2006 Mazda MX-5 Service Highlights

CONTENTS

FOREWORD

This manual explains each component or system operation and function for the Mazda MX-5.

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

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

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

Mazda Motor Corporation
HIROSHIMA, JAPAN

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

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VEHICLE IDENTIFICATION NUMBERS (VIN)

JM1 NC15F⁎6# 100001—
JM1 NC25F⁎6# 100001—

RELATED MATERIALS

Material Name	MNAO Part No.	Mazda Material No.
2006 Mazda MX-5 Workshop Manual	9999–95–042B–06	1846–1U–05F
Engine Workshop Manual LF L3	9999–95–LFL3–05	1866–1U–05H
Manual Transmission Workshop Manual M15M-D	9999–95–421H–06	1847–1U–05F
Manual Transmission Workshop Manual P66M-D	9999–95–423H–06	1848–1U–05F
2006 Mazda MX-5 Bodyshop Manual	9999–95–060F–06	3405–1U–05F
2006 Mazda MX-5 Wiring Diagram	9999–95–026G–06	5639–1U–05F

GENERAL INFORMATION

00 SECTION

00–00 GENERAL INFORMATION

AIM OF DEVELOPMENT

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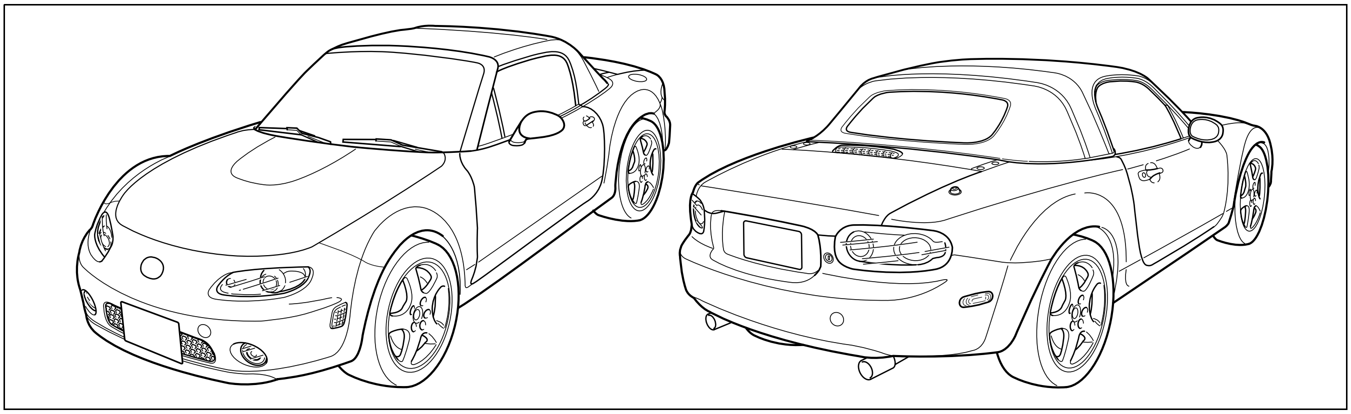
Product Concept

- A car in which “oneness between car and driver, and still the one” dynamics and “lots of fun” are carried forward and further evolved for a new generation.

External View



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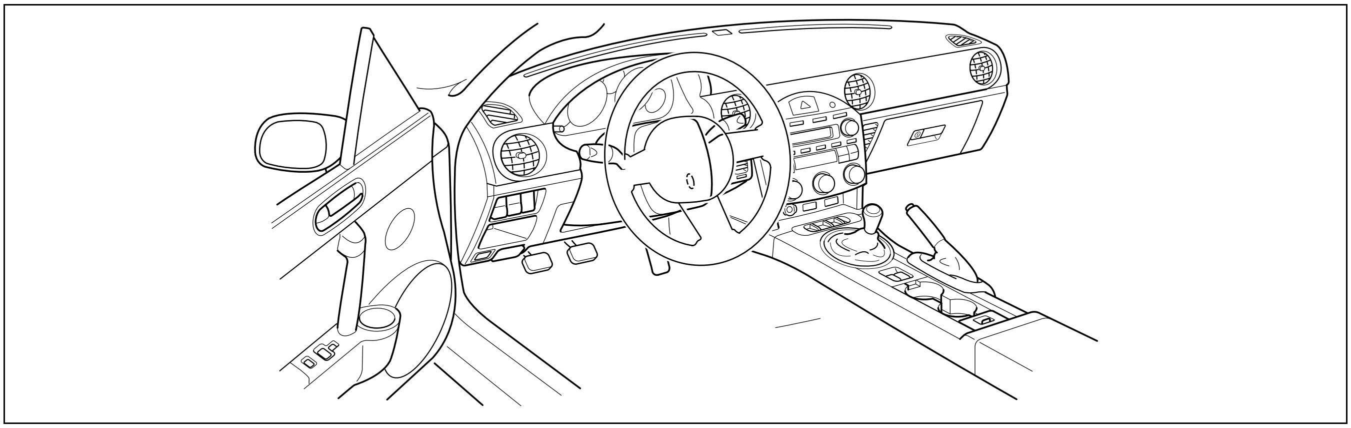
Vehicle Outline

Exterior design

- Fun-to-drive with instinctively attractive styling
  — A two-fold type soft top has been adopted for improved ease of opening/closing.

Interior design

- A comfortable interior and sporty design incorporating Mazda's inherited DNA
  — A simple, clean-cut dashboard with a spacious feel has been adopted.
  — A center panel that integrates module audio and air conditioning controls has been adopted.
  — An instrument cluster with an emphasized sportiness has been adopted.
  — Illumination that is both easily visible and comfortable for the eye has been adopted.



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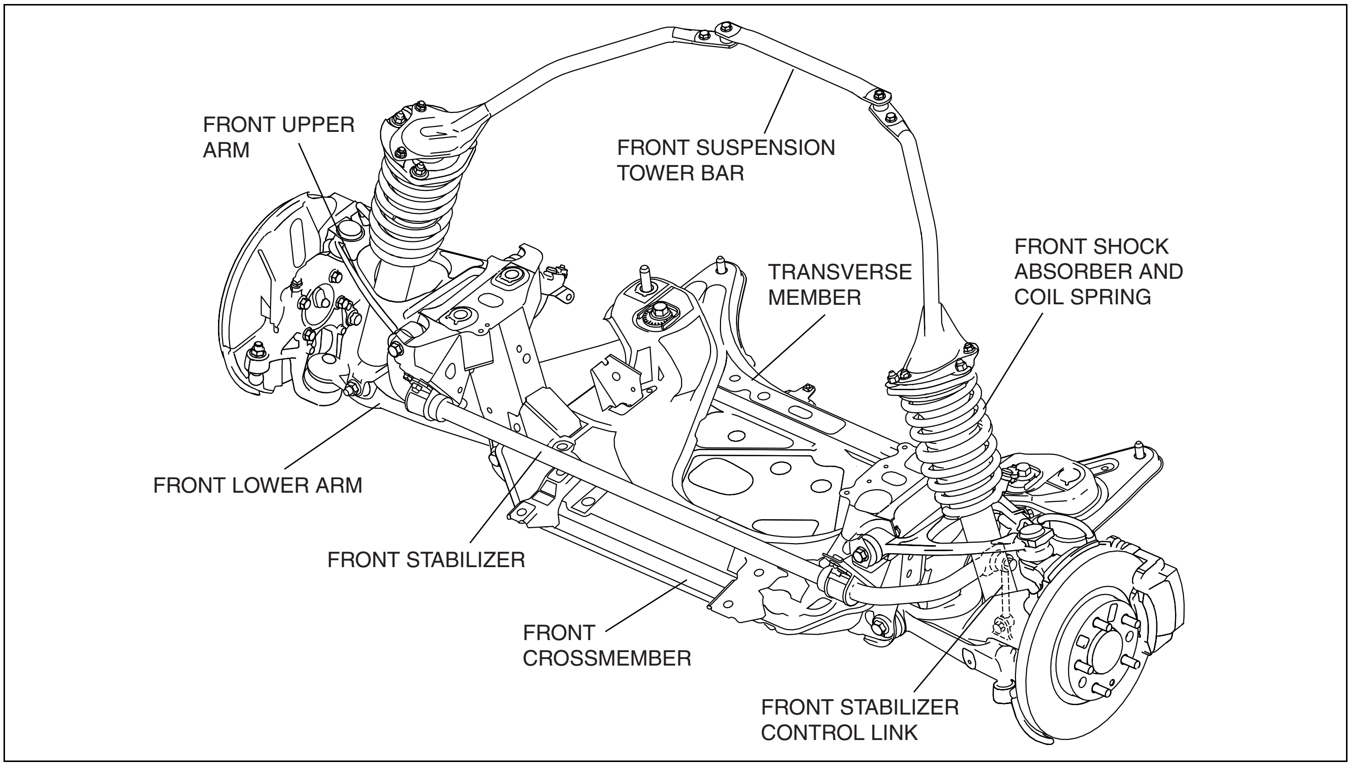
Engine

- Engine block
  — Variable valve timing that optimally adjusts valve timing in accordance with driving conditions has been adopted.
  — An aluminum-alloy cylinder head and cylinder block have been adopted.
  — Lightweight pistons, low-tension piston rings, and shimless tappets have been adopted to minimize friction losses, thereby contributing to improved fuel economy.
  — An auto-tensioner that automatically adjusts the belt to compensate for stretching has been adopted to minimize maintenance requirements.
- Intake, exhaust, control
  — Weight reduction has been achieved due to a hard-plastic dynamic chamber.
  — High torque is obtained from the lower-middle to the high engine speed ranges due to the adoption of the variable intake air system.
  — Maximum torque is achieved at all engine speeds due to the adoption of a variable valve timing system that controls intake valve timing in accordance with driving conditions to attain highly efficient air charging.
  — An exhaust gas recirculation (EGR) system has been adopted for all models resulting in cleaner exhaust emissions and reduced fuel consumption.

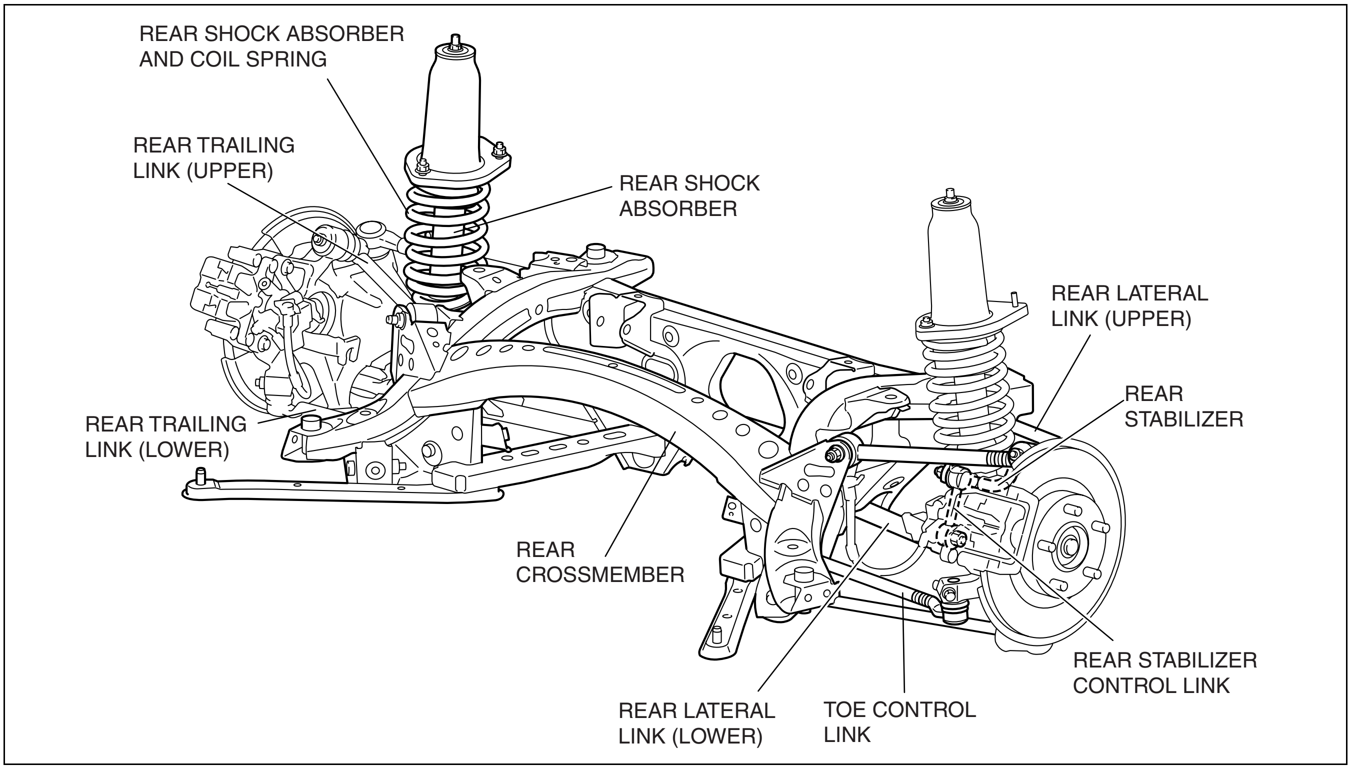
Suspension and steering

- Front suspension
  - — 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.



E5U213ZS5001

- Rear suspension
  — 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.



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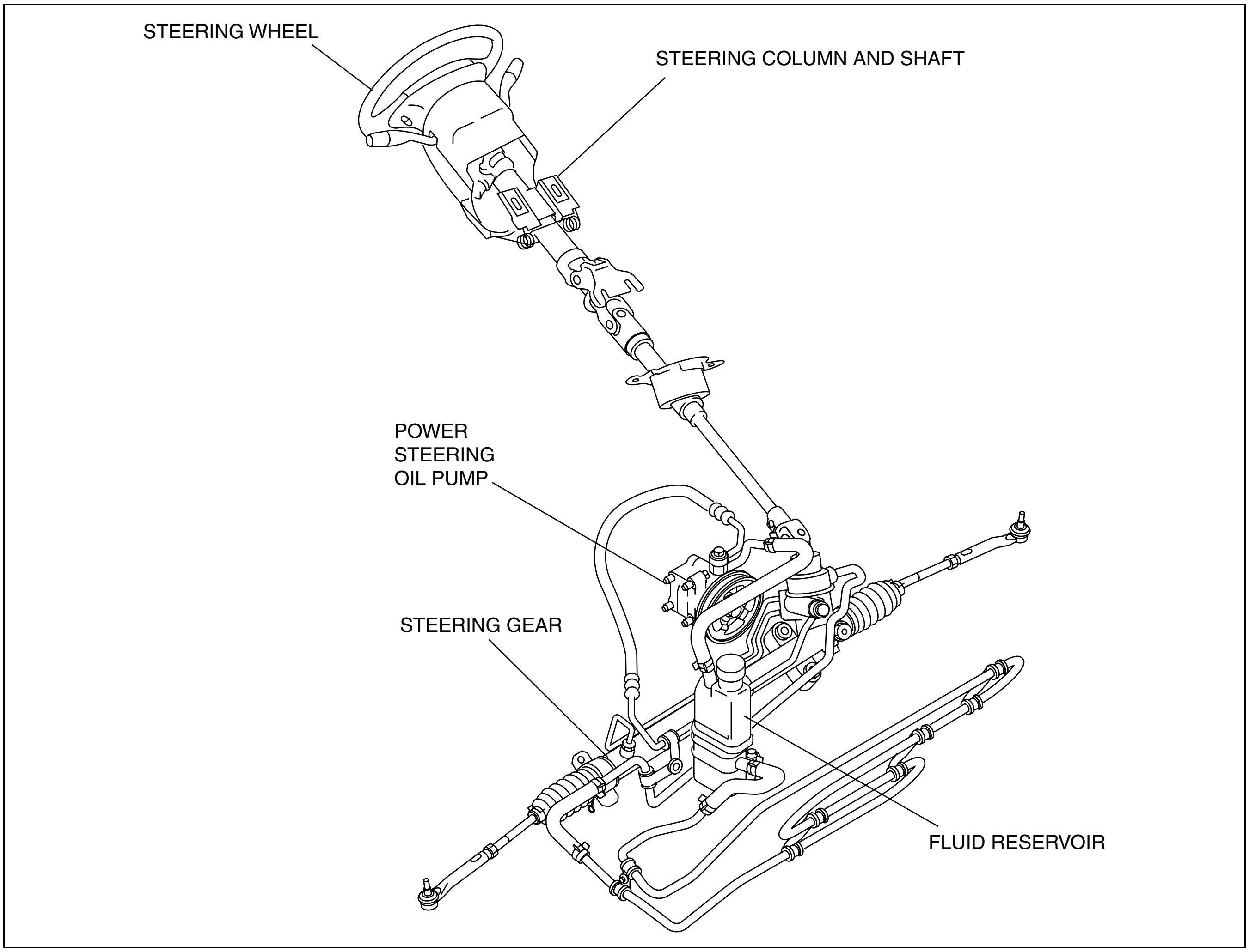
- Power steering
  - — With the adoption of an integrated mount for the steering gear, handling stability has been improved.
  - — With the adoption, for all vehicles, of a steering column with a tilt mechanism, operability has been improved.
  - — With the adoption of a steering shaft with an energy absorbing mechanism, safety has been improved.



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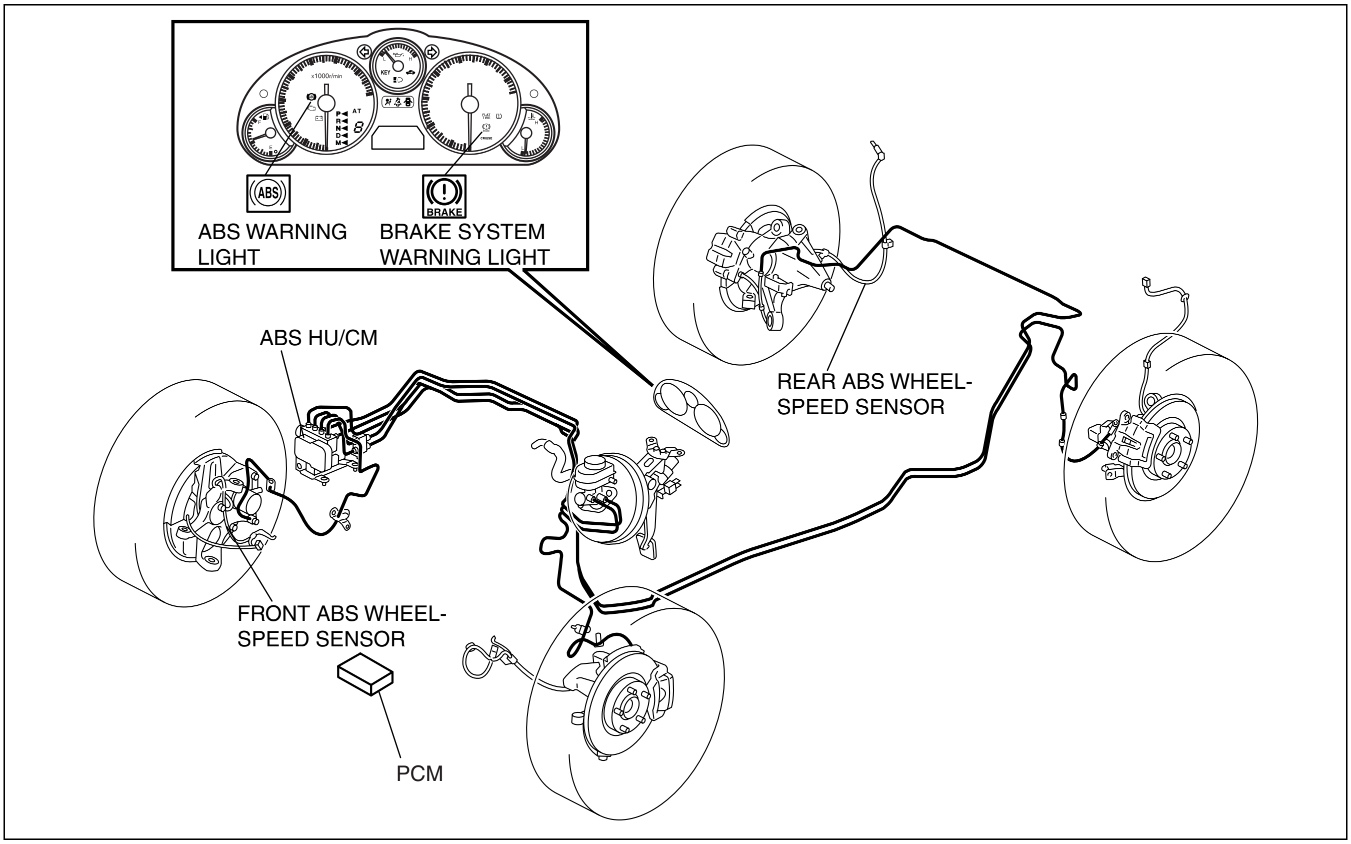
Brakes

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



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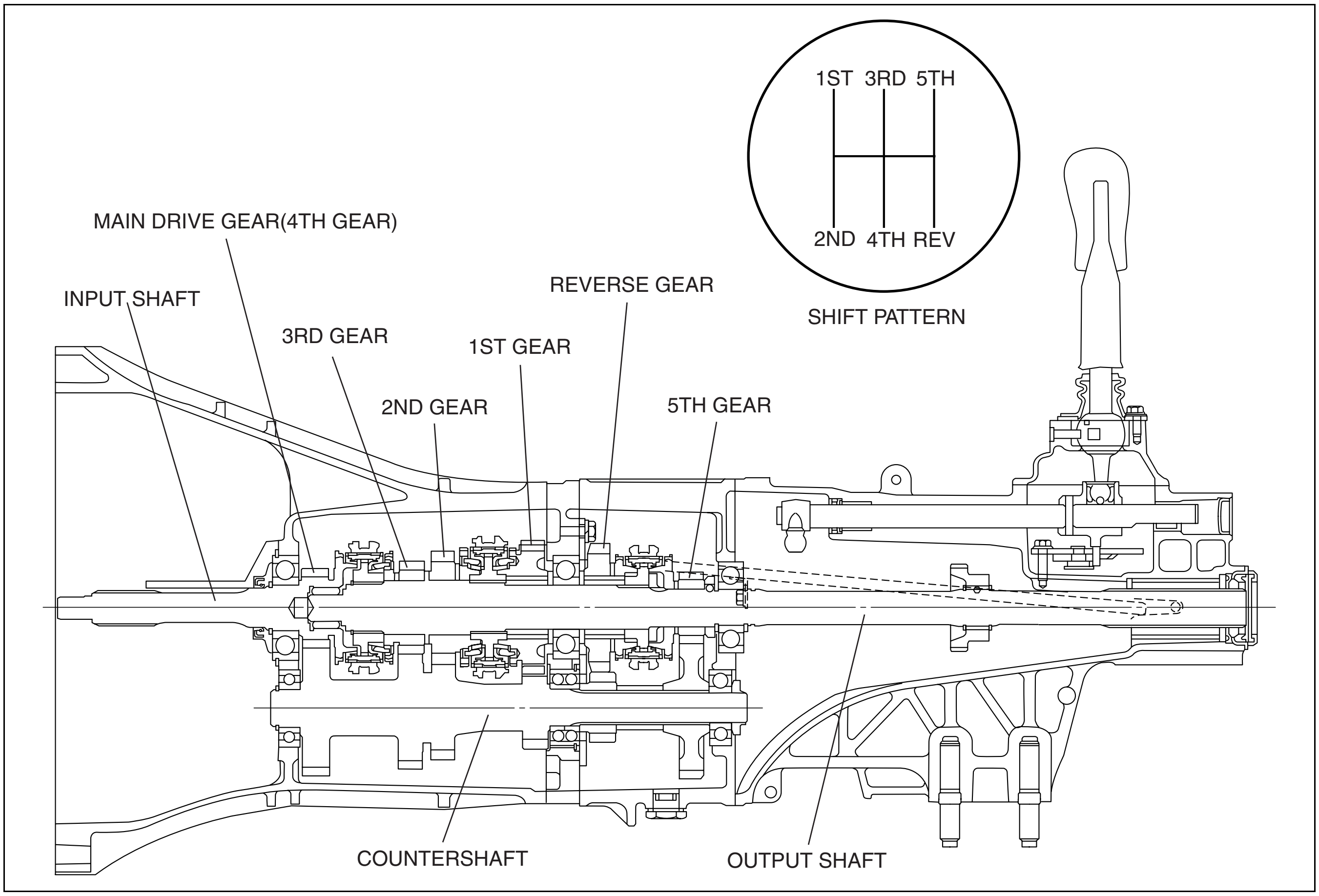
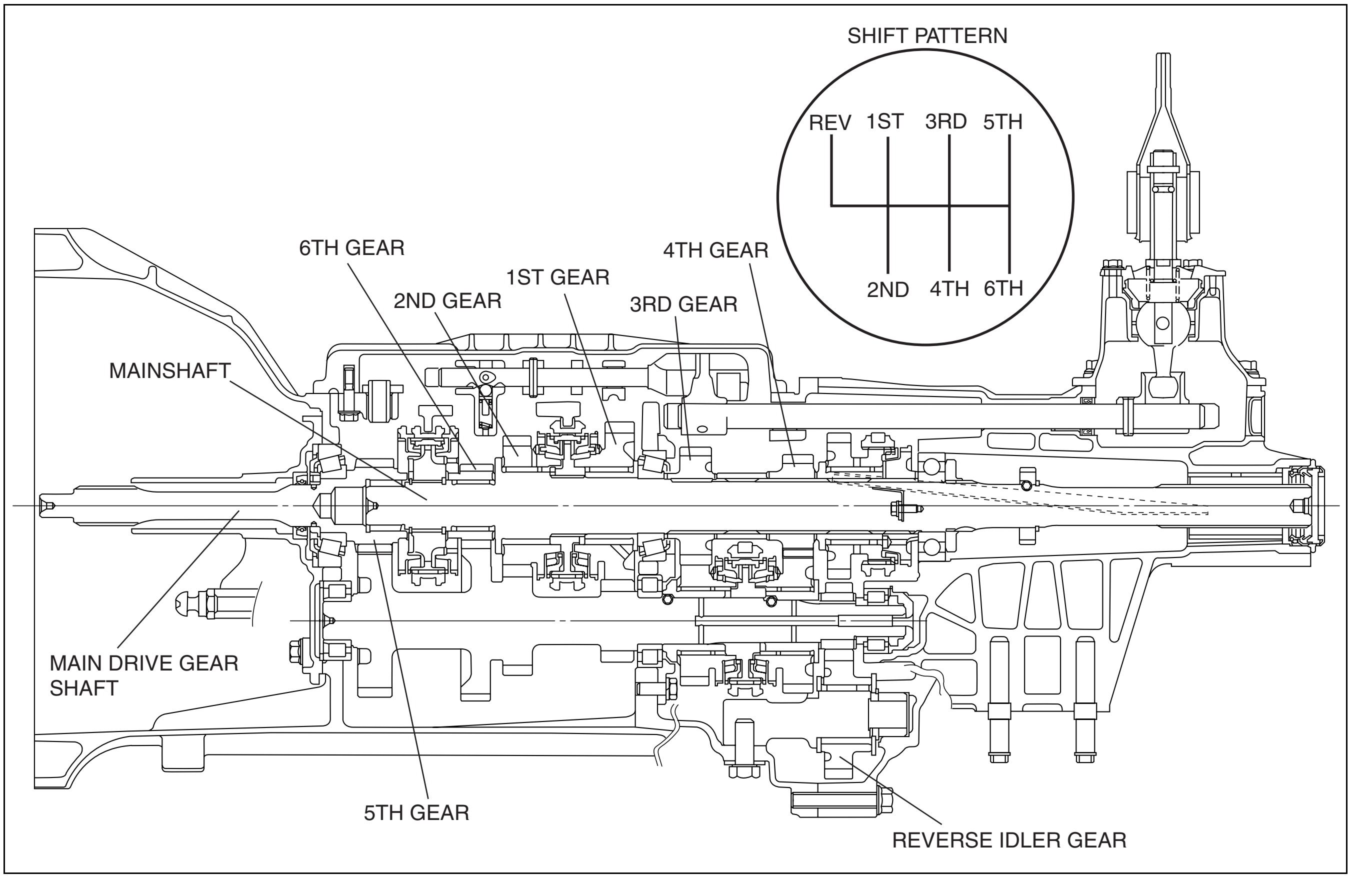
Transmission

- Manual transmission [M15M-D]
  - — A linked, triple-cone synchronizer mechanism has been adopted for 1st and 2nd gears.
  - — A linked, double-cone synchronizer mechanism has been adopted for 3rd gears.
  - — A linked, carbon-cone synchronizer mechanism has been adopted for 4th gears.
  - — A cam-type reverse lockout mechanism has been adopted.



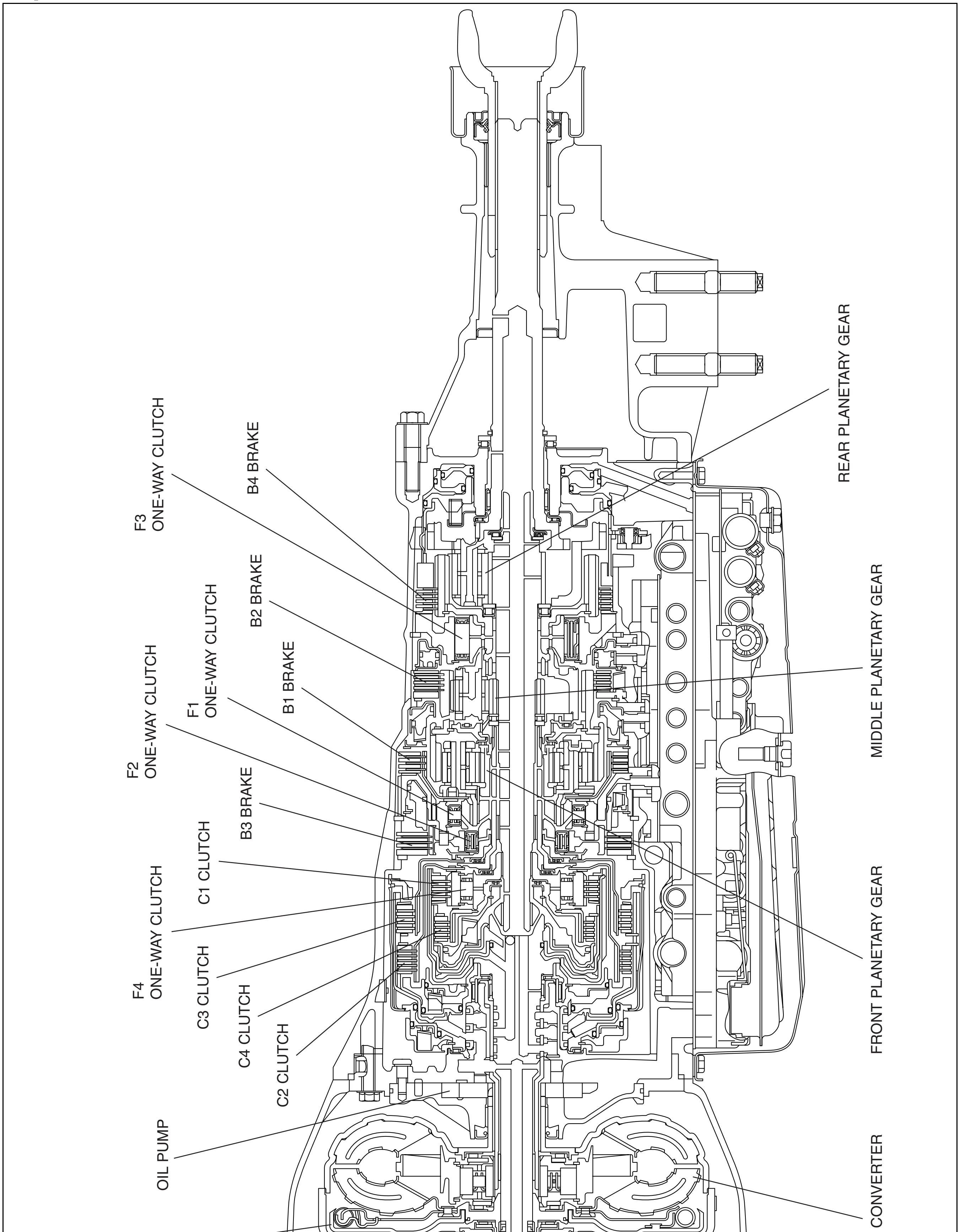
E5U511AS5001

- Manual transmission [P66M-D]
  - — A linked, triple-cone synchronizer mechanism has been adopted for 1st, 2nd, 3rd and 4th gears.
  - — A guide plate type reverse lockout mechanism has been adopted.



E5U511BS5007

- Automatic transmission [SJ6A-EL]
  - — Newly developed SJ6A-EL type 6-speed AT has been adopted.
  - — With the adoption of the line pressure solenoid, TCC control solenoid, solenoid for C3 clutch, solenoid for B2 brake, and the linear type solenoid, dynamic shift quality has been realized.



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Safety

- An immobilizer system has been adopted. This anti-theft device prevents the engine from being started unless the encrypted identification code, transmitted from a special electronic chip embedded in the key, corresponds with the identification code registered in the vehicle.
- World-class collision protection is provided due to the lightweight and highly rigid Mazda Advanced Impact-energy Distribution and Absorption System body.
- 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 seat passengers.
- Side air bags that effectively protect the chest area have been adopted for the seats.
- Pre-tensioner and load limiter mechanisms have been adopted for the seat belts.
- A steering column designed to collapse horizontally to minimize impact to the driver's head and chest has been adopted.
- An intrusion minimizing brake pedal has been adopted.
- Both ISOFIX and tether strap anchors are provided in the seat for child-seat fixing.

VEHICLE IDENTIFICATION NUMBER (VIN) CODE

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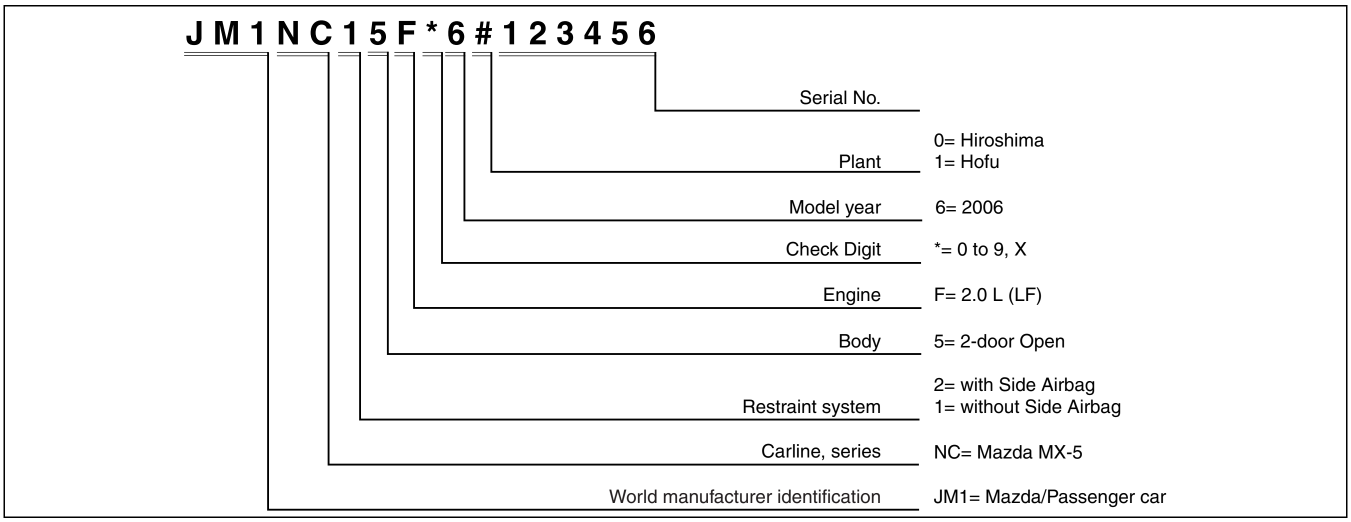

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VEHICLE IDENTIFICATION NUMBERS (VIN)

E5U000000000N07

JM1 NC15F*6# 100001—
JM1 NC25F*6# 100001—

UNITS

E5U000000000N04

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

E5U000000000N05

- 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 sensor	Mass Air Flow Sensor	
ACL	Air Cleaner			MFL	Multiport Fuel Injection	
A/C	Air Conditioning			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	
CAC	Charge Air Cooler			PNP	Park/Neutral Position	
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 Test 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 sensor	Throttle Position Sensor	
EGR	Exhaust Gas Recirculation			TCC	Torque Converter Clutch	
FC	Fan Control			TCM	Transmission (Transaxle) Control Module	
FF	Flexible Fuel					
4GR	Fourth Gear			TR	Transmission (Transaxle) Range	
GEN	Generator			TC	Turbocharger	
GND	Ground			VSS	Vehicle Speed Sensor	
HO2S	Heated Oxygen Sensor	With heater		VR	Voltage Regulator	
				VAF sensor	Volume Air Flow Sensor	
IAC	Idle Air Control			WU-TWC	Warm Up Three Way Catalytic Converter	#4
IAT	Intake Air Temperature					
KS	Knock Sensor			WOP	Wide Open Throttle	
MIL	Malfunction Indicator Lamp					

#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 [LF]

E5U010002000N01

ABS	Antilock Brake System
AT	Automatic Transmission
ATF	Automatic Transmission Fluid
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CM	Control Module
DC	Drive Cycle
DSC	Dynamic Stability Control
E/L	Electrical Load
EX	Exhaust
FFD	Freeze Frame Data
HU	Hydraulic Unit
IG	Ignition
IN	Intake
KOEO	Key On Engine Off
KOER	Key On Engine Running
M	Motor
MAX	Maximum
MT	Manual Transmission
OCV	Oil Control Valve
PCV	Positive Crankcase Ventilation
PID	Parameter Identification
P/S	Power Steering
RAM	Random Access Memory
SST	Special Service Tool
TDC	Top Dead Center
WDS	Worldwide Diagnostic System

ENGINE FEATURES [LF]

E5U010002000N02

Mechanical

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

Lubrication

Reduced noise	• Aluminum alloy oil pan adopted
Reduced weight	• Plastic oil strainer adopted
Improved lubricity	• Trochoid gear type oil pump adopted • Oil jet valves adopted

Cooling System

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

Intake-Air System

Improved engine torque	• Variable intake air system adopted

Fuel System

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

Emission System

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

Charging System

Improved reliability	• Battery duct adopted
Miniaturization	• Non-regulator type generator with built-in power transistor adopted
Reduced operation noise	• Generator with two delta connection type stator coils adopted

Ignition System

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

Starting System

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

Control System

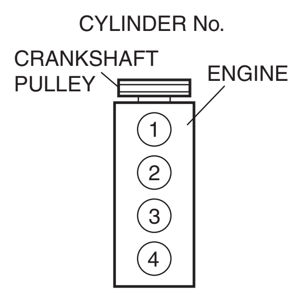
Improved driveability	• Drive-by-wire control adopted • Variable intake air control adopted • Variable valve timing control adopted
Improved exhaust emission performance	• Wide-range air/fuel ratio sensor has been adopted for the front HO2S • EGR control adopted
Wiring harness simplification	• CAN adopted

ENGINE SPECIFICATION [LF]

E5U010002000N03

Specification

Item			Specification LF (2.0L)
MECHANICAL			
Type			DOHC-16V in-line, 4-cylinder
Combustion chamber			Pentroof
Displacement (ml {cc, cu in})			1,999 {1,999, 122.0}
Bore × stroke (mm {in})			87.5 × 83.1 {3.44 ×3.27}
Compression ratio			10:8
Compression pressure (kPa {kgf/cm^2, psi} [rpm])			1,720 {17.54, 249.5} [300]
Valve timing	IN	Open BTDC (°)	0—30
		Close ABDC (°)	32—62
	EX	Open BBDC (°)	42
		Close ATDC (°)	5
Valve clearance (mm {in})		IN	0.22—0.28 {0.0087—0.011} [Engine cold]
		EX	0.27—0.33 {0.0107—0.0129} [Engine cold]
LUBRICATION SYSTEM			
Type			Force-fed type
Oil pressure (reference value) [oil temperature: 100°C {212°F}] (kPa {kgf/cm^2, psi} [rpm])			337—591 {3.44—6.03, 49.0—85.8} [3,000]
Oil pump	Type		Trochoid gear type
	Relief valve opening pressure (reference value) (kPa {kgf/cm^2, psi}		420—520 {4.28—5.30, 60.9—75.4}
Oil filter	Type		Full-flow, paper element
	Bypass pressure (kPa {kgf/cm^2, psi})		80—120 {0.82—1.22, 11.6—17.4}
Oil capacity (approx. quantity)	Total (dry engine) (L {US qt, Imp qt})		4.6 {4.9, 4.0}
	Oil replacement (L {US qt, Imp qt})		3.9 {4.1, 3.4}
	Oil and oil filter replacement (L {US qt, Imp qt})		4.3 {4.5, 3.8}
COOLING SYSTEM			
Type			Water-cooled, Electromotive
Coolant capacity (approx. quantity) (L {US qt, Imp qt})			7.5 {7.9, 6.6}
Water pump	Type		Centrifugal, V-ribbed belt-driven
Thermostat	Type		Wax, bottom-bypass
	Opening temperatur e (°C {°F})		80—84 {176—183}
	Full-open temperature (°C {°F})		97 {207}
	Full-open lift (mm {in})		8.0 {0.31} or more
Radiator	Type		Corrugated fin
Cooling system cap	Cap valve opening pressure (kPa {kgf/cm^2, psi})		93.2—122.6 {0.95—1.25, 13.5—17.8}
Cooling fan	Type		Electric
	Number of blades		5
	Outer diameter (mm {in})		360 {14.2}
	Fan motor output (W)		120

Item		Specification LF (2.0L)
FUEL SYSTEM		
Injector	Type	Hi-ohmic
	Type of fuel delivery	Top-feed
	Type of drive	Voltage
Pressure regulator control pressure (kPa {kgf/cm^2, psi})		Approx. 390 {3.98, 56.6}
Fuel pump type		Electric
Fuel tank capacity (L {US gal, Imp gal})		48 {12, 10}
Fuel type (Anti-knock index)		Premium unleaded fuel (96 RON or more)
EMISSION SYSTEM		
EGR type		Stepping motor
Catalyst form		WU-TWC (monolith), TWC (monolith)
Evaporative emission (EVAP) control system		Charcoal canister type
Positive crankcase ventilation (PCV) system		Closed type
CHARGING SYSTEM		
Battery	Voltage (V)	12
	Type and capacity (5-hour rate) (A·h)	46B24L (36)
Generator	Output (V-A)	12-100
	Regulated voltage	Controlled by PCM
	Self diagnosis function	
IGNITION SYSTEM		
Ignition system	Type	SEI (Single Electronic Ignition)
	Spark advance	Electronic
	Firing order	1—3—4—2 (all cylinders independent firing) 
Spark plug	Type	L3G2 18 110, L3Y1 18 110
STARTING SYSTEM		
Starter	Type	Coaxial reduction
	Output (kW)	1.4

Engine oil specification

Item	U.S.A. and CANADA	Except U.S.A. and CANADA
Engine oil grade	AMERICAN PETROLEUM INSTITUE FOR GASOLINE ENGINES CERTIFIED (ILSAC)	API SERVICE SL SAE 5W-20 ENERGY CONSERVINGII AMERICAN PETROLEUM INSTITUE FOR GASOLINE ENGINES CERTIFIED (ILSAC) API SL or ILSAC
Engine oil viscosity	5W–20	

01–02 ON-BOARD DIAGNOSTIC

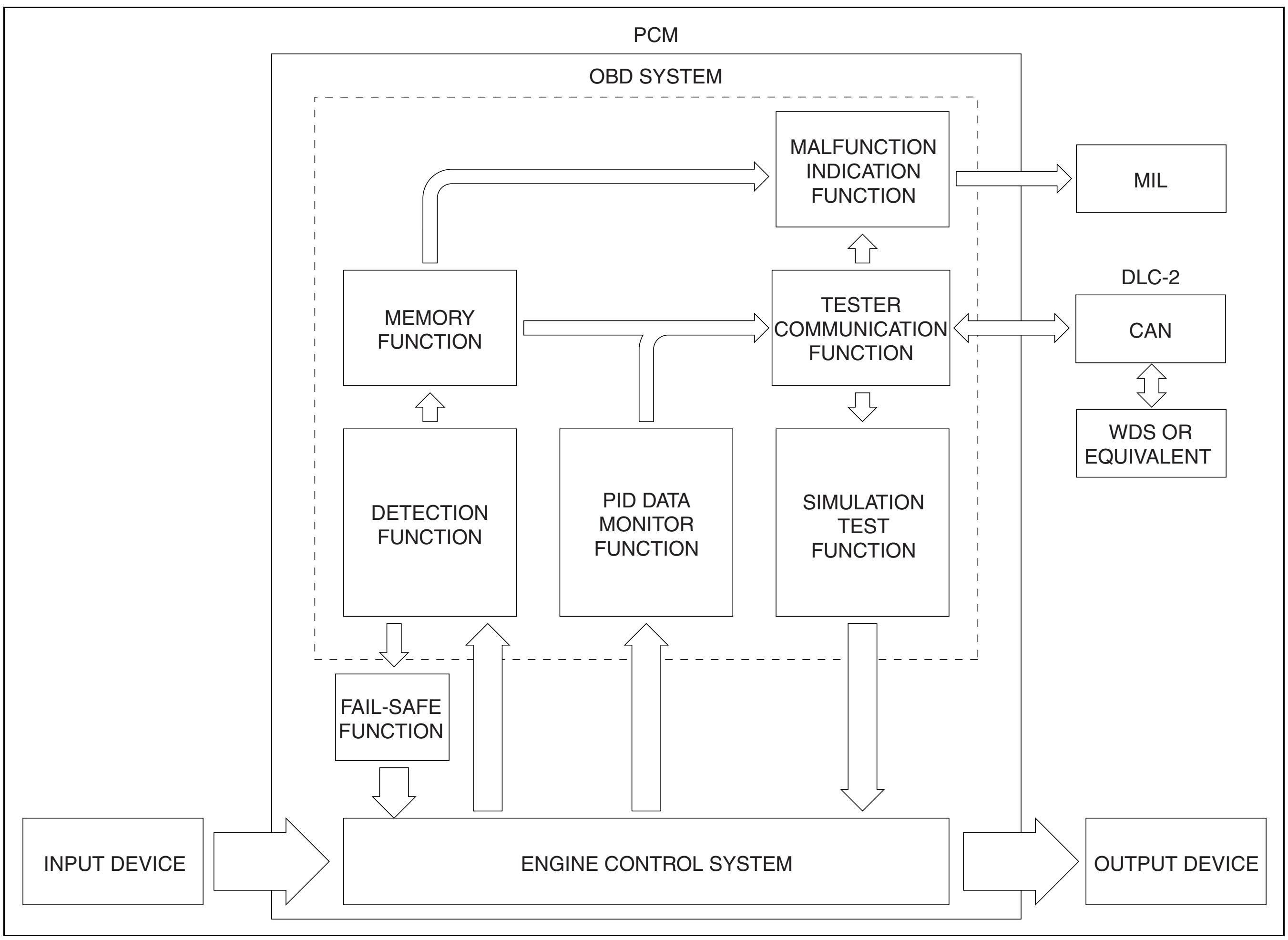
ON-BOARD DIAGNOSTIC OUTLINE [LF]

E5U010200000N01

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 SYSTEM WIRING DIAGRAM [LF]

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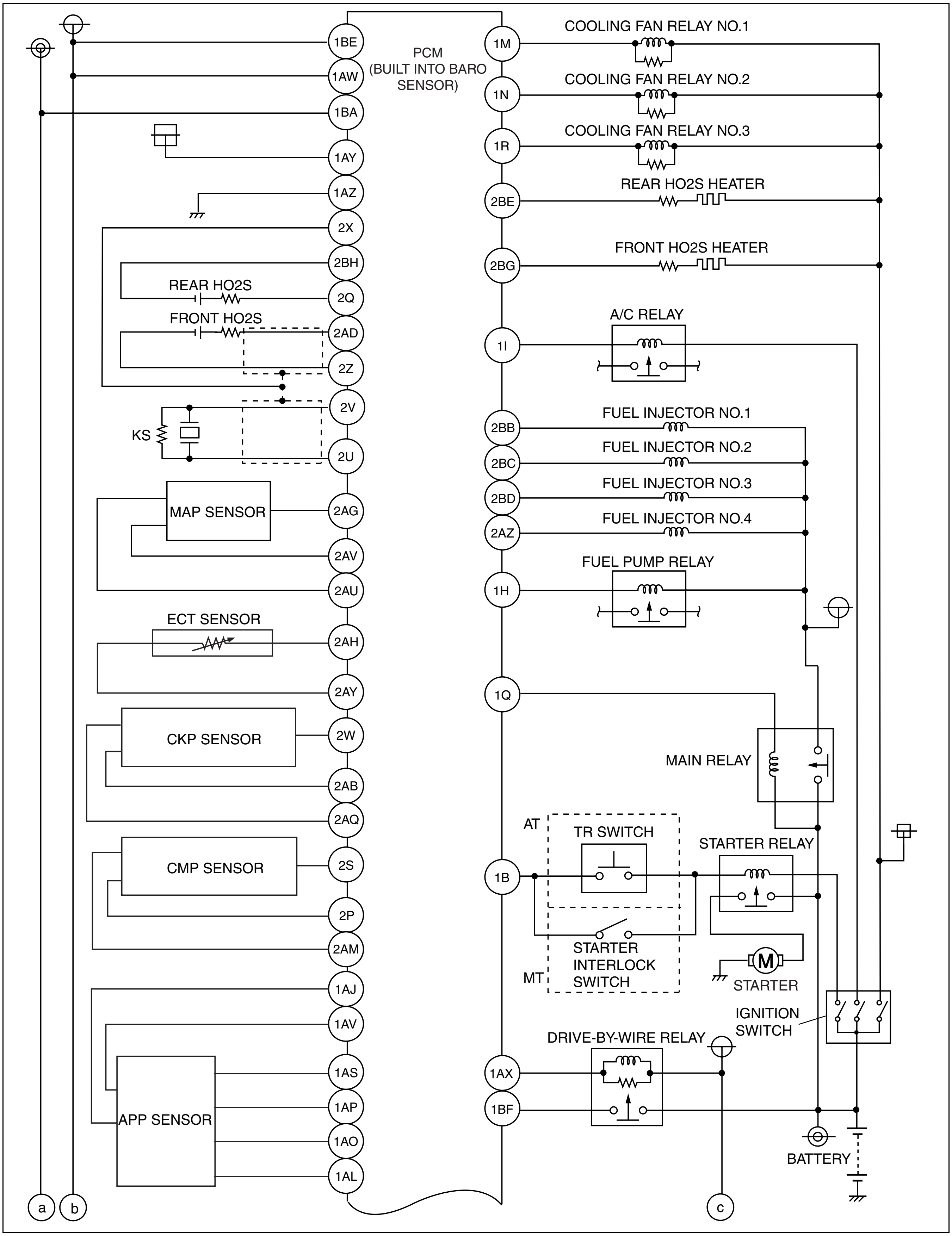

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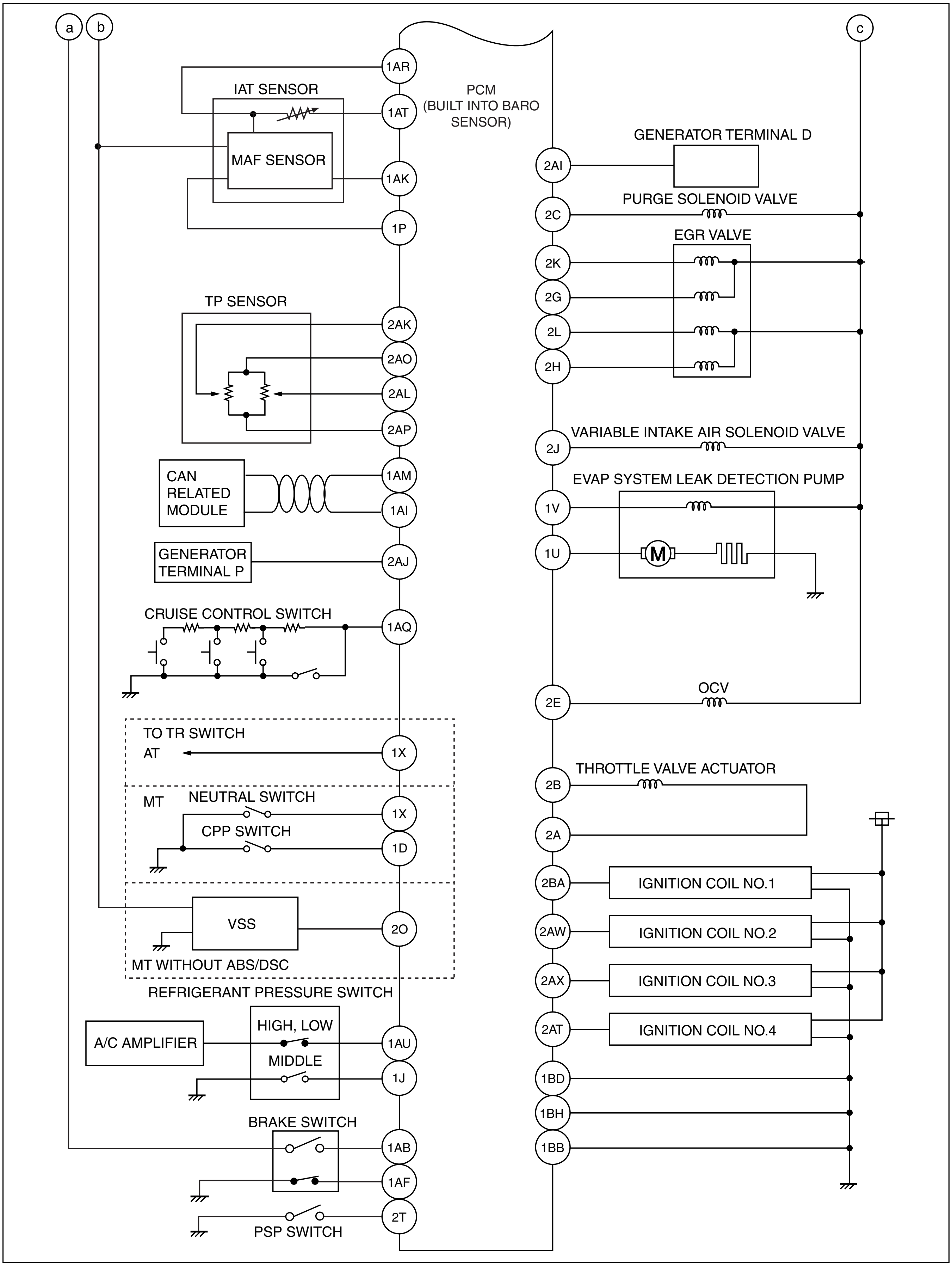

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DIAGNOSTIC TEST MODE [LF]

E5U010200000N02

- 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

Full names	Unit	
Fuel system loop status	Refer to list below.	
LOAD	%	
ECT	°C	°F
Short term fuel trim	%	
Long term fuel trim	%	
MAP	kPa	
Engine speed	rpm	
Vehicle speed	km/h	mph
Spark advance	°	
IAT	°C	°F
MAF	g/s	
Absolute TP	%	
O2S location	No unit	
Input voltage from rear HO2S	V	
Short term fuel trim associated with rear HO2S	%	
OBD requirement according to vehicle design	No unit	
Time since engine start	s	
Distance travelled while MIL is activated	km	miles
EGR valve control signal	%	
Purge solenoid valve control signal	%	
Fuel level	%	
Number of warm-ups since DTCs cleared	No unit	
Distance travelled since DTCs cleared	km	miles
Barometric pressure	kPa	
Lambda	—	
Front HO2S output current	mA	
Estimated catalyst converter temperature	°C	°F
PCM voltage	V	
Absolute load value	%	
Theoretical air/fuel ratio coefficient to calculate target air/fuel ratio	No unit	
Relative TP	%	
Ambient air temperature	°C	°F
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 stops: ECT is lower than the determined feedback zone.
  - — Feedback operating: HO2S being used for feedback is normal.
  - — Feedback stops: Open loop due to driving condition
  - — Feedback stops: Open loop due to detected system fault
  - — Feedback operating: Malfunction occurred in HO2S (rear) system

On-board system readiness test

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

  Continuous monitoring system
  - — HO2S heater
  - — HO2S
  - — Fuel system
  - — Misfire
  - — CCM

  Intermittent monitoring system
  - — HO2S heater
  - — HO2S
  - — Catalyst
  - — EGR system
  - — Evaporative system
  - — Engine cooling system

Sending Freeze Frame Data

- The Freeze Frame Data monitor items are shown below.

Freeze frame data monitor table

Full names	Unit	
DTC that caused required Freeze Frame Data storage	No unit	
Fuel system loop status	Refer to list below.	
LOAD	%	
ECT	°C	°F
Short term fuel trim	%	
Long term fuel trim	%	
MAP	kPa	
Engine speed	rpm	
Vehicle speed	km/h	mph
Spark advance	°	
IAT	°C	°F
MAF	g/s	
Absolute TP	%	
Time since engine start	s	
EGR valve control signal	%	
Purge solenoid valve control signal	%	
Fuel level	%	
Number of warm-ups since DTCs cleared	No unit	
Distance travelled since DTCs cleared	km	miles
Barometric pressure	kPa	
Estimated catalyst converter temperature	°C	°F
PCM voltage	V	
Absolute load value	%	
Theoretical air/fuel ratio coefficient to calculate target air/fuel ratio	No unit	
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 stops: ECT is lower than the determined feedback zone.
  — Feedback operating: HO2S being used for feedback is normal.
  — Feedback stops: Open loop due to driving condition
  — Feedback stops: Open loop due to detected system fault
  — Feedback operating: Malfunction occurred in HO2S (rear) system

Sending Emission-related Malfunction Code

- The DTCs are shown below.

×: Applicable
—: Not applicable

DTC No.	Condition	MIL	DC	Monitor item	Self-test type*3	Memory function
B1342	PCM malfunction	OFF	—	—	C, R	×
P0011	CMP timing over-advanced	ON	1	CCM	C, R	×
P0012	CMP timing over-retarded	ON	2	CCM	C, R	×
P0016	CKP-CMP correlation	ON	2	CCM	C	×
P0030	Front HO2S heater control circuit problem	ON	2	HO2S heater	C, O, R	×
P0031	Front HO2S heater circuit low input	ON	2	HO2S heater	C, O, R	×
P0032	Front HO2S heater circuit high input	ON	2	HO2S heater	C, O, R	×
P0037	Rear HO2S heater circuit low input	ON	2	HO2S heater	C, O, R	×
P0038	Rear HO2S heater circuit high input	ON	2	HO2S heater	C, O, R	×

DTC No.	Condition	MIL	DC	Monitor item	Self-test type*3	Memory function
P0069	Manifold absolute pressure/atmospheric pressure correlation	ON	2	CCM	C	×
P0101	MAF sensor circuit range/performance problem	ON	2	CCM	C	×
P0102	MAF sensor circuit low input	ON	1	CCM	C, O, R	×
P0103	MAF sensor circuit high input	ON	1	CCM	C, O, R	×
P0107	MAP sensor circuit low input	ON	1	CCM	C, O, R	×
P0108	MAP sensor circuit high input	ON	1	CCM	C, O, R	×
P0111	IAT sensor circuit range/performance problem	ON	2	CCM	C	×
P0112	IAT sensor circuit low input	ON	1	CCM	C, O, R	×
P0113	IAT sensor circuit high input	ON	1	CCM	C, O, R	×
P0116	Engine coolant temperature circuit range/ performance	ON	1	Engine cooling system	C	×
P0117	ECT sensor circuit low input	ON	1	Engine cooling system	C, O, R	×
P0118	ECT sensor circuit high input	ON	1	Engine cooling system	C, O, R	×
P0122	TP sensor No.1 circuit low input	ON	1	CCM	C, O, R	×
P0123	TP sensor No.1 circuit high input	ON	1	CCM	C, O, R	×
P0125	Excessive time to enter closed loop fuel control	ON	2	Engine cooling system	C	×
P0126	Coolant thermostat stuck open	ON	2	Engine cooling system	C	×
P0128		ON	2	Engine cooling system	C	×
P0130	Front HO2S circuit problem	ON	2	HO2S	C, O, R	×
P0131	Front HO2S circuit low input	ON	2	HO2S	C, O, R	×
P0132	Front HO2S circuit high input	ON	2	HO2S	C, O, R	×
P0133	Front HO2S circuit problem	ON	2	HO2S	C	×
P0134	Front HO2S no activity detected	ON	2	HO2S	C, R	×
P0137	Rear HO2S circuit low input	ON	2	HO2S	C, O, R	×
P0138	Rear HO2S circuit high input	ON	2	HO2S	C, O, R	×
P0139	Rear HO2S circuit problem	ON	2	HO2S	C	×
P0140	Rear HO2S no activity detected	ON	2	HO2S	C, R	×
P0222	TP sensor No.2 circuit low input	ON	1	CCM	C, O, R	×
P0223	TP sensor No.2 circuit high input	ON	1	CCM	C, O, R	×
P0300	Random misfire detected	Flash/ ON	1 or 2	Misfire	C, R	×
P0301	Cylinder No.1 misfire detected	Flash/ ON	1 or 2	Misfire	C, R	×
P0302	Cylinder No.2 misfire detected	Flash/ ON	1 or 2	Misfire	C, R	×
P0303	Cylinder No.3 misfire detected	Flash/ ON	1 or 2	Misfire	C, R	×
P0304	Cylinder No.4 misfire detected	Flash/ ON	1 or 2	Misfire	C, R	×
P0327	KS circuit low input	ON	1	CCM	C, O, R	×
P0328	KS circuit high input	ON	1	CCM	C, O, R	×
P0335	CKP sensor circuit problem	ON	1	CCM	C	×
P0340	CMP sensor circuit problem	ON	1	CCM	C	×
P0401	EGR flow insufficient detected	ON	2	EGR system	C, R	×
P0403	EGR valve (stepping motor) circuit problem	ON	2	CCM	C, O, R	×
P0421	Warm up catalyst system efficiency below threshold	ON	2	Catalyst	C	×
P0441	Evaporative emission control system incorrect purge flow	ON	2	Evaporative system	C, R	×

DTC No.	Condition	MIL	DC	Monitor item	Self-test type*3	Memory function
P0442	Evaporative emission control system leak detected (small leak)	ON	2	Evaporative system	C, R	×
P0443	Purge solenoid valve circuit problem	ON	2	CCM	C, O, R	×
P0446	Change over valve (COV) (EVAP system leak detection pump) stuck close	ON	2	CCM	C, R	×
P0455	Evaporative emission control system leak detected (gross leak)	ON	2	Evaporative system	C, R	×
P0456*1	Evaporative emission control system leak detected (very small leak)	ON	2	Evaporative system	C, R	×
P0461	Fuel gauge sender unit range/performance problem	ON	2	CCM	C	×
P0462	Fuel gauge sender unit circuit low input	ON	2	CCM	C, O, R	×
P0463	Fuel gauge sender unit circuit high input	ON	2	CCM	C, O, R	×
P0480	Cooling fan relay No.1 control circuit malfunction	OFF	1	Other	C, O, R	×
P0481	Cooling fan relay No.2 control circuit malfunction	OFF	1	Other	C, O, R	×
P0482	Cooling fan relay No.3 control circuit malfunction	OFF	1	Other	C, O, R	×
P0500*4	VSS circuit problem	ON	2	CCM	C	×
P0505	Idle speed control system problem	OFF	—	—	R	—
P0506	Idle speed control system RPM lower than expected	ON	2	CCM	C	×
P0507	Idle speed control system RPM higher than expected	ON	2	CCM	C	×
P0550	PSP switch circuit malfunction	ON	2	CCM	C	×
P0564	Cruise control switch circuit malfunction	OFF	1	Other	C	×
P0571	Brake switch circuit problem	OFF	1	Other	C	×
P0601	PCM memory check sum error	ON	1	CCM	C, O, R	×
P0602	PCM programming error	ON	1	CCM	C, O, R	×
P0604	PCM random access memory (RAM) error	ON	1	CCM	C, O, R	×
P0606	PCM processor	ON	1	CCM	C, O, R	×
P0610	PCM vehicle options error	ON	1	CCM	C, O, R	×
P0638	Throttle actuator control circuit range/ performance problem	ON	1	CCM	C	×
P0661	Variable intake air solenoid valve circuit low input	OFF	1	Other	C, O, R	×
P0662	Variable intake air solenoid valve circuit high input	OFF	1	Other	C, O, R	×
P0703	Brake switch input circuit problem	ON	2	CCM	C	×
P0704*2	Clutch pedal position (CPP) switch input circuit problem	ON	2	CCM	C	×
P0850*2	Neutral switch input circuit problem	ON	2	CCM	C	×
P1260	Immobilizer system problem	OFF	1	Other	C, O	×
P2088	Oil control valve (OCV) circuit low	ON	1	CCM	C, O, R	×
P2089	Oil control valve (OCV) circuit high	ON	1	CCM	C, O, R	×
P2096	Target A/F feedback system too lean	ON	2	Fuel system	C	×
P2097	Target A/F feedback system too rich	ON	2	Fuel system	C	×
P2101	Throttle actuator circuit range/performance	ON	1	CCM	C, R	×
P2107	Throttle actuator control module processor error	ON	1	CCM	C, R	×
P2108	Throttle actuator control module performance error	ON	1	CCM	C, R	×
P2109	TP sensor minimum stop range/performance problem	ON	1	CCM	C, R	×
P2112	Throttle actuator control system range/ performance problem	ON	1	CCM	C, R	×

DTC No.	Condition	MIL	DC	Monitor item	Self-test type*3	Memory function
P2119	Throttle actuator control throttle body range/ performance problem	ON	2	CCM	C, R	×
P2122	APP sensor No.1 circuit low input	ON	1	CCM	C, O, R	×
P2123	APP sensor No.1 circuit high input	ON	1	CCM	C, O, R	×
P2127	APP sensor No.2 circuit low input	ON	1	CCM	C, O, R	×
P2128	APP sensor No.2 circuit high input	ON	1	CCM	C, O, R	×
P2135	TP sensor No.1/No.2 voltage correlation problem	ON	1	CCM	C, O, R	×
P2138	APP sensor No.1/No.2 voltage correlation problem	ON	1	CCM	C, O, R	×
P2177	Fuel system too lean at off idle	ON	2	Fuel system	C, R	×
P2178	Fuel system too rich at off idle	ON	2	Fuel system	C, R	×
P2187	Fuel system too lean at idle	ON	2	Fuel system	C, R	×
P2188	Fuel system too rich at idle	ON	2	Fuel system	C, R	×
P2195	Front HO2S signal stuck lean	ON	2	HO2S	C	×
P2196	Front HO2S signal stuck rich	ON	2	HO2S	C	×
P2228	BARO sensor circuit low input	ON	1	CCM	C, O, R	×
P2229	BARO sensor circuit high input	ON	1	CCM	C, O, R	×
P2401	EVAP system leak detection pump motor circuit low	ON	2	CCM	C, R	×
P2402	EVAP system leak detection pump motor circuit high	ON	2	CCM	C, R	×
P2404	EVAP system leak detection pump sense circuit problem	ON	2	CCM	C, R	×
P2405	EVAP system leak detection pump sense circuit low input	ON	2	CCM	C, R	×
P2407	EVAP system leak detection pump sense circuit intermittent	ON	2	CCM	C, R	×
P2502	Charging system voltage problem	OFF	1	Other	C, R	×
P2503	Charging system voltage low	OFF	1	Other	C, R	×
P2504	Charging system voltage high	OFF	1	Other	C, R	×
P2507	PCM B+ voltage low	ON	1	CCM	C, O, R	×
P2610	PCM internal engine off timer performance	ON	2	CCM	C	×

*1 : California emission regulation applicable model
*2 : MT
*3 : C: CMDTC self-test, O: KOEO self-test, R: KOER self-test
*4 : With ABS/DSC or MT without ABS/DSC

Sending Intermittent Monitoring System Test Results

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

TEST ID	Description	Related system
10:01:84	HO2S (Front) period (calculated)	HO2S
10:02:03	Low HO2S (Rear) voltage for switch time calculation (constant)	
10:02:04	High HO2S (Rear) voltage for switch time calculation (constant)	
10:02:05	HO2S (Rear) rich-to-lean response time (calculated)	
10:21:80	HO2S (Front) and HO2S (Rear) switching time ratio	Catalyst
10:31:83	EGR pressure variation	EGR
10:3A:80	EVAP system leak detection pump large leak check	EVAP
10:3B:80	EVAP system leak detection pump small leak check	
10:3C:80*1	EVAP system leak detection pump very small leak check	
10:3D:80	Purge flow monitor	
10:A2:0B	Cylinder No.1 average misfire counts for last 10 DC	Misfire
10:A2:0C	Cylinder No.1 misfire counts for last/current DC	
10:A3:0B	Cylinder No.2 average misfire counts for last 10 DC	
10:A3:0C	Cylinder No.2 misfire counts for last/current DC	
10:A4:0B	Cylinder No.3 average misfire counts for last 10 DC	
10:A4:0C	Cylinder No.3 misfire counts for last/current DC	
10:A5:0B	Cylinder No.4 average misfire counts for last 10 DC	
10:A5:0C	Cylinder No.4 misfire counts for last/current DC	
10:E1:80	Heat radiation ratio	Thermostat
10:E1:81	Engine coolant temperature	

*1 : California emission regulation applicable model

Sending Continuous Monitoring System Test Results

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

1-drive cycle type

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

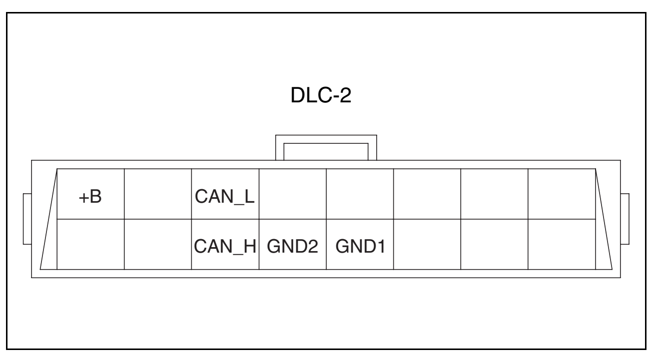
2-drive cycle type

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

DLC-2 Outline

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

Terminal name	Function
B+	Battery positive voltage
CAN_L	Serial communication Lo terminal
CAN_H	Serial communication Hi terminal
GND1	Ground (chassis)
GND2	Ground (signal)



E5U102ZS4001

DTC DETECTION LOGIC AND CONDITIONS [LF]

E5U010200000N03

B1342 PCM malfunction
- Malfunction in the PCM internal circuit.

P0011 CMP Timing over-advanced
- The actual valve timing is over-advanced by **15** ° from the target valve timing for specified period when the oil control valve (OCV) is controlled in the maximum valve timing retard condition.
  Monitoring condition
  — Engine coolant temperature is **above 63 °C {145.4 °F}**

P0012 CMP timing over-retarded
- Actual valve timing is over-retarded by **10** ° from the target valve timing for specified period when the oil control valve (OCV) system control is within the feedback range.
  Monitoring condition
  — Engine coolant temperature is **above 63 °C {145.4 °F}**

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

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 circuit low input
- The PCM monitors the front HO2S heater control voltage when the PCM turns the front HO2S heater off. If the control voltage **exceeds 50%** of the battery voltage, the PCM determines that the front HO2S heater control circuit voltage is low.

P0032 Front HO2S heater circuit high input
- 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 50%** of the battery voltage, the PCM determines that the front HO2S heater control circuit voltage is high.

P0037 Rear HO2S heater circuit low input
- 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 circuit high input
- 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.

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

P0101 MAF sensor circuit range/performance problem
- PCM monitors mass intake air flow amount when the engine is running.
  — If the mass intake air flow amount is **above 37 l/s** for **5 s** and the engine speed is **below 2,000 rpm** with the engine running, the PCM determines that the detected mass intake air flow amount is too high.
  — If the mass intake air flow amount is **below 4.4—59 l/s** (The value depends on engine speed.) for **5 s** and the engine speed is **above 1,000 rpm** with the engine running and the throttle opening angle **above 50 %**, the PCM determines that detected the mass intake air flow amount is too low.

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

P0103 MAF sensor circuit high input
- The PCM monitors the input voltage from the MAF sensor when the engine running. If the input voltage is **above 4.92 V**, the PCM determines that the MAF circuit has a malfunction.

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

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

P0111 IAT sensor circuit range/performance problem
- If intake air temperature is higher than engine coolant temperature by **18 °C {32.4 °F} for 1.2 s** with ignition switch on*, the PCM determines that there is a intake air temperature sensor circuit range/performance problem.

*: Ignition switch on when **6 h** or more has passed since the previous ignition switch off

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

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

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

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

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

P0122 TP sensor No.1 circuit low input
- If the PCM detects that the TP sensor No.1 voltage is **below 0.1 V** while the engine is running, the PCM determines that the TP sensor No.1 circuit has a malfunction.

P0123 TP sensor No.1 circuit high input
- If the PCM detects the TP sensor No.1 voltage is to be **above 4.9 V** after ignition switch to the ON position, PCM determines that TP sensor No.1 circuit has a malfunction.

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

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

P0128 Coolant thermostat stuck open
- PCM monitors MAF, IAT, VSS and EAT signals and calculate radiator's heat radiation ratio while following monitoring conditions are met. If calculated value exceeds threshold, PCM determines that the coolant thermostat is stuck open.
  MONITORING CONDITIONS
  — IAT: **above –10°C {14 °F}**
  — ECT at engine start: **Below 36 °C {97 °F}**
  — Difference between ECT at engine start and minimum IAT: **Below 6 °C {10.8 °F}**
  — Vehicle speed: **over 30 km/h {18.6 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 input
- 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 input
- 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 problem

- Front HO2S malfunction is detected by measuring of the average frequency of front HO2S signal, time required to pass from rich to lean, time required to pass from lean to rich. If the average frequency of front HO2S signal is more than the threshold value, the PCM determines that there is the front HO2S circuit problem.
  MONITORING CONDITIONS
  — HO2S heater, HO2S, and TWC Repair Verification Drive Mode
  — Following conditions are met:
    - Engine speed is **1,750—3,500 rpm**.
    - Charging efficiency is **25—63 %** (at engine speed **2,500 rpm**).
    - Engine coolant temperature is **above 70 °C {158 °F}**
    - Front HO2S heater monitor is completed.
    - Fuel system loop status is closed loop fuel control.

P0134 Front HO2S no activity detected

- The PCM monitors the front HO2S element impedance when the following conditions are met. If the front HO2S element impedance is **80 ohms** or more, the PCM determines that front HO2S is not activated.
  MONITORING CONDITIONS
  — HO2S, HO2S heater and TWC Repair Verification Drive Mode
  — Following conditions are met
    - Time from engine start is **above 30 s** (ECT when engine start is **20 °C {68 °F}**).

P0137 Rear HO2S circuit low input

- The PCM monitors input voltage from rear HO2S. If the input voltage from the rear HO2S is below **0.1 V** for **35.2 s** the PCM determines that circuit input is low.
  MONITORING CONDITIONS
  — HO2S, HO2S heater and TWC repair verification drive mode
  — Following conditions are met.
    - Engine speed is **above 1,500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.
    - Fuel injector control in rear HO2S closed loop control.
- The PCM monitors the input voltage from the rear HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the rear HO2S does not even **exceed 0.1 V** though the short term fuel trim is controlled up to **20.5 %** for **9.6 s**, the PCM determines that sensor circuit input is low.
  MONITORING CONDITIONS
  — HO2S, HO2S heater and TWC repair verification drive mode
  — Following conditions are met for **above 20.8 s**.
    - Engine speed is **above 1,500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.

P0138 Rear HO2S circuit high input

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

P0139 Rear HO2S circuit problem

- The PCM monitors the rich (**0.4 V**) to lean (**0.3 V**) response time of the rear HO2S. The PCM measures the response time when the following conditions are met. The PCM determines a rear HO2S response deterioration malfunction when the measured response time is more than the threshold value (**80 ms**) five consecutive times.
  MONITORING CONDITIONS
  — PCM Adaptive Memory Production, HO2S heater, HO2S, and TWC Repair Verification Drive Mode
  — Following conditions are met:
    - During deceleration fuel cut
    - Engine speed is **above 500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.
    - Rear HO2S output voltage ia **above 0.4 V**.
- The PCM monitors for a time-out malfunction (when rear HO2S remains **above 0.3 V** for longer than a specified period of time during fuel cut control). The PCM measures the amount of time from when the following conditions are met until the rear HO2S output voltage drops **below 0.3 V**. The PCM determines a rear HO2S time-out malfunction when the detected time is more than the threshold value (**6 s**) three consecutive times.
  MONITORING CONDITIONS
  — PCM Adaptive Memory Production, HO2S heater, HO2S, and TWC Repair Verification Drive Mode
  — Following conditions are met:
    - During deceleration fuel cut
    - Engine speed is **above 500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.
    - Rear HO2S is activated (**more than 0.55 V**)

P0140 Rear HO2S no activity detected

- The PCM monitors the input voltage from the rear HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the rear HO2S does not even **exceed 0.55 V** though the short term fuel trim is controlled up to **20.5%** for **9.6 s**, the PCM determines that sensor circuit is not activated.

  MONITORING CONDITIONS

  — HO2S, HO2S heater and TWC repair verification drive mode

  — Following conditions are met for **above 20.8 s**

    - Engine speed is **above 1,500 rpm**.
    - Engine coolant temperature is **above 70 °C {158 °F}**.

  — Rear HO2S voltage is **above 0.1 V**

P0222 TP sensor No.2 circuit low input

- If PCM detects TP sensor No.2 voltage is to be **below 0.1 V** after the ignition switch to the ON position, the PCM determines that TP circuit has a malfunction.

P0223 TP sensor No.2 circuit high input

- If the PCM detects the TP sensor No.2 voltage is to be **above 4.9 V** after the ignition switch to the ON position, the PCM determines that the TP circuit has a malfunction.

P0300 Random misfire detected

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

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

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

P0327 KS circuit low input

- The PCM monitors input signal from the KS when the engine is running. If the input voltage is **below 0.01 V** the PCM determines that the KS circuit has a malfunction.

P0328 KS circuit high input

- The PCM monitors the input signal from the KS when the engine is running. If the input voltage is **above 4.58 V** the PCM determines that KS circuit has a malfunction.

P0335 CKP sensor circuit problem

- If the PCM does not receive the input voltage from the CKP sensor for **4.2 s** while the MAF is **1.95 g/s {0.25 lb/min.} or above**, the PCM determines that the CKP sensor circuit has a malfunction.
- If a malfunction is detected in the input pulse pattern from the CKP sensor.

P0340 CMP sensor circuit problem

- The PCM monitors the input voltage from the CMP sensor when the engine is running. If the PCM does not receive the input voltage from the CMP sensor while the PCM receives the input signal from the CKP sensor, the PCM determines that the CMP circuit has a malfunction.
- If a malfunction is detected in the input pulse pattern from the CMP sensor.

P0401 EGR flow insufficient detected

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

P0403 EGR valve (stepping motor) circuit problem

- The PCM monitors the EGR valve control signal voltage and current. If the following conditions are met, the PCM determines that there is the EGR control circuit problem.

  — The PCM turns the EGR valve off, but the voltage of the EGR valve control signal remains low.

  — The PCM turns the EGR valve on, but the current of the EGR valve control signal remains high.

P0421 Warm up catalyst system efficiency below threshold

- PCM compares number of front HO2S and rear HO2S inversions for a predetermined time. PCM monitors number of inversions rear side performs while front side inverts for a specified number of times when the following monitoring conditions are met, PCM detects inversion ratio. If inversion ratio is below threshold, PCM determines that catalyst has deteriorated.
  MONITORING CONDITION
  — ECT: **more than 70 °C {158 °F}**
  — Calculated TWC temperature: **more than 400 °C {752 °F}**
  — Engine speed: **1,500—3,000 rpm**
  — LOAD: **15—48 %** (at engine speed **2,000 rpm**)
  — Time with purge control system does not operate: **more than 3 s**

P0441 Evaporative emission control system incorrect purge flow

- PCM measures the purge line pressure, which is the vacuum when a following condition. If vacuum between charcoal canister and intake manifold does not reach the specified, PCM determines that the EVAP system has clogging.
  MONITORING CONDITION
  — Engine speed: **1,500—3,500 rpm**
  — Throttle opening angle: **11—20%**
  — Vehicle speed: **69.5—136 km/h {43.2—84.5 mph} [MT]/34.5—136 km/h {21.4—84.5 mph} [AT]**

P0442 Evaporative emission control system leak detected (small leak)

- PCM measures the pump load current (EVAP line pressure) when the specified period has passed after EVAP system is sealed when monitoring conditions are met. If the load does not reach the reference current value within the specified period, PCM determines that the EVAP system has small leak.
  MONITORING CONDITION
  — The ignition switch is turned off.
  — IAT: **4.4—35 °C {40—95 °F}**
  — Battery voltage: **11 V or above**
  — Atmospheric pressure: **72.2 kPa {542 mmHg, 21.3 inHg} or above**
  — Fuel tank level: **15—85%**
  — Time from engine off : **5 h 10 min.**

P0443 Purge solenoid valve circuit problem

- The PCM monitors the purge solenoid valve control signal voltage and current. If the following conditions are met, the PCM determines that there is the purge solenoid valve control circuit problem.
  — The PCM turns the purge solenoid valve off, but the voltage of the purge solenoid valve control signal remains low.
  — The PCM turns the purge solenoid valve on, but the current of the purge solenoid valve control signal remains high.

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

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

P0455 Evaporative emission control system leak detected (gross leak)

- PCM measures the pump load current (EVAP line pressure) when the specified period has passed after EVAP system is sealed when monitoring conditions are met. If the load does not reach the reference current value within the specified period, PCM determines that the EVAP system has gross leak.
  MONITORING CONDITION
  — The ignition switch is turned off.
  — IAT: **4.4—35 °C {40—95 °F}**
  — Battery voltage: **11 V or above**
  — Atmospheric pressure: **72.2 kPa {542 mmHg, 21.3 inHg} or above**
  — Fuel tank level: **15—85%**
  — Time from engine off : **5 h 10 min.**

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

- PCM measure the pump load current (EVAP line pressure) when a specified period has passed after EVAP system is sealed when monitoring conditions are met. If the load does not reach the reference load value or rate of the load increase lower than the specified within a specified period, PCM determines that the EVAP system has very small leak.
  MONITORING CONDITION
  — The ignition switch is turned off.
  — IAT: **4.4—35 °C {40—95 °F}**
  — Battery voltage: **11 V or above**
  — Atmospheric pressure: **72.2 kPa {542 mmHg, 21.3 inHg} or above**
  — Fuel tank level: **15—85%**
  — Time from engine off : **5 h 10 min.**

P0461 Fuel gauge sender unit range/performance problem

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

P0462 Fuel gauge sender unit circuit low input

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

P0463 Fuel gauge sender unit circuit high input

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

P0480 Cooling fan relay No.1 control circuit malfunction

- The PCM monitors the cooling fan relay No.1 control signal voltage and current. If the following conditions are met, the PCM determines that there is the cooling fan relay No.1 control circuit problem.
  — The PCM turns the cooling fan relay No.1 off, but the voltage of the cooling fan relay No.1 control signal remains low.
  — The PCM turns the cooling fan relay No.1 on, but the current of the cooling fan relay No.1 control signal remains high.

P0481 Cooling fan relay No.2 control circuit malfunction

- The PCM monitors the cooling fan relay No.2 control signal voltage and current. If the following conditions are met, the PCM determines that there is the cooling fan relay No.2 control circuit problem.
  — The PCM turns the cooling fan relay No.2 off, but the voltage of the cooling fan relay No.2 control signal remains low.
  — The PCM turns the cooling fan relay No.2 on, but the current of the cooling fan relay No.2 control signal remains high.

P0482 Cooling fan relay No.3 control circuit malfunction

- The PCM monitors the cooling fan relay No.3 control signal voltage and current. If the following conditions are met, the PCM determines that there is the cooling fan relay No.3 control circuit problem.
  — The PCM turns the cooling fan relay No.3 off, but the voltage of the cooling fan relay No.3 control signal remains low.
  — The PCM turns the cooling fan relay No.3 on, but the current of the cooling fan relay No.3 control signal remains high.

P0500 VSS circuit problem

With ABS/DSC

- If an error in the wheel speed signal from the ABS/DSC HU/CM is detected by CAN when the following conditions are met:
  — Neutral switch and clutch pedal position switch are OFF
  — Load is **above 40 %**
  — Engine speed is **2,000 rpm or above**
  — Brake switch is OFF
  — Shift lever position (P, N, R position) (AT)

MT without ABS/DSC

- Vehicle speed signal from vehicle speed sensor is **below 3.7 km/h {2.3 mph}** when the following conditions are met:
  — Neutral switch and clutch pedal position switch are OFF
  — Load is above **40 %**
  — Engine speed is **2,000 rpm or above**
  — Brake switch is OFF

P0505 Idle speed control system problem

- The PCM cannot control idle speed toward target idle speed while KOER self test.

P0506 Idle speed control system RPM lower than expected
- Actual idle speed is lower than expected by **100 rpm** for **14 s**, when brake pedal is depressed (brake switch is on) and steering wheel is held straight ahead (power steering pressure (PSP) switch is off).

P0507 Idle speed control system RPM higher than expected
- Actual idle speed is higher than expected by **200 rpm** for **14 s**, when the brake pedal is depressed (brake switch is on) and steering wheel is held straight ahead (power steering pressure (PSP) switch is off).

P0550 PSP switch circuit malfunction
- The PCM monitors PSP switch signal at PCM terminal 2T. If input voltage is low voltage (switch stays on) for **1 min.** when the VSS is **above 60.0 km/h {37.4 mph}** and ECT is **above 60 °C {140 °F}**, the PCM determines that PSP switch circuit has malfunction.

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

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

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

P0602 PCM programming error
- No configuration data in the PCM

P0604 PCM random access memory (RAM) error
- PCM internal RAM malfunction.

P0606 PCM processor
- The PCM internal CPU malfunction

P0610 PCM vehicle options error
- PCM data configuration error

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

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

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

P0703 Brake switch input circuit problem
- The PCM monitors changes in input voltage from the brake switch No.1. If the PCM does not the voltage changes while alternately accelerating and decelerating **8 times**, the PCM determines that the brake switch No.1 circuit has a malfunction.

P0704 Clutch pedal position (CPP) switch input circuit problem
- The PCM monitors changes in input voltage from the CPP switch. If the PCM does not detect the voltage changes while the vehicle runs with vehicle speed **above 30 km/h {19 mph}** and stops **8 times** alternately, the PCM determines that the CPP switch circuit has a malfunction.

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

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

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

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

P2096 Target A/F feedback system too lean

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

P2097 Target A/F feedback system too rich

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

P2101 Throttle actuator circuit range/performance

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

P2107 Throttle actuator control module processor error

- Throttle actuator control module internal processor error

P2108 Throttle actuator control module performance error

- PCM internal malfunction.

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 6.03%** or **more than 18.7%**, 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 actual TP with initial setting TP when the ignition switch is off. If the difference is less than the specification, the PCM determines that there is a throttle actuator control circuit range/performance problem.

P2122 APP sensor No.1 circuit low input

- The PCM monitors the input voltage from APP sensor No.1 when the engine is running. If the input voltage is **less than 0.35 V**, the PCM determines that the APP sensor No.1 circuit input voltage is low.

P2123 APP sensor No.1 circuit high input

- The PCM monitors the input voltage from APP sensor No.1 when the engine is running. If the input voltage is **above 4.8 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 APP sensor No.2 when the engine is running. If the input voltage is **less than 0.35 V**, the PCM determines that the APP sensor No.2 circuit has a malfunction.

P2128 APP sensor No.2 circuit high input

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

P2135 TP sensor No.1/No.2 voltage correlation problem

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

P2138 APP sensor No.1/No.2 voltage correlation problem

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

P2177 Fuel system too lean at off idle

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

P2178 Fuel system too rich at off idle

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

P2187 Fuel system too lean at idle

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

P2188 Fuel system too rich at idle

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

P2195 Front HO2S signal stuck lean

- The PCM monitors the front HO2S output 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
  — Output voltage from the middle HO2S: **more than 0.2 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 0.85 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
  — Output voltage from the middle HO2S: **less than 0.7 V**

P2228 BARO sensor circuit low input

- PCM monitors input voltage from BARO sensor. If input voltage is **below 2.1 V**, PCM determines that BARO sensor circuit has malfunction.

P2229 BARO sensor circuit high input

- PCM monitors input voltage from BARO sensor. If input voltage is **above 4.0 V**, PCM determines that BARO sensor circuit has malfunction.

P2401 EVAP system leak detection pump motor circuit low

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

P2402 EVAP system leak detection pump motor circuit high

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

P2404 EVAP system leak detection pump sense circuit problem

- The PCM monitors pump load current (EVAP line pressure), while evaporative leak monitor is operating. After obtaining the reference current value, if the time in which the pump load current reaches the reference current value is less than the specification, the PCM determines air filter has a malfunction.

P2405 EVAP system leak detection pump sense circuit low input

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

P2407 EVAP system leak detection pump sense circuit intermittent

- The PCM monitors pump load current (EVAP line pressure), while evaporative leak monitor is operating. When either of the following is detected 6 times or more successively, the PCM determines EVAP system leak detection pump heater has a malfunction:
  — While obtaining the reference current value, the change in pump load current exceeds the specification.
  — After obtaining the reference current value, the pump load current is kept lower than the maximum pump load current for more than the specified time.

P2502 Charging system voltage problem

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

P2503 Charging system voltage low

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

P2504 Charging system voltage high

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

P2507 PCM B+ voltage low

- The PCM monitors the voltage of back-up battery positive terminal. If the PCM detects battery positive terminal voltage **below 2.5 V** for **2 s**, the PCM determines that the backup voltage circuit has a malfunction.

P2610 PCM internal engine off timer performance

- PCM internal engine off timer is damaged.

KOEO/KOER SELF-TEST [LF]

E5U010200000N04

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

KOEO (Key ON, Engine Off) Self-test

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

KOER (Key ON, Engine Running) Self-test

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

KOEO/KOER self-test table

×: Applicable
—: Not applicable

DTC No.	Condition	Test condition	
		KOEO	KOER
B1342	PCM malfunction	×	—
P0011	CMP timing over-advanced	—	×
P0012	CMP timing over-retarded	—	×
P0016	CKP-CMP correlation	—	—
P0030	Front HO2S heater control circuit problem	×	×
P0031	Front HO2S heater circuit low input	×	×
P0032	Front HO2S heater circuit high input	×	×
P0037	Rear HO2S heater circuit low input	×	×
P0038	Rear HO2S heater circuit high input	×	×
P0069	Manifold absolute pressure/atmospheric pressure correlation	—	—
P0101	MAF sensor circuit range/performance problem	—	—
P0102	MAF sensor circuit low input	×	×
P0103	MAF sensor circuit high input	×	×
P0107	MAP sensor circuit low input	×	×
P0108	MAP sensor circuit high input	×	×
P0111	IAT sensor circuit range/performance problem	—	—
P0112	IAT sensor circuit low input	×	×
P0113	IAT sensor circuit high input	×	×
P0116	Engine coolant temperature circuit range/performance	—	—
P0117	ECT sensor circuit low input	×	×
P0118	ECT sensor circuit high input	×	×
P0122	TP sensor No.1 circuit low input	×	×
P0123	TP sensor No.1 circuit high input	×	×
P0125	Excessive time to enter closed loop fuel control	—	—
P0126	Coolant thermostat stuck open	—	—
P0128		—	—
P0130	Front HO2S circuit problem	×	×
P0131	Front HO2S circuit low input	×	×
P0132	Front HO2S circuit high input	×	×
P0133	Front HO2S circuit problem	—	—
P0134	Front HO2S no activity detected	—	×
P0137	Rear HO2S circuit low input	×	×
P0138	Rear HO2S circuit high input	×	×

DTC No.	Condition	Test condition	
		KOEO	KOER
P0139	Rear HO2S circuit problem	—	—
P0140	Rear HO2S no activity detected	—	×
P0222	TP sensor No.2 circuit low input	×	×
P0223	TP sensor No.2 circuit high input	×	×
P0300	Random misfire detected	—	×
P0301	Cylinder No.1 misfire detected	—	×
P0302	Cylinder No.2 misfire detected	—	×
P0303	Cylinder No.3 misfire detected	—	×
P0304	Cylinder No.4 misfire detected	—	×
P0327	KS circuit low input	×	×
P0328	KS circuit high input	×	×
P0335	CKP sensor circuit problem	—	—
P0340	CMP sensor circuit problem	—	—
P0401	EGR flow insufficient detected	—	×
P0403	EGR valve (stepping motor) circuit problem	×	×
P0421	Warm up catalyst system efficiency below threshold	—	—
P0441	Evaporative emission control system incorrect purge flow	—	×
P0442	Evaporative emission control system leak detected (small leak)	—	×
P0443	Purge solenoid valve circuit problem	×	×
P0446	Change over valve (COV) (EVAP system leak detection pump) stuck close	—	×
P0455	Evaporative emission control system leak detected (gross leak)	—	×
P0456*1	Evaporative emission control system leak detected (very small leak)	—	×
P0461	Fuel gauge sender unit range/performance problem	—	—
P0462	Fuel gauge sender unit circuit low input	×	×
P0463	Fuel gauge sender unit circuit high input	×	×
P0480	Cooling fan relay No.1 control circuit malfunction	×	×
P0481	Cooling fan relay No.2 control circuit malfunction	×	×
P0482	Cooling fan relay No.3 control circuit malfunction	×	×
P0500*3	VSS circuit problem	—	—
P0505	Idle speed control system problem	—	×
P0506	Idle speed control system RPM lower than expected	—	—
P0507	Idle speed control system RPM higher than expected	—	×
P0550	PSP switch circuit malfunction	—	—
P0564	Cruise control switch circuit malfunction	—	—
P0571	Brake switch circuit problem	—	—
P0601	PCM memory check sum error	×	×
P0602	PCM programming error	×	×
P0604	PCM random access memory (RAM) error	×	×
P0606	PCM processor	×	×
P0610	PCM vehicle options error	×	×
P0638	Throttle actuator control circuit range/performance problem	—	—
P0661	Variable intake air solenoid valve circuit low input	×	×
P0662	Variable intake air solenoid valve circuit high input	×	×
P0703	Brake switch input circuit problem	—	—
P0704*2	Clutch pedal position (CPP) switch input circuit problem	—	—
P0850*2	Neutral switch input circuit problem	—	—
P1260	Immobilizer system problem	×	—
P2088	Oil control valve (OCV) circuit low	×	×
P2089	Oil control valve (OCV) circuit high	×	×
P2096	Target A/F feedback system too lean	—	—
P2097	Target A/F feedback system too rich	—	—
P2101	Throttle actuator circuit range/performance	—	×

DTC No.	Condition	Test condition	
		KOEO	KOER
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	×	×
P2138	APP sensor No.1/No.2 voltage correlation problem	×	×
P2177	Fuel system too lean at off idle	—	×
P2178	Fuel system too rich at off idle	—	×
P2187	Fuel system too lean at idle	—	×
P2188	Fuel system too rich at idle	—	×
P2195	Front HO2S signal stuck lean	—	—
P2196	Front HO2S signal stuck rich	—	—
P2228	BARO sensor circuit low input	×	×
P2229	BARO sensor circuit high input	×	×
P2401	EVAP system leak detection pump motor circuit low	—	×
P2402	EVAP system leak detection pump motor circuit high	—	×
P2404	EVAP system leak detection pump sense circuit problem	—	×
P2405	EVAP system leak detection pump sense circuit low input	—	×
P2407	EVAP system leak detection pump sense circuit intermittent	—	×
P2502	Charging system voltage problem	—	×
P2503	Charging system voltage low	—	×
P2504	Charging system voltage high	—	×
P2507	PCM B+ voltage low	×	×
P2610	PCM internal engine off timer performance	—	—

*1 : California emission regulation applicable model
*2 : MT
*3 : With ABS/DSC or MT without ABS/DSC

PID/DATA MONITOR AND RECORD [LF]

E5U010200000N05

- The PID/DATA monitor items are shown below.

PID/DATA monitor table (reference)

Item	Definition	Unit/Condition	PCM terminal
AAT	Ambient air temperature	°C	—
AC_REQ	Refrigerant pressure switch (high, low)	On/Off	1AU
ACCS	A/C relay	On/Off	1I
AFR	Air/fuel ratio	—	2AD
AFR_ACT	Actual air/fuel ratio	—	—
ALTF	Generator field coil control duty value	%	2AI
ALTT V	Generator output voltage	V	2AJ
APP	Accelerator pedal position	%	1AO, 1AP
APP1	APP sensor No.1	%	1AO
		V	
APP2	APP sensor No.2	%	1AP
		V	
ARPMDES	Target engine speed	RPM	—
BARO	Barometric pressure	Pa	—
		V	
BOO	Brake switch	On/Off	1AB, 1AF
CATT11_DSD	Catalyst temperature	°C	—
CHRGLP	Generator warning light	On/Off	—
COLP	Refrigerant pressure switch (middle)	On/Off	1J
CPP*1	Clutch pedal position	On/Off	1D
CPP/PNP*1	Shift lever position	Drive/Neutral	1X
DTCCNT	Number of DTC detected	—	—
ECT	Engine coolant temperature	°C	2AH
		V	
EQ_RAT11	Actual lambda signal	—	—
EQ_RAT11_DSD	Target lambda	—	—
ETC_ACT	Throttle control	°	—
ETC_DSD	Throttle control desired	%	—
		°	
EVAPCP	Purge solenoid valve duty value	%	2C
FAN1	Cooling fan relay No.1 control signal	On/Off	1M
FAN2	Cooling fan relay No.2 control signal	On/Off	1N
FAN3	Cooling fan relay No.3 control signal	On/Off	1R
FLI	Fuel level	%	—
FP	Fuel pump relay	On/Off	1H
FUELPW	Fuel injector duration	ms	2BB, 2BC, 2BD, 2AZ
FUELSYS	Fuel system status	OL/CL/ OL–Drive/ OL–Fault/ CL–Fault	—
GENVDSD	Target generator voltage	V	—
HTR11	Front HO2S heater control	On/Off	2BG
HTR12	Rear HO2S heater control	On/Off	2BE
IAT	Intake air temperature	°C	1AT
		V	
IMTV	Variable intake air control	On/Off	2J
INGEAR	Gears are engaged	On/Off	1D*1,1X*1, —*6
IVS	CTP condition	Idle/Off Idle	—
KNOCKER	Knocking retard	°	2U

Item	Definition	Unit/Condition	PCM terminal
LDP_EVAPCP	EVAP system leak detection pump detect incorrect purge flow	A	—
LDP_IDL	EVAP system leak detection pump idle current	A	—
LDP_MON	EVAP system leak detection pump monitoring current	A	—
LDP_REF	EVAP system leak detection pump reference current	A	—
LDP_SLDV	EVAP system small leak detection value	A	—
LDP_VSL_FV*2	EVAP system very small leak detection fail value	mA/sec	—
LDP_VSL_SV*2	EVAP system very small leak detection safe value	mA/sec	—
LDP_VSLDV*2	EVAP system very small leak detection value	mA/sec	—
LOAD	Engine load	%	—
LONGFT1	Long term fuel trim	%	—
MAF	Mass air flow	g/s	1AK
		V	
MAP	Manifold absolute pressure	Pa	2AG
		V	
MIL	Malfunction indicator lamp	On/Off	—
MIL_DIS	Travelled distance since MIL illuminated	km	—
O2S11	Front HO2S	A	2AD
O2S12	Rear HO2S	V	2Q
PSP	PSP switch	Low/High	2T
RFCFLAG	PCM adaptive memory produce verification	Learnt/ Not Learnt	—
RO2FT1	Rear HO2S fuel trim	—	—
RPM	Engine speed	RPM	2W
SCCS	Cruise control switch	V	1AQ
SEGRP	EGR control	—	2K, 2G, 2L, 2H
SEGRP DSD	EGR valve position desired	%	—
SHRTFT1	Short term fuel trim (front)	%	—
SHRTFT12	Short term fuel trim (rear)	%	—
SPARKADV	Ignition timing	°	2S
test	Test mode	On/Off	—
TIRESIZE	Tire revolution per mile	rev/mile	—
TP REL	Throttle position signal (relative value)	%	—
TP1	TP sensor No.1	%	2AK
		V	
TP2	TP sensor No.2	%	2AL
		V	
TPCT	TP sensor voltage at CTP	V	—
VPWR	Battery positive voltage	V	1BA
VSS	Vehicle speed	Km/h	2O*4
			1AM*3, 5, 1AI*3, 5
VT ACT1	Actual valve timing	°	2E
VT DIFF1	Difference between target valve timing and actual valve timing	°	—
VT DUTY1	OCV control	%	2E

*1 : MT
*2 : California emission regulation applicable model
*3 : With ABS/DSC
*4 : MT without ABS/DSC
*5 : AT without ABS/DSC
*6 : AT

SIMULATION TEST [LF]

E5U010200000N06

- The simulation items are shown below.

Simulation item table

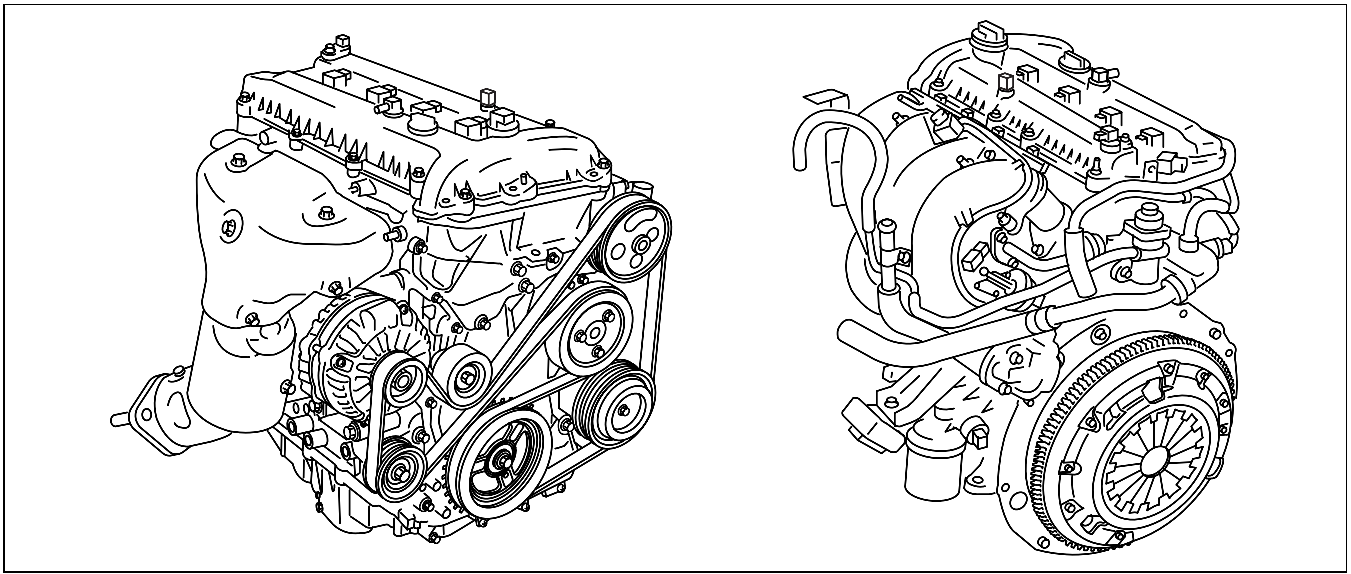
×: Applicable
—: Not applicable

Item	Applicable component	Unit/condition	Test condition		PCM terminal
			KOEO	KOER	
ACCS	A/C relay	Off/On	×	×	1I
ALTF	Generator (field coil)	%	—	×	2AI
EVAPCP	Purge solenoid valve	%	×	×	2C
FAN1	Cooling fan relay No.1	Off/On	×	×	1M
FAN2	Cooling fan relay No.2	Off/On	×	×	1N
FAN3	Cooling fan relay No.3	Off/On	×	×	1R
FP	Fuel pump relay	Off/On	×	×	1H
FUELPW1	Fuel injector	%	×	×	2BB, 2BC, 2BD, 2AZ
GENVDSD	Target generator voltage	V	—	×	—
HTR11	Front HO2S heater	Off/On	×	×	2BG
HTR12	Rear HO2S heater	Off/On	×	×	2BE
IMTV	Variable intake air solenoid valve	Off/On	×	×	2J
INJ_1	Fuel injector No.1	OFF	—	×	2BB
INJ_2	Fuel injector No.2	OFF	—	×	2BC
INJ_3	Fuel injector No.3	OFF	—	×	2BD
INJ_4	Fuel injector No.4	OFF	—	×	2AZ
SEGRP	EGR valve stepping motor position	—	×	×	2K, 2G, 2L, 2H
test	Test mode	Off/On	×	×	—
VT DUTY1 Wt	CMP sensor	%	×	×	2E

01–10 MECHANICAL

ENGINE STRUCTURAL VIEW [LF]

E5U011002000N01

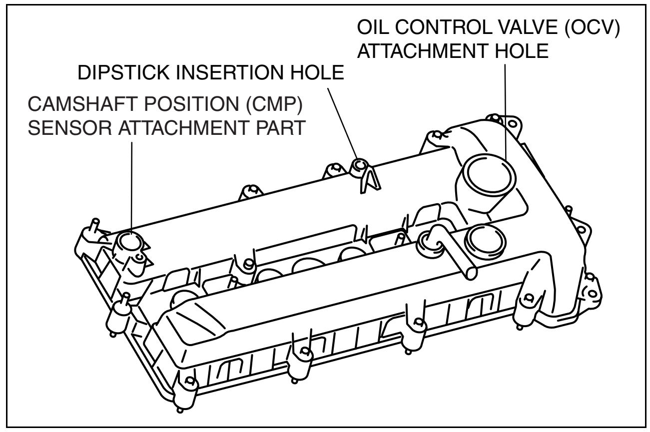


E5U110ZT5040

CYLINDER HEAD COVER CONSTRUCTION [LF]

E5U011010100N01

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

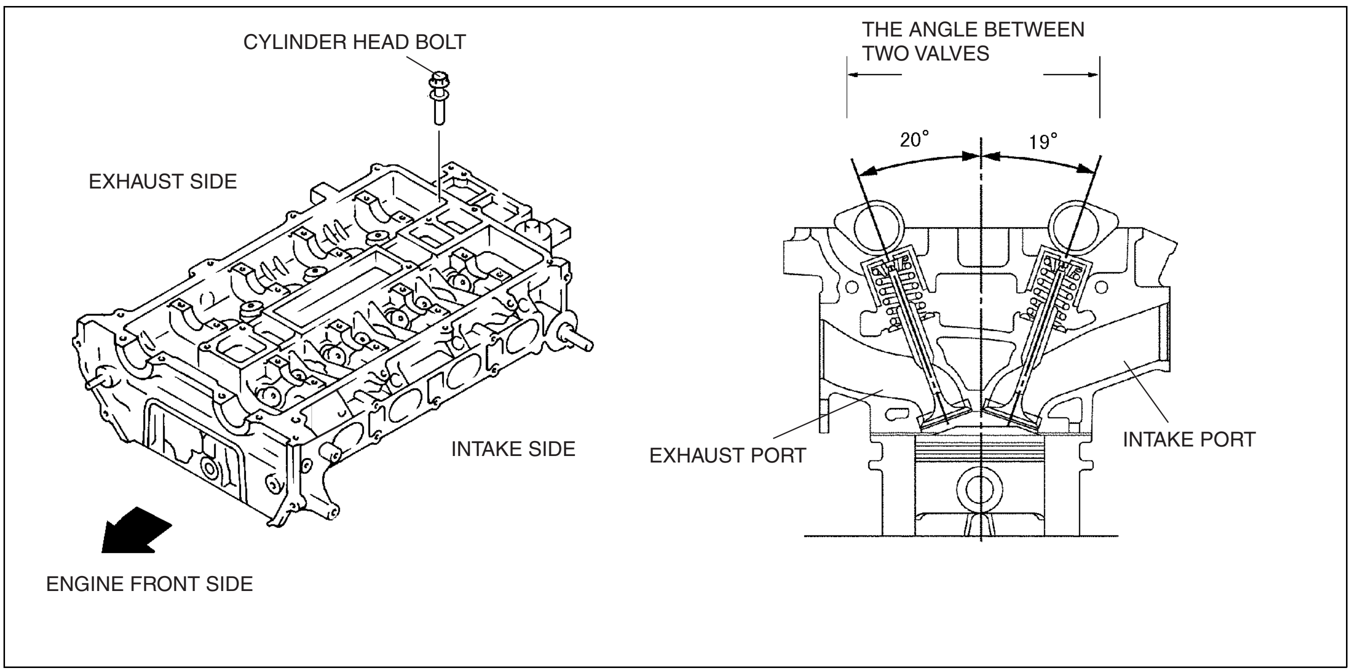


E5U110ZT5041

CYLINDER HEAD CONSTRUCTION [LF]

E5U011010100N02

- The cylinder head is made of a high heat conductive, lightweight aluminum alloy, which is quenched.
- Compact, pentroof-type combustion chambers have been adopted. The spark plugs are mounted at the top of the combustion chambers to improve combustion efficiency.
- The intake/exhaust port layout is a cross flow type, (the angle between two valves is 39°, the two intake valves and the two exhaust valves per cylinder) which improves air intake/exhaust efficiency.
- The cylinder head bolts are torque-to-yield type to be tightened in five motions to insure tightening stability and cannot be reused.

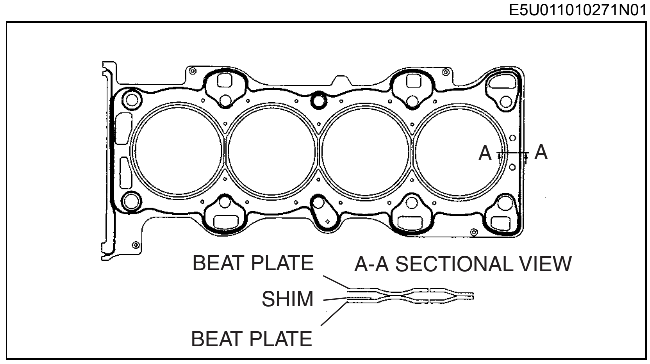


E5U110ZT5007

CYLINDER HEAD GASKET CONSTRUCTION [LF]

E5U011010271N01

- Cylinder head gaskets are 2 layer-metal gaskets.

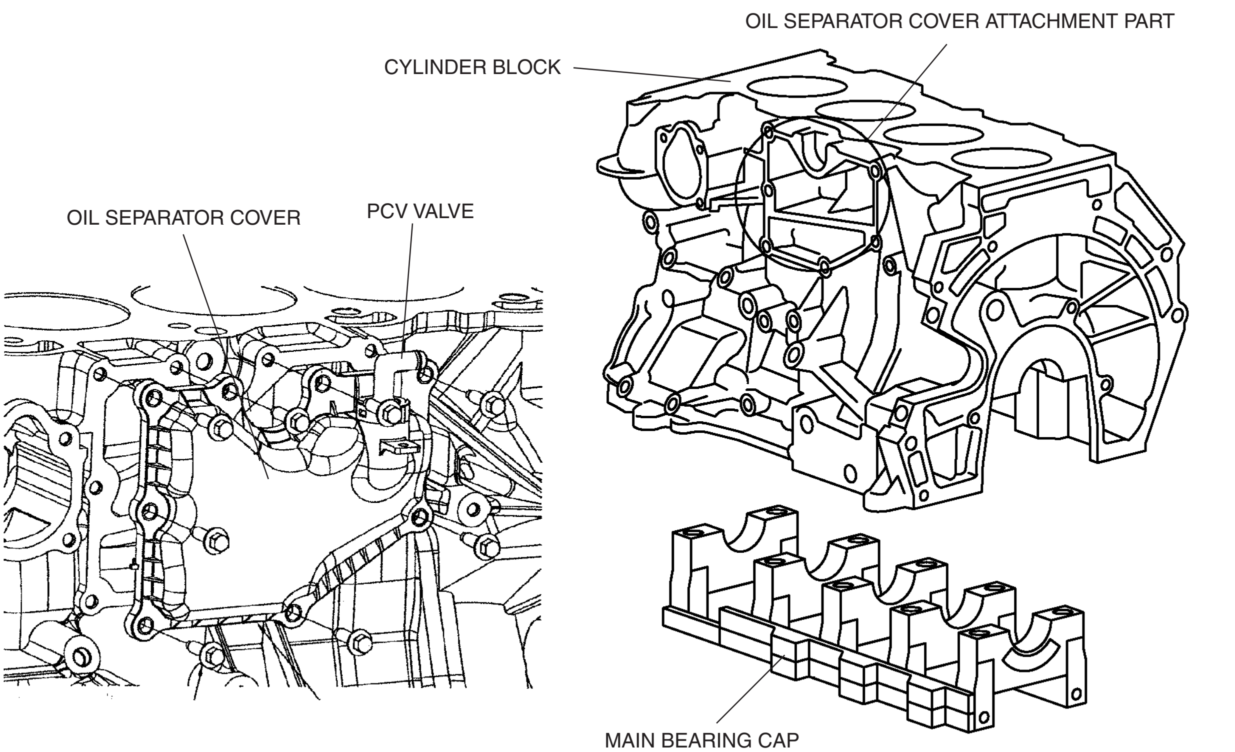


E5U110ZT5008

CYLINDER BLOCK CONSTRUCTION [LF]

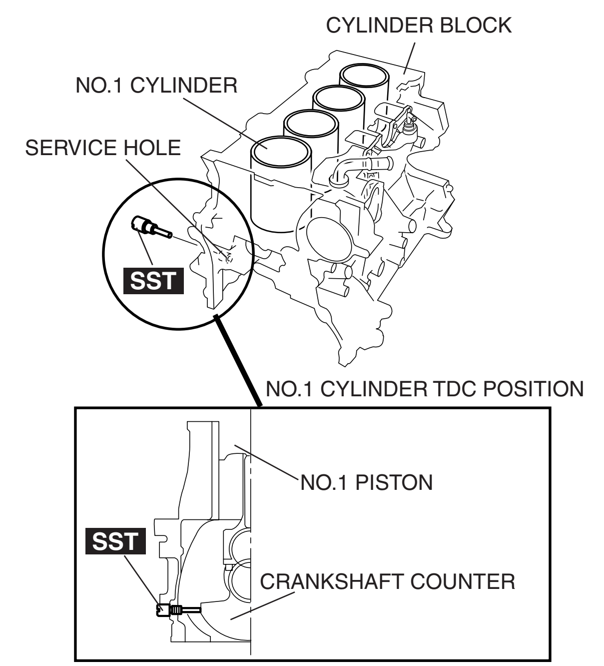
E5U011010300N01

- The cylinder block is made of aluminum alloy, which is cast with the cast iron liner, improving heat radiation and decreasing weight.
- The cylinder block is a deep skirt type and forms the ladder frame structure with the integrated main bearing cap. The water jacket of the cylinder block is a closed deck type. Its higher rigidity reduces vibration and noise.
- The cylinder block has the oil separator cover on the opposite side of the fresh air intake, the PCV (positive crankcase ventilation) valve is installed in the oil separator. Together they function to improve blow-by gas ventilation efficiency.
- There is no positioning tab where the upper and lower main bearings are installed.
- The main bearing cap bolts are torque-to-yield type and cannot be reused.



E5U110ZT5009

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

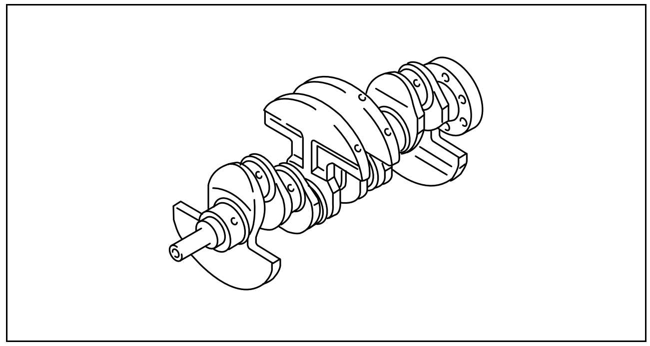


E5U110ZT5010

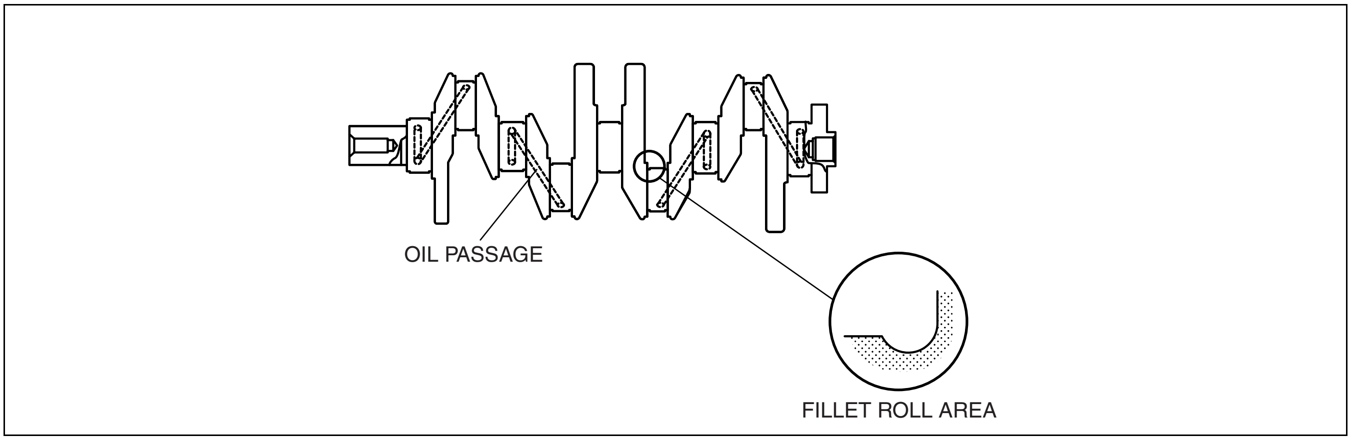
CRANKSHAFT, MAIN BEARING CONSTRUCTION [LF]

E5U011011301N01

- A five axle-hole, 4 counter weight cast iron crankshafts have been adopted.
- There is no positioning key where the crankshaft sprocket and crankshaft pulley are installed. The crankshaft sprocket must be installed using the **SST** with the No.1 cylinder aligned with TDC position. Tightening pressure on the tightening bolt is used to secure the crankshaft sprocket and crankshaft pulley.
- An oil line for supplying oil to each journal is provided in the crankshaft. Crank pins and fillets on both sides of the journal are rolled to bear heavy loads.

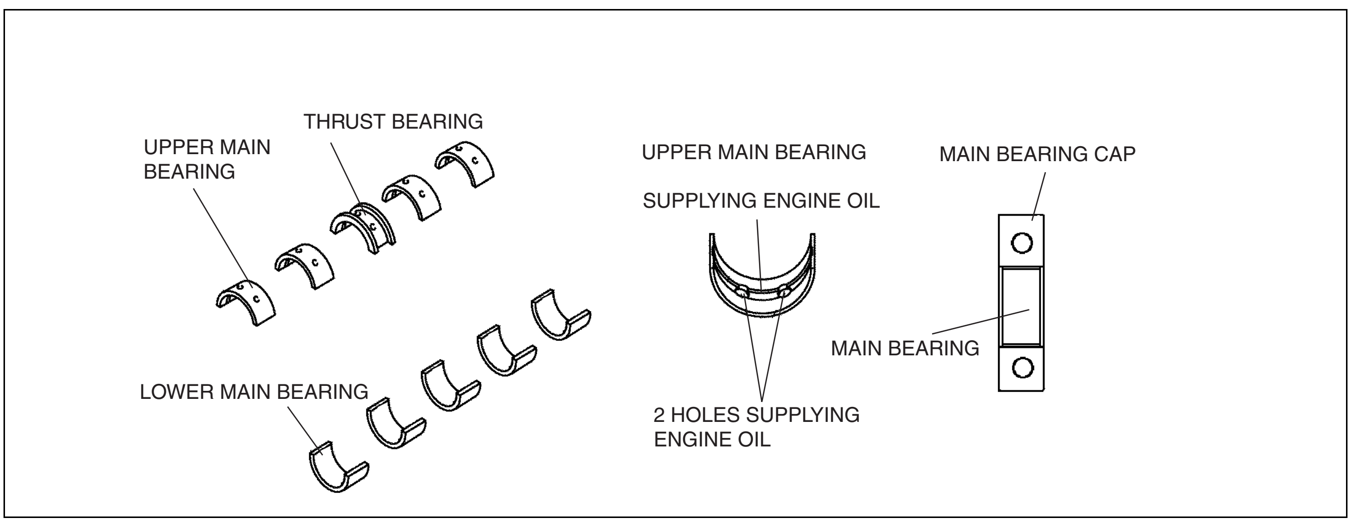


E5U110ZT5001



E5U110ZT5002

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



E5U110ZT5011

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

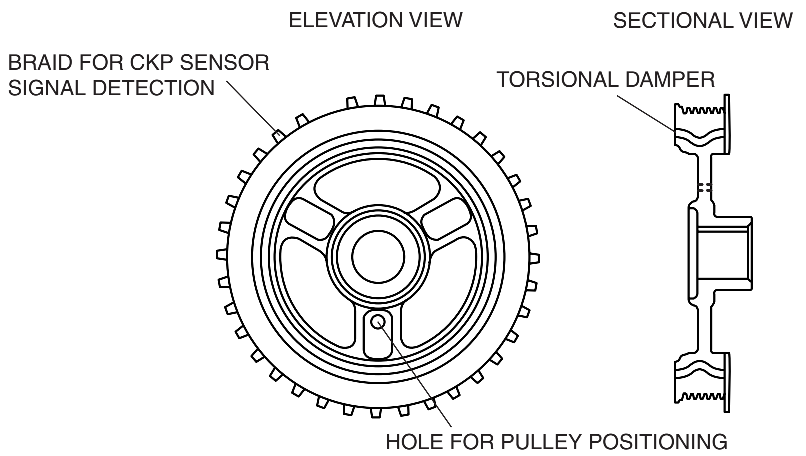
Bearings

Bearing size	Bearing thickness (mm {in})	
	upper	lower
STD	2.501—2.522 {0.0985—0.0992}	2.501—2.529 {0.0985—0.0995}
0.25OS	2.623—2.629 {0.1033—0.1035}	2.624—2.630 {0.1034—0.1035}
0.50OS	2.748—2.754 {0.1082—0.1084}	2.749—2.755 {0.1083—0.1084}

CRANKSHAFT PULLEY CONSTRUCTION [LF]

E5U011011371N01

- The crankshaft position (CKP) signal detecting blade has been adopted for the crankshaft pulley. The torsional damper, which prevents the crankshaft from wobbling, has also been adopted for the crankshaft.
- There is no positioning key slot on the crankshaft pulley. Instead, the positioning hole on the crankshaft pulley and the engine front cover are used for aligning the crankshaft pulley with the crankshaft.
- Crankshaft pulley bolt is torque-to-yield type to be tightened in two steps to insure crankshaft pulley tightening stability and cannot be reused.

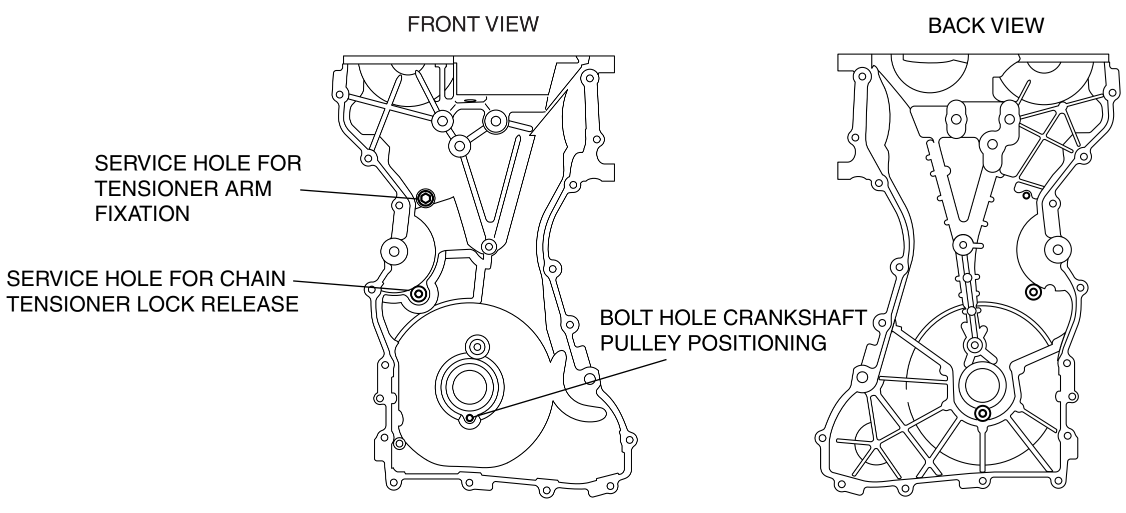


E5U110ZT5012

ENGINE FRONT COVER CONSTRUCTION [LF]

E5U011000000N01

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



E5U110ZT5042

PISTON, PISTON RING, PISTON PIN CONSTRUCTION [LF]

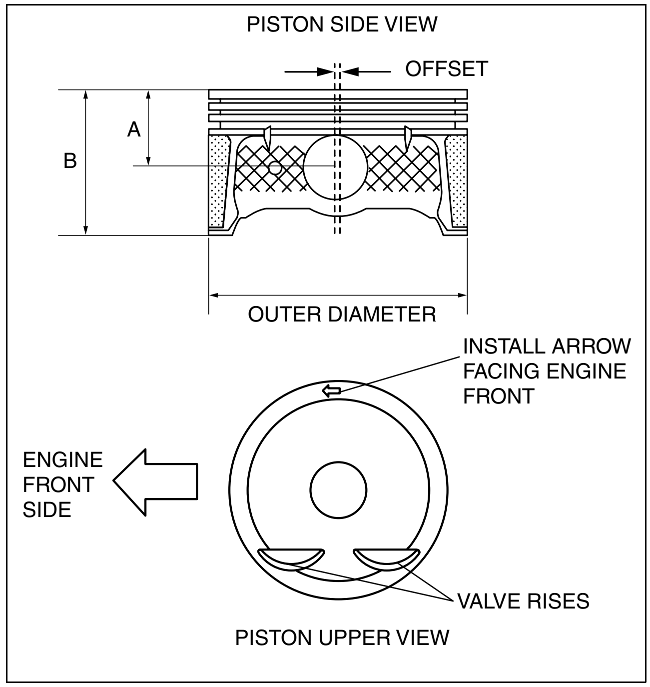
E5U011011010N01

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

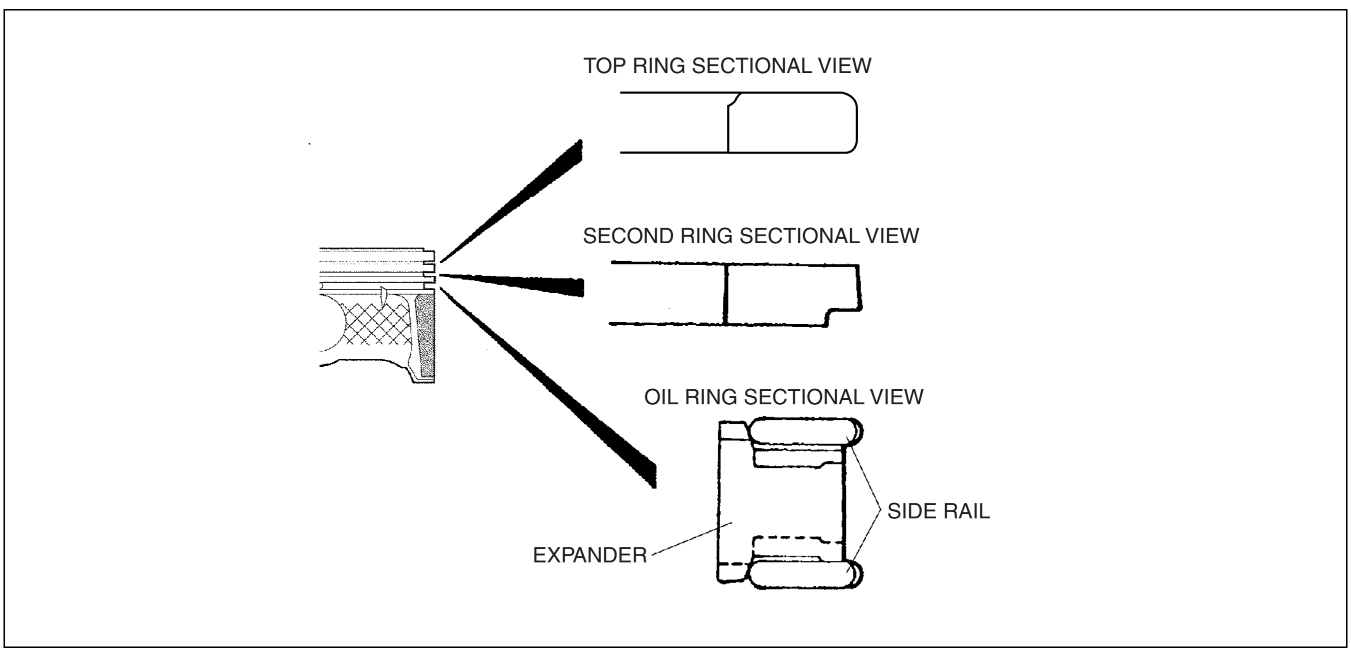
Piston Specification.

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

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



E5U110ZT5043

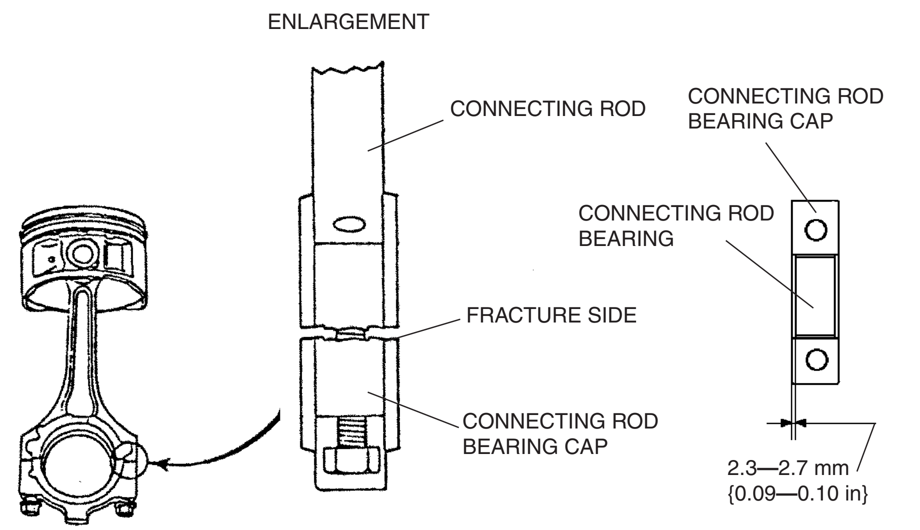


E5U110ZT5013

CONNECTING ROD, CONNECTING ROD BEARING CONSTRUCTION [LF]

E5U011011211N01

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



E5U110ZT5014

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

Bearing size	Bearing thickness (mm {in})
Standard	1.498—1.522 {0.0589—0.0599}
0.25OS	1.623—1.629 {0.0639—0.0641}
0.50OS	1.748—1.754 {0.0688—0.0690}

DRIVE BELT CONSTRUCTION [LF]

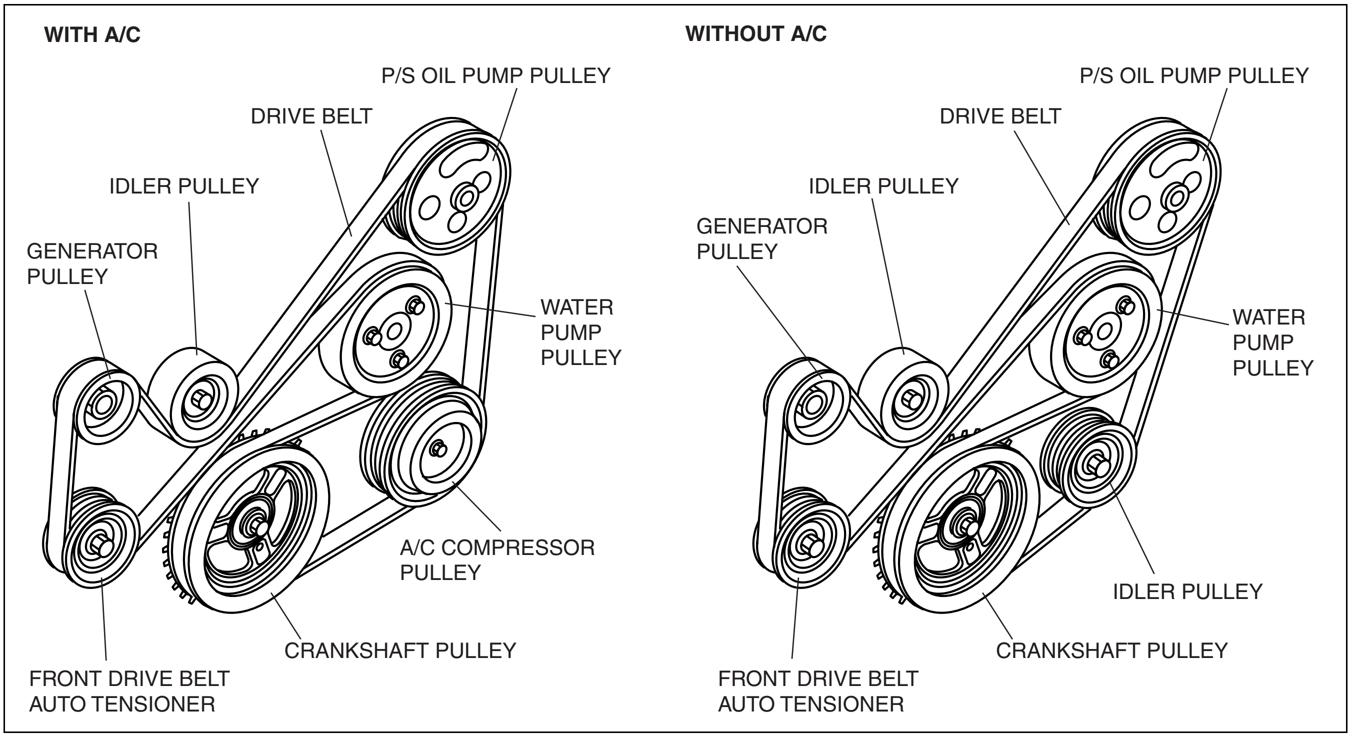
E5U011015800N01

- A V-ribbed drive belt is employed.
- A single, serpentine type drive belt drives auxiliary parts, resulting in a shortened overall belt length and improved serviceability.
- A front drive belt auto tensioner with an embedded coil spring has been adopted to automatically maintain the optimal drive belt tension.

Drive Belt Specification.

item		Specification
Belt length	mm {in}	About 2,243 {88.31} (About 2,163 {85.16})*
Belt width	mm {in}	About 20.5 {0.81}

* : A/C non-equipping vehicle specification.



E5U110ZT5015

VALVE MECHANISM OUTLINE [LF]

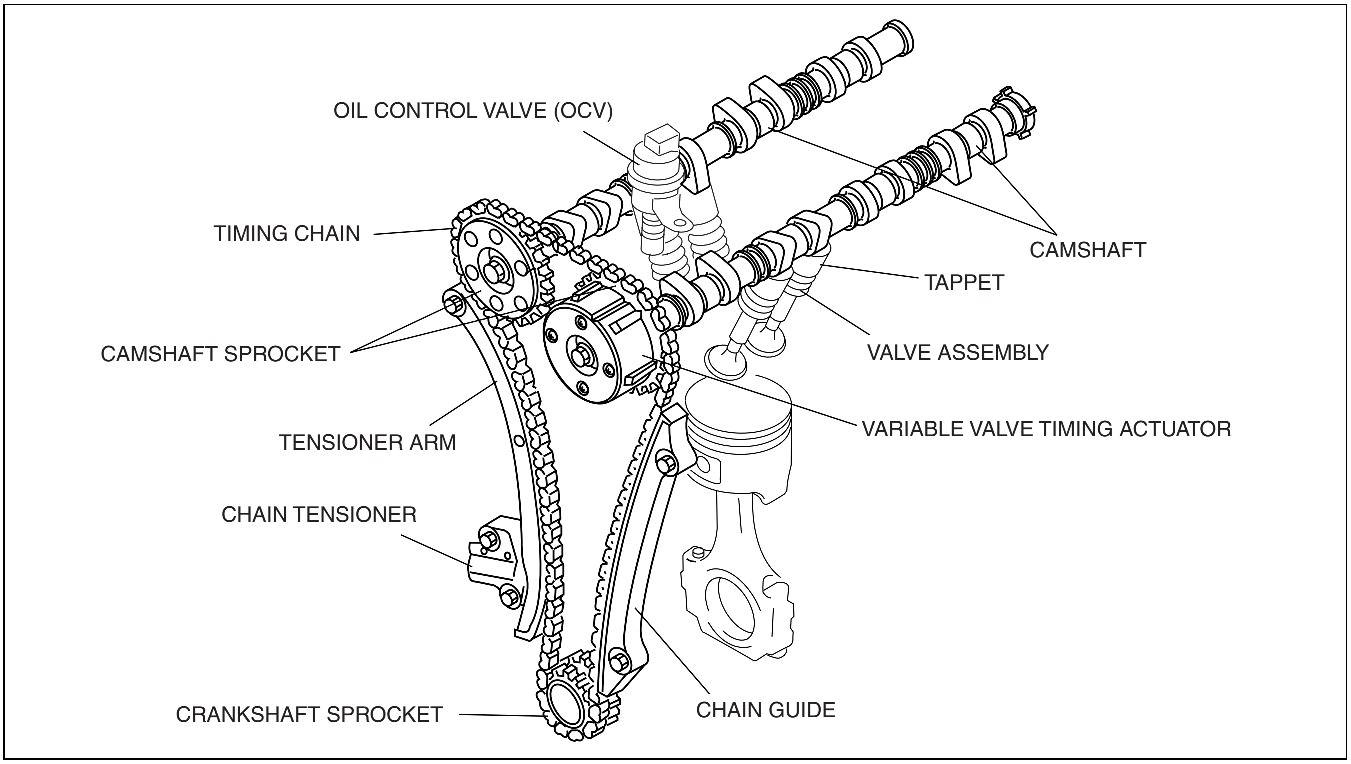
E5U011012111N01

- There are two intake ports and two exhaust ports each cylinder. Totally 16 valves are directly driven by two camshafts.
- The variable valve timing mechanism, which insures the best valve timing depending on the drive condition by constantly changing the phase of the intake port side camshaft, has been adopted.

VALVE MECHANISM STRUCTUAL VIEW [LF]

E5U011012111N02

Structural view



E5U110ZT5003

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

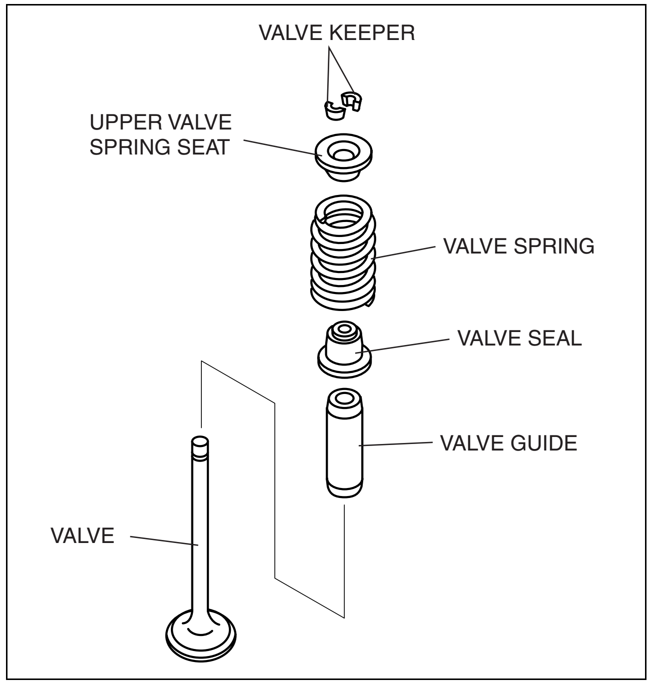
E5U011012111N03

- The valves are heat-resistant steel. There are two intake valves, two exhaust valves per cylinder.

Valve specification

item		Specification
valve full length	(mm {in})	Intake valve: About 103.4 {4.070} Exhaust valve: About 104.7 {4.122}
Intake valve umbrella diameter	(mm {in})	About 35 {1.38}
Exhaust valve umbrella diameter	(mm {in})	About 30 {1.18}
Stem diameter	(mm {in})	Intake valve: About 5.5 {0.22} Exhaust valve: About 5.5 {0.22}

- The intake valve and the exhaust valve are treated with the tufftride process to improve abrasion resistance.
- The valve spring is an uneven outer dimension type. It has been improved by reducing the size of the upper seat.
- The valve guide is made of the sintered alloy to improve abrasion resistance.
- The valve seat is integrated with the lower valve spring seat to simplify the unit and improve its serviceability.



E5U110ZT5016

CAMSHAFT CONSTRUCTION [LF]

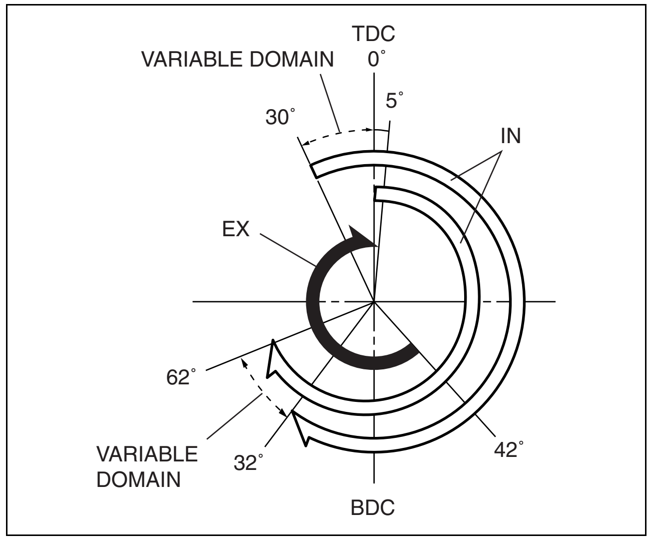
E5U011012420N01

- The cast iron 5 axis-hole, which has great rigidity, has been adopted for the camshaft to insure higher reliability.
- The endplay of the camshaft is regulated at the rear of the No. 1 journal.
- The lubricating oil is supplied through the oil supply hole at each journal. Additionally the cam nose part is chill cast to improve the abrasion resistance and the width of cam hill part is shortened to reduce the weight.
- There is no camshaft sprocket positioning pin or key slot at the camshaft end. The camshaft sprocket is secured using tightening pressure of the installation bolts.
- There is an oil line, by which the oil is supplied to the variable valve timing actuator, located at intake camshaft (front of camshaft).

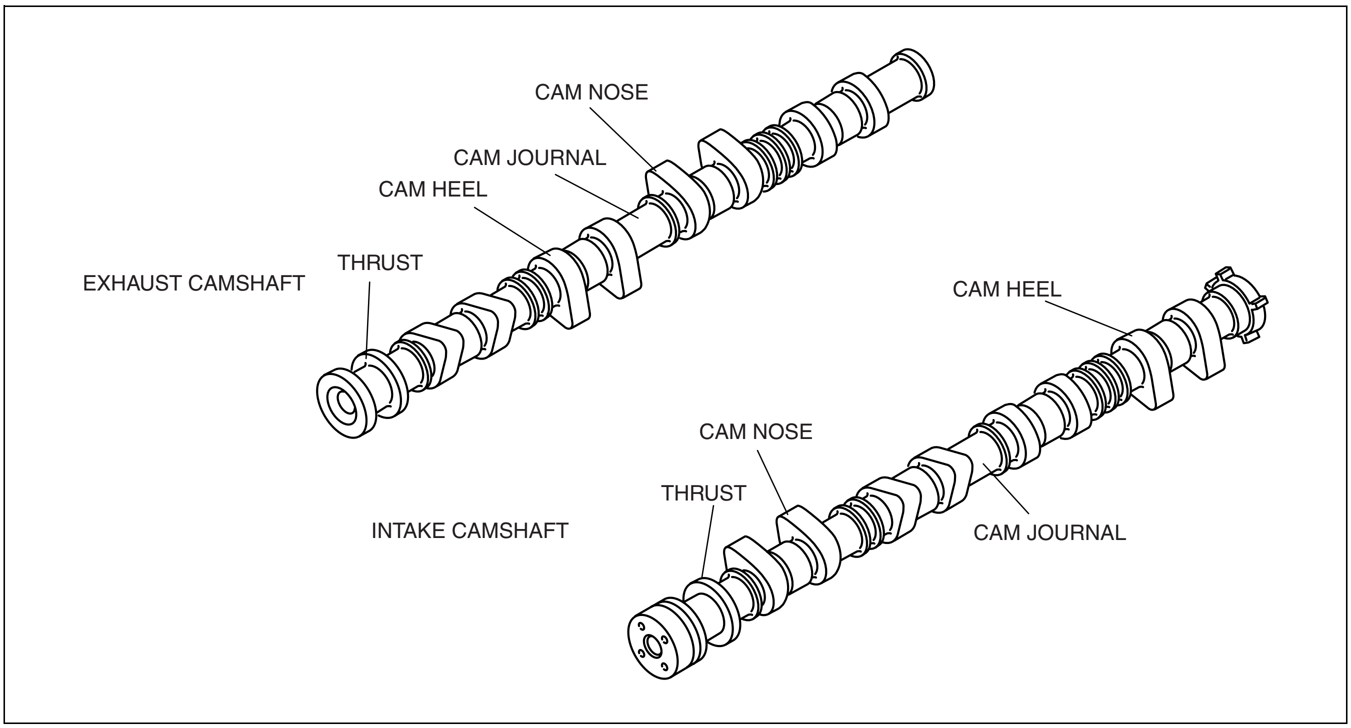
Camshaft Specification.

item		Specification	
		IN	EX
LIFT	(mm {in})	9.1 {0.35}	7.8 {0.30}
Overlap	(°)	5—35	

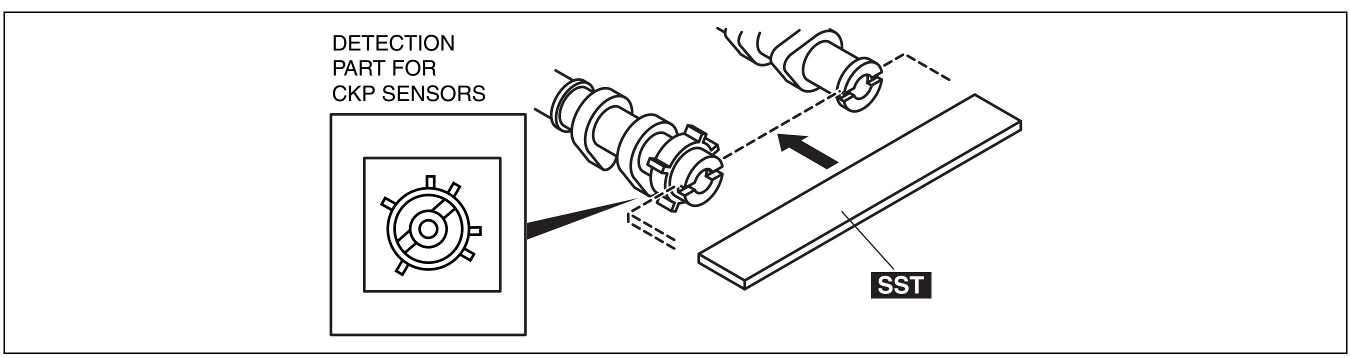
- The detection unit (trigger plate) for the camshaft position (CMP) sensor is at the intake port side camshaft.
- The groove for securing the No.1 cylinder TDC for the camshaft, is provided at the rear of the intake and exhaust camshaft.



E5U110ZT5004



E5U110ZT5017

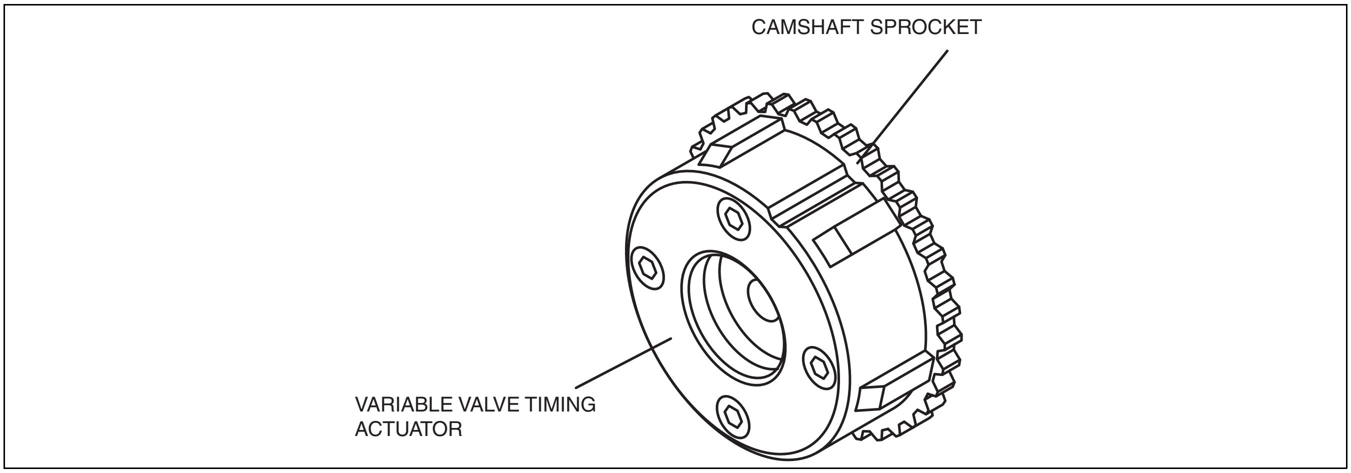


E5U110ZT5044

CAMSHAFT SPROCKET CONSTRUCTION [LF]

E5U011012420N02

- The sintered alloy, which has high rigidity, has been adopted for the camshaft sprocket and is quenched to improve the abrasion resistance at the contact point with the timing chain.
- The intake camshaft sprocket is integrated (cannot be disassembled) with the variable valve timing actuator.



E5U110ZT5005

CRANKSHAFT SPROCKET CONSTRUCTION [LF]

E5U011012420N03

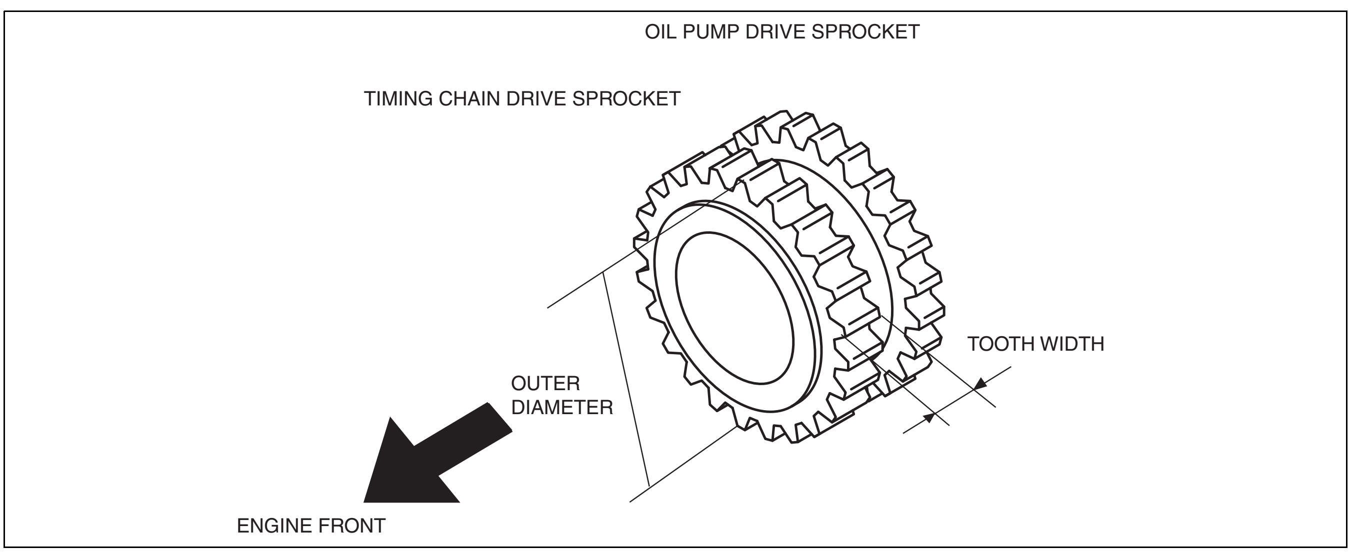
- High-strength chromium steel has been adopted for the crankshaft sprocket. Due to carbonizing protection, abrasion resistance at all chain contact points is increased.
- The crankshaft sprocket consists of the timing chain sprocket and oil pump sprocket, which are integrated into a single unit.
- The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

Timing Drive Sprocket Specification.

item	Specification
Outer diameter (mm {in})	About 47.955 {1.8880}
Tooth width (mm {in})	About 7.35 {0.289}

Oil Pump Drive Sprocket Specification.

item	Specification
Outer diameter (mm {in})	About 47.955 {1.8880}
Tooth width (mm {in})	About 6.15 {0.242}



E5U110ZT5018

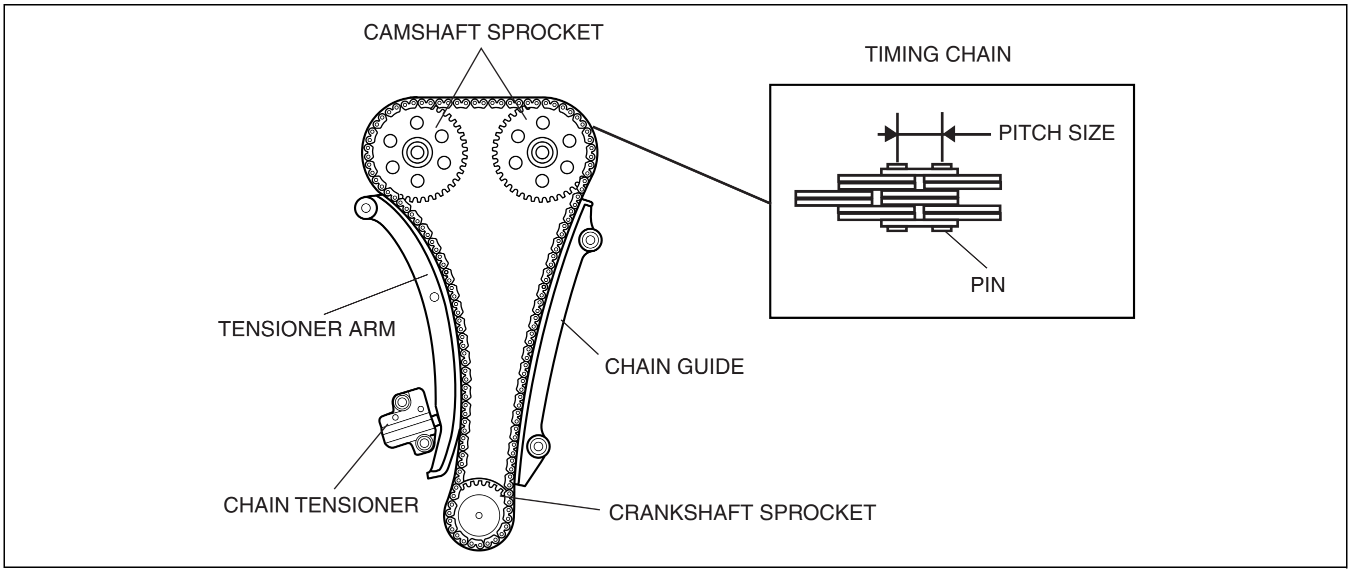
TIMING CHAIN, CHAIN TENSIONER CONSTRUCTION [LF]

E5U011012040N01

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

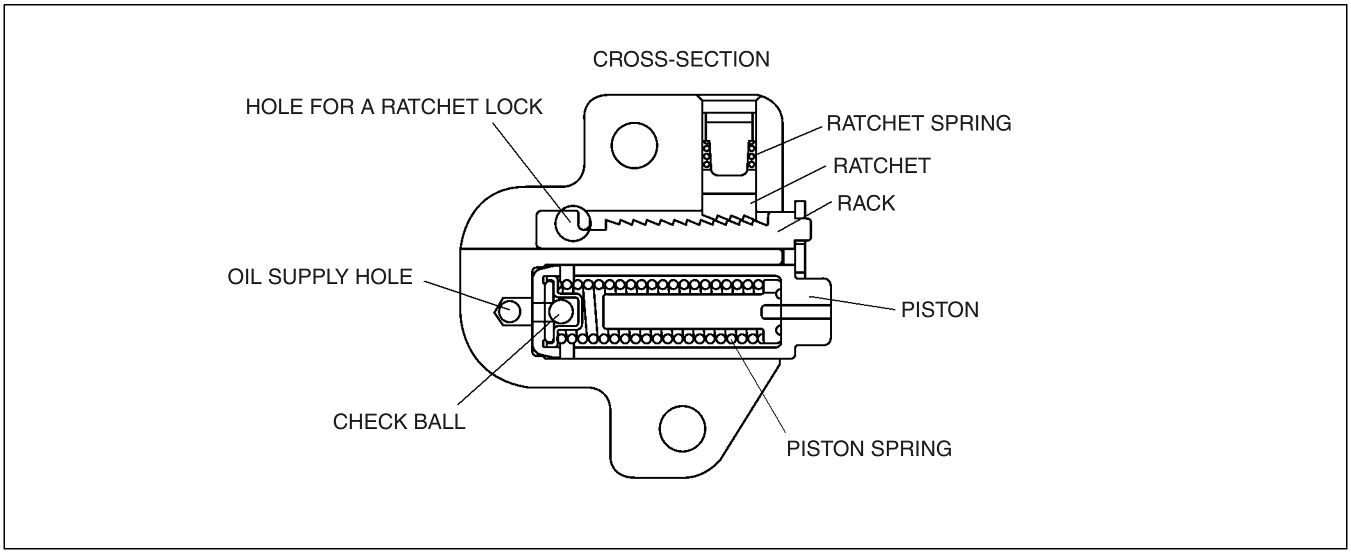
Timing Chain Specification.

item		Specification
Pitch size	(mm {in})	8 {0.32}



E5U110ZT5006

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



E5U110ZT5019

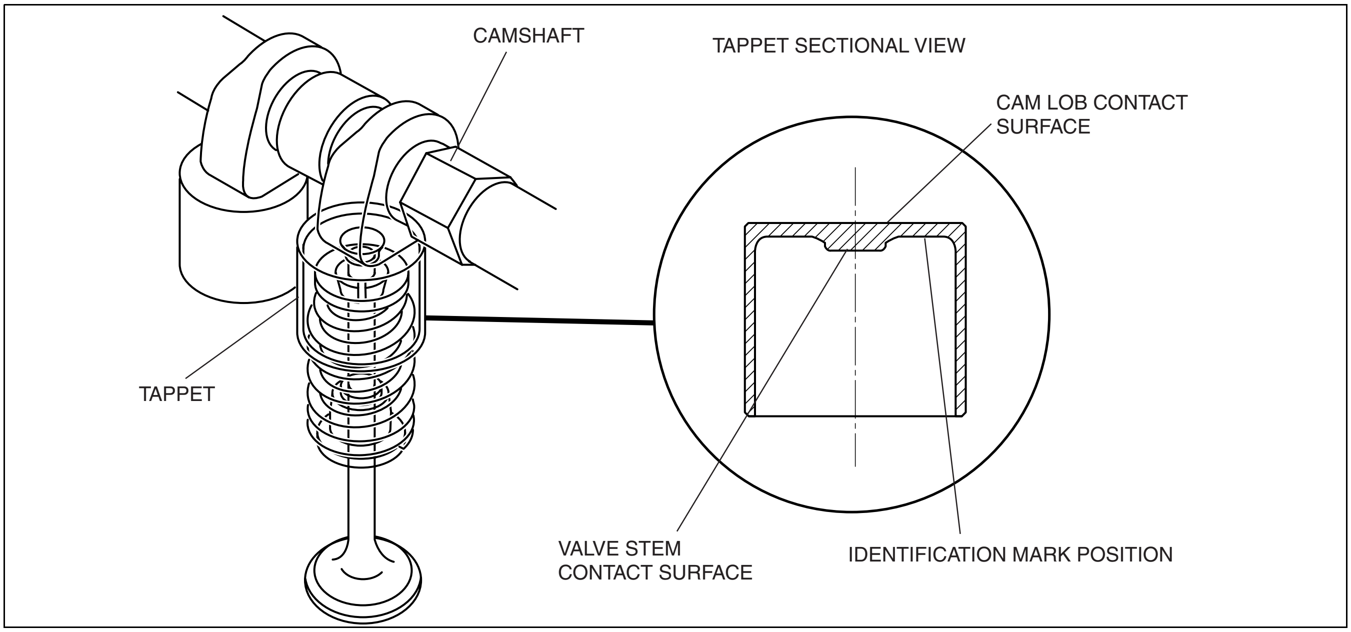
TAPPET CONSTRUCTION [LF]

E5U011012431N01

- The tappet is a shimless tappet which is integrated with the shim.
- The tappet surface is phosphate-coated to smooth the attaching surface to the cam and improve abrasion resistance.
- The valve clearance can be adjusted by replacing the tappet. There are 35 kinds of tappets depending on the thickness. The tappet kind can be determined by the engraved identification mark (3 digits).

Tappet Specification.

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

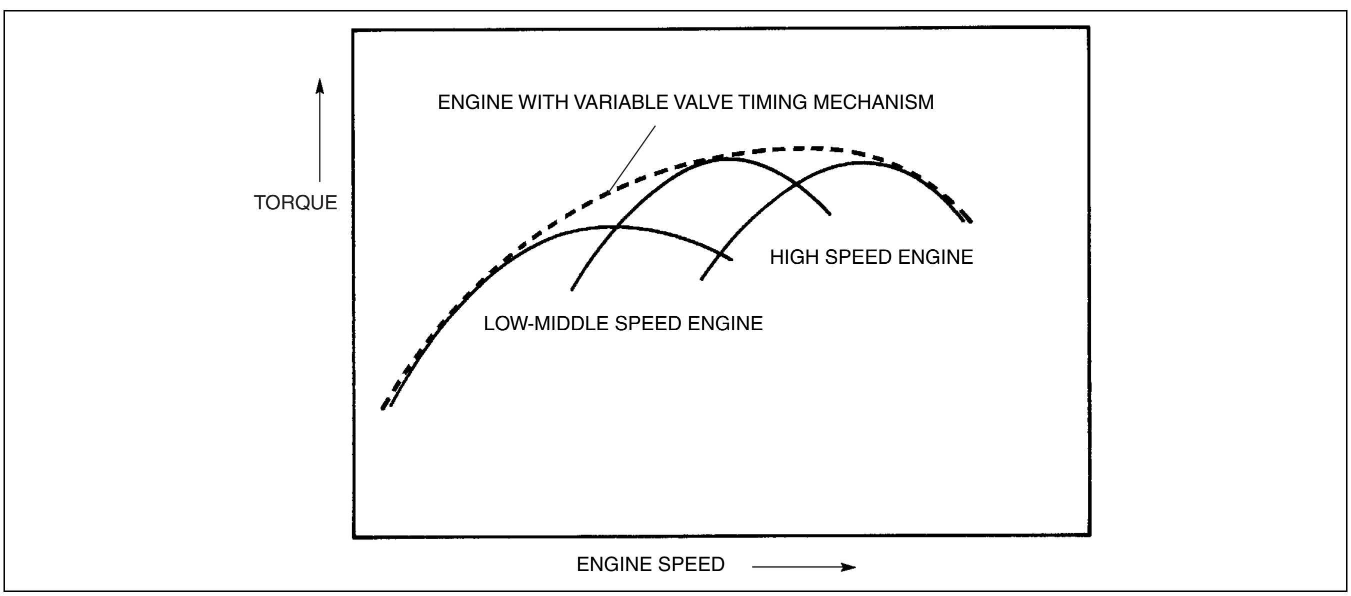


E5U110ZT5020

VARIABLE VALVE TIMING MECHANISM OUTLINE [LF]

E5U011012111N04

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



E5U110ZT5021

Variable Valve Timing Mechanism
Function

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

Operation and purpose according to driving condition
Idling range, light load range

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

Medium load range

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

Heavy load, low-middle speed range

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

Heavy load, high speed range

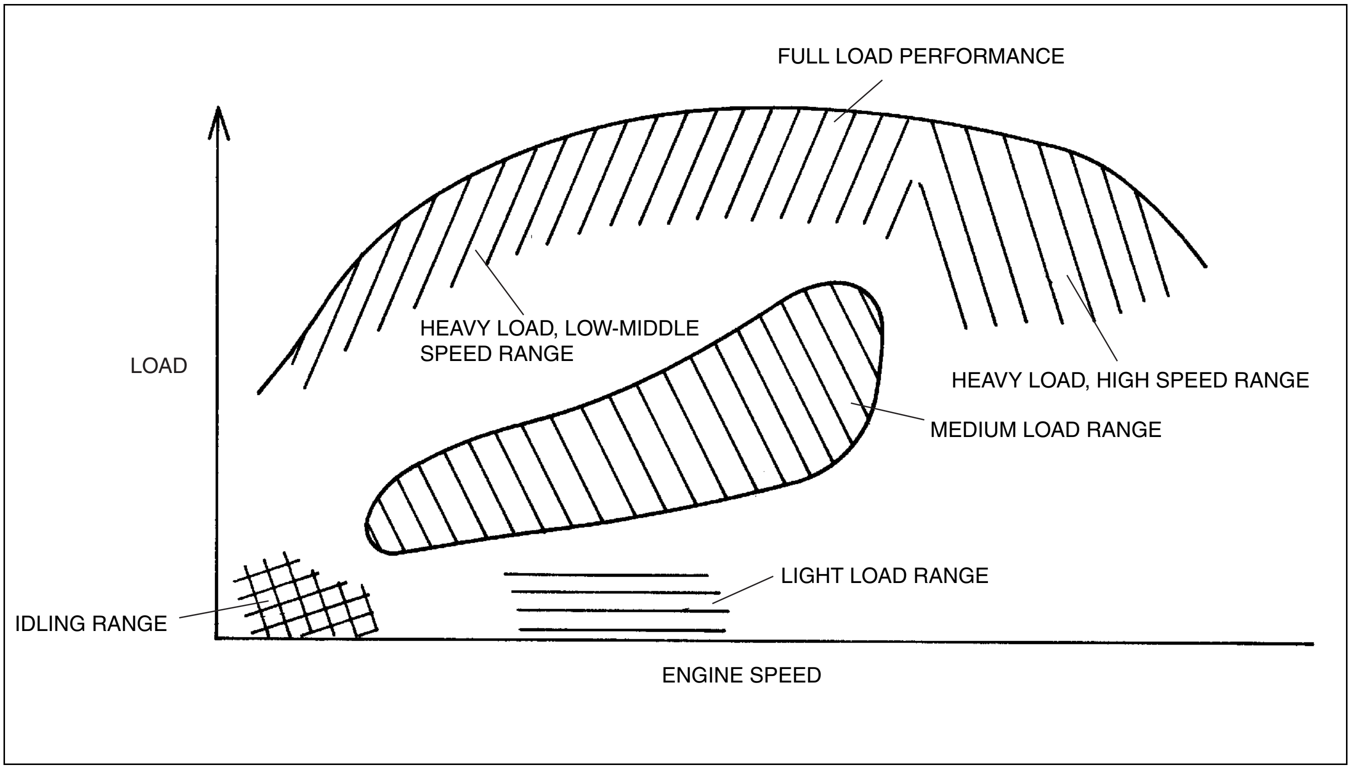
- Timing for intake valve closure is delayed and high volumetric efficiency is obtained to improve maximum output.

When temperature is low

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

When engine is started or stopped

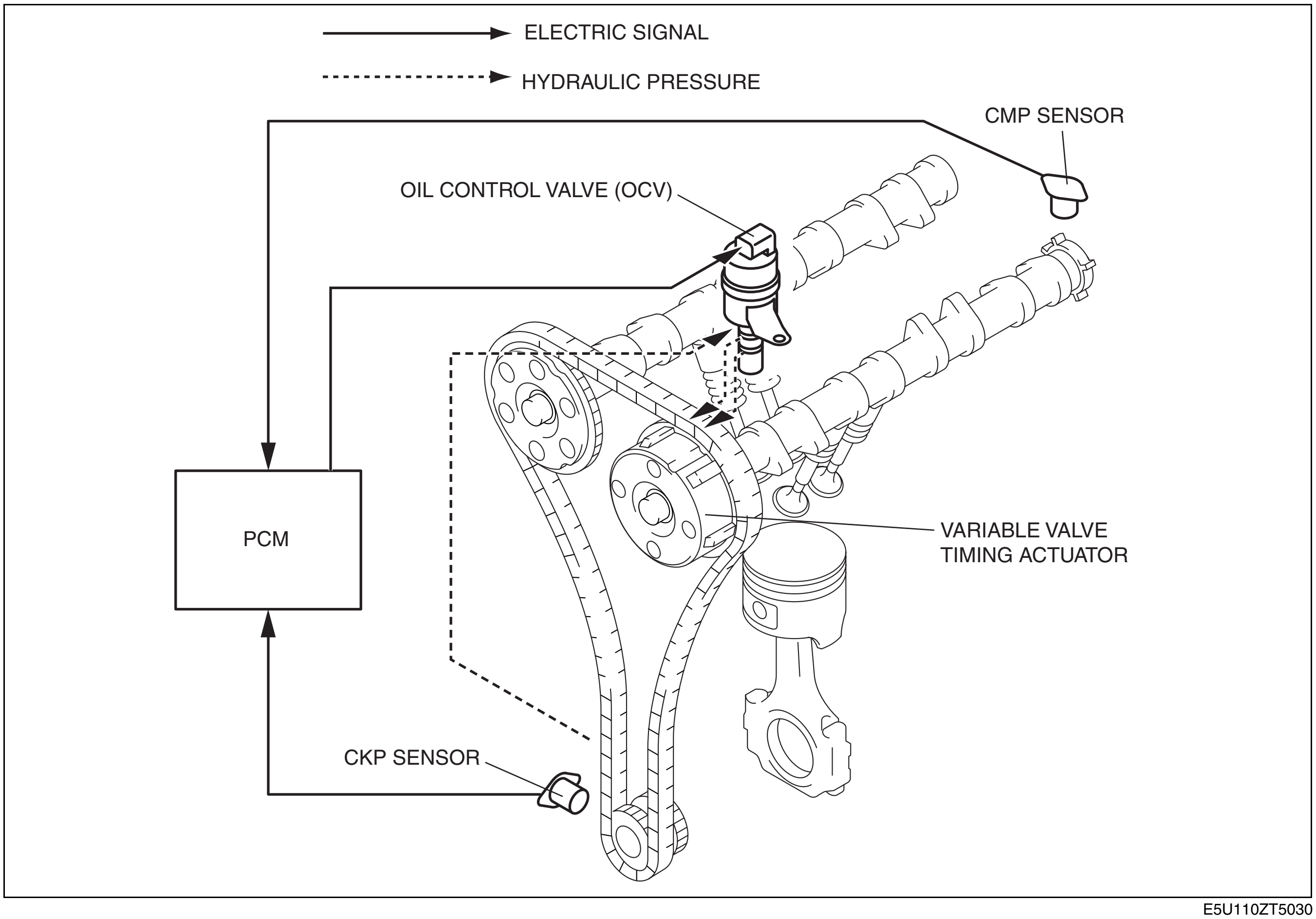
- Startability has been improved because the overlap amount has been minimized to prevent combusted gas from returning to the intake port.



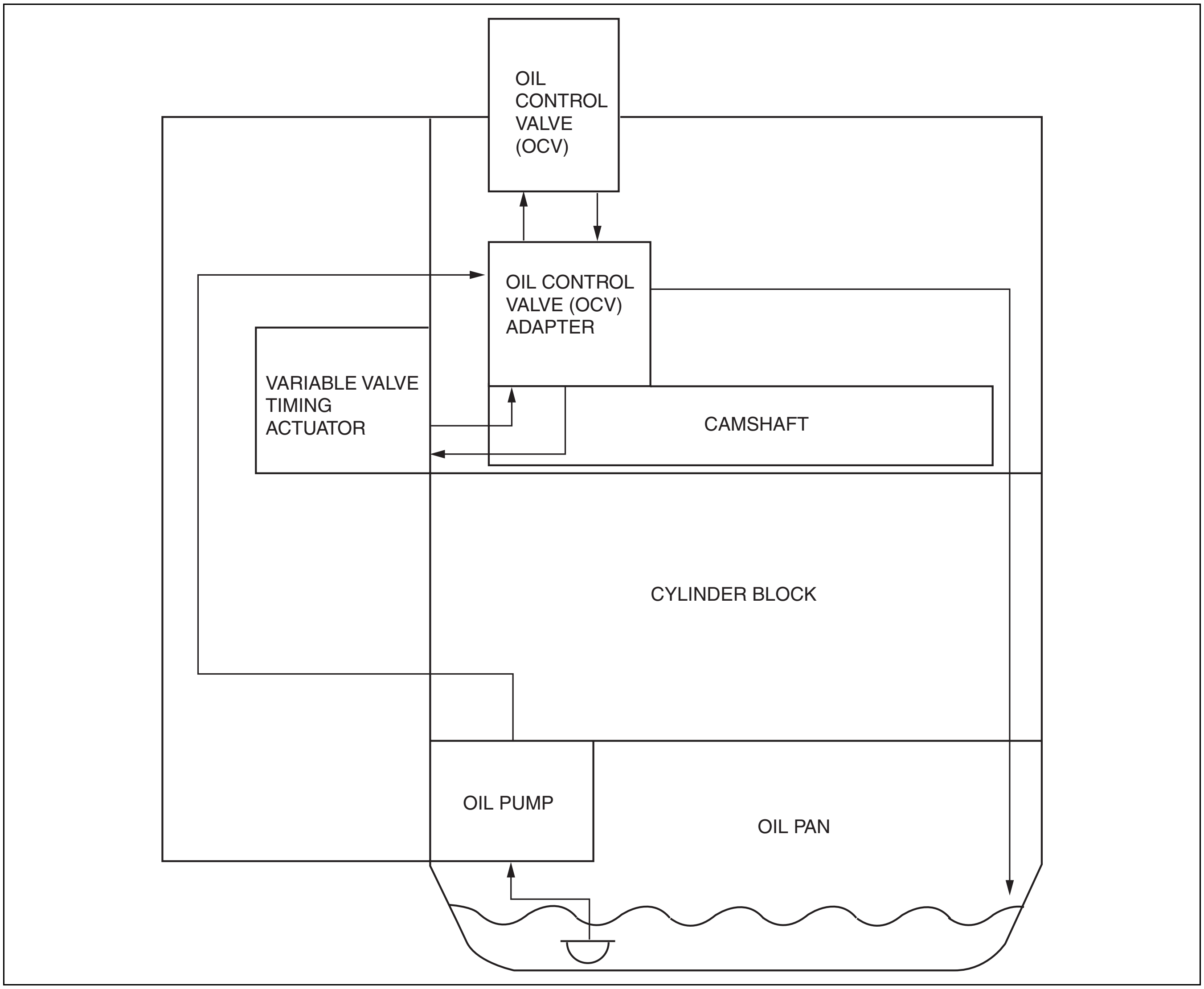
E5U110ZT5022

Construction

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



Hydraulic Pressure Flow Diagram



E5U110ZT5031

VARIABLE VALVE TIMING MECHANISM CONSTRUCTION/OPERATION [LF]

E5U011012111N05

Component and Function

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

Operation outline

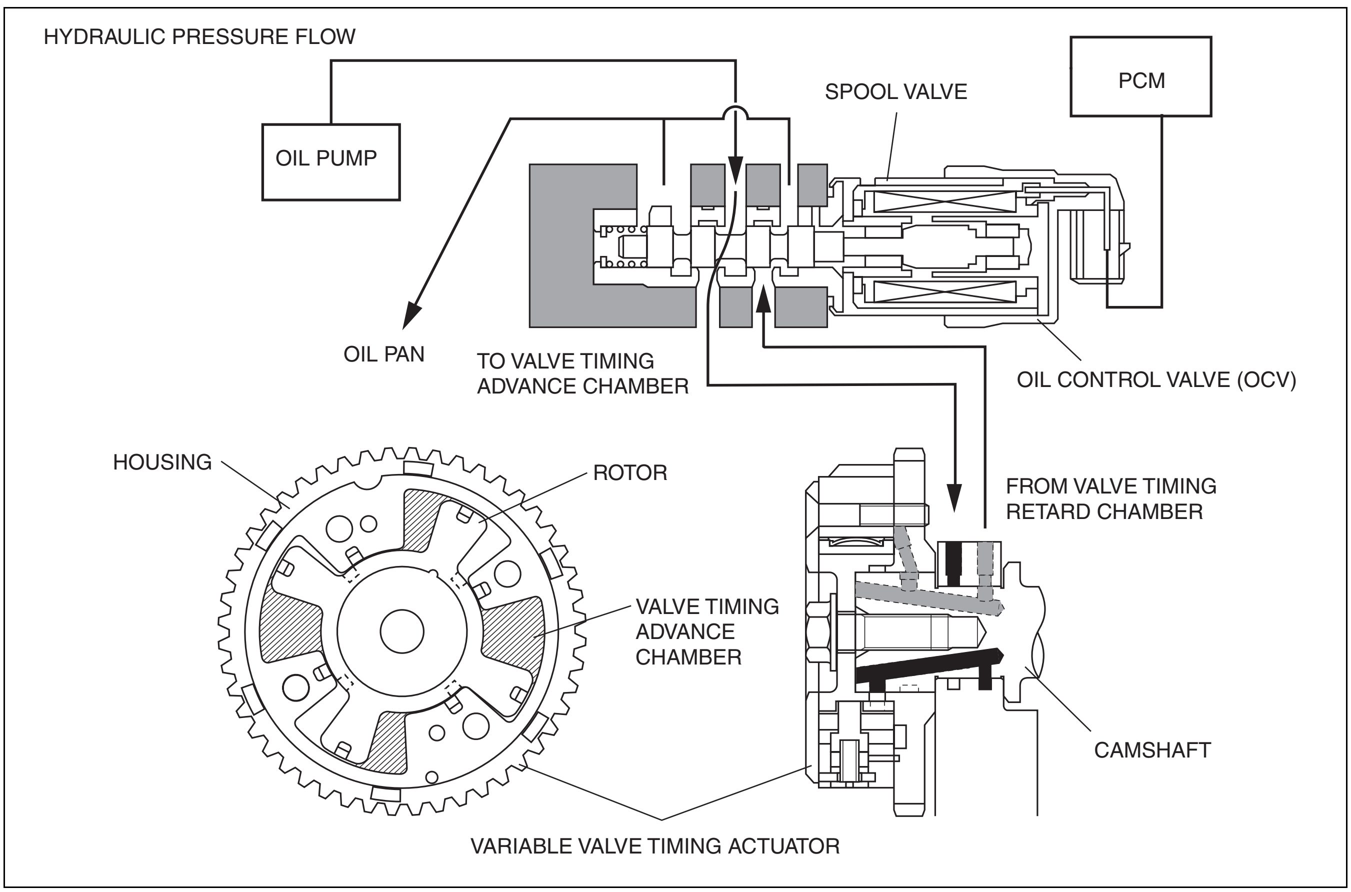
- The variable valve timing actuator has two hydraulic chambers: a valve timing advance chamber and a valve timing retard chamber. They are located between the integrated housing of the camshaft sprocket and the camshaft integrated rotor. The oil pump supplies engine oil. to each chamber. Hydraulic pressure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

At engine start

- When the stopper pin in the variable valve timing actuator engages with the rotor, which is at the position of maximum valve timing retard due to spring force, the camshaft sprocket and the camshaft rotate as one unit. When the oil pump pressure rises and the stopper pin is disengaged, it becomes possible to modify the relative angles of the camshaft sprocket and the camshaft.

Advancing valve timing

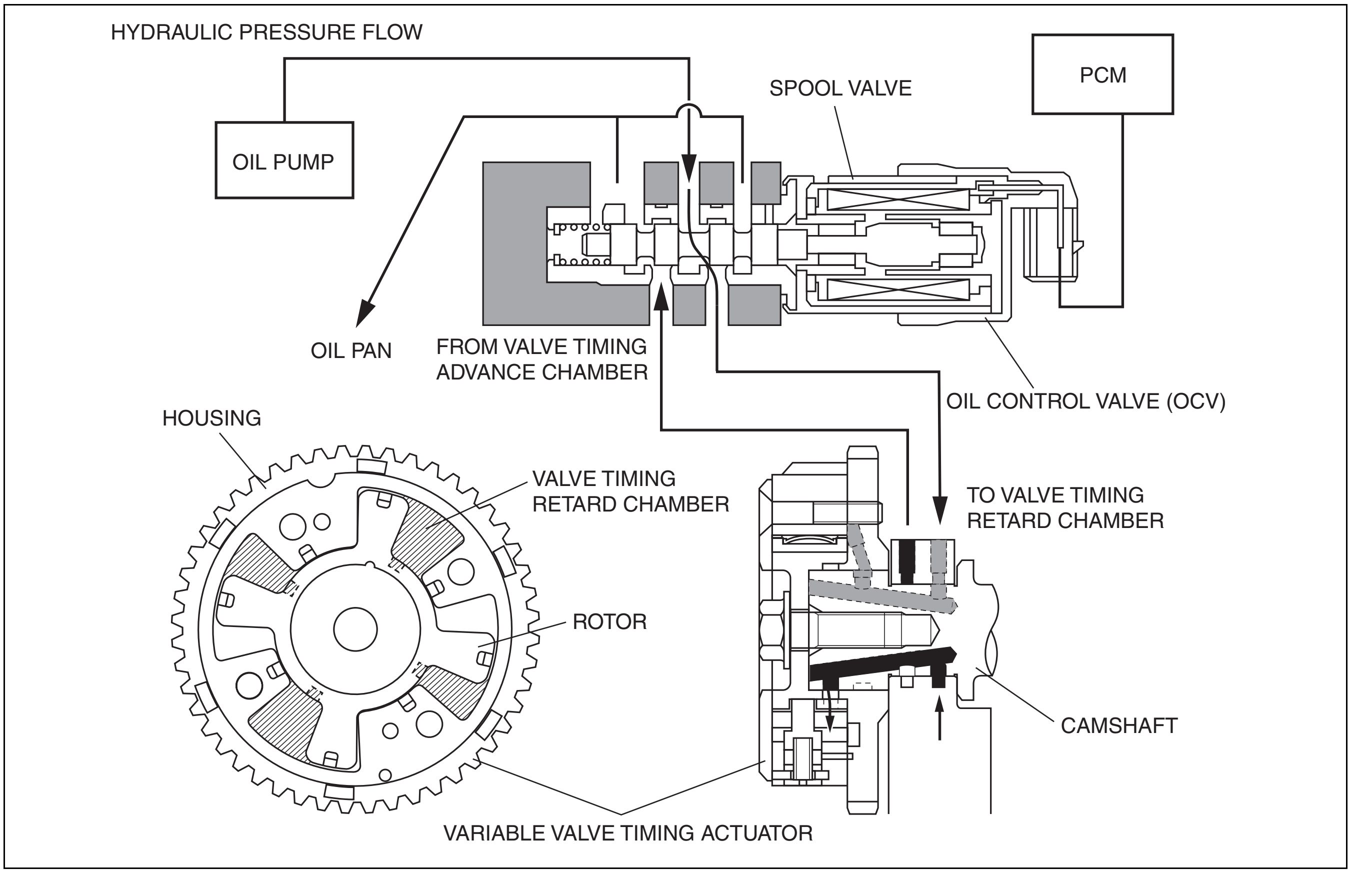
- When the spool valve in the oil control valve (OCV) moves to the left according to the PCM signal, hydraulic pressure, from the oil pump, feeds into the valve timing advance passage and finally to the valve timing advance chamber in the variable valve timing actuator. Then, the rotor integrated with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



E5U110ZT5032

Retarding valve timing

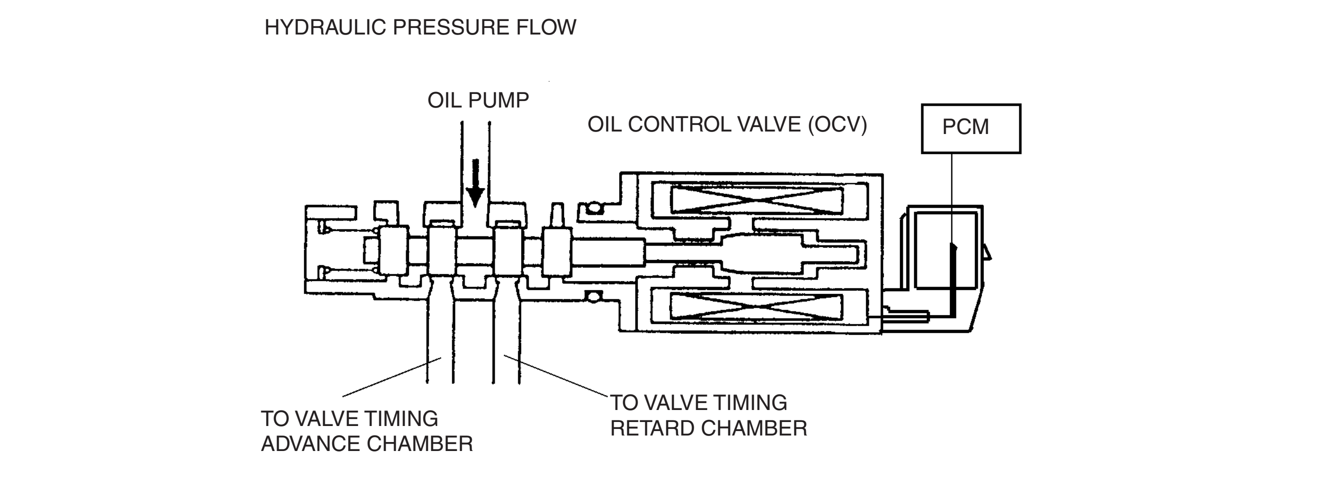
- When the spool valve in the oil control valve (OCV) moves to the right according to the PCM signal, hydraulic pressure, from the oil pump, feeds into the valve timing retard passage and finally to the valve timing retard chamber in the variable valve timing actuator. Then, the rotor integrated with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



E5U110ZT5033

Maintaining intermediate valve timing

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

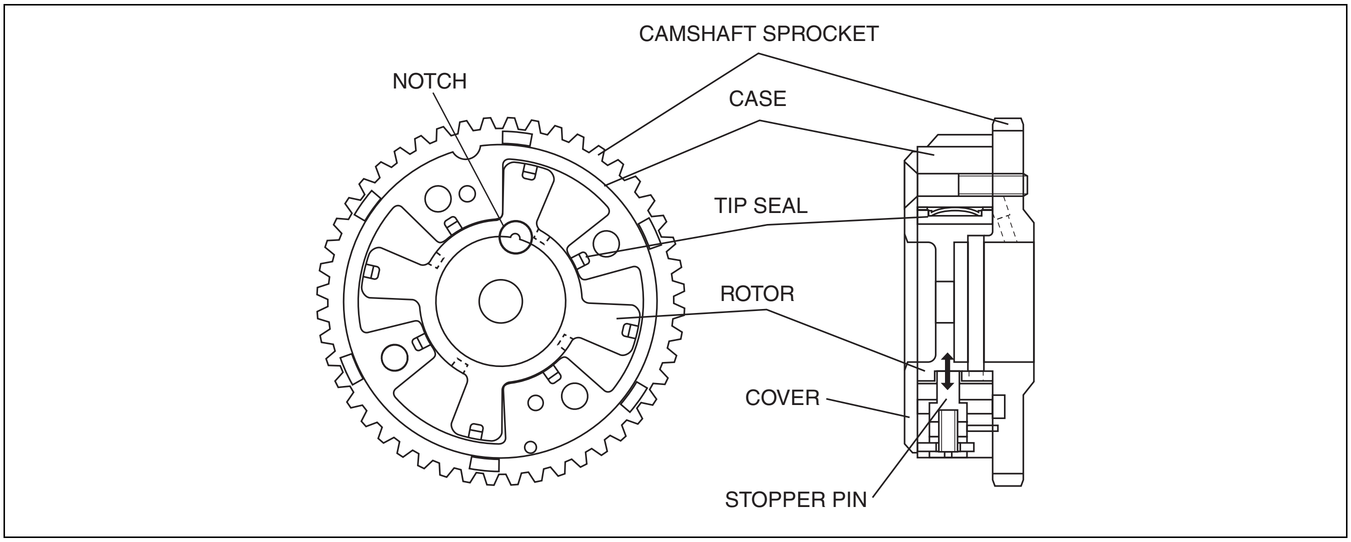


E5U110ZT5034

VARIABLE VALVE TIMING ACTUATOR CONSTRUCTION [LF]

E5U011012490N01

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

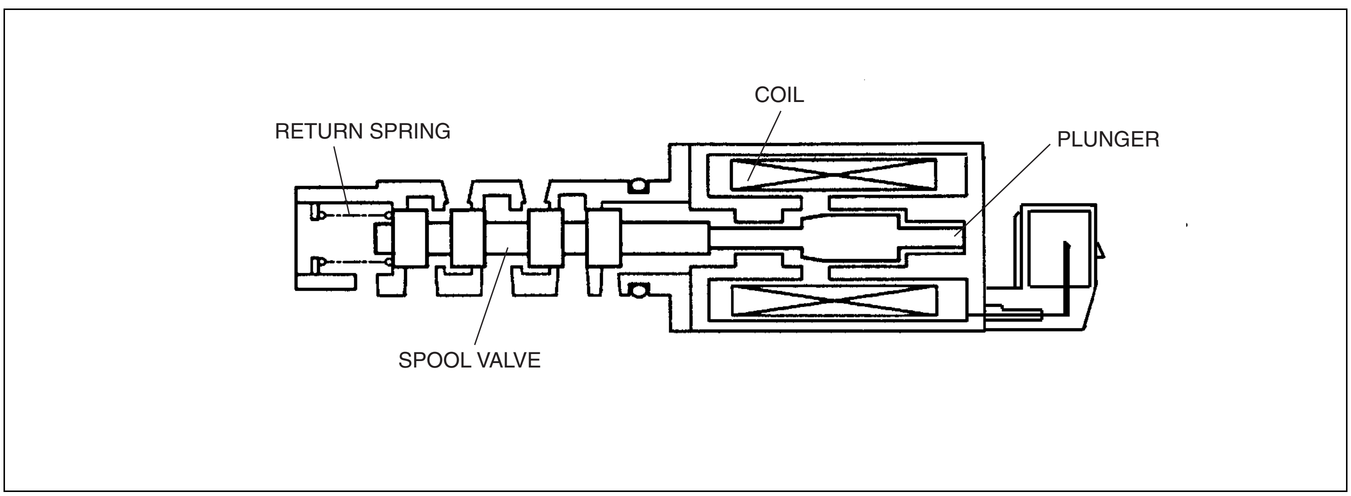


E5U110ZT5035

OIL CONTROL VALVE (OCV) CONSTRUCTION [LF]

E5U011014420N01

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



E5U110ZT5036

01–11 LUBRICATION

LUBRICATION SYSTEM OUTLINE [LF]

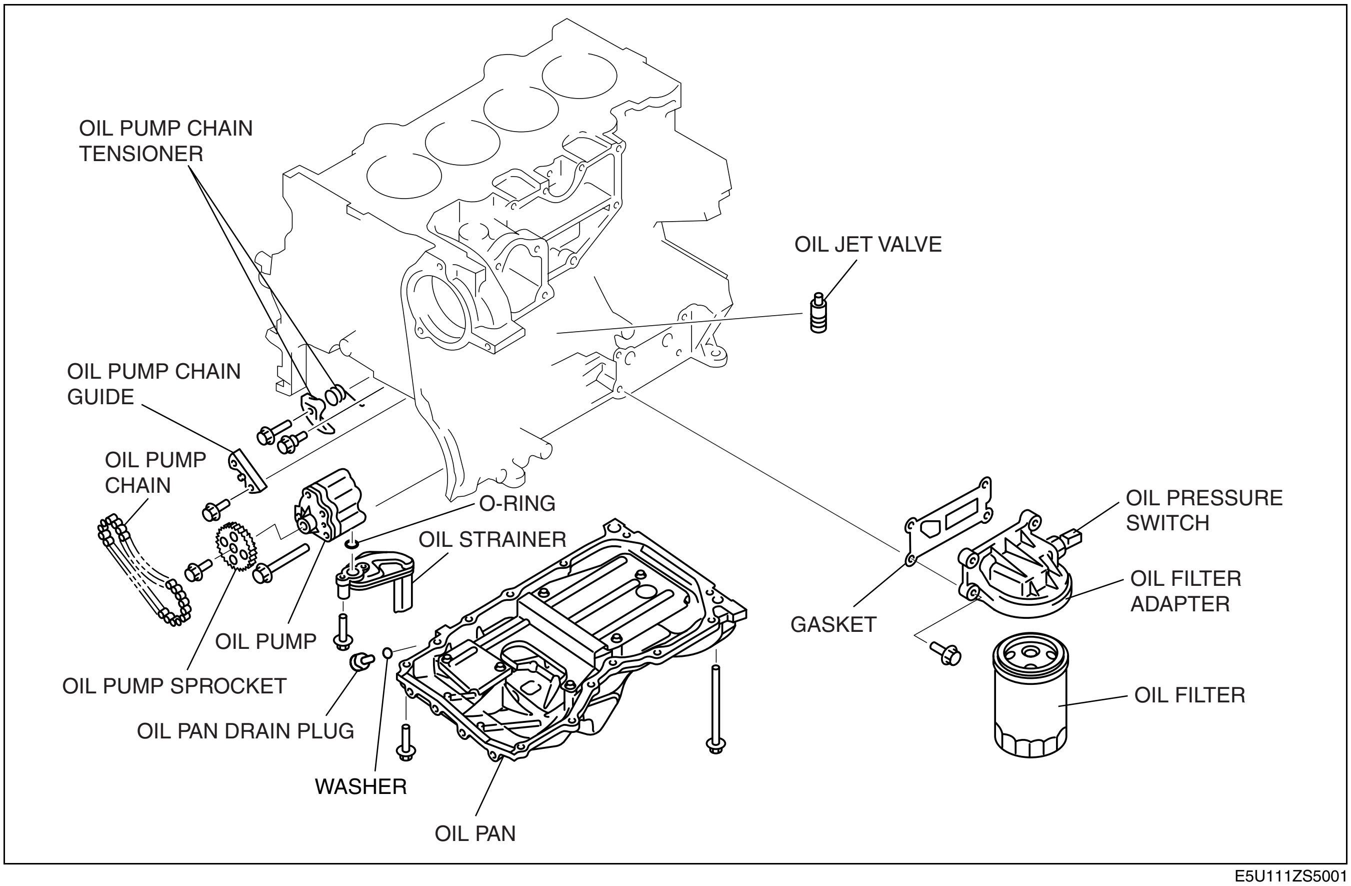
E5U011100000N01

Features

Reduced noise	• Aluminum alloy oil pan adopted
Reduced weight	• Plastic oil strainer adopted
Improved lubricity	• Trochoid gear type oil pump adopted • Oil jet valves adopted

LUBRICATION SYSTEM STRUCTURAL VIEW [LF]

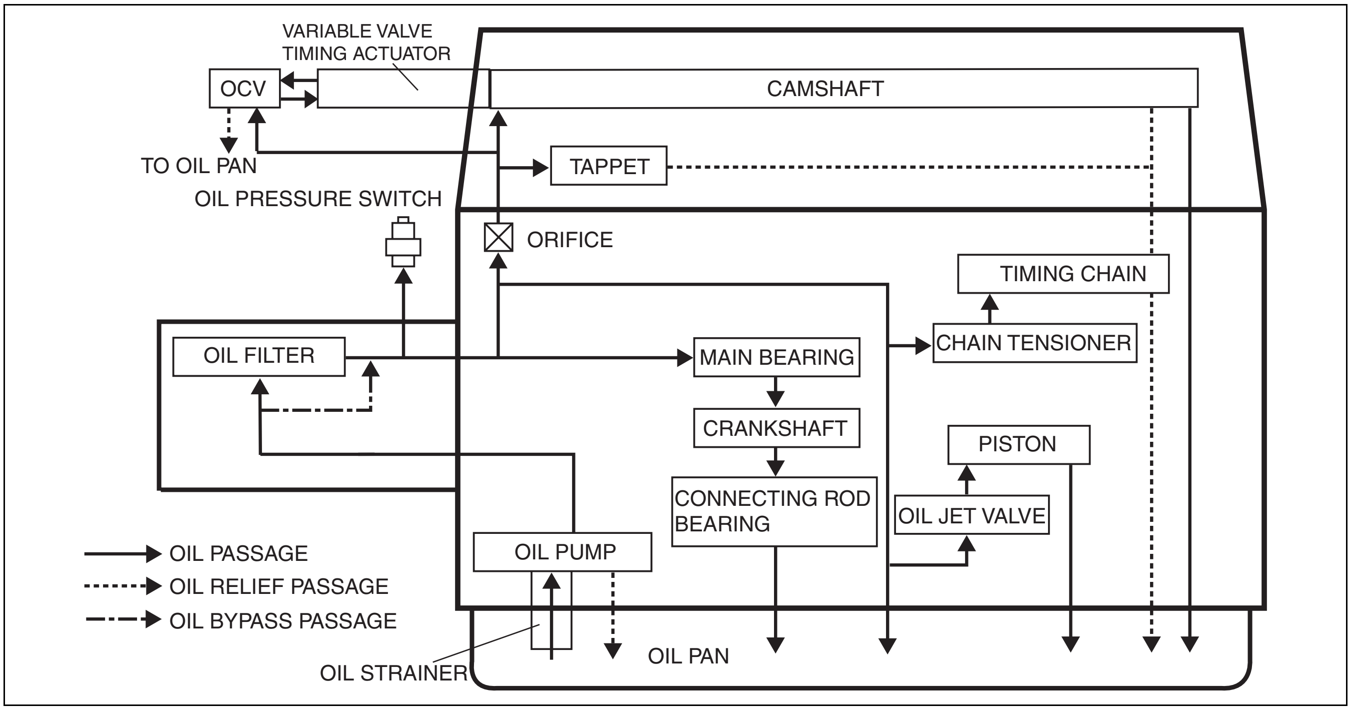
E5U011100000N02



E5U111ZS5001

LUBRICATION SYSTEM FLOW DIAGRAM [LF]

E5U011100000N03

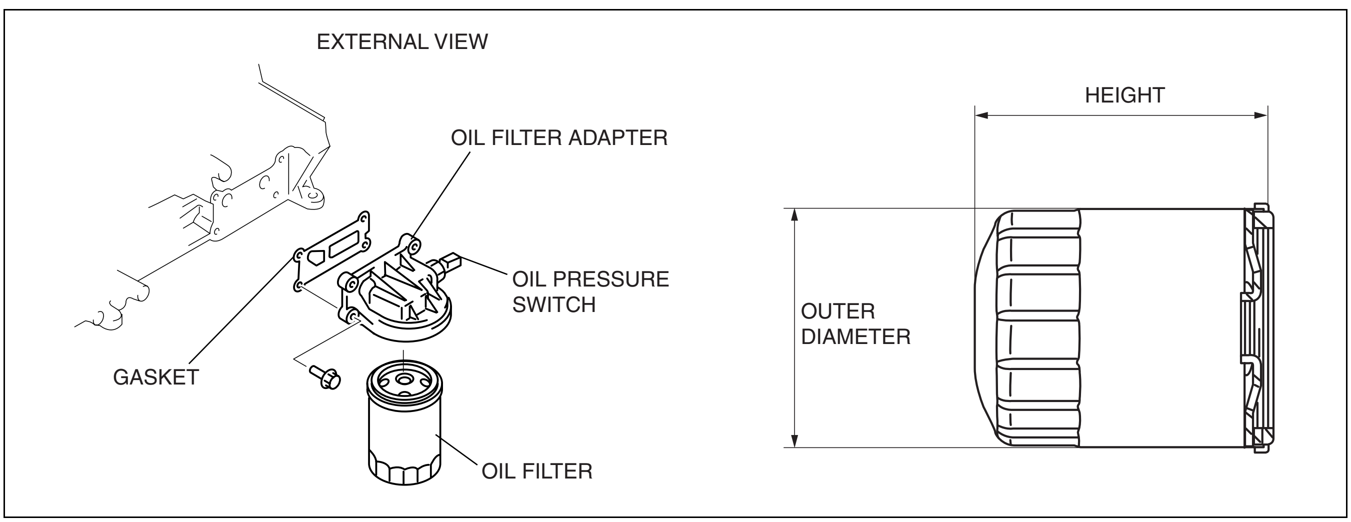


E5U111ZS5002

OIL FILTER CONSTRUCTION [LF]

E5U011114300N01

- The oil filter component is installed on the left surface (vehicle left) of the cylinder block.
- An aluminum oil filter adapter has been adopted for weight reduction. The oil pressure switch is installed on the rear of the oil filter adapter.
- The oil filter is a full-flow paper element type with an outer diameter of 76.2 mm {3.00 in} and height of 94.0 mm {3.70 in}.

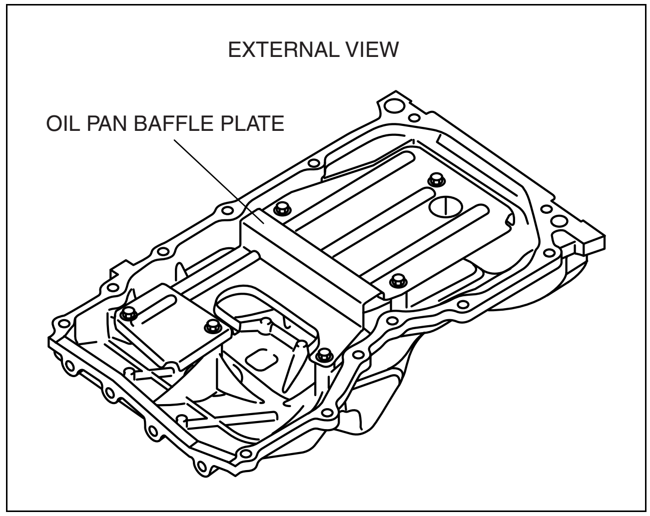


E5U111ZS5003

OIL PAN CONSTRUCTION [LF]

E5U011110040N01

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

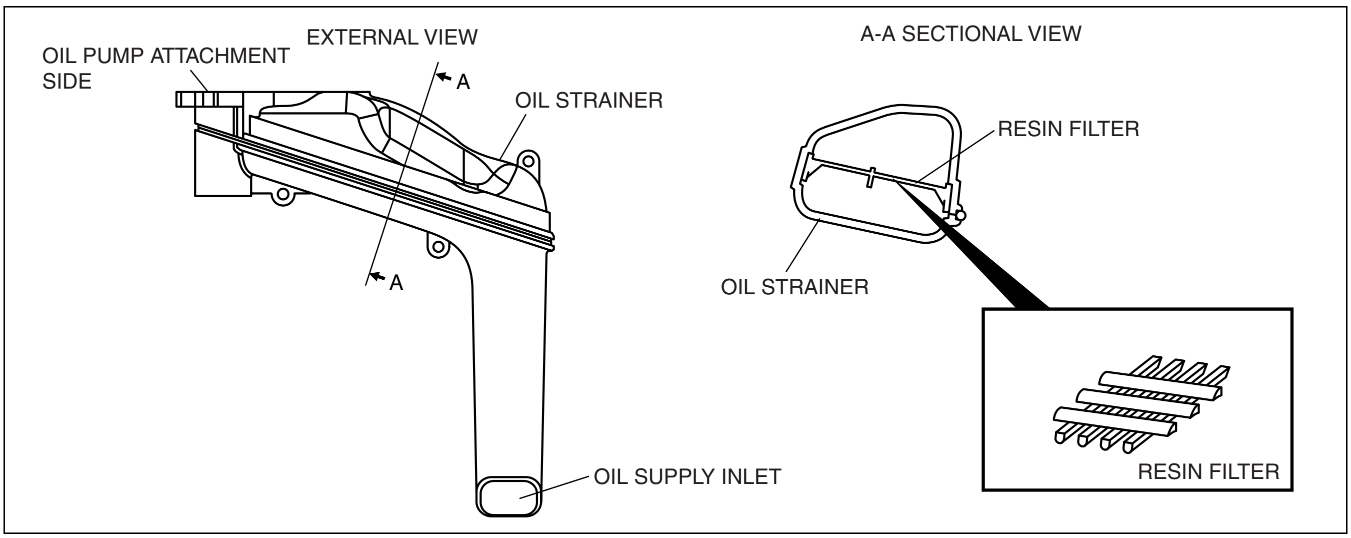


E5U111ZS5004

OIL STRAINER CONSTRUCTION [LF]

E5U011114240N01

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

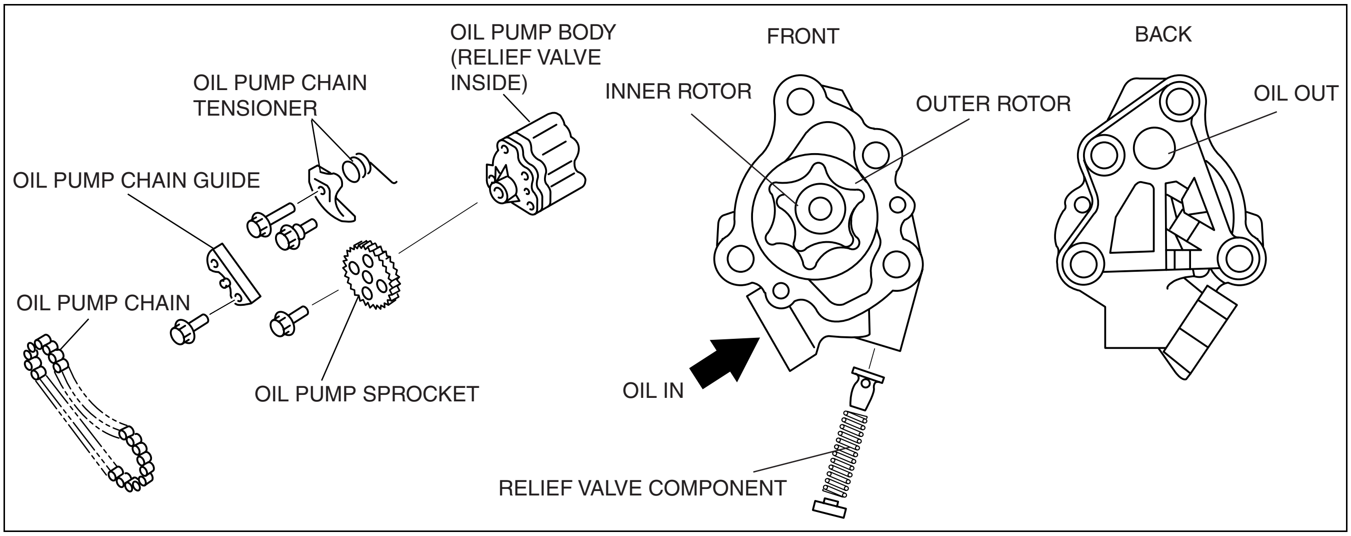


E5U111ZS5005

OIL PUMP CONSTRUCTION [LF]

E5U011114100N01

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

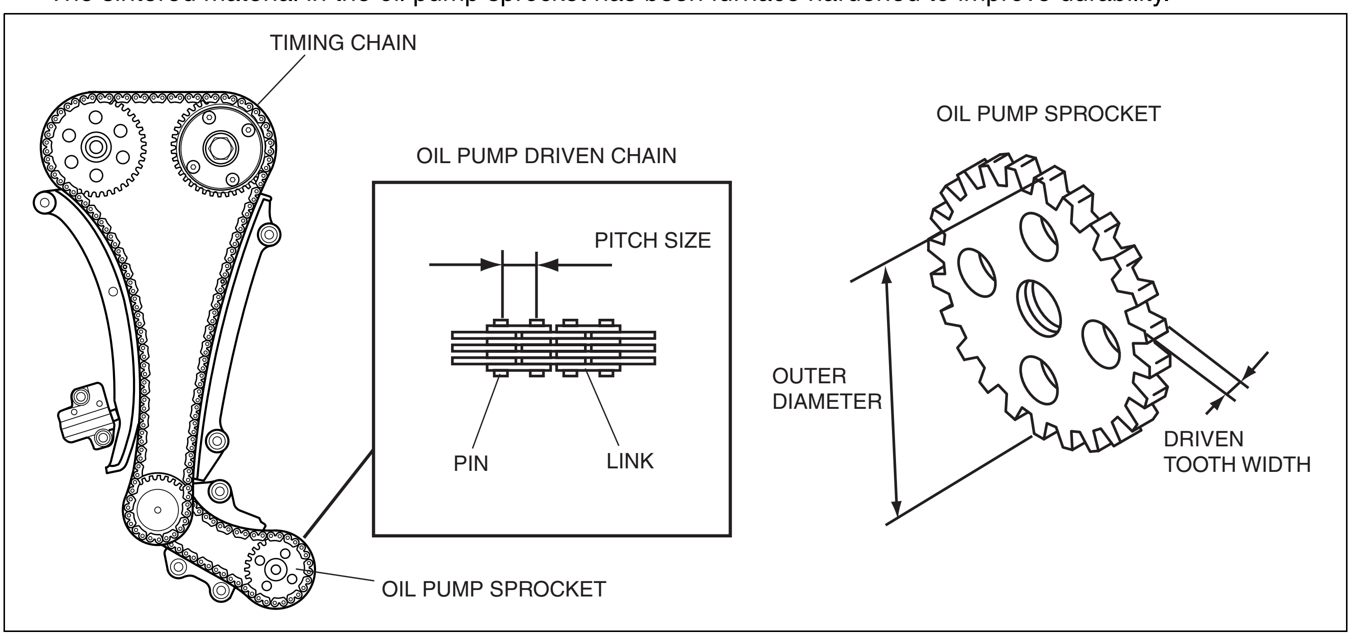


EPU111ZS3008

Oil pump specification

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

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



EPU111ZS3005

Oil pump driven chain, oil pump sprocket specification

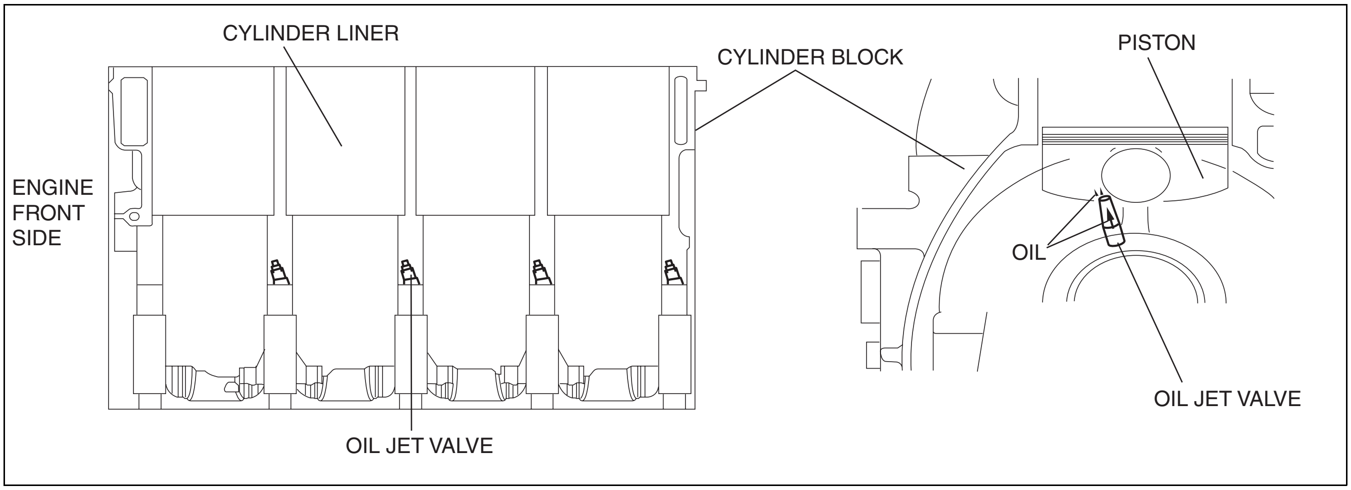
Item		Specification [mm {in}]
Oil pump driven chain	Pitch size	8 {0.3}
Oil pump sprocket	Outer diameter	60.78 {2.392}
	Driven tooth width	6.15 {0.242}

OIL JET VALVE CONSTRUCTION/OPERATION [LF]

E5U011110730N01

Construction

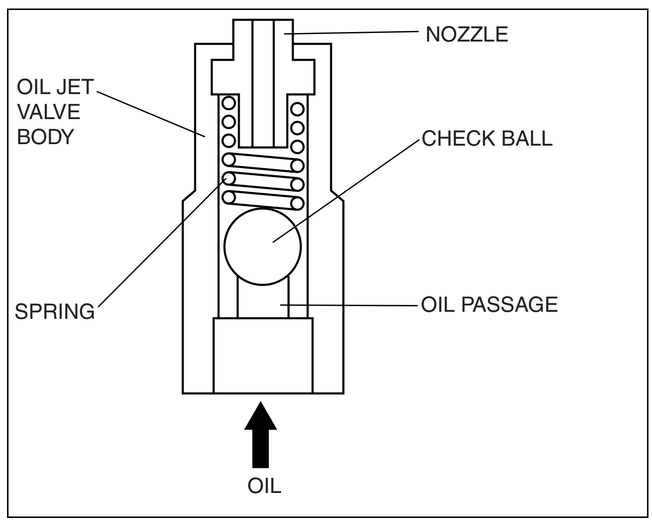
- The oil jet valves are installed in the cylinder block (in the main journal). The oil jet valve nozzles are installed pointed toward the back surface of each piston.
- The oil jet valves are designed to maintain optimum oil pressure in the engine by controlling the oil injection according to the oil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



EPU111ZS3006

Operation

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



EPU111ZS3007

01–12 COOLING SYSTEM

COOLING SYSTEM OUTLINE [LF]

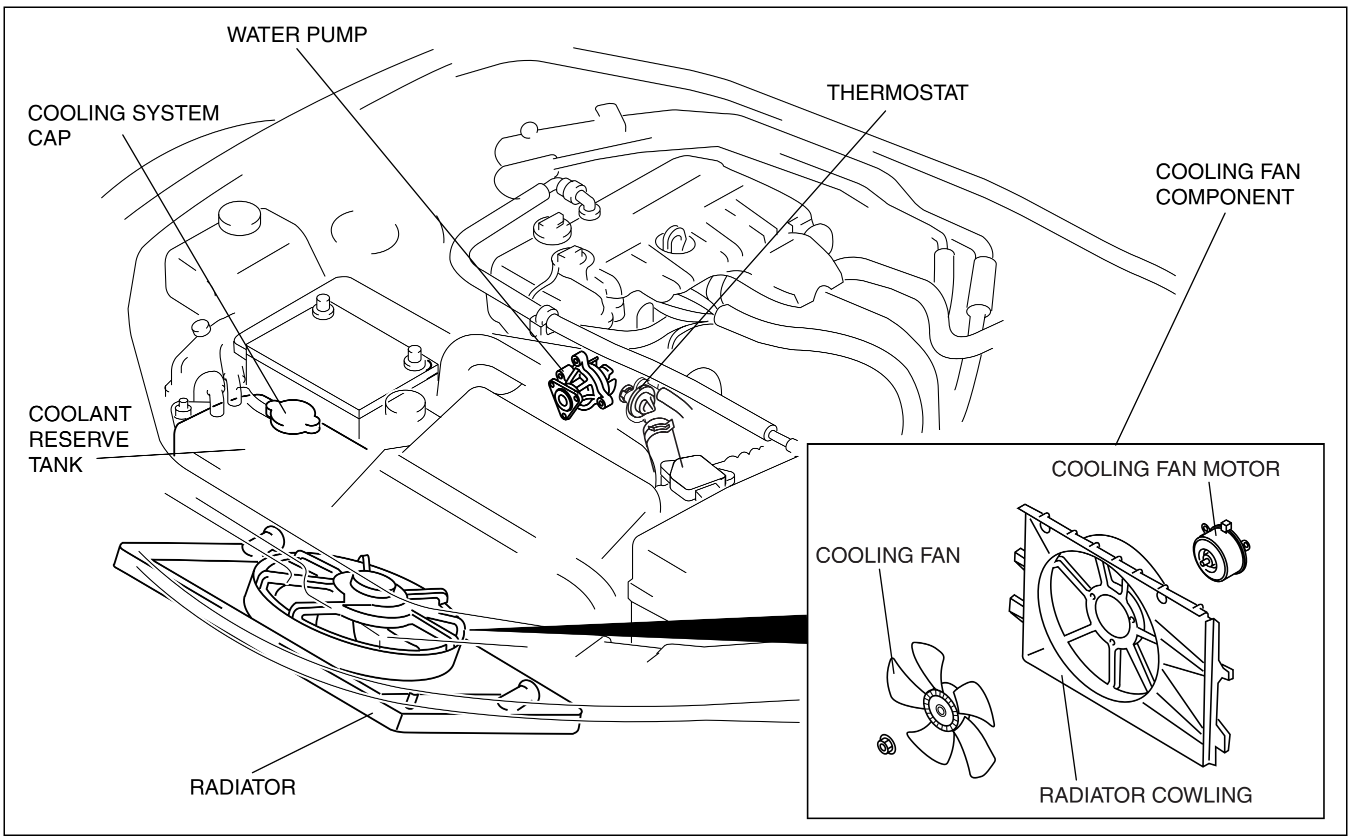
E5U011200000N01

Features

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

COOLING SYSTEM STRUCTURAL VIEW [LF]

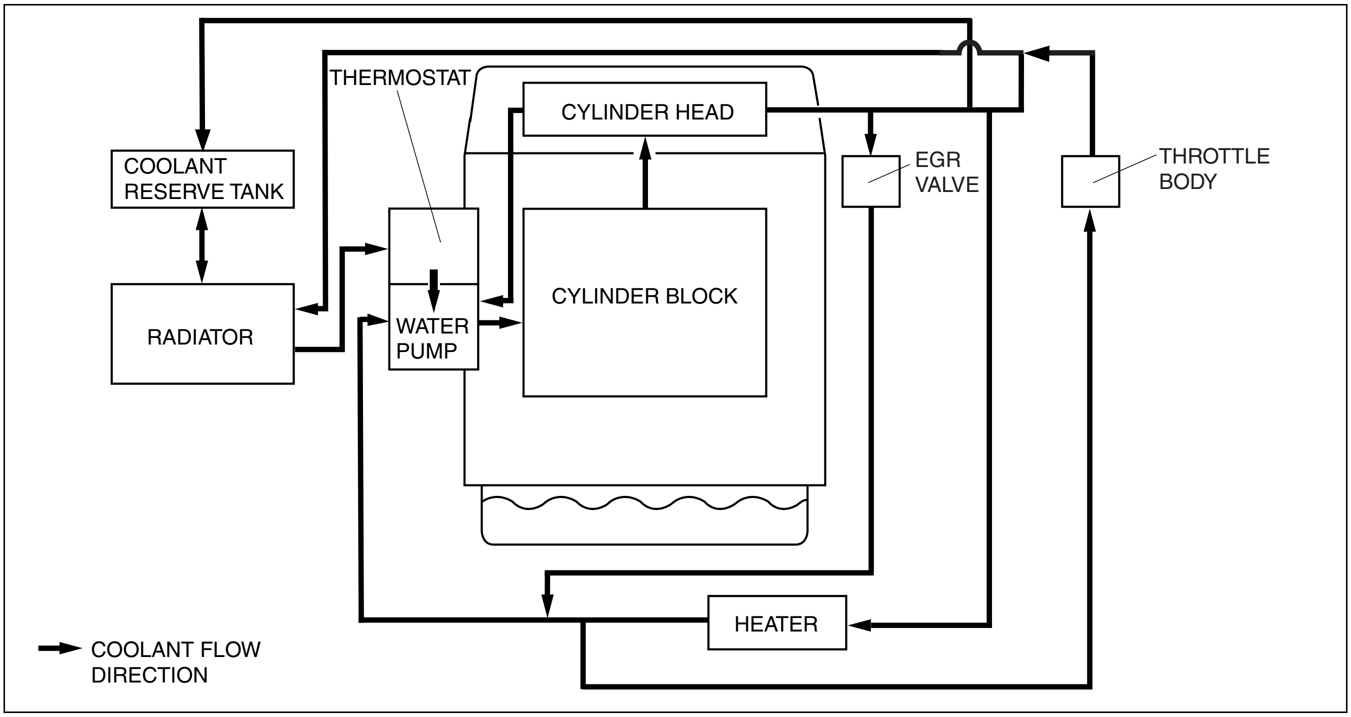
E5U011200000N02



E5U112ZS5001

COOLING SYSTEM FLOW DIAGRAM [LF]

E5U011200000N03

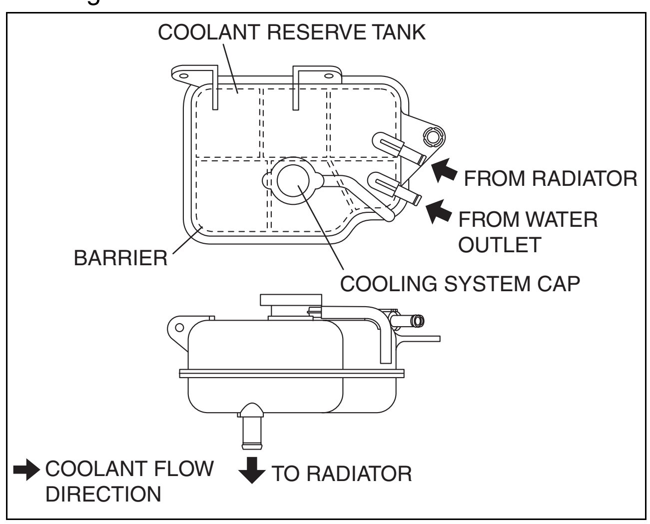


E5U112ZS5002

COOLING SYSTEM CAP, COOLANT RESERVE TANK CONSTRUCTION [LF]

E5U011215201N02

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

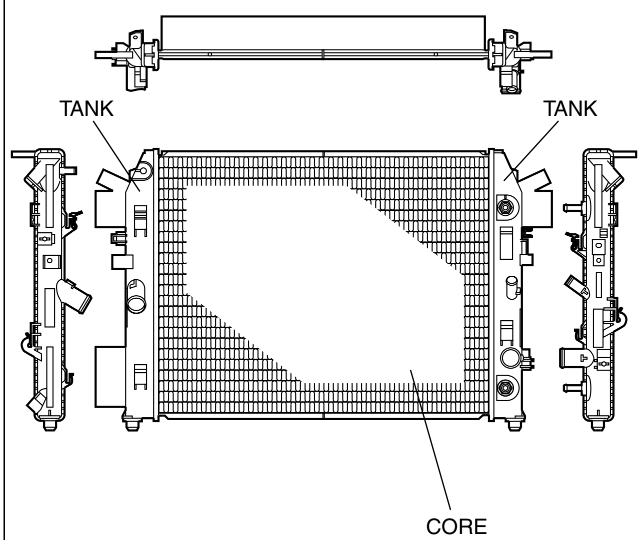


E5U112ZS5003

RADIATOR CONSTRUCTION [LF]

E5U011215200N01

- A cross-flow radiator with corrugated fins is used to improve cooling performance.
- The radiator tanks are made of plastic and the core is made of aluminum for weight reduction.
- Four rubber-insulated mounting brackets are utilized to decrease vibration.
- To improve both the cooling ability and allow 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.
- The radiator has an ATF cooler in the right side radiator tank. (AT)



E5U112ZS5004

THERMOSTAT CONSTRUCTION/OPERATION [LF]

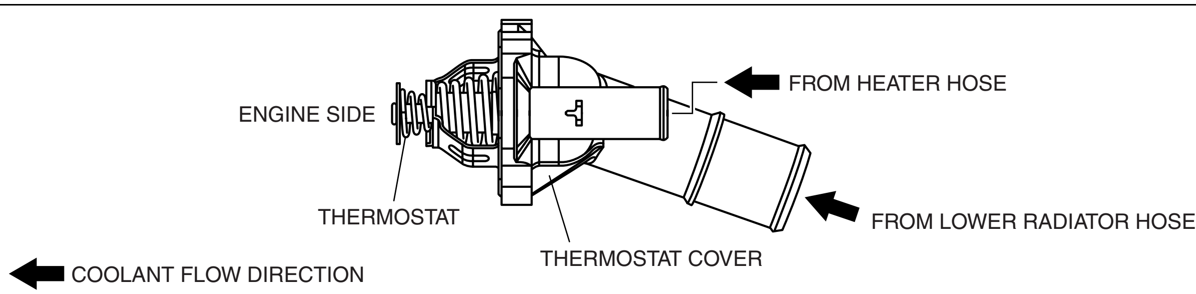
E5U011215171N01

Construction

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

Operation

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



E5U112ZS5005

WATER PUMP CONSTRUCTION/OPERATION [LF]

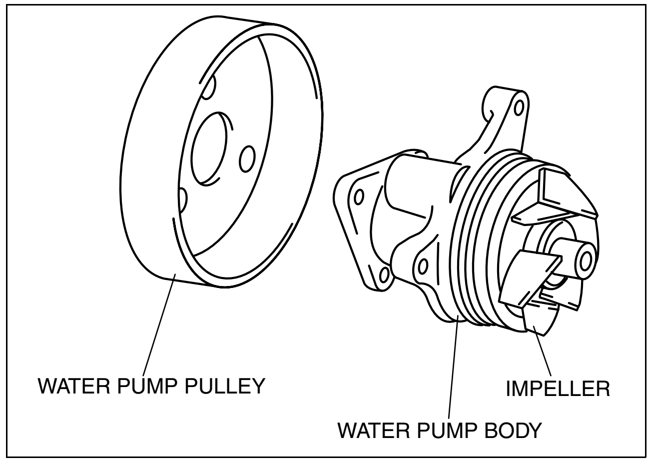
E5U011215010N01

Construction

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

Operation

- The water pump is driven by the drive belt.



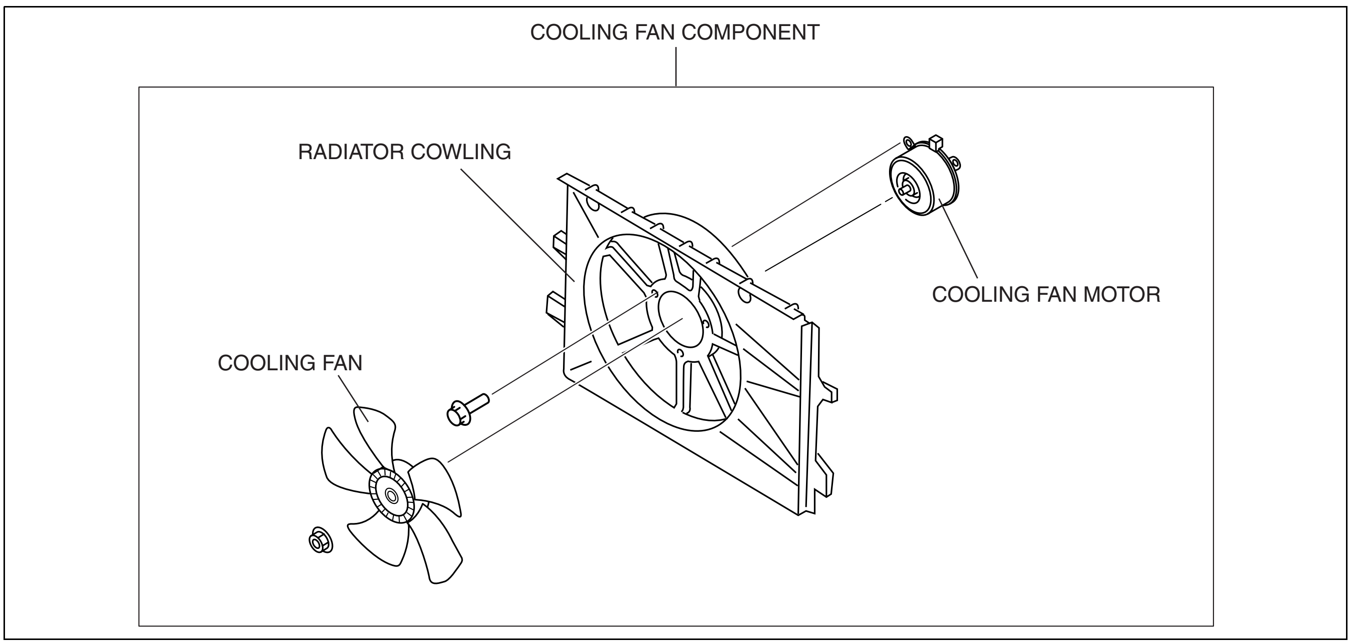
C3E0112T019

COOLING FAN COMPONENT CONSTRUCTION/OPERATION [LF]

E5U011215140N01

Construction

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



E5U112ZS5006

Cooling fan, cooling fan motor specification

Item		Specification
Cooling fan	Number of blades	5
	Outer diameter (mm {in})	360 {14.2}
Cooling fan motor output (W)		120

Operation

- Cooling fan operates according to the engine coolant temperature and whether the A/C is on or off. Three-stage control has been adopted to the cooling fan with high, middle, and low speed rotation allowing noise reduction and power savings. (See 01–40–34 ELECTRICAL FAN CONTROL OPERATION [LF].)

01–13 INTAKE-AIR SYSTEM

INTAKE-AIR SYSTEM OUTLINE [LF]

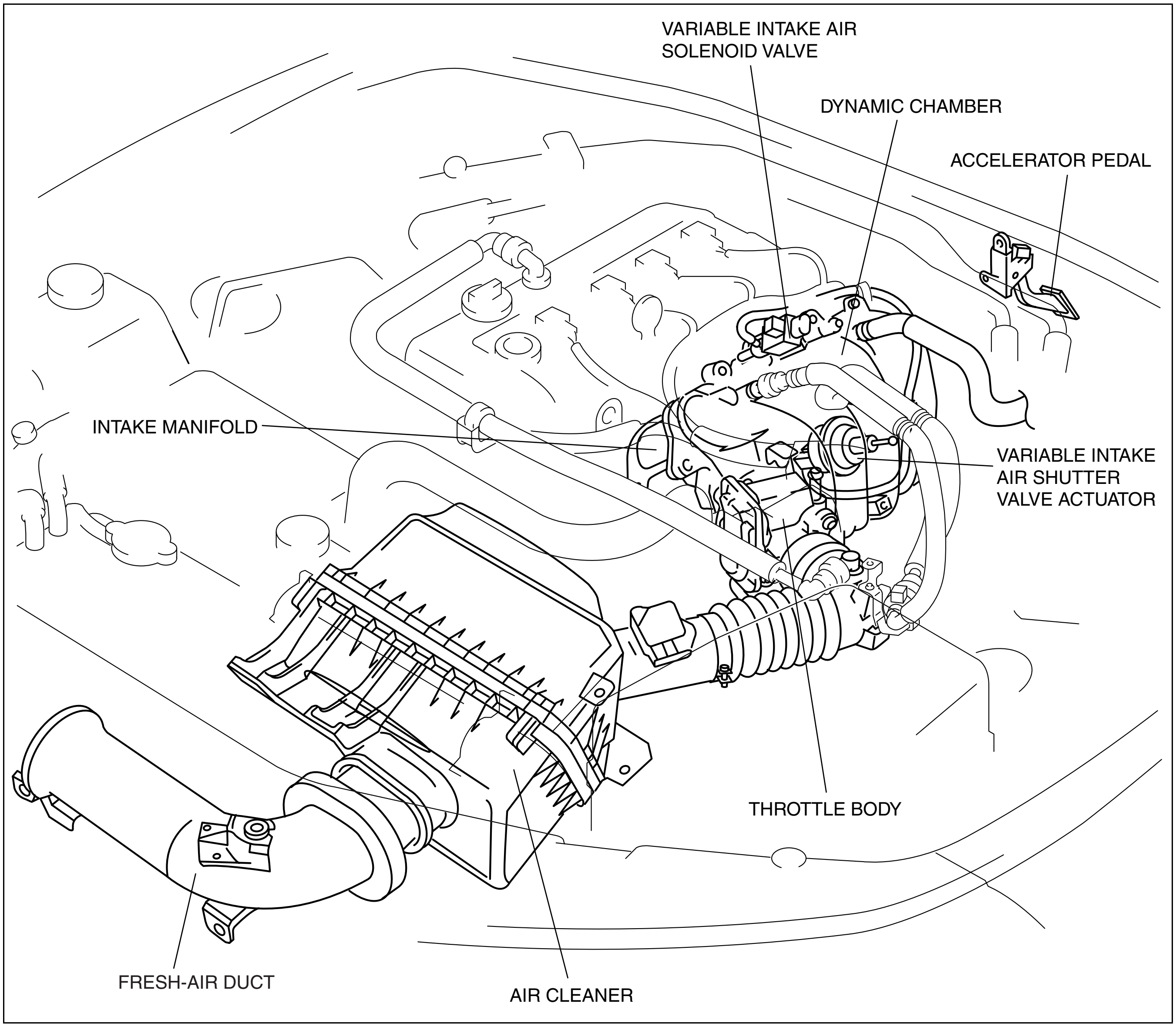
E5U011300000N01

Features

Improved engine torque	• Variable intake air system adopted

INTAKE-AIR SYSTEM STRUCTURAL VIEW [LF]

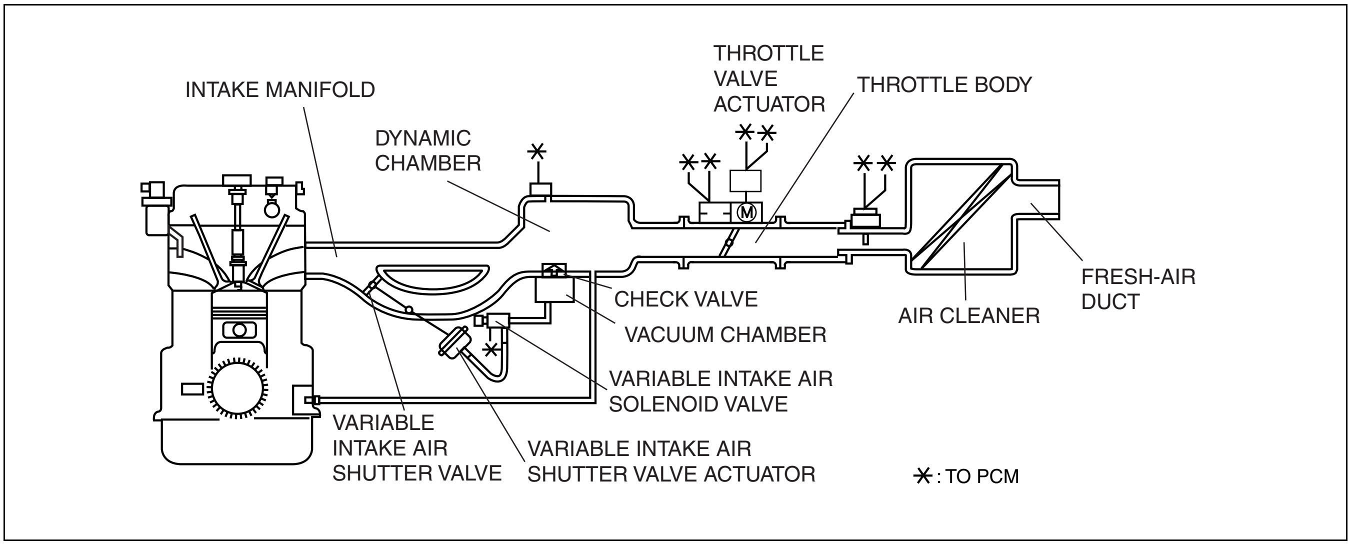
E5U011300000N02



E5U113ZS5010

INTAKE-AIR SYSTEM DIAGRAM [LF]

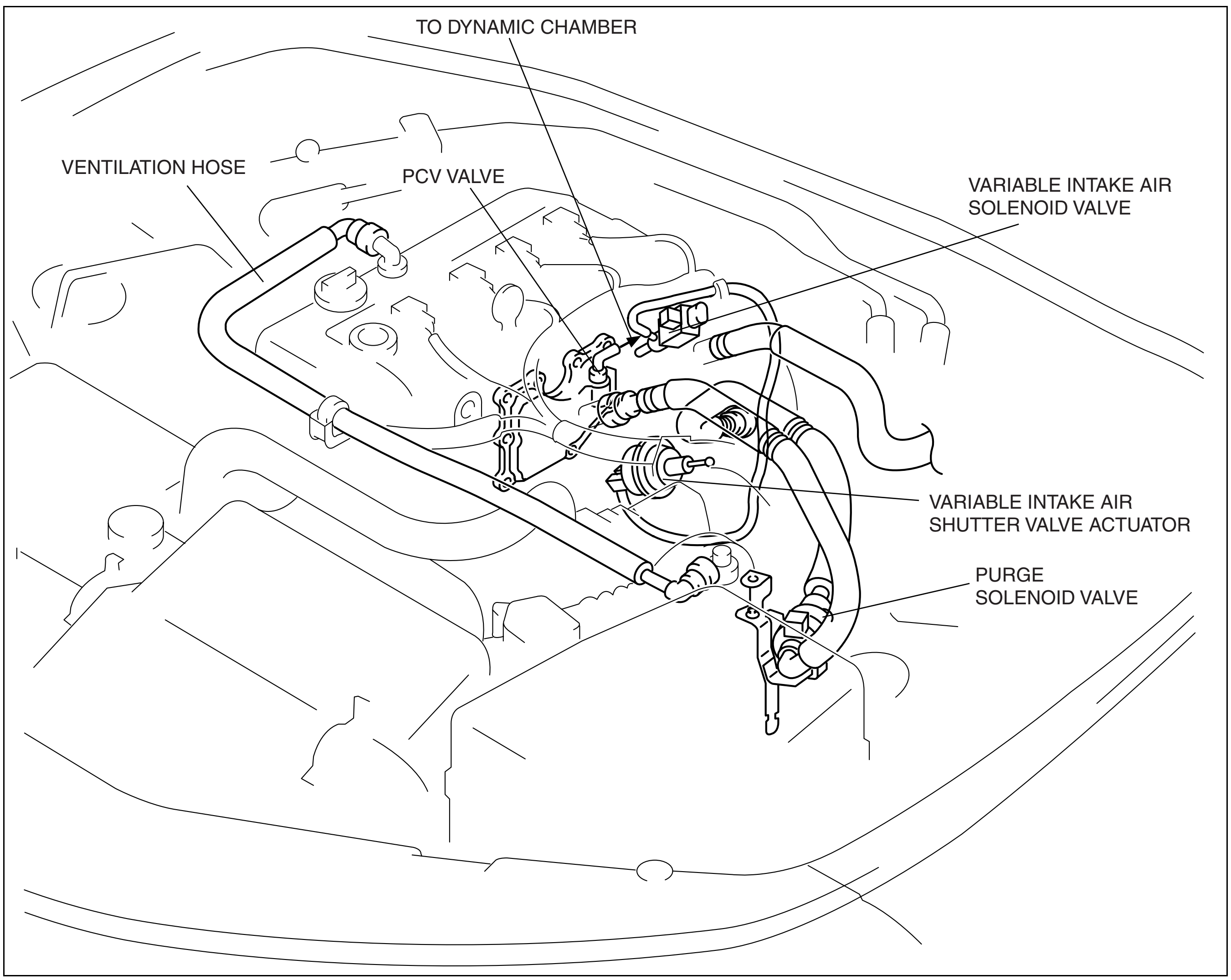
E5U011300000N04



E5U113ZS5001

INTAKE-AIR SYSTEM HOSE ROUTING DIAGRAM [LF]

E5U011300000N05

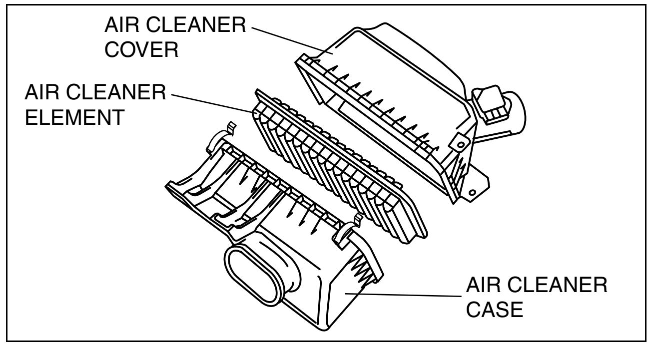


E5U113ZW5001

AIR CLEANER CONSTRUCTION [LF]

E5U011313300N01

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

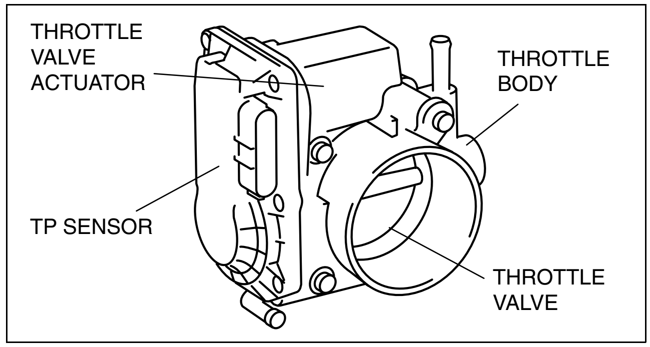


E5U113ZS5012

THROTTLE BODY FUNCTION [LF]

E5U011313640N03

- 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.



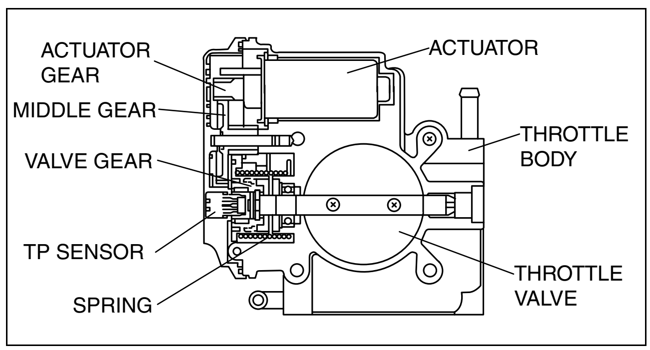
E5U113ZS5013

THROTTLE BODY CONSTRUCTION/OPERATION [LF]

E5U011313640N04

Construction

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



E5U113ZS5014

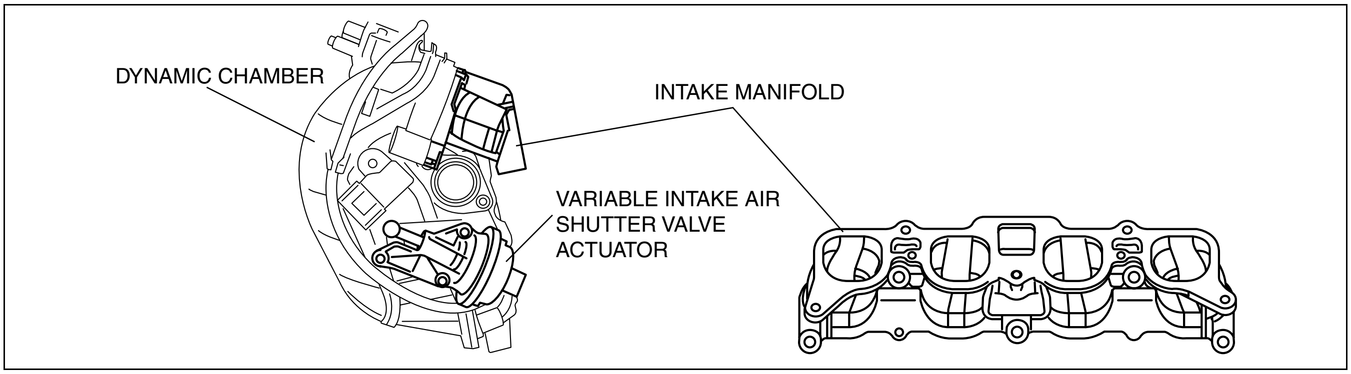
Operation

- 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 body has a control spring. If a malfunction occurs and the actuator cannot be controlled, the throttle valve is maintained balanced at an opening angle of approx. 6 ° by the spring. Due to this, the required amount of air for vehicle operation is ensured.

INTAKE MANIFOLD/DYNAMIC CHAMBER CONSTRUCTION [LF]

E5U011313100N01

- The intake manifold composed of the variable intake air shutter valve actuator.

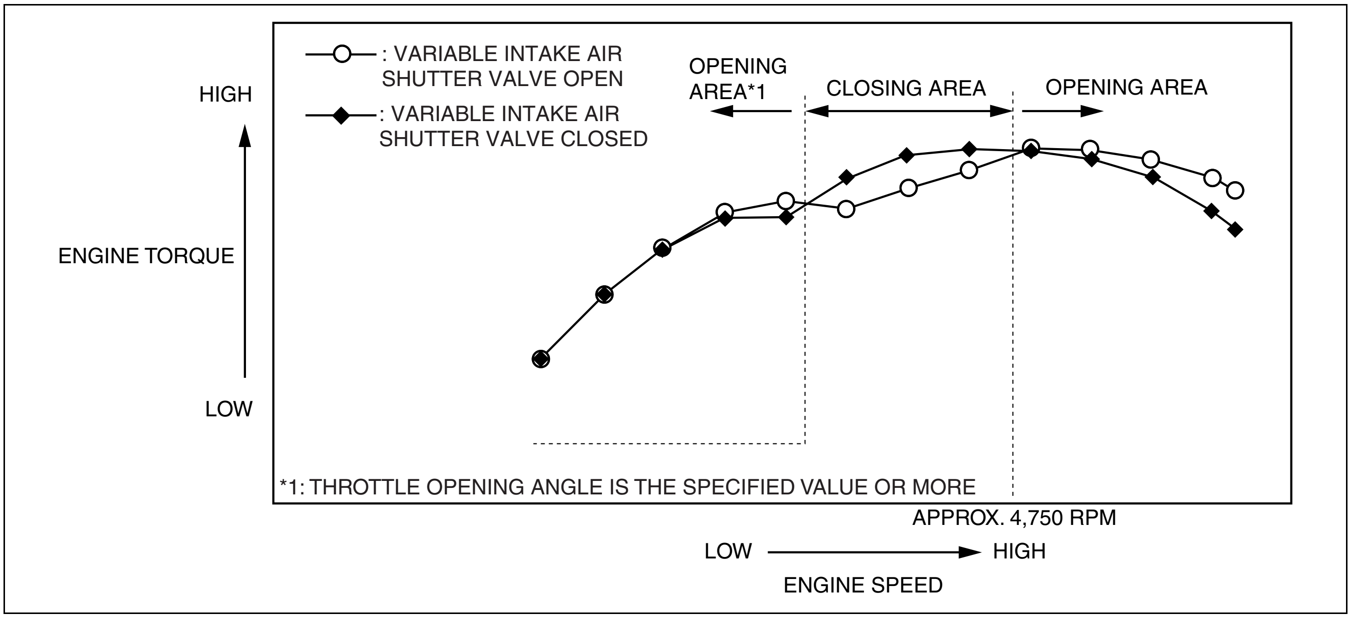


E5U113ZS5015

VARIABLE INTAKE AIR SYSTEM FUNCTION [LF]

E5U011300020N01

- The variable intake air system maintains high torque from the low to high engine speed ranges.
- If any of the following conditions are met, the effective intake manifold length is changed to enhance the inertia charging effect. As a result, higher torque is obtained in all ranges.
  — Engine speed is approx. 4,750 rpm or more.
  — Engine speed is approx. 3,150 rpm or less and the throttle opening angle is the specified value or more. (heavy load condition)
- For the variable intake air control, refer to CONTROL SYSTEM, Variable Intake Air Control (See 01–40–15 VARIABLE INTAKE AIR CONTROL OUTLINE [LF].)



E5U113ZS5002

Inertia charging effect

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

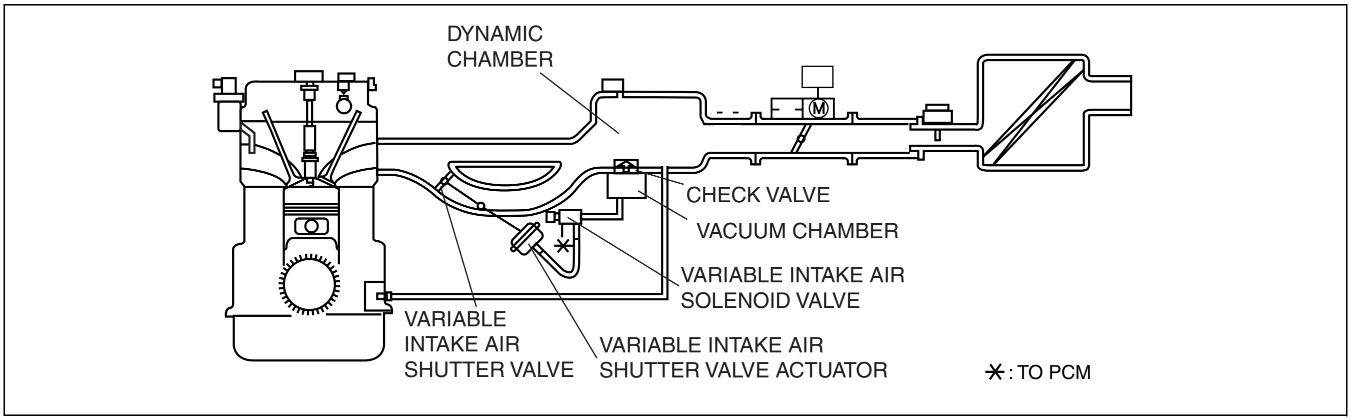
Effective intake manifold length

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

VARIABLE INTAKE AIR SYSTEM STRUCTURE [LF]

E5U011300020N03

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



E5U113ZS5003

VARIABLE INTAKE AIR SYSTEM OPERATION [LF]

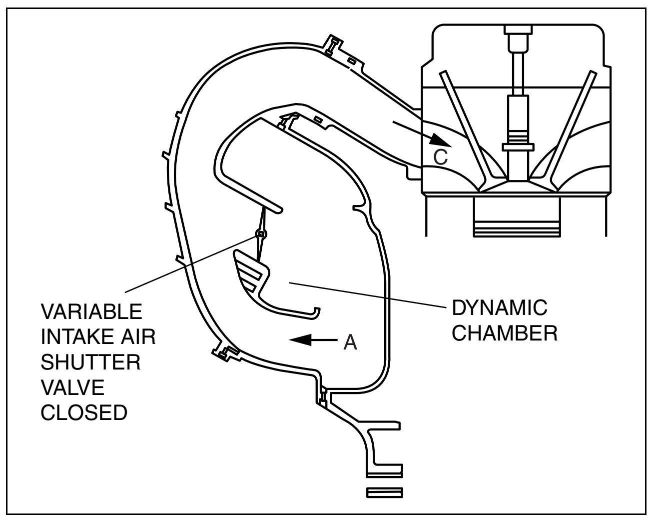
E5U011300020N04

Operation Conditions

- If any of the following conditions are met:
  - — Engine speed is approx. 4,750 rpm or more.
  - — Engine speed is approx. 3,150 rpm or less and the throttle opening angle is the specified value or more. (heavy load condition)

Except for Operation Conditions. (Variable Intake Air Shutter Valve Is Closed)

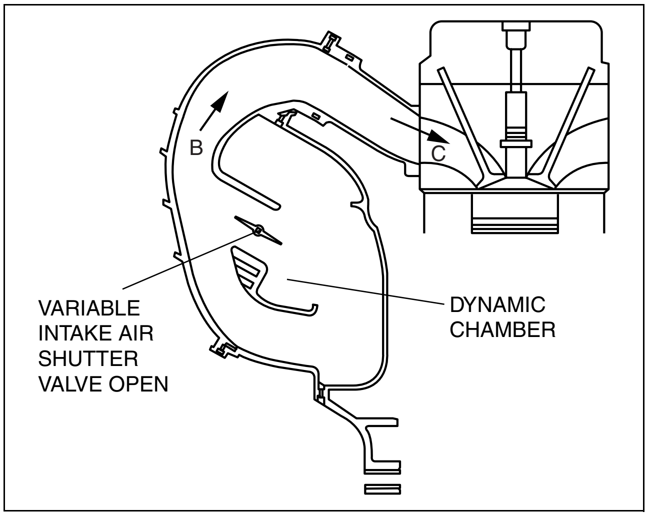
- Intake manifold vacuum is applied to the variable intake air shutter valve actuator by the operation of the variable intake air solenoid valve, closing the variable intake air shutter valve.
- Under this condition, the effective intake manifold length is from the intake valve to the dynamic chamber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



E5U113ZS5004

When Operation Conditions Are Met. (Variable Intake Air Shutter Valve Is Open)

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



E5U113ZS5005

VARIABLE INTAKE AIR SOLENOID VALVE FUNCTION [LF]

E5U011318742N01

- Switches the intake manifold vacuum passage between the dynamic chamber and the variable intake air shutter valve actuator.

VARIABLE INTAKE AIR SOLENOID VALVE CONSTRUCTION/OPERATION [LF]

E5U011318742N02

Construction

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

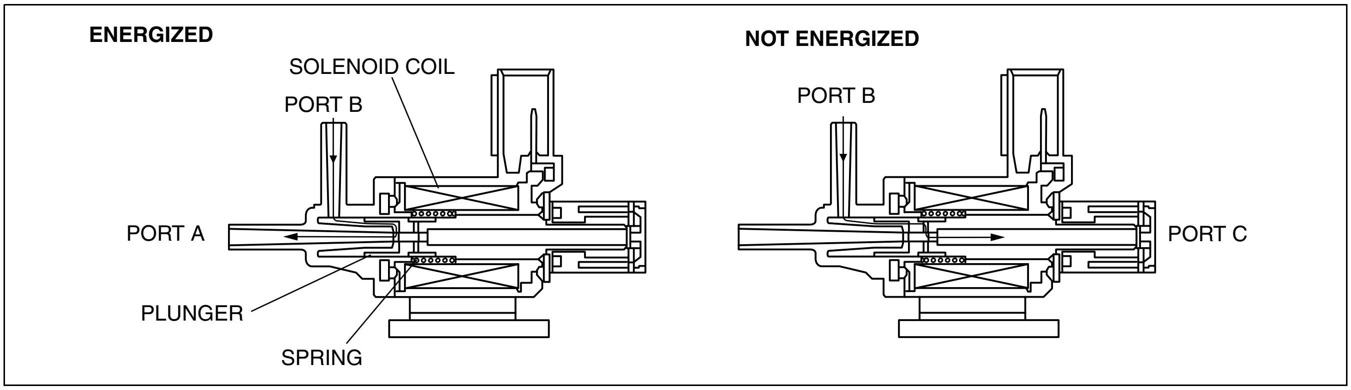
Operation

Energized

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

Not energized

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



E5U113ZS5006

VARIABLE INTAKE AIR SHUTTER VALVE ACTUATOR FUNCTION [LF]

E5U011320132N01

- Opens and closes the variable intake air shutter valve.

VARIABLE INTAKE AIR SHUTTER VALVE ACTUATOR CONSTRUCTION/OPERATION [LF]

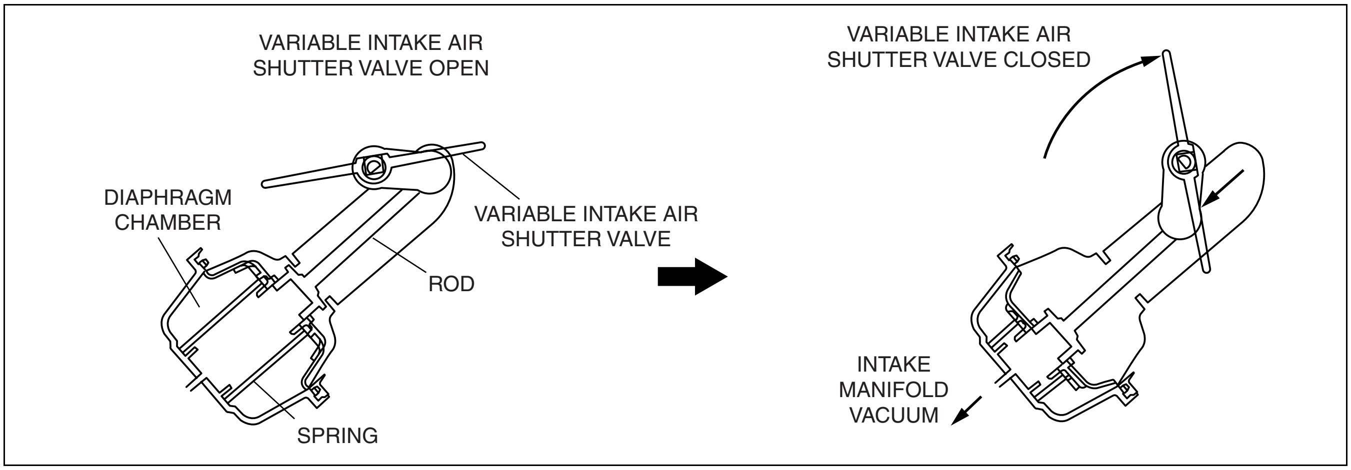
E5U011320132N02

Construction

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

Operation

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



E5U113ZS5007

01–14 FUEL SYSTEM

FUEL SYSTEM OUTLINE [LF]

E5U011400000N01

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	• Returnees fuel system adopted

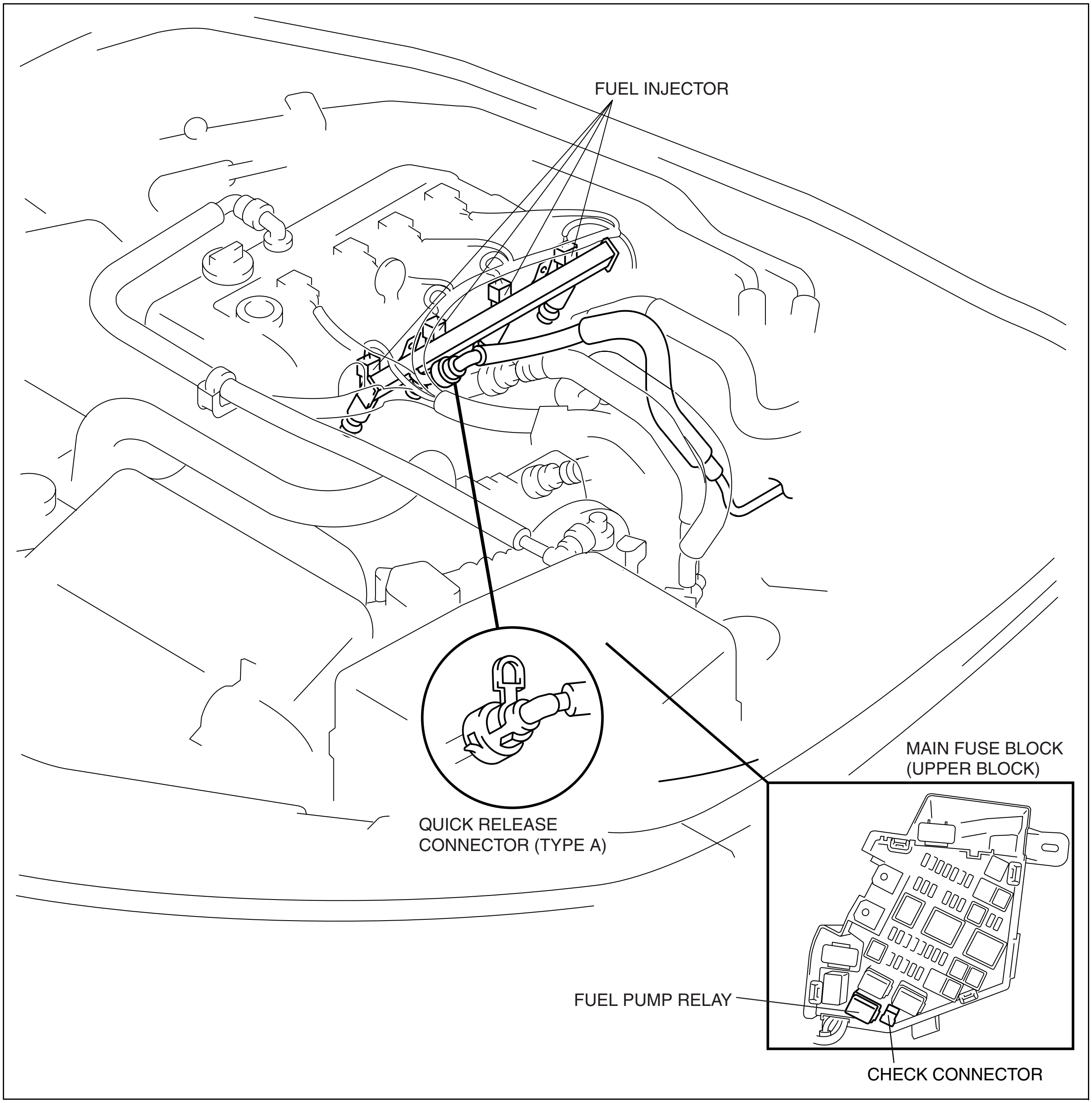
Specification

Item		Specification
Injector	Type	Hi-ohmic
	Type of fuel delivery	Top-feed
	Type of drive	Voltage
Pressure regulator control pressure	(kPa {kgf/cm^2, psi})	Approx. 390 {3.98, 56.6}
Fuel pump type		Electric
Fuel tank capacity	(L {US gal, Imp gal})	48 {12, 10}
Fuel type (Anti-knock index)		Premium unleaded fuel (96 RON or more)

FUEL SYSTEM STRUCTURAL VIEW [LF]

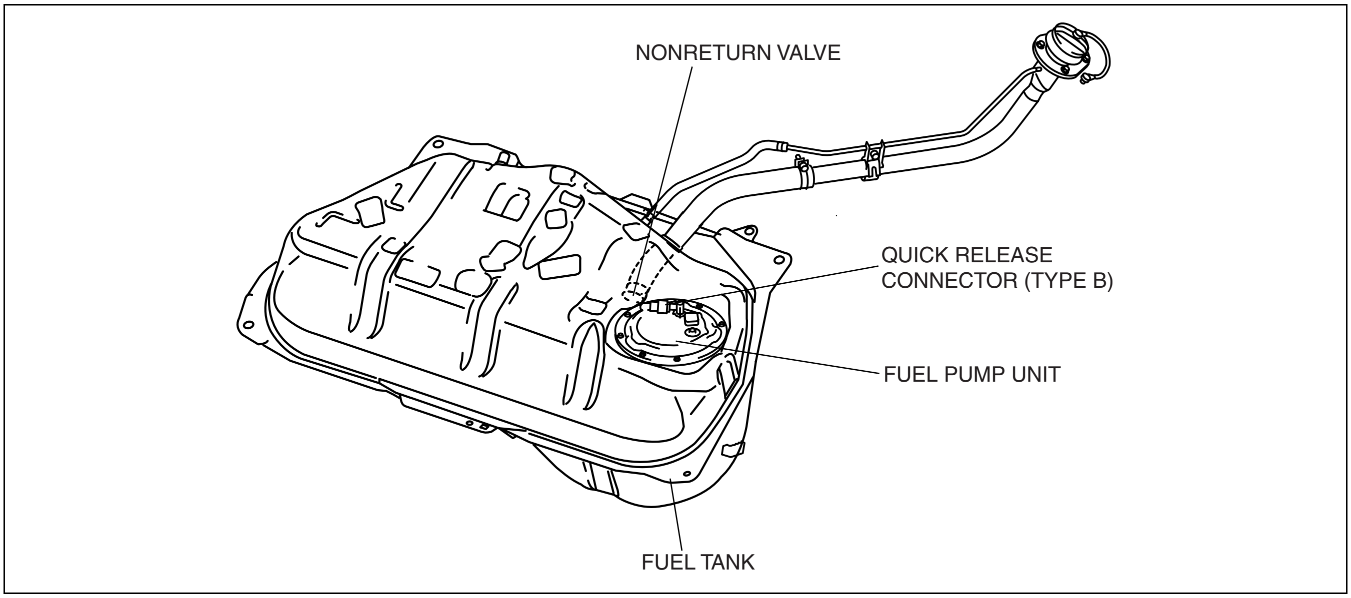
E5U011400000N02

Engine Compartment Side



E5U114ZS5020

Fuel Tank Side

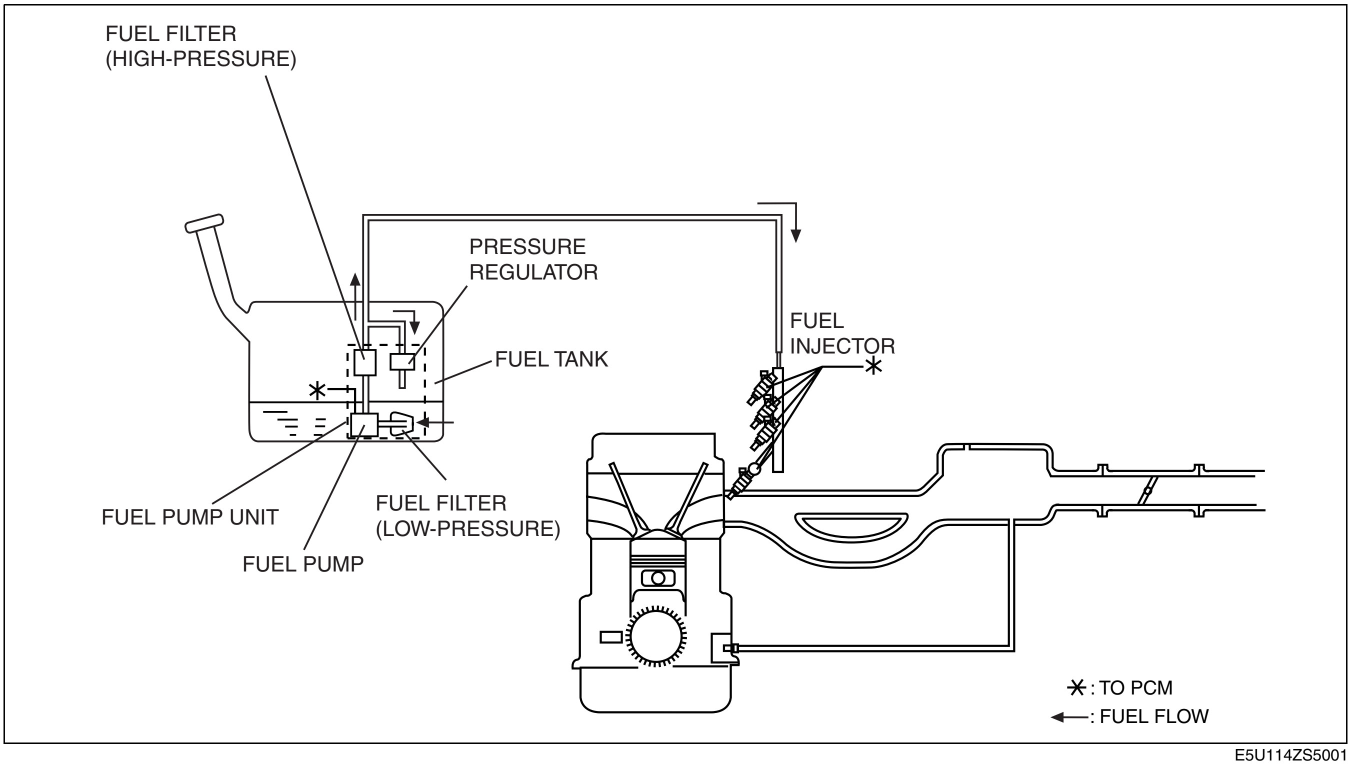


E5U114ZS5030

FUEL SYSTEM FLOW DIAGRAM [LF]

E5U011400000N03

Fuel Flow



E5U114ZS5001

RETURNEES FUEL SYSTEM OUTLINE [LF]

E5U011400000N04

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

RETURNEES FUEL SYSTEM OPERATION [LF]

E5U011400000N05

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

FUEL TANK CONSTRUCTION [LF]

E5U011442110N01

- Capacity is **48 L {12 US gal, 10 Imp gal}**.
- Two rollover valves and a fuel shut-off valve are built-in. For the rollover valve and the fuel shut-off valve, refer to the emission system.
- Made of steel.

NONRETURN VALVE FUNCTION [LF]

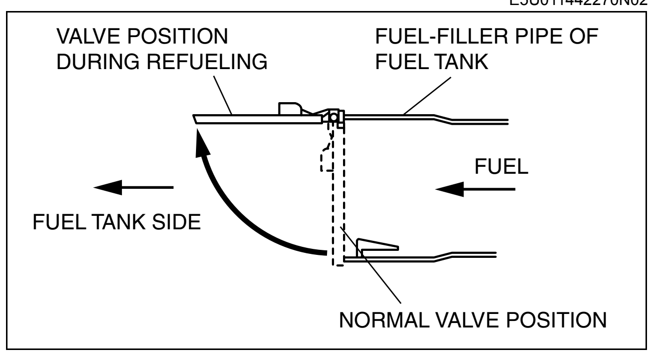
E5U011442270N01

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

NONRETURN VALVE CONSTRUCTION/OPERATION [LF]

E5U011442270N02

- A single valve type has been adopted.
- The nonreturn valve is built into the fuel-filler pipe of the fuel tank.
- The nonreturn valve cannot be removed because it is integrated with the fuel tank. Replace the fuel tank if the nonreturn valve requires replacement.
- 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.



E5U114ZS5021

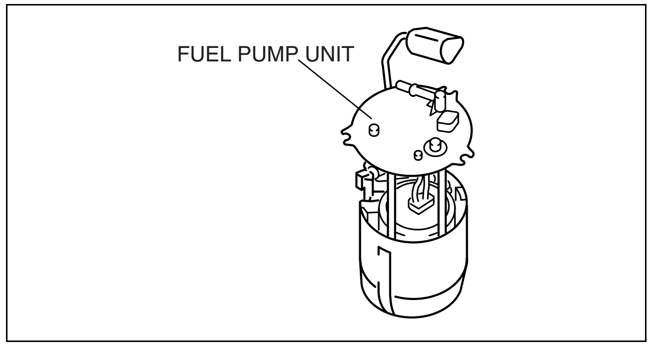
FUEL PUMP UNIT FUNCTION [LF]

E5U011413350N01

- The fuel pump siphons fuel from the fuel tank and pumps it to the fuel injectors.

FUEL PUMP UNIT CONSTRUCTION/OPERATION [LF]

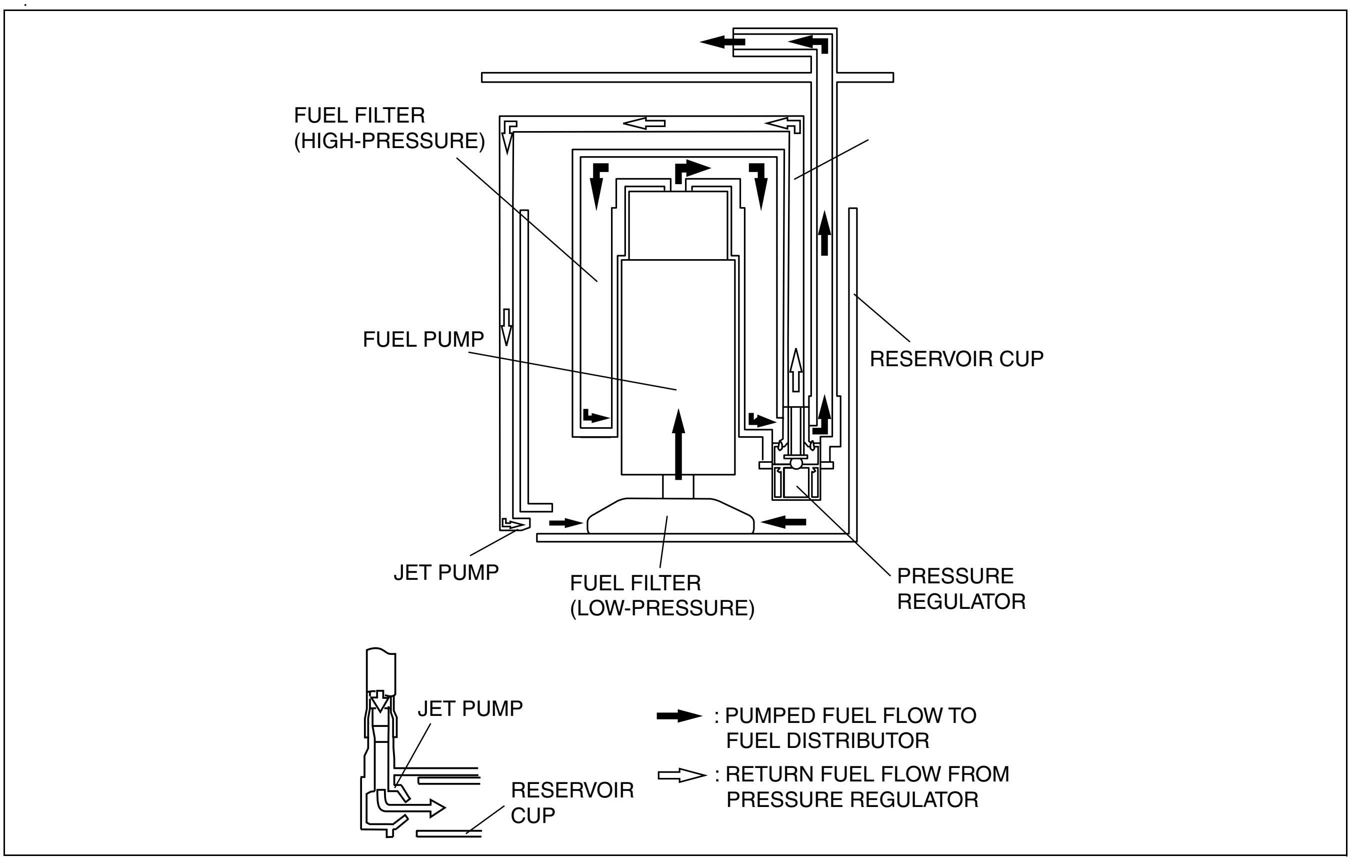
E5U011413350N02



E5U114ZS5022

Fuel Pump Unit

- Mainly consists of a fuel filter (high-pressure), pressure regulator, fuel pump, fuel reserve cup, and fuel filter (low-pressure).
- A pressure regulator is built-in due to the adoption of a returnees fuel system.
- A hard-plastic fuel pump unit, with an integrated fuel filter (high-pressure) and fuel pump, has been adopted to simplify the fuel line.
- The fuel pump unit can be disassembled.
- Fuel in the fuel reserve cup is sectioned 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.



E5U114ZS5002

Pressure Regulator

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

QUICK RELEASE CONNECTOR (FUEL SYSTEM) FUNCTION [LF]

E5U011442692N01

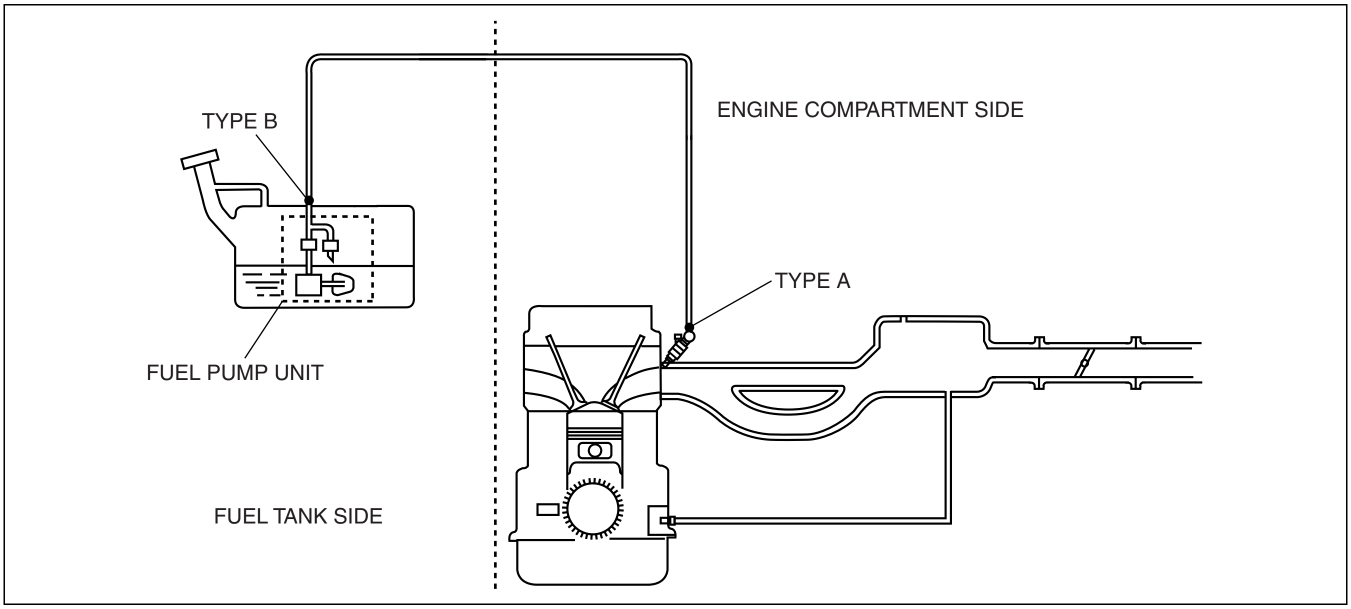
- Quick release connectors that can be easily connected/disconnected have been adopted to improve serviceability.

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

E5U011442692N02

- There are two types of quick release connectors.

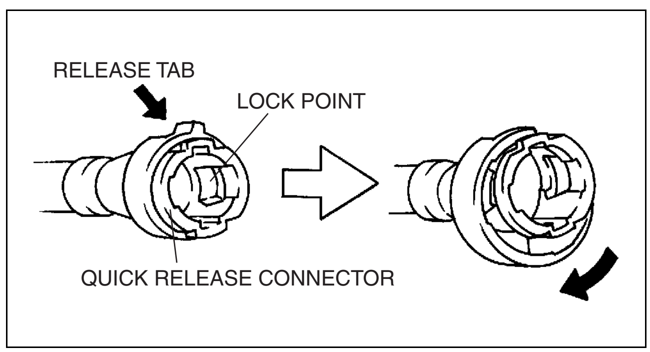
Quick release connector locations



E5U114ZW5011

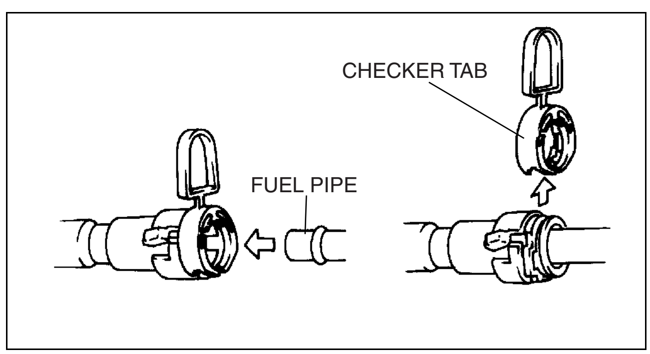
Type A

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



C3U0114S091

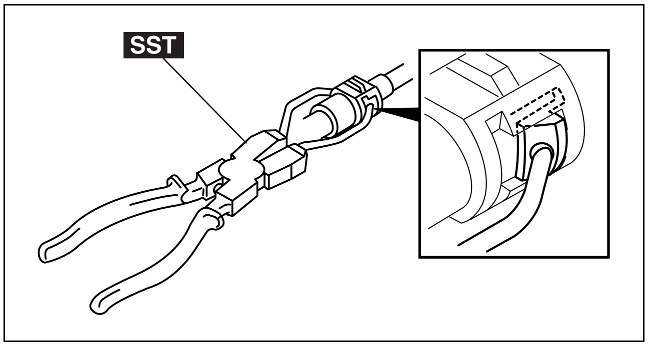
- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the fuel pipe, the lock is released and the checker tab comes off. Due to this, it can be verified that the quick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



C3U0114S092

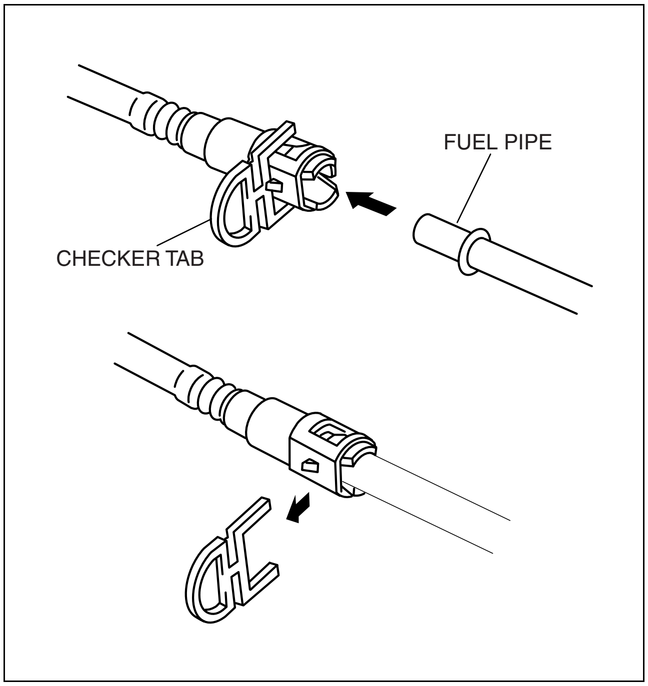
Type B

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



E5U114ZW5003

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



E5U114ZS5004

FUEL INJECTOR FUNCTION [LF]

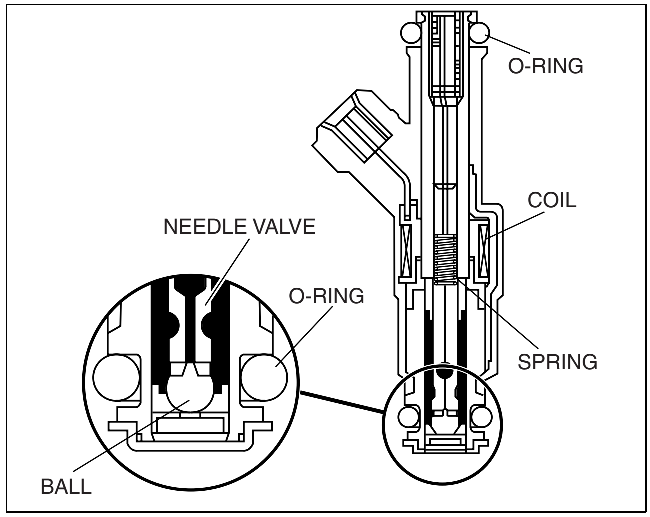
E5U011413250N01

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

FUEL INJECTOR CONSTRUCTION/OPERATION [LF]

E5U011413250N02

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



C3U0114S111

FUEL PUMP RELAY FUNCTION [LF]

E5U011400000N06

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

01–15 EXHAUST SYSTEM

EXHAUST SYSTEM OUTLINE [LF]

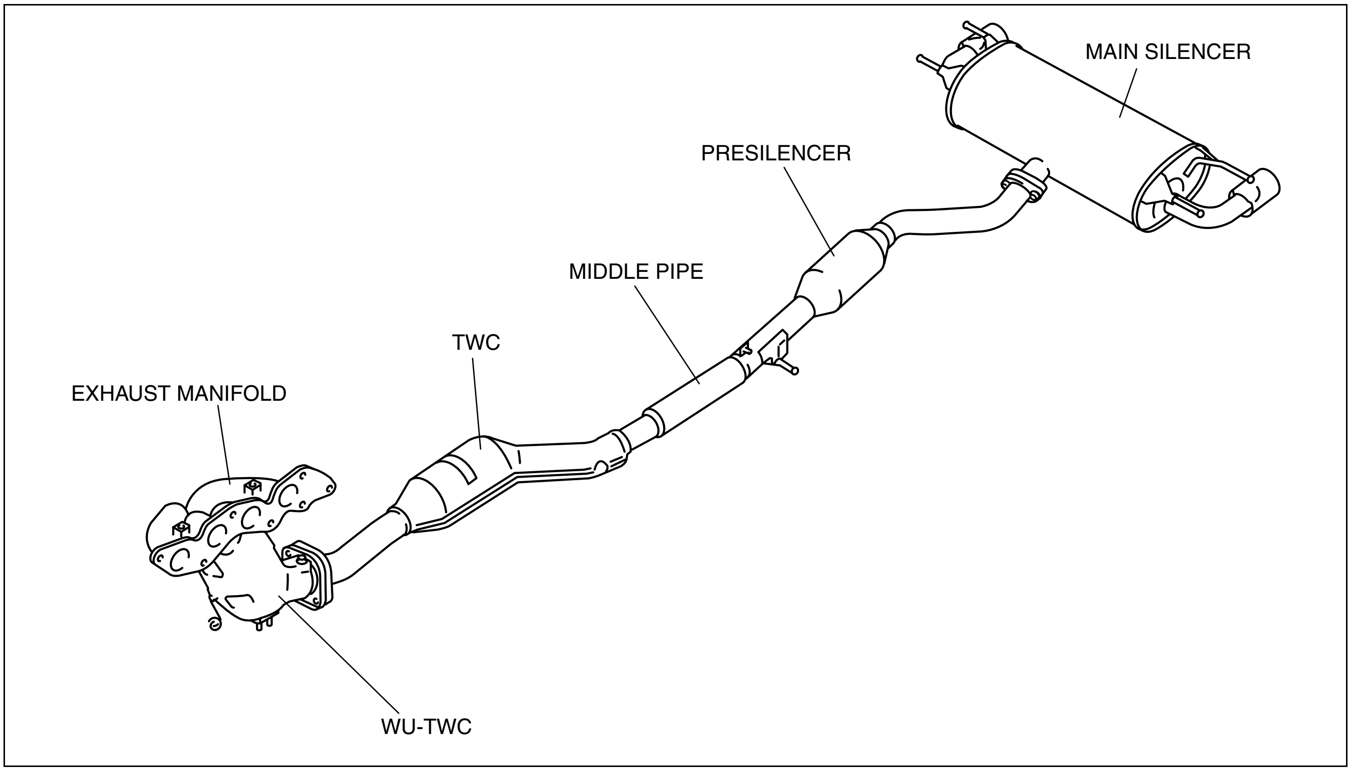
E5U011500000N01

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.

EXHAUST SYSTEM STRUCTURAL VIEW [LF]

E5U011500000N02



E5U115ZS5001

01–16 EMISSION SYSTEM

EMISSION SYSTEM OUTLINE [LF]

E5U011600000N01

Feature

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

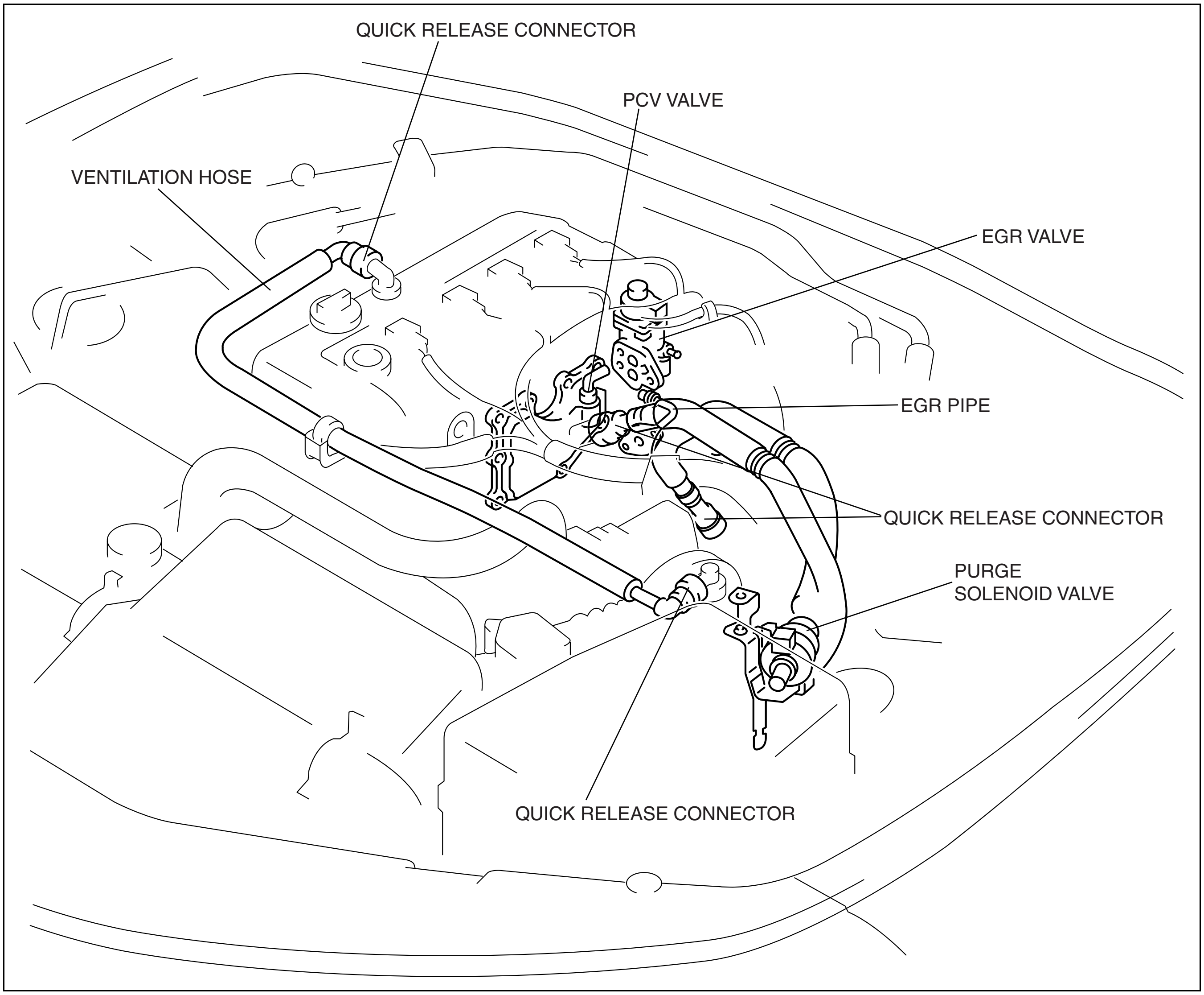
Specification

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

EMISSION SYSTEM STRUCTURAL VIEW [LF]

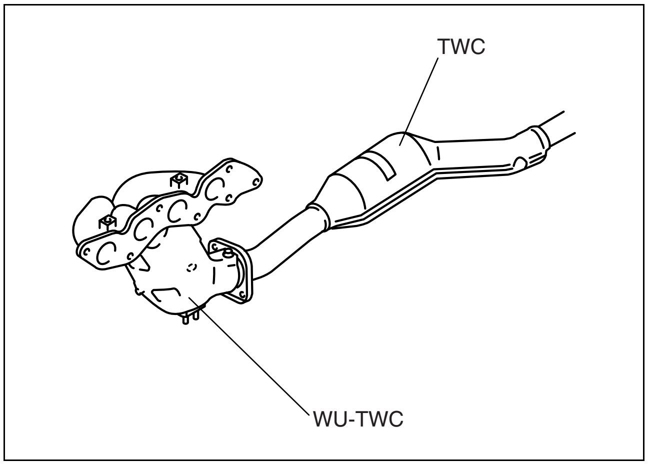
E5U011600000N02

Engine Compartment Side



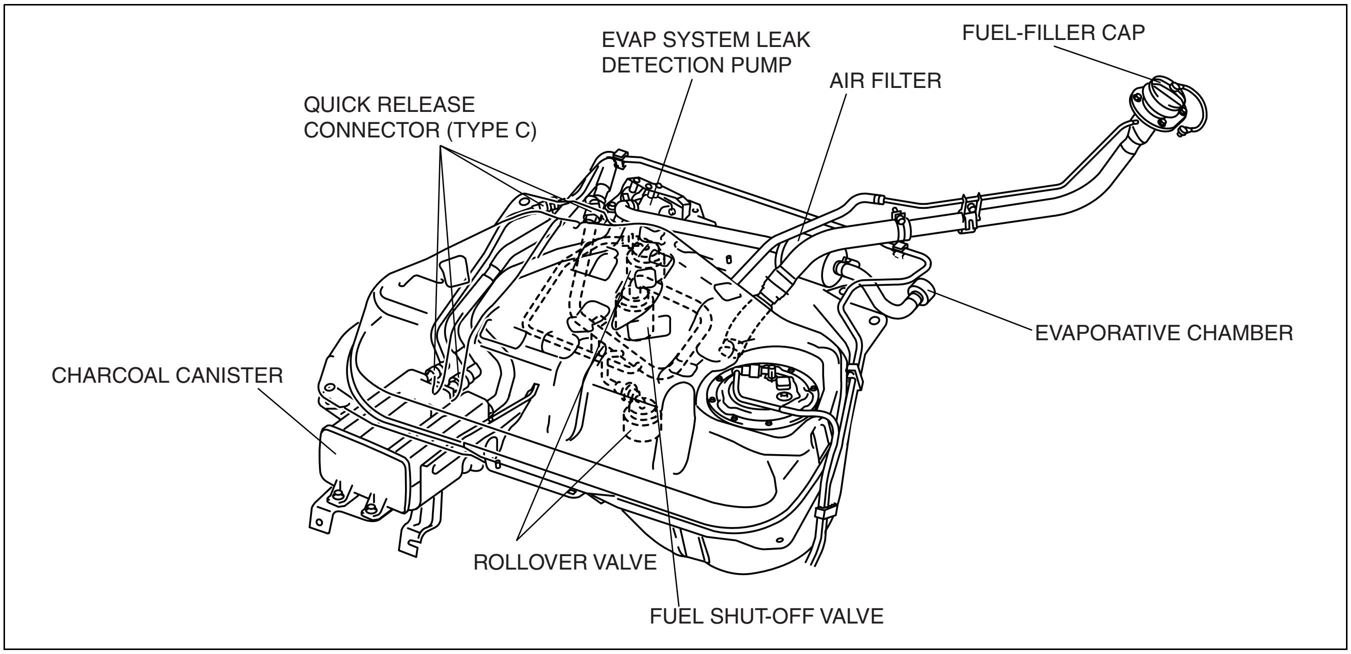
E5U116ZS5020

Exhaust System



E5U116ZS5008

Fuel Tank Side



E5U116ZS5030

EXHAUST PURIFICATION SYSTEM OUTLINE [LF]

E5U011600010N01

Feature

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

EGR SYSTEM OUTLINE [LF]

E5U011600020N01

Features

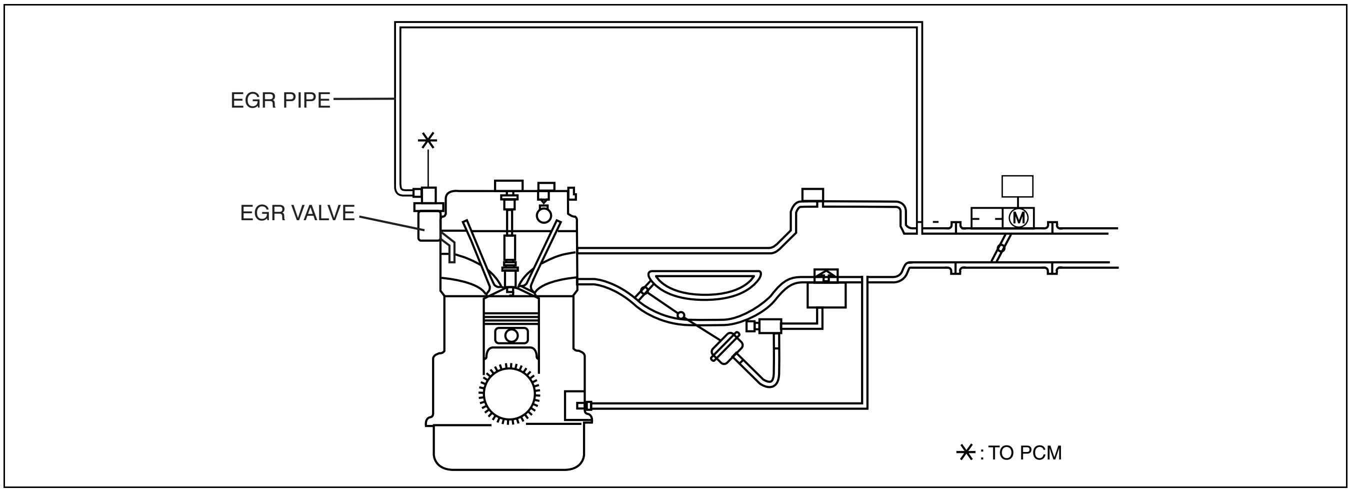
- An EGR valve with a stepping motor has been adopted for optimum control according to engine operation conditions.
- For control of EGR system, refer to CONTROL SYSTEM, EGR CONTROL. (See 01–40–30 EGR CONTROL OUTLINE [LF], 01–40–30 EGR CONTROL BLOCK DIAGRAM [LF], 01–40–30 EGR CONTROL OPERATION [LF].)

EGR SYSTEM STRUCTURE [LF]

E5U011600020N02

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

System diagram



E5U116ZS5002

EGR SYSTEM OPERATION [LF]

E5U011600020N03

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

EGR VALVE FUNCTION [LF]

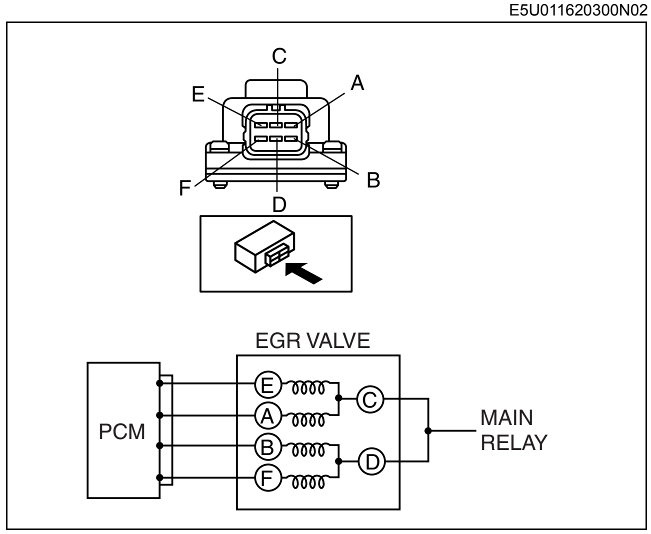
E5U011620300N01

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

EGR VALVE CONSTRUCTION/OPERATION [LF]

E5U011620300N02

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



C3U0116S031

CATALYTIC CONVERTER SYSTEM OUTLINE [LF]

E5U011600050N01

Feature

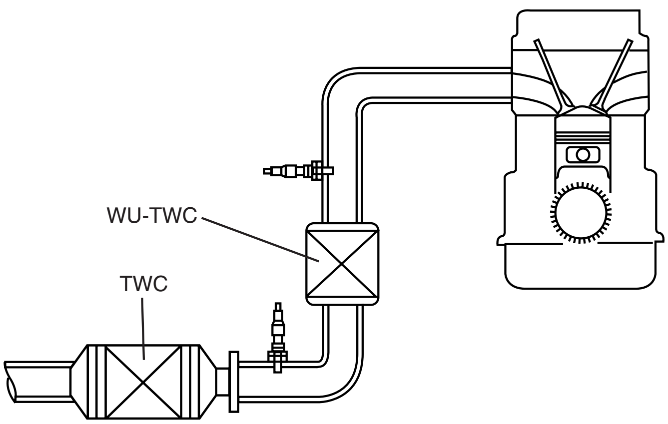
- Purifies contaminants in the exhaust gas by utilizing a chemical reaction in a three way catalytic converter.

CATALYTIC CONVERTER SYSTEM STRUCTURE [LF]

E5U011600050N02

- Consists of a three way catalytic converter and insulator.
- The WU-TWC utilizing a platinum-rhodium-palladium system has been adopted.
- The TWC utilizing a platinum-rhodium system has been adopted.

System diagram



E5U116ZS5852

CATALYTIC CONVERTER SYSTEM OPERATION [LF]

E5U011600050N03

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

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OUTLINE [LF]

E5U011600040N01

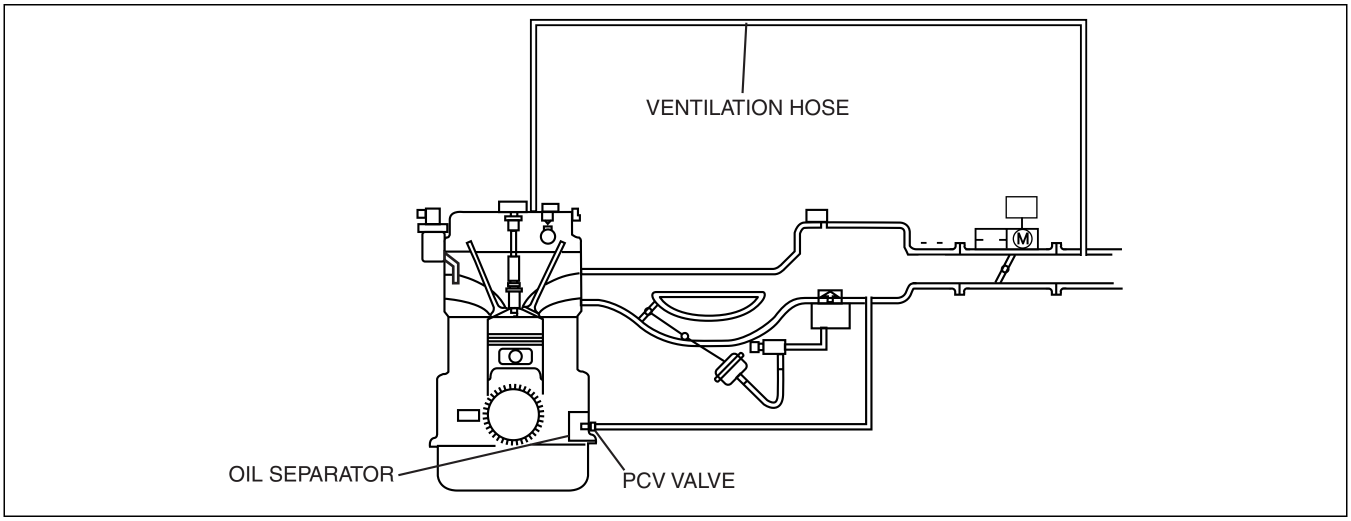
Feature

- A closed type PCV system has been adopted.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM STRUCTURE [LF]

E5U011600040N02

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



E5U116ZS5853

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM OPERATION [LF]

E5U011600040N03

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

POSITIVE CRANKCASE VENTILATION (PCV) VALVE FUNCTION [LF]

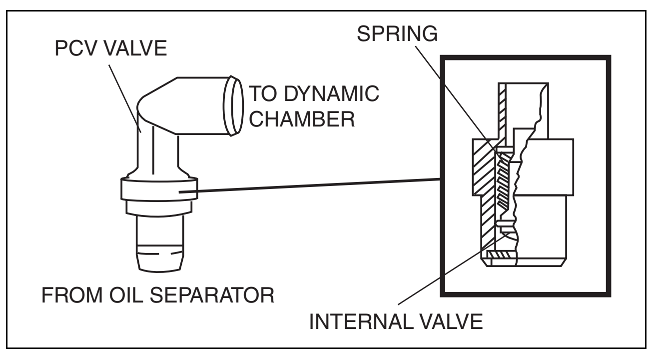
E5U011613890N01

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

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

E5U011613890N02

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



E5U116ZW5043

EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM OUTLINE [LF]

E5U011600030N01

Features

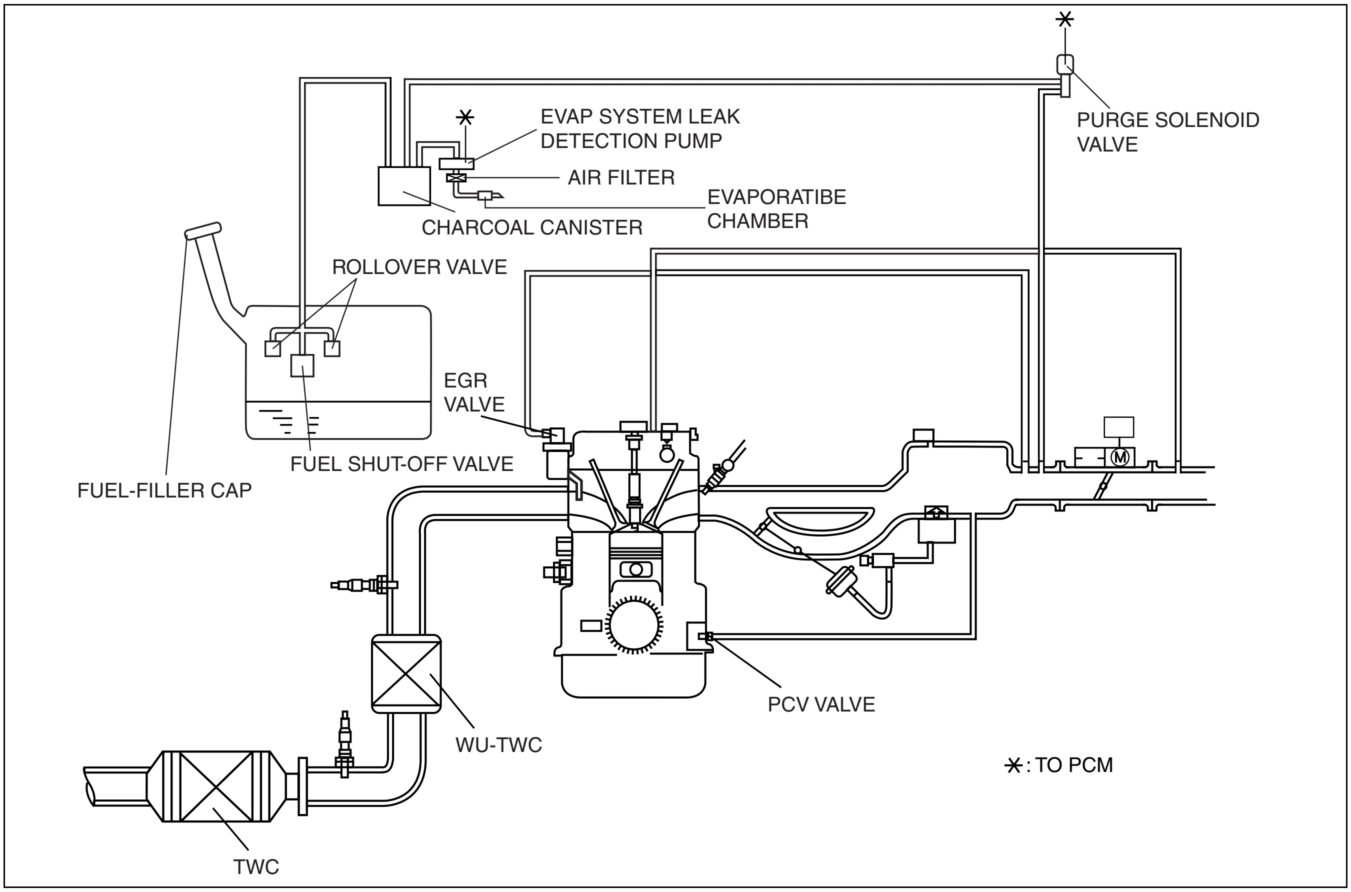
- With the adoption of the charcoal canister, release of evaporative gas into the atmosphere has been prevented.
- A duty solenoid valve (purge control valve) has been adopted for optimum control according to engine operation conditions.
- For control of evaporative purge, refer to CONTROL SYSTEM, EVAPORATIVE PURGE CONTROL. (See 01–40–28 EVAPORATIVE PURGE CONTROL OUTLINE [LF], 01–40–29 EVAPORATIVE PURGE CONTROL BLOCK DIAGRAM [LF], 01–40–29 EVAPORATIVE PURGE CONTROL OPERATION [LF].)

EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM STRUCTURE [LF]

E5U011600030N02

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

System diagram



E5U116ZS5003

EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM OPERATION [LF]

E5U011600030N03

- When the engine is stopped, evaporative gas in the fuel tank flows out when the pressure increases and is absorbed by the charcoal canister.
- Evaporative gas that was absorbed by the charcoal canister passes through the solenoid valve together with air introduced from the charcoal canister orifice when the engine is running, and is fed to the engine according to engine operation conditions.
- If the pressure in the fuel tank decreases, air is introduced from the charcoal canister orifice through the rollover valve. If the charcoal canister orifice is clogged, the fuel-filler cap negative pressure valve opens and air is introduced to the fuel tank to prevent increased vacuum in the fuel tank, causing a load on the fuel tank.
- If there is a malfunction in the rollover valve, the fuel-filler cap positive pressure valve opens and evaporative gas is released into the atmosphere to prevent increased pressure in the fuel tank, causing a load on it.

QUICK RELEASE CONNECTOR (EMISSION SYSTEM) FUNCTION [LF]

E5U011642692N01

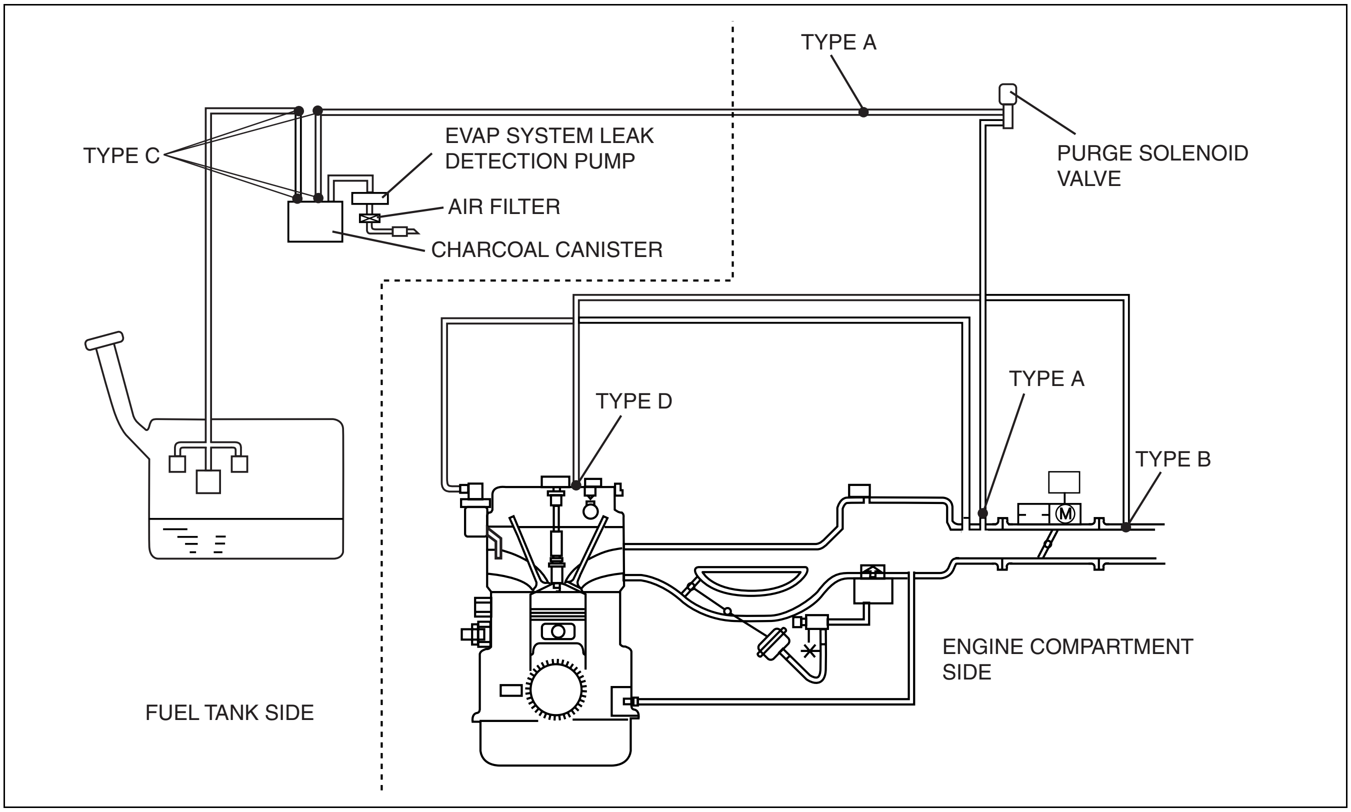
- Quick release connectors that can be easily connected/disconnected have been adopted to improve serviceability.

QUICK RELEASE CONNECTOR (EMISSION SYSTEM) CONSTRUCTION/OPERATION [LF]

E5U011642692N02

- There are four types of quick release connectors.

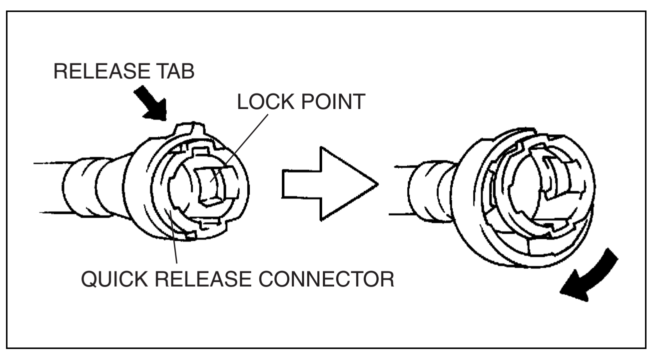
Quick release connector locations



E5U116ZS5004

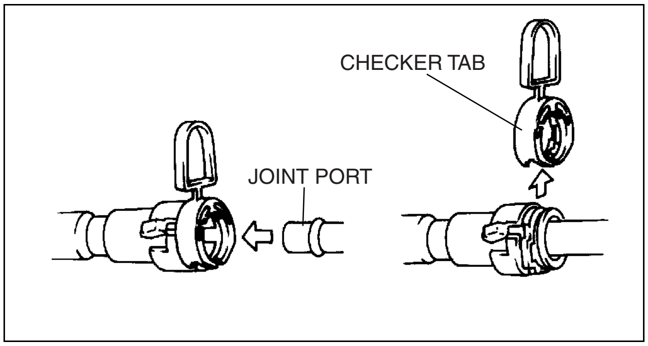
Type A

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



C3U0114S091

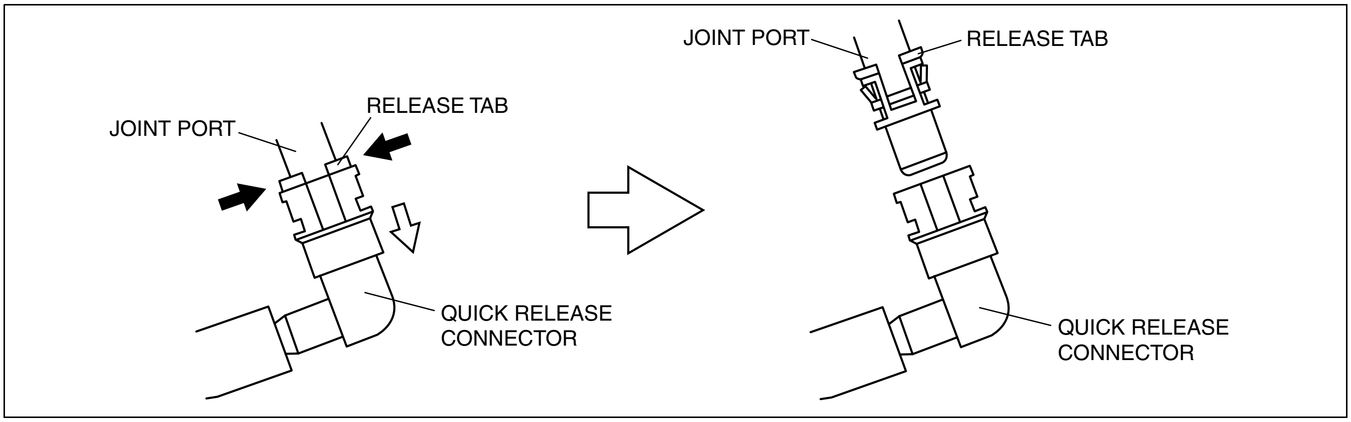
- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the joint port, the lock is released and the checker tab comes off. Due to this, it can be verified that the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



C3U0116S105

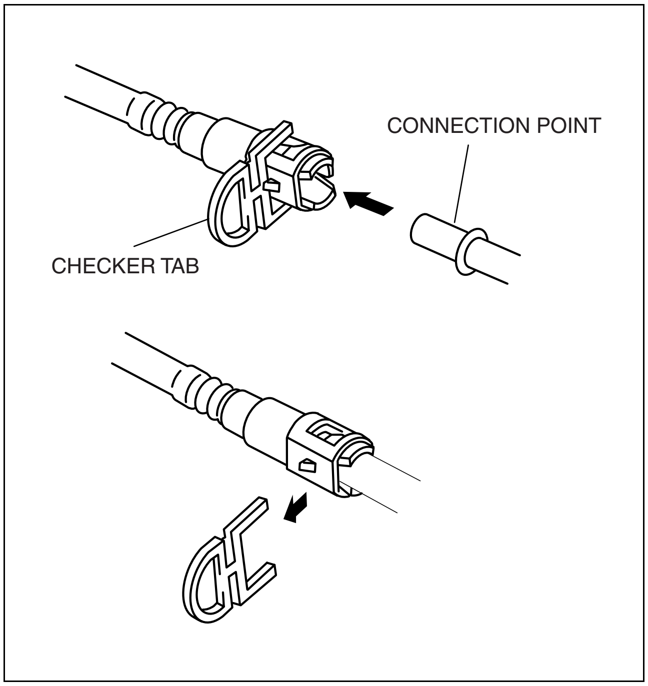
Type B

- An **SST** is not used with this type.
- The joint port can be disconnected by squeezing the release tab until the locking tabs release.



E5U116ZW5041

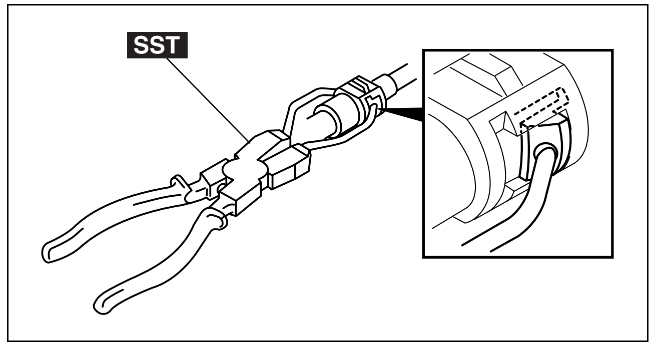
- To connect the quick release connector properly, push it into the joint port until a locking click sound is heard.
- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the connection point, the lock is released and the checker tab comes off. Due to this, it can be verified that the quick release connector is completely connected.



EPU113ZT4610

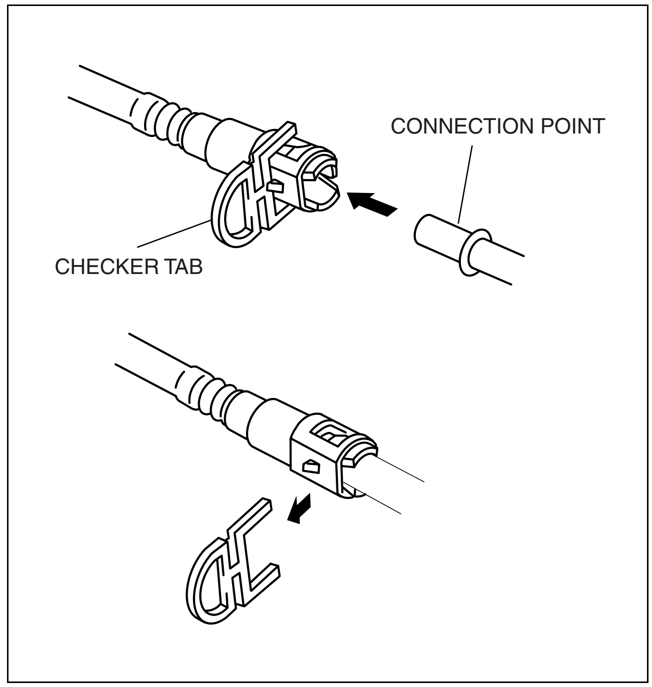
Type C

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



E5U114ZW5003

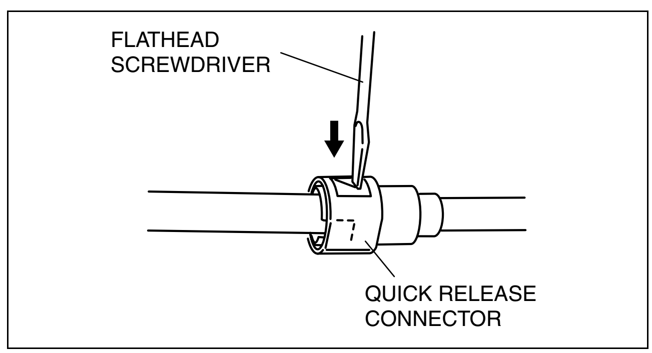
- New quick release connectors are fitted with a checker tab that prevents improper fit. This checker tab cannot normally be removed. When the quick release connector is properly connected to the connection point, the lock is released and the checker tab comes off. Due to this, it can be verified that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



EPU113ZT4610

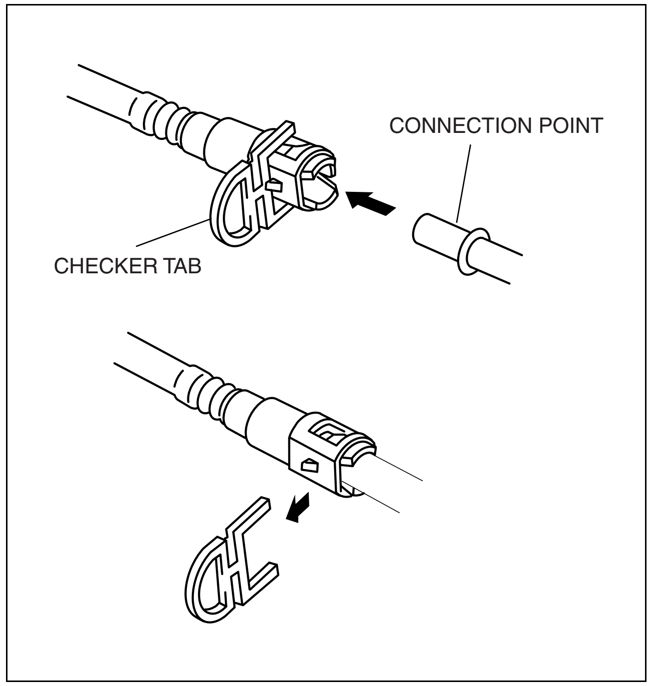
Type D

- Release the locks between the retainer and joint port by pressing each retainer lock one by one using a flathead screwdriver or a similar tool.
- To connect the quick release connector properly, push it into the joint port until a locking click sound is heard.



C3U0116W153

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



EPU113ZT4610

PURGE SOLENOID VALVE FUNCTION [LF]

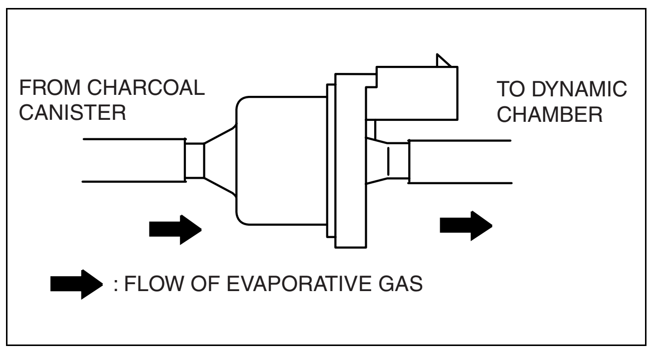
E5U011618744N01

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

PURGE SOLENOID VALVE CONSTRUCTION/OPERATION [LF]

E5U011618744N02

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



E5U116ZW5042

FUEL-FILLER CAP FUNCTION [LF]

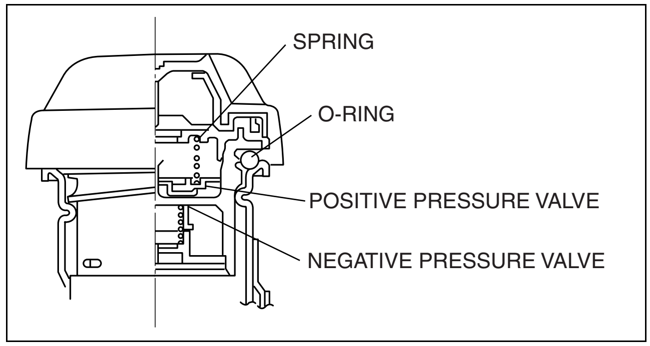
E5U011642250N01

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

FUEL-FILLER CAP CONSTRUCTION/OPERATION [LF]

E5U011642250N02

- Consists of a positive pressure valve, negative pressure valve, spring, and O-ring.
- When there is positive pressure in the fuel tank due to evaporative gas, the evaporative gas is released into the atmosphere. When there is negative pressure, air is introduced to the fuel tank.
- The positive pressure valve and negative pressure valve opening pressures are higher than the check valve (two-way) built into the rollover valve, therefore the positive and negative pressure valves are normally not open.



E5U116ZS5900

ROLLOVER VALVE FUNCTION [LF]

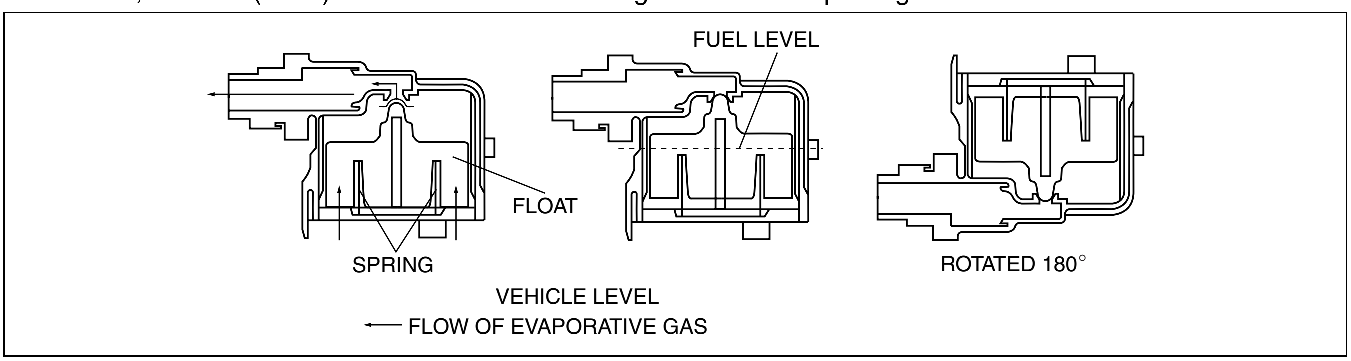
E5U011642720N03

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

ROLLOVER VALVE CONSTRUCTION/OPERATION [LF]

E5U011642720N04

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



E5U116ZS5901

FUEL SHUT-OFF VALVE FUNCTION [LF]

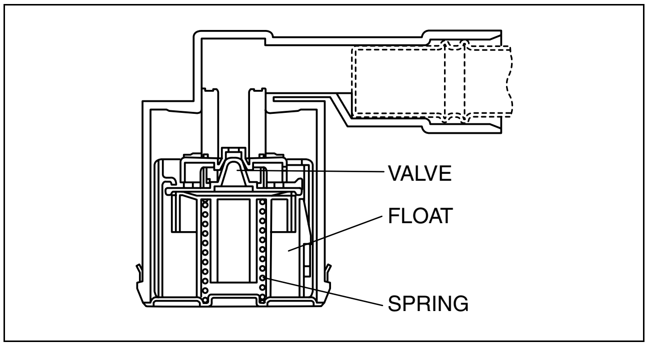
E5U011642990N01

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

FUEL SHUT-OFF VALVE CONSTRUCTION/OPERATION [LF]

E5U011642990N02

- The fuel shut-off valve is built into the fuel tank.
- The fuel shut-off valve mainly consists of a valve, float, spring, and by-pass valve.
- During refueling or due to fuel sloshing, the float is flooded with fuel and the floating force causes the valve to close. Also, during vehicle rollover, the valve closes due to balance between the float gravity and spring.



E5U116ZS5006

CHARCOAL CANISTER FUNCTION [LF]

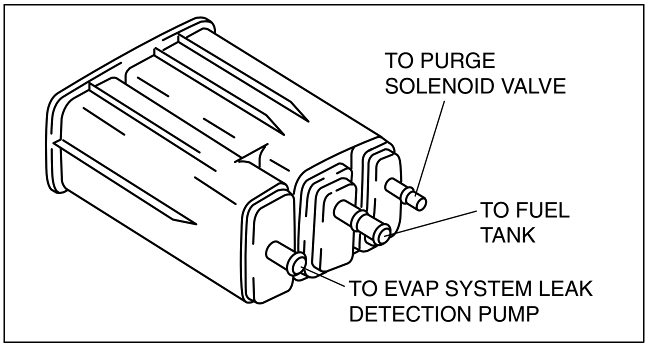
E5U011613970N01

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

CHARCOAL CANISTER CONSTRUCTION/OPERATION [LF]

E5U011613970N02

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



EPU116ZT4502

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

E5U011618581N01

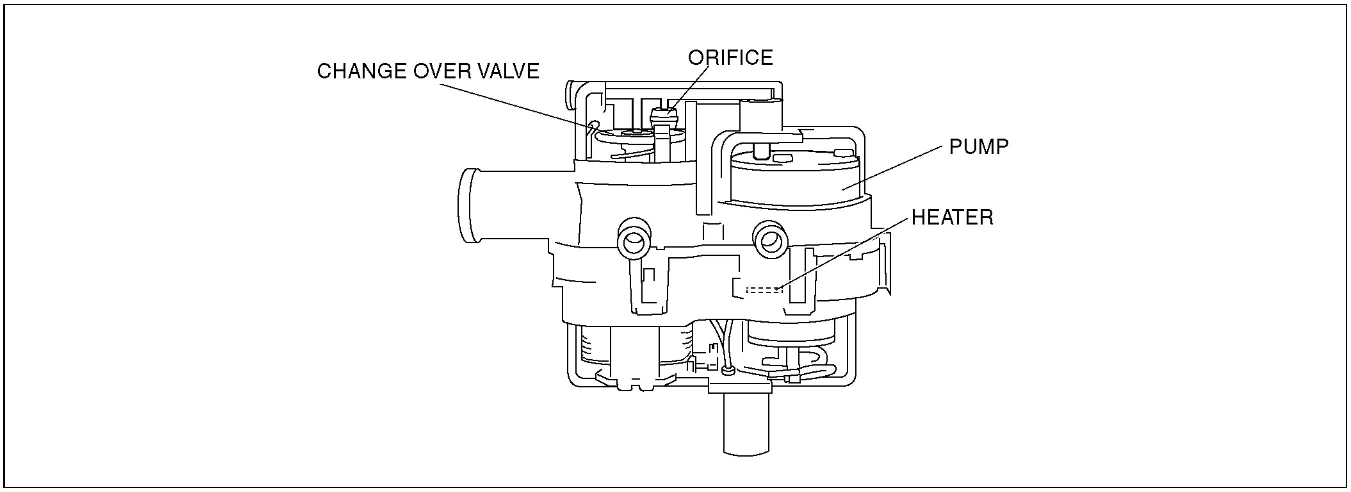
- The internal pump pressurizes the emission system by pumping air to check clogging and leakage in the emission system.

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

E5U011618581N02

Structure

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

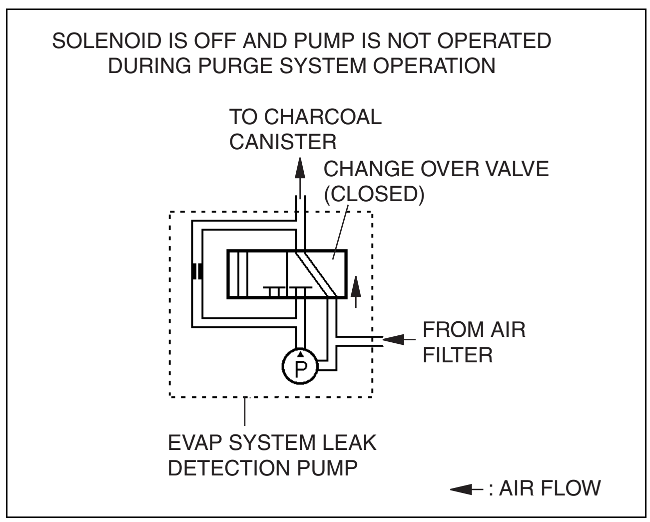


B6U0116S028

Operation

Evaporative system monitor is not operated

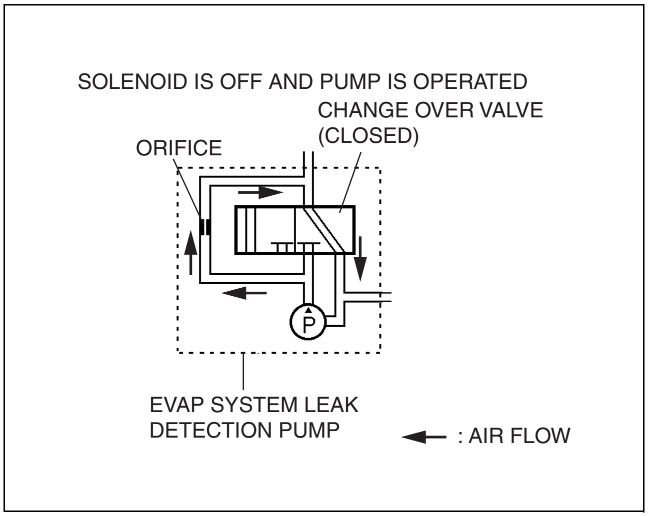
- The passage between the canister and the air filter is connected.



B6U0116S017

Evaporative system monitor is operated
When obtaining the reference current value

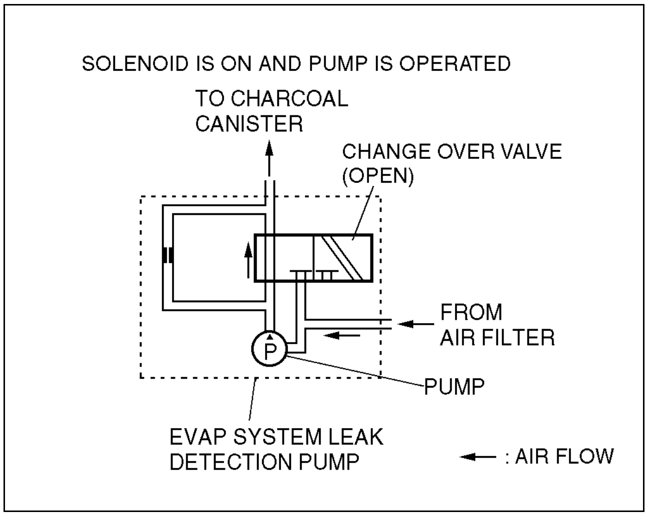
- Air is sent from the pump to the orifice.



B6U0116S018

Small leak and very small leak determination

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



B6U0116S029

AIR FILTER FUNCTION [LF]

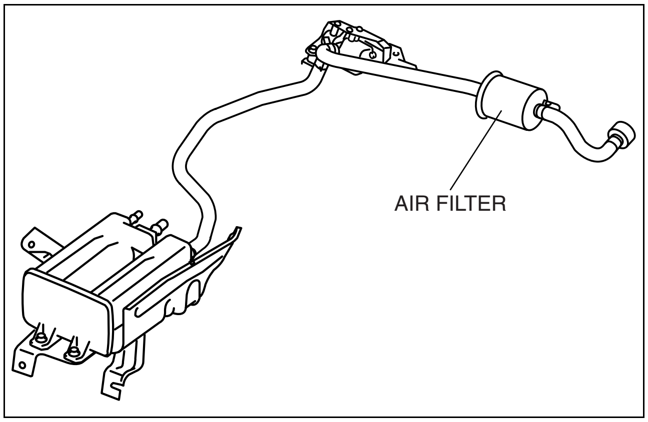
E5U011613988N01

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

AIR FILTER CONSTRUCTION/OPERATION [LF]

E5U011613988N02

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



E5U116ZS5007

EVAPORATIVE CHAMBER FUNCTION [LF]

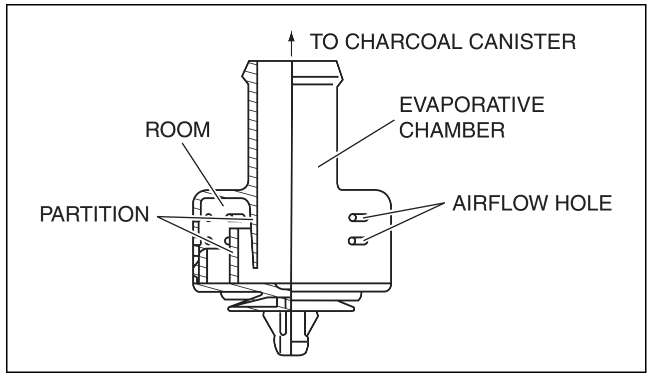
E5U011642590N01

- The evaporative chamber prevents penetration of water and dust in the charcoal canister.

EVAPORATIVE CHAMBER CONSTRUCTION/OPERATION [LF]

E5U011642590N02

- 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.



CHU0116S016

01–17 CHARGING SYSTEM

CHARGING SYSTEM OUTLINE [LF]

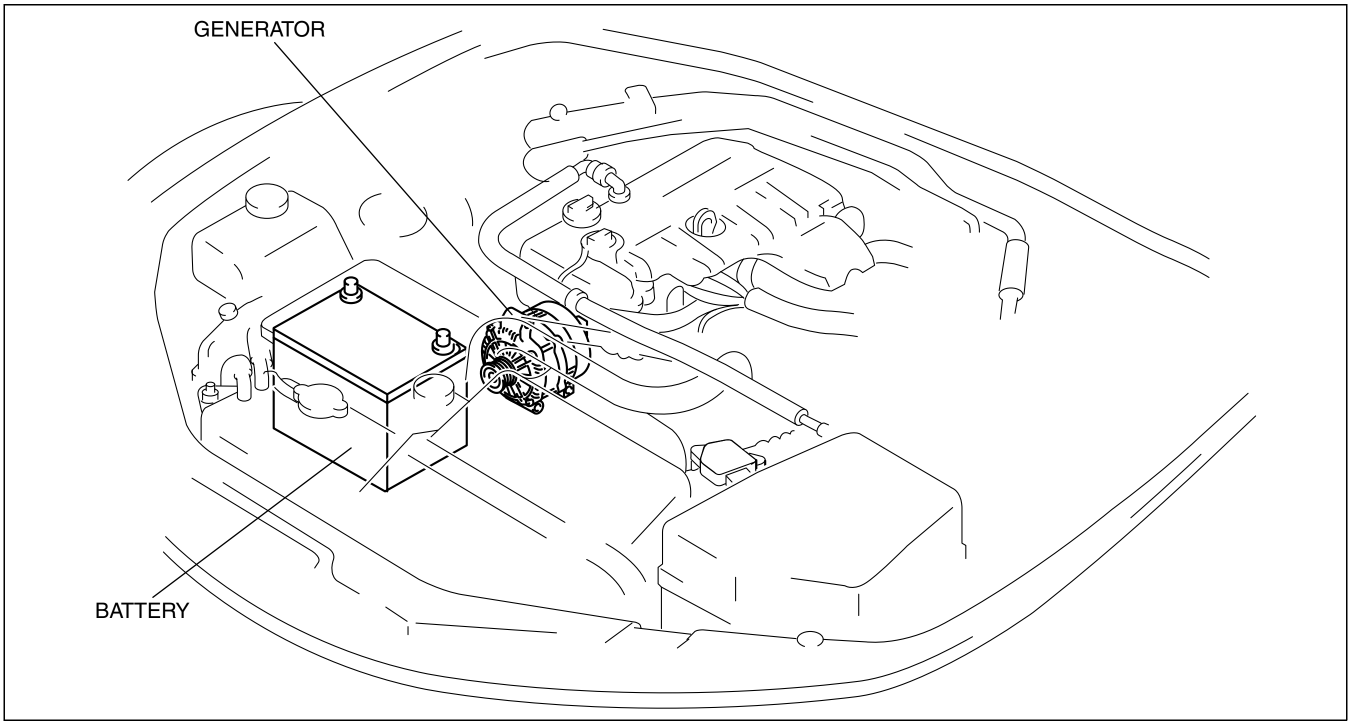
E5U011700000N01

Features

Improved reliability	• Battery duct adopted
Miniaturization	• Non-regulator type generator with built-in power transistor adopted
Reduced operation noise	• Generator with two delta connection type stator coils adopted

CHARGING SYSTEM STRUCTURAL VIEW [LF]

E5U011700000N02

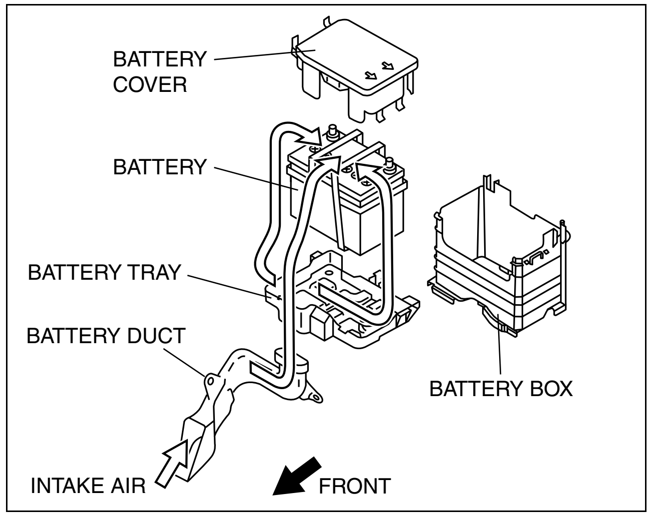


E5U117ZS5001

BATTERY CONSTRUCTION [LF]

E5U011718520N01

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

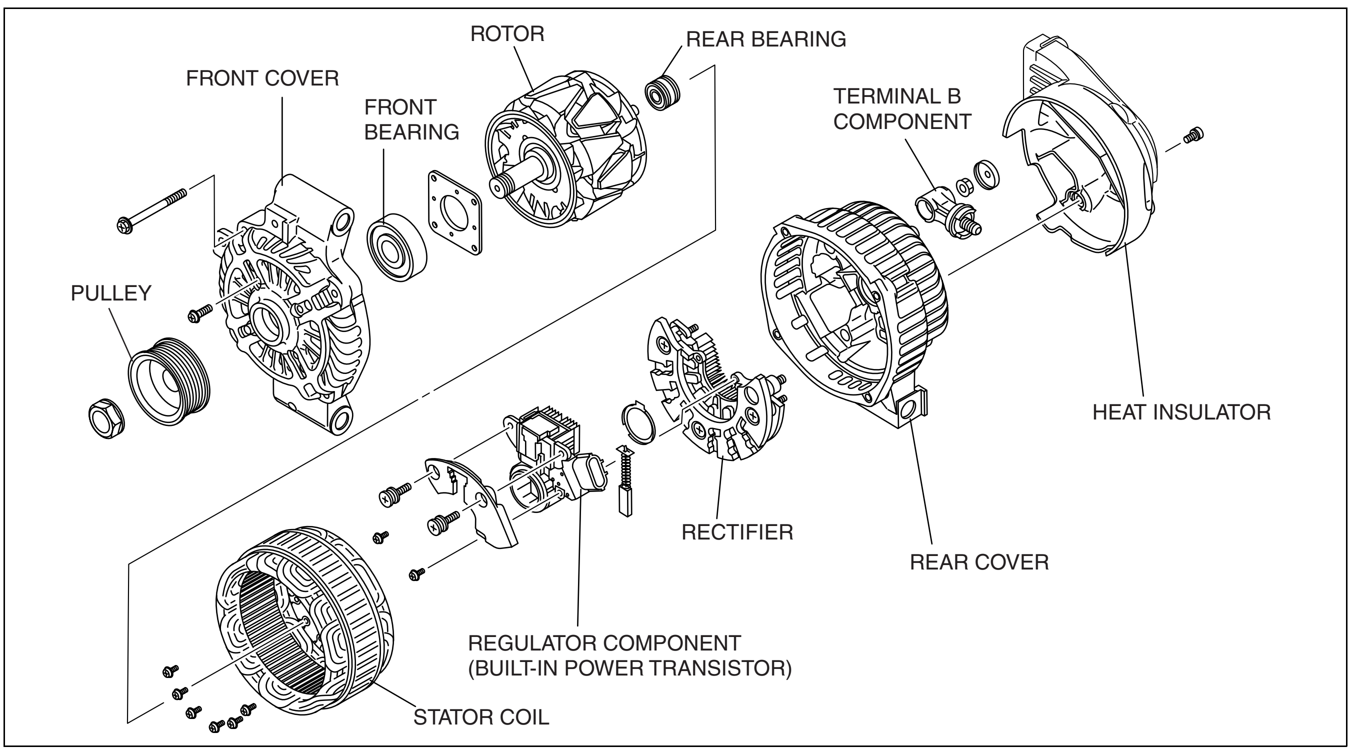


E5U117ZS5002

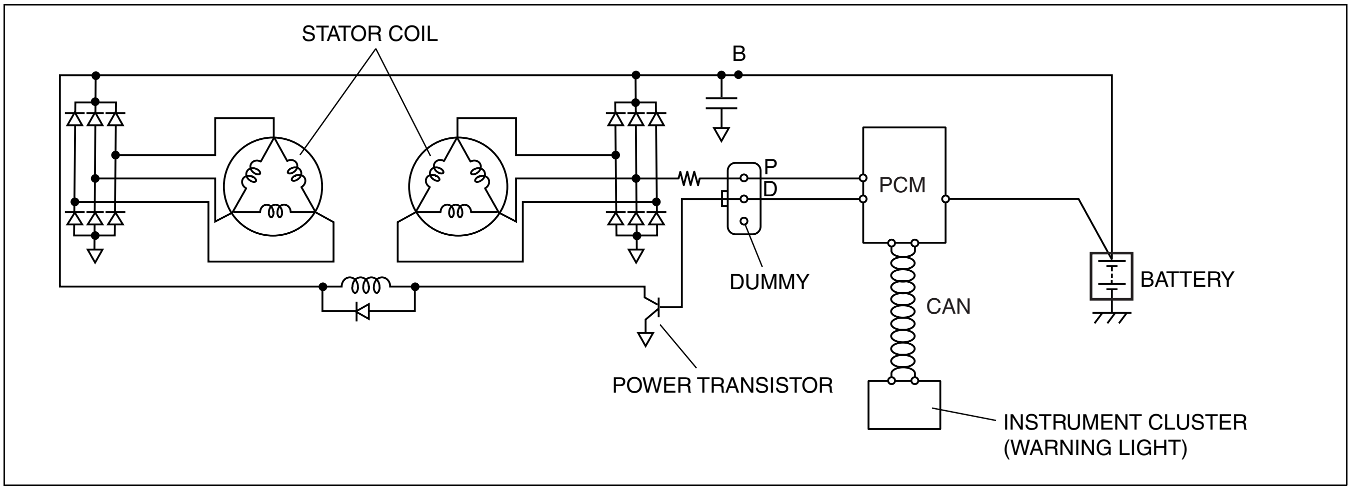
GENERATOR CONSTRUCTION [LF]

E5U011718300N01

- With the elimination of the voltage regulator, generator control is carried out by the PCM. Excitation current in the field coil is increased or decreased by the duty signal from the PCM sent to the power transistor built into the generator.
- Two delta connection type stator coils have been adopted.
- A generator duct and a generator heat insulator made of plastic have been adopted to protect the generator from the exhaust manifold heat.

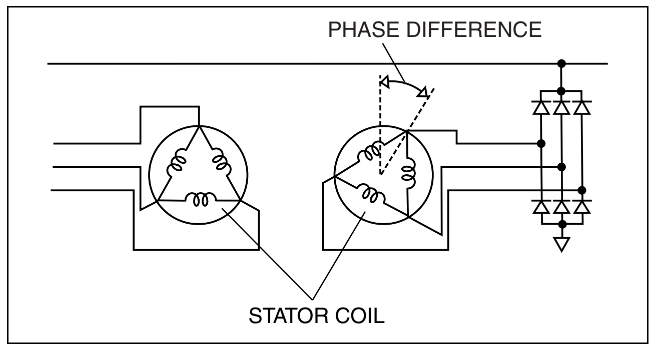


E5U117ZS5003

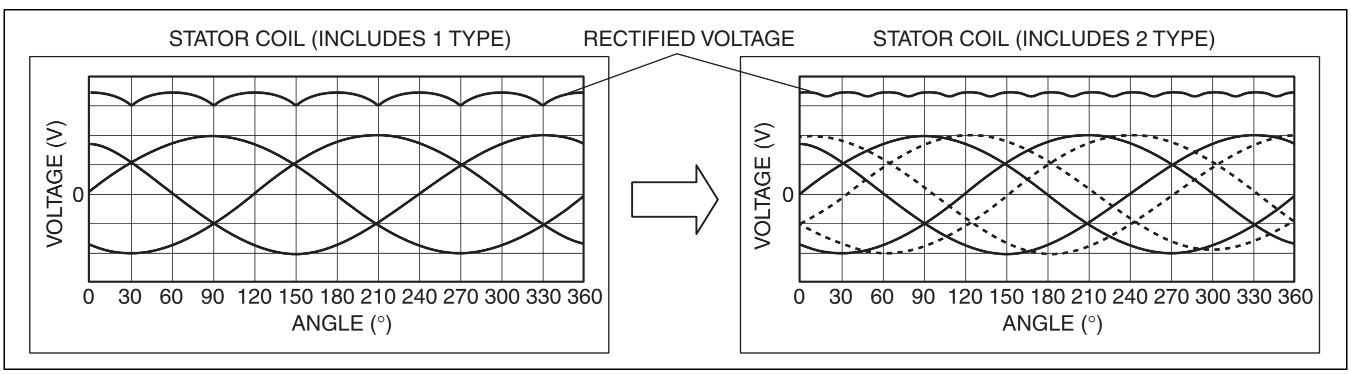


E6U117ZNB003

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



E5U117ZS5004



E5U117ZS5005

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

01–18 IGNITION SYSTEM

IGNITION SYSTEM OUTLINE [LF]

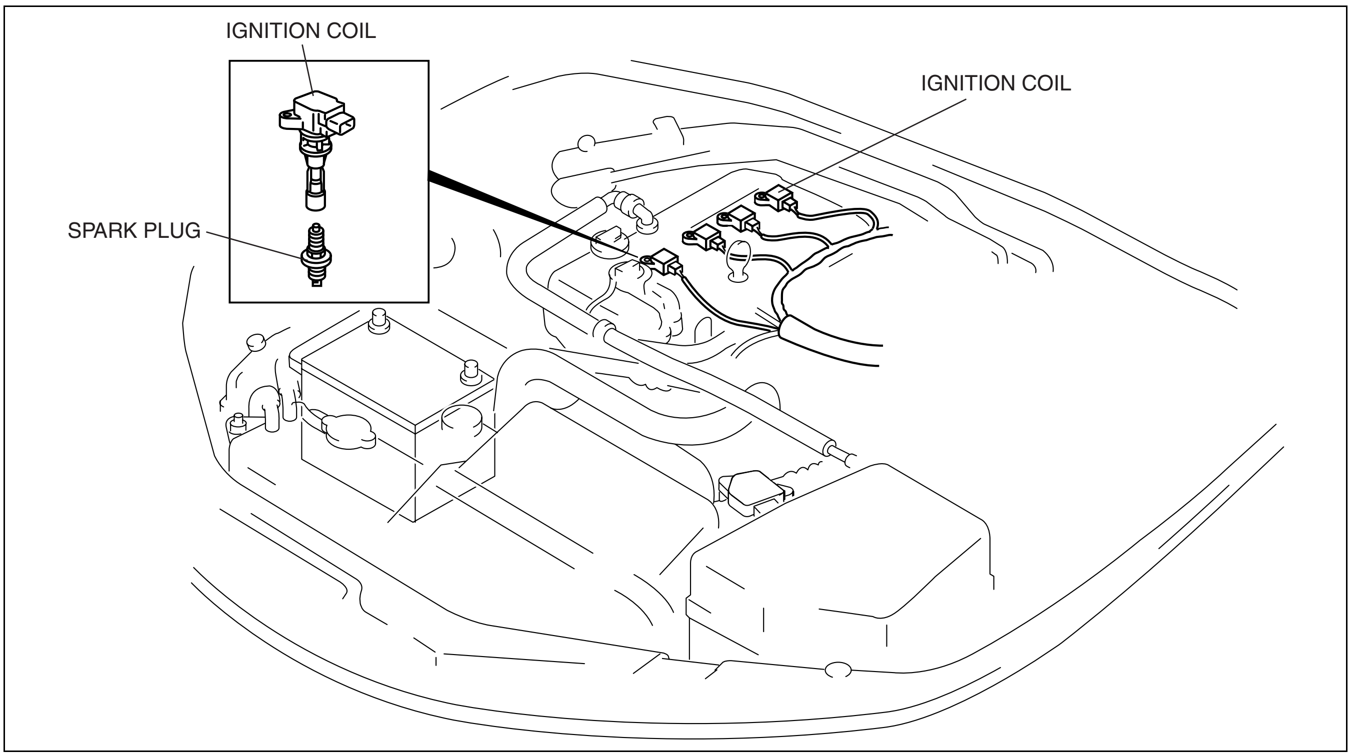
E5U011800000N01

Features

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

IGNITION SYSTEM STRUCTURAL VIEW [LF]

E5U011800000N02



E5U118ZS5001

IGNITION COIL CONSTRUCTION/OPERATION [LF]

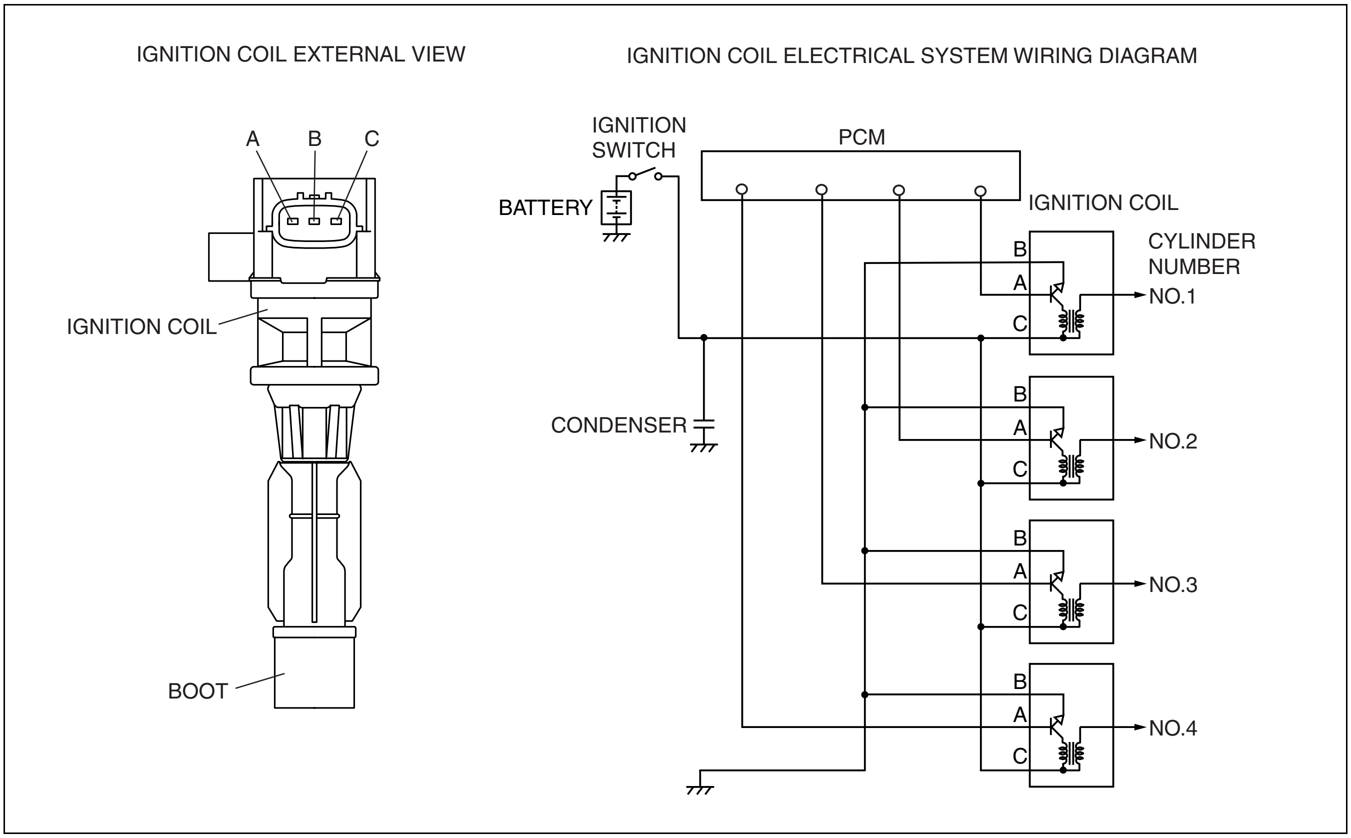
E5U011818100N01

Construction

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

Operation

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



E5U118ZS5002

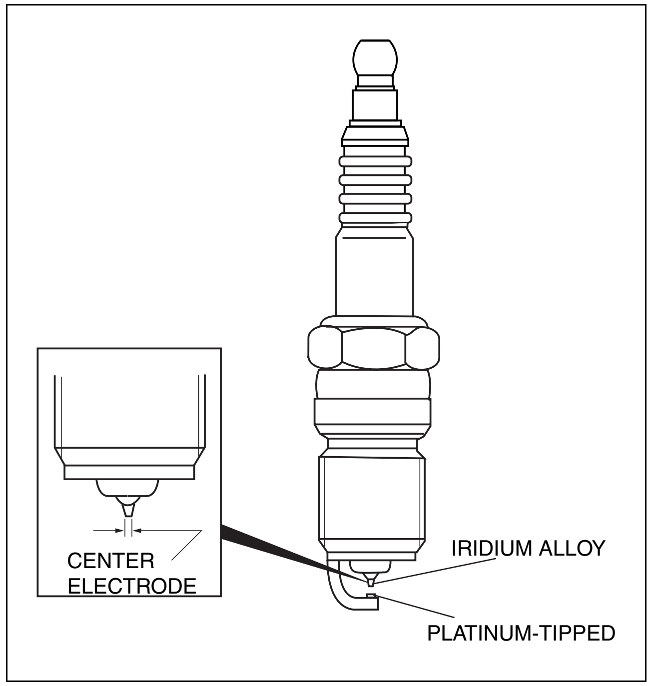
Terminal layout

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

SPARK PLUG CONSTRUCTION [LF]

E5U011818110N01

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



C3U0118S010

01–19 STARTING SYSTEM

STARTING SYSTEM OUTLINE [LF]

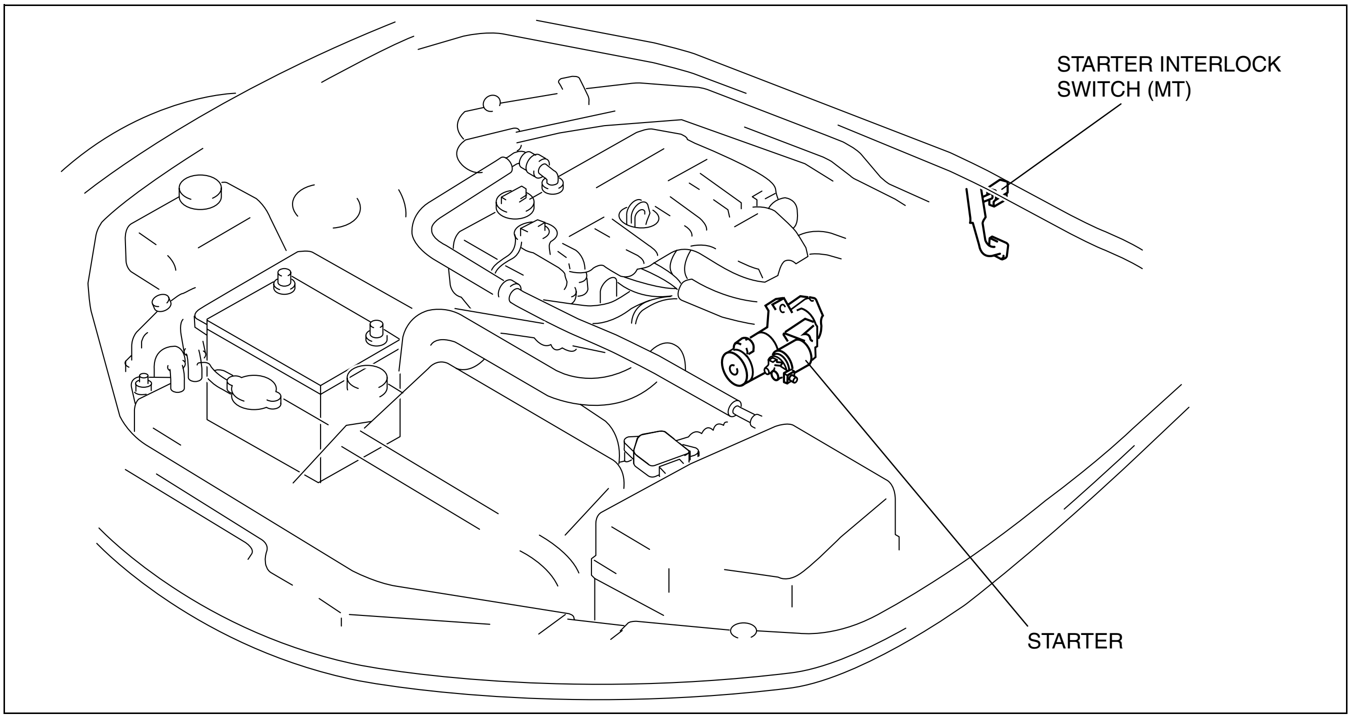
E5U011900000N01

Features

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

STARTING SYSTEM STRUCTURAL VIEW [LF]

E5U011900000N02

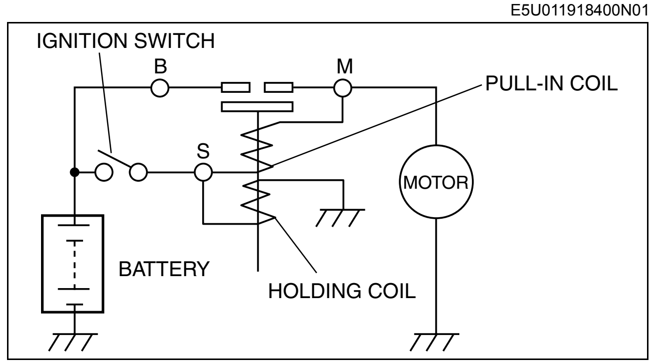


E5U119ZS5001

STARTER CONSTRUCTION [LF]

E5U011918400N01

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



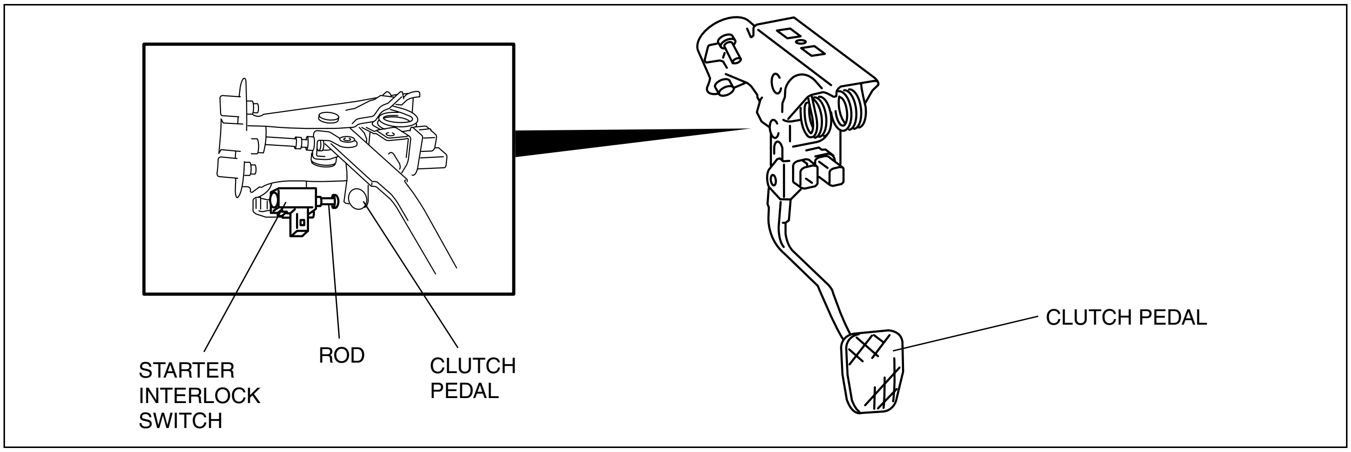
C3U0119S005

STARTER INTERLOCK SWITCH CONSTRUCTION/OPERATION [MT]

E5U011943440N01

Construction

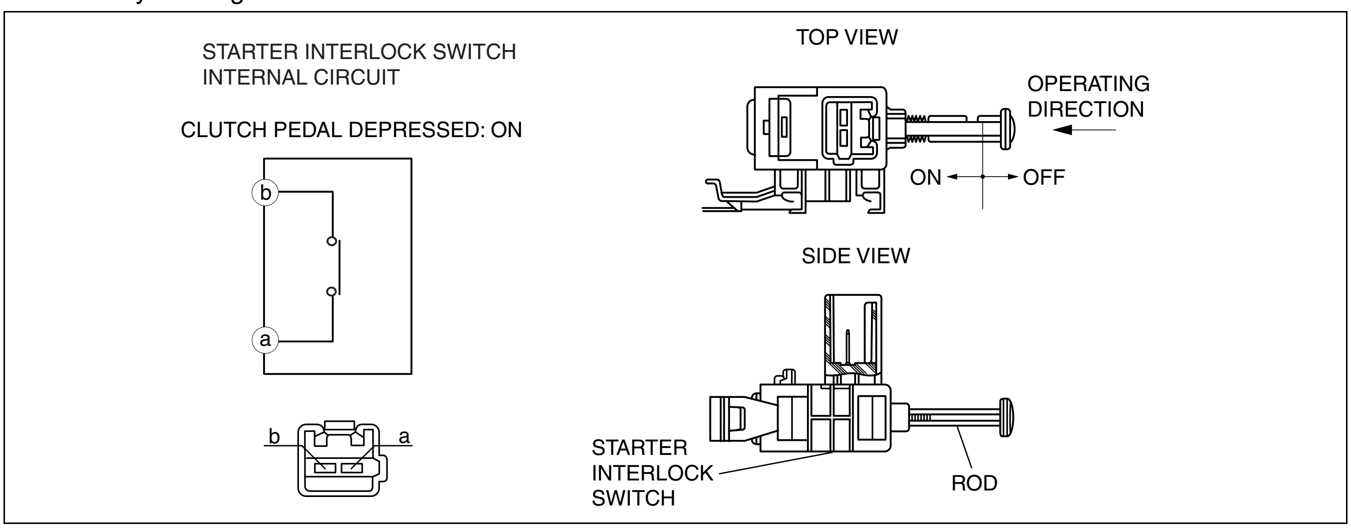
- The starter interlock switch mechanism prevents vehicle surge when the engine is started, enhancing the safety. The engine cannot be started unless the clutch is depressed.
- The mechanism is provided with a starter interlock switch on the circuit between the ignition switch and the starter.



E5U119ZS5002

Operation

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



E5U119ZS5003

01–20 CRUISE CONTROL SYSTEM

CRUISE CONTROL SYSTEM OUTLINE [LF]

E5U012000000N01

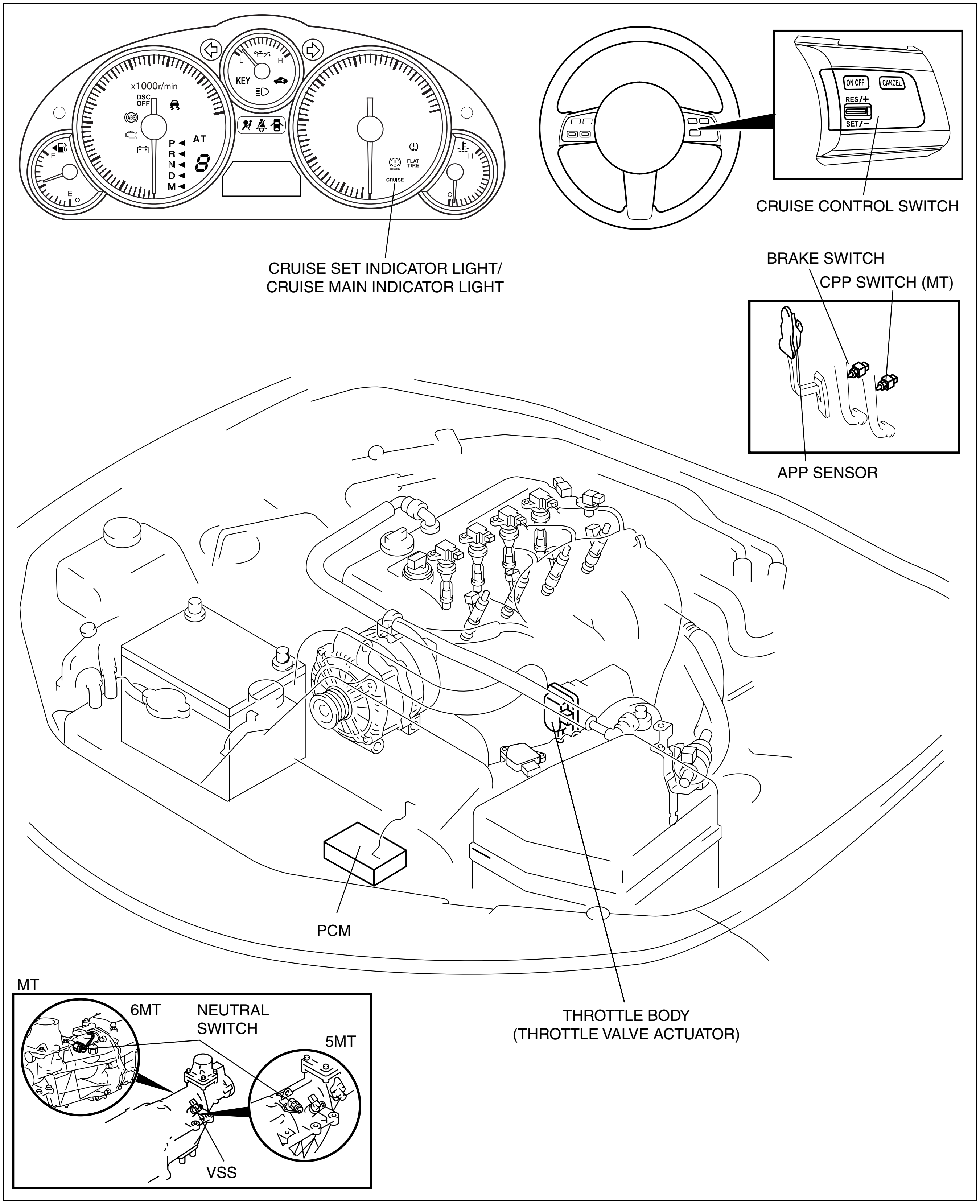
- The cruise control system enables driving at a constant speed by setting the vehicle speed with the cruise control switch instead of operating the accelerator pedal.
- The PCM controls the throttle valve actuator to maintain the vehicle at a constant speed.

Component and function

Component		Function		Installation location
ABS HU/CM (CAN communication: Vehicle speed signal) or VSS		The vehicle speed signal is sent to the PCM from either the ABS HU/CM or VSS.		Engine compartment
Cruise control switch	ON OFF	ON OFF	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.	Steering wheel
	SET/–	SET	When the vehicle speed exceeds 27 km/h {17 mph} during normal driving (cruise control system is in standby status) and the SET/– switch is released after it is pressed, the PCM stores the vehicle speed at the time the switch is released and the cruise control begins.	
		–	Tapping the SET/– switch (tap-down operation) or continuously pressing it during cruise control decreases the set vehicle speed.	
	RES/+	RES	If the RES/+ 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 {17 mph} during normal driving, the cruise control system activates to control the vehicle speed to the set vehicle speed.	
		+	Tapping the RES/+ switch (tap-up operation) or continuously pressing it during cruise control increases the set vehicle speed.	
	CANCEL	CANCEL	Pressing the CANCEL switch during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).	
Brake switch		Depressing the brake pedal during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).		Brake pedal
CPP switch (MT)		Depressing the clutch pedal during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).		Clutch pedal
Neutral switch (MT)		Shifting to neutral during cruise control switches the cruise control system to standby status (Set vehicle speed is saved).		Manual transaxle
PCM		• 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.		Engine compartment
Throttle valve actuator		The duty signal sent from the PCM adjusts the throttle valve opening angle.		Throttle body
Cruise main indicator light		This illuminates an amber color while the cruise control system is on standby.		Instrument cluster
Cruise set indicator light		This illuminates a green color while the cruise control system is in control status.		

CRUISE CONTROL SYSTEM STRUCTURAL VIEW [LF]

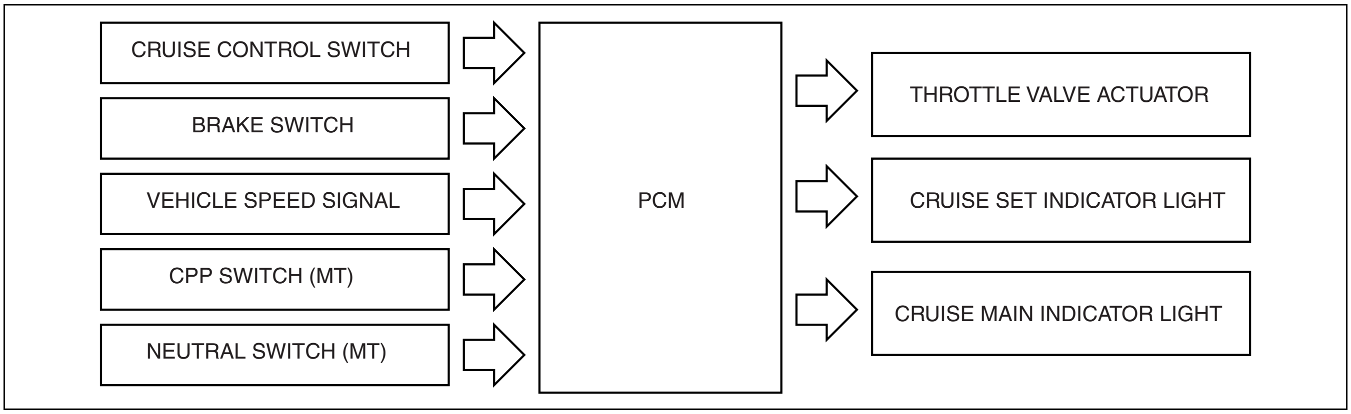
E5U012000000N02



E5U120ZN5001

CRUISE CONTROL SYSTEM BLOCK DIAGRAM [LF]

E5U012000000N03



E5U120ZN5002

01–40 CONTROL SYSTEM

ENGINE CONTROL SYSTEM OUTLINE [LF]

E5U014000000N01

Features

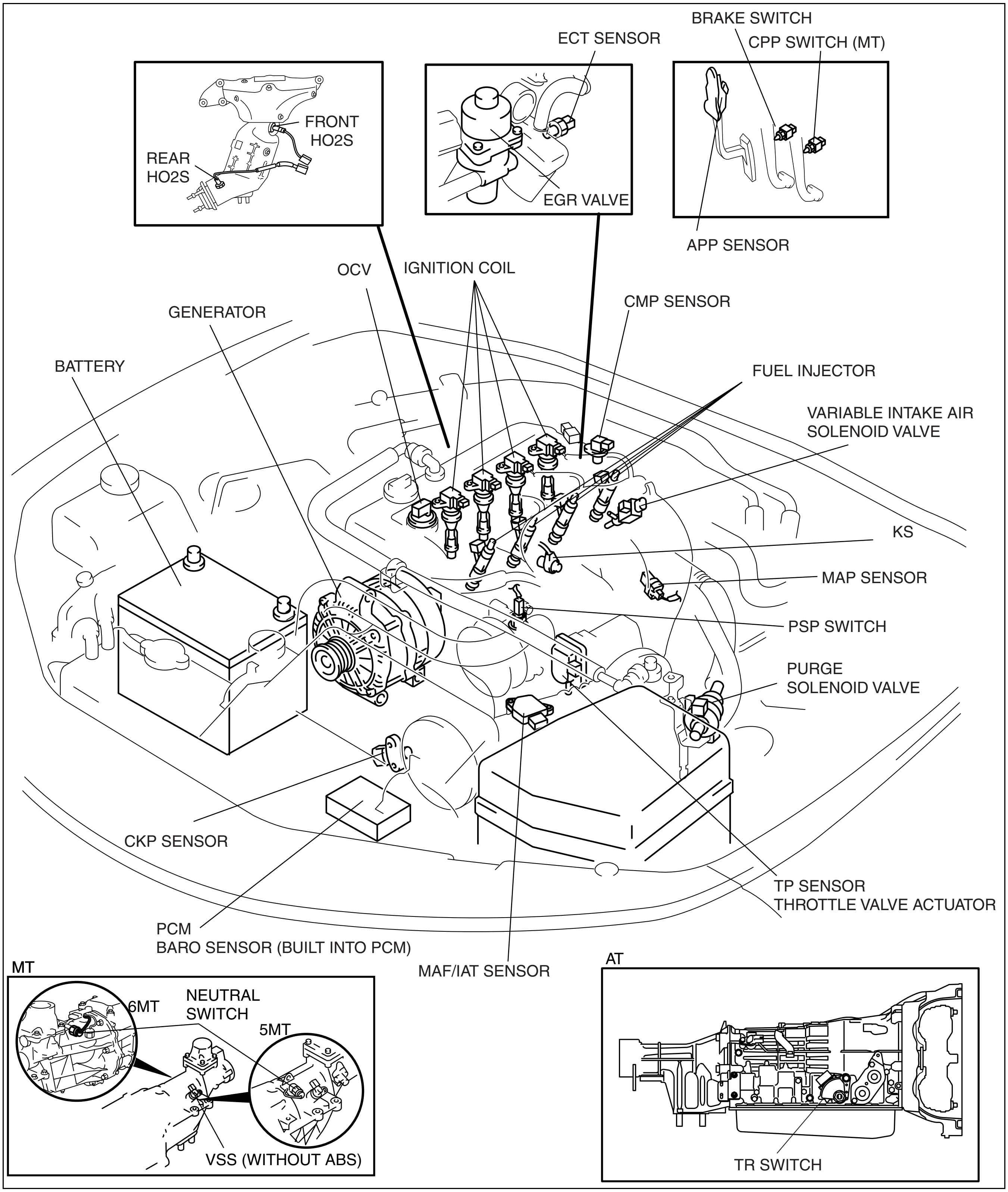
Improved driveability	• Drive-by-wire control adopted • Variable intake air control adopted • Variable valve timing control adopted
Improved exhaust emission performance	• Wide-range air/fuel ratio sensor has been adopted for the front HO2S • EGR control adopted
Wiring harness simplification	• CAN adopted

Specification

Item	LF
Neutral switch (MT)	ON/OFF
CPP switch (MT)	ON/OFF
PSP switch	ON/OFF
Brake switch	ON/OFF
ECT sensor	Thermistor
IAT sensor (Inside MAF)	Thermistor
CKP sensor	Hall element
CMP sensor	Hall element
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)
MAP sensor	Piezoelectric element
BARO sensor (Built into PCM)	Piezoelectric element
KS	Piezoelectric element

ENGINE CONTROL SYSTEM STRUCTURAL VIEW [LF]

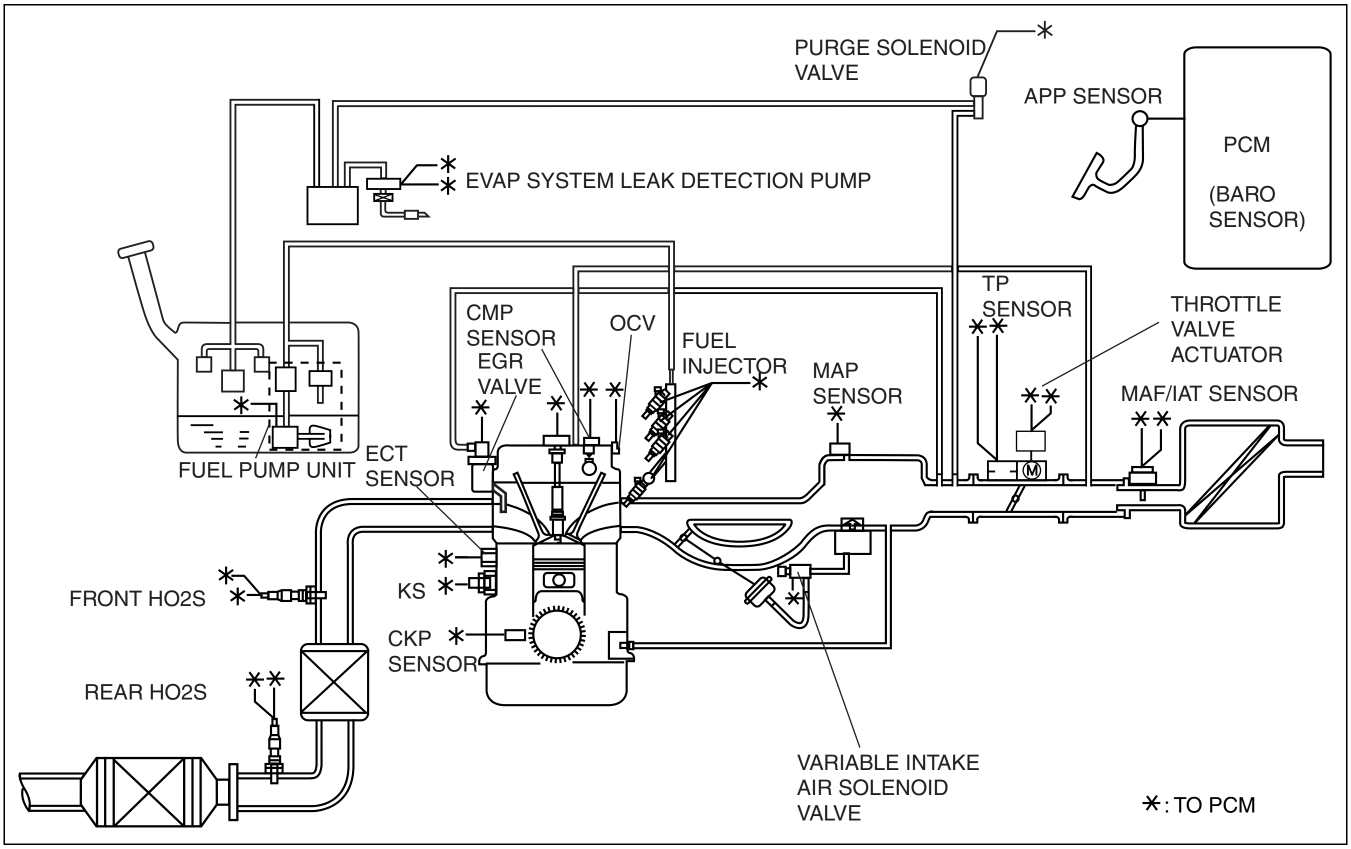
E5U014000000N02



E5U140ZT5014

ENGINE CONTROL SYSTEM DIAGRAM [LF]

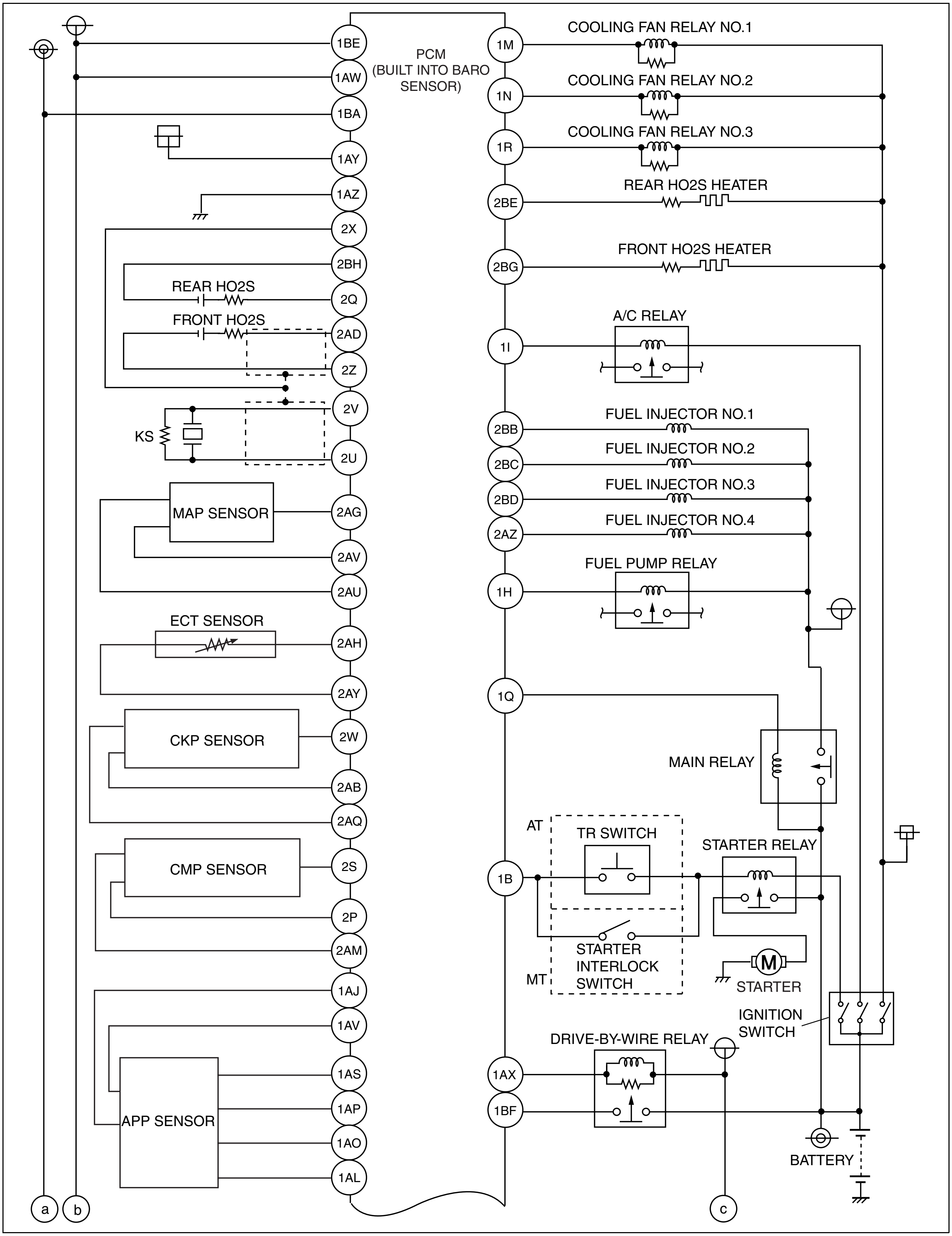
E5U014000000N03



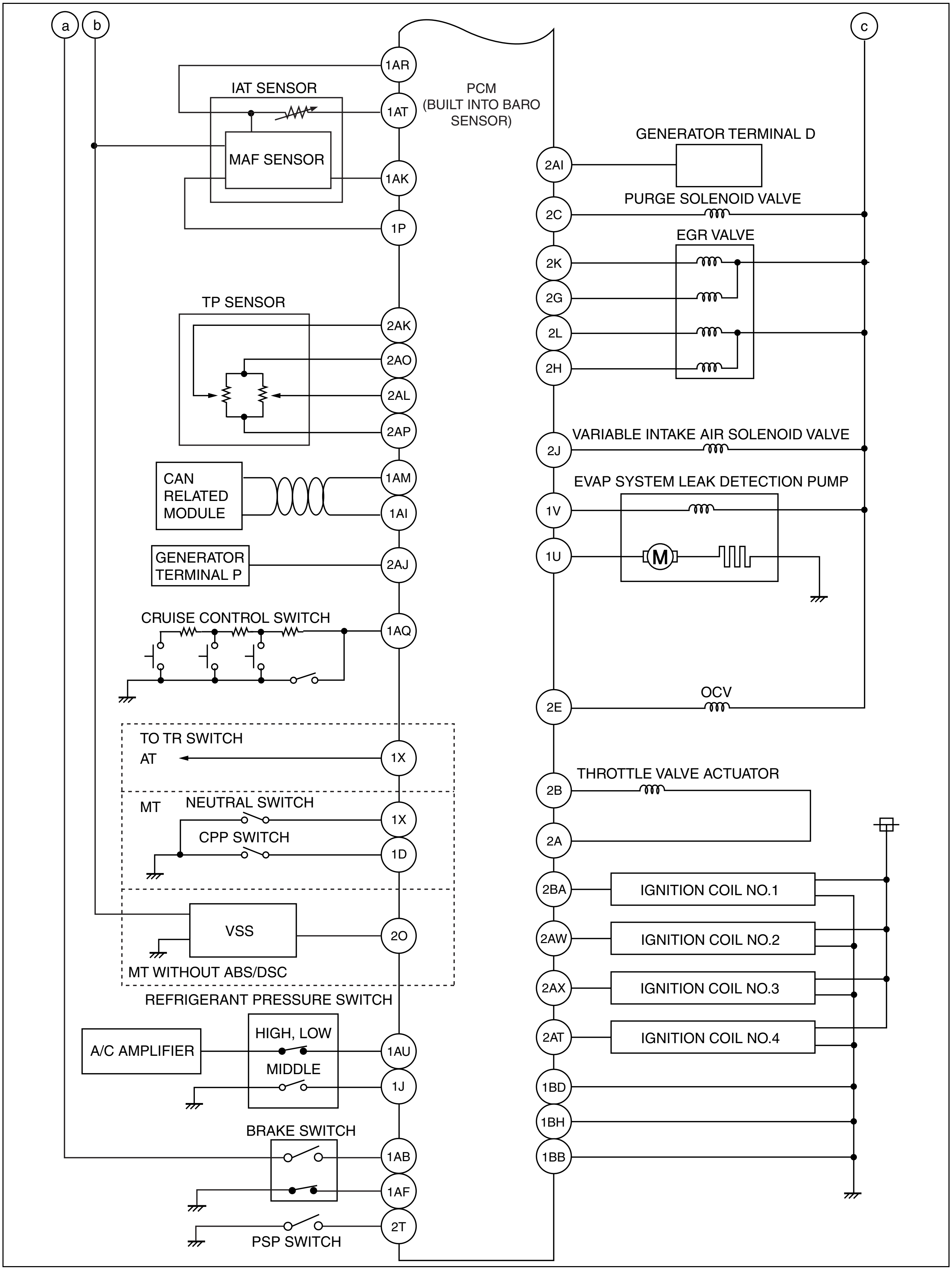
E5U140ZT5019

ENGINE CONTROL SYSTEM WIRING DIAGRAM [LF]

E5U014000000N04



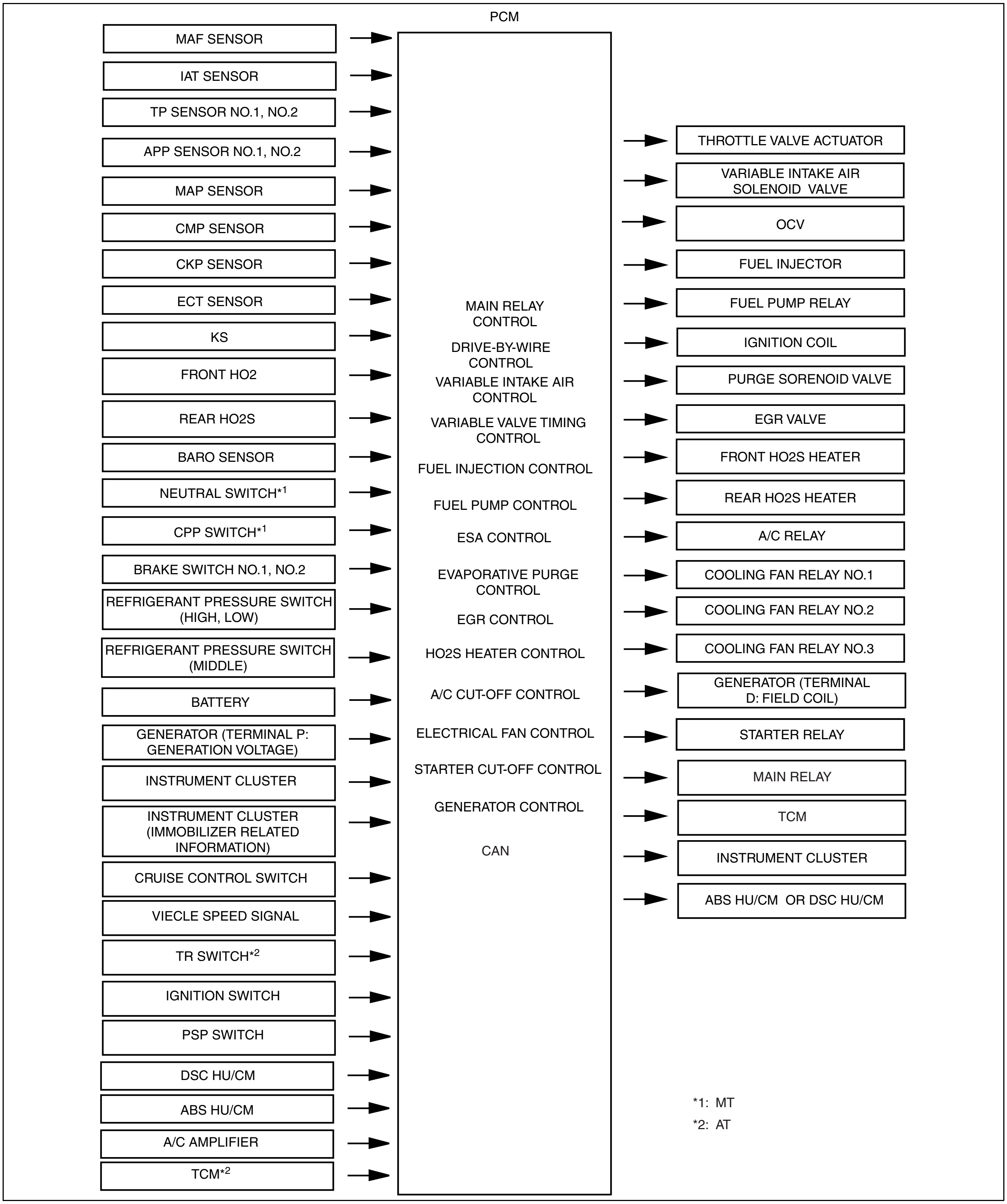
E5U102ZW4917



E5U102ZW4918

ENGINE CONTROL SYSTEM BLOCK DIAGRAM [LF]

E5U014000000N05



E5U140ZT5017

ENGINE CONTROL SYSTEM RELATION CHART [LF]

E5U014000000N06

×: Applicable

Item	MAIN RELAY CONTROL	DRIVE-BY-WIRE CONTROL	VARIABLE INTAKE AIR CONTROL	VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	ESA CONTROL	EVAPORATIVE PURGE CONTROL	EGR CONTROL	HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	ELECTRICAL FAN CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	CAN
Input device															
Neutral switch (MT)		×			×		×	×	×		×				
CPP switch (MT)		×			×		×		×		×				
ECT sensor		×		×	×		×	×	×	×	×	×		×	
IAT sensor		×			×		×	×	×	×		×		×	
CKP sensor		×	×	×	×	×	×	×	×	×	×			×	
CMP sensor				×	×		×								
TP sensor No.1, No.2		×	×	×	×		×	×	×	×	×	×			
APP sensor No.1, No.2		×			×		×				×				
MAF sensor		×		×	×		×	×	×	×					
Front HO2S					×			×							
Rear HO2S					×										
MAP sensor		×			×			×	×	×					
BARO sensor (Built into PCM)		×			×			×	×	×					
KS							×								
Ignition switch	×	×				×						×			
TR switch (AT)		×			×		×	×	×		×				
Brake switch No.1, No.2		×			×		×	×							
A/C amplifier		×			×		×				×	×			
Refrigerant pressure switch (high, low)		×			×		×				×	×			
Refrigerant pressure switch (middle)		×			×							×			
Cruise control switch		×													
PSP switch		×													
Vehicle speed signal		×			×		×		×			×		×	
Instrument cluster (Immobilizer related information)													×		
Instrument cluster															×
DSC HU/CM		×													
ABS HU/CM or DSC HU/CM															×
Generator (Terminal P: stator coil)		×					×							×	
Battery					×		×	×	×	×				×	
TCM (AT)		×					×								×

Item	MAIN RELAY CONTROL	DRIVE-BY-WIRE CONTROL	VARIABLE INTAKE AIR CONTROL	VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	ESA CONTROL	EVAPORATIVE PURGE CONTROL	EGR CONTROL	HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	ELECTRICAL FAN CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	CAN
Output device															
Main relay	×														
Fuel pump relay						×									
A/C relay											×				
Cooling fan relay No.1												×			
Cooling fan relay No.2												×			
Cooling fan relay No.3												×			
Starter relay													×		
Purge solenoid valve								×							
EGR valve									×						
Variable intake air solenoid valve			×												
Throttle valve actuator		×													
Front HO2S heater										×					
Rear HO2S heater										×					
OCV				×											
TCM (AT)															×
Fuel injector					×										
Ignition coil							×								
Generator (Terminal D: field coil)														×	
Instrument cluster															×
ABS HU/CM or DSC HU/CM															×
Keyless control module															×

MAIN RELAY CONTROL OUTLINE [LF]

E5U014000000N56

- 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 after-cleaning function of the electrical fan control, and EVAP system leak detection function of the EVAP control system.

MAIN RELAY CONTROL BLOCK DIAGRAM [LF]

E5U014000000N57

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

IGNITION SWITCH → PCM → MAIN RELAY

E5U140ZT5301

MAIN RELAY CONTROL OPERATION [LF]

E5U014000000N58

- 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 01–40–13 DRIVE-BY-WIRE CONTROL OPERATION [LF].)
  2. After-cooling function of the electrical fan control (See 01–40–34 ELECTRICAL FAN CONTROL OPERATION [LF].)
  3. EVAP system leak detection function of the EVAP control system (See 01–16–7 EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM OUTLINE [LF].)
- When the on request signal from the controls stop, the main relay turns off.

DRIVE-BY-WIRE CONTROL OUTLINE [LF]

E5U014000000N59

- 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 and cruise control.

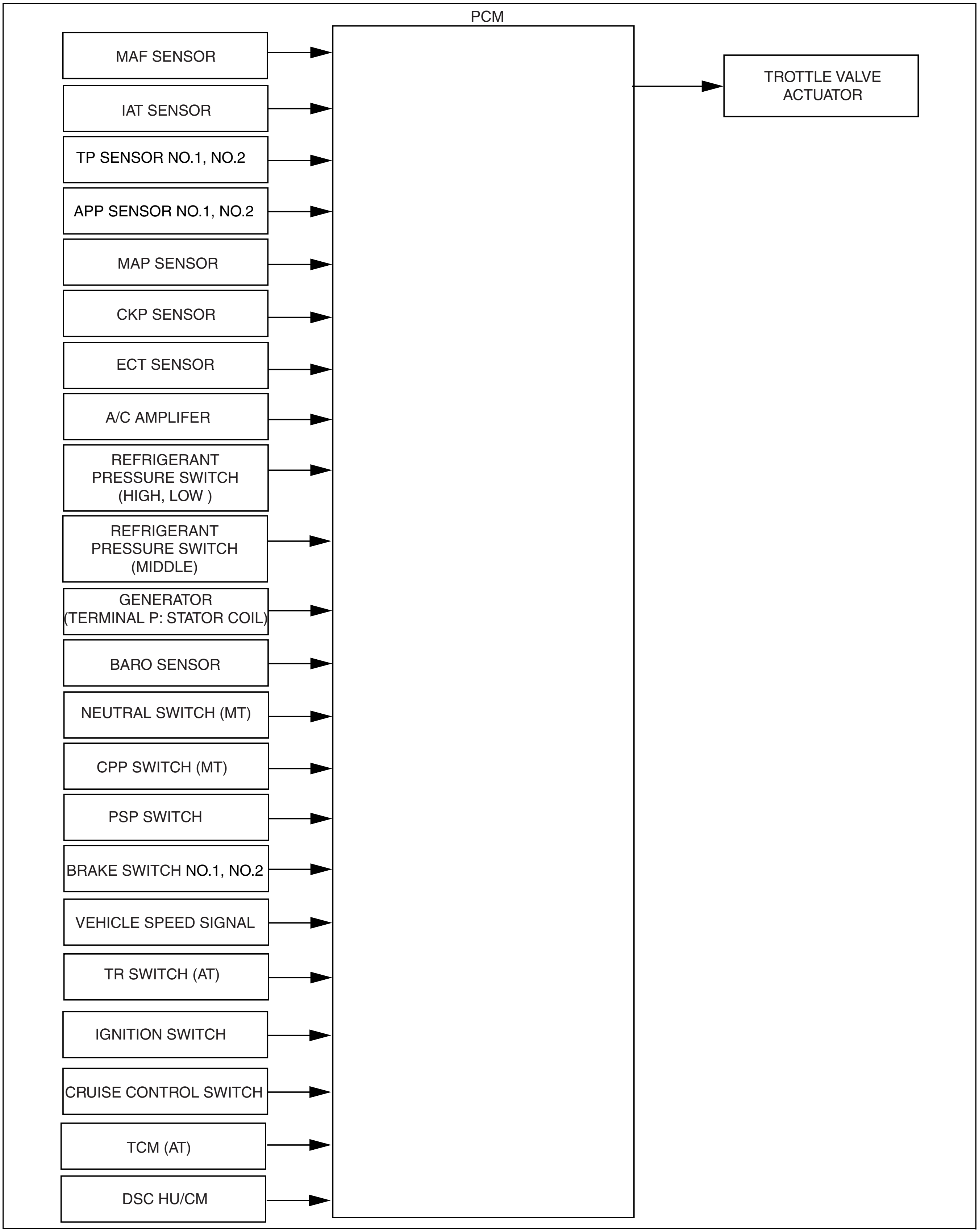
Control List

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.

DRIVE-BY-WIRE CONTROL BLOCK DIAGRAM [LF]

E5U014000000N64

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



E5U140ZT5002

DRIVE-BY-WIRE CONTROL OPERATION [LF]

E5U014000000N60

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

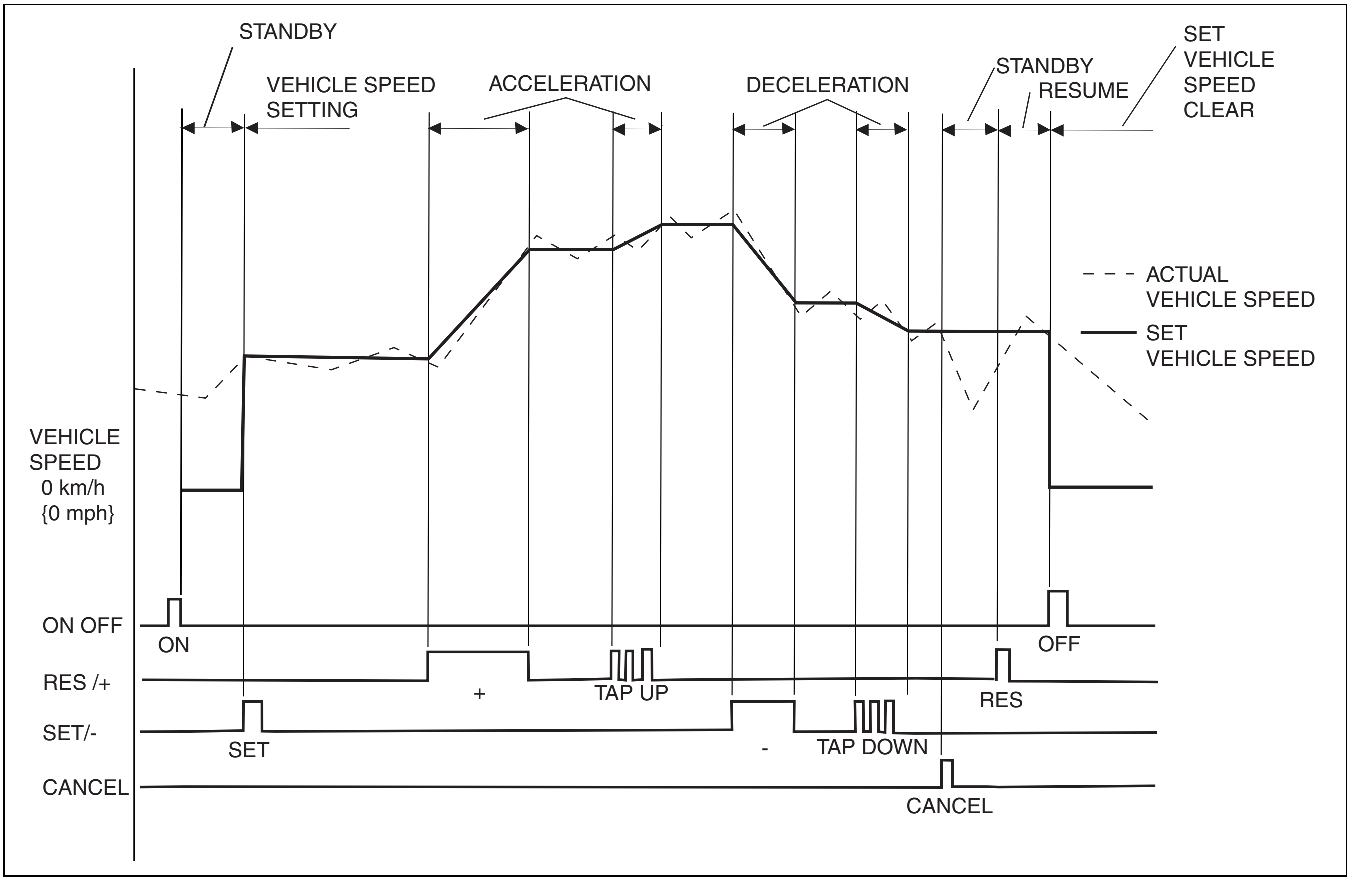
Correction	Purpose	Condition	Amount of Correction
Correction	Target	Conditions	Correction amount
A/C load correction	Prevents decrease in idle speed due to A/C operation.	A/C is operating.	A/C operation time→correction
Electrical load correction	Prevents decrease in idle speed due to electrical load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

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 01–40–11 MAIN RELAY CONTROL OPERATION [LF].)

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.



E5U140ZW5501

- 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 ON OFF switch: ON
  — Vehicle speed: More than 27 km/h {17 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 ON OFF 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.
  — Cruise control CANCEL switch: ON
  — Neutral switch (MT) or CPP switch (MT): ON
  — TR 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 RES/+ 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 RES/+ switch is continuously pressed, the PCM gradually increases the set vehicle speed. — Except during resume operation — The RES/+ switch is on one time or more during resume operation.
Coasting	• When the SET/- switch is continuously pressed, the PCM gradually decreases the set vehicle speed.
Resume	• When the RES/+ 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 {1.0 mph} and controls the throttle valve actuator. — During cruise control — RES/+ switch off — The RES/+ switch switches from off to on — When actual vehicle speed is lower (set vehicle speed +2.0 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 {1.0 mph} and controls the throttle valve actuator so that the vehicle speed is close to the set vehicle speed. — During cruise control — The RES/+ switch switches from off to on
Downshift (AT)	• When the following conditions are met, a downshift signal is sent to the TCM via CAN. — RES/+ switch on — Target vehicle acceleration is not reached

DRIVE-BY-WIRE RELAY CONTROL OUTLINE [LF]

E5U014000000N61

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

DRIVE-BY-WIRE RELAY CONTROL OPERATION [LF]

E5U014000000N62

- When the main relay is on, the drive-by-wire relay also turns on. (See 01–40–11 MAIN RELAY CONTROL OPERATION [LF].)

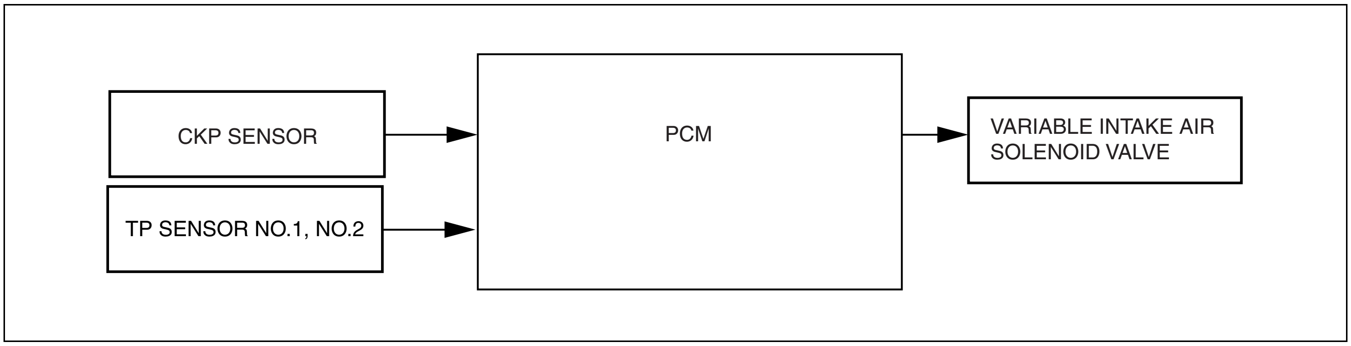
VARIABLE INTAKE AIR CONTROL OUTLINE [LF]

E5U014000000N16

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

VARIABLE INTAKE AIR CONTROL BLOCK DIAGRAM [LF]

E5U014000000N17



E5U140ZT5001

VARIABLE INTAKE AIR CONTROL OPERATION [LF]

E5U014000000N18

Operation conditions

- If any of the following conditions are met:
  - — Engine speed is approx. 4,750 rpm or more
  - — Engine speed is approx. 3,150 rpm or less and the throttle opening angle is the specified value or more. (heavy load condition)

When operation conditions are not met

- The PCM energizes the variable intake air solenoid valve, closing the variable intake air shutter valve to enhance the inertia charging effect in the engine low to middle speeds and low load ranges.

When operation conditions are met

- The PCM blocks energization the variable intake air solenoid valve, opening the variable intake air shutter valve to enhance the inertia charging effect in the engine high speed and high-load range.

VARIABLE VALVE TIMING CONTROL OUTLINE [LF]

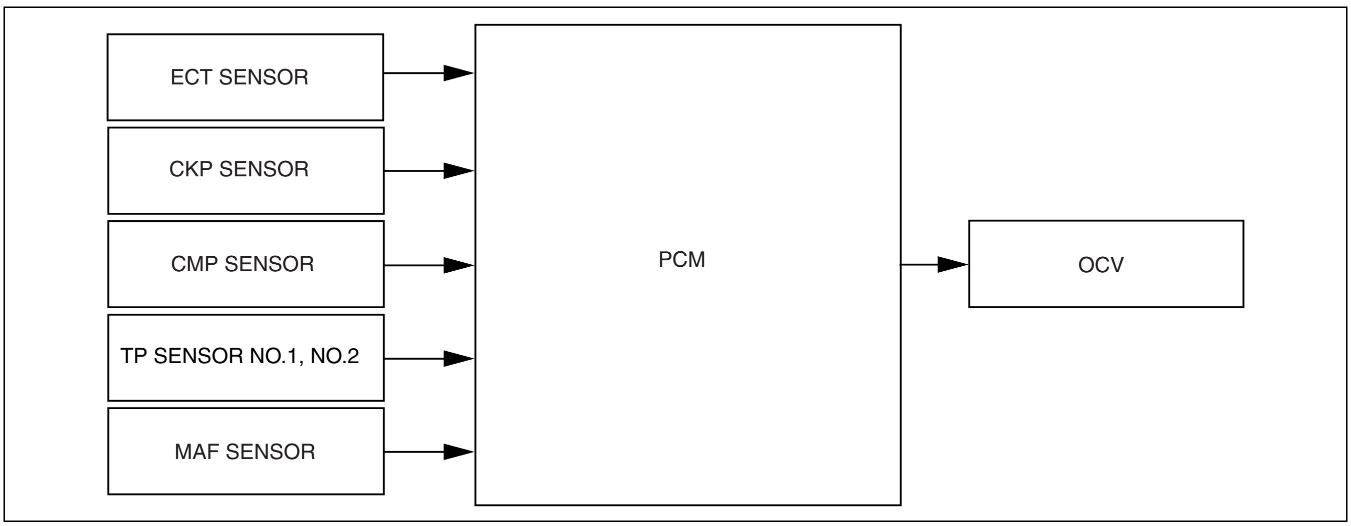
E5U014000000N22

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

VARIABLE VALVE TIMING CONTROL BLOCK DIAGRAM [LF]

E5U014000000N23

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



E5U140ZT5100

VARIABLE VALVE TIMING CONTROL OPERATION [LF]

E5U014000000N63

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

Cleaning Mode

Mode execution condition

- When the following condition is met:
  - — Idle speed control feedback execution condition

Purpose

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

Operation

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

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

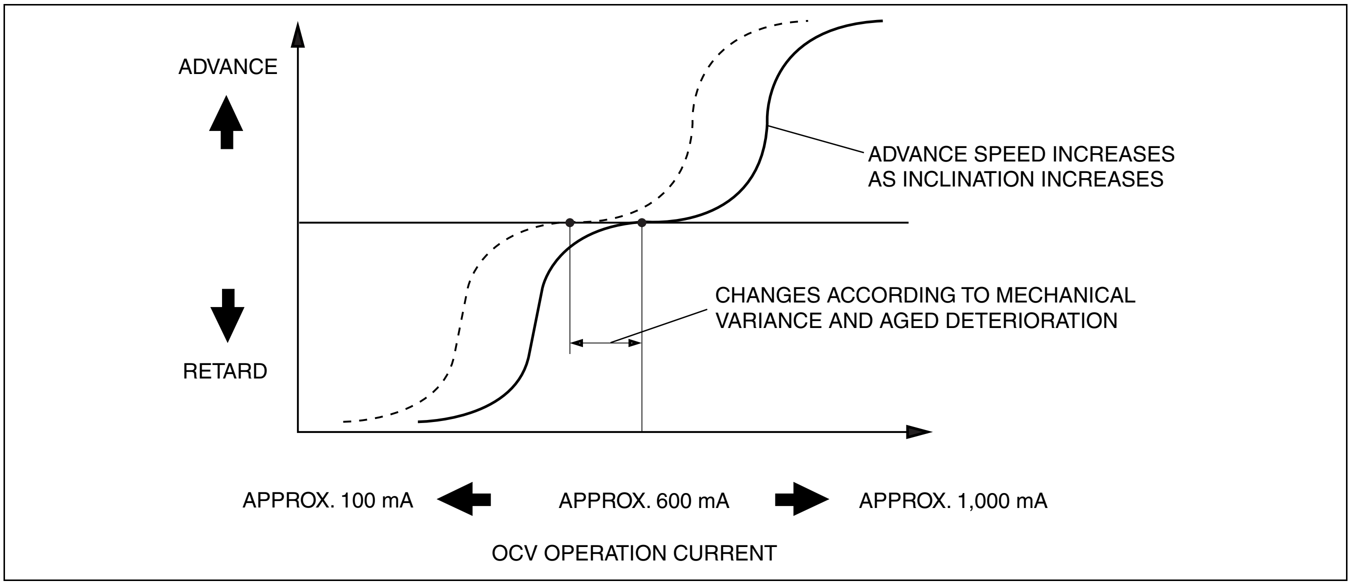
Purpose
- Maximum cam retard mode stabilizes engine speed by maximally retarding the valve timing when the engine speed is low during idling.

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

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

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

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



E5U140ZT5101

Feedback Mode

Mode execution condition

- Except during cleaning, maximum cam retard, or feedback hold modes.

Purpose

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

Operation

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

Advance Spark Speed Correction

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

Valve Timing Determination

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

Target valve timing

- Determined according to engine speed and charging efficiency.

Actual valve timing

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

Cam maximum retard learning value

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

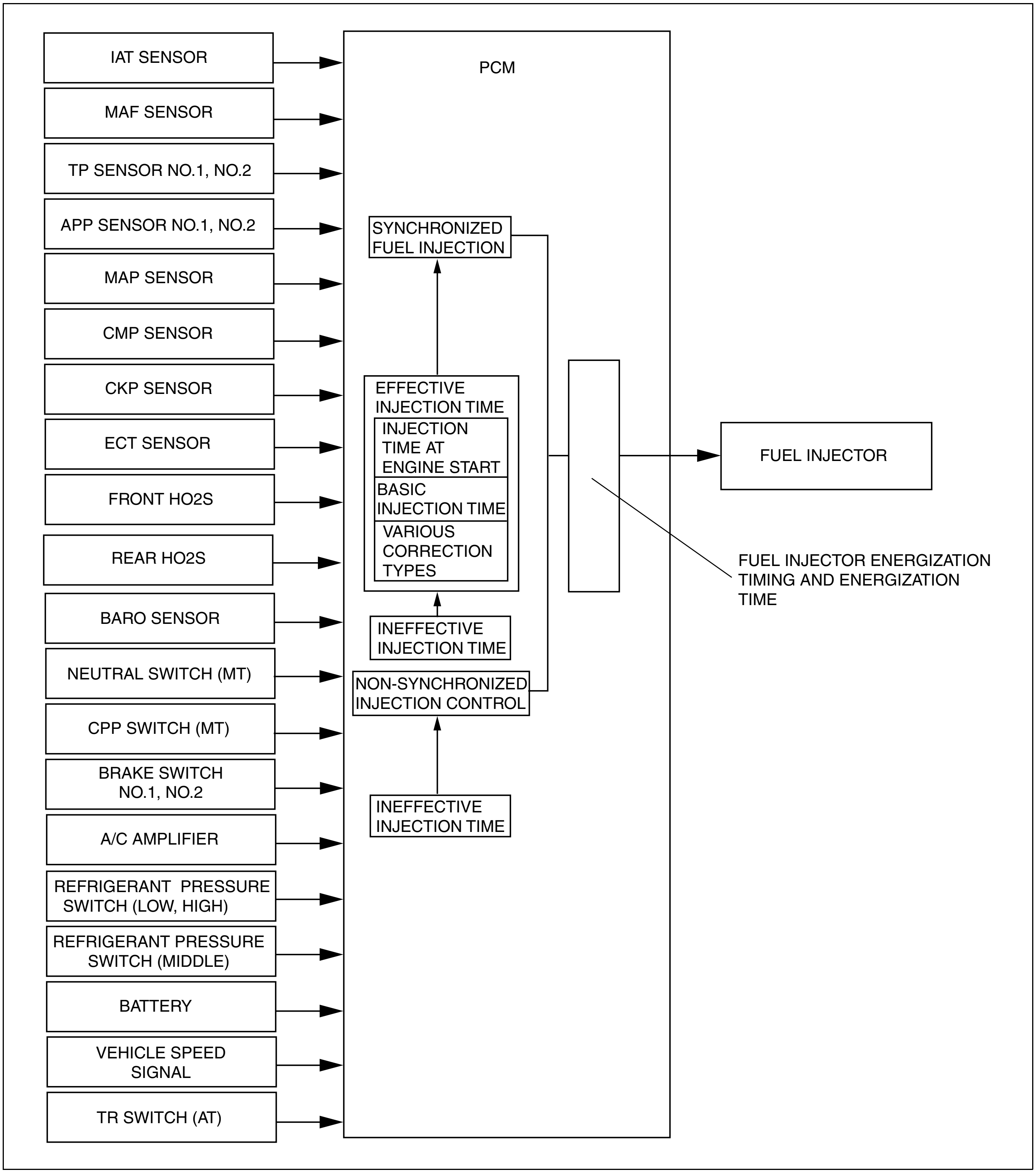
FUEL INJECTION CONTROL OUTLINE [LF]

E5U014000000N25

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

FUEL INJECTION CONTROL BLOCK DIAGRAM [LF]

E5U014000000N26



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FUEL INJECTION CONTROL OPERATION [LF]

E5U014000000N27

Operation

Injection timing

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

Synchronized fuel injection

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

Non-synchronized fuel injection

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

Relation between synchronized and non-synchronized fuel injection

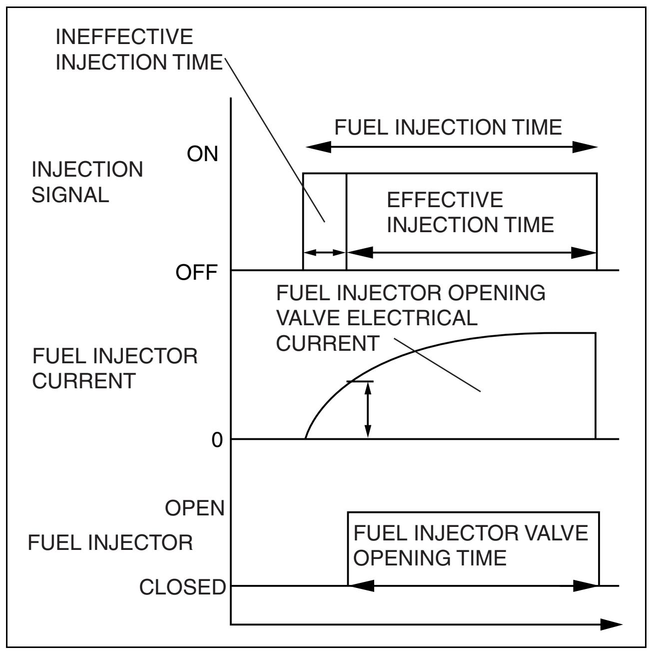
- If synchronized and non-synchronized fuel injection happen to occur together, fuel is injected by adding the fuel injection timing of both.

Injection Time

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

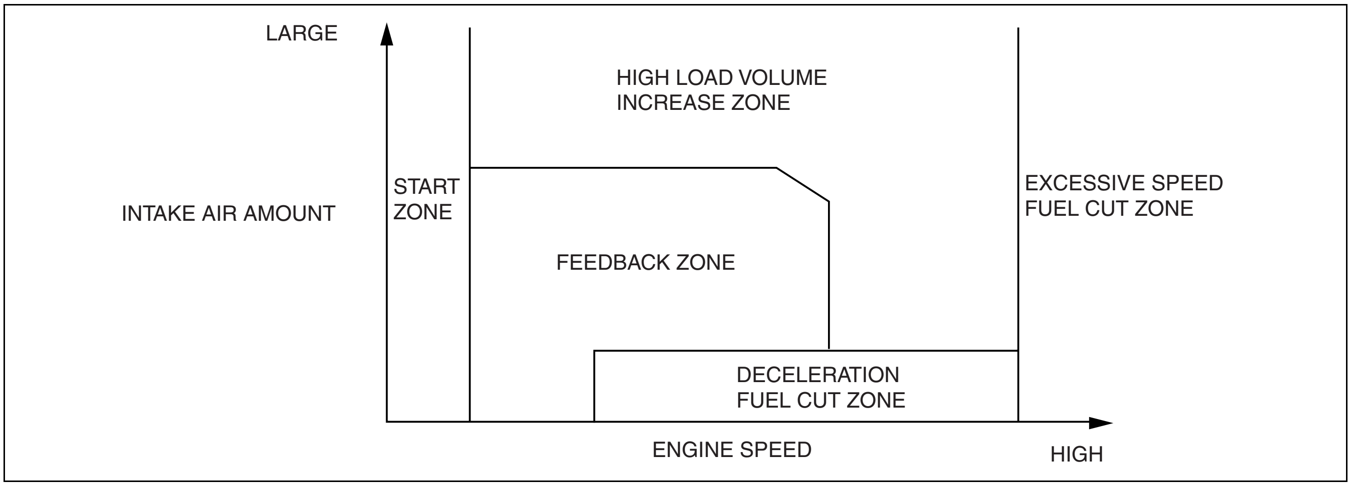
Fuel injector energization time and operation conditions

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



C3U0140S014

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



Start zone
Purpose
- Improved engine startability

Operation condition
- When engine speed is 500 rpm or less.

Determination of fuel injection time
- According to engine coolant temperature (ECT sensor) and engine speed (CKP sensor)

Feedback Zone
Purpose
- Improved fuel economy
- Improved exhaust gas purification

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

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

High load volume increase zone
Purpose
- Improved driveability
- TWC protection

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

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

Excessive speed fuel cut zone
Purpose
- Engine protection

Control conditions
- When the engine speed is 7,000 rpm or more (WOT).
- When engine speed is 5,500 rpm or more and the engine coolant temperature is approx. -15 °C {5 °F} or less.
- When the following conditions continue for 2 min or more:
  — Vehicle is stopped.
  — Engine speed is 2,500 rpm or more.
  — Engine coolant temperature is approx. 112 °C {234 °F}.

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

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

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

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

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

Calculation method list for fuel injection time

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

Contents (Fuel injection time, calculation method, or determination method)		Control zone: Start	Control zone: Feedback	Control zone: High load volume increase	Control zone: Excessive speed fuel cut	Control zone: Deceleration fuel cut
Injection time at start	**Set value according to engine coolant temperature (low engine coolant temperature→long injection time)**	A				
Basic injection time	**Basic injection time = charging efficiency x fuel flow coefficient**		A	A		
Fuel cut	**Fuel injection time = 0**				A	A
Ineffective injection time	**Set time according to injector performance**	A	A	A		
Volume increase correction at engine start	Purpose: Maintains stability of engine speed just after engine start **Correction condition** • Specified time according to engine coolant temperature directly after engine start **Correction amount** • Low engine coolant temperature→large correction • Low intake air temperature→large correction	B	B			
Front HO2S feedback correction	Purpose: Controls air/fuel ratio to the theoretical air/fuel ratio **Correction condition** • When engine coolant temperature is at set value or more **Correction amount** • Front HO2S electromotive force is approx. 0.45 V or more→volume decrease correction • Front HO2S electromotive force is approx. 0.45 V or more→volume increase correction		B			
Rear HO2S feedback correction	Purpose: Corrects feedback amount according to deterioration of front HO2S and catalytic converter **Correction condition** • Engine coolant temperature is at set value or more • Engine speed is 500—4,250 rpm • Charging efficiency is 10—80% **Correction amount** • According to rear HO2S electromotive force→correction		B			
D-range correction (AT)	Purpose: Ensures engine speed stability during D-range shifting **Correction condition** • Throttle valve fully-closed and shifted into D range **Correction amount** • Low engine coolant temperature→large correction		B			

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

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

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

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

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

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

Fuel cut during immobilizer system activation

Purpose

- To prevent vehicle theft

Execution conditions

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

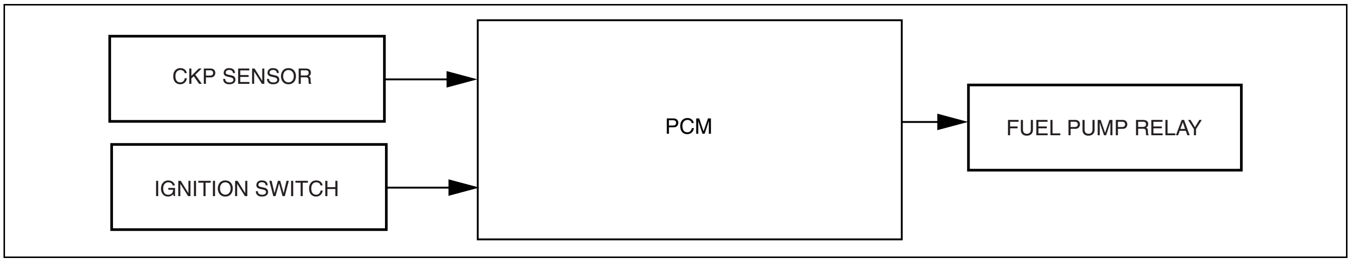
FUEL PUMP CONTROL OUTLINE [LF]

E5U014000000N28

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

FUEL PUMP CONTROL BLOCK DIAGRAM [LF]

E5U014000000N29



E5U140ZW5401

FUEL PUMP CONTROL OPERATION [LF]

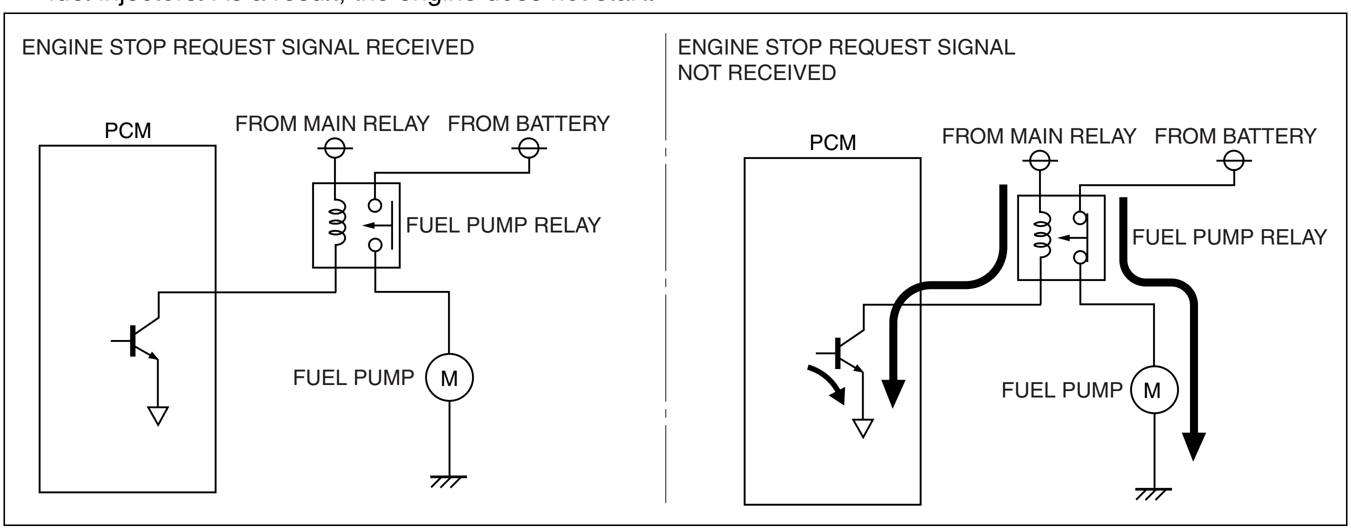
E5U014000000N30

Operation Condition

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

Operation Inhibition Condition

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



C3U0140S017

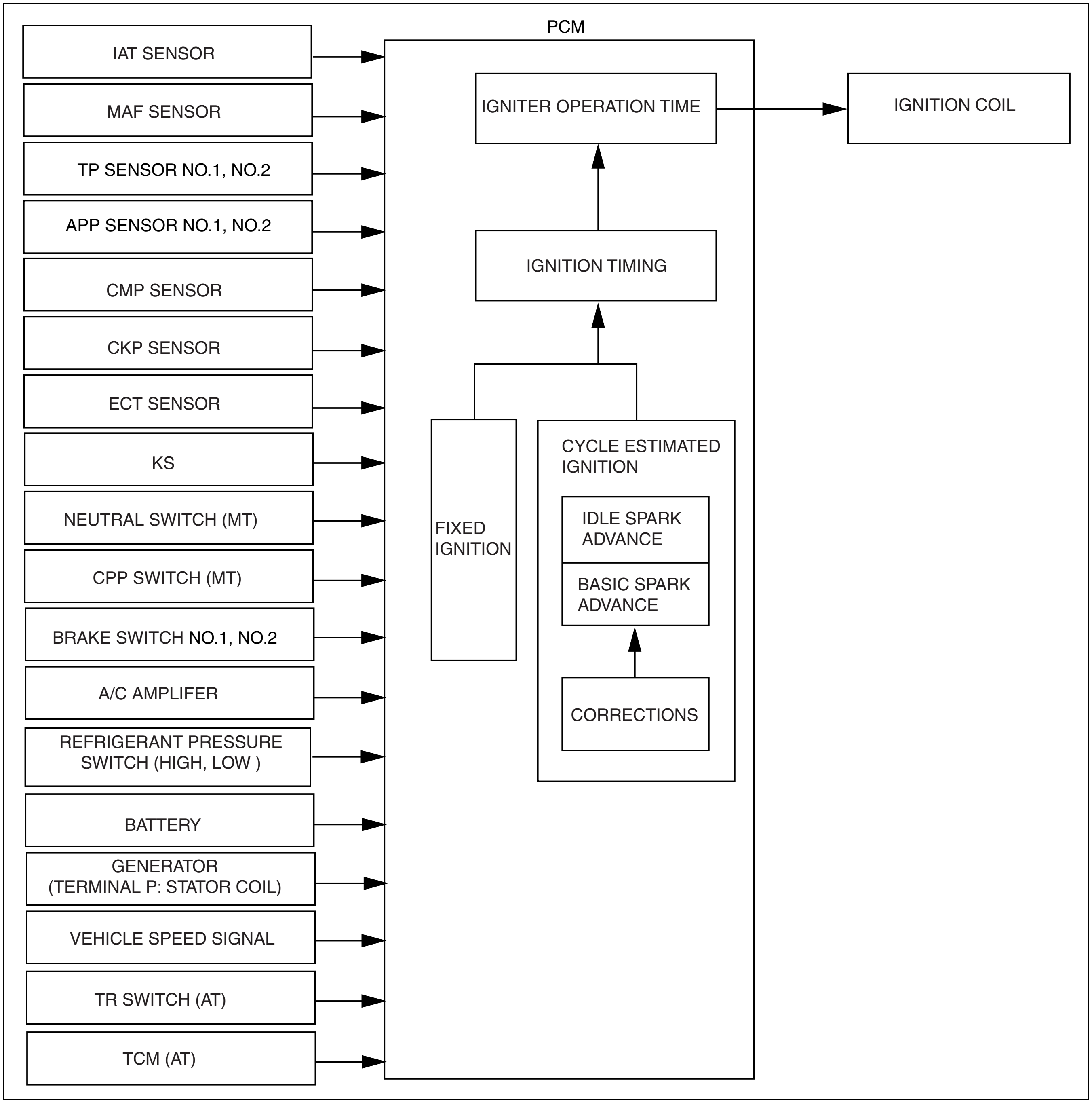
ELECTRONIC SPARK ADVANCE (ESA) CONTROL OUTLINE [LF]

E5U014000000N31

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

ELECTRONIC SPARK ADVANCE (ESA) CONTROL BLOCK DIAGRAM [LF]

E5U014000000N32



E5U140ZT5004

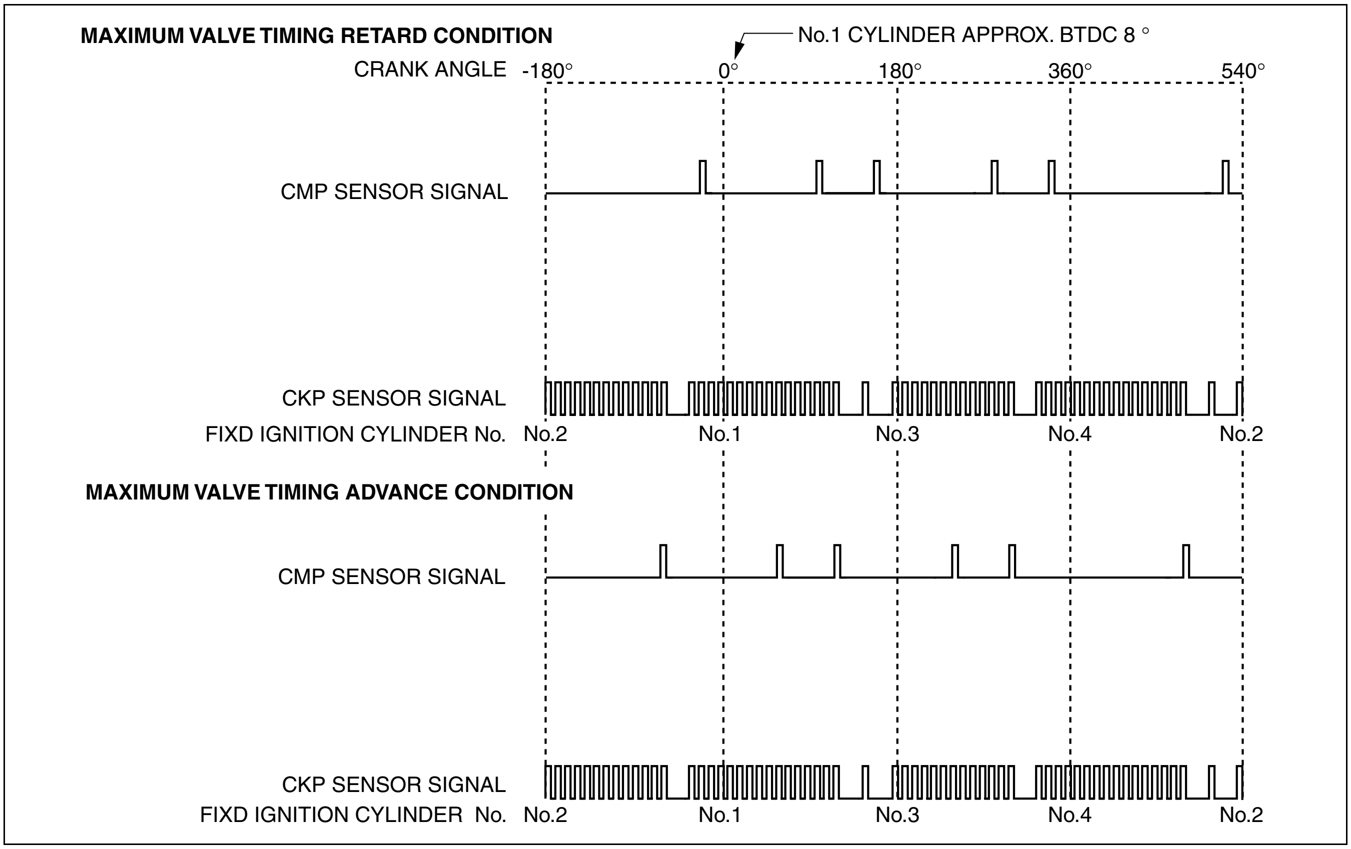
ELECTRONIC SPARK ADVANCE (ESA) CONTROL OPERATION [LF]

E5U014000000N33

Ignition Method

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

Ignition method	Ignition timing	Ignition coil energization period
Fixed ignition	Fixed at BTDC 8 °	Fixed period at BTDC 8 ° to end of energization
Cycle estimated ignition	Ignition at timing appropriate to engine operation conditions based on input signals	• Energization time (ignition coil energization time) to igniter is determined according to battery voltage • Cylinder independent ignition

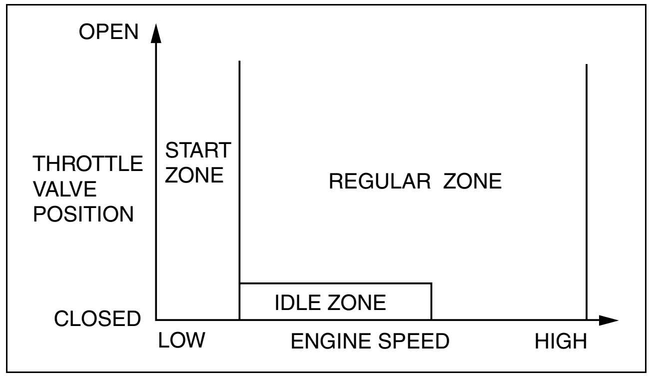


E5U140ZT5102

Determination of Ignition Timing

Division of control zones

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



C3U0140S020

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

Ignition timing calculation method table

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

Contents		Calculation method or determination method for ignition timing, advance value and correction	Control zone		
			Start zone	Idling zone	Cycle estimated zone
Fixed ignition		**Fixed at BTDC approx. 8 ° CA**	A		
Cycle estimated ignition	**Idle spark advance**	Set value according to target speed and charging efficiency*		A	
	Basic spark advance	Set value according to engine speed and charging efficiency*			A

Correction	Engine coolant temperature advance correction	Purpose: Ensures combustion stability when engine coolant temperature is low **Except during idling** • High charging efficiency*, low engine coolant temperature→large correction		B	B
	Warm-up promotion spark retard correction	Purpose: Activates the catalytic converter earlier **Approx. 50 s after engine start** • According to engine coolant temperature→correction		B	
	Feedback correction	Purpose: Ensures idling stability **During idling (inhibited during test mode)** • Large difference between actual engine speed and target engine speed→large correction • Small difference between actual engine speed and target engine speed→small correction		B	
	EGR correction	Purpose: Prevents deviation of required ignition timing during EGR gas feed **When EGR valve position is the specified value or more except during EGR valve initialization** • According to engine speed and charging efficiency*→correction			B
	Shift spark retard/ advance corrections (AT)	Purpose: Reduce shift shock during upshifting or manual downshifting. **Determined according to torque reduction/increase request signals from the TCM.** • Large torque reduction request during upshifting→large spark retard correction • Large torque increase request during manual downshifting→large spark advance correction			B
	Deceleration fuel cut recovery retard correction	Purpose: Reduces shock after recovery from deceleration fuel cut and during re-acceleration while in deceleration fuel cut **Re-acceleration after recovery from deceleration fuel cut and while in deceleration fuel cut** • Low engine coolant temperature→large correction		B	B
	Acceleration spark retard correction	Purpose: Prevents knocking and shock during sudden acceleration **Acceleration when charging efficiency* volume increase (acceleration amount) is specified value or more** • High acceleration amount→high retard			B
	Standing start spark retard correction	Purpose: Prevents shock when vehicle accelerates from a standing start **When vehicle accelerates from a standing start** • According to engine speed, throttle valve opening angle, engine coolant temperature and intake air temperature→correction			B
	Knocking spark retard correction	Purpose: Knocking suppression **When knocking is detected while driving under high load** • Large amount of knocking→large correction			B

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

Ignition Inhibition Condition

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

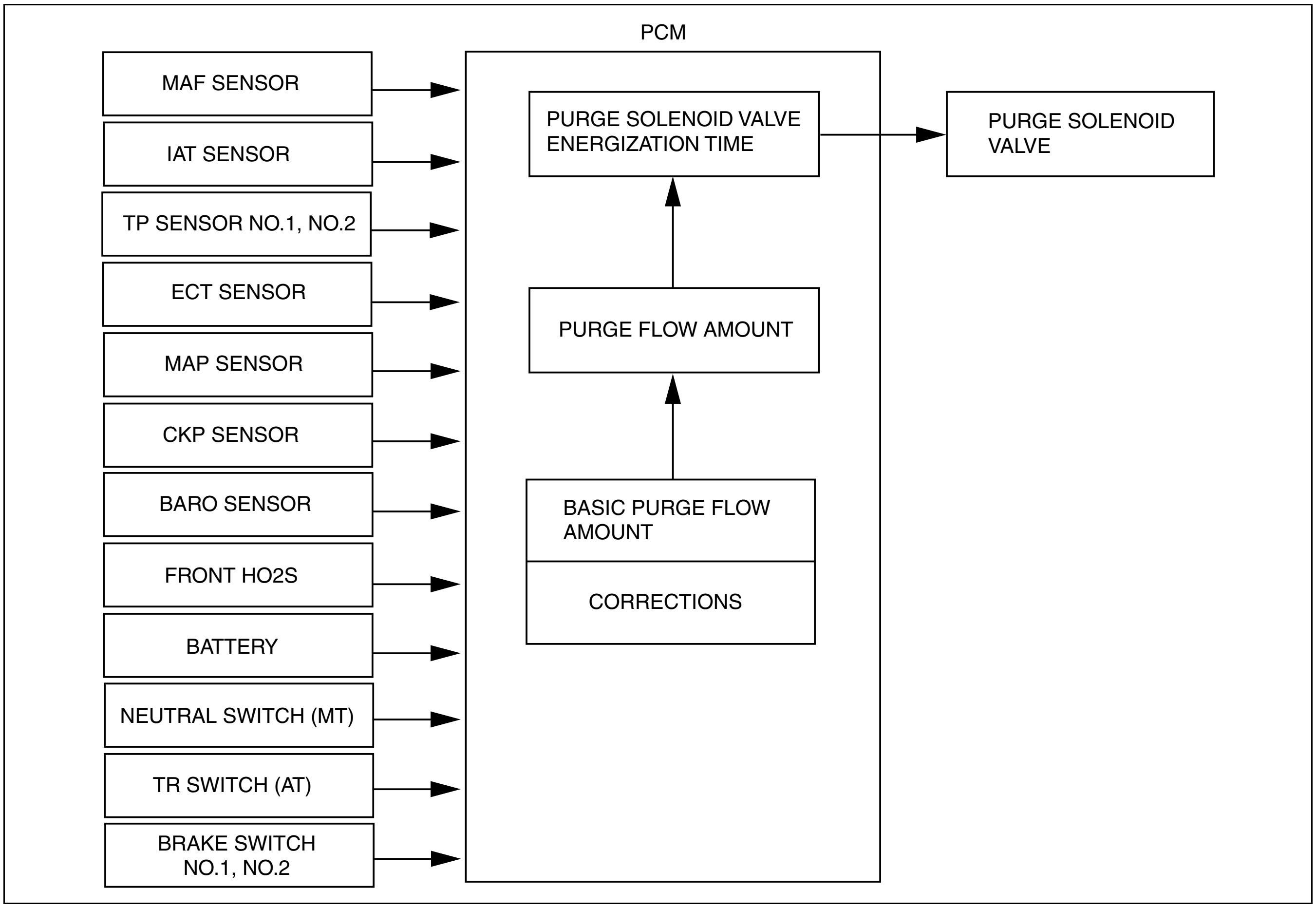
EVAPORATIVE PURGE CONTROL OUTLINE [LF]

E5U014000000N37

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

EVAPORATIVE PURGE CONTROL BLOCK DIAGRAM [LF]

E5U014000000N38



E5U140ZT5007

EVAPORATIVE PURGE CONTROL OPERATION [LF]

E5U014000000N39

Determination of Purge Solenoid Valve Energization Time

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

Calculation Method for Purge Flow Amount

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

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

Operation Conditions

- For purge control during normal driving, the PCM sends a duty signal to the purge solenoid valve when all of the following conditions are met.
  — Fuel injection control is in the feedback zone or the high load volume increase zone.
  — Airflow passage damage related DTC is not stored.
  — Engine coolant temperature is 70 °C {158 °F} or more.

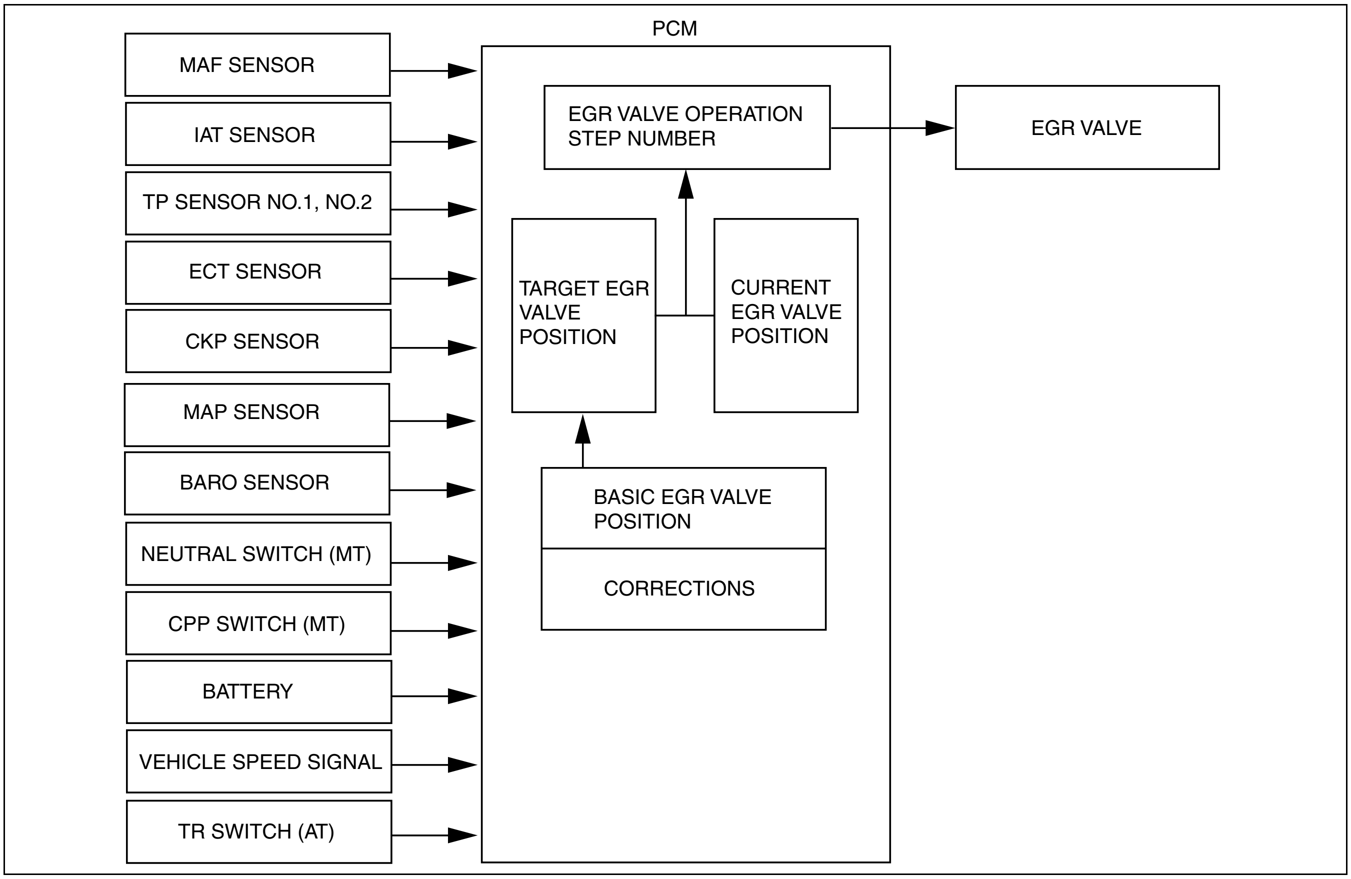
EGR CONTROL OUTLINE [LF]

E5U014000000N34

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

EGR CONTROL BLOCK DIAGRAM [LF]

E5U014000000N35



E5U140ZT5006

EGR CONTROL OPERATION [LF]

E5U014000000N36

Stepping Motor Operation Principles

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

Energization condition for each coil

ON: Energization, OFF: Non-energization

When current step number divided by eight	0	1	2	3	4	5	6	7
Coil No.1	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
Coil No.2	OFF	OFF	OFF	OFF	ON	ON	ON	OFF
Coil No.3	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
Coil No.4	ON	OFF	OFF	OFF	OFF	OFF	ON	ON

Example of energization condition for each coil and step number

ON: Energization, OFF Non-energization

Step number	0	1	2	3	4	5	6	7	8	9	10	30	52
Coil No.1	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
Coil No.2	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON
Coil No.3	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
Coil No.4	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	ON	OFF

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

Control Outline

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

Target EGR Valve Position

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

Target EGR valve position determination table

Contents		Method for calculating or determining the EGR valve position and correction
Basic EGR valve position		Within steps 0—52 in the stepping motor determined as follows: • When the engine speed is 1,200—4,200 rpm and the charging efficiency[*1] is within 12.5—75%, the engine speed and charging efficiency are determined to be at basic position • When the EGR control inhibition conditions are met, step 0
Correction[*2]	Engine coolant temperature correction	Purpose: Improved driveability **Engine coolant temperature is 50—55 °C {122—131 °F}** • The step number is restricted between 0—50% of the basic EGR valve position (low engine coolant temperature—low step number) according to the engine coolant temperature. **Engine coolant temperature is 55—65 °C {131—149 °F}** • The step number is restricted between 50—100% of the basic EGR valve position (low engine coolant temperature→low step number) according to the engine coolant temperature.
	Intake air temperature correction	Purpose: Improved driveability **Intake air temperature is 50 °C {122 °F} or less** • Step number is restricted to 100% of the basic EGR valve position (basic EGR valve position = step number) **Intake air temperature is 50 °C {122 °F} or more** • Step number is restricted between 40—100% of basic EGR valve position (low intake air temperature→large step number)
	Acceleration/ deceleration correction	Purpose: Improved driveability **During acceleration/deceleration, when the throttle valve opening angle fluctuation rate is the set value or more** • During acceleration→step number is restricted to 20% of basic EGR valve position • During deceleration→step number is restricted to 0% of basic EGR valve position

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

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

Inhibition Conditions

- To improve driveability and ensure exhaust emission performance, the EGR valve closes when any of the following conditions are met.
  - — When throttle valve is fully closed
  - — When vehicle is stopped
  - — When the fuel injection control is in the high volume increase zone
  - — The engine coolant temperature is 50 °C {122 °F} or less
  - — During deceleration
  - — Engine speed is less than 1,200 rpm or more than 4,200 rpm
  - — Charging efficiency is less than 12.5% or more than 75%
  - — During traction control

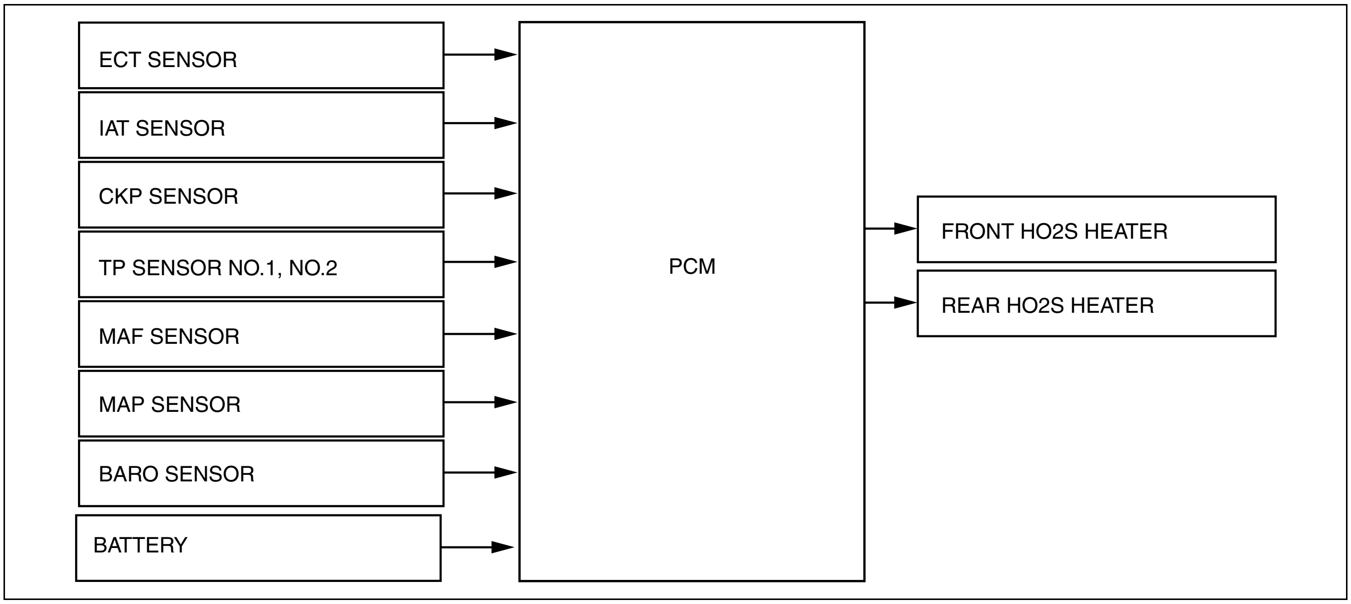
HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL OUTLINE [LF]

E5U014000000N40

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

HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL BLOCK DIAGRAM [LF]

E5U014000000N41



E5U140ZW5402

HEATED OXYGEN SENSOR (HO2S) HEATER CONTROL OPERATION [LF]

E5U014000000N42

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 –10 °C {14 °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 lengthen if the ECT falls below 0°C {32°F}. • ECT is –10 °C {14 °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.

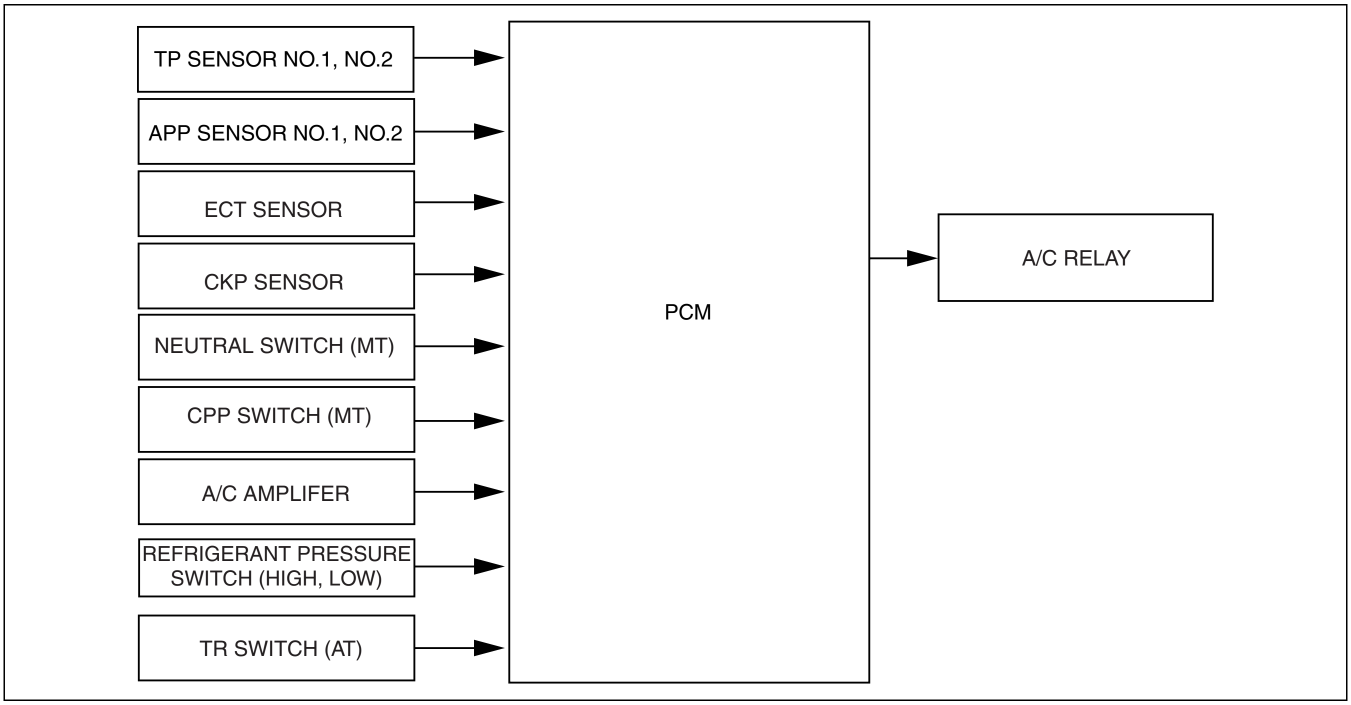
A/C CUT-OFF CONTROL OUTLINE [LF]

E5U014000000N43

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

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

E5U014000000N44



E5U140ZT5009

A/C CUT-OFF CONTROL OPERATION [LF]

E5U014000000N45

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

A/C cut-off control operation conditions

Operation condition	A/C relay non-energization period	Purpose
At engine start	Approx. 4 s	Improved startability
At drive-away	Approx. 3 s	Improved drive-away performance
During acceleration (throttle valve opening angle 50% or more)	Approx. 5 s	Improved acceleration performance
When the engine coolant temperature is 113 °C {235 °F}	Repeatedly turns on and off every 10 s until the engine coolant temperature is less than approx. 110 °C {230 °F}	Improved engine reliability
When the engine coolant temperature is 118 °C {245 °F} or more	Until the engine coolant temperature decreases to less than approx. 114 °C {237 °F}	Improved engine reliability
At high engine speed (engine speed 6,600 rpm or more)	Approx. 1 s	Improved engine speed stability

ELECTRICAL FAN CONTROL OUTLINE [LF]

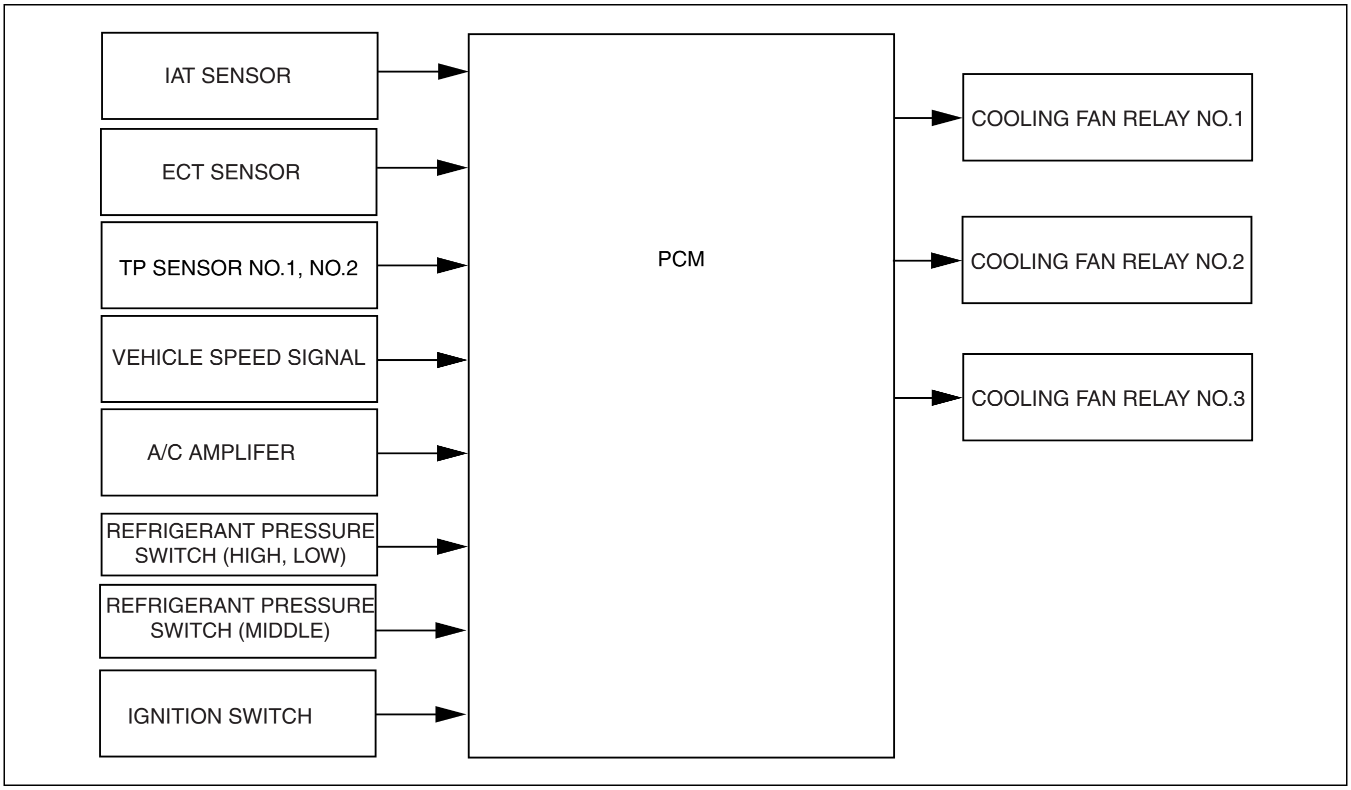
E5U014000000N46

- Through cooling of the radiator and condenser by operation of the cooling fan according to vehicle conditions, engine reliability and cooling performance have been improved.
- 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 01–40–11 MAIN RELAY CONTROL OPERATION [LF].)

ELECTRICAL FAN CONTROL BLOCK DIAGRAM [LF]

E5U014000000N47

- The PCM determines the engine operation conditions based on input signals from the sensors, and sends a signal to the cooling fan relay No.1, No.2, No.3.



E5U140ZT5010

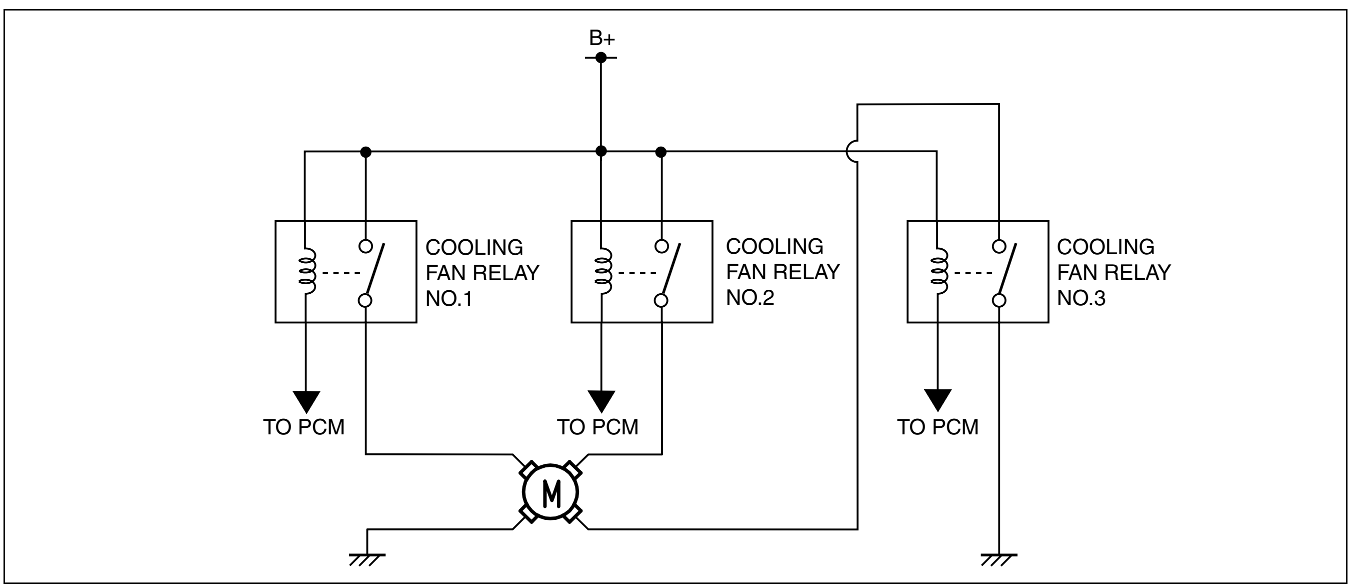
ELECTRICAL FAN CONTROL OPERATION [LF]

E5U014000000N48

- 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 three levels according to a combination of the cooling fan relays.
- The cooling fan motor operation switches in the order of stop, low speed, middle speed, and high speed, taking 3 s for each operation while regular-driving cooling.

Operation Conditions

<table>
<tr><th rowspan="2">Function</th><th colspan="4">Operation condition</th><th rowspan="2">Cooling fan motor rotation speed</th><th colspan="3">Cooling fan relay</th></tr>
<tr><th>ECT</th><th>A/C amplifier (A/C switch)</th><th>Refrigerant pressure switch (high, low)</th><th>Vehicle speed</th><th>No.1</th><th>No.2</th><th>No.3</th></tr>
<tr><td rowspan="8">Regular-driving cooling</td><td rowspan="5">Less than 100 °C {212 °F}</td><td>OFF</td><td colspan="2">—</td><td rowspan="2">Stop</td><td colspan="3" rowspan="2">OFF</td></tr>
<tr><td rowspan="4">ON</td><td rowspan="3">OFF</td><td>More than 70 km/h {44 mph}</td></tr>
<tr><td>45 —70 km/h {28—43 mph}</td><td>Low</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>Less than 45 km/h {27 mph}</td><td>Middle</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>ON</td><td>—</td><td>High</td><td colspan="3">ON</td></tr>
<tr><td rowspan="2">100—108 °C {213—226.4 °F}</td><td>OFF</td><td colspan="2" rowspan="2">—</td><td>Middle</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>ON</td><td rowspan="2">High</td><td colspan="3" rowspan="2">ON</td></tr>
<tr><td>More than 108 °C {227 °F}</td><td colspan="3">—</td></tr>
<tr><td rowspan="2">After-cooling</td><td colspan="4">• When all the following conditions are met:
— Ignition switch: OFF
— Estimated maximum engine coolant temperature is high after engine stop</td><td>Low</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="4">• When all the following conditions are met:
— Estimated maximum engine coolant temperature is the specified value or more even when operating at low rotation speed.</td><td>Middle</td><td>ON</td><td>OFF</td><td>ON</td></tr>
</table>



E5U140ZN5855

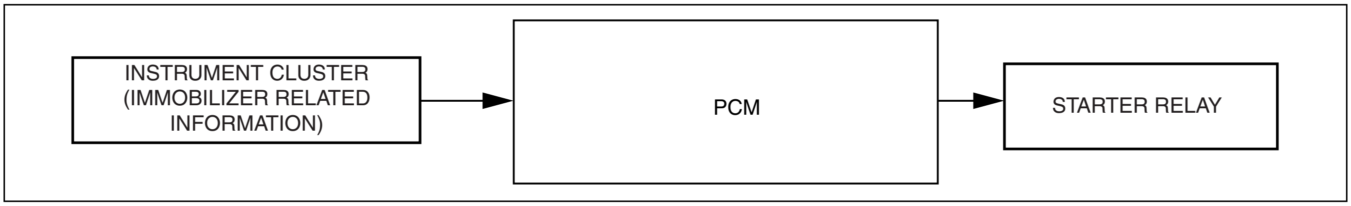
STARTER CUT-OFF CONTROL OUTLINE [LF]

E5U014000000N49

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

STARTER CUT-OFF CONTROL BLOCK DIAGRAM [LF]

E5U014000000N50



E5U140ZW5403

STARTER CUT-OFF CONTROL OPERATION [LF]

E5U014000000N51

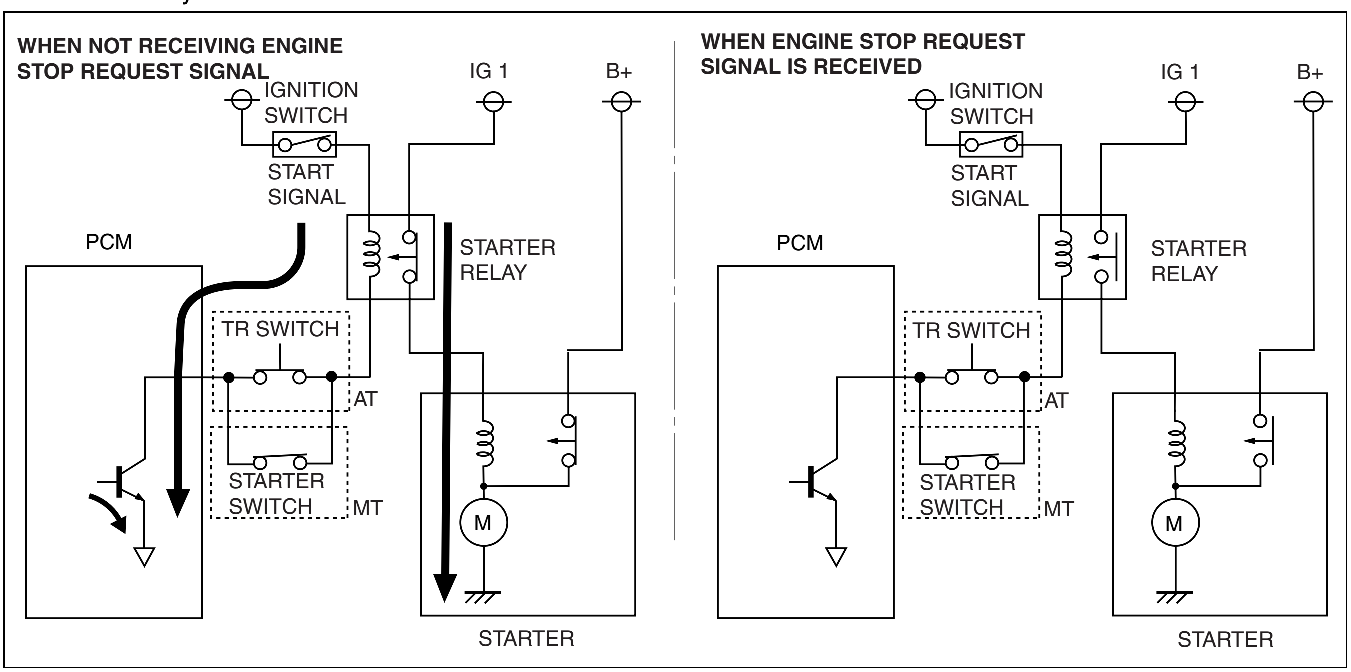
- The PCM stops energization of the starter relay according to an engine stop request from the immobilizer system.

  When receiving engine stop request signal

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

  When not receiving engine stop request signal

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



E5U140ZT5200

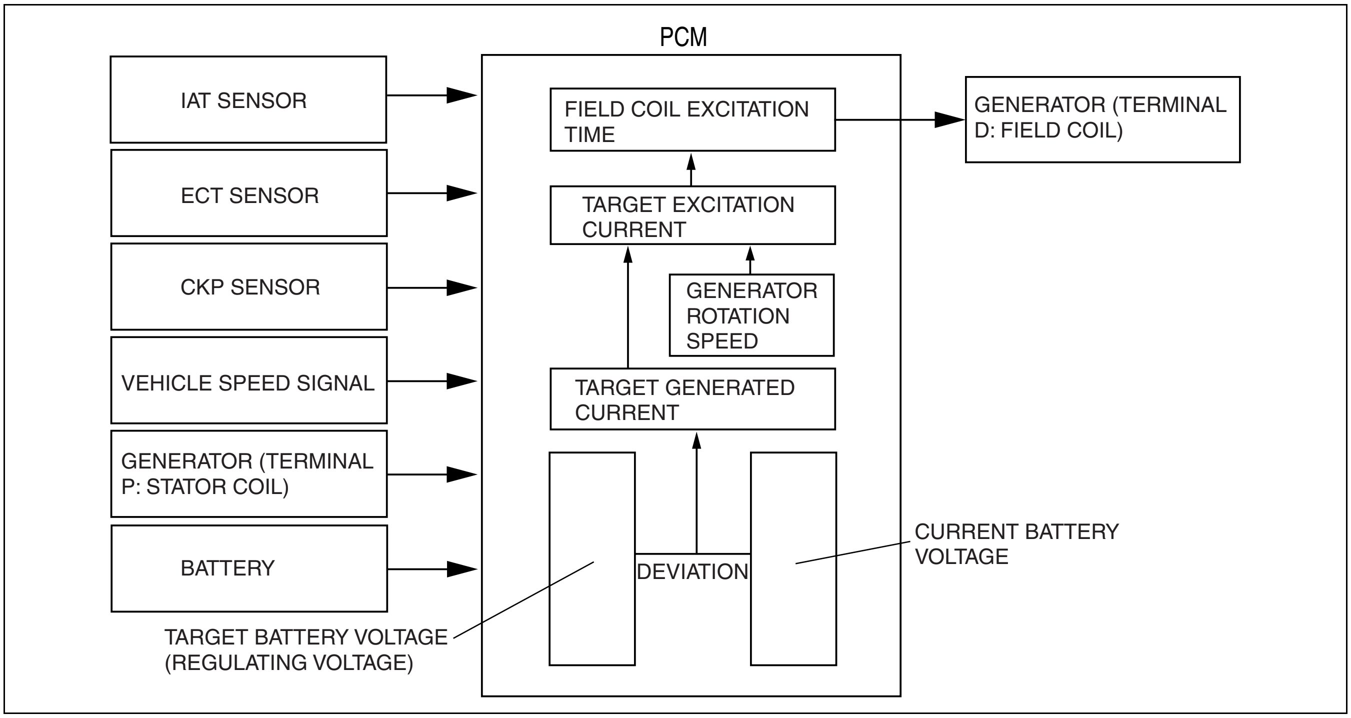
GENERATOR CONTROL OUTLINE [LF]

E5U014000000N52

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

GENERATOR CONTROL BLOCK DIAGRAM [LF]

E5U014000000N53



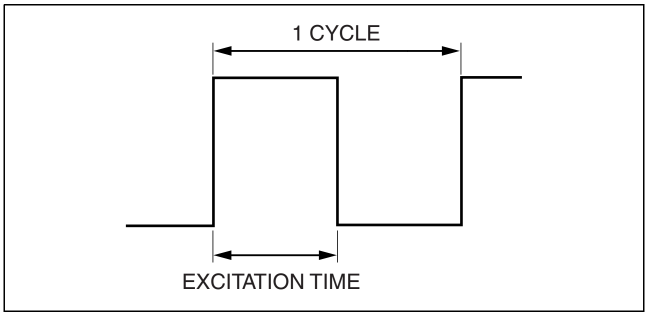
E5U140ZT5011

GENERATOR CONTROL OPERATION [LF]

E5U014000000N54

Determination of Field Coil Excitation Time

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



C3U0140S029

Control

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

CONTROLLER AREA NETWORK (CAN) OUTLINE [LF]

E5U014000000N55

- The PCM sends and receives data to and from other modules via the CAN system. Refer to Section 09 for a detailed explanation of the CAN. (See 09–40–2 CAN SYSTEM DESCRIPTION.)

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

Signal	Multiplex module					
	PCM	TCM	ABS HU/CM or DSC HU/CM	Keyless control module	Steering angle sensor	Instrument cluster
Engine speed	OUT	IN	IN (DSC)	IN	–	IN
Vehicle speed	OUT	IN	–	IN	–	IN
	IN	OUT		–		–
Engine coolant temperature	OUT	IN	–	–	–	IN
Engine torque	OUT	IN	IN (DSC)	–	–	–
Accelerator pedal position	OUT	IN	IN (DSC)	–	–	–
TP	OUT	IN	IN (DSC)	–	–	–
Intake air temperature	OUT	IN	–	–	–	–
Ignition timing	OUT	IN	–	–	–	–
Engine specification	OUT	–	IN	–	–	–
Brake pedal position	OUT	IN	–	–	–	–
Tire circumference (front/rear)	OUT	IN	IN	–	–	–
	IN	–	OUT			
Immobilizer related information	OUT	–	–	–	–	IN
	IN				–	OUT
Travelled distance	OUT	–	–	–	–	IN
	IN	OUT				–
Fuel injection amount	OUT	–	–	–	–	IN
MIL on request	OUT	–	–	–	–	IN
	–	OUT				
Generator warning light on request	OUT	–	–	–	–	IN
Cruise main/set indicator light on request	OUT	–	–	–	–	IN
AT gear position/selector lever position (AT)	IN	OUT	–	–	–	IN
ATF temperature (AT)	IN	OUT	–	–	–	–
Desired gear position (AT)	IN	OUT	IN (DSC)	–	–	–
TCC status (AT)	IN	OUT	IN (DSC)	–	–	–
AT warning light on request (AT)	IN	OUT	–	–	–	IN
Brake system status (EBD/ABS/DSC)	IN	–	OUT	–	–	–
Wheel speed (LF, RF, LR, RR)	IN	–	OUT	–	–	–
Brake system warning light on request	–	–	OUT	–	–	IN
ABS warning light on request	–	–	OUT	–	–	IN
DSC indicator light on request	–	–	OUT (DSC)	–	–	IN
DSC OFF light on request	–	–	OUT (DSC)	–	–	IN
Security light on request	–	–	–	OUT	–	IN
Steering angle sensor status	–	–	IN (DSC)	–	OUT	–
Fuel tank level	IN	–	–	–	–	OUT
Parking brake position	–	–	IN (DSC)	–	–	OUT

PCM FUNCTION [LF]

E5U014018880N01

Function List

- The control descriptions are as shown below.

Function	Description
Main relay control	When the ignition switch is turned to the ON position, the main relay turns on.
Drive-by-wire control	The drive-by-wire control calculates the optimum target throttle valve opening angle at all ranges of engine speeds and controls the throttle valve actuator.
Drive-by-wire relay control	Supplies power to the drive-by-wire control.
Variable intake air control	Switches energization of the variable shutter valve actuator according to engine speed to enhance the inertia charging effect.
Variable valve timing control	Changes the intake valve timing according to engine operation conditions to improve engine output, fuel economy and exhaust emission performance.
Fuel injection control	Performs optimum fuel injection according to engine operation conditions.
Fuel pump control	Performs energization of the fuel pump relay only when the engine is running (operates fuel pump) to improve stability and durability.
ESA control	Controls ignition to optimum timing according to engine operation conditions.
Evaporative purge control	An appropriate amount of evaporative gas is fed into the dynamic chamber by the driving of the purge solenoid valve according to the engine operation conditions to ensure driveability and prevent release of fuel vapor gas into the atmosphere.
EGR control	Adjusts the EGR to the optimum opening angle according to engine operation conditions.
HO2S heater control	Based on the control of the front and rear HO2S heater, a stabilized oxygen concentration is detected even at low exhaust gas temperature and feedback control of fuel injection even during cold engine start is made possible for improved cold temperature emission performance.
A/C cut-off control	The current application (energize/non-energize) to the A/C relay (magnetic clutch) is controlled according to the engine operation conditions to prevent deterioration of engine performance, damage to the engine, and deterioration of the A/C function.
Electrical fan control	Through cooling of the radiator and condenser by operation of the cooling fan according to vehicle conditions, engine reliability and cooling performance have been improved.
Starter cut-off control	Theft deterrence has been improved by controlling energization to the starter relay according to an engine stop request signal from the immobilizer system.
Generator control	Generator output is optimized according to the engine operation and electrical load conditions, ensuring idling stability and anti-load performance.
CAN	Used for communication with the EHPAS control module, ABS HU/CM, instrument cluster and DLC-2.

PCM CONSTRUCTION/OPERATION [LF]

E5U014018880N02

Structure

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

NEUTRAL SWITCH FUNCTION [LF]

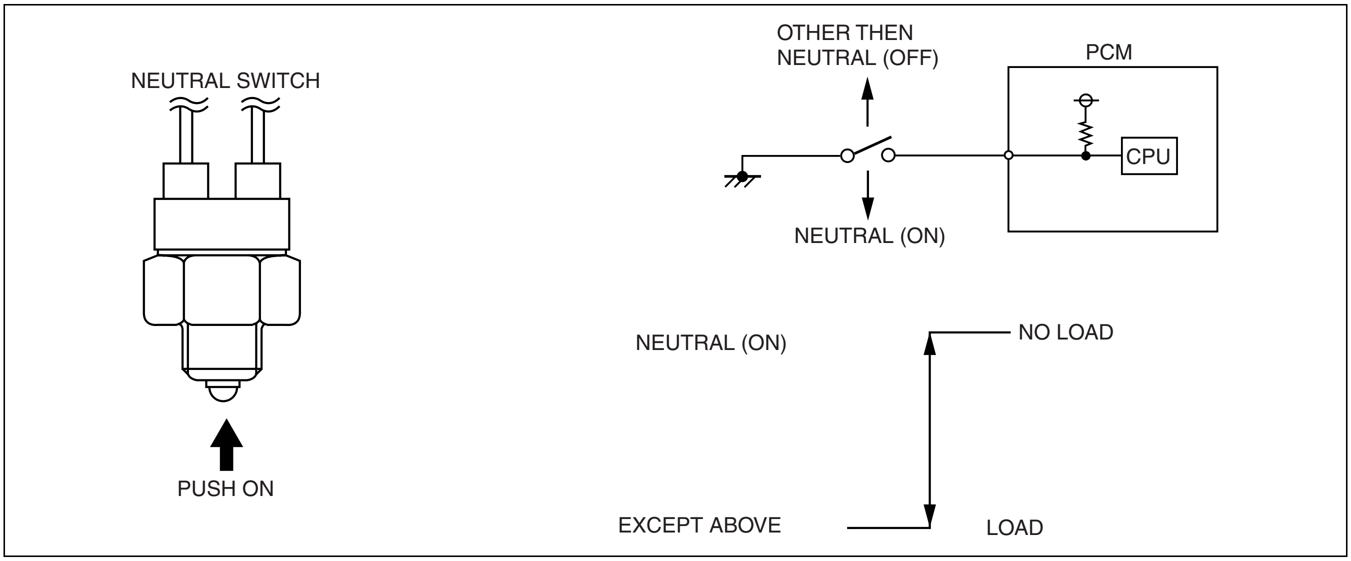
E5U014017640N01

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

NEUTRAL SWITCH CONSTRUCTION/OPERATION [LF]

E5U014017640N02

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



C3U0140S030

CLUTCH PEDAL POSITION (CPP) SWITCH FUNCTION [LF]

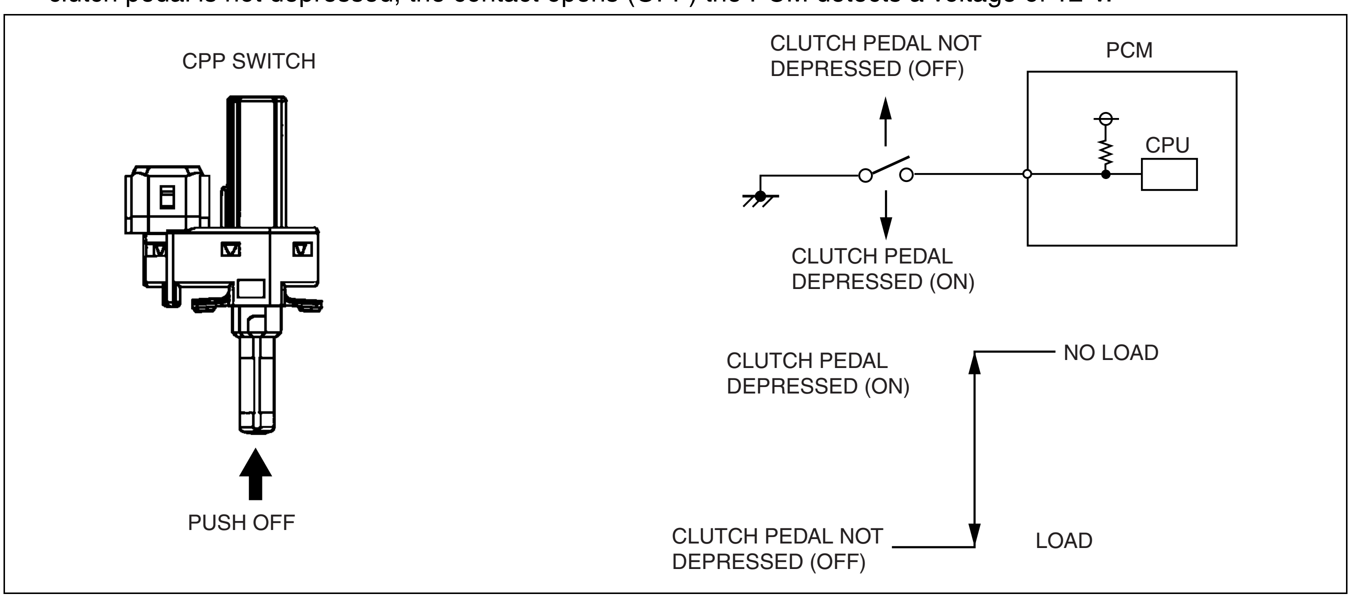
E5U014018660N01

- 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 [LF]

E5U014018660N02

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



C3U0140S031

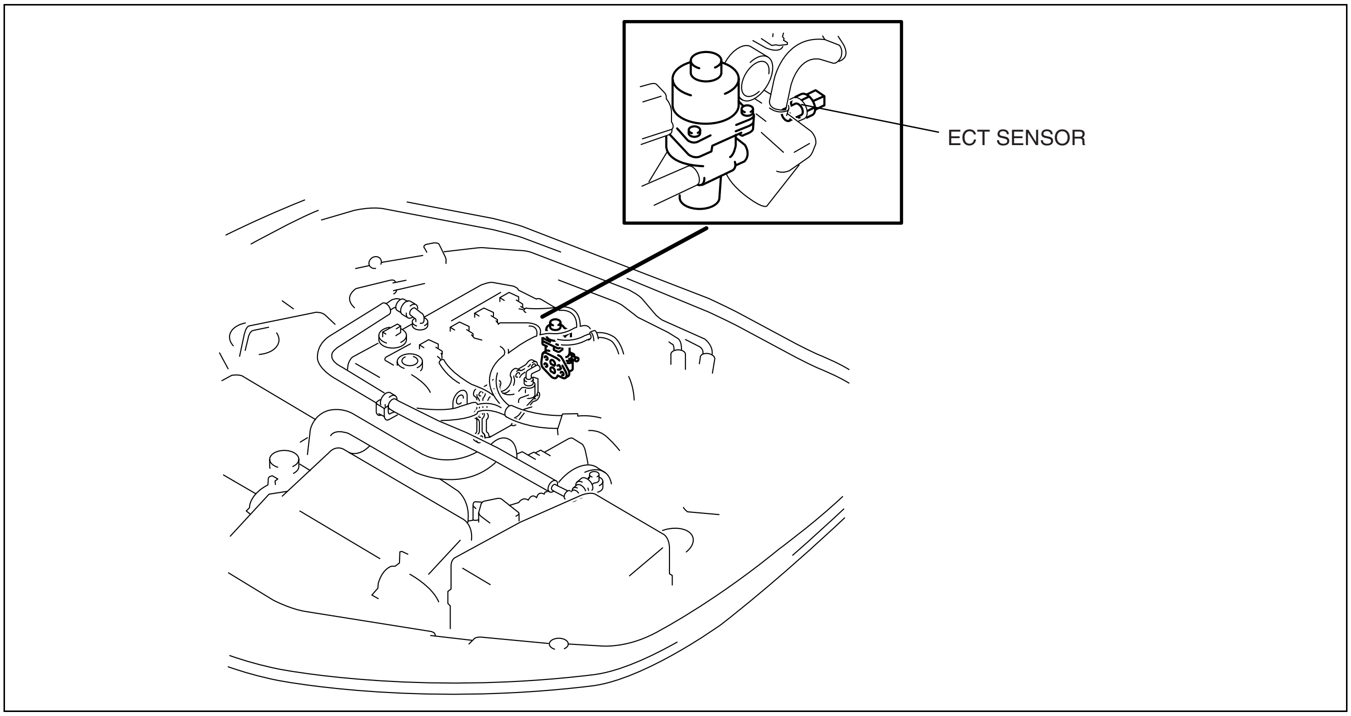
ENGINE COOLANT TEMPERATURE (ECT) SENSOR FUNCTION [LF]

E5U014018841N01

- Detects the engine coolant temperature.

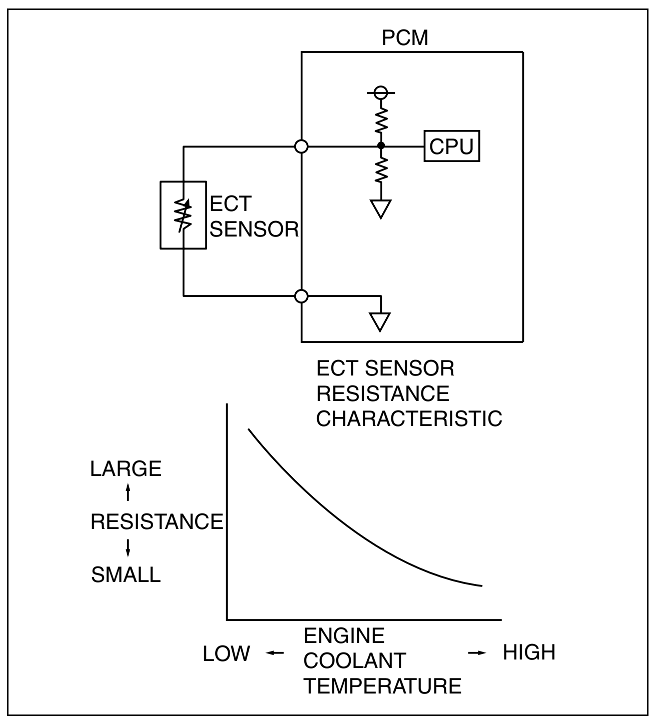
ENGINE COOLANT TEMPERATURE (ECT) SENSOR CONSTRUCTION/OPERATION [LF]

E5U014018841N02



E5U140ZN5201

- Installed on the water outlet.
- The ECT is a thermistor type, the resistance changes according to the engine coolant temperature.
- The resistance decreases if the engine coolant temperature increases, and increases if the engine coolant temperature decreases.



C3U0140S033

INTAKE AIR TEMPERATURE (IAT) SENSOR FUNCTION [LF]

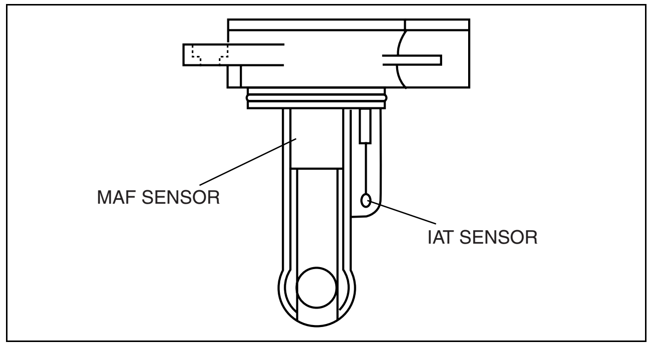
E5U014018842N01

- Detects air temperature inducted in the engine.

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

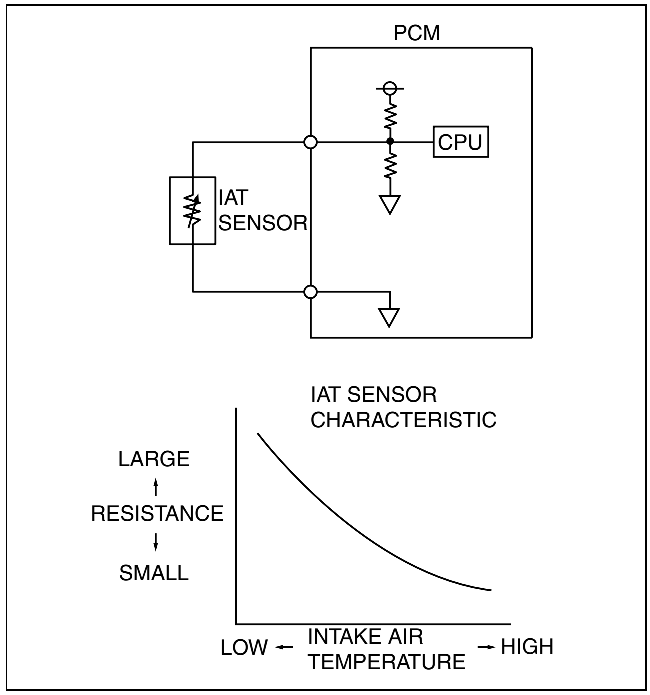
E5U014018842N02

- Built into the MAF sensor.



C3U0140S034

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



E5U140ZT5012

CRANKSHAFT POSITION (CKP) SENSOR FUNCTION [LF]

E5U014018220N01

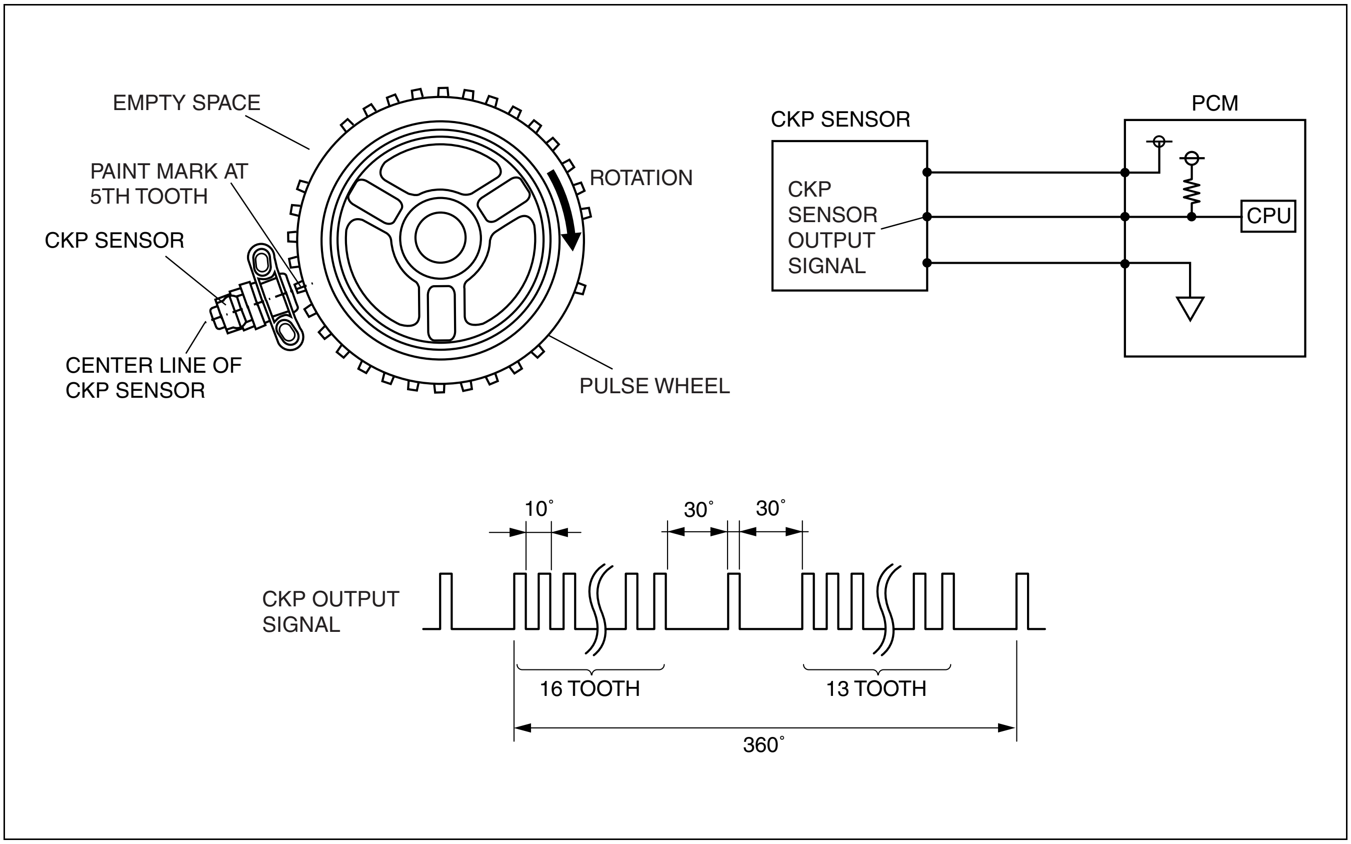
- Detects the pulse wheel rotation pulse as the engine crank angle signal.

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

E5U014018220N02

- The CKP sensor is installed on the engine front cover.
- The crankshaft position sensor pulse wheel has 30 projections with 10 ° of crank angle between the rising edge of each projection.
- The crankshaft position sensor consists of a Hall element with a magnetic sensor, and a processing circuit that performs signal amplification and identification.
- The projections on the plate installed to the crankshaft pulley cause a change in the magnetic flux when they pass near the magnetic sensor of the CKP sensor by the rotation of the crankshaft. The CKP sensor converts the change in magnetic flux to a digital waveform (rectangular waves) by the processing circuit. The PCM detects the engine speed and crankshaft position based on the crankshaft position waveforms.

01–40



E5U140ZT5013

CAMSHAFT POSITION (CMP) SENSOR FUNCTION [LF]

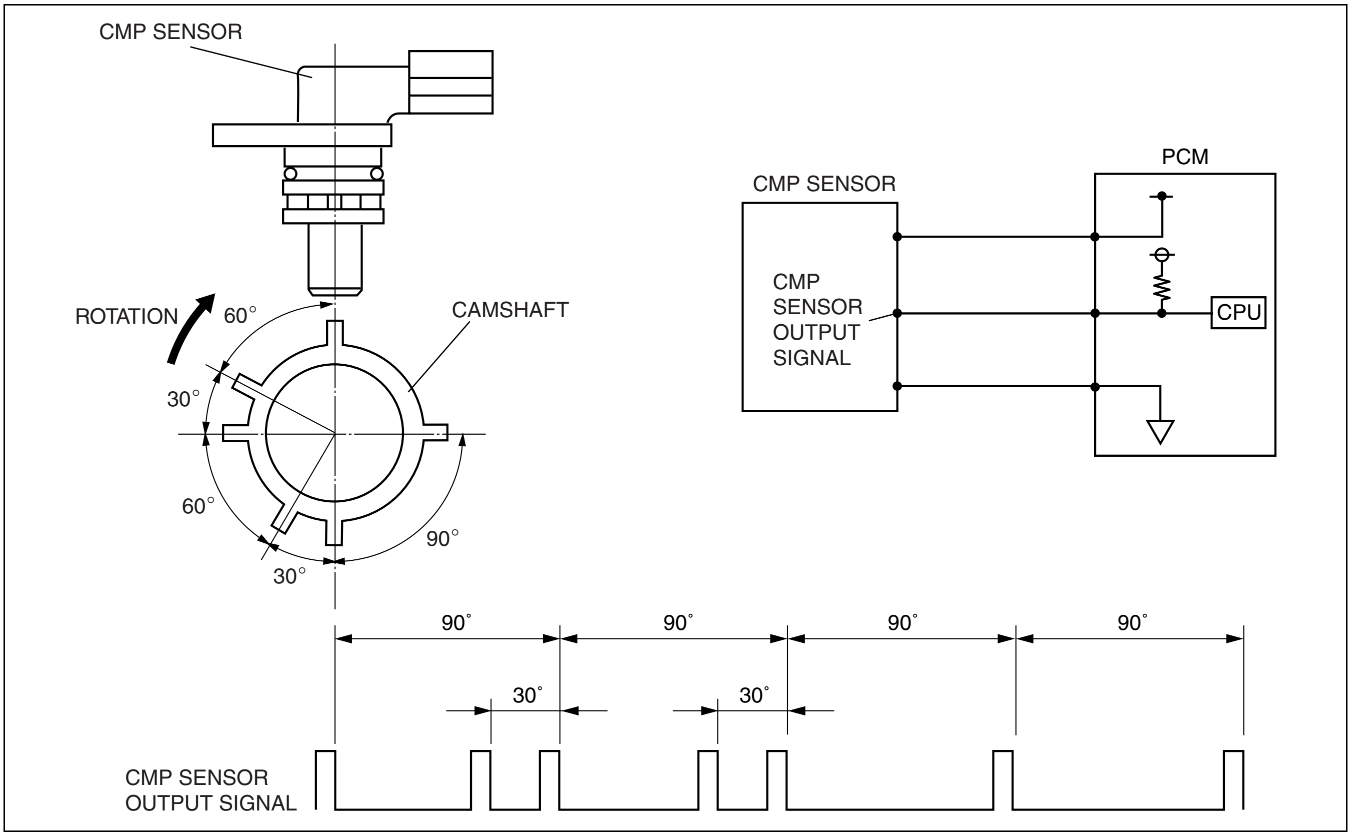
E5U014018230N01

- Detects the rotation angle of the intake-side camshaft.

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

E5U014018230N02

- Installed on the engine head cover.
- Six pulses per one camshaft rotation are detected by a wide projection and a narrow projection installed on the intake air side camshaft.
- The camshaft position sensor consists of a Hall element with a magnetic sensor, and a processing circuit that performs signal amplification and identification.
- The projections on the camshaft cause a change in the magnetic flux when they pass near the magnetic sensor of the CMP sensor by the rotation of the camshaft. The CMP sensor converts the change in magnetic flux to a digital waveform (rectangular waves) by the processing circuit. The PCM detects the engine speed and camshaft position based on the camshaft position waveforms.



E5U140ZT5660

THROTTLE POSITION (TP) SENSOR FUNCTION [LF]

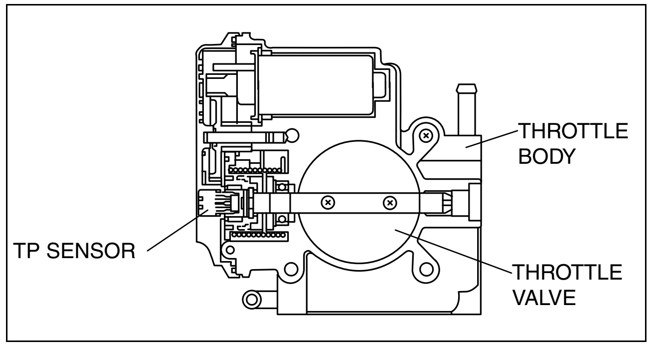
E5U014018910N01

- Detects the throttle valve opening angle.

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

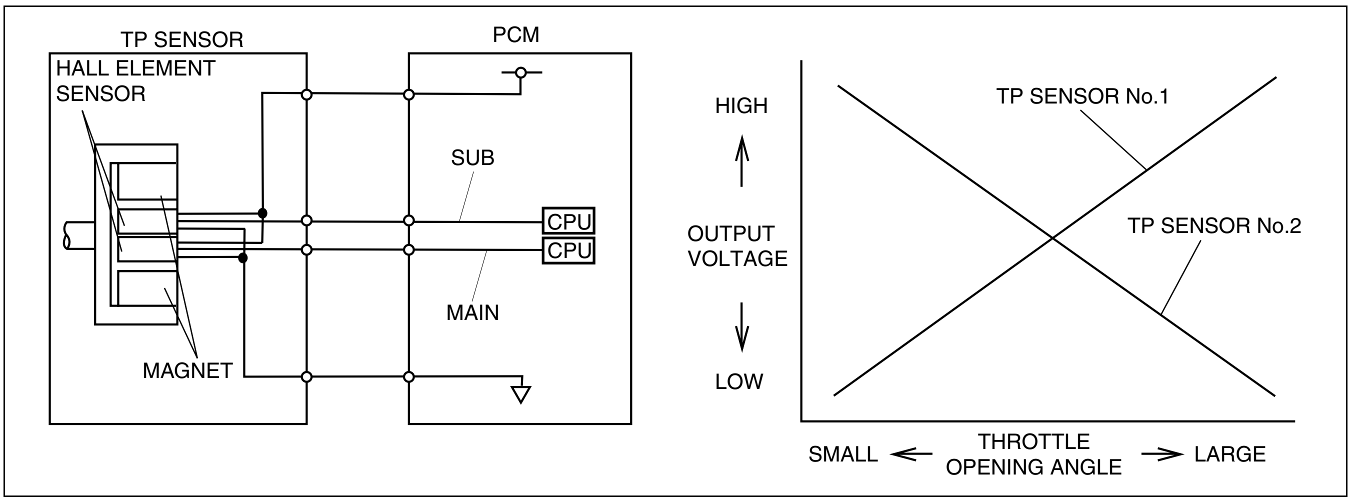
E5U014018910N02

- 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.



E5U140ZN5853

- 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.



E5U140ZN5854

ACCELERATOR PEDAL POSITION (APP) SENSOR FUNCTION [LF]

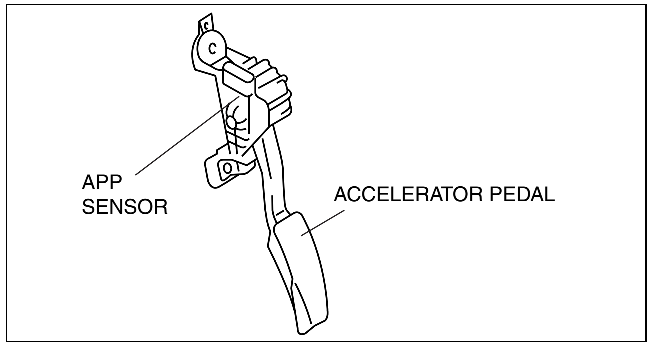
E5U014041609N01

- Detects how much the accelerator pedal is depressed.

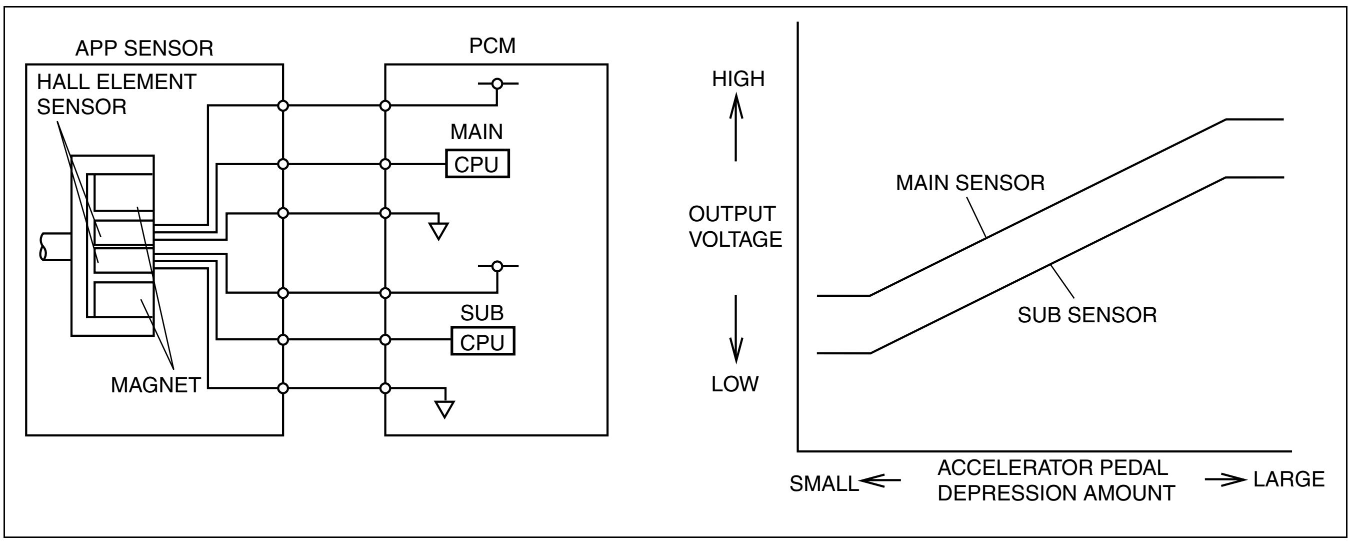
ACCELERATOR PEDAL POSITION (APP) SENSOR CONSTRUCTION/OPERATION [LF]

E5U014041609N02

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



E5U140ZW5306



CHU0140S057

MASS AIR FLOW (MAF) SENSOR FUNCTION [LF]

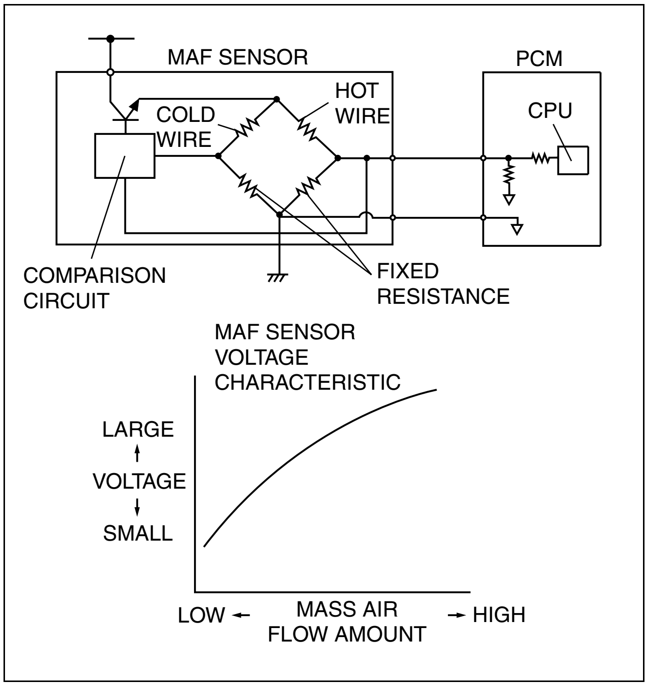
E5U014013215N01

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

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

E5U014013215N02

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



E5U140ZN5852

HEATED OXYGEN SENSOR (HO2S) FUNCTION [LF]

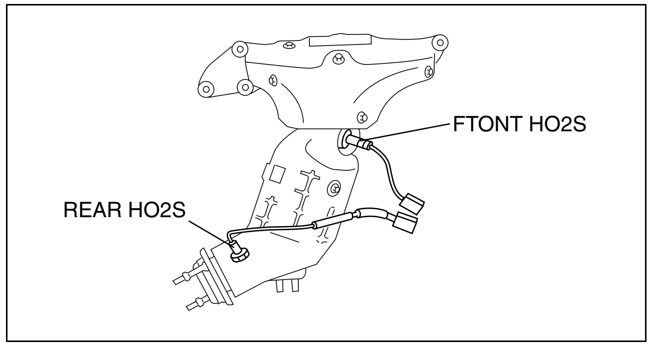
E5U014018860N01

- Front HO2S: 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.
- Rear HO2S: detects the oxygen concentration in the exhaust gas.
- A heater has been adopted, allowing stable detection of the oxygen concentration even when the exhaust gas temperature is low.

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

E5U014018860N02

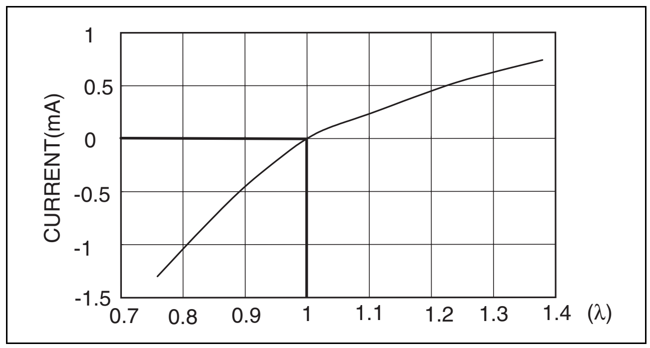
- Installed on the front of the WU-TWC, and back of the TWC.



E5U140ZW5307

Front HO2S

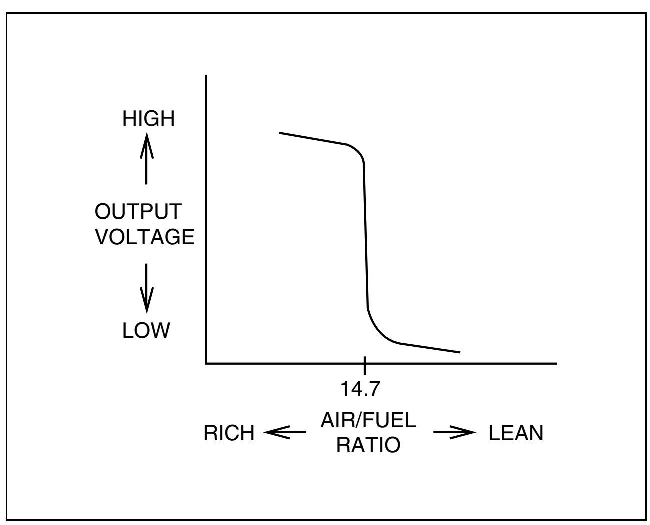
- The wide-range air/fuel ratio sensor is a limited current type sensor, and can detect the oxygen concentration (air/fuel ratio of the air-fuel mixture) in the exhaust gas in all ranges, from lean to rich.
- A heater is built into the sensor to facilitate the activation of the HO2S at engine startup (when the exhaust gas temperature is low).
- 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)/14.7



E5U140ZN5851

Rear HO2S

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



CHU0140S075

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR FUNCTION [LF]

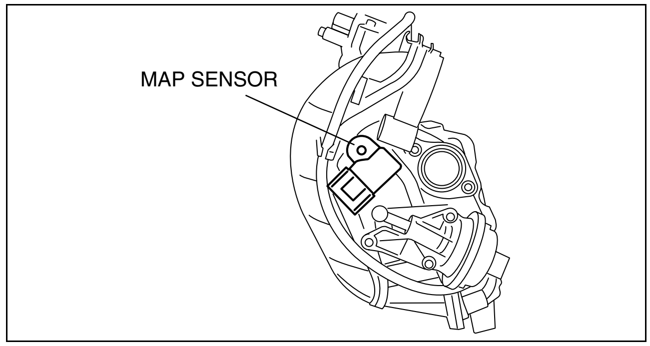
E5U014018210N01

- Detects intake air pressure in the intake manifold.

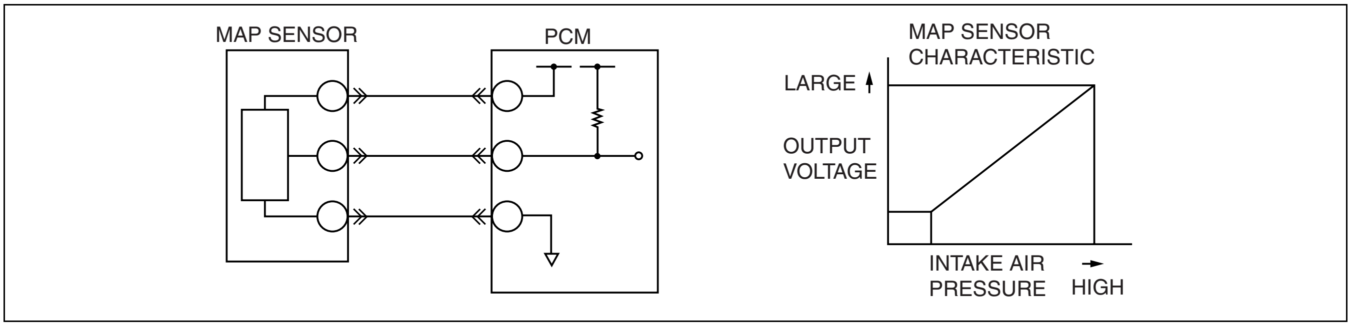
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CONSTRUCTION/OPERATION [LF]

E5U014018210N02

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



E5U140ZW5308



C3U0140S049

01–40

BAROMETRIC PRESSURE (BARO) SENSOR FUNCTION [LF]

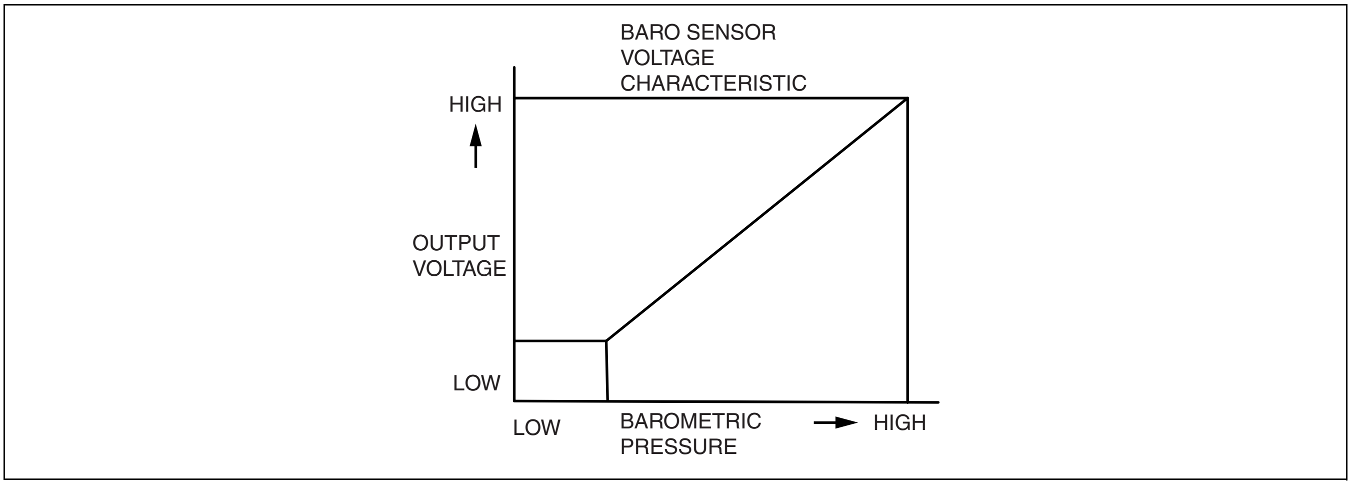
E5U014018211N01

- Detects the BARO.

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

E5U014018211N02

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



E5U140ZW5404

KNOCK SENSOR (KS) FUNCTION [LF]

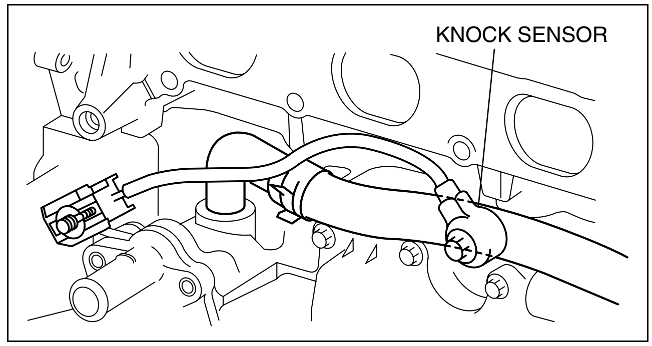
E5U014018920N01

- Detects abnormal combustion in the engine.

KNOCK SENSOR (KS) CONSTRUCTION/OPERATION [LF]

E5U014018920N02

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



E5U140ZW5309

SUSPENSION

02
SECTION

02–00 OUTLINE

SUSPENSION ABBREVIATIONS

E5U020000000N01

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

E5U020000000N02

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 • Aluminum front upper arm and aluminum front lower arm 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 mounting system adopted • Zero-stopper-clearance bushings adopted • Roll axis position optimized • Gas-filled monotube shock absorbers 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
Improved safety	• Run-flat tire adopted for standard suspension equipped with 17-inch wheel and tire
Tire condition maintenance assistance	• Tire pressure monitoring system (TPMS) adopted • The flat tire warning function as well as TPMS have been adopted for vehicles with run-flat tires.

SUSPENSION SPECIFICATIONS

E5U020000000N03

Suspension

Item					Specification	
					Vehicle equipped with 16-inch wheel and tire	Vehicle equipped with 17-inch wheel and tire
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})	21.0 {0.83}	
	Wheel alignment (Unloaded*)	Total toe-in	Tire [Tolerance ±4 {0.15}]	(mm {in})	2 {0.08}	
			Rim inner		1.2±2.4 {0.05±0.09}	1.4±2.8 {0.06±0.11}
				Degree	0°11′±21′	
		Maximum steering angle [Tolerance ±3°]		Inner	38°42′	
				Outer	32°54′	
		Caster angle (Reference) [Tolerance ±1°]			5°59′	6°06′
		Caster angle (Reference) [Tolerance ±1°]			-0°07′	-0°15′
		Steering axis inclination (Reference)			10°39′	10°47′
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})	11.0 {0.43}	Standard suspension: 11.0 {0.43} Sport suspension: 12.0 {0.47}
	Wheel alignment (Unloaded*)	Total toe-in	Tire [Tolerance ±4 {0.15}]	(mm {in})	3 {0.12}	
			Rim inner		1.8±2.4 {0.071±0.094}	2.2±2.8 {0.083±0.110}
				Degree	0°17′±22′	
		Camber angle [Tolerance ±1°]			-1°04′	-1°11′

* : 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		205/50R16 87V	205/45R17 84W
Wheel	Size		16 x 6 1/2J	17 x 7J
	Material		Aluminum alloy	
	Offset	(mm {in})	55 {2.17}	
	Pitch circle diameter	(mm {in})	114.3 {4.50}	

02–02 ON-BOARD DIAGNOSTIC

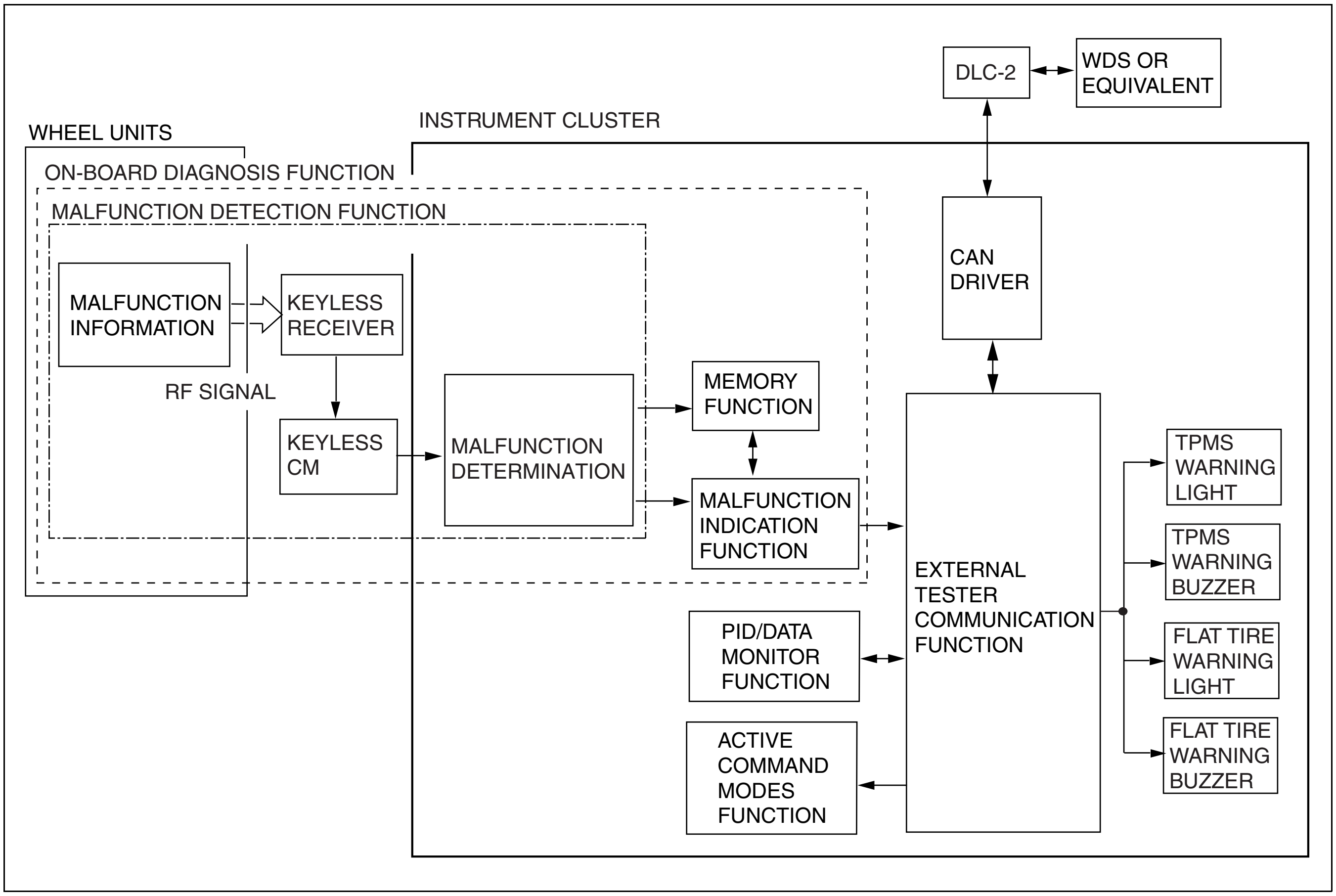
ON-BOARD DIAGNOSTIC SYSTEM OUTLINE (TIRE PRESSURE MONITORING SYSTEM)

E5U020237020N01

- The on-board diagnostic system consists of a malfunction detection system that detects abnormalities in input/output signals when the ignition switch is at the ON position, a data monitor function that reads out specified input/output signals, and an active command modes function that execuse the wheel unit ID registration.
- The Data Link Connector 2 (DLC-2), which groups together all the connectors used for malfunction diagnosis into a single location, has been adopted, thereby improving serviceability. Diagnosis is performed by connecting the 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.

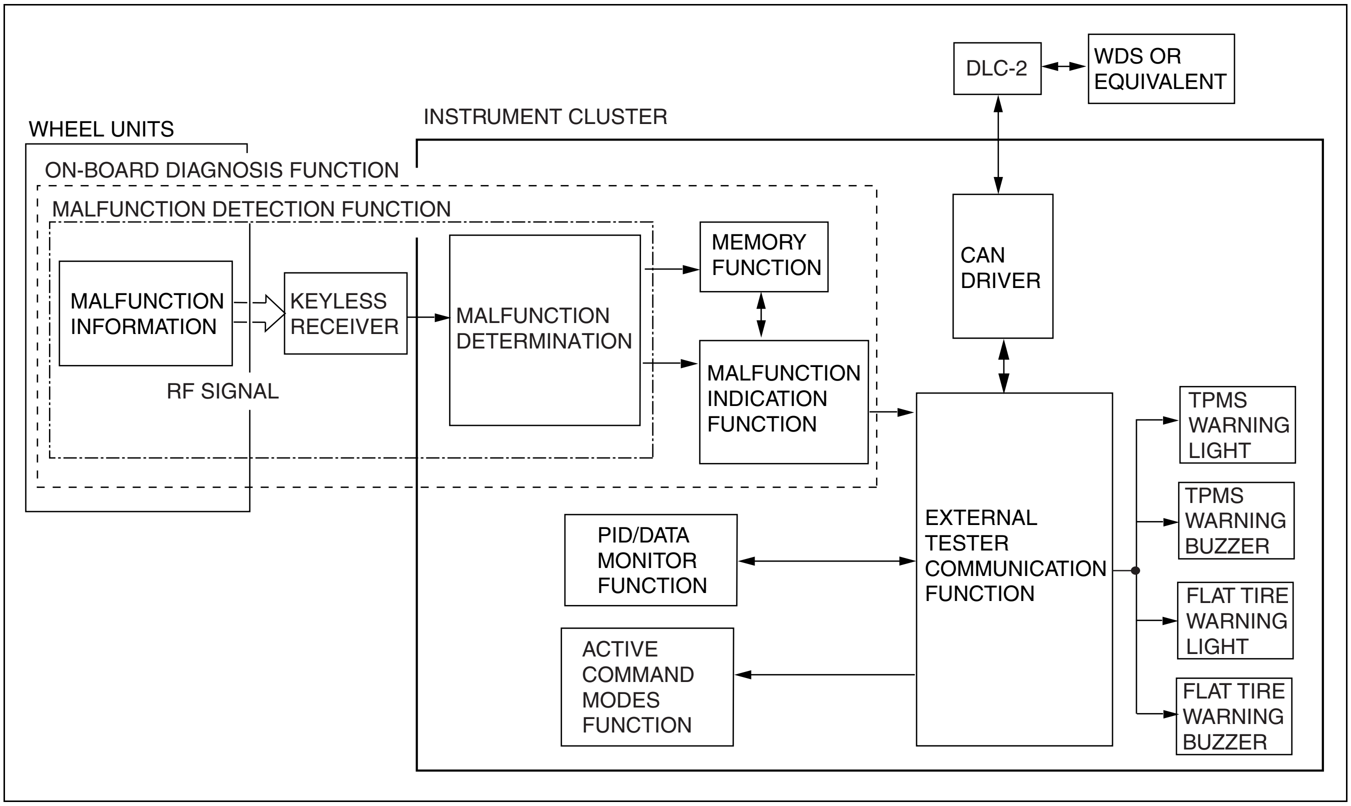
Block Diagram

With advanced keyless system or keyless entry system



E5U202ZS5001

Without advanced keyless system and keyless entry system



E5U202ZS5003

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

E5U020237020N02

Malfunction Detection Function

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

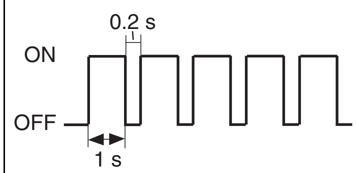
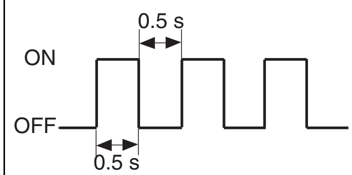
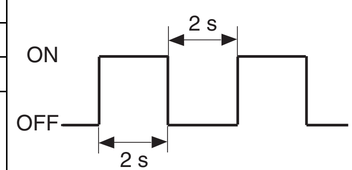
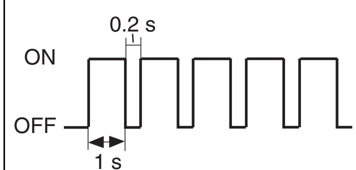
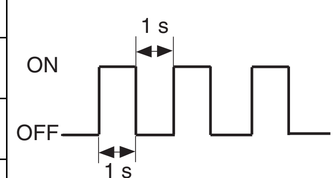
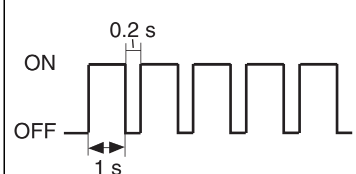
Malfunction Indication Function

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

Memory Function

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

DTC Table

Malfunction location	DTC (WDS or equivalent)	TPMS warning light illumination condition	TPMS warning light illumination pattern
Instrument cluster	B1342	Illuminated	
System configuration malfunction	B2477	Illuminated	
Wheel unit 1 internal fault	B2868	Illuminated	
Wheel unit 2 internal fault	B2869	Illuminated	
Wheel unit 3 internal fault	B2870	Illuminated	
Wheel unit 4 internal fault	B2871	Illuminated	
Non-volatile memory failure	B2143	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	
Lost communication with keyless receiver	U0127	Illuminated	

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

E5U020237020N03

- 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)
AI_WU1_ID	Candidate wheel unit during registering wheel unit ID	–
AI_WU_P	Tire pressure during registering wheel unit ID	Pa/psi
FFD1_WU1_P	Freeze frame PID data1_tire pressure (wheel unit 1)	Pa/psi
FFD1_WU2_P	Freeze frame PID data1_tire pressure (wheel unit 2)	Pa/psi
FFD1_WU3_P	Freeze frame PID data1_tire pressure (wheel unit 3)	Pa/psi
FFD1_WU4_P	Freeze frame PID data2_tire pressure (wheel unit 4)	Pa/psi
FFD2_WU1_P	Freeze frame PID data2_tire pressure (wheel unit 1)	Pa/psi
FFD2_WU2_P	Freeze frame PID data2_tire pressure (wheel unit 2)	Pa/psi
FFD2_WU3_P	Freeze frame PID data2_tire pressure (wheel unit 3)	Pa/psi
FFD2_WU4_P	Freeze frame PID data2_tire pressure (wheel unit 4)	Pa/psi
FFD1_WU1_T	Freeze frame PID data1_tire temperature (wheel unit 1)	°C/°F
FFD1_WU2_T	Freeze frame PID data1_tire temperature (wheel unit 2)	°C/°F
FFD1_WU3_T	Freeze frame PID data1_tire temperature (wheel unit 3)	°C/°F
FFD1_WU4_T	Freeze frame PID data2_tire temperature (wheel unit 4)	°C/°F
FFD2_WU1_T	Freeze frame PID data2_tire temperature (wheel unit 1)	°C/°F
FFD2_WU2_T	Freeze frame PID data2_tire temperature (wheel unit 2)	°C/°F
FFD2_WU3_T	Freeze frame PID data2_tire temperature (wheel unit 3)	°C/°F
FFD2_WU4_T	Freeze frame PID data2_tire temperature (wheel unit 4)	°C/°F
FFD1_MLG	Freeze frame PID data1 mileage	m/mi (ft)
FFD2_MLG	Freeze frame PID data2 mileage	m/mi (ft)
FFD1_SPD	Freeze flame PID data1_speed	KPH/MPH
FFD2_SPD	Freeze flame PID data2_speed	KPH/MPH
IC_DTC_CNT	Number of continuous DTCs	–
ID_WU1*	Registered wheel unit ID (Wheel unit 1)	–
ID_WU2*	Registered wheel unit ID (Wheel unit 2)	–
ID_WU3*	Registered wheel unit ID (Wheel unit 3)	–
ID_WU4*	Registered wheel unit ID (Wheel unit 4)	–
IC_VPWR	Module supply voltage	V
ID_LAST	Last received tire transmitter ID code value	–
WU1_P*	Tire pressure (wheel unit 1)	Pa/psi
WU2_P*	Tire pressure (wheel unit 2)	Pa/psi
WU3_P*	Tire pressure (wheel unit 3)	Pa/psi
WU4_P*	Tire pressure (wheel unit 4)	Pa/psi
WU1_T*	Tire temperature (wheel unit 1)	°C/°F
WU2_T*	Tire temperature (wheel unit 2)	°C/°F
WU3_T*	Tire temperature (wheel unit 3)	°C/°F
WU4_T*	Tire temperature (wheel unit 4)	°C/°F

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

ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION (TIRE PRESSURE MONITORING SYSTEM)

E5U020237020N06

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

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

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

E5U020237020N07

- The Freeze Frame Data monitor items are shown below.

Freez frame data monitor table

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

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

E5U020237020N04

External Tester Communication Function

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

Connection and communication information

	External tester	
	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
Active command modes 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 instrument cluster via the CAN communication line.
- The instrument cluster 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.

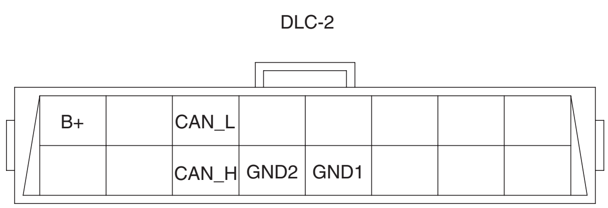
Diagnostic function	Signal received	Signal sent
Malfunction detection function	DTC verification signal	DTC
PID/Data monitor function	Request signal to read selected monitor item	Monitor information for requested monitor item
Active command modes function	Operation command signal for selected active command modes item	Wheel unit ID registration

02–02

DLC-2 CONSTRUCTION

E5U020237020N05

- 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

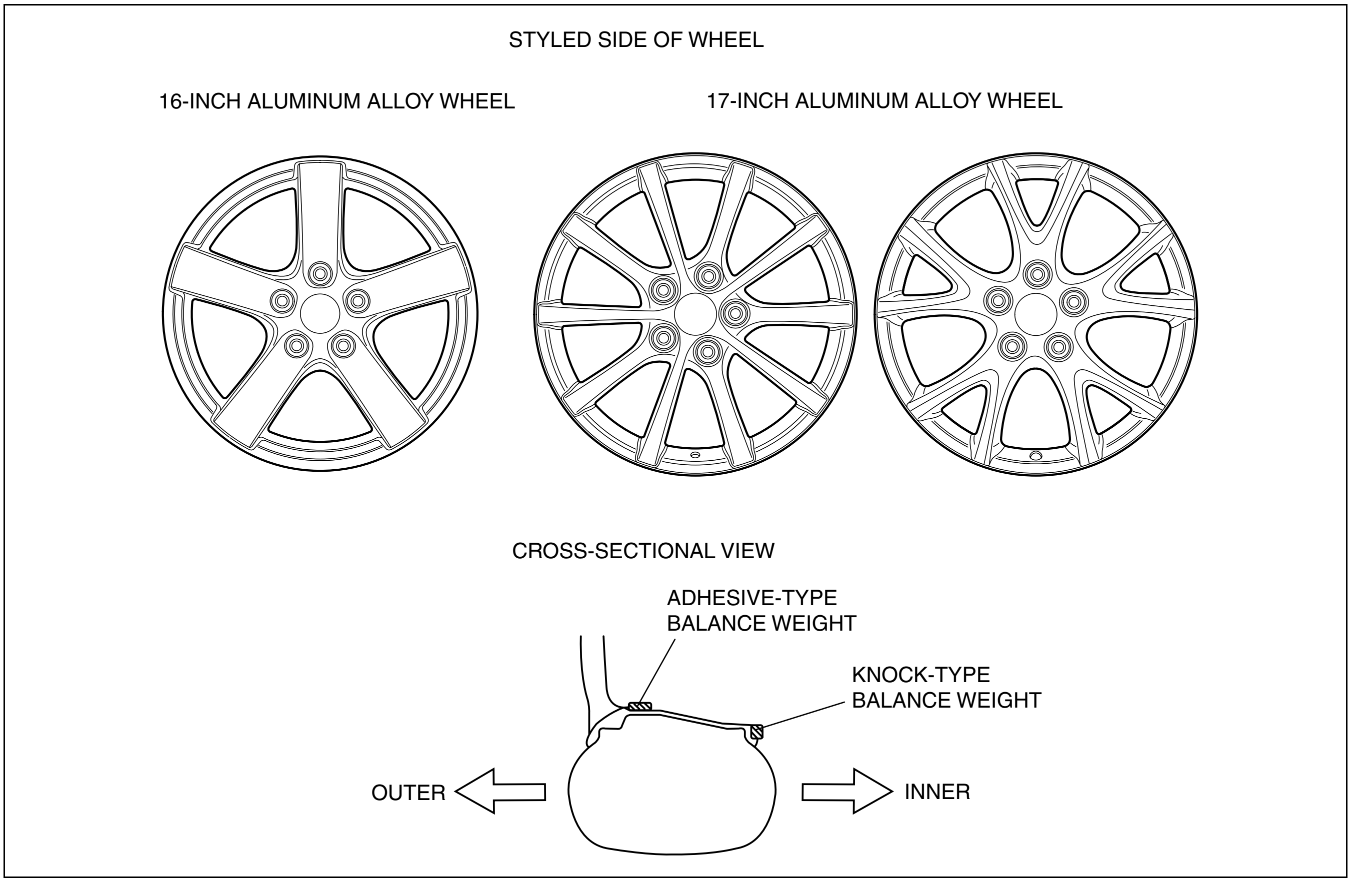
WHEELS AND TIRES OUTLINE

E5U021200000N01

- 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.
- A repair agent has been equipped instead of a spare tire. This results in an enlarged trunk compartment and reduced vehicle weight.
- Run-flat tires have been adopted for improved safety.

WHEELS AND TIRES STRUCTURAL VIEW

E5U021200000N02

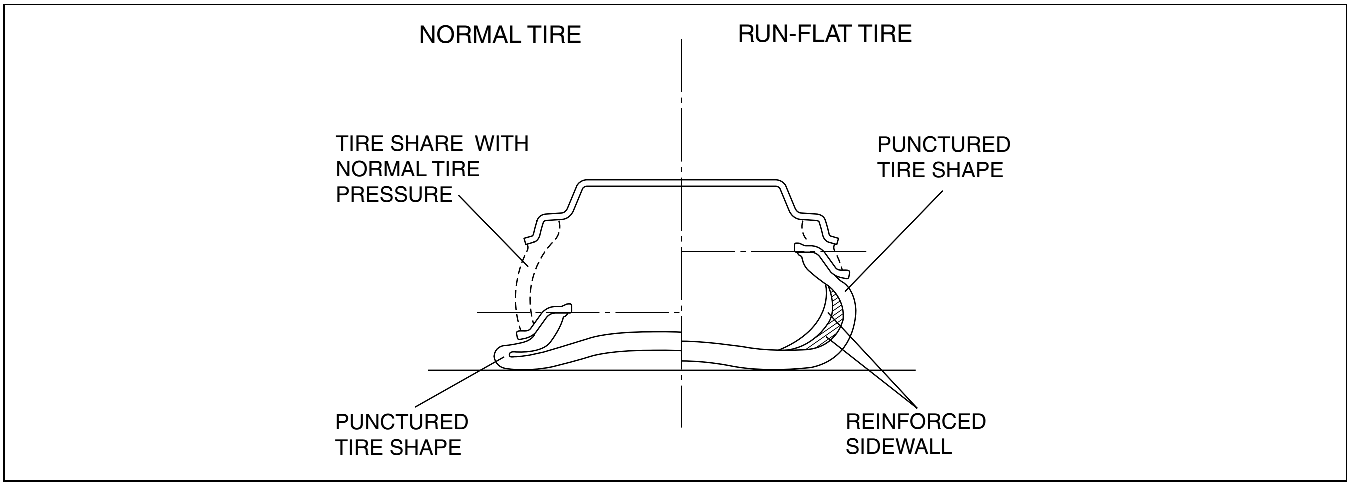


E5U212ZS5001

RUN-FLAT TIRES OUTLINE

E5U021200000N03

- Because the run-flat tire sidewalls have been reinforced, vehicles with run-flat tires can be driven for **80 km {49.6 mile}** at **89 km/h {55.2 MPH}** even with air leakage caused by tire damage. As a result, safety is ensured even when the vehicles has a flat tire.



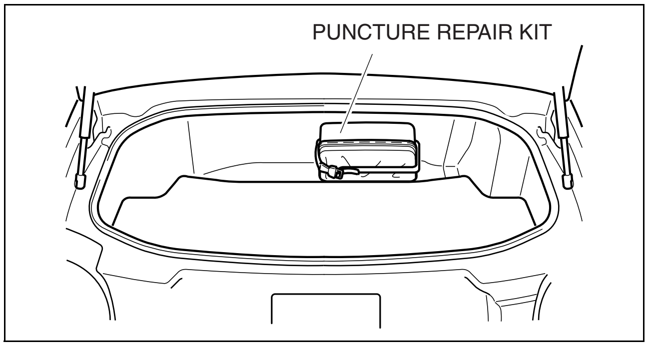
E5U212ZS5008

- Because a spare tire is not necessary, the vehicle weight has been reduced and fuel economy has been improved.
- The flat tire warning function has been added to the TPMS on vehicles with run-flat tires to inform the driver of a puncture.

PUNCTURE REPAIR KIT OUTLINE

E5U021237100N01

- An emergency puncture repair kit has been provided for the vehicle not equipped with the run-flat tire 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 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 (12 V DC) is used as an input power source for the air compressor and the compressor plug includes a 10 A fuse.



E5U212ZW5007

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

E5U021237020N01

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

Caution

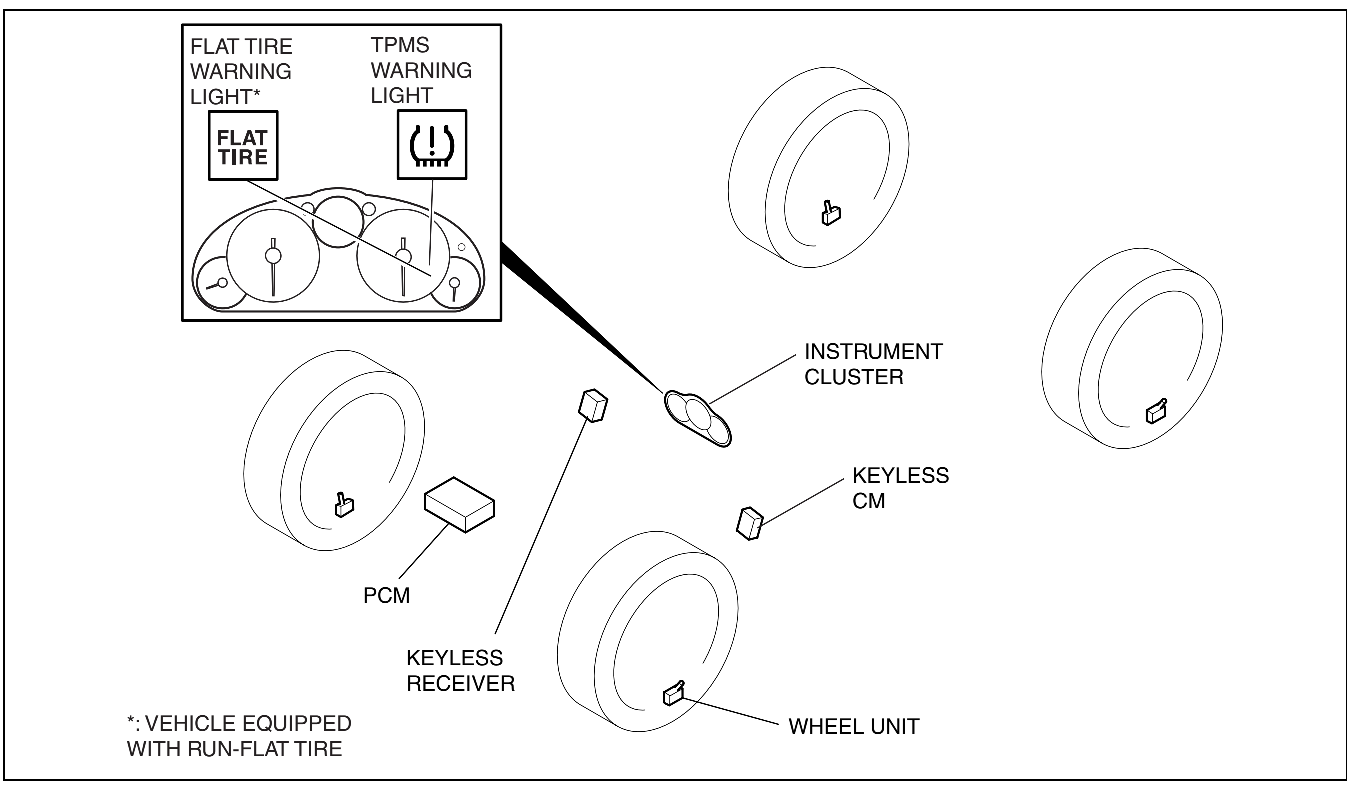
- **Each wheel unit has its own preset identification code. If a system component is replaced, the system becomes inoperative since the instrument cluster cannot recognize the identification codes. Therefore, be sure to configure the identification codes of wheel units when any of the following items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

Note

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

TIRE PRESSURE MONITORING SYSTEM (TPMS) STRUCTURAL VIEW

E5U021237020N02

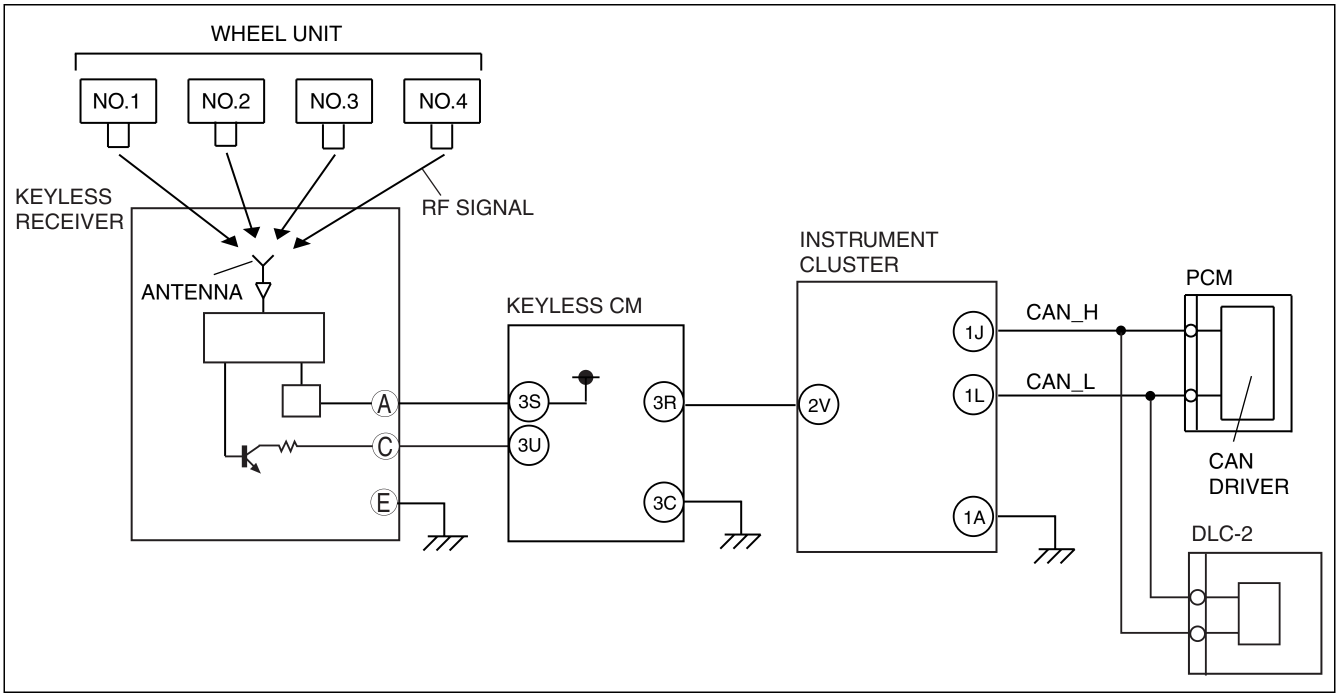


E5U212ZS5003

TIRE PRESSURE MONITORING SYSTEM (TPMS) WIRING DIAGRAM

E5U021237020N03

With advanced keyless system or keyless entry system



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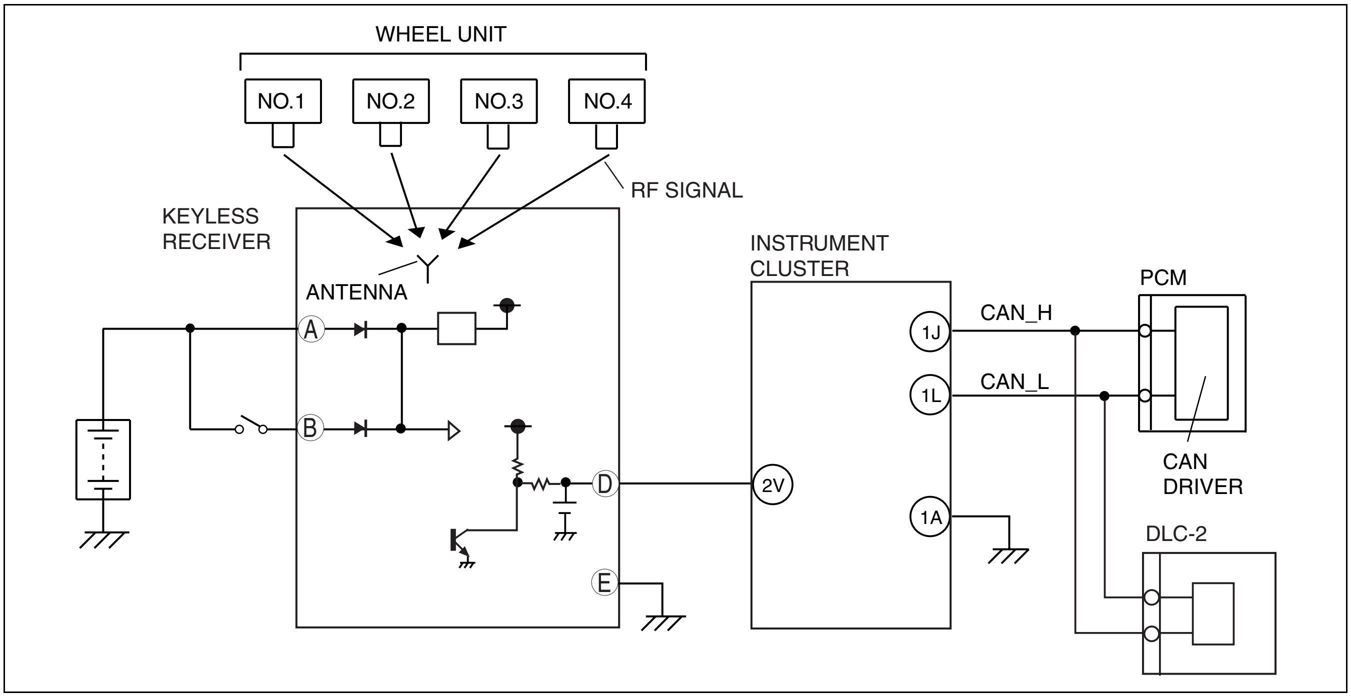
Without advanced keyless system and keyless entry system



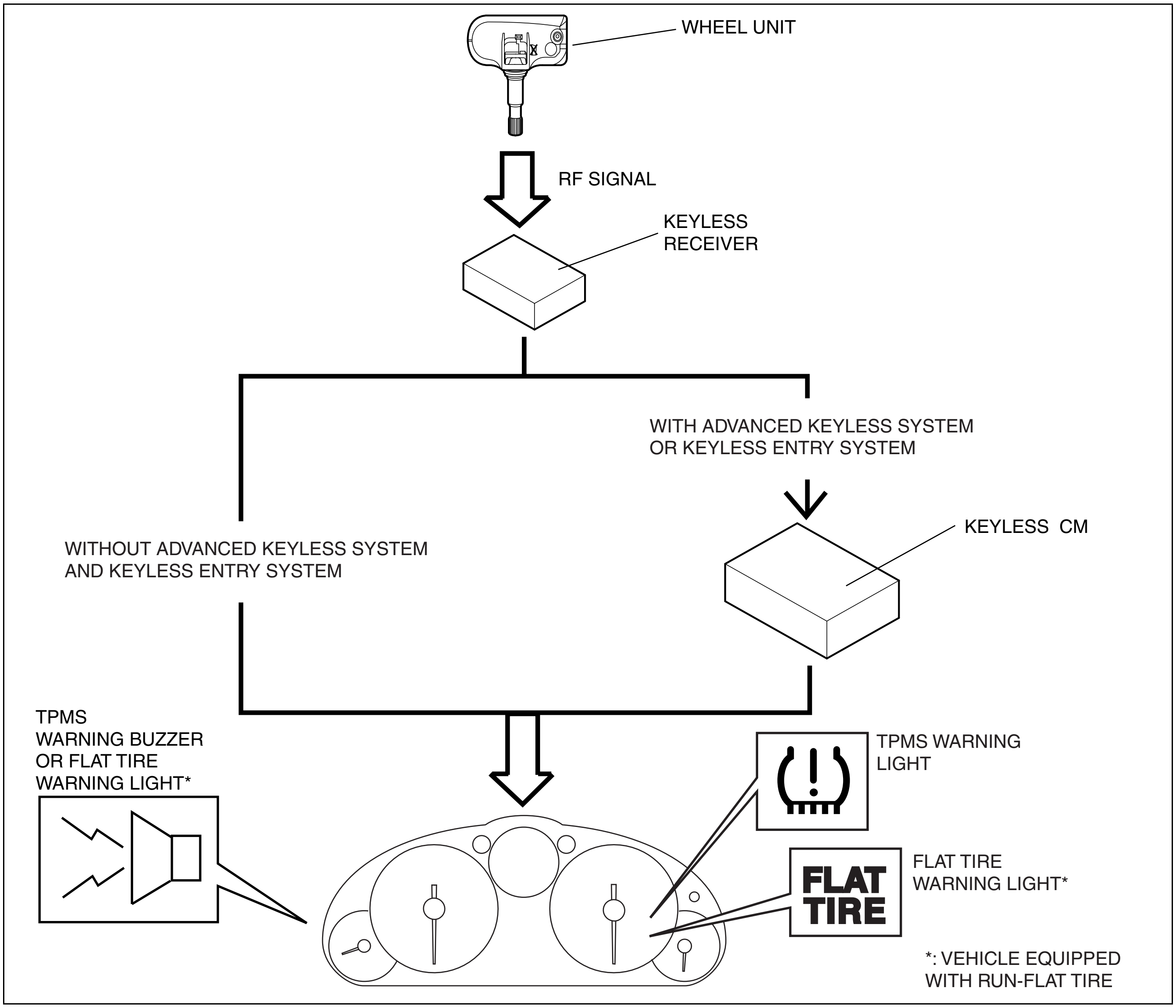
E5U202ZW5002

TIRE PRESSURE MONITORING SYSTEM (TPMS) CONSTRUCTION/OPERATION

E5U021237020N04

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.



E5U212ZS5004

Operation

- The wheel unit installed to each wheel sends data on air pressure, temperature and acceleration of each tire by means of RF signals. The keyless receiver receives these signals with a built-in antenna.
- For vehicles with the advanced keyless system or keyless entry system, signals received by the keyless receiver are transmitted tot he instrument cluster via the keyless CM.
- For vehicle without the advanced keyless system or keyless entry system, signals are transmitted from the keyless receiver to the instrument cluster directly.
- The instrument cluster monitors the air pressure of each tire based on the tire data sent from each wheel unit. If the instrument cluster detects an excessive drop in air pressure or flat tire, the instrument cluster illuminates the TPMS warning light or flat tire warning light and sounds the TPMS warning buzzer or flat tire warning buzzer to alert the driver.

Component Parts/Function

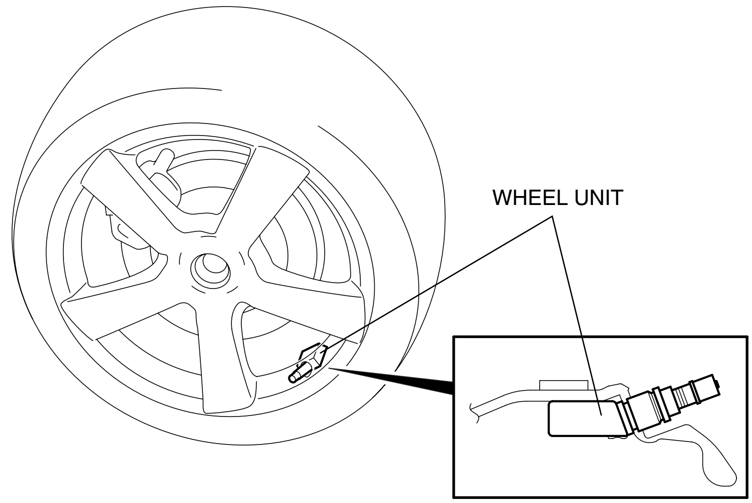
Part name		Function
Wheel unit		• Monitors air pressure, temperature, and acceleration of each tire, and sends RF signals. • Sends data if any abnormality is detected in the wheel unit.
Keyless receiver		• Receives from the keyless receiver. • With advanced keyless system or keyless entry system: Send the RF signals received from the wheel unit to the keyless CM. • Without advanced keyless system or keyless entry system: Send the RF signals received from the wheel unit to the instrument cluster.
Keyless CM (with advanced keyless system or keyless entry system)		• Receives data from the keyless receiver. • Sends data to the instrument cluster.
PCM	Vehicle speed signal	• Inputs vehicle speed signals to the instrument cluster via CAN communication.
Instrument cluster		• Receives data from keyless CM (with advanced keyless system or keyless entry system) or keyless receiver (without advanced keyless system or keyless entry system) and monitor the air pressure of each wheel. If it determines from those signals that tire pressure is abnormal, it controls the TPMS warning light, flat tire warning light, TPMS warning buzzer and flat tire warning buzzer to alert the driver.
	TPMS warning light	• If the instrument cluster detects abnormal air pressure or any abnormality in the system, the light is illuminated to alert the driver.
	Flat tire warning light	• If the instrument cluster detects flat tire, the light is illuminated to alert the driver.
	TPMS warning buzzer	• If the instrument cluster detects abnormal air pressure any abnormality in the system, the buzzer is sounded to alert the driver.
	Flat tire warning buzzer	• If the instrument cluster detects flat tire, the buzzer is sounded to alert the driver.

WHEEL UNIT CONSTRUCTION/OPERATION

E5U021237140N01

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.



E5U212ZW5005

Operation

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

Sensing Function

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

Self-diagnostic Function

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

TIRE PRESSURE MONITORING SYSTEM (TPMS) OPERATION

E5U021267502N01

- The instrument cluster monitors the tire pressure of each tire and the wheel units for abnormalities using the received data. If any abnormality is found, it controls TPMS warning light, TPMS warning buzzer, flat tire warning light and flat tire warning buzzer to alert and notify the driver.
- The instrument cluster controls the following functions based on the received data:

Function list

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

Identification Code Recognition Function

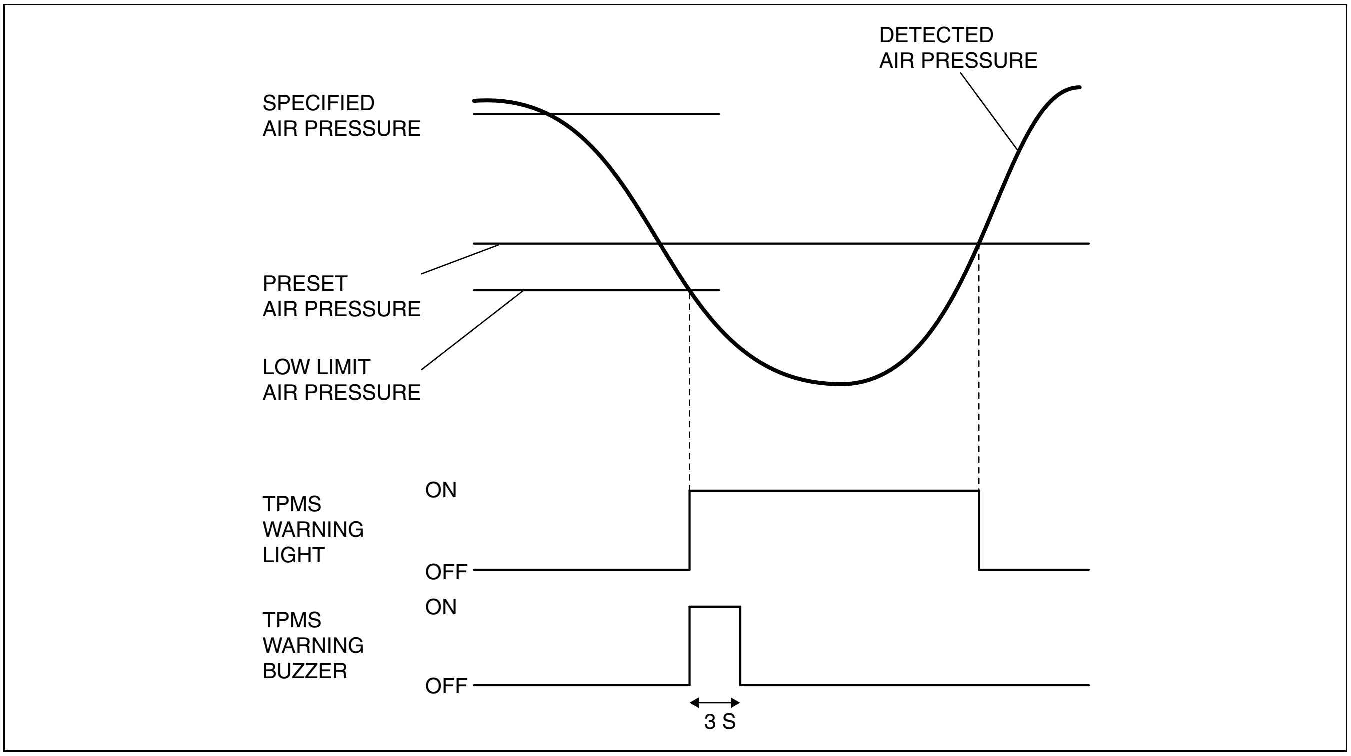
- Since the identification codes of wheel units mounted on the vehicle have been configured in the instrument cluster, the instrument cluster can verify the identification codes sent from the wheel units against the configured identification codes.
- When the received identification code agrees with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

Tire Pressure Determination And Warning Function

- The instrument cluster determines the tire pressure status of each wheel by comparing tire pressure data received from the wheel units with the preset values in the instrument cluster.
- If a malfunction is detected in the received signals, the instrument cluster flashes the TPMS warning light to notify the driver of a tire malfunction.
- The tire pressure monitoring function is classified into the two low-pressure and flat tire 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

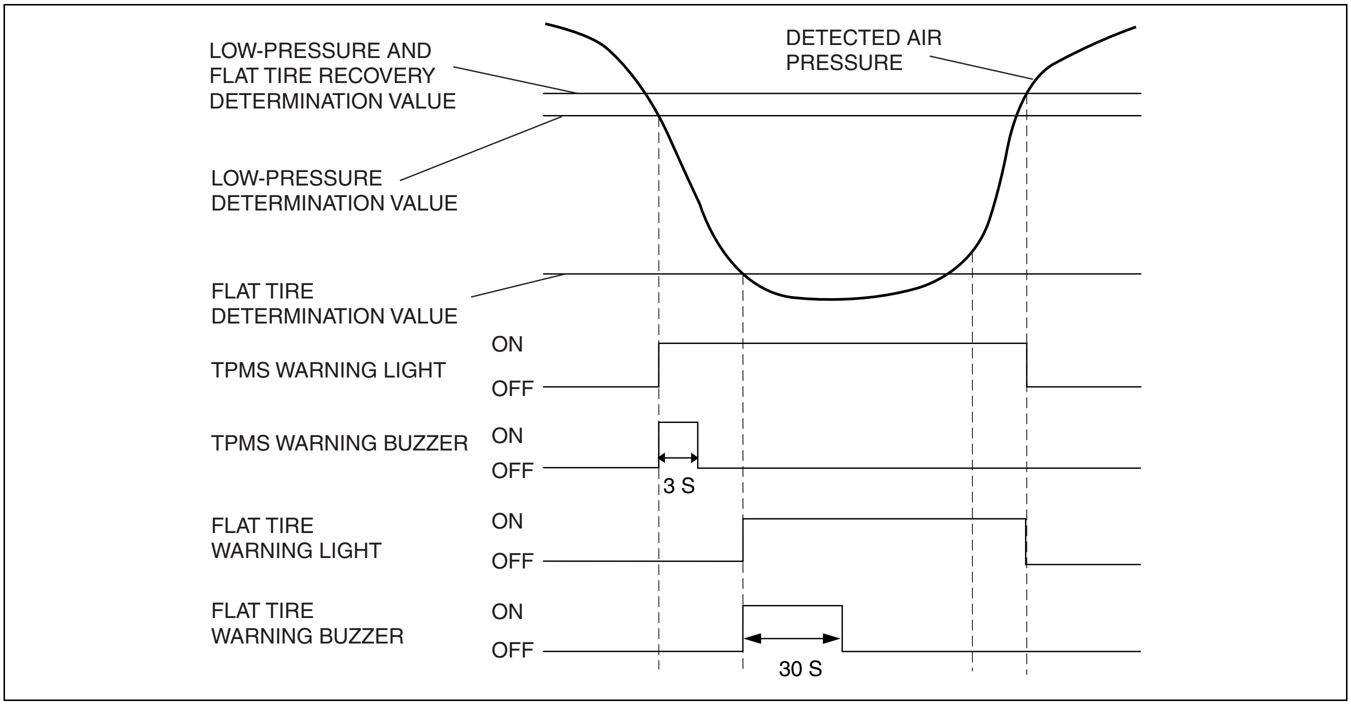
- When tire pressure data is lower than the detection value configured in the instrument cluster, the instrument cluster determines that the tire for that wheel unit has low tire pressure.
  — If low tire pressure is determined when the ignition is on, the TPMS warning light is illuminated and sounds the TPMS warning buzzer for **3 s** to alert the driver.
  — If low tire pressure is determined when the ignition is off, the instrument cluster performs an open-circuit check[*1] on the TPMS warning light and flat tire warning light after the ignition is turned on, and then illuminates the TPMS warning light and flat tire warning light and sounds the TPMS warning buzzer and flat tire 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

Flat tire determination

- The instrument cluster determines that there is a flat tire when it receives a signal that the air pressure is lower than the specified low-pressure value, and then it illuminates the flat tire warning light and sounds the flat tire warning buzzer.
  - — The flat tire warning light turns off when the system detects that the flat tire has been repaired.
  - — When a flat tire is detected, the flat tire warning buzzer sounds every time the ignition switch is turned to the ON position until recovery is detected.
  - — The system stores the most recent data when the power is cut (battery removal/installation) and holds this data until the ignition switch is turned to the ON position next time.
  - — The system stores puncture and recovery freeze frame data.

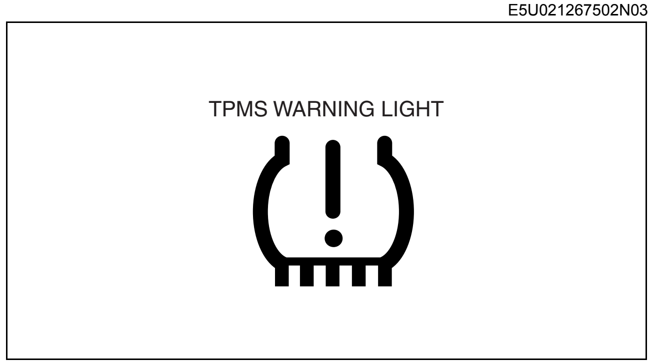


E5U212ZS5007

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

E5U021267502N03

- 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 illuminate the warning light and sound the warning buzzer to alert the driver.



CHU0212S010

FLAT TIRE WARNING LIGHT, FLAT TIRE WARNING BUZZER CONSTRUCTION

E5U021267502N04

- The flat tire warning light and the flat tire warning buzzer are built into the instrument cluster.
- If the tire pressure decreases to the level that a flat tire is detected, the flat tire warning light illuminates and the flat tire warning buzzer sounds to inform the driver of a puncture.

E5U212ZW5006

CONTROLLER AREA NETWORK (CAN) OUTLINE

E5U021267502N02

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

Received Information from PCM

- Vehicle speed

02–13 FRONT SUSPENSION

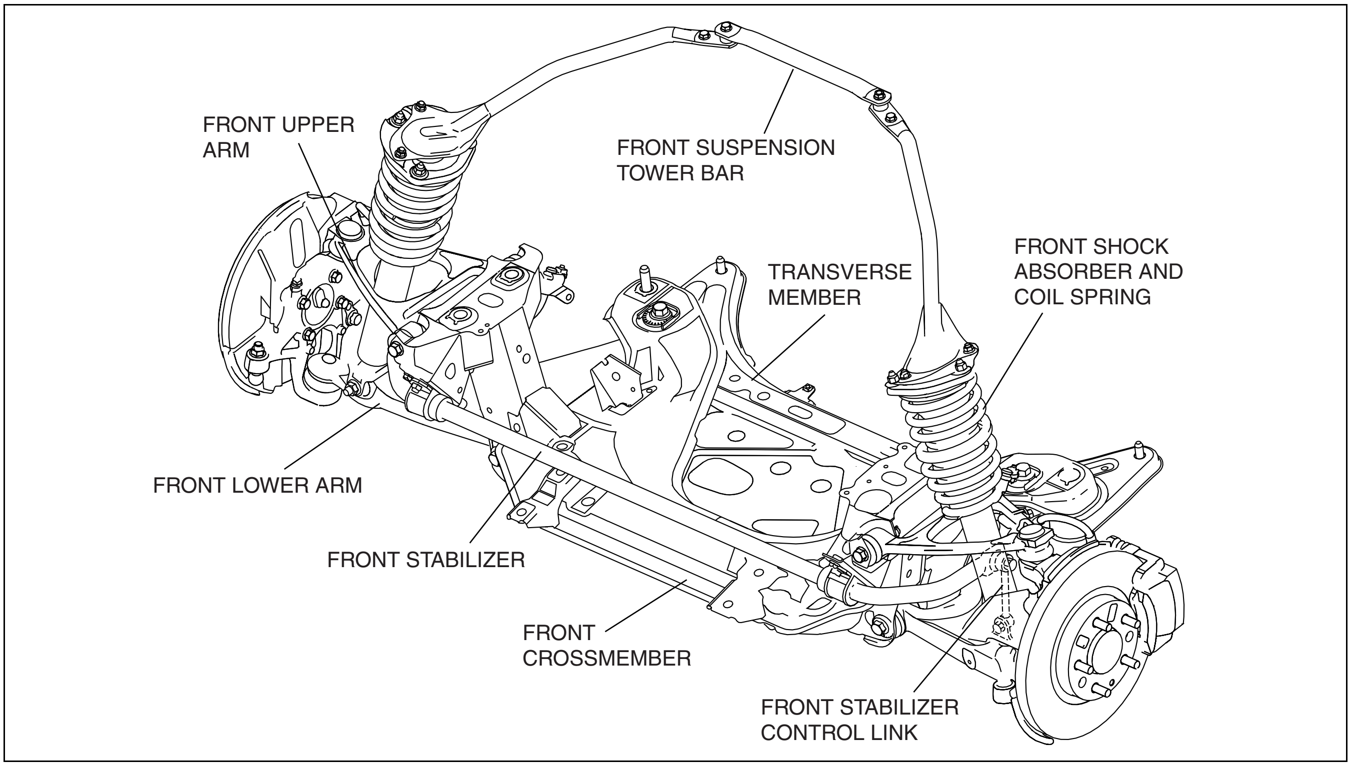
FRONT SUSPENSION OUTLINE

E5U021300000N01

- An 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

E5U021300000N02



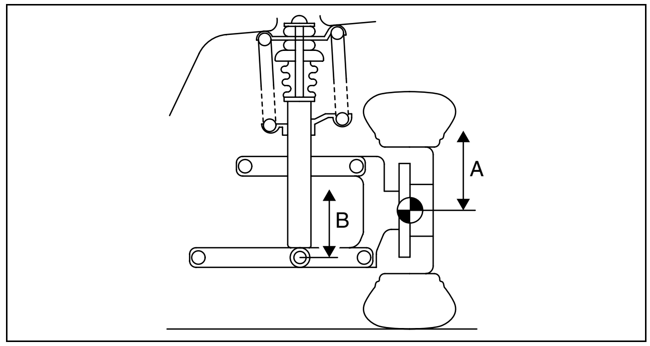
E5U213ZS5001

DOUBLE WISHBONE FRONT SUSPENSION CONSTRUCTION

E5U021300000N03

Improved roadholding

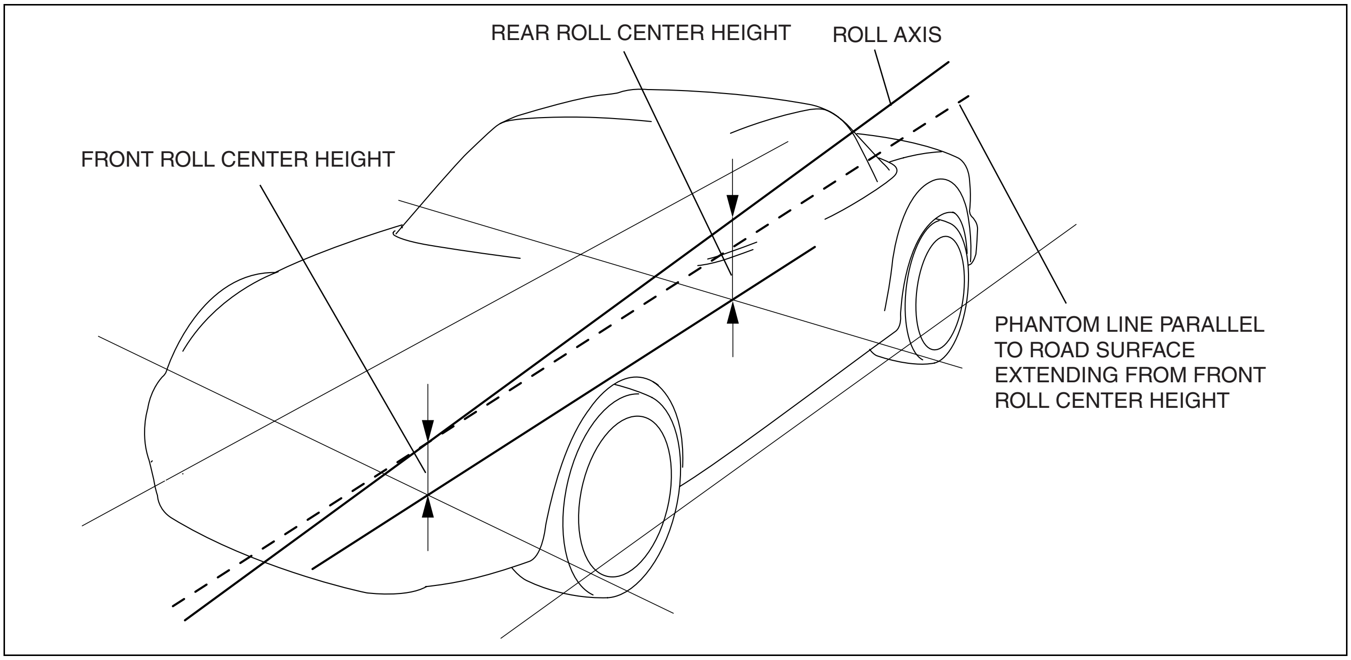
- The heightened damper lever ratio has improved the efficiency of shock absorber operation.
  — Damper lever ratio:
  shock absorber stroke (B)/wheel vertical stroke (A)
  — The heightened damper lever ratio has made it possible to provide a damping force even during minute strokes. As a result, excellent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

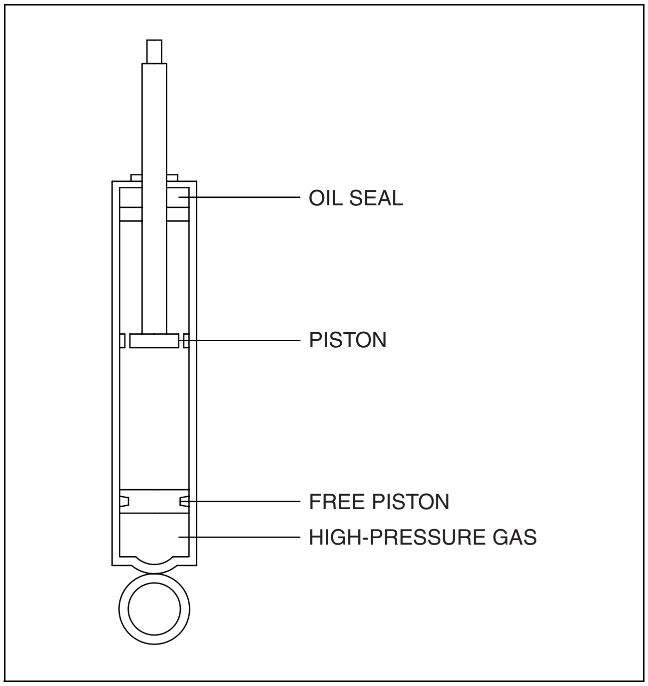


E5U213ZS5002

FRONT SHOCK ABSORBER CONSTRUCTION

E5U021334700N01

- 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.

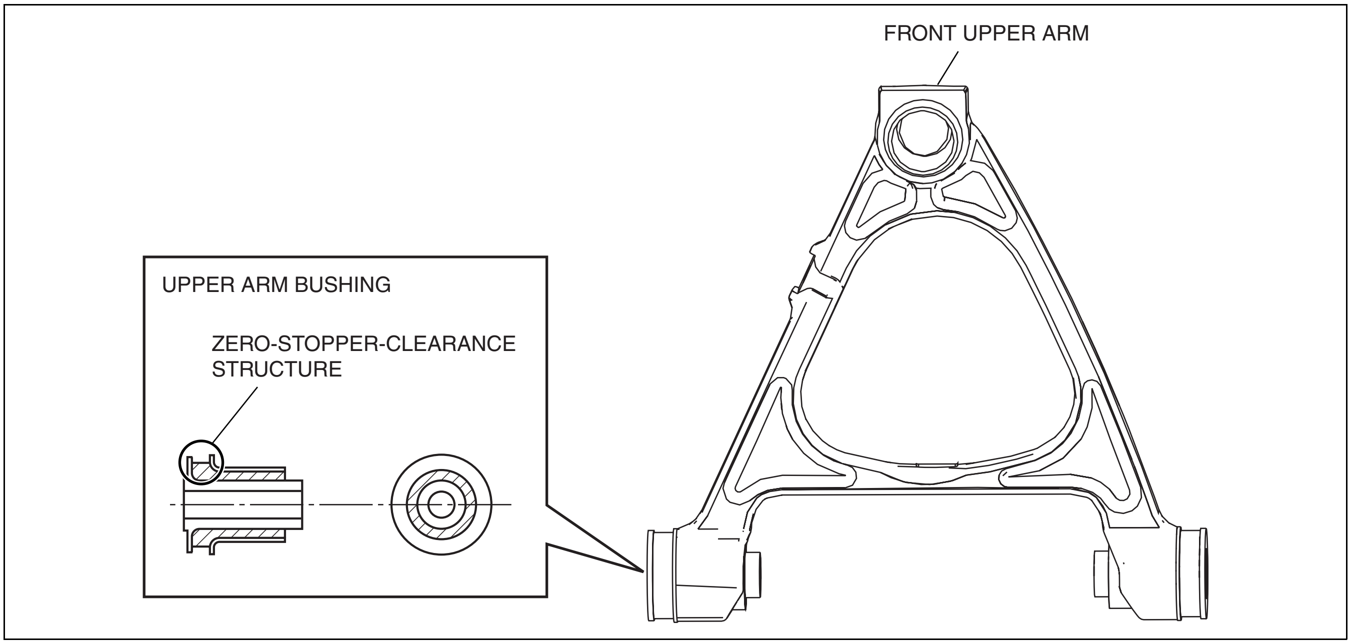


CHU0213S005

FRONT UPPER ARM CONSTRUCTION

E5U021334200N01

- The front upper arm is made of aluminum for improved rigidity and weight reduction.
- The 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.



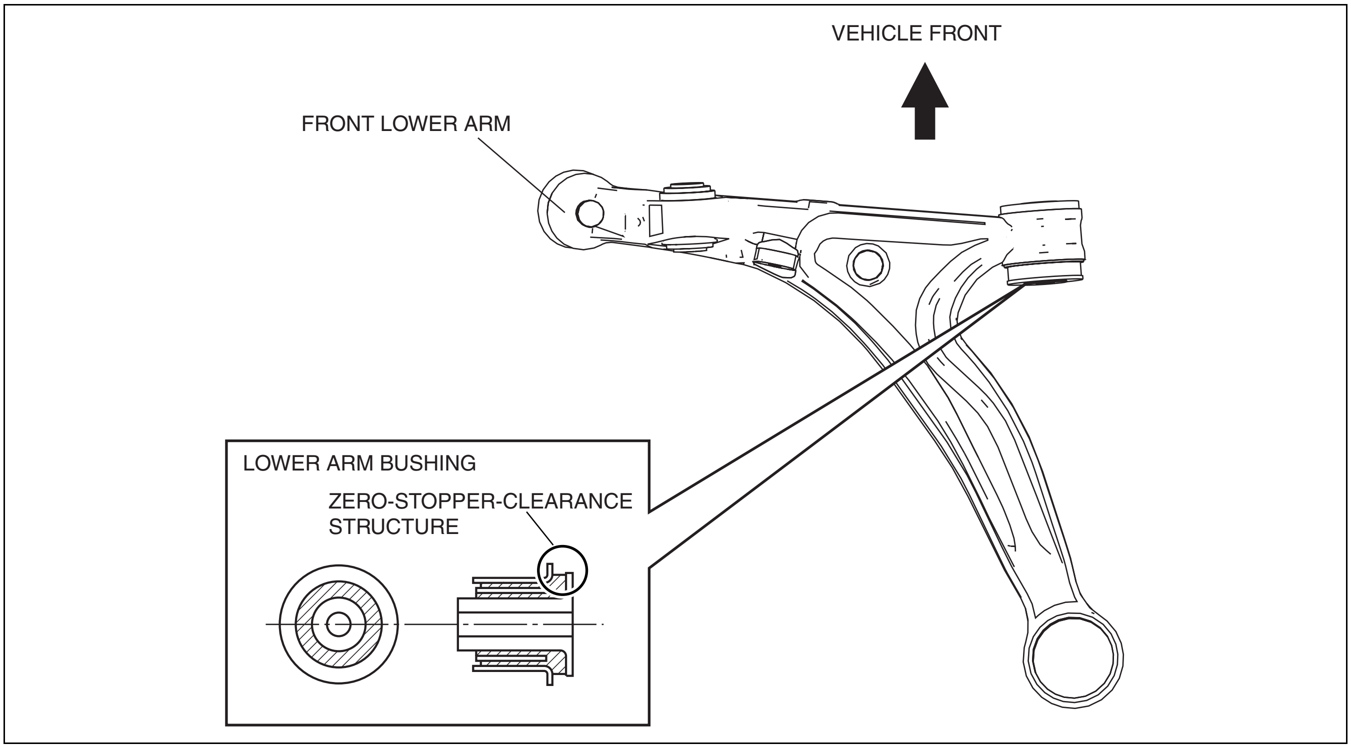
E5U213ZS5003

02–13

FRONT LOWER ARM CONSTRUCTION

E5U021334300N01

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

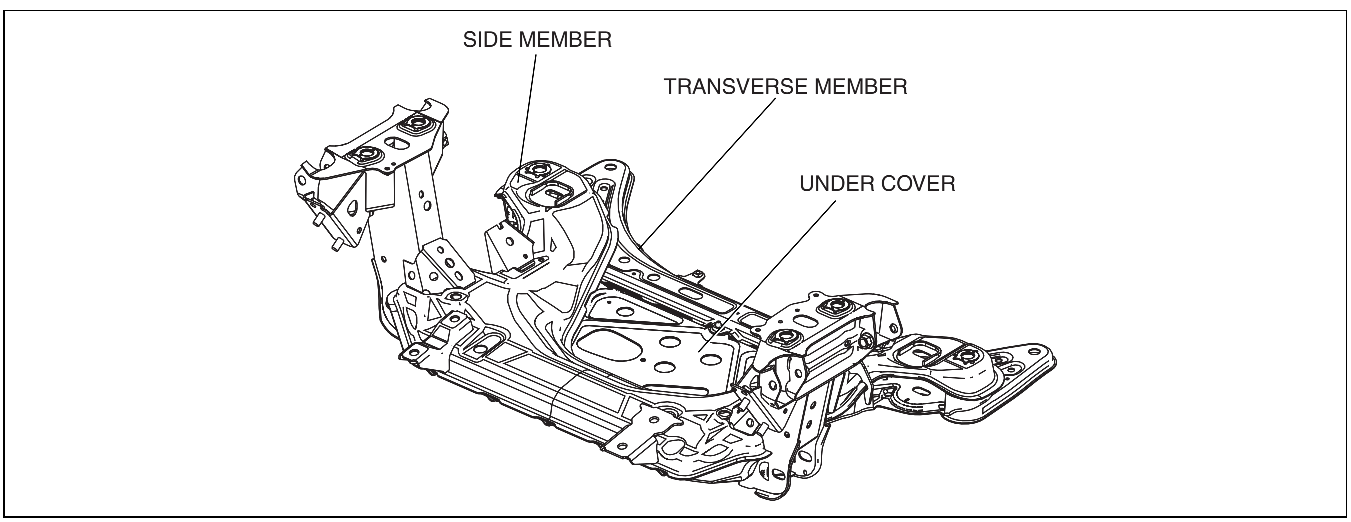


E5U213ZS5004

FRONT CROSSMEMBER CONSTRUCTION

E5U021334800N01

- 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.



E5U213ZS5005

02–14 REAR SUSPENSION

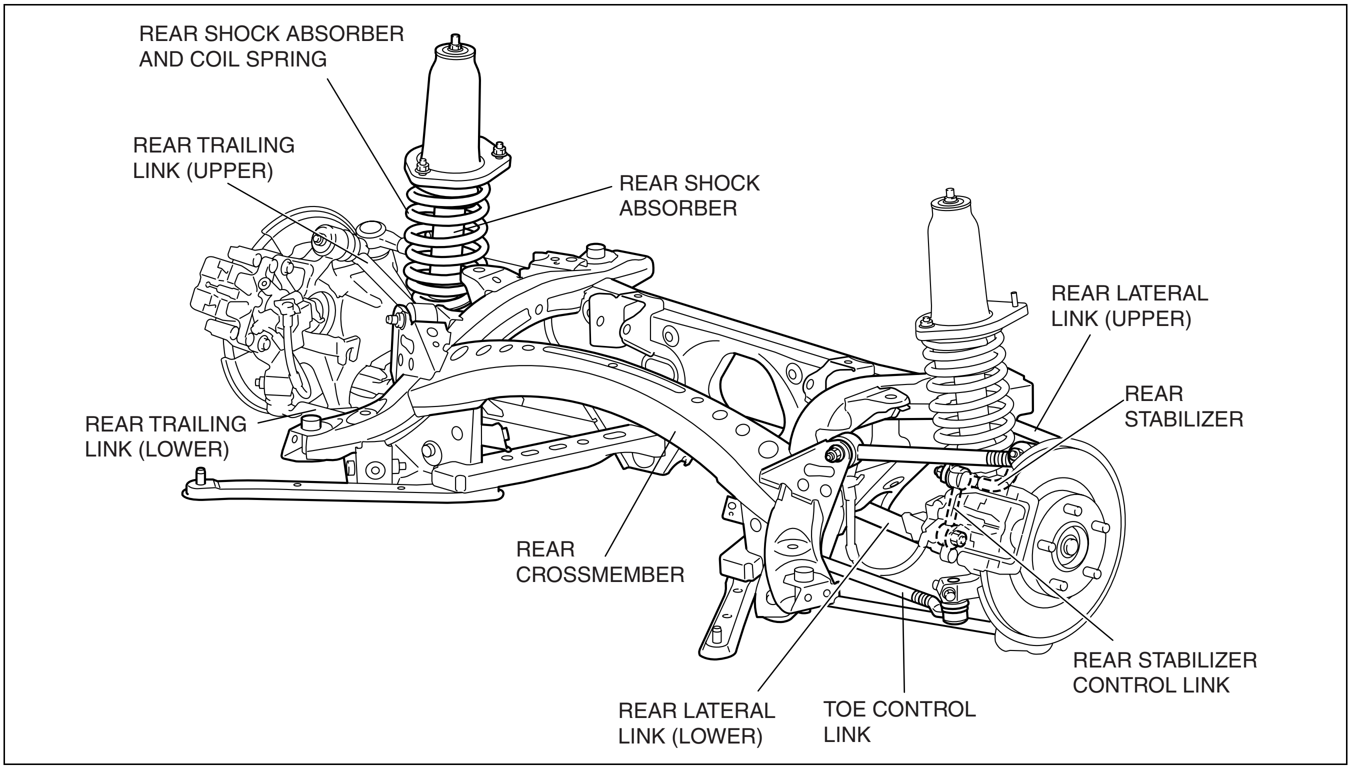
REAR SUSPENSION OUTLINE

E5U021400000N01

- 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

E5U021400000N02



E5U214ZS5001

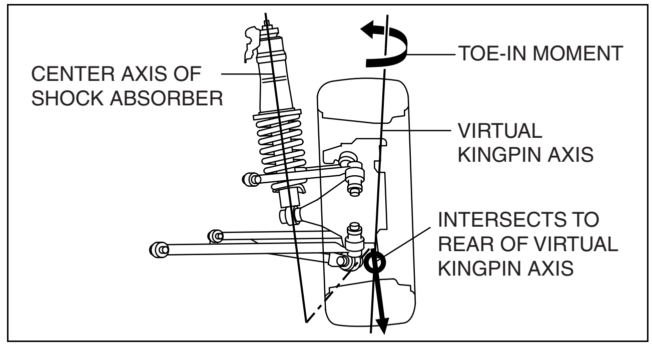
MULTI-LINK REAR SUSPENSION CONSTRUCTION

E5U021400000N03

Optimized Link and Shock Absorber Layout

Compliance toe control

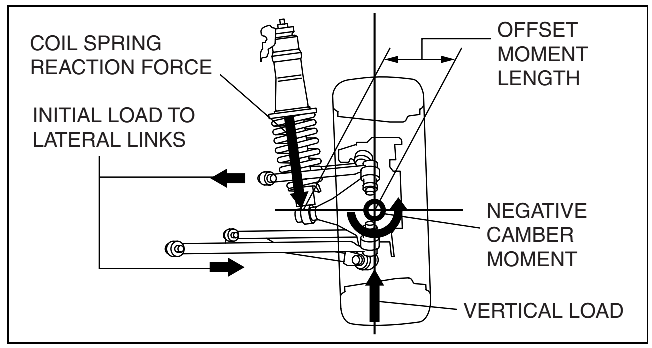
- The suspension system layout is such that the center axis line of the shock absorber intersects to the outside and rear of the virtual kingpin axis. This layout ensures that the toe-in moment is constantly produced around the virtual kingpin axis of the rear wheels. Due to this, the rear wheels constantly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



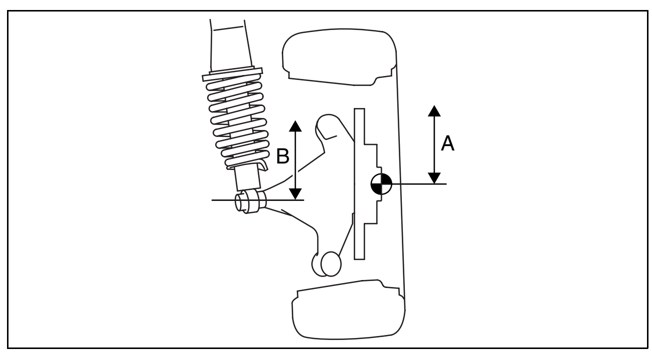
CHU0214S003

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

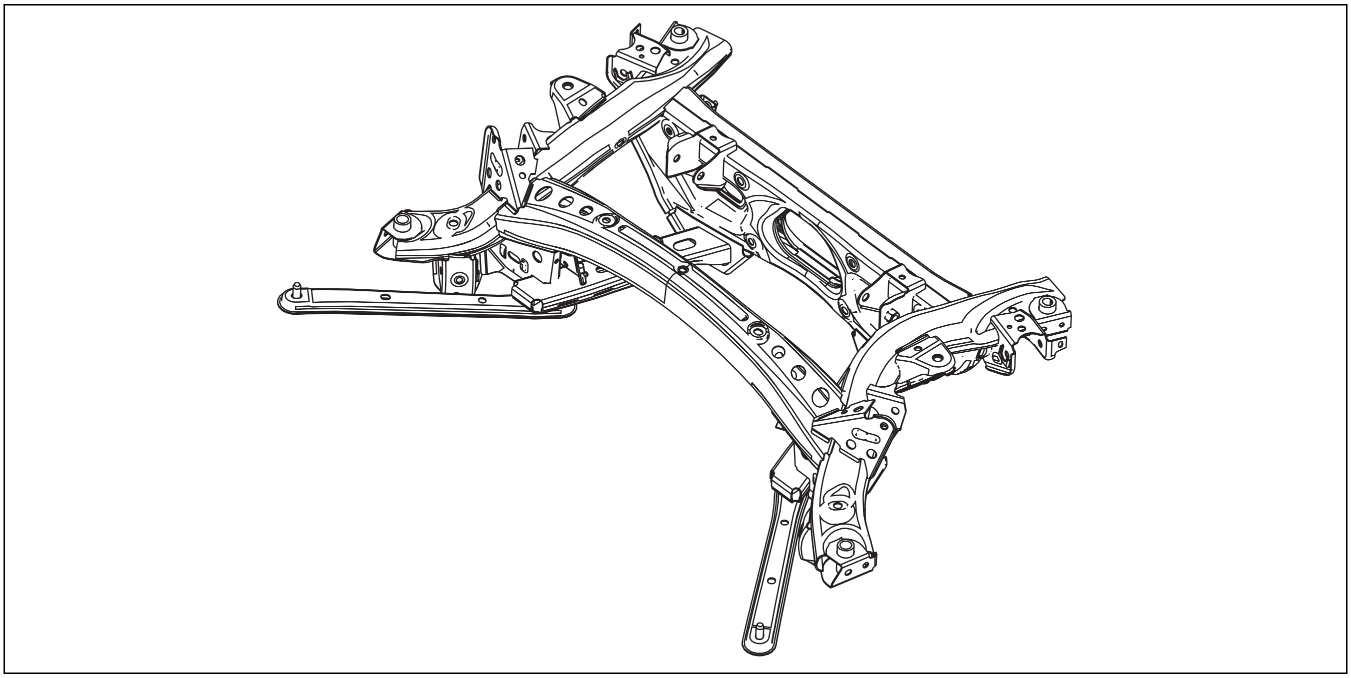
E5U021428700N01

- 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

E5U021428400N01

- Adoption of a six-point mounting system rear crossmember ensures link support stiffness and isolates vibration improving riding comfort and reducing road noise.



E5U214ZS5002

DRIVELINE/AXLE

03
SECTION

03–00 OUTLINE

DRIVELINE/AXLE ABBREVIATIONS

E5U030000000N01

AT	Automatic Transmission
LSD	Limited Slip Differential
MT	Manual Transmission

DRIVELINE/AXLE FEATURES

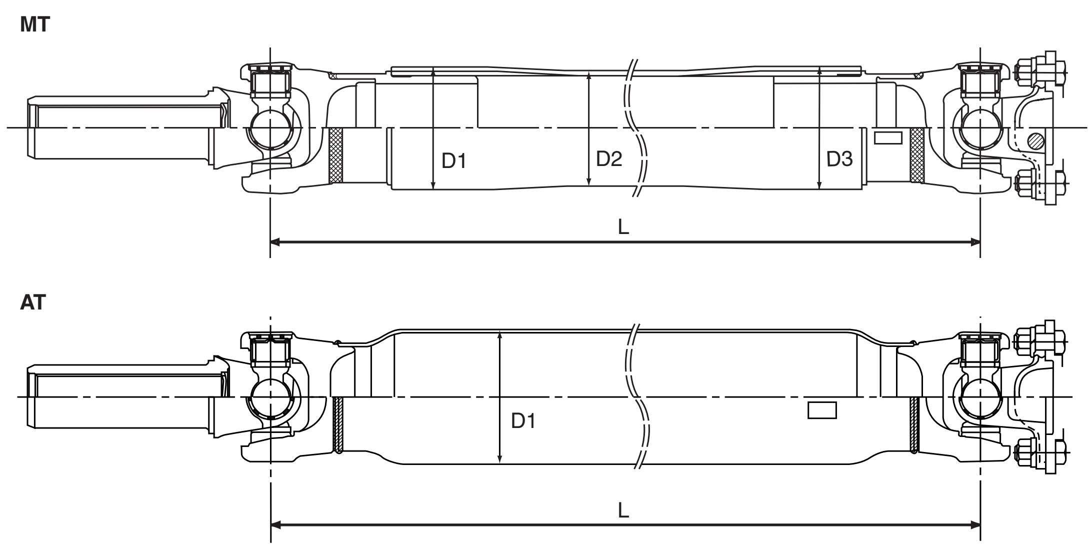
E5U030000000N02

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)
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

E5U030000000N03

Item				Specification	
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})				26.6 {1.05} (Minimum diameter) 36.0 {1.42} (Maximum diameter)	
Rear differential					
Reduction gear type				Hypoid gear	
Differential gear type				Straight bevel gear	
Ring gear size (inch)				7.35	
Reduction ratio				4.100	
Number of gear teeth		Drive pinion		10	
		Ring gear		41	
Differential oil	Type	Grade		API service GL-5	
		Viscosity		SAE 90 SAE 80W-90 SAE 75W-90 (Not available from Mazda)	
	Capacity (approx. quantity) (L {US qt, Imp qt})			0.6—0.8 {0.63—0.85, 0.53—0.70}	
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

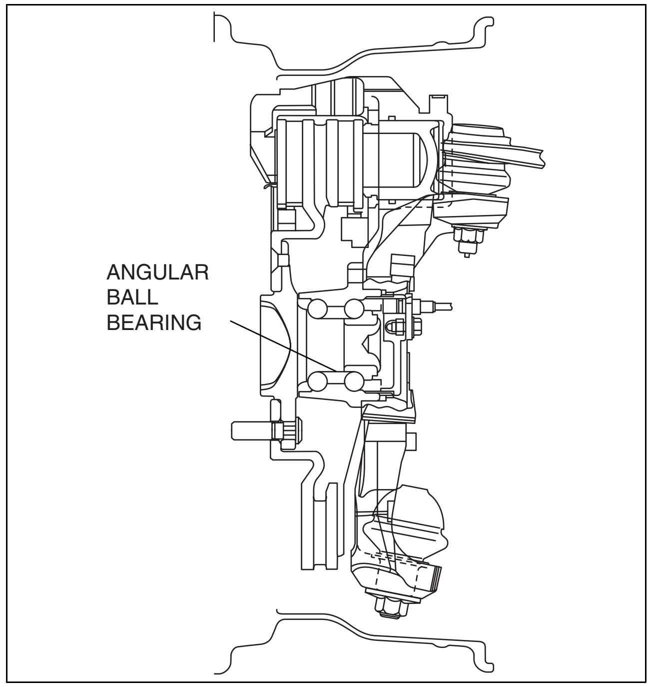
FRONT AXLE OUTLINE

E5U031104000N01

- 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.

FRONT AXLE CROSS-SECTIONAL VIEW

E5U031104000N02



E5U311ZS5001

03–12 REAR AXLE

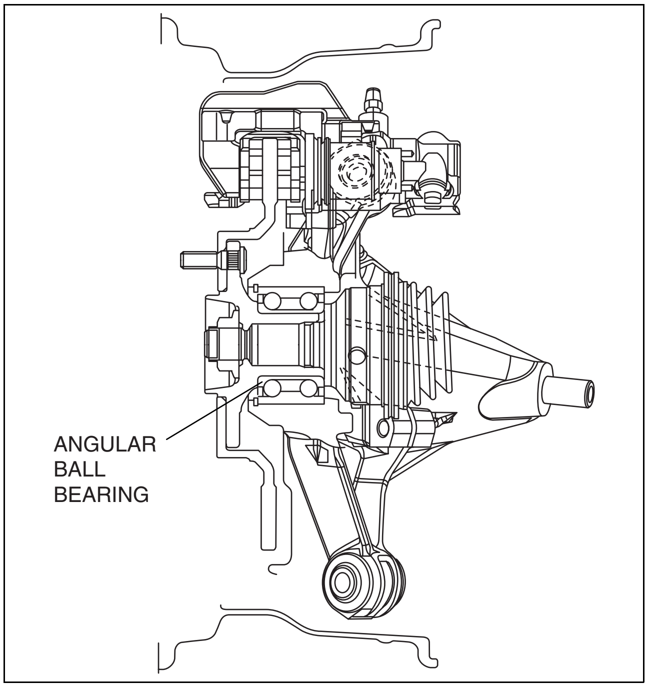
REAR AXLE OUTLINE

E5U031205000N01

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

REAR AXLE CROSS-SECTIONAL VIEW

E5U031205000N02



E5U312ZS5001

03–13 DRIVE SHAFT

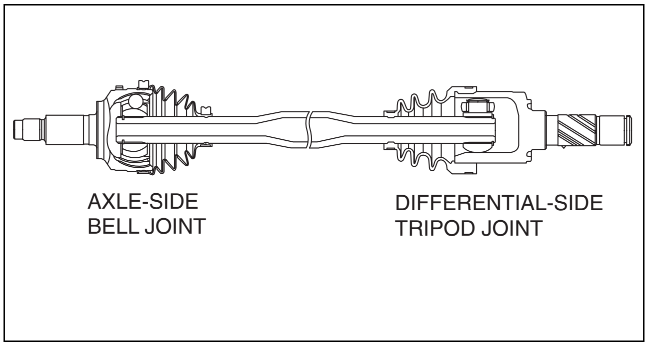
REAR DRIVE SHAFT OUTLINE

E5U031325600N01

- 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

E5U031325600N02



E5U313ZS5001

03–14 DIFFERENTIAL

03–14

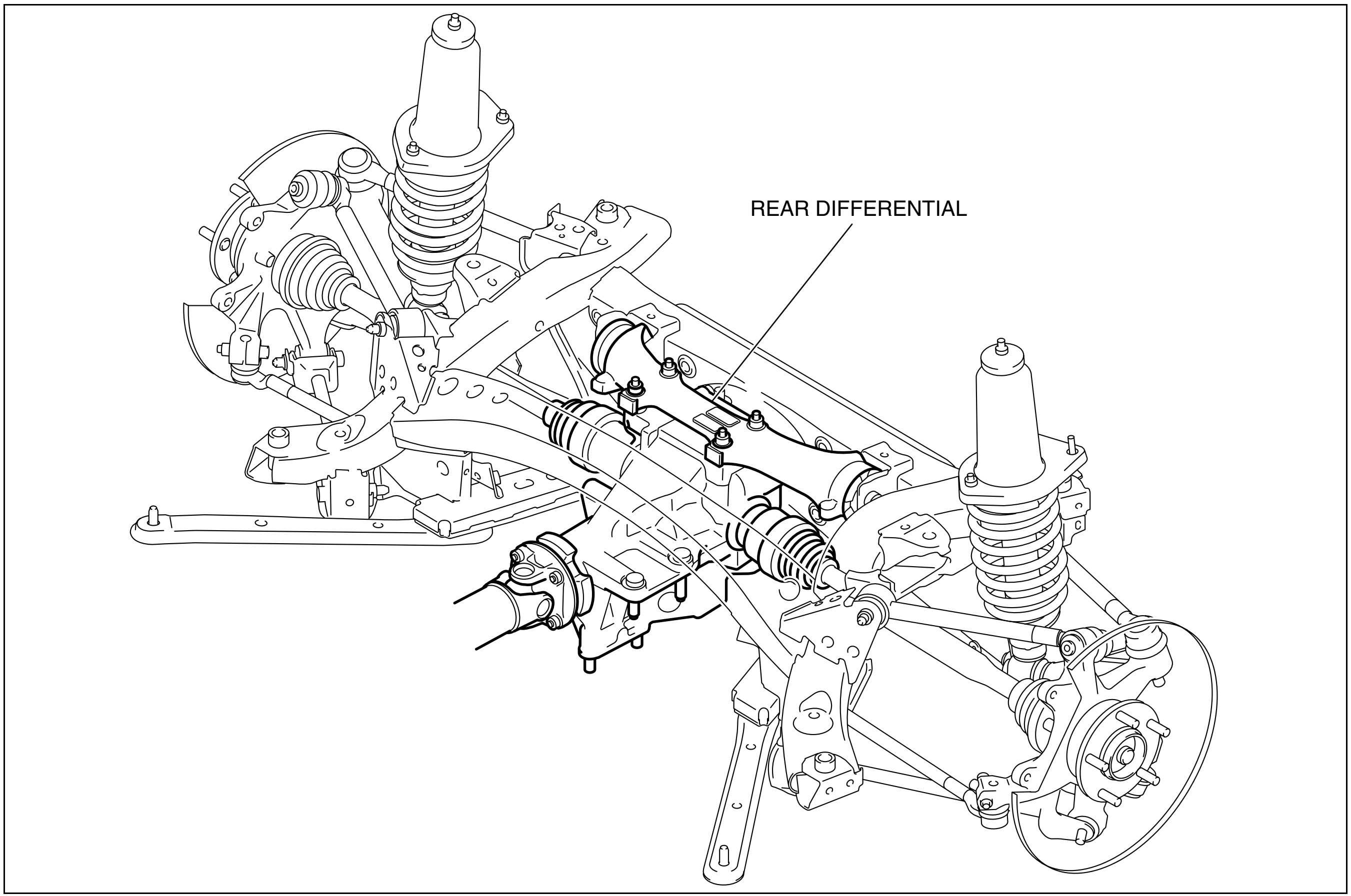
REAR DIFFERENTIAL OUTLINE

E5U031427100N01

- 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

E5U031427100N02



E5U314ZS5002

SUPER-LSD OUTLINE

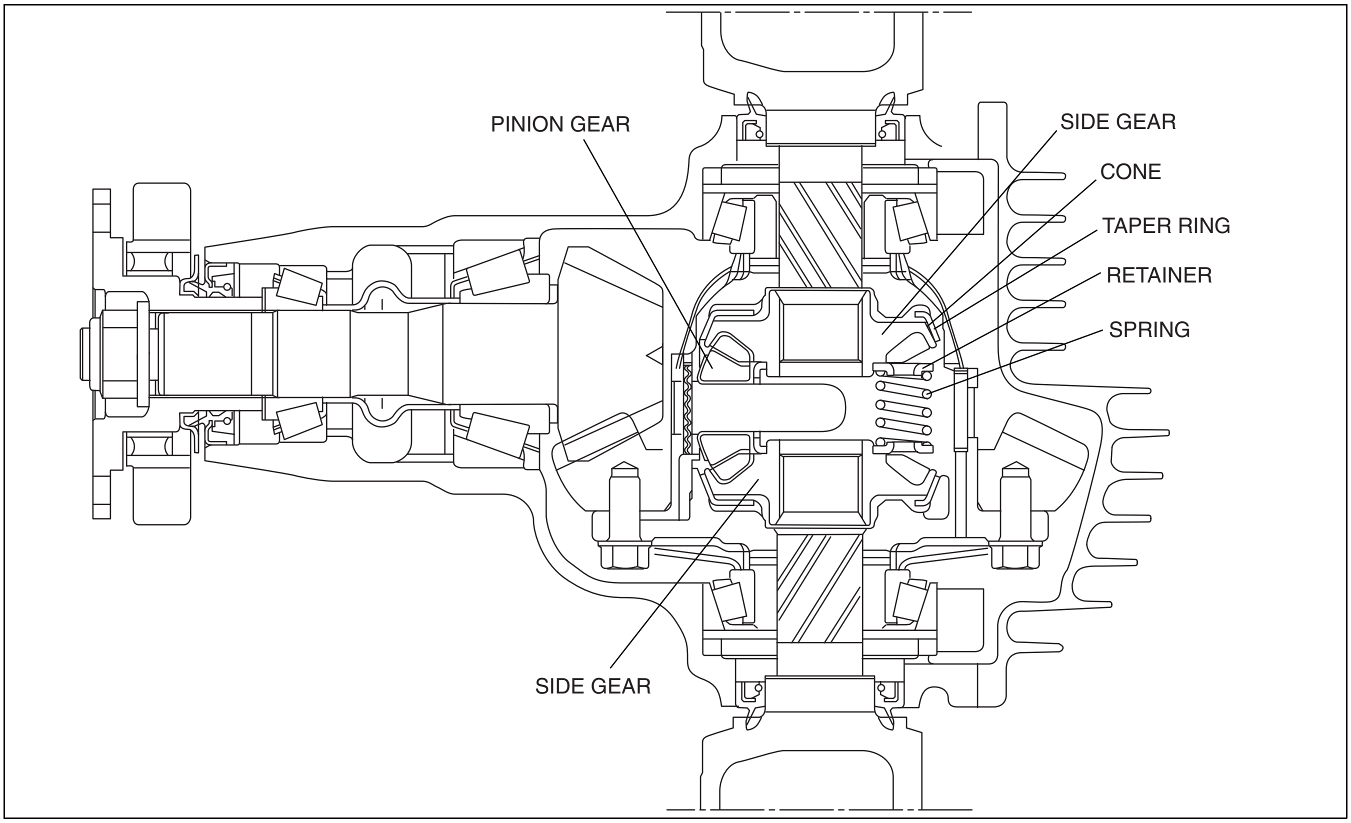
E5U031427100N03

- 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

E5U031427100N04

- 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.



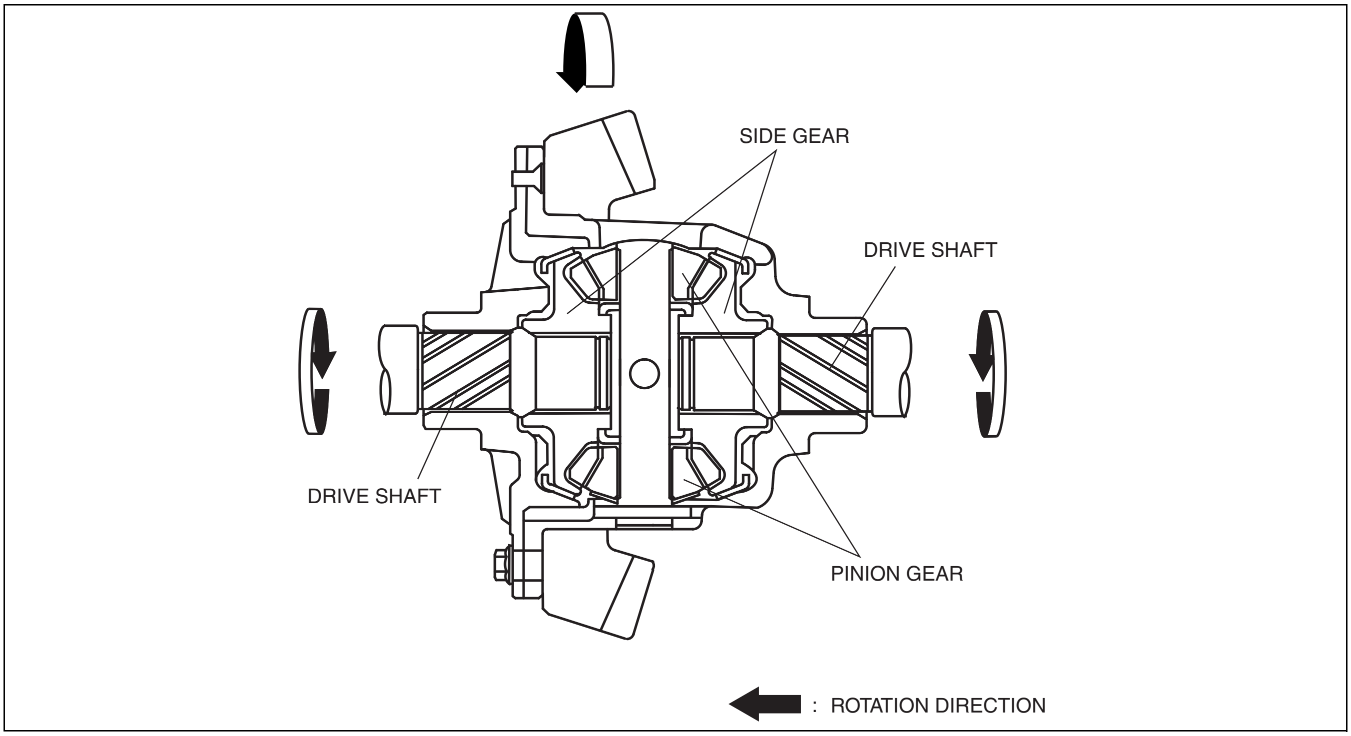
E5U314ZS5001

SUPER-LSD OPERATION

E5U031427100N05

Straight ahead driving

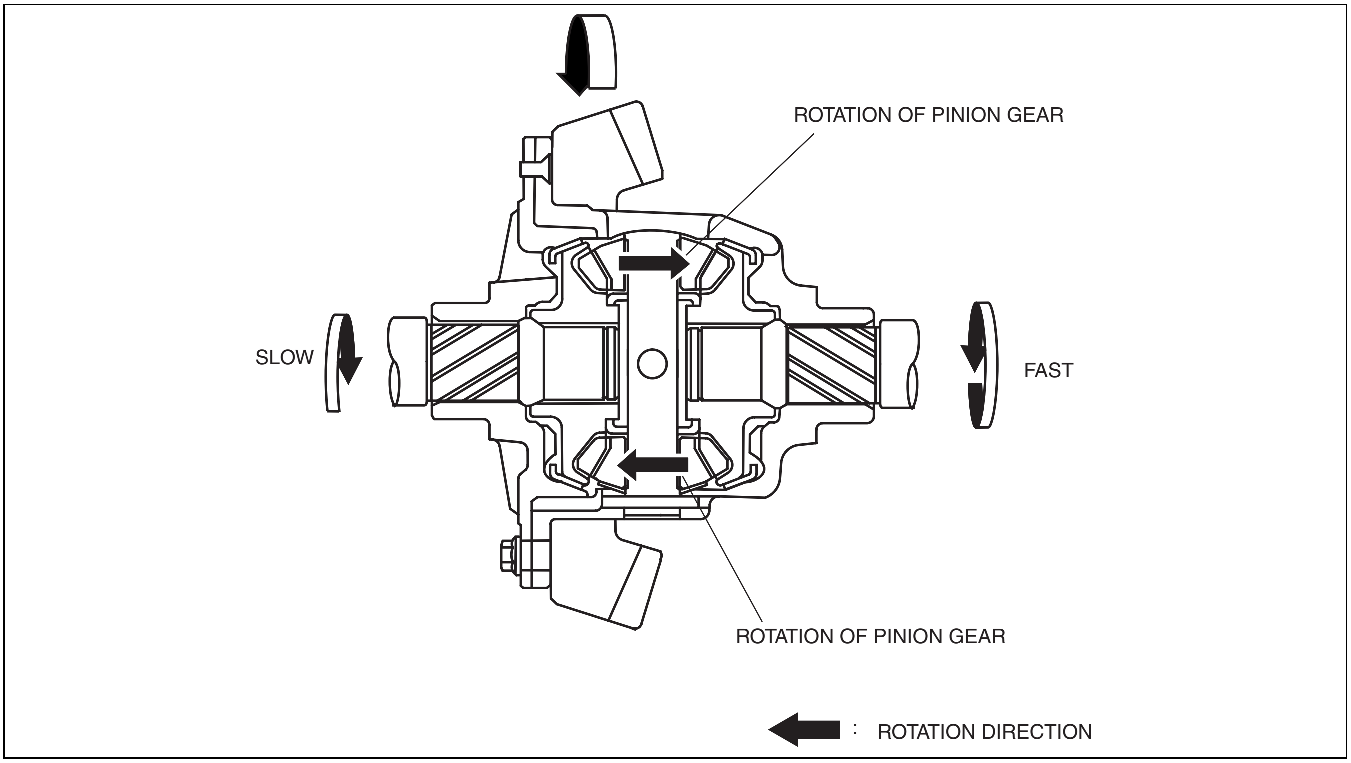
- When driving straight, the right and left side gears rotate at the same speed, and the pinion and side gears rotate together with the differential gear case. Input force from the ring gear is transmitted to the pinion gears via the gear case and to the drive shaft via the side gears. Due to this, a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



CHU0314S003

Differential operation

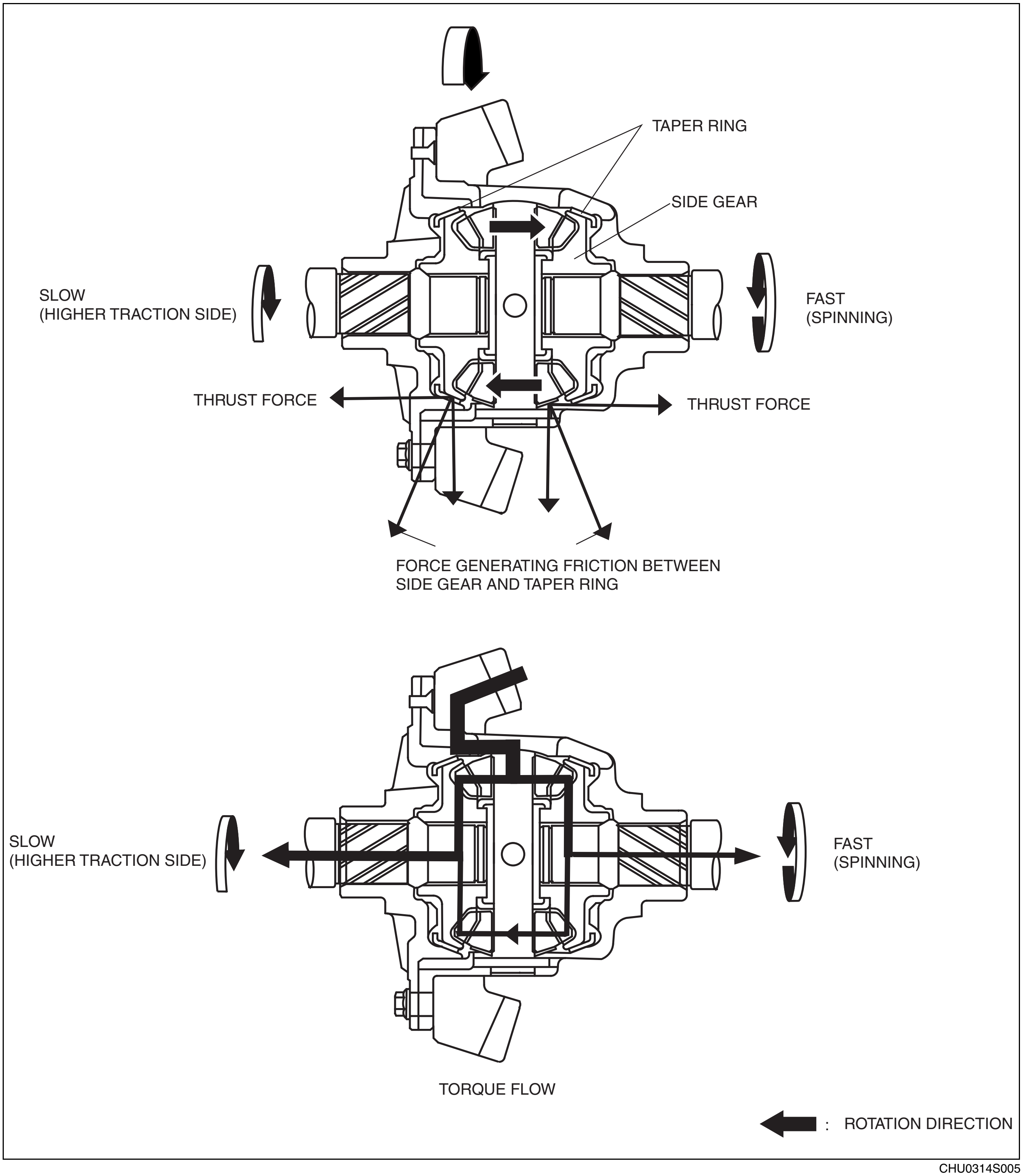
- If the rotation speed between the right and left wheels becomes different (during normal driving), the pinion gears rotate together while revolving around the center axle of the drive shaft, thereby absorbing the difference in rotation speed. This mechanism serves as a differential.



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.



BRAKES

04
SECTION

04–00 OUTLINE

BRAKE ABBREVIATIONS

E5U040000000N01

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

E5U040000000N02

Improved safety	• Intrusion minimizing brake pedal adopted • Electronic brakeforce distribution (EBD) control adopted • Antilock brake system (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
Improved reliability	• Semi-conductor element type front ABS wheel-speed sensor adopted • Magnetic encoder type front ABS sensor rotor adopted • DSC HU/CM with built-in brake fluid pressure sensor

BRAKE SPECIFICATIONS

E5U040000000N03

Item		Specification
Brake pedal	Type	Suspended design
	Pedal lever ratio	2.9
	Max. stroke (mm {in})	133 {5.24}
Master cylinder	Type	Tandem (plunger type)
	Cylinder bore (mm {in})	22.2 {0.87}
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})	4,670 x 9 {7.472 x 0.35}
	Disc plate dimensions (outer diameter x thickness) (mm {in})	290 x 22 {11.4 x 0.87}
Rear brake (disc)	Type	Solid disc
	Cylinder bore (mm {in})	38.18 {1.5}
	Pad dimensions (area x thickness) (mm^2 x mm {in^2 x in})	2,470 x 7.5 {3.952 x 0.3}
	Disc plate dimensions (outer diameter x thickness) (mm {in})	280 x 10 {11.0 x 0.39}
Power brake unit	Type	Vacuum multiplier Single diaphragm
	Outer diameter (mm {in})	248 {9.75}
Rear wheel braking force control device	Type	Without ABS/DSC: Dual proportioning valve With ABS/DSC: 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

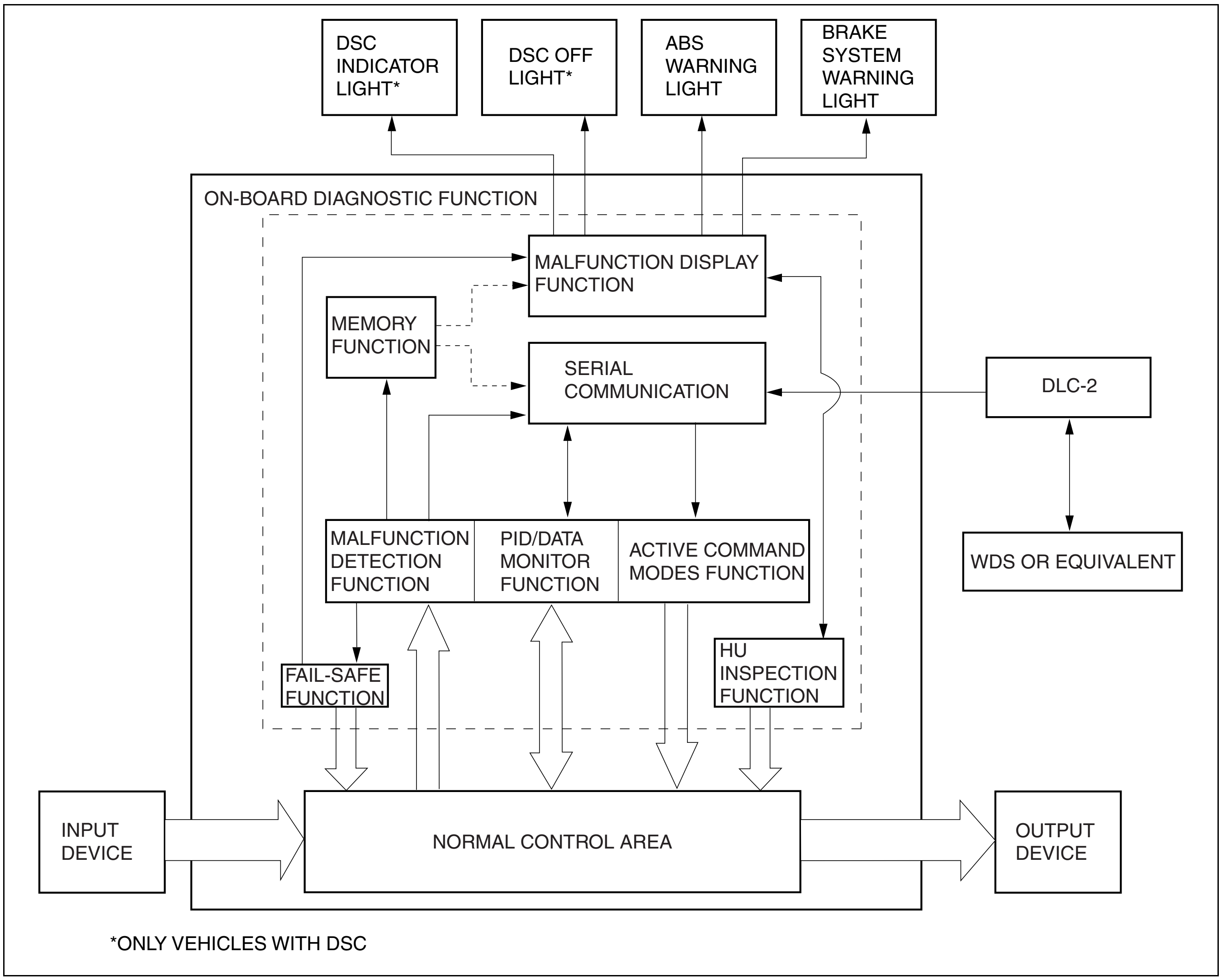
04–02 ON-BOARD DIAGNOSTIC

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

E5U040243750N01

- 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



E5U402ZS5001

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

E5U040243750N02

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. 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. 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 CAN_H and CAN_L of the DLC-2. At the same time, malfunction detection results are sent to the memory and fail-safe functions.

Memory Function

- The memory function stores DTCs of malfunctions in input/output signal systems. With this function, once a DTC is stored it is not cleared after the ignition switch has been turned off (LOCK position), even if the malfunctioning signal system has returned to normal.
- Since the ABS 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)

<table>
<tr><th rowspan="3">Malfunction location</th><th>DTC number</th><th colspan="4">Fail-safe function</th></tr>
<tr><th rowspan="2">WDS or equivalent display</th><th colspan="2">Warning light illumination status</th><th colspan="2">Control status</th></tr>
<tr><th>ABS warning light</th><th>Brake system warning light (when parking brake is released)</th><th>ABS control</th><th>EBD control</th></tr>
<tr><td rowspan="2">Power supply system</td><td>B1317</td><td rowspan="2">Illuminated[*1]</td><td rowspan="2">Illuminated[*1]</td><td rowspan="2">Control disabled[*2]</td><td rowspan="2">Control disabled[*2]</td></tr>
<tr><td>B1318</td></tr>
<tr><td>ABS HU/CM system</td><td>B1342</td><td>Illuminated</td><td>Illuminated</td><td>Control disabled</td><td>Control disabled</td></tr>
<tr><td>Brake switch signal system</td><td>B1484</td><td>Not illuminated</td><td>Not illuminated</td><td>Control enabled</td><td>Control enabled</td></tr>
<tr><td>ABS HU/CM configuration system</td><td>B2477</td><td>Flash</td><td>Not illuminated</td><td>Control disabled</td><td>Control enabled</td></tr>
<tr><td rowspan="4">ABS sensor rotor</td><td>C1141</td><td rowspan="16">Illuminated</td><td rowspan="16">Not illuminated</td><td rowspan="16">Control disabled</td><td rowspan="16">Control enabled</td></tr>
<tr><td>C1142</td></tr>
<tr><td>C1143</td></tr>
<tr><td>C1144</td></tr>
<tr><td rowspan="8">ABS wheel-speed sensor system</td><td>C1145</td></tr>
<tr><td>C1148</td></tr>
<tr><td>C1155</td></tr>
<tr><td>C1158</td></tr>
<tr><td>C1165</td></tr>
<tr><td>C1168</td></tr>
<tr><td>C1175</td></tr>
<tr><td>C1178</td></tr>
<tr><td rowspan="4">ABS wheel-speed sensor/ABS sensor rotor systems</td><td>C1233</td></tr>
<tr><td>C1234</td></tr>
<tr><td>C1235</td></tr>
<tr><td>C1236</td></tr>
<tr><td rowspan="8">Solenoid valve system</td><td>C1194</td><td rowspan="8">Illuminated</td><td rowspan="8">Illuminated</td><td rowspan="8">Control disabled</td><td rowspan="8">Control disabled</td></tr>
<tr><td>C1198</td></tr>
<tr><td>C1210</td></tr>
<tr><td>C1214</td></tr>
<tr><td>C1242</td></tr>
<tr><td>C1246</td></tr>
<tr><td>C1250</td></tr>
<tr><td>C1254</td></tr>
<tr><td rowspan="2">Valve relay system</td><td>C1186</td><td rowspan="2">Illuminated</td><td>Illuminated</td><td rowspan="2">Control disabled</td><td>Control disabled</td></tr>
<tr><td>C1266</td><td>Not illuminated</td><td>Control enabled</td></tr>
<tr><td rowspan="2">Pump motor, motor relay systems</td><td>C1095</td><td rowspan="2">Illuminated</td><td rowspan="2">Illuminated</td><td rowspan="2">Control disabled</td><td rowspan="2">Control enabled</td></tr>
<tr><td>C1096</td></tr>
<tr><td rowspan="3">CAN communication system</td><td>U0073</td><td rowspan="3">Not illuminated</td><td rowspan="3">Not illuminated</td><td rowspan="3">Control enabled</td><td rowspan="3">Control enabled</td></tr>
<tr><td>U1900</td></tr>
<tr><td>U2023</td></tr>
</table>

[*1] : If the ignition voltage returns to normal, the light goes out.
[*2] : If the ignition voltage returns to normal, control is enabled.

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	B1317	Illuminated *1	Illuminated *1	Illuminated *1	Not illuminated	Control disabled *2	Control disabled *2	Control disabled *2	Control disabled *2
	B1318								
DSC HU/CM system	B1342	Illuminated	Illuminated	Illuminated	Not illuminated	Control disabled	Control disabled	Control disabled	Control disabled
	C1730	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
Brake switch signal system	B1484	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
	C1954								
DSC HU/CM configuration system	B2477	Flash	Not illuminated	Flash	Not illuminated	Control disabled	Control disabled	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	Illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
	C1096								
PCM communication system	C1134	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled	Control disabled
ABS sensor rotor	C1141	Illuminated	Not illuminated	Illuminated	Not illuminated	Control disabled	Control enabled	Control disabled	Control disabled
	C1142								
	C1143								
	C1144								
ABS wheel-speed sensor system	C1145								
	C1155								
	C1165								
	C1175								
	C1233								
	C1234								
	C1235								
	C1236								
ABS wheel-speed sensor/ ABS sensor rotor systems	C1148								
	C1158								
	C1168								
	C1178								
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	Illuminated	Illuminated	Illuminated	Not illuminated	Control disabled	Control disabled	Control disabled	Control disabled
	C1266		Not illuminated		Illuminated		Control enabled		

<table>
<tr><th rowspan="3">Malfunction location</th><th rowspan="2">DTC number</th><th colspan="8">Fail-safe function</th></tr>
<tr><th colspan="4">Warning light illumination status</th><th colspan="4">Control status</th></tr>
<tr><th>WDS or equivalent Display</th><th>ABS warning light</th><th>Brake system warning light (when parking brake is released)</th><th>DSC indicator light</th><th>DSC OFF light</th><th>ABS control</th><th>EBD Control</th><th>TCS control</th><th>DSC control</th></tr>
<tr><td rowspan="12">Solenoid valve system</td><td>C1194</td><td rowspan="12">Illuminated</td><td rowspan="12">Illuminated</td><td rowspan="12">Illuminated</td><td rowspan="12">Not illuminated</td><td rowspan="12">Control disabled</td><td rowspan="12">Control disabled</td><td rowspan="12">Control disabled</td><td rowspan="12">Control disabled</td></tr>
<tr><td>C1198</td></tr>
<tr><td>C1210</td></tr>
<tr><td>C1214</td></tr>
<tr><td>C1242</td></tr>
<tr><td>C1246</td></tr>
<tr><td>C1250</td></tr>
<tr><td>C1254</td></tr>
<tr><td>C1400</td></tr>
<tr><td>C1410</td></tr>
<tr><td>C1957</td></tr>
<tr><td>C1958</td></tr>
<tr><td rowspan="3">Brake fluid pressure sensor system</td><td>C1288</td><td rowspan="3">Illuminated</td><td rowspan="3">Not illuminated</td><td rowspan="3">Illuminated</td><td rowspan="3">Not illuminated</td><td rowspan="3">Control disabled</td><td rowspan="3">Control enabled</td><td rowspan="3">Control disabled</td><td rowspan="3">Control disabled</td></tr>
<tr><td>C1290</td></tr>
<tr><td>C1953</td></tr>
<tr><td rowspan="6">Steering angle sensor system</td><td>C1295</td><td rowspan="6">Not illuminated</td><td rowspan="6">Not illuminated</td><td rowspan="6">Illuminated</td><td>Not illuminated</td><td rowspan="6">Control enabled</td><td rowspan="6">Control enabled</td><td rowspan="6">Control disabled</td><td rowspan="6">Control disabled</td></tr>
<tr><td>C1306</td><td>Flash</td></tr>
<tr><td>C1307</td><td rowspan="4">Not illuminated</td></tr>
<tr><td>C1937</td></tr>
<tr><td>C1938</td></tr>
<tr><td>C1956</td></tr>
<tr><td rowspan="8">Combined sensor system</td><td>C1279</td><td rowspan="8">Not illuminated</td><td rowspan="8">Not illuminated</td><td rowspan="8">Illuminated</td><td rowspan="8">Not illuminated</td><td rowspan="8">Control enabled</td><td rowspan="8">Control enabled</td><td rowspan="8">Control disabled</td><td rowspan="8">Control disabled</td></tr>
<tr><td>C1280</td></tr>
<tr><td>C1281</td></tr>
<tr><td>C1282</td></tr>
<tr><td>C1951</td></tr>
<tr><td>C1952</td></tr>
<tr><td>C1959</td></tr>
<tr><td>C2768</td></tr>
<tr><td>Incorrect DSC HU/CM installed</td><td>C1805</td><td>Illuminated</td><td>Illuminated</td><td>Illuminated</td><td>Not illuminated</td><td>Control disabled</td><td>Control disabled</td><td>Control disabled</td><td>Control disabled</td></tr>
<tr><td>DSC HU/CM control system</td><td>C1994</td><td>Illuminated *3</td><td>Not illuminated</td><td>Illuminated *3</td><td>Not illuminated</td><td>Control disabled *4</td><td>Control enabled</td><td>Control disabled *4</td><td>Control disabled *4</td></tr>
<tr><td rowspan="6">CAN communication system</td><td>U0073</td><td rowspan="6">Not illuminated</td><td rowspan="6">Not illuminated</td><td rowspan="6">Illuminated</td><td rowspan="6">Not illuminated</td><td rowspan="6">Control enabled</td><td rowspan="6">Control enabled</td><td rowspan="6">Control disabled</td><td rowspan="6">Control disabled</td></tr>
<tr><td>U0100</td></tr>
<tr><td>U0101</td></tr>
<tr><td>U0155</td></tr>
<tr><td>U1900</td></tr>
<tr><td>U2023</td></tr>
</table>

*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.

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

E5U040243750N03

- 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_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
CCNTABS	Number of continuous DTCs	—
LF_WSPD	ABS wheel-speed sensor (LF)	KPH, MPH
LR_WSPD	ABS wheel-speed sensor (LR)	KPH, MPH
PMP_MOTOR	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_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
CCNTABS	Number of continuous DTCs	—
LAT_ACCL	Combined sensor (lateral-G value)	G
LF_WSPD	ABS wheel-speed sensor (LF)	KPH, MPH
LR_WSPD	ABS wheel-speed sensor (LR)	KPH, MPH
MCYLI P	Brake fluid pressure sensor	Pa, psi
PMP_MOTOR	Pump motor	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	°
TPI	PCM (throttle opening angle)	%
V_STB_L	LF stability control solenoid valve	On/Off
V_STB_R	RF stability control solenoid valve	On/Off
V_TRC_L	LF traction control solenoid valve	On/Off
V_TRC_R	RF traction control solenoid valve	On/Off
YAW_RATE	Combined sensor (yaw rate value)	°/s

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

E5U040243750N04

- 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
LF_INLET	LF inlet solenoid valve	On/Off	Ignition switch at ON
LF_OUTLET	LF outlet solenoid valve		
LR_INLET	LR inlet solenoid valve		
LR_OUTLET	LR outlet solenoid valve		
PMP_MOTOR	Pump motor		
RF_INLET	RF inlet solenoid valve		
RF_OUTLET	RF outlet solenoid valve		
RR_INLET	RR inlet solenoid valve		
RR_OUTLET	RR outlet solenoid valve		

Active Command Modes Table (Vehicles with DSC)

Command name	Output part name	Operation	Operation condition
LATACCEL	Combined sensor (lateral acceleration) initialization	FALSE/TRUE	Ignition switch at ON
LF_INLET	LF inlet solenoid valve	On/Off	
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		
SAS_CAL	Steering angle sensor initialization	FALSE/TRUE	
STAB_IND	DSC indicator light	On/Off	
TRAC_OFF	DSC OFF switch		
V_STB_L	LF stability control solenoid valve		
V_STB_R	RF stability control solenoid valve		
V_TRC_L	LF traction control solenoid valve		
V_TRC_R	RF traction control solenoid valve		
YAWRATE	Combined sensor (yaw rate) initialization		

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

E5U040243750N05

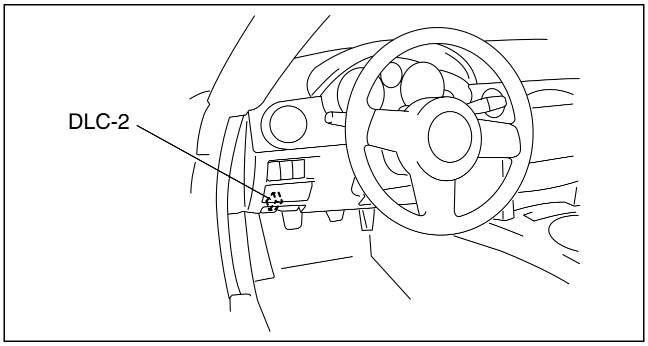
- The external tester communication function enables communication of diagnostic data (DTC read-outs, input/output signal read-outs, and operation of input/output parts) between the ABS HU/CM or the DSC HU/CM and an external tester.

Connections and Communication Contents

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

Serial communication

- Serial communication (two-way communication) allows for multiple data to be sent and received instantly along the same line.
- By connecting the WDS or equivalent to the DLC-2, diagnostic data can be sent and received between the WDS or equivalent and the ABS HU/CM or DSC HU/CM using the CAN_H and CAN_L terminals (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.



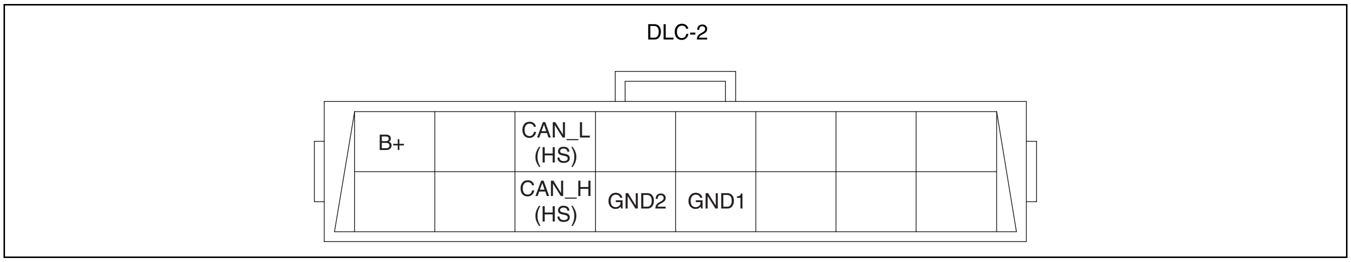
E5U402AW5001

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

E5U040243750N06

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



E5U402ZS5002

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

04–11 CONVENTIONAL BRAKE SYSTEM

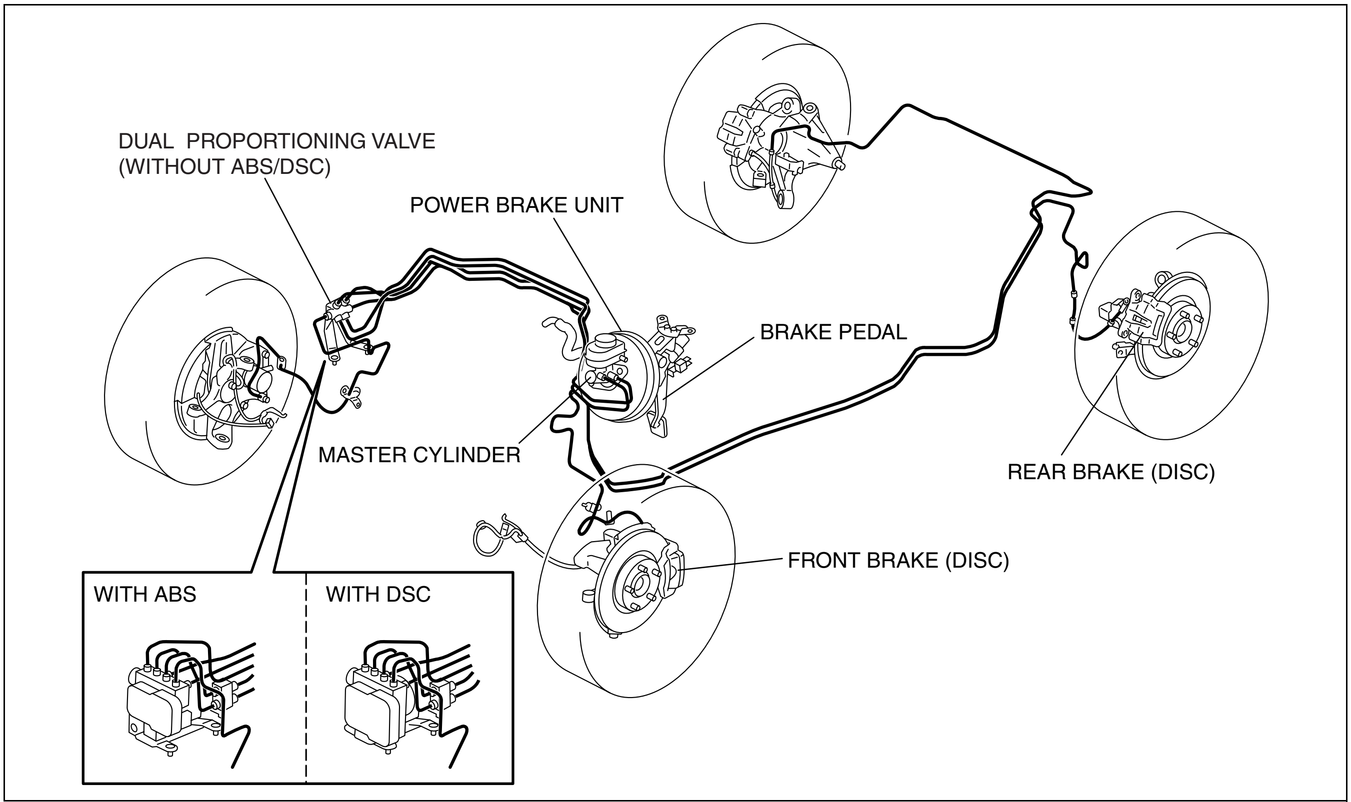
CONVENTIONAL BRAKE SYSTEM OUTLINE

E5U041100000N01

- 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, solid disc-type rear brake has been adopted, improving braking force.

CONVENTIONAL BRAKE SYSTEM STRUCTURAL VIEW

E5U041100000N02



E5U411ZS5001

INTRUSION-MINIMIZING BRAKE PEDAL FUNCTION

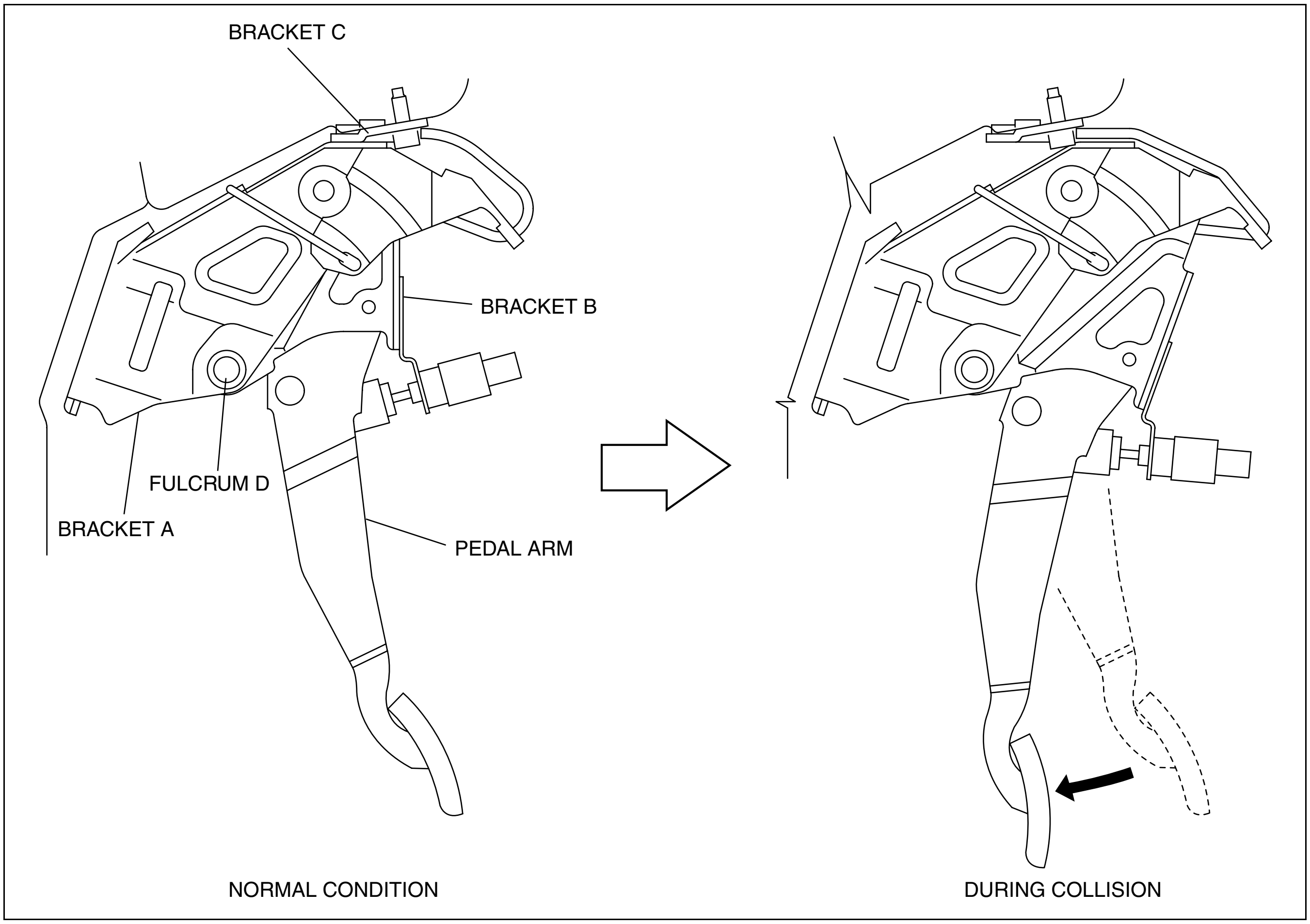
E5U041143300N01

- 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

E5U041143300N02

- 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.



E5U411ZS5002

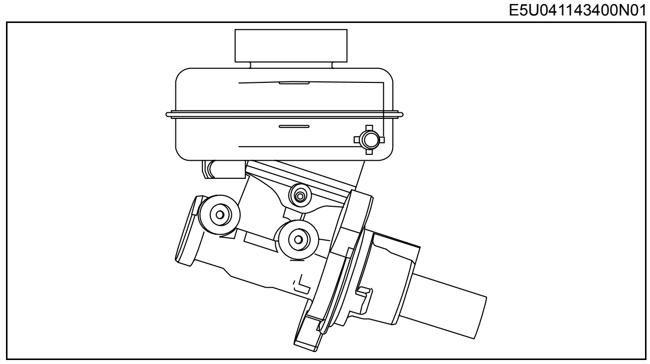
MASTER CYLINDER CONSTRUCTION

E5U041143400N01

- A plunger-type master cylinder with a **22.2 mm {0.87 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.



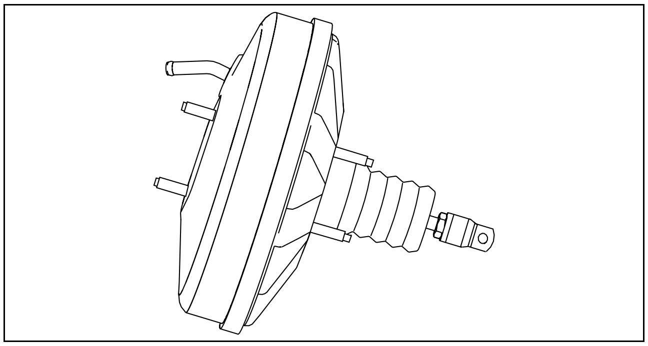
E5U411ZS5003

- 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.

POWER BRAKE UNIT CONSTRUCTION

E5U041143800N01

- A 9-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.

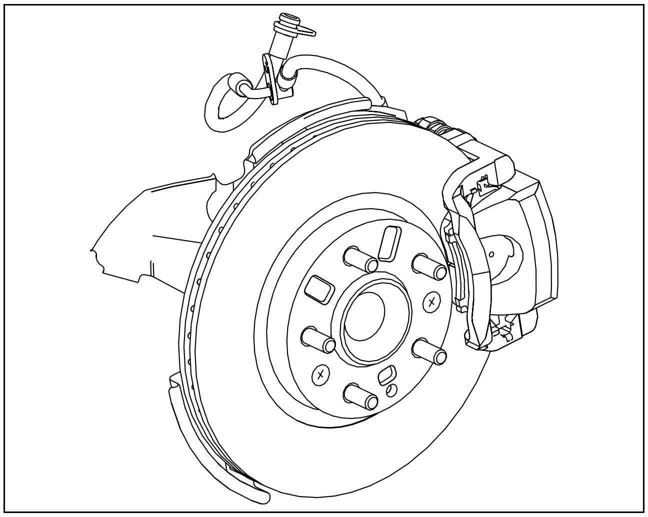


E5U411ZS5004

FRONT BRAKE (DISC) CONSTRUCTION

E5U041133980N01

- Large diameter, ventilated disc type front brakes with a **290 mm {11.4 in}** diameter and **22 mm {0.87 in}** thickness have been adopted for all models, improving braking force and fade resistance.

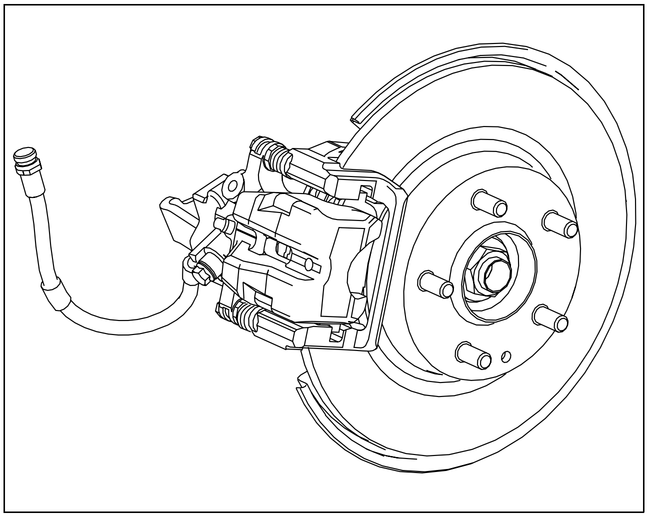


E5U411ZS5005

REAR BRAKE (DISC) CONSTRUCTION

E5U041126980N01

- A large diameter, solid disc type rear brake with a **280 mm {11.0 in}** diameter and **10 mm {0.39 in}** thickness has been adopted for all models, improving braking force and fade resistance.



E5U411ZS5006

04–12 PARKING BRAKE SYSTEM

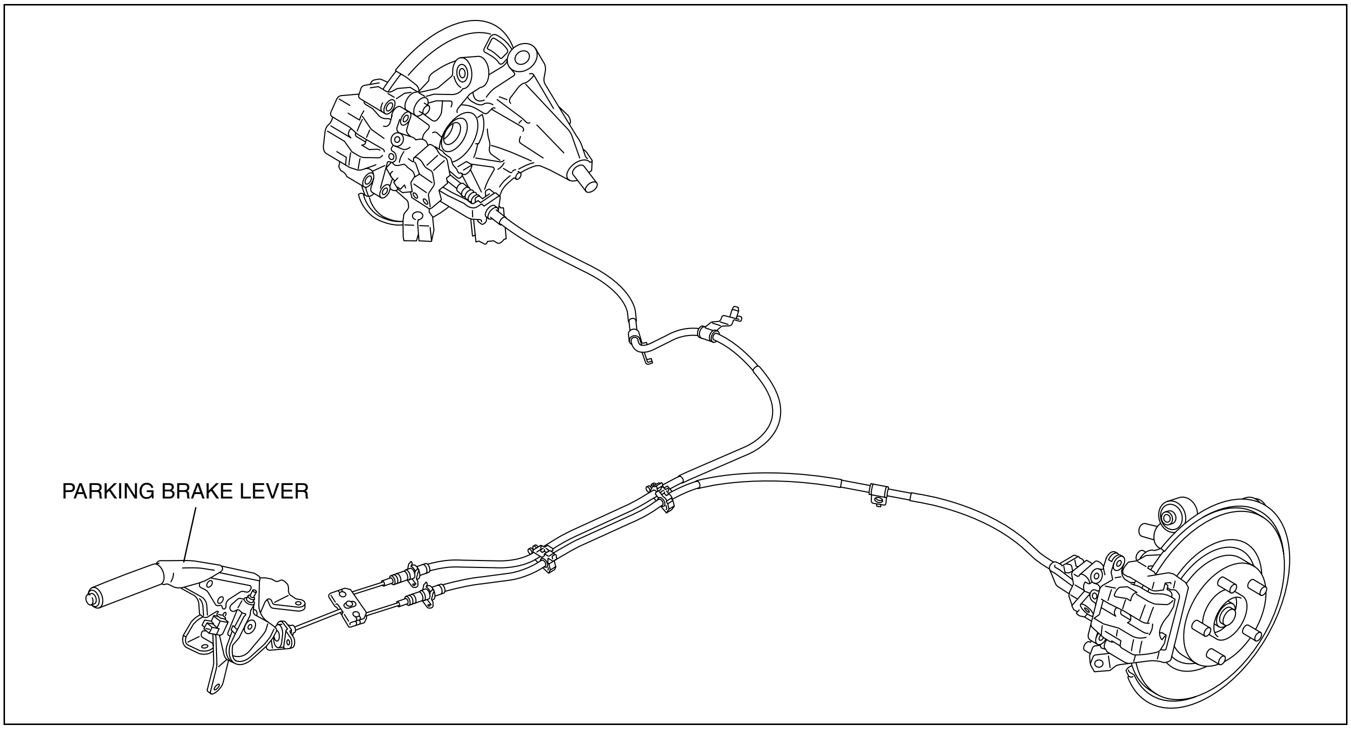
PARKING BRAKE SYSTEM OUTLINE

E5U041200000N01

- A center lever type parking brake that can be adjusted from the vehicle interior has been adopted, improving operability.

PARKING BRAKE SYSTEM STRUCTURAL VIEW

E5U041200000N02



E5U412ZS5001

04–13 ANTILOCK BRAKE SYSTEM

04–13

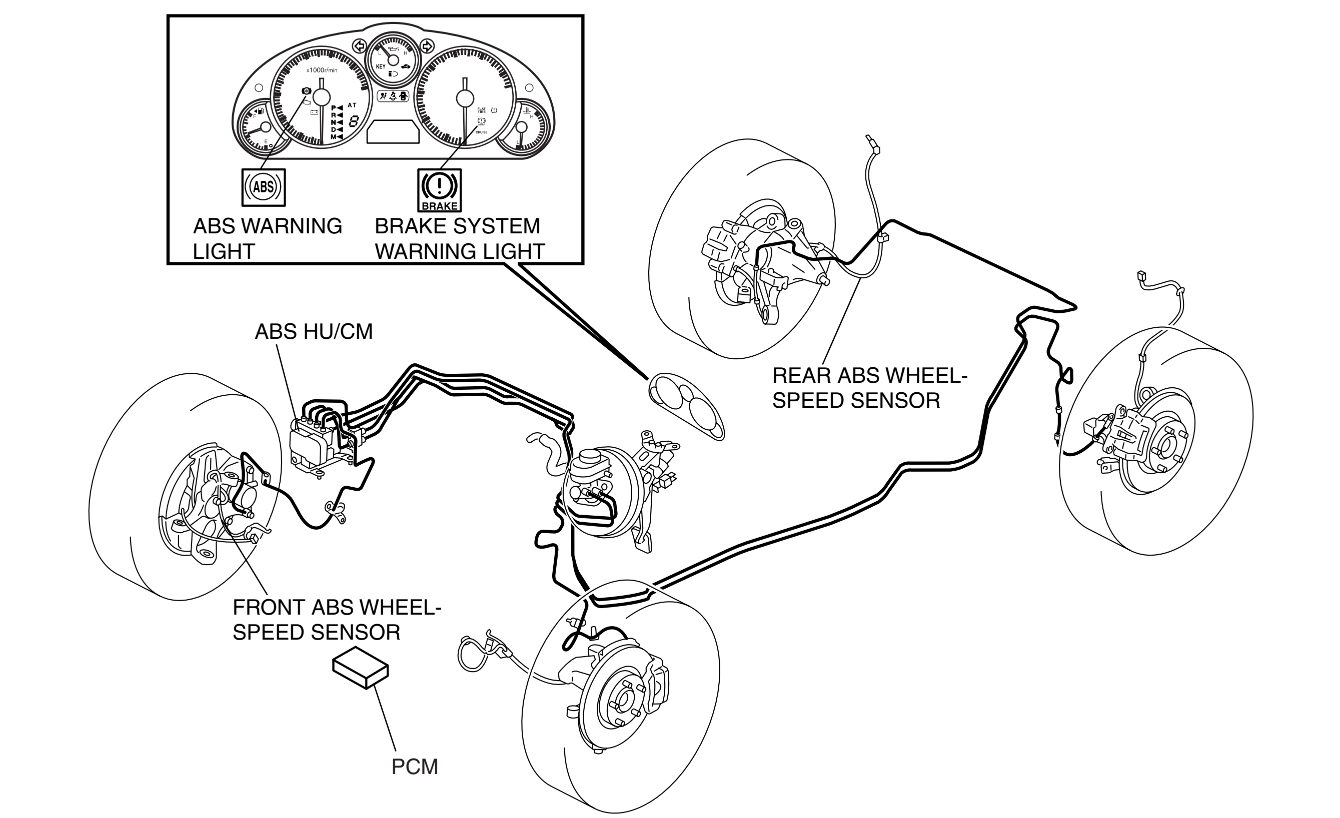
ABS OUTLINE

E5U041300000N01

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

ABS STRUCTURAL VIEW

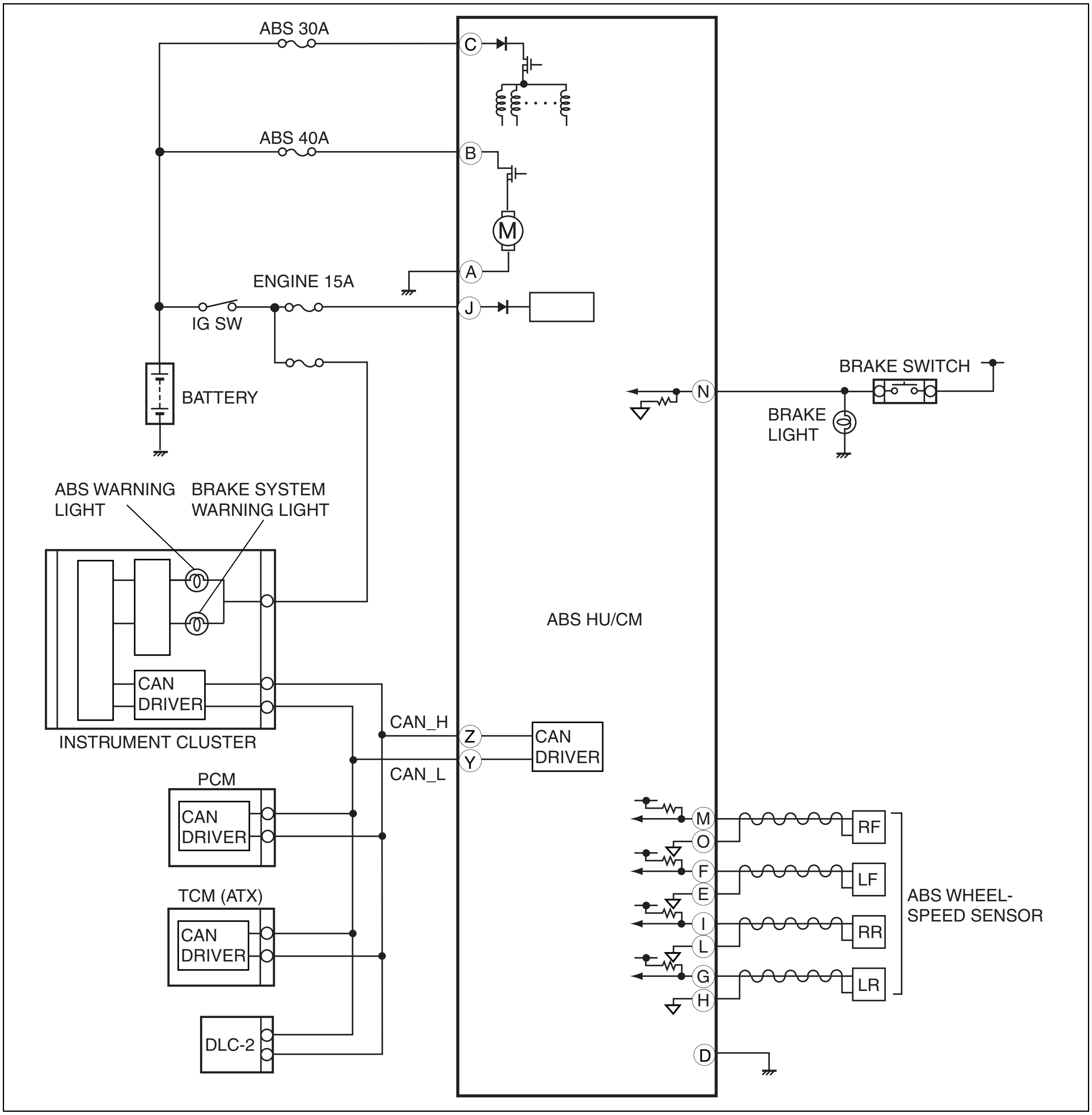
E5U041300000N02



E5U413ZS5001

ABS SYSTEM WIRING DIAGRAM

E5U041300000N03

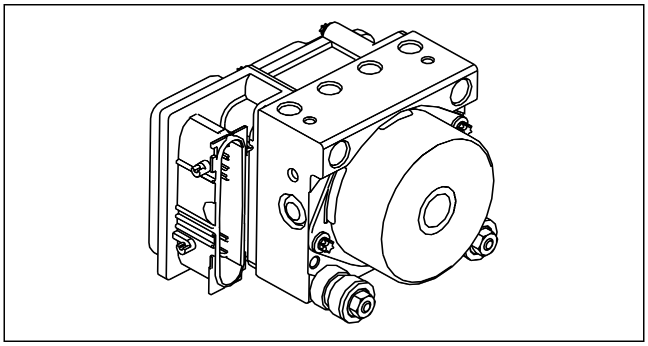


E5U403ZW5001

ABS HU/CM CONSTRUCTION

E5U041343750N01

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



E5U413ZS5002

ABS HU PART FUNCTION

E5U041343750N02

- 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

E5U041343750N03

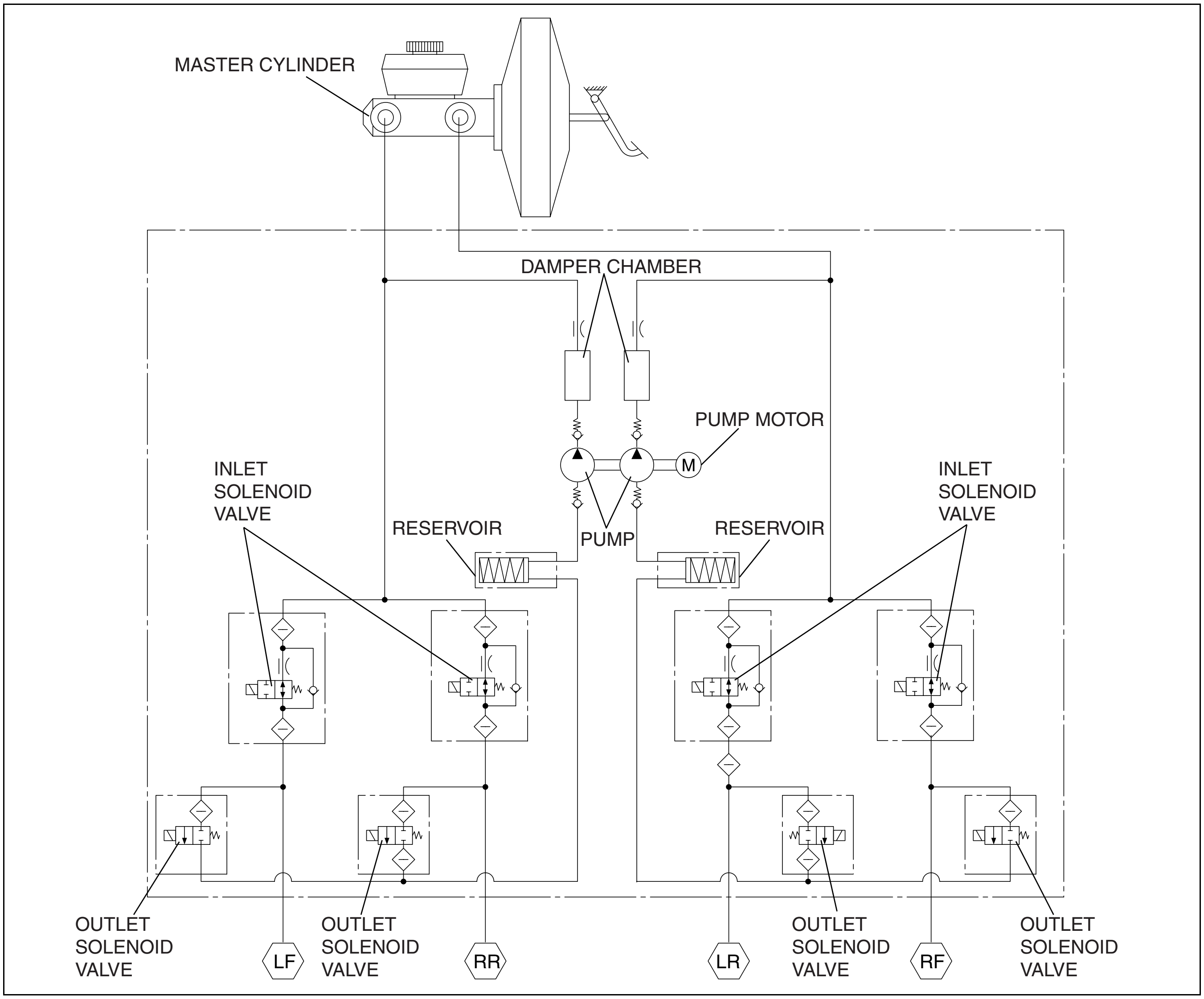
Construction

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

Function of main component Parts

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

Hydraulic circuit diagram



E5U413ZS5003

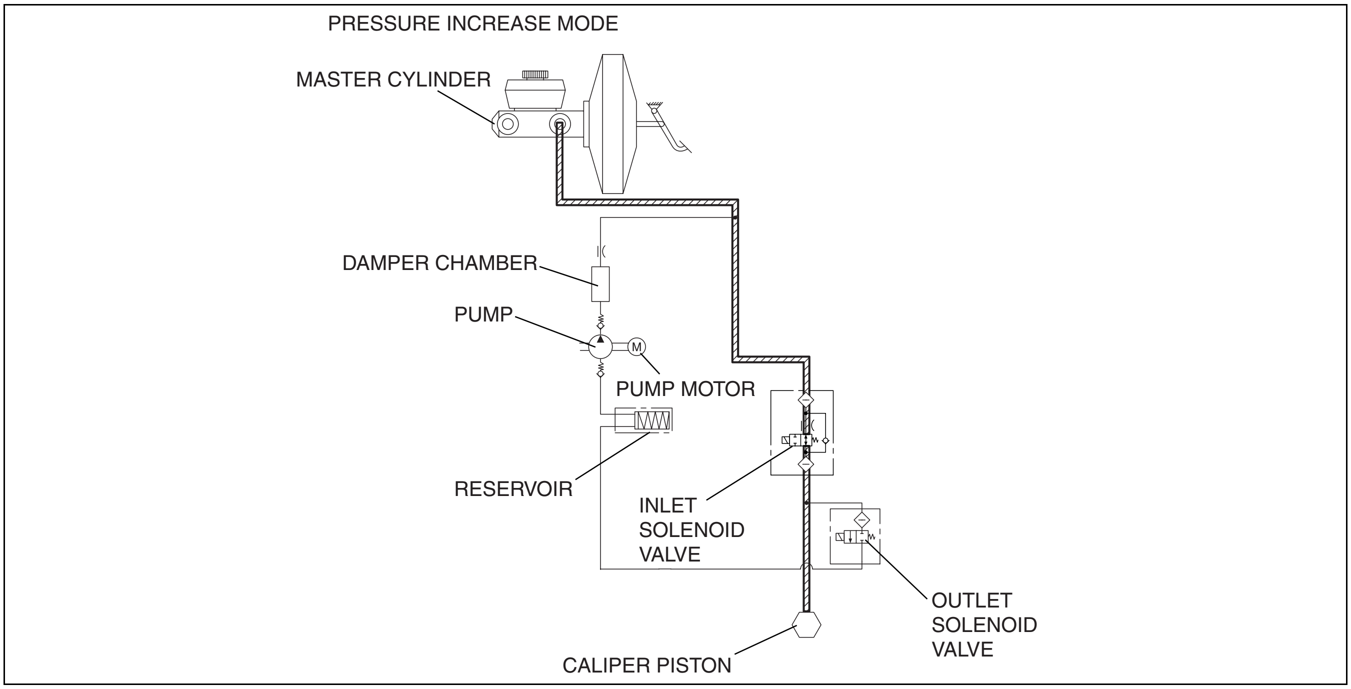
Operating

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



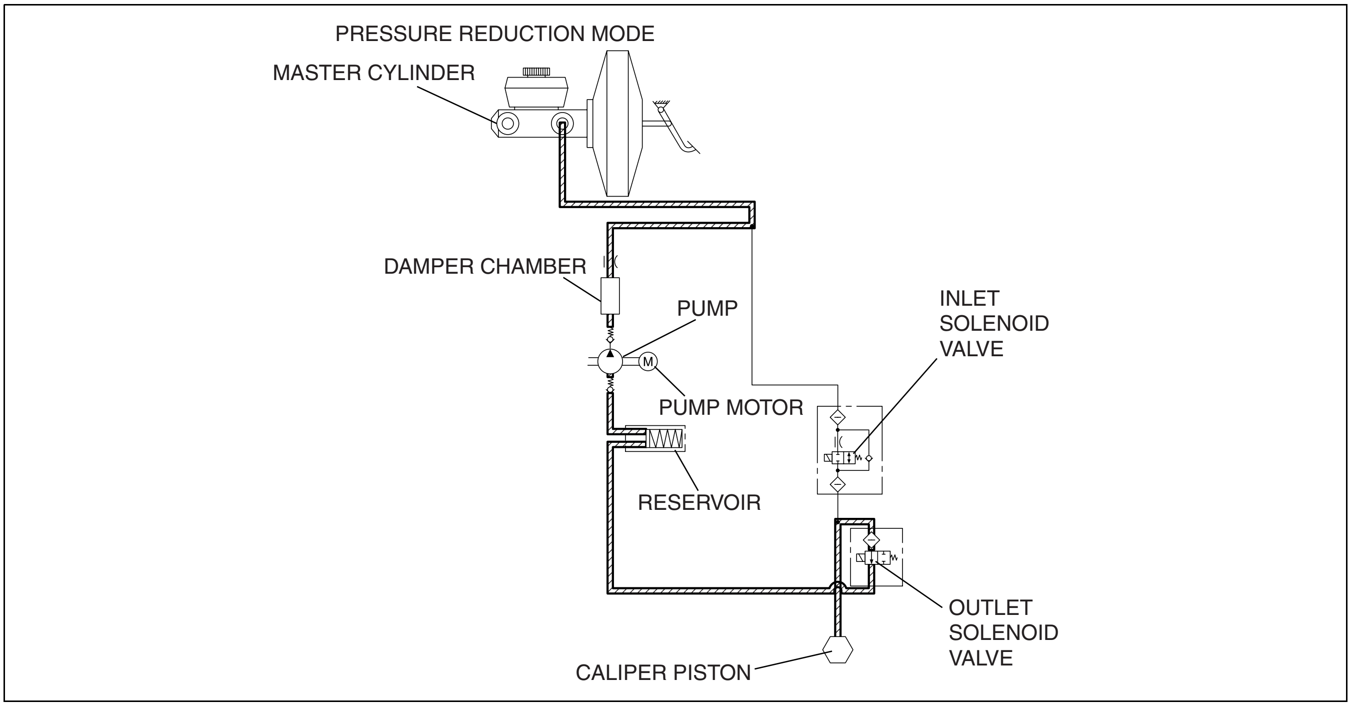
E5U413ZS5004

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



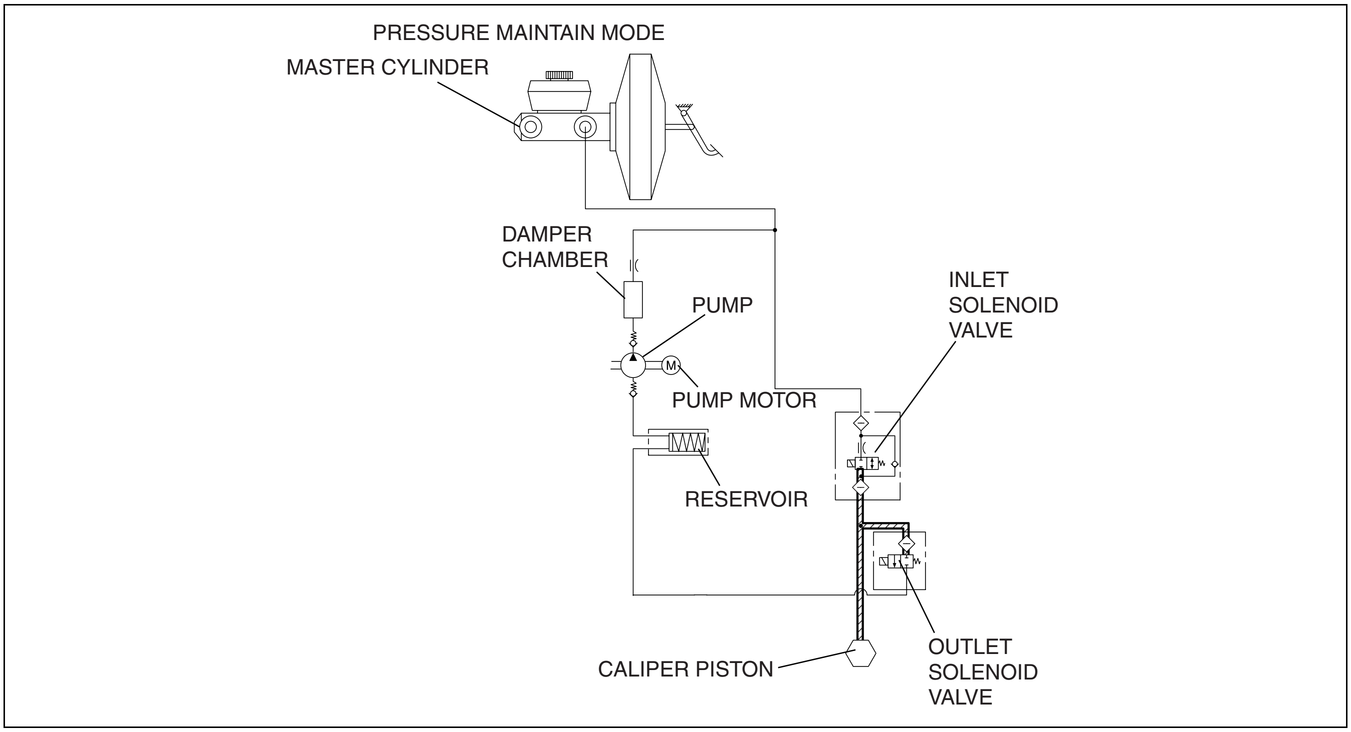
E5U413ZS5005

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



E5U413ZS5006

ABS CM PART FUNCTION

E5U041343750N04

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

Function Table

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

ABS CONTROL OUTLINE

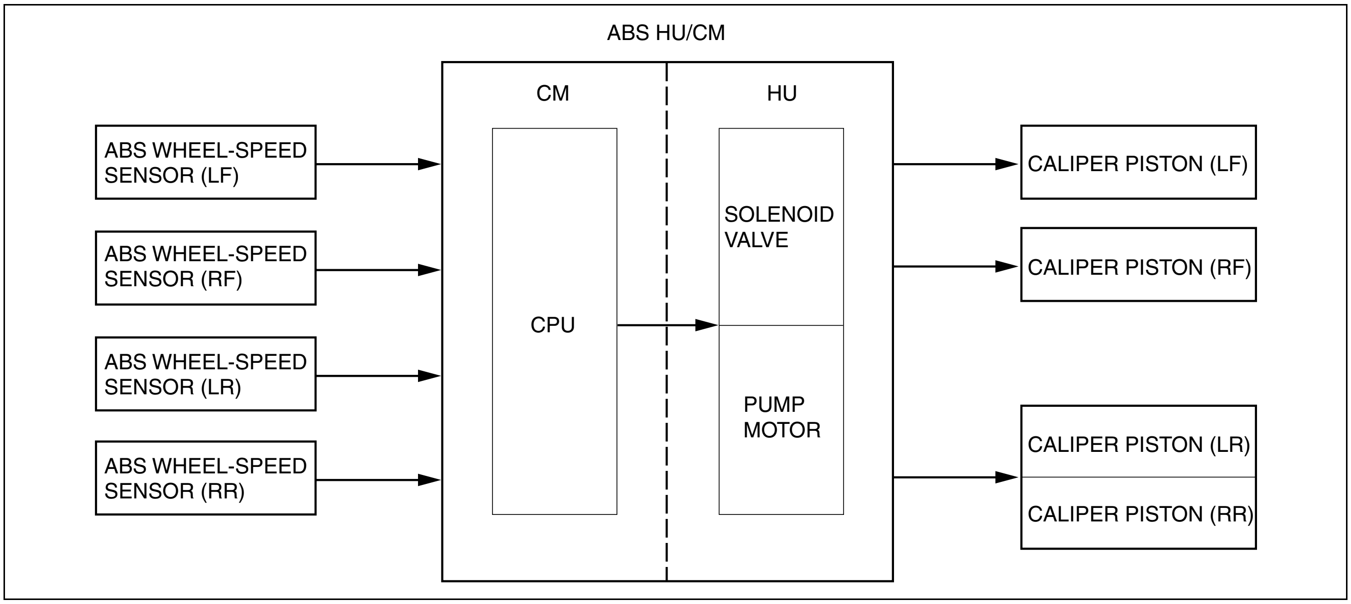
E5U041343750N05

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

Note

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

Block Diagram



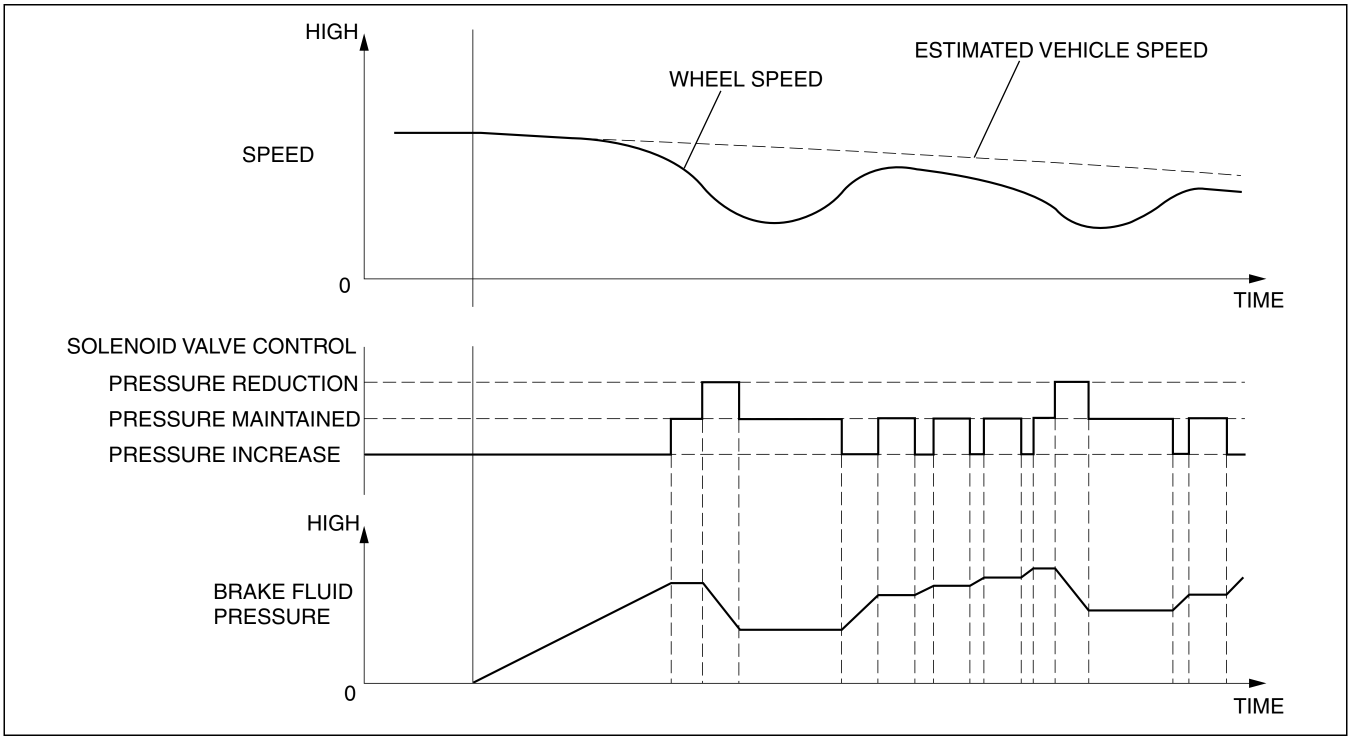
C3U0413S009

ABS CONTROL OPERATION

E5U041343750N06

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

Operating Condition Transition Diagram



C3U0413S010

EBD CONTROL OUTLINE

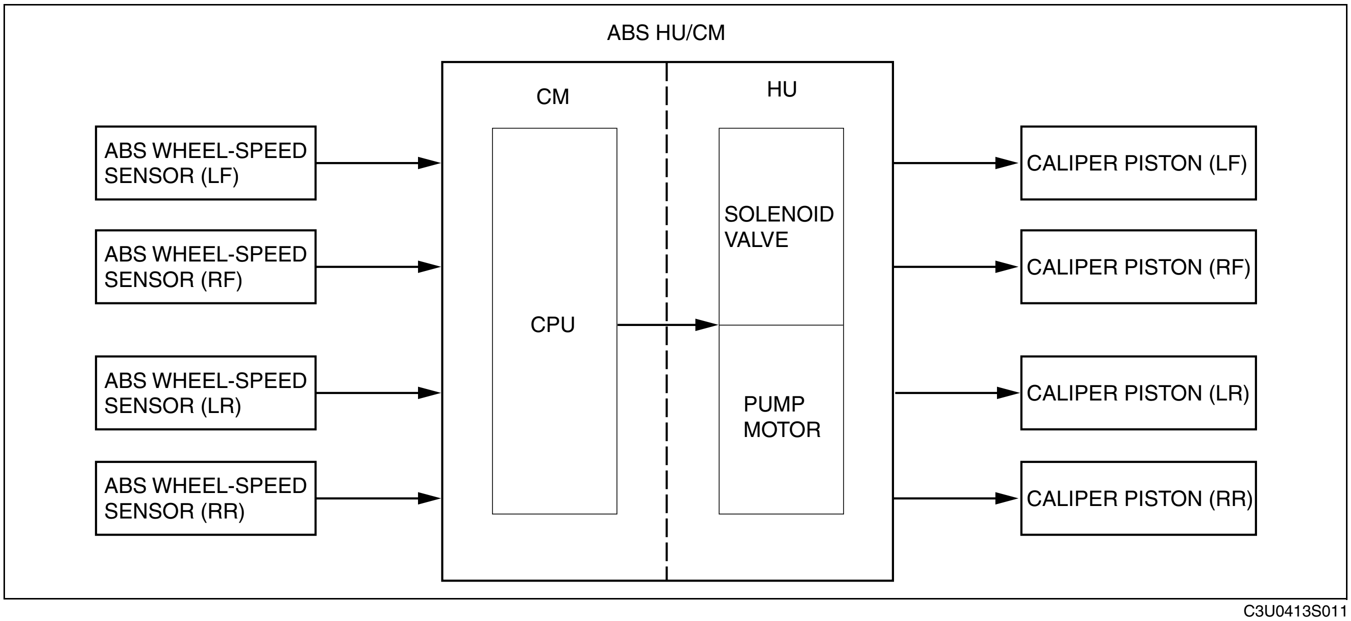
E5U041343750N07

- 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



EBD CONTROL OPERATION

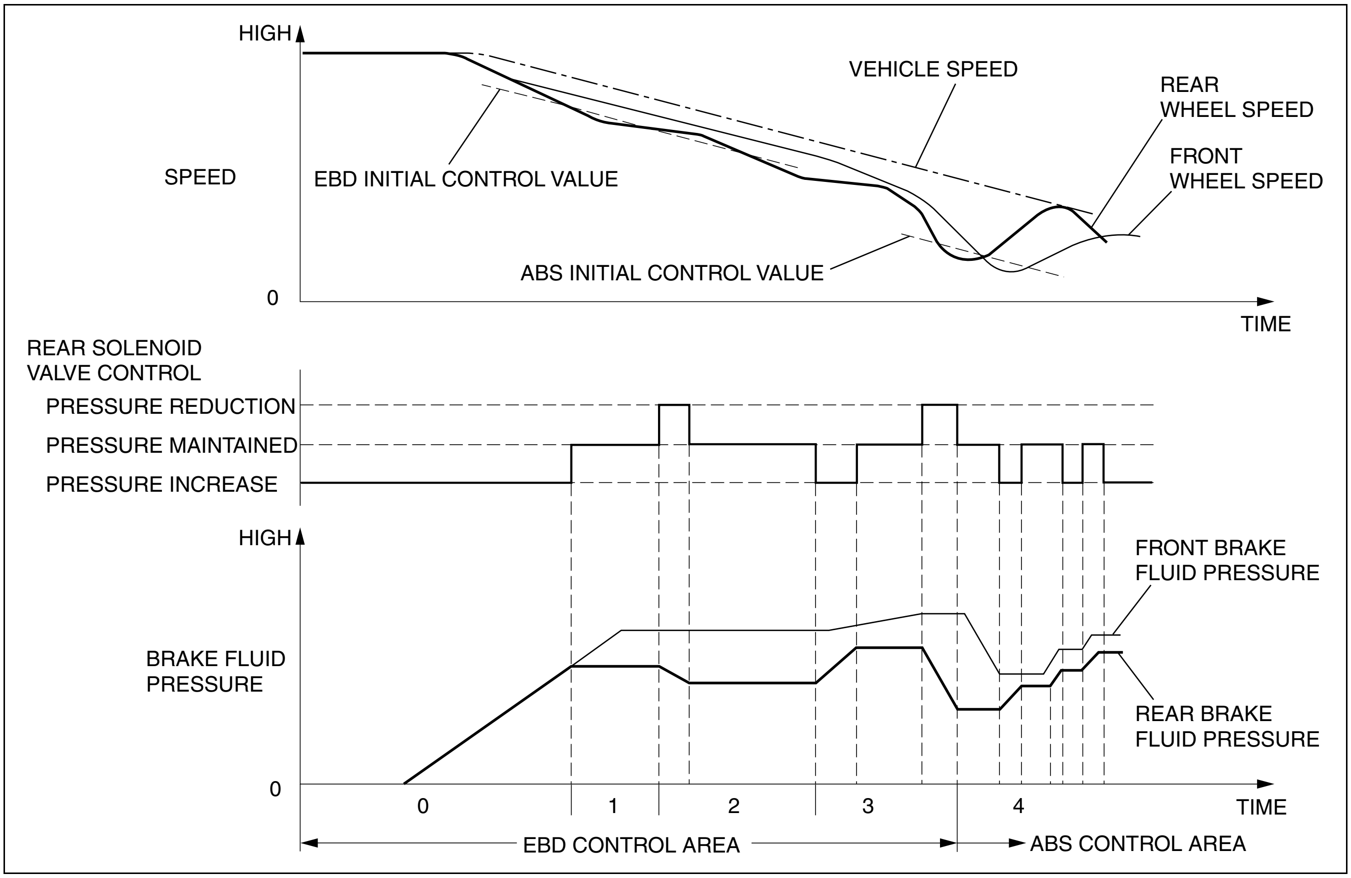
E5U041343750N08

- 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



C3U0413S012

CONTROLLER AREA NETWORK (CAN) OUTLINE

E5U041343750N09

- The ABS HU/CM sends and receives data to and from other modules via the CAN system. Refer to Section 09 for a detailed explanation of the CAN. (See 09–40–1 CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE.)

Data sent

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

Data received

- Brake pedal position
- Tire size

ABS WHEEL-SPEED SENSOR AND ABS SENSOR ROTOR FUNCTION

E5U041343720N01

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

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

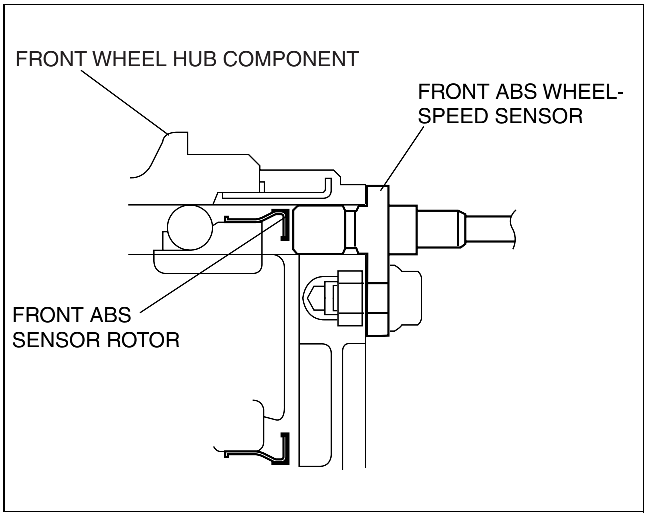
E5U041343720N02

Construction

Front

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

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



E5U413ZS5010

Caution

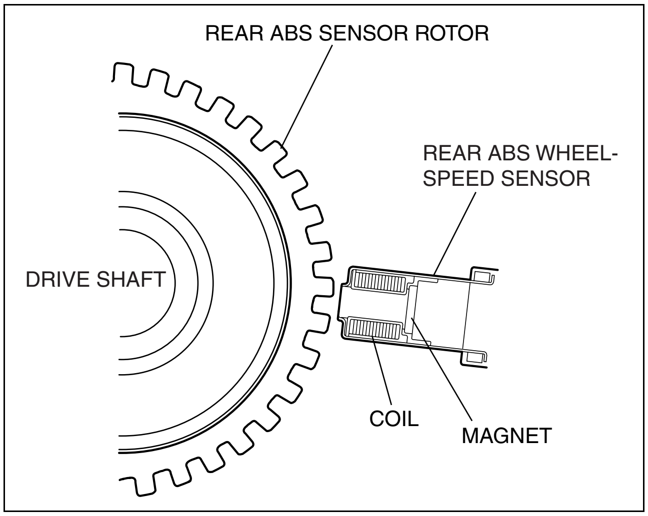
- **When inspecting the ABS wheel-speed sensor, do not use a tester to inspect resistance. It is possible that the voltage from the tester could damage the semiconductor inside the ABS wheel-speed sensor. Inspect using the PID data monitor of the WDS or equivalent.**

Note

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

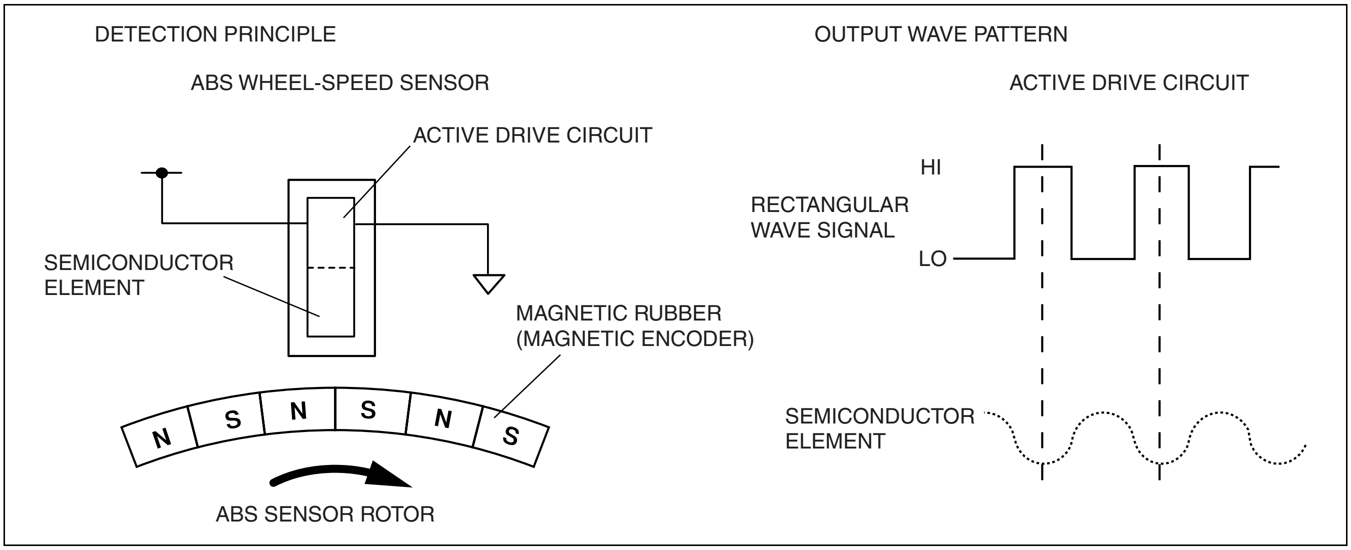
Rear

- 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 on the rear ABS sensor rotor, replace the drive shaft.



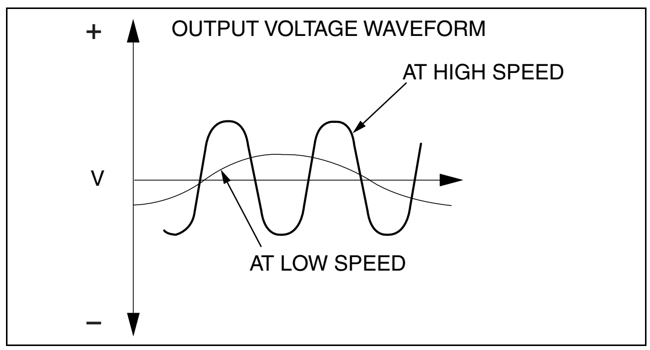
E5U413ZS5007

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



C3U0413S015

Rear
- 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.



E5U413ZS5008

04–15 DYNAMIC STABILITY CONTROL

DYNAMIC STABILITY CONTROL (DSC) OUTLINE

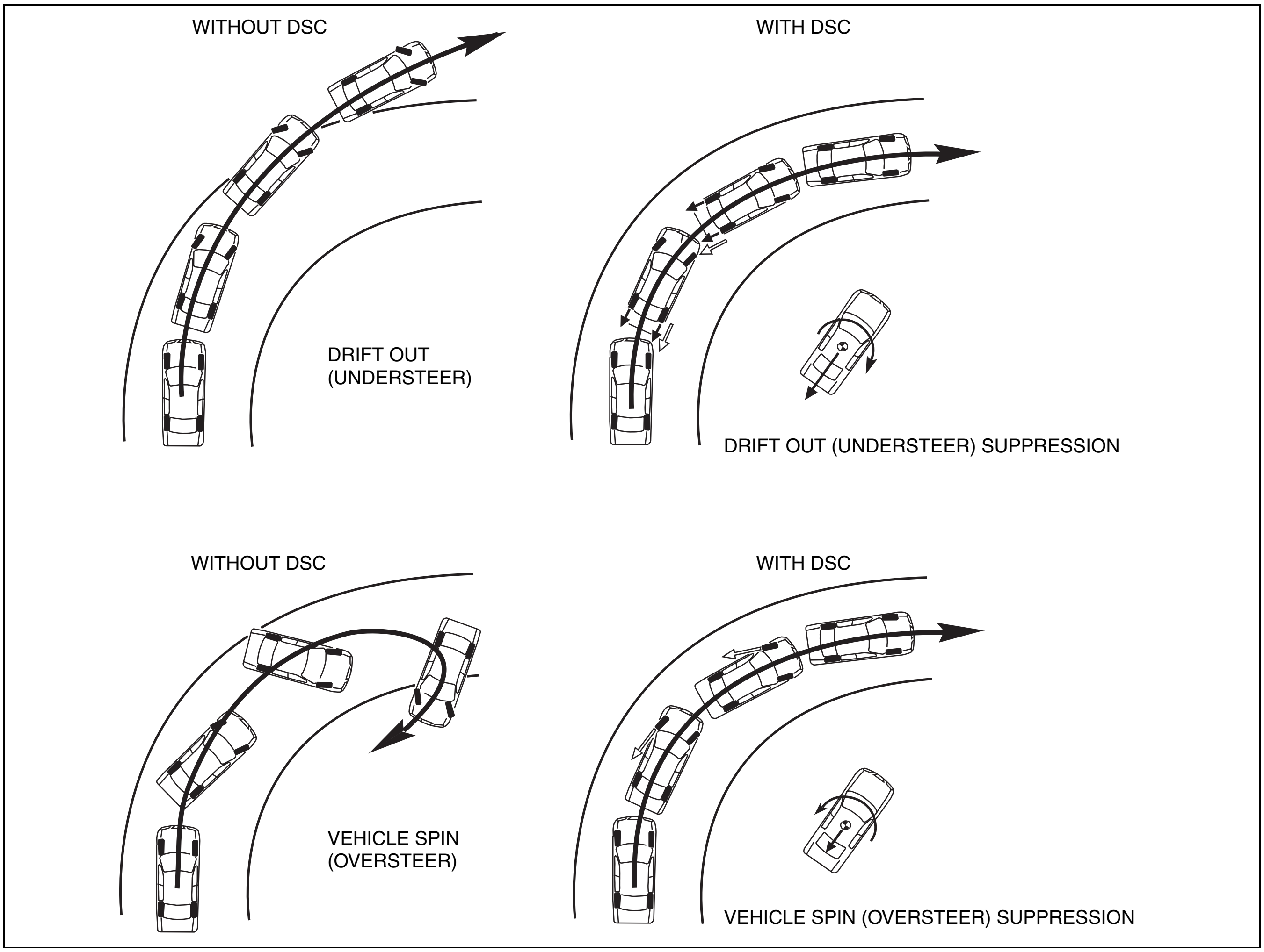
E5U041500000N01

- 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



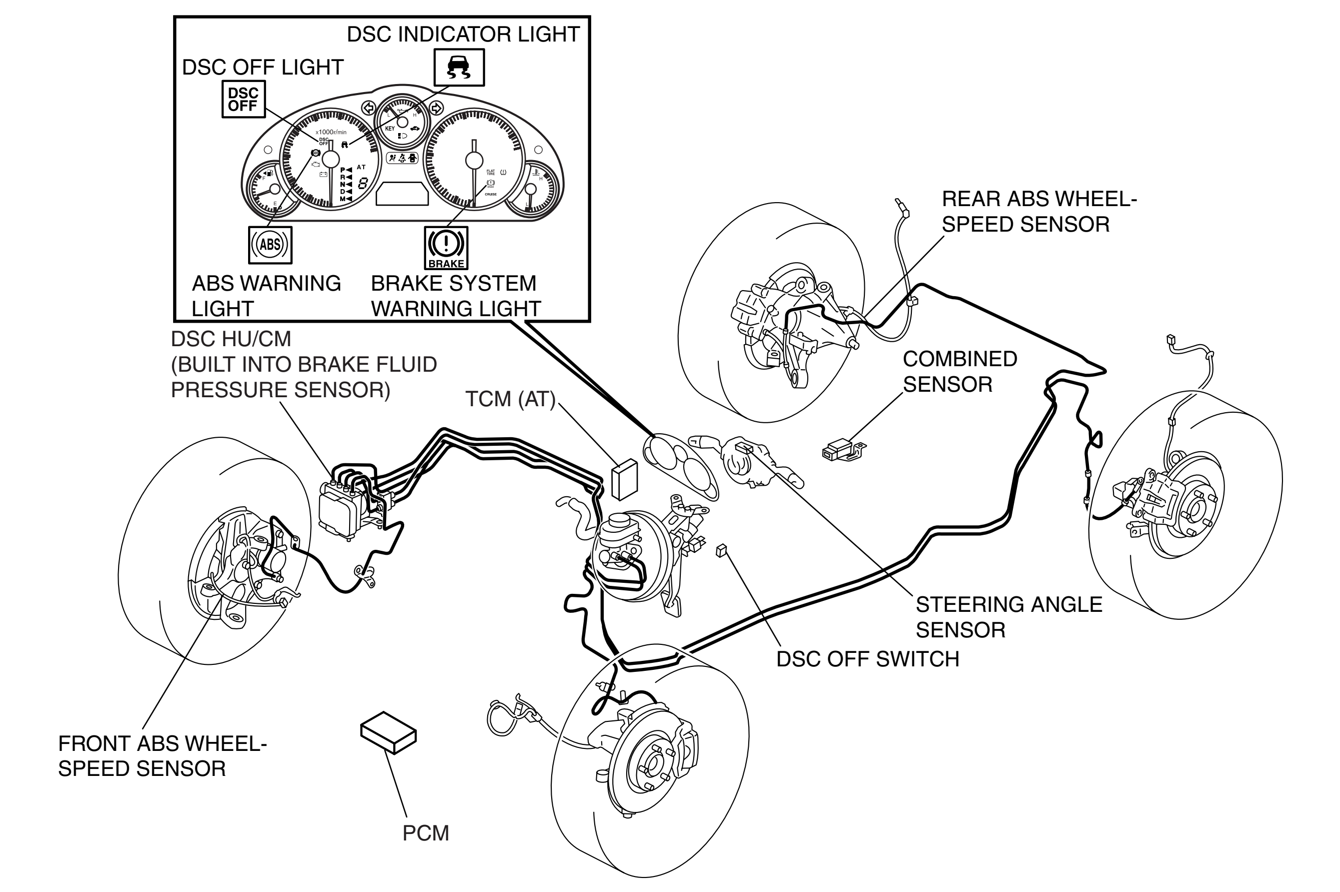
E5U415ZS5001

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

E5U041500000N02



E5U415ZS5002

DYNAMIC STABILITY CONTROL (DSC) CONSTRUCTION

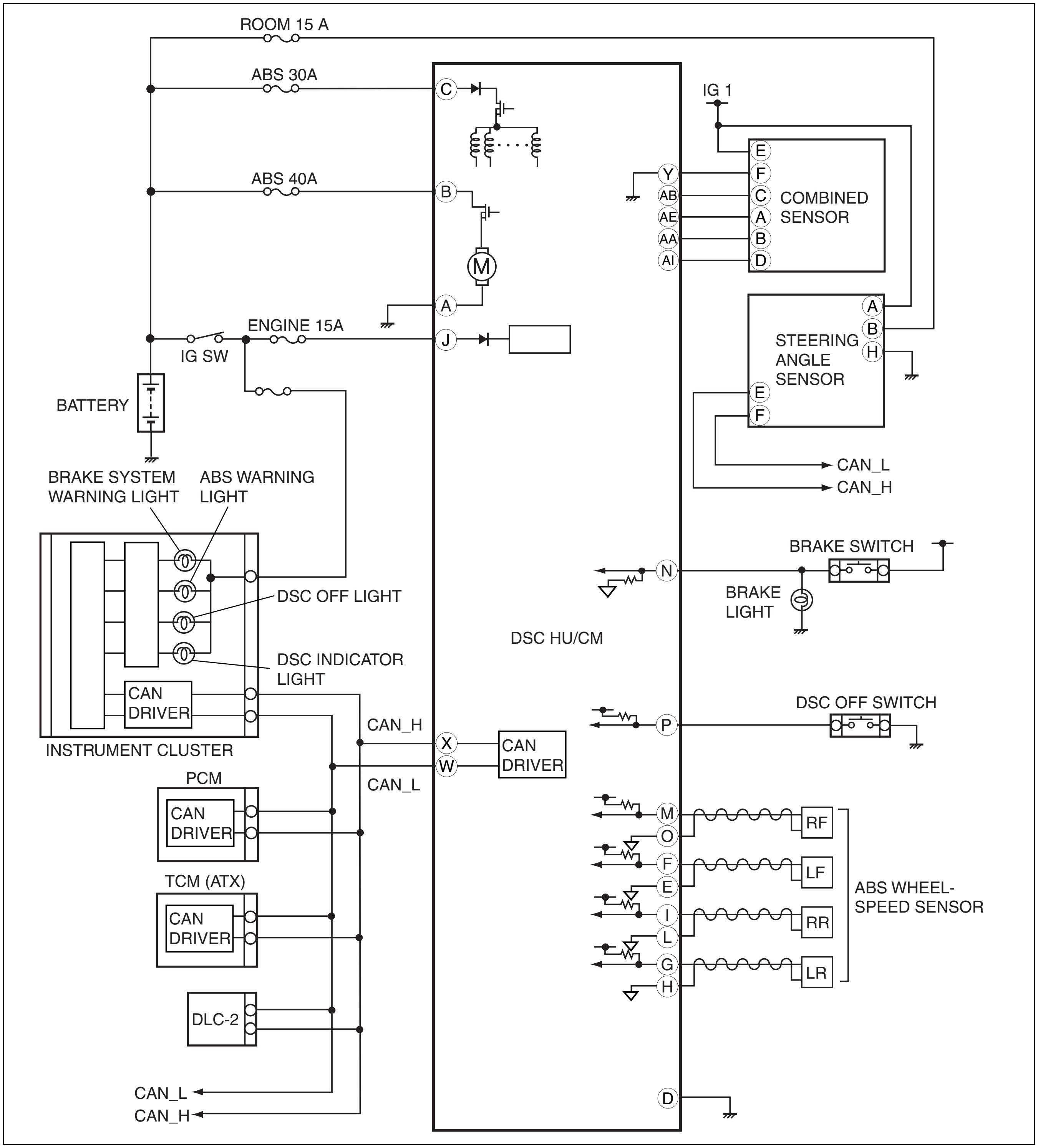
E5U041500000N03

- 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 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

E5U041500000N04

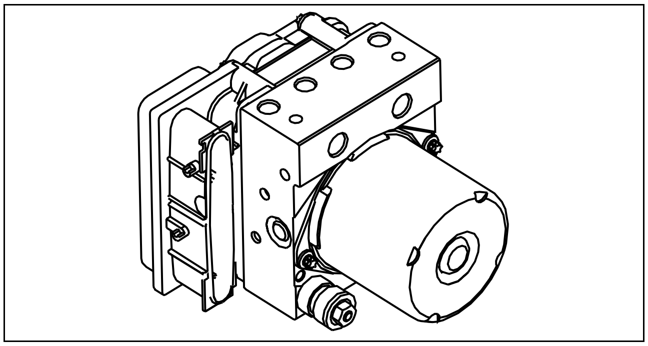


E5U403ZW5002

DSC HU/CM CONSTRUCTION

E5U041543750N01

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



E5U415ZS5003

DSC HU PART FUNCTION

E5U041543750N02

- 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

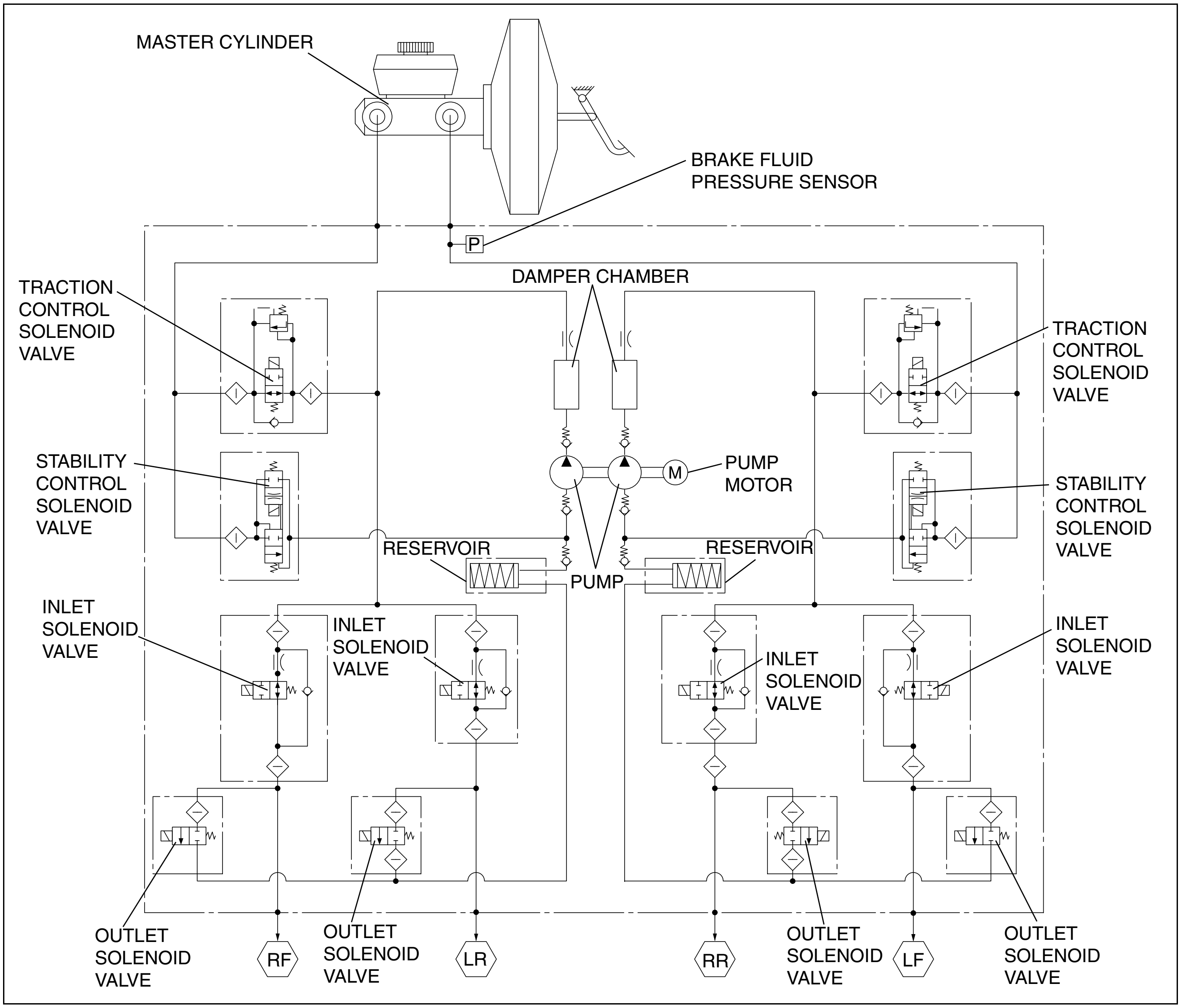
E5U041543750N03

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 control solenoid valve	• Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control and DSC control.
Reservoir	• Temporarily stores brake fluid from the caliper piston to ensure smooth pressure reduction during ABS and EBD control, TCS control and DSC control.
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



E5U415ZS5004

Operation

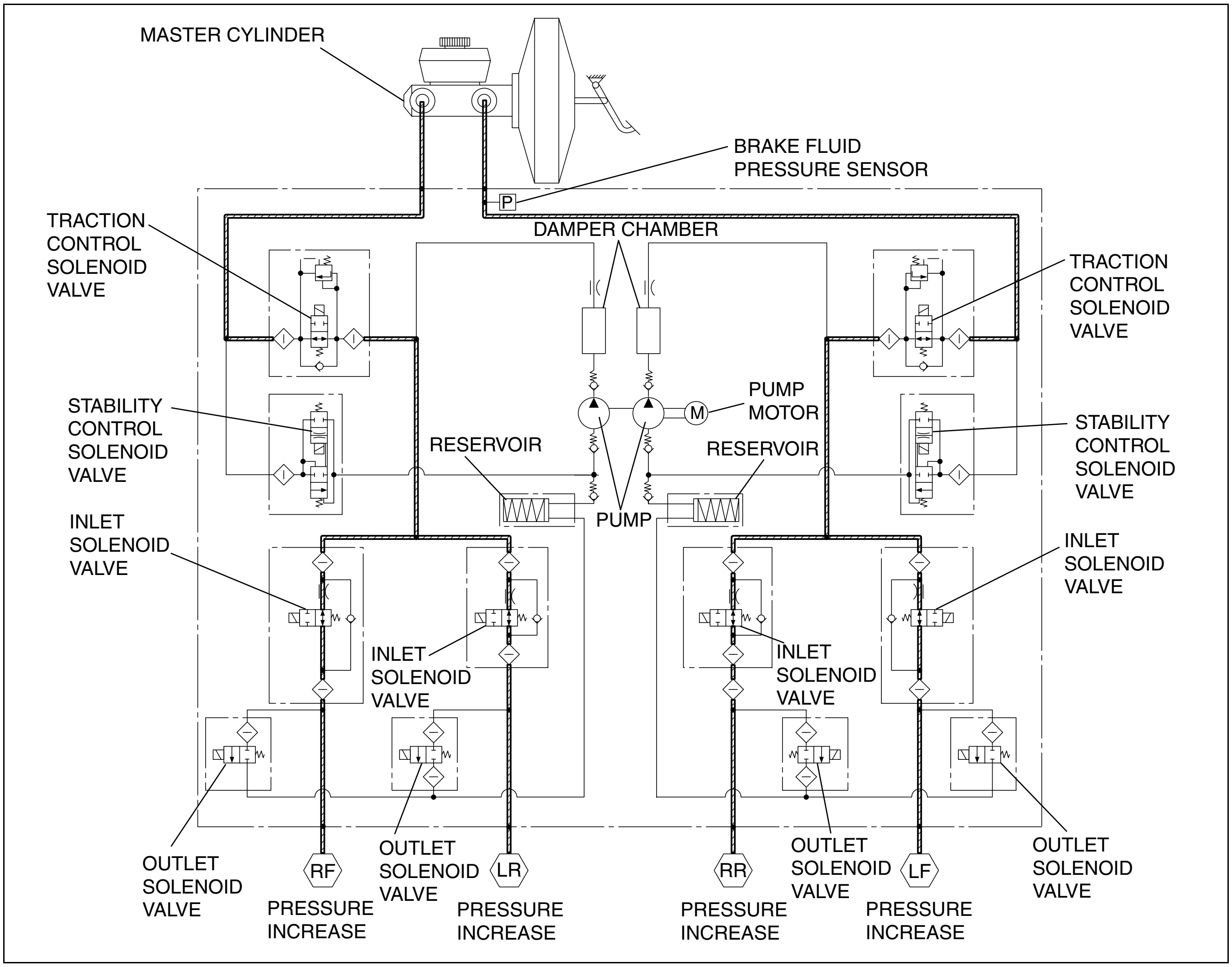
During normal braking

- During normal braking, the solenoid valves are not energized and all of them are off. When the brake pedal is depressed, brake fluid pressure is transmitted from the master cylinder, through the traction switch and inlet solenoid valves, and then to the caliper piston.

Solenoid valve operation table

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

Hydraulic circuit diagram



E5U415ZS5005

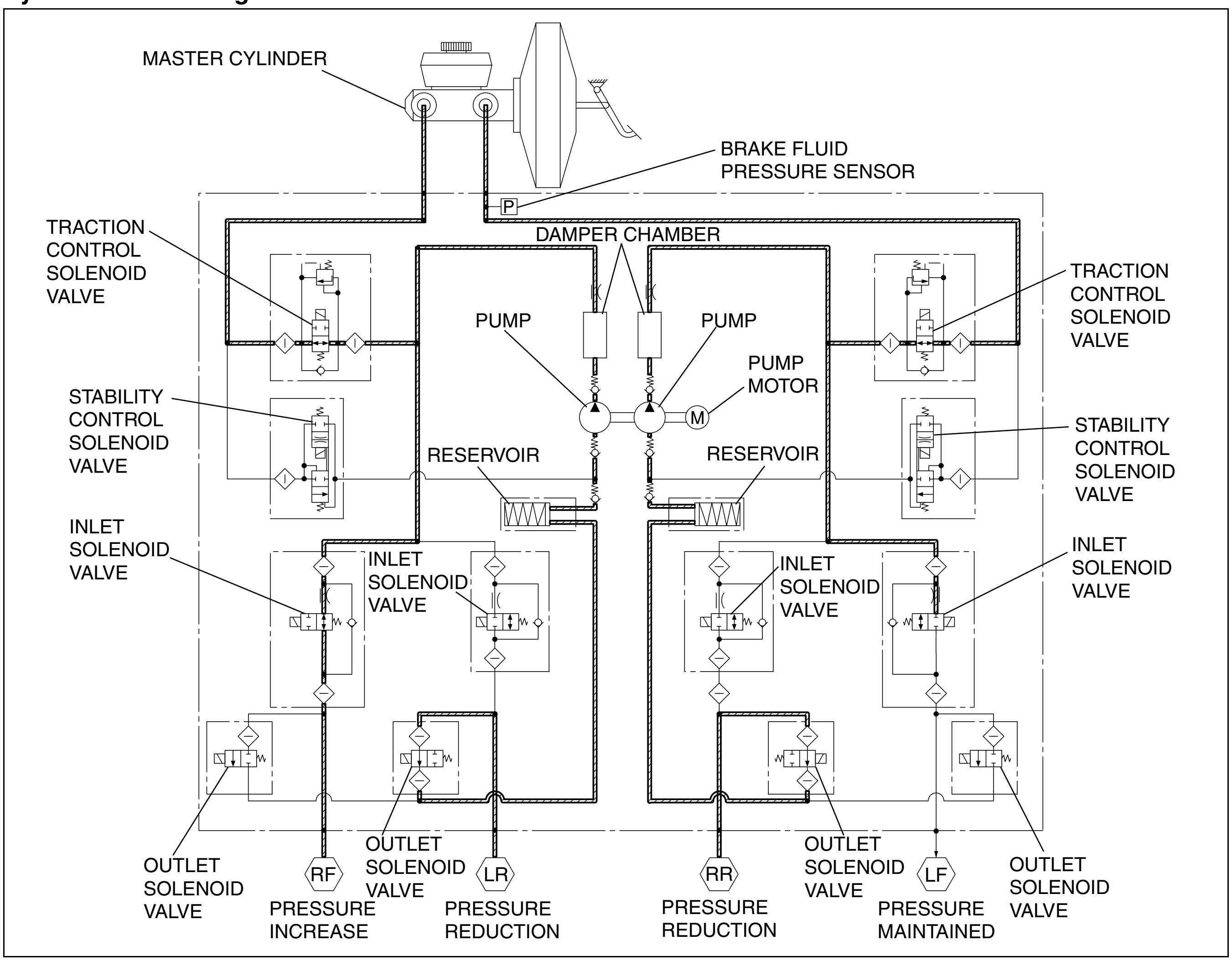
During ABS and EBD control

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

Hydraulic circuit diagram



E5U415ZS5006

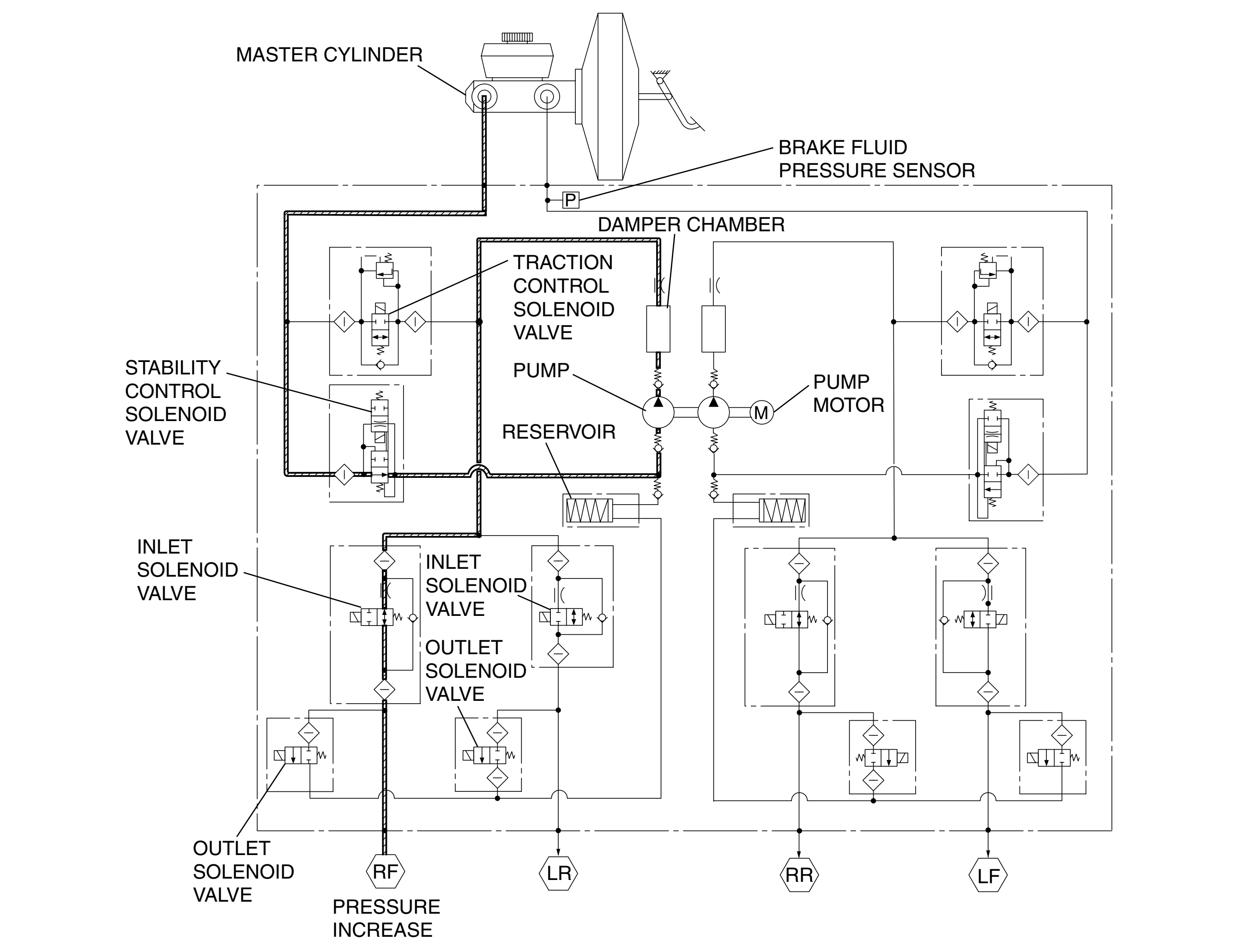
During DSC control (suppress oversteer tendency)

- When a large oversteer 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 outer front wheel cylinder. 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 (during pressure increase mode).)

Solenoid valve operation table

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



E5U415ZS5017

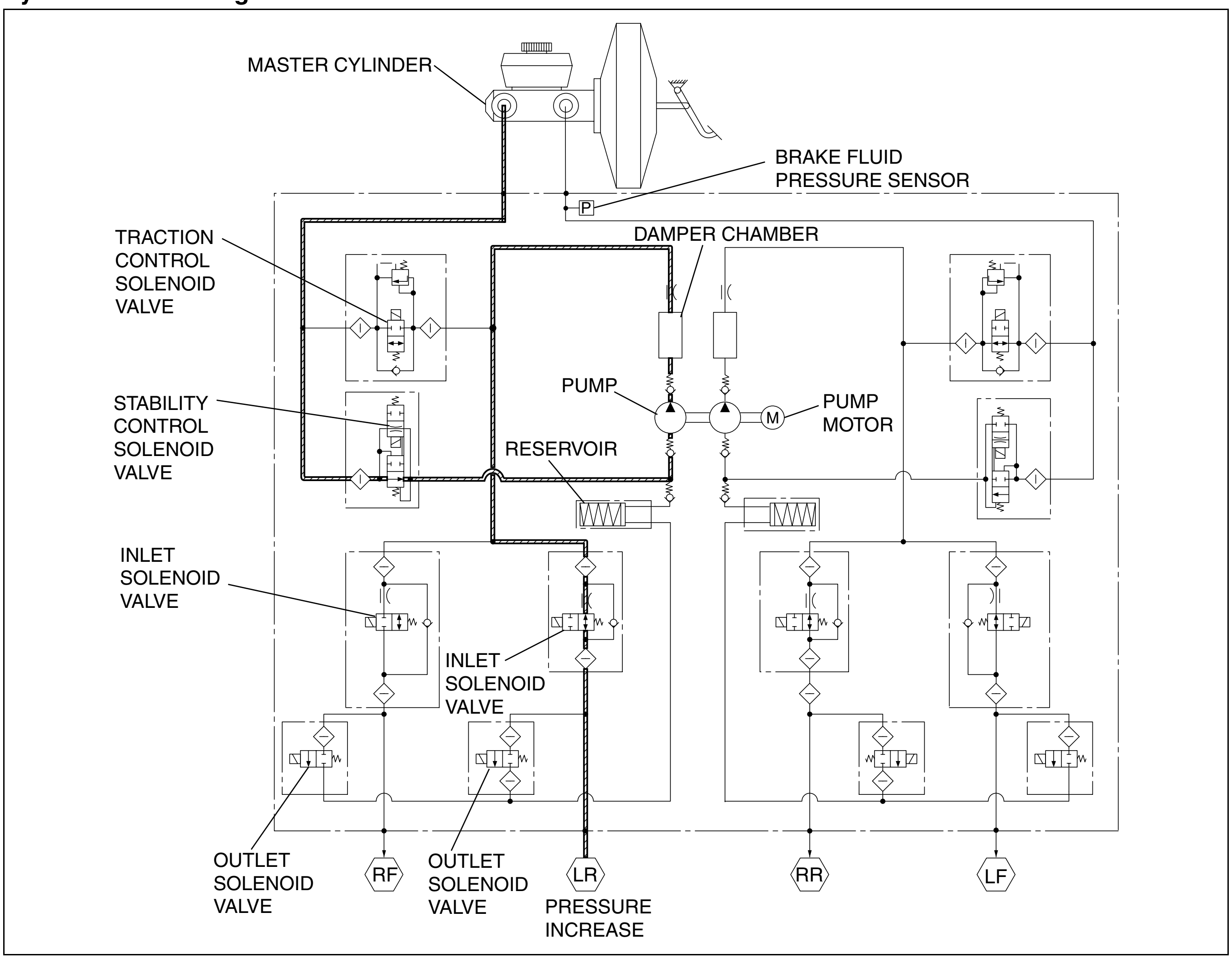
During DSC control (to suppress understeer tendency) and TCS control

- 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, thereby increasing pressure by supplying brake fluid pressure to the caliper piston of the inner rear wheel or the slipping driving wheel. 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 a left turn, or control of left rear wheel spin (during pressure increase mode).)

Solenoid valve operation table

	Traction control solenoid valve		Stability control solenoid valve		Inlet solenoid valve				Outlet solenoid valve				Pump motor, pump
	LF—RR	RF—LR	LF—RR	RF—LR	LF	RF	LR	RR	LF	RF	LR	RR	
During pressure increase mode	OFF (open)	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



E5U415ZS5008

DSC CM PART FUNCTION

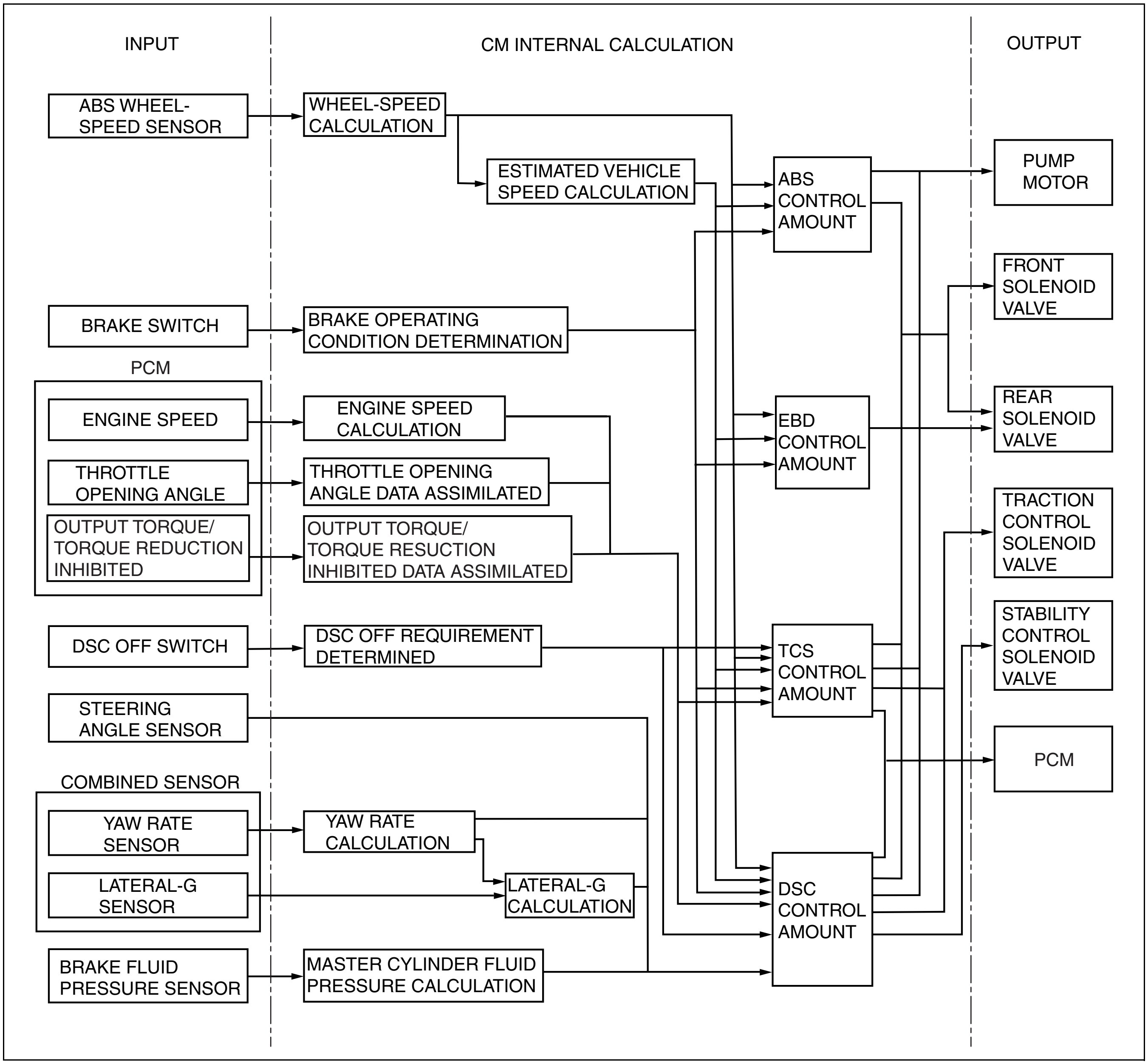
E5U041543750N04

- 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.
CAN signal function	• Transmits the wheel speed signal to the PCM using CAN communication.
On-board diagnostic system	• A function that allows important parts of the DSC 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



E5U415ZS5009

ABS CONTROL FUNCTION

E5U041543750N05

- 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

E5U041543750N06

- 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

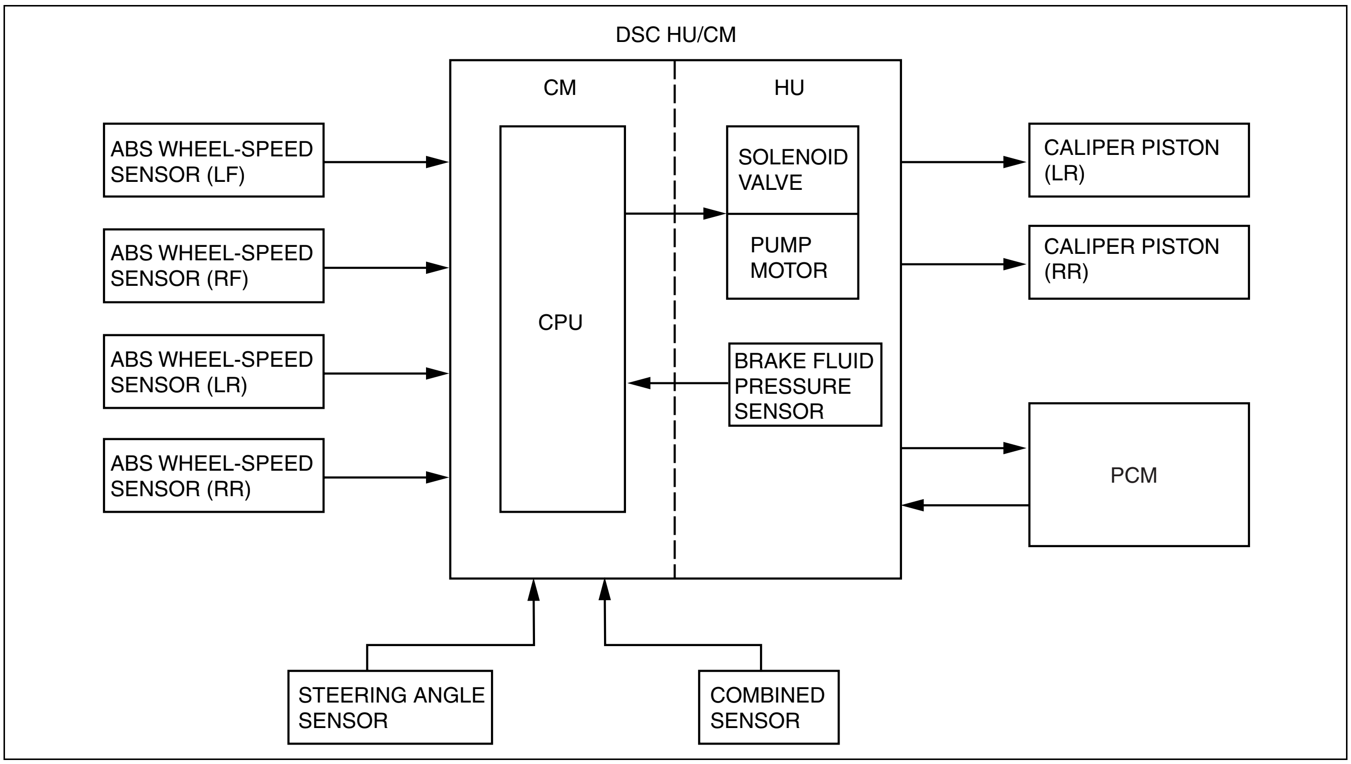
E5U041543750N07

- 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



E5U415ZS5010

TCS CONTROL OPERATION

E5U041543750N08

- 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

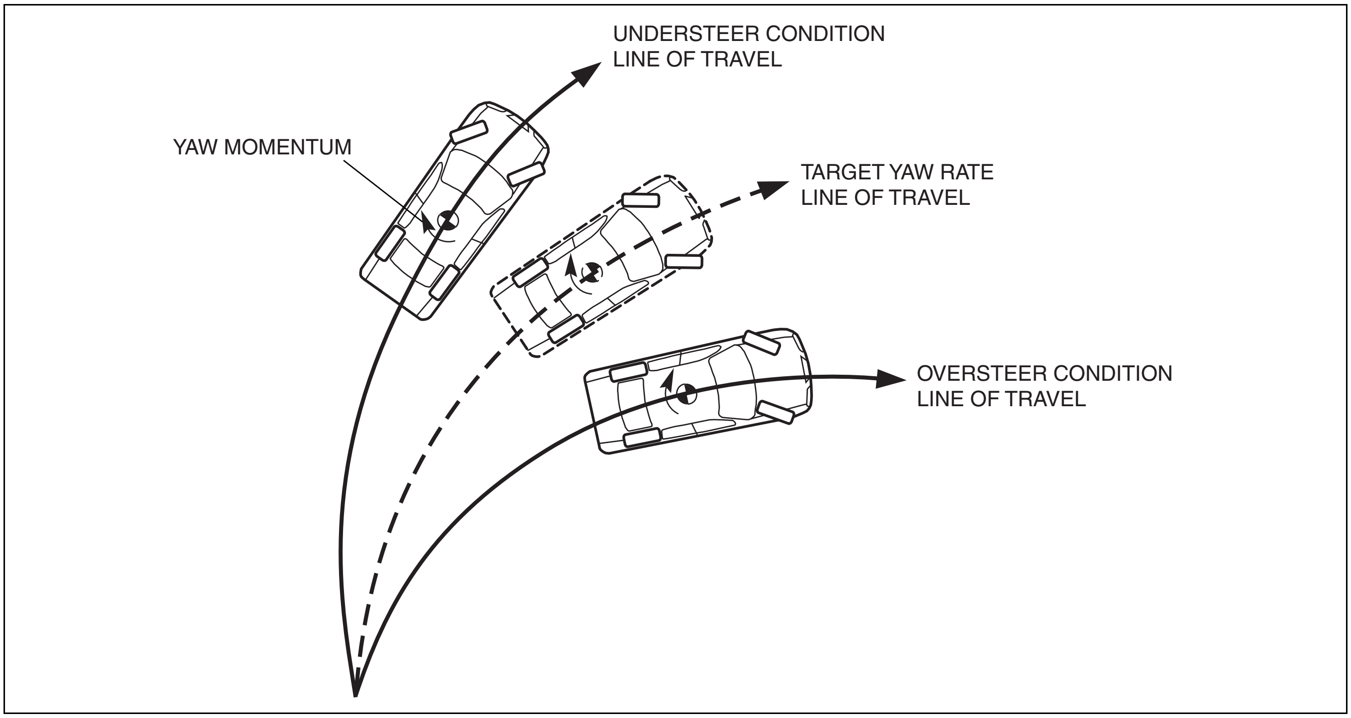
DSC CONTROL OUTLINE

E5U041543750N09

- 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.



E5U415ZS5011

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.

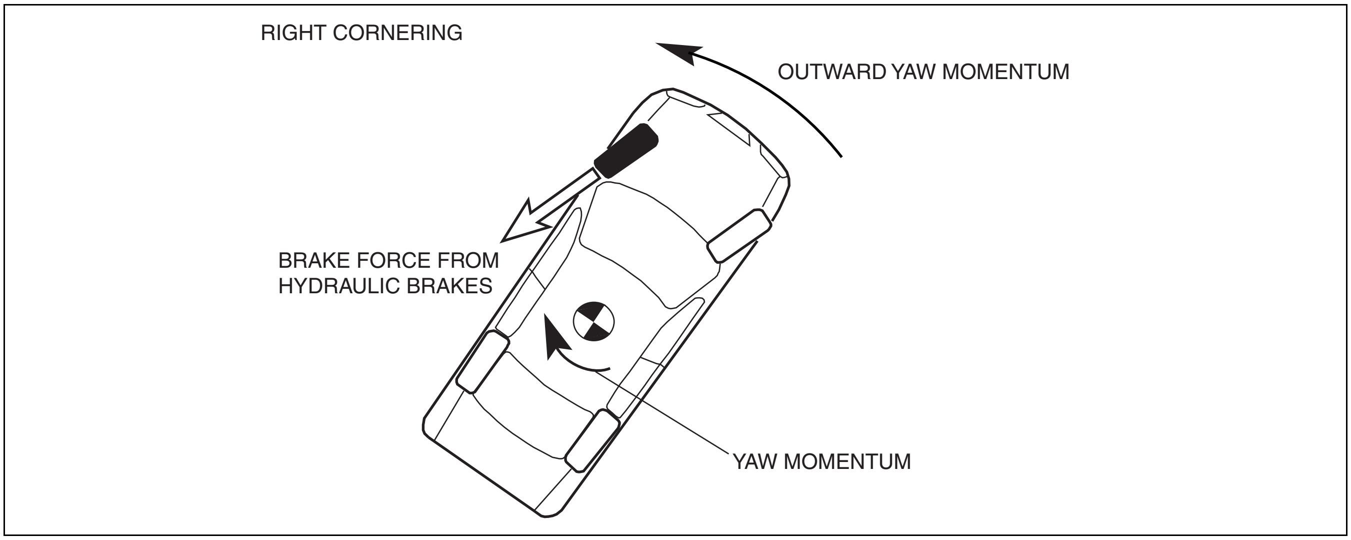
DSC CONTROL OPERATION

E5U041543750N10

- 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

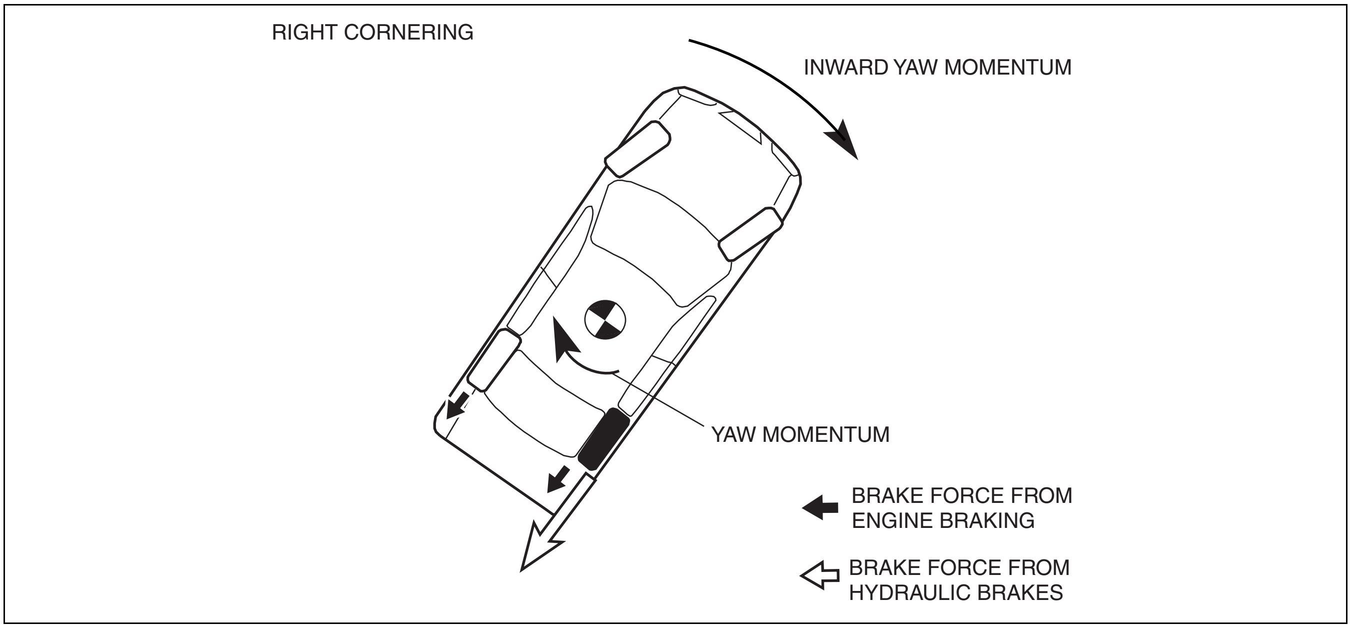
- When a large oversteer tendency is determined, braking is applied the outer front wheel according to the degree of the tendency. As a result, a yaw moment is formed towards the outer side of the vehicle and the oversteer tendency is suppressed.



E5U415ZS5012

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.



E5U415ZS5013

CONTROLLER AREA NETWORK (CAN) OUTLINE

E5U041543750N11

- 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

E5U041543720N01

- The ABS wheel-speed sensor detects and transmits the rotation condition of each wheel to the DSC HU/CM.
- The signal from the ABS wheel-speed sensors is the primary signal for DSC HU/CM control.

ABS WHEEL-SPEED SENSOR CONSTRUCTION/OPERATION

E5U041543720N02

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

COMBINED SENSOR FUNCTION

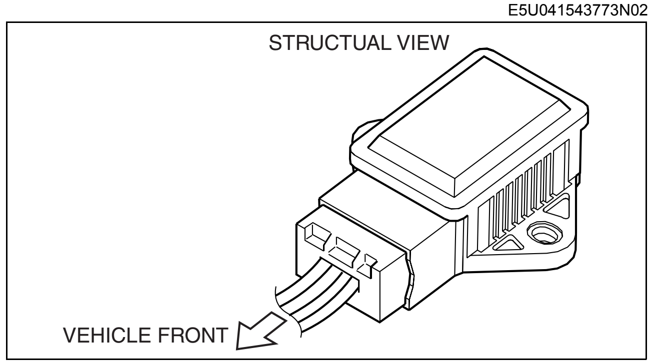
E5U041543773N01

- 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

E5U041543773N02

- 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.



E5U415ZS5014

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.

BRAKE FLUID PRESSURE SENSOR FUNCTION

E5U041543774N01

- 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

E5U041543774N02

- 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.

STEERING ANGLE SENSOR FUNCTION

E5U041566120N01

- 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 disconnection**
  - **— Steering angle sensor connector disconnection**
  - **— Fuse (ROOM 15A) removal**
  - **— Wiring harness disconnection between battery and steering angle sensor connector**

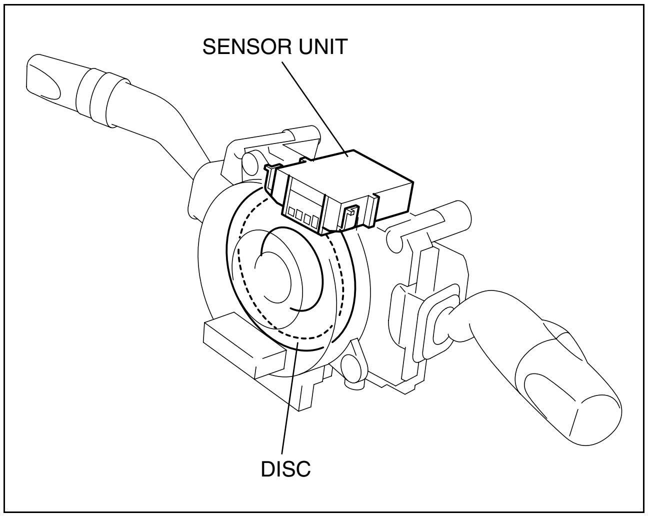
Note

- 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

E5U041566120N02

- 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

E5U041555430N01

- 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)

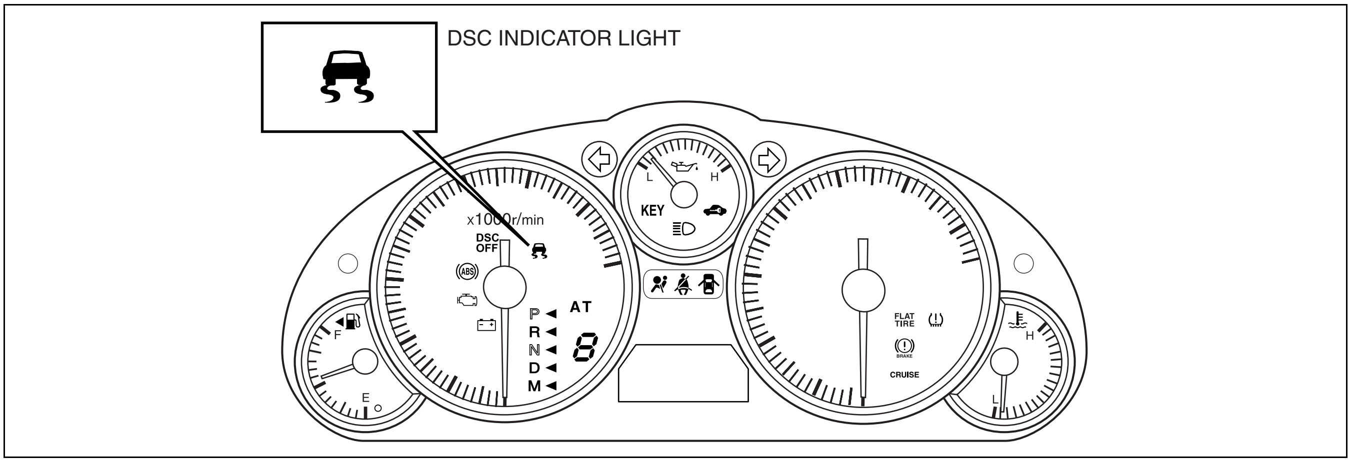
DSC INDICATOR LIGHT OPERATION

E5U041555430N02

- 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	



E5U415ZS5015

DSC OFF SWITCH, DSC OFF LIGHT FUNCTION

E5U041566410N01

- 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.

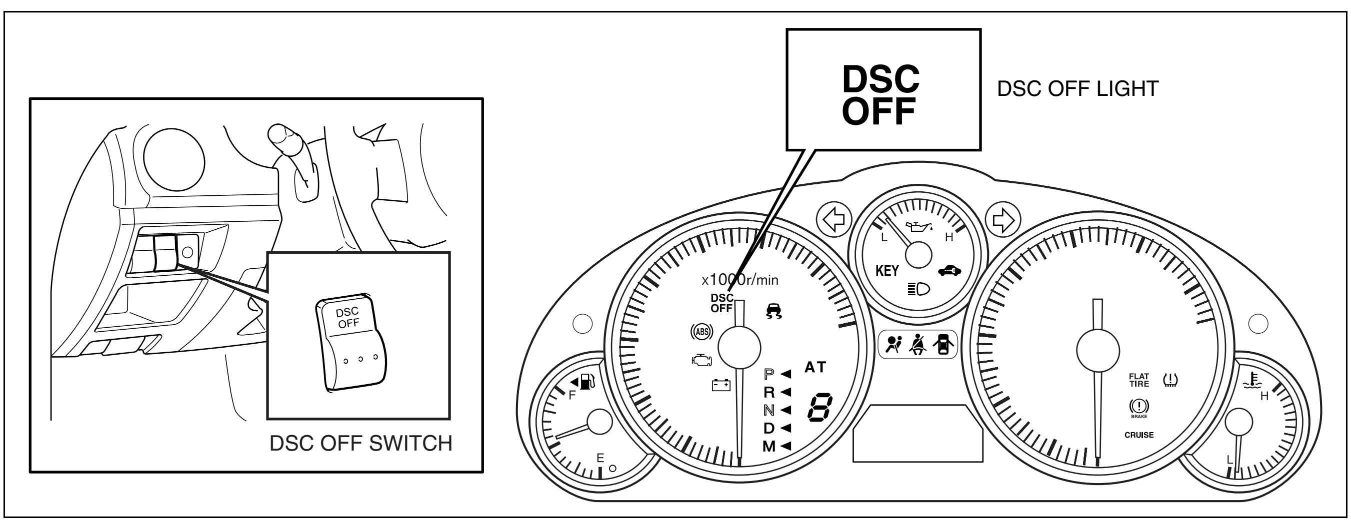
DSC OFF SWITCH, DSC OFF LIGHT OPERATION

E5U041566410N02

- When the DSC system and CAN lines are functionally normally, the DSC OFF light illuminates for **approx. 1.8 s** when the ignition switch is turned to the ON position to check the light function.
- When the DSC OFF switch is pressed to disable DSC control, the DSC OFF light illuminates.

Note

- When releasing the DSC, continue to press the DSC OFF switch until the DSC OFF light illuminates.



E5U415ZS5016

TRANSMISSION/TRANSAXLE

05
SECTION

05–00 OUTLINE

TRANSMISSION/TRANSAXLE ABBREVIATIONS

E5U050000000N01

ATF	Automatic Transmission Fluid
AT	Automatic Transmission
CAN	Controller Area Network
CPU	Central Processing Unit
DC	Drive Cycle
EC-AT	Electronically Controlled Automatic Transaxle
LH	Left Hand
MT	Manual Transmission
PID	Parameter Identification
PPF	Power Plant Frame
RAM	Random Access Memory
RH	Right Hand
ROM	Read Only Memory
TFT	Transmission Fluid Temperature
WDS	Worldwide Diagnostic System
1GR	First Gear
2GR	Second Gear
3GR	Third Gear
4GR	Fourth Gear
5GR	Fifth Gear
6GR	Sixth Gear

TRANSMISSION/TRANSAXLE FEATURES

E5U050000000N02

CLUTCH	
Improved operability	• A hydraulic clutch control mechanism is used.
5-SPEED MT [M15M-D]	
Improved operability	• A triple synchronizer mechanism has been adopted for 1GR and 2GR. • A double synchronizer mechanism has been adopted for 3GR. • A carbon synchronizer mechanism has been adopted for 4GR. • Low friction bushings have been adopted for the shift rod supporting area. • With the adoption of a low spring constant and high set load type 1-2 return spring, a secure neutral position is assured.
Improved driveability	• To improve drivetrain rigidity, a closed section power plant frame (PPF) has been adopted.
Improved reliability	• A double engagement prevention mechanism (interlock mechanism) has been adopted.
Mis-shift prevention	• A cam-type reverse lock-out mechanism has been adopted.
6-SPEED MT [P66M-D]	
Improved operability	• A triple synchronizer mechanism has been adopted for 1GR, 2GR, 3GR and 4GR. • Low friction bushings for the shift rod have been adopted.
Improved driveability	• In order to obtain more power from the engine, the total gear ratio has been set lower and the difference between each gear ratio has been set closer. • To improve drivetrain rigidity, the power plant frame (PPF) has been adopted.
Improved fuel economy	• Six-speed P66M-D manual transmission has been adopted.
Improved marketability	• Six-speed P66M-D manual transmission has been adopted.
Improved reliability	• A double engagement prevention mechanism (interlock mechanism) has been adopted.
Mis-shift prevention	• A push-type reverse lockout mechanism has been adopted.
6-SPEED AT [SJ6A-EL]	
Improved fuel economy	• Six-speed SJ6A-EL automatic transmission has been adopted.
Improved marketability	• Six-speed SJ6A-EL automatic transmission has been adopted. • 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. • A 5-6 shift inhibit control has been adopted for rapid engine warming.
Superior shift quality	• Torque reduction control and line pressure control has been adopted. • Shift learning control has been adopted.
Improved driveability	• To improve drivetrain rigidity, power plant frame (PPF) has been adopted. • A control feature for climbing/descending hills has been adopted, improving driveability when climbing/descending.

TRANSMISSION/TRANSAXLE SPECIFICATIONS

E5U050000000N03

Clutch

Item			Specification
Clutch control			Hydraulic
Clutch cover	Spring type		Diaphragm
	Set load	(N {kgf, lbf})	5,200 {530, 1,169}
Clutch disc	Outer diameter	(mm {in})	215 {8.46}
	Inner diameter	(mm {in})	155 {6.10}
Clutch pedal	Type		Suspended
	Pedal ratio		5.5
	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 [M15M-D]

Item			Specification
Transmission type			M15M-D
Transmission control			Floor-shift
Shift assist			Synchromesh
Gear ratio	1GR		3.136
	2GR		1.888
	3GR		1.330
	4GR		1.000
	5GR		0.814
	Reverse		3.758
Oil	Grade		API Service GL-4 or GL-5
	Viscosity	All season	SAE 75W-90
		Above 10°C {50°F}	SAE 80W-90
	Capacity (approx. quantity)	(L {US qt, Imp qt})	2.0 {2.1, 1.8}

Manual Transmission [P66M-D]

Item			Specification
Transmission type			P66M-D
Transmission control			Floor-shift
Shift assist			Synchromesh
Gear ratio	1GR		3.815
	2GR		2.260
	3GR		1.640
	4GR		1.177
	5GR		1.000
	6GR		0.832
	Reverse		3.603
Oil	Grade		API service GL-4
	Viscosity	All season	SAE 75W-90
	Capacity (approx. quantity)	(L {US qt, Imp qt})	2.1 {2.2, 1.8}

Manual Transmission Shift Mechanism

Item	Specification
Transmission control	Floor-shift
Operation system	Direct

Automatic Transmission

Item		Specification
Transmission type		SJ6A-EL
Gear ratio	1GR	3.538
	2GR	2.060
	3GR	1.404
	4GR	1.000
	5GR	0.713
	6GR	0.582
	Reverse	3.168
ATF	Type	JWS3309
	Capacity (Approx. quantity) (L {US qt, Imp qt})	7.4 {7.8, 6.5}
Torque converter stall torque ratio		2.00
Hydraulic system (Number of drive/driven plates)	C1 clutch	4/4
	C2 clutch	5/5
	C3 clutch	4/3
	C4 clutch	4/4
	B1 brake	3/3
	B2 brake	4/3
	B3 brake	3/3
	B4 brake	5/4
Front planetary gear (Number of teeth)	Sun gear	33
	Pinion gear (inner)	19
	Pinion gear (outer)	18
	Ring gear	75
Middle planetary gear (Number of teeth)	Sun gear	26
	Pinion gear	20
	Ring gear	66
Rear planetary gear (Number of teeth)	Sun gear	26
	Pinion gear	20
	Ring gear	66

Automatic Transmission Shift Mechanism

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

Revised 8/2005 (Ref. No. R091/05)

05–02 ON-BOARD DIAGNOSTIC [SJ6A-EL] 6-SPEED AT

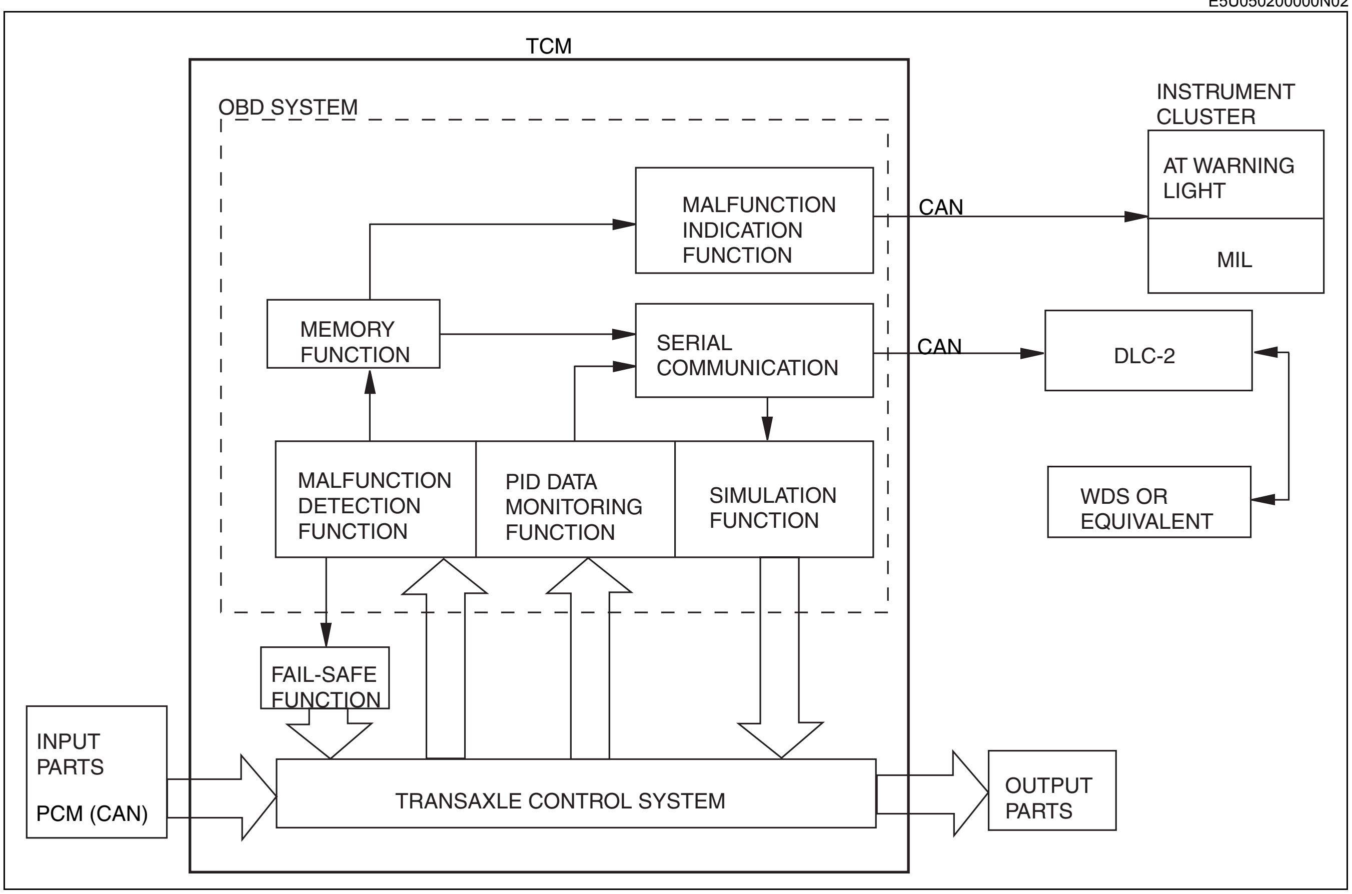
ON-BOARD DIAGNOSTIC (OBD) SYSTEM OUTLINE [SJ6A-EL]

E5U050200000N01

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

ON-BOARD DIAGNOSTIC (OBD) SYSTEM BLOCK DIAGRAM [SJ6A-EL]

E5U050200000N02



E5U502ZS5001

MALFUNCTION DETECTION FUNCTION [SJ6A-EL]

E5U050200000N03

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

X: Available
–: N/A

DTC No.	Condition	MIL	AT warning light	DC	Memory function
P0601	Flash ROM malfunction	X	X	1	X
P0603	EEPROM malfunction	X	X	1	X
P0604	RAM malfunction	X	X	1	X
P0707	Transmission range (TR) switch circuit low input (short to ground)	X	X	1	X
P0708	Transmission range (TR) switch circuit high input (open circuit)	X	X	2	X
P0711	Transmission fluid temperature (TFT) sensor malfunction (stuck)	X	X	2	X
P0712	Transmission fluid temperature (TFT) sensor circuit malfunction (short to ground)	X	X	1	X
P0713	Transmission fluid temperature (TFT) sensor circuit malfunction (short to power/open circuit)	X	X	1	X
P0717	Turbine sensor circuit malfunction (open circuit/short circuit)	X	X	1	X
P0722	Vehicle speed sensor (VSS) circuit malfunction (open circuit/short circuit)	X	X	1	X
P0751	Shift solenoid A malfunction (stuck off)	X	X	2	X
P0752	Shift solenoid A malfunction (stuck on)	X	X	2	X
P0756	Shift solenoid B malfunction (stuck off)	X	X	2	X
P0757	Shift solenoid B malfunction (stuck on)	X	X	2	X
P0761	Shift solenoid C malfunction (stuck off)	X	X	2	X
P0762	Shift solenoid C malfunction (stuck on)	X	X	2	X
P0766	Shift solenoid D malfunction (stuck off)	X	X	2	X
	Shift solenoid G malfunction (stuck on)	X	X	2	X
P0781	1-2 shift valve malfunction	X	X	2	X
P0813	Reverse sequence valve malfunction	X	X	2	X
P0819	Manual switch/up switch/down switch circuit malfunction (open circuit/short circuit)	–	X	1	X
P0826	Steering shift switch circuit malfunction (open circuit/short to ground)	X	X	1	X
P0882	TCM B+ low (less than 9 V)	–	X	1	X
P0883	TCM B+ low (less than 11 V)	–	X	1	X
P0961	Line pressure control solenoid range/performance (stuck)	X	X	1	X
P0962	Line pressure control solenoid circuit malfunction (short to ground/open circuit)	X	X	1	X
P0963	Line pressure control solenoid circuit malfunction (short to power)	X	X	1	X
P0969	Shift solenoid F range/performance (stuck)	X	X	1	X
P0970	Shift solenoid F circuit malfunction (short to ground/open circuit)	X	X	1	X
P0971	Shift solenoid F circuit malfunction (short to power)	X	X	1	X
P0973	Shift solenoid A circuit malfunction (short to ground)	X	X	1	X
P0974	Shift solenoid A circuit malfunction (short to power/open circuit)	X	X	1	X
P0976	Shift solenoid B circuit malfunction (short to ground)	X	X	1	X
P0977	Shift solenoid B circuit malfunction (short to power/open circuit)	X	X	1	X
P0979	Shift solenoid C circuit malfunction (short to ground)	X	X	1	X
P0980	Shift solenoid C circuit malfunction (short to power/open circuit)	X	X	1	X
P0982	Shift solenoid D circuit malfunction (short to ground)	X	X	1	X
P0983	Shift solenoid D circuit malfunction (short to power/open circuit)	X	X	1	X
P0985	Shift solenoid E circuit malfunction (short to ground)	X	X	1	X
P0986	Shift solenoid E circuit malfunction (short to power/open circuit)	X	X	1	X

DTC No.	Condition	MIL	AT warning light	DC	Memory function
P2719	Shift solenoid G range/performance (stuck)	X	X	1	X
P2720	Shift solenoid G circuit malfunction (short to ground/open circuit)	X	X	1	X
P2721	Shift solenoid G circuit malfunction (short to power)	X	X	1	X
P2757	Torque converter clutch (TCC) stuck on	X	X	2	X
P2758	Torque converter clutch (TCC) stuck off	X	X	2	X
P2762	TCC control solenoid range/performance (stuck)	X	X	1	X
P2763	TCC control solenoid circuit malfunction (short to power)	X	X	1	X
P2764	TCC control solenoid circuit malfunction (short to ground/open circuit)	X	X	1	X
U0073	CAN BUS OFF	X	X	1	X
U0100	TCM cannot receive any signals from PCM	X	X	1	X

MIL: Malfunction Indicator Lamp
DC: Drive Cycle

MEMORY FUNCTION [SJ6A-EL]

E5U050200000N04

- 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 [SJ6A-EL]

E5U050200000N05

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

FAIL-SAFE FUNCTION [SJ6A-EL]

E5U050200000N06

- 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
P0601	Flash ROM malfunction	• Flash ROM (in TCM) internal circuit malfunction is detected.	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0603	EEPROM malfunction	• Different numeric values for EEPRROM and RAM (in TCM) are detected.	N/A
P0604	RAM malfunction	• RAM (in TCM) read/write error is detected.	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0707	Transmission range (TR) switch circuit low input (short to ground)	• TR switch position voltage input to TCM is **less than 0.127 V** when ignition switch is at ON position.	• D range is determined when there is no TR switch signal input. • Inhibits slope mode control
P0708	Transmission range (TR) switch circuit high input (open circuit)	• Vehicle speed is **30 km/h {18.6 mph} or more**, and no range signal is input from the TR switch.	• D range is determined when there is no TR switch signal input. • Inhibits slope mode control
P0711	Transmission fluid temperature (TFT) sensor malfunction (stuck)	• Change in ATF temperature cannot be detected for **10 min or more** when driving in D range.	• Fixes ATF temperature value at **80 °C {176 °F}** • Inhibits slope mode control • Inhibits self learning control
P0712	Transmission fluid temperature (TFT) sensor circuit malfunction (short to ground)	• TCM detects ATF temperature of **200 °C {392 °F} or more**.	• Fixes ATF temperature value at **80 °C {176 °F}** • Inhibits slope mode control • Inhibits self learning control

DTC No.	On-board diagnostic function	Detection condition	Fail-safe
P0713	Transmission fluid temperature (TFT) sensor circuit malfunction (short to power/open circuit)	• TCM detects ATF temperature of **less than -43 °C {-45.4 °F}** when engine is warmed-up and running.	• Fixes ATF temperature value at **80 °C {176 °F}** • Inhibits slope mode control • Inhibits self learning control
P0717	Turbine sensor circuit malfunction (open circuit/ short circuit)	• Turbine speed signal is not input during vehicle speed signal **12 pulse** period when driving in D range.	• Substitutes vehicle speed signal for turbine speed signal. • Inhibits 5GR and 6GR • Inhibits self learning control • Inhibits driver adaptive shift control
P0722	Vehicle speed sensor (VSS) circuit malfunction (open circuit/short circuit)	• Vehicle speed signal is not input during turbine speed signal **12 pulse** period when driving in D range.	• Substitutes turbine speed signal for vehicle speed signal. • Inhibits 5GR and 6GR • Inhibits self learning control • Inhibits driver adaptive shift control
P0751	Shift solenoid A malfunction (stuck off)	• TCM detects that shift solenoid A does not change from off when engine is running	• Inhibits 4GR, 5GR and 6GR • Inhibits 1GR and 2GR (manual mode)
P0752	Shift solenoid A malfunction (stuck on)	• TCM detects that shift solenoid A does not change from on when engine is running	N/A
P0756	Shift solenoid B malfunction (stuck off)	• TCM detects that shift solenoid B does not change from off when engine is running	N/A
P0757	Shift solenoid B malfunction (stuck on)	• TCM detects that shift solenoid B does not change from on when engine is running	N/A
P0761	Shift solenoid C malfunction (stuck off)	• TMC detects that shift solenoid C does not change from off when engine is running	N/A
P0762	Shift solenoid C malfunction (stuck on)	• TMC detects that shift solenoid C doe not change from on when engine is running	• Inhibits 4GR, 5GR and 6GR
P0766	Shift solenoid D malfunction (stuck off)	• TCM detects that shift solenoid D does not change from off when engine is running	• Inhibits 4GR, 5GR and 6GR
	Shift solenoid G malfunction (stuck on)	• TCM detects that shift solenoid G does not change from on when engine is running	• Inhibits 4GR, 5GR and 6GR
P0781	1-2 shift valve malfunction	• TCM detects 1–2 shift valve malfunction.	• Inhibits 4GR, 5GR and 6GR • Inhibits 1GR and 2GR (manual mode)
P0813	Reverse sequence valve malfunction	• TCM detects reverse sequence valve malfunction.	• Inhibits 6GR
P0819	Manual switch/up switch/ down switch circuit malfunction (open circuit/ short circuit)	**M range switch circuit malfunction** • M range switch remains on for **2 s or more** except in D range.	• Inhibits manual mode control
		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**.	• Inhibits manual mode control using selector lever
P0826	Steering shift switch circuit malfunction (open circuit/ short to ground)	• TCM detects short circuit or short to ground in steering shift switch circuit when engine is running.	• Inhibits manual mode control
P0882	TCM B+ low (less than 9 V)	• Voltage of **less than 9 V** detected at TCM terminals 1AD when engine is running.	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0883	TCM B+ low (less than 11 V)	• Voltage of **less than 11 V** detected at TCM terminals 1AD when engine is running.	• Inhibits self learning control

DTC No.	On-board diagnostic function	Detection condition	Fail-safe
P0961	Line pressure control solenoid range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0962	Line pressure control solenoid circuit malfunction (short to ground/open circuit)	• Open or short circuit in line pressure control solenoid signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0963	Line pressure control solenoid circuit malfunction (short to power)	• Short circuit in line pressure control solenoid signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0969	Shift solenoid F range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0970	Shift solenoid F circuit malfunction (short to ground/open circuit)	• Open or short circuit in shift solenoid F signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0971	Shift solenoid F circuit malfunction (short to power)	• Short circuit in shift solenoid F signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits N—D shift pressure control • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0973	Shift solenoid A circuit malfunction (short to ground)	• Short to ground in shift solenoid A signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0974	Shift solenoid A circuit malfunction (short to power/open circuit)	• Open or short circuit in shift solenoid A signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0976	Shift solenoid B circuit malfunction (short to ground)	• Short to ground in shift solenoid B signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0977	Shift solenoid B circuit malfunction (short to power/open circuit)	• Open or short circuit in shift solenoid B signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0979	Shift solenoid C circuit malfunction (short to ground)	• Short to ground in shift solenoid C signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0980	Shift solenoid C circuit malfunction (short to power/open circuit)	• Open or short circuit in shift solenoid C signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0982	Shift solenoid D circuit malfunction (short to ground)	• Short to ground in shift solenoid D signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control

DTC No.	On-board diagnostic function	Detection condition	Fail-safe
P0983	Shift solenoid D circuit malfunction (short to power/open circuit)	• Open or short circuit in shift solenoid D signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0985	Shift solenoid E circuit malfunction (short to ground)	• Short to ground in shift solenoid E signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P0986	Shift solenoid E circuit malfunction (short to power/open circuit)	• Open or short circuit in shift solenoid E signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P2719	Shift solenoid G range/ performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P2720	Shift solenoid G circuit malfunction (short to ground/open circuit)	• Open or short circuit in shift solenoid G signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P2721	Shift solenoid G circuit malfunction (short to power)	• Short circuit in shift solenoid G signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Emergency mode • Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control
P2757	Torque converter clutch (TCC) stuck on	• TCM detects that TCC control solenoid does not change from on when engine is running	• Inhibits acceleration from 2GR
P2758	Torque converter clutch (TCC) stuck off	• TCM detects that TCC control solenoid does not change from off when engine is running	N/A
P2762	TCC control solenoid range/performance (stuck)	• Feedback current corresponding to solenoid current command value is irregular when engine is running.	• Inhibits acceleration from 2GR • Inhibits TCC control
P2763	TCC control solenoid circuit malfunction (short to power)	• Short circuit in TCC control solenoid signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Inhibits acceleration from 2GR • Inhibits TCC control
P2764	TCC control solenoid circuit malfunction (short to ground/open circuit)	• Open or short circuit in TCC control solenoid signal system (while TCM monitors solenoid output voltage, the voltage that differs from the signal output by CPU in TCM is detected).	• Inhibits acceleration from 2GR • Inhibits TCC control
U0073	CAN BUS OFF	• Bus off error is detected.	• Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control • Inhibits 5GR, 6GR
U0100	TCM cannot receive any signals from PCM	• Communication error is detected between TCM and PCM.	• Inhibits self learning control • Inhibits driver adaptive shift control • Inhibits TCC control • Inhibits 5GR, 6GR

Emergency Mode

- Emergency mode shifts as follows when in D range or R position.

Condition	Selector lever position						
	D range						R position
Normal shifting	1GR	2GR	3GR	4GR	5GR	6GR	Reverse
When there is any malfunction in shift solenoids A, B, C, D, E, F, G, line pressure, or TCC control solenoid	4GR						Reverse

PARAMETER IDENTIFICATION (PID) DATA MONITORING FUNCTION [SJ6A-EL]

E5U050200000N07

- 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
BOO TCM	Brake switch	On/Off	N/A
DTCCNT	DTC count (includes those needing no action)	N/A	N/A
DWN SW	Down switch	On/Off	2F
ECT TCM	Engine coolant temperature	°C	N/A
FDPDTC	Freeze frame data	N/A	N/A
GEAR_RA	Gear ratio	N/A	N/A
GEAR_SEL	Calculated gear range in TCM	1/2/3/4/5/6	N/A
LPS	Line pressure control solenoid	A	1E, 1R
MNL SW	M range switch	On/Off	2G
OSS	Output shaft speed	RPM	2C, 2D
PNP_TCM	Park/Neutral	Drive/Neutral	2K, 2M, 2N, 2O
RPM TCM	Engine speed	RPM	N/A
SS SW-	Steering shift switch (shift down)	On/Off	2AB, 2AF
SS SW+	Steering shift switch (shift up)	On/Off	2AB, 2AF
SSA	Shift solenoid A	On/Off	1AF
SSB	Shift solenoid B	On/Off	1AB
SSC	Shift solenoid C	On/Off	1AA
SSD	Shift solenoid D	On/Off	1S
SSE	Shift solenoid E	On/Off	1V
SSF	Shift solenoid F	A	1O, 1Z
SSG	Shift solenoid G	A	1L, 1Y
TCCC	TCC control solenoid	A	1D, 1Q
TFT	ATF temperature	°C	1J, 1M
TFTV	ATF temperature signal voltage	V	1J, 1M
THOP	Throttle position	%	N/A
TR	TR switch	R/N/D/P	2K, 2M, 2N, 2O
TRD	TR switch [D range]	On/Off	2K
TRR	TR switch [R position]	On/Off	2M
TSS	Input/turbine speed sensor	RPM	2A, 2B
UP SW	Up switch	On/Off	2J
VPWR_TCM	Battery voltage	V	1AD
VSS	Vehicle speed	KPH	2C, 2D

SIMULATION FUNCTION [SJ6A-EL]

E5U050200000N08

- 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

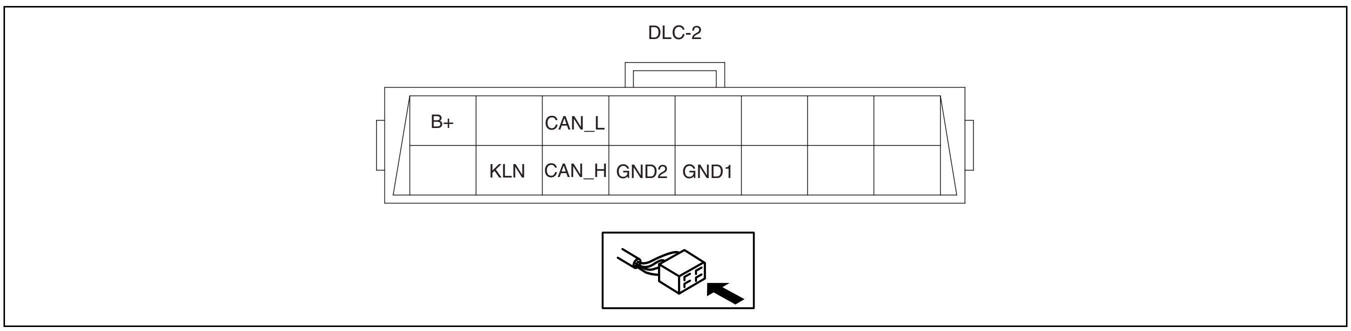
X: Available

Simulation item	Applicable component	Unit/Condition	Operation		TCM terminal
			IG ON	Idle	
LPS	Line pressure control solenoid	A	N/A	X	1E, 1R
SSA	Shift solenoid A	On/Off	N/A	X	1AF
SSB	Shift solenoid B	On/Off	N/A	X	1AB
SSC	Shift solenoid C	On/Off	N/A	X	1AA
SSD	Shift solenoid D	On/Off	N/A	X	1S
SSE	Shift solenoid E	On/Off	N/A	X	1V
SSF	Shift solenoid F	A	N/A	X	1O, 1Z
SSG	Shift solenoid G	A	N/A	X	1L, 1Y
TCCC	TCC control solenoid	A	N/A	X	1D, 1Q

DLC-2 OUTLINE [SJ6A-EL]

E5U050200000N09

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



D6U502BS7004

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

05–10 CLUTCH

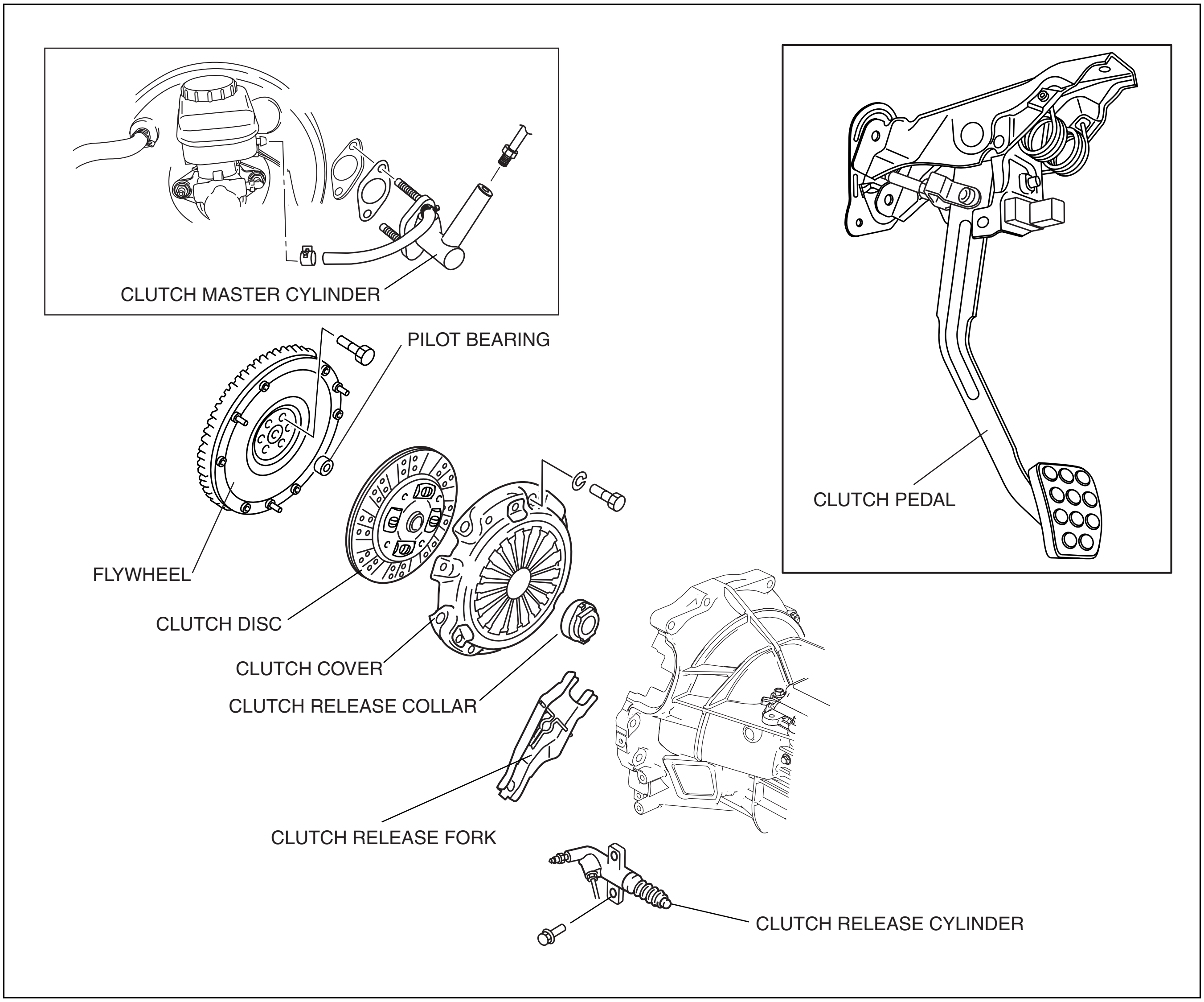
CLUTCH OUTLINE

E5U051000000N01

- A hydraulic clutch control mechanism is used.

CLUTCH STRUCTURAL VIEW

E5U051000000N02

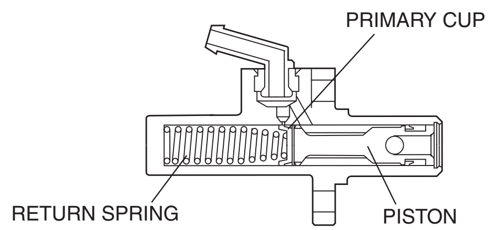


E5U510ZS5001

CLUTCH MASTER CYLINDER

E5U051000000N03

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



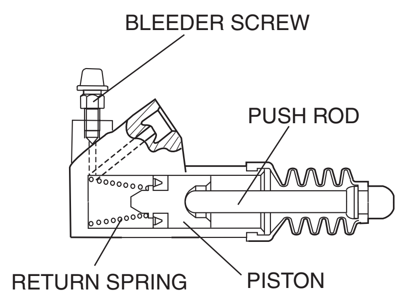
E5U510ZS5002

CLUTCH RELEASE CYLINDER

E5U051000000N04

STRUCTURE

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



E5U510ZS5003

- 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.

05–11A MANUAL TRANSMISSION [M15M-D] 5-SPEED MT

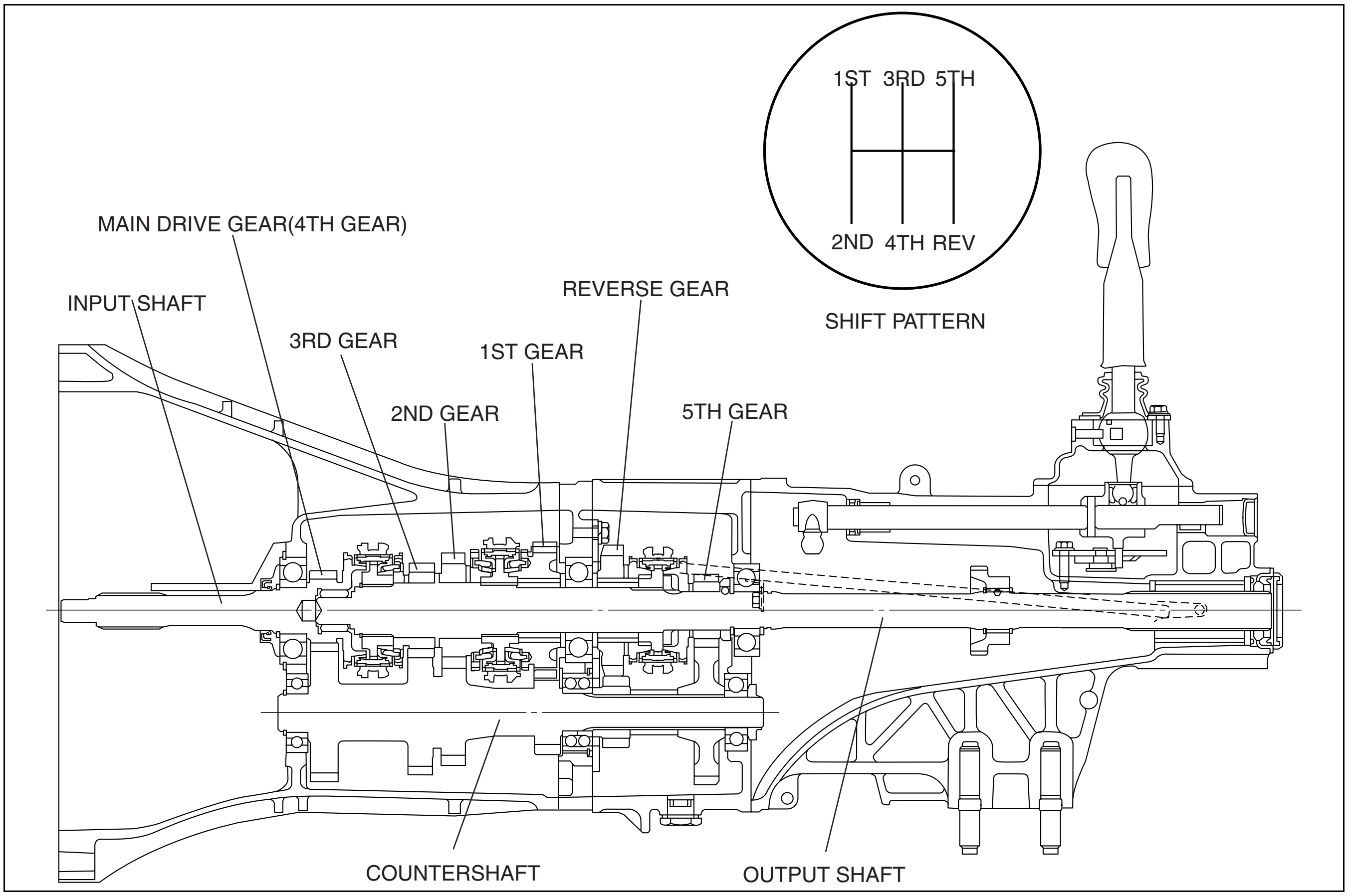
MANUAL TRANSMISSION OUTLINE [M15M-D]

E5U051100000N10

- A linked, triple-cone synchronizer mechanism has been adopted for 1st and 2nd gears.
- A linked, double-cone synchronizer mechanism has been adopted for 3rd gears.
- A linked, carbon-cone synchronizer mechanism has been adopted for 4th gears.
- A cam-type reverse lockout mechanism has been adopted.

MANUAL TRANSMISSION CROSS-SECTIONAL VIEW [M15M-D]

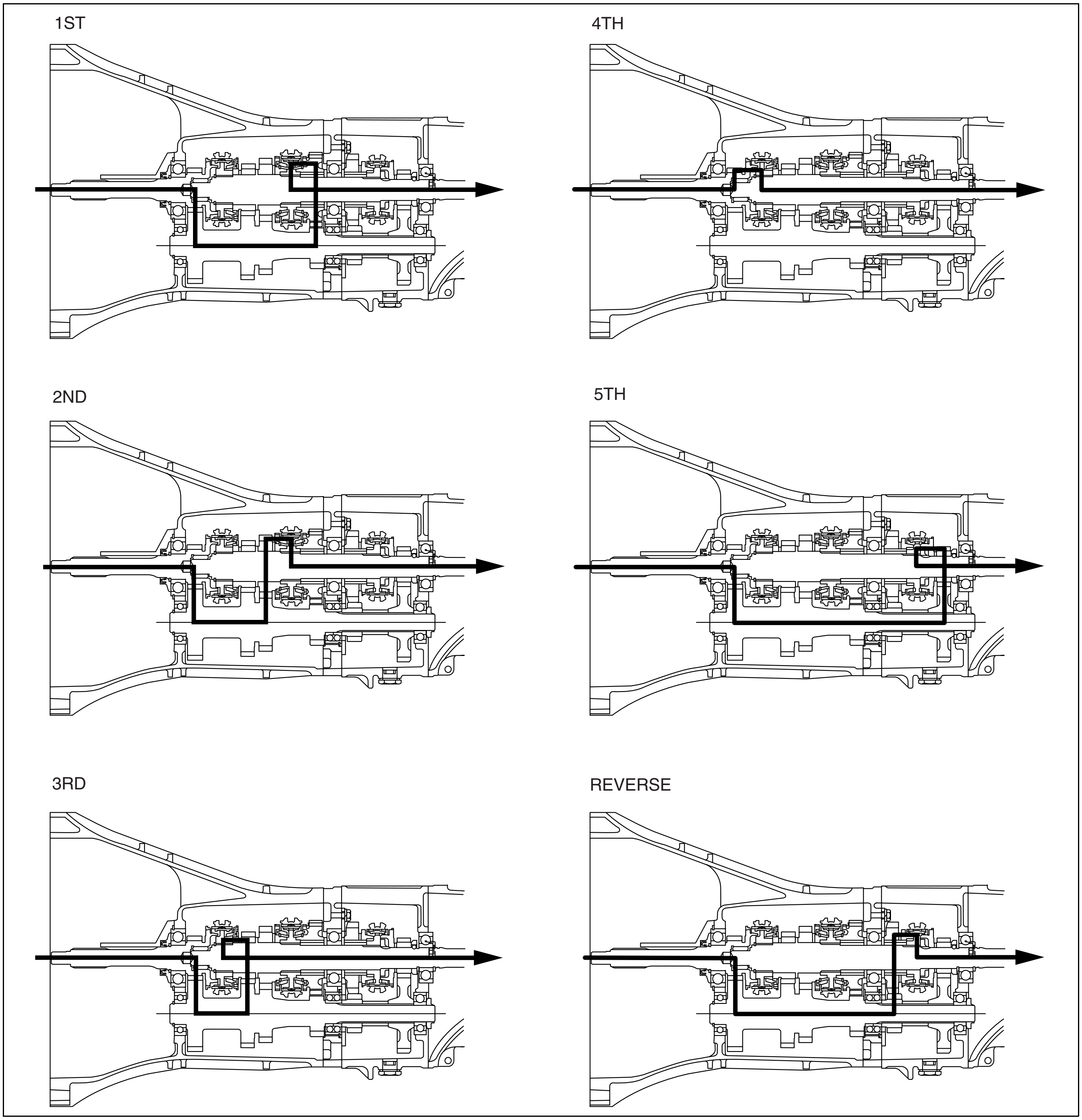
E5U051100000N11



E5U511AS5001

MANUAL TRANSMISSION POWER FLOW [M15M-D]

E5U051100000N12



E5U511AS5002

SHIFT MECHANISM [M15M-D]

E5U051100000N13

Detent Spring

- Due to the addition of anti-friction material between the detent springs and balls, hiss and rasping feeling have been greatly reduced, thus improving shift feeling.

Shift Return Spring

- Due to the use of a low spring constant and high set load type 1-2 return spring, the neutral position is crisply felt when shifting from 1-2 or 5-R, thus improving the secure shift feeling.

TRIPLE SYNCHRONIZER MECHANISM STRUCTURE [M15M-D]

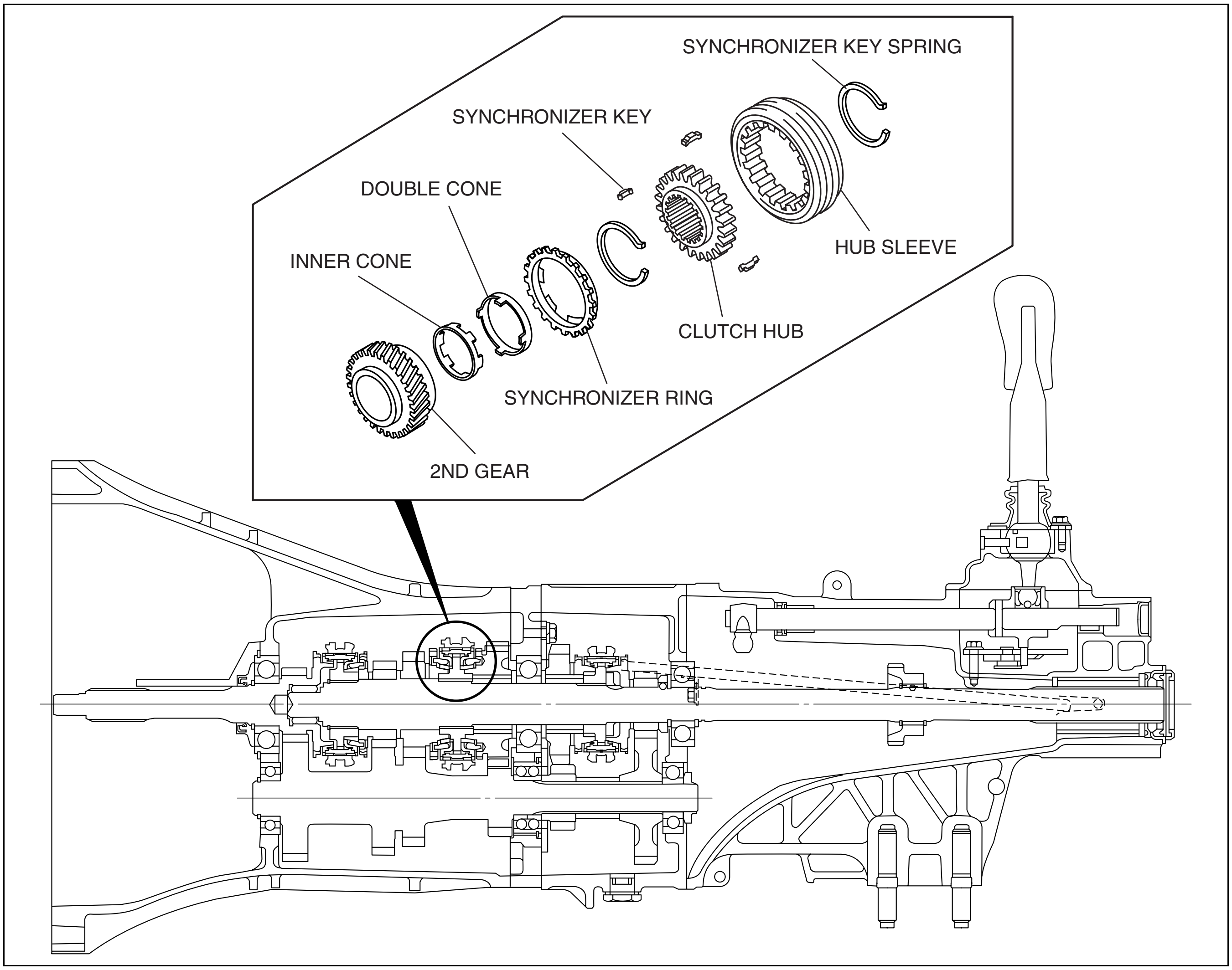
E5U051100000N14

Features

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

Structure

Structural view

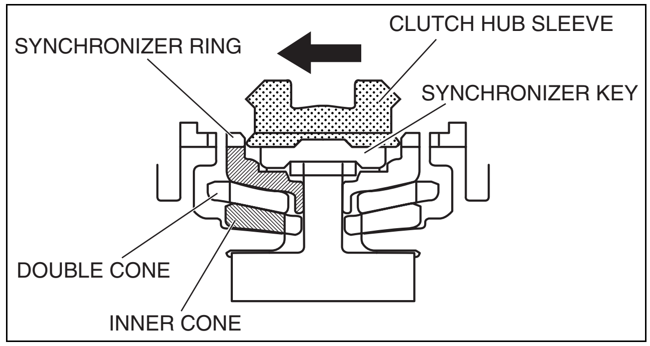


E5U511AS5003

TRIPLE SYNCHRONIZER MECHANISM OPERATION [M15M-D]

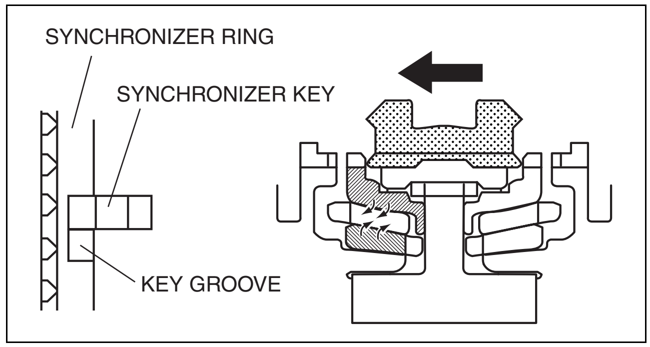
E5U051100000N15

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



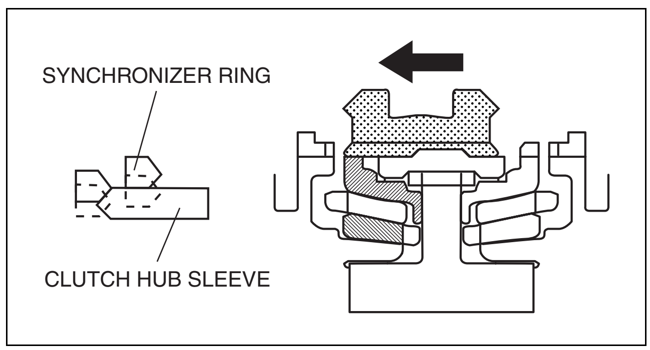
E5U511AS5005

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



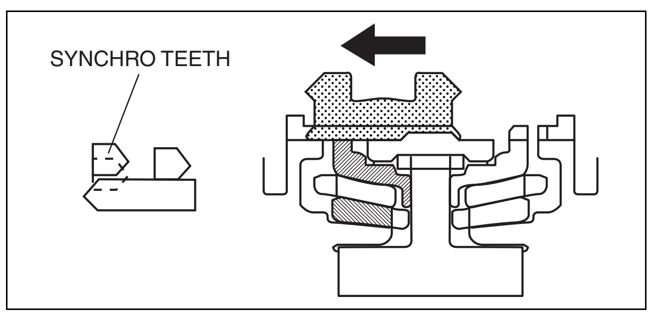
E5U511AS5006

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



E5U511AS5007

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



E5U511AS5008

DOUBLE SYNCHRONIZER MECHANISM OUTLINE [M15M-D]

E5U051100000N19

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

DOUBLE SYNCHRONIZER MECHANISM CONSTRUCTION/OPERATION [M15M-D]

E5U051100000N20

- The basic construction of the double-cone synchronizer mechanism is the same as a triple-cone synchronizer mechanism except that the inner side of the inner cone is not used as a friction surface.
- The basic construction of the double-cone synchronizer mechanism is the same as a triple-cone synchronizer mechanism except that friction force is not generated because there is no contact surface between the inner cone and gear.
- For the double-cone synchronizer mechanism operation, refer to the triple-cone synchronizer mechanism. (See 05–11A–4 TRIPLE SYNCHRONIZER MECHANISM OPERATION [M15M-D].)

SHIFT INTERLOCK MECHANISM FUNCTION [M15M-D]

E5U051100000N16

- This provides reliable double-engagement prevention.

SHIFT INTERLOCK MECHANISM OPERATION [M15M-D]

E5U051100000N17

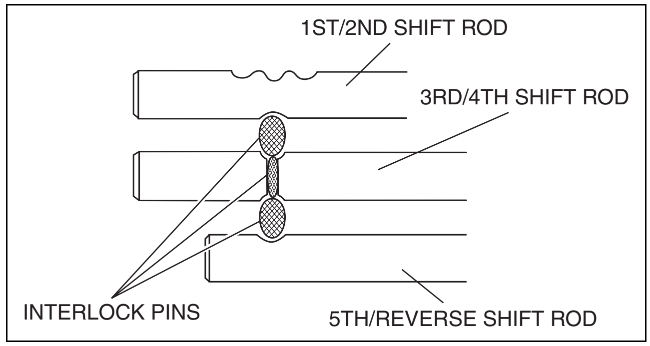
Structure

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

Operation

Neutral

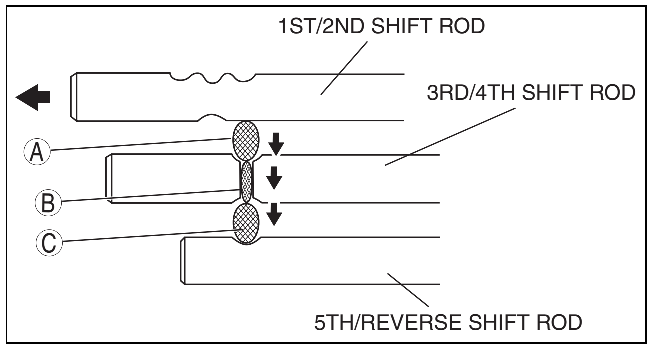
- Because no shift rod is operated, the interlock pins are seated in the grooves.



E5U511AS5009

1st/2nd shifting

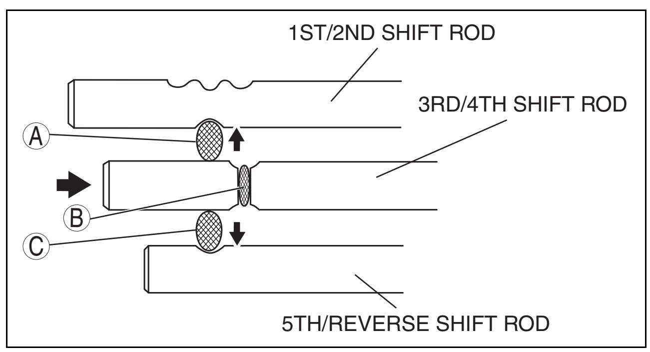
- Movement of the 1st/2nd shift rod forces interlock pin A out of the 1st/2nd shift rod groove, and locks the 3rd/4th shift rod. Pin B, forced by pin A, pushes out pin C to lock the 5th/Reverse shift rod.



E5U511AS5010

3rd/4th shifting

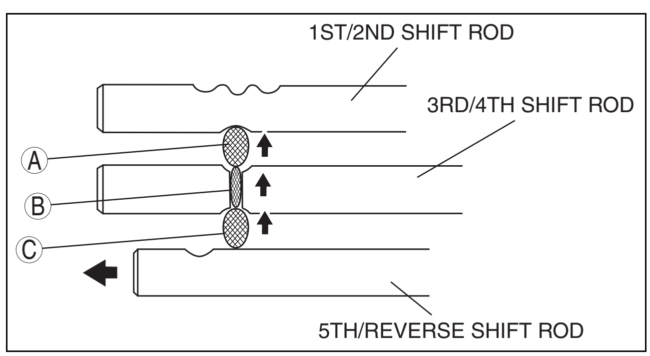
- Movement of the 3rd/4th shift rod forces out pins A and C, and locks the 1st/2nd and 5th/Reverse shift rods. Pin B does not affect the other pins or shift rods during 3rd/4th shifting.



E5U511AS5011

5th/Reverse shifting

- When performing 5th/Reverse shifting, the interlock pins function the same way as in 1st/2nd shifting, except the pin movement order is in reverse, and the 3rd/4th and 1st/2nd shift rods are locked.



E5U511AS5012

05–11A

REVERSE LOCKOUT MECHANISM FUNCTION [M15M-D]

E5U051117570N03

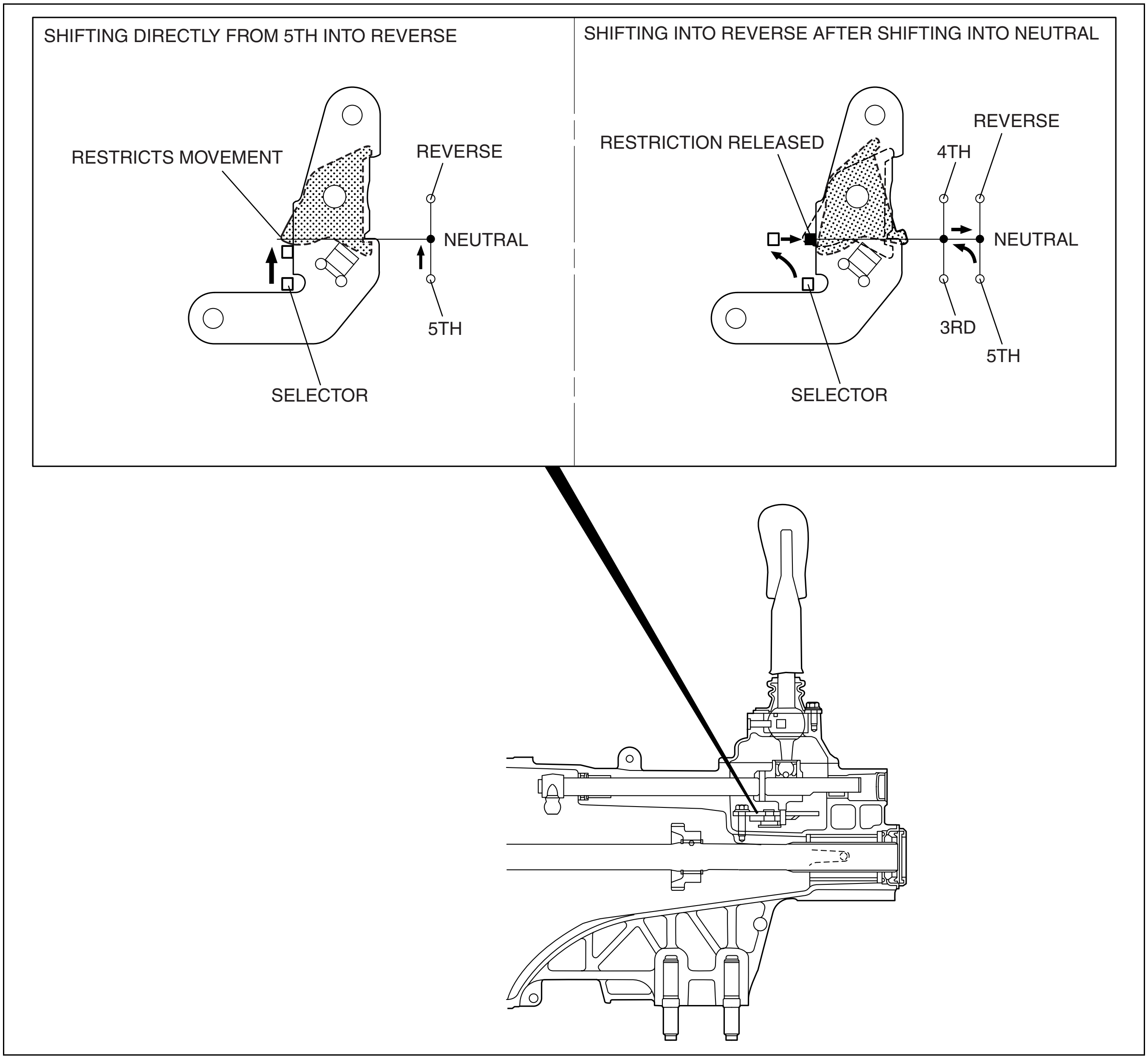
- The reverse lockout mechanism prevents the driver from accidentally shifting into reverse gear when downshifting from 5th to 4th gear.

REVERSE LOCKOUT MECHANISM CONSTRUCTION/OPERATION [M15M-D]

E5U051117570N04

- A cam-type reverse lockout mechanism is adopted to ensure reliability.
- A cam, which is installed to the shift guide plate in the shift control case, restricts the selector movement to prevent the driver from miss shifting.
- When shifting into reverse, by shifting the selector back into the neutral position once and then shifting to the 5th/reverse direction, the selector pushes the cam outward to release the shifting restriction, and shifting into reverse is made possible.

Shift guide component operation



E5U511AS5004

POWER PLANT FRAME (PPF) FUNCTION [M15M-D]

E5U051100000N21

Features

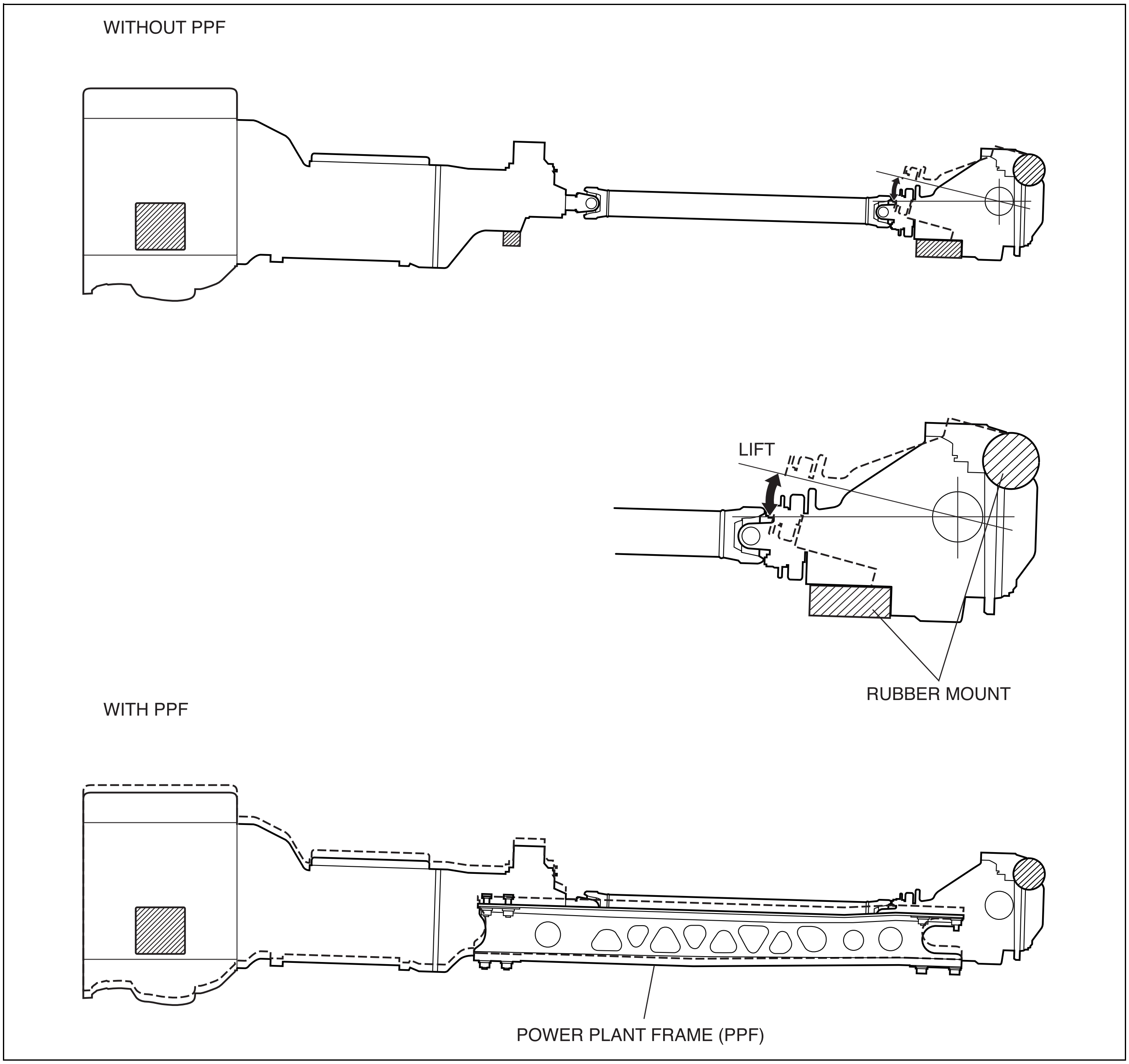
- The power plant frame (PPF) maintains rigidity with a bracket installed between the transmission and the differential. Due to this the shift feeling is solid and a feeling of direct drive when starting from a standstill or accelerating is created.

Vehicle without PPF

— In order to suppress the transmission of excessive 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.

Vehicles with PPF

— With PPF, the transmission and differential are joined in a single unit which, even though the differential is 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.



E5U513ZS5040

05–11B MANUAL TRANSMISSION [P66M-D] 6-SPEED MT

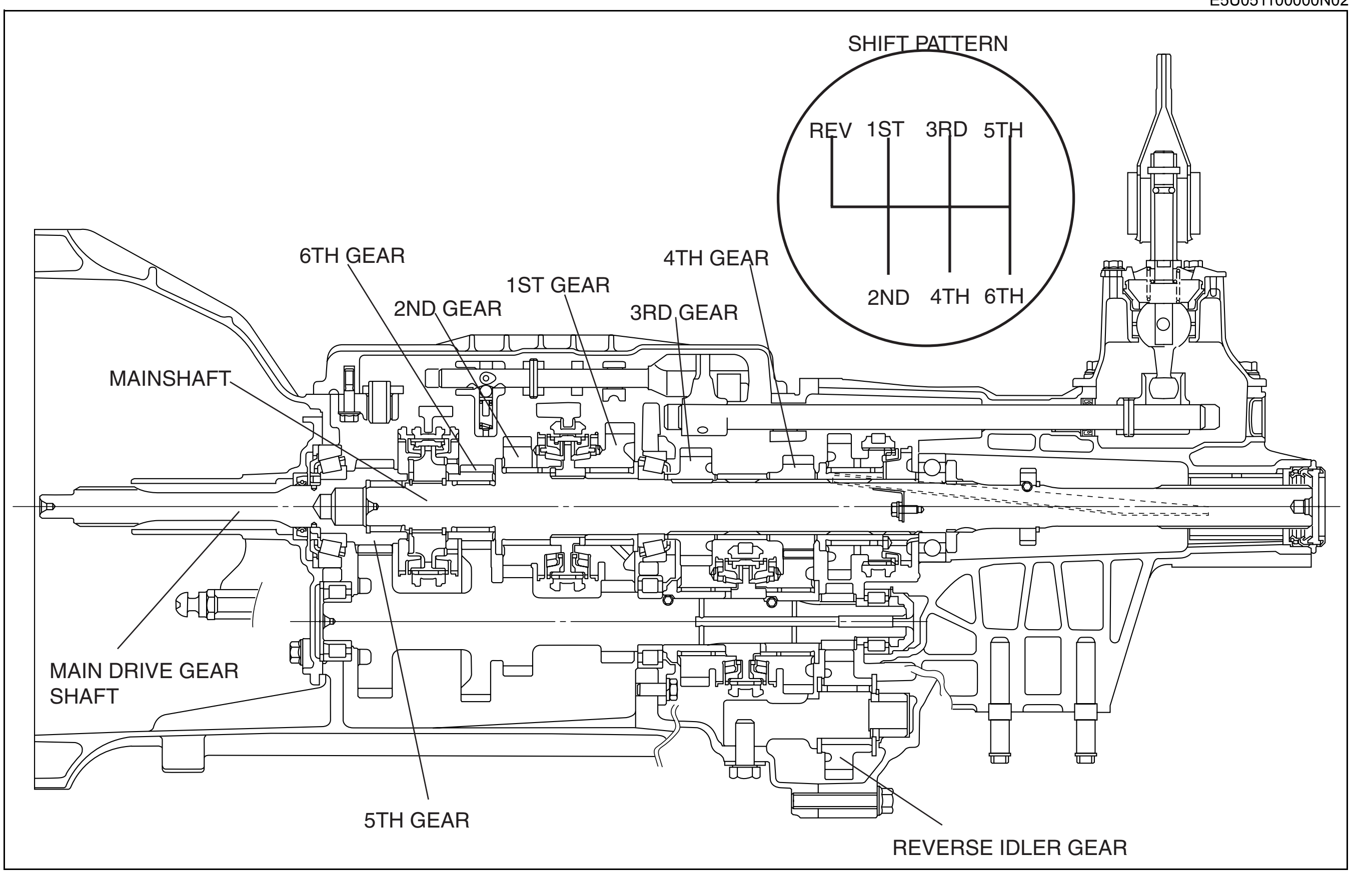
MANUAL TRANSMISSION OUTLINE [P66M-D]

E5U051100000N01

- A linked, triple-cone synchronizer mechanism has been adopted for 1st, 2nd, 3rd and 4th gears.
- A guide plate type reverse lockout mechanism has been adopted.

MANUAL TRANSMISSION CROSS-SECTIONAL VIEW [P66M-D]

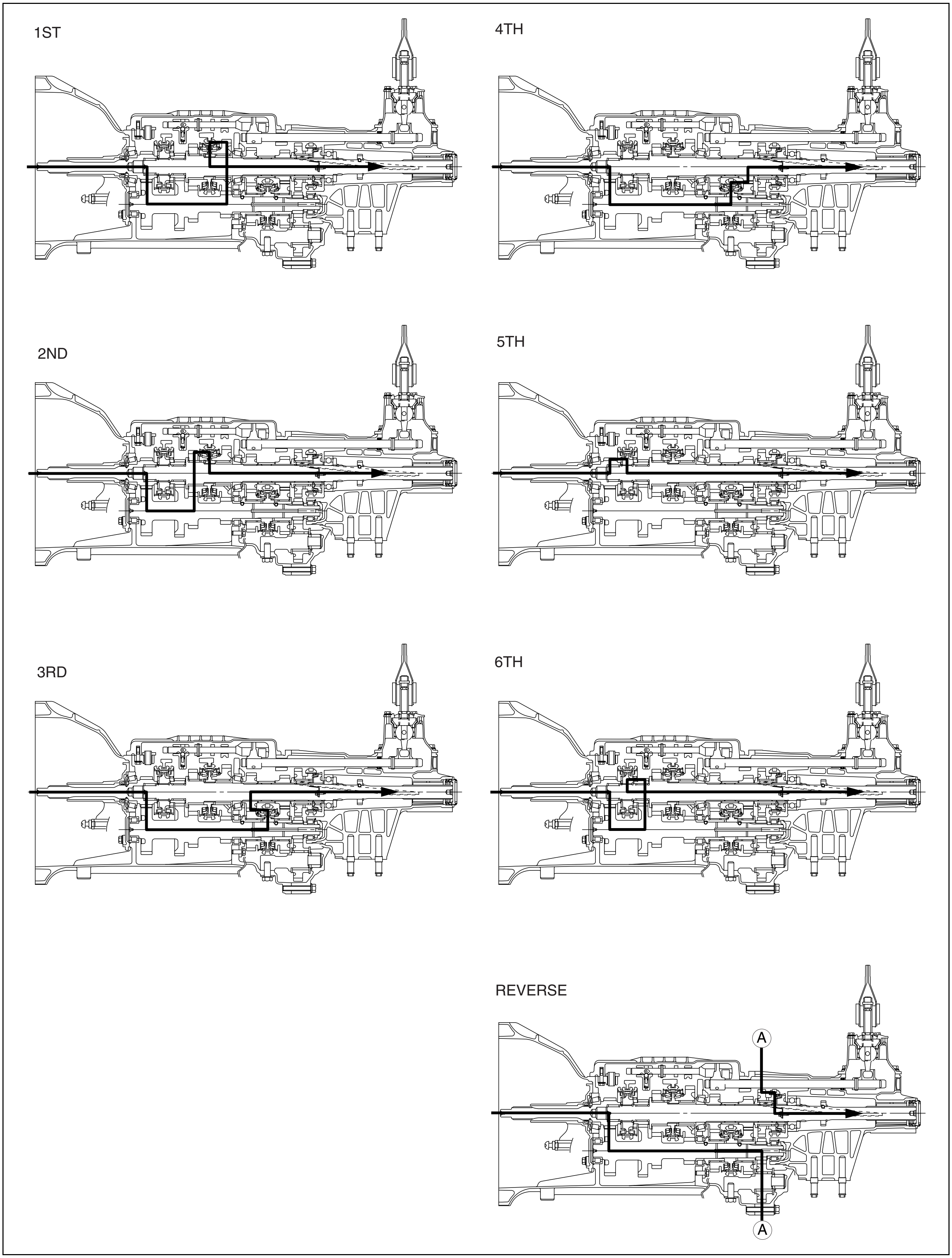
E5U051100000N02



E5U511BS5007

MANUAL TRANSMISSION POWER FLOW [P66M-D]

E5U051100000N03



E5U511BS5008

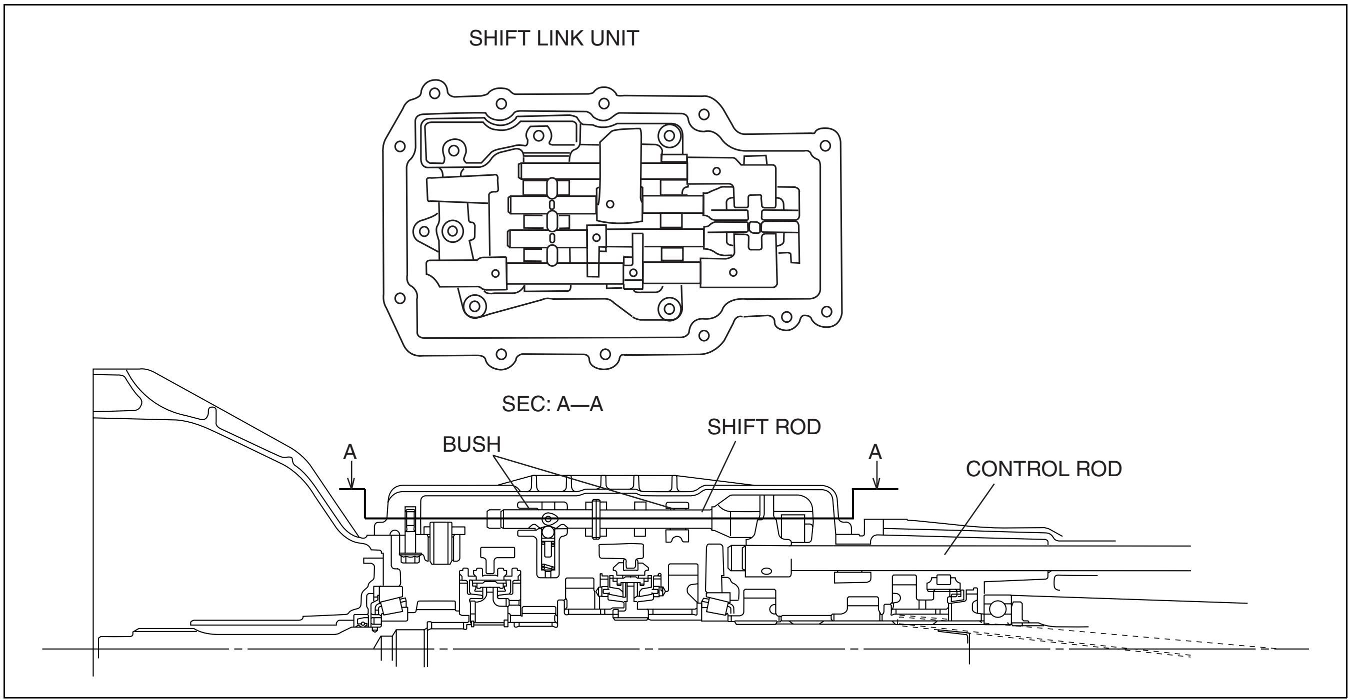
SHIFT MECHANISM [P66M-D]

E5U051100000N04

Shift rod

STRUCTURE

- The shift lever stroke has been set shorter to provide optimal shift feel.
- To realize assured shift feel, the shift link mechanism has been integrated.
- Due to the use of metal bushings for the sliding parts of the shift rod, sliding resistance during shifting is greatly reduced, thus improving shift quality.



E5U511BS5006

05–11B

TRIPLE SYNCHRONIZER MECHANISM STRUCTURE [P66M-D]

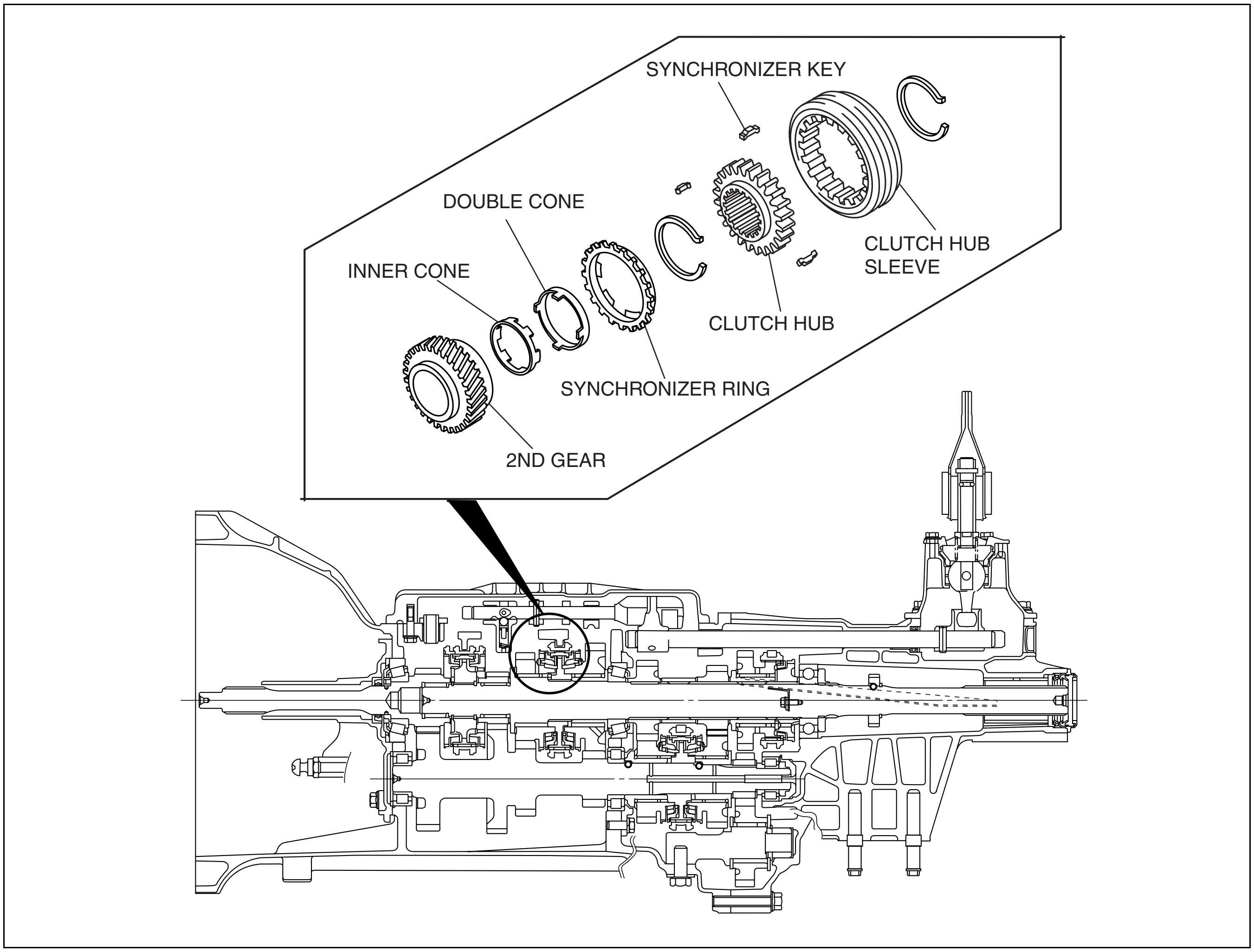
E5U051100000N05

Features

- A triple cone synchronizer mechanism is used for the 1st, 2nd, 3rd and 4th gears.
- The triple cone synchronizer mechanism is a compact device capable of heavy duty meshing.
- The synchro mechanism reduces meshing time and improves operation.
- The triple cone synchro mechanism includes a synchronizer ring, a double cone, and an inner cone.

Structure

Structural view

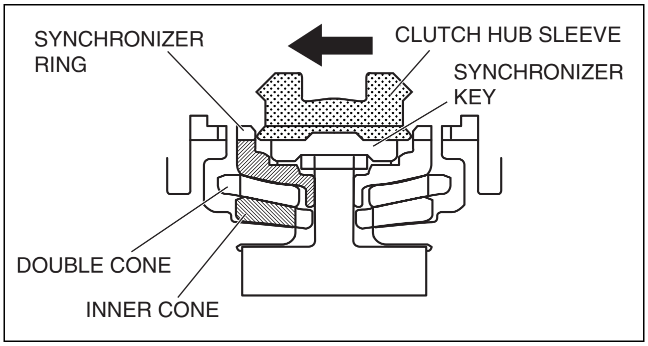


E5U511BS5009

TRIPLE SYNCHRONIZER MECHANISM OPERATION [P66M-D]

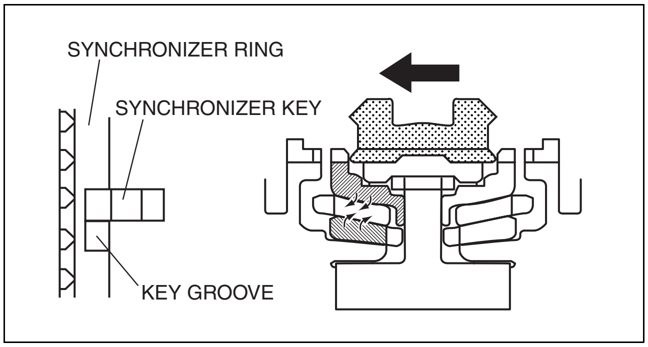
E5U051100000N06

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



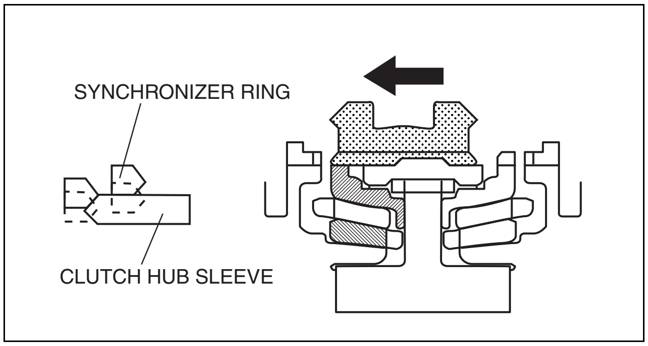
E5U511BS5010

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



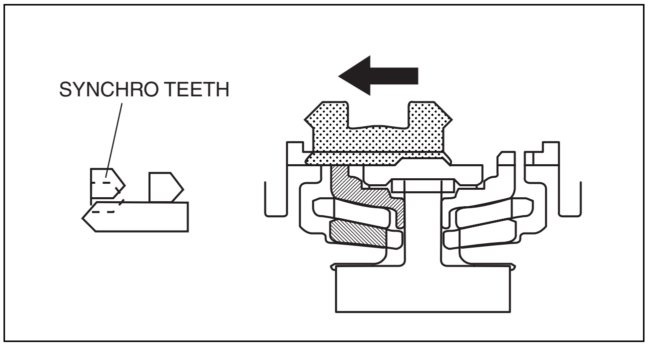
E5U511BS5011

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



E5U511BS5012

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



E5U511BS5013

05–11B

SHIFT INTERLOCK MECHANISM FUNCTION [P66M-D]

E5U051100000N07

- This provides reliable double-engagement prevention.

SHIFT INTERLOCK MECHANISM OPERATION [P66M-D]

E5U051100000N08

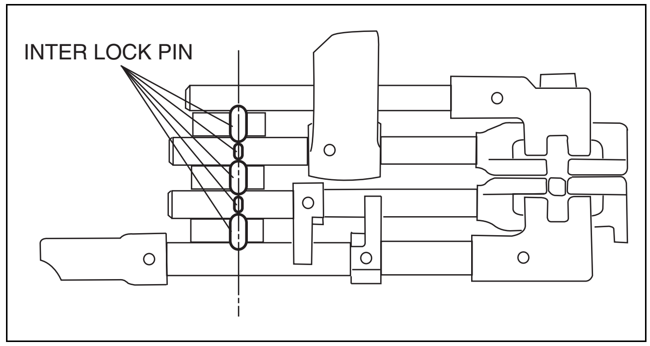
Structure

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

Operation

Neutral

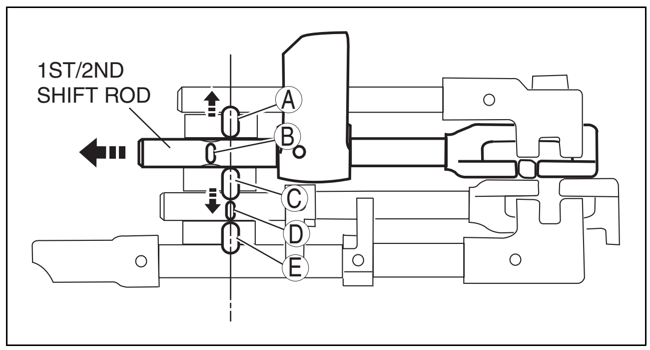
- Each interlock pin is in the groove of each shift rod because no shift rod is operating.



E5U511BS5001

1st/2nd shifting

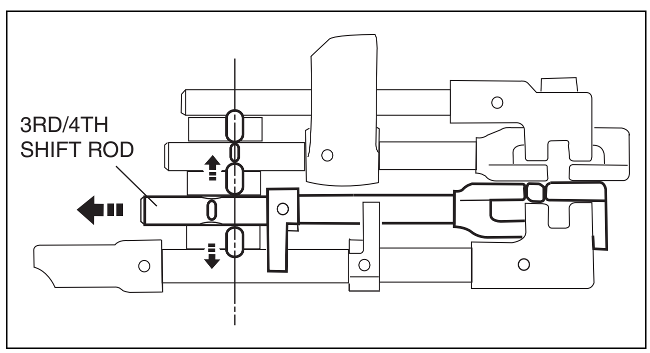
- Movement of the 1st/2nd shift rod forces interlock pins A and C out of the 1st/2nd shift rod grooves, and the reverse shift rod and 3rd/4th shift rod are locked. In addition, interlock pin C forces interlock pin E out via interlock pin D, and the 5th/6th shift rod is locked.



E5U511BS5002

3rd/4th shifting

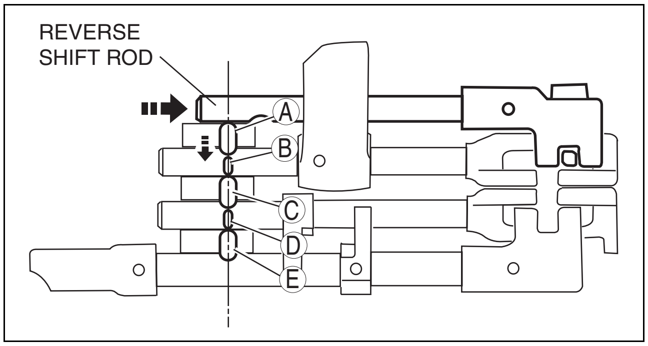
- When the 3rd/4th shift rod operates, the other three shift rods are locked in the same way as the 1st/2nd shifting.



E5U511BS5003

Reverse shifting

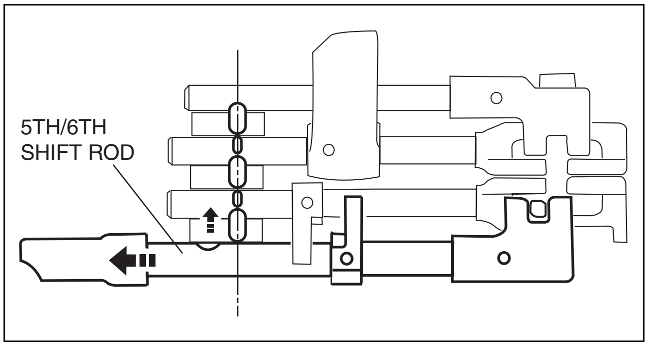
- Movement of the reverse shift rod forces interlock pin A out of the reverse shift rod groove, and the 1/2 shift rod is locked. In addition, interlock pin A forces interlock pins C and E out via interlock pins B and D, and the 3rd/4th shift rod and 5th/6th shift rod are locked.



E5U511BS5004

5th/6th shifting

- When the 5th/6th shift rod operates, the other three shift rods are locked in the same way as the reverse shifting.



E5U511BS5005

REVERSE LOCKOUT MECHANISM FUNCTION [P66M-D]

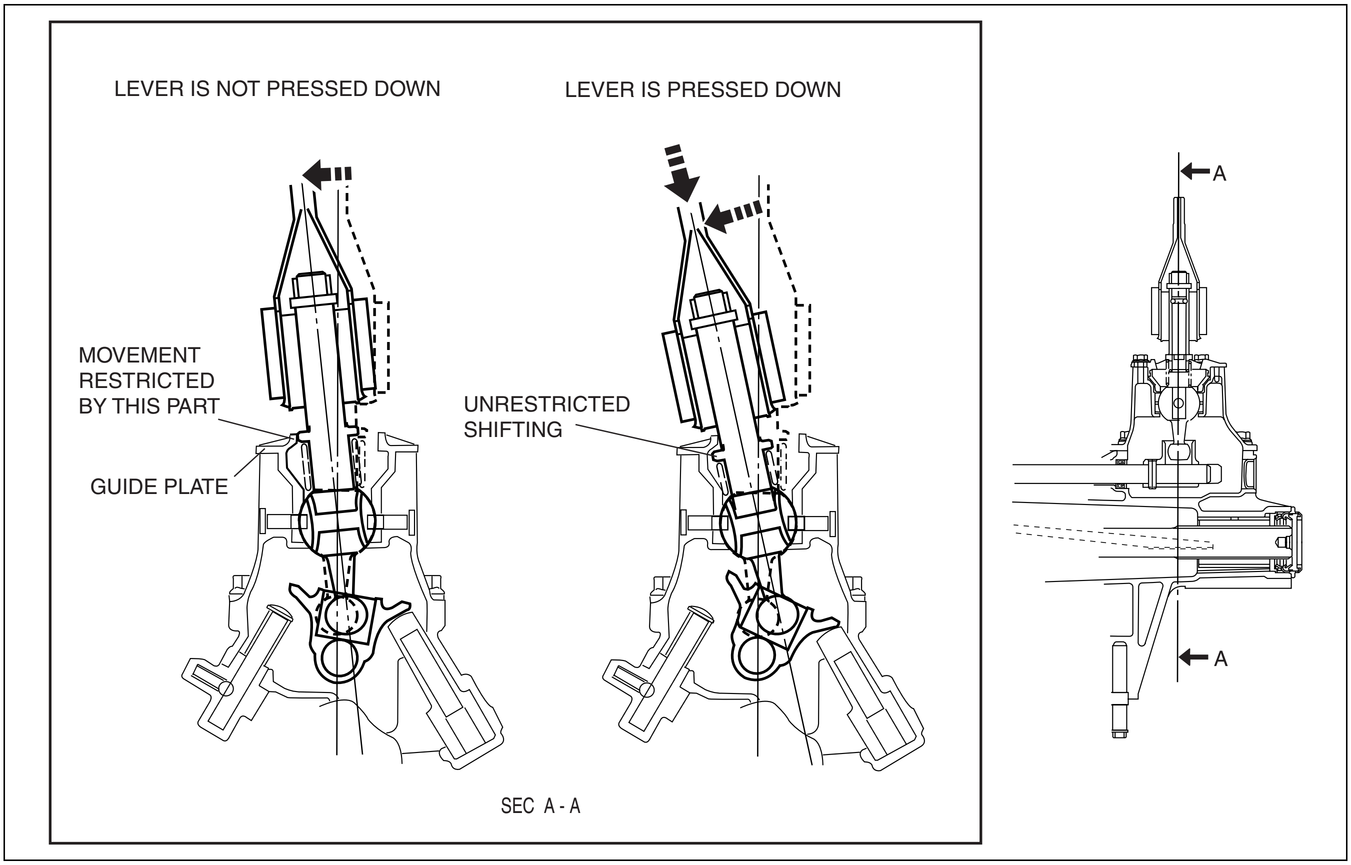
E5U051117570N01

- The reverse lockout mechanism prevents the driver from accidentally shifting into reverse gear when shifting from neutral to 1st gear.

REVERSE LOCKOUT MECHANISM CONSTRUCTION/OPERATION [P66M-D]

E5U051117570N02

- 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 neutral to 1st 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.



E5U511BS5014

POWER PLANT FRAME (PPF) FUNCTION [P66M-D]

E5U051100000N09

- The Power Plant Frame feature has been adopted for all models. For detailed information, refer to the M15M-D manual transmission description. (See 05–11A–7 POWER PLANT FRAME (PPF) FUNCTION [M15M-D].)

05–13 AUTOMATIC TRANSMISSION [SJ6A-EL] 6-SPEED AT

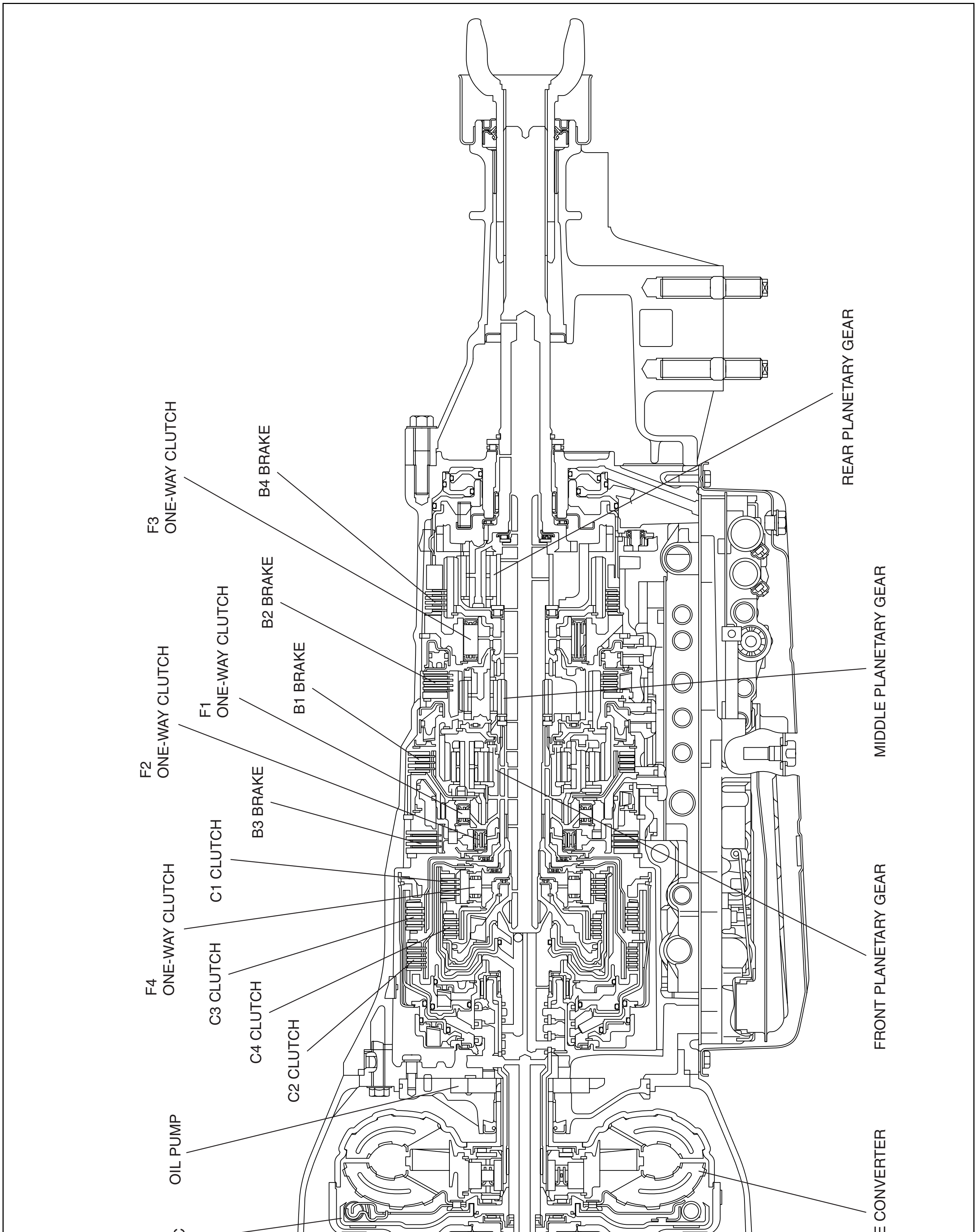
AUTOMATIC TRANSMISSION OUTLINE [SJ6A-EL]

E5U051300000N01

- Newly developed SJ6A-EL type 6-speed AT has been adopted.
- With the adoption of the line pressure solenoid, TCC control solenoid, solenoid for C3 clutch (shift solenoid F), solenoid for B2 brake (shift solenoid G), and the linear type solenoid, dynamic shift quality has been realized.

AUTOMATIC TRANSMISSION CROSS-SECTIONAL VIEW [SJ6A-EL]

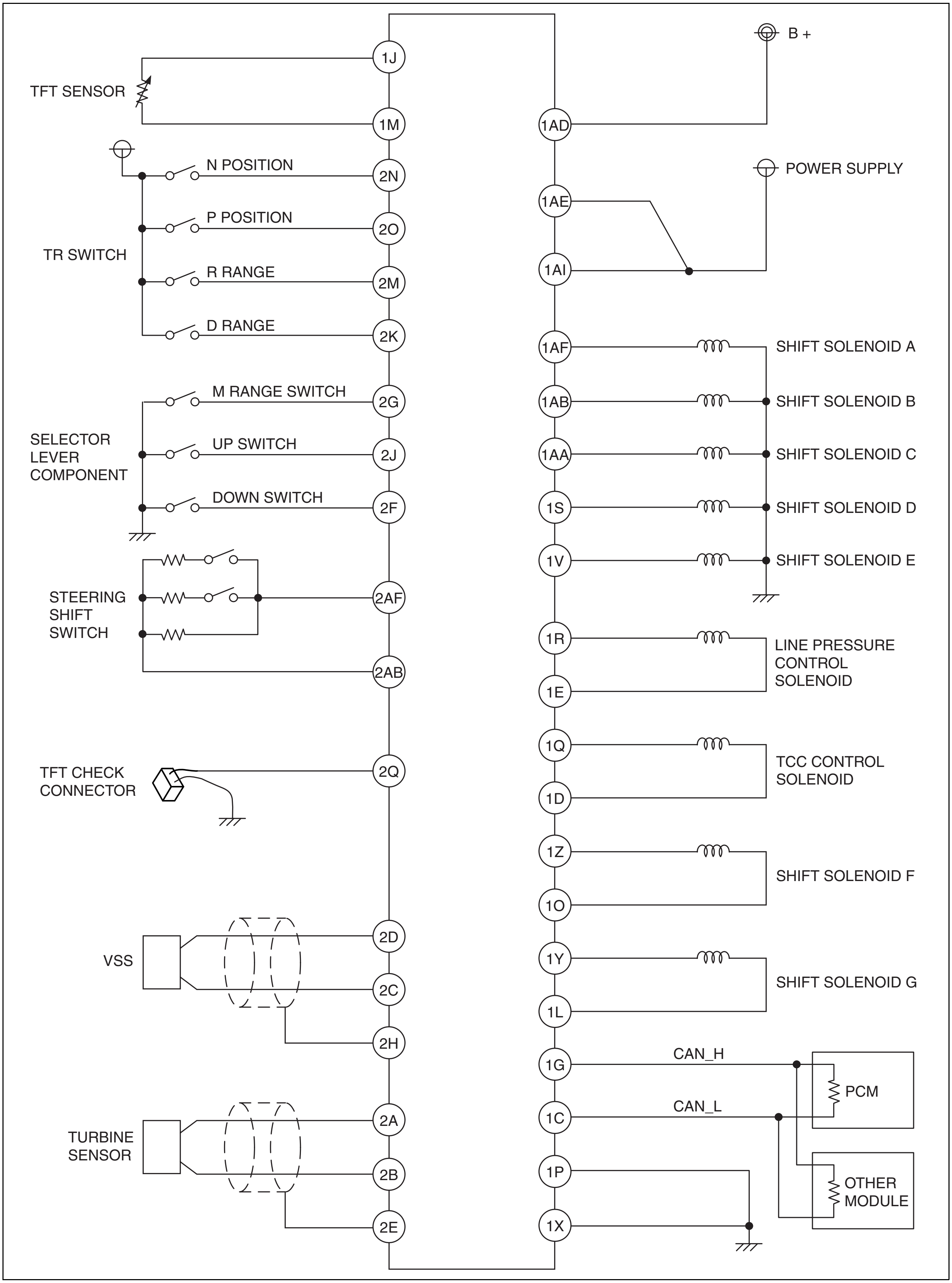
E5U051300000N02



E5U513ZS5001

AUTOMATIC TRANSMISSION CONTROL SYSTEM WIRING DIAGRAM [SJ6A-EL]

E5U051300000N03



E5U513ZS5002

EC-AT OPERATION CHART [SJ6A-EL]

E5U051300000N04

Position/Range	Mode	Gear position		Shift pattern: Shift	Shift pattern: TCC	Shift pattern: Engine brake	Transmission: C1 clutch	C2 clutch	C3 clutch	C4 clutch	B1 brake	B2 brake	B3 brake	B4 brake	F1 one-way clutch	F2 one-way clutch	F3 one-way clutch	F4 one-way clutch	Solenoid ON/OFF type: Shift solenoid A	Shift solenoid B	Shift solenoid C	Shift solenoid D	Shift solenoid E	Linear type: Shift solenoid F	Shift solenoid G	TCC control solenoid
P	–	Neutral	–	–																○	○		○		○	
R	less than 11km/h {7mph}	Reverse	3.168	–		○			○		○			○	○					○	○		○		○	
	more than 11km/h {4mph}			–							○			○	○				○				○		○	
N	–	Neutral	–	–																○	○		○		○	
D	*1 POWER/ NORMAL	1GR	3.538				○										○	○		○	○		○		○	
		2GR	2.060				○						○		○	○		○	○	○	○		○		○	
		3GR	1.404				○		○				△		○			○	○		○		○		○	
		4GR	1.000			○	○	○	△	◎			△					○*3	○				○		○	
		5GR	0.713			○	△	○	○		○		△						○			○		○		
		5GR*2 TCC ON			○	○	△	○	○		○		△						○			○		○		○
		6GR	0.582			○	△	○			△	○	△						○	○		○		○		
		6GR*2 TCC ON			○	○	△	○			△	○	△						○	○		○		○		○
M	MANUAL	1GR	3.538			○	○			◎				◎			○*3	○*3		○	○		○			
		2GR	2.060			○	○			◎		◎	○		○*3	○*3		○*3	○	○	○	○	○			
		3GR	1.404			○	○		○	◎	◎		△		○*3			○*3	○		○		○			
		4GR	1.000			○	○	○	△	◎			△					○*3	○				○		○	
		5GR	0.713			○	△	○	○		○		△						○			○		○		
		5GR TCC ON			○	○	△	○	○		○		△						○			○		○		○
		6GR	0.582			○	△	○			△	○	△						○	○		○		○		
		6GR TCC ON			○	○	△	○			△	○	△						○	○		○		○		○

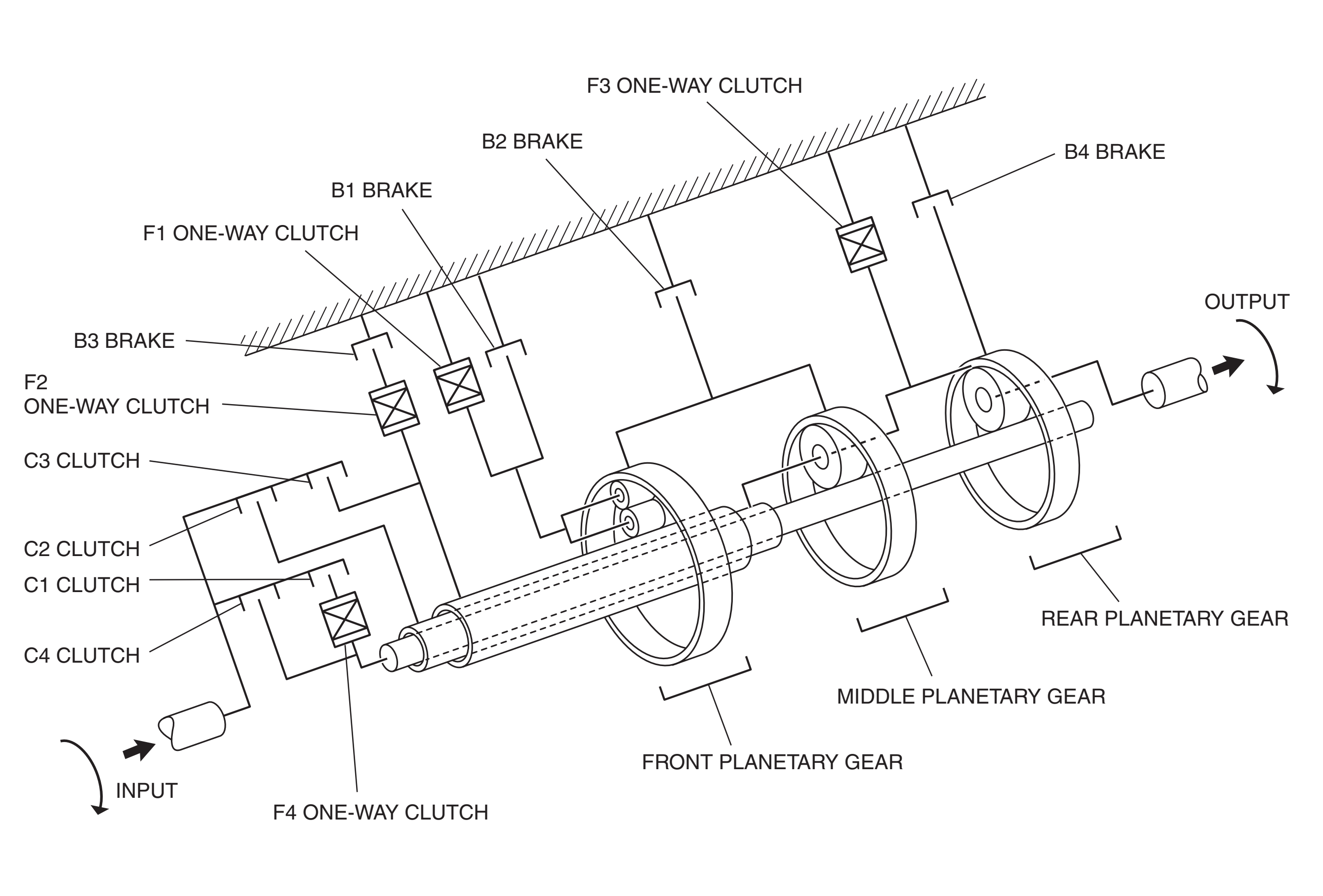
↕ : Automatic shift according to set speed and throttle opening angle
⬍ : Manual shift based on selector lever operation
⇣ : Consecutive shift by tapping selector lever two times in the down-shift (—) direction or up-shift (+) direction
*1 : Automatically switches between POWER and NORMAL modes according to accelerator pedal depressing speed
*2 : Performs TCC operation in NORMAL mode
*3 : Not operating when engine braking
○ : Operating
◎ : Operating when engine braking
△ : Operating but not contributing to transmission power

E5U513ZS5003

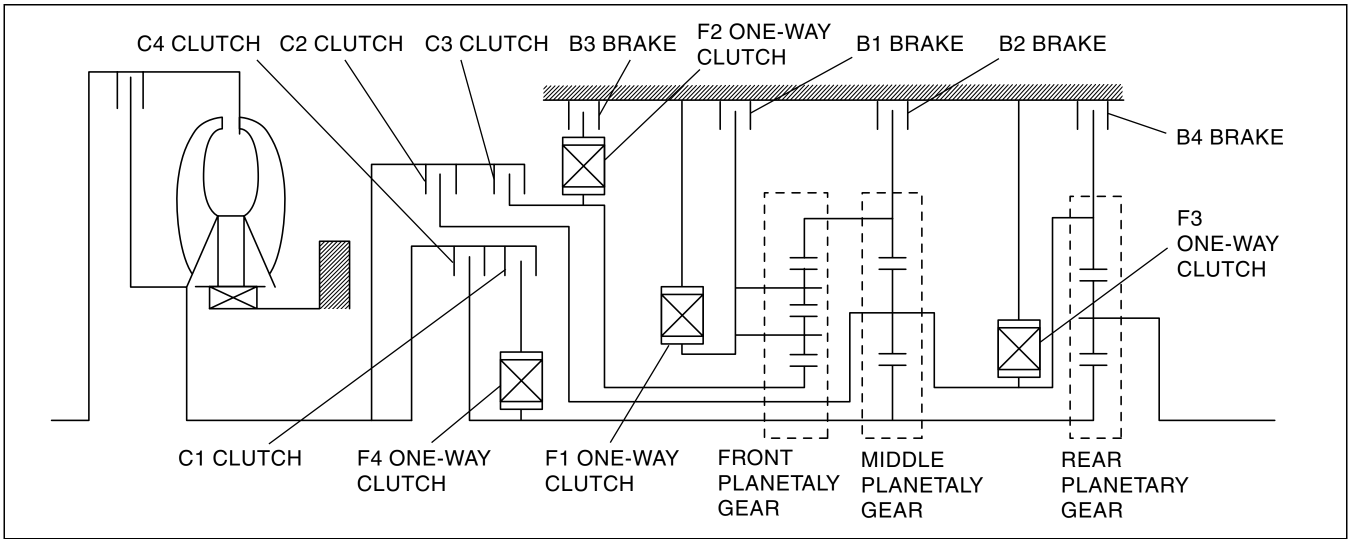
POWERFLOW STRUCTURE [SJ6A-EL]

E5U051300000N05

Description of Components



E5U513ZS5004



E5U513ZS5005

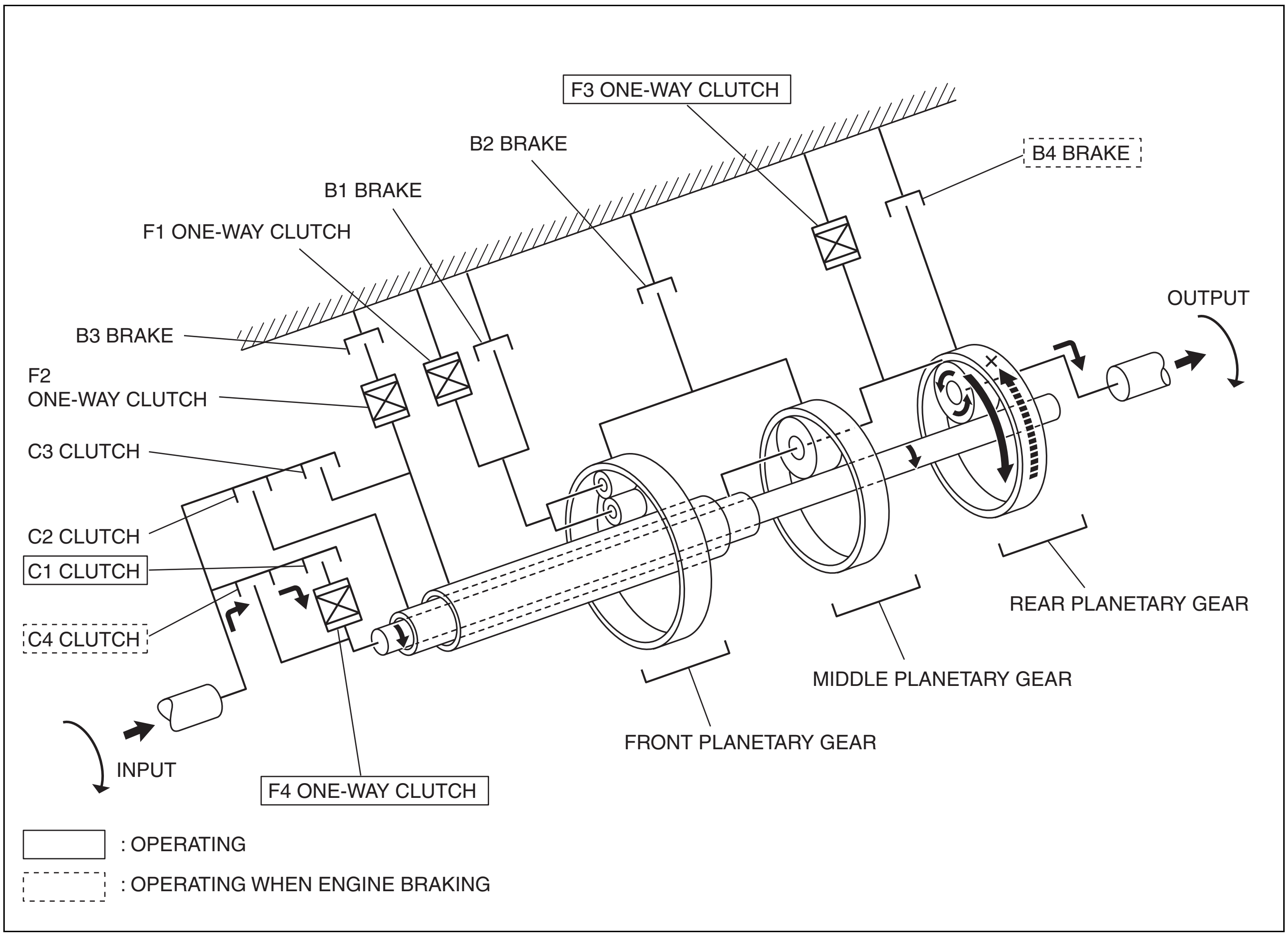
POWERFLOW OPERATION [SJ6A-EL]

E5U051300000N06

List of operating components

Clutch / Brake	Operation
C1 clutch	• Engages input shaft and intermediate shaft via F4 one-way clutch.
C2 clutch	• Engages input shaft and middle planetary carrier.
C3 clutch	• Engages input shaft and front sun gear.
C4 clutch	• Engages input shaft and intermediate shaft.
B1 brake	• Locks rotation of front planetary carrier.
B2 brake	• Locks rotation of front and middle ring gear.
B3 brake	• Locks F2 one-way clutch outer race.
B4 brake	• Locks rotation of rear ring gear.
F1 one-way clutch	• Locks counterclockwise rotation of front planetary carrier on transmission case.
F2 one-way clutch	• Locks counterclockwise rotation of front sun gear during B3 brake operation.
F3 one-way clutch	• Locks counterclockwise rotation of rear ring gear. • Locks counterclockwise rotation of middle planetary carrier.
F4 one-way clutch	• Locks counterclockwise rotation of intermediate shaft during C1 clutch operation.

1GR



E5U513ZS5006

1. INPUT SHAFT ROTATES CLOCKWISE.

   C1 CLUTCH OPERATES.

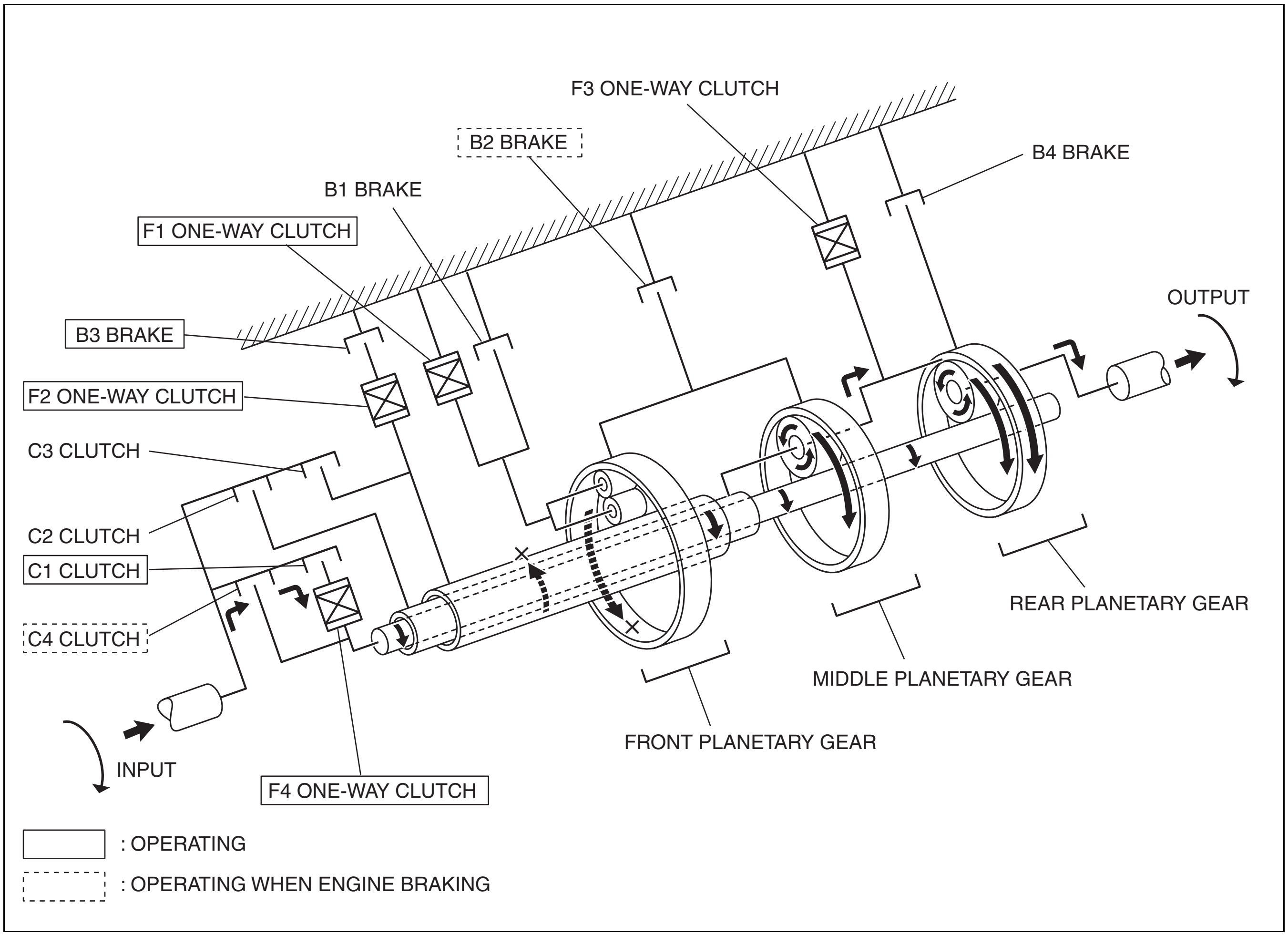
2. INTERMEDIATE SHAFT ROTATES CLOCKWISE.
3. REAR SUN GEAR ROTATES CLOCKWISE.
4. REAR PLANETARY PINION GEAR ROTATE COUNTERCLOCKWISE.
5. REAR RING GEAR TRIES TO ROTATE COUNTERCLOCKWISE.

   F3 ONE-WAY CLUTCH OPERATES (LOCKS COUNTERCLOCKWISE ROTATION OF REAR PLANETARY CARRIER).

6. REAR PLANETARY CARRIER ROTATES CLOCKWISE DUE TO REACTION FORCE OF REAR PLANETARY PINION GEARS.
7. OUTPUT SHAFT ROTATES CLOCKWISE.

E5U513ZS5016

2GR



E5U513ZS5007

1 INPUT SHAFT ROTATES CLOCKWISE.

C1 CLUTCH OPERATES.

2 INTERMEDIATE SHAFT ROTATES CLOCKWISE.

3 MIDDLE SUN GEAR ROTATES CLOCKWISE.

3 REAR SUN GEAR ROTATES CLOCKWISE.

4 MIDDLE PLANETARY PINION GEAR ROTATE COUNTERCLOCKWISE.

5 B3 BRAKE, F2 ONE-WAY CLUTCH, AND F1 ONE-WAY CLUTCH OPERATE (LOCKS COUNTERCLOCKWISE ROTATION OF MIDDLE RING GEAR AND FRONT RING GEAR).

6 MIDDLE PLANETARY CARRIER ROTATES CLOCKWISE DUE TO REACTION FORCE OF MIDDLE PLANETARY PINION GEARS.

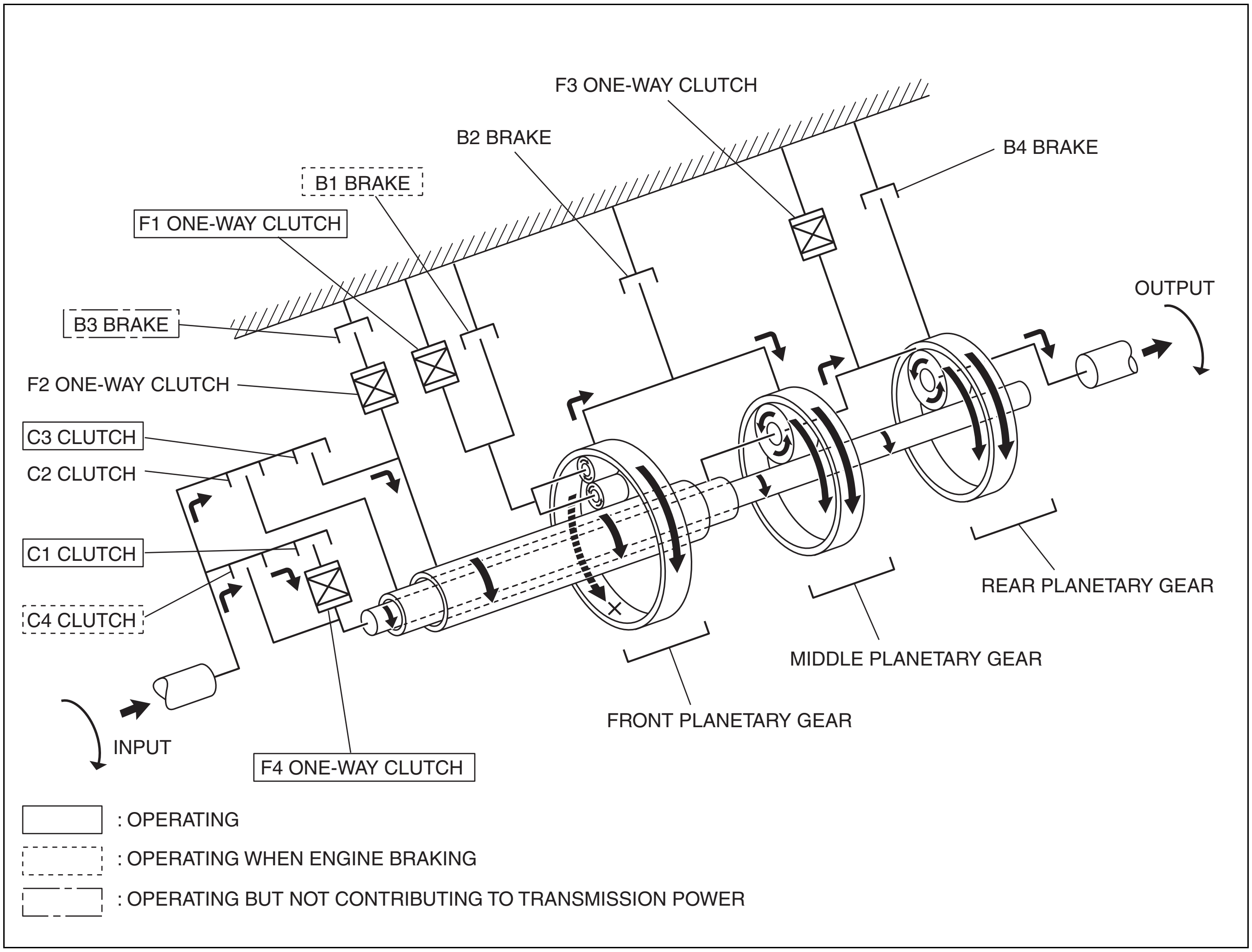
7 REAR RING GEAR ROTATES CLOCKWISE.

8 REAR PLANETARY CARRIER ROTATES CLOCKWISE AT A ROTATIONAL SPEED IN WHICH ROTATION OF REAR RING GEAR IS SUBTRACTED FROM THAT OF REAR SUN GEAR (REAR PLANETARY PINION GEARS ROTATE COUNTERCLOCKWISE).

9 OUTPUT SHAFT ROTATES CLOCKWISE.

E5U513ZS5017

3GR



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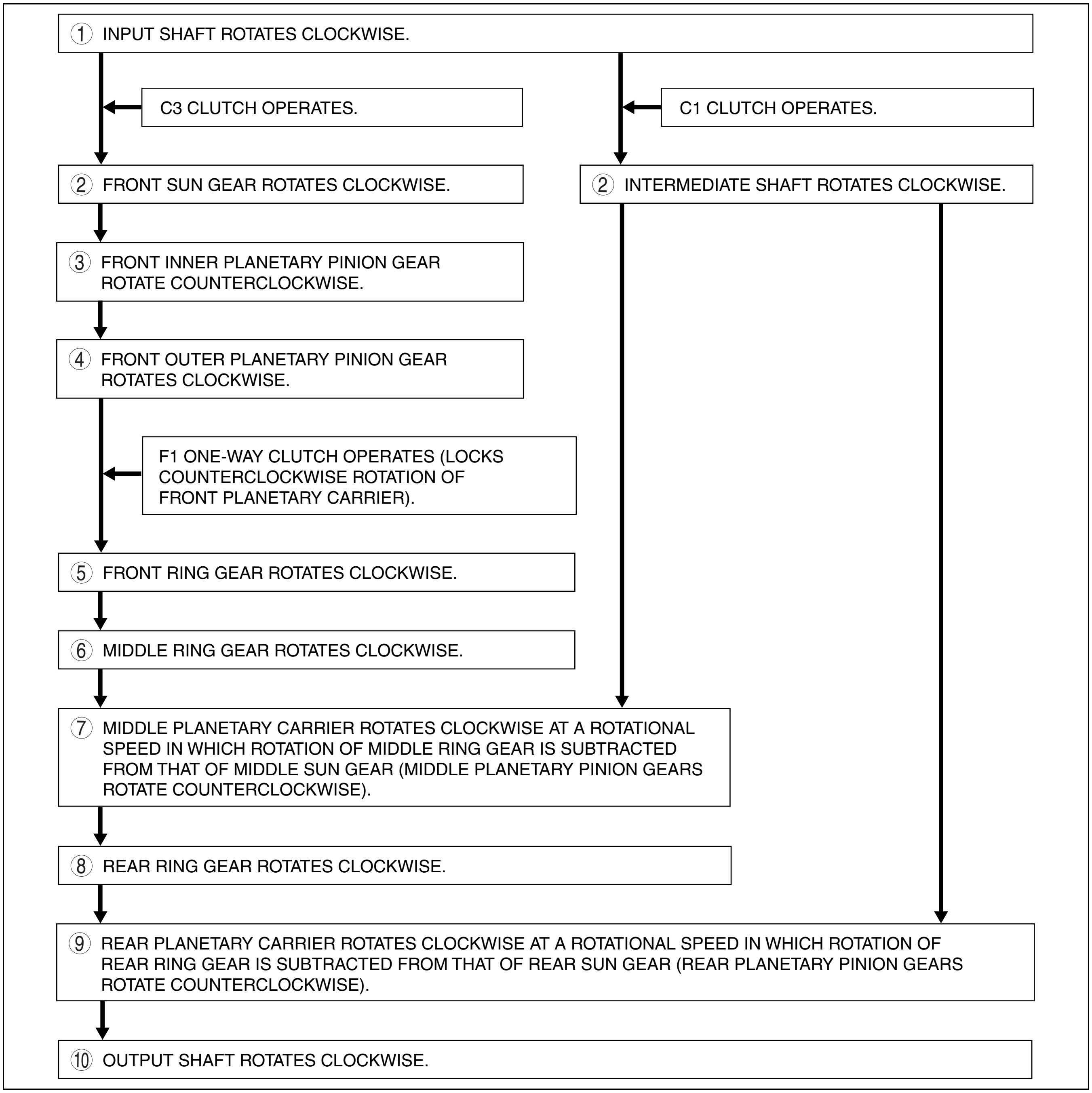
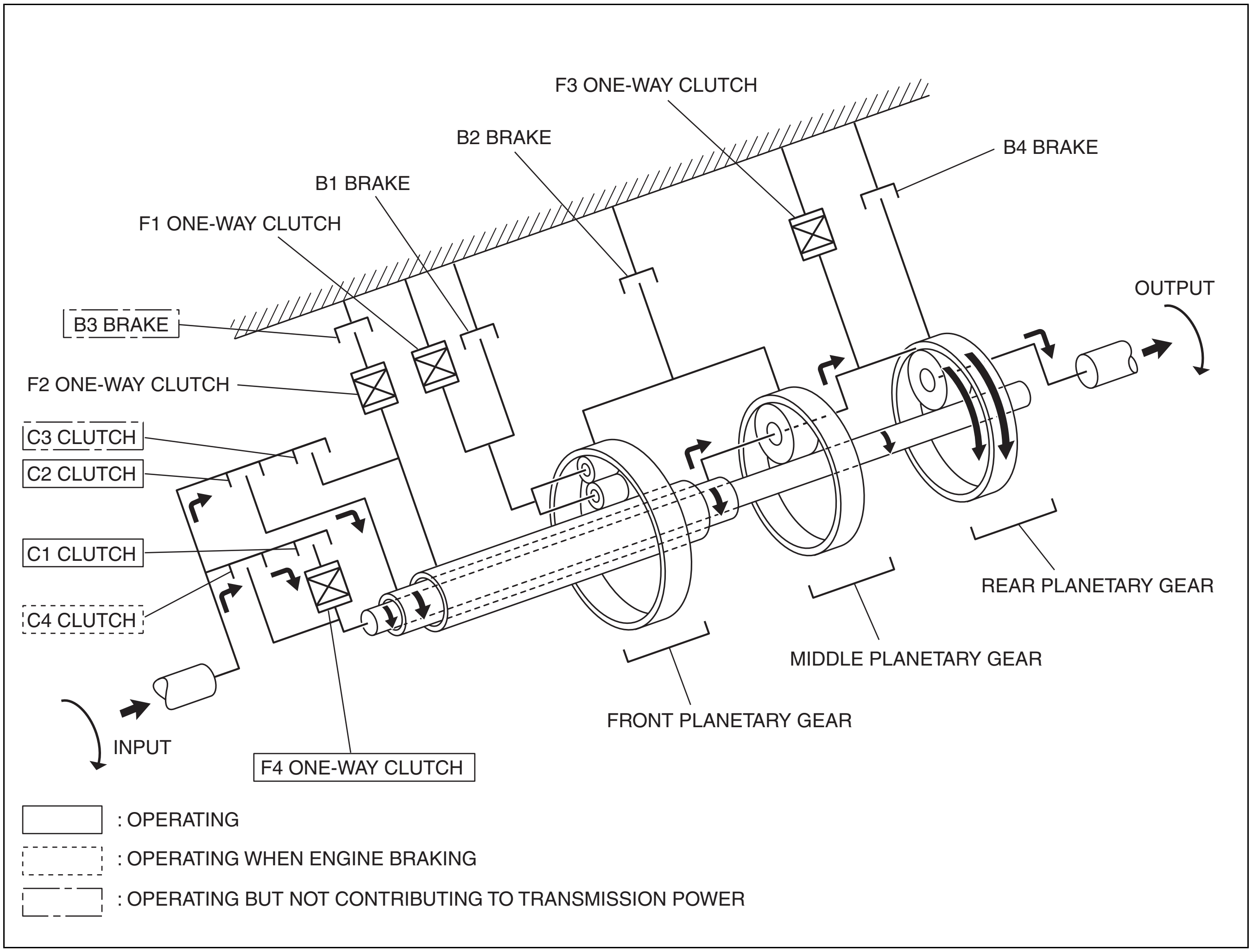


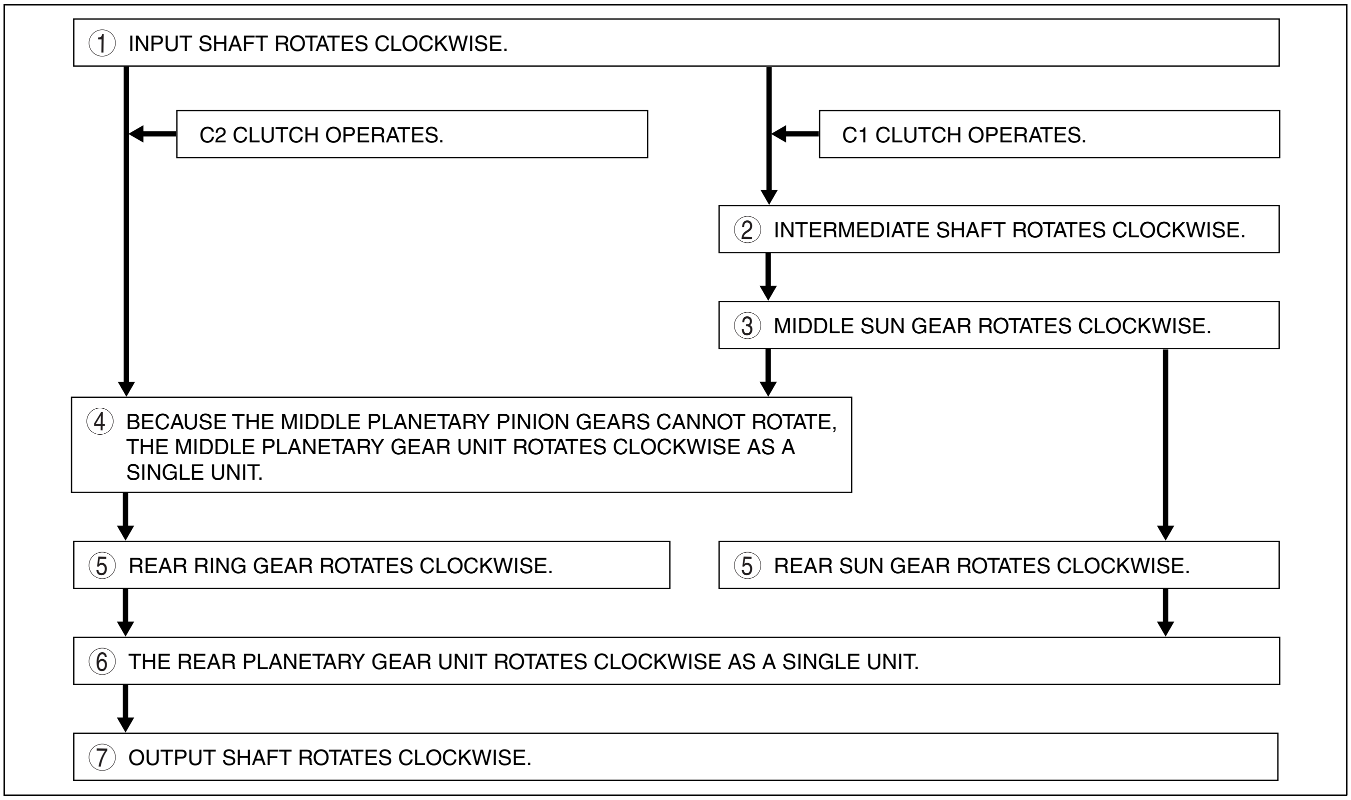
E5U513ZS5018

05–13

4GR

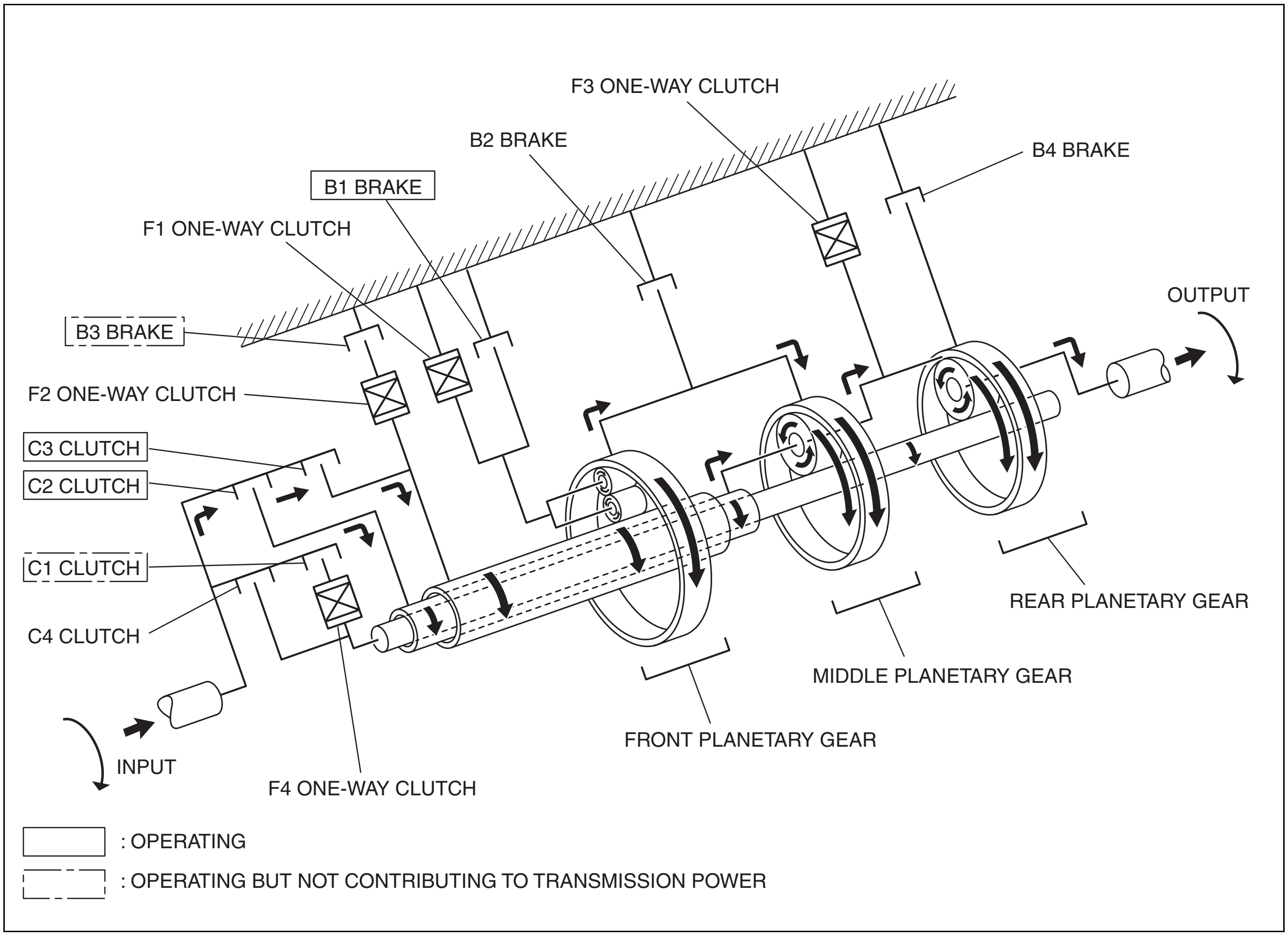


E5U513ZS5009

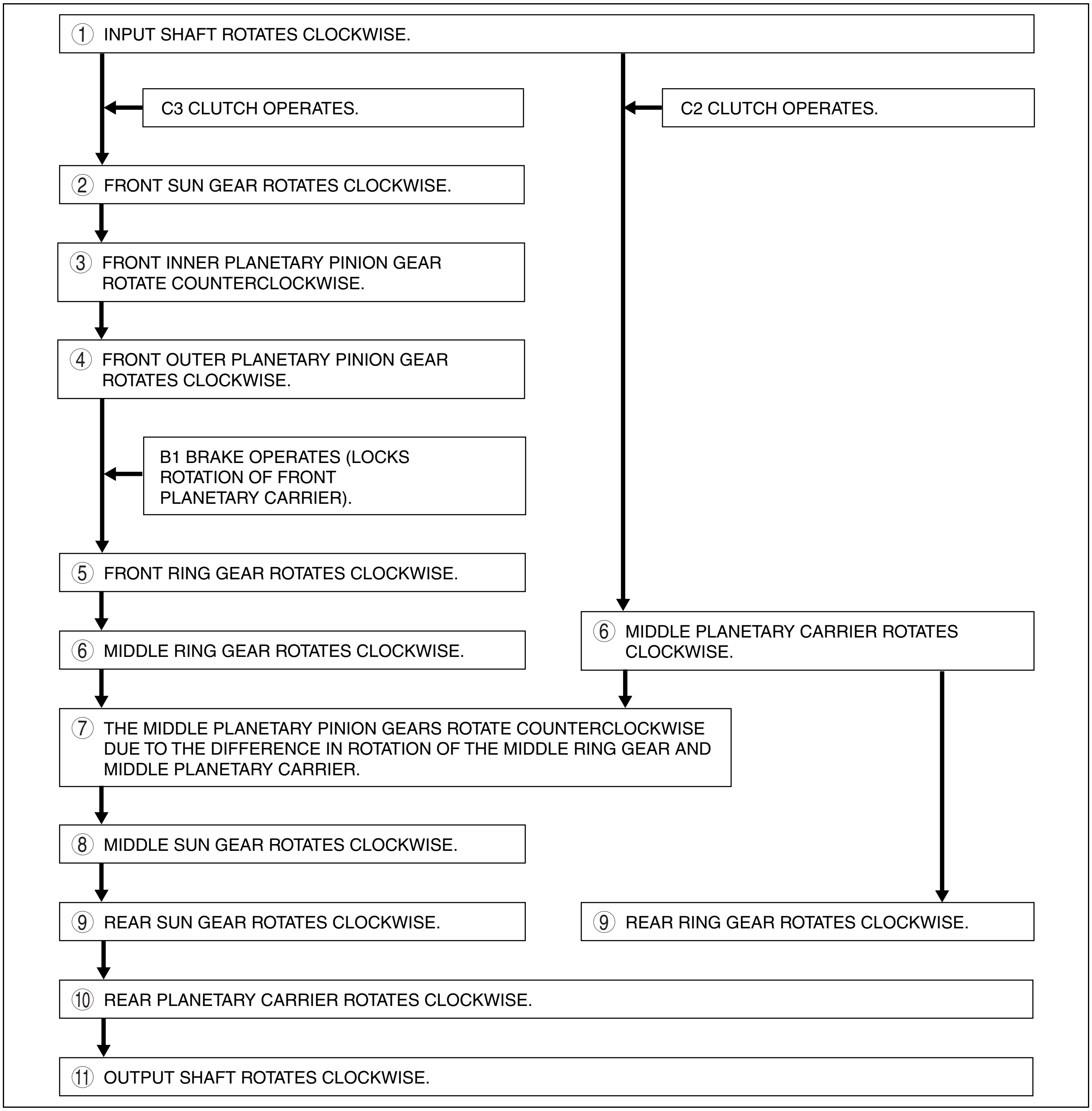


E5U513ZS5019

5GR

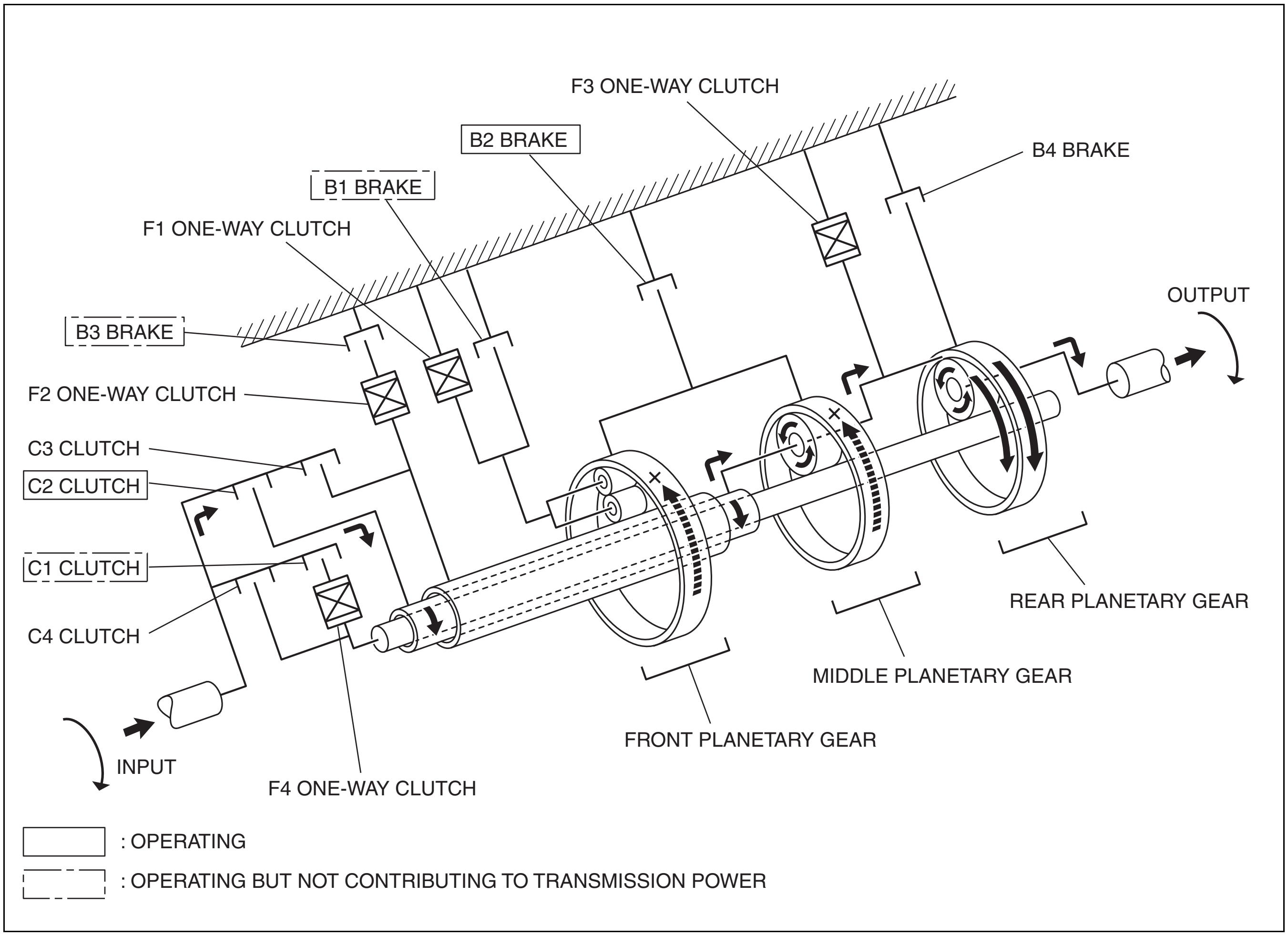


E5U513ZS5010

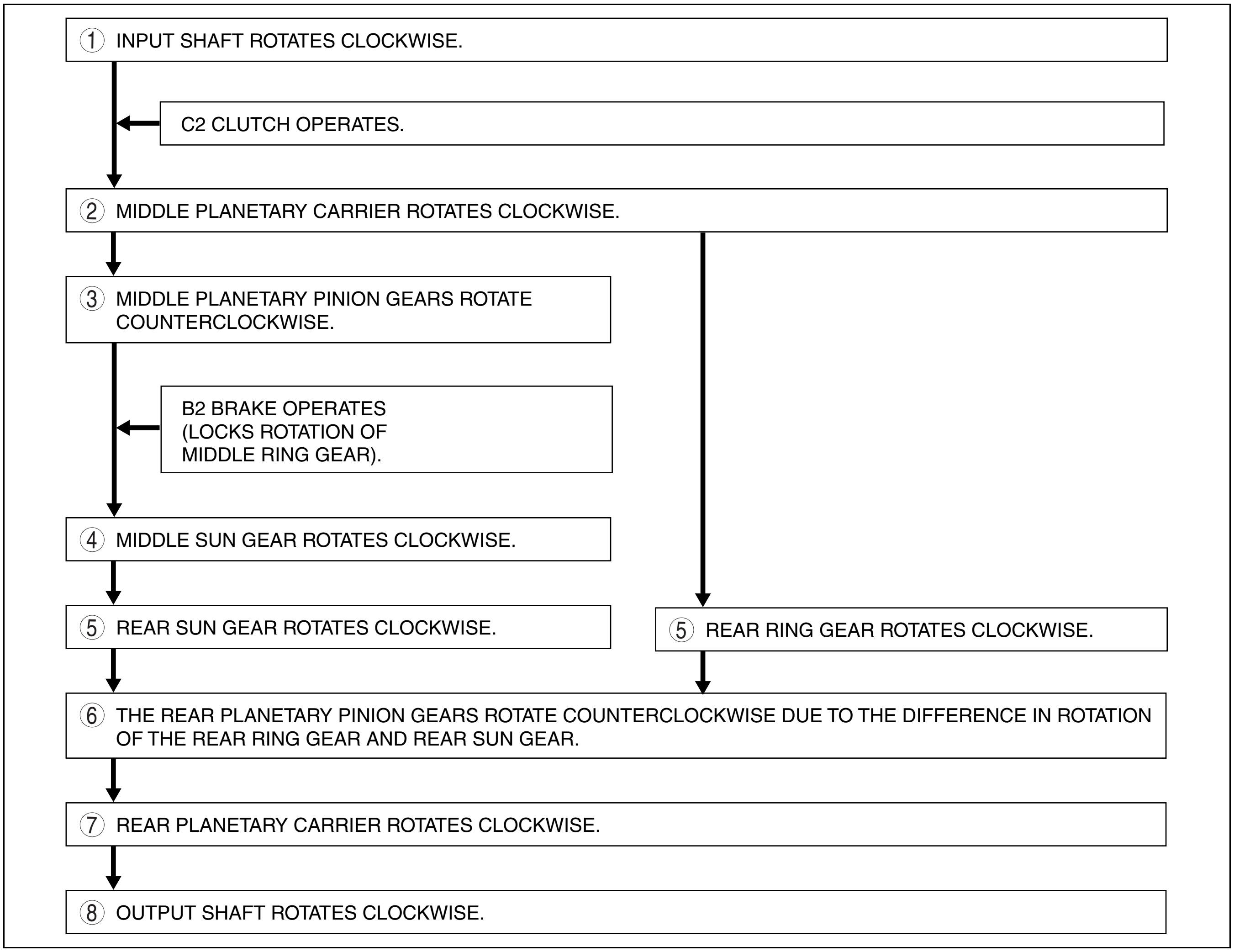


E5U513ZS5020

6GR

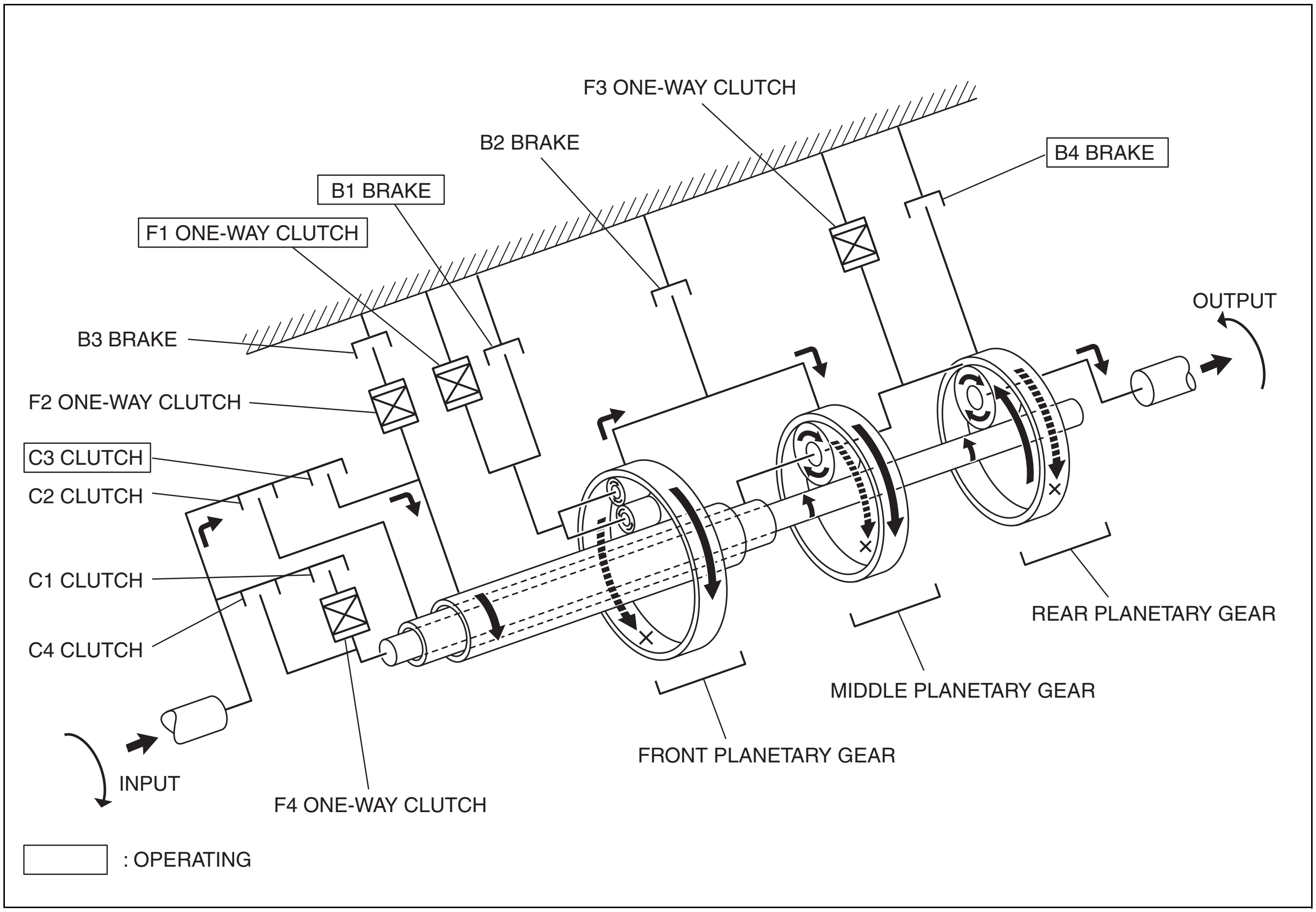


E5U513ZS5011



E5U513ZS5021

R position



E5U513ZS5012

1 INPUT SHAFT ROTATES CLOCKWISE.

↓ ← C3 CLUTCH OPERATES.

2 FRONT SUN GEAR ROTATES CLOCKWISE.

↓

3 FRONT INNER PLANETARY PINION GEAR ROTATE COUNTERCLOCKWISE.

↓

4 FRONT OUTER PLANETARY PINION GEAR ROTATES CLOCKWISE.

↓ ← B1 BRAKE AND F1 ONE-WAY CLUTCH OPERATES (LOCKS FRONT PLANETARY CARRIER).

5 FRONT RING GEAR ROTATES CLOCKWISE.

↓

6 MIDDLE RING GEAR ROTATES CLOCKWISE.

↓

7 MIDDLE PLANETARY PINION GEAR ROTATES CLOCKWISE.

↓ ← B4 BRAKE OPERATES (LOCKS MIDDLE PLANETARY CARRIER AND REAR RING GEAR).

8 MIDDLE SUN GEAR ROTATE COUNTERCLOCKWISE.

↓

9 REAR SUN GEAR ROTATE COUNTERCLOCKWISE.

↓

10 REAR PLANETARY PINION GEAR ROTATES CLOCKWISE.

↓ ← B4 BRAKE OPERATES (LOCKS MIDDLE PLANETARY CARRIER AND REAR RING GEAR).

11 REAR PLANETARY CARRIER ROTATE COUNTERCLOCKWISE DUE TO REACTION FORCE OF REAR PLANETARY PINION GEARS.

↓

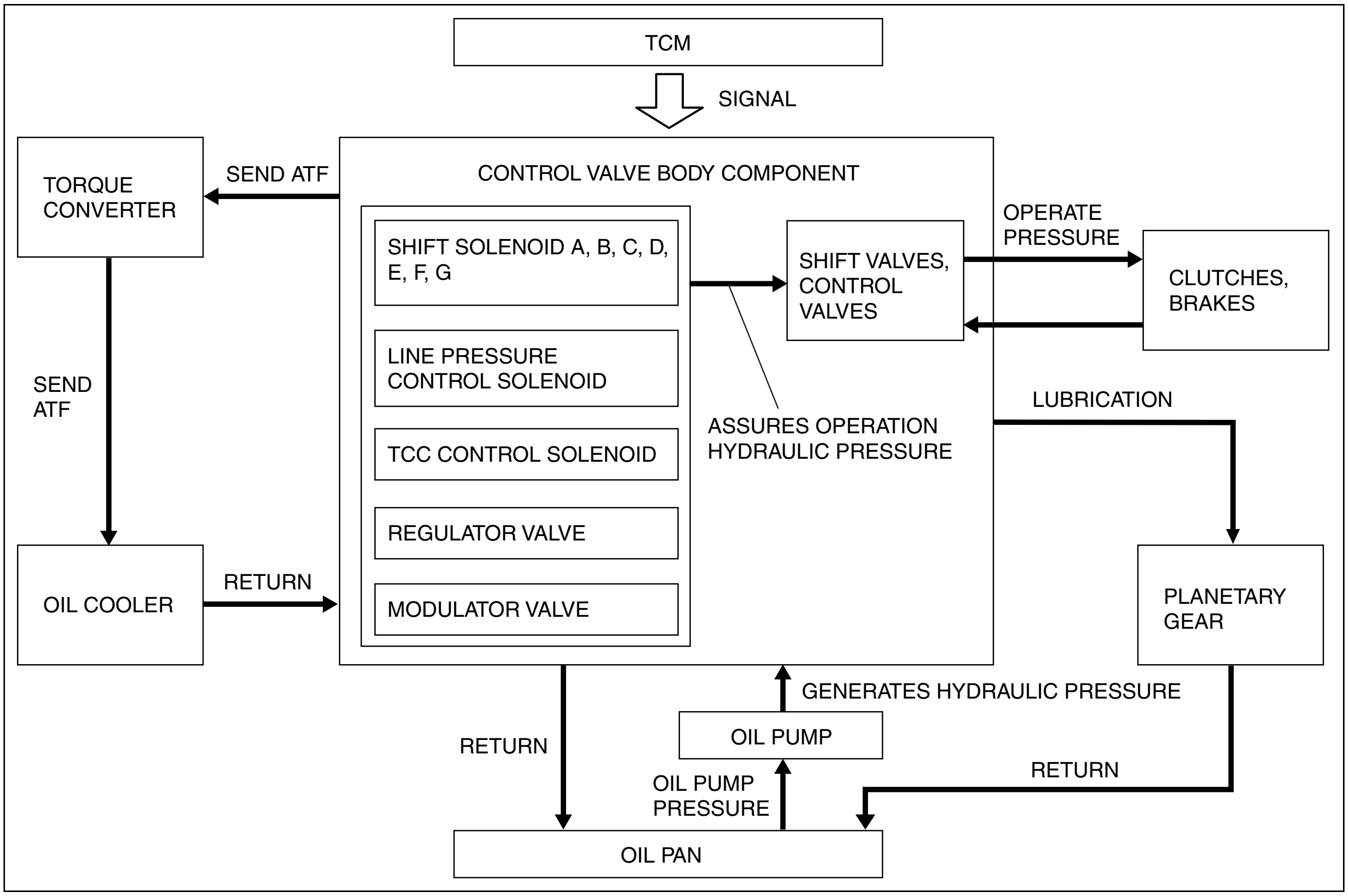
12 OUTPUT SHAFT ROTATE COUNTERCLOCKWISE.

E5U513ZS5022

CONTROL VALVE BODY COMPONENT OUTLINE [SJ6A-EL]

E5U051321100N01

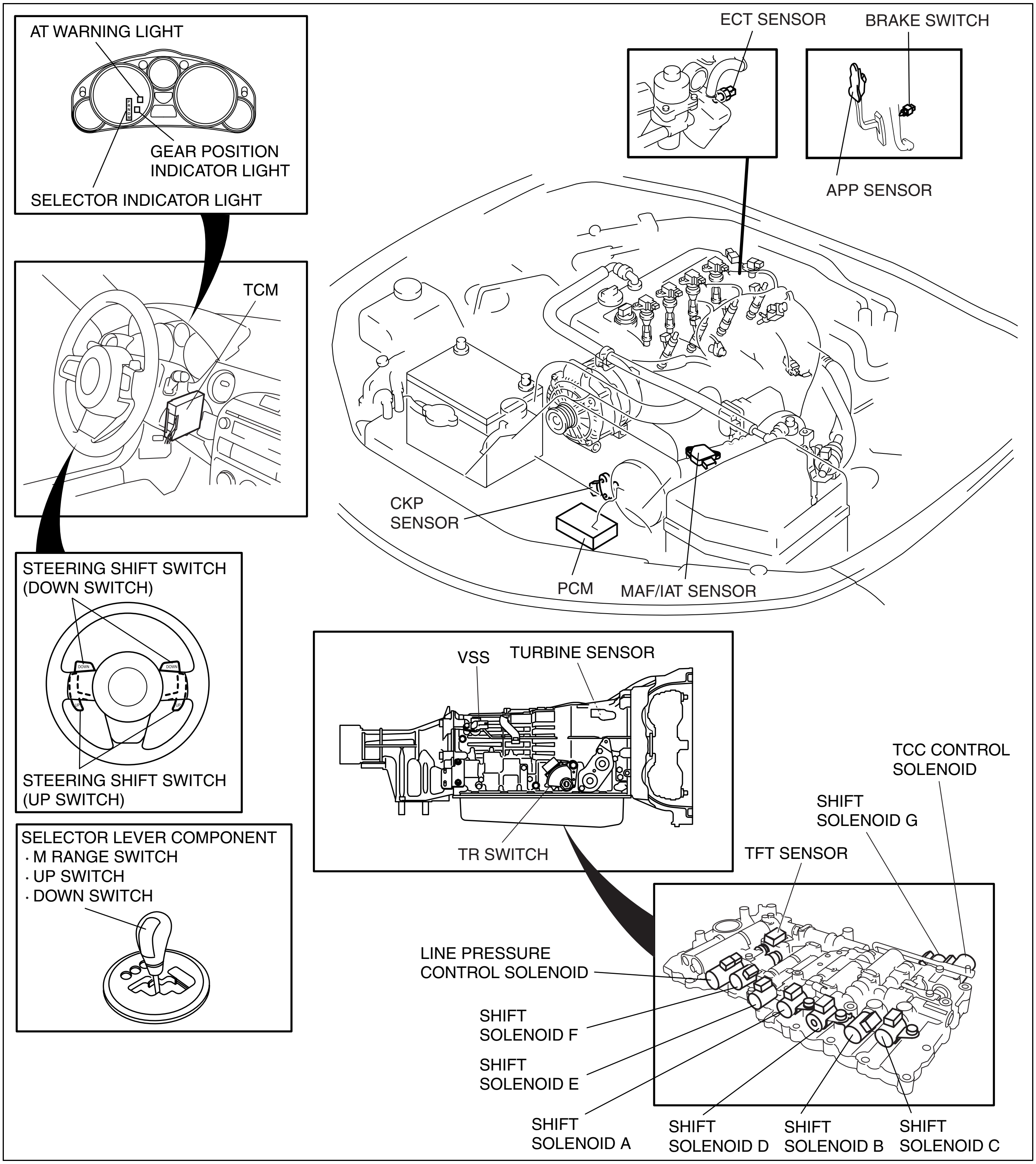
- The control valve body supplys oil by switching the oil circuit for the hydraulic pressure generated by the oil pump. Based on the control signal from the TCM, the solenoid valves are activated to control the hydraulic pressure to the clutch and brakes, performing gear shift and TCC. In addition, an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



E5U513ZS5013

ELECTRONIC CONTROL SYSTEM CONSTRUCTION [SJ6A-EL]

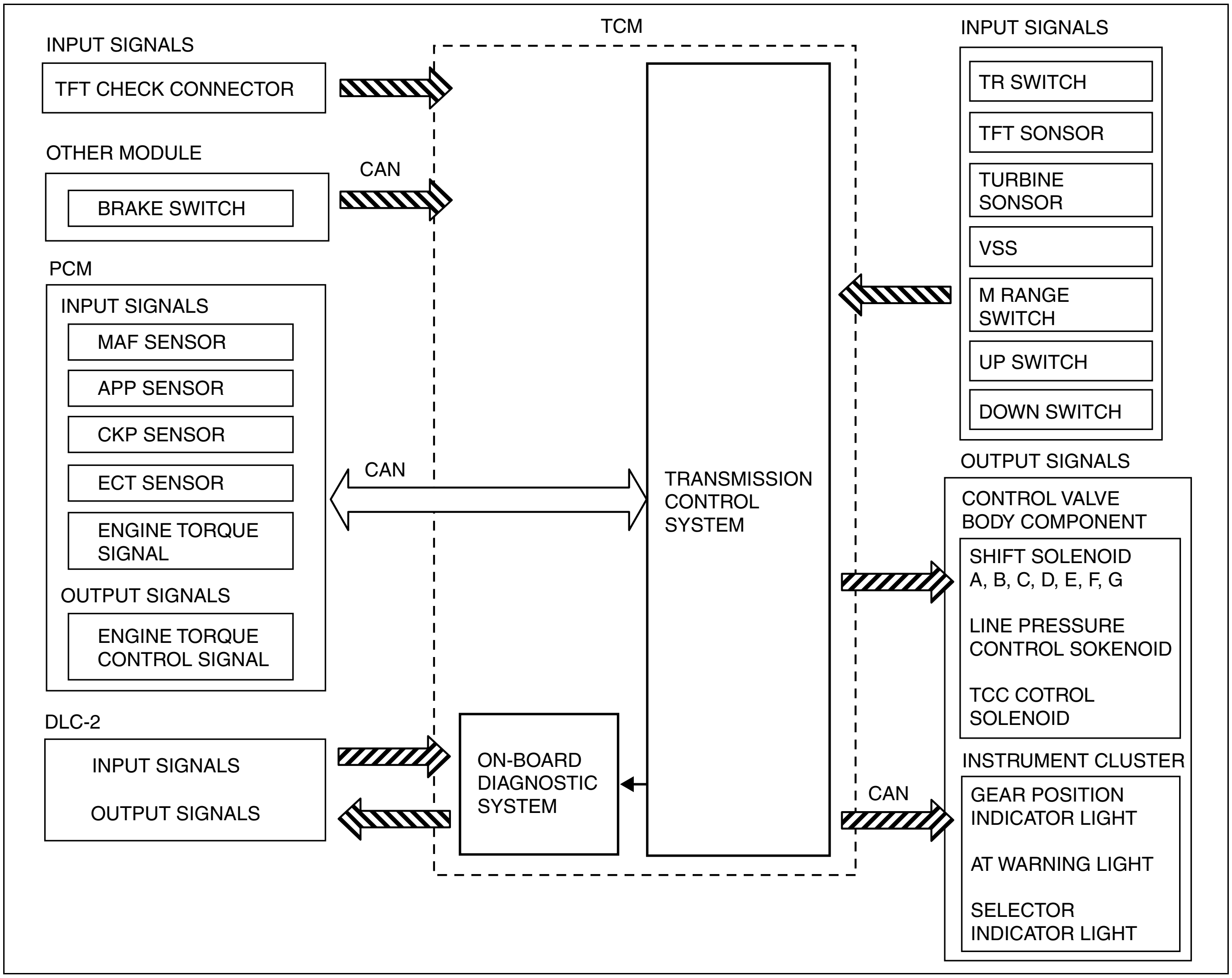
E5U051318901N01



E5U513ZS5014

ELECTRONIC CONTROL SYSTEM BLOCK DIAGRAM [SJ6A-EL]

E5U051318901N02



E5U513ZS5015

ELECTRONIC CONTROL ITEMS AND CONTENTS [SJ6A-EL]

E5U051318901N03

Item	Content
Shift control	• Detects engine load and vehicle speed, and switches to optimum gear in accordance with preset shift program. • In D range, automatically switches between NORMAL, POWER, DOWN-SLOPE, UP-SLOPE modes according to specific conditions.
Manual mode shift control	• Shifts to selected gear position by manual shifting of the selector lever forward and back. • The up/down operation of the steering shift switch is the same as the manual operation of the selector lever.
TCC control	• According to preset TCC point, performs TCC operation.
Torque reduction control	• Optimally controls engine output torque when shifting.
Shift learning control	• Performs optimal correction for clutch engagement pressure to reduce changes in engine performance and/or elapsed transmission.
On-board diagnostic system	• Detects and/or memorizes failure of input/output part and transmission condition.

COMPONENT DESCRIPTIONS (ELECTRONIC CONTROL) [SJ6A-EL]

E5U051318901N04

Part name			Function
Input system	VSS		• Detects parking gear (output) revolution speed.
	Turbine sensor		• Detects direct and reverse disc clutch case (input) revolution speed.
	TR switch		• Detects selector lever ranges/positions.
	M range switch		• Selects driving modes (M range) and changes driving patterns.
	Up switch		• Detects shift up request.
	Down switch		• Detects shift down request.
	TFT sensor		• Detects ATF temperature.
	CAN communication	Brake switch	• Detects the brake pedal depressed.
		Throttle opening signal (APP sensor)	• Input throttle opening angle from PCM.
		Engine speed signal (CKP sensor)	• Input engine speed signal from PCM.
		Engine torque signal (MAF sensor)	• Input engine torque signal from PCM.
		Cruise control signal	• Detects cruise control is in use.
		Engine coolant temperature signal (ECT sensor)	• Input engine coolant temperature signal from PCM.
Output system	ON/OFF type	Shift solenoid A	• Controls the clutch engagement pressure.
		Shift solenoid B	• Controls the clutch engagement pressure.
		Shift solenoid C	• Controls the clutch engagement pressure.
		Shift solenoid D	• Controls the clutch engagement pressure.
		Shift solenoid E	• Controls the clutch engagement pressure.
	Linear type	Line pressure control solenoid	• Adjusts the line pressure.
		TCC control solenoid	• Controls the TCC hydraulic pressure.
		Shift solenoid F	• Controls the clutch engagement pressure.
		Shift solenoid G	• Controls the clutch engagement pressure.
	CAN communication	AT warning light	• Illuminates when failure is detected by diagnosis function.
		Speedometer signal	• Outputs the vehicle speed signal to speedometer.
		Reduce torque signal	• Sends signals to the PCM during shifting.

INPUT/OUTPUT SIGNAL AND RELATED CONTROLS [SJ6A-EL]

E5U051318901N05

Component		Control item							
		Shift control	Manual mode shift control	TCC control	5-6 shift inhibit control	Torque reduction control	Line pressure control	Shift learning control	On-board diagnostic function
Input									
VSS		X	X	X			X		X
Turbine sensor		X	X	X		X	X	X	X
TR switch		X	X		X				
M range switch			X				X		
Up switch			X				X		
Down switch			X				X		
TFT sensor		X	X	X			X		
CAN communication	Brake switch			X					
	Throttle opening signal (APP sensor)	X	X			X	X		X
	Engine speed signal (CKP sensor)			X		X	X	X	X
	Engine torque signal (MAF sensor)					X	X	X	X
	Cruise control signal	X							
	Engine coolant temperature signal (ECT sensor)	X		X	X				X
Output									
ON/OFF type	Shift solenoid A	X	X					X	X
	Shift solenoid B	X	X					X	X
	Shift solenoid C	X	X					X	X
	Shift solenoid D	X	X					X	X
	Shift solenoid E	X	X					X	X
Linear type	Line pressure control solenoid	X	X				X	X	X
	TCC control solenoid			X					X
	Shift solenoid F	X	X		X		X	X	X
	Shift solenoid G	X	X		X		X	X	X
CAN communication	AT warning light	X	X						X
	Reduce torque signal					X			
Speedometer signal									

X : Available

TRANSMISSION RANGE (TR) SWITCH FUNCTION [SJ6A-EL]

E5U051319200N01

- The TR switch sends information on which range is selected in the automatic transmission using a combination of the position circuit terminals, and its functions are as follows:
  1. Enables engine starting only in P or N positions
  2. Used as shifting control signals

○—○ : Continuity

Position/Range	Connector terminal						
	Starter circuit		Position-circuit				
	I	A	E	B	C	H	D
P	○	○	○	○			
R			○	—	○		
N	○	○	○	—	—	○	
D			○	—	—	—	○
Polarity	+	-	+	-	-	-	-

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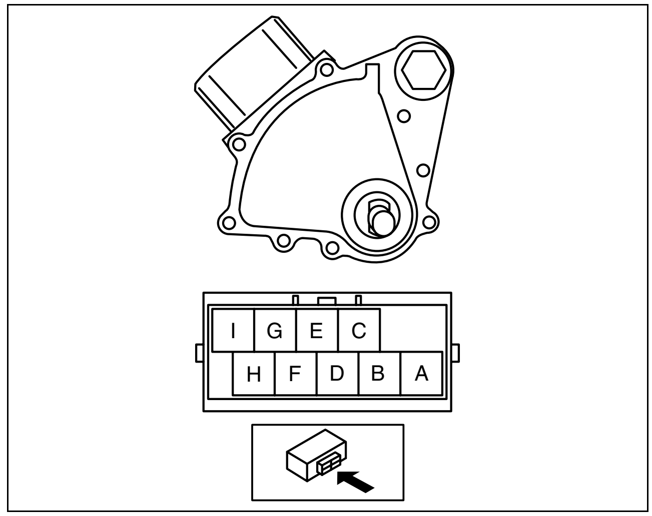
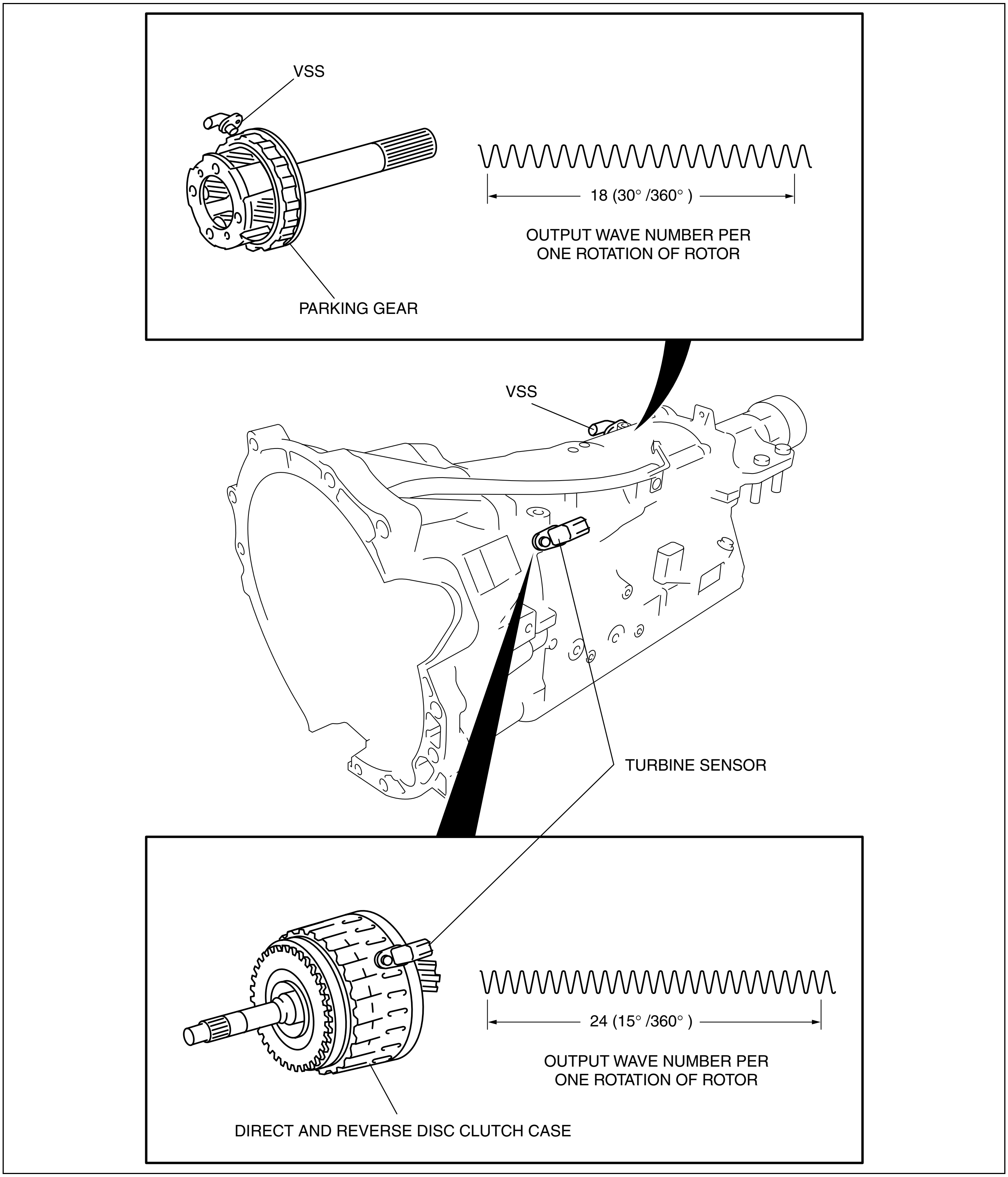


E5U513ZS5023

TURBINE SENSOR, VEHICLE SPEED SENSOR (VSS) CONSTRUCTION/OPERATION [SJ6A-EL]

E5U051319200N02

- The turbine sensor detects the rotation speed of the direct and reverse disc clutch case, and sends it to the TCM as a signal.
- The VSS detects the rotation speed of the parking gear and sends it to the TCM as a signal.
- A magnetic pick sensor which has high detection accuracy has been adopted for each sensor. When the rotor rotates, air gap between the sensor and detection projections varies, magnetic flux which passes through the sensor coil increases and decreases, and electromotive force is generated in the coil. This generated voltage is shown as alternative current since the current direction while the projections are approaching the sensor is reversed from that of when the projections are moving away from the sensor.

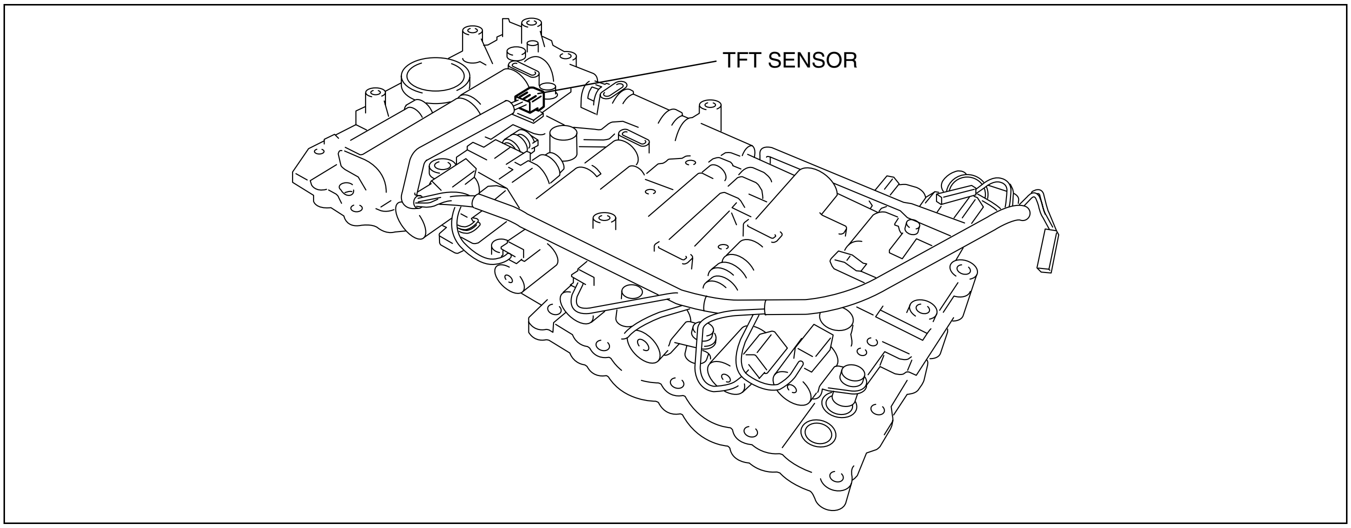


E5U513ZS5025

TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR OUTLINE [SJ6A-EL]

E5U051319200N03

- The TFT sensor and the coupler component are equipped to the control valve body component as a single unit.
- A hydraulic pressure sensor for hydraulic control during shifting has been equipped inside the control valve body component.

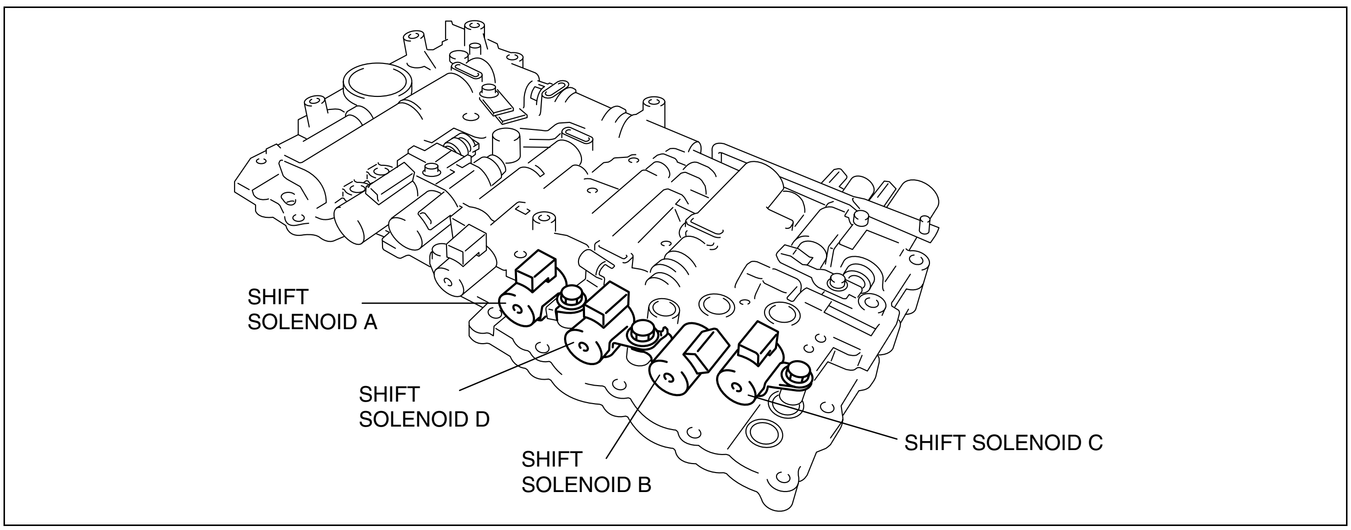


E5U513ZS5026

SHIFT SOLENOID A, B, C AND D OUTLINE [SJ6A-EL]

E5U051321101N01

- Shift solenoids A, B, C, and D are directly equipped to the control valve body component.
- Shift solenoids A, B, C, and D turn on and off according to the control signals from the TCM, and change the gear between 1st to 6th using a combination of each shift valve.

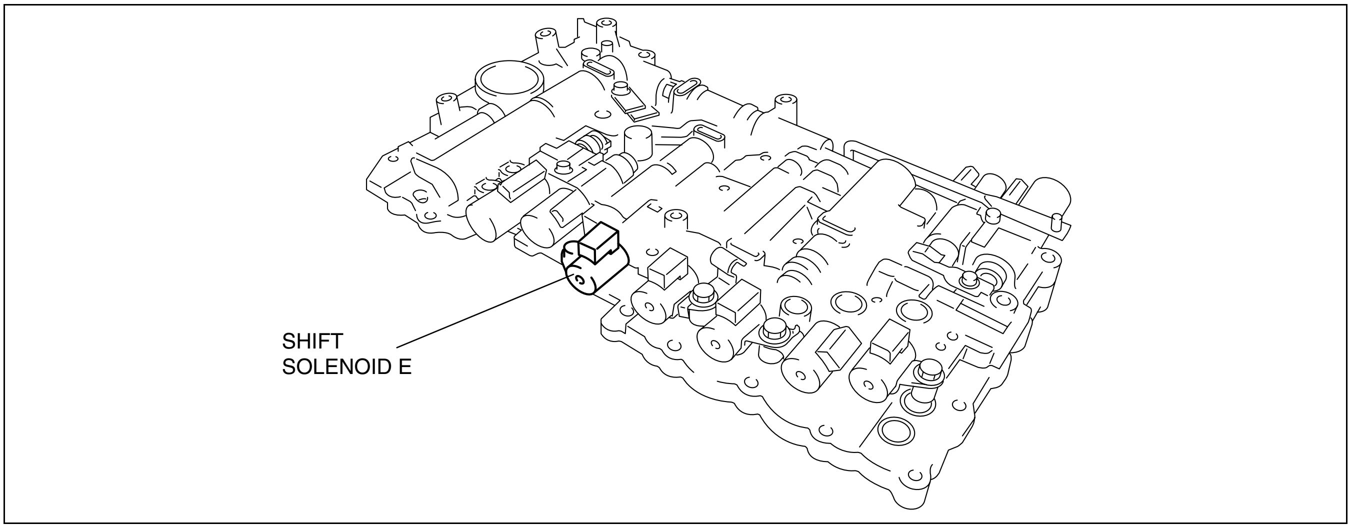


E5U513ZS5027

SHIFT SOLENOID E OUTLINE [SJ6A-EL]

E5U051321101N02

- Shift solenoid E is directly equipped to the control valve body component.
- Shift solenoid E turns on and off according to the control signals from the TCM, and switches the C4 clutch and the B1 brake.

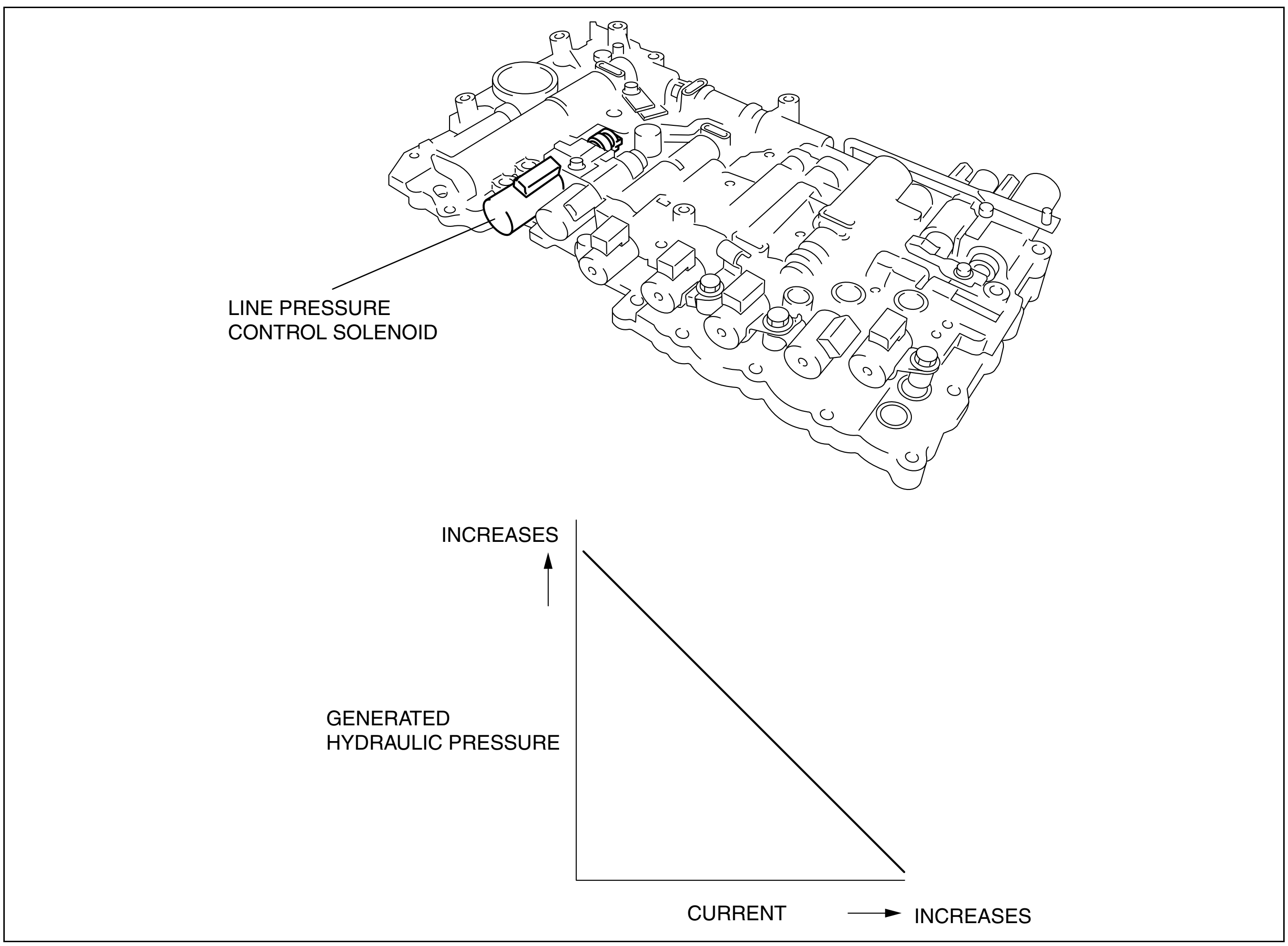


E5U513ZS5028

LINE PRESSURE CONTROL SOLENOID OUTLINE [SJ6A-EL]

E5U051321101N03

- Performs linear adjustment of the throttle pressure based on the control signals from the TCM, and controls the pressure which is applied to the clutches and brakes to adjust the line pressure and to reduce shift shock.

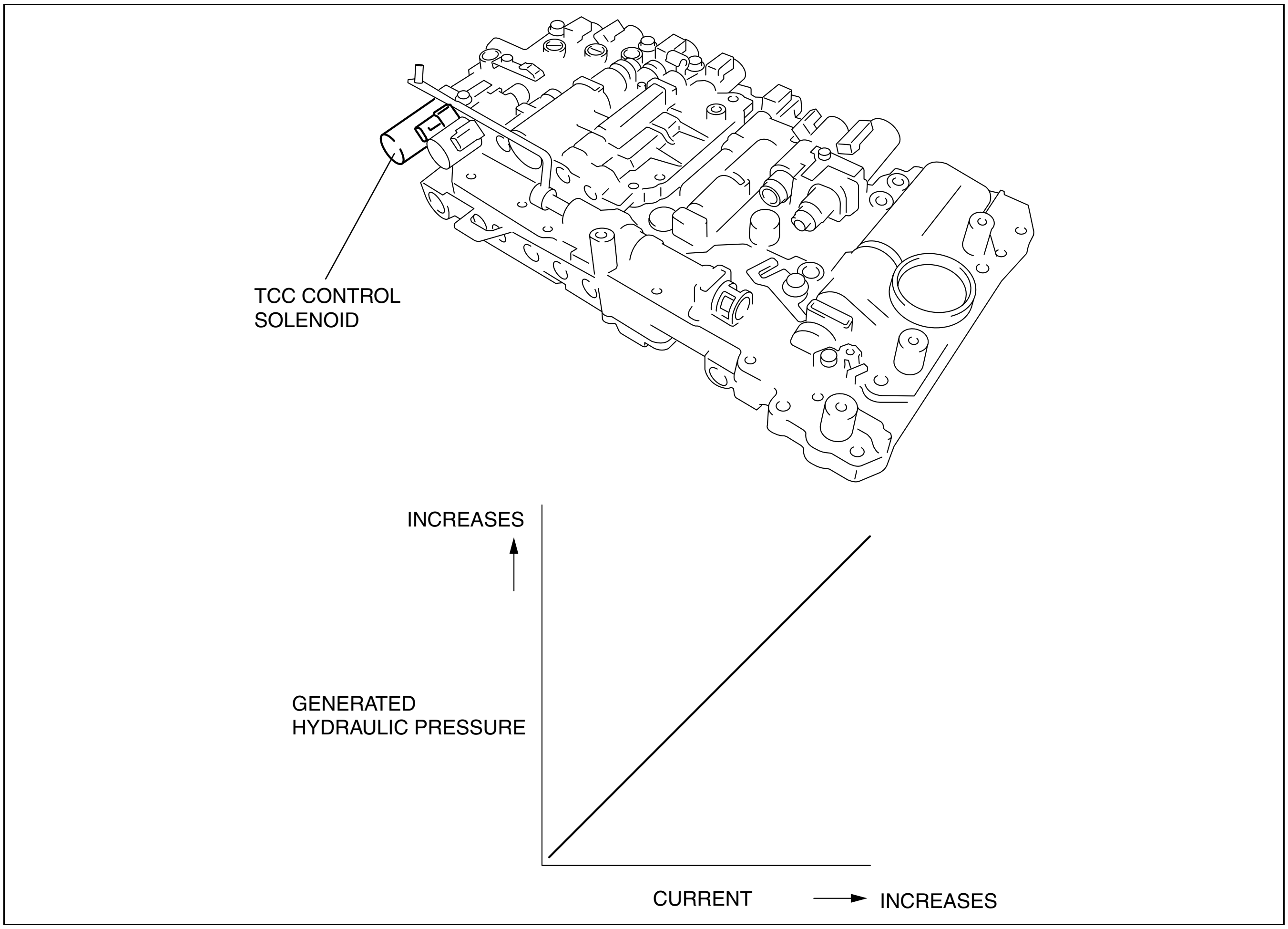


E5U513ZS5029

TORQUE CONVERTER CLUTCH (TCC) CONTROL SOLENOID OUTLINE [SJ6A-EL]

E5U051321101N04

- Adjusts the pressure of the TCC in the torque converter based on the control signals from the TCM.

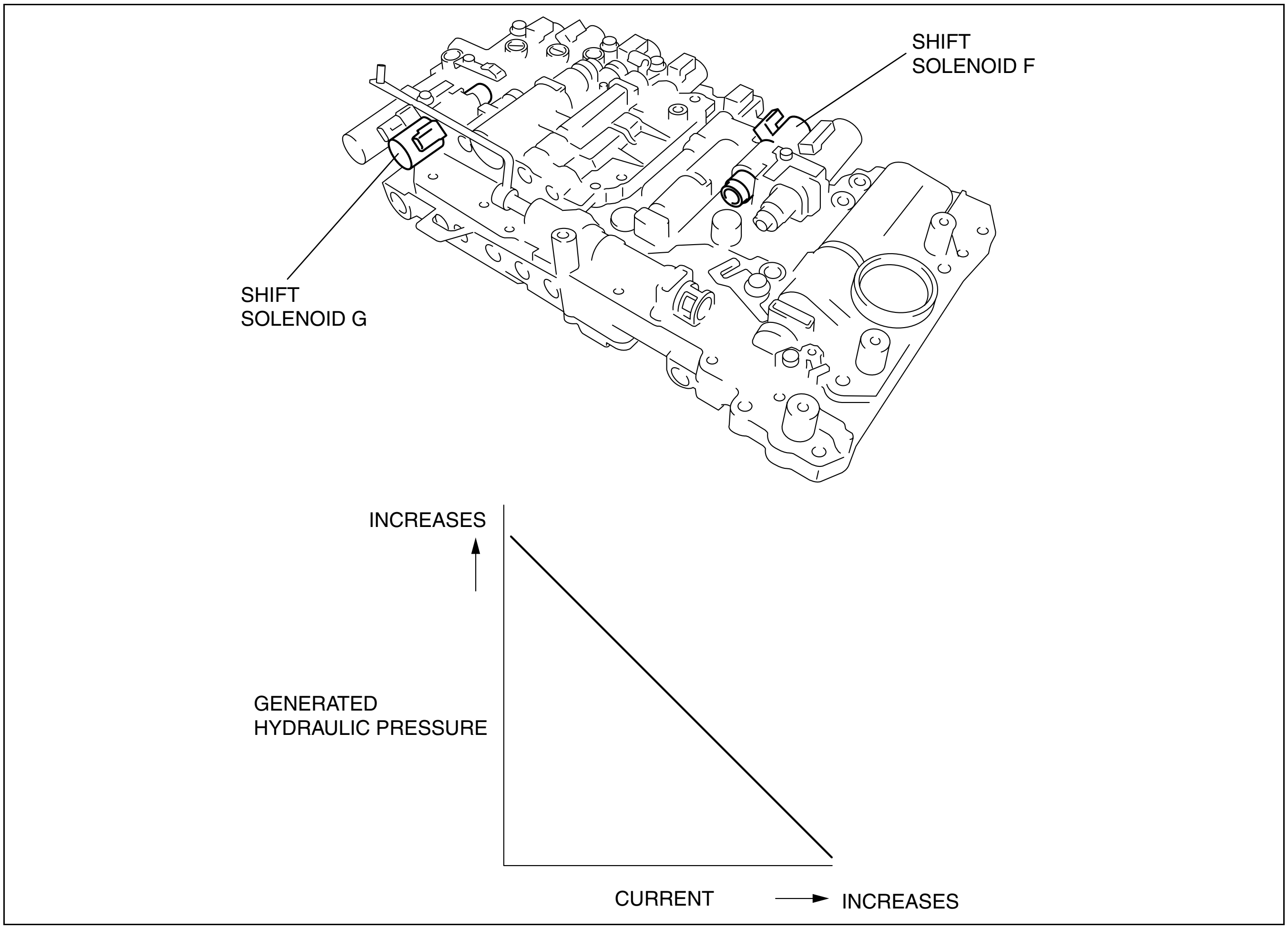


E5U513ZS5030

SHIFT SOLENOID F, G OUTLINE [SJ6A-EL]

E5U051321101N05

- By performing linear adjustment of the C3 clutch pressure and the B2 brake pressure based on the control signals from the TCM, the pressure which is applied to the C3 clutch and the B2 brake is directly controlled during shift changes from 5th to 6th gears. Technical Training DH

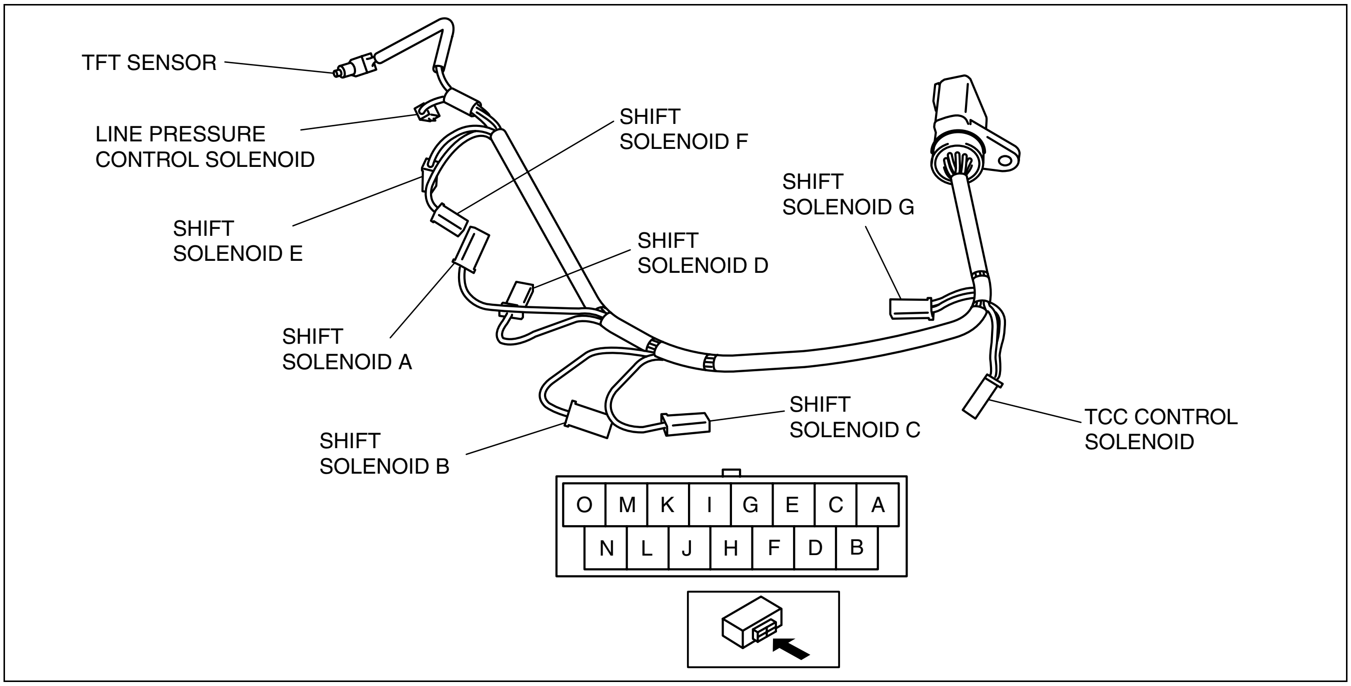


E5U513ZS5031

COUPLER COMPONENT OUTLINE [SJ6A-EL]

E5U051321101N06

- The coupler component are installed on the transmission case as the grouped connectors of the TFT sensor and solenoids.



E5U513ZS5032

Terminal No.	Signal
A	TFT sensor (–)
B	TFT sensor (+)
C	Shift solenoid G (–)
D	Shift solenoid G (+)
E	Shift solenoid F (–)
F	Shift solenoid F (+)
G	TCC control solenoid (–)
H	TCC control solenoid (+)

Terminal No.	Signal
I	Line pressure control solenoid (–)
J	Line pressure control solenoid (+)
K	Shift solenoid E
L	Shift solenoid D
M	Shift solenoid C
N	Shift solenoid B
O	Shift solenoid A

SHIFT CONTROL OUTLINE [SJ6A-EL]

E5U051318901N06

- Based on the shift diagram, shift solenoids A, B, C, D, E, F, and G are controlled according to the vehicle speed and the throttle opening angle, and the shift control of the transmission is performed.
- When certain conditions are met, the TCM selects a shift mode suitable to the driving conditions and automatically switches to the mode to perform smooth shifting.

POWER MODE

- The POWER MODE in which the shift point is set higher than the normal shift point is automatically selected when certain conditions are met so that high-engine speed high-output conditions are available.

DOWN SLOPE MODE

- While the vehicle is being driven on a down slope, the TCM determines that the vehicle is being driven on a down slope based on the signals and output engine speed from the PCM, and switches the driving mode to the DOWN SLOPE MODE. Due to this, load to the brake is reduced.

UP SLOPE MODE

- When the vehicle is climbing a slope, the TCM determines that the vehicle is being driven on an up slope based on the signals and output engine speed from the PCM, and switches the driving mode to the UP SLOPE MODE. Due to this, reduction in traction is prevented.

MANUAL MODE SHIFT CONTROL STRUCTURE [SJ6A-EL]

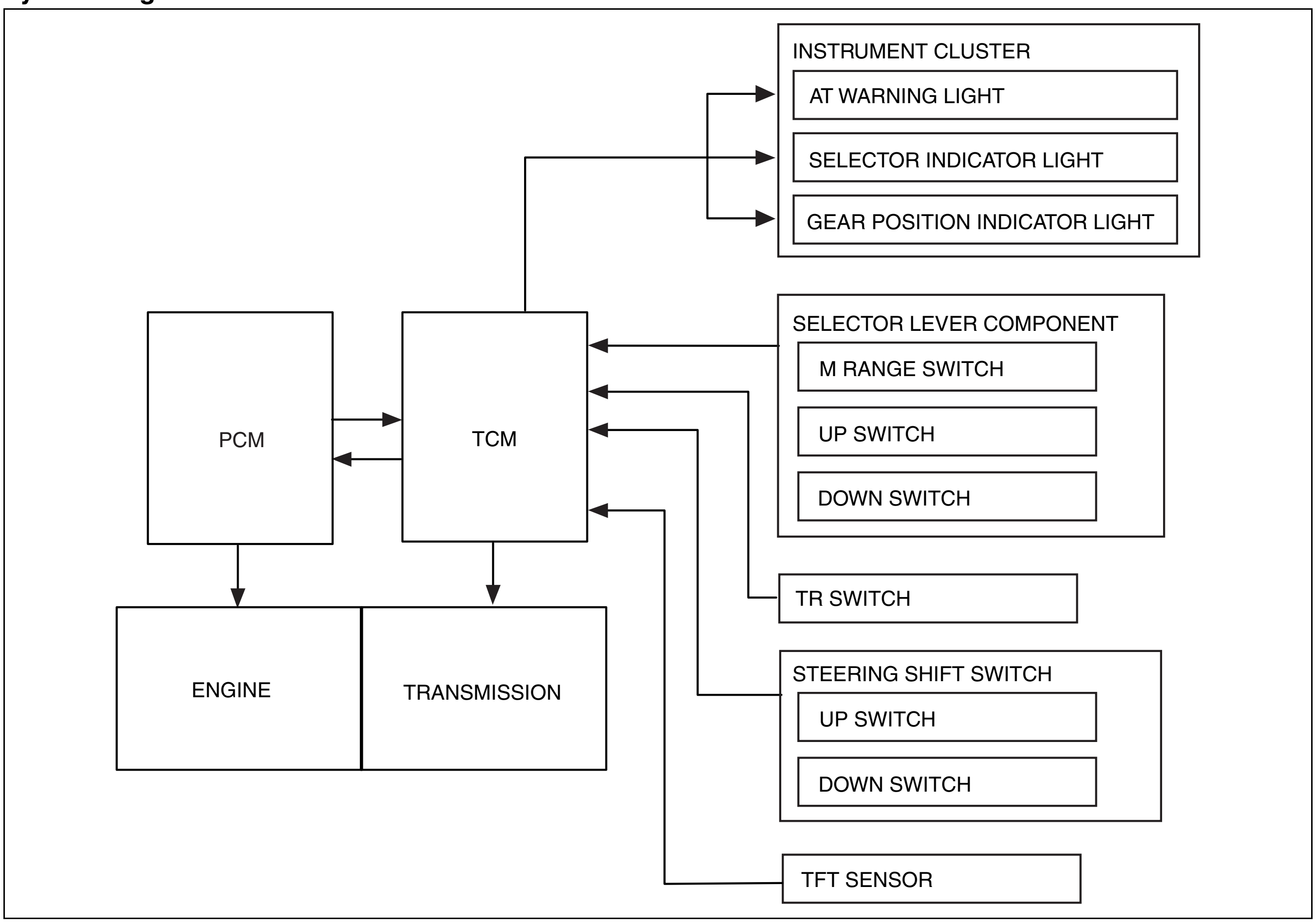
E5U051318901N07

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 1—4GR 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 6GR or 5GR, one gear can be skipped over by rapidly tapping the selector lever two times in the down-shift (–) direction.
- Specialized manual mode 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 while in manual mode.
  - — The selector indicator light includes a selector lever position indicator that displays selector lever positions and, in M range, a gear position indicator light that displays gear positions.

Structure

System diagram



E5U513ZS5033

MANUAL MODE SHIFT CONTROL OPERATION [SJ6A-EL]

E5U051318901N08

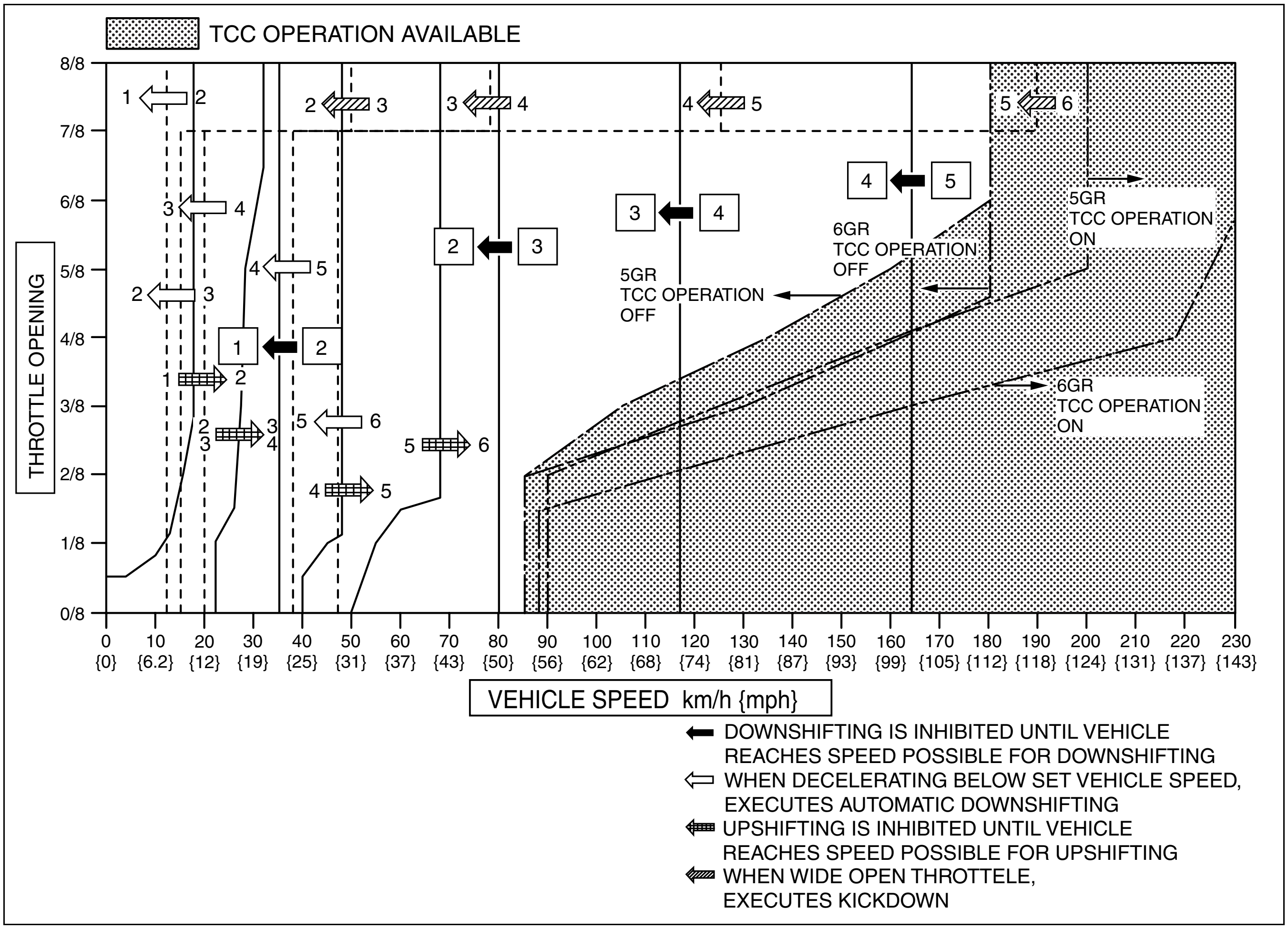
Manual Mode Shift

- When the selector lever is shifted over from the D to M range position, the M range switch in the selector lever component turns on, sending a manual mode command signal to the TCM which activates the manual mode shift control.
- When in manual mode and the selector lever is operated in the back (+) direction, the up switch in the selector lever component is turned on and an up-shift command signal is input to the TCM.
  - — The TCM, triggered by the up-shift command signal, carries out shifting by outputting an operation signal to the shift control solenoid.

- Conversely, when the selector lever is operated in the forward (–) direction, the down switch in the selector lever component turns on, and a down-shift command signal is input to the TCM.
  — The TCM, triggered by the down-shift command signal, carries out shifting by outputting an operation signal to the shift control solenoid if the vehicle speed is less than the set speed and the gear position is 2GR or above.
- The up/down operation of the steering 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
1GR→2GR up-shift command, at low speed	• To reduce load on the AT, upshifting is inhibited until vehicle reaches speed possible for upshifting	—
2GR→3GR up-shift command, at low speed		
3GR→4GR up-shift command, at low speed		
4GR→5GR up-shift command, at low speed		
5GR→6GR up-shift command, at low speed		
5GR→6GR up-shift command, low ECT	• To reduce load on the AT, upshifting to 6GR is inhibited	
6GR→5GR down-shift command, above set speed	• To prevent engine over-rev, downshifting is inhibited until vehicle reaches speed possible for downshifting	• Gear position indicator light flash to alert driver
5GR→4GR down-shift command, above set speed		
4GR→3GR down-shift command, above set speed		
3GR→2GR down-shift command, above set speed		
2GR→1GR down-shift command, above set speed		
In 6GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 6GR to 5GR	—
In 5GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 5GR to 4GR	
In 4GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 4GR to 3GR	
In 3GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 3GR to 2GR	
In 2GR deceleration, speed goes below coast-down set speed (deceleration down-shift)	• To assure drive stability, automatically downshifts from 2GR to 1GR	
Wide open throttle at 125—190 km/h {78—118 mph} in 6GR	• To improve acceleration performance, 6GR to 5GR kickdown occurs	—
Wide open throttle at 78—124 km/h {49—77 mph} in 5GR	• To improve acceleration performance, 5GR to 4GR kickdown occurs	
Wide open throttle at 50—77 km/h {32—48 mph} in 4GR	• To improve acceleration performance, 4GR to 3GR kickdown occurs	
Wide open throttle at 15—49 km/h {10—31 mph} in 3GR	• To improve acceleration performance, 3GR to 2GR kickdown occurs	

Shift Diagram



E5U513ZS5034

AT WARNING LIGHT FUNCTION [SJ6A-EL]

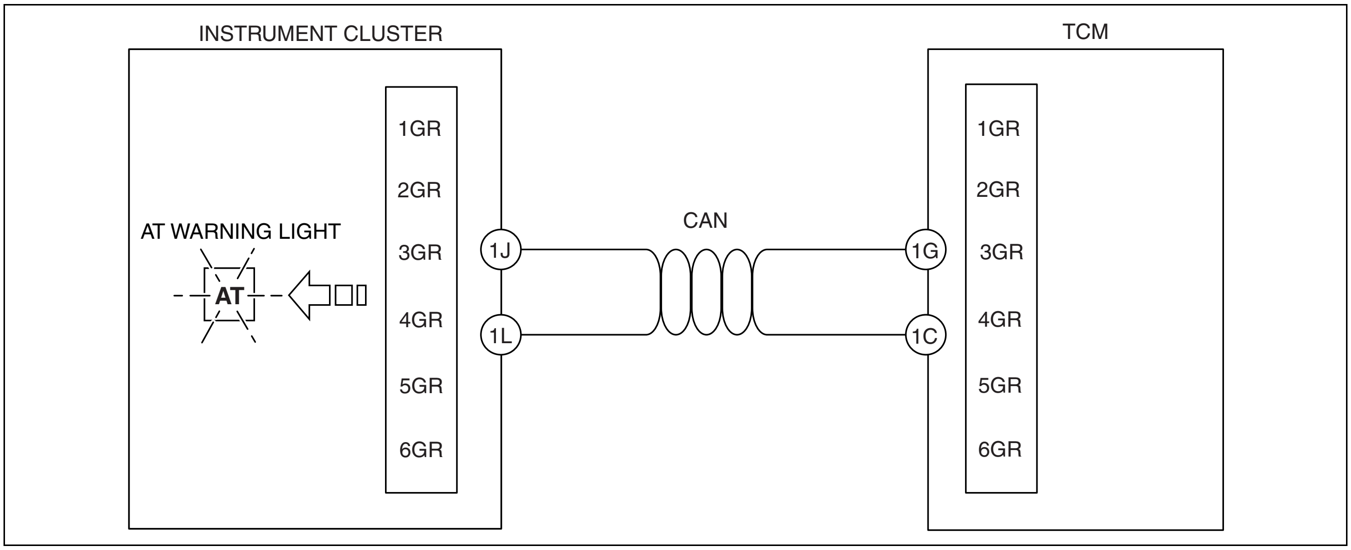
E5U051321101N07

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

AT WARNING LIGHT CONSTRUCTION/OPERATION [SJ6A-EL]

E5U051321101N08

- 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.



E5U513ZS5035

SELECTOR INDICATOR LIGHT FUNCTION [SJ6A-EL]

E5U051321101N09

- 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 [SJ6A-EL]

E5U051321101N10

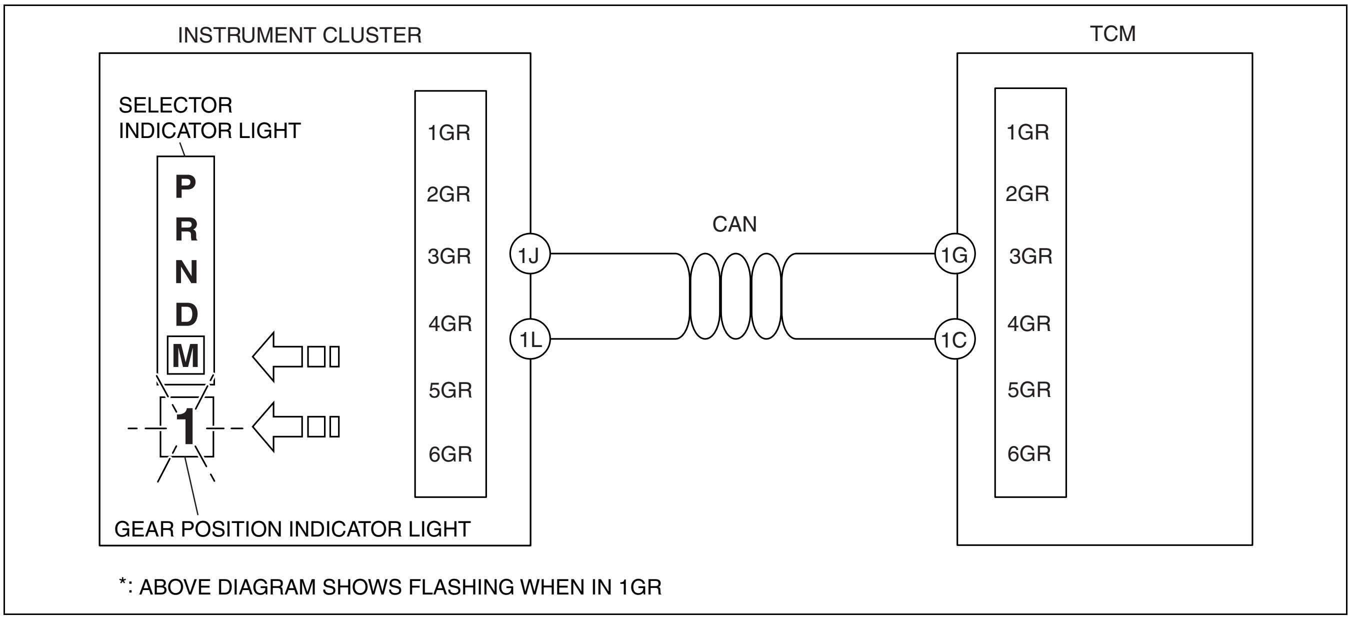
Construction

- The selector indicator light is built into the instrument cluster.
- When in the P, R, N or D range, the TCM detects the selector lever position based on an analog signal from the TR switch. When in the M range, the TCM detects the selector lever position based on a signal from the M range switch inside the selector lever component.
- When the instrument cluster receives a range signal or a gear position signal from the TCM via CAN communication, the selector lever position and the gear position indicator lights illuminate or flash accordingly.

Operation

Gear position indicator light flash

- When the driver's down-shift operation is cancelled, the gear position indicator light flash twice.
  — When the TCM cancels a shift operation, all of the signals are pulsed ON/OFF and when finally input to the instrument cluster, the on signal (ex. M1 signal when in 1GR) and the remaining three off signals (M2, M3, M4, M5, M6) are reversed to off and on signals respectively.
- Based on a combination of input signals from the TCM, the instrument cluster determines the gear number (1GR displayed as "1"), and flashes the gear position number in the gear position indicator light and the selector indicator "M" light.



E5U513ZS5036

TORQUE CONVERTER CLUTCH (TCC) CONTROL OUTLINE [SJ6A-EL]

E5U051318901N09

- Based on the TCC diagram, the TCC control solenoid is turned on and off according to the vehicle speed and throttle opening angle, and the TCC point control is performed.
- If any of the following three conditions are met, TCC is cancelled.

TCC Cancel Conditions

- Brake switch is ON
- Accelerator is fully closed (determined being idling)
- Engine coolant temperature is low

5-6 SHIFT INHIBIT CONTROL OUTLINE [SJ6A-EL]

E5U051318901N10

- The TCM inhibits shift change from the 5th to 6th gears when it determines that the engine is cold based on the engine coolant temperature signal from the engine.

TORQUE REDUCTION CONTROL AND LINE PRESSURE CONTROL OUTLINE [SJ6A-EL]

E5U051318901N11

- While in a shift change between 1st and 6th gears, a torque reduction request signal is output from the TCM to the PCM to cut engine torque amplification caused by shift changes to realize smooth shift shock.
- In addition, line pressure control in which line pressure is controlled during shift change between 1st and 6th gears has been adopted to improve shift shock.

SELF-DIAGNOSIS FUNCTION OUTLINE [SJ6A-EL]

E5U051318901N12

- The TCM monitors the communication status of each sensor, electronic component and PCM including the PCM. If any malfunction should occur, the TCM functions to warn the driver and stores the malfunction as a diagnosis code.

On-board diagnosis	• If any malfunction should occur in the automatic transmission, the TCM will cause warning light to light up in order to inform the driver of the malfunction.
Off-board diagnosis	• The TCM stores the malfunction as a diagnosis code. The diagnosis code and TCM data can be inspected by connecting the WDS or equivalent.

Caution

- **To erase stored DTCs, always perform one of the below procedures. If not performed, a miss-reading of the DTC may occur.**

Stored DTC Erasing Method

- Use the WDS or equivalent.
- Disconnect the negative battery cable and reconnect it after 5 min. or more.

FAIL-SAFE OUTLINE [SJ6A-EL]

E5U051318901N13

- With the fail-safe function, if any malfunction should occur in the automatic transmission system, the TCM will output a control signal, and control will be performed to make travelling a minimum distance possible. If shift solenoid malfunction, the TCM will cancel the output of control signals to the solenoid.

SHIFT LEARNING FUNCTION [SJ6A-EL]

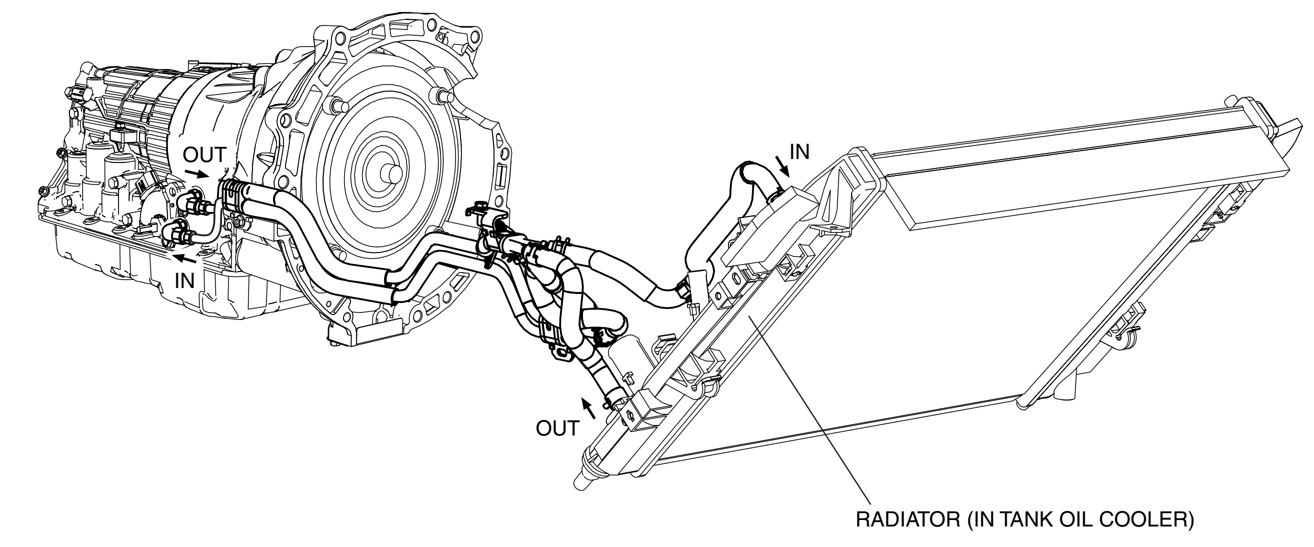
E5U051318901N14

- Learns optimum hydraulic pressures for each clutch and brake to reduce shift shock during shift change.

COOLING SYSTEM OUTLINE [SJ6A-EL]

E5U051319900N01

- 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.



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POWER PLANT FRAME (PPF) FUNCTION [SJ6A-EL]

E5U051300000N07

- The Power Plant Frame feature has been adopted for all models. For detailed information, refer to the M15M-D manual transmission description. (See 05–11A–7 POWER PLANT FRAME (PPF) FUNCTION [M15M-D].)

05–14 AUTOMATIC TRANSMISSION SHIFT MECHANISM

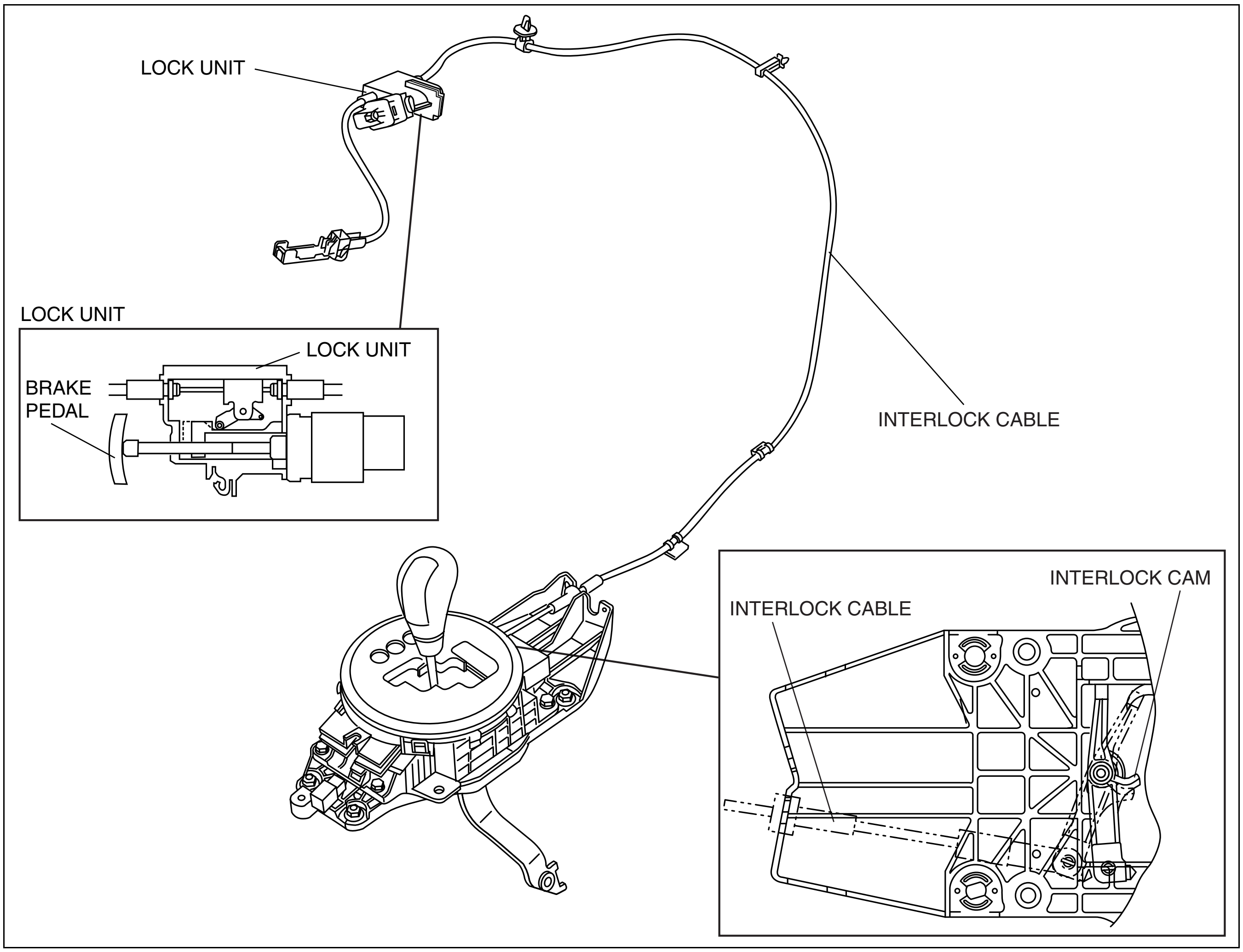
AUTOMATIC TRANSMISSION SHIFT MECHANISM OUTLINE

E5U051446010N01

- The mechanical type key interlock and shift-lock system is adopted.

AUTOMATIC TRANSMISSION SHIFT MECHANISM STRUCTURAL VIEW

E5U051446010N02



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KEY INTERLOCK SYSTEM OUTLINE

E5U051409000N01

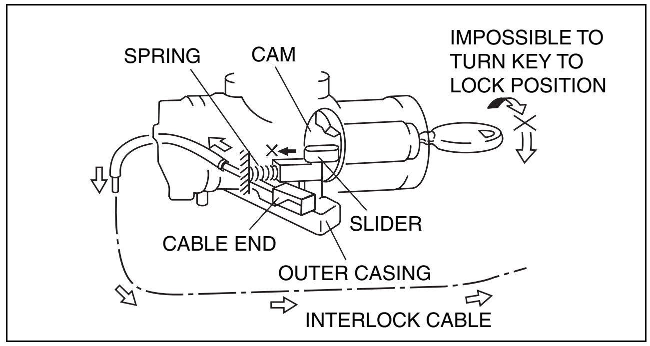
- The key interlock system, which is composed of the interlock cable and steering lock, prevents the ignition switch from being removed when the selector lever is in any position other than the P range. (The ignition switch cannot be turned to the LOCK position.)

KEY INTERLOCK SYSTEM OPERATION

E5U051409000N02

Positions other than P position (Key interlock is operating)

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



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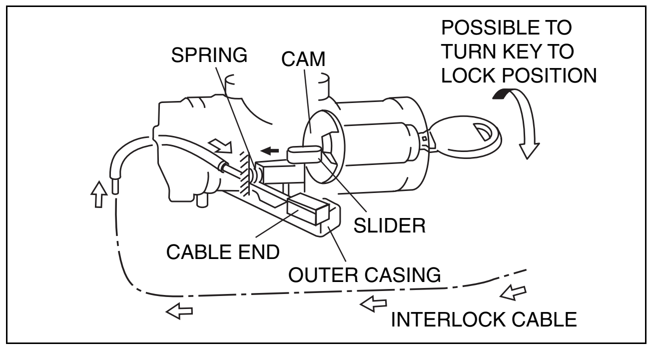
P Position (Key interlock is not operating)

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



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SHIFT LOCK SYSTEM OUTLINE

E5U051430000N01

- 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.

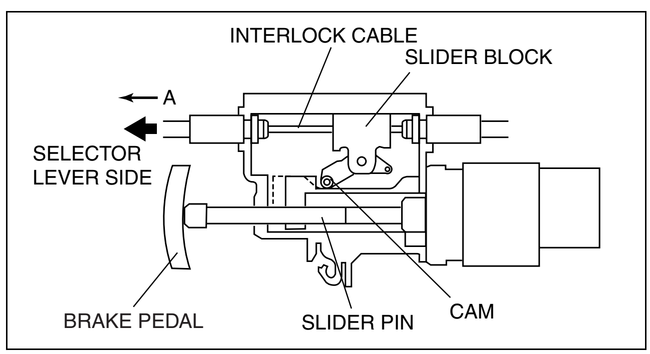
SHIFT-LOCK SYSTEM OPERATION

E5U051430000N02

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

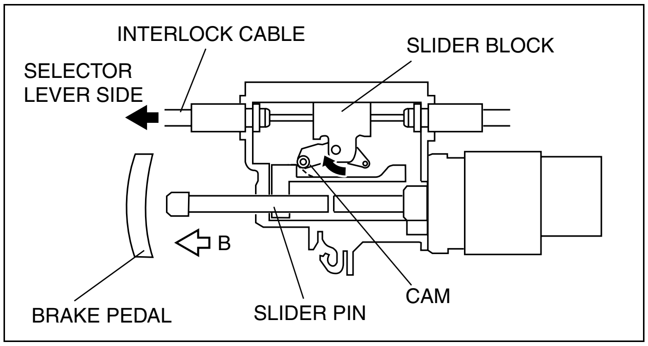
- The brake pedal is depressed.

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

E5U051446102N01

- 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.

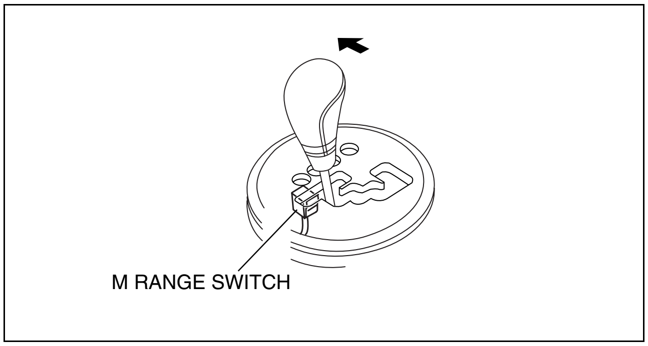
SELECTOR LEVER STRUCTURE

E5U051446102N02

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

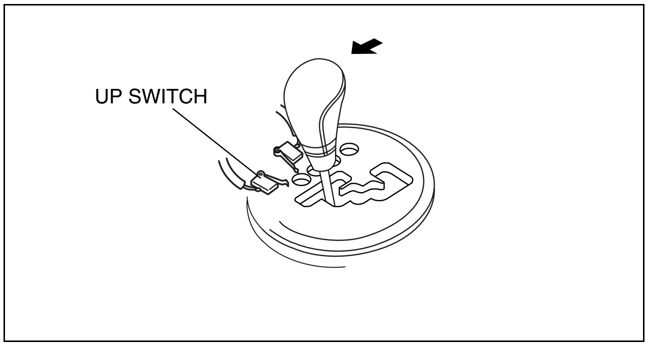
Operation

- 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.

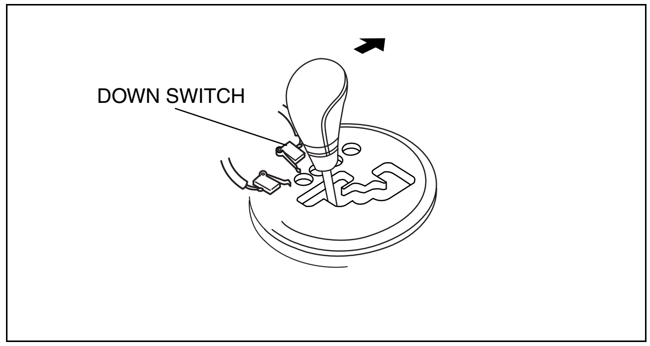
Down Switch

Outline

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

Operation

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



CHU0514S004

STEERING SHIFT SWITCH FUNCTION

E5U051446102N03

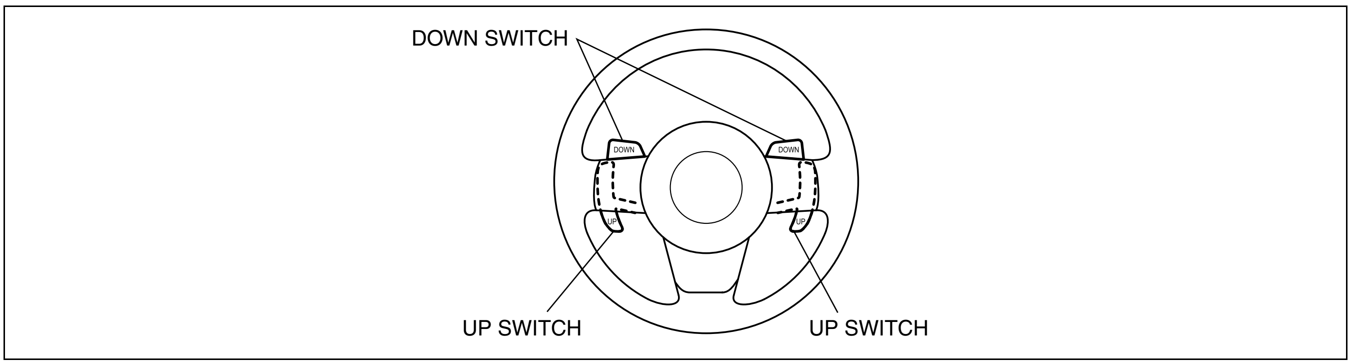
- When an up-shift or down-shift operation is detected in M range, an up-shift or down-shift request signal is sent to the TCM.

STEERING SHIFT SWITCH CONSTRUCTION/OPERATION

E5U051446102N04

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.

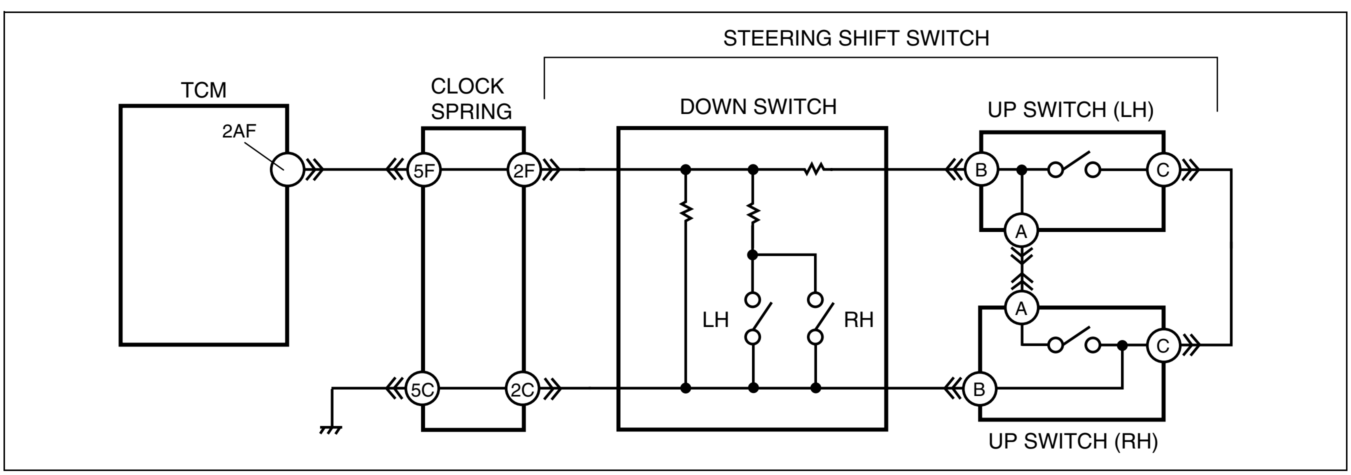


E5U514ZS5002

Operation

Sending of up/down-shift request signals

- The TCM detects an up/down-shift request signal according to the voltage applied to terminal 2AF.
- When the up or down switch is operated, the resistor built into the down switch changes the voltage applied to TCM terminal 2AF.
- The TCM controls upshifting or downshifting based on this change in voltage.



E5U514ZS5003

STEERING

06
SECTION

06–00 OUTLINE

STEERING ABBREVIATION

E5U060000000N01

AT	Automatic transmission
ATF	Automatic transmission fluid
MT	Manual transmission

STEERING FEATURES

E5U060000000N02

Improved handling stability	• Engine speed sensing power steering adopted
Improved operability	• Steering shaft with a tilt mechanism adopted
Improved safety	• Steering shaft with an energy absorbing mechanism adopted

STEERING SPECIFICATIONS

E5U060000000N03

Item			Specification
Steering wheel	Outer diameter (mm {in})		370 {14.6}
	Lock-to-lock (turns)		2.6
Steering gear and linkage	Type		Rack-and-pinion
	Rack stroke (mm {in})		156.4 {6.157}
Steering column and shaft	Shaft type		Collapsible
	Joint type		2-cross joint
	Amount of tilt (mm {in})		32 {1.3}
Power steering system	Power assist type		Engine speed sensing
	Power steering fluid	Type	ATF M-III or equivalent (e.g. Dexron®II)
		Fluid capacity*1 (approximate quantity) (L {US qt, Imp qt})	1.19 {1.26, 1.05}

*1 : When fluid reservoir is at maximum volume.

06–14 POWER STEERING

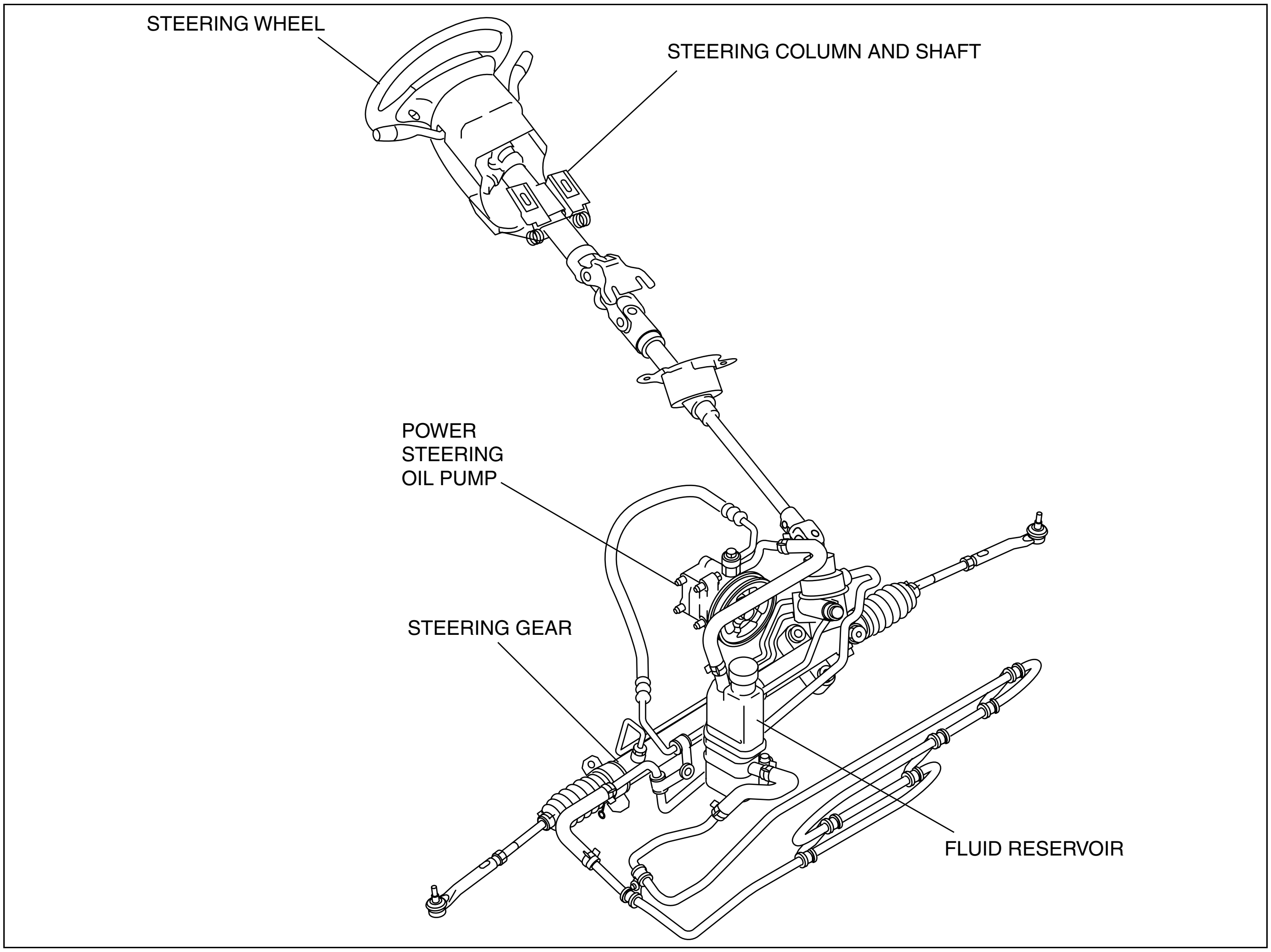
POWER STEERING OUTLINE

E5U061400000N01

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

POWER STEERING STRUCTURAL VIEW

E5U061400000N02

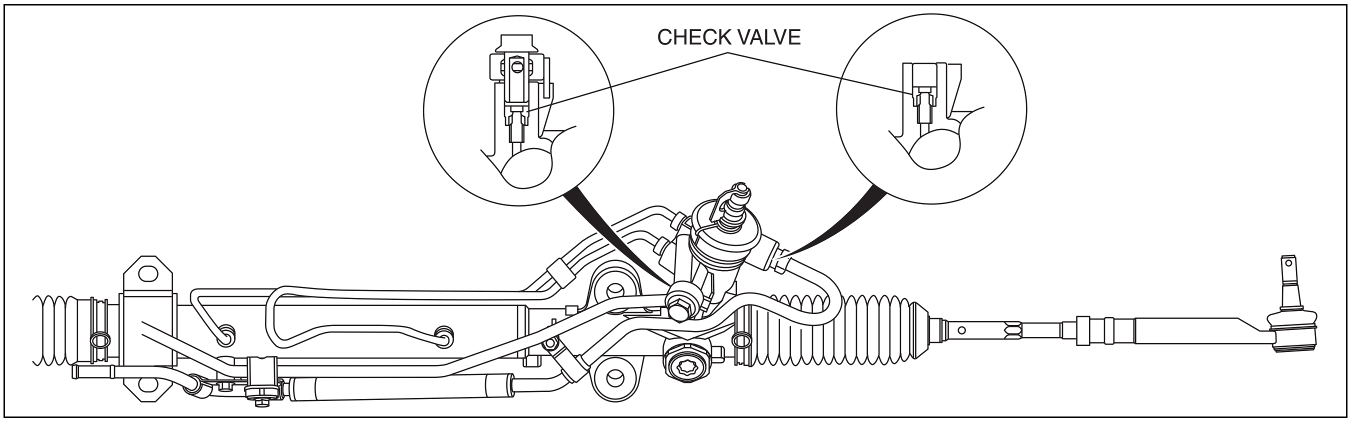


E5U614ZS5001

STEERING GEAR AND LINKAGE CONSTRUCTION

E5U061432960N01

- A size and weight reduced rack and pinion system steering gear has been adopted.
- Heightened support rigidity has been achieved due to the integration of the steering gear mounts (two locations) and gear housing, improving response and steering stability.
- A check valve equipped to the power steering fluid intake port prevents the power steering fluid from flowing back as a result of road surface resistance. Due to this, kickback from the road surface is reduced.

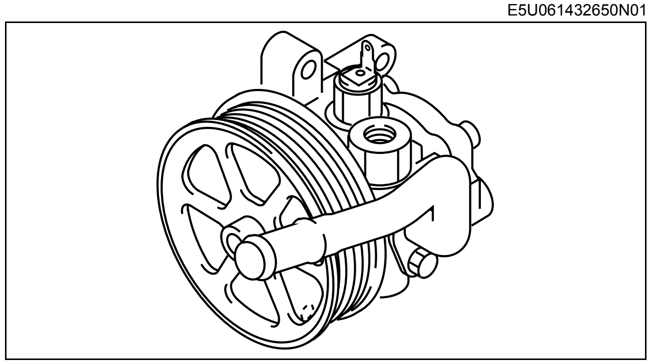


E5U614ZS5002

POWER STEERING OIL PUMP CONSTRUCTION

E5U061432650N01

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

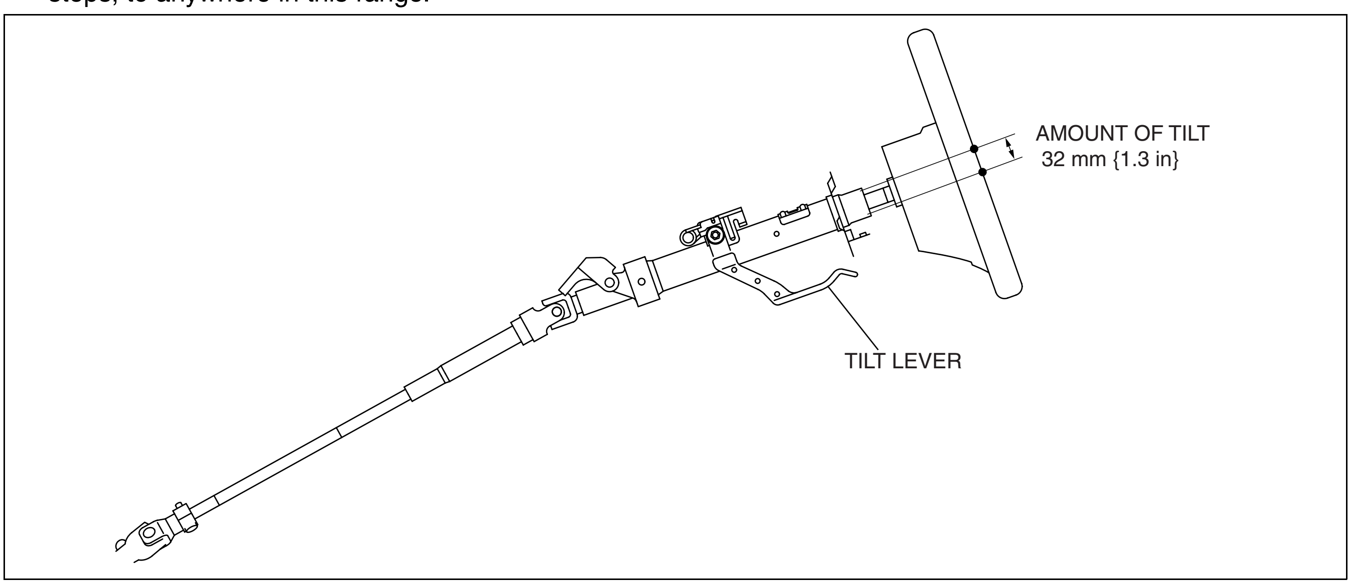


E5U614ZS5005

STEERING SHAFT CONSTRUCTION

E5U061432010N02

- Due to the adoption of a tilt mechanism for the steering shaft on all vehicles, operability has been improved.
- The tilt mechanism has an up-and-down movement range of **32 mm {1.3 in}** and can be adjusted, without steps, to anywhere in this range.



E5U614ZS5003

ENERGY ABSORBING SYSTEM CONSTRUCTION / OPERATION

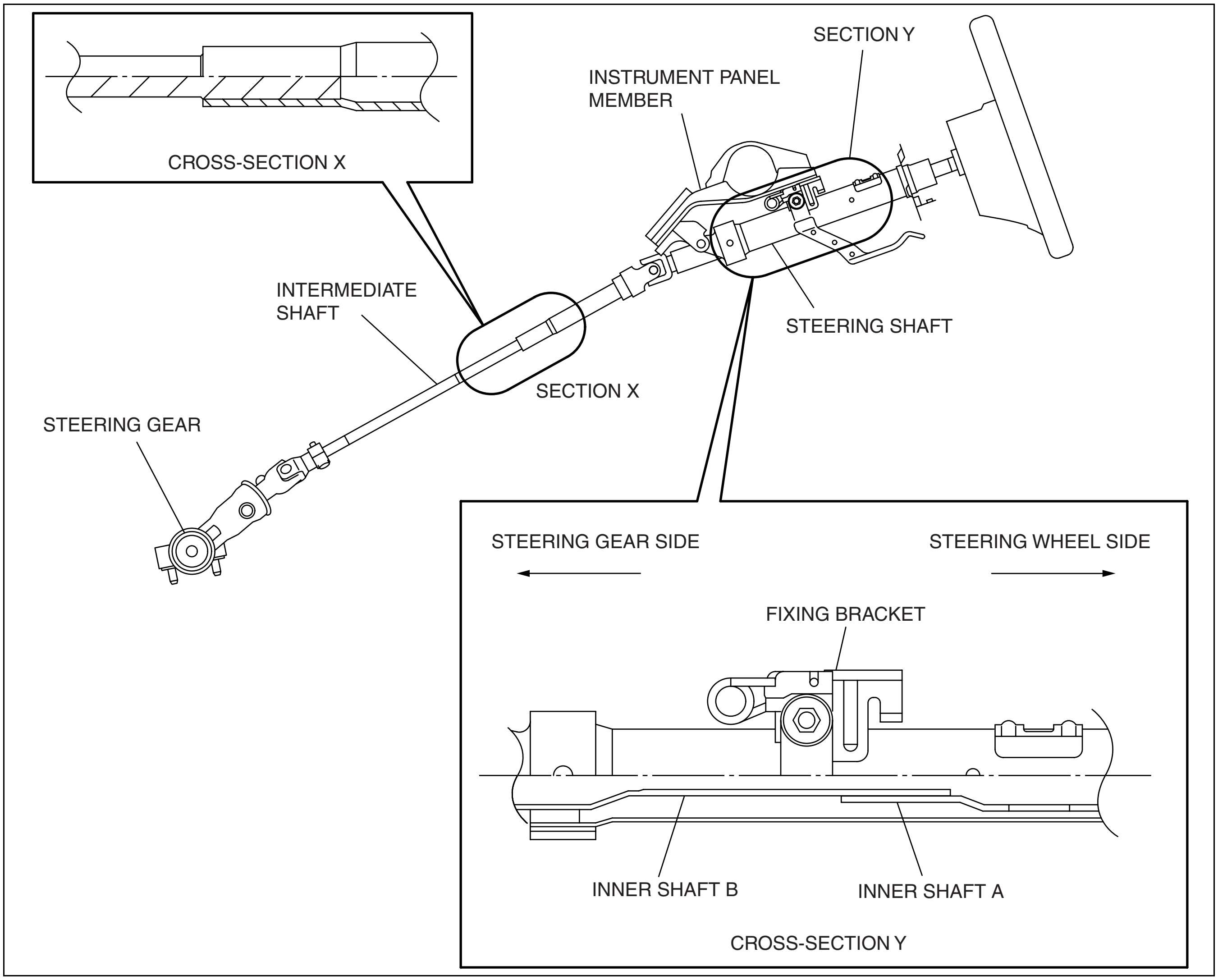
E5U061432010N01

Construction

- Due to impact absorbing mechanisms at two points on the steering shaft, when a collision occurs, the steering shaft effectively absorbs the impact energy that would be transmitted to the driver, thereby reducing injury.

Operation

- At the moment of a collision, the rearward collapse of the steering gear and linkage (first stage impact) takes in the impact energy from the front, 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)



E5U614ZS5004

HEATER, VENTILATION & AIR CONDITIONING (HVAC)

07
SECTION

07–00 OUTLINE

HVAC ABBREVIATION

E5U070000000N01

A/C	Air Conditioning
B+	Battery Positive Voltage
HI	High
IG	Ignition
LO	Low
M	Motor
MAX	Maximum
OFF	Switch Off
ON	Switch On
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
PCM	Powertrain Control Module

HVAC FEATURES

E5U070000000N02

Reduced weight	• Integrated A/C unit adopted
Improved air conditioning performance	• Sub-cooling system to multi-flow condenser adopted
Improved comfort	• Open mode has been added to the air flow mode

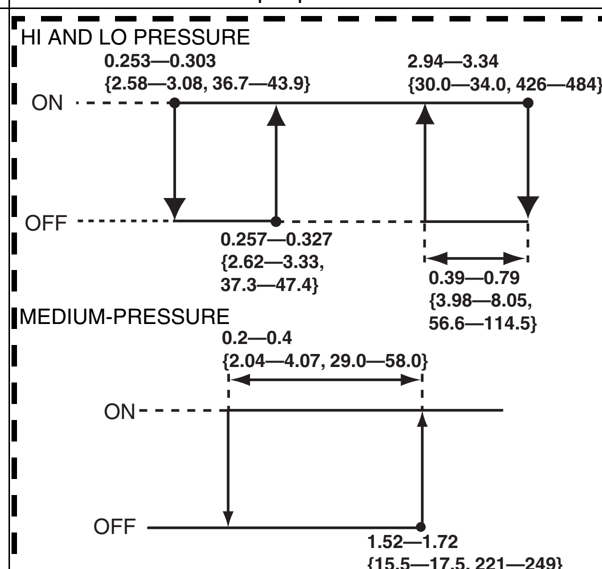
HVAC SPECIFICATIONS

E5U070000000N03

Basic System

Item				Specification
Heating capacity			(kW {kcal/h})	3.700 {3,182}
Cooling capacity			(kW {kcal/h})	3.700 {3,182}
Refrigerant	Type			R-134a
	Regular amount (approx. quantity)		(g {oz})	450 {15.9}
A/C compressor	Type			5 vane rotaly type
	Discharge capacity		(ml {cc, fl oz})	83 {83, 2.81}
	Max. allowable speed		(rpm)	7,800
	Lube oil	Type		DH-PR
		Sealed volume (approx. quantity)	(ml {cc, fl oz})	130 {130, 4.39}
Condenser	Type			Multiflow (sub-cooling type)
	Radiated heat		(kW {kcal/h})	5.76 {4,953}
	Receiver/drier capacity		(ml {cc, fl oz})	200 {200, 6.76}
	Desiccant			XH-7S
Expansion valve	Type			Internal equalizing type
Evaporator	Type			Laminated type
Temperature control				Reheat full air mix type

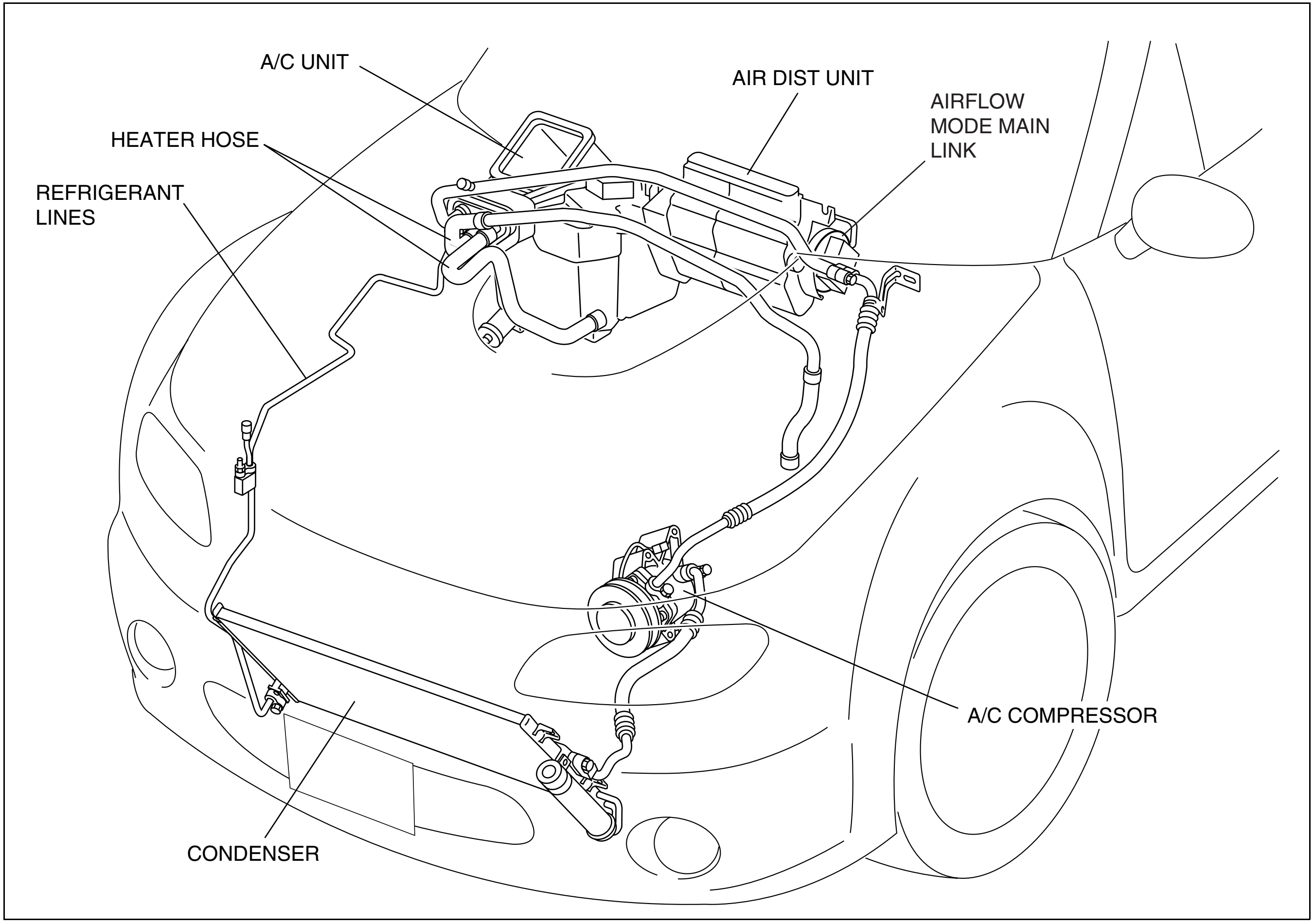
Control System

Item			Specification
Airflow volume (during heater operation)	Blower motor	(m^3/h)	230
Electricity consumption (during heater operation)	Blower motor	(W)	159
Airflow volume (during air conditioner operation)	Blower motor	(m^3/h)	355
Electricity consumption (during air conditioner operation)	Blower motor	(W)	198
	Magnetic clutch	(W)	45
Magnetic clutch clearance		(mm {in})	0.3—0.6 {0.012—0.023}
Fan type	Blower motor		Sirocco fan
Refrigerant pressure switch	Type		Triple-pressure
	Operating pressure	(MPa {kgf/cm^2, psi})	
Sensor	Evaporator temperature sensor		Thermistor
Actuator	Air intake actuator		Communication type
	Air mix actuator		
	Airflow mode actuator		

07–11 BASIC SYSTEM

BASIC SYSTEM STRUCTURAL VIEW

E5U071100000N02

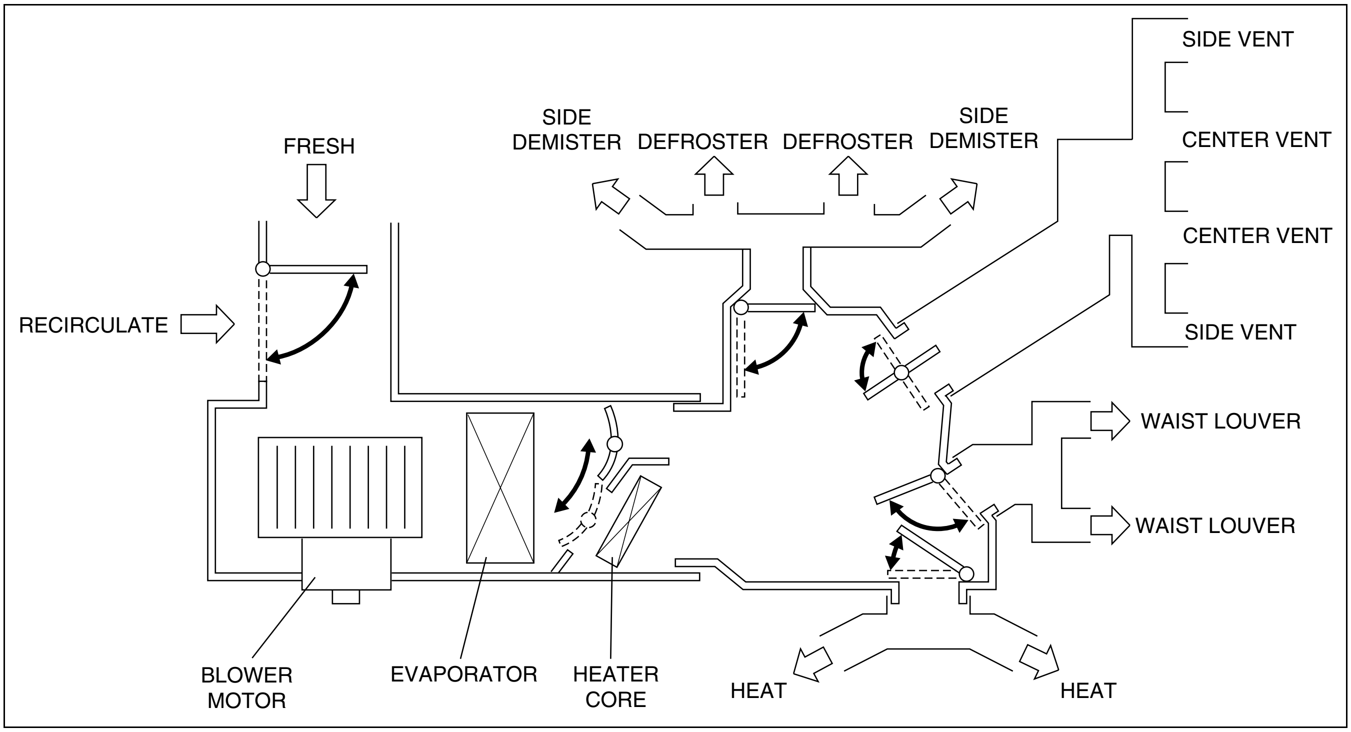


E5U711ZS5101

BASIC SYSTEM FLOW DIAGRAM

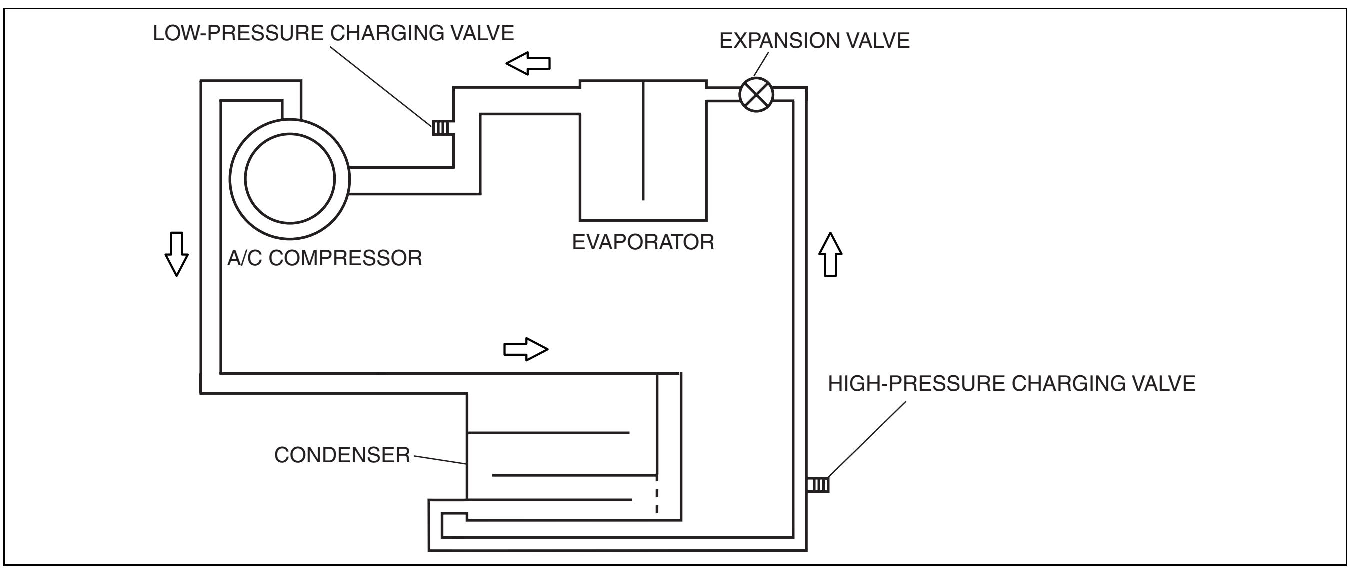
E5U071100000N03

VENTILATION SYSTEM



E5U711ZS5002

REFRIGERANT SYSTEM

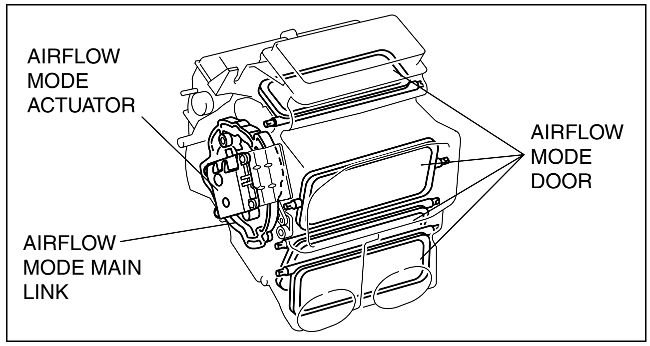


CHU0711S005

AIR DIST UNIT CONSTRUCTION

E5U071161140N01

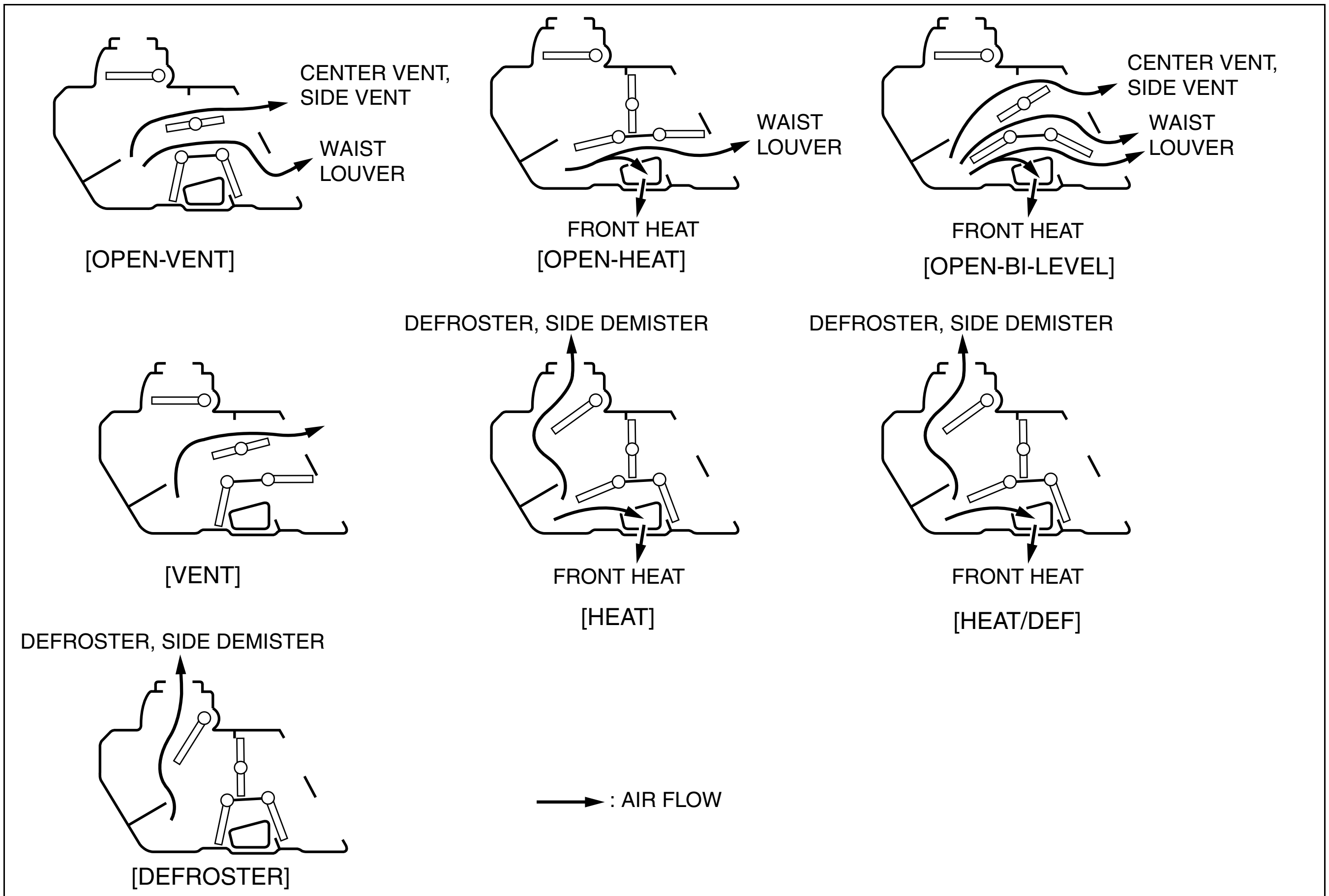
- Composed of the following parts:
  - — Airflow mode actuator
  - — Airflow mode main link
  - — Airflow mode door



E5U711ZS5003

Airflow Mode Door Operation

- The airflow mode doors move to the OPEN-VENT, OPEN-BI-LEVEL, OPEN-HEAT, VENT HEAT, HEAT/DEF or DEFROSTER position, depending on the position of the airflow mode control dial. As a result, the airflow mode changes.



E5U711ZS5004

Airflow Distribution

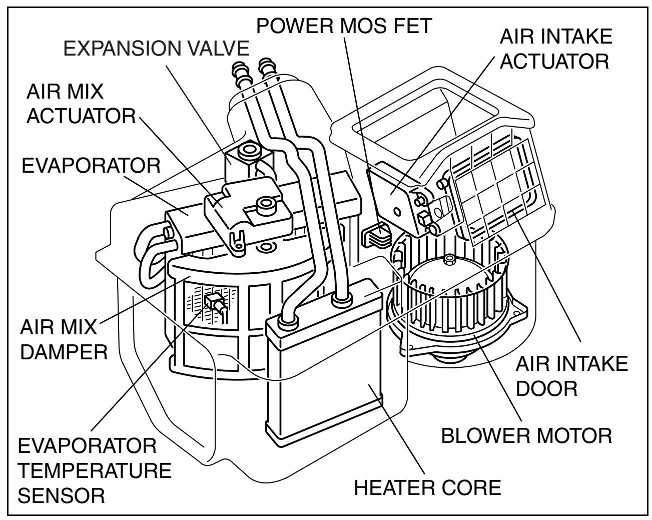
AIRFLOW MODE	AIRFLOW RATE (%)											
	VENT				WAIST		HEAT		DEFROSTER			
	DRIVER-SIDE		PASSENGER-SIDE		DRIVER-SIDE	PASSENGER-SIDE	DRIVER-SIDE	PASSENGER-SIDE	DRIVER-SIDE		PASSENGER-SIDE	
	SIDE	CENTER	CENTER	SIDE					SIDE	CENTER	CENTER	SIDE
OPEN-VENT	21.25	21.25	21.25	21.25	7.5	7.5	–	–	–	–	–	–
OPEN-BI-LEVEL	12.5	12.5	12.5	12.5	7.5	7.5	17.5	17.5	–	–	–	–
OPEN-HEAT	–	–	–	–	12.5	12.5	25	25	25			
VENT	25	25	25	25	–	–	–	–	–	–	–	–
HEAT	–	–	–	–	–	–	35	35	4.5	3	19.5	3
HEAT/DEF	–	–	–	–	–	–	25	25	7.5	7.5	27.5	7.5
DEFROSTER	–	–	–	–	–	–	–	–	15	20	50	15

A/C UNIT CONSTRUCTION/OPERATION

E5U071161132N01

Construction

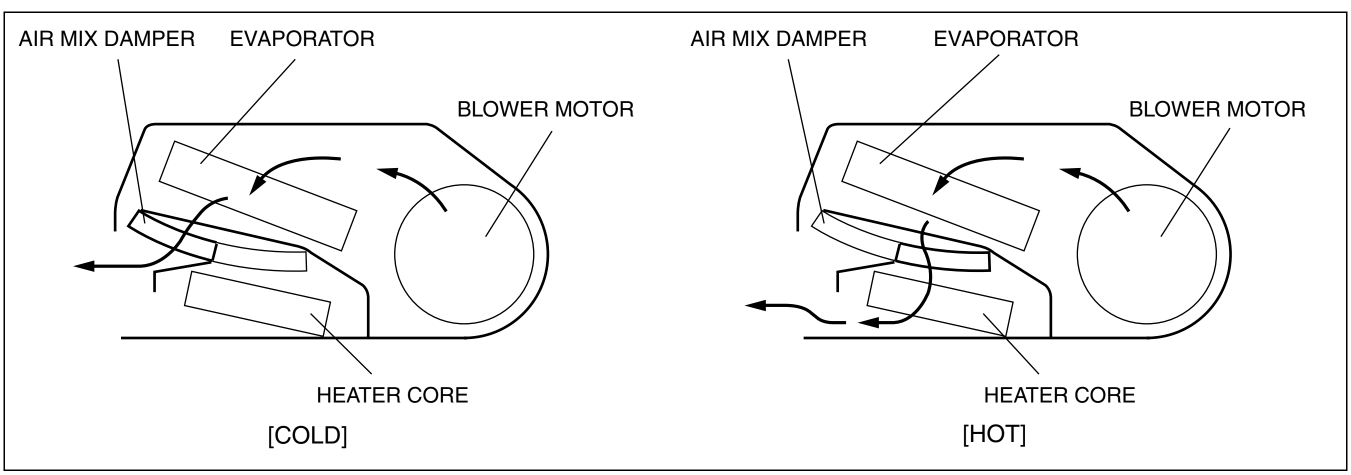
- An A/C unit with integrated cooling and heater units has been adopted.
  - — Evaporator
  - — Heater core
  - — Expansion valve
  - — Air mix damper
  - — Air intake door
  - — Evaporator temperature sensor
  - — Power MOS FET
  - — Air mix actuator
  - — Air intake actuator
  - — Blower motor



E5U711ZS5005

Air Mix Damper Operation

- The air mix damper, 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 temperature is controlled.

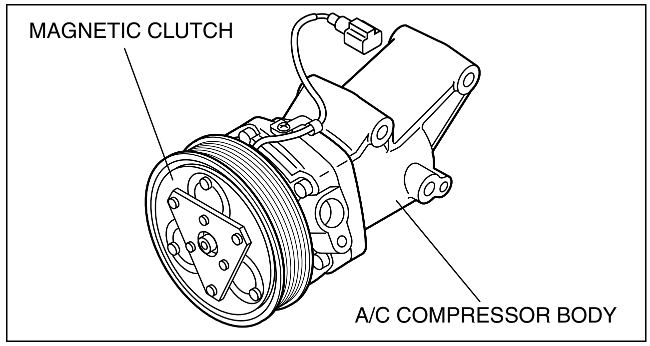


E5U711ZS5006

A/C COMPRESSOR CONSTRUCTION

E5U071161450N01

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

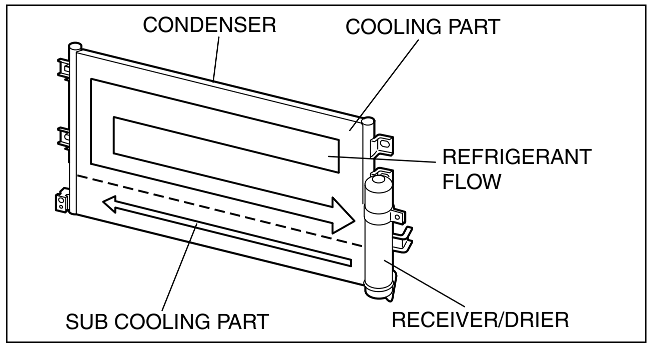


E5U711ZS5007

CONDENSER CONSTRUCTION

E5U071161480N01

- 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.

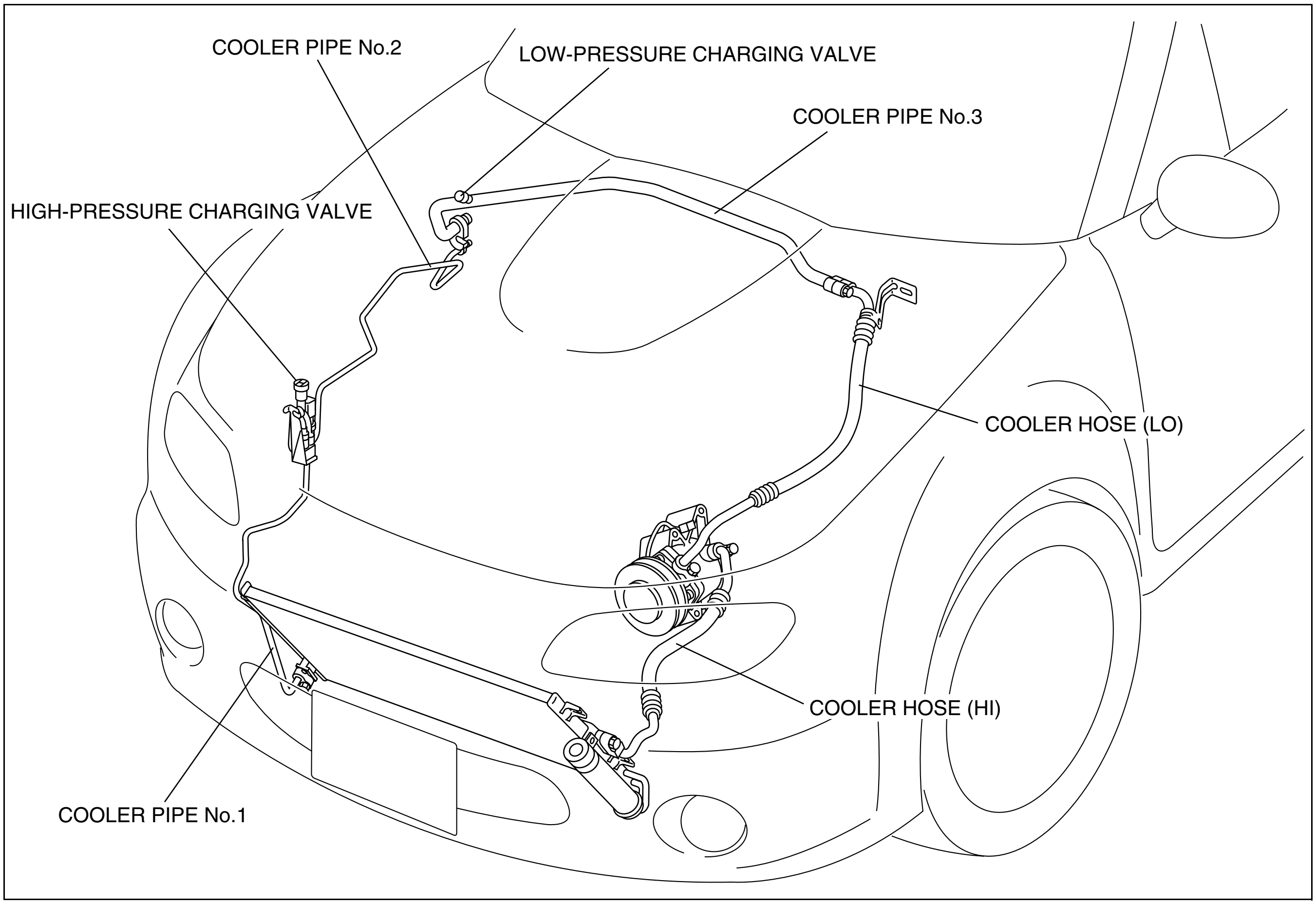


E5U740ZS5106

REFRIGERANT LINES CONSTRUCTION

E5U071161460N01

- 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 pipe No.3.

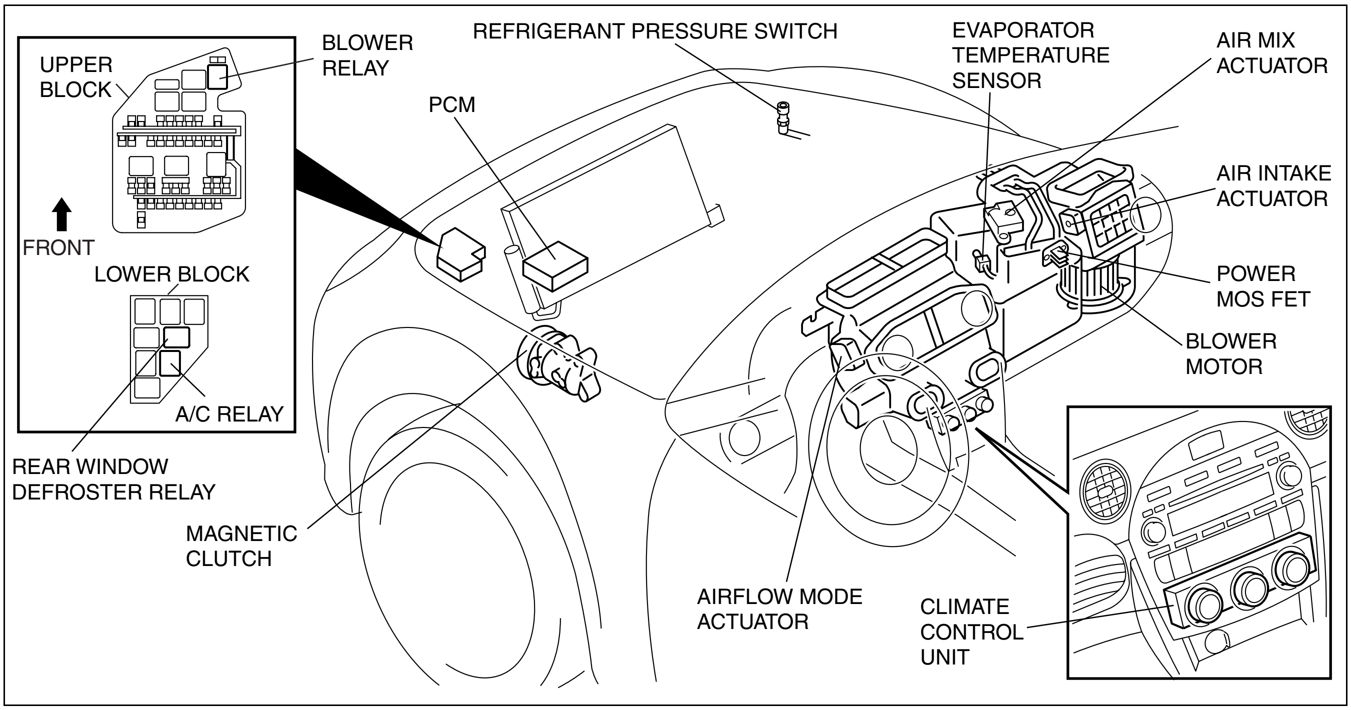


E5U711ZS5010

07–40 CONTROL SYSTEM

CONTROL SYSTEM STRUCTURAL VIEW

E5U074000000N02

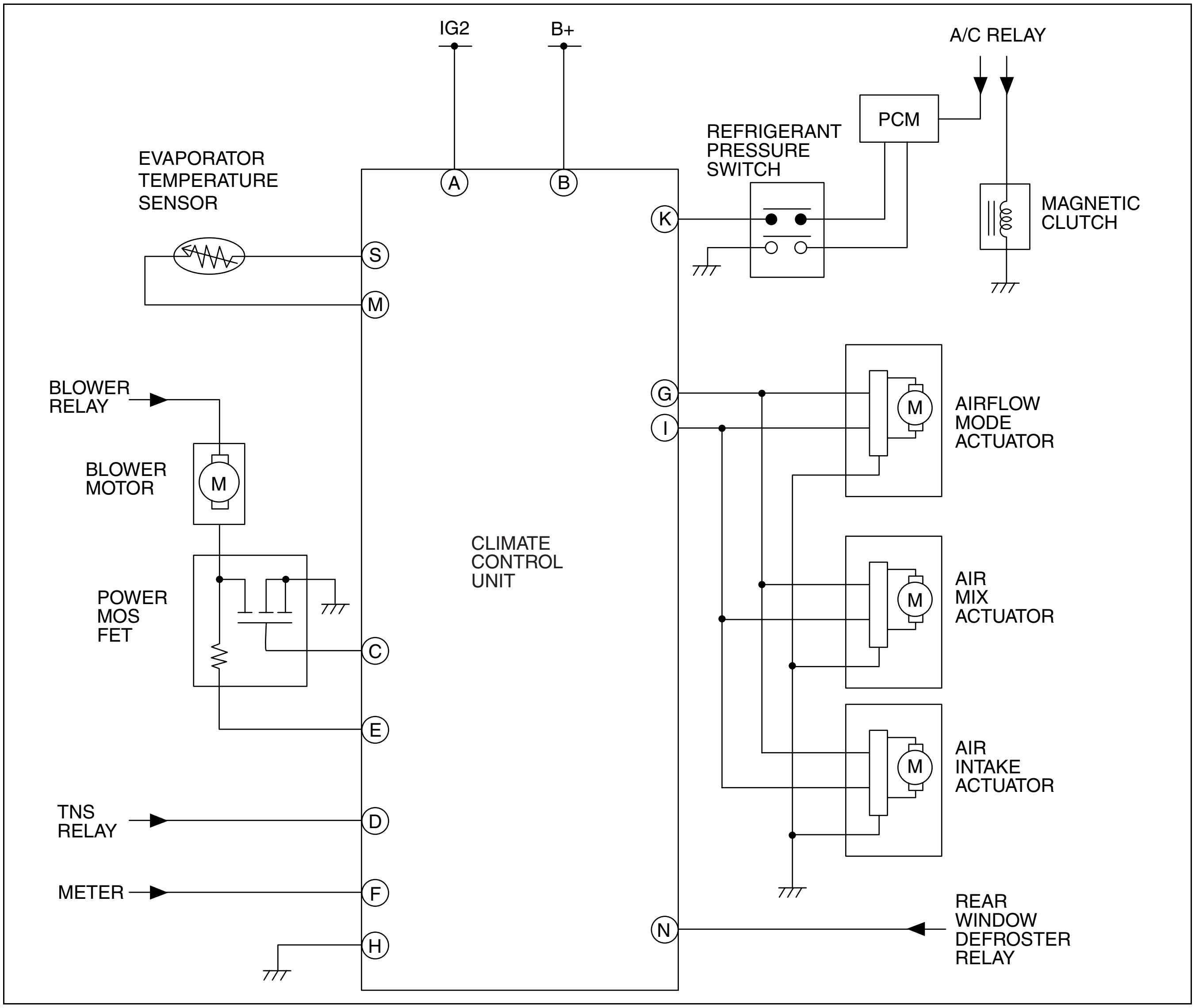


E5U740ZS5105

07–40

CONTROL SYSTEM SYSTEM WIRING DIAGRAM

E5U074000000N03

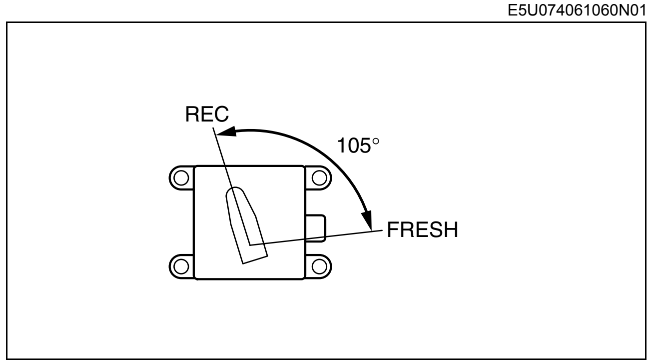


E5U740ZS5107

AIR INTAKE ACTUATOR CONSTRUCTION

E5U074061060N01

- A communication type has been adopted.

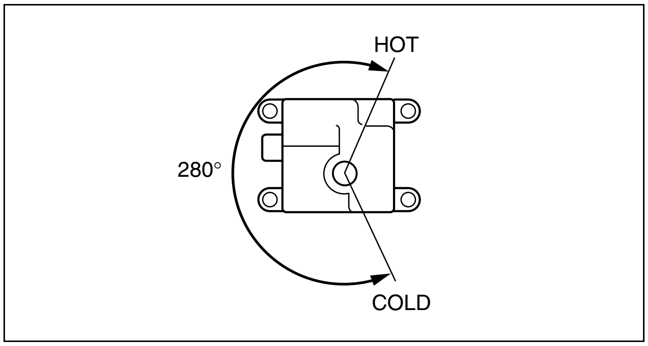


E5U740ZS5003

AIR MIX ACTUATOR CONSTRUCTION

E5U074061415N01

- A communication type has been adopted.

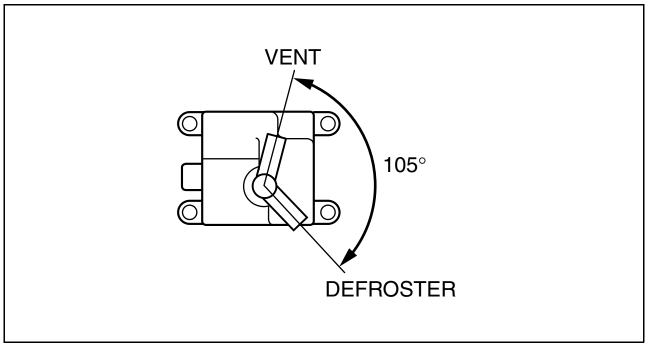


E5U740ZS5004

AIRFLOW MODE ACTUATOR CONSTRUCTION

E5U074061070N01

- A communication type has been adopted.

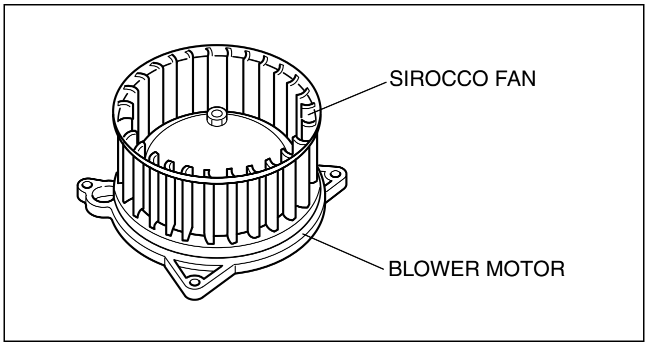


E5U740ZS5005

BLOWER MOTOR CONSTRUCTION

E5U074061020N01

- A sirocco fan has been adopted.



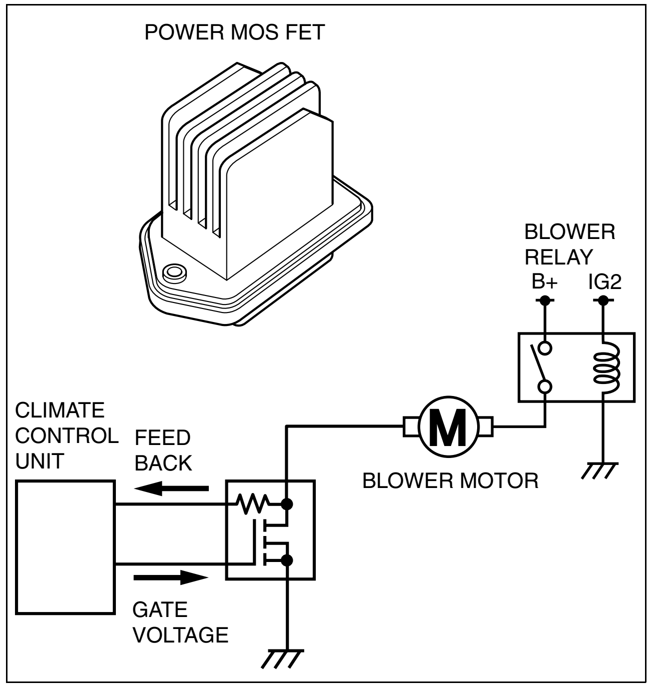
E5U740ZS5006

POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (POWER MOS FET) FUNCTION

E5U074000116N01

Function

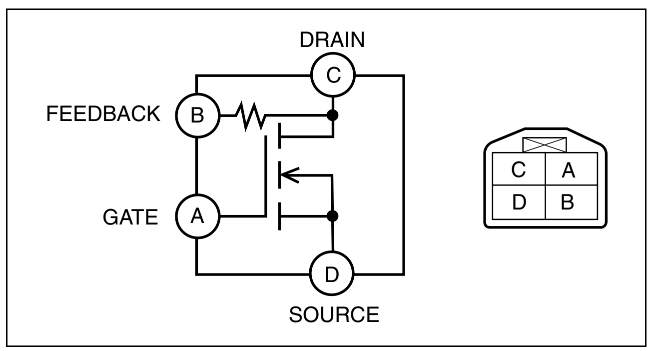
- Controls the supply voltage to the blower motor according to the gate voltage sent from the climate control unit and adjusts the rotation speed (airflow volume).



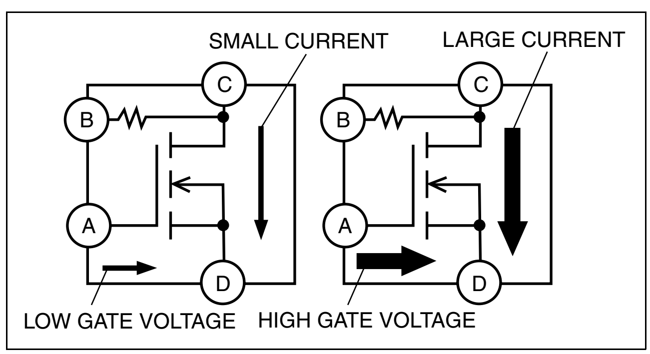
E5U740ZS5007

Construction/Operation

- There are four electrodes: source, gate, drain and feedback electrodes.
- The resistance between terminals C and D (between drain and source) changes according to the voltage (gate voltage) applied to terminal A (gate).
- When the gate voltage increases, the resistance between terminals C and D decreases, allowing the current to flow easily.



E5U740ZS5008

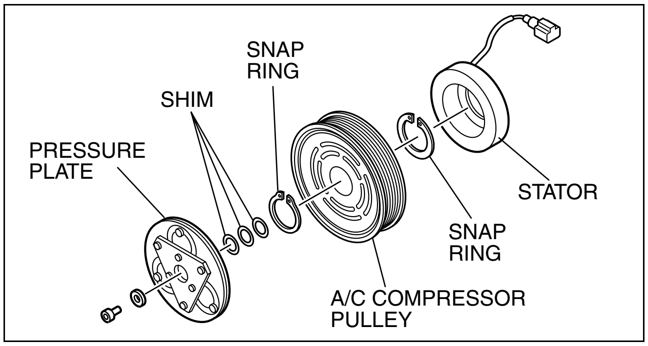


E5U740ZS5009

MAGNETIC CLUTCH CONSTRUCTION

E5U074061010N01

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

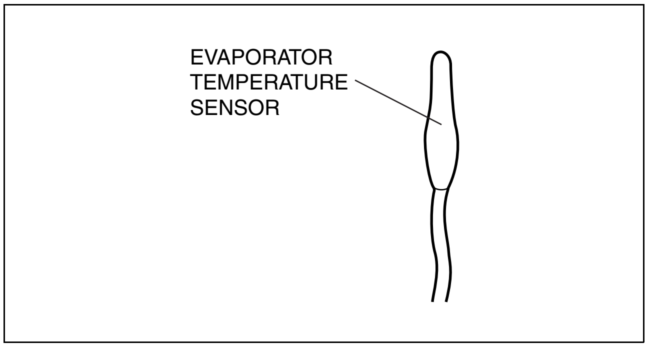


E5U740ZS5104

EVAPORATOR TEMPERATURE SENSOR CONSTRUCTION

E5U074061022N01

- A thermistor type has been adopted.



E5U740ZS5101

07–40

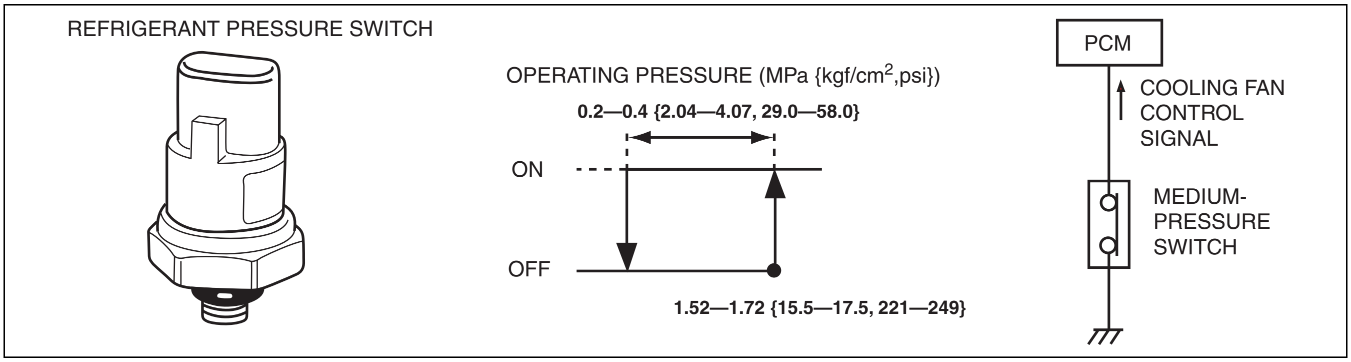
REFRIGERANT PRESSURE SWITCH CONSTRUCTION

E5U074061503N01

- 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. 1.52 MPa {15.5 kgf/cm^2, 221 psi} or more**, the contact turns on, and a cooling fan control signal is sent to the PCM.

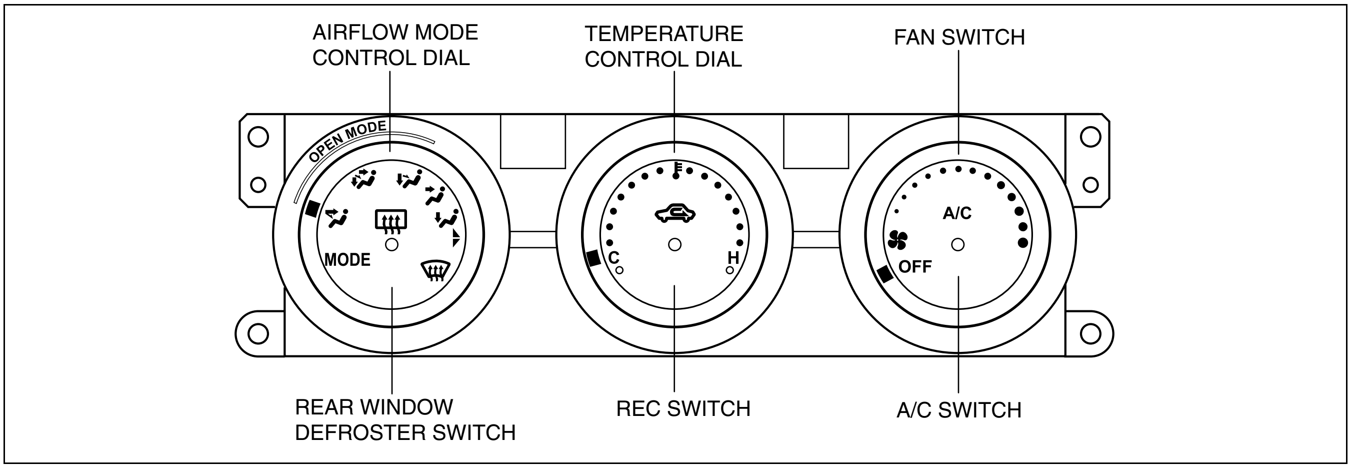


E5U740ZS5103

CLIMATE CONTROL UNIT CONSTRUCTION

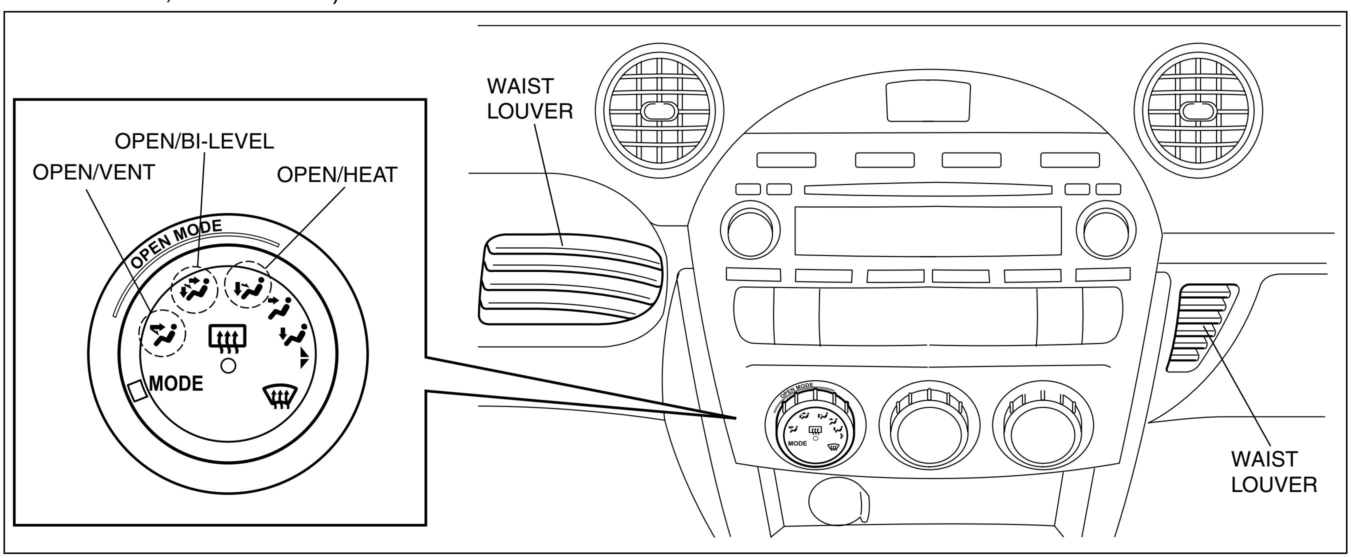
E5U074061190N01

- Composed of the following parts:
  - Fan switch
  - Airflow mode control dial
  - REC switch
  - A/C switch
  - Temperature control dial
  - Rear window defroster switch



E5U740ZS5011

- Hot or cold air is blown from the waist louver beside the audio when any mode position (OPEN-VENT, OPEN-BI-LEVEL, OPEN-HEAT) is selected.



E5U740ZS5012

MANUAL AIR CONDITIONER FUNCTION

E5U074000005N01

Defroster Control

- A/C is on (A/C indicator is the same as before the operation) and the intake mode is automatically switched to FRESH by setting the mode to HEAT, HEAT/DEF, or DEFROSTER.
  - — REC switch is not operable when the mode is in HEAT/DEF or DEFROSTER because it is fixed at FRESH.
  - — When the A/C switch is operated while in HEAT, HEAT/DEF, or DEFROSTER mode, the A/C indicator illuminates or goes out and the A/C is on at all times.

CURRENT AIRFLOW MODE	ACTION			
	REC SWITCH PRESSED	A/C SWITCH PRESSED		SET AIRFLOW MODE TO HEAT, HEAT/DEF OR DEFROSTER
		A/C	A/C ILLUMINATION	
OPEN-VENT OPEN-BI-LEVEL OPEN HEAT VENT	REC ⇔ FRESH	ON ⇔ OFF	ON ⇔ OFF	Switches to each mode A/C to ON A/C indicator is the same as before operation air intake to FRESH
HEAT	REC ⇔ FRESH	A/C on at all times	ON ⇔ OFF	Switches to each mode
HEAT/DEF DEFROSTER	Fresh at all times	A/C on at all times	ON ⇔ OFF	Switches to each mode

RESTRAINTS

08
SECTION

08–00 OUTLINE

RESTRAINTS ABBREVIATIONS

E5U080000000N01

ALR	Automatic Locking Retractor
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
ELR	Emergency Locking Retractor
GND	Ground
IG	Ignition
LED	Light Emitting Diode
PAD	Passenger Air bag Deactivation
PID	Parameter Identification
SAS	Sophisticated Air bag Sensor
SST	Special Service Tool
WDS	Worldwide Diagnostic System

RESTRAINTS FEATURES

E5U080000000N02

Improved safety	• 2-step deployment control added to front air bag system (driver and passenger-side) deployment control. • Side air bag module adopted. • Three-point seat belt with the following functions for seat passengers adopted — ELR (Emergency Locking Retractor: emergency locking mechanism) — Pre-tensioner seat belt (See 08–10–16 PRE-TENSIONER SEAT BELT CONSTRUCTION/ OPERATION.) — Load limiter, which adjusts restraint force of the seat belt to reduce the possibility of injury to passengers caused by excess seat belt pressure after pre-tensioner or ELR operation — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism)(passenger's side)

08–02 ON-BOARD DIAGNOSTIC

ON-BOARD DIAGNOSTIC FUNCTION OUTLINE

E5U080200000N01

- The air bag system has an on-board diagnostic function to facilitate the system diagnosis.
- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the air bag system-related parts; a memory function, which stores detected DTCs; a display function, which indicates system malfunctions by DTC display; a PID/data monitoring function, which reads out specific input/output signals.
- Using the WDS or equivalent, DTCs can be read out and deleted, and the PID/data monitoring function can be activated.
- The system has a fail-safe function to prevent the accidental activation of the air bags in case of an air bag system malfunction.

08–02

ON-BOARD DIAGNOSTIC FUNCTION

E5U080200000N02

Self-Malfunction Diagnostic Function

Malfunction detection function

- Detects overall malfunctions in the air bag system-related parts.

Fail-safe function

- If the SAS control module performance/function cannot be maintained due to any cause, the fail-safe function stops air bag system control and flashes the air bag system warning light to prevent the air bags from operating (deploying) accidentally.

Memory function

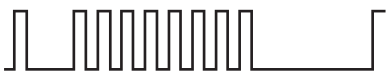
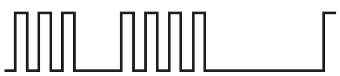
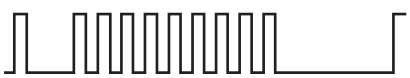
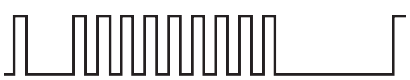
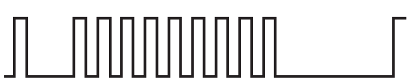
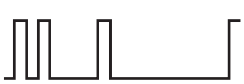
- Stores malfunctions in the air bag system-related parts detected by the malfunction detection function, and the stored malfunction contents are not cleared even if the ignition switch is turned to the LOCK position or the negative battery cable is disconnection.

Display function

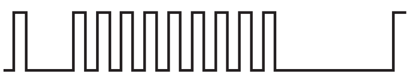
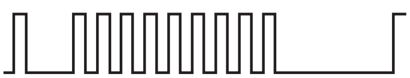
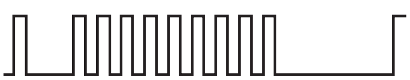
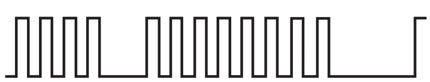
- When the malfunction detection function detects a malfunction, the air bag system warning light illuminates to advise the driver. Using the external tester communication function, DTCs can be output to the DLC-2 via the K-line.

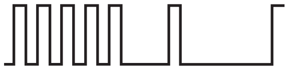
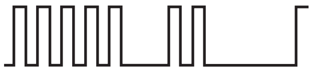
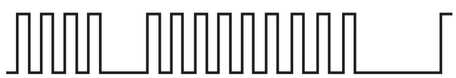
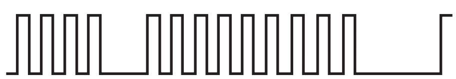
DTC table

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1013	48		14	Seat weight sensor calibration error
B1047	22		7	Driver-side side air bag module assembly incorrect
B104B	63		12	Driver-side side air bag sensor assembly incorrect
B104C	64		13	Passenger-side side air bag sensor assembly incorrect
B104D	42		11	Crash zone sensor assembly incorrect
B104F	64		13	Passenger-side air bag sensor system internal circuit disabled
B1051	63		12	Driver-side side air bag sensor system internal circuit disabled
B1055	23		8	Passenger-side side air bag module assembly incorrect
B1318	—	Continuously illuminated	1	SAS control module power supply voltage decreases (less than 9 V)
B1342	12		4	SAS control module
B1428	57		19	Seat belt warning light circuit open

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1869	—	Continuously illuminated	1	Air bag system warning light circuit open
	—	Does not illuminate	—	Air bag system warning light circuit short to body ground
B1877	33		9	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		10	Passenger-side pre-tensioner seat belt circuit resistance high
B1882				Passenger-side pre-tensioner seat belt circuit short to power supply
B1883				Passenger-side pre-tensioner seat belt circuit short to body ground
B1884	18		18	Passenger air bag deactivation (PAD) indicator circuit open or short to body ground
B1885	33		9	Driver-side pre-tensioner seat belt circuit resistance low
B1886	34		10	Passenger-side pre-tensioner seat belt circuit resistance low
B1916	19		5	Driver-side air bag module (inflator No. 1) circuit short to power supply
B1925	21		6	Passenger-side air bag module (inflator No. 1) circuit short to power supply
B1932	19		5	Driver-side air bag module (inflator No. 1) circuit resistance high
B1933	21		6	Passenger-side air bag module (inflator No. 1) circuit resistance high
B1934	19		5	Driver-side air bag module (inflator No. 1) circuit resistance low
B1935	21		6	Passenger-side air bag module (inflator No. 1) circuit resistance low
B1936	19		5	Driver-side air bag module (inflator No. 1) circuit short to body ground
B1938	21		6	Passenger-side air bag module (inflator No. 1) circuit short to body ground

08–02

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1992	22		7	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		8	Passenger-side side air bag module circuit short to power supply
B1997				Passenger-side side air bag module circuit short to body ground
B1998				Passenger-side side air bag module circuit resistance high
B1999				Passenger-side side air bag module circuit resistance low
B2226	42		11	Crash zone sensor system internal circuit disabled
B2227				Crash zone sensor system communication error
B2228	19		5	Driver-side air bag module (inflator No.2) circuit short to body ground
B2229	21		6	Passenger-side air bag module (inflator No.2) circuit short to body ground
B2230	19		5	Driver-side air bag module (inflator No.2) circuit short to power supply
B2231	21		6	Passenger-side air bag module (inflator No.2) circuit short to power supply
B2232	19		5	Driver-side air bag module (inflator No.2) circuit resistance high
B2233	21		6	Passenger-side air bag module (inflator No.2) circuit resistance high
B2234	19		5	Driver-side air bag module (inflator No.2) circuit resistance low
B2235	21		6	Passenger-side air bag module (inflator No.2) circuit resistance low
B2290	48		14	Passenger sensing system malfunction
B2433	51		16	Driver-side buckle switch circuit open or short to power supply

DTC				System malfunction location
WDS display	Air bag system warning light			
	Flashing pattern		Priority ranking	
B2434	51		16	Driver-side buckle switch circuit short to body ground
B2437	52		17	Passenger-side buckle switch circuit open or short to power supply
B2438	52		17	Passenger-side buckle switch circuit short to body ground
B2477	54		2	Configuration error
B2856	42		11	Crash zone sensor system communication data error
B2867	31		3	Poor connection of any SAS control module connectors
B2886	64		13	Passenger-side air bag sensor system communication data error
B2887	63		12	Driver-side air bag sensor system communication data error
C1946	49		15	Seat track position sensor circuit open
C1947	49		15	Seat track position sensor circuit short to body ground
C1948	49		15	Seat track position sensor circuit resistance not within specification
C1982	49		15	Seat track position sensor circuit short to power supply
U2017	63		12	Driver-side side air bag sensor system communication error
U2018	64		13	Passenger-side side air bag sensor system communication error

PID/Data Monitoring Function

- By using the PID/data monitoring function, the monitored item of the input/output signal, as set on the SAS control module, can be freely selected and read out in real-time.
- The WDS or equivalent is used to read out PID/data monitor information.

PID/data monitor table

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
BUCKLE_D (Driver-side buckle switch status)	Buckled/ Unbuckled	• Driver-side buckle switch on: Buckled • Driver-side buckle switch off: Unbuckled	3A, 3D
BUCKLE_P (Passenger-side buckle switch status)	Buckled/ UNbuckled	• Passenger-side buckle switch on: Buckled • Passenger-side buckle switch off: Unbuckled	3J, 3G
CCNT_RCM (Number of continuous DTCs)	—	• DTCs detected: 1—255 • No DTCs detected: 0	—
CR2D_Comm (Driver-side side air bag sensor system communication data error)	OK/ FAULT	• Sensor normal: OK • Sensor communication malfunction: FAULT	2C, 2F
CR2D_Inter (Driver-side side air bag sensor system internal circuit disabled)	OK/ FAULT	• Sensor normal: OK • Sensor internal malfunction: FAULT	2C, 2F
CR2D_Mount (Driver-side side air bag sensor assembly incorrect)	OK/ FAULT	• Sensor normal: OK • Sensor Install malfunction: FAULT	2C, 2F
CR2D_Short (Driver-side side air bag sensor system communication error)	OK/ FAULT	• Sensor normal: OK • Sensor open or short circuit: FAULT	2C, 2F
CR2P_Comm (Passenger-side side air bag sensor system communication data error)	OK/ FAULT	• Sensor normal: OK • Sensor communication malfunction: FAULT	2X, 2AA
CR2P_Inter (Passenger-side side air bag sensor system internal circuit disabled)	OK/ FAULT	• Sensor normal: OK • Sensor internal malfunction: FAULT	2X, 2AA
CR2P_Mount (Passenger-side side air bag sensor assembly incorrect)	OK/ FAULT	• Sensor normal: OK • Sensor Install malfunction: FAULT	2X, 2AA
CR2P_Short (Passenger-side side air bag sensor system communication error)	OK/ FAULT	• Sensor normal: OK • Sensor open or short circuit: FAULT	2X, 2AA
DTC_CLR_ST* (Seat weight sensor status)	Starting/ Normal End/ In Process/ OCS Fault	Fault information cleared at seat weight sensor	3B
IGN_V_2 (IG1 voltage)	V	Ignition switch is at ON: B+	—
OCS_CAL_ST* (Seat weight sensor calibration status)	Starting/ Normal End/ Commanding/ NG (Voltage)/ NG (Weight)/ Timeout/ In Process/ OCS Fault	• Seat weight sensor calibration start-up: Starting • Seat weight sensor calibration completed normally: Normal End • Seat weight sensor calibration command being sent: Commanding • Voltage malfunction during seat weight sensor calibration: NG (Voltage) • Weight error during seat weight sensor calibration: NG (Weight) • Seat weight sensor calibration time limit passed: Timeout • Seat weight sensor calibration being processed: In Process • Seat weight sensor or Seat weight sensor control module malfunction: OCS Fault	3B
OCS_PSG_ST* (Seat weight sensor status)	Empty/ Child/ Adult/ OCS Fault	Occupant classification status determined by seat weight sensor	3B

PID name (definition)	Unit/Condition	Operation Condition (Reference)	Terminal
OCSFLT_CAL (Seat weight sensor calibration status)	OK/ FAULT	• Sensor normal: OK • Passenger sensing system calibration error: FAULT	3B
OCSFLT_COM (Seat weight sensor control module communication status)	OK/ FAULT	• Sensor normal: OK • Passenger sensing system communication error: FAULT	3B
OCSFLT_L (Seat weight sensor (LH) malfunction status)	OK/ FAULT	• Sensor normal: OK • Passenger sensing system (LH) malfunction: FAULT	3B
OCSFLT_MDL (Seat weight sensor control module malfunction status)	OK/ FAULT	• Sensor normal: OK • Passenger sensing system control module malfunction: FAULT	3B
OCSFLT_R (Seat weight sensor (RH) malfunction status)	OK/ FAULT	• Sensor normal: OK • Passenger sensing system (RH) malfunction: FAULT	3B
OCSFLT_SNS (Seat weight sensor malfunction status)	OK/ FAULT	• Sensor normal: OK • Passenger sensing system malfunction: FAULT	3B
PS_WEIGHT (Seat weight sensor measured weight of passenger)	kg	Display of load (body weight) on passenger-side seat	3B
RES_AB_D (Driver-side air bag module (inflator No. 1) resistance)	Ohm	Under any condition: 1.5—4.7 ohms	1A, 1D
RES_AB_P (Passenger-side air bag (inflator No. 1) module resistance)	Ohm	Under any condition: 1.3—4.7 ohms	1V, 1S
RES_AB2_D (Driver-side air bag module (inflator No. 2) resistance)	Ohm	Under any condition: 1.5—4.7 ohms	1J, 1G
RES_AB2_P (Passenger-side air bag (inflator No. 2) module resistance)	Ohm	Under any condition: 1.3—4.7 ohms	1M, 1P
RES_PT_D (Driver-side pre-tensioner seat belt resistance)	Ohm	Under any condition: 1.3—4.7 ohms	2A, 2D
RES_PT_P (Passenger-side pre-tensioner seat belt resistance)	Ohm	Under any condition: 1.3—4.7 ohms	2Y, 2V
RES_SAB_D (Driver-side side air bag module resistance)	Ohm	Under any condition: 1.3—4.7 ohms	2J, 2G
RES_SAB_P (Passenger-side side air bag module resistance)	Ohm	Under any condition: 1.3—4.7 ohms	2P, 2S
TRAK_SW (Seat track position sensor state)	Forward/ Rearward	• Seat front position: Forward • Seat rear position: Rearward	3M, 3P

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

08–10 AIR BAG SYSTEM

AIR BAG SYSTEM OUTLINE

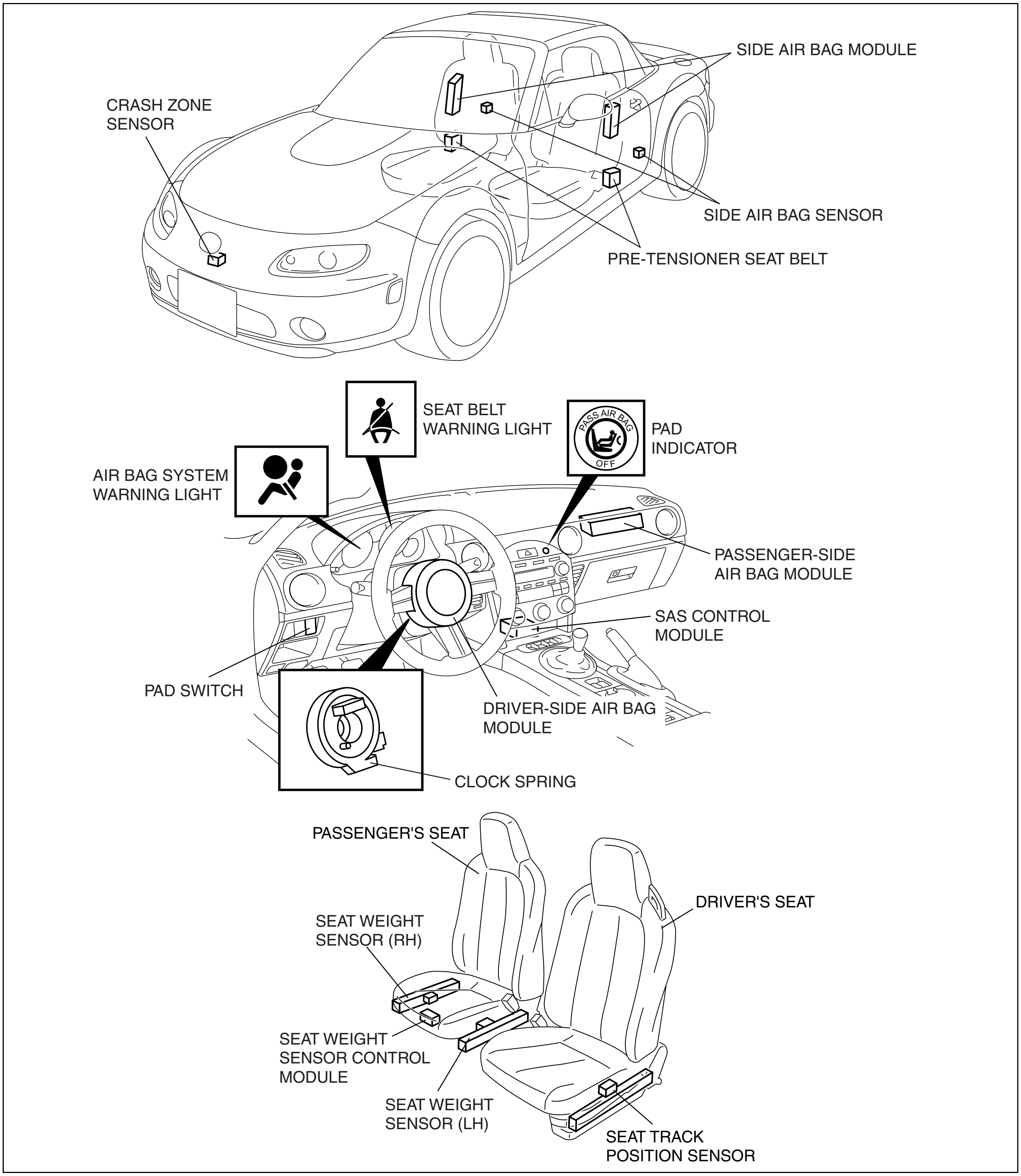
E5U081000000N01

- The air bag system is a device that supplements the passenger restraint function of the seat belts. The air bag system will not have the designed effect if the seat belts are not worn properly.
- The air bag system is composed of the following parts:

Item	Outline
SAS control module	• Two-step deployment control has been added to the front air bag system (driver and passenger-side) deployment control. • Recognizes actually equipped air bag module or pre-tensioner 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 Buckle Deployment Operation. (See 08–10–5 SAS CONTROL MODULE CONSTRUCTION/OPERATION)
Side air bag sensor	
Driver-side air bag module	• Dual inflators, inflator 1 and inflator 2, have been adopted in accordance with the front air bag system two-step deployment control.
Passenger-side air bag module	
Side air bag module	• The side air bag module with a head-protection function has been adopted to soften the impact during a collision to the side of the vehicle.
Pre-tensioner seat belt	• Piston-type pre-tensioner seat belt has been adopted.
Seat track position sensor	• Detects the seat track position of the driver's seat, and sends a corresponding signal to the SAS control module.
PAD switch	• PAD switch has been adopted enabling optional deactivation of passenger-side air bag module, passenger-side side air bag module, and passenger-side pre-tensioner seat belt.
PAD indicator	• PAD indicator has been adopted to inform driver and passenger of the deployment standby status of the passenger-side air bag module, passenger-side side air bag module, and passenger-side pre-tensioner seat belt.
Air bag system warning light	• LED has been adopted.
Seat belt warning light	
Seat weight sensor	• Measures the compression weight of the load applied to the passenger-side seat by the distortion amount using two seat weight sensor and sends an electrical signal corresponding to the distortion amount to the seat weight sensor control module.
Seat weight sensor control module	• Based on the electrical signal sent from the seat weight sensor corresponding to the distortion amount, calculates the total seated weight to determine the passenger, and sends the determination result to the SAS control module.

AIR BAG SYSTEM STRUCTURAL VIEW

E5U081000000N02

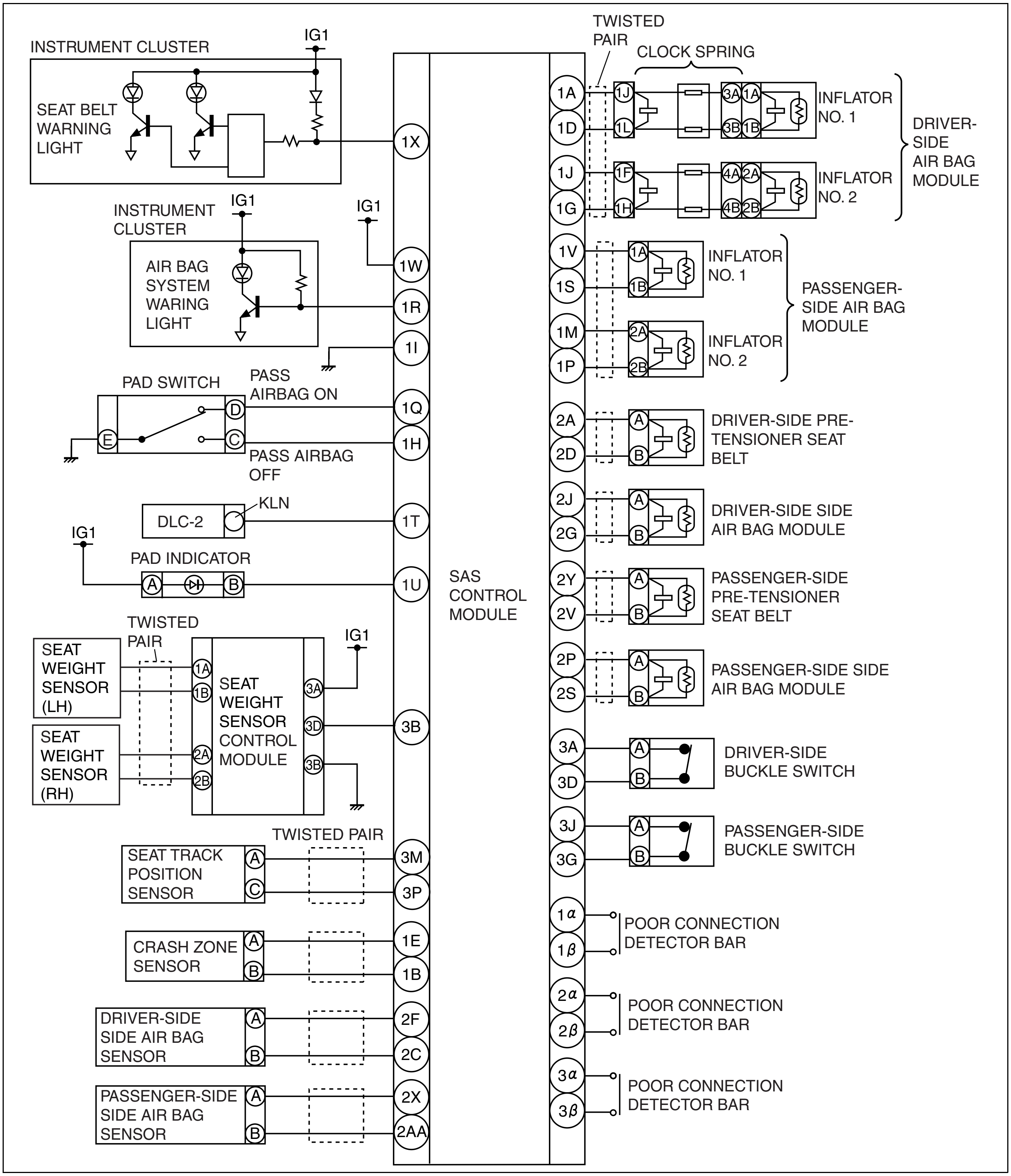


E5U810ZS5201

08–10

AIR BAG SYSTEM WIRING DIAGRAM

E5U081000000N03



E5U810ZS5002

SAS CONTROL MODULE FUNCTION

E5U081057030N01

Outline

- A two-step air bag deployment control system has been adopted. In case of a frontal or frontal offset collision, an optimal air bag deployment force is matched to the impact force. The inflators for the driver and passenger-side air bag modules have two tiers, and deploy at either a low or high rate, according to the force of the impact.
- A drip-proof sheet has been installed to the connector for improved waterfroofing.

SAS CONTROL MODULE CONSTRUCTION/OPERATION

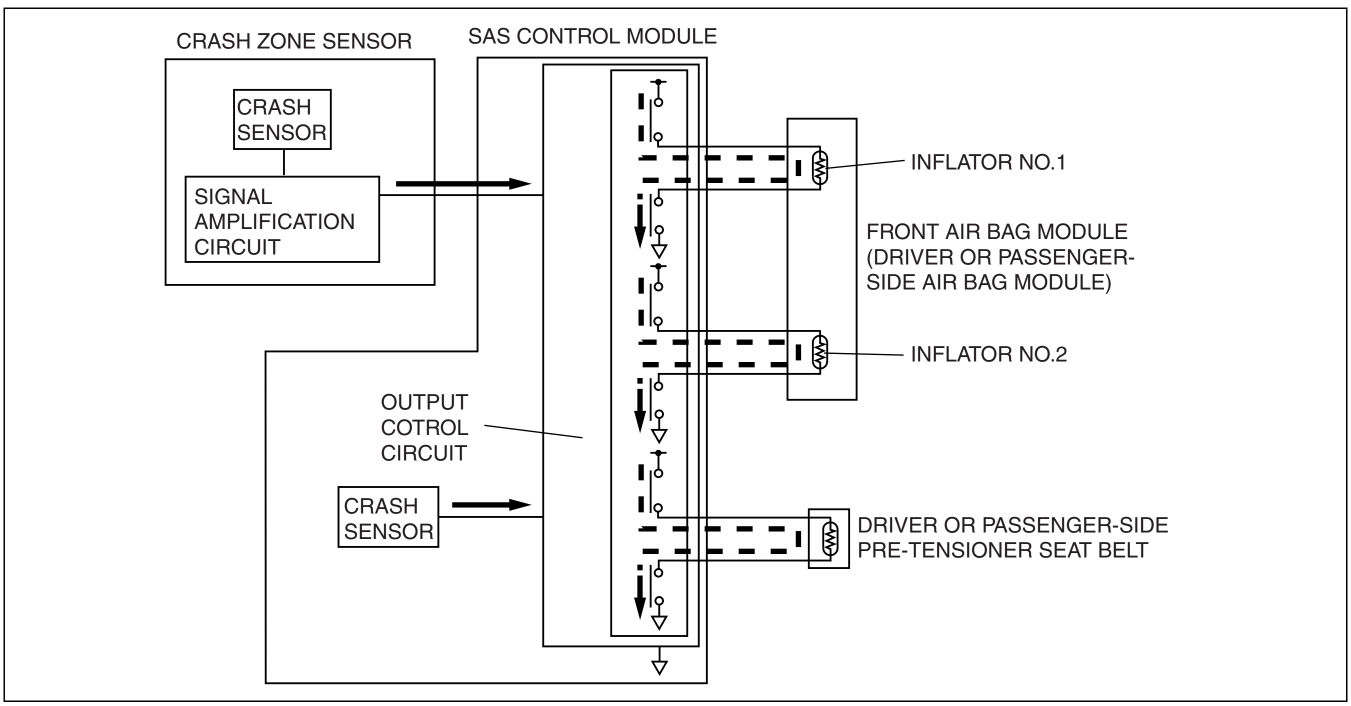
E5U081057030N02

Front Air Bag System (Two-Step Deployment Control)

1. During a frontal or frontal offset collision, the crash sensors in the crash zone sensor and the SAS control module detect the impact.
2. The level of impact detected by the crash sensors in the crash zone sensor is converted to an electric signal and sent to the SAS control module.
3. Simultaneously, the SAS control module crash sensor converts the level of impact detected to an electrical signal.
4. The SAS control module processes the calculations for the two electrical signals at the output control circuit and compares the value to a preset value.
5. The output control circuit determines the level of impact to the vehicle by the value from the crash sensors, completes an inflator No.1 or inflator No.2 ignition circuit, and sends the deployment signal to the air bag modules.

No.	Level of collision force	Air bag module deployment force	Inflator deployment pattern
1	Large	Large	Inflator No.1 and inflator No.2 deploy.
2	Small	Small	Inflator No.1 deploys.

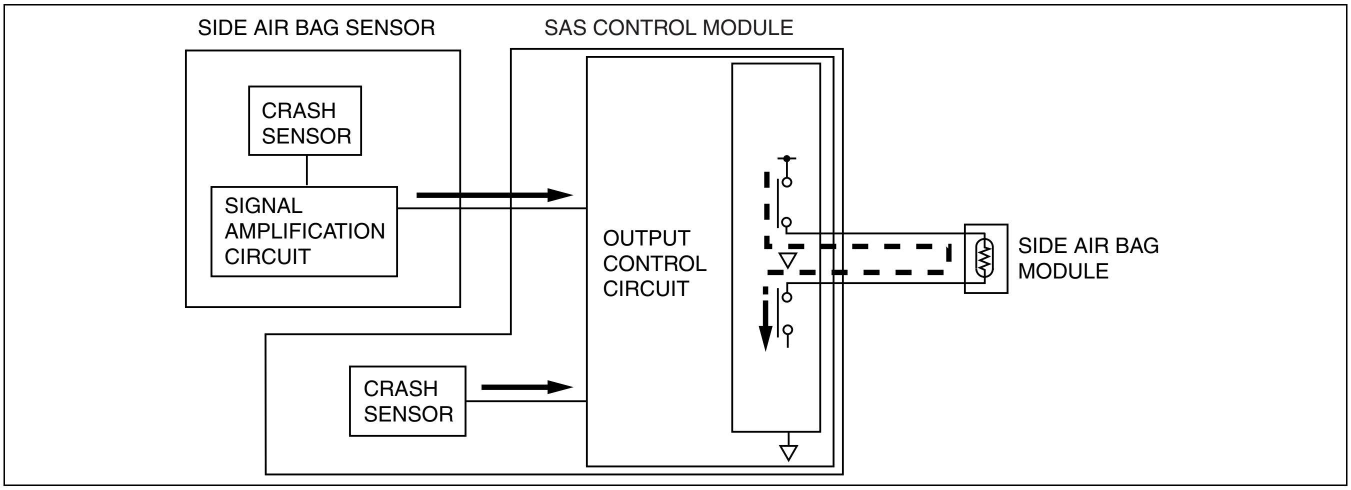
6. The SAS control module completes an ignition circuit for the pre-tensioner seat belts that is synchronized to the deployment of the driver and passenger-side air bag modules, and an operation (deployment) signal is sent to the pre-tensioner seat belts.



C3U0810S601

Side air bag system

1. During a lateral collision to the vehicle, the crash sensors in the side air bag sensor and SAS control module detect the collision.
2. The level of impact detected by the crash sensor in the side air bag sensor is converted to an electrical signal and sent to the SAS control module through the signal amplification circuit.
3. Simultaneously, the SAS control module crash sensor converts the level of impact detected to an electrical signal.
4. The SAS control module processes the calculations for the two electrical signals at the output control circuit and compares the value to a preset value.
5. The output control circuit determines the level of impact to the vehicle by the value from the crash sensors, completes a side air bag module ignition circuit, and sends the deployment signal to the air bag modules.

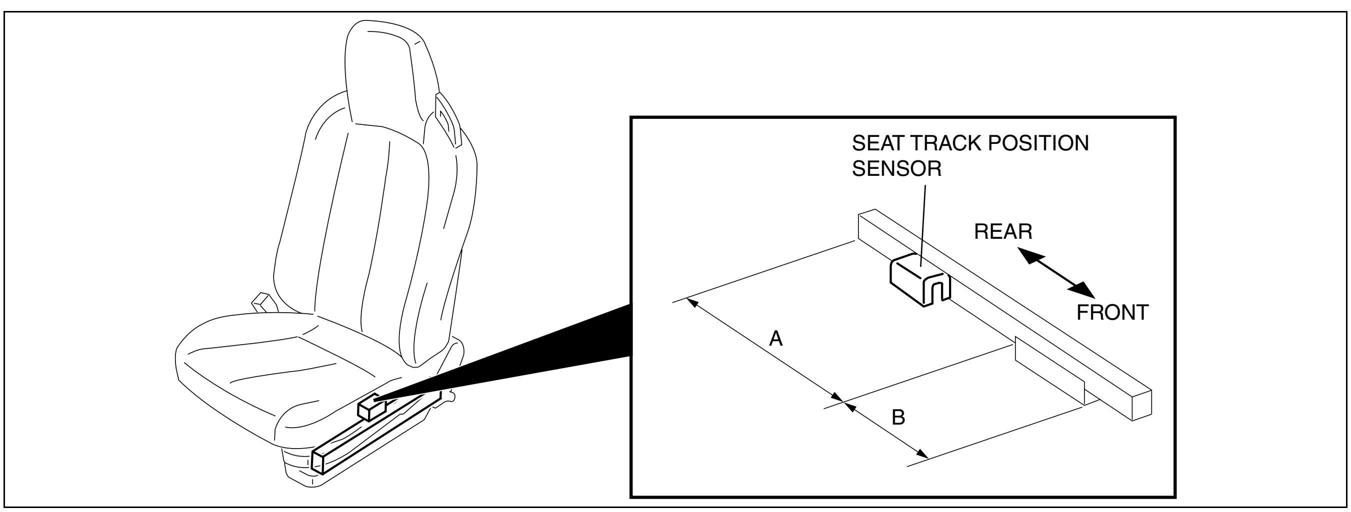


E5U810ZS5103

Seat Position Matching Deployment Control

- The SAS control module controls the air bag deployment operation pattern (deployment only inflator No.1 or both inflator No.1 and No.2) according to the seat track position of the driver's seat.
- The SAS control module detects the seat track position based on the seat position signal received from the seat track position sensor.
- When the driver's seat is in a forward position, the SAS control module deploys only inflator No.1 to lessen the air bag module deployment force.

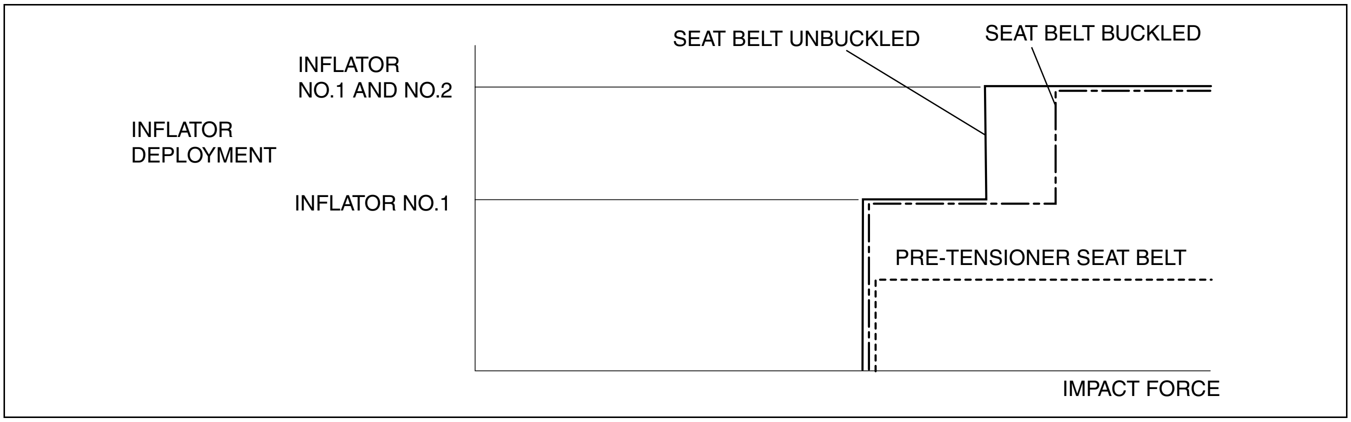
Seat Position	Air bag module deployment control
A	Normal control (only inflator No.1 deploys or both inflator No.1 and No.2 deploy)
B	Only inflator No.1 deploys



E5U810ZS5004

Seat Belt Buckled/Unbuckled Condition Matching (Deployment) Control

- The SAS control module detects the buckled or unbuckled condition of the driver-side and passenger-side seat belts based on a signal received from the 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 driver-side or passenger-side or seat-belt is unbuckled, it lowers the minimum specified value of the impact profile (speed) for high-output deployment (inflator No.1 and No.2 deploy simultaneously). This means that the SAS control module controls deployment so that in a collision with an impact profile which normally dose not lead to high-output deployment (inflator No.1 and No.2 deploy simultaneously) of the air bag modules, the corresponding air bag will deploy if either one of the seat belts is unbuckled.



C3U0810S015

Passenger Detection System Operation (Deployment) Control

- The SAS control module, which receives the signal from the seat weight sensor control module, controls the passenger-side air bag module operation (deployment) and the illumination on/off for the PAD indicator based on the passenger determination result for the passenger-side seat.
- If the seat weight sensor control module determines that the passenger-side seat is occupied by a child (including the child restraint seat), the SAS control module controls the system so that the passenger-side air bag module, passenger-side side air bag module and the passenger-side pre-tensioner seat belt do not operate (deploy), even if the level of impact from the collision would normally cause the air bag modules to operate (deploy). The seat weight sensor control module also informs the driver and other passenger (passenger-side seat) that the air bag module is in non-operation (non-deployment) status by illuminating the PAD indicator.
- If the seat weight sensor control module determines that the passenger-side seat is not occupied, the SAS control module sets the air bags to non-operation (non-deployment) status, the same as when a child is determined, and turns off the PAD indicator.
- If the seat weight sensor control module determines that an adult is seated in the passenger-side seat, the SAS control module controls the system so that the passenger-side air bag module, passenger-side side air bag module and the passenger-side pre-tensioner seat belt operate (deploy) normally during a collision, and turns off the PAD indicator
- When the ignition switch is turned to the ON position, the PAD indicator illuminates for **approx. 6 s** while the SAS control module inspects for malfunctions in the circuit. If a malfunction is detected in the circuit, a DTC is displayed.

Passenger Air Bag Deactivation (PAD) Switch Operation (Deployment) Control

- When the PAD switch is turned to the OFF position, the SAS control module inhibits operation (deployment) of the passenger-side air bag module, passenger-side side air bag module, and the passenger-side pre-tensioner seat belt even if the degree of impact from a collision is sufficient for normal air bag module operation (deployment). At the same time, the PAD indicator illuminates to alert the driver and passengers (passenger-side seat) of the inoperational (undeployable) condition of the air bag.
- When the PAD switch turned to the ON position, the passenger-side air bag module, passenger-side side air bag module, and the passenger-side pre-tensioner seat belt operate (deploy) normally during a collision and the PAD indicator goes out.
- When the ignition switch is turned to the ON position, the PAD indicator illuminates for **approx. 6 s** while the SAS control module inspects for malfunctions in the circuit. If a malfunction is detected in the circuit, a DTC is displayed.

SEAT TRACK POSITION SENSOR FUNCTION

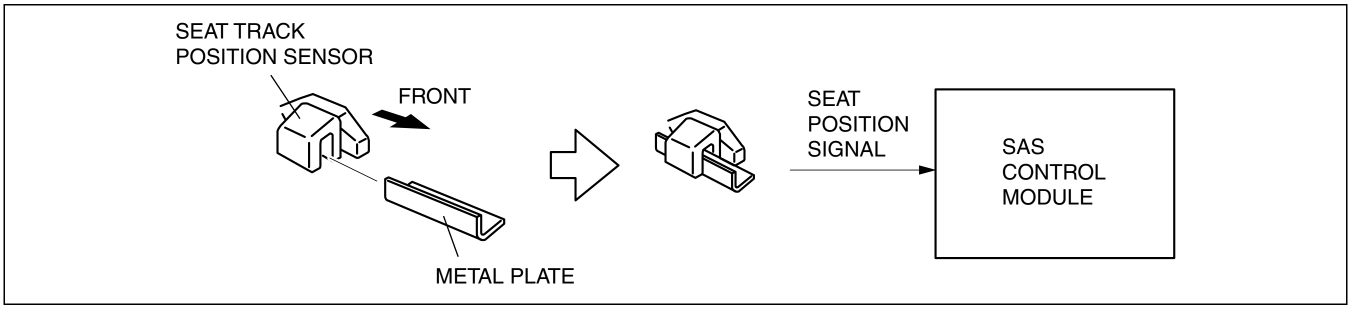
E5U081057030N03

- 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

E5U081057030N04

- The seat track position sensor consists of a Hall element (semi-conductor) and a magnet. The sensor converts the effect of the magnetic flux (produced by the magnet) on the Hall element, into an electrical signal.
- When the driver's seat is moved to a forward position, the metal plate installed near the front of the seat track passes through the groove in the seat track position sensor. When this occurs the magnetic flux of the sensor changes and that change is sent as an electrical signal to the SAS control module. The SAS control module receives this signal and determines that the driver's seat has been moved to a forward position.



CHU0810S004

PASSENGER SENSING SYSTEM OUTLINE

E5U081057031N01

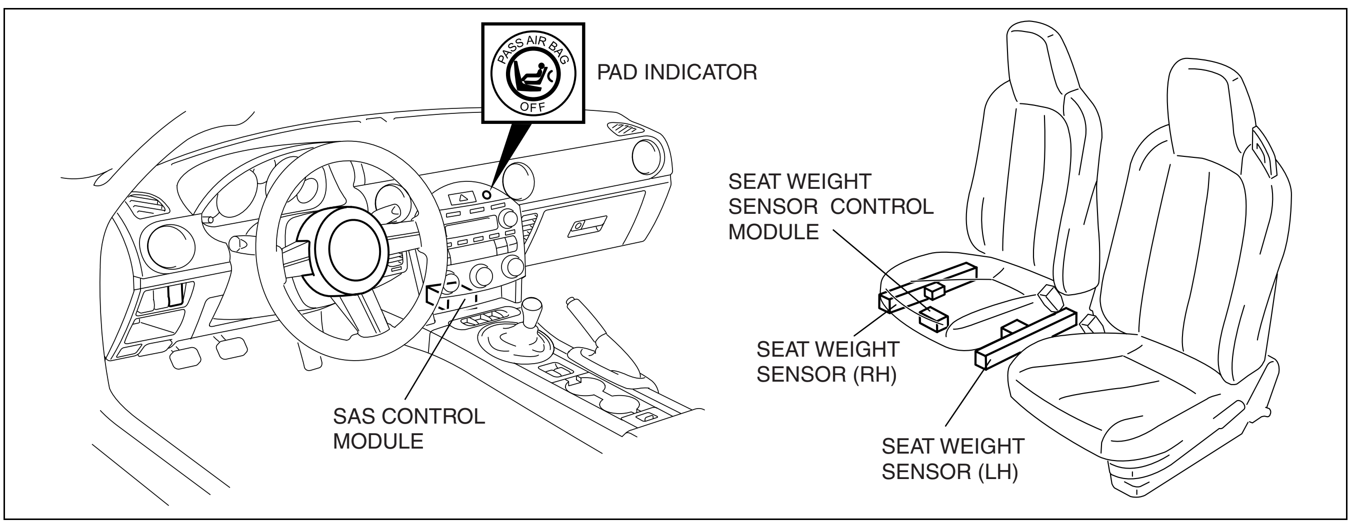
Outline

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

PASSENGER SENSING SYSTEM CONSTRUCTION

E5U081057031N02

- Consists of seat weight sensors installed above the passenger-side seat rails, a seat weight sensor control module installed on the back side of the passenger-side seat cushion, the PAD indicator, and SAS control module installed in the console panel.



E5U810ZS5005

PASSENGER SENSING SYSTEM OPERATION

E5U081057031N03

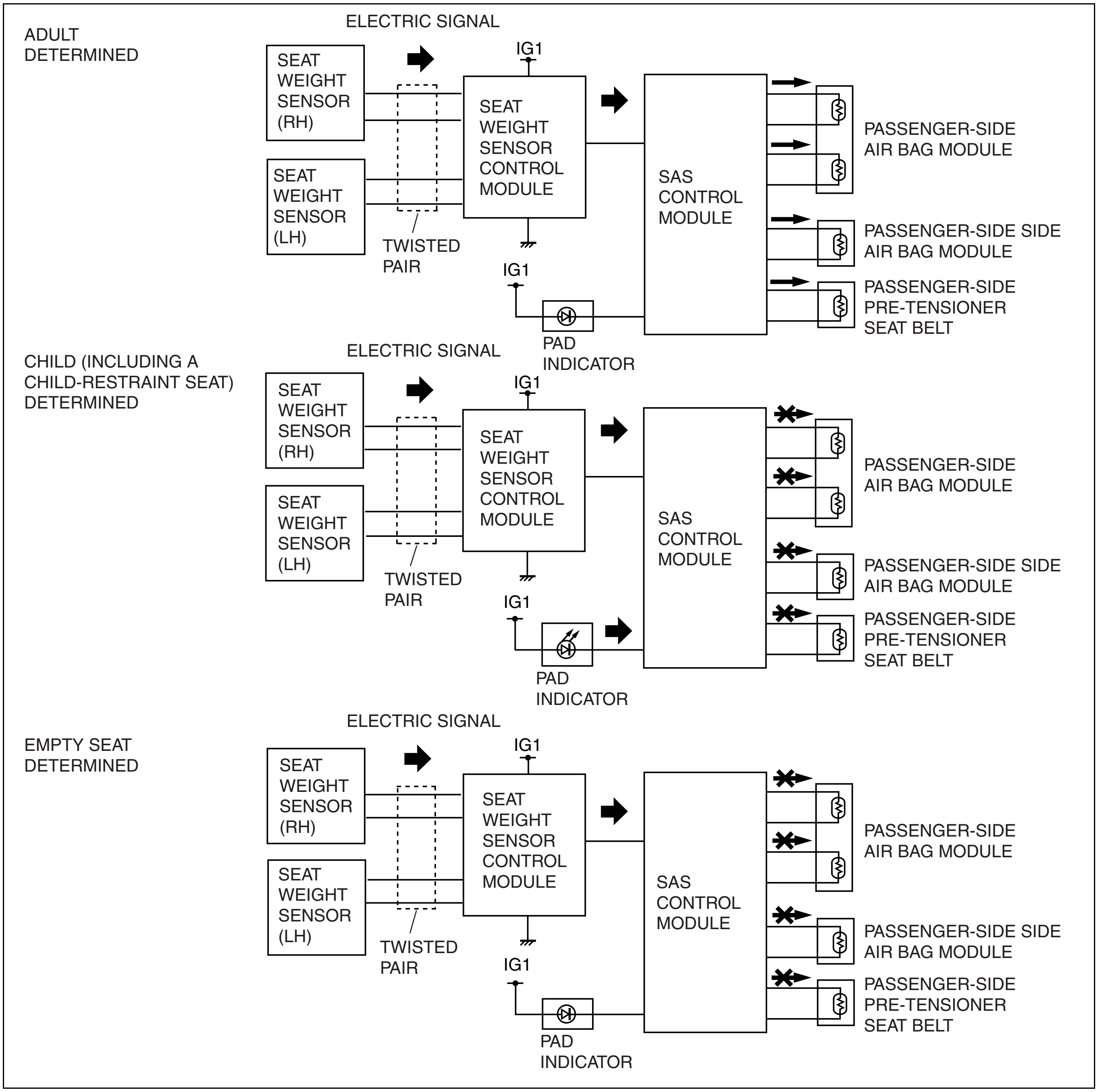
1. The load on the passenger-side seat is converted into an electric signal by the strain gauge built into the seat weight sensor, and this signal is sent to the seat weight sensor control module.
2. The electronic signals from the two seat weight sensor are used for calculation by the seat weight sensor control module, which divides the result and then determines whether there is an adult or child (including a child-restraint seat) in the passenger-side seat, or that it is empty. The determined result is sent to the SAS control module.
3. The SAS control module performs control based on this determined result as shown in the following table when the module detects a level of impact requiring operation (deployment).

×: Possible
-: Not possible

Determined result	Determined weight	Passenger-side air bag module operation (deployment)	Passenger-side side air bag module operation (deployment)	Passenger-side pre-tensioner seat belt operation (deployment)	PAD indicator
Adult	Approx. 42 kg {93 lb} or more	×	×	×	Not illuminated
Child (including child-restraint seat)	Approx. 30 kg {66 lb} or less	-	-	-	Illuminated
Empty	Approx. 0 kg {0 lb}	-	-	-	Not illuminated

Note

- The passenger-side air bag module, the passenger-side side air bag module and the passenger-side pre-tensioner seat belt system will be turned off as the total seated weight drops toward 30kg {66 lb} and they will be turned on again before the weight exceeds 42kg {93 lb}.



E5U810ZS5006

Caution

- **If any of the following work is performed, perform the seat weight sensor calibration using the WDS or equivalent.**
  - **Replacement with a new seat weight sensor**
  - **Replacement with a new seat weight sensor control module**
  - **Replacement with new passenger-side seat parts**
  - **Disassembly of the passenger-side seat**
- **If any of the following work is performed, perform the seat weight sensor inspection using the WDS or equivalent.**
  - **Removal of the passenger-side seat**
  - **Loosening and retightening of passenger’s seat fixing bolts**
  - **Or, the vehicle is involved in a collision**

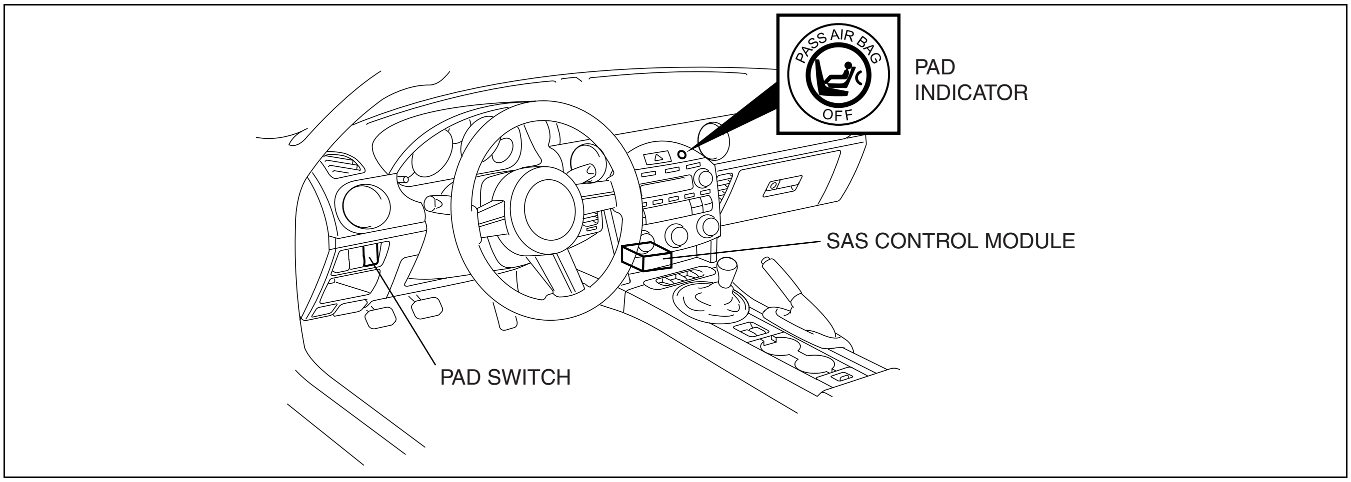
PASSENGER AIR BAG DEACTIVATION (PAD) SYSTEM FUNCTION

E5U081064170N01

- By operation of the PAD switch, vehicle occupants can optionally switch the passenger-side air bag module, passenger-side side air bag module, and the passenger-side pre-tensioner seat belt between operational (deployable) and inoperational (undeployable) conditions.

PASSENGER AIR BAG DEACTIVATION (PAD) SYSTEM STRUCTURAL VIEW

E5U081064170N02

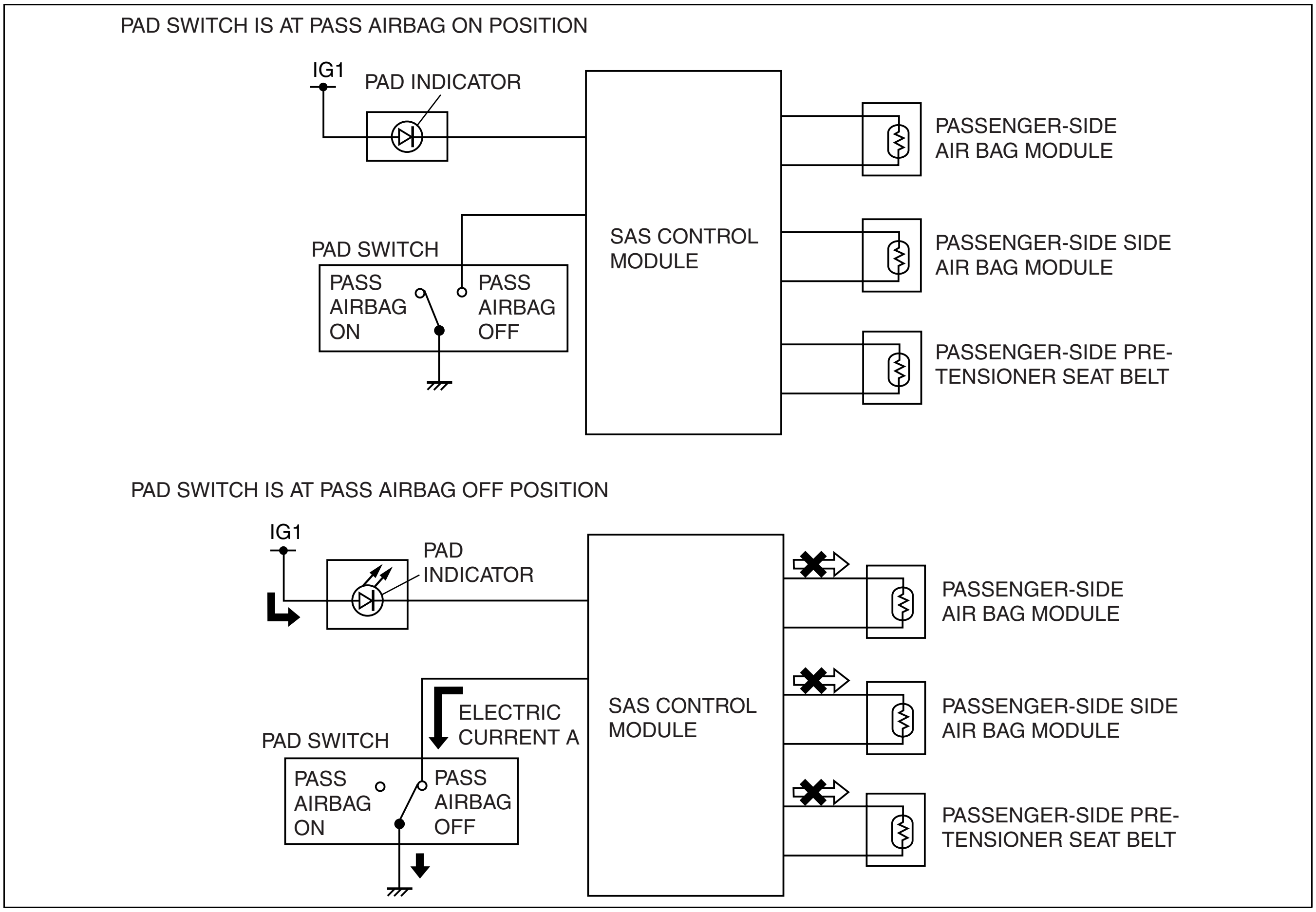


E5U810ZS5008

PASSENGER AIR BAG DEACTIVATION (PAD) SYSTEM CONSTRUCTION/OPERATION

E5U081064170N03

- Consists of the PAD switch, installed on the left side of the dashboard, the PAD indicator, installed near the center of the dashboard, and the SAS control module.
- With the key inserted, when the PAD switch is turned to the OFF position, electric current A from the SAS control module passes through the PAD switch to ground, thereby forming an off circuit. At the same time, the PAD indicator illuminates and operation (deployment) of the passenger-side air bag module, passenger-side side air bag module, and the passenger-side pre-tensioner seat belt is inhibited.



E5U810ZS5009

DRIVER-SIDE AIR BAG MODULE FUNCTION

E5U081057010N01

Outline

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

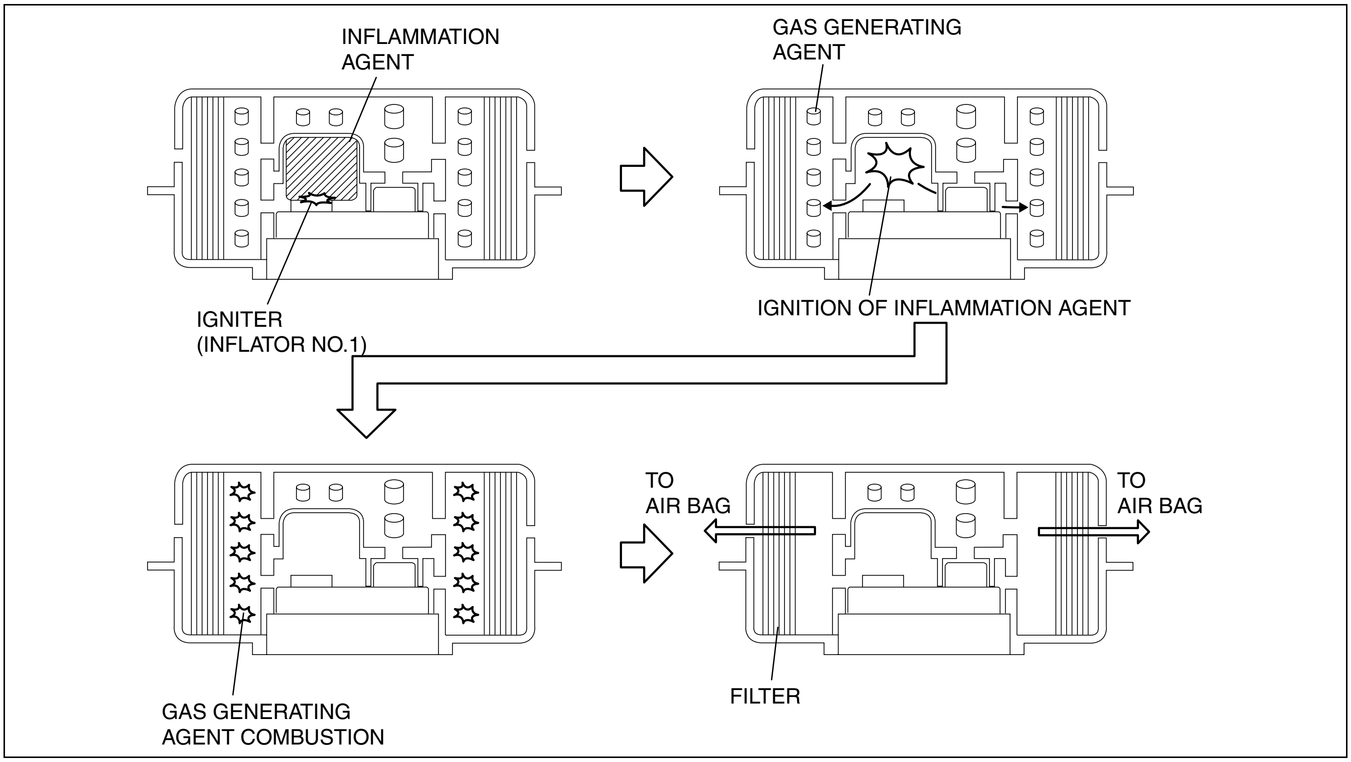
DRIVER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

E5U081057010N02

Inflator Operation

Inflator No.1

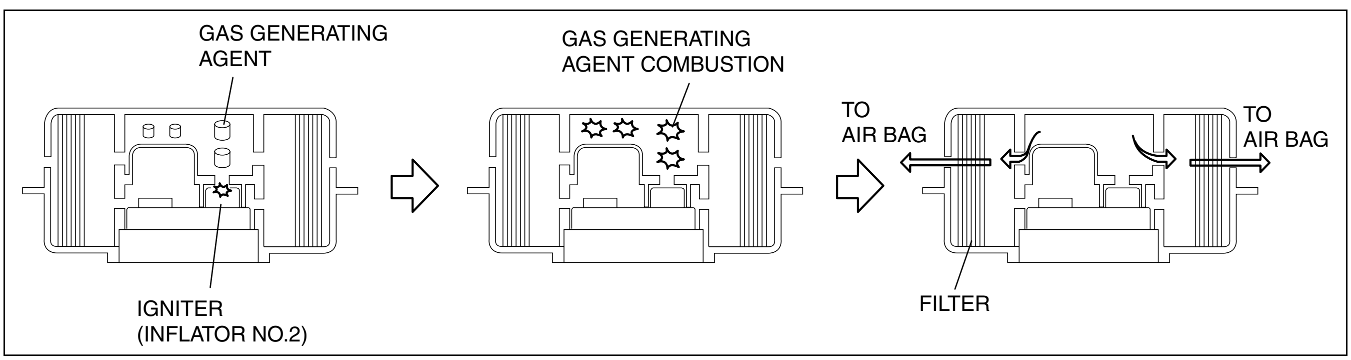
1. When the driver-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.1 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



ADA8130T003

Inflator No.2

1. When the driver-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.2 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



ADA8130T004

PASSENGER-SIDE AIR BAG MODULE FUNCTION

E5U081057050N01

Outline

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

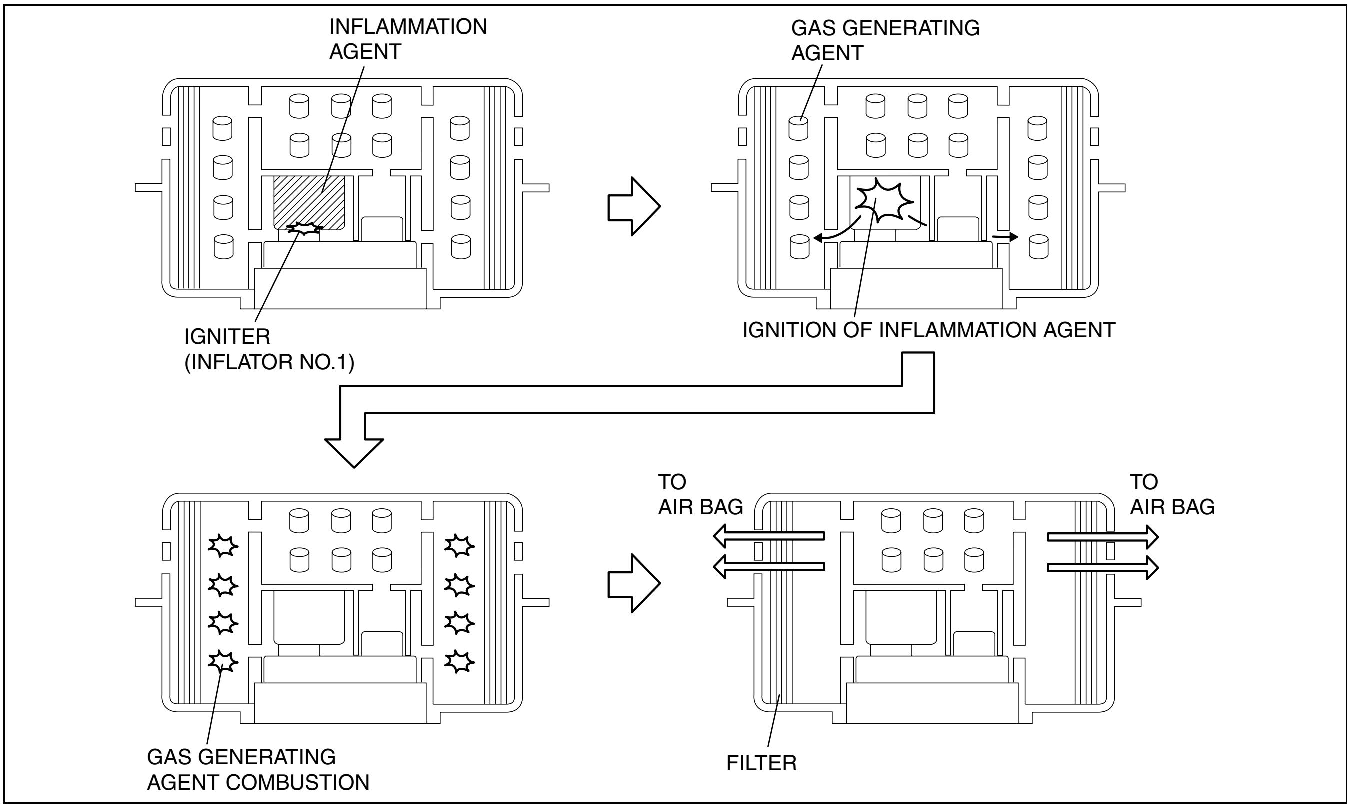
PASSENGER-SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

E5U081057050N02

Inflator Operation

Inflator No.1

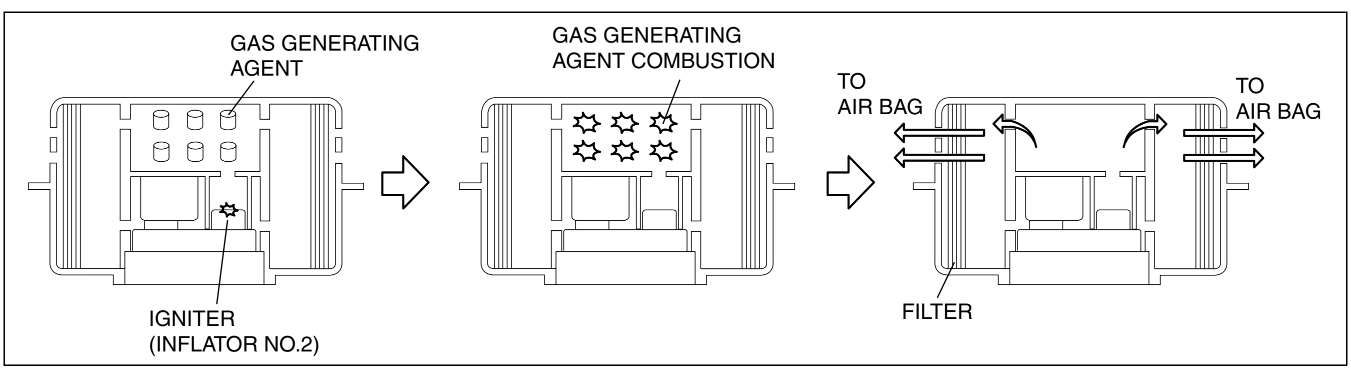
1. When the passenger-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.1 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



EPU810ZT3022

Inflator No.2

1. When the passenger-side air bag module receives an operation (deployment) signal from the SAS control module, the igniter built into inflator No.2 builds up heat and ignites the inflammation agent.
2. The ignition of the inflammation agent causes the combustion of a gas-generating agent which releases nitrogen gas.
3. The nitrogen gas is cooled at the filter and the filtrate is injected into the air bag.



EPU810ZT3023

SIDE AIR BAG MODULE FUNCTION

E5U081000147N01

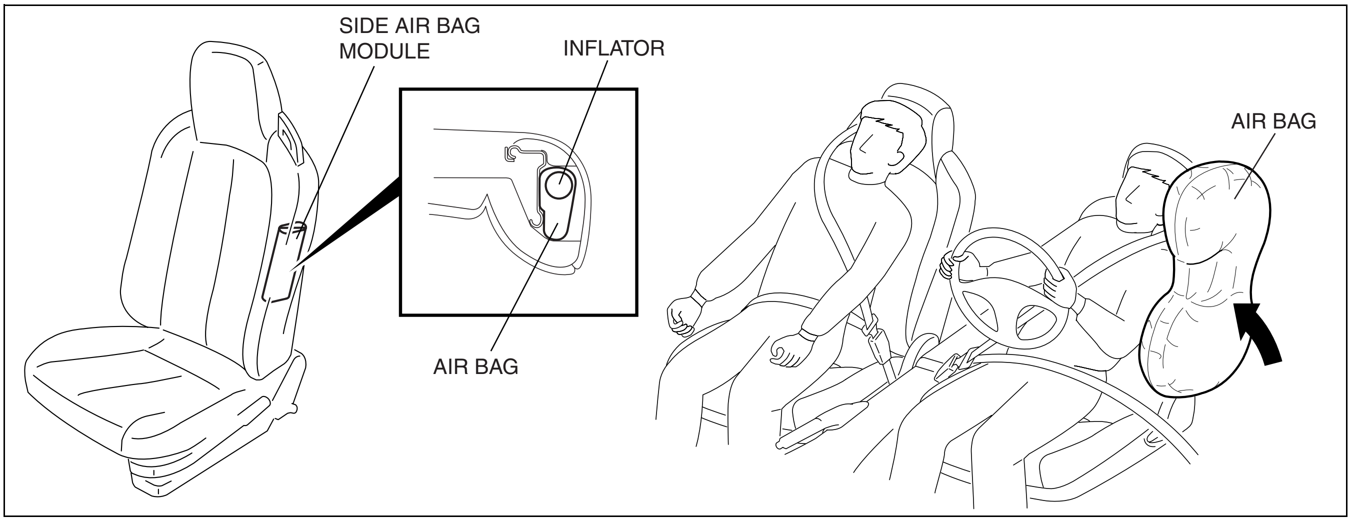
- During a collision to the side of the vehicle, the air bag operates (deploys) after receiving an operation signal from the SAS control module, defusing impact to the head and chest areas of the driver or front passenger.

SIDE AIR BAG MODULE CONSTRUCTION/OPERATION

E5U081000147N02

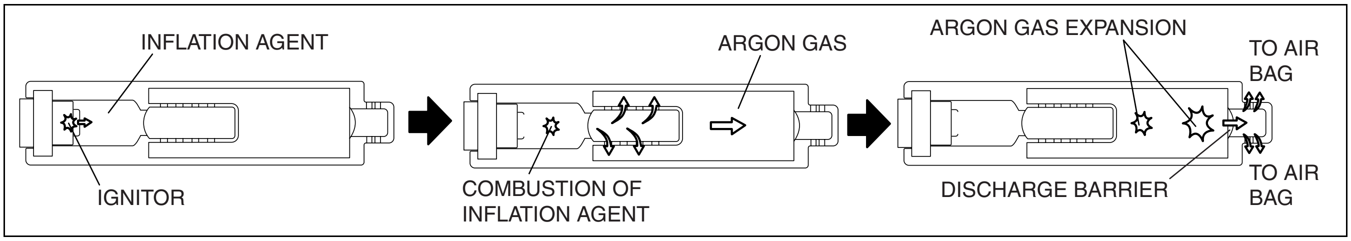
Construction

- Side air bag modules are installed on the outboard sides of the seat backs.
- The side air bag module is composed of an inflator and air bag.
- When the air bag operates (deploys), the seat back trim is spread apart by argon gas generated from the inflator, inflating the air bag.



E5U810ZS5107

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



EPU810ZT3006

PRE-TENSIONER SEAT BELT FUNCTION

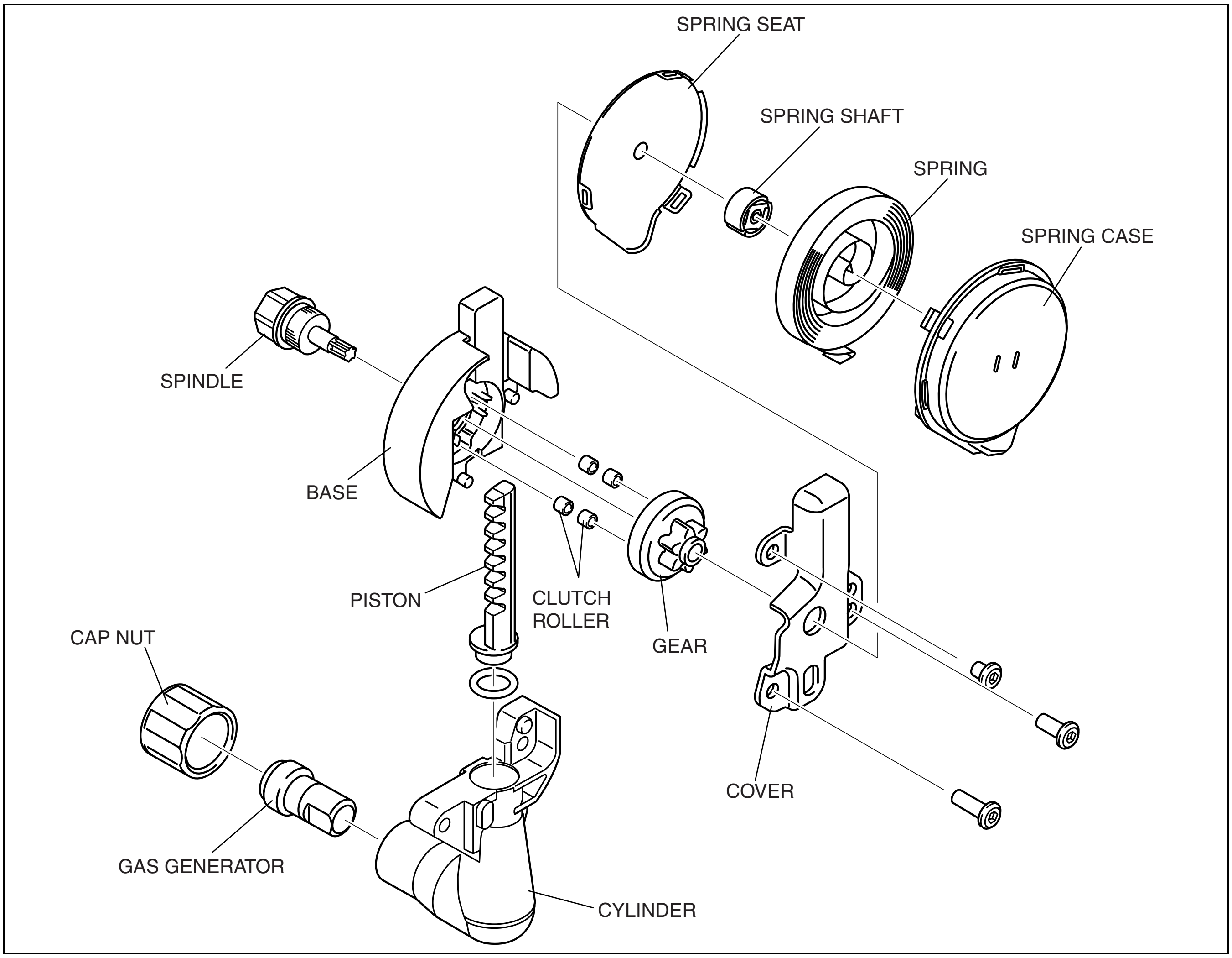
E5U081057630N01

- When a vehicle is involved in a frontal or frontal offset collision and the front seat belts are buckled, the pretensioner 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

E5U081057630N02

Construction

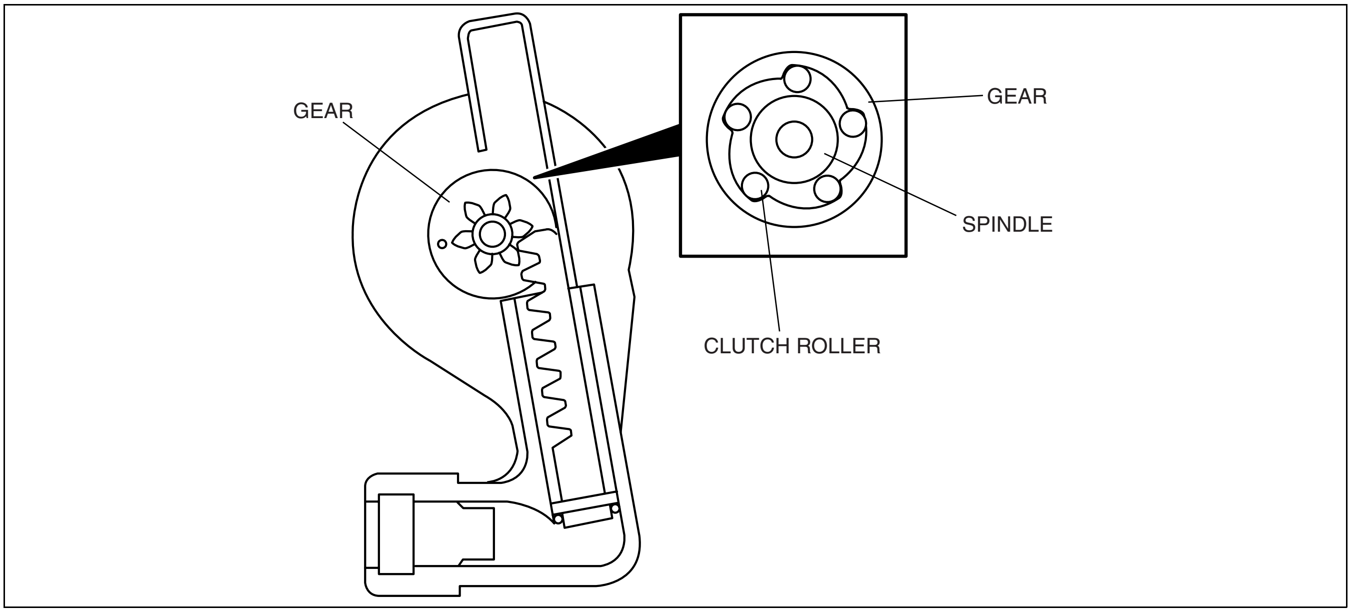


EPU810ZT3011

Operation

Normal (Seat Belt Pretensioners Not Operating)

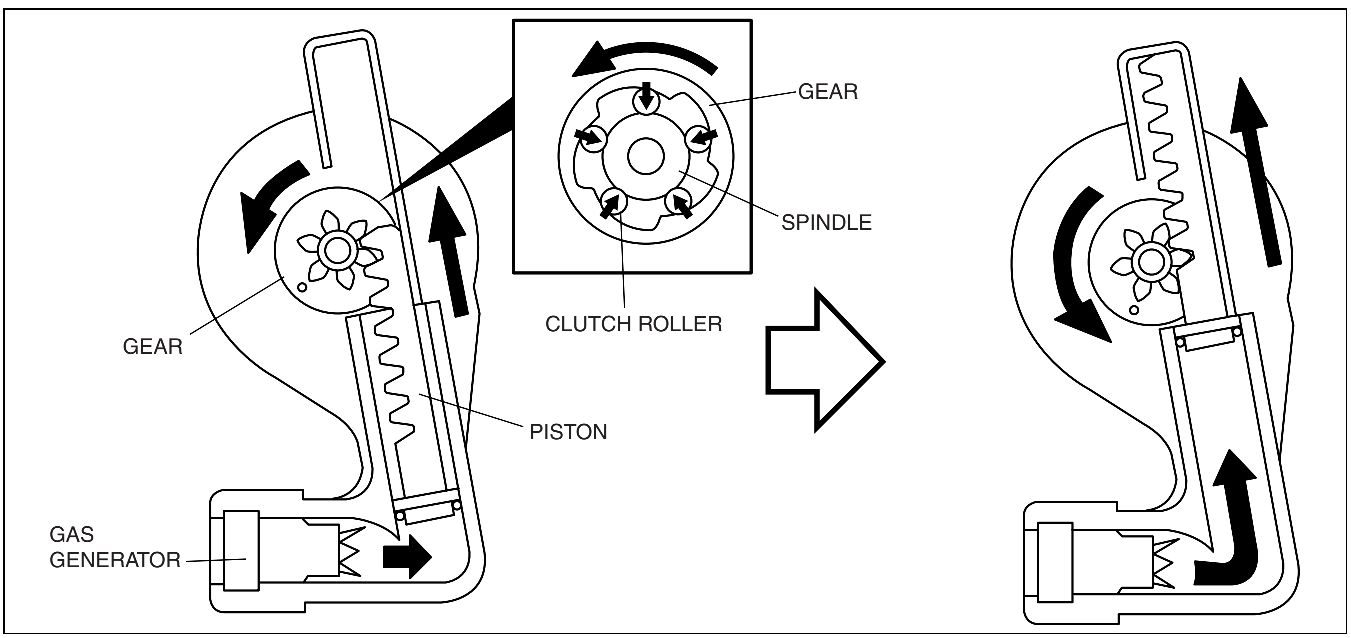
- Normally, the clutch roller installed to the outer circumference of the spindle sits in the recess of the gear and does not interfere with the spindle.
- The gear does not rotate when the belt is pulled or retracted because the spindle and gear are not engaged.



EPU810ZT3012

Seat Belt Pretensioners Operating

1. When an operation signal is received from the SAS control module, the gas generator produces gas. Due to the pressure from the gas, the piston in the cylinder is pressed up.
2. The gear rotates while the piston moves up.
3. Based on the gear rotation, the clutch roller in the gear presses against the spindle.Due to this, the gear and spindle are engaged.
4. The belt is retracted in conjunction with the gear rotation.



EPU810ZT3013

08–11 SEAT BELT

SEAT BELT OUTLINE

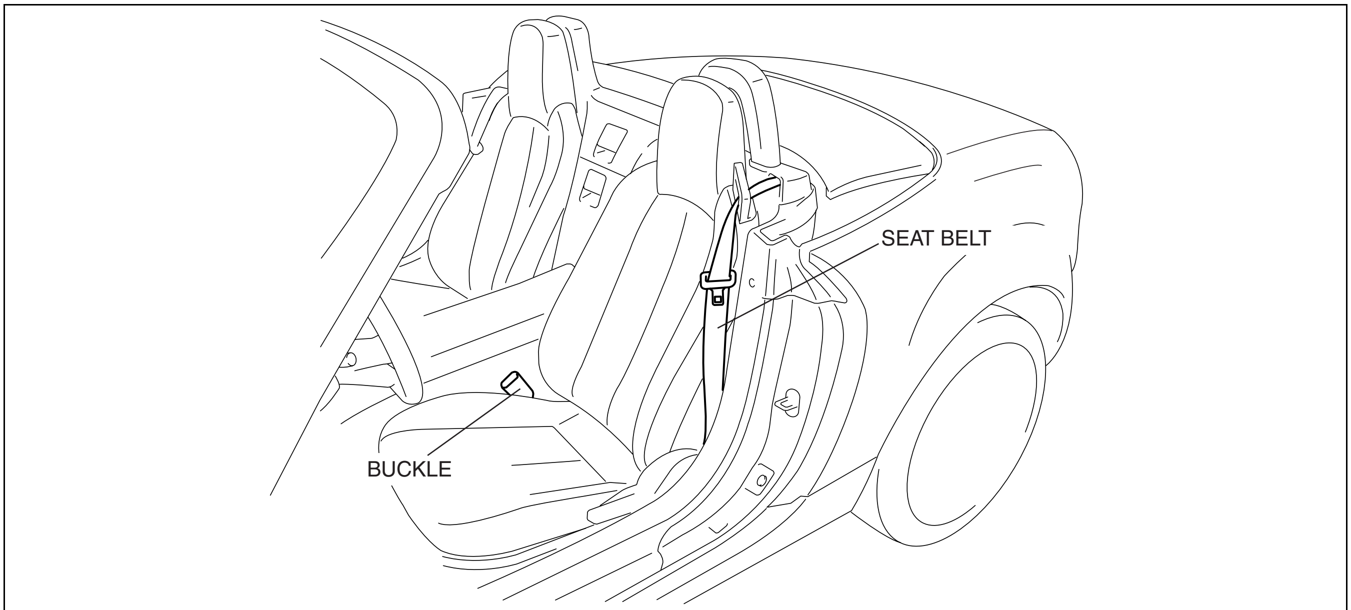
E5U081157000N01

Features

Improved safety	• Three-point seat belt with the following functions for seat passengers adopted — ELR (Emergency Locking Retractor: emergency locking mechanism) — Pre-tensioner seat belt (See 08–10–16 PRE-TENSIONER SEAT BELT CONSTRUCTION/OPERATION.) — Load limiter, which adjusts restraint force of the seat belt to reduce the possibility of injury to passengers caused by excess seat belt pressure after pre-tensioner or ELR operation — ALR (Automatic Locking Retractor: child-restraint seat locking mechanism) (passenger's side)

SEAT BELT STRUCTURAL VIEW

E5U081157000N02

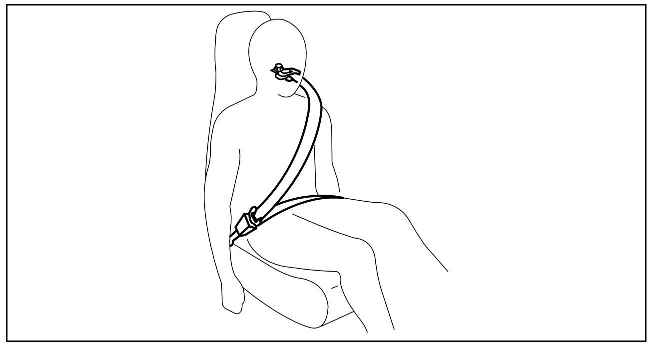


E5U811ZS5101

LOAD LIMITER RETRACTOR CONSTRUCTION/OPERATION

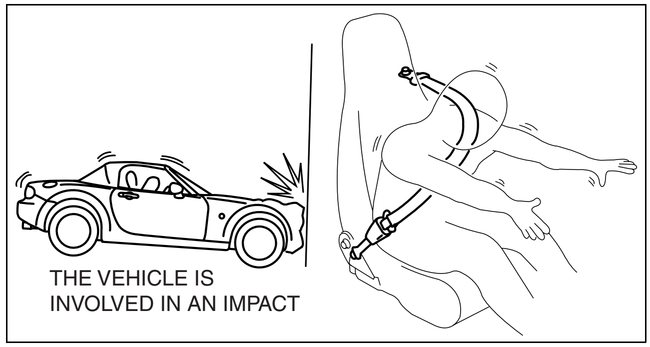
E5U081157000N03

1. Initial state



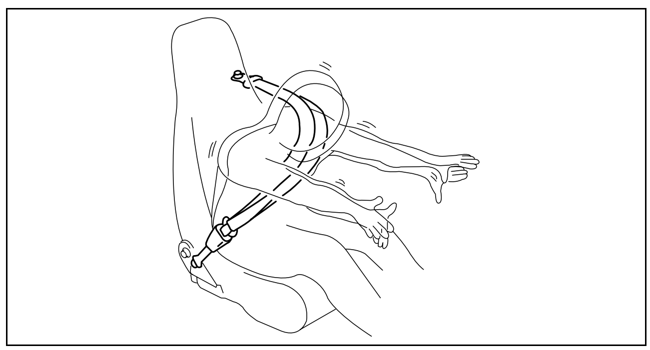
CPJ811ZNB004

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



E5U811ZS5002

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



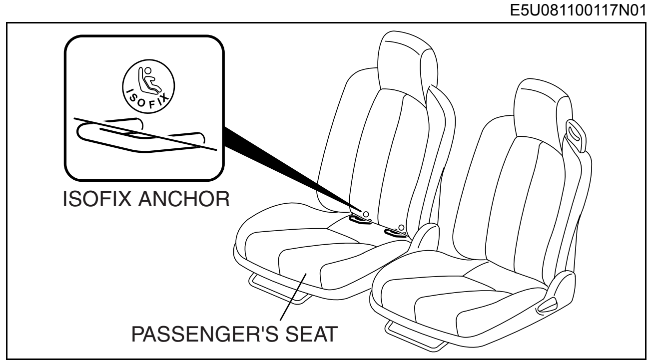
CPJ811ZNB006

CHILD-RESTRAINT SEAT ANCHOR CONSTRUCTION

E5U081100117N01

- ISOFIX anchors for securing an ISOFIX child-restraint seat 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.**



E5U811ZS5103

BODY & ACCESSORIES

09
SECTION

09–00 OUTLINE

BODY AND ACCESSORIES ABBREVIATIONS

E5U090000000N01

A/C	Air Conditioner
ACC	Accessories
ALC	Auto Level Control
AT	Automatic Transmission
CAN	Controller Area Network
CM	Control Module
CPU	Central Processing Unit
CTR	Center
DLC	Data Link Connector
DRL	Daytime Running Light
DTC	Diagnostic Trouble Code
GND	Ground
HI	High
IG	Ignition
INT	Intermittent
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left Hand
LO	Low
M	Motor
MT	Manual Transmission
OFF	Switch Off
ON	Switch On
PCM	Powertrain Control Module
PID	Parameter Identification
PTC	Positive Temperature Coefficient
P/W CM	Power Window Control Module
RH	Right Hand
SW	Switch
TNS	Tail Number Side Lights
WDS	Worldwide Diagnostic System

BODY AND ACCESSORIES NEW FEATURES

E5U090000000N02

Improved marketability	• Power window system adopted • Power door lock system adopted • Advanced keyless entry and start system adopted
Improved convenience	• A center panel unit, composed of the installed audio unit and the audio switches built into the center panel, has been adopted
Improved safety	• Daytime running light (DRL) system adopted
Improved security	• Immobilizer system adopted • Theft-deterrent system adopted
Wiring harness simplification	• Controller area network (CAN) system adopted

09–10 BODY PANELS

BODY PANEL OUTLINE

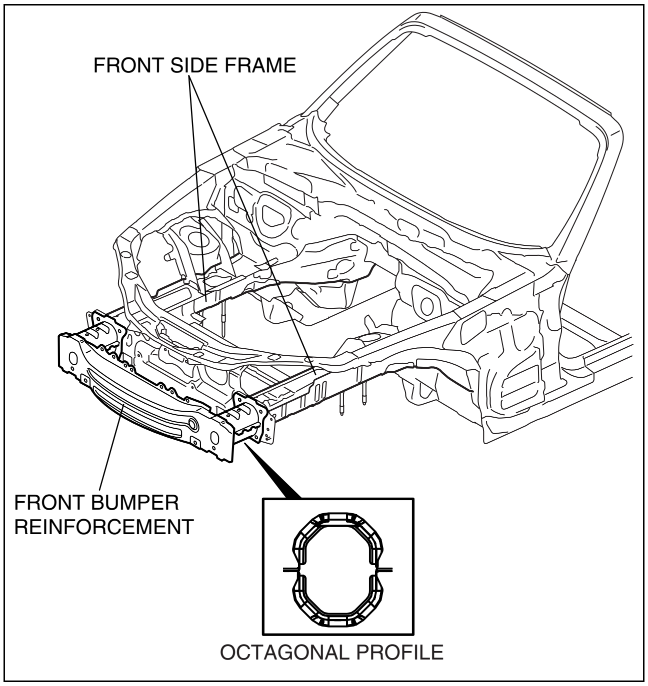
E5U091056100N01

- Aluminum hood with a shock-absorbing cone structure has been adopted.

CRUSH ZONE CONSTRUCTION

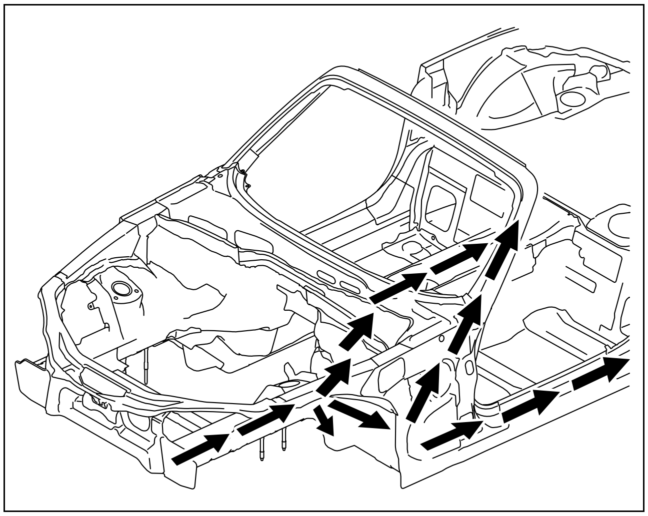
E5U091056100N02

- 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.



E5U910ZS1004

- 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.



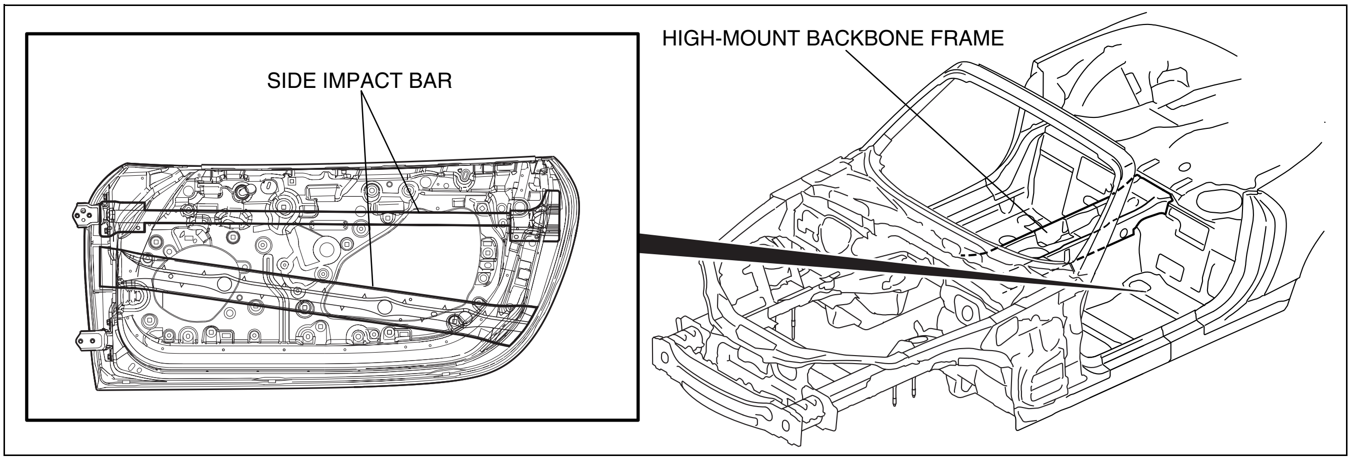
E5U910ZS1001

09–10

CABIN CONSTRUCTION

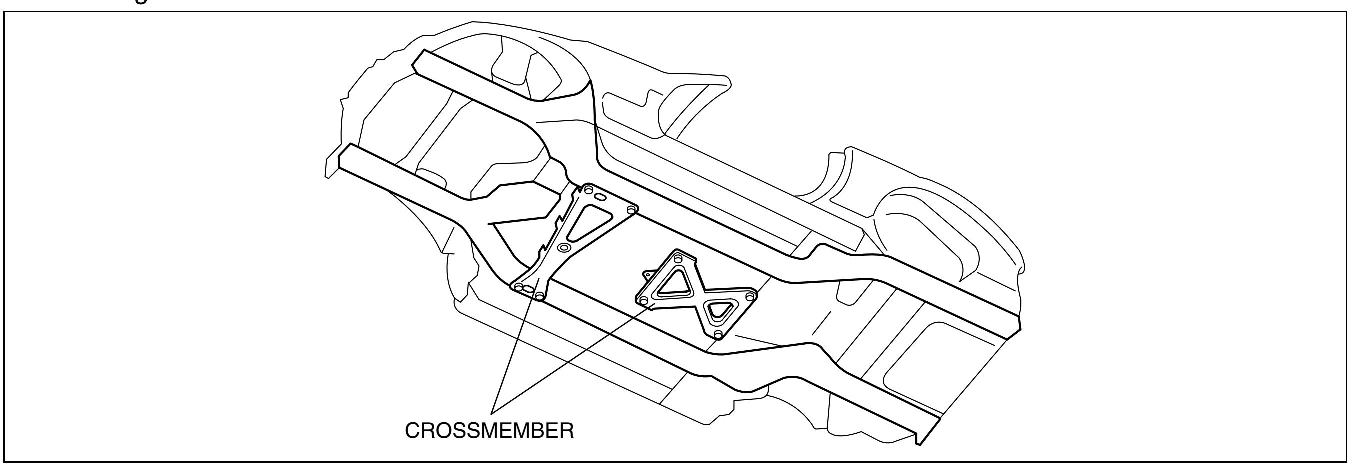
E5U091056100N03

- The side impact bar inside the front door is positioned to effectively disperse an impact throughout the body.
- 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.



E5U910ZS1002

- 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.

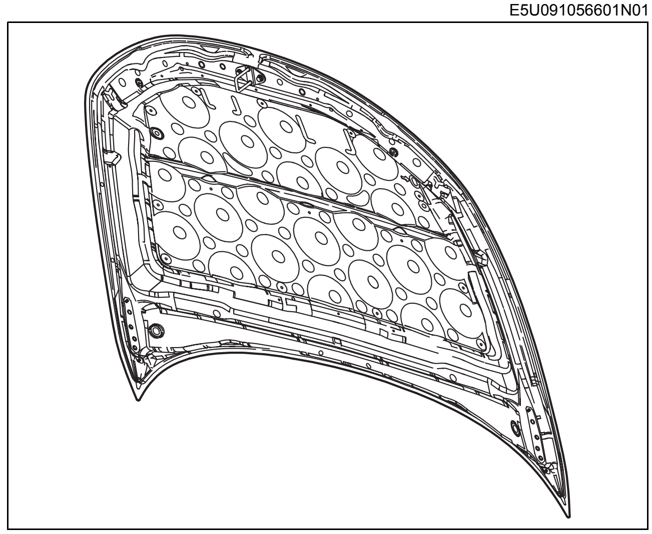


E5U910ZS1005

HOOD CONSTRUCTION

E5U091056601N01

- 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.



E5U910ZS1003

09–11 DOORS AND LIFTGATE

DOOR OUTLINE

E5U091158010N01

Features

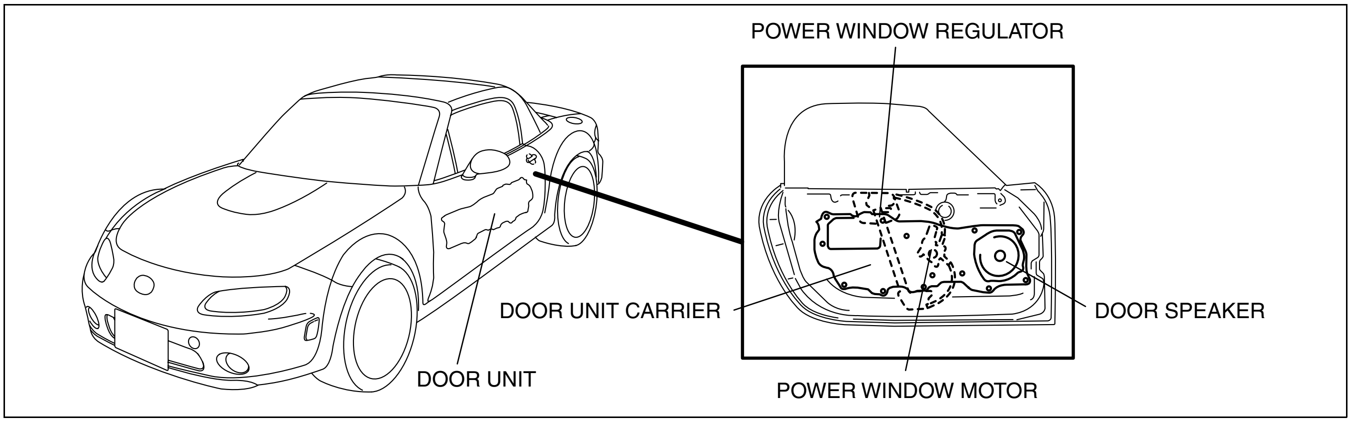
Improved marketability	• Door unit integrating internal parts adopted
Improved safety	• Side impact bar adopted • Shock-absorbing pad adopted

09–11

DOOR CONSTRUCTION

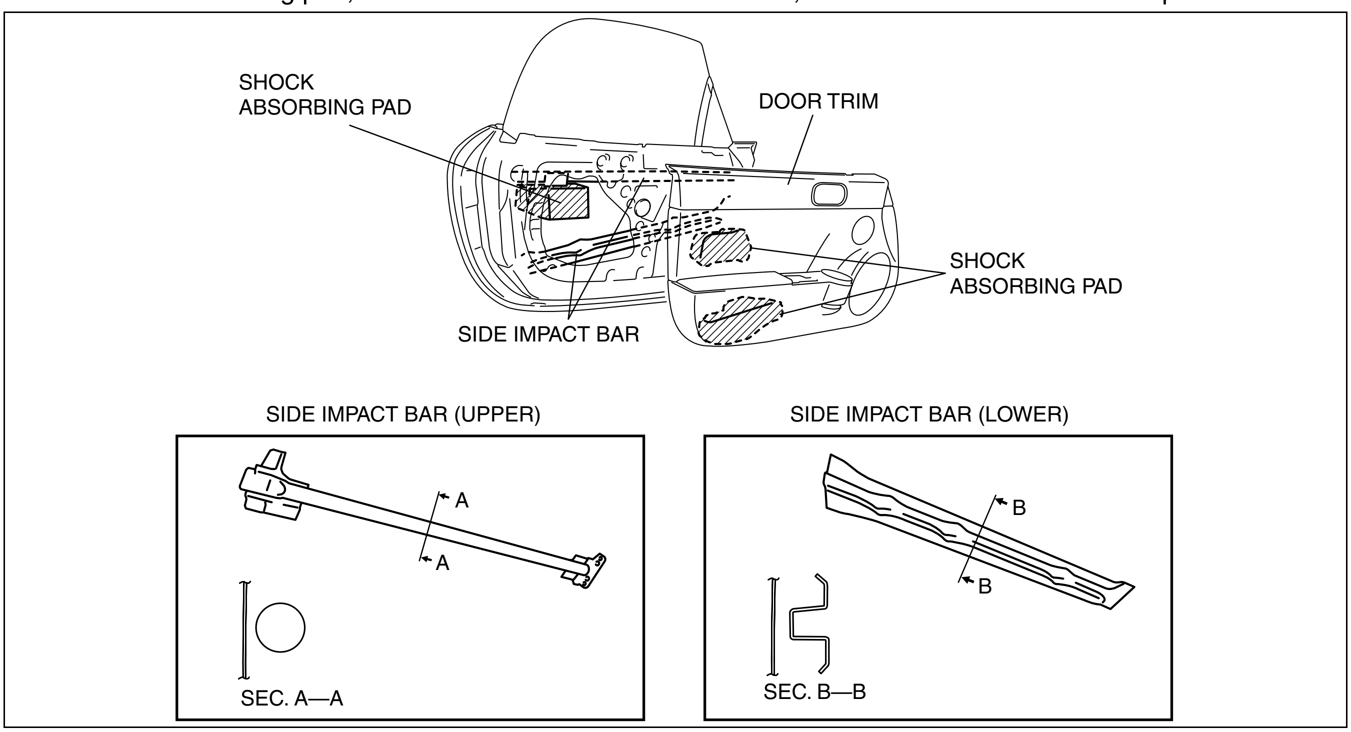
E5U091158010N02

- The internal parts of the door (door speaker, and door harness) have been integrated into a door unit carrier.
- Due to the integrated door unit, weight reduction has been achieved for the whole door.
- Waterproofing of the internal door parts is achieved due to the sectional design of the door unit carrier.
- Fiberglass reinforced plastic has been adopted for the door unit carrier to improve rigidity.



E5U911ZS5001

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



E5U911ZS5002

09–12 GLASS/WINDOWS/MIRRORS

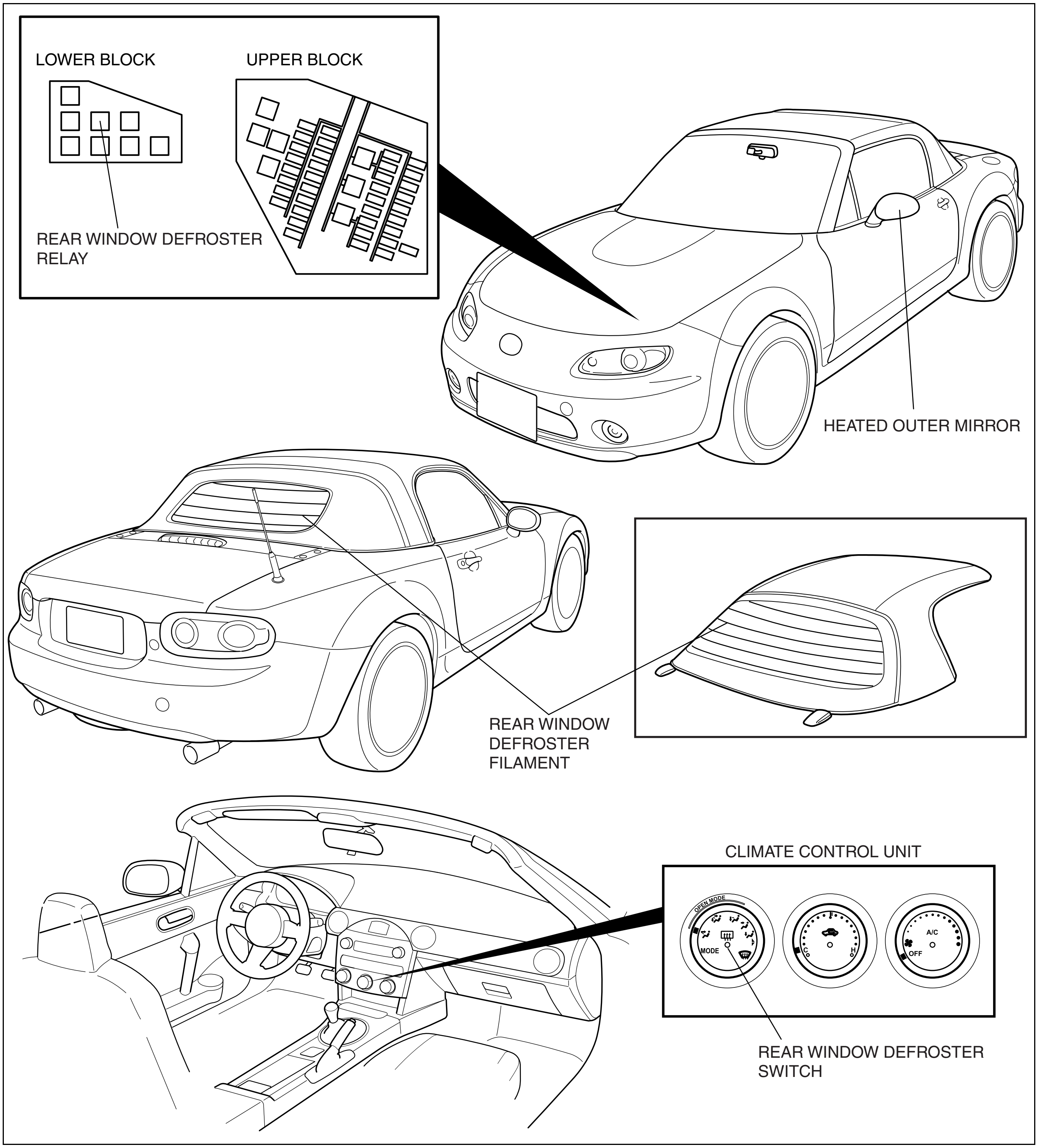
REAR WINDOW DEFROSTER SYSTEM OUTLINE

E5U091263000N01

Improved visibility	• Rear window defroster adopted

REAR WINDOW DEFROSTER SYSTEM STRUCTURAL VIEW

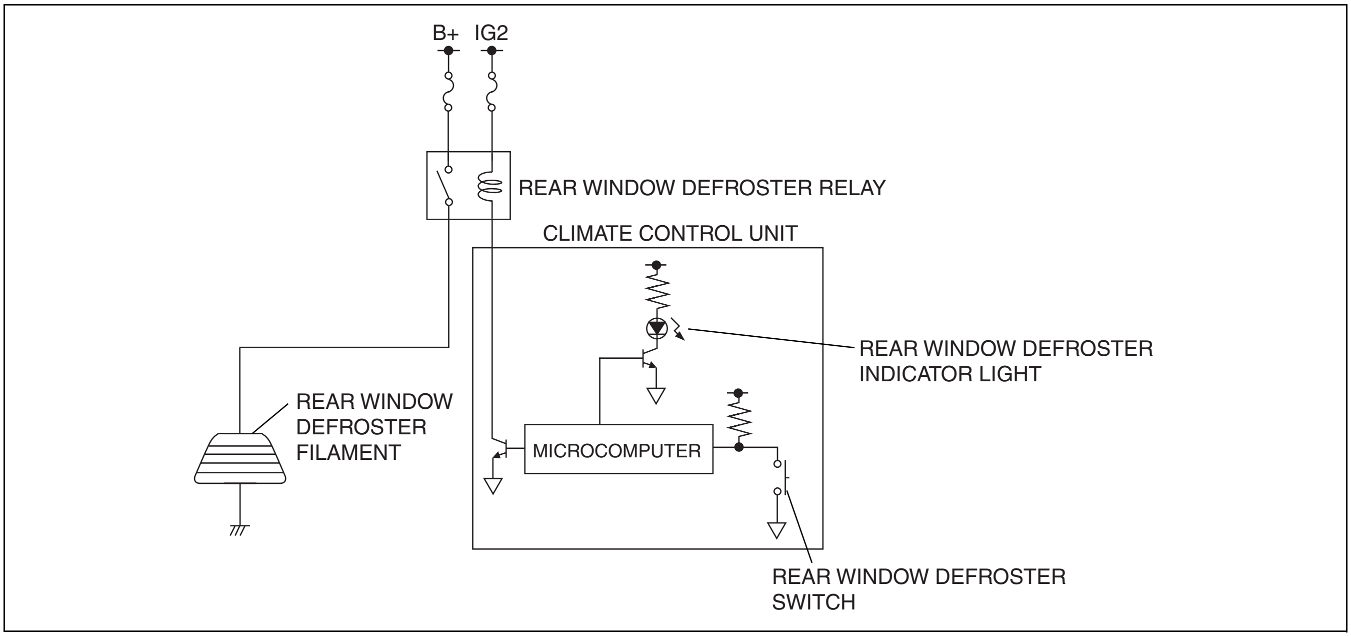
E5U091263000N02



REAR WINDOW DEFROSTER SYSTEM CONSTRUCTION/OPERATION

E5U091263000N03

- Fogging is cleared from the rear window by heating of the filament.



E5U912ZS5008

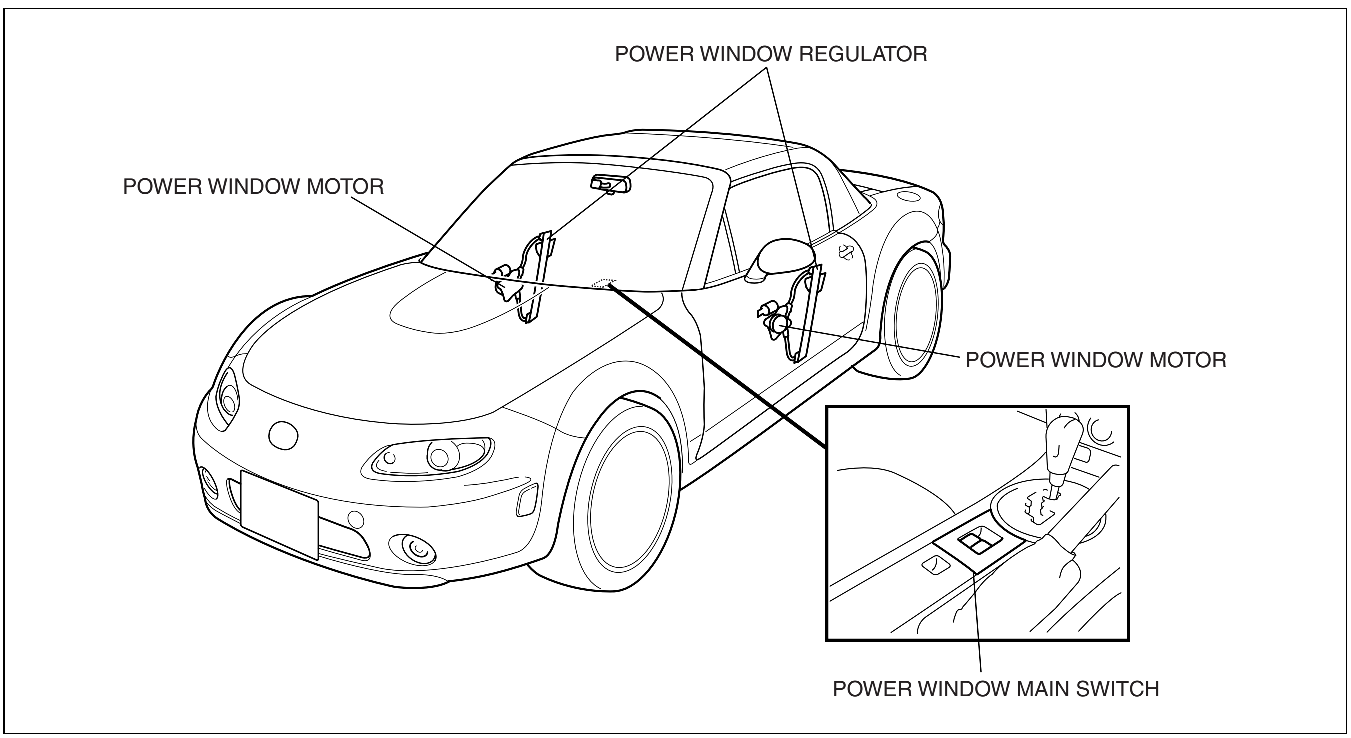
POWER WINDOW SYSTEM OUTLINE

E5U091258000N01

- The power window system has the following functions.
  — Auto open function (driver's side)
  — Manual open/close function

POWER WINDOW SYSTEM STRUCTURAL VIEW

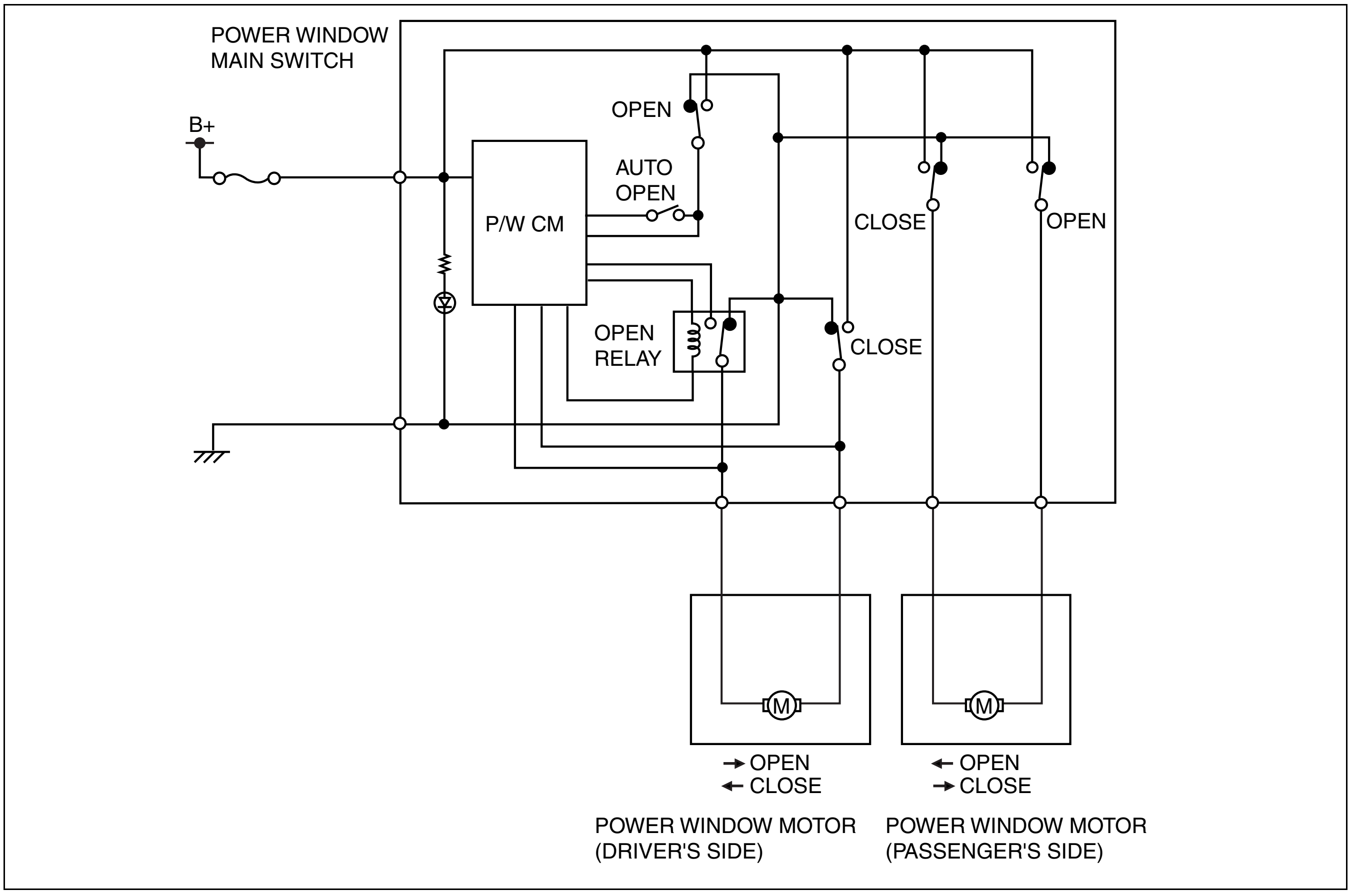
E5U091258000N02



E5U912ZS5003

POWER WINDOW SYSTEM WIRING DIAGRAM

E5U091258000N03



E5U912ZS5004

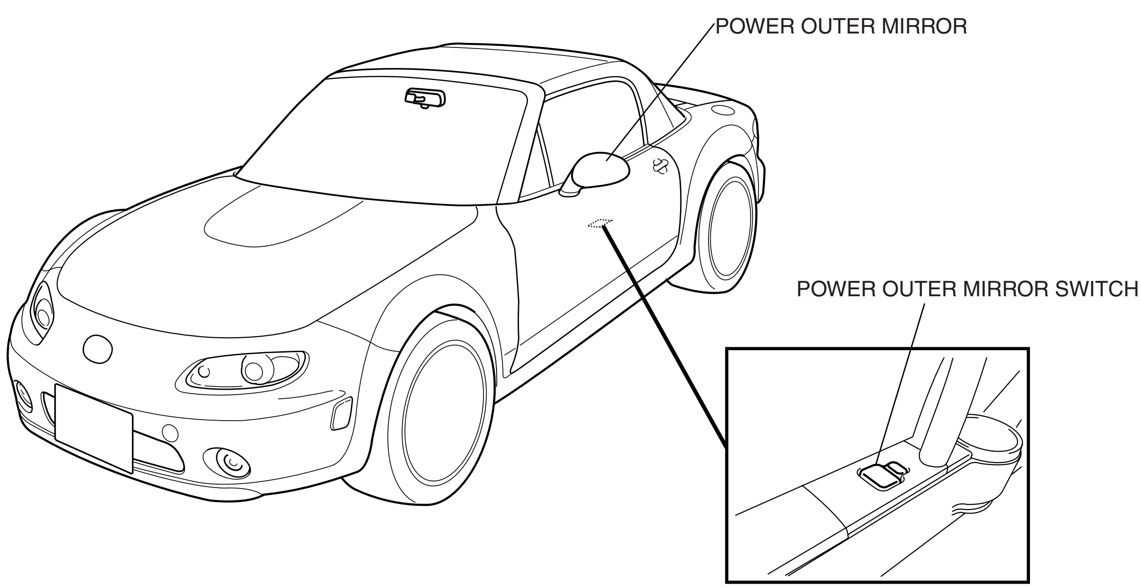
POWER OUTER MIRROR OUTLINE

E5U091269100N01

Improved convenience	• Power outer mirror (mirror glass adjusting function) adopted

POWER OUTER MIRROR STRUCTURAL VIEW

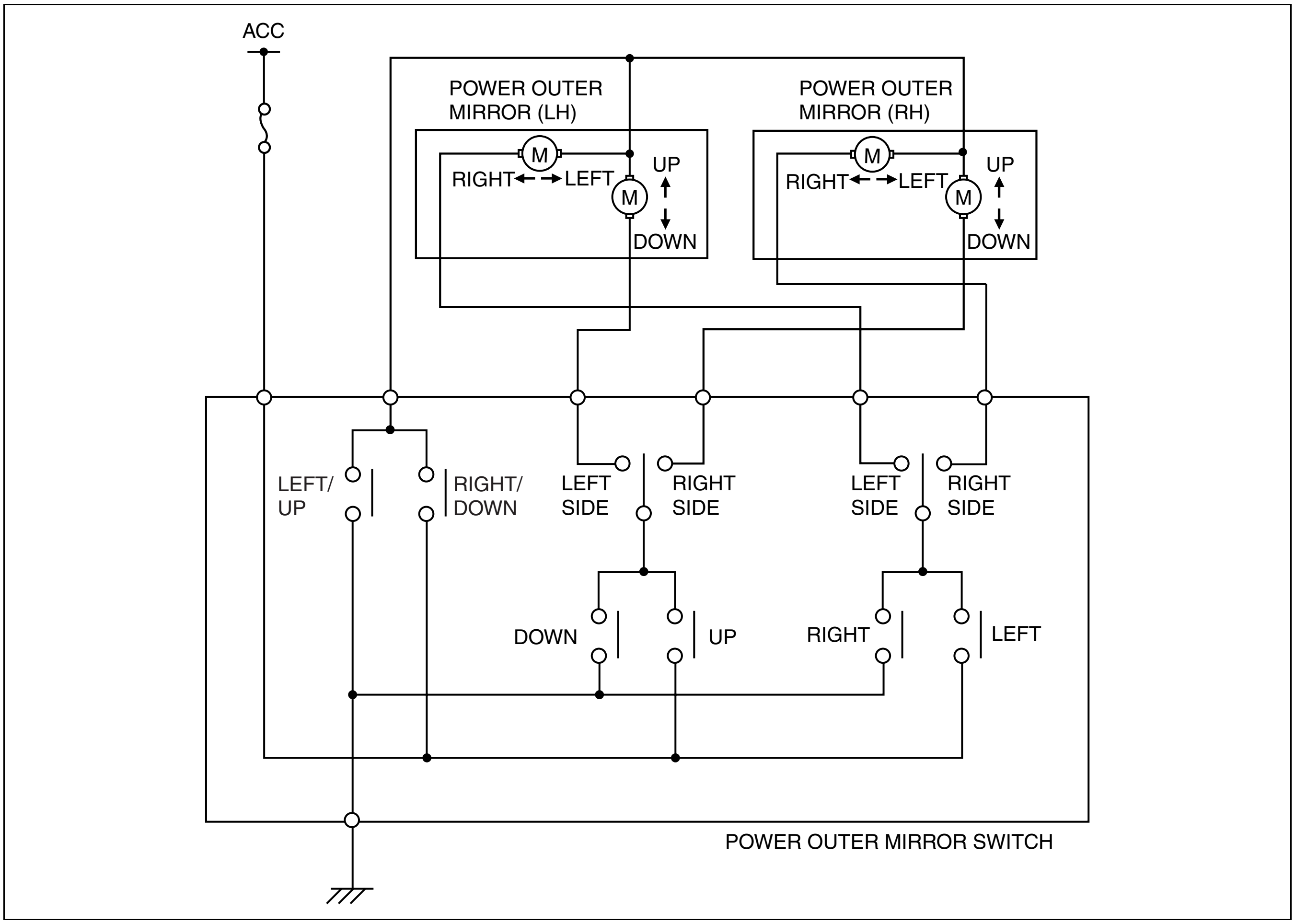
E5U091269100N02



E5U912ZS5005

POWER OUTER MIRROR SYSTEM WIRING DIAGRAM

E5U091269100N03



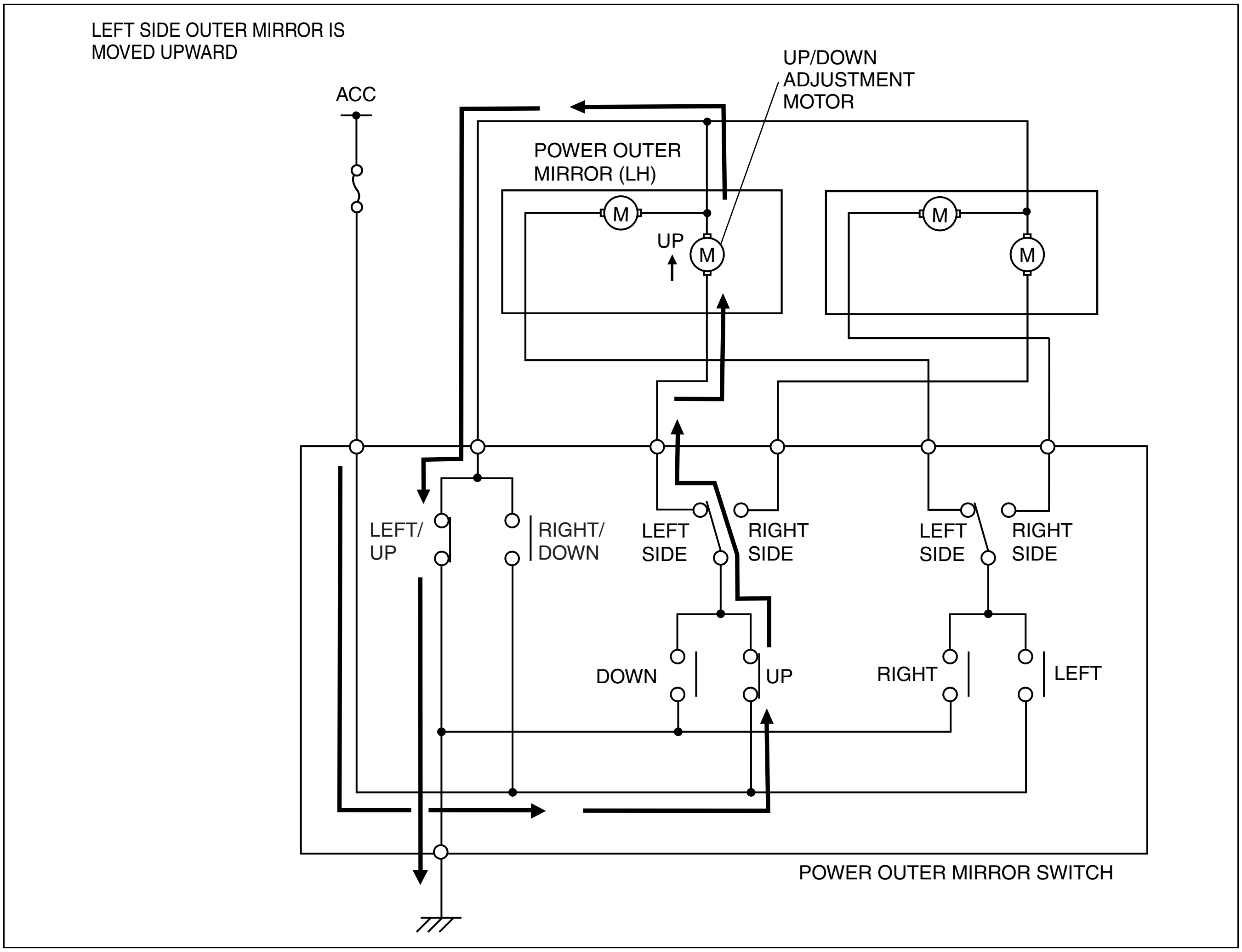
E5U912ZS5006

POWER OUTER MIRROR OPERATION

E5U091269100N04

Mirror Glass Adjustment

- The left/right selection switch establishes left or right side outer mirror circuit and current is supplied in either one of the four directions according to the position of the mirror glass adjustment switch. Due to this, the motor rotates either up or down, left or right.



E5U912ZS5007

09–13 SEATS

SEATS OUTLINE

E5U091357000N01

FEATURES

Improved marketability	• Seat warmer has been adopted for the seat (Canada only).
Improved safety	• Built-in side air bag has been adopted for the seat.

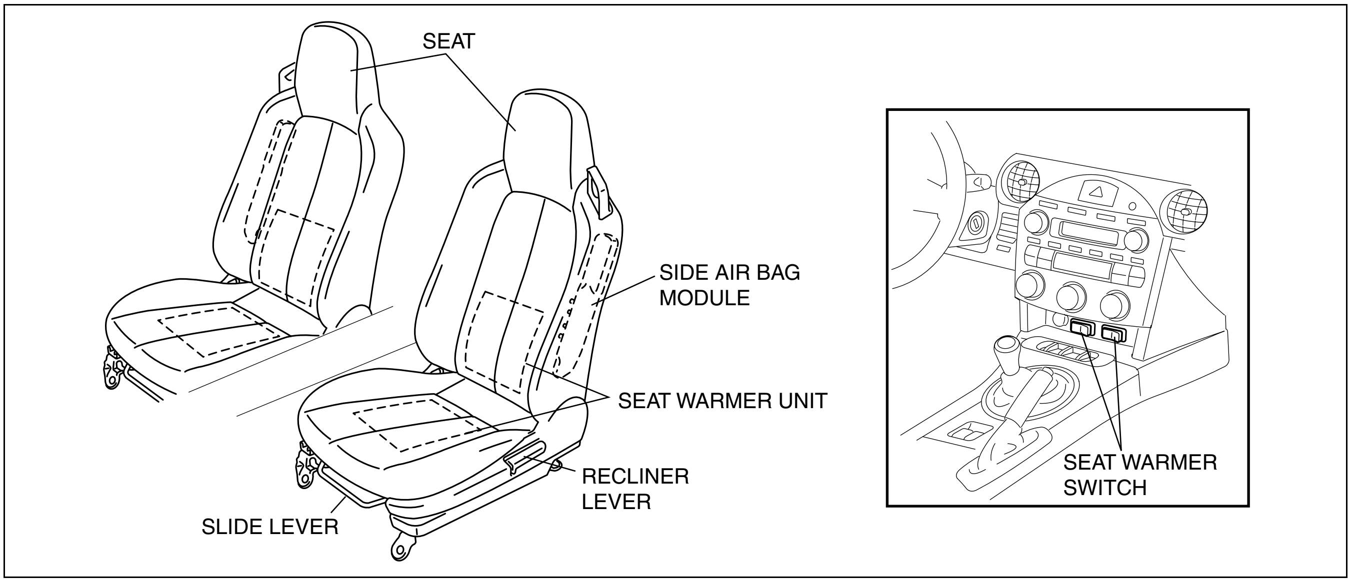
SEATS SPECIFICATION

E5U091357000N02

Item		Function
Seat	Driver’s seat	Recliner
		Slide
		Seat warmer unit
		Seat track position sensor (See 08–10–8 SEAT TRACK POSITION SENSOR FUNCTION.)
		Side air bag module (See 08–10–14 SIDE AIR BAG MODULE FUNCTION.)
	Passenger's seat	Recliner
		Slide
		Seat warmer unit
		Seat weight sensor (See 08–10–8 PASSENGER SENSING SYSTEM OUTLINE.)
		Seat weight sensor control module (See 08–10–8 PASSENGER SENSING SYSTEM OUTLINE.)
		Side air bag module (See 08–10–14 SIDE AIR BAG MODULE FUNCTION.)

SEATS STRUCTURAL VIEW

E5U091357000N03



E5U913ZS5001

09–14A SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

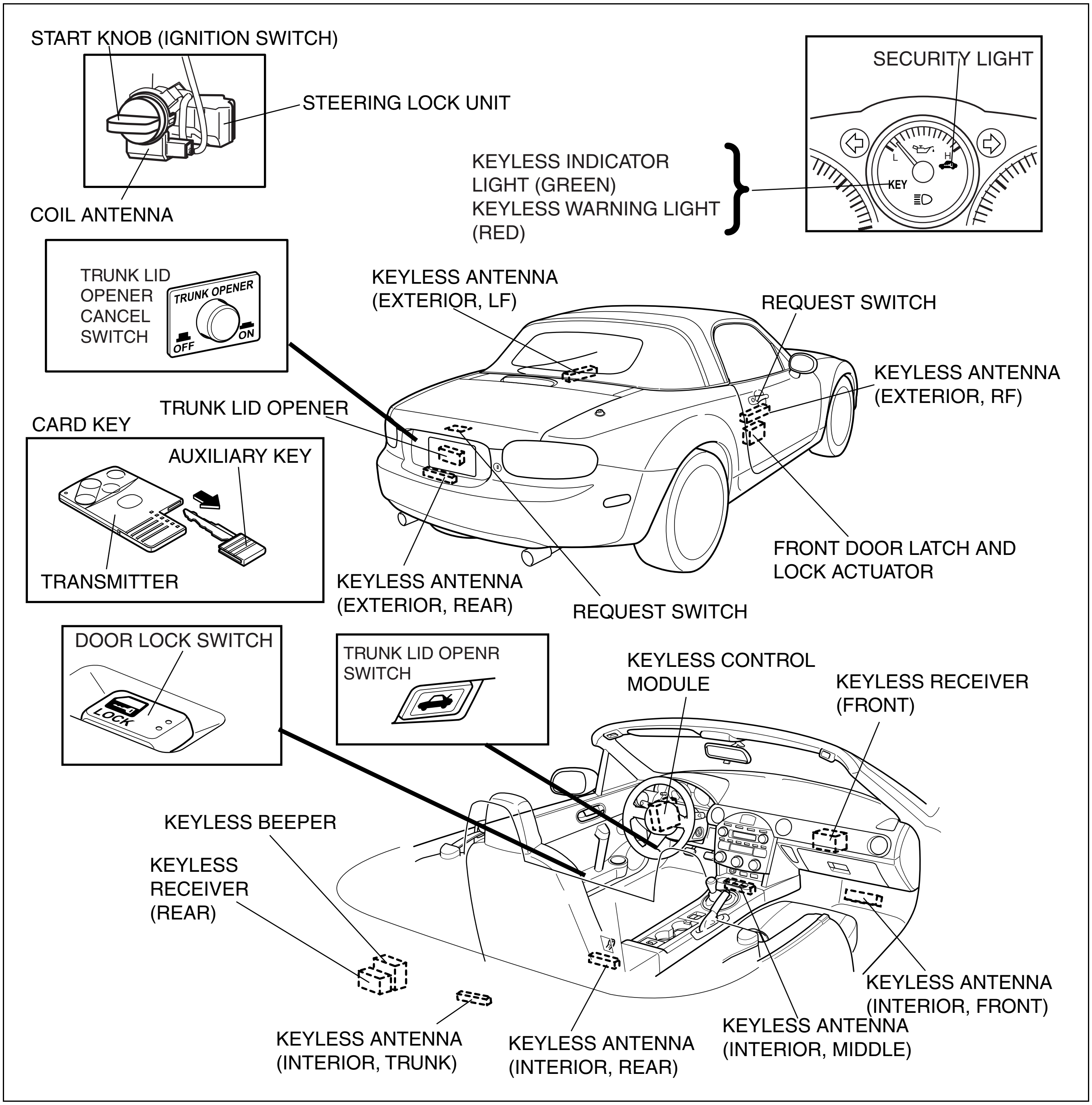
SECURITY AND LOCKS OUTLINE

E5U091400001N01

Improved marketability	• Power door lock system adopted • Advanced keyless entry and start system adopted
Improved serviceability	• Keyless control module that integrates the control of the keyless entry module and immobilizer system adopted
Improved security	• Theft-deterrent system adopted • Immobilizer system adopted

SECURITY AND LOCKS STRUCTURAL VIEW

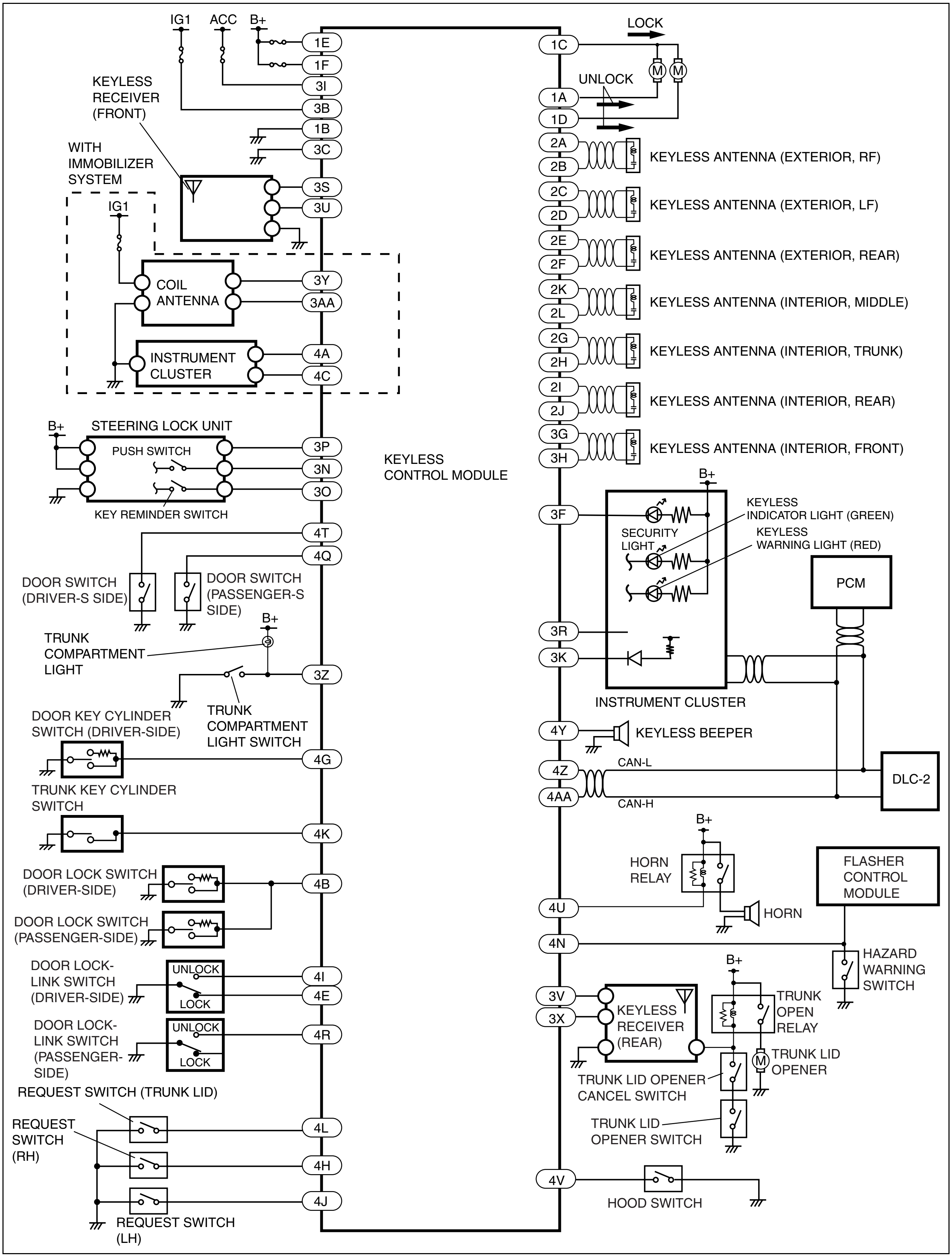
E5U091400001N02



E5U914AS1001

SECURITY AND LOCKS SYSTEM WIRING DIAGRAM

E5U091400001N03



E5U914AS1002

09–14A

POWER DOOR LOCK SYSTEM OUTLINE

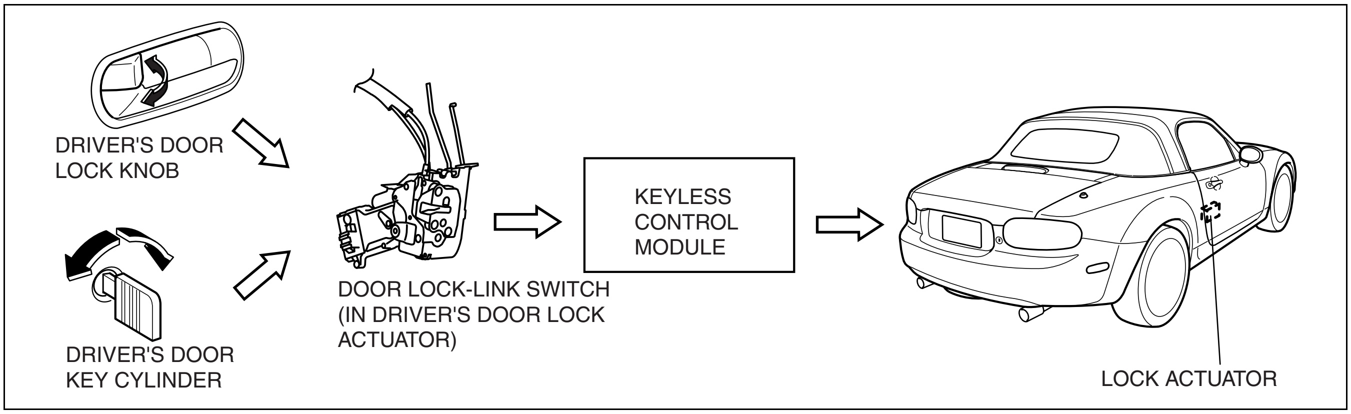
E5U091466000N01

- A door lock knob interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door lock knob.
- A door key interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door key cylinder.

POWER DOOR LOCK SYSTEM OPERATION

E5U091466000N02

- When the driver's door is locked/unlocked with the driver's door lock knob or key cylinder, the door lock-link switch in the door lock actuator is locked/unlocked via the rod.
- The keyless control module activates each lock actuator to lock/unlock according to the lock/unlock signal from the door lock-link switch.



E5U914AS1003

ADVANCED KEYLESS ENTRY SYSTEM OUTLINE

E5U091469000N01

- An advanced keyless system has been adopted that enables the driver to start the engine or lock/unlock the doors without operating the key or transmitter (card key) by carrying the card key that has been programmed to the vehicle.
- The doors also can be locked/unlocked by operating the key (auxiliary key) or transmitter (card key).
- The answer-back function has been adopted where the hazard warning light flashes and a beeping sound confirms that the doors are locked/unlocked. Also, the advanced keyless entry system indicates activation by a buzzer sound.
- A warning and guidance function has been adopted that promotes correction if the system is operated improperly, and uses the indicator light in the instrument cluster, a buzzer sound, and the keyless beeper from behind passenger compartment.
- A customize function that switches the activation/deactivation of each function has been adopted.
- A rolling code type transmitter (card key) has been adopted to prevent theft by radiowave interception.
- To prevent improper operation while the vehicle is moving, the doors cannot be locked/unlocked by operating the transmitter (card key) or request switch when the start knob is in any position except LOCK.

ADVANCED KEYLESS ENTRY SYSTEM OPERATION

E5U091469000N02

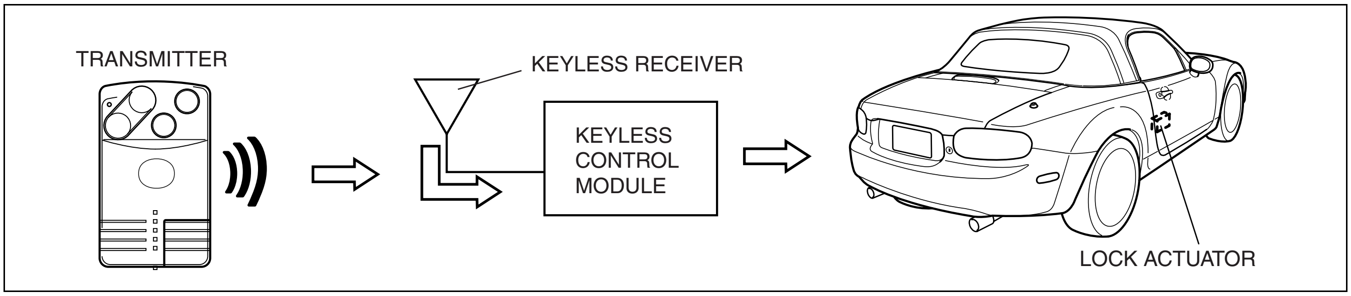
Normal Keyless Entry Function
Lock/unlock

Note

- If any of the following conditions are met, the doors cannot be locked by operating the transmitter (card key).
  — The auxiliary key is inserted in the ignition key cylinder.
  — The start knob is not in the LOCK position.
  — The start knob is being pressed.
  — Any door is open.
- If any of the following conditions are met, the doors cannot be unlocked by operating the transmitter (card key).
  — The auxiliary key is inserted in the ignition key cylinder.
  — The start knob is not in the LOCK position.
  — The start knob is being pressed.

1. When the transmitter (card key) is operated, the card key sends ID data and rolling code. They are received by the keyless receiver and sent to the keyless control module.
2. When the keyless control module receives a lock/unlock signal from the transmitter (card key) and verifies the ID, the signal is sent to the all lock actuators activate to lock/unlock.

3. The keyless control module operates the hazard warning lights flash to flash according to lock/unlock signal from the transmitter (card key).
   — When the LOCK button is pressed, the hazard warning lights flash once.
   — When the UNLOCK button is operated, the hazard warning lights flash twice.



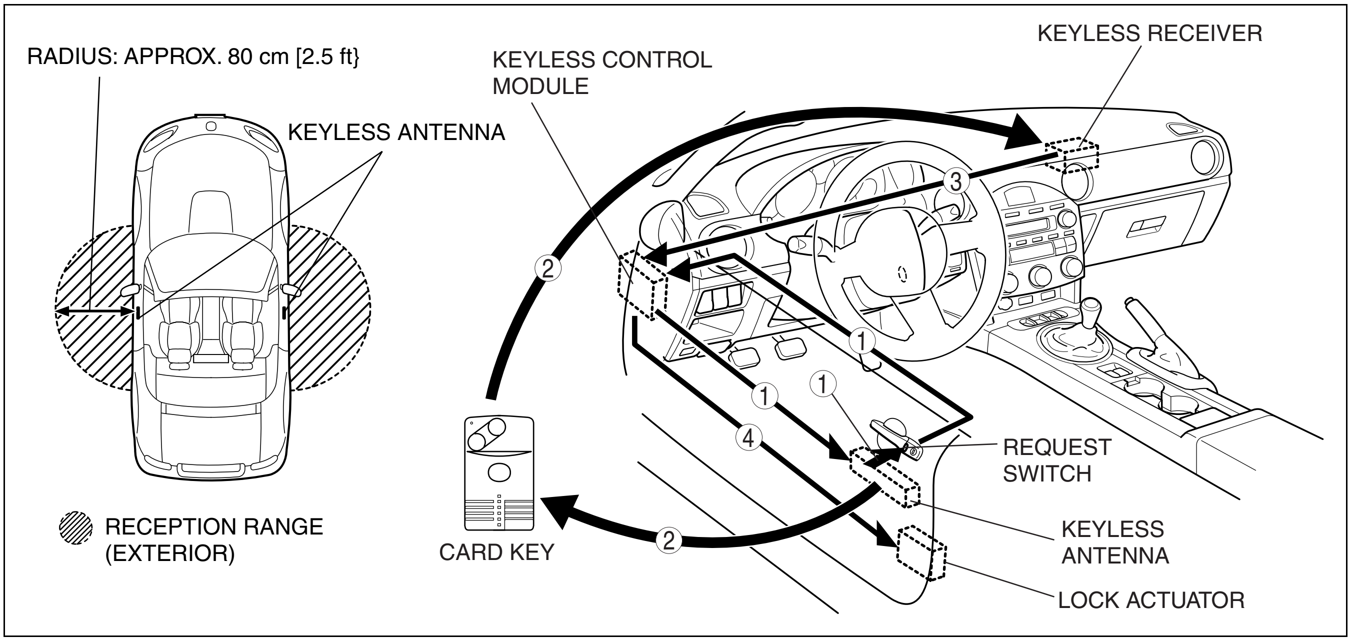
E5U914AS1004

Advanced Keyless Entry Function
Door lock/unlock

Note

- If any of the following conditions are not met, the doors cannot be locked by operating the request switch.
  — The card key is not inside the vehicle.
  — All doors and trunk lid are closed.
  — The auxiliary key is not inserted in the ignition key cylinder.
  — The start knob is in the LOCK position and not being pressed.
  — The card key is within the reception range outside the vehicle.
- If any of the following conditions are not met, the doors cannot be unlocked by operating the request switch.
  — The auxiliary key is not inserted in the ignition key cylinder.
  — The start knob is in the LOCK position and not being pressed.
  — The card key is within the reception range outside the vehicle.

1. When a request switch is pressed, the keyless control module sends a request signal from the keyless antenna. The request signal is sent to the area around the door that the request switch is pressed, and the signal is sent to the cabin area.
2. When the card key receives a request signal, the card key sends back ID data.
3. The ID data is received at the keyless receiver, and sent to the keyless control module.
4. When the ID data is verified by the keyless control module and the card key is determined to be outside the vehicle, a signal is sent to the lock actuators are activated to lock/unlock.
5. The keyless control module commands the hazard warning lights to flash.
   — When the doors are locked, the hazard warning lights flash once.
   — When the doors are unlocked, the hazard warning lights flash twice.



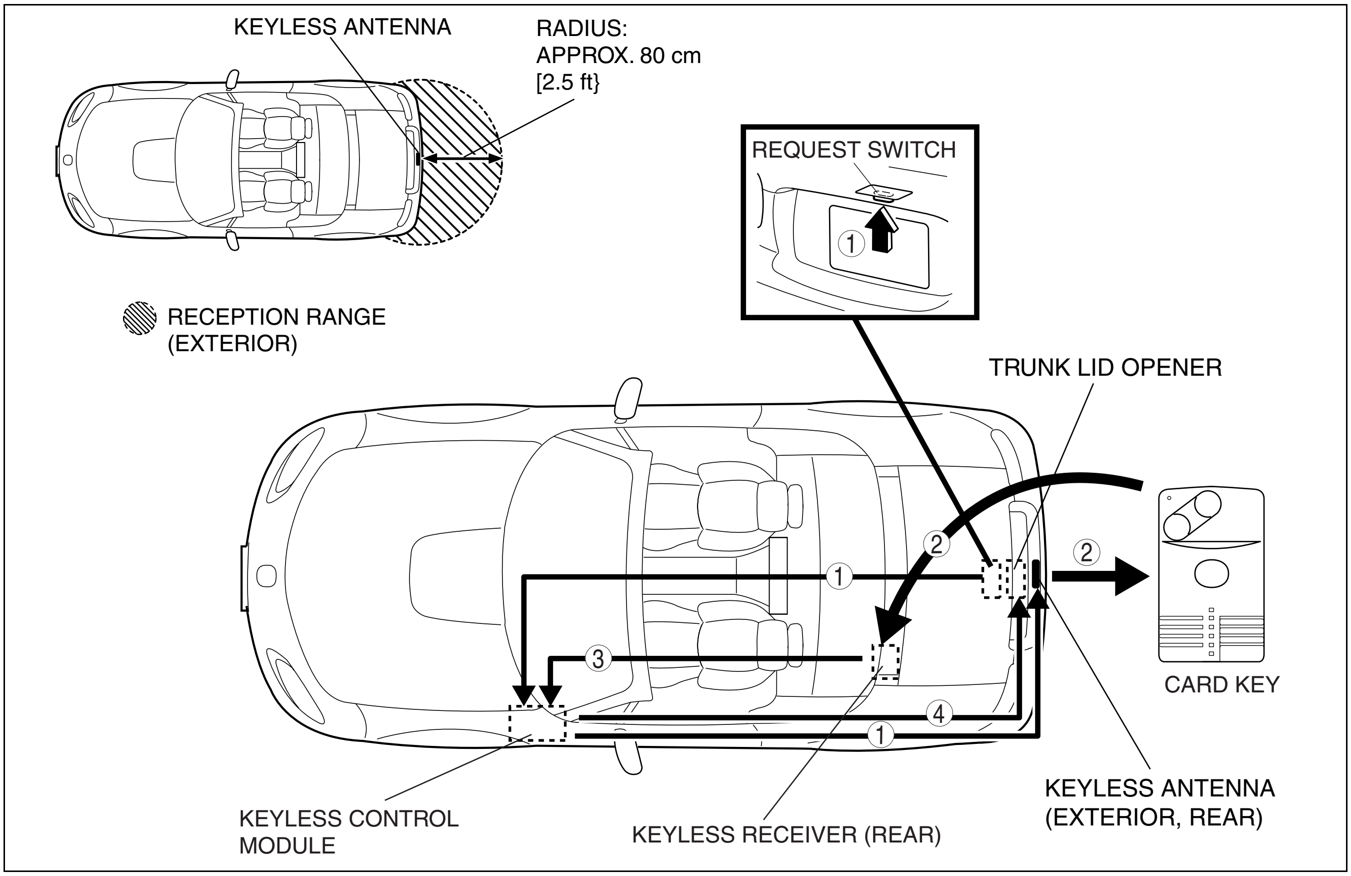
E5U914AS1005

09–14A

Trunk lid opening

Note
- If any of the following conditions are not met, the trunk lid cannot be opened by operating the request switch.
  — The auxiliary key is not inserted in the ignition key cylinder.
  — The start knob is in the LOCK position and not being pressed.
  — The card key is within the reception range outside the vehicle.
  — The trunk lid opener cancel switch is in the ON position.

1. When the trunk lid request switch is pressed and held for 1 s or more, the keyless control module sends a request signal from the keyless antenna. The request signal is sent to the area around the trunk lid, and the signal is sent to the rear area.
2. When the card key receives a request signal, the card key sends back ID data.
3. The ID data is received at the keyless receiver (rear), and sent to the keyless control module.
4. When the ID data is verified by the keyless control module and the card key is determined to be outside the vehicle, a signal is sent to the trunk lid opener to open the trunk lid.
5. The keyless control module commands the hazard warning lights to flash.
   — When the trunk lid is unlocked, the hazard warning lights flash twice.



E5U914AS1006

Auto re-lock function

- The auto re-lock function automatically locks the doors if any of the following operations are performed within approx. 30 s after the UNLOCK button of the card key is pressed, or after the request switch is pressed to unlock the doors.
  — A door or the trunk lid is opened.
  — The auxiliary key is inserted in the ignition key cylinder.
  — The start knob is pressed.
  — The transmitter (card key) is operated. (If the UNLOCK button is pressed, the timer is reset.)
  — A request switch is operated.

Out-of-area (reception area) autolock function

- When all doors are closed and the driver is out of the reception area carrying the card key, the doors are automatically locked. (Initial setting is OFF.)

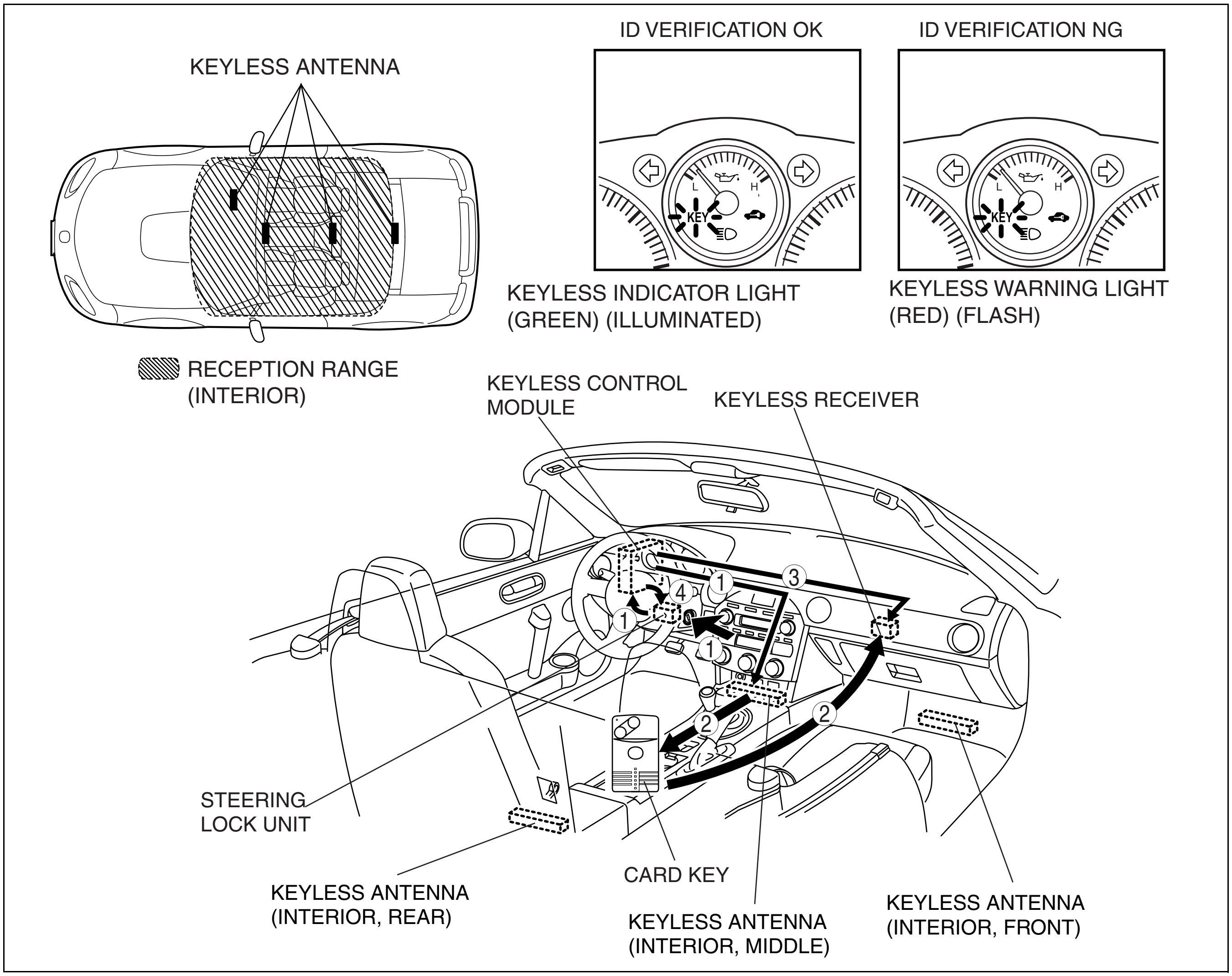
1. When all the following conditions are met and all doors are closed after any door or the trunk lid is open, the keyless beeper sound is heard and the function starts operation. (The doors are not locked at this time.)
   — The card key is not inside the vehicle.
   — The card key is within the reception area outside the vehicle.
   — The auxiliary key is not inserted in the ignition key cylinder.
   — The start knob is in the LOCK position, and not being pressed.
2. After the operation has started, the card key is monitored within the reception area by the keyless antenna. After about 2 s from where the card key has been determined to be out of the reception area, all lock actuators activate to lock. If approx. 30 s have passed since the operation started, the doors also locks regardless of whether the card key is within or out of the reception area.
3. The hazard warning light flashes once and keyless beep spund will be heard once at the same time the door locks.

ADVANCED KEYLESS START FUNCTION OPERATION

E5U091469000N03

- The advanced start function activates to start the engine by operating the start knob, and not by inserting the key but by the driver carrying the card key while in the vehicle.

1. When the start knob is pressed, the keyless control module sends a request signal from the keyless antennas (interior).
2. The card key receives the request signal, and sends back ID data.
3. The ID data is received by the keyless receiver, and sent to the keyless control module.
4. When the ID data is verified by the keyless control module and the card key is determined to be inside the vehicle, the start knob of the steering lock unit is released. The keyless indicator light (green) in the instrument cluster illuminates at the same time to indicate that the start knob is operable.
   — If the ID verification is not acceptable (for reasons such as an unprogrammed card key, or card key battery depletion or transmitter interference), the start knob is not released and the keyless warning light (red) illuminates to indicate that the start knob is inoperable.
   — For vehicles with the immobilizer system, ID verification is performed when the start knob is turned to the ON position, and if the verification is acceptable, permission is given to start the engine.
5. Turn the start knob to the START position to start the engine.



E5U914AS1007

WARNING/GUIDANCE FUNCTION OPERATION

E5U091469000N04

- If the system is operated improperly, it warns the driver using the indicator light in the instrument cluster, buzzer sound, and keyless beeper in the trunk compartment.
- The operation condition of the advanced keyless system is indicated by the indicator light and beeper sound to guide user's operation.

Item		Operation condition	Keyless buzzer (outside the vehicle)	Instrument cluster		
				Buzzer (Interior)	Keyless warning light (red)	Keyless indicator light (green)
Warning	Start knob not in LOCK warning	Driver's door is open with start knob in ACC position	–	Continuous	Flashes	–
	Card key out of vehicle warning*1	Card key cannot be detected inside vehicle with driver's door open and start knob not in LOCK position	–	Continuous	Flashes*2	–
		Card key cannot be detected inside vehicle with all doors closed and start knob not in LOCK position	Sounds 6 times	—	Flashes*3	–
		Card key cannot be detected inside vehicle with start knob not in LOCK position and under any condition other than above	–	—	Flashes*2	–
	Card key left in vehicle warning	Door/trunk lid is open with proper card key inside vehicle and another card key carried	Continuous for 10 s	–	–	–
	Door lock inoperable warning	Request switch is pressed with card key carried and a door open or start knob not in LOCK position	Sounds 6 times	–	–	–
	Battery voltage low indication	Card key battery voltage depleted	–	–	–	Flashes (Approx. 30 s after IG OFF)
Guidance	Start knob operable guidance	Start knob is operable (lock released) when it is pressed	–	–	–	On (Max. 3 s)
	Start knob inoperable guidance	Start knob is inoperable (locked) when it is pressed	–	–	Flashes	–
	Lock/unlock answer back	Doors are locked/unlocked with normal/advanced keyless entry function	Locked: Once Unlocked: Twice	–	–	–

*1 : If the start knob is turned to the LOCK position with the card key out of the vehicle, the start knob is inoperable (the engine cannot be restarted). For vehicles with the immobilizer system, the engine cannot be restarted by turning the start knob from the ACC position to the START position even though the start knob has not been turned to the LOCK position.
*2 : Stops flashing and goes out if the card key is detected inside the vehicle.
*3 : Stops flashing and goes out if the card key is detected inside the vehicle and door is opened.

CUSTOMIZE FUNCTION OUTLINE

E5U091469000N05

- The settings of the following functions, and warning and guidance functions for the advanced keyless entry system can be turned ON/OFF optionally.
- The WDS or equivalent is necessary for settings. Refer to the Workshop Manual for the detailed setting procedure.

Function name	WDS or equivalent display	Initial setting
Auto lock function (Out-of-area type)	Auto Lock	OFF
Keyless buzzer answer back	Answer Back Buzzer	OFF
Battery voltage low indication	Low Battery Warning	ON

ON-BOARD DIAGNOSYS SYSTEM OUTLINE (ADVANCED KEYLESS ENTRY SYSTEM)

E5U091469000N06

Special Features

- The keyless entry system has an on-board diagnostic function to facilitate system diagnosis.
- The on-board diagnostic function consists of the following functions: a malfunction detection function, which detects overall malfunctions in the keyless entry system-related parts; a memory function, which stores detected DTCs; a display function, which indicates system malfunctions by DTC display; and a PID/data monitoring function, which reads out specific input/output signals.
- Using the WDS or equivalent, DTCs can be read out and cleared, and the PID/data monitoring function can be activated.

ON-BOARD DIAGNOSYS SYSTEM PID DATA/MONITOR FUNCTION OPERATION (ADVANCED KEYLESS ENTRY SYSTEM)

E5U091469000N07

On-board Diagnostic Function

Malfunction detection function

- Detects overall malfunctions in the keyless entry system-related parts.

Display function

- If any malfunction is detected, the keyless warning light (red) in the instrument cluster illuminates to inform the driver of a system malfunction.

Memory function

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

DTC table

DTC	System malfunction location
WDS or equivalent display	
B1342	Keyless control module internal malfunction
B1134	Unprogrammed card key
B2477	Configuration error
B1317	Keyless control module power supply voltage increases.
B1318	Keyless control module power supply voltage decreases
B2170	Push switch (Steering lock unit)
B1126	Steering lock unit internal malfunction
U0236	Steering lock unit communication system
B1093	Steering lock unit communication error
U0214	Keyless receiver
B1133	Keyless antenna (exterior, RF)
B1132	Keyless antenna (exterior, LF)
B1127	Keyless antenna (Interior, trunk)
B1128	Keyless antenna (Interior, rear)
B1131	Keyless antenna (exterior, rear)
B1129	Keyless antenna (Interior, middle)
B112A	Keyless antenna (Interior, front)
U0323	Communication error to instrument cluster
U0100	Communication error to PCM
U0073	Control module communication error
U2023	Error signal from CAN related module
B1681*	No detected communication with the coil antenna.
B2103*	Coil malfunction
B1213*	Only one key ID number is programmed.

* : With immobilizer system

PID/data monitor function

- The PID/data monitor function is used for optionally selecting input/output signal monitor items preset in the keyless control module and reading them out in real-time.
- Use the WDS or equivalent to read the PID/data monitor.

PID/data monitor table

PID name (definition)	Data contents	Unit/ Operation	Terminal
DTC_CNT	Number of continuous DTCs	–	–
RPM	Engine speed	RPM	4Z, 4AA
VSS	Vehicle speed	KPH	4Z, 4AA
VPWR	Supply voltage	V	1F
NUMCARD	Number of programmed card keys	–	–
NUMKEY*	Number of programmed key ID numbers	–	–
DRSW_D	Door switch (driver's door)	CLOSE/ OPEN	4T
DRSW_P	Door switch (passenger's door)	CLOSE/ OPEN	4Q
REQ_SW_R	Request switch (right side door)	On/Off	4H
REQ_SW_L	Request switch (left side door)	On/Off	4J
REQ_SW_BK	Request switch (trunk lid)	On/Off	4L
LOCK_SW_D	Door lock-link switch (driver's side)	On/Off	4I, 4E
CLS_LOCK	Door lock switch (lock)	On/Off	4B
CLS_UNLOCK	Door lock switch (unlock)	On/Off	4B
KCS_LOCK	Key cylinder switch (lock)	On/Off	4G
KCS_UNLOCK	Key cylinder switch (unlock)	On/Off	4G
IMMOBI	Immobilizer system equipped or not	On*/Off	–
TR/LG_SW	Trunk compartment light switch	CLOSE/ OPEN	3Z
IG_KEY_IN	Key reminder switch	Key-In/Key-Out	3O
IG_SW_ST	Ignition switch (Push switch)	Pushed/Not Pushed	3N
BUZZER	Keyless buzzer	On/Off	4Y
PWR_IG1	Power supply (IG1)	On/Off	3B
PWR_ACC	Power supply (ACC)	On/Off	3I
HOOD_SW	Hood latch switch	CLOSE/ OPEN	4V
LOCK_SW_P	Door lock-link switch (passenger's side)	On/Off	4R

* : Vehicles with immobilizer system

Simulation Function

- The simulation function is used for optionally selecting simulation items of output parts preset in the keyless control module, and to operate them regardless of control.

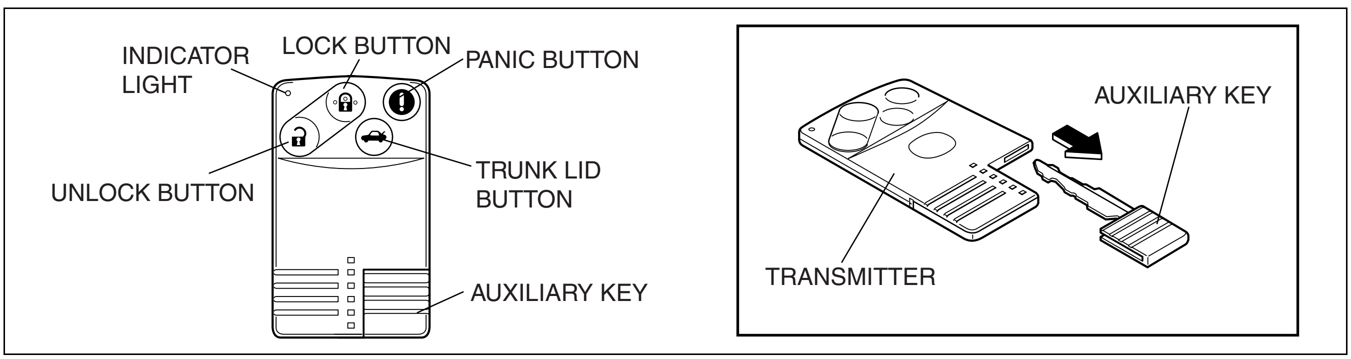
ACTIVE COMMAND MODE TABLE

Command name	Output part name	Unit/ Operation	Terminal
BZR_OUT	Keyless beeper	On/Off	4Y
BZR_INN	Interior buzzer (Instrument cluster)	On/Off	4Z, 4AA
LNP_RED	Keyless warning light (red)	On/Off	4Z, 4AA
LNP_GREEN	Keyless indicator light (green)	On/Off	4Z, 4AA
HAZARD	Hazard warning light	On/Off	4N
HORN	Horn	On/Off	4U
ANT_RF	Keyless antenna (exterior, RF)	On/Off	2A, 2B
ANT_LF	Keyless antenna (exterior, LF)	On/Off	2C, 2D
ANT_BK	Keyless antenna (exterior, rear)	On/Off	2E, 2F
ANT_INN1	Keyless antenna (Interior, trunk)	On/Off	2G, 2H
ANT_INN2	Keyless antenna (Interior rear)	On/Off	2I, 2J
ANT_INN3	Keyless antenna (Interior, middle)	On/Off	2K, 2L
ANT_INN4	Keyless antenna (Interior, front)	On/Off	3G, 3H
DR_LOCK	All doors lock	Off/Lock	1A, 1C
DR_UNLOCK	All doors unlock	Off/Unlock	1A, 1C
2STG_UNLK	All doors unlock	Off/Unlock	1A, 1D

CARD KEY (TRANSMITTER) CONSTRUCTION/OPERATION

E5U091469000N08

- A card-type transmitter that is thin and convenient to carry has been adopted.
- A maximum of six transmitters can be programmed for one vehicle.
- A built-in operation indicator light illuminates according to LOCK/UNLOCK button operation and request signal from the vehicle.
- In case the transmitter is inoperable due to battery depletion, the doors can be locked/unlocked and the engine can be started using the auxiliary key.
- A transponder is built into the auxiliary key for vehicles with the immobilizer system.

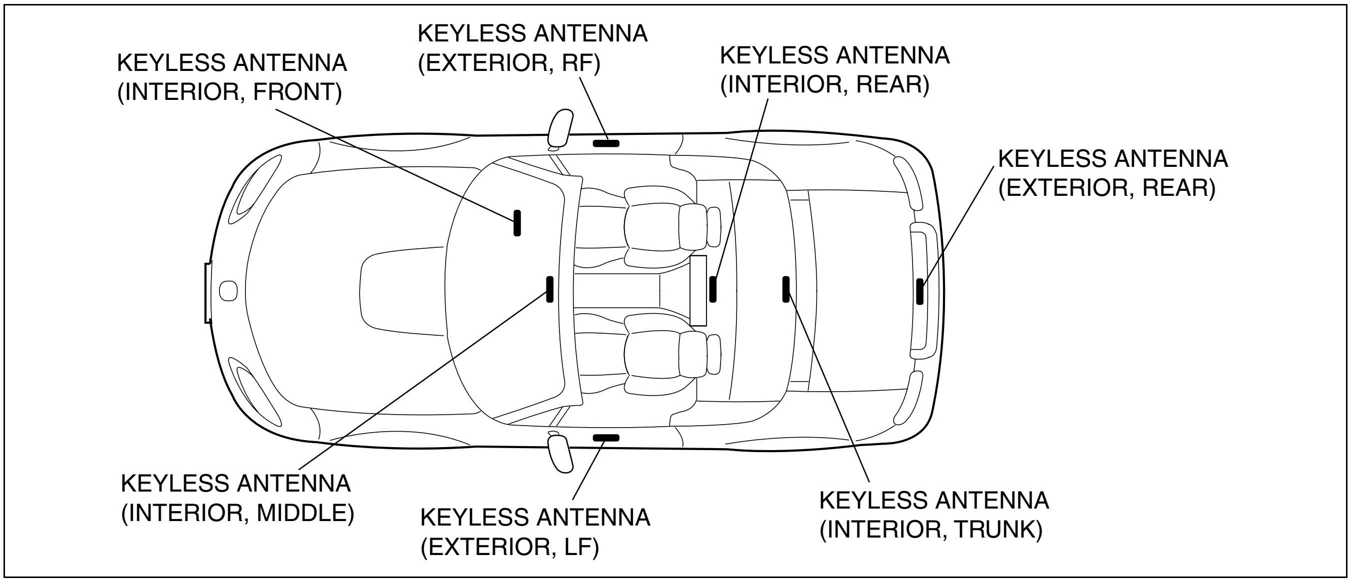


E5U914AS1008

KEYLESS ANTENNA CONSTRUCTION/OPERATION

E5U091469000N09

- Consists of the antennas for request signal output (7 locations).
- Operated by the keyless control module, the keyless antennas send request signals to produce the reception areas inside and outside the vehicle.
- The keyless antennas built-into the front doors can output signals to both inside or outside the vehicle, and change the level of the radiowave (output to inside or outside the vehicle) according to operation conditions.
- The keyless control module locates the card key by determining the antenna which is receiving the signal the strongest.

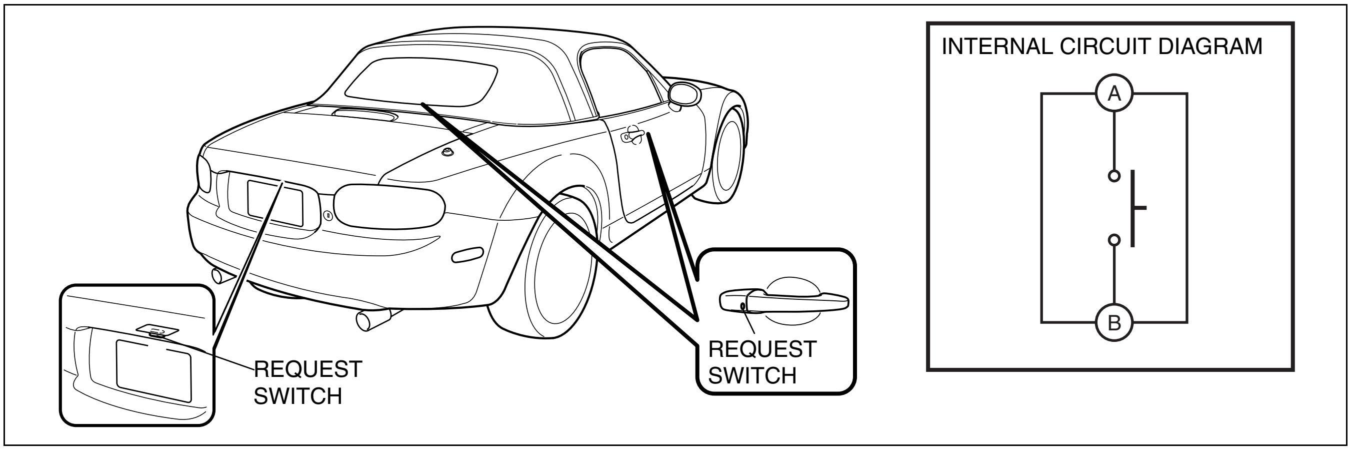


E5U914AS1009

REQUEST SWITCH CONSTRUCTION

E5U091469000N10

- Installed on both doors and trunk lid.

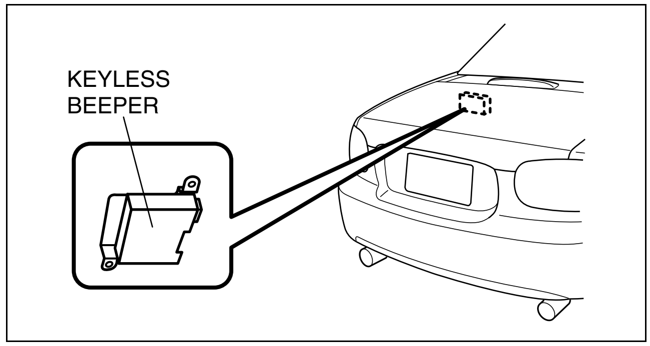


E5U914AS1010

KEYLESS BEEPER CONSTRUCTION

E5U091469000N11

- Installed on the trunk compartment.

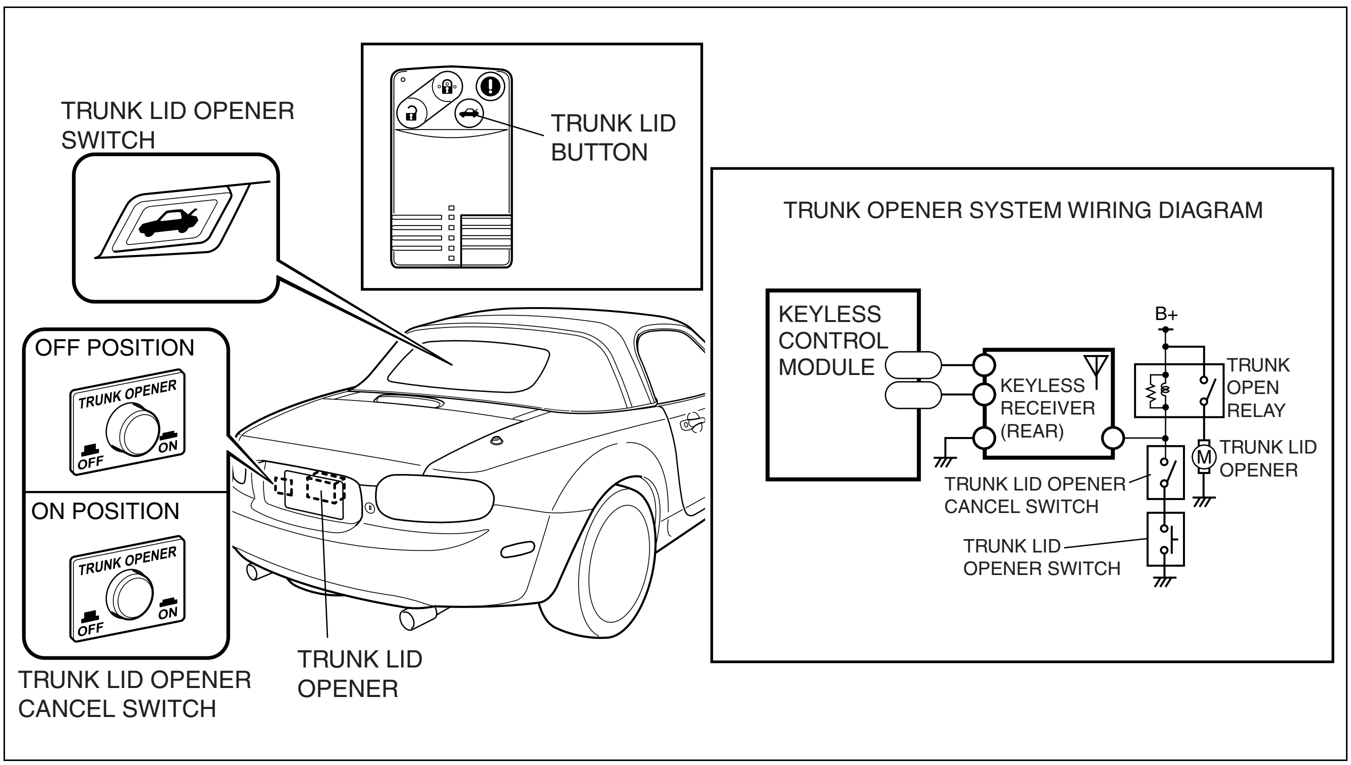


E5U914AS1011

TRUNK LID OPENER SYSTEM CONSTRUCTION/OPERATION

E5U091466000N03

- The trunk lid can be opened by following items:
  - — Key
  - — Transmitter
  - — Trunk lid opener switch
  - — Trunk lid request switch
- If the trunk lid opener cancel switch in the OFF position, the trunk lid opener cannot be operated to prevent anyone from opening the trunk lid without the key.



E5U914AS1012

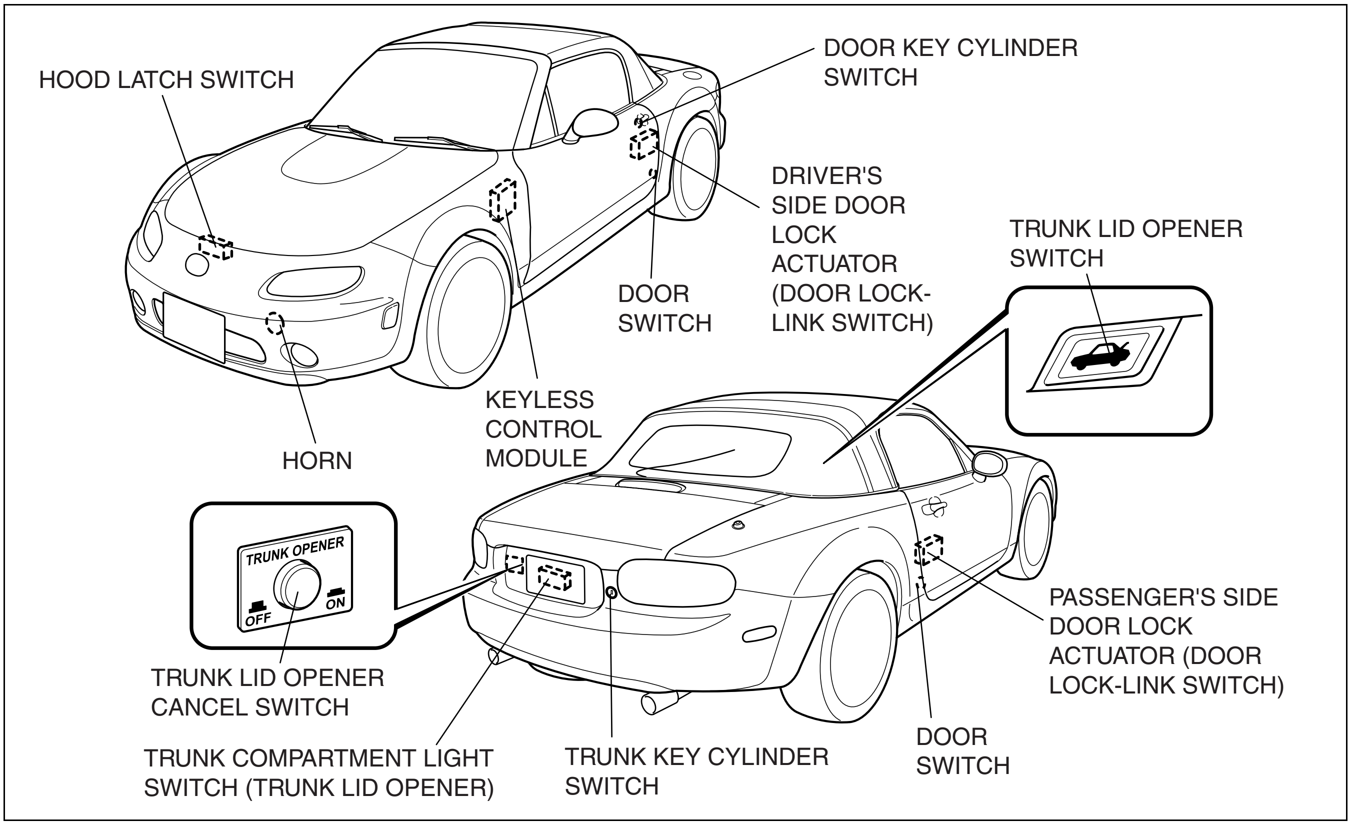
THEFT-DETERRENT SYSTEM OUTLINE

E5U091450000N01

- 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 hazard warning lights flash and the horn sounds.
- When the ignition key is inserted into the door or trunk key cylinder and turned to unlock, the transmitter unlock button is pressed, or request switch is pressed, the alarm stops.

THEFT-DETERRENT SYSTEM STRUCTURAL VIEW

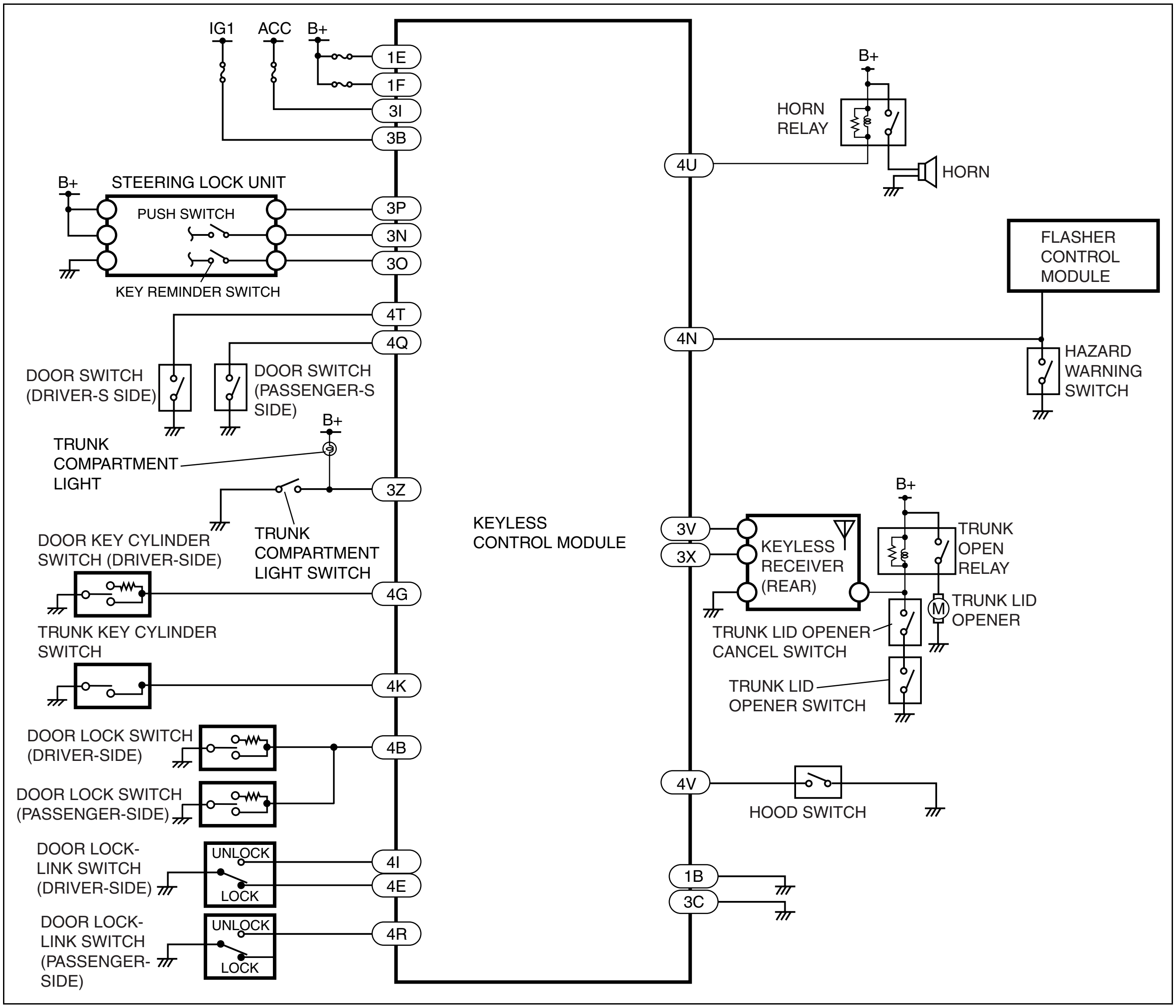
E5U091450000N02



E5U914AS1013

THEFT-DETERRENT SYSTEM WIRING DIAGRAM

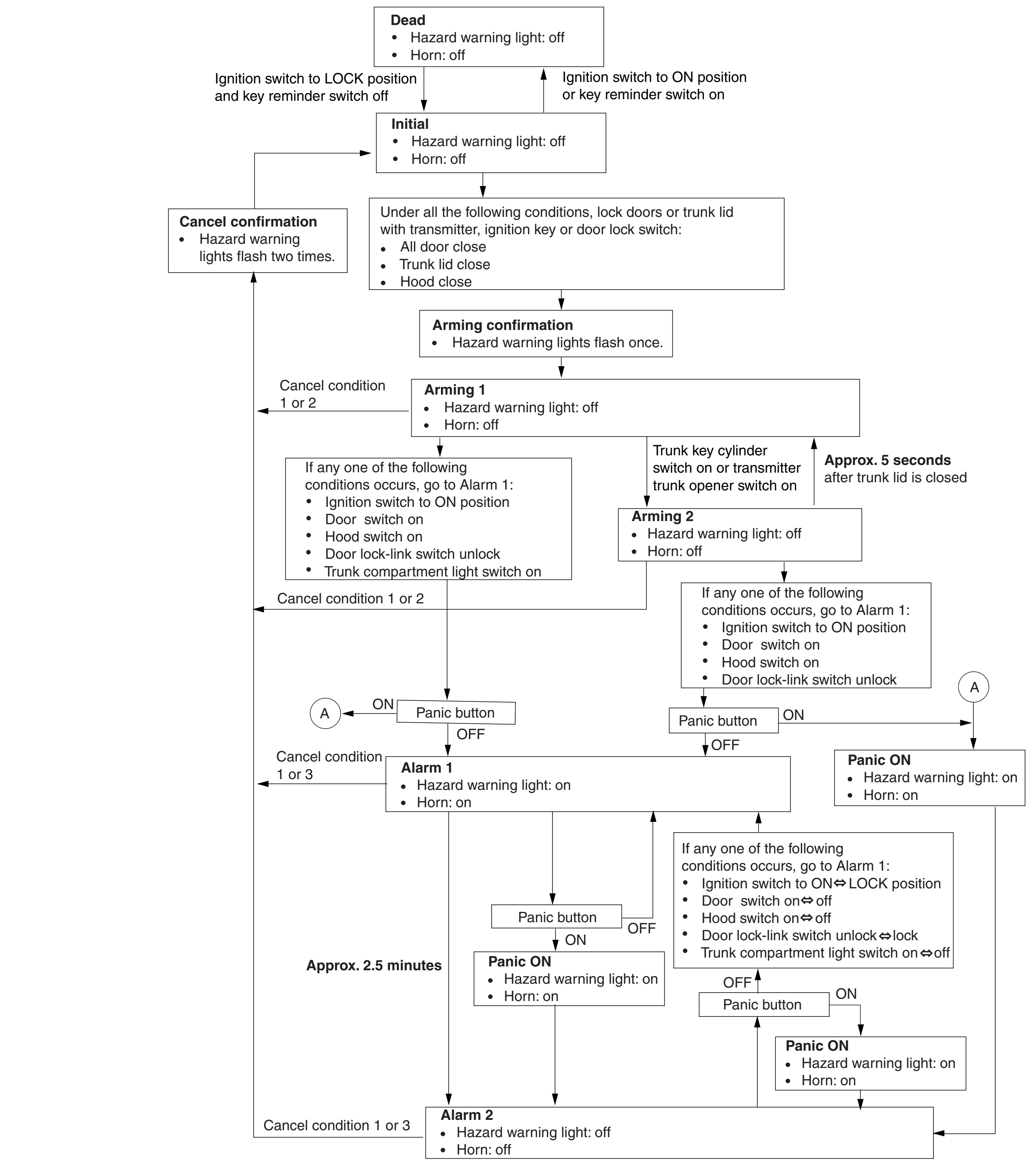
E5U091450000N03



E5U914AS1014

SYSTEM FLOWCHART

E5U091450000N04



CANCEL CONDITION

1: Door unlock with transmitter or ignition key.
2: Key reminder switch on and ignition switch to ON position.
3: Trunk lid open with transmitter or ignition key.

B6U0914S303

09–14A

IMMOBILIZER SYSTEM OUTLINE

E5U091467000N01

Note

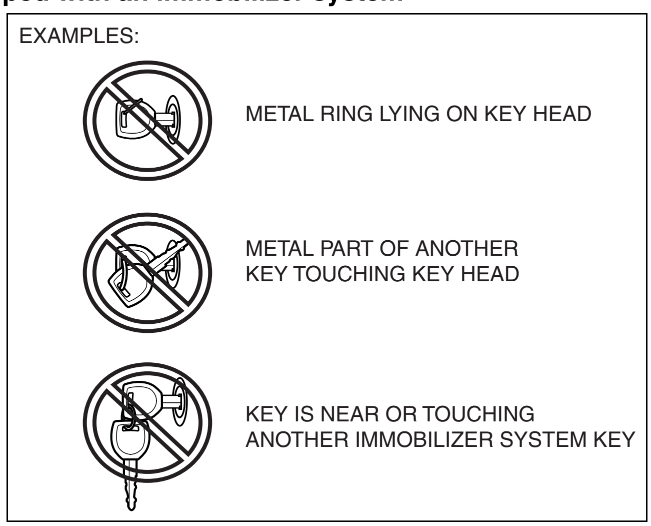
- The construction and operation of the auxiliary key is described. Refer to “ADVANCED KEYLESS START FUNCTION OPERATION” for starting engine with the card key. (See 09–14A–8 ADVANCED KEYLESS START FUNCTION OPERATION.)

Special Features

- The immobilizer system is a vehicle theft prevention device that only allows keys that have previously been programmed to the vehicle to start the engine. It functions to prevent theft by means such as a forged key or hotwiring.
- The system consists of the key (with built-in transponder), coil antenna, PCM, instrument cluster, and keyless control module.
- The immobilizer system activates automatically when the start knob is turned to the LOCK or ACC position. (The security light in the instrument cluster flashes while the immobilizer system is activated.)
- When the start knob is pressed (push switch ON) and turned to the ON position with a previously programmed auxiliary key, the immobilizer system deactivation operation begins automatically. The engine is allowed to start only after the deactivation operation is completed successfully. (The security light illuminates for 3 s and then goes out when the immobilizer system has been deactivated.)
- The immobilizer system cannot be disabled.
- Due to immobilizer system characteristics, the engine cannot be started unless two or more keys are programmed. Therefore, when resetting the immobilizer system (PCM replacement, Keyless control module replacement, or Replacement of all programmed keys), two or more keys usable with the immobilizer system must be readied before starting the operation.
- A maximum of eight keys can be programmed to one vehicle. The PID/data monitor function can be used to verify the number of keys programmed to the vehicle.
- If there is a system malfunction or the immobilizer system is not properly deactivated due to deactivation operation failure, the malfunction location can be verified by the flashing pattern of the security light in the instrument cluster, or using the malfunction diagnosis function of the on-board diagnostic system.

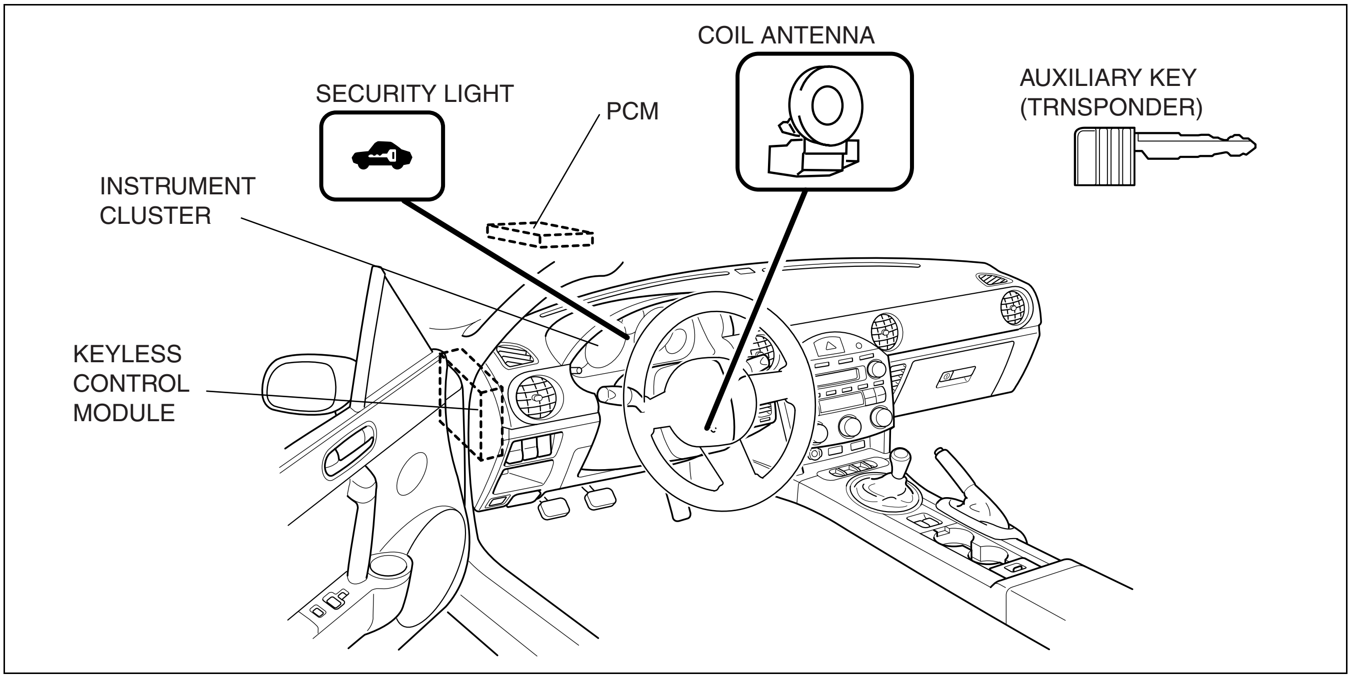
Caution

- **If any of the following items are touching or near the key head, signal communication between the key and vehicle is negatively affected, resulting in the engine not starting or a key programming error. Do not perform procedures if any of the following items are touching or near the key head.**
  - **— Any metallic object**
  - **— Spare keys or keys for other vehicles equipped with an immobilizer system**
  - **— Any electronic device, or any credit or other cards with magnetic strips**



B3E0914W006

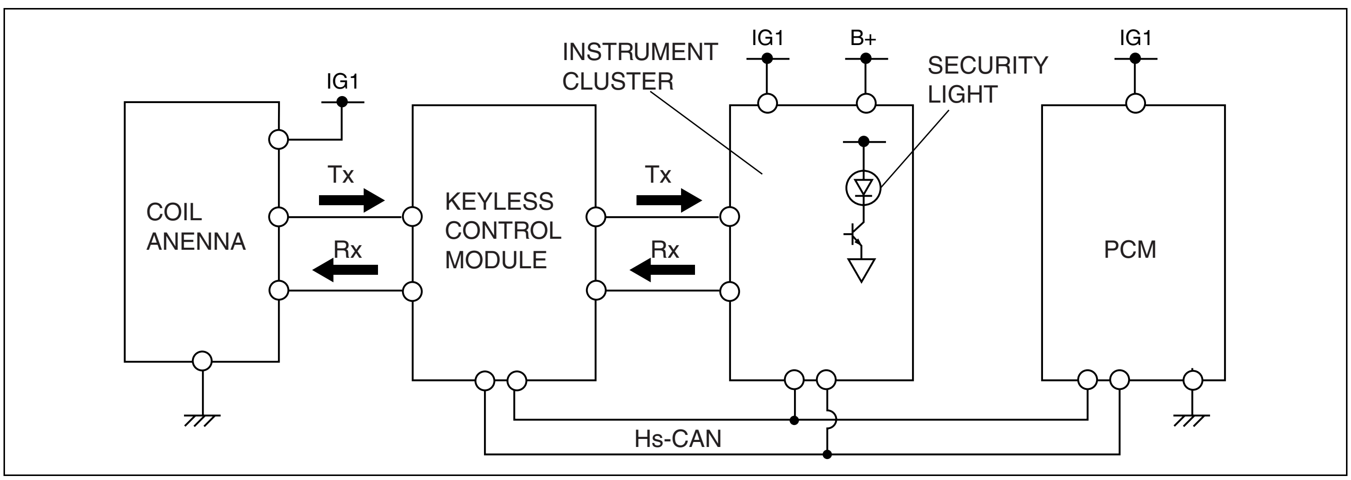
Structural View



E5U914AS1015

IMMOBILIZER SYSTEM BLOCK DIAGRAM

E5U091467000N02



E5U914AS1016

IMMOBILIZER SYSTEM CONSTRUCTION/OPERATION

E5U091467000N03

- Keys contain a unique ID number that is previously programmed to the keyless control module and PCM. Due to this, if immobilizer system component parts are replaced (such as key addition/clearing or replacement of the keyless control module, instrument cluster or PCM), it is necessary to reset the system.

Key ID Number Verification Procedure

The start knob is pressed and the ignition switch is turned to the ON position.

↓

(1) The instrument cluster transmits data α* to the key (transponder) via the keyless control module and coil antenna.

↓

(2) The key (transponder) calculates data β from received data α, and transmits unique key ID number γ and data β to the keyless control module via the coil antenna.

↓

(3) The instrument cluster generates γ' from γ, and transmits γ' and β to the PCM.

↓

(4) The PCM verifies that the received key ID number matches the key ID number which has already been programmed.

Result: NG → Engine start is disabled.

Result: OK ↓

(5) The PCM compares the received data β from the key via the instrument cluster with the value calculated from the transmitted data α.

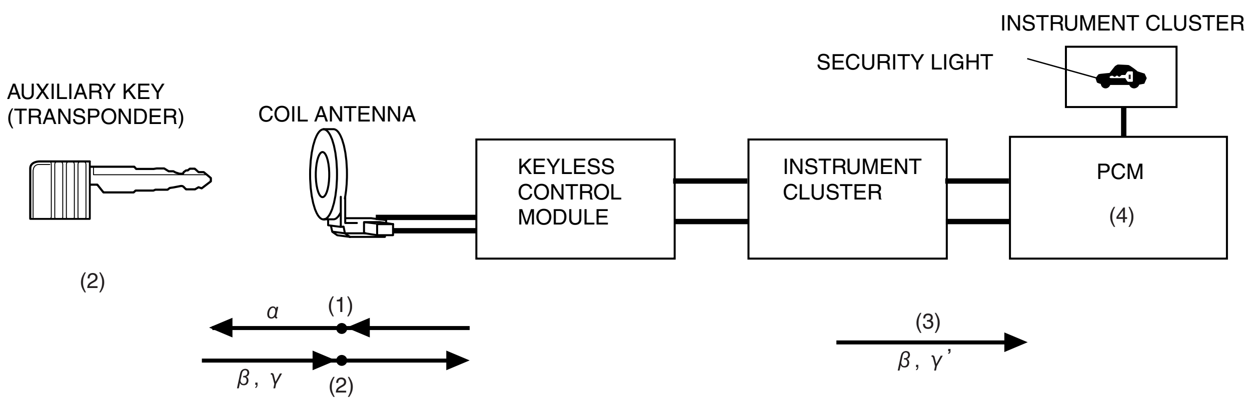
Result: NG → Engine start is disabled.

Result: OK ↓

Engine start is enabled.
(The security light illuminates approx. 3 s and goes off.)

Engine start is disabled.
(The security light starts flashing/illuminating after an error, such as verification failure or malfunction, is detected, and then indicates the DTC for ten times repeatedly.)

*: Data α is a random value which changes each time.



E5U914AS1017

Immobilizer System Setting

- Some immobilizer system settings can be performed only using the WDS or equivalent. When using the WDS or equivalent, first, security access must be requested. Obtain security access permission according to the WDS or equivalent screen and then perform system procedures.

WDS or equivalent setting items	Contents
Programming an additional ignition key	Allows key ID number programming.
Ignition key ID number clearing	Clears all programmed key ID numbers and programs new key ID numbers.
Customer spare key programming enable	"Additional ignition key programming" is enabled. **Note** • This is the default setting on new vehicles.
Customer spare key programming disable	"Additional ignition key programming" is disabled. **Note** • When only the WDS or equivalent must be used to program key ID numbers, making a forged key by using two keys that can start the engine is prevented. This function is for use by rental car agencies or other companies with vehicle fleets.

- When immobilizer system component parts (key, PCM, coil antenna, and keyless control module) are replaced, the system must be reset as described below. Refer to the Workshop Manual for the detailed setting procedure.

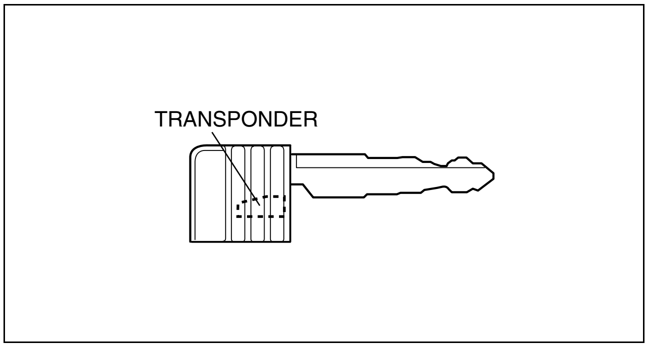
Component part	Setting
Key addition	Key ID number of added key must be programmed. Key ID number programming can be performed according to the following methods: • Method for programming additional keys using two keys that can start the engine • Method using the WDS or equivalent
Key clearing	The programmed key ID number can only be cleared using the WDS or equivalent. When clearing key ID numbers using the WDS or equivalent, all the programmed key ID numbers are cleared.
PCM replacement	• The key ID numbers for all keys that were being used must be programmed using the WDS or equivalent. Two or more keys must be programmed.
Instrument cluster	• The key ID numbers for all keys that were being used must be programmed using the WDS or equivalent. Two or more keys must be programmed.
Keyless control module replacement	• Card key and steering lock unit must be programmed. • The key ID numbers for all keys that were being used must be programmed using the WDS or equivalent. Two or more keys must be programmed.
Steering lock unit replacement (including key replacement)	• Steering lock unit must be programmed. • The key ID number must be programmed using the WDS or equivalent. Two or more keys must be programmed.
Coil antenna replacement	Immobilizer system resetting is not necessary.

09–14A

AUXILIARY KEY CONSTRUCTION

E5U091467000N04

- 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).

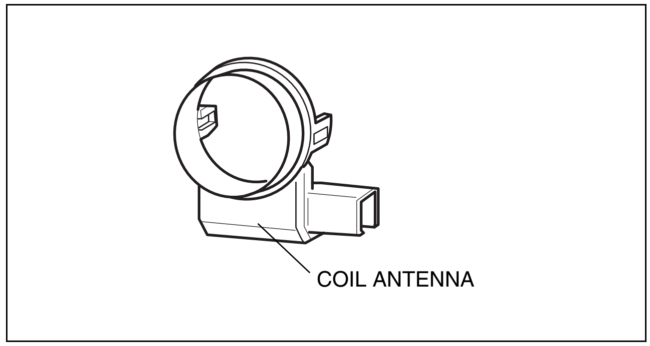


E6U914AS1016

COIL ANTENNA CONSTRUCTION

E5U091467000N05

- Installed on the steering lock.
- Forms a magnetic field near the steering lock and communicate to the key.
- Demodulates the received key signal and outputs the signal to the keyless control module.



E6U914AS1017

SECURITY LIGHT CONSTRUCTION/OPERATION

E5U091467000N06

Construction

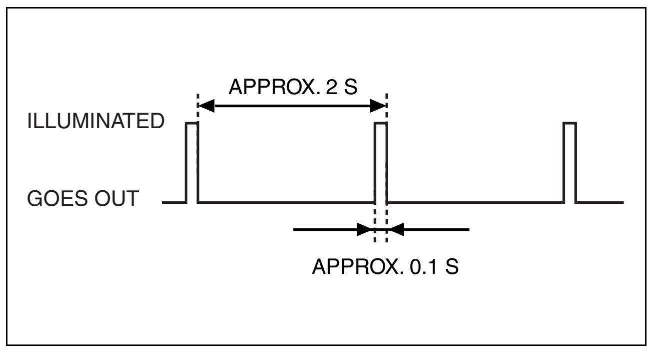
- Allows visual confirmation of immobilizer system operation.
- If any malfunction is detected in the immobilizer system, the malfunction location can be verified by the security light illumination/flashing pattern.

Caution

- **Always use the WDS or equivalent to verify DTCs even if the security light indicates a DTC. If the security light itself has a malfunction, a DTC may not be indicated properly.**

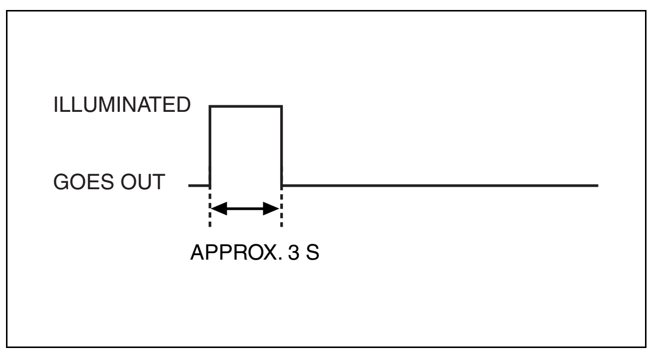
Operation

- When the immobilizer system is operating, the security light flashes repeatedly 0.1 s every approx. 2 s.



C3U0914S011

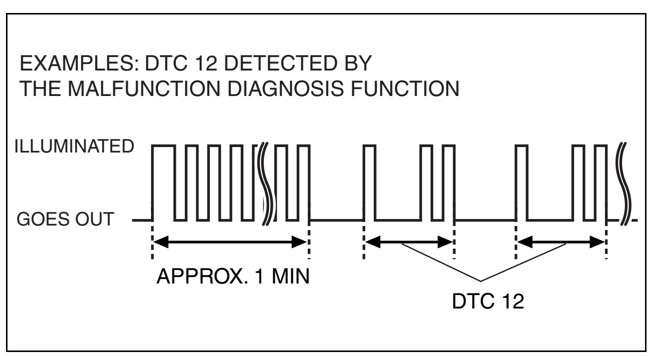
- When the immobilizer system is deactivated normally, the security light illuminates for approx. 3 s and then goes out when the start knob is turned to the ON position.
- If the immobilizer system is not deactivated normally (malfunction detected by the malfunction diagnosis function), the security light indicates a DTC. When the start knob is turned to the ON position, the security light flashes or illuminates for 1 min in the following pattern:
  — DTC 15 or lower: Flashes
  — DTC 21: On



C3U0914S012

Note

- The security light indicates the DTC 10 times.
- If multiple DTCs that can be confirmed with the security light are detected, only the DTC with the lowest number of those detected will be indicated by the security light.



C3U0914S013

ON-BOARD DIAGNOSYS SYSTEM OUTLINE (IMMOBILIZER SYSTEM)

E5U091467000N07

- The immobilizer system is provided with a malfunction diagnosis function.
- Malfunction diagnosis of the immobilizer system occurs automatically when the start knob 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 indicates 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 indicates a DTC. If the security light itself has a malfunction, it is possible that a DTC may not be indicated properly. There are certain DTCs which can only be verified using the WDS or equivalent, not the security light.**

Note

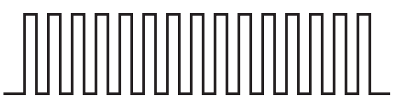
- If two or more malfunctions are detected as a result of malfunction diagnosis, only the DTC with the lowest number of those detected will be indicated by the security light. The PCM and keyless control module store multiple DTCs at the same time.
- If two or more immobilizer system DTCs are verified, first repair the part of the DTC indicated by the security light. After completely repairing one location, turn the ignition switch from the LOCK to the ON position and perform immobilizer system malfunction diagnosis.

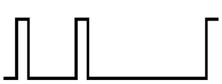
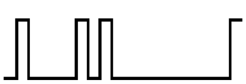
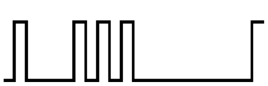
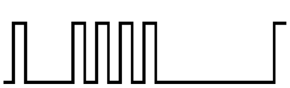
DTC table

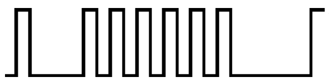
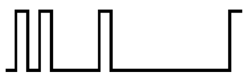
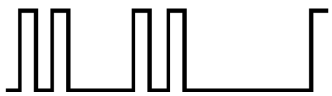
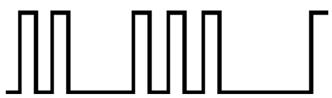
Note

- In the approx. 1 min after detecting a malfunction and before indicating the DTC, the security light illuminates or flashes in the following patterns:

09–14A

Security light flashing pattern (Before indicating a DTC)	DTC
ILLUMINATED  GOES OUT	11, 12, 13, 14, 15, 16
ILLUMINATED  GOES OUT	21, 22, 23

DTC						Detection condition
Security light flashing pattern		Keyless warning light	WDS or equivalent display			
			Keyless control module	Instrument cluster	PCM	
11		Off	–	B1681	P1260	No communication detected between keyless control module and PCM
		On	B1681	B1681	P1260	No communication detected between coil antenna and instrument cluster
12		On	B2103	B2103	P1260	Coil antenna malfunction
13		Off	–	B1600 B2431	P1260	Key ID number cannot be read
14		Off	–	B1602	P1260	Key ID number cannot be read

DTC						Detection condition
Security light flashing pattern		Keyless warning light	WDS or equivalent display			
			Keyless control module	Instrument cluster	PCM	
15		Off	–	B1601	P1260	Unprogrammed key ID number detected
		On	B1342	B1601	P1260	Keyless control module malfunction
16		Off	–	U2510	P1260	Communication error between instrument cluster and PCM (no response)
21		On	B1213	B1213	P1260	Only one key ID number is programmed to the instrument cluster
22		On	–	B2141	P1260	Communication error between instrument cluster and PCM (data transfer error)
23		On	–	B2139	P1260	ID number data i the PCM and instrument cluster do not match
–	–	On	B1213	–	P1260	Only one key ID number is programmed to the keyless control module
–	–	On	U0073	–	–	CAN malfunction
–	–	Off	U0323 U0100 U2023	–	–	CAN malfunction

ON-BOARD DIAGNOSYS SYSTEM PID DATA/MONITOR FUNCTION OPERATION (IMMOBILIZER SYSTEM)

E5U091467000N08

- The following item can be verified
  — Number of keys programmed to the vehicle.
- Use the WDS or equivalent to read the PID/data monitor.

Note
- The engine cannot be started unless two or more keys are programmed to the vehicle.
- A maximum of eight keys can be programmed for one vehicle.

PID/DATA Monitor Table

PID name (definition)	Detection condition
NUMKEYS (Number of key ID numbers programmed to the keyless control module)	Number of programmed key ID numbers: 0–8

09–14B SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM (RETRACTABLE KEY TYPE)]

SECURITY AND LOCKS OUTLINE

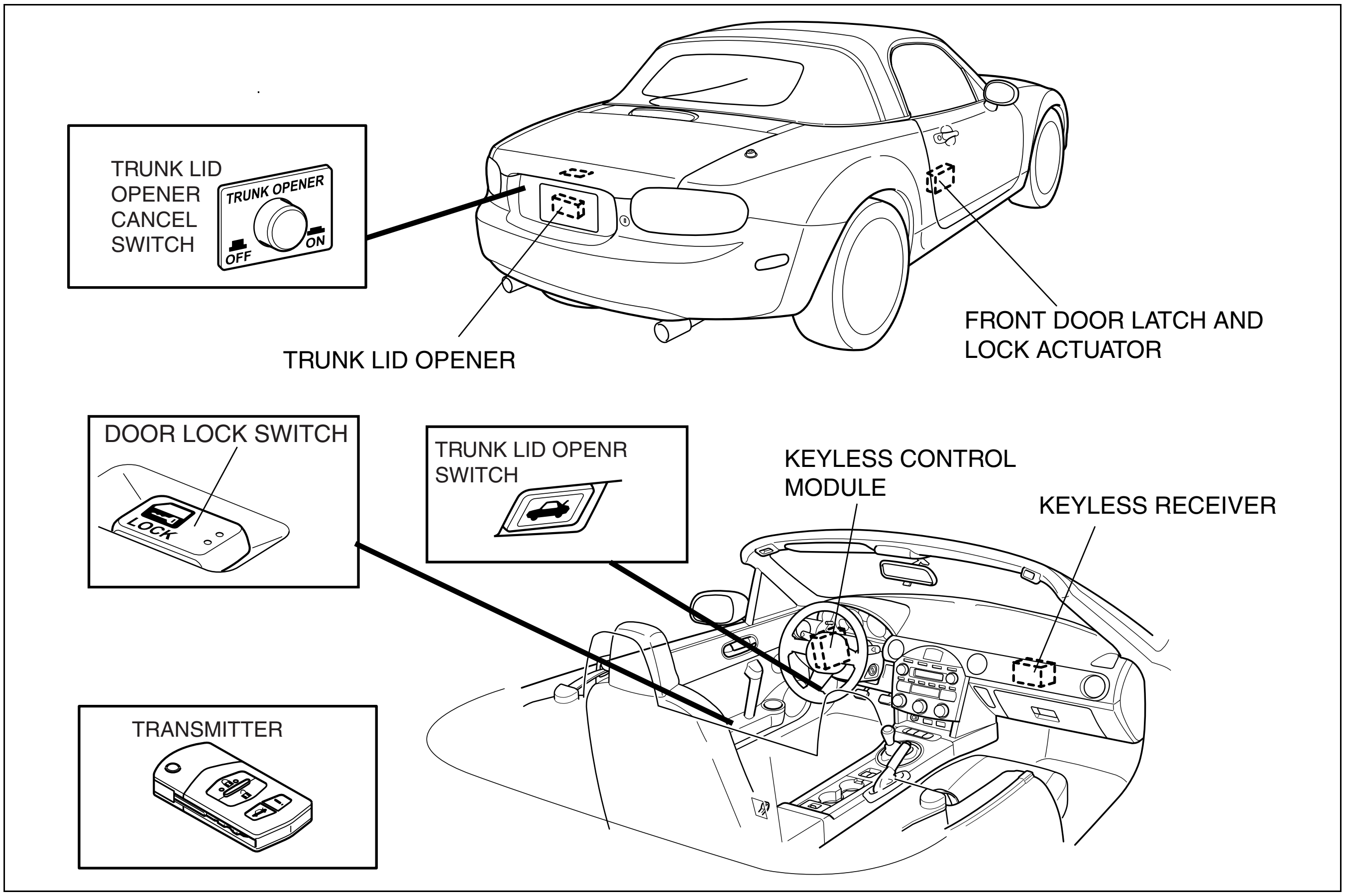
E5U091400001N04

Improved marketability	• Power door lock system adopted • Keyless entry system adopted
Improved security	• Theft-deterrent system adopted (See 09–14A–14 THEFT-DETERRENT SYSTEM OUTLINE) • Immobilizer system adopted

09–14B

SECURITY AND LOCKS STRUCTURAL VIEW

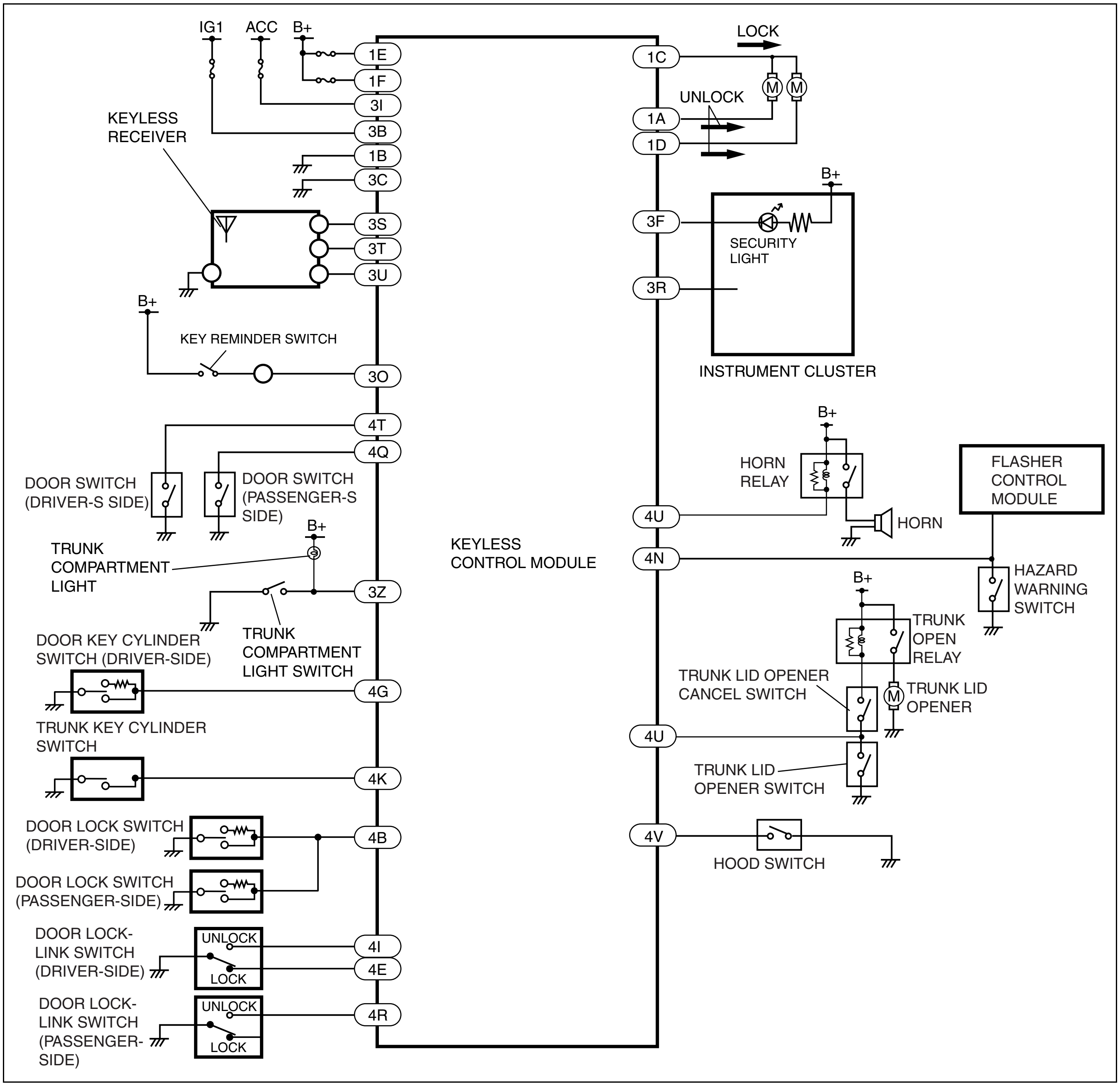
E5U091400001N05



E5U914BS1001

SECURITY AND LOCKS SYSTEM WIRING DIAGRAM

E5U091400001N06



E5U914BS1002

POWER DOOR LOCK SYSTEM OUTLINE

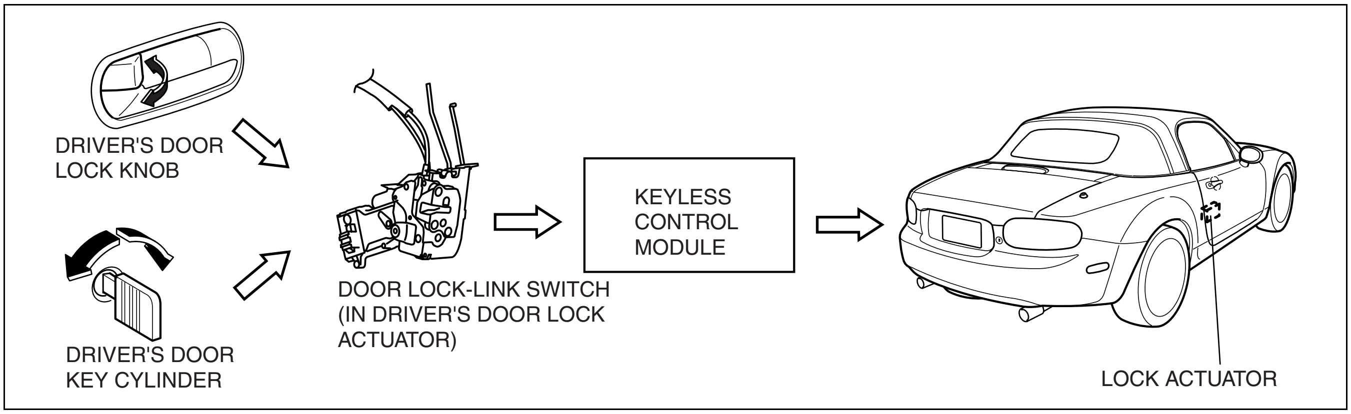
E5U091466000N04

- A door lock knob interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door lock knob.
- A door key interlock function has been adopted where all doors are locked/unlocked when the driver's door is locked/unlocked with the driver's door key cylinder.

POWER DOOR LOCK SYSTEM OPERATION

E5U091466000N05

- When the driver's door is locked/unlocked with the driver's door lock knob or key cylinder, the door lock-link switch in the door lock actuator is locked/unlocked via the rod.
- The keyless control module activates each lock actuator to lock/unlock according to the lock/unlock signal from the door lock-link switch.



E5U914AS1003

KEYLESS ENTRY SYSTEM OUTLINE

E5U091469000N12

- The doors also can be locked/unlocked by operating the key or transmitter.
- The answer-back function has been adopted where the hazard warning lights flash and a buzzer sounds to confirm that the doors are locked/unlocked.
- A rolling code type transmitter has been adopted to prevent theft by radiowave interception.
- To prevent improper operation while the vehicle is moving, the doors cannot be locked/unlocked by operating the transmitter if the ignition key is not in the LOCK position.

KEYLESS ENTRY SYSTEM OPERATION

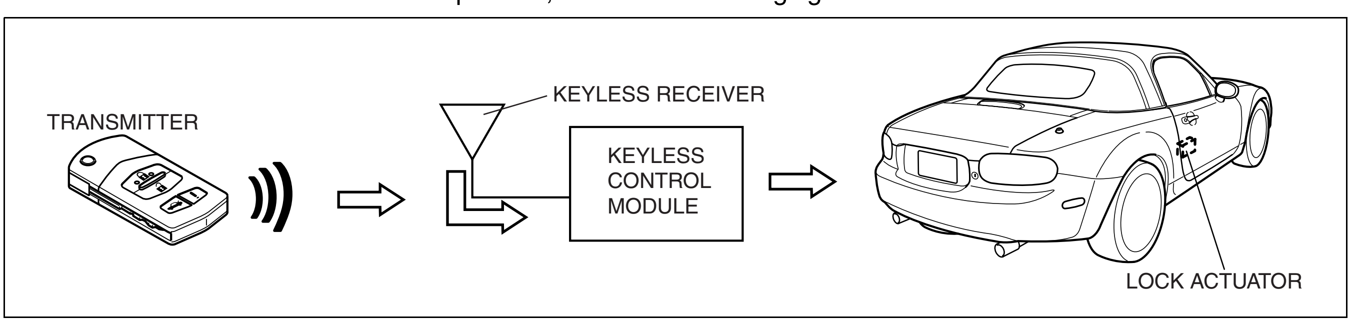
E5U091469000N13

Lock/unlock

Note

- If any of the following conditions are met, the doors cannot be locked by operating the transmitter.
  — The key is inserted in the ignition key cylinder.
  — The ignition switch is not in the LOCK position.
  — Any door is open.
- If any of the following conditions are met, the doors cannot be unlocked by operating the transmitter.
  — The key is inserted in the ignition key cylinder.
  — The ignition switch is not in the LOCK position.

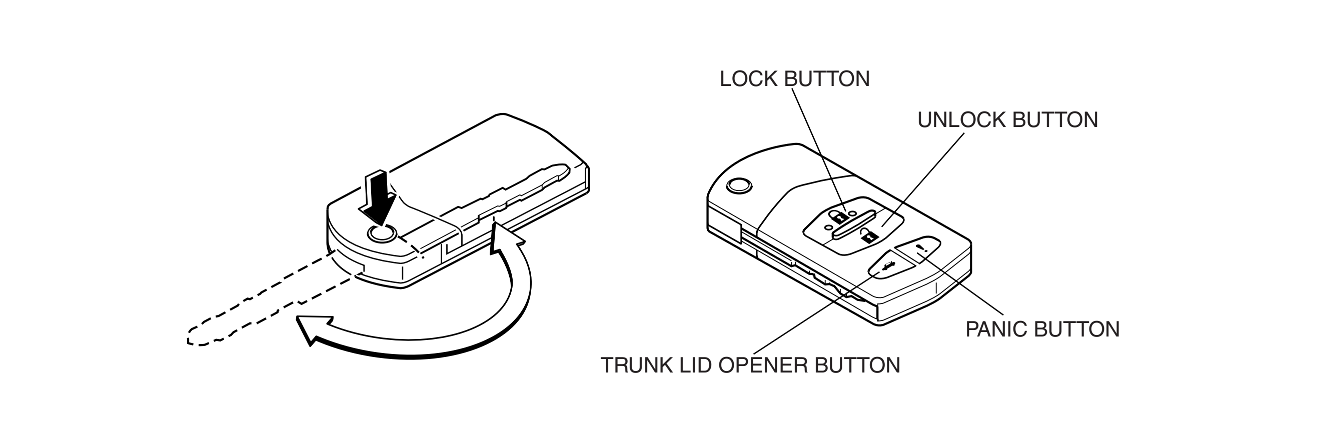
1. When the transmitter is operated, the transmitter sends ID data and rolling code. They are received by the keyless receiver and sent to the keyless control module.
2. When the keyless control module receives a lock/unlock signal from the transmitter and verifies the ID, the signal is sent to the all lock actuators activate to lock/unlock.
3. The keyless control module operates the hazard warning light to flash according to lock/unlock signal from the transmitter.
   — When the LOCK button is pressed, the hazard warning lights flash once.
   — When the UNLOCK button is operated, the hazard warning lights flash twice.



E5U914BS1003

TRANSMITTER (RETRACTABLE KEY TYPE) STRUCTURAL VIEW

E5U091469000N14



C5U914ZS5001

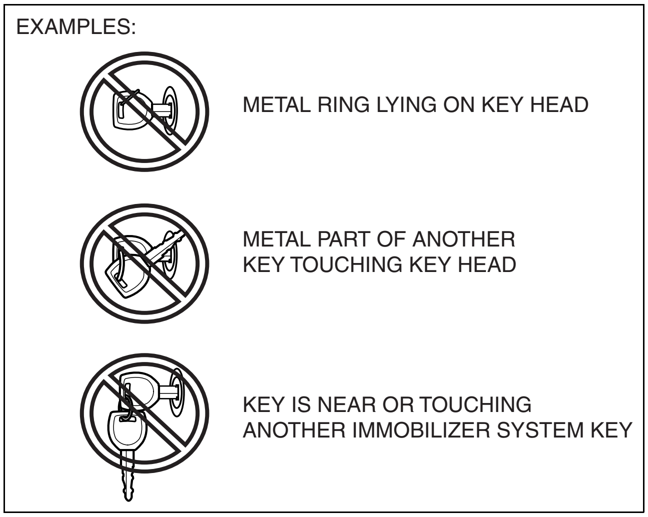
IMMOBILIZER SYSTEM OUTLINE

E5U091467000N09

- The immobilizer system is a vehicle theft prevention device that only allows keys that have previously been registered to the vehicle to start the engine. Therefore, it functions to prevent theft by means such as a forged key or electrical 'hotwiring'.
- Consists of the key (with built-in transponder), coil antenna, PCM, instrument cluster and security light (in the instrument cluster).
- The immobilizer system operates automatically when the ignition switch is turned to the LOCK or ACC position. (The security light illuminates when the immobilizer system is in operation)
- When the ignition switch is turned from the LOCK (or ACC position) to the ON (or START position) with a previously registered key, the release operation begins automatically. The engine is allowed to start only after this operation is successful. (The security light illuminates for **3 s** and then goes out when the immobilizer system has been released.)
- The immobilizer system cannot be deactivated.
- Due to immobilizer system characteristics, the engine cannot be started unless two or more keys are registered. Moreover, when performing “Instrument cluster replacement”, “PCM replacement”, or “Replacement of all the keys”, two or more keys usable with the immobilizer system must be readied.
- A maximum of eight keys can be registered for one vehicle. The PID/data monitor function can be used to verify the number of keys registered for a single vehicle.
- If there is a system malfunction or the immobilizer system is not properly released due to release operation failure, the malfunction location can be verified using the malfunction diagnosis function of the on-board diagnostic system.

Caution

- **If any of the following items are touching or near the key head, signal communication between the key and vehicle is negatively affected, resulting in the engine not starting or a key registration error. Do not perform procedures if any of the following items are touching or near the key head.**
  - **— Any metallic object**
  - **— Spare keys or keys for other vehicles equipped with an immobilizer system**
  - **— Any electronic device, or any credit or other cards with magnetic strips**



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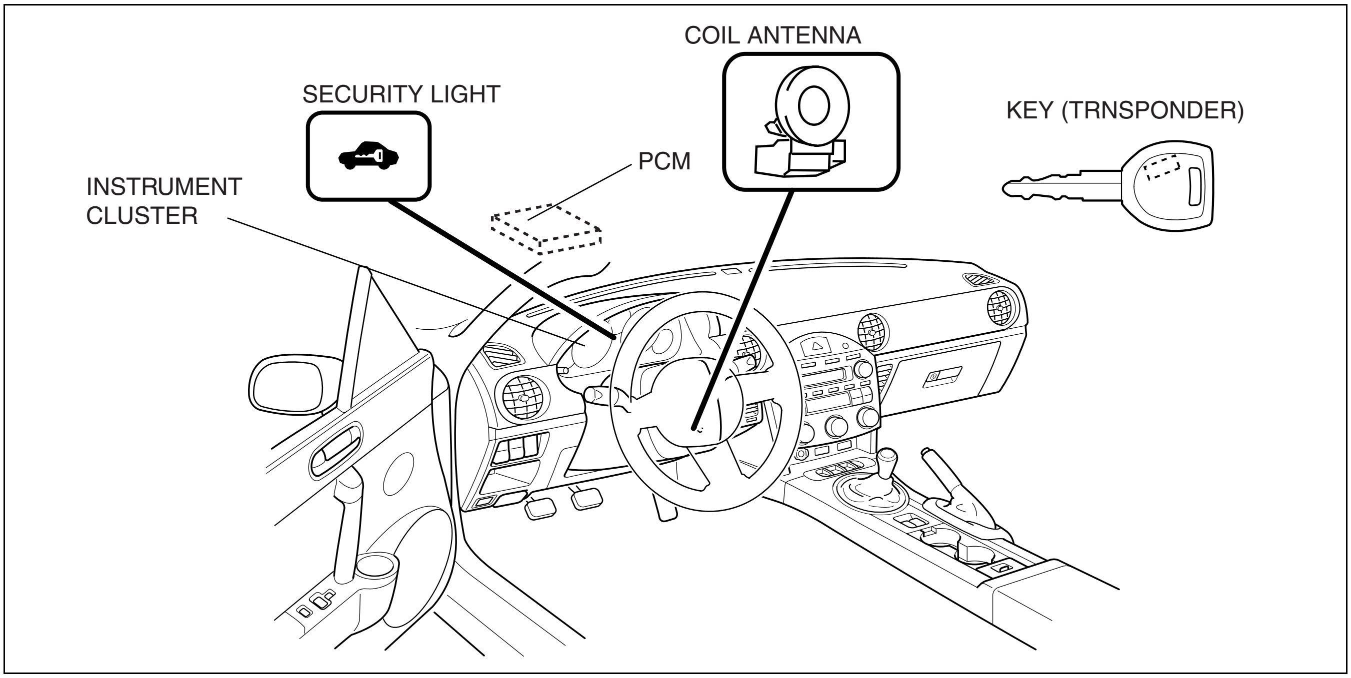
IMMOBILIZER SYSTEM STRUCTURAL VIEW

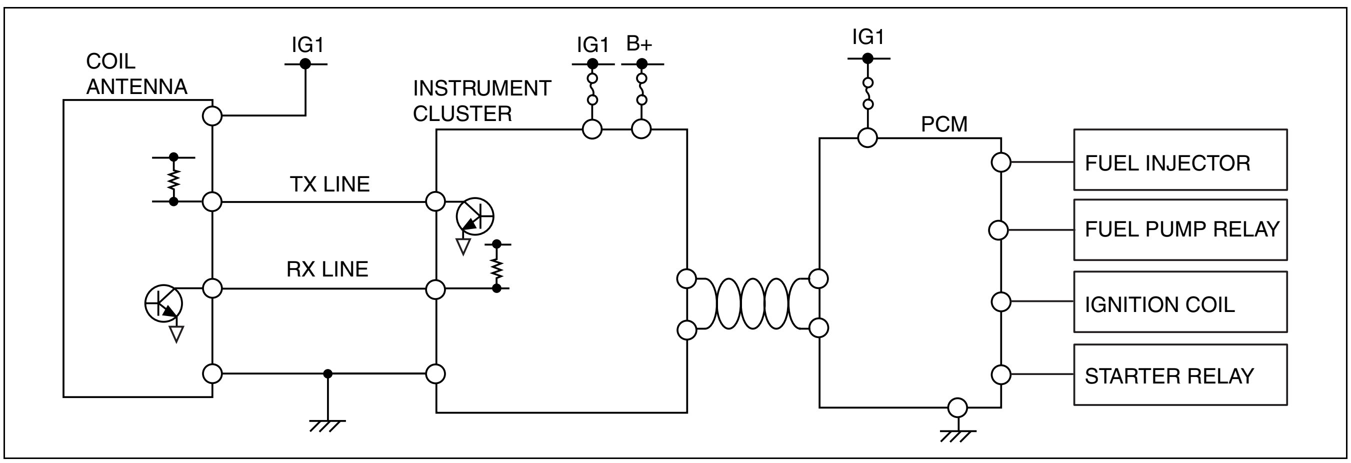
E5U091467000N10



E5U914BS1004

IMMOBILIZER SYSTEM WIRING DIAGRAM

E5U091467000N11



C3U0914S008

IMMOBILIZER SYSTEM CONSTRUCTION/OPERATION

E5U091467000N12

- When a key is inserted into the key cylinder, the key ID number of the key and the key ID number registered in the PCM are compared. If the comparison is successful, permission is given to start the engine. For PCM control, see Section 01, CONTROL SYSTEM.
- Keys contain a unique ID number that is previously registered in the instrument cluster. Due to this, if immobilizer system component parts are replaced (such as key addition/clearing and instrument cluster replacement), it is necessary to reset the system.

Immobilizer System Release Operation

The ignition switch is turned from the LOCK (ACC) to the ON (START) position. (Security light illuminates.)

↓

(1) The instrument cluster sends data A* to the key (transponder) via the coil.

↓

(2) The key (transponder) calculates data B from received data A and sends its specific key ID number and data B to the instrument cluster via the coil.

↓

(3) The instrument cluster verifies consistency between the received key ID number and the previously registered key ID numbers.

UNSATISFACTORY RESULT → Engine starting is not permitted.

SATISFACTORY RESULT ↓

(4) The instrument cluster makes a calculation using received data B and compares it with sent data A.

UNSATISFACTORY RESULT → Engine starting is not permitted.

SATISFACTORY RESULT ↓

(5) The instrument cluster requests data for verification from the PCM.

↓

(6) The PCM sends data C* to the instrument cluster.

↓

(7) The instrument cluster calculates data D from received data C and sends it to the PCM.

↓

(8) The PCM makes a calculation using received data D and compares it with sent data C.

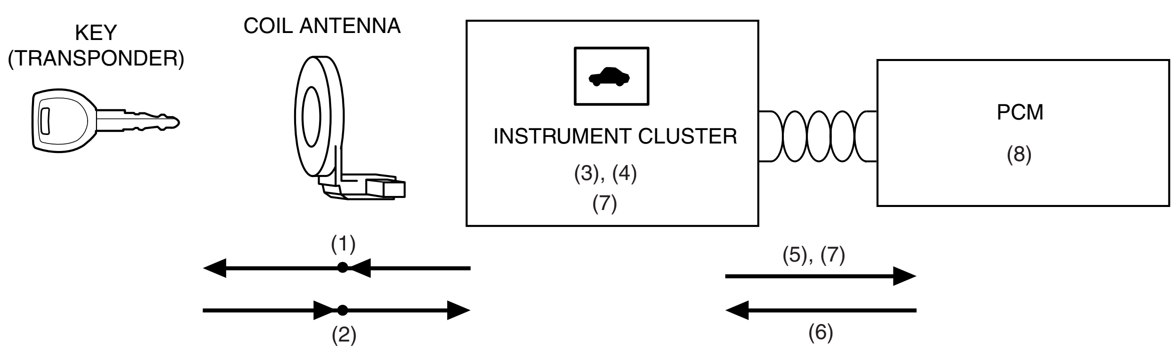
UNSATISFACTORY RESULT → Engine starting is not permitted.

SATISFACTORY RESULT ↓

Engine starting is permitted.
(The security light goes out after approx. 3 s.)

Engine starting is not permitted.
(After detecting the error (such as non-verification or malfunction), the security light illuminates or flashes continuously for approx. 1 min, and then a DTC is repeatedly displayed 10 times.)

*: Data A and C are different random values each time.



B3E0914T005

09–14B

Immobilizer System Setting

- The immobilizer system can be set so that only the WDS or equivalent must be used to perform system procedures. When using the WDS or equivalent, first security access must be requested. Obtain security access permission according the WDS or equivalent screen and then perform system procedures.

WDS or equivalent setting items	Contents
Programming an additional ignition key	Allows key ID number registration.
Ignition key ID number clearing	Clearing and registration of key ID numbers.
Parameter reset	Initialization of either of the following: • PCM • Instrument cluster
Customer spare key programming enable	"Method for adding other keys using two keys that can start the engine" is enabled. **Note** • This is the default setting on new vehicles.
Customer spare key programming disable	"Method for adding other keys using two keys that can start the engine" is disabled. **Note** • When only the WDS or equivalent must be used to register key ID numbers, making a forged key by using two keys that can start the engine is prevented. This function is for use by rental car or other companies with vehicle fleets.

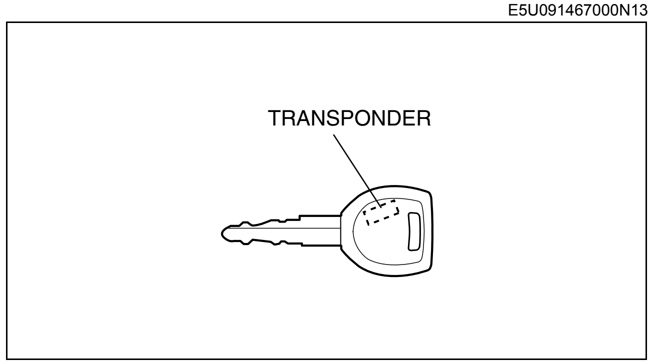
- When immobilizer system component parts (key, Instrument cluster, PCM, and coil antenna) are replaced, the system must be reset as described below. For setting method details, see Mazda3 Workshop Manual.

Component part	Setting
Key addition	Key ID number of added key must be registered. Key ID number registration is performed according to the following methods: • Method for registering other keys using two keys that can start the engine • Method using the WDS or equivalent
Key clearing	The registered key ID number can only be cleared using the WDS or equivalent. When clearing a key ID number using the WDS or equivalent, all key ID numbers are cleared.
PCM replacement	• Parameter reset must be performed. • The key ID numbers for all keys that were being used must be registered in the WDS or equivalent. Two or more keys must be registered.
Instrument cluster replacement	• Parameter reset must be performed. • The key ID numbers for all keys that were being used must be registered in the WDS or equivalent. Two or more keys must be registered.
Coil antenna replacement	Resetting of the immobilizer system does not need to be performed.

KEY CONSTRUCTION

E5U091467000N13

- 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).

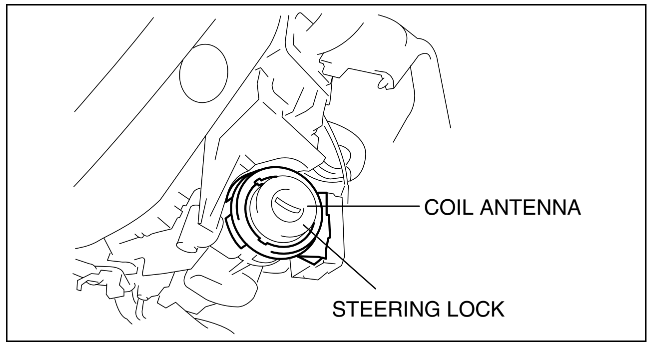


C3U0914S009

COIL ANTENNA CONSTRUCTION

E5U091467000N14

- Installed on the steering lock.
- Forms a magnetic field near the steering lock and receives the key signal.
- The received key signal is demodulated and input to the instrument cluster.



C3U0914S010

SECURITY LIGHT CONSTRUCTION/OPERATION

E5U091467000N15

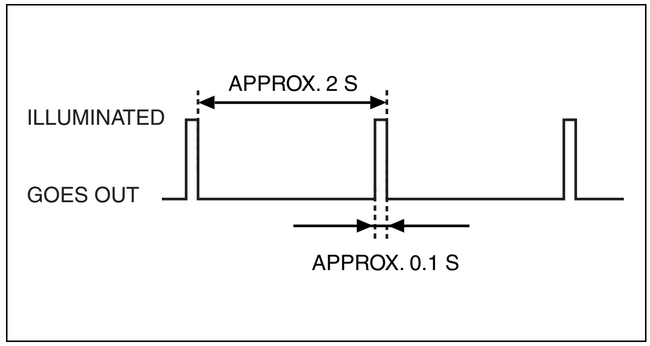
Construction

- Allows visual confirmation of immobilizer system operation.
- If any malfunction is detected in the immobilizer system, the malfunction location can be verified by the security light flashing pattern.

Note
- If there is security light system malfunction, DTCs may not be properly displayed. Always use the WDS or equivalent to verify DTCs.

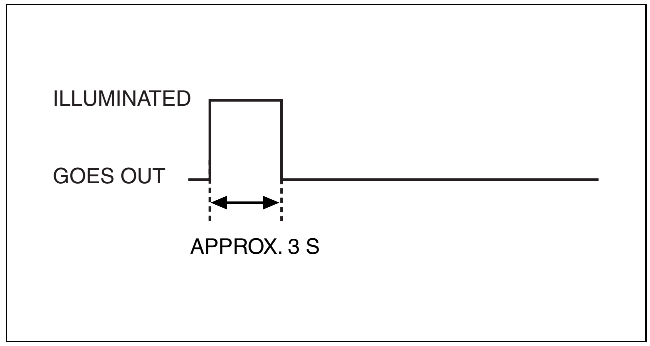
Operation

- When the immobilizer system is operating, the security lights flash repeatedly **0.1 s every 2 s**.



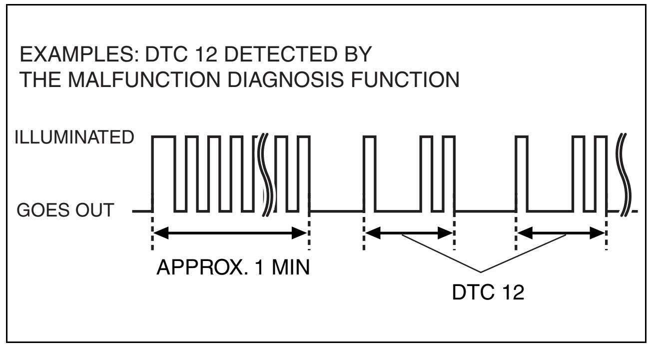
C3U0914S011

- When the immobilizer system is released normally, the security light illuminates **for 3 s** and then goes off when the ignition switch is turned to the ON position.
- If the immobilizer system is not released normally (malfunction detected by the malfunction diagnosis function), the security light displays a DTC. If this occurs, the security lights flash or illuminates **for 1 min** and then displays the DTC when the ignition switch is turned to the ON position.
  — DTC 16 and lower: Flashes
  — DTC 21 and higher: Illuminated



C3U0914S012

Note
- The security lights flash to display the DTC **10 times**.
- If multiple DTCs that can be confirmed with the security light are detected, only the DTC with the lowest number of those detected will be displayed by the security light.



C3U0914S013

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [IMMOBILIZER SYSTEM]

E5U091467000N16

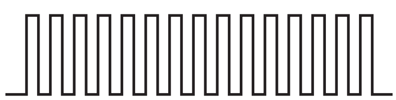
- The immobilizer system is provided with a malfunction diagnosis function.
- Malfunction diagnosis of the immobilizer system occurs automatically when the ignition switch is turned from the LOCK (ACC) to the ON (START) position.
- If the results of the malfunction diagnosis show a malfunction in the immobilizer system, the security light displays a DTC. At the same time, DTCs are stored in the PCM and instrument cluster. The stored DTCs can be verified using the WDS or equivalent.

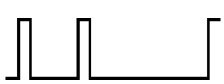
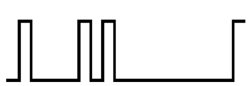
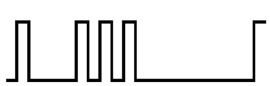
Caution
- **Always use the WDS or equivalent to verify DTCs even if the security light display a DTC. If the security light itself has a malfunction, it is possible that a DTC may not be properly displayed. There are certain DTCs which can only be verified using the WDS or equivalent, not the security light.**
- **DTCs for the immobilizer system that are stored in the instrument cluster and PCM are cleared when the ignition switch is turned from the ON to the LOCK (ACC) position.**

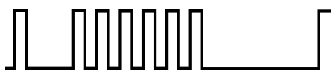
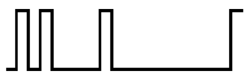
Note
- If two or more malfunctions are detected as a result of malfunction diagnosis, only the DTC with the lowest number of those detected will be displayed by the security light. However, multiple DTCs are stored at the same time.
- If two or more immobilizer system DTCs are verified, first repair the part indicated by the security light displayed DTC. After completely repairing one location, turn the ignition switch from the LOCK to the ON position and perform immobilizer system malfunction diagnosis.

DTC Table

Note
- In the approx. 1 min after detecting a malfunction and before displaying the DTC, the security light will illuminate or flash the following patterns:

Security light flashing pattern (Before displaying DTC)	DTC
ILLUMINATED / GOES OUT 	11, 12, 13, 14, 15, 16
ILLUMINATED / GOES OUT 	21, 22, 23

DTC				Detection condition
Security light flashing pattern		WDS or equivalent display*		
		Instrument cluster	PCM	
11		B1681	P1260	No detected communication with the coil
12		B2103	P1260	• Coil antenna malfunction • The PCM determined a malfunction in the coil antenna even though it is normal.
13		B1600	P1260	The key ID number data cannot be read.
		B2431	P1260	Key ID number registration error

DTC				Detection condition
Security light flashing pattern		WDS or equivalent display*		
		Instrument cluster	PCM	
14		B1602	P1260	The instrument cluster cannot read key ID number data normally.
15		B1601	P1260	The instrument cluster has detected unregistered key ID number.
16		U2510	P1260	Communication error between the instrument cluster and the PCM (no response)
		U1147	P1260	Communication error between the instrument cluster and the PCM (mismatched conditions)
21		B1213	P1260	Only one key ID number is registered.
22		B2141	P1260	Communication error between the instrument cluster and the PCM (data transfer error)
23		B2139	P1260	ID number data in the PCM and the instrument cluster do not match.
Not illuminated		B1342	-	Instrument cluster malfunction

ON-BOARD DIAGNOSTIC SYSTEM (IMMOBILIZER SYSTEM) PID/DATA MONITOR FUNCTION

E5U091467000N17

- The following items can be verified:
  — Number of key ID numbers registered with the vehicle
- Use the WDS or equivalent to read the PID/data monitor.

PID/Data Monitor Table

PID name (definition)	Detected condition
NUMKEYS (Number of key ID numbers registered with the vehicle)	Number of key ID numbers registered: 0—8

09–16 EXTERIOR TRIM

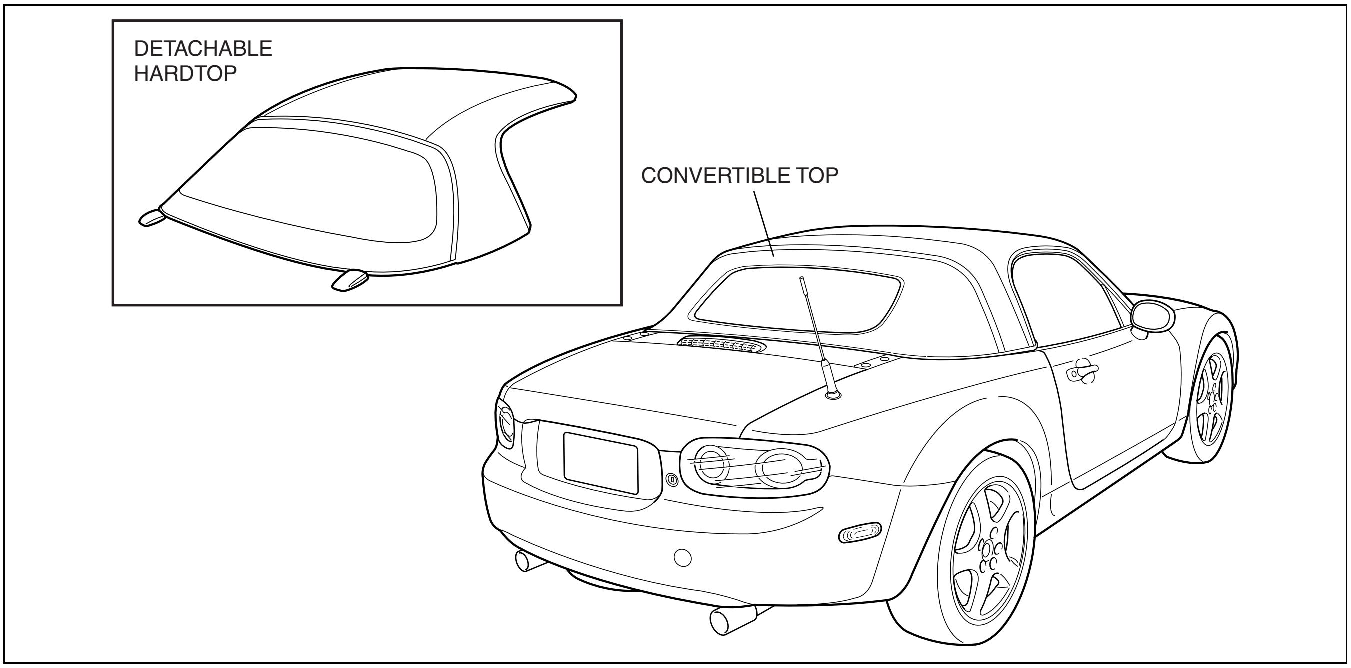
EXTERIOR TRIM OUTLINE

E5U091600000N01

- Convertible top has been adopted.
- Folded type convertible top has been adopted.
- Detachable hardtop has been adopted.

EXTERIOR TRIM STRUCTURAL VIEW

E5U091600000N02



E5U916ZS9000

09–17 INTERIOR TRIM

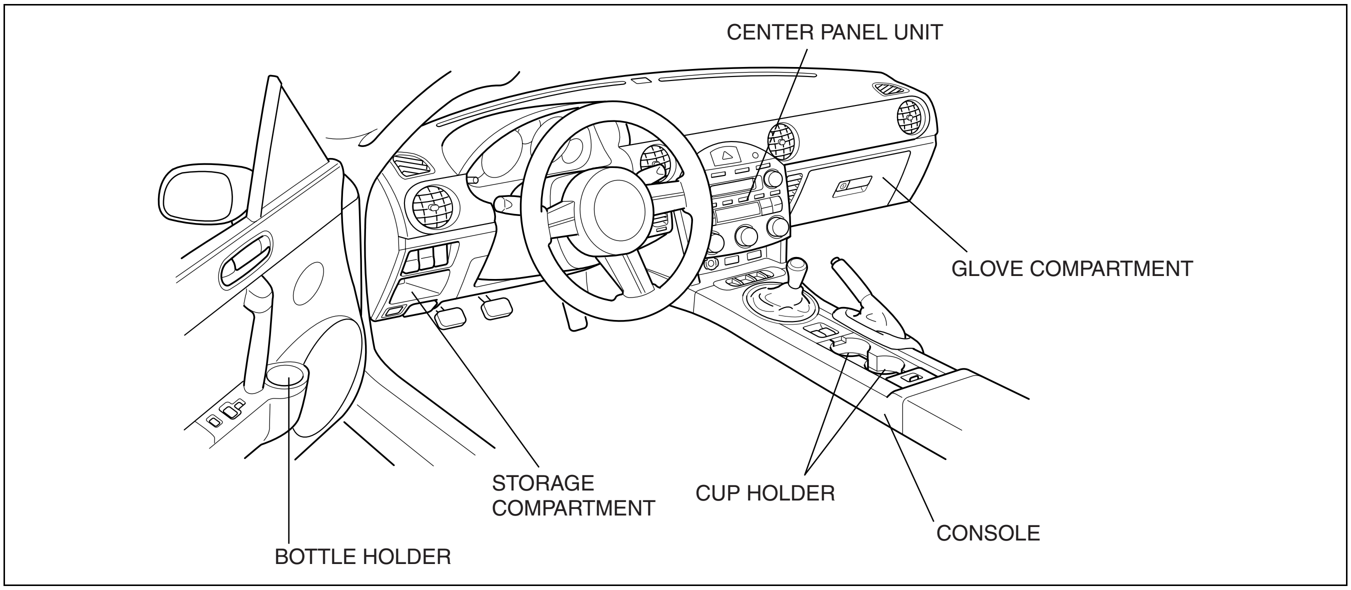
INTERIOR TRIM OUTLINE

E5U091755000N01

- The center panel unit with integrated audio and climate control units, is located at the center of the dashboard panel. This improves functionality and gives a unified appearance.
- Various storage spaces have been added.

INTERIOR TRIM STRUCTURAL VIEW

E5U091755000N02



E5U917ZS5000

09–18 LIGHTING SYSTEMS

LIGHTING SYSTEMS OUTLINE

E5U091800000N01

- 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
- Ignition key illumination that illuminates the ignition key slot adopted

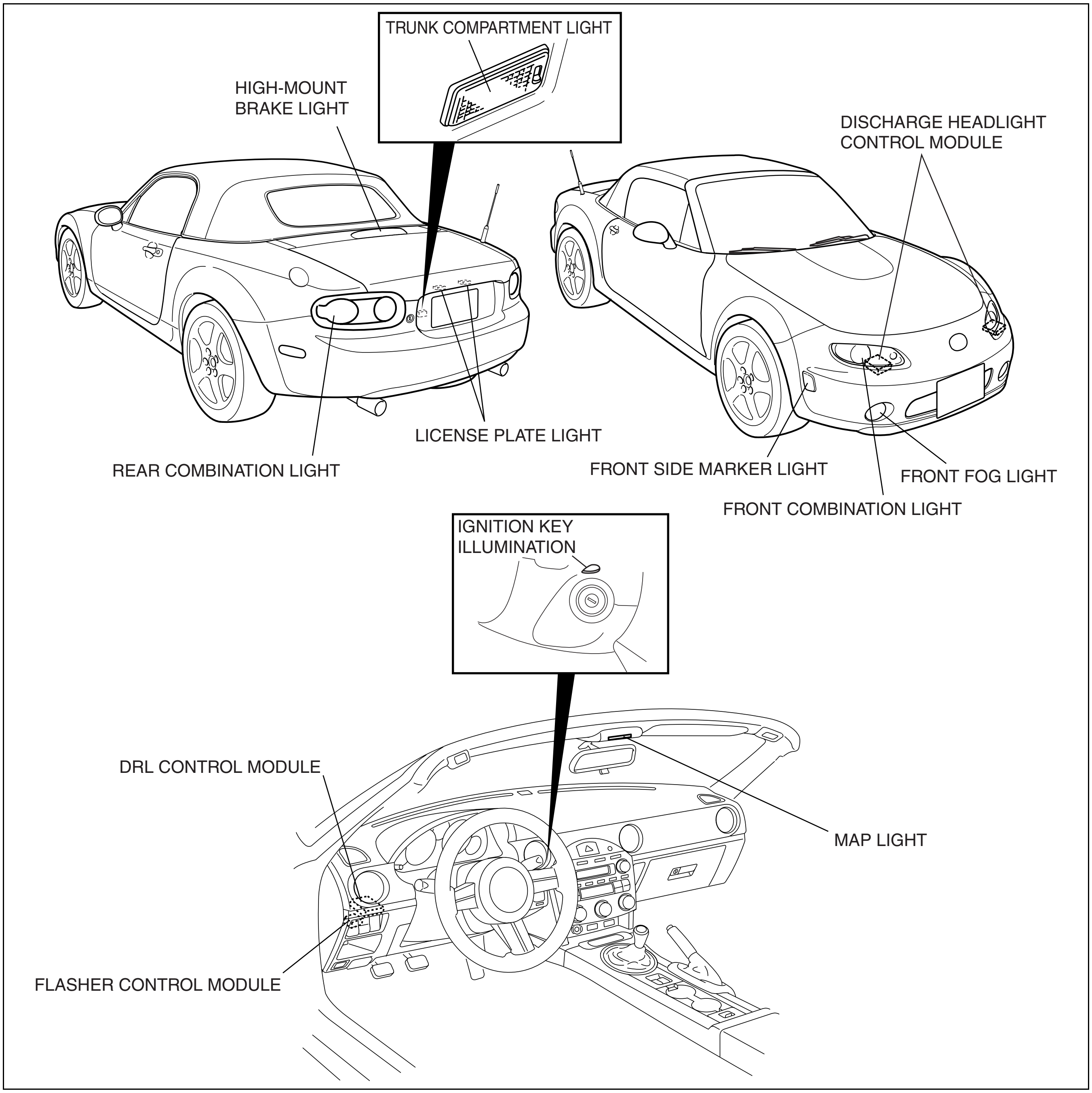
LIGHTING SYSTEMS SPECIFICATION

E5U091800000N02

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	5 × 2
	Brake/taillight bulb	21/5 × 2
	Rear turn light bulb	21 × 2
	Back-up light bulb	18 × 2
	License plate light bulb	5 × 1
	High-mount brake light bulb (LED)	1
Interior light bulb capacity (W)	Map light bulb	10 × 1
	Trunk compartment light bulb	8 × 1
	Ignition key illumination bulb	1.4 × 1

LIGHTING SYSTEMS STRUCTURAL VIEW

E5U091800000N03

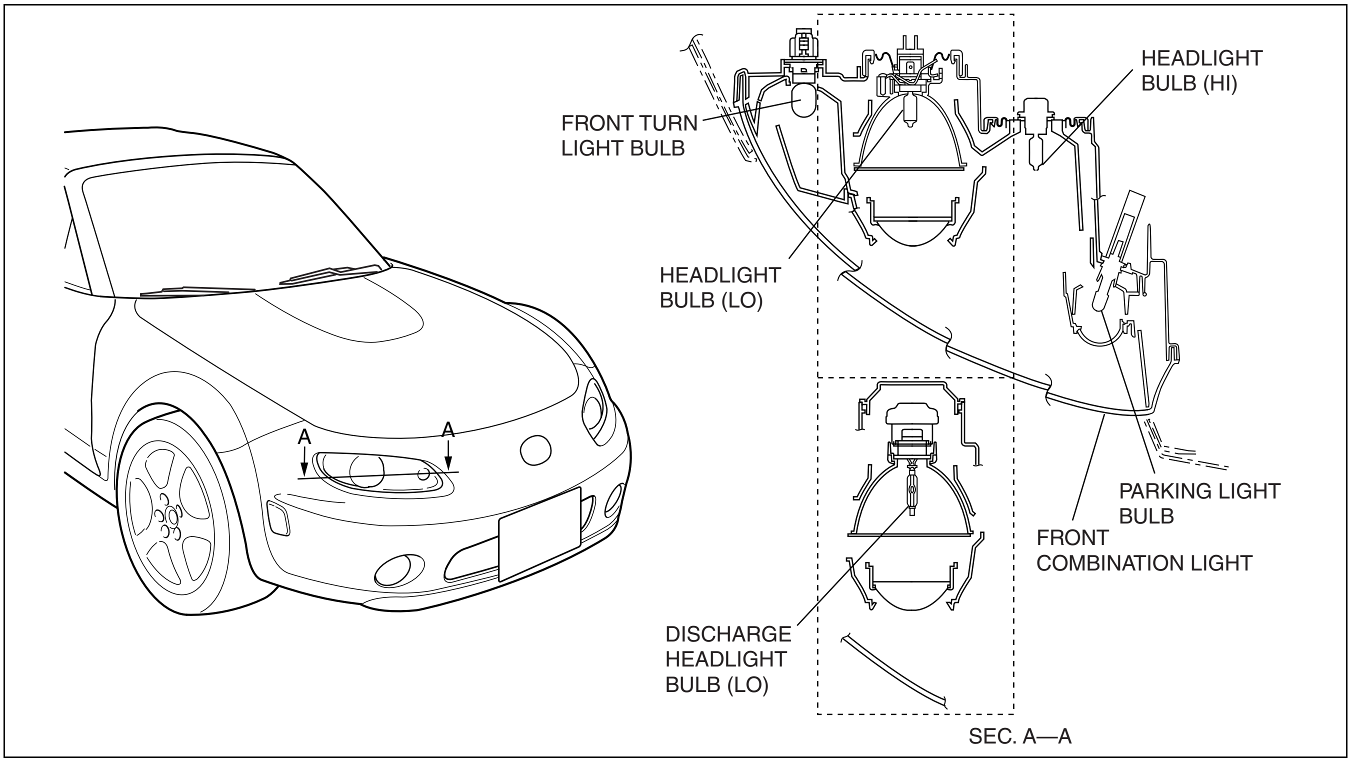


E5U918ZS5101

FRONT COMBINATION LIGHT CONSTRUCTION

E5U091851060N01

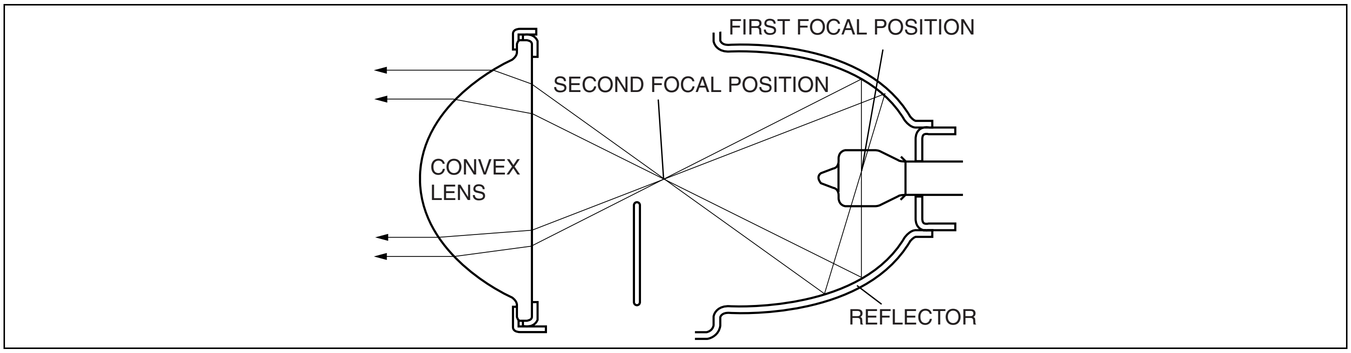
- A headlight with built-in front turn light and parking light has been adopted for design improvement.
- Projector type headlights have been adopted, and these have been incorporated, along with the front turn light and the parking light, into a single unit to reduce size.
- Discharge headlights, with a wide illumination area and projection of white light with a hue similar to sunlight, have been adopted.



E5U918ZS5102

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

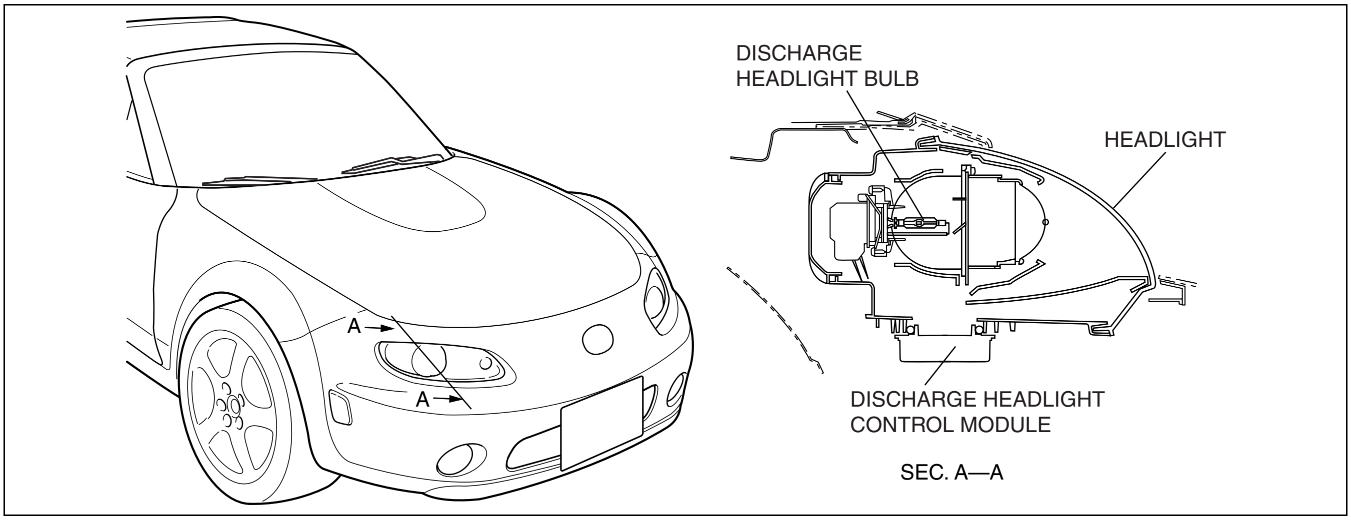
E5U091851030N01

- Compared with the current model, the illumination area is wider. Moreover, due to projection of white light with a hue similar to sunlight, night visibility while driving has been improved.
- The gas discharge bulb is efficient with low power consumption and high luminosity.

09–18

DISCHARGE HEADLIGHT STRUCTURAL VIEW

E5U091851030N02

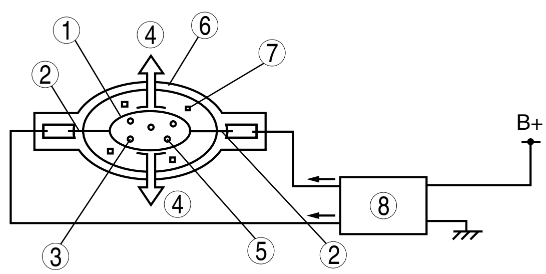


E5U918ZS5103

DISCHARGE HEADLIGHT OPERATION

E5U091851030N03

1. A high voltage pulse (alternating current **approx. 25,000 V**) travelling from the discharge headlight control module is applied between both discharge headlight bulb terminals, energizing the xenon gas in the bulb.
2. Due to the energizing of the xenon gas, the temperature of the discharge headlight bulb interior increases, vaporizing the mercury and discharging an arc.
3. Due to the mercury and discharging of 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.



B3E0918T121

1	Metallic atoms
2	Terminal
3	Metallic iodide
4	Light

5	Mercury
6	Discharge headlight bulb
7	Xenon gas
8	Discharge headlight control module

DISCHARGE HEADLIGHT CONTROL MODULE FUNCTION

E5U091851030N04

- 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.

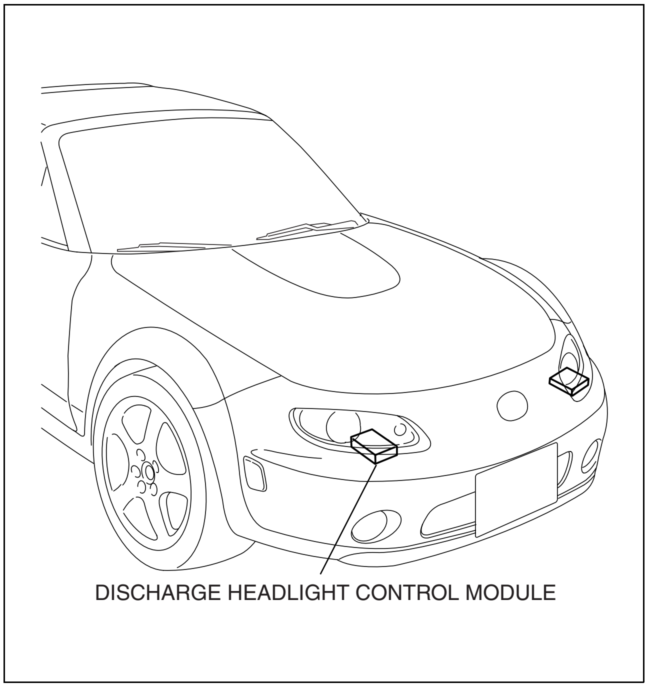
DISCHARGE HEADLIGHT CONTROL MODULE CONSTRUCTION/OPERATION

E5U091851030N05

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 MX-5 Workshop Manual.)**

- Built into the headlight and installed on the front combination light lower side.
- Switches the direct current from the battery to alternating current (**25,000 V**) and optimally controls the current supply output to the bulb.

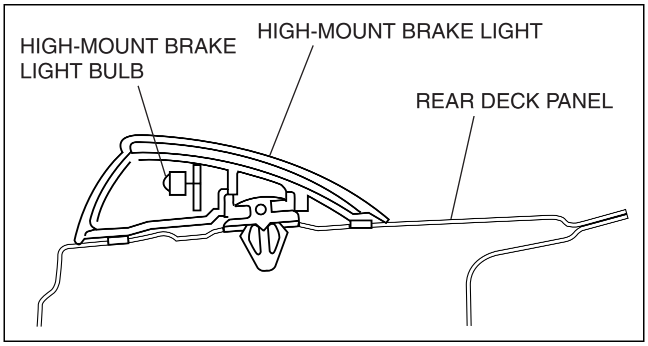


E5U918ZS5104

HIGH-MOUNT BRAKE LIGHT CONSTRUCTION

E5U091851580N01

- Installed to the rear deck panel with the clips.
- Using LED has resulted in reduced energy consumption.



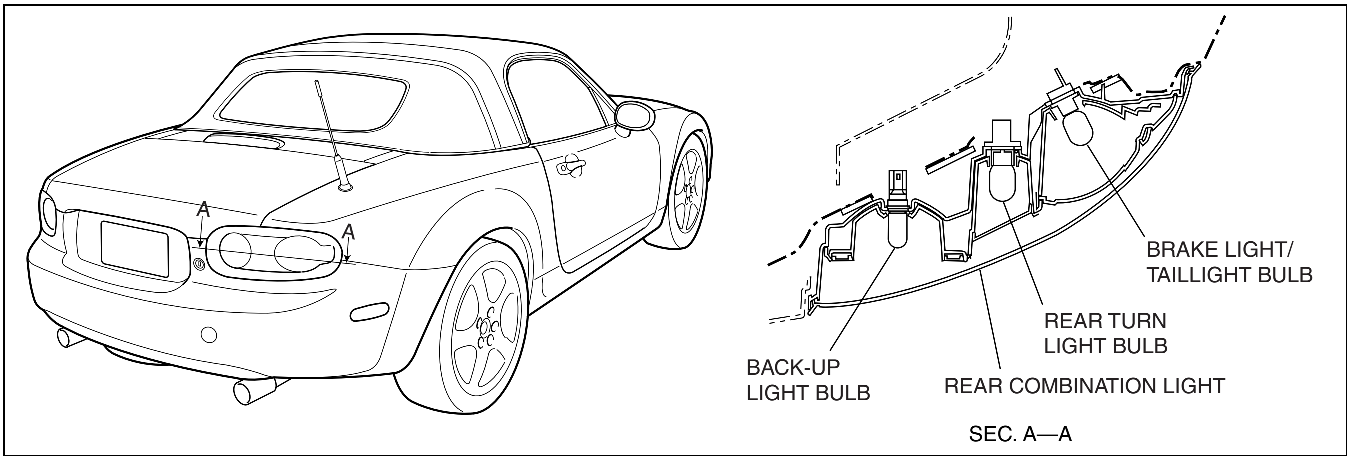
E5U918ZS5009

09–18

REAR COMBINATION LIGHT CONSTRUCTION

E5U091851150N01

- 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.

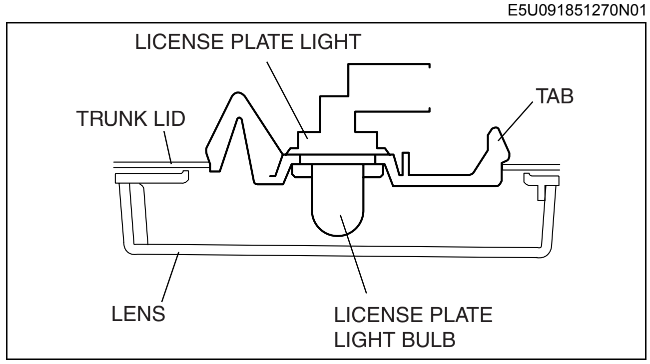


E5U918ZS5005

LICENSE PLATE LIGHT CONSTRUCTION

E5U091851270N01

- Installed to the trunk lid with the connecting tabs.



E5U918ZS5006

DRL SYSTEM OUTLINE

E5U091800200N01

- The DRL system automatically operates the low-beam headlights when the ignition switch is turned to the ON position.

DRL SYSTEM OPERATION

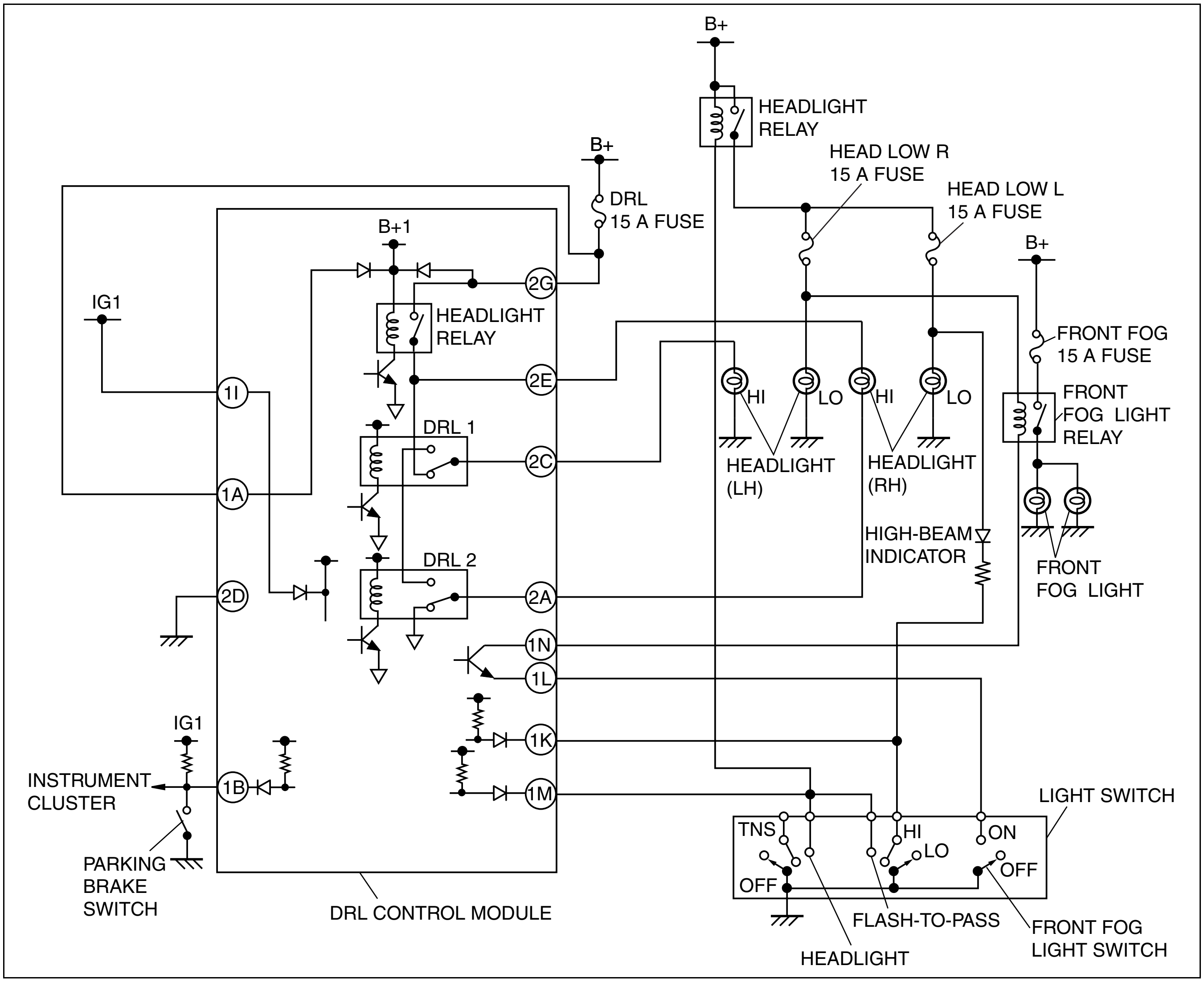
E5U091800200N02

- The DRL 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**	**Front fog light**
ON	OFF	OFF TNS	OFF	-	Illuminates (DRL)	-
			ON	Illuminates	Illuminates	-
		HEAD	OFF	Illuminates	-	Illuminates
			ON	Illuminates	Illuminates	-
	ON	OFF TNS	OFF	-	-	-
		HEAD		Illuminates	-	Illuminates
LOCK	-	OFF TNS	OFF	-	-	-

DRL SYSTEM WIRING DIAGRAM

E5U091800200N03

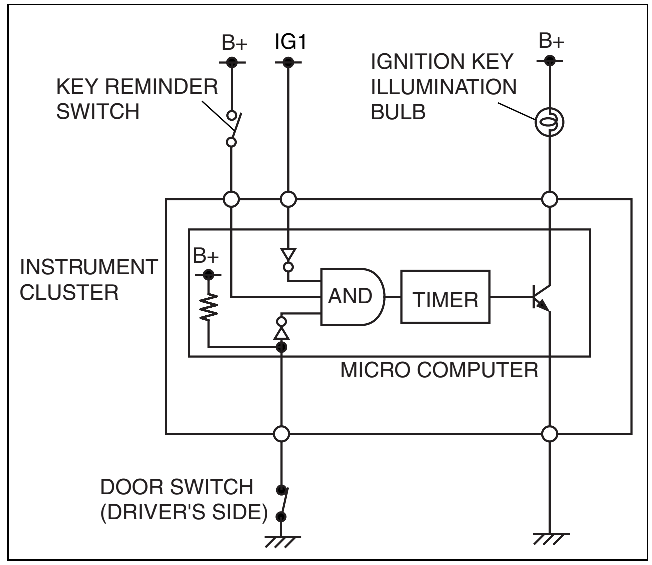


E5U918ZS5110

IGNITION KEY ILLUMINATION FUNCTION

E5U091851311N05

- 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.



E5U918ZS5011

IGNITION KEY ILLUMINATION OPERATION

E5U091851311N06

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 min** after ignition key illumination begins.

09–19 WIPER/WASHER SYSTEM

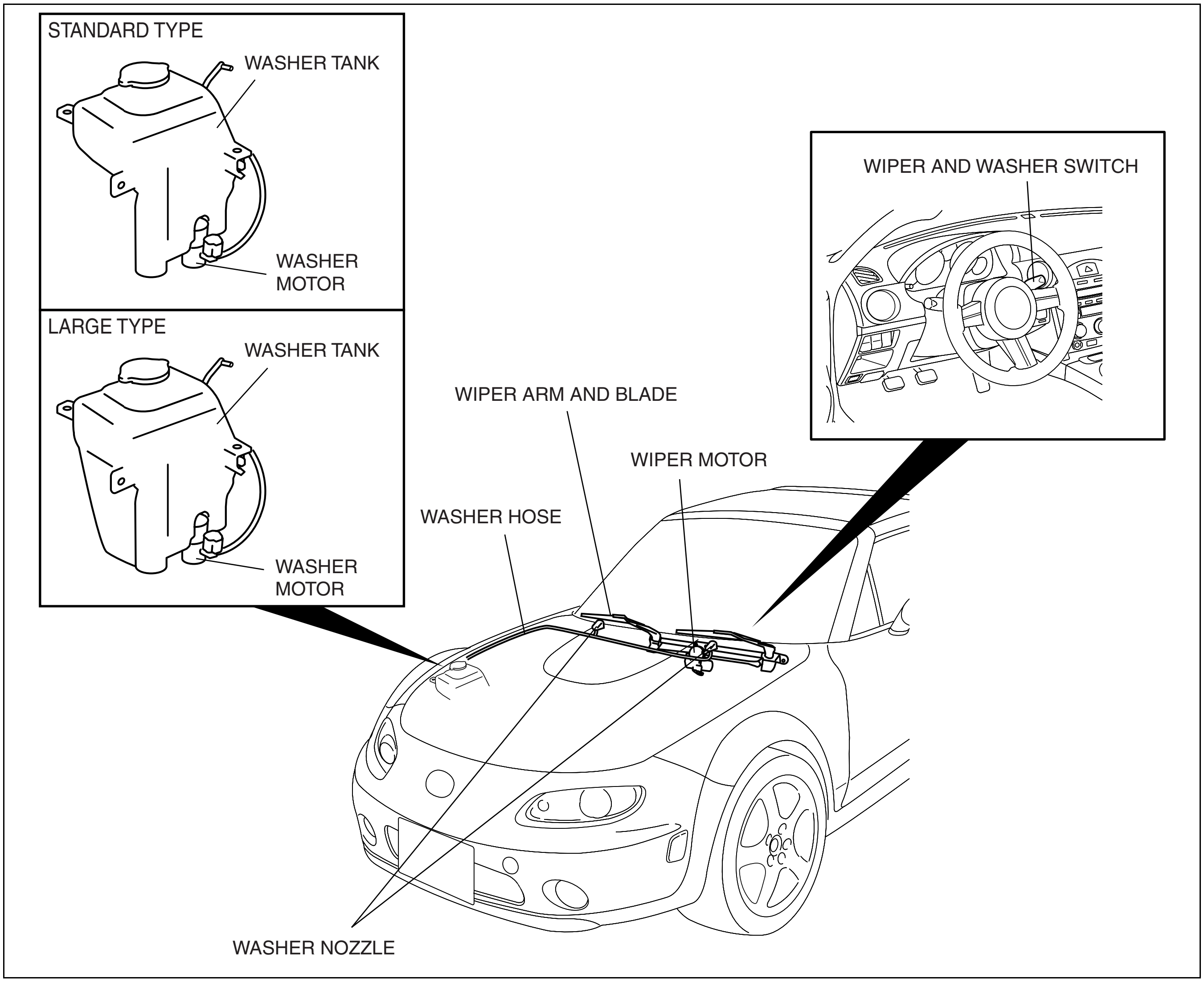
WIPER/WASHER SYSTEM OUTLINE

E5U091900000N01

Improved marketability	• The intermittent wiper relay is built into the wiper and washer switch.

WIPER/WASHER SYSTEM STRUCTURAL VIEW

E5U091900000N02



E5U919ZS5101

09–19

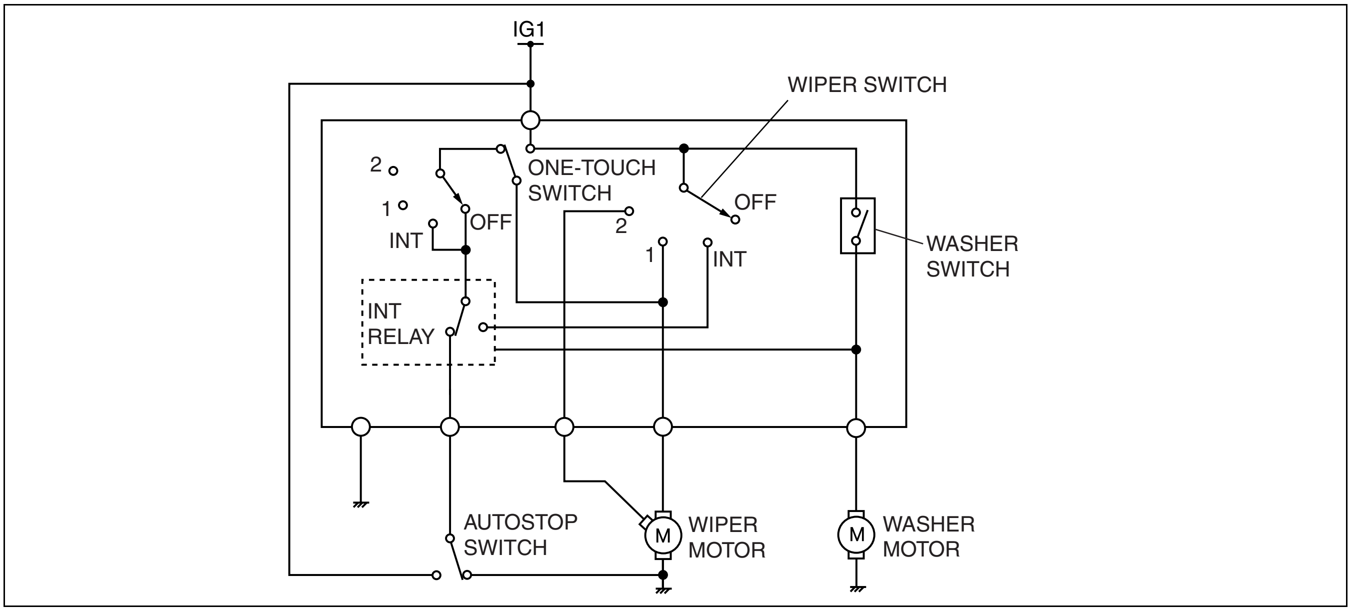
WIPER SYSTEM OUTLINE

E5U091900000N03

- The wiper system has autostop function, one-touch function, and intermittent function with various timings.

WIPER SYSTEM WIRING DIAGRAM

E5U091900000N04



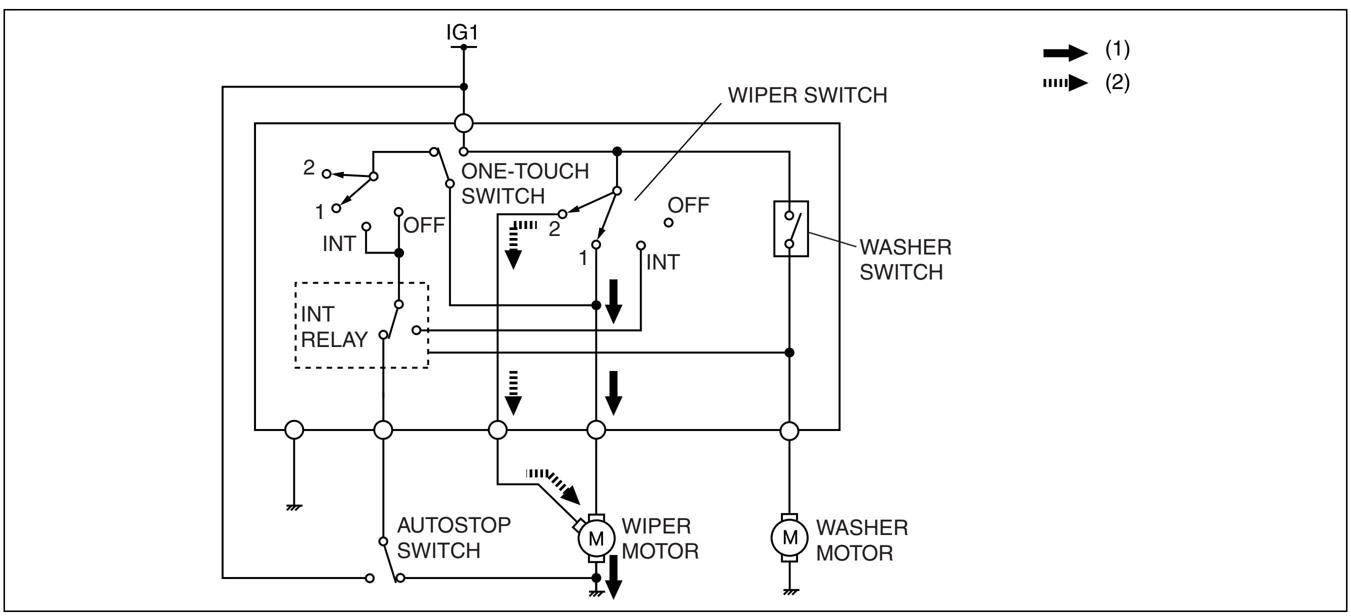
E5U919ZS5002

WIPER SYSTEM OPERATION

E5U091900000N05

Low Speed And High Speed Operation

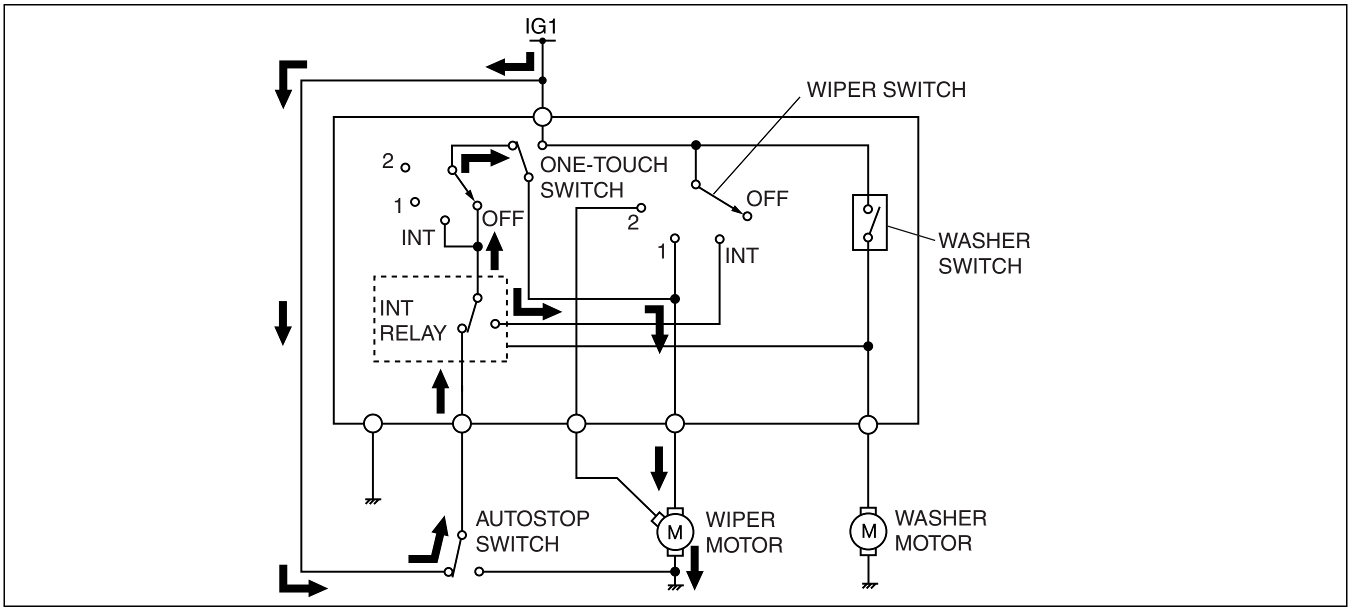
- When the wiper switch moves to the 1 (low) position, current (1) flows through the wiper switch to the wiper motor, then to ground. The wipers operate at low speed.
- When the wiper switch moves to the 2 (high) position, current (2) flows through the wiper switch to the wiper motor, then to ground. The wipers operate at high speed.
- When the wiper switch returns to the OFF position, the autostop function activates and the wipers stop at the park position.



E5U919ZS5003

Autostop Function

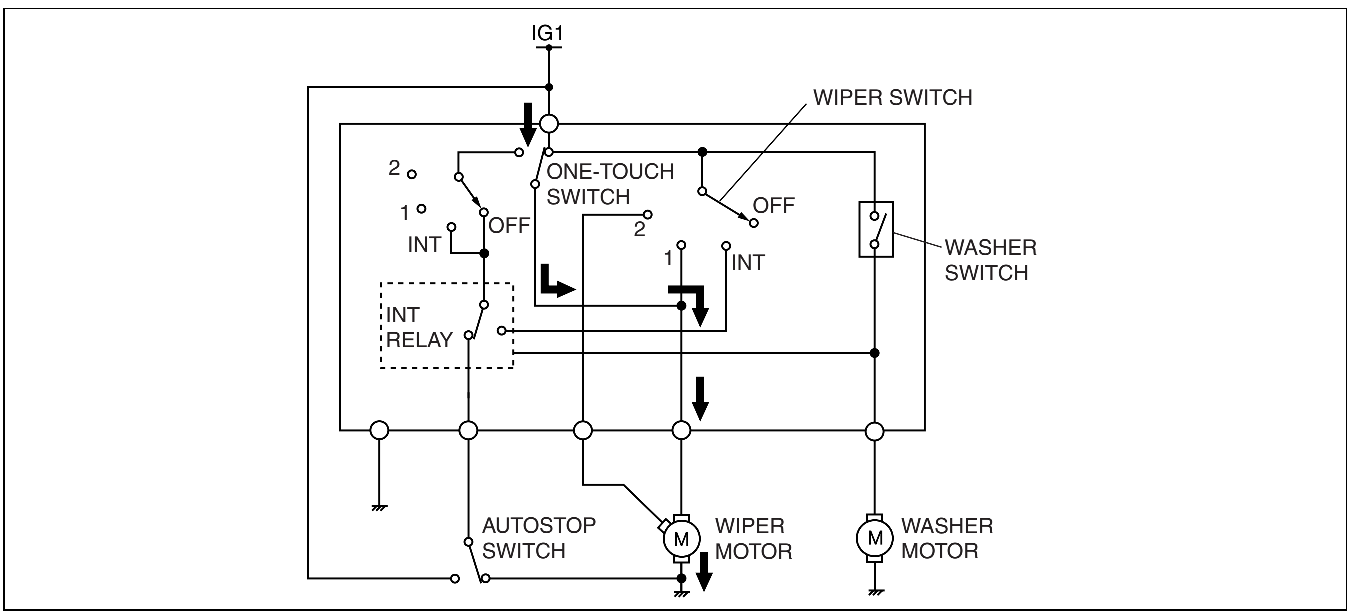
- While the wipers are operating, the autostop switch remains on except when the wipers are in the park position. Current flows through the INT relay to the wiper switch, wiper motor, then to ground. Thus, the wipers continue to operate until they reach the park position even if the wiper switch moves to the OFF position.



E5U919ZS5004

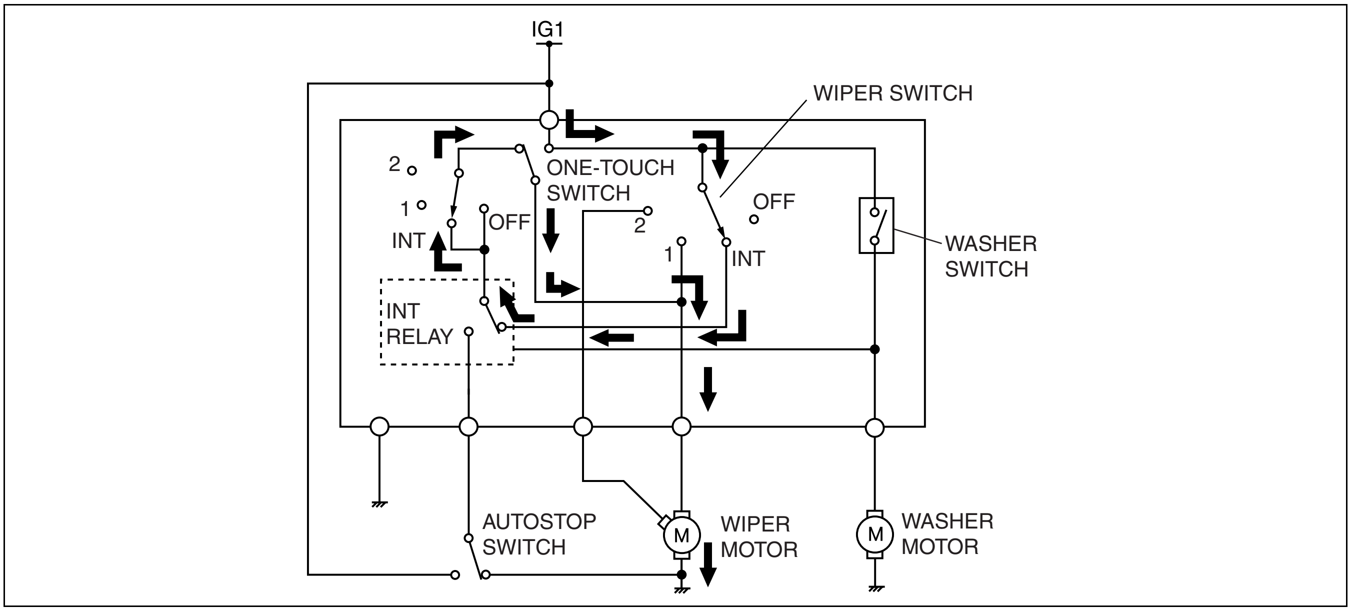
One-touch Wiper Operation

- When the wiper lever is pushed up, the one-touch switch turns on, and current flows through the one-touch switch to the 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.



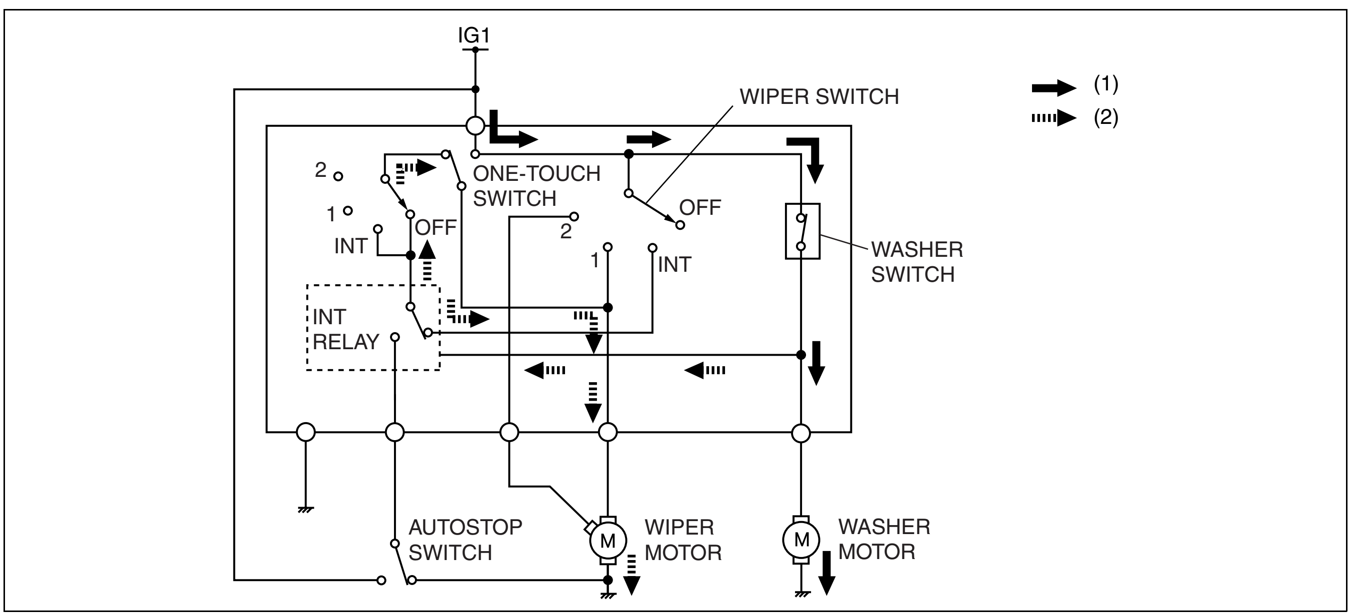
E5U919ZS5005

Intermittent Wiper Operation
- When the wiper switch moves to the INT position, the intermittent wiper (INT) relay turns on, and current flows through the INT relay to the wiper switch, wiper motor, then to ground. The wipers operate at low speed.
- When the preset period of time has passed, the INT relay turns off. The current stops flowing through the wiper motor. The autostop function activates, and the wipers stop at the park position. Cycling through this sequence of operations, the wipers operate at specified intervals.
- The INT volume provides optional settings of the wiper sweep interval (timing that the INT relay turns from off to on).



E5U919ZS5006

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 washer motor, then to ground. The 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 wiper switch, the wiper motor, then to ground. The wipers operate at low speed.



E5U919ZS5007

WASHER TANK SPECIFICATION

E5U091967480N01

Item	Standard type	Large type
Washer tank capacity	1.2 L {1.3 US qt, 1.1 Imp qt}	4.5 L {4.8 US qt, 4.0 Imp qt}

09–20 ENTERTAINMENT

ENTERTAINMENT OUTLINE

E5U092000001N01

- A center panel unit, composed of the installed audio unit and the audio switches built into the center panel, has been adopted.
- Module availability depends on vehicle grade.
- An audio control switch is equipped on the steering wheel for audio operation.
- A manual antenna has been adopted.
- The following speakers have been adopted for vehicles with standard audio system:
  - — Door speaker (2)
  - — Rear speaker (2)*1
  - — Tweeter (2)*1
- The following speakers have been adopted for vehicles with BOSE (7 speakers):
  - — Door speaker (2)
  - — Rear speaker (2)
  - — Door upper speaker (2)
  - — Center speaker (1)
- The auto level control (ALC) function has been adopted. (vehicles with standard audio system)
- The noise-response sound compensation system (AudioPilot*2) has been adopted. (vehicles with BOSE)
- A condenser has been installed on the rear window defroster for improved noise reduction.
- All information related to the audio system is displayed on the information display.

*1 : May or may not be equipped, depending on the vehicle.

*2 : “AudioPilot” is a registered trademark of Bose Corporation.

AUDIO SYSTEM SPECIFICATIONS

E5U092000001N05

Audio Unit

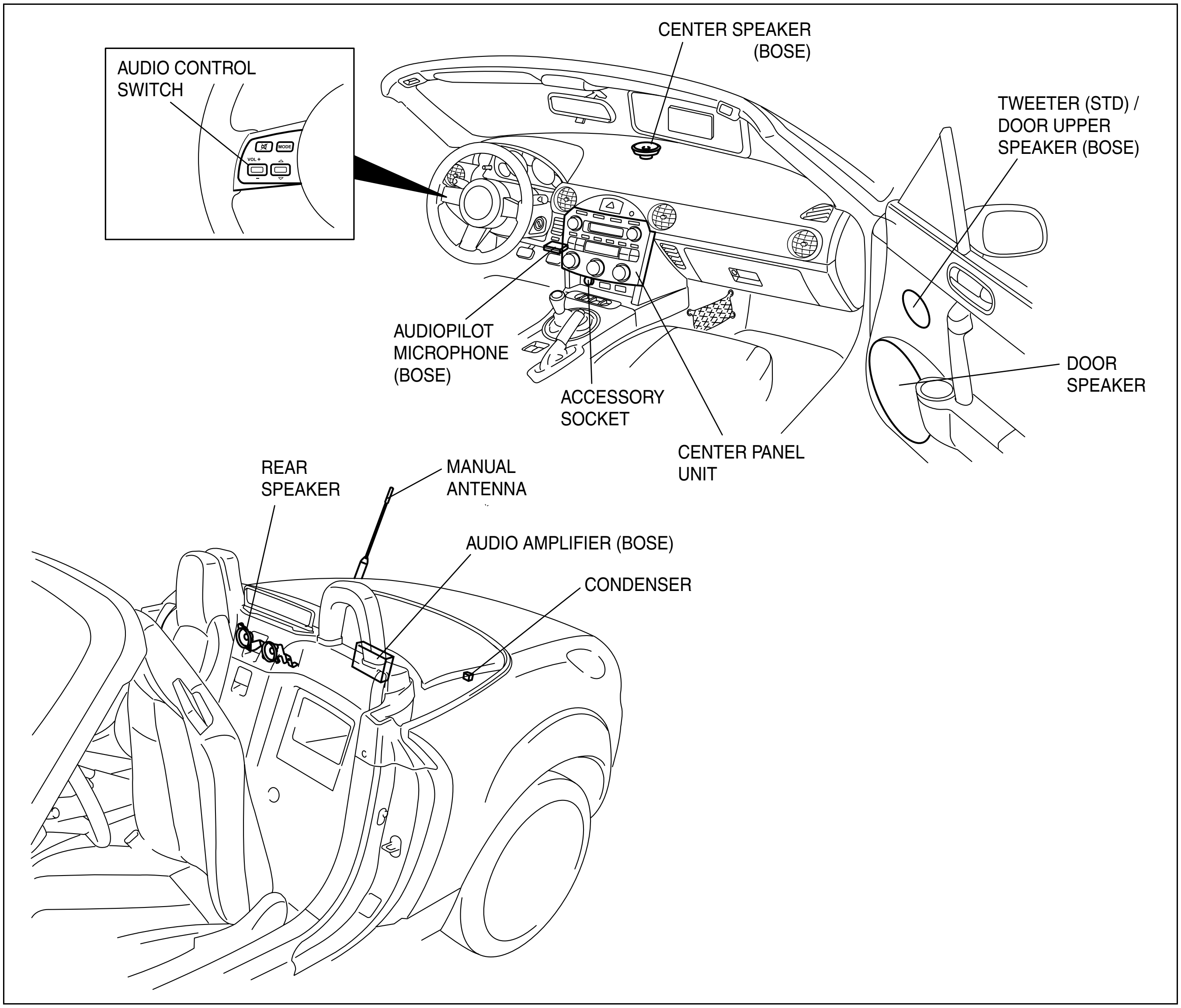
Item			Specification	
			BOSE	Standard
Rated voltage		(V)	12	
Frequency band	AM	(kHz)	Type A : 530—1710, Type B : 522—1629	
	FM	(MHz)	Type A : 87.7—107.9, Type B : 87.5—108	
Audio amplifier maximum output power		(W)	External type audio amplifier Door speaker : 74 × 2 Rear speaker : 18.5 × 2 Center speaker : 18.5	40 × 4
Output impedance		(ohm)	Door speaker : 1 × 2 Rear speaker : 4 × 2 Center speaker : 4	4

Speaker

Item		Specification						
		Door speaker		Rear speaker		Tweeter / Door upper speaker		Center speaker
		Standard	BOSE	Standard	BOSE	Standard	BOSE	
Maximum input	(W)	25	74	25	18.5	25	18.5	18.5
Impedance	(ohm)	4	1	8	3.6	4	3.6	3.6
Size		5.5×7.5 in	8 in	70 mm	80 mm	30 mm	80 mm	80 mm

AUDIO SYSTEM STRUCTURAL VIEW

E5U092000001N02

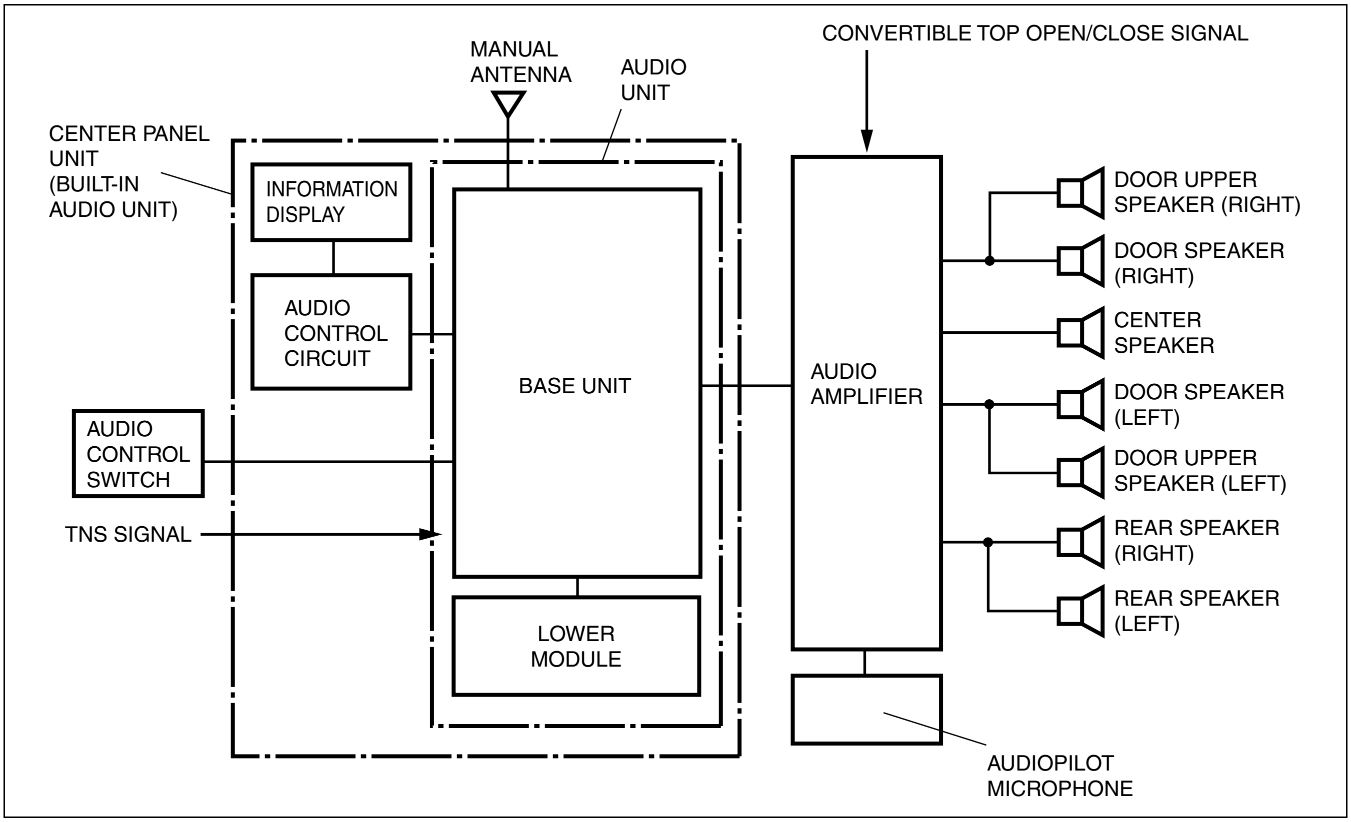


E5U920ZS5003

AUDIO SYSTEM BLOCK DIAGRAM

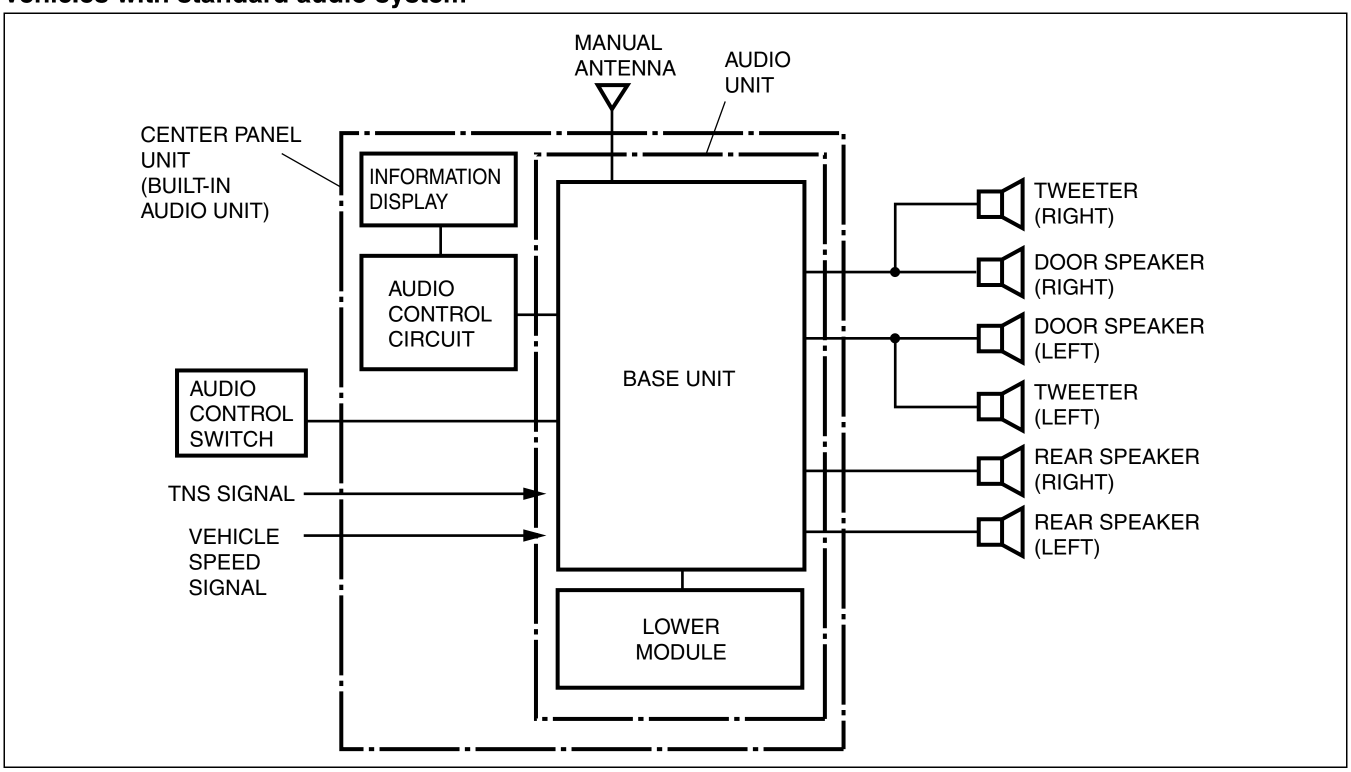
E5U092000001N06

Vehicles with BOSE



E5U920ZS5001

Vehicles with standard audio system



E5U920ZS5002

CENTER PANEL UNIT OUTLINE

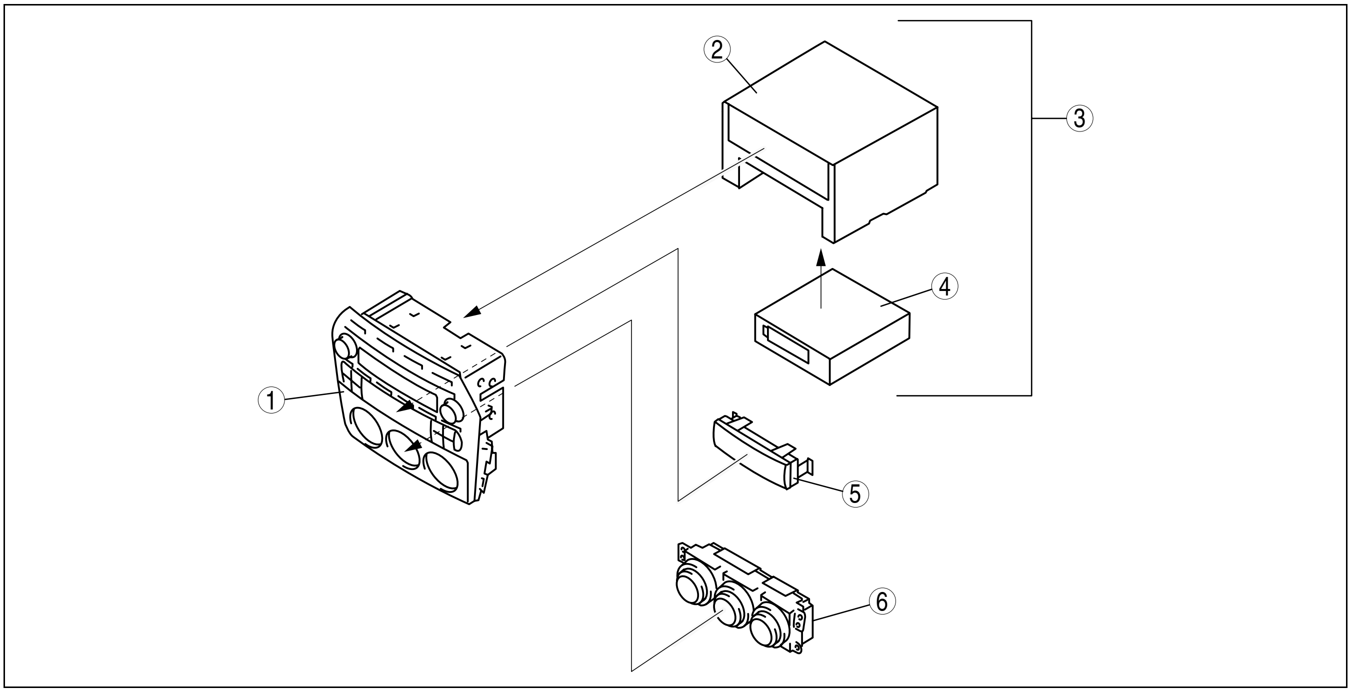
E5U092066900N01

- The center panel unit is composed of the installed audio unit and the audio switches built into the center panel.

CENTER PANEL UNIT CONSTRUCTION

E5U092066900N02

Structural View

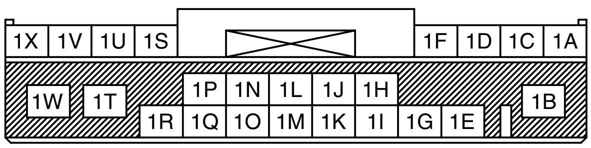


E5U920ZS5010

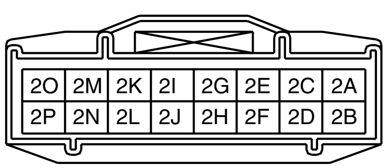
1	Center panel
2	Base unit
3	Audio unit

4	Lower module
5	Cover
6	Climate control unit

Terminal Layout and Signal
Audio unit



Terminal	Signal
1A	Door speaker LH (+)
1B	B+ (Power back up)
1C	Door speaker LH (–)
1D	Door speaker RH (+)
1E	TNS (+)
1F	Door speaker RH (–)
1G	Illumination (–)
1H	Antenna control
1I	Vehicle speed signal*2
1J	AMP control*1
1K	UART–1
1L	—
1M	UART–2
1N	Audio control switch 1
1O	—
1P	Audio control switch 2
1Q	—
1R	ACC
1S	Rear speaker LH (+)
1T	Audiopilot control*1
1U	Rear speaker LH (–)
1V	Rear speaker RH (+)
1W	Power ground
1X	Rear speaker RH (–)

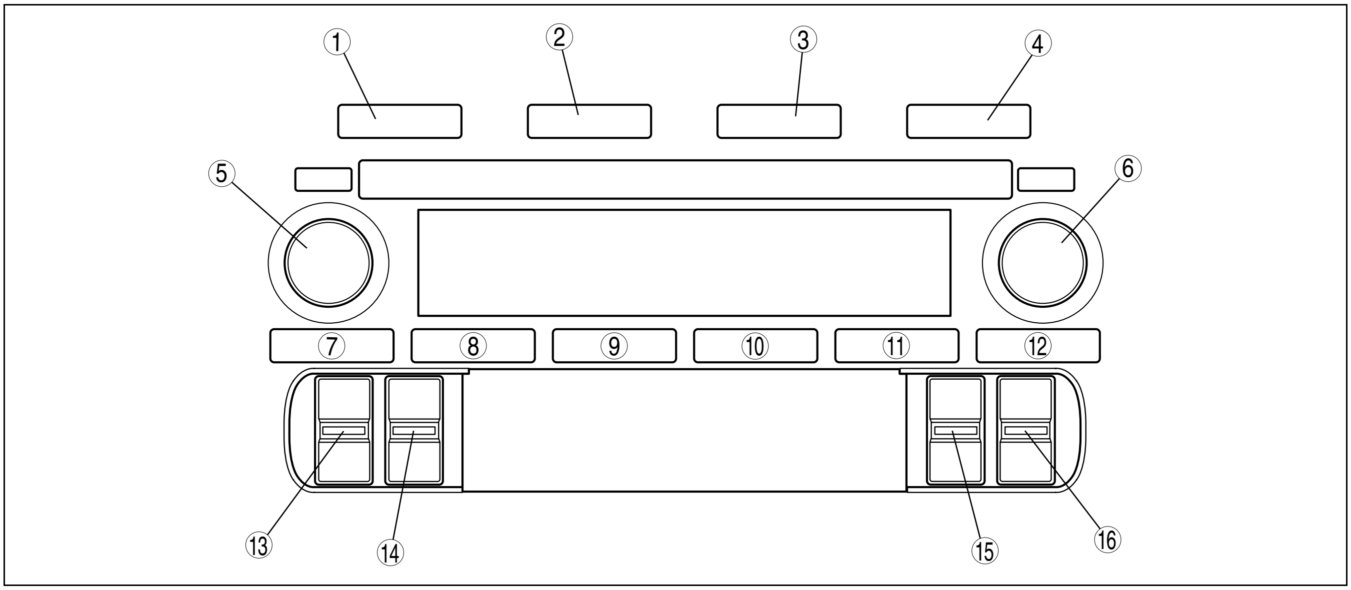


Terminal	Signal
2A	Power ground
2B	System mute
2C	Input signal RH (+)
2D	Input signal RH (–)
2E	Input signal LH (+)
2F	Input signal LH (–)
2G	Signal ground
2H	TEXT DATA
2I	TEXT CLK
2J	TNS (+)
2K	BUS (–)
2L	BUS (+)
2M	AUX control
2N	Illumination (–)
2O	ACC
2P	+B

*1 : vehicles with BOSE

*2 : vehicles without BOSE

Button and switch Location



No.	Type A	Type B
1	FM/AM button	FM 1/2 button
2	SAT button	AM button
3	CD button	
4	MEDIA button	
5	POWER/VOLUME button	AUDIO CONT/TUNE/ TEXT button
6	AUDIO CONT/TUNE/ TEXT button	POWER/VOLUME button
7	Preset button 1	
8	Preset button 2	

No.	Type A	Type B
9	Preset button 3	
10	Preset button 4	
11	Preset button 5	
12	Preset button 6	
13	SEEK switch	Fast-forward/Reverse switch
14	CLOCK switch	
15	SCAN/AUTO-M switch	
16	Fast-forward/Reverse switch	SEEK switch

AUTO LEVEL CONTROL (ALC) FUNCTION [WITHOUT BOSE]

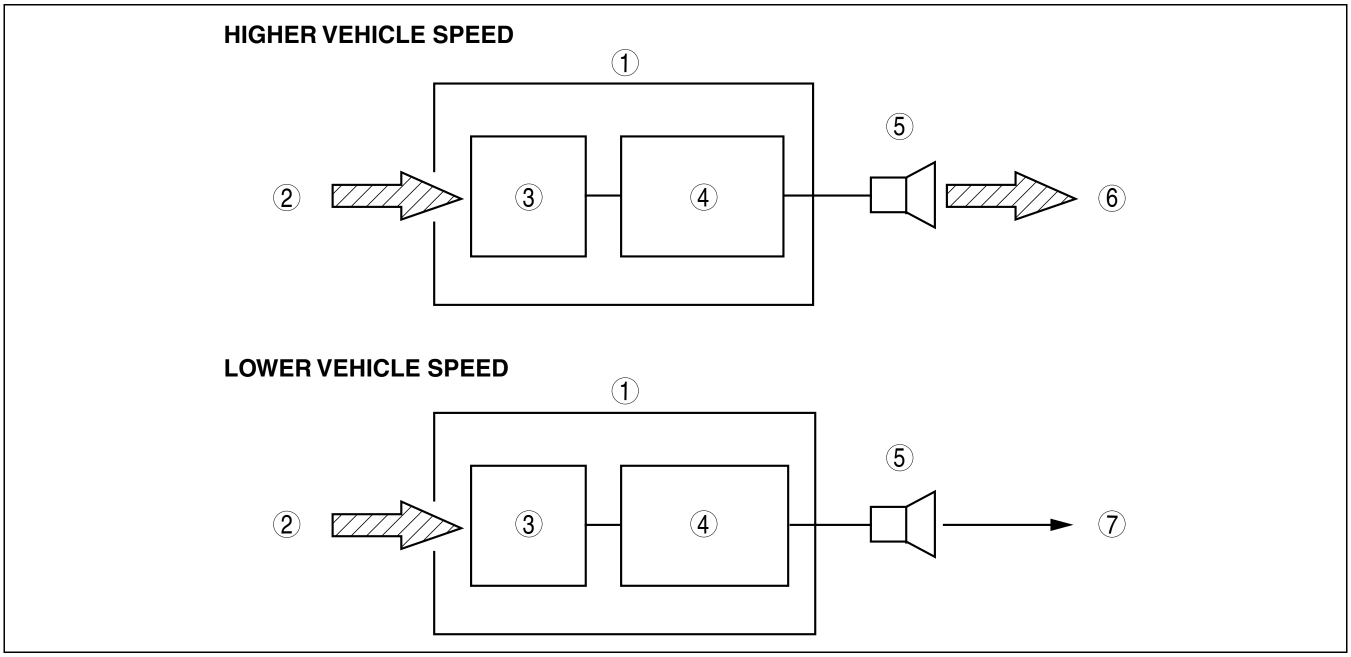
E5U092066900N03

- Adjusts the audio volume so that the sound is balanced against wind and road noise while driving.

AUTO LEVEL CONTROL (ALC) OPERATION [WITHOUT BOSE]

E5U092066900N08

- The audio unit changes the volume automatically based on the vehicle speed signal sent from the instrument cluster.



E5U920ZS5106

1	Audio unit (base unit)
2	Vehicle speed signal
3	ALC circuit
4	Power amplifier

5	Speaker
6	Higher volume
7	Normal volume

- The ALC function is divided into seven modes that can be used effectively to match the driving conditions.

Mode	Condition	
ALC OFF	ALC function cancelled	
TOP UP 1	Convertible top close	Outside road noise low
TOP UP 2		Outside road noise slightly high
TOP UP 3		Outside road noise high
TOP DWN 1	Convertible top open	Outside road noise low
TOP DWN 2		Outside road noise slightly high
TOP DWN 3		Outside road noise high

AUDIOPILOT OUTLINE [WITH BOSE]

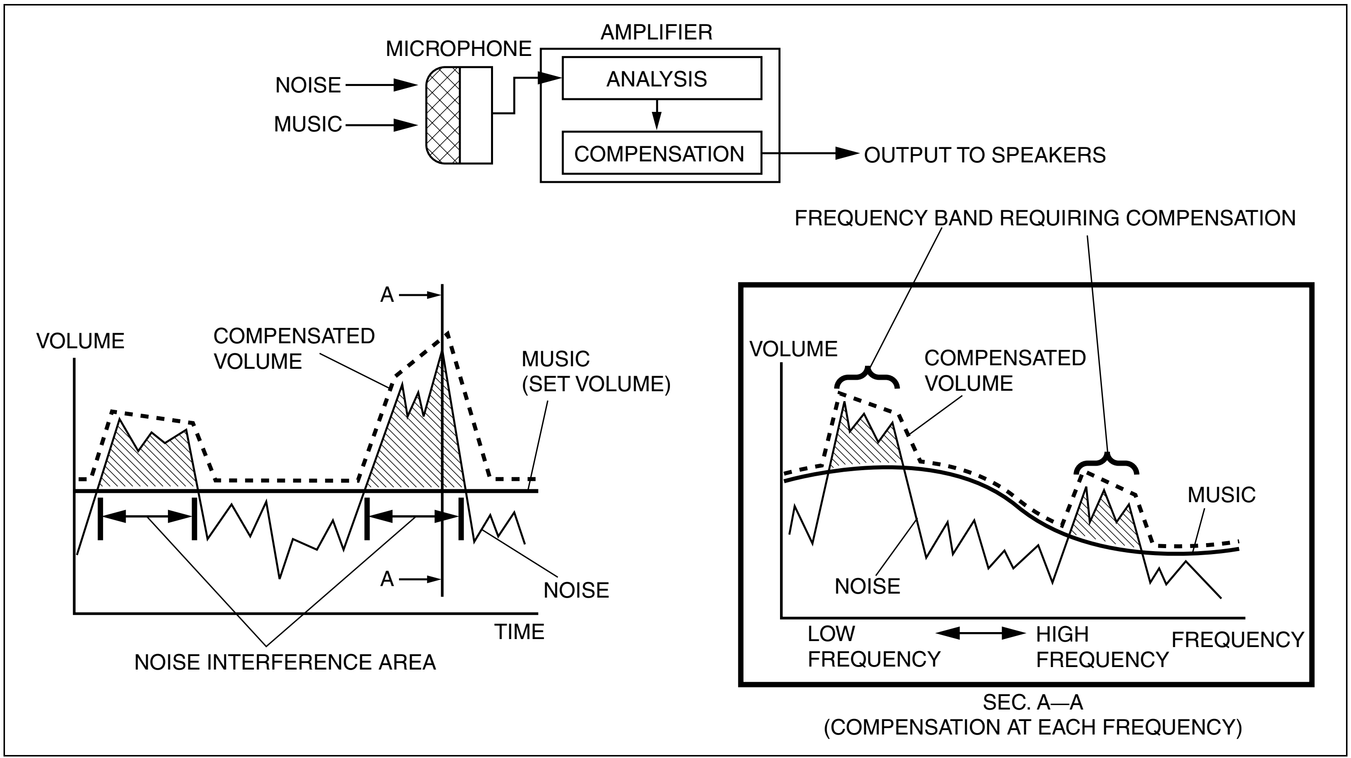
E5U092066900N06

- Measures the driving noise level inside the vehicle with a specialized microphone, and the amplifier adjusts the volume in accordance with the degree of noise masking the music component. Due to this, passengers can enjoy music at a constantly perceived volume level regardless of the noise level.

AUDIOPILOT CONSTRUCTION/OPERATION [WITH BOSE]

E5U092066900N07

- A microphone is installed on the lower panel.
- The amplifier separates the sound inside the vehicle, measured with a microphone, into music and noise, and compares the noise and music levels at each frequency. Then, volume compensation is performed for frequency bands where the noise is determined to interfere with the music.



E5U920ZS5004

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE

E5U092066900N04

- The on-board diagnostic system has a self-diagnostic function and diagnostic assist function to help technicians locate malfunctions.

ON-BOARD DIAGNOSTIC SYSTEM FUNCTION

E5U092066900N05

Self-diagnostic Function

Malfunction detection function

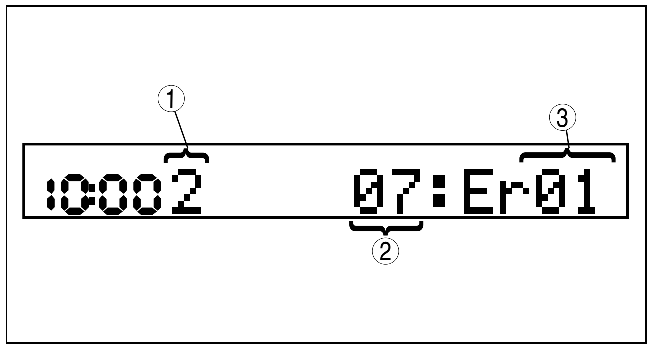
- The malfunction detection section detects malfunctions occurring in the system.

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.



E5U920ZS5201

1	Supplier code
2	Part number
3	Error code

Supplier code	Supplier name
1	SANYO Automedia
2	Panasonic
3	Clarion
4	Pioneer

Parts number	Parts name
03	CD player
05	CD changer (external)
06	CD changer (upper module)
07	MD player (lower module)
09	Base unit
10	MP3 applicable CD player
11	Sirius unit
21	Center panel
22	MP3 applicable CD changer

Error code	Malfunction description
01	Internal mechanism error
02	Servo mechanism error
03	Mechanism stuck
04	Tape malfunction
07	Disc reading error
08	Blank media
10	BUS line (communication line) error
17	Incorrect combination
18	Incorrect combination
19	Communication line
20	Insufficient power supply
21	Amplifier related circuit
22	Tuner error

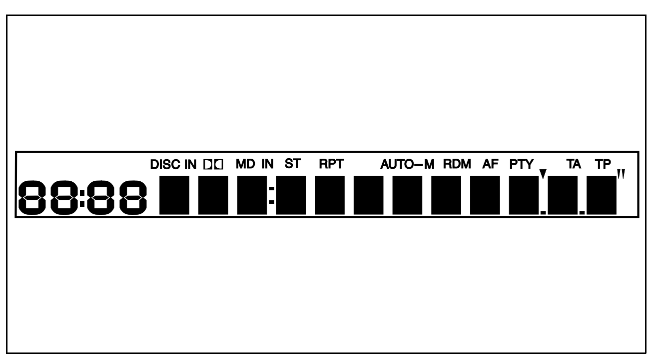
Screen display		Malfunction location
DTC	Output signal	
03: Er01	—	CD player system
03: Er02	CHECK CD	CD player system
03: Er07	CHECK CD	CD player system
03: Er10	—	CD player communication circuit system
05: Er01	—	CD changer system
05: Er07	CHECK CD	CD changer system
05: Er10	—	CD changer communication circuit system
06: Er01	—	CD changer system
06: Er02	CHECK CD	CD changer system
06: Er07	CHECK CD	CD changer system
06: Er10	—	CD changer communication circuit system
07: Er01	—	MD player system
07: Er02	CHECK MD	MD player system
07: Er07	CHECK MD	MD player system
07: Er08	—	MD system
07: Er10	—	MD player communication circuit system
09: Er20	—	Power supply circuit to base unit
09: Er21	—	Base unit (peripheral circuit for power amplifier)
09: Er22	—	Base unit (peripheral circuit for tuner)
10: Er01	—	MP3 applicable CD player system
10: Er02	CHECK CD	MP3 applicable CD player system
10: Er07	CHECK CD	MP3 applicable CD player system
10: Er10	—	MP3 applicable CD player communication circuit system
11: Er01	—	Sirius unit
11: Er03	—	Sirius unit
11: Er10	—	Sirius unit—Base unit communication line
21: Er17	—	Center panel system
21: Er18	—	Center panel system
21: Er19	—	Center panel system
22: Er01	—	CD system
22: Er02	—	CD system
22: Er07	—	CD system
22: Er10	—	MP3 applicable CD changer system
no Er	—	No DTCs stored

Diagnostic Assist Function

- The diagnostic assist function displays the operating condition of the following functions (components) and forces them to operate in order to examine whether they are malfunctioning or not.
- For the start procedure of each mode, refer to the Service Section.

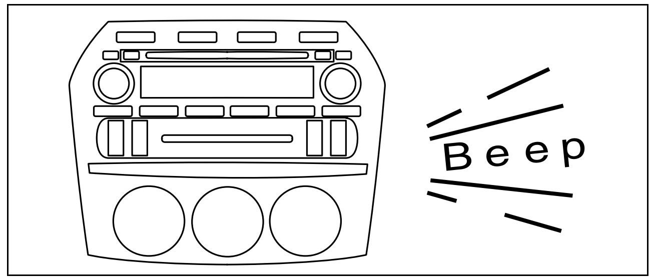
Information display

- The diagnostic assist function illuminates all characters in the information display to check for truncated or faint characters.



E5U920ZS5015

Button and switch
- The diagnostic assist function sounds the buzzer when the buttons and switches are pressed to check their operating condition.

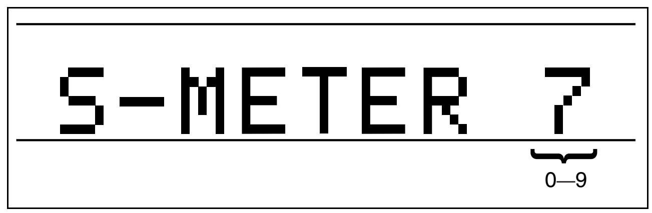


E5U920ZS5012

Speaker
With BOSE
- The diagnostic assist function outputs sound to all the speakers to determine the operating condition of the speakers and wiring harnesses between the base unit and each speaker.

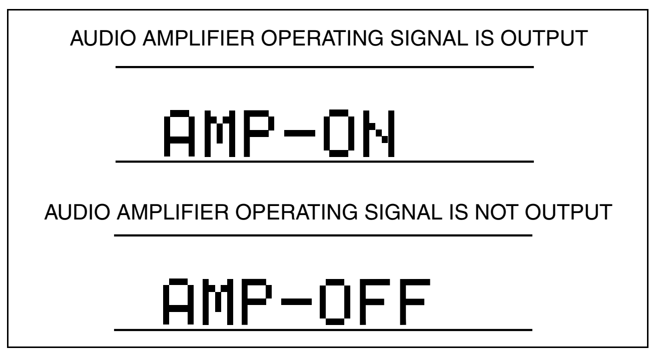
Without BOSE
- The diagnostic assist function outputs sound to the speakers in the following order to determine the operating condition of the speakers and wiring harnesses between the base unit and each speaker.
  1. Left door speaker and tweeter
  2. Right door speaker and tweeter
  3. Left rear speaker
  4. Right rear speaker

Radio
- The diagnostic assist function displays the radio reception condition in 10 levels (0-9) to assist in determining the condition of the antenna, antenna feeders, and base unit (tuner).



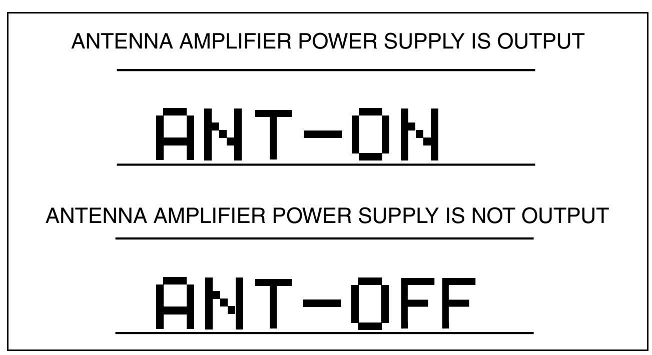
E5U920ZS5008

Audio amplifier (external)
- The diagnostic assist function displays the output state of the audio amplifier operating signal to determine the condition of the audio amplifier, base unit, and wiring harness between the base unit and audio amplifier.



E5U920ZS5009

Antenna control condition
- The diagnostic assist function displays the output state of the antenna amplifier power supply to determine the condition of the antenna amplifier, base unit, and wiring harness between the base unit and antenna amplifier.



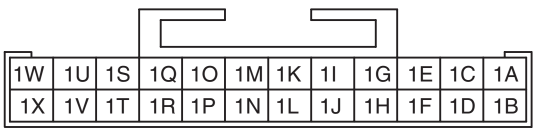
E5U920ZS5202

AUDIO AMPLIFIER CONSTRUCTION

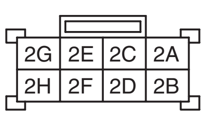
E5U092066910N01

- Located under 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



Terminal		Signal
		24-pin connector
	1A	—
	1B	AudioPilot control
	1C	—
	1D	—
	1E	Microphone (+)
	1F	Rear speaker RH input (–)
	1G	Microphone (–)
	1H	Rear speaker RH input (+)
	1I	Door speaker LH output (+)
	1J	Rear speaker LH input (–)
	1K	Door speaker LH output (–)
	1L	Rear speaker LH input (+)
	1M	Door speaker LH output (+)
	1N	Door speaker RH input (–)
	1O	Door speaker LH output (–)
	1P	Door speaker RH input (+)
	1Q	Center speaker output (+)
	1R	Door speaker LH input (–)
	1S	Center speaker output (–)
	1T	Door speaker LH input (+)
	1U	Rear speaker output (+)
	1V	AMP ON
	1W	Rear speaker output (–)
	1X	Top Open/Close



Terminal		Signal
		8-pin connector
	2A	B+
	2B	Power GND
	2C	Door speaker RH output (–)
	2D	Door speaker RH output (+)
	2E	Door speaker RH output (–)
	2F	Door speaker RH output (+)
	2G	—
	2H	—

DOOR SPEAKER CONSTRUCTION

E5U092066961N01

- Located in the door trim.
- BOSE-manufactured speakers have been adopted for vehicles with BOSE (all speakers).

REAR SPEAKER CONSTRUCTION

E5U092066961N02

- Located on the center of the back tray.
- BOSE-manufactured speakers have been adopted for vehicles with BOSE (all speakers).

CENTER SPEAKER CONSTRUCTION

E5U092066961N03

- Located at the center of the dashboard.

TWEETER CONSTRUCTION

E5U092068966N01

- Tweeters (high-frequency speaker) are installed in the door trim, providing wide-range sound.

DOOR UPPER SPEAKER CONSTRUCTION

E5U092068966N02

- The door upper speakers (speakers for middle and upper register sound range) have been installed to the upper part of the left and right doors, improving the sound quality and output.

MANUAL ANTENNA CONSTRUCTION

E5U092066939N01

- For improved convenience, the manual antenna is removable.
- An amplifier which amplifies the received radio signals and sends them to the audio unit has been built into the manual antenna .

AUDIO CONTROL SWITCH OUTLINE

E5U092000148N01

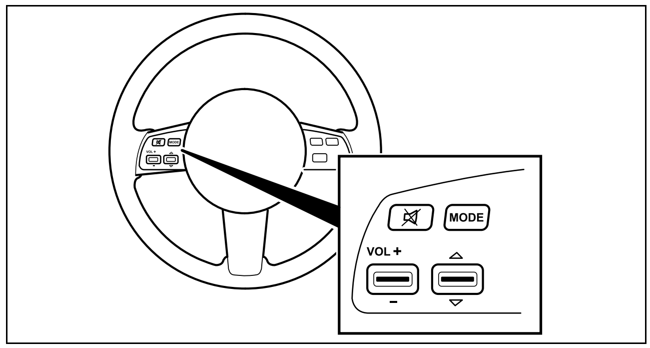
- A steering wheel remote control for the audio system, with simplified design for easy operation, has been adopted.

AUDIO CONTROL SWITCH CONSTRUCTION/OPERATION

E5U092000148N02

Construction

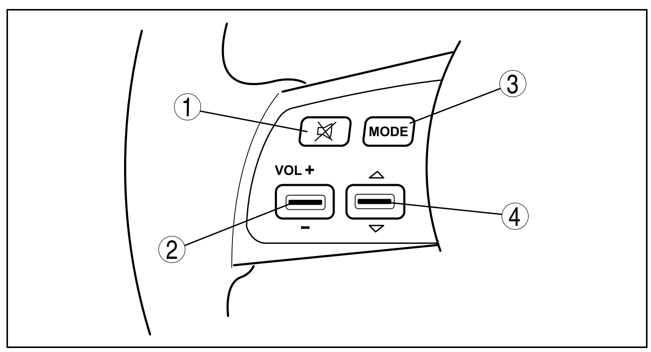
- The audio control switch is located on the steering wheel.



E5U920ZS5005

Operation

No.	Button (component)	Function
1	Mute button	Mute
2	Volume switch	Volume up/down
3	Mode button	Selects the audio mode (FM1→FM2→AM→CD→TAPE→SAT1→SAT2→SAT3→(AUX)
4	SEEK switch	Selects radio stations

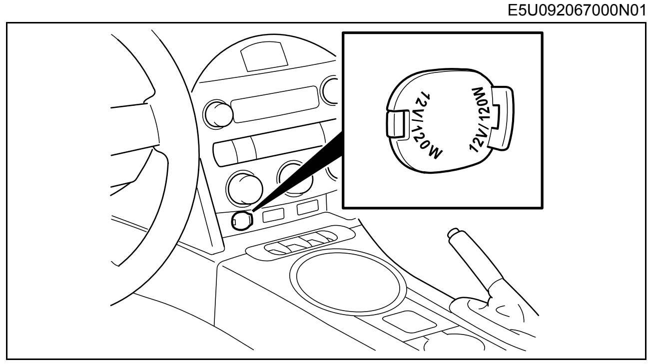


E5U920ZS5006

ACCESSORY SOCKET CONSTRUCTION

E5U092067000N01

- The accessory socket is installed to the front console.
- 12 V/120 W power is supplied from the socket.



E5U920ZS5007

09–21 POWER SYSTEMS

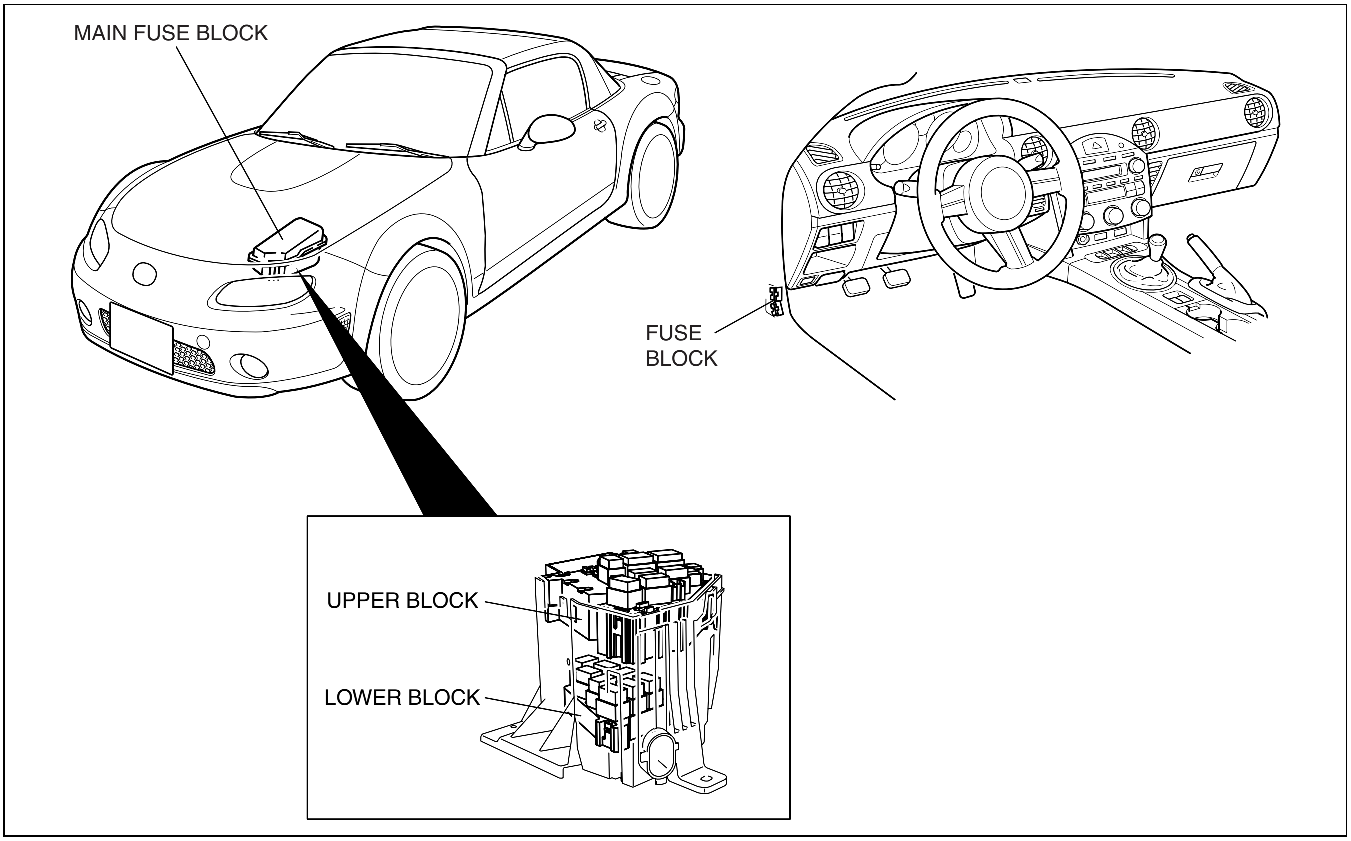
POWER SYSTEMS OUTLINE

E5U092167730N01

- A double-layered type has been adopted for the main fuse block.

POWER SYSTEMS STRUCTURAL VIEW

E5U092167730N02



E5U921ZS5000

09–22 INSTRUMENTATION/DRIVER INFO.

INSTRUMENT CLUSTER OUTLINE

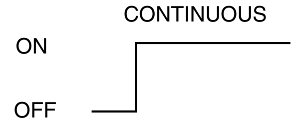
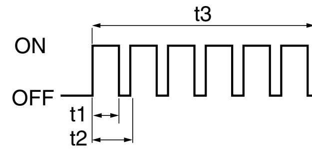
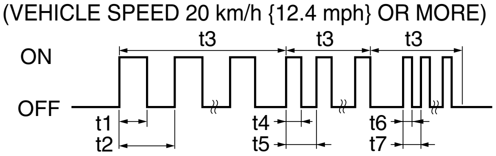
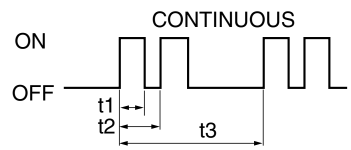
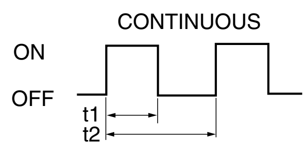
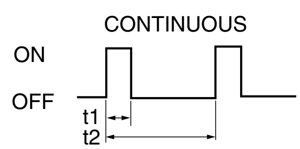
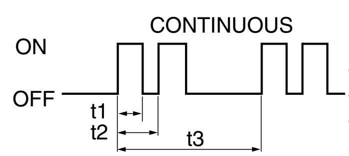
E5U092255430N01

- The CAN system has been adopted for the control signals of the input/output communication circuit of the meters, gauges and warning and indicator lights. (See 09–40–1 CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE.)
- LEDs have been adopted for warning and indicator lights installed on the instrument cluster.
- A flat-type horn has been adopted.

INSTRUMENT CLUSTER SPECIFICATIONS

E5U092255430N02

Item			Specification
Speedometer	Meter type		Stepping motor type
	Indication range	(mph {km/h})	0—150 {0—240}
	Input signal communication system		CAN system
	Input signal source		PCM
	Rated voltage	(V)	DC 12
Tachometer	Meter type		Stepping motor type
	Indication range	(rpm)	0—7,500
	Red zone	(rpm)	6,700—7,500
	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
Oil pressure gauge	Meter type		Stepping motor 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

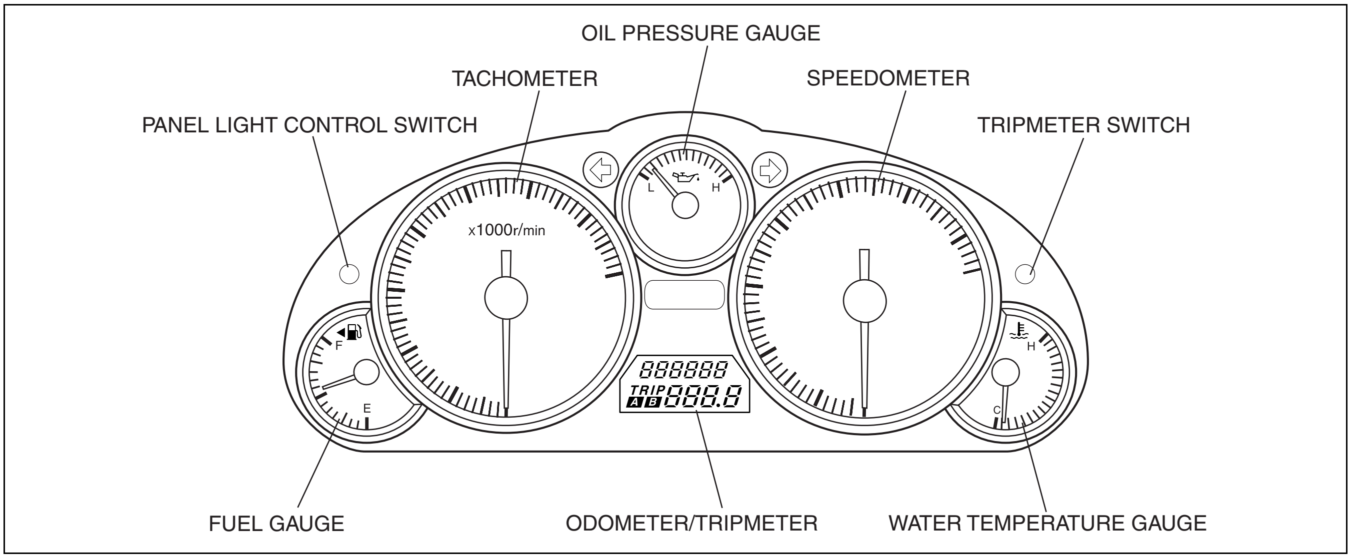
Item			Specification
Warning alarms	Sound frequency (Hz)		1,800—2,600
	Output sound pressure level (dB)		54.0—70.0
	Lights-on reminder warning alarm	Sound frequency (Hz)	1,900
		Sound cycle	
	Seat belt warning alarm	Sound frequency (Hz)	2,400
		Sound cycle	WHEN IGNITION SWITCH TURNED ON  t1: approx. 0.7 s t2: approx. 1 s t3: approx. 6 s WHILE VEHICLE DRIVING (VEHICLE SPEED 20 km/h {12.4 mph} OR MORE)  t1: approx. 0.25 s t2: approx. 0.50 s t3: approx. 31.0 s t4: approx. 0.10 s t5: approx. 0.20 s t6: approx. 0.05 s t7: approx. 0.10 s
	Key reminder warning alarm	Sound frequency (Hz)	1,800
		Sound cycle	 t1: approx. 0.22 s t2: approx. 0.33 s t3: approx. 1.25 s
	Tire pressure warning alarm	Sound frequency (Hz)	2,600
		Sound cycle	 t1: approx. 0.3 s t2: approx. 0.6 s
	Flat tire warning alarm	Sound frequency (Hz)	2,600
		Sound cycle	 t1: approx. 0.05 s t2: approx. 0.25 s
	Advanced keyless entry system warning alarm	Sound frequency (Hz)	1,800
		Sound cycle	 t1 : approx. 0.22 s t2 : approx. 0.33 s t3 : approx. 1.25 s

09–22

INSTRUMENT CLUSTER STRUCTURAL VIEW

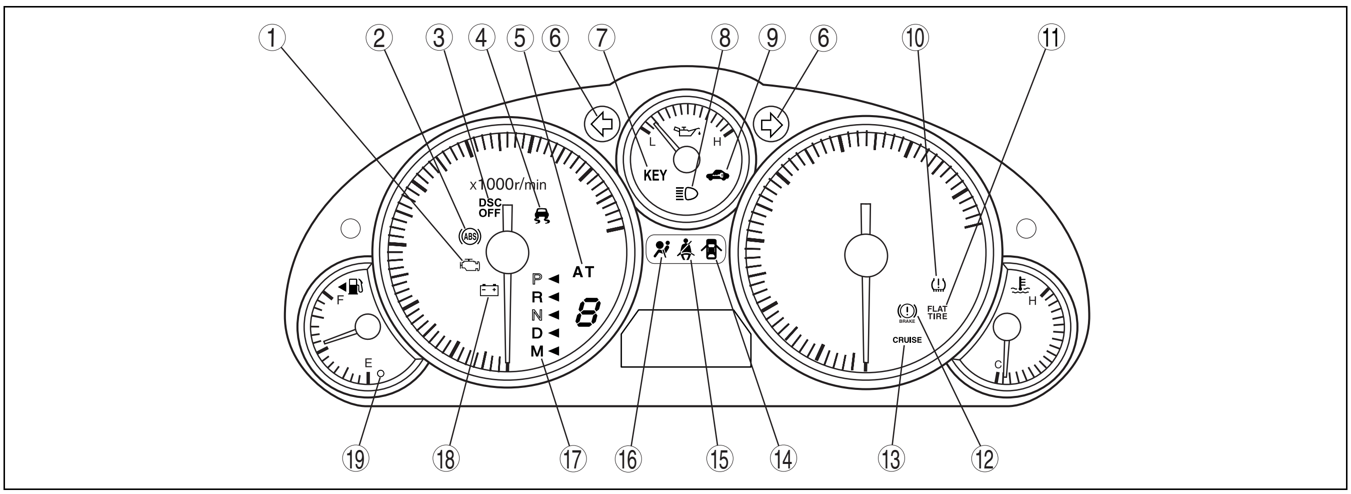
E5U092255430N03

Meter And Gauge



E5U922ZS5001

Warning And Indicator Light



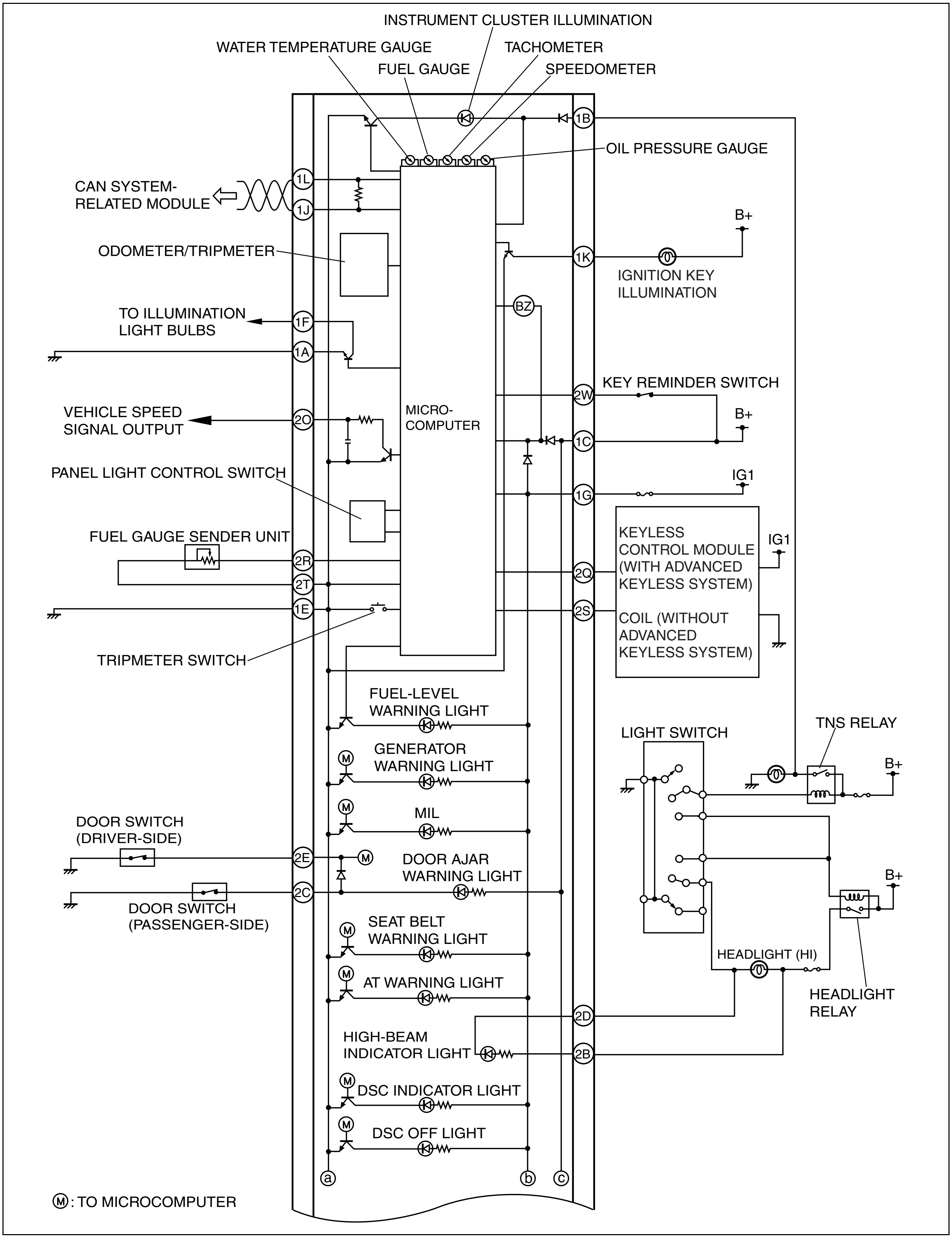
E5U922ZS5014

×: Applicable

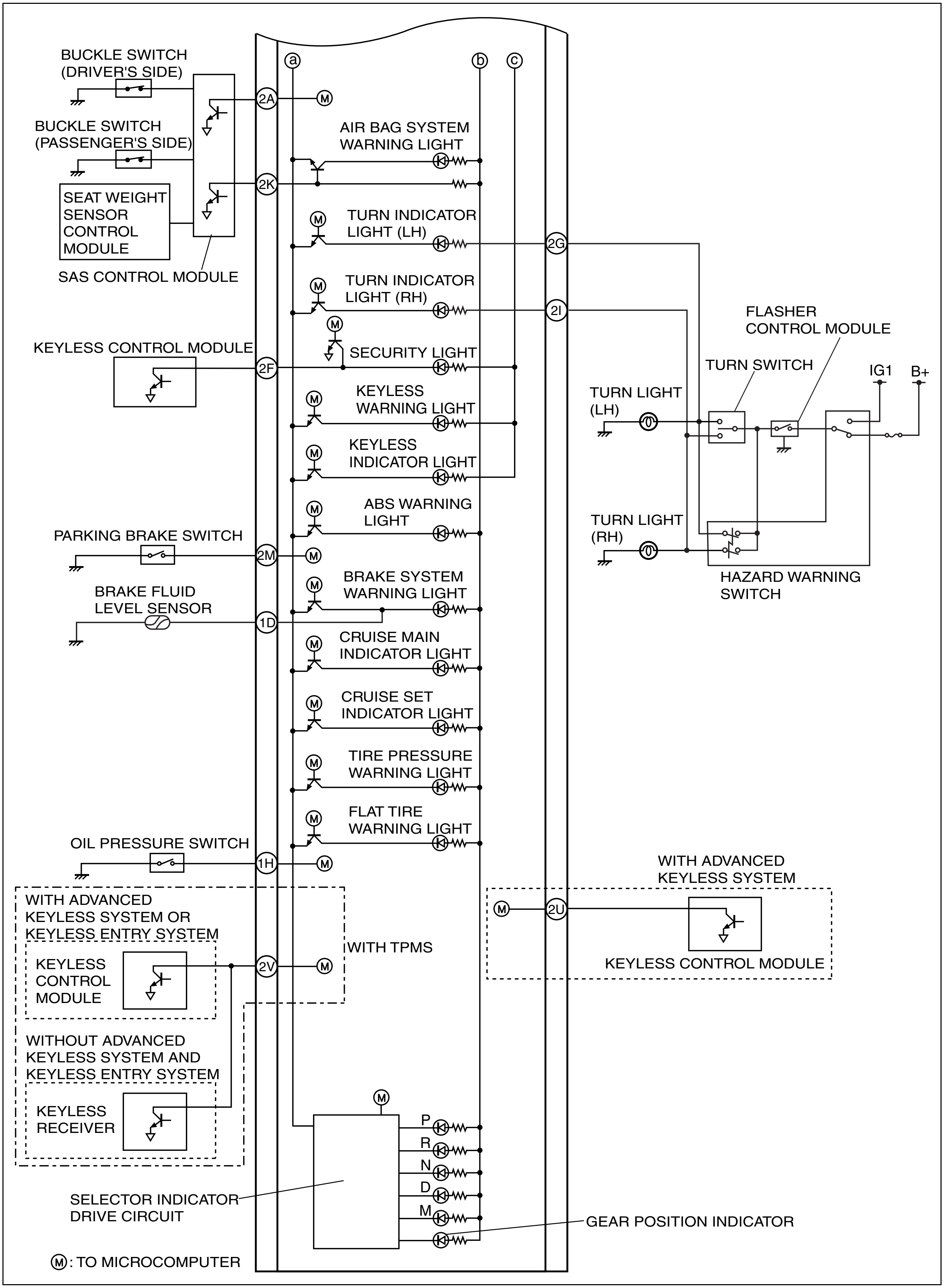
No.	Warning and indicator light	Input signal source	CAN system	Note
1	MIL	PCM	×	—
2	ABS warning light	• DSC HU/CM • ABS HU/CM	×	—
3	DSC OFF light	DSC HU/CM	×	With DSC
4	DSC indicator light	DSC HU/CM	×	With DSC
5	AT warning light	TCM	×	AT
6	Turn indicator light	Flasher control module	—	—
7	Keyless indicator light Keyless warning light	Keyless control module	×	With advanced keyless system
8	High-beam indicator light	Headlight (HI)	—	—
9	Security light	Keyless control module	×	—
10	Tire pressure warning light	• Keyless control module (with advanced keyless system or keyless entry system) • Keyless receiver (without advanced keyless system and keyless entry system)	—	With TPMS
11	Flat tire warning light			
12	Brake system warning light	• DSC HU/CM • ABS HU/CM	×	—
		• Parking brake switch • Brake fluid level sensor	—	—
13	Cruise main indicator light Cruise set indicator light	PCM	×	With cruise control system
14	Door ajar warning light	Door switches	—	—
15	Seat belt warning light	SAS control module	—	—
16	Air bag system warning light	SAS control module	—	—
17	Selector indicator light	TCM	×	AT
18	Generator warning light	PCM	×	—
19	Fuel-level warning light	Fuel gauge sender unit	—	—

INSTRUMENT CLUSTER SYSTEM WIRING DIAGRAM

E5U092255430N04



E5U922ZS5002



E5U922ZS5003

09–22

INPUT/OUTPUT CHECK MODE OUTLINE

E5U092255430N05

- The microcomputer built into instrument cluster detects the quality of input signals and individual parts.
- Input/output check mode has both input circuit inspection and individual part inspection functions.

INPUT/OUTPUT CHECK MODE OPERATION

E5U092255430N06

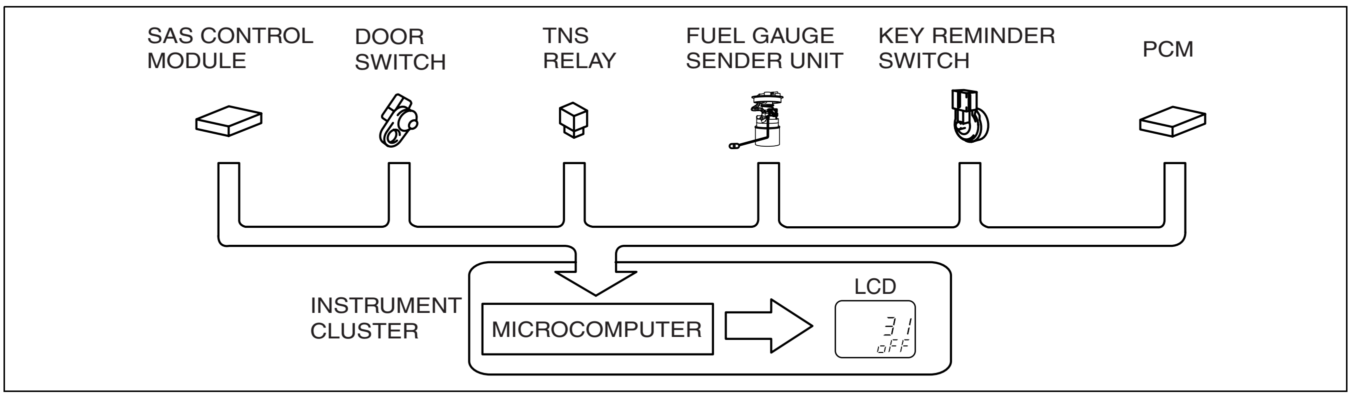
Operation procedure

- Refer to Mazda MX-5 Workshop Manual.

Input circuit check

- When the parts listed in the chart are operated and a signal is output to the instrument cluster, the built-in microcomputer determines the operability of the input circuit based on that signal.

Check code	Parts sending input signal
01	SAS control module
04	Door switch
08	TNS relay
22	Fuel gauge sender unit
31	Key reminder switch (built into the ignition switch or steering lock unit)
59	Fuel system signal

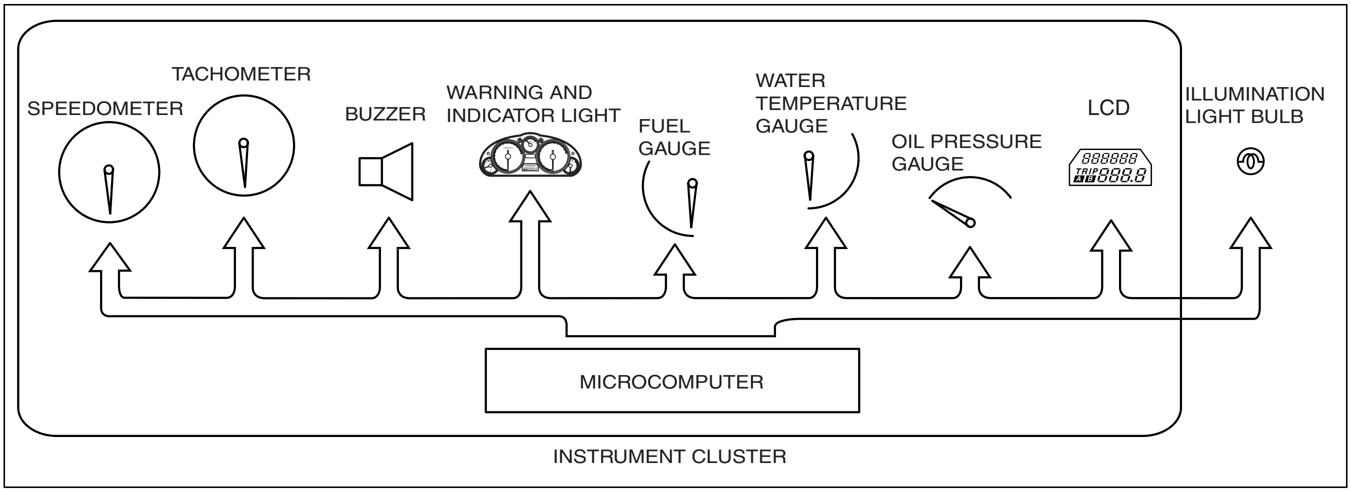


E5U922ZS5004

Individual circuit check

- By operating the parts listed in the chart, the built-in microcomputer determines the operability of the individual parts.

Check code	Parts sending input signal
12	Speedometer
13	Tachometer
14	Buzzer
16	Fuel-level warning light
18	Ignition key illumination output
23	Fuel gauge
25	Water temperature gauge
26	LCD, warning and indicator light
28	Oil pressure gauge
57	Panel light control



E5U922ZS5005

PID/Data Monitor and Record

- The PID/data monitoring items for the instrument cluster is as shown in following the table:

Monitor item table

—: Not applicable

Monitor item	Input-output signal/part name	Unit/State		Terminal
IC_DTC_CNT	Number of continuous DTCs	—		—
IC_ECT	Water temperature gauge	°F	°C	1J, 1L
IC_NUMKEYS	Number of key ID numbers registered with the vehicle	—		—
IC_ODO_CNT	Odometer	m		1J, 1L
IC_SPDMTR	Speedometer	MPH	KPH	
IC_TACHO	Tachometer	RPM		
IC_VPWR	Power supply voltage	V		1C

Odometer-data Transfer

- If all the following conditions are met, the odometer data (total traveled distance) in the previous instrument cluster is automatically transferred to a new instrument cluster during the configuration. If any of the conditions are not met, odometer-data transfer cannot be performed.

  Previous instrument cluster
  — No malfunction (Configuration data can be read using the WDS or equivalent.)

  New instrument cluster
  — Odometer display is **less than 100 km**
  — Odometer has no malfunction

Note

- If the odometer display of a new instrument cluster is **100 km or more**, an error is displayed on the WDS after the configuration is completed. In this case, the configuration data for items other than the odometer are transferred to a new instrument cluster.

LIGHTS-ON REMINDER WARNING ALARM OUTLINE

E5U092255430N07

- Warns the driver that the headlights or TNS are on when the driver-side door is opened.

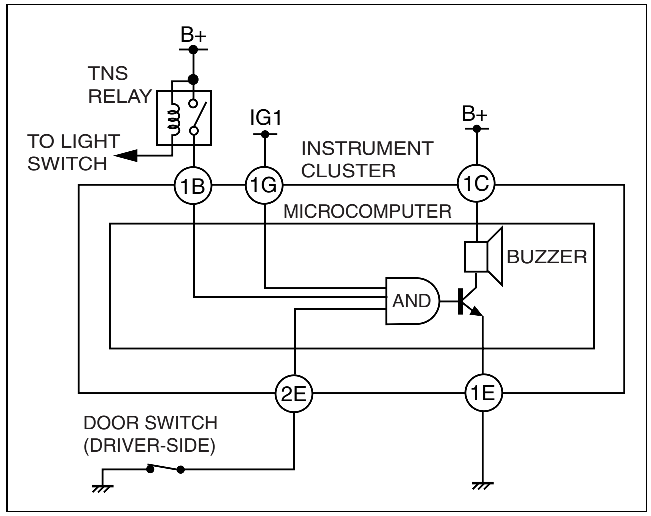
LIGHTS-ON REMINDER WARNING ALARM CONSTRUCTION/OPERATION

E5U092255430N08

System Wiring Diagram

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).



E5U922ZS5006

SEAT BELT WARNING ALARM OUTLINE

E5U092255430N09

- Warns the driver that the seat belt (driver-side or passenger-side) is unfastened.

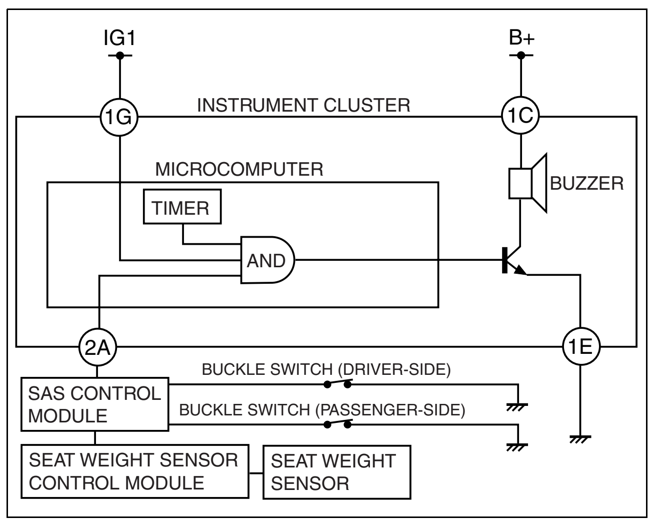
SEAT BELT WARNING ALARM CONSTRUCTION/OPERATION

E5U092255430N10

System Wiring Diagram

Operation

- The buzzer in the instrument cluster sounds for **6 s** when all the following two conditions are met:
  — After the ignition switch is turned to ON position.
  — The seat belt (driver-side) is unfastened (buckle switch is off).
- The buzzer in the instrument cluster sounds for **93 s** when all the following two conditions are met:
  — The seat belt (driver-side or passenger-side) is unfastened (driver-side: buckle switch is off, passenger-side: buckle switch is off and seat weight sensor detects passenger).
  — The vehicle speed is **20 km/h {12.4 mph} or more**.



E5U922ZS5007

KEY REMINDER WARNING ALARM OUTLINE

E5U092255430N11

- Warns the driver that the key is in the steering lock when the driver-side door is opened.

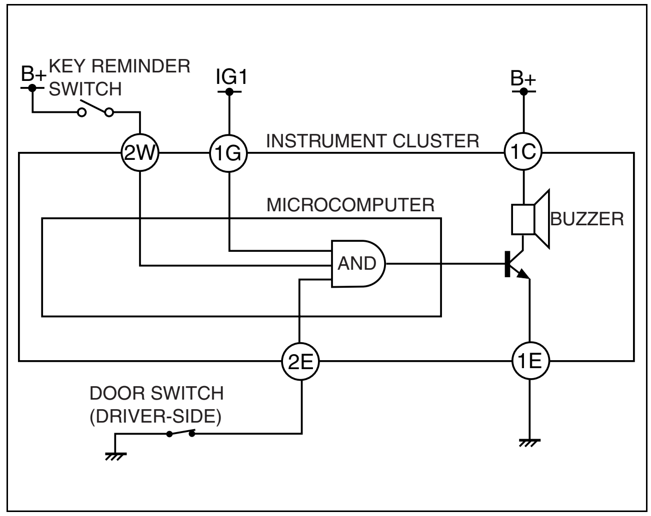
KEY REMINDER WARNING ALARM CONSTRUCTION/OPERATION

E5U092255430N12

System Wiring Diagram

Operation

- The buzzer in the instrument cluster sounds when all the following three conditions are met:
  — The ignition switch is in the LOCK or ACC position.
  — The key is in the steering lock (key reminder switch is on).
  — The driver-side door is open (driver-side door switch is on).



E5U922ZS5008

BURNT OUT BULB CHECK FUNCTION OUTLINE

E5U092255430N15

- The microcomputer in the instrument cluster illuminates the brake system warning light when the ignition switch is in the ON position. Due to this, the brake system warning light function can be inspected for a burnt out bulb.

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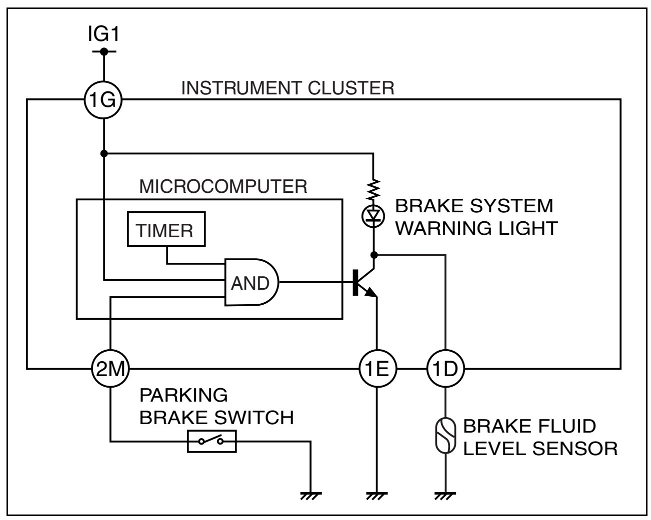
BURNT OUT BULB CHECK FUNCTION CONSTRUCTION/OPERATION

E5U092255430N16

System Wiring Diagram

Operation

- The microcomputer in the instrument cluster illuminates the brake system warning light for **approx. 3 s** and then turns it off when the ignition switch is turned to the ON position. (When the parking brake switch or the brake fluid level sensor is on, the brake system warning light remains illuminated.)



E5U922ZS5016

SPEEDOMETER CONTROL OUTLINE

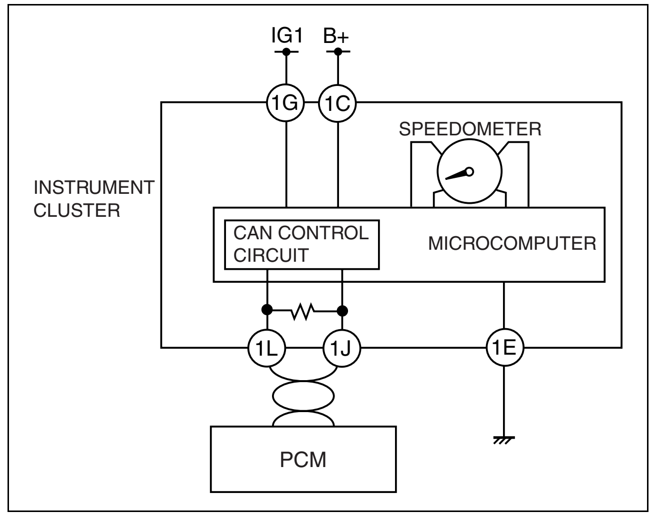
E5U092255430N17

- The vehicle speed signal is output from the PCM to the microcomputer in the instrument cluster.

SPEEDOMETER CONTROL CONSTRUCTION/OPERATION

E5U092255430N18

System Wiring Diagram



E5U922ZS5009

Operation

- The vehicle speed signal sent from the PCM via the CAN system is input to the microcomputer in the instrument cluster. The microcomputer calculates the current vehicle speed based on the vehicle speed signal, and sends an output signal to the speedometer.

TACHOMETER CONTROL OUTLINE

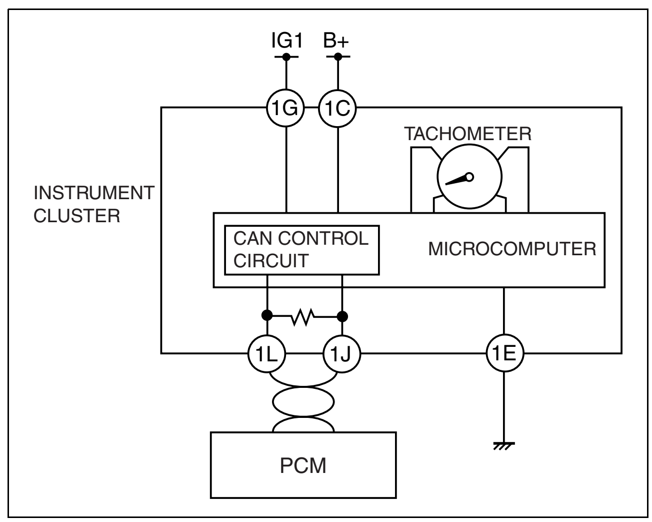
E5U092255430N19

- The engine speed signal is output from the PCM to the microcomputer in the instrument cluster.

TACHOMETER CONTROL CONSTRUCTION/OPERATION

E5U092255430N20

System Wiring Diagram



E5U922ZS5010

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

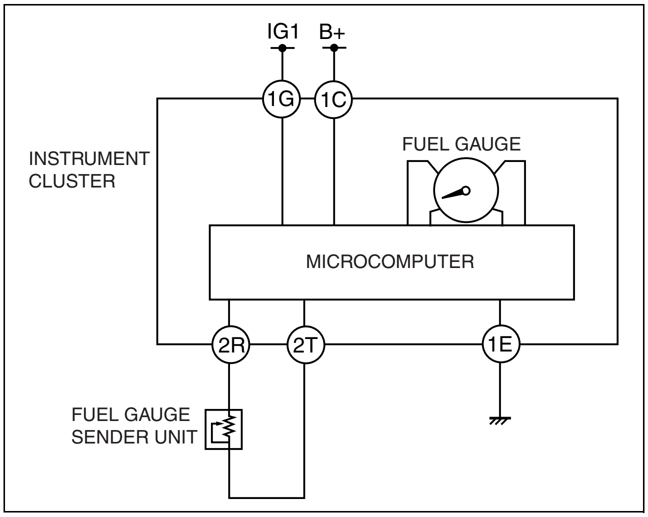
E5U092255430N21

- 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

E5U092255430N22

System Wiring Diagram



E5U922ZS5011

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

E5U092255430N23

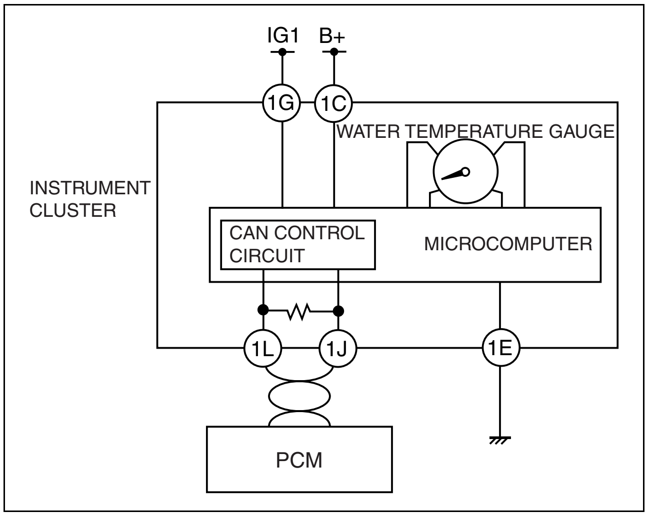
- The engine coolant temperature signal is output from the PCM to the microcomputer in the instrument cluster.

09–22

WATER TEMPERATURE GAUGE CONTROL CONSTRUCTION/OPERATION

E5U092255430N24

System Wiring Diagram



E5U922ZS5012

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

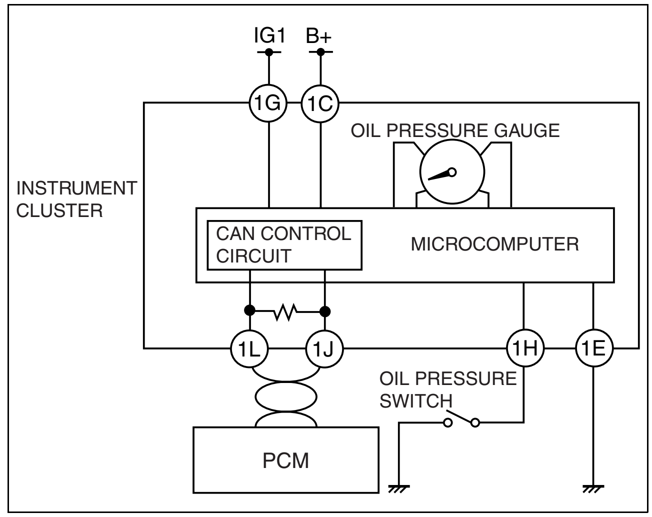
E5U092255430N25

- The engine coolant temperature signal and engine speed signal are output from the PCM to the microcomputer in the instrument cluster.

OIL PRESSURE GAUGE CONTROL CONSTRUCTION/OPERATION

E5U092255430N26

System Wiring Diagram



E5U922ZS5013

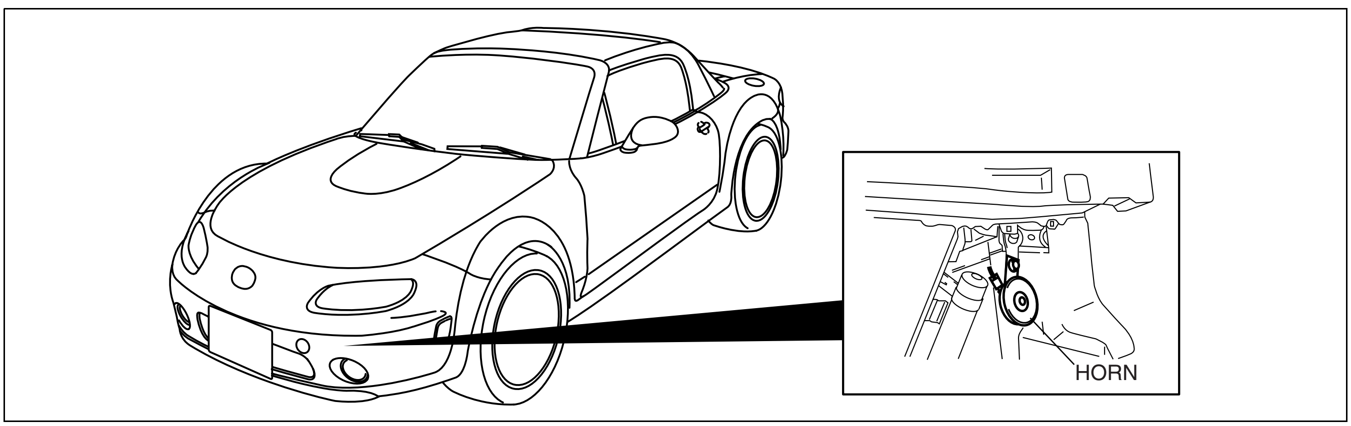
Operation

- The engine coolant temperature signal and engine speed signal sent from the PCM via the CAN system is input to the microcomputer in the instrument cluster. The microcomputer calculates the oil pressure based on the engine coolant temperature signal and engine speed signal, and sends the output signal to the oil pressure gauge according to the calculated value.

HORN CONSTRUCTION

E5U092266790N01

- A flat-type horn has been adopted.



E5U922ZS5015

09–40 CONTROL SYSTEM

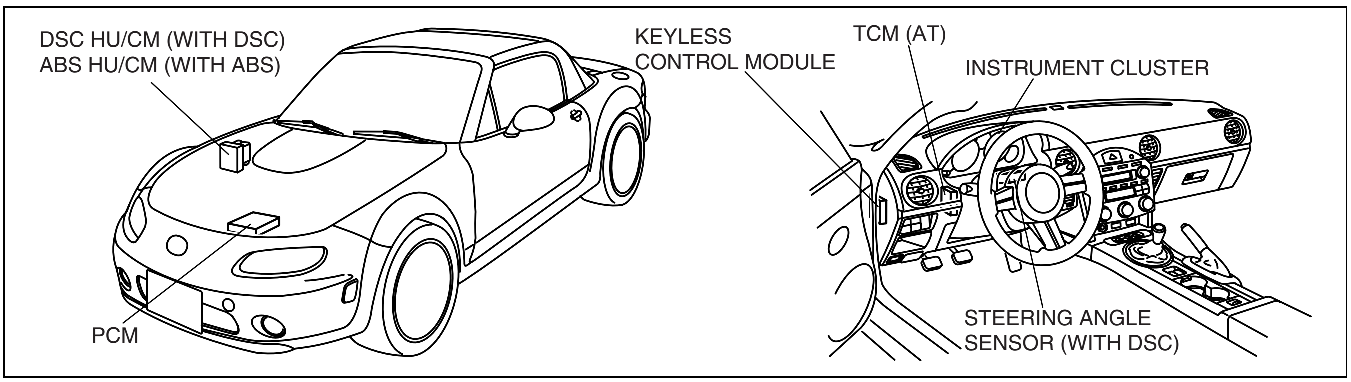
CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE

E5U094055430N01

- Due to the simplification of the wiring harness, a CAN system for transmission of multiplex input/output signals among electrical modules has been adopted.
- Twisted-pair wiring is used for connections between the following modules. (Each electrical module hereafter referred to as a CAN system-related module):
  — PCM
  — TCM
  — DSC HU/CM (with DSC)
  — ABS HU/CM (with ABS)
  — Keyless control module (with advanced keyless system)
  — Steering angle sensor (with DSC)
  — Instrument cluster
- With an on-board diagnostic function included for each multiplex module, display of DTCs using the WDS or equivalent has improved serviceability.

CAN SYSTEM STRUCTURAL VIEW

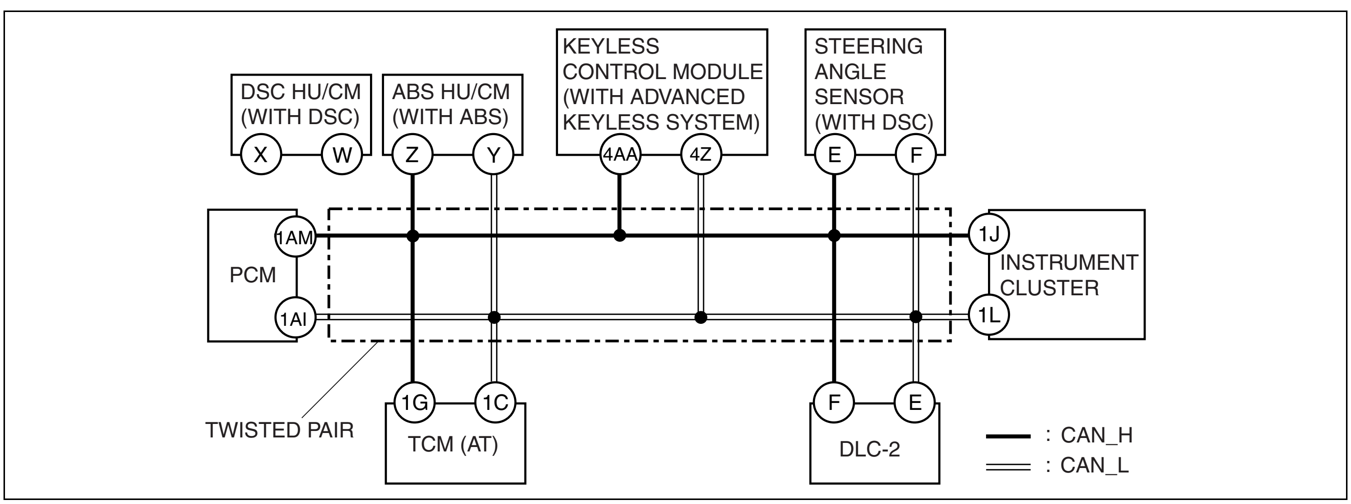
E5U094055430N02



E5U940ZS5001

CAN SYSTEM WIRING DIAGRAM

E5U094055430N03



E5U940ZS5002

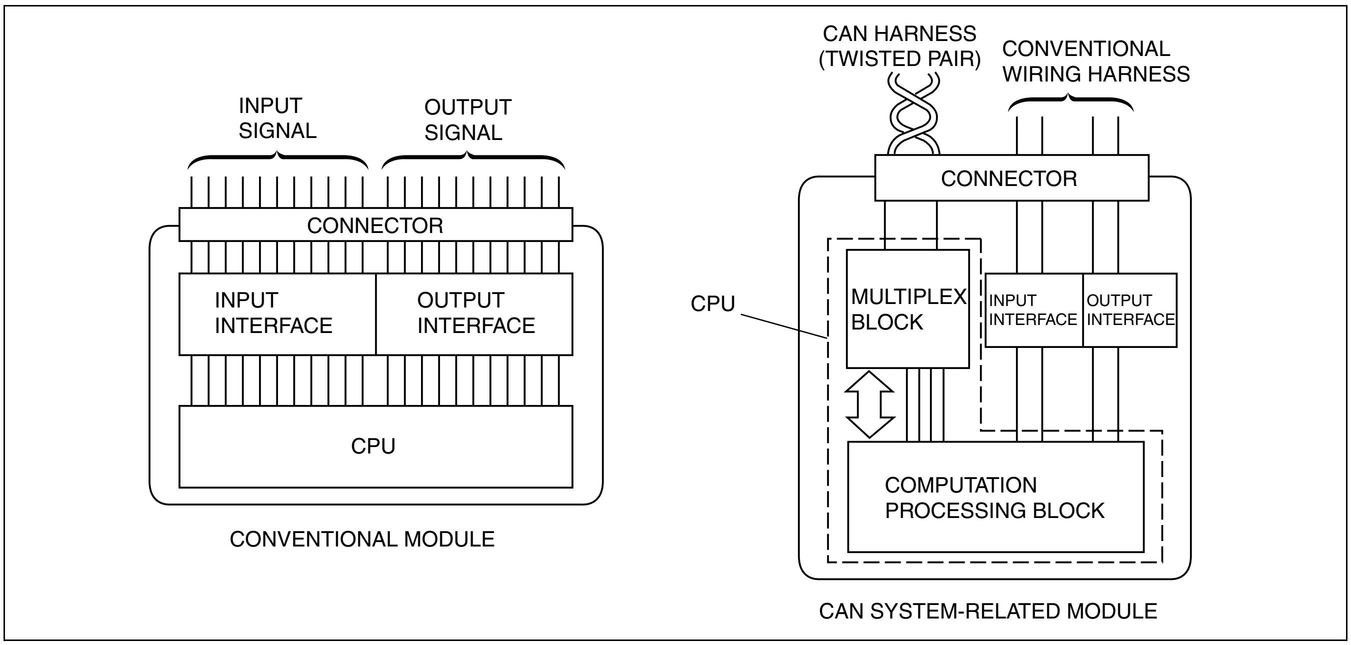
CAN SYSTEM DESCRIPTION

E5U094055430N04

Mechanism of CAN System-Related Module

- A CAN system-related module is composed of an electrical circuit, CPU, and input/output interface.
- The size of the module has been reduced due to the elimination of the bulky, superfluous, input/output interface in the conventional type of electrical module.
- The CPU (multiplex block) controls all signals exchanged on the CAN harness.
- Communication with non-multiplex parts is carried out by conventional input/output interface.
- The functions of each component are shown below.

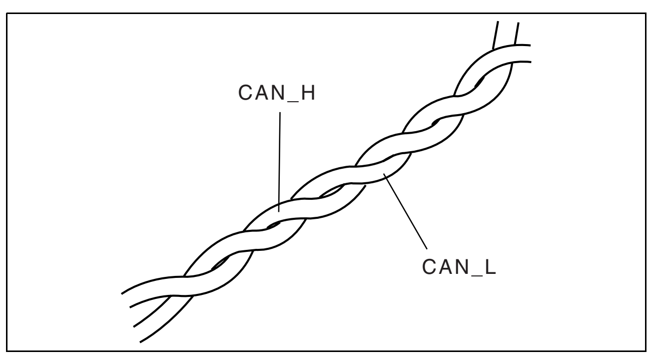
Component		Function
Electrical circuit		Supplies power to CPU and vicinity, and to input/output interface.
CPU	Computation processing block	Control function has been expanded, and when transmission is necessary, transmitted data is stored in a multiplex block. If a multiplex block receives a request to read stored data, transmitted data is read from the multiplex block.
	Multiplex block	Transmits data received from bus line to computation processing block. In addition, sends transmitted data stored from computation processing block to bus line.
Input/Output interface		Electrically converts information signals from switches to, be input to CPU, and signals output from CPU for operating actuator or indicator lights.



C3U0940S006

Twisted Pair

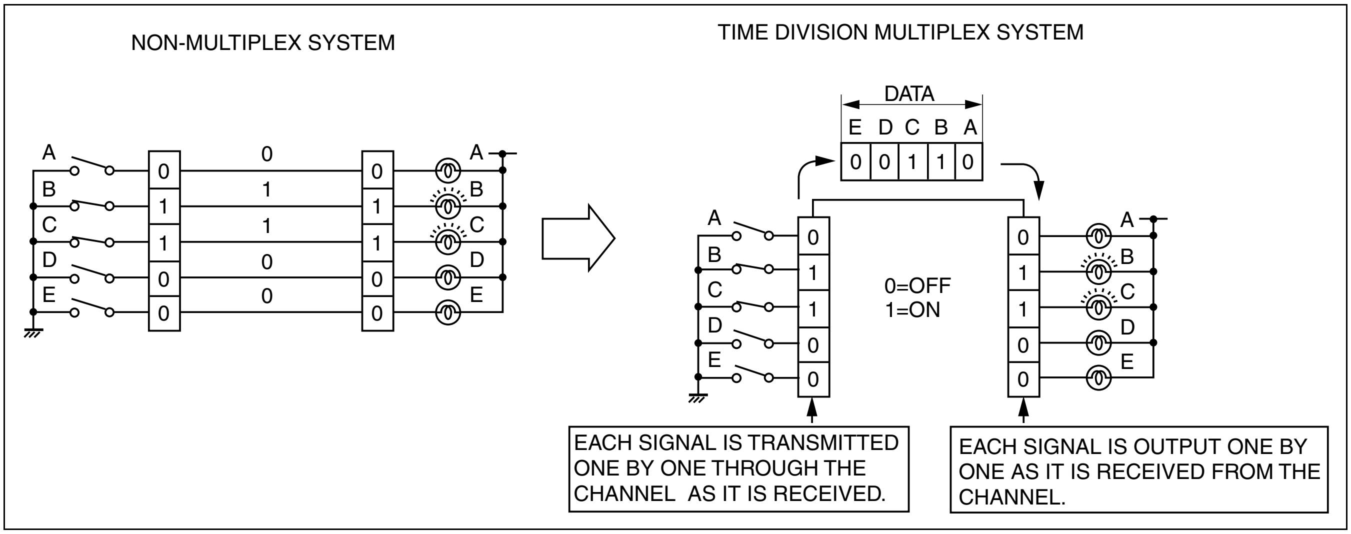
- The multichannel use two spirally twisted wires called a twisted pair, and each wire, CAN_L and CAN_H, has its own special function.
- Both bus lines are opposite phase voltage. This allows for minimal noise being emitted and makes if difficult for noise interference to be received.



B3E0940T202

Time Division Multiplex

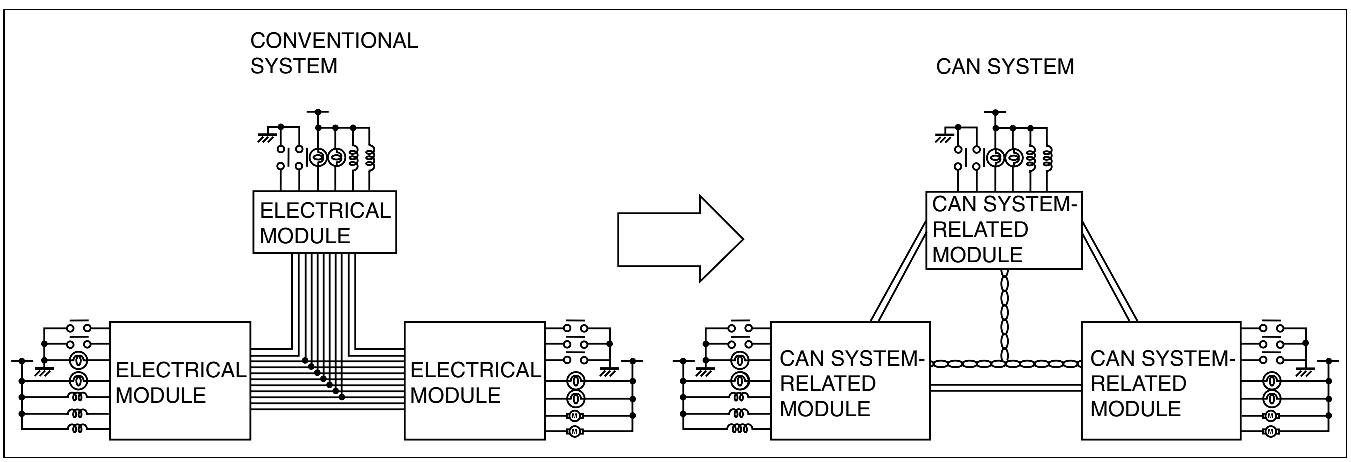
- For information exchange between electrical modules in a conventional system, a wire connection was necessary for each information signal. However, by sending the different signal at varying times over one channel, it is possible to send a large amount of information via a small wiring harness.
- In the conventional, non-multiplex system, in order to control the illumination of the five bulbs, one switch and one channel was necessary for each bulb. For bulbs B and C to illuminate, switches B and C must be ON and electricity must flow through the channel. With the time multiplex system, this can be done through one channel. The channel is comprised of five data signal transmitters which transmit either a “0” or “1” signal to indicate whether a bulb turns ON or OFF. For example, to illuminate bulbs B and C, transmitters B and C transmit a “1” and transmitters A, D, and E transmit a “0”. When the receiver receives these signal, bulbs B and C illuminate.



C3U0940S007

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

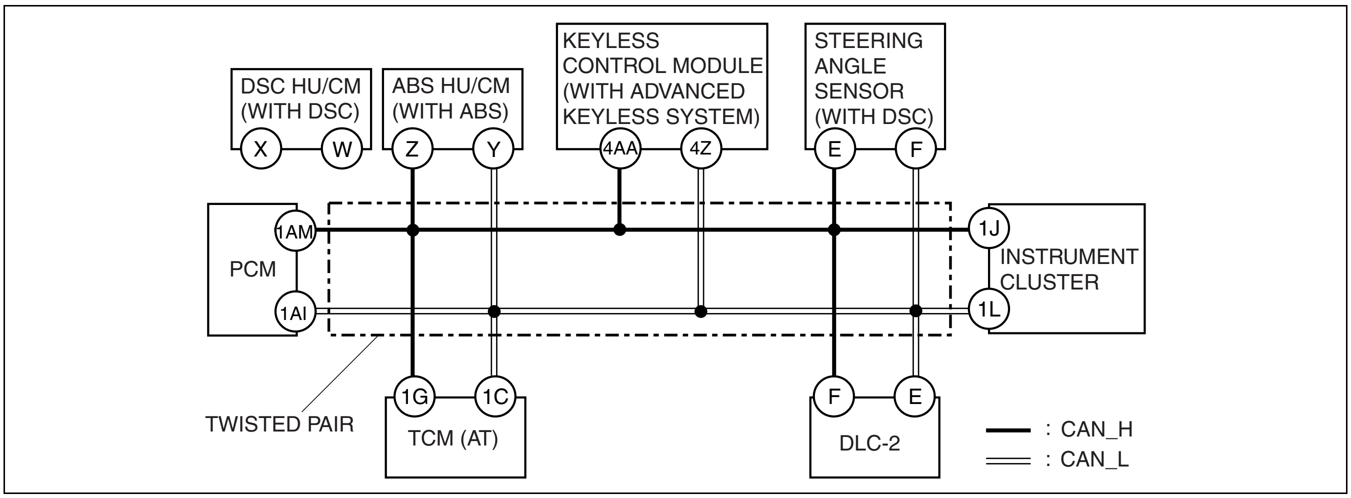
OUT: Output (sends signal)
IN: Input (receives signal)

Signal	Multiplex module					
	PCM	**TCM**	**ABS HU/CM or DSC HU/CM**	**Keyless control module**	**Steering angle sensor**	**Instrument cluster**
Engine speed	OUT	IN	IN (DSC)	IN	–	IN
Vehicle speed	OUT	IN	–	IN	–	IN
	IN	OUT		–		–
Engine coolant temperature	OUT	IN	–	–	–	IN
Engine torque	OUT	IN	IN (DSC)	–	–	–
Accelerator pedal position	OUT	IN	IN (DSC)	–	–	–
TP	OUT	IN	IN (DSC)	–	–	–
Intake air temperature	OUT	IN	–	–	–	–
Ignition timing	OUT	IN	–	–	–	–
Engine specification	OUT	–	IN	–	–	–
Brake pedal position	OUT	IN	–	–	–	–
Tire circumference (front/rear)	OUT	IN	IN	–	–	–
	IN	–	OUT			
Immobilizer-related information	OUT	–	–	–	–	IN
	IN				–	OUT
Travelled distance	OUT	–	–	–	–	IN
	IN	OUT				–
Fuel injection amount	OUT	–	–	–	–	IN
MIL on request	OUT	–	–	–	–	IN
	–	OUT				
Generator warning light on request	OUT	–	–	–	–	IN
Cruise main/set indicator light on request	OUT	–	–	–	–	IN
AT gear position/selector lever position (AT)	IN	OUT	–	–	–	IN
ATF temperature (AT)	IN	OUT	–	–	–	–
Desired gear position (AT)	IN	OUT	IN (DSC)	–	–	–
TCC status (AT)	IN	OUT	IN (DSC)	–	–	–
AT warning light on request (AT)	IN	OUT	–	–	–	IN
Brake system status (EBD/ABS/DSC)	IN	–	OUT	–	–	–
Wheel speed (LF, RF, LR, RR)	IN	–	OUT	–	–	–
Brake system warning light on request	–	–	OUT	–	–	IN
ABS warning light on request	–	–	OUT	–	–	IN
DSC indicator light on request	–	–	OUT (DSC)	–	–	IN
DSC OFF light on request	–	–	OUT (DSC)	–	–	IN
Security light on request	–	–	–	OUT	–	IN
Steering angle sensor status	–	–	IN (DSC)	–	OUT	–
Fuel tank level	IN	–	–	–	–	OUT
Parking brake position	–	–	IN (DSC)	–	–	OUT

On-Board Diagnostic Function

- The on-board diagnostic function is incorporated into the following module:
  — PCM
  — TCM
  — DSC HU/CM (with DSC)
  — ABS HU/CM (with ABS)
  — Keyless control module
  — Steering angle sensor
  — Instrument cluster
- This function can narrow down CAN system malfunction locations.
- The on-board diagnostic function consists of the following functions.
  — Failure detection function, which detects DTCs malfunctions in CAN system-related parts.
  — Memory function, which stores detected.
  — Self-malfunction diagnostic function, which indicates system malfunctions using DTCs and warning lights.
- Using the WDS or equivalent, DTCs can be read out and deleted.
- The CAN system has a fail-safe function. When a malfunction occurs in CAN system, the transmission module sends a warning signal and the receiving module illuminates the warning light.

Block diagram



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Failure detection function

- The failure detection function in each CAN system-related module detects malfunctions in input/output signals.
- This function outputs the DTC for the detected malfunction to the DLC-2, and also sends the detected result to the memory function and fail-safe function.

Fail-safe function

- When the failure detection function determines that there is a malfunction, the fail-safe function illuminates a warning light to inform the driver of the malfunction.

Memory function

- The memory function stores the DTC for the malfunction of input/output signals for related parts, as determined by the failure detection function.

Self-malfunction diagnostic function

- The self-malfunction diagnostic function determines that there is a malfunction, and outputs a signal, as a DTC, to the DLC-2. The DTC can be read out using the WDS or equivalent.

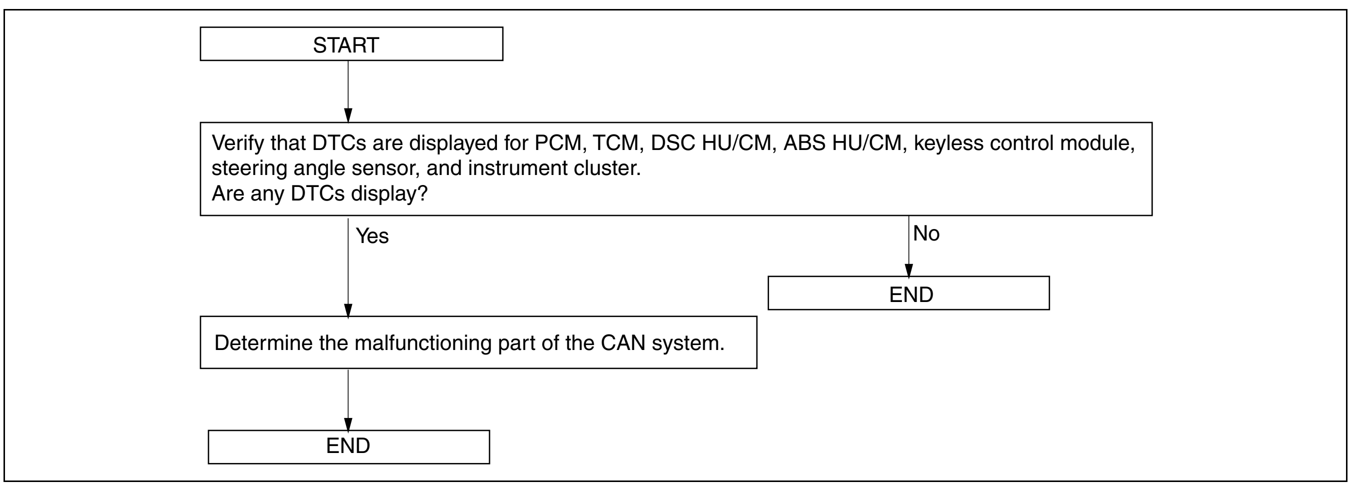
DTC table

DTC	Malfunction location	DTC output module
U0073	CAN system communication error	• PCM • TCM • ABS HU/CM • DSC HU/CM • Keyless control module • Instrument cluster
U0100	Communication error to PCM	• TCM • DSC HU/CM • Keyless control module • Instrument cluster
U0101	Communication error to TCM	• PCM • DSC HU/CM • Instrument cluster
U0121	Communication error to ABS HU/CM or DSC HU/CM	• PCM • Instrument cluster
U0155	Communication error to instrument cluster	• PCM • DSC HU/CM
U0214	Communication error to keyless control module	Instrument cluster
U0323	Communication error to instrument cluster	Keyless control module
U1900	Communication error to other module	• ABS HU/CM • DSC HU/CM • Steering angle sensor
U2023	Abnormal message from PCM	• ABS HU/CM • DSC HU/CM • Keyless control module
U2516	CAN system communication error	Steering angle sensor

Narrowing down malfunction locations

- The on-board diagnostic function, by verifying the detected DTC information from each module, can narrow down a CAN system malfunction location. Refer to the self-malfunction diagnostic function for detailed information regarding DTCs. (See09–40–5 Self-malfunction diagnostic function.)

Flowchart



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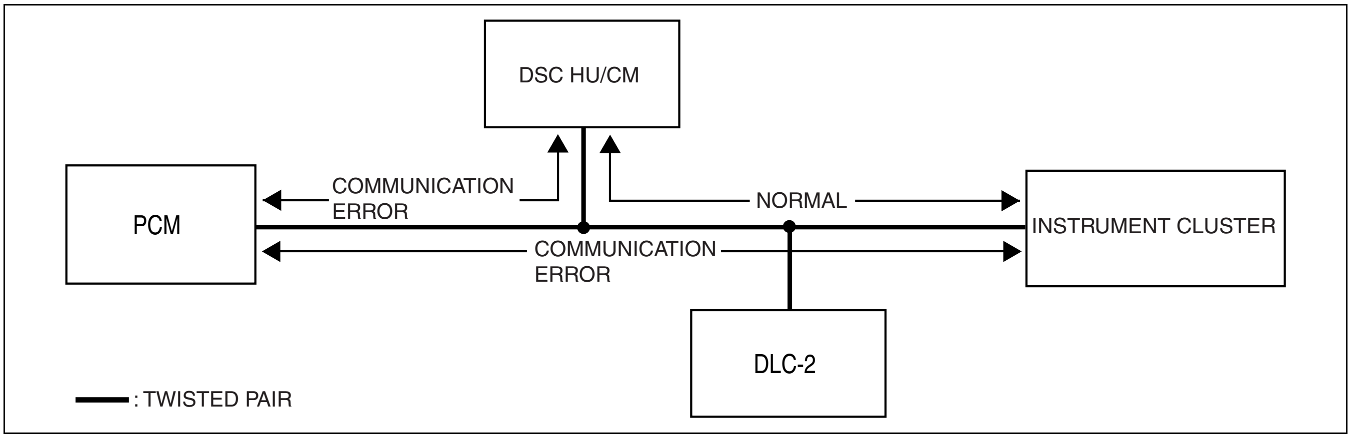
Example (PCM-related communication error)

Note
- This example is for MT with DSC.

1. DTCs for the PCM, DSC HU/CM, steering angle sensor and instrument cluster can be verified using the WDS or equivalent.

Module	Displayed DTC	Probable malfunction location
PCM	U0073	PCM-related CAN system malfunction
	U0121	Communication error between PCM and DSC HU/CM
	U0155	Communication error between PCM and instrument cluster
DSC HU/CM	U0100	Communication error between DSC HU/CM and PCM
Instrument cluster	U0100	Communication error between instrument cluster and PCM



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2. If there is a communication error between the instrument cluster and PCM, even if the communication between the DSC HU/CM and the instrument cluster is normal, it is probable that there is a malfunction in the PCM or PCM-related wiring harnesses.