

# 2006 Mazda6 MAZDASPEED6 Service Highlights

## FOREWORD

This manual explains components, system operations and functions for the Mazda6, MAZDASPEED6.

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. 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.

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**Mazda Motor Corporation**  
**HIROSHIMA, JAPAN**

## APPLICATION:

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

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## VEHICLE IDENTIFICATION NUMBERS (VIN)

1YV	FP80C*65	M00001—
1YV	FP80D*65	M00001—
1YV	FP81C*65	M00001—
1YV	FP81D*65	M00001—
1YV	FP82D*65	M00001—
1YV	FP83D*65	M00001—
1YV	FP84C*65	M00001—
1YV	FP84D*65	M00001—
1YV	FP85C*65	M00001—
1YV	FP85D*65	M00001—
1YV	HP80C*65	M00001—
1YV	HP80D*65	M00001—
1YV	HP81C*65	M00001—
1YV	HP81D*65	M00001—
1YV	HP82D*65	M00001—
1YV	HP83D*65	M00001—
1YV	HP84C*65	M00001—
1YV	HP84D*65	M00001—
1YV	HP85C*65	M00001—
1YV	HP85D*65	M00001—
JM1	GG12L*6#	100001— (MAZDASPEED6)

## RELATED MATERIALS

Material Name	MNAO Part No.	Mazda Material No.
2003 (U.S.A.)/2004 (Canada) Mazda6 Service Highlights	9999-95-101F-03	3372-1U-02I
2004 Mazda MX-5 Miata/MX-5, Mazda6, MPV Service Highlights	9999-95-MODL-04	3384-1U-03H
2004 Mazda6 Hatchback Wagon Service Highlights Supplement	9999-95-101F-04	3394-1U-04A
2005 Mazda6 Service Highlights Supplement	9999-95-101F-05	3399-1U-04H
1995, 1996, 1997, 1998, 1999, 2000 OBD-II Service Highlights	9999-95-OBD2-00	3344-1U-99K
2006 Mazda6, MAZDASPEED6 Workshop Manual	9999-95-063B-06	1858-1U-05H
Engine Workshop Manual AJ with Variable Valve Timing	9999-95-EAJV-03	1766-1U-02I
Engine Workshop Manual LF L3	9999-95-LFL3-05	1866-1U-05H
Engine Workshop Manual L3 WITH TC	9999-95-0L3T-06	1833-1U-05H
Manual Transaxle and Transfer Workshop Manual A26MX-R	9999-95-0AA6-06	1834-1U-05H
Manual Transaxle Workshop Manual A65M-R	9999-95-0A65-03	1755-1U-02I
Manual Transaxle Workshop Manual G35M-R	9999-95-0G35-03	1756-1U-02I
Automatic Transaxle Workshop Manual FN4A-EL	9999-95-FN4A-04	1793-1U-03I
Automatic Transaxle Workshop Manual FS5A-EL	9999-95-FS5A-06	1859-1U-05F
2003 (U.S.A.)/2004 (Canada) Mazda6 Bodyshop Manual	9999-95-099F-03	3373-1U-02I
2004 Mazda6 Hatchback Wagon Bodyshop Manual Supplement	9999-95-099F-04	3393-1U-04A

Material Name	MNAO Part No.	Mazda Material No.
2006 MAZDASPEED6 Bodyshop Manual Supplement	9999-95-099F-06	3402-1U-05H
2006 Mazda6, MAZDASPEED6 Wiring Diagram	9999-95-039G-06	5651-1U-05H



# ENGINE

## 01 SECTION

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## 01-00 OUTLINE

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### ENGINE ABBREVIATION

E6U010002000S01

A/C	Air Conditioning
CAN	Controller Area Network
DEI	Double Electronic Ignition
EGR	Exhaust Gas Recirculation
IAT	Intake Air Temperature
IG	Ignition
LH	Left Hand
OCV	Oil Control Valve
PCM	Powertrain Control Module
RH	Right Hand
SEI	Single Electronic Ignition
TC	Turbocharger

# OUTLINE

## ENGINE FEATURES

E6U010002000S02

### Lubrication

Reduced noise	<ul style="list-style-type: none"> <li>Oil pan changed (L3 WITH TC)</li> </ul>
Improved lubricity	<ul style="list-style-type: none"> <li>Oil pump driven chain and oil pump sprocket changed (L3 WITH TC)</li> <li>Oil jet valves changed (L3 WITH TC)</li> <li>Water-cooled type oil cooler adopted (L3 WITH TC)</li> </ul>

### Cooling System

Reduced engine noise and vibration	<ul style="list-style-type: none"> <li>Fan control module adopted (L3 WITH TC)</li> </ul>
Reduced power consumption	<ul style="list-style-type: none"> <li>Fan control module adopted (L3 WITH TC)</li> </ul>
Improved serviceability	<ul style="list-style-type: none"> <li>Longer-life new engine coolant (type FL22) adopted</li> </ul>

### Exhaust System

Improved reliability	<ul style="list-style-type: none"> <li>TWC changed (AJ)</li> </ul>
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### Charging System

Reduced operation noise	<ul style="list-style-type: none"> <li>Generator changed (L3, L3 WITH TC)</li> </ul>
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### Ignition System

Improved reliability	<ul style="list-style-type: none"> <li>Ignition coil changed (L3, L3 WITH TC)</li> </ul>
Improved durability	<ul style="list-style-type: none"> <li>Spark plug changed (L3, L3 WITH TC)</li> </ul>

### Control System

Improved driveability	<ul style="list-style-type: none"> <li>High pressure fuel pump control adopted (L3 WITH TC)</li> <li>Throttle control changed (L3 WITH TC)</li> <li>Fuel pressure sensor adopted (L3 WITH TC)</li> <li>Fuel injection control changed (L3 WITH TC) <ul style="list-style-type: none"> <li>Air charging zone added (L3 WITH TC)</li> <li>HO2S feedback control changed (L3 WITH TC)</li> <li>Injection pulse width calculation added (L3 WITH TC)</li> <li>Injection timing width calculation added (L3 WITH TC)</li> </ul> </li> </ul>
Improved exhaust emission performance	<ul style="list-style-type: none"> <li>Boost air temperature sensor adopted (L3 WITH TC)</li> <li>HO2S (Front) changed (L3 WITH TC)</li> </ul>
Improved reliability	<ul style="list-style-type: none"> <li>Injector driver module adopted (L3 WITH TC)</li> <li>CKP sensor changed (L3, L3 WITH TC)</li> <li>CMP sensor changed (L3, L3 WITH TC)</li> <li>HO2S heater control changed (L3 WITH TC) <ul style="list-style-type: none"> <li>Pre-heater control added (L3 WITH TC)</li> </ul> </li> <li>Fuel injection control changed (L3 WITH TC) <ul style="list-style-type: none"> <li>Fuel cut changed (L3 WITH TC)</li> </ul> </li> <li>Idle air control changed (L3 WITH TC)</li> <li>Wastegate added (L3 WITH TC)</li> </ul>

## ENGINE SPECIFICATIONS

E6U010002000S03

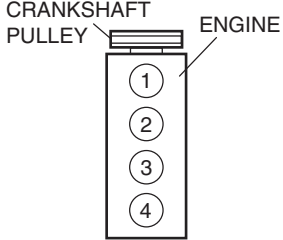
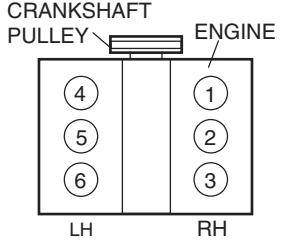
Item		Specification				
		2006MY MAZDASPEED 6	2006MY Mazda6	2005MY Mazda6	2006MY Mazda6	2005MY Mazda6
		L3 WITH TC (2.3L)	L3 (2.3L)	L3 (2.3L)	AJ (3.0L)	AJ (3.0L)
<b>MECHANICAL</b>						
Compression ratio		9.5:1	10.6:1	←	10.0: 1	←
Compression pressure	(kPa {kgf/cm <sup>2</sup> , psi} [rpm])	1,280 {13.1, 185.65} [250]	1,372 {14.0, 199.08} [285]	←	—	←
Valve timing	IN	Open BTDC	0°—30°	0°—25°	←	-9.5°—20.5°
		Close ABDC	62°—32°	62°—37°	←	65.5°—25.5°
	EX	Open BBDC	42°	←	←	71°
		Close ATDC	5°	←	←	17°

# OUTLINE

01-00

Item			Specification				
			2006MY MAZDASPEED 6	2006MY Mazda6	2005MY Mazda6	2006MY Mazda6	2005MY Mazda6
			L3 WITH TC (2.3L)	L3 (2.3L)	L3 (2.3L)	AJ (3.0L)	AJ (3.0L)
LUBRICATION SYSTEM							
Type			Force-fed type	←	←	Force-fed type	←
Oil pump	Type		Trochoid gear	←	←	Trochoid gear	←
Oil filter	Type		Full-flow, paper element	←	←	Full-flow, paper element	←
COOLING SYSTEM							
Type			Water-cooled, forced circulation	←	←	Water-cooled, forced circulation	←
Coolant capacity (approx. quantity) (L {US qt, Imp qt})			8.0 {8.5, 7.0}	7.0 {7.4, 6.2}	←	8.5 {9.0, 7.5}	←
Water pump	Type		Centrifugal	←	←	Centrifugal	←
	Water seal		Unified mechanical seal	←	←	Unified mechanical seal	←
Thermostat	Type		Wax, bottom-bypass	←	←	Wax, bottom-bypass	←
Radiator	Type		Corrugated fin	←	←	Corrugated fin	←
Cooling fan	Type		Electric	←	←	Electric	←
	Blade	Outer diameter (mm {in})	320 {12.6}	←	←	340 {13.4}	←
		Number	No.1: 5 No.2: 7	←	←	No.1: 4 No.2: 5	←
INTAKE-AIR SYSTEM							
Air cleaner element	Type		Paper element (dry type)	←	←	Paper element (dry type)	←
FUEL SYSTEM							
Fuel pump	Type		Electrical	←	←	Electrical	←
Fuel tank	Capacity (L {US gal, Imp gal})		60 {15.9, 13.2}	68 {18, 15}	←	68 {18, 15}	←
Required fuel			93 {(R+M)/2 method] or above (98 RON or above)*	Unleaded (RON 91 or higher)	←	Unleaded (RON 91 or higher)	←
Fuel line pressure (kPa {kgf/cm <sup>2</sup> , psi})			410—490 {4.2—4.9, 60—71}	375—450 {3.9—4.5, 55—65}	←	430—510 {4.4—5.2, 63—73}	←
EMISSION SYSTEM							
EGR control	Type		Stepping motor type	←	←	Stepping motor type	←
CHARGING SYSTEM							
Battery	Voltage (V)		12	←	←	12	←
	Type and capacity (5-hour rate) (A·h)		55D23L (48) 80D26L (55)	GROUP 40R (50)	←	GROUP 40R (50)	←
Generator	Output (V·A)		12·110	12·100	12·90	12·110	←
	Regulated voltage (V)		Controlled by PCM	←	←	Controlled by PCM	←
	Self-diagnosis function						




# OUTLINE

Item		Specification				
		2006MY MAZDASPEED 6	2006MY Mazda6	2005MY Mazda6	2006MY Mazda6	2005MY Mazda6
		L3 WITH TC (2.3L)	L3 (2.3L)	L3 (2.3L)	AJ (3.0L)	AJ (3.0L)
<b>IGNITION SYSTEM</b>						
Type		SEI	←	DEI, SEI	SEI	←
Spark advance		Electronic	←	←	Electronic	←
Firing order		1-3-4-2			1-4-2-5-3-6	
		CYLINDER No. 			CYLINDER No. 	
Spark plug	Type	L3K9 18 110A (ILTR6A-8G) L3Y3 18 110 (ILTR6A-8G)	LFG1 18 110 (ILTR5A-13G), L3Y2 18 110 (ILTR5A-13G)	L303 18 110 (ITR5F-13), L341 18 110 (ITR6F-13)	AJ57 18 110 (AGSF 22FSCM)	←

\* : This vehicle is designed to use 93 [(R+M)/2 method] (98RON) or higher gasoline for best performance. If 93 [(R+M)/2 method] (98RON) is not available, 91 or 92 [(R+M)/2 method] (96 or 97RON) gasoline can be used. In case 91 or 92 [(R+M)/2 method] (96 or 97RON) is not available, gasoline as low as 87 [(R+M)/2 method] (91RON) can be used temporarily for emergency purposes. Use of gasoline lower than 93 [(R+M)/2 method] (98RON) can decrease performance during its use.




# OUTLINE

## Engine oil specification (Except L3 WITH TC)

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

01-00

## Engine oil specification (L3 WITH TC)

Item	U.S.A. and CANADA	Except U.S.A. and CANADA
Engine oil grade	 (ILSAC)	  (ILSAC) API SL or ILSAC
Engine oil viscosity	5W-30	



# 01-02A ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

## ON-BOARD DIAGNOSTIC SYSTEM

OUTLINE [L3] ..... 01-02A-1  
Features..... 01-02A-1

## ON-BOARD DIAGNOSTIC

WIRING DIAGRAM [L3] ..... 01-02A-2  
California Emission Regulation  
Applicable ATX Model ..... 01-02A-2  
Except for California Emission  
Regulation Applicable ATX Model ... 01-02A-4

## ON-BOARD DIAGNOSTIC SYSTEM

DESCRIPTION [L3] .....01-02A-6  
OBD-II Diagnostic Trouble Code  
(Mode 03) .....01-02A-6

DTC.....01-02A-10

## PID/DATA MONITOR AND RECORD

[L3] .....01-02A-12

01-02A

## ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [L3]

E6U010200000S01

### Features

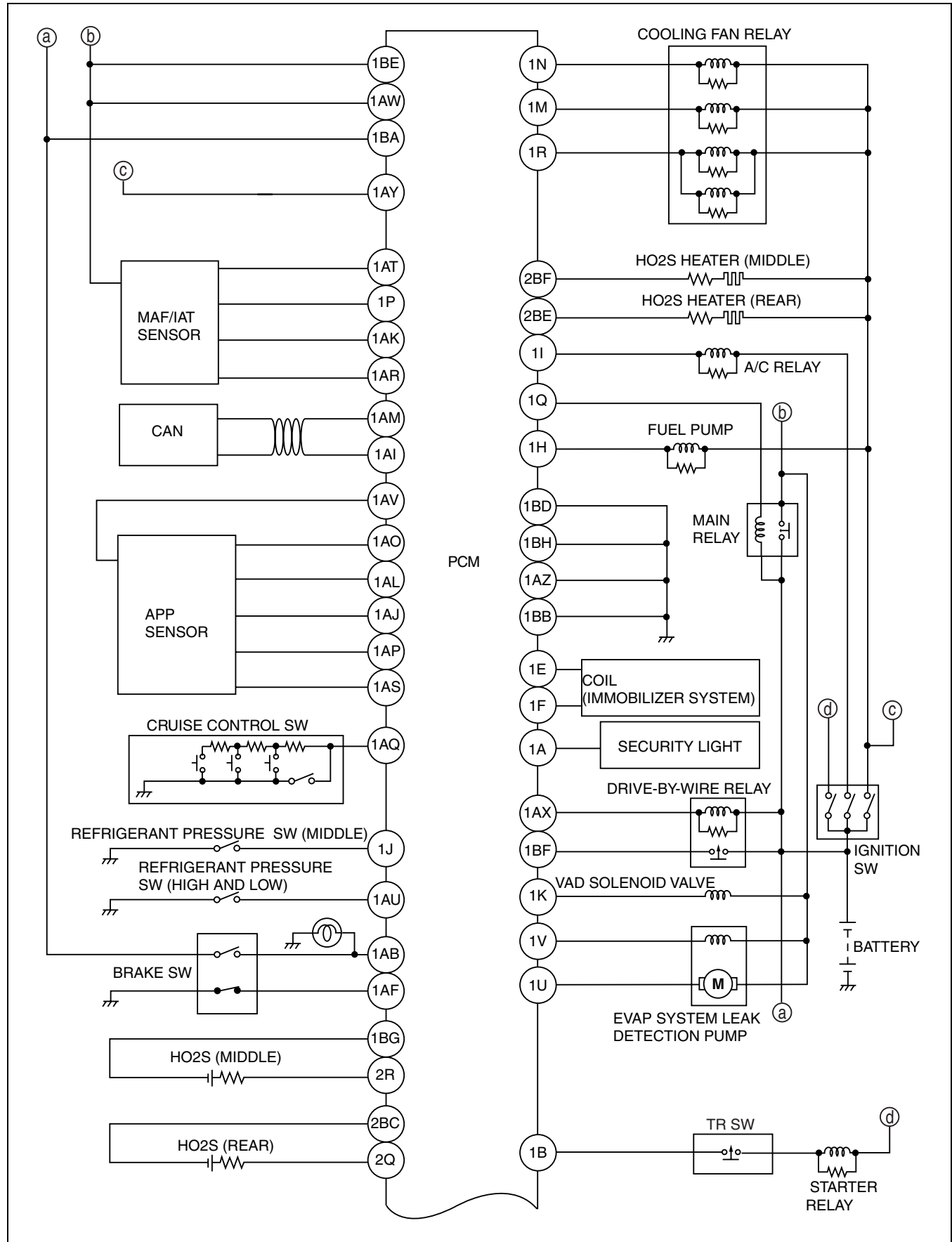
To meet OBD-II regulations	• Modes 03 of diagnostic test modes changed
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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

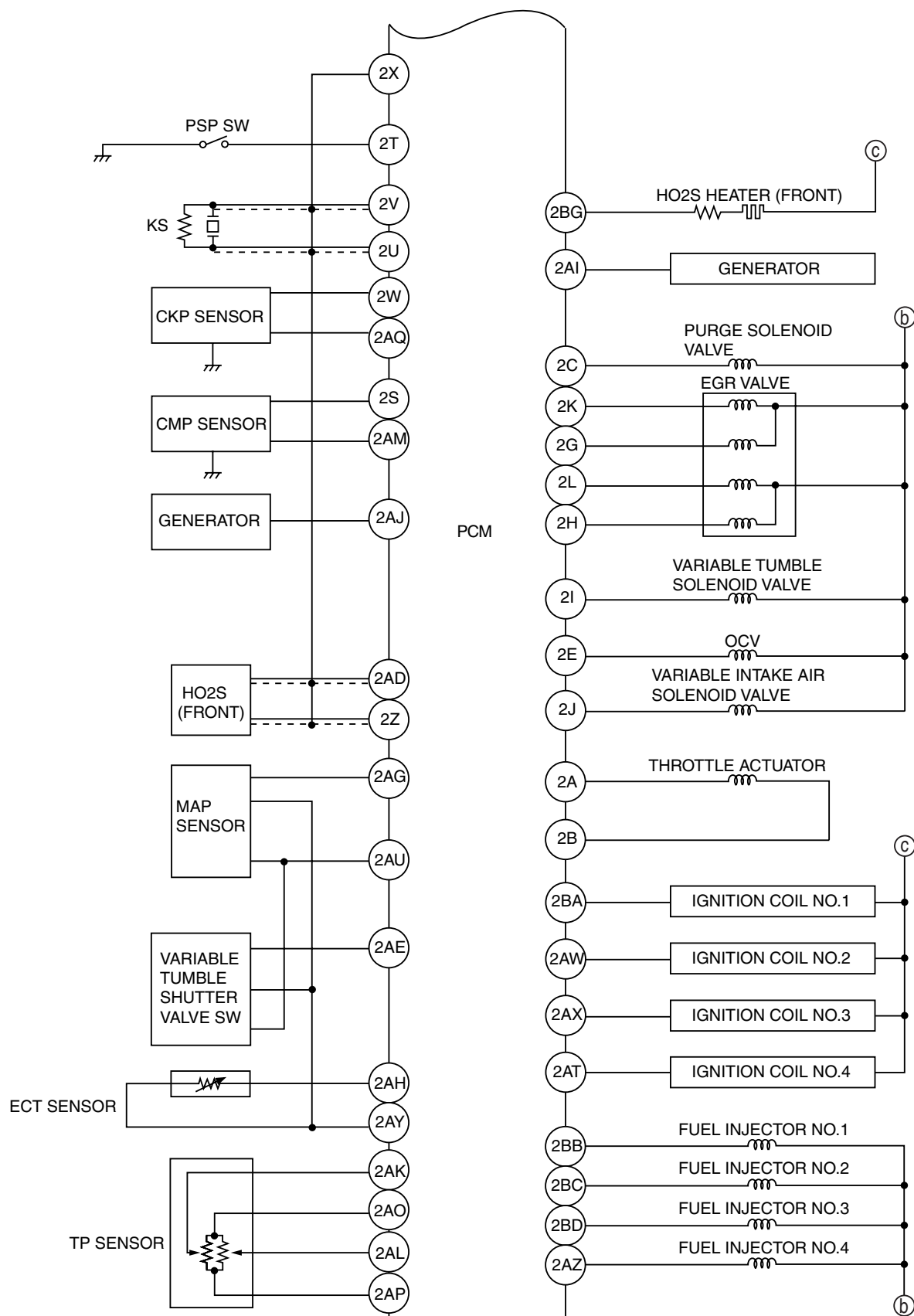
## ON-BOARD DIAGNOSTIC WIRING DIAGRAM [L3]

E6U01020000S04

California Emission Regulation Applicable ATX Model



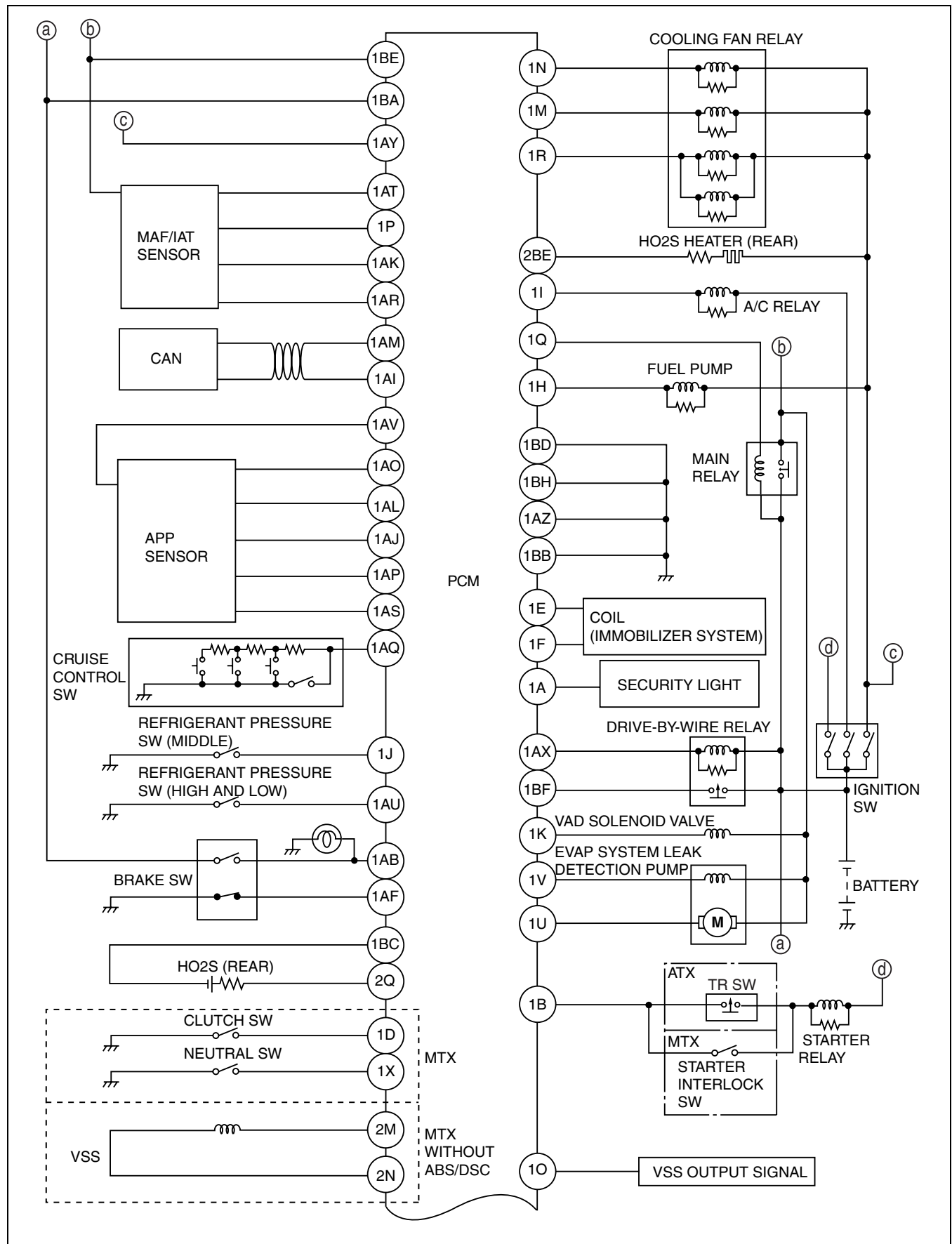
E6U140AW5901



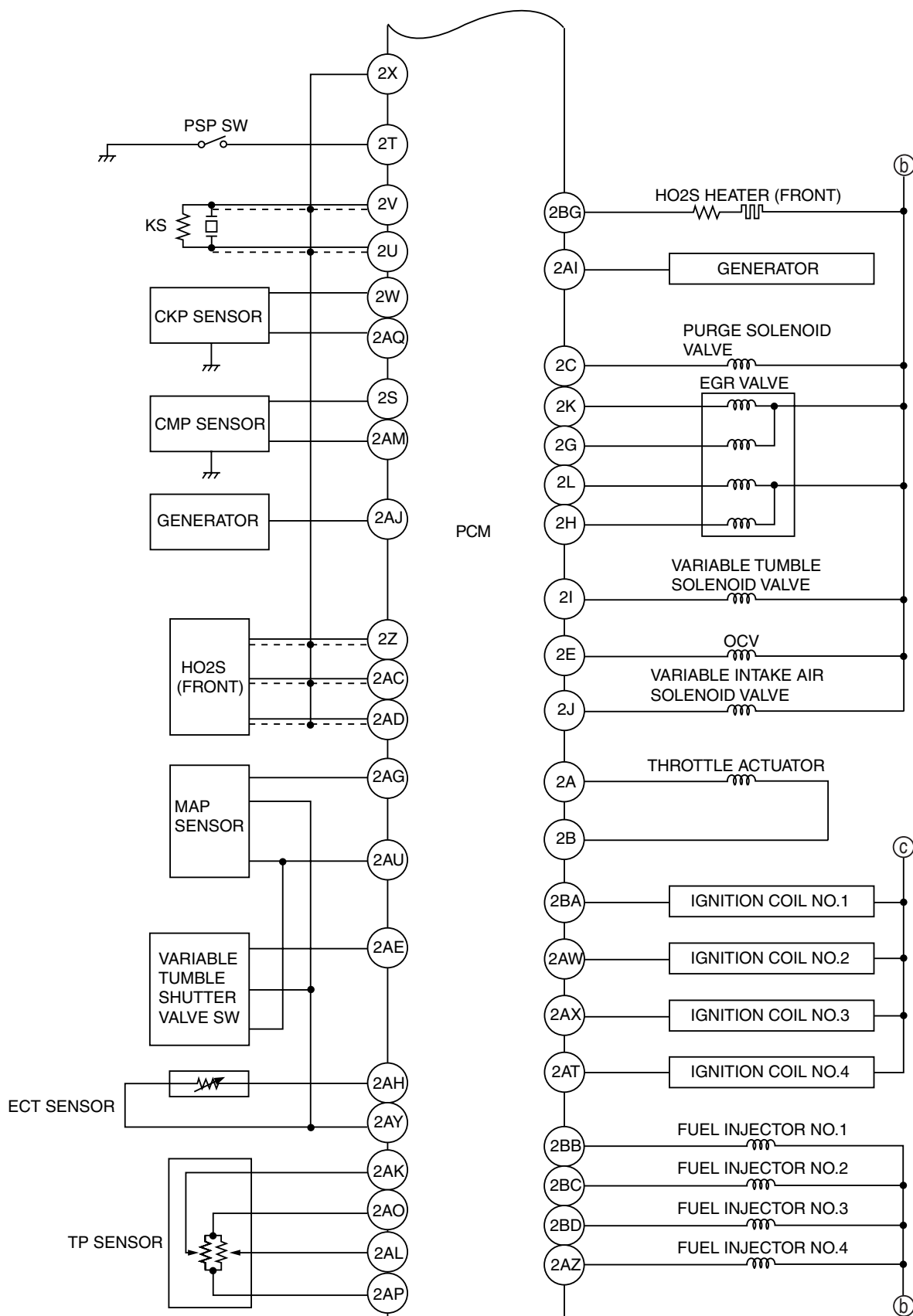
E6U140AW5902

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

Except for California Emission Regulation Applicable ATX Model



E6U140AW5903



E6U140AW5904

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

## ON-BOARD DIAGNOSTIC SYSTEM DESCRIPTION [L3]

E6U010200000S02

- The diagnostic test mode is essentially carried over from that of the 2005 MY except for following.
  - To meet OBD-II regulations, modes 03 have been changed.

Diagnostic test mode	Item
Mode 01	Sending diagnostic data (PID data monitor/On-board system readiness test)
Mode 02	Sending freeze frame data
Mode 03	Sending emission-related malfunction code (DTC)
Mode 04	Clearing/resetting emission-related malfunction information
Mode 06	Sending intermittent monitoring system test results (DMTR)
Mode 07	Sending continuous monitoring system test results (pending code)
Mode 08	On-board device control (simulation test, active command mode)
Mode 09	Request vehicle information

### OBD-II Diagnostic Trouble Code (Mode 03)

- The following DTCs have been changed.
  - P0030, P0031, P0032, P0131, P0132, P0133, P0134
- The following DTCs have been adopted.
  - P0016, P0069, P0116, P0137, P2237, P2251
- Differences between the 2006 MY and 2005 MY DTCs are shown below.

### DTC table

×: Applicable  
N/A: Not applicable

DTC No.		Condition	MIL	DC	Monitor item	Self-test type <sup>*1</sup>	Memory function
2006MY	2005MY						
B1342	←	PCM malfunction	OFF	—	—	C, O	×
P0011	←	CMP Timing over-advanced	ON	1	CCM	C, R	×
P0012	←	CMP Timing over-retarded	ON	2	CCM	C, R	×
P0016	N/A	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	←	Middle <sup>*2</sup> /Rear <sup>*3</sup> HO2S heater circuit low input	ON	2	HO2S heater	C, O, R	×
P0038	←	Middle <sup>*2</sup> /Rear <sup>*3</sup> HO2S heater circuit high input	ON	2	HO2S heater	C, O, R	×
P0043 <sup>*2</sup>	←	Rear HO2S heater circuit low input	ON	2	HO2S heater	C, O, R	×
P0044 <sup>*2</sup>	←	Rear HO2S heater circuit high input	ON	2	HO2S heater	C, O, R	×
P0069	N/A	MAF circuit range/performance problem	ON	2	CCM	C	×
P0101	←	Manifold absolute pressure/atmospheric pressure correlation	ON	2	CCM	C	×
P0102	←	MAF circuit low input	ON	1	CCM	C, O, R	×
P0103	←	MAF 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 circuit performance problem	ON	2	CCM	C	×
P0112	←	IAT circuit low input	ON	1	CCM	C, O, R	×
P0113	←	IAT circuit high input	ON	1	CCM	C, O, R	×
P0116	N/A	Engine coolant temperature circuit range/performance	ON	2	Engine cooling system	C	×
P0117	←	ECT circuit low input	ON	1	Engine cooling system	C, O, R	×
P0118	←	ECT 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	×

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*1	Memory function
2006MY	2005MY						
P0126	←	Coolant thermostat stuck open	ON	2	Engine cooling system	C	×
P0128	←	Coolant thermostat stuck open	ON	2	Engine cooling system	C	×
P0130*2	←	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 circuit no activity detected	ON	2	HO2S	C, R	×
P0137*3	N/A	Rear HO2S circuit low input	ON	2	HO2S	C, O, R	×
P0138	←	Middle*2/Rear*3 HO2S circuit high input	ON	2	HO2S	C, O, R	×
P0139	←	Middle*1/Rear*2 HO2S circuit malfunction	ON	2	HO2S	C	×
P0140*3	←	Rear HO2S circuit no activity detected	ON	2	HO2S	C, R	×
P0144*2	←	Rear HO2S circuit high input	ON	2	HO2S	C, O, R	×
P0171*2	←	Fuel trim system too lean	ON	2	Fuel system	C, R	×
P0172*2	←	Fuel trim system too rich	ON	2	Fuel system	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	←	Knock sensor circuit low input	ON	1	CCM	C, O, R	×
P0328	←	Knock sensor circuit high input	ON	1	CCM	C, O, R	×
P0335	←	CKP sensor circuit malfunction	ON	1	CCM	C	×
P0340	←	CMP sensor circuit malfunction	ON	1	CCM	C	×
P0401	←	EGR flow insufficient detected	ON	2	EGR	C, R	×
P0403	←	EGR valve (stepper motor) circuit malfunction	ON	2	CCM	C, O, R	×
P0420*3	←	Catalyst system efficiency below threshold	ON	2	Catalyst	C	×
P0421*2	←	Catalyst system efficiency below threshold	ON	2	Catalyst	C	×
P0441	←	EVAP control system incorrect purge flow	ON	2	EVAP system monitor	C, R	×
P0442	←	EVAP control system leak detected (small leak)	ON	2	EVAP system monitor	C, R	×
P0443	←	EVAP control system purge control valve circuit malfunction	ON	2	CCM	C, O, R	×
P0446	←	Change over valve (COV) (EVAP system leak detection pump) stuck close	ON	2	CCM	C, R	×
P0455	←	EVAP control system leak detected (gross leak)	ON	2	EVAP system monitor	C, R	×
P0456*4	←	EVAP control system leak detected (very small leak)	ON	2	EVAP system monitor	C, R	×
P0461	←	Fuel gauge sender unit circuit range/performance	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	×

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*1	Memory function
2006MY	2005MY						
P0480	←	Fan relay No.1 control circuit malfunction	OFF	1	CCM	C, O, R	×
P0481	←	Fan relay No.2 and No.3 control circuit malfunction	OFF	1	CCM	C, O, R	×
P0482	←	Fan relay No.4 control circuit malfunction	OFF	1	Other	C, O, R	×
P0500	←	Vehicle speed sensor (VSS) circuit malfunction	ON	2	CCM	C	×
P0505	←	Idle control system malfunction	OFF	—	—	R	—
P0506	←	Idle control system RPM lower than expected	ON	2	CCM	C	×
P0507	←	Idle 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 malfunction	OFF	1	Other	C	×
P0601	←	Internal control module memory check sum error	ON	1	CCM	C, O, R	×
P0602	←	PCM programming error	ON	1	CCM	C, O, R	×
P0604	←	PCM RAM error	ON	1	CCM	C, O, R	×
P0606	←	PCM processor	ON	1	CCM	C, O, R	×
P0607*3	←	Control module performance	OFF	1	Other	C, O, R	×
P0610	←	Control module vehicle options error	ON	1	CCM	C, O, R	×
P0638	←	Throttle actuator control range/performance	ON	1	CCM	C	×
P0661	←	Variable intake air solenoid valve circuit low input	OFF	1	Other	C, O, R	×
P0662	←	Variable intake-air system solenoid valve circuit high input	OFF	1	Other	C, O, R	×
P0703	←	Brake switch No.1 circuit malfunction	ON	2	CCM	C	×
P0704*5	←	Clutch switch circuit malfunction	ON	2	CCM	C	×
P0850*5	←	Neutral switch circuit malfunction	ON	2	CCM	C	×
P2004	←	Variable tumble shutter valve stuck open	ON	2	CCM	C, R	×
P2006	←	Variable tumble shutter valve stuck closed	ON	2	CCM	C, R	×
P2009	←	Variable tumble solenoid valve circuit low input	ON	2	CCM	C, O, R	×
P2010	←	Variable tumble solenoid valve circuit high input	ON	2	CCM	C, O, R	×
P2088	←	OCV actuator circuit low	ON	1	CCM	C, O, R	×
P2089	←	OCV actuator 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	×
P2100*3	←	Throttle actuator circuit open	ON	1	CCM	C, O, R	×
P2101	←	Throttle actuator circuit range/performance	ON	1	CCM	C, R	×
P2102*3	←	Throttle actuator circuit low input	ON	1	CCM	C, O, R	×
P2103*3	←	Throttle actuator circuit high input	ON	1	CCM	C, O, R	×
P2107	←	Throttle actuator control module processor problem	ON	1	CCM	C, R	×
P2108	←	Throttle actuator control module performance problem	ON	1	CCM	C, R	×
P2109*2	←	TP sensor minimum stop range/performance problem	ON	1	CCM	C, R	×
P2112*2	←	Throttle actuator control system range/performance problem	ON	1	CCM	C, R	×
P2119	←	Throttle actuator control throttle body range/performance	ON	2	CCM	C, R	×

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*1	Memory function
2006MY	2005MY						
P2122	←	Accelerator pedal position (APP) sensor No.1 circuit low input	ON	1	CCM	C, O, R	×
P2123	←	Accelerator pedal position (APP) sensor No.1 circuit high input	ON	1	CCM	C, O, R	×
P2127	←	Accelerator pedal position (APP) sensor No.2 circuit low input	ON	1	CCM	C, O, R	×
P2128	←	Accelerator pedal position (APP) sensor No.2 circuit high input	ON	1	CCM	C, O, R	×
P2135	←	Throttle position sensor No.1/No.2 voltage correlation problem	ON	1	CCM	C, O, R	×
P2138	←	Accelerator pedal position (APP) sensor No.1/No.2 voltage correlation problem	ON	1	CCM	C, O, R	×
P2177*3	←	Fuel system too lean at off idle	ON	2	Fuel system	C, R	×
P2178*3	←	Fuel system too rich at off idle	ON	2	Fuel system	C, R	×
P2187*3	←	Fuel system too lean at idle	ON	2	Fuel system	C, R	×
P2188*3	←	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	×
P2237*3	N/A	Front HO2S positive current control circuit open	ON	2	HO2S	C, O, R	×
P2251*3	N/A	Front HO2S negative current control circuit open	ON	2	HO2S	C, O, R	×
P2270*2	←	Middle HO2S signal stuck lean	ON	2	HO2S	C	×
P2271*2	←	Middle HO2S signal stuck rich	ON	2	HO2S	C	×
P2274*2	←	Rear HO2S signal stuck lean	ON	2	HO2S	C	×
P2275*2	←	Rear HO2S signal stuck rich	ON	2	HO2S	C	×
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 sensor circuit malfunction	ON	2	CCM	C, R	×
P2405	←	EVAP system leak detection pump sensor circuit low input	ON	2	CCM	C, R	×
P2407	←	EVAP system leak detection pump sensor circuit intermittent	ON	2	CCM	C, R	×
P2502	←	Generator terminal B circuit open	OFF	1	—	C, R	×
P2503	←	Generator output voltage signal no electricity	OFF	1	Other	C, R	×
P2504	←	Battery overcharge	OFF	1	Other	C, R	×
P2507	←	PCM +BB (back-up battery) voltage low	ON	1	CCM	C, O, R	×
P2610	←	PCM internal engine off timer performance	ON	2	CCM	C	×
P2676	←	Variable air duct (VAD) solenoid valve circuit low input	OFF	1	Other	C, O, R	×
P2677	←	Variable air duct (VAD) solenoid valve circuit high input	OFF	1	Other	C, O, R	×

- \*1 : C; CMDTC self test, O; KOEO selftest, R; KOER selftest  
 \*2 : California emission regulation applicable ATX model  
 \*3 : Except for California emission regulation applicable ATX model  
 \*4 : California emission regulation applicable model  
 \*5 : MTX model  
 \*6 : ATX model

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## ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

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### DTC

- Detection logics and conditions are as shown below.

#### **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 (California emission regulation applicable ATX model)**

- 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.

#### **P0030 Front HO2S heater control circuit problem (Except for California emission regulation applicable ATX model)**

- OBD system monitors the output signal voltage from oxygen sensor which is proportion to the element impedance of oxygen sensor.
- If the output signal voltage isn't between 0.75 V and 1.5 V after specified time from engine start, heater performance considered failed.

##### **MONITORING CONDITIONS**

- Battery voltage: 10—18 V
- Time from engine start is 74 s or more

#### **P0031 Front HO2S heater circuit low input (California emission regulation applicable ATX model)**

- 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.

#### **P0031 Front HO2S heater circuit low input (Except for California emission regulation applicable ATX model)**

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

##### **Note**

- The front HO2S heater is controlled by duty signal.

#### **P0032 Front HO2S heater circuit high input (California emission regulation applicable ATX model)**

- 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.

#### **P0032 Front HO2S heater circuit high input (Except for California emission regulation applicable ATX model)**

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

##### **Note**

- The front HO2S heater is controlled by duty signal.

#### **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}.

#### **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.

#### **P0131 Front HO2S circuit low input (California emission regulation applicable ATX model)**

- 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.

## **P0131 Front HO2S circuit low input (Except for California emission regulation applicable ATX model)**

- The PCM monitors the input voltage from the front HO2S while the engine is running. If the input voltage is above 1.0 V for 2 s, the PCM determines that the front HO2S circuit voltage is low.

## **P0132 Front HO2S circuit high input (California emission regulation applicable ATX model)**

- 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.

## **P0132 Front HO2S circuit high input (Except for California emission regulation applicable ATX model)**

- The PCM monitors the input voltage from the front HO2S when the engine is running. If the input voltage is less than 1.0 V for 2 s, the PCM determines that the front HO2S circuit voltage is high.

## **P0133 Front HO2S circuit problem (California emission regulation applicable ATX model)**

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

### **MONITORING CONDITIONS**

- HO2S heater, HO2S, and TWC Repair Verification Drive Mode
- Following conditions are met:
  - Front HO2S heater monitor is completed.
  - Fuel system loop status is closed loop fuel control.

## **P0133 Front HO2S circuit problem (Except for California emission regulation applicable ATX model)**

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

### **MONITORING CONDITIONS**

- HO2S heater, HO2S, and TWC Repair Verification Drive Mode
- Following conditions are met:
  - Front HO2S heater monitor is completed.
  - Fuel system loop status is closed loop fuel control.

## **P0134 Front HO2S no activity detected (California emission regulation applicable ATX model)**

- The PCM monitors the front HO2S element impedance when the following conditions are met. If the front HO2S element impedance is 150 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}).

## **P0134 Front HO2S no activity detected (Except for California emission regulation applicable ATX model)**

- The PCM monitors the input voltage from front HO2S when the following conditions are met. Under the following monitoring conditions, the input voltage more than 3.22 V, the PCM determines that the front HO2S is not activated.

### **MONITORING CONDITIONS**

- HO2S, HO2S heater and TWC Repair Verification Drive Mode
- Following conditions are met
  - Front HO2S heater is turned on for more than 30 s.
  - Battery voltage: 10 —18 V

## **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}.

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

## P2237 Front HO2S positive current control circuit open

- The PCM monitors front HO2S positive current control circuit voltage. If the voltage is not changed against the PCM control value while the engine running, the PCM determines that the front HO2S positive current control circuit is open.

## P2251 Front HO2S negative current control circuit open

- The PCM monitors front HO2S negative current control circuit voltage. If the voltage is not changed against the PCM control value while the engine running, the PCM determines that the front HO2S negative current control circuit is open.

## PID/DATA MONITOR AND RECORD [L3]

E6U01020000S03

- Differences between the 2006 MY and 2005 MY PID/DATA monitor items are shown below.

### PID/DATA monitor table

N/A: Not applicable

Monitor item		Definition	Unit/ Condition		PCM terminal
2006 MY	2005 MY				
AAT	←	Ambient Air Temperature	°C	°F	—
AC_REQ	←	A/C switch	ON/OFF		1AU
ACCS	←	A/C relay	ON/OFF		1I
AFR	N/A	Air fuel ratio	—		—
AFR_ACT	N/A	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
APP 1	←	Accelerator pedal position sensor 1	%		1AO
			V		
APP 2	←	Accelerator pedal position sensor 2	%		1AP
			V		
ARPMDES	←	Target engine speed	RPM		—
N/A	B+	Battery positive voltage	V		—
BARO	←	Barometric pressure	kPa, Bar, psi		—
			V		
BOO	←	Brake switch	ON/OFF		1AB 1AF
BPA	←	Brake pressure applied switch	ON/OFF		—
CATT11_DSD	←	Desired catalyst temperature bank one, sensor one	°C		—
CHRG LP	←	Generator warning light	ON/OFF		—
COLP	←	Refrigerant pressure switch (middle)	ON/OFF		1J
CPP*3	←	Clutch pedal position	ON/OFF		1D
CPP/PNP*3	←	Shift lever position	Drive/Neutral		1X
DTCCNT	DTC_CNT	Number of DTC detected	—		—
ECT	←	Engine coolant temperature	°C	°F	2AH
			V		
EQ_RAT11	←	Equivalence ratio (lambda)	—		2Z 2AC 2AD
EQ_RAT11_DSD	←	Desired equivalence ratio (lambda)	—		2Z 2AC 2AD
ETC_ACT	←	Electronic throttle control actual	°		2AL 2AK
ETC_DSD	←	Electronic throttle control desired	%		1AO 1AP
			°		
EVAPCP	←	Purge solenoid valve duty value	%		2C
FAN1	←	Cooling fan control	ON/OFF		1M
FAN2	←	Cooling fan control	ON/OFF		1R
FAN3	←	Cooling fan control	ON/OFF		1R

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

Monitor item		Definition	Unit/ Condition	PCM terminal
2006 MY	2005 MY			
FLI	←	Fuel level	%	—
FP	←	Fuel pump relay	ON/OFF	1H
FUELPW	←	Fuel injector duration	ms	2AZ 2BB 2BC 2BD
FUELSYS	←	Fuel system status	OL/CL/ OL-Drive/OL- Fault/CL-Fault	—
GENVDSD	←	Generator voltage desired	V	—
HTR11	←	HO2S heater (front)	ON/OFF	2BG
HTR12	←	HO2S heater (middle <sup>*1</sup> /rear <sup>*2</sup> )	ON/OFF	2BF <sup>*1</sup> 2BE <sup>*2</sup>
HTR13 <sup>*1</sup>	←	HO2S heater (rear)	ON/OFF	2BE
IASV	←	Variable air duct control solenoid valve	ON/OFF	1K
IAT	←	Intake air temperature	°C   °F V	1AT
IMRC	←	Variable tumble solenoid valve	ON/OFF	2I
IMTV	←	Variable intake air solenoid valve	ON/OFF	2J
INGEAR	←	Load/no load condition	ON/OFF	1D 1X
IVS	←	CTP condition	IDLE/ OFF IDLE	1AO 1AP
KNOCKR	←	Knocking retard	°	2U 2V
LDP_EVAPCP	←	EVAP system leak detection pump detect incorrect purge flow	mA	—
LDP_IDL	←	EVAP system leak detection pump idle current	mA	—
LDP_MON	←	EVAP system leak detection pump monitoring current	mA	—
LDP_REF	←	EVAP system leak detection pump reference current	mA	—
LDP_SLDV	←	EVAP system small leak detection value	mA	—
LDP_VSL FV <sup>*4</sup>	N/A	EVAP system small leak detection value	mA/sec	—
LDP_VSL SV <sup>*4</sup>	N/A	EVAP system small leak detection value	mA/sec	—
LDP_VSLDV <sup>*4</sup>	←	EVAP system small leak detection value	mA/sec	—
LOAD	←	Engine load	%	—
LONGFT1	←	long term fuel trim	%	—
MAF	←	Mass airflow	g/s V	1AK
MAP	←	Manifold absolute pressure	kPa, inHg V	2AG
MIL	←	Malfunction indicator lamp	ON/OFF	—
MIL_DIS	←	Traveled distance since the MIL illuminated	km, mile	—
NUMKEYS	←	Number of keys stored in module	—	—
O2S11	←	Front oxygen sensor	V	2Z 2AC <sup>*2</sup> 2AD
O2S12	←	Middle <sup>*1</sup> / rear <sup>*2</sup> oxygen sensor	V	2R <sup>*1</sup> 2Q <sup>*2</sup>
O2S13 <sup>*1</sup>	←	Rear oxygen sensor	V	2Q
PSP	←	Power steering pressure switch	Low/High	2T
RFCFLAG	←	Readness function code	Learnt/Not Learnt	—
RO2FT1	←	Rear oxygen sensor fuel trim	—	—

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3)]

Monitor item		Definition	Unit/ Condition	PCM terminal
2006 MY	2005 MY			
RPM	←	Engine speed	rpm	2W
SCCS	←	Speed control command switch	V	—
SEGRP	←	EGR valve (stepping motor) position	Step	2G 2H 2K 2L
SEGRP DSD	←	Desired SEGRP valve position	%	2G 2H 2K 2L
N/A	SELTESTDTC	DTC of KOEO/KOER self-test	—	—
SHRTFT1	←	Short term fuel trim	%	—
N/A	SHRTFT11*2	Short term fuel trim (rear HO2S)	%	—
SHRTFT12	←	Short term fuel trim bank 1 sensor 2	%	—
SHRTFT13*1	←	Short term fuel trim bank 1 sensor 3	%	—
SPARKADV	←	Ignition timing	°	2AT 2AW 2AX 2BA
test	←	Test mode	ON/OFF	—
TIRESIZE	←	Tire Size (rev / mile)	rev/mile	—
TP REL	←	Relative throttle position	%	—
TP 1	←	TP sensor 1	%	2AK
	←		V	
TP 2	←	TP sensor 2	%	2AL
	←		V	
TPCT	←	TP sensor voltage at CTP	V	2AK 2AL
N/A	Vref*2	Constant voltage	V	—
VPWR	N/A	Module supply voltage	V	—
VSS	←	Vehicle speed	kph, mph	—
VT ACT1	←	Actual valve timing	°	2E
VT DIFF1	←	Difference between target and actual valve timing	°	2E
VT DUTY1	N/A	Oil control valve duty value	%	2E
VTC	N/A	Variable tumble shutter valve control	Off/On	2AE

\*1 : California emission regulation applicable ATX model

\*2 : Except for California emission regulation applicable ATX model

\*3 : MTX

\*4 : California emission regulation applicable model

01-02B ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

<b>ON-BOARD DIAGNOSTIC OUTLINE</b>		MAP sensor.....01-02B-9
[L3 WITH TC] .....	01-02B-1	Fuel pressure regulator.....01-02B-9
Features.....	01-02B-1	Boost air temperature sensor .....01-02B-9
<b>DIAGNOSTIC TEST MODE</b>		ECT sensor.....01-02B-9
[L3 WITH TC] .....	01-02B-2	Front HO2S.....01-02B-9
OBD-II Diagnostic Data Monitor		Rear HO2S .....01-02B-10
(Mode 01).....	01-02B-2	Fuel pressure sensor .....01-02B-10
OBD-II Freeze Frame Data		Fuel injector.....01-02B-10
(Mode 02).....	01-02B-3	Turbocharger.....01-02B-10
OBD-II Diagnostic Trouble Code		Wastegate control solenoid valve .....01-02B-10
(Mode 03).....	01-02B-4	Warm up catalytic converter .....01-02B-11
OBD-II Diagnostic Monitoring System		PCM .....01-02B-11
Test Results (Mode 06) .....	01-02B-8	<b>KOEO/KOER SELF-TEST</b>
<b>DTC DETECTION LOGIC AND</b>		[L3 WITH TC] .....
<b>CONDITIONS [L3 WITH TC].....</b>	<b>01-02B-8</b>	<b>PID/DATA MONITOR AND RECORD</b>
CKP sensor, CMP sensor .....	01-02B-8	[L3 WITH TC] .....
Front HO2S heater.....	01-02B-8	<b>SIMULATION TEST [L3 WITH TC] .....</b>
		<b>01-02B-16</b>

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ON-BOARD DIAGNOSTIC OUTLINE [L3 WITH TC]

E6U01020000S05

Features

To meet OBD-II regulations	• Modes 01, 02, 03, and 06 of diagnostic test modes changed
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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

## DIAGNOSTIC TEST MODE [L3 WITH TC]

E6U01020000S06

- The diagnostic test mode is essentially carried over from that of the 2005MY except for following.
  - To meet OBD-II regulations, modes 01, 02, 03, and 06 have been changed.

Diagnostic test mode	Item
Mode 01	Sending diagnostic data (PID data monitor/On-board system readiness test)
Mode 02	Sending freeze frame data
Mode 03	Sending emission-related malfunction code (DTC)
Mode 04	Clearing/resetting emission-related malfunction information
Mode 06	Sending intermittent monitoring system test results (DMTR)
Mode 07	Sending continuous monitoring system test results (pending code)
Mode 08	On-board device control (simulation test, active command mode)
Mode 09	Request vehicle information

## OBD-II Diagnostic Data Monitor (Mode 01)

### PID data monitor

- Differences between the 2006MY and 2005MY PID data monitor items are shown below.

### PID data monitor table

×: Applicable

—: Not applicable

2006MY	2005MY	Full names	Condition/unit	
×	×	Fuel system loop status	Refer to list below.	
×	×	Engine load calculated value	%	
×	×	Engine coolant temperature	°C	°F
×	×	Short fuel trim	%	
×	×	Long fuel trim	%	
×	×	Intake manifold absolute pressure	kPa	
×	×	Engine speed	rpm	
×	×	Vehicle speed	km/h	mph
×	×	Spark advance	BTDC	
×	×	Intake air temperature	°C	°F
×	×	Mass air flow	g/s	
×	×	Throttle position (sensor No.1)	%	
×	×	Oxygen sensor location	—	
—	×	Front heated oxygen sensor	V	%
×	×	Rear heated oxygen sensor	V	%
×	×	OBD requirement to which vehicle is designed	—	
×	×	Time since engine start	s	
×	×	Distance travelled while MIL is activated	km	miles
×	—	Fuel rail pressure	kPa	
×	×	Desired EGR valve opening angle	%	
×	×	Desired purge solenoid valve control duty	%	
×	×	Fuel level	%	
×	×	Number of warm-ups since DTCs cleared	—	
×	×	Distance travelled since DTCs cleared	km	miles
×	×	Barometric pressure	kPa	
×	—	Lambda	—	
×	—	Front HO2S output current	mA	
×	×	Estimated catalyst converter temperature	°C	°F
×	×	PCM power supply voltage	V	
×	×	Absolute load value	%	
×	×	Theoretical air/fuel ratio coefficient to calculate target air/fuel ratio	—	
×	×	Relative throttle position	%	
×	×	Ambient air temperature	°C	°F
×	×	Throttle position (sensor No.2)	%	
×	×	Accelerator pedal position (sensor No.1)	%	
×	×	Accelerator pedal position (sensor No.2)	%	
×	×	Desired throttle valve opening angle	%	

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

## Meaning of fuel system loop status

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

## On-board system readiness test

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

### Continuous monitoring system

- HO2S heater
- Engine cooling system
- Fuel system
- Misfire
- CCM

### Intermittent monitoring system

- HO2S
- EGR
- Catalyst
- EVAP system

## OBD-II Freeze Frame Data (Mode 02)

- Differences between the 2006MY and 2005MY Freeze Frame Data monitor items are shown below.

### Freeze Frame Data monitor table

X: Applicable  
—: Not applicable

2006MY	2005MY	Full names	Condition/unit
x	x	DTC that caused required FFD storage	—
x	x	Fuel system loop status	Refer to list below.
x	x	Engine load calculated value	%
x	x	Engine coolant temperature	°C   °F
x	x	Short fuel trim	%
x	x	Long fuel trim	%
x	x	Intake manifold absolute pressure	kPa
x	x	Engine speed	rpm
x	x	Vehicle speed	km/h   mph
x	x	Spark advance	BTDC
x	x	Intake air temperature	°C   °F
x	x	Mass air flow	g/s
x	x	Throttle position (sensor No.1)	%
x	x	Time since engine start	s
x	—	Fuel rail pressure	kPa
x	x	Desired EGR valve opening angle	%
x	x	Desired purge solenoid valve control duty	%
x	x	Fuel level	%
x	x	Number of warm-ups since DTCs cleared	—
x	x	Distance travelled since DTCs cleared	km   miles
x	x	Barometric pressure	kPa
x	x	Estimated catalyst converter temperature	°C   °F
x	x	PCM power supply voltage	V
x	x	Absolute load value	%
x	x	Theoretical air/fuel ratio coefficient to calculate target air/fuel ratio	—
x	x	Relative throttle position	%
x	x	Ambient air temperature	°C   °F
x	x	Throttle position (sensor No.2)	%
x	x	Accelerator pedal position (sensor No.1)	%
x	x	Accelerator pedal position (sensor No.2)	%
x	x	Desired throttle valve opening angle	%

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

## Meaning of fuel system loop status

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

## OBD-II Diagnostic Trouble Code (Mode 03)

- The following DTCs have been adopted.
  - P0016, P0030, P0069, P0089, P0091, P0092, P0096, P0097, P0098, P0116, P0131, P0137, P0192, P0193, P0201, P0202, P0203, P0204, P0234, P0245, P0246, P0421, P0611, P2237, P2245, P2246, P2251, P2610
- The following DTCs have been deleted.
  - P0106, P0420, P0481, P0482, P0661, P0662, P2676, P2677
- Differences between the 2006MY and 2005MY DTCs are shown below.

## DTC table

×: Applicable

—: Not applicable

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*2	Memory function
2006MY	2005MY						
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	×
P0069	—	Manifold absolute pressure/atmospheric pressure correlation	ON	2	CCM	C	×
P0089	—	Fuel pressure regulator performance	OFF	1	Other	C, O, R	×
P0091	—	Fuel pressure regulator control circuit low	ON	1	CCM	C, O, R	×
P0092	—	Fuel pressure regulator control circuit high	ON	1	CCM	C, O, R	×
P0096	—	IAT sensor 2 circuit range/performance problem	ON	2	CCM	C	×
P0097	—	IAT sensor 2 circuit low	ON	1	CCM	C, O, R	×
P0098	—	IAT sensor 2 circuit high	ON	1	CCM	C, O, R	×
P0101	←	MAF circuit range/performance problem	ON	2	CCM	C	×
P0102	←	MAF circuit low input	ON	1	CCM	C, O, R	×
P0103	←	MAF circuit high input	ON	1	CCM	C, O, R	×
—	P0106	MAP sensor performance problem	ON	2	CCM	C	×
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 circuit performance problem	ON	2	CCM	C	×
P0112	←	IAT circuit low input	ON	1	CCM	C, O, R	×
P0113	←	IAT circuit high input	ON	1	CCM	C, O, R	×
P0116	—	ECT circuit range/performance problem	ON	1	Engine cooling system	C	×
P0117	←	ECT circuit low input	ON	1	Engine cooling system	C, O, R	×
P0118	←	ECT 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	←	Coolant thermostat stuck open	ON	2	Engine cooling system	C	×

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*2	Memory function
2006MY	2005MY						
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 circuit 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 malfunction	ON	2	HO2S	C	×
P0140	←	Rear HO2S circuit no activity detected	ON	2	HO2S	C, R	×
P0192	—	Fuel rail pressure sensor circuit low input	ON	1	CCM	C, O, R	×
P0193	—	Fuel rail pressure sensor circuit high input	ON	1	CCM	C, O, R	×
P0201	—	Injector circuit/open cylinder No.1	ON	1	CCM	C, R	×
P0202	—	Injector circuit/open cylinder No.2	ON	1	CCM	C, R	×
P0203	—	Injector circuit/open cylinder No.3	ON	1	CCM	C, R	×
P0204	—	Injector circuit/open cylinder No.4	ON	1	CCM	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	×
P0234	—	Turbo/supercharger overboost condition	OFF	1	Other	C, R	×
P0245	—	Turbocharger wastegate solenoid low	OFF	2	Other	C, O, R	×
P0246	—	Turbocharger wastegate solenoid high	OFF	2	Other	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	←	Knock sensor circuit low input	ON	1	CCM	C, O, R	×
P0328	←	Knock sensor circuit high input	ON	1	CCM	C, O, R	×
P0335	←	CKP sensor circuit malfunction	ON	1	CCM	C	×
P0340	←	CMP sensor circuit malfunction	ON	1	CCM	C	×
P0401	←	EGR flow insufficient detected	ON	2	EGR	C, R	×
P0403	←	EGR valve (stepper motor) circuit malfunction	ON	2	CCM	C, O, R	×
—	P0420	Catalyst system efficiency below threshold	ON	2	Catalyst	C	×
P0421	—	Catalyst system efficiency below threshold	ON	2	Catalyst	C	×
P0441	←	EVAP control system incorrect purge flow	ON	2	EVAP system monitor	C, R	×
P0442	←	EVAP control system leak detected (small leak)	ON	2	EVAP system monitor	C, R	×
P0443	←	EVAP control system purge control valve circuit malfunction	ON	2	CCM	C, O, R	×
P0446	←	Change over valve (COV) (EVAP system leak detection pump) stuck closed	ON	2	CCM	C, R	×
P0455	←	EVAP control system leak detected (gross leak)	ON	2	EVAP system monitor	C, R	×
P0456*1	←	EVAP control system leak detected (very small leak)	ON	2	EVAP system monitor	C, R	×
P0461	←	Fuel gauge sender unit circuit range/performance	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	←	Fan relay No.1 control circuit malfunction	OFF	1	Other	C, O, R	×
—	P0481	Fan relay No.2 and No.3 control circuit malfunction	OFF	1	CCM	C, O, R	×

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*2	Memory function
2006MY	2005MY						
—	P0482	Fan relay No.4 control circuit malfunction	OFF	1	Other	C, O, R	×
P0500	←	Vehicle speed sensor (VSS) circuit malfunction	ON	2	CCM	C	×
P0505	←	Idle control system malfunction	OFF	—	—	R	—
P0506	←	Idle control system RPM lower than expected	ON	2	CCM	C	×
P0507	←	Idle 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 malfunction	OFF	1	Other	C	×
P0601	←	Internal control module memory check sum error	ON	1	CCM	C, O, R	×
P0602	←	PCM programming error	ON	1	CCM	C, O, R	×
P0604	←	PCM RAM error	ON	1	CCM	C, O, R	×
P0606	←	PCM processor	ON	1	CCM	C, O, R	×
P0607	←	Control module performance	OFF	1	Other	C, O, R	×
P0610	←	Control module vehicle options error	ON	1	CCM	C, O, R	×
P0611	—	Fuel injector control module performance	OFF	1	Other	C, O, R	×
P0638	←	Throttle actuator control range/performance	ON	1	CCM	C	×
—	P0661	Variable intake-air system (VIS) control solenoid valve circuit low input	OFF	1	Other	C, O, R	×
—	P0662	Variable intake-air system (VIS) control solenoid valve circuit high input	OFF	1	Other	C, O, R	×
P0703	←	Brake switch No.1 circuit malfunction	ON	2	CCM	C	×
P0704	←	Clutch switch circuit malfunction	ON	2	CCM	C	×
P0850	←	Neutral switch circuit malfunction	ON	2	CCM	C	×
P2004	←	Variable swirl control system shutter valve stuck open	ON	2	CCM	C, R	×
P2006	←	Variable swirl control system shutter valve stuck closed	ON	2	CCM	C, R	×
P2009	←	Variable swirl solenoid valve control circuit low	ON	2	CCM	C, O, R	×
P2010	←	Variable swirl solenoid valve control circuit high	ON	2	CCM	C, O, R	×
P2088	←	OCV actuator circuit low	ON	1	CCM	C, O, R	×
P2089	←	OCV actuator 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	×
P2100	←	Throttle actuator circuit open	ON	1	CCM	C, O, R	×
P2101	←	Throttle actuator circuit range/performance	ON	1	CCM	C, R	×
P2102	←	Throttle actuator circuit low input	ON	1	CCM	C, O, R	×
P2103	←	Throttle actuator circuit high input	ON	1	CCM	C, O, R	×
P2107	←	Throttle actuator control module processor problem	ON	1	CCM	C, R	×
P2108	←	Throttle actuator control module performance problem	ON	1	CCM	C, R	×
P2119	←	Throttle actuator control throttle body range/performance	ON	1	CCM	C, R	×
P2122	←	Accelerator pedal position (APP) sensor No.1 circuit low input	ON	1	CCM	C, O, R	×
P2123	←	Accelerator pedal position (APP) sensor No.1 circuit high input	ON	1	CCM	C, O, R	×
P2127	←	Accelerator pedal position (APP) sensor No.2 circuit low input	ON	1	CCM	C, O, R	×
P2128	←	Accelerator pedal position (APP) sensor No.2 circuit high input	ON	1	CCM	C, O, R	×
P2135	←	Throttle position sensor No.1/No.2 voltage correlation problem	ON	1	CCM	C, O, R	×

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*2	Memory function
2006MY	2005MY						
P2138	←	Accelerator pedal position (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	×
P2237	—	Front HO2S positive current control circuit open	ON	2	HO2S	C, O, R	×
P2245	—	Front HO2S sensor reference voltage circuit low input	ON	2	HO2S	C, O, R	×
P2246	—	Front HO2S sensor reference voltage circuit high input detection condition	ON	2	HO2S	C, O, R	×
P2251	—	Front HO2S negative current control circuit open	ON	2	HO2S	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 sensor circuit malfunction	ON	2	CCM	C, R	×
P2405	←	EVAP system leak detection pump sensor circuit low input	ON	2	CCM	C, R	×
P2407	←	EVAP system leak detection pump sensor circuit intermittent	ON	2	CCM	C, R	×
P2502	←	Generator terminal B circuit open	OFF	1	—	C, R	×
P2503	←	Generator output voltage signal no electricity	OFF	1	Other	C, R	×
P2504	←	Battery overcharge	OFF	1	Other	C, R	×
P2507	←	PCM +BB (back-up battery) voltage low	ON	1	CCM	C, O, R	×
P2610	—	PCM internal engine off timer performance	ON	2	CCM	C	×
—	P2676	Variable air duct (VAD) solenoid valve circuit low input	OFF	1	Other	C, O, R	×
—	P2677	Variable air duct (VAD) solenoid valve circuit high input	OFF	1	Other	C, O, R	×

\*1 : California emission regulation applicable model

\*2 : C; CMDTC self test, O; KOEO self test, R; KOER self test

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

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

- Differences between the 2006MY and 2005MY diagnostic monitoring system test results are shown below.

### DMTR table

—: Not applicable

TEST ID		Description	Related system
2006MY	2005MY		
—	10: 01: 01	HO2S (Front) rich-to-lean sensor threshold voltage (constant)	HO2S
—	10: 01: 02	HO2S (Front) lean-to-rich sensor threshold voltage (constant)	
—	10: 01: 03	Low HO2S (Front) voltage for switch time calculation (constant)	
—	10: 01: 04	High HO2S (Front) voltage for switch time calculation (constant)	
—	10: 01: 05	HO2S (Front) rich-to-lean response time (calculated)	
—	10: 01: 06	HO2S (Front) lean-to-rich response time (calculated)	
—	10: 01: 0A	HO2S (Front) period (calculated)	
10: 01: 80	—	HO2S (Front) lean-to-rich response time (calculated)	
10: 02: 03	←	Low HO2S (Rear) voltage for switch time calculation (constant)	
10: 02: 04	←	High HO2S (Rear) voltage for switch time calculation (constant)	
10: 02: 05	←	HO2S (Rear) rich-to-lean response time (calculated)	
10: 21: 80	←	Front and HO2S (Rear) switching time ratio	Catalyst
10: 31: 83	←	EGR pressure variation	EGR
10: 3A: 80	←	EVAP system leak detection pump gross leak check	EVAP
10: 3B: 80	←	EVAP system leak detection pump small leak check	
10: 3C: 80 <sup>*1</sup>	←	EVAP system leak detection pump very small leak check	
10: 3D: 80	←	Purge flow monitor	
10: A2: 0B	←	EWMA misfire counts for last 10 driving cycles	Misfire
10: A2: 0C	←	Misfire counts for last/current driving cycles	
10: A3: 0B	←	EWMA misfire counts for last 10 driving cycles	
10: A3: 0C	←	Misfire counts for last/current driving cycles	
10: A4: 0B	←	EWMA misfire counts for last 10 driving cycles	
10: A4: 0C	←	Misfire counts for last/current driving cycles	
10: A5: 0B	←	EWMA misfire counts for last 10 driving cycles	
10: A5: 0C	←	Misfire counts for last/current driving cycles	
10: E1: 80	←	Heat radiation ratio	Engine cooling system
10: E1: 81	←	Misfire counts for last/current driving cycles	

<sup>\*1</sup> : California emission regulation applicable model

## DTC DETECTION LOGIC AND CONDITIONS [L3 WITH TC]

E6U01020000S07

- The following DTCs have been adopted.
  - P0016, P0030, P0069, P0089, P0091, P0092, P0096, P0097, P0098, P0116, P0131, P0137, P0192, P0193, P0201, P0202, P0203, P0204, P0234, P0245, P0246, P0421, P0611, P2237, P2245, P2246, P2251, P2610
- The following failure detection conditions are summarized information.

### CKP sensor, CMP sensor

#### 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.

### Front HO2S heater

#### P0030 Front HO2S heater control circuit problem

- OBD system monitors the output signal voltage from oxygen sensor which is in proportion to the element impedance of oxygen sensor. If the output signal voltage is not between **0.75 V** and **1.5 V** after specified time from engine start, heater performance is considered failed.

#### Monitoring condition

- 74 s elapsed from engine start
- Battery voltage: **10—18 V**

## MAP sensor

### 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}**.

## Fuel pressure regulator

### P0089 Fuel pressure regulator performance

- If the fuel pressure average value measured by the PCM exceeds the specification when the camshaft is rotating at a specified rate, the PCM determines that there is a fuel pressure regulator performance problem.

### P0091 Fuel pressure regulator control circuit low

- When the PCM turns the spill valve control solenoid valve off but the spill valve control solenoid valve control circuit voltage is low, the PCM determines that the spill valve control solenoid valve control circuit voltage is low.

#### MONITORING CONDITIONS

- The following conditions are met:
  - Engine speed is **3,000 rpm or less**.
  - Battery voltage is **10 V or more**.

### P0092 Fuel pressure regulator control circuit high

- When the PCM turns the spill valve control solenoid valve on but the spill valve control solenoid valve circuit voltage is high, the PCM determines that the spill valve control solenoid valve control circuit voltage is high.

#### MONITORING CONDITIONS

- The following conditions are met:
  - Engine speed is **3,000 rpm or less**.
  - Battery voltage is **10 V or more**.

## Boost air temperature sensor

### P0096 IAT sensor 2 circuit range/performance problem

- If the intake air temperature is higher than the engine coolant temperature by **23 °C {41.4 °F}** for **1.2 s** with the ignition switch turn to the ON position\*, the PCM determines that there is a boost air temperature sensor circuit range/performance problem.

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

### P0097 IAT sensor 2 circuit low

- If the PCM detects that the boost air temperature sensor voltage is **0.1 V or less**, the PCM determines that the boost air temperature sensor circuit voltage is low.

### P0098 IAT sensor 2 circuit high

- If the PCM detects that the boost air temperature sensor voltage is **4.96 V or more**, the PCM determines that the boost air temperature sensor circuit voltage is high.

## ECT sensor

### P0116 ECT circuit range/performance problem

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

## Front HO2S

### P0131 Front HO2S circuit low input

- The PCM monitors the input voltage from the front HO2S when the engine is running. If the input voltage is **above 1.0 V** for **25 s**, the PCM determines that the front HO2S circuit voltage is low.

### P2237 Front HO2S positive current control circuit open

- The PCM monitors the front HO2S positive current control circuit voltage. If the voltage does not change with the PCM control value while the engine is running, the PCM determines that the front HO2S positive current control circuit is open.

### P2245 Front HO2S sensor reference voltage circuit low input

- The PCM monitors is front HO2S sensor reference voltage circuit voltage. If the voltage below the threshold value while the engine is running, the PCM determines that the front HO2S sensor reference voltage circuit is low.

### P2246 Front HO2S sensor reference voltage circuit high input

- The PCM monitors the front HO2S sensor reference voltage circuit voltage. If the voltage is above the threshold value while the engine is running, the PCM determines that the front HO2S sensor reference voltage circuit is high.

### P2251 Front HO2S negative current control circuit open

- The PCM monitors the front HO2S negative current control circuit voltage. If the voltage does not change with the PCM control value while the engine is running, the PCM determines that the front HO2S negative current control circuit is open.

## ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

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### Rear HO2S

#### P0137 Rear HO2S circuit low input

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

##### MONITORING CONDITIONS

- HO2S,HO2S heater and TWC repair verification drive mode.
- The 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 is in 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 exceed **0.1 V** through the short term fuel trim is controlled up to **20.5%** for **9.6 s**, the PCM determines that the sensor circuit input is low.

##### MONITORING CONDITIONS

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

### Fuel pressure sensor

#### P0192 Fuel rail pressure sensor circuit low input

- If the input voltage from the fuel pressure sensor is less than **0.19 V** for **1.3 s**, the PCM determines that the fuel pressure sensor circuit is low.

#### P0193 Fuel rail pressure sensor circuit high input

- If the input voltage from the fuel pressure sensor is more than **4.8 V** for **1.3 s**, the PCM determines that the fuel pressure sensor circuit is high.

### Fuel injector

#### P0201, P0202, P0203, P0204 Injector circuit/open cylinder

- If the fuel injection verification signal is not input at **255 times** continuously even though the PCM drives the fuel injector, the PCM determines that there is an open circuit in the fuel injector control circuit.

##### MONITORING CONDITION

- The following conditions are met:
  - Engine speed: **4,000 rpm or less**
  - Battery voltage: **10.03 V or more**
  - Fuel injection control: except during fuel cut

#### P0611 Fuel injector control module performance

- When the PCM drives fuel injectors No.1—No.4 but the IDM No.1—No.4 circuit voltage is low, the PCM determines that there is a fuel injector control module performance problem.

##### MONITORING CONDITION

- When the following conditions are met:
  - Battery voltage: **10.03 V or more**
  - Fuel injection control: except during fuel cut

### Turbocharger

#### P0234 Turbo/supercharger overboost condition

- If the manifold absolute pressure or charging efficiency are more than the specification for the specified period of time, the PCM determines that the turbocharger is in an overboost condition.

##### MONITORING CONDITIONS

- Engine speed is **2,000 rpm or more**.

### Wastegate control solenoid valve

#### P0245 Turbocharger wastegate solenoid low

- When the PCM turns the wastegate control solenoid valve off but the wastegate control solenoid valve circuit voltage is low, the PCM determines that the wastegate control solenoid valve control circuit voltage is low.

#### P0246 Turbocharger wastegate solenoid high

- When the PCM turns the wastegate control solenoid valve on but the wastegate control solenoid valve circuit voltage is high, the PCM determines that the wastegate control solenoid valve control circuit voltage is high.

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

## Warm up catalytic converter

### P0421 Warm up catalyst system efficiency below threshold

- The PCM compares the number of front HO2S and rear HO2S inversions for a predetermined time. The PCM monitors the number of inversions the rear side performs while the front side inverts for a specified number of times when the following monitoring conditions are met. The PCM detects the inversion ratio. If the inversion ratio is below the threshold, The PCM determines that the catalyst system has deteriorated.

#### MONITORING CONDITIONS

- Engine speed: **1,500—3,000 rpm**
- Calculated TWC temperature: **above 400 °C {752 °F}**
- LOAD: **15—48%** (at engine speed of **2,000 rpm**)

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## PCM

### P2610 PCM internal engine off timer performance

- PCM internal engine off timer is damaged.

## KOEO/KOER SELF-TEST [L3 WITH TC]

E6U01020000S08

- Differences between the 2006MY and 2005MY KOEO/KOER self-test items are shown below.

### KOEO/KOER self-test table

×: Applicable  
—: Not applicable

DTC No.		Condition	Test condition	
2006MY	2005MY		KOEO	KOER
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	—	—
P0089	—	Fuel pressure regulator performance	×	×
P0091	—	Fuel pressure regulator control circuit low	×	×
P0092	—	Fuel pressure regulator control circuit high	×	×
P0096	—	IAT sensor 2 circuit range/performance problem	—	—
P0097	—	IAT sensor 2 circuit low	×	×
P0098	—	IAT sensor 2 circuit high	×	×
P0101	←	MAF circuit range/performance problem	—	—
P0102	←	MAF circuit low input	×	×
P0103	←	MAF circuit high input	×	×
—	P0106	MAP sensor performance problem	—	—
P0107	←	MAP sensor circuit low input	×	×
P0108	←	MAP sensor circuit high input	×	×
P0111	←	IAT circuit performance problem	—	—
P0112	←	IAT circuit low input	×	×
P0113	←	IAT circuit high input	×	×
P0116	—	ECT circuit range/performance problem	—	—
P0117	←	ECT circuit low input	×	×
P0118	←	ECT 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	←	Coolant thermostat stuck open	—	—
P0131	—	Front HO2S circuit low input	×	×
P0132	←	Front HO2S circuit high input	×	×
P0133	←	Front HO2S circuit problem	—	—
P0134	←	Front HO2S circuit no activity detected	—	×
P0137	—	Rear HO2S circuit low input	×	×

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

DTC No.		Condition	Test condition	
2006MY	2005MY		KOEO	KOER
P0138	←	Rear HO2S circuit high input	×	×
P0139	←	Rear HO2S circuit malfunction	—	—
P0140	←	Rear HO2S circuit no activity detected	—	×
P0192	—	Fuel rail pressure sensor circuit low input	×	×
P0193	—	Fuel rail pressure sensor circuit high input	×	×
P0201	—	Injector circuit/open cylinder No.1	—	×
P0202	—	Injector circuit/open cylinder No.2	—	×
P0203	—	Injector circuit/open cylinder No.3	—	×
P0204	—	Injector circuit/open cylinder No.4	—	×
P0222	←	TP sensor No.2 circuit low input	×	×
P0223	←	TP sensor No.2 circuit high input	×	×
P0234	—	Turbo/supercharger overboost condition	—	×
P0245	—	Turbocharger wastegate solenoid low	×	×
P0246	—	Turbocharger wastegate solenoid high	×	×
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	←	Knock sensor circuit low input	×	×
P0328	←	Knock sensor circuit high input	×	×
P0335	←	CKP sensor circuit malfunction	—	—
P0340	←	CMP sensor circuit malfunction	—	—
P0401	←	EGR flow insufficient detected	—	×
P0403	←	EGR valve (stepper motor) circuit malfunction	×	×
—	P0420	Catalyst system efficiency below threshold	—	—
P0421	—	Catalyst system efficiency below threshold	—	—
P0441	←	EVAP control system incorrect purge flow	—	×
P0442	←	EVAP control system leak detected (small leak)	—	×
P0443	←	EVAP control system purge control valve circuit malfunction	×	×
P0446	←	Change over valve (COV) (EVAP system leak detection pump) stuck close	—	×
P0455	←	EVAP control system leak detected (gross leak)	—	×
P0456*1	←	EVAP control system leak detected (very small leak)	—	×
P0461	←	Fuel gauge sender unit circuit range/performance	—	—
P0462	←	Fuel gauge sender unit circuit low input	×	×
P0463	←	Fuel gauge sender unit circuit high input	×	×
P0480	←	Fan relay No.1 control circuit malfunction	×	×
—	P0481	Fan relay No.2 and No.3 control circuit malfunction	×	×
—	P0482	Fan relay No.4 control circuit malfunction	×	×
P0500	←	Vehicle speed sensor (VSS) circuit malfunction	—	—
P0505	←	Idle control system malfunction	—	×
P0506	←	Idle control system RPM lower than expected	—	—
P0507	←	Idle control system RPM higher than expected	—	—
P0550	←	PSP switch circuit malfunction	—	—
P0564	←	Cruise control switch circuit malfunction	—	—
P0571	←	Brake switch circuit malfunction	—	—
P0601	←	Internal control module memory check sum error	×	×
P0602	←	PCM programming error	×	×
P0604	←	PCM RAM error	×	×
P0606	←	PCM processor	×	×
P0607	←	Control module performance	×	×
P0610	←	Control module vehicle options error	×	×
P0611	—	Fuel injector control module performance	×	×

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

DTC No.		Condition	Test condition	
2006MY	2005MY		KOEO	KOER
P0638	←	Throttle actuator control range/performance	—	—
—	P0661	Variable intake-air system (VIS) control solenoid valve circuit low input	×	×
—	P0662	Variable intake-air system (VIS) control solenoid valve circuit high input	×	×
P0703	←	Brake switch No.1 circuit malfunction	—	—
P0704	←	Clutch switch circuit malfunction	—	—
P0850	←	Neutral switch circuit malfunction	—	—
P2004	←	Variable swirl control system shutter valve stuck open	—	×
P2006	←	Variable swirl control system shutter valve stuck closed	—	×
P2009	←	Variable swirl solenoid valve control circuit low	×	×
P2010	←	Variable swirl solenoid valve control circuit high	×	×
P2088	←	OCV actuator circuit low	×	×
P2089	←	OCV actuator circuit high	×	×
P2096	←	Target A/F feedback system too lean	—	—
P2097	←	Target A/F feedback system too rich	—	—
P2100	←	Throttle actuator circuit open	×	×
P2101	←	Throttle actuator circuit range/performance	—	×
P2102	←	Throttle actuator circuit low input	×	×
P2103	←	Throttle actuator circuit high input	×	×
P2107	←	Throttle actuator control module processor problem	—	×
P2108	←	Throttle actuator control module performance problem	—	×
P2119	←	Throttle actuator control throttle body range/performance	—	×
P2122	←	Accelerator pedal position (APP) sensor No.1 circuit low input	×	×
P2123	←	Accelerator pedal position (APP) sensor No.1 circuit high input	×	×
P2127	←	Accelerator pedal position (APP) sensor No.2 circuit low input	×	×
P2128	←	Accelerator pedal position (APP) sensor No.2 circuit high input	×	×
P2135	←	Throttle position sensor No.1/No.2 voltage correlation problem	×	×
P2138	←	Accelerator pedal position (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	×	×
P2237	—	Front HO2S positive current control circuit open	×	×
P2245	—	Front HO2S sensor reference voltage circuit low input	×	×
P2246	—	Front HO2S sensor reference voltage circuit high input	×	×
P2251	—	Front HO2S negative current control circuit open	×	×
P2401	←	EVAP system leak detection pump motor circuit low	—	×
P2402	←	EVAP system leak detection pump motor circuit high	—	×
P2404	←	EVAP system leak detection pump sensor circuit malfunction	—	×
P2405	←	EVAP system leak detection pump sensor circuit low input	—	×
P2407	←	EVAP system leak detection pump sensor circuit intermittent	—	×
P2502	←	Generator terminal B circuit open	—	×
P2503	←	Generator output voltage signal no electricity	—	×
P2504	←	Battery overcharge	—	×
P2507	←	PCM +BB (back-up battery) voltage low	×	×
P2610	—	PCM internal engine off timer performance	—	—
—	P2676	Variable air duct (VAD) solenoid valve circuit low input	—	—
—	P2677	Variable air duct (VAD) solenoid valve circuit high input	—	—

\*1 : California emission regulation applicable model

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

## PID/DATA MONITOR AND RECORD [L3 WITH TC]

E6U01020000S09

- Differences between the 2006MY and 2005MY PID/DATA monitor items are shown below.

### PID/DATA monitor item table

—: Not applicable

Monitor item		Definition	Unit/Condition		PCM terminal
2006MY	2005MY				
AAT	←	Ignition switch at ON position: Indicate the ambient air temperature	°C	°F	2V
AC_REQ	←	A/C switch	On/Off		1AC
ACCS	←	A/C relay	On/Off		4N
ALTF	←	Generator field coil control duty value	%		1AD
ALTT V	←	Generator output voltage	V		1AB
AFR	—	Target air-fuel ratio	—		—
AFR_ACT	—	Actual air-fuel ratio	—		—
APP	←	Accelerator pedal position	%		2A 3D
APP1	←	Accelerator pedal position	%		3D
			V		
APP2	←	Accelerator pedal position	%		2A
			V		
ARPMDES	←	Target engine speed	RPM		—
B+	←	Battery positive voltage	V		2Y
BARO	←	Barometric pressure	kPa, Bar, psi		—
			V		
BAT	—	Boost air temperature	°C		1S
BAT_V	—	Boost air temperature output voltage	V		1S
BOO	←	Brake switch	On/Off		1K 3T
BPA	←	Brake pressure applied switch	On/Off		1K 3T
CATT11_DSD	←	Estimated catalytic converter temperature	°C	°F	—
CHRG LP	←	Generator warning light	On/Off		—
COLP	←	Refrigerant pressure switch (middle)	ON/OFF		1Q
CPP	←	Clutch pedal position	On/Off		1H
CPP/PNP	←	Shift lever position	Drive/Neutral		1W
DTCCNT	←	Number of DTC detected	—		—
ECT	←	Engine coolant temperature	°C	°F	1M
			V		
EQ_RAT11	—	Equivalence ratio (lambda)	—		2D 2G 2J
EQ_RAT11_DSD	←	Front oxygen sensor	—		2D 2G 2J
ETC_ACT	←	Electronic throttle control actual	°		3J 3M
ETC_DSD	←	Electronic throttle control desired	%		3J 3M
			°		
EVAPCP	←	Purge solenoid valve duty value	%		4T
FAN_DUTY	—	Cooling fan control	%		4A
—	FAN1	Cooling fan control	On/Off		—
—	FAN2	Cooling fan control	On/Off		—
—	FAN3	Cooling fan control	On/Off		—
FIA	—	Fuel injection amount	mg/cylinder		—
FLI	←	Fuel level	%		—
FP	←	Fuel pump relay	On/Off		4Q
FP_Hi_PRES	—	High pressure fuel pump	On/Off		1A 1B

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

Monitor item		Definition	Unit/Condition	PCM terminal
2006MY	2005MY			
FUEL_PRES	—	Fuel pressure	Pa	1V
FUEL_PRES_V	—	Fuel pressure output voltage	V	1V
—	FUELPW	Fuel injector duration	ms	—
FUELSYS	←	Fuel system status	OL/CL/ OL-Drive/ OL-Fault/ CL-Fault	—
GENVDSD	←	Generator voltage desired	V	—
HTR11	←	HO2S heater (front)	On/Off	4AD
HTR12	←	HO2S heater (rear)	On/Off	4Z
—	IASV	Variable air duct control solenoid valve	On/Off	—
IAT	←	Intake air temperature	°C   °F V	2V
IMRC	←	Variable swirl solenoid valve	On/Off	4K
—	IMTV	Variable intake air solenoid valve	On/Off	—
INGEAR	←	Load/no load condition	On/Off	1H 1W
IVS	←	CTP condition	Idle/ Off Idle	3J 3M
KNOCKR	←	Knocking retard	°	2P 2S
LDP_EVAPCP	←	EVAP system leak detection pump detect incorrect purge flow	A	—
LDP_IDL	←	EVAP system leak detection pump idle current	A	3V 3Y
LDP_MON	←	EVAP system leak detection pump monitoring current	A	3V 3Y
LDP_REF	←	EVAP system leak detection pump reference current	A	—
LDP_SLDV	←	EVAP system large leak detection value	A	3V 3Y
LDP_VSLDV	←	EVAP system small leak detection value	mA/sec	3V 3Y
LOAD	←	Engine load	%	—
LONGFT1	←	Long term fuel trim	%	—
MAF	←	Mass airflow	g/s V	1P
MAP	←	Manifold absolute pressure	kPa, Bar, psi V	1J
MIL	←	Malfunction indicator lamp	On/Off	—
MIL_DIS	←	Traveled distance since the MIL illuminated	km   mile	—
NUMKEYS	←	Number of keys stored in module	—	—
O2S11	—	Front oxygen sensor	A	2D 2G 2J
O2S12	←	Rear oxygen sensor	V	1Y
PSP	←	Power steering pressure switch	High/Low	1Z
RFCFLAG	←	Readness function code	Learnt/ Not Learnt	1Y
RO2FT1	←	Rear oxygen sensor fuel trim	—	1Y
RPM	←	Engine speed	RPM	2C
SCCS	—	Speed control command switch	V	—
SEGRP	←	EGR valve (stepping motor) position	No. of step	—
SEGRP DSD	←	Desired EGR valve (stepping motor) position	%	—
SELTESTDTC	←	DTC of KOEO/KOER self-test	—	—
SHRTFT1	←	Short term fuel trim [front HO2S]	%	—
—	SHRTFT11	Short term fuel trim [rear HO2S]	%	—

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (L3 WITH TC)]

Monitor item		Definition	Unit/Condition		PCM terminal
2006MY	2005MY				
SHRTFT12	←	Short term fuel trim	%		—
SPARKADV	←	Ignition timing	°(BTDC)		—
test	←	Test mode	On/Off		—
TIRESIZE	←	Tire revolution per mile	rev/mile		—
TP REL	←	Relative TP	%		3J 3M
TP1	←	TP sensor 1	%		3M
			V		
TP2	←	TP sensor 2	%		3J
			V		
TPCT	←	Lowest closed throttle voltage	V		3J 3M
VSS	←	Vehicle speed	KPH	MPH	—
VT ACT1	←	Actual valve timing	°		—
VT DIFF1	←	Difference between actual valve timing and target valve timing	°		4S
VT DUTY1 Wt	←	Variable valve timing control	%		4S
VTC	—	Variable swirl shutter valve switch	On/Off		1N
WGC	—	Wastegate control solenoid valve	%		4H

## SIMULATION TEST [L3 WITH TC]

E6U01020000S10

- Differences between the 2006MY and 2005MY simulation items are shown below.

### Simulation item table

×: Applicable  
—: Not applicable

Item		Applicable component	Operation	Test condition		PCM terminal
2006MY	2005MY			IG ON	Idle	
ACCS	←	A/C relay	On/Off	×	×	4N
ALTF	←	Generator field coil control	On/Off	—	×	1AD
ARPMDES	←	Desired RPM	RPM	×	×	—
EVAPCP	←	Purge solenoid valve	%	×	×	4T
FAN_DUTY	—	Fan control	%	×	×	4A
—	FAN1	Fan relay No.1	On/Off	×	×	—
—	FAN2	Fan relay No.2 and No.3	On/Off	×	×	—
—	FAN3	Fan relay No.4	On/Off	×	×	—
FP	←	Fuel pump relay	On/Off	×	×	4Q
FUELPW1	←	Fuel injection duration	%	—	×	3B, 3E, 3H, 3K
GENVDSD	←	Generator voltage desired	V	—	×	—
HTR11	←	HO2S heater (Front)	On/Off	×	×	4AD
HTR12	←	HO2S heater (Rear)	On/Off	×	×	4Z
—	IASV	VAD solenoid valve	On/Off	×	×	—
IMRC	←	Variable swirl solenoid valve	On/Off	×	×	4K
—	IMTV	VIS solenoid valve	On/Off	×	×	—
INJ_1	←	Fuel injector (Cylinder No.1)	Off	—	×	3B
INJ_2	←	Fuel injector (Cylinder No.2)	Off	—	×	3E
INJ_3	←	Fuel injector (Cylinder No.3)	Off	—	×	3H
INJ_4	←	Fuel injector (Cylinder No.4)	Off	—	×	3K
SEGRP	←	EGR valve (stepping motor)	step	×	×	4D, 4G, 4J, 4M
test	←	Test mode	On/Off	×	×	—
VT DUTY1 Wt	←	Camshaft position commanded duty cycle	%	×	×	4S
WGC	—	Wastegate control solenoid valve	%	×	×	4H

01-02C ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

ON-BOARD DIAGNOSTIC SYSTEM		ON-BOARD DIAGNOSTIC SYSTEM	
OUTLINE [AJ] .....	01-02C-1	DESCRIPTION [AJ] .....	01-02C-3
Features .....	01-02C-1	OBD-II Diagnostic Trouble Code (Mode 03) .....	01-02C-3
DIAGNOSTIC SYSTEM		DTC .....	01-02C-7
WIRING DIAGRAM [AJ] .....	01-02C-2	PID/DATA MONITOR AND RECORD .....	01-02C-14

ON-BOARD DIAGNOSTIC SYSTEM OUTLINE [AJ]

E6U010218881S01

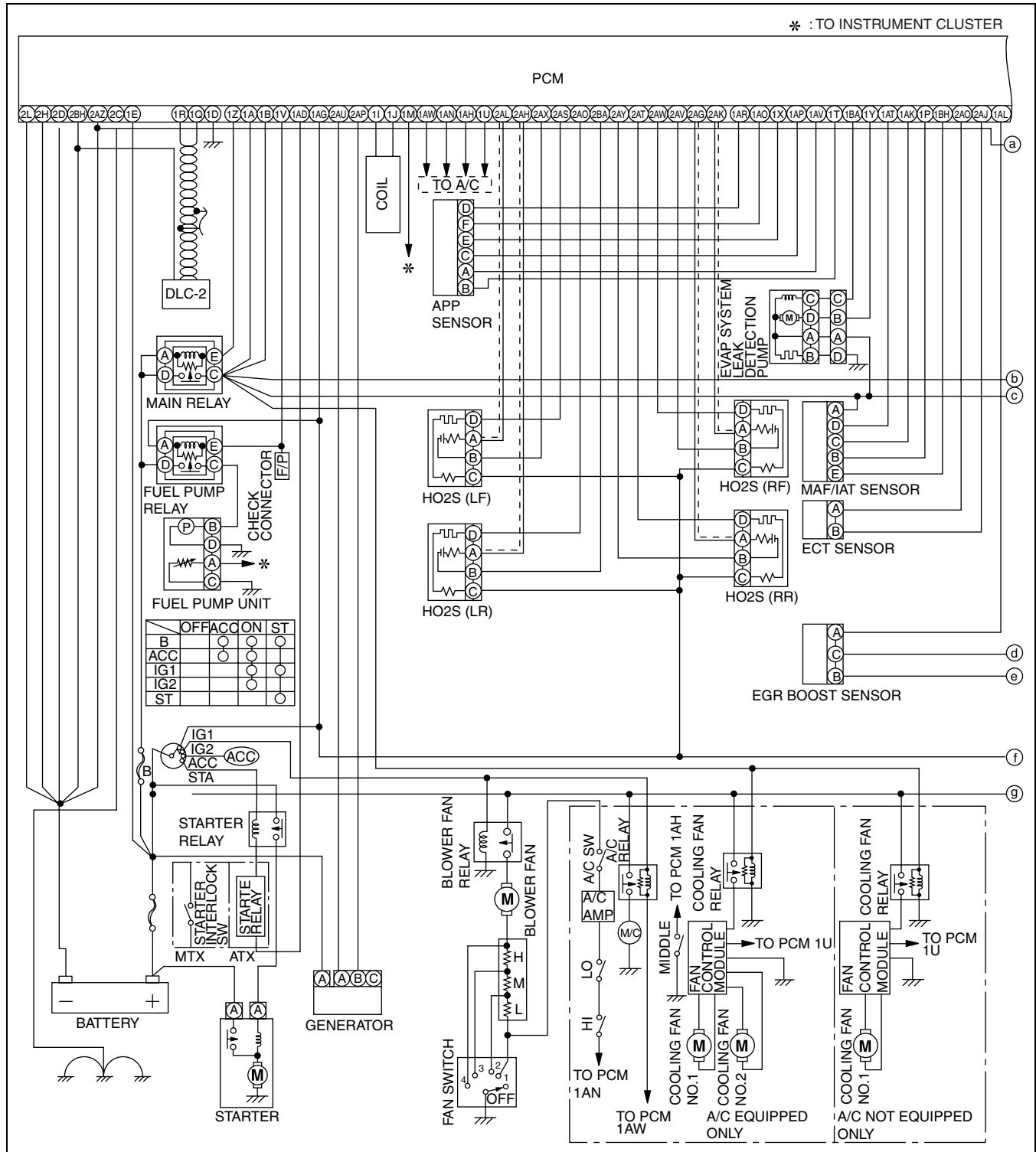
Features

To meet OBD-II regulations	• Mode 03 of diagnostic test modes changed
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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

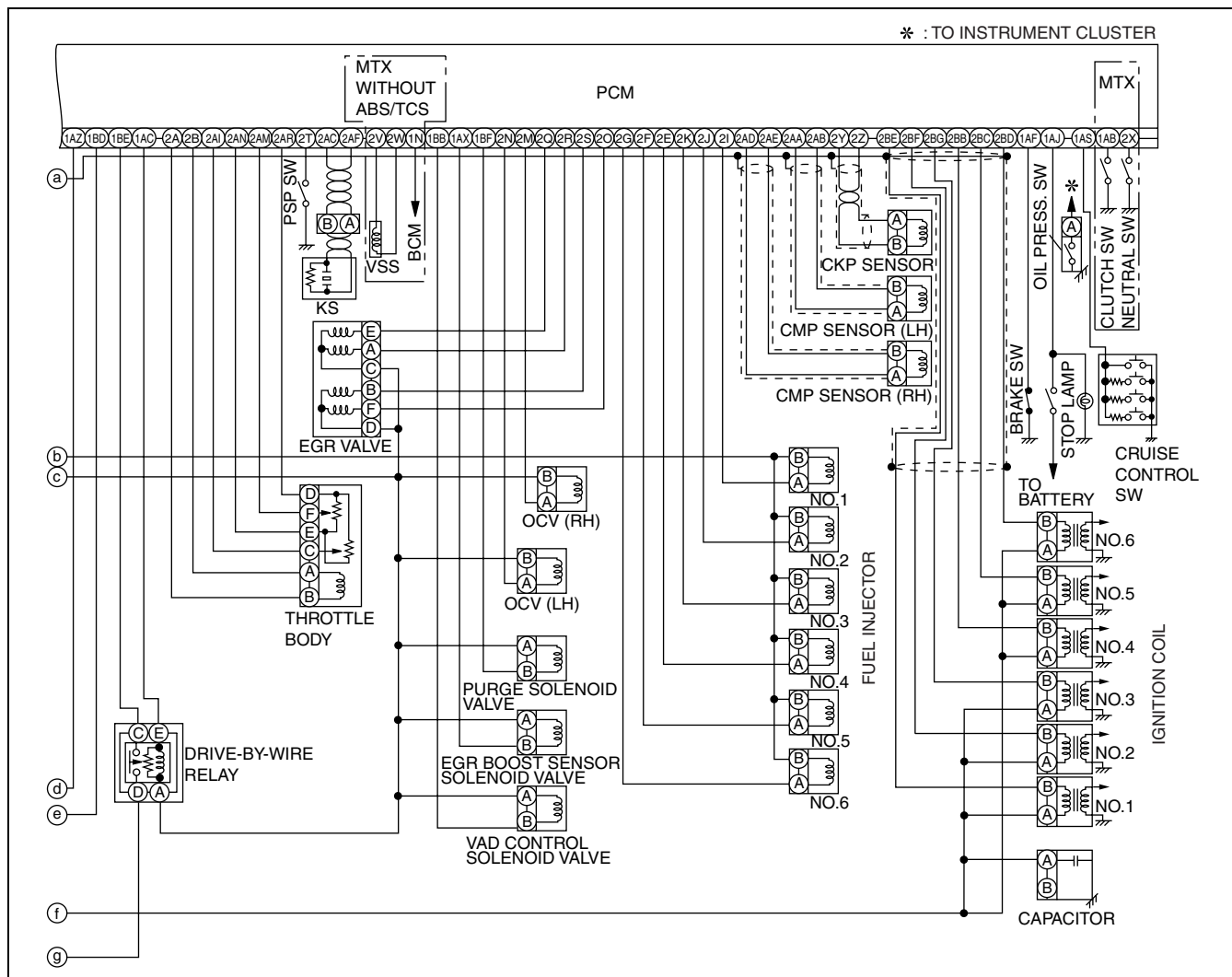
## DIAGNOSTIC SYSTEM WIRING DIAGRAM [AJ]

E6U010218881S04



E6U000BW5L01

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]



E6U000BW5L02

## ON-BOARD DIAGNOSTIC SYSTEM DESCRIPTION [AJ]

E6U010218881S02

- The diagnostic test mode is essentially carried over from that of the 2005MY except for following.
  - To meet OBD-II regulations, modes 03 have been changed.

Diagnostic test mode	Item
Mode 01	Sending diagnostic data (PID data monitor/On-board system readiness test)
Mode 02	Sending freeze frame data
Mode 03	Sending emission-related malfunction code (DTC)
Mode 04	Clearing/resetting emission-related malfunction information
Mode 06	Sending intermittent monitoring system test results (DMTR)
Mode 07	Sending continuous monitoring system test results (pending code)
Mode 08	On-board device control (simulation test, active command mode)
Mode 09	Request vehicle information

## OBD-II Diagnostic Trouble Code (Mode 03)

- The following DTCs have been changed.
  - P0011, P0012, P0021, P0022, P0031, P0032, P0037, P0038, P0051, P0052, P0057, P0058, P0101, P0102, P0103, P0111, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0133, P0134, P0140, P0153, P0154, P0160, P0222, P0223, P0327, P0328, P0403, P0421, P0431, P0441, P0442, P0443, P0455, P0456, P0461, P0480, P0550, P0500, P564, P571, P601, P606, P704, P850, P2096, P2098, P2108, P2119, P2122, P2123, P2127, P2144, P2145, P2195, P2196, P2197, P2198, P2229, P2507, P2676, P2677
- The following DTCs have been adopted.
  - P0016, P0018, P0116, P0131, P0137, P0151, P0157, P050A, P050B, P2610
- Differences between the 2006 MY and 2005 MY DTCs are shown below.

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

**DTC table**

×: Applicable

N/A: Not applicable

DTC No.		Condition	MIL	DC	Monitor item	Self-test type <sup>2</sup>	Memory function
2006MY	2005MY						
B1342	←	PCM malfunction	OFF	—	—	C, O	×
P0011	←	CMP timing over-advanced (RH)	ON	1	CCM	C, R	×
P0012	←	CMP timing over-retarded (RH)	ON	2	CCM	C, R	×
P0016	N/A	CKP-CMP (RH) correlation	ON	2	CCM	C	×
P0018	N/A	CKP-CMP (LH) correlation	ON	2	CCM	C	×
P0021	←	CMP timing over-advanced (LH)	ON	1	CCM	C, R	×
P0022	←	CMP timing over-retarded (LH)	ON	2	CCM	C, R	×
P0031	←	HO2S heater (RF) circuit low	ON	2	HO2S heater	C, O, R	×
P0032	←	HO2S heater (RF) circuit high	ON	2	HO2S heater	C, O, R	×
P0037	←	HO2S heater (RR) circuit low	ON	2	HO2S heater	C, O, R	×
P0038	←	HO2S heater (RR) circuit high	ON	2	HO2S heater	C, O, R	×
P0051	←	HO2S heater (LF) circuit low	ON	2	HO2S heater	C, O, R	×
P0052	←	HO2S heater (LF) circuit high	ON	2	HO2S heater	C, O, R	×
P0057	←	HO2S heater (LR) circuit low	ON	2	HO2S heater	C, O, R	×
P0058	←	HO2S heater (LR) circuit high	ON	2	HO2S heater	C, O, R	×
P0101	←	MAF sensor inconsistent with TP sensor	ON	2	CCM	C	×
P0102	←	MAF circuit low input	ON	1	CCM	C, O, R	×
P0103	←	MAF circuit high input	ON	1	CCM	C, O, R	×
P0111	←	IAT circuit performance problem	ON	2	CCM	C	×
P0112	←	IAT circuit low input	ON	1	CCM	C, O, R	×
P0113	←	IAT circuit high input	ON	1	CCM	C, O, R	×
P0116	N/A	Engine coolant temperature circuit range/performance	ON	1	Engine cooling system	C	×
P0117	←	ECT circuit low input	ON	1	Engine cooling system	C, O, R	×
P0118	←	ECT 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	ON	2	Engine cooling system	C	×
P0128	←	Coolant thermostat	ON	2	Engine cooling system	C	×
P0131	N/A	HO2S (RF) circuit low input	ON	2	HO2S	C, O, R	×
P0132	←	HO2S (RF) circuit high input	ON	2	HO2S	C, O, R	×
P0133	←	HO2S (RF) circuit malfunction	ON	2	HO2S	C	×
P0134	←	HO2S (RF) circuit no activity detected	ON	2	HO2S	C, R	×
P0137	N/A	HO2S (RR) circuit low input	ON	2	HO2S	C, O, R	×
P0138	←	HO2S (RR) circuit high input	ON	2	HO2S	C, O, R	×
P0139	←	HO2S (RR) circuit problem	ON	2	HO2S	C	×
P0140	←	HO2S (RR) circuit no activity detected	ON	2	HO2S	C, R	×
P0151	N/A	HO2S (LF) circuit low input	ON	2	HO2S	C, O, R	×
P0152	←	HO2S (LF) circuit high input	ON	2	HO2S	C, O, R	×
P0153	←	HO2S (LF) circuit malfunction	ON	2	HO2S	C	×
P0154	←	HO2S (LF) circuit no activity detected	ON	2	HO2S	C, R	×
P0157	N/A	HO2S (LR) circuit low input	ON	2	HO2S	C, O, R	×
P0158	←	HO2S (LR) circuit high input	ON	2	HO2S	C, O, R	×
P0159	←	HO2S (LR) circuit problem	ON	2	HO2S	C	×
P0160	←	HO2S (LR) circuit no activity detected	ON	2	HO2S	C, R	×
P0222	←	TP sensor No.2 circuit low input	ON	1	CCM	C, O, R	×

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DTC No.		Condition	MIL	DC	Monitor item	Self-test type*2	Memory function
2006MY	2005MY						
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	×
P0305	←	Cylinder No.5 misfire detected	Flash / ON	1 or 2	Misfire	C, R	×
P0306	←	Cylinder No.6 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 malfunction	ON	1	CCM	C	×
P0340	←	CMP sensor (RH) circuit malfunction	ON	1	CCM	C	×
P0345	←	CMP sensor (LH) circuit malfunction	ON	1	CCM	C	×
P0401	←	EGR flow insufficient detected	ON	2	EGR	C, R	×
P0403	←	EGR valve (stepper motor) circuit malfunction	ON	2	CCM	C, O, R	×
P0421	←	Warm-up catalyst system (RH) efficiency below threshold	ON	2	Catalyst	C	×
P0431	←	Warm-up catalyst system (LH) efficiency below threshold	ON	2	Catalyst	C	×
P0441	←	EVAP control system incorrect purge flow	ON	2	EVAP	C, R	×
P0442	←	EVAP control system leak detected (small leak)	ON	2	EVAP	C, R	×
P0443	←	EVAP control system purge control valve circuit malfunction	ON	2	CCM	C, O, R	×
P0446	←	Change-over valve (EVAP system leak detection pump) stuck close	ON	2	CCM	C, R	×
P0455	←	EVAP control system leak detected (large leak)	ON	2	EVAP	C, R	×
P0456*1	←	EVAP control system leak detected (very small leak)	ON	2	EVAP	C, R	×
P0461	←	Fuel gauge sender unit circuit range/performance	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	←	Fan control circuit malfunction	OFF	1	Other	C, O, R	×
P0500	←	VSS circuit malfunction	ON	2	CCM	C	×
P0505	←	Idle control system malfunction	OFF	—	—	R	N/A
P0506	←	Idle control system RPM lower than expected	ON	2	CCM	C	×
P0507	←	Idle control system RPM higher than expected	ON	2	CCM	C	×
P050A	N/A	Cold start idle air control system performance	ON	2	CCM	C, R	×
P050B	N/A	Cold start ignition timing performance	ON	2	CCM	C, R	×
P0550	←	PSP switch circuit malfunction	ON	2	CCM	C	×
P0564	←	Cruise control switch circuit malfunction	OFF	1	Other	C	×
P0571	←	Brake switch circuit malfunction	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	×

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# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*2	Memory function
2006MY	2005MY						
P0604	←	PCM random access memory error	ON	1	CCM	C, O, R	×
P0606	←	ECM/PCM processor	ON	1	Other	C, O, R	×
P0610	←	Control module vehicle options error	ON	1	CCM	C, O, R	×
P0638	←	Throttle actuator control circuit range/performance problem	ON	1	CCM	C	×
P0703	←	Brake switch No.1 input malfunction	ON	2	CCM	C	×
P0704*3	←	Clutch switch input malfunction	ON	2	CCM	C	×
P0850*3	←	Neutral switch input malfunction	ON	2	CCM	C	×
P2088	←	CMP actuator (RH) circuit low	ON	1	CCM	C, O, R	×
P2089	←	CMP actuator (RH) circuit high	ON	1	CCM	C, O, R	×
P2092	←	CMP actuator (LH) circuit low	ON	1	CCM	C, O, R	×
P2093	←	CMP actuator (LH) circuit high	ON	1	CCM	C, O, R	×
P2096	←	Target A/F feedback system too lean (Right bank)	ON	2	Fuel system	C	×
P2097	←	Target A/F feedback system too rich (Right bank)	ON	2	Fuel system	C	×
P2098	←	Target A/F feedback system too lean (Left bank)	ON	2	Fuel system	C	×
P2099	←	Target A/F feedback system too rich (Left bank)	ON	2	Fuel system	C	×
P2101	←	Throttle actuator control motor circuit range/performance	ON	1	CCM	C, R	×
P2107	←	Throttle actuator control module processor problem	ON	1	CCM	C, R	×
P2108	←	Throttle actuator control module performance problem	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	×
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	×
P2144	←	EGR boost sensor solenoid valve circuit low input	ON	2	CCM	C, O, R	×
P2145	←	EGR boost sensor solenoid valve circuit high input	ON	2	CCM	C, O, R	×
P2177	←	Fuel system too lean at off idle (Right bank)	ON	2	Fuel system	C, R	×
P2178	←	Fuel system too rich at off idle (Right bank)	ON	2	Fuel system	C, R	×
P2179	←	Fuel system too lean at off idle (Left bank)	ON	2	Fuel system	C, R	×
P2180	←	Fuel system too rich at off idle (Left bank)	ON	2	Fuel system	C, R	×
P2187	←	Fuel system too lean at idle (Right bank)	ON	2	Fuel system	C, R	×
P2188	←	Fuel system too rich at idle (Right bank)	ON	2	Fuel system	C, R	×
P2189	←	Fuel system too lean at idle (Left bank)	ON	2	Fuel system	C, R	×
P2190	←	Fuel system too rich at idle (Left bank)	ON	2	Fuel system	C, R	×
P2195	←	HO2S (RF) signal stuck lean	ON	2	HO2S	C	×
P2196	←	HO2S (RF) signal stuck rich	ON	2	HO2S	C	×
P2197	←	HO2S (LF) signal stuck lean	ON	2	HO2S	C	×

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

DTC No.		Condition	MIL	DC	Monitor item	Self-test type*2	Memory function
2006MY	2005MY						
P2198	←	HO2S (LF) signal stuck rich	ON	2	HO2S	C	×
P2227	←	EGR boost sensor circuit performance problem	ON	2	CCM	C	×
P2228	←	EGR boost sensor circuit low input	ON	1	CCM	C, O, R	×
P2229	←	EGR boost sensor circuit high input	ON	1	CCM	C, O, R	×
P2401	←	EVAP system leak detection pump control circuit low	ON	2	CCM	C, R	×
P2402	←	EVAP system leak detection pump control circuit high	ON	2	CCM	C, R	×
P2404	←	EVAP system leak detection pump sense circuit malfunction	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	←	Generator terminal B circuit open	OFF	1	Other	C, R	×
P2503	←	Generator output voltage signal no electricity	OFF	1	Other	C, R	×
P2504	←	Battery overcharge	OFF	1	Other	C, R	×
P2507	←	PCM B+ voltage low	ON	1	CCM	C, O, R	×
P2610	N/A	PCM internal engine off timer performance	ON	2	CCM	C	×
P2676	←	Variable air duct (VAD) control solenoid valve circuit low input	OFF	1	Other	C, O, R	×
P2677	←	Variable air duct (VAD) solenoid valve circuit high input	OFF	1	Other	C, O, R	×

\*1 : California emission regulation applicable model

\*2 : C; CMDTC self test, O; KOEO selftest, R; KOER selftest

\*3 : MTX

\*4 : ATX

## DTC

- Detection logics and conditions are as shown below.

### P0011 CMP timing over-advanced (RH)

- The actual valve timing is over-advanced by **20°** from the target valve timing when the OCV is controlled in the maximum valve timing retard condition.

#### MONITORING CONDITIONS

- Engine coolant temperature is **above 63 °C {145 °F}**

### P0012 CMP timing over-retarded (RH)

- The actual valve timing is over-retarded by **10°** from the target valve timing for **4 s** when the OCV system control is within the feed-back range.

#### MONITORING CONDITIONS

- Engine coolant temperature is **above 63 °C {145 °F}**

### P0016 CKP-CMP (RH) correlation/P0018 CKP-CMP (LH) correlation

- The PCM monitors the input pulses from the CKP sensor and CMP sensor (RH, LH). 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.

### P0021 CMP timing over-advanced (LH)

- The actual valve timing is over-advanced by **20°** from the target valve timing when the OCV is controlled in the maximum valve timing retard condition.

#### MONITORING CONDITIONS

- Engine coolant temperature is **above 63 °C {145 °F}**

### P0022 CMP timing over-retarded (LH)

- The actual valve timing is over-retarded by **10°** from the target valve timing for **4 s** when the OCV system control is within the feed-back range.

#### MONITORING CONDITIONS

- Engine coolant temperature is **above 63 °C {145 °F}**

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## ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

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### **P0031 HO2S heater (RF) circuit low**

- The PCM monitors the HO2S heater (RF) control signal at PCM terminal 2AW. If the PCM turns the HO2S heater (RF) off but the HO2S heater (RF) circuit remains low voltage, the PCM determines that the HO2S heater (RF) circuit has a malfunction.

### **P0032 HO2S heater (RF) circuit high**

- The PCM monitors the HO2S heater (RF) control signal at PCM terminal 2AW. If the PCM turns the HO2S heater (RF) on but the HO2S heater (RF) circuit remains high voltage, the PCM determines that the HO2S heater (RF) circuit has a malfunction.

### **P0037 HO2S heater (RR) circuit low**

- The PCM monitors the HO2S heater (RR) control signal at PCM terminal 2AT. If the PCM turns the HO2S heater (RR) off but the HO2S heater (RR) circuit remains low voltage, the PCM determines that the HO2S heater (RR) circuit has a malfunction.

### **P0038 HO2S heater (RR) circuit high**

- The PCM monitors the HO2S heater (RR) control signal at PCM terminal 2AT. If the PCM turns the HO2S heater (RR) on but the HO2S heater (RR) circuit remains high voltage, the PCM determines that the HO2S heater (RR) circuit has a malfunction.

### **P0051 HO2S heater (LF) circuit low**

- The PCM monitors the HO2S heater (LF) control signal at PCM terminal 2AS. If the PCM turns the HO2S heater (LF) off but the HO2S heater (LF) circuit remains low voltage, the PCM determines that the HO2S heater (LF) circuit has a malfunction.

### **P0052 HO2S heater (LF) circuit high**

- The PCM monitors the HO2S heater (LF) control signal at PCM terminal 2AS. If the PCM turns the HO2S heater (LF) on but the HO2S heater (LF) circuit remains high voltage, the PCM determines that the HO2S heater (LF) circuit has a malfunction.

### **P0057 HO2S heater (LR) circuit low**

- The PCM monitors the HO2S heater (LR) control signal at PCM terminal 2AO. If the PCM turns the HO2S heater (LR) off but the HO2S heater (LR) circuit remains low voltage, the PCM determines that the HO2S heater (LR) circuit has a malfunction.

### **P0058 HO2S heater (LR) circuit high**

- The PCM monitors the HO2S heater (LR) control signal at PCM terminal 2AO. If the PCM turns the HO2S heater (LR) on but the rear heater circuit remains high voltage, the PCM determines that the HO2S heater (LR) circuit has a malfunction.

### **P0101 MAF sensor inconsistent with TP sensor**

- The PCM monitors mass intake air flow amount when the engine is running.
  - If the mass intake airflow amount is the **8.4—81 l/s or below** (the value depends on engine speed) for **5 s** and the throttle opening angle is **50% or above** with the engine speed is **above 1,000 rpm**, the PCM determines that the detected mass intake airflow amount is too low.
  - If the mass intake airflow amount is **73 l/s or above** for **5 s** and the engine speed is **2,500 rpm or below** with engine running, the PCM determines that the detected mass intake airflow amount is too high.

### **P0102 MAF circuit low input**

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

### **P0103 MAF circuit high input**

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

### **P0111 IAT circuit performance problem**

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

\*: Ignition switch is in the ON position when **6 h or more** have passed since the ignition switch was turned off

### **P0112 IAT circuit low input**

- The PCM monitors the IAT sensor signal at PCM terminal 1AT. If the PCM detects IAT sensor voltage of **0.16 V or below**, the PCM determines that the IAT sensor circuit has a malfunction.

### **P0113 IAT circuit high input**

- The PCM monitors the IAT sensor signal at PCM terminal 1AT. If the PCM detects IAT sensor voltage of **4.84 V or above**, the PCM determines that the 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 the difference between the maximum and the minimum values of the engine coolant temperature is **below 6 °C {10.8 °F}**, the PCM determines that there is an ECT circuit range/performance problem.

### **P0117 ECT circuit low input**

- The PCM monitors the ECT sensor signal at PCM terminal 2AQ. If the PCM detects ECT sensor voltage of **0.18 V or below**, the PCM determines that the ECT sensor circuit has a malfunction.

## P0118 ECT circuit high input

- The PCM monitors the ECT sensor signal at PCM terminal 2AQ. If the PCM detects ECT sensor voltage of **4.58 V or above**, the PCM determines that the ECT sensor circuit has a malfunction.

## P0122 TP sensor No.1 circuit low input

- If the PCM detects that TP sensor No.1 voltage at PCM terminal 2AM is **0.1 V or below** after the ignition switch is ON, the PCM determines that the TP circuit has a malfunction.

## P0123 TP sensor No.1 circuit high input

- If the PCM detects that TP sensor No.1 voltage at PCM terminal 2AM is **4.9 V or above** after ignition switch is ON, the PCM determines that the TP circuit has a malfunction.

## P0125 Excessive time to enter closed loop fuel control

- The PCM monitors the ECT sensor signal at PCM terminal 2AQ after the engine is cold started. If the engine coolant temperature does not reach the expected temperature in a certain 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 the closed-loop fuel control.

## P0131 HO2S (RF) circuit low input/P0151 HO2S (LF) circuit low input

- The PCM monitors the front HO2S output voltage when the following conditions are met. If output voltage is less than **0.1 V** for **41 s**, the PCM determines that the front HO2S signal remains lean.

### MONITORING CONDITION

- Fuel injection control system status: feedback zone
- The PCM monitors the input voltage from the front HO2S when the following conditions are met. Under the following monitoring conditions, if the input voltage from the front HO2S does not even **exceed 0.1 V** though the short term fuel trim is controlled up to **25%** for **9.6 s**, the PCM determines that sensor circuit is not activated.

### MONITORING CONDITIONS

- HO2S, HO2S heater and TWC Repair Verification Drive Mode
- Following conditions are met
  - Time from engine start is **above 50 s** (ECT when engine start is **20 °C {68 °F}**).

## P0133 HO2S (RF) circuit malfunction/P0153 HO2S (LF) circuit malfunction

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

### MONITORING CONDITIONS

- Drive mode 3
- The following conditions are to be met:
  - Calculation load **18—58%**, (at engine speed **2,000 rpm**)
  - Engine speed **1,400—2,500 rpm** (MTX)
  - Engine speed **1,200—2,500 rpm** (ATX)
  - Engine coolant temperature is **-10 °C {14 °F} or above**
  - Front HO2S signal invention cycle is **above 10 cycle**
- The inversion cycle period and the lean-to-rich/ rich-to-lean response time cannot be measured even once even though the accumulated occurrence time of the following monitoring conditions has exceeded the prescribed time limit.

### MONITORING CONDITIONS

- Drive mode 3
- The following conditions are to be met:
  - Calculation load **18—58%**, (at engine speed **2,000 rpm**)
  - Engine speed **1,400—2,500 rpm** (MTX)
  - Engine speed **1,200—2,500 rpm** (ATX)
  - Engine coolant temperature is **-10 °C {14 °F} or above**

## P0134 HO2S (RF) circuit no activity detected/P0154 HO2S (LF) circuit no activity detected

- The PCM monitors the input voltage from the HO2S (RF, LF) when the following monitoring conditions are met. If the input voltage never **exceeds 0.55 V** through the short trim is controlled up to **25%**, the PCM determines that the sensor circuit is not activated.

### MONITORING CONDITIONS

- Drive mode 3
- The following conditions are to be met:
  - The time from engine start is **above 50 s**. (ECT at engine start **20 °C {68 °F}**)

## ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

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### P0137 HO2S (RR) circuit low input

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

#### MONITORING CONDITIONS

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

#### MONITORING CONDITIONS

- HO2S, HO2S heater and TWC repair verification drive mode
- Following conditions are met for **above 32 s**
  - Engine speed is **above 1,500 rpm**.
  - Engine coolant temperature is **above 70 °C {158 °F}**.

### P0140 HO2S (RR) circuit no activity detected/P0160 HO2S (LR) circuit no activity detected

- The PCM monitors the input voltage from the HO2S (RR, LR) when the following monitoring conditions are met. If the input voltage never **exceeds 0.55 V** through the short fuel trim is controlled up to **25%** for **9.6 s**, the PCM determines that the sensor circuit is not activated.

#### MONITORING CONDITIONS

- Drive mode 3
- The following conditions are to be met for **32 s**:
  - The engine speed is **1,500 rpm or above**.
  - The engine coolant temperature is **70 °C {158 °F} or above**.
- HO2S (RR, LR) voltage is **above 0.1 V**

### P0157 HO2S (LR) circuit low input

- The PCM monitors input voltage from rear HO2Ss. If the input voltages from the rear HO2Ss are **below 0.2 V** for **20.8 s**, the PCM determines that circuit input is low.

### P0222 TP sensor No.2 circuit low input

- If the PCM detects that TP sensor No.2 voltage at PCM terminal 2AI is **0.1 V or below** after the ignition switch is ON, the PCM determines that the TP circuit has a malfunction.

### P0223 TP sensor No.2 circuit high input

- If the PCM detects that TP sensor No.2 voltage at PCM terminal 2AI is **4.9 V or above** after the ignition switch is ON, the PCM determines that the TP circuit has a malfunction.

### P0327 KS circuit low input

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

### P0328 KS circuit high input

- The PCM monitors the input signal from the KS when the engine is running. If the input voltage at PCM terminals between 2AF and 2AC is **above 4.79 V**, the PCM determines that KS circuit has a malfunction.

### P0403 EGR valve (stepper motor) circuit malfunction

- 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 (RH) efficiency below threshold/P0431 Warm-up catalyst system (LH) efficiency below threshold

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

#### MONITORING CONDITION

- The engine speed is **1,250—2,750 rpm**.
- Calculated TWC temperature is **above 400 °C {752 °F}**
- The calculated load is **15—44%**

## P0441 EVAP control system incorrect purge flow

- The PCM measures the purge line pressure, which is the vacuum, when the following conditions are met. If the vacuum between the charcoal canister and intake manifold does not reach the specification, the PCM determines that the EVAP system is clogged.

### MONITORING CONDITION

- Engine speed: **1,500—3,550 rpm** (MTX)
- Engine speed: **1,220—3,000 rpm** (ATX)
- Throttle opening angle: **25%** (At engine speed is **2500 rpm**)
- Vehicle speed: **69.5—136 km/h {43.1—84.3 mph}** (MTX)
- Vehicle speed: **34.5—136 km/h {21.4—84.3 mph}** (ATX)

## P0442 EVAP control system leak detected (small leak)

- The PCM measures the pump load current (EVAP line pressure) when a certain period has passed after the EVAP system is sealed when the following monitoring conditions are met. If the load does not reach the reference current value within a certain period, PCM determines that the EVAP system has a small leak.

### MONITORING CONDITION

- Ignition switch OFF
- IAT: **5—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%**

## P0443 EVAP control system purge control valve circuit malfunction

- 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.

## P0455 EVAP control system leak detected (large leak)

- The PCM measures the pump load current (EVAP line pressure) when a certain period has passed after the EVAP system is sealed when the following monitoring conditions are met. If the load does not reach the reference current value within a certain period, the PCM determines that the EVAP system has a large leak.

### MONITORING CONDITION

- Ignition switch OFF
- IAT: **5—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%**

## P0456 EVAP control system leak detected (very small leak)

- The PCM measures the pump load current (EVAP line pressure) when a certain period has passed after the EVAP system is sealed when monitoring condition are met. If the load does not reach the reference load value or a rate of load increase lower than specified within a certain period, the PCM determines that the EVAP system has a very small leak.

### MONITORING CONDITION

- Ignition switch OFF
- IAT: **5—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%**

## P0461 Fuel gauge sender unit circuit range/performance

- The PCM monitors the fuel level difference before and after the PCM-calculated fuel consumption has reached **more than 25.0 L {26.4 US qt., 22.0 Imp qt.}**. If the difference **less than 5%**, the PCM determines that there is the fuel gauge sender unit range/performance problem.

## P0480 Fan control circuit malfunction

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

## ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

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### **P0500 VSS circuit malfunction**

#### **With ABS/TCS**

If an error in the wheel speed signal from the ABS/TCS HU/CM is detected by CAN when the following conditions are met, the PCM detects a malfunction in the vehicle speed signal.

- In a shift range other than P, N or R position (ATX).
- The neutral switch and clutch pedal position switch are OFF (MTX).
- The load is **40% or above**.
- The engine speed is **2,000 rpm or above**.
- Brake switch is off

#### **MTX Without ABS/TCS**

The vehicle speed signal from the vehicle speed sensor is **3.7 km/h {2.3 mph} or below** when the following conditions are met:

- The neutral switch and clutch pedal position switch are OFF.
- The load is **40% or above**.
- The engine speed is **2,000 rpm or above**.
- Brake switch is off

### **P050A Cold start idle air control system performance**

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

### **P050B Cold start ignition timing performance**

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

### **P0550 PSP switch circuit malfunction**

- The PCM monitors the PSP switch signal at PCM terminal 2T. If the input voltage is low (switch stays on) for **1 min** when the VSS is **60.2 km/h {37.4 mph} or above** and the ECT is **60 °C {140 °F} or above**, the PCM determines that the PSP switch circuit has a malfunction.

### **P0564 Cruise control switch circuit malfunction**

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

### **P0571 Brake switch circuit malfunction**

- The PCM monitors changes the 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**, the PCM determines that the brake switch circuit has a malfunction.

### **P0601 PCM memory check sum error**

- PCM internal memory check sum error
- PCM has internal abnormalities

### **P0606 ECM/PCM processor**

- PCM internal CPU malfunction.

### **P0704 Clutch switch input malfunction**

- The PCM monitors changes in input voltage from the clutch pedal position switch. If the PCM does not detect voltage changes at PCM terminal 1AB when the vehicle run with vehicle speed **above 30 km/h {18.6 mph}** and stop **8 times** alternately, the PCM determines that the clutch pedal position switch circuit has a malfunction.

### **P0850 Neutral switch input malfunction**

- The PCM monitors changes in input voltage from the neutral switch. If the PCM does not detect voltage changes at PCM terminal 2X voltage when running the vehicle at a vehicle speed of **30 km/h {18.6 mph} or above** clutch pedal turns press and depress **10 times** repeatedly, the PCM determines that the neutral switch circuit has a malfunction.

### **P2096 Target A/F feedback system too lean (Right bank)/P2098 Target A/F feedback system too lean (Left bank)**

- 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 too lean.

#### **MONITORING CONDITION**

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

### **P2108 Throttle actuator control module performance error**

- Throttle actuator control module internal communication error
- PCM has internal abnormalities

### **P2119 Throttle actuator control throttle body range/performance problem**

- The PCM compares the actual TP with initial setting TP when the engine is running. 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 APP sensor No.1 signal at PCM terminal 1AO. If the PCM detects APP sensor No.1 voltage of **0.35 V or below**, the PCM determines that the APP sensor No.1 circuit has a malfunction.

## P2123 APP sensor No.1 circuit high input

- The PCM monitors the APP sensor No.1 signal at PCM terminal 1AO. If the PCM detects APP sensor No.1 voltage of **4.8 V or above**, the PCM determines that the APP sensor No.1 circuit has a malfunction.

## P2127 APP sensor No.2 circuit low input

- The PCM monitors the APP sensor No.2 signal at PCM terminal 1AP. If the PCM detects APP sensor No.2 voltage of **0.35 V or below**, the PCM determines that the APP sensor No.2 circuit has a malfunction.

## P2144 EGR boost sensor solenoid valve circuit low input

- PCM monitors EGR boost sensor solenoid valve control signal at PCM terminal 1AX. If PCM turns EGR boost sensor solenoid valve off but voltage at PCM terminal 1AX still remains low, PCM determines that EGR boost sensor solenoid valve circuit has malfunction.

## P2145 EGR boost sensor solenoid valve circuit high input

- PCM monitors EGR boost sensor solenoid valve control signal at PCM terminal 1AX. If PCM turns EGR boost sensor solenoid valve on but voltage at PCM terminal 1AX still remains high, PCM determines that EGR boost sensor solenoid valve circuit has malfunction.

## P2195 HO2S (RF) signal stuck lean/P2197 HO2S (LF) signal stuck lean

- The PCM monitors the HO2S (RF, LF) output voltage when the following conditions are met. If output voltage is less than **0.45 V** for **25.6 s**, the PCM determines that the HO2S (RF, LF) signal remains lean.

### MONITORING CONDITION

- Fuel injection control system status: feedback zone
- HO2S (RF, LH) voltage is **above 0.1 V**

## P2196 HO2S (RF) signal stuck rich/P2198 HO2S (LF) signal stuck rich

- The PCM monitors the HO2S (RF, LF) output voltage when the following conditions are met. If output voltage is more than **0.45 V** for **25.6 s**, the PCM determines that the HO2S (RF, LF) signal remains rich.

### MONITORING CONDITION

- Fuel injection control system status: feedback zone

## P2229 EGR boost sensor circuit high input

- The PCM monitors the input voltage from the EGR boost sensor. If the input voltage at PCM terminal 1AL is **4.9 V or above**, the PCM determines that EGR boost sensor circuit has a malfunction.

## P2507 PCM B+ voltage low

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

## P2610 PCM internal engine off timer performance

- PCM internal engine off timer is damaged.

## P2676 Variable air duct (VAD) control solenoid valve circuit low input

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

## P2677 Variable air duct (VAD) solenoid valve circuit high input

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

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

## PID/DATA MONITOR AND RECORD

E6U010218881S03

- Differences between the 2006 MY and 2005 MY PID/DATA monitor items are shown below.

### PID/DATA monitor item table

N/A: Not applicable

Item		Definition	Unit/Condition	PCM terminal
2006MY	2005MY	Definition		Definition
AAT	←	Ambient air temperature	°C or °F	—
AC REQ	←	A/C switch	On/Off	1AN
ACCS	←	A/C relay	On/Off	1AW
ALTF	←	Generator field coil control duty value	%	2AP
ALTT V	←	Generator output voltage	V	2AU
APP	←	Accelerator pedal position	%	1AP, 1AO
APP1	←	APP sensor No.1	%	1AO
	←		V	
APP2	←	APP sensor No.2	%	1AP
	←		V	
ARPMDES	←	Target engine speed	RPM	—
BARO	←	Barometric pressure	kPa, Bar, psi	1AL
			V	
BARO/EGR	←	EGR boost sensor solenoid valve	On/Off	1AX
BOO	←	Brake switch No.1	On/Off	1AJ
BPA	←	Brake switch No.2	On/Off	1AF
CATT11_DSD	←	Estimated catalytic converter temperature	°C or °F	—
CATT21_DSD	←	Estimated catalytic converter temperature	°C or °F	—
CHRG LP	←	Generator warning light	On/Off	—
COLP	←	Refrigerant pressure switch (middle)	On/Off	1AH
CPP*1	←	Clutch pedal position	On/Off	1AB
CPP/PNP*1	←	Shift lever position	Neutral/Drive	2X
DTCCNT	←	Number of DTC detected	—	—
ECT	←	Engine coolant temperature	°C or °F	2AQ
	←		V	
EQ_RAT11_DSD	←	Front oxygen sensor	—	—
ETC_ACT	←	Electronic throttle control actual	°	2AI, 2AM
ETC_DSD	←	Electronic throttle control desired	%	2AI, 2AM
	←		°	
EVAPCP	←	Purge solenoid valve duty value	%	1BF
FAN_DUTY	←	Fan control signal	%	1U
FLI	←	Fuel level	%	—
FP	←	Fuel pump relay	On/Off	1V
FUELPW	←	Fuel injection duration	ms	2G, 2E, 2J, 2F, 2K, 2I
FUEL SYS1	←	Fuel system status	OL/CL/ OL-Drive/ OL-Fault/ CL-Fault	—
FUEL SYS2	←	Fuel system status	OL/CL/ OL-Drive/ OL-Fault/ CL-Fault	—
GENVDSD	←	Generator voltage desired	V	—
HTR11	←	HO2S heater (RF)	On/Off	2AW
HTR12	←	HO2S heater (RR)	On/Off	2AT
HTR21	←	HO2S heater (LF)	On/Off	2AS
HTR22	←	HO2S heater (LR)	On/Off	2AO
IASV	←	VAD control solenoid valve	On/Off	1BB
IAT	←	Intake air temperature	°C or °F	1AT
	←		V	

# ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

Item		Definition	Unit/Condition	PCM terminal
2006MY	2005MY	Definition		Definition
INGEAR	←	Load/no load condition	On/Off	1AB, 2X <sup>*1</sup> — <sup>*2</sup>
IVS	←	CTP condition	Idle/Off Idle	2AI, 2AM
KNOCKR	←	Knocking retard	°	2AF, 2AC
LDP_EVAPCP	←	EVAP system leak detection pump detect incorrect purge flow	mA	—
LDP_IDL	←	EVAP system leak detection pump idle current	mA	—
LDP_MON	←	EVAP system leak detection pump monitoring current	mA	—
LDP_REF	←	EVAP system leak detection pump reference current	mA	—
LDP_SLDV	←	EVAP system small leak detection value	mA	—
LDP_VSL_FV <sup>*2</sup>	N/A	EVAP system small leak detection fail value	mA/sec	—
LDP_VSL_SV <sup>*2</sup>	N/A	EVAP system small leak detection fail value	mA/sec	—
LDP_VSLDV <sup>*2</sup>	←	EVAP system small leak detection value	mA/sec	—
LOAD	←	Engine load	%	—
LONGFT1	←	Long term fuel trim (RH)	%	—
LONGFT2	←	Long term fuel trim (LH)	%	—
MAF	←	Mass airflow	g/s	1AK
	←		V	
MIL	←	Malfunction indicator light	On/Off	—
MIL_DIS	←	Travelled distance since the MIL illuminated	km or mile	—
NUMKEYS	←	Number of keys stored in module	—	—
O2S11	←	HO2S (RF)	V	2AK
O2S12	←	HO2S (RR)	V	2AG
O2S21	←	HO2S (LF)	V	2AL
O2S22	←	HO2S (LR)	V	2AH
PSP	←	PSP switch	High/Low	2T
RFCFLAG	←	Readiness Function Code	Learnt/Not Learnt	—
RO2FT1	←	HO2S (RR) fuel trim	—	—
RO2FT2	←	HO2S (RL) fuel trim	—	—
RPM	←	Engine speed	RPM	2Z, 2Y
SCCS	←	Cruise control switch	V	1AS
SEGRP	←	EGR valve position	No. of step	—
SEGRP DSD	←	Desired EGR valve position	%	—
SHRTFT1	←	Short term fuel trim (RH)	%	—
SHRTFT11	←	Short term fuel trim (RF)	%	—
SHRTFT12	←	Short term fuel trim (LF)	%	—
SHRTFT2	←	Short term fuel trim (LH)	%	—
SHRTFT21	←	Short term fuel trim (RR)	%	—
SHRTFT22	←	Short term fuel trim (LR)	%	—
SPARKADV	←	Ignition timing	° (BTDC)	—
test	←	Test mode	On/Off	—
TIRESIZE	←	Tire revolution per mile	rev/mile	—
TP_REL	←	Relative throttle position	%	2AI, 2AM
TP1	←	TP sensor No.1 signal voltage	%	2AM
	←		V	
TP2	←	TP sensor No.2 signal voltage	%	2AI
	←		V	
TPCT	←	Relative throttle position	V	2AI, 2AM
VPWR	←	Battery positive voltage	V	—
VSS	←	Vehicle speed	KPH or MPH	—
VT ACT1	←	Actual valve timing (RH)	°	2AE, 2AD

01-02C

## ON-BOARD DIAGNOSTIC [ENGINE CONTROL SYSTEM (AJ)]

Item		Definition	Unit/Condition	PCM terminal
2006MY	2005MY	Definition		Definition
VT ACT2	←	Actual valve timing (LH)	°	2AB, 2AA
VT DIFF1	←	Difference between actual and target valve timing (RH)	°	2AE, 2AD
VT DIFF2	←	Difference between actual and target valve timing (LH)	°	2AB, 2AA
VT DUTY1	←	OCV control signal (RH)	%	2AE, 2AD
VT DUTY2	←	OCV control signal (LH)	%	2AB, 2AA

\*1 : MTX

\*2 : California emission regulation applicable model

## 01-10 MECHANICAL [L3 WITH TC]

### MECHANICAL OUTLINE

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[L3 WITH TC] .....	01-10-4
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01-10

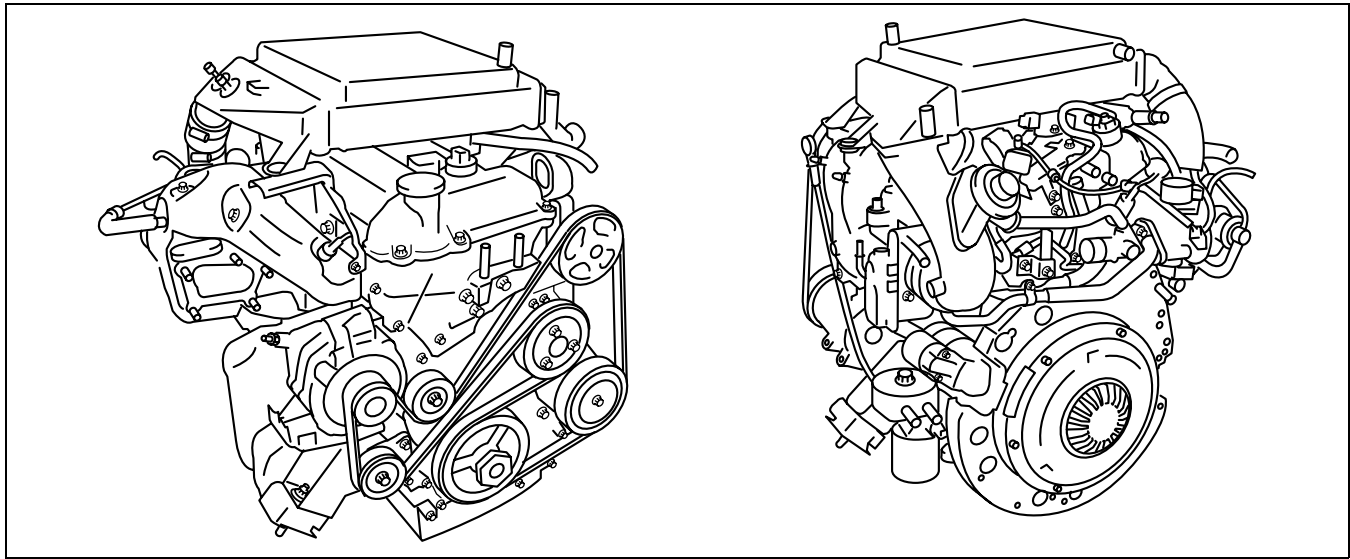
### MECHANICAL OUTLINE [L3 WITH TC]

E6U011000000S01

Improved engine performance	<ul style="list-style-type: none"> <li>Variable valve timing mechanism adopted</li> </ul>
Weight reduction	<ul style="list-style-type: none"> <li>Aluminum-alloy adopted for mainframe parts (cylinder head and block)</li> </ul>
Reduced vibration and noise	<ul style="list-style-type: none"> <li>Aluminum-alloy cylinder head adopted</li> <li>Pendulum-type engine mounts adopted</li> </ul>
Improved serviceability	<ul style="list-style-type: none"> <li>Roller timing chain adopted</li> </ul>

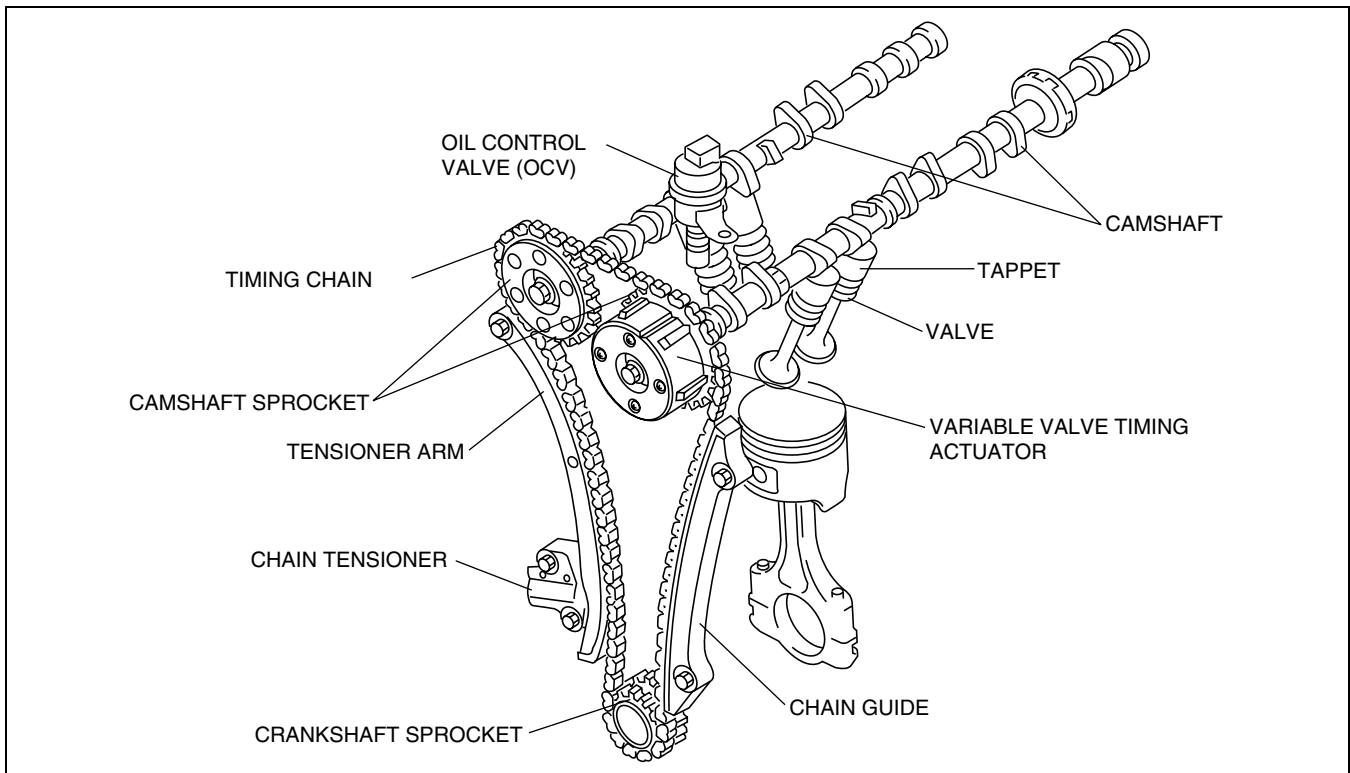
## Structure

### Engine external view



E6U110ZSB009

## Valve mechanism

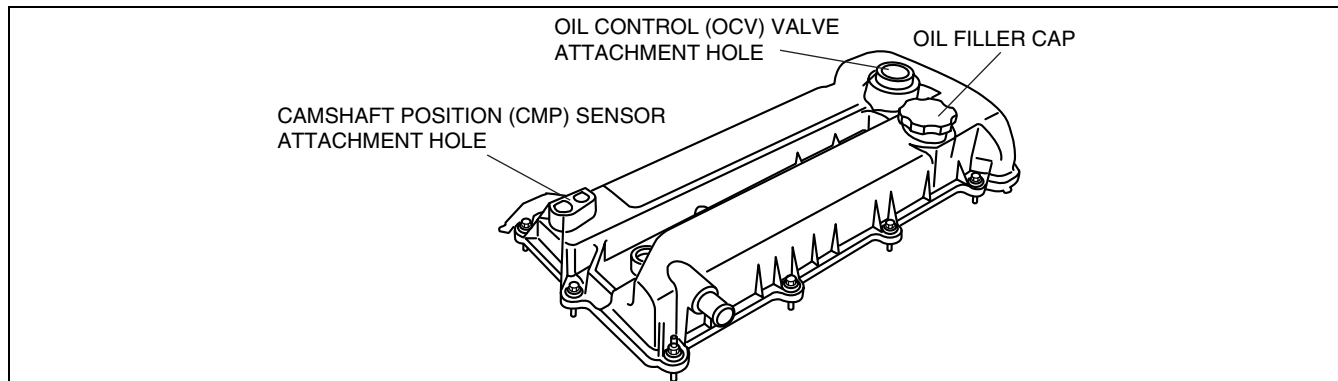


E6U110ZSB019

### CYLINDER HEAD COVER CONSTRUCTION [L3 WITH TC]

E6U011010100S01

- The cylinder head cover is made of integrated aluminum alloy, which is lightweight and sound absorbent.
- The oil filler cap is a screw-in type. The boss for installing the camshaft position (CMP) sensor is provided at the rear of the cylinder head cover.
- L3 with TC engine models has a hole for installing the oil control (OCV) valve.



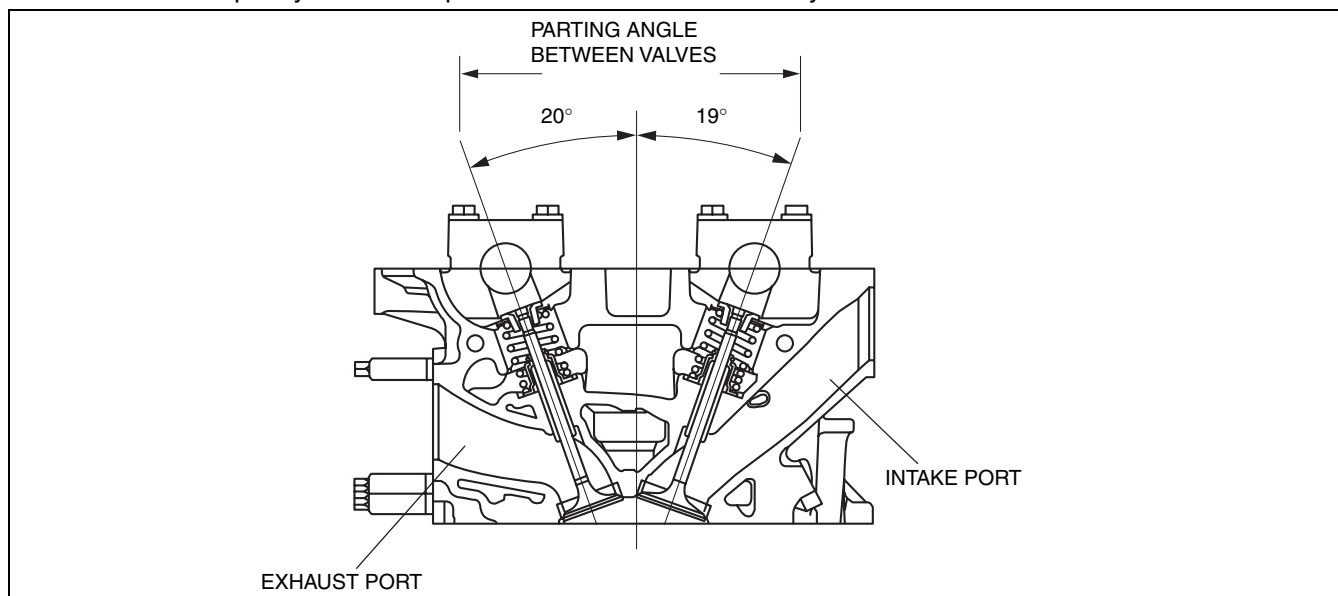
E6U110ZSB021

01-10

### CYLINDER HEAD CONSTRUCTION [L3 WITH TC]

E6U011010100S02

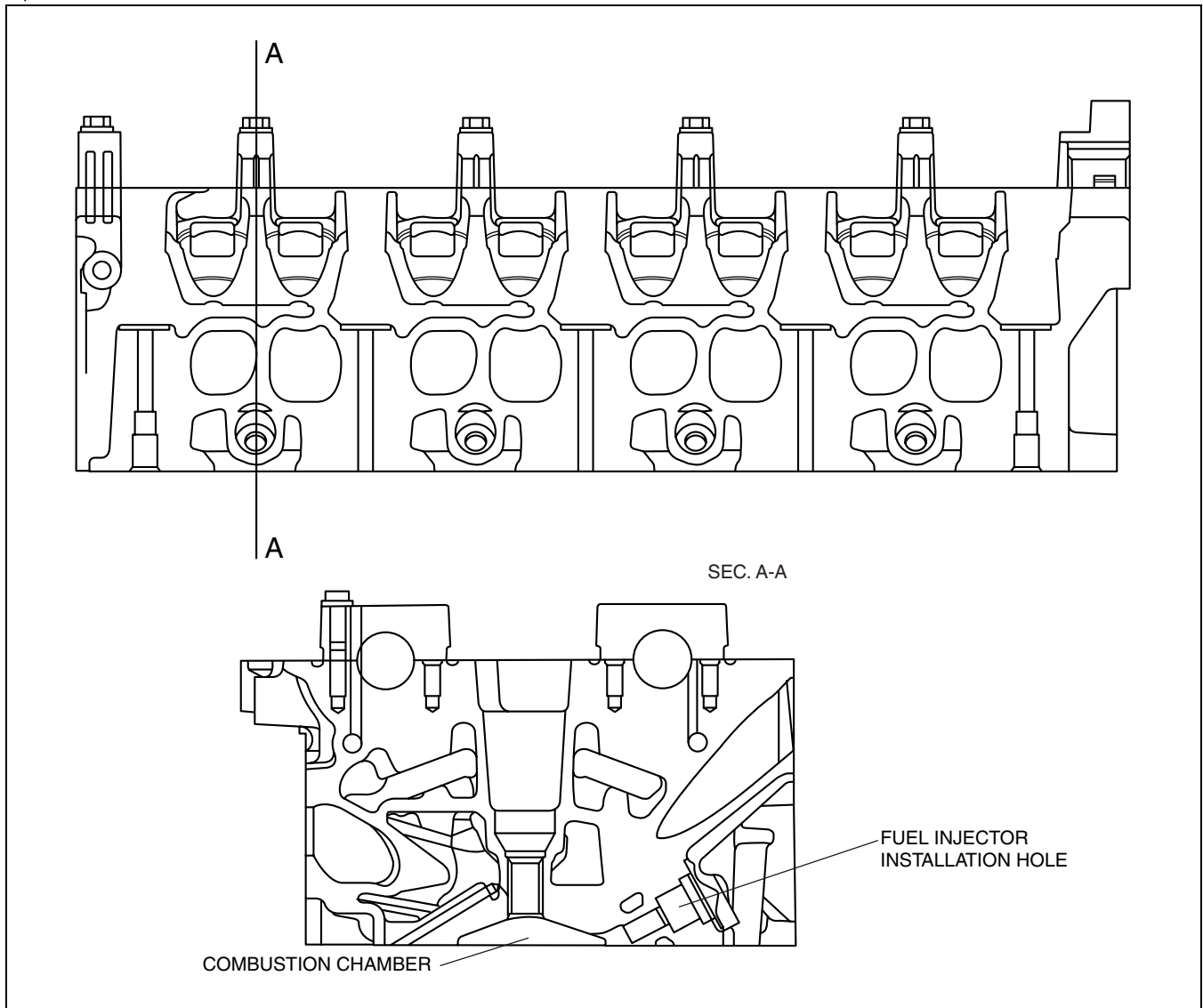
- A lightweight, quenched aluminum alloy with excellent heat conductance has been adopted for the cylinder heads.
- Compact, pentroof shaped combustion chambers have been adopted together with spark plugs positioned at the apex of the combustion chamber to provide improved combustion efficiency.
- The intake/exhaust layout consists of valves set at a 39° parting angle, and two cross-flow type intake and exhaust valves per cylinder for improved intake/exhaust efficiency.



E6U110ZSB002

## MECHANICAL [L3 WITH TC]

- With the adoption of direct injection, the structure of the cylinder head consists of an injector with an edge that reaches the combustion chamber.

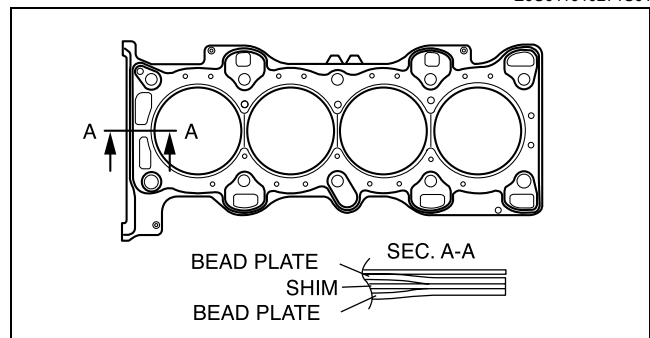


E6U110ZSB010

### CYLINDER HEAD GASKET CONSTRUCTION [L3 WITH TC]

- A four-layer, metal cylinder head gasket has been adopted.

E6U011010271S01



E6U110ZSB020

### CYLINDER BLOCK CONSTRUCTION [L3 WITH TC]

E6U011010300S01

#### Structure

- The main bearing cap bolts are elastic region tightening bolts.

## CRANKSHAFT, MAIN BEARING CONSTRUCTION [L3 WITH TC]

E6U011011301S01

- The main bearing can be selected from among three different sizes according to 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}

01-10

## CRANKSHAFT SPROCKET, OIL PUMP DRIVE SPROCKET CONSTRUCTION [L3 WITH TC]

E6U011011301S02

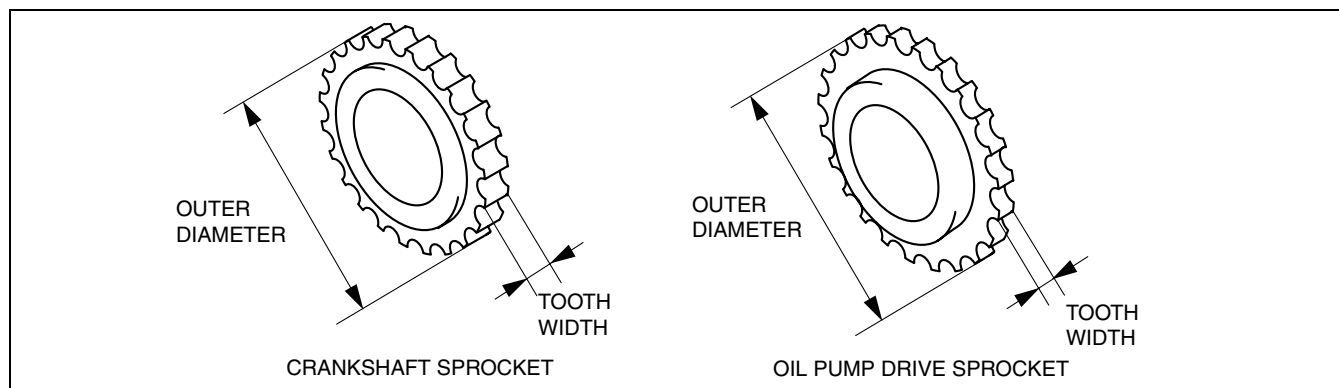
- The crankshaft sprocket and oil pump drive sprocket are different sizes. Be careful to install them correctly.

### Timing chain drive sprocket specification

Item	
Outer diameter (mm {in})	52.5 {2.0669}
Tooth width (mm {in})	4.22 {0.1661}

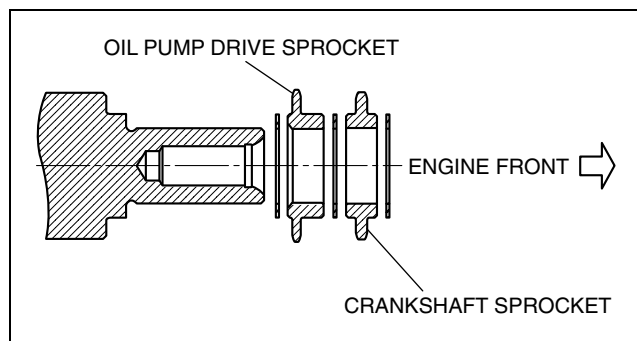
### Oil pump chain drive sprocket specification

Item	
Outer diameter (mm {in})	54.5 {2.1456}
Tooth width (mm {in})	3.1 {0.1220}



E6U110ZSB013

- The oil pump drive sprocket has the assembly direction as shown in the figure.



E6U110ZWB059

## MECHANICAL [L3 WITH TC]

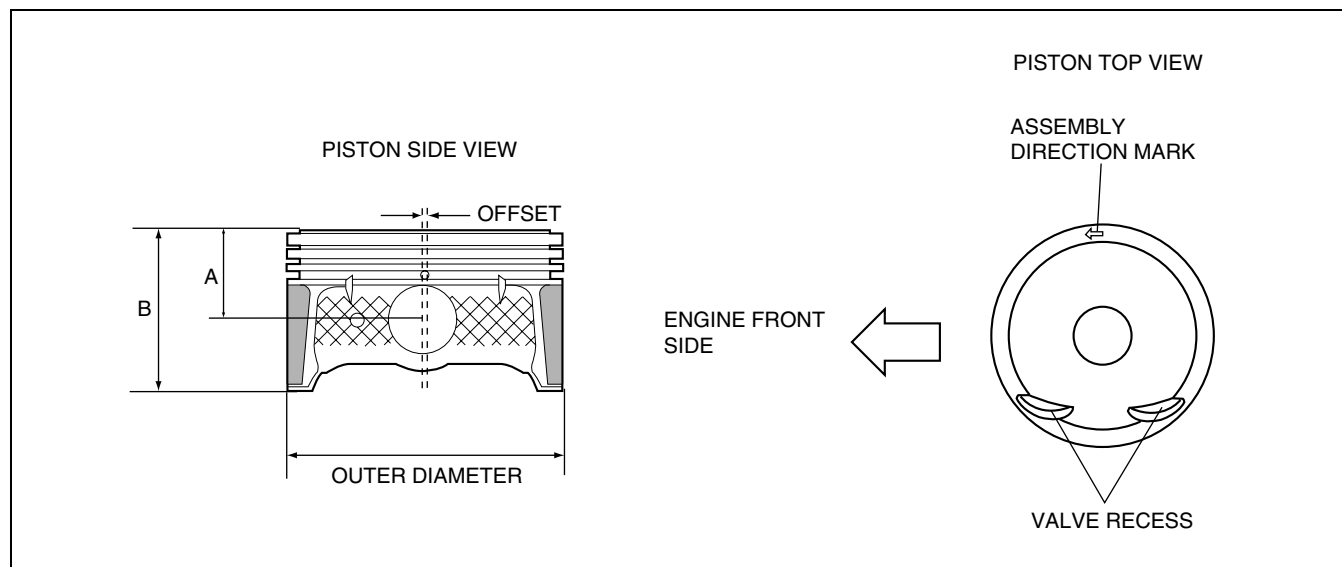
### PISTON, PISTON RING, PISTON PIN CONSTRUCTION [L3 WITH TC]

E6U011011010S01

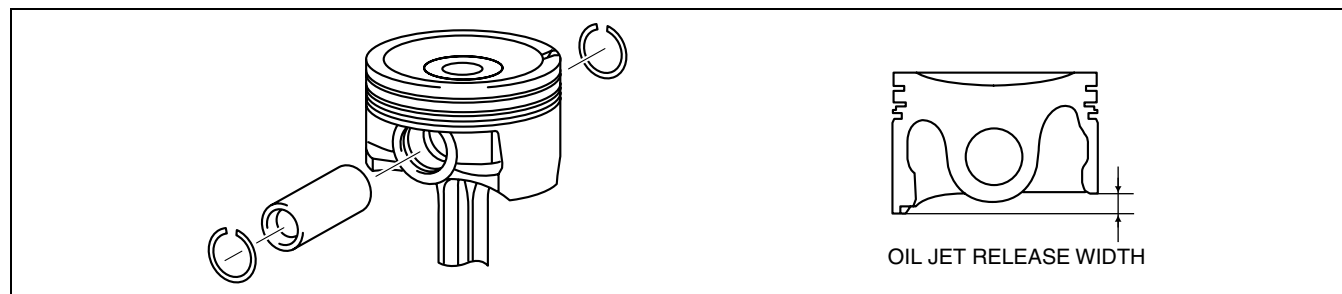
- The piston head has a concave recess to accommodate the turbocharger.
- A superior quality, heat resistant, highly-conductive aluminum alloy has been adopted for the pistons.
- Offset pistons have been adopted to reduce piston slapping.
- The piston has an arrow mark, located on top of the piston, pointing to the front side in order to prevent improper installation.
- A bushing is installed on the small end of the connecting rod for a full-floating connection of the piston, piston pin, and connecting rod.
- The construction of the piston skirt is asymmetric on the left and right side to prevent interference between the piston and oil jet.

#### Piston specification

Item		L3 with TC
Outer diameter	(mm {in})	87.465—87.495 {3.4435—3.4446}
Offset	(mm {in})	0.8 {0.04}
Compression height: A	(mm {in})	32.5 {1.2795}
Total height: B	(mm {in})	55.0 {2.1654}



E6U110ZSB004



E6U110ZSB005

### CONNECTING ROD, CONNECTING ROD BEARING CONSTRUCTION [L3 WITH TC]

E6U011011211S01

- The connecting rod bearing can be selected from among three different sizes according to the oil clearance.

#### Bearings

Bearing size	Bearing thickness (mm {in})
STD	1.495—1.519 {0.0588—0.0598}
0.25 OS	1.614—1.626 {0.0635—0.0640}
0.50 OS	1.739—1.751 {0.0684—0.0689}

# MECHANICAL [L3 WITH TC]

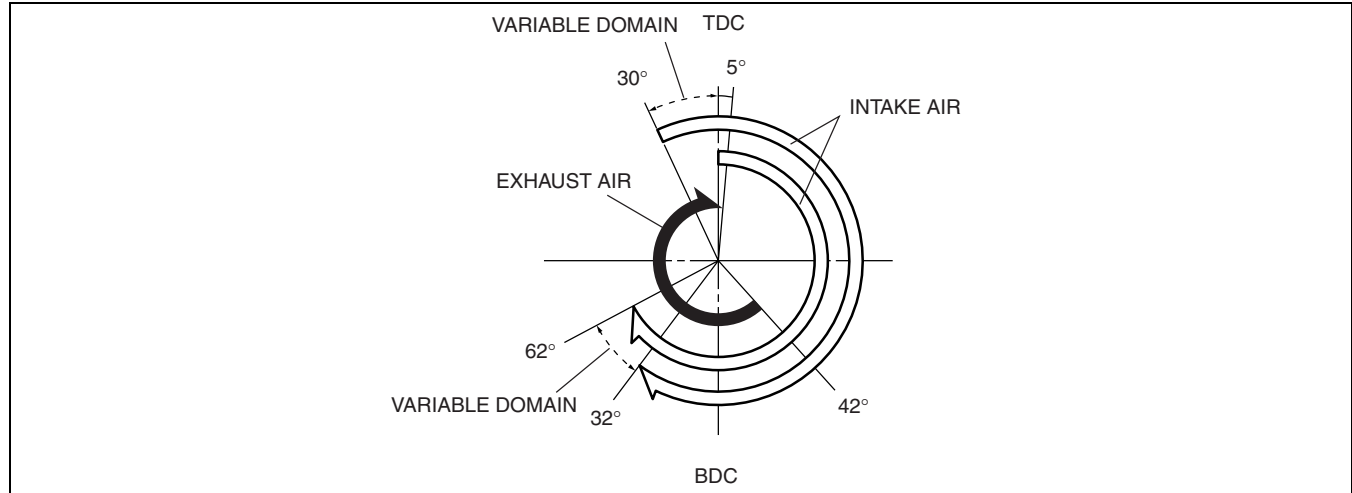
## CAMSHAFT CONSTRUCTION [L3 WITH TC]

E6U011012420S01

### Camshaft specification

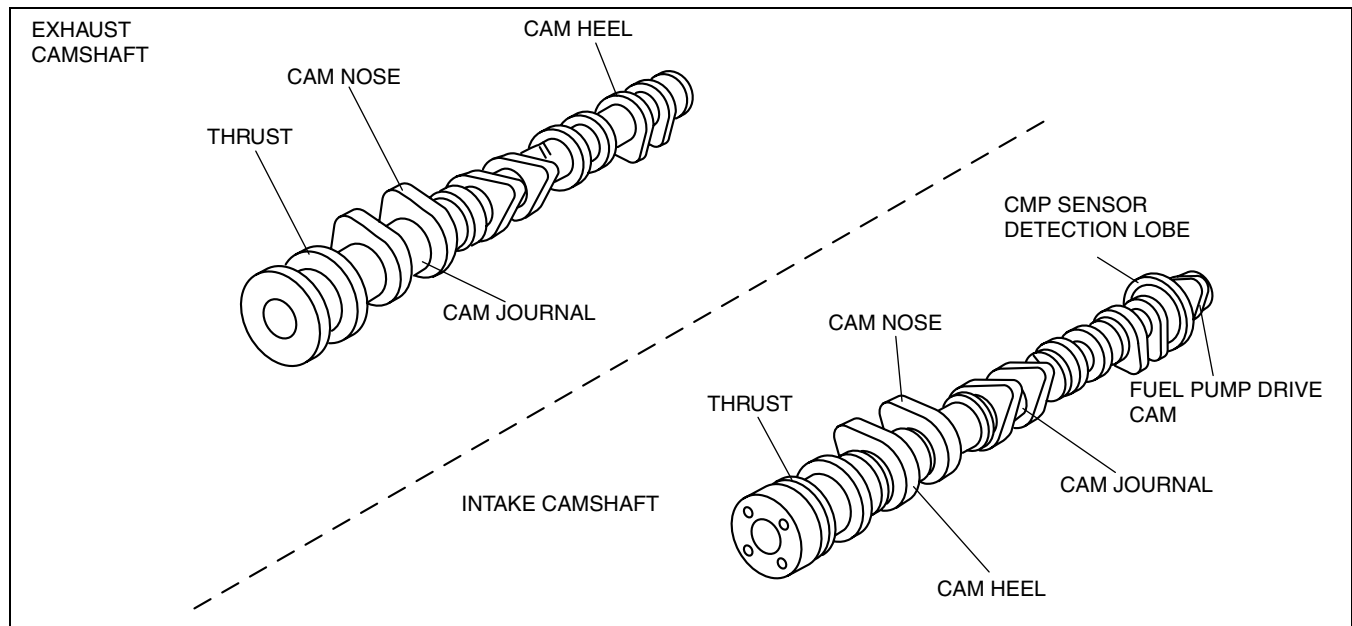
Item		L3 with TC	
		Intake	Exhaust
Lift	(mm {in})	9.1 {0.35}	7.8 {0.31}
Overlap	(°)	5—35	

### Valve timing

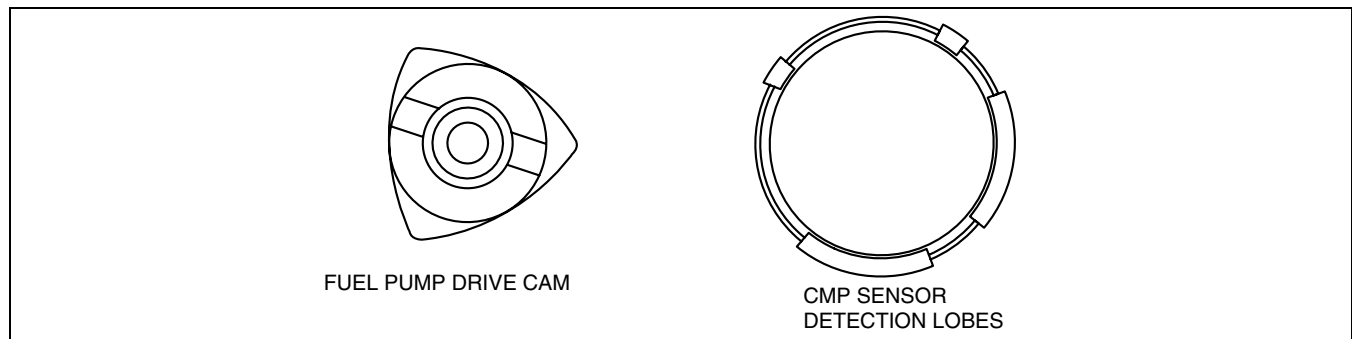


E6U110ZSB017

- The fuel pump drive cam and CMP sensor detection lobe are located at the rear of the intake camshaft.



E6U110ZSB011



E6U110ZSB012

01-10

## MECHANICAL [L3 WITH TC]

### VALVE, VALVE SPRING, VALVE SEAL, VALVE GUIDE CONSTRUCTION [L3 WITH TC]

E6U011012111S01

- In order to provide resistance against high-temperature loads, a nickel-based steel with a high heat resistance has been adopted for the exhaust valves.

#### Valve specification

Item		L3 with TC
Valve length (overall)	(mm {in})	Intake valve: 102.99—103.79 {4.055—4.086} Exhaust valve: 104.25—105.05 {4.105—4.135}
Intake valve umbrella diam.	(mm {in})	34.85—35.15 {1.3720—1.3838}
Exhaust valve umbrella diam.	(mm {in})	29.85—30.15 {1.1752—1.1870}
Stem diam.	(mm {in})	Intake valve: 5.970—5.985 {0.2351—0.2356} Exhaust valve: 5.965—5.980 {0.2349—0.2354}

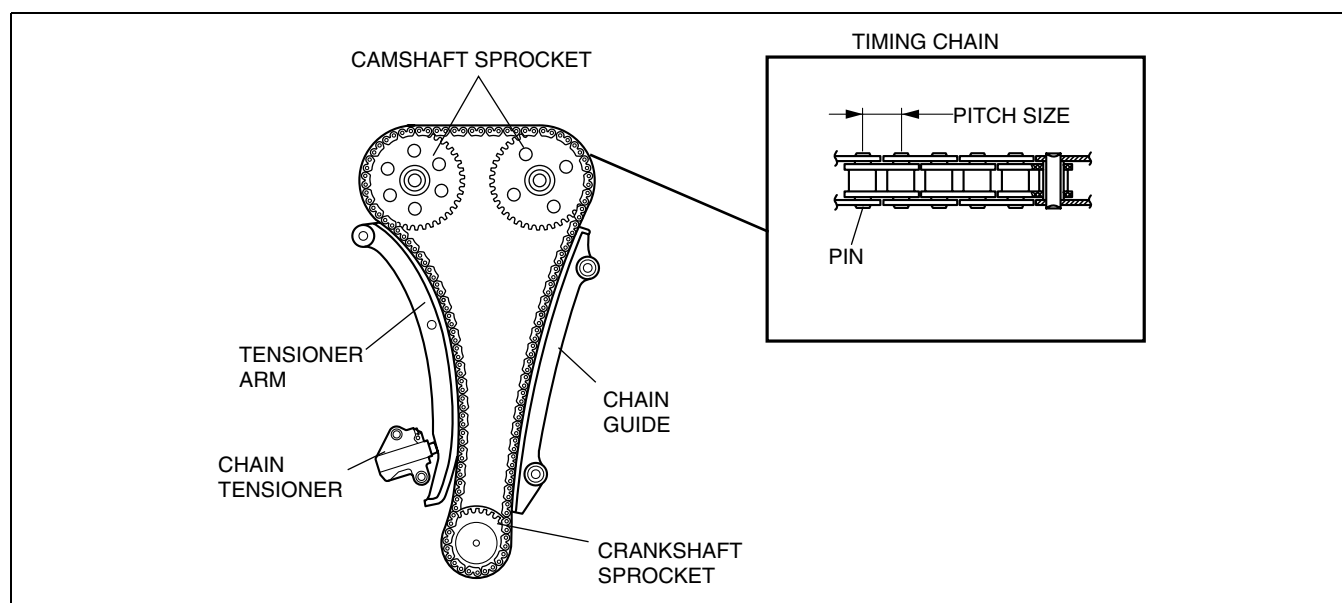
### TIMING CHAIN, CHAIN TENSIONER CONSTRUCTION [L3 WITH TC]

E6U011012201S01

- A roller chain has been adopted in order to improve durability against high output and heavy loads.

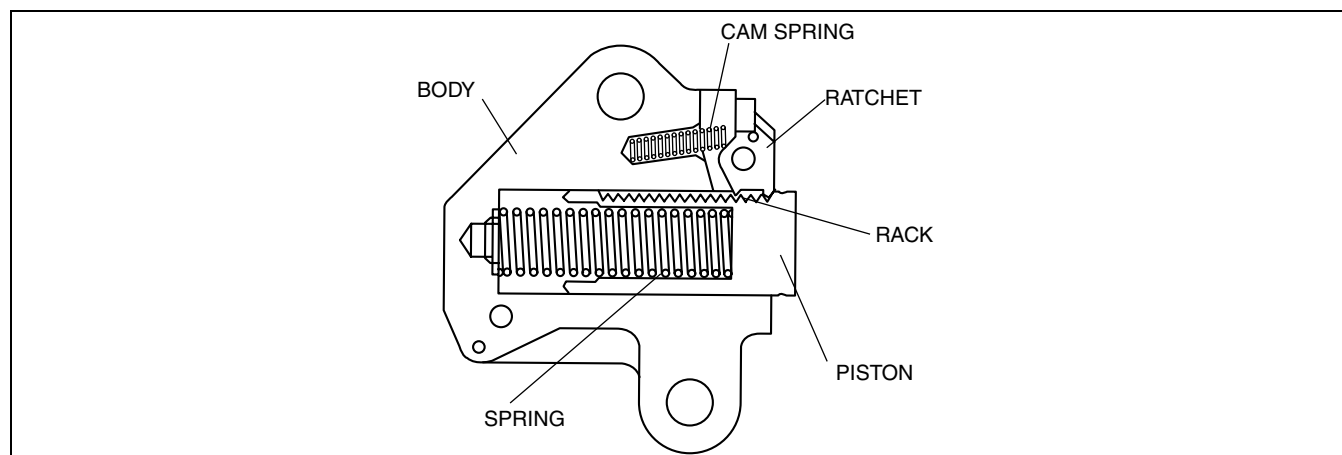
#### Timing chain specifications

Item		L3 with TC
Pitch dimension (mm {in})		8 {0.3}
Pitch number		138



E6U110ZSB001

- The oil pressure chain tensioner consists of a ratchet and rack that fixes the piston in place when the engine is started, and a piston and spring that push against the tensioner arm.



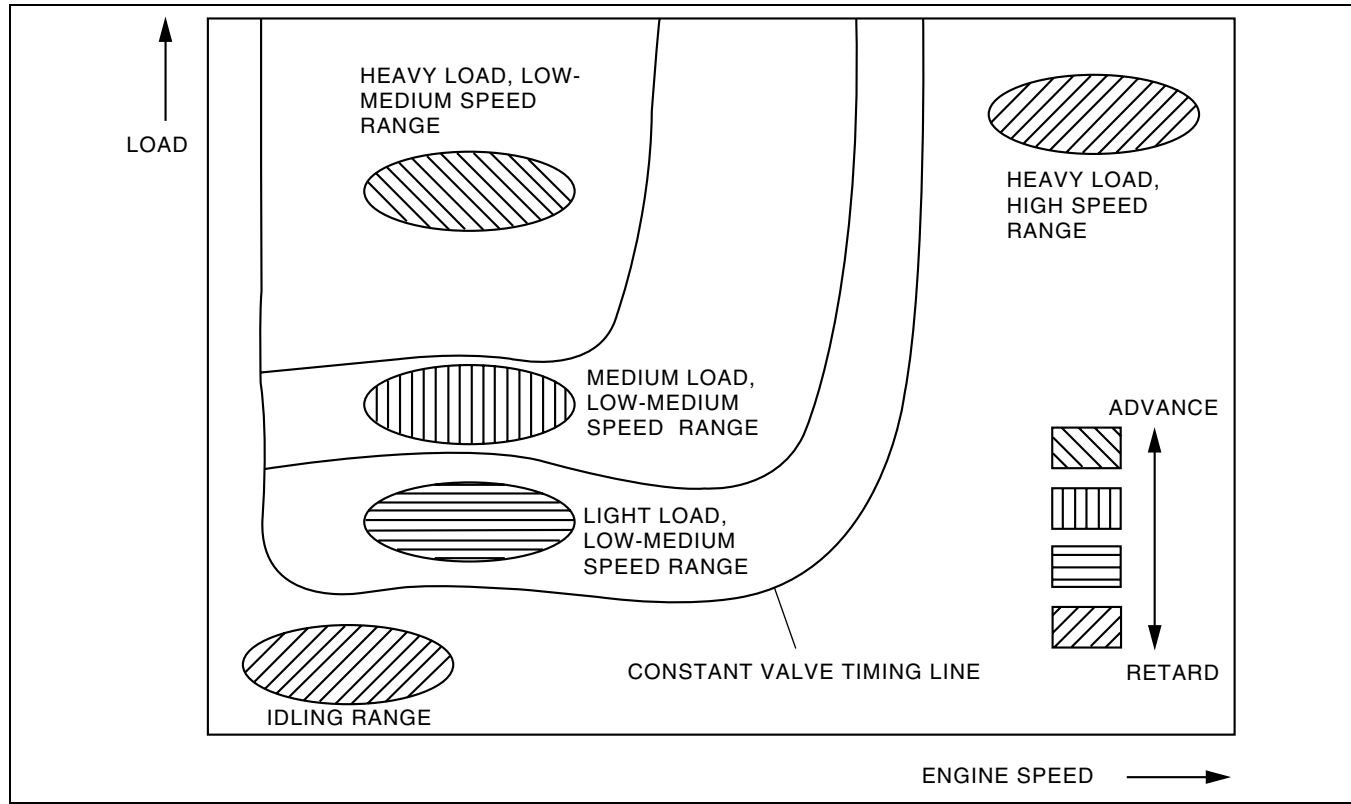
E6U110ZSB007

## VARIABLE VALVE TIMING MECHANISM FUNCTION [L3 WITH TC]

E6U011012010S01

- With the adoption of an direct fuel injector layout and turbocharger, the operation ranges are as shown in the following figure.

### Operation ranges according to driving conditions

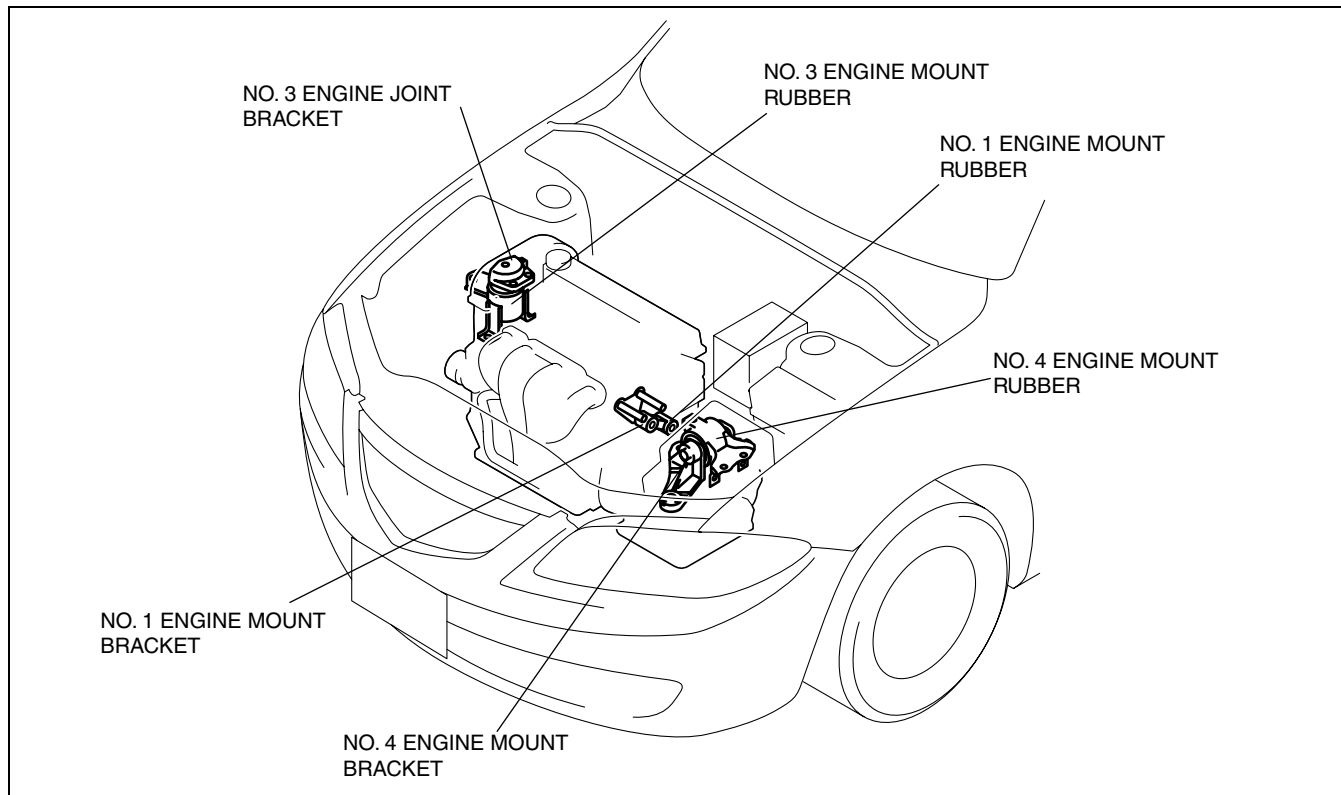


E6U110ZSB015

### ENGINE MOUNT OUTLINE [L3 WITH TC]

E6U011039000S01

- A pendulum-type layout for the engine mounts have been adopted to reduce the noise level in the passenger cabin.
- The engine is supported by engine mounts in three locations to simplify engine mount components.
- An aluminum alloy has been adopted for the exterior of the No.1 engine mount rubber to decrease weight.



E6U110ZSB014

# 01-11 LUBRICATION

<b>LUBRICATION SYSTEM OUTLINE</b> . . . .	01-11-1
Features . . . . .	01-11-1
<b>LUBRICATION SYSTEM STRUCTURAL</b>	
VIEW [L3 WITH TC] . . . . .	01-11-1
<b>LUBRICATION SYSTEM FLOW</b>	
DIAGRAM [L3 WITH TC] . . . . .	01-11-2
<b>OIL PAN CONSTRUCTION</b>	
[L3 WITH TC] . . . . .	01-11-2

<b>OIL PUMP CONSTRUCTION</b>	
[L3 WITH TC] . . . . .	01-11-2
<b>OIL COOLER CONSTRUCTION</b>	
[L3 WITH TC] . . . . .	01-11-4
<b>OIL JET VALVE</b>	
<b>CONSTRUCTION/OPERATION</b>	
[L3 WITH TC] . . . . .	01-11-4
Construction . . . . .	01-11-4
Operation . . . . .	01-11-4

01-11

## LUBRICATION SYSTEM OUTLINE

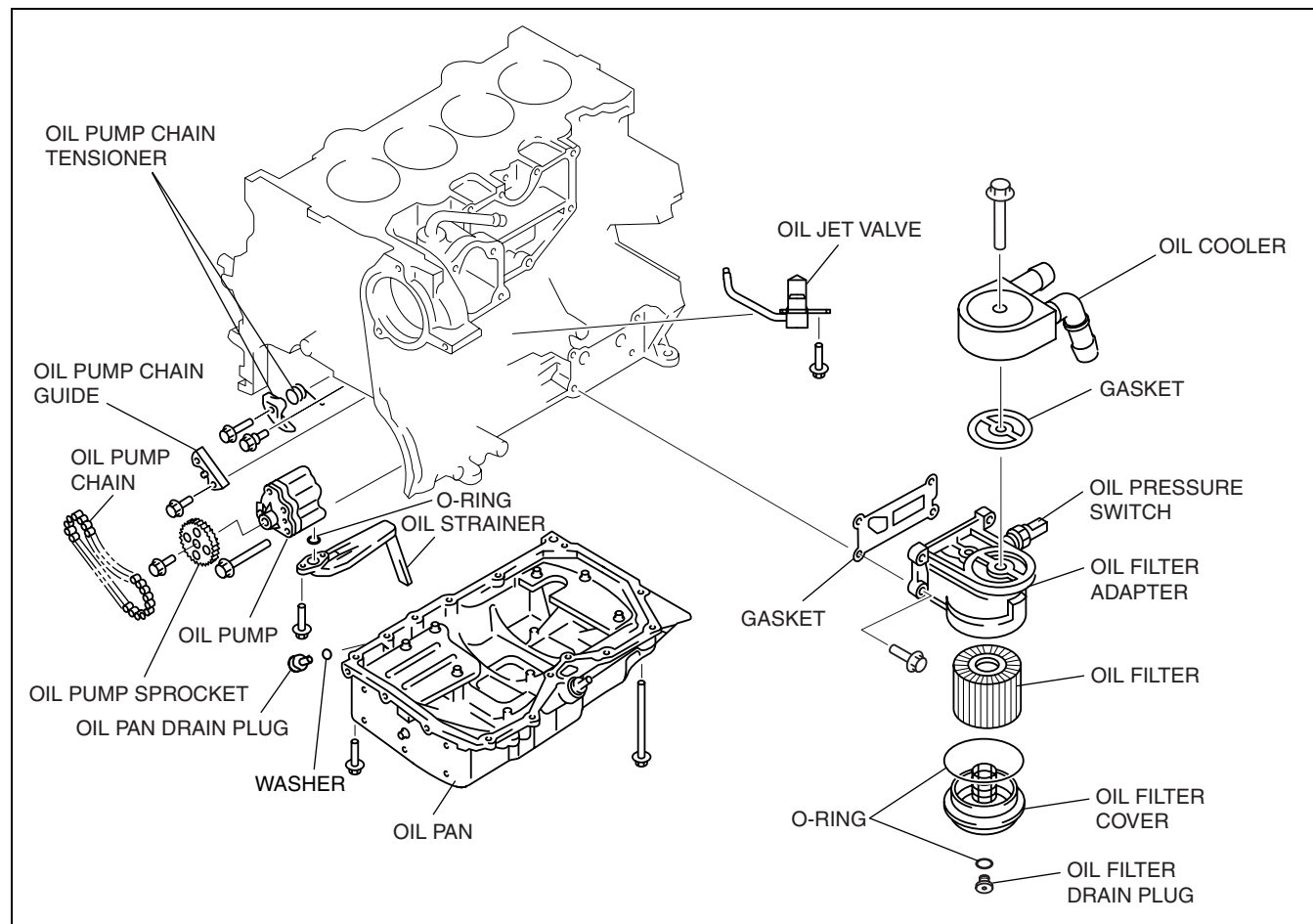
E6U011100000S01

### Features

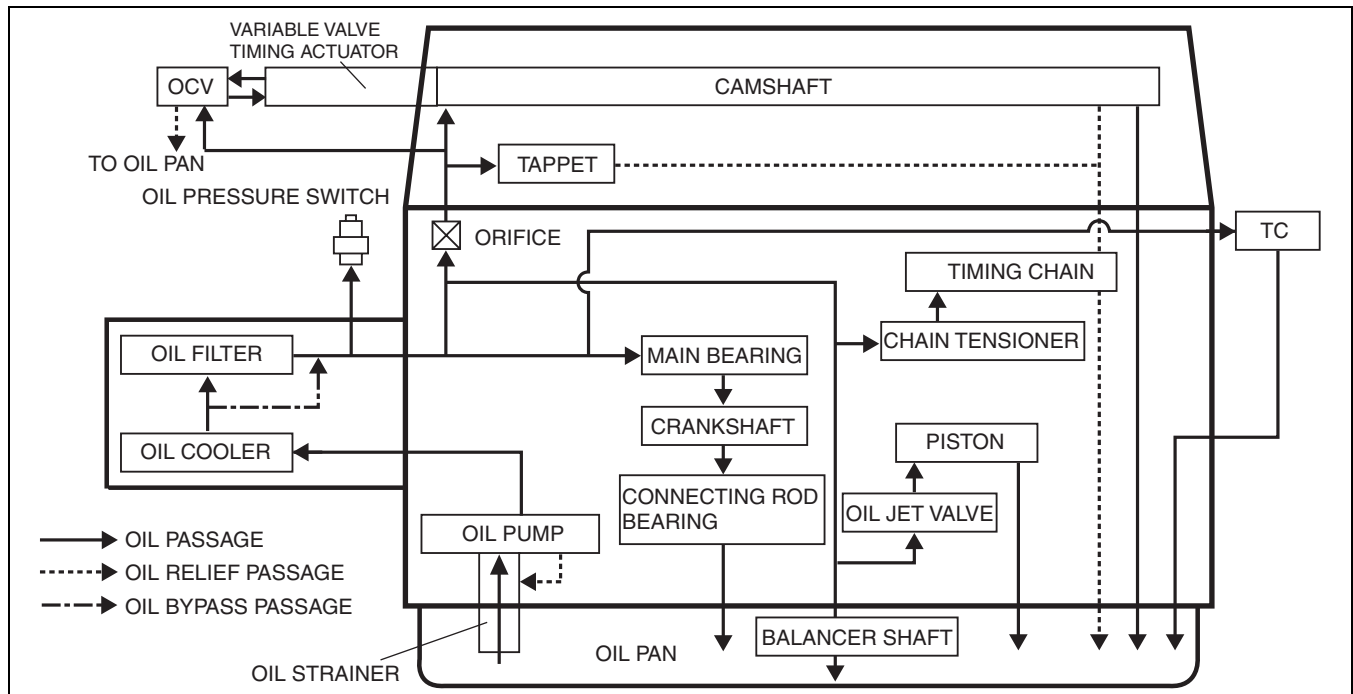
Reduced noise	<ul style="list-style-type: none"> <li>Oil pan changed (L3 WITH TC)</li> </ul>
Improved lubricity	<ul style="list-style-type: none"> <li>Oil pump driven chain and oil pump sprocket changed (L3 WITH TC)</li> <li>Oil jet valves changed (L3 WITH TC)</li> <li>Water-cooled type oil cooler adopted (L3 WITH TC)</li> </ul>

## LUBRICATION SYSTEM STRUCTURAL VIEW [L3 WITH TC]

E6U011100000S02



E6U111ZNB001

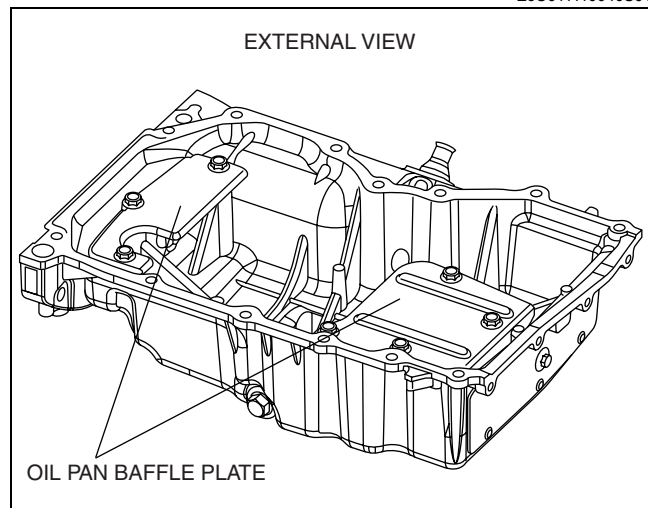


E6U111ZS7002

## OIL PAN CONSTRUCTION [L3 WITH TC]

- 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.

E6U011110040S01



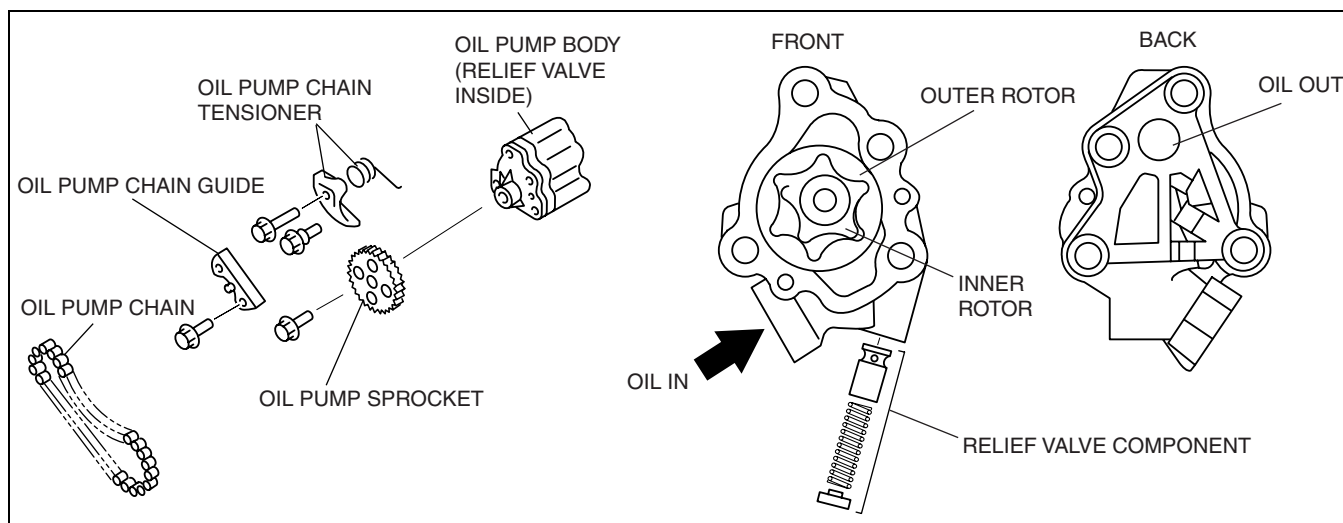
E6U111ZNB002

### OIL PUMP CONSTRUCTION [L3 WITH TC]

- 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 envelop 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.

E6U011114100S01

## LUBRICATION

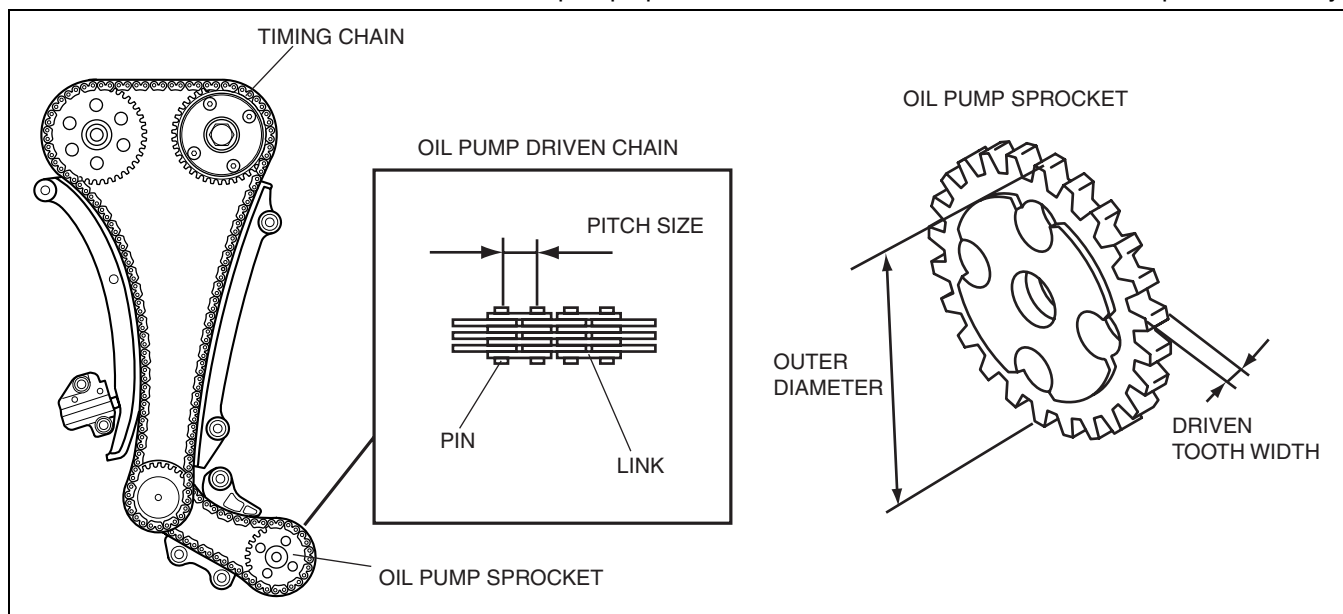


D5E111ZT6006

### Oil pump specification

Item	Engine speed [rpm]	Specification (kPa {kgf/cm <sup>2</sup> , psi})
Oil discharge pressure (reference value) [Oil temperature: 100°C {212°F}]	1,500	156—363 {1.59—3.70, 22.7—52.6}
	3,000	297—551 {3.03—5.61, 43.1—79.9}
Relief valve opening pressure (reference value)		420—520 {4.28—5.30, 60.9—75.4}

- A bush chain has been adopted for the oil pump chain, improving durability during high-output or high-load operation.
- The engine oil in the engine front cover lubricates the oil pump chain. Wear resistance has been improved by furnace hardening the pins constructing the oil pump chain.
- The teeth of the sintered material in the oil pump sprocket have been induction hardened to improve durability.



E6U111ZNB007

### Oil pump driven chain, oil pump sprocket specification

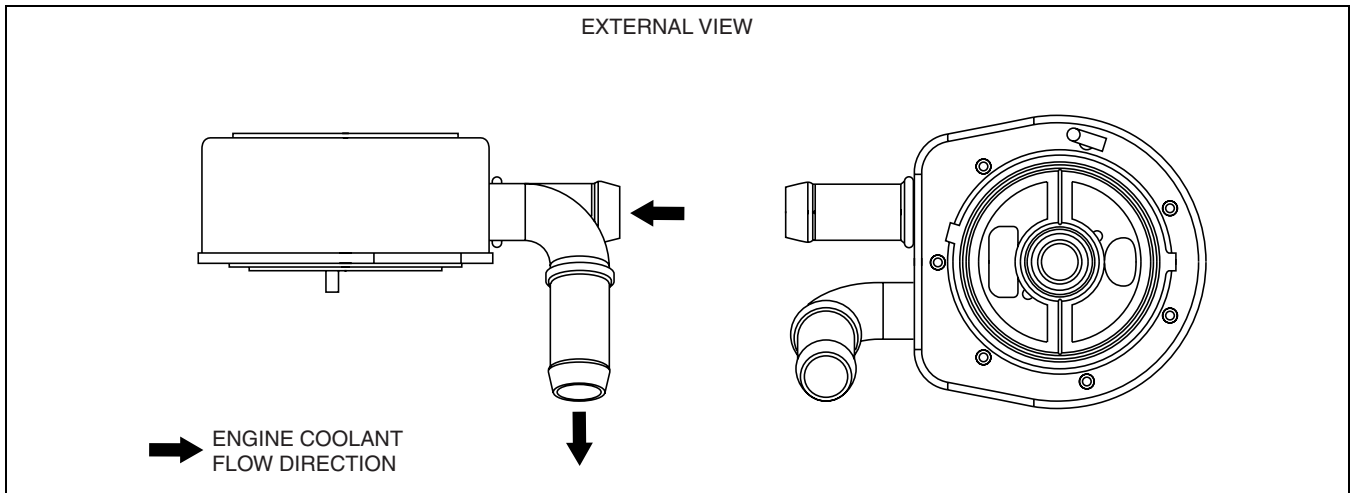
Item	Item	Specification (mm {in})
Oil pump driven chain	Pitch size	7 {0.28}
	Outer diameter	52 {2.05}
Oil pump sprocket	Drive tooth width	3.1 {0.12}

## LUBRICATION

### OIL COOLER CONSTRUCTION [L3 WITH TC]

E6U011114700S01

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



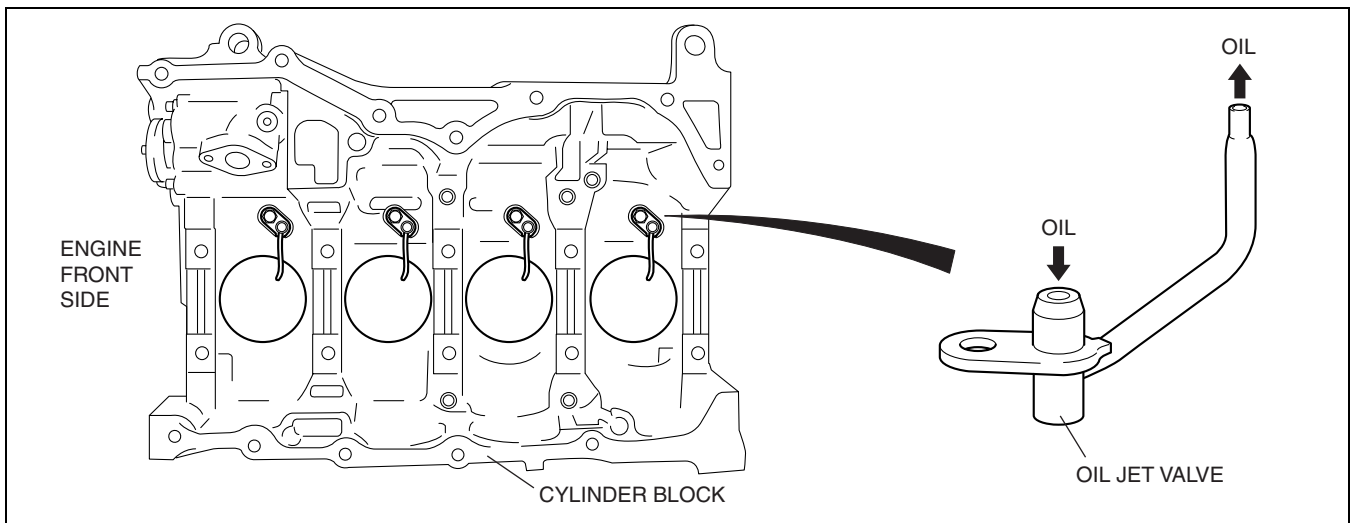
E6U1111ZNB003

### OIL JET VALVE CONSTRUCTION/OPERATION [L3 WITH TC]

E6U011110730S01

#### Construction

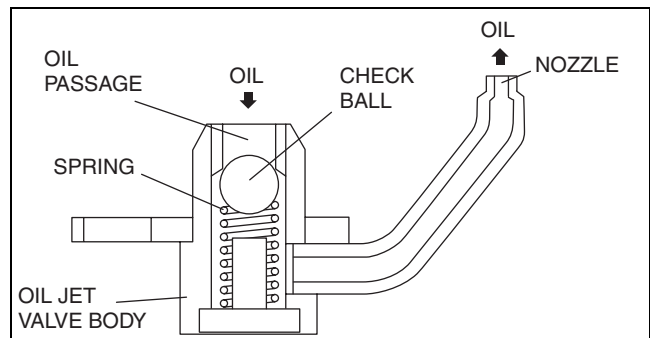
- The oil jet valves are installed in the cylinder block. The oil jet valve nozzles are installed pointed toward the back surface of each piston.
- The oil jet valves are designed to maintain optimum oil pressure in the engine by controlling the oil injection according to the oil pressure applied to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



E6U1111ZNB005

#### 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.



E6U1111ZS7001

## 01-12 COOLING SYSTEM

COOLING SYSTEM OUTLINE .....	01-12-1
Features.....	01-12-1
COOLING SYSTEM STRUCTURAL	
VIEW [L3 WITH TC] .....	01-12-1
COOLING SYSTEM FLOW DIAGRAM	
[L3 WITH TC] .....	01-12-2
COOLING FAN COMPONENT	
CONSTRUCTION [L3 WITH TC]. ....	01-12-2

FAN CONTROL MODULE	
CONSTRUCTION/OPERATION	
[L3 WITH TC] .....	01-12-3
Construction .....	01-12-3
Operation .....	01-12-3
Fail-safe function.....	01-12-3

01-12

### COOLING SYSTEM OUTLINE

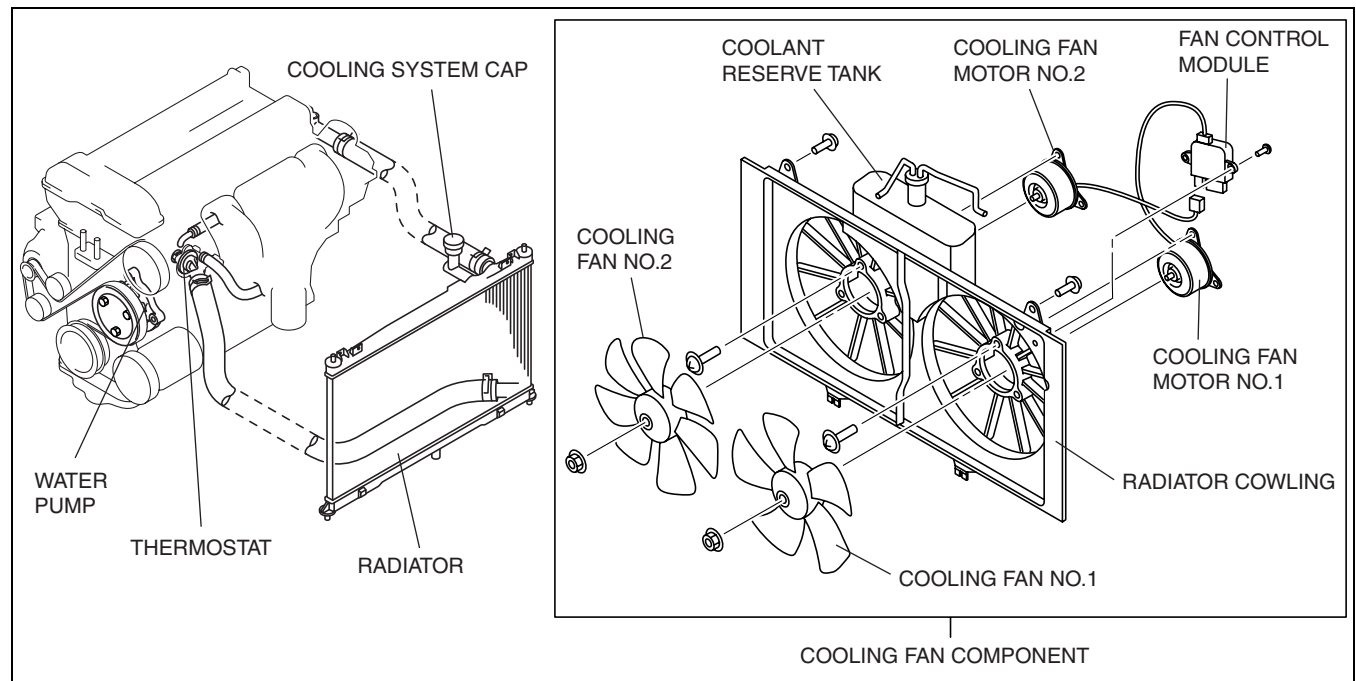
E6U011200000S01

#### Features

Reduced engine noise and vibration	<ul style="list-style-type: none"> <li>Fan control module adopted (L3 WITH TC)</li> </ul>
Reduced power consumption	<ul style="list-style-type: none"> <li>Fan control module adopted (L3 WITH TC)</li> </ul>
Improved serviceability	<ul style="list-style-type: none"> <li>Longer-life new engine coolant (type FL22) adopted</li> </ul>

### COOLING SYSTEM STRUCTURAL VIEW [L3 WITH TC]

E6U011200000S02

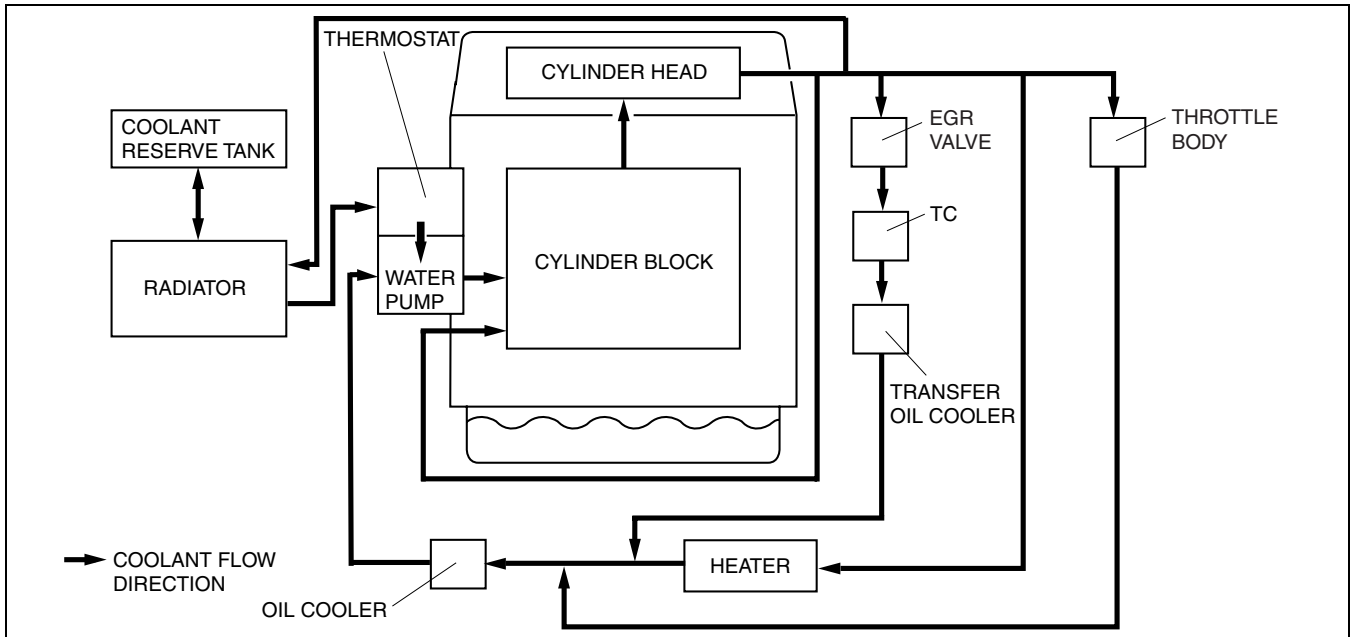


E6U112ZNB001

# COOLING SYSTEM

## COOLING SYSTEM FLOW DIAGRAM [L3 WITH TC]

E6U01120000S03

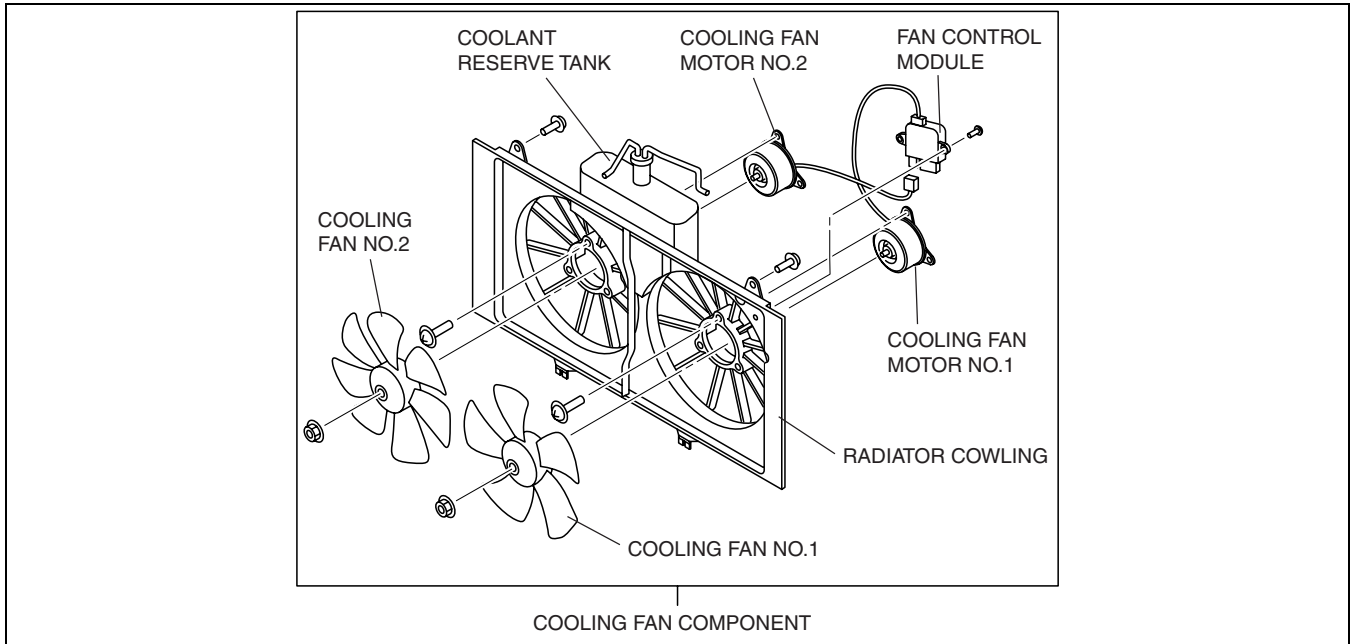


E6U112ZS7001

## COOLING FAN COMPONENT CONSTRUCTION [L3 WITH TC]

E6U011215140S01

- The cooling fan component consists of the radiator cowling, cooling fans, cooling fan motors, and fan control module.
- Electric cooling fans No.1 and No.2, which operate according to the fan control signal sent from the PCM to the fan control module, have been adopted. Due to this, engine noise has been reduced and rapid engine warming-up is possible.
- Cooling fan motor No.1 and the fan control module cannot be separated because they are integrated.
- The radiator cowling and cooling fans are made of plastic for weight reduction.
- Coolant reserve tank can be removed from the radiator cowling.



E6U112ZNB002

## Cooling fan, cooling fan motor specification

Item		Specification	
		No.1	No.2
Cooling fan	Number of blades	5	7
	Outer diameter (mm {in})	320 {12.6}	
Cooling fan motor output (W)		160	

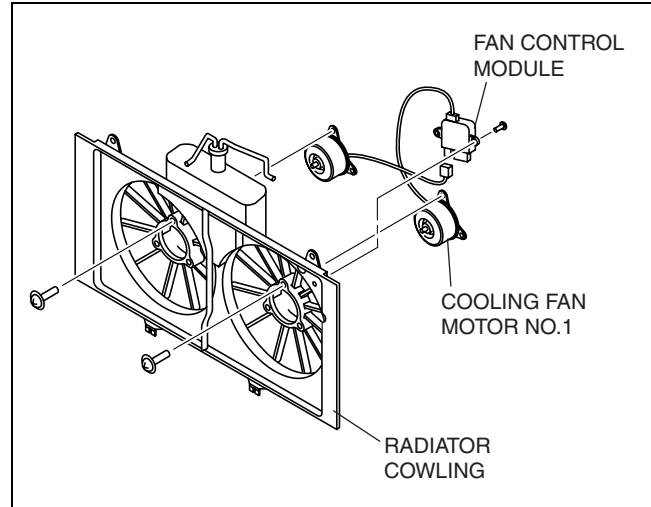
# COOLING SYSTEM

## FAN CONTROL MODULE CONSTRUCTION/OPERATION [L3 WITH TC]

E6U011215150S01

### Construction

- Fan control module is installed on the radiator cowl.
- Fan control module cannot be separated from cooling fan motor No.1 because they are integrated.

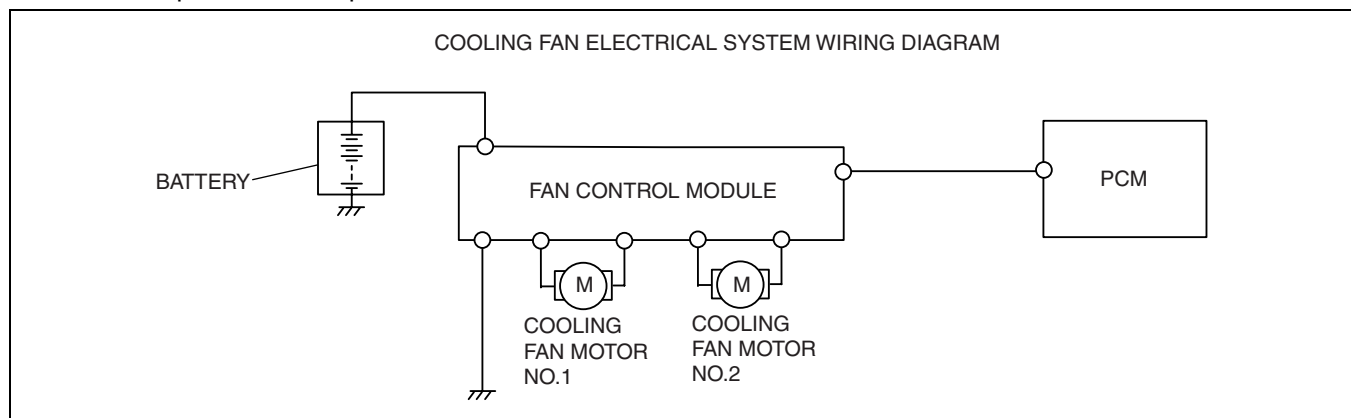


E6U112ZN003

01-12

### Operation

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



E6U112ZN004

### Fail-safe function

1. Over-heat fail-safe
  - If the internal area of the fan control module exceeds the specified temperature, the fan control module fixes the output duty value to the set value.
  - If the internal area of the fan control module returns to the specified temperature, the fan control module returns to normal control.
2. Input signal open circuit fail-safe
  - If there is an open circuit in the wiring harness between the PCM and the fan control module, the fan control module fixes the output duty value to the set value.



# 01-13B INTAKE-AIR SYSTEM [L3 WITH TC]

## INTAKE-AIR SYSTEM OUTLINE

[L3 WITH TC] .....	01-13B-1
Structure .....	01-13B-1
Features .....	01-13B-1
Specification .....	01-13B-1
<b>INTAKE-AIR SYSTEM STRUCTURAL</b>	
VIEW [L3 WITH TC] .....	01-13B-2
<b>INTAKE-AIR SYSTEM FLOW DIAGRAM</b>	
[L3 WITH TC] .....	01-13B-3
<b>INTAKE-AIR SYSTEM HOSE ROUTING</b>	
DIAGRAM [L3 WITH TC] .....	01-13B-4
<b>AIR CHARGING SYSTEM FUNCTION</b>	
[L3 WITH TC] .....	01-13B-5
<b>AIR CHARGING SYSTEM</b>	
<b>CONSTRUCTION/OPERATION</b>	
[L3 WITH TC] .....	01-13B-5
Construction .....	01-13B-5
Operation .....	01-13B-6
<b>AIR BYPASS VALVE FUNCTION</b>	
[L3 WITH TC] .....	01-13B-7
<b>TURBOCHARGER FUNCTION</b>	
[L3 WITH TC] .....	01-13B-8
<b>TURBOCHARGER</b>	
<b>CONSTRUCTION/OPERATION</b>	
[L3 WITH TC] .....	01-13B-8
<b>VARIABLE SWIRL SYSTEM FUNCTION</b>	
[L3 WITH TC] .....	01-13B-8

## VARIABLE SWIRL SYSTEM STRUCTURE

[L3 WITH TC] .....	01-13B-8
<b>VARIABLE SWIRL SYSTEM OPERATION</b>	
[L3 WITH TC] .....	01-13B-9
Intake manifold pressure: less than threshold, throttle opening: 20% or more, engine load: threshold or more (variable swirl shutter valve is closed) .....	01-13B-9
<b>VARIABLE SWIRL SHUTTER</b>	
<b>VALVE ACTUATOR FUNCTION</b>	
[L3 WITH TC] .....	01-13B-9
<b>VARIABLE SWIRL SHUTTER</b>	
<b>VALVE ACTUATOR</b>	
<b>CONSTRUCTION/OPERATION</b>	
[L3 WITH TC] .....	01-13B-9
Construction .....	01-13B-9
Operation .....	01-13B-9
<b>WASTEGATE CONTROL SOLENOID</b>	
VALVE FUNCTION [L3 WITH TC] .....	01-13B-10
<b>WASTEGATE CONTROL SOLENOID</b>	
<b>VALVE CONSTRUCTION/OPERATION</b>	
[L3 WITH TC] .....	01-13B-10
Construction .....	01-13B-10
Operation .....	01-13B-10

01-13B

## INTAKE-AIR SYSTEM OUTLINE [L3 WITH TC]

E6U011300000S01

### Structure

- The following items have been changed the same as with the 2005MY Mazda6.

### Features

Improved driveability	<ul style="list-style-type: none"> <li>Air charging system adopted                             <ul style="list-style-type: none"> <li>— Charge air cooler adopted</li> <li>— Turbocharger adopted</li> </ul> </li> <li>Wastegate control solenoid valve adopted</li> </ul>
Improvement of reliability	<ul style="list-style-type: none"> <li>Bypass air valve adopted</li> </ul>

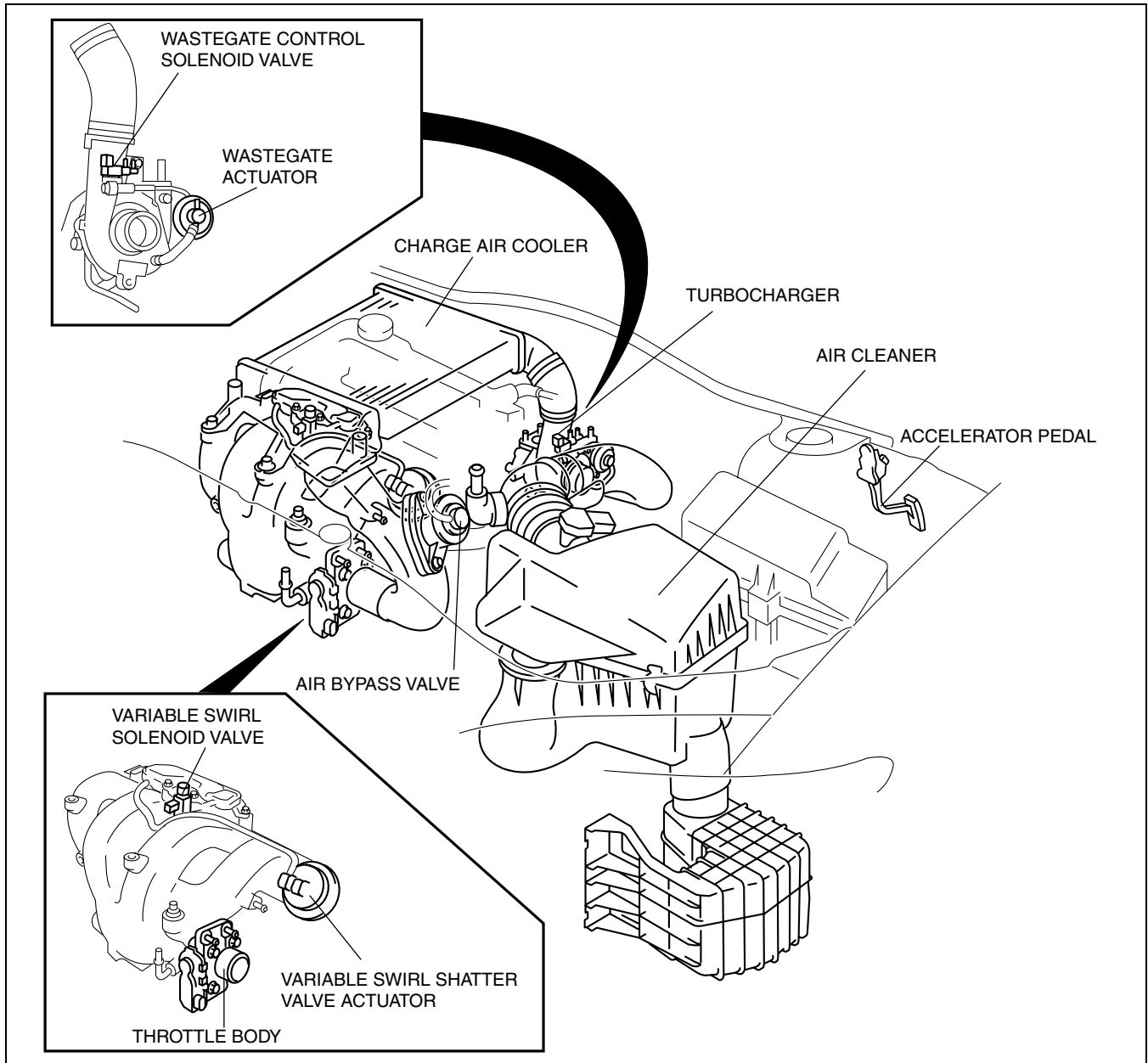
### Specification

Item	Specification
Wastegate control solenoid valve	Duty type
Variable swirl solenoid valve	Duty type

## INTAKE-AIR SYSTEM [L3 WITH TC]

### INTAKE-AIR SYSTEM STRUCTURAL VIEW [L3 WITH TC]

E6U01130000S02

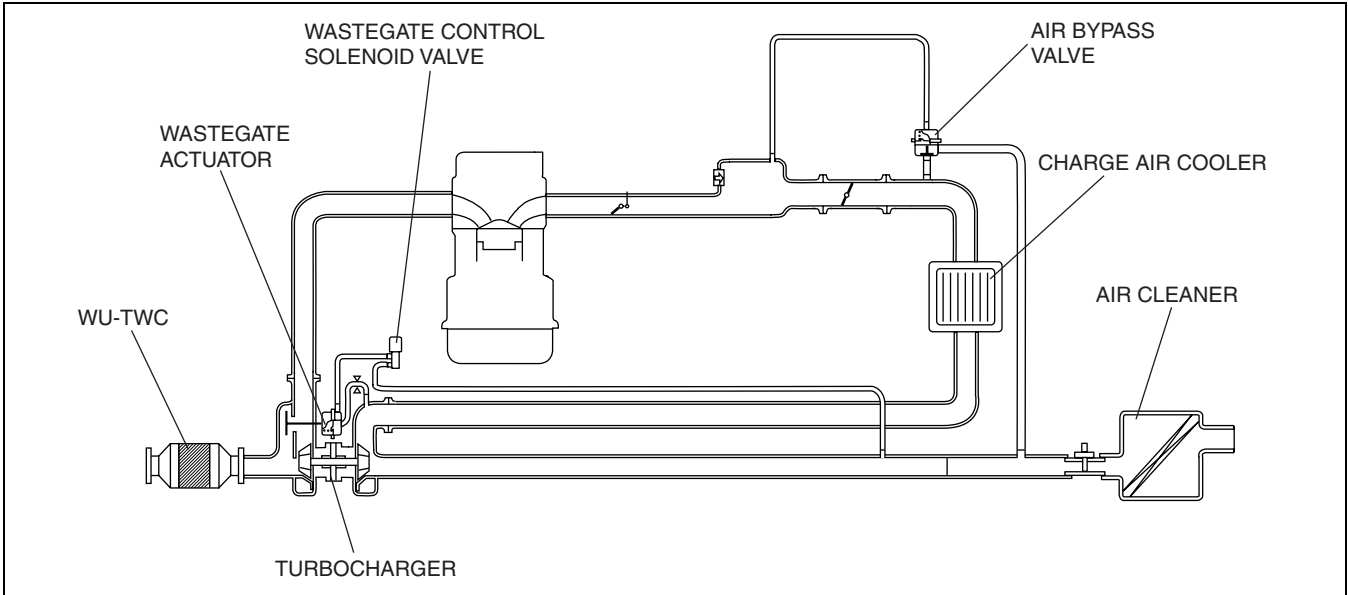


D6U113ZSC001

INTAKE-AIR SYSTEM [L3 WITH TC]

INTAKE-AIR SYSTEM FLOW DIAGRAM [L3 WITH TC]

E6U011300000S03



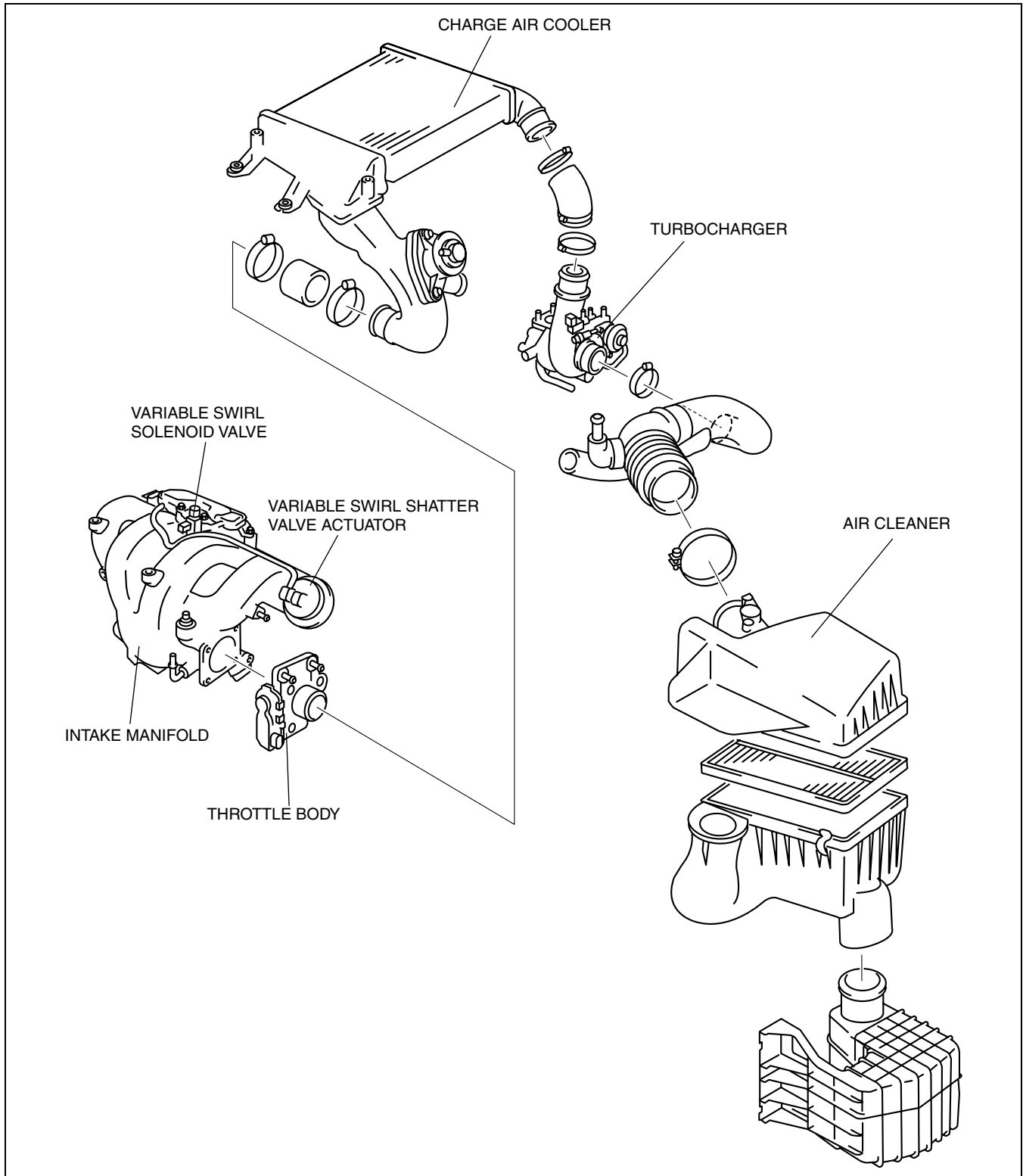
D6U113ZSC007

01-13B

# INTAKE-AIR SYSTEM [L3 WITH TC]

## INTAKE-AIR SYSTEM HOSE ROUTING DIAGRAM [L3 WITH TC]

E6U01130000S04



D6U113ZSC005

## INTAKE-AIR SYSTEM [L3 WITH TC]

### AIR CHARGING SYSTEM FUNCTION [L3 WITH TC]

E6U011313240S01

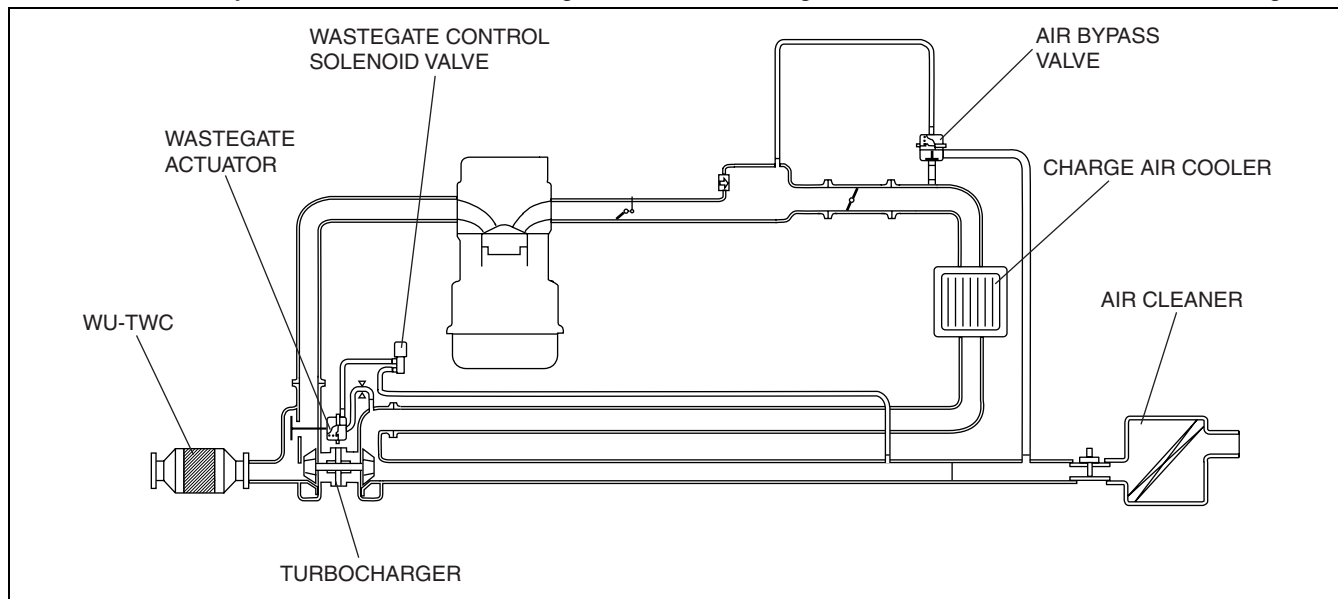
- A wastegate type turbocharger has been adopted for the air charging pressure system, which utilizes exhaust gas pressure to pressurize the intake air and forcefully blow the air to the cylinder. Due to this, power efficiency, driveability, and fuel economy have been improved. Furthermore, with the adoption of the wastegate solenoid valve, the wastegate actuator operation is controlled to heighten the pressure during turbocharger operation.

### AIR CHARGING SYSTEM CONSTRUCTION/OPERATION [L3 WITH TC]

E6U011313240S02

#### Construction

- The intake air system consists of the wastegate actuator, wastegate control solenoid, and the turbocharger.



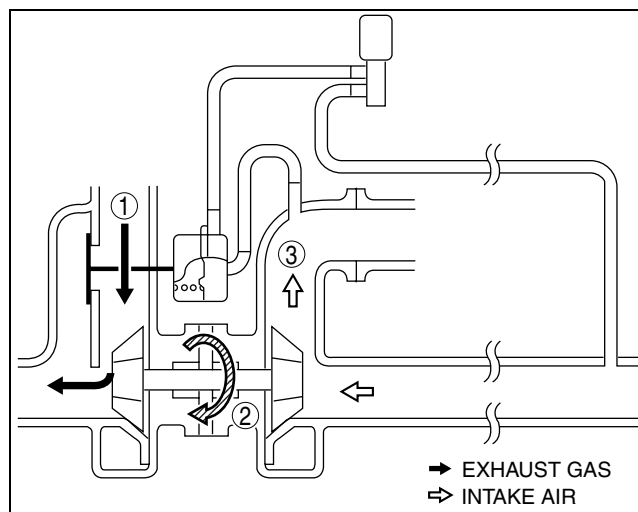
D6U113ZSC007

01-13B

## INTAKE-AIR SYSTEM [L3 WITH TC]

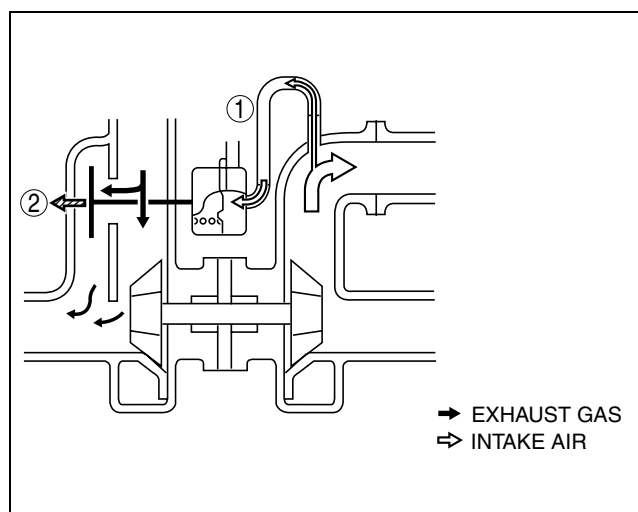
### Operation

- Normal operation: Exhaust gas pressure rotates the turbine causing the turbine on the intake air side above the coaxial to rotate so that it pressurizes the intake air and sends it to the engine.



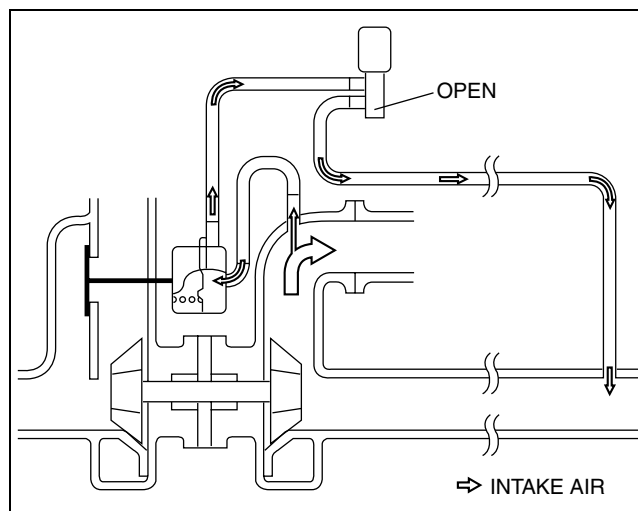
D6U113ZSC009

- When air charging pressure is too high: If the air charging pressure exceeds a specified value, the wastegate opens by this pressure. Turbine rotation lowers due to the exhaust gas pressure escaping from the wastegate, and the intake air pressure lowers.



D6U113ZSC010

- Turbocharger operation begins: When the wastegate operation begins, increased intake air pressure is necessary. Due to this, the wastegate valve does not open even if the intake air pressure reaches the pressure to operate the wastegate actuator.



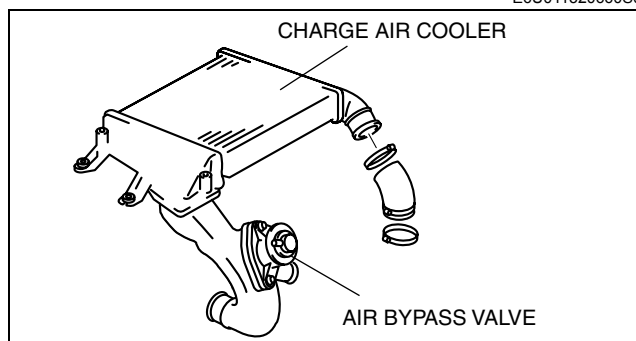
D6U113ZSC011

# INTAKE-AIR SYSTEM [L3 WITH TC]

## AIR BYPASS VALVE FUNCTION [L3 WITH TC]

- If the actuator fully closes after each operation of the air charging system, the intake air pressure in the air charging system increases excessively, which could cause the air hose to come off, or damage the air charging system. To prevent this, if the air pressure in the air charging system exceeds a specified value, the pressure is released upstream of the turbocharger.

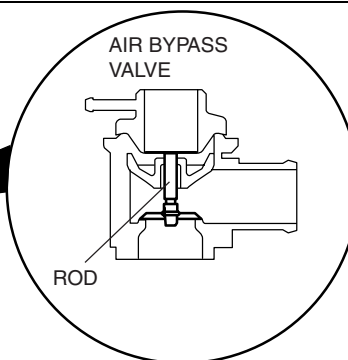
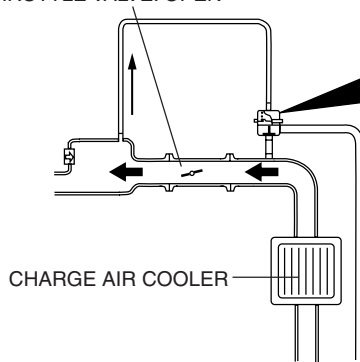
E6U011320660S01



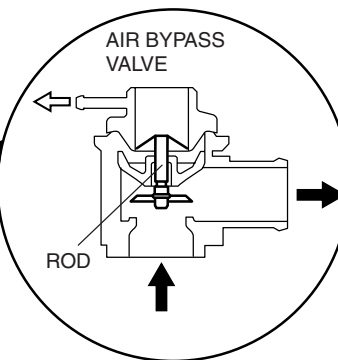
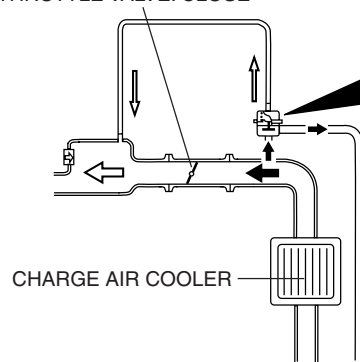
E6U113ZS6001

01-13B

THROTTLE VALVE: OPEN



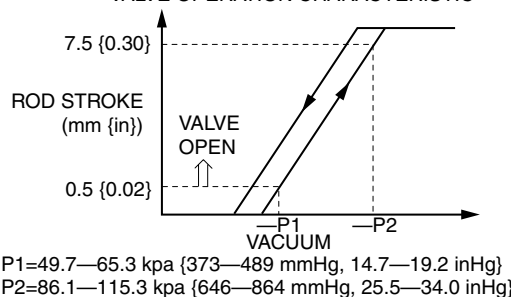
THROTTLE VALVE: CLOSE



← POSITIVE PRESSURE  
↔ VACUUM

E6U113ZS6003

VALVE OPERATION CHARACTERISTIC



D6U113ZWC018

## INTAKE-AIR SYSTEM [L3 WITH TC]

### TURBOCHARGER FUNCTION [L3 WITH TC]

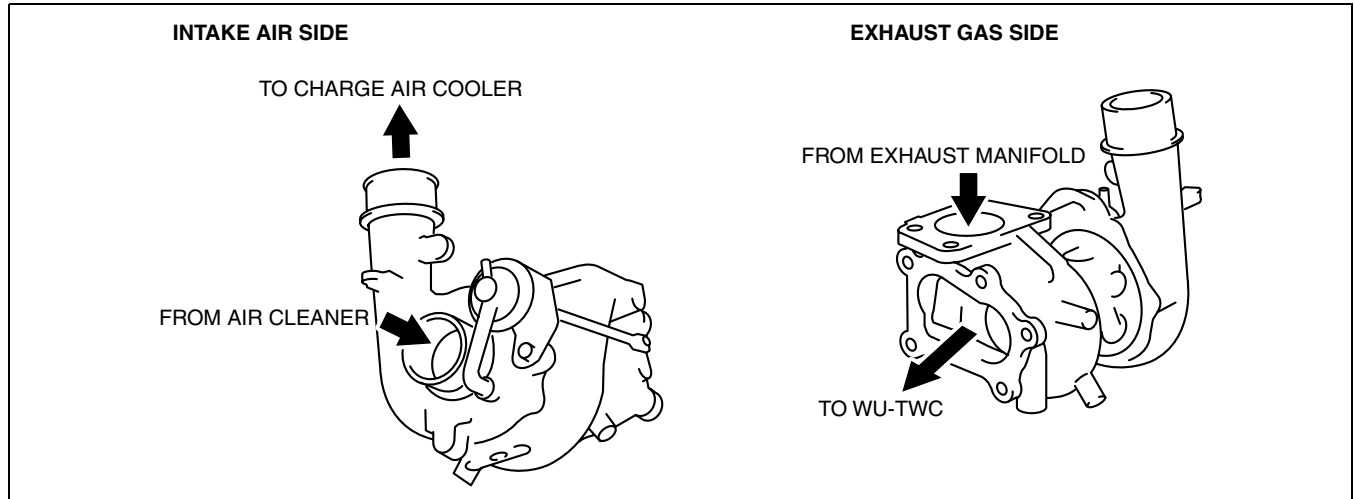
E6U011313700S01

- The turbocharger pressurizes the intake air utilizing the exhaust gas pressure.

### TURBOCHARGER CONSTRUCTION/OPERATION [L3 WITH TC]

E6U011313700S02

- The turbocharger consists of the turbine wheel, compressor wheel, wastegate valve, and wastegate actuator.
- When exhaust gas flows to the turbocharger turbine wheel, the coaxial compressor wheel rotates and intake air is pressurized.
- When the air charging pressure rises, the wastegate actuator opens the wastegate valve, which lowers the exhaust gas pressure, and an excessive increase of air charging pressure is suppressed.



D6U0113ZSC008

### VARIABLE SWIRL SYSTEM FUNCTION [L3 WITH TC]

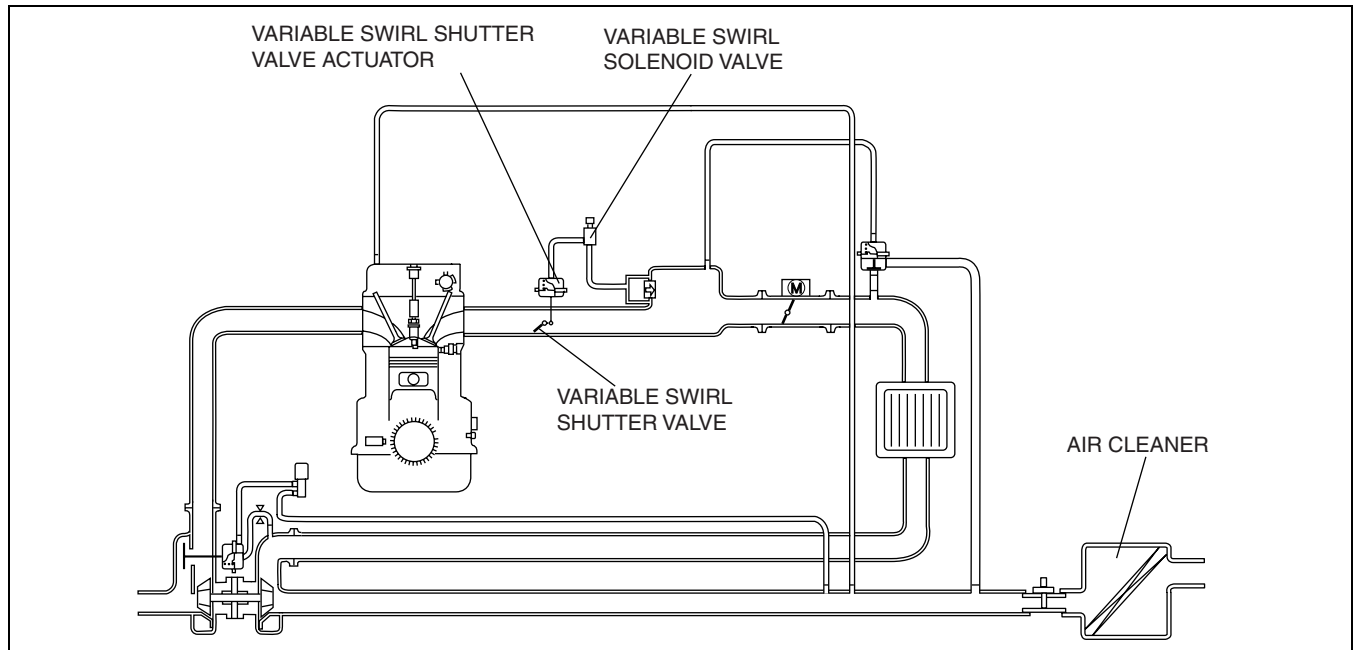
E6U011300050S01

- The variable swirl system functions to lower emissions at cold-engine start.
- At cold-engine start, the variable swirl system increases intake airflow speed by closing the shutter valve and narrowing the intake passage. As a result, the air-fuel mixture quality from the injector is improved. Additionally, the creation of a powerful air swirl in the combustion chamber promotes the atomization of the air-fuel mixture. Due to this, exhaust emission efficiency is improved.
- For the variable swirl control, refer to CONTROL SYSTEM, Variable Swirl Control.

### VARIABLE SWIRL SYSTEM STRUCTURE [L3 WITH TC]

E6U011300050S02

- Mainly consists of the variable swirl solenoid valve, variable swirl shutter valve and variable swirl shutter valve actuator.



E6U113ZSC002

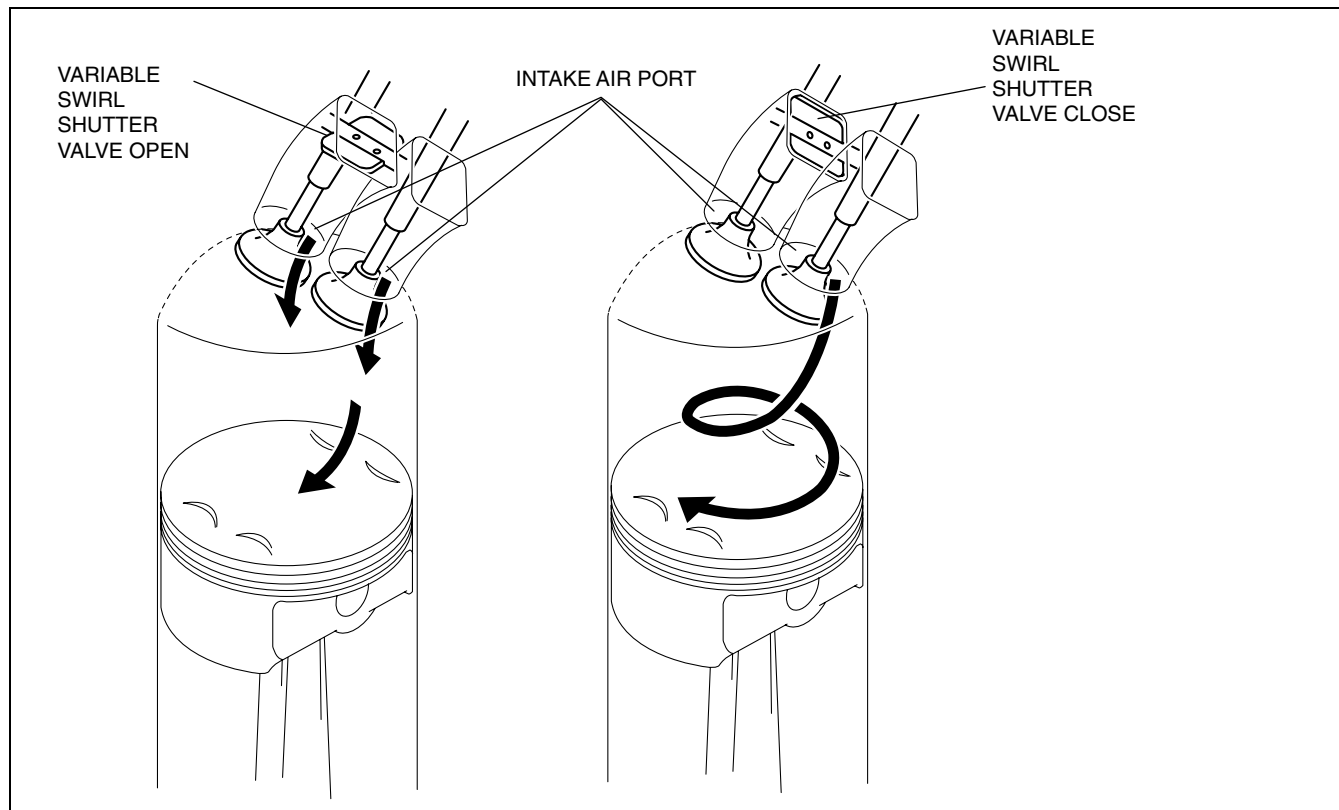
## INTAKE-AIR SYSTEM [L3 WITH TC]

### VARIABLE SWIRL SYSTEM OPERATION [L3 WITH TC]

E6U011300050S03

**Intake manifold pressure: less than threshold, throttle opening: 20% or more, engine load: threshold or more (variable swirl shutter valve is closed)**

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



E6U113ZSC001

### VARIABLE SWIRL SHUTTER VALVE ACTUATOR FUNCTION [L3 WITH TC]

E6U011320135S01

- Opens and closes the shutter valve.

### VARIABLE SWIRL SHUTTER VALVE ACTUATOR CONSTRUCTION/OPERATION [L3 WITH TC]

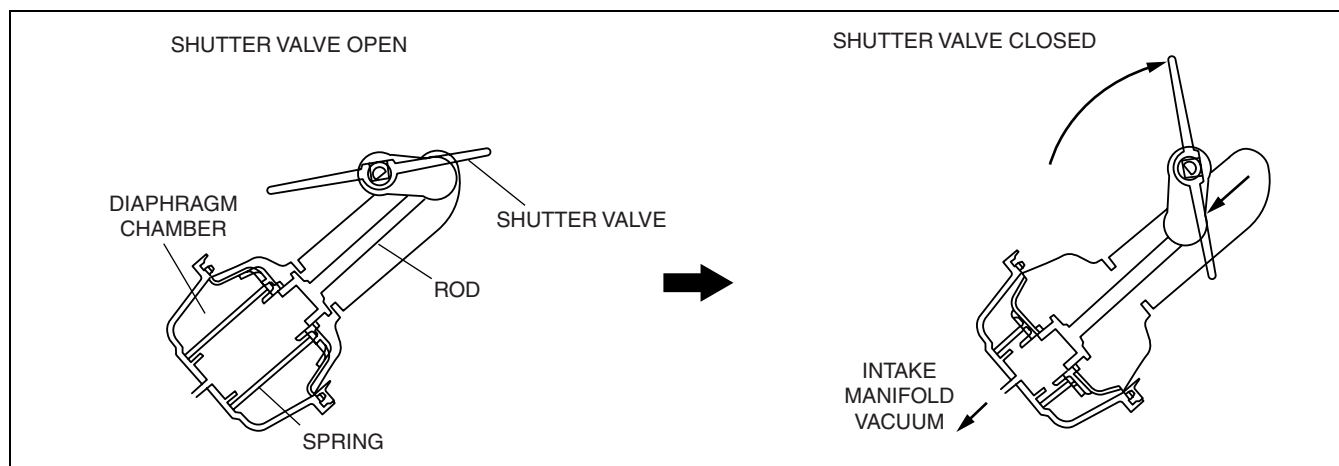
E6U011320135S02

#### Construction

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

#### Operation

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



C3U0113S018

01-13B

## INTAKE-AIR SYSTEM [L3 WITH TC]

### WASTEGATE CONTROL SOLENOID VALVE FUNCTION [L3 WITH TC]

E6U011313240S03

- Performs duty control on the pressure applied to the wastegate actuator.

### WASTEGATE CONTROL SOLENOID VALVE CONSTRUCTION/OPERATION [L3 WITH TC]

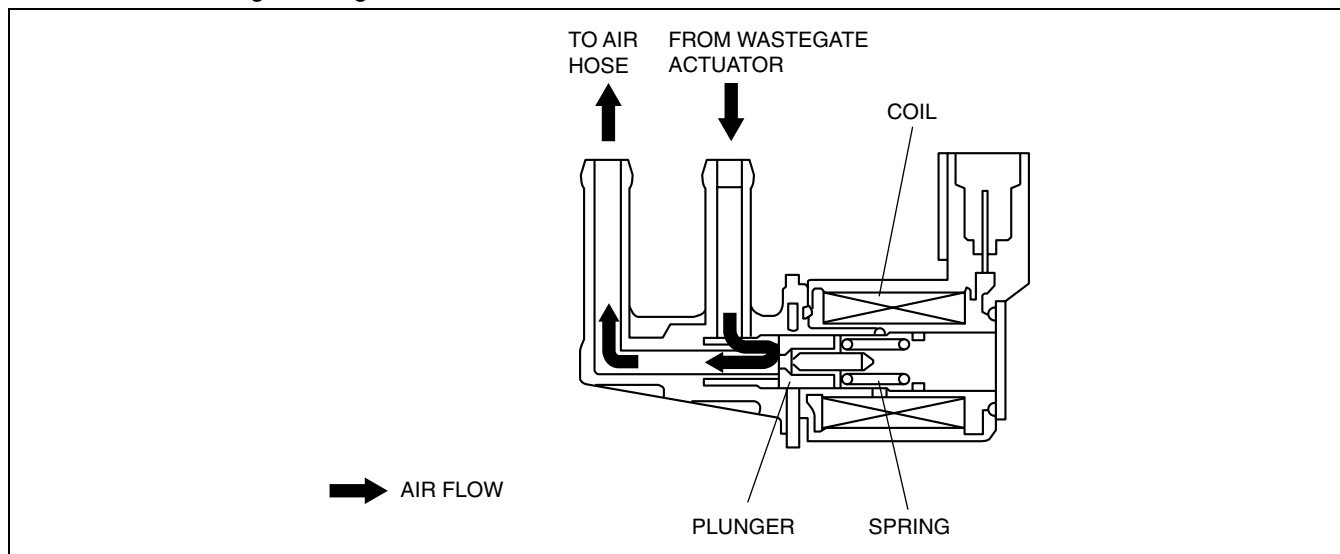
E6U011313240S04

#### Construction

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

#### Operation

- During energization, the valve opens and performs linear adjustment of the pressure applied to the wastegate actuator releasing it through the air hose.



D6U113ZSC012

# 01-14B FUEL SYSTEM [L3 WITH TC]

## FUEL SYSTEM OUTLINE

[L3 WITH TC]	01-14B-1
Structure	01-14B-1
Features	01-14B-1
Specification	01-14B-1

## FUEL SYSTEM STRUCTURAL VIEW

[L3 WITH TC]	01-14B-2
Engine Compartment Side	01-14B-2
Fuel Tank Side	01-14B-2

## FUEL SYSTEM FLOW DIAGRAM

[L3 WITH TC]	01-14B-3
Fuel Flow	01-14B-3

## DIRECT FUEL INJECTION SYSTEM

FUNCTION [L3 WITH TC]	01-14B-4
-----------------------	----------

## DIRECT FUEL INJECTION SYSTEM

### CONSTRUCTION/OPERATION

[L3 WITH TC]	01-14B-4
Construction	01-14B-4
Operation	01-14B-4

## FUEL PUMP UNIT FUNCTION

[L3 WITH TC]	01-14B-5
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## FUEL PUMP UNIT

### CONSTRUCTION/OPERATION

[L3 WITH TC]	01-14B-6
Fuel Pump Unit	01-14B-6
Pressure Regulator	01-14B-6

## HIGH PRESSURE FUEL PUMP

FUNCTION [L3 WITH TC]	01-14B-6
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## HIGH PRESSURE FUEL PUMP

### CONSTRUCTION/OPERATION

[L3 WITH TC]	01-14B-6
Construction	01-14B-6
Operation	01-14B-6

## FUEL PUMP RESISTOR FUNCTION

[L3 WITH TC]	01-14B-7
--------------	----------

## FUEL PUMP RELAY FUNCTION

[L3 WITH TC]	01-14B-8
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## FUEL PUMP SPEED CONTROL RELAY

FUNCTION [L3 WITH TC]	01-14B-8
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## FUEL PUMP SPEED CONTROL RELAY

OPERATION [L3 WITH TC]	01-14B-8
------------------------	----------

## FUEL INJECTOR FUNCTION

[L3 WITH TC]	01-14B-9
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## FUEL INJECTOR

### CONSTRUCTION/OPERATION

[L3 WITH TC]	01-14B-9
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01-14B

## FUEL SYSTEM OUTLINE [L3 WITH TC]

E6U011400000S01

### Structure

- The following items have been changed the same as with the 2005MY Mazda6.

### Features

Improved driveability	<ul style="list-style-type: none"> <li>Direct injection system adopted                             <ul style="list-style-type: none"> <li>High pressure fuel pump adopted</li> <li>Fuel injector for high pressure adopted</li> </ul> </li> </ul>
Improved startability	<ul style="list-style-type: none"> <li>Fuel line pressure changed</li> </ul>
improved reliability	<ul style="list-style-type: none"> <li>Fuel pump which switches between two stages adopted</li> </ul>
Modification to match the vehicle characteristics	<ul style="list-style-type: none"> <li>Saddle type fuel tank adopted</li> <li>Fuel pump (transfer), for fuel transmission adopted</li> </ul>

### Specification

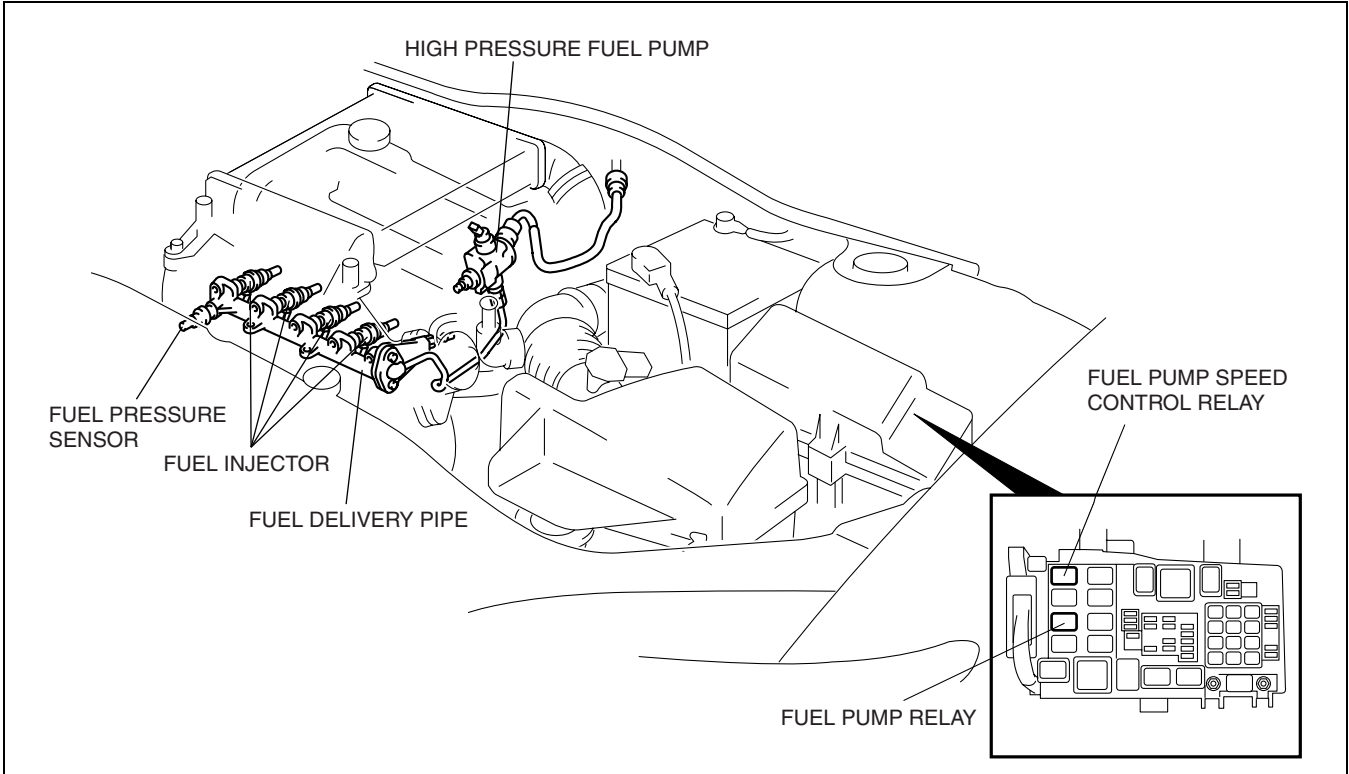
Item		Specification
Injector	Type	Hi-ohmic
	Type of fuel delivery	Top-feed
	Type of drive	Voltage
Pressure regulator control pressure (within the fuel tank) (kPa {kgf/cm <sup>2</sup> , psi})		Approx. 430 {4.38, 62.4}
Relief valve control pressure (within the fuel delivery pipe) (MPa {kgf/cm <sup>2</sup> , psi})		Approx. 13 {132, 1885}
Fuel pump type		Electric
Fuel tank capacity (L {US gal, Imp gal})		60 {15.9, 13.2}
Fuel type		93 [(R+M)/2 method] or above (98 RON or above)*

\* : This vehicle is designed to use 93 [(R+M)/2 method] (98RON) or higher gasoline for best performance. If 93 [(R+M)/2 method] (98RON) is not available, 91 or 92 [(R+M)/2 method] (96 or 97RON) gasoline can be used. In case 91 or 92 [(R+M)/2 method] (96 or 97RON) is not available, gasoline as low as 87 [(R+M)/2method] (91RON) can be used temporarily for emergency purposes. Use of gasoline lower than 93 [(R+M)/2 method] (98RON) can decrease performance during its use.

FUEL SYSTEM [L3 WITH TC]

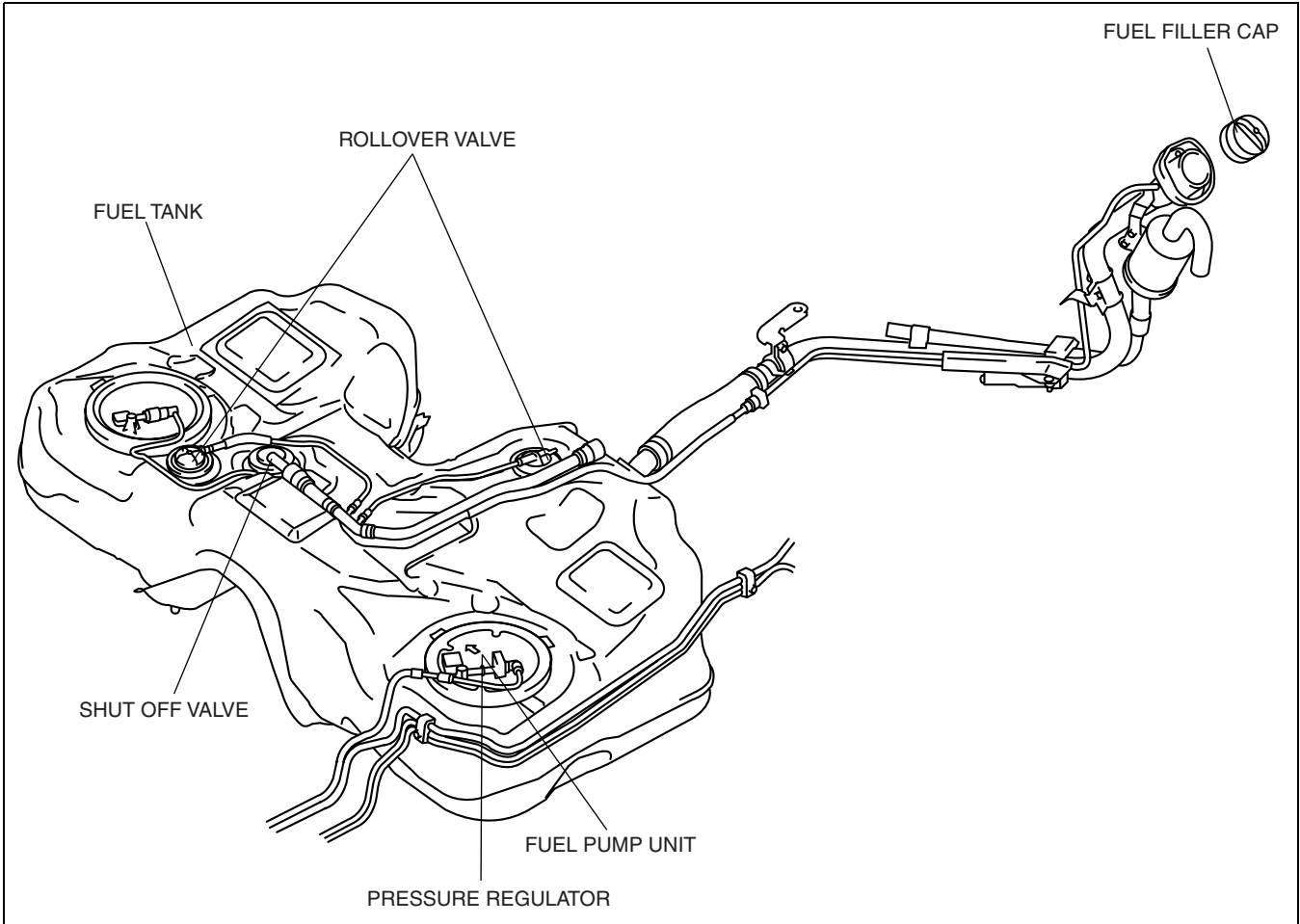
FUEL SYSTEM STRUCTURAL VIEW [L3 WITH TC]  
Engine Compartment Side

E6U01140000S02



D6U114ZSC001

Fuel Tank Side



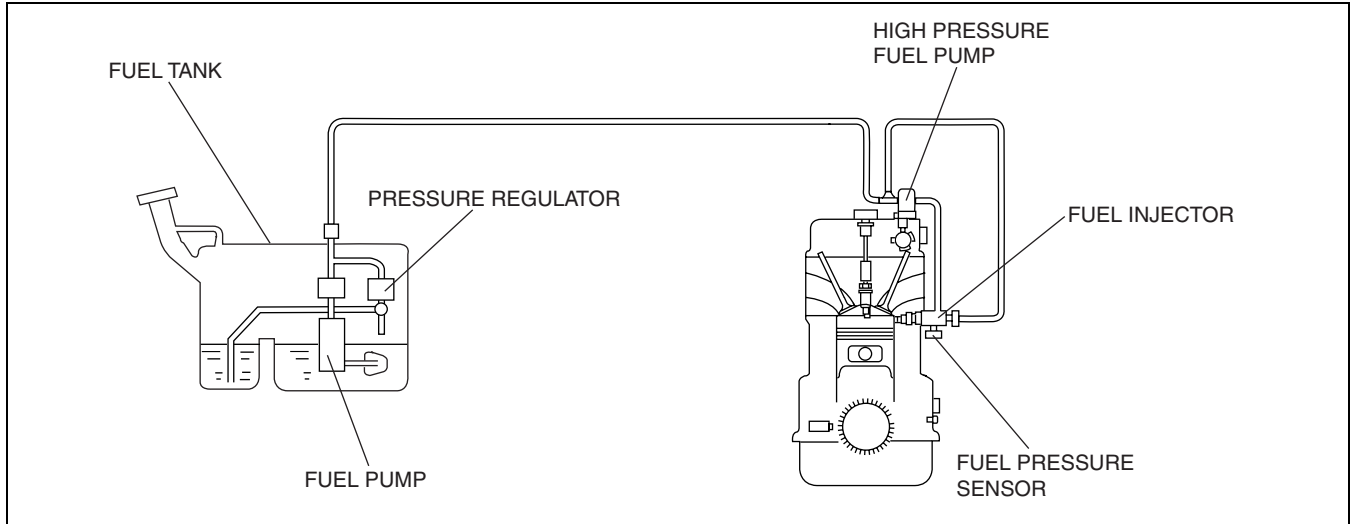
D6U114ZSC002

# FUEL SYSTEM [L3 WITH TC]

## FUEL SYSTEM FLOW DIAGRAM [L3 WITH TC]

E6U011400000S03

### Fuel Flow



D6U114ZWC006

01-14B

## FUEL SYSTEM [L3 WITH TC]

### DIRECT FUEL INJECTION SYSTEM FUNCTION [L3 WITH TC]

E6U01140000S04

- High response and output have been realized through the direct injection of fuel into the combustion chamber.

High response	High engine output and response are obtained through direct control with no time lag in the amount of fuel in the combustion chamber.
High output	A fine mist of fuel is injected due to the enhanced fuel pressure obtained via the high pressure fuel pump. The temperature of the air intake from the turbocharger increases due to the rise in pressure, but the temperature of the combustion chamber decreases as a result of vaporization heat caused by refined atomization of the injected fuel. Due to this, engine knocking is reduced, and high engine output is obtained.

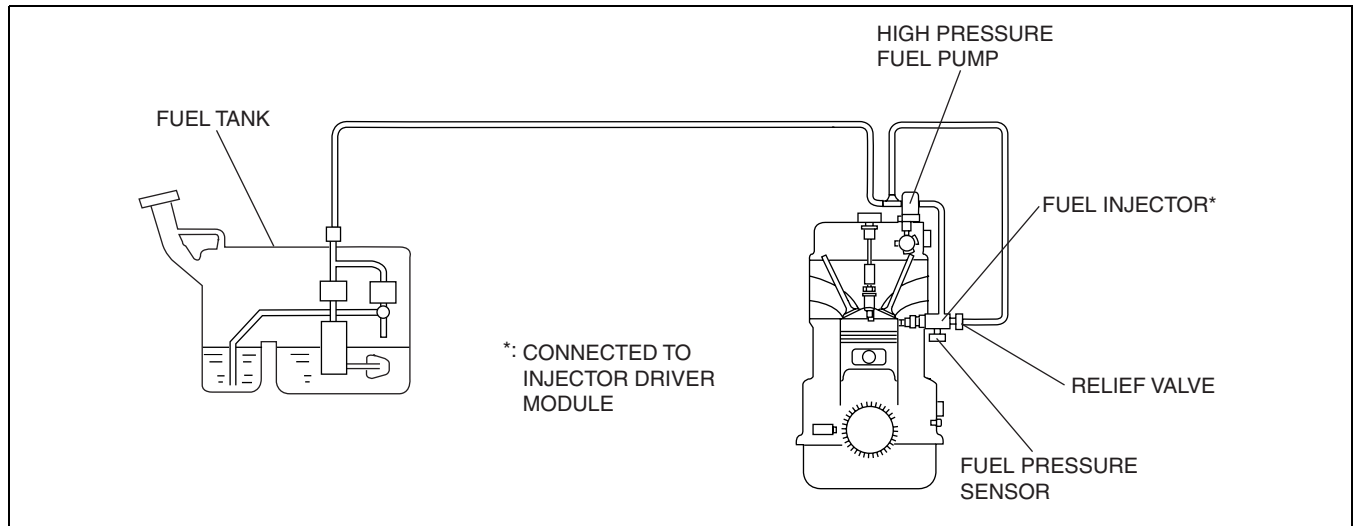
- Uniform combustion in all areas regardless of load conditions is obtained.

### DIRECT FUEL INJECTION SYSTEM CONSTRUCTION/OPERATION [L3 WITH TC]

E6U01140000S05

#### Construction

- The direct fuel injection system consists of a high pressure fuel pump, fuel injectors, injector driver module, fuel pressure sensor, and a relief valve.



E6U114ZS1001

#### Operation

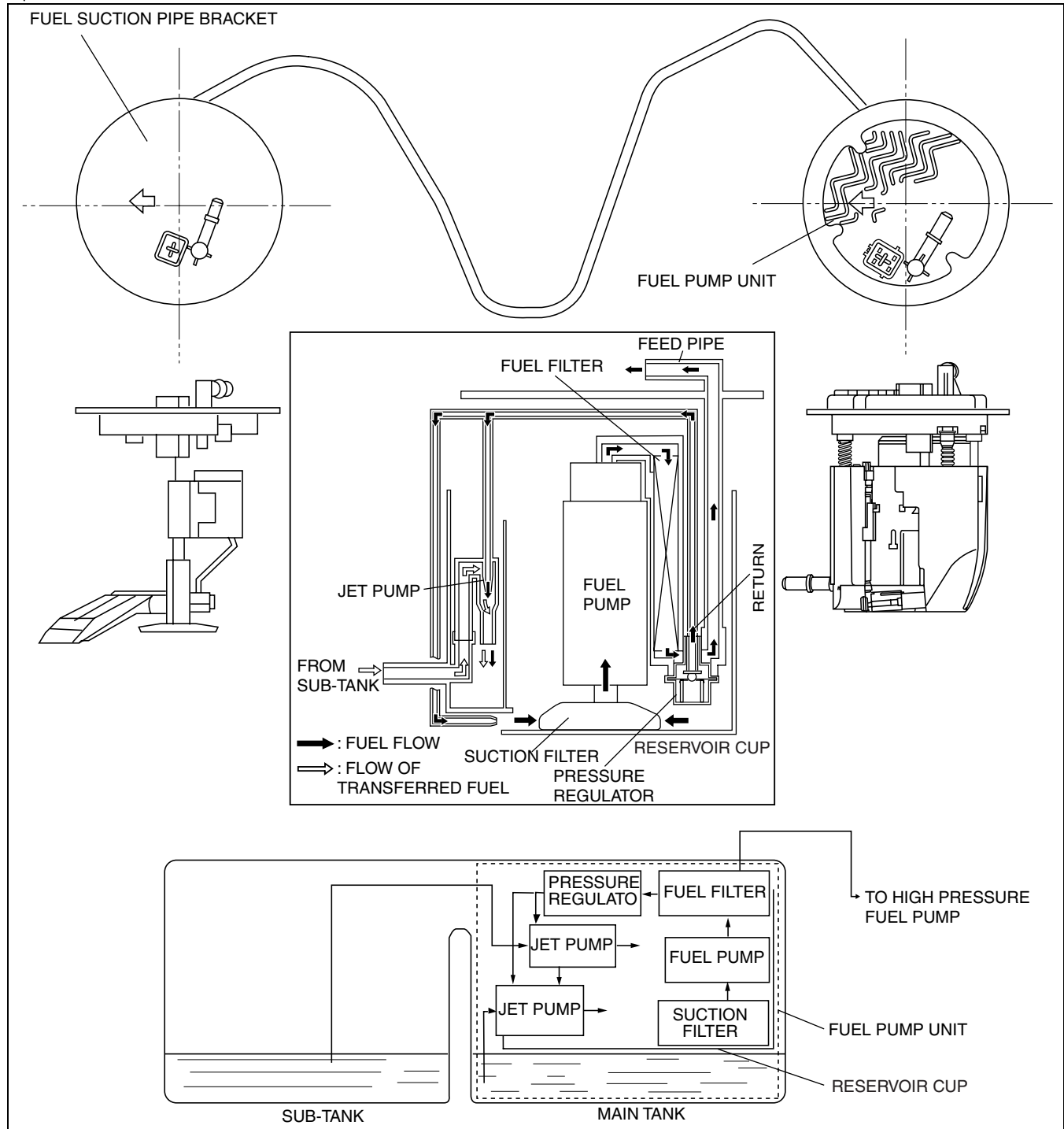
- Fuel is injected during the intake process and diffused uniformly in the combustion chamber by the flow of intake air.
- Fuel injection timing is explained in CONTROL SYSTEM and FUEL INJECTION CONTROL.

# FUEL SYSTEM [L3 WITH TC]

## FUEL PUMP UNIT FUNCTION [L3 WITH TC]

E6U011413350S01

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



E6U114ZSC101

01-14B

## FUEL SYSTEM [L3 WITH TC]

### FUEL PUMP UNIT CONSTRUCTION/OPERATION [L3 WITH TC]

E6U011413350S02

#### Fuel Pump Unit

- Mainly consists of a fuel filter, pressure regulator, fuel pump, fuel reservoir cup, suction filter, and jet pump.
- A pressure regulator has been built-in fuel pump unit due to the adoption of a returnless fuel system.
- A hard-plastic fuel pump unit, with an integrated fuel filter (top side) and fuel pump, has been adopted to simplify the fuel line.
- The fuel pump unit, located on top of the fuel tank, can be removed and installed through the service hole in the bottom of the rear seat.
- Fuel in the fuel reservoir cup is suctioned through the suction filter by the fuel pump, and pumped to the fuel filter. Return fuel is sent back to the fuel reservoir cup or send to jet pump.
- A venturi, located in the path of fuel returning from the pressure regulator, creates negative pressure that is used to transfer fuel from the reserve to the main tank.

#### Pressure Regulator

- Built into the fuel pump unit due to the adoption of a returnless fuel system.
- Mainly consists of a spring, and diaphragm.

### HIGH PRESSURE FUEL PUMP FUNCTION [L3 WITH TC]

E6U011413350S03

- Applies pressure to fuel sent from the fuel pump (low pressure) located on the fuel tank, from **430 kPa {4.38 kgf/cm<sup>2</sup>, 62.4 psi}** to **3—11.5 MPa {30.6—117 kgf/cm<sup>2</sup>, 435.2—1667 psi}**, and then pumps it to the fuel delivery pipe.

### HIGH PRESSURE FUEL PUMP CONSTRUCTION/OPERATION [L3 WITH TC]

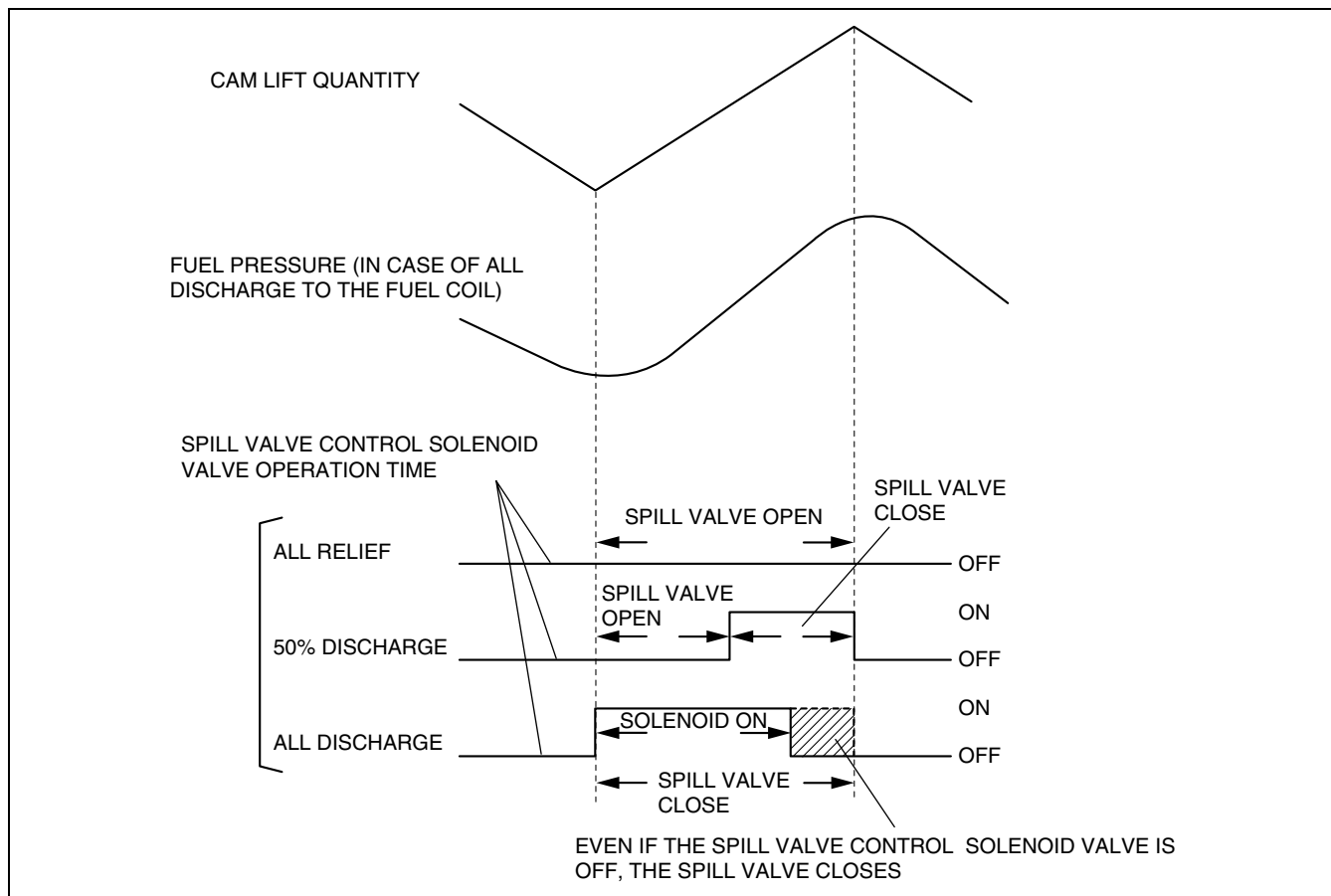
E6U011413350S04

#### Construction

- Located on left side (drive plate side) of the cylinder head.
- Consists of a spill valve control solenoid valve, spill valve, camshaft, piston, and spring.

#### Operation

- Fuel is suctioned and pumped due to the up and down movement of the piston caused by the rotation of the 3 head cam installed to the rear end of the camshaft (intake side).
- Fuel pressure is adjusted by the spill valve control solenoid valve, and has a relief valve for fail-safe operation. If the fuel pressure in the fuel delivery pipe reaches **13 MPa {132 kgf/cm<sup>2</sup>, 1885 psi}**, the relief valve opens and fuel is returned upstream by the high pressure fuel pump.
- When the spill valve control solenoid valve is off, the spill valve is open and fuel pushed out by the piston is returned to upstream, and fuel pressure lowers. When the spill valve control solenoid valve is on, the spill valve is open and fuel pushed out by the piston is discharged to the fuel delivery pipe, and fuel pressure rises.
- The following chart shows the energization to the spill valve control solenoid valve and the open/close of the spill valve.



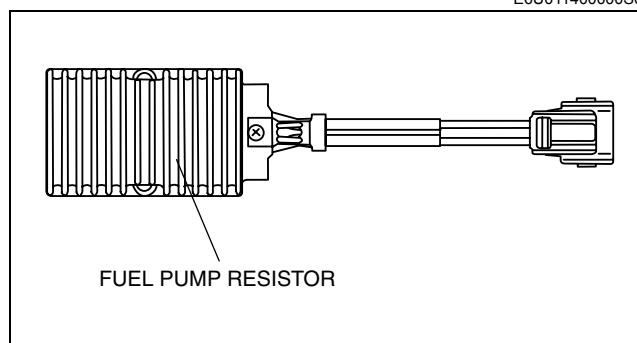
E6U114ZSA002

- ALL RELIEF: Fuel is returned upstream while the spill valve control solenoid valve remains off.
- 50% DISCHARGE: The spill valve control solenoid valve is on at the latter 50% of the discharge control area, and fuel is discharged while the spill valve is closed in the same area.
- ALL DISCHARGE: The spill valve control solenoid valve turns on at the beginning of the discharge control range and turns off at the end of the range: however, the spill valve closes naturally during the discharging process due to the fuel pressure increase. Due to this, damage to the spill valve control solenoid valve from the excessive temperature increase is prevented.

## FUEL PUMP RESISTOR FUNCTION [L3 WITH TC]

- Supplies voltage to the fuel pump via the fuel pump resistor to protect the fuel pump when the injection amount is low (when engine speed is low).
- A fuel pump resistor with a resistance of **0.304—0.336 ohms (20 °C {68 °F})** has been adopted.

E6U01140000S06

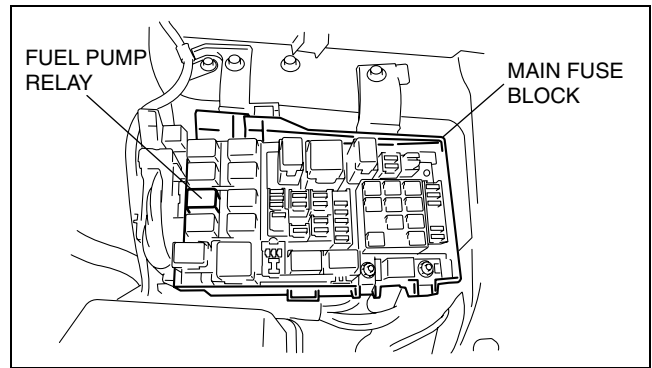


E6U114ZSC028

## FUEL SYSTEM [L3 WITH TC]

### FUEL PUMP RELAY FUNCTION [L3 WITH TC]

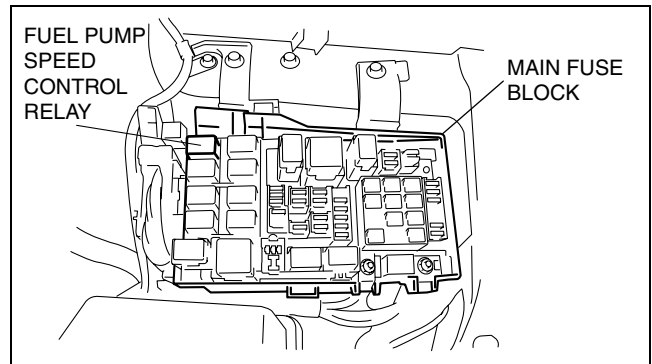
- Controls the fuel pump on/off according to control signals from the PCM.
- For fuel pump relay control, refer to CONTROL SYSTEM, FUEL PUMP CONTROL. (See 01-40B-21 FUEL PUMP CONTROL OUTLINE [L3 WITH TC], 01-40B-21 FUEL PUMP CONTROL BLOCK DIAGRAM [L3 WITH TC], 01-40B-21 FUEL PUMP CONTROL OPERATION [L3 WITH TC].)
- Supplies voltage to the fuel pump via the fuel pump resistor when the fuel pump speed control relay is off.



D6U114ZWC007

### FUEL PUMP SPEED CONTROL RELAY FUNCTION [L3 WITH TC]

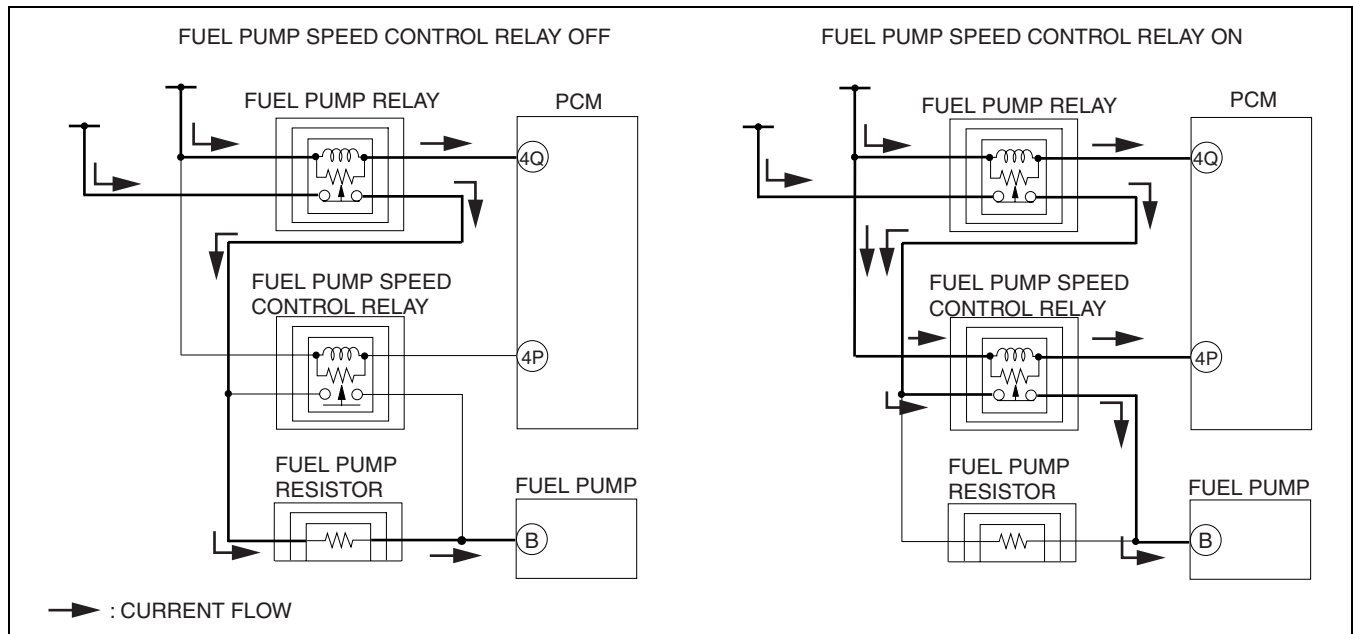
- Supplies power to the fuel pump according to control signals from the PCM.
- For fuel pump speed control, refer to CONTROL SYSTEM, FUEL PUMP SPEED CONTROL. (See 01-40B-21 FUEL PUMP CONTROL OUTLINE [L3 WITH TC], 01-40B-21 FUEL PUMP CONTROL BLOCK DIAGRAM [L3 WITH TC], 01-40B-21 FUEL PUMP CONTROL OPERATION [L3 WITH TC].)



D6U114ZWC008

### FUEL PUMP SPEED CONTROL RELAY OPERATION [L3 WITH TC]

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



E6U114S9999

## FUEL SYSTEM [L3 WITH TC]

### FUEL INJECTOR FUNCTION [L3 WITH TC]

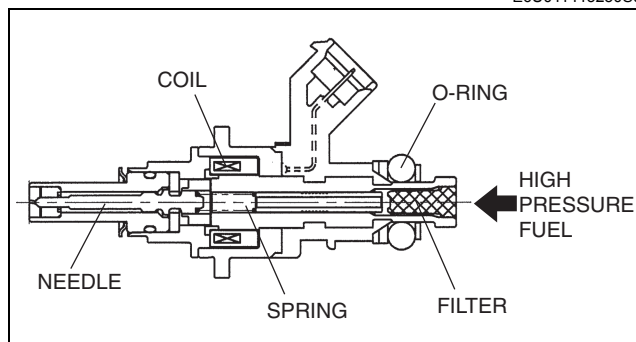
E6U011413250S01

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

### FUEL INJECTOR CONSTRUCTION/OPERATION [L3 WITH TC]

E6U011413250S02

- Located under the intake manifold, installed directly to the cylinder head.
- Consists of a coil, spring, needle valve, filter and o-ring.
- Drive current is sent from the injector driver module causing excitation current to pass through the coil and thereby pull in the needle valve. Due to this, the injection nozzle opens and fuel is injected.
- The amount of injection is determined by the open time of the needle valve, i.e. the energization time of the coil.



E6U114ZSC301

01-14B



# 01-15B EXHAUST SYSTEM [L3 WITH TC]

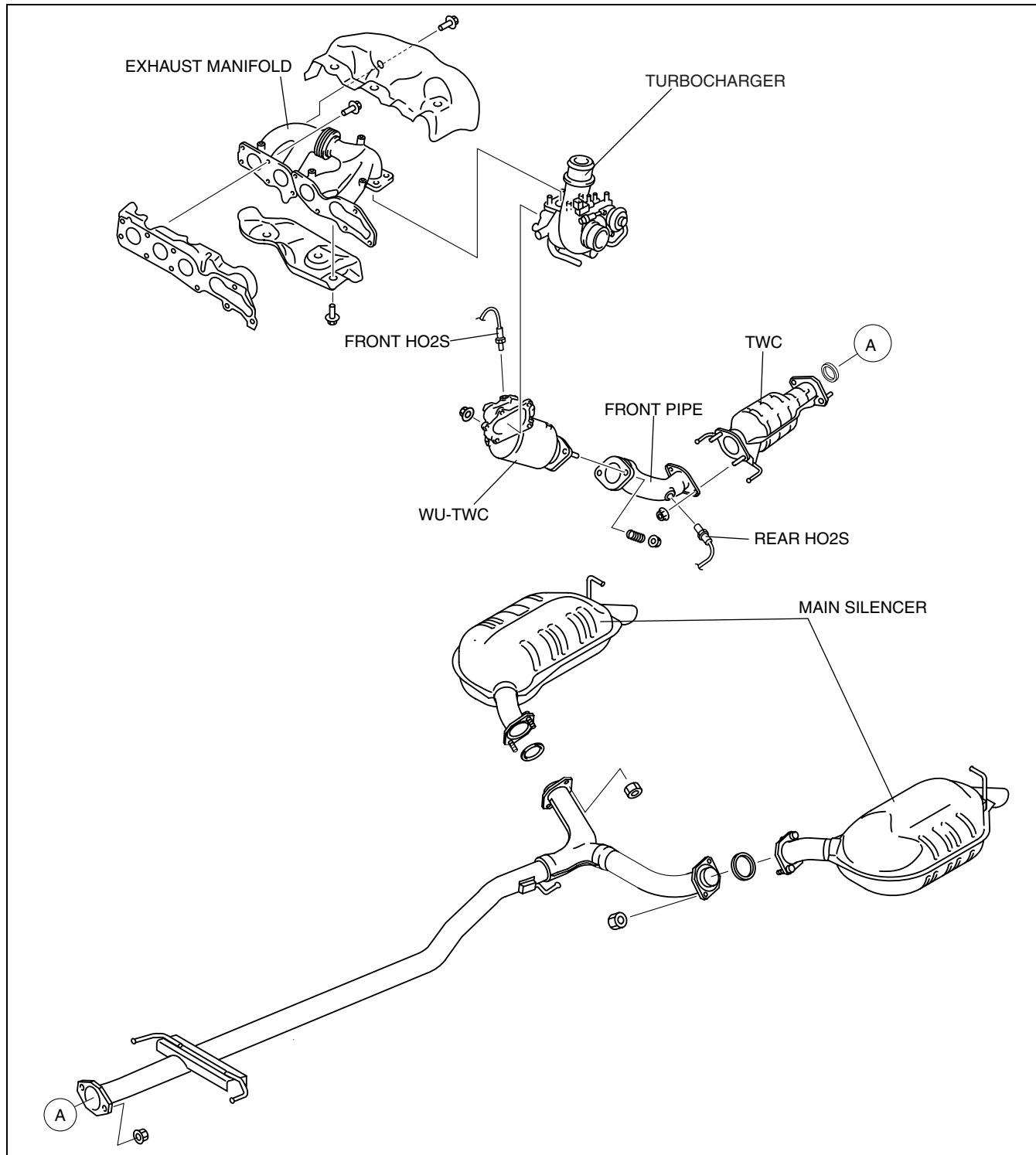
EXHAUST SYSTEM STRUCTURAL

VIEW [L3 WITH TC] ..... 01-15B-1

## EXHAUST SYSTEM STRUCTURAL VIEW [L3 WITH TC]

E6U01150000S03

01-15B



D6U115ZWC002



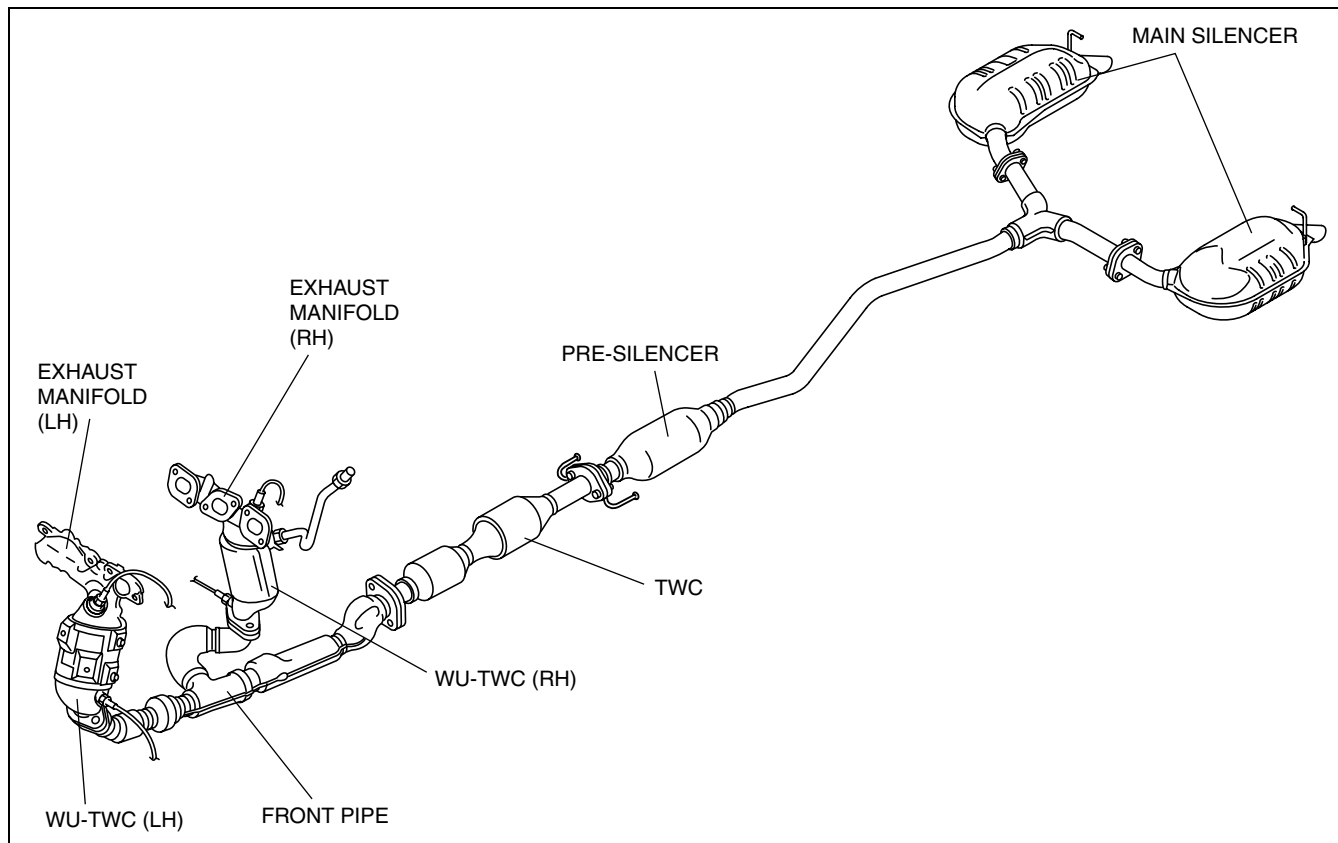
# 01-15C EXHAUST SYSTEM [AJ]

EXHAUST SYSTEM STRUCTURAL  
VIEW [AJ] ..... 01-15C-1

## EXHAUST SYSTEM STRUCTURAL VIEW [AJ]

E6U011500000S02

01-15C



E6U115BS5L01



## 01-17 CHARGING SYSTEM

CHARGING SYSTEM OUTLINE..... 01-17-1  
Features..... 01-17-1

GENERATOR CONSTRUCTION  
[L3, L3 WITH TC] .....01-17-2

### CHARGING SYSTEM OUTLINE

E6U011700000S02

#### Features

Reduced operation noise	• Generator with two delta connection type stator coils adopted (L3, L3 WITH TC)
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01-17

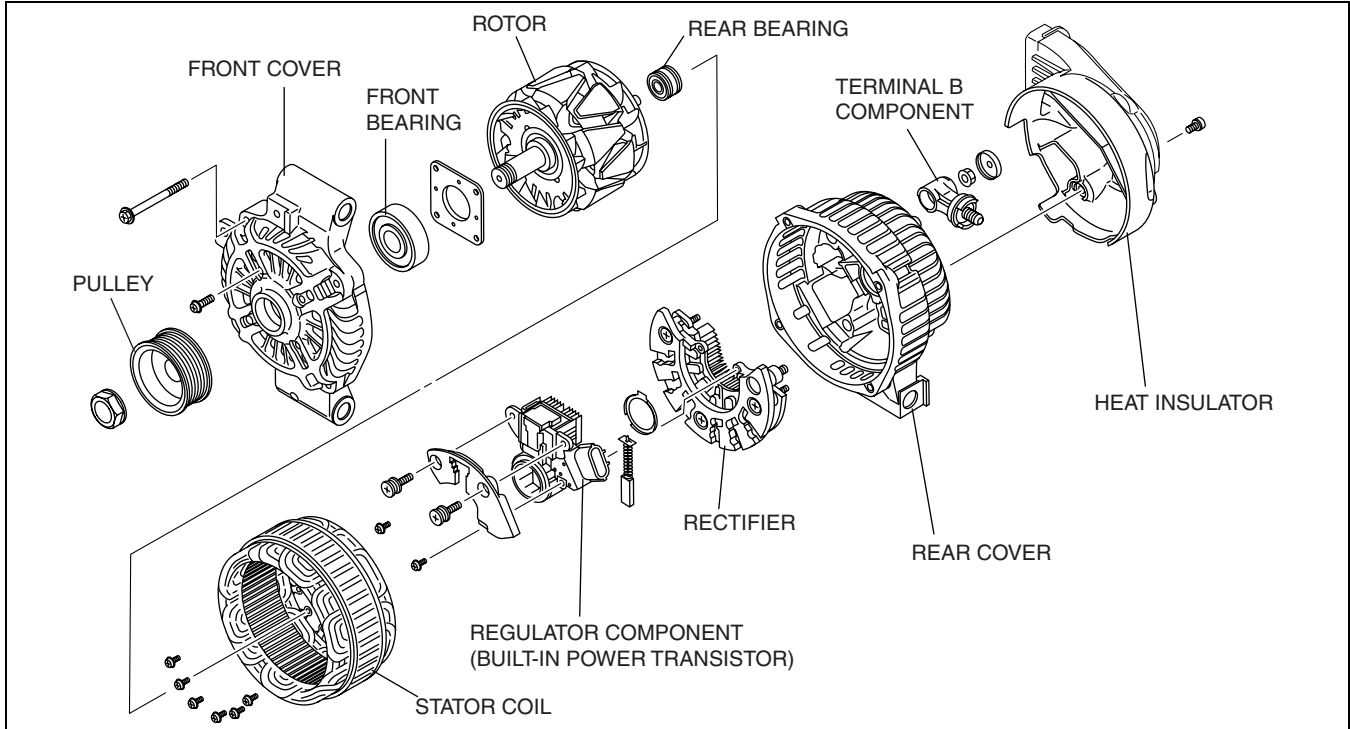
## CHARGING SYSTEM

### GENERATOR CONSTRUCTION [L3, L3 WITH TC]

E6U011718300S02

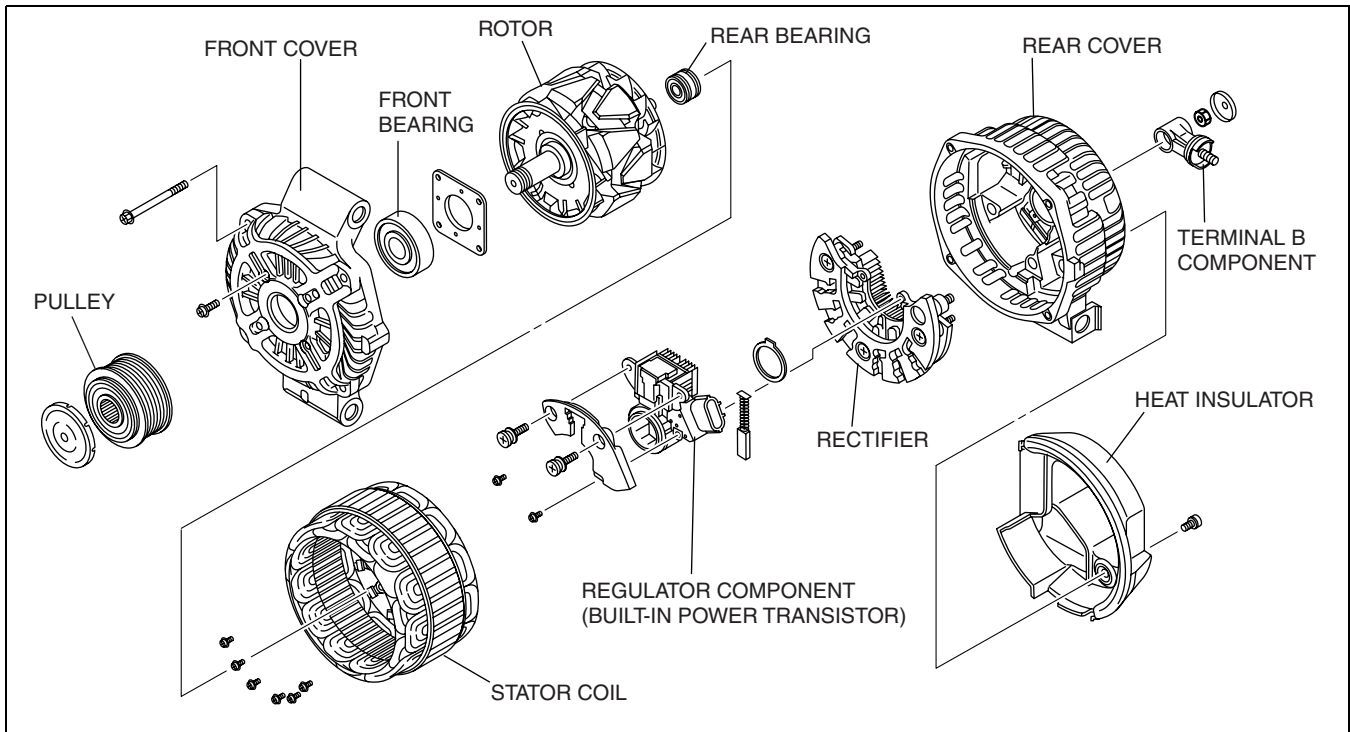
- With the elimination of the voltage regulator, generator control is carried out by the PCM. Excitation current in the field coil is increased or decreased by the duty signal from the PCM sent to the power transistor built into the generator.
- Two delta connection type stator coils have been adopted.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

#### L3



E5U117ZS5003

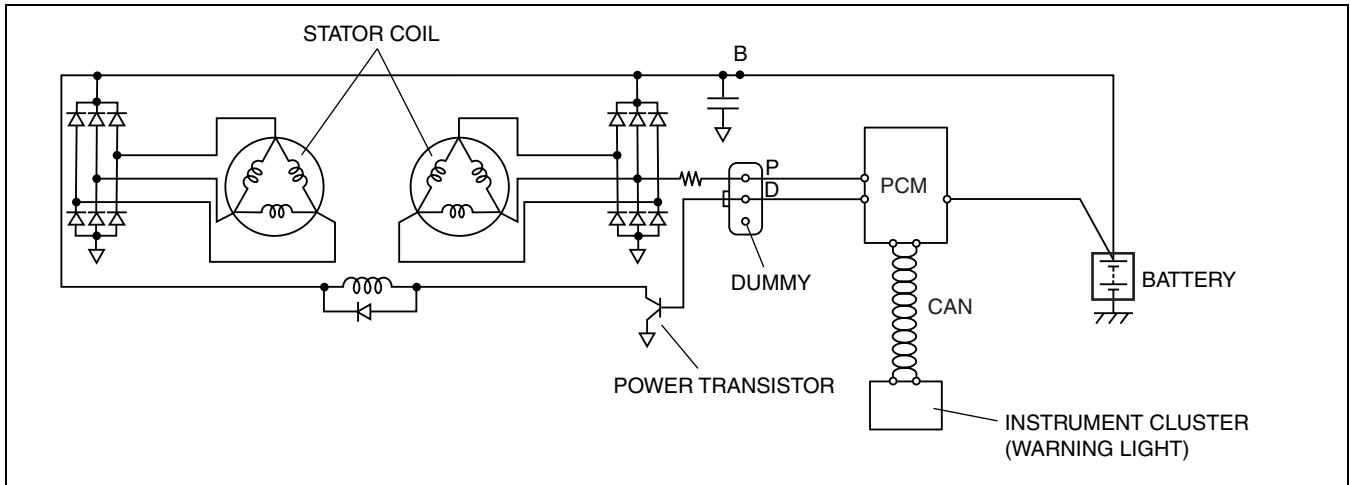
#### L3 WITH TC



E6U117ZNB002

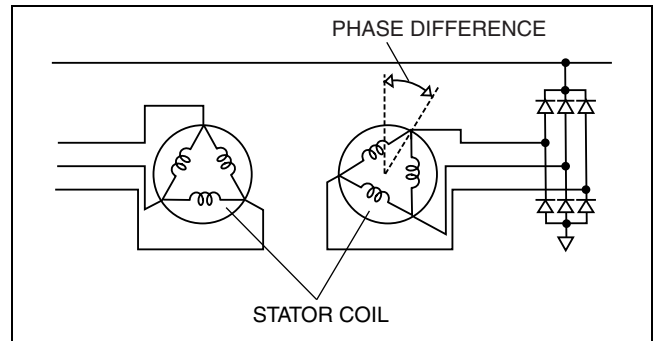
# CHARGING SYSTEM

01-17

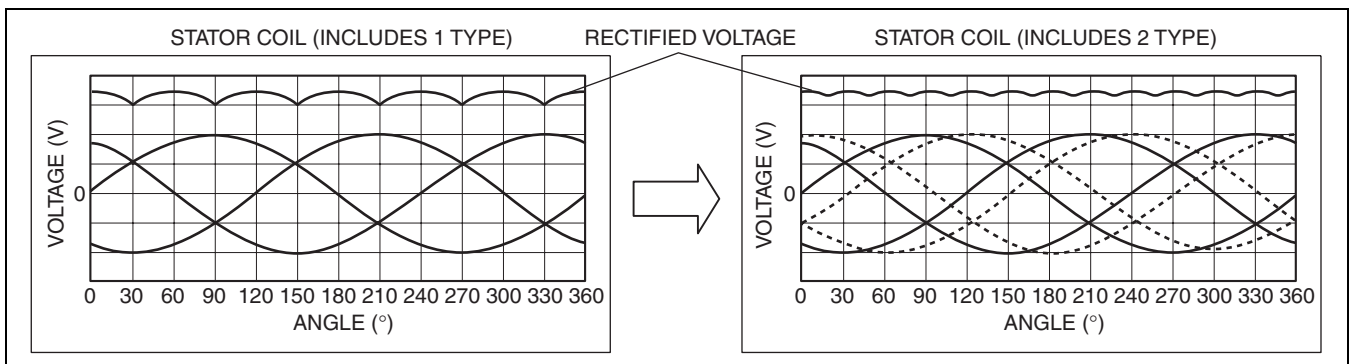


E6U117ZNB003

- 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 input
  - Charging system voltage high input
  - IAT sensor circuit low input
  - IAT sensor circuit high input



## 01-18 IGNITION SYSTEM

IGNITION SYSTEM OUTLINE.....	01-18-1
Features.....	01-18-1
IGNITION SYSTEM STRUCTURAL	
VIEW [L3, L3 WITH TC] .....	01-18-1

IGNITION COIL	
CONSTRUCTION/OPERATION	
[L3, L3 WITH TC] .....	01-18-2
Construction .....	01-18-2
Operation .....	01-18-2
IGNITION COIL DESCRIPTION [AJ]....	01-18-3

01-18

### IGNITION SYSTEM OUTLINE

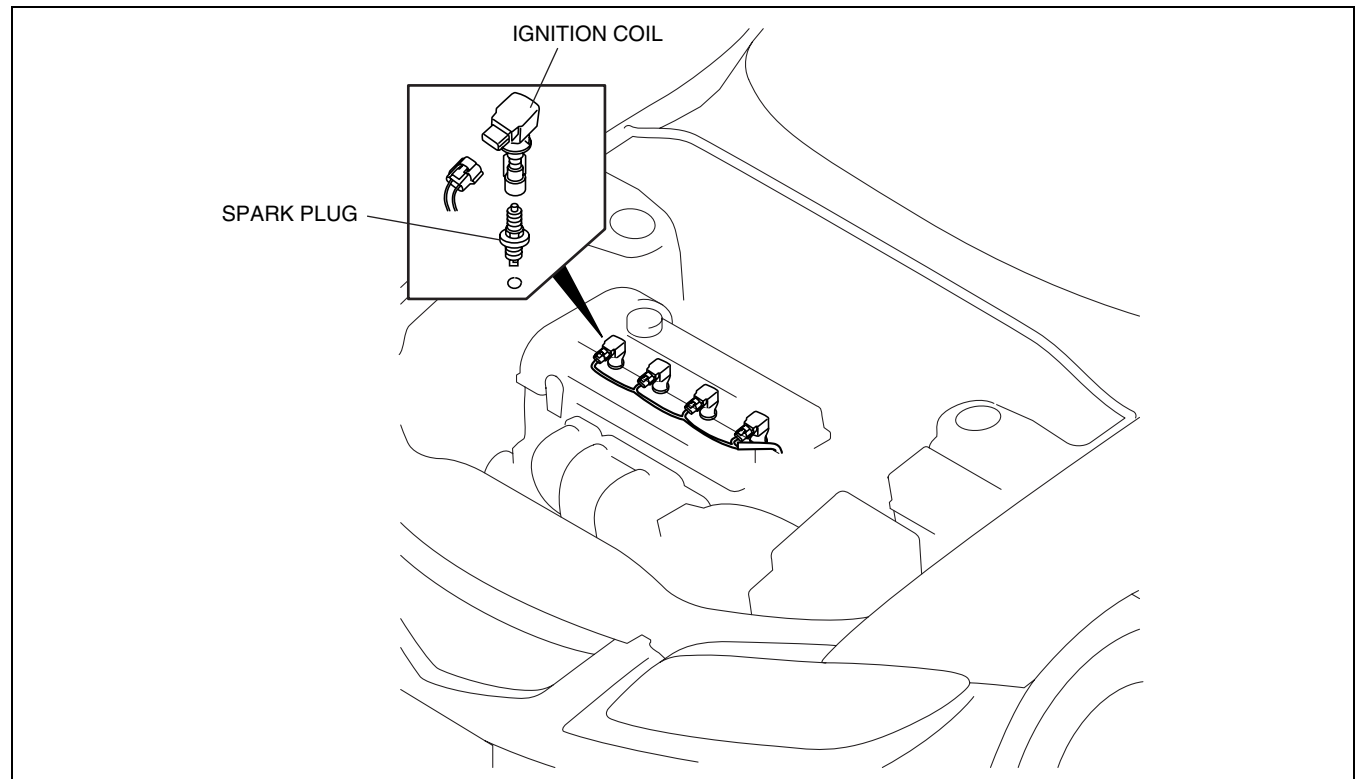
E6U01180000S03

#### Features

Improved reliability	• Ignition coil changed (L3, L3 WITH TC)
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### IGNITION SYSTEM STRUCTURAL VIEW [L3, L3 WITH TC]

E6U01180000S04



E6U118ZNB001

# IGNITION SYSTEM

## IGNITION COIL CONSTRUCTION/OPERATION [L3, L3 WITH TC]

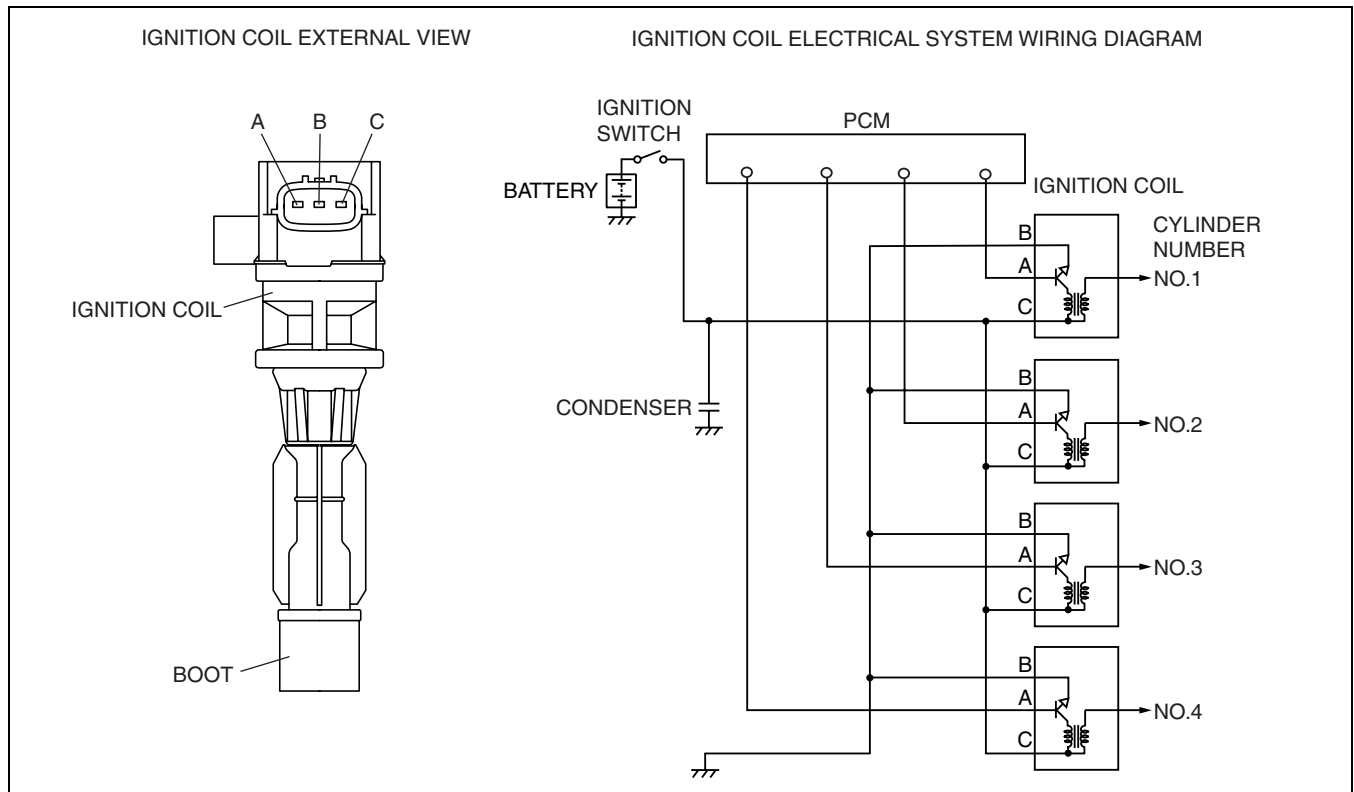
E6U011818100S04

### 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

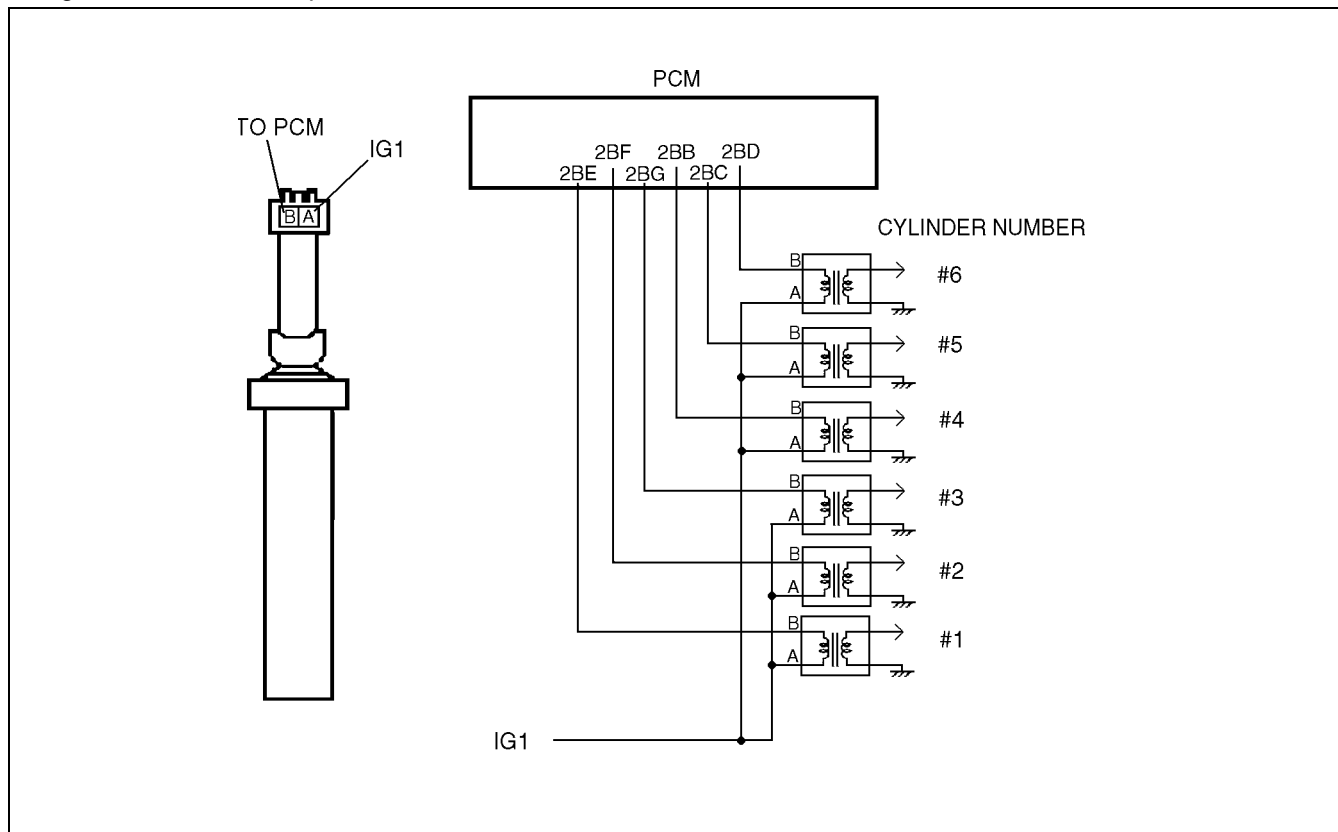
Terminal		Signal
Three terminals	A	Ignition coil control signal
	B	Ground
	C	Power supply

# IGNITION SYSTEM

## IGNITION COIL DESCRIPTION [AJ]

E6U011818100S02

- The PCM terminals connected to the ignition coil have been changed in accordance with PCM modification.  
Ignition coil function/operation is the same as that of 2005MY.



E6U1182S5001



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**01-40A CONTROL SYSTEM [L3]****CONTROL SYSTEM WIRING DIAGRAM**

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California Emission Regulation	
Applicable ATX Model .....	01-40A-2
Except for California Emission	
Regulation Applicable ATX Model ...	01-40A-4

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Structure .....	01-40A-6

**CRANKSHAFT POSITION (CKP)**

SENSOR FUNCTION [L3] .....	01-40A-6
----------------------------	----------

**CRANKSHAFT POSITION (CKP)****SENSOR CONSTRUCTION/OPERATION**

[L3] .....	01-40A-6
------------	----------

**CAMSHAFT POSITION (CMP) SENSOR**

FUNCTION [L3] .....	01-40A-7
---------------------	----------

**CAMSHAFT POSITION (CMP) SENSOR**

CONSTRUCTION/OPERATION [L3] ....	01-40A-7
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**BAROMETRIC PRESSURE (BARO)**

SENSOR FUNCTION [L3] .....	01-40A-8
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**BAROMETRIC PRESSURE (BARO)****SENSOR CONSTRUCTION/OPERATION**

[L3] .....	01-40A-8
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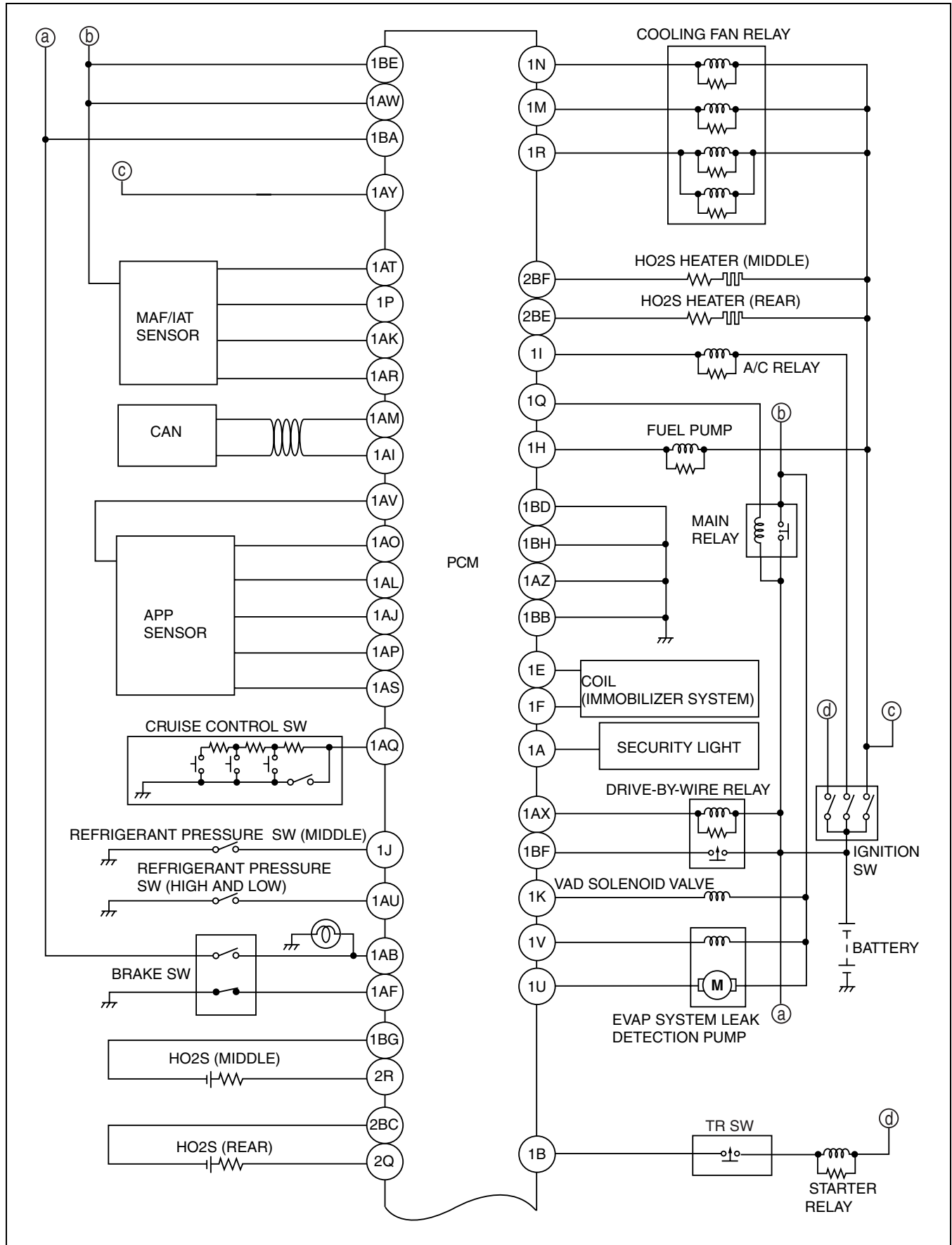
01-40A

# CONTROL SYSTEM [L3]

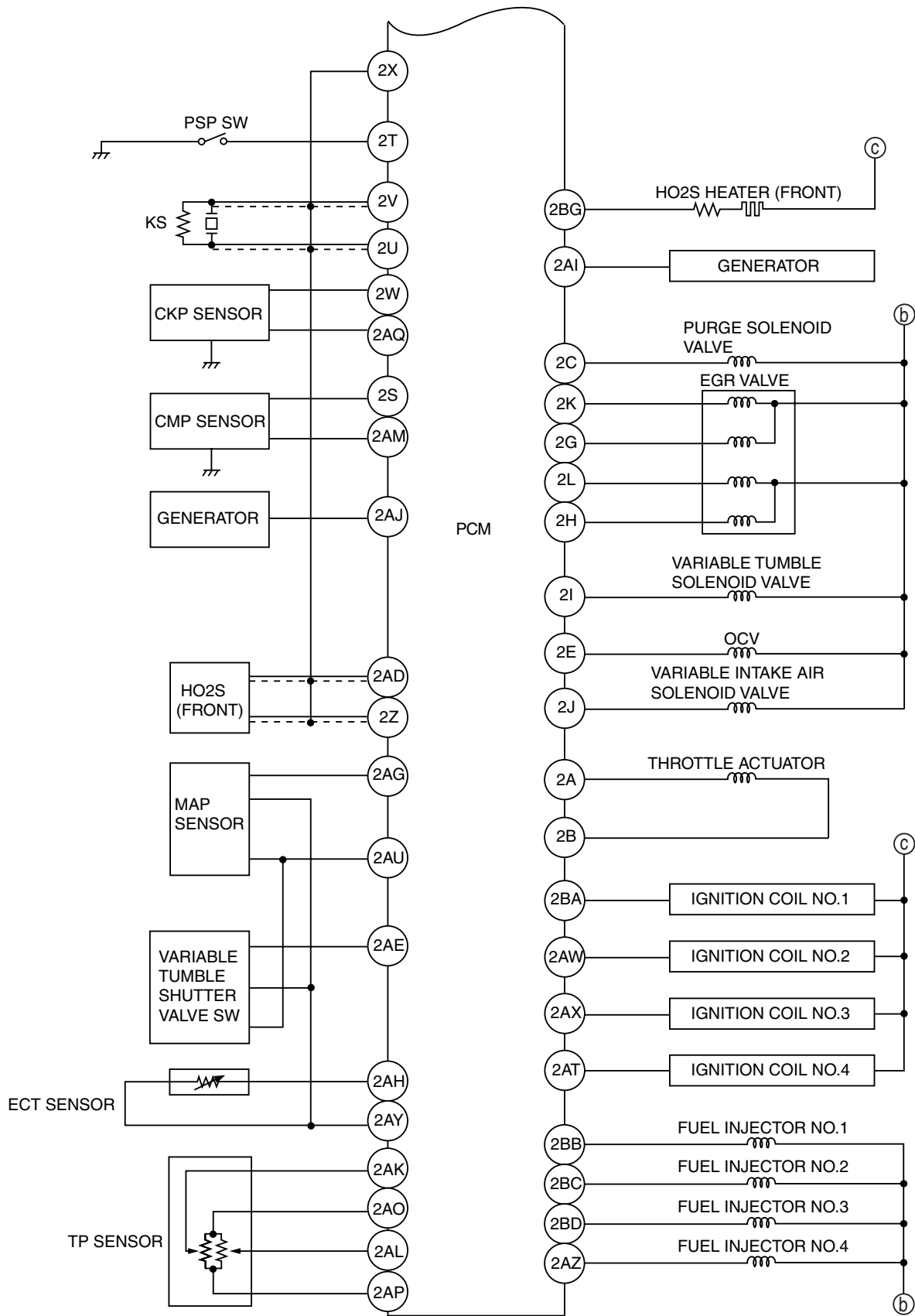
## CONTROL SYSTEM WIRING DIAGRAM [L3]

California Emission Regulation Applicable ATX Model

E6U01400000S02



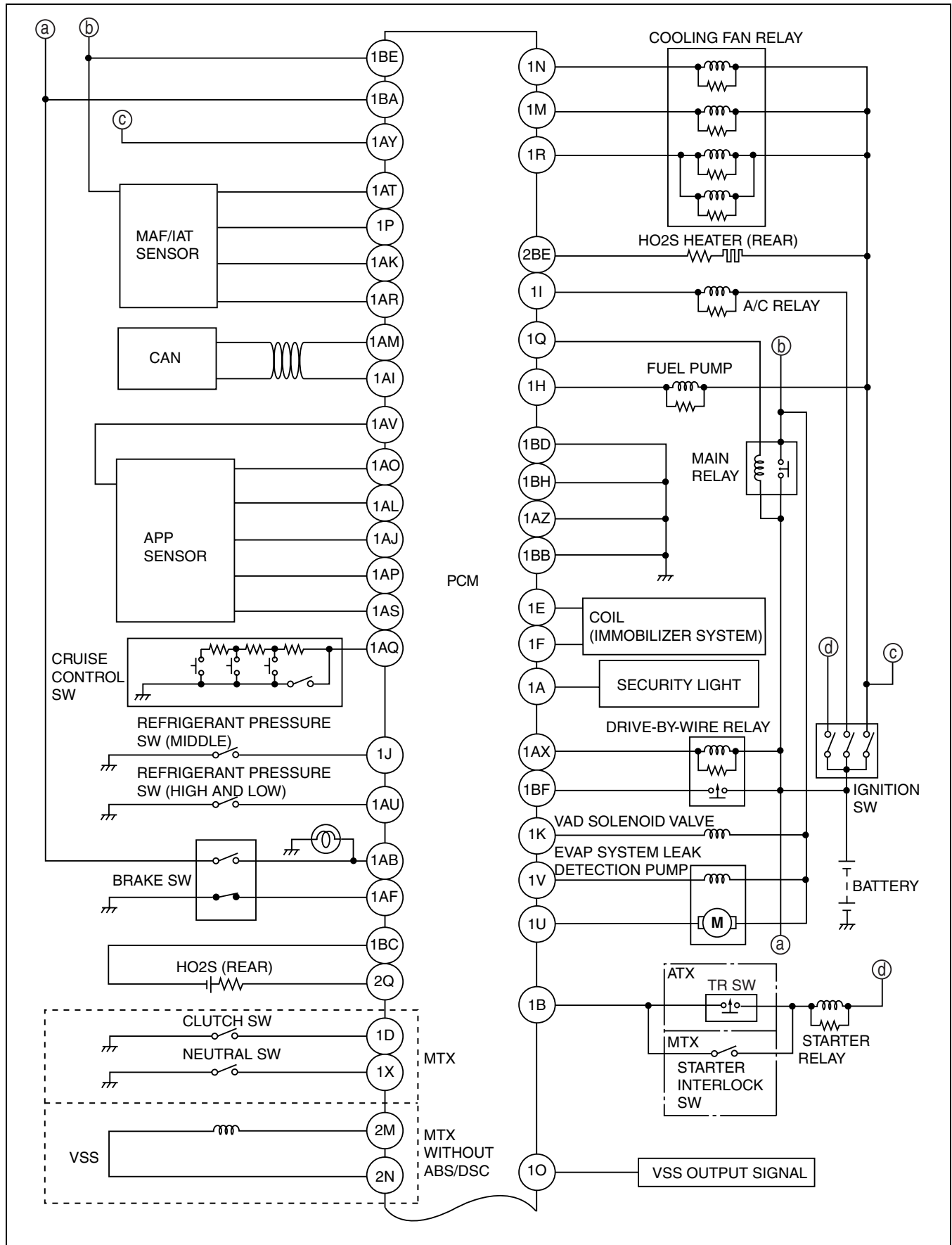
E6U140AW5901



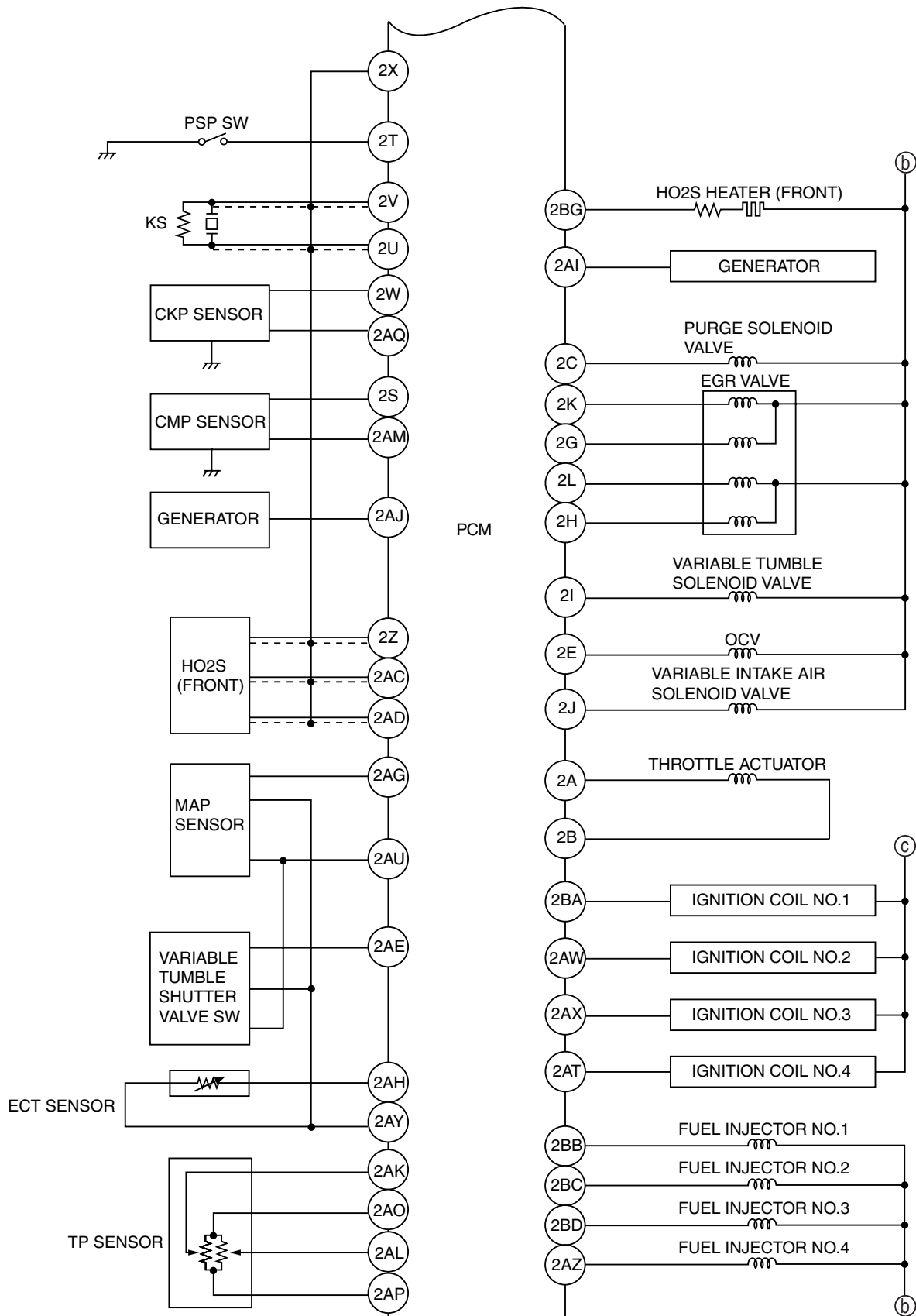
E6U140AW5902

# CONTROL SYSTEM [L3]

Except for California Emission Regulation Applicable ATX Model



E6U140AW5903



E6U140AW5904

## CONTROL SYSTEM [L3]

### PCM CONSTRUCTION/OPERATION [L3]

E6U014018880S02

#### Structure

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

### CRANKSHAFT POSITION (CKP) SENSOR FUNCTION [L3]

E6U014018220S01

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

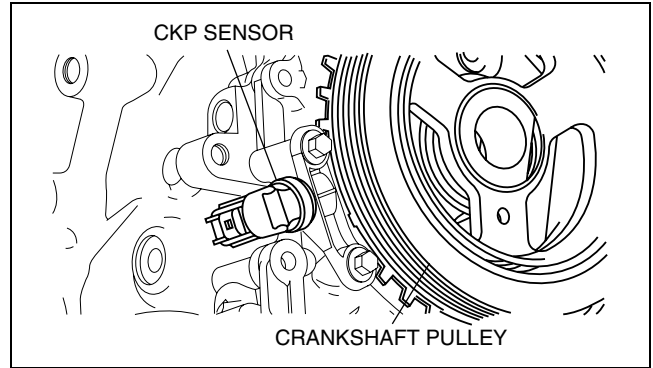
### CRANKSHAFT POSITION (CKP) SENSOR CONSTRUCTION/OPERATION [L3]

E6U014018220S02

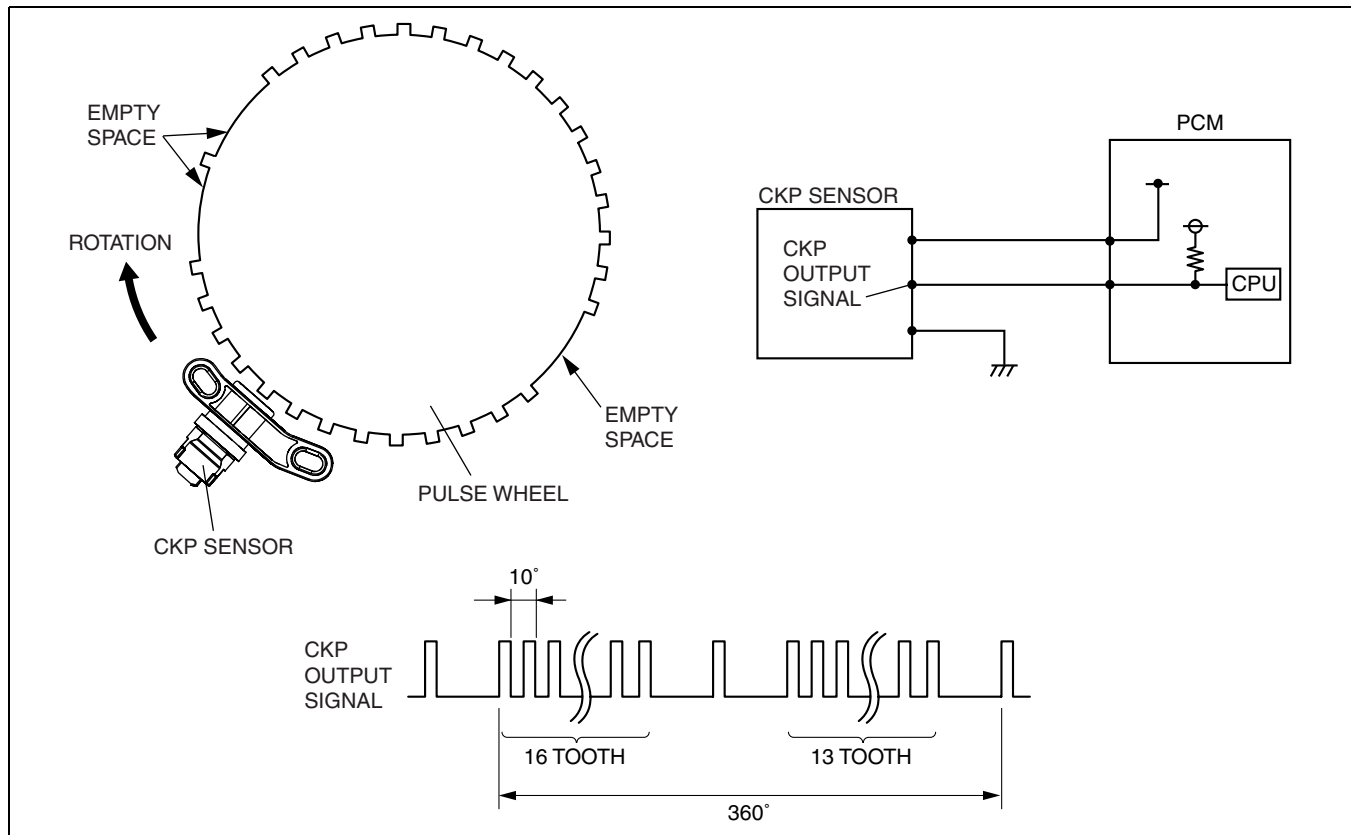
- Installed on the side surface of the cylinder block (driver's side).
- The crankshaft position sensor pulse wheel has 30 projections with  $10^\circ$  of crank angle between the rising edge of each projection.
- The crankshaft position sensor consists of a Hall element with a magnetic sensor, and a 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.



C3U0140S036



E6U140AS5001

## CAMSHAFT POSITION (CMP) SENSOR FUNCTION [L3]

E6U014018230S01

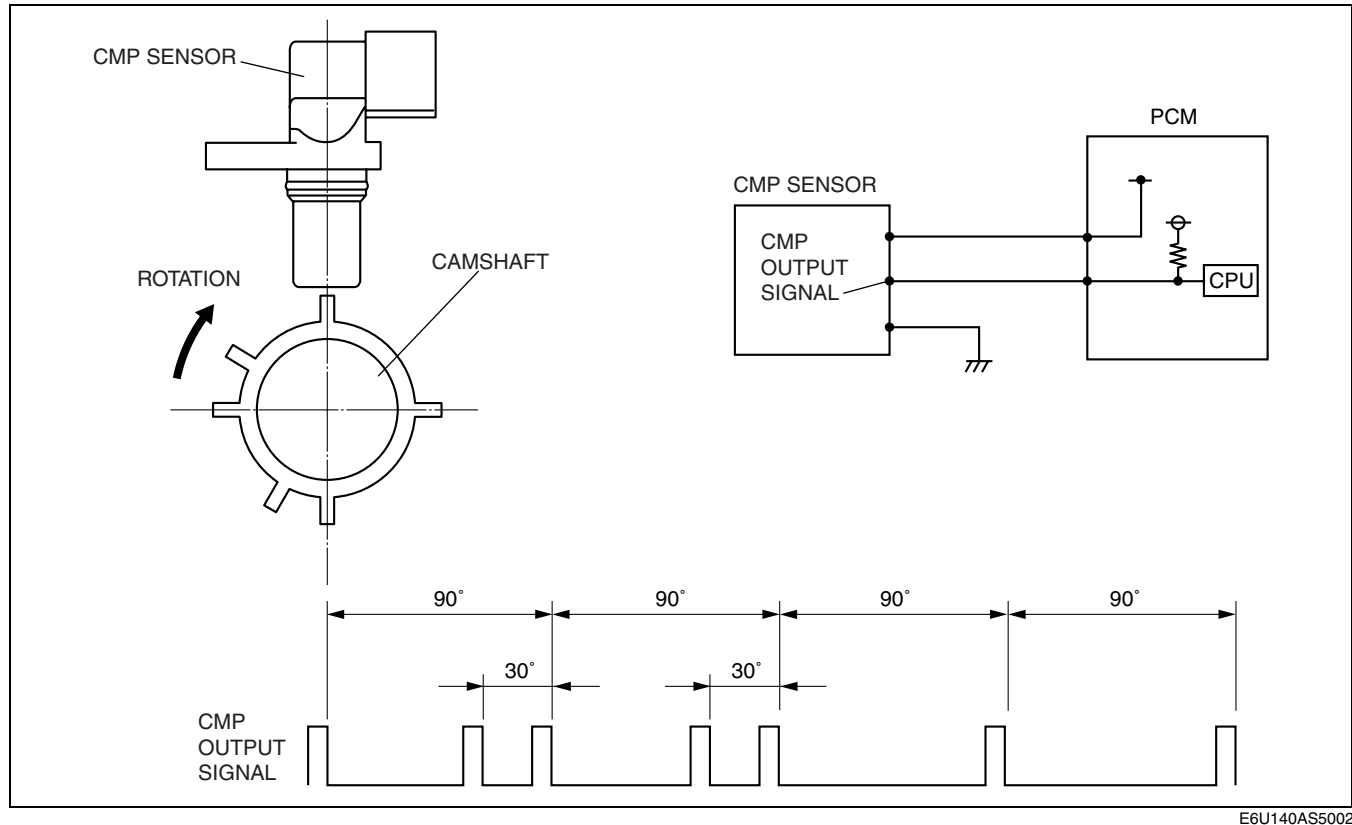
- The camshaft angle and TDC at each cylinder is detected.

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

E6U014018230S02

- 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.

01-40A



E6U140AS5002

## CONTROL SYSTEM [L3]

### BAROMETRIC PRESSURE (BARO) SENSOR FUNCTION [L3]

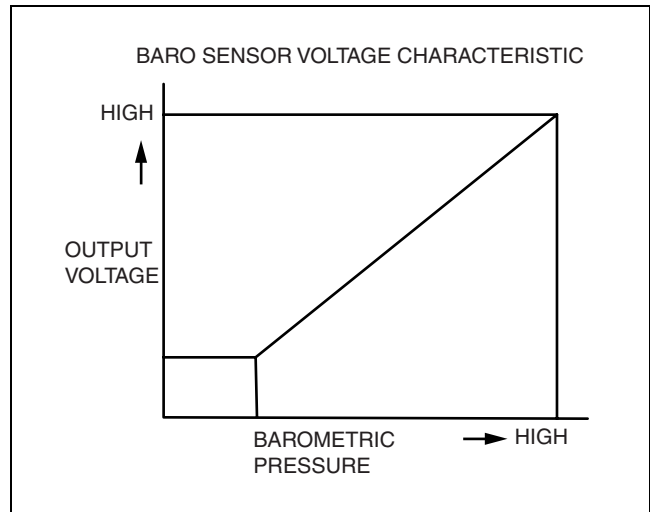
E6U014018211S01

- Detects the BARO.

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

E6U014018211S02

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



E6U140AS5003

## 01-40B CONTROL SYSTEM [L3 WITH TC]

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01-40B

## CONTROL SYSTEM [L3 WITH TC]

<b>INJECTOR DRIVER MODULE (IDM)</b>		<b>CRANKSHAFT POSITION (CKP) SENSOR</b>	
<b>CONSTRUCTION/OPERATION</b>		<b>CONSTRUCTION/OPERATION</b>	
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<b>CAMSHAFT POSITION (CMP) SENSOR</b>		<b>CONSTRUCTION/OPERATION</b>	
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		<b>SENSOR OUTLINE [L3 WITH TC] . . . .</b>	01-40B-38

### ENGINE CONTROL SYSTEM OUTLINE [L3 WITH TC]

E6U01400000S04

#### Features

Improved driveability	<ul style="list-style-type: none"> <li>• High pressure fuel pump control adopted</li> <li>• Throttle control changed</li> <li>• Fuel pressure sensor adopted</li> <li>• Fuel injection control changed               <ul style="list-style-type: none"> <li>— Air charging zone added</li> <li>— HO2S feedback control changed</li> <li>— Injection pulse width calculation added</li> <li>— Injection timing width calculation added</li> </ul> </li> </ul>
Improved exhaust emission performance	<ul style="list-style-type: none"> <li>• Boost air temperature sensor adopted</li> <li>• HO2S (Front) changed</li> </ul>
Improved reliability	<ul style="list-style-type: none"> <li>• Injector driver module adopted</li> <li>• CKP sensor changed</li> <li>• CMP sensor changed</li> <li>• HO2S heater control changed               <ul style="list-style-type: none"> <li>— Pre-heater control added</li> </ul> </li> <li>• Fuel injection control changed               <ul style="list-style-type: none"> <li>— Fuel cut changed</li> </ul> </li> <li>• Idle air control changed</li> <li>• Wastegate added</li> </ul>

#### Specification

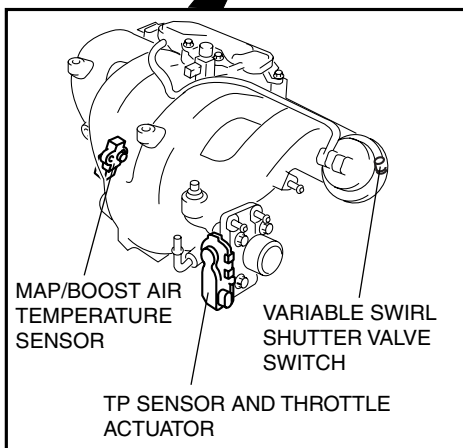
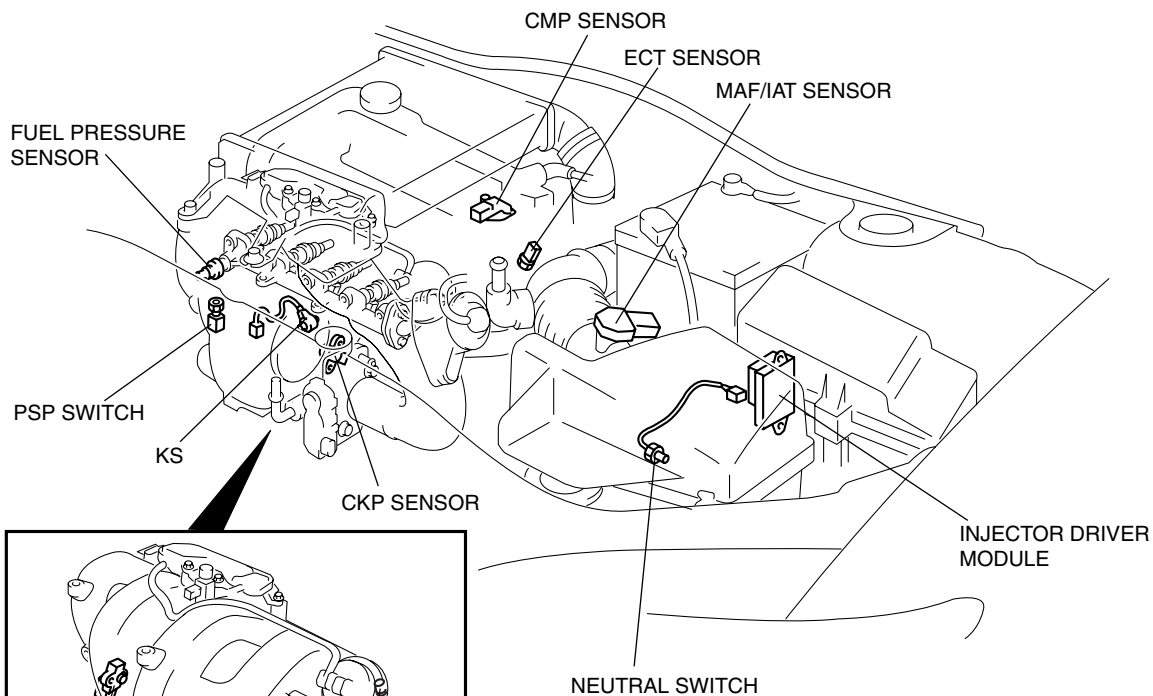
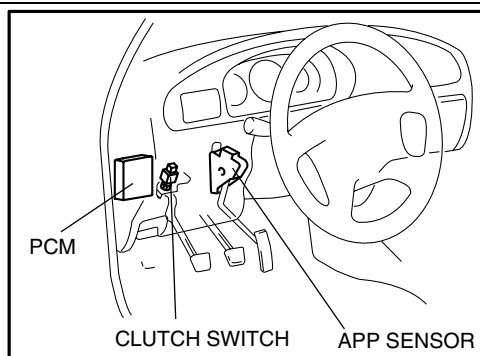
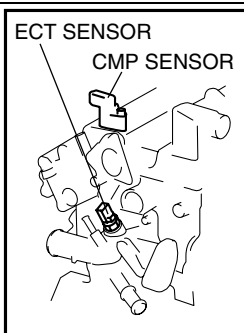
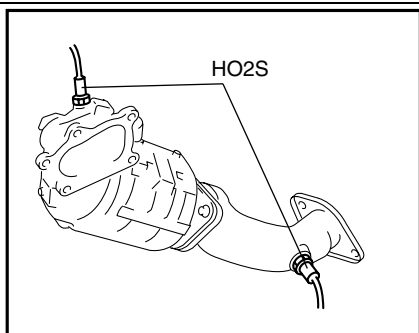
Item	Specification
Neutral switch	ON/OFF
CPP switch	ON/OFF
ECT sensor	Thermistor
IAT sensor (Inside MAF)	Thermistor
Boost air temperature sensor (Inside MAP)	Thermistor
TP sensor	Hall element
APP sensor	Inductance coil
Throttle valve actuator	DC motor
MAF sensor	Hot-wire
Front HO2S	Zirconia element (All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

# CONTROL SYSTEM [L3 WITH TC]

## ENGINE CONTROL SYSTEM STRUCTURAL VIEW [L3 WITH TC]

E6U01400000S05

01-40B

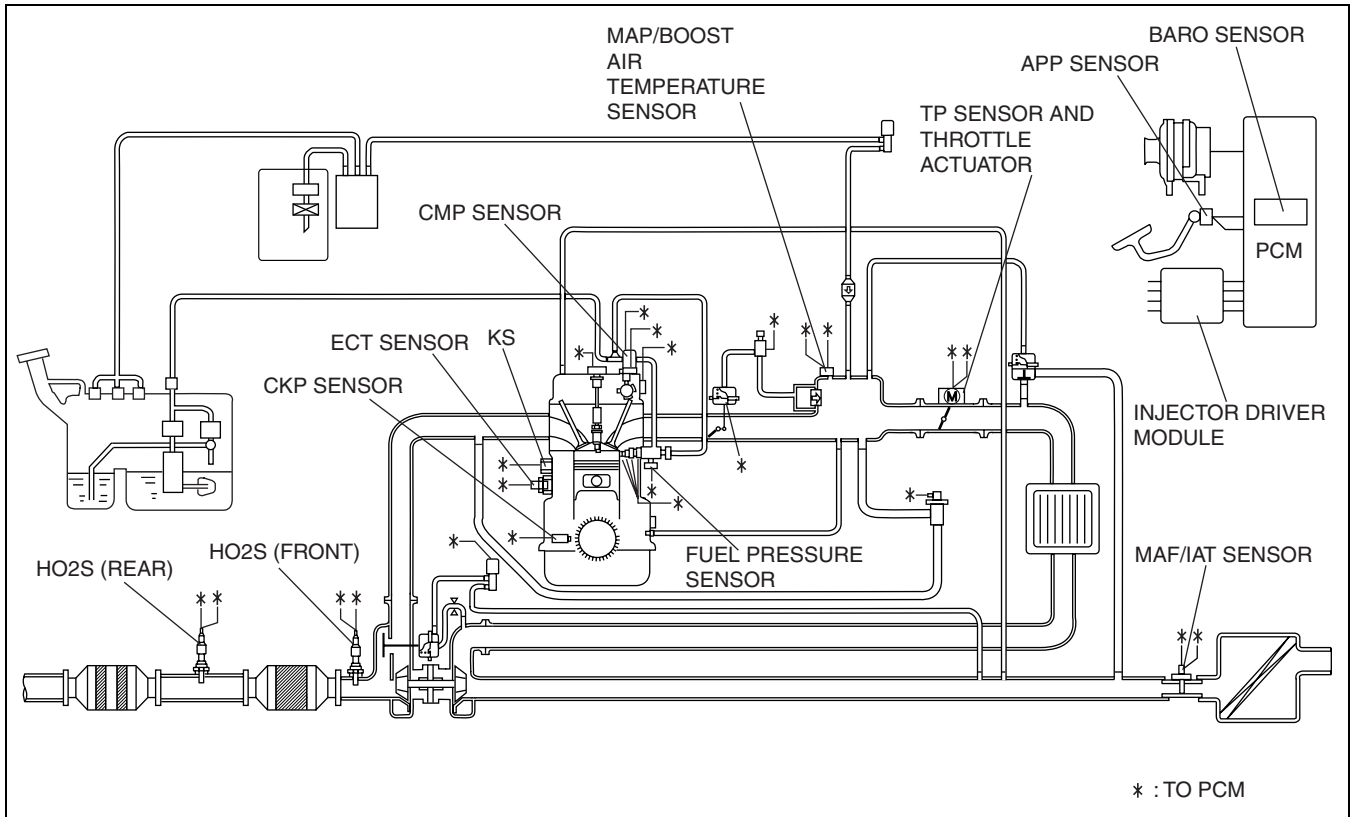


D6U140ZSC001

# CONTROL SYSTEM [L3 WITH TC]

## ENGINE CONTROL SYSTEM DIAGRAM [L3 WITH TC]

E6U01400000S06

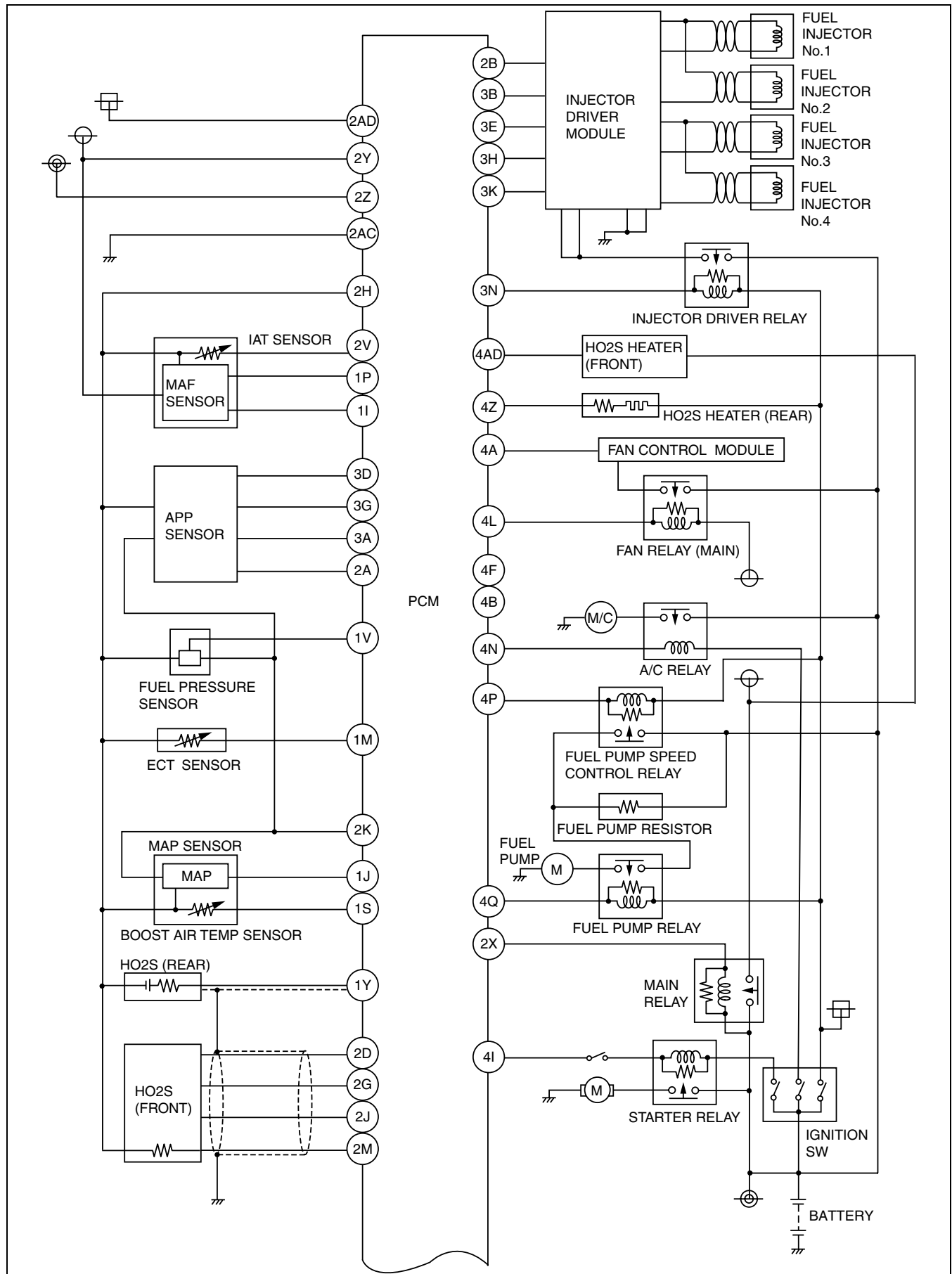


D6U140ZWC006

# CONTROL SYSTEM [L3 WITH TC]

## ENGINE CONTROL SYSTEM WIRING DIAGRAM [L3 WITH TC]

E6U01400000S07

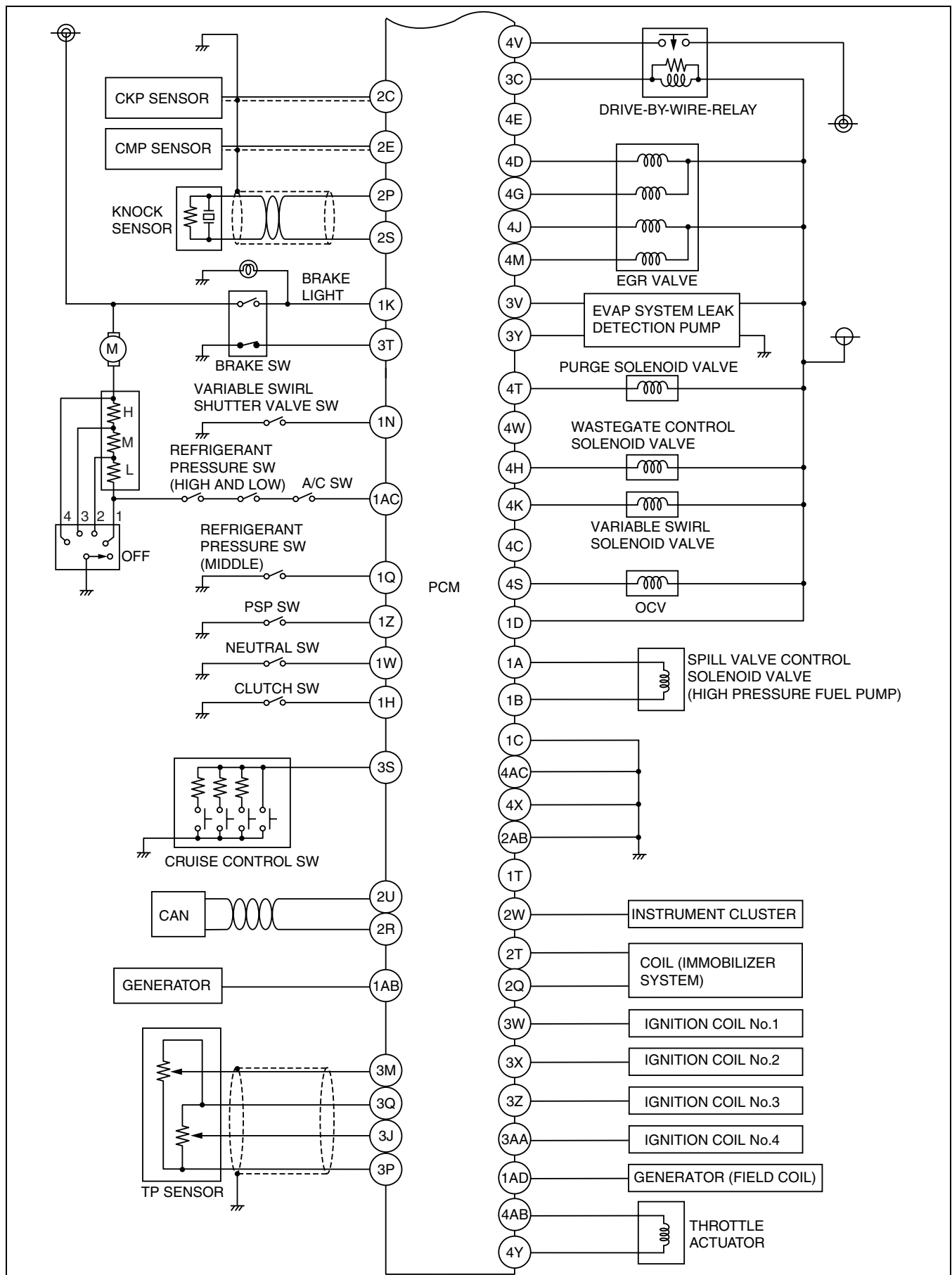


E6U103ZWC001

01-40B

01-40B-5

# CONTROL SYSTEM [L3 WITH TC]

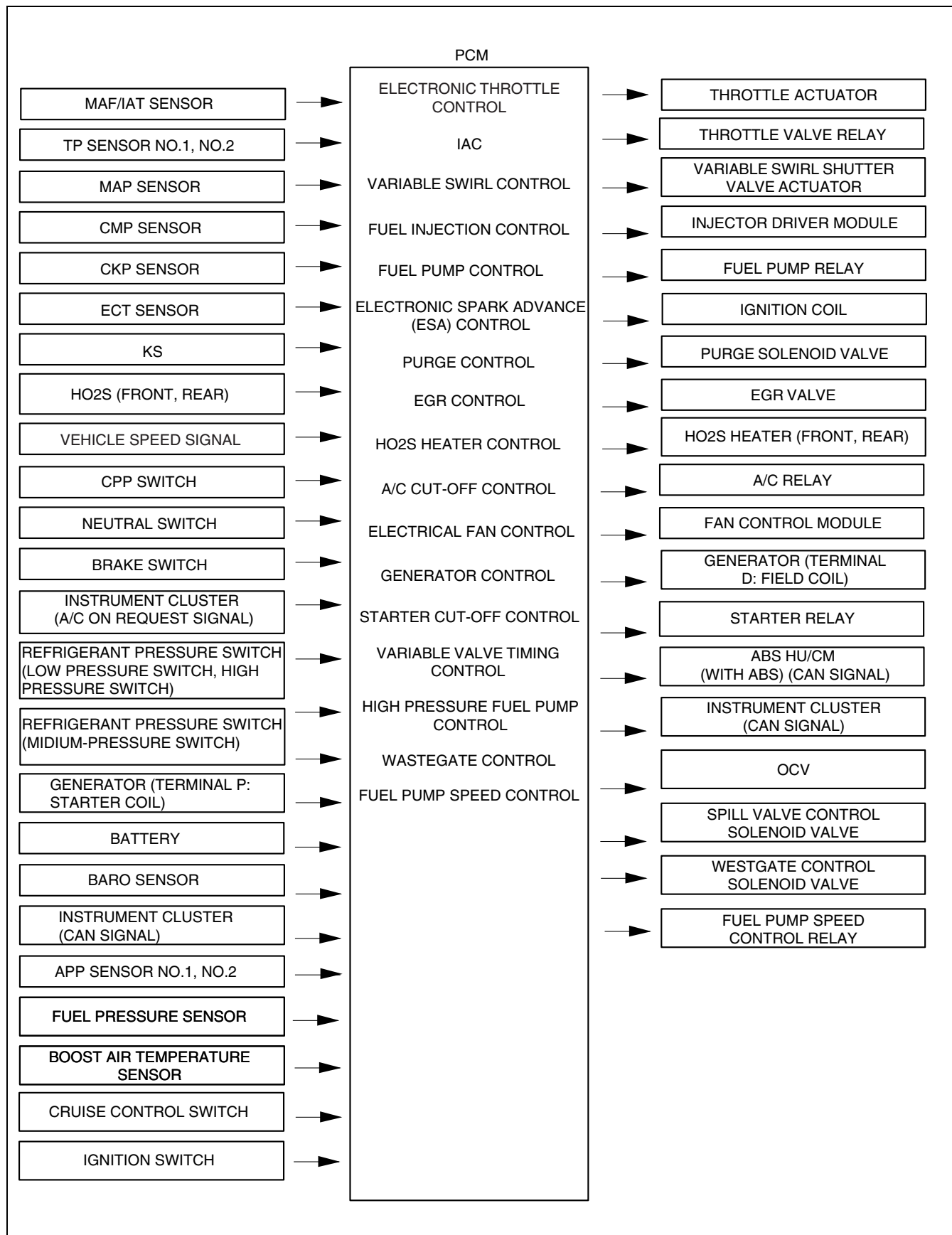


E6U103ZWC002

# CONTROL SYSTEM [L3 WITH TC]

## ENGINE CONTROL SYSTEM BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S08



E6U140ZSC700

01-40B

# CONTROL SYSTEM [L3 WITH TC]

## ENGINE CONTROL SYSTEM RELATION CHART [L3 WITH TC]

E6U01400000S09

X: Applied

Item	ELECTRONIC THROTTLE CONTROL	IAC	VARIABLE SWIRL CONTROL	VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	ESA CONTROL	EGR CONTROL	EVAPORATIVE PURGE CONTROL	HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	ELECTRICAL FAN CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	CRUISE CONTROL	CAN	HIGH PRESSURE FUEL PUMP CONTROL	WASTEGATE CONTROL	FUEL PUMP SPEED CONTROL
<b>Input device</b>																			
IAT sensor	X	X			X		X		X					X			X	X	X
MAF sensor	X	X	X	X	X		X	X	X	X		X					X	X	X
TP sensor No.1, No.2	X	X			X		X	X			X							X	X
APP sensor No.1, No.2	X	X	X	X	X		X	X	X		X	X							
MAP sensor	X	X			X				X		X								
ECT sensor	X	X	X	X	X		X	X	X	X	X	X		X					X
CMP sensor		X		X	X		X										X		
CKP sensor	X	X	X	X	X	X	X	X	X	X	X	X		X			X	X	X
KS							X												
HO2S (front, rear)					X				X										X
BARO sensor	X	X			X				X			X						X	
Neutral switch	X	X			X		X	X	X		X				X			X	
CPP switch	X	X			X		X	X	X		X				X			X	
Brake switch		X			X		X								X				
Instrument cluster (A/C on request signal)		X									X	X							
Refrigerant pressure switch (low pressure switch, high pressure switch)		X									X	X							
Refrigerant pressure switch (medium pressure switch)		X										X							
Battery	X			X		X	X	X	X	X				X			X	X	X
Generator (Terminal P: starter coil)		X												X					
Vehicle speed signal	X	X			X		X	X				X		X	X	X			
Cruise control switch															X				
Instrument cluster (CAN signal)	X	X			X		X			X						X			
Ignition switch				X	X	X	X	X		X		X							
Fuel pressure sensor	X				X	X											X		
Boost air temperature sensor		X			X		X	X									X		

# CONTROL SYSTEM [L3 WITH TC]

01-40B

Item	ELECTRONIC THROTTLE CONTROL	IAC	VARIABLE SWIRL CONTROL	VARIABLE VALVE TIMING CONTROL	FUEL INJECTION CONTROL	FUEL PUMP CONTROL	ESA CONTROL	EGR CONTROL	EVAPORATIVE PURGE CONTROL	HO2S HEATER CONTROL	A/C CUT-OFF CONTROL	ELECTRICAL FAN CONTROL	STARTER CUT-OFF CONTROL	GENERATOR CONTROL	CRUISE CONTROL	CAN	HIGH PRESSURE FUEL PUMP CONTROL	WASTEGATE CONTROL	FUEL PUMP SPEED CONTROL
<b>Output device</b>																			
Throttle actuator	X	X													X				
Throttle valve relay	X	X																	
Variable swirl shutter valve actuator			X																
OCV (L3)				X															
Injector driver module					X														
Fuel pump relay						X													
Ignition coil							X												
EGR valve								X											
Purge solenoid valve									X										
HO2S heater (front, rear)										X									
A/C relay											X								
Fan control module												X							
Starter relay													X	X					
Generator (Terminal D: field coil)														X					
ABS HU/CM (With ABS) (CAN signal)																X			
Instrument cluster (CAN signal)																X			
Spill valve control solenoid valve																	X		
Wastegate control solenoid valve																		X	
Fuel pump speed control relay																			X

## CONTROL SYSTEM [L3 WITH TC]

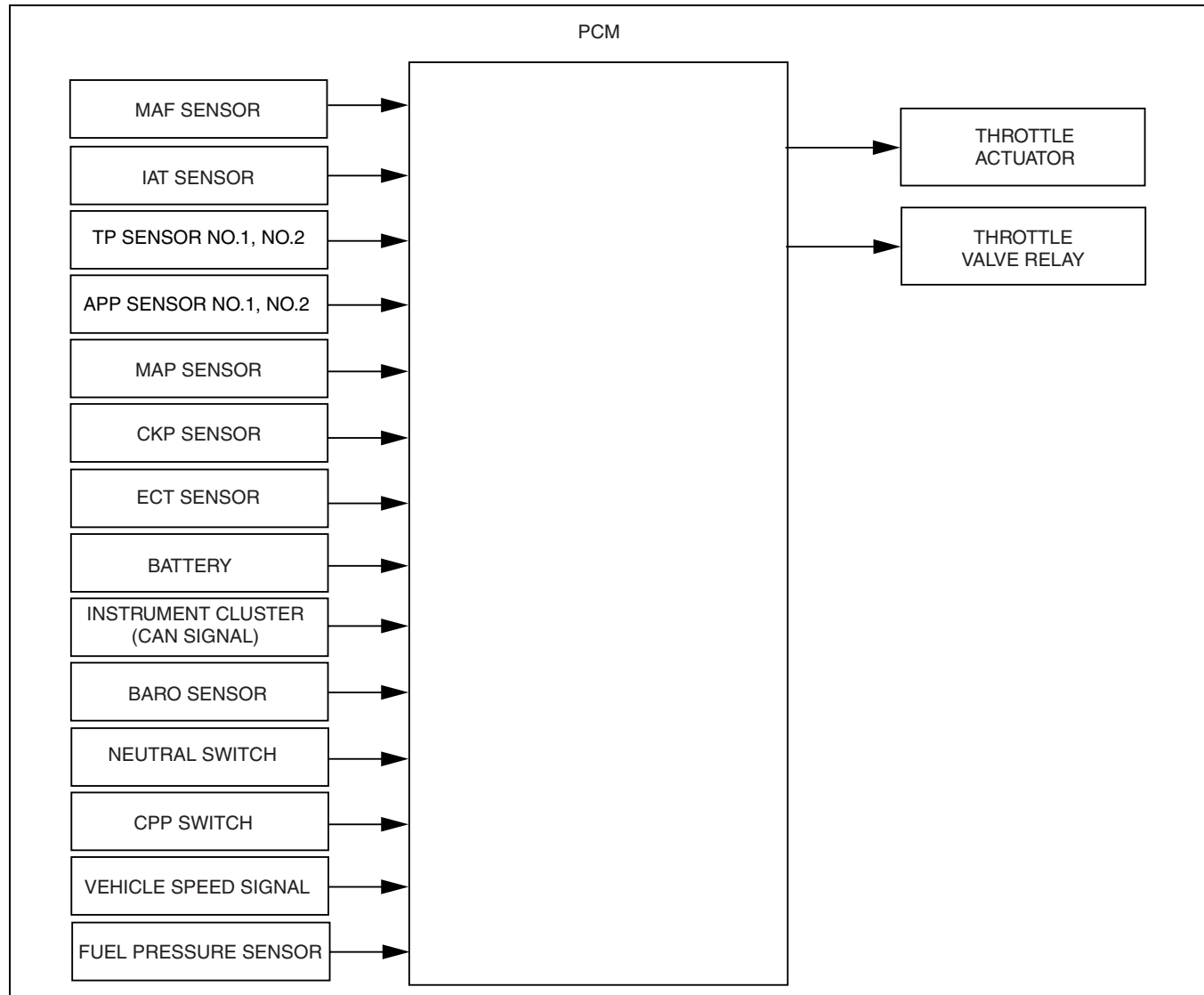
### ELECTRONIC THROTTLE CONTROL OUTLINE [L3 WITH TC]

E6U01400000S10

- The throttle actuator is controlled to the appropriate throttle opening angle according to the accelerator opening angle, gear position, and engine speed.

### ELECTRONIC THROTTLE CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S11



E6U140ZSC026

### ELECTRONIC THROTTLE CONTROL OPERATION [L3 WITH TC]

E6U01400000S12

- Feedback control has been adopted to the throttle actuator and it is monitored by the TP sensor so that it reaches the target throttle opening angle.

#### Target throttle opening angle

- Throttle opening angle according to the engine speed and target charging efficiency table has been set.

#### Target charging efficiency table

- This table has been created by assuming a target charging efficiency according to the engine speed and virtual accelerator opening angle.

#### Virtual accelerator opening angle

- The virtual accelerator opening angle has been set according to the gear position, vehicle speed, accelerator opening angle, and accelerator opening change rate to improve driveability.

## CONTROL SYSTEM [L3 WITH TC]

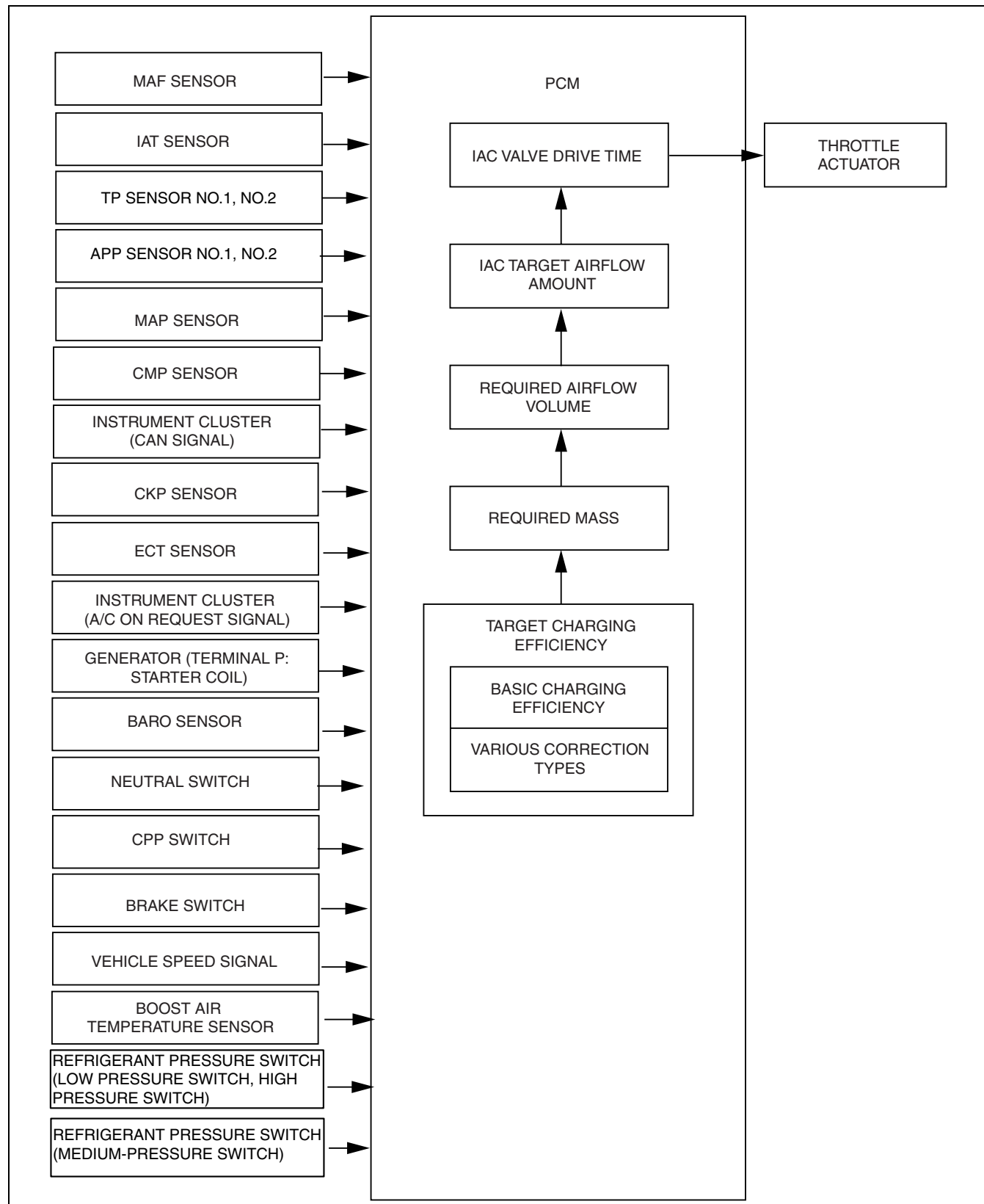
### IDLE AIR CONTROL (IAC) OUTLINE [L3 WITH TC]

E6U01400000S13

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

### IDLE AIR CONTROL (IAC) BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S14



01-40B

E6U140ZSC304

# CONTROL SYSTEM [L3 WITH TC]

E6U01400000S15

## IDLE AIR CONTROL (IAC) OPERATION [L3 WITH TC]

### Target throttle valve opening angle determination

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

### IAC target airflow amount

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

#### Required volumetric airflow amount

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

#### Target charging efficiency

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

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

Correction	Target	Conditions	Correction amount
A/C load correction	Prevents decrease in idle speed due to A/C operation.	A/C is operating.	A/C operation time→correction
Electrical load correction	Prevents decrease in idle speed due to electrical load operation.	Idle speed during electrical load operation and under any condition during driving	High electrical load→large correction
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 <b>60 °C {140 °F} or more</b> the IAT is <b>40 °C {104 °F} or more</b>	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 <b>300 rpm or less</b> ).	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 <b>85 °C {185 °F} or more</b> .	During idling→average value of feedback correction A
Volume increase correction at vehicle start	Ensures driveability just after vehicle start.	When the accelerator pedal is depressed while the clutch pedal is kept depressing.	Large APP→large correction

## Target idle speed

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

### Standard

Load status		Idle speed (rpm) Neutral position
No load		650—750
Electrical loads on		650—750
P/S operating		650—750
A/C on	Low load <sup>*1</sup>	700—800
	High load <sup>*2</sup>	725—825

<sup>\*1</sup> : Refrigerant pressure switch (medium pressure switch) is off.

<sup>\*2</sup> : Refrigerant pressure switch (medium pressure switch) is on.

01-40B

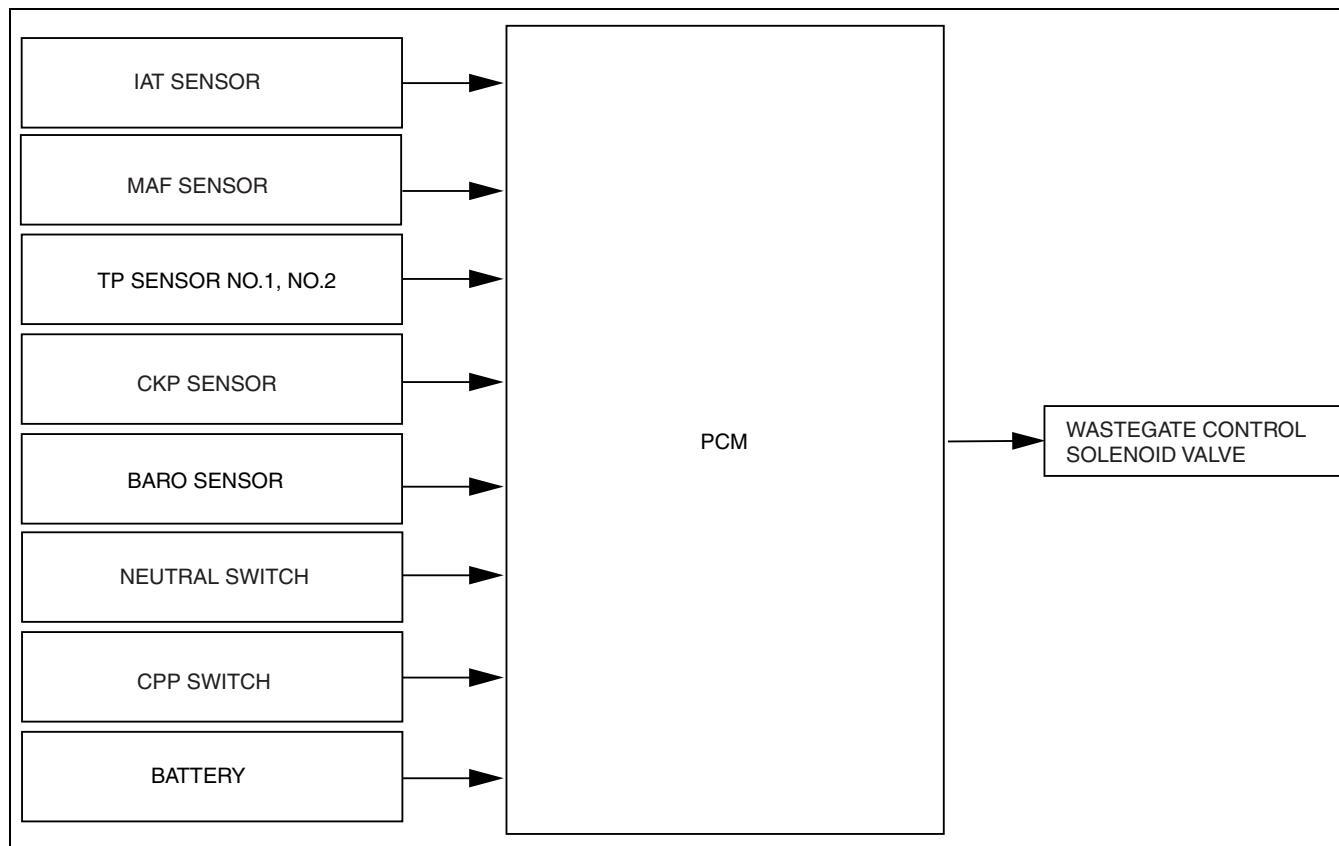
## WASTEGATE CONTROL OUTLINE [L3 WITH TC]

E6U01400000S16

- Duty control has been adopted to the wastegate control solenoid valve to control the air charging pressure according to driving conditions.
- The duty value of the wastegate control solenoid valve increases as the air charging pressure increases.

## WASTEGATE CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S17



E6U140ZSC007

# CONTROL SYSTEM [L3 WITH TC]

## WASTEGATE CONTROL OPERATION [L3 WITH TC]

E6U01400000S18

### Basic Operation Condition

- Under the following conditions, the PCM operates the wastegate control solenoid valve to adjust the air charging pressure to the target value with the duty value that matches the condition.

Condition		Wastegate control solenoid valve Duty value (%)
Accelerator opening angle	Engine speed (rpm)	
18.75% or more	Below 2250	100
	2500—4500	Approx. 60
	Approx. 5000	Approx. 70
	Approx. 5500	Approx. 80
	Approx. 6000	Approx. 55
	Approx. 6500	Approx. 30
	Approx. 7000	0
Below 18.75%	All range	0

### Feedback operation control

- While driving with the air charging pressure at more than a given value, feedback control is performed so that air charging can be performed between the maximum and minimum values.
  - Maximum value: If the air charging pressure increases excessively, the intake air system connection area may be disengaged or the components may be damaged. This is a threshold value to prevent such damage.
  - Minimum value: If the air charging pressure decreases excessively, the wastegate actuator cannot be operated. This is the limit value to operate the actuator.

### Correction

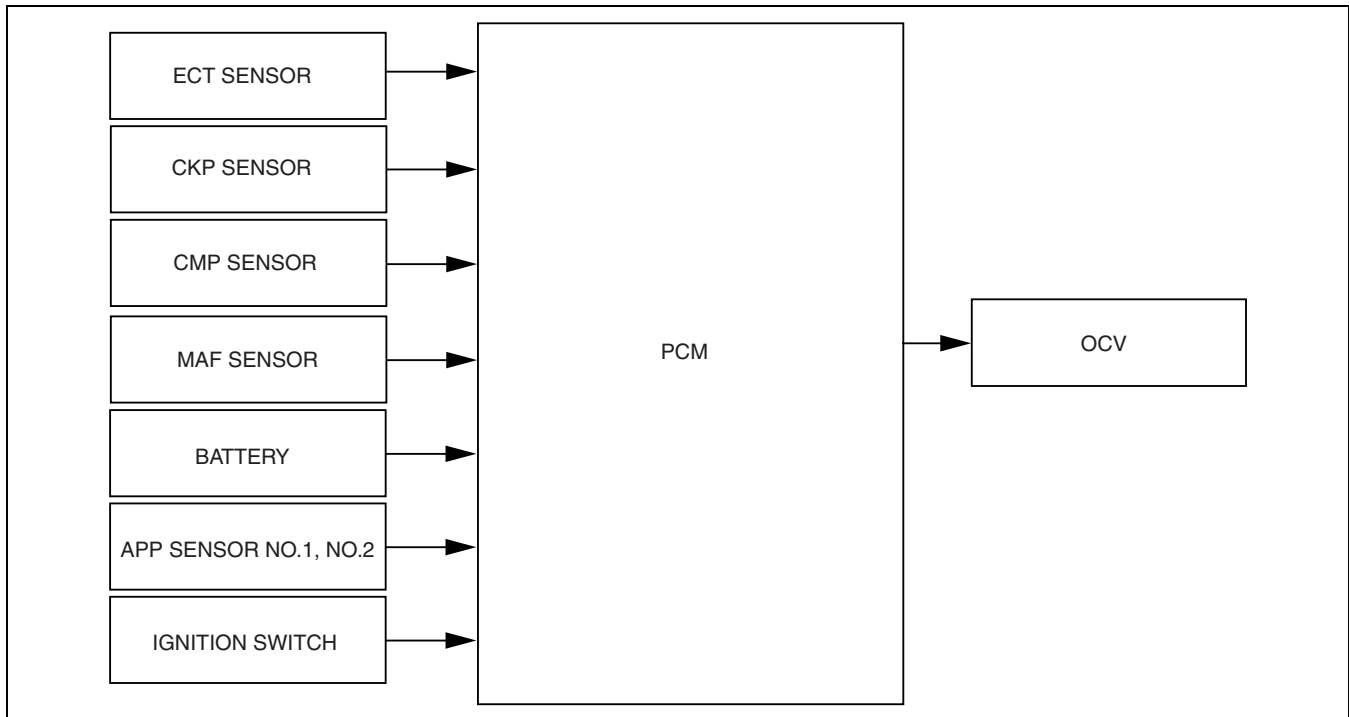
Name	Contents	
	Purpose	Correction amount
Intake air charging temperature correction	<ul style="list-style-type: none"> <li>Improves injection efficiency when intake air density is low</li> </ul>	<ul style="list-style-type: none"> <li>High intake airflow temperature→large correction</li> </ul>
Barometric pressure correction	<ul style="list-style-type: none"> <li>The intake air amount increases when air density is low, preventing excessive turbocharger speed.</li> </ul>	<ul style="list-style-type: none"> <li>High barometric pressure→large correction</li> </ul>
Battery voltage correction	<ul style="list-style-type: none"> <li>Controls basic duty value deviation due to supply voltage increase/decrease</li> </ul>	<ul style="list-style-type: none"> <li>Low battery voltage→large correction</li> </ul>
Air charging pressure guard feedback correction	<ul style="list-style-type: none"> <li>Prevents excessive turbocharger speed</li> </ul>	<ul style="list-style-type: none"> <li>High barometric pressure→large correction</li> <li>High engine speed→small correction</li> </ul>
Acceleration correction	<ul style="list-style-type: none"> <li>Improves acceleration feel</li> </ul>	<ul style="list-style-type: none"> <li>Rapid acceleration and fully depressed accelerator pedal</li> </ul>
Charging efficiency feedback correction	<ul style="list-style-type: none"> <li>Prevents engine damage</li> </ul>	<ul style="list-style-type: none"> <li>Charging efficiency is less than target charging efficiency→volume increase correction</li> <li>Charging efficiency is more than target charging efficiency→decrease correction</li> </ul>

## CONTROL SYSTEM [L3 WITH TC]

### VARIABLE VALVE TIMING CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U014000000S19

- 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.



E6U140ZSC027

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## CONTROL SYSTEM [L3 WITH TC]

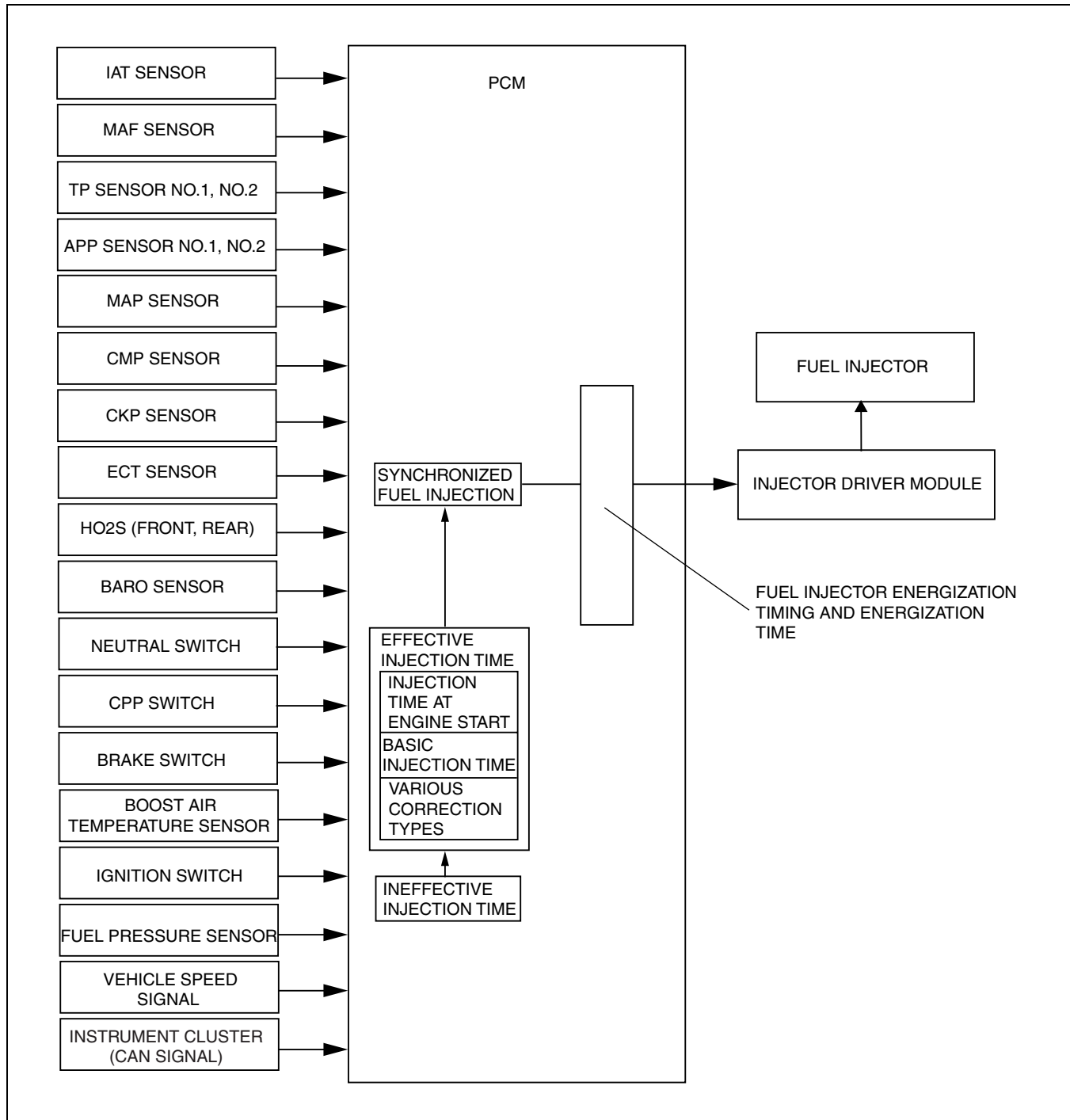
### FUEL INJECTION CONTROL OUTLINE [L3 WITH TC]

E6U01400000S20

- 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”.
- Final fuel injection time is determined by the demand fuel injection amount and the fuel pressure.

### FUEL INJECTION CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S21



E6U140ZSC301

## FUEL INJECTION CONTROL OPERATION [L3 WITH TC]

E6U01400000S22

### Operation

#### Injection timing

- A synchronized fuel injection at the set crank position is performed.

#### Synchronized fuel injection

- Fuel injection is performed with the appropriate injection timing and amount based on the below sensor input signals synchronized with the crankshaft rotation during the intake air process at each cylinder.
  - Crankshaft position sensor
  - MAF sensor
  - ECT sensor
  - IAT sensor
  - BARO sensor
  - Boost air temperature sensor

01-40B

#### Injection time

- The PCM calculates the fuel injection amount according to the engine operation conditions at fuel injection 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) to 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:

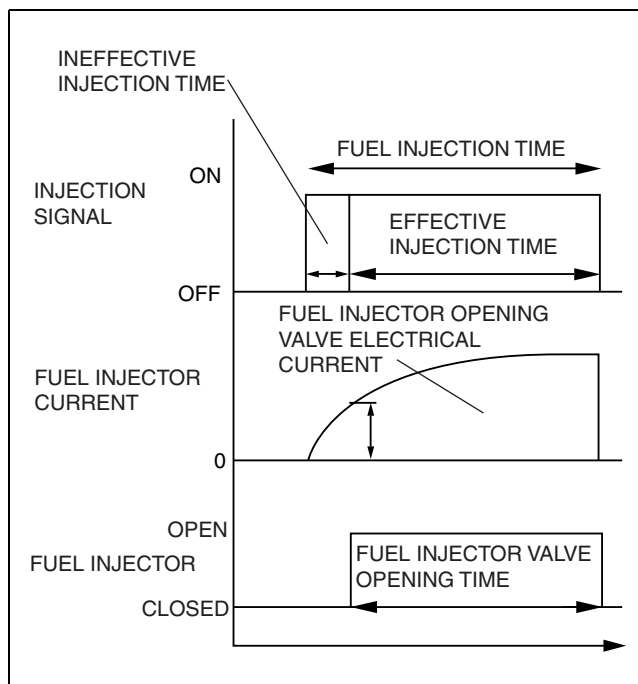
**Fuel injection time = effective injection time + ineffective injection time**

##### Ineffective injection time

- The fuel injectors cause an operation delay due to a delay in the rise of operation current due to coil inductance at 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 positive voltage. Accordingly, the PCM sets the non-injection time according to the battery voltage.

##### Effective injection time

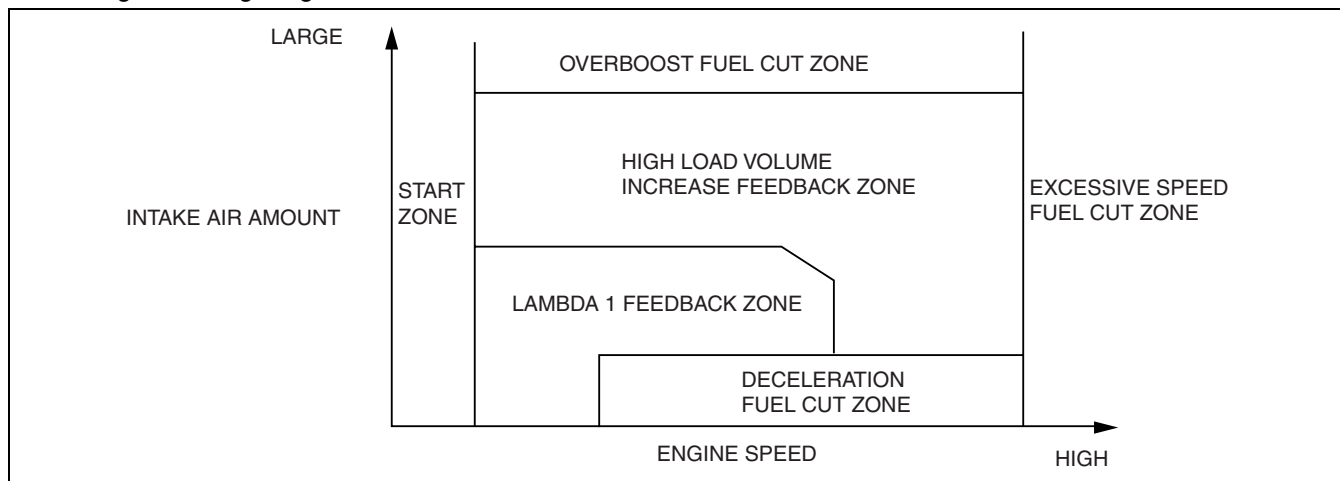
- The fuel injector opening valve time, which is the actual fuel injection time, is called the effective injection time.



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.



E6U140ZSC002

## Overboost fuel cut zone

### Purpose

- Intake air system component protection

### Control condition

- Manifold absolute pressure or charging efficiency is at the given value or more.

### Determination of fuel injection time

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

## Start zone

### Purpose

- Improved startability

### Control condition

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

### Determination of fuel injection time

- Determination is based on the engine coolant temperature (ECT sensor) and engine speed (CKP sensor)

## Lambda 1 feedback zone

### Purpose

- Improved fuel economy
- Improved exhaust gas purification

### Control condition

- Occurs during engine operation except for high load volume increases and engine start zones

### Determination of fuel injection time

- During normal driving, the various correction amounts are added to the basic injection time to obtain the ratio that is close to the theoretical air/fuel ratio.

## High load volume increase feedback zone

### Purpose

- Improved driveability, exhaust system component protection (suppress gas temperature)

### Control condition

- Either the charging efficiency or the accelerator opening angle is a given 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 condition

- When the engine speed is **6,700 rpm or more**.
- When the engine speed is **5,500 rpm or more** and the engine coolant temperature is approx. **-15°C 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} or more**

### Note

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

## Determination of fuel injection time

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

## Deceleration fuel cut zone

### Purpose

- Improved fuel economy
- Prevents overheating of the catalytic converter.

### Control condition

- When the engine conditions are as follows **10 s or more** has elapsed after engine start).
  - Throttle valve is fully closed
  - Engine speed is the set value or more (charging efficiency at given value or more, mass airflow sensor normal).

## Determination of fuel injection time

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

## Fuel injection time calculation method table

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

Contents (Fuel injection time, calculation method, or determination method)		Control zone					
		Start	Feedback	High load volume increase	Excessive speed fuel cut	Deceleration fuel cut	Over boost 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	A
Ineffective injection time	Set time according to injector performance	A	A	A			
Volume increase correction at engine start	Purpose: Ensures engine speed stability just after engine start <b>Correction condition</b> <ul style="list-style-type: none"> <li>• Specified time according to the engine coolant temperature directly after engine start</li> </ul> <b>Correction amount</b> <ul style="list-style-type: none"> <li>• Low engine coolant temperature→large correction</li> <li>• High intake air temperature→large correction</li> </ul>	B	B				
Lambda 1 feedback correction	Purpose: Controls air/fuel ratio to target air/fuel ratio <b>Correction condition</b> <ul style="list-style-type: none"> <li>• When the engine coolant temperature is at the set value or more</li> </ul> <b>Correction amount</b> <ul style="list-style-type: none"> <li>• HO2S lambda value 1 or less→volume decrease correction</li> <li>• HO2S lambda value 1 or more→volume increase correction</li> </ul>		B				

## CONTROL SYSTEM [L3 WITH TC]

Rear HO2S feedback correction	Purpose: Corrects feedback amount according to deterioration of front HO2S and catalytic converter <b>Correction condition</b> <ul style="list-style-type: none"> <li>Engine coolant temperature is at set value or more</li> <li>Engine speed is 500—4,250 rpm</li> <li>Charging efficiency is 10—80%</li> </ul> <b>Correction amount</b> <ul style="list-style-type: none"> <li>According to rear HO2S electromotive force→correction</li> </ul>		B				
High load value increase feedback correction	Purpose: Improved engine output, decrease of exhaust gas temperature <b>Correction condition</b> <ul style="list-style-type: none"> <li>Based on the engine speed when the accelerator opening angle is the fixed value or more, otherwise, based on the engine speed and charging efficiency.</li> </ul> <b>Correction amount</b> <ul style="list-style-type: none"> <li>High engine speed, high charging efficiency→large correction</li> </ul>			B			
Warm-up volume increase correction	Purpose: Ensures combustion stability when the engine coolant temperature is low <b>Correction condition</b> <ul style="list-style-type: none"> <li>While at the set engine coolant temperature</li> </ul> <b>Correction amount</b> <ul style="list-style-type: none"> <li>High charging efficiency, low engine coolant temperature→large correction</li> </ul>		B	B			
Volume increase correction during acceleration	Purpose: Corrects fuel injection delay during acceleration, to ensure drive stability <b>Correction condition</b> <ul style="list-style-type: none"> <li>When the acceleration amount (change in the amount of charging efficiency) is at the set value or more.</li> </ul> <b>Correction amount</b> <ul style="list-style-type: none"> <li>Low engine coolant temperature→large correction</li> <li>Large acceleration amount→large correction</li> </ul>		B	B			
Learning correction	Purpose: Corrects deviation in air/fuel ratio from deterioration over time of mechanical devices <b>Correction condition</b> <ul style="list-style-type: none"> <li>Under any condition except purge control</li> </ul> <b>Correction amount</b> <ul style="list-style-type: none"> <li>Learning value based on average of feedback correction value</li> </ul>		B	B			

### Fuel cut

- Includes fuel cut under the following condition, except for fuel cut at excessive engine speed, deceleration, sensor malfunction, overspeed, and dechoke according to engine operation.

#### Overboost fuel cut

- Purpose
  - Intake air system component protection
- Control conditions
  - Manifold absolute pressure or charging efficiency is at the given value or more

## CONTROL SYSTEM [L3 WITH TC]

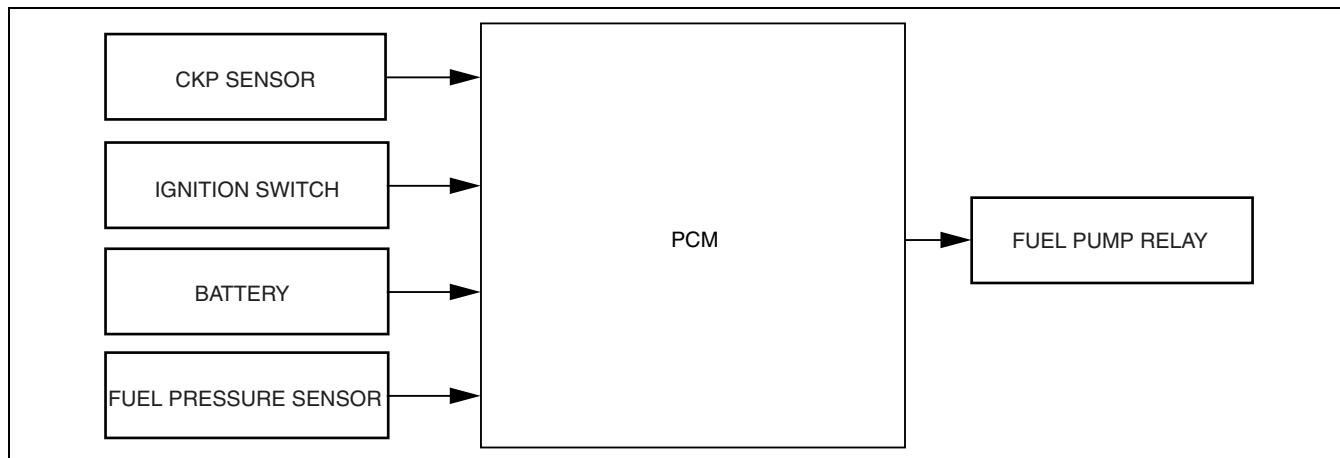
### FUEL PUMP CONTROL OUTLINE [L3 WITH TC]

E6U01400000S23

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

### FUEL PUMP CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S24



E6U140ZSC001

### FUEL PUMP CONTROL OPERATION [L3 WITH TC]

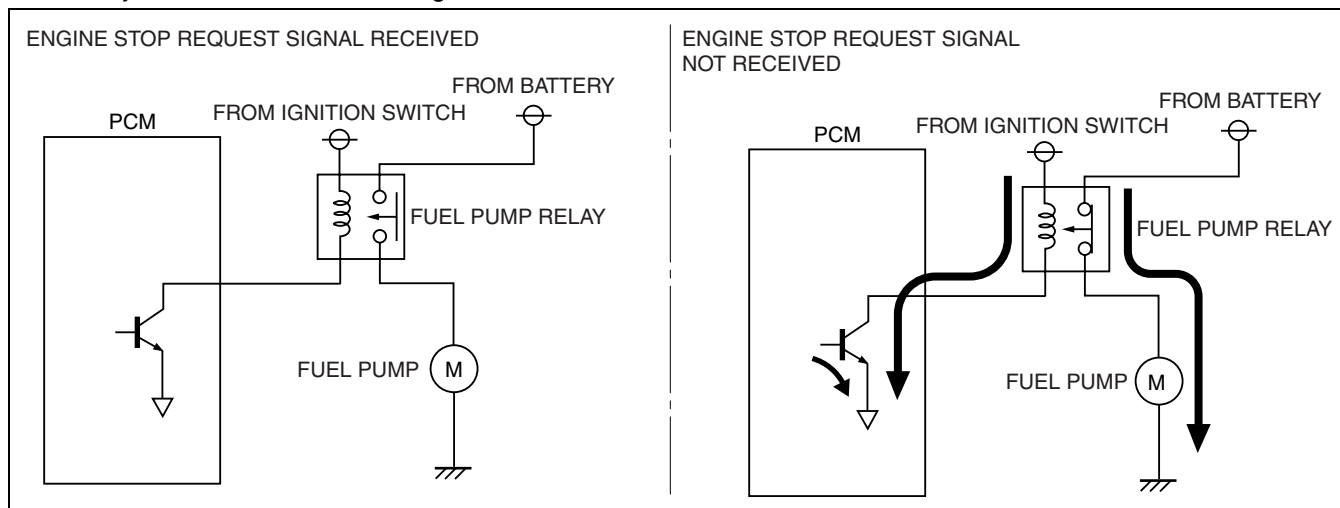
E6U01400000S25

#### 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 NE 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.



E6U140ZSC102

## CONTROL SYSTEM [L3 WITH TC]

### FUEL PUMP SPEED CONTROL OUTLINE [L3 WITH TC]

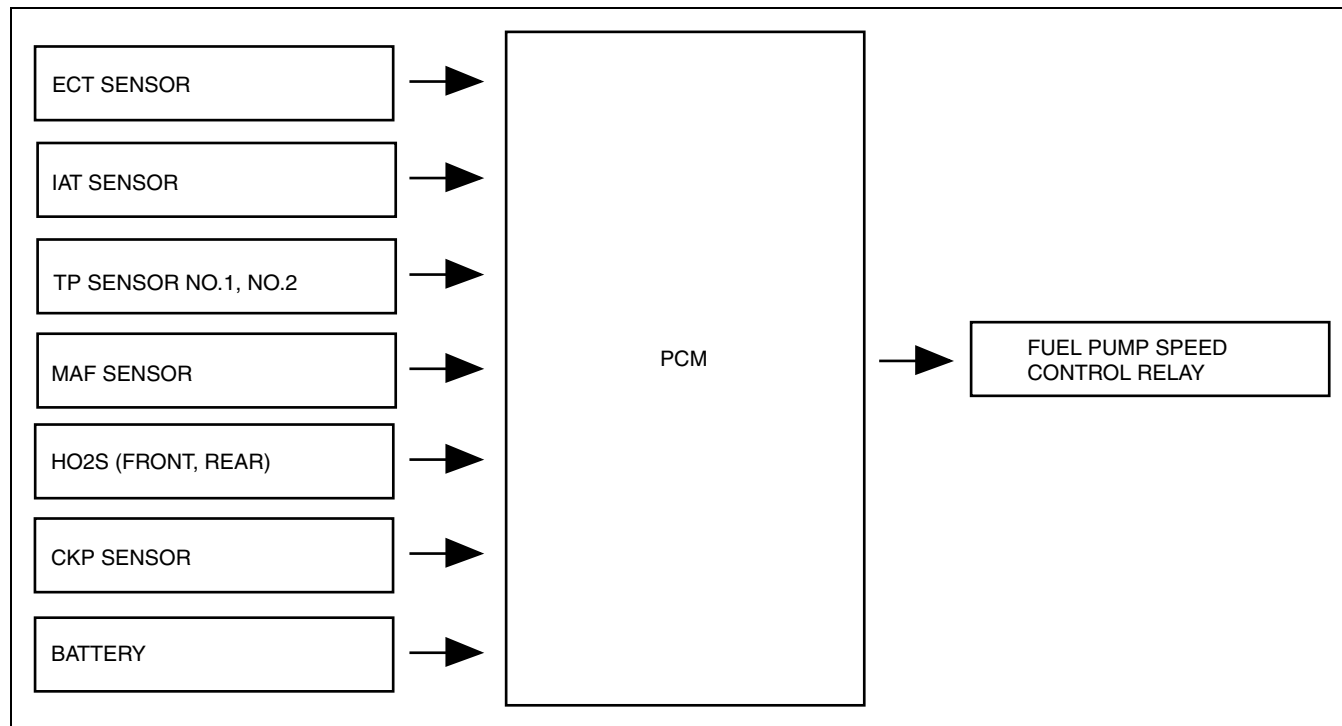
E6U01400000S26

- The fuel pump speed control turns the fuel pump speed control relay on/off according to the required fuel amount, switching between two fuel pump speed levels.
- Excess load on the fuel pump is reduced by control of the fuel pump speed. Due to this, reliability has been improved as well as an assured delivery of the optimum fuel injection time according to the engine conditions.
- In addition, at warm engine start and cold engine start, the fuel pump speed control relay is turned on during cranking to improve startability.

### FUEL PUMP SPEED CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S27

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



E6U140ZSC009

### FUEL PUMP SPEED CONTROL OPERATION [L3 WITH TC]

E6U01400000S28

- Controls the fuel pump speed control relay according to the fuel amount required by the engine.
- The required fuel amount is determined by the engine speed, the ECT and MAF.
- When the required fuel amount exceeds the fixed amount, the PCM turns the fuel pump speed control relay on.
- The fuel pump speed is switched by the demand fuel injection amount and the battery voltage.
- At cold engine start, the cranking speed may decrease. When the engine coolant temperature is low, the fuel pump speed control relay is turned on during cranking, and fuel flow is promoted.
- At warm engine start, bubbles are easily formed in the fuel. If the intake air temperature and the engine coolant temperature are high, the fuel pump speed control relay is turned on during cranking and the fuel line pressure (low-pressure) is raised.
- The circuit driving the fuel pump switches by the fuel pump speed control relay turning on or off.

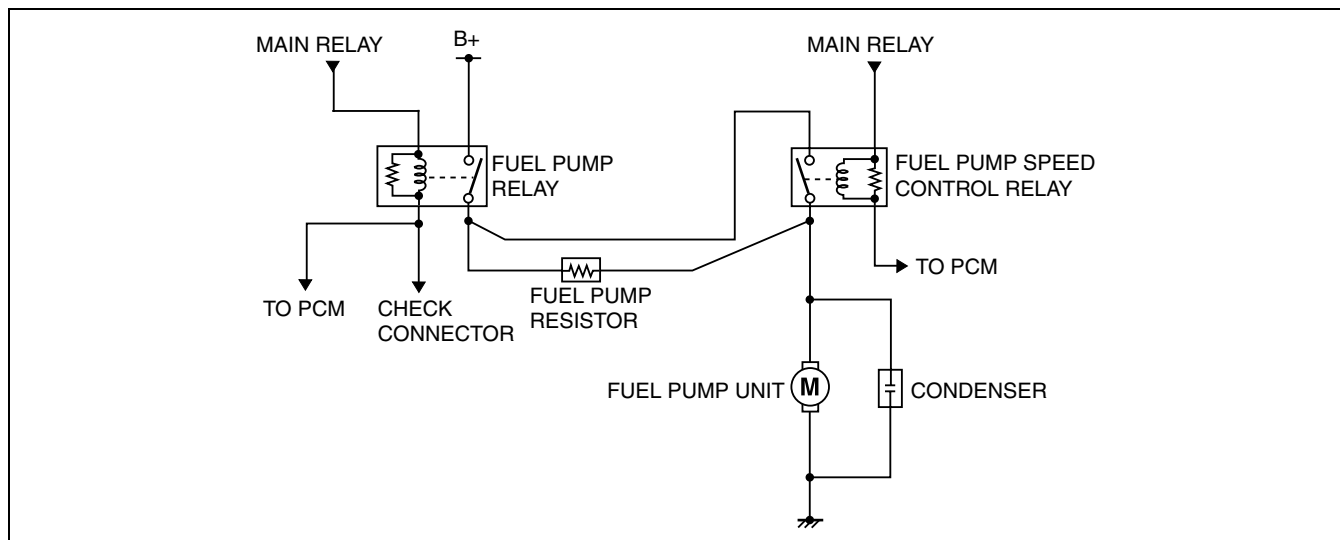
#### When Fuel Pump Speed Control Relay Off

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

#### When Fuel Pump Speed Control Relay On

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

## CONTROL SYSTEM [L3 WITH TC]



CHU0140S083

### Operation Conditions

#### During cranking

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

#### At low engine speed

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

#### At high engine speed

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

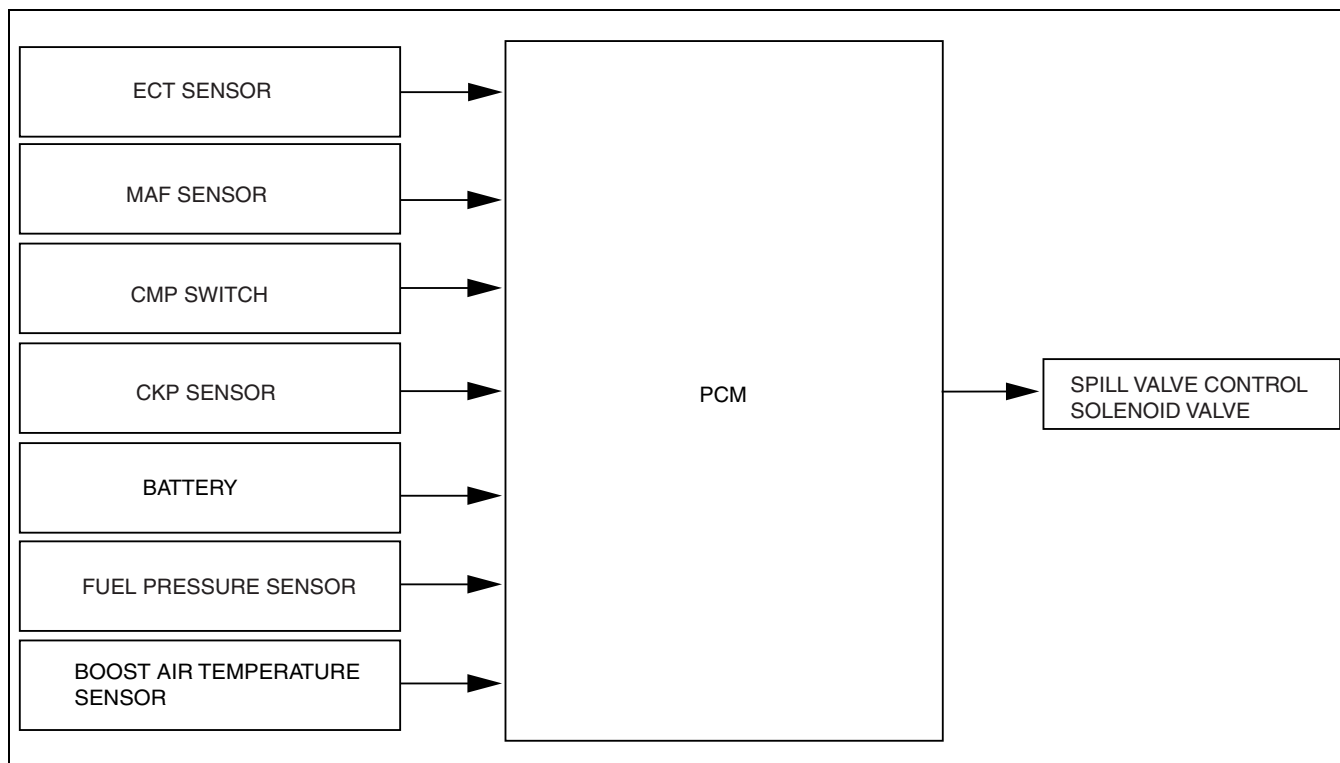
### HIGH PRESSURE FUEL PUMP CONTROL OUTLINE [L3 WITH TC]

E6U01400000S29

- The spill valve control solenoid valve is controlled according to the engine speed, charging efficiency, and so that optimum fuel pressure can be applied to the fuel injector.

### HIGH PRESSURE FUEL PUMP CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S30



E6U140ZSC008

01-40B

## CONTROL SYSTEM [L3 WITH TC]

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### HIGH PRESSURE FUEL PUMP CONTROL OPERATION [L3 WITH TC]

E6U014000000S31

#### Just After Engine Start

- At cold engine start, the fuel pressure is increased to promote the atomization of fuel.

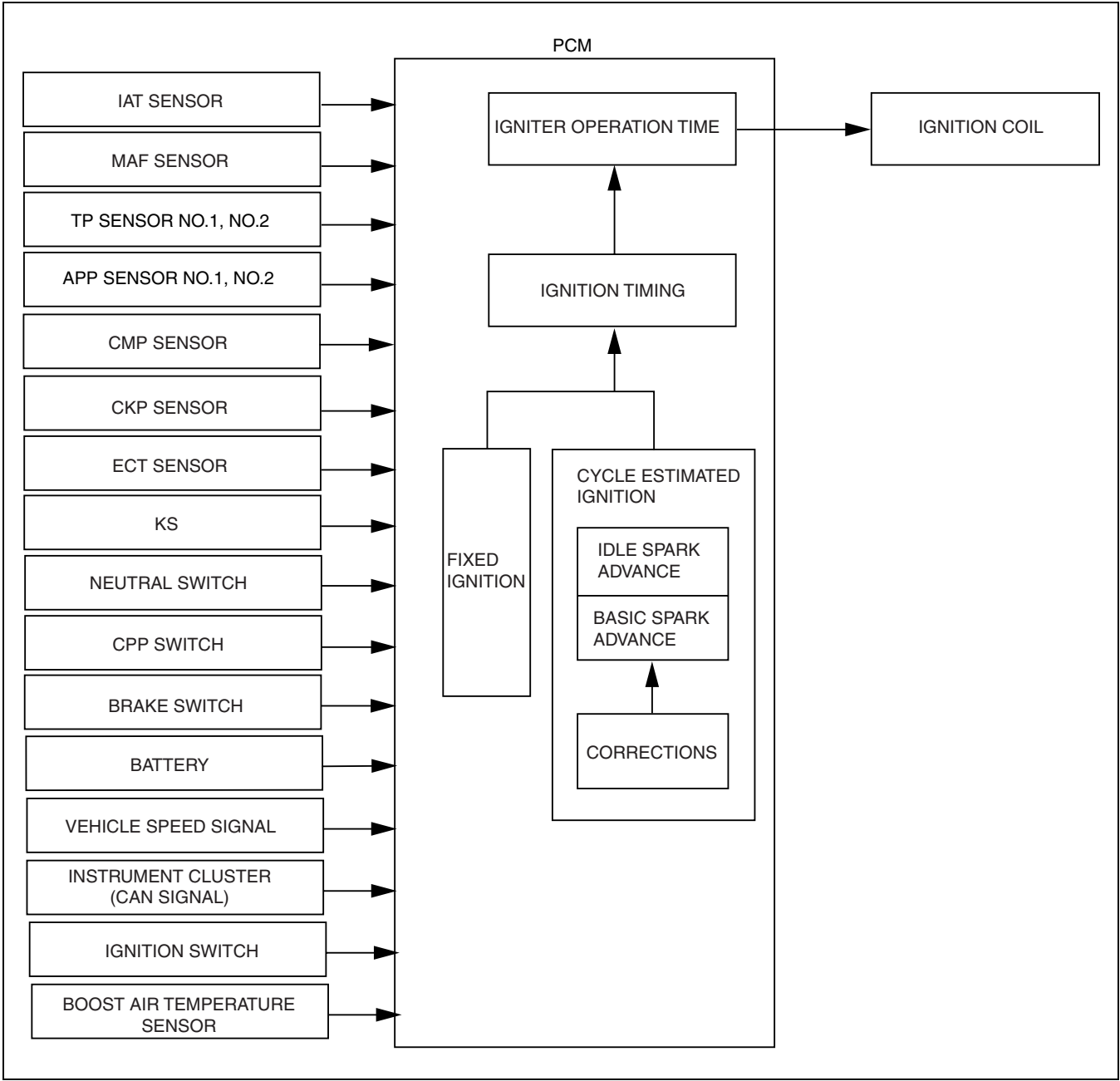
#### Basic Control

- The target fuel pressure is set based on the engine speed and charging efficiency, and the feedback control is performed by monitoring with the fuel pressure sensor.
  - When idling after engine warm up: **approx. 3 MPa {31 kgf/cm<sup>2</sup>, 435 psi}**
  - After engine warm up, engine speed is **3,000 rpm or more**, charging efficiency is **60% or more: Approx. 11.5 MPa {117 kgf/cm<sup>2</sup>, 1668 psi}**

### ELECTRONIC SPARK ADVANCE (ESA) OUTLINE [L3 WITH TC]

E6U014000000S32

- 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.



# CONTROL SYSTEM [L3 WITH TC]

## ELECTRONIC SPARK ADVANCE (ESA) OPERATION [L3 WITH TC]

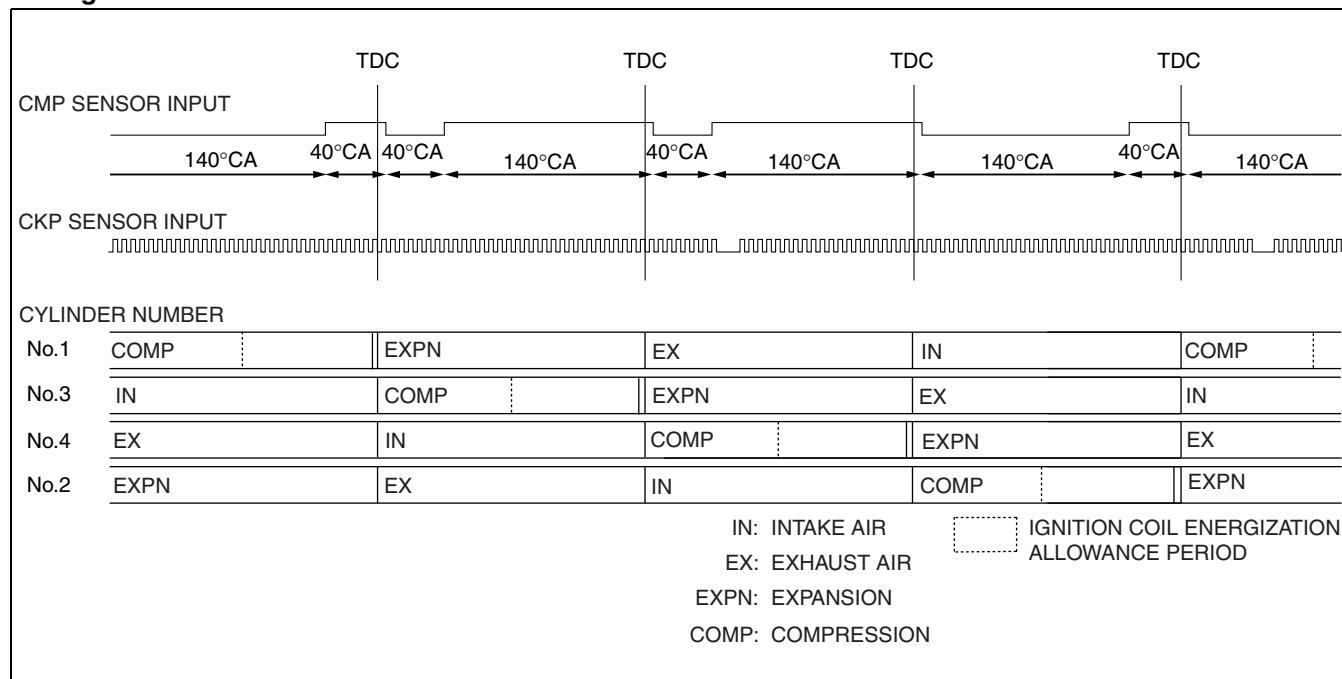
E6U01400000S34

### 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 12°	Fixed period at BTDC 12° to end of energization
Cycle estimated ignition	Ignition at timing appropriate to engine operation conditions based on input signals	<ul style="list-style-type: none"> <li>Energization time (ignition coil energization time) to igniter is determined according to battery voltage and engine speed</li> <li>Cylinder independent ignition</li> </ul>

### Timing chart

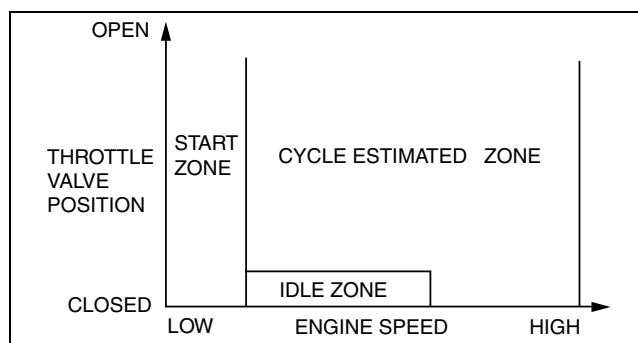


E6U140ZSC022

### 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.



E6U140ZS6201

Control zone	Control condition	Ignition method
Start zone	Engine speed is <b>500 rpm or less</b> . When mass airflow sensor is damaged.	Fixed ignition
Idle zone	Fully-closed throttle valve when engine speed is the target idle speed + <b>1,750 rpm or less</b>	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

# CONTROL SYSTEM [L3 WITH TC]

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	Idle zone	Cycle estimated zone
<b>Fixed ignition</b>		<b>Fixed at BTDC approx. 12° CA</b>	A		
<b>Cycle estimated ignition</b>	<b>Idle spark advance</b>	Set value according to target engine speed and charging efficiency*		A	
	<b>Basic spark advance</b>	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 <b>Except during idling</b> <ul style="list-style-type: none"> <li>High charging efficiency*, low engine coolant temperature→large correction</li> </ul>		B	B
	Warm-up promotion spark retard correction	Purpose: Activates the catalytic converter earlier <b>Approx. 21 s after engine start</b> <ul style="list-style-type: none"> <li>According to engine coolant temperature→correction</li> </ul>		B	
	Feedback correction	Purpose: Ensures idling stability <b>During idling (inhibited during test mode)</b> <ul style="list-style-type: none"> <li>Large difference between actual engine speed and target engine speed→large correction</li> <li>Small difference between actual engine speed and target engine speed→small correction</li> </ul>		B	
	EGR correction	Purpose: Prevents deviation of required ignition timing during EGR gas feed <b>When EGR valve position is the specified value or more except during EGR valve initialization</b> <ul style="list-style-type: none"> <li>According to engine speed and charging efficiency*→correction</li> </ul>			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 <b>Re-acceleration after recovery from deceleration fuel cut and while in deceleration fuel cut</b> <ul style="list-style-type: none"> <li>Low engine coolant temperature→large correction</li> </ul>		B	B
	Acceleration spark retard correction	Purpose: Prevents knocking and shock during sudden acceleration <b>Acceleration when charging efficiency* volume increase (acceleration amount) is specified value or more</b> <ul style="list-style-type: none"> <li>High acceleration amount→high retard</li> </ul>			B
	Standing start spark retard correction	Purpose: Prevents shock when vehicle accelerates from a standing start <b>When vehicle accelerates from a standing start</b> <ul style="list-style-type: none"> <li>According to engine speed, throttle valve opening angle, accelerator, gear, clutch, engine coolant temperature and intake air temperature→correction</li> </ul>			B
	Knocking spark retard correction	Purpose: Knocking suppression <b>When knocking is detected while driving under high load</b> <ul style="list-style-type: none"> <li>Large amount of knocking→large correction</li> </ul>			B
	Torque correction	Purpose: Improves drive operation feel <b>Deceleration when the accelerator pedal is fully released</b> <ul style="list-style-type: none"> <li>Air increase at throttle control→large correction</li> </ul>			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.

01-40B

## CONTROL SYSTEM [L3 WITH TC]

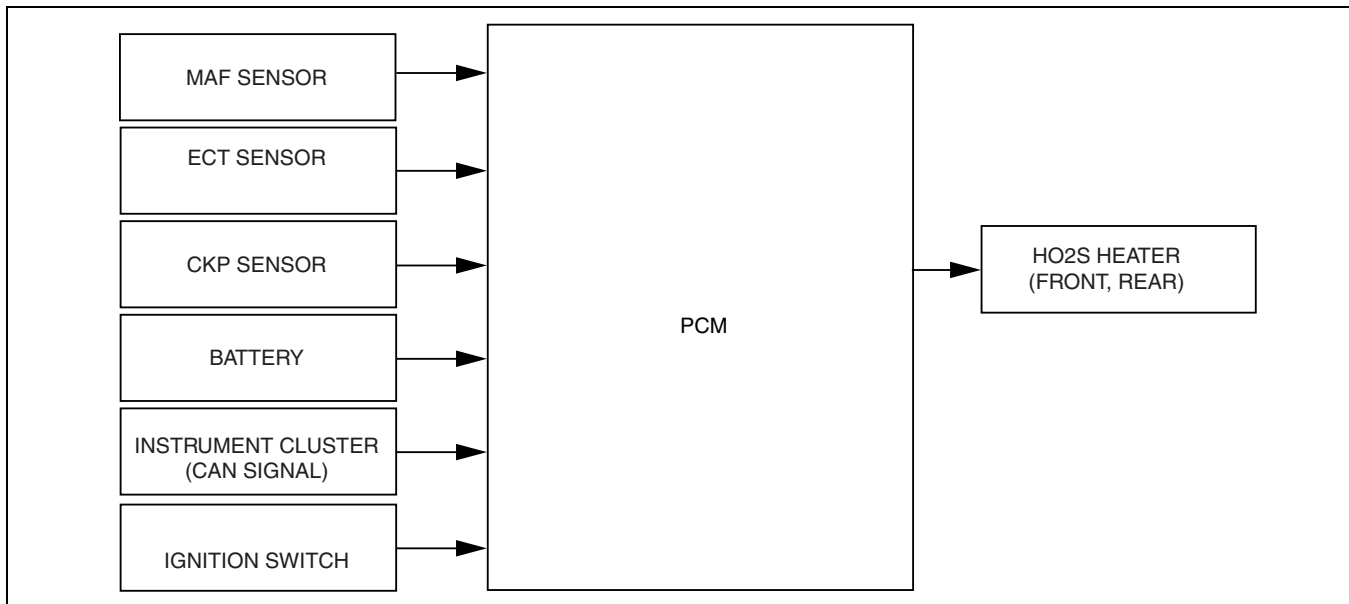
### HO2S HEATER CONTROL OUTLINE [L3 WITH TC]

E6U014000000S35

- 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).
- The water in the exhaust system at the engine start damages the HO2S. The pre-heater control has been adapted to prevent a damage.

### HO2S HEATER CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U014000000S36



E6U140ZS7060

### HO2S HEATER CONTROL OPERATION [L3 WITH TC]

E6U014000000S37

#### Pre-heater Control

##### Operation condition

- From the engine start to the threshold time: The PCM supplies voltage of approx. 6 V.

#### Cycle Estimated Control

##### Operation condition

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

HO2S	Activation condition	Drive signal
Front	<ul style="list-style-type: none"><li>• After engine start</li><li>• 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).</li><li>• ECT is 5°C {41°F} or more.</li><li>• Battery positive voltage is 9 V or more and less than 16 V.</li><li>• MAF sensor is normal (no DTC is stored in PCM).</li></ul>	<ul style="list-style-type: none"><li>• The PCM outputs a duty signal.</li><li>• The element temperature is measured by the impedance of the HO2S and a duty ratio is determined.</li></ul>
Rear	<ul style="list-style-type: none"><li>• Starter is off</li><li>• After engine start</li><li>• 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}).</li><li>• ECT is 10°C {50°F} or more.</li><li>• Battery positive voltage is 9 V or more and less than 16 V.</li><li>• Charging efficiency is the fixed value or less, or during fuel cut.</li></ul>	<ul style="list-style-type: none"><li>• The PCM outputs a duty signal. However the duty signal is either 100% or 0%.</li></ul>

## CONTROL SYSTEM [L3 WITH TC]

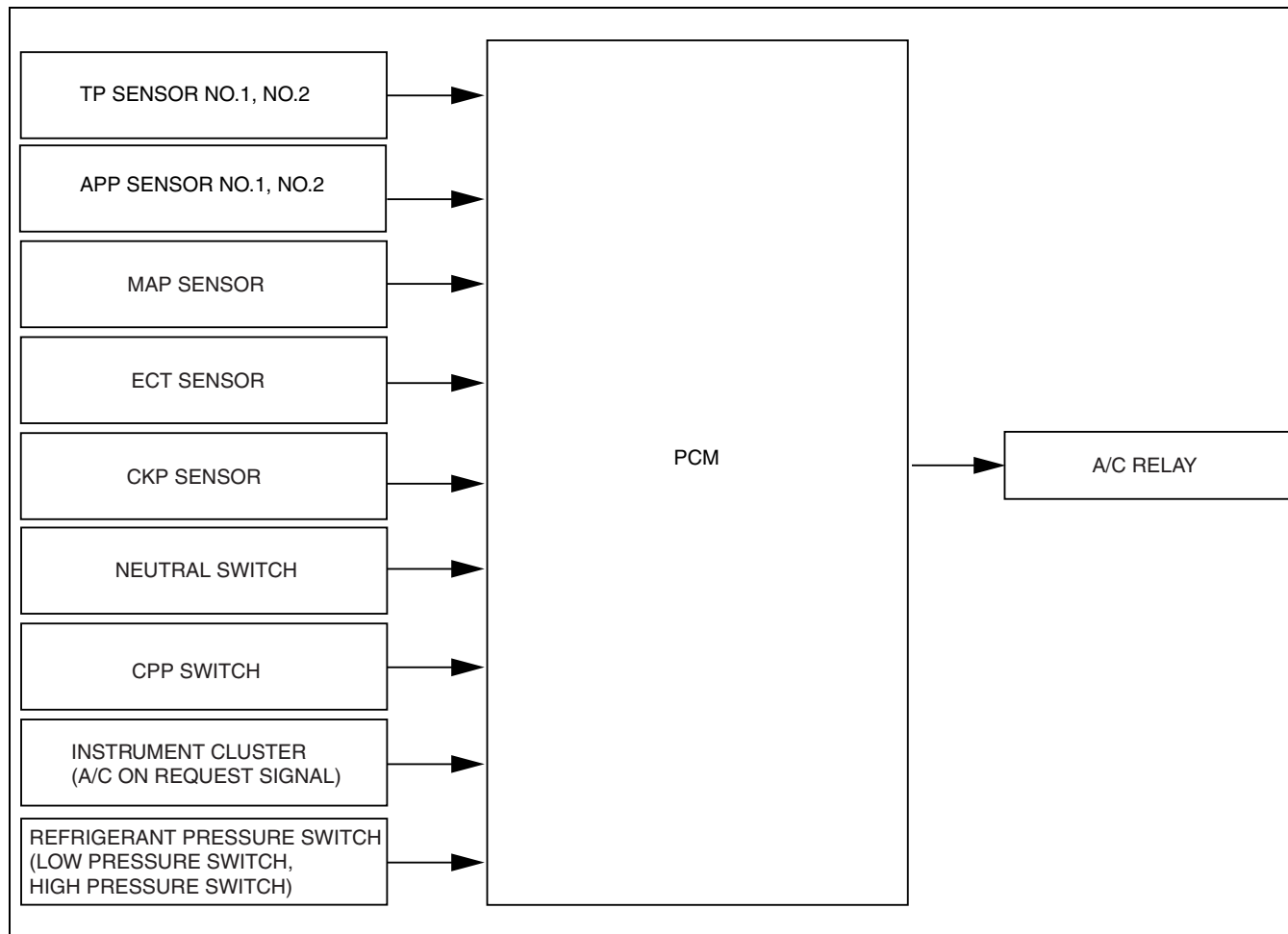
### A/C CUT-OFF CONTROL OUTLINE [L3 WITH TC]

E6U01400000S38

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

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

E6U01400000S39



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E6U140ZSC006

### A/C CUT-OFF CONTROL OPERATION [L3 WITH TC]

E6U01400000S40

- 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	<b>Approx. 4 s</b>	Improved startability
Fully open acceleration	<b>Approx. 3 s</b>	Improved drive-away performance
During acceleration (throttle valve opening angle <b>50% or more</b> )	<b>Approx. 5 s</b>	Improved acceleration performance
When the engine coolant temperature is <b>113 °C {235 °F}</b>	Repeatedly turns on and off <b>every 10 s</b> until the engine coolant temperature is less than <b>approx. 108 °C {226 °F}</b>	Improved engine reliability
When the engine coolant temperature is <b>118 °C {244 °F} or more</b>	Until the engine coolant temperature decreases to less than <b>approx. 110 °C {230 °F}</b>	Improved engine reliability
At high engine speed (engine speed <b>5,330 rpm or more</b> )	<b>Approx. 5 s</b> after engine speed is <b>4,830 rpm or less</b>	Improved engine speed stability

## CONTROL SYSTEM [L3 WITH TC]

### ELECTRICAL FAN CONTROL OUTLINE [L3 WITH TC]

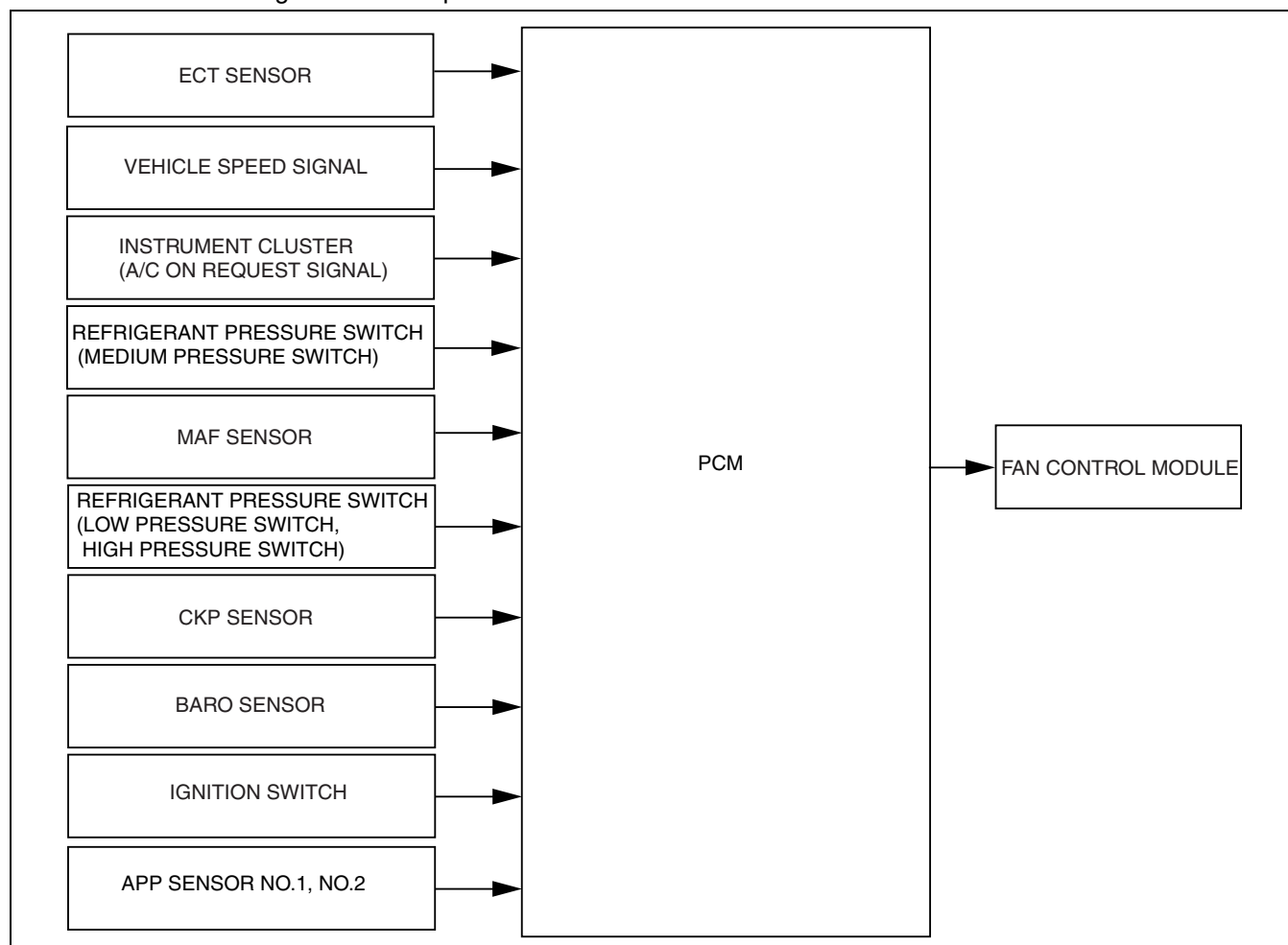
E6U01400000S41

- The cooling fan operates based on the vehicle condition to cool down the radiator and condenser, improving engine reliability and idling stability.
- The PCM determines the engine operation conditions based on the following input component signals to send appropriate fan rotation speed as a duty signal to the fan control module. Refer to the Section 0112 Cooling System, Fan Control Module Structure/Operation for the fan control module structure and operation.
- An after cooling control which operates the fan while the vehicle is stopped and the engine temperature is high has been adopted to suppress bubble formation and to improve re-startability.

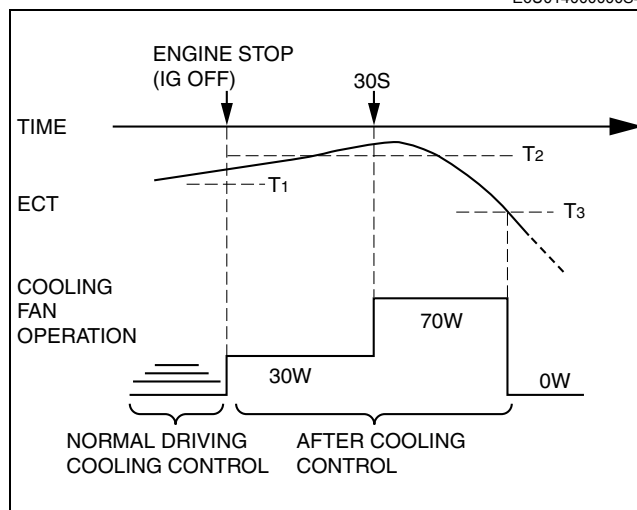
### ELECTRICAL FAN CONTROL BLOCK DIAGRAM [L3 WITH TC]

E6U01400000S42

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



E6U140ZSC005



E6U140ZSC023

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### Normal Driving Cooling Control

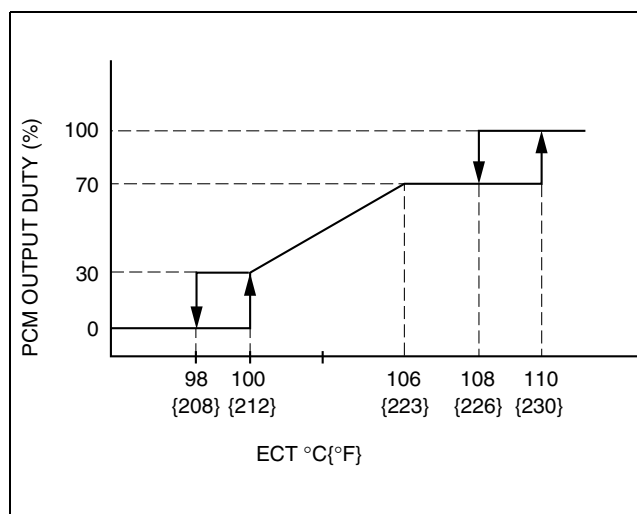
- Controls the PCM output duty ratio according to the engine coolant temperature as indicated in the graph.
- The control temperature while the engine coolant temperature is decreasing is controlled differently than when it is increasing.

### High-Altitude Fan Control

- Because bubbles are easily formed in high-altitude locations where the air pressure is low, the fan is operated to control even a small increase in engine coolant temperature.

### After Cooling Control

- If the engine coolant temperature is at the set value (T1) or more and the estimated water temperature increases to the specified value or more when the engine is stopped (the ignition switch is turned off), the after cooling control starts operating and the cooling fan is operated at 30 W.
- If the engine coolant temperature is at the set value (T2) or more after 30 s from when the cooling control operation started, the engine coolant temperature is determined to be increasing abnormally and the cooling fan is operated at 70 W.
- When the engine coolant temperature decreases to the set value (T3) or less with the cooling fan operation maintained at 30 W or 70 W, the cooling fan is stopped and the after cooling control finishes.



E6U140ZSC024

### When the A/C Signal is ON and the Refrigerant Pressure Signal is ON

- Turn the A/C switch ON and when the refrigerant pressure increases more than the given value, the control duty ratio from the PCM becomes **approx. 100%** regardless of the engine coolant temperature, and the cooling fan operates at the maximum speed.

### During Test Mode

- Turn on the test mode using the WDS or equivalent, and with the accelerator pedal depressed, the PCM fixes the control duty ratio at the maximum value.

### Fail-safe

- If the engine coolant temperature sensor is damaged, the PCM fixes the control duty ratio at the maximum value.

# CONTROL SYSTEM [L3 WITH TC]

## CONTROLLER AREA NETWORK (CAN) OUTLINE [L3 WITH TC]

E6U01400000S44

- 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 09–40–6 CAN SYSTEM DESCRIPTION.)

OUT: Output (sends signal)

IN: Input (receives signal)

Signal	Multiplex module					
	PCM	DSC HU/CM	AWD control module	Keyless control module	TPMS control module	Instrument cluster
Engine torque	OUT	IN	–	–	–	–
Torque reduction inhibit	OUT	IN	–	–	–	–
Engine speed	OUT	IN	IN	IN	–	IN
Vehicle speed	OUT	–	–	IN	IN	IN
TP	OUT	IN	IN	–	–	–
Neutral determination	OUT	–	IN	–	–	–
Gear ratio	OUT	IN	–	–	–	–
ECT	OUT	–	–	–	–	IN
Travelled distance	OUT	–	–	–	–	IN
	IN	OUT	–	–	–	–
MIL condition	OUT	–	–	–	–	IN
Generator warning light condition	OUT	–	–	–	–	IN
Engine specifications	OUT	IN	–	–	–	–
Tire circumference (front/rear)	OUT	IN	–	–	–	–
Cruise main indicator light condition	OUT	–	–	–	–	IN
Cruise set indicator light condition	OUT	–	–	–	–	IN
Brake pedal position	OUT	IN	IN	–	–	–
Steering wheel angle	–	OUT	IN	–	–	–
Brake fluid pressure	–	OUT	IN	–	–	–
Back-up light switch position	–	OUT	IN	–	–	–
Yaw rate	–	OUT	IN	–	–	–
Lateral-G	–	OUT	IN	–	–	–
Torque reduction request	IN	OUT	–	–	–	–
Brake system configuration (EBD/ABS/TCS/DSC)	–	OUT	IN	–	–	IN
Brake system status	EBD/ABS/TCS/DSC	–	OUT	IN	–	IN
Wheel speed (front left/front right/rear left/rear right)	IN	OUT	IN	–	–	–
Desired coupling torque	–	OUT	IN	–	–	–
AWD system condition	–	–	OUT	–	–	IN
Coupling torque	–	IN	OUT	–	–	–
Keyless warning buzzer on request	–	–	–	OUT	–	IN
Keyless indicator light on request	–	–	–	OUT	–	IN
Keyless warning light on request	–	–	–	OUT	–	IN
Tire pressure warning buzzer on request	–	–	–	–	OUT	IN
Tire pressure warning light indicate request	–	–	–	–	OUT	IN
Fuel tank level	IN	–	–	–	–	OUT
Brake fluid level	–	IN	–	–	–	OUT

## CONTROL SYSTEM [L3 WITH TC]

### PCM FUNCTION [L3 WITH TC]

E6U014018880S03

#### Function List

- The control descriptions are as shown below.

Function	Description
Electronic throttle control	By controlling the throttle actuator, the PCM sets an optimal throttle valve opening angle according to the engine speed and accelerator opening angle.
IAC	In order to ensure idling stability, the PCM controls the throttle valve and sets an optimal throttle valve opening angle based on the engine operating conditions.
Variable swirl control	At cold engine start, the following effects occur due to the closing of the variable swirl control for improved cold engine emission performance. <ul style="list-style-type: none"><li>Improved intake airflow speed near intake air valve</li><li>Strong air swirl occurs in the combustion chamber, promoting vaporization mixture of intake air and fuel</li></ul>
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 AWD control unit, ABS HU/CM, instrument cluster and DLC-2.
High pressure fuel pump control	The spill valve control solenoid valve is controlled to adjust the fuel pressure generated from the high pressure fuel pump.
Wastegate control	The wastegate control solenoid valve is controlled to properly adjust the charging efficiency according to the driving conditions.
Fuel pump speed control	Controls fuel pump speed control relay according to the fuel amount required by the engine.

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### PCM CONSTRUCTION/OPERATION [L3 WITH TC]

E6U014018880S04

#### Structure

- A 117-pin (four-block) PCM connector has been adopted.

## CONTROL SYSTEM [L3 WITH TC]

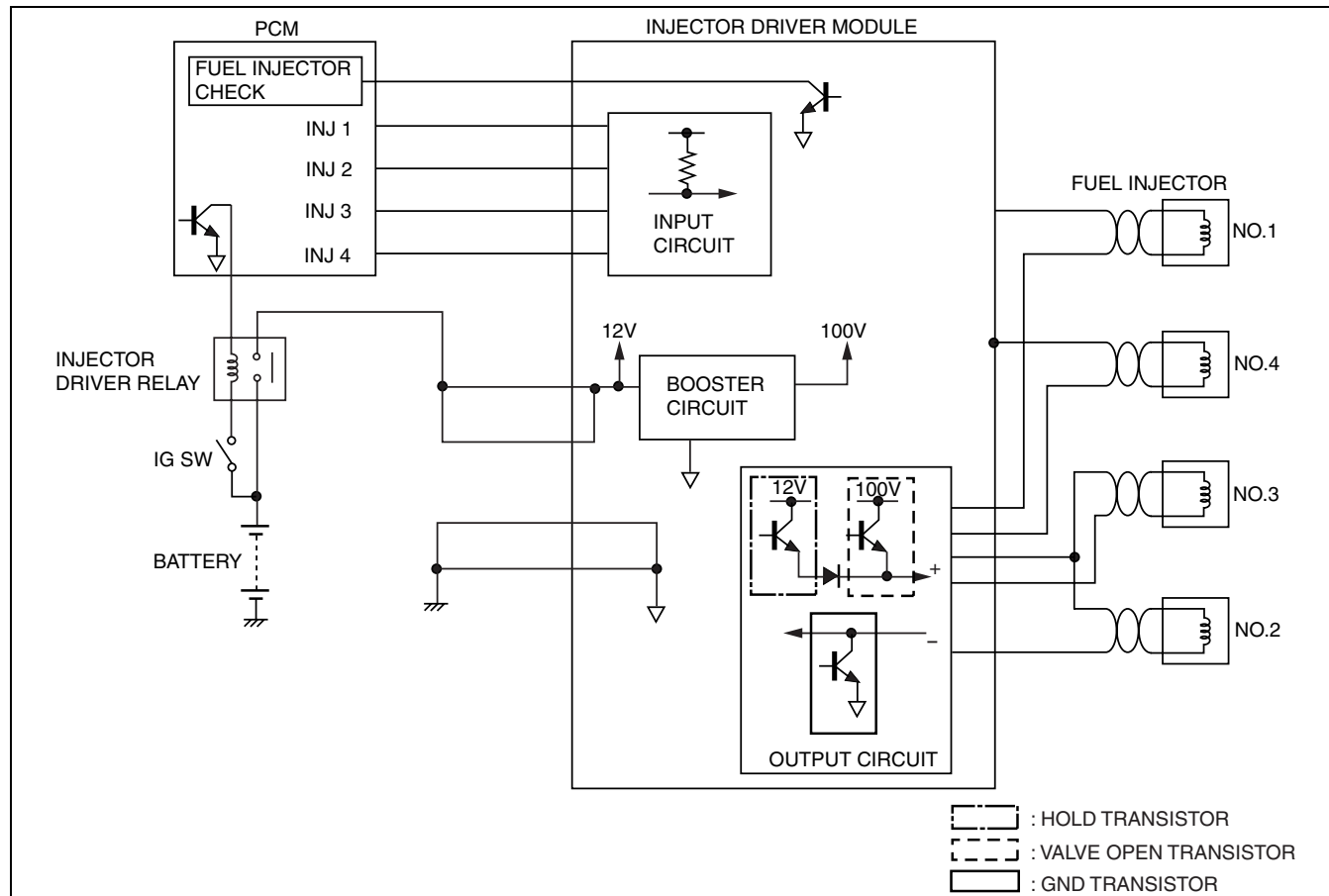
### INJECTOR DRIVER MODULE (IDM) FUNCTION [L3 WITH TC]

E6U014018701S01

- An injector driver module which can provide high voltage has been adopted to drive the fuel injector which corresponds to a base high fuel pressure of **3—11.5 Mpa {31—117 kgf/cm<sup>2</sup>, 435—1667 psi}**.
- The injector driver module is located on the side frame under the battery tray.
- The injector driver module provides the boosted voltage to the fuel injector according to the fuel injection signal from the PCM.

### INJECTOR DRIVER MODULE (IDM) CONSTRUCTION/OPERATION [L3 WITH TC]

E6U014018701S02



E6U140ZSC018

#### Boost Circuit

- The battery positive voltage input via the injector driver relay is boosted up to **100 V**.

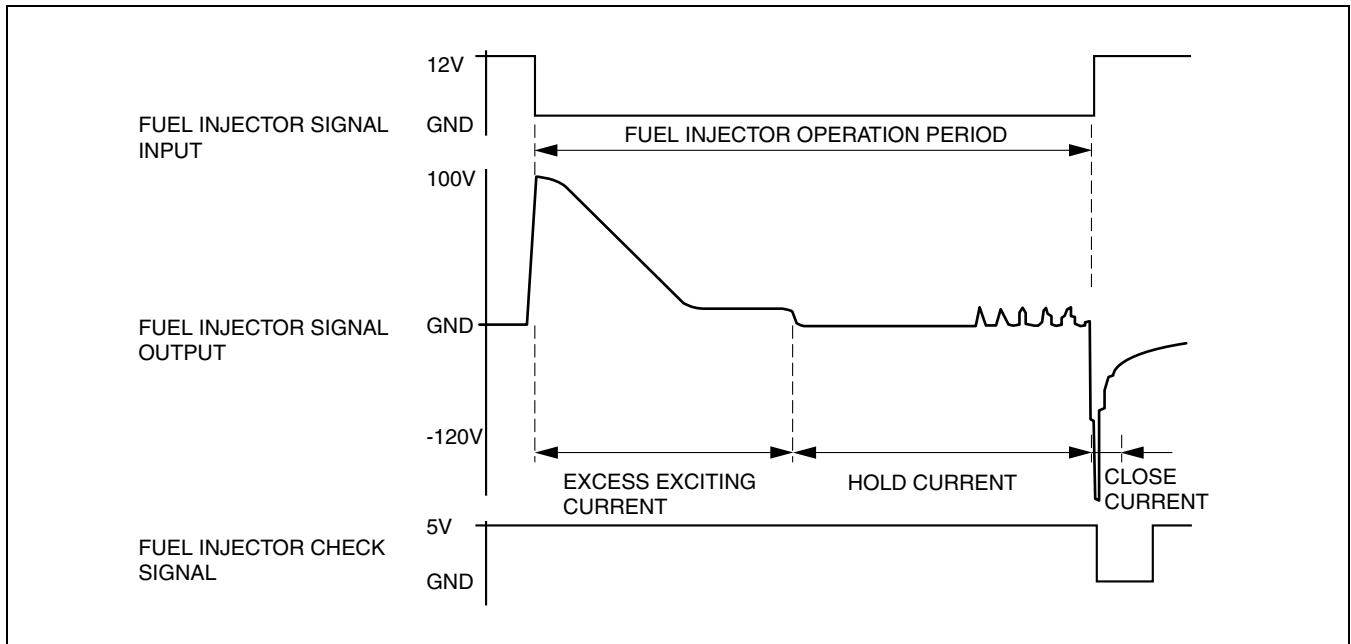
#### Output Circuit

- To improve fuel injection response, the plunger pulling force is strengthened by providing high current (over excitation current) when the fuel injector is open.
- To reduce fuel injector heat generation, the opening of the fuel injector is kept opened using low current after it opens.

Fuel injector status	Injector driver module operation
Opening starts	<ol style="list-style-type: none"> <li>1. Provides 100 V, boosted by the boost circuit, to the opening transistor (<b>100 V</b> output).</li> <li>2. When the voltage is provided to the fuel injector and turns on the GND transistor, the fuel injector opens.</li> <li>3. After the fuel injector is opened, the opening transistor is turned off.</li> </ol>
Opening held	<ul style="list-style-type: none"> <li>• Controls the on/off of the holding transistor (<b>12 V</b> output) so that the hold current of the fuel injector is constant.</li> </ul>
Closing	<ul style="list-style-type: none"> <li>• Turns off the holding and GND transistors at the same time the fuel injection signal from the PCM is stopped, and cuts the current.</li> </ul>

### Fuel Injection Verification Circuit

- The fuel injection verification circuit detects the breaking current (surge voltage) generated during the opening, and outputs the injection verification signal to the PCM. The PCM detects a malfunction in the fuel injector circuit based on this signal.



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- The fuel injector signal output shown in the figure indicates the waveform when both ends of the fuel injector are measured.

## CAMSHAFT POSITION (CMP) SENSOR FUNCTION [L3 WITH TC]

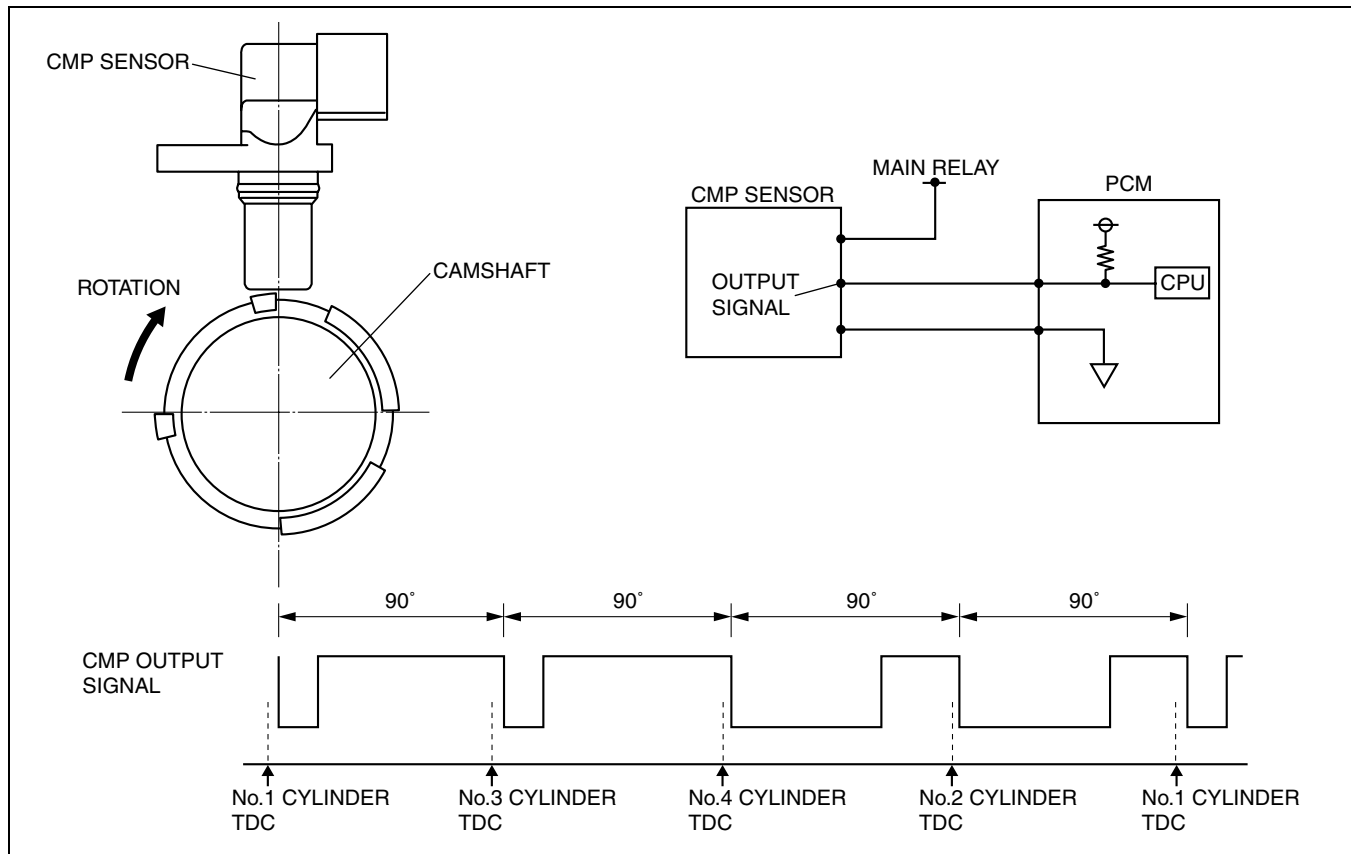
E6U014018230S03

- The camshaft angle and TDC at each cylinder is detected.

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

E6U014018230S04

- Installed on the engine head cover.
- Four pulses per one camshaft rotation are detected by a wide projection and a narrow projection installed on the intake air side camshaft.
- Consists of an IC with a giant magneto resistive (GMR) element and an integrated signal processing circuit, and a magnet. Signal reliability has been improved with the adoption of the GMR element resulting in the signal amplitude being wider compared to the hall element.
- Signal detection uses the special characteristics of GMR to change the electrical resistance corresponding to the magnetic field.
- The size of the magnetic field detected by the GMR element is changed into short waves at the signal processing circuit, and then input to the PCM as a sensor output signal.
- If the camshaft position sensor is removed/installed or replaced, magnetized objects such as metal shavings adhering to the sensor could cause distortion in the magnetic flux of the magnetic pickup coil, causing abnormal sensor output which could adversely affect the engine control.



E6U140ZSC019

## CRANKSHAFT POSITION (CKP) SENSOR FUNCTION [L3 WITH TC]

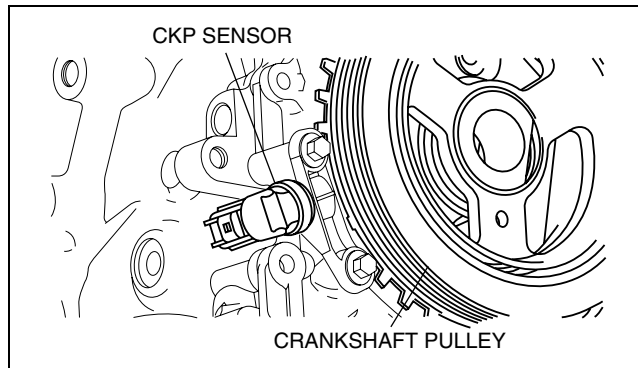
E6U014018220S03

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

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

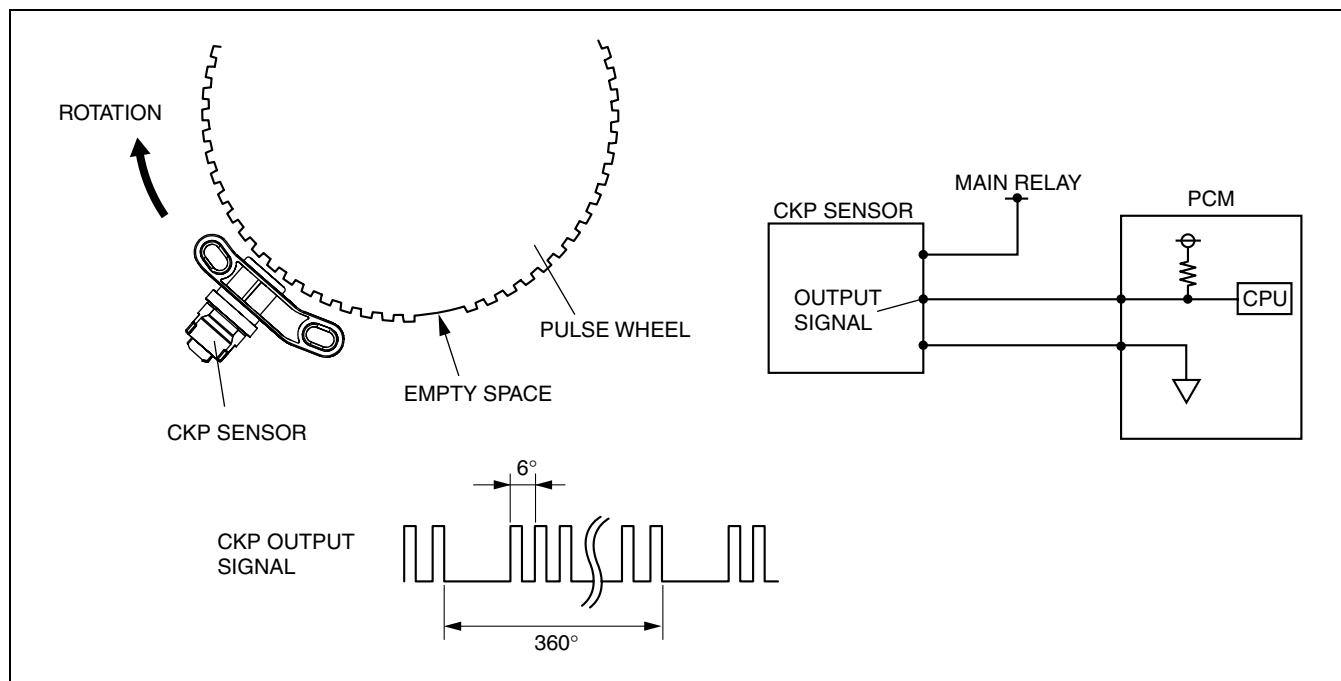
E6U014018220S04

- Installed on the side surface of the cylinder block (driver's side). Assembled at the twentieth pulse position ( $120^\circ$ ) from the area where there is no single projection on the crankshaft position sensor pulse wheel.
- The crankshaft position sensor pulse wheel has 58 projections with  $6^\circ$  of crank angle between the rising edge of each projection.
- Consists of an IC with a giant magneto resistive (GMR) element and an integrated signal processing circuit, and a magnet. Signal reliability has been improved with the adoption of the GMR element resulting in the signal amplitude being wider compared to the hall element.
- Signal detection uses the special characteristics of GMR to change the electrical resistance corresponding to the magnetic field.
- The size of the magnetic field detected by the GMR element is changed into short waves at the signal processing circuit, and then input to the PCM as a sensor output signal.
- If the crankshaft position sensor is removed/installed or replaced, magnetized objects such as metal shavings adhering to the sensor could cause fluctuation in the magnetic flux of the magnetic pickup coil, causing abnormal sensor output which could adversely affect engine control.



C3U0140S036

01-40B



E6U140ZSC020

## CONTROL SYSTEM [L3 WITH TC]

### BOOST AIR TEMPERATURE SENSOR FUNCTION [L3 WITH TC]

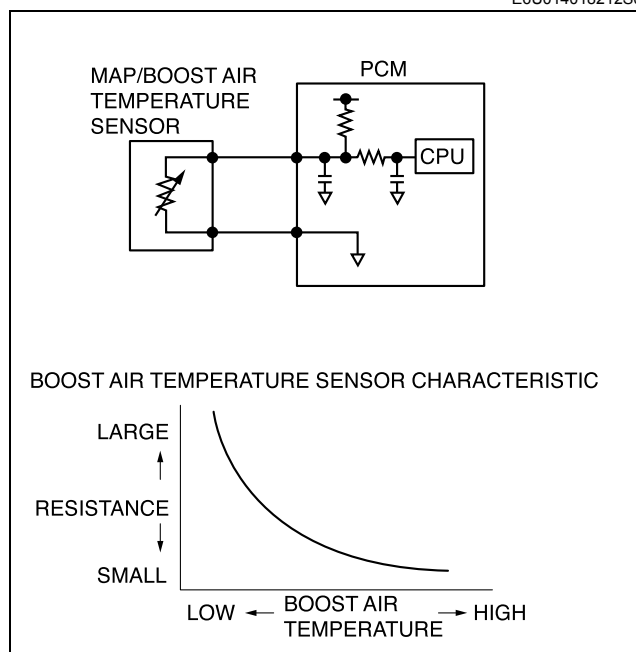
E6U014018212S01

- Detects the intake air temperature after the air passes through the charge air cooler.

### BOOST AIR TEMPERATURE SENSOR CONSTRUCTION/OPERATION [L3 WITH TC]

E6U014018212S02

- The boost air temperature sensor is built into the MAP sensor.
- The boost air temperature 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.



E6U140ZSC028

### FUEL PRESSURE SENSOR FUNCTION [L3 WITH TC]

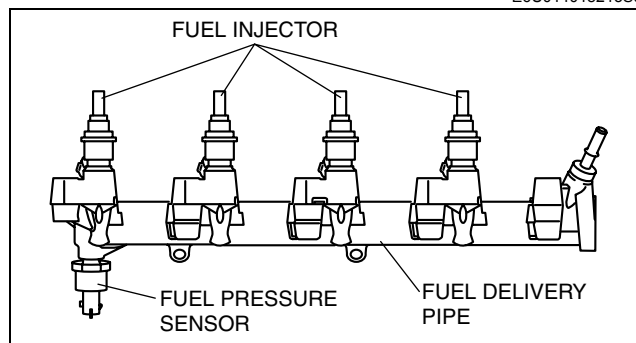
E6U014018213S01

- Monitors the fuel pressure in the fuel delivery pipe.

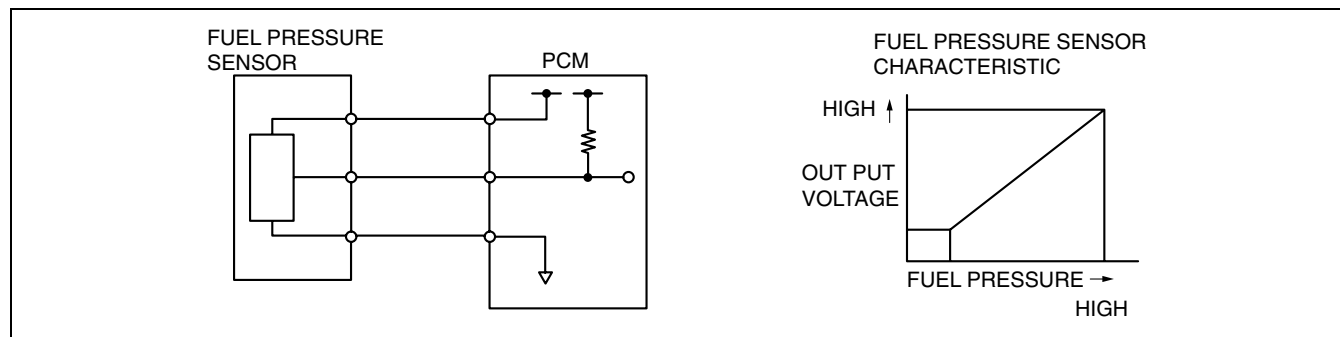
### FUEL PRESSURE SENSOR CONSTRUCTION/OPERATION [L3 WITH TC]

E6U014018213S02

- Installed to the end of the fuel delivery pipe.
- When pressure is applied to the piezoelectric element in the sensor, an electric potential difference occurs.
- Output voltage increases as the fuel pressure increases.



D6U140ZWC007



D6U140ZWC008

### BAROMETRIC PRESSURE (BARO) SENSOR OUTLINE [L3 WITH TC]

E6U014018211S03

- A barometric pressure sensor which has the same characteristics as the 2005MY model has been built-into the PCM.

## 01-40C CONTROL SYSTEM [AJ]

CONTROL SYSTEM DIAGRAM [AJ] . . . 01-40C-1

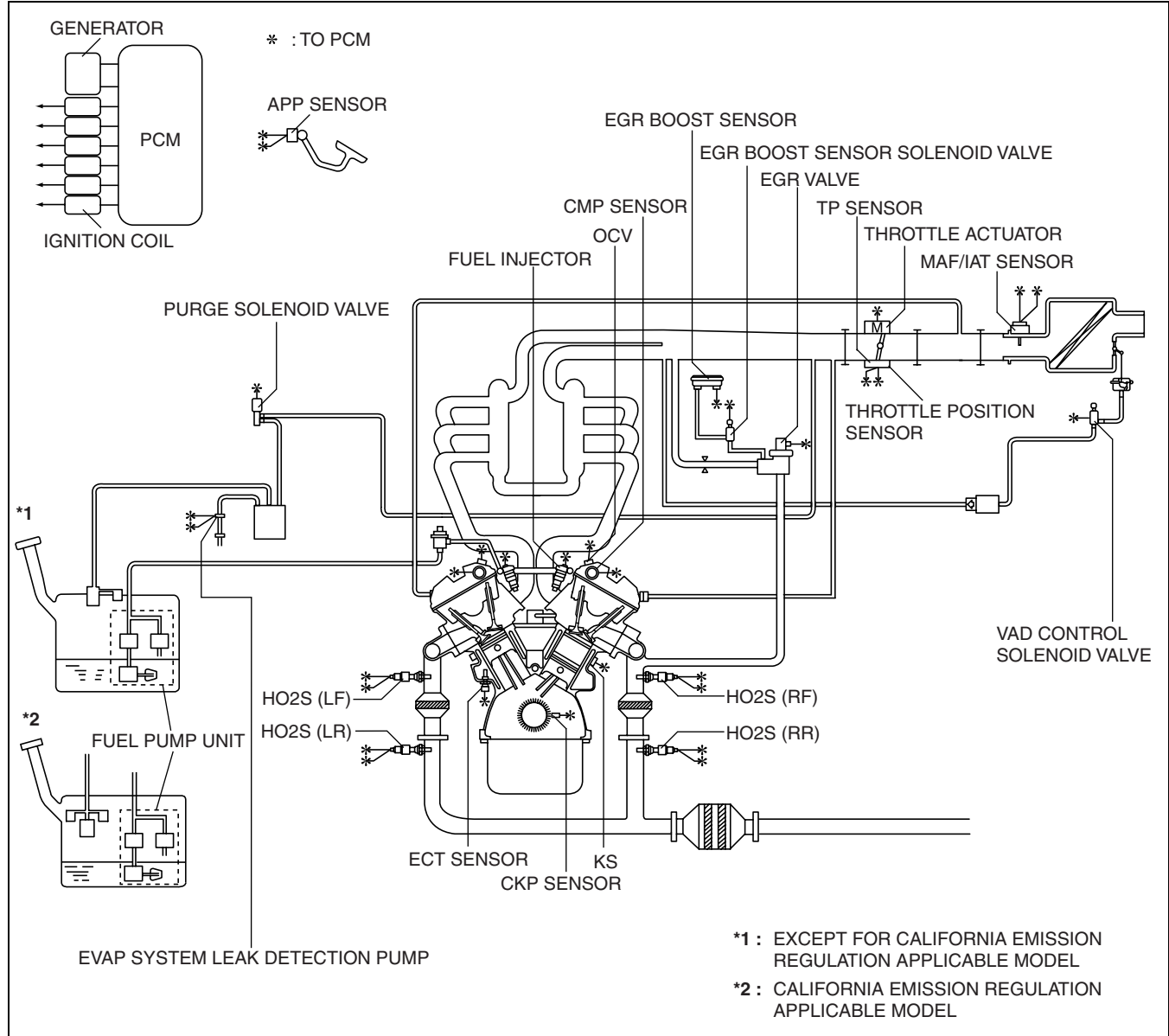
CONTROL SYSTEM WIRING

DIAGRAM [AJ] . . . . . 01-40C-2

### CONTROL SYSTEM DIAGRAM [AJ]

E6U01400000S03

01-40C

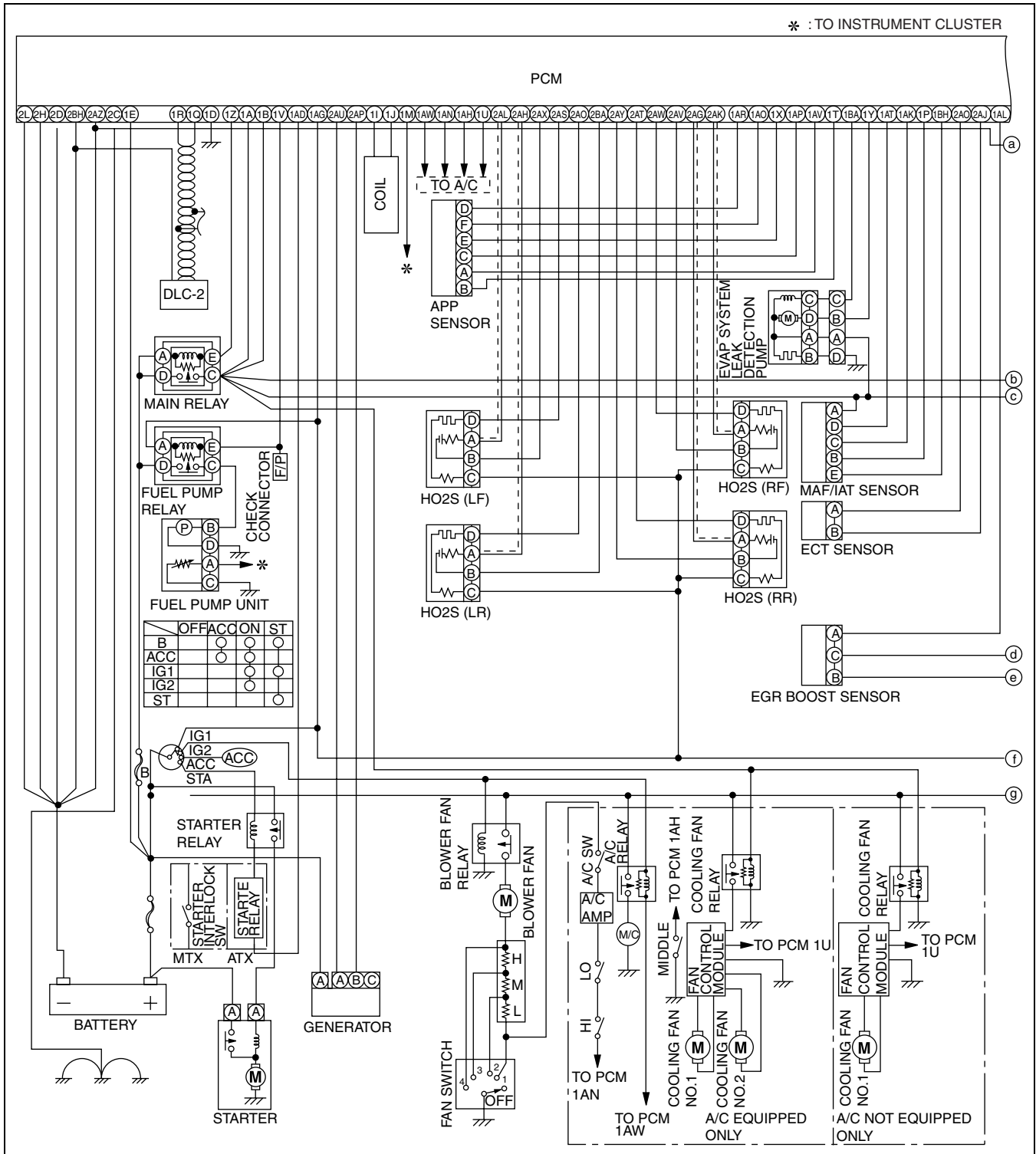


E6U140BW5L02

# CONTROL SYSTEM [AJ]

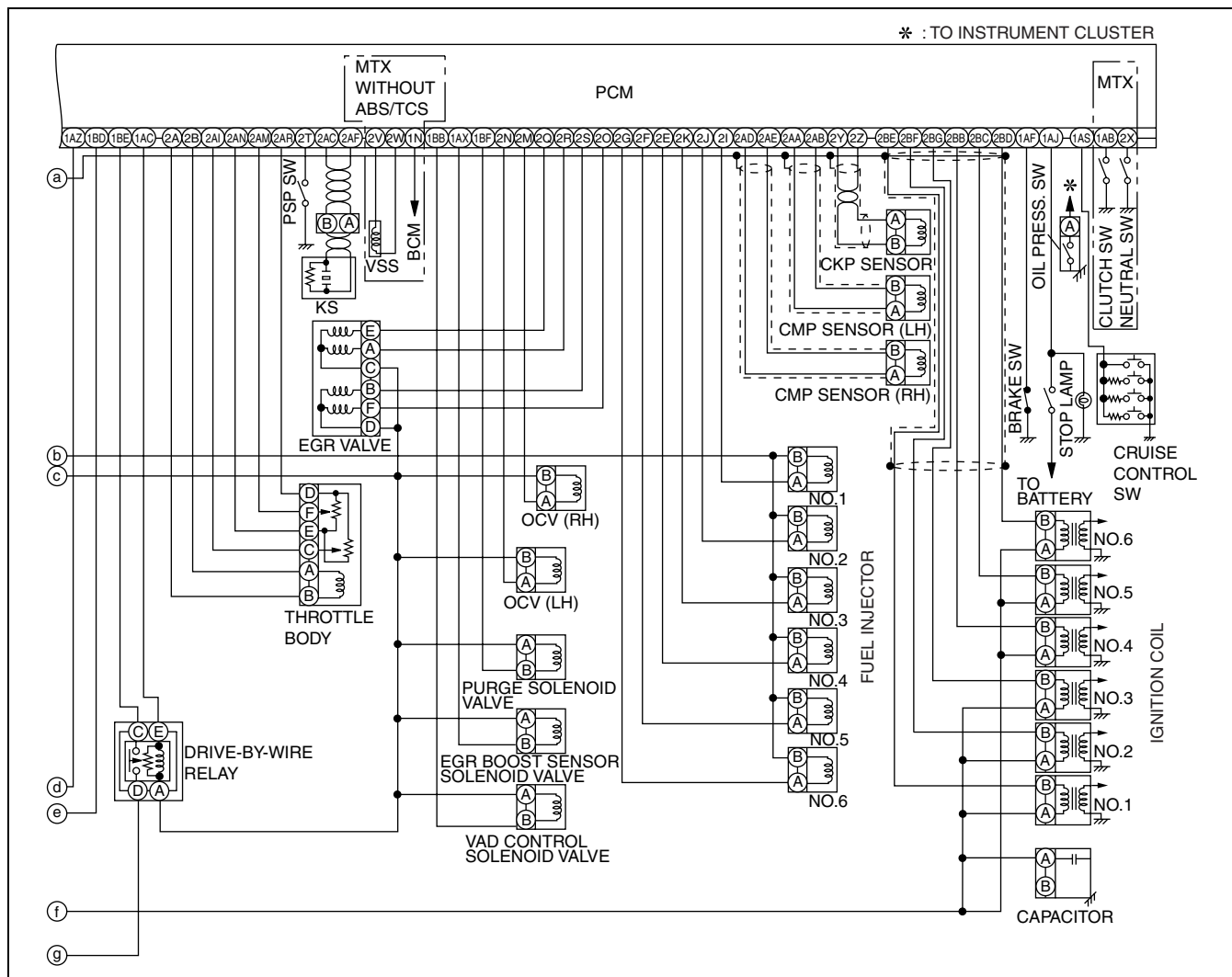
## CONTROL SYSTEM WIRING DIAGRAM [AJ]

E6U01400000S01



E6U000BW5L01

# CONTROL SYSTEM [AJ]



E6U000BW5L02

01-40C



# SUSPENSION

**02**  
SECTION

OUTLINE ..... 02-00

WHEEL AND TIRES. .... 02-12

02-00

## 02-00 OUTLINE

SUSPENSION FEATURES. .... 02-00-1

SUSPENSION SPECIFICATIONS. .... 02-00-1

### SUSPENSION FEATURES

E6U02000000S02

Improved rigidity	<ul style="list-style-type: none"> <li>Suspension characteristic has been optimized for 2006MY MAZDASPEED6</li> </ul>
Improved marketability	<ul style="list-style-type: none"> <li>An 18-inch aluminum alloy wheel has been adopted</li> </ul>

### SUSPENSION SPECIFICATIONS

E6U02000000S03

Item				Specification				
				2006MY MAZDASPEED6		2006MY Mazda6		2005MY Mazda6
				4SD	4SD, 5HB	WGN	4SD	
Front suspension	Type			High-mount double wishbone (with double-pivoted lower arm(s))			←	
	Spring type			Coil spring			←	
	Shock absorber type			Cylindrical, double-acting (Low-pressure gas charged with rebound spring)			←	
	Stabilizer	Type		Torsion bar			←	
		Diameter	(mm {in})	24 {0.94}	23 {0.91}		23 {0.91}	
	Wheel alignment (Unloaded)*1	Total toe-in	(mm {in})	Tire: 2±4 {0.08±0.16} Rim inner: 1.4±2.8 {0.06±0.12}			←	
			(degree)	0°11'±0°22'			←	
		Maximum steering angle	Inner	36°±3°	34°±3°		34°±3°	
			Outer	30°±3°	29°±3°		29°±3°	
		Caster angle*2	16-inch wheel	—	3°47'±1° (reference value)	L3: 3°40'±1° (reference value) AJ: 3°39'±1° (reference value)	3°47'±1° (reference value)	
			17-inch wheel	—				
			18-inch wheel	3°53'±1° (reference value)				
		Camber angle*2		−0°17'±1° (reference value)	L3: −0°17'±1° (reference value) AJ: −0°18'±1° (reference value)	−0°17'±1° (reference value)	−0°17'±1° (reference value)	
		Steering axis inclination		5°30' (reference value)	L3: 5°28' (reference value) AJ: 5°29' (reference value)	L3: 5°25' (reference value) AJ: 5°27' (reference value)	5°28' (reference value)	

# OUTLINE

Item				Specification				
				2006MY MAZDASPEED6		2006MY Mazda6		2005MY Mazda6
				4SD		4SD, 5HB	WGN	4SD
Rear suspension	Type			E-type multi-link			←	
	Spring type			Coil spring			←	
	Stabilizer	Type		Torsion bar			←	
		Diameter	(mm {in})	23 {0.91}	19 {0.75}		19 {0.75}	
	Shock absorber type			Cylindrical, double-acting (Low-pressure gas charged)			←	
	Wheel alignment (Unloaded)*1	Total toe-in	(mm {in})	Tire: 2±4 {0.08±0.16} Rim inner: 1.4±2.8 {0.06±0.12}			←	
			(degree)	0°11'±0°22'			←	
		Camber angle*2		-1°37'±1° (reference value)	-1°13'±1° (reference value)	-1°06'±1° (reference value)	-1°13'±1° (reference value)	
		Thrust angle	(degree)	0°±0°48'			←	

\*1 : Engine coolant and engine oil are at specified level. Fuel is full. Spare tire, jack and tools are in designated position.

\*2 : Difference between left and right must not exceed 1°30'.

## Wheel and Tires

Item		Specification		
Standard tire and wheel				
Tire	Size	P205/50R16 91V	P215/50R17 93V	2006MY Mazda6: 215/45R18 93W 2006MY MAZDASPEED6: 215/45R18 93Y
Wheel	Size	16 × 6 1/2JJ	17 × 7JJ	18 × 7J
	Offset (mm {in})	55 {2.17}	60 {2.36}	55 {2.17}
	Pitch circle diameter (mm {in})	114.3 {4.50}		
	Material	Steel	Aluminum alloy	
Temporary spare tire				
Tire	Size	T115/70 D16		2006MY Mazda6: T115/70 D16 2006MY MAZDASPEED6: T145/70 D17
Wheel	Size	16×4T		2006MY Mazda6: 16×4T 2006MY MAZDASPEED6: 17×4T
	Offset (mm {in})	40 {1.57}		
	Pitch circle diameter (mm {in})	114.3 {4.50}		
	Material	Steel		

## 02-12 WHEEL AND TIRES

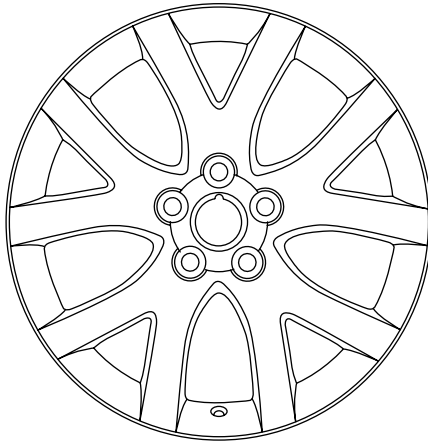
WHEELS AND TIRES  
STRUCTURAL VIEW..... 02-12-1

### WHEELS AND TIRES STRUCTURAL VIEW

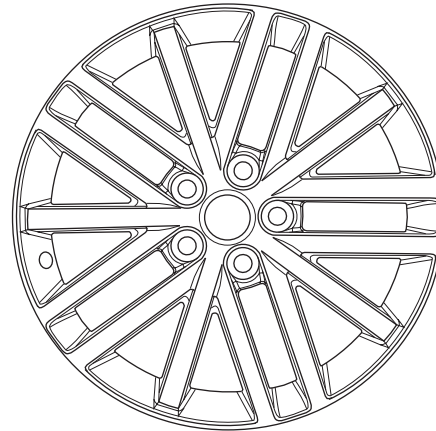
E6U021200000S02

STYLED SIDE OF WHEEL  
18-INCH ALUMINUM ALLOY WHEEL

2006MY Mazda6



2006MY MAZDASPEED6



E6U212ZS7001

02-12



# DRIVELINE/AXLE

# 03

SECTION

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**ON-BOARD DIAGNOSTIC . . . 03-02**  
**REAR AXLE . . . . . 03-12**  
**DRIVE SHAFT . . . . . 03-13**

**DIFFERENTIAL . . . . . 03-14**  
**TRANSFER . . . . . 03-16**  
**ALL WHEEL DRIVE (AWD) . . . 03-19**

03-00

## 03-00 OUTLINE

**DRIVELINE/AXLE ABBREVIATIONS . . . 03-00-1**  
**DRIVELINE/AXLE FEATURES . . . . . 03-00-1**

**DRIVELINE/AXLE SPECIFICATIONS . . . . 03-00-2**

### DRIVELINE/AXLE ABBREVIATIONS

E6U03000000S01

ATF	Automatic Transaxle Fluid
API	American Petroleum Institute
AWD	All-Wheel Drive
CAN	Controller Area Network
CM	Control Module
DSC	Dynamic Stability Control
HU	Hydraulic Unit
LSD	Limited Slip Differential
MTX	Manual Transaxle
OFF	Switch Off
ON	Switch On
SAE	Society of Automotive Engineers
WDS	Worldwide Diagnostic System

### DRIVELINE/AXLE FEATURES

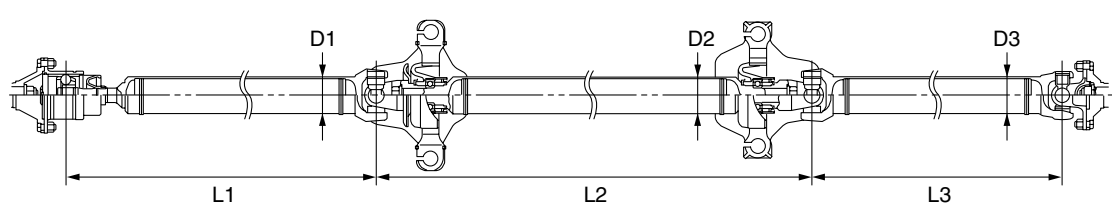
E6U03000000S02

Improved rigidity, reduced noise and vibration	<ul style="list-style-type: none"><li>• Characteristics of front drive shaft optimized</li><li>• Constant velocity joint type rear drive shaft adopted</li><li>• 3-part, 4-joint type propeller shaft with middle shaft bearing has been adopted</li></ul>
Improved off-road mobility, handling stability and marketability	<ul style="list-style-type: none"><li>• Electronic AWD control system adopted</li></ul>
Size and weight reduction	<ul style="list-style-type: none"><li>• Rear differential with an integrated coupling component adopted</li><li>• Aluminum differential carrier adopted</li></ul>
Improved driveability	<ul style="list-style-type: none"><li>• Super-LSD adopted</li></ul>
Improved serviceability	<ul style="list-style-type: none"><li>• Self diagnostic function adopted for electronic AWD control system</li></ul>
Improved reliability	<ul style="list-style-type: none"><li>• Separate oil pump and oil cooler have been adopted to the transfer</li></ul>

# OUTLINE

## DRIVELINE/AXLE SPECIFICATIONS

E6U03000000S03

Item		Specification		
		2006MY MAZDASPEED6	2006MY Mazda6	2005MY Mazda6
Front axle				
Bearing type		Angular ball bearing		←
Rear axle				
Bearing type		Angular ball bearing		←
Front drive shaft				
Front drive shaft joint type	Wheel side	Bell joint		←
	Differential side	Double offset joint	ATX: Tripod joint MTX: Double offset joint	←
Front drive shaft diameter (mm {in})		27.0 {1.06}		25.0 {0.99}
Joint shaft diameter (mm {in})		28.0 {1.10}		26.0 {1.02}
Rear drive shaft (AWD)				
Rear drive shaft joint type	Wheel side	Bell joint	—	—
	Differential side	Double offset joint		
Rear drive shaft diameter (mm {in})		24.0 {0.94}		
Rear differential (AWD)				
Rear and front wheel torque distribution unit		Electronic control coupling	—	—
Reduction gear		Hypoid gear		
Differential gear		Straight bevel gear		
Ring gear size (Inches)		7.4		
Final gear ratio		2.928		
Gears: Number of teeth	Drive pinion	14		
	Ring gear	41		
Differential oil	Type	Grade	API service GL-5	
		Viscosity	SAE 80W-90	
	Amount (Approximate quantity)	(L {US qt, Imp qt})	1.0 {1.1, 0.9}	
Propeller shaft (AWD)				
Length (mm {in})	L1	728 {28.66}	—	—
	L2	750 {29.53}		
	L3	454 {17.87}		
Outer diameter (mm {in})	D1	60.5 {2.38}		
	D2	60.5 {2.38}		
	D3	60.5 {2.38}		
				
Joint type		Constant velocity joint and cross-shaped joint	—	—
Constant velocity joint		Double offset joint		
Transfer (AWD)				
Transfer oil	Type	Grade	API service GL-5	—
		Viscosity	SAE 80 or 90	
	Oil capacity (approx. quantity)	(L {US qt, Imp qt})	1.2 {1.3, 1.1}	

## 03-02 ON-BOARD DIAGNOSTIC

### ON-BOARD DIAGNOSTIC OUTLINE

#### [ELECTRONIC AWD CONTROL

SYSTEM] . . . . . 03-02-1

Block Diagram . . . . . 03-02-1

Self-diagnostic Function . . . . . 03-02-1

External Tester Communication

Function . . . . . 03-02-2

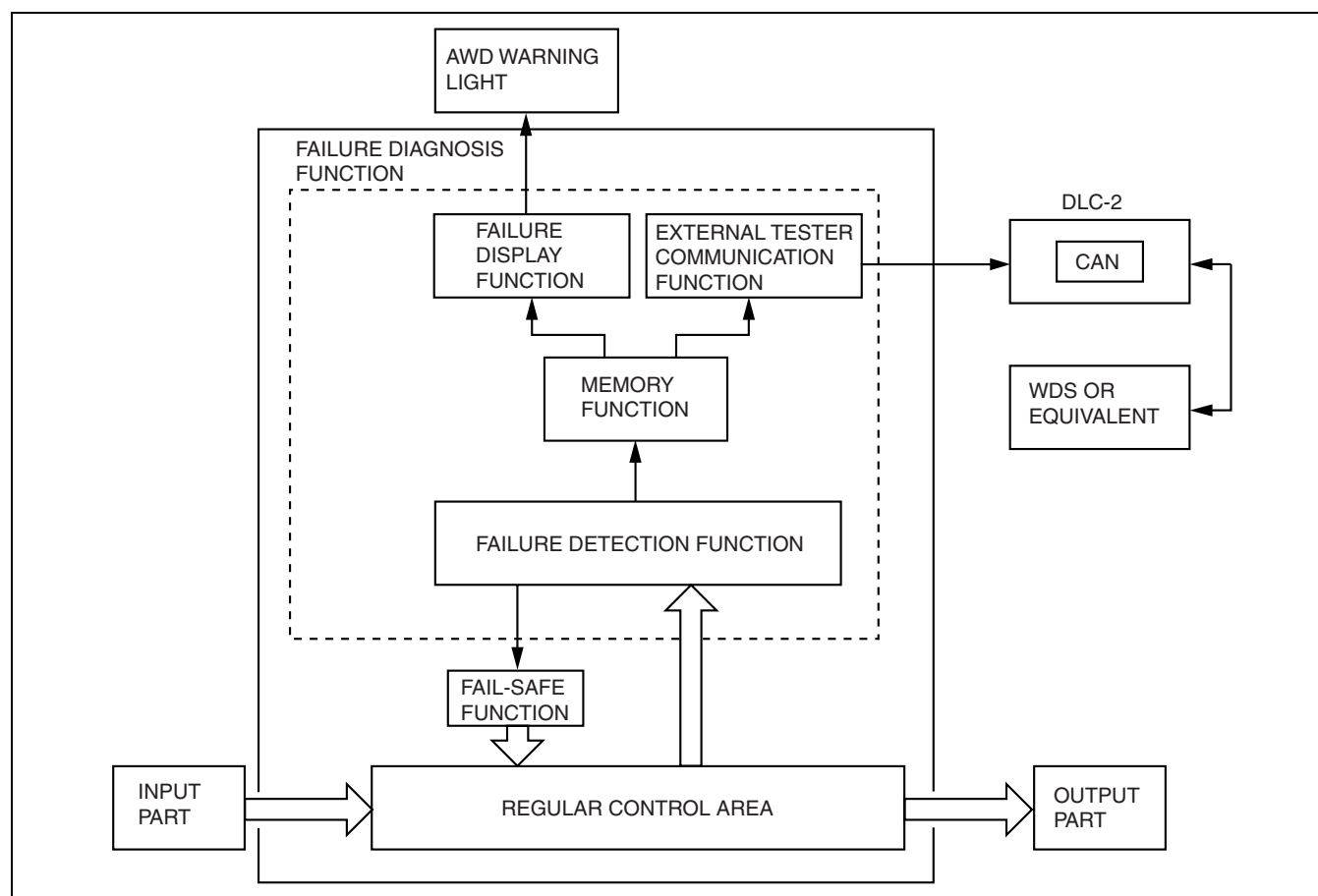
### ON-BOARD DIAGNOSTIC OUTLINE [ELECTRONIC AWD CONTROL SYSTEM]

E6U030227100S01

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

03-02

### Block Diagram



E6U3022S6001

### Self-diagnostic Function

#### Failure detection function

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

## ON-BOARD DIAGNOSTIC

### Memory function

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

### Fail-safe function

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

X:Available

DTC	Malfunction location	AWD warning light condition	DTC stored in memory	Control condition
P1887	AWD solenoid circuit	Illuminated	X	Stop
P1888	Differential oil temperature sensor circuit	Illuminated	X	Stop
U0073	CAN system communication error	Illuminated	X	Stop
U0100	Communication error to PCM	Illuminated	X	Stop
U0121	Communication error to DSC HU/CM	Illuminated <sup>*1</sup>	X	Stop <sup>*2</sup>

<sup>\*1</sup> : Does not illuminate when only the coupling torque request signal from the DSC HU/CM cannot be received.

<sup>\*2</sup> : Only integrated DSC control is prohibited when only the coupling torque request signal from the DSC HU/CM cannot be received.

### External Tester Communication Function

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

## 03-12 REAR AXLE

REAR AXLE OUTLINE ..... 03-12-1

REAR AXLE CROSS-SECTIONAL  
VIEW .....03-12-1

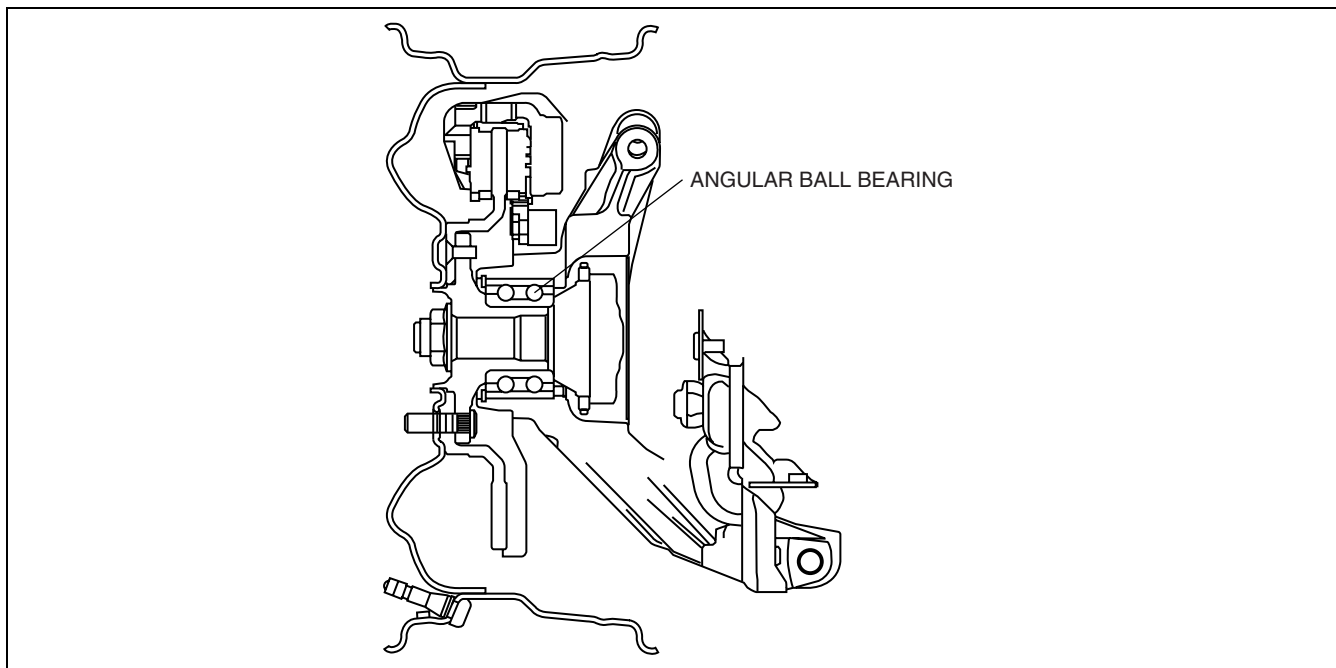
### REAR AXLE OUTLINE

E6U031205000S01

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

### REAR AXLE CROSS-SECTIONAL VIEW

E6U031205000S02



E6U312ZSC001

03-12



## 03-13 DRIVE SHAFT

DRIVE SHAFT OUTLINE ..... 03-13-1  
DRIVE SHAFT STRUCTURAL VIEW ... 03-13-1

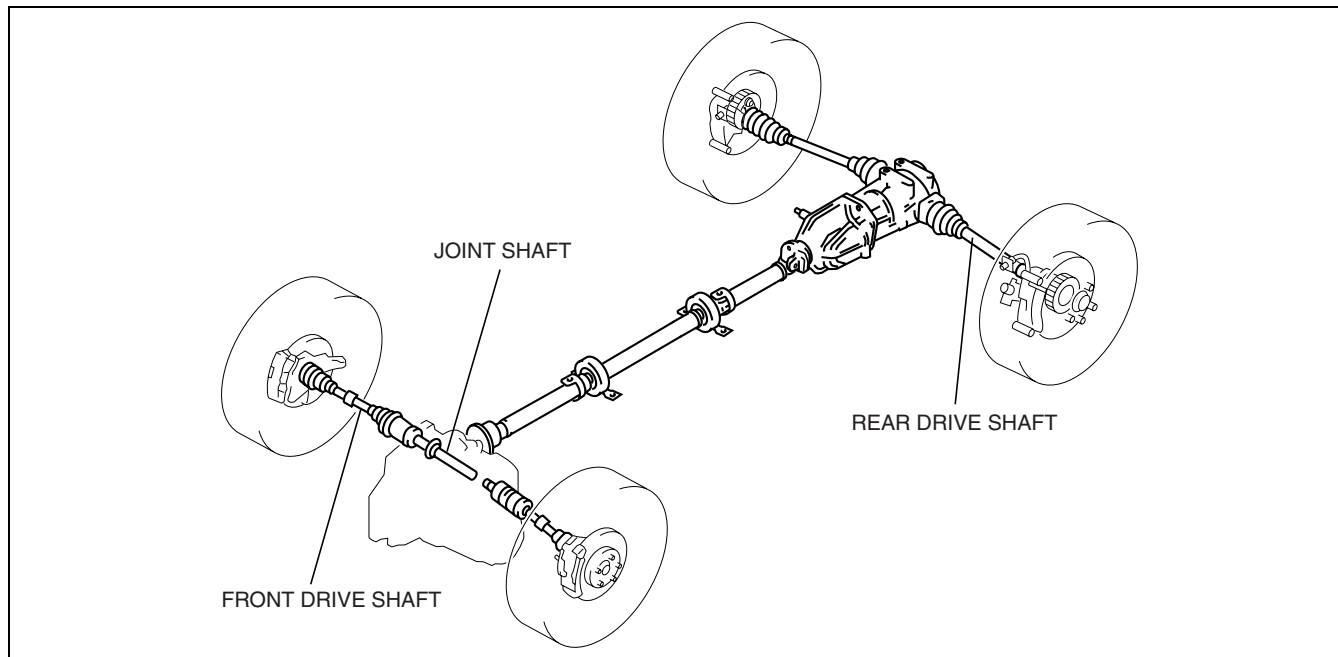
REAR DRIVE SHAFT STRUCTURE ....03-13-1

### DRIVE SHAFT OUTLINE

- A large size front drive shaft and joint shaft has been adopted, improving driveability and reducing noise/vibration. E6U031325501S01
- A constant velocity joint system has been adopted for the rear drive shaft, improving driveability and reducing noise/vibration.

### DRIVE SHAFT STRUCTURAL VIEW

E6U031325501S02

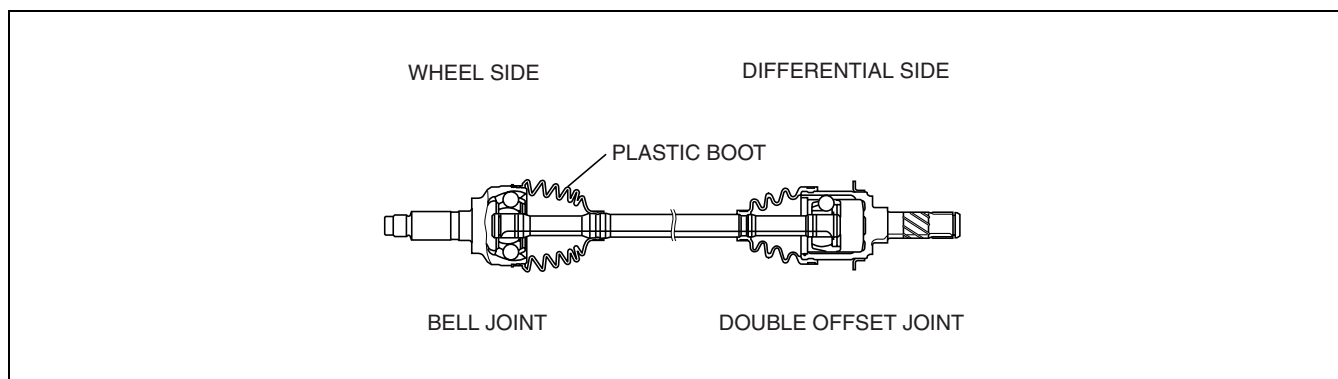


E6U313ZSC001

### REAR DRIVE SHAFT STRUCTURE

E6U031325501S03

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



E6U313ZSC002



## 03-14 DIFFERENTIAL

REAR DIFFERENTIAL OUTLINE .....	03-14-1
REAR DIFFERENTIAL CROSS-SECTIONAL VIEW .....	03-14-1
SUPER-LSD OUTLINE .....	03-14-2
SUPER-LSD CONSTRUCTION .....	03-14-2

SUPER-LSD OPERATION .....	03-14-2
Straight ahead driving .....	03-14-2
Differential operation .....	03-14-3
Limited-slip operation .....	03-14-4

### REAR DIFFERENTIAL OUTLINE

E6U031427100S01

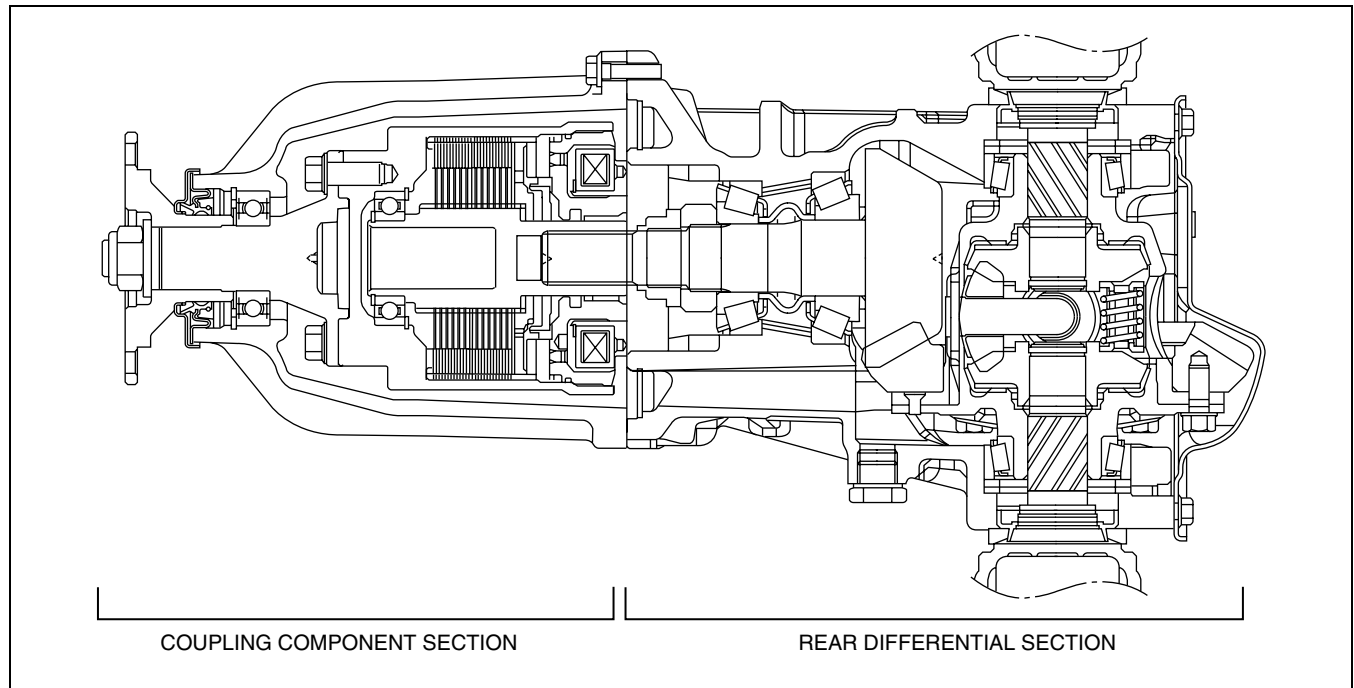
- A rear differential with an integrated coupling component has been adopted, reducing size and weight.
- An aluminum differential carrier has been adopted, reducing weight.
- A super-LSD with a low torque bias ratio\* has been adopted to improve performance when starting from a standstill, driving straight-ahead 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.

03-14

### REAR DIFFERENTIAL CROSS-SECTIONAL VIEW

E6U031427100S02



E6U314ZSC001

# DIFFERENTIAL

## SUPER-LSD OUTLINE

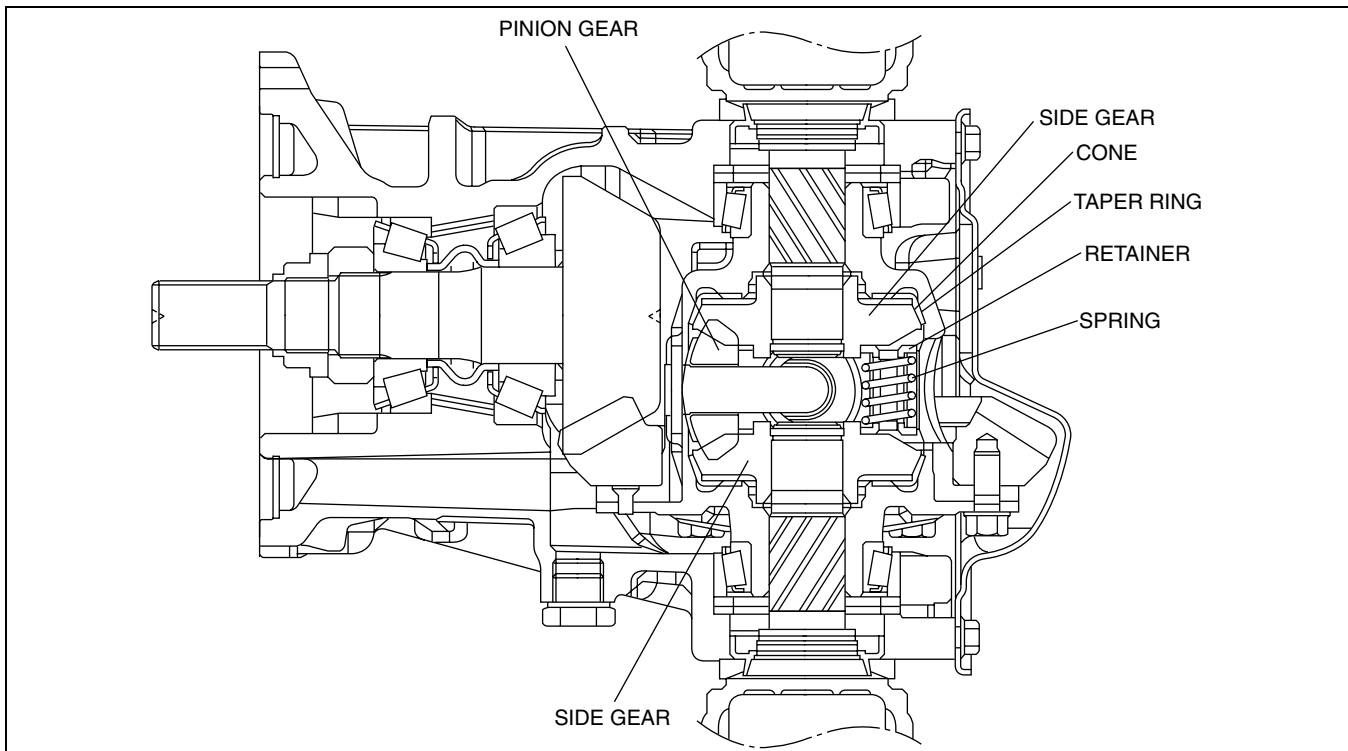
E6U031427100S03

- 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: 25 N·m {2.5 kgf·m, 18 ft·lbf})
  - Simplified construction provides weight reduction
- The gear case component of the super-LSD cannot be disassembled.

## SUPER-LSD CONSTRUCTION

E6U031427100S04

- 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.



E6U314ZSC002

## SUPER-LSD OPERATION

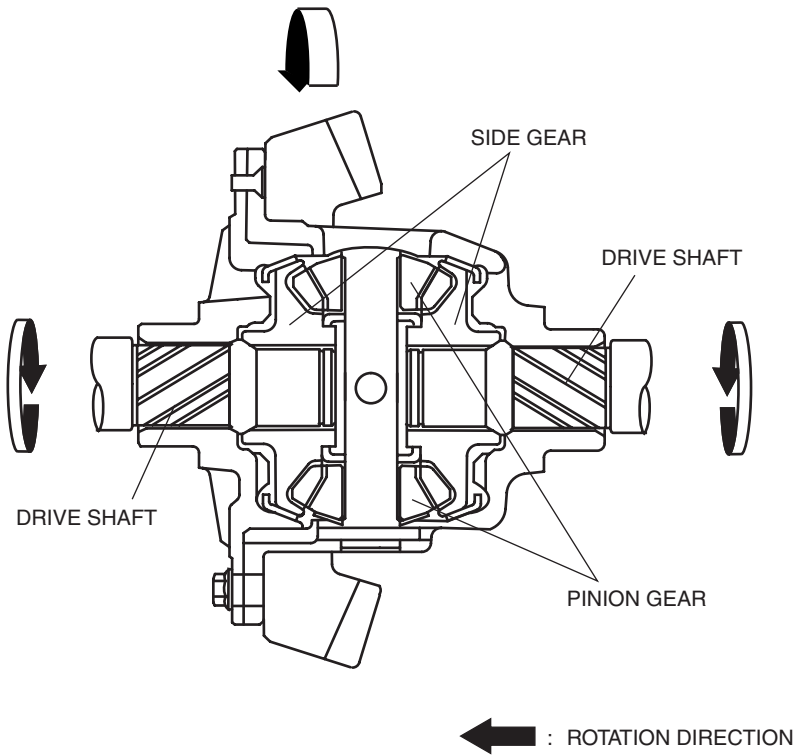
E6U031427100S05

### 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.

## DIFFERENTIAL

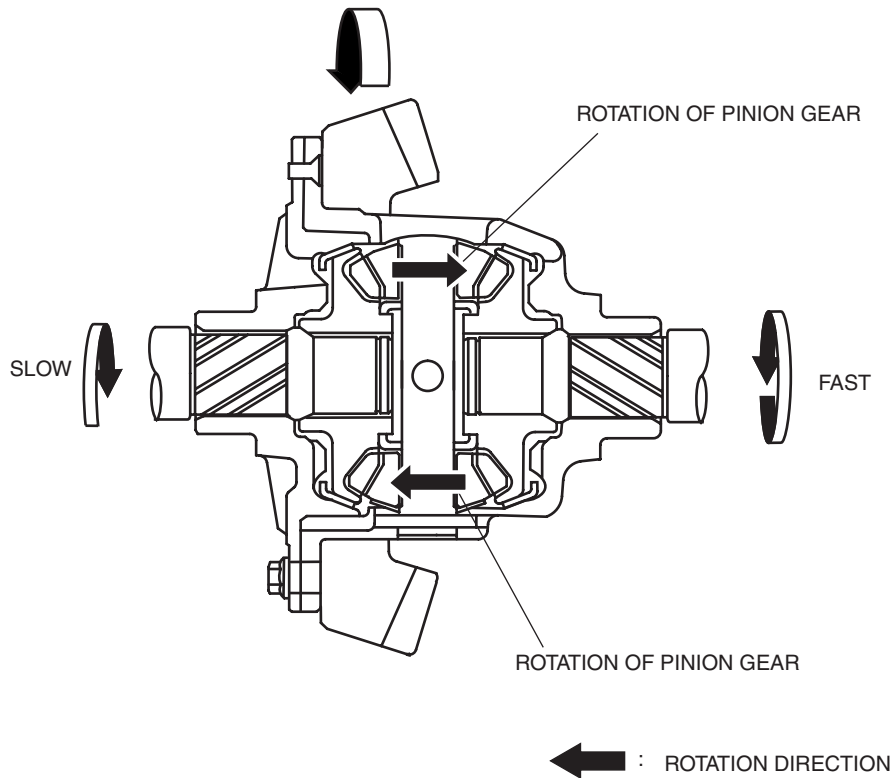
03-14



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.

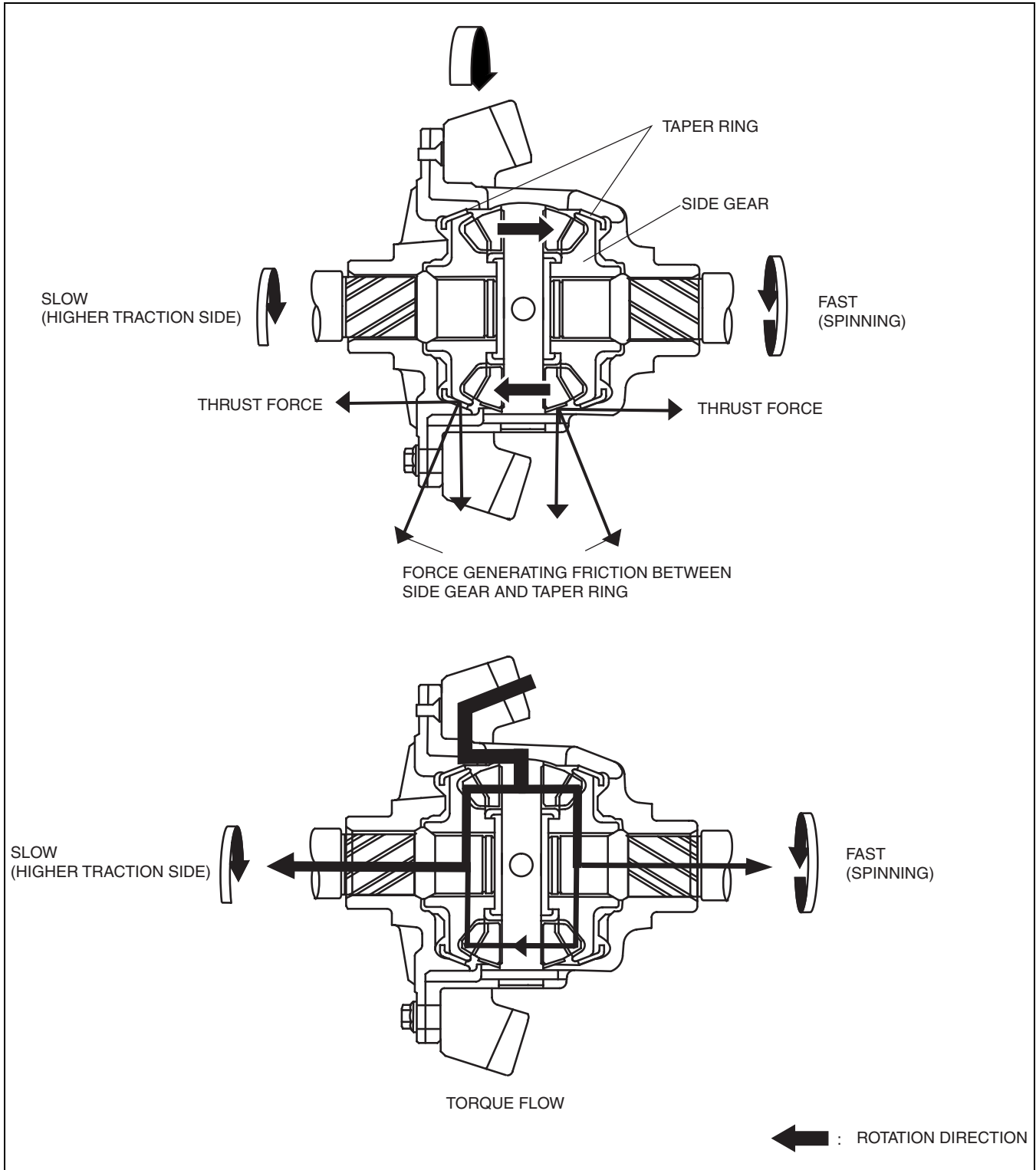


CHU0314S004

## DIFFERENTIAL

### Limited-slip operation

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



CHU0314S005

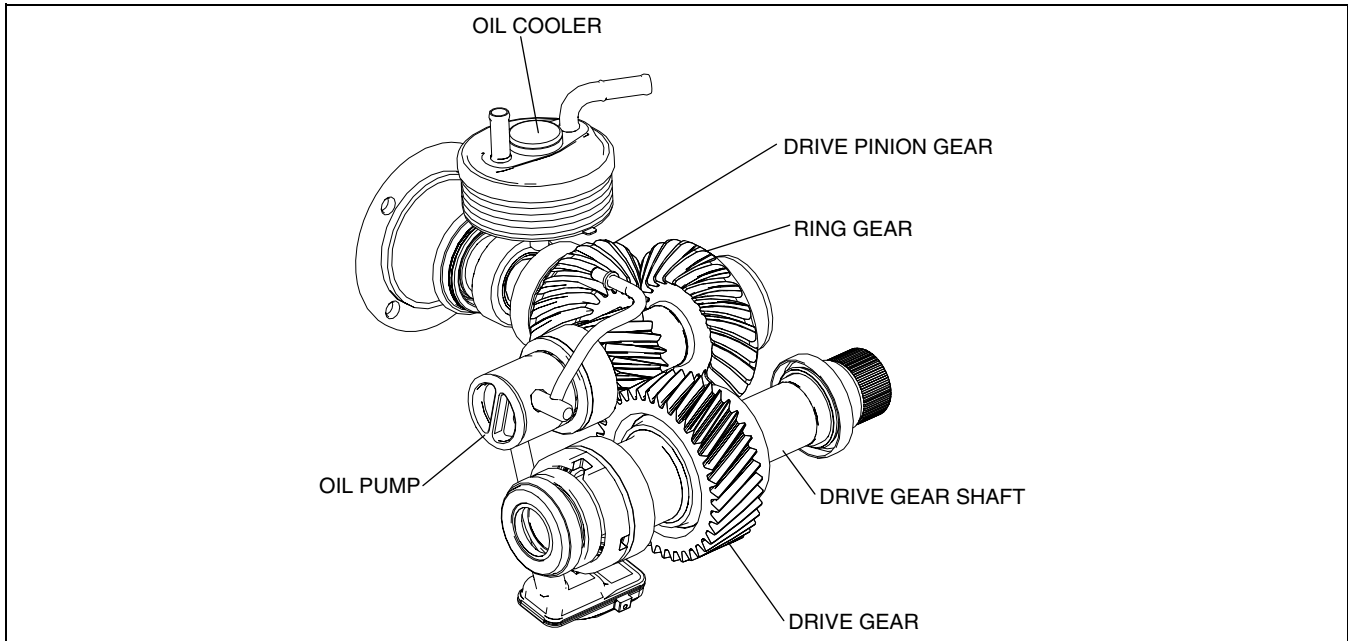
## 03-16 TRANSFER

TRANSFER STRUCTURAL VIEW ..... 03-16-1  
 TRANSFER CROSS-SECTIONAL  
 VIEW ..... 03-16-1

TRANSFER POWER FLOW.....03-16-2  
 TRANSFER OIL COOLER  
 CONSTRUCTION .....03-16-2

### TRANSFER STRUCTURAL VIEW

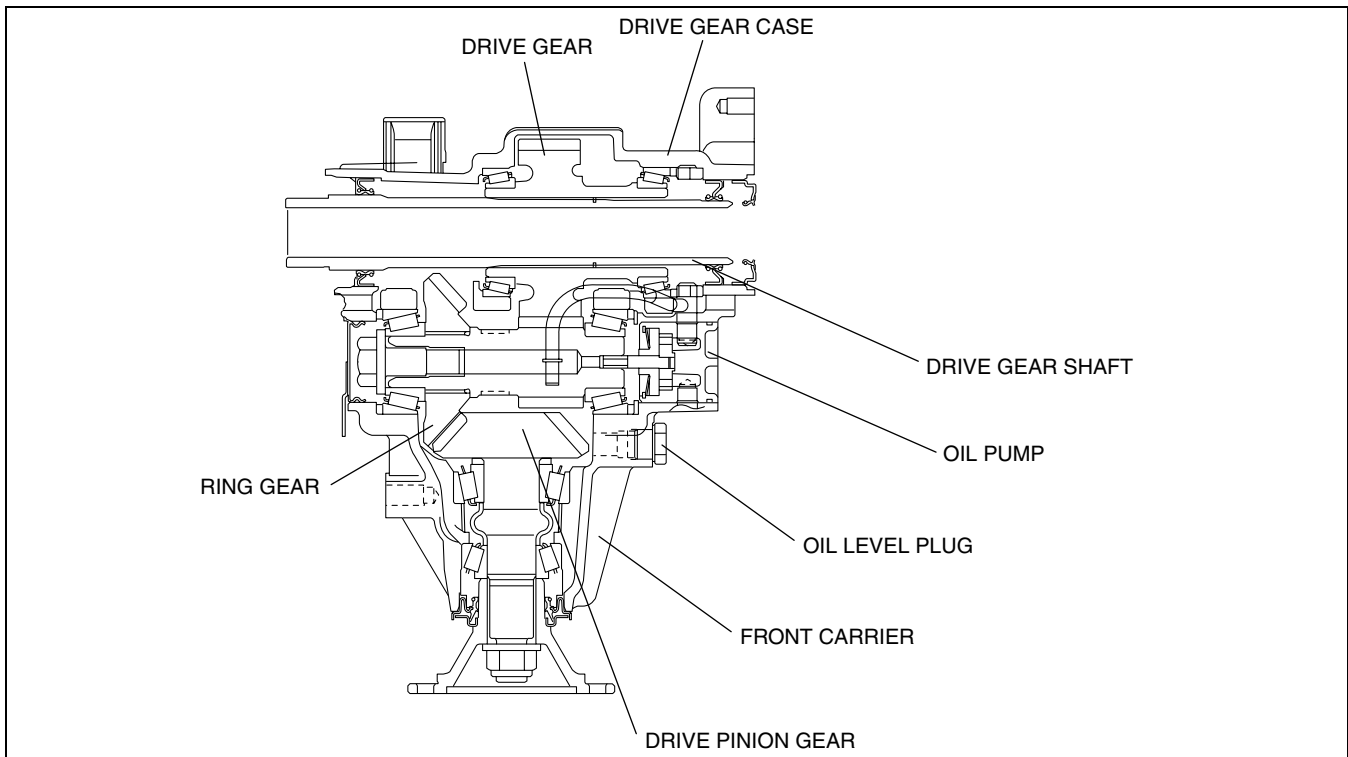
E6U03160000S01



E6U316ZSC004

### TRANSFER CROSS-SECTIONAL VIEW

E6U03160000S02



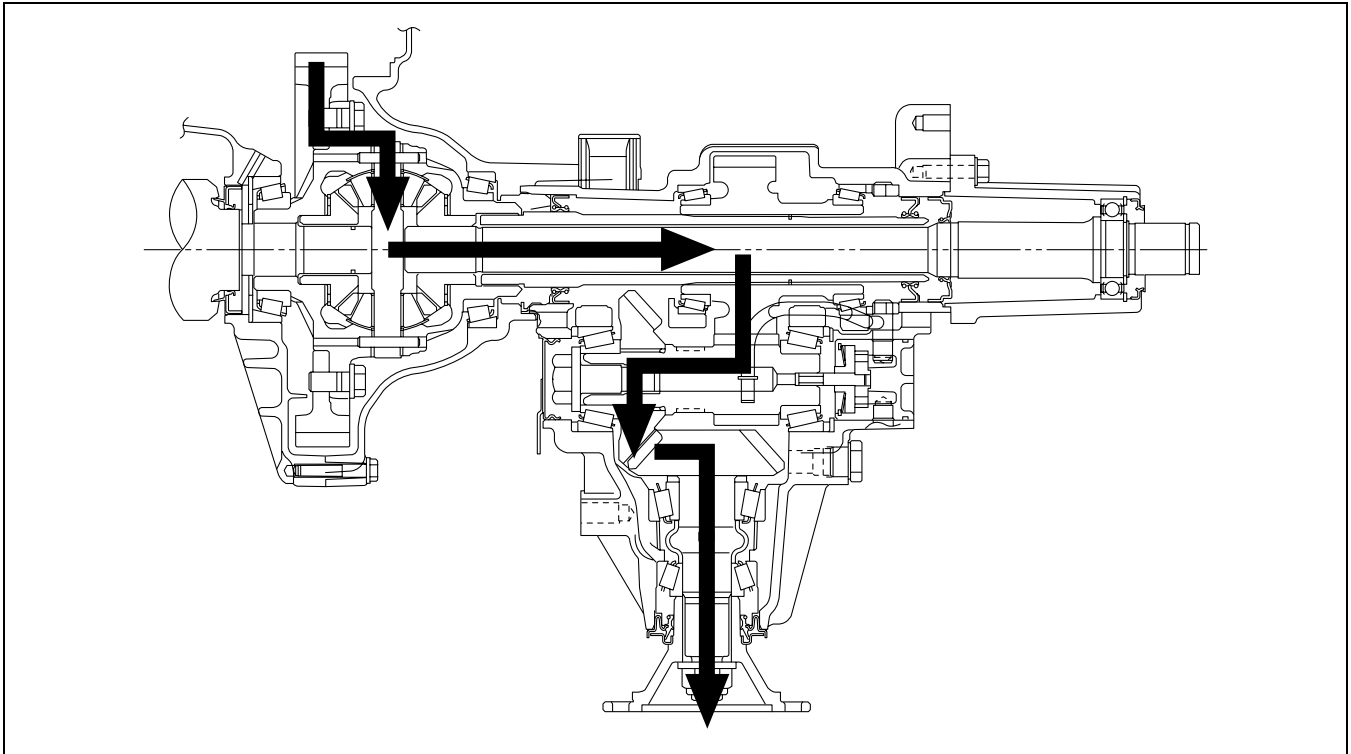
E6U316ZSC001

03-16

# TRANSFER

## TRANSFER POWER FLOW

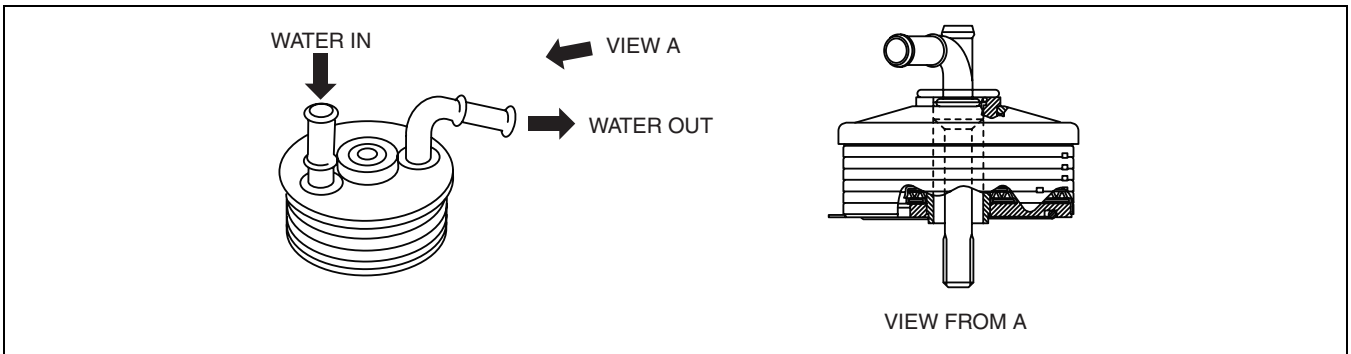
E6U03160000S03



E6U316ZSC002

## TRANSFER OIL COOLER CONSTRUCTION

E6U03160000S04



E6U316ZSC003

**03-19 ALL WHEEL DRIVE (AWD)**

<b>ALL-WHEEL DRIVE OUTLINE</b> . . . . .	03-19-1	<b>AWD WARNING LIGHT</b>	
Electronic AWD Control System		<b>CONSTRUCTION</b> . . . . .	03-19-7
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<b>ELECTRONIC CONTROL COUPLING</b>		<b>AWD SYSTEM CONTROL</b>	
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<b>CONSTRUCTION/OPERATION</b> . . . . .	03-19-7		

03-19

**ALL-WHEEL DRIVE OUTLINE**

E6U031927100S01

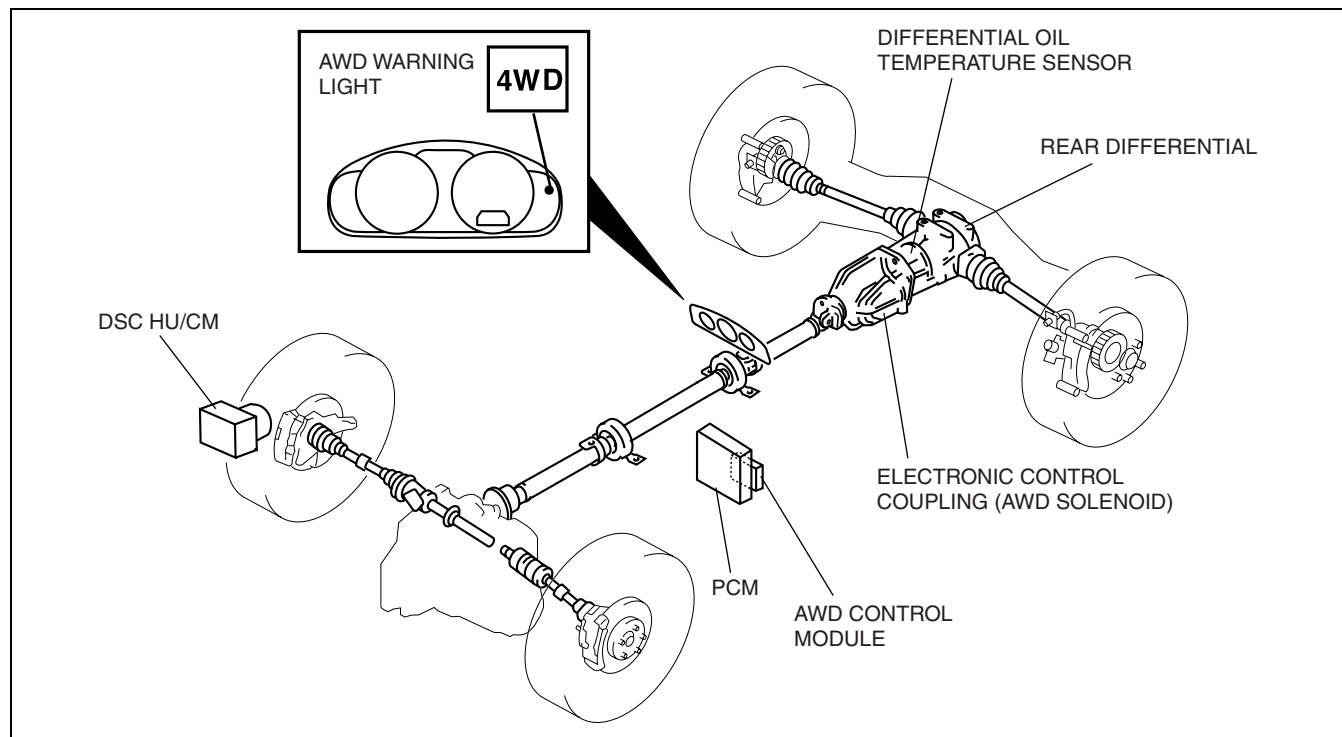
**Electronic AWD Control System Outline**

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

## ALL WHEEL DRIVE (AWD)

### ALL-WHEEL DRIVE STRUCTURAL VIEW

E6U031927100S02



E6U3182S6001

### ALL-WHEEL DRIVE COMPONENTS AND FUNCTIONS

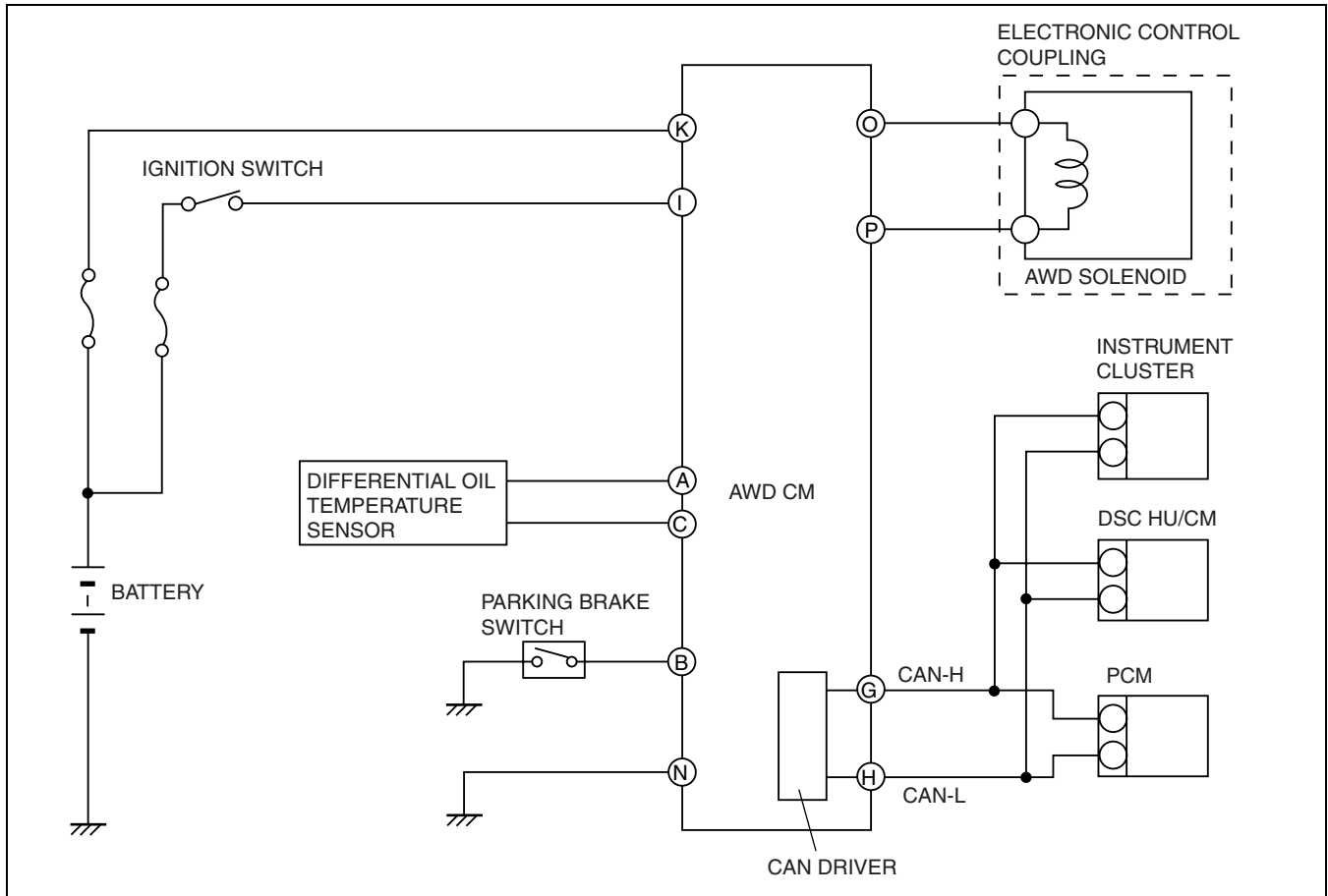
E6U031927100S03

Part name	Function
Electronic control coupling (AWD solenoid)	<ul style="list-style-type: none"> <li>Based on a signal from the AWD CM, it operates the electromagnetic clutch and transmits drive torque to the rear wheels.</li> </ul>
Differential oil temperature sensor	<ul style="list-style-type: none"> <li>Informs the AWD CM of the rear differential oil temperature.</li> </ul>
AWD CM	<ul style="list-style-type: none"> <li>Controls operation of the electronic control coupling (AWD solenoid) based on signals input from the accelerator pedal opening angle, wheel speed, differential oil temperature and other sensors.</li> <li>Outputs coupling control condition and AWD warning control information as a CAN signal.</li> <li>Controls the on-board diagnostic system and the fail-safe system if there is a malfunction in the AWD system.</li> </ul>
AWD warning light	<ul style="list-style-type: none"> <li>Illuminates or flashes to alert driver of a malfunction or control failure in the AWD system.</li> </ul>
PCM	<ul style="list-style-type: none"> <li>Sends the accelerator pedal opening angle, engine speed signal and gear position signal and other signals, as CAN signals, to the AWD CM.</li> </ul>
DSC HU/CM	<ul style="list-style-type: none"> <li>Sends the four-wheel speed, DSC operating condition signal, steering wheel angle signal and other signals, as CAN signals, to the AWD CM.</li> <li>Sends the coupling torque request signal, as a CAN signal, to the AWD CM.</li> </ul>

# ALL WHEEL DRIVE (AWD)

## ALL-WHEEL DRIVE SYSTEM DIAGRAM

E6U031927100S04



E6U318ZSC002

## ALL WHEEL DRIVE (AWD)

### ELECTRONIC CONTROL COUPLING OUTLINE

E6U031927100S05

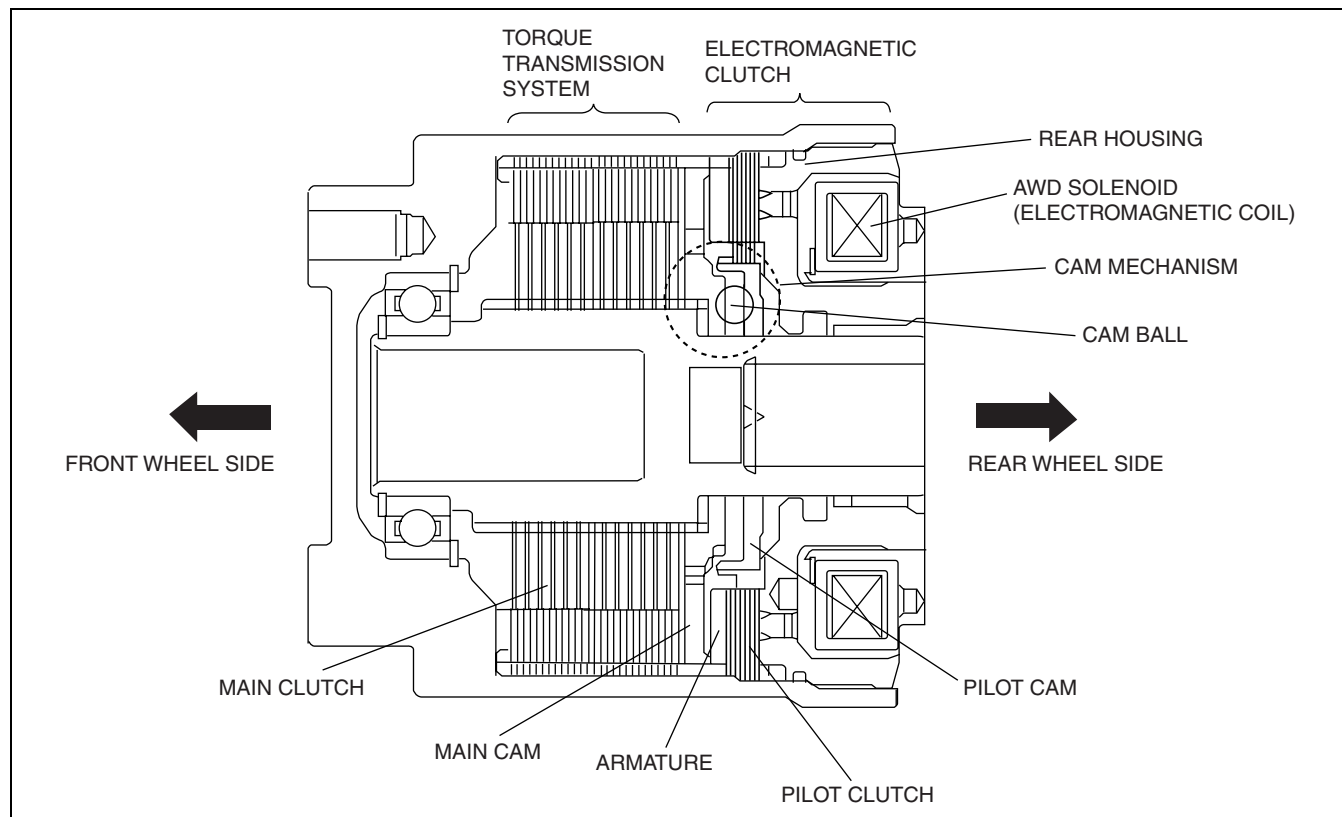
#### Features

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

### ELECTRONIC CONTROL COUPLING CONSTRUCTION

E6U031927100S06

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



E6U318ZS7001

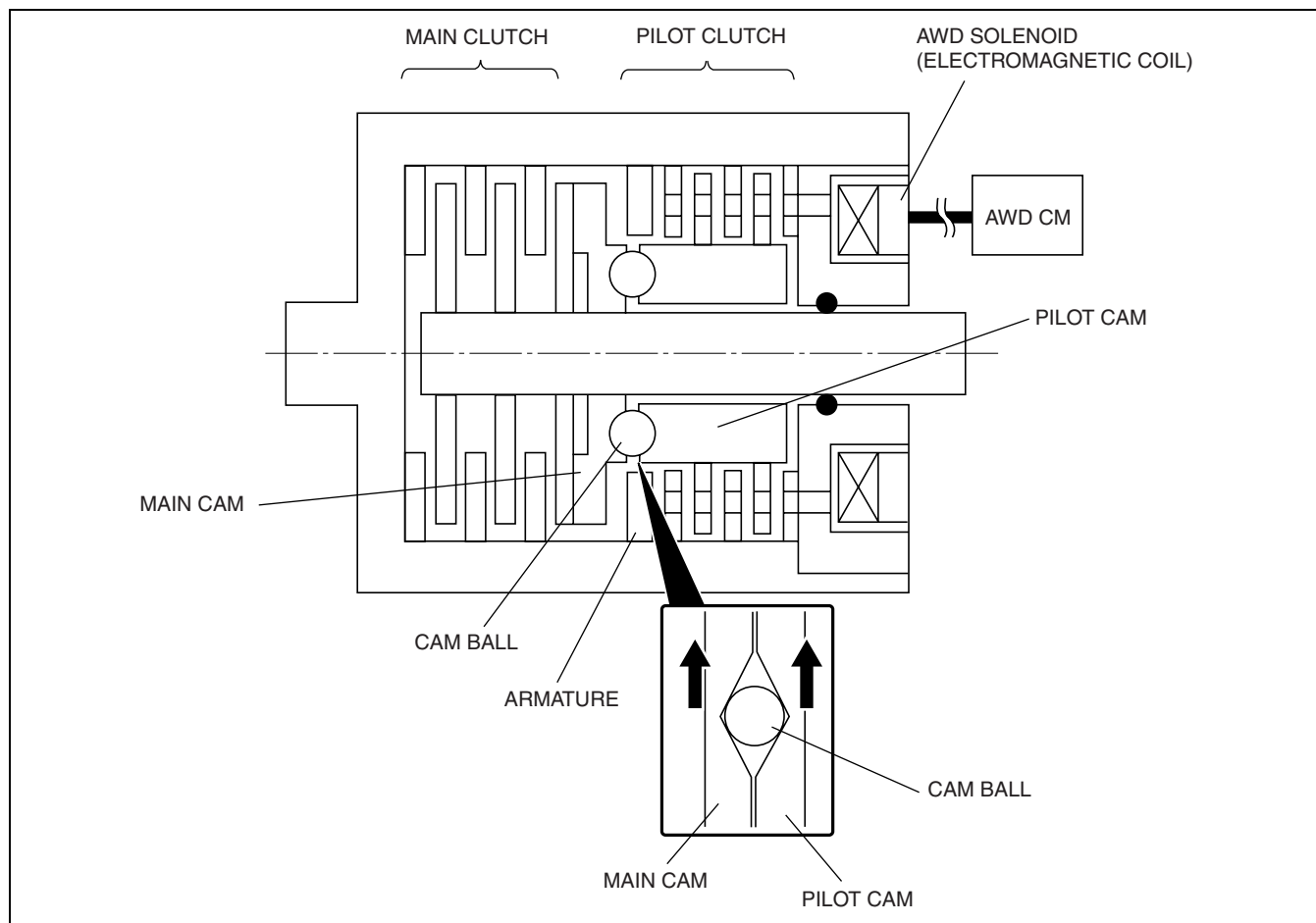
## ALL WHEEL DRIVE (AWD)

### ELECTRONIC CONTROL COUPLING OPERATION

E6U031927100S07

#### AWD Solenoid Control Current Is OFF

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



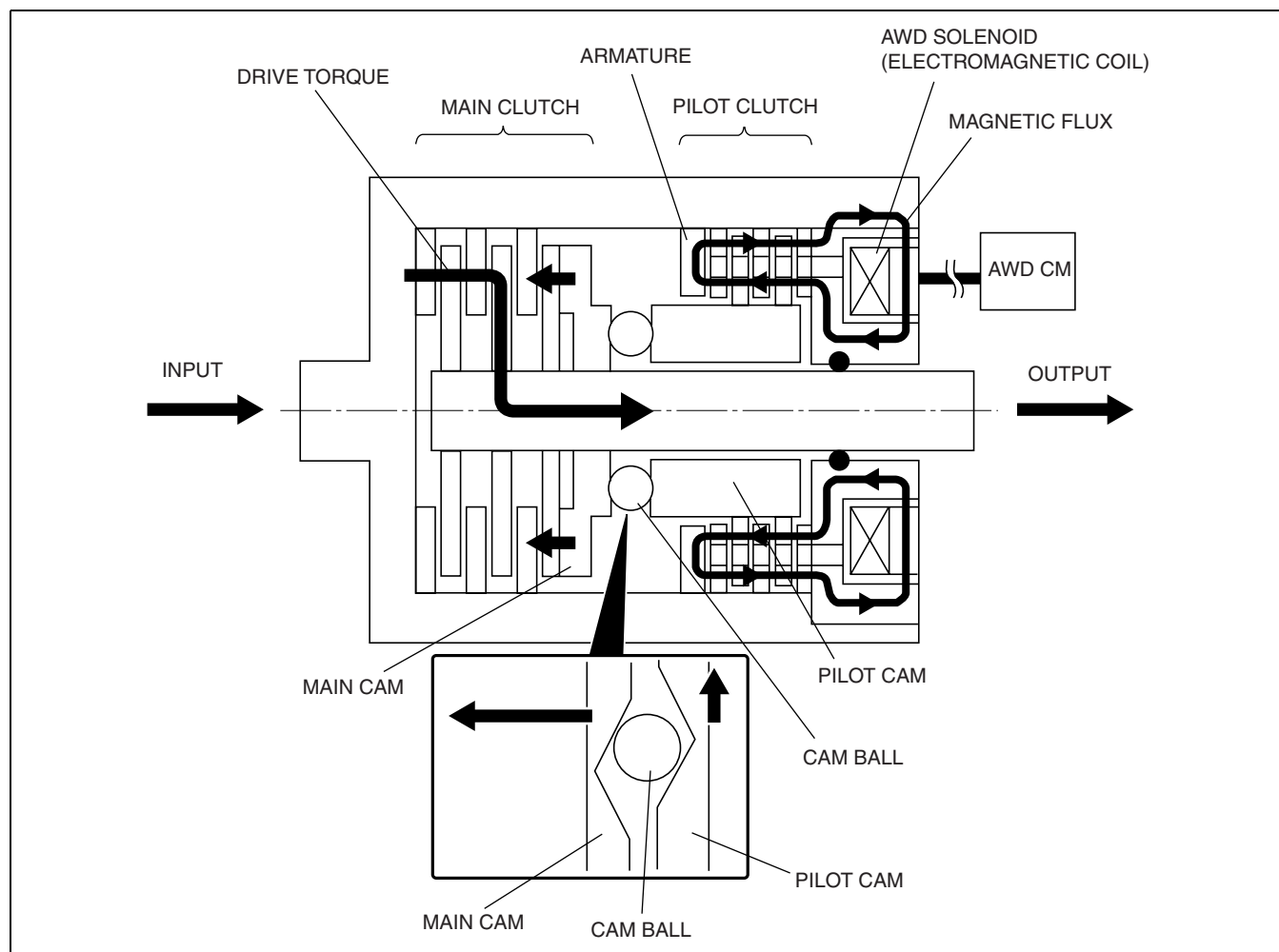
E6U318ZS7002

03-19

## ALL WHEEL DRIVE (AWD)

### AWD Solenoid Control Current Is ON

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



E6U318ZS7003

## ALL WHEEL DRIVE (AWD)

### DIFFERENTIAL OIL TEMPERATURE SENSOR FUNCTION

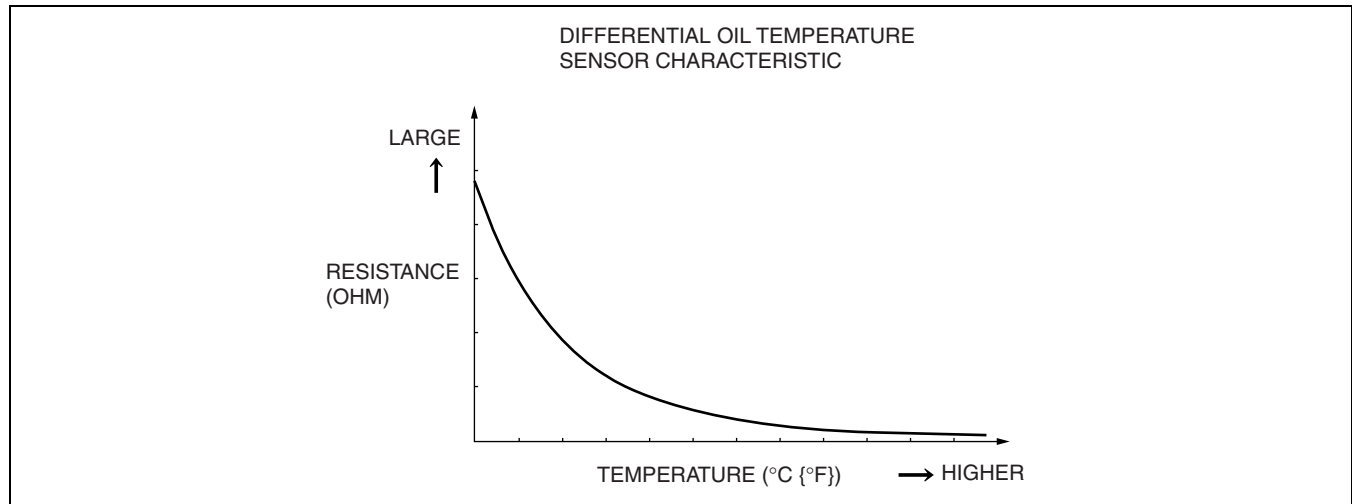
E6U031927100S08

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

### DIFFERENTIAL OIL TEMPERATURE SENSOR CONSTRUCTION/OPERATION

E6U031927100S09

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



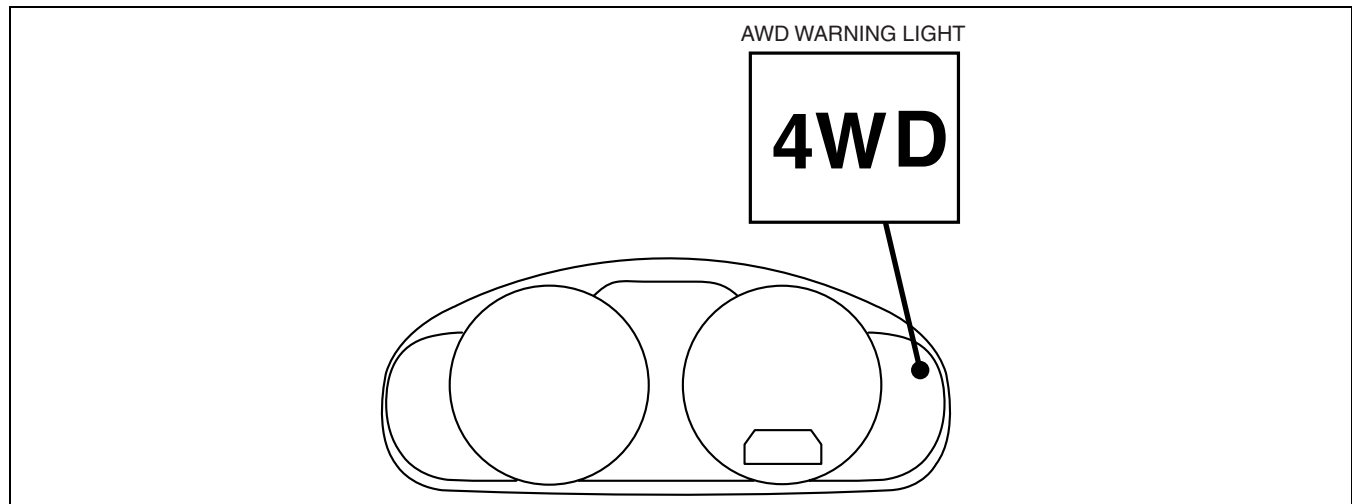
E6U318ZSC006

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### AWD WARNING LIGHT CONSTRUCTION

E6U031927100S10

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



E6U318ZSC007

# ALL WHEEL DRIVE (AWD)

## AWD CONTROL MODULE FUNCTION

E6U031927100S11

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

### Function table

Function name	Contents
AWD system control function	<ul style="list-style-type: none"> <li>Based on each input signal, the electronic control current sent to the electronic control coupling (AWD solenoid) is optimally controlled.</li> </ul>
Diagnostic system	<ul style="list-style-type: none"> <li>If the self-diagnostic system detects a malfunction, the AWD warning light illuminates to alert the driver, and at the same time the system suspends control or performs other measures to prevent a loss of driving stability and protect the system.</li> <li>The detected malfunction is stored as a DTC in the AWD CM.</li> </ul>

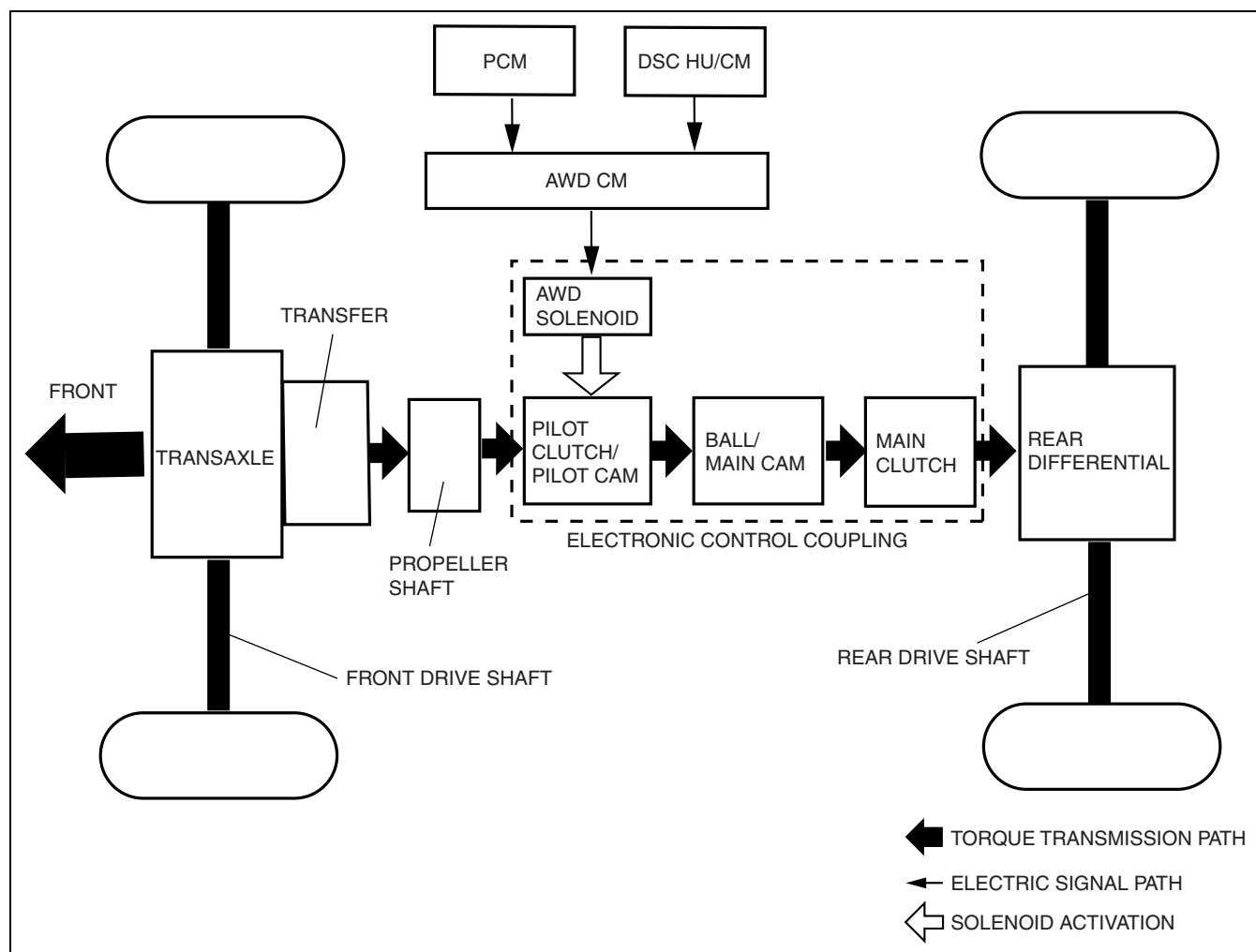
## AWD CONTROL MODULE CONSTRUCTION

E6U031927100S12

- The AWD CM is installed to the left of the clutch pedal.

## AWD CONTROL MODULE BLOCK DIAGRAM

E6U031927100S13



E6U318ZS7004

## ALL WHEEL DRIVE (AWD)

### AWD SYSTEM CONTROL OUTLINE

E6U031927100S14

#### Features

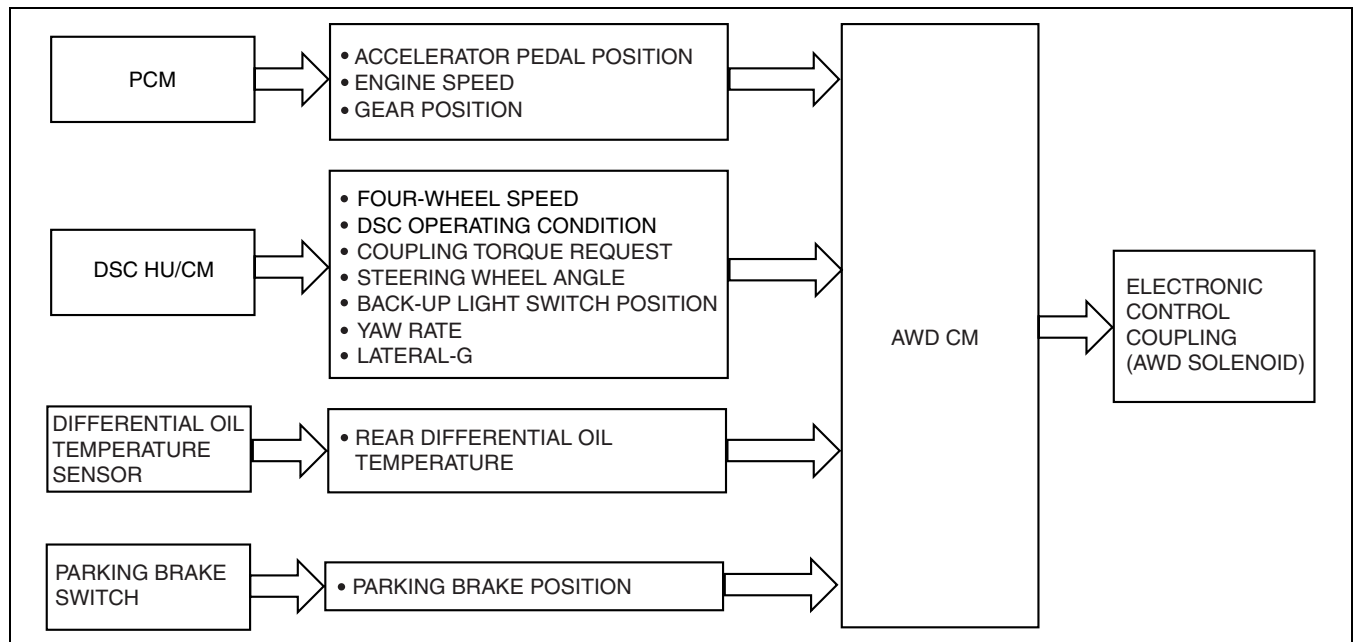
- Based on the inputted signals listed below, the AWD CM calculates the optimal amount of torque distribution for the rear wheels and outputs a corresponding electric control current to the electronic control coupling (AWD solenoid).
- The module controls the current outputted to the AWD solenoid by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

Signal output part	Signal name	Note
PCM	Accelerator pedal position Engine speed Gear position	Transmitted as a CAN signal
DSC HU/CM	Four-wheel speed DSC operating condition Coupling torque request Steering wheel angle Back-up light switch position Yaw rate Lateral-G	
Differential oil temperature sensor	Rear differential oil temperature	—
Parking brake switch	Parking brake position	

03-19

### AWD SYSTEM CONTROL BLOCK DIAGRAM

E6U031927100S15



E6U318ZS7005

## ALL WHEEL DRIVE (AWD)

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### AWD SYSTEM CONTROL OPERATION

E6U031927100S16

#### Normal Control

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

#### Tight Cornering Control

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

#### Integrated DSC Control

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

#### Other Control

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

### CONTROLLER AREA NETWORK (CAN) OUTLINE

E6U031927100S17

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

### CONTROLLER AREA NETWORK (CAN) OPERATION

E6U031927100S18

#### Transmitted Information

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

#### Received Information

- Four-wheel speed
- Accelerator pedal opening angle
- Engine speed
- DSC operating condition
- Gear position
- Coupling torque request
- Steering wheel angle
- Back-up light switch position
- Yaw rate
- Lateral-G

# BRAKES

# 04

SECTION

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04-00

## 04-00 OUTLINE

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### BRAKES ABBREVIATIONS

E6U04000000S01

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

### BRAKES FEATURES

E6U04000000S02

Improved braking stability	<ul style="list-style-type: none"><li>• Large diameter front disc plate adopted</li><li>• Large dimension front disc pad adopted</li><li>• Large diameter rear disc plate adopted</li><li>• Large dimension rear disc pad adopted</li></ul>
Improved safety and marketability	<ul style="list-style-type: none"><li>• Dynamic stability control (DSC) has been adopted</li><li>• Electrical brake assist control has been adopted</li></ul>
Improved serviceability	<ul style="list-style-type: none"><li>• Combined sensor (integrating yaw rate sensor, lateral-G sensor and forward-G sensor) has been adopted</li><li>• CAN communication function adopted</li><li>• Enhanced malfunction diagnosis system for use with WDS or equivalent</li></ul>
Improved Reliability	<ul style="list-style-type: none"><li>• Integrated construction of the hydraulic unit (HU) and control module (CM) has been adopted for the DSC HU/CM</li><li>• DSC HU/CM with built-in brake fluid pressure sensor has been adopted</li></ul>

04-00-1

# OUTLINE

## BRAKES SPECIFICATIONS

E6U04000000S03

Item		Specification		
		2006MY MAZDASPEED6	2006MY Mazda6	2005MY Mazda6
Brake pedal	Type	Suspended		←
	Pedal lever ratio	2.7		←
	Max. stroke (mm {in})	128.5 {5.059}		←
Master cylinder	Type	Tandem (with level sensor)		←
	Type	Port-less	Port-less (with ABS/TCS) Conventional (without ABS/TCS)	Port-less (with ABS/TCS) Conventional (without ABS/TCS)
	Cylinder diameter (mm {in})	20.64 {0.813}		←
Front brake (disc)	Type	Ventilated disc		←
	Cylinder bore (mm {in})	57 {2.2}	57.22 {2.253}	57.15 {2.250}
	Pad dimensions (area × thickness) (mm <sup>2</sup> {in <sup>2</sup> } × mm {in})	3,918 {6.27} × 12.5 {0.49}	5,380 {8.608} × 12.0 {0.47}	4,010 {6.416} × 12.0 {0.47}
	Disc plate dimensions (outer diameter × thickness) (mm {in})	320 {12.6} × 25.0 {0.98}	299 {11.8} × 25.0 {0.98}	283 {11.1} × 25.0 {0.98}
Rear brake (disc)	Type	Solid disc		←
	Cylinder bore (mm {in})	33.96 {1.337}	33.96 {1.337}	34.93 {1.375}
	Pad dimensions (area × thickness) (mm <sup>2</sup> {in <sup>2</sup> } × mm {in})	2,195 {3.51} × 9.0 {0.35}	2,970 {4.752} × 9.0 {0.4}	2,820 {4.512} × 8.0 {0.3}
	Disc plate dimensions (outer diameter × thickness) (mm {in})	314 {12.4} × 11.0 {0.43}	280 {11.0} × 10.0 {0.39}	280 {11.0} × 10.0 {0.39}
Power brake unit	Type	Vacuum multiplier, single diaphragm		←
	Diameter (mm {in})	279 {11.0}	271.7 {10.7}	276.1 {10.9}
Braking force control device	Type	EBD (Electronic Brakeforce Distribution)	With ABS/TCS: EBD (Electronic Brakeforce Distribution) Without ABS/TCS: Dual proportioning valve	With ABS/TCS: EBD (Electronic Brakeforce Distribution) Without ABS/TCS: Dual proportioning valve
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 ..... 04-02-1

### ON-BOARD DIAGNOSTIC SYSTEM

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Malfunction Detection Function ..... 04-02-2

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### ON-BOARD DIAGNOSTIC SYSTEM

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PID/DATA Monitor Table ..... 04-02-6

### ON-BOARD DIAGNOSTIC SYSTEM

#### ACTIVE COMMAND MODES

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Active Command Modes Function

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### ON-BOARD DIAGNOSTIC SYSTEM

#### EXTERNAL TESTER COMMUNICATION

FUNCTION ..... 04-02-7

Connections/Communication

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Serial Communication ..... 04-02-7

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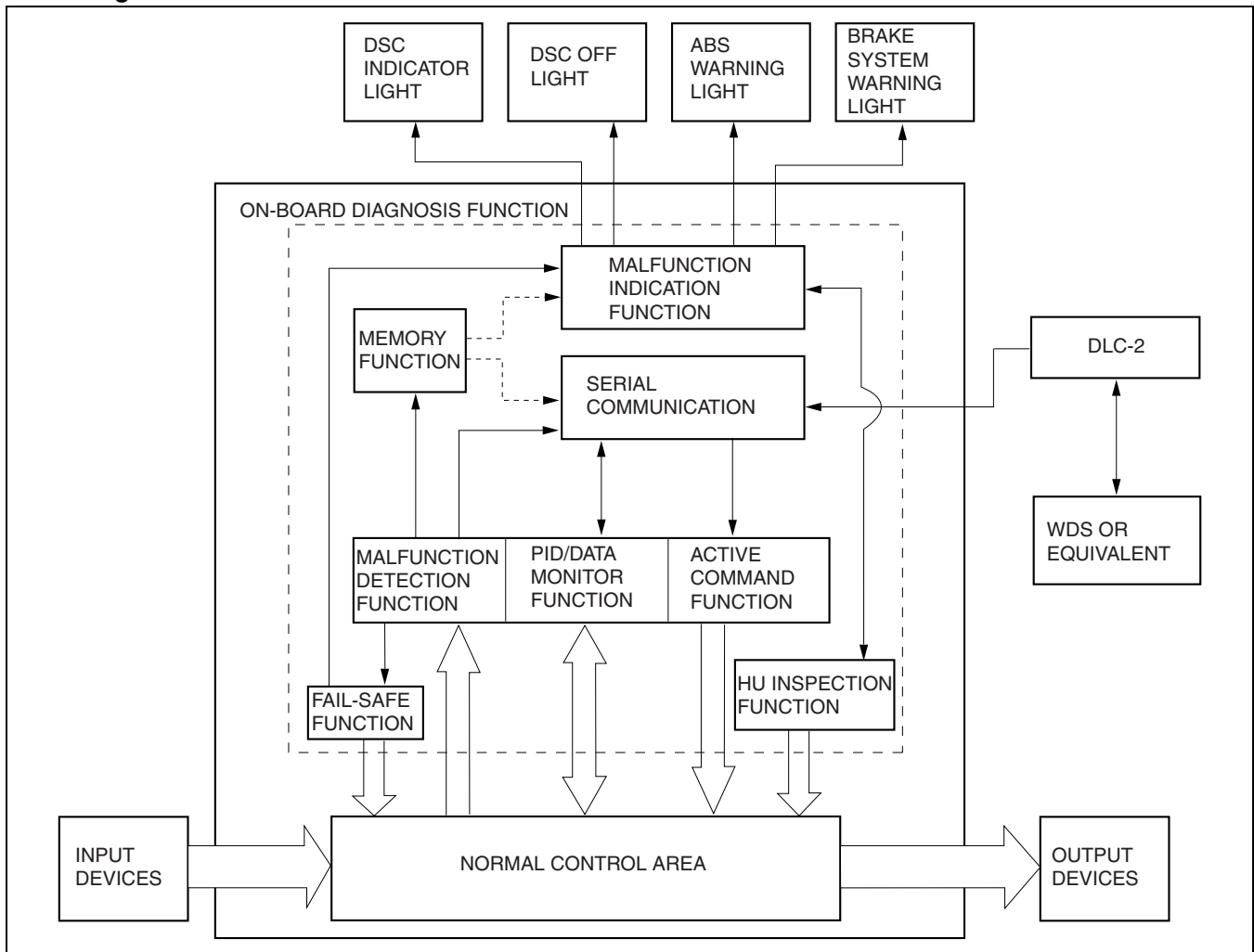
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### ON-BOARD DIAGNOSTIC SYSTEM OUTLINE

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

E6U04020000S01

## Block diagram



E6U402ZS7001

## ON-BOARD DIAGNOSTIC SYSTEM FUNCTION

E6U040200000S02

### Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the DSC HU/CM when the ignition switch is at the ON position.
- When the DSC HU/CM are started up, the following malfunction detections are performed.
  - The ABS and brake system warning lights, DSC indicator light, and DSC OFF light illuminate for **approx. 2.4 s** when the ignition switch is turned to the ON position to inspect for open circuits in the lights. At the same time, the fail-safe relay is operated, and the input/output signals of each part is monitored for malfunction diagnosis. After starting to drive, the first time the vehicle speed is **approx. 10 km/h {6.2 mph} or more** the pump motor is operated and malfunction diagnosis is performed again. Input/output signals are monitored for malfunction determination when the ignition switch is at the ON position.
- When malfunctions are detected, the corresponding lights are illuminated to alert the driver. Using the external tester communication function, DTCs can be output through the KLN terminal 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 DSC control modules have built-in non-volatile memory, DTCs are not cleared even if the battery is removed. Therefore, it is necessary to clear the memory after performing repairs. Refer to the Workshop Manual for the DTC clearing procedure.

# ON-BOARD DIAGNOSTIC

## 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.

## 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.

Malfunction location	DTC	Fail-safe function														
	WDS or equivalent	Warning light illumination condition				Control condition										
		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	Brake assist control						
Brake fluid pressure sensor	C1953	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled *1	Control disabled	Control disabled						
	C1954															
Combined sensor (lateral-G, yaw rate)	C1280	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled						
	C1730															
	C1951															
	C1952															
	C1959															
Combined sensor (forward-G)	C1949	Illuminated	Not illuminated	Illuminated	Illuminated	Control disabled	Control enabled	Control disabled	Control disabled	Control disabled						
	C1950															
ABS wheel-speed sensor	C1145	Illuminated *1	Not illuminated *1, *2	Illuminated *1	Illuminated *1	Control disabled	Control enabled *3	Control disabled	Control disabled	Control disabled						
	C1155															
	C1165															
	C1175															
ABS wheel-speed sensor/ABS sensor rotor	C1148															
	C1158															
	C1168															
	C1178															
	C1233															
	C1234															
	C1235															
C1236																
Engine control system	C1119							Not illuminated	Not illuminated	Illuminated	Not illuminated *22	Control enabled	Control enabled	Control disabled	Control disabled	Control enabled
														Control enabled	Control enabled	
															Control disabled *5	
															Control disabled *4	

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# ON-BOARD DIAGNOSTIC

Malfunction location	DTC	Fail-safe function								
	WDS or equivalent	Warning light illumination condition				Control condition				
		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	Brake assist control
Solenoid valve	C1194	Illuminated *7, *8	Illuminated *8, *9	Illuminated *7	Not illuminated	Control disabled *10	Control disabled *11	Control disabled *12	Control disabled	Control disabled
	C1198									
	C1210									
	C1214									
	C1242									
	C1246									
	C1250									
	C1254									
	C1400									
	C1410									
	C1957									
	C1957									
	C1958									
DSC HU/CM (pump)	C1140	Illuminated	Not illuminated	Not illuminated *13	Not illuminated	Control disabled	Control enabled	Control disabled *12	Control disabled	Control disabled
Solenoid valve, motor or ABS wheel-speed sensor/ABS sensor rotor	C1510		Not illuminated *2		Illuminated		Control enabled *3	Control disabled *14		
	C1511									
	C1512									
DSC control	C1513		Not illuminated		Not illuminated			Control enabled		
	C1507									
	C1508									
Fail-safe relay	C1186	Illuminated	Not illuminated	Not illuminated	Illuminated	Control disabled	Control disabled	Control disabled *12	Control disabled	Control disabled
	C1266		Illuminated				Control enabled			
Motor relay, pump motor	C1095	Illuminated *1	Not illuminated	Illuminated *1	Not illuminated	Control disabled	Control enabled	Control disabled *12	Control disabled	Control disabled
	C1096									
DSC HU/CM	B1342	Illuminated *15, *16	Illuminated *15, *16	Illuminated *16, *17	Illuminated *17	Control disabled *18, *19	Control disabled *18, *19	Control disabled *19	Control disabled	Control disabled *20
DSC power supply	B1318	Illuminated	Illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control enabled	Control enabled	Control enabled
DSC HU/CM	C1414	Illuminated *21	Not illuminated	Illuminated *21	Illuminated	Control disabled	Control enabled	Control disabled	Control disabled	Control disabled
Steering angle sensor	C1955	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled
	C1956									
Brake fluid level sensor	C1125	Not illuminated	illuminated *22	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled *12	Control disabled	Control disabled
Reverse signal	B1627	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control enabled	Control disabled	Control enabled
Brake switch	B1483	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control enabled	Control enabled	Control disabled
	B1484									
	B1486									
Module configuration	B2477	Not illuminated	Not illuminated	Flash	Flash	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled

# ON-BOARD DIAGNOSTIC

Malfunction location	DTC	Fail-safe function								
	WDS or equivalent	Warning light illumination condition				Control condition				
		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	Brake assist control
CAN communication	U0073	Not illuminated	Not illuminated	Illuminated	Illuminated	Control enabled	Control enabled	Control disabled	Control disabled	Control disabled
	U0100	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled <sup>*23</sup>	Control disabled <sup>*23</sup>	Control enabled
	U0114	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	-	Control enabled	Control enabled
	U0155	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	Control disabled <sup>*12</sup>	Control disabled	Control enabled
	U2511	Not illuminated	Not illuminated	Illuminated	Not illuminated	Control enabled	Control enabled	-	Control enabled	Control enabled

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- <sup>\*1</sup> : If a malfunction was detected in the previous driving mode, the light remains illuminated until the system is verified to be normal when the vehicle is driven at a speed of **10 km/h {6.2 mph}** or more.
- <sup>\*2</sup> : The warning light illuminates during rear wheel malfunction.
- <sup>\*3</sup> : Stops control when there is malfunction in both rear wheels.
- <sup>\*4</sup> : When engine control system has malfunction, only brake TCS is enable.
- <sup>\*5</sup> : When engine speed signal has malfunction, only brake DSC is enable.
- <sup>\*6</sup> : When engine control system has malfunction, only brake DSC is enable.
- <sup>\*7</sup> : If a malfunction was detected in the previous driving mode, the light remains illuminated until the wheel-speed sensor is verified to be normal.
- <sup>\*8</sup> : The warning light does not illuminates only during stability control solenoid valve or traction switch solenoid valve off stuck malfunction.
- <sup>\*9</sup> : The warning light illuminates during rear solenoid valves off stuck malfunction.
- <sup>\*10</sup> : Control dose not stop during stability control solenoid valves or traction switch solenoid valve off stuck malfunction.
- <sup>\*11</sup> : Control does not stop during each solenoid valves (except rear inlet solenoid valve) off stuck malfunction.
- <sup>\*12</sup> : Engine TCS is only enable
- <sup>\*13</sup> : If malfunction is related to DSC performance, the light illuminates.
- <sup>\*14</sup> : Engine TCS is only enable when impossibility of pressure reduction in operation is detected.
- <sup>\*15</sup> : If malfunction is related to CAN, light does not illuminate.
- <sup>\*16</sup> : If malfunction is related to combine sensor 0 point adjustment or configuration, light dose not illuminate.
- <sup>\*17</sup> : If the module does not configured, light flashes.
- <sup>\*18</sup> : If malfunction is related to CAN, system does not disabled.
- <sup>\*19</sup> : If malfunction is related to combine sensor 0 point adjustment or configuration, system dose not disabled.
- <sup>\*20</sup> : If malfunction is related to combined sensor 0 point adjustment, system does not disabled.
- <sup>\*21</sup> : When vehicle data is mismatch installed, the light does not illuminate.
- <sup>\*22</sup> : The light will go out when the failure is solved.
- <sup>\*23</sup> : The control is permitted according to the malfunction.

## ON-BOARD DIAGNOSTIC

### ON-BOARD DIAGNOSTIC SYSTEM PID/DATA MONITOR FUNCTION

E6U040200000S03

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

**PID/DATA Monitor Table**

PID name	Input/output part	Operation/unit (WDS or equivalent)
ABS_LAMP	ABS warning light driver output state	On/Off
ABSLF_I	LF ABS pressure retention valve output state	On/Off
ABSLF_O	LF ABS pressure reduction valve output state	On/Off
ABSLR_I	LR ABS pressure retention valve output state	On/Off
ABSLR_O	LR ABS pressure reduction valve output state	On/Off
ABSRF_I	RF ABS pressure retention valve output state	On/Off
ABSRF_O	RF ABS pressure reduction valve output state	On/Off
ABSRR_I	RR ABS pressure retention valve output state	On/Off
ABSRR_O	RR ABS pressure reduction valve output state	On/Off
ABSPMPRLY	ABS pump motor relay	On/Off
ABSVLVRLY	ABS valve control relay	On/Off
ABS_VOLT	System battery voltage value	V
ACCLMTR	Combined sensor (forward-G sensor)	G
AWD_MSG	AWD control module	Present/Not Present
BOO_ABS	Brake pedal switch input	On/Off
BRK_FLUID	Brake fluid level sensor input	OK/Low
BRAKE_LMP	BRAKE system warning light driver output state	On/Off
CCNTABS	Number of continuous trouble code set	-
IC_MSG	Instrument cluster	Present/Not Present
LAT_ACCL	Combined sensor (Lateral-G sensor)	G
L_DSC_O	Stability control solenoid valve (LF—RR)	On/Off
LF_WSPD	LF ABS wheel-speed sensor input	KPH, MPH
LR_WSPD	LR ABS wheel-speed sensor input	KPH, MPH
MCYLI P	Brake fluid pressure sensor	Pa
PCM_MSG	PCM	Present/Not Present
PMPSTAT	ABS pump motor states	On/Off
R_DSC_O	Stability control solenoid valve (RF—LR)	On/Off
RF_WSPD	RF ABS wheel-speed sensor input	KPH, MPH
RPM	PCM	RPM
RR_WSPD	RR ABS wheel-speed sensor input	KPH, MPH
SWA_POS	Steering angle sensor	°
TC LVAL	Traction switch solenoid valve (LF—RR)	On/Off
TC RVAL	Traction switch solenoid valve (RF—LR)	On/Off
TPI	PCM	%
TRAC_SW	DSC OFF switch	On/Off
TRANSGR	PCM (MTX) or TCM (ATX)	1/2/3/4/5/6/R/N/Error
YAW_RATE	Combined sensor (yaw rate sensor)	°/s

# ON-BOARD DIAGNOSTIC

## ON-BOARD DIAGNOSTIC SYSTEM ACTIVE COMMAND MODES FUNCTION

E6U04020000S04

- The active command modes function is used for optionally selecting simulation items of input/output parts preset in the DSC HU/CM, and to operate them regardless of CM control.

Active Command Modes Function Table

Command Name	Definition	Operation	Note
ABS_POWER	Fail-safe relay	On/Off	Ignition key at ON (Engine OFF), and driving
LATACCEL	Lateral-G sensor initialization	TRUE/FALSE	
LF_DSC_V	Stability control solenoid valve (LF-RR)	On/Off	
LF_INLET	Left front ABS pressure retention solenoid valve	On/Off	
LF_OUTLET	Left front ABS pressure reduction solenoid valve	On/Off	
LF_TC_VLV	Traction switch solenoid valve (LF-RR)	On/Off	
LR_INLET	Left rear ABS pressure retention solenoid valve	On/Off	
LR_OUTLET	Left rear ABS pressure reduction solenoid valve	On/Off	
PMP_MOTOR	ABS motor	On/Off	
RF_DSC_V	Stability control solenoid valve (RF-LR)	On/Off	
RF_INLET	Right front ABS pressure retention solenoid valve	On/Off	
RF_OUTLET	Right front ABS pressure reduction solenoid valve	On/Off	
RF_TC_VLV	Traction switch solenoid valve (RF-LR)	On/Off	
RR_INLET	Right rear ABS pressure retention solenoid valve	On/Off	
RR_OUTLET	Right rear ABS pressure reduction solenoid valve	On/Off	
STAB_IND	DSC indicator light	On/Off	
TRAC OFF	DSC OFF light	On/Off	
YAWRATE	Yaw rate sensor initialization	On/Off	

### Note

- When operating the ABS motor and each valve forcibly, turn ABS\_POWER on, and then each command on. ABS\_POWER regulates the power supply for the ABS motor and eight valves.

## ON-BOARD DIAGNOSTIC SYSTEM EXTERNAL TESTER COMMUNICATION FUNCTION

E6U04020000S05

- The external tester communication function communicates diagnostic information (reading DTCs, reading input/output signal, driving output parts) by sending and receiving signal between the DSC unit and external tester.

### Connections/Communication Contents

	External tester	
	WDS or equivalent	
	Connection	Communication method
On-board diagnostic (malfunction detection) function	Input/output: KLN signal	Serial communication
Data monitor function	Input/output: KLN signal	Serial communication
Active command modes function	Input/output: KLN signal	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 data link connector, diagnostic information can be sent and received between the WDS or equivalent and the DSC HU/CM via the KLN terminal.
- The DSC HU/CM receives signals for the malfunction detection function, data monitor function, and active command modes function from the WDS or equivalent, and sends information about DTCs and input/output part operating conditions to the WDS or equivalent.

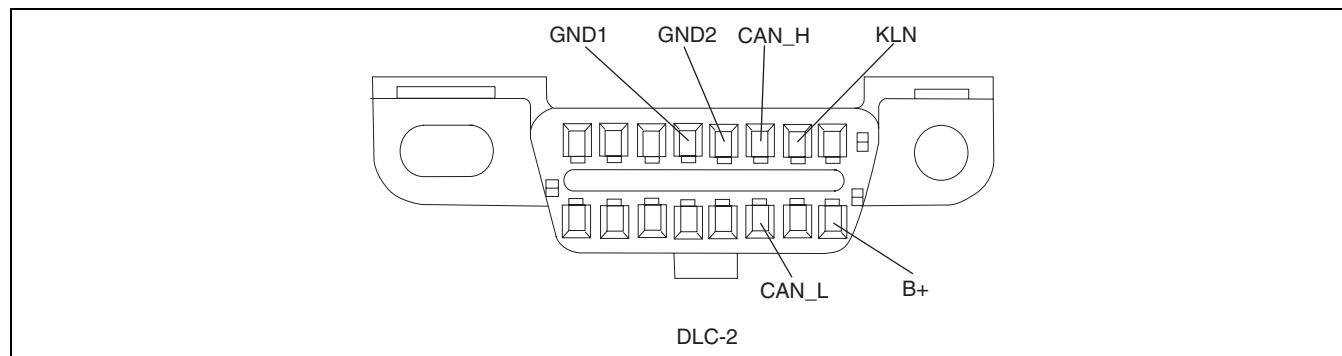
Diagnostic function	Signal received	Signal sent
Malfunction detection function	DTC verification signal	DTC
Data monitor function	Request signal to read selected monitor item	Monitor information for requested monitor item
Active command modes function	Request signal to read selected active command modes item	Output part drive signal

## ON-BOARD DIAGNOSTIC

### DLC-2 CONSTRUCTION

E6U04020000S06

- The data link connector-2 (DLC-2) is composed of 16-pin connectors containing terminals KLN, CAN\_H, CAN\_L, +B, GND1, and GND2.



ADA6970T003

Terminal	Function	Remark	
KLN	<ul style="list-style-type: none"> <li>Outputs DTC related to DSC HU/CM</li> <li>PID/DATA monitor and record function</li> <li>Active command modes function</li> </ul>	WDS or equivalent communication line	
CAN_H	CAN line (HI)	—	—
CAN_L	CAN line (LO)	—	—
GND1	Body ground	—	—
GND2	Ground for WDS or equivalent	—	—
B+	Battery positive voltage for WDS or equivalent	—	—

## 04-11 CONVENTIONAL BRAKE SYSTEM

### CONVENTIONAL BRAKE SYSTEM

OUTLINE ..... 04-11-1

### CONVENTIONAL BRAKE SYSTEM

STRUCTURAL VIEW ..... 04-11-1

### FRONT BRAKE (DISC)

CONSTRUCTION ..... 04-11-2

### REAR BRAKE (DISC)

CONSTRUCTION ..... 04-11-2

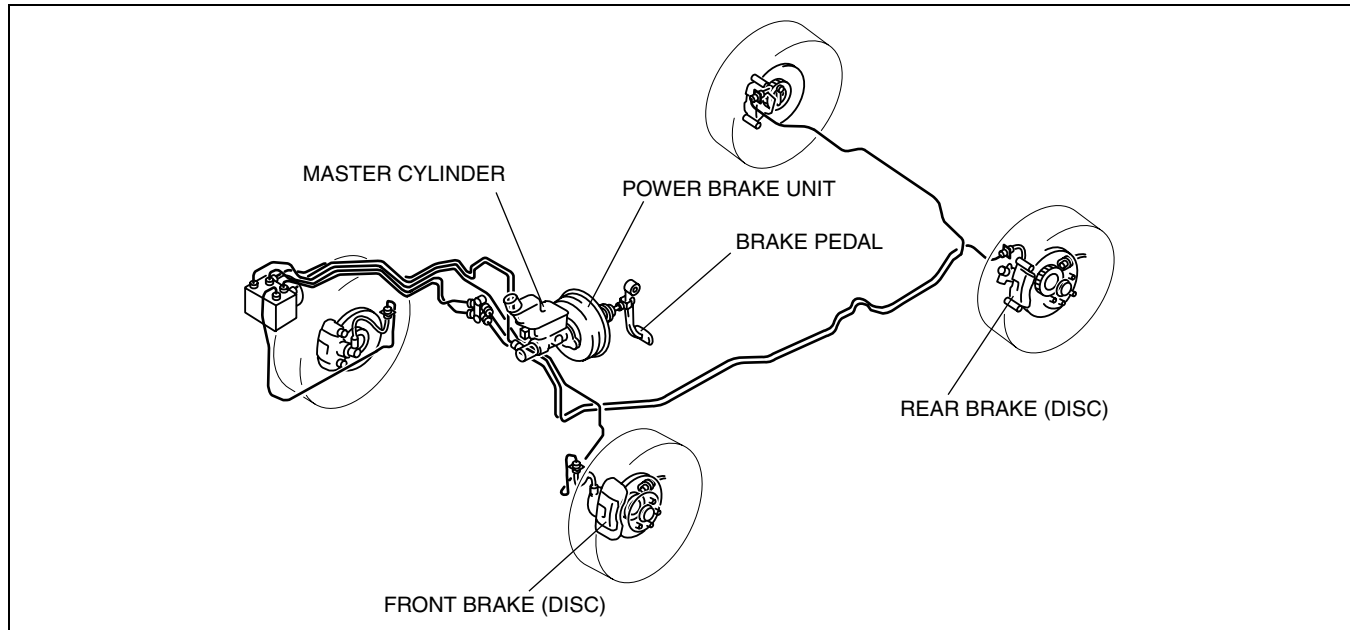
### CONVENTIONAL BRAKE SYSTEM OUTLINE

E6U041100000S01

- 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

E6U041100000S02

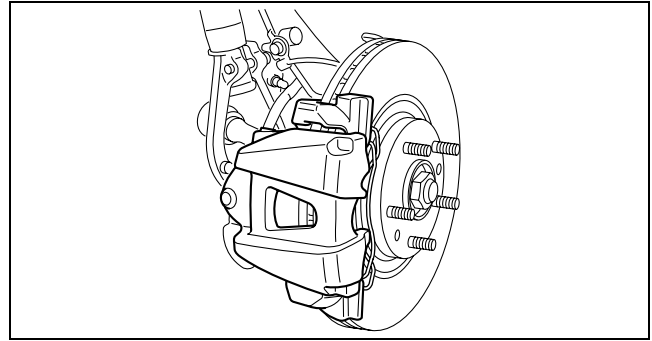


E6U411ZS7001

## CONVENTIONAL BRAKE SYSTEM

### FRONT BRAKE (DISC) CONSTRUCTION

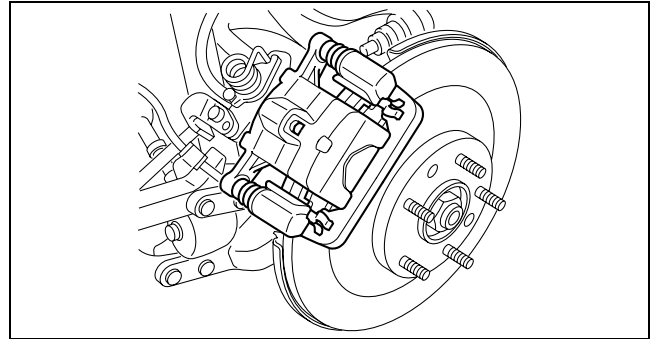
- Large diameter, ventilated disc type front brakes with a **320 mm {12.6 in}** diameter and a **25 mm {0.984 in}** thickness have been adopted, improving braking force and fade resistance.



E6U411ZSB002

### REAR BRAKE (DISC) CONSTRUCTION

- Large diameter, solid disc type front brakes with a **314 mm {12.4 in}** diameter and a **11 mm {0.43 in}** thickness have been adopted, improving braking force and fade resistance.



E6U411ZSB003

# 04-15 DYNAMIC STABILITY CONTROL

<b>DYNAMIC STABILITY CONTROL (DSC)</b>		<b>BRAKE ASSIST CONTROL</b>	
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DSC Operation Outline . . . . .	04-15-1	<b>BRAKE ASSIST CONTROL</b>	
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04-15

## DYNAMIC STABILITY CONTROL (DSC) OUTLINE

E6U04150000S01

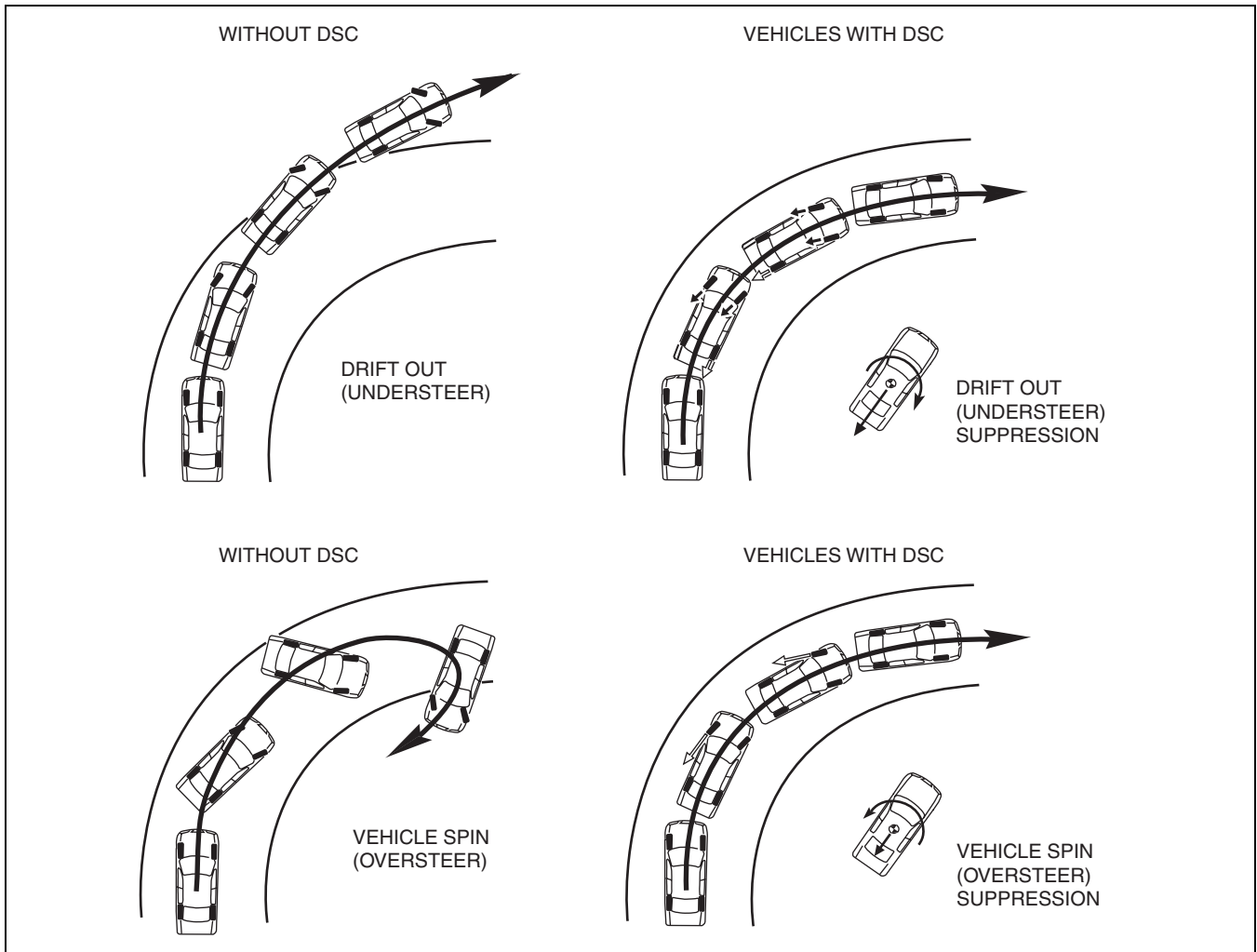
- The DSC HU/CM, integrating both the hydraulic unit (HU) and control module (CM), has been adopted, improving reliability.
- The electrical brake assist control has been adopted, improved safety.
- A combined sensor, integrating both the yaw rate sensor, lateral-G sensor and forward G sensor, has been adopted, improving serviceability.
- An enhanced malfunction diagnosis system, used with the WDS or equivalent, 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.

# DYNAMIC STABILITY CONTROL

## Results of DSC Operation



B6R6900W003

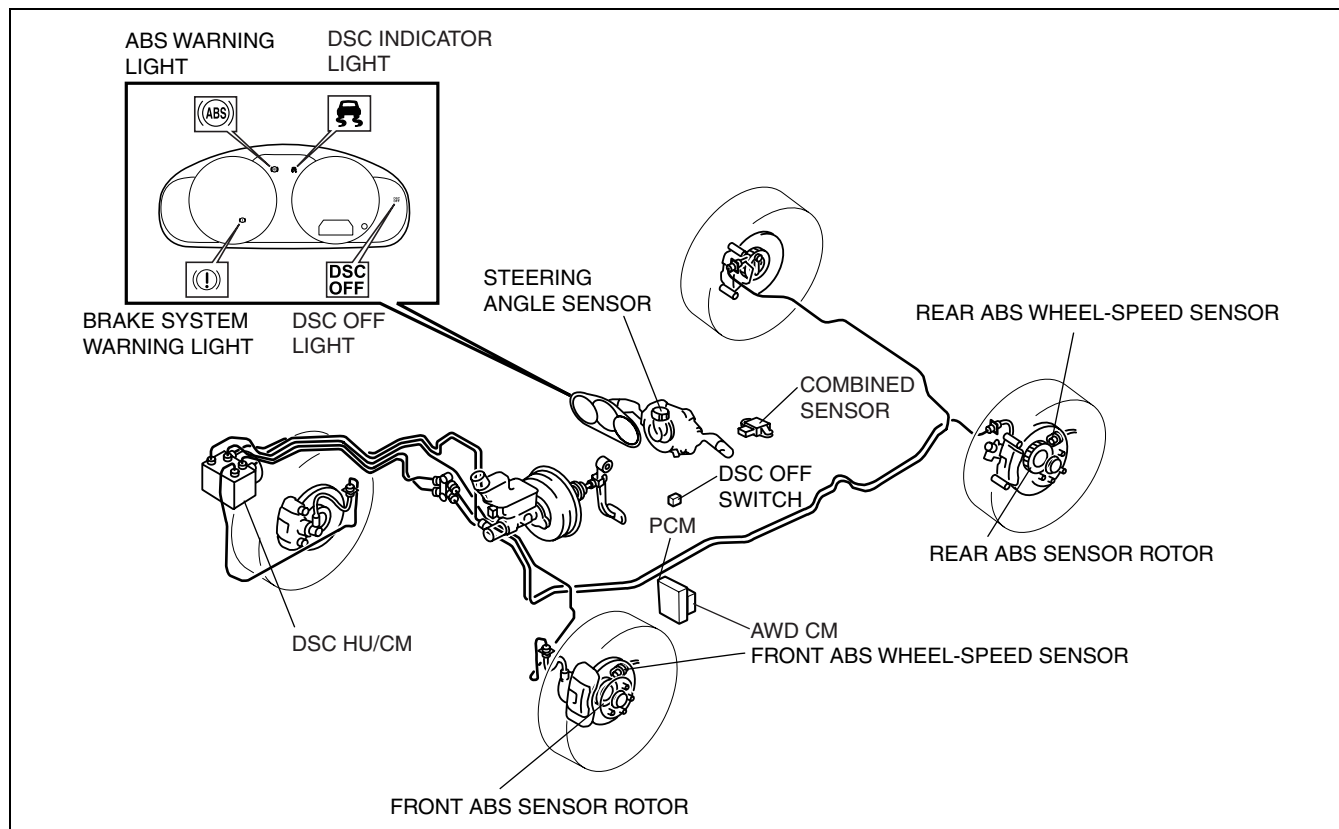
### Caution

- 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.
- If the configuration/initialization procedures for the DSC HU/CM and combined sensor are not performed correctly, an incorrectly determined initial point may cause a discrepancy between the actual driving conditions of the vehicle and the signals from the sensors, resulting in improper DSC operation. Therefore, after replacing or removing the following parts, make sure to perform the DSC HU/CM configuration/initialization procedures of the parts with the stopped on a level ground to insure proper DSC operation. For the configuration/initialization procedures of the parts, refer to the Workshop Manual.
  - DSC HU/CM
  - Combined sensor
- 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
  - With an emergency spare tire

# DYNAMIC STABILITY CONTROL

## DYNAMIC STABILITY CONTROL (DSC) STRUCTURAL VIEW

E6U04150000S02



E6U415ZS7001

04-15

## DYNAMIC STABILITY CONTROL (DSC) CONSTRUCTION

E6U04150000S03

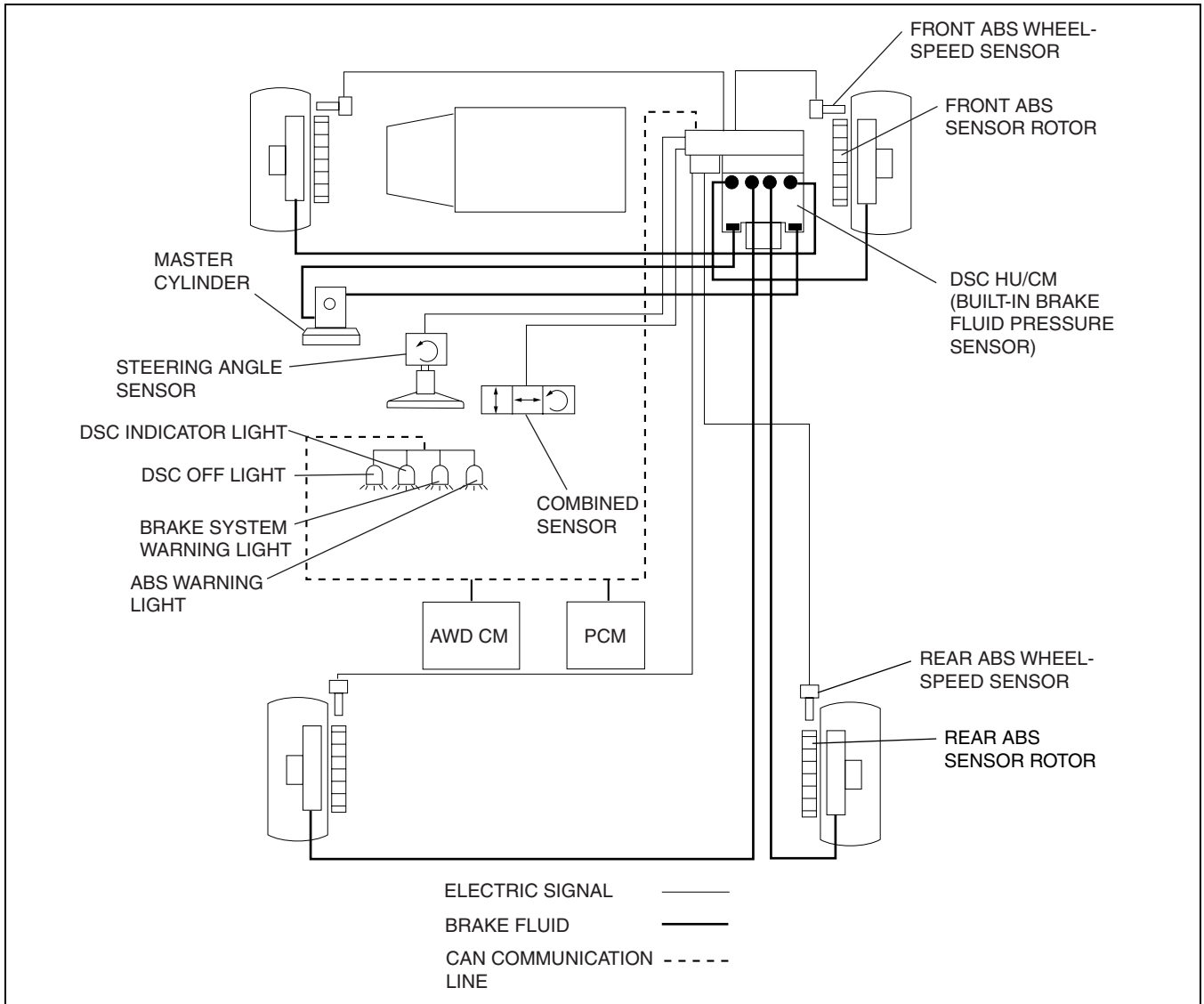
- The DSC system consists of the following components. Moreover, the function of common components in other systems as they are related to each DSC structural component is explained in terms of DSC system functions.

Part name	Function
DSC HU/CM	<ul style="list-style-type: none"> <li>Calculates input signal from each sensor, and controls brake fluid pressure applied to each wheel, and activates each DSC system function (ABS, EBD, TCS, and DSC).</li> <li>Outputs control signal regulating the function of the TCS/DSC system and speed signal through CAN.</li> <li>Controls the diagnosis system and fail-safe function when an abnormality is detected in the DSC system.</li> </ul>
PCM	<ul style="list-style-type: none"> <li>Controls engine torque based on the signal from DSC HU/CM.</li> <li>Transmits engine conditions and tire information to DSC HU/CM through CAN.</li> </ul>
DSC indicator light	<ul style="list-style-type: none"> <li>Notifies driver of DSC operation (Vehicle is in side slip situation).</li> <li>Notifies driver of TCS operation (Drive-wheel slippage situation).</li> </ul>
DSC OFF switch	<ul style="list-style-type: none"> <li>DSC system non-operation based on driver intention is transmitted to DSC HU/CM.</li> </ul>
DSC OFF light	<ul style="list-style-type: none"> <li>Notifies driver of DSC system non-operation by DSC OFF switch.</li> <li>Notifies driver of DSC system is forbidden by fail-safe function.</li> </ul>
ABS wheel-speed sensor	<ul style="list-style-type: none"> <li>Detects rotation state of each wheel and transmits signal to the DSC HU/CM.</li> </ul>
Combined sensor	<ul style="list-style-type: none"> <li>Detects lateral-G force, forward-G force and yaw rate (vehicle cornering angle velocity) of vehicle and transmits to DSC HU/CM.</li> </ul>
Brake fluid pressure sensor (Built-in DSC HU/CM)	<ul style="list-style-type: none"> <li>Detects fluid pressure from the master cylinder.</li> </ul>
Steering angle sensor	<ul style="list-style-type: none"> <li>Detects steering angle and transmits to the DSC HU/CM.</li> </ul>

# DYNAMIC STABILITY CONTROL

## DYNAMIC STABILITY CONTROL (DSC) SYSTEM DIAGRAM

E6U04150000S04

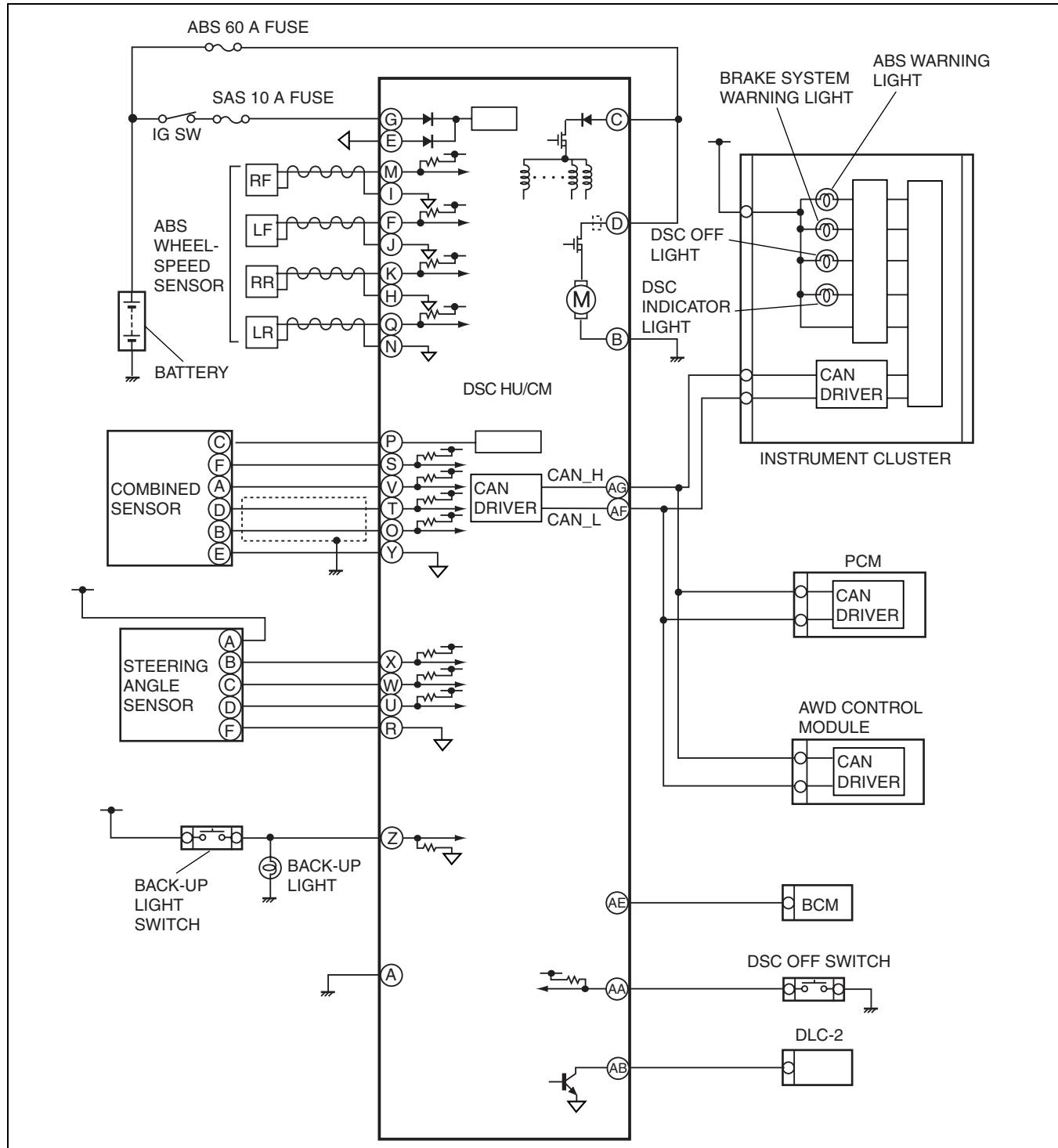


E6U415ZSB015

# DYNAMIC STABILITY CONTROL

## DYNAMIC STABILITY CONTROL (DSC) SYSTEM WIRING DIAGRAM

E6U04150000S05



E6U402BW7001

### DSC HU/CM CONSTRUCTION

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

E6U041543750S01

### DSC HU PART FUNCTION

- 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, DSC and electrical brake assist) of the DSC system.

E6U041543750S02

# DYNAMIC STABILITY CONTROL

## DSC HU PART CONSTRUCTION/OPERATION

E6U041543750S03

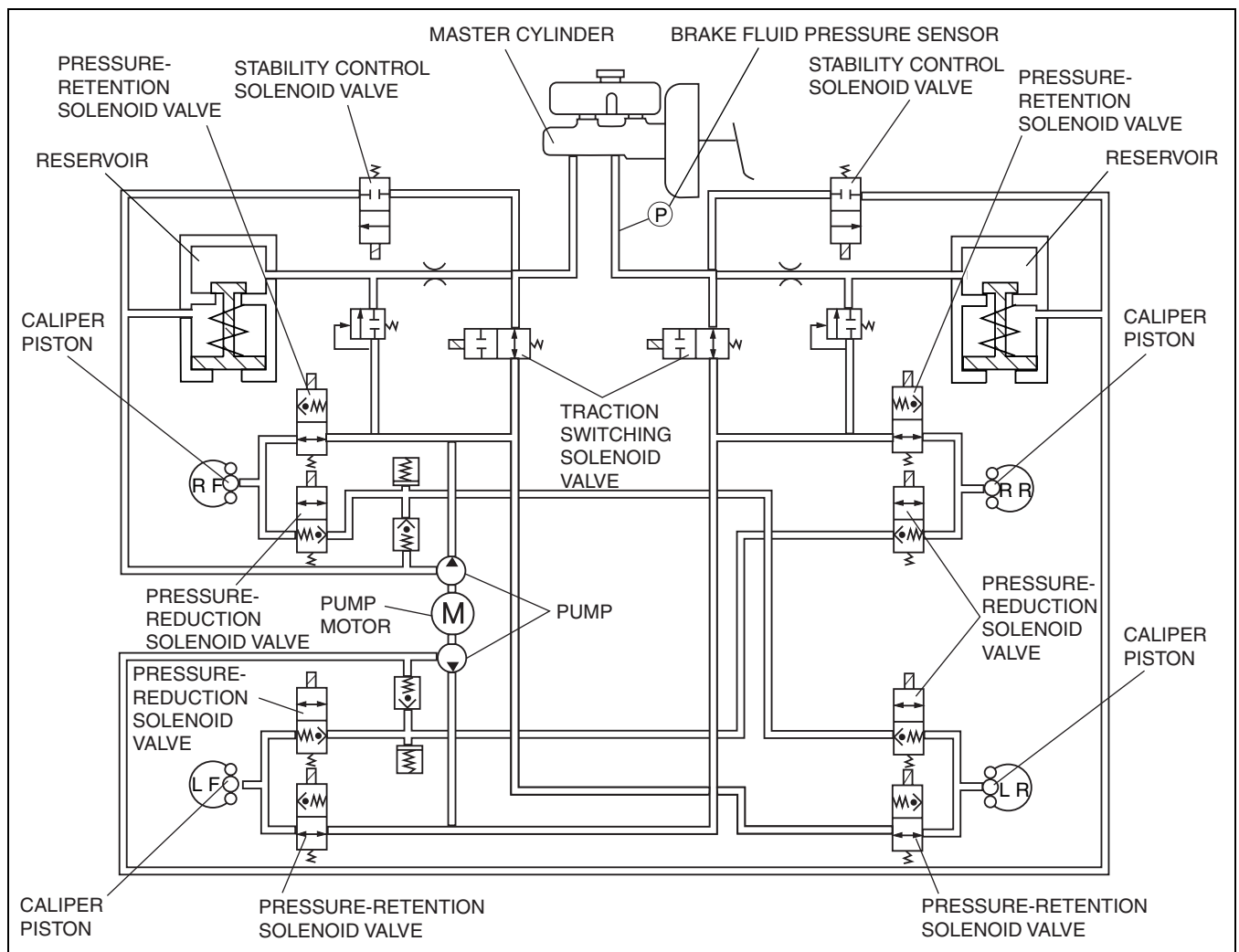
### Construction

- The ABS HU mainly consists of the pressure-retention/pressure reduction solenoid valves, pump motor (pump), stability control solenoid valves and traction switching solenoid valves.

### Function Of Main Component Parts

Part name	Function
Pressure-retention solenoid valve	<ul style="list-style-type: none"> <li>Adjusts the fluid pressure in each brake system according to DSC HU/CM signals.</li> </ul>
Pressure-reduction solenoid valve	<ul style="list-style-type: none"> <li>Adjusts the fluid pressure in each brake system according to DSC HU/CM signals.</li> </ul>
Stability control solenoid valve	<ul style="list-style-type: none"> <li>Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control and DSC control.</li> </ul>
Traction switching solenoid valve	<ul style="list-style-type: none"> <li>Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control and DSC control.</li> </ul>
Reservoir	<ul style="list-style-type: none"> <li>Temporarily stores brake fluid from the caliper piston to ensure smooth pressure reduction during ABS and EBD control, TCS control and DSC control.</li> </ul>
Pump	<ul style="list-style-type: none"> <li>Returns the brake fluid stored in the reservoir to the master cylinder during ABS and DSC control.</li> <li>Increases brake fluid pressure and sends brake fluid to each caliper piston during TCS control and DSC control.</li> </ul>
Pump motor	<ul style="list-style-type: none"> <li>Operates the pump according to DSC HU/CM signals.</li> </ul>

### Hydraulic Circuit Diagram



E6U415ZSB004

# DYNAMIC STABILITY CONTROL

## Operation

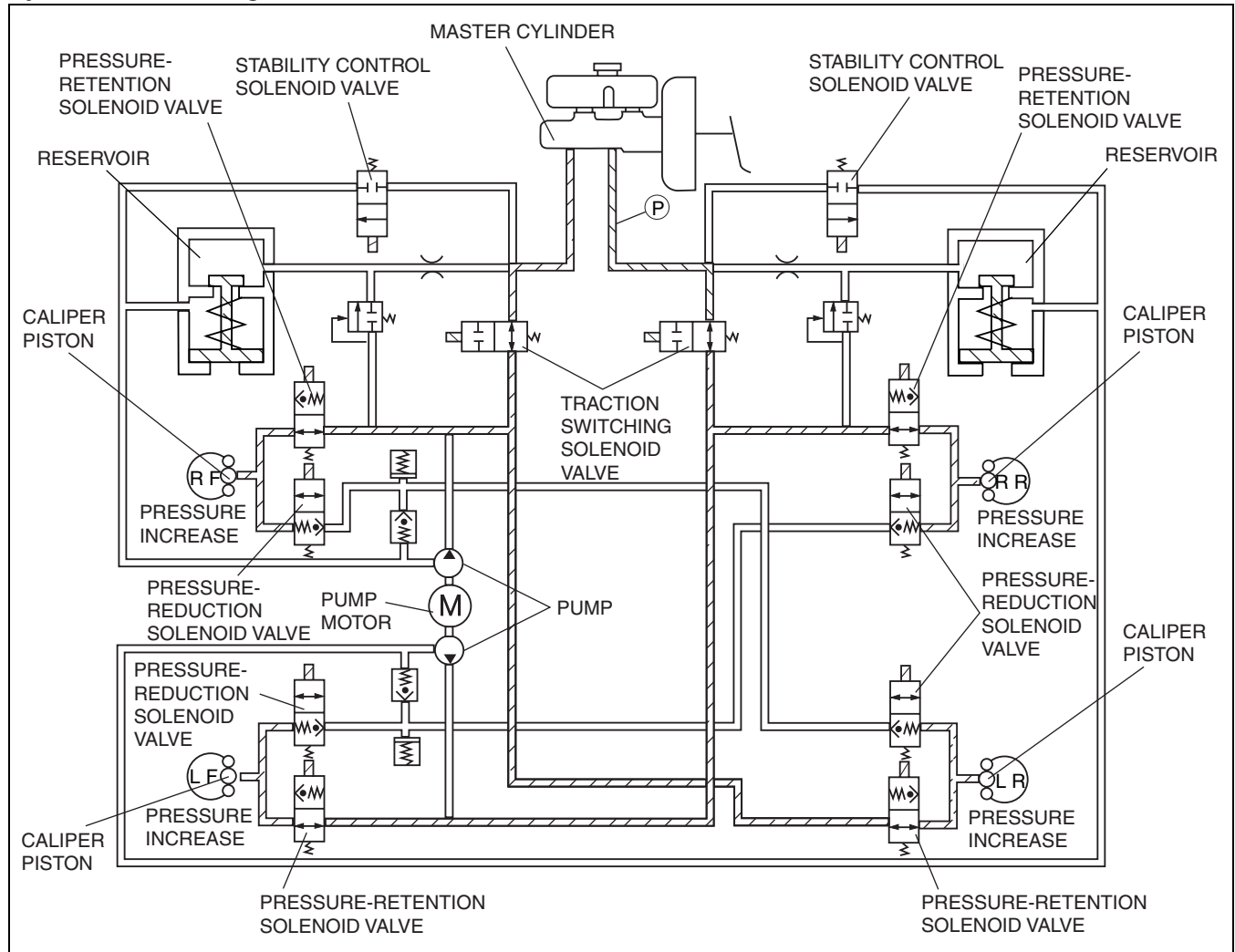
### During normal braking

- 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 solenoid valve and pressure-retention solenoid valves, and then to the caliper piston.

### Solenoid valve operation table

Traction switching solenoid valve		Stability control solenoid valve		Pressure-retention solenoid valve				Pressure-reduction 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



E6U415ZSB005

# DYNAMIC STABILITY CONTROL

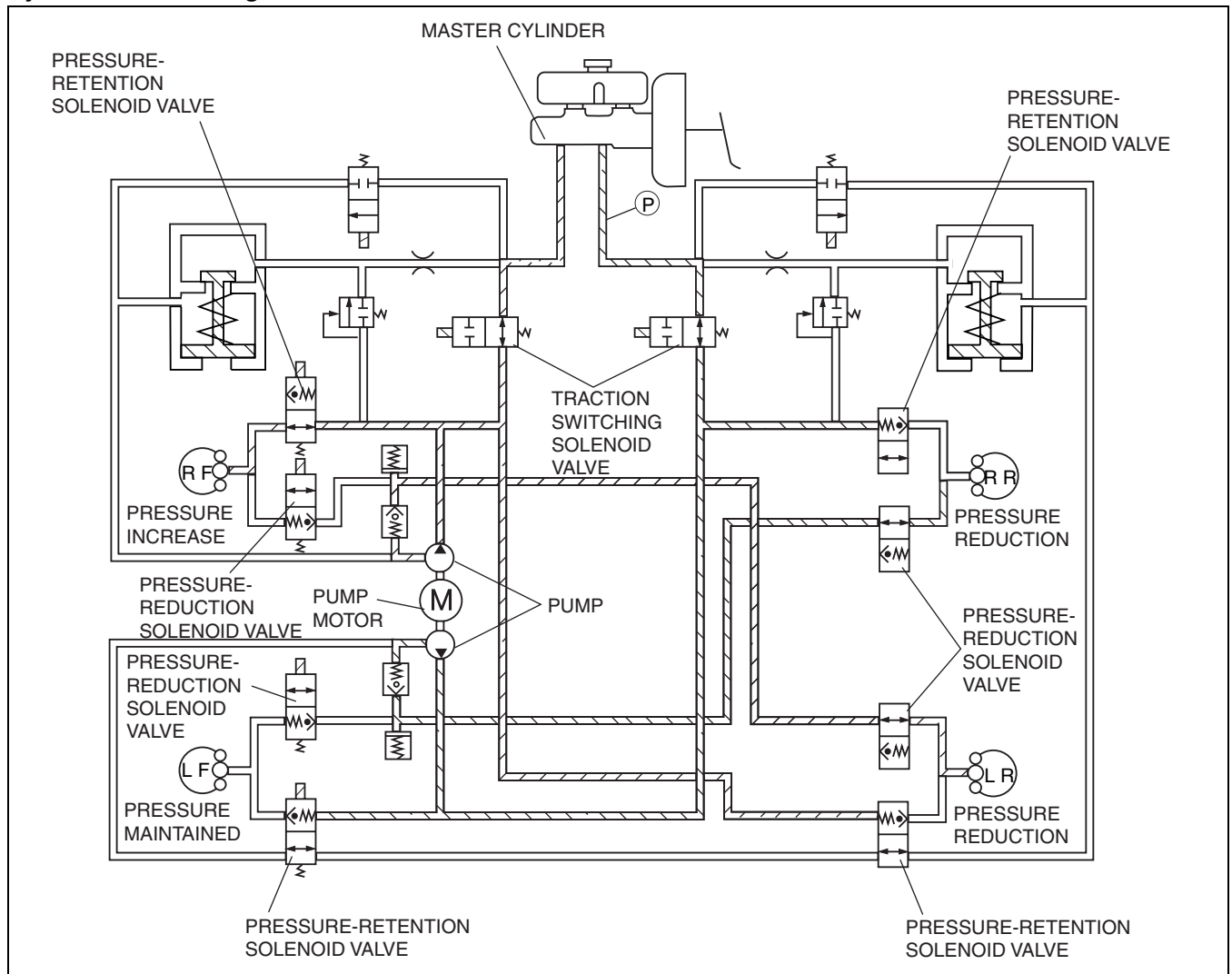
## During ABS and EBD control

- During ABS and EBD control, when wheel lock-up is about to occur, the traction switching solenoid valve and stability control solenoid valves are not energized, and the pressure-retention and pressure-reduction 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 switching solenoid valve		Stability control solenoid valve		Pressure-retention solenoid valve				Pressure-reduction 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



E6U415ZSB006

# DYNAMIC STABILITY CONTROL

## During DSC control (to suppress oversteer tendency) and TCS control

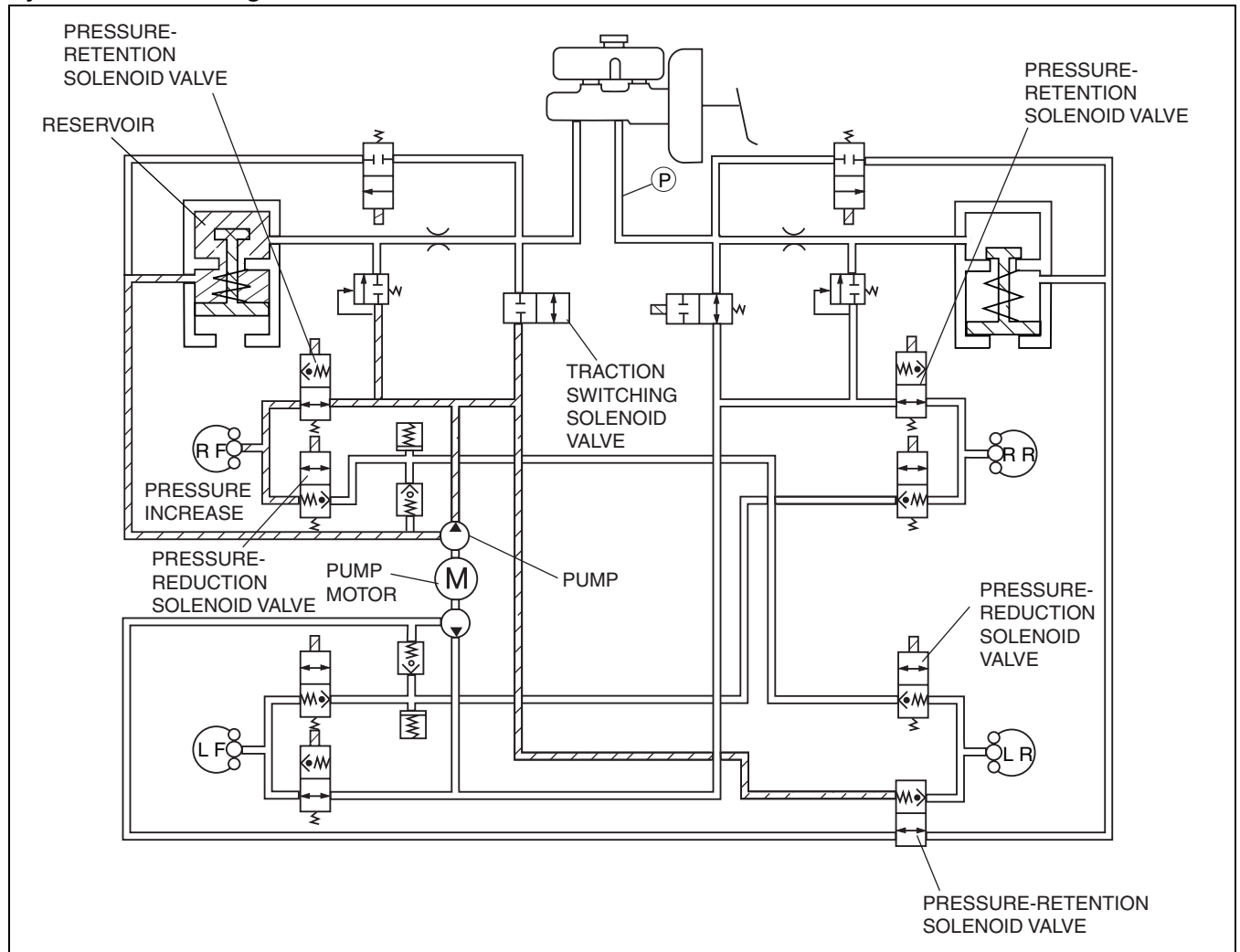
- When a large oversteer tendency or driving wheel spin is determined, the traction switching solenoid and stability control solenoid valves are energized, switching the hydraulic circuits. At the same time, the pump motor is actuated to operate the pump, thereby increasing pressure by supplying brake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

## Solenoid valve operation table

	Traction switching solenoid valve		Stability control solenoid valve		Pressure-retention solenoid valve				Pressure-reduction 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)		OFF (open)		ON (closed)	OFF (open)	OFF (closed)				Operating
During pressure maintain mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)		OFF (open)	OFF (closed)				Stopped
During pressure reduction mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)		OFF (open)	OFF (closed)	ON (open)	OFF (closed)		Operating

04-15

## Hydraulic Circuit Diagram



E6U415ZSB007

# DYNAMIC STABILITY CONTROL

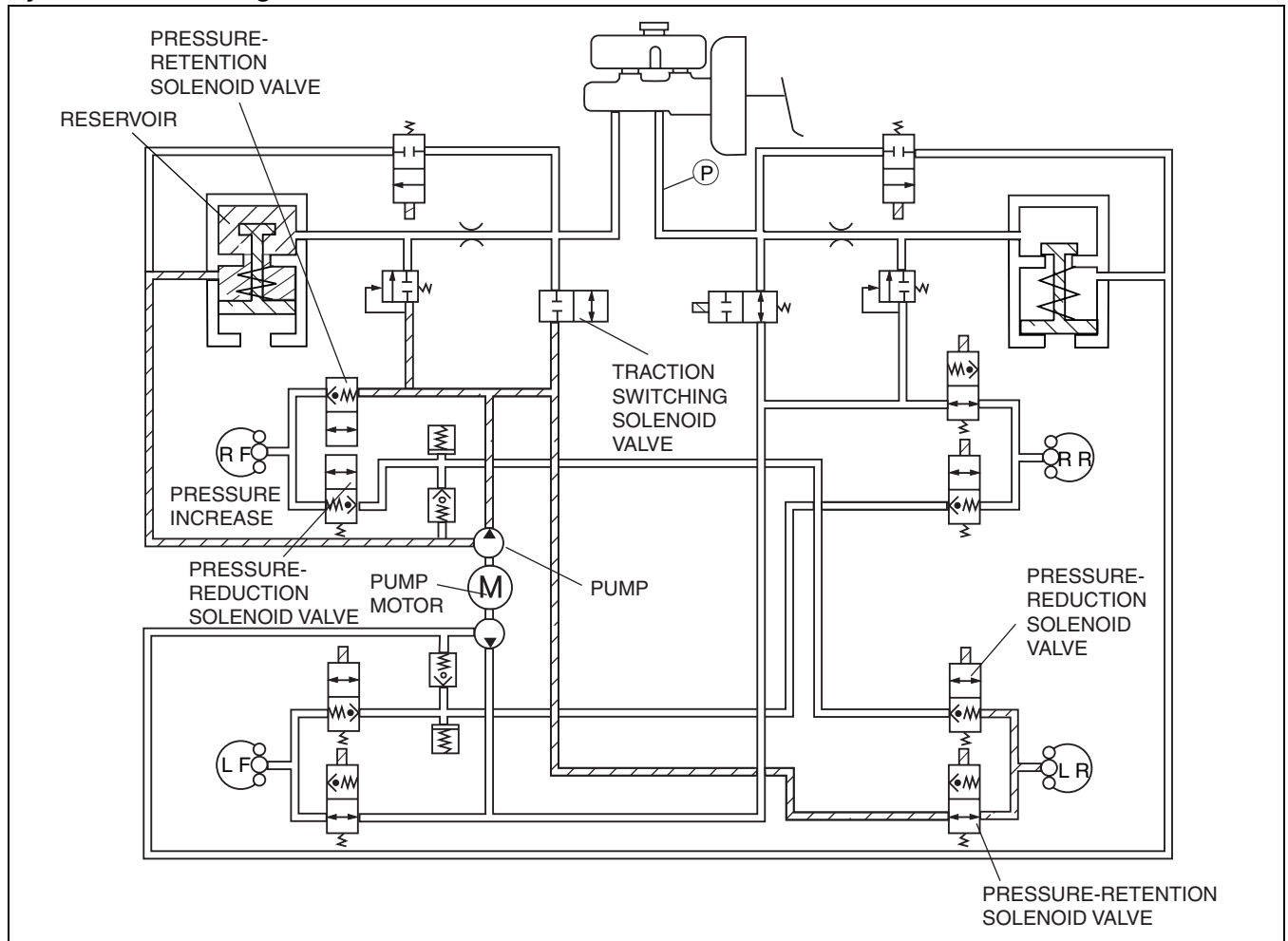
## During DSC control (to suppress understeer tendency)

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

## Solenoid valve operation table

	Traction switching solenoid valve		Stability control solenoid valve		Pressure-retention solenoid valve				Pressure-reduction 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)		OFF (open)	ON (closed)	OFF (open)		OFF (closed)				Operating
During pressure maintain mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)	OFF (open)		OFF (closed)				Stopped
During pressure reduction mode	OFF (open)	ON (closed)	OFF (closed)		OFF (open)	ON (closed)	OFF (open)		OFF (closed)	ON (open)	OFF (closed)		Operating

## Hydraulic Circuit Diagram



E6U415ZSB008

## DYNAMIC STABILITY CONTROL

### DSC CM PART FUNCTION

E6U041543750S04

- 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	Content
ABS control function	<ul style="list-style-type: none"><li>• When braking, maintains direction stability during braking operation, secures handling and provides shortened braking distance by control of brake fluid pressure.</li></ul>
EBD (Electronic brakeforce distribution) control	<ul style="list-style-type: none"><li>• Prevents rear-wheel lockup through optimum control of normal brake fluid pressure distribution to front and rear wheels in response to vehicle load, condition of road surface and vehicle speed.</li></ul>
TCS control	<ul style="list-style-type: none"><li>• Provides improved safety of start and acceleration performance by keeping traction within limits of road surface friction in response to road and vehicle speed conditions.</li></ul>
DSC control	<ul style="list-style-type: none"><li>• Inhibits strong tendency of the vehicle to oversteer or understeer, by controlling engine torque and braking on each wheel to provide assured vehicle stability.</li></ul>
Brake assist control	<ul style="list-style-type: none"><li>• Controls the fluid of the wheel cylinder during emergency braking, provides increased fluid pressure to each wheels.</li></ul>
Vehicle speed output	<ul style="list-style-type: none"><li>• The value of the calculation from the 4 wheel-speed sensors is output as a speed signal to CAN communication line.</li></ul>
Diagnostic system	<ul style="list-style-type: none"><li>• Important parts in the DSC control have a self-detection function that, in the event of any abnormality, illuminate each warning light to inform the driver of an abnormality together with recording the DTC in the DSC unit.</li><li>• When occurrence of an abnormality is judged by self-detection, cancels the controls so as not to cause loss of driving safety.</li></ul>

04-15

# DYNAMIC STABILITY CONTROL

## ABS CONTROL OUTLINE

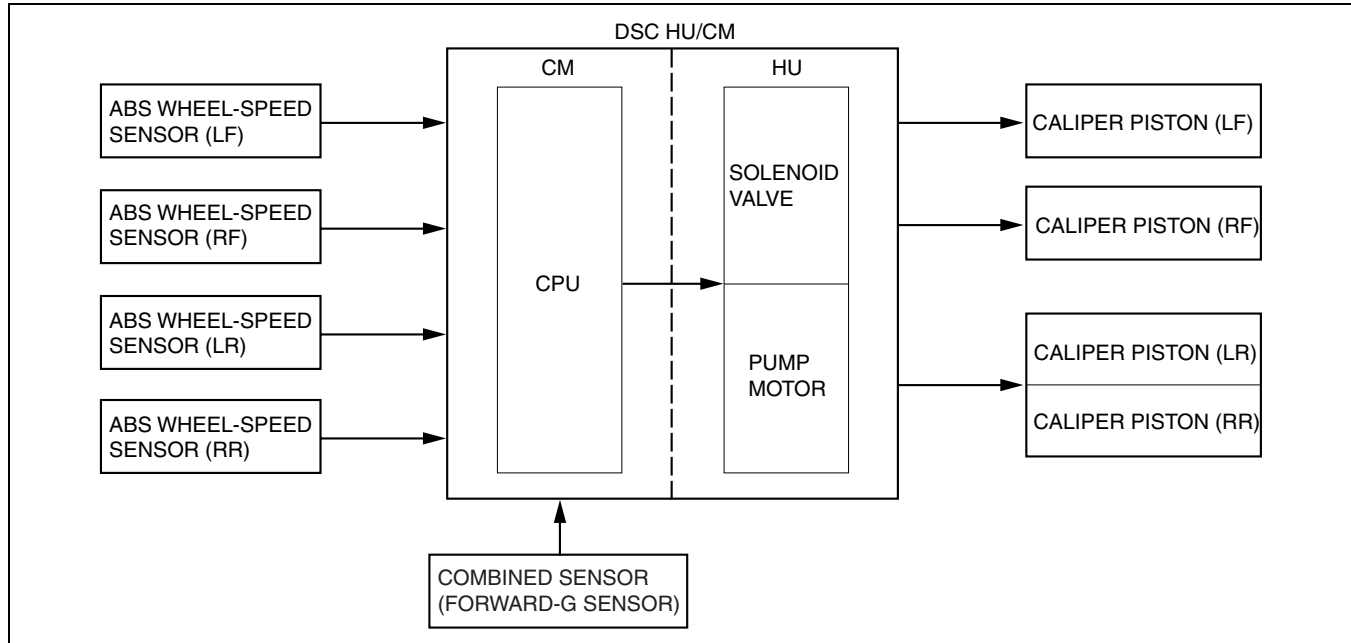
E6U041543750S05

- ABS control occurs when wheel slip is determined by the DSC CM (based on the four ABS wheel-speed sensors and combined sensor (forward-G sensor)). Then, the DSC HU pressure-retention and pressure-reduction 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



E6U415ZSB009

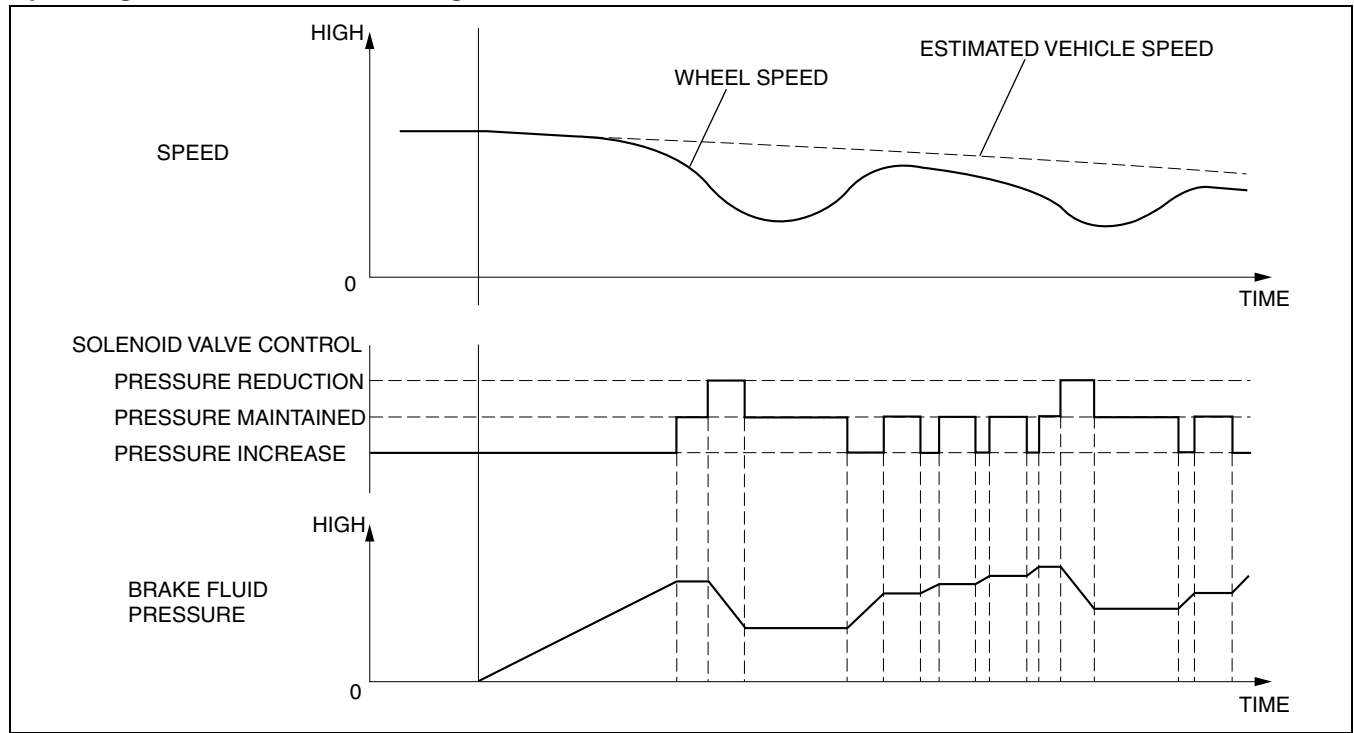
# DYNAMIC STABILITY CONTROL

## ABS CONTROL OPERATION

E6U041543750S06

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

### Operating Condition Transition Diagram



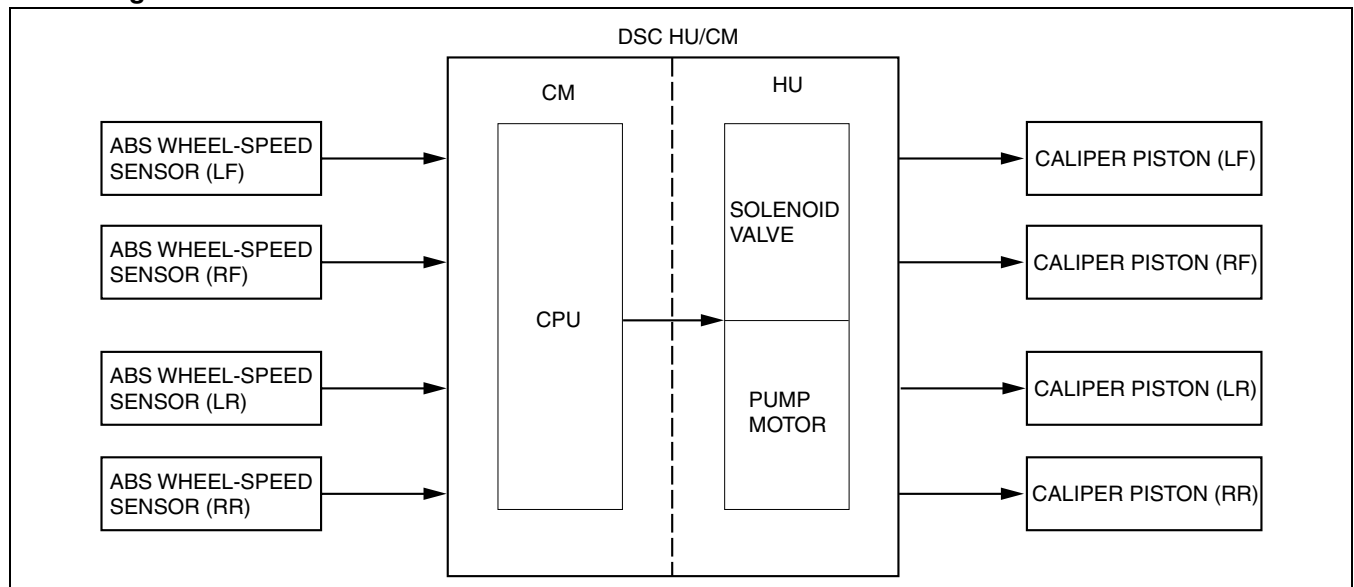
CHU0413S010

## EBD CONTROL OUTLINE

E6U041543750S07

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

### Block Diagram



E6U415ZSB010

# DYNAMIC STABILITY CONTROL

## EBD CONTROL OPERATION

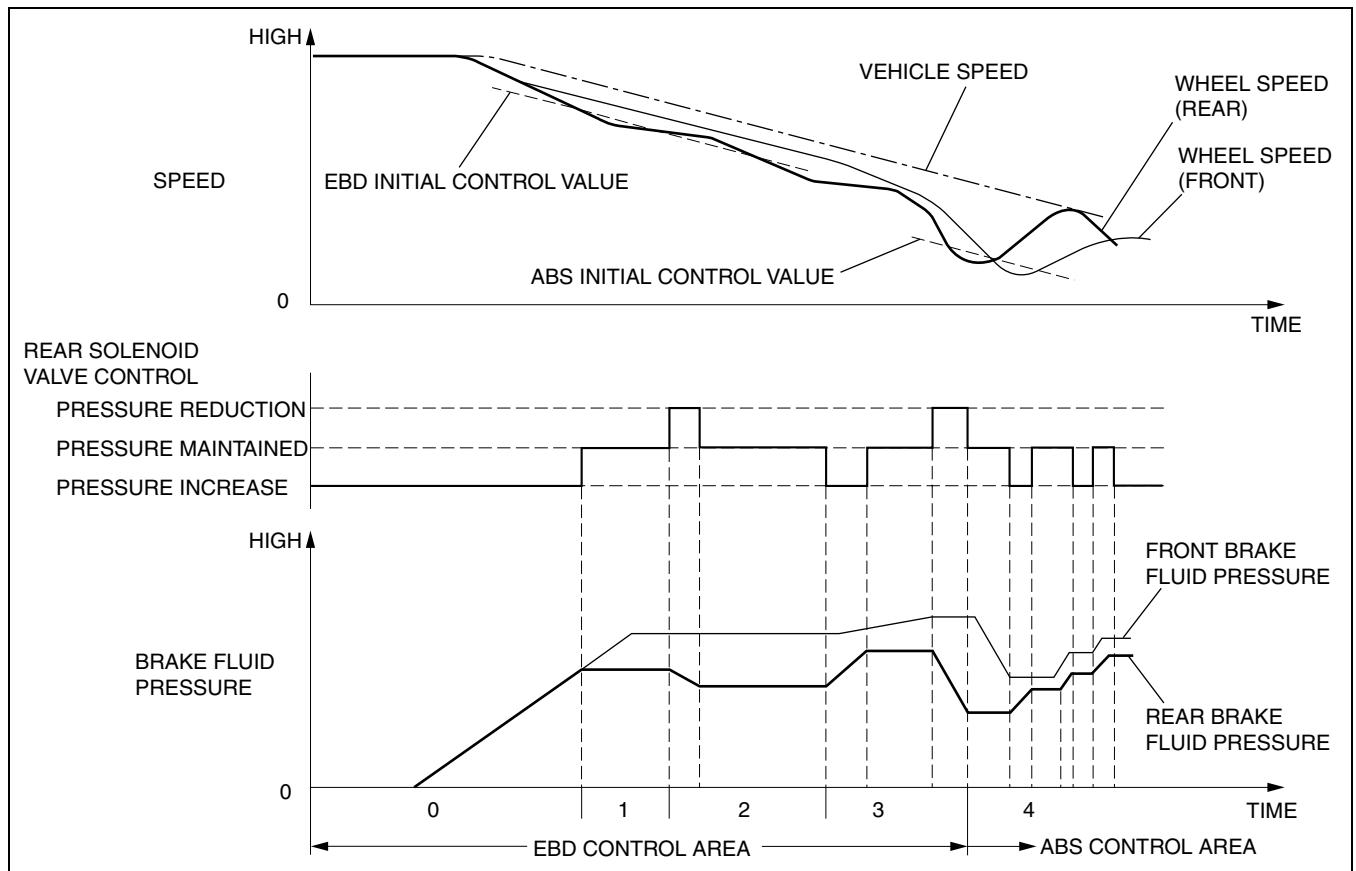
E6U041543750S08

- 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 DSC 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 DSC HU outlet and inlet solenoid valves are operated and the brake fluid pressure controlled according to these conditions.
- If ABS control conditions are met during EBD control, EBD control is stopped and ABS control is given priority.

Status	Rear wheel slip ratio determination	EBD control	Solenoid valve	Comment
0	No slip	No control	Pressure increase	—
1	$\alpha\%$ — $\beta\%$	Control	Pressure maintained	—
2	$\beta\%$ or more	Control	Reduction/maintained	—
3	After EBD control, slip ratio is $\gamma\%$	Control	Increase/maintain	—
4	Front wheel slip ratio is $\delta\%$ or more	Control	Pressure reduction/maintained/ increase	ABS control operates

$\alpha$ — $\delta$ :Specified value

## Operating Condition Transition Diagram



CHU0413S012

## TCS CONTROL OUTLINE

E6U041543750S09

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

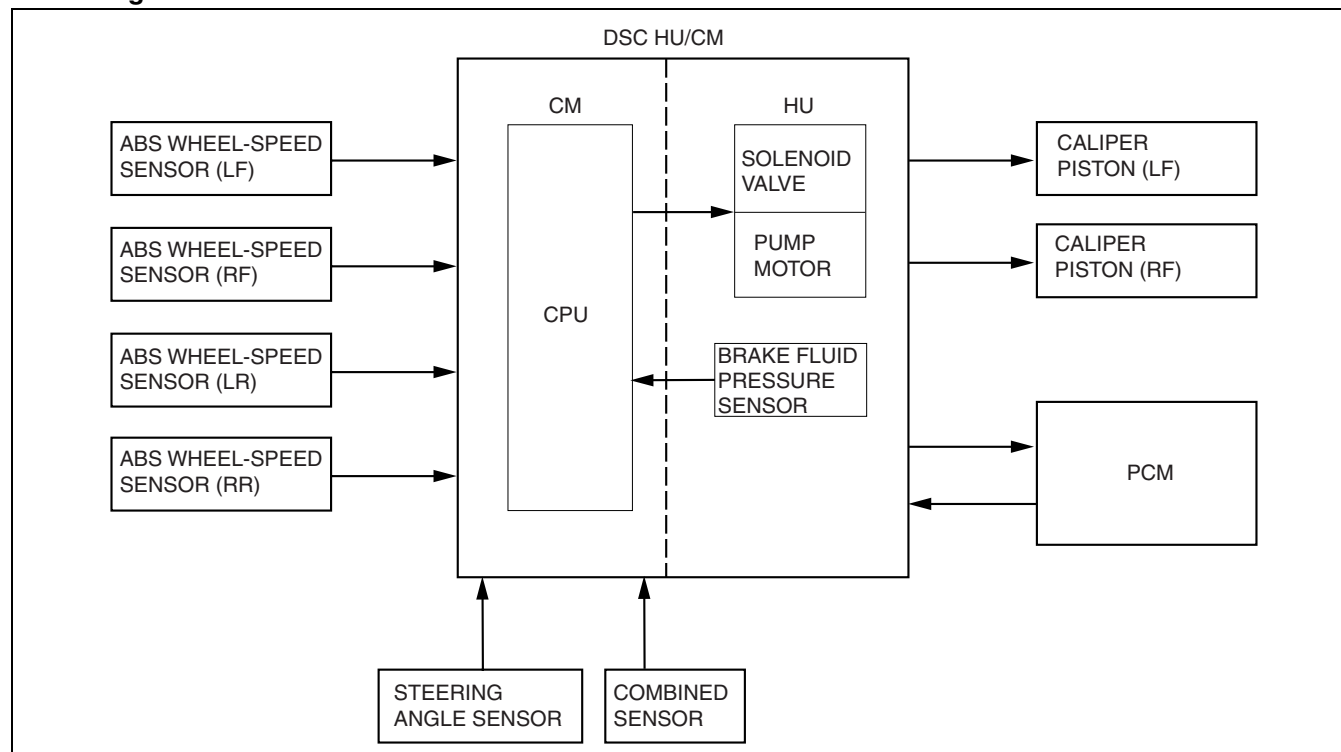
### Note

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

## Features

- The left and right wheels are controlled at the same time by 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 stabler vehicle control.

## Block diagram



E6U415ZSB003

## TCS CONTROL OPERATION

E6U041543750S10

- TCS control detects driving wheel spin based on the signals listed below, sends torque reduction request signals to the PCM, and also controls the solenoid valves and pump motor in the DSC HU/CM.
  - Vehicle wheel speed signals from the front and rear 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 signal from the brake fluid pressure sensor (built into the DSC HU/CM)

# DYNAMIC STABILITY CONTROL

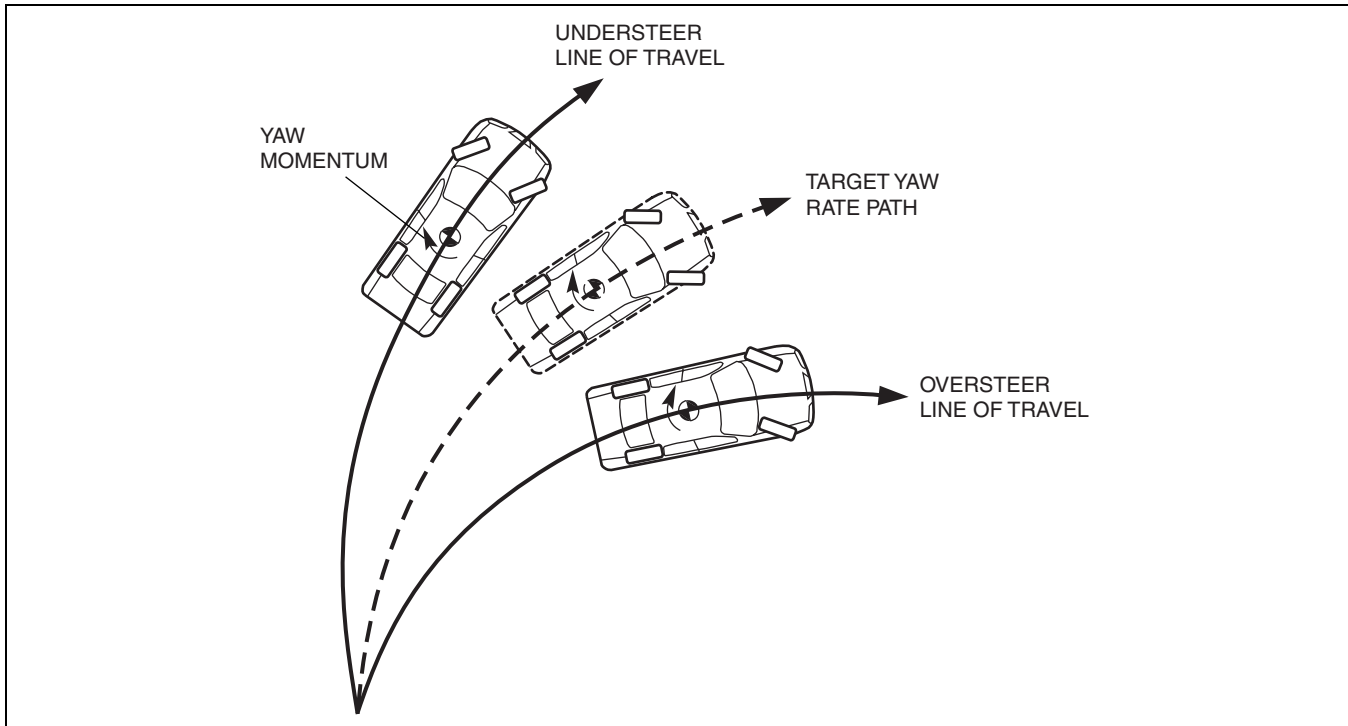
## DSC CONTROL OUTLINE

E6U041543750S11

- 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 **approx. 20 km/h {12.4 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.



B6R6920W015

### 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.

# DYNAMIC STABILITY CONTROL

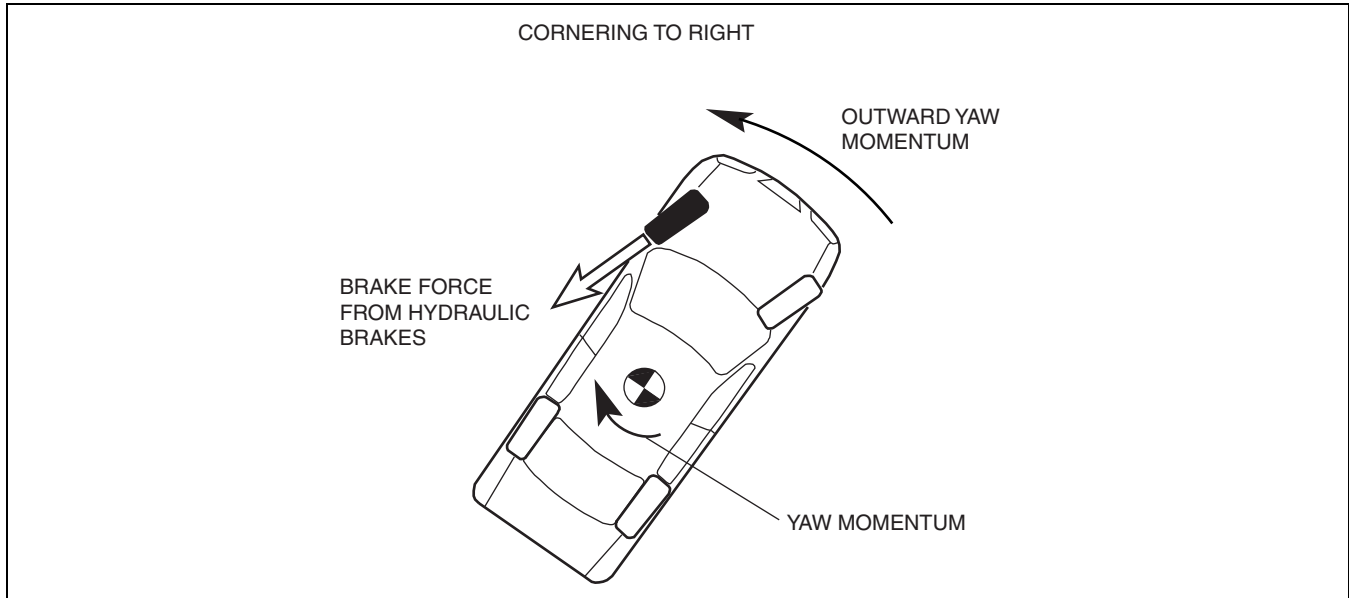
## DSC CONTROL OPERATION

E6U041543750S12

- 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

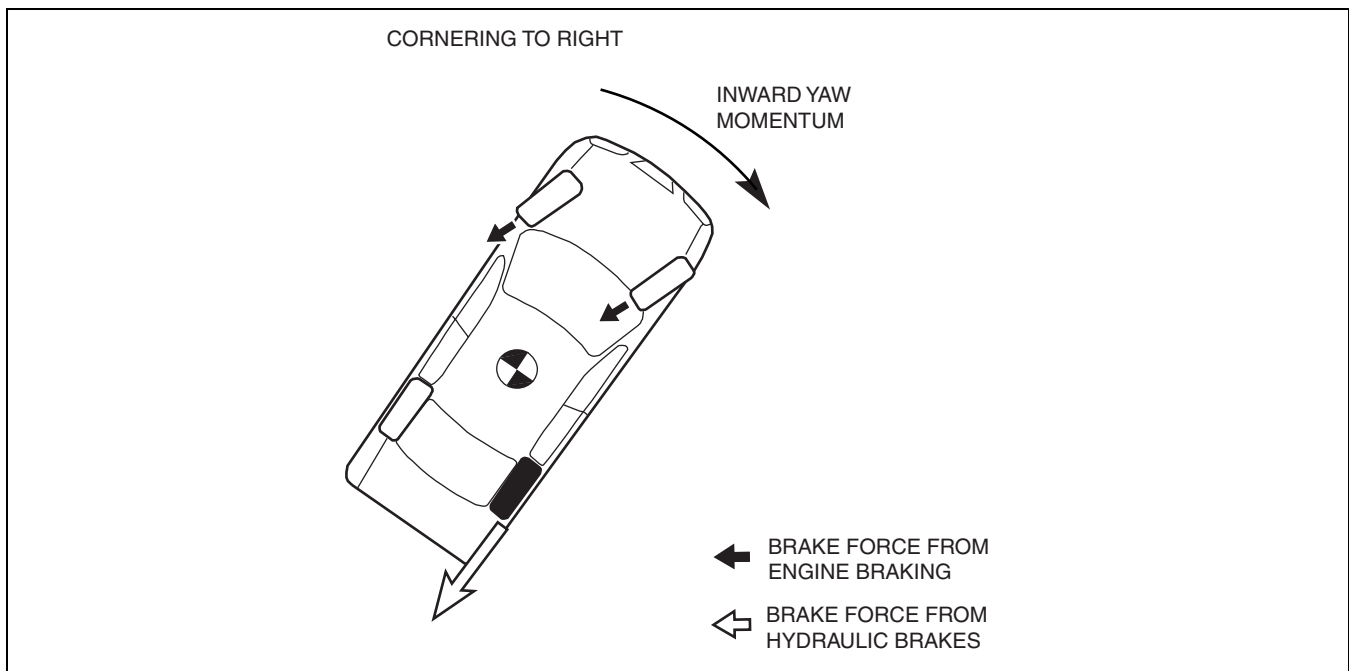
- When a large oversteer tendency is determined, braking is applied the outer front wheel according to the degree of the tendency. As a result, a yaw momentum is formed towards the outer side of the vehicle and the oversteer tendency is suppressed.



B6R6920W016

### 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 momentum is formed towards the inner side of the vehicle and the understeer tendency is suppressed.



E6U415ZSB011

# DYNAMIC STABILITY CONTROL

## BRAKE ASSIST CONTROL FUNCTION

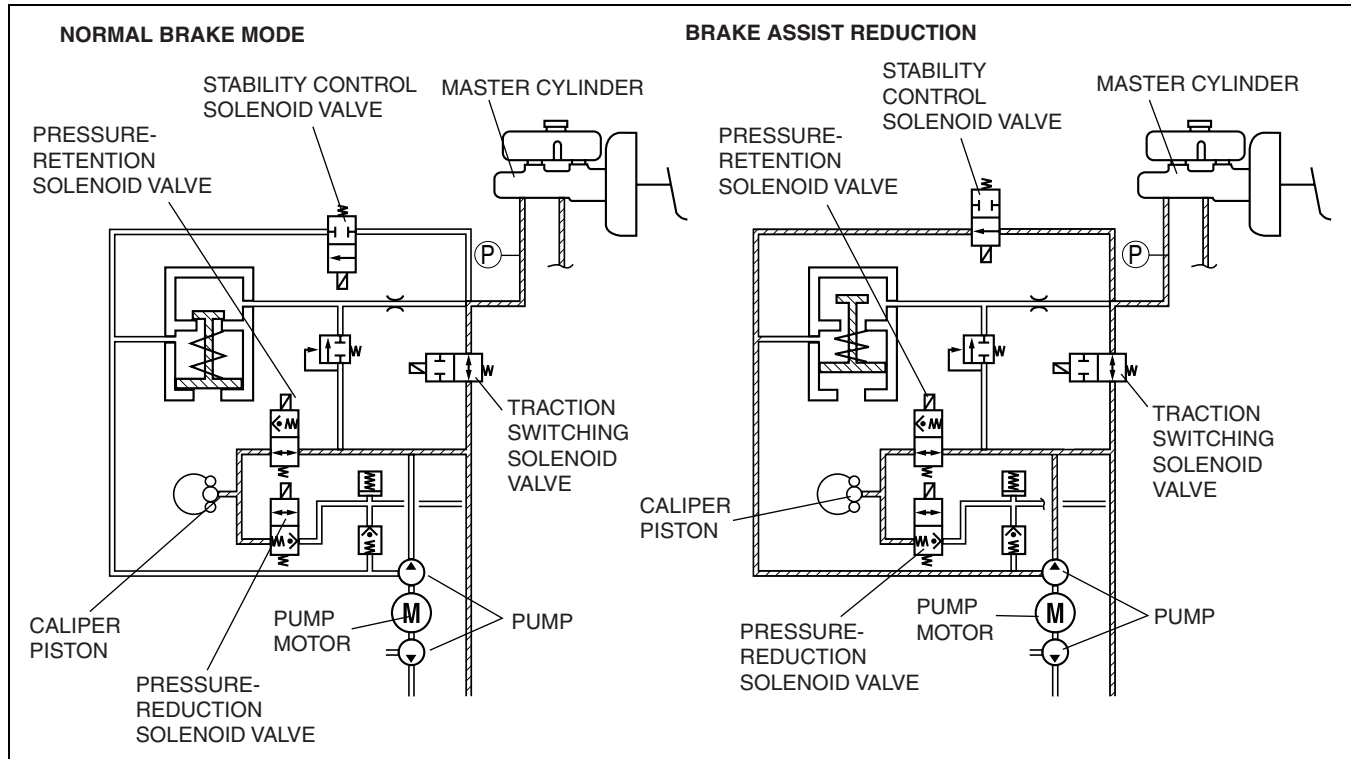
E6U041543750S13

- During emergency braking, the DSC HU/CM increases brake fluid pressure by increasing the master cylinder pressure, and therefore lessens the burden on the driver and enables use of a large braking force.

## BRAKE ASSIST CONTROL OPERATION

E6U041543750S14

- The DSC HU/CM uses the built-in brake fluid pressure sensor to monitor the rate at which the master cylinder pressure changes, and it initiates brake assist when it determines, from the pressure change, that emergency braking is occurring.
- The DSC HU/CM calculates the wheel cylinder pressure, increases fluid pressure in the master cylinder above the specified amount and, due to the change in master cylinder pressure, wheel cylinder pressure can be increased.
- In addition to normal brake fluid pressure, as each solenoid valve is switched, the pump motor is operated to pump fluid from the reservoir which increases brake pressure force in the wheel cylinders.
- Brake assist is initiated at speeds of **17 km/h or above**, and is inhibited at speeds of **5 km/h or below**.



E6U415ZSB013

## CONTROLLER AREA NETWORK (CAN) OUTLINE

E6U041543750S15

- 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. (See 09-40-5 CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE.)

### Transmit Information

- Travelled distance to PCM
- Steering wheel angle to AWD CM
- Brake fluid pressure to AWD CM
- Back-up light switch position to AWD CM
- Yaw rate to AWD CM
- Lateral-G to AWD CM
- Torque reduction request to PCM
- Brake system configuration to AWD CM and instrument cluster
- Brake system status to AWD CM and instrument cluster
- Wheel speed to AWD CM and PCM
  - Front left
  - Front right
  - Rear left
  - Rear right
- Desired coupling torque to AWD CM

## Received Information

- Engine torque from PCM
- Torque reduction inhibit from PCM
- Engine speed from PCM
- TP from PCM
- Gear ratio from PCM
- Engine specifications from PCM
- Tire circumference from PCM
- Brake pedal position from PCM
- Coupling torque from AWD CM
- Brake fluid level from instrument cluster

## ABS WHEEL-SPEED SENSOR AND ABS SENSOR ROTOR FUNCTION

E6U041543720S01

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

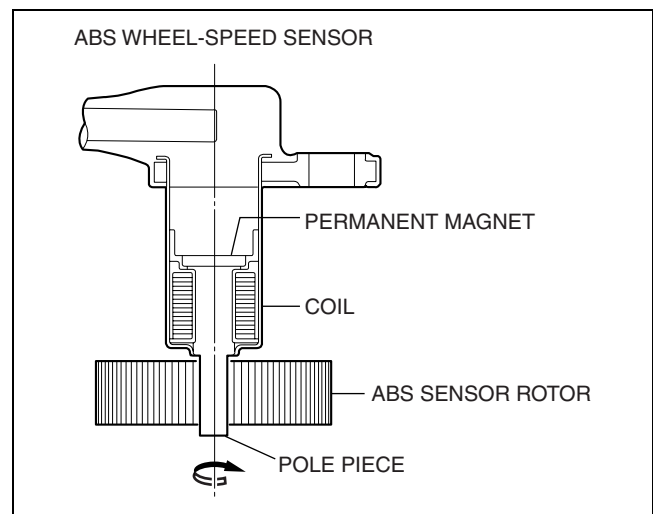
04-15

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

E6U041543720S02

### Construction

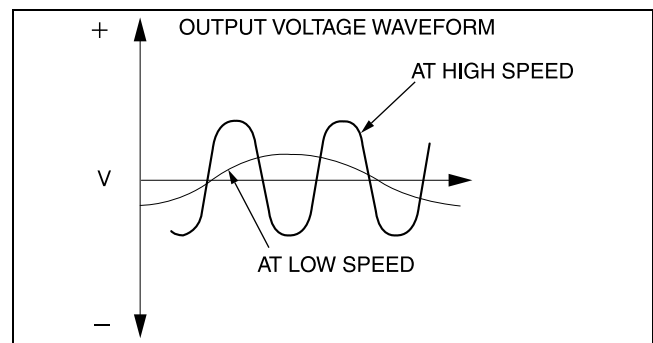
- The front ABS wheel-speed sensor is installed on the steering knuckle and the front ABS sensor rotor is integrated with the drive shaft.
- The rear ABS wheel-speed sensor is installed on the hub spindle and the rear ABS sensor rotor is integrated with the wheel hub.



C6A413ZTA008

### Operation

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



CHU0413S004

# DYNAMIC STABILITY CONTROL

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## COMBINED SENSOR FUNCTION

E6U041543773S01

- Yaw rate sensor, lateral-G sensor and forward-G sensor have been integrated to combined sensor.
- The combined sensor is installed on the right side of the parking brake lever and detects vehicle yaw rate (vehicle cornering angle velocity), lateral G and forward G, and transmits the signal to the DSC HU/CM.

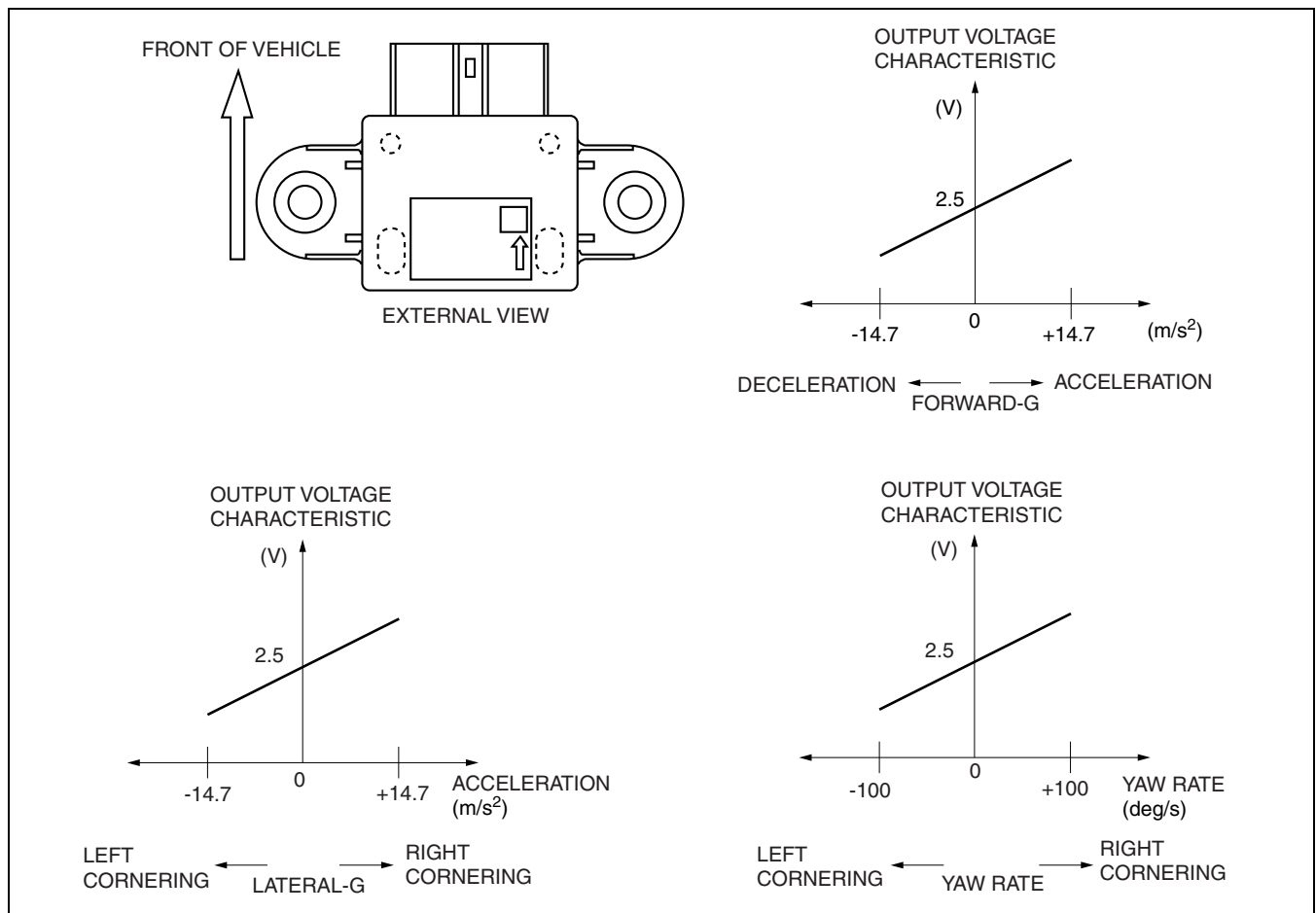
## COMBINED SENSOR CONSTRUCTION/OPERATION

E6U041543773S02

- The output voltage characteristic for the combined sensor is **2.5 V** when the vehicle is standing still, and changes accordingly as yaw rate, lateral G and forward G is formed.
- Yaw rate is formed when the sensor detects a Coriolis force created by, and in proportion to, the rotation speed of a rotating tuning fork.
- Lateral G is formed when the sensor detects an inertial force created by, and in proportion to, a G force acting on a silicon detection component.
- Forward-G is formed when the sensor detects an inertial force created by, and in proportion to, a G- force acting on a silicon detection component.
- The drive train of AWD vehicles delivers driving force to all four wheels, and due to this interlocking, the speed of all wheels during braking is the same. When driving on road surfaces with especially low  $\hat{E}$  (friction coefficient), it is difficult to estimate the vehicle speed based on the wheel speed, and DSC braking becomes unreliable. (For 2WD vehicles, the front and rear wheels are independent, so it is possible to accurately estimate the vehicle speed by measuring the difference between the rotation speeds of the front and rear tires.) A forward-G sensor has been installed to overcome this situation. When braking, the change in G-force is detected, and the road surface  $\hat{E}$  is judged (low  $\hat{E}$ , high  $\hat{E}$ ), enabling a correction of the vehicle speed estimation.

### Note

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



E6U415ZSB012

## BRAKE FLUID PRESSURE SENSOR FUNCTION

E6U041543774S01

- 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

E6U041543774S02

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

# DYNAMIC STABILITY CONTROL

## DSC INDICATOR LIGHT FUNCTION

E6U041555430S01

- The DSC indicator light is integrated in the instrument cluster and notifies the driver of DSC activation (vehicle is in side slip situation) or TCS activation (drive-wheel slippage situation) when DSC has not been cancelled by pressing the DSC OFF switch.

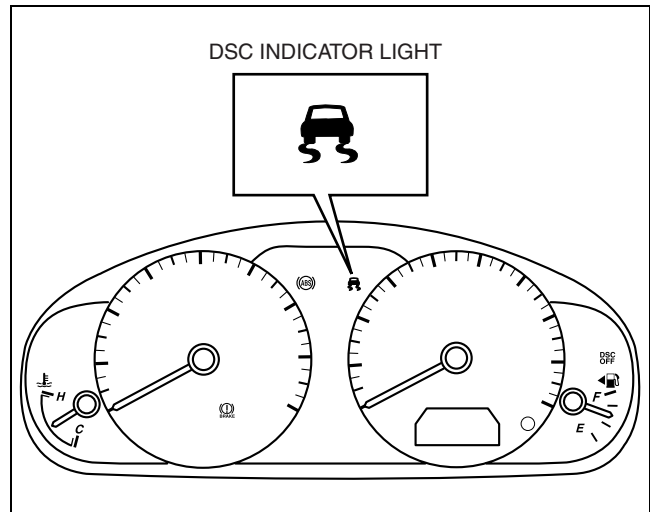
## DSC INDICATOR LIGHT OPERATION

E6U041555430S02

- When the DSC and CAN system is normal, the DSC indicator light illuminates for **2.4 s** when the ignition switch is at ON, and goes out, checking the light function. When the system is malfunctioning, the DSC indicator light remains illuminated.
- When DSC and TCS are operating, the DSC indicator light operates as follows:

### DSC indicator light operation table

Item	DSC indicator light
TCS, DSC non-operation	Not illuminated
TCS operation	Flashes ( <b>0.5 s</b> intervals)
DSC operation	Flashes ( <b>0.5 s</b> intervals)



E6U415ZSB016

## DSC OFF SWITCH, DSC OFF LIGHT FUNCTION

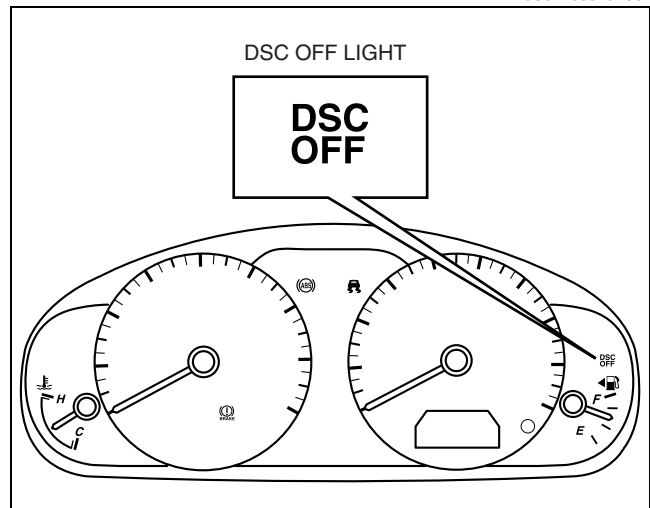
E6U041555431S01

- The DSC OFF switch is installed in the instrument panel and cancels the DSC activation by pressing the DSC OFF switch.
- The DSC OFF light is integrated in the instrument cluster and notifies the driver of DSC activation is cancelled by pressing the DSC OFF switch.

## DSC OFF SWITCH, DSC OFF LIGHT OPERATION

E6U041555431S02

- When the DSC and CAN system is normal, the DSC indicator light illuminates for 2.4 s when the ignition switch is at ON, and goes out, checking the light function. When the system is malfunctioning, the DSC OFF indicator light remains illuminated.



E6U415ZSB017

# TRANSMISSION/TRANSAXLE

# 05

SECTION

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MANUAL TRANSAXLE SHIFT MECHANISM [A26MX-R] ...	05-16
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## 05-00 OUTLINE

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TRANSMISSION/TRANSAXLE	

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### TRANSMISSION/TRANSAXLE ABBREVIATIONS

E6U05000000S01

ABS	Antilock Brake System
APP	Accelerator Pedal Position
ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
BCM	Body Control Module
CAN	Controller Area Network
CCM	Comprehensive Component Monitor
CM	Control Module
DC	Drive Cycle
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
EC-AT	Electronically Controlled Automatic Transaxle
GND	Ground
HU	Hydraulic Unit
MIL	Malfunction Indicator Lamp
MTX	Manual Transaxle

OBD	On-board Diagnostic
PCM	Powertrain Control Module
PID	Parameter Identification
TCC	Torque Converter Clutch
TCM	Transaxle Control Module
TCS	Traction Control System
TFT	Transaxle Fluid Temperature
TR	Transaxle Range
VSS	Vehicle Speedometer Sensor
WDS	Worldwide Diagnostic System
1GR	First Gear
2GR	Second Gear
3GR	Third Gear
4GR	Fourth Gear
5GR	Fifth Gear
6GR	Sixth Gear

# OUTLINE

## TRANSMISSION/TRANSAXLE FEATURES

E6U05000000S02

<b>CLUTCH [A26MX-R]</b>	
Reduced noise and vibration	<ul style="list-style-type: none"> <li>Dual mass flywheel adopted</li> </ul>
Improved durability	<ul style="list-style-type: none"> <li>Clutch cover with wear assurance function adopted</li> </ul>
Improved startability	<ul style="list-style-type: none"> <li>One-way valve that fits inside a clutch master cylinder adopted</li> </ul>
<b>MANUAL TRANSAXLE [A26MX-R]</b>	
Improved fuel economy and marketability	<ul style="list-style-type: none"> <li>Six-speed A26MX-R manual transaxle adopted</li> </ul>
Miniaturization	<ul style="list-style-type: none"> <li>3-axle type MTX adopted</li> </ul>
Improved operability	<ul style="list-style-type: none"> <li>Ball type synchromesh mechanism adopted</li> <li>Triple-cone synchronizer mechanism adopted for 1GR, 2GR and 3GR</li> </ul>
Improved reliability	<ul style="list-style-type: none"> <li>Double engagement prevention mechanism (interlock mechanism) adopted</li> </ul>
<b>MANUAL TRANSAXLE SHIFT MECHANISM [A26MX-R]</b>	
Mis-shift prevention	<ul style="list-style-type: none"> <li>Reverse lock-out mechanism adopted</li> </ul>
<b>ATX [FS5A-EL]</b>	
Superior shift quality	<ul style="list-style-type: none"> <li>Direct electric shift control adopted</li> <li>Feedback control system adopted</li> <li>Centrifugal balance clutch chamber adopted</li> <li>Engine-transaxle total control system adopted</li> </ul>
High efficiency, compactness, lightweight	<ul style="list-style-type: none"> <li>Miniature trochoid gear oil pump with torque converter direct drive adopted</li> </ul>
Improved reliability	<ul style="list-style-type: none"> <li>Variable resistor type TR switch has been adopted</li> </ul>
Improved driveability	<ul style="list-style-type: none"> <li>Control feature for climbing/descending hills adopted, improving driveability when climbing/descending</li> </ul>
Improved marketability	<ul style="list-style-type: none"> <li>Sport AT adopted</li> <li>Sub-shifting mechanism has been adopted</li> </ul>
Improved reliability, reduced noise and vibration	<ul style="list-style-type: none"> <li>A double arranged gear with a single planetary gear unit is has been adopted as the main shifting mechanism</li> <li>A single planetary gear unit is has been adopted as the sub-shifting mechanism</li> </ul>

## TRANSMISSION/TRANSAXLE SPECIFICATIONS

E6U05000000S03

### Clutch Specifications

Item		2006MY MAZDASPEED6	2006MY Mazda6	
Manual transaxle type		A26MX-R	A65M-R	G35M-R
Clutch control		Hydraulic	←	←
Clutch cover	Spring type	Diaphragm	←	←
	Set load (N {kgf, lbf})	10,100 {1,030, 2,271}	6,600 {673, 1,484}	6,000 {611, 1,350}
Clutch disc	Outer diameter (mm {in})	250 {9.84}	240 {9.45}	215 {8.46}
	Inner diameter (mm {in})	155 {6.10}	160 {6.30}	150 {5.91}
Clutch pedal	Type	Suspended	←	←
	Pedal ratio	6.6	←	←
	Full stroke (mm {in})	140 {5.512}	135.6 {5.339}	←
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, FMVSS 116 DOT-3	←	←

### Manual Transaxle Specifications

Item		2006MY MAZDASPEED6	2006MY Mazda6	
Manual transaxle type		A26MX-R	A65M-R	G35M-R
Operation system		Cable	←	←
Transaxle control		Floor-shift	←	←
Shift assist	Forward	Synchromesh	←	←
	Reverse	Synchromesh (Lever type)	Synchromesh	Selective sliding and synchromesh

# OUTLINE

Item			2006MY MAZDASPEED6	2006MY Mazda6	
Manual transaxle type			A26MX-R	A65M-R	G35M-R
Gear ratio	1GR		3.538	3.416	3.307
	2GR		2.238	1.842	←
	3GR		1.535	1.258	1.233
	4GR		1.171	0.947	0.914
	5GR		1.085	0.733	0.717
	6GR		0.853	—	—
	Reverse		3.831	3.252	3.166
Final gear ratio			1GR, 2GR, 3GR, 4GR: 3.941 5GR, 6GR, Reverse: 3.350	4.133	4.105
Oil	Grade		API service GL-4 or GL-5	←	←
	Viscosity	All season	SAE 75W-90	←	←
		Above 10°C {50°F}	SAE 75W-90	←	SAE 80W-90
	Capacity (approx. quantity)	(L {US qt, Imp qt})	2.55 {2.69, 2.24}	2.3 {2.4, 2.0}	2.87 {3.03, 2.53}

05-00

## Automatic Transaxle [FS5A-EL]

Item			Specification
Engine type			L3 (2.3L)
Automatic transaxle type			FS5A-EL
Gear ratio		1GR	3.620
		2GR	1.925
		3GR	1.285
		4GR	0.933
		5GR	0.692
		Reverse	3.405
Final gear ratio			3.863
ATF	Type		ATF M-V
	Capacity (Approx. quantity)	(L {US qt, Imp qt})	8.14 {8.60, 7.16}
Torque converter stall torque ratio			1.84
Hydraulic system (Number of drive/driven gear plates)	Forward clutch		4/4
	3-4 clutch		3/3
	Reverse clutch		2/2
	Direct clutch		2/3
	Low and reverse brake		5/5
	Reduction brake		3/5
Band servo	Servo diameter (Piston outer dia.)	(mm {in})	64.6 {2.54}
Front planetary gear (Number of teeth)	Front sun gear		49
	Front pinion gear		20
	Front internal gear		89
Rear planetary gear (Number of teeth)	Rear sun gear		37
	Rear pinion gear		30
	Rear internal gear		98
Primary gear (number of teeth)			86
Secondary gear (number of teeth)			82
Secondary planetary gear (Number of teeth)	Secondary sun gear		31
	Secondary pinion gear		29
	Secondary internal gear		89
Output gear (number of teeth)			22
Ring gear (number of teeth)			85



## 05-02 ON-BOARD DIAGNOSTIC [FS5A-EL]

### ON-BOARD DIAGNOSTIC (OBD) SYSTEM

OUTLINE [FS5A-EL] ..... 05-02-1

### ON-BOARD DIAGNOSTIC (OBD) SYSTEM

BLOCK DIAGRAM [FS5A-EL] ..... 05-02-1

### MALFUNCTION DETECTION FUNCTION

[FS5A-EL] ..... 05-02-2

Malfunction Detection Function ..... 05-02-2

DTC Table ..... 05-02-2

MEMORY FUNCTION [FS5A-EL] ..... 05-02-3

### MALFUNCTION INDICATION FUNCTION

[FS5A-EL] ..... 05-02-3

FAIL-SAFE FUNCTION [FS5A-EL] ..... 05-02-3

### PARAMETER IDENTIFICATION (PID)

#### DATA MONITORING FUNCTION

[FS5A-EL] ..... 05-02-7

Monitor Item Table ..... 05-02-7

SIMULATION FUNCTION [FS5A-EL] ..... 05-02-8

Simulation Item Table ..... 05-02-8

DLC-2 OUTLINE [FS5A-EL] ..... 05-02-8

### ON-BOARD DIAGNOSTIC (OBD) SYSTEM OUTLINE [FS5A-EL]

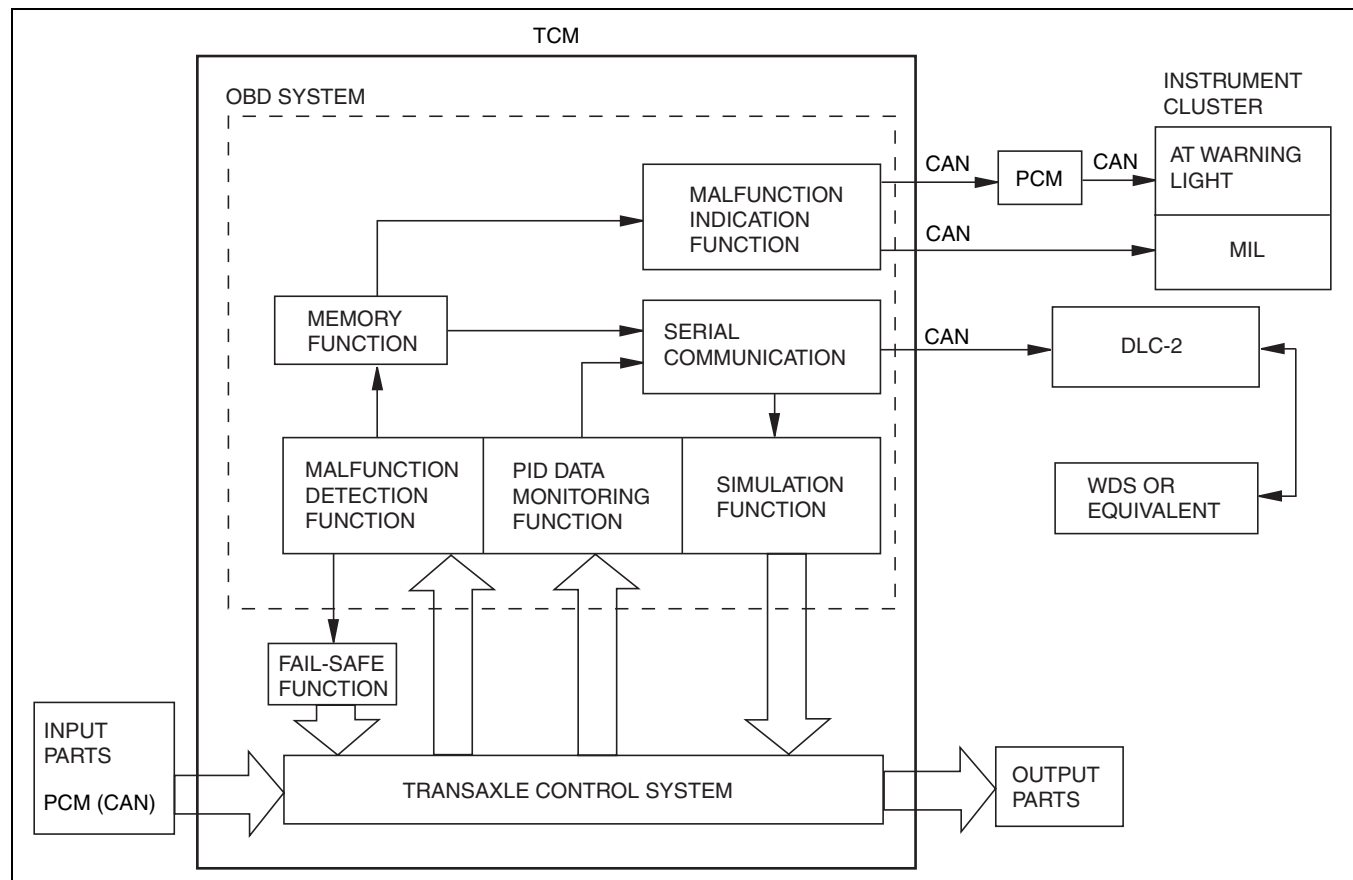
E6U05020000S01

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

05-02

### ON-BOARD DIAGNOSTIC (OBD) SYSTEM BLOCK DIAGRAM [FS5A-EL]

E6U05020000S02



E6U0502AS5001

# ON-BOARD DIAGNOSTIC [FS5A-EL]

## MALFUNCTION DETECTION FUNCTION [FS5A-EL]

E6U050200000S03

### Malfunction Detection Function

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

### DTC Table

×: Available

DTC No.	Condition	MIL	AT warning light illuminates	DC	Monitor item	Memory function
P0706	Transaxle range (TR) switch circuit range/performance	ON	YES	2	CCM	X
P0707	Transaxle range (TR) switch circuit low input	ON	YES	1	CCM	X
P0708	Transaxle range (TR) switch circuit high input	ON	YES	2	CCM	X
P0711	Transaxle fluid temperature (TFT) sensor circuit range/performance (stuck)	ON	NO	2	CCM	X
P0712	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to ground)	ON	YES	1	CCM	X
P0713	Transaxle fluid temperature (TFT) sensor circuit malfunction (open circuit)	ON	YES	1	CCM	X
P0715	Input/turbine speed sensor circuit malfunction	ON	YES	1	CCM	X
P0720	Vehicle speed sensor (VSS) circuit malfunction	ON	YES	1	CCM	X
P0731	Gear 1 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0732	Gear 2 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0733	Gear 3 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0734	Gear 4 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0735	Gear 5 incorrect (incorrect gear ratio detected)	OFF	YES	1	CCM	X
P0741	Torque converter clutch (TCC) (stuck off)	OFF	YES	1	CCM	X
P0742	Torque converter clutch (TCC) (stuck on)	OFF	YES	1	CCM	X
P0744	Slip control malfunction	OFF	YES	2	CCM	X
P0745	Pressure control solenoid A malfunction	OFF	YES	1	CCM	X
P0751	Shift solenoid A stuck off	ON	YES	2	CCM	X
P0752	Shift solenoid A stuck on	ON	YES	2	CCM	X
P0753	Shift solenoid A malfunction (electrical)	ON	YES	1	CCM	X
P0756	Shift solenoid B stuck off	ON	YES	2	CCM	X
P0757	Shift solenoid B stuck on	ON	YES	2	CCM	X
P0758	Shift solenoid B malfunction (electrical)	ON	YES	1	CCM	X
P0761	Shift solenoid C stuck off	ON	YES	2	CCM	X
P0762	Shift solenoid C stuck on	ON	YES	2	CCM	X
P0763	Shift solenoid C malfunction (electrical)	ON	YES	1	CCM	X
P0766	Shift solenoid D stuck off	ON	YES	2	CCM	X
P0767	Shift solenoid D stuck on	ON	YES	2	CCM	X
P0768	Shift solenoid D malfunction (electrical)	ON	YES	1	CCM	X
P0771	Shift solenoid E stuck off	ON	YES	2	CCM	X
P0772	Shift solenoid E stuck on	ON	YES	2	CCM	X
P0773	Shift solenoid E malfunction (electrical)	ON	YES	1	CCM	X
P0777	Pressure control solenoid B stuck on	ON	YES	2	CCM	X
P0778	Pressure control solenoid B malfunction (electrical)	ON	YES	1	CCM	X
P0791	Intermediate sensor circuit malfunction	ON	YES	1	CCM	X
P0841	Oil pressure switch circuit malfunction	OFF	NO	2	CCM	X
P0882	Battery back-up power supply circuit malfunction	ON	NO	1	CCM	X
P0894	Forward clutch torque transmission	OFF	YES	1	CCM	X
P1783	ATF high oil temperature malfunction	OFF	YES	1	CCM	X
P2707	Shift solenoid F stuck off	ON	YES	2	CCM	X

## ON-BOARD DIAGNOSTIC [FS5A-EL]

DTC No.	Condition	MIL	AT warning light illuminates	DC	Monitor item	Memory function
P2708	Shift solenoid F stuck on	ON	YES	2	CCM	X
P2709	Shift solenoid F malfunction (electrical)	ON	YES	1	CCM	X
U0073	Control module communication bus off	OFF	YES	N/A	CCM	X
U0100	Lost communication with PCM	OFF	YES	N/A	CCM	X

### MEMORY FUNCTION [FS5A-EL]

E6U050200000S04

- 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 [FS5A-EL]

E6U050200000S05

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

### FAIL-SAFE FUNCTION [FS5A-EL]

E6U050200000S06

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

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0706	Transaxle range (TR) switch circuit range/performance	<ul style="list-style-type: none"> <li>No TR signal (P, R, N or D range/position) input to TCM terminal 2H when the engine speed is <b>530 rpm or more</b>, vehicle speed is <b>20 km/h {12 mph} or more</b> and voltage at TCM terminal 2H is <b>0.5 V or more</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits gear shifting and maximizes line pressure</li> </ul>	Disabled
P0707	Transaxle range (TR) switch circuit low input	<ul style="list-style-type: none"> <li>Input voltage from the TR switch to TCM terminal 2H is <b>0.5 V or less</b> when the engine speed is <b>530 rpm or more</b> and vehicle speed is <b>20 km/h {12 mph} or more</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits gear shifting and maximizes line pressure</li> </ul>	Disabled
P0708	Transaxle range (TR) switch circuit high input	<ul style="list-style-type: none"> <li>Input voltage from the TR switch to TCM terminal 2H is <b>4.79 V or more</b> when the engine speed is <b>530 rpm or more</b> and vehicle speed is <b>20 km/h {12 mph} or more</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits gear shifting and maximizes line pressure</li> </ul>	Disabled
P0711	Transaxle fluid temperature (TFT) sensor circuit range/performance (Stuck)	<ul style="list-style-type: none"> <li>Input voltage from the TFT sensor to TCM terminal 2M and 2O is maintained at <b>0.03 V or less</b> when <b>180 s</b> have passed after the engine is started and the vehicle is driven for <b>90 s or more</b> at vehicle speed <b>between 25—59 km/h {15—36 mph}</b>, and then <b>60 km/h {37 mph} or more</b> for <b>60 s or more</b>.</li> </ul>	N/A	Disabled
P0712	Transaxle fluid temperature (TFT) sensor circuit malfunction (short to ground)	<ul style="list-style-type: none"> <li>Input voltage from the TFT sensor to TCM terminal 2M and 2O is maintained at <b>0.06 V or less</b> when the vehicle speed is <b>20 km/h {12 mph} or more</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Switch the automatic shift control to the high oil temperature mode to expand the lockup range and maximizes line pressure.</li> </ul>	Enabled
P0713	Transaxle fluid temperature (TFT) sensor circuit malfunction (open circuit)	<ul style="list-style-type: none"> <li>Input voltage from the TFT sensor to TCM terminal 2M and 2O is maintained at <b>4.67 V or more</b> when vehicle speed is <b>20 km/h {12 mph} or more</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Switch the automatic shift control to the high oil temperature mode to expand the lockup range and maximizes line pressure.</li> </ul>	Enabled

## ON-BOARD DIAGNOSTIC [FS5A-EL]

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0715	Input/turbine speed sensor circuit malfunction	<ul style="list-style-type: none"> <li>No input/turbine speed sensor signal to TCM terminals 2I and 2K when the vehicle speed is <b>41 km/h {25 mph} or more</b> and selector lever position is at D or M range.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 4GR and 5GR</li> </ul>	Disabled
P0720	Vehicle speed sensor (VSS) circuit malfunction	<ul style="list-style-type: none"> <li>No VSS signal is input to TCM terminal 2P when and engine coolant temperature is <b>60 °C {140 °F} or more</b>, input/turbine speed sensor signal is <b>1,500 rpm or more</b> and selector lever position is at D or M range.</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle speed signal calculated from intermediate sensor and inhibits 5GR</li> </ul>	Enabled
P0731	Gear 1 incorrect (incorrect gear ratio detected)	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>2.157 or less</b> while in 1GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR</li> </ul>	Enabled
P0732	Gear 2 incorrect (incorrect gear ratio detected)	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>1.249 or less</b> or <b>2.157 or more</b> while in 2GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 2GR and maximizes line pressure</li> </ul>	Enabled
P0733	Gear 3 incorrect (incorrect gear ratio detected)	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>2.157 or more</b> while in 3GR.</li> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>within 1.345—1.644</b> while in 3GR (TCC no operating).</li> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>0.863 or less</b> while in 3GR (TCC no operating).</li> </ul>	N/A	Enabled
P0734	Gear 4 incorrect (incorrect gear ratio detected)	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>0.6 or less</b> or <b>1.249 or more</b> while in 4GR.</li> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>within 0.91—1.09</b> while in 4GR (TCC no operating).</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 4GR and 5GR, and maximizes line pressure</li> </ul>	Enabled
P0735	Gear 5 incorrect (incorrect gear ratio detected)	<ul style="list-style-type: none"> <li>Speed ratio of the secondary gear and the differential gear case is <b>1.11 or less</b> when driving in 3GR or 4GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR, 2GR, 4GR and 5GR, and maximizes line pressure</li> </ul>	Enabled
		<ul style="list-style-type: none"> <li>Speed ratio of the secondary gear and differential gear case is <b>1.11 or more</b> when driving in 5GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 5GR, and maximizes line pressure</li> </ul>	Enabled
P0741	Torque converter clutch (TCC) (stuck off)	<ul style="list-style-type: none"> <li>Difference between the engine speed and turbine speed is <b>more than 100 rpm</b> while TCC is operating.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits TCC and maximizes line pressure</li> </ul>	Disabled
P0742	Torque converter clutch (TCC) (stuck on)	<ul style="list-style-type: none"> <li>Difference between the engine speed and turbine speed is <b>50 rpm or less</b> while TCC is not operating.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits TCC and maximizes line pressure</li> </ul>	Disabled
P0744	Slip control malfunction	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>1.334 or less</b> or <b>1.645 or more</b> while in 2GR.</li> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>0.9 or less</b> or <b>1.09 or more</b> while in 3GR.</li> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>0.636 or less</b> or <b>0.817 or more</b> while in 4GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits slip control</li> </ul>	Enabled

# ON-BOARD DIAGNOSTIC [FS5A-EL]

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0745	Pressure control solenoid A malfunction	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at pressure control solenoid control terminals 1E and 1G of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	<ul style="list-style-type: none"> <li>Maximizes line pressure</li> </ul>	Enabled
P0751	Shift solenoid A stuck off	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>within 0.91—1.09</b> in 4GR and DTCs not output</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 4GR, 5GR and TCC, and maximizes line pressure</li> </ul>	Disabled
P0752	Shift solenoid A stuck on	<ul style="list-style-type: none"> <li>Input/turbine speed sensor signal is <b>187.5 rpm or more</b> in D range</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR, 2GR, and 3GR and maximizes line pressure</li> </ul>	Enabled
P0753	Shift solenoid A malfunction (electrical)	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at shift solenoid A control terminal 1A of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 4GR, 5GR and TCC, and maximizes line pressure</li> </ul>	Disabled
P0756	Shift solenoid B stuck off	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>2.157 or less</b> in 1GR and DTCs not output.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR, 4GR and 5GR, and maximizes line pressure</li> </ul>	Enabled
P0757	Shift solenoid B stuck on	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>1.249 or less</b> or <b>2.157 or more</b> in D range 2GR.</li> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>0.6 or less</b> or <b>1.249 or more</b> in D range 4GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 2GR, 4GR and 5GR and maximized line pressure</li> </ul>	Enabled
P0758	Shift solenoid B malfunction (electrical)	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at shift solenoid B control terminal 1B of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR, 4GR and 5GR and maximizes line pressure</li> </ul>	Enabled
P0761	Shift solenoid C stuck off	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>2.157 or less</b> in D range 1GR.</li> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>1.249 or less</b> or <b>2.157 or more</b> in D range 2GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR and 2GR and maximizes line pressure</li> </ul>	Enabled
P0762	Shift solenoid C stuck on	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>within 1.345—1.644</b> in D range 3GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 3GR, 4GR and 5GR, and maximizes line pressure</li> </ul>	Enabled
P0763	Shift solenoid C malfunction (electrical)	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at shift solenoid C control terminal 1C of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR and 2GR and maximizes line pressure</li> </ul>	Enabled
P0766	Shift solenoid D stuck off	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>0.6 or less</b> or <b>1.249 or more</b> in D range 4GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 4GR and 5GR, and maximizes line pressure</li> </ul>	Enabled
P0767	Shift solenoid D stuck on	<ul style="list-style-type: none"> <li>Revolution ratio of the forward clutch drum to secondary gear revolution is <b>0.863 or less</b> in D range 3GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 2GR, 4GR, 5GR, and TCC and maximizes line pressure</li> </ul>	Disabled
P0768	Shift solenoid D malfunction (electrical)	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at shift solenoid D valve control terminal 1F of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 4GR and 5GR, and maximizes line pressure</li> </ul>	Disabled
P0771	Shift solenoid E stuck off	<ul style="list-style-type: none"> <li>Difference between engine speed and turbine speed is <b>more than 100 rpm</b> while driving in 4GR is at D range during TCC operation.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits TCC and maximized line pressure</li> </ul>	Disabled

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## ON-BOARD DIAGNOSTIC [FS5A-EL]

DTC No.	On-board diagnostic function	Detection condition	Fail-safe	TCC
P0772	Shift solenoid E stuck on	<ul style="list-style-type: none"> <li>Difference between the engine speed and turbine speed is <b>50 rpm or less</b> while driving in 4GR at D range while TCC is not operating.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 1GR and maximizes line pressure</li> </ul>	Enabled
P0773	Shift solenoid E malfunction (electrical)	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at shift solenoid E control terminal 1H of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits TCC and maximized line pressure</li> </ul>	Disabled
P0777	Pressure control solenoid B stuck on	<ul style="list-style-type: none"> <li>Speed ratio of the secondary gear and differential gear case is <b>1.11 or more</b> when driving in 5th gear.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 5GR and maximizes line pressure</li> </ul>	Enabled
P0778	Pressure control solenoid B malfunction (electrical)	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at pressure control solenoid B control terminal 1D of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	N/A	Enabled
P0791	Intermediate sensor circuit malfunction	<ul style="list-style-type: none"> <li>No intermediate sensor signal is input to TCM terminal 2L when and engine coolant temperature is <b>60 °C {140 °F} or more</b>, vehicle speed is <b>40 km/h {25 mph} or more</b> and selector lever position is at D or M range.</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle speed signal calculated from VSS</li> </ul>	Enabled
P0841	Oil pressure switch circuit malfunction	<ul style="list-style-type: none"> <li>No oil pressure switch signal input when revolution ratio of forward clutch drum revolution to differential gear case revolution is <b>within 0.91—3.07</b> while in 1, 2 or 3GR.</li> <li>Oil pressure switch signal input when revolution ratio of forward clutch drum revolution to differential gear case revolution is <b>within 0.64—0.81</b> while in 4GR.</li> </ul>	N/A	Enabled
P0882	Battery back-up power supply circuit malfunction	<ul style="list-style-type: none"> <li>When the signal of the battery back-up power supply circuit is less than 2.5 V.</li> </ul>	N/A	Enabled
P0894	Forward clutch torque transmission	<ul style="list-style-type: none"> <li>Turbine speed does not fall to <b>less than 187.5 rpm 3 s or more</b> after starting the engine with the vehicle stopped (brake applied) and the selector lever shifted to D range from N position.</li> </ul>	<ul style="list-style-type: none"> <li>Driving restricted to 4GR</li> </ul>	Enabled
P1783	ATF high oil temperature malfunction	<ul style="list-style-type: none"> <li>ATF oil temperature is <b>149.5 °C {301 °F} or more</b></li> </ul>	N/A	Enabled
P2707	Shift solenoid F stuck off	<ul style="list-style-type: none"> <li>Speed ratio of the secondary gear and the differential gear case is <b>1.11 or less</b> when driving in 3GR or 4GR.</li> </ul>	<ul style="list-style-type: none"> <li>Driving restricted to 3GR and maximizes line pressure</li> </ul>	Enabled
P2708	Shift solenoid F stuck on	<ul style="list-style-type: none"> <li>Speed ratio of the secondary gear and differential gear case is <b>1.11 or more</b> when driving in 5GR.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibits 5GR and maximizes line pressure</li> </ul>	Enabled
P2709	Shift solenoid F malfunction (electrical)	<ul style="list-style-type: none"> <li>Voltage is stuck at <b>0 V</b> or <b>B+</b> at shift solenoid F control terminal 1J of the TCM when the solenoid valve operates according to TCM calculation.</li> </ul>	<ul style="list-style-type: none"> <li>Driving restricted to 3GR and maximizes line pressure</li> </ul>	Enabled
U0073	Control module communication bus off	<ul style="list-style-type: none"> <li>CAN controller damaged.</li> </ul>	<ul style="list-style-type: none"> <li>Throttle valve opening angle is fixed (10%) at the time in order to determine shift</li> <li>Maximizes line pressure</li> </ul>	Enabled
U0100	Lost communication with PCM	<ul style="list-style-type: none"> <li>TCM cannot receive any signals from PCM</li> </ul>		Disabled

# ON-BOARD DIAGNOSTIC [FS5A-EL]

## PARAMETER IDENTIFICATION (PID) DATA MONITORING FUNCTION [FS5A-EL]

E6U05020000S07

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

Monitor Item Table

Item	Definition	Unit/ Condition	TCM terminal
DTCCNT	Number of DTC detected	N/A	N/A
DWN SW	Down switch	On/Off	2F
ETC TCM	Engine coolant temperature	°C   °F	N/A
GEAR_SEL	Gear commanded by module	1/2/3/4/5	N/A
HTM_CNT	Indicates number of high oil temperature mode (ATF temperature at 130 °C {266 °F} or more) operations	N/A	N/A
HTM_DIS	Indicates travel distance after operation of high oil temperature mode (ATF temperature at 130 °C {266 °F} or more)	km	N/A
ISS	Intermediate shaft speed	RPM	2L
LINEDES	Target line pressure	kPa   inHg	N/A
LPS	Pressure control solenoid control A signal in TCM	A	1E 1G
LPS B	Pressure control solenoid control B signal in TCM	%	1D
MNL SW	M range switch	On/Off	2B
OP_SW_B	Oil pressure switch	On/Off	2J
OSS	Output shaft speed	RPM	2P
RPM TCM	Engine speed	RPM	N/A
SSA/SS1	Shift solenoid A control signal in TCM	%	1A
SSB/SS2	Shift solenoid B control signal in TCM	%	1B
SSC/SS3	Shift solenoid C control signal in TCM	%	1C
SSD/SS4	Shift solenoid D control signal in TCM	On/Off	1F
SSE_SS5	Shift solenoid E control signal in TCM	On/Off	1H
SSF_SS6	Shift solenoid F control signal in TCM	On/Off	1J
TFT	ATF temperature	°C   °F	2M
TFTV	ATF temperature signal voltage	V	2M
THOP	Throttle position signal in TCM	%	N/A
TR	Transaxle range	P/R/N/D	2H
TR_SENS	TR switch signal voltage	V	2H
TSS	Input/turbine speed	RPM	2I 2K
UP SW	Up switch	On/Off	2D
VPWR TCM	Battery voltage	V	1K
VSS	Vehicle speed	KPH	2P

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# ON-BOARD DIAGNOSTIC [FS5A-EL]

## SIMULATION FUNCTION [FS5A-EL]

E6U050200000S08

- 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

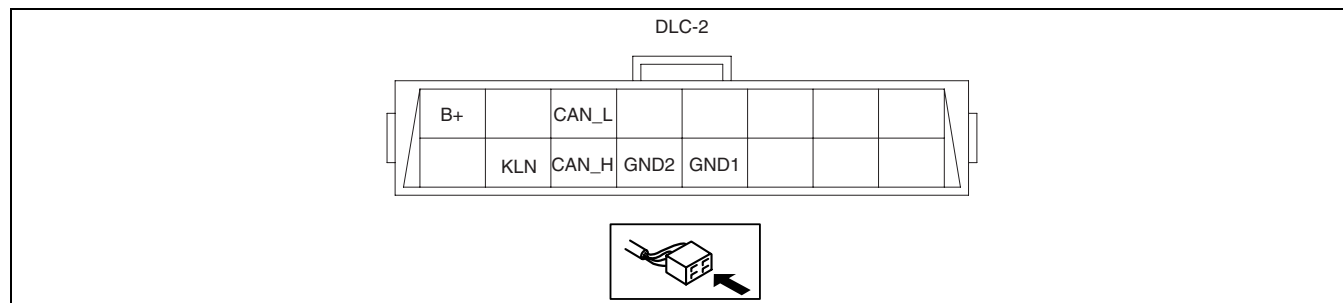
X: Available

Simulation item	Applicable component	Unit/Condition	Operation		TCM terminal
			IG ON	Idle	
LPS	Pressure control solenoid control A signal in TCM	%		X	1E 1G
LPS B	Pressure control solenoid control B signal in TCM	%		X	1D
SSA/SS1	Shift solenoid A control signal in TCM	%		X	1A
SSB/SS2	Shift solenoid B control signal in TCM	%		X	1B
SSC/SS3	Shift solenoid C control signal in TCM	%		X	1C
SSD/SS4	Shift solenoid D control signal in TCM	On/Off		X	1F
SSE_SS5	Shift solenoid E control signal in TCM	On/Off		X	1H
SSF_SS6	Shift solenoid F control signal in TCM	On/Off		X	1J

## DLC-2 OUTLINE [FS5A-EL]

E6U050200000S09

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



B3E0502T002

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

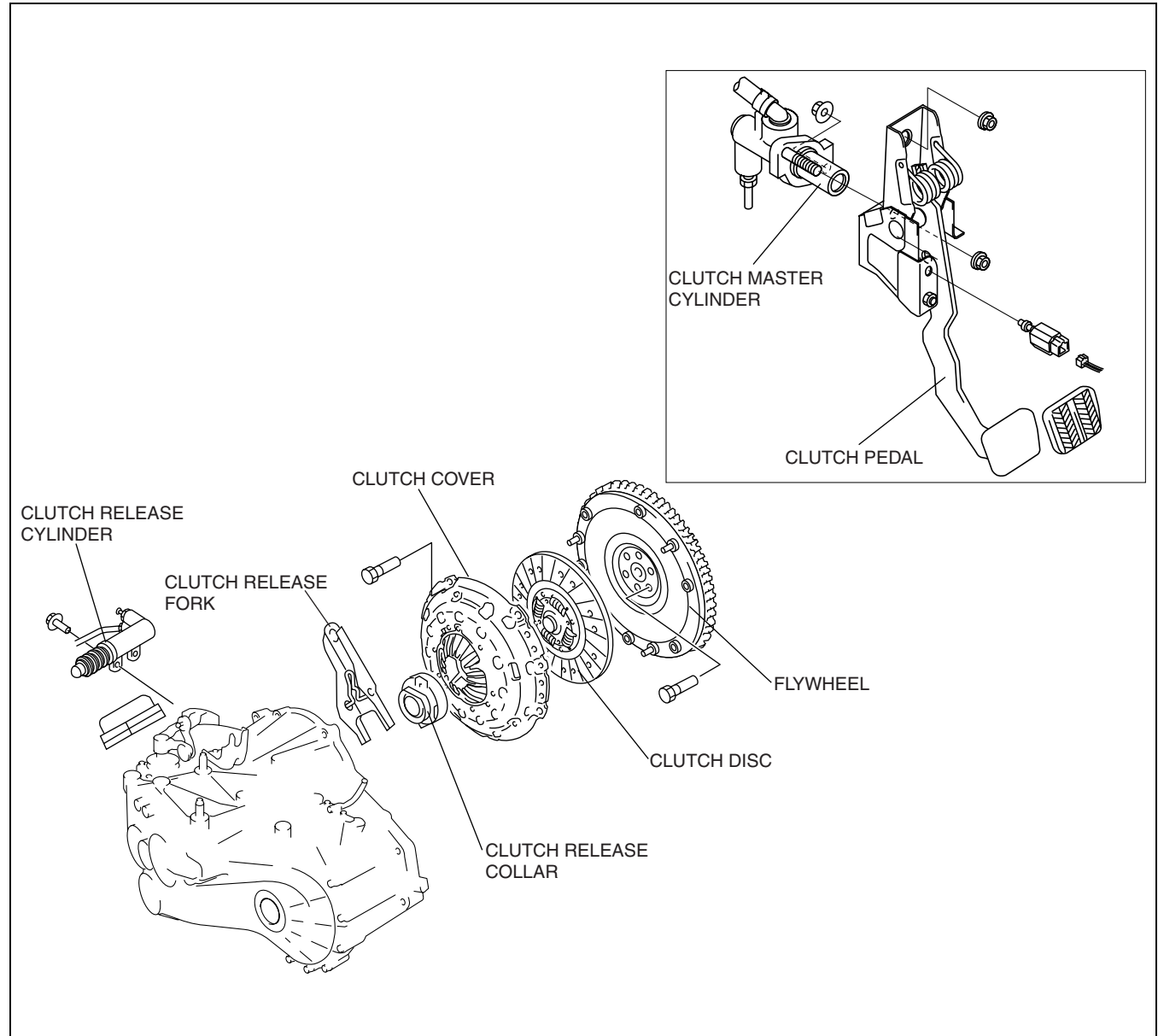
## 05-10 CLUTCH [A26MX-R]

CLUTCH STRUCTURAL VIEW [A26MX-R].....	05-10-1
CLUTCH MASTER CYLINDER CONSTRUCTION [A26MX-R].....	05-10-2

CLUTCH COVER OUTLIN E [A26MX-R].....	05-10-2
DUAL-MASS FLYWHEEL FUNCTION [A26MX-R] .....	05-10-2

### CLUTCH STRUCTURAL VIEW [A26MX-R]

E6U051016003S01



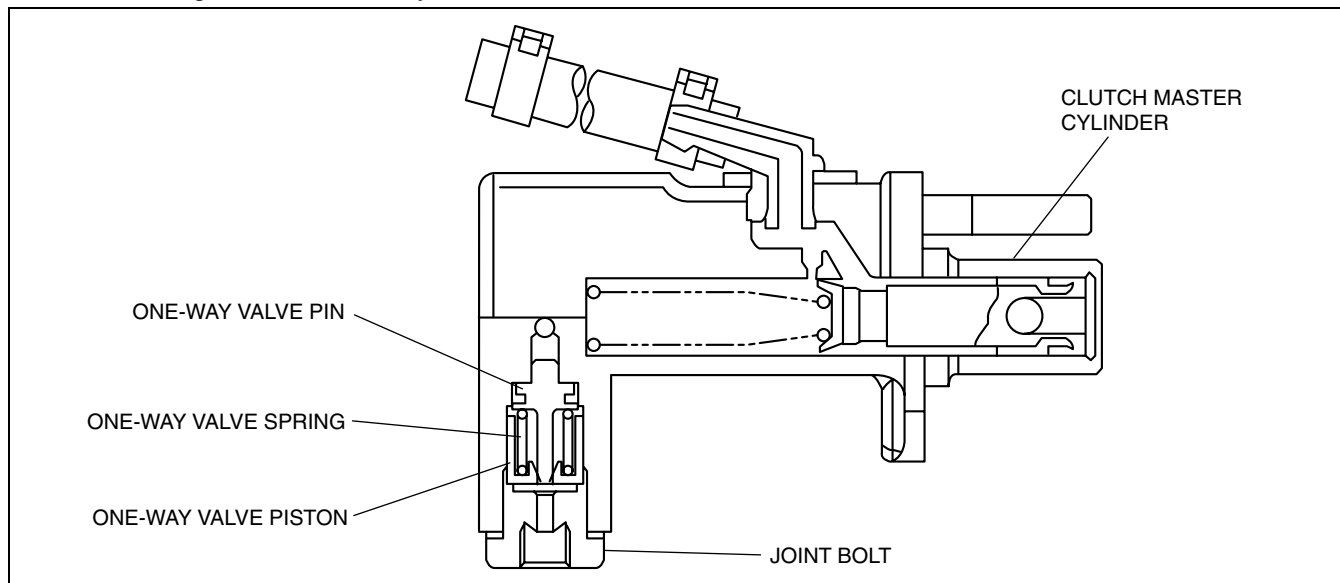
E6U510ZSC002

## CLUTCH [A26MX-R]

### CLUTCH MASTER CYLINDER CONSTRUCTION [A26MX-R]

E6U051041990S01

- A clutch master cylinder with a built-in one-way valve has been adopted preventing sudden clutch engagement and ensuring smooth startability .



E6U510ZSC004

### CLUTCH COVER OUTLINE [A26MX-R]

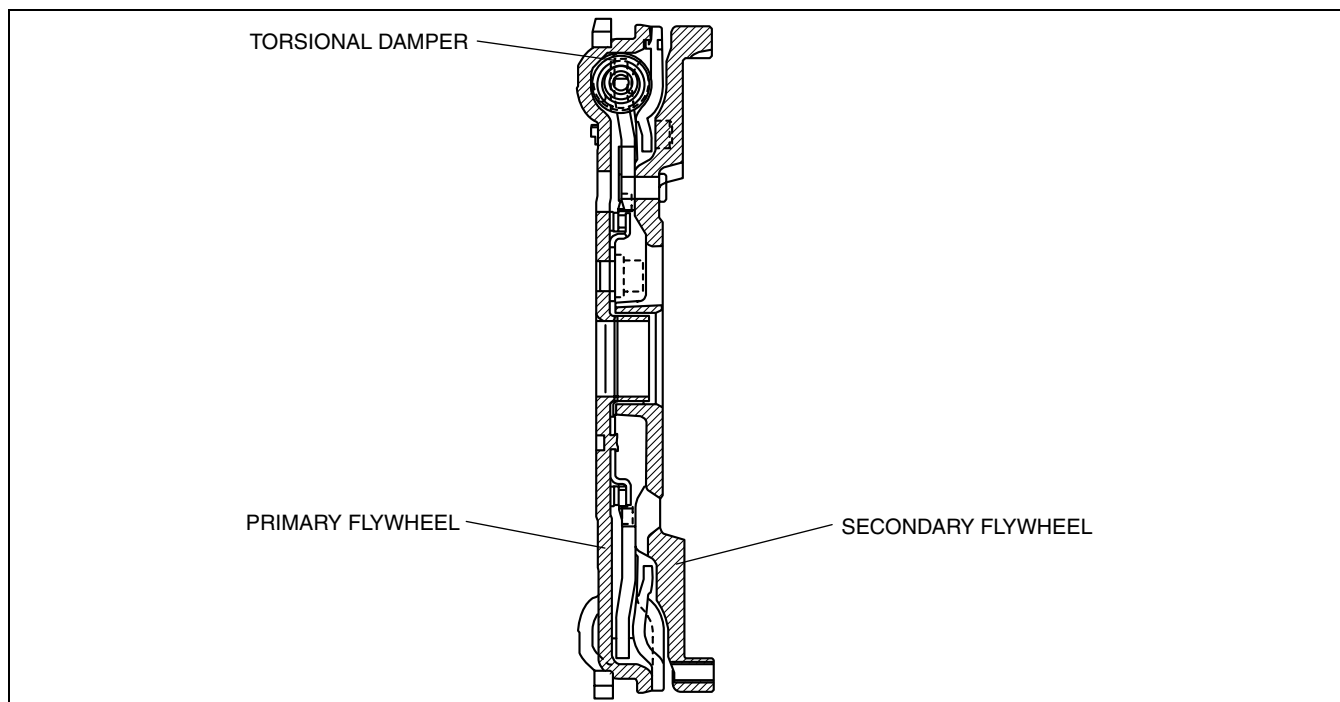
E6U051016410S01

- The wear assurance function of the clutch cover maintains the set load of the clutch cover unchanged even as the clutch disc becomes worn, thereby extending disc life.

### DUAL-MASS FLYWHEEL FUNCTION [A26MX-R]

E6U051011500S01

- The dual-mass flywheel has separated primary and secondary flywheel, and a torsional damper that is located inside the flywheel. Due to this structure, the transaxle primary shaft rotation can be stabilized, decreasing noise inside the transaxle (gear teeth rattling) created by engine speed fluctuation, and thereby greatly reducing vehicle booming noise also.



E6U510ZSC003

# 05-15 MANUAL TRANSAXLE [A26MX-R]

## MANUAL TRANSMISSION OUTLINE

[A26MX-R]..... 05-15-1

## MANUAL TRANSAXLE STRUCTURAL

VIEW [A26MX-R]..... 05-15-1

## MANUAL TRANSMISSION

### CROSS-SECTIONAL VIEW

[A26MX-R]..... 05-15-2

## MANUAL TRANSMISSION POWER

FLOW [A26MX-R]..... 05-15-3

## SYNCHRONIZER MECHANISM

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## TRIPLE SYNCHRONIZER MECHANISM

CONSTRUCTION [A26MX-R] ..... 05-15-4

## TRIPLE SYNCHRONIZER MECHANISM

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## TRIPLE SYNCHRONIZER MECHANISM

OPERATION [A26MX-R] ..... 05-15-6

## SHIFT INTERLOCK MECHANISM

FUNCTION [A26MX-R] ..... 05-15-6

## SHIFT INTERLOCK MECHANISM

OPERATION [A26MX-R] ..... 05-15-6

## MANUAL TRANSMISSION OUTLINE [A26MX-R]

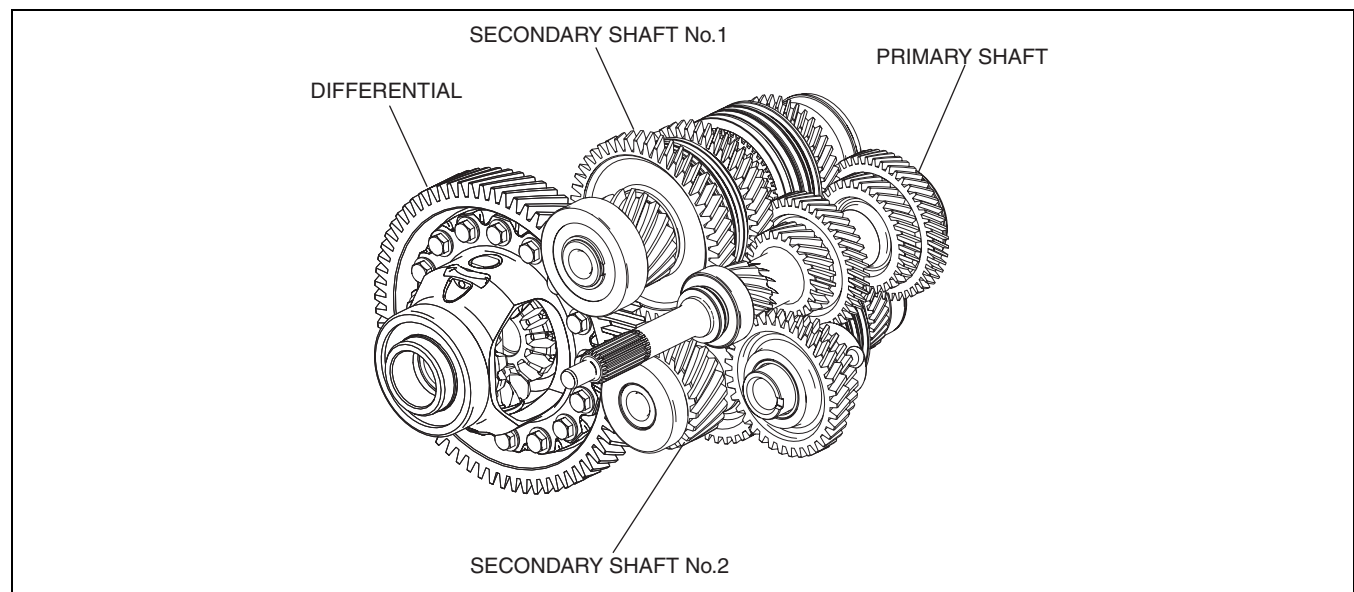
- The full length of the MTX has been shortened due to the adoption of the 3-axle type MTX.
- A triple synchronizer mechanism has been adopted for first, second, and third gears.

E6U051500000S01

05-15

## MANUAL TRANSAXLE STRUCTURAL VIEW [A26MX-R]

E6U051500000S02

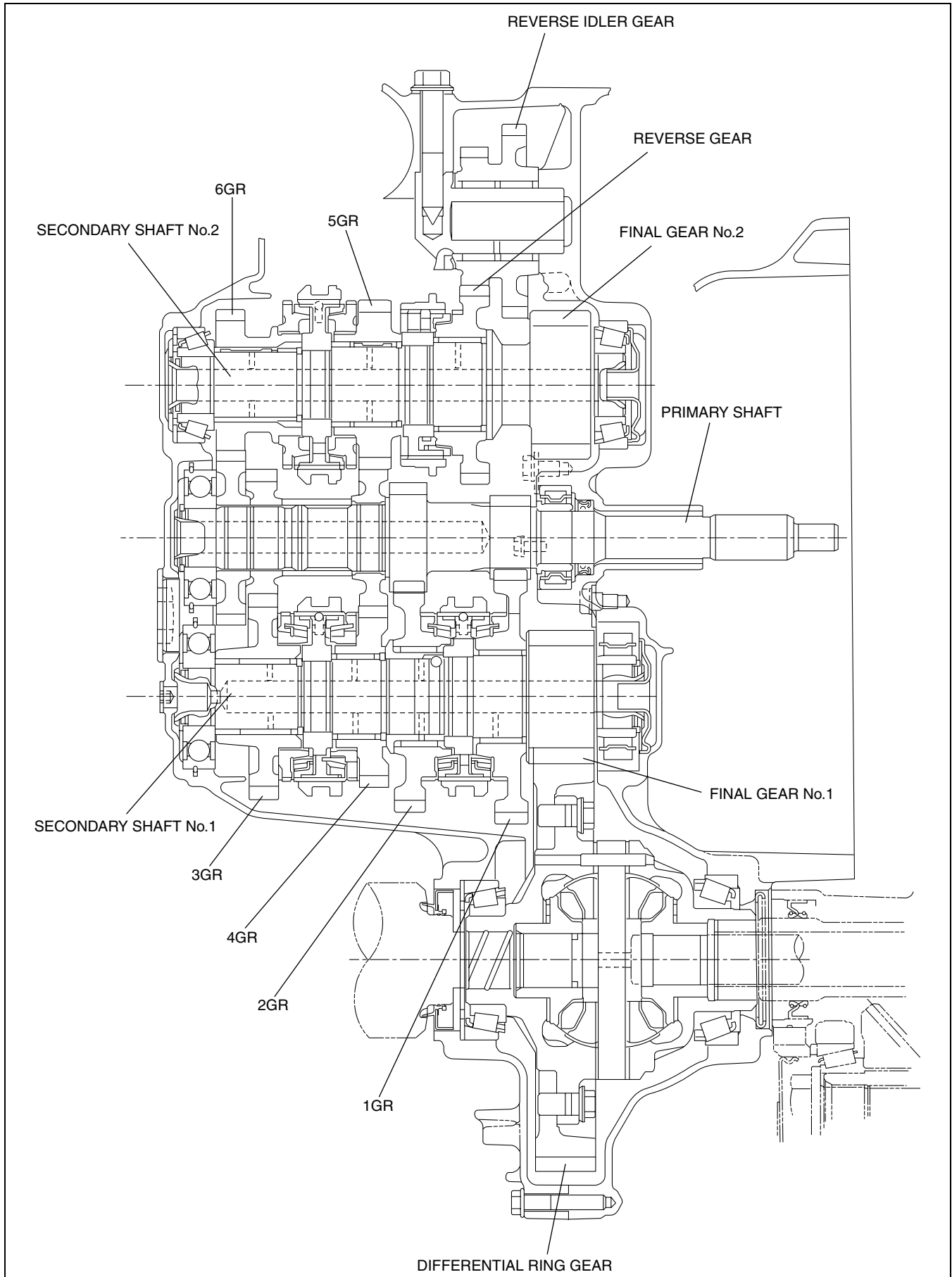


E6U515ZSC012

# MANUAL TRANSAXLE [A26MX-R]

## MANUAL TRANSMISSION CROSS-SECTIONAL VIEW [A26MX-R]

E6U05150000S03

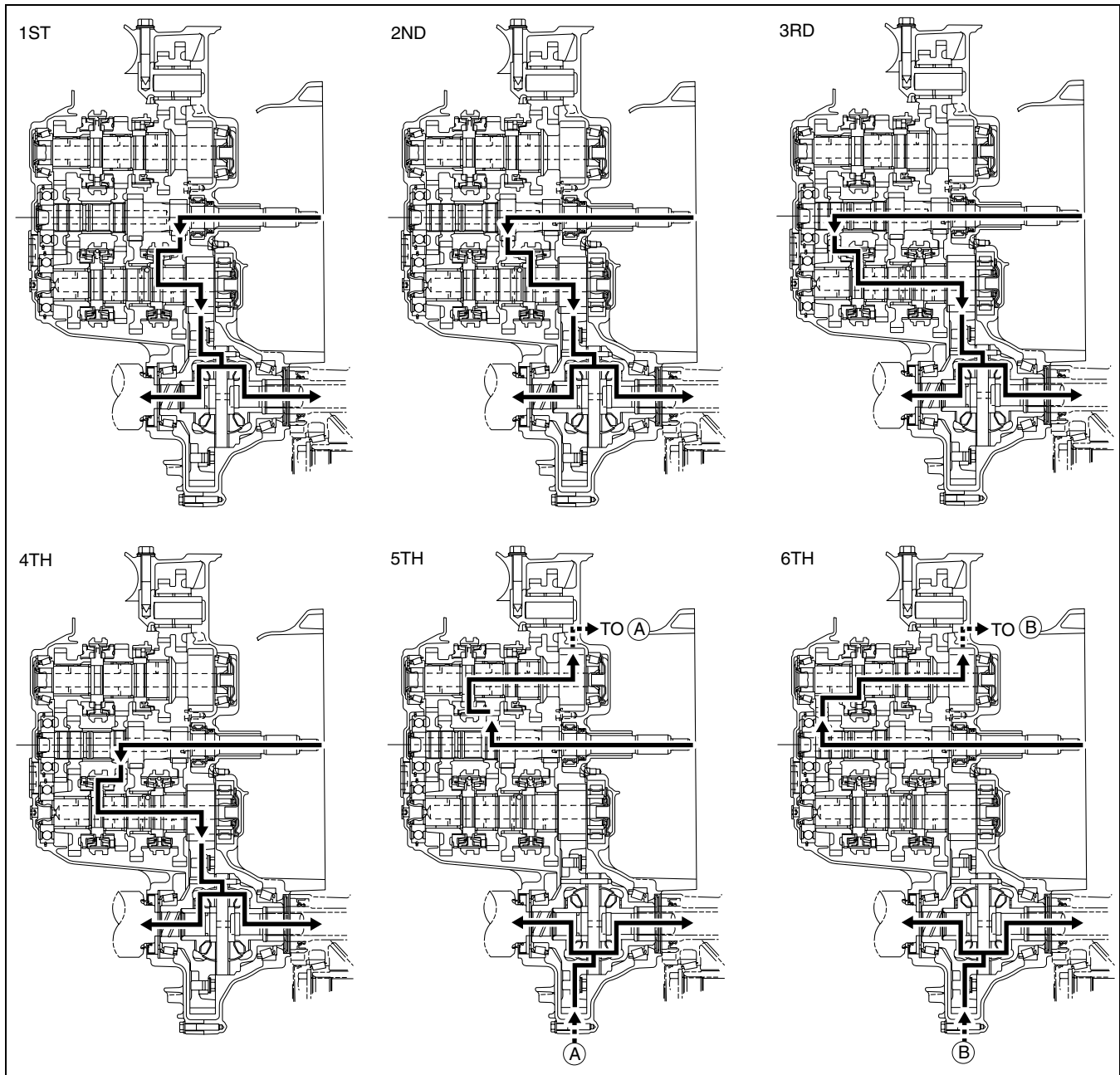


E6U515ZSC001

# MANUAL TRANSAXLE [A26MX-R]

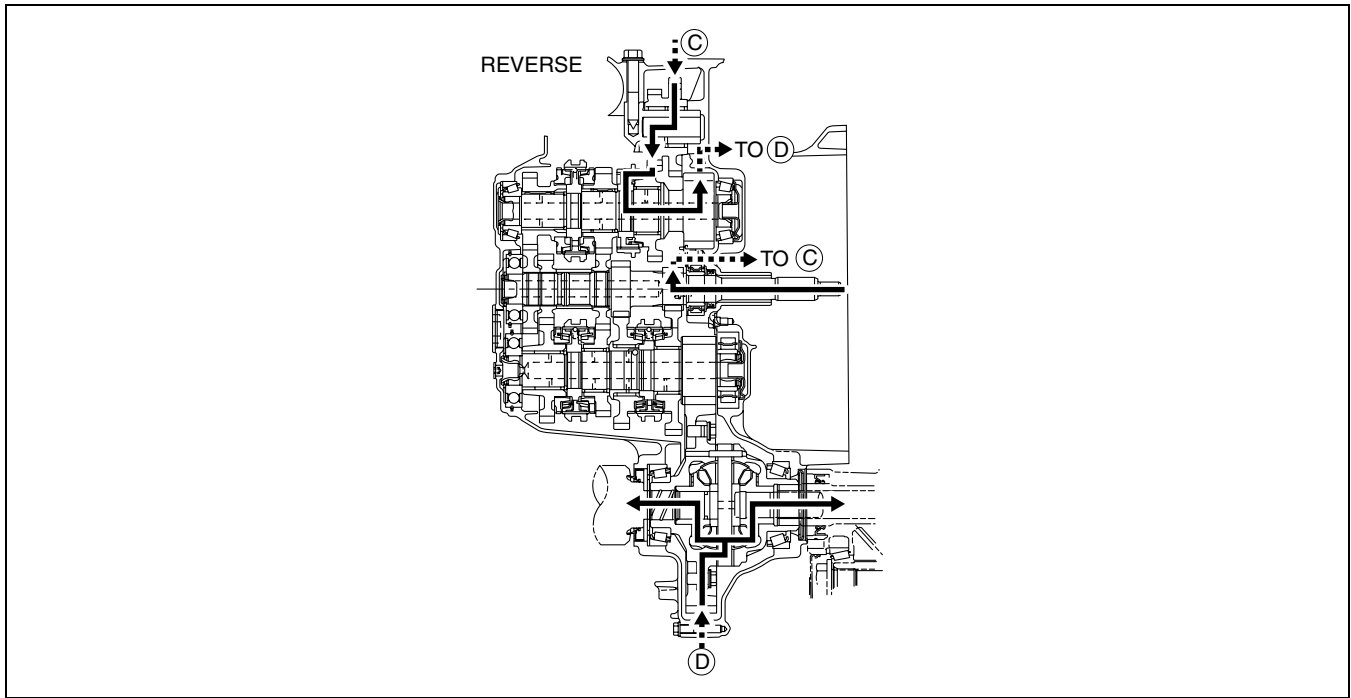
## MANUAL TRANSMISSION POWER FLOW [A26MX-R]

E6U051500000S04



05-15

E6U515ZSC002



E6U515ZSC003

## SYNCHRONIZER MECHANISM OUTLINE [A26MX-R]

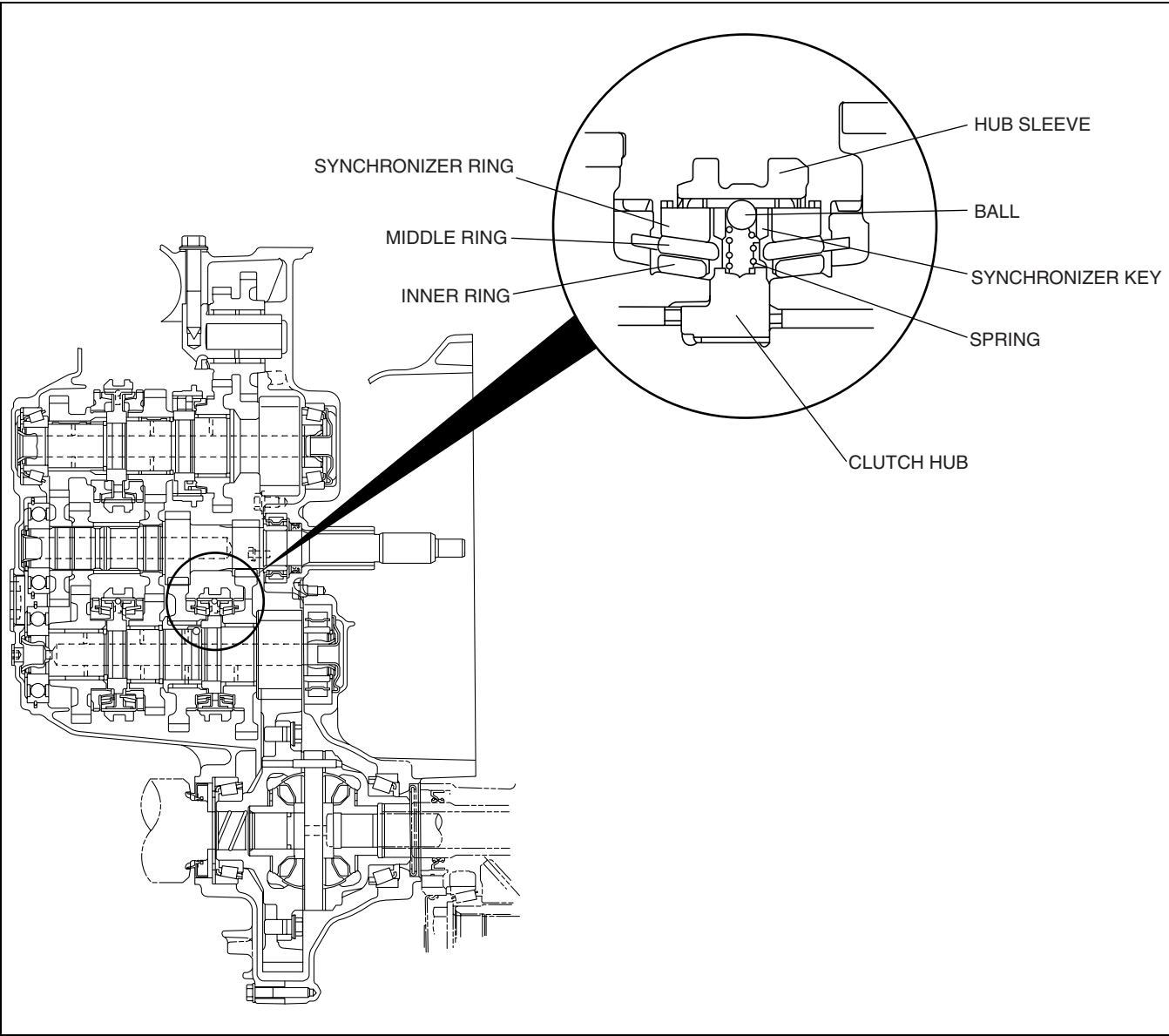
E6U05150000S05

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

## TRIPLE SYNCHRONIZER MECHANISM CONSTRUCTION [A26MX-R]

E6U05150000S06

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

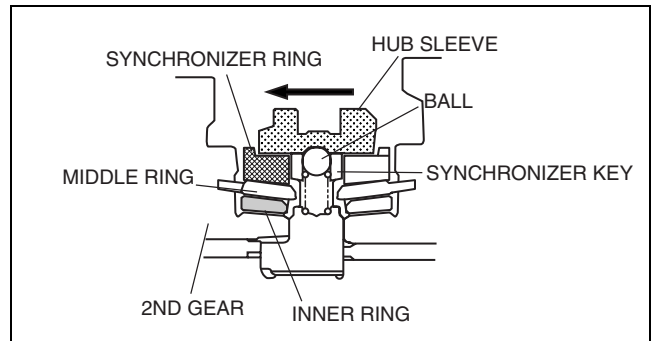


## MANUAL TRANSAXLE [A26MX-R]

### TRIPLE SYNCHRONIZER MECHANISM OPERATION [A26MX-R]

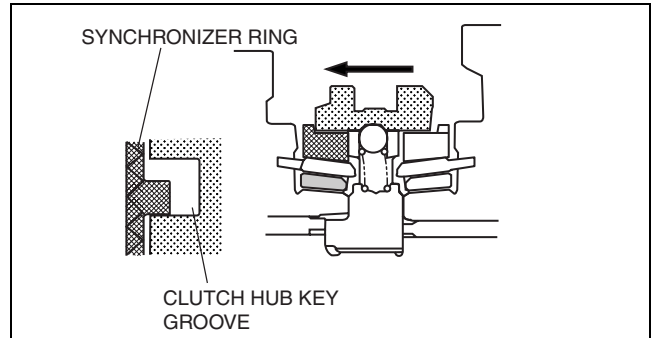
E6U05150000S08

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



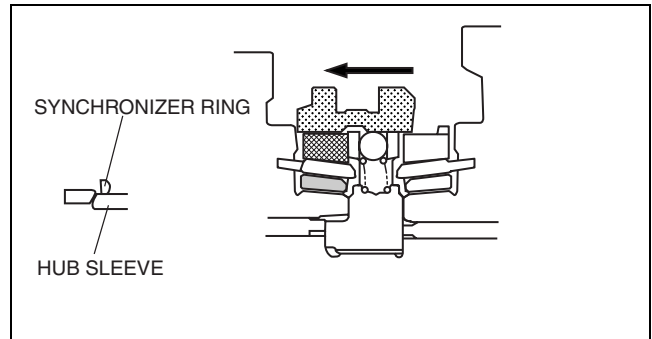
E6U515ZSC006

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

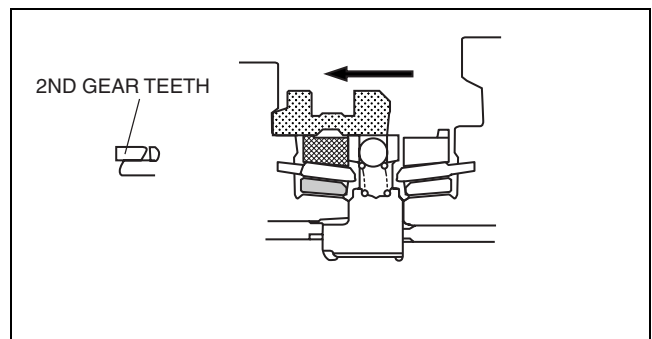


E6U515ZSC007

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



E6U515ZSC009



E6U515ZSC010

### SHIFT INTERLOCK MECHANISM FUNCTION [A26MX-R]

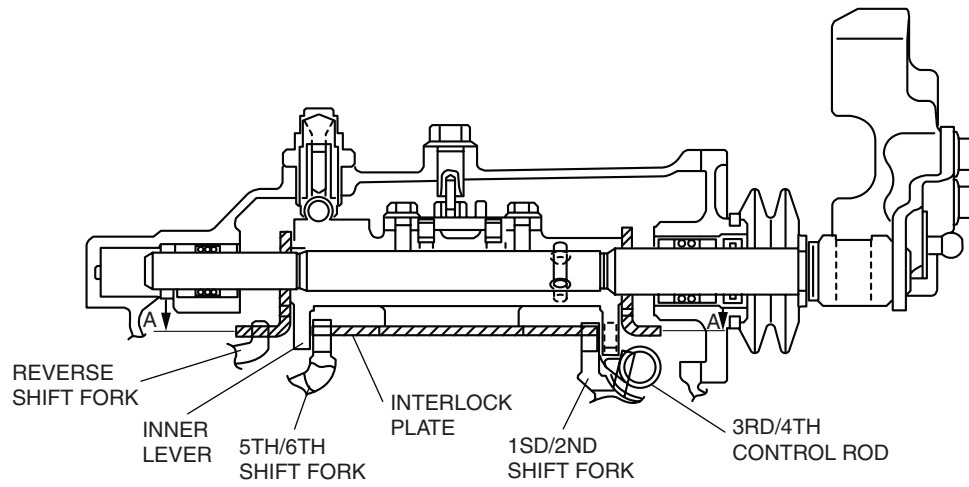
E6U05150000S09

- This provides reliable double-engagement prevention.

### SHIFT INTERLOCK MECHANISM OPERATION [A26MX-R]

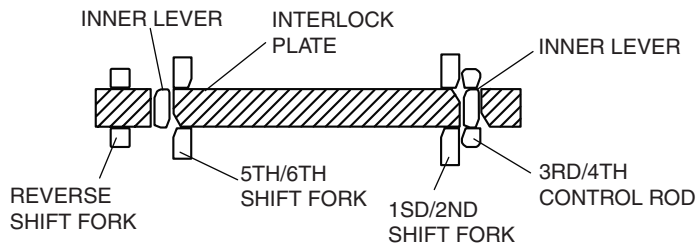
E6U05150000S10

- During shifting, the shift forks and control rod, except for the one in operation, are locked in the neutral position by the interlock plate.

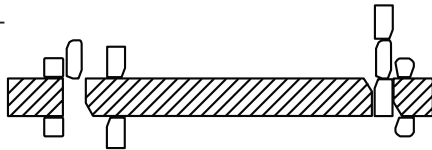


A—A SECTIONAL VIEW

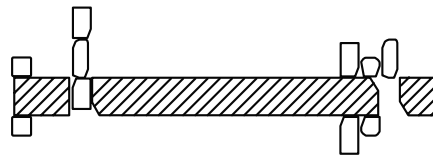
NEUTRAL



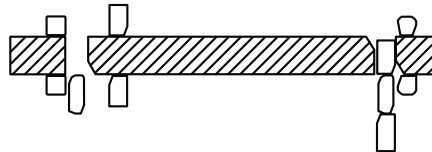
1ST



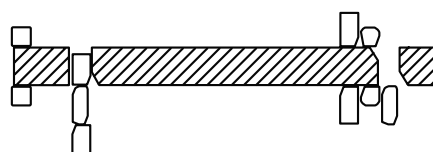
5TH



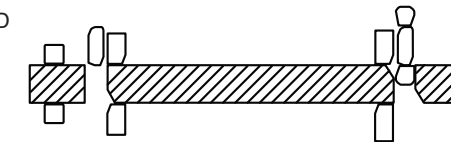
2ND



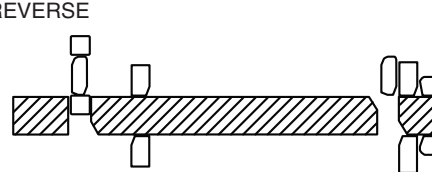
6TH



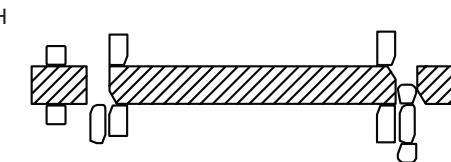
3RD



REVERSE



4TH



E6U515ZSC011



# 05-16 MANUAL TRANSAXLE SHIFT MECHANISM [A26MX-R]

## MANUAL TRANSAXLE SHIFT MECHANISM STRUCTURAL VIEW

[A26MX-R]..... 05-16-1

## REVERSE LOCKOUT MECHANISM

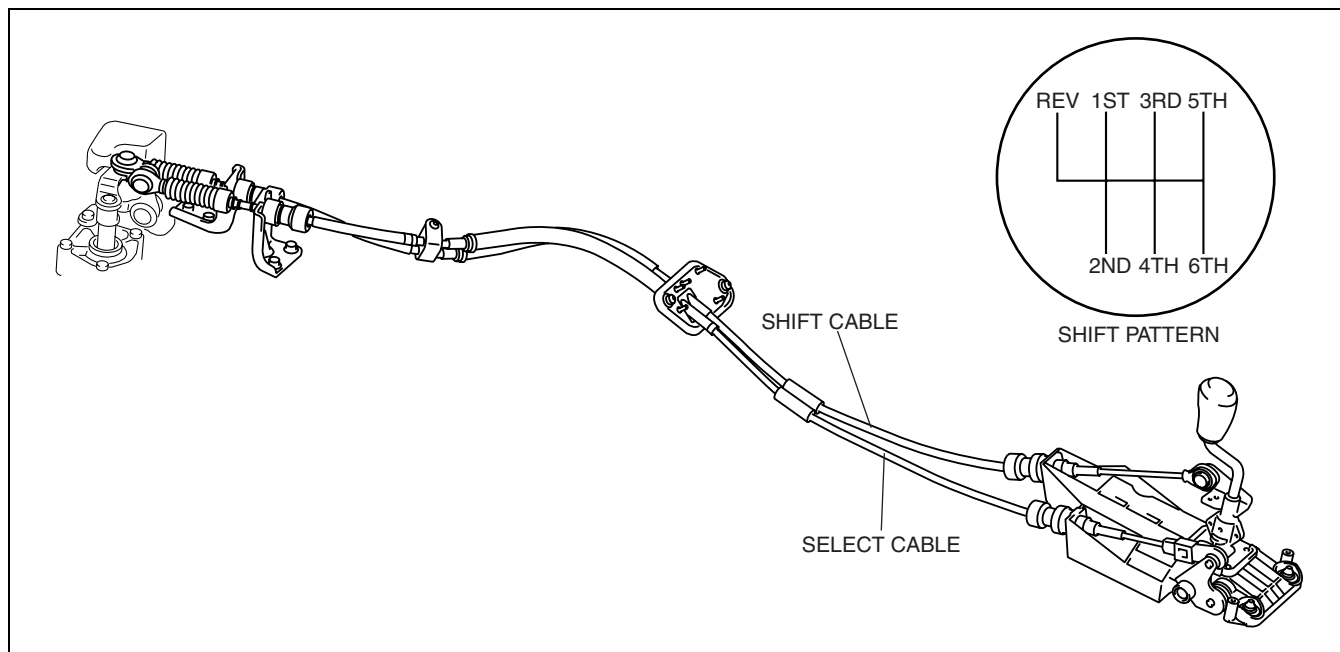
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## REVERSE LOCKOUT MECHANISM CONSTRUCTION/OPERATION

[A26MX-R] .....05-16-2

## MANUAL TRANSAXLE SHIFT MECHANISM STRUCTURAL VIEW [A26MX-R]

E6U051646010S01



E6U516ZSC001

05-16

# MANUAL TRANSAXLE SHIFT MECHANISM [A26MX-R]

## REVERSE LOCKOUT MECHANISM FUNCTION [A26MX-R]

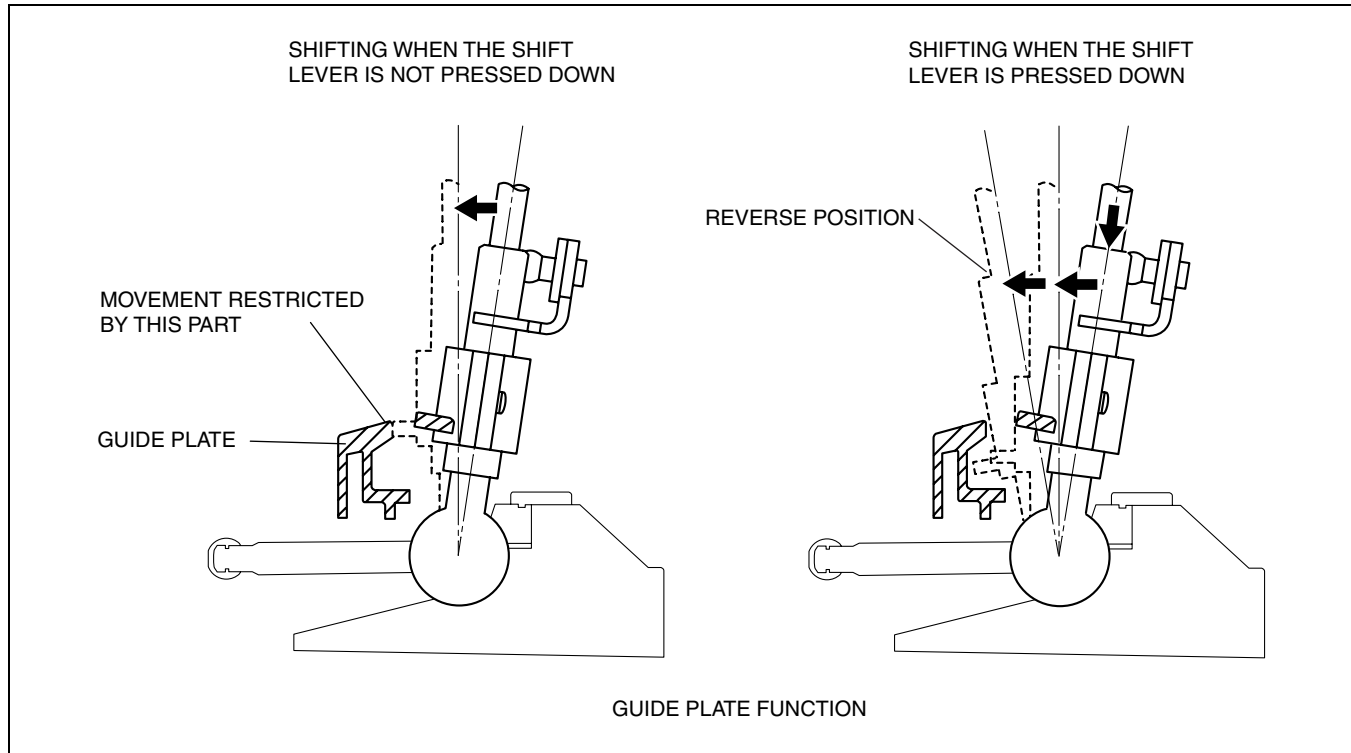
E6U051646010S02

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

## REVERSE LOCKOUT MECHANISM CONSTRUCTION/OPERATION [A26MX-R]

E6U051646010S03

- A guide plate, attached to the shift lever assembly, prevents accidental shifting into reverse when shifting into 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.



E6U515ZSC005

# 05-17 AUTOMATIC TRANSAXLE [FS5A-EL]

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### AUTOMATIC TRANSAXLE OUTLINE [FS5A-EL]

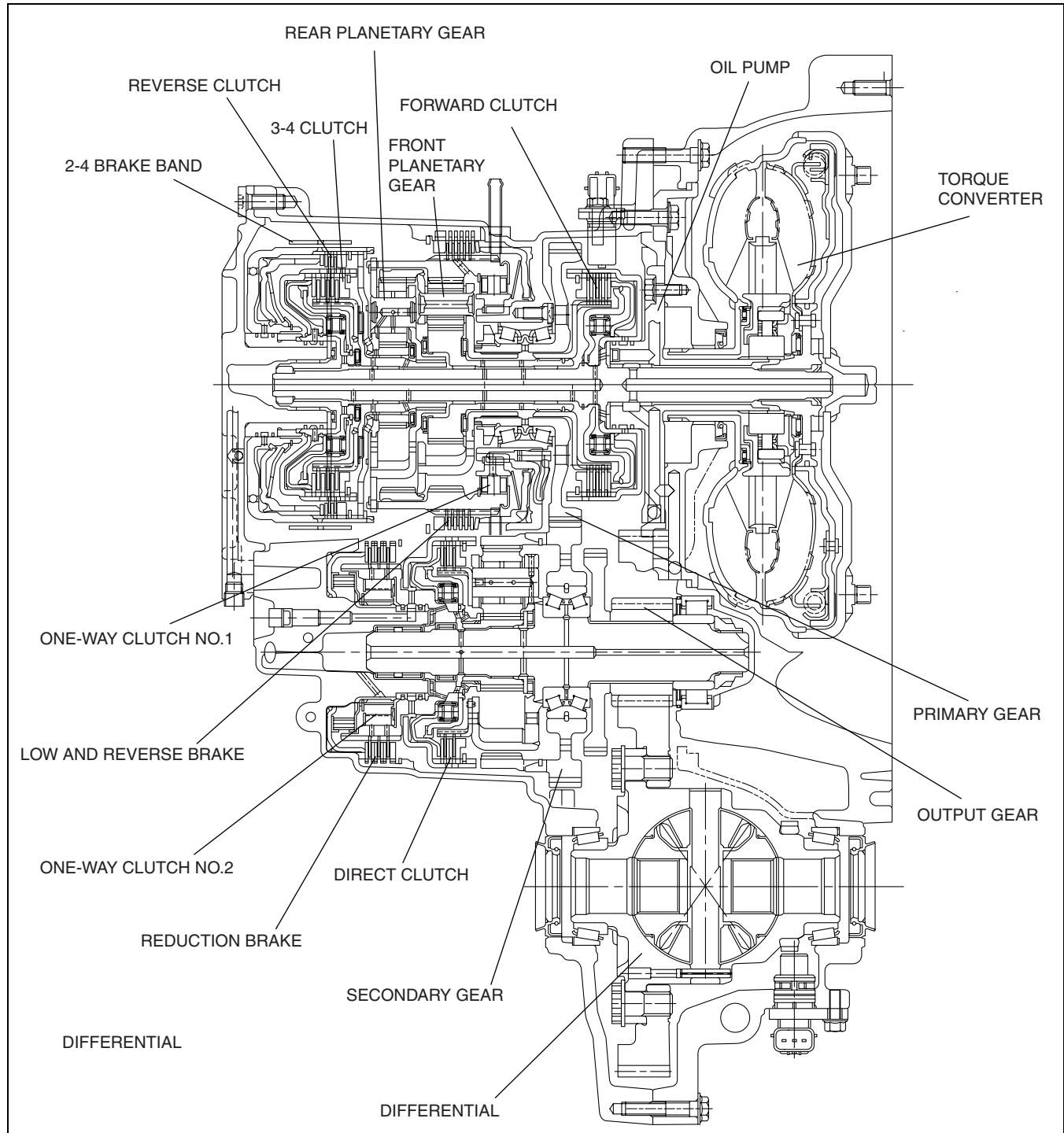
E6U05170000S01

- The electronic control automatic transaxle with the FS5A-EL type 5-speed lockup function, merging advanced electrical and mechanical technologies, has been adopted.
- A manual mode shift control has been adopted.
  - The manual mode shift control is activated by moving the selector lever from the D to M range position.
  - The automatic shift system automatically shifts between 1GR and 5GR. The manual shift system allows for free gear position selection by manually operating the selector lever forward and back.
- The level gauge of the FS5A-EL type measures the ATF level on the differential side, and the ATF inspection procedure differs from the FN4A-EL type.

# AUTOMATIC TRANSAXLE [FS5A-EL]

## AUTOMATIC TRANSAXLE CROSS-SECTIONAL VIEW [FS5A-EL]

E6U051700000S02



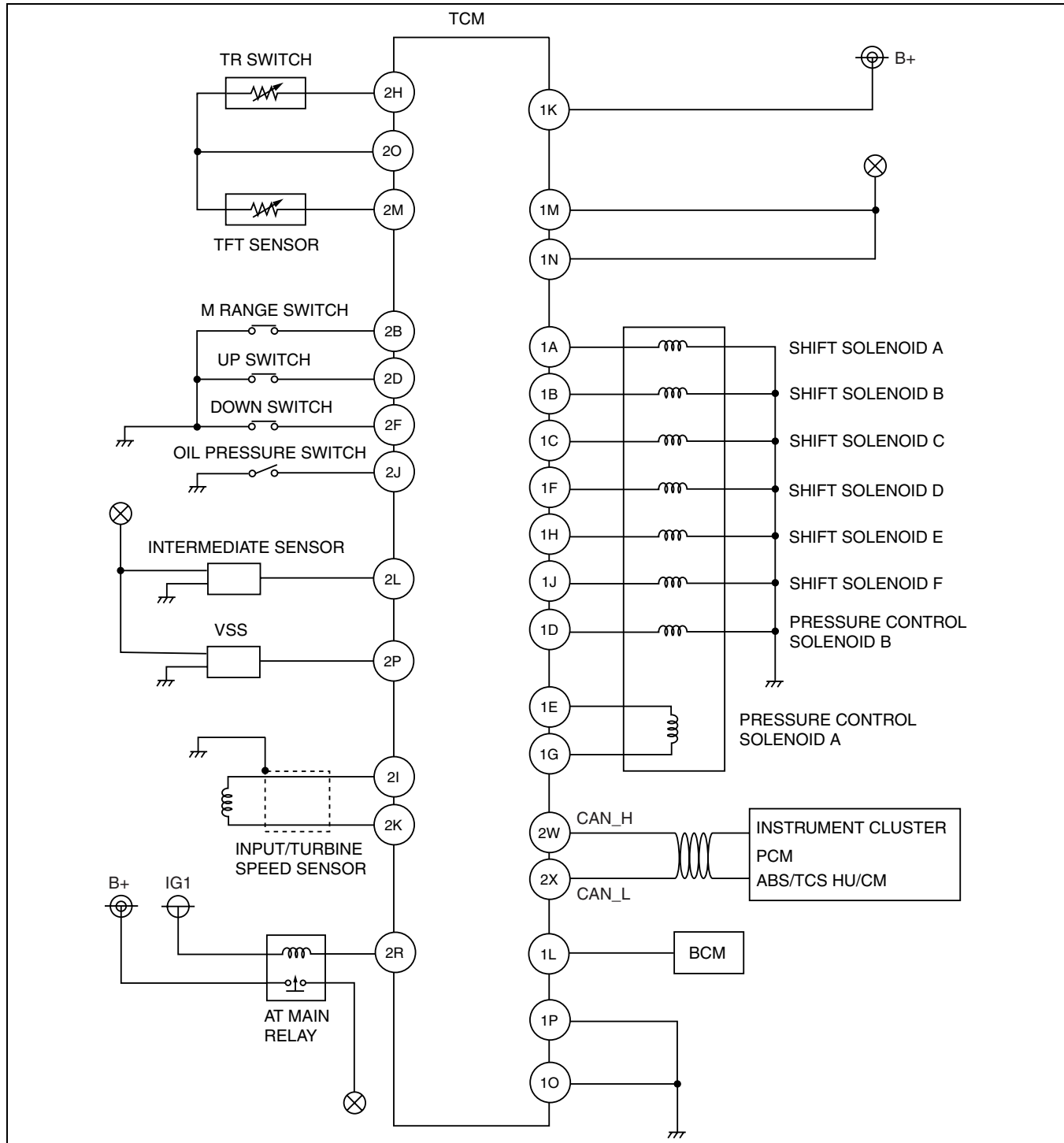
05-17

E6U517AS5001

# AUTOMATIC TRANSAXLE [FS5A-EL]

## AUTOMATIC TRANSAXLE CONTROL SYSTEM WIRING DIAGRAM [FS5A-EL]

E6U05170000S08



E6U503AW5003

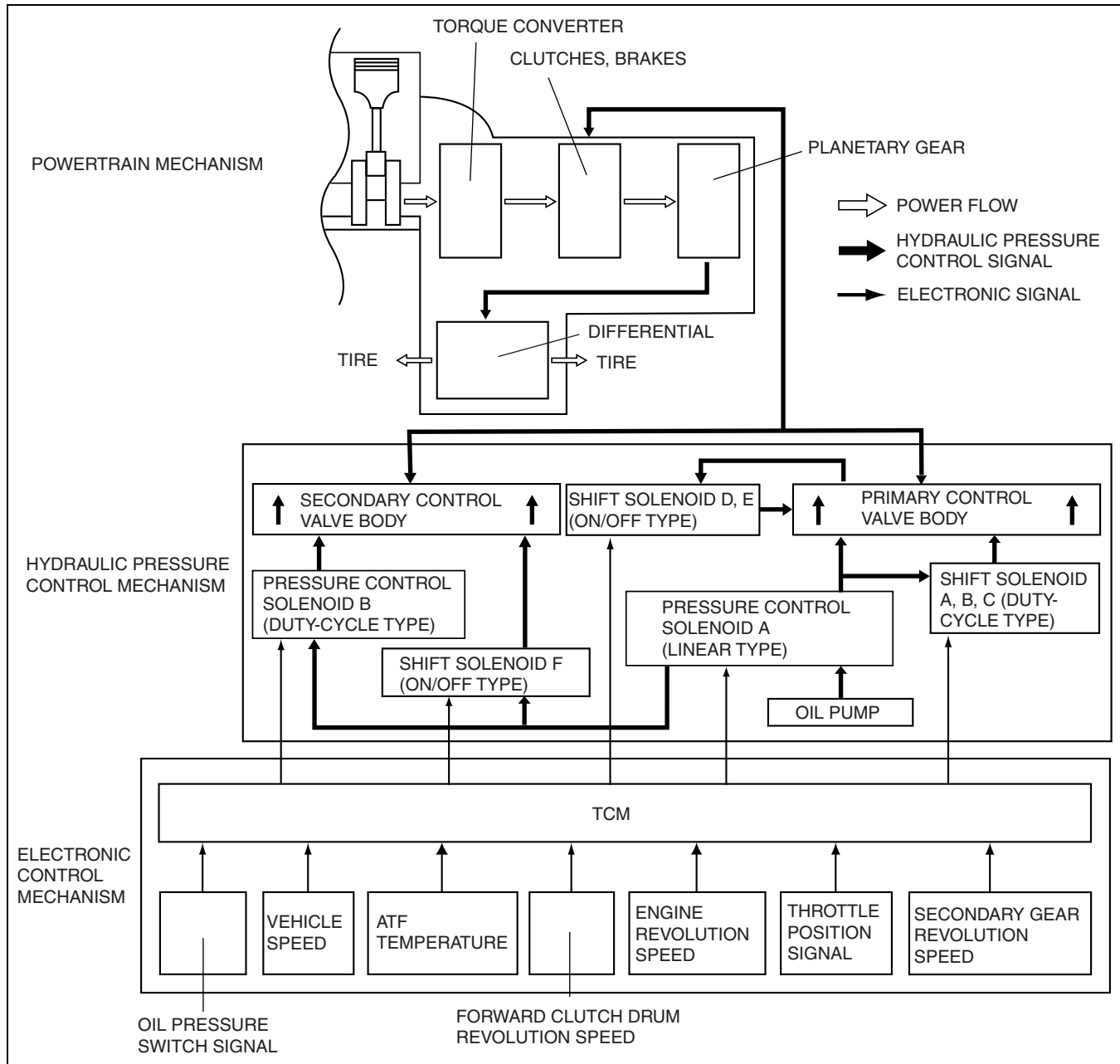
## OUTLINE OF OPERATION [FS5A-EL]

E6U05170000S03

- The operation of the electronic automatic transaxle is classified into three systems: the electronic control mechanism, the hydraulic pressure control mechanism, and the powertrain mechanism (includes the torque converter mechanism). The operation of each system is as follows:
  - Electronic control mechanism
    - According to the signals from the switches and sensors in the input system, the TCM outputs the signal which matches the present driving condition to the linear type solenoid, ON/OFF type solenoids and the duty-cycle type solenoids in the hydraulic pressure control mechanism.

# AUTOMATIC TRANSAXLE [FS5A-EL]

- Hydraulic pressure control mechanism
  - According to the signals from the TCM, each solenoid operates to switch the hydraulic passages in the control valve body and controls the clutch engagement pressure.
  - The line pressure is adjusted by the linear type pressure control solenoid A and duty-cycle type pressure control solenoid B. The hydraulic passages are switched by the ON/OFF type solenoids (shift solenoids D and E.) And the clutch engagement pressure is controlled by the duty-cycle type solenoids (shift solenoids A, B, and C) and ON/OFF type solenoid (shift solenoids F).
- Powertrain mechanism
  - The driving force from the engine is transmitted through the torque converter to the transaxle.
  - The transmitted driving force operates each clutch and brake according to the clutch engagement pressure from the duty-cycle type solenoid (shift solenoids A, B, and C), ON/OFF type solenoid (shift solenoids F) and the planetary gears change the gear ratio to the optimal driving force. The changed driving force is transmitted through the differential to the axle shaft and then the tires.



E6U517AS5002

# AUTOMATIC TRANSAXLE [FS5A-EL]

## EC-AT OPERATION CHART [FS5A-EL]

E6U051700000S04

Position/Range	Mode	Gear position		Shift pattern			Transaxle									
				Shift	TCC	Engine brake	Forward clutch	3-4 clutch	Reverse clutch	Direct clutch	2-4 brake band		Low and reverse brake	Reduction brake	One-way clutch No.1	One-way clutch No.2
											Applied	Released				
P	-	Neutral	-	-												
R	-	Reverse	3.405	-		×			×				×	×		
N	-	Neutral	-	-												
D	POWER/ NORMAL	1GR	3.620	↑			×							×	⊗	×
		2GR	1.925	↑		×	×				×			×		×
		3GR	1.285	↑		×	×	×			×	×		×		×
		4GR	0.933	↑		×		×			×			×		×
		4GR <sup>+2</sup> TCC ON	0.933		×	×		×			×			×		×
		5GR	0.692	↑		×		×		×	×					
		5GR <sup>+2</sup> TCC ON	0.692		×	×		×		×	×					
M	MANUAL	1GR	3.620	↑↑↑↑		×	×						×	×	⊗	×
		2GR	1.925	↑↑↑↑		×	×				×			×		×
		3GR	1.285	↑↑↑↑		×	×	×			×	×		×		×
		4GR	0.933	↑↑↑↑		×		×			×			×		×
		4GR TCC ON	0.933	↑↑↑↑	×	×		×			×			×		×
		5GR	0.692	↑↑↑↑		×		×		×	×					
		5GR TCC ON	0.692	↑↑↑↑	×	×		×		×	×					

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

↑↑ : Manual shift based on selector lever operation

↑↑↑ : Consecutive shift by tapping selector lever two times in the down-shift (—) direction or up-shift (+) direction

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

\*2 : Performs TCC operation in NORMAL mode

\*3 : Indicates operation although the band servo remains deactivated due to the large area of the release pressure side.

× : Operating

⊗ : Transmits the torque only when driving

D6E517AT5003

# AUTOMATIC TRANSAXLE [FS5A-EL]

Position/Range	Mode	Gear position		Shift pattern			Operation of shift solenoid					
				Shift	TCC	Engine brake	Solenoid valve (duty-cycle type)			Solenoid valve (ON /OFF type)		
							Shift solenoid A	Shift solenoid B	Shift solenoid C	Shift solenoid D	Shift solenoid E	Shift solenoid F
P	-	Neutral	-	-			-	-	-	ON	OFF	ON
R	-	Reverse	3.405	-		×	OPEN	OPEN	OPEN	OFF	OFF	ON
N	-	Neutral	-	-			-	-	-	ON	OFF	ON
D	POWER/ NORMAL	1GR	3.620	↕			OPEN	CLOSE	CLOSE	OFF	OFF	ON
		2GR	1.925	↕		×	OPEN	OPEN	CLOSE	OFF	OFF	ON
		3GR	1.285	↕		×	OPEN	OPEN	OPEN	OFF	OFF	ON
		4GR	0.933	↕		×	CLOSE	OPEN	OPEN	ON	OFF	ON
		4GR*2 TCC ON	0.933	↕	×	×	CLOSE	OPEN	OPEN	ON	ON	ON
		5GR	0.692	↕		×	CLOSE	OPEN	OPEN	ON	OFF	OFF
		5GR*2 TCC ON	0.692	↕	×	×	CLOSE	OPEN	OPEN	ON	ON	OFF
M	MANUAL	1GR	3.620	↕		×	OPEN	OPEN	CLOSE	ON	ON	ON
		2GR	1.925	↕		×	OPEN	OPEN	CLOSE	OFF	OFF	ON
		3GR	1.285	↕		×	OPEN	OPEN	OPEN	OFF	OFF	ON
		4GR	0.933	↕		×	CLOSE	OPEN	OPEN	ON	OFF	ON
		4GR TCC ON	0.933	↕	×	×	CLOSE	OPEN	OPEN	ON	ON	ON
		5GR	0.692	↕		×	CLOSE	OPEN	OPEN	ON	OFF	OFF
		5GR TCC ON	0.692	↕	×	×	CLOSE	OPEN	OPEN	ON	ON	OFF

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↕ : 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

× : Operating

OPEN: Engages the line pressure to the clutch pressure (Solenoid de-energized)

CLOSE: Drains the clutch pressure (Solenoid energized)

ON: Engages the output port and the supply port (Solenoid reducing pressure)

OFF: Engages the output port and the drain port (Drains the output port)

D6E517AT5004

## AUTOMATIC TRANSAXLE [FS5A-EL]

### POWER FLOW OUTLINE [FS5A-EL]

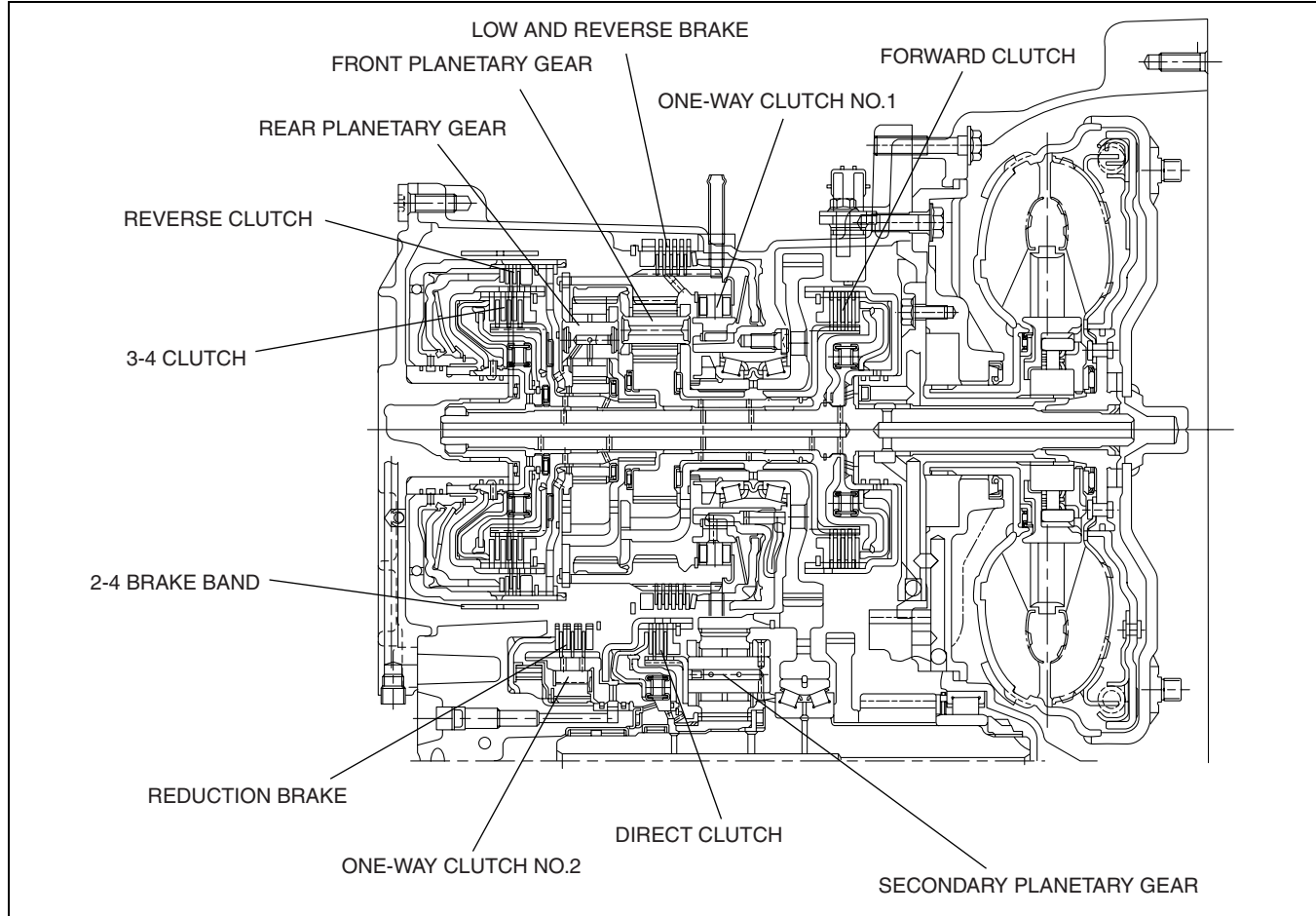
E6U051700000S05

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

### POWER FLOW STRUCTURE [FS5A-EL]

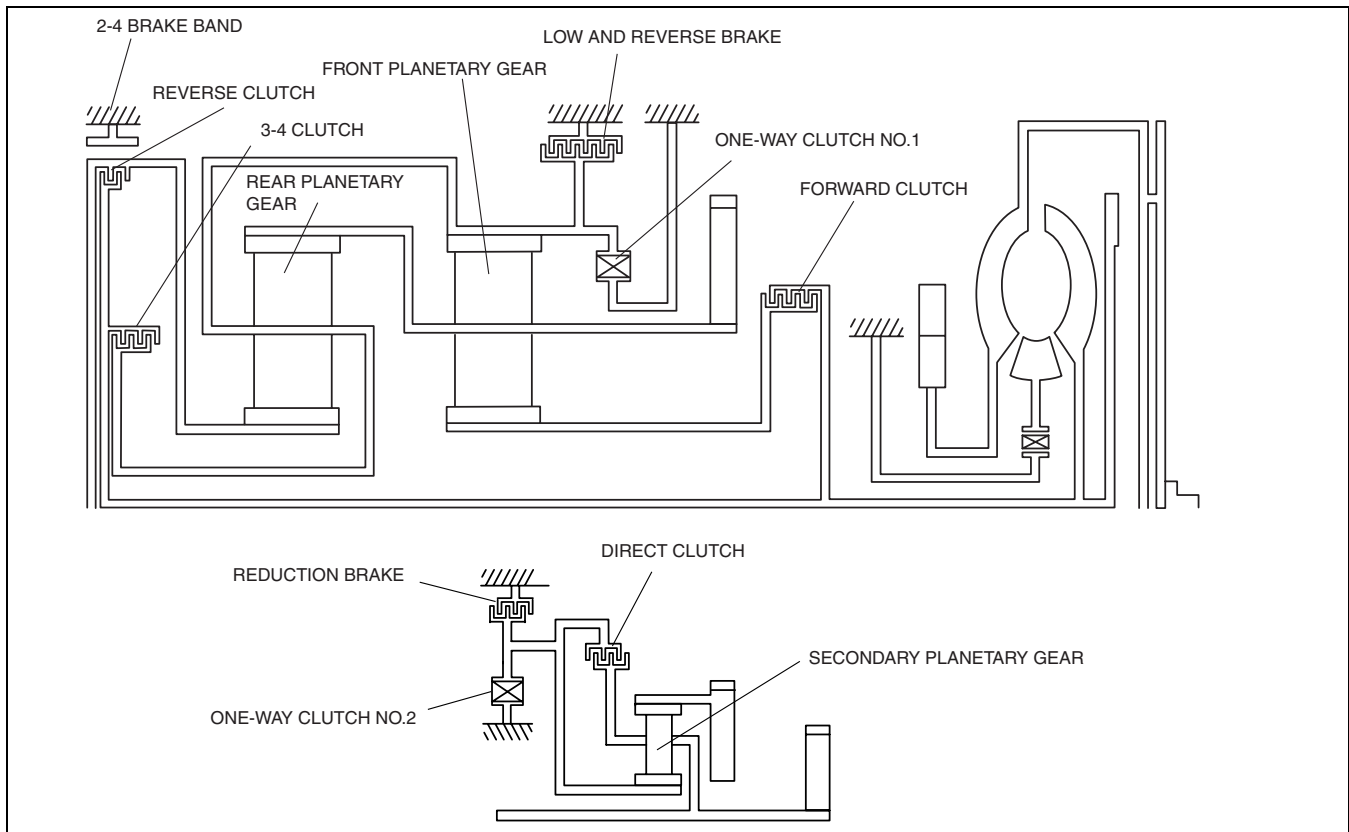
E6U051700000S06

- The powertrain mechanism of the FS5A-EL type consists of four pairs of clutches, two pairs of brakes, band brake, two pairs of one-way clutches, and three pairs of single type planetary gears.



E6U517AS5003

# AUTOMATIC TRANSAXLE [FS5A-EL]



E6U517AS5004

## POWER FLOW OPERATION [FS5A-EL]

E6U05170000S07

### Component description

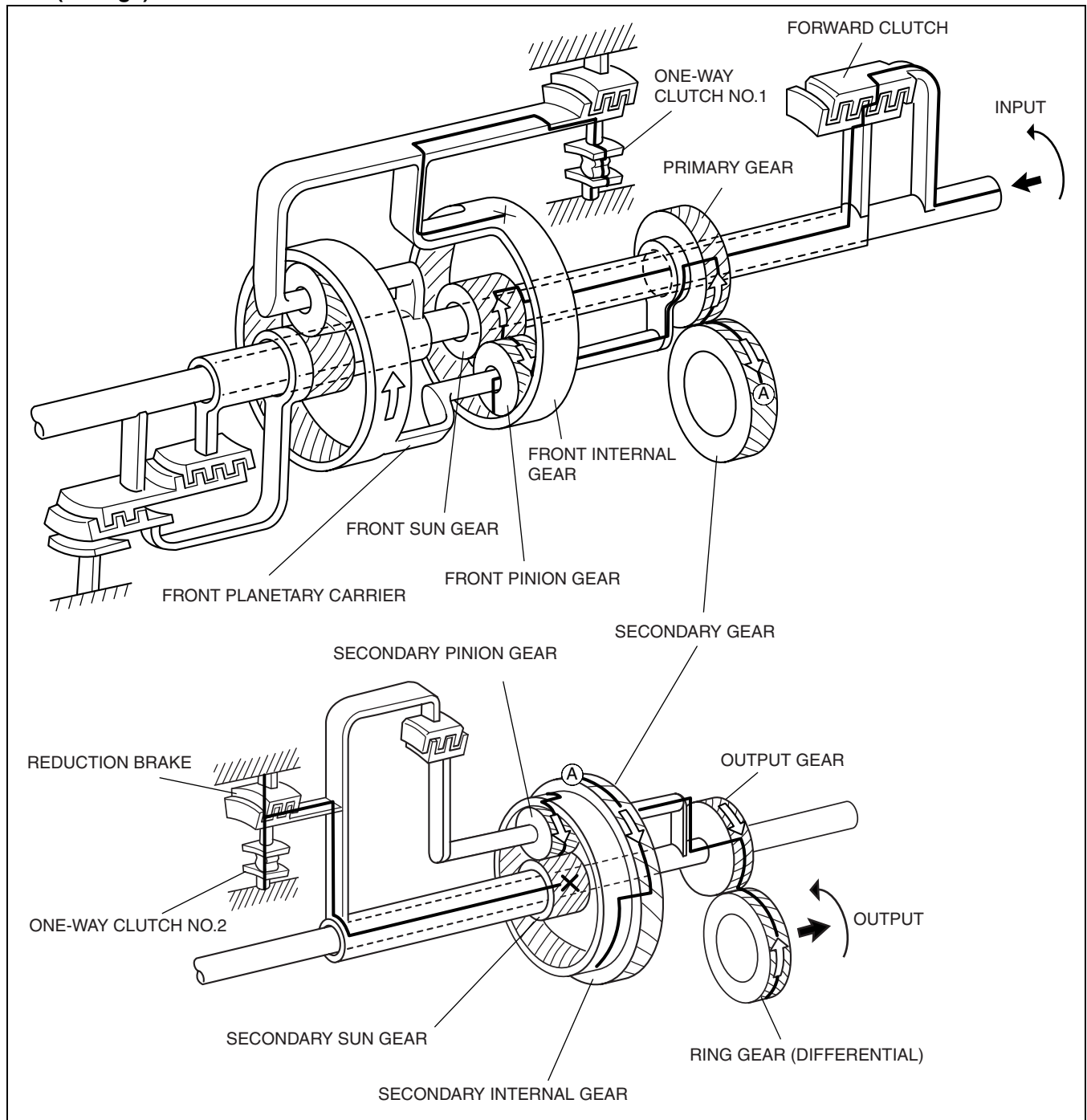
Component	Function
Forward clutch	<ul style="list-style-type: none"> <li>Transmits the input torque from the turbine shaft to the front sun gear.</li> <li>Operates in the forward range of the first, second, or third gear position.</li> </ul>
3-4 clutch	<ul style="list-style-type: none"> <li>Transmits the input torque from the turbine shaft to the rear planetary carrier.</li> <li>Operates in the forward range of the third, fourth or fifth gear position.</li> </ul>
Reverse clutch	<ul style="list-style-type: none"> <li>Transmits the input torque from the turbine shaft to the rear sun gear.</li> <li>Operates when the vehicle is backing up.</li> </ul>
Direct clutch	<ul style="list-style-type: none"> <li>Engage the secondary planetary carrier and the secondary sun gear.</li> <li>Operates in the fifth gear position.</li> </ul>
2-4 brake band	<ul style="list-style-type: none"> <li>Locks rotation of the reverse drum and fixes the rear sun gear.</li> <li>Operates in the second or fourth gear position.</li> </ul>
Low and reverse brake	<ul style="list-style-type: none"> <li>Fixes the rotation of the front internal gear.</li> <li>Operates when the vehicle is backing up or in the first gear position (M range 1GR).</li> </ul>
Reduction brake	<ul style="list-style-type: none"> <li>Fixes the rotation of the secondary sun gear.</li> <li>Operates when the vehicle is backing up.</li> <li>Operates in the first, second, third or fourth gear position.</li> </ul>
One-way clutch No.1	<ul style="list-style-type: none"> <li>Locks the counterclockwise rotation of the front internal gear in the first gear position.</li> </ul>
One-way clutch No.2	<ul style="list-style-type: none"> <li>Operates in the first, second, third or fourth gear position.</li> </ul>
Front planetary gear	<ul style="list-style-type: none"> <li>The front planetary gear and rear planetary gear functions as a transmission due to the engagement/ disengagement of clutches and/or brakes, converts the transmitted driving force of the turbine shaft and transmits it to the primary gear.</li> </ul>
Rear planetary gear	
Secondary planetary gear	<ul style="list-style-type: none"> <li>The secondary planetary gear functions as a transmission due to the engagement/ disengagement of clutches and/or brakes, converts the transmitted driving force of the turbine shaft and transmits it to the output gear.</li> </ul>

### Note

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

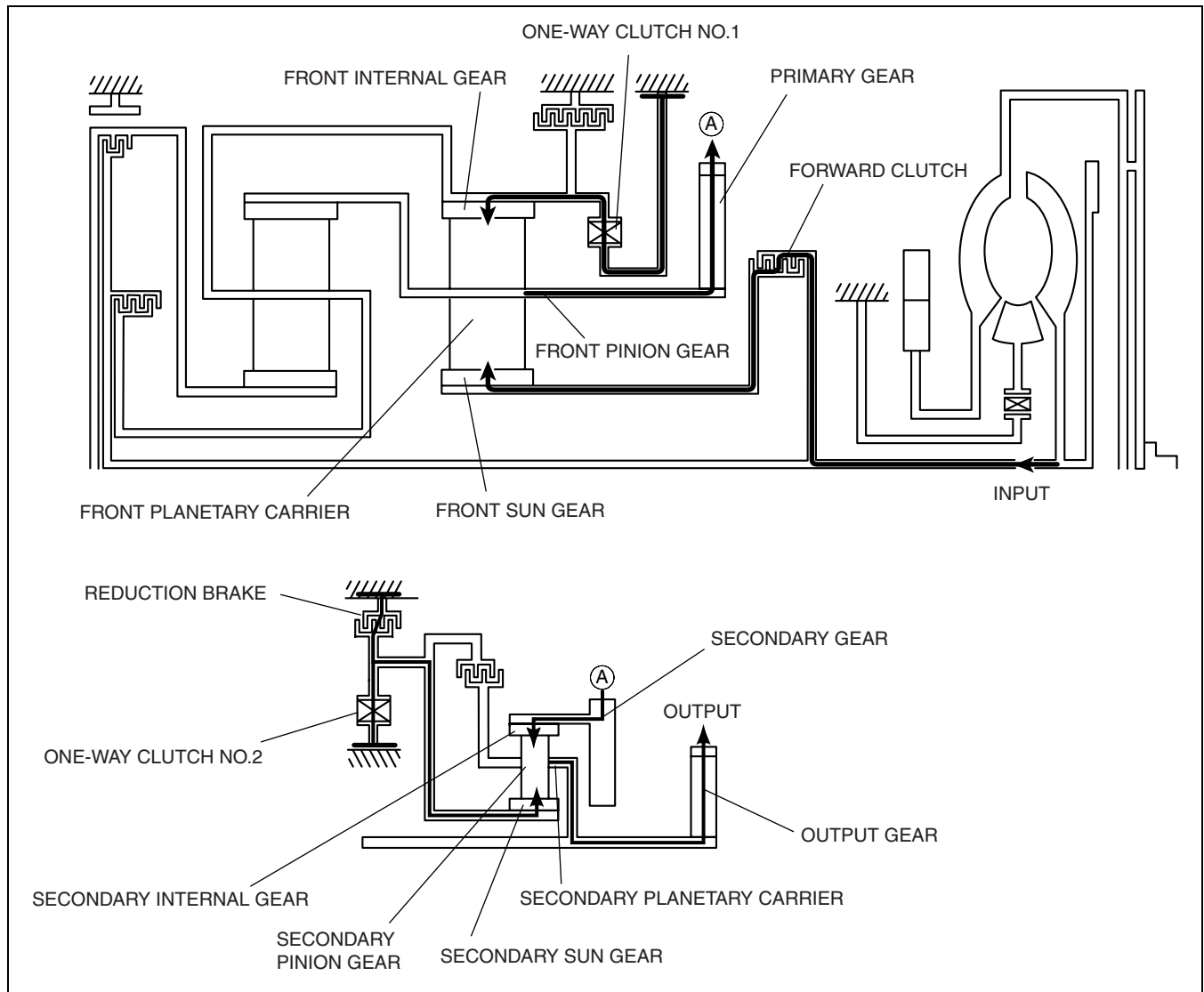
# AUTOMATIC TRANSAXLE [FS5A-EL]

1GR (D range)



E6U517AS5005

# AUTOMATIC TRANSAXLE [FS5A-EL]

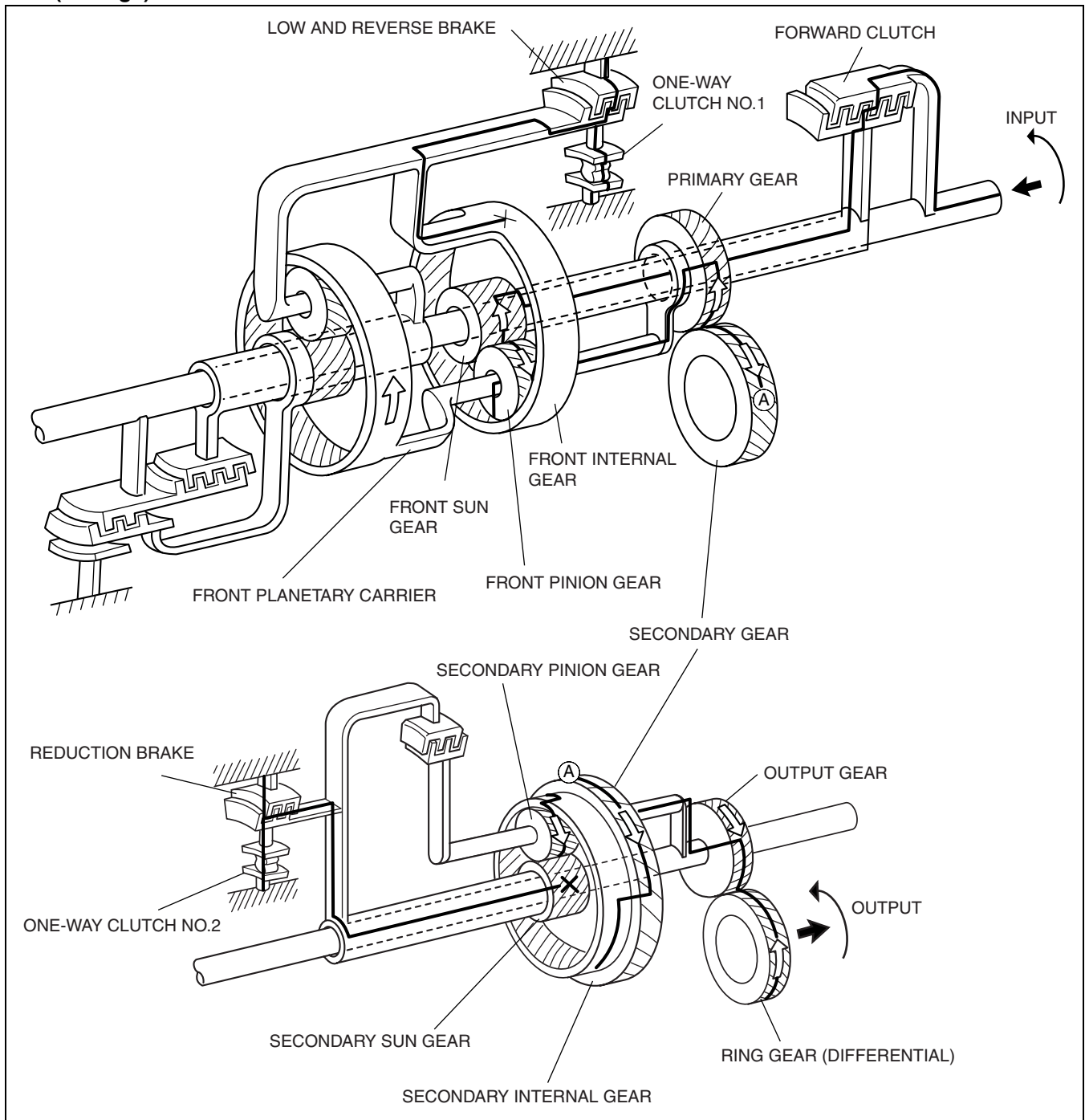


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E6U517AS5006

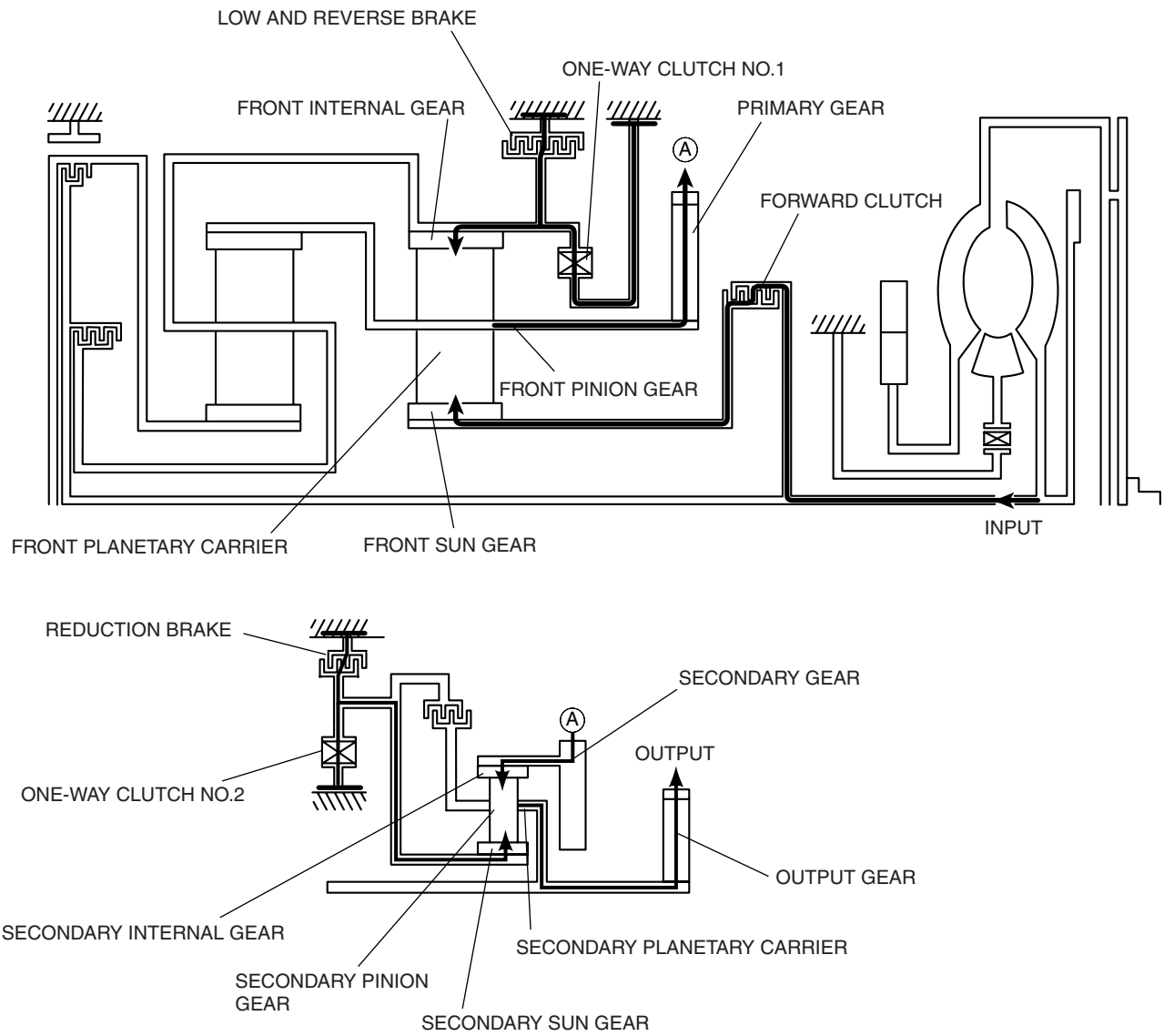
# AUTOMATIC TRANSAXLE [FS5A-EL]

1GR (M range)



E6U517AS5007

# AUTOMATIC TRANSAXLE [FS5A-EL]

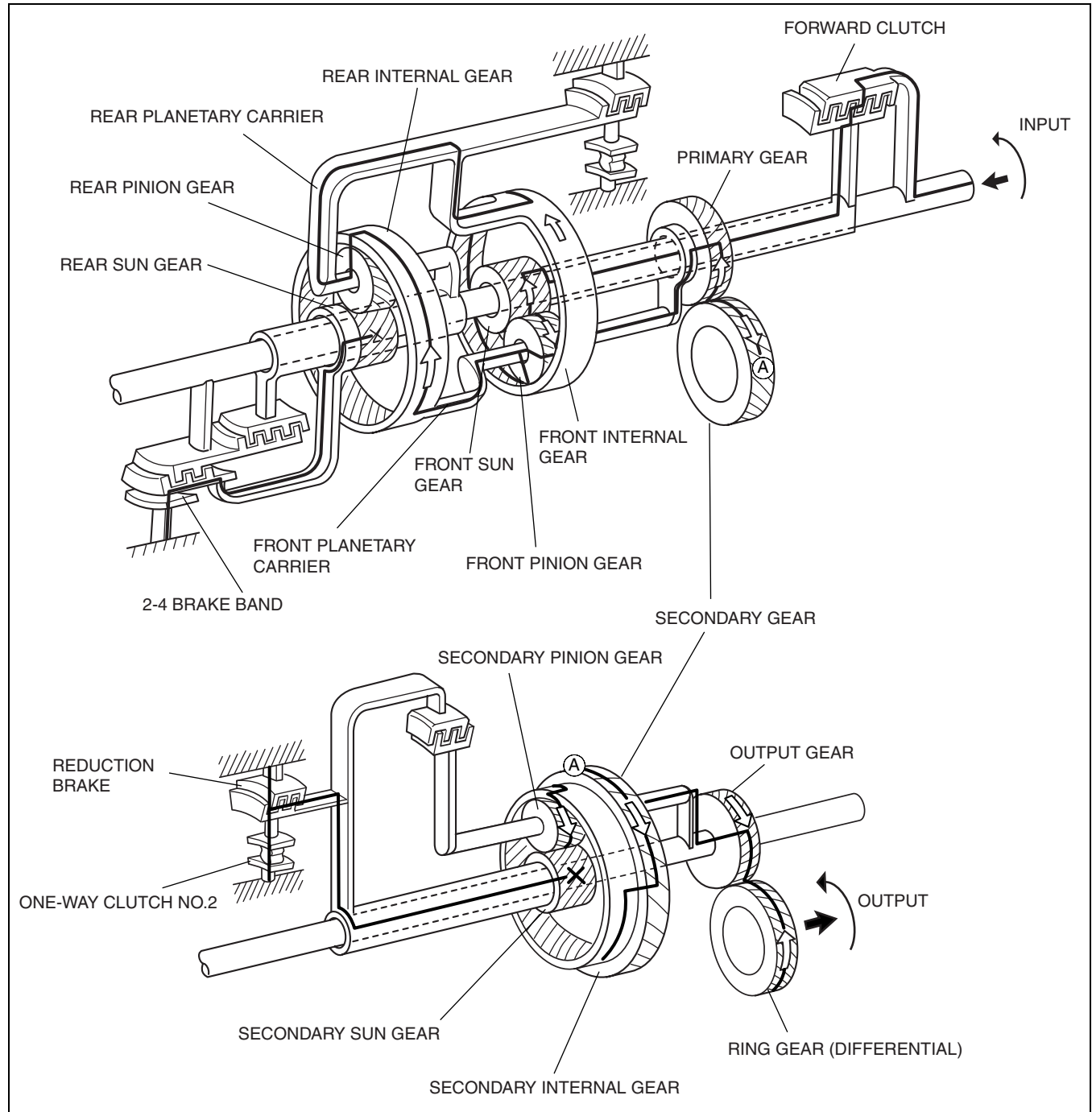


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E6U517AS5008

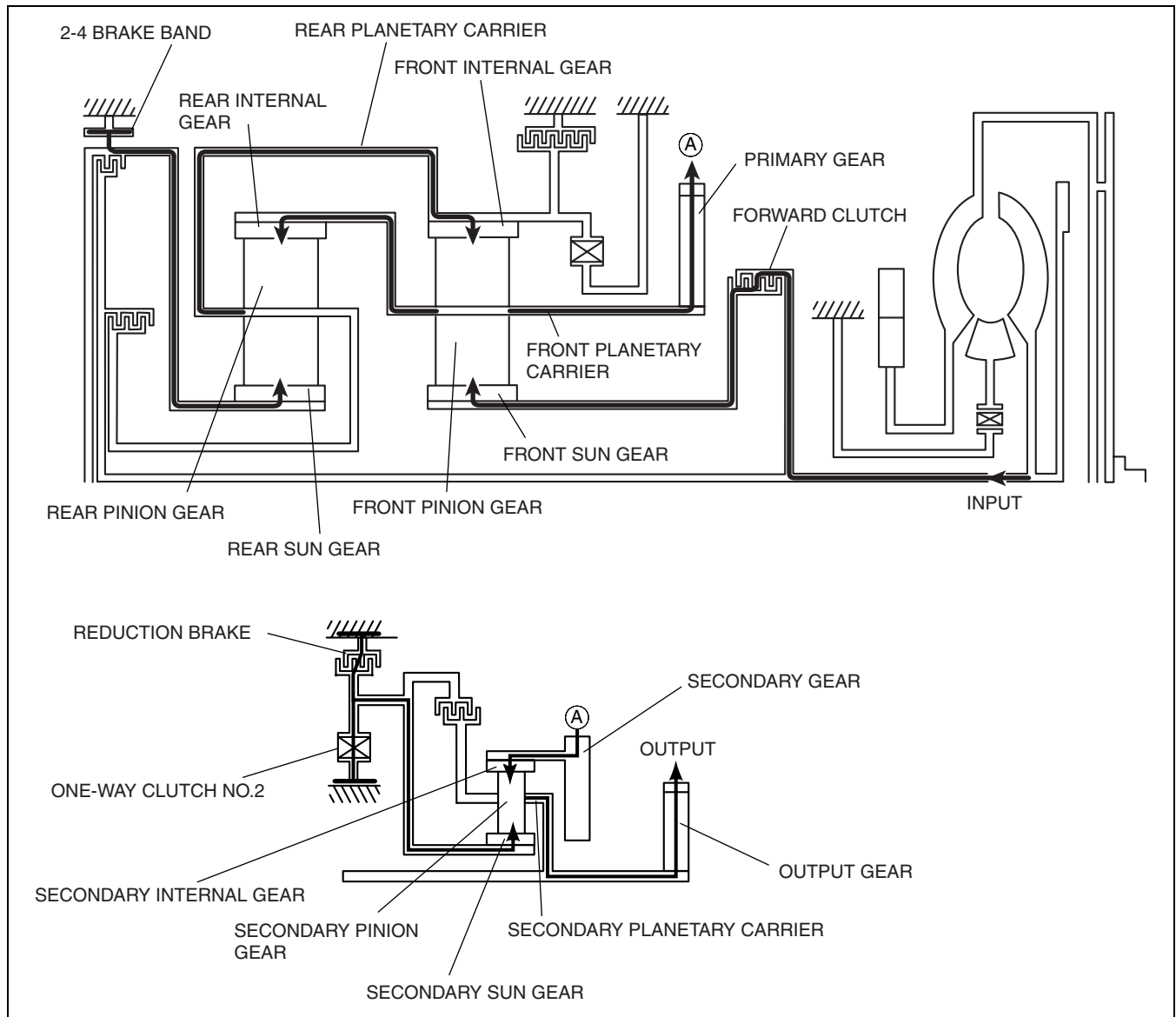
# AUTOMATIC TRANSAXLE [FS5A-EL]

2GR



E6U517AS5009

# AUTOMATIC TRANSAXLE [FS5A-EL]

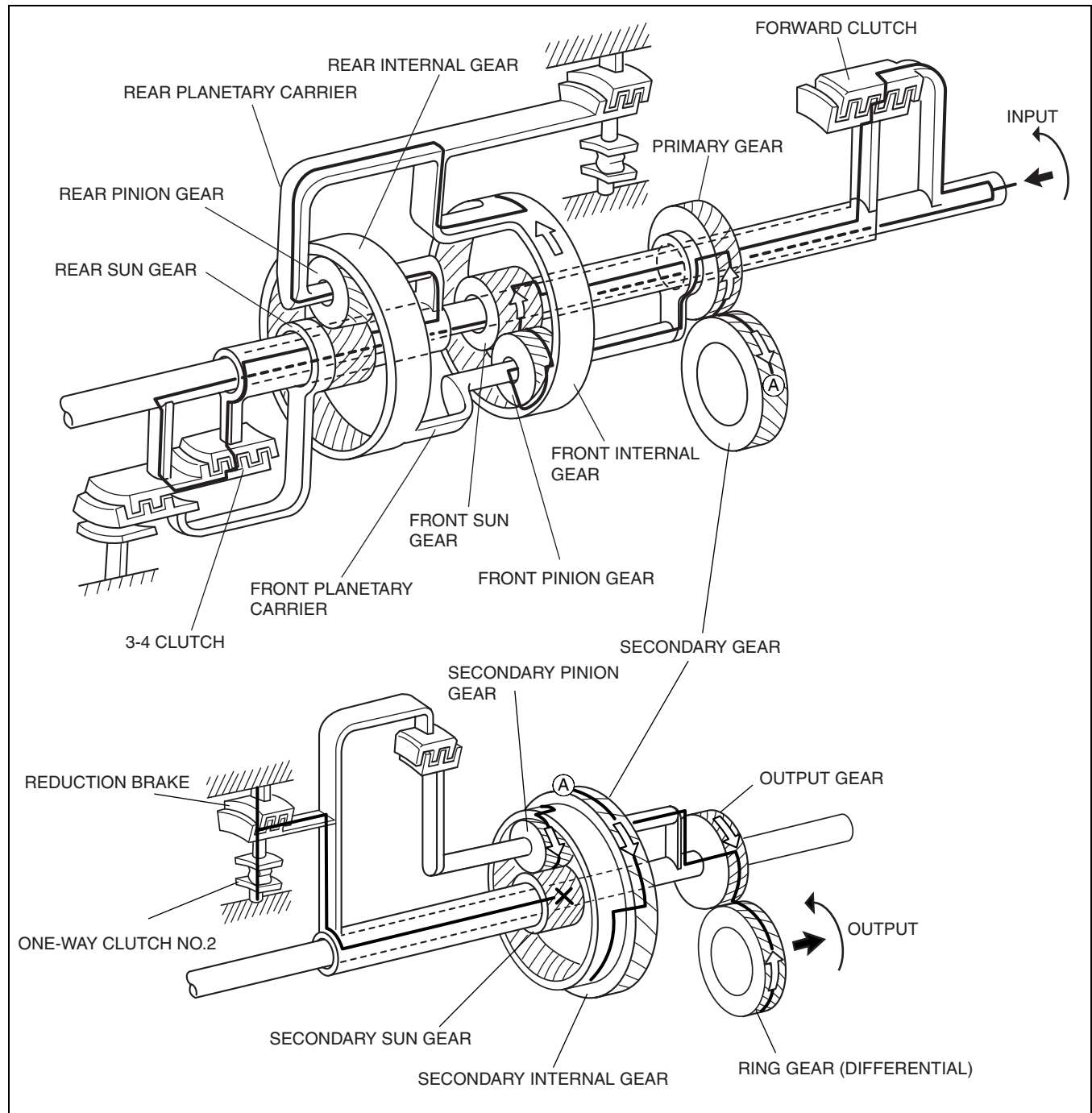


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E6U517AS5010

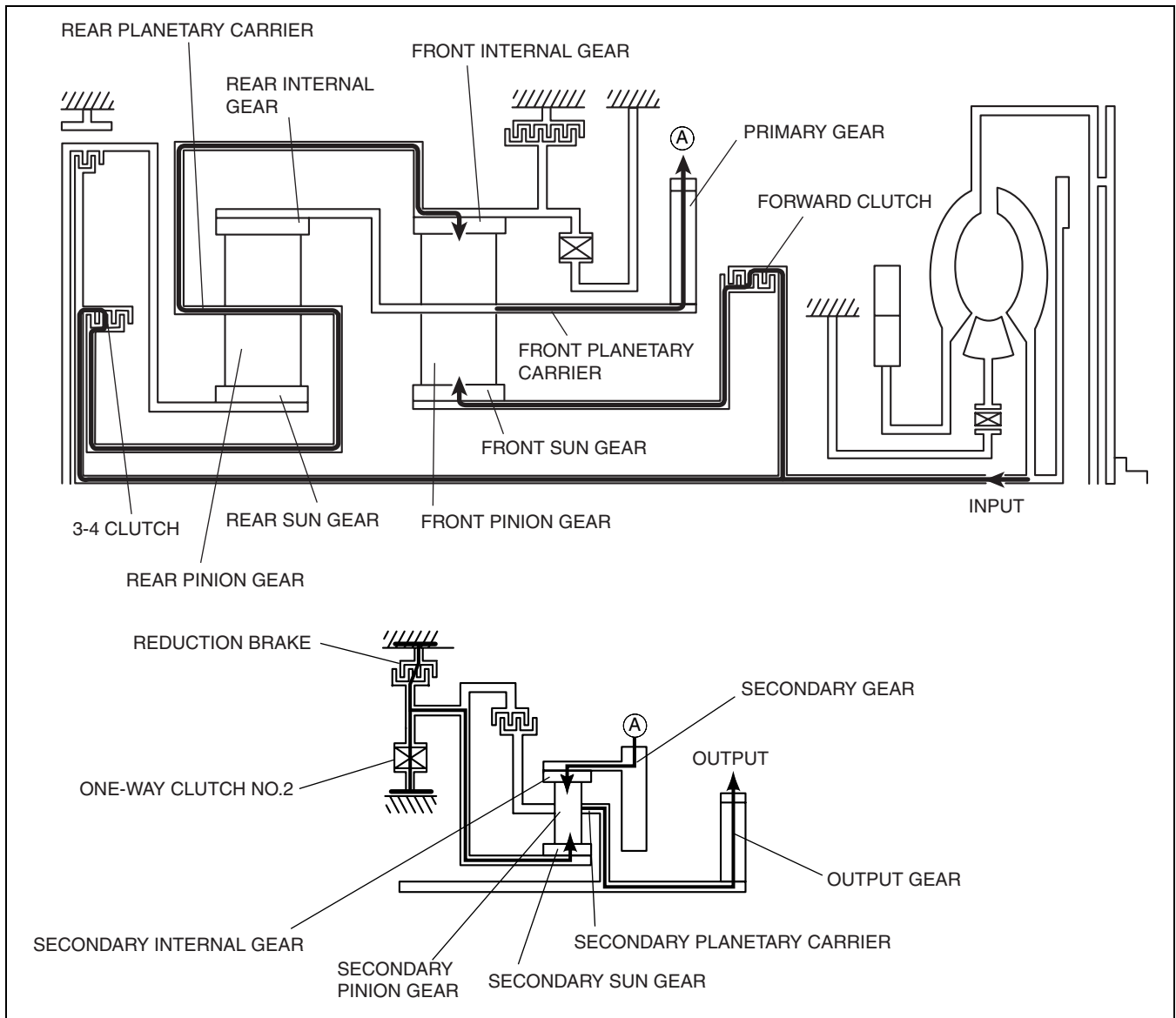
# AUTOMATIC TRANSAXLE [FS5A-EL]

3GR



E6U517AS011

# AUTOMATIC TRANSAXLE [FS5A-EL]

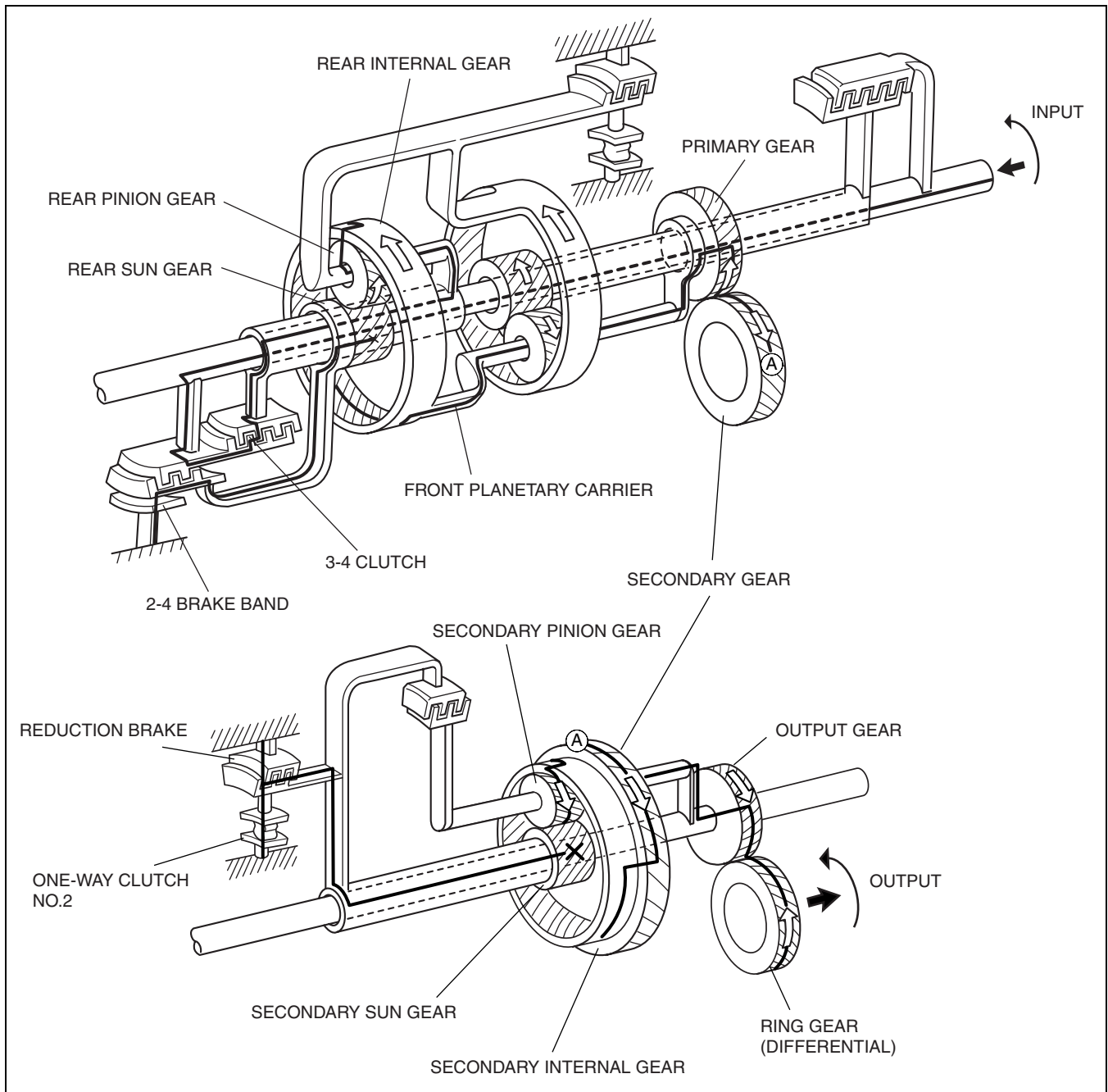


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E6U517AS5012

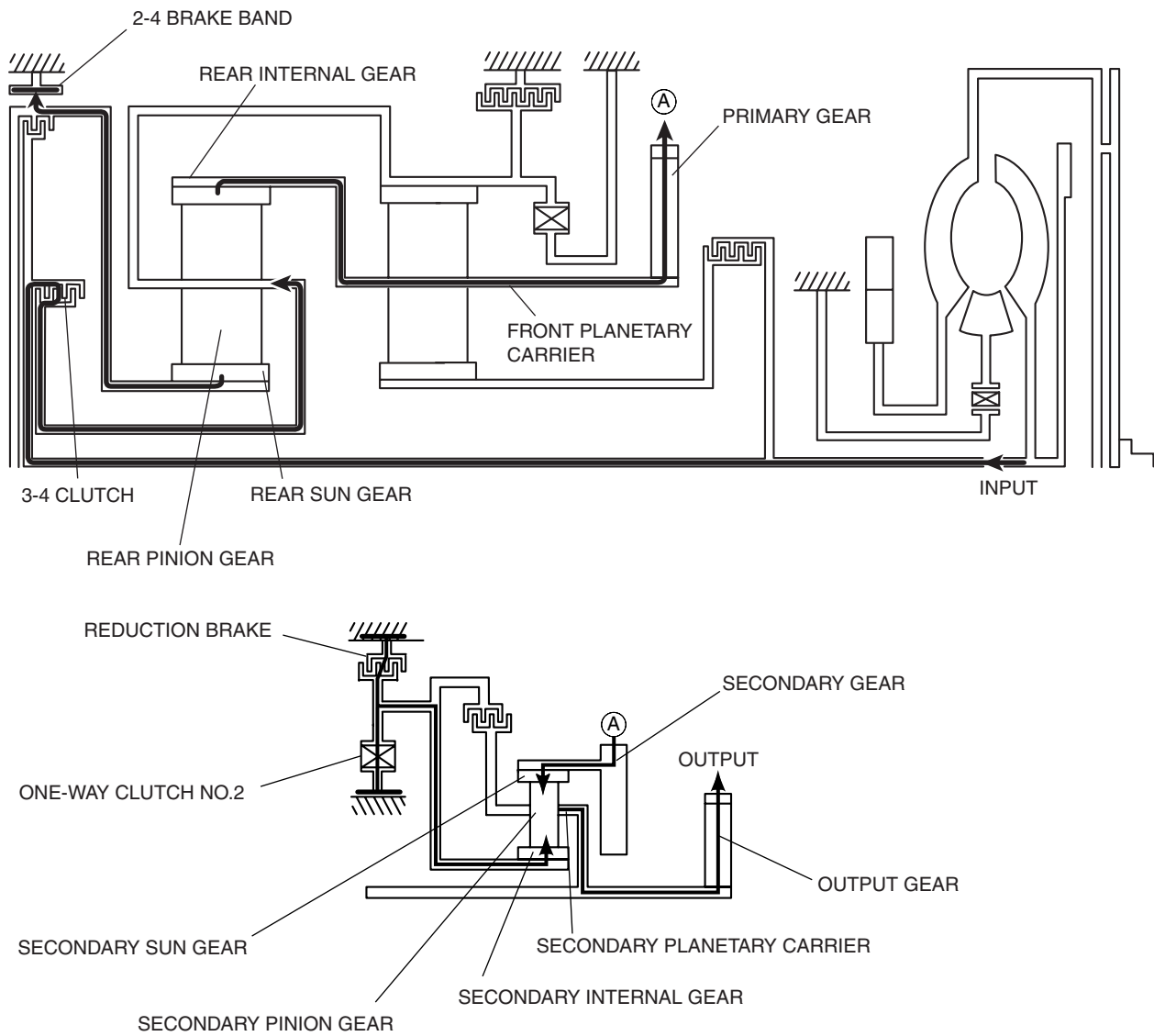
# AUTOMATIC TRANSAXLE [FS5A-EL]

4GR



E6U517AS5013

# **AUTOMATIC TRANSAXLE [FS5A-EL]**

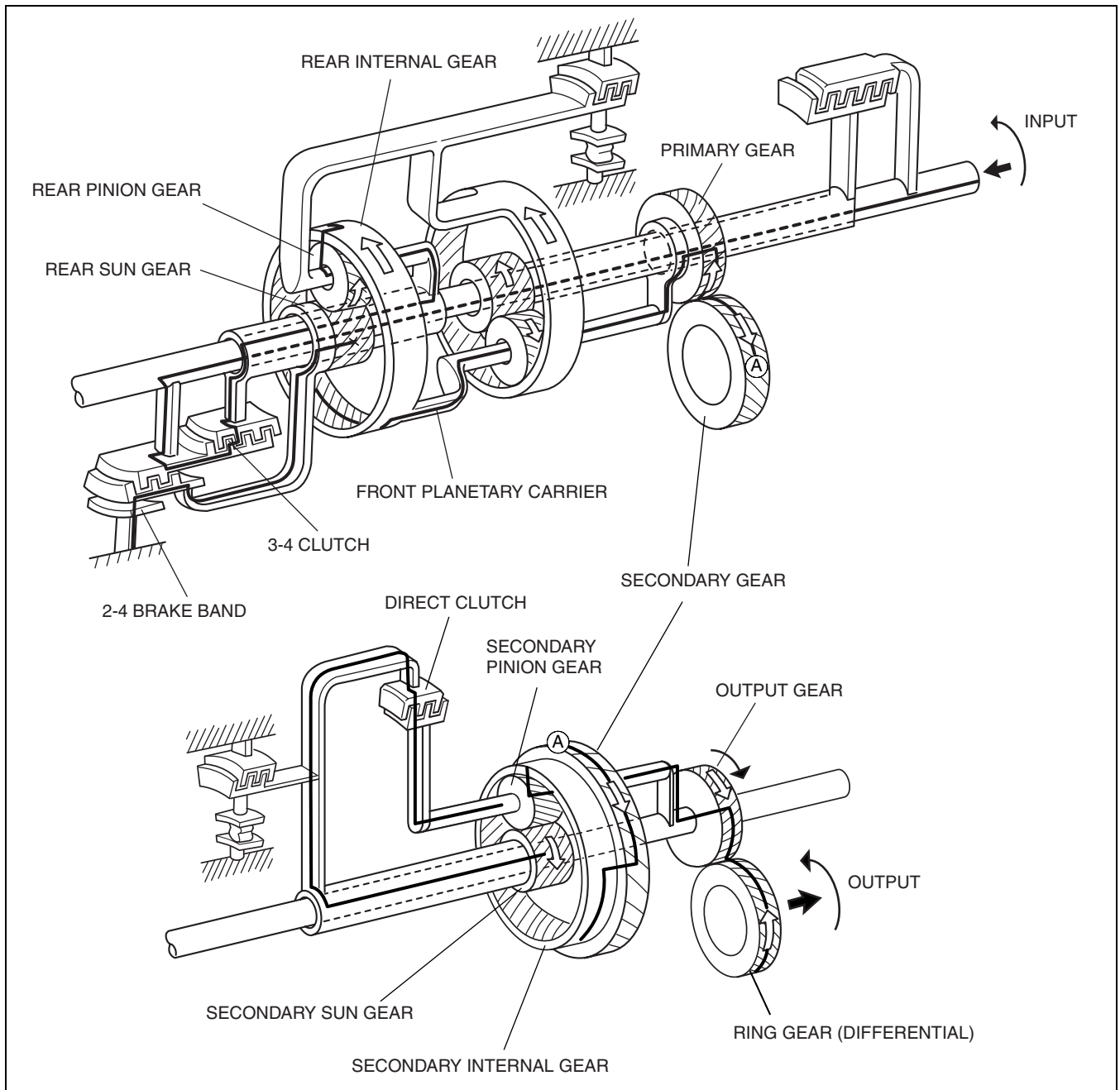


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E6U517AS5014

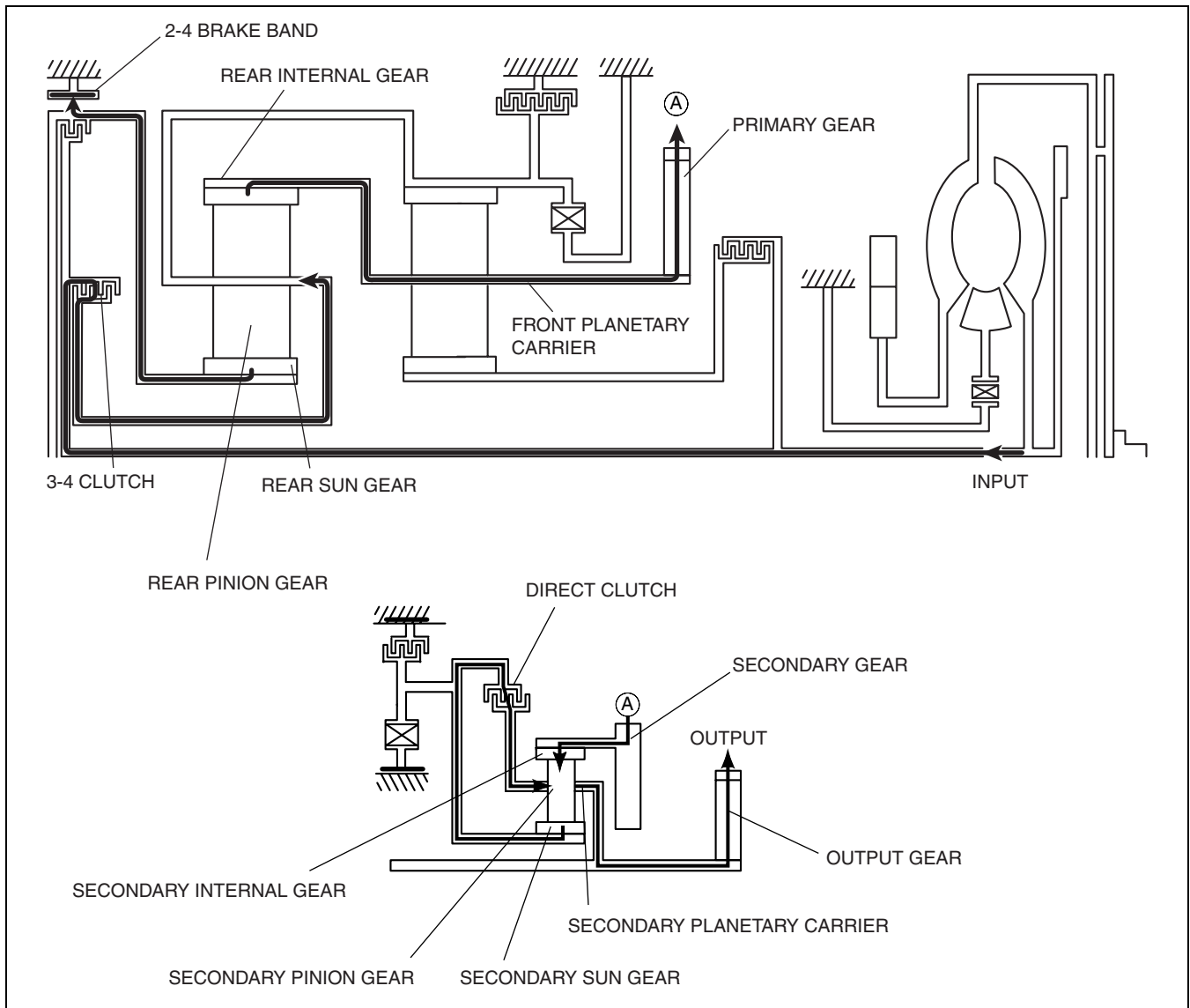
# AUTOMATIC TRANSAXLE [FS5A-EL]

5GR



E6U517AS5015

# AUTOMATIC TRANSAXLE [FS5A-EL]

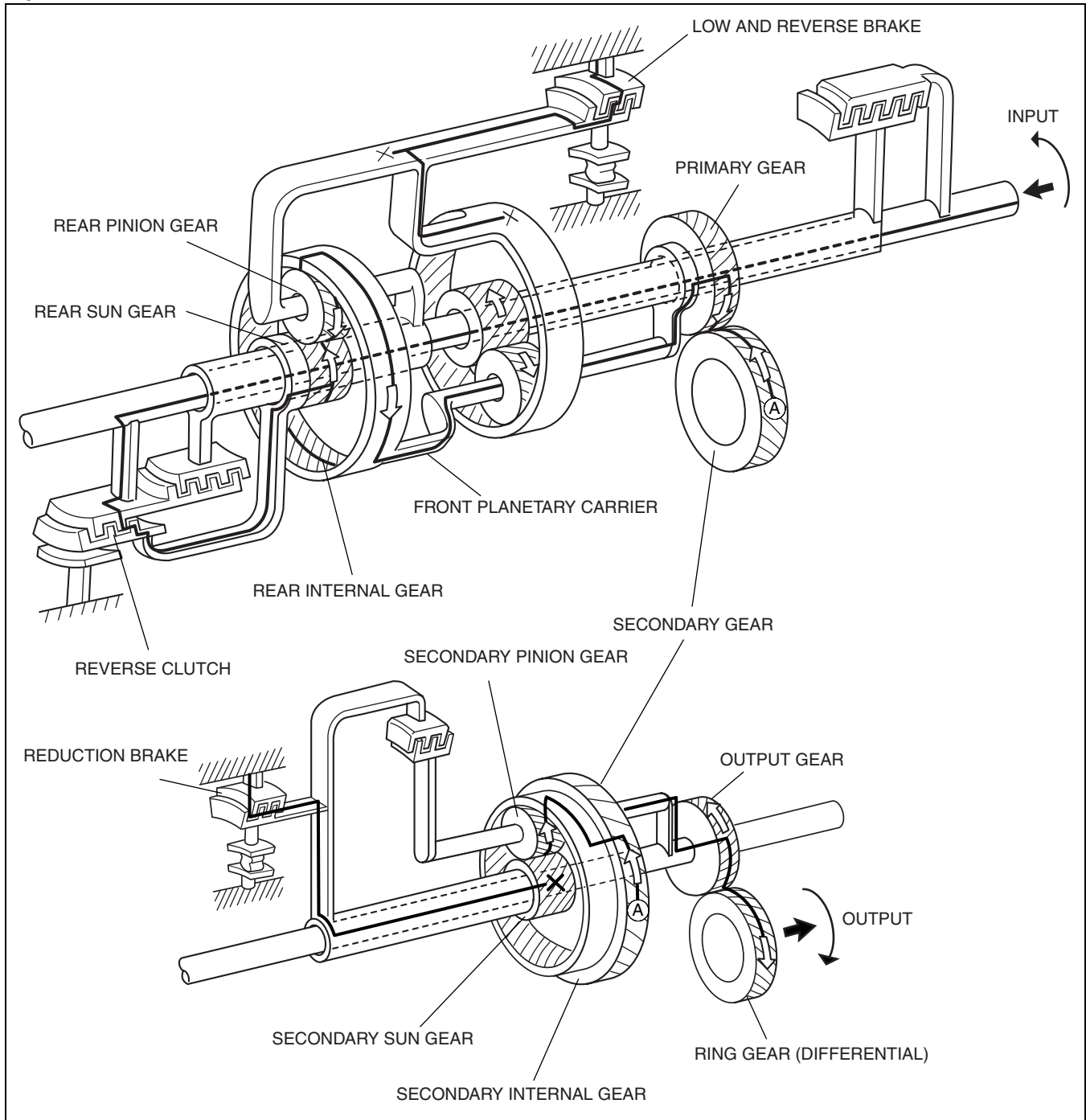


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E6U517AS5016

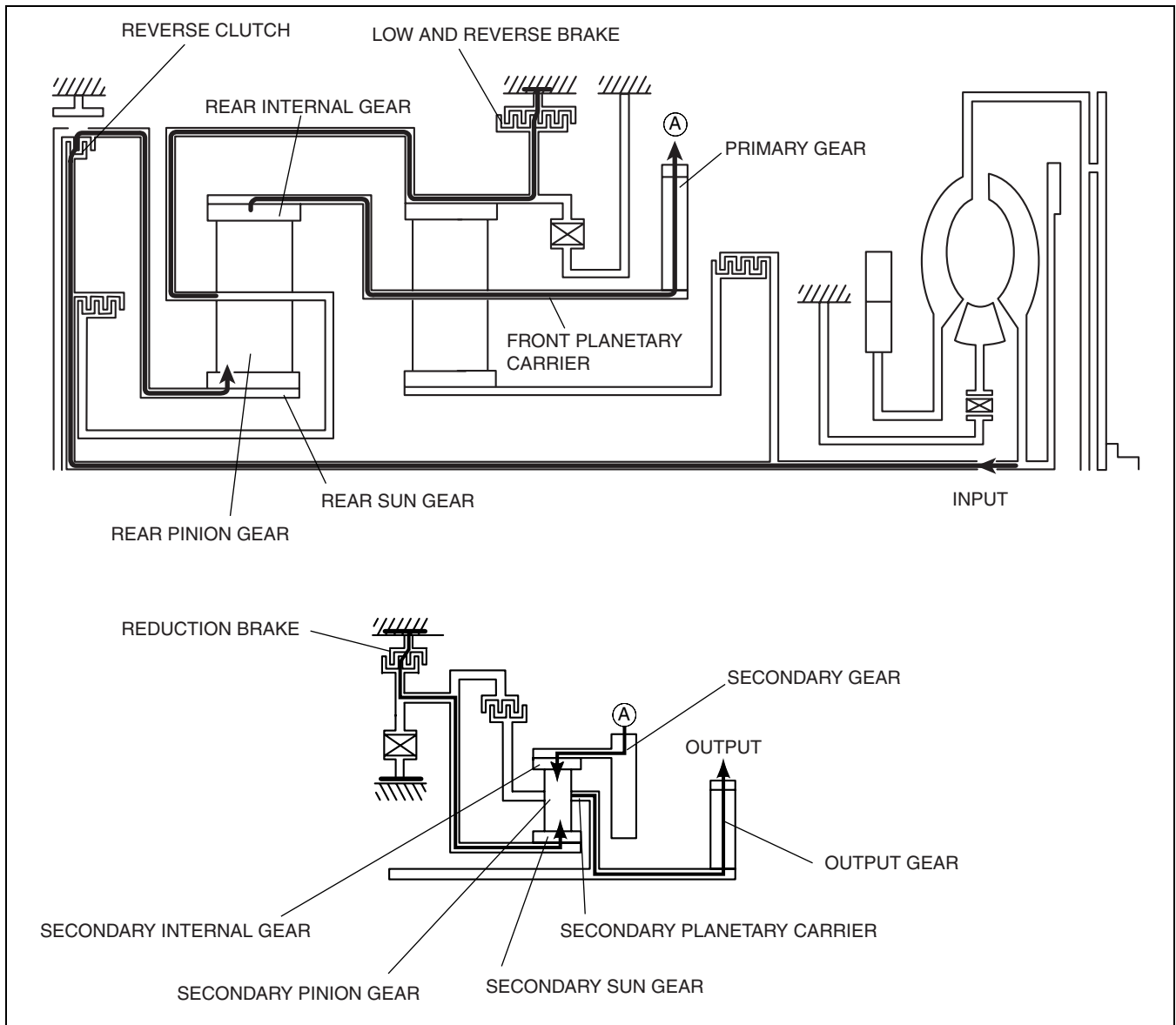
# AUTOMATIC TRANSAXLE [FS5A-EL]

R position



E6U517AS017

# AUTOMATIC TRANSAXLE [FS5A-EL]



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E6U517AS5018

# AUTOMATIC TRANSAXLE [FS5A-EL]

## CENTRIFUGAL BALANCE CLUTCH OUTLINE [FS5A-EL]

E6U051719500S01

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

## CENTRIFUGAL BALANCE CLUTCH STRUCTURE [FS5A-EL]

E6U051719500S02

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

## CENTRIFUGAL BALANCE CLUTCH OPERATION [FS5A-EL]

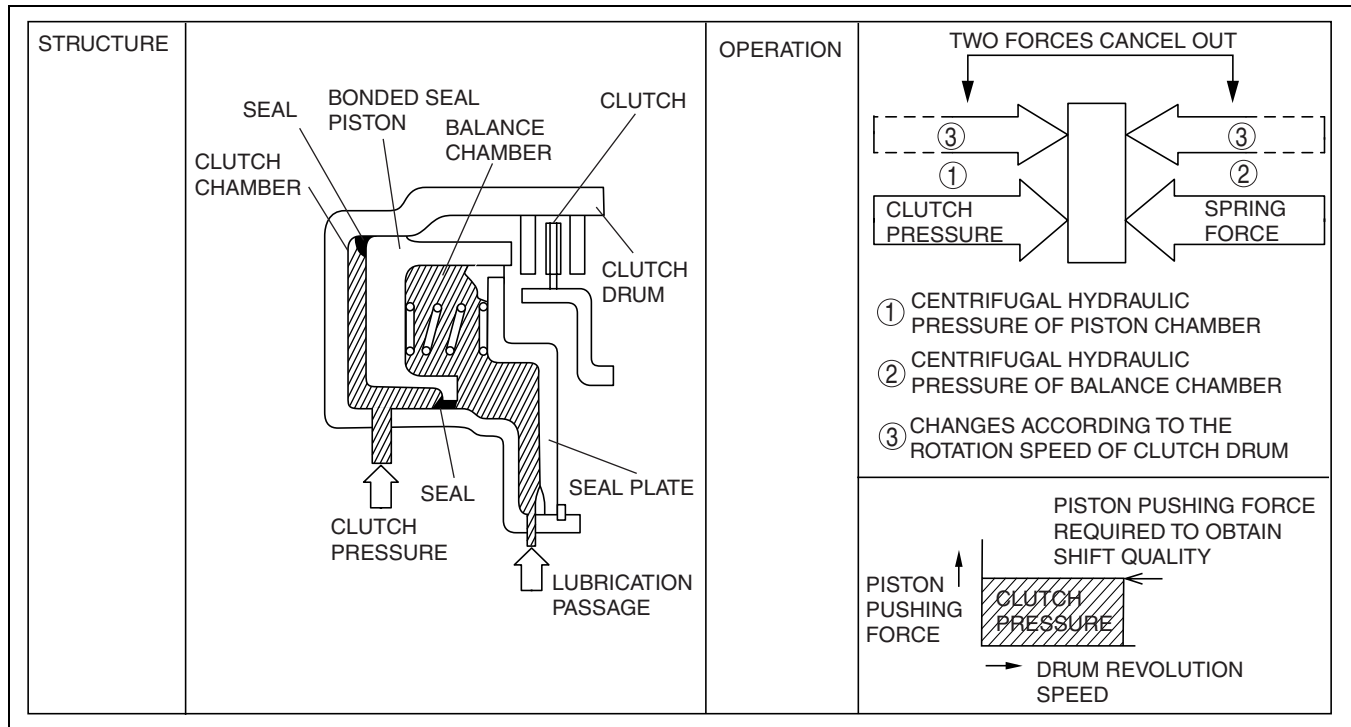
E6U051719500S03

### When clutch pressure is not applied

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

### When clutch pressure is applied

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



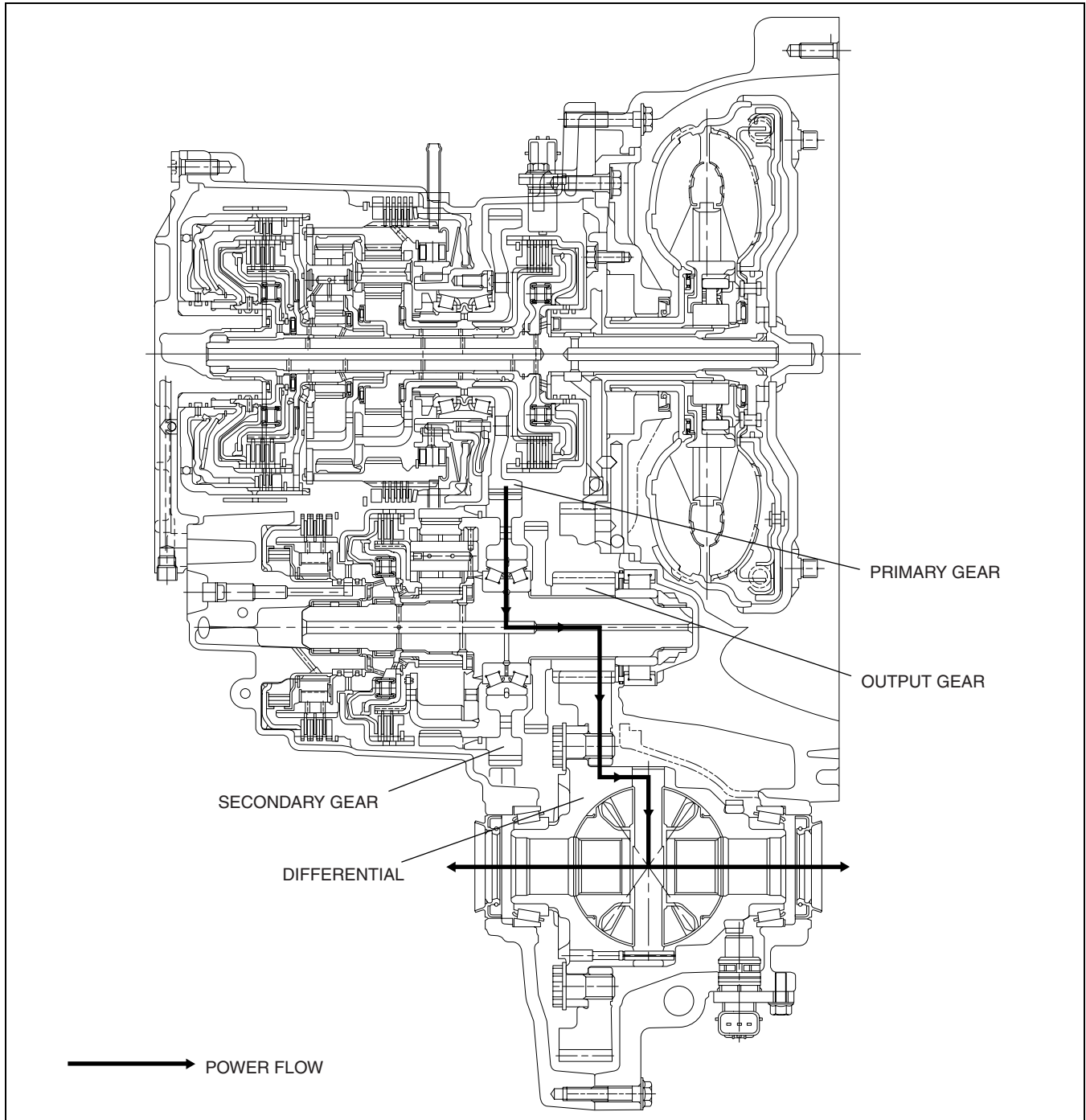
E6U517AS5019

## AUTOMATIC TRANSAXLE [FS5A-EL]

### OUTPUT GEAR OUTLINE [FS5A-EL]

E6U051719204S01

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



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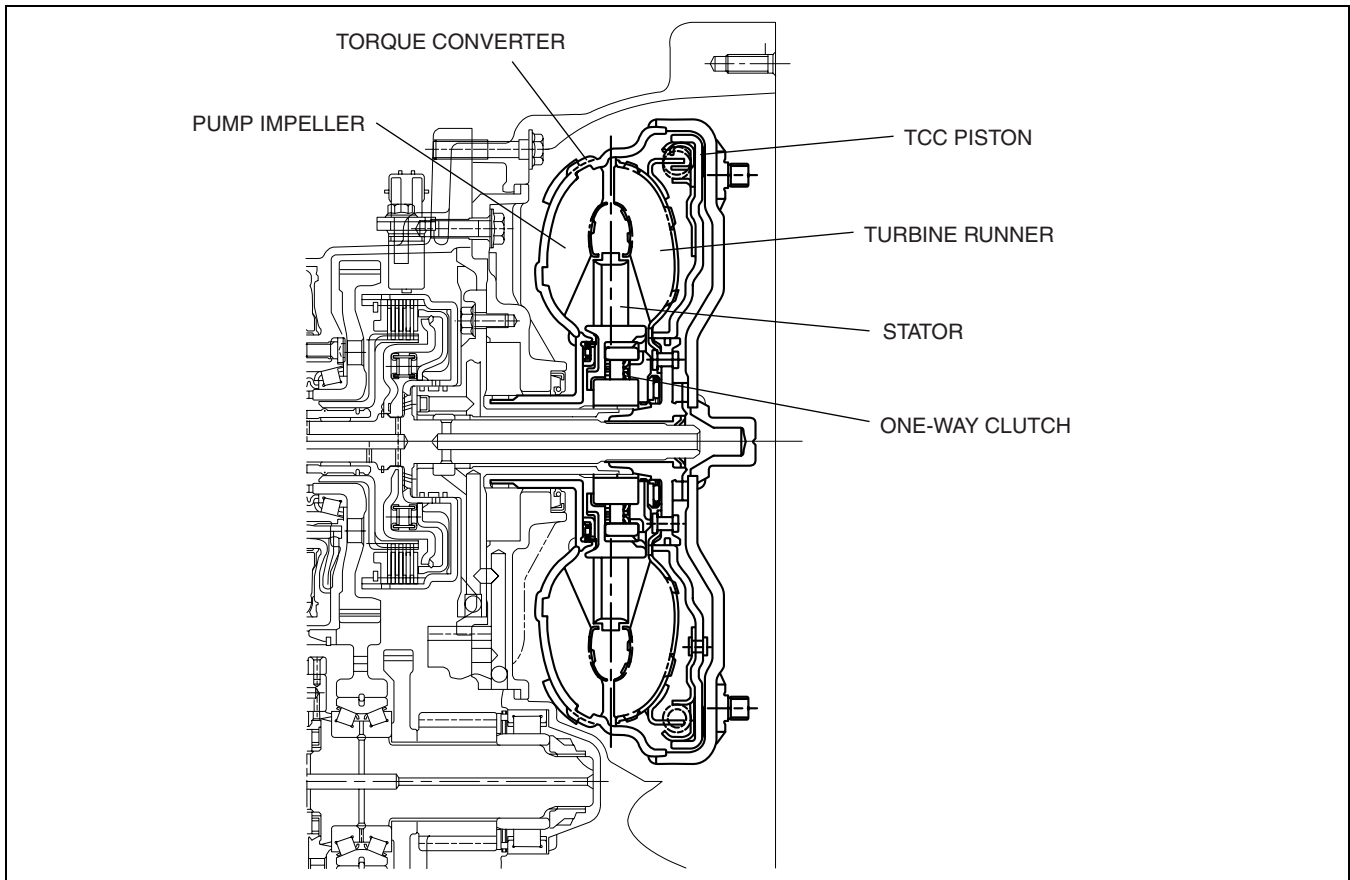
E6U517AS5020

## AUTOMATIC TRANSAXLE [FS5A-EL]

### TORQUE CONVERTER OUTLINE [FS5A-EL]

E6U051719100S01

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



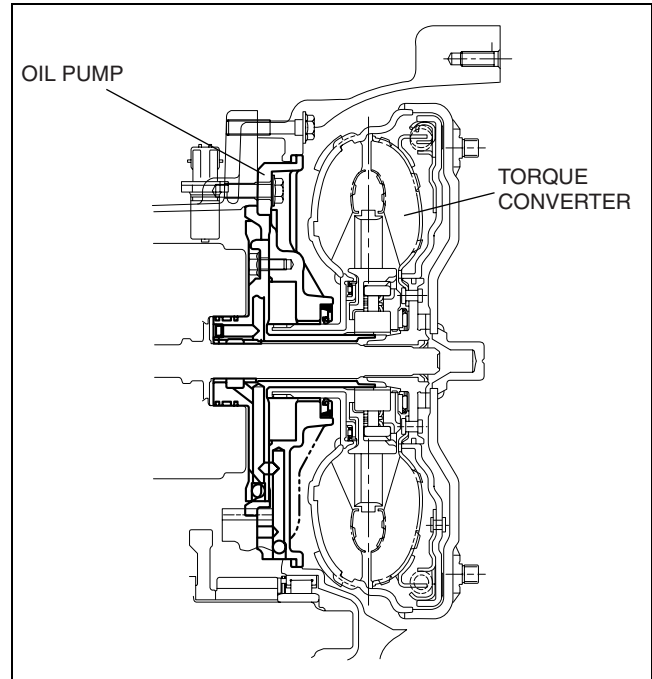
E6U517AS5021

## AUTOMATIC TRANSAXLE [FS5A-EL]

### OIL PUMP OUTLINE [FS5A-EL]

E6U051719220S01

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

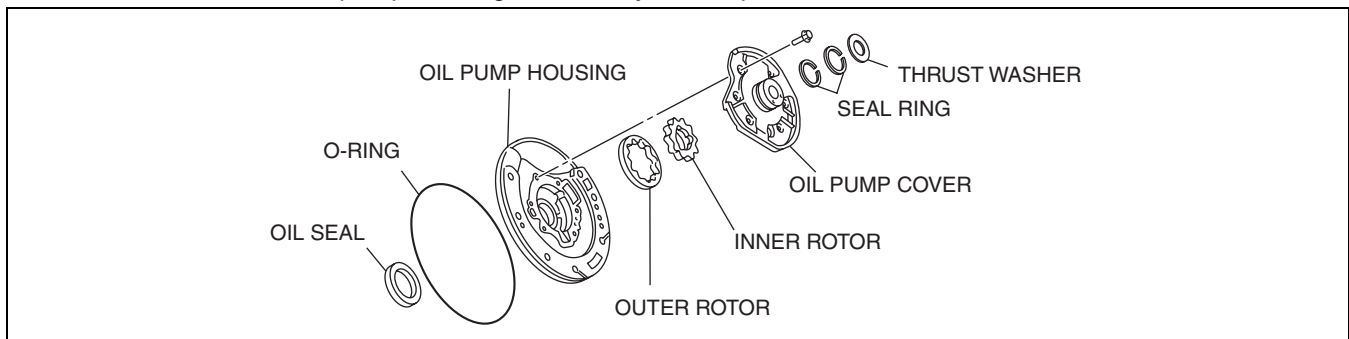


E6U517AS5022

### OIL PUMP STRUCTURE [FS5A-EL]

E6U051719220S02

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

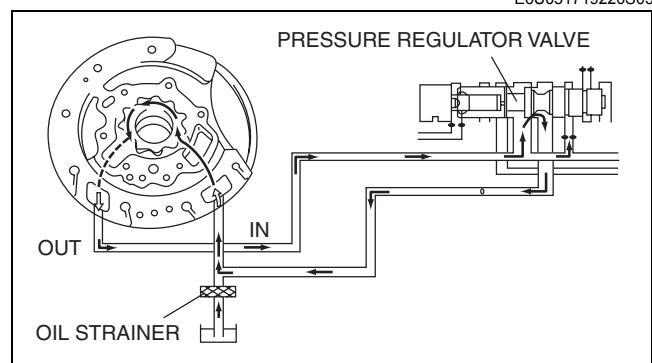


E6U517AS5023

### OIL PUMP OPERATION [FS5A-EL]

E6U051719220S03

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



E6U517AS5024

## AUTOMATIC TRANSAXLE [FS5A-EL]

### CONTROL VALVE BODY OUTLINE [FS5A-EL]

E6U051721100S01

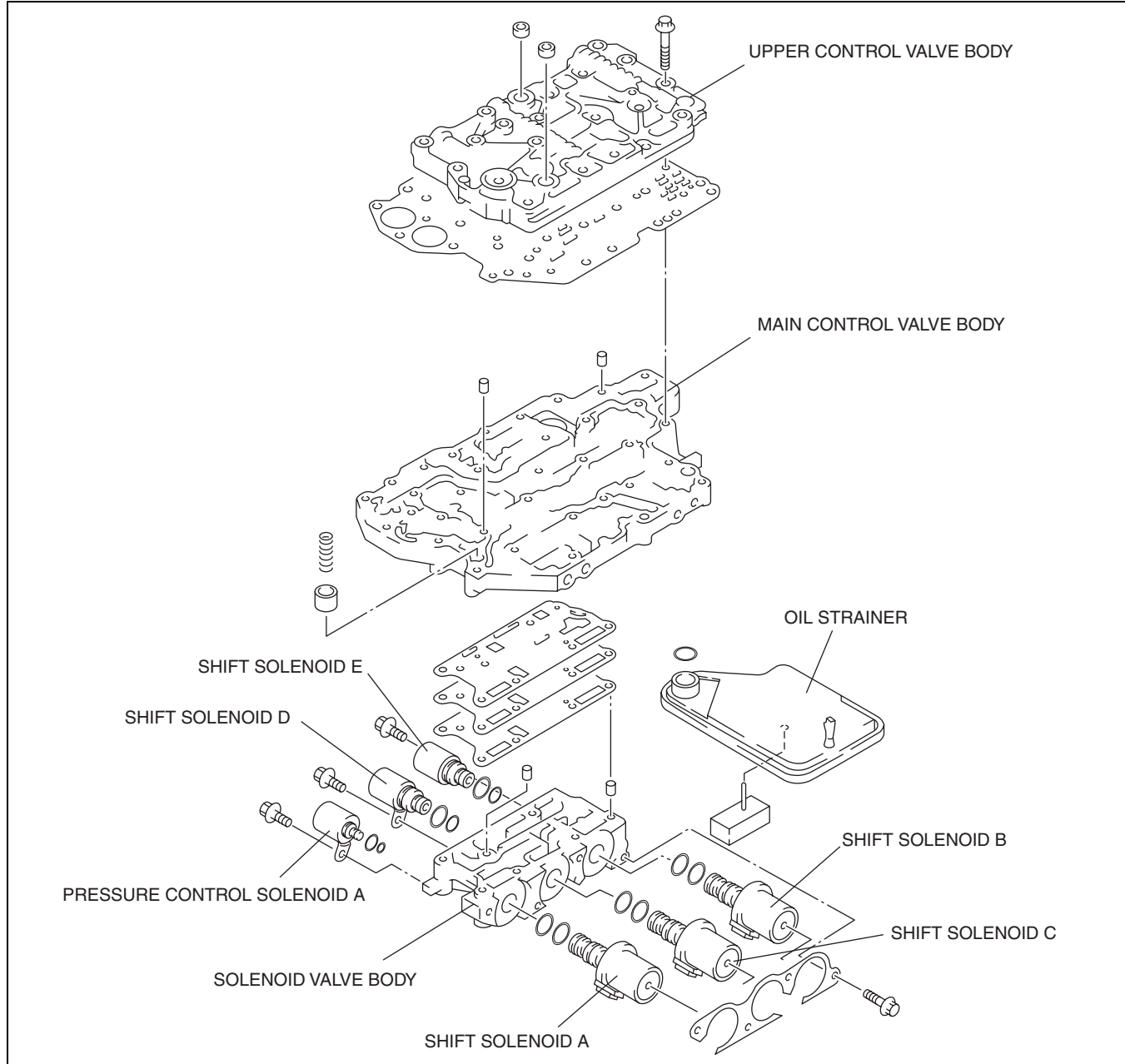
- The primary control valve body has been adopted as the main shifting mechanism.
- The secondary control valve body has been adopted as the sub-shifting mechanism.
- Because the clutch engagement pressure is controlled electronically, the hydraulic circuits are simplified, the valve types are reduced, and the control valve body is miniaturized.
- The nonwoven fabric oil strainer is installed in the primary control valve body to prevent contamination.

### CONTROL VALVE BODY CONSTRUCTION [FS5A-EL]

E6U051721100S02

#### Primary Control Valve Body

- The primary control valve body is composed of three bodies: the upper control valve body, main control valve body, and the solenoid control valve body.

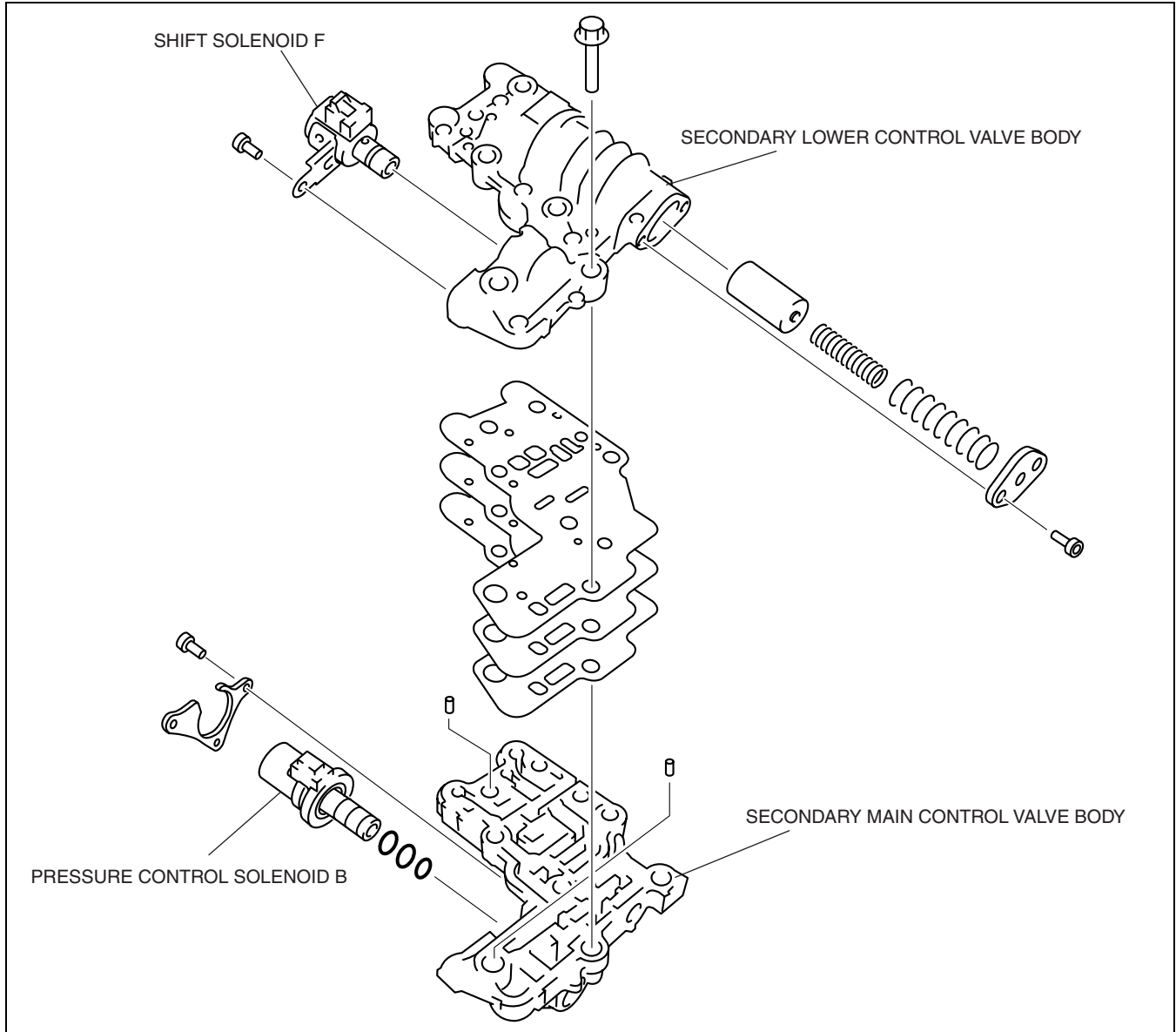


E6U517AS5025

## AUTOMATIC TRANSAXLE [FS5A-EL]

### Secondary Control Valve Body

- The secondary control valve body is composed of two bodies: the secondary lower control valve body, and secondary main control valve body.



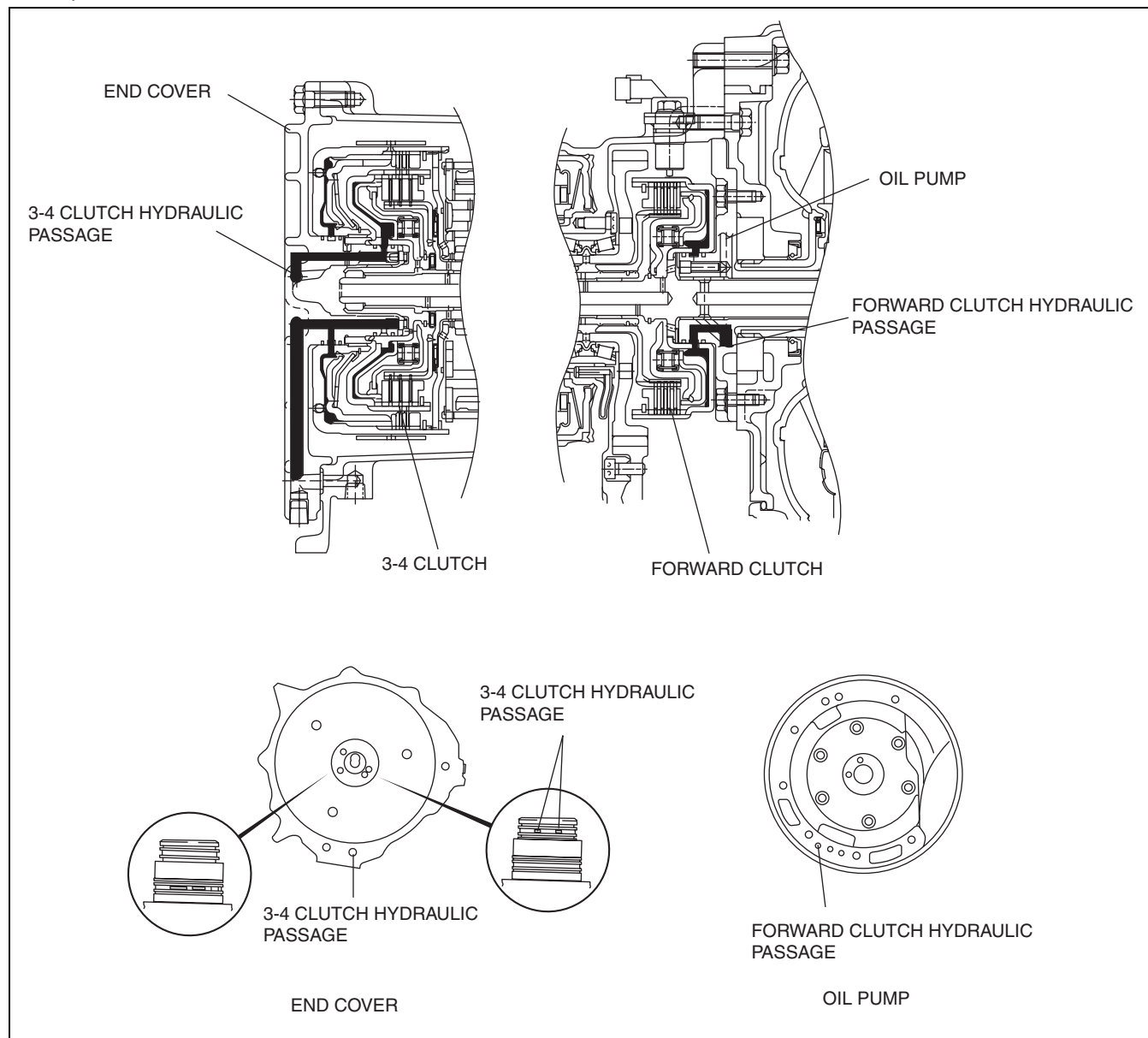
E6U517AS5026

## AUTOMATIC TRANSAXLE [FS5A-EL]

### FORWARD CLUTCH, 3-4 CLUTCH HYDRAULIC CIRCUIT OUTLINE [FS5A-EL]

E6U051719500S04

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



E6U517AS5027

## AUTOMATIC TRANSAXLE [FS5A-EL]

### TRANSAXLE RANGE (TR) SWITCH FUNCTION [FS5A-EL]

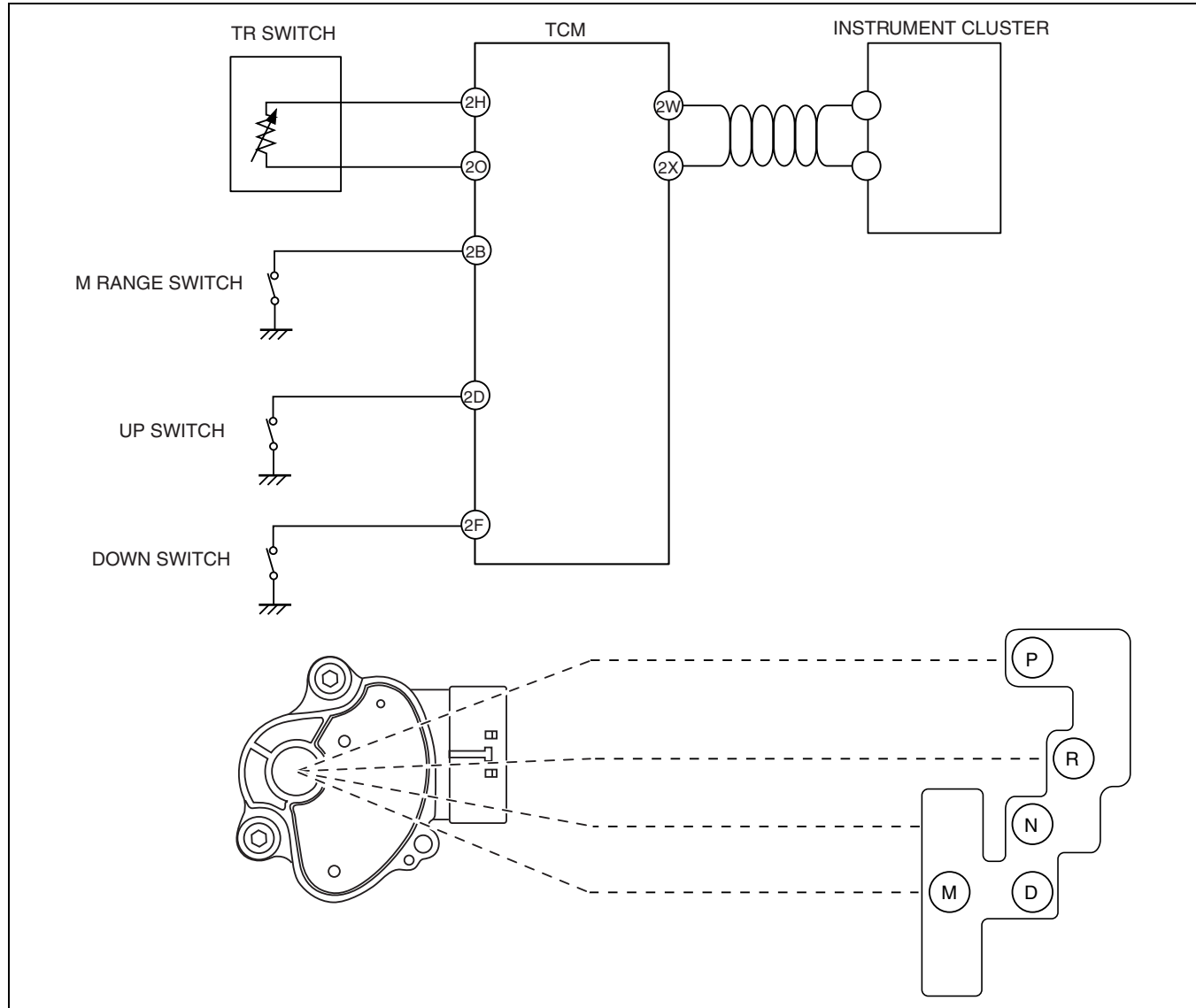
E6U051719200S01

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

### TRANSAXLE RANGE (TR) SWITCH CONSTRUCTION/OPERATION [FS5A-EL]

E6U051719200S02

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



E6U517AS5028

## AUTOMATIC TRANSAXLE [FS5A-EL]

### VEHICLE SPEED SENSOR (VSS) FUNCTION [FS5A-EL]

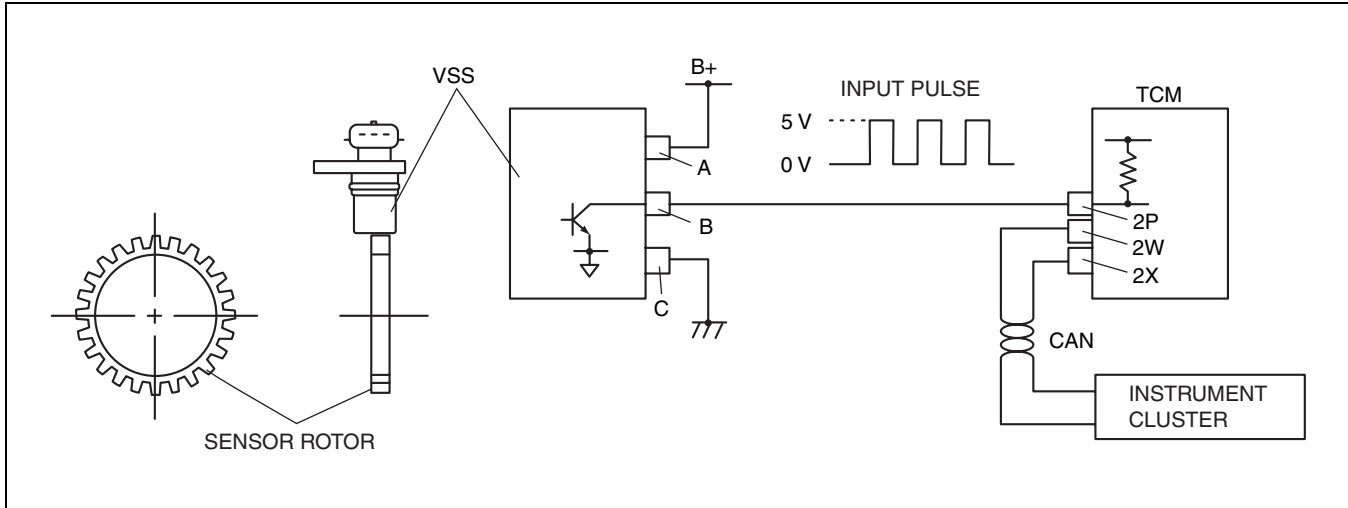
E6U051719200S03

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

### VEHICLE SPEED SENSOR (VSS) CONSTRUCTION/OPERATION [FS5A-EL]

E6U051719200S04

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



E6U517AS5029

## INTERMEDIATE SENSOR FUNCTION [FS5A-EL]

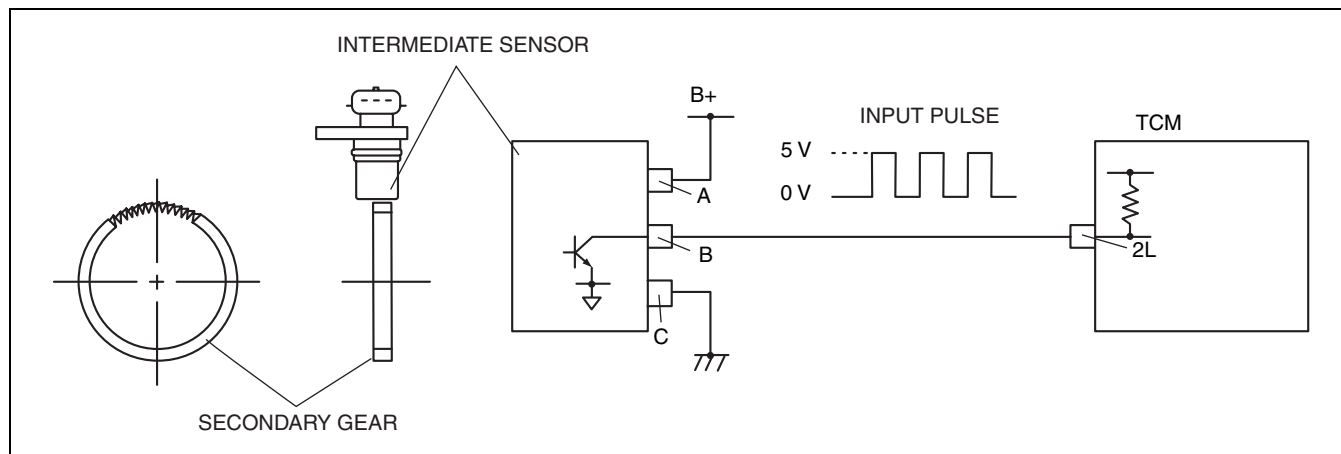
E6U051719200S05

- The intermediate sensor is located in the transaxle case with clearance between it and the secondary gear, and detects the secondary gear rotating speed.

## INTERMEDIATE SENSOR CONSTRUCTION/OPERATION [FS5A-EL]

E6U051719200S06

- The intermediate sensor is a GMR element type. A 82-pulse signal is generated per rotation of the secondary gear and the intermediate sensor sends this signal to the TCM.
- Consists of an IC in which a giant magneto resistive (GMR) element and signal processing circuit have been integrated, and a magnet. Signal reliability has been improved with the adoption of the GMR element resulting in the signal amplitude being wider compared to the hall element.
- The size (GMR output) of the magnetic field detected by the GMR element is changed into short waves as a sensor output signal at the signal processing circuit.
- The TCM detects the shift start/stop timings based on the signals from the intermediate sensor and performs a detailed control, improving the shift quality.



E6U517AS5030

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## INPUT/TURBINE SPEED SENSOR FUNCTION [FS5A-EL]

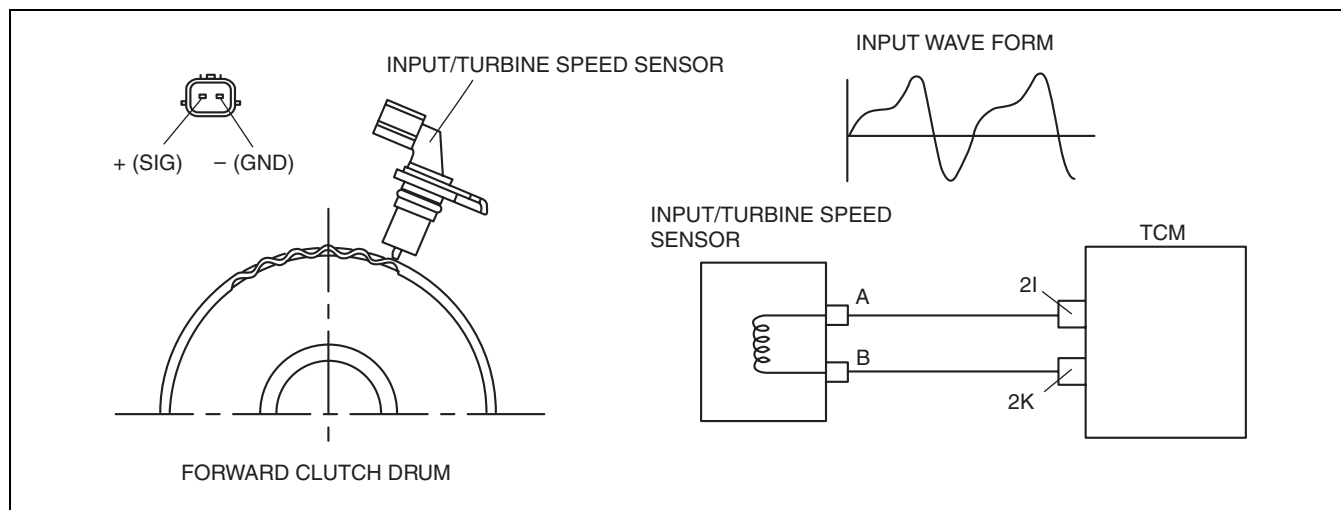
E6U051719200S07

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

## INPUT/TURBINE SPEED SENSOR CONSTRUCTION/OPERATION [FS5A-EL]

E6U051719200S08

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



E6U517AS5031

## AUTOMATIC TRANSAXLE [FS5A-EL]

### TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR FUNCTION [FS5A-EL]

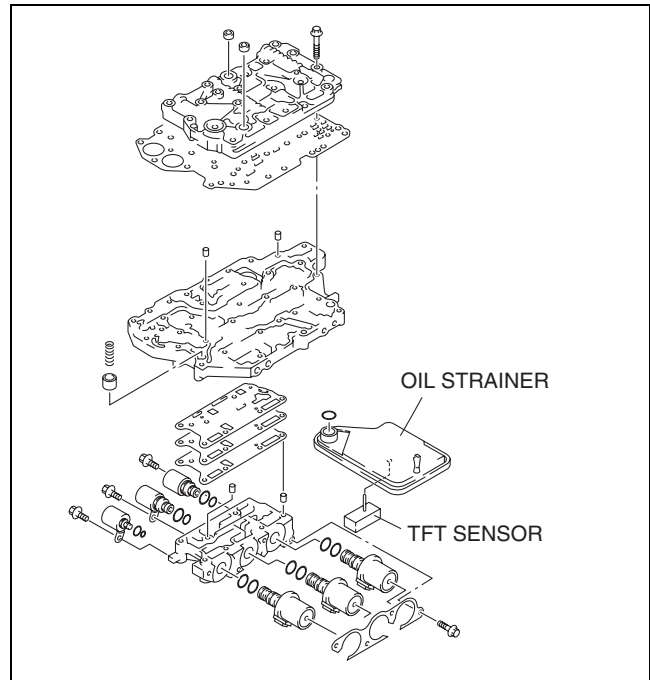
E6U051719200S09

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

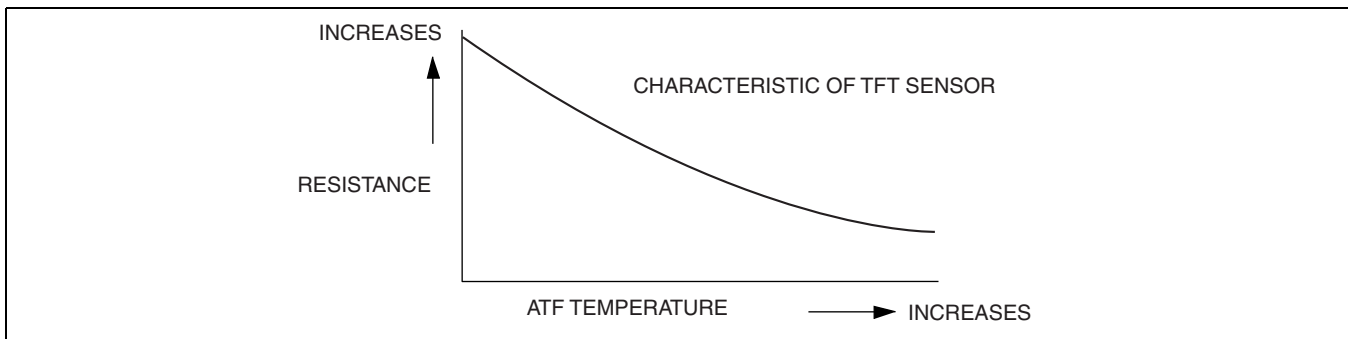
### TRANSAXLE FLUID TEMPERATURE (TFT) SENSOR CONSTRUCTION/OPERATION [FS5A-EL]

E6U051719200S10

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



E6U517AS5032



E6U517AS5033

### ELECTRONIC CONTROL SYSTEM OUTLINE [FS5A-EL]

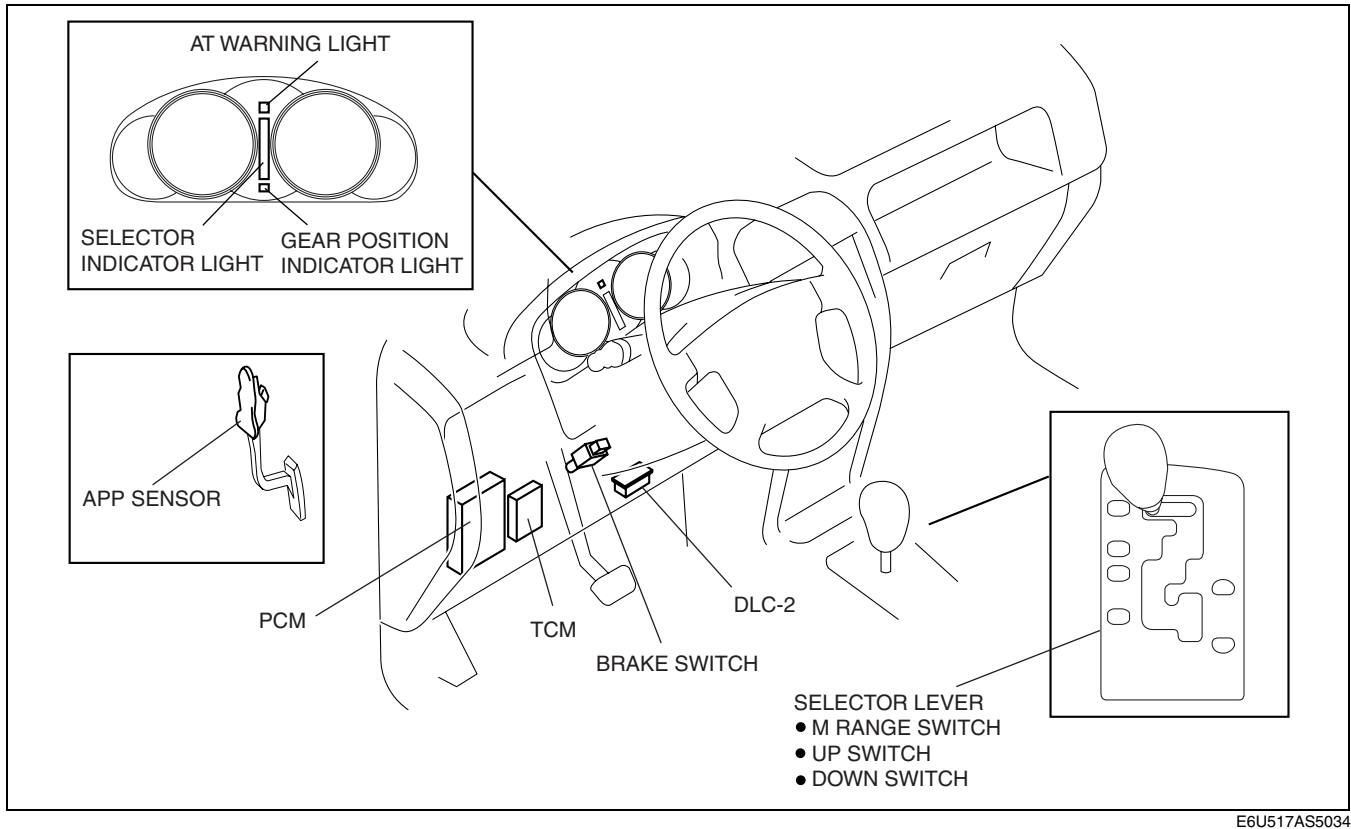
E6U051718901S01

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

# AUTOMATIC TRANSAXLE [FS5A-EL]

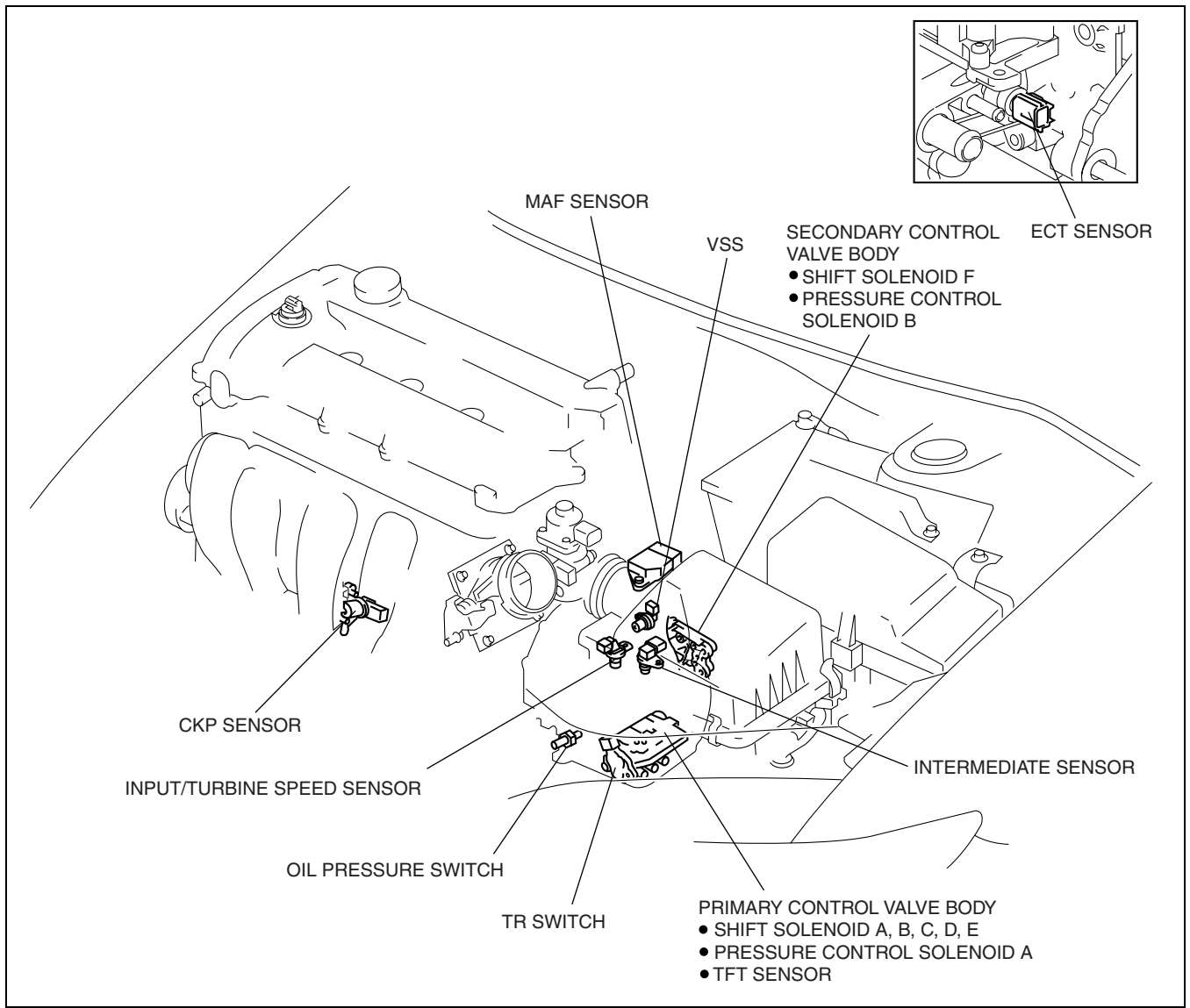
## ELECTRONIC CONTROL SYSTEM CONSTRUCTION [FS5A-EL]

E6U051718901S02



E6U517AS5034

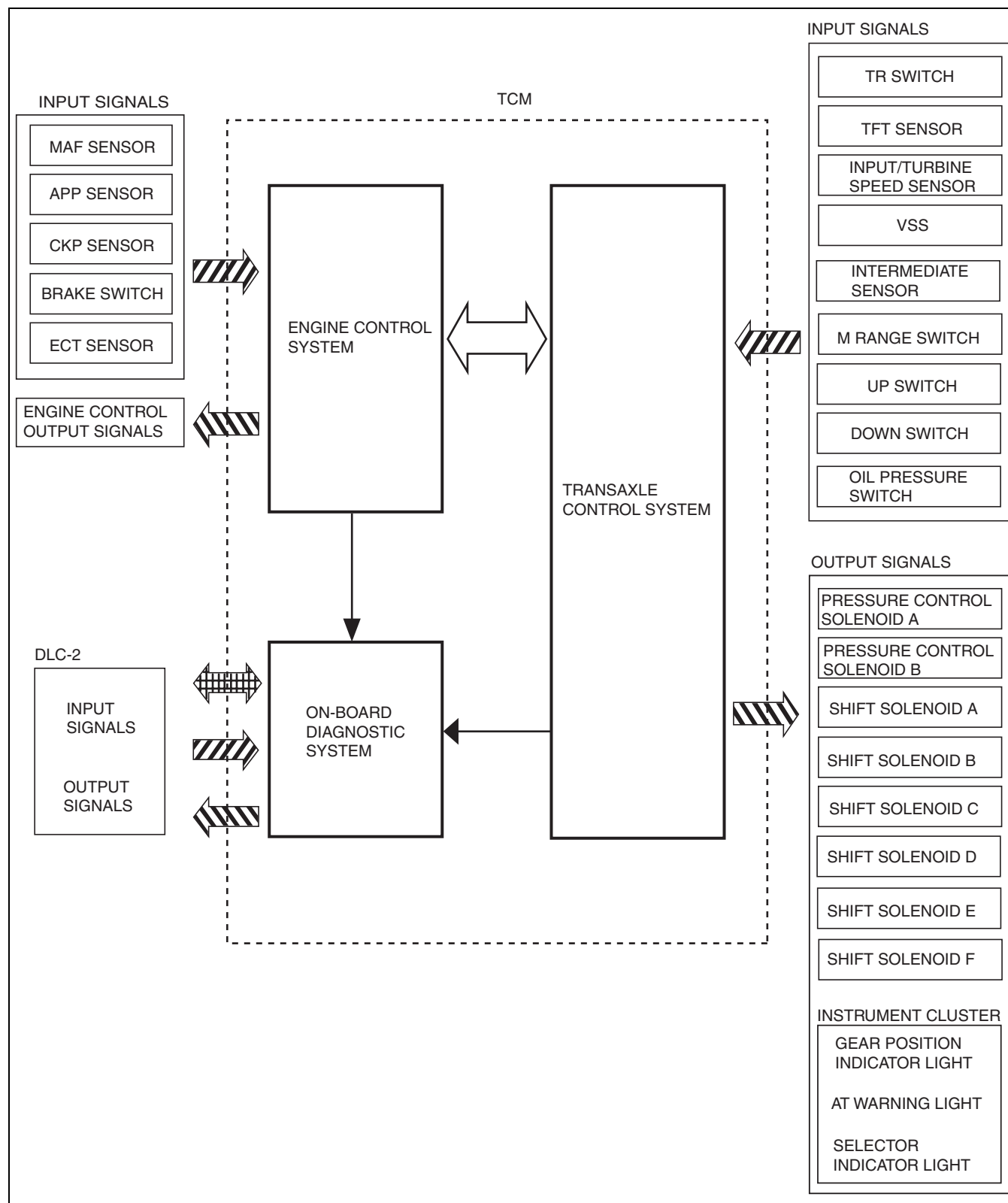
## AUTOMATIC TRANSAXLE [FS5A-EL]



# AUTOMATIC TRANSAXLE [FS5A-EL]

## ELECTRONIC CONTROL SYSTEM BLOCK DIAGRAM [FS5A-EL]

E6U051718901S03



E6U517AS5036

## AUTOMATIC TRANSAXLE [FS5A-EL]

### ELECTRONIC CONTROL ITEMS AND CONTENTS [FS5A-EL]

E6U051718901S04

Item	Content
Line pressure control	<ul style="list-style-type: none"><li>Using linear type pressure control solenoid A, adjusts line pressure according to engine load condition and vehicle driving condition.</li></ul>
Shift control	<ul style="list-style-type: none"><li>Detects engine load condition and vehicle speed, and switches to the most suitable gear position according to the preset shift diagram.</li><li>In D range, automatically switches between POWER and NORMAL modes according to accelerator pedal depressing speed.</li></ul>
Clutch pressure direct control (Direct electric shift control)	<ul style="list-style-type: none"><li>With duty-cycle type shift solenoids A, B, C and pressure control solenoid B, directly performs electronic control for clutch engagement pressure according to engine load condition and vehicle driving condition.</li></ul>
Feedback control	<ul style="list-style-type: none"><li>Performs real-time feedback correction for clutch engagement pressure to achieve target shifts.</li><li>Performs optimal correction for clutch engagement pressure to reduce changes in engine performance and/or elapsed transaxle.</li></ul>
Engine-transaxle total control	<ul style="list-style-type: none"><li>Optimally controls engine output torque when shifting.</li><li>Operates optimal clutch engagement pressure corresponding to engine output torque.</li></ul>
TCC control	<ul style="list-style-type: none"><li>According to preset TCC point, performs TCC operation via smooth TCC.</li></ul>
Slip control	<ul style="list-style-type: none"><li>When the accelerator pedal is fully released for deceleration, power transfer efficiency has been improved through a slip lockup control on the torque converter set under a specified range of conditions (speed or throttle angle). As a result, fuel economy, emission performance, and ride comfort have been improved.</li></ul>
Slope mode control	<ul style="list-style-type: none"><li>Changes the shift point to prevent frequent shifting up/down when climbing hills and descending hills.</li></ul>
On-board diagnostic system	<ul style="list-style-type: none"><li>Detects and/or memorizes failure of input/output part and transaxle condition.</li></ul>
Manual mode shift control	<ul style="list-style-type: none"><li>Shifts to selected gear position by manual shifting of the selector lever forward and back.</li></ul>

# AUTOMATIC TRANSAXLE [FS5A-EL]

## COMPONENT DESCRIPTIONS (ELECTRONIC CONTROL) [FS5A-EL]

E6U051718901S05

Part name		Function
Input system	M range switch	<ul style="list-style-type: none"> <li>Selects driving modes (M range) and changes driving patterns.</li> </ul>
	Up switch	<ul style="list-style-type: none"> <li>Detects shift up request.</li> </ul>
	Down switch	<ul style="list-style-type: none"> <li>Detects shift down request.</li> </ul>
	TR switch	<ul style="list-style-type: none"> <li>Detects the selector lever ranges/positions.</li> </ul>
	APP sensor	<ul style="list-style-type: none"> <li>Detects the accelerator pedal depressing amount.</li> </ul>
	Input/turbine speed sensor	<ul style="list-style-type: none"> <li>Detects the forward clutch drum (input) revolution speed.</li> </ul>
	Oil pressure switch	<ul style="list-style-type: none"> <li>Detects the forward clutch pressure.</li> </ul>
	VSS	<ul style="list-style-type: none"> <li>Detects the differential gear case (output) revolution speed.</li> </ul>
	Intermediate sensor	<ul style="list-style-type: none"> <li>Detects the secondary gear revolution speed.</li> </ul>
	Brake switch	<ul style="list-style-type: none"> <li>Detects the use of service brake.</li> </ul>
	TFT sensor	<ul style="list-style-type: none"> <li>Detects the ATF temperature.</li> </ul>
	ECT sensor	<ul style="list-style-type: none"> <li>Detects the engine coolant temperature.</li> </ul>
	CKP sensor	<ul style="list-style-type: none"> <li>Detects the engine revolution speed.</li> </ul>
	MAF sensor	<ul style="list-style-type: none"> <li>Detects the intake air amount.</li> </ul>
Output system	Linear type	Pressure control solenoid A
	Duty-cycle type	Shift solenoid A
		Shift solenoid B
		Shift solenoid C
		Pressure control solenoid B
	ON/OFF type	Shift solenoid D
		Shift solenoid E
		Shift solenoid F
	AT warning light	
	Speedometer signal	

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# AUTOMATIC TRANSAXLE [FS5A-EL]

## INPUT/OUTPUT SIGNAL AND RELATED CONTROLS [FS5A-EL]

E6U051718901S06

Component	Control item									
	Line pressure control	Shift control	Manual mode shift control	Clutch pressure direct control (Direct electric shift control)	Feedback control	Engine-transaxle total control	Torque converter clutch control	Slip control	Slope mode control	On-board diagnostic function
<b>Input</b>										
M range switch		X	X	X						
Up switch		X	X	X						
Down switch		X	X	X						
TR switch	X	X		X						X
APP sensor	X	X	X	X			X	X		X
Input/turbine speed sensor	X	O		X	X		X	X		X
VSS	X	X		X			X	X	X	X
Intermediate sensor	X	O	O	X	X	X				X
Brake switch							X	X	X	
TFT sensor	X	X		X	X		X			X
ECT sensor							X			X
CKP sensor	X			X		X	X	X		X
MAF sensor	X			X	X	X			X	X
Oil pressure switch		X		X						X
<b>Output</b>										
Pressure control solenoid A	X									X
Pressure control solenoid B		X	X	X	X	X				X
Shift solenoid A		X	X	X	X		X	X	X	X
Shift solenoid B		X	X	X	X					X
Shift solenoid C		X	X	X	X					X
Shift solenoid D		X	X						X	X
Shift solenoid E		X	X				X	X	X	X
Shift solenoid F		X	X						X	X
AT warning light		X								X

X : Available

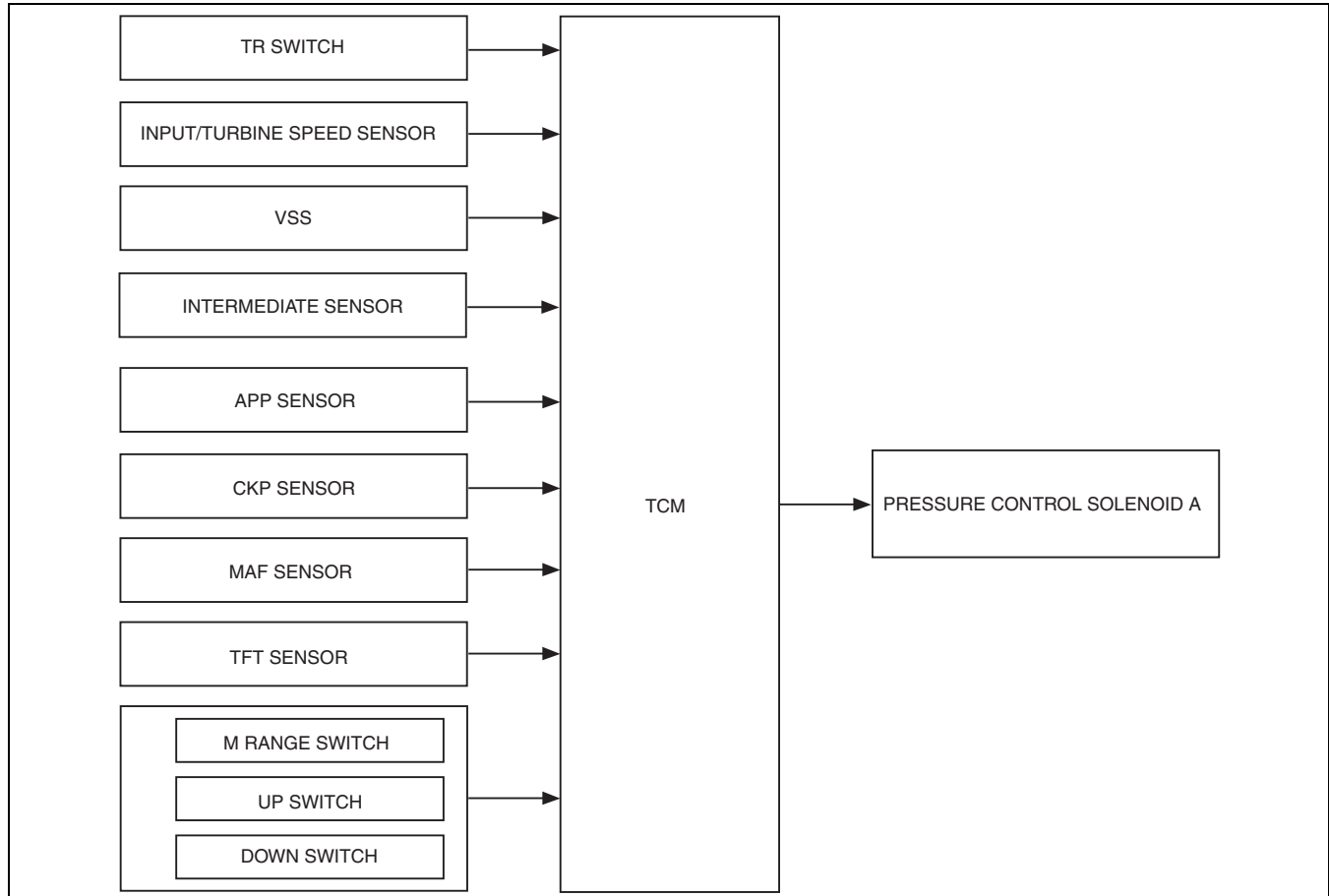
O : Back up

# AUTOMATIC TRANSAXLE [FS5A-EL]

## LINE PRESSURE CONTROL OUTLINE [FS5A-EL]

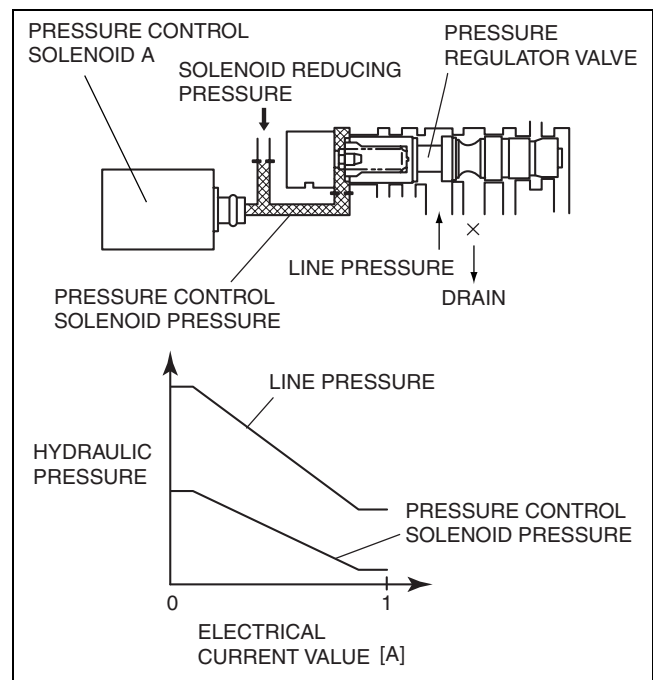
E6U051718901S07

- The TCM determines the optimum line pressure and drives the liner-type pressure control solenoid A based on input signals in accordance with the vehicle driving conditions including the engine torque (calculated from throttle opening angle, vehicle speed, engine speed, gear position, intake air rate, and other operational parameters). As a result, the line pressure is controlled very accurately and closely.



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E6U517AS5037



E6U517AS5038

## AUTOMATIC TRANSAXLE [FS5A-EL]

### PRESSURE CONTROL SOLENOID A (LINEAR TYPE) OUTLINE [FS5A-EL]

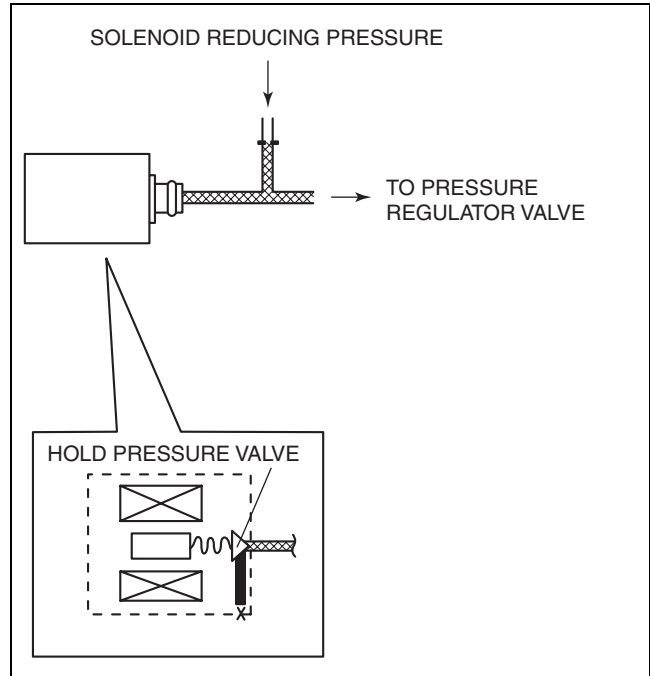
E6U051721101S01

- A pressure control solenoid A with high stability in hydraulic pressure has been adopted for the line pressure control.
- Because the pressure control solenoid controls the hydraulic pressure according to the current value, the degree of freedom in control increases. The controllability is maintained even under aeration, and pressure variation can be reduced.

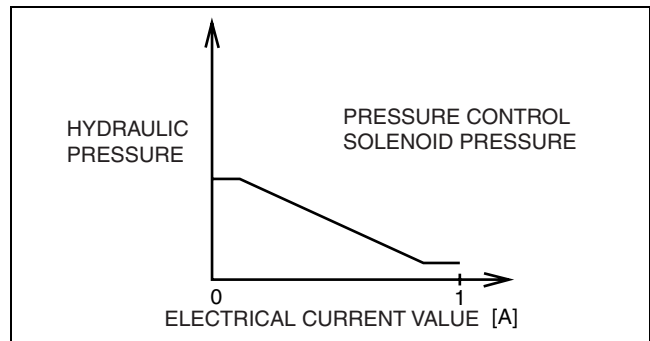
### PRESSURE CONTROL SOLENOID A (LINEAR TYPE) OPERATION [FS5A-EL]

E6U051721101S02

- By changing the electrical current value (0 A—1 A) inside the solenoid, the pressure control solenoid A adjusts the hold power of the hold pressure valve, controlling the pressure control solenoid pressure to the prescribed hydraulic pressure.



E6U517AS5039



E6U517AS5040

## SHIFT CONTROL STRUCTURE [FS5A-EL]

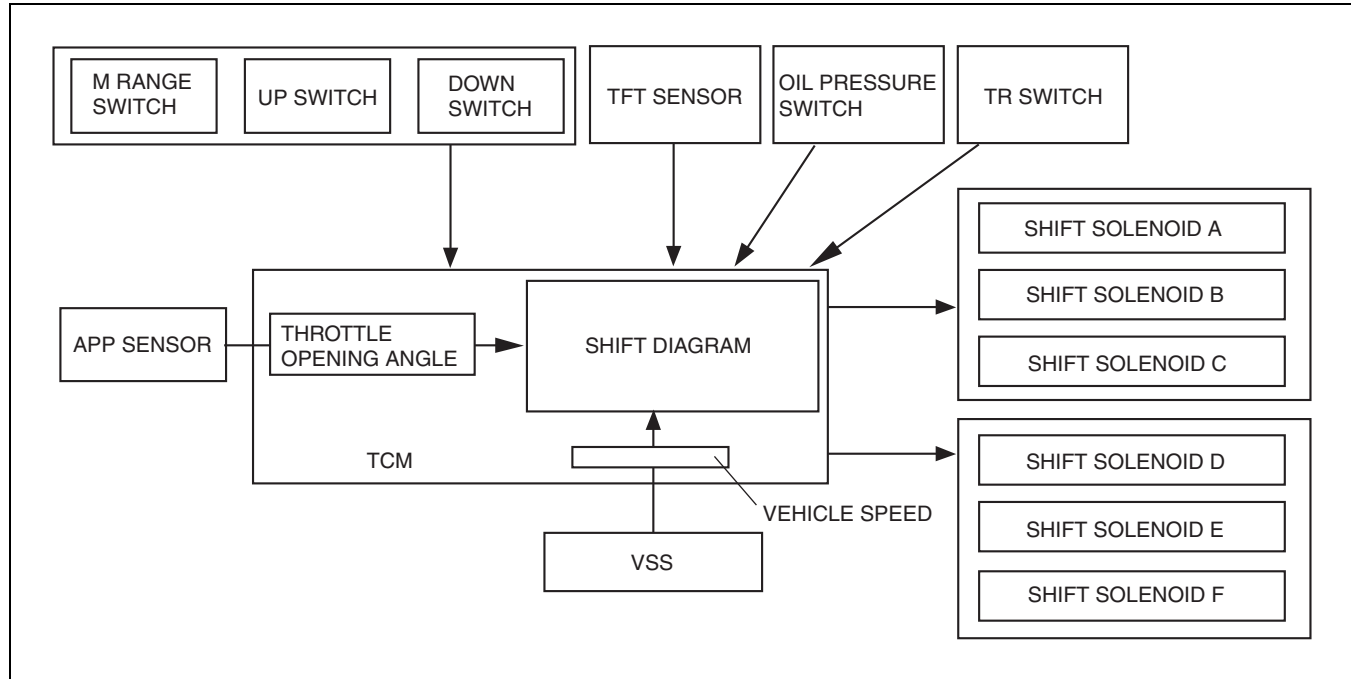
E6U051718901S08

### Features

- An automatic shift system in the D range and a manual shift system have been adopted for the AT system. The automatic shift system, with automatic shifting between 1GR and 4GR. The manual shift system allows option gear position selection by manually operating the selector lever forward and back.
- In the D range, automatic shifting occurs between 1GR and 5GR. Moreover, in the M range, the specialized AT manual mode shift control is available.
  - Shifting is controlled by the TCM which, based on range/position determination, selects and determines the shift diagram. In the D range the automatic shift diagram is followed and in the M range the manual mode shift diagram is followed.
- The TCC is engaged in D and range, 4GR and 5GR.
- The selector lever indicator light and the gear position indicator light are built into the instrument cluster.

### Structure

#### System diagram



E6U517AS5041

## AUTOMATIC TRANSAXLE [FS5A-EL]

### SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) OUTLINE [FS5A-EL]

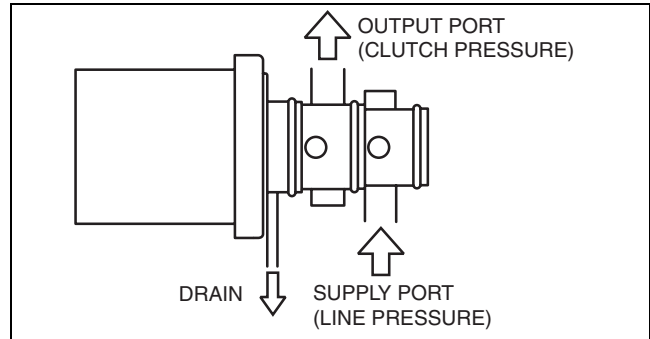
E6U051721101S03

- A clutch pressure direct control, which supplies the clutch pressure directly to each clutch and/or brake, has been adopted. A three-way duty-cycle type solenoids with excellent controllability have been adopted, to improve response.

### SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) FUNCTION [FS5A-EL]

E6U051721101S04

- The duty-cycle type shift solenoid adjusts the amount of output pressure according to the signal from the TCM, and controls the pressure of each clutch.
- The duty-cycle type shift solenoid, which switches on/off at 50 Hz (20 ms cycle) and controls the output pressure, is adopted. By changing the on time ratio a cycle (0—100%), the solenoid adjusts the time ratio of the open (supply) and close (drain), and maintains the clutch pressure at the designated hydraulic pressure. As a result, the clutch pressure rises when the duty ratio (50 Hz on time ratio) is reduced, and falls when the duty ratio is raised.



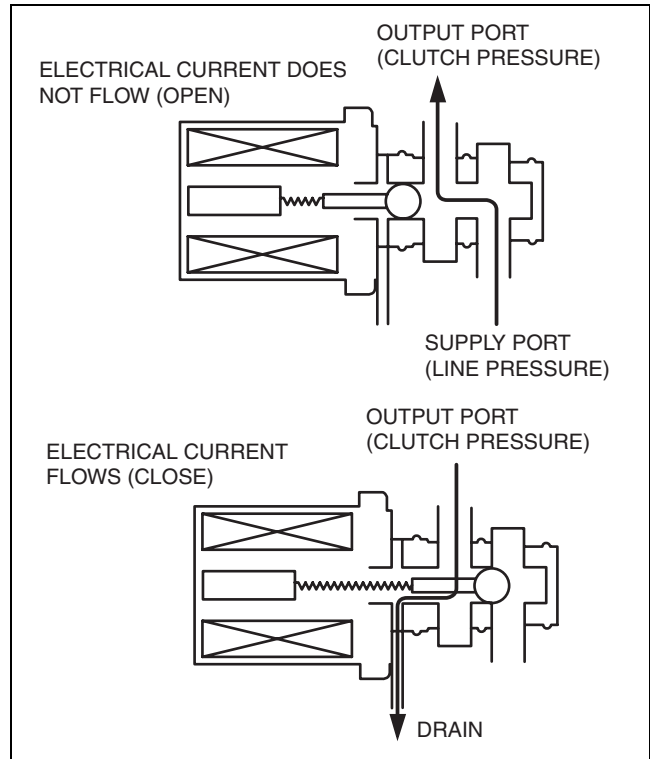
E6U517AS5042

### SHIFT SOLENOID A, B AND C (DUTY-CYCLE TYPE) OPERATION [FS5A-EL]

E6U051721101S05

**Open:** When the electrical current does not flow, the supply port (line pressure) in the solenoid opens and is engaged with the output port (clutch pressure). As a result, hydraulic pressure is supplied to the hydraulic passage for the clutch pressure.

**Close:** When the electrical current flows, the supply port (line pressure) in the solenoid closes and the output port (clutch pressure) and the drain port are engaged to drain the clutch pressure.



E6U517AS5043

# AUTOMATIC TRANSAXLE [FS5A-EL]

## SHIFT SOLENOID D, E AND F (ON/OFF TYPE) OUTLINE [FS5A-EL]

E6U051721101S06

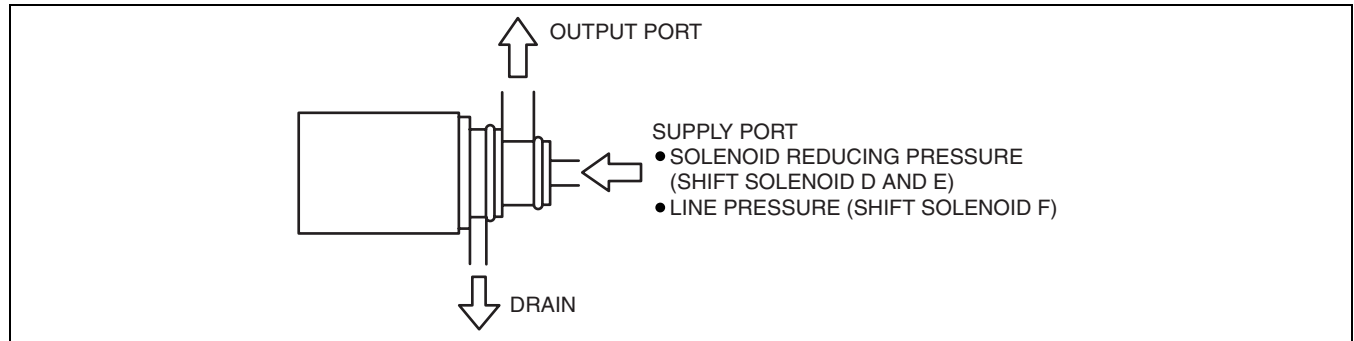
- A compact, light-weight three-way solenoid has been adopted for shift solenoids D, E and F to reduce consumption discharge amount.

Shift solenoid	Function
Shift solenoid D	Switches the bypass valve and 3-4 shift valve.
Shift solenoid E	Switches the low and reverse shift valve and TCC control valve.
Shift solenoid F	Switches the hydraulic passages for each clutch on the sub-shifting side and the brake.

## SHIFT SOLENOID D, E AND F (ON/OFF TYPE) FUNCTION [FS5A-EL]

E6U051721101S07

- An on/off type solenoid valve switches the supply drain of output port according to the electrical current flow switching.



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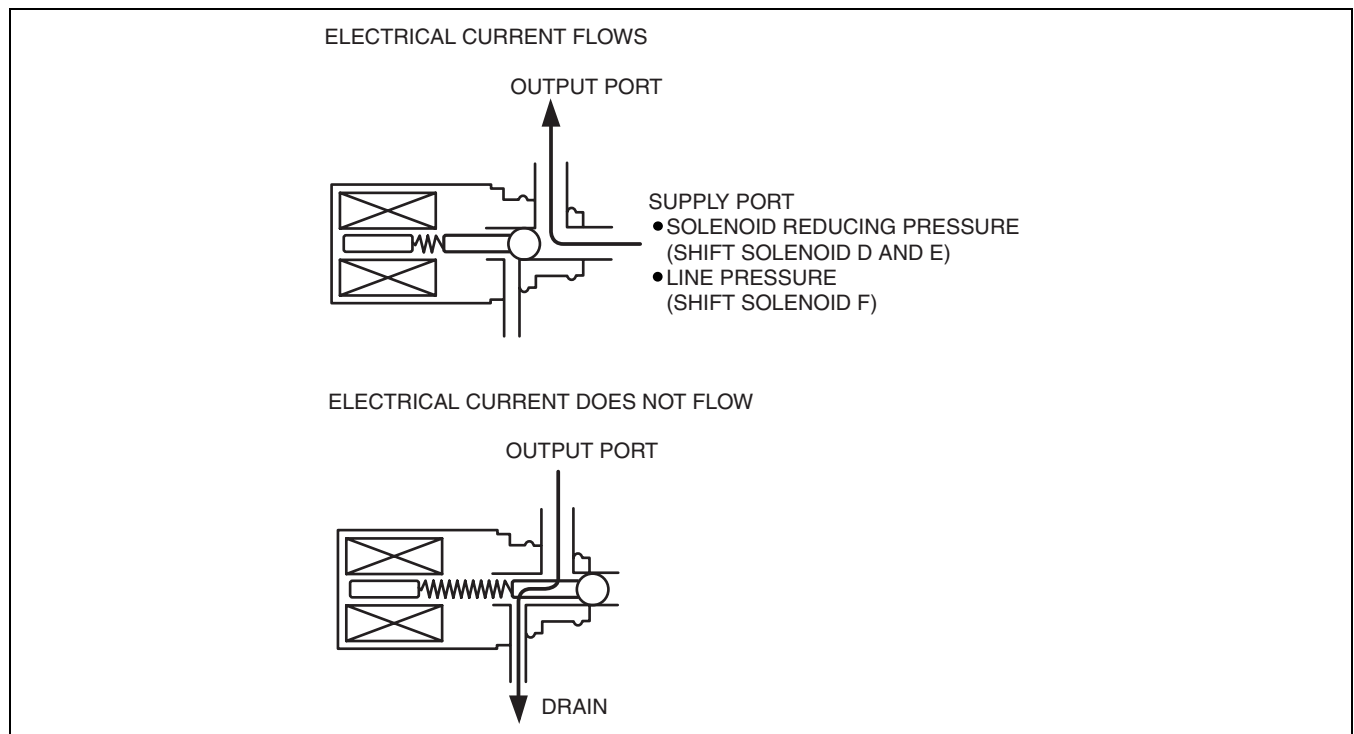
E6U517AS5044

## SHIFT SOLENOID D, E AND F (ON/OFF TYPE) OPERATION [FS5A-EL]

E6U051721101S08

**On:** When the electrical current flows, the output port and the supply port (solenoid reducing pressure or line pressure) are engaged in the solenoid, and the output pressure becomes equivalent to the solenoid reducing pressure.

**Off:** When the electrical current does not flow, the output port and the drain port are engaged in the solenoid, and the output pressure is drained.



E6U517AS5045

## AUTOMATIC TRANSAXLE [FS5A-EL]

### PRESSURE CONTROL SOLENOID B (DUTY-CYCLE TYPE) OUTLINE [FS5A-EL]

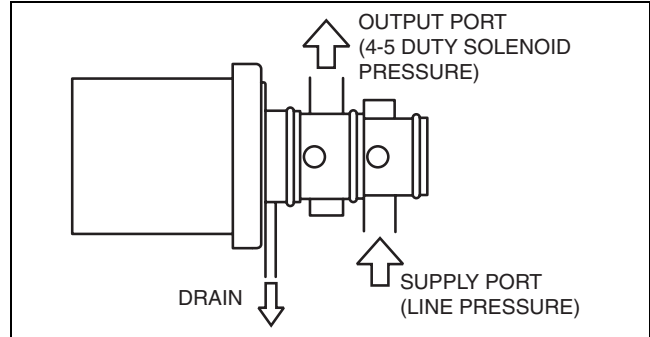
E6U051721101S09

- A clutch pressure direct control, which supplies the clutch pressure directly to each clutch and/or brake, has been adopted. A three-way duty-cycle type solenoids with excellent controllability have been adopted, to improve response.

### PRESSURE CONTROL SOLENOID B (DUTY-CYCLE TYPE) FUNCTION [FS5A-EL]

E6U051721101S10

- The duty-cycle type shift solenoid adjusts the amount of output pressure according to the signal from the TCM, and controls the pressure of each clutch.
- The duty-cycle type shift solenoid, which switches on/off at 50 Hz (20 ms cycle) and controls the output pressure, is adopted. By changing the on time ratio a cycle (0—100%), the solenoid adjusts the time ratio of the open (supply) and close (drain), and maintains the 4-5 duty solenoid pressure at the designated hydraulic pressure. As a result, the clutch pressure rises when the duty ratio (50 Hz on time ratio) is reduced, and falls when the duty ratio is raised.



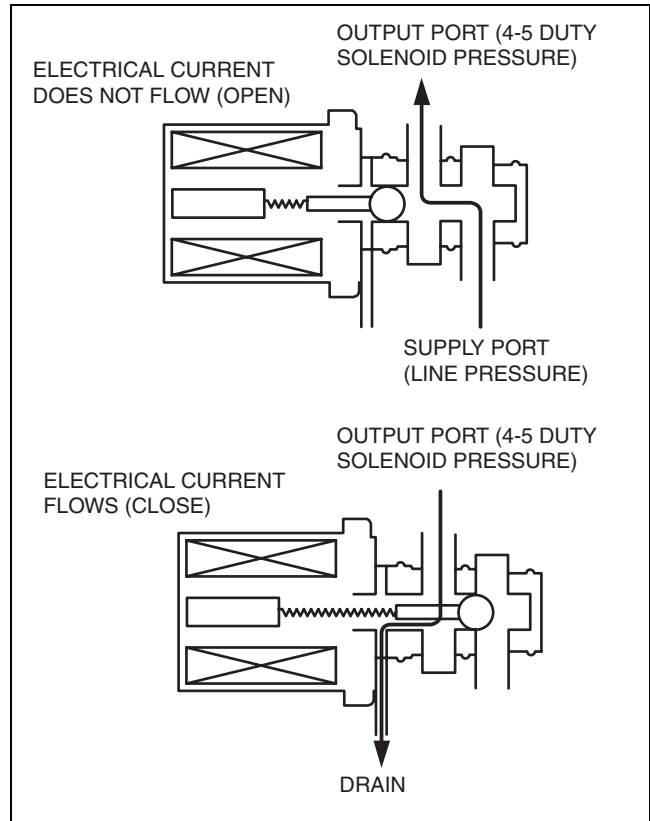
E6U517AS5046

### PRESSURE CONTROL SOLENOID B (DUTY-CYCLE TYPE) OPERATION [FS5A-EL]

E6U051721101S11

**1GR to 4GR or 5GR (Open):** When driving in 1GR to 4GR or 5GR, the supply port (line pressure) in the solenoid opens and is engaged with the output port (4-5 duty solenoid pressure). As a result, hydraulic pressure is supplied to the hydraulic passage for the 4-5 duty solenoid.

**Shifted from 4GR to 5GR or from 5GR to 4GR (Close):** When the gear is shifted from 4GR to 5GR or from 5GR to 4GR, the line pressure is regulated to the optimum hydraulic pressure for the driving condition by energizing for a specified time.



E6U517AS5047

## AUTOMATIC TRANSAXLE [FS5A-EL]

### OIL PRESSURE SWITCH FUNCTION [FS5A-EL]

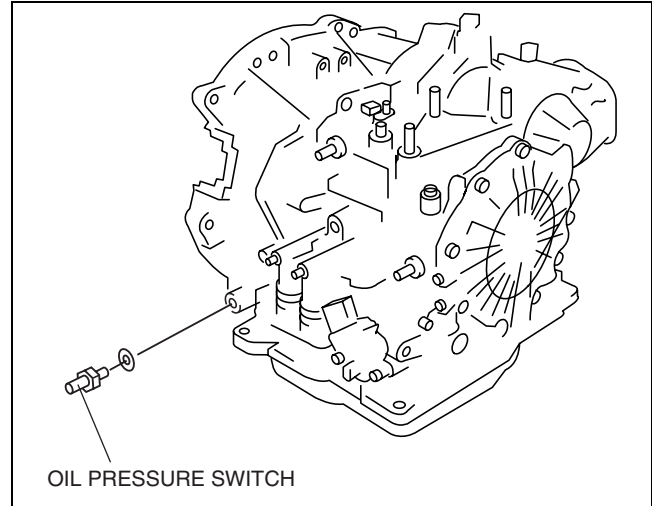
E6U051721101S16

- The oil pressure switch detect pressure applied to the forward clutch, and send control signals to the TCM.
- The TCM controls clutch engagement based on these signals.

### OIL PRESSURE SWITCH CONSTRUCTION/OPERATION [FS5A-EL]

E6U051721101S17

- While forward clutch pressure is applied, the oil pressure switches turn on when the oil pressure reaches the operating pressure of the switch, and turn off when the oil pressure is below the operating pressure of the switch.
- The oil pressure switch is mounted on the transaxle case.



E6U517AS5048

### DRIVING MODE DETERMINATION OPERATION [FS5A-EL]

E6U051718901S09

#### D range

- When above a certain vehicle speed and the accelerator pedal depressing speed is above the preset value, the driving mode is automatically switched to POWER mode, and shifts the shift point to high speed side.
- When the ATF temperature is high or low, the mode is automatically switched to each shift pattern: when the ATF temperature is high, the TCC point is shifted to low speed side, and when the ATF temperature is low, 5GR is inhibited.

#### M range

- When the selector lever is shifted over from the D to M range position, the M range switch in the selector lever component turns on, sending a manual mode command signal to the TCM which activates the manual mode shift control.

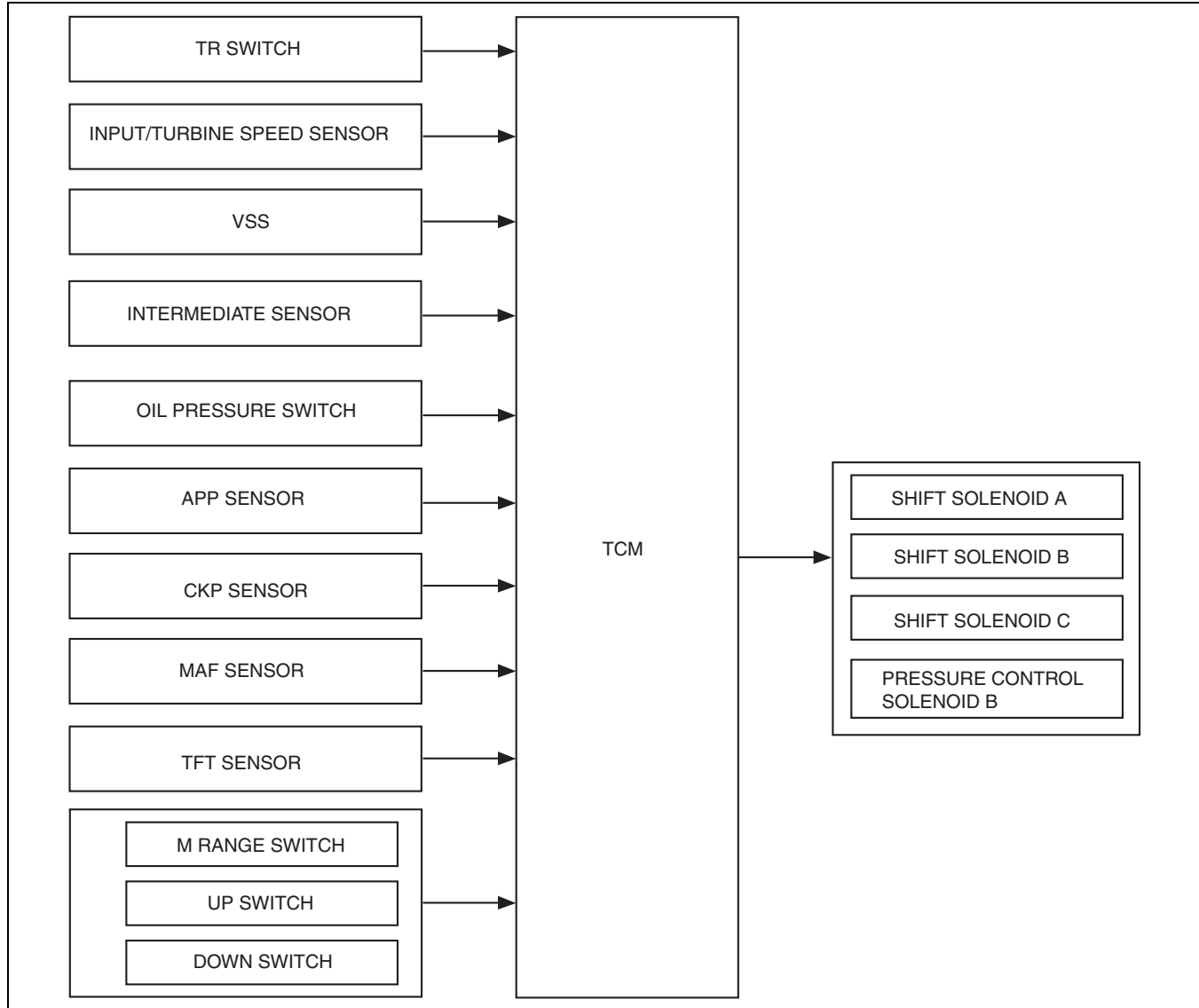
## AUTOMATIC TRANSAXLE [FS5A-EL]

### DIRECT ELECTRIC SHIFT CONTROL OUTLINE [FS5A-EL]

E6U051718901S10

- The TCM determines the optimum clutch engagement pressure and drives the duty-cycle shift solenoids and duty-cycle type pressure control solenoid B based on input signals in accordance with the vehicle driving conditions including the engine torque (calculated from throttle opening angle, vehicle speed, engine speed, gear position, intake air rate, and other operational parameters).
- By driving the duty-cycle solenoid valves, and performing the electronic control of the clutch engagement pressure directly through the TCM, minute hydraulic control, which could not be obtained by the clutch engagement pressure control with the accumulator, is obtained.

#### Block diagram



E6U517AS5049

## DIRECT ELECTRIC SHIFT CONTROL OPERATION [FS5A-EL]

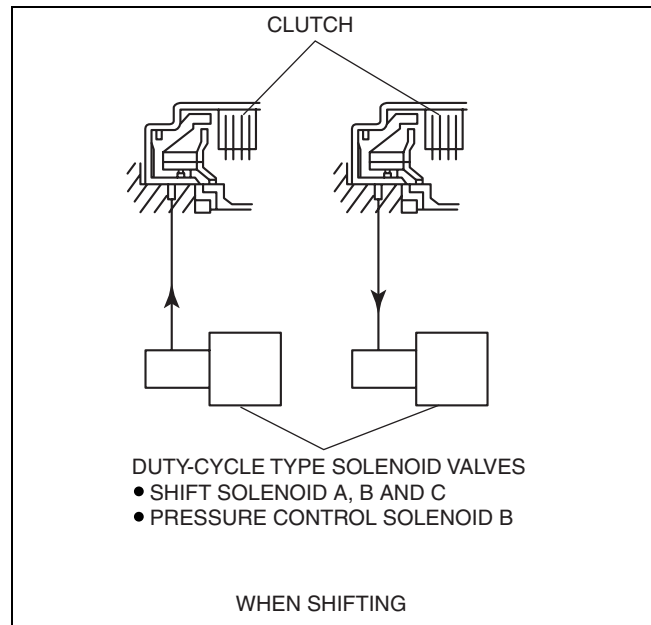
E6U051718901S11

### When Shifting N→D or N→R Shift

- When shifting N→D or N→R, the duty-cycle solenoid valves is driven to control the clutch engagement pressure optimally.

### Up-Down Shift

- The clutch engagement pressure is directly controlled to be optimal by the duty-cycle solenoid valves.
- When shifting 2GR→3GR, 3GR→4GR, 4GR→5GR, 3GR→2GR, or 4GR→3GR, 5GR→4GR, the clutch pressures of engagement side and release side are controlled simultaneously. As a result, the clutch capacities of both clutches are controlled relatively when switching the clutches. This prevents sudden increases in engine speed and clutch interlocks during shifting, realizing smooth and responsive shifting.



E6U517AS5050

## MANUAL MODE SHIFT CONTROL STRUCTURE [FS5A-EL]

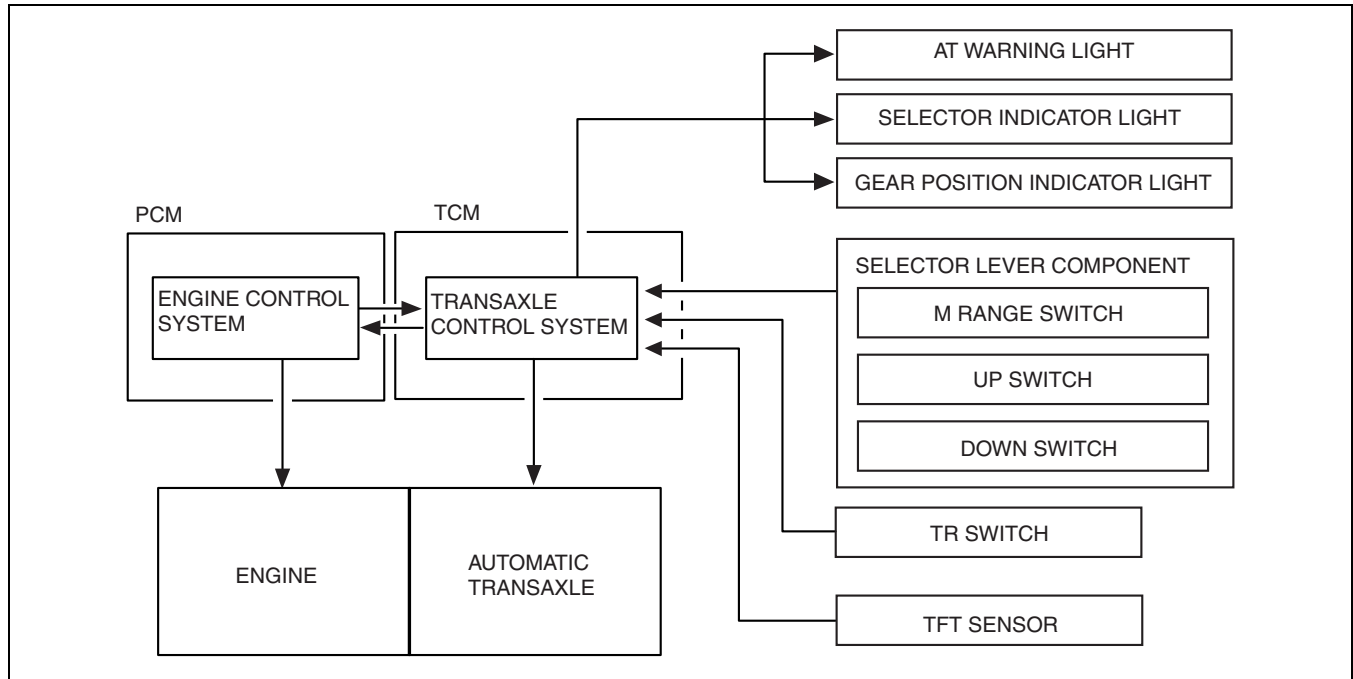
E6U051718901S12

### Features

- The manual mode shift control is activated by moving the selector lever from the D to M range position (selector lever is shifted over toward driver side).
- Manual mode shift control with a manual shifting system allowing selection of gear positions by manual operation of the selector lever forward (–) and back (+) has been adopted. Moreover, engine braking for all gears in manual mode according to the gear ratio is available.
  - Shifting between 1GR and 2GR when the vehicle is stopped is possible. Moreover, when shifting from the D to M range while driving, the same gear position is maintained.
  - Consecutive shifting in the M range has been adopted. When shifting down from M range 5GR, 4GR or 3GR, one gear can be skipped over by rapidly tapping the selector lever two times in the down-shift (–) direction.
- Selector lever position and gear position indicator lights, built into the instrument cluster, have been adopted. The gear position indicator light displays the selected gear position.
  - The selector indicator light includes a selector lever position indicator that displays selector lever positions and, a gear position indicator light that displays gear positions.
- If the ATF temperature reaches 130 °C {266 °F} or more while driving in manual shift mode, the gear position indicator illumination turns off and the transaxle switches to auto shift mode to reduce load on the ATX. After a period of time has passed and the ATF temperature decreases to 120 °C {248 °F} or less, the gear position indicator illumination turns back on and driving in manual shift mode is restored.

# AUTOMATIC TRANSAXLE [FS5A-EL]

**Structure  
System diagram**



E6U517AS5051

## MANUAL MODE SHIFT CONTROL OPERATION [FS5A-EL]

E6U051718901S13

### 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 solenoid if the ATF temperature is not low (for 4GR only), vehicle speed is higher than the set speed and the gear position is 4GR or lower.
- Conversely, when the selector lever is operated in the forward (–) direction, the down switch in the selector lever component turns on, and a down-shift command signal is input to the TCM.
  - The TCM, triggered by the down-shift command signal, carries out shifting by outputting an operation signal to the shift solenoid if the vehicle speed is less than the set speed and the gear position is 2GR or above.
- The 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 ATX, preventing engine over-rev and ensuring drive stability.

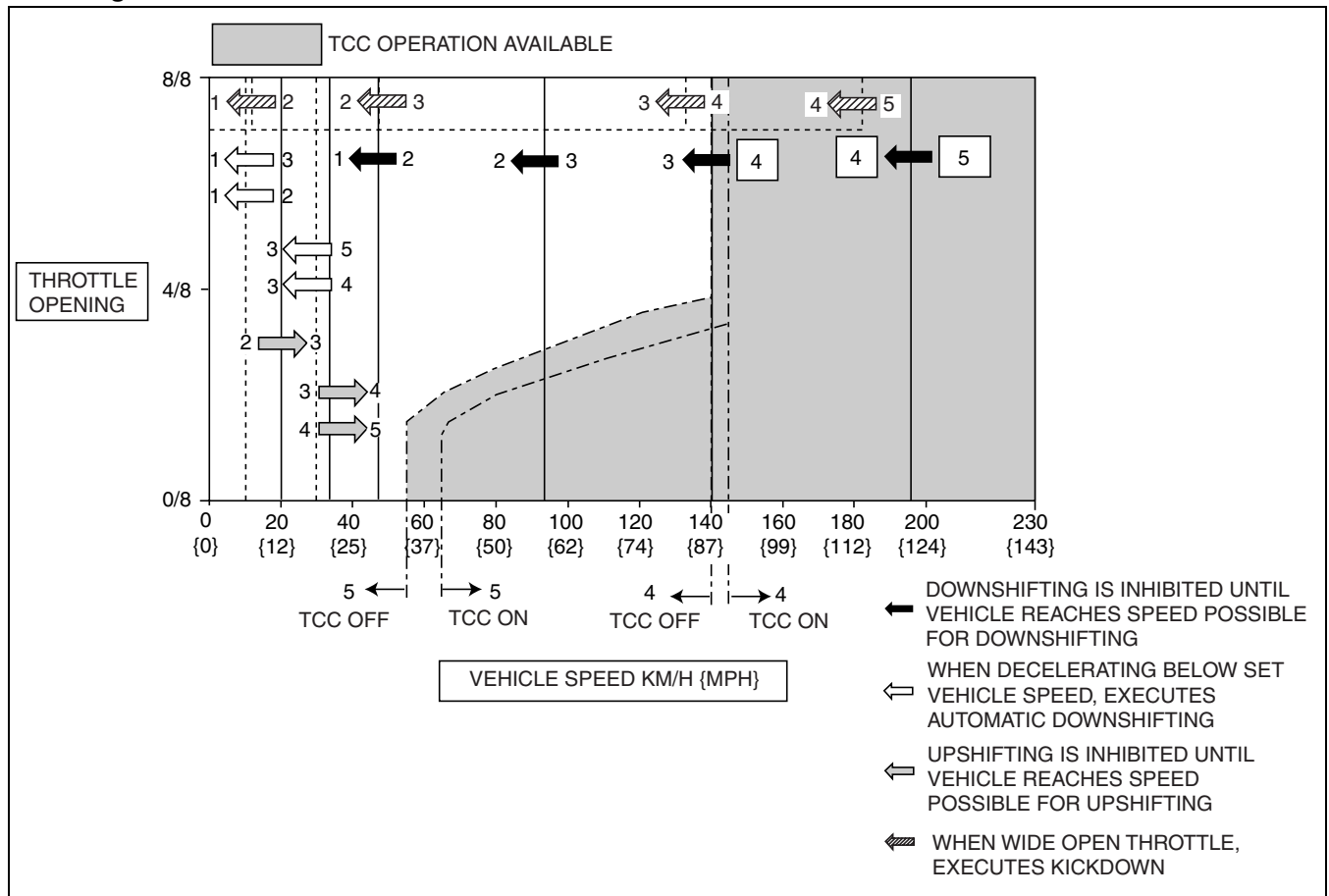
Condition	Shift control	Note
2GR→3GR up-shift command at low speed	<ul style="list-style-type: none"><li>To reduce load on the ATX, upshifting is inhibited until vehicle reaches speed possible for upshifting</li></ul>	—
3GR→4GR up-shift command at low speed		
4GR→5GR up-shift command at low speed		
4GR→5GR up-shift command, low ATF temperature	<ul style="list-style-type: none"><li>To reduce load on the ATX, upshifting to 5GR is inhibited</li></ul>	
5GR→4GR down-shift command, above set speed	<ul style="list-style-type: none"><li>To prevent engine over-rev, downshifting is inhibited until vehicle reaches speed possible for downshifting</li></ul>	<ul style="list-style-type: none"><li>Gear position indicator light flash to alert driver</li></ul>
4GR→3GR down-shift command, above set speed		
3GR→2GR down-shift command, above set speed		
2GR→1GR down-shift command, above set speed		

# AUTOMATIC TRANSAXLE [FS5A-EL]

Condition	Shift control	Note
In 5GR deceleration, speed goes below coast-down set speed (deceleration downshift)	<ul style="list-style-type: none"> <li>To assure drive stability, automatically downshifts from 5GR to 3GR</li> </ul>	—
In 4GR deceleration, speed goes below coast-down set speed (deceleration downshift)	<ul style="list-style-type: none"> <li>To assure drive stability, automatically downshifts from 4GR to 3GR</li> </ul>	
In 3GR deceleration, speed goes below coast-down set speed (deceleration downshift)	<ul style="list-style-type: none"> <li>To assure drive stability, automatically downshifts from 3GR to 1GR</li> </ul>	
In 2GR deceleration, speed goes below coast-down set speed (deceleration downshift)	<ul style="list-style-type: none"> <li>To assure drive stability, automatically downshifts from 2GR to 1GR</li> </ul>	
Wide open throttle, at 134—182 km/h {83—112 mph} in 5GR	<ul style="list-style-type: none"> <li>To improve acceleration performance, 5GR to 4GR kickdown occurs</li> </ul>	—
Wide open throttle, at 49—133 km/h {31—82 mph} in 4GR	<ul style="list-style-type: none"> <li>To improve acceleration performance, 4GR to 3GR kickdown occurs</li> </ul>	—
Wide open throttle, at 13—48 km/h {9—29 mph} in 3GR	<ul style="list-style-type: none"> <li>To improve acceleration performance, 3GR to 2GR kickdown occurs</li> </ul>	—
Wide open throttle, at 10—12 km/h {6—7 mph} in 2GR	<ul style="list-style-type: none"> <li>To improve acceleration performance, 2GR to 1GR kickdown occurs</li> </ul>	—

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## Shift diagram



E6U517AS5052

## AUTOMATIC TRANSAXLE [FS5A-EL]

### AT WARNING LIGHT FUNCTION [FS5A-EL]

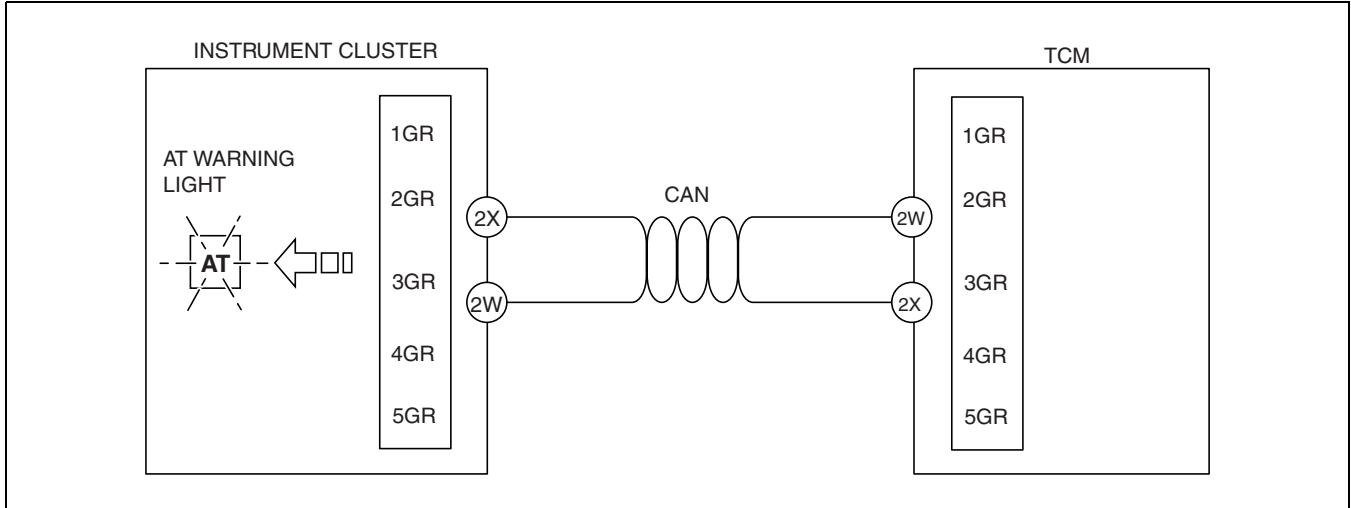
E6U051721101S12

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

### AT WARNING LIGHT CONSTRUCTION/OPERATION [FS5A-EL]

E6U051721101S13

- 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.



E6U517AS5053

### SELECTOR INDICATOR LIGHT FUNCTION [FS5A-EL]

E6U051721101S14

- 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.
- If the ATF temperature reaches 130 °C {266 °F} or more while driving in manual shift mode, the gear position indicator illumination turns off and the transaxle switches to auto shift mode to reduce load on the ATX. After a period of time has passed and the ATF temperature decreases to 120 °C {248 °F} or less, the gear position indicator illumination turns back on and driving in manual shift mode is restored.

### SELECTOR INDICATOR LIGHT CONSTRUCTION/OPERATION [FS5A-EL]

E6U051721101S15

#### Construction

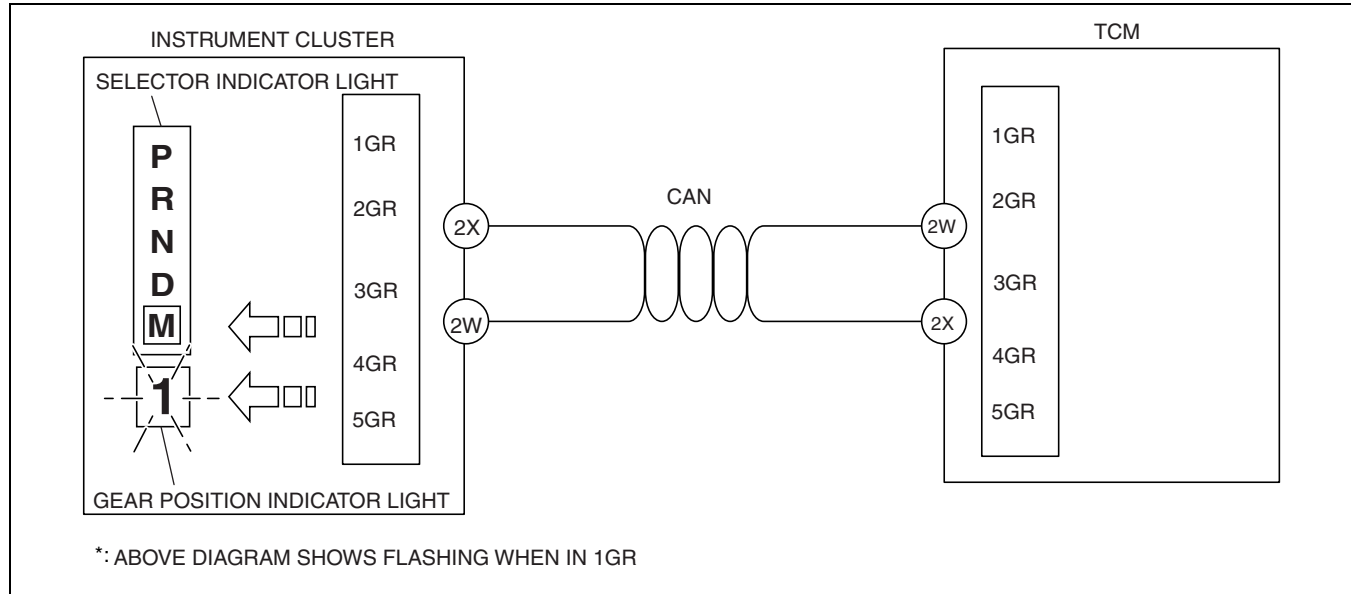
- The selector indicator light is built into the instrument cluster.
- When in the P, R, N or D range, the TCM detects the selector lever position based on an analog signal from the TR switch. When in the M range, the TCM detects the selector lever position based on a signal from the M range switch inside 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.

## AUTOMATIC TRANSAXLE [FS5A-EL]

### 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 down-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) 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.



E6U517AS5054

### FEEDBACK CONTROL STRUCTURE [FS5A-EL]

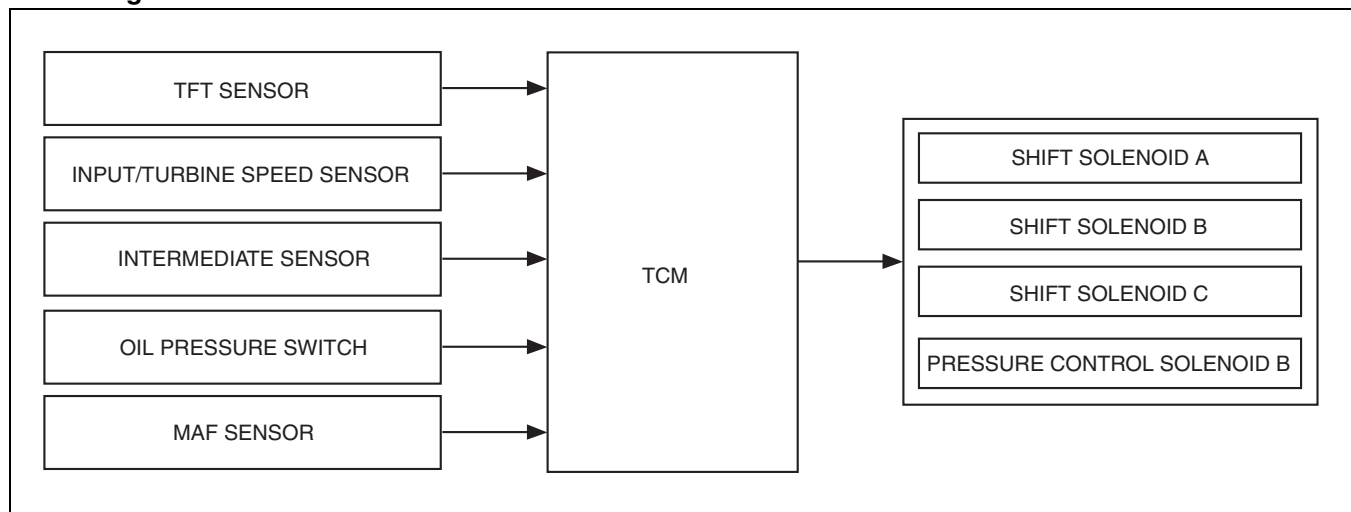
E6U051718901S14

#### Features

- Regulation of hydraulic pressure for engagement and disengagement is optimized through feedback and learning correction of the clutch engagement pressure.

### Structure

#### Block diagram



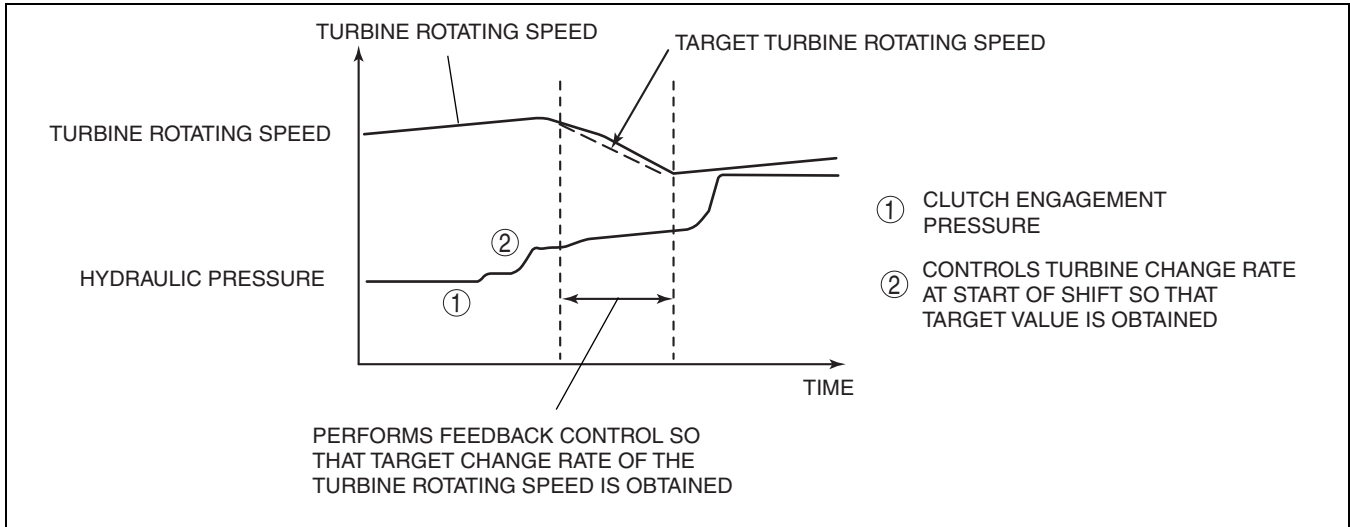
E6U517AS5055

## AUTOMATIC TRANSAXLE [FS5A-EL]

### FEEDBACK CONTROL OPERATION [FS5A-EL]

E6U051718901S15

- When shifting, real-time feedback correction of the clutch engagement pressure is operated by the duty-cycle solenoid valves so that the speed change of the turbine shaft (change of the turbine rotating speed) matches the predetermined target value.
- Also, the clutch engagement pressure is optimally corrected so as to absorb the changes in engine performance and/or of elapsed transaxle, according to the shift results in the past.



E6U517AS5056

### ENGINE-TRANSAXLE TOTAL CONTROL STRUCTURE [FS5A-EL]

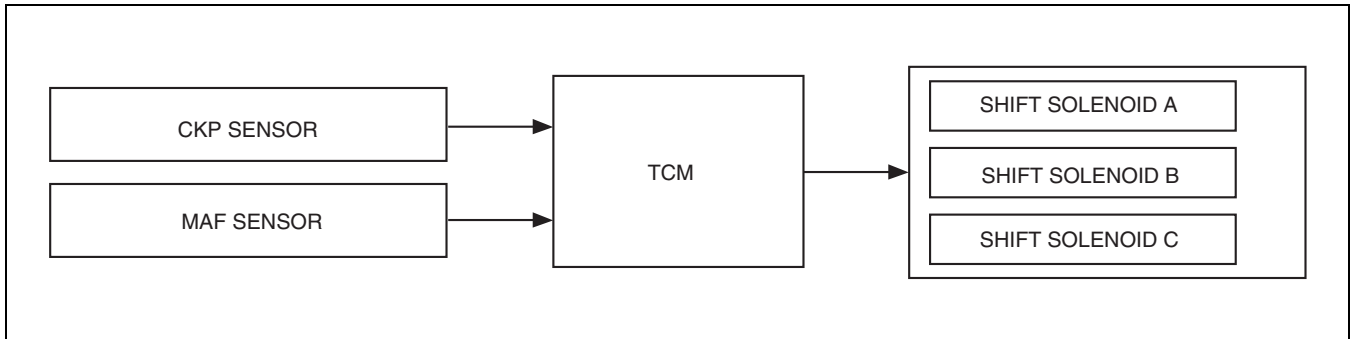
E6U051718901S16

#### Features

- When shifting, engine output torque is controlled for optimized clutch capacity.

#### Structure

##### Block diagram



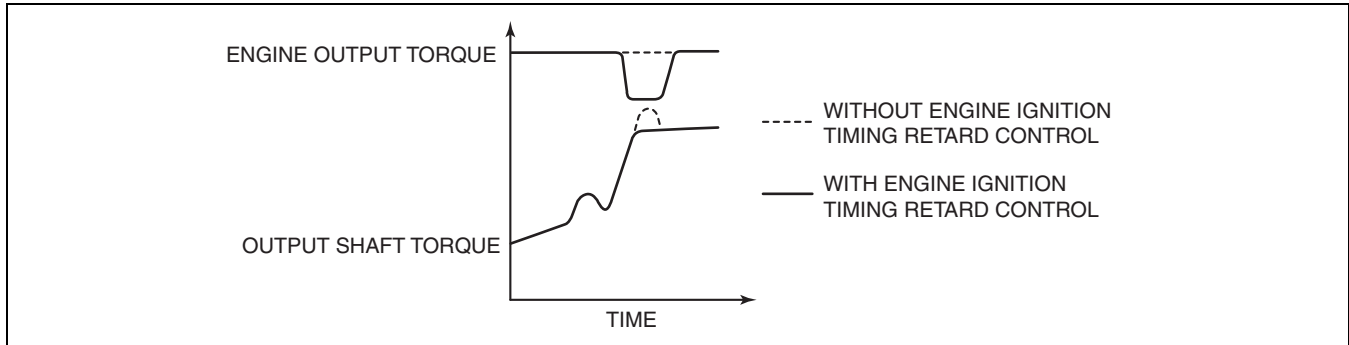
E6U517AS5057

## AUTOMATIC TRANSAXLE [FS5A-EL]

### ENGINE-TRANSAXLE TOTAL CONTROL OPERATION [FS5A-EL]

E6U051718901S17

- When shifting, engine output torque is reduced temporarily and the clutch is engaged smoothly by engine ignition timing retard control to reduce the fluctuation of the output shaft torque during shifting.
- Engine output torque is estimated according to the engine speed, intake air amount, etc., and the clutch engagement pressure is determined according to the engine output torque. Thus the set accuracy of the clutch hydraulic pressure control is improved, realizing smooth shifting.



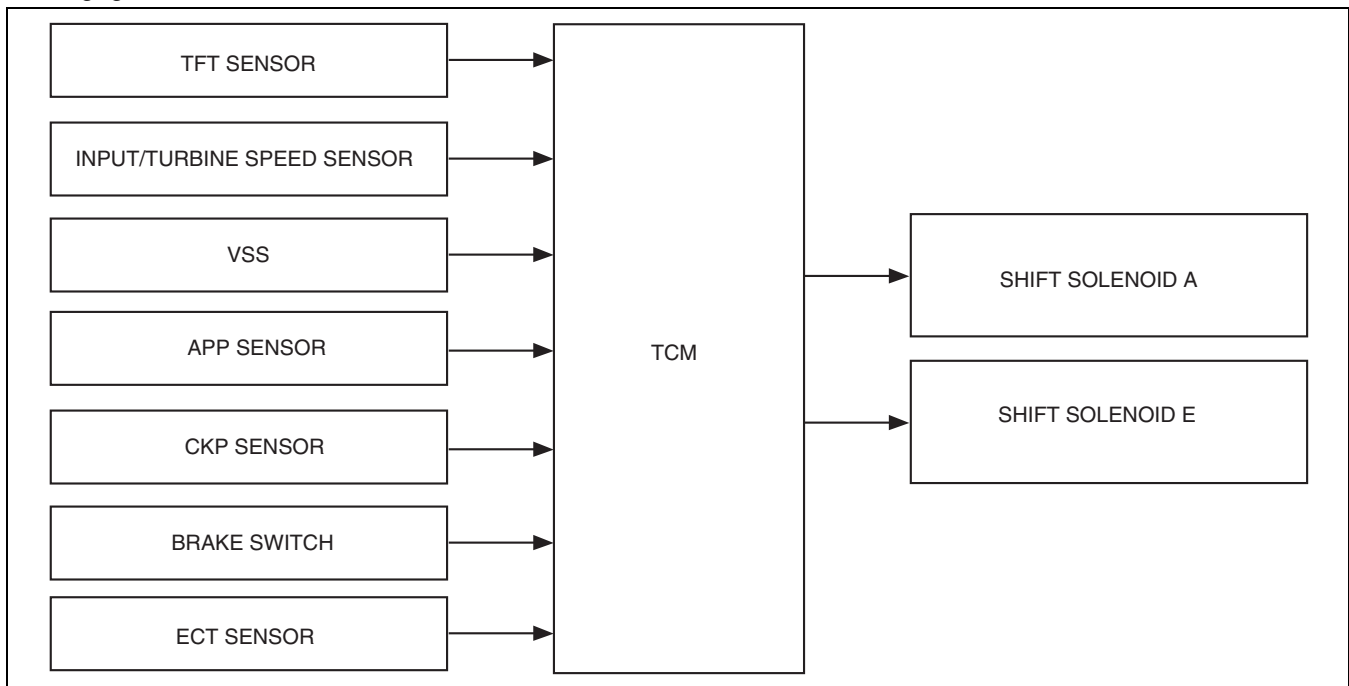
E6U517AS5058

05-17

### TORQUE CONVERTER CLUTCH (TCC) CONTROL OUTLINE [FS5A-EL]

E6U051718901S18

- The TCM selects and determines the TCC diagram based on the shift control results. With this TCC diagram, and according to the signals from VSS, APP sensor, and other switches and sensors, the TCM sends the signal to the duty-cycle type shift solenoids A and on/off type shift solenoid E to operate TCC control.
- Smooth TCC control, which engages the TCC gradually, has been adopted to reduce the shock when the TCC engages.



E6U517AS5059

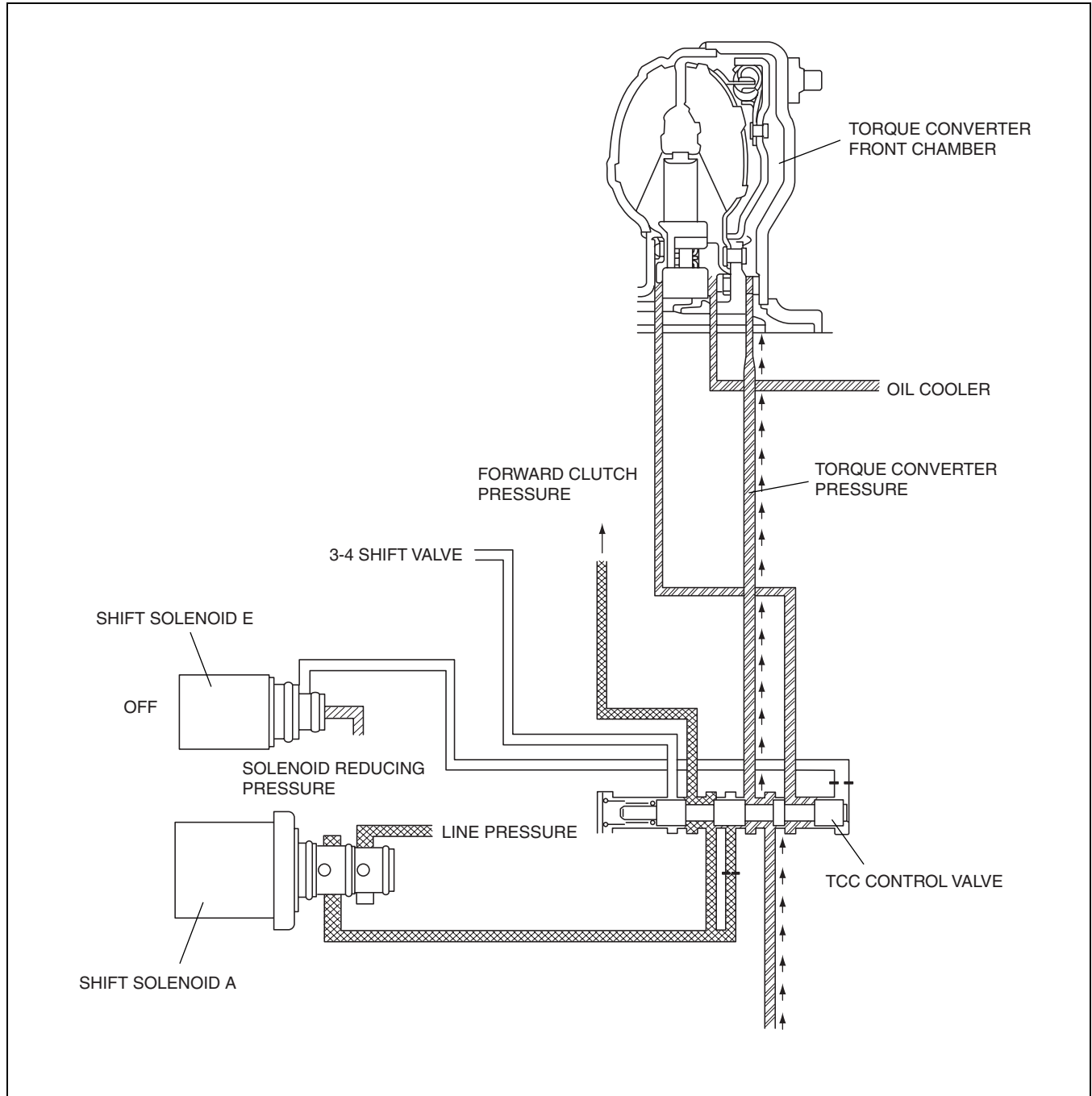
## AUTOMATIC TRANSAXLE [FS5A-EL]

### TORQUE CONVERTER CLUTCH (TCC) OPERATION [FS5A-EL]

E6U051718901S19

#### TCC Release

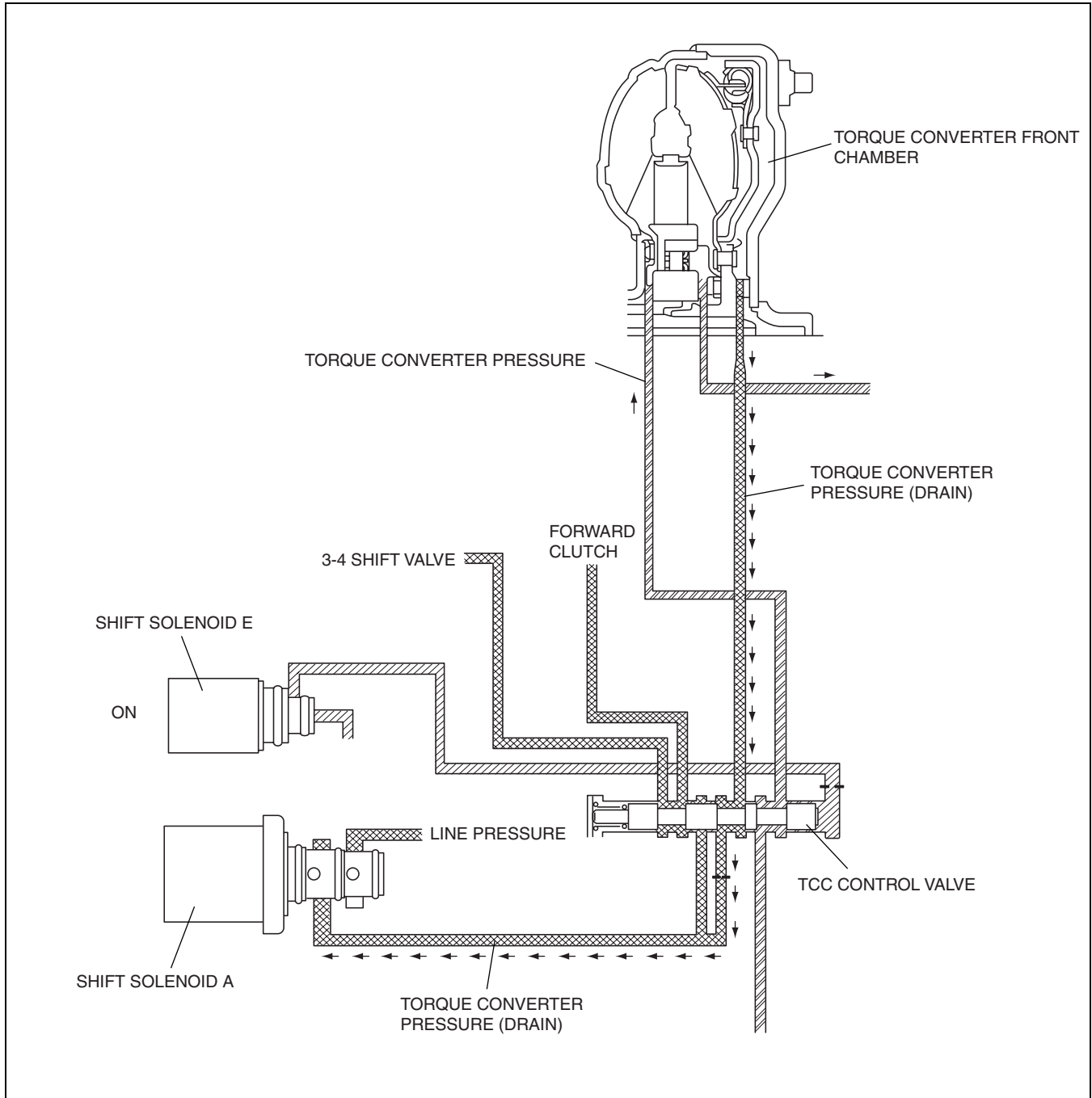
- The TCM sends an off signal to shift solenoid E when the TCC is determined to be released. In this condition, the TCC control valve is pushed to the right by the spring force, and torque converter pressure acts on the torque converter front chamber, releasing the TCC from the converter cover.



E6U517AS5060

## TCC Engaging Operation

- When the TCM determines that TCC operation is smooth, it sends an on signal to the shift solenoid E to push the TCC control valve to the left. After engaging the torque converter front chamber and shift solenoid A, the TCM gradually increases the signal of duty ratio (50 Hz on time ratio) to shift solenoid A. As a result, the torque converter pressure acted on the torque converter front chamber is drained gradually by shift solenoid A. By reducing the torque converter pressure in the torque converter front chamber gradually in this way, the TCC is pressed smoothly to the torque converter cover, and smooth TCC operation is possible.



E6U517AS5061

## Determination of TCC Inhibition

- The TCC control is inhibited when any of the following conditions are met:
- Engine coolant temperature is below 60 °C {140 °F}
- ATF temperature is low
- Brake switch is on (when depressing the brake pedal)
- Accelerator depressing speed and accelerator opening angle are above specified value
- Engine speed signal is below specified value
- Malfunction is detected by diagnosis function.

## AUTOMATIC TRANSAXLE [FS5A-EL]

### SLIP CONTROL OUTLINE [FS5A-EL]

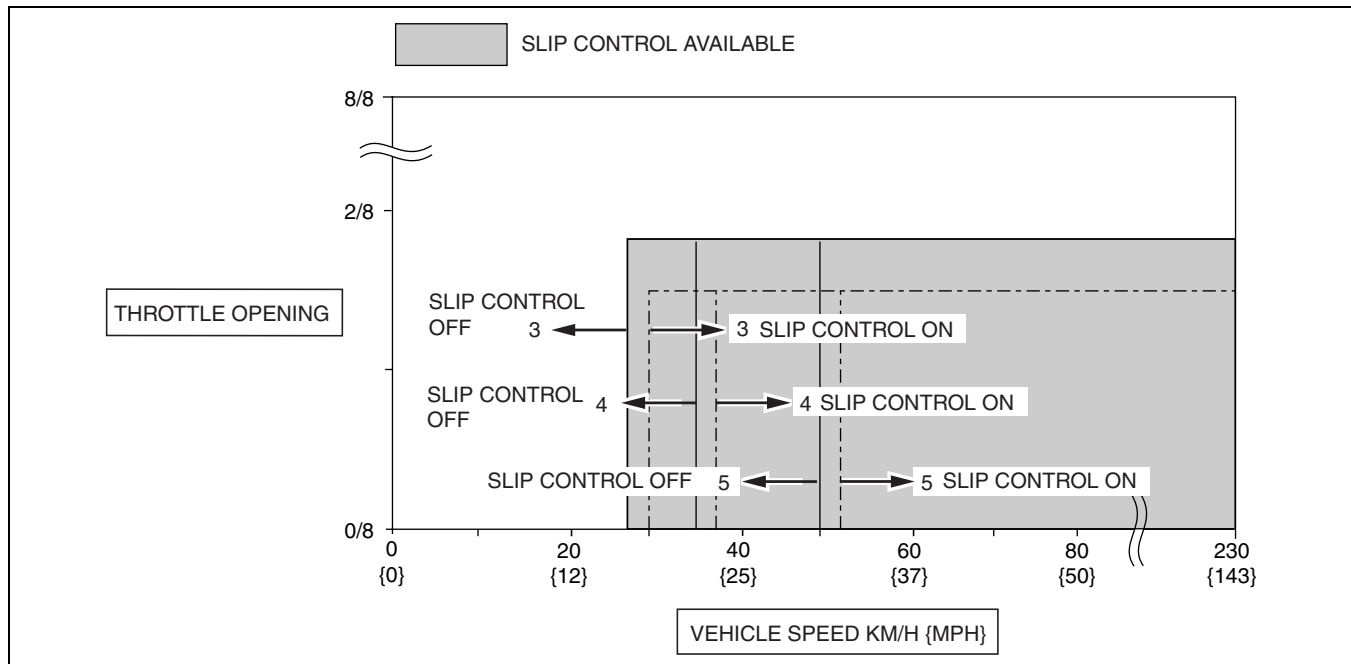
E6U051718901S20

- When the accelerator pedal is fully released for deceleration, power transfer efficiency has been improved through a slip lockup control on the torque converter set under a specified range of conditions (speed or throttle angle). As a result, fuel economy, emission performance, and ride comfort have been improved.
  - Slip lockup control gradually lowers engine speed and prolongs the fuel cut period, realizing improved fuel economy and emission performance. (If the accelerator pedal is fully released for deceleration, and lockup control is released under conventional control, engine speed suddenly lowers and fuel cut cannot continue for a longer period of time.)
  - Distinct from deceleration under conditions of lockup, slip lockup control adjusts the engine braking effect for improved ride comfort.

### SLIP CONTROL OPERATION [FS5A-EL]

E6U051718901S21

- If the engine speed exceeds the set value with the accelerator pedal fully released for deceleration under normal driving or lockup conditions, shift solenoid A (duty type) and shift solenoid E (on/off type) operate to implement the slip lockup control (lockup clutch is half engaged).
- At the point where vehicle speed drops below the set value during deceleration in slip lockup, slip lockup control is released.



E6U517AS5062

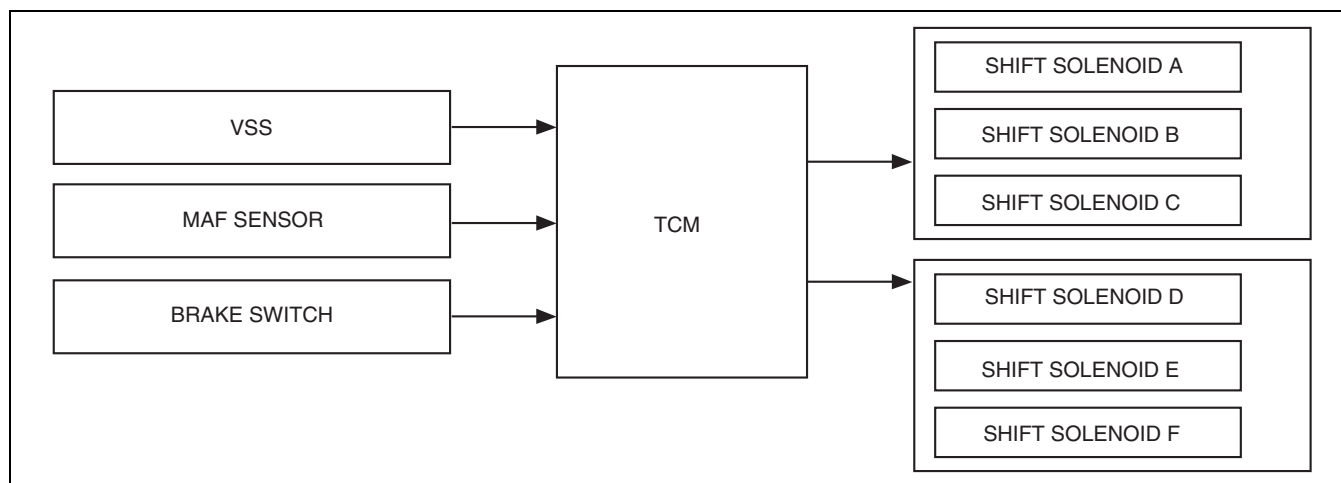
## AUTOMATIC TRANSAXLE [FS5A-EL]

### SLOPE MODE CONTROL OUTLINE [FS5A-EL]

E6U051718901S22

- Climbing or descending is determined based on the engine output torque and the vehicle acceleration, and the shift gear is controlled to realize smooth vehicle driving.

#### Block diagram



E6U517AS5063

### SLOPE MODE CONTROL OPERATION [FS5A-EL]

E6U051718901S23

#### Climbing hill

- When the hill is steeper than a specified grade, unnecessary shift up is prevented by holding an appropriate shift gear.

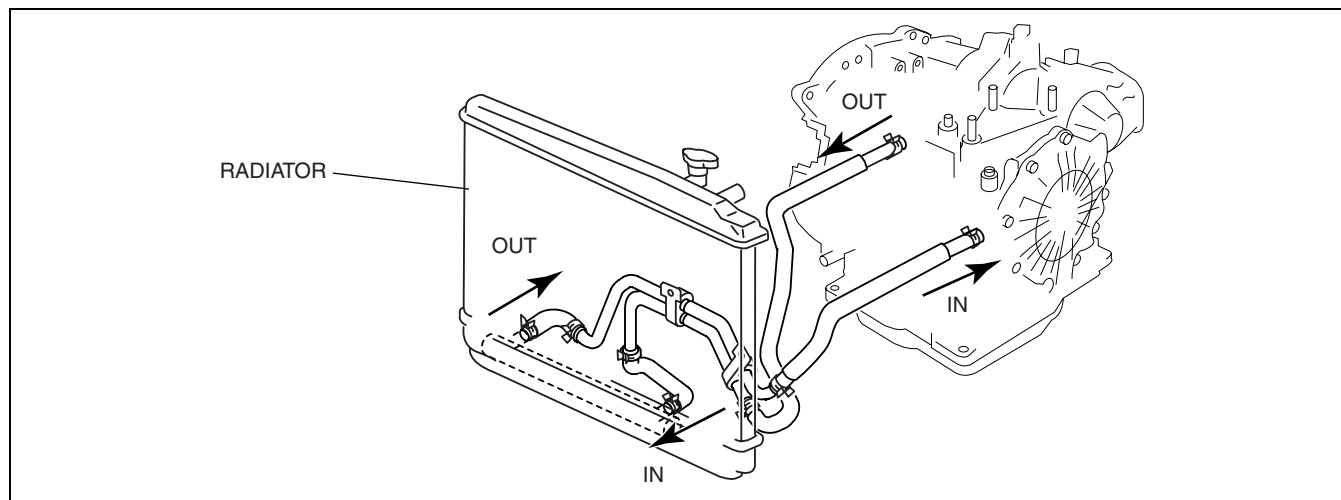
#### Descending hill

- When the descent is steeper than a specified grade and the brake switch is depressed, use of the brake pedal is reduced by shifting from 5GR to 4GR or from 4GR to 3GR and applying the engine brake effectively.

### COOLING SYSTEM OUTLINE [FS5A-EL]

E6U051719900S01

- A water-cooled AT oil cooler installed the radiator has been adopted.



E6U517AS5064



# STEERING

**06**  
SECTION

## OUTLINE ..... 06-00

## 06-00 OUTLINE

STEERING ABBREVIATION ..... 06-00-1  
STEERING FEATURES ..... 06-00-1

STEERING SPECIFICATIONS ..... 06-00-1

### STEERING ABBREVIATION

E6U060000000S01

**06-00**

ATF	Automatic Transaxle Fluid
ATX	Automatic Transaxle
MTX	Manual Transaxle

### STEERING FEATURES

E6U060000000S02

Optimized steering gear for 18inch wheels	<ul style="list-style-type: none"> <li>Rack stroke and lock-to-lock optimized (MAZDASPEED6)</li> </ul>
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### STEERING SPECIFICATIONS

E6U060000000S03

Item		2006MY MAZDASPEED6	2006MY Mazda6	2005MY Mazda6
Steering wheel	Outer diameter (mm {in})	372 {14.8}		←
	Lock-to-lock (turns)	2.65	2.54	2.54
Steering gear and linkage	Type	Rack-and-pinion		←
	Rack stroke (mm {in})	141.6—143.6 {5.575—5.654}	135.4—137.4 {5.330—5.409}	135.4—137.4 {5.330—5.409}
Steering column and shaft	Shaft type	Collapsible		←
	Joint type	2-cross joint		←
	Amount of tilt (mm {in})	45 {1.8}		←
	Amount of telescope (mm {in})	50 {2.0}		←
Power steering system	Power assist type		Engine speed sensing	
	Power steering fluid	Type	ATF M-III, M-V or equivalent (e.g. Dexron®III)	
		Fluid capacity* (approximate quantity) (L {US qt, Imp qt})	0.89 {0.94, 0.78}	L3 MTX: 0.77 {0.81, 0.68} L3 ATX: 0.84 {0.89, 0.74} AJ: 1.02 {1.08, 0.90}

\* : When reservoir tank is at maximum volume

**06-00-1**



# HEATER, VENTILATION & AIR CONDITIONING (HVAC)

# 07

SECTION

**OUTLINE** ..... 07-00  
**ON-BOARD DIAGNOSTIC**  
**[HVAC]** ..... 07-02

**BASIC SYSTEM** ..... 07-11  
**CONTROL SYSTEM** ..... 07-40

## 07-00 OUTLINE

**HVAC ABBREVIATION** ..... 07-00-1  
**HVAC OUTLINE OF**  
**CONSTRUCTION** ..... 07-00-1

**HVAC FEATURES** ..... 07-00-1  
**HVAC SPECIFICATIONS**  
**[L3 WITH TC]** ..... 07-00-2

### HVAC ABBREVIATION

E6U07000000S01

CPU	Central processing unit
DEF	Defroster
HI	High
HVAC	Heater, ventilation and air conditioning
IG	Ignition
LO	Low
M	Motor
MAX	Maximum
OFF	Switch off
ON	Switch on
POWER MOS FET	Power Metal Oxide Semiconductor Field Effect Transistor
REC	Recirculate
TNS	Tail number side light
VENT	Ventilation

### HVAC OUTLINE OF CONSTRUCTION

E6U07000000S02

- The construction and operation of the heater, ventilation & air conditioning (HVAC) system is essentially carried over from that of the previous 2003MY(U.S.A)/2004MY(Canada) Mazda6, except for the following features.  
(See 2003 (U.S.A.) 2004 (Canada) Mazda6 Service Highlights 3372-1U-02I.)

### HVAC FEATURES

E6U07000000S03

Improved air conditioning performance	<ul style="list-style-type: none"><li>A sub-cooling system integrating the condenser and receiver/drier has been adopted to facilitate evaporator operation. This system also reduces the number of parts and the amount of refrigerant.</li></ul>
Improved visibility	<ul style="list-style-type: none"><li>To improve windshield and front door glass defogging, the climate control unit is designed to automatically turn the air intake mode to FRESH when the airflow mode selector dial is turned to DEFROSTER position.</li></ul>
Reduce weight	<ul style="list-style-type: none"><li>The A/C unit integrating the cooling unit and heater unit has been adopted to reduce weight.</li></ul>

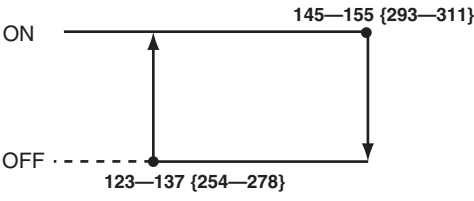
# OUTLINE

## HVAC SPECIFICATIONS [L3 WITH TC]

E6U07000000S04

Item		Specification
Heating capacity (kW {kcal/h})		4.400 {3,784}
Airflow volume (during heater operation)	Blower motor (m <sup>3</sup> /h)	310
Electricity consumption (during heater operation)	Blower motor (W)	184
Cooling capacity (kW {kcal/h})		4.200 {3,612}
Airflow volume (during air conditioner operation)	Blower motor (m <sup>3</sup> /h)	460
Electricity consumption (during air conditioner operation)	Blower motor (W)	225
	Magnetic clutch (W)	46
Fan type	Blower motor	Sirocco fan
Refrigerant	Type	R-134a
	Regular amount (approx. quantity) (g {oz})	470 {16.6}
A/C compressor	Type	Vane-rotary
	Discharge capacity (ml {cc, fl oz})	120 {120, 4.06}
	Max. allowable speed (rpm)	7,200
	Type	ATMOS GU10
	Lube oil Sealed volume (approx. quantity) (ml {cc, fl oz})	150 {150, 5.07}
	Magnetic clutch clearance (mm {in})	0.3—0.5 {0.012—0.019}
Condenser	Type	Multiflow (sub-cooling type)
	Radiated heat (kW {kcal/h})	5.96 {5,130}
	Receiver/drier capacity (ml {cc, fl oz})	190 {190, 6.42}
	Desiccant	Synthetic zeolite
Expansion valve	Type	Block type
Evaporator	Type	Double-tank drawn cup
Refrigerant pressure switch	Type	Triple-pressure
	Operating pressure (MPa {kgf/cm <sup>2</sup> , psi})	<p>HI AND LO PRESSURE SWITCH</p> <p>0.176—0.216 {1.795—2.202, 25.53—31.31}</p> <p>2.94—3.34 {30.0—34.0, 427—483}</p> <p>ON ————</p> <p>OFF ————</p> <p>0.02 {0.20, 2.84} or less</p> <p>0.39—0.79 {3.98—8.05, 56.6—114}</p> <p>0.195—0.250 {1.989—2.549, 28.30—36.24}</p> <p>MEDIUM-PRESSURE SWITCH</p> <p>1.08—1.38 {11.1—14.0, 158—199}</p> <p>ON ————</p> <p>OFF ————</p> <p>1.39—1.65 {14.2—16.8, 202—238}</p>

## OUTLINE

Item		Specification
Thermal protector	Type	Bimetallic (Indirect sensing type)
	Operating temperature (°C {°F})	 <p>ON ————— 145—155 {293—311}</p> <p>OFF ······ 123—137 {254—278}</p>
Sensor	Solar radiation sensor	Photodiode
	Ambient temperature sensor	Thermistor
	Passenger compartment temperature sensor	
	Evaporator temperature sensor	
	A/C water temperature sensor	
Actuator	Air intake actuator	Sliding contact type
	Air mix actuator, airflow mode actuator	Potentiometer type
Temperature control		Reheat full air mix type

07-00



## 07-02 ON-BOARD DIAGNOSTIC [HVAC]

### ON-BOARD DIAGNOSTIC FUNCTION

OUTLINE [L3 WITH TC] ..... 07-02-1

### ON-BOARD DIAGNOSTIC FUNCTION

BLOCK DIAGRAM [L3 WITH TC]..... 07-02-2

### ON-BOARD DIAGNOSTIC FUNCTION

[L3 WITH TC] .....07-02-2

Present Failure Indication Mode .....07-02-2

Past Failure Indication Mode.....07-02-2

Output Device Operation Check

Mode.....07-02-4

### ON-BOARD DIAGNOSTIC FUNCTION OUTLINE [L3 WITH TC]

E6U070200000S01

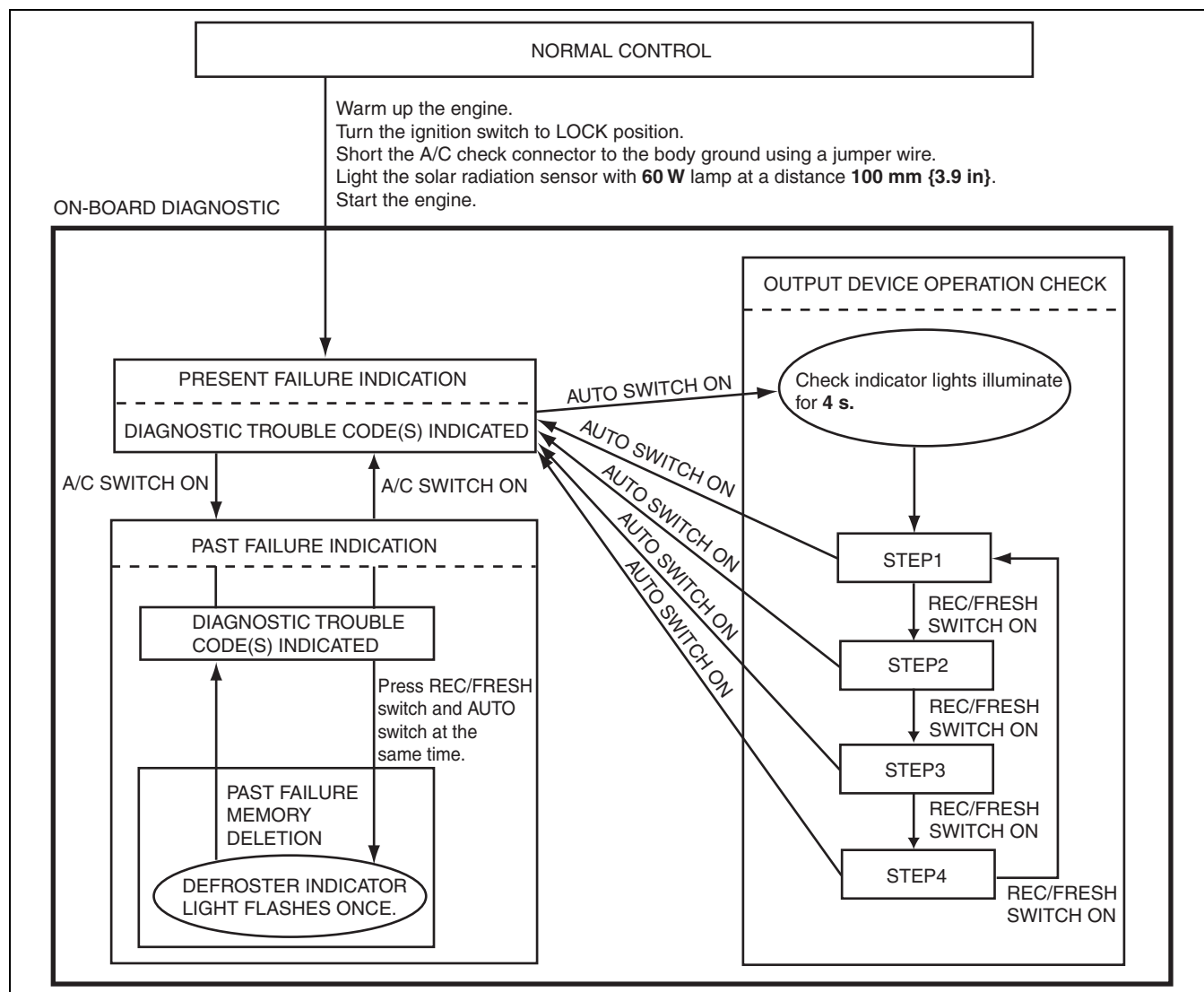
- Based on the sunlight intensity and temperature signals from the various sensors, the climate control unit performs very complex control to the output actuation devices. Therefore, the operating condition of the output devices may vary due to input conditions, even though the controls on the climate control unit are not changed. As a result, when a malfunction occurs in the control system, it may be difficult to reproduce the symptom and to isolate the malfunctioning part of the system. To avoid such difficulty, the climate control unit is programmed with a on-board diagnostic function which input system is malfunctioning. It can also check the output system separately from the input system.
- The on-board diagnostic function has three modes: present failure indication, past failure indication, and output device operation check.
- The climate control unit terminal 1F is connected to the body ground by the body grounding of the A/C check connector, whereby voltage fluctuation occurs. The climate control unit detects this voltage fluctuation and activates the on-board diagnostic function.

07-02

# ON-BOARD DIAGNOSTIC [HVAC]

## ON-BOARD DIAGNOSTIC FUNCTION BLOCK DIAGRAM [L3 WITH TC]

E6U07020000S02



E6U0702ZSB101

## ON-BOARD DIAGNOSTIC FUNCTION [L3 WITH TC]

E6U07020000S03

### Present Failure Indication Mode

- In present failure indication mode, present failures in the control system circuits (open, short circuits) are detected, and the flashing of the defroster indicator light on the climate control unit indicates the DTCs shown in the table below.


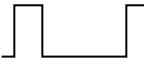











### Past Failure Indication Mode

- In past failure indication mode, past failures (intermittent problems) in the input sensor circuits (open, short circuits) are stored, and the flashing of the defroster indicator light on the climate control unit indicates the DTCs shown in the table below. Erase DTCs from the memory after failures have been corrected so they are not maintained as past failures.

### Diagnostic trouble codes

DTC No.	Indicator pattern	Diagnosed circuit	Detected condition	Memo rized
02	ON OFF	Solar radiation sensor (present)	Open circuit in solar radiation sensor circuit Short circuit in solar radiation sensor circuit (terminal B side only)	No
06	ON OFF	Passenger compartment temperature sensor (present)	Open/short circuit is in passenger compartment temperature sensor circuit	No

# ON-BOARD DIAGNOSTIC [HVAC]

DTC No.	Indicator pattern	Diagnosed circuit	Detected condition	Memo rized
07	ON  OFF	Passenger compartment temperature sensor (past)	Passenger compartment temperature sensor circuit is entered fail-safe mode at least once	Yes
10	ON  OFF	Evaporator temperature sensor (present)	Open/short circuit is in evaporator temperature sensor circuit	No
11	ON  OFF	Evaporator temperature sensor (past)	Evaporator temperature sensor circuit is entered fail-safe mode at least once	Yes
12	ON  OFF	Ambient temperature sensor (present)	Open/short circuit is in ambient temperature sensor circuit	No
13	ON  OFF	Ambient temperature sensor (past)	Ambient temperature sensor circuit is entered fail-safe mode at least once	Yes
14	ON  OFF	A/C water temperature sensor (present)	Open/short circuit is in A/C water temperature sensor circuit	No
15	ON  OFF	A/C water temperature sensor (past)	A/C water temperature sensor circuit is entered fail-safe mode at least once	Yes
18	ON  OFF	Air mix actuator (potentiometer) (present)	Open/short circuit is in air mix actuator (potentiometer) circuit	No
19	ON  OFF	Air mix actuator (potentiometer) (past)	Air mix actuator (potentiometer) circuit is entered fail-safe mode at least once	Yes
21	ON  OFF	Airflow mode actuator (potentiometer) (present)	Open/short circuit is in airflow mode actuator (potentiometer) circuit	No
22	ON  OFF	Airflow mode actuator (potentiometer) (past)	Airflow mode actuator (potentiometer) circuit is entered fail-safe mode at least once	Yes
58	ON  OFF	Air mix actuator (motor lock) (past)	Air mix actuator circuit is entered fail-safe mode at least once	Yes
59	ON  OFF	Airflow mode actuator (motor lock) (past)	Airflow mode actuator circuit is entered fail-safe mode at least once	Yes

07-02

## ON-BOARD DIAGNOSTIC [HVAC]

### Output Device Operation Check Mode

- In the output device operation check mode, the climate control unit forces all the output system actuation devices to operate regardless of the input system. The displays change and the switch indicator lights illuminate automatically according to the actuator operated.
- Inspect visually, listen for operation sound, and place hands over air discharge outlets to check for correct operating conditions and to locate the malfunctioning system.

### Output device operation check table

Step	Operating device	Operating conditions	Monitor*	Other device conditions
1	Blower motor speed		1	<ul style="list-style-type: none"> <li>• Air mix actuator operation — 50%</li> <li>• Airflow mode actuator operation — VENT</li> <li>• Air intake actuator operation — FRESH</li> <li>• A/C compressor operation — ON</li> </ul>
2	Air mix actuator operation		21.0 20.5 20.0	<ul style="list-style-type: none"> <li>• Blower motor speed — 3rd</li> <li>• Airflow mode actuator operation — VENT</li> <li>• Air intake actuator operation — FRESH</li> <li>• A/C compressor operation — ON</li> </ul>
3	Airflow mode actuator operation		3	<ul style="list-style-type: none"> <li>• Blower motor speed — 3rd</li> <li>• Air mix actuator operation — 50%</li> <li>• Air intake actuator operation — FRESH</li> <li>• A/C compressor operation — ON</li> </ul>
4	Air intake actuator operation		4	<ul style="list-style-type: none"> <li>• Blower motor speed — 3rd</li> <li>• Air mix actuator operation — 0%</li> <li>• Airflow mode actuator operation — VENT</li> </ul>
	A/C compressor operation			

\* : Shown on the information display according to step.

## 07-11 BASIC SYSTEM

### BASIC SYSTEM LOCATION INDEX

[L3 WITH TC] ..... 07-11-1

### A/C UNIT CONSTRUCTION/OPERATION

[L3 WITH TC] ..... 07-11-2

Air Mix Door Operation ..... 07-11-2

Airflow Mode Door Operation .....07-11-3

Evaporator.....07-11-4

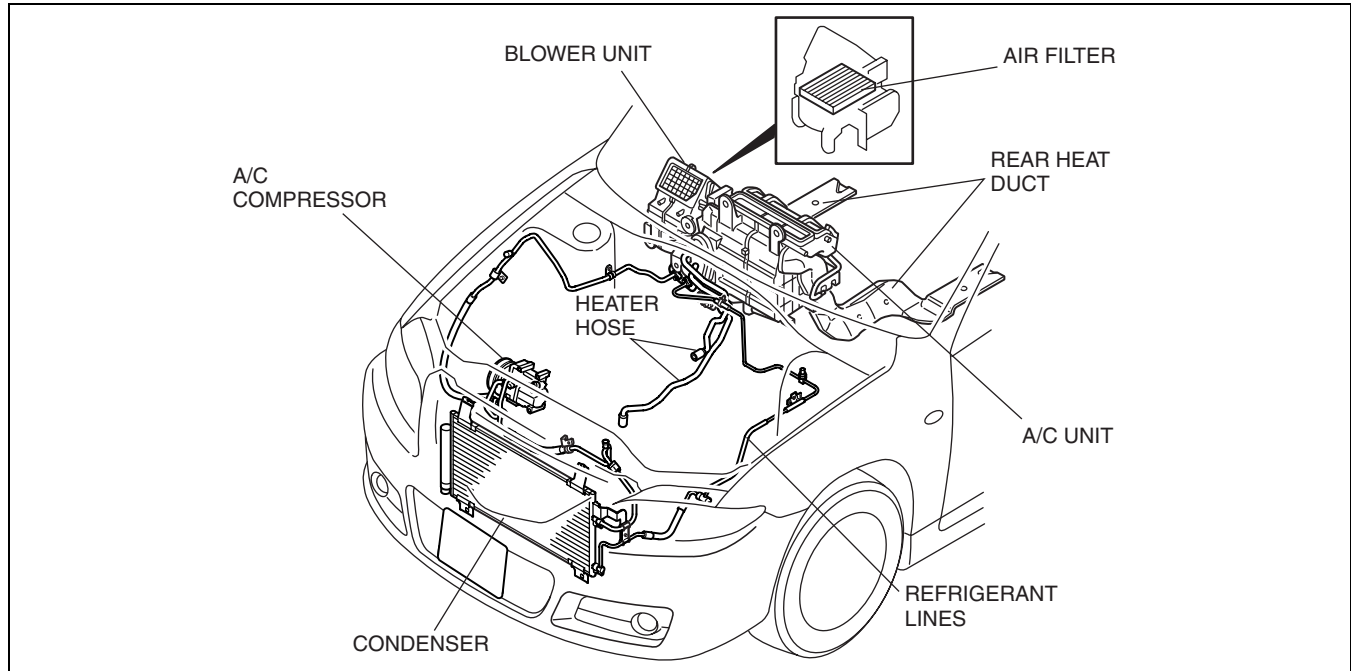
Expansion Valve .....07-11-4

### AIR FILTER FUNCTION

[L3 WITH TC] .....07-11-5

### BASIC SYSTEM LOCATION INDEX [L3 WITH TC]

E6U071100000S01



E6U711ZSB001

## BASIC SYSTEM

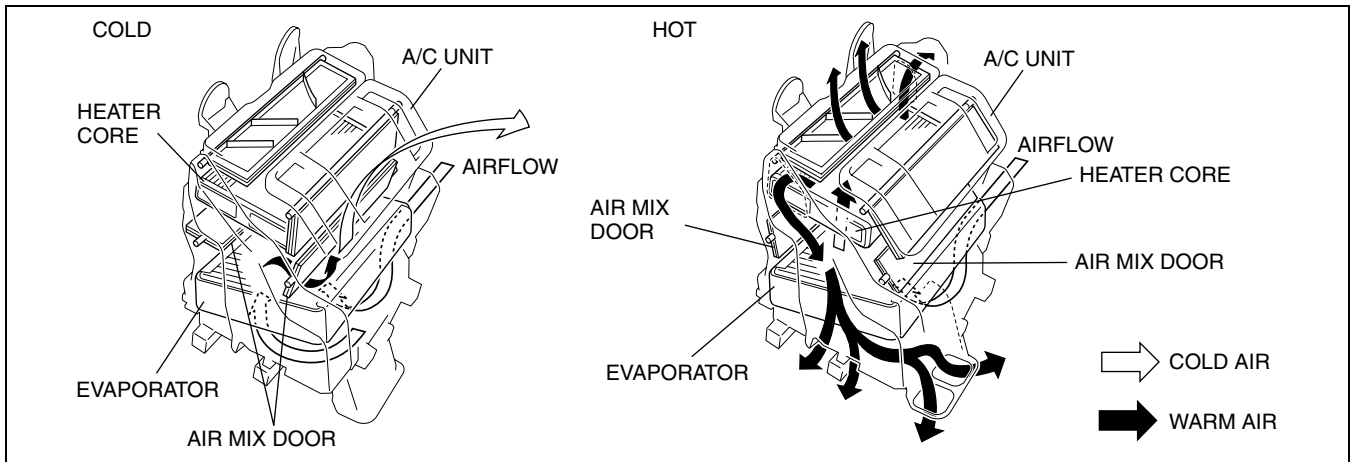
### A/C UNIT CONSTRUCTION/OPERATION [L3 WITH TC]

E6U071161130S01

- The A/C unit which integrates the cooling and heater units has been adopted.

#### Air Mix Door Operation

- The air mix door, installed in the A/C unit, controls HOT or COLD position, depending on the position of the temperature control dial. As a result, airflow distribution changes, and the airflow temperature is controlled.

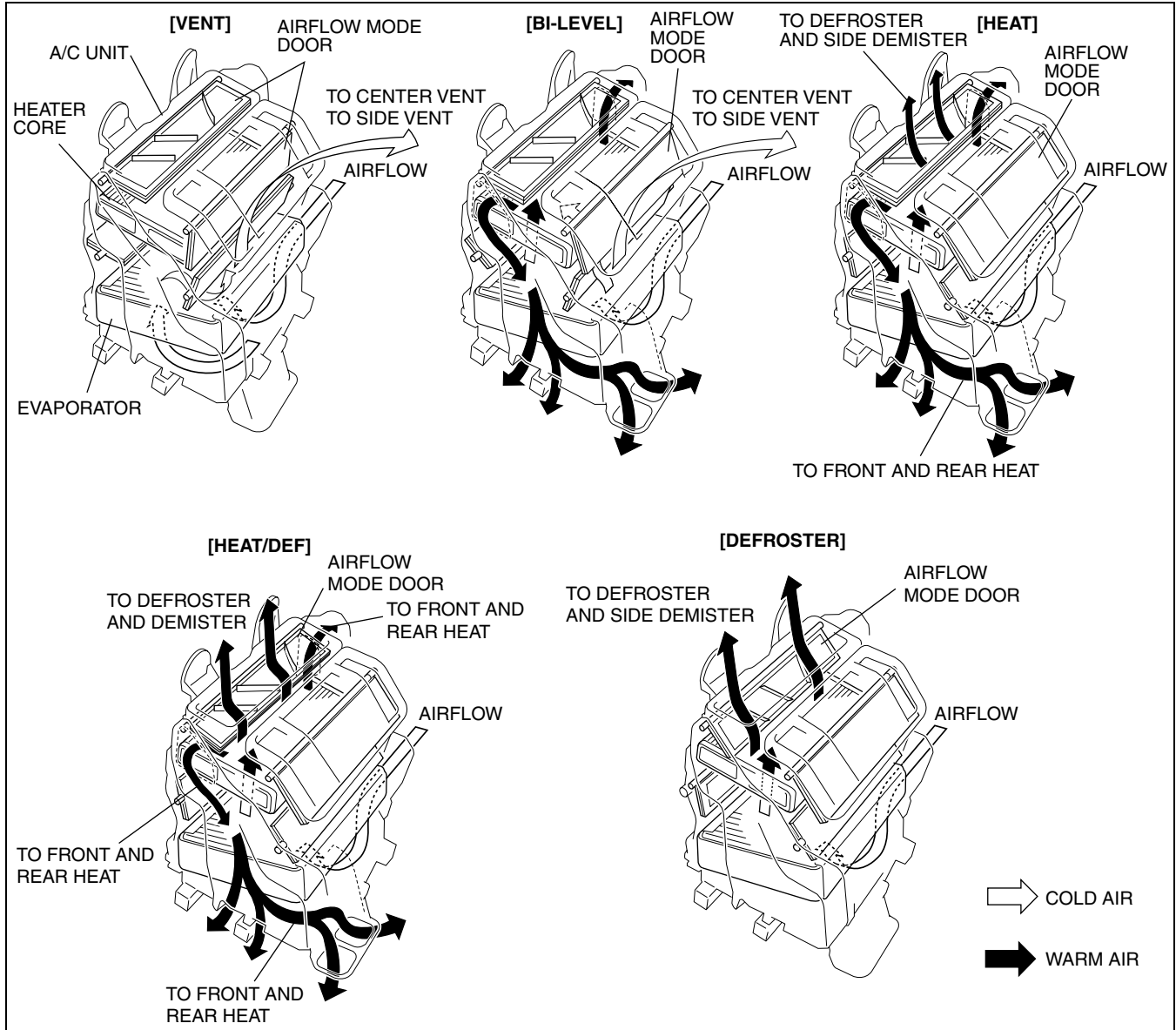


E6U711ZSB002

## BASIC SYSTEM

### Airflow Mode Door Operation

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

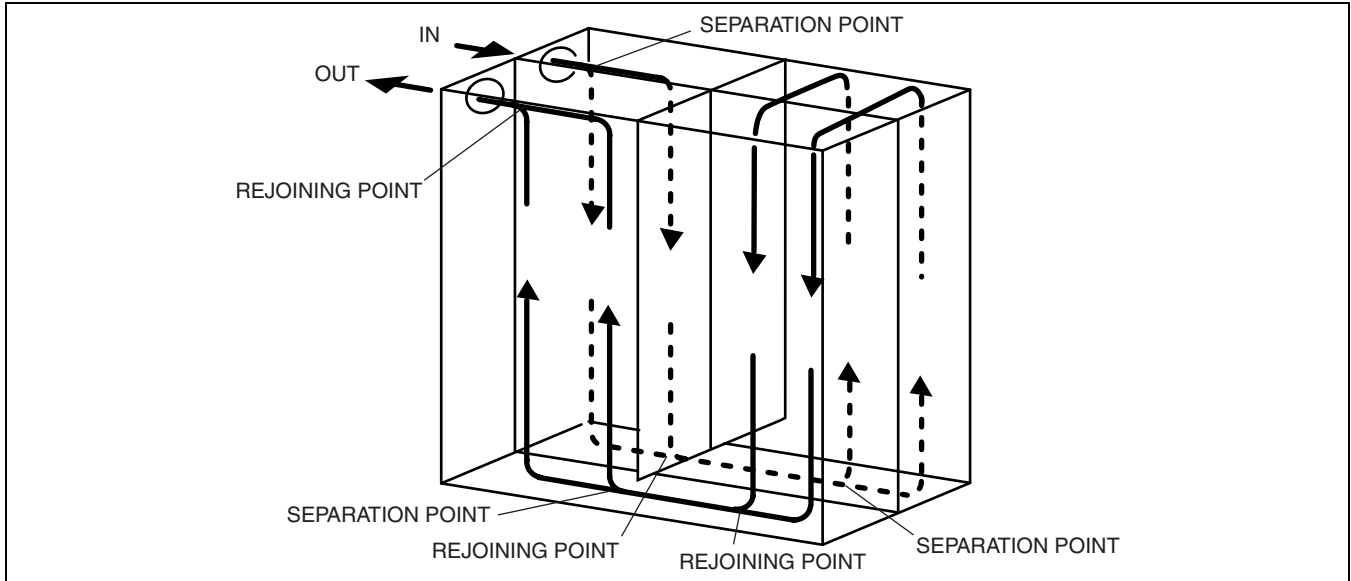


E6U711ZSB003

## BASIC SYSTEM

### Evaporator

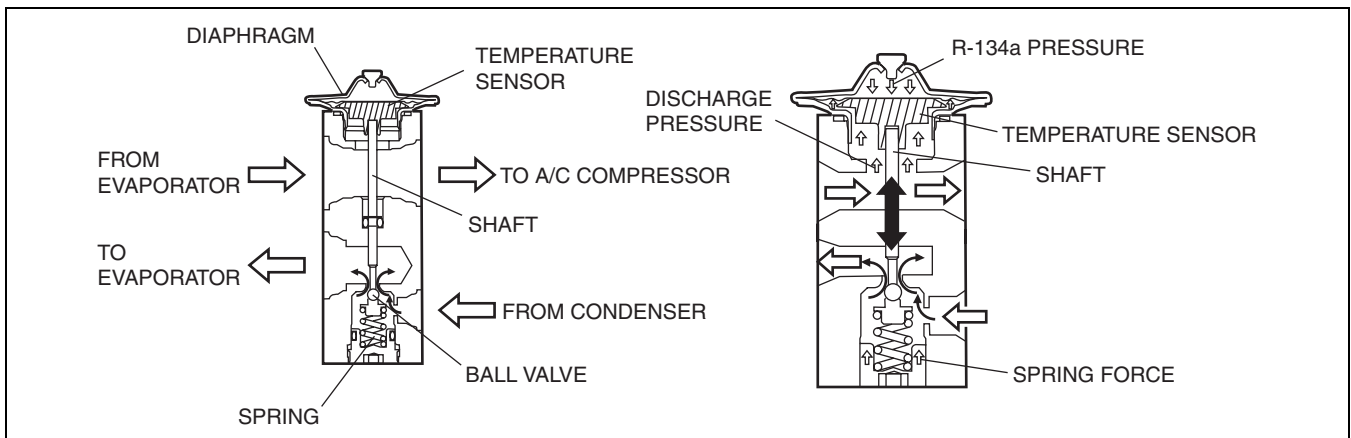
- The double-tank drawn cup is the same as the previous model except that a new refrigerant flow pattern has been adopted. Due to this, size and weight reduction is achieved while maintaining performance.



A6E8516T007

### Expansion Valve

- The expansion valve causes a sudden decrease in the pressure of the liquid refrigerant. This atomizes the refrigerant, making it easier for the evaporator to vaporize it. The expansion valve also regulates the flow volume of the refrigerant sent to the evaporator.
- The amount of refrigerant delivered to the evaporator is adjusted by the opening angle of the ball valve in the expansion valve.
- Opening angle is adjusted by a balance of the R-134a pressure ( $P_d$ ) in the diaphragm, and a composite force of evaporator discharge pressure ( $P_i$ ) against the lower part of the diaphragm and spring force ( $F_s$ ) pushing up the ball valve. When  $P_i$  increases, the temperature of the temperature sensor near the diaphragm rises and the  $P_d$  heated by the R-134a in the diaphragm increases. When the  $P_d$  increases more than  $P_i + F_s$ , the diaphragm is pushed down, and the shaft attached to end of the temperature sensor rod pushes down the ball valve, increasing the amount of liquid refrigerant flow. When the evaporator discharge refrigerant temperature decreases,  $P_i + F_s$  increases more than  $P_d$ , the ball valve is pushed up, and the amount of liquid refrigerant flow decreases.



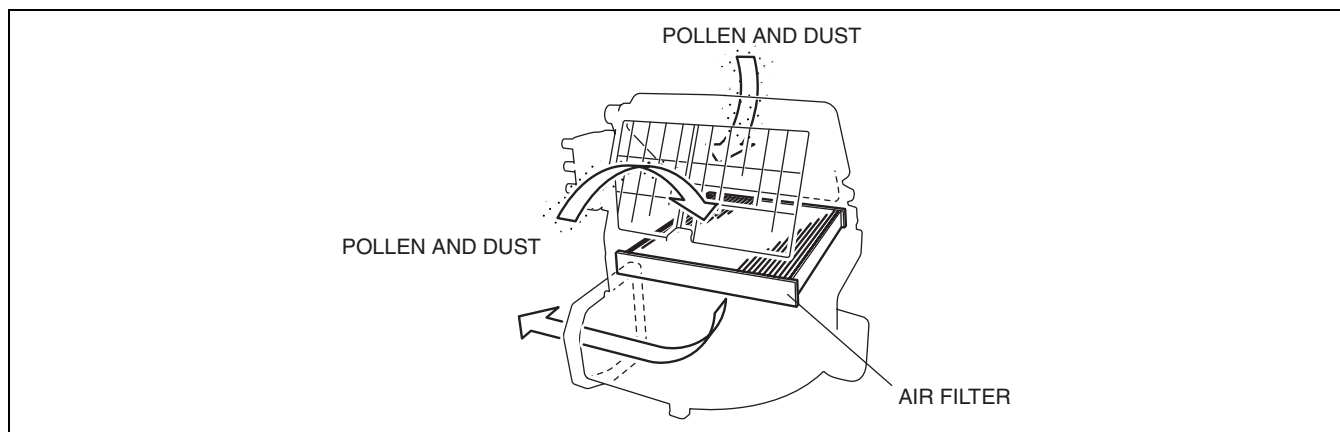
E6U711ZS7101

## BASIC SYSTEM

### AIR FILTER FUNCTION [L3 WITH TC]

E6U071161142S01

- An air filter that can remove pollen and dust have been added.
- The dust filter removes pollen and dust.
- The air filter can not be reused and must be replaced periodically.



E6U711ZSB101



## 07-40 CONTROL SYSTEM

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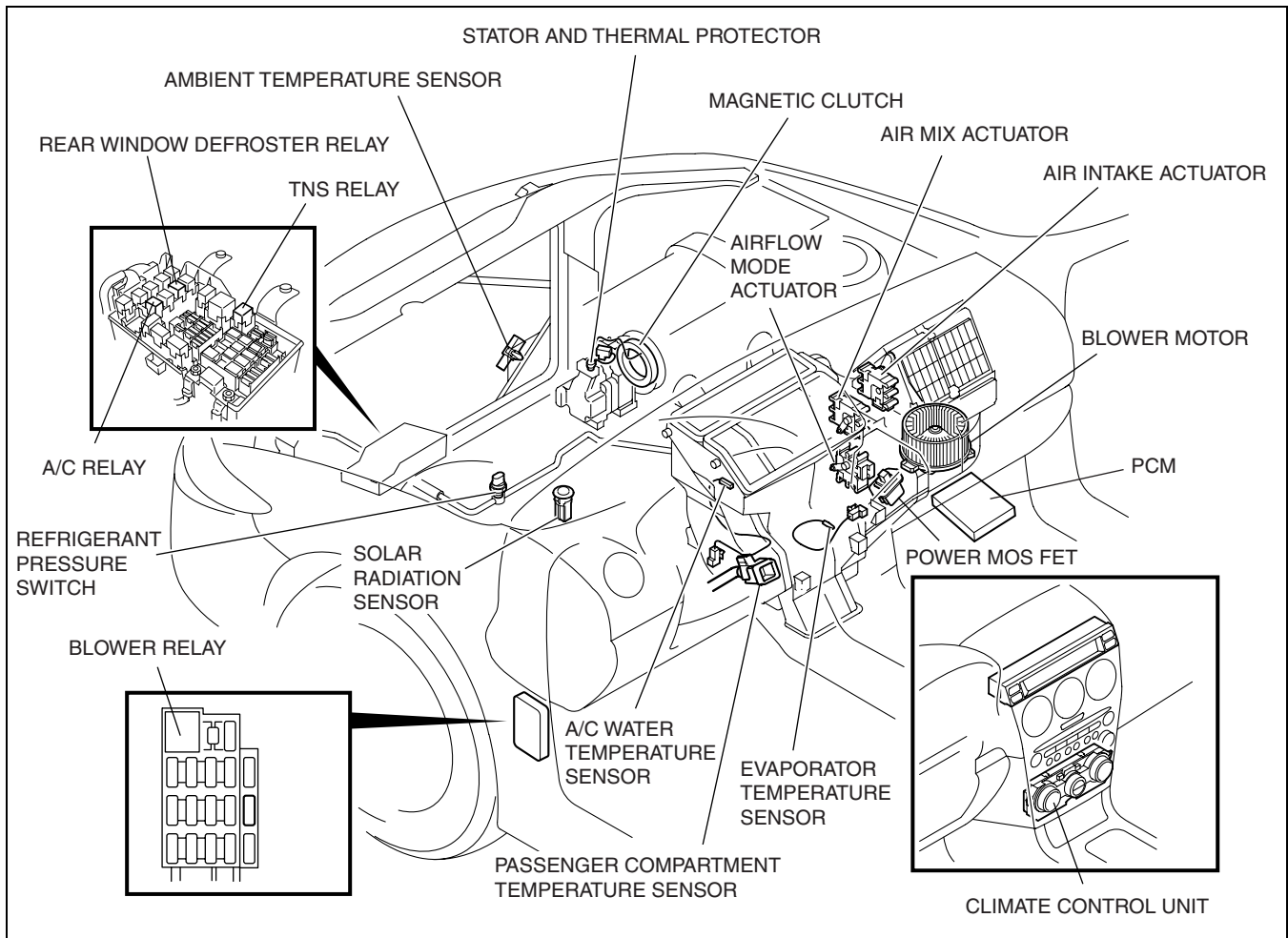
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# CONTROL SYSTEM

## CONTROL SYSTEM LOCATION INDEX [L3 WITH TC]

E6U07400000S01



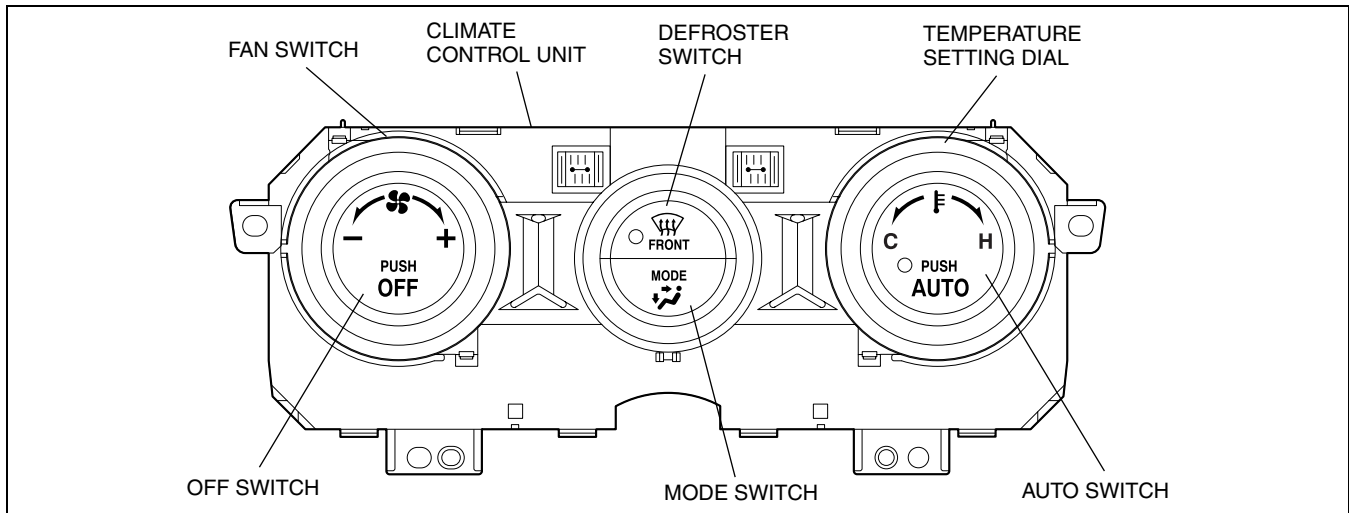
E6U740ZSB001

## CONTROL SYSTEM

### CLIMATE CONTROL UNIT CONSTRUCTION [L3 WITH TC]

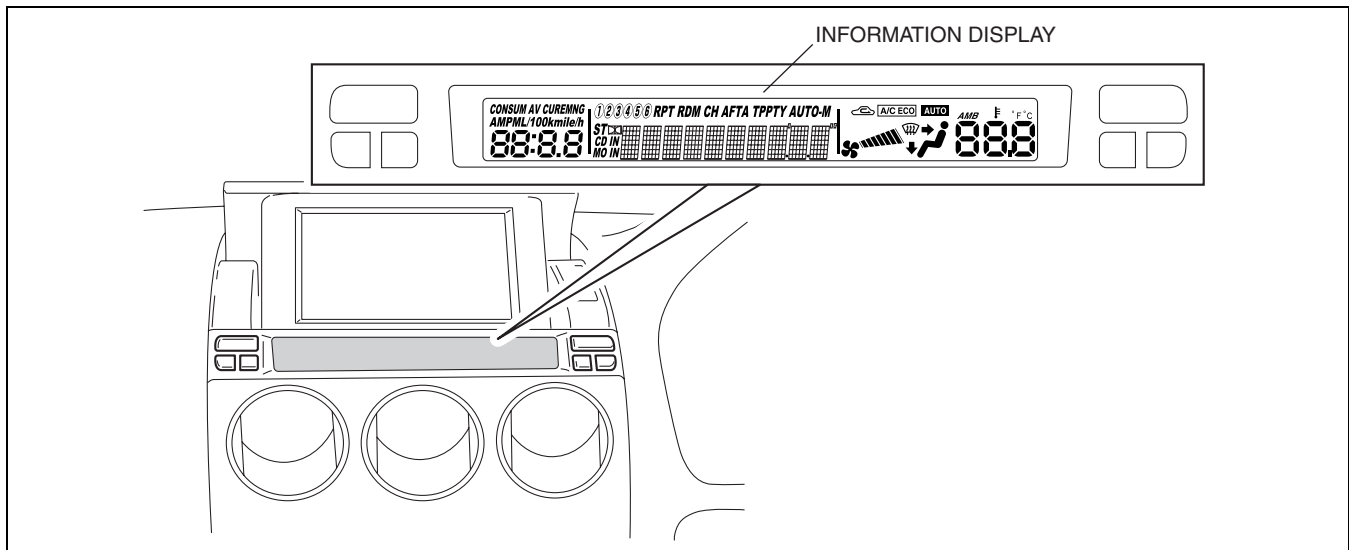
E6U07400000S02

- The MODE switch, temperature setting dial, fan switch have been enlarged to improve ease of operation.
- The A/C, REC/FRESH and rear window defroster switches equipped in the current climate control unit have been relocated to the center panel.



E6U740ZSB002

- Information about the operating condition of the system is displayed on the information display.



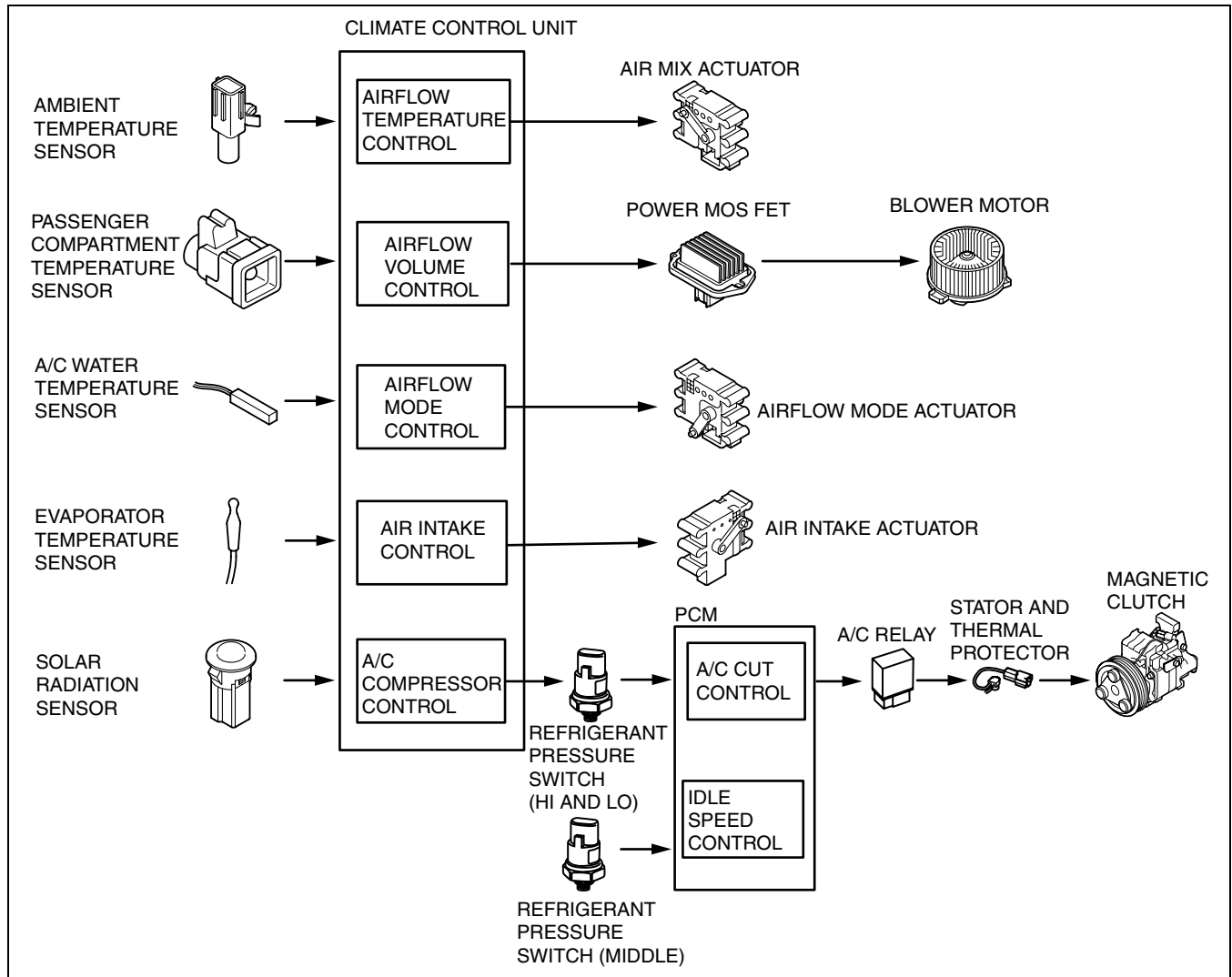
A6A8540T004

# CONTROL SYSTEM

## CONTROL SYSTEM BLOCK DIAGRAM [L3 WITH TC]

E6U07400000S03

- The control system consists of input components (sensors), output components (actuators, magnetic clutch, power MOS FET, and other parts), and a control device (climate control unit).

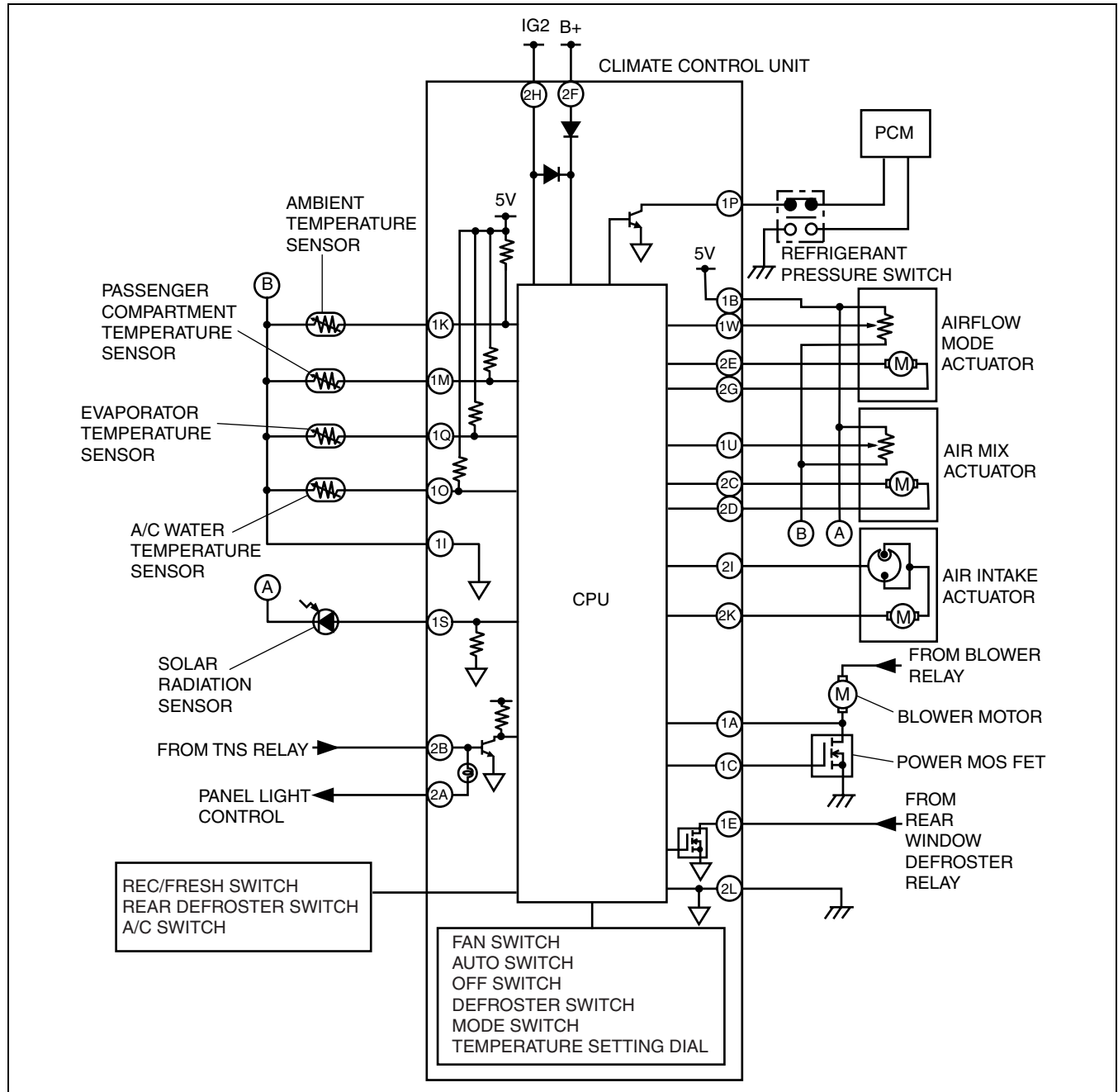


E6U740ZS7101

# CONTROL SYSTEM

## CONTROL SYSTEM WIRING DIAGRAM [L3 WITH TC]

E6U07400000S04



E6U740ZW7101

# CONTROL SYSTEM

## CONTROL SYSTEM FUNCTION [L3 WITH TC]

E6U07400000S05

### Outline of Control System

- In the full-auto air conditioner system, the climate control unit carries out five basic types of controls based on signals from various sensors and control signals from the climate control unit. The climate control unit also has three supplementary functions.

Basic control	Control description	Correction
Airflow temperature control	Airflow temperature automatic control	<ul style="list-style-type: none"> <li>Air intake correction</li> <li>A/C correction</li> <li>MAX HOT and MAX COLD correction</li> <li>Coolant temperature correction</li> <li>Fail-safe function</li> </ul>
Airflow volume control	Airflow volume automatic control	<ul style="list-style-type: none"> <li>Coolant temperature correction (warm-up correction)</li> <li>Mild start correction</li> <li>MAX HOT and MAX COLD correction</li> <li>Windshield mist prevention correction</li> <li>Start compensation correction</li> <li>Defroster correction</li> <li>Fail-safe function</li> </ul>
	Airflow volume manual control	<ul style="list-style-type: none"> <li>Defroster correction</li> <li>Fail-safe function</li> </ul>
Airflow mode control	Airflow mode automatic control	<ul style="list-style-type: none"> <li>Engine coolant temperature correction (warm-up correction)</li> <li>Fail-safe function</li> </ul>
	Airflow mode manual control	<ul style="list-style-type: none"> <li>Fail-safe function</li> </ul>
Air intake control	Air intake automatic control	<ul style="list-style-type: none"> <li>MAX COLD correction</li> <li>Defroster correction</li> <li>Ambient temperature correction</li> <li>A/C OFF correction</li> </ul>
	Air intake manual control	<ul style="list-style-type: none"> <li>Defroster correction</li> </ul>
A/C compressor control	A/C compressor automatic control	<ul style="list-style-type: none"> <li>Defroster correction</li> <li>Ambient temperature correction</li> <li>Windshield mist prevention correction</li> <li>MAX COLD correction</li> </ul>
	A/C compressor manual control	<ul style="list-style-type: none"> <li>Defroster correction</li> <li>Ambient temperature correction</li> <li>Windshield mist prevention correction</li> </ul>

Supplementary function
Sensor fail-safe function
Sensor signal delay function
On-board diagnostic function

### Control Transition

#### Air mix, airflow volume control

Operation switch		Air mix control	Airflow volume control									
		Control before switched	Control before switched									
		Automatic control	Automatic control	Defroster correction	Manual control							
					OFF	1	2	3	4	5	6	7
OFF switch		AUTO	OFF	OFF	OFF							
AUTO switch		AUTO	AUTO	AUTO	AUTO							
Fan switch	+	AUTO	MANUAL <sup>*2</sup>	MANUAL <sup>*2</sup>	1	2	3	4	5	6	7	7
	–	AUTO	MANUAL <sup>*3</sup>	MANUAL <sup>*3</sup>	1	1	1	2	3	4	5	6
MODE switch		AUTO	AUTO	<sup>*5</sup>	No change							
DEFROSTER switch		AUTO	Defroster correction	<sup>*5</sup>	Defroster correction							
A/C switch		AUTO	AUTO	No change	No change							
REC/FRESH switch		AUTO	AUTO	No change	No change							

## CONTROL SYSTEM

Operation switch		Air mix control	Airflow volume control										
		Control before switched	Control before switched										
		Automatic control	Automatic control	Defroster correction	Manual control								
OFF	1				2	3	4	5	6	7			
Temperature setting dial <sup>*1</sup>	60	MAX COLD	MAX HI	MAX HI	No change								
	61—89	AUTO	AUTO	No change	No change								
	90	MAX HOT	AUTO HI <sup>*4</sup>	AUTO HI	No change								

<sup>\*1</sup> : Setting temperature fluctuates up or down in increments of 1, within the range of 60 to 90. When the fan is OFF, the setting temperature can be adjusted in the range of  $\pm 1$ .

<sup>\*2</sup> : Goes up to the closest manual voltage to auto voltage or defroster correction voltage.

<sup>\*3</sup> : Goes down to the closest manual voltage to auto voltage or defroster correction voltage.

<sup>\*4</sup> : Coolant temperature correction takes precedence.

<sup>\*5</sup> : Returns to condition prior to defroster operation. However, if it is off prior to defroster operation, it switches to automatic control.

### Airflow mode control, air intake control, A/C compressor control

Operation switch		Airflow mode control		Air intake control		A/C compressor control	
		Control before switched		Control before switched		Control before switched	
		Automatic control	Manual control	Automatic control	Manual control	Automatic control	Manual control
OFF switch		Condition before OFF switch ON <sup>*2</sup>	No change <sup>*2</sup>	FRESH	No change <sup>*2</sup>	OFF	OFF
AUTO switch		AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
Fan switch	+	AUTO	No change	AUTO	No change	AUTO	No change
	—	AUTO	No change	AUTO	No change	AUTO	No change
MODE switch		VENT→ BI-LEVEL BI-LEVEL→ HEAT HEAT→ HEAT/DEF HEAT/DEF→ VENT DEFROSTER →HEAT	VENT→ BI-LEVEL BI-LEVEL→ HEAT HEAT→ HEAT/DEF HEAT/DEF→ VENT DEFROSTER →HEAT	AUTO <sup>*6</sup>	No change <sup>*2,*6</sup>	AUTO	No change <sup>*3</sup>
DEFROSTER switch		DEFROSTER <sup>*2</sup>	DEFROSTER <sup>*2</sup>	DEFROSTER correction <sup>*2</sup>	DEFROSTER correction <sup>*2</sup>	DEFROSTER correction <sup>*3</sup>	DEFROSTER correction <sup>*3</sup>
A/C switch		AUTO	No change	AUTO	No change	A/C→OFF OFF→A/C <sup>*4,*5</sup>	A/C→OFF OFF→A/C <sup>*4,*5</sup>
REC/FRESH switch		AUTO	No change	FRESH→REC REC→FRESH <sup>*</sup> 6	FRESH→REC REC→FRESH <sup>*</sup> 6	AUTO	No change
Temperature setting dial <sup>*1</sup>	60	AUTO	No change	AUTO	No change	AUTO	No change
	61—89						
	90						

<sup>\*1</sup> : Setting temperature fluctuates up or down in increments of 1, within the range of 60 to 90. When the fan is OFF, the setting temperature can be adjusted in the range of  $\pm 1$ .

<sup>\*2</sup> : If operated when in defroster correction, it returns to the condition prior to defroster operation.

<sup>\*3</sup> : Ambient temperature correction takes precedence. If operated when in defroster correction, it returns to the condition prior to defroster operation. However, if it is off prior to defroster operation, it switches to automatic control.

<sup>\*4</sup> : Ambient temperature correction takes precedence. When the fan is OFF, the A/C is fixed at off.

<sup>\*5</sup> : The A/C compressor is fixed at on when in heat, heat/defroster, or defroster mode. (The display changes according to the A/C switch operation.)

<sup>\*6</sup> : When it is in heat mode, it switches to FRESH, but recognizes the REC/FRESH switch operation. However, if it is in HEAT/DEF or DEFROSTER mode, it is fixed at FRESH and does not recognize the REC/FRESH operation.

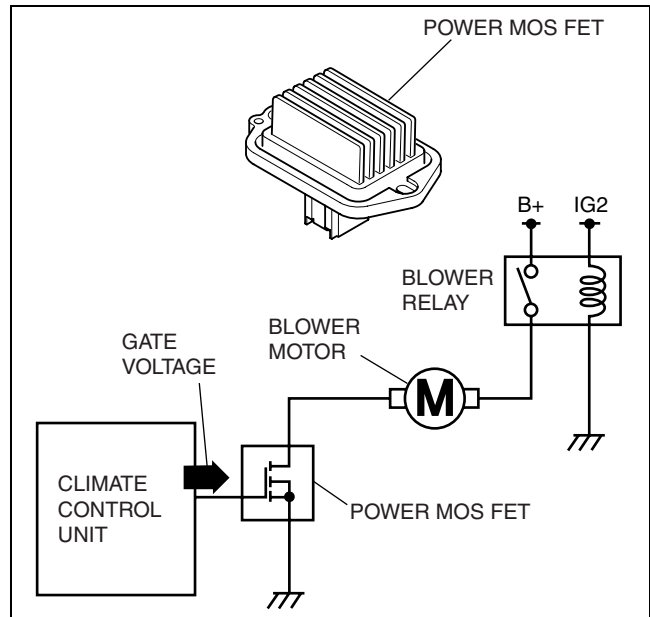
## CONTROL SYSTEM

### POWER METAL OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (POWER MOS FET) FUNCTION [L3 WITH TC]

E6U074000116S01

#### Function

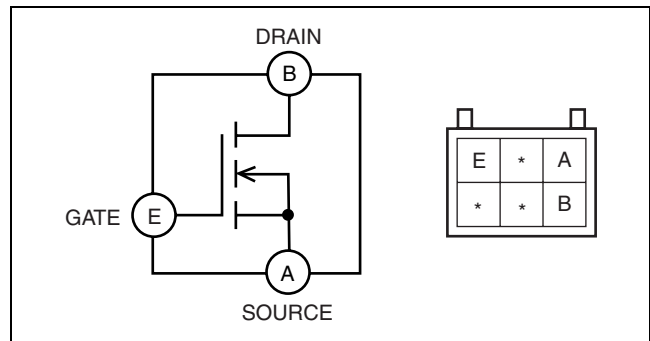
- Controls the supply voltage to the blower motor according to the gate voltage sent from the climate control unit and adjusts the rotation speed (airflow volume).



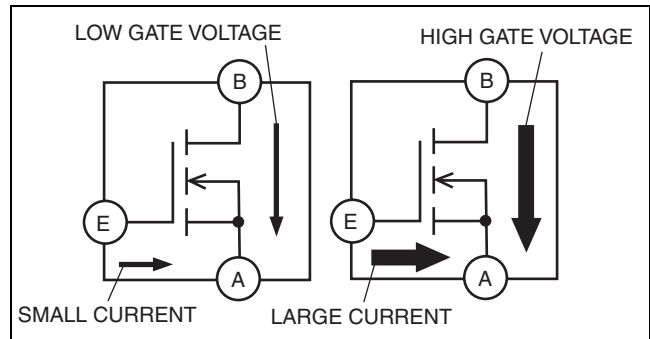
E6U740ZSB101

#### Construction/Operation

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



E6U740ZSB102



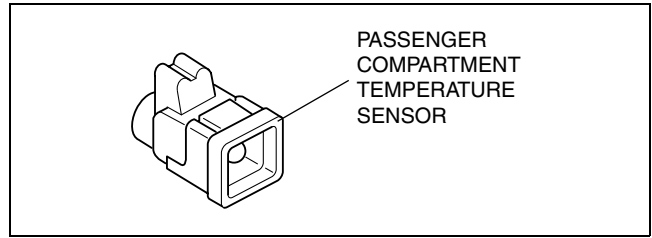
E6U740ZSB103

## CONTROL SYSTEM

### PASSENGER COMPARTMENT TEMPERATURE SENSOR CONSTRUCTION [L3 WITH TC]

E6U074061757S01

- A thermistor has been adopted.



E6U740ZSB104

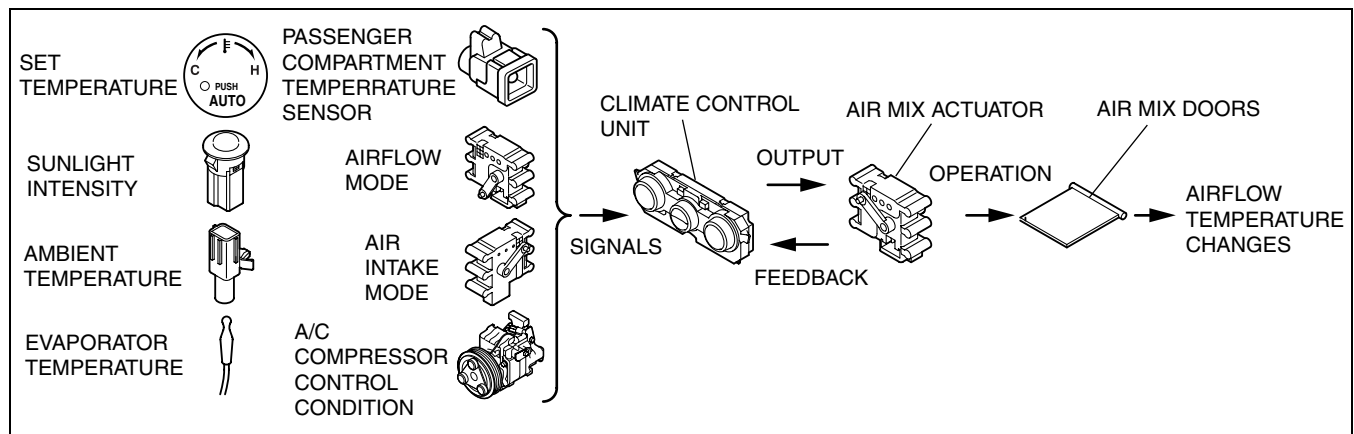
### AIRFLOW TEMPERATURE CONTROL OUTLINE [L3 WITH TC]

E6U07400003S01

- Airflow temperature is controlled by the air mix actuator so that the passenger compartment temperature remains at the target temperature (control computation value T1).
- Control computation value T1 is the target temperature in the cabin set by the climate control unit based on differences among set temperature, input temperature from the sensors, and sunlight intensity.

### AIRFLOW TEMPERATURE CONTROL SYSTEM DIAGRAM [L3 WITH TC]

E6U07400003S02



E6U740ZSB005

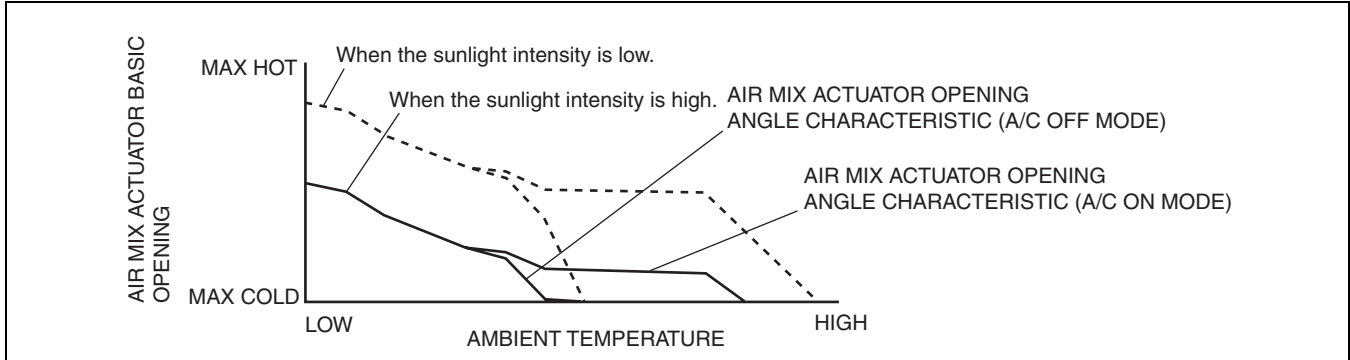
# CONTROL SYSTEM

## AIRFLOW TEMPERATURE CONTROL OPERATION [L3 WITH TC]

E6U074000003S03

### Airflow Temperature Automatic Control

- Based on the set temperature and sunlight intensity, the climate control unit calculates the air mix actuator opening angle characteristic. The higher the sunlight intensity, the lower the air mix actuator opening angle characteristic.
- The climate control unit compares the air mix actuator opening angle characteristic, the present ambient temperature and target temperature (control computation value T1) and determines a basic angle of opening for the air mix actuator.

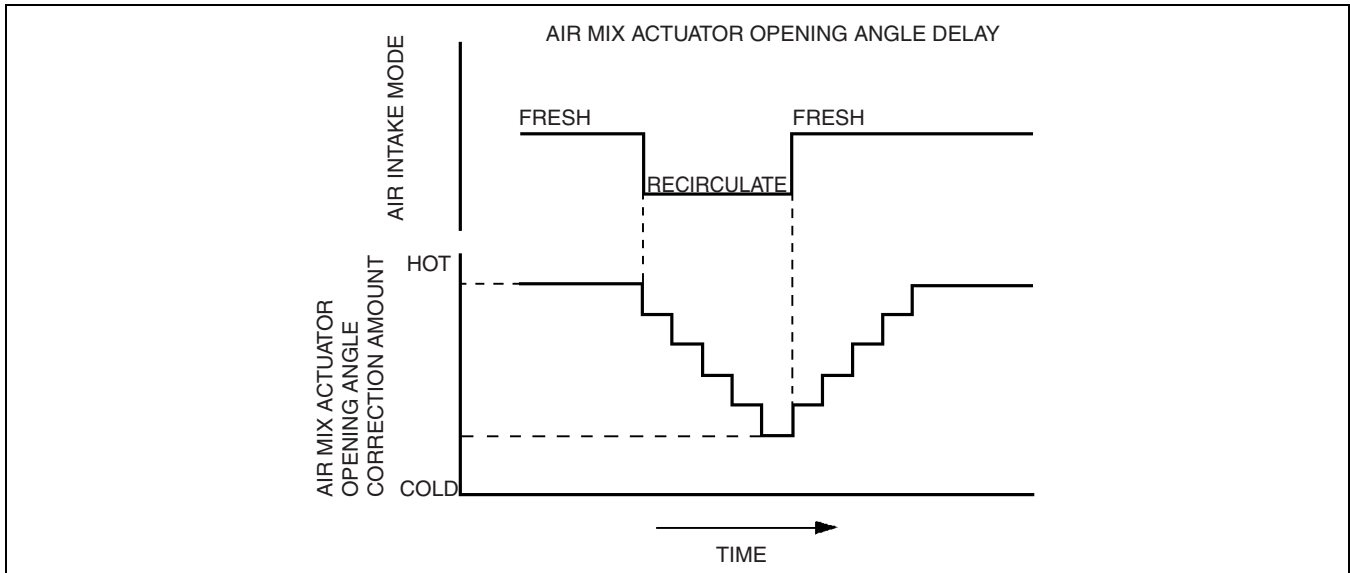


A6A8540T013

### Correction

#### Air intake correction

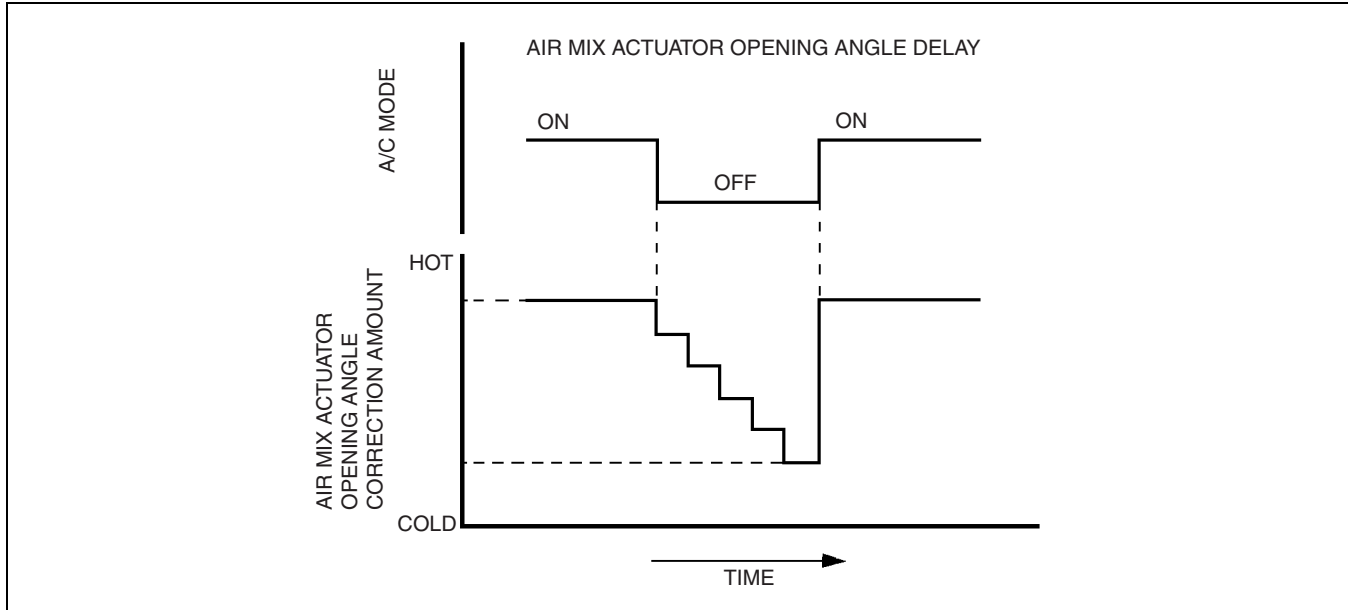
- When the A/C mode is off, the air mix actuator opening angle is corrected to prevent airflow temperature rise when the air intake mode is switched from fresh air to recirculated air. In addition, this correction retards the air mix actuator operation to prevent a sudden drop in airflow temperature.



A6A8540T014

## A/C correction

- When the A/C compressor is switched from A/C ON mode to OFF mode, the basic opening angle of the air mix actuator is switched from the A/C ON mode opening angle to the A/C OFF mode opening angle. This prevents a rise in airflow temperature. In addition, this correction retards the air mix actuator operation to prevent a sudden drop in airflow temperature. However, this retarding correction will not occur if the evaporator temperature is **15 °C {59 °F} or more**.



A6A8540T015

## MAX HOT and MAX COLD correction

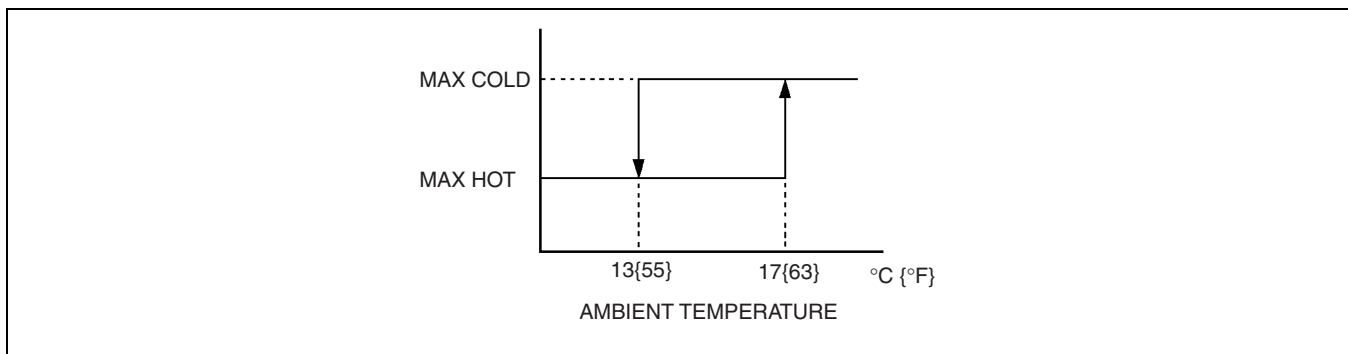
- When the temperature is set to MAX HOT (temperature setting dial is turned to the right), air mix actuator is completely open (100%), when set to MAX COLD (temperature setting dial is turned to the left), it is firmly closed.

## Coolant temperature correction

- There are cases where the engine coolant temperature is lowered when continuously idling in extremely low outside temperature. To prevent lower airflow temperature in this situation, the climate control unit adjusts the HOT air mix actuator to opening according to the engine coolant temperature. However, coolant temperature correction does not operate when the ambient temperature is **10 °C {50 °F} or more**.

## Fail-safe function

- When the potentiometer of air mix actuator is malfunctioning, the air mix door is fixed. Under this situation, if the ignition switch is turned to the ON/LOCK position, the air mix door is controlled to be fully opened (MAX HOT) or closed (MAX COLD) based on the ambient temperature. In addition, the door is fully closed (MAX COLD) at the set temperature MAX COLD, and fully opened (MAX HOT) at the set temperature MAX HOT.



A6A8540T016

- If the air mix door locks and the target air mix actuator opening angle is not reached within **20 s**, the air mix actuator drive signal is stopped to prevent burning the motor.

# CONTROL SYSTEM

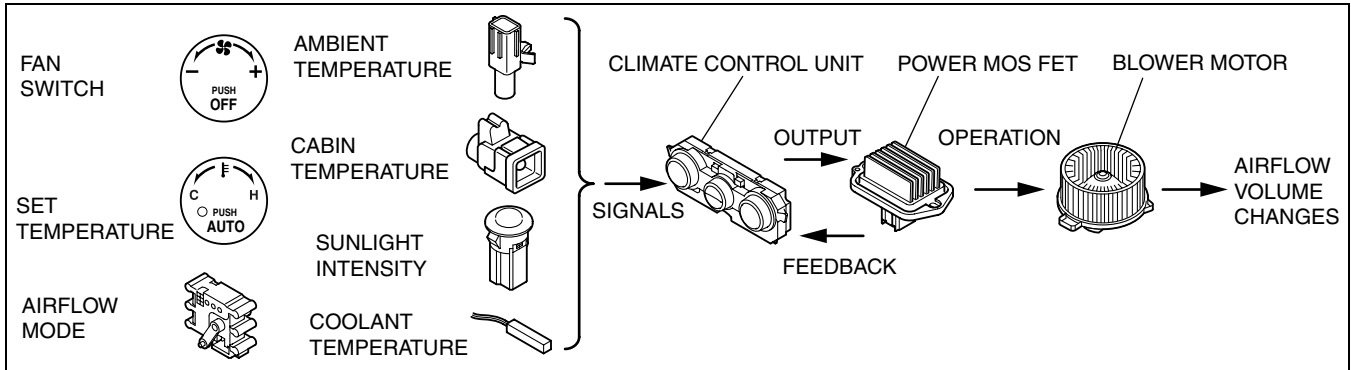
## AIRFLOW VOLUME CONTROL OUTLINE [L3 WITH TC]

E6U07400003S04

- Airflow volume is controlled by the power MOS FET so that the passenger compartment temperature remains at the target temperature (control computation value T2).
- Control computation value T2 is the target temperature in the cabin set by the climate control unit based on differences between set temperature and input temperature from the sensors.

## AIRFLOW VOLUME CONTROL SYSTEM DIAGRAM [L3 WITH TC]

E6U07400003S05



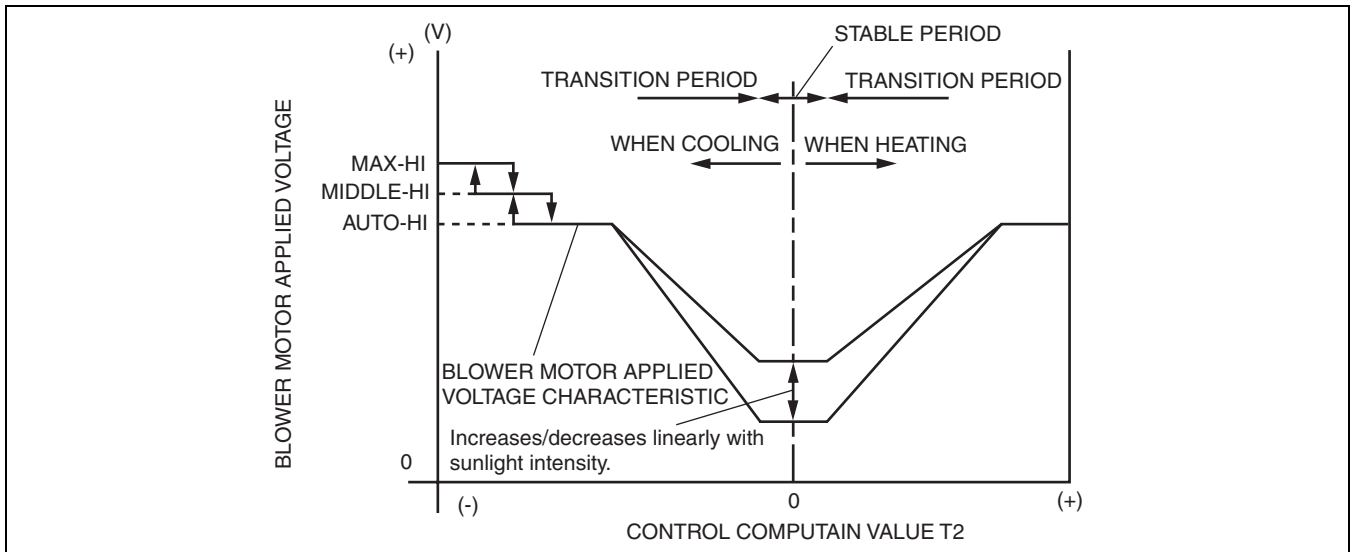
E6U740ZSB006

## AIRFLOW VOLUME CONTROL OPERATION [L3 WITH TC]

E6U07400003S06

### Airflow Volume Automatic Control

- Based on the set temperature, the ambient temperature, and sunlight intensity, the climate control unit calculates the blower motor voltage characteristic (AUTO voltage). It compares the differences among this voltage characteristic, and the target temperature (control computation value T2) and then determines the voltage to be applied to the blower motor.



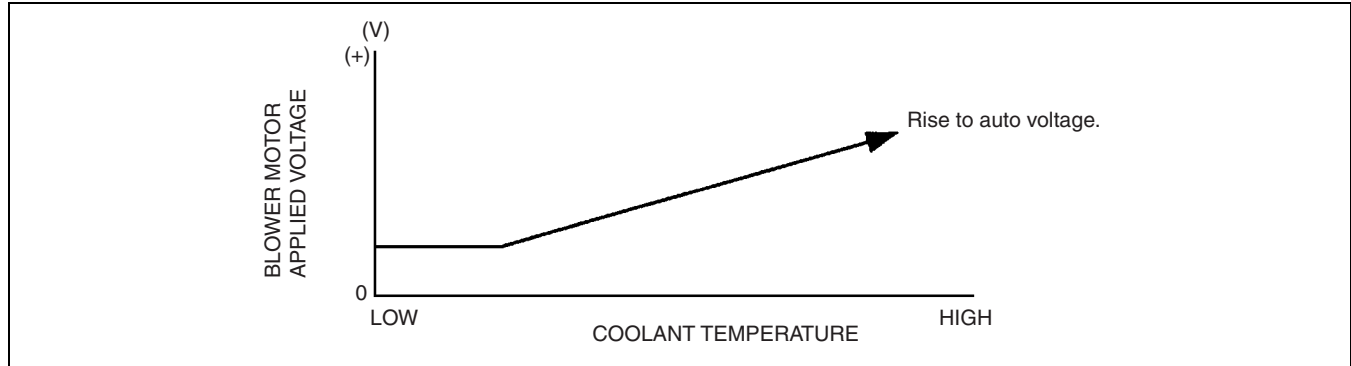
A6A8540T018

# CONTROL SYSTEM

## Correction

### Coolant temperature correction (warm-up correction)

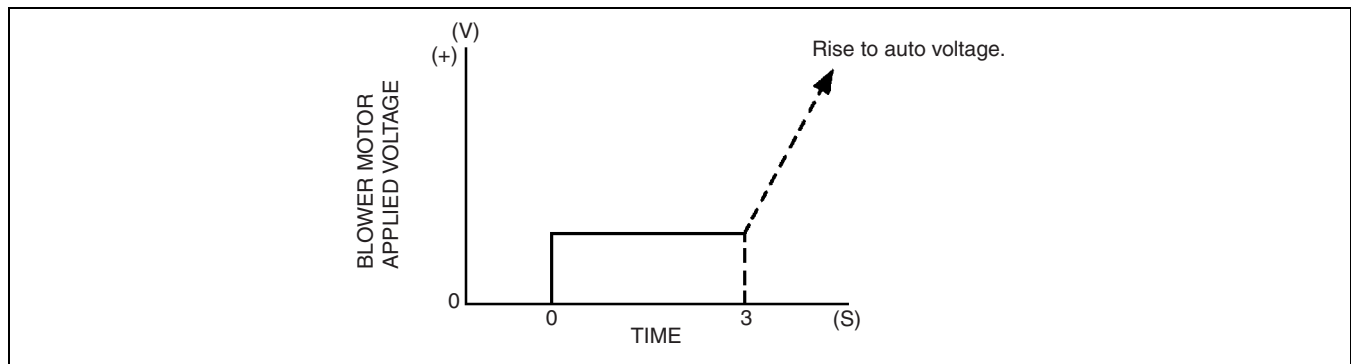
- To prevent a large volume of cold air from blowing through the ventilation outlets when the engine is started in winter, coolant temperature control links the blower motor voltage to the rise in engine coolant temperature. However, coolant temperature correction does not operate when the defroster correction is running, when the cabin temperature is **above 20 °C {68 °F}**, or when airflow is in VENT mode.



A6A8540T019

### Mild start correction

- To prevent a large volume of warm air from blowing through the ventilation outlets when the blower motor is started in summer, the voltage applied to the blower motor is restricted for **3 s** after it starts. However, mild start correction does not operate when the passenger compartment temperature is **below 20 °C {68 °F}**, or when airflow is in any mode other than VENT.



A6A8540T020

### MAX HOT and MAX COLD correction

- When the temperature is set to 90, the applied voltage of the blower motor is set at AUTO-HI, when at 60, the applied voltage of the blower motor is set at MAX-HI. However, when in water temperature correction, MAX HOT correction does not take place.

Correction	Set temperature	Blower motor applied voltage
MAX HOT	90	12.1 (V): AUTO-HI
MAX COLD	60	B+: MAX-HI

### Windshield mist prevention correction

- To prevent the air blown from the defroster when the heater is started in winter from clouding the windows, the blower motor and the A/C signal output are switched off for **6 s** after the ignition is turned to the ON position. This control only operates if the airflow is in HEAT, HEAT/DEF, or DEFROSTER mode.

### Start compensation correction

- When the blower motor is started at **3.2 V**, it is run at a voltage of **4.4 V** for **2 s** to help it stabilize at the target voltage.

### Defroster correction

- To improve defrosting and heating, **2.0 V** is added to the AUTO voltage calculated airflow volume automatic control when the defroster switch is turned on.

### Fail-safe function

- If the blower motor is started with **more than 4.4 V**, a surge will occur and the power MOS FET may burn. To prevent this, the voltage applied to the power MOS FET is regulated to **4.4 V** for **1 s** when it is started.

## CONTROL SYSTEM

### Airflow Volume Manual Control

- The blower motor (airflow) has seven speeds and is operated by the fan switch.

Fan speed	Switch operation	Control device	Blower motor voltage
1st	Airflow volume automatic control, manual 2nd (–), manual 1st (–) or OFF (+ or –) →manual 1st	Power MOS FET	4.4 (V)
2nd	Airflow volume automatic control, manual 1st (+), or manual 4th (–) →manual 2nd	Power MOS FET	6.1 (V)
3rd	Airflow volume automatic control, manual 2nd (+), or manual 4th (–) →manual 3rd	Power MOS FET	7.8 (V)
4th	Airflow volume automatic control, manual 3rd (+), or manual 5th (–) →manual 4th	Power MOS FET	9.5 (V)
5th	Airflow volume automatic control, manual 4th (+), or manual 6th (–) →manual 5th	Power MOS FET	10.8 (V)
6th	Airflow volume automatic control, manual 5th (+), or manual 7th (–) →manual 6th	Power MOS FET	12.1 (V)
7th	Airflow volume automatic control, manual 6th (+), or manual 7th (+) →manual 7th	Power MOS FET	B+

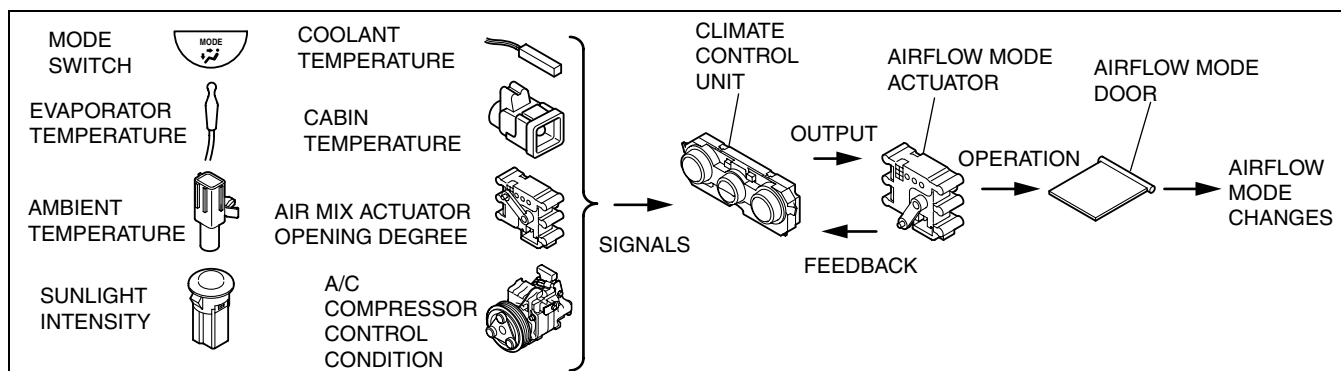
### AIRFLOW MODE CONTROL OUTLINE [L3 WITH TC]

E6U07400003S07

- Airflow mode is controlled by the airflow mode actuator to improve efficiency, heating, and A/C comfort.

### AIRFLOW MODE CONTROL SYSTEM DIAGRAM [L3 WITH TC]

E6U07400003S08



E6U740ZSB007

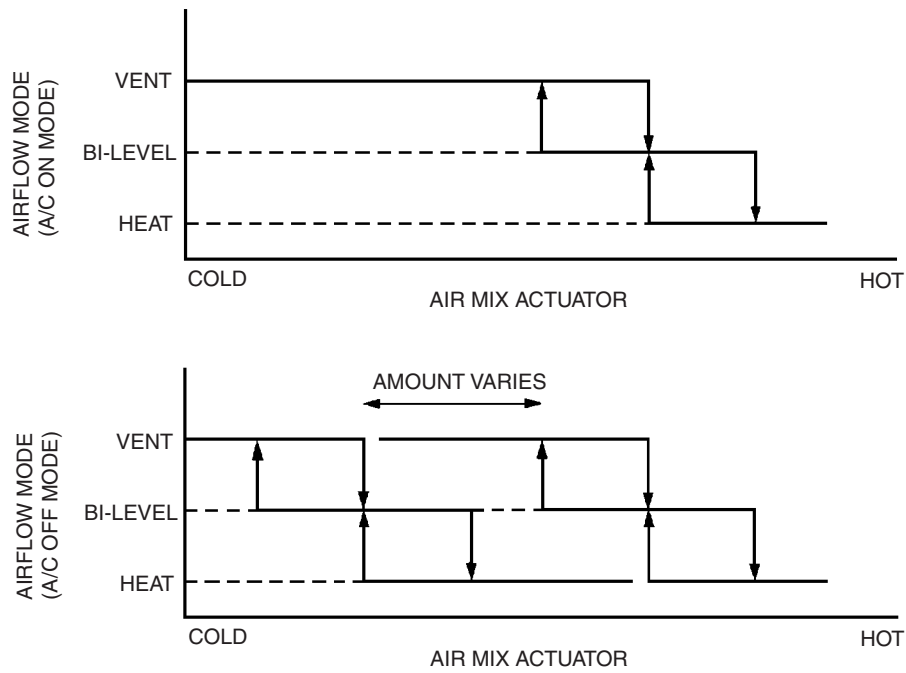
### AIRFLOW MODE CONTROL OPERATION [L3 WITH TC]

E6U07400003S09

#### Airflow Mode Automatic Control

- The climate control unit uses the present opening angle of the air mix actuator and the control condition of the A/C compressor to determine the airflow mode. When the A/C compressor is in OFF mode, the climate control unit varies the determined value of airflow mode according to the temperature signals received from the evaporator temperature sensor.

# CONTROL SYSTEM



A6A8540T022

07-40

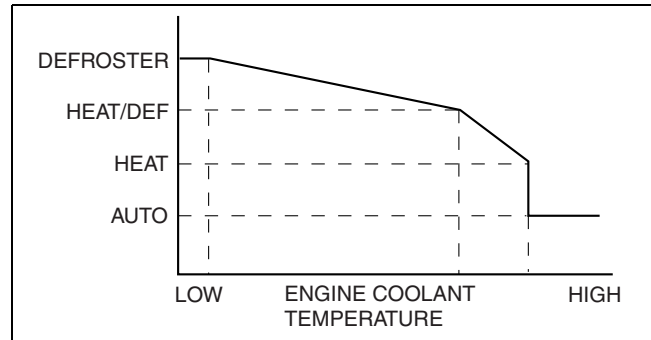
## Correction

### Engine coolant temperature correction (Warm-up correction)

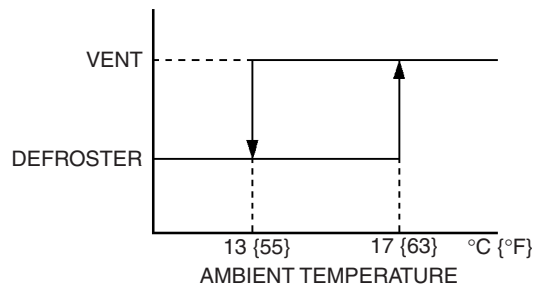
- Switches the airflow mode after the engine is started in winter in accordance with the increase in engine coolant temperature to prevent discomfort caused by cold air blown towards the feet. The engine coolant temperature correction is performed only when the cabin temperature is **13 °C {55 °F} or less**, or the cabin temperature is **23 °C {73 °F} or less** and sunlight intensity is relatively low.

### Fail-safe function

- When the potentiometer of airflow mode actuator is malfunctioning, the airflow mode door is fixed. Under this situation, if the ignition switch is turned to the ON/LOCK position, the airflow mode door is controlled to be fully opened (DEFROSTER) or closed (VENT) based on the ambient temperature. In addition, the door is fully closed (VENT) in the manual VENT, and fully opened (DEFROSTER) in the manual DEFROSTER.



B3A0740T037



A6A8540T023

- If the airflow mode doors are locked and the target airflow mode is set by the climate control unit which does not reach to within **9 s**, the airflow mode actuator drive signal will be stopped to prevent the motor from burning.

## CONTROL SYSTEM

### Airflow Mode Manual Control

- Airflow can be selected by operating the MODE switch and the DEFROSTER switch.

Airflow mode	Switch operation	Air outlet
VENT	MODE switch set from HEAT/DEF to VENT	CENTER VENT, SIDE VENT
BI-LEVEL	MODE switch set from VENT to BI-LEVEL	CENTER VENT, SIDE VENT, HEAT
HEAT	MODE switch set from BI-LEVEL to HEAT MODE switch set from DEFROSTER to HEAT	SIDE VENT, HEAT, REAR HEAT (minimum air from DEFROSTER and SIDE DEMISTER)
HEAT/DEF	MODE switch set from HEAT to HEAT/DEF	SIDE VENT, HEAT, REAR HEAT, DEFROSTER, SIDE DEMISTER
DEFROSTER	DEFROSTER switch to ON	SIDE VENT, DEFROSTER, SIDE DEMISTER

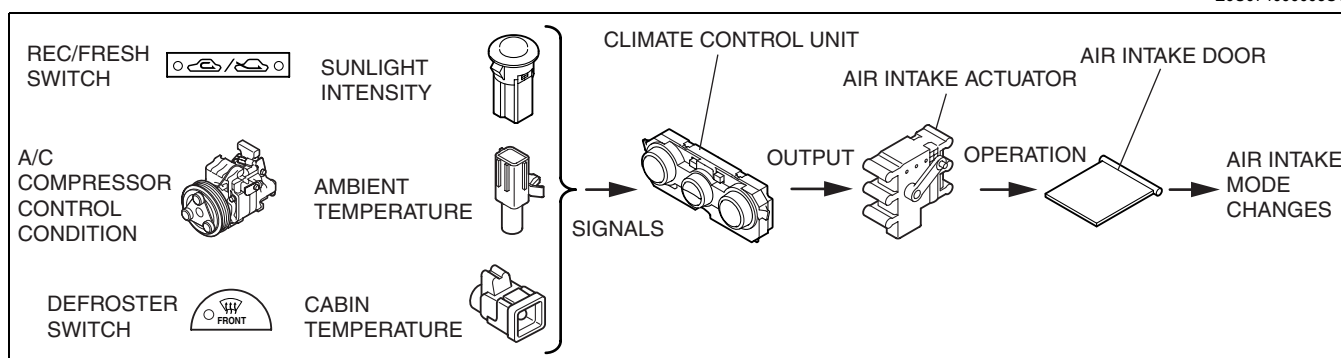
### AIR INTAKE CONTROL OUTLINE [L3 WITH TC]

- Air intake mode is controlled by air intake actuator to adjust and cool down the cabin temperature quickly adjusting to cooling condition.

E6U07400003S10

### AIR INTAKE CONTROL SYSTEM DIAGRAM [L3 WITH TC]

E6U07400003S11



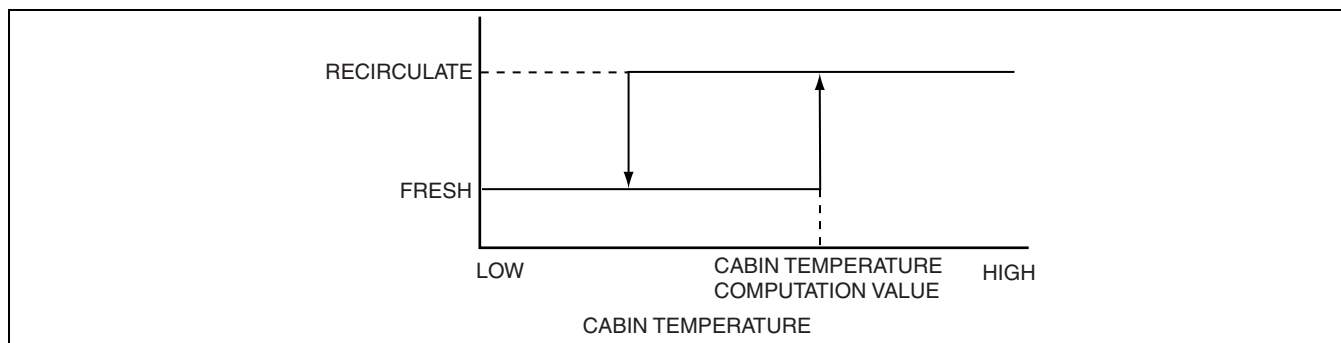
E6U740ZSB008

### AIR INTAKE CONTROL OPERATION [L3 WITH TC]

E6U07400003S12

#### Air Intake Automatic Control

- Based on the ambient temperature and sunlight intensity, the climate control unit calculates the cabin temperature computation value. By comparison with this cabin temperature computation value and actual cabin temperature, air intake mode is determined.



A6A8540T025

#### Correction

##### MAX COLD correction

- When the temperature is set to 60, air intake is fixed in recirculated air intake mode to improve cooling effect. This correction does not operate when defroster correction is on or when the A/C compressor is in OFF mode or when the ambient temperature is 5 °C {41 °F} or less.

##### Defroster correction

- When the defroster switch is on, air intake is fixed in fresh air intake mode to improve defrosting effect, and this correction also operates when recirculated air intake mode is on by manual operation.

##### Ambient temperature correction

- When the ambient temperature is 5 °C {41 °F} or less, air intake mode is fixed at FRESH to prevent windshield and front door glass fogging.

## CONTROL SYSTEM

### A/C OFF correction

- While in air intake automatic control and A/C OFF mode, air intake mode is fixed at FRESH.

### Air Intake Manual Control

- The driver can switch air intake mode by operating the REC/FRESH switch. However, if it is in HEAT/DEF or DEFROSTER mode, it is fixed at FRESH.

Air intake mode	REC/FRESH switch operation
FRESH	Switching from RECIRCULATE to FRESH fixes mode in FRESH
RECIRCULATE	Switching from FRESH to RECIRCULATE fixes mode in RECIRCULATE

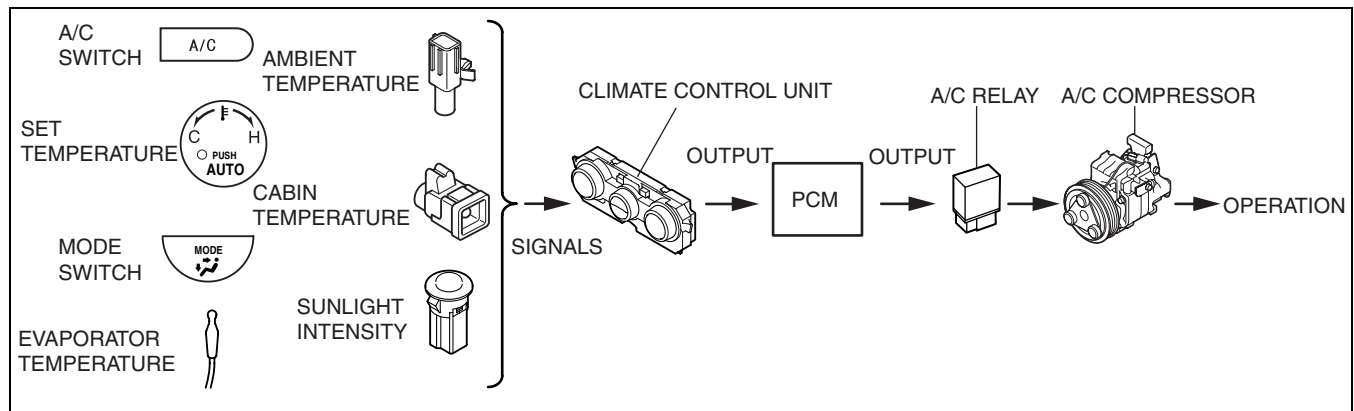
### A/C COMPRESSOR CONTROL OUTLINE [L3 WITH TC]

E6U07400003S13

- In A/C compressor control, the A/C relay (A/C compressor) is controlled via the PCM so that discharged air is simultaneously cooled and dehumidified to provide comfortable air conditioning.
- The climate control unit sends A/C signals to the PCM which actuates the A/C relay.

### A/C COMPRESSOR CONTROL SYSTEM DIAGRAM [L3 WITH TC]

E6U07400003S14



E6U740ZSB009

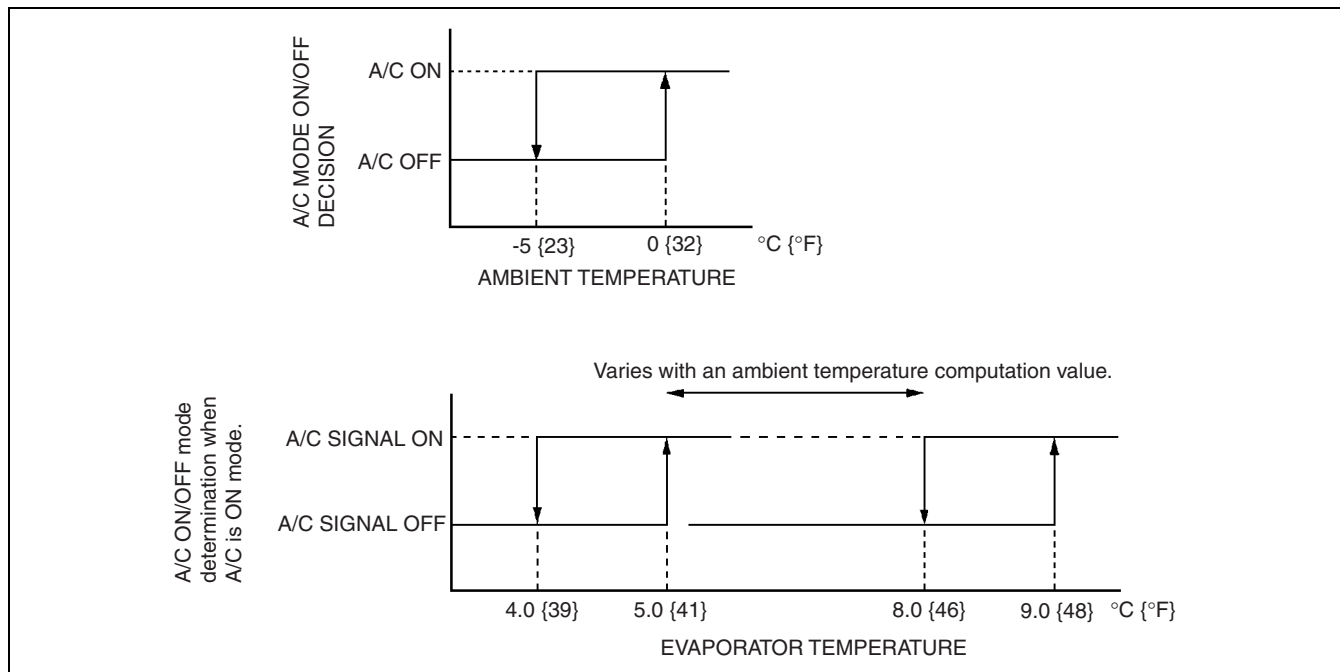
# CONTROL SYSTEM

## A/C COMPRESSOR CONTROL OPERATION [L3 WITH TC]

E6U07400003S15

### A/C Compressor Automatic Control

- The climate control unit determines A/C ON/OFF mode based on the ambient temperature. When A/C is in ON mode, an ambient temperature computation value is calculated based on the ambient temperature, set temperature, and temperatures from various sensors. This value is used to determine the temperature of the air passing through the evaporator. The temperature of this air determines whether the climate control unit turns the magnetic clutch (A/C signal) off or on. When the ambient temperature is high/low, the climate control unit lowers/raises the magnetic clutch off temperature. This improves cooling comfort.



A6A8540T027

### Correction

#### Defroster correction

- To improve defrost effect when the DEFROSTER switched on, select A/C mode and set the A/C signal ON/OFF temperature is set at **5.0/4.0 °C**. However, when in ambient temperature correction, defroster correction does not take place.

#### Ambient temperature correction

- When the ambient temperature is **-5 °C {23 °F} or less**, this correction fixes the A/C compressor in OFF mode to protect the A/C compressor (that is, to prevent A/C compressor fluid compression). If the A/C switch is pressed, only the indicator will indicate; the A/C compressor will not operate.

#### Windshield mist prevention correction

- To prevent the air blown from the defroster when the heater is started in winter from clouding the windows, the blower motor and the A/C signal output are switched off for **6 s** after the ignition is turned to ON position. This control only operates if the airflow is in HEAT, HEAT/DEF, or DEFROSTER mode during airflow volume automatic control.

#### MAX COLD correction

- When temperature is set to 60, the A/C signal ON/OFF temperature is at **5.0/4.0 °C**. However, when in ambient temperature correction, MAX COLD correction does not take place.

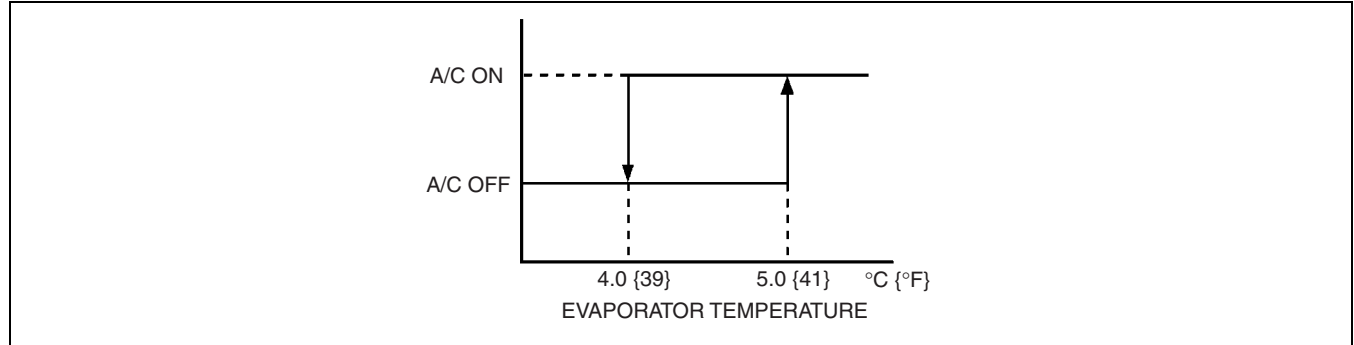
## CONTROL SYSTEM

### A/C Compressor Manual Control

- A/C ON (A/C mode) or OFF mode is selected by operating the A/C switch. However, if it is in HEAT, HEAT/DEF, or DEFROSTER mode, it is fixed at A/C ON mode. (Only the display changes if the A/C switch is operated.)

A/C mode		Operation condition
A/C ON MODE	A/C MODE (A/C display)	A/C compressor is set in ON mode A/C compressor operates below evaporator freezing level so that the evaporator temperature is within a certain range
A/C OFF MODE		A/C compressor does not operate

### A/C ON/OFF mode determination in A/C mode



A6A8540T028

07-40



# RESTRAINTS

## 08 SECTION

ON-BOARD DIAGNOSTIC . . . . 08-02

AIR BAG SYSTEM . . . . . 08-10

## 08-02 ON-BOARD DIAGNOSTIC

### ON-BOARD DIAGNOSTIC FUNCTION

OUTLINE . . . . . 08-02-1

### ON-BOARD DIAGNOSTIC

FUNCTION . . . . . 08-02-2

### Self-Malfunction Diagnostic

Function . . . . . 08-02-2

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### ON-BOARD DIAGNOSTIC FUNCTION OUTLINE

E6U080200000S02

- 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

### 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				Malfunction location
WDS or equivalent	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1013	16		19	Seat weight sensor calibration error
B1017	14		4	Deployment prohibited because configuration is not set
B1317	—	Air bag system warning light is illuminated all the time	—	The SAS control module power supply voltage increases (16.1 V or more)
B1318	—	Air bag system warning light is illuminated all the time	—	The SAS control module power supply voltage decreases (less than 9 V)
B1231	13		3	SAS control module activation (deployment) control freeze
B1342	12		2	SAS control module
	—	Air bag system warning light is illuminated all the time.	1	SAS control module (DTC 12 detection circuit malfunction)
B1869	—	Air bag system warning light is illuminated all the time.	1	Air bag system warning light system circuit open
	—	Air bag system warning light does not illuminate.	—	Air bag system warning light system circuit short to ground
B1870	—	Air bag system warning light is illuminated all the time.	1	Air bag system warning light system circuit short to power supply
B1877	33		13	Driver-side pre-tensioner seat belt system resistance high
B1878				Driver-side pre-tensioner seat belt system circuit short to power supply
B1879				Driver-side pre-tensioner seat belt system circuit short to ground
B1881	34		12	Passenger-side pre-tensioner seat belt system resistance high
B1882				Passenger-side pre-tensioner seat belt system circuit short to power supply
B1883				Passenger-side pre-tensioner seat belt system circuit short to ground

# ON-BOARD DIAGNOSTIC

DTC				Malfunction location
WDS or equivalent	Air bag system warning light			
	Flashing pattern		Priority ranking	
B1884	18		20	Passenger air bag deactivation (PAD) indicator circuit open or short to body ground
B1885	33		13	Driver-side pre-tensioner seat belt system resistance low
B1886	34		12	Passenger-side pre-tensioner seat belt system resistance low
B1890	18		20	Passenger air bag deactivation (PAD) indicator circuit short to power supply
B1913	19		11	Driver-side air bag module (inflator No.1) system circuit short to ground
	21		10	Passenger-side air bag module (inflator No.1) system circuit short to ground
B1916	19		11	Driver-side air bag module (inflator No.1) system circuit short to power supply
B1925	21		10	Passenger-side air bag module (inflator No.1) system circuit short to power supply
B1932	19		11	Driver-side air bag module (inflator No.1) system resistance high
B1933	21		10	Passenger-side air bag module (inflator No.1) system resistance high
B1934	19		11	Driver-side air bag module (inflator No.1) system resistance low
B1935	21		10	Passenger-side air bag module (inflator No.1) system resistance low
B1992	22		15	Driver-side side air bag module system circuit short to power supply
B1993				Driver-side side air bag module system circuit short to ground
B1994				Driver-side side air bag module system resistance high
B1995				Driver-side side air bag module system resistance low

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# ON-BOARD DIAGNOSTIC

DTC			Malfunction location	
WDS or equivalent	Air bag system warning light			
	Flashing pattern	Priority ranking		
B1996	23		14	Passenger-side side air bag module system circuit short to power supply
B1997				Passenger-side side air bag module system circuit short to ground
B1998				Passenger-side side air bag module system resistance high
B1999				Passenger-side side air bag module system resistance low
B2228	19		11	Driver-side air bag module (inflator No.2) system circuit short to ground
B2229	21		10	Passenger-side air bag module (inflator No.2) system circuit short to ground
B2230	19		11	Driver-side air bag module (inflator No.2) system circuit short to power supply
B2231	21		10	Passenger-side air bag module (inflator No.2) system circuit short to power supply
B2232	19		11	Driver-side air bag module (inflator No.2) system resistance high
B2233	21		10	Passenger-side air bag module (inflator No.2) system resistance high
B2234	19		11	Driver-side air bag module (inflator No.2) system resistance low
B2235	21		10	Passenger-side air bag module (inflator No.2) system resistance low
B2290	16		19	Seat weight sensor signal malfunction
B2296	42		9	Crash zone sensor system (communication error, sensor internal circuit abnormal)
B2444	43		8	Driver-side side air bag sensor system (sensor internal circuit abnormal)
B2445	44		7	Passenger-side side air bag sensor system (sensor internal circuit abnormal)
B2477	54		5	Configuration error

**08-02**

## PID/Data Monitoring Function

- | PID name (definition)  | Unit/condition | Condition/specification   | SAS control module terminal |
|--|----------------|---|-----------------------------|
| CCNT_RCM<br>(Number of continuous DTC)                                 | —              | <ul style="list-style-type: none"> <li>DTC is detected: 1—255</li> <li>DTC is not detected: 0</li> </ul>          | —                           |
| CRSH_ST_D1<br>(Driver-side side air bag sensor communication state)    | OK/<br>FAULT   | <ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor communication error: FAULT</li> </ul>    | 2Z, 2AA                     |
| CRSH_ST_D2<br>(Driver-side side air bag sensor circuit state)          | OK/<br>FAULT   | <ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor internal circuit error: FAULT</li> </ul> | 2Z, 2AA                     |
| CRSH_ST_F1<br>(Crash zone sensor communication state)                  | OK/<br>FAULT   | <ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor communication error: FAULT</li> </ul>    | 1B, 1C                      |
| CRSH_ST_F2<br>(Crash zone sensor circuit state)                        | OK/<br>FAULT   | <ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor internal circuit error: FAULT</li> </ul> | 1B, 1C                      |
| CRSH_ST_P1<br>(Passenger-side side air bag sensor communication state) | OK/<br>FAULT   | <ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor communication error: FAULT</li> </ul>    | 2B, 2C                      |

## ON-BOARD DIAGNOSTIC

PID name (definition)	Unit/condition	Condition/specification	SAS control module terminal
CRSH_ST_P2 (Passenger-side side air bag sensor circuit state)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor internal circuit error: FAULT</li> </ul>	2B, 2C
D_ABAGR2 (Driver-side air bag module (inflator No.2) resistance)	ohm	Under any condition: 1.5—3.7 ohms	1G, 1J
D_PTENSFLT (Driver-side pre-tensioner seat belt circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Pre-tensioner seat belt circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2P, 2S
DABAGR (Driver-side air bag module (inflator No.1) resistance)	ohm	Under any condition: 1.5—3.7 ohms	1S, 1V
DR_BUKL (Driver-side buckle switch state)	Buckled/ Unbuckled	<ul style="list-style-type: none"> <li>Buckle switch on: Buckled</li> <li>Buckle switch off: Unbuckled</li> </ul>	2T
DR_PTENS (Driver-side pre-tensioner seat belt resistance)	ohms	Under any condition: 1.5—3.1 ohms	2P, 2S
DS_AB (Driver-side side air bag module resistance)	ohms	Under any condition: 1.4—3.2 ohms	2M, 2O
DS_AB_ST (Driver-side side air bag module circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Pre-tensioner seat belt circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2M, 2O
DS_CURT_ST (Driver-side curtain air bag module circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2V, 2Y
DS1_STAT (Driver-side air bag module (inflator No.1) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1S, 1V
DS2_STAT (Driver-side air bag module (inflator No.2) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1G, 1J
DSB_P_ST (Driver-side pre-tensioner seat belt circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Pre-tensioner seat belt circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2P, 2S
DTC_CLR_ST* (Seat weight sensor status)	Started/ Normal/ End In Process/ OCS Fault	Fault information cleared at seat weight sensor	1I
IGN_V_2 (IG1 voltage)	V	Ignition switch to ON position: B+	1W

## ON-BOARD DIAGNOSTIC

PID name (definition)	Unit/condition	Condition/specification	SAS control module terminal
OCS_CAL_ST* (Seat weight sensor calibration status)	Starting/ Normal End/ Commanding/ NG (Voltage)/ NG (Weight)/ In Process Timeout/ OCS Fault	<ul style="list-style-type: none"> <li>Seat weight sensor calibration start-up: Starting</li> <li>Seat weight sensor calibration completed normally: Normal End</li> <li>Seat weight sensor calibration command being sent: Commanding</li> <li>Voltage malfunction during seat weight sensor calibration: NG (Voltage)</li> <li>Weight error during seat weight sensor calibration: NG (Weight)</li> <li>Seat weight sensor calibration time limit passed: Timeout</li> <li>Seat weight sensor calibration being processed: In Process</li> <li>Seat weight sensor or Seat weight sensor control module malfunction: OCS Fault</li> </ul>	11
OSC_SYS_ST* (Seat weight sensor status)	Empty/ SMALL/ Indeterminate/ LARGE/ Invalid	Occupant classification status determined by seat weight sensor	11
OCSFLT_BTS (Passenger sensing system belt tension sensor malfunction status)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Seat weight sensor calibration error: FAULT</li> </ul>	11
OCSFLT_CAL (Passenger sensing system calibration status)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Seat weight sensor calibration error: FAULT</li> </ul>	11
OCSFLT_COM (Passenger sensing system communication status)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Seat weight sensor control module communication error: FAULT</li> </ul>	11
OCSFLT_L (Passenger sensing system (LH) malfunction status)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Seat weight sensor (LH) malfunction: FAULT</li> </ul>	11
OCSFLT_MDL (Passenger sensing system control module malfunction status)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Seat weight sensor control module malfunction: FAULT</li> </ul>	11
OCSFLT_R (Passenger sensing system (RH) malfunction status)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Seat weight sensor (RH) malfunction: FAULT</li> </ul>	11
OD_CRST_D1 (On demand driver-side side air bag sensor communication state)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor communication error: FAULT</li> </ul>	2Z, 2AA
OD_CRST_D2 (On demand driver-side side air bag sensor circuit state)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor internal circuit error: FAULT</li> </ul>	2Z, 2AA
OD_CRST_F1 (On demand crash zone sensor communication state)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor communication error: FAULT</li> </ul>	1B, 1C
OD_CRST_F2 (On demand crash zone sensor circuit state)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor internal circuit error: FAULT</li> </ul>	1B, 1C
OD_CRST_P1 (On demand passenger-side side air bag sensor communication state)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor communication error: FAULT</li> </ul>	2B, 2C
OD_CRST_P2 (On demand passenger-side side air bag sensor circuit state)	OK/ FAULT	<ul style="list-style-type: none"> <li>Sensor normal: OK</li> <li>Sensor internal circuit error: FAULT</li> </ul>	2B, 2C

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## ON-BOARD DIAGNOSTIC

PID name (definition)	Unit/condition	Condition/specification	SAS control module terminal
OD_D_CURT (On demand driver-side curtain air bag module circuit fault state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2V, 2Y
OD_DAB1_ST (On demand driver-side air bag module (inflator No.1) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1S, 1V
OD_DAB2_ST (On demand driver-side air bag module (inflator No.2) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1G, 1J
OD_DSAB_ST (On demand driver-side side air bag module circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2M, 2O
OD_P_CURT (On demand passenger-side curtain air bag module circuit fault state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2A, 2D
OD_PAB1_ST (On demand passenger-side air bag module (inflator No.1) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1M, 1P
OD_PAB2_ST (On demand passenger-side air bag module (inflator No.2) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1A, 1D
OD_PSAB_ST (On demand passenger-side side air bag module circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2I, 2L
P_ABAGR2 (Passenger-side air bag module (inflator No.2) resistance)	ohms	Under any condition: 1.4—2.9 ohms	1A, 1D
P_PTENSFLT (Passenger-side pre-tensioner seat belt circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Pre-tensioner seat belt circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2G, 2J
PABAGR (Passenger-side air bag module (inflator No.1) resistance)	ohms	Under any condition: 1.4—2.9 ohms	1M, 1P
PS_AB (Passenger-side side air bag module resistance)	ohms	Under any condition: 1.4—3.2 ohms	2I, 2L
PS_AB_ST (Passenger-side side air bag module circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2I, 2L

## ON-BOARD DIAGNOSTIC

PID name (definition)	Unit/condition	Condition/specification	SAS control module terminal
PS_BUKL (Passenger-side buckle switch state)	Buckled/ Unbuckled	<ul style="list-style-type: none"> <li>Buckle switch on: Buckled</li> <li>Buckle switch off: Unbuckled</li> </ul>	2H
PS_CURT_ST (Passenger-side curtain air bag module circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2A, 2D
PS_PTENS (Passenger-side pre-tensioner seat belt resistance)	ohm	Under any condition: 1.5—3.1 ohms	2G, 2J
PS_WEIGHT (Seat weight sensor measured weight of passenger)	Kg	Display of load (body weight) on passenger-side seat	1I
PS1_STAT (Passenger-side air bag module (inflator No.1) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1M, 1P
PS2_STAT (Passenger-side air bag module (inflator No.2) circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Air bag module circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	1A, 1D
PSB_P_ST (Passenger-side pre-tensioner seat belt circuit state)	SQ_LOWRES OPEN SHRT_B+ SHRT_GND Normal	<ul style="list-style-type: none"> <li>Pre-tensioner seat belt circuit resistance low: SQ_LOWRES</li> <li>Related wiring harness circuit open: OPEN</li> <li>Related wiring harness short to power supply: SHRT_B+</li> <li>Related wiring harness short to ground: SHRT_GND</li> <li>Related wiring harness normal: Normal</li> </ul>	2G, 2J
TRAK_SW (Seat track position sensor state)	Forward/ Rearward	<ul style="list-style-type: none"> <li>Front seat front position: Forward</li> <li>Front seat rear position: Rearward</li> </ul>	2W, 2X

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



## 08-10 AIR BAG SYSTEM

### SAS CONTROL MODULE

#### CONSTRUCTION/OPERATION

[EXCEPT L3 WITH TC] ..... 08-10-1

Seat Position Matching Deployment

Control ..... 08-10-1

### SEAT TRACK POSITION SENSOR

#### CONSTRUCTION/OPERATION

[EXCEPT L3 WITH TC] ..... 08-10-2

Function .....08-10-2

Operation .....08-10-2

### SIDE AIR BAG MODULE

#### CONSTRUCTION/OPERATION

[L3 WITH TC] .....08-10-3

Construction .....08-10-3

### SAS CONTROL MODULE CONSTRUCTION/OPERATION [EXCEPT L3 WITH TC]

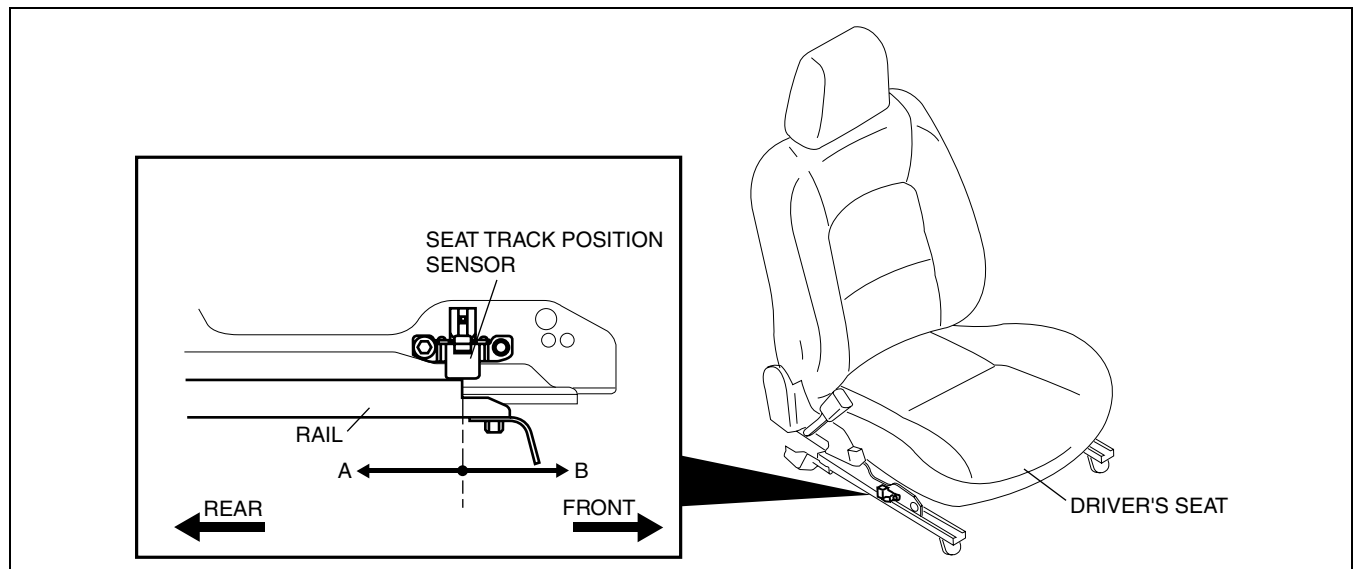
E6U081057031S01

#### Seat Position Matching Deployment Control

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

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

08-10



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## AIR BAG SYSTEM

### SEAT TRACK POSITION SENSOR CONSTRUCTION/OPERATION [EXCEPT L3 WITH TC]

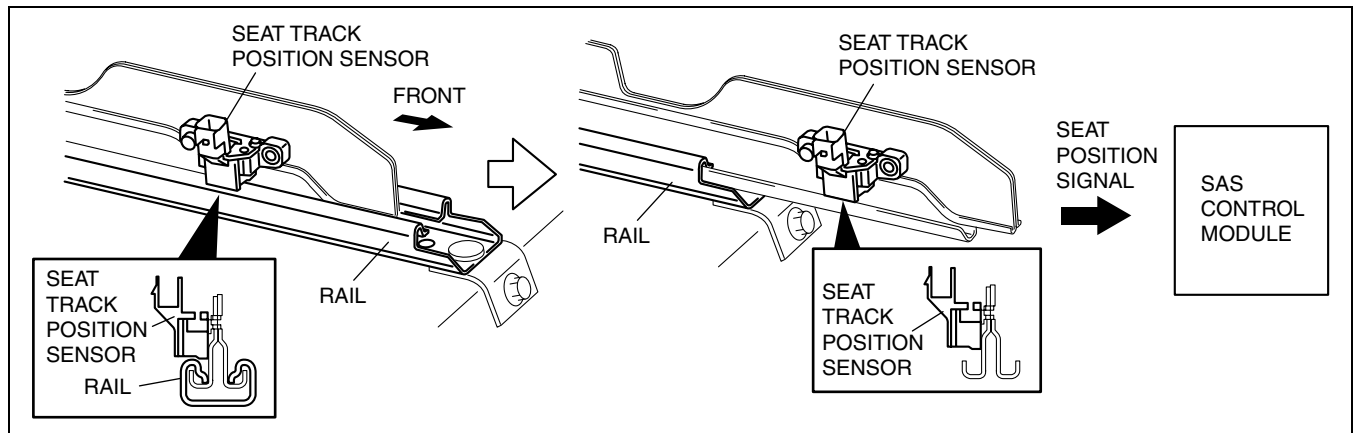
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#### Function

- The seat track position sensor converts the seat position into an electrical signal and sends it to the SAS control module.

#### Operation

- 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 forward, the seat track position sensor moves together with it. As the driver's seat continues to move forward, the seat track position sensor passes the end of the rail causing a change in the magnetic flux of the sensor. This change in magnetic flux is sent to the SAS control module as an electrical signal. The SAS control module receives this signal and determines that the driver's seat has moved forward.



E6U810S7A10

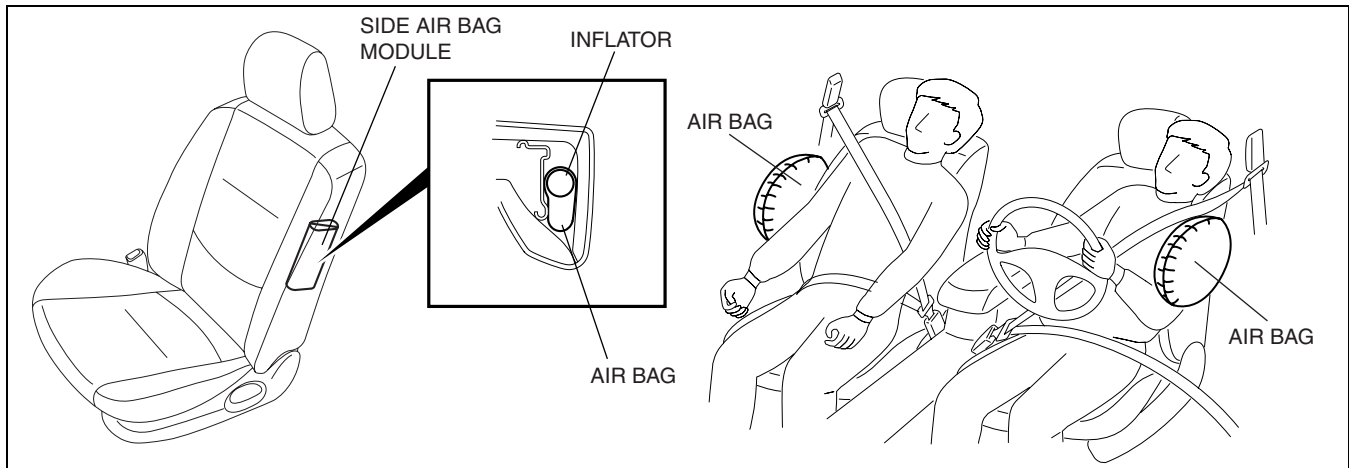
# AIR BAG SYSTEM

## SIDE AIR BAG MODULE CONSTRUCTION/OPERATION [L3 WITH TC]

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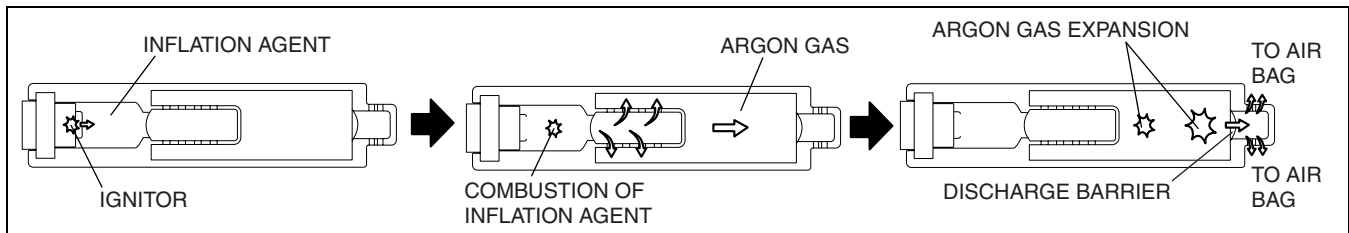
### Construction

- Side air bag modules are installed on the outboard sides of the front seat backs.
- The side air bag module is composed of an inflator and air bag.
- When the air bag operates (deploys), the seat back trim is spread apart by argon gas generated from the inflator, inflating the air bag.



EPU8102T3005

- 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.



EPU8102T3006

08-10



# BODY & ACCESSORIES

# 09

SECTION

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09-00

### BODY AND ACCESSORIES ABBREVIATIONS

E6U09000000S01

BCM	Body Control Module
GND	Ground
GPS	Global Positioning System
OFF	Switch Off
ON	Switch On
WDS	Worldwide Diagnostic System

### BODY AND ACCESSORIES NEW FEATURES

E6U09000000S02

Improved marketability	<ul style="list-style-type: none"><li>• Auto-close/open function adopted for driver-side power window</li><li>• Headlight leveling system adopted</li></ul>
Improved convenience	<ul style="list-style-type: none"><li>• Car-navigation system adopted</li></ul>
Improved safety	<ul style="list-style-type: none"><li>• Discharge headlight (low-beam) that illuminate a wide area adopted</li></ul>



## 09-12 GLASS/WINDOWS/MIRRORS

### POWER WINDOW SYSTEM

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### POWER WINDOW SYSTEM

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Two-step down function .....	09-12-4
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### EXTERIOR OPEN/CLOSE FUNCTION

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### EXTERIOR OPEN/CLOSE FUNCTION

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### POWER WINDOW SYSTEM OUTLINE

#### Features

- The following functions have been added.
  - Auto-open/close function (passenger's side)
  - Auto reverse pinch protection function
  - Two-step down function
  - Fail-safe function
  - Exterior open/close function

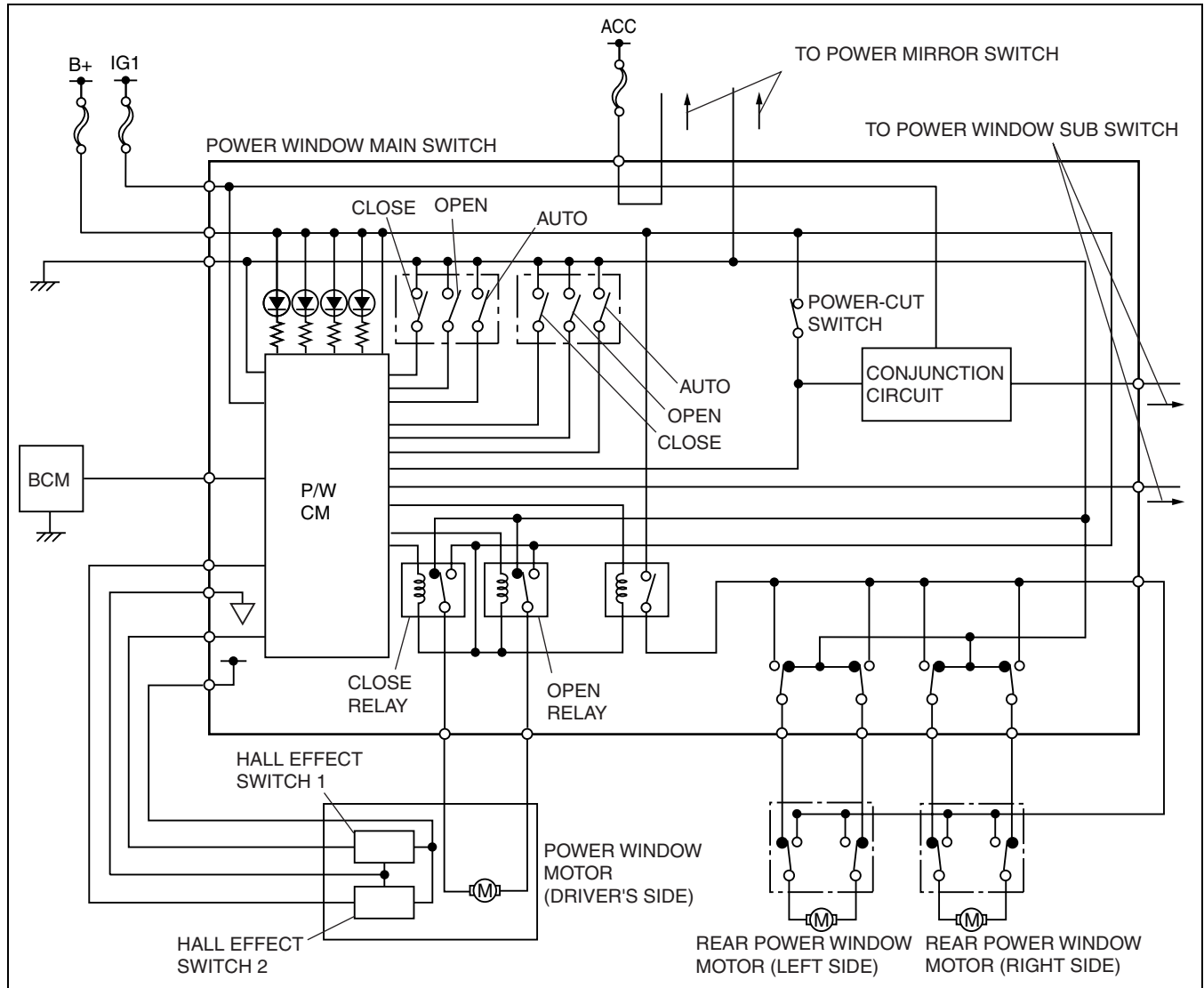
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# GLASS/WINDOWS/MIRRORS

## POWER WINDOW SYSTEM WIRING DIAGRAM

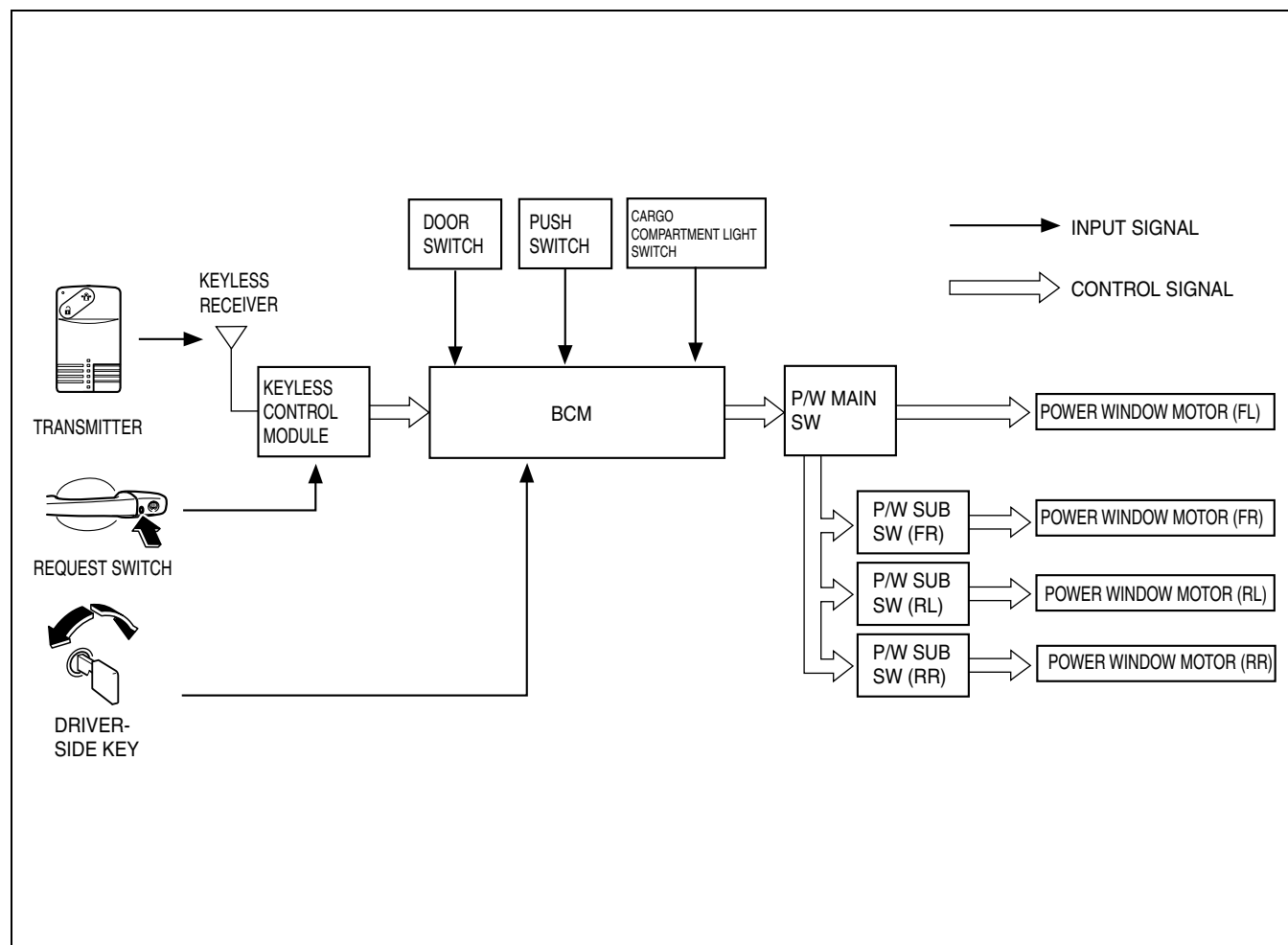
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### Power Window Main Switch



E6U912ZS5101

## Power Window Subswitch



E6U912ZS5107

## POWER WINDOW SYSTEM OPERATION

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### Auto-Open/Close

- The window automatically moves to a fully-opened or closed position when the power window main switches or the power window subswitches are operated two times, either down (push) or up (pull).

### Auto Reverse Pinch Protection Function

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

### Two-step down function

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

### Fail-safe

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

Detection condition	IG switch ON	IG switch OFF	Recovery items
Hall effect switch 1 (for jam-safe and window position detection) operation malfunction <ul style="list-style-type: none"> <li>During up/down movement, Hall effect switch 2 pulse detected but Hall effect switch 1 pulse not detected</li> </ul>	Automatic operation prohibited	Automatic and manual operation prohibited	During up movement, pulse signals for Hall effect switches 1 and 2 detected normally, and fully closed position return/non-return ranges redetected
Hall effect switch 2 (for window movement direction detection) operation malfunction <ul style="list-style-type: none"> <li>During up/down movement, Hall effect switch 1 pulse detected but Hall effect switch 2 pulse not detected</li> </ul>			
Pulse signal malfunction detected (Inversion of input signals of or large phase deviation between, Hall effect switch 1 and 2.) <ul style="list-style-type: none"> <li>During up/down movement, difference detected between the direction signals from Hall effect switches 1 and 2, and actual direction</li> </ul>			
Non-return range downturn malfunction <ul style="list-style-type: none"> <li>During up movement, the signal input from Hall effect switch 1 higher than the position stored in the P/W main switch</li> </ul>			
Hall effect switches 1 and 2 operation malfunction <ul style="list-style-type: none"> <li>Hall effect switches 1 and 2 pulse signal not detected after down movement initiated from the fully closed position</li> </ul>			

## GLASS/WINDOWS/MIRRORS

### EXTERIOR OPEN/CLOSE FUNCTION OUTLINE

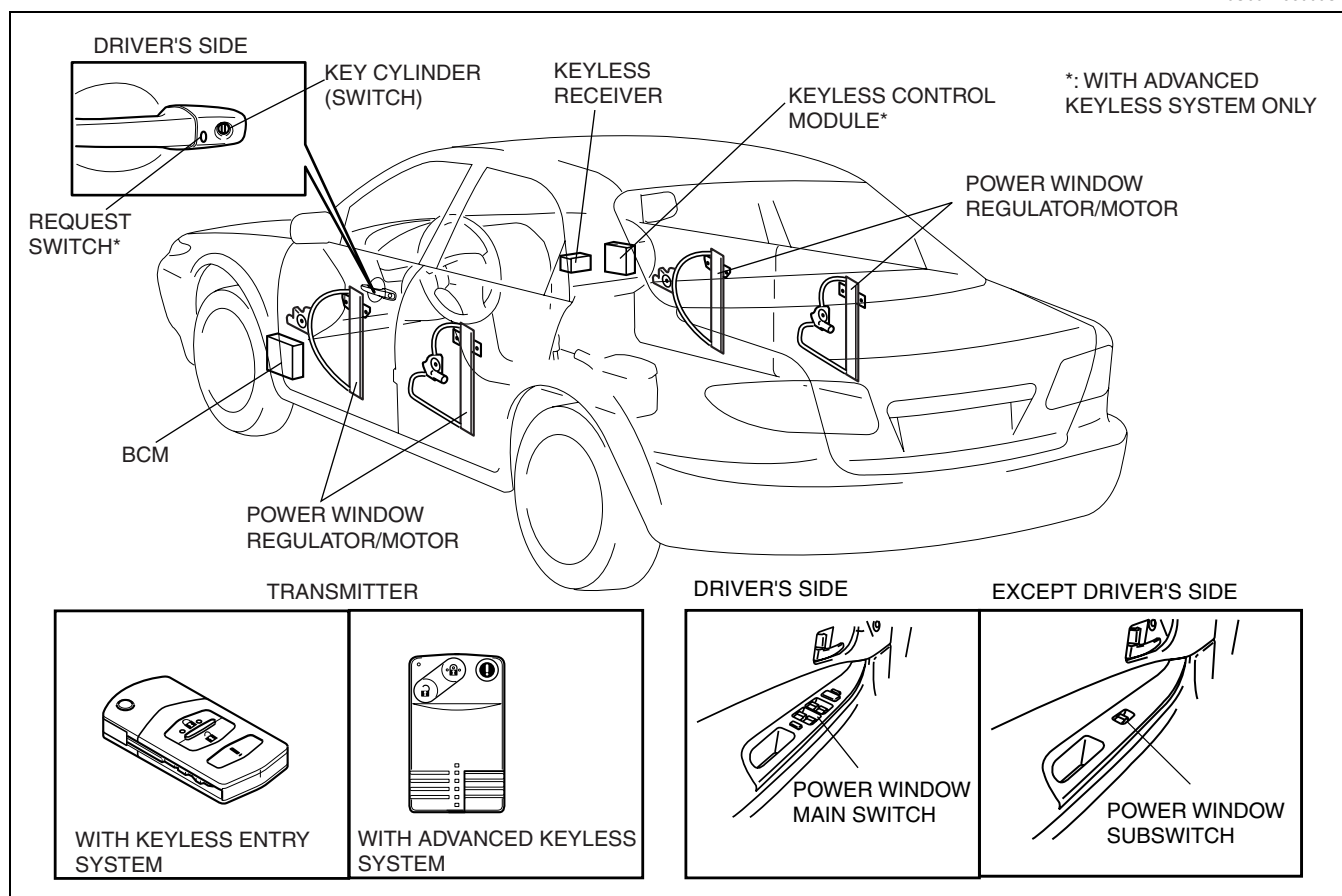
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- A exterior open/close function has been adopted so that the power window system can be operated from outside the vehicle.
- This system can operate in conjunction with the following:
  - Transmitter (open operation only)
  - Driver-side door key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

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

### EXTERIOR OPEN/CLOSE FUNCTION STRUCTURAL VIEW

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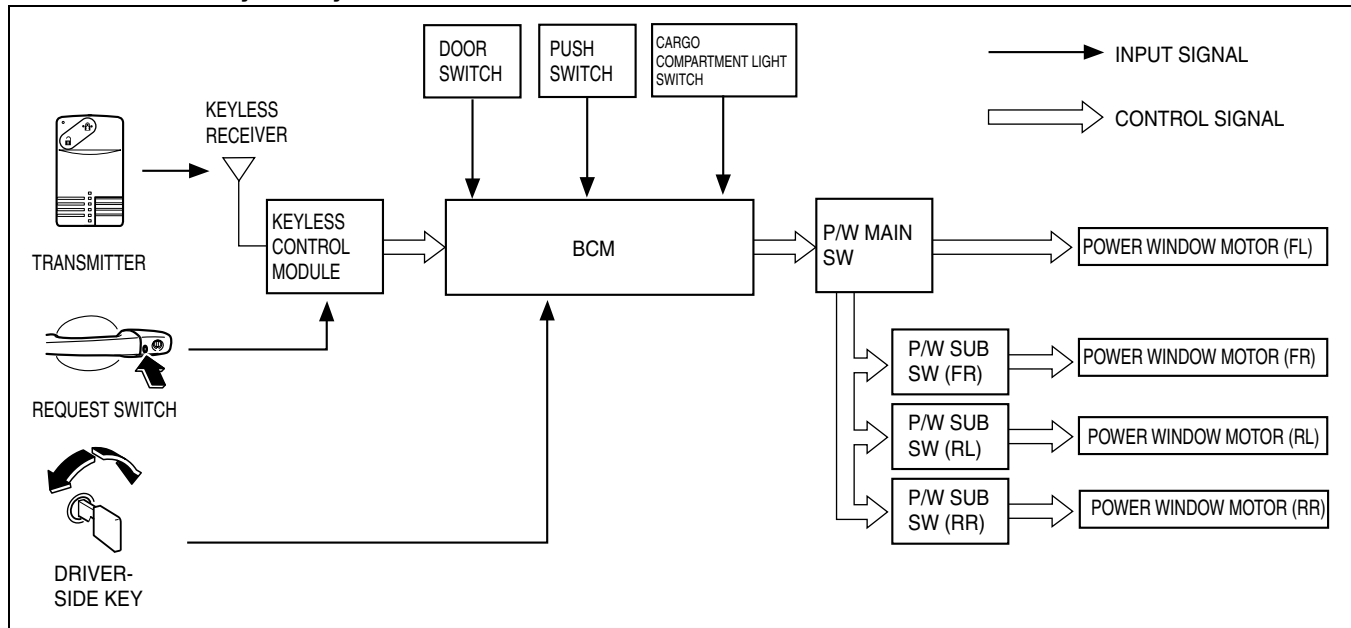
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## GLASS/WINDOWS/MIRRORS

### EXTERIOR OPEN/CLOSE FUNCTION BLOCK DIAGRAM

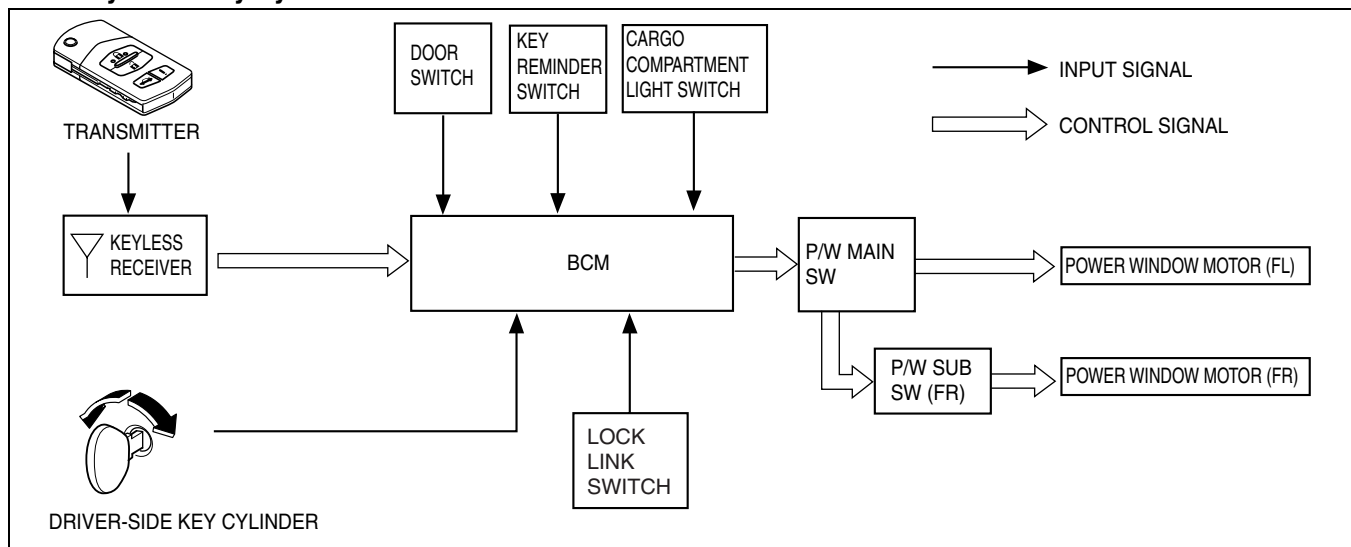
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#### With Advanced Keyless System



E6U912ZS5107

#### With Keyless Entry System



E6U912ZS5105

### EXTERIOR OPEN/CLOSE FUNCTION OPERATION

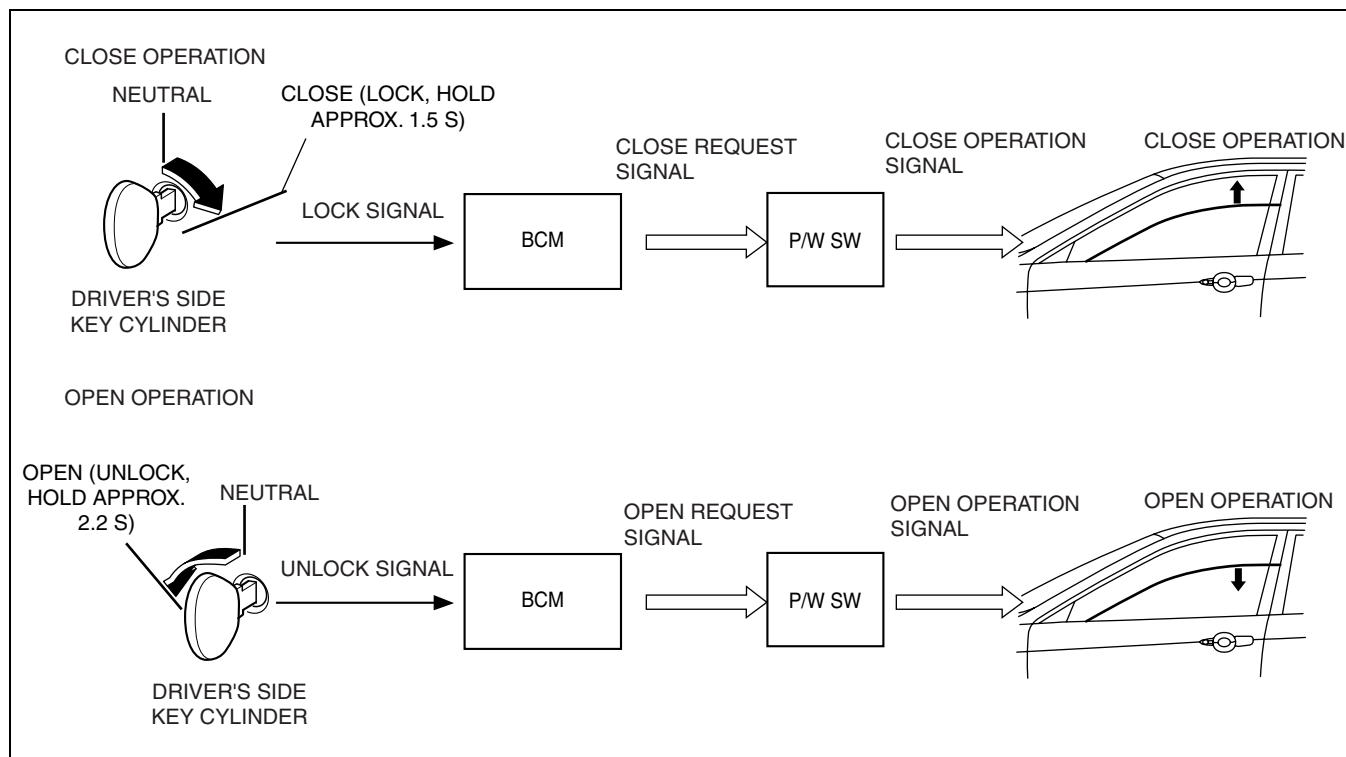
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- With the system, front door glass can open/close in conjunction with the LOCK/UNLOCK operation of the driver-side key cylinder, transmitter, and request switch (with advanced keyless system).
- One opening operation fully opens (automatic open) front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

## Open/Close Function/Operation in Conjunction with Key Operation

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

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



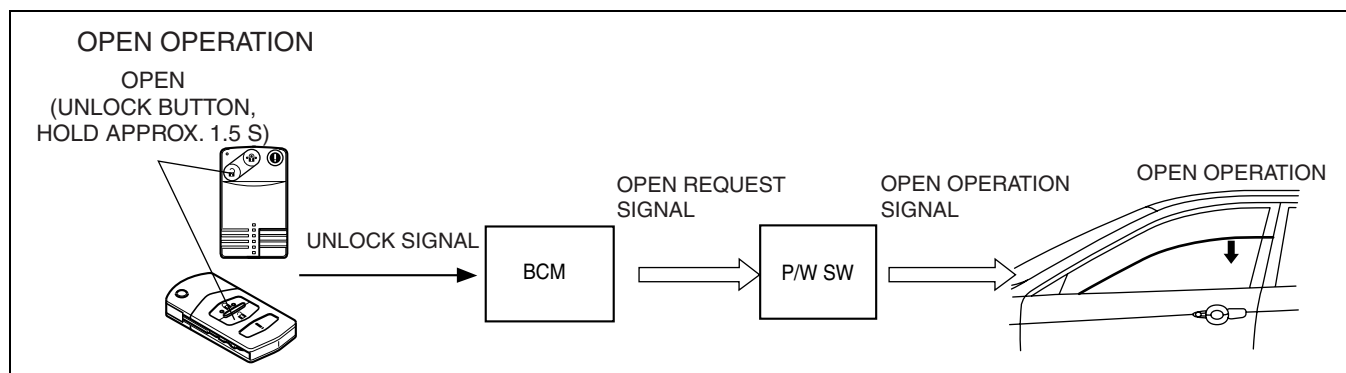
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09-12

## Open Function/Operation in Conjunction with Transmitter

- The door glass can be opened by holding the button in the UNLOCK position for approx. 1.5 s or more within the transmitter reception area.
- When the door glass is not fully open, operate and hold the transmitter UNLOCK position for approx. 1.5 s, and the door glass performs automatic open operation to fully open the door glass. During the automatic open operation, if the transmitter is operated again<sup>\*1</sup>, it stops in that position.

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

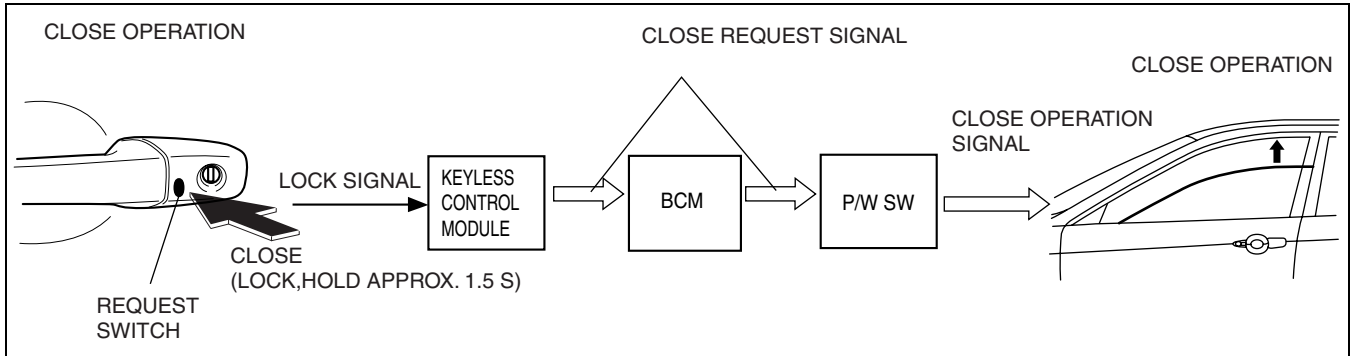


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## GLASS/WINDOWS/MIRRORS

### Close Function/Operation in Conjunction with Request Switch

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



E6U912ZS1006

### Operation Prohibition/Stop Condition

- When the following conditions are met before the operation, the global open/close function does not operate. Also, if the conditions are met during the operation, the operation stops.
  - Either door/trunk/hatch/liftgate is open (when the door switch or cargo compartment light switch is ON)
  - The key is inserted in the steering lock (when the keyless switch is ON)
  - The transmitter is not in the reception area
  - The transmitter is operated during the operation (LOCK, UNLOCK, PANIC operation)

# 09-14A SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

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**09-14A**

## SECURITY AND LOCKS OUTLINE

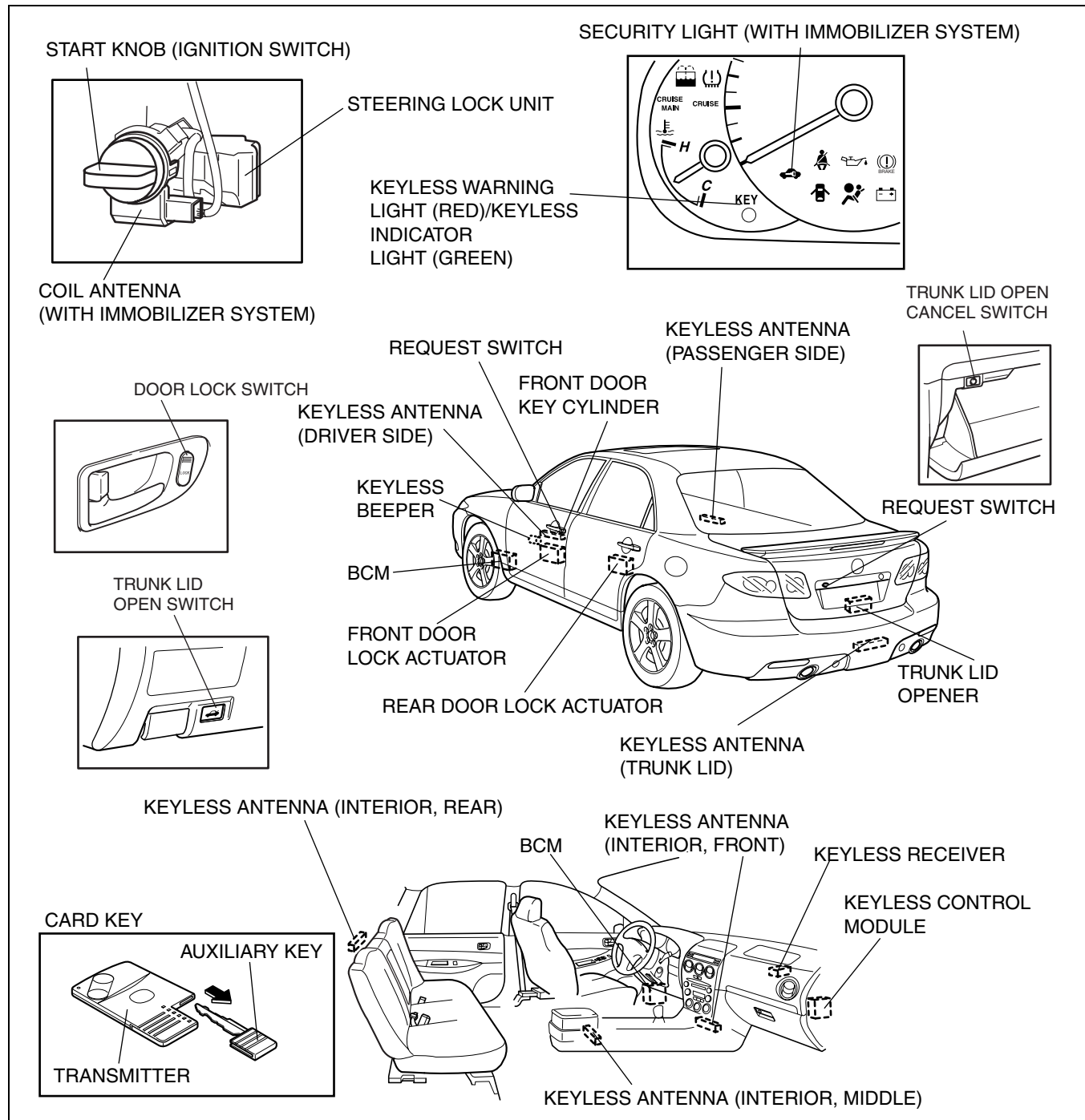
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Improved marketability	<ul style="list-style-type: none"> <li>• Power door lock system adopted</li> <li>• Advanced keyless entry &amp; start system adopted</li> </ul>
Improved serviceability	<ul style="list-style-type: none"> <li>• Keyless control module that integrates the control of the keyless entry system and immobilizer system adopted</li> </ul>
Improved security	<ul style="list-style-type: none"> <li>• Immobilizer system adopted</li> <li>• Theft-deterrent system adopted</li> </ul>

# SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

## SECURITY AND LOCKS STRUCTURAL VIEW

E6U091400001S02

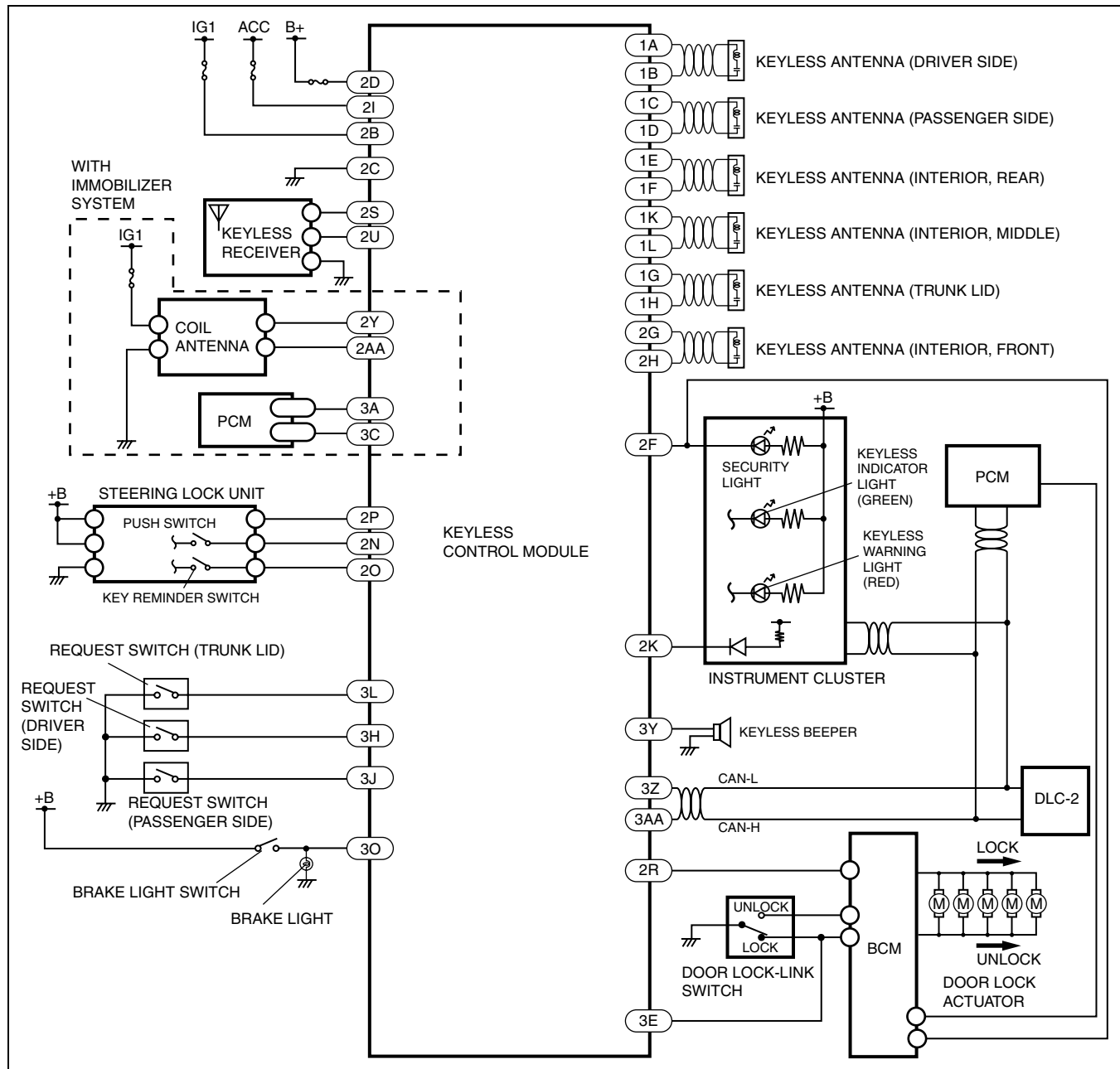


E6U914AS1001

# SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

## SECURITY AND LOCKS SYSTEM WIRING DIAGRAM

E6U09140001S03



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09-14A

## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

### POWER DOOR LOCK SYSTEM OUTLINE

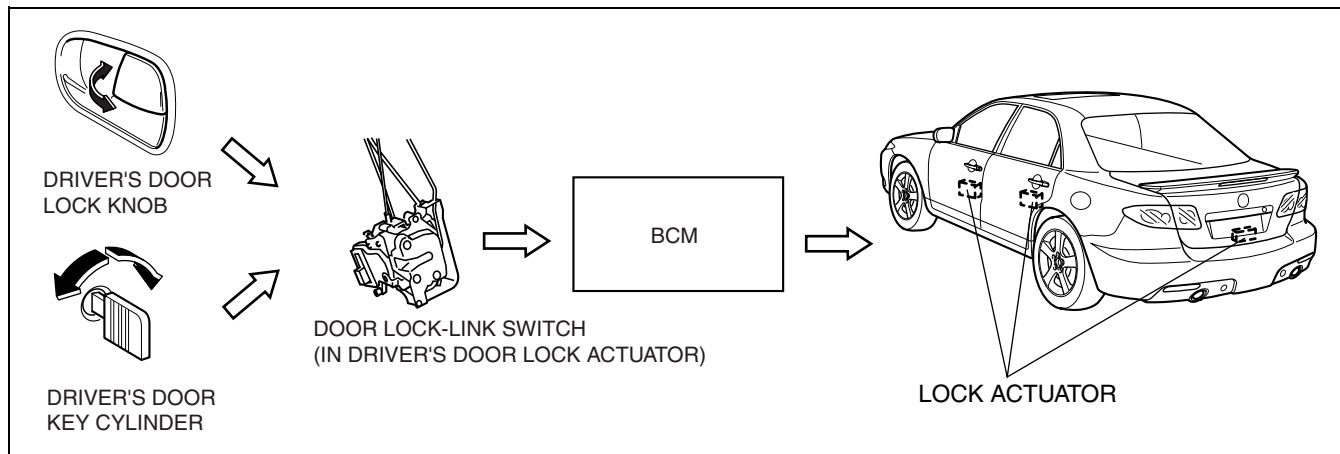
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- A door lock knob interlock function has been adopted where all doors and the trunk lid are locked/unlocked when the driver's door is locked/unlocked with the driver's door lock knob.
- A door key interlock function has been adopted where all doors and the trunk lid are locked/unlocked when the driver's door is locked/unlocked with the driver's door key cylinder.

### POWER DOOR LOCK SYSTEM OPERATION

E6U091466000S12

- When the driver's door is locked/unlocked with the driver's door lock knob or key cylinder, the door lock-link switch in the door lock actuator is locked/unlocked via the rod.
- The BCM (body control module) activates each lock actuator to lock/unlock according to the lock/unlock signal from the door lock-link switch.



E6U914AS1003

### KEYLESS ENTRY SYSTEM OUTLINE

E6U091469000S01

- 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 (sub-key) or transmitter (card key).
- The answer-back function has been adopted where the hazard warning light flashes and a buzzer sounds to confirm 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 the driver's side front fender panel.
- 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 if the start knob is not in the LOCK position.

## KEYLESS ENTRY SYSTEM OPERATION

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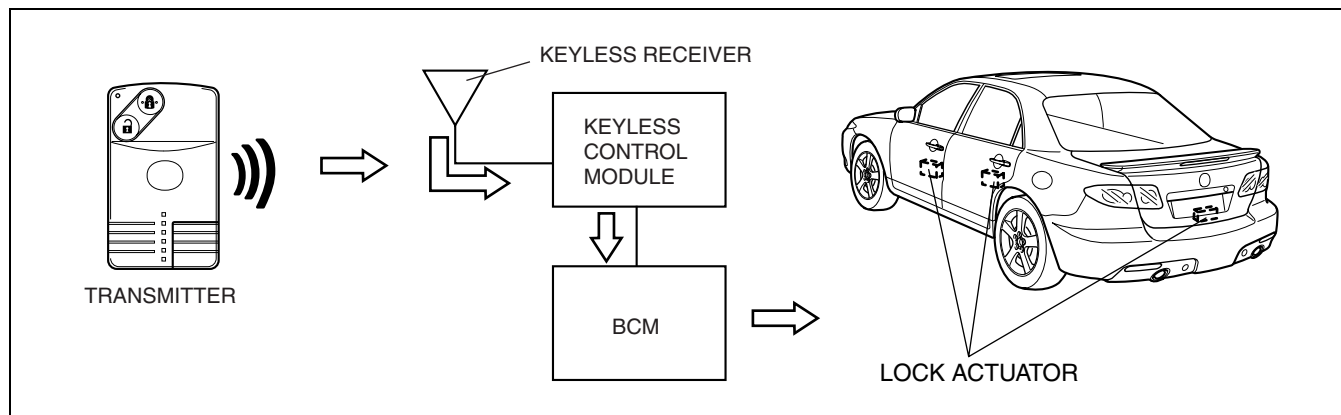
### Normal Keyless Entry Function

#### 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 BCM and all lock actuators activate to lock/unlock.
3. The keyless control module operates the hazard warning light to flash via the BCM according to lock/unlock signal from the transmitter (card key). Also, the keyless control module operates the keyless beeper at the same time.
  - When the LOCK button is pressed, the hazard warning light flashes once and keyless beeper sounds once.
  - When the UNLOCK button is operated, the hazard warning light flashes twice and keyless beeper sounds twice.



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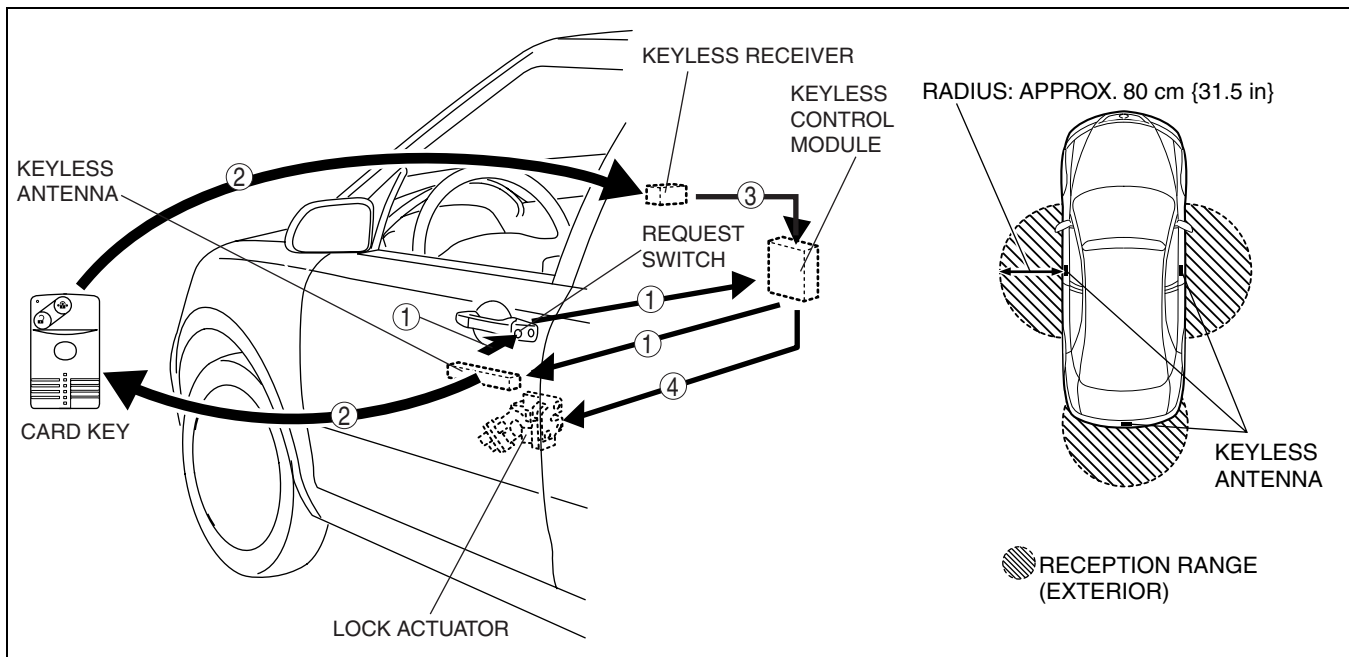
## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

### Advanced Keyless Entry Function 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. If an exterior request switch is pressed, a request signal is sent to the area around the door that the request switch is pressed, and if an interior request switch is pressed, the signal is sent to the whole cabin area (front and rear of the cabin).
2. When the card key receives a request signal, the card key sends back an ID data.
3. The ID data is received at the keyless receiver, and sent to the keyless control module.
4. When the ID data is verified by the keyless control module and the card key is determined to be outside the vehicle, a signal is sent to the BCM and all the lock actuators are activated to lock/unlock.
5. The keyless control module operates the hazard warning light to flash via the BCM. Also, the keyless control module operates the keyless beeper at the same time.
  - When the doors are locked, the hazard warning light flashes once and keyless beeper sounds once.
  - When the doors are unlocked, the hazard warning light flashes twice and keyless beeper sounds twice.



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#### Auto re-lock function

- The auto re-lock function that automatically locks the doors activates 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

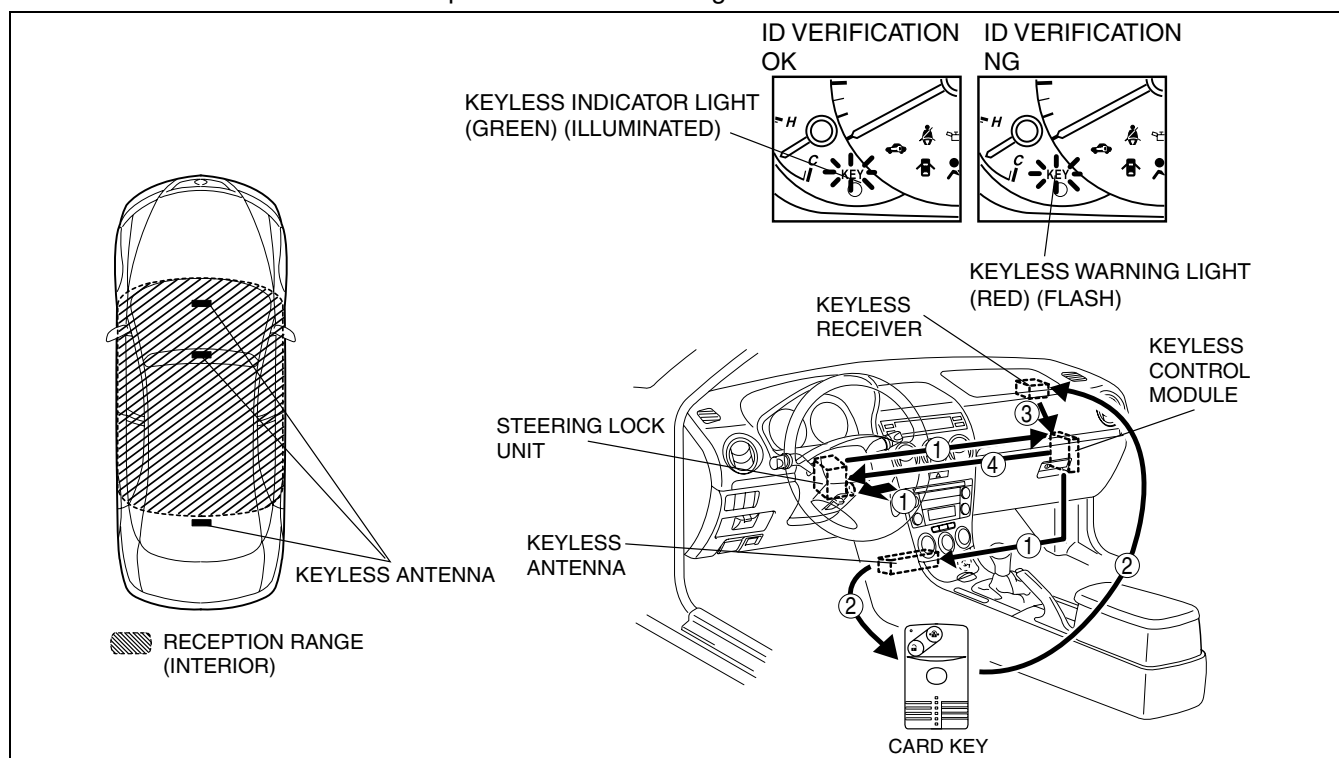
- When all doors are closed and the driver is out of the reception area carrying the card key, the doors are automatically locked. (Initial setting is OFF.)
- When all the following conditions are met and all doors are closed after any door or the trunk lid is open, the keyless beeper sounds and the 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.
  - 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.
  - The hazard warning light flashes once and keyless beeper sounds once at the same time the door locks.

## ADVANCED KEYLESS START FUNCTION OPERATION

E6U091469000S03

- The advanced start function activates to start the engine by operating the start knob, and not by inserting the key but by carrying the card key in the vehicle.
- When the start knob is pressed, the keyless control module sends a request signal from the keyless antennas (Interior).
  - The card key receives the request signal, and sends back an ID data.
  - The ID data is received by the keyless receiver, and sent to the keyless control module.
  - 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 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), 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.
  - Turn the start knob to the START position to start the engine.

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## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

### WARNING/GUIDANCE FUNCTION OPERATION

E6U091469000S04

- 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 driver's side front fender panel.
- The operation condition of the actuator is indicated by the indicator light and buzzer sound to guide user's operation.

Item		Operation condition	Keyless beeper (outside the vehicle)	Instrument cluster		
				Buzzer (Interior)	Keyless warning light (red)	Keyless indicator light (green)
Warning	Start knob not in LOCK warning	Driver's door is open with start knob in ACC position	—	Sounds continuously	—	—
	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	—	Sounds 3 times*2	Flashes*4	—
		Card key cannot be detected inside vehicle with all doors closed and start knob not in LOCK position	Sounds 3 times	—	Flashes*4	—
		Card key cannot be detected inside vehicle with start knob not in LOCK position and under any condition other than above	—	—	Flashes*4	—
	Door lock inoperable warning	Request switch is pressed from outside vehicle with proper card key inside vehicle and another card key carried	Sounds 3 times	—	—	—
		Request switch is pressed with card key is carried and a door open or start knob not in LOCK position	Sounds 3 times	—	—	—
	Battery voltage low indication	Card key battery voltage depleted	—	—	—	Flashes (Approx. 30 s after IG ON)
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 : When the ignition switch is off (except for LOCK position), "Start knob not in LOCK warning" (continuous buzzer sound) overrides.

\*3 : Initial setting is OFF.

\*4 : Stops flashing and goes out if the card key is detected inside the vehicle.

## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

### CUSTOMIZE FUNCTION OUTLINE

E6U091469000S05

- 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 beeper answer back	Answer Back Buzzer	ON
Battery voltage low indication	Low Battery Warning	ON

### ON-BOARD DIAGNOSTIC SYSTEM OUTLINE (KEYLESS ENTRY SYSTEM)

E6U091469000S06

#### 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 deleted, and the PID/data monitoring function can be activated.

### ON-BOARD DIAGNOSTIC SYSTEM PID DATA/MONITOR FUNCTION OPERATION (KEYLESS ENTRY SYSTEM)

E6U091469000S07

#### 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.

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## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

**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 (Front passenger's door)
B1132	Keyless antenna (Driver's door)
B1127	Keyless antenna (Interior, Rear)
B1131	Keyless antenna (Trunk lid)
B1129	Keyless antenna (Interior, Middle)
B112A	Keyless antenna (Interior, Front)
U0140	Communication error to BCM
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.

## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

**PID/data monitor table**

PID name (definition)	Data contents	Unit/ Operation	Terminal
DTC_CNT	Number of continuous DTCs	–	–
RPM	Engine speed	RPM	3Z, 3AA
VSS	Vehicle speed	KPH	3Z, 3AA
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)	OPEN/ CLOSE	3R
DRSW_ALL	Door switch (All doors and trunk lid)	OPEN/ CLOSE	3R
BOO	Brake pedal position (Brake switch)	On/Off	3O
REQ_SW_D	Request switch (Driver's door)	On/Off	3H
REQ_SW_P	Request switch (Passenger door)	On/Off	3J
REQ_SW_BK	Request switch (Trunk lid)	On/Off	3L
LOCK_SW_D	Door lock-link switch	On/Off	3E
IMMOBI	Immobilizer system equipped or not	On*/Off	–
TR/LG_SW	Trunk light switch	OPEN/ CLOSE	3R
IG_KEY_IN	Key reminder switch	Key-In/Key- Out	2O
IG_SW_ST	Ignition switch (Push switch)	Pushed/Not Pushed	2N
BUZZER	Keyless beeper	On/Off	3Y
SECURITY	Security light	On/Off	2F
PWR_IG1	Power supply (IG1)	On/Off	2B
PWR_ACC	Power supply (ACC)	On/Off	2I

\* : 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	3Y
BZR_INN	Interior buzzer (Instrument cluster)	On/Off	3Z, 3AA
LNP_RED	Keyless warning light (red)	On/Off	3Z, 3AA
LNP_GREEN	Keyless indicator light (green)	On/Off	3Z, 3AA
HAZARD	Hazard light	On/Off	3R
HORN	Horn	On/Off	3R
DR_LOCK	All doors Lock/Off	Lock/Off	3R
DR_UNLOCK	All doors Unlock/Off	Unlock/Off	3R
2STG_UNLK	2 stage unlock	Unlock/Off	3R

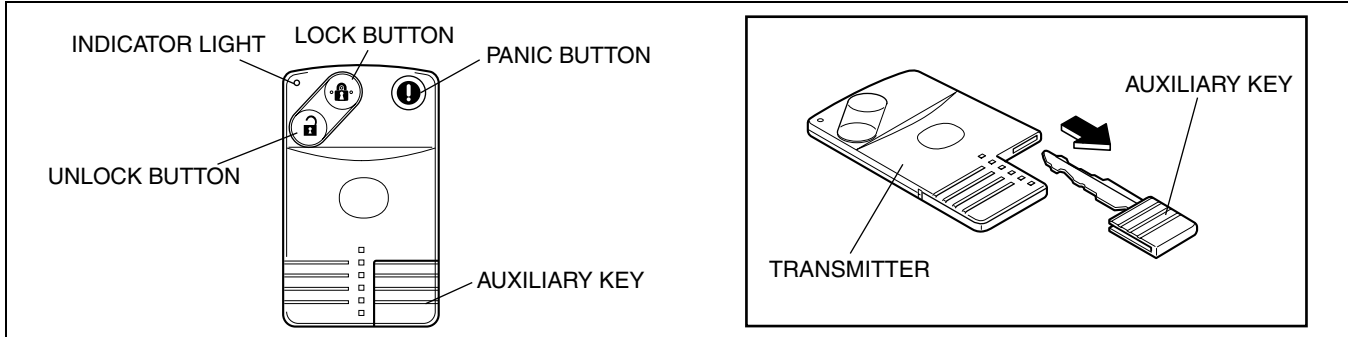
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## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

### CARD KEY (TRANSMITTER) CONSTRUCTION/OPERATION

E6U091469000S08

- A card-type transmitter that is thin and convenient to carry has been adopted.
- A maximum of six transmitters can be programmed for one vehicle.
- A built-in operation indicator light illuminates according to LOCK/UNLOCK button operation and request signal from the vehicle.
- In case the transmitter is inoperable due to battery depletion, the doors can be locked/unlocked and the engine can be started using the auxiliary key.
- A transponder is built into the auxiliary key for vehicles with the immobilizer system.

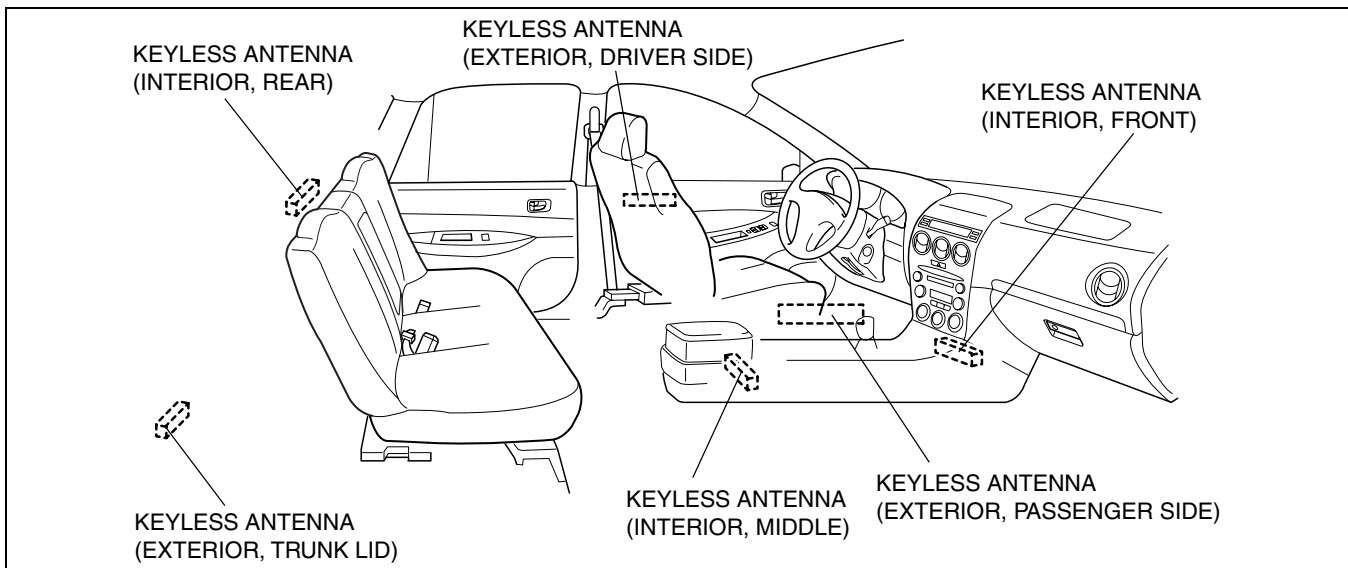


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### KEYLESS ANTENNA CONSTRUCTION/OPERATION

E6U091469000S09

- Consists of the antennas for request signal output (6 locations).
- Operated by the keyless control module, the keyless antennas send request signals to produce the reception areas inside and outside the vehicle.
- The keyless antennas built-into the front doors can output signals to both inside or outside the vehicle, and change the level of the radiowave (output to inside or outside the vehicle) according to operation conditions.
- The keyless control module locates the card key by determining the antenna which is receiving the signal the strongest.



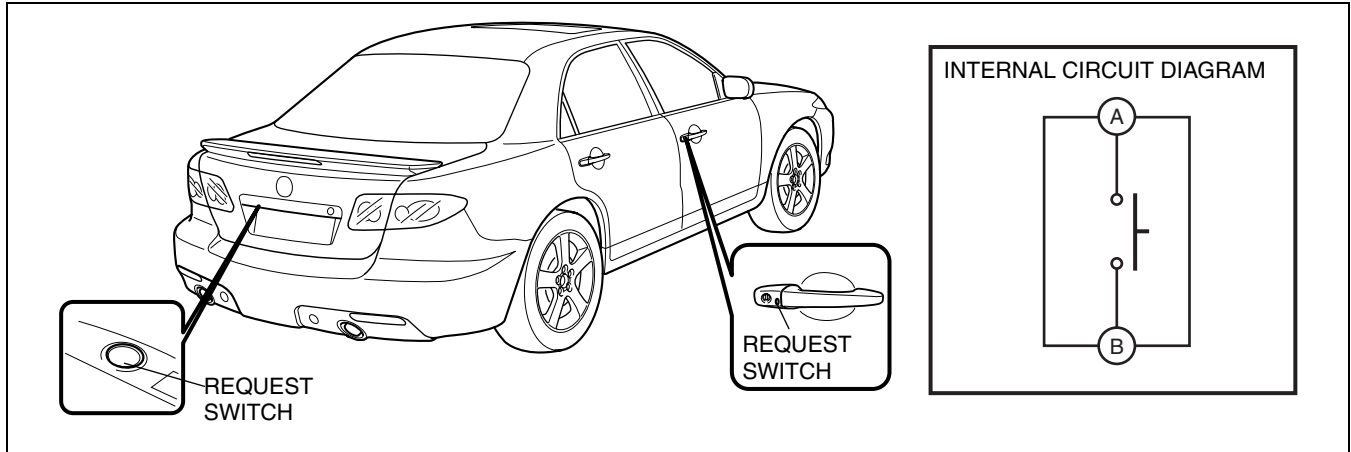
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## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

### REQUEST SWITCH CONSTRUCTION

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- Installed on the front doors and trunk lid.

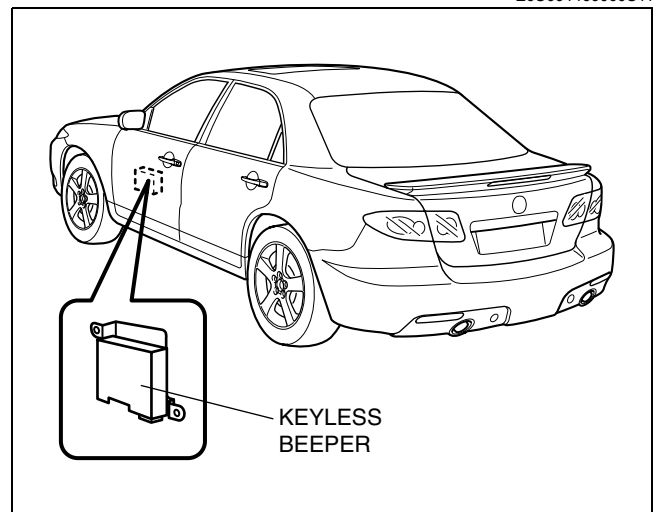


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### KEYLESS BEEPER CONSTRUCTION

E6U091469000S11

- Installed on the driver's door.



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# SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

## IMMOBILIZER SYSTEM OUTLINE

E6U091467000S13

### Note

- The construction and operation of the auxiliary key is described. Refer to “ADVANCED KEYLESS START FUNCTION OPERATION” for engine start with the card key. (See 09–14A–7 ADVANCED KEYLESS START FUNCTION OPERATION.)

### Special Features

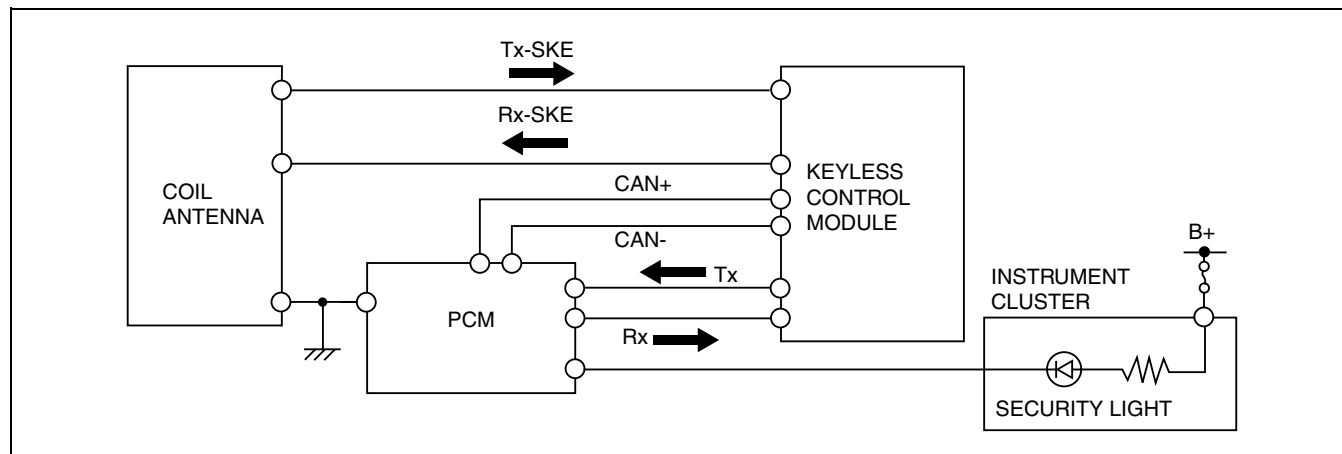
- The immobilizer system is a vehicle theft prevention device that only allows keys that have previously been programmed to the vehicle to start the engine. It functions to prevent theft by means such as a forged key or hotwiring.
- Consists of the key (with built-in transponder), coil antenna, PCM, 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

## IMMOBILIZER SYSTEM BLOCK DIAGRAM

E6U091467000S14



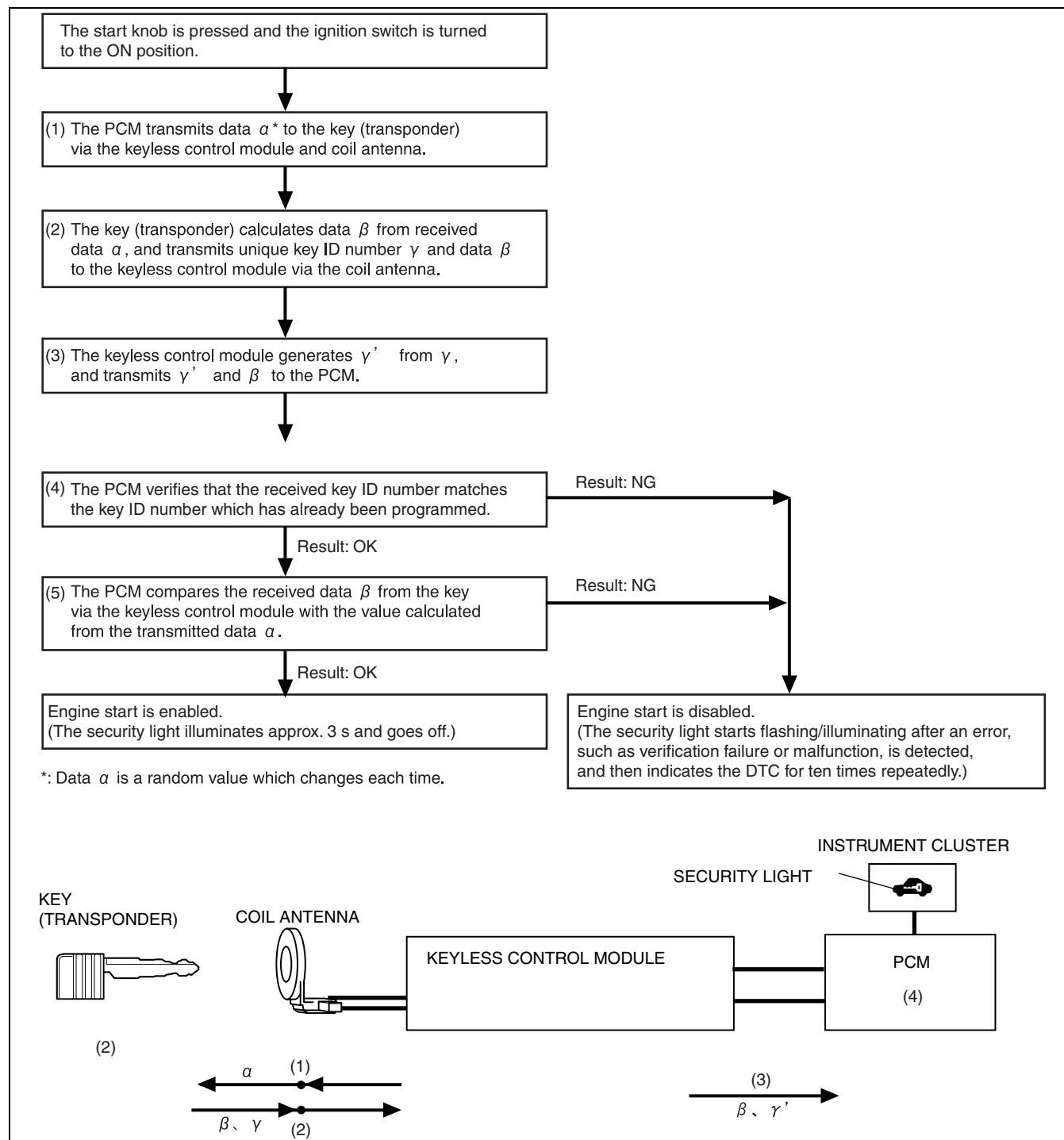
E6U914AS1018

## IMMOBILIZER SYSTEM CONSTRUCTION/OPERATION

E6U091467000S15

- 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 or PCM), it is necessary to reset the system.

### Key ID Number Verification Procedure



E6U914AS1015

## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

### 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.

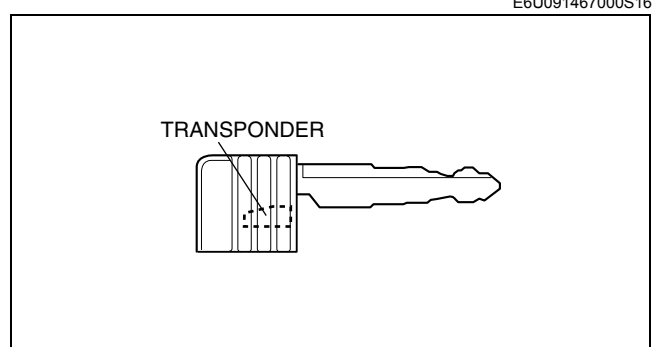
WDS or equivalent setting items	Contents
Programming an additional ignition key	Allows key ID number programming.
Ignition key ID number clearing	Clears all programmed key ID numbers and programs new key ID numbers.
Customer spare key programming enable	<p>“Additional ignition key programming” is enabled.</p> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>This is the default setting on new vehicles.</li> </ul>
Customer spare key programming disable	<p>“Additional ignition key programming” is disabled.</p> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul>

- 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	<p>Key ID number of added key must be programmed. Key ID number programming can be performed according to the following methods:</p> <ul style="list-style-type: none"> <li>Method for programming additional keys using two keys that can start the engine</li> <li>Method using the WDS or equivalent</li> </ul>
Key clearing	<p>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.</p>
PCM replacement	<ul style="list-style-type: none"> <li>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.</li> </ul>
Keyless control module replacement	<ul style="list-style-type: none"> <li>Card key and steering lock unit must be programmed.</li> <li>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.</li> </ul>
Steering lock unit replacement (including key replacement)	<ul style="list-style-type: none"> <li>Steering lock unit must be programmed.</li> <li>The key ID number must be programmed using the WDS or equivalent. Two or more keys must be programmed.</li> </ul>
Coil antenna replacement	Immobilizer system resetting is not necessary.

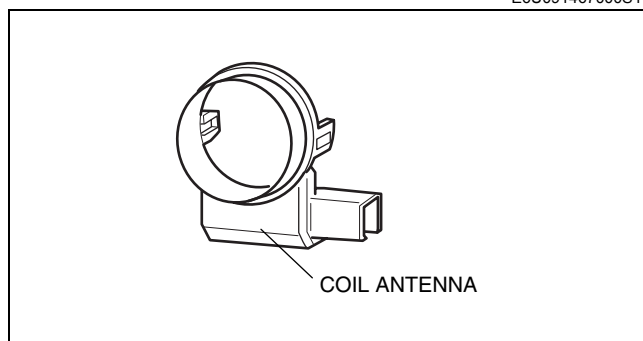
### AUXILIARY KEY CONSTRUCTION

- 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).



## COIL CONSTRUCTION

- Installed on the steering lock.
- Forms a magnetic field near the steering lock and receives the key signal.
- Demodulates the received key signal and outputs the signal to the keyless control module.



E6U914AS1017

## SECURITY LIGHT CONSTRUCTION/OPERATION

### Construction

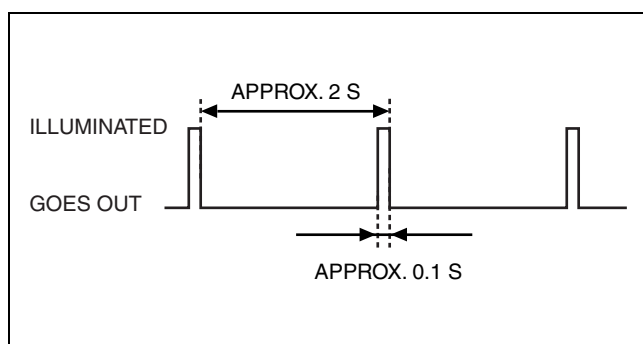
- Allows visual confirmation of immobilizer system operation.
- If any malfunction is detected in the immobilizer system, the malfunction location can be verified by the security light illumination/flashing pattern.

### 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.**

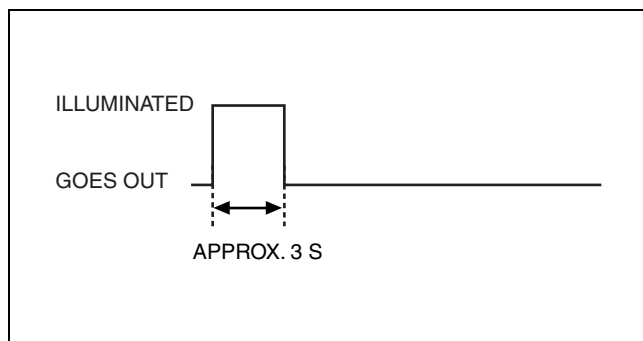
### Operation

- When the immobilizer system is operating, the security light flashes repeatedly 0.1 s every approx. 2 s.



C3U0914S011

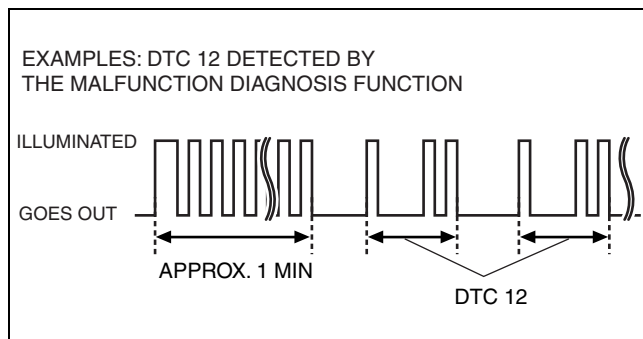
- When the immobilizer system is deactivated normally, the security light illuminates for approx. 3 s and then goes out when the start knob is turned to the ON position.
- If the immobilizer system is not deactivated normally (malfunction detected by the malfunction diagnosis function), the security 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

# SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

## ON-BOARD DIAGNOSTIC SYSTEM OUTLINE (IMMOBILIZER SYSTEM)

E6U091467000S19

- 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.**

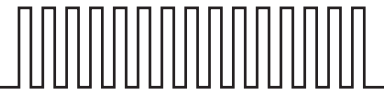
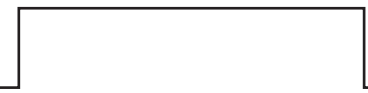
### Note

- 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



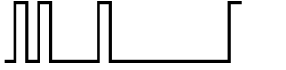
#### Note

- In the approx. 1 min after detecting a malfunction and before indicating the DTC, the security light illuminates or flashes in the following patterns:

Security light flashing pattern (Before indicating a DTC)	DTC
ILLUMINATED GOES OUT 	11, 12, 13, 14, 15
ILLUMINATED GOES OUT 	21

DTC					Detection condition
Security light flashing pattern		Keyless warning light	WDS or equivalent display		
			Keyless control module	PCM	
11					

## SECURITY AND LOCKS [ADVANCED KEYLESS SYSTEM]

DTC					Detection condition
Security light flashing pattern		Keyless warning light	WDS or equivalent display		
			Keyless control module	PCM	
14		Off	—	B1602	Key ID number cannot be read
15		Off	—	B1601	Unprogrammed key ID number detected
		On	B1342	B1601	Keyless control module malfunction
21		On	B1213	B1213	Only one key ID number is programmed to the PCM
—	—	On	B1213	—	Only one key ID number is programmed to the keyless control module
—	—	On	U0073	—	CAN malfunction
—	—	Off	U0323 U0100 U2023	—	CAN malfunction

### ON-BOARD DIAGNOSTIC SYSTEM PID DATA/MONITOR FUNCTION OPERATION (IMMOBILIZER SYSTEM)

E6U091467000S20

09-14A

- 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]

**POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM**  
**OUTLINE** ..... 09-14B-1  
**POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM**  
**STRUCTURAL VIEW** ..... 09-14B-2  
**POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM WIRING**  
**DIAGRAM** ..... 09-14B-3  
**POWER DOOR LOCK SYSTEM CONSTRUCTION/OPERATION** ..... 09-14B-4  
**KEYLESS ENTRY SYSTEM CONSTRUCTION/OPERATION** ..... 09-14B-4  
**TRANSMITTER (RETRACTABLE KEY TYPE) STRUCTURAL VIEW** ..... 09-14B-5  
**THEFT-DETERRENT SYSTEM OUTLINE** ..... 09-14B-6

**THEFT-DETERRENT SYSTEM**  
**STRUCTURAL VIEW** .....09-14B-6  
**THEFT-DETERRENT SYSTEM WIRING DIAGRAM** .....09-14B-7  
**SYSTEM FLOWCHART** .....09-14B-8  
**IMMOBILIZER SYSTEM OUTLINE** .....09-14B-9  
**IMMOBILIZER SYSTEM STRUCTURAL VIEW** .....09-14B-9  
**IMMOBILIZER SYSTEM WIRING DIAGRAM** .....09-14B-9  
**IMMOBILIZER SYSTEM DESCRIPTION** .....09-14B-10  
 Verification Method Between Key (Transponder) and PCM .....09-14B-10  
 On-Board Diagnostic Function .....09-14B-11

## POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM OUTLINE

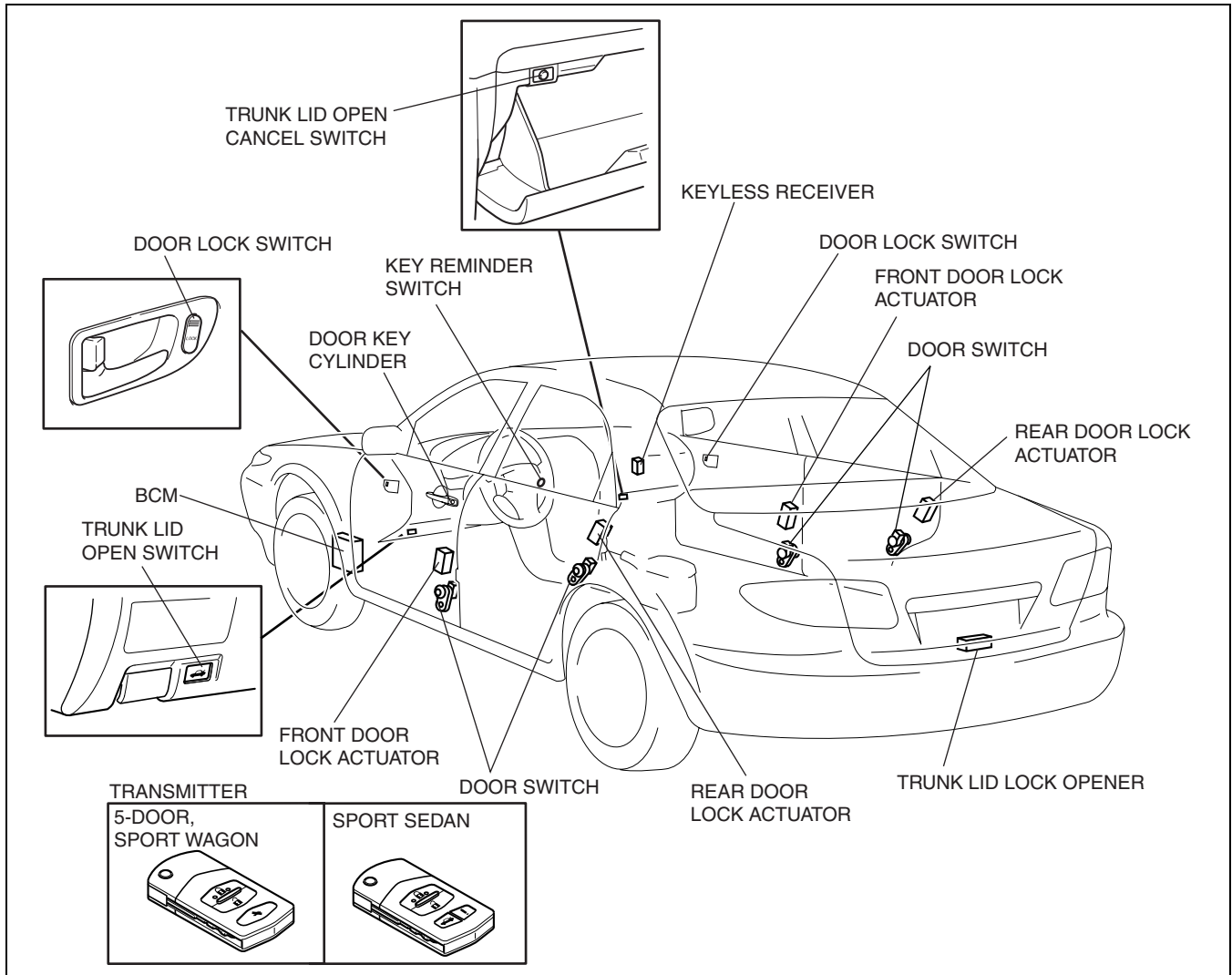
E6U091466000S05

Improved marketability	<ul style="list-style-type: none"> <li>Power door lock system adopted</li> <li>A retractable key type transmitter has been adopted.</li> </ul>
Improved security	<ul style="list-style-type: none"> <li>Immobilizer system adopted</li> <li>Theft-deterrent system adopted</li> </ul>

# SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

## POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM STRUCTURAL VIEW

E6U09146600S06

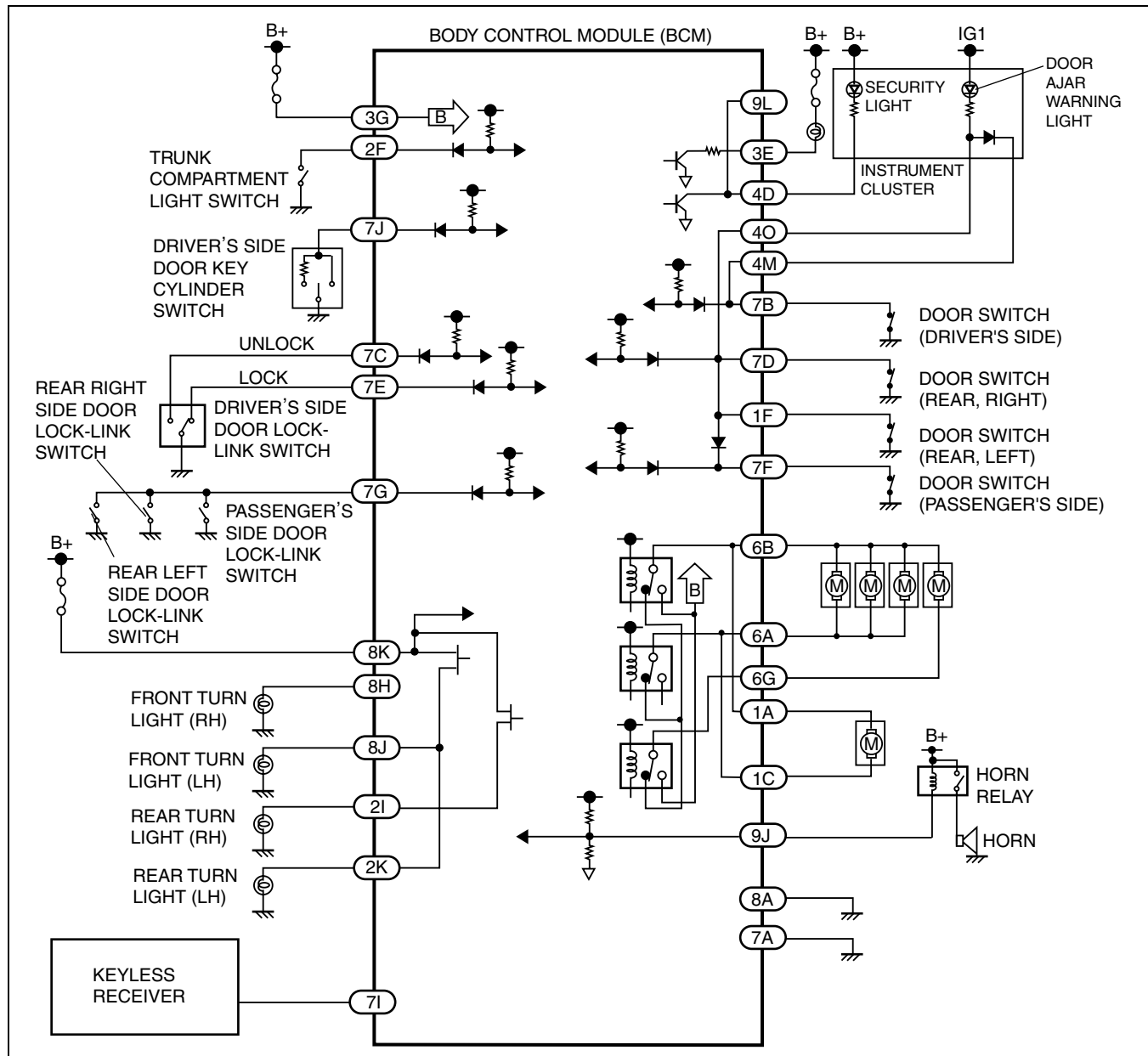


E6U914BS1001

# SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

## POWER DOOR LOCK SYSTEM AND KEYLESS ENTRY SYSTEM WIRING DIAGRAM

E6U09146600S07



E6U0914BS1002

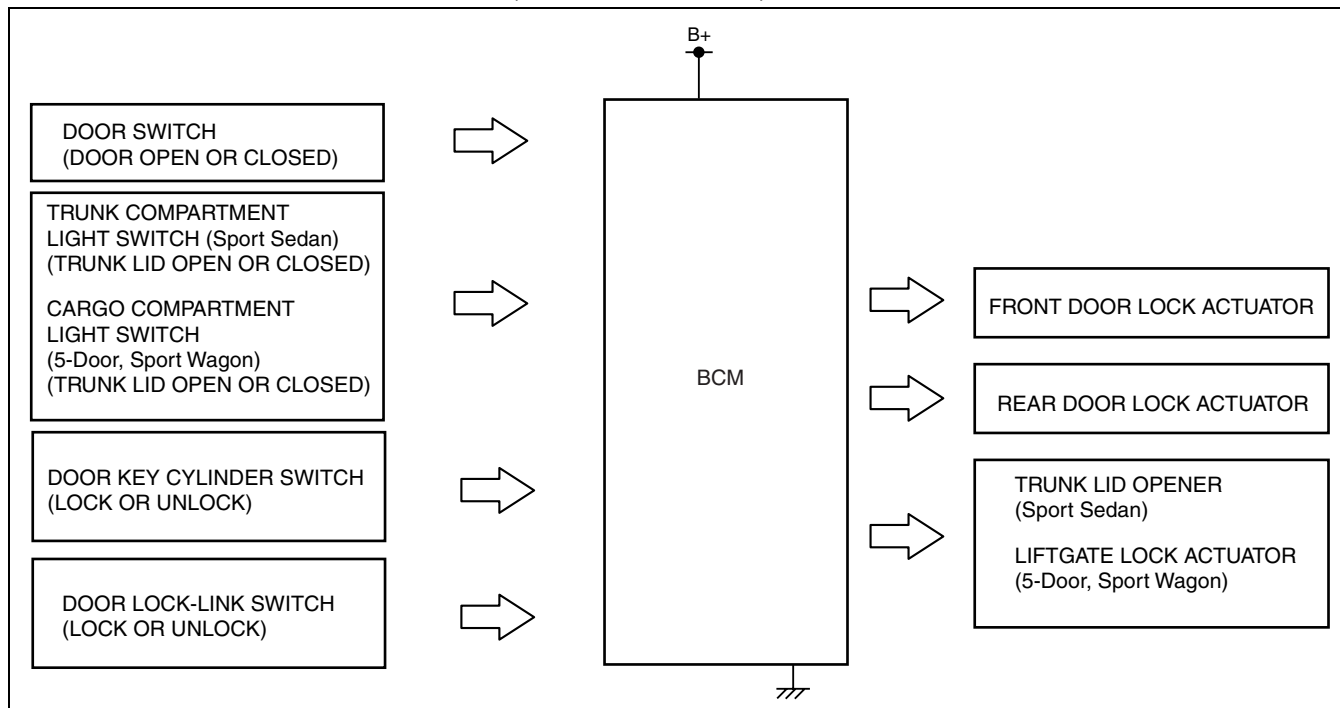
09-14B

## SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

### POWER DOOR LOCK SYSTEM CONSTRUCTION/OPERATION

E6U09146600S08

- Consists of the following parts;
  - BCM
  - Front door lock actuator
  - Rear door lock actuator
  - Trunk lid opener/liftgate lock actuator
  - Door lock-link switch (built into the driver-side front door lock actuator)
  - Door key cylinder switch (built into the driver-side front door lock actuator)
- Unlocking/locking of all doors and liftgate is performed by operation of the door key cylinder (door key cylinder switch) and driver-side door knob (door lock-link switch).
- When unlocking using the door key cylinder, operating one time will unlock the driver-side door and operating a second time will unlock the passenger-side door.
- When any door is open, locking operation using the door key cylinder or the driver-side door lock knob is cancelled and the doors are unlocked. (Lock cancel function)



E6U914BS1003

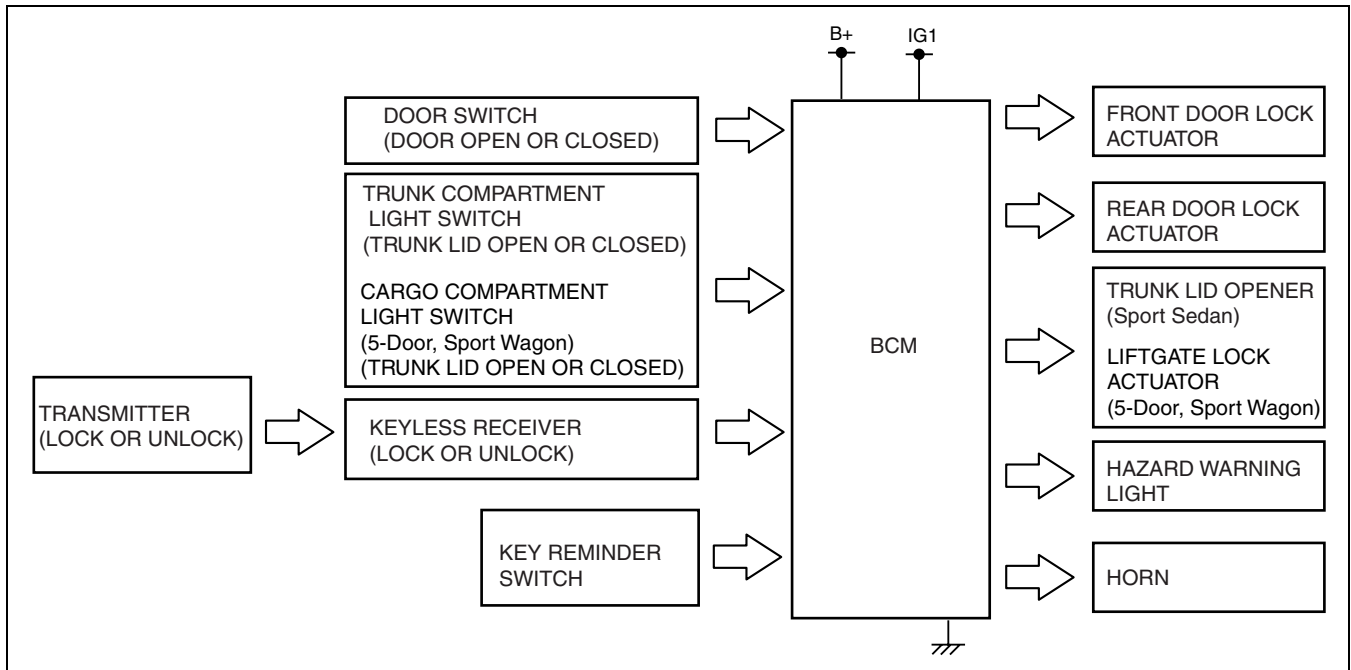
### KEYLESS ENTRY SYSTEM CONSTRUCTION/OPERATION

E6U09146600S09

- Consists of the following parts;
  - BCM
  - Keyless receiver
  - Transmitter
  - Front door lock actuator
  - Rear door lock actuator
  - Trunk lid opener/liftgate lock actuator
- The following operations can be performed using the transmitter when away from the vehicle (approx. 2.5 m {8.2 ft}):
  - Lock all doors (by pressing the LOCK button.)
  - Unlock all doors (by pressing the UNLOCK button.)
- When the transmitter LOCK button is pressed two times within 5 s, the horn sounds once to indicate that all doors are locked.
- An auto-locking device has been adopted that automatically locks the doors if any of the following operations are not performed within 30 s of pressing the transmitter UNLOCK button:
  - Any door is opened.
  - The door is locked/unlocked using the door key cylinder.
  - The door is locked/unlocked using the driver-side door lock knob.
  - The key is inserted the steering lock.
- In order to prevent accidental operation when driving, pushing any transmitter button will have no affect when the ignition switch is at the ON position.

## SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

- In response to transmitter operation (lock/unlock), the hazard warning light flashes to enable visual verification of operation.
  - When the transmitter LOCK button is pushed, the hazard warning light flashes once.
  - When the transmitter UNLOCK button is pushed, the hazard warning light flashes twice.

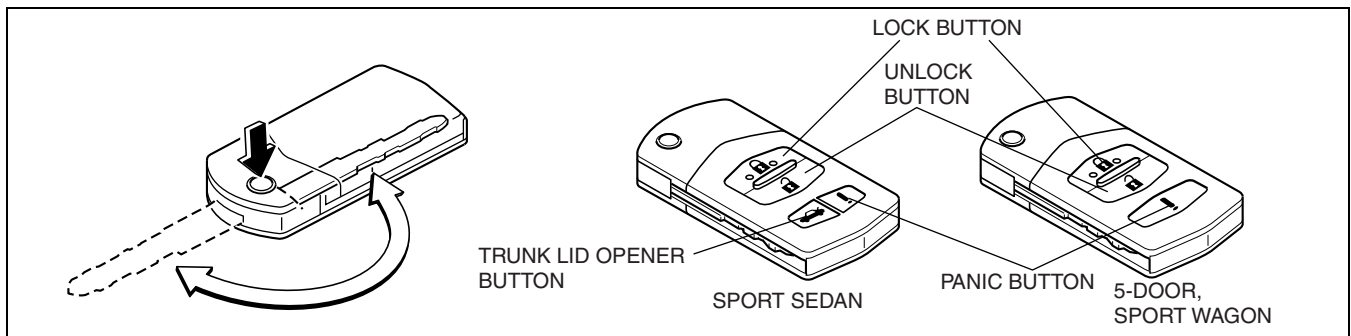


E6U914BS1004

09-14B

### TRANSMITTER (RETRACTABLE KEY TYPE) STRUCTURAL VIEW

E6U09146600S10



E6U914BS1006

## SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

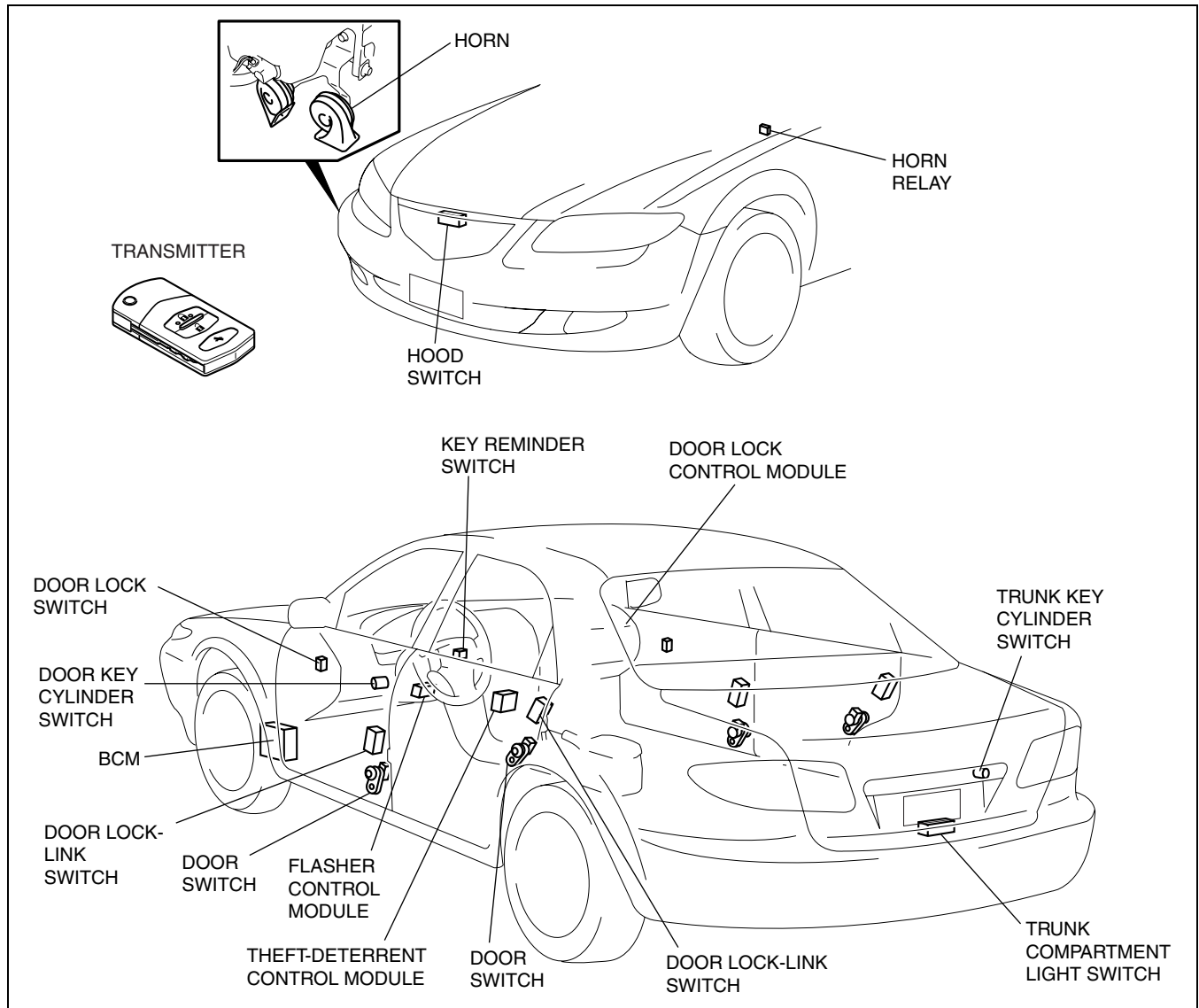
### THEFT-DETERRENT SYSTEM OUTLINE

E6U09145000S05

- The theft-deterrent system includes sound and light alarms that activate when the hood, the trunk lid, or a door is opened by means other than the ignition key or the transmitter. The turn lights flash and the horn sounds.
- When the ignition key is inserted into the door or trunk key cylinder and turned to unlock or the transmitter unlock button is pressed, the alarms stop.

### THEFT-DETERRENT SYSTEM STRUCTURAL VIEW

E6U09145000S06

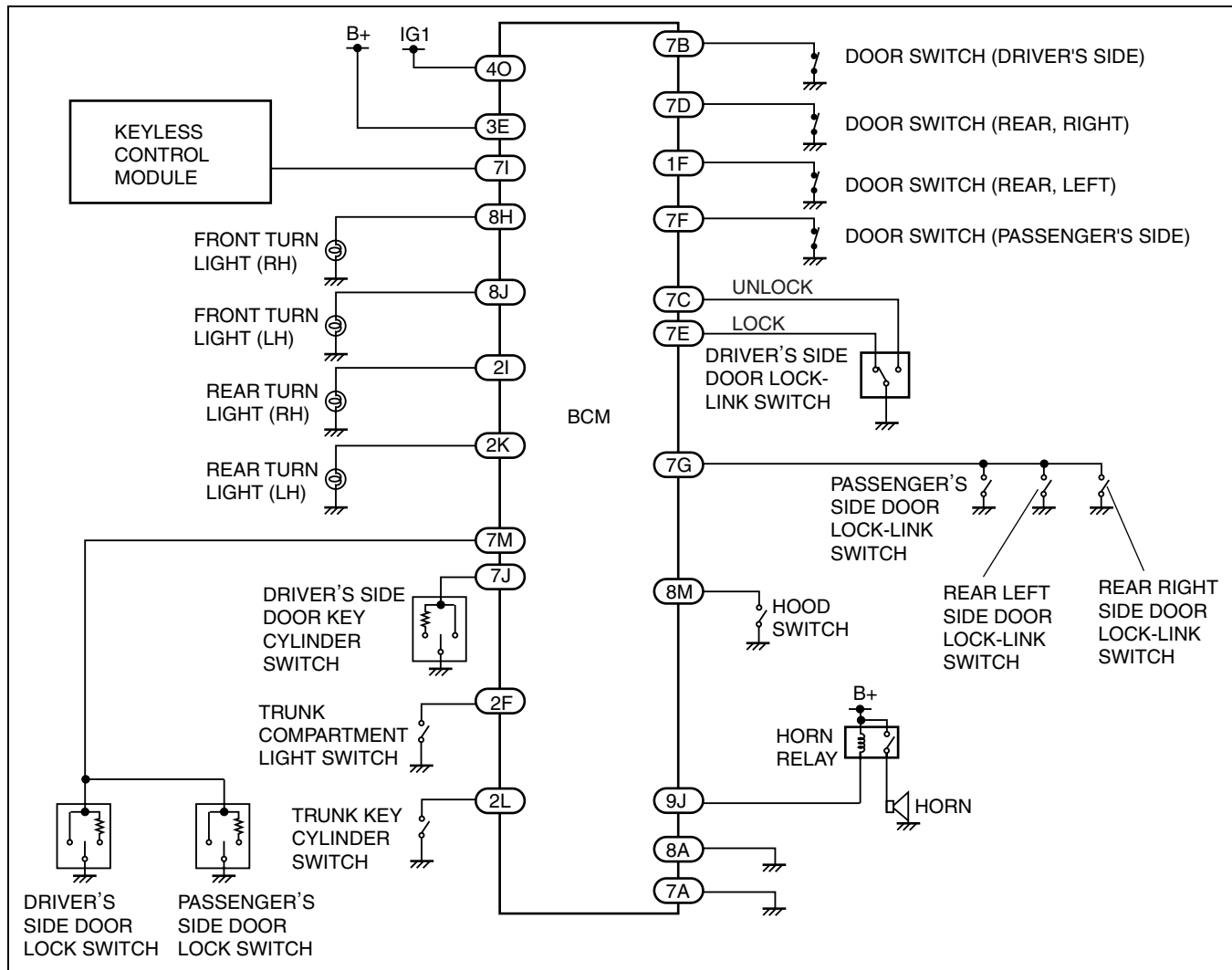


E6U914BS1005

# SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

## THEFT-DETERRENT SYSTEM WIRING DIAGRAM

E6U09145000S07



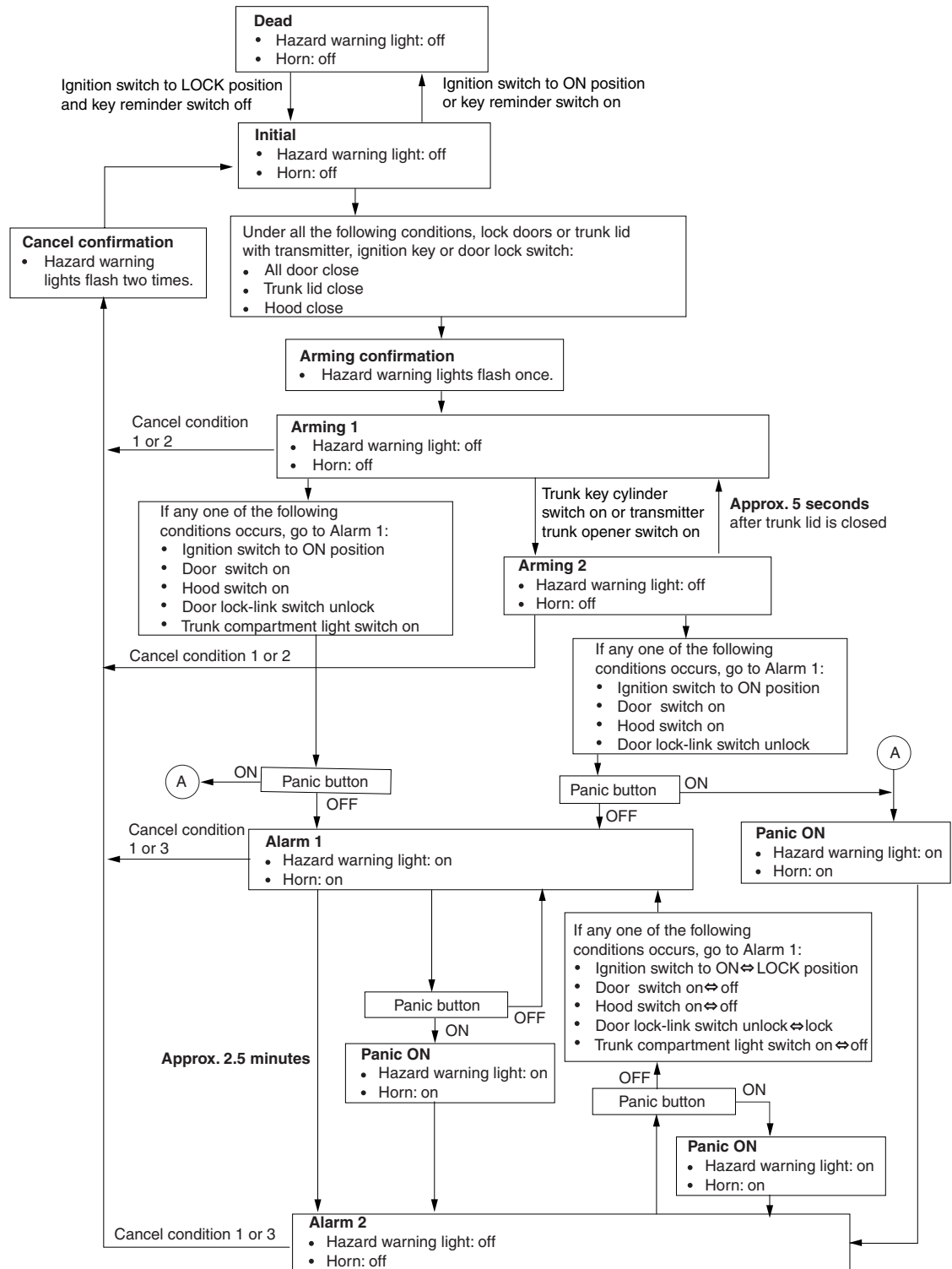
E6U914AS1020

09-14B

# SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

## SYSTEM FLOWCHART

E6U09145000S08



### 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

# SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

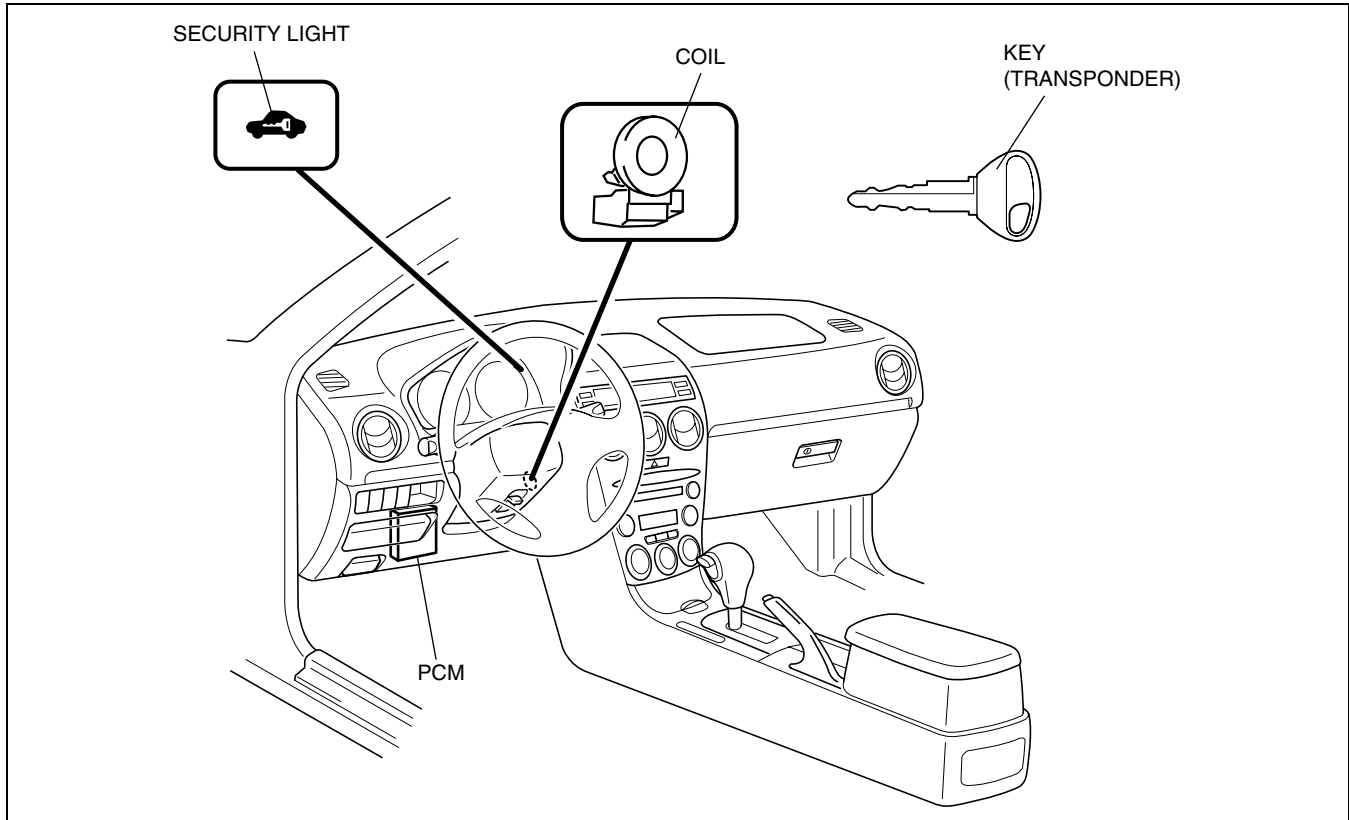
## IMMOBILIZER SYSTEM OUTLINE

E6U091467000S09

- A passive anti-theft system (PATS), which incorporates the former immobilizer unit function, has been adopted and is built-into the PCM.
- The PATS prevents vehicle theft by only allowing keys that have been registered specifically for the vehicle to start the engine and prohibits the engine from being started using any other method (such as using an unregistered key or by shorting the starter relay circuit).
- The system is composed of the transponder equipped key, the coil, and the PCM.
- If there is a malfunction in the system, the security light will display the DTC by flashing when the ignition switch is turned to the ON position. Also, the DTC can be displayed using the **SST** (WDS).

## IMMOBILIZER SYSTEM STRUCTURAL VIEW

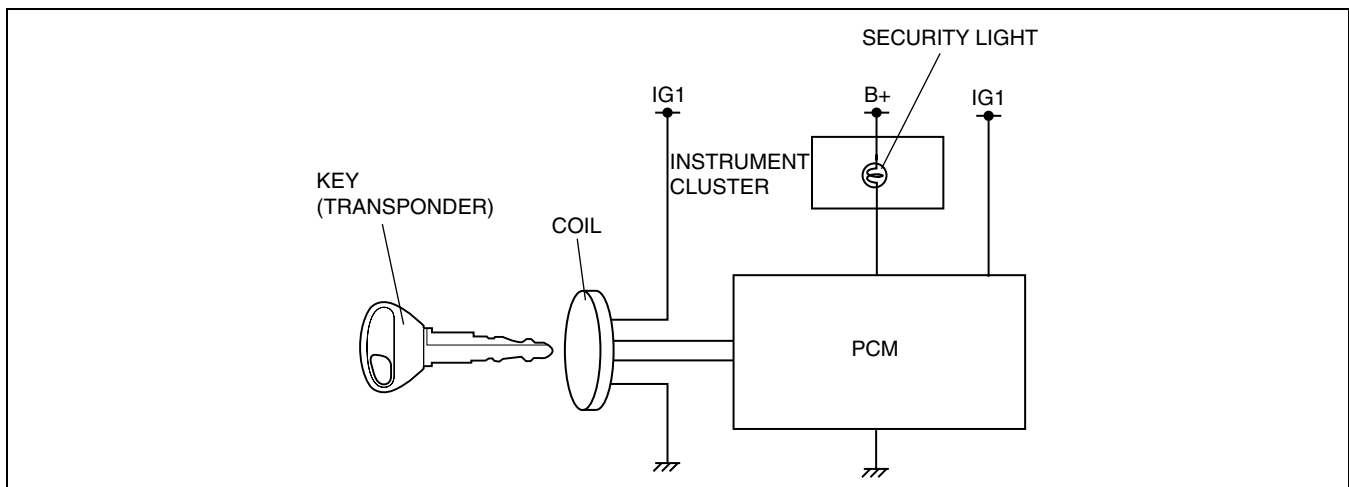
E6U091467000S10



B6U0914S201

## IMMOBILIZER SYSTEM WIRING DIAGRAM

E6U091467000S11



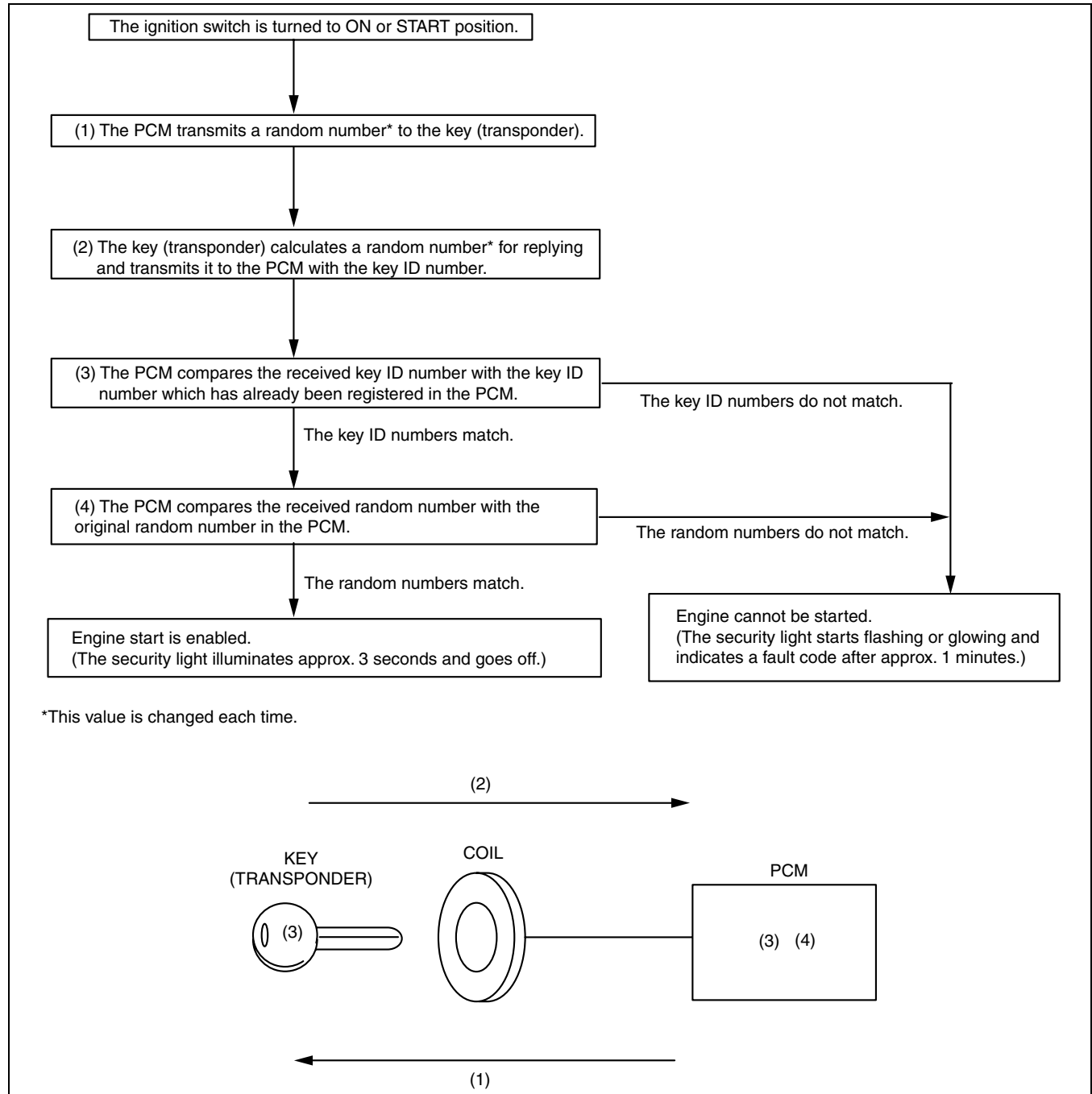
A6A8122T002

# SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

## IMMOBILIZER SYSTEM DESCRIPTION

E6U091467000S12

### Verification Method Between Key (Transponder) and PCM



B6U0914S202







## SECURITY AND LOCKS [KEYLESS ENTRY SYSTEM]

### On-Board Diagnostic Function

#### Self-malfunction diagnosis system

- If the immobilizer system has a malfunction, the security light starts flashing and indicates a fault code when the ignition switch is turned to the ON position. In this case, check the DTC using the **SST** (WDS) to verify the malfunction.

#### DTC table

DTC			Description
Security light	Security light flashing pattern	WDS	
11		B1681	Coil signal is not received.
12		B2103	Coil failure.
13		B1600	ID number signal is not received.
		B2431	Transponder programming failure.
14		B1602	PCM received invalid format of ID number from transponder.
15		B1601	PCM received incorrect ID number from key (transponder).
21		B1213	Number of valid keys is below minimum.
Not illuminated	—	B1342	PCM is defective.

09-14B

#### PID/data monitor and record

- The PID/data monitoring item for the immobilizer system is shown in the table below.

#### PID/data monitor table

PID name (Description)	Unit	Specification	PCM terminal
NUMKEYS (Number of key stored in module)	—	Number of registered keys: 0—8	—



## 09-16 EXTERIOR TRIM

### EXTERIOR TRIM OUTLINE

[L3 WITH TC] ..... 09-16-1

### EXTERIOR TRIM STRUCTURAL VIEW

[L3 WITH TC] ..... 09-16-1

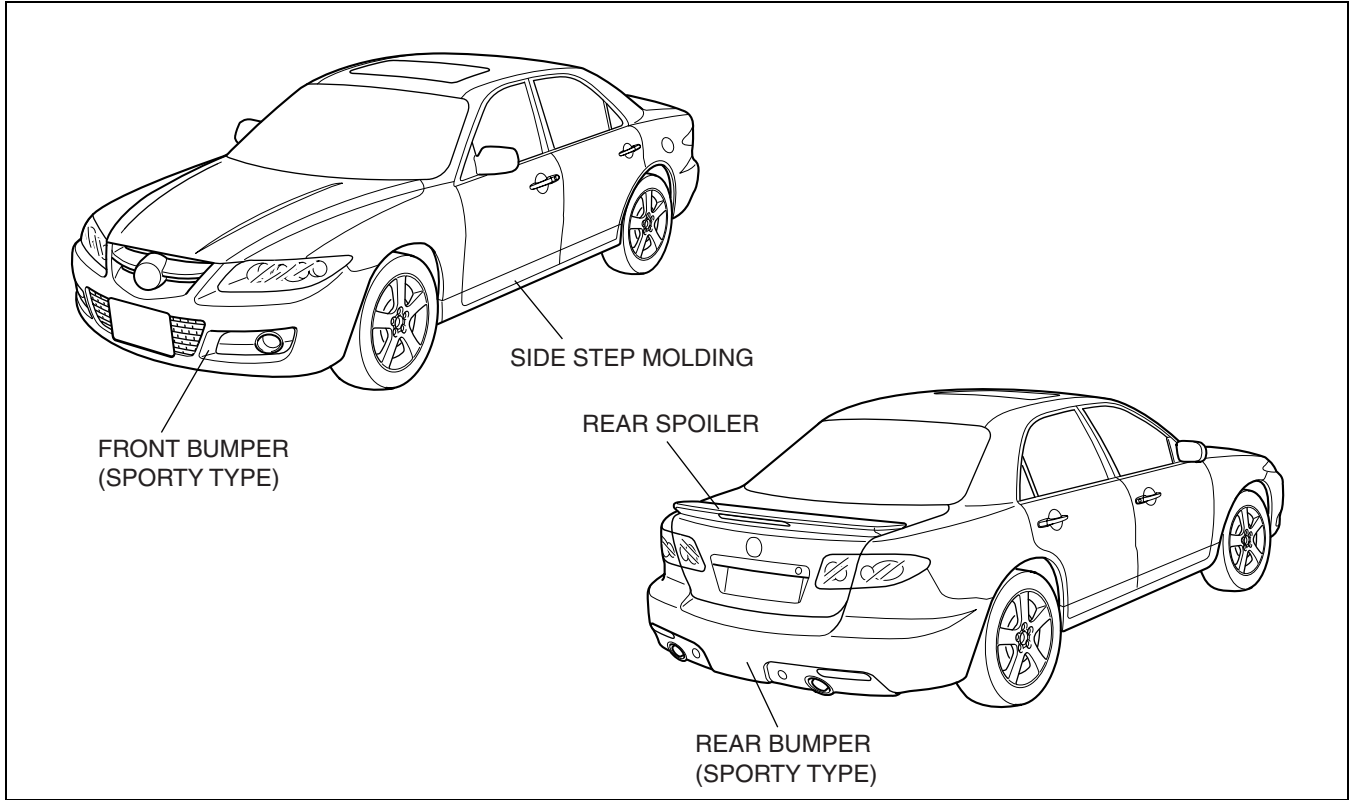
#### EXTERIOR TRIM OUTLINE [L3 WITH TC]

E6U091600000S01

- The front and rear bumpers are equipped in sporty types.

#### EXTERIOR TRIM STRUCTURAL VIEW [L3 WITH TC]

E6U091600000S02



E6U916ZS1001



## 09-18 LIGHTING SYSTEMS

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DRL SYSTEM WIRING DIAGRAM .....	09-18-6
DRL SYSTEM OPERATION .....	09-18-6

### LIGHTING SYSTEM OUTLINE

E6U091800000S01

- Front fog light has been adopted to the front bumper.
- Discharge headlight has been adopted.
- Headlight leveling system has been adopted.

### LIGHTING SYSTEMS SPECIFICATION

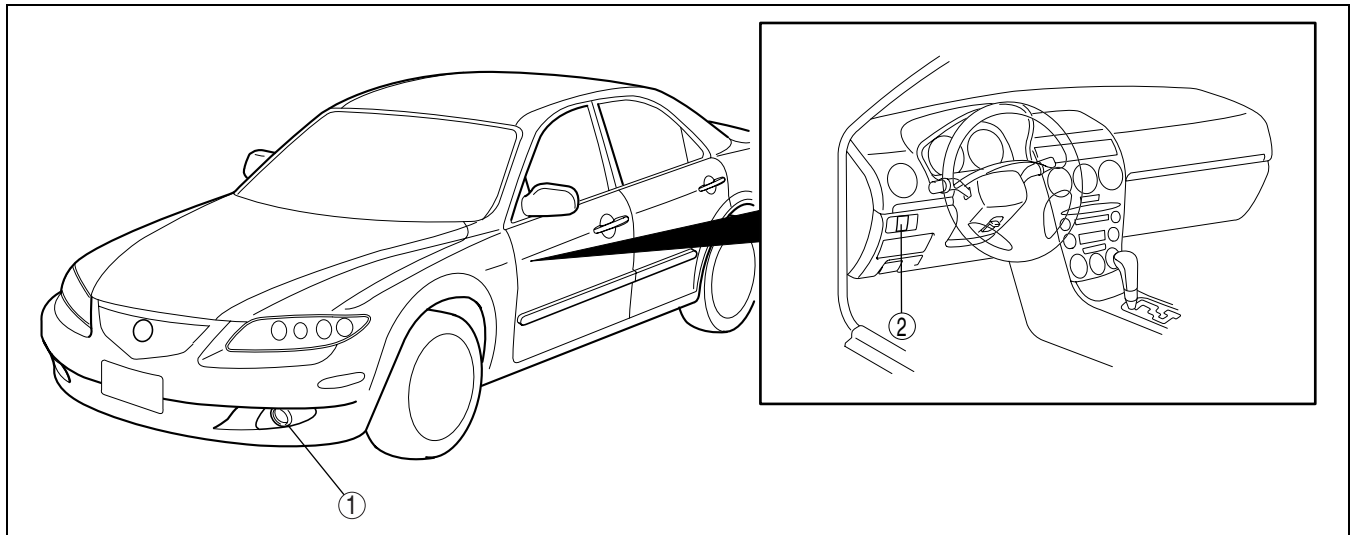
E6U091800000S02

Item		Specifications (W) × number
Exterior light bulb capacity	Discharge headlight bulb (low-beam)	35 × 2

09-18

### LIGHTING SYSTEM STRUCTURAL VIEW

E6U091800000S03



E6U9182S5001

1	Front fog light
---	-----------------

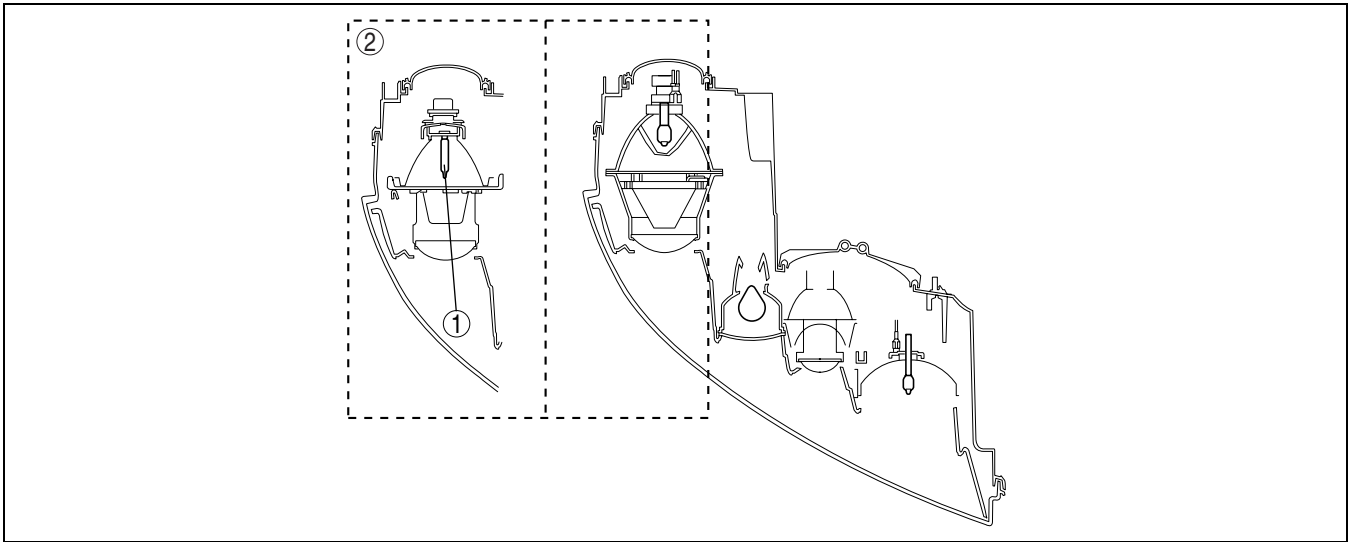
2	Headlight leveling switch
---	---------------------------

# LIGHTING SYSTEMS

## FRONT COMBINATION LIGHT CONSTRUCTION

E6U091851060S01

- Discharge headlights, with a wide illumination area and projection of white light with a hue approaching that of the sunlight, have been adopted. (For vehicles equipped with discharge headlights.)



E6U918ZS5002

1	Discharge headlight bulb (low-beam)
2	Discharge type

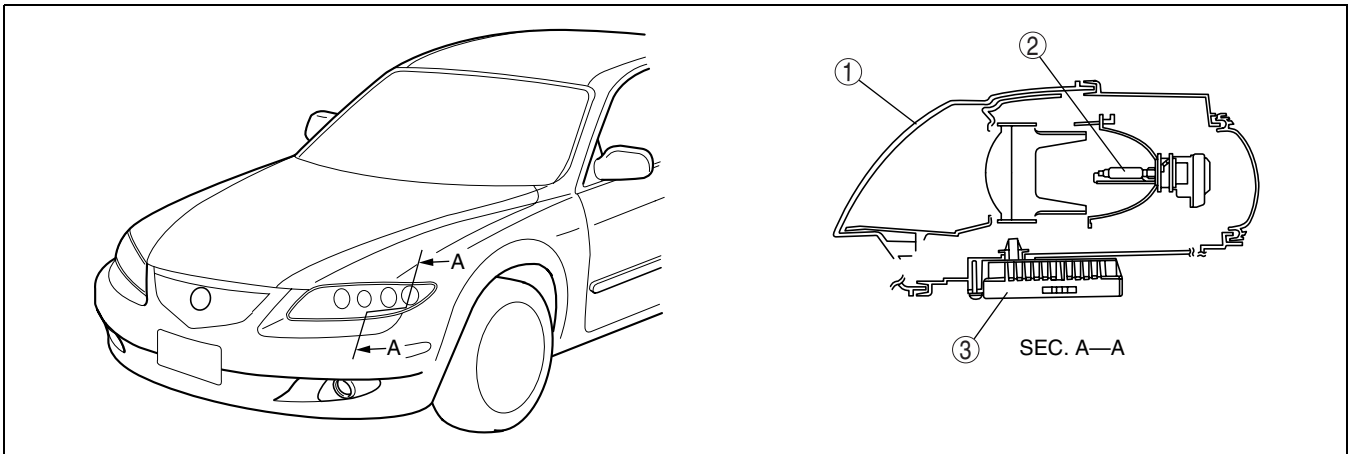
## DISCHARGE HEADLIGHT OUTLINE

E6U091851030S01

- Compared with the current headlights, the illumination area is wider. Moreover, due to projection of white light with a hue approaching that of the sunlight, night visibility white driving has been improved.
- Use of the gas discharge bulb realizes high efficiency and low power consumption luminosity.

## DISCHARGE HEADLIGHT STRUCTURAL VIEW

E6U091851030S02



E6U918ZS5003

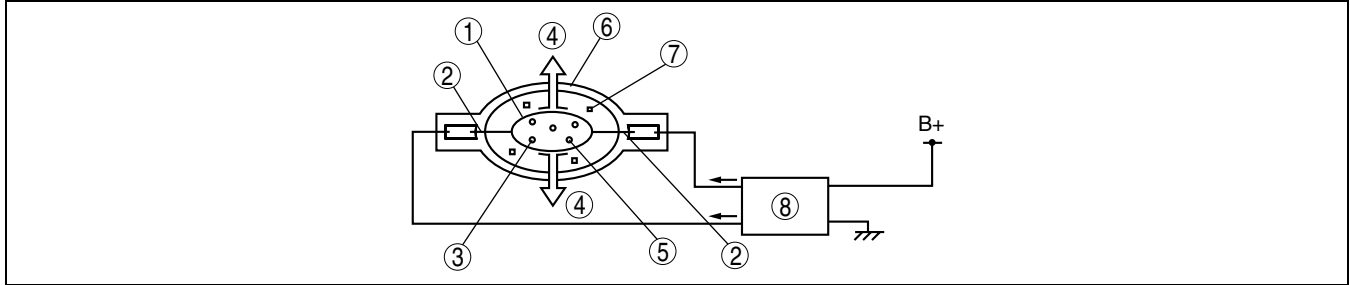
1	Front combination light
2	Discharge headlight bulb
3	Discharge headlight control module

# LIGHTING SYSTEMS

## DISCHARGE HEADLIGHT OPERATION

E6U091851030S03

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

E6U091851030S04

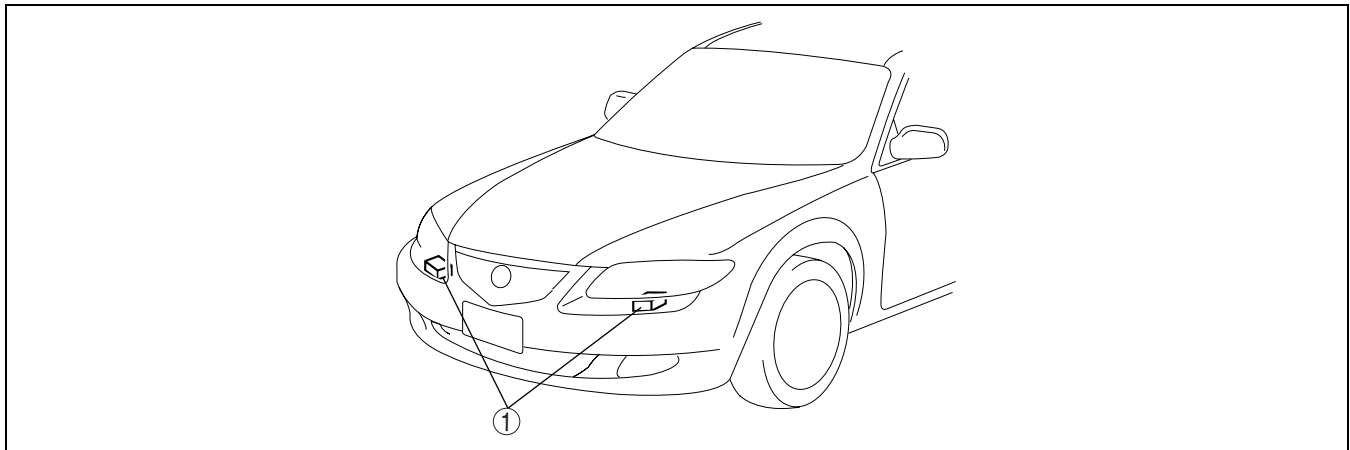
09-18

- Controls the amount of electrical current while the discharge headlight 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

## DISCHARGE HEADLIGHT CONTROL MODULE CONSTRUCTION/OPERATION

E6U091851030S05

- Built into the headlight and installed on the headlight lower side.
- Switches the direct current from the battery to alternating current and optimally controls the current supply output to the bulb.



E6U9182S5006

1	Discharge headlight control unit
---	----------------------------------

## LIGHTING SYSTEMS

### Failure Detection Function

#### Abnormal input detection function

- If the discharge headlight control unit 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 unit turns off the headlights for protection or to prevent part operation errors.
- The discharge headlight control unit 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 unit turns off the headlights for protection or to prevent part operation errors.
- If the discharge headlight control unit turns off the headlights due to an abnormality in the output system, the discharge headlight control unit will maintain them in the off condition until the light switch is turned again from off to on.

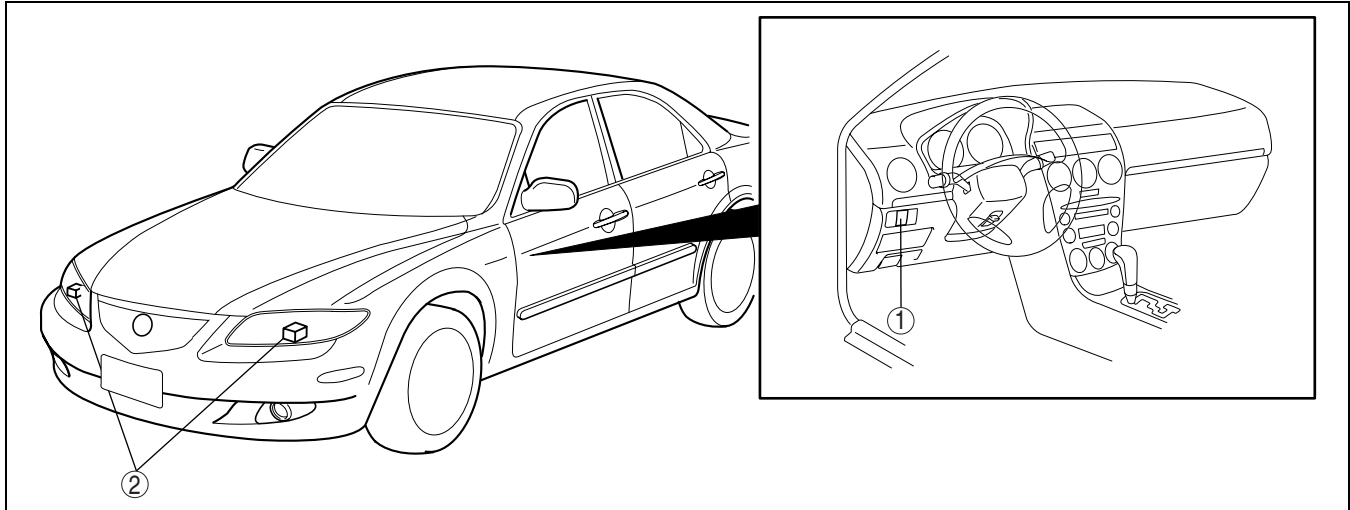
### HEADLIGHT LEVELING SYSTEM OUTLINE

E6U091851032S01

- Allows adjustment of the headlight optical axis (changes due to varying cargo and passenger conditions) from the vehicle interior, in order to prevent blinding of oncoming vehicles.
- Paired with discharge headlights which can easily blind oncoming vehicles.
- The headlight optical axis can be freely adjusted by setting the headlight leveling switch between 0-3 ("0" is the maximum upward angle, "3" is the maximum downward angle).

### HEADLIGHT LEVELING SYSTEM STRUCTURAL VIEW

E6U091851032S02



E6U9182S5004

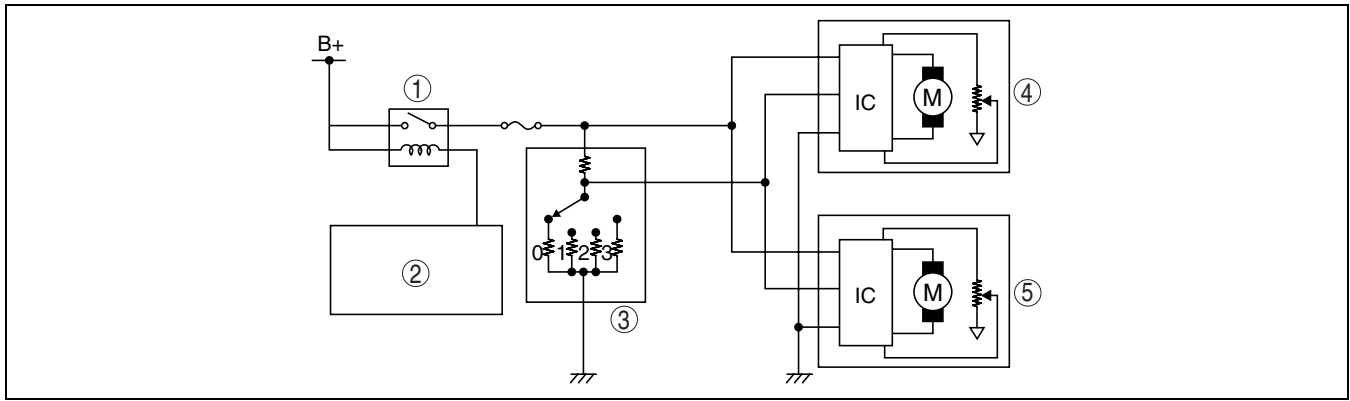
1	Headlight leveling switch
---	---------------------------

2	Headlight leveling actuator
---	-----------------------------

# LIGHTING SYSTEMS

## HEADLIGHT LEVELING SYSTEM WIRING DIAGRAM

E6U091851032S03



DPE918ZN1006

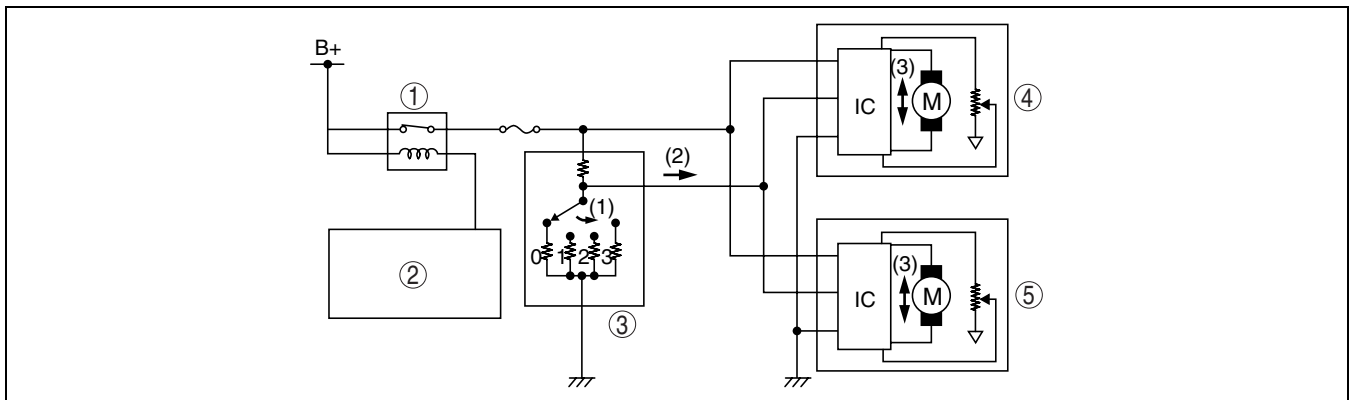
1	TNS relay
2	Light switch
3	Headlight leveling switch

4	Headlight leveling actuator (LH)
5	Headlight leveling actuator (RH)

## HEADLIGHT LEVELING SYSTEM OPERATION

E6U091851032S04

1. Switch the headlight leveling switch position.
2. The headlight level switch position signal is output to the headlight leveling actuator.
3. The motor inside the headlight leveling actuator operates, moving the headlight reflector angle upward or downward, and the headlight beam is adjusted accordingly.



DPE918ZN1007

1	TNS relay
2	Light switch
3	Headlight leveling switch

4	Headlight leveling actuator (LH)
5	Headlight leveling actuator (RH)

# LIGHTING SYSTEMS

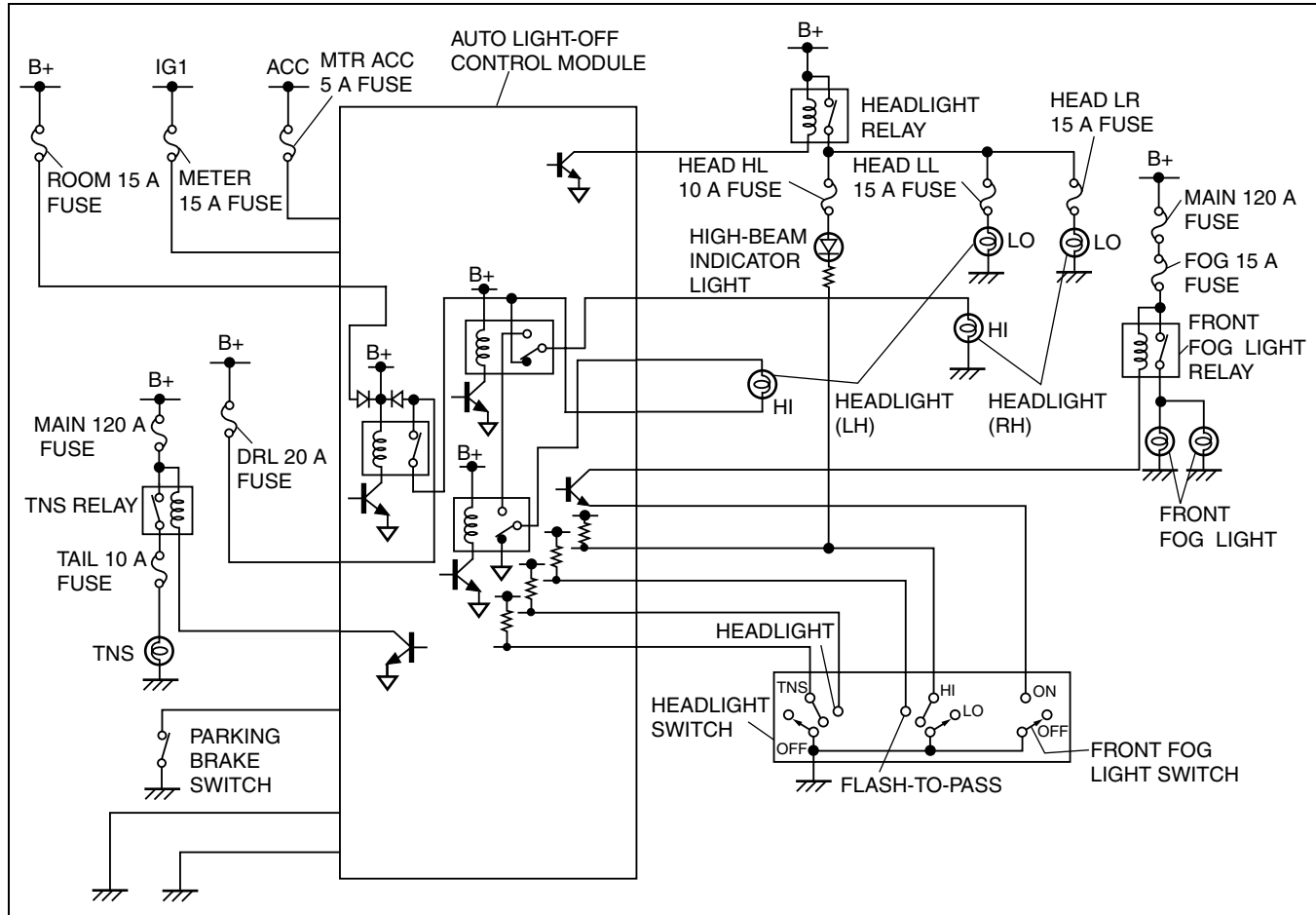
## DRL SYSTEM OUTLINE

E6U091800200S01

- The DRL system automatically operates the high-beam headlights when the ignition switch is turned to the ON position and the parking brake is released.

## DRL SYSTEM WIRING DIAGRAM

E6U091800200S02



E6U918ZS5005

## DRL SYSTEM OPERATION

E6U091800200S03

Operation condition (Input signal)				Operation condition of illumination (Output signal)			
Ignition switch	Parking brake switch	Light switch		Flash-to-pass switch	Low-beam headlight	High-beam headlight	Front fog light
ON	OFF	OFF TNS	LOW	OFF	-	Illuminates (DRL)	-
			HIGH		-	Illuminates (DRL)	-
	ON	OFF TNS	LOW		-	-	-
			HIGH		-	-	-
	-	Headlight	LOW		Illuminates	-	Illuminates
			HIGH		Illuminates	Illuminates	-
-	-	-	ON	Illuminates	Illuminates	-	

## 09-20 ENTERTAINMENT

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### CAR-NAVIGATION SYSTEM OUTLINE

E6U09206600S01

- A 7 inch wide, pop-up LCD (\*TFT) has been adopted to improve marketability.
- A hybrid in car-navigation system and map-matching function has been adopted to improve accuracy of vehicle position.
- A voice recognition function has been adopted.
- A remote control with an infrared transmitter has been adopted to improve operational ability.
- The languages and voices available for use with the car-navigation unit include English, French, and Spanish. However, the language used in this manual is in **English only**.

\*TFT: Thin Film Transistor

### Specifications

#### Car-navigation unit

Item		Specification
Unit type		Stand alone
Rated voltage	(V)	12
ROM type		DVD-ROM
Output impedance	(ohm)	Standard: 4, BOSE: 2
Voice guidance output power	(W)	5

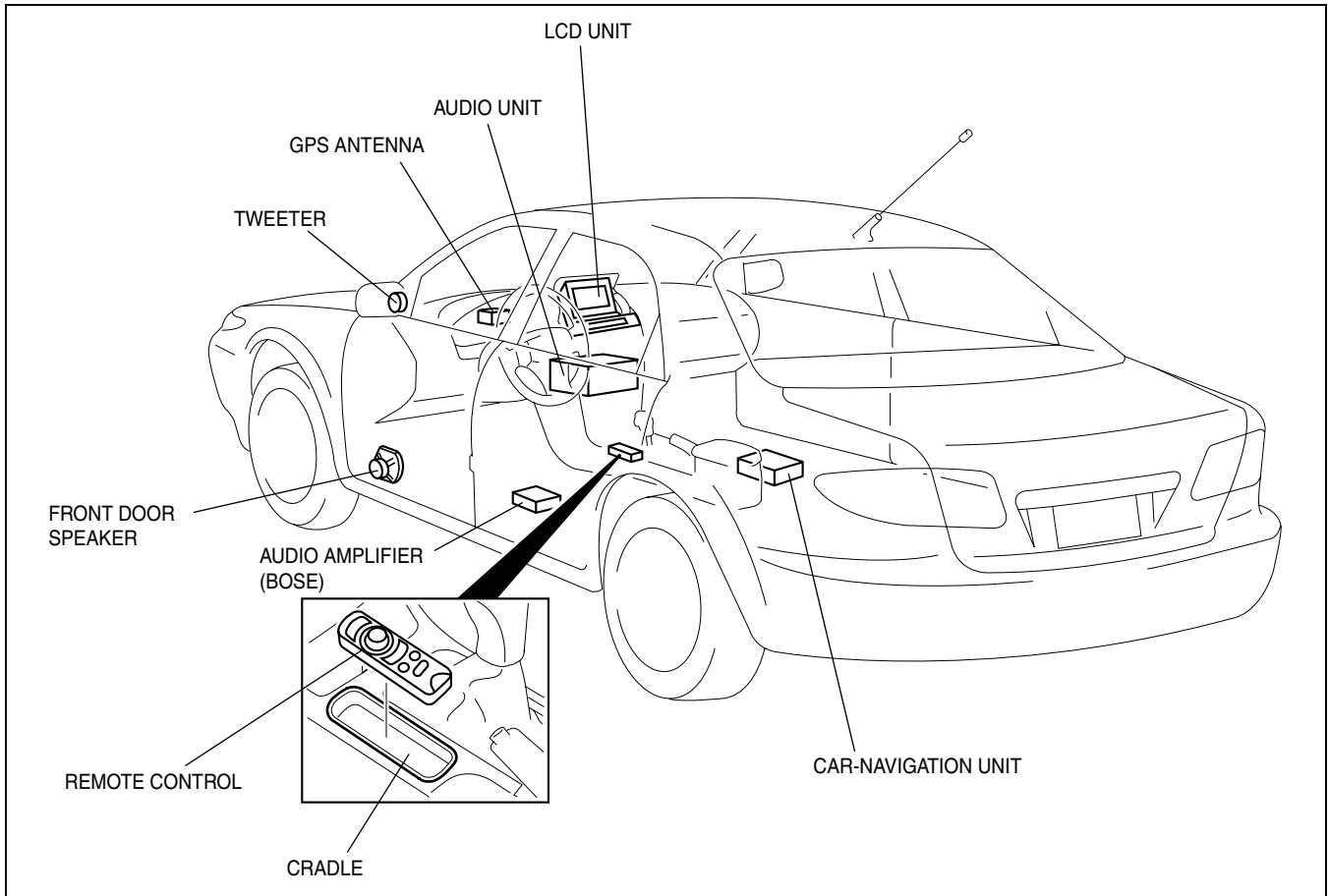
#### LCD unit

Item		Specification
Unit type		Pop-up
Rated voltage	(V)	12
Display (for car-navigation system)	Size	7 (wide)
	Type	TFT (Thin Film Transistor); Full-color
Display (for audio and A/C)	Type	LCD; Amber-color

## ENTERTAINMENT

### CAR-NAVIGATION SYSTEM STRUCTURAL VIEW

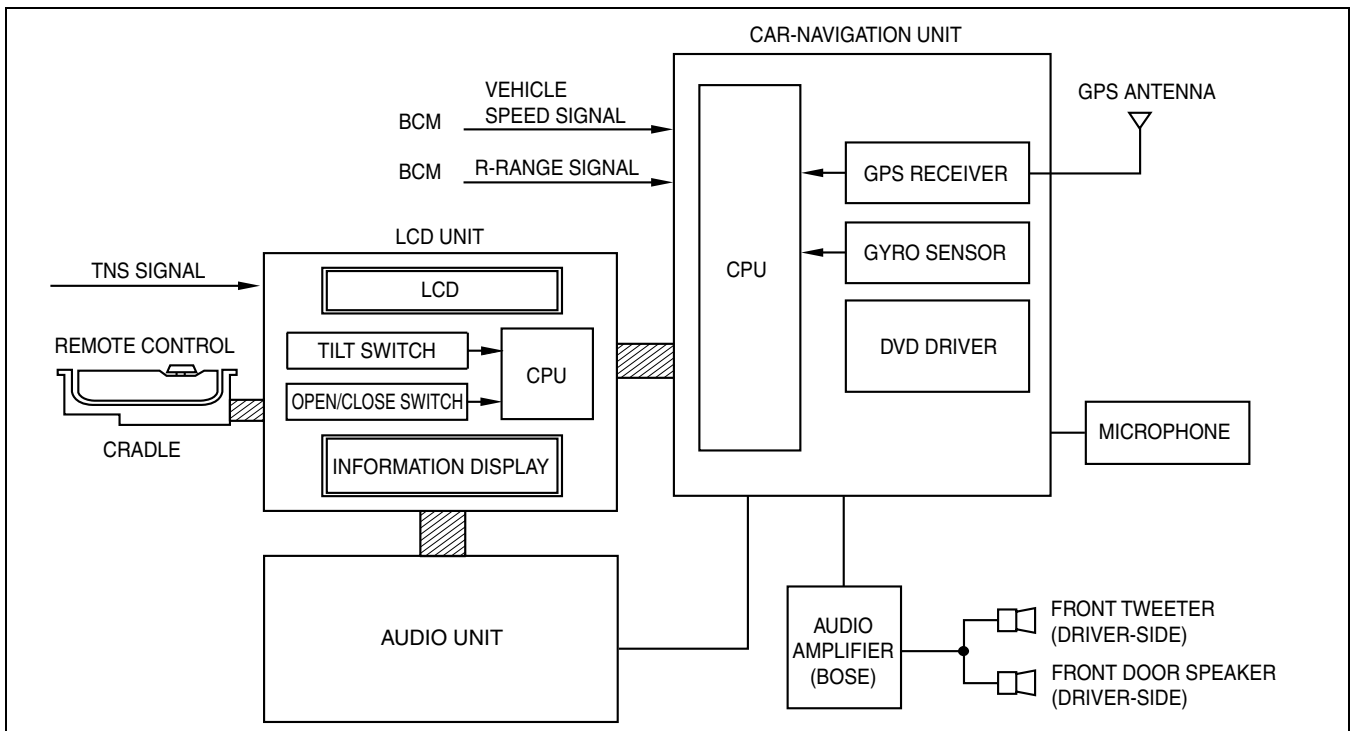
E6U09206600S02



E6U920ZS5001

### CAR-NAVIGATION SYSTEM BLOCK DIAGRAM

E6U09206600S03



E6U920ZS5002

## CAR-NAVIGATION SYSTEM STRUCTURE

E6U09206600S04

Item	Function
Car-navigation unit	<ul style="list-style-type: none"> <li>• Reads the data (map, voice and other) from the DVD-ROM.</li> <li>• Calculates and displays the vehicle's position from various signals.</li> <li>• Calculates the route to the destination.</li> <li>• Navigates the driver to the destination using the map screen and/or the voice.</li> </ul> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>• DVD audio and video are not supported by this system.</li> <li>• This unit does not support all Video CD and CD formats.</li> </ul>
LCD unit	<ul style="list-style-type: none"> <li>• Displays the screen (menus, maps and other screens) by remote control operation on the LCD.</li> <li>• Displays the status of audio and A/C by button operation on the information display.</li> </ul>
GPS antenna	<ul style="list-style-type: none"> <li>• Receives GPS signal from satellites.</li> </ul>
Gyro sensor (inside of the car-navigation unit)	<ul style="list-style-type: none"> <li>• Sends yaw-rate signal to the CPU in the car-navigation unit.</li> </ul>
BCM	<ul style="list-style-type: none"> <li>• Sends R-range or reverse signal to the car-navigation unit.</li> <li>• Sends vehicle speed signal to the car-navigation unit by CAN system.</li> </ul>
Front speaker and tweeter (driver side)	<ul style="list-style-type: none"> <li>• Outputs voice and audio sound.</li> </ul>
DVD-ROM (inside of the car-navigation unit)	<ul style="list-style-type: none"> <li>• Map information data of each country is recorded.</li> <li>• Voice data used to guide the route is recorded.</li> <li>• Route information data to search for the route is recorded.</li> </ul>
Voice recognition switch	<ul style="list-style-type: none"> <li>• Set the voice recognition function activate/deactivate</li> </ul>
Remote control	<ul style="list-style-type: none"> <li>• Changes display screens, settings and other functions by button operation.</li> </ul>
Cradle	<ul style="list-style-type: none"> <li>• Provides power source (B+, TNS) for remote control.</li> <li>• Sends remote control signal to the car-navigation unit.</li> </ul>

09-20

## CAR-NAVIGATION UNIT OUTLINE

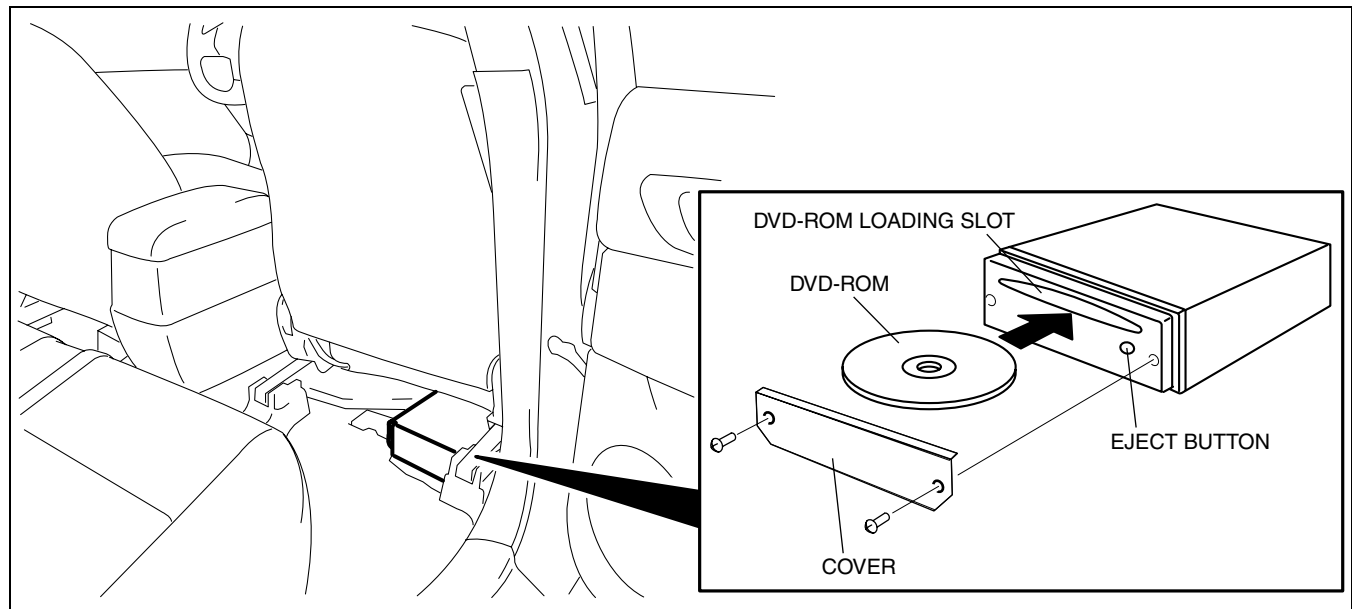
E6U092066902S01

- Using exterior signal input and DVD-ROM information, this unit detects vehicle position, provides destination route guidance, and displays color maps.

## CAR-NAVIGATION UNIT STRUCTURAL VIEW

E6U092066902S02

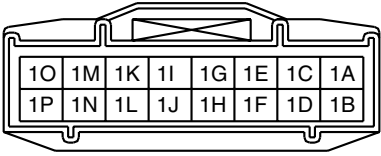
- The car-navigation unit is located under the passenger-side seat.
- An Eject button, to eject the DVD-ROM from the loading slot, is included in the unit.
- A gyro sensor which detects vehicle cornering angle is built into the unit.



E6U920ZS5198

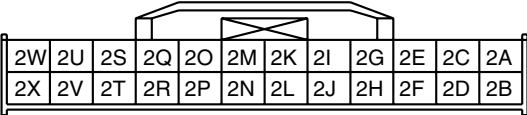
# ENTERTAINMENT

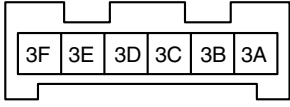
## Terminal Layout and Signals


Terminal		Signals
		16-pin connector
	1A	GND
	1B	B+
	1C	—
	1D	ACC
	1E	Front speaker input (-)*1
	1F	—
	1G	Front speaker input (+)*1
	1H	Vehicle speed
	1I	Front speaker output (-)*1
	1J	—
	1K	Front speaker output (+)*1
	1L	R-range
	1M	Front speaker output (-)*2
	1N	Front speaker output (+)*2
	1O	Front speaker input (-)*2
	1P	Front speaker input (+)*2

\*1 : Vehicles with BOSE

\*2 : Vehicles without BOSE

Terminal		Signals
		24-pin connector
	2A	—
	2B	—
	2C	—
	2D	—
	2E	—
	2F	—
	2G	—
	2H	—
	2I	—
	2J	—
	2K	—
	2L	—
	2M	—
	2N	Monitor serial input
	2O	Shield GND
	2P	Monitor serial output
	2Q	Shield GND
	2R	Video (composit sync)
	2S	—
	2T	Video (B)
	2U	Video GND
	2V	Video (G)
	2W	—
	2X	Video (R)

Terminal		Signals
		6-pin connector
	3A	Mic (+)
	3B	Mic (-)
	3C	Mic power
	3D	GND
	3E	Mic sense
	3F	—

Terminal		Signal
		1-pin connector
	4A	GPS antenna input
	4B	GND

## AUTONOMOUS NAVIGATION OPERATION

E6U092066902S05

- The navigation unit detects the position of the vehicle from a cumulative calculation of the vehicle's direction and travelled distance based on the processing of direction data obtained from the gyro sensor and vehicle speed signals obtained from BCM.
- Even when GPS satellite reception is not available, accurate detection of vehicle's position is still possible.
- Signals from GPS satellites are used partially for detecting direction data.

## GYRO SENSOR FUNCTION

E6U092066902S06

- The gyro sensor is located in the navigation unit. The sensor converts yaw rate, which is one of the inputs used in calculating the vehicle direction of travel from the vehicle cornering angle, into electrical signals. It then sends these signals to the navigation unit.

09-20

## GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OUTLINE

E6U092066902S07

- GPS is a navigation system developed by the U.S. Department of Defence. The system has GPS satellites orbiting the earth at an altitude of approximately 21,000 km {13,000 miles}.
- There are at least five satellites over any point 24 hours a day.
- The navigation unit receives radio signals from these satellites and determines a vehicle's position.

## GPS (GLOBAL POSITIONING SYSTEM) NAVIGATION OPERATION

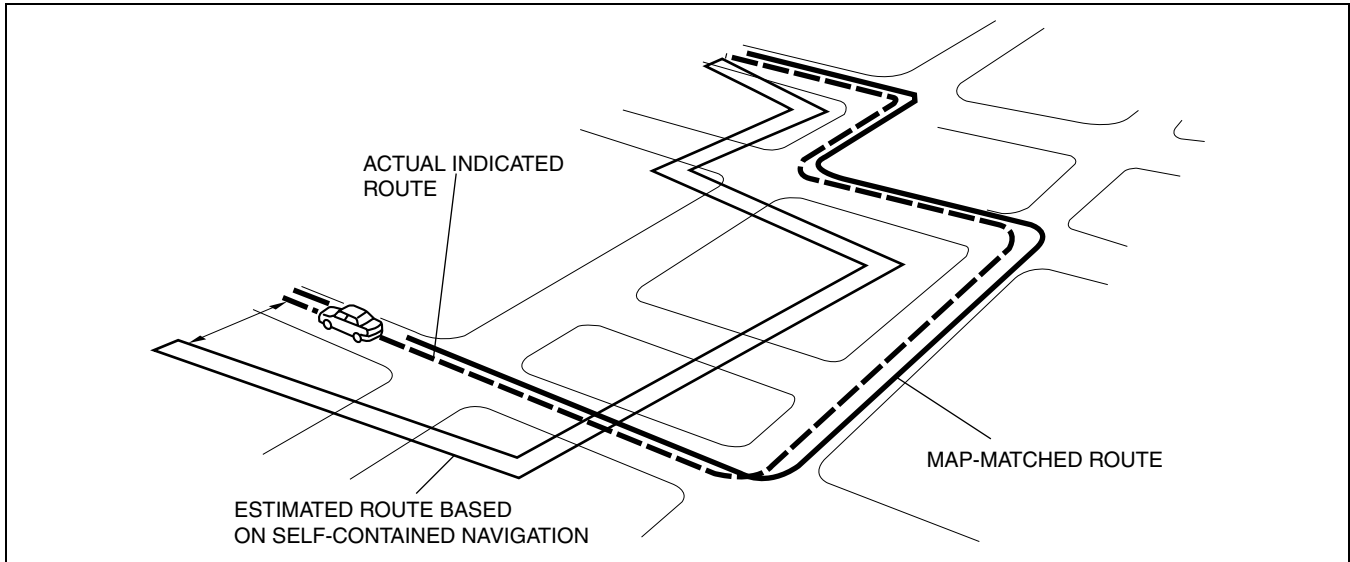
E6U092066902S08

- When using the navigation system for the first time after purchase or for the first time after a long period during which it was not used, it may take about 5—15 min. until the current position is measured. Also, even during normal use, it may take about 2—3 min. for measurement.
- The GPS antenna may be unable to receive GPS satellite signals when a vehicle passes through tunnels, valleys between tall buildings, or in the mountains.
- Placing an object above the GPS antenna may prevent the navigation unit from taking measurements.
- When GPS measurement conditions are bad, the navigation unit may be unable to compute dimensions or correct to the proper position.
- The position measurement error for GPS information can be reduced by reception conditions, the time band, and by deliberate reduction in satellite accuracy by the United States Department of Defence. Also, under the following conditions, interference with satellite signals may make it temporally impossible to receive signals from GPS satellites.
  - When receiving monitor channel 56 (UHF)
  - When an automobile phone or cellular phone is used near the GPS antenna
- The navigation unit can locate absolute position only when the vehicle is in motion. Therefore, the navigation unit does not correct direction when the vehicle is not moving.
- The navigation unit computes three positions (latitude, longitude, and altitude) using radio signals from four or more satellites, called three-dimensional positioning. The more GPS satellite signals received, the more accurate the three-dimensional positioning is performed. The navigation unit can receive a maximum of eight satellite signals to compute a vehicle's position.
- If only three satellite signals can be received, the navigation unit uses two positions (latitude and longitude) and the altitude calculated while in three-dimensional positioning to compute a vehicle's position. This is called two-dimensional positioning.
- There can be as much as a 30-m +/- factor in the position detection system, even using the three-dimensional positioning, which is highly accurate.
- The position detection system is affected by positions of the GPS satellites which send signals.

## MAP MATCHING OUTLINE

E6U092066902S09

- This function compares the route shape the vehicle is travelling to map data using the GPS satellite signals, and corrects the vehicle's position to the most appropriate road on the map data.



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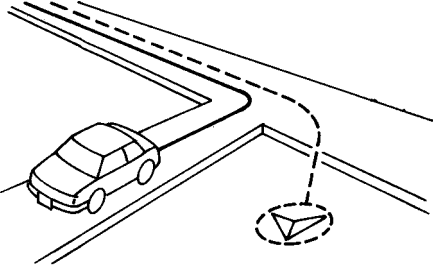
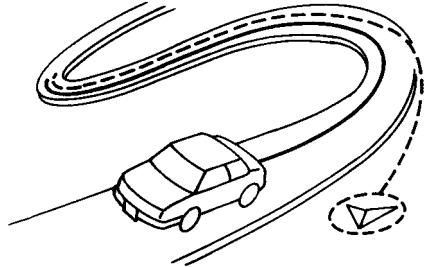
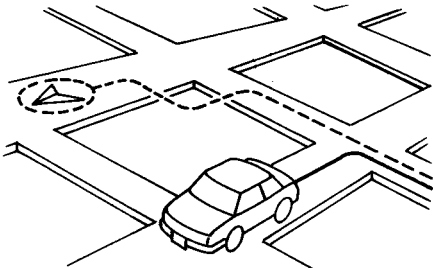
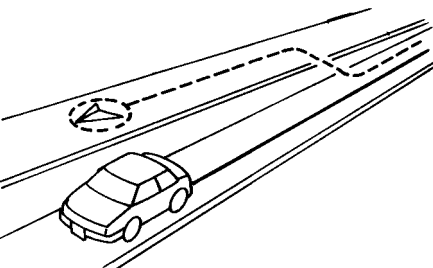
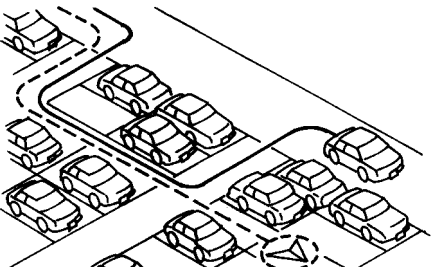
## MAP MATCHING OPERATION

E6U092066902S10

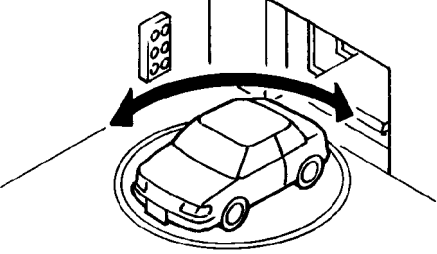
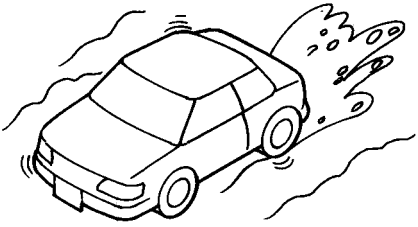
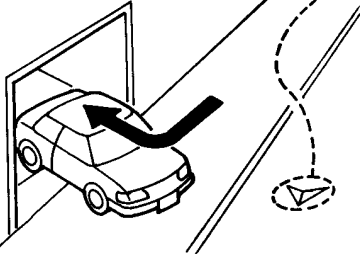
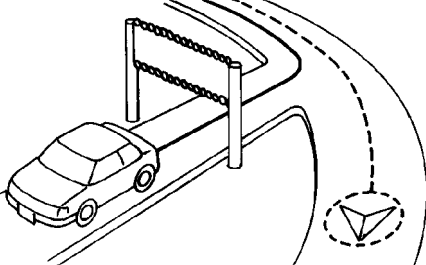
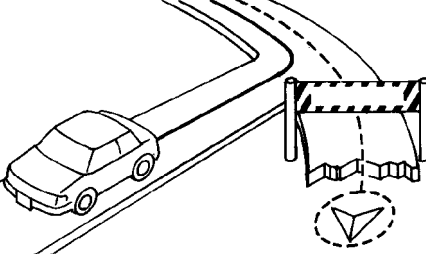
### Map Matching Remarks

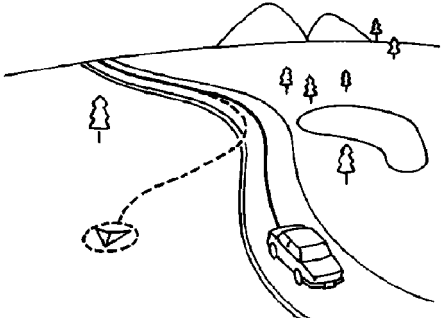
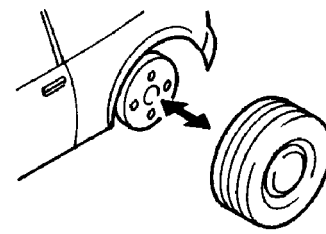
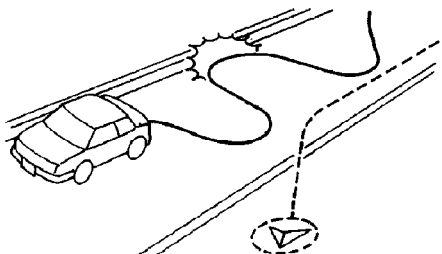
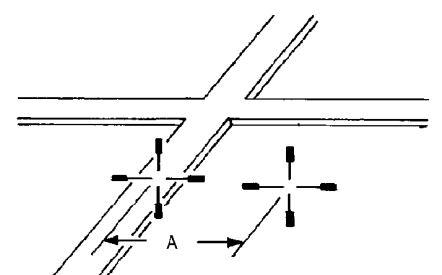
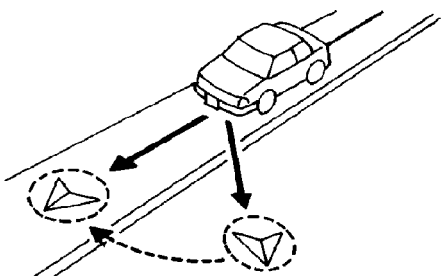
- The map matching function proposes route correction on an order of priority other than the currently indicated route. Therefore, when the navigation unit detects travelling speed or progressive direction errors, it could mistake the order of priority and fail to correct the route.
- Due to the system operation principles, the map matching function may be unable to determine which route a vehicle is taking when there are similar roads around the vehicle, and may not correct the vehicle's position until it can find a particular route.
- While driving on a road that does not exist in the map data or when the actual vehicle's position is far away from the position indicated by the vehicle locator mark, map matching will not be performed.
- Under the following driving conditions and GPS satellite conditions, the vehicle locator mark may deviate from the actual position of the vehicle. This does not indicate any breakdown in the system and if driving continues for a while, the current position will be corrected automatically.

Cause (Condition)	Driving condition
	<ul style="list-style-type: none"> <li>• At a Y-shaped fork in the road where the roads separate gradually, the vehicle locator mark may be displayed on the wrong road.</li> </ul>
	<ul style="list-style-type: none"> <li>• If the vehicle makes continuous, large turns, for example on a loop structure, the vehicle locator mark may go off the road altogether.</li> </ul>

Cause (Condition)	Driving condition
	<ul style="list-style-type: none"><li>After driving for a long distance in a straight line or through gentle curves, if the vehicle turns a corner, the vehicle locator mark may be displayed on the wrong road.</li></ul>
	<ul style="list-style-type: none"><li>On a zigzag road, the vehicle locator mark may go off the road.</li></ul>
	<ul style="list-style-type: none"><li>If the roads form a grid, the vehicle locator mark may go off the road.</li></ul>
	<ul style="list-style-type: none"><li>If there are parallel roads nearby, for example motorways and service roads, the vehicle locator mark may go off the road.</li></ul>
	<ul style="list-style-type: none"><li>If driving in an area where roads are not available on the map, the vehicle locator mark may deviate from the correct position when the vehicle returns to the road. Also, when you turn or go back and forth repeatedly, the vehicle locator mark may not line up correctly with the road.</li></ul>

## ENTERTAINMENT

Cause (Condition)	Driving condition
	<ul style="list-style-type: none"> <li>• If the vehicle rotates on a turntable, the navigation system may have difficulty returning the vehicle locator mark to the road correctly.</li> </ul>
	<ul style="list-style-type: none"> <li>• On slippery roads; for example, snow and ice-covered roads, wet roads, gravel roads, the vehicle locator mark may deviate from the correct road.</li> </ul>
	<ul style="list-style-type: none"> <li>• If the vehicle turns on an embankment; for example, at a parking garage entrance, on slope or banked roads, the vehicle locator mark may go off the road.</li> </ul>
	<ul style="list-style-type: none"> <li>• If driving on a new road not registered in the map data, the navigation system may incorrectly match the vehicle's position with a nearby road and when the vehicle returns to a road available in the map data, the vehicle locator mark may be off the correct road.</li> </ul>
	<ul style="list-style-type: none"> <li>• If the road registered in the map data and the actual road configuration differ, the vehicle locator mark may be off the correct road.</li> </ul>

Cause (Condition)	Driving condition
	<ul style="list-style-type: none"> <li>For regions where there is no detailed map, the navigation system compares regions where there are detailed maps and configuration is sometimes not expressed correctly. Also, because few minor roads are registered, when the vehicle drives on a road not available in the map data, the vehicle locator mark may go off the correct road.</li> </ul>
	<ul style="list-style-type: none"> <li>If the vehicle has tire chains, the distance travelled is not correctly detected and the vehicle locator mark may go off the correct road.</li> </ul>
	<ul style="list-style-type: none"> <li>If the vehicle moves erratically, for example spinning wheels, the vehicle locator mark may go off the correct road.</li> </ul>
	<ul style="list-style-type: none"> <li>In locations such as cities where there are a lot of roads, if the setting accuracy is poor when the vehicle's position is moved, the navigation system may be unable to find the correct road and accuracy may drop.</li> </ul>
	<ul style="list-style-type: none"> <li>If the vehicle's position is moved and the vehicle direction does not match, the accuracy may drop afterwards.</li> </ul>

LCD UNIT OUTLINE

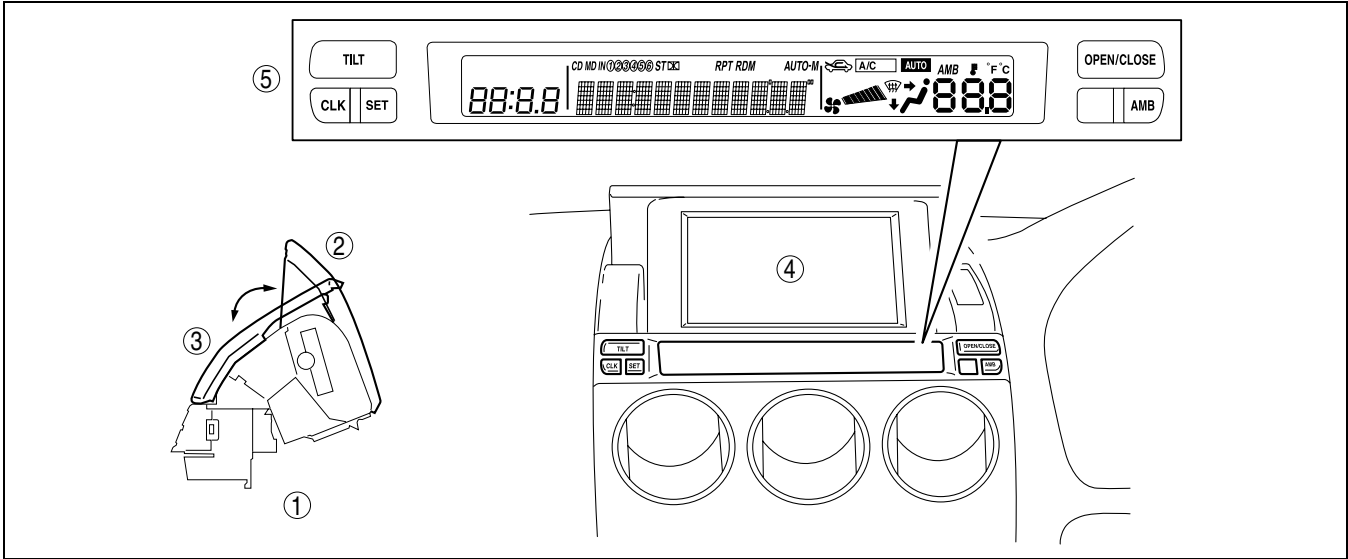
E6U092066902S03

- The car-navigation system LCD and the information display are incorporated into one unit. Based on signals from the car-navigation unit and remote control, the LCD displays navigational information. Based on signals from a specialized systems (audio and A/C) module, the information display displays information about these systems
- The LCD unit senses the user operations from the remote control and sends a signal to the car-navigation unit.

LCD UNIT CONSTRUCTION/OPERATION

E6U092066902S04

- An LCD unit, located in the upper-center part of the dashboard to improve visibility, has been adopted.
- A pop-up LCD, controlled by an [OPEN/CLOSE] switch, has been adopted.
- The angle of the display screen can be adjusted in stages using the [TILT] switch.
- The audio and A/C information display is located on the lower portion of the unit.

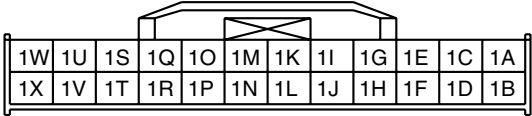


E6U920ZS5301

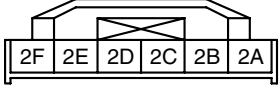
1	LCD unit
2	Open
3	Close


4	LCD for car-navigation system
5	Information display

## Terminal Layout and Signals

Terminal		Signals
		24-pin connector
	1A	Video (B)
	1B	Video (G)
	1C	Video (composite sync)
	1D	Video (R)
	1E	Video GND
	1F	–
	1G	Digital GND
	1H	–
	1I	Monitor serial output
	1J	–
	1K	Monitor serial input
	1L	–
	1M	–
	1N	–
	1O	ACC
	1P	GND
	1Q	B+
	1R	–
	1S	Shield GND
	1T	–
	1U	UART2
	1V	Illumination
	1W	UART1
	1X	–

09–20

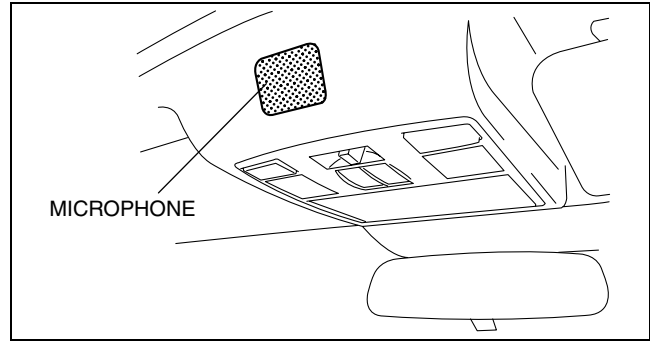
Terminal		Signals
		6-pin connector
	2A	Power
	2B	GND
	2C	Illumination
	2D	–
	2E	Remote-data
	2F	Shield GND

Terminal		Signal
		1-pin connector
	3A	GND

## MICROPHONE CONSTRUCTION/OPERATION

E6U092000175S01

- Located on the back of the map light.
- Recognize the voice entry.



E6U920ZS5101

## Terminal Layout and Signals

Terminal		Signals
		6-pin connector
<p>A diagram of a 6-pin connector terminal block. The pins are labeled A, B, C, D, E, and F from right to left. The terminal block has a central row of six pins and a top row of three pins (A, B, C) and a bottom row of three pins (F, E, D).</p>	A	Mic (+)
	B	Mic (-)
	C	Mic power
	D	GND
	E	Mic sense
	F	—

## REMOTE CONTROL AND CRADLE OUTLINE

E6U092000174S03

- A remote control for the car-navigation system, with simplified design for easy operation, has been adopted.
- A cradle to hold the remote control has been adopted.

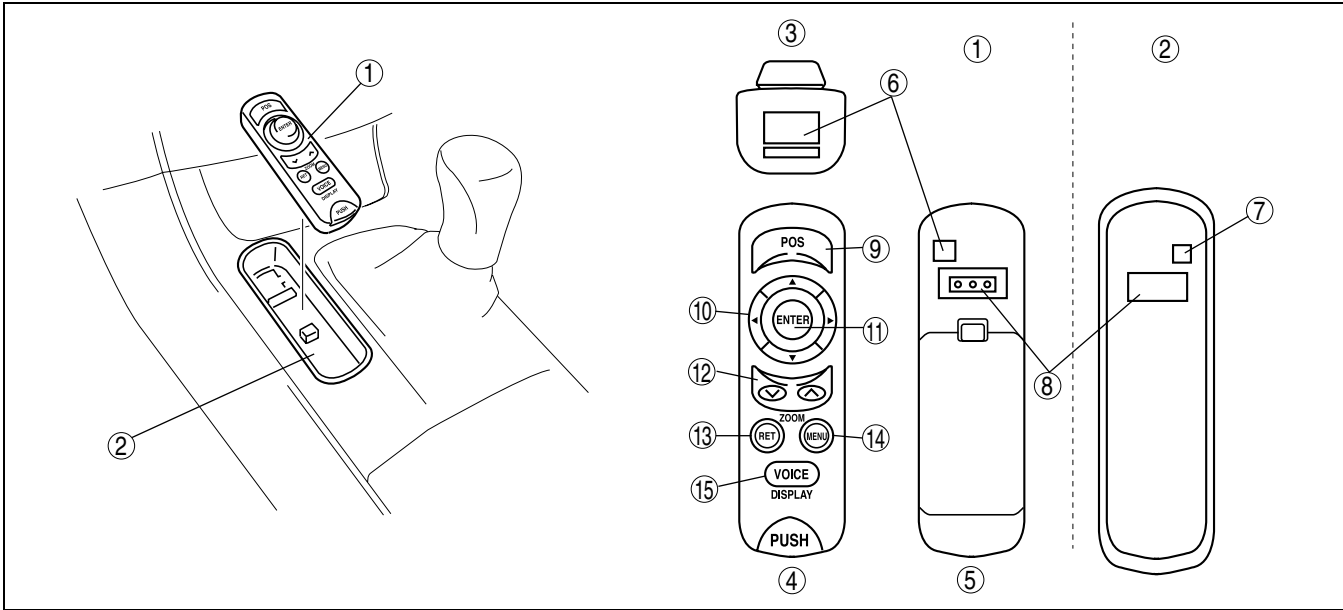
## REMOTE CONTROL AND CRADLE CONSTRUCTION/OPERATION

E6U092000174S04

- The remote control and cradle are located on the console.
- The buttons and joystick for controlling car-navigation are located on the top side of the remote control. The infrared transmitter sends signals through a terminal on the front and back of the remote control.
- An infrared sensor that receives signals from the remote control is located on the cradle. The received signals are sent to the LCD unit.
- The remote control uses the batteries as a power source when not in the cradle and uses the power supply connector when set in the cradle. (Ignition switch at ACC or ON position)

### Note

- The batteries are not charged when the remote control is in the cradle.



E6U920ZS5303

1	Remote control
2	Cradle
3	Front view
4	Top view

5	Underside view
6	Infrared transmitter
7	Infrared sensor
8	Power supply connector

09-20

No.	Button (component)	Function
9	[POS (Position)] button	Displays the current position.
10	Joystick	Selects items by tilting it up, down, right and left.
11	[ENTER] button	Executes a selected item.
12	[ZOOM] button	Changes the map scale.
13	[RET] button	Returns to the previous screen.
14	[MENU] button	Select a menu.
15	[VOICE] button	Initiates vocal guidance for route maneuvers. /Adjusts screen quality.

## NAVIGATION FUNCTION

E6U09206600S06

### Outline

- A vehicle's position is measured by a hybrid method of autonomous navigation (using yaw-rate signals from the gyro sensor and vehicle speed signals from BCM) and GPS navigation (using signals from GPS satellites). Accurate detection of the vehicle's position is possible based on the adoption of a map-matching function which specifies the vehicle's position as compared with the map data read from the DVD-ROM and the vehicle's position measured from autonomous navigation and GPS navigation.
- Guidance to destination is provided via display of the recommended route on the map screen, as well as voice messaging guidance at intersections and points of divergence.
- Based on inputted signals and information on the DVD-ROM, the following features are available:
  - Destination can be selected based on address, POI (Point of Interest), emergency, and memory point, home, preset destination, intersection, free way on/off ramp, coordinates, map or previous destination.
  - Route information is available in map, turn list, turn arrow, enlarged junction diagram, and freeway information mode.
  - Voice guidance and menus are available in three languages.
  - A map screen that displays maps in thirteen steps with scales from 50 m to 256 km {1/32 mile to 128mile}.
  - A map screen that displays routes according to Search condition and route preferences.

### Search condition

Quick: The route with the quickest time will be used.

Altern.: The alternative route will be used.

Short: The route with the shortest distance.

### Route preferences

Allow Major roads

Allow toll road

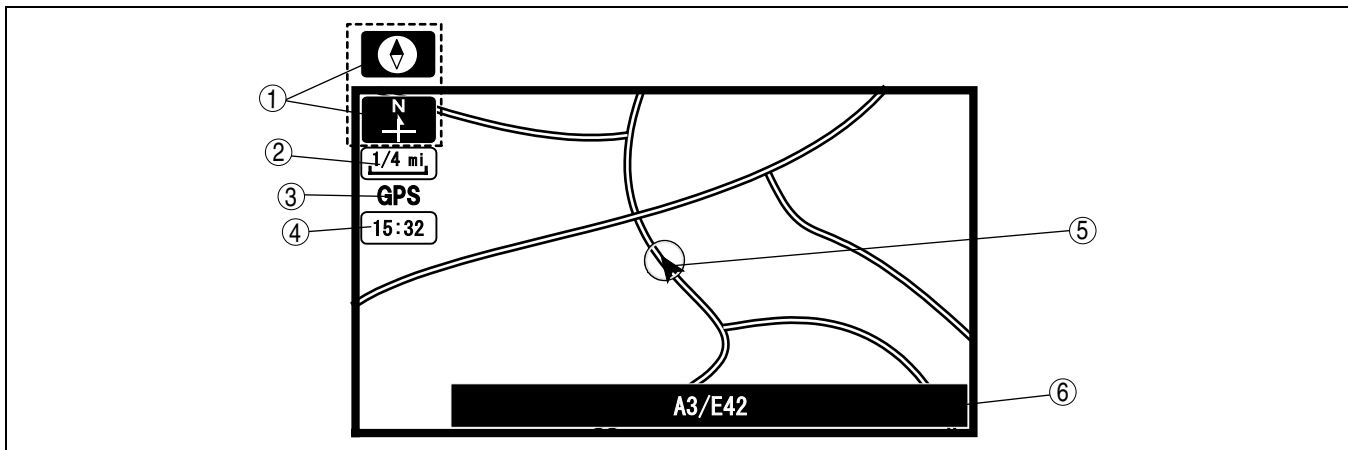
Allow time restricted road

Allow ferry

### Map Screen Selection

#### Current position map

- The location of the vehicle and surrounding area are shown.

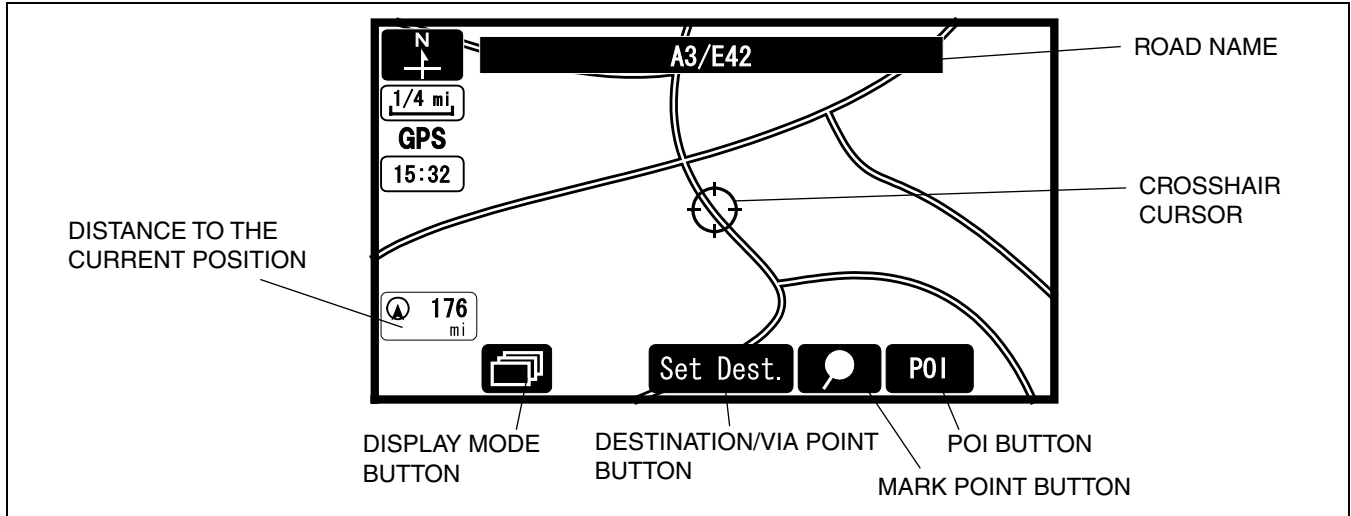


EPU920ZS2016

No.	Contents	Description
1	Map orientation	<b>North up</b> <ul style="list-style-type: none"> <li>• Geographic north is up.</li> </ul> <b>Head up</b> <ul style="list-style-type: none"> <li>• The direction you are heading is up.</li> </ul>
2	Map scale	The map can be displayed in 13 steps with scale from 50 m to 256 km {1/32 mile to 128 mile}
3	GPS reception indicator	Illuminates when receiving signals from 3 or more satellites.
4	Clock	Clock will be displayed when you set up clock on navigation set up on.
5	Vehicle position	Shows the current position and direction of the vehicle.
6	Road name	Shows the name of the road you are currently driving on.

## Scroll map mode

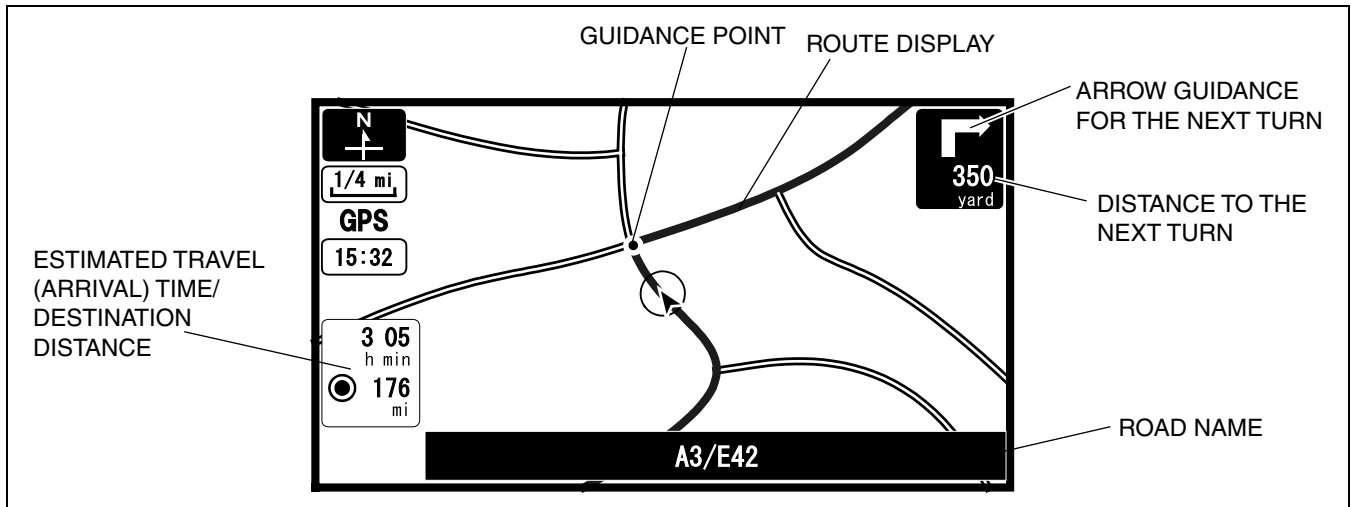
- The scroll map is displayed when operating the joystick on the current position map.
- This map can be scrolled with the crosshair cursor.



EPU920ZS2017

## Guide mode

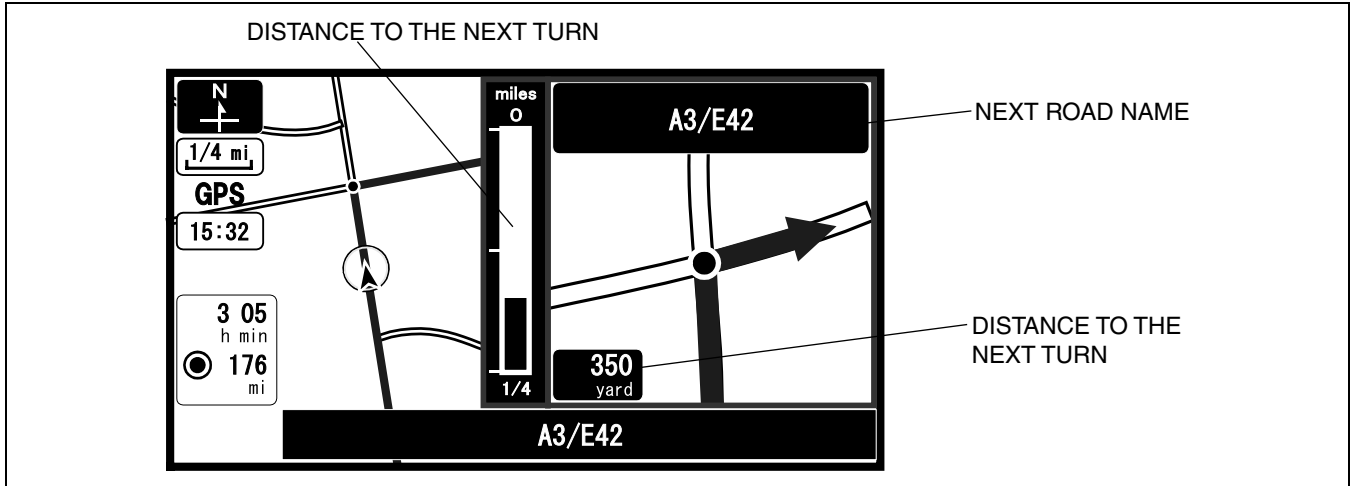
- Displays an arrow guidance to indicate destination, and also displays route and destination guidance information. (While in route guidance.)



E6U920ZS5305

## Intersection zoom map

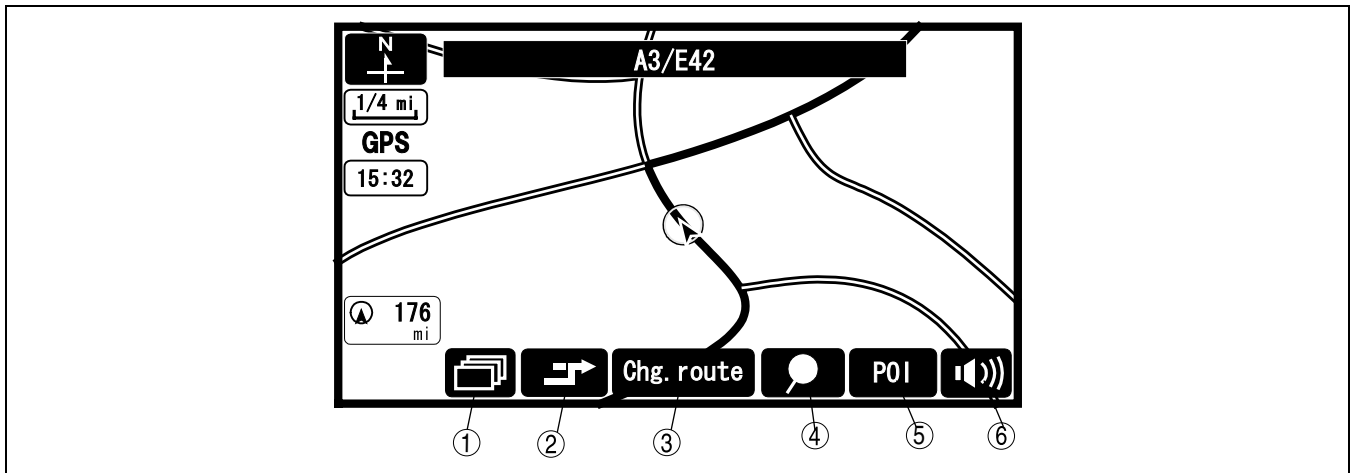
- An enlarged map is displayed when approaching an intersection. (While in route guidance.) Activated by selecting Guidance Screen (On) in setup mode.



EPU920ZS2019

## Pop Up Menu

- Pop up menu appears when pressing the [ENTER] button.
- The following items are displayed on the pop up menu. The actual displayed items vary according to whether the destination has been set or not.



EPU920ZS2020

No.	Contents	Description
1	Display configuration	The following items can be selected. <ul style="list-style-type: none"> <li>single or dual map</li> <li>Turn list</li> <li>Turn arrow</li> <li>Enlarged junction diagram</li> <li>Free way information</li> </ul>
2	Detour	Searches for detour.
3	Change route	Changes route search settings.
4	Store memory point	Stores markers on the map.
5	POI (Point of Interest) display	Displays POI on the map.
6	Volume	Adjusts volume of voice guidance.

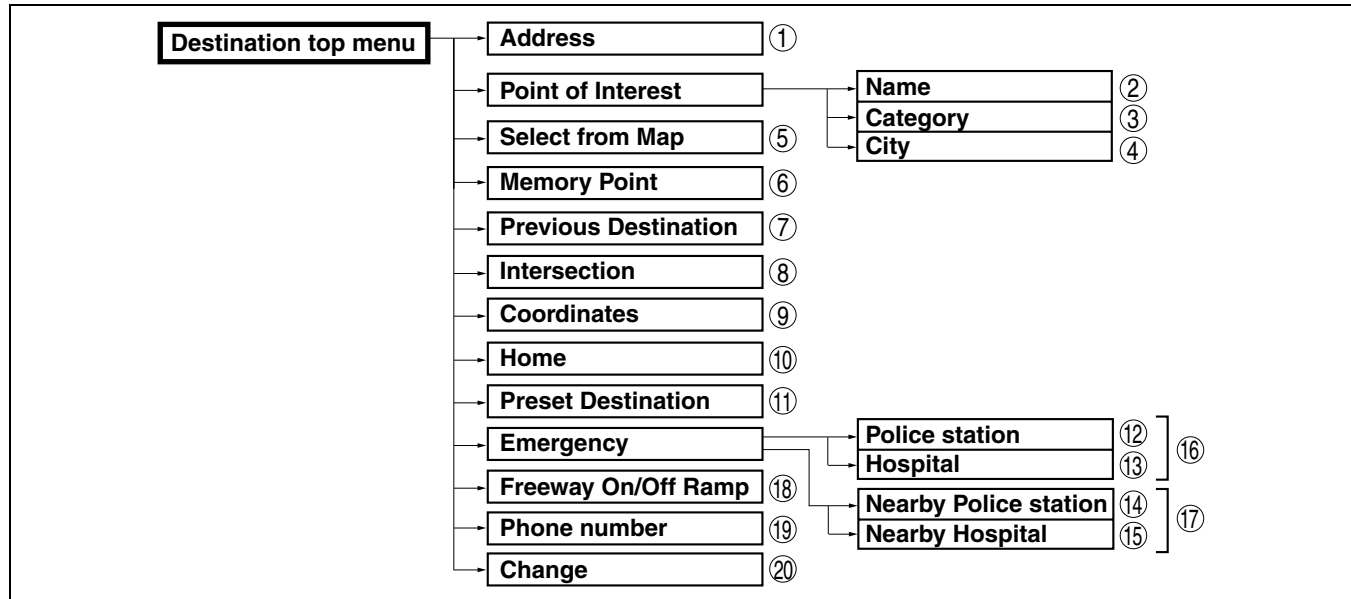
## Destination Setting Function

### Outline

- The following instructions explain how destinations can be chosen and set.

### Note

- A destination can be set to where the crosshair cursor indicates by selecting the Destination option of the scroll map mode pop-menu.



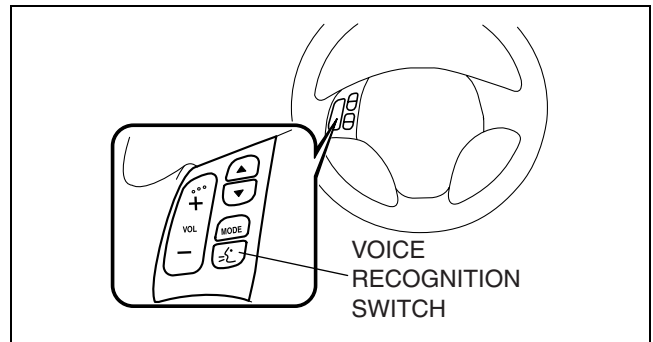
E6U920ZS5199

09-20

No.	Contents
1	Sets destination by inputting address.
2	Sets destination by inputting POI name.
3	Sets destination by selecting POI category, inputting target name and selecting POI.
4	Sets destination by inputting city name and selecting POI.
5	Sets destination by moving the crosshair cursor to the destination when in scroll map mode.
6	Sets destination from a list of points stored by the user.
7	Sets destination from a list of recent destinations.
8	Sets destination by selecting intersection name.
9	Sets destination by inputting coordinates.
10	Sets destination to home.
11	Sets destination to preset destination point.
12	Sets destination to police station.
13	Sets destination to hospital.
14	Sets destination to nearby police station.
15	Sets destination to nearby hospital.
16	Vehicle is stopped.
17	Vehicle is running.
18	Sets destination by selecting Freeway On Ramp/Off Ramp
19	Sets destination by inputting phone number.
20	Changes search area.

### Voice Recognition Function

- Voice control can be carried out by simply pressing voice recognition switch and speaking voice command into the microphone.



EPU920ZS2023

# 09-22 INSTRUMENTATION/DRIVER INFO.

INSTRUMENT CLUSTER OUTLINE . . . .	09-22-1
INSTRUMENT CLUSTER STRUCTURAL	
VIEW [L3 WITH TC] . . . . .	09-22-1
Structural View . . . . .	09-22-1
INSTRUMENT CLUSTER SYSTEM	
WIRING DIAGRAM [EXCEPT	
L3 WITH TC] . . . . .	09-22-2

INSTRUMENT CLUSTER SYSTEM	
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INSTRUMENT CLUSTER	
DESCRIPTION . . . . .	09-22-4
Specifications . . . . .	09-22-4
Input/Output Check Mode . . . . .	09-22-6

## INSTRUMENT CLUSTER OUTLINE

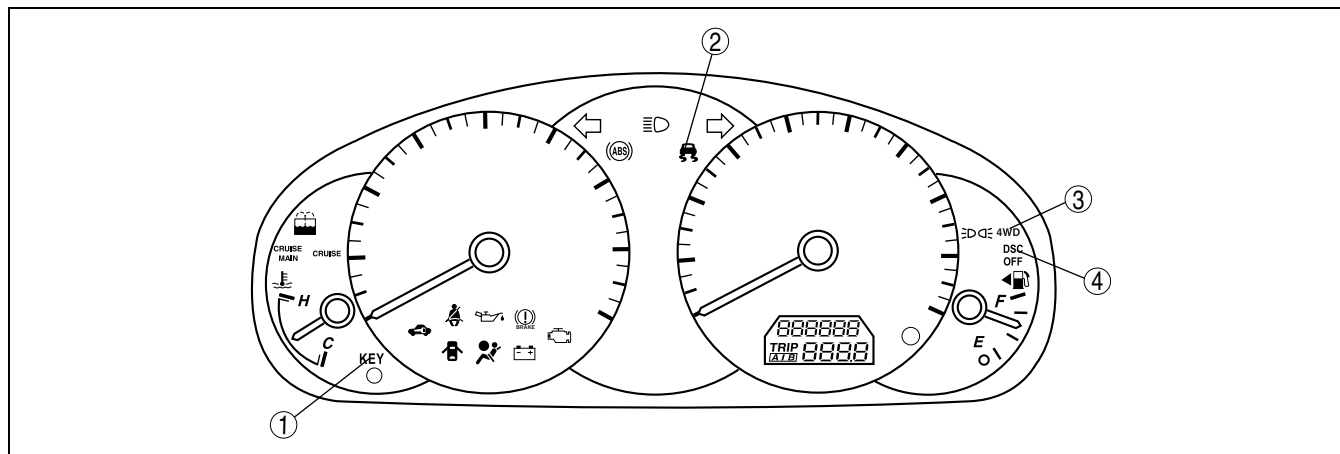
E6U092255430S09

- Following indicator lights have been added.
  - Keyless indicator light (with advanced keyless system)
  - Keyless warning light (with advanced keyless system)
  - DSC indicator light
  - AWD indicator light
  - DSC OFF light
- The check code 33, 55, 58 and 59 have been adopted.

## INSTRUMENT CLUSTER STRUCTURAL VIEW [L3 WITH TC]

E6U092255430S10

### Structural View



E6U9222S1001

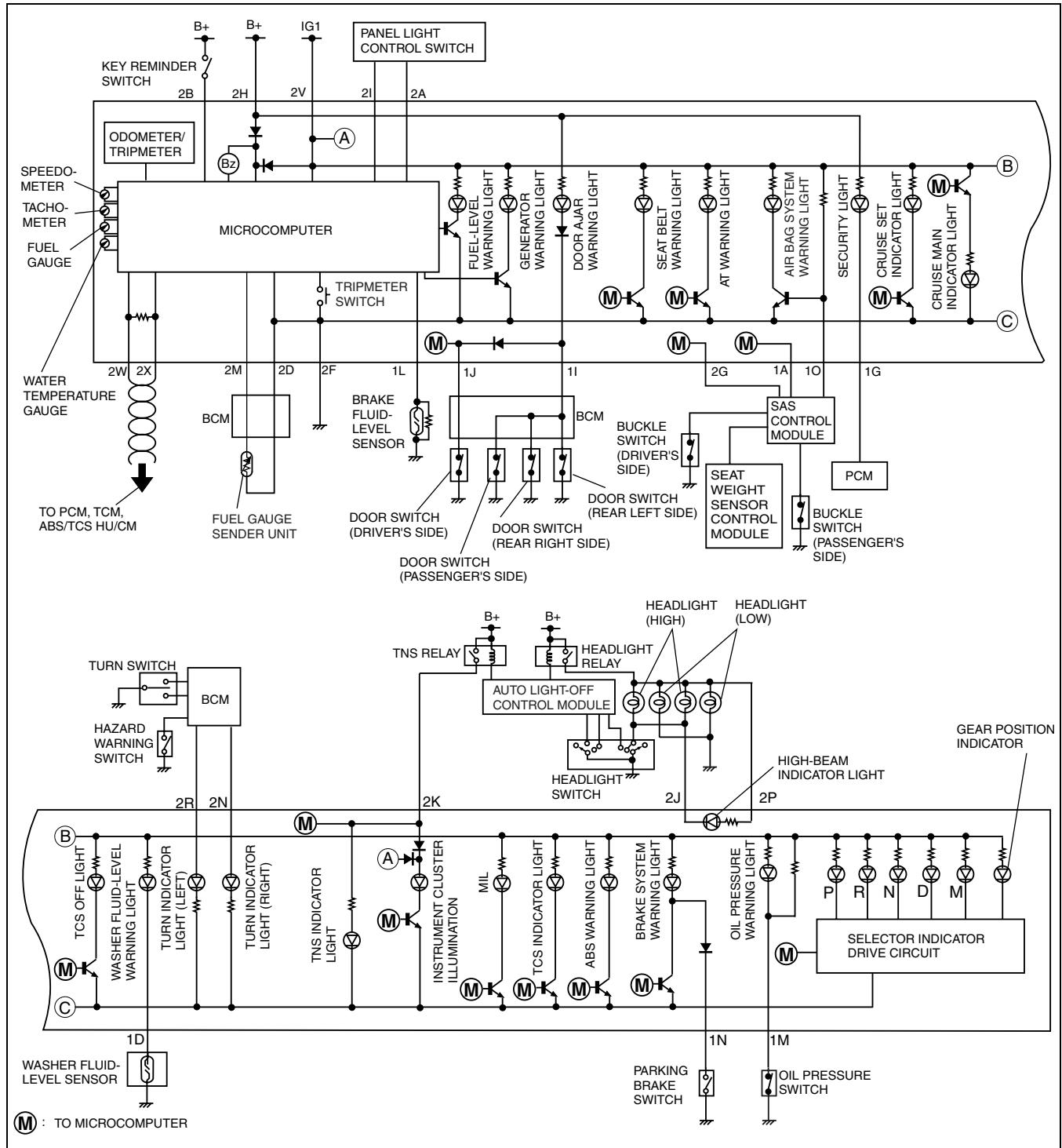
X: Applied

No.	Warning and indicator light	Input signal source	CAN system	Note
1	Keyless indicator light	Keyless control module	X	With advanced keyless system
	Keyless warning light	Keyless control module	X	With advanced keyless system
2	DSC indicator light	DSC HU/CM	X	—
3	AWD indicator light	AWD control module	X	—
4	DSC OFF light	DSC HU/CM	X	—

# INSTRUMENTATION/DRIVER INFO.

## INSTRUMENT CLUSTER SYSTEM WIRING DIAGRAM [EXCEPT L3 WITH TC]

E6U092255430S03



E6U0922ZS5001



## INSTRUMENTATION/DRIVER INFO.

### INSTRUMENT CLUSTER DESCRIPTION

E6U092255430S12

#### Specifications

#### Instrument cluster

Item		Specification
Speedometer	Meter type	Stepping motor type
	Indication range (mph {km/h})	0—180 {0—280}
	Input signal communication system	CAN system
	Input signal source	PCM
	Rated voltage (V)	DC 12
Tachometer	Meter type	Stepping motor type
	Indication range (rpm)	0—8,000
	Red zone (rpm)	6,500—8,000
	Input signal communication system	CAN system
	Input signal source	PCM
	Rated voltage (V)	DC 12
Fuel gauge	Meter type	Stepping motor type (Reset-to-zero type)
	Input signal communication system	Conventional communication system
	Input signal source	Fuel gauge sender unit
	Rated voltage (V)	DC 12
Water temperature gauge	Meter type	Stepping motor type (Medium range stabilized type)
	Input signal communication system	CAN system
	Input signal source	PCM
	Rated voltage (V)	DC 12
Odometer/ Tripmeter	Display	LCD
	Indication digits	Odometer: 6 digits, Tripmeter: 4 digits
	Input signal communication system	CAN system
	Input signal source	PCM
	Rated voltage (V)	DC 12

# INSTRUMENTATION/DRIVER INFO.

Item			Specification
Warning alarms	Sound frequency	(Hz)	1,800—2,600
	Output sound pressure level	(dB)	67.5
	Lights-on reminder warning alarm	Sound frequency	1,900
		Sound cycle	CONTINUOUS 
	Key reminder warning alarm	Sound frequency	1,800
		Sound cycle	CONTINUOUS t 1 : approx. 0.22 S t 2 : approx. 0.33 S t 3 : approx. 1.25 S
	Seat belt warning alarm*	Sound frequency	1,800
		Sound cycle	CONTINUOUS t 1 : approx. 0.7 S t 2 : approx. 1 S t 3 : approx. 6 S t 4 : approx. 30 S
	Tire pressure warning alarm	Sound frequency	2,600
		Sound cycle	CONTINUOUS t 1 : approx. 0.3 S t 2 : approx. 0.6 S
	Advanced keyless system warning alarm	Sound frequency	1,800
		Sound cycle	CONTINUOUS t 1 : approx. 0.22 S t 2 : approx. 0.33 S
Indicator alarm	Output sound pressure level	(dB)	54.5
	Turn and hazard indicator alarm	Sound cycle	DEPEND ON MESSAGE FROM PJB 

\* :

- The seat belt warning alarm can be temporarily deactivated by the following method.
  - Turn the ignition switch to the ON position, fasten the driver's seat belt for **about 2 s** or longer, and then unfasten it **within 20 s**. The seat belt warning alarm will be deactivated until the ignition switch is turned to the ON position again.

## Information display

Item	Specification
Clock accuracy (reference)* (Second/day)	± 1.5

\* : If not as specified, malfunction in battery or information display.

## INSTRUMENTATION/DRIVER INFO.

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### Input/Output Check Mode

- The microcomputer built into instrument cluster detects the quality of input signal or individual part.
- Input/output check mode has both input circuit check and individual part check functions.

### Operation procedure

- Refer to Mazda6 Workshop Manual.

### Input circuit check

- When the parts listed in the chart are operated and output a signal to the instrument cluster, the built in microcomputer judges the quality of the input circuit based on that signal.

No.	Parts sending input signal
01	Buckle switch (driver-side)
04	Door switch
08	TNS relay
22	Fuel gauge sender unit
31	Key reminder switch
33	Turn switch
55	Dimmer cancel switch
58	Buckle switch (passenger-side)
59	Fuel system

### Individual circuit check

- By operating the parts listed in the chart, the built in microcomputer judges the quality of the individual parts.

No.	Parts sending input signal
12	Speedometer
13	Tachometer
14	Buzzer
16	Fuel-level warning light
18	Ignition key illumination
23	Fuel gauge
25	Water temperature gauge
26	LCD

## 09-40 CONTROL SYSTEM

<b>BODY CONTROL MODULE (BCM)</b>	
OUTLINE .....	09-40-1
<b>BODY CONTROL MODULE (BCM)</b>	
STRUCTURAL VIEW .....	09-40-1
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<b>ON-BOARD DIAGNOSTIC</b>	
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<b>CONTROLLER AREA NETWORK</b>	
(CAN) SYSTEM OUTLINE .....	09-40-5
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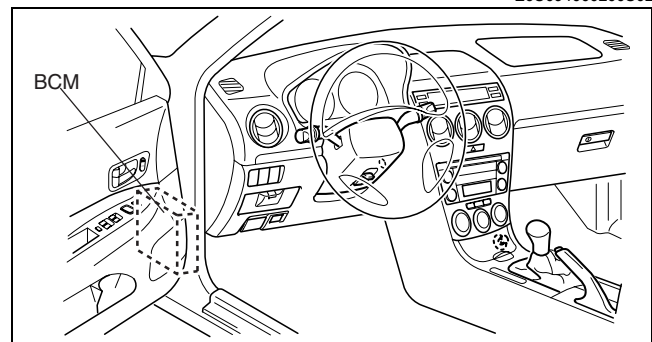
### BODY CONTROL MODULE (BCM) OUTLINE

E6U094000200S01

- The following relays are built into the BCM:
  - Door lock/unlock relays
- The BCM controls the following systems:
  - Turn/hazard light system
  - Rear wiper and washer system
  - Room light control system
  - Power door lock system
  - Keyless entry system (without advanced keyless system)
  - Theft-deterrent system

### BODY CONTROL MODULE (BCM) STRUCTURAL VIEW

E6U094000200S02

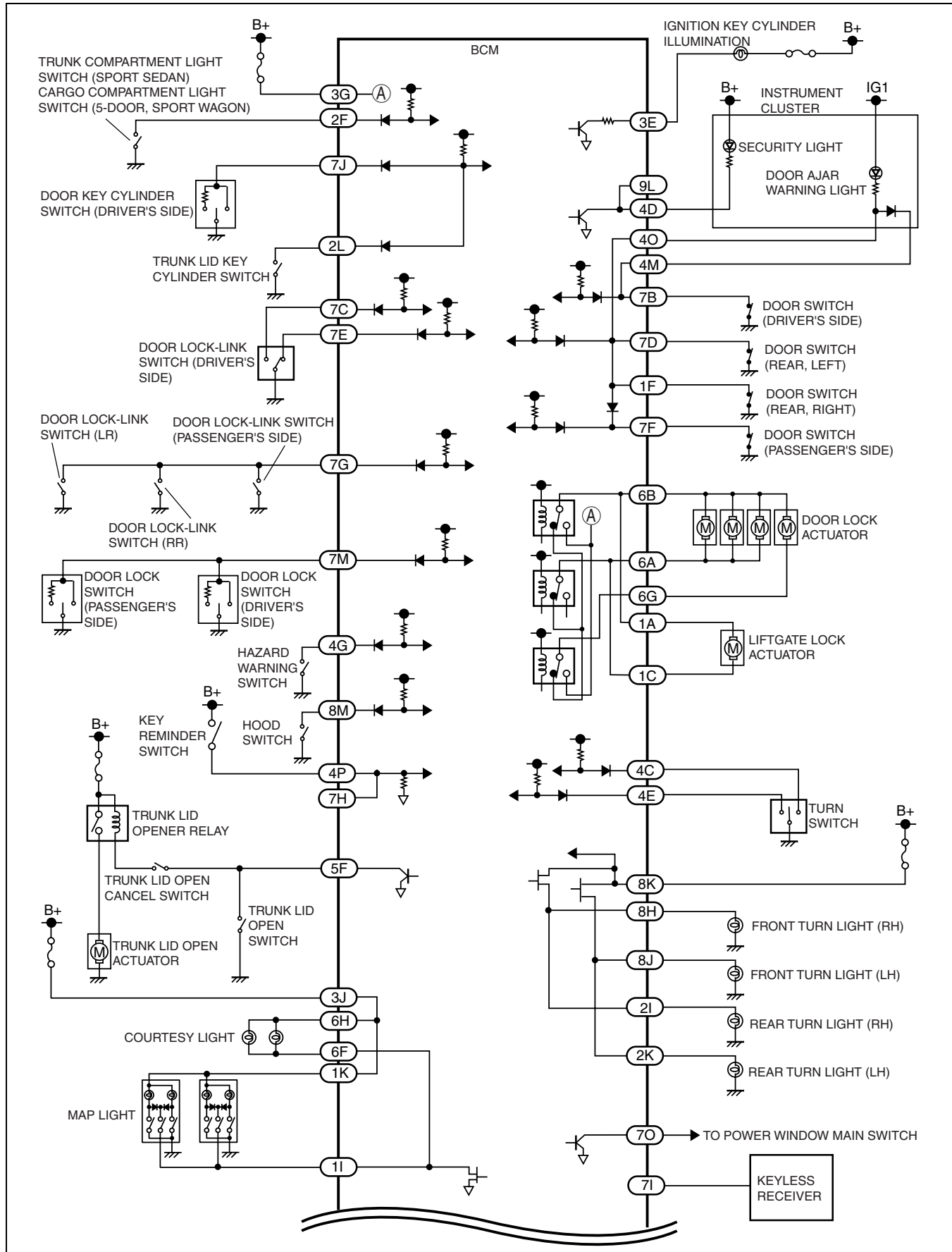


E6U940ZS5003

# CONTROL SYSTEM

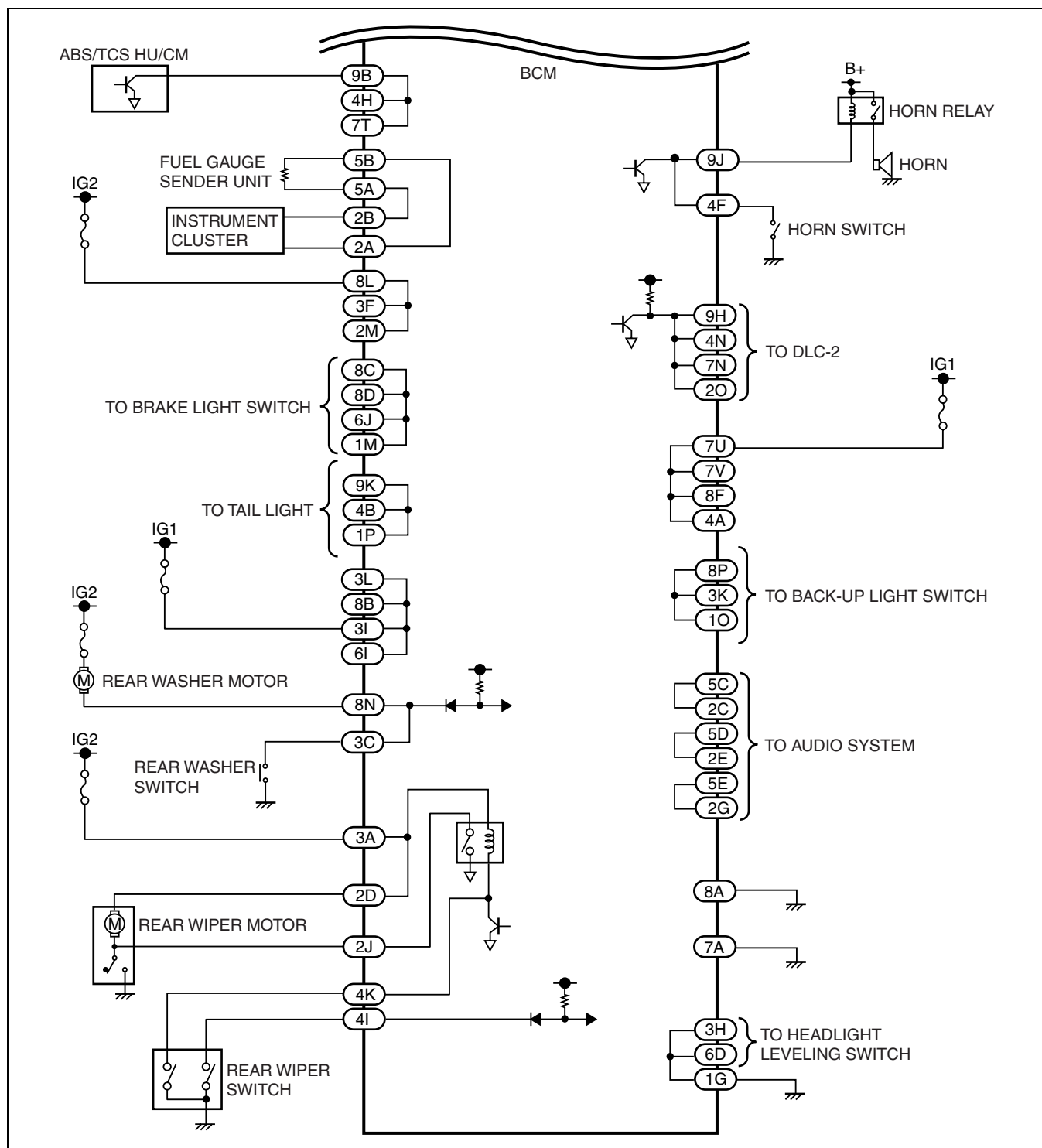
## BODY CONTROL MODULE (BCM) WIRING DIAGRAM

E6U094000200S03



E6U940ZS5001

# CONTROL SYSTEM



E6U940ZS5002

09-40

# CONTROL SYSTEM

## ON-BOARD DIAGNOSTIC FUNCTION

E6U094000200S04

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

## Malfunction Detection Function

- The malfunction detection function detects malfunctions in the input/output signal system of the BCM.

### DTC table

DTC No.	Description	Detection condition
B1317	Battery voltage high	Input voltage from the battery is excessively high
B1318	Battery voltage low	Input voltage from the battery is excessively low
B1342	ECU is faulted	BCM microcomputer malfunction
B2572	Driver door lock switch short to ground	Short to GND in wiring harness between BCM and driver-side door lock-link switch
B2721	Trunk lid/liftgate ajar output short to ground	Short to GND in wiring harness between BCM and trunk lid compartment light switch/cargo compartment light switch
B1873	Turn signal/hazard power feed circuit short to ground	Short to GND in wiring harness between BCM and hazard warning switch
B1320	Driver door ajar circuit open	Open circuit in wiring harness between BCM and front door switch (driver-side)
B1328	Passenger door ajar circuit open	Open circuit in wiring harness between BCM and front door switch (passenger-side)
B1572	Door ajar RL/RR circuit open	Open circuit in wiring harness between BCM and rear door switch (LH/RH)
B1614	Rear wiper interval switch input circuit short to ground	Short to GND in wiring harness between BCM and rear wiper and washer switch (INT)
B1520	Hood switch circuit open	Open circuit in wiring harness between BCM and hood switch
B1506	Turn light signal circuit short to ground	Short to GND in wiring harness between BCM and turn switch
B2218	Door lock switch circuit short to ground	Short to GND in wiring harness between BCM and door lock switch
B1311	Unlock switch circuit open	Open circuit in wiring harness between BCM and driver-side door lock-link switch (unlock signal)

## PID/Data Monitor Function

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

PID/data monitor item	Unit/Condition (Tester display)	Input/output part	BCM terminal
C_LOCK_SW	LOCK/OFF	Door lock switch	7M
C_UNLK_SW	UNLOCK/OFF		
CCNT_GE	—	DTC	—
DRSW_REAR	OPEN/CLOSE	Rear door switch (LH/RH)	7D, 1F
DRSW_P	OPEN/CLOSE	Front door switch (passenger's side)	7F
DRSW_D	OPEN/CLOSE	Front door switch (driver's side)	7B
HAZARD	On/Off	Hazard warning switch	4G
HOOD_SW	OPEN/CLOSE	Hood switch	8M
LLSW_D	LOCK/UNLOCK	Driver-side door lock-link switch	7C, 7E
LLSW_P_R	LOCK/UNLOCK	Except driver-side door lock-link switch	7G
TR/LG_SW	OPEN/CLOSE	Trunk compartment light switch	2F
TRNK_UNLK	UNLOCK/OFF	Trunk lid key cylinder switch	2L
TURN_SW_L	On/Off	Turn switch (LH)	4C
TURN_SW_R	On/Off	Turn switch (RH)	4E
WPINT_REAR	On/Off	Rear wiper switch (INT position)	4I

# CONTROL SYSTEM

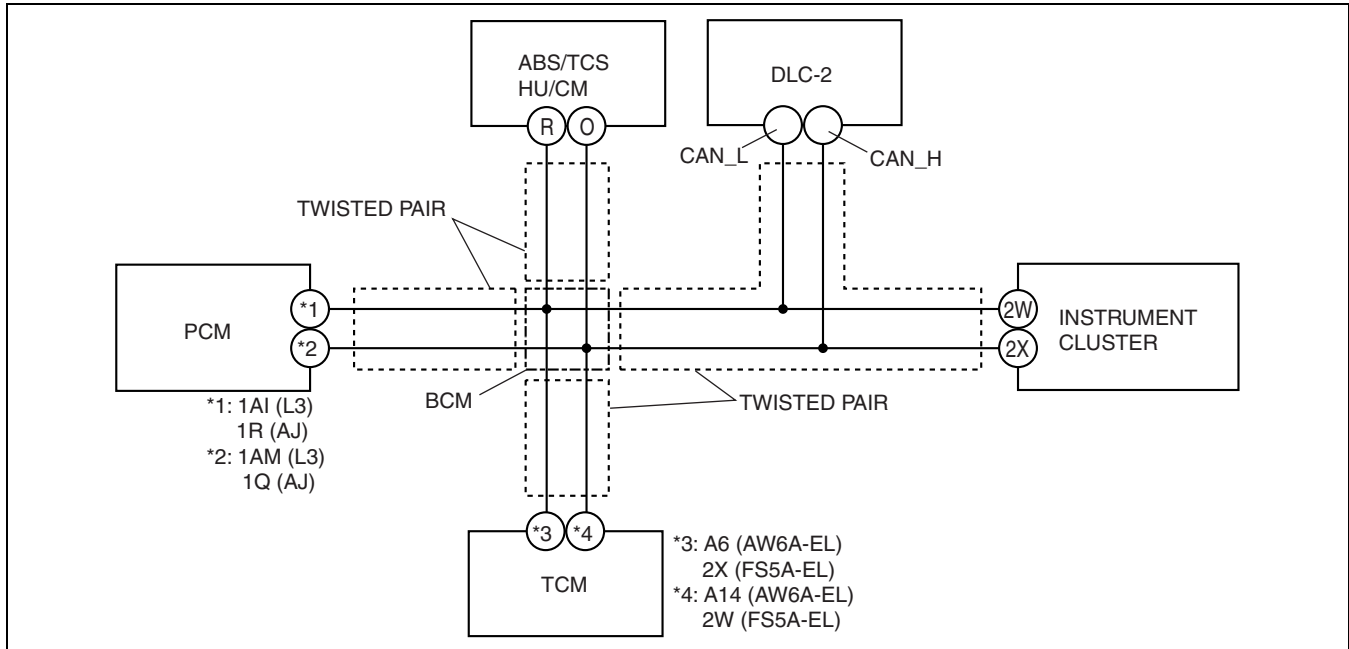
## CONTROLLER AREA NETWORK (CAN) SYSTEM OUTLINE

E6U094055430S09

- According to the AWD control module and keyless control module adoption, CAN system has been changed.  
(L3 with TC)

## CAN SYSTEM WIRING DIAGRAM [EXCEPT L3 WITH TC]

E6U094055430S03

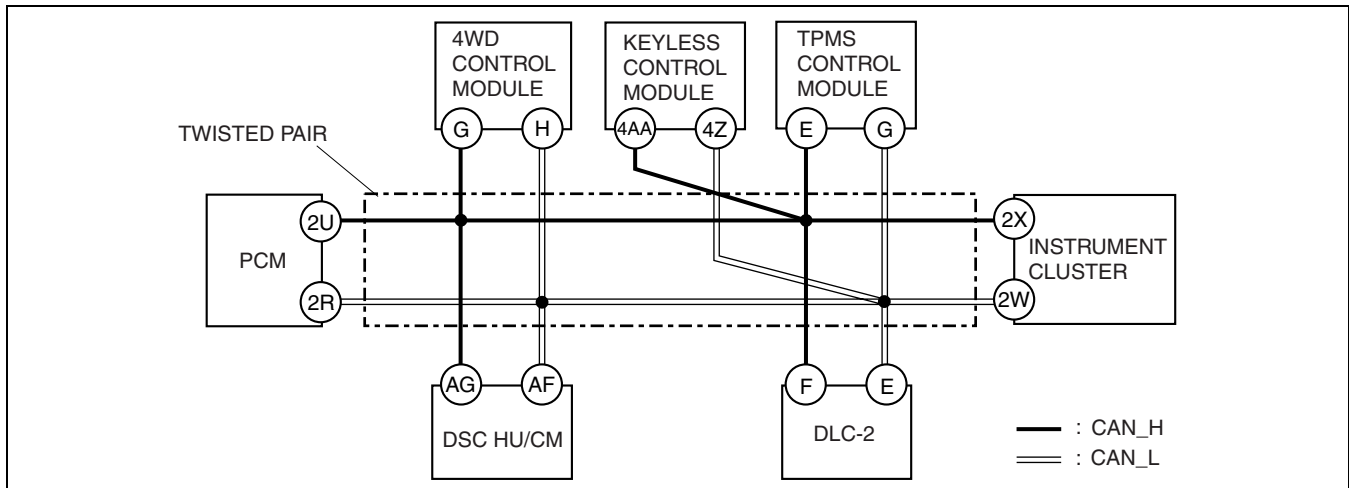


E6U0940ZS5501

09-40

## CAN SYSTEM WIRING DIAGRAM [L3 WITH TC]

E6U094055430S10



E6U0940ZSC002

# CONTROL SYSTEM

## CAN SYSTEM DESCRIPTION

E6U094055430S04

### CAN Signal-Chart [L3 With TC]

OUT: Output (sends signal)

IN: Input (receives signal)

Signal	Multiplex module				
	PCM	DSC HU/CM	AWD control module	Keyless control module	Instrument cluster
Engine torque	OUT	IN	—	—	—
Torque reduction inhibit	OUT	IN	—	—	—
Engine speed	OUT	IN	IN	IN	IN
Vehicle speed	OUT	—	—	IN	IN
TP	OUT	IN	IN	—	—
Neutral determination	OUT	—	IN	—	—
Gear ratio	OUT	IN	—	—	—
ECT	OUT	—	—	—	IN
Travelled distance	OUT	—	—	—	IN
	IN	OUT	—	—	—
MIL condition	OUT	—	—	—	IN
Generator warning light condition	OUT	—	—	—	IN
Engine specifications	OUT	IN	—	—	—
Tire circumference (front/rear)	OUT	IN	—	—	—
Cruise main indicator light condition	OUT	—	—	—	IN
Cruise set indicator light condition	OUT	—	—	—	IN
Brake pedal position	OUT	IN	IN	—	—
Steering wheel angle	—	OUT	IN	—	—
Brake fluid pressure	—	OUT	IN	—	—
Back-up light switch position	—	OUT	IN	—	—
Yaw rate	—	OUT	IN	—	—
Lateral-G	—	OUT	IN	—	—
Torque reduction request	IN	OUT	—	—	—
Brake system configuration (EBD/ABS/TCS/DSC)	—	OUT	IN	—	IN
Brake system status	EBD/ABS/TCS/DSC	OUT	IN	—	IN
Wheel speed (front left/front right/rear left/rear right)	IN	OUT	IN	—	—
Desired coupling torque	—	OUT	IN	—	—
AWD system condition	—	—	OUT	—	IN
Coupling torque	—	IN	OUT	—	—
Keyless warning buzzer on request	—	—	—	OUT	IN
Keyless indicator light on request	—	—	—	OUT	IN
Keyless warning light on request	—	—	—	OUT	IN
Fuel tank level	IN	—	—	—	OUT
Brake fluid level	—	IN	—	—	OUT

## CONTROL SYSTEM

### On-Board Diagnostic Function

#### Self-malfunction diagnostic function

- Some DTCs have been changed.

#### DTC table [Except L3 With TC]

DTC	Malfunction location	DTC output module
U0073	CAN system communication error	<ul style="list-style-type: none"> <li>• PCM</li> <li>• TCM</li> <li>• ABS/TCS HU/CM</li> </ul>
U0100	Communication error to PCM	<ul style="list-style-type: none"> <li>• ABS/TCS HU/CM</li> <li>• TCM</li> </ul>
U0101	Communication error to TCM	<ul style="list-style-type: none"> <li>• PCM</li> <li>• ABS/TCS HU/CM</li> </ul>
U0121	Communication error to ABS/TCS HU/CM	<ul style="list-style-type: none"> <li>• PCM</li> <li>• TCM (AW6A-EL)</li> </ul>
U0140	Communication error to instrument cluster	TCM (AW6A-EL)
U0155	Communication error to instrument cluster	<ul style="list-style-type: none"> <li>• PCM</li> <li>• ABS/TCS HU/CM</li> </ul>
U0415	Abnormal message from ABS/TCS HU/CM	TCM (AW6A-EL)
U1900	Communication error to other modules	Instrument cluster
U2516	CAN system communication error	Instrument cluster

#### DTC table [L3 With TC]

DTC	Malfunction location	DTC output module
U0073	CAN system communication error	<ul style="list-style-type: none"> <li>• PCM</li> <li>• DSC HU/CM</li> <li>• AWD control module</li> <li>• Keyless control module</li> </ul>
U0100	Communication error to PCM	<ul style="list-style-type: none"> <li>• DSC HU/CM</li> <li>• AWD control module</li> <li>• Keyless control module</li> </ul>
U0114	Communication error to AWD control module	DSC HU/CM
U0121	Communication error to DSC HU/CM	<ul style="list-style-type: none"> <li>• PCM</li> <li>• AWD control module</li> </ul>
U0155	Communication error to instrument cluster	<ul style="list-style-type: none"> <li>• PCM</li> <li>• DSC HU/CM</li> </ul>
U0323	Communication error to instrument cluster	Keyless control module
U1900	Communication error to other modules	Instrument cluster
U2023	Abnormal message from PCM	Keyless control module
U2511	Abnormal message from AWD control module	DSC HU/CM
U2516	CAN system communication error	Instrument cluster

## CONTROL SYSTEM

### PID/data monitoring function [L3 with TC]

- Some PIDs have been added.

PID name (definition)	Condition	Specification	PID monitor module	Terminal
ABS_MSG (Missing message from the DSC HU/CM)	Present	Circuit in the DSC HU/CM is normal	Instrument cluster	<ul style="list-style-type: none"><li>• DSC HU/CM: AF, AG</li><li>• Instrument cluster: 2W, 2X</li></ul>
	Not Present	Circuit in the ABS/TCS HU/CM is abnormal		
AWD_MSG (Missing message from the AWD control module)	Present	Circuit in the AWD control module is normal	<ul style="list-style-type: none"><li>• DSC HU/CM</li><li>• Instrument cluster</li></ul>	
	Not Present	Circuit in the AWD control module is abnormal		
IC_MSG (Missing message from the instrument cluster)	Present	Circuit in the instrument cluster is normal	DSC HU/CM	
	Not Present	Circuit in the instrument cluster is abnormal		
PCM_MSG (Missing message from the PCM)	Present	Circuit in the PCM is normal	<ul style="list-style-type: none"><li>• DSC HU/CM</li><li>• Instrument cluster</li></ul>	
	Not Present	Circuit in the PCM is abnormal		
RKE_MSG (Missing message from the keyless control module)	Present	Circuit in the keyless control module is normal	Instrument cluster	
	Not Present	Circuit in the keyless control module is abnormal		