pressing the LOCK button).
  - — Unlock the driver-side door (by pressing the UNLOCK button one time).
  - — Unlock the driver and passenger-side doors (by pressing the UNLOCK button two times within 5 s).
  - — Unlock the trunk lid (by pressing the TRUNK LID button). (When the trunk lid opener cancel switch is at the ON position, the trunk lid does not unlock even when the TRUNK LID button is pressed.)
  - — Alarm (by pressing the PANIC button). (Cancelled by pressing any transmitter button, inserting the key into the steering lock, or after 5 min.)
- When the transmitter LOCK button is pressed two times within 5 s, the horn sounds once to indicate that all doors are locked.
- An auto-locking device has been adopted that automatically locks the doors if any of the following operations are not performed within 30 s of pressing the transmitter UNLOCK button:
  - — Any door is opened.
  - — The door is lock/unlock using the door key cylinder.
  - — The door is lock/unlock using the door lock switch.
  - — The key is inserted the steering lock.
- In order to prevent accidental operation when driving, pushing any transmitter button will have no affect when the key is inserted into the steering lock.

09–14

KEYLESS ENTRY SYSTEM STRUCTURAL VIEW

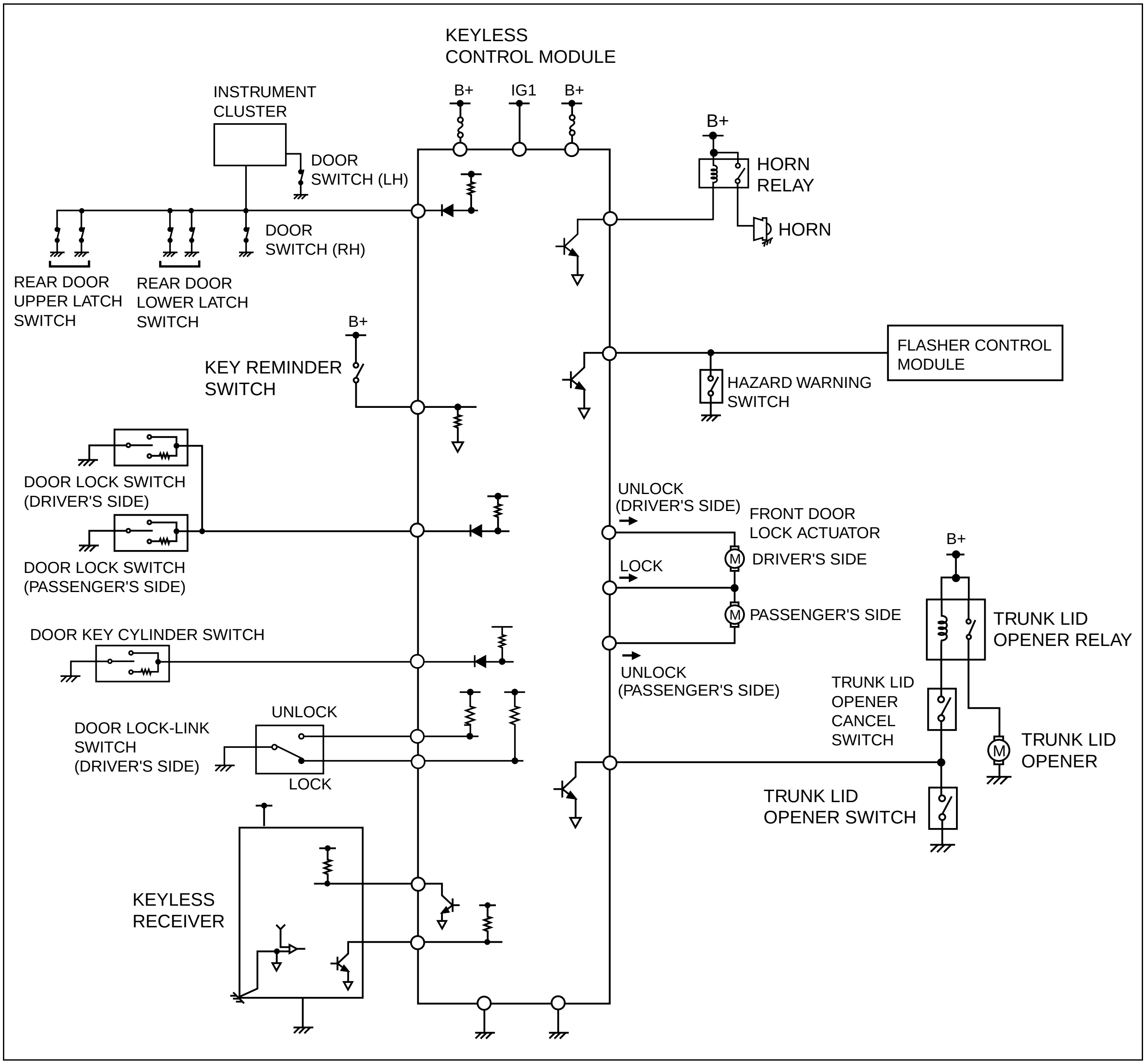
CHU091401090S05



CHU0914S208

KEYLESS ENTRY SYSTEM WIRING DIAGRAM

CHU091401090S06



CHU0914S206

THEFT-DETERRENT SYSTEM OUTLINE

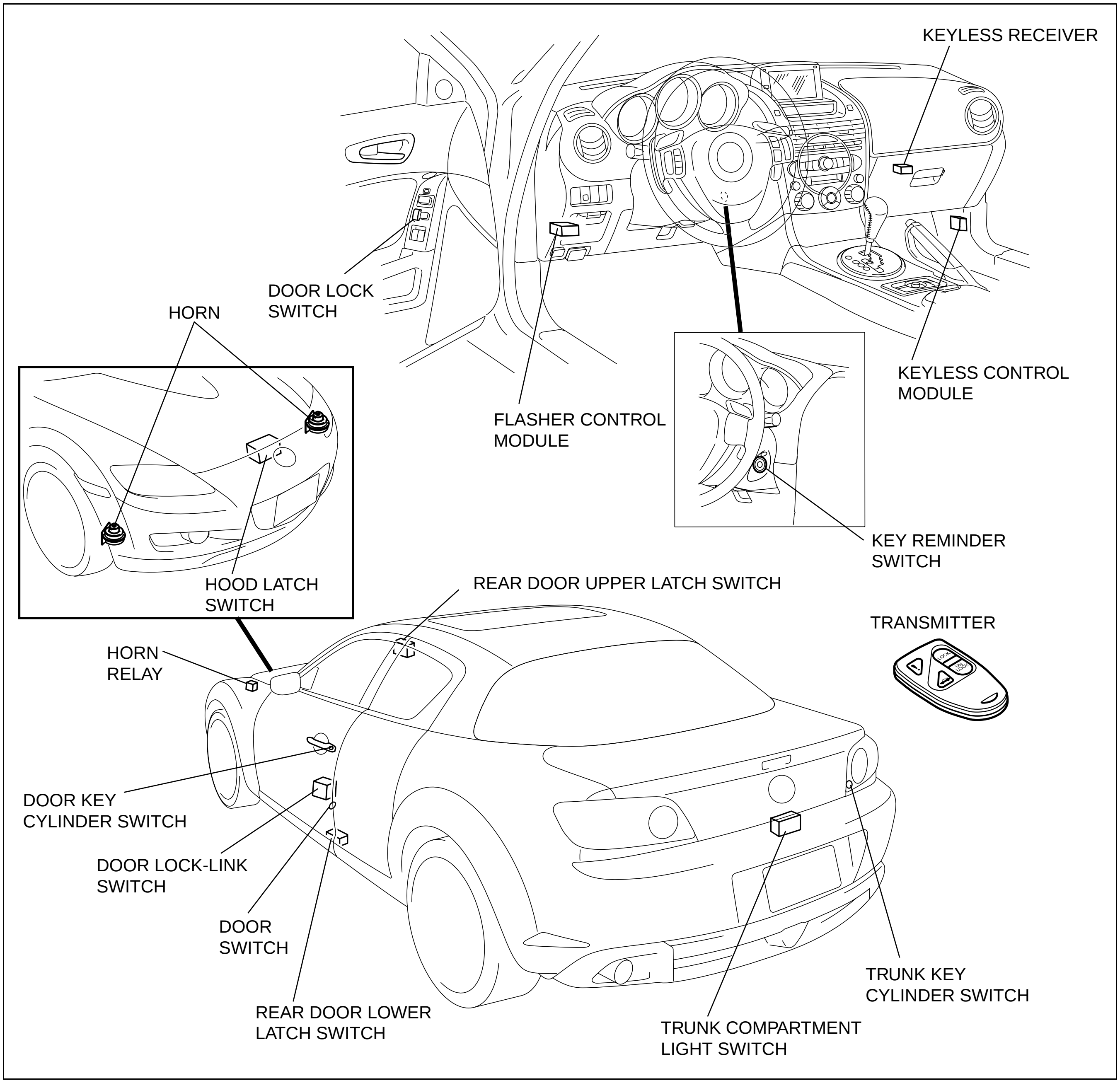
CHU091450000S01

- The theft-deterrent system includes sound and light alarms that activate when the hood, the trunk lid, or a door is opened by means other than the ignition key or the transmitter. The turn lights flash and the horn sounds.
- When the ignition key is inserted into the door or trunk key cylinder and turned to unlock or the transmitter unlock button is pressed, the alarms stop.

09–14

THEFT-DETERRENT SYSTEM STRUCTURAL VIEW

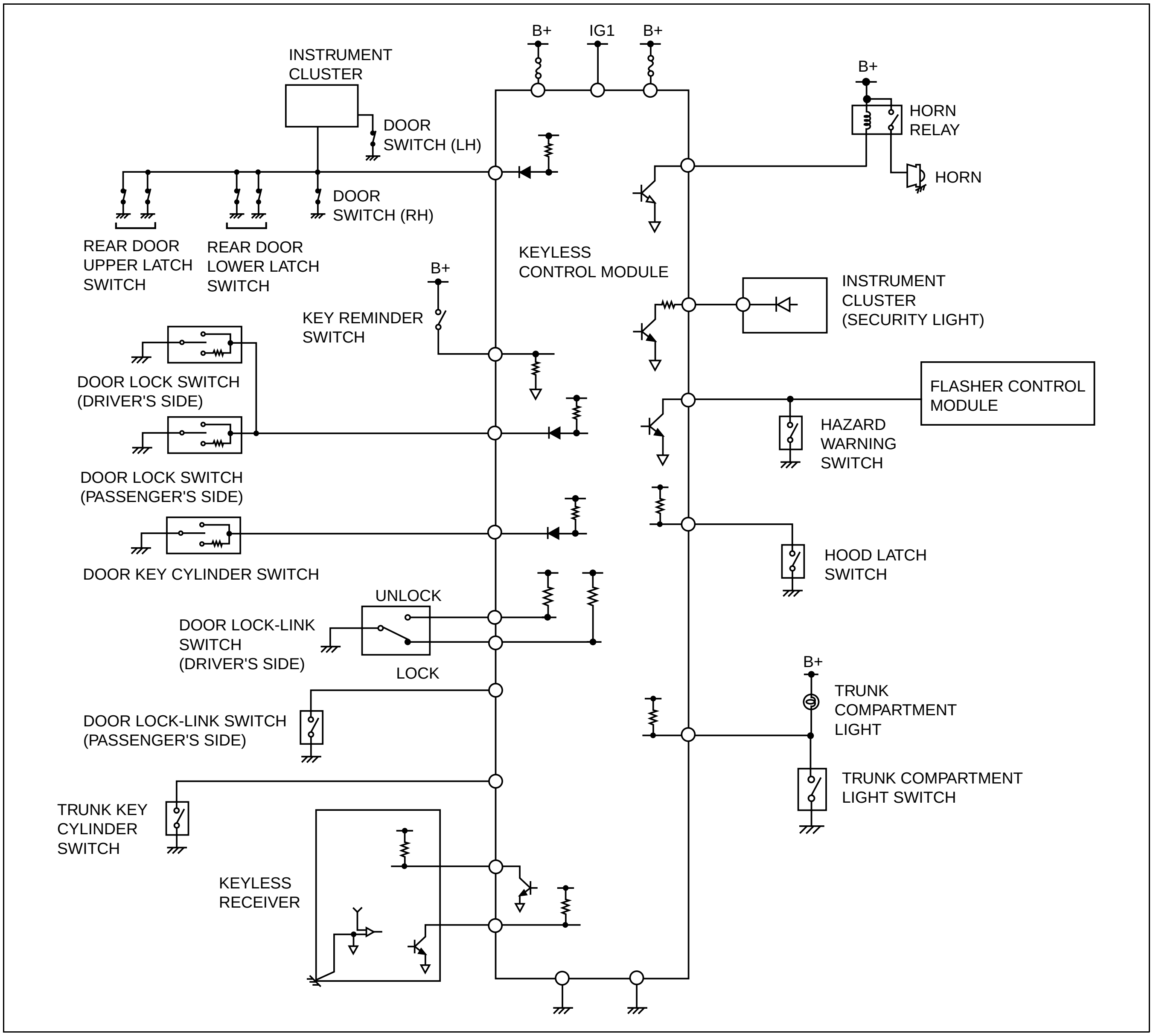
CHU091450000S02



CHU0914S201

THEFT-DETERRENT SYSTEM WIRING DIAGRAM

CHU091450000S03



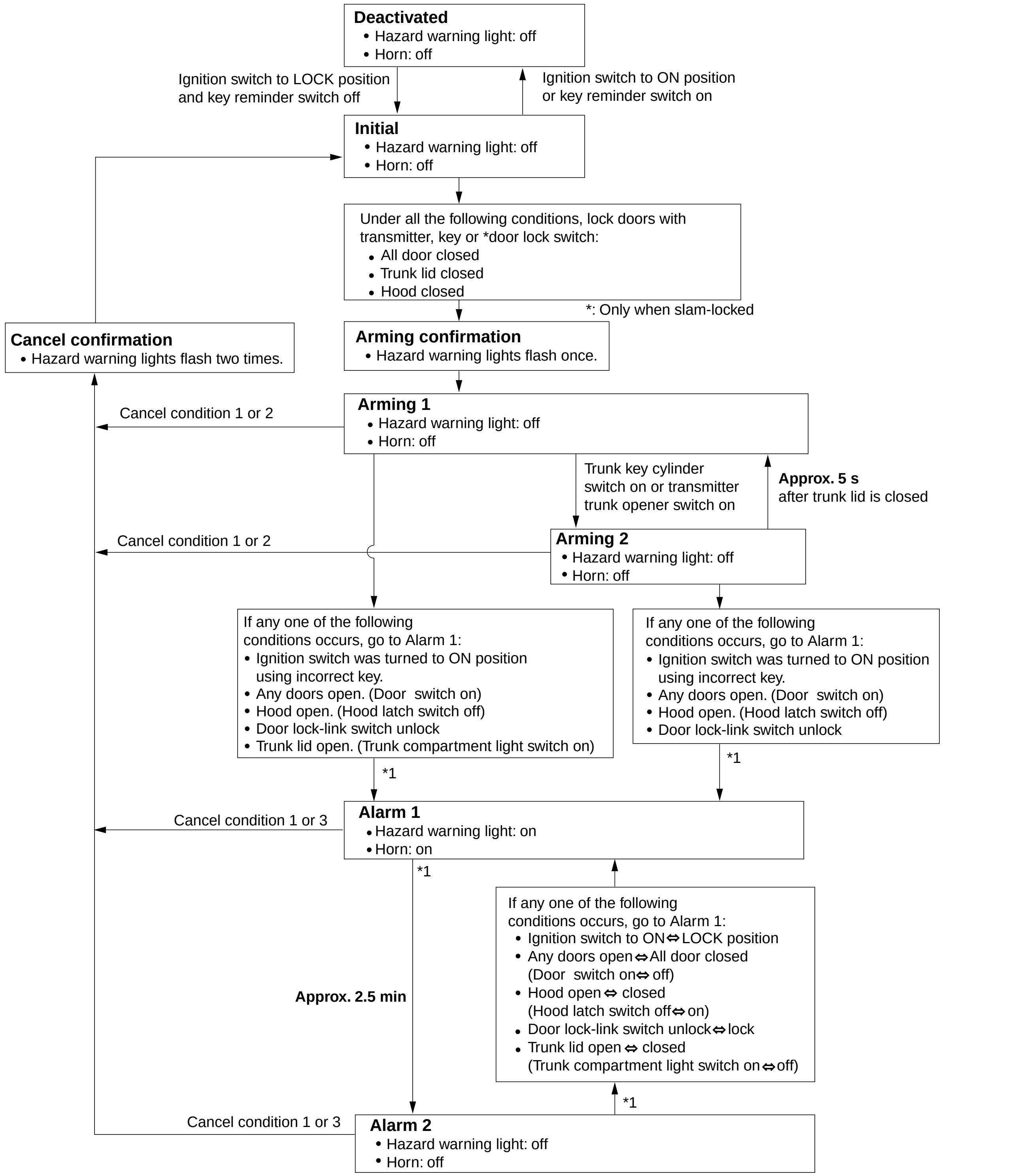
CHU0914S204

THEFT-DETERRENT SYSTEM OPERATION

CHU091450000S04

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 trunk lid. • 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 trunk lid 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 trunk lid is open, the doors will lock but the alarm will not arm until the hood or trunk lid 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 trunk lid. • Unlock any doors without using the transmitter or key. • Open a door, the hood or the trunk lid by operating an door lock switch, the hood release lever or the trunk lid 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. • Trunk lid open with transmitter or key.	-	-

System flowchart



*1: If the PANIC button is pressed, the keyless entry system operates (alarm status) and the theft-deterrent system shifts to Alarm 2 status.
(See 09-14-3 KEYLESS ENTRY SYSTEM OUTLINE.)

CANCEL CONDITION
1: Door unlock with transmitter or key.
2: Key reminder switch on and ignition switch to ON position.
3: Trunk lid open with transmitter or key.

CHU0914S203

09–14

IMMOBILIZER SYSTEM OUTLINE

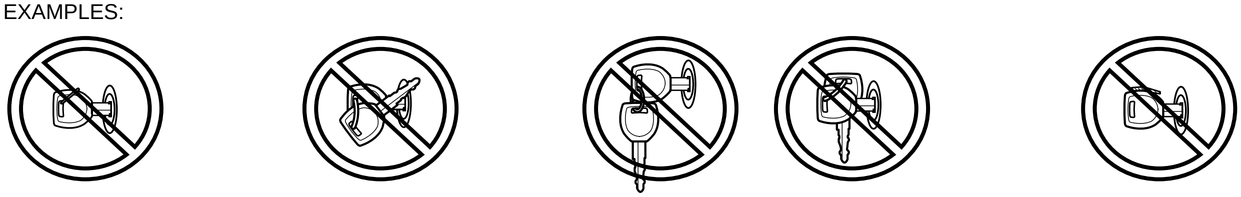
CHU091467000S01

- 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, 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 “09–14–11 IMMOBILIZER SYSTEM OPERATION”.
- 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 WDS or equivalent. Repair the malfunctioning part using the verified DTCs. For details, refer to “09–14–13 ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) MALFUNCTION DIAGNOSIS FUNCTION”.
- The immobilizer system cannot be deactivated.

Caution

- **The immobilizer system must be reset using the WDS or equivalent 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 “09–14–15 IMMOBILIZER SYSTEM COMPONENT REPLACEMENT/KEY ADDITION AND CLEARING OUTLINE”.**
- **Two or more key ID numbers must be registered for the engine to start. For key ID number registration, refer the Mazda RX-8 Workshop Manual (1772-1U-03C) Section 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 “09–14–14 ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION”.**
- **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**

EXAMPLES:

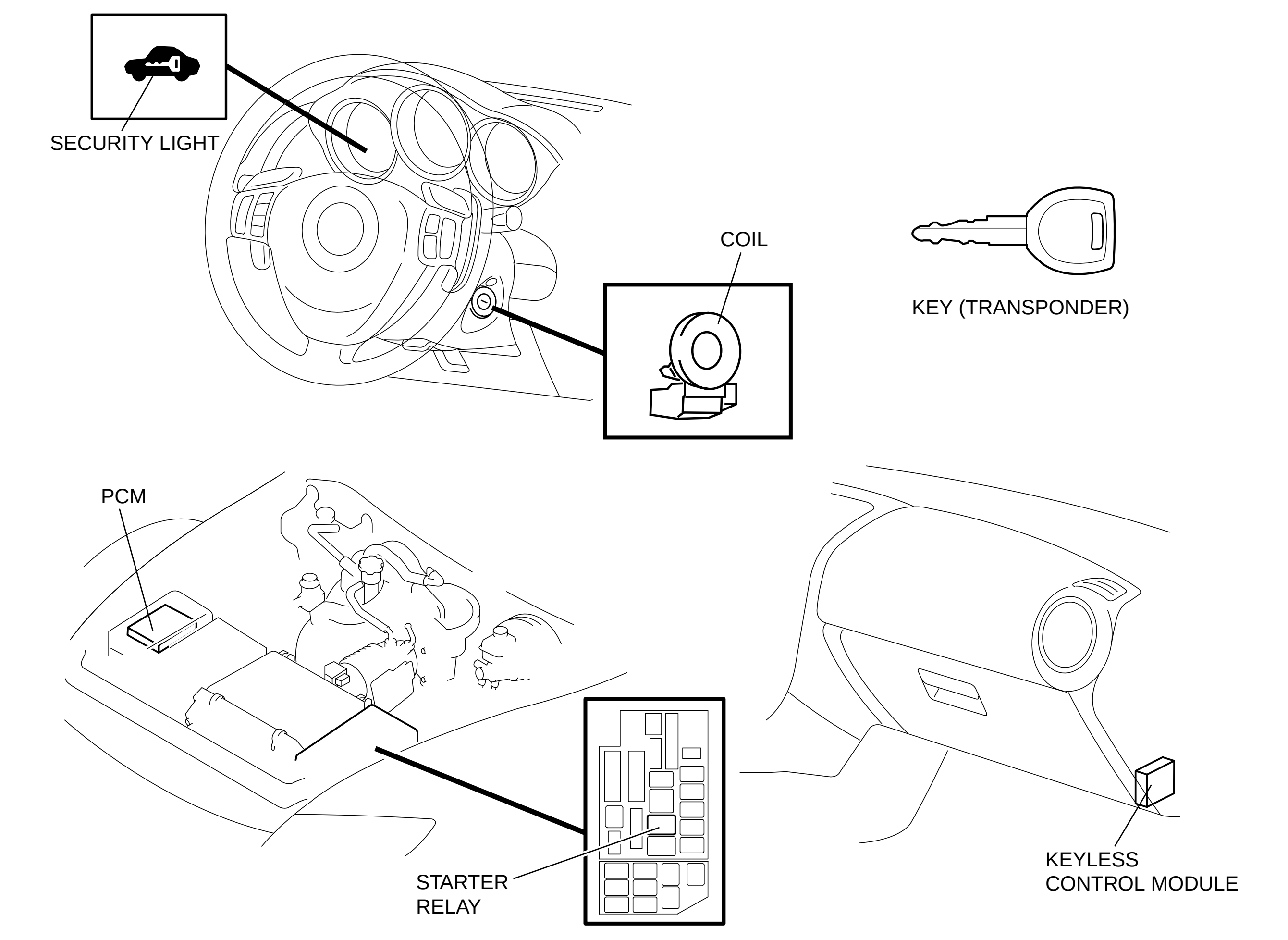


METAL RING LYING ON KEY HEAD | METAL PART OF ANOTHER KEY TOUCHING KEY HEAD | KEY IS CLOSE TO OR TOUCHING ANOTHER IMMOBILIZER SYSTEM KEY | METAL OBJECT TOUCHING KEY HEAD

CHU0914S213

IMMOBILIZER SYSTEM STRUCTURAL VIEW

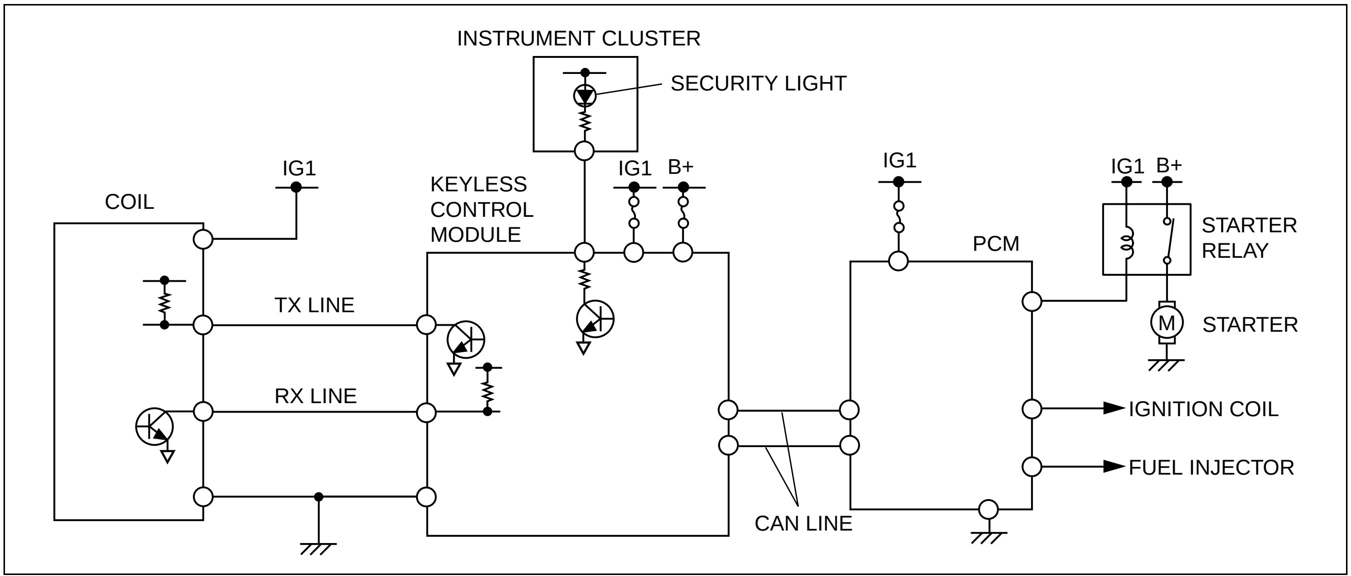
CHU091467000S02



CHU0914S202

IMMOBILIZER SYSTEM WIRING DIAGRAM

CHU091467000S03



CHU0914S005

IMMOBILIZER SYSTEM OPERATION

CHU091467000S04

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.

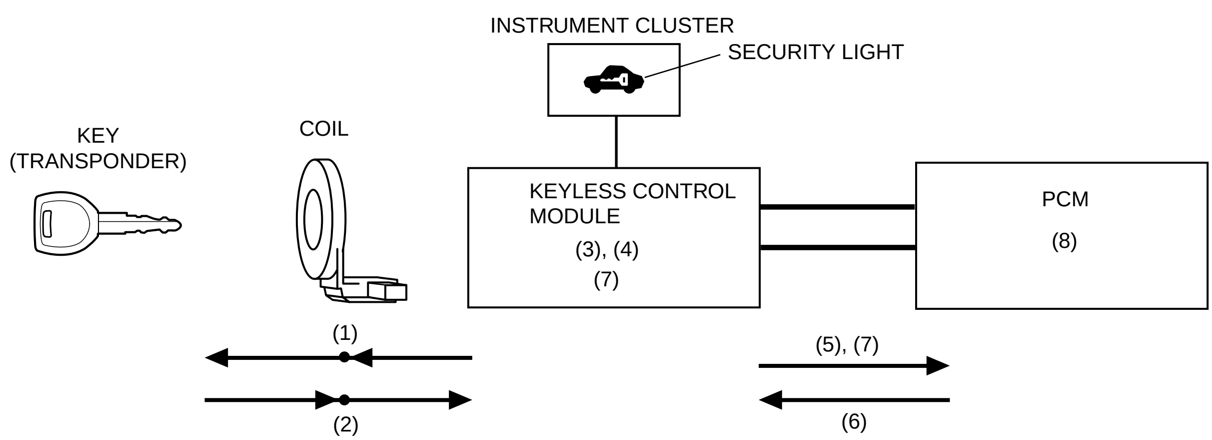
UNSATISFACTORY RESULT → Engine starting is not permitted.

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



CHU0914S210

ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) MALFUNCTION DIAGNOSIS FUNCTION

CHU091467000S05

- 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 WDS or equivalent.

Caution

- **Always use the WDS or equivalent to verify DTCs even if the security light display a DTC. If the security light itself has a malfunction, it is possible that a DTC may not be properly displayed. There are certain DTCs which can only be verified using the WDS or equivalent, not the security light.**
- **DTCs for the immobilizer system that are stored in the keyless control module and PCM are cleared when the ignition switch is turned from the ON to the LOCK (ACC) position.**

Note

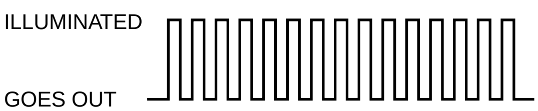
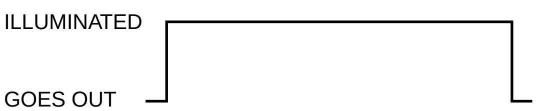
- If two or more malfunctions are detected as a result of malfunction diagnosis, only the DTC with the lowest number of those detected will be displayed by the security light. However, multiple DTCs are stored at the same time.
- If two or more immobilizer system DTCs are verified, first repair the part 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.

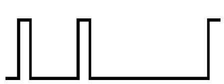
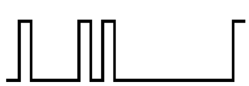
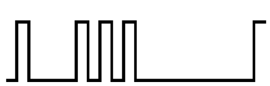
DTC TABLE

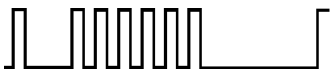
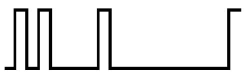
Note

- In the approx. 1 min after detecting a malfunction and before displaying the DTC, the security light will illuminate or flash the following patterns:

09–14

Security light flashing pattern (Before displaying DTC)	DTC
	11, 12, 13, 14, 15, 16
	21, 22, 23

DTC				Detected condition
Security light flashing pattern		WDS or equivalent display		
		Keyless control module	PCM	
11		B1681	P1260	Signal communication with the coil cannot be detected.
12		B2103	P1260	Coil malfunction
13		B1600	P1260	The key ID number data cannot be read.
		B2431	P1260	Key ID number registration error

DTC				Detected condition
Security light flashing pattern		WDS or equivalent display		
		Keyless control module	PCM	
14		B1602	P1260	The keyless control module cannot read key ID number data normally.
15		B1601	P1260	Unregistered key detected.
16		U2510	P1260	Communication error between the keyless control module and the PCM (no response)
		U1147	P1260	Communication error between the keyless control module and the PCM (mismatched conditions)
21		B1213	P1260	Only one key is registered.
22		B2141	P1260	Communication error between the keyless control module and the PCM (data transfer error)
23		B2139	P1260	PCM ID number data mismatch
Not illuminated		B1342	-	Keyless control module malfunction

ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION

CHU091467000S06

- The following items can be verified:
  - — Number of continuous DTCs
  - — Number of key ID numbers registered with the vehicle
- Use the WDS or equivalent to read the PID/data monitor.

PID/Data Monitor Table

PID name (definition)	Detected condition
CCNT_DD (Number of continuous DTCs)	• DTCs are detected: 1—255 • No DTCs are detected: 0
NUMKEYS (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

CHU091467000S07

- When performing the following procedures, the immobilizer resetting procedure using the WDS or equivalent 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 WDS or equivalent.
- 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 Mazda RX-8 Workshop Manual (1772-1U-03C) Section 09-14, “IMMOBILIZER SYSTEM COMPONENT REPLACEMENT/KEY ADDITION AND CLEARING”.

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 WDS or equivalent, the WDS or equivalent 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 • WDS or equivalent	–
Clearing previously registered key ID numbers.	• Keys for registration (two or more keys) • WDS or equivalent	• 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) • WDS or equivalent	• 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.)	• WDS or equivalent	• After performing this procedure, additional keys can only be registered using the WDS or equivalent. • The setting can be changed to the original using the WDS or equivalent.
Changing the method for registering additional keys. (Method for registering other keys using two keys that can start the engine is enabled.)	• WDS or equivalent	• 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) • WDS or equivalent	• 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 PCM only.	• New PCM • WDS or equivalent	-

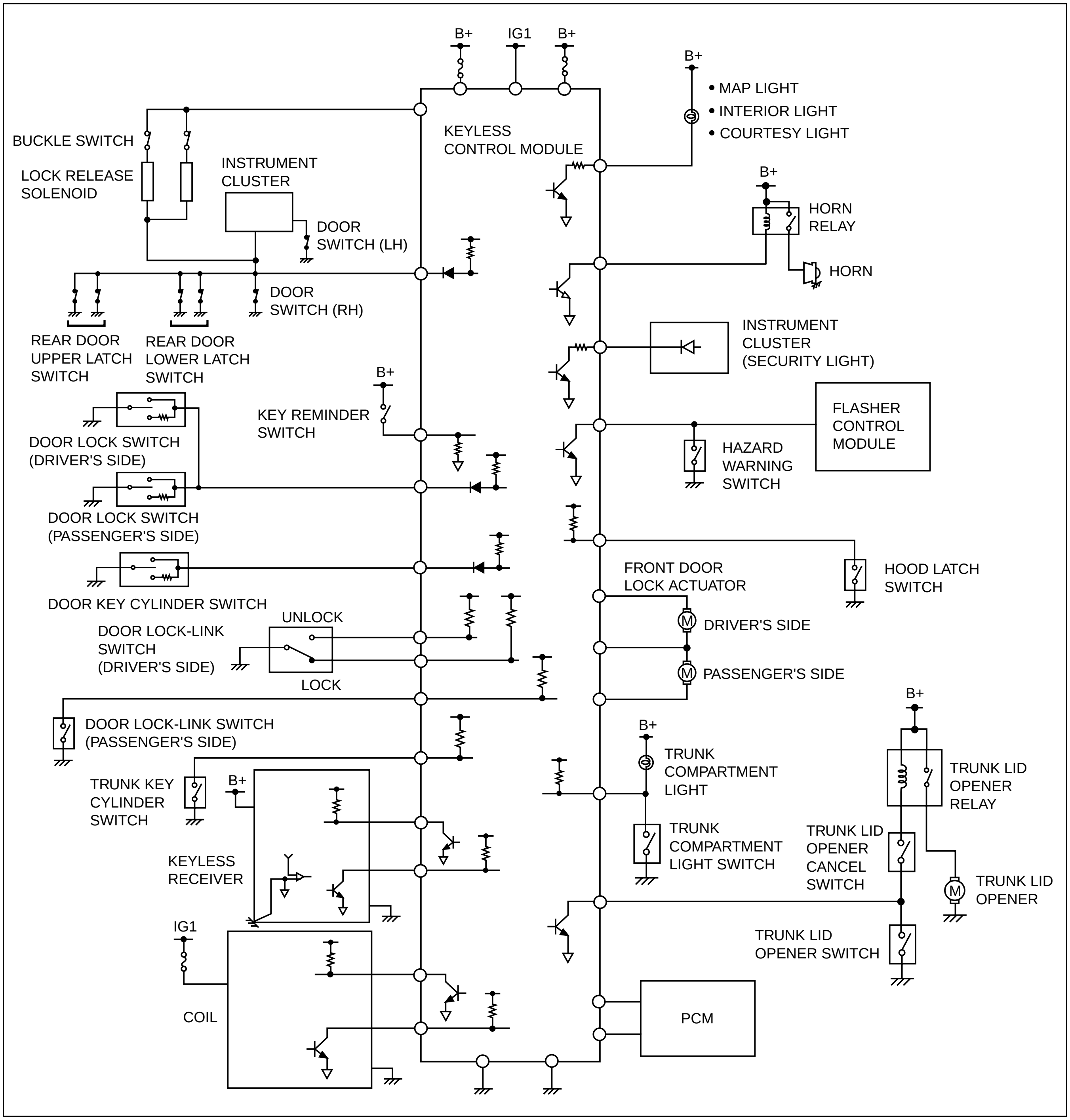
Situation	Items neccesary to perform procedure (always have these ready before beginning the procedure)	Cautionary notes
Replacing the PCM and keyless control module.	• New PCM • New keyless control module • Keys for registration (two or more keys) • WDS or equivalent	• Unless keys are re-registered 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.	• New coil	• 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 CONTROL MODULE OUTLINE

CHU091467520S01

- Controls the following systems:
  - Power door lock system
  - Keyless entry system
  - Interior light control system
  - Immobilizer system
  - Theft-deterrent system
- Supplies power to the front seat belt lock release system.
- An on-board diagnostic system, which can determine if the input/output signals in the keyless entry system are normal, has been adopted. The on-board diagnostic system is initiated by the key reminder switch, ignition switch and driver-side door switch, and the following operations can be verified. Refer to the Mazda RX-8 Workshop Manual for detailed procedures and descriptions regarding the operations.
  - Lock/unlock operation of door lock actuator for all doors
  - Trunk lid opener unlock operation
  - Hazard light flashing (vehicles without theft-deterrent system)
  - Horn sound

- When replacing the keyless control module for vehicles with the immobilizer system, initialization configuration according to the vehicle information and immobilizer system resetting are required. Refer to the Mazda RX-8 Workshop Manual for detailed procedures and descriptions regarding the operations.



CHU0914S006

09–15 SUNROOF

SLIDING SUNROOF OUTLINE

CHU091501049S01

- Electric sunroof with tilt mechanism adopted
- Deflector adopted, throbbing noise reduced
- System control using pulse sensor (Hall IC) adopted for system simplification
- Sunroof motor with integrated control unit adopted

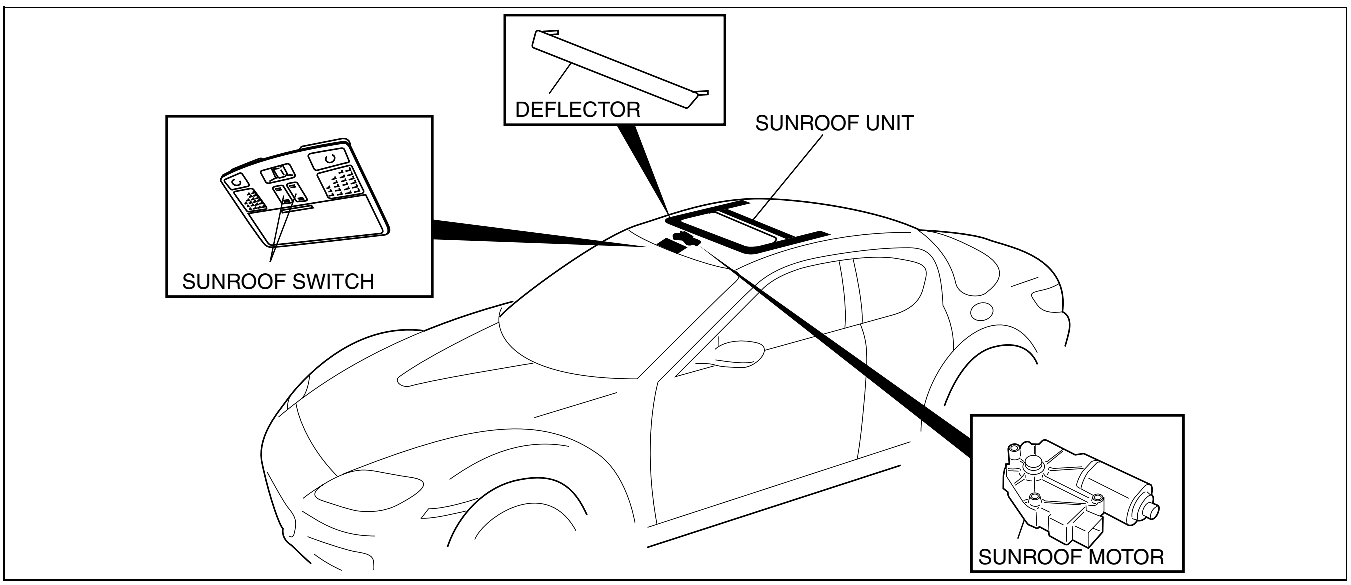
SUNROOF SPECIFICATION

CHU091501049S02

Item	Specification
Slide system	Outer slide
Opening measurement (mm {in})	208 × 722 {8.2 × 28.4}
Tilt-up amount (mm {in})	22—28 {0.9—1.1}
Opening/closing time (s)	Slide : 2.5—5.5, Tilt : 0.9 or less

SLIDING SUNROOF STRUCTURAL VIEW

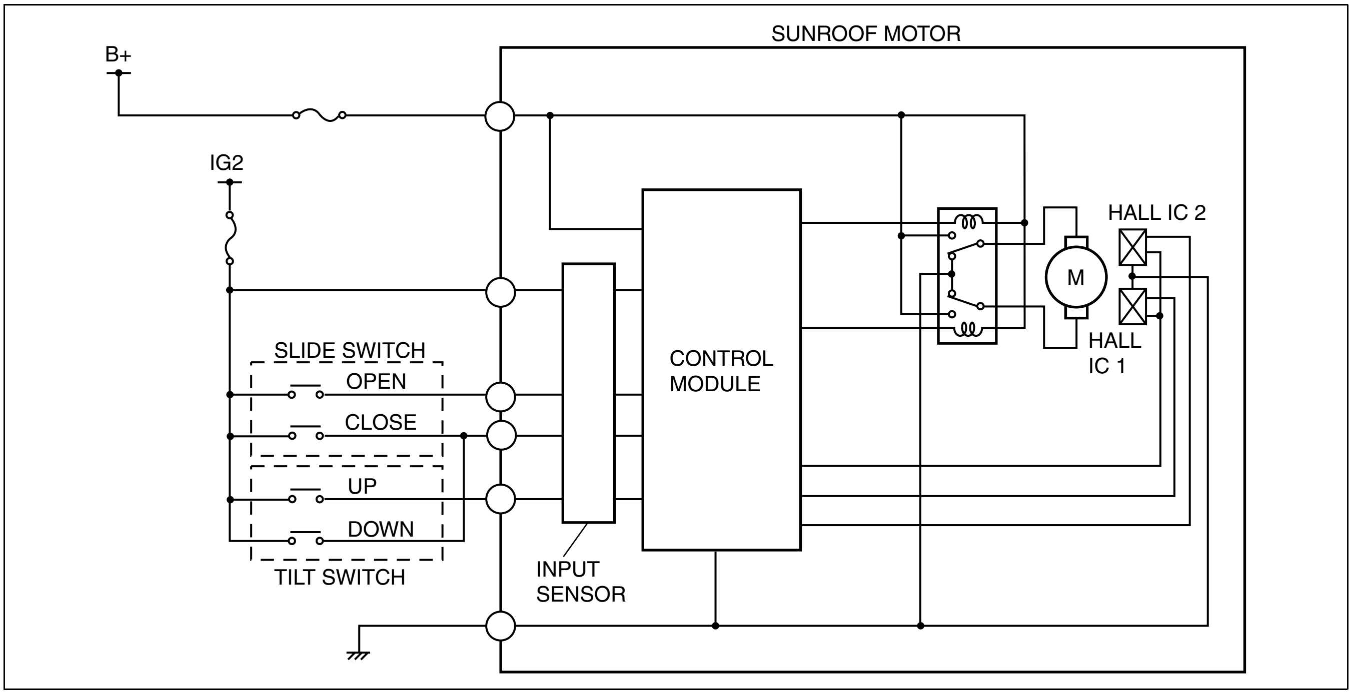
CHU091501049S03



CHU0915S101

SLIDING SUNROOF SYSTEM WIRING DIAGRAM

CHU091501049S04



CHU0915S102

SLIDING SUNROOF OPERATION

CHU091501049S05

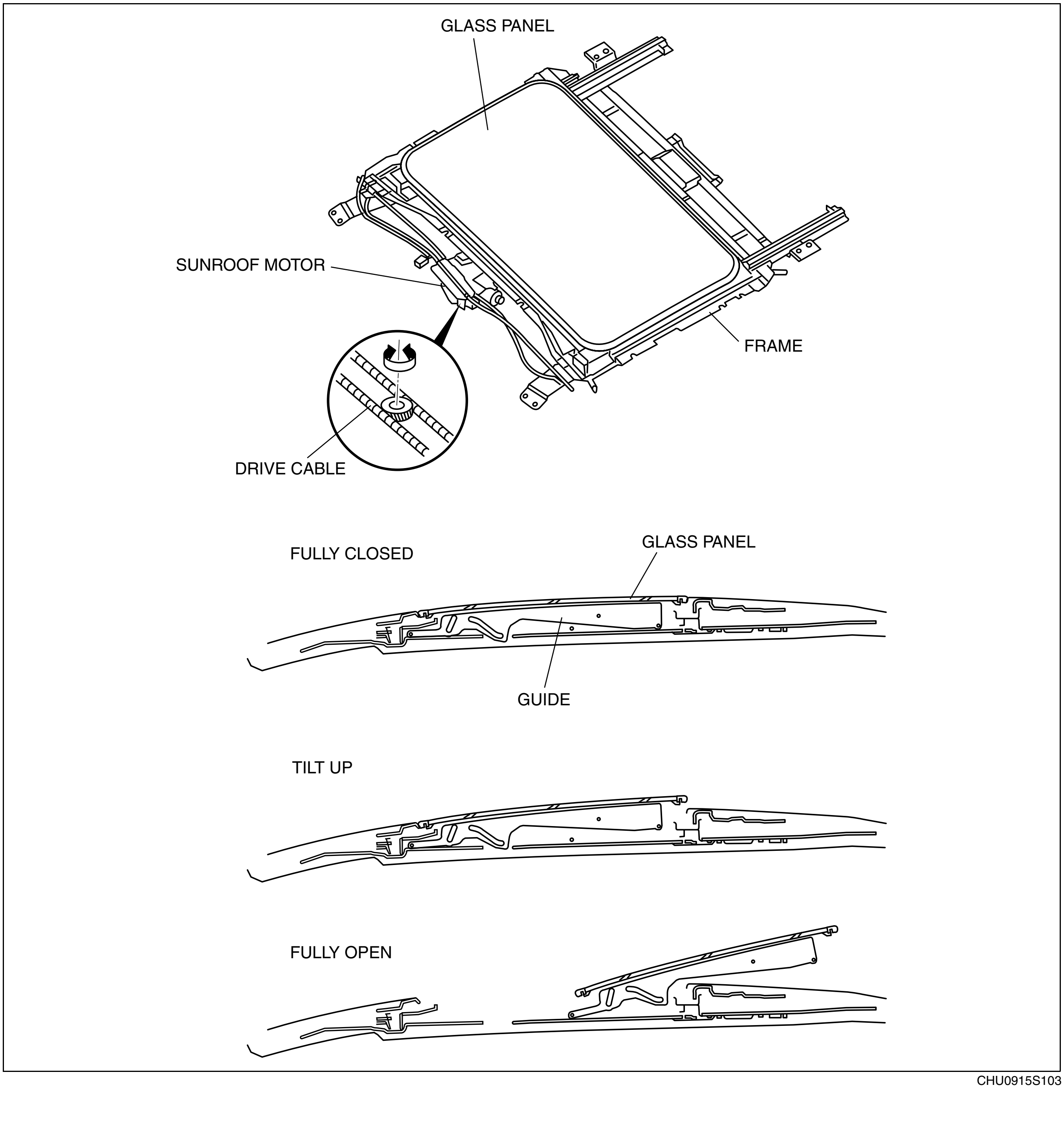
- The glass panel opens/closes using tilting and sliding operations.
- When the ignition switch is at the ON position, the sunroof operates by use of the sunroof switch.
- If the ignition switch is turned to the LOCK or ACC position while the sunroof is operating, it will stop.
- One-touch operation of the SLIDE open or the TILT up switch provides auto-operation.
- If any switch is operated during auto-operation, the sunroof stops.
- If any malfunction is detected during sunroof operation, the fail-safe function operates to ensure safety.

Item	Specification	Cancel condition
Continuous energization observation function (switch stuck-on observation function)	If the switch is continuously on for longer than the set time (60 s), operation is stopped.	The switch is turned off, then on
Continuous operation observation function	If the period of accumulated energization due to continuous opening/closing is longer than the set time (120 s), operation is stopped. (If set time is reached while closing, sunroof returns to fully open position.)	20 s after operation is stopped
Relay observation function	If the motor power supply is on continuously due to stuck breaker points in a relay on one side or similar malfunction, the other relay is turned on, cutting off energization to the motor. (Even if the ignition switch is turned to the LOCK or ACC position, the coil is energized.)	Relay is no longer stuck
Pinching detection function	If the pulse variation of Hall IC 1 is not longer than the set time (400 ms), operation is stopped (pinching detected).	Pinching is resolved, and the switch is turned off, then on
Static load detection function	If pinching is detected while the glass panel is sliding, sliding operation is stopped. Set load: 343 N {35 kgf, 77 lbf} or more	Pinching is resolved, and the switch is turned off, then on
Hall IC malfunction	If an abnormal Hall IC pulse is detected, the system enters safe mode. • Abnormality while operating: Operation stopped • Abnormal condition when the switch is operated: Glass panel operates for 400 ms in the direction of sunroof switch operation and stops.	Hall IC pulse is detected to be normal (Complete normal recovery is achieved only after completion of initial position setting.)

SUNROOF UNIT CONSTRUCTION/OPERATION

CHU091569850S01

- 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.

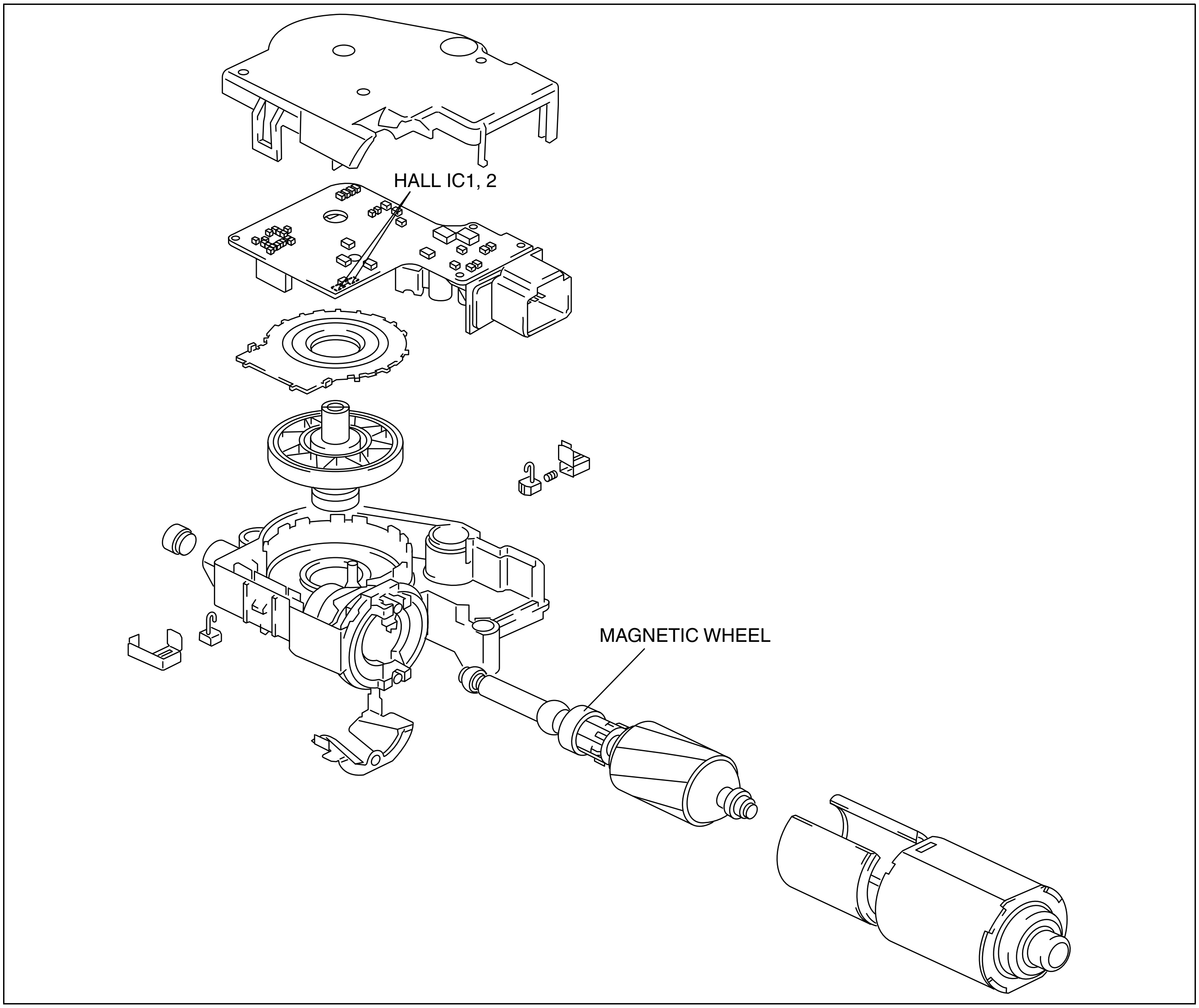


CHU0915S103

SUNROOF MOTOR CONSTRUCTION

CHU091569873S01

- The motor consists of gear and control parts.
- A magnetic wheel is provided on the motor shaft.
- Two Hall ICs are provided in the control part.
- The control unit detects the rotation direction, speed and amount based on pulse signals from the two Hall ICs, and controls the position and static load of the glass panel accordingly.



CHU0915S104

09–17 INTERIOR TRIM

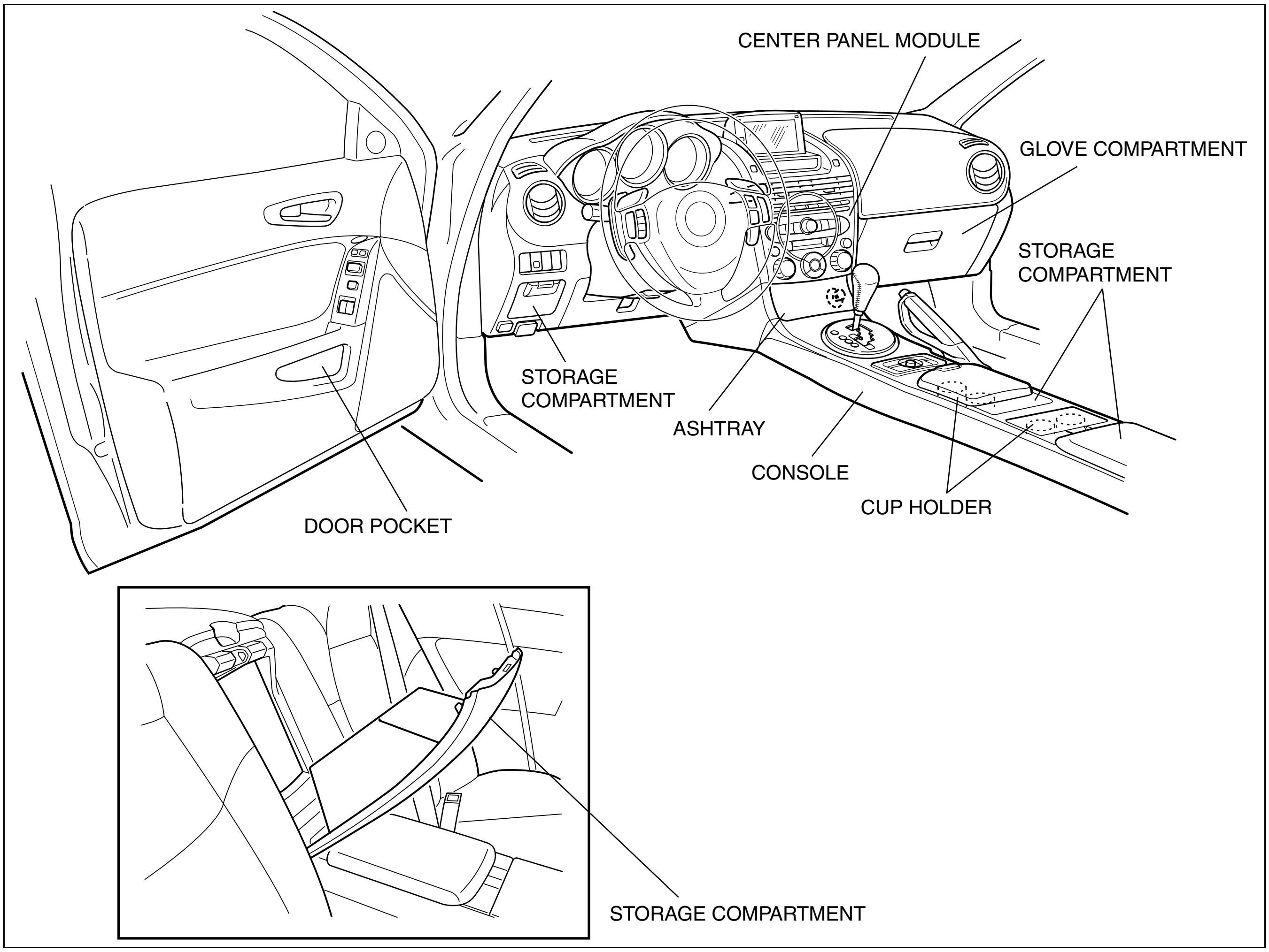
INTERIOR TRIM OUTLINE

CHU091755000S01

- The center module with integrated audio and climate control units, is located at the center of the dashboard panel. This improves functionality and gives a unified appearance.
- Various storage spaces have been added.

INTERIOR TRIM STRUCTURAL VIEW

CHU091755000S02



CHU0917S101

09–18 LIGHTING SYSTEMS

LIGHTING SYSTEMS OUTLINE

CHU091801051S01

- Headlights with built-in front turn and parking lights adopted
- Projector type headlights (low-beam) adopted
- Front fog lights adopted (Located in front bumper)
- Stepped reflectors adopted for rear combination lights
- Discharge headlights (low-beam) that illuminate a wide area adopted
- Rear side marker lights adopted
- Ignition key illumination that illuminates the ignition key slot adopted
- Interior light control system that changes illumination time and intensity using a keyless control module adopted
- A headlight auto leveling system, which responds to the vehicle attitude and automatically adjusts the optical axis of the headlights, has been adopted.

LIGHTING SYSTEMS SPECIFICATION

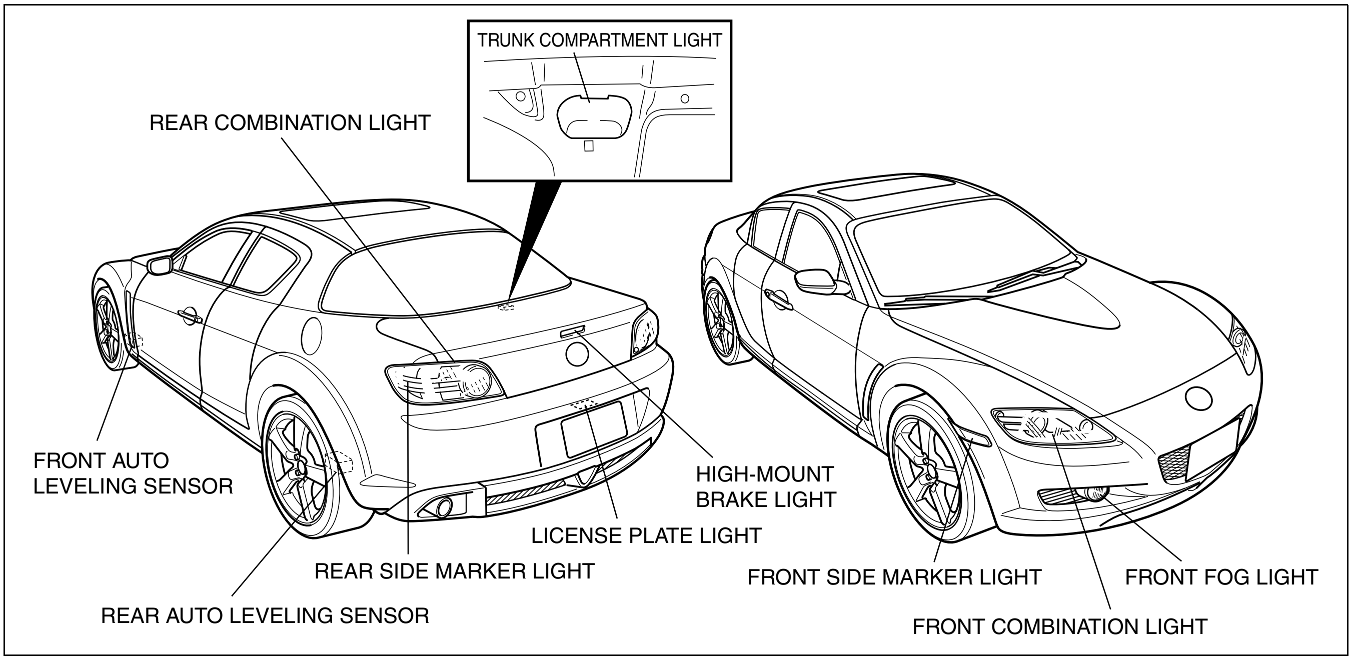
CHU091801051S02

Item		Specifications
Exterior light bulb capacity (W)	Headlight bulb (High-beam)	65 × 2
	Discharge headlight bulb (low-beam)	35 × 2
	Halogen headlight bulb (low-beam)	55 × 2
	Parking light bulb	5 × 2
	Front fog light bulb	55 × 2
	Front turn light bulb	21 × 2
	Front side marker light bulb	3.8 × 2
	Stop/tail light bulb	21/5 × 2
	Rear turn light bulb	21 × 2
	Back-up light bulb	21 × 2
	Rear side marker light bulb	0.57 × 2
	License plate light bulb	5 × 1
	High-mount brake light bulb	21 × 1

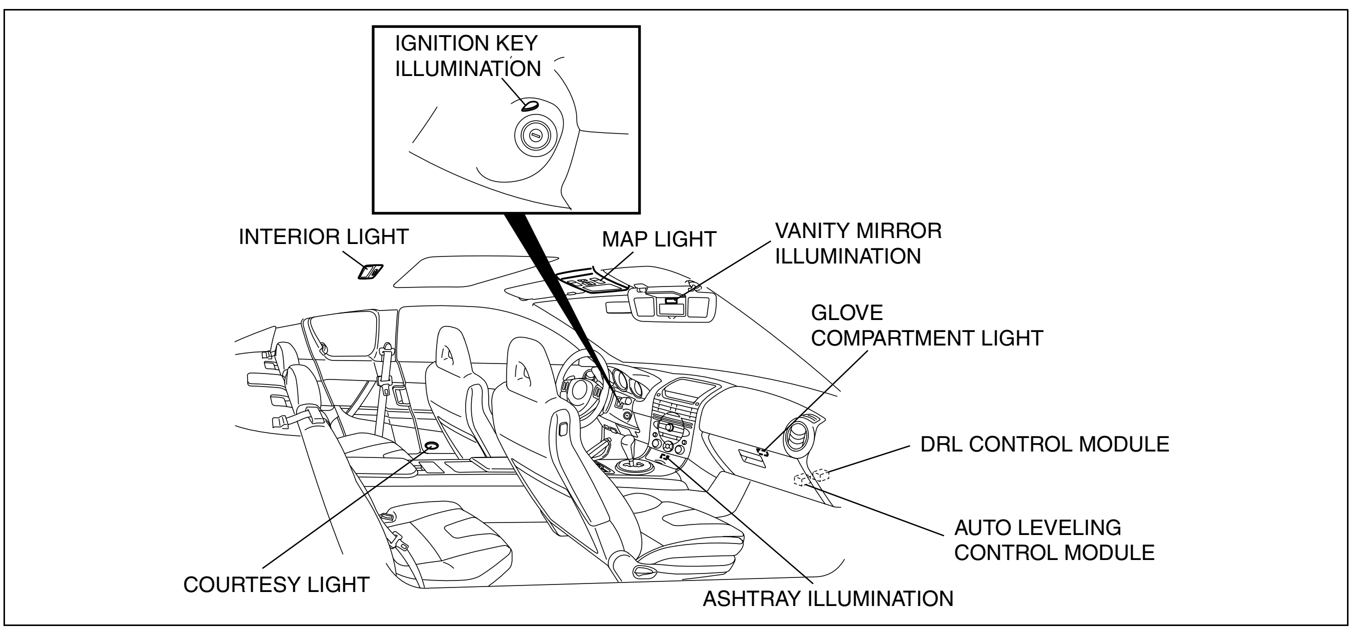
Item		Specifications
Interior light bulb capacity (W)	Map light bulb	5 × 2
	Interior light bulb	10 × 1
	Courtesy light bulb	5 × 2
	Trunk compartment light bulb	5 × 1
	Glove compartment light bulb	1.7 × 1
	Ignition key illumination bulb	1.4 × 1
	Ashtray illumination bulb	1.4 × 1
	Vanity mirror illumination bulb	1.8 × 2

LIGHTING SYSTEMS STRUCTURAL VIEW

CHU091801051S03



CHU0918S136

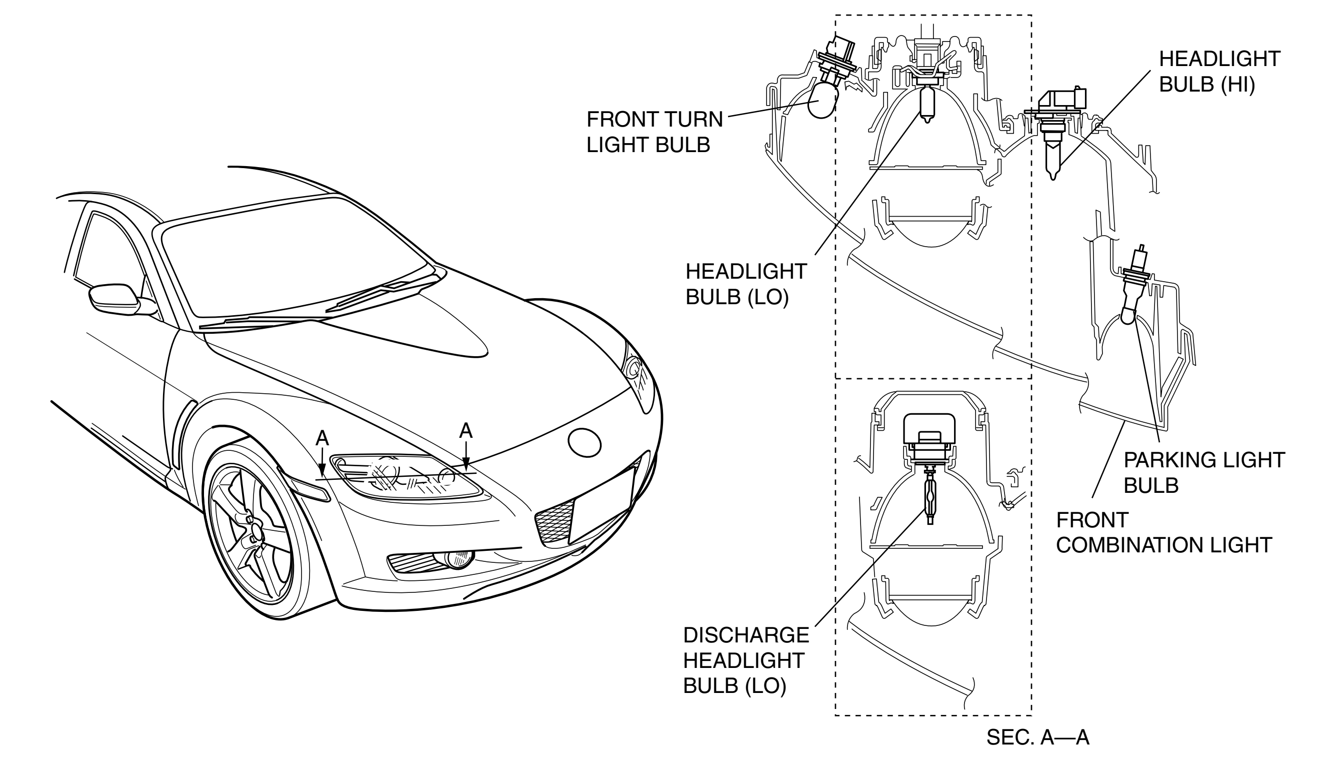


CHU0918S138

FRONT COMBINATION LIGHT CONSTRUCTION

CHU091851060S01

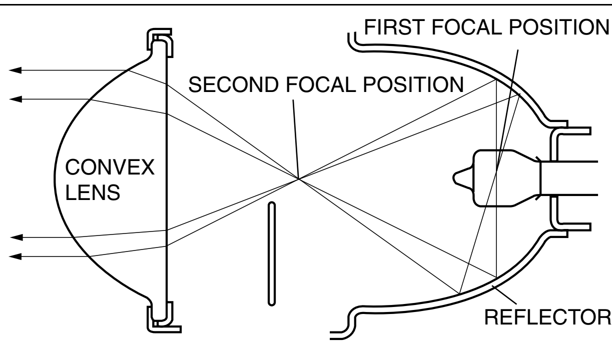
- A headlight with built-in front turn light and parking light has been adopted for design improvement.
- Projector type headlights have been adopted, and these have been incorporated, along with the front turn light and the parking light, into a single unit to reduce size.
- Discharge headlights, with a wide illumination area and projection of white light with a hue similar to sunlight, have been adopted.



CHU0918S134

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.



CHU0918S129

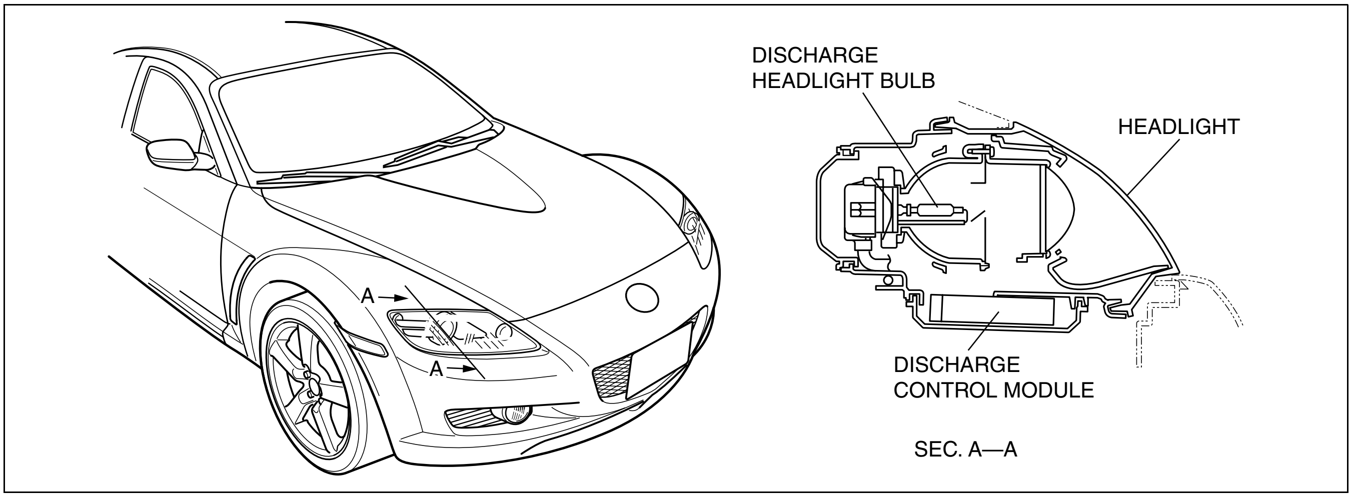
DISCHARGE HEADLIGHT OUTLINE

CHU091801052S01

- Compared with the current headlights, 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

CHU091801052S02

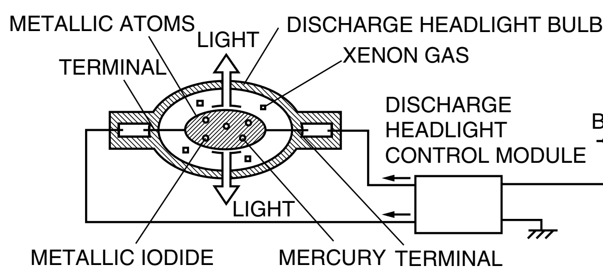


CHU0918S132

DISCHARGE HEADLIGHT OPERATION

CHU091801052S03

1. A high voltage pulse (approx. 25,000 V) traveling from the discharge headlight control unit 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.



CHU0918S128

DISCHARGE HEADLIGHT CONTROL MODULE FUNCTION

CHU091801052S04

- 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

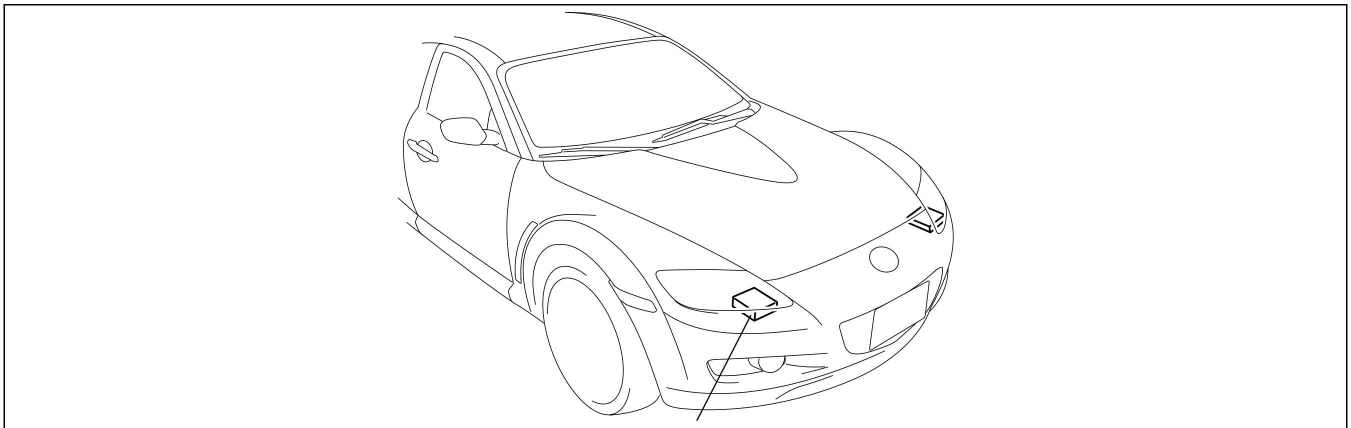
- If there is an abnormality in the output system (detects an open or GND short circuit in harness), the discharge headlight control module turns off the headlights for protection and to prevent partial operation errors.
- If the discharge headlight control module turns off the headlights due to an abnormality 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

CHU091801052S05

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 Mazda RX-8 Workshop Manual (1772-1U-03C).)**

- Built into the headlight and installed on the headlight lower side.



CHU0918S133

- Switches the direct current from the battery to alternating current (25,000 V) and optimally controls the current supply output to the bulb.

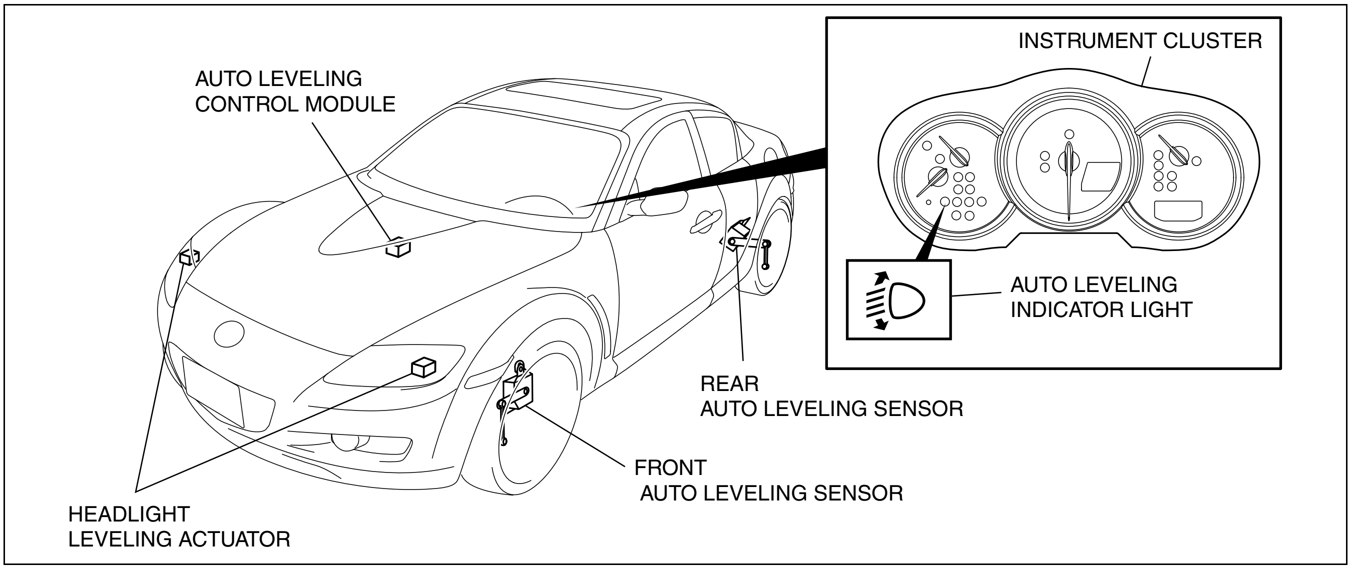
HEADLIGHT AUTO LEVELING SYSTEM OUTLINE

CHU091801052S06

- The optical axis of the headlights adjusts automatically at fixed angles to improve visibility and prevent blinding from oncoming traffic when the vehicle is under varying cargo and passenger weight conditions.

HEADLIGHT AUTO LEVELING SYSTEM STRUCTURAL VIEW

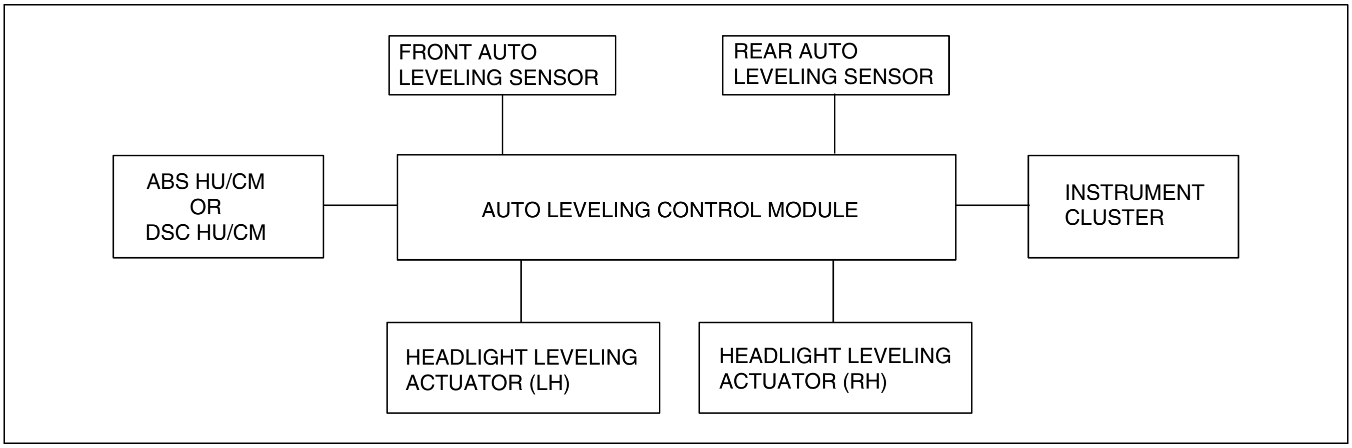
CHU091801052S07



CHU0918S113

HEADLIGHT AUTO LEVELING SYSTEM DIAGRAM

CHU091801052S08



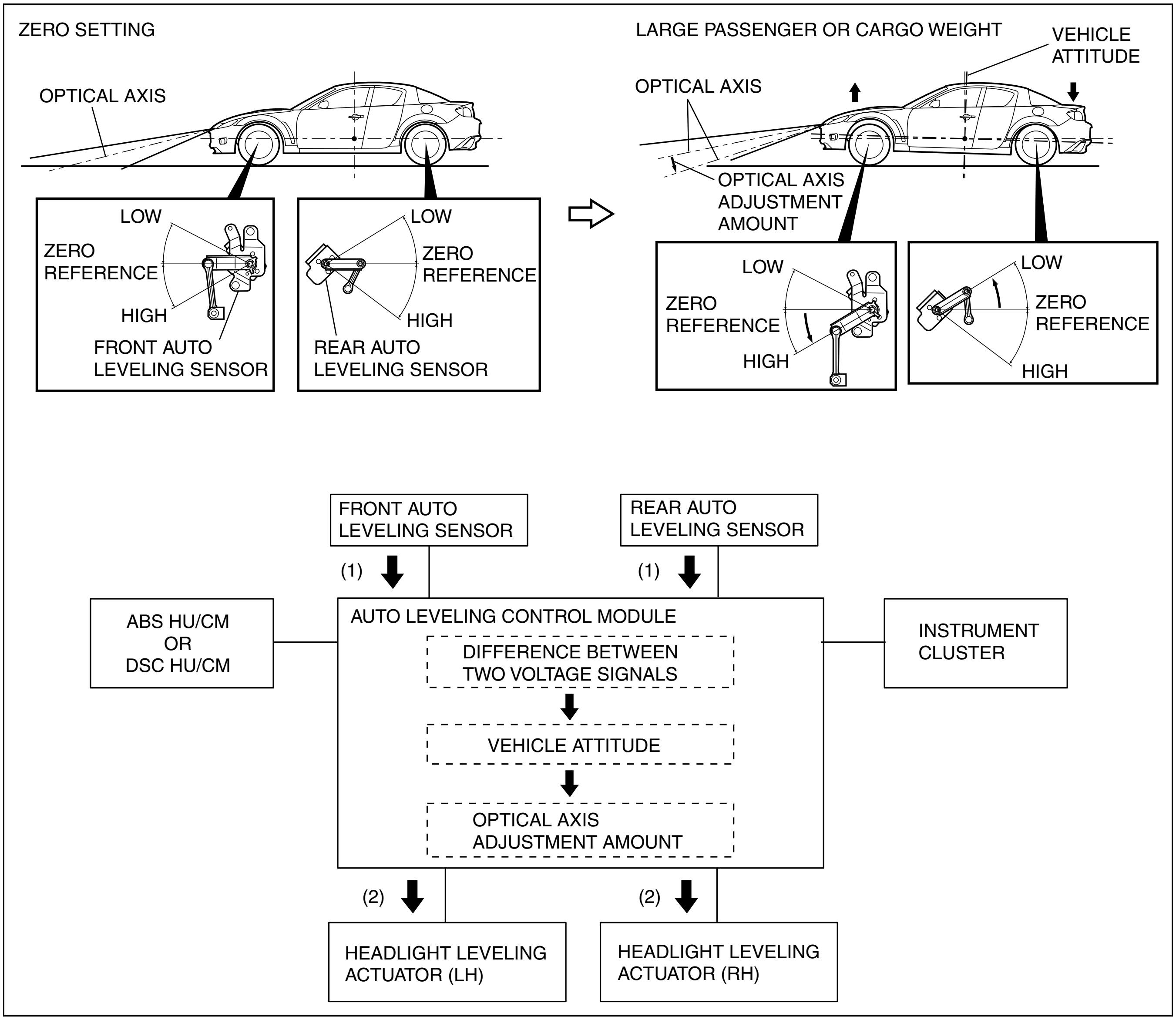
CHU0918S112

HEADLIGHT AUTO LEVELING SYSTEM OPERATION

CHU091801052S09

Varying Passenger and Cargo Conditions Operation

1. According to the fluctuation of the suspension, the auto leveling sensors installed in the front and rear of the vehicle send a signal to the auto leveling control module.
2. When a difference between two of the signals input from the auto leveling sensors is detected, the auto leveling control module verifies the vehicle attitude, then calculates the amount of optical axis adjustment. The auto leveling control module compares the actual and required positions of the reflector, then inputs a command signal to the headlight leveling actuator.



CHU0918S101

Operation When Driving

1. When the auto leveling control module detects the vehicle is running at a constant vehicle speed between 30—180 km/h for 3 s continuously while the headlights are on, the average value of the vehicle attitude during the period is calculated and the optical axis is adjusted. (The adjustment control is operated only once per each period of driving.)

Note

- When the ignition switch is turned to the ON position, it is normal to hear the headlight leveling actuator operating for a few seconds, as it verifies system operating conditions.

AUTO LEVELING CONTROL MODULE FUNCTION

CHU091801052S10

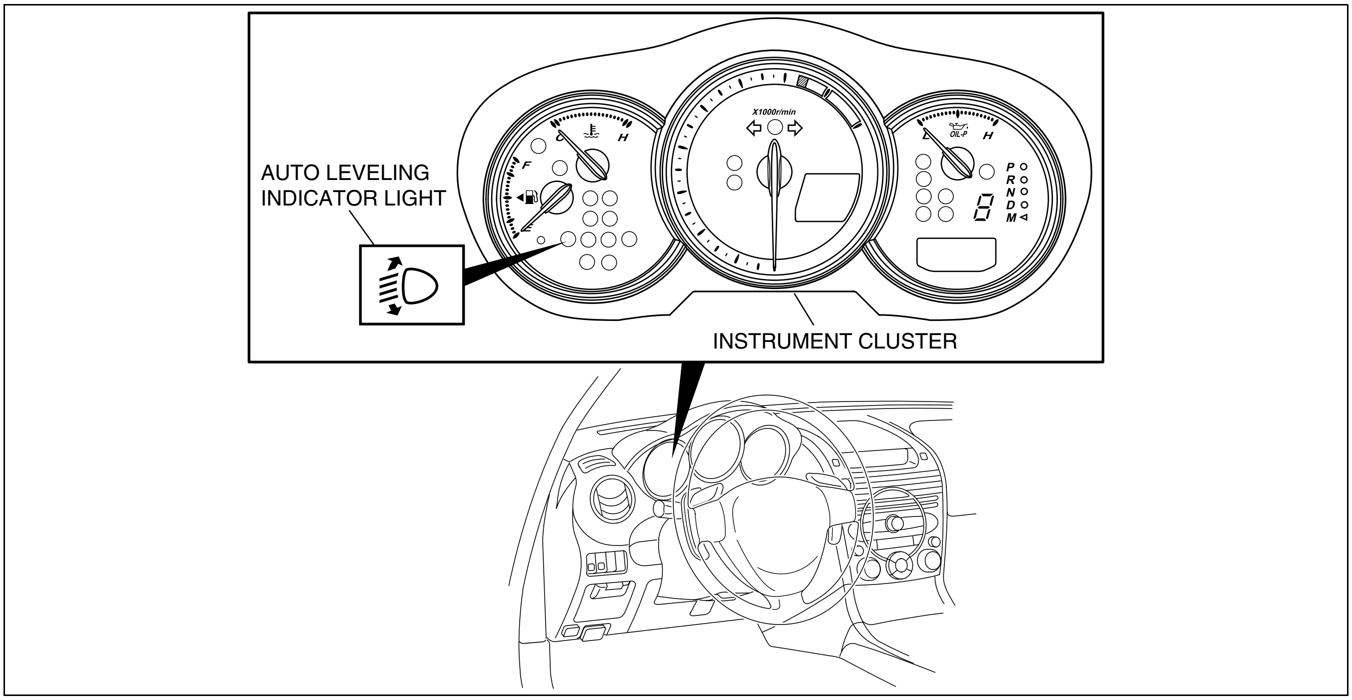
- In order to prevent blinding from oncoming traffic and to improve visibility, the auto leveling control module automatically controls the optical axis direction for optimal illumination based on signals input from the ABS (DSC) HU/CM and the auto leveling sensor.
- If an error signal from the auto leveling sensor or excessive power supply voltage is detected, the auto leveling indicator light is illuminated to warn the driver of a malfunction.

Fail-safe Function

- The fail-safe function operates when the auto leveling control module detects a malfunction. It also warns the driver of a malfunction by illuminating the indicator light as shown in the fail-safe function table.
- The fail-safe function controls each part as shown in the fail-safe function table.

Note

- When the ignition switch is turned to the ON position, the auto leveling control module checks the auto leveling indicator light bulb and illuminates the bulb for 3 s to indicate that there is no malfunction.



CHU0918S110

Fail-safe Function Table

Item	Test condition		Fail-safe function	Indicator light	Cancel condition
Auto leveling sensor	Signal malfunction	Signal voltage of 4.0 V or less detected 10 times or more within 5 s	Returns headlights to the initial set position if they are pointing higher than initial set position. Fixes them in position where the malfunction is determined if pointing lower than the initial set position.	Illuminated*1	Continuous normal operation for 5 s or ignition switch is turned off and then to the ON position again.
	Power supply malfunction	Power supply voltage of 0.25 V or less, or 4.75 V or more detected 10 times or more within 5 s			
Auto leveling control module	Malfunction detected by auto leveling control module		Resets microcomputer in auto leveling control module.	Illuminated	Ignition switch is turned off and then to the ON position again.

Item	Test condition		Fail-safe function	Indicator light	Cancel condition
ABS (DSC) HU/CM	Vehicle speed of 180 km/h or more detected		Fixes the optical axis angle at the position where vehicle speed of 180 km/h or more detected	Not illuminated	Vehicle speed of less than 180 km/h detected
Battery voltage	Excessive power supply voltage	Battery voltage of 18.5 V or more detected	Fixes headlights in position where excessive power supply voltage was determined.	Illuminated	When battery voltage of 17.5 V or less is detected, or ignition switch is turned off and then to the ON position again.

*1 : Indicator light illuminates only when either malfunction condition is detected two consecutive times.

AUTO LEVELING CONTROL MODULE CONSTRUCTION/OPERATION

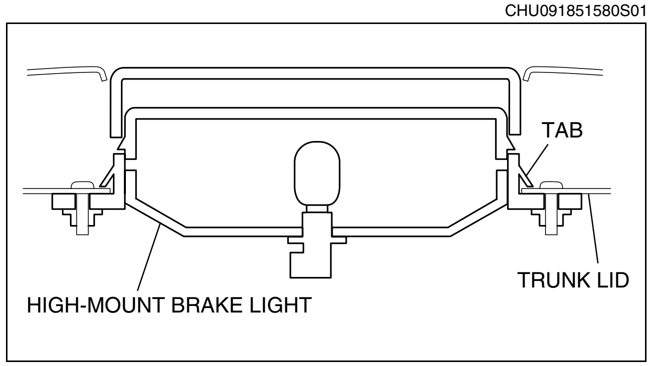
CHU091801052S11

- The auto leveling control module is located in the underside of the blower unit in the dashboard.
- The auto leveling control module verifies changes in vehicle speed and attitude based on signal inputted from the ABS (DSC) HU/CM, and front and rear auto leveling sensors. The control module then calculates the optimal direction for the optical axis.
- Based on the calculation of the optical axis adjustment amount, the auto leveling control module controls the headlight leveling actuator.

HIGH-MOUNT BRAKE LIGHT CONSTRUCTION

CHU091851580S01

- Installed to the trunk lid with the connecting tabs and nuts.

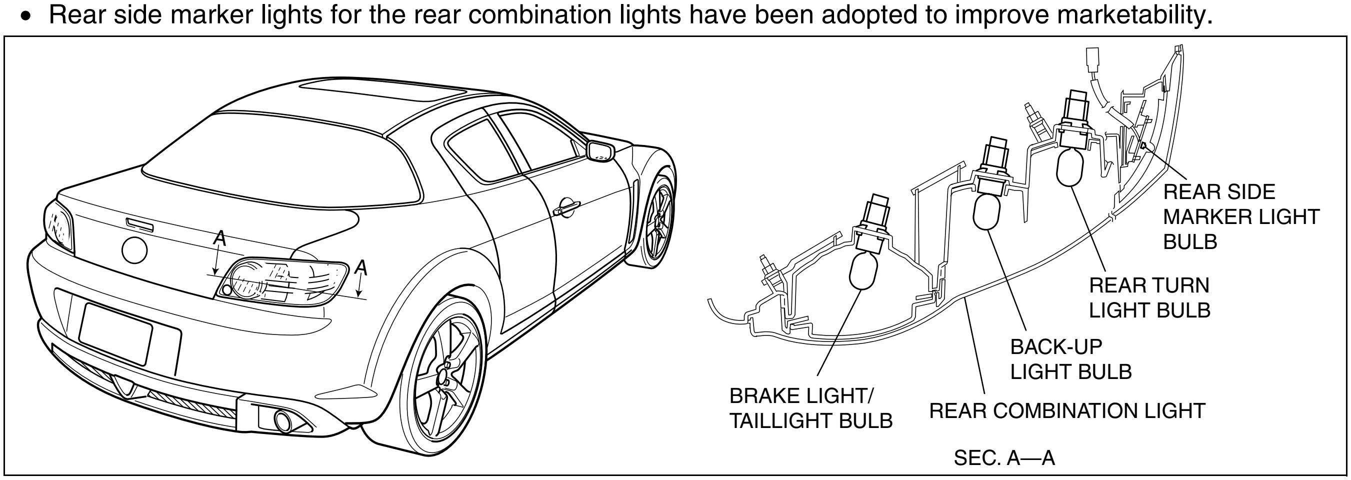


CHU0918S109

REAR COMBINATION LIGHT CONSTRUCTION

CHU091801052S12

- A step reflector that diffuses and reflects the light of the rear combination light bulbs, has been adopted. A flat, uncut lens has been adopted to control illumination distribution.
- A round reflector for the rear combination lights has been adopted to improve design.
- Rear side marker lights for the rear combination lights have been adopted to improve marketability.

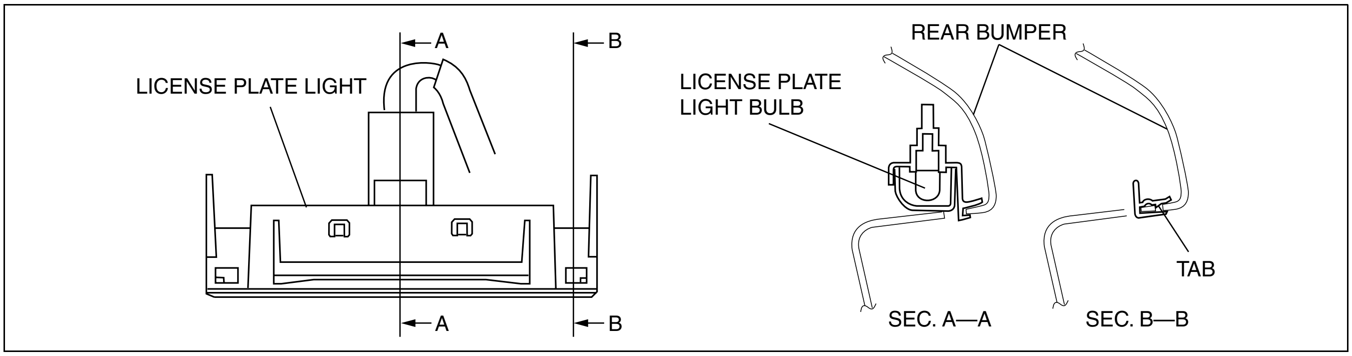


CHU0918S108

LICENSE PLATE LIGHT CONSTRUCTION

CHU091851270S01

- Installed to the rear bumper with the connecting tabs.



CHU0918S135

DRL SYSTEM OUTLINE

CHU091801056S01

- The DRL system automatically operates the low-beam headlights when the ignition switch is turned to the ON position.

DRL SYSTEM OPERATION

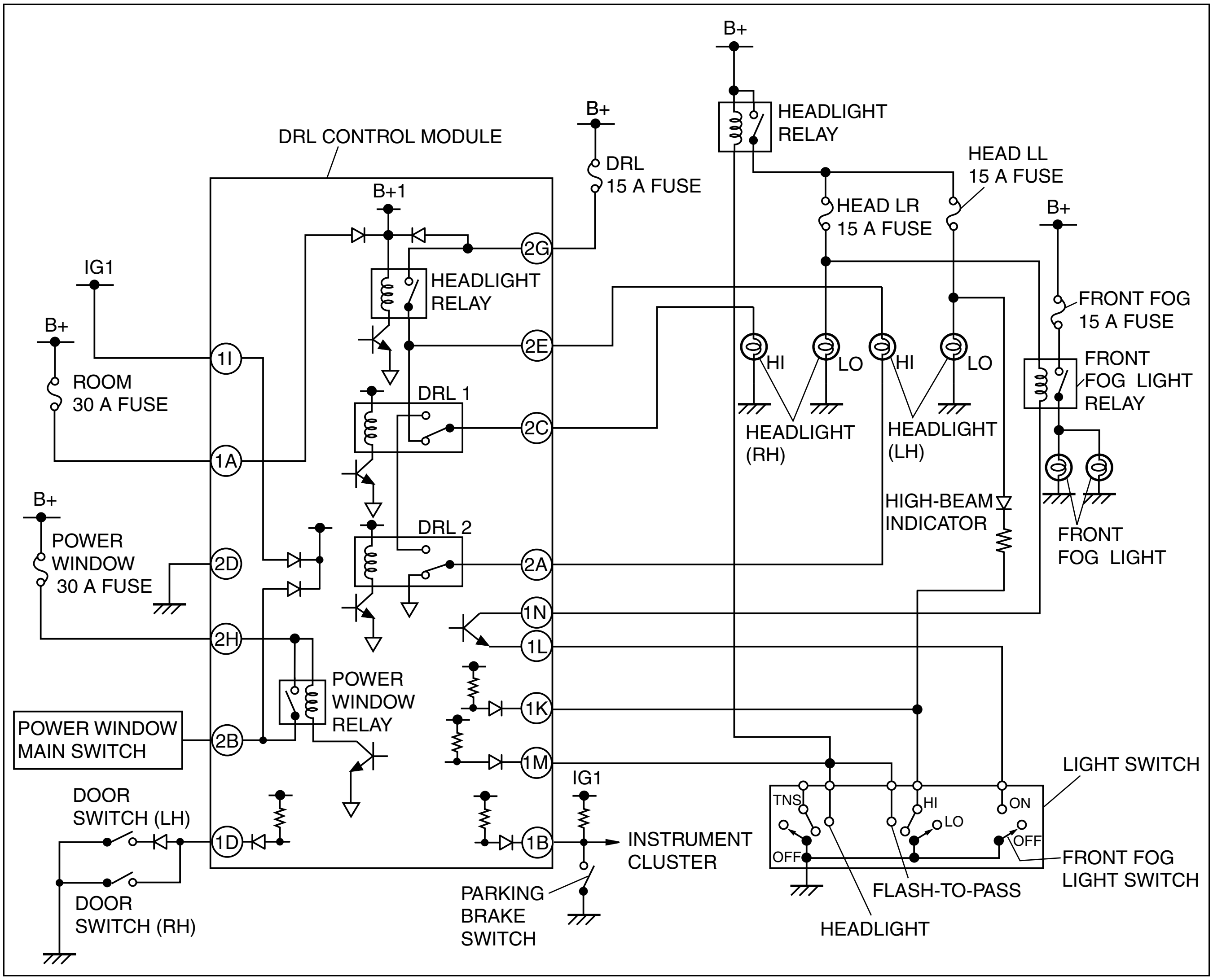
CHU091801056S02

- The running light system automatically turns on the high-beam headlights with their brightness reduced under the following conditions:

Operation condition (Input signal)				Operation condition of illumination (Output signal)			
Ignition switch	**Parking brake switch**	**Headlight switch**	**Flash-to-pass switch**	**Low-beam headlight**	**High-beam headlight**	**Taillight, Parking light, License light, Front side marker light**	**Illumination light**
ON	OFF	OFF	OFF	-	Illuminates (DRL)	-	-
	ON			-	-	-	-
LOCK	OFF			-	-	-	-
ON		TNS		-	-	Illuminates	Illuminates
		Headlight		Illuminates	-	Illuminates	Illuminates
		OFF	ON	Illuminates	Illuminates	-	-

DRL SYSTEM WIRING DIAGRAM

CHU091801056S03



CHU0918S106

INTERIOR LIGHT SYSTEM OUTLINE

CHU091851311S01

- The lighting period and the brightness of the interior light are controlled by the door lock timer control module.
- The interior lighting control system controls the lighting period and the brightness of the interior light in accordance with the motions of the driver when the interior light switch is at DOOR.

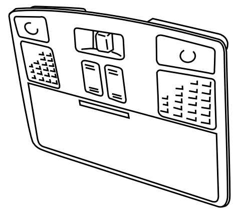
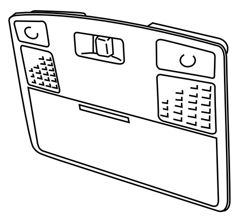
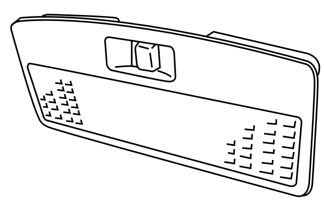
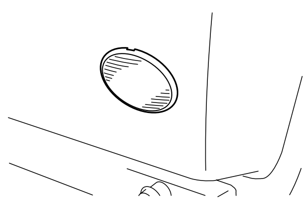
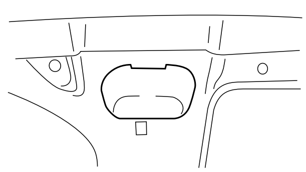
09–18

INTERIOR LIGHTING SYSTEM CONSTRUCTION

CHU091851311S02

- The map light is located on the roof, towards the front. There are two types of map lights: one for vehicles with sunroofs and one for vehicles without.
- The map, interior and courtesy lights settings are controlled by the interior light control system.

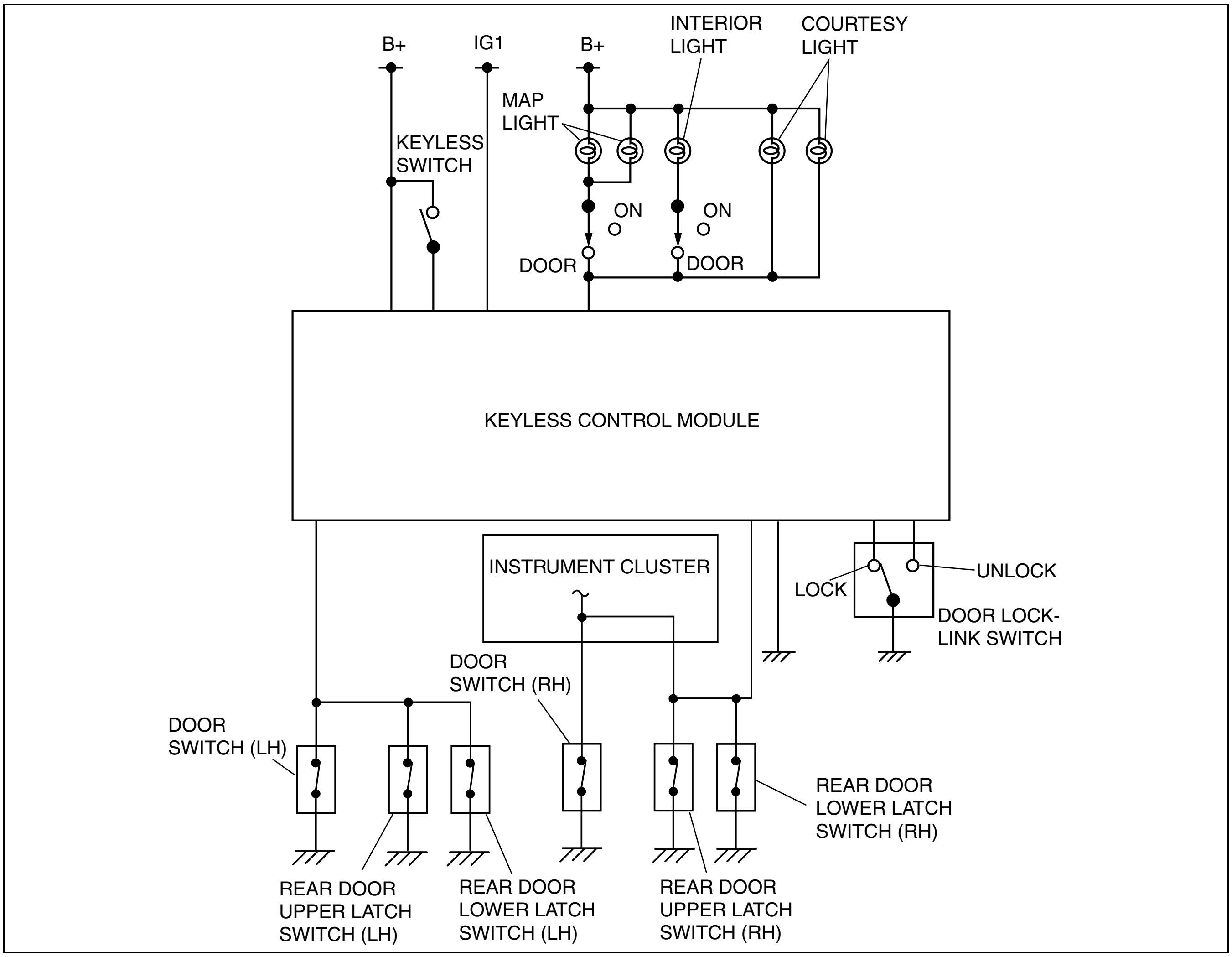
×: Equipped
–: Not equipped

Type		Installation position	Interior light control system	Roof
Map light		Front	×	Sunroof
Map light			×	Normal roof
Interior light		Rear	×	Both
Courtesy light		Front door trim	×	
Trunk compartment light		Trunk room	—	

ROOM LIGHT CONTROL SYSTEM FUNCTION

CHU091851311S03

- The interior light control system turns on, turns off, or dims the interior light when the interior light switch is in the DOOR position.



CHU0918S130

ROOM LIGHT CONTROL SYSTEM OPERATION

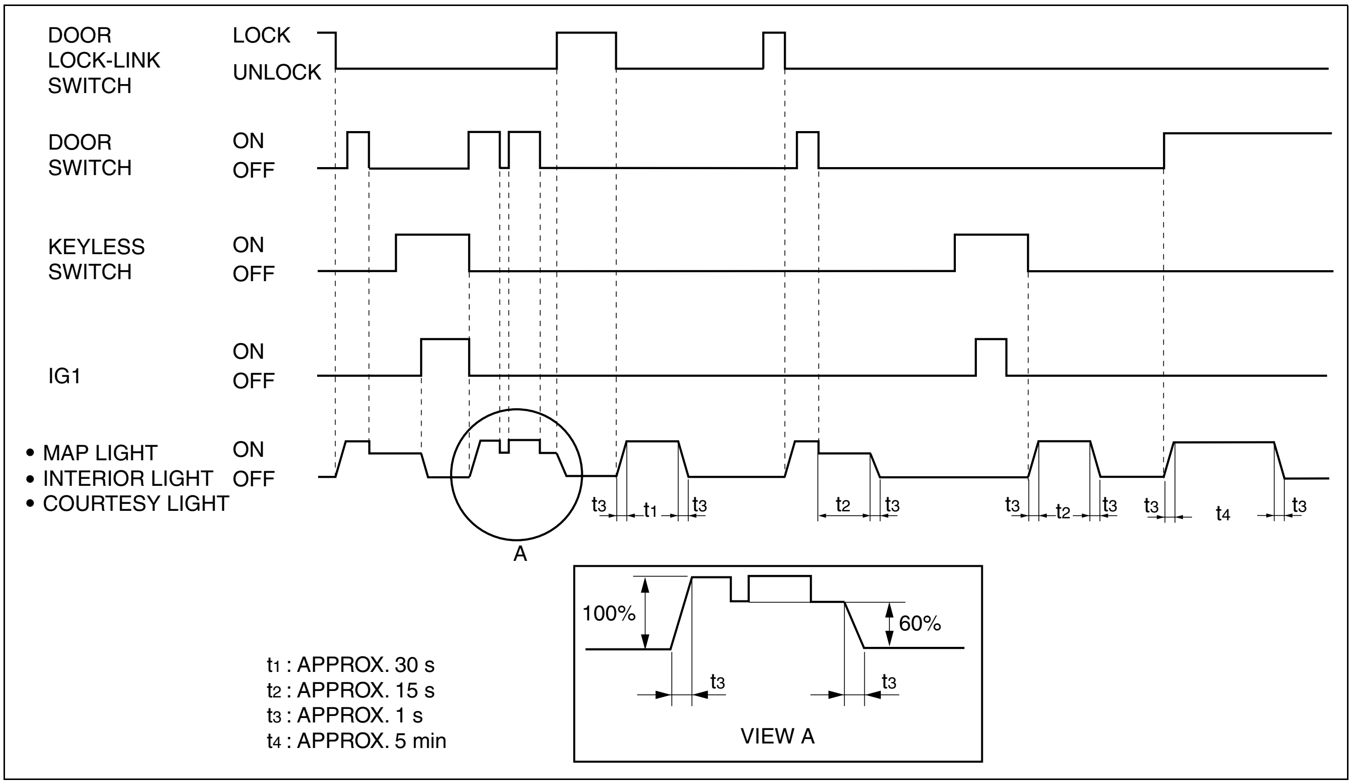
CHU091851311S04

Conditions before operation (Conditions which must be satisfied)	Operation condition	Interior light		Cancel condition (When any condition satisfied)
		Illumination time	Brightness	
• Turn the ignition switch to the LOCK or ACC position. • All doors are closed. (All door switches are off.)	Any door open. (Any door switch is on.)	Aprox.5 min	100 %	• All doors are closed. (All door switches off.) • After illumination time.*1
• Key extracted from steering lock. (Key reminder switch is off.) • All doors are closed. (All door switches are off.) • Driver's door lock knob is locked. (Door lock-link switch is in lock position.)	Driver's door lock knob is unlocked. (Door lock-link switch is in unlock position.)	Aprox.30 s	100 %	• Turn the ignition switch to the ON position. • Any door open. (Any door switch is on.) • Driver's door lock knob is locked. (Door lock-link switch is in lock position.) • After illumination time.*1
• Key inserted into steering lock. (Key reminder switch is on.) • All doors are closed. (All door switches are off.)	Key extracted from steering lock. (Key reminder switch is off.)	Aprox.15 s	100 %	• Turn the ignition switch to the ON position. • Driver's door lock knob is locked. (Door lock-link switch is in lock position.) • After illumination time.*1

Conditions before operation (Conditions which must be satisfied)	Operation condition	Interior light		Cancel condition (When any condition satisfied)
		Illumination time	Brightness	
• Turn the ignition switch to the LOCK or ACC position. • Any door open. (Any door switch is on.) • Driver's door lock knob is unlocked. (Door lock-link switch is in unlock position.)	All doors are closed. (All door switches are off.)	Aprox.15 s	60 %	• Turn the ignition switch to the ON position. • Any door open. (Any door switch is on.) • Driver's door lock knob is locked. (Door lock-link switch is in lock position.) • After illumination time.*1

*1 : After interior light is turned off according to this cancel condition, the light will illuminate again when either of the following conditions are satisfied

- After all doors are closed, then any door is reopened. (After All door switches are off, any door switch is on.)
- Ignition switch is at the ON position. (IG on.)

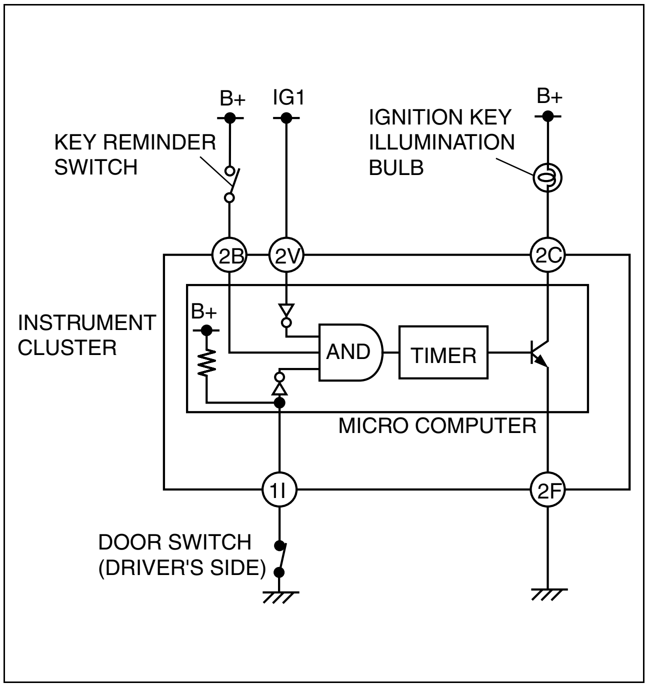


CHU0918S131

IGNITION KEY ILLUMINATION FUNCTION

CHU091851311S05

- The illumination time of the ignition key illumination is controlled by the microcomputer in the instrument cluster.
- The ignition key illumination glows when the ignition switch is at the LOCK or ACC position and any door is open.



CHU0918S114

IGNITION KEY ILLUMINATION OPERATION

CHU091851311S06

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 at the LOCK or ACC position. (IG1 off)

Cancel Condition

- The ignition key illumination goes out under any of the following conditions.
  — Approx. 30 s after all doors are closed. (Approx. 30 s after all door switches are off.)
  — Ignition switch is at the ON position. (IG1 on)
  — Approx. 5 minutes after ignition key illumination begins.

09–19 WIPER/WASHER SYSTEM

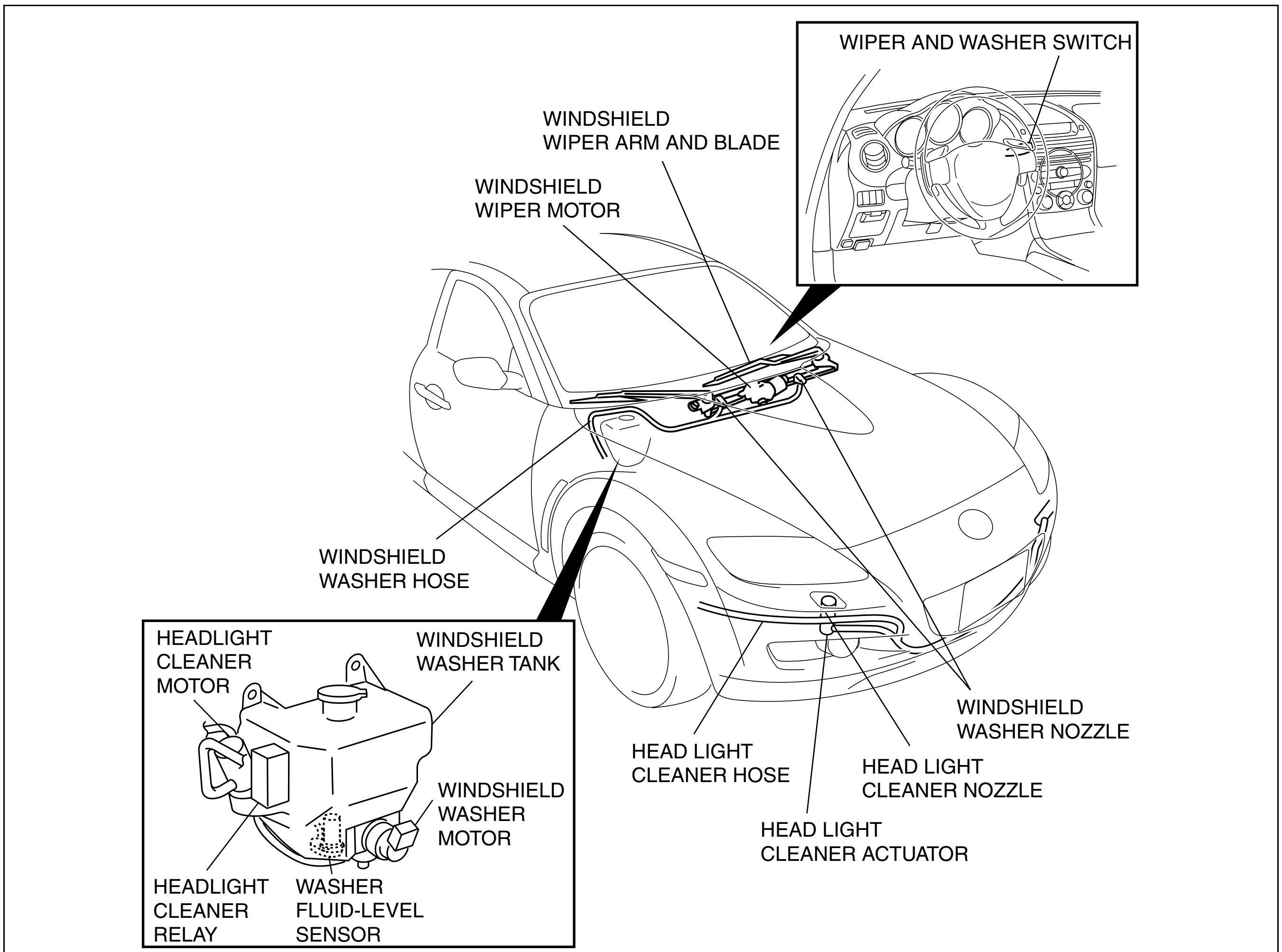
WIPER/WASHER SYSTEM OUTLINE

CHU091901052S01

- The intermittent wiper relay is built into the windshield wiper and washer switch.
- Pop-up type headlight cleaner has been adopted in the front bumper.
- A washer fluid-level sensor is installed in the windshield washer tank.

WIPER/WASHER SYSTEM STRUCTURAL VIEW

CHU091901052S02



CHU0919S113

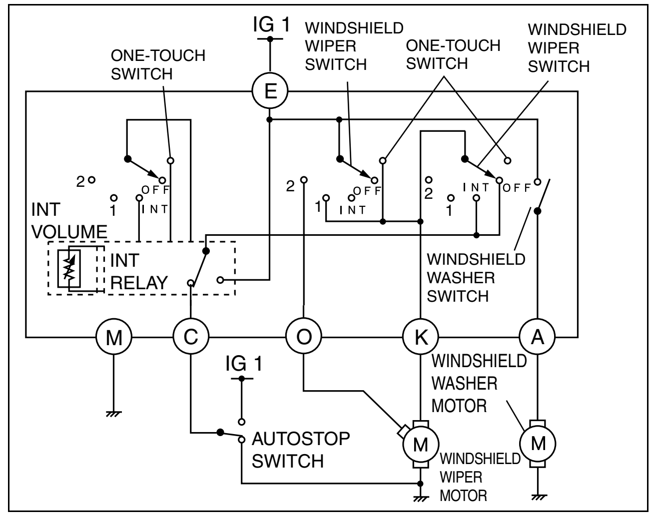
WINDSHIELD WIPER SYSTEM OUTLINE

CHU091901052S03

- The windshield wiper system has autostop function, one-touch function, and intermittent function with various timings.

WINDSHIELD WIPER SYSTEM WIRING DIAGRAM

CHU091901052S04



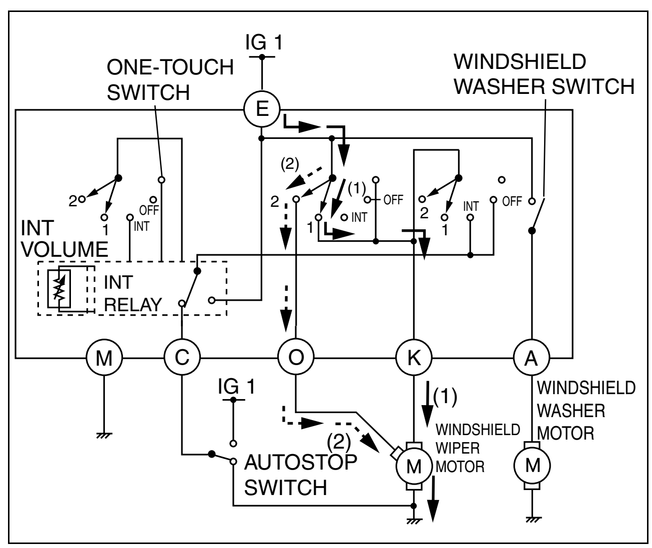
CHU0919S102

WINDSHIELD WIPER SYSTEM OPERATION

CHU091901052S05

Low Speed And High Speed Operation

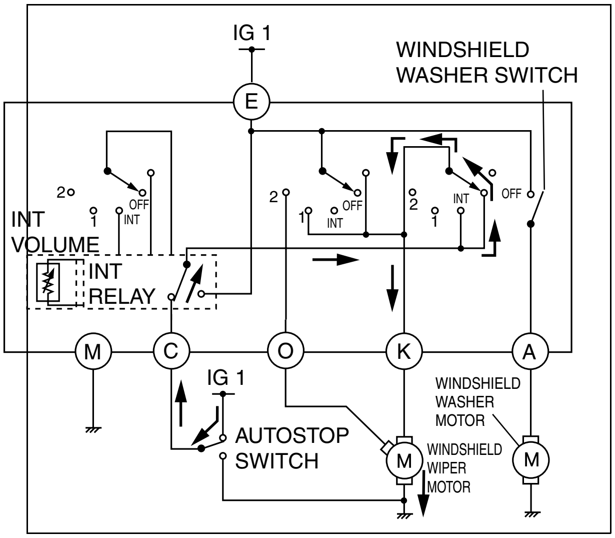
- When the windshield wiper switch moves to the 1 (low) position, current (1) flows through the windshield wiper switch to the windshield wiper motor, then to ground. The wipers operate at low speed.
- When the windshield wiper switch moves to the 2 (high) position, current (2) flows through the windshield wiper switch to the windshield wiper motor, then to ground. The wipers operate at high speed.
- When the windshield wiper switch returns to the OFF position, the autostop function activates and the wipers stop at the park position.



CHU0919S103

Autostop Function

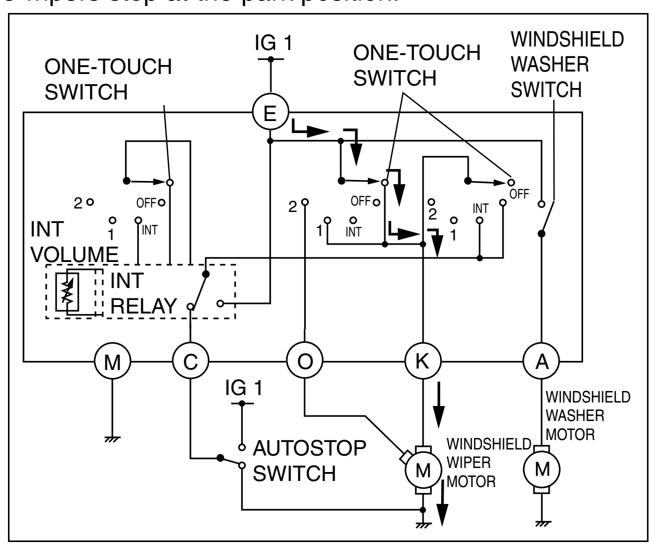
- While the wipers are operating, the autostop switch remains on except when the wipers are in the park position. Current flows through the INT relay to the windshield wiper switch, windshield wiper motor, then to ground. Thus, the wipers continue to operate until they reach the park position even if the windshield wiper switch moves to the OFF position.



CHU0919S104

One-touch Wiper Operation

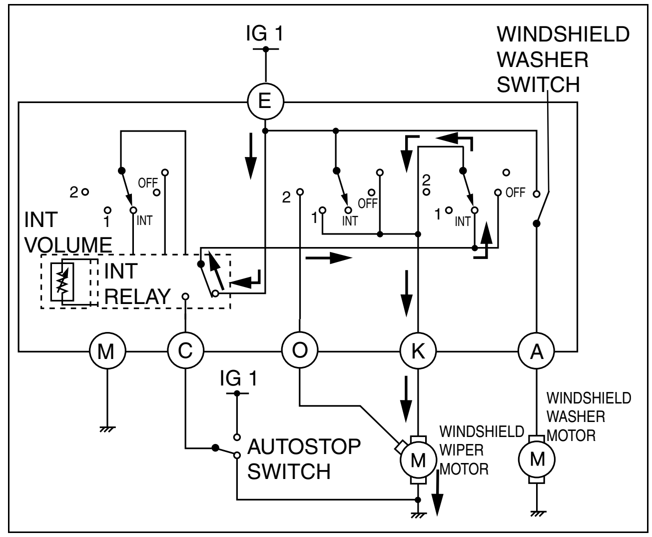
- When the wiper lever is pushed up, the one-touch switch turns on, and current flows through the one-touch switch to the windshield wiper motor, then to ground. The wipers operate at low speed for one cycle.
- While the wiper lever is pushed up and held, the wipers operate continuously at low speed. When the wiper lever is released, the autostop function activates and the wipers stop at the park position.



CHU0919S105

Intermittent Wiper Operation

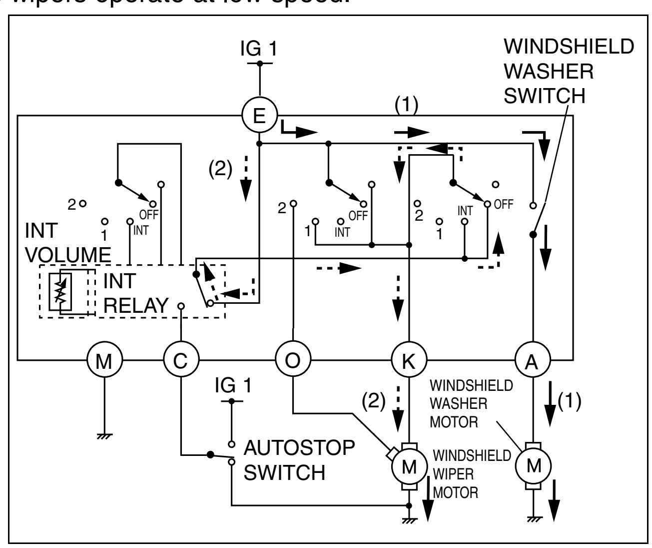
- When the windshield wiper switch moves to the INT position, the intermittent wiper (INT) relay turns on, and current flows through the INT relay to the windshield wiper switch, windshield wiper motor, then to ground. The wipers operate at low speed.
- When the preset period of time has passed, the INT relay turns off. The current stops flowing through the windshield 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.
- The INT volume provides optional settings of the wiper sweep interval (timing that the INT relay turns from off to on).



CHU0919S106

Synchronized Washer And Wiper Operation

- When the wiper lever is pulled toward the driver, the washer switch turns on and current (1) flows through the washer switch to the windshield washer motor, then to ground. The windshield washer motor activates and washer fluid is sprayed.
- At the same time, the INT relay turns on, and current (2) flows through the INT relay to the windshield wiper switch, the windshield wiper motor, then to ground. The wipers operate at low speed.



CHU0919S107

WINDSHIELD WASHER TANK SPECIFICATION

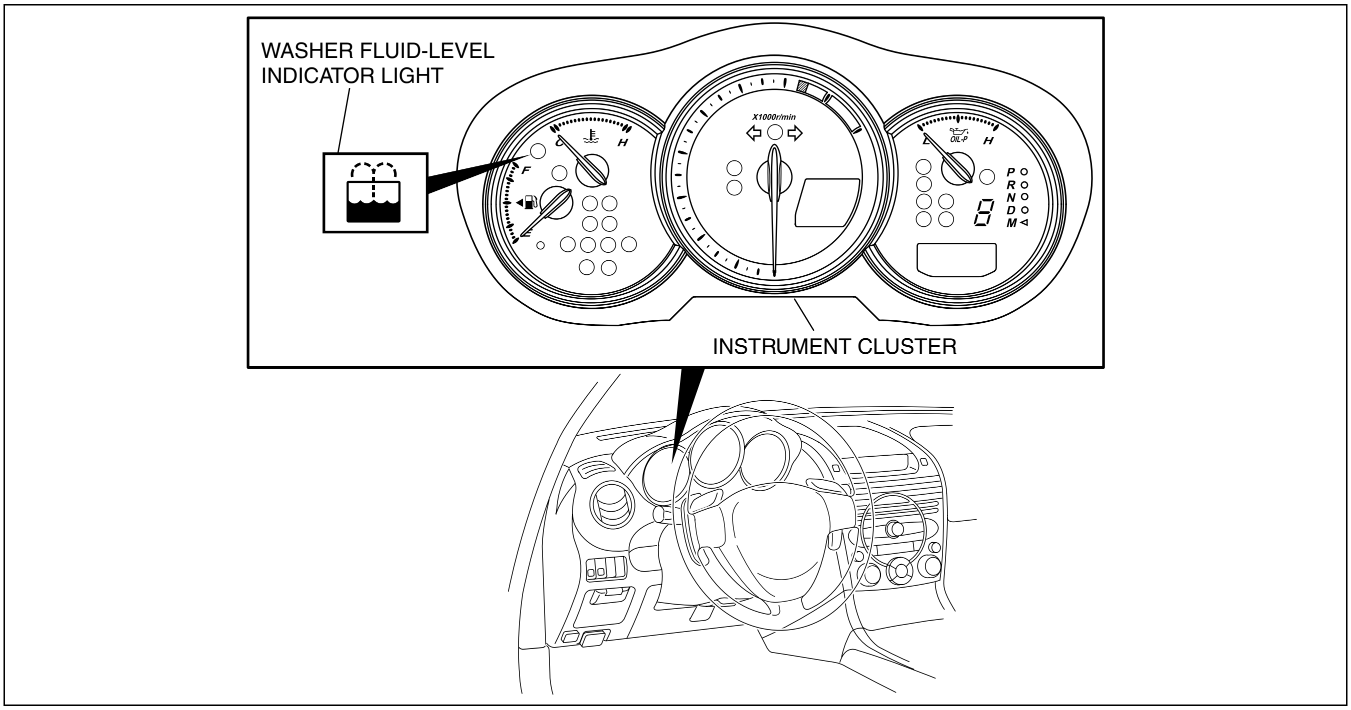
CHU091967480S01

Item	Vehicles with the headlight cleaner	Vehicles without the headlight cleaner	
		Large	Small
Windshield washer tank capacity	2.3 L {2.4 US qt, 2.0 Imp qt}	5.5 L {5.8 US qt, 4.8 Imp qt}	2.3 L {2.4 US qt, 2.0 Imp qt}

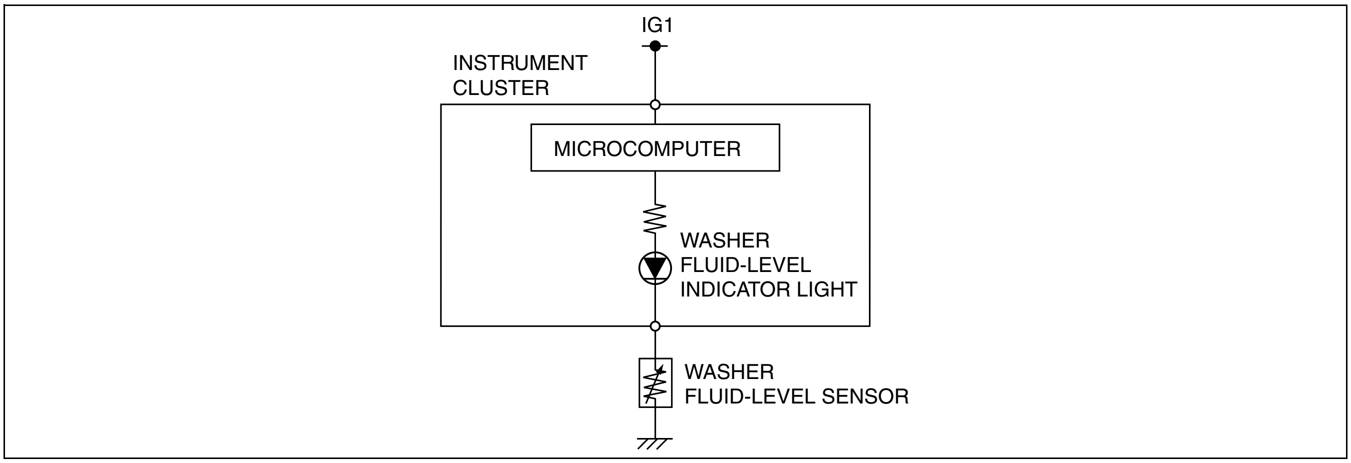
WASHER FLUID-LEVEL SENSOR FUNCTION

CHU091967488S01

- Warn the driver that the washer fluid-level is low.



CHU0919S114



CHU0919S115

HEADLIGHT CLEANER SYSTEM OUTLINE

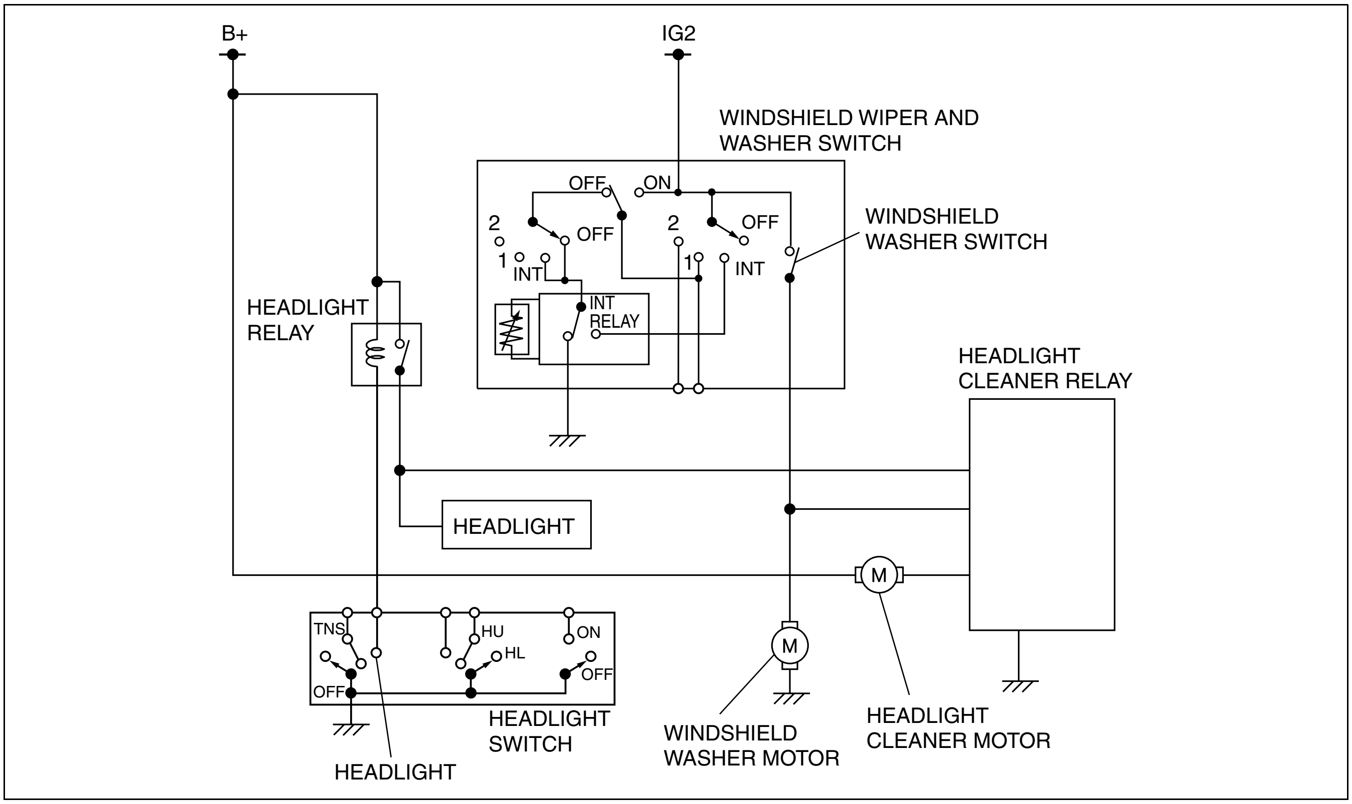
CHU091901052S06

- Pop-up type headlight cleaner adopted

09–19

HEADLIGHT CLEANER SYSTEM WIRING DIAGRAM

CHU091901052S07



CHU0919S108

HEADLIGHT CLEANER SYSTEM OPERATION

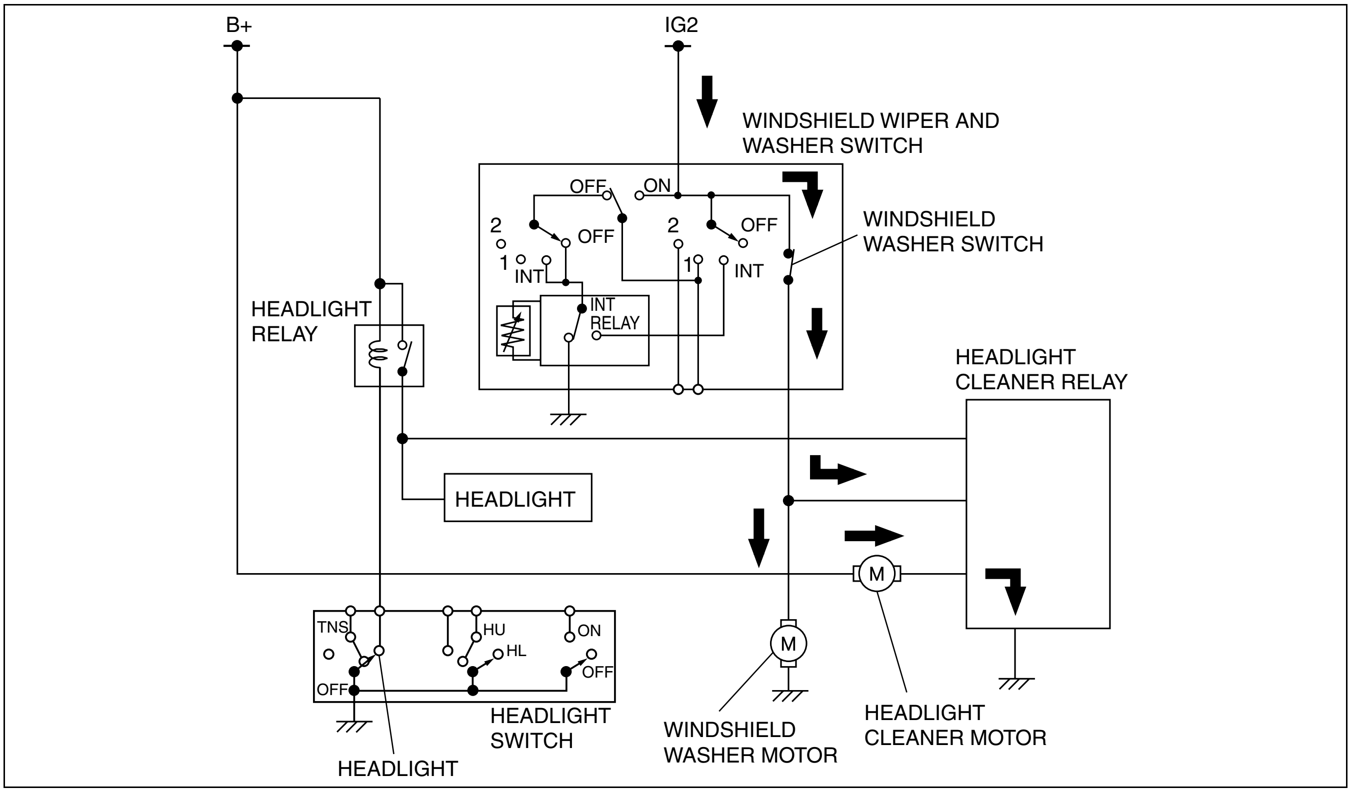
CHU091901052S08

Auto-operation

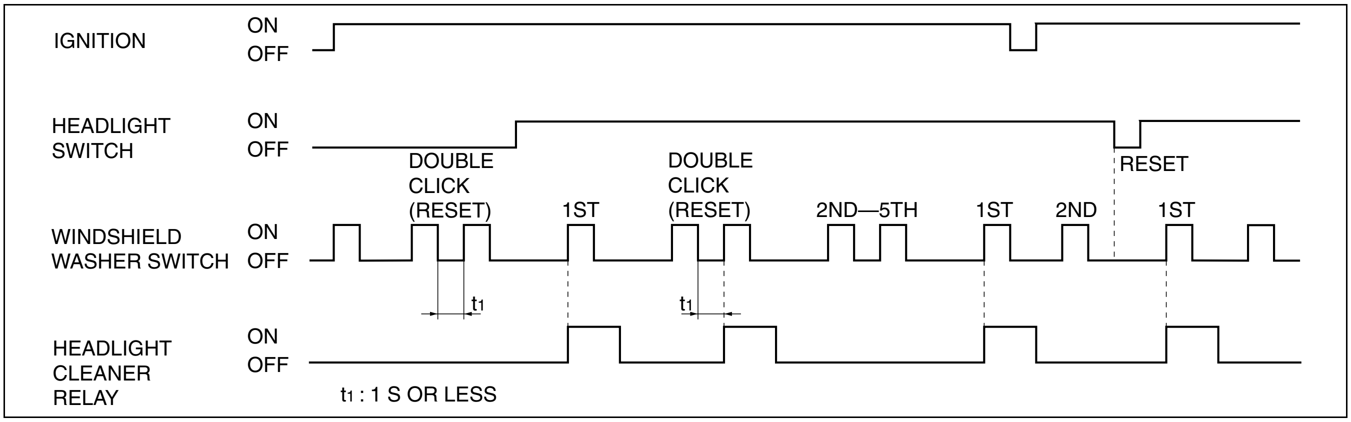
- If the windshield washer switch is turned on when the ignition and headlight switches are at the ON position, the headlight cleaner motor operates.
- The headlight cleaner operates only one time for every five times the windshield washer switch is operated.
- If manual operation occurs within two to five times of the windshield washer switch being operated, the number count is reset. Also, if the headlight switch is turned to the OFF and then to the ON position, the count is reset when the windshield washer switch is turned on.

Manual Operation

- If the windshield washer switch is turned on two consecutive times when the ignition and headlight switches are at the ON position, the headlight cleaner motor operates.



CHU0919S110



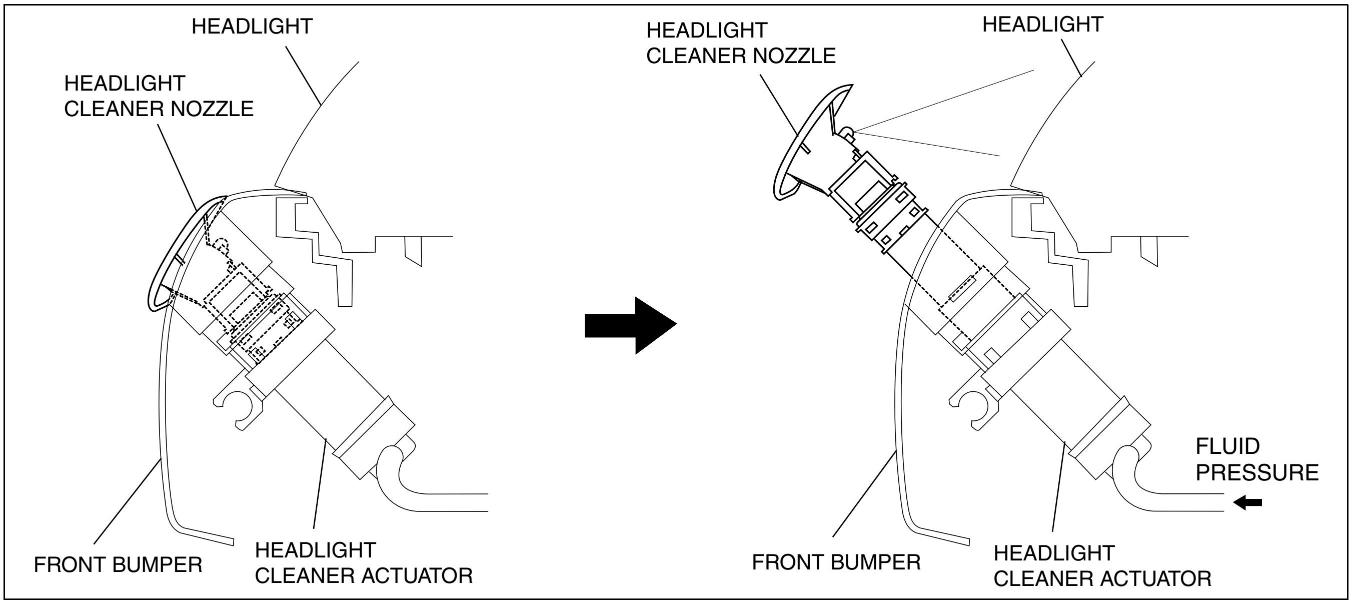
CHU0919S109

09–19

HEADLIGHT CLEANER ACTUATOR OPERATION

CHU091901052S09

- The headlight cleaner nozzle is held retracted by a spring within the headlight cleaner actuator.
- When fluid pressure rises due to the operation of the headlight cleaner motor, the piston in the headlight cleaner actuator is pushed, causing the nozzle to pop out of the front bumper and spray washer fluid.



CHU0919S112

09–20 ENTERTAINMENT

ENTERTAINMENT OUTLINE

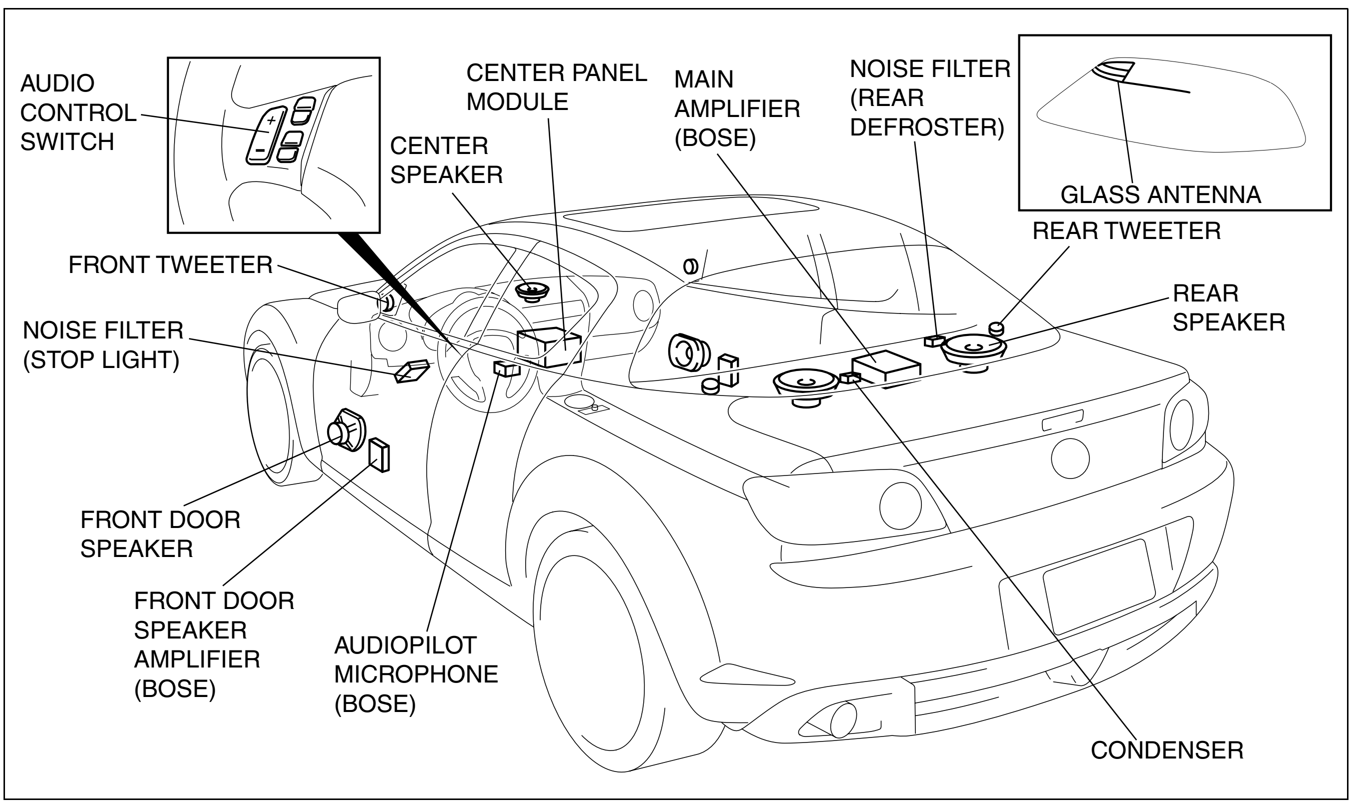
CHU092001066S01

- The center panel module installed with the audio unit and the audio switch, A/C switch, hazard warning switch and rear window defroster switch built into the center panel has been adopted.
- The audio unit consists of the following parts:
  — Base unit, which has AM/FM tuner and control function for each module
  — Upper module (CD player or CD changer)
  — Lower module (cassette deck or MD player)
  — Cover
- Upper module (CD player or CD changer) and lower module (cassette deck or MD player) are options.
- Module availability depends on vehicle grade.
- An audio control switch is equipped on the steering wheel for audio operation.
- The glass antenna has been adopted.
- The following speakers have been adopted for standard specification vehicles (6 speakers):
  — Front door speaker (2)
  — Rear speaker (2)
  — Front tweeter (2)
- The following speakers have been adopted for BOSE specification vehicles (9 speakers):
  — Front door speaker (2)
  — Rear speaker (2)
  — Front tweeter (2)
  — Rear tweeter (2)
  — Center speaker (1)
- The auto level control (ALC) function has been adopted. (Standard specification vehicle)
- The noise-response sound compensation system (AudioPilot*) has been adopted. (BOSE specification vehicle)
- A noise filter has been installed on the brake light, and rear window defroster circuit, and a condenser has been installed on the high-mount brake light and trunk compartment light circuit for improved noise reduction.
- All information related to the audio system appears on the information display's LCD.

* : "AudioPilot" is a registered trademark of Bose Corporation.

AUDIO SYSTEM STRUCTURAL VIEW

CHU092001066S02

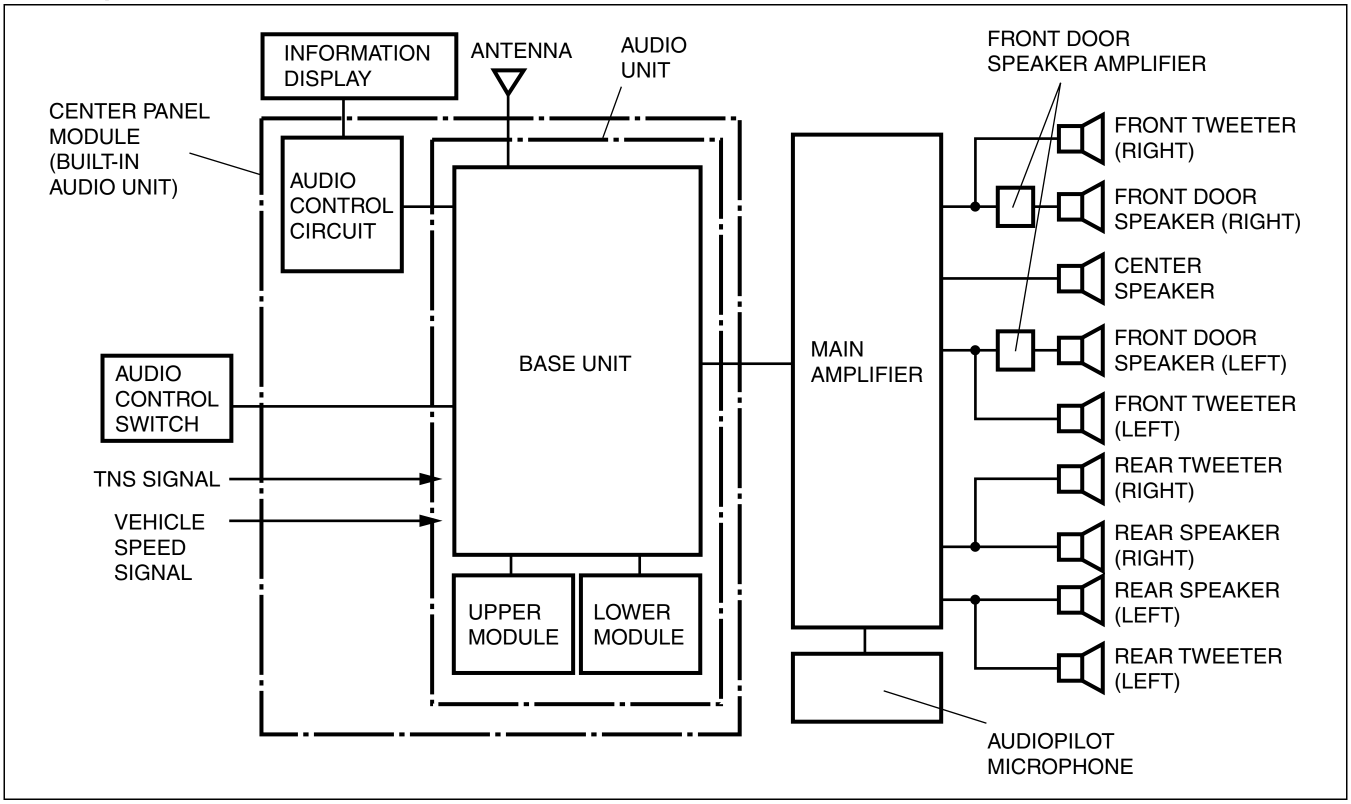


CHU0920N001

AUDIO SYSTEM BLOCK DIAGRAM

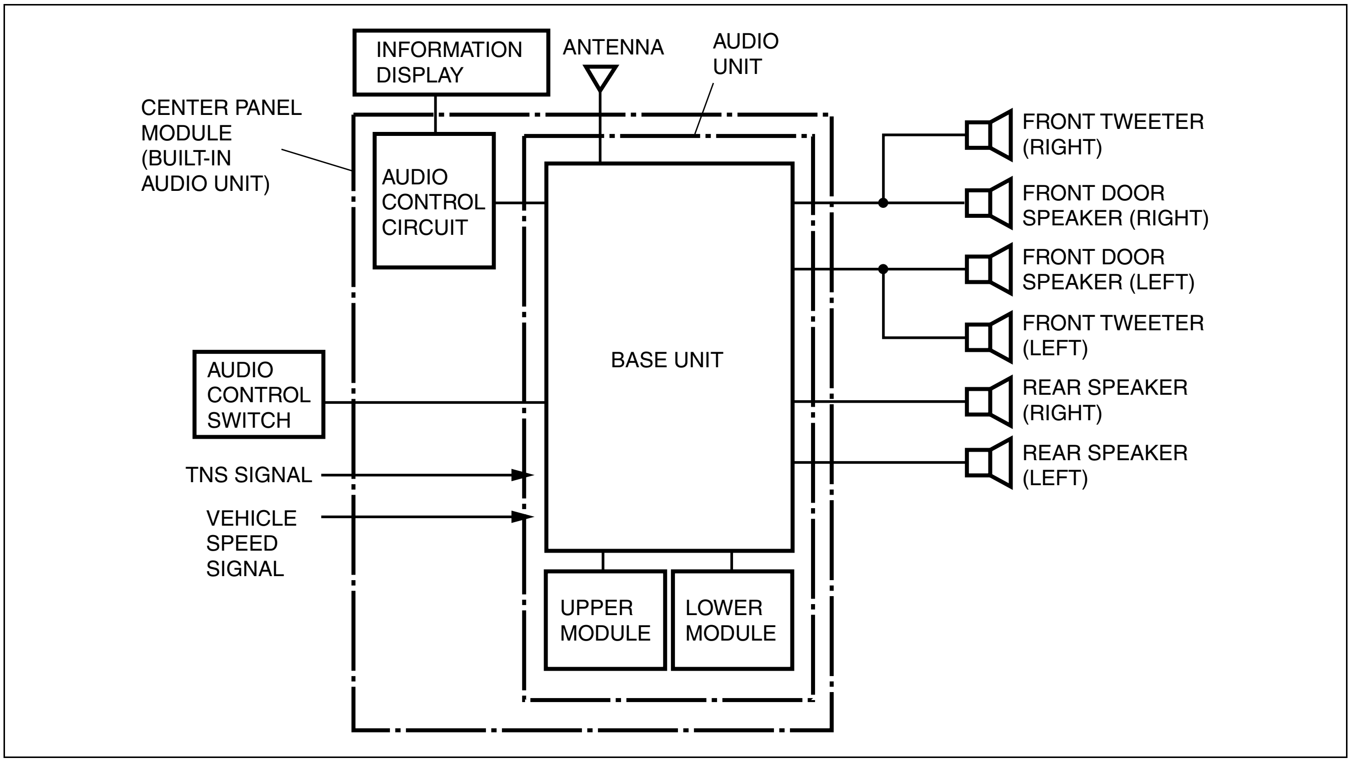
CHU092001066S03

BOSE Specification Vehicles



CHU0920S002

Standard specification Vehicles



CHU0920S129

AUDIO SYSTEM SPECIFICATIONS

CHU092001066S04

Audio Unit

Item		Specification	
		BOSE	Standard
Rated voltage (V)		12	
Frequency band	AM (kHz)	530—1620	
	FM (MHz)	87.5—108.0	
Audio amplifier maximum output power (W)		**External type audio amplifier** • Main amplifier — 25×3 — 12.75×2 • Front door speaker amplifier — 100×1	25×4
Output impedance (ohm)		2	4

Speaker

Item	Specification							
	Front door speaker		Rear speaker		Tweeter			Center speaker
	Standard	BOSE	Standard	BOSE	Front		Rear	
					Standard	BOSE		
Maximum input (W)	25	100	25	37.5	25	12.5	12.5	37.5
Impedance (ohm)	4	0.5	4	2	4			2
Size (in)	5.5×7.5	9	6×9		1	2	2	80 mm

CENTER PANEL MODULE OUTLINE

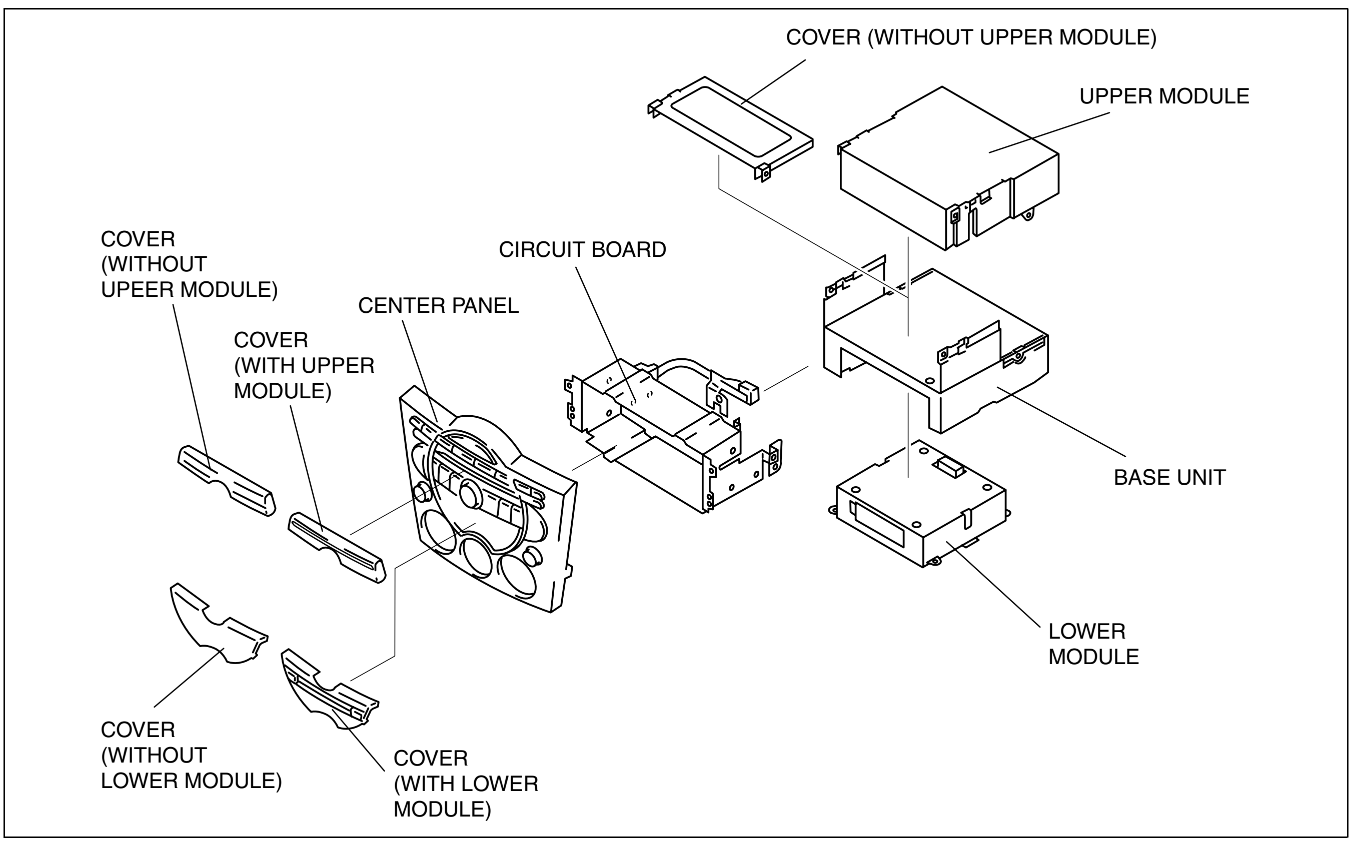
CHU092066900S01

- The center panel module is composed of the installed audio unit with the audio switch, A/C switch, hazard warning switch, and rear defroster switch built into the center panel.

CENTER PANEL MODULE CONSTRUCTION

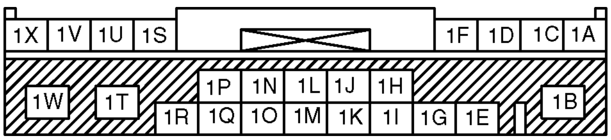
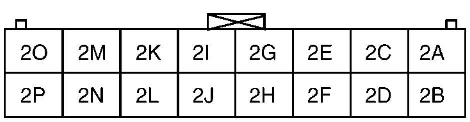
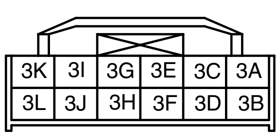
CHU092066900S02

Structural View

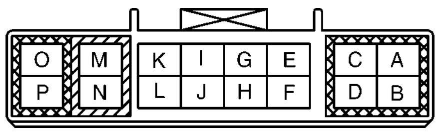


CHU0920S003

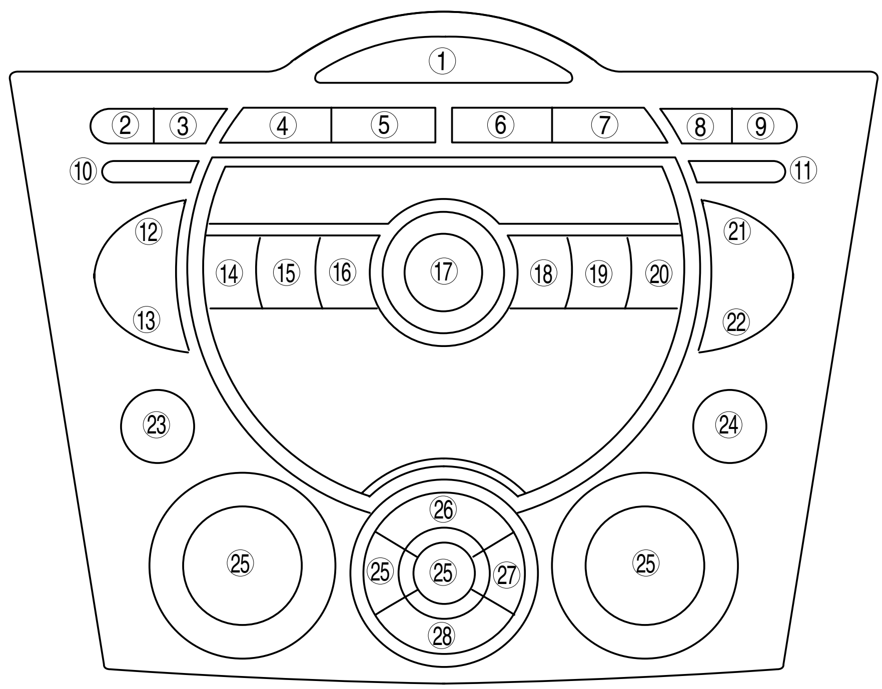
Terminal Layout and Signal
Audio unit

Terminal		Signal
	1A	Left front speaker (+)
	1B	B+ (Power back up)
	1C	Left front speaker (–)
	1D	Right front speaker (+)
	1E	TNS (+)
	1F	Right front speaker (–)
	1G	Illumination (–)
	1H	AudioPilot control
	1I	Vehicle speed signal
	1J	AMP. control
	1K	UART 1 (car-navigation signal 1)
	1L	TEL. mute
	1M	UART 2 (car-navigation signal 2)
	1N	Audio control switch 1
	1O	—
	1P	Audio control switch 2
	1Q	—
	1R	ACC
	1S	Left rear speaker (+)
	1T	Ground
	1U	Left rear speaker (–)
	1V	Right rear speaker (+)
	1W	Power ground
	1X	Right rear speaker (–)
	2A	Power ground
	2B	System mute
	2C	Right input (+)
	2D	Right input (–)
	2E	Left input (+)
	2F	Left input (–)
	2G	Signal ground
	2H	—
	2I	—
	2J	—
	2K	BUS (–)
	2L	BUS (+)
	2M	—
	2N	—
	2O	ACC
	2P	B+
	3A	—
	3B	—
	3C	—
	3D	Hazard warning switch
	3E	Hazard warning ground
	3F	Dimmer cancel signal
	3G	IG2
	3H	—
	3I	A/C signal 1
	3J	A/C signal 2
	3K	A/C signal GND
	3L	—

Information display harness

Terminal		Signal
	A	LCD DRV (8 V)
	B	ACC (5 V)
	C	LCD CONT. RC
	D	LCD CONT. AC
	E	LCD CONT. CS
	F	LCD CONT. SCL
	G	LCD CONT. DATA
	H	—
	I	LCD CONT. INH
	J	Digital ground
	K	TNS (8V)
	L	Power ground
	M	—
	N	—
	O	—
	P	—

Switch/Button Location



BHJ0920N004

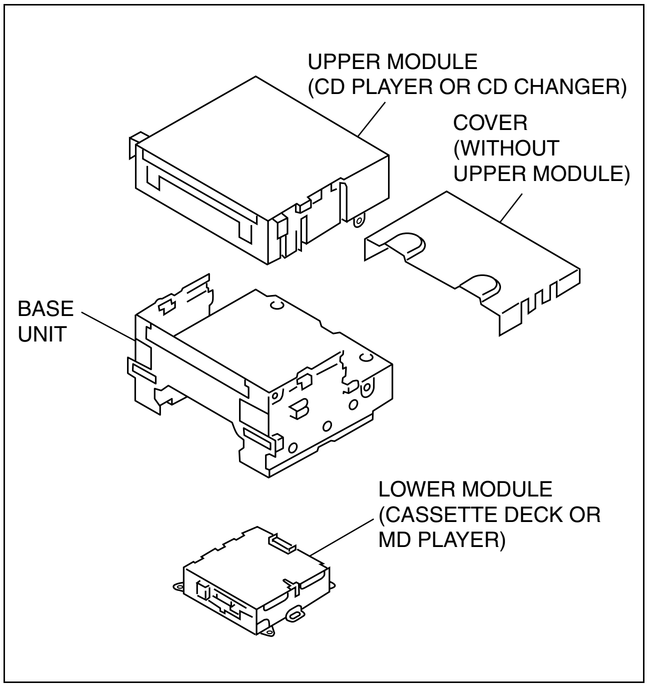
No.	Switch/button	Related system
1	Hazard warning switch	Hazard warning system
2	SET button	Information display
3	CLK button	Information display
4	FM1/2 button	Audio system
5	AM button	Audio system
6	CD button	Audio system
7	TAPE/MD button	Audio system
8	DISP button	Information display
9	AMB button	Information display
10	LOAD button	Audio system
11	EJECT button	Audio system
12	SEEK UP button	Audio system
13	SEEK DOWN button	Audio system
14	Preset button “1”	Audio system
15	Preset button “2”	Audio system
16	Preset button “3”	Audio system
17	POWER/VOLUME button	Audio system
18	Preset button “4”	Audio system
19	Preset button “5”	Audio system

No.	Switch/button	Related system
20	Preset button “6”	Audio system
21	SCAN (upper) button	Audio system
22	SCAN (lower) button	Audio system
23	TUNE AUTO-M button	Audio system
24	TEXT AUDIO CONT button	Audio system
25	Climate control unit (See 07–40–6 CLIMATE CONTROL UNIT CONSTRUCTION)	Air conditioner system
26	A/C switch	Air conditioner system
27	Rear window defroster switch	Rear window defroster system
28	REC/FRESH switch	Air conditioner system

AUDIO UNIT CONSTRUCTION/OPERATION

CHU092066900S03

- The audio unit is composed of the base unit, upper module, and lower module.
- Upper and lower module availability depends on vehicle grade.



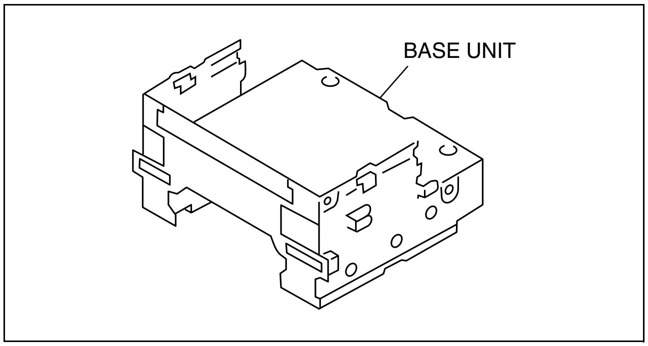
A6A8124T005

Terminal Layout and Signal

- (See 09–20–4 CENTER PANEL MODULE CONSTRUCTION.)

Base Unit

- The base unit controls the AM/FM tuner and upper/lower modules.
- An auto level control (ALC) function that controls speaker volume according to vehicle speed has been adopted.



A6A8124T006

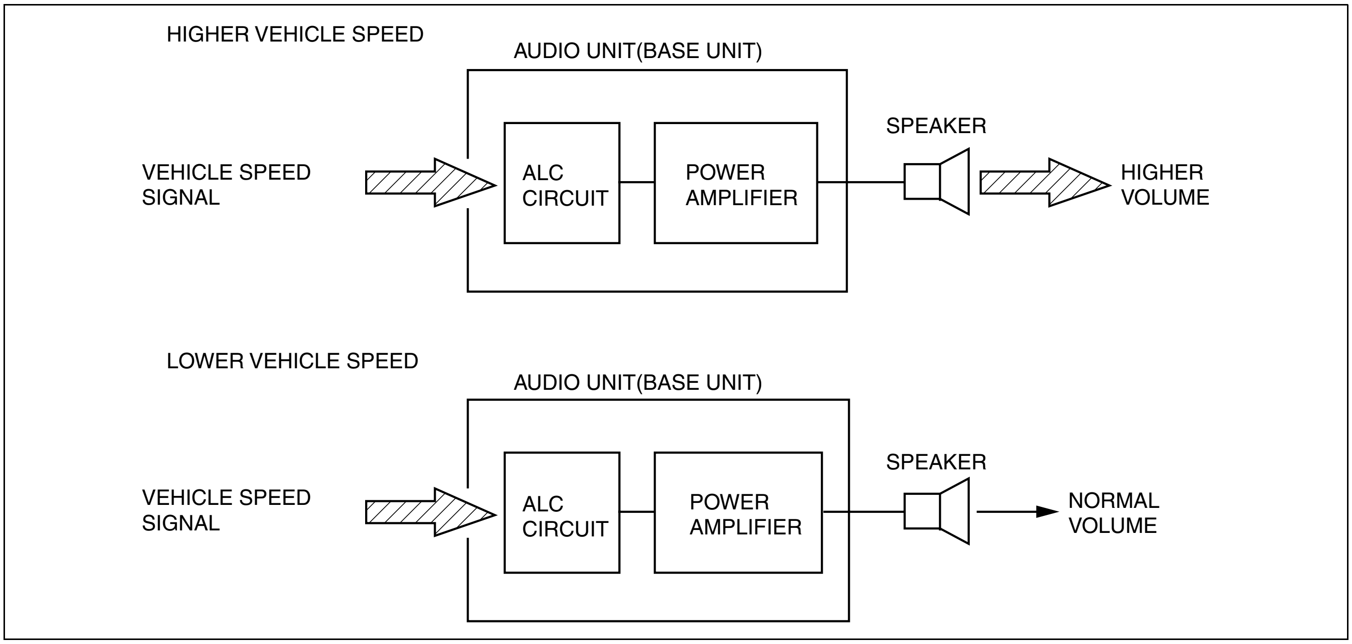
09–20

Auto Level Control (ALC)
Function

- Adjusts the audio volume so that the sound is balanced against wind and road noise while driving.

Operation

- The audio unit changes the volume automatically based on the vehicle speed signal sent from the ABS HU/CM (with ABS) or DSC HU/CM (with DSC).



A6A8124T007

- The ALC function is divided into four modes, and can be used effectively to match the driving conditions.

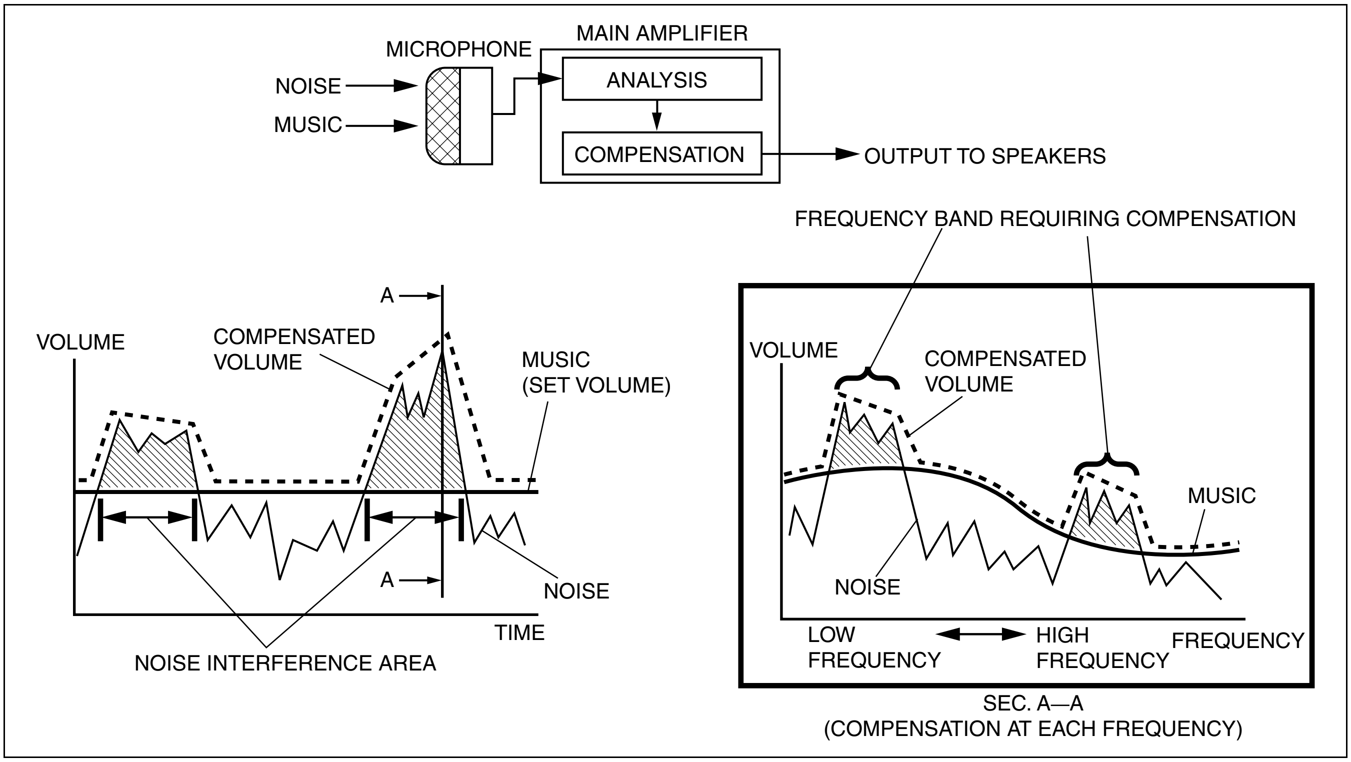
Mode	Condition
ALC OFF	ALC function cancel
ALC LEVEL1	Outside road noise low
ALC LEVEL2	Outside road noise rather high
ALC LEVEL3	Outside road noise high

AudioPilot (BOSE specification vehicle)
Function

- Measures the driving noise level inside the vehicle with a specialized microphone, and the main amplifier modifies the volume accordingly. Due to this, passengers can enjoy music with constant sufficient volume.

Construction/Operation

- A microphone is installed on the lower panel.
- The main 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.



CHU0920S004

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE

CHU092066900S04

- The on-board diagnostic system has a self-diagnostic function and diagnostic assist function to help technicians locate malfunctions.

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION

CHU092066900S05

Self-diagnostic Function
Malfunction detection function

- The malfunction detection section detects malfunctions occurring in the system.

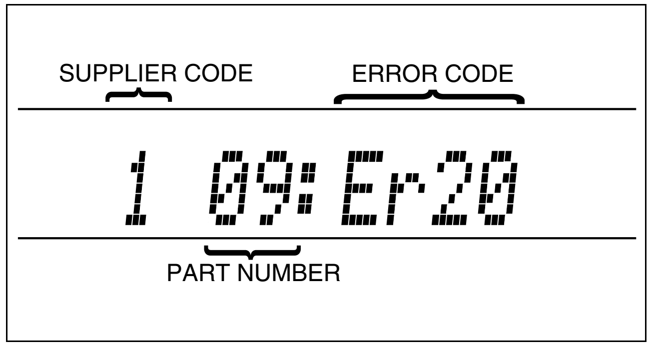
Memory function

- The memory function detects a malfunction, changes it to a DTC, and stores it in the memory. The memory can store a maximum of three DTCs. If another malfunction is detected when three DTCs are already stored, the memory function clears the oldest DTC and stores the new one.
- Once a DTC is stored, it can only be cleared by the designated procedure; not by turning the ignition switch to the LOCK position or disconnecting the negative battery cable. The procedure is mentioned in the Service Section.

Display function

- When the self-diagnostic function is activated, the information display displays the DTC stored in the memory.
- The DTC consists of the following codes and numbers:
  — Supplier code (indicates manufacturer)
  — Part number (indicates malfunctioning part)
  — Error code (indicates malfunction description)
- Refer to the Service Section for the display method.

Supplier code	Supplier name
1	FMS Audio
2	Panasonic
3	Clarion



CHU0920S005

Parts number	Parts name
00	Cassette deck (lower module)
03	CD player (upper module)
06	CD changer (upper module)
07	MD player (lower module)
09	Base 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
20	Insufficient power supply
22	Tuner error

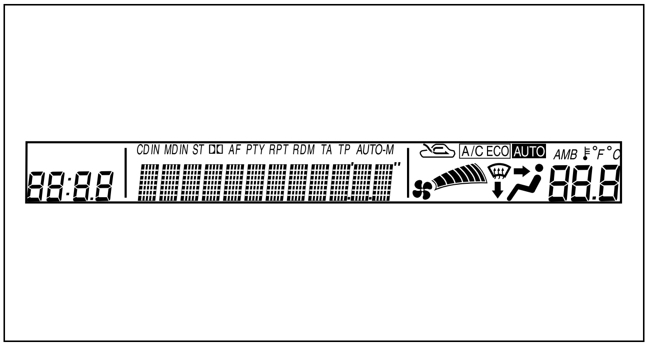
Screen display		Malfunction location
DTC	Output signal	
09:Er22	—	Base unit (peripheral circuit)
09:Er20	—	Power supply circuit of base unit
00:Er10	—	Cassette deck—base unit communication line
03:Er10	—	CD player—base unit communication line
06:Er10	—	CD changer (upper module)—base unit communication line
07:Er10	—	MD player—base unit communication line
03:Er01	—	CD player
03:Er02	CHECK CD	CD player
03:Er07	CHECK CD	CD player
00:Er01	—	Cassette deck
00:Er03	—	Cassette deck
00:Er04	CHECK TAPE	Cassette tape
06:Er01	—	CD changer (upper module)
06:Er02	CHECK CD	CD changer (upper module)
06:Er07	CHECK CD	CD changer (upper module)
07:Er01	—	MD player
07:Er02	CHECK MD	MD player
07:Er07	CHECK MD	MD player
07:Er08	CHECK MD	MD
10:Er01	—	CD player MP3 operation
10:Er02	CHECK CD	CD player MP3 operation
no Err	—	No stored DTCs

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.

LCD

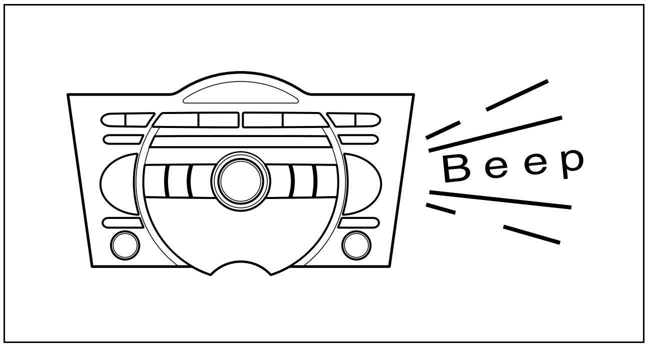
- The diagnostic assist function illuminates all characters in the LCD of information display to check for truncated or faint characters.



BHJ0920N005

Switch

- The diagnostic assist function sounds the buzzer when the switches are pressed to check the switches.



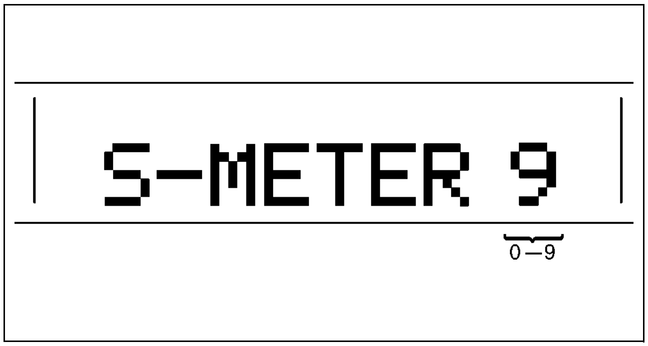
BHJ0920N006

Speaker

- The diagnostic assist function outputs sound to the speakers in the following order to determine condition of the speakers and wiring harness between the base unit and each speaker.
  1. Left front door speaker and tweeter
  2. Right front door speaker and tweeter
  3. Right rear door speaker and woofer
  4. Left rear door speaker and woofer

Radio

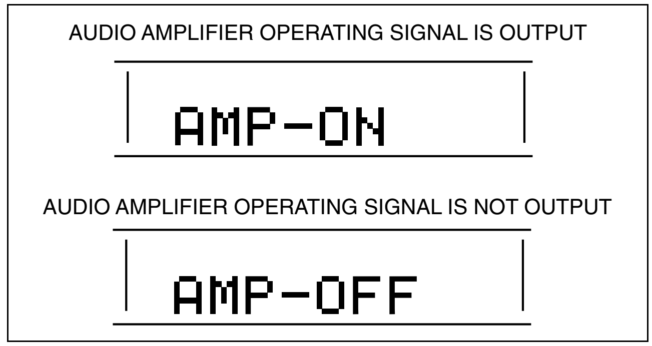
- The diagnostic assist function displays the radio reception condition in 10 levels (0-9) to assist in determining the condition of the antenna, antenna feeders, and base unit (tuner).



A6E8124T011

Audio amplifier (external)

- The diagnostic assist function displays the output state of the audio amplifier operating signal to determine condition of the audio amplifier, base unit, and wiring harness between the base unit and audio amplifier.



A6A8124T009

AUDIO AMPLIFIER CONSTRUCTION

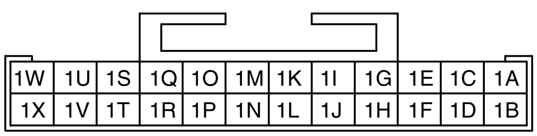
CHU092066910S01

Main Amplifier

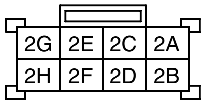
- Located in the rear package tray.
- A digital amplifier has been adopted.
- Converts music signals (analog voltage waves) output from an audio unit, into digital pulse signals, and then amplifies and outputs them.

Terminal Layout and Signal

Main amplifier



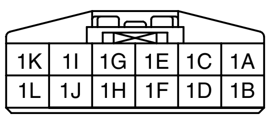
Terminal	Signal: 24-pin connector
1A	—
1B	AudioPilot control
1C	—
1D	AMP. mute
1E	Microphone (+)
1F	Right rear speaker input (–)
1G	Microphone (–)
1H	Right rear speaker input (+)
1I	Left rear speaker output (+)
1J	Left rear speaker input (–)
1K	Left rear speaker output (–)
1L	Left rear speaker input (+)
1M	Right rear speaker output (+)
1N	Right front speaker input (–)
1O	Right rear speaker output (–)
1P	Right front speaker input (+)
1Q	Left front speaker input (+)
1R	Left front speaker input (–)
1S	Left front speaker output (–)
1T	Left front speaker input (+)
1U	Left front speaker output (–)
1V	—
1W	—
1X	—

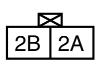
Terminal		Signal
		8-pin connector
	2A	B+
	2B	Power GND
	2C	Center speaker output (–)
	2D	Center speaker output (+)
	2E	—
	2F	—
	2G	—
	2H	—

Front Door Speaker Amplifier

- Located in the front door trim.
- A digital amplifier (switching amplifier) has been adopted.
- On/off digital signals are amplified and output, allowing power conservation and lower heat generation. Due to this, a radiating plate (heat sink) is not required, and downsizing of the amplifier has been achieved.

Terminal Layout and Signal
Front door speaker amplifier

Terminal		Signal
		12-pin connector
	1A	Front speaker input (+)
	1B	Front speaker input (–)
	1C	—
	1D	—
	1E	—
	1F	—
	1G	—
	1H	—
	1I	—
	1J	AMP. mute
	1K	B+
	1L	GND

Terminal		Signal
		2-pin connector
	2A	B+
	2B	Power GND

FRONT DOOR SPEAKER CONSTRUCTION

CHU092066961S01

- Located in the font door trim.
- BOSE-manufactured speakers have been adopted for BOSE specification vehicles (all speakers).

REAR SPEAKER CONSTRUCTION

CHU092066961S02

- Located in the rear package tray.
- BOSE-manufactured speakers have been adopted for BOSE specification vehicles (all speakers).

CENTER SPEAKER CONSTRUCTION (BOSE SPECIFICATION VEHICLE)

CHU092066961S03

- Located at the center of the dashboard.

TWEETER CONSTRUCTION

CHU092066966S01

- Tweeters (speaker for high sound) are installed in the front door inner garnishes (right and left), and rear package tray (BOSE specification vehicle), providing wide-range sound.

ANTENNA CONSTRUCTION

CHU092066939S01

Glass Antenna

- A glass antenna with high noise resistance has been adopted inside the rear window glass.

AUDIO CONTROL SWITCH OUTLINE

CHU092000148S01

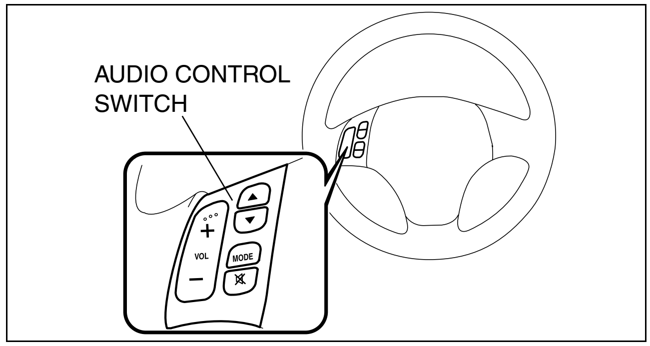
- A steering wheel remote control for the audio system, with simplified design for easy operation, has been adopted.

AUDIO CONTROL SWITCH CONSTRUCTION/OPERATION

CHU092000148S02

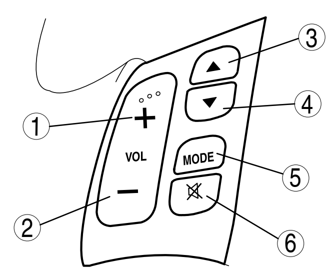
Construction

- The audio control switch is located on the steering wheel.



CHU0920S006

Operation



CHU0920S007

No.	Button (component)	Function
1	Volume button (+)	Volume up
2	Volume button (-)	Volume down
3	AUTO scan button	Select the radio station
	AUTO track button	Track change
4	Preset button	Select the preset button

No.	Button (component)	Function
5	Mode button	Select the audio mode (AM→FM1→FM2→Cassette tape/MD→CD/CD changer)
6	Mute button	Mute

CAR-NAVIGATION SYSTEM OUTLINE

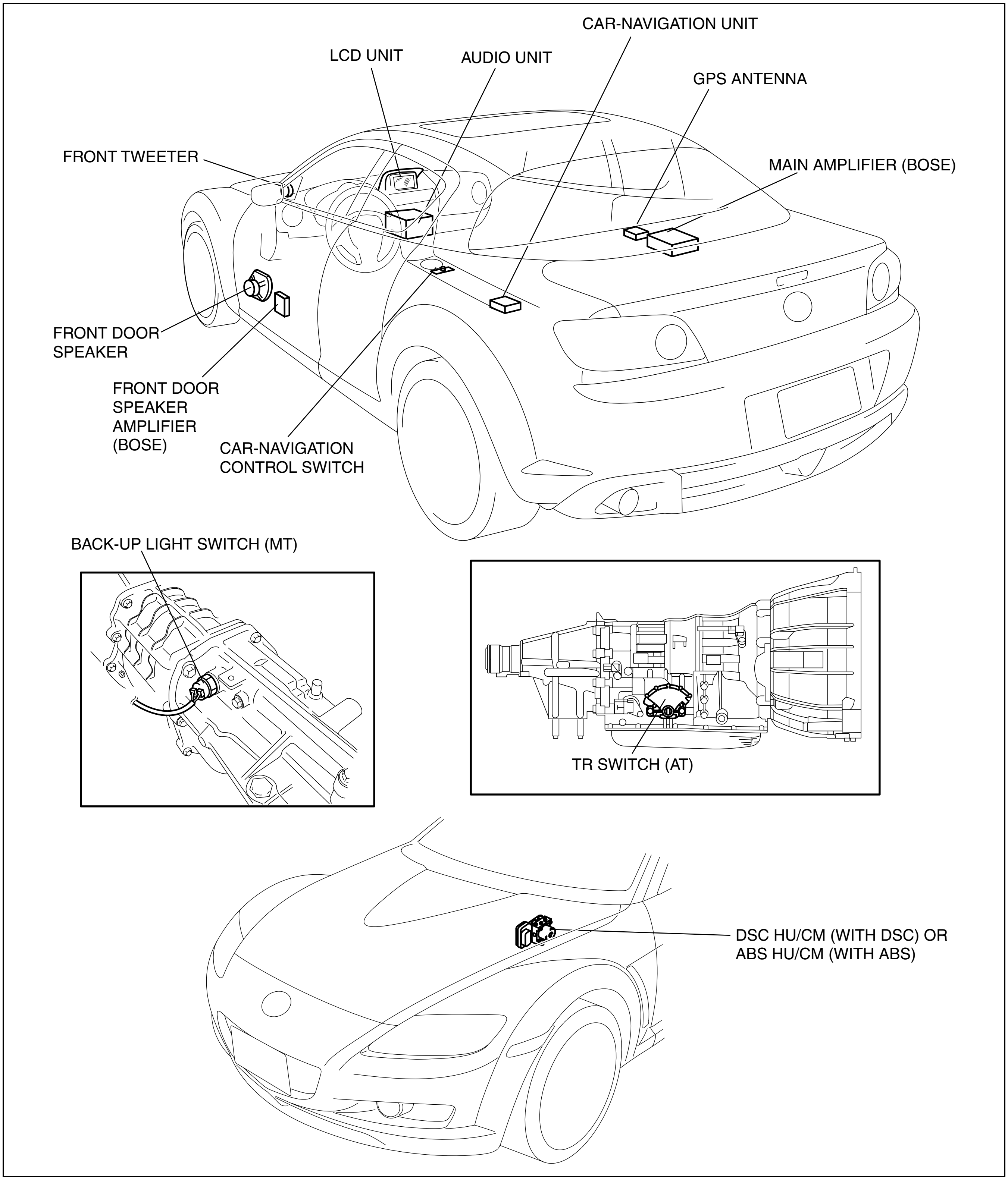
CHU092066000S01

- A 7 inch wide, pop-up LCD (*TFT) has been adopted to improve marketability.
- A hybrid in car-navigation system and map-matching function has been adopted to improve accuracy of detection of the vehicle's position.
- A remote control with an infrared transmitter has been adopted to improve operational ability.
- The languages and voices available for use with the car-navigation unit include English and French. However, the language used in this manual is in **English only**.

*TFT: Thin Film Transistor

CAR-NAVIGATION SYSTEM STRUCTURAL VIEW

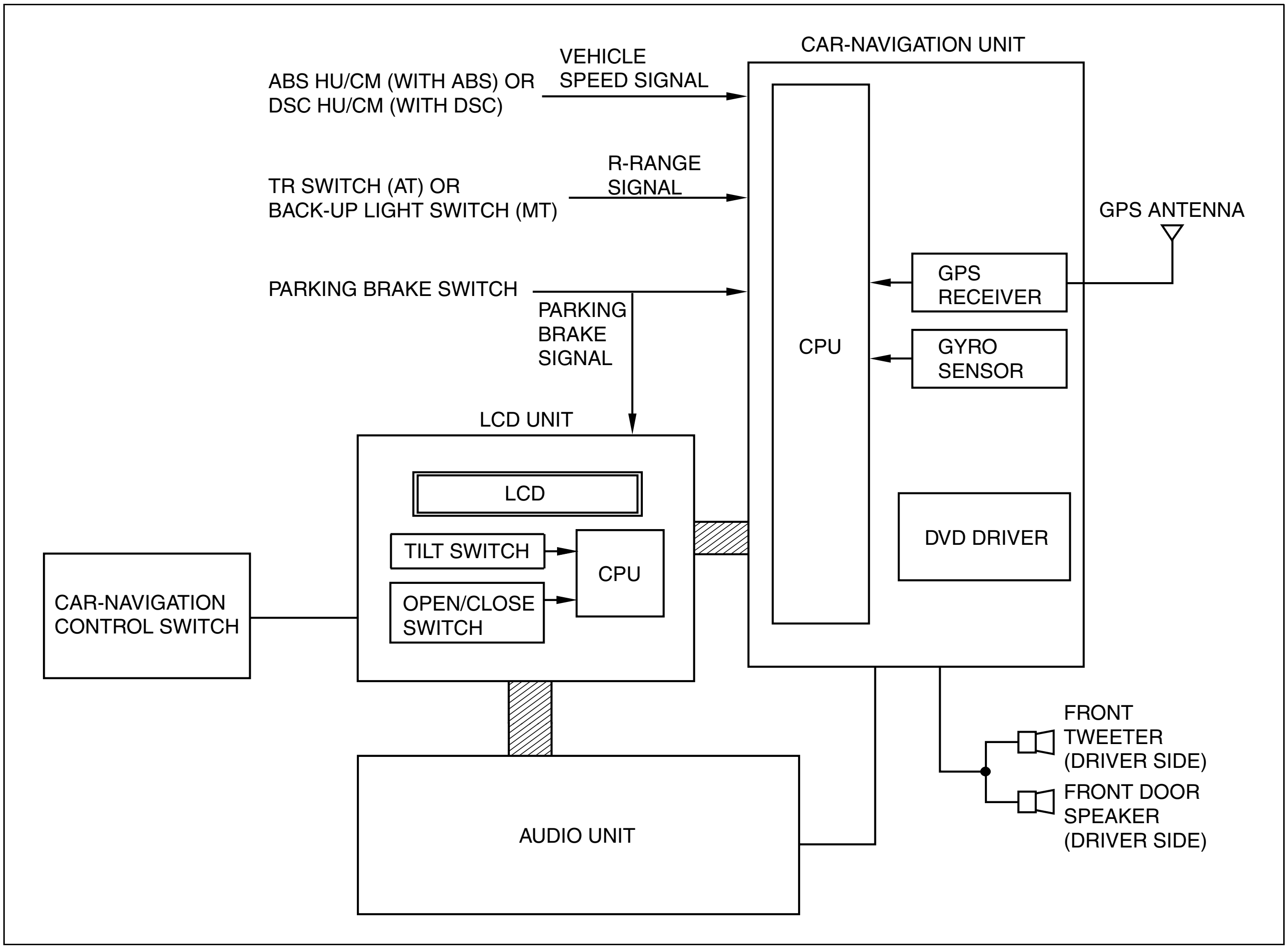
CHU092066000S02



CHU0920S100

CAR-NAVIGATION SYSTEM BLOCK DIAGRAM

CHU092066000S03



CHU0920S101

CAR-NAVIGATION SYSTEM SPECIFICATIONS

CHU092066000S04

Car-navigation Unit

Item		Specification
Unit type		Stand alone
Rated voltage	(V)	12
ROM type		DVD-ROM
Voice guidance output power	(W)	5

LCD Unit

Item			Specification
Unit type			Pop-up
Rated voltage		(V)	12
Display (for car-navigation system)	Size	(inch)	7 (wide)
	Type		TFT (Thin Film Transistor); Full-color
Display (for audio, and A/C)	Type		LCD; Amber-color

Speaker

- Refer to audio system. (See 09–20–4 AUDIO SYSTEM SPECIFICATIONS.)

COMPONENT PART AND FUNCTION

CHU092066000S05

Item	Function
Car-navigation unit	• Reads the data (map, voice and other) from the DVD-ROM. • Calculates and displays the vehicle's position from various signals. • Calculates the route to the destination. • Navigates the driver to the destination using the map screen and/or the voice. **Note** • DVD audio and video are not supported by this system. • This unit does not support all Video CD and CD formats.
LCD unit	• Displays the screen (menus, maps and other screens) by remote control operation.
GPS antenna	• Receives GPS signal from satellites.
Gyro sensor (inside of the car-navigation unit)	• Sends yaw-rate signal to the CPU in the car-navigation unit.
TR switch (AT) or back-up light switch (MT)	• Sends R-range or reverse signal to the car-navigation unit.
DSC unit (with DSC) or ABS HU/CM (with ABS)	• Sends vehicle speed signal to the car-navigation unit by CAN system.
Front speaker and tweeter (driver side)	• Outputs voice and audio sound.
DVD-ROM (inside of the car-navigation unit)	• Map information data of each country is recorded. • Voice data used to guide the route is recorded. • Route information data to search for the route is recorded.
Car-navigation control switch	• Changes display screens, settings etc., by button operation.

CAR-NAVIGATION UNIT OUTLINE

CHU092066902S01

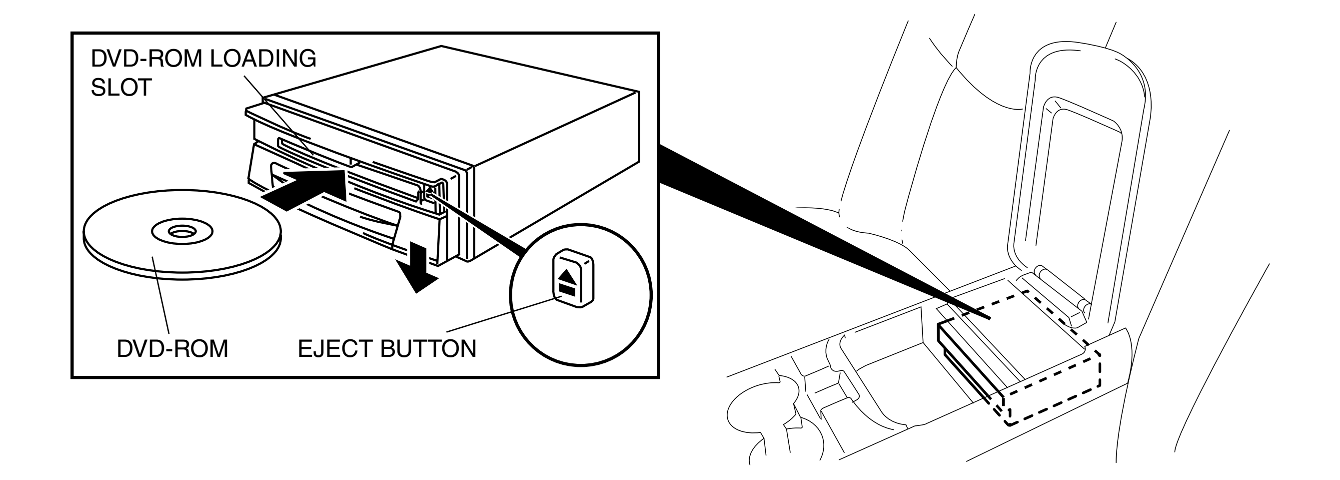
- Using exterior signal input and DVD-ROM information, this unit detects vehicle position, provides destination route guidance, and displays color maps.

CAR-NAVIGATION UNIT CONSTRUCTION

CHU092066902S02

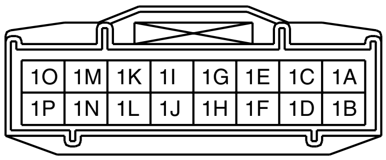
Structure

- The car-navigation unit is located in the console.
- 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.

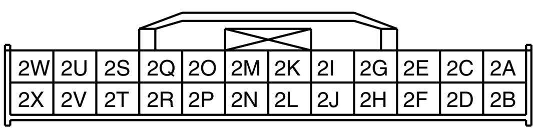


CHU0920S102

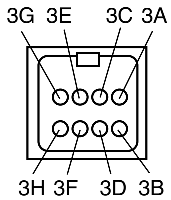
Terminal Layout and Signals



Terminal		Signals
		16-pin connector
	1A	GND
	1B	B+
	1C	–
	1D	ACC
	1E	PR front speaker input (-)
	1F	Illumination (-)
	1G	PR front speaker input (+)
	1H	Vehicle speed signal
	1I	PR front speaker output (-)
	1J	Parking brake signal
	1K	PR front speaker output (+)
	1L	R-range signal
	1M	Front speaker output (-)
	1N	Front speaker output (+)
	1O	Front speaker input (-)
	1P	Front speaker input (+)



Terminal		Signals
		24-pin connector
	2A	–
	2B	–
	2C	–
	2D	–
	2E	–
	2F	–
	2G	–
	2H	–
	2I	–
	2J	–
	2K	–
	2L	–
	2M	–
	2N	Monitor serial input
	2O	Shield GND
	2P	Monitor serial output
	2Q	Shield GND
	2R	Video (composite sync)
	2S	–
	2T	Video (B)
	2U	Video GND
	2V	Video (G)
	2W	–
	2X	Video (R)

<table>
<tr><th colspan="2" rowspan="2">Terminal</th><th>Signals</th></tr>
<tr><th>8-pin connector (for extended function)</th></tr>
<tr><td rowspan="8">
</td><td>3A</td><td>–</td></tr>
<tr><td>3B</td><td>Serial output</td></tr>
<tr><td>3C</td><td>–</td></tr>
<tr><td>3D</td><td>Serial input</td></tr>
<tr><td>3E</td><td>Power</td></tr>
<tr><td>3F</td><td>Reset</td></tr>
<tr><td>3G</td><td>B+</td></tr>
<tr><td>3H</td><td>GND</td></tr>
</table>

<table>
<tr><th colspan="2" rowspan="2">Terminal</th><th>Signal</th></tr>
<tr><th>1-pin connector</th></tr>
<tr><td>
</td><td>4A</td><td>GPS antenna input</td></tr>
</table>

GYRO SENSOR FUNCTION

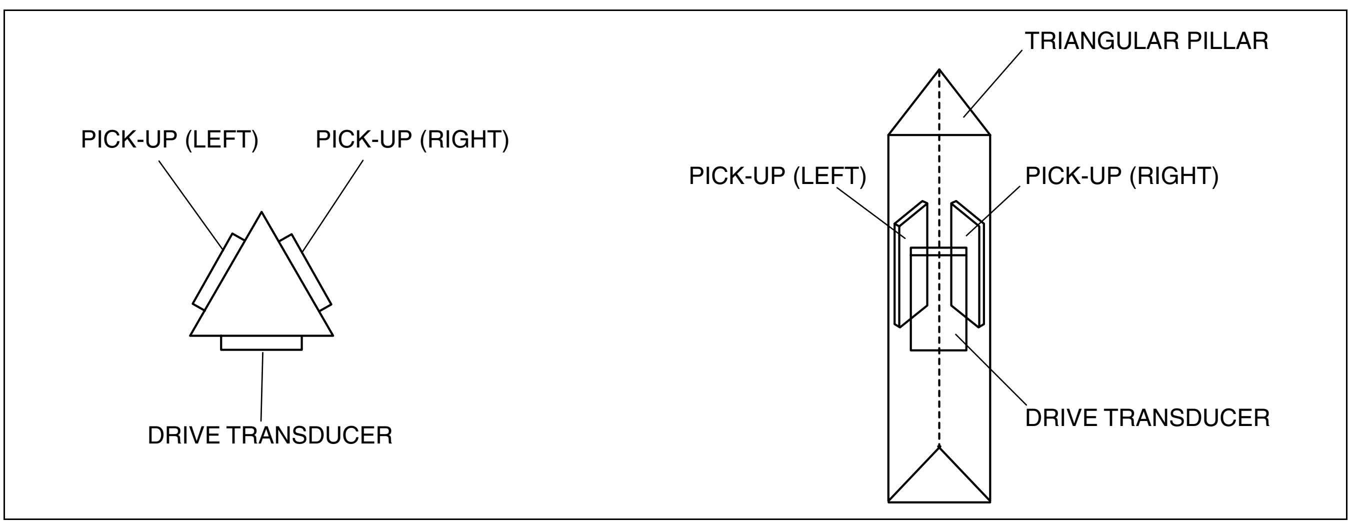
CHU092066902S03

- 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's direction of travel from the vehicle's cornering angle, into electrical signals. It then sends these signals to the navigation unit.

GYRO SENSOR CONSTRUCTION/OPERATION

CHU092066902S04

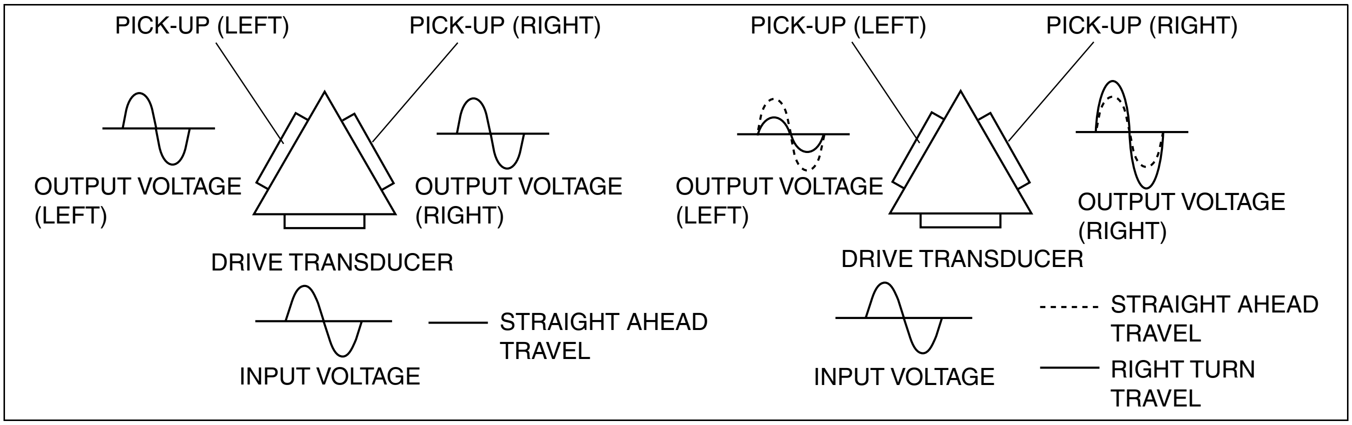
- A piezoelectric type (utilizes the piezoelectric effect) gyro sensor is used. It is composed of three piezoelectric transducers, a drive transducer and two pick-ups, used to drive and sense the vibrations of the triangular pillar. Both parts are installed on each surface of the triangle pillar. Piezoelectric transducer can either be distorted by electrical voltage, or can create electrical voltage by being distorted. The gyro sensor uses both characteristics of the piezoelectric material.



CHU0920S107

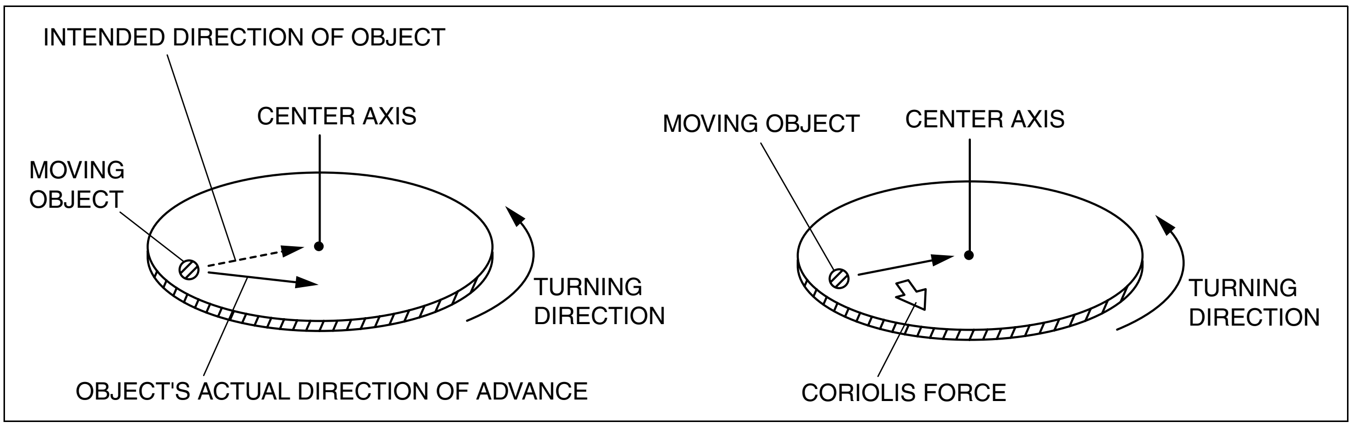
- One face of the triangular pillar functions as the driving side, the others function as pick-up sides. Electrically induced vibration of the drive transducer causes the pick-up sides to vibrate, and the pick-up sides produce an electrical current.

- The pick-up sides are distorted by Coriolis force*, which happens as a result of the turning arc and its effect on the center axis of the sensor pillar. Two piezoelectric pick-up sides convert the distortion amount into two electrical signals to indicate the exact yaw ratio.



CHU0920S108

*Coriolis force:If turning velocity is added to an already-moving object, force is produced at a right angle to the object's path of travel.



CHU0920S109

AUTONOMOUS NAVIGATION OPERATION

CHU092066902S05

- 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 speedometer sensor (built into microcomputer inside 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.

GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OUTLINE

CHU092066902S06

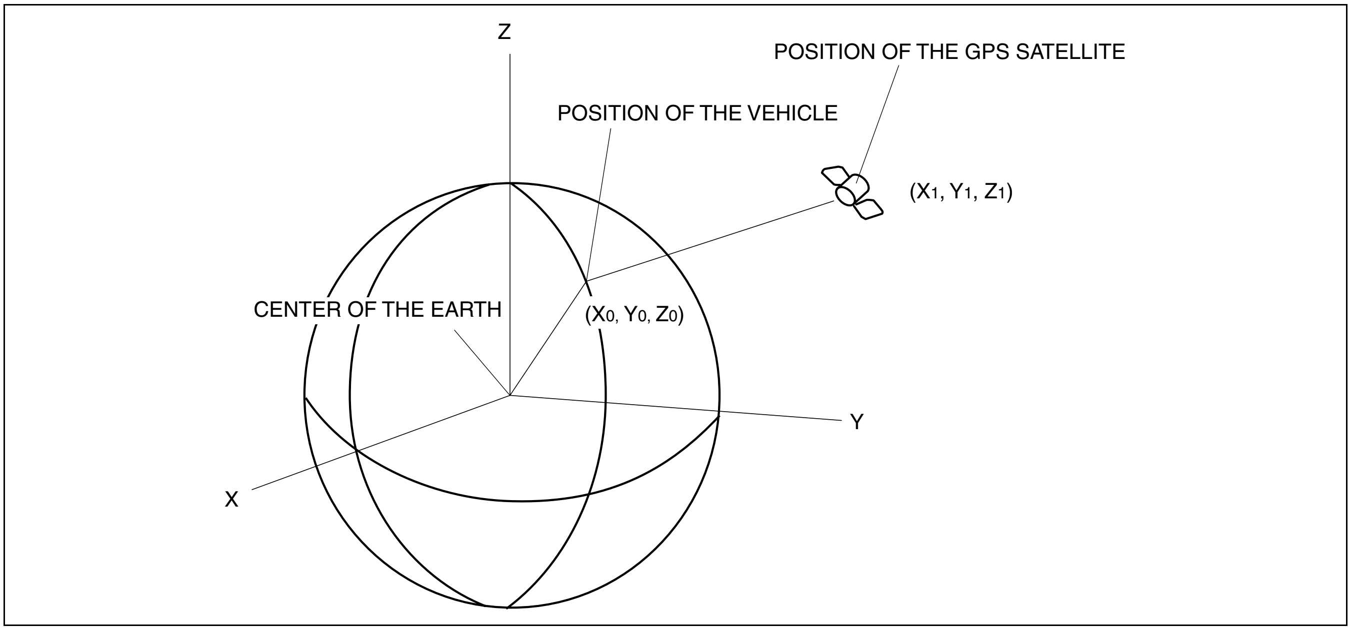
- GPS is a navigation system developed by the U.S. Department of Defence. The system has GPS satellites orbiting the earth at an altitude of approximately 21,000 km {13,000 miles}.
- There are at least five satellites over any point 24 hours a day.
- The navigation unit receives radio signals from these satellites and determines a vehicle's position.

GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OPERATION

CHU092066902S07

Principles of Measurement

- A vehicle's present position is defined as X_0, Y_0, and Z_0, with the center of the earth being the point of reference. A GPS satellite sends its position (X_1, Y_1, and Z_1) and time T_1 when it sends the signal.



CHU0920S110

- The difference between time T_0 when the GPS antenna receives the signal and time T_1 when the GPS satellite sends the signal is used to estimate distance between the vehicle and the satellite and is represented by the following formula:
  $\{C (T_0 - T_1)\}^2 = (X_1 - X_0)^2 + (Y_1 - Y_0)^2 + (Z_1 - Z_0)^2$ C: the speed of light
- The above formula represents a synchronized navigation unit clock with a GPS satellite clock. However, in fact there is a difference of time T_2 between the GPS satellite and navigation unit clocks. The following formula represents the relationship of time T_2:
  $\{C (T_0 - T_1 + T_2)\}^2 = (X_1 - X_0)^2 + (Y_1 - Y_0)^2 + (Z_1 - Z_0)^2$ C: the speed of light
- Four GPS satellite signals producing four of the above formula are required to compute the vehicle's exact position (X_0, Y_0, and Z_0).
- 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.

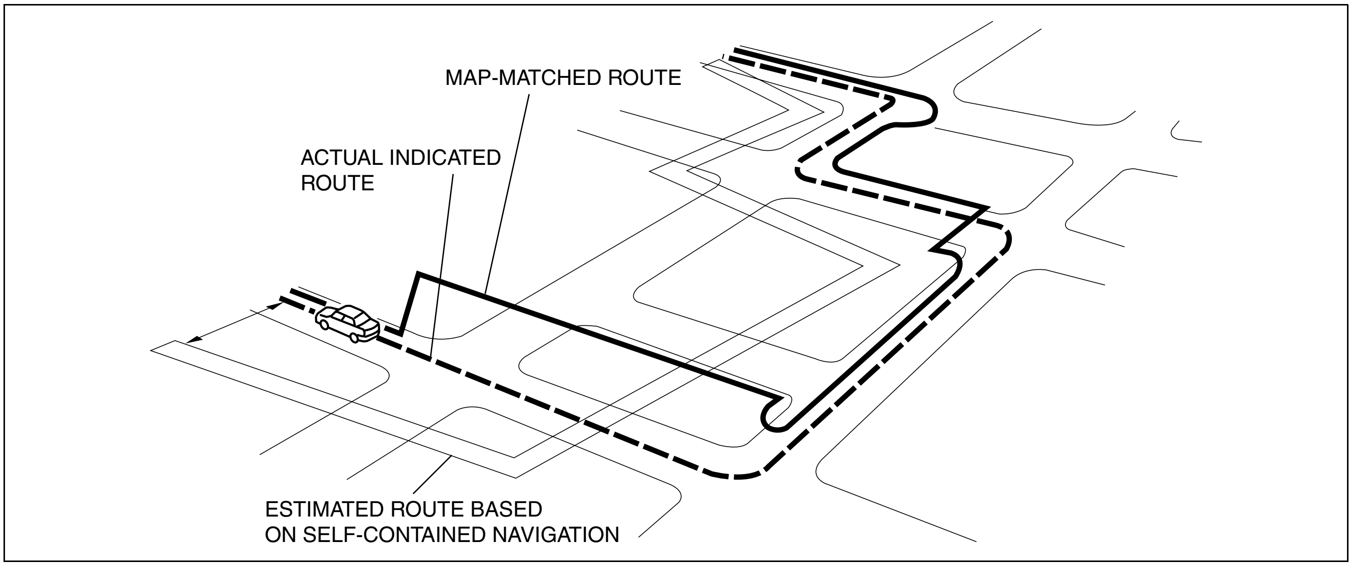
Note

- 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 direction.
- 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 position when the vehicle is not moving.
- Because two-dimensional positioning uses the altitude calculated in three-dimensional positioning, accuracy of positioning may be lowered if the altitude changes.
- There can be as much as a 100-m {328 ft} +/- 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

CHU092066902S08

- 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.



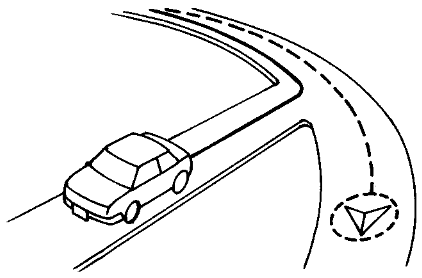
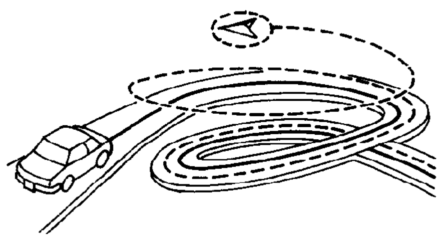
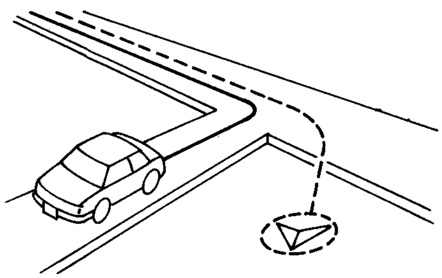
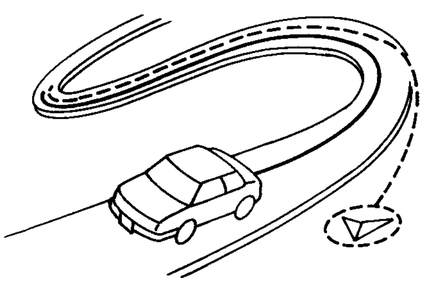
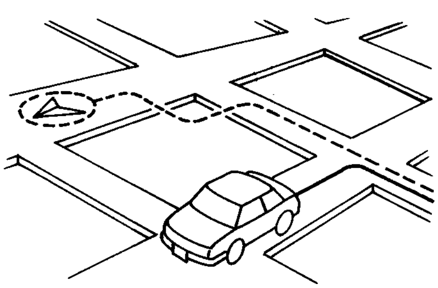
CHU0920S111

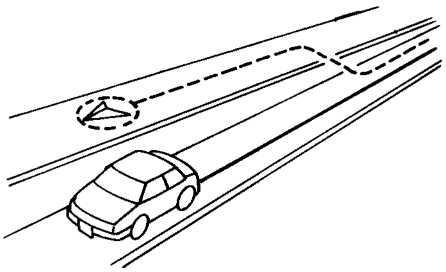
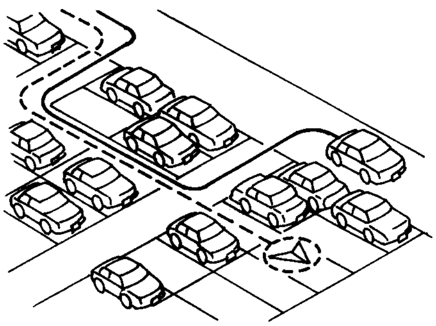
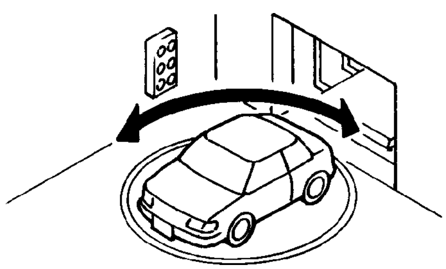
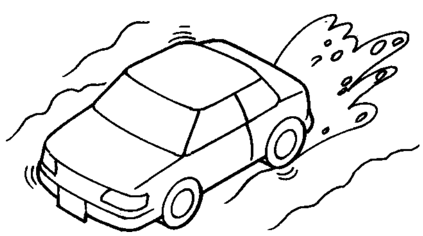
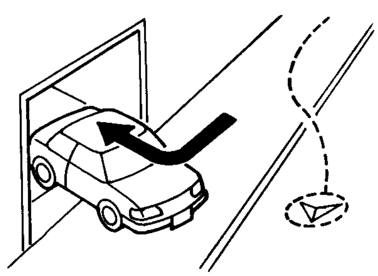
MAP MATCHING OPERATION

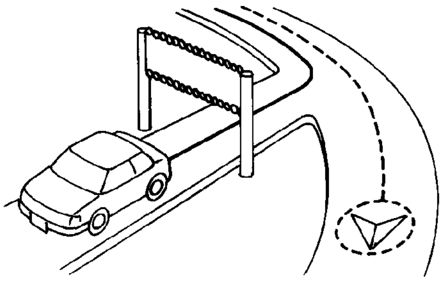
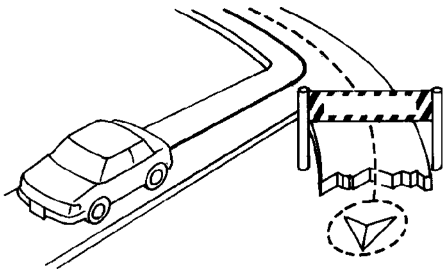
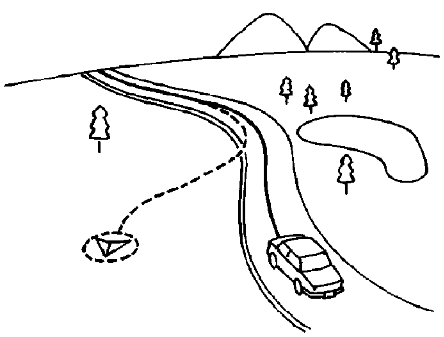
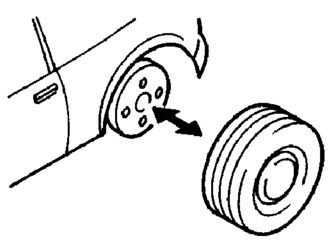
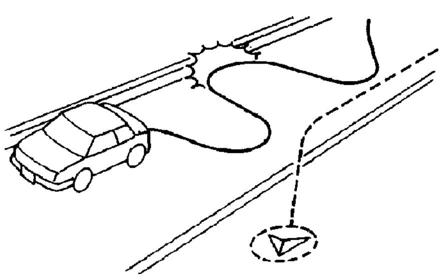
CHU092066902S09

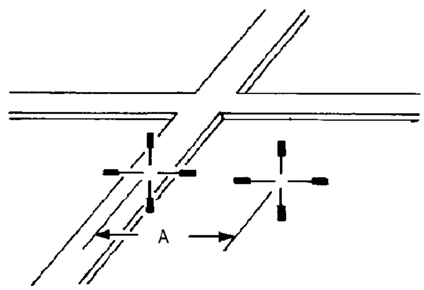
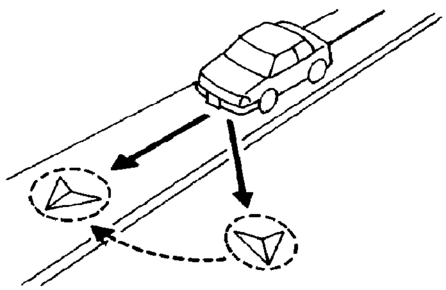
Map Matching Remarks

- 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 five to fifteen minutes until the current position is measured**. Also, even during normal use, it may take about two to three minutes for measurement.
- 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.
- When the route can not be calculated, manually shift the vehicle locator mark to a major road near the destination and recalculate. Also, in certain map data situations, the distance to the destination calculation may be different.
- 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	Remarks (Solution etc.)
	• 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.	• If the vehicle locator mark does not return to the correct position within approx. 10 km {6.2 mile} of driving, move the vehicle's position manually.
	• On a zigzag road, the vehicle locator mark may go off the road.	
	• If the roads form a grid, the vehicle locator mark may go off the road.	

Cause (Condition)	Driving condition	Remarks (Solution etc.)
	• 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.	• If the vehicle locator mark does not return to the correct position within approx. 10 km {6.2 mile} of driving, move the vehicle's position manually.
	• On slippery roads; for example, snow and ice-covered roads, wet roads, gravel roads, the vehicle locator mark may deviate from the correct road.	
	• If the vehicle turns on an embankment; for example, at a parking garage entrance, on slope or banked roads, the vehicle locator mark may go off the road.	

Cause (Condition)	Driving condition	Remarks (Solution etc.)
	• 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 vehicle locator mark does not return to the correct position within approx. 10 km {6.2 mile} of driving, move the vehicle's position manually.
	• 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.	• If the distance remains incorrect even after driving for a while, execute "Calibration."
Non-stop continuous driving.	• If the vehicle moves a long distance continuously without stopping, the vehicle locator mark may go off the correct road.	• Stop for a moment and correct the vehicle's position and movement orientation.
	• If the vehicle moves erratically, for example spinning wheels, the vehicle locator mark may go off the correct road.	• If the vehicle mark does not return to the correct position within approx. 10 km {6.2 mile} of driving, move the vehicle's position manually.

Cause (Condition)	Driving condition	Remarks (Solution etc.)
	• 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.	• Input with precision (A) of approx. 1 mm {0.039 in} on the screen with a road displayed on the vehicle position movement screen. (As much as possible, correct with the detailed map scale.)
	• If the vehicle's position is moved and the vehicle direction does not match, the accuracy may drop afterwards.	• Correct with the vehicle's position and movement direction correction function.

LCD UNIT OUTLINE

CHU092066901S01

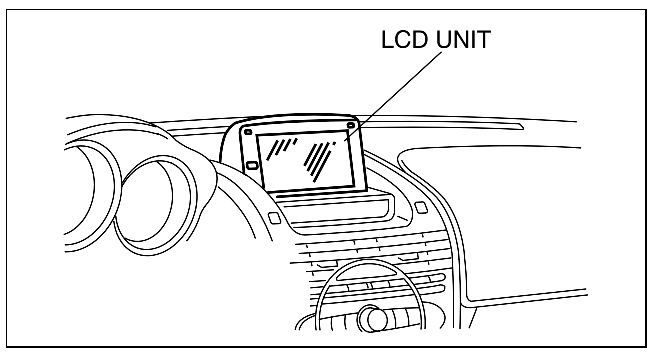
- The car-navigation system LCD unit and the information display are incorporated into one unit. Based on signals from the car-navigation unit and remote control, the LCD display navigational information. Based on signals from a specialized systems (audio and A/C) module, the LCD displays information about these systems.
- The LCD unit senses the user operations from the remote control and sends a signal to the car-navigation unit.

LCD UNIT CONSTRUCTION

CHU092066901S02

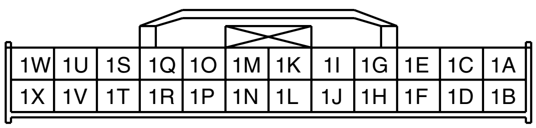
Structural View

- Located at the center of the dashboard.

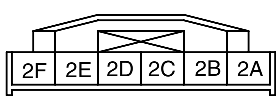


CHU0920S112

Terminal Layout and Signal



Terminal	Signal: 24-pin connector
1A	Video (B)
1B	Video (G)
1C	Video (composite sync)
1D	Video (R)
1E	Video GND
1F	Video GND
1G	Shield GND
1H	Video input
1I	Monitor serial output 1
1J	Shield GND
1K	Monitor serial output 2
1L	—
1M	Control illumination
1N	—
1O	ACC
1P	GND
1Q	B+
1R	Parking brake signal
1S	Shield GND
1T	R-range signal
1U	UART 2
1V	TNS (+)
1W	UART 1
1X	Illumination (-)



Terminal	Signal: 6-pin connector
2A	B+
2B	GND
2C	TNS (+)
2D	—
2E	Remote data
2F	Shield GND

09–20

CAR-NAVIGATION CONTROL SWITCH OUTLINE

CHU092066921S01

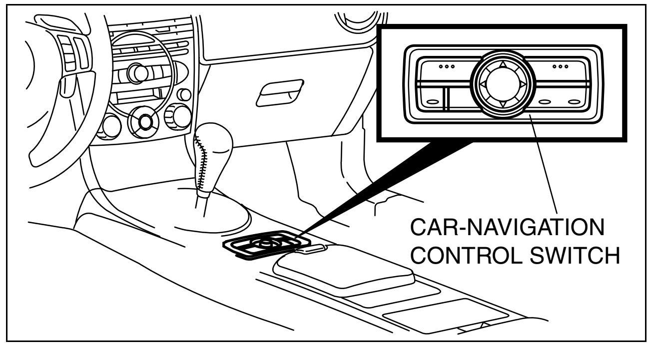
- A remote control for the car-navigation system, with simplified design for easy operation, has been adopted.

CAR-NAVIGATION CONTROL SWITCH CONSTRUCTION/OPERATION

CHU092066921S02

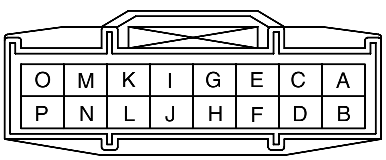
Construction

- The car-navigation control switch is located on the console.

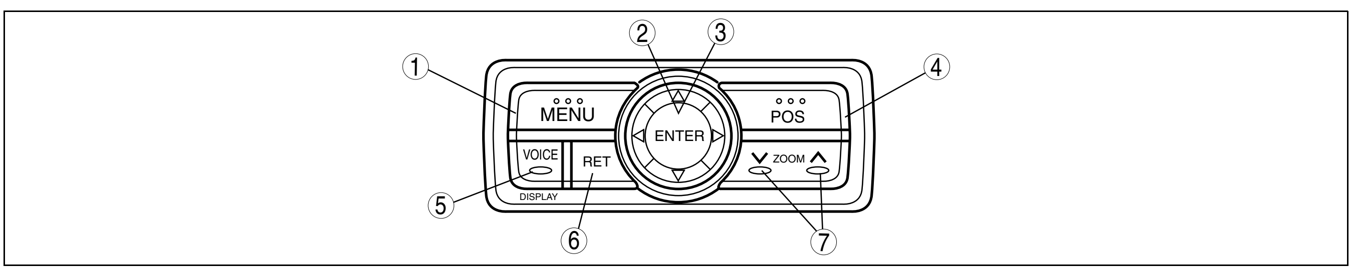


CHU0920S114

Terminal layout and signal

Terminal		Signal
	A	—
	B	—
	C	—
	D	—
	E	—
	F	—
	G	B+
	H	GND
	I	TNS (+)
	J	—
	K	Remote data
	L	Shield GND
	M	—
	N	—
	O	—
	P	—

Operation



CHU0920S115

No.	Button (component)	Function
1	[MENU] button	Select a menu.
2	Joystick	Selects items by tilting it up, down, right and left.
3	[ENTER] button	Executes a selected item.
4	[POS (Position)] button	Displays the current position.

No.	Button (component)	Function
5	[VOICE] button	Initiates vocal guidance for route maneuvers.
6	[RET] button	Returns to the previous screen.
7	[ZOOM] button	Changes the map scale.

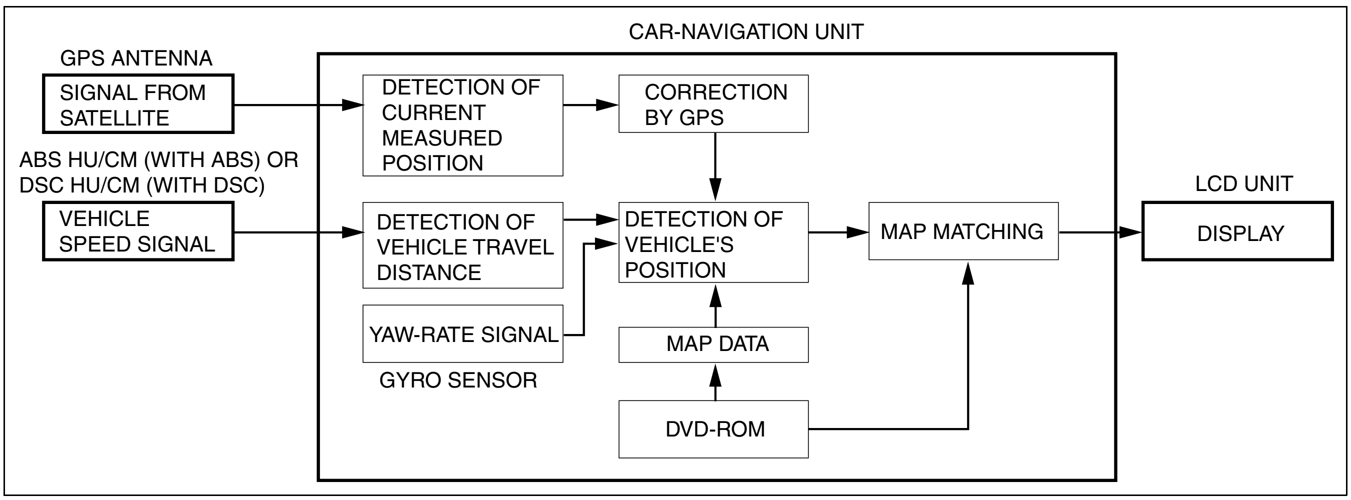
NAVIGATION FUNCTION

CHU092066000S06

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 DSC HU/CM (with DSC) or ABS HU/CM (with ABS) 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, intersection, POI (Point of Interest), history, memory or map.
  — Route information is available in map and guide mode.
  — Voice guidance and menus are available in six languages.
  — A map screen that displays maps in twelve steps with scales from 100 m to 500 km {1/20 to 250 mile}.
  — A map screen that displays routes according to Shortest Route and Avoid Motorway functions.
  — A detour function which provides three routes to select from based on streets selected to avoid, up to five via points and calculation of set detour distance.
  — A wide variety of preferential settings are available.

Block Diagram

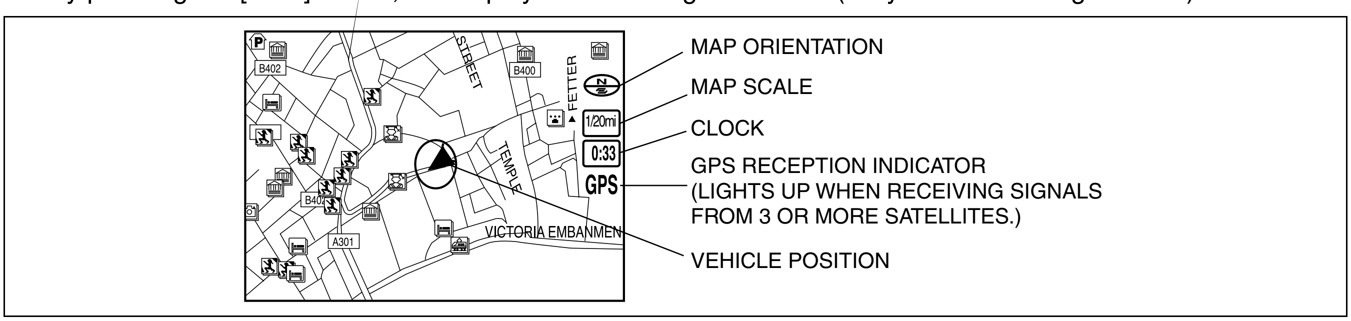


CHU0920S116

Map Screen Selection

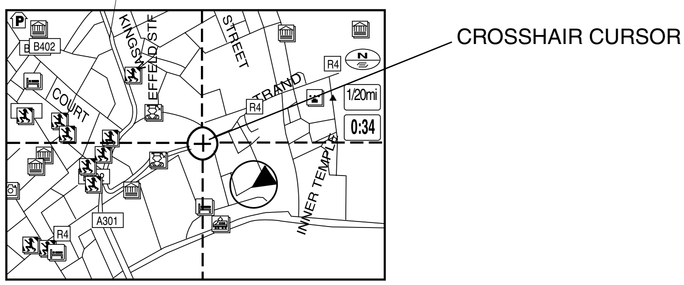
Current position map

- The location of the vehicle and surrounding area are shown.
- By pressing the [POS] button, the display switches to guide mode. (Only while in route guidance.)



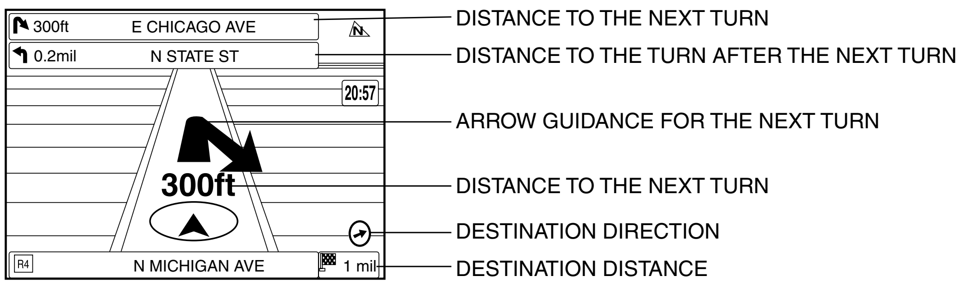
CHU0920S117

Scroll map mode
- The scroll map is displayed when operating the joystick on the current position map.
- This map can be scrolled with the crosshair cursor.
- By moving the crosshair cursor to a road and pressing [ENTER] button, the road name is displayed on the screen.



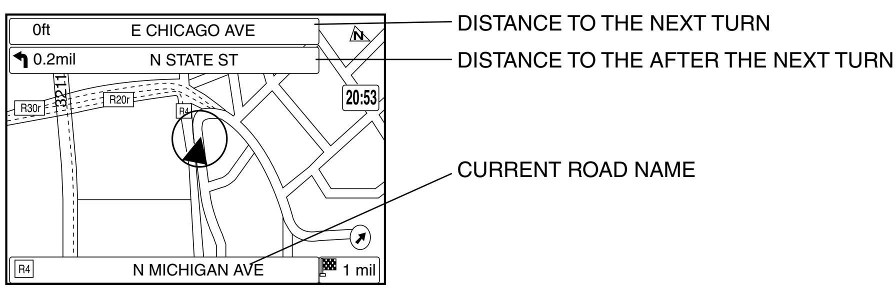
CHU0920S118

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)
- By pressing the [POS] button, the display switches to the current position map.



CHU0920S119

Intersection zoom map
- An enlarged map is displayed when approaching a roundabout or intersection. (While in route guidance.) Activated by selecting Zoom (On) in setup mode.



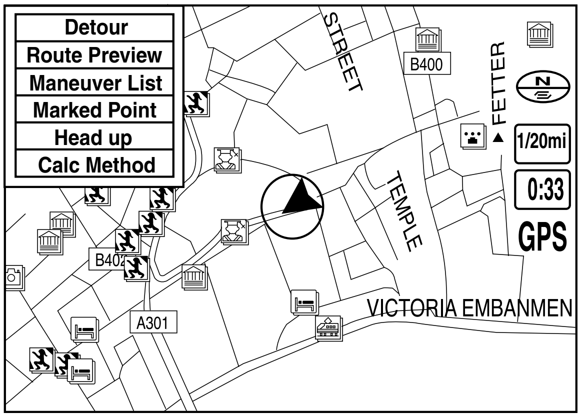
CHU0920S120

Pop-up Menu

- Pop-up menu appears when pressing [ENTER] button.
- The following items are displayed on the pop-up menu. The actual displayed items vary according to the selected map, guidance, and other factors.

Note

- Pop-up menu is not available on intersection zoom maps.
- Pop-up menu cannot be displayed when the intersection zoom map is displayed.



CHU0920S131

No.	Contents	Description
1	Detour	Displays route change options. (See 09–20–34 Detour function.)
2	Route Preview	Displays complete route preview.
3	Maneuver List	Displays a route list.
4	Marked Point	Registers a point indicated by the crosshair cursor.
5	North up/Head up	Selects either north up or head up map display direction.
6	Stop Calc	Cancels route search.
7	Reroute	Searches for another route to return to the original route when the vehicle has moved away from it. (Appears only when the auto reroute function is inactivated. See 09–20–34 Setup Function.)
8	Calc Method	Changes route search settings. (See 09–20–34 Whole route search function.)
9	Volume	Adjusts volume of voice guidance.
10	Guidance Off	Selects/cancels voice guidance.
11	Destination	Registers a point indicated by the crosshair cursor as a destination.
12	Nearest POI	Searches for POI’s close to current location of the vehicle.

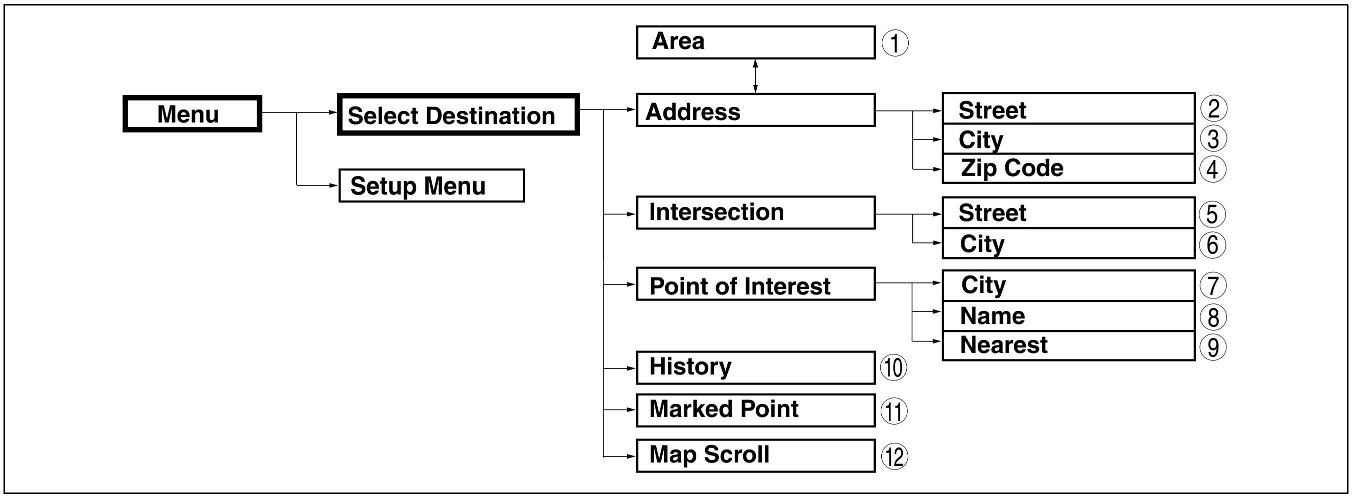
Destination Setting Function

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.



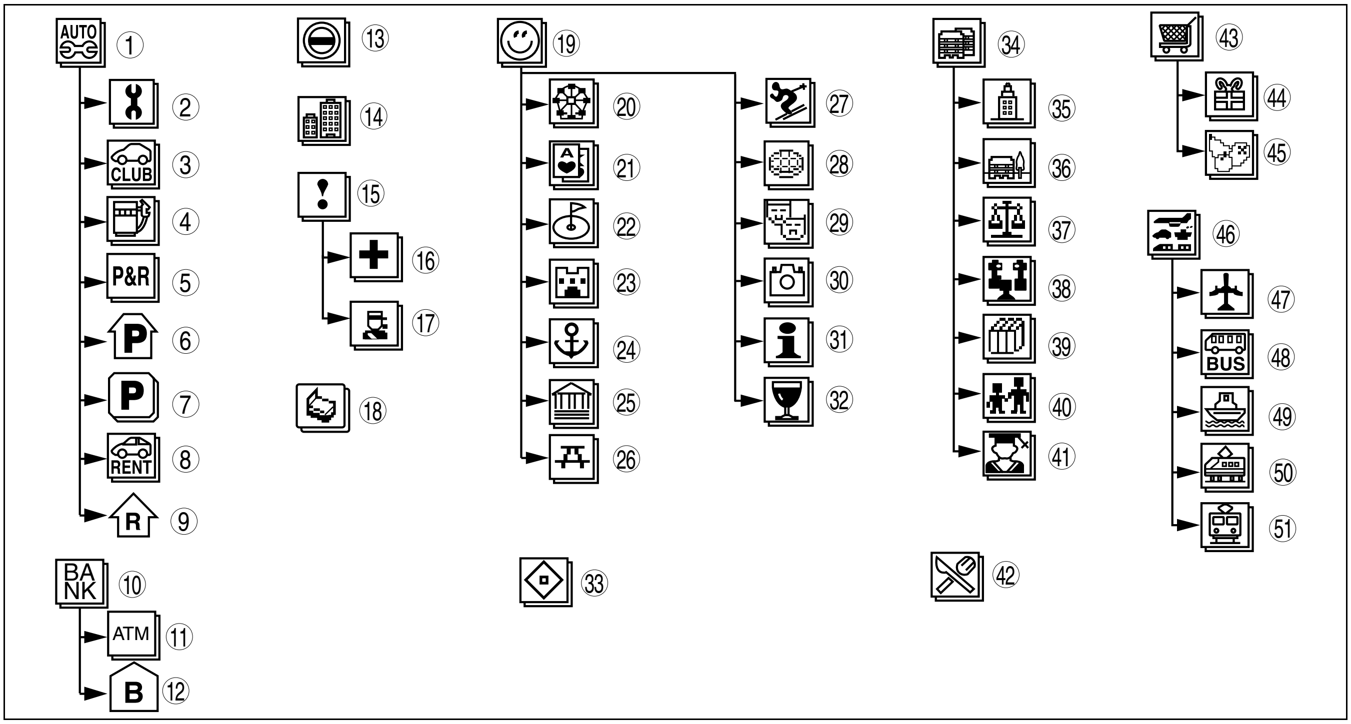
CHU0920S132

No.	Contents
1	Changes area set from the previous destination.
2	Sets destination by selecting city name*, inputting street name and selecting house number.
3	Sets destination by inputting city name*, inputting street name and selecting house number.
4	Sets destination by inputting zip code and street name, and selecting house number.
5	Sets intersection as destination by inputting main street name → cross street names.
6	Sets intersection as destination by inputting city name → main street name → cross street names.
7	Sets destination by selecting POI category, inputting city name and selecting POI.
8	Sets destination by selecting POI category, inputting target name and selecting POI.
9	Sets destination from a list of 20 POI destinations closest to the current position (within a radius of 50 km {30 mile}) by inputting POI category and selecting POI.
10	Sets destination from a list of recent destinations. Up to 50 points including the latest starting point are in the system memory.
11	Sets destination from a list of points stored by the user. Up to 100 points can be stored in the memory.
12	Sets destination by moving the crosshair cursor to the destination when in scroll map mode.

* : Memory stores up to 10 cities visited recently, and city names can be selected.

POI categories

- When setting POI destination, the following categories can be selected. Data for categories according to the selected country will be displayed.



CHU0920S128

1	Auto services
2	Auto repair
3	Automobile association
4	Gas station
5	Park & Ride
6	Parking garage
7	Parking lot
8	Rent al car facility
9	Rest area
10	Banking
11	ATM
12	Bank
13	Border crossing
14	Business facility
15	Emergency
16	Hospital
17	Police station
18	Hotel or motel
19	Leisure/Recreation
20	Amusement park
21	Casino
22	Golf course
23	Historical monument
24	Marina
25	Museum
26	Parking and recreation

27	Ski resort
28	Stadium/arena
29	Theater
30	Tourist attraction
31	Tourist information
32	Winery
33	Named place
34	Public facility
35	City hall
36	Community center
37	Court house
38	Exhibition or conference center
39	Library
40	School
41	University or college
42	Restaurant
43	Shopping
44	Shopping center
45	Grocery store
46	Transportation
47	Airport
48	Bus station
49	Ferry terminal
50	Light rail station
51	Train station

Route Search Function

Whole route search function

- After setting a destination, the following route search methods can be used:

No.	Items	Route search method
1	Shortest route setting	• Selects a route according to the shortest distance.
2	Avoid motorway setting	• Selects a route that reduces use of motorways.

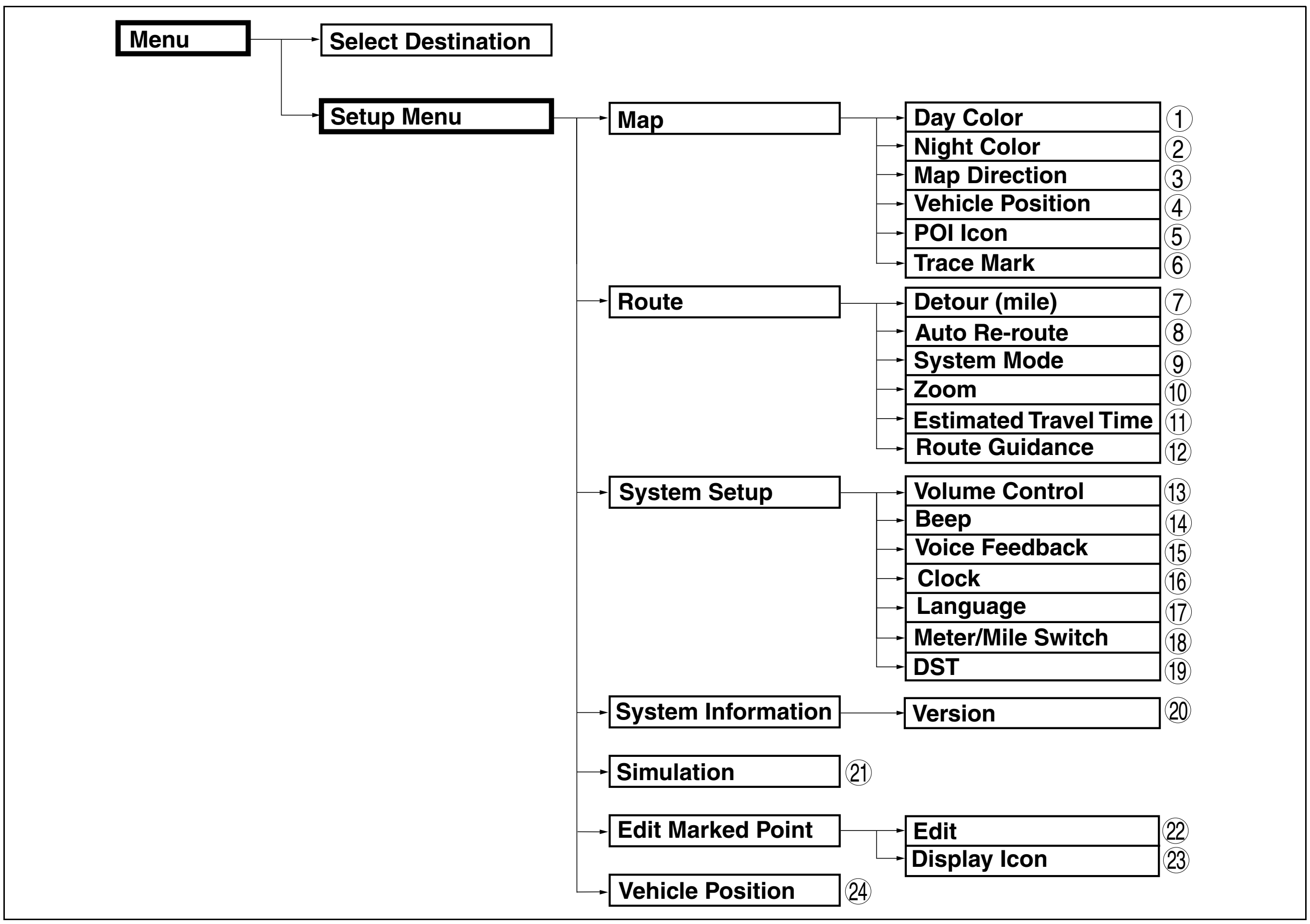
Detour function

- The following settings are available when using the detour function:

No.	Items	Contents
1	Alt route setting	• Searches for a maximum of three routes.
2	Detour distance (xx km {xx mile}) setting	• Calculates a detour for the current route based on inputted (xx km {xx mile}) detour distance. • Detour distance (xx km {xx mile}) is designated in setup (route).
3	Avoid streets setting	• Calculates a detour for the current route to avoid user selected streets.
4	Via point setting	• Selects via points. • Up to five points can be set.

Setup Function

- Map, route and system settings can be changed using this function. Also, system information and route simulation can be displayed.



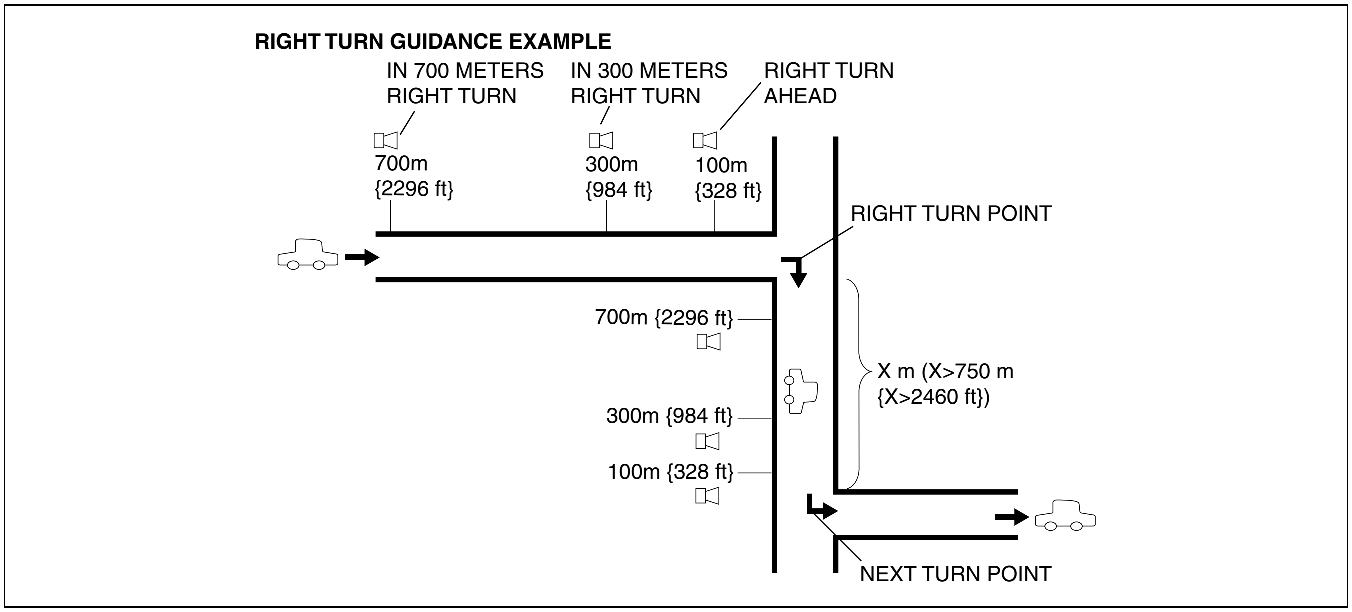
No.	Contents	Selected items	Default
1	Sets map screen color (daytime).	Green, Beige, Black	Beige
2	Sets map screen color (nighttime).	Green, Beige, Black	Beige
3	Sets map direction.	North up, Head up	North up
4	Sets display of the vehicle position indicator on the map screen.	Center: The current vehicle position indicator is displayed in the center of the screen. Off Ctr: The current vehicle position indicator is displayed at the bottom of the screen.	Center
5	Selects/cancels display of the POI icons on the map screen.	On (Icons displayed), Off (Icons not displayed)	On
6	Selects/cancels display of the traced route mark on the map screen.	On (Mark displayed), Off (Mark not displayed)	Off
7	Sets the detour distance for the detour xx km {xx mile} function. If mile are selected in the meter/mile setting, then the distance will be in miles.	1, 2, 5, 10, 20	5
8	Selects/cancels automatic activation of auto re-route function.	On (Automatically activated), Off (Not automatically activated)	On
9	Selects map mode/guide map mode after start-up and route calculation. Guide map mode is displayed only while vehicle is on set route.	Map (Map screen), Guide (Guide mode)	Map
10	Selects/cancels automatic display of intersection zoom map.	On (Automatically displayed), Off (Not automatically displayed)	On
11	Selects/cancels voice guidance announcement of estimated travel time.	On (Makes announcement), Off (No announcement)	On
12	Selects/cancels route guidance. The route will not be deleted if route guidance is disabled.	On (Route guidance enabled), Off (Route guidance disabled)	On
13	Adjusts volume for voice guidance.	0, 1, 2, 3, 4,	2
14	Selects/cancels beeping sound when pressing buttons.	On (Emits beep), Off (No beep)	On
15	Selects/cancels voice guidance.	On (Voice guidance enabled), Off (Voice guidance disabled)	On
16	Selects/cancels display of the clock.	On (Displayed), Off (Not displayed)	Off
17	Sets language used.	English, French	English
18	Sets unit of measurement used.	Metric (Meters), English (Miles)	Metric
19	Selects/cancels daylight saving time mode.	On (enabled), Off (Disabled)	On
20	Displays map disc and software version/information.	–	–
21	Performs a simulation of a route, after Route setup, from starting point to destination.	–	–
22	Displays detailed information about a marked point from the stored list. The icon and name can be changed, or the marked point can be deleted.	–	–
23	Selects/cancels display of icons on the map.	On (Icons displayed), Off (Icons not displayed)	On
24	Adjusts position and direction of the vehicle on the map display.	–	–

Guidance Function

- When using route guidance, the map displays and the system voice announces upcoming intersections, highway entrances/ exits, destination information, and passing via points.
- The types of voice guidance are as follows:
  — Normal intersection guidance
  — Roundabout guidance
  — Highway entrance guidance
  — Destination guidance
  — Via point guidance.
  — Highway exit guidance

Simple junction guidance

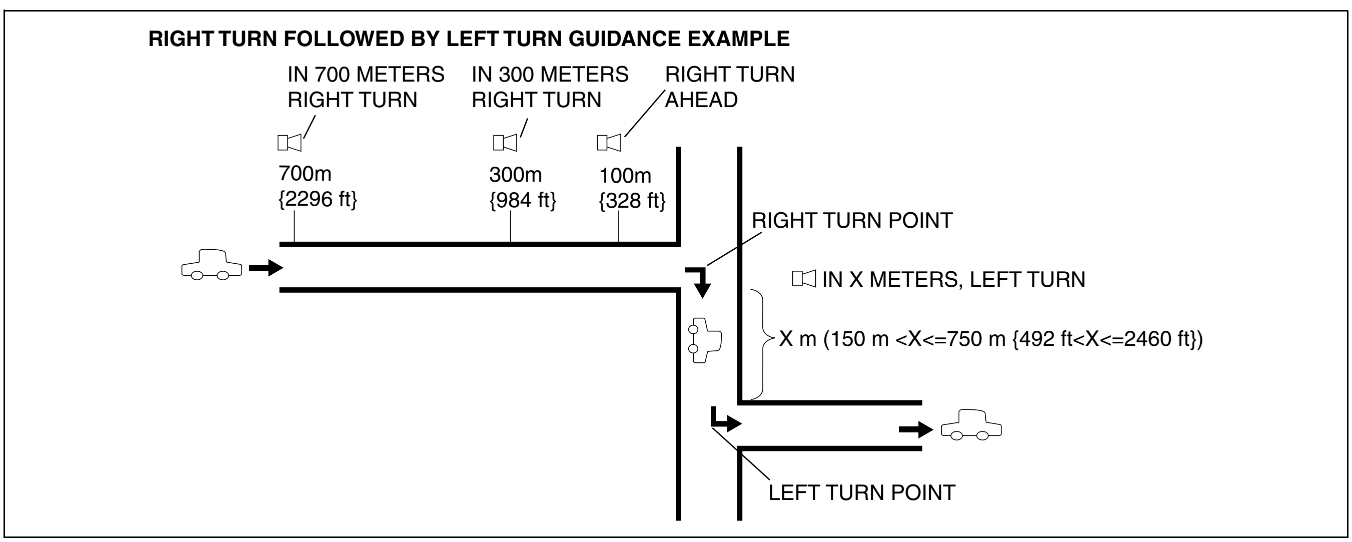
- The following voice guidance is provided:



CHU0920S121

Continuous junction guidance

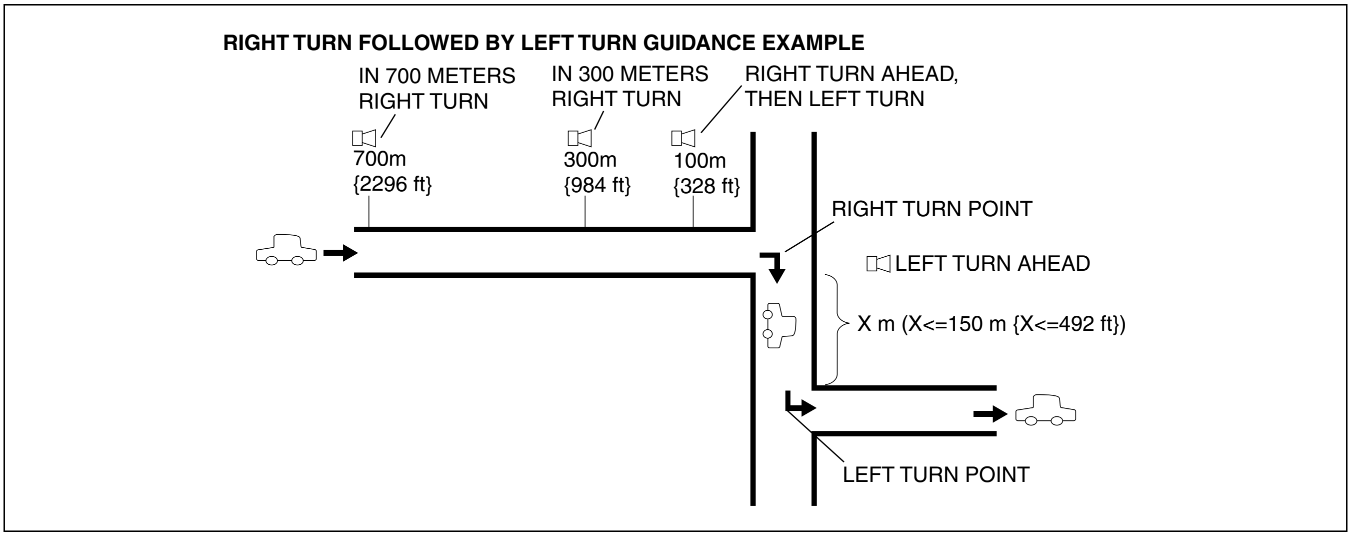
- A continuous junction condition occurs when the distance from the first to the second turn point is more than 150 meters {492 feet} and less than or equal to 750 meters {2460 feet}.
- After passing the first turn point, the next voice guidance is provided.



CHU0920S122

Multiple junction guidance

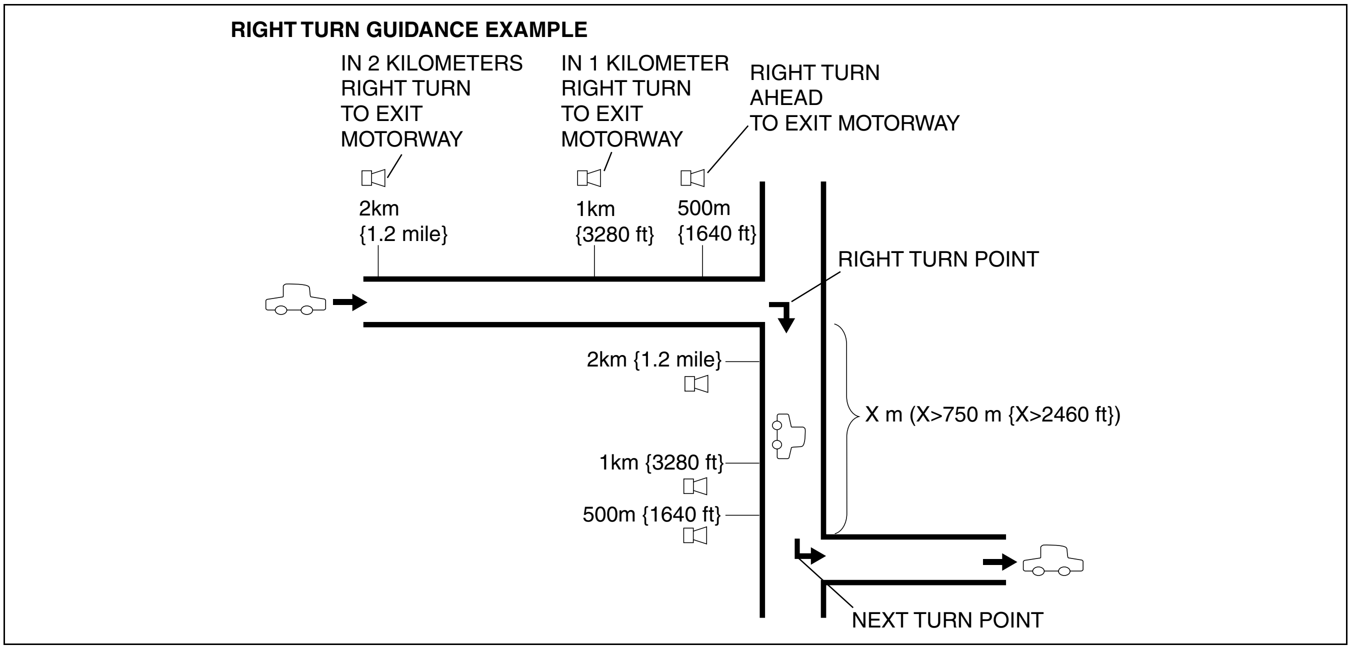
- A multiple junction condition occurs when the distance from the first to the second turn point is less than or equal to 150 meters {492 feet}.
- When the last guidance for the first turn point is announced, guidance for the second turn point is also provided.



CHU0920S123

Simple highway junction guidance

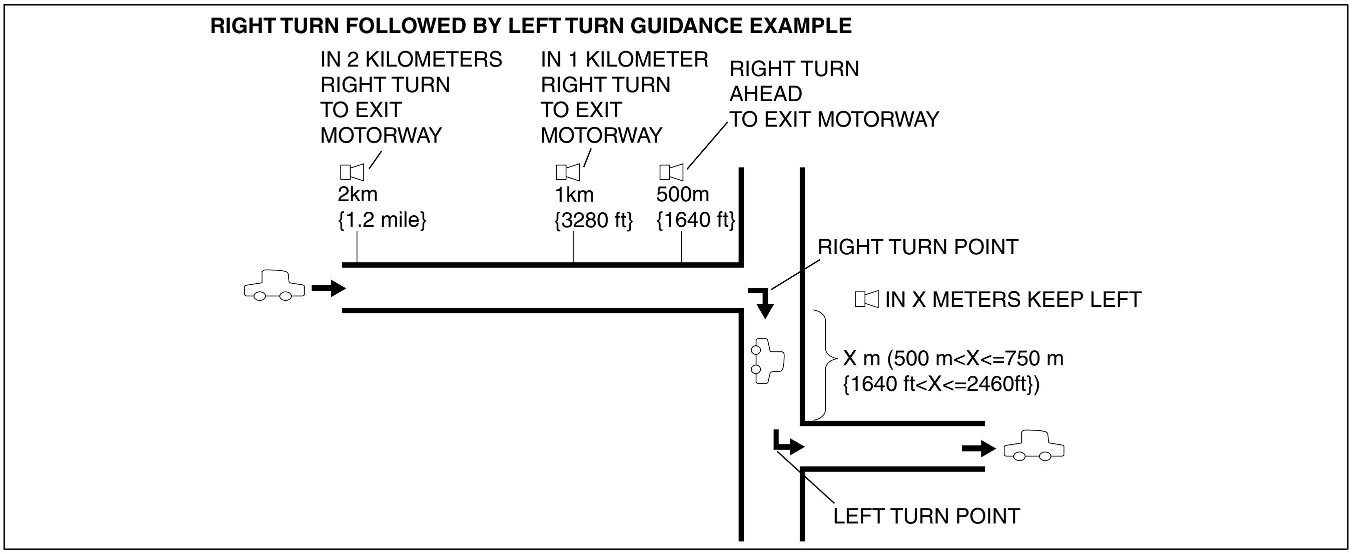
- The following guidance is provided:



CHU0920S124

Continuous highway junction guidance

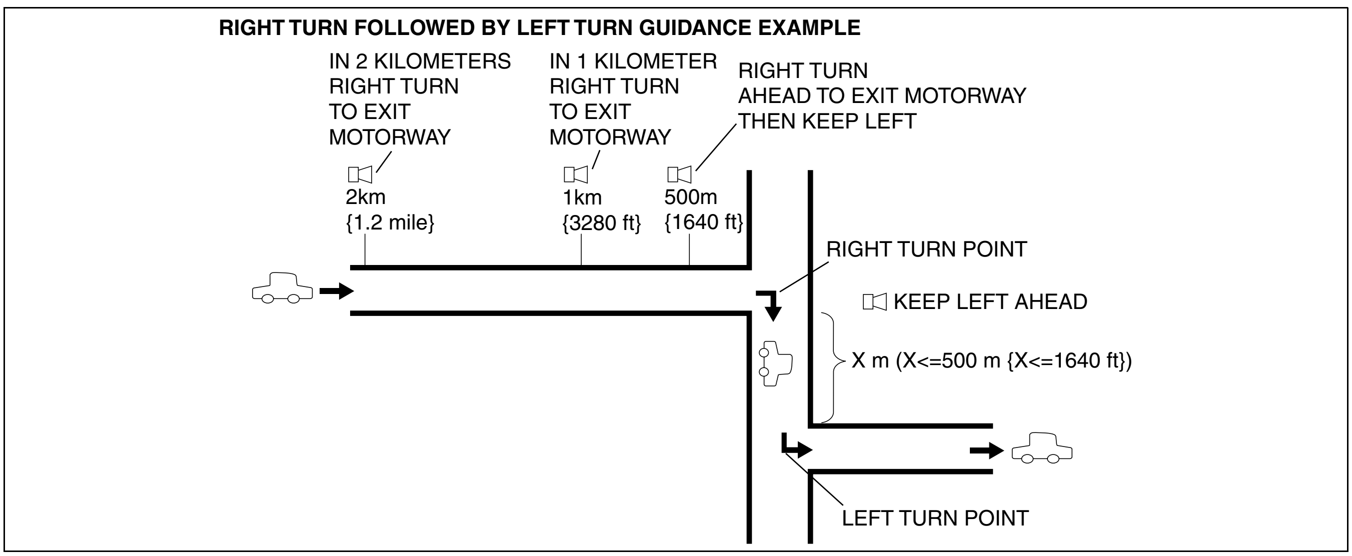
- A continuous highway junction condition occurs when the distance from the first to the second turn point is more than 500 meters {1640 feet} and less than or equal to 750 meters {2460 feet}.
- After passing the first turn point, the next voice guidance is provided.



CHU0920S125

Multiple highway junction guidance

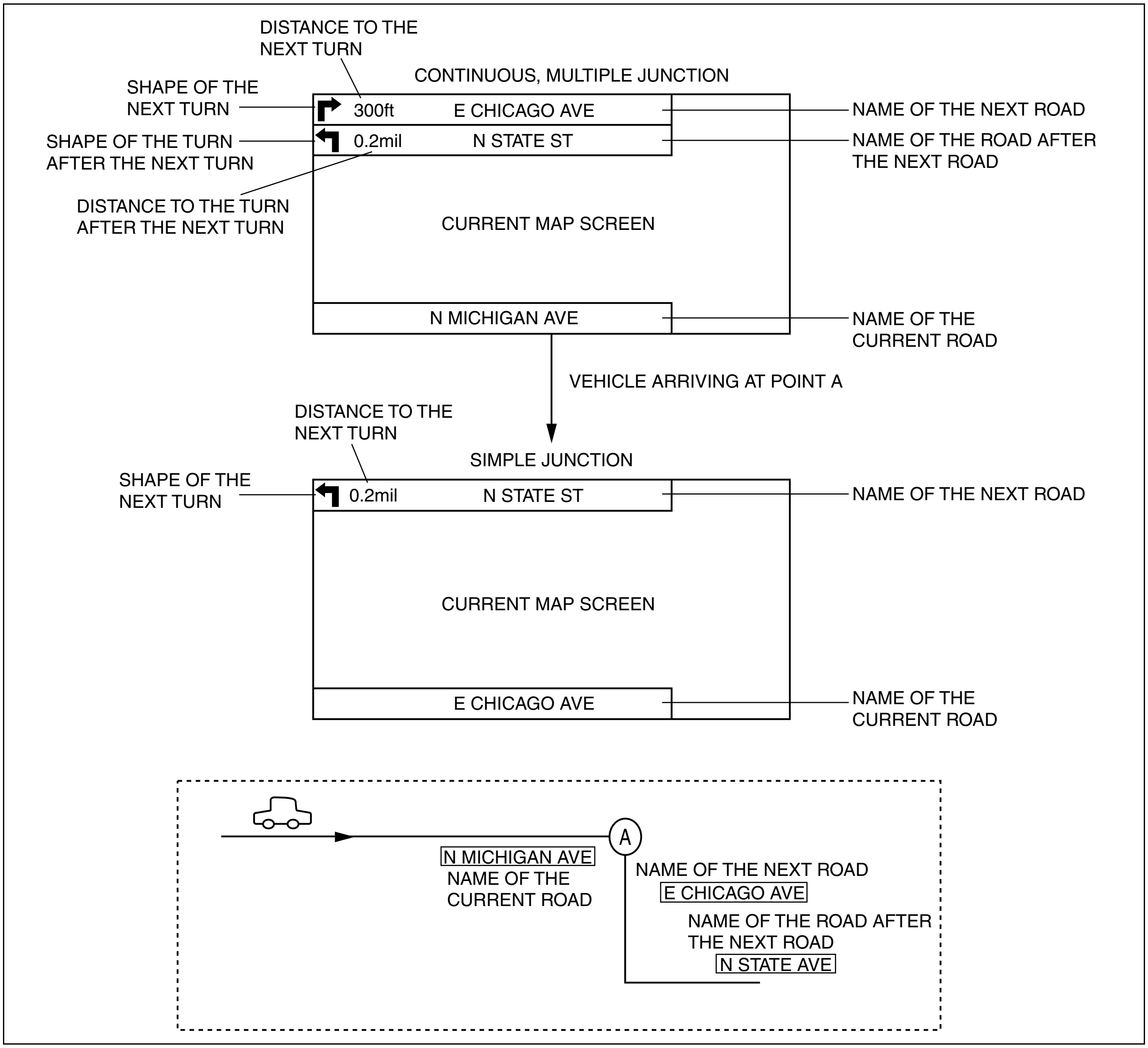
- A multiple highway junction condition occurs when the distance from the first to the second turn point is less than or equal to 500 meters {1640 feet}.
- When the last guidance for the first turn point is announced, guidance for the second turn point is also provided.



CHU0920S126

Intersection Distance Display

- When approaching the next guidance point, the distance to that point is counted down.
- In case of a continuous or multiple junction, guidance point bars for the next two turns will be displayed.
- In case of a continuous or multiple junction, after the first turn point is passed the following occurs:
  1. Next turn guidance point bar → Current road
  2. Turn after next turn guidance point bar → Next turn guidance point bar

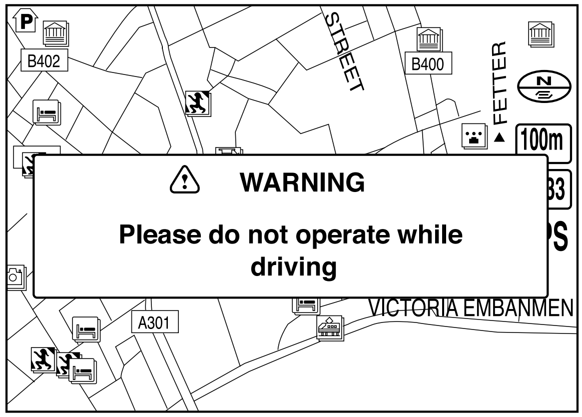


CHU0920S127

Operation While Driving Display Function

Screen activation

- The following operation while driving warning screen appears when the unit determines from the pulse of the speedometer sensor that the vehicle is moving.



A6E8126T076

Activation condition

- When driving and the following screens are displayed, operating the following buttons will activate the warning screen.

No.	Items		Screen contents/Cursor position	Indicated buttons
1	Menu screen		Menu screen, destination setting screen, set up screen	[Joystick], [ENTER], [ZOOM], [MENU]
2	Current position map screen, scroll map screen	No pop-up	–	[Joystick], [MENU]
		Pop-up	Detour, Destination, Nearest POI	[ENTER], [MENU]
			Route Preview, Maneuver List, Marked Point, Head up/North up, Calc Method, Reroute, Volume, Guidance Off	[MENU]
3	Guide mode map screen	No pop-up	–	[MENU]
		Pop-up	Detour	[ENTER], [MENU]
			Route Preview, Maneuver List, Marked Point, Calc Method, Reroute, Volume, Guidance Off	[MENU]
4	Intersection zoom map		–	[MENU]

09–21 POWER SYSTEMS

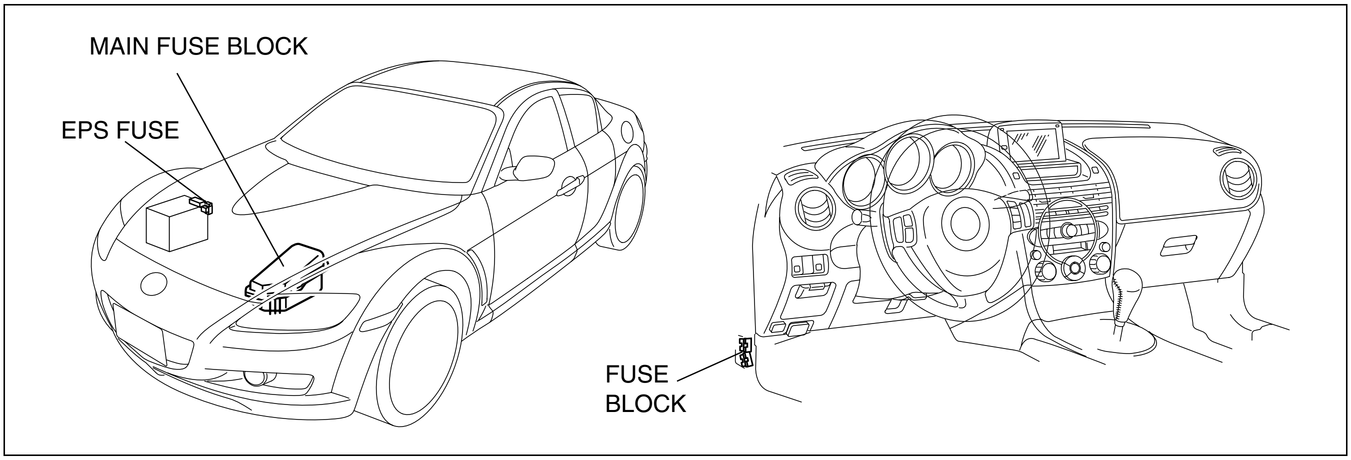
POWER SYSTEMS OUTLINE

CHU092167730S01

- All relays and fuses are located in the main fuse block of the engine compartment and inside the front side trim, to the left of the driver's seat.

POWER SYSTEMS STRUCTURAL VIEW

CHU092167730S02



CHU0921S001

09–22 INSTRUMENTATION/DRIVER INFO.

INSTRUMENT CLUSTER OUTLINE

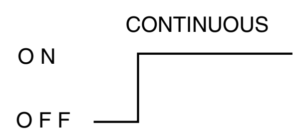
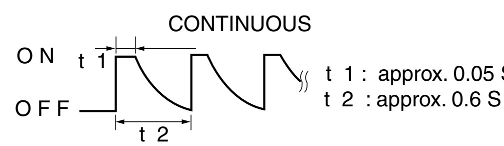
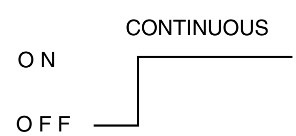
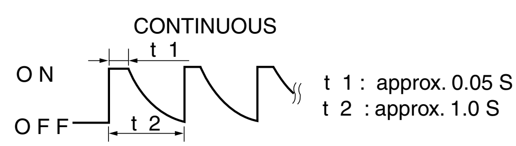
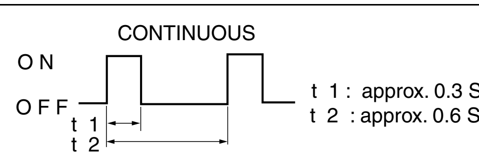
CHU092255430S01

- A 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 all warning and indicator lights installed on the instrument cluster.
- The information display, which includes clock, audio system, and A/C system displays, has been placed in the center of the instrument panel. It also includes the drive information system, depending on the vehicle grade.
- A trumpet-type horn with spiral, resonant pipes, has been adopted.

INSTRUMENT CLUSTER SPECIFICATIONS

CHU092255430S02

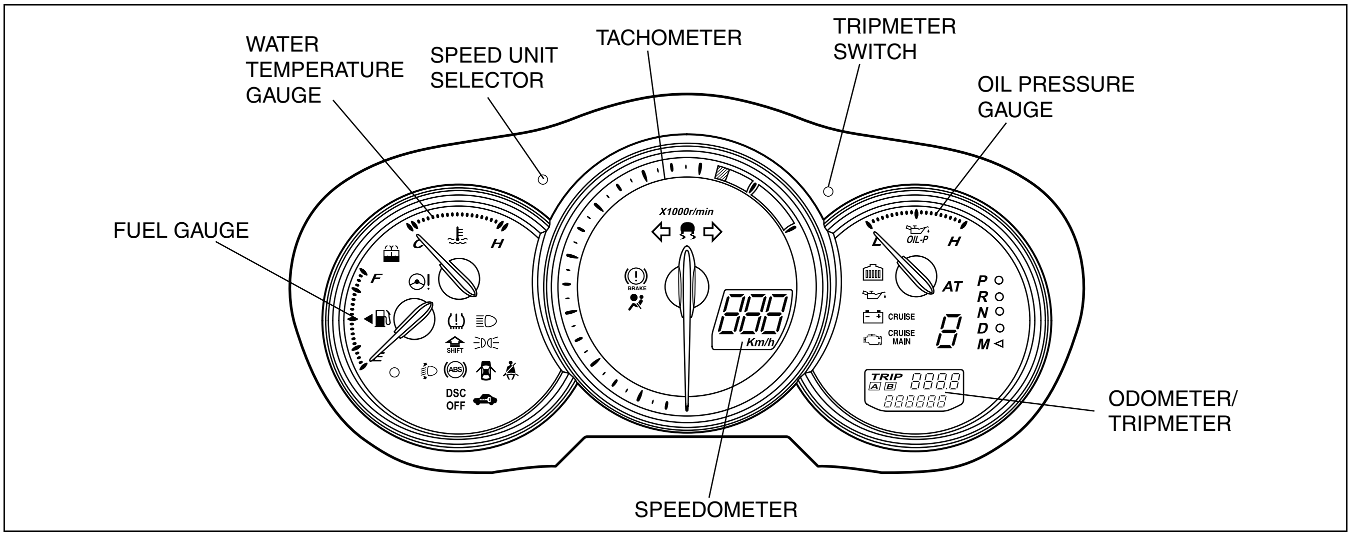
Item		Specification
Speedometer	Meter type	LCD
	Indication range (mph {km/h})	0—186 {0—299}
	Input signal communication system	CAN system
	Input signal source	ABS HU/CM (with ABS) DSC HU/CM (with DSC)
	Rated voltage (V)	DC 12

Item			Specification
Tachometer	Meter type		Stepping motor type
	Indication range (rpm)		0—9,000 (13B-MSP (Standard Power)) 0—10,000 (13B-MSP (High Power))
	Red zone (rpm)		7,500—9,000 (13B-MSP (Standard Power)) 9,000—10,000 (13B-MSP (High Power))
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage (V)		DC 12
Fuel gauge	Meter type		Stepping motor type (Reset-to-zero type)
	Input signal communication system		Conventional communication system
	Input signal source		Fuel gauge sender unit
	Rated voltage (V)		DC 12
Water temperature gauge	Meter type		Stepping motor type (Medium range stabilized type)
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage (V)		DC 12
Odometer/ Tripmeter	Display		LCD
	Indication digits		Odometer: 6 digits, Tripmeter: 4 digits
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage (V)		DC 12
WARNING ALARMS	Sound frequency (Hz)		800—1,500
	Output sound pressure level (dB)		75.0 (over-revolution warning alarm) 67.5 (except over-revolution warning alarm)
	Lights-on reminder warning alarm	Sound frequency (Hz)	1,000
		Sound cycle	
	Key reminder warning alarm	Sound frequency (Hz)	800
		Sound cycle	
	Over-revolution warning alarm	Sound frequency (Hz)	1,500
		Sound cycle	
	Seat belt warning alarm	Sound frequency (Hz)	800
		Sound cycle	
	Tire pressure warning alarm	Sound frequency (Hz)	1,500
		Sound cycle	

INSTRUMENT CLUSTER STRUCTURAL VIEW

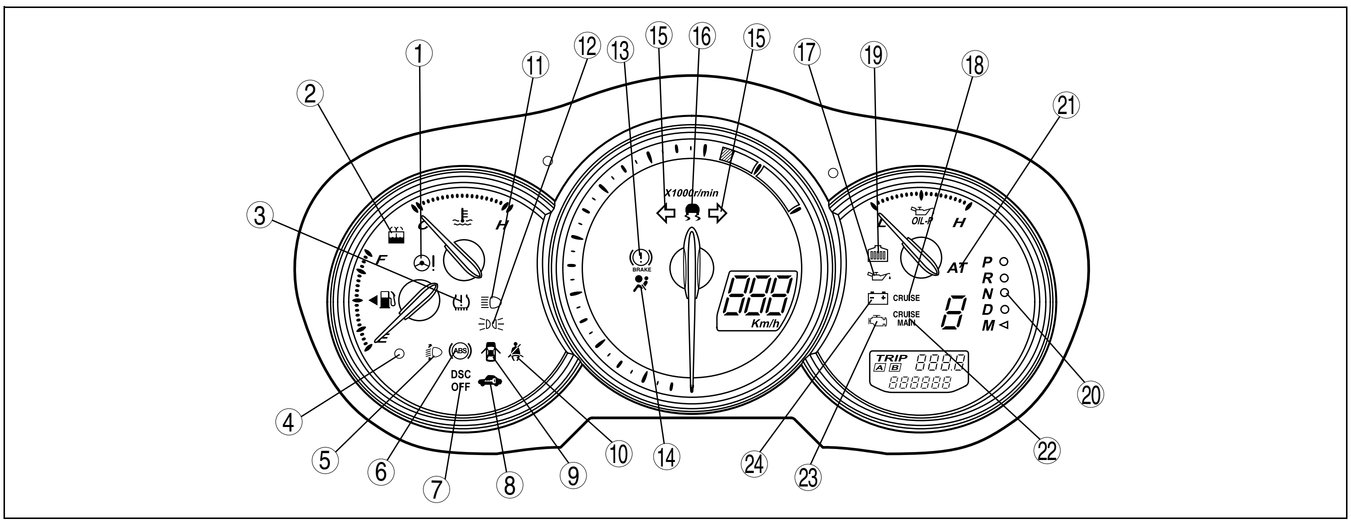
CHU092255430S03

Meter And Gauge



CHU0922S009

Warning And Indicator Light



CHU0922S001

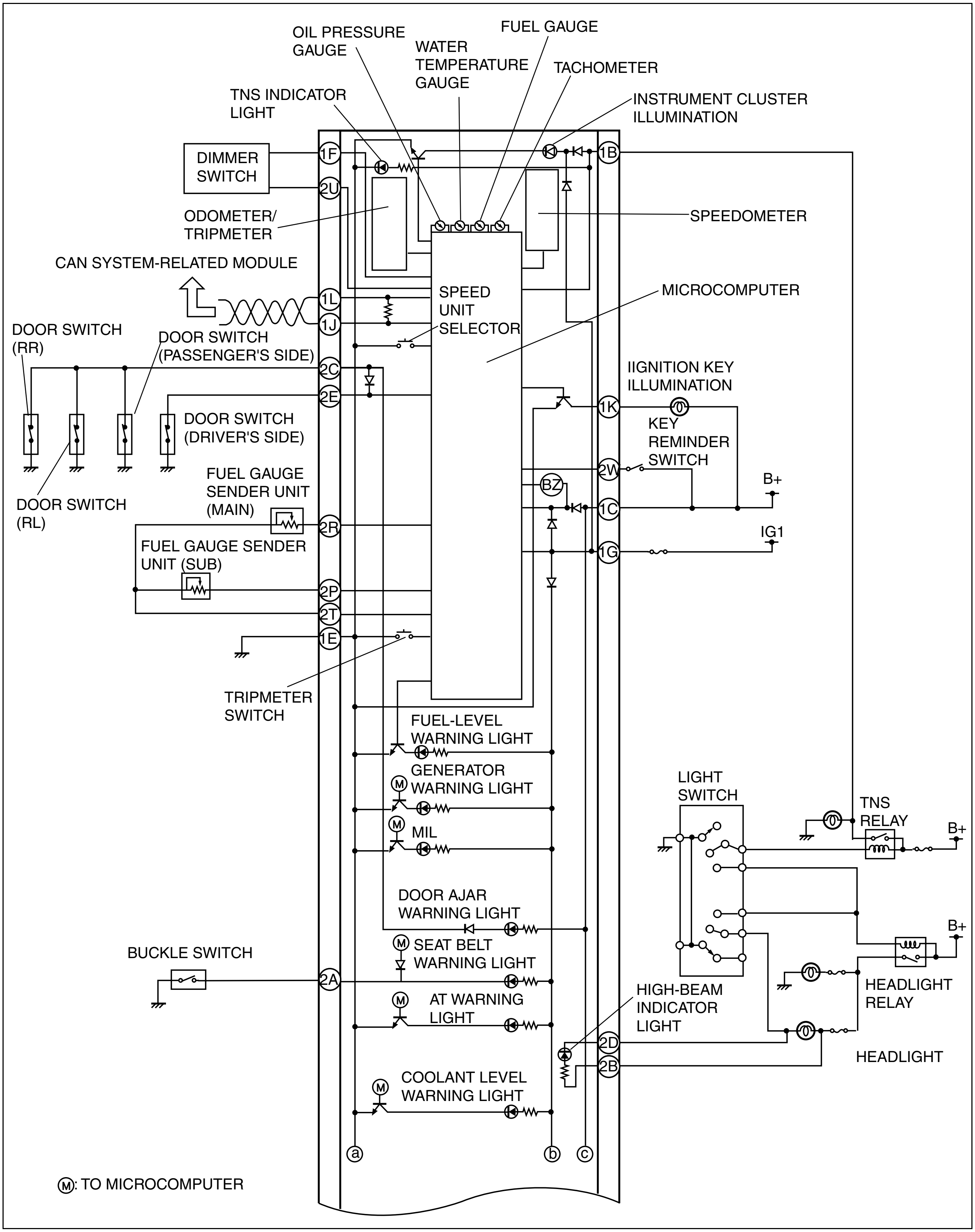
X: Applied

09–22

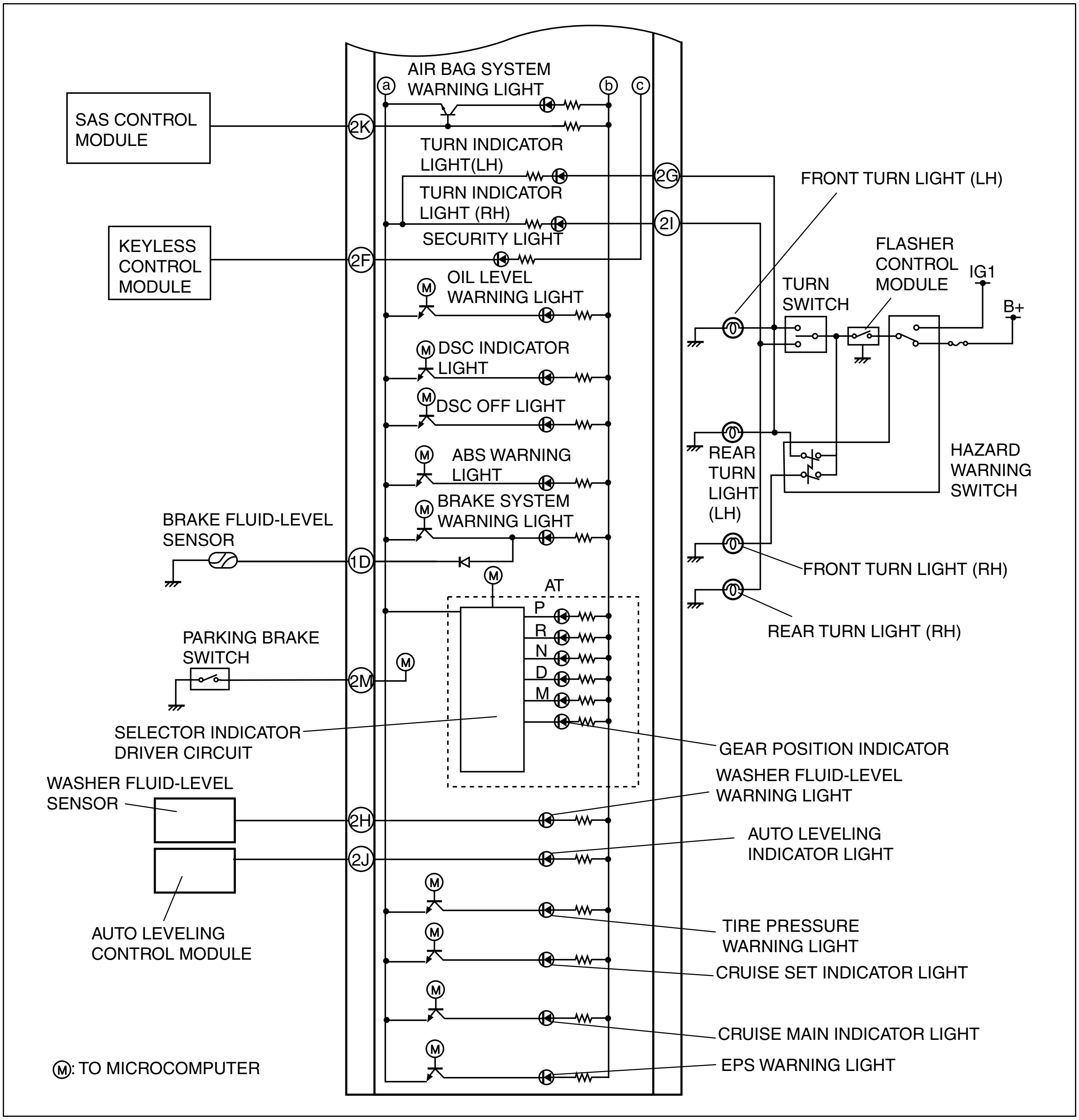
No.	Warning and indicator light	Input signal source	CAN system	Note
1	EPS warning light	EPS control module	X	—
2	Washer fluid-level warning light	Washer fluid-level sensor	—	With washer fluid-level warning system
3	Tire pressure warning light	TPMS control module	X	—
4	Fuel-level warning light	Fuel gauge sender unit	—	—
5	Headlight auto leveling warning light	Auto leveling control module	—	With discharge headlight
6	ABS warning light	ABS HU/CM	X	With ABS
7	DSC OFF light	DSC HU/CM	X	With DSC
8	Security light	Keyless control module	—	—
9	Door ajar warning light	Door switch	—	—
10	Seat belt warning light	Buckle switch	—	—
11	High-beam indicator light	Headlight switch	—	—
12	TNS indicator light	TNS relay	—	—
13	Brake system warning light	• Parking brake switch • Brake fluid level sensor	—	—
		ABS HU/CM (EBD)	X	—
14	Air bag system warning light	SAS control module	—	—
15	Turn indicator light	Turn switch	—	—
16	DSC indicator light	DSC HU/CM	X	With DSC
17	Coolant level warning light	PCM	X	—
18	Oil level warning light	PCM	X	—
19	AT warning light	TCM	X	AT
20	Cruise set indicator light	PCM	X	With cruise control system
21	Selector indicator light	TCM	X	AT
22	Cruise main indicator light	PCM	X	With cruise control system
23	MIL	PCM	X	—
24	Generator warning light	PCM	X	—

INSTRUMENT CLUSTER SYSTEM WIRING DIAGRAM

CHU092255430S04



CHU0922S002



CHU0922S003

INPUT/OUTPUT CHECK MODE OUTLINE

CHU092255430S05

- The microcomputer built into instrument cluster detects the quality of input signal or individual part.
- Input/output check mode has both input circuit check and individual part check functions.

INPUT/OUTPUT CHECK MODE OPERATION

CHU092255430S06

Operation procedure

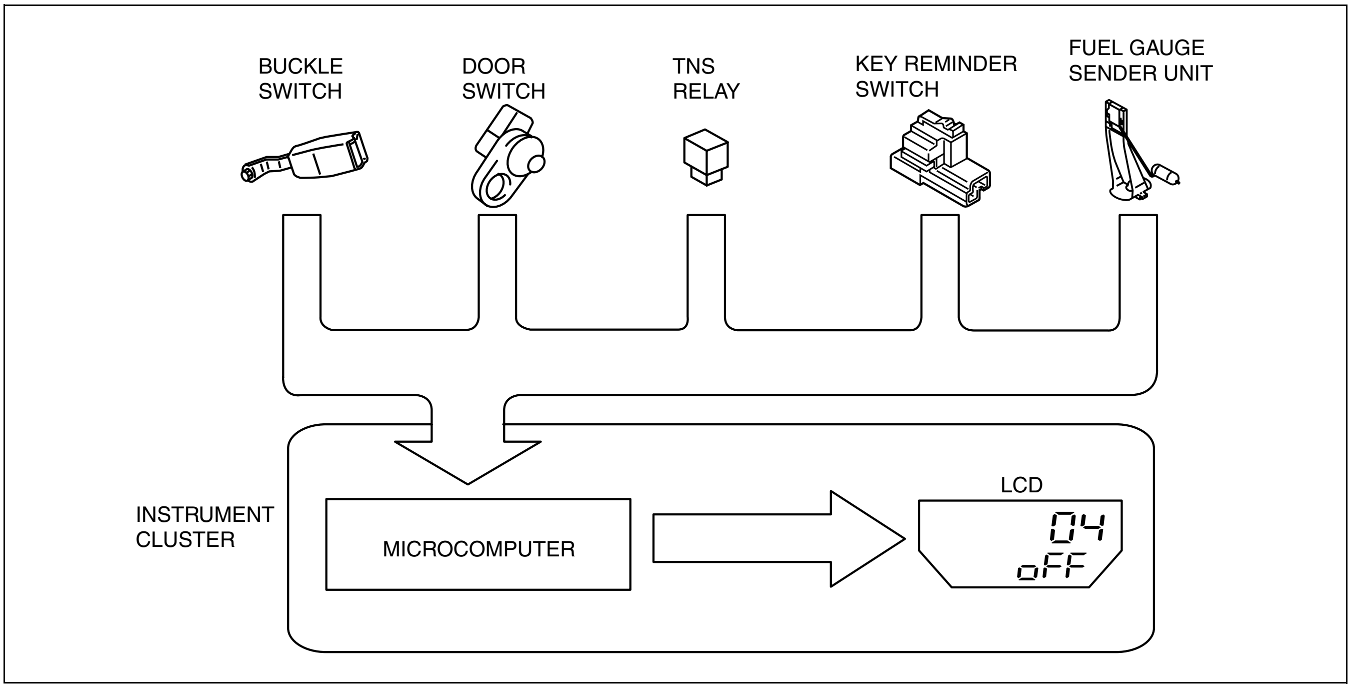
- Refer to RX-8 Workshop Manual.

Input circuit check

- When the parts listed in the chart are operated and output a signal to the instrument cluster, the built in microcomputer judges the quality of the input circuit based on that signal.

Check code	Parts sending input signal
01	Buckle switch
04	Door switch
08	TNS relay

Check code	Parts sending input signal
22	Fuel gauge sender unit
31	Key reminder switch



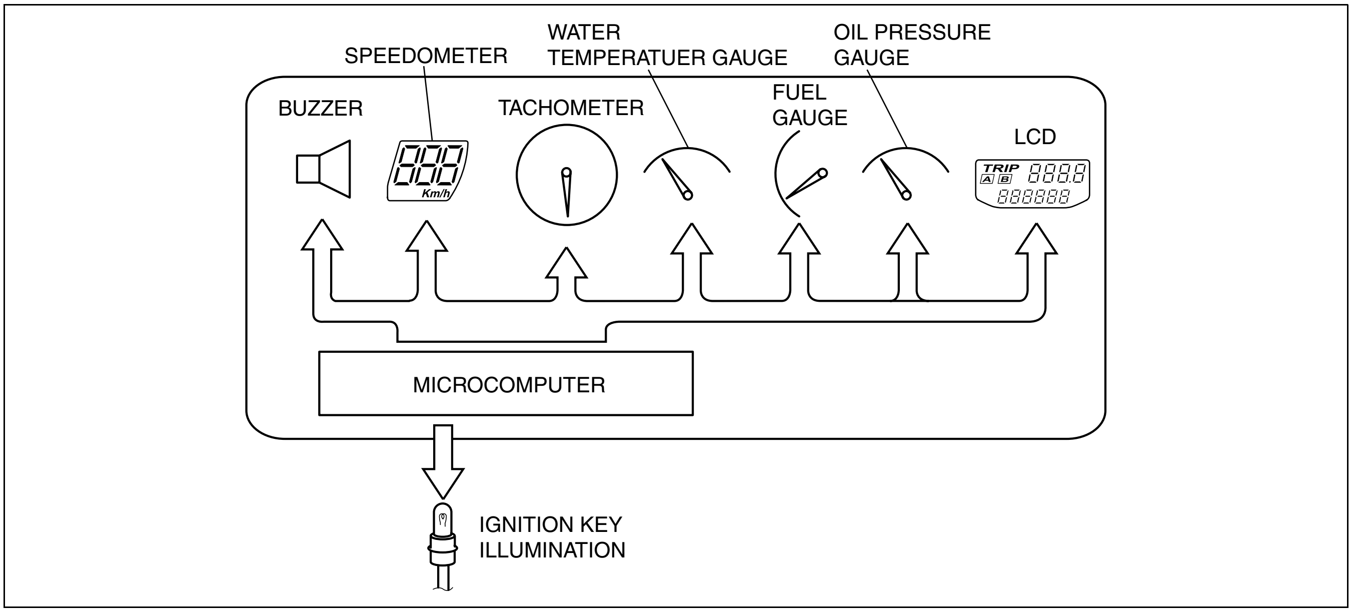
CHU0922S004

Individual circuit check

- By operating the parts listed in the chart, the built in microcomputer judges the quality of the individual parts.

Check code	Parts sending input signal
12	Speedometer
13	Tachometer
14	Buzzer
16	Fuel-level warning light

Check code	Parts sending input signal
18	Ignition key illumination
23	Fuel gauge
25	Water temperature gauge
26	LCD



CHU0922S005

PID/Data Monitor and Record

- The PID/data monitoring items for the instrument cluster is as shown in the table below.

Monitor item table

—: Not applicable

PID item	Definition	Unit/Condition		Terminal
CCNT_HE	Continuous codes	Number of continuous codes		—
ECT_GAUGE	Temperature gauge	°C	°F	1J, 1L
FUEL	Fuel flow	l/min		
ODOMETR	Total distance	km	mile	
SPEEDSG	Speedometer	mph	km/h	
RPM	Tachometer	rpm		

LIGHTS-ON REMINDER WARNING ALARM OUTLINE

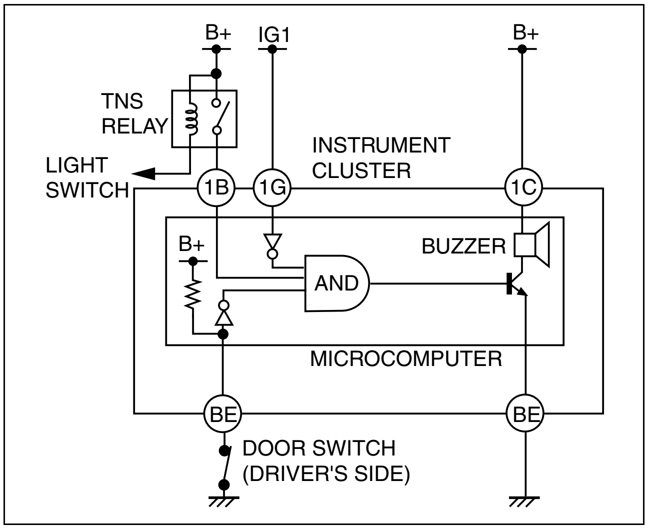
CHU092255430S07

- Warns the driver that the headlights or TNS are on when the driver-side door is opened.

LIGHTS-ON REMINDER WARNING ALARM CONSTRUCTION/OPERATION

CHU092255430S08

System Wiring Diagram



CHU0922S101

Operation

- The buzzer in the instrument cluster sounds continuously when all the following three conditions are met:
  — The ignition switch is in the LOCK or ACC position.
  — The headlight switch is in the TNS or headlight position.
  — The driver-side door is open (driver-side door switch is on).

Note
- When the conditions for the lights-on reminder warning and the key reminder warning alarms are present at the same time, the key reminder warning alarm is given first priority.

09–22

OVER-REVOLUTION WARNING ALARM OUTLINE

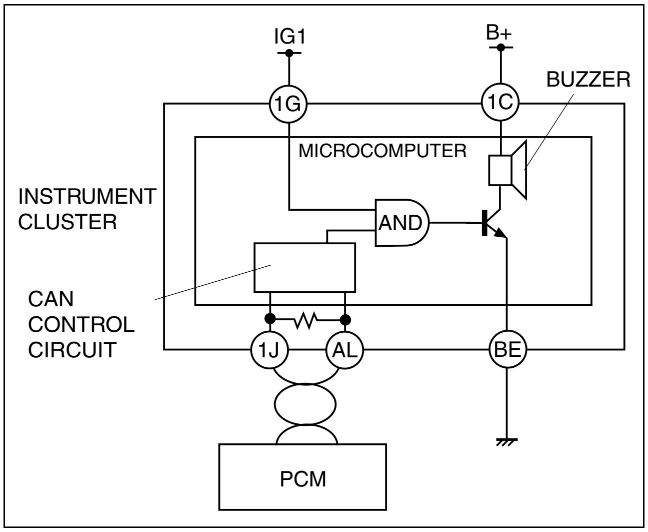
CHU092255430S09

- Warns the driver when the engine speed enters the striped zone.

OVER-REVOLUTION WARNING ALARM CONSTRUCTION/OPERATION

CHU092255430S10

System Wiring Diagram



CHU0922S103

Operation

- The buzzer in the instrument cluster sounds continuously when both the following two conditions are met:
  — The ignition switch is in ON position.
  — The engine speed is 8,500 rpm or more (13B-MSP (High Power)) or (7,300 rpm or more(13B-MSP (Standard Power)).

SPEEDOMETER CONTROL OUTLINE

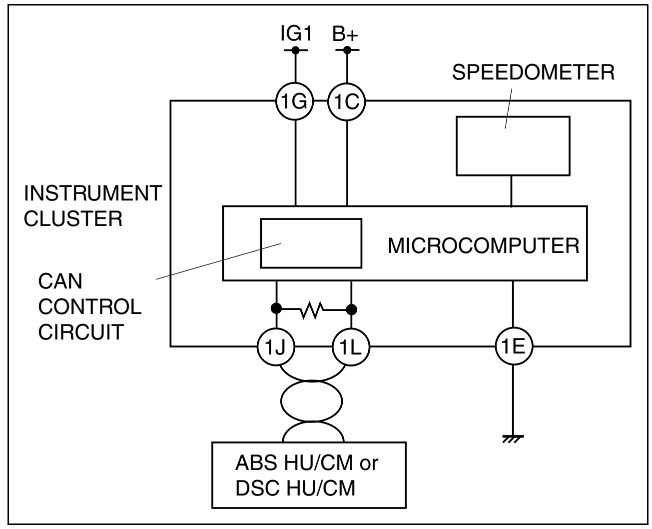
CHU092255430S11

- The vehicle speed signal is output from the ABS HU/CM or DSC HU/CM to the microcomputer in the instrument cluster.

SPEEDOMETER CONTROL CONSTRUCTION/OPERATION

CHU092255430S12

System Wiring Diagram



CHU0922S104

Operation

- The vehicle speed signal sent from the ABS HU/CM or DSC HU/CM 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

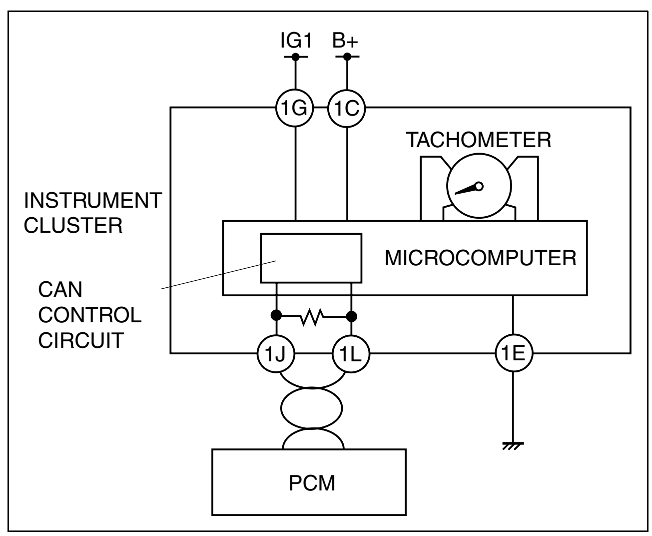
CHU092255430S13

- The engine speed signal is output from the PCM to the microcomputer in the instrument cluster.

TACHOMETER CONTROL CONSTRUCTION/OPERATION

CHU092255430S14

System Wiring Diagram



CHU0922S105

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

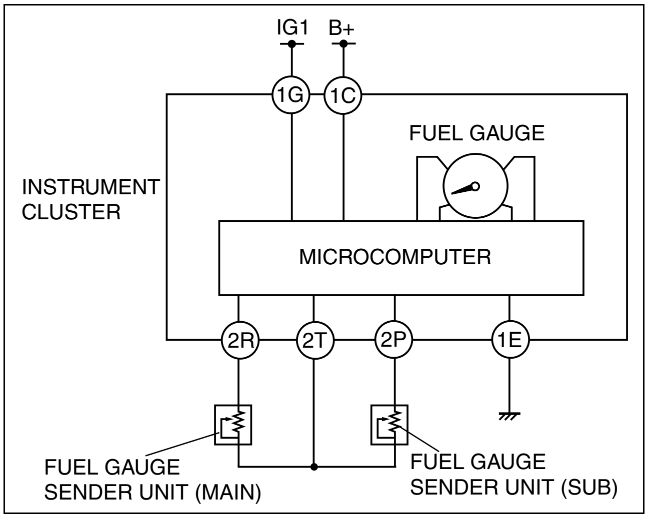
CHU092255430S15

- 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

CHU092255430S16

System Wiring Diagram



CHU0922S106

Operation

- A resistance according to fuel level is sent from the fuel gauge sender unit to the microcomputer. The microcomputer calculates the average resistance within a specified time, and sends the output signal to the fuel gauge based on the calculated value.

WATER TEMPERATURE GAUGE CONTROL OUTLINE

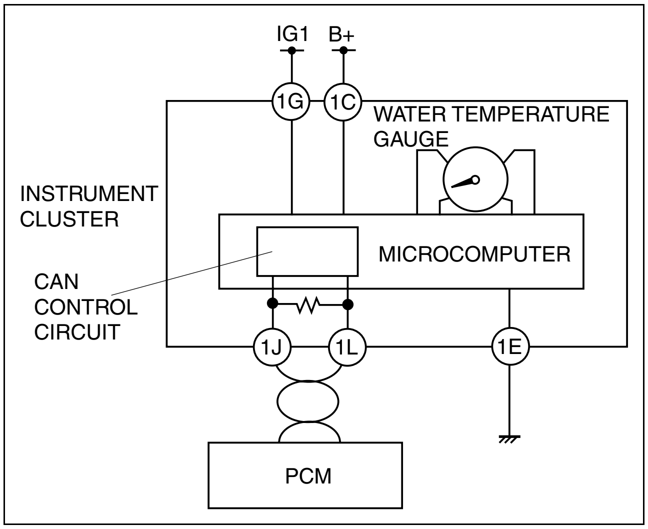
CHU092255430S17

- The engine coolant temperature signal is output from the PCM to the microcomputer in the instrument cluster.

WATER TEMPERATURE GAUGE CONTROL CONSTRUCTION/OPERATION

CHU092255430S18

System Wiring Diagram



CHU0922S107

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.

OIL PRESSURE GAUGE CONTROL OUTLINE

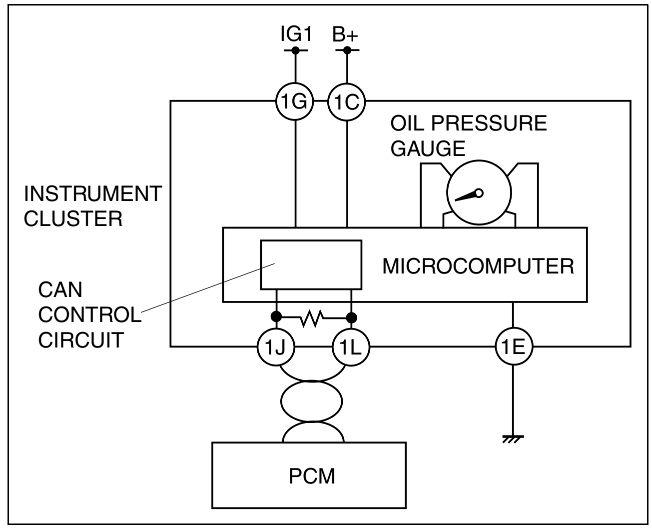
CHU092255430S19

- The oil pressure signal is output from the PCM to the microcomputer in the instrument cluster.

OIL PRESSURE GAUGE CONTROL CONSTRUCTION/OPERATION

CHU092255430S20

System Wiring Diagram



CHU0922S108

Operation

- The oil pressure signal sent from the PCM via the CAN system is input to the microcomputer in the instrument cluster. The microcomputer sends an output signal to the oil pressure gauge based on the oil pressure signal.

INFORMATION DISPLAY FUNCTION

CHU092255000S01

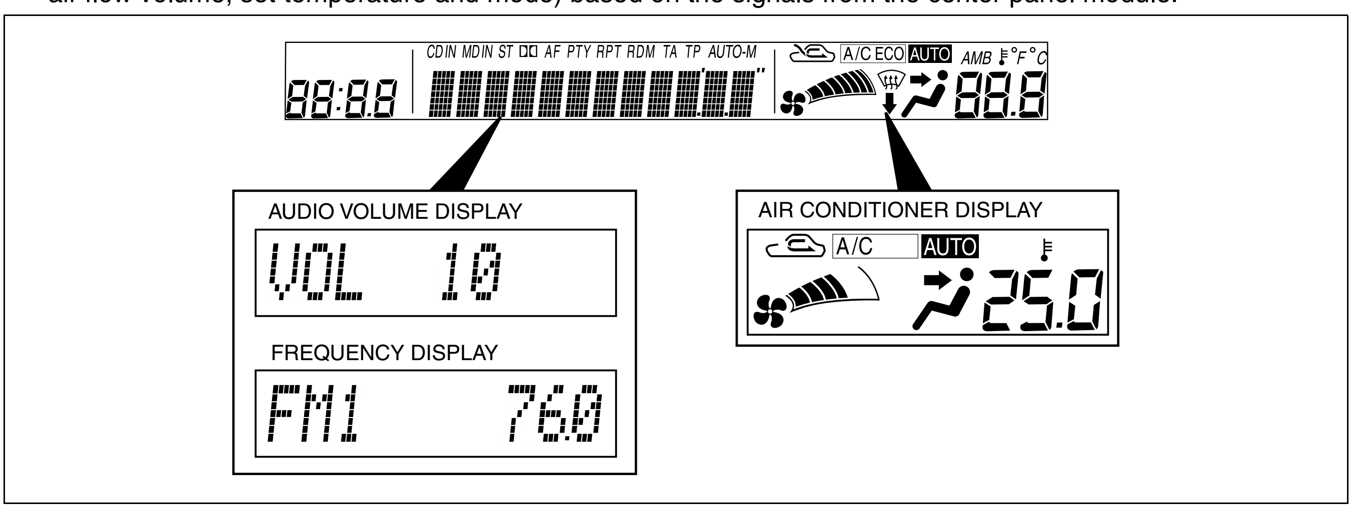
- The information display has the following functions:
  — Display function
  — Clock function

INFORMATION DISPLAY CONSTRUCTION/OPERATION

CHU092255000S02

Display Function

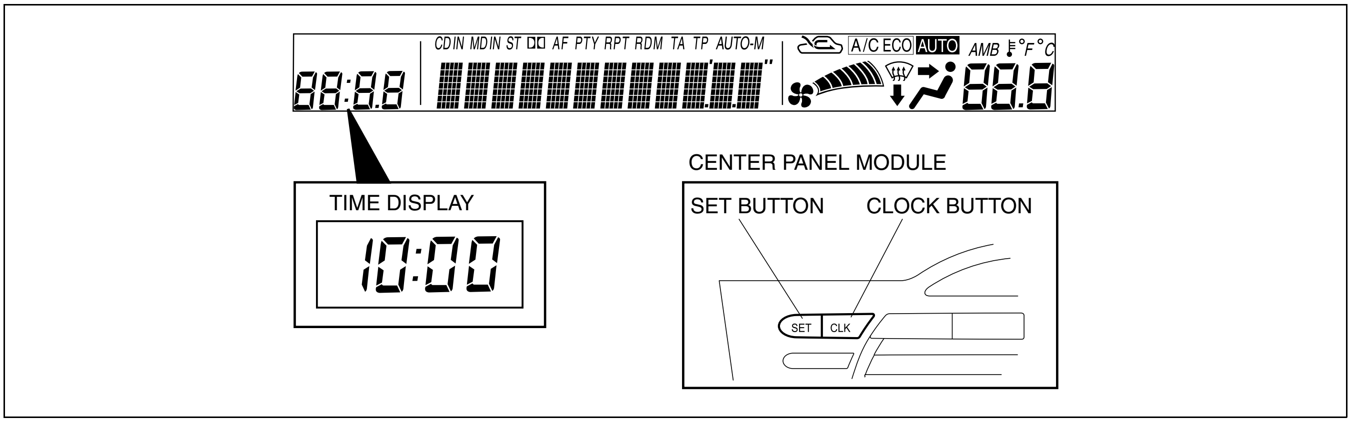
- Displays information for the audio system (such as volume and frequency) and air conditioner system (such as air flow volume, set temperature and mode) based on the signals from the center panel module.



CHU0922S006

Clock function

- A clock is integrated.
- Time can be adjusted with the buttons on the center panel module.

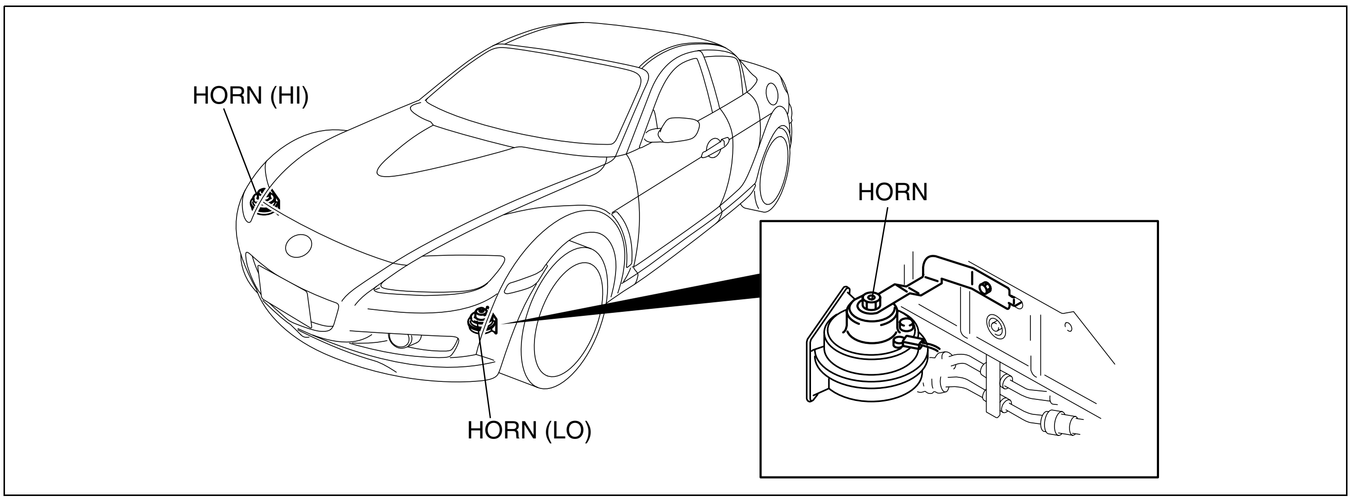


CHU0922S007

HORN CONSTRUCTION

CHU092266790S01

- A trumpet-type horn with spiral-shaped resonant pipes has been adopted. Horns are located symmetrically, one each on the right and left.



CHU0922S008

09–22

09–40 CONTROL SYSTEM

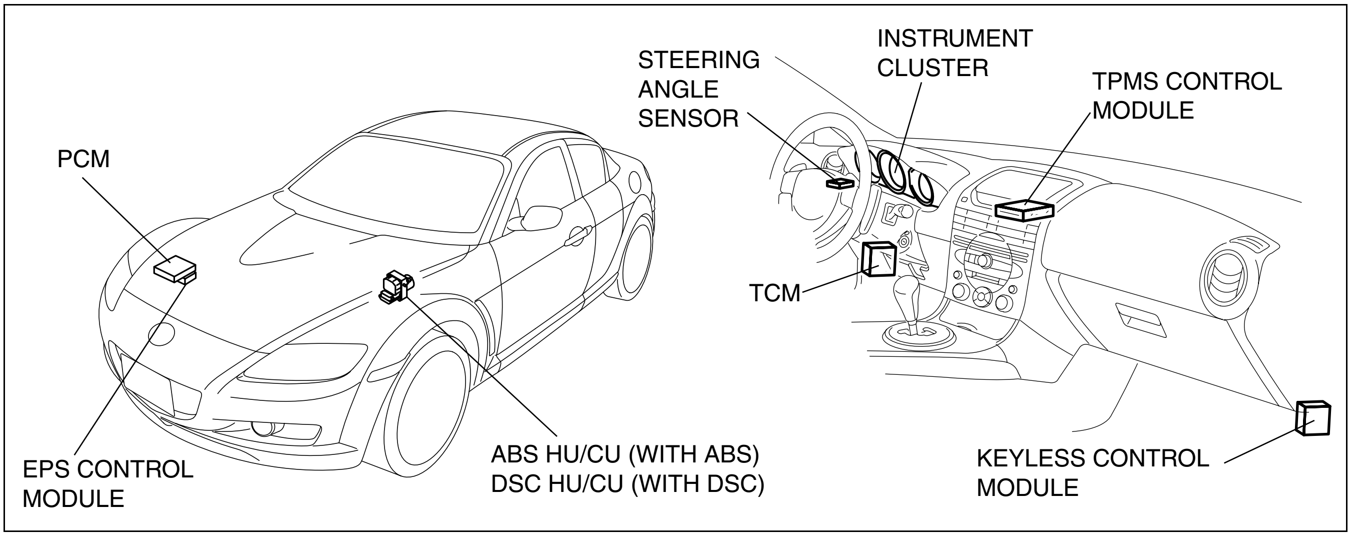
CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE

CHU094055430S01

- Due to the simplification of the wiring harness, a controller area network (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 to TCM to ABS HU/CM (or DSC HU/CM) to steering angle sensor to keyless control module to EPS control module to TPMS control module to instrument cluster
- With an on-board diagnostic function included for each multiplex module, display of DTCs using the SST (WDS or equivalent) has improved serviceability.

CAN SYSTEM STRUCTURAL VIEW

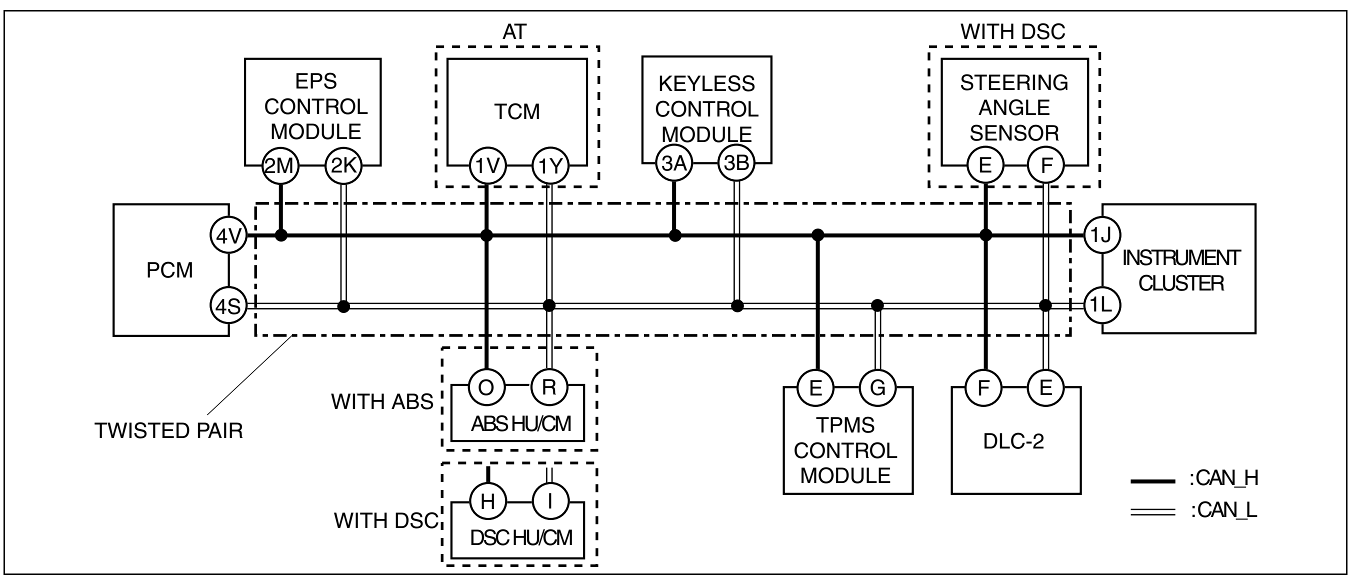
CHU094055430S02



CHU0940S001

CAN SYSTEM WIRING DIAGRAM

CHU094055430S03



CHU0940S002

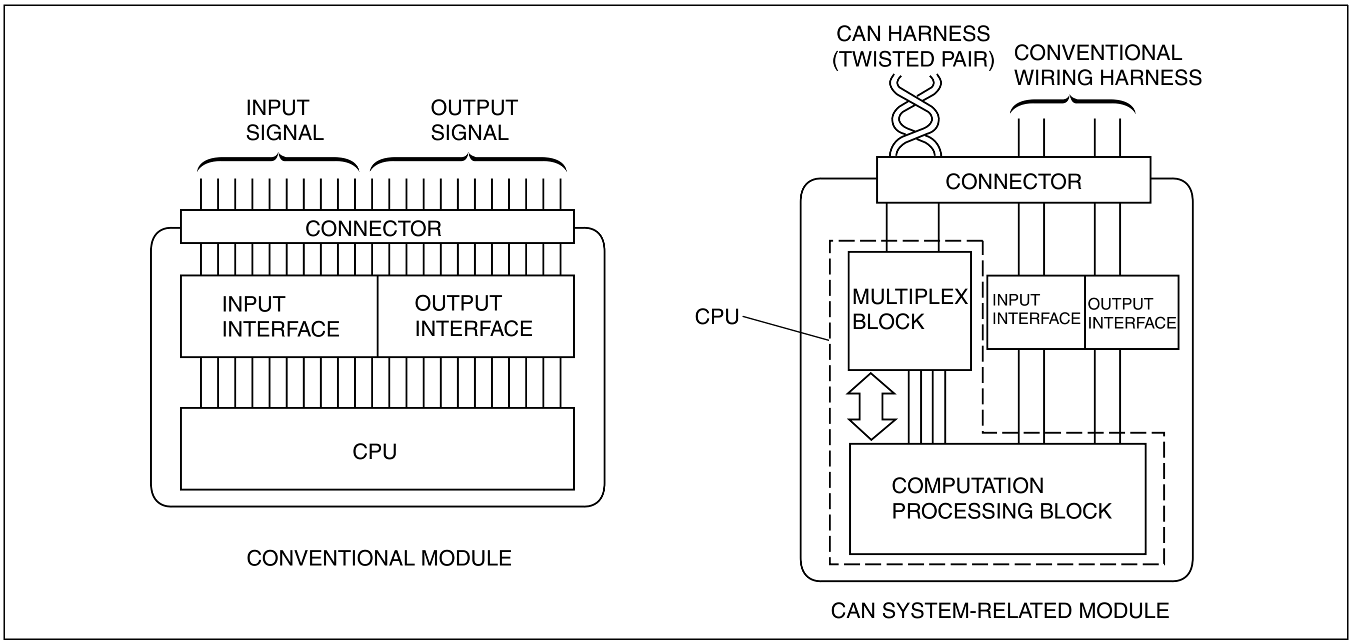
CAN SYSTEM DESCRIPTION

CHU094055430S04

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.

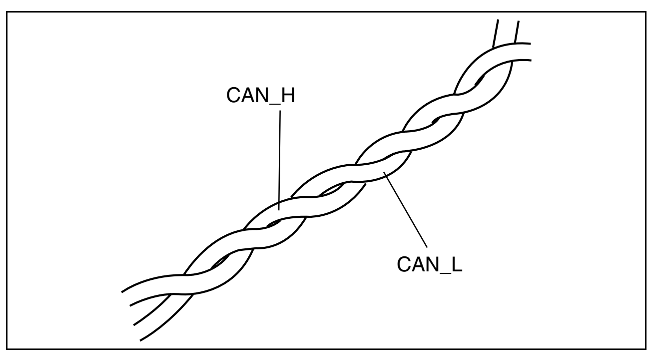
Component		Function
Electrical circuit		Supplies power to CPU and vicinity, and to input/output interface.
CPU	Computation processing block	Control function has been expanded, and when transmission is necessary, transmitted data is stored in a multiplex block. If a multiplex block receives a request 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.



A6A8111T003

Twisted Pair

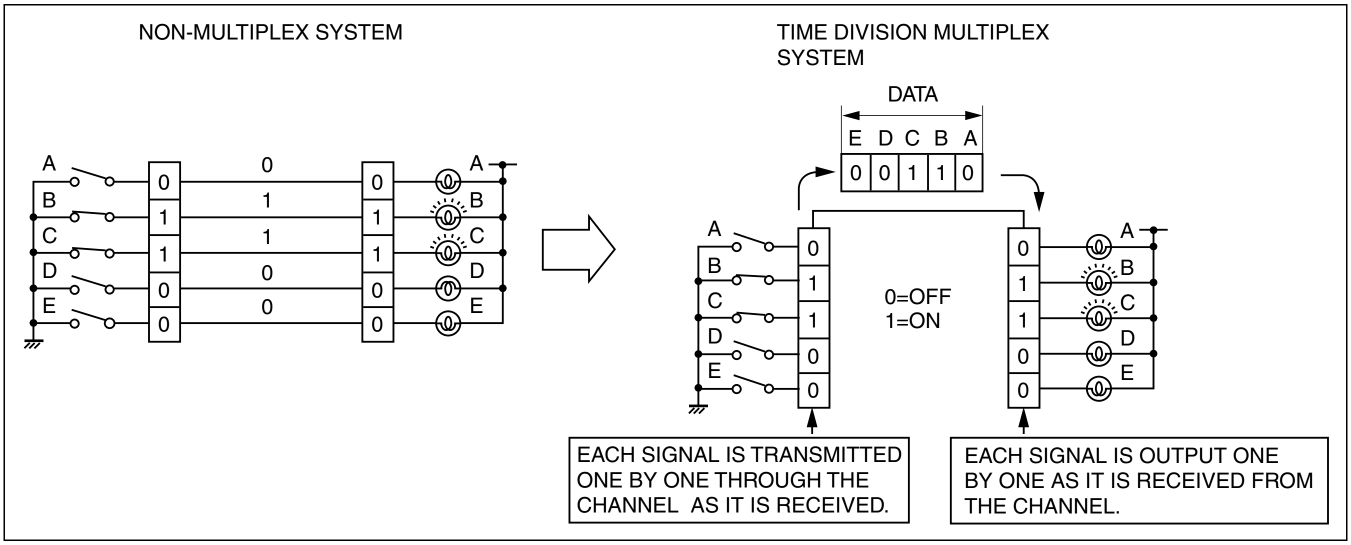
- The multichannel uses two spirally twisted wires called a twisted pair, and each wire, CAN_L and CAN_H, has its own special function.
- Both bus lines are opposite phase voltage. This allows for minimal noise being emitted and makes it difficult for noise interference to be received.



B6U0940S003

Time Division Multiplex

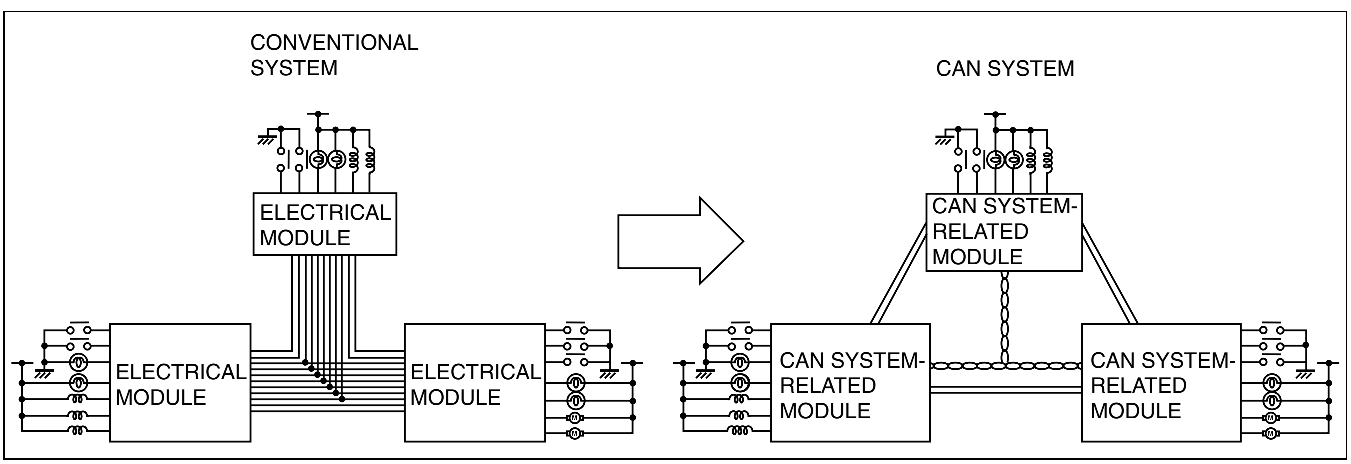
- For information exchange between electrical modules in a conventional system, a wire connection was necessary for each information signal. However, by sending different signals at varying times over one channel, it is possible to send a large amount of information via a small harness.
- In the conventional, non-multiplex system, in order to control the illumination of 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.



A6A8111T005

Vehicle CAN System

- By rearranging the multiple signal, common information between the CAN system-related modules is transmitted and received through the multichannel.
- The signal transmitted by one CAN system-related module is sent through the multichannel to all the CAN system-related modules, but only the concerned module(s) receives the signal and performs the appropriate operation (ex. light illumination, fan operation).



A6A8111T006

CAN Signal-Chart

OUT: Output (sends signal)
IN: Input (receives signal)

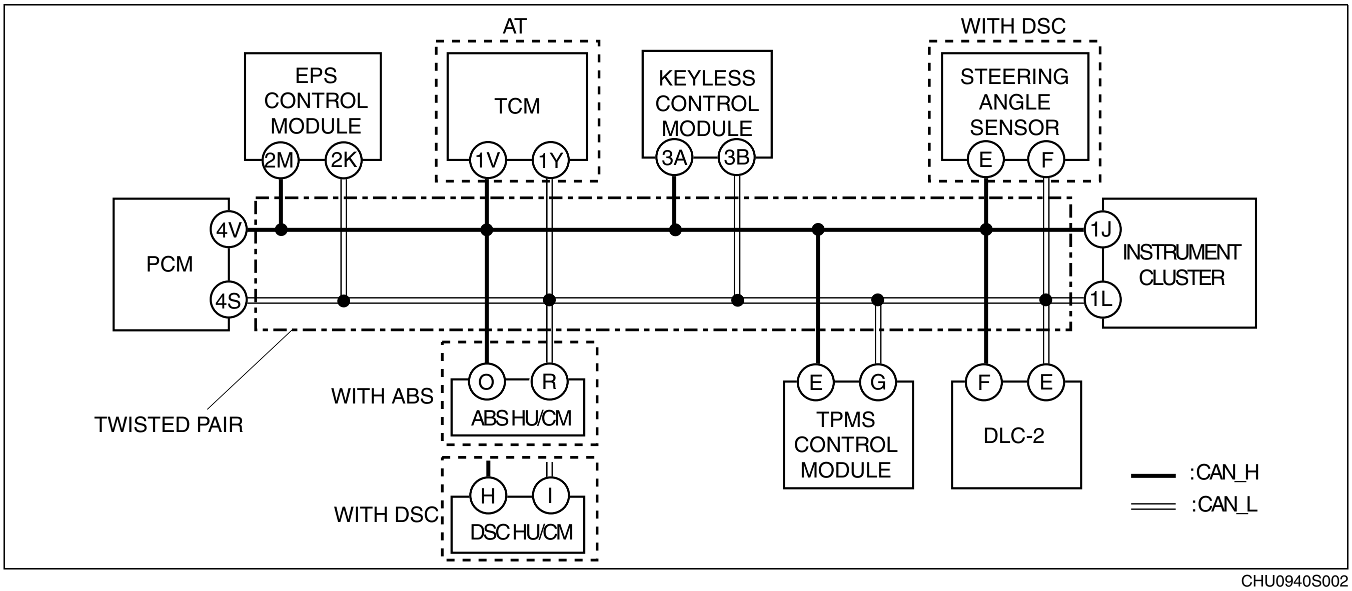
Signal	Multiplex module							
	PCM	EPS control module	TCM (AT)	ABS HU/CM / DSC HU/CM	Keyless control module	TPMS control module	Steering angle sensor	Instrument cluster
Immobilizer-related information	OUT	–	–	–	IN	–	–	–
	IN	–	–	–	OUT	–	–	–
Engine speed	OUT	IN	IN	– / IN	IN	– / IN	–	IN
Vehicle speed	OUT	IN	–	–	–	IN	–	IN
	IN	–	OUT	–	–	–	–	–
Throttle valve opening angle	OUT	–	IN	– / IN	–	–	–	–
Engine coolant temperature	OUT	–	IN	–	–	–	–	IN
Engine torque	OUT	–	IN	– / IN	–	–	–	IN
Torque reduction disable	OUT	–	IN	– / IN	–	IN	–	–
Travelled distance	OUT	–	–	–	–	–	–	IN
	–	–	–	OUT	–	–	–	IN
Fuel injection amount	OUT	–	–	–	–	–	–	IN
Engine oil pressure	OUT	–	–	–	–	–	–	IN
Engine oil level	OUT	–	–	–	–	–	–	IN
Engine coolant level	OUT	–	–	–	–	–	–	IN
Fuel pump status	OUT	–	–	–	–	–	–	IN
MIL on request	OUT	–	–	–	–	–	–	IN
	IN	–	OUT	–	–	–	–	–
Generator warning light on request	OUT	–	–	–	–	–	–	IN
Transmission/axle specifications	OUT	–	–	– / IN	–	–	–	–
Tire size	OUT	–	–	IN	–	–	–	–
Cruise control main indicator light on request	OUT	–	IN	–	–	–	–	IN
Cruise control indicator light on request	OUT	–	IN	–	–	–	–	IN
Downshift request	OUT	–	IN	–	–	–	–	–
EPS warning light on request	–	OUT	–	–	–	–	–	IN
Idle speed increase request	IN	OUT	OUT	–	–	–	–	–
Ignition switch off time	IN	–	–	–	OUT	–	–	–
Target torque	IN	–	OUT	–	–	–	–	–
Torque upper limit	IN	–	OUT	–	–	–	–	–
Turbine shaft speed	IN	–	OUT	–	–	–	–	–
Target gear position/ selector lever position	IN	–	OUT	– / IN	–	–	–	IN
Gear ratio	IN	–	OUT	–	–	–	–	–

Signal		Multiplex module							
		PCM	EPS control module	TCM (AT)	ABS HU/CM / DSC HU/CM	Keyless control module	TPMS control module	Steering angle sensor	Instrument cluster
Brake system status	ABS/ EBD	IN	IN	IN	OUT	–	–	–	IN
	EBD/ ABS/ DSC				OUT				
Torque down request		IN	–	OUT	– / OUT	–	–	–	–
Wheel speed (LF, RF, LR, RR)		IN	–	–	OUT	–	–	–	–
Wheel speed status (LF, RF, LR, RR)		IN	–	–	OUT	–	–	–	–
Steering angle		–	–	–	– / IN	–	–	OUT	–
Steering angle sensor status (sensor malfunction, circuit malfunction)		–	–	–	– / IN	–	–	OUT	–
Fuel tank level		IN	–	–	–	–	–	–	OUT
Parking brake position		–	–	–	– / IN	–	–	–	OUT
AT warning light on request		–	–	OUT	–	–	–	–	IN
Tire pressure warning light on request		–	–	–	–	–	OUT	–	IN
Tire pressure warning buzzer on request		–	–	–	–	–	OUT	–	IN

On-Board Diagnostic Function

- The on-board diagnostic function is incorporated into the PCM, TCM, ABS HU/CM (or DSC HU/CM), keyless control module, EPS control module, TPMS control module and instrument cluster. This function can narrow down CAN system malfunction locations.
- The on-board diagnostic function consists of the following functions.
  — Failure detection function, which detects malfunctions in CAN system-related parts.
  — Memory function, which stores detected DTCs.
  — Self-malfunction diagnostic function, which indicates system malfunctions using DTCs and warning lights.
  — PID/data monitoring function, which verifies the input/output condition of specific input/output signals being read out.
- Using an SST (WDS or equivalent), DTCs can be read out and deleted, and the PID/data monitoring function can be activated.
- 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



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.

Module	Fail-safe function
PCM	• MIL illuminated
EPS control module	• EPS warning light illuminated
TCM	• AT warning light illuminated
ABS HU/CM (with ABS)	–
DSC HU/CM (with DSC)	• ABS suspended • TCS suspended • DSC suspended • ABS warning light illuminated • DSC indicator light illuminated • DSC OFF light illuminated
Keyless control module	–
TPMS control module	–
Steering angle sensor (with DSC)	• Send malfunction data to DSC HU/CM
Instrument cluster	• Speedometer, tachometer, water temperature gauge: 0 displayed

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 an SST (WDS or equivalent).

DTC table

DTC	Malfunction location	Module outputting DTC
U0073	CAN system communication error	• PCM • TCM • EPS control module • Keyless control module
U0100	Communication error to PCM	TCM
U0101	Communication error to TCM	PCM
U0121	Communication error to ABS HU/CM	PCM
U0155	Communication error to instrument cluster	
U0167	Communication error to keyless control module	
U0516	CAN bus communication error	TPMS control module
U2510	Communication error to PCM	Keyless control module
U1147		
U1900	CAN system communication error	• ABS HU/CM • DSC HU/CM • EPS control module • Steering angle sensor • Keyless control module • TPMS control module • Instrument cluster
U2516	CAN system wiring harness open or short circuit	• ABS HU/CM • DSC HU/CM • Steering angle sensor • Instrument cluster

PID/data monitoring function

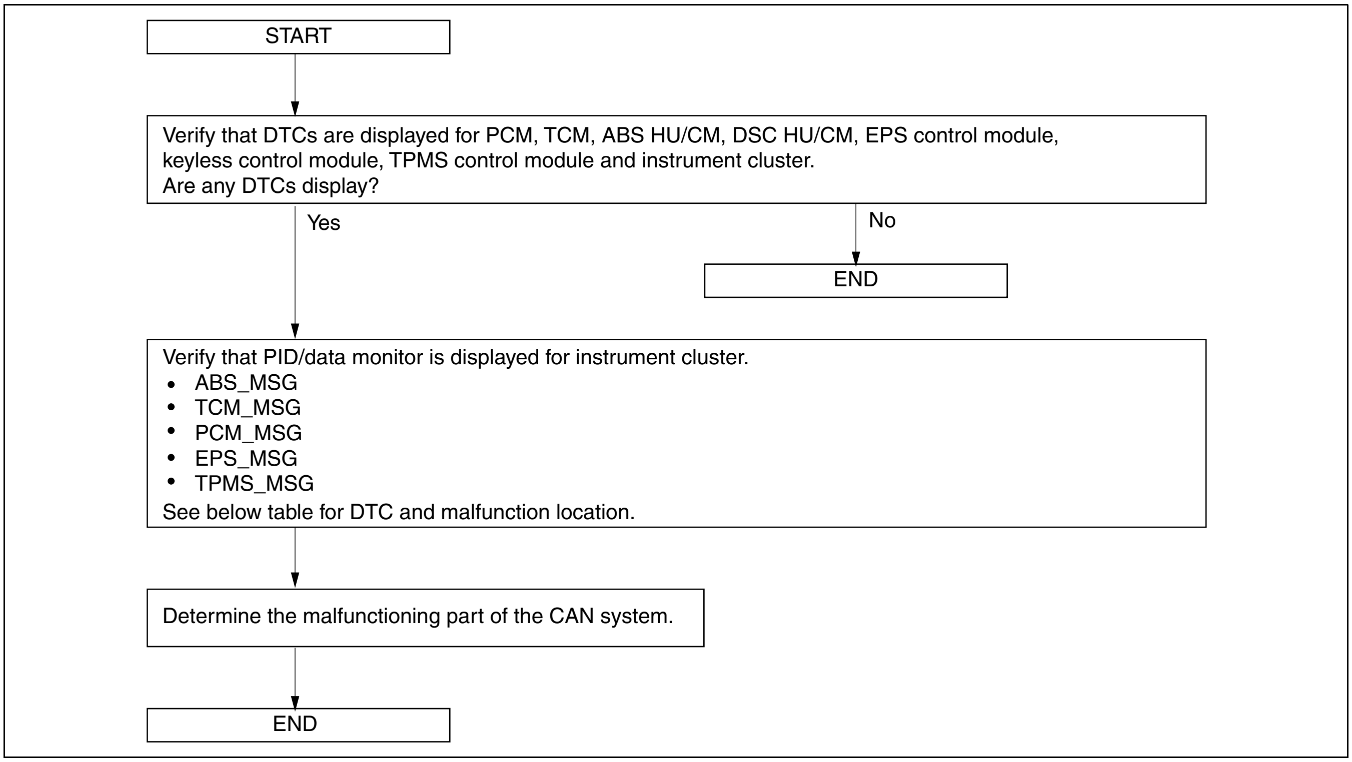
- The PID/data monitoring function is used to freely select and read out, in real time, the monitored items for the input/output signals of the ABS HU/CM and instrument cluster.
- An SST (WDS or equivalent) is used to read out the PID/data monitor information.

PID name (definition)	Condition	Specification	PID monitor module	Terminal
ABS_MSG (Missing message from the ABS HU/CM or DSC HU/CM)	Present	Circuit in the ABS HU/CM is normal	Instrument cluster	• ABS HU/CM: O, R • DSC HU/CM: H, I • Instrument cluster: 1J, 1L
	Not Present	Circuit in the ABS HU/CM is disable		
TCM_MSG (Missing message from the TCM)	Present	Circuit in the TCM is normal		• TCM: 1V, 1Y • Instrument cluster: 1J, 1L
	Not Present	Circuit in the TCM is disable		
EPS_MSG (Missing message from the EPS control module)	Present	Circuit in the EPS control module is normal		• EPS control module: 2K, 2M • Instrument cluster: 1J, 1L
	Not Present	Circuit in the EPS control module is disable		
PCM_MSG (Missing message from the PCM)	Present	Circuit in the PCM is normal		• PCM: 4S, 4V • Instrument cluster: 1J, 1L
	Not Present	Circuit in the PCM is disable		
TPM_MSG (Missing message from the TPMS control module)	Present	Circuit in the TPMS control module is normal		• TPMS control module: E, G • Instrument cluster: 1J, 1L
	Not Present	Circuit in the TPMS control module is disable		

Narrowing down malfunction locations

- The on-board diagnostic function, by verifying the detected DTC and PID/data monitor information from each module, can narrow down a CAN system malfunction location. Refer to the Self-malfunction diagnostic Function and PID/data monitoring function for detailed information regarding DTCs and the PID/data monitor. (See 09–40–6 Self-malfunction diagnostic function.) (See 09–40–7 PID/data monitoring function.)

Flowchart



CHU0940S005

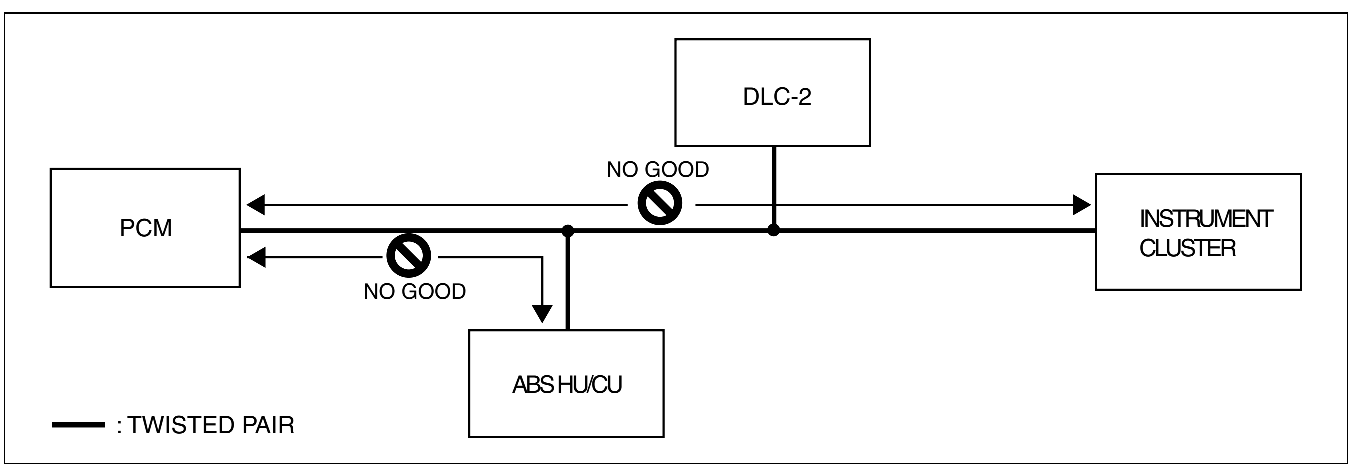
Example (PCM-related communication error)

Note

- This example is for MT with ABS.

1. DTCs for the PCM, ABS HU/CM and instrument cluster can be verified using a SST (WDS or equivalent).

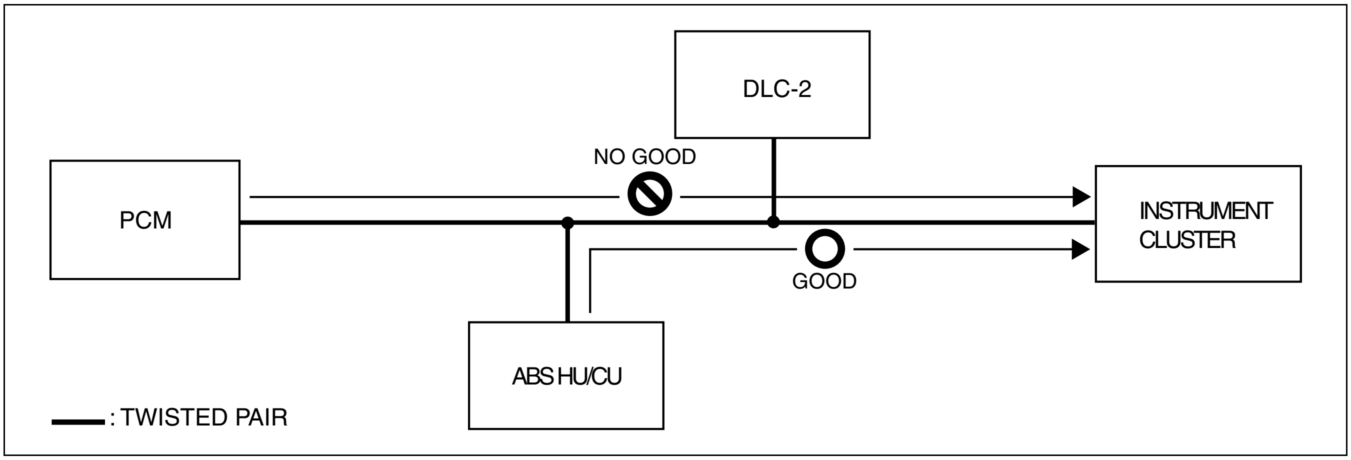
Module	Displayed DTC	Probable malfunction location
PCM	U0073	PCM-related CAN system malfunction
	U0121	Communication error between PCM and ABS HU/CM
	U0155	Communication error between PCM and instrument cluster
ABS HU/CM	U1900, U2516	ABS HU/CM-related CAN system malfunction
Instrument cluster	U1900, U2516	Instrument cluster-related CAN system malfunction



CHU0940S003

2. PID/data monitor information for the ABS HU/CM and instrument cluster can be verified using an SST (WDS or equivalent).

Module	PID name (definition)	Condition	Probable malfunction point
ABS HU/CM	PCM_MSG (Missing message from the PCM)	Not Present	Communication error between ABS HU/CM and PCM
Instrument cluster	PCM_MSG (Missing message from the PCM)	Not Present	Communication error between instrument cluster and PCM
	ABS_MSG (Missing message from the ABS HU/CM	Present	Normal communication between instrument cluster and ABS HU/CM



CHU0940S004

3. If there is a communication error between the ABS HU/CM and PCM, or between the instrument cluster and PCM, even if the communication between the ABS HU/CM and the instrument cluster is normal, it is probable that there is a malfunction in the PCM or PCM-related wiring harnesses.