

WORKSHOP MANUAL

ENGINE DRIVEABILITY AND EMISSIONS

ENGINE C24SE on TF

SECTION 6E

ISUZU

ISUZU



International Service & Parts
Tokyo, Japan

NOTICE

Before using this Workshop Manual to assist you in performing vehicle service and maintenance operations, it is recommended that you carefully read and thoroughly understand the information contained in Section - 0A under the headings "GENERAL REPAIR INSTRUCTIONS" and "HOW TO USE THIS MANUAL".

All material contained in this Manual is based on the latest product information available at the time of publication.

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Applicable Model : TFR/TFS

This manual is applicable to 2003 year model and later vehicles.

ENGINE

C24SE ENGINE DRIVEABILITY AND EMISSIONS

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6E-4 ENGINE DRIVEABILITY AND EMISSIONS

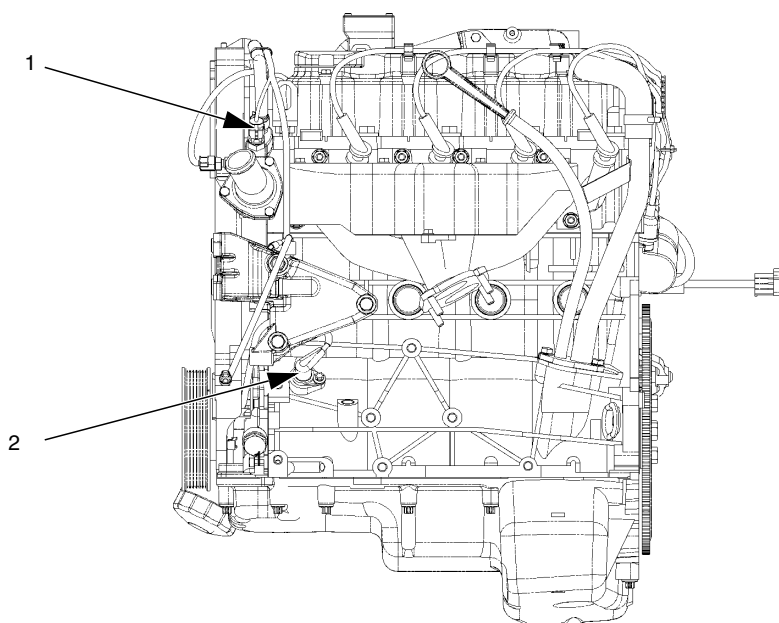
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ABBREVIATIONS CHARTS

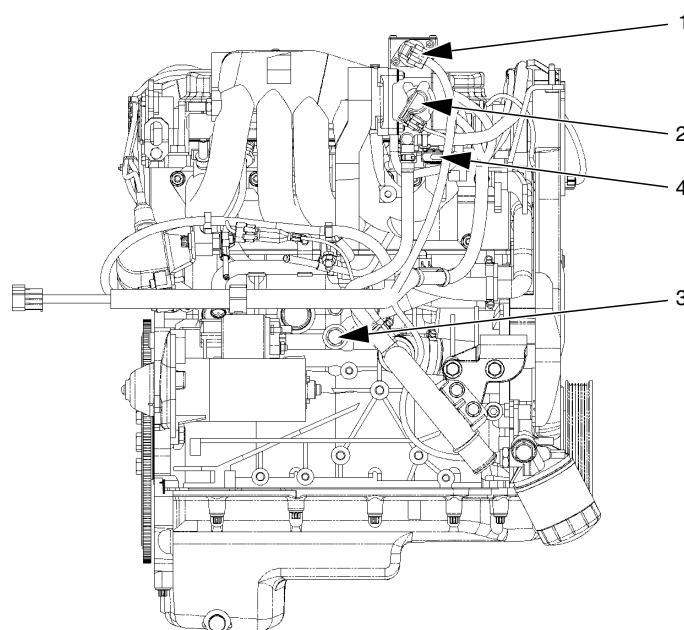
Abbreviations	Appellation
A/C	Air Conditioner
A/T	Automatic Transmission
ACC	Accessory
BLK	Black
BLU	Blue
BRN	Brown
CEL	Check Engine Lamp
CKP	Crankshaft Position
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
DVM	Digital Volt Meter
ECM	Engine Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable & Programmable Read Only Memory
EVAP	Evaporative Emission
EVRV	Electric Vacuum Regulating Valve
EXH	Exhaust
FT	Fuel Temperature
GND	Ground
GRY	Gray
HOS2	Heated Oxygen Sensor
IAC	Idle Air Control
IAT	Intake Air Temperature
IG	Ignition
ITP	Intake Throttle Position
KS	Knock Sensor
M/T	Manual Transmission
MAP	Manifold Absolute Pressure
MIL	Malfunction Indicator Lamp
OBD	On-Board Diagnostic
ORN	Orange
OT	Oil Temperature
PNK	Pink
RED	Red
SW	Switch
TB	Throttle Body
TEMP	Temperature
TP	Throttle Position
VSS	Vehicle Speed Sensor
WHT	White
YEL	Yellow

COMPONENT LOCATOR



Legend

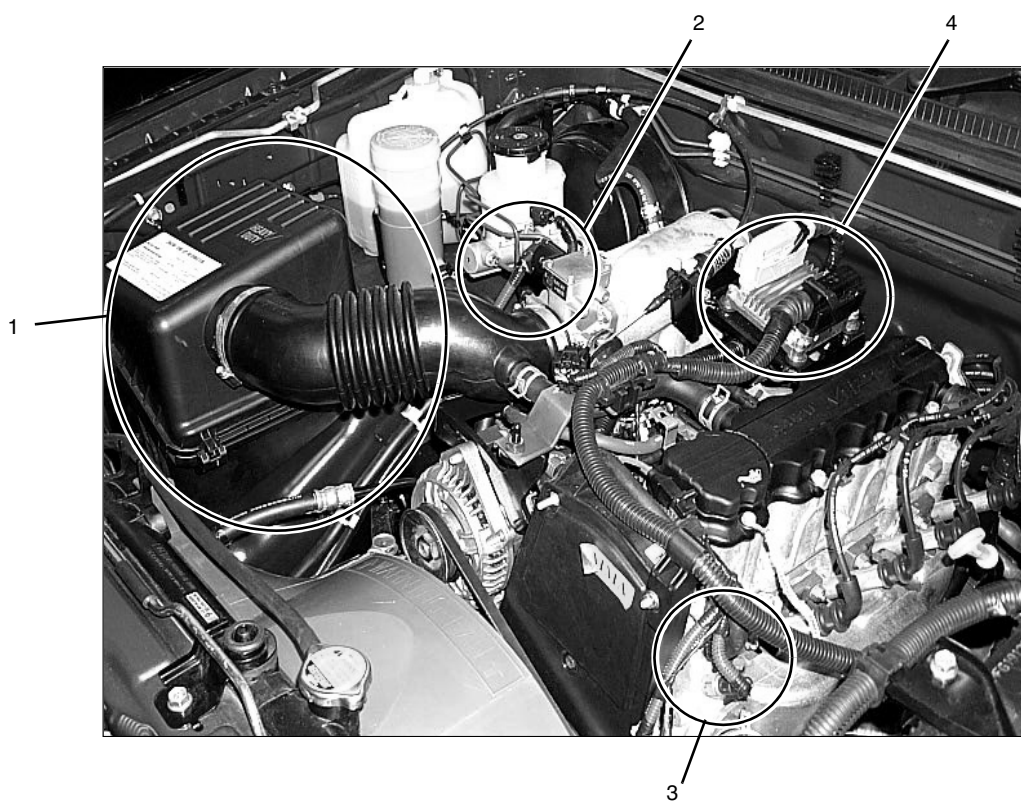
- (1) Engine Coolant Temperature (ECT) Sensor
- (2) Crankshaft Position (CKP) Sensor



Legend

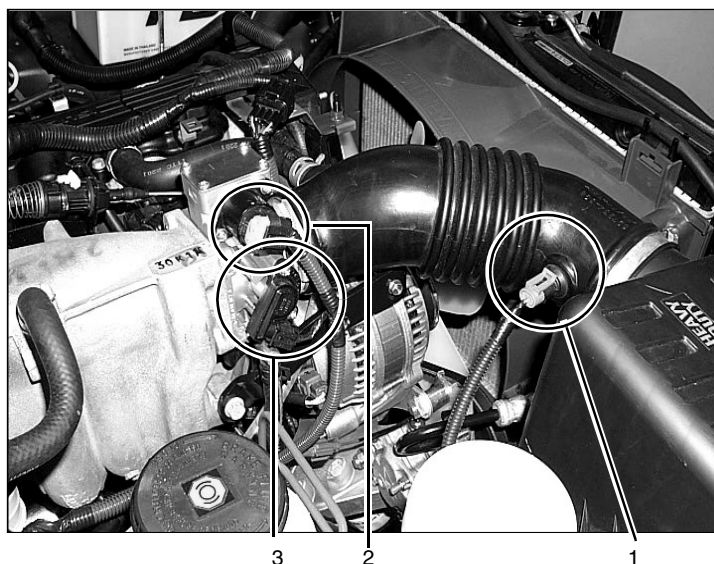
- (1) Idle Air Control (IAC) Valve
- (2) Throttle Position Sensor (TPS)

- (3) Knock Sensor (KS)
- (4) Manifold Absolute Pressure (MAP) Sensor

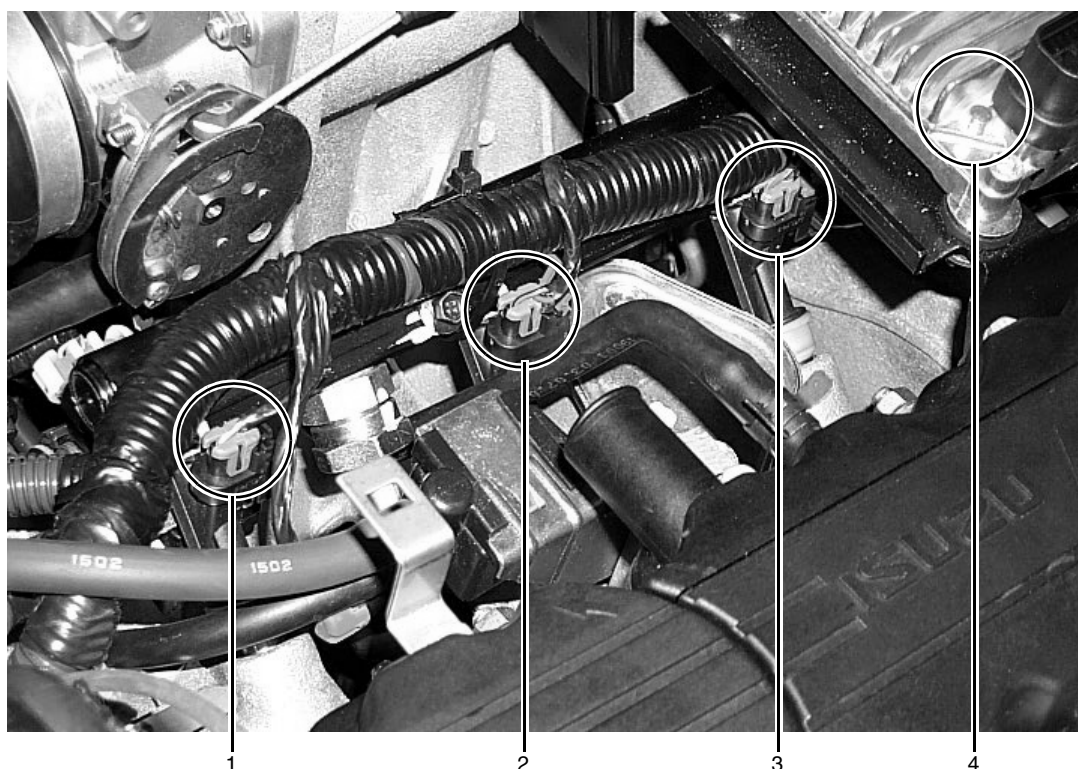


- (1) Air Cleaner
- (2) Idle Air Control (IAC) Valve

- (3) Engine Coolant Temperature (ECT) Sensor
- (4) Engine Control Module (ECM)



- (1) Intake Air Temperature (IAT) Sensor
- (2) Idle Air Control (IAC) Valve
- (3) Throttle Position Sensor (TPS)

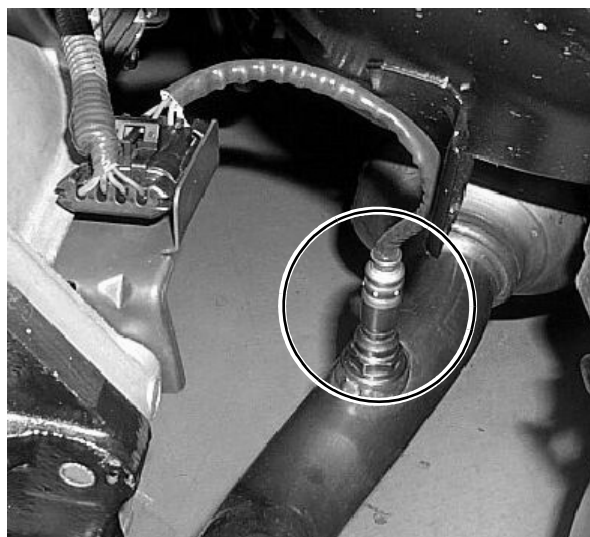


- (1) Injector #1 Cylinder
- (2) Injector #2 Cylinder

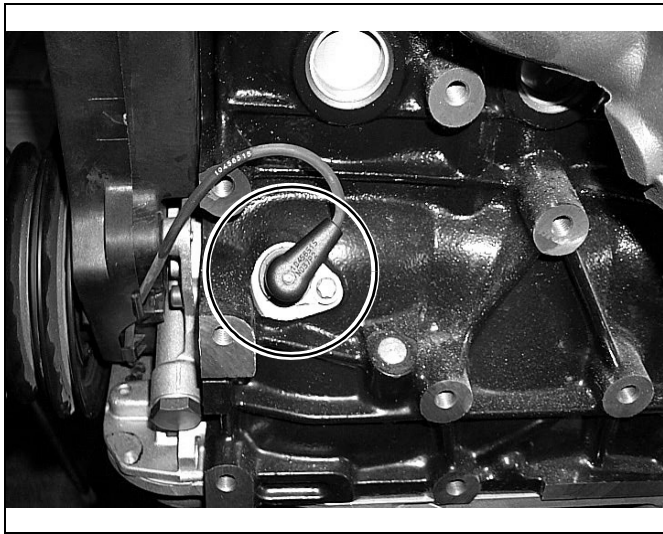
- (3) Injector #3 Cylinder
- (4) Injector #4 Cylinder (Under the ECM)



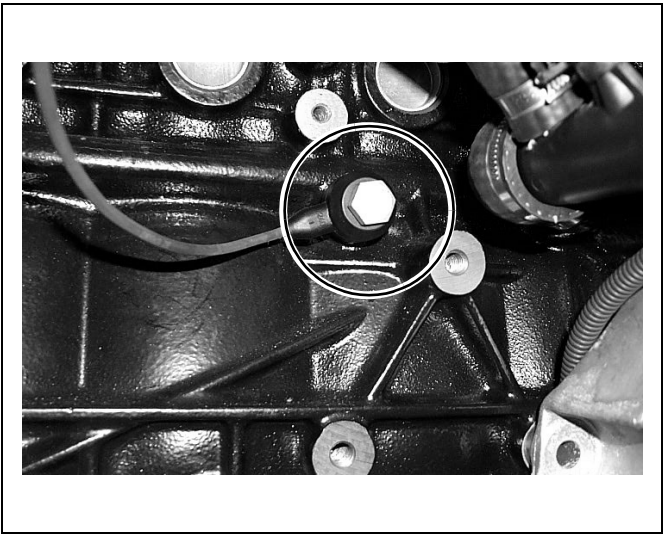
- (1) Ignition Coil Module Assembly



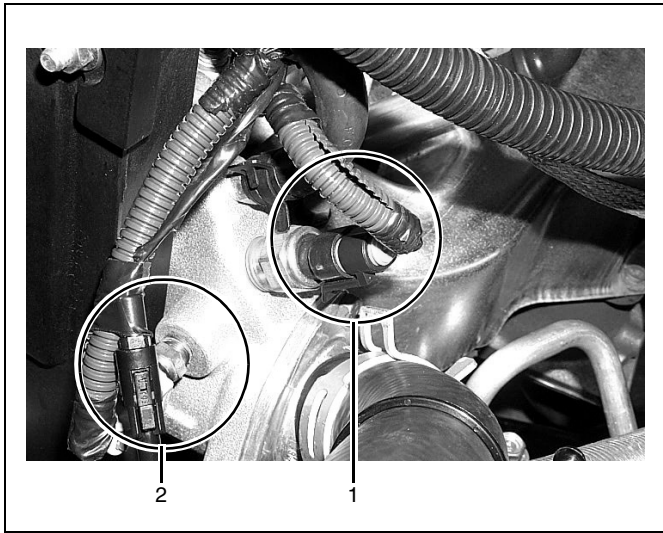
- (1) Heated Oxygen Sensor



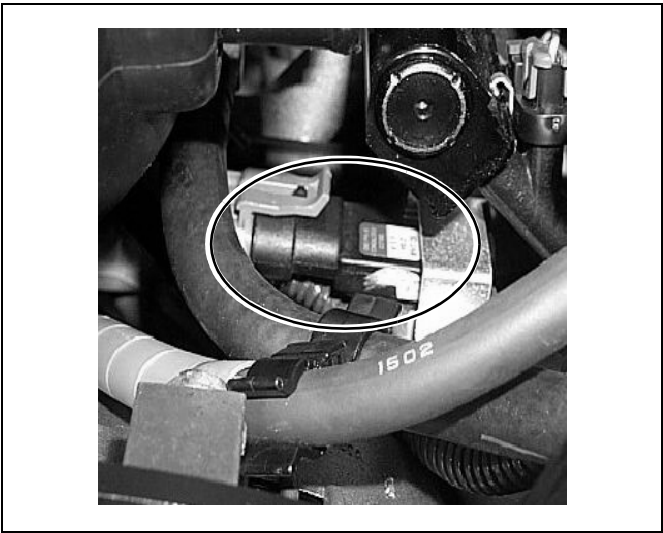
(1) Crankshaft Position (CKP) Sensor



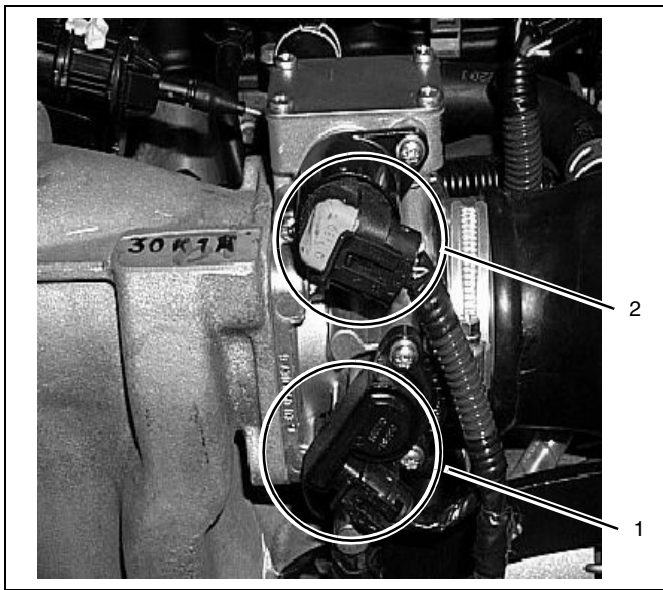
(1) Knock Sensor (KS)



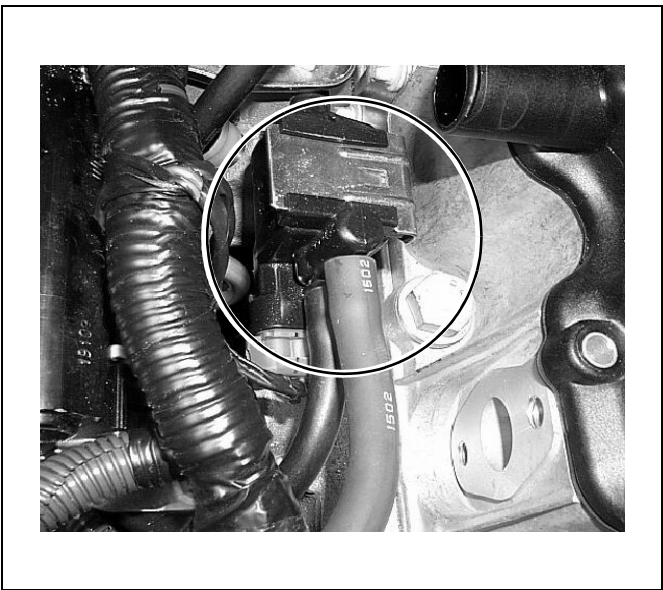
(1) Engine Coolant Temperature (ECT) Sensor
(2) Thermo Meter Sensor



(1) Manifold Absolute Pressure (MAP) Sensor



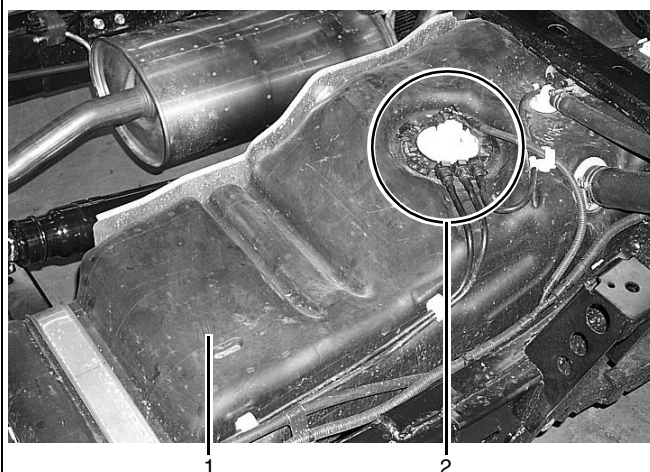
(1) Throttle Position Sensor
(2) Idle Air Control (IAC) Valve



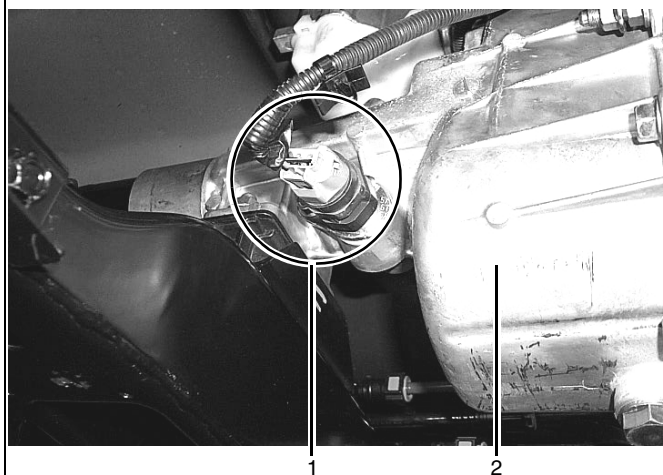
(1) EVAP Purge Solenoid



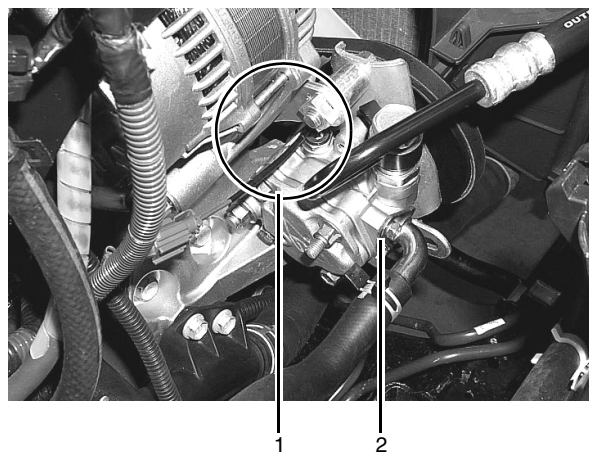
(1) Canister



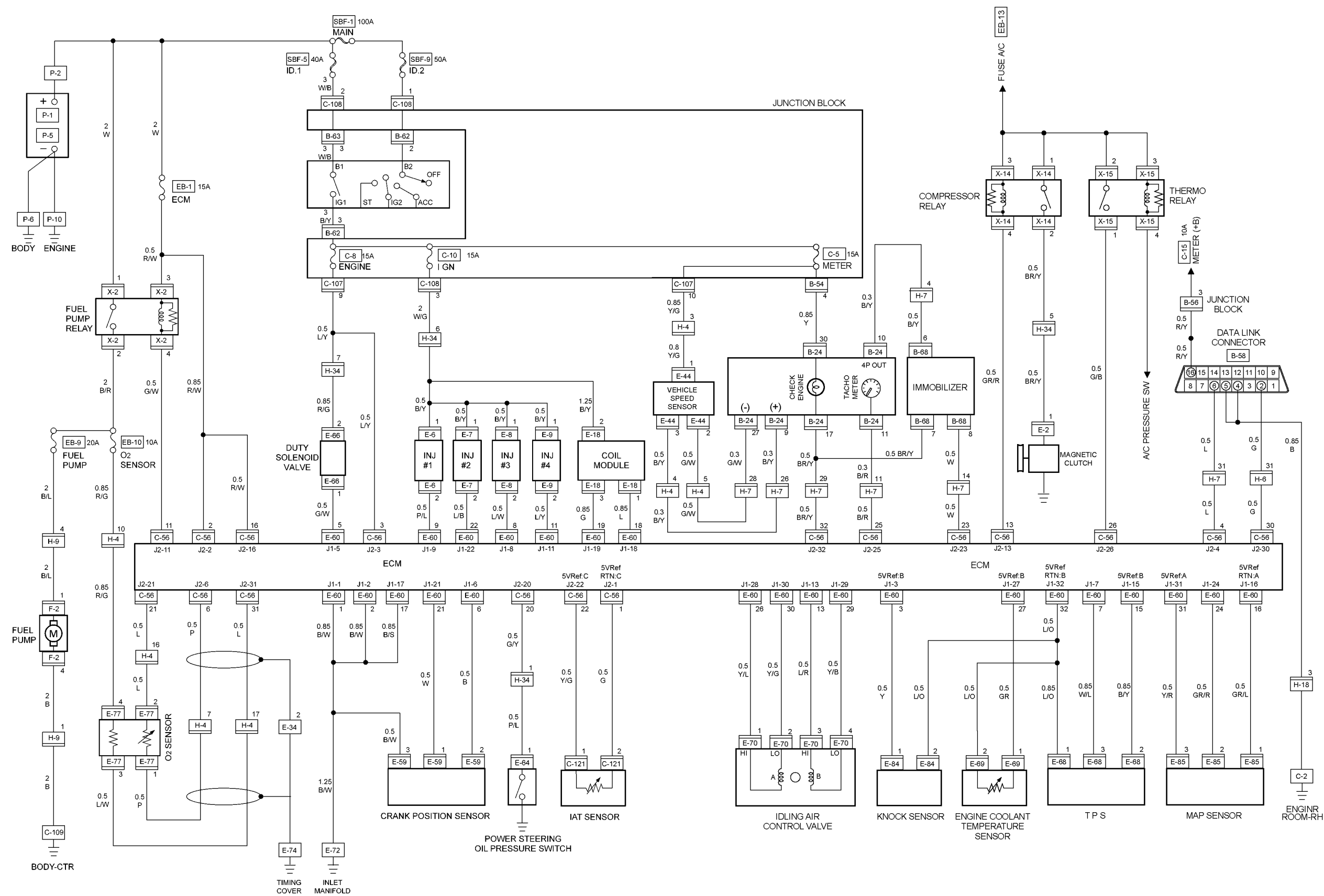
(1) Fuel Tank
(2) Fuel Pump



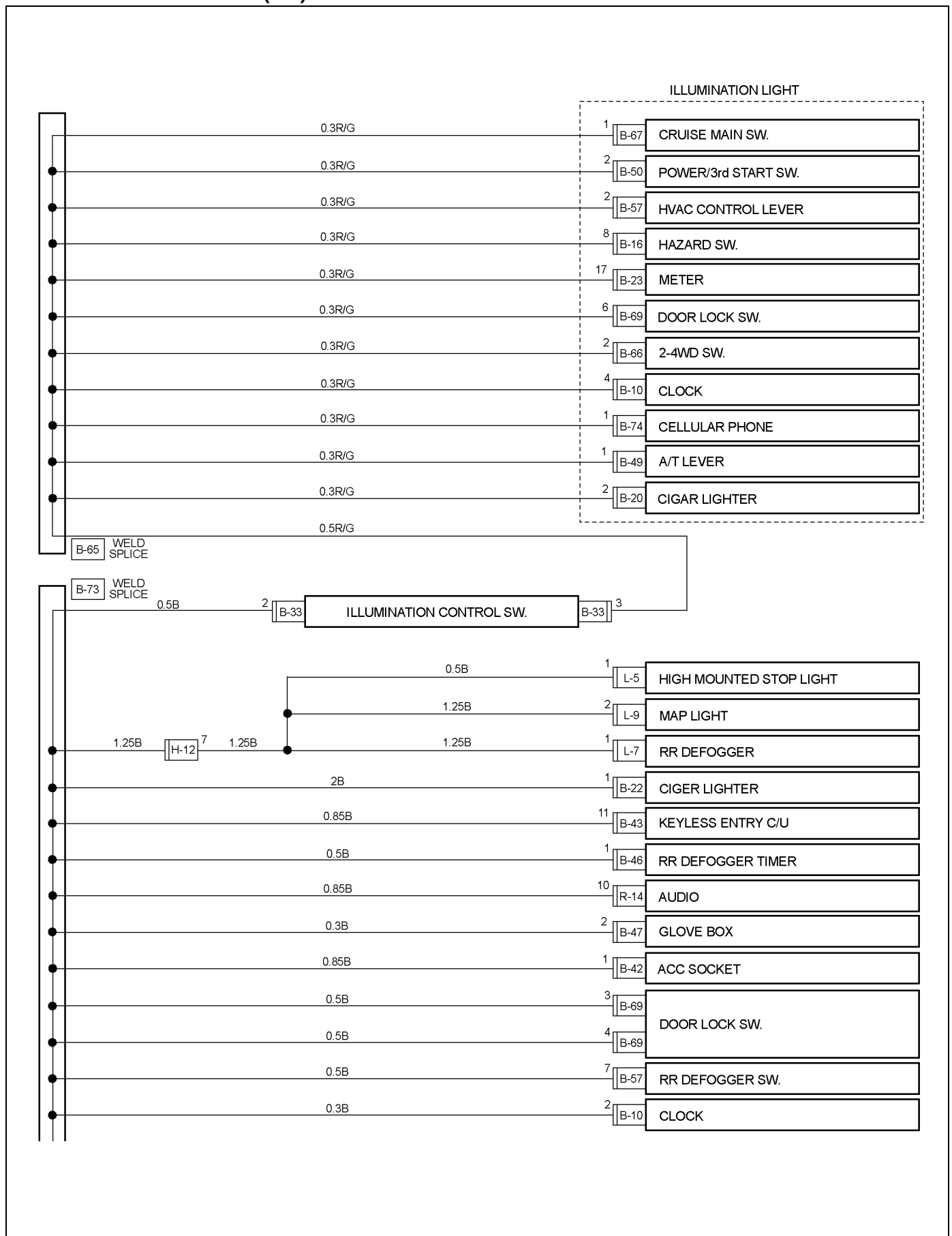
(1) Vehicle Speed Sensor (VSS)
(2) Transmission Assembly



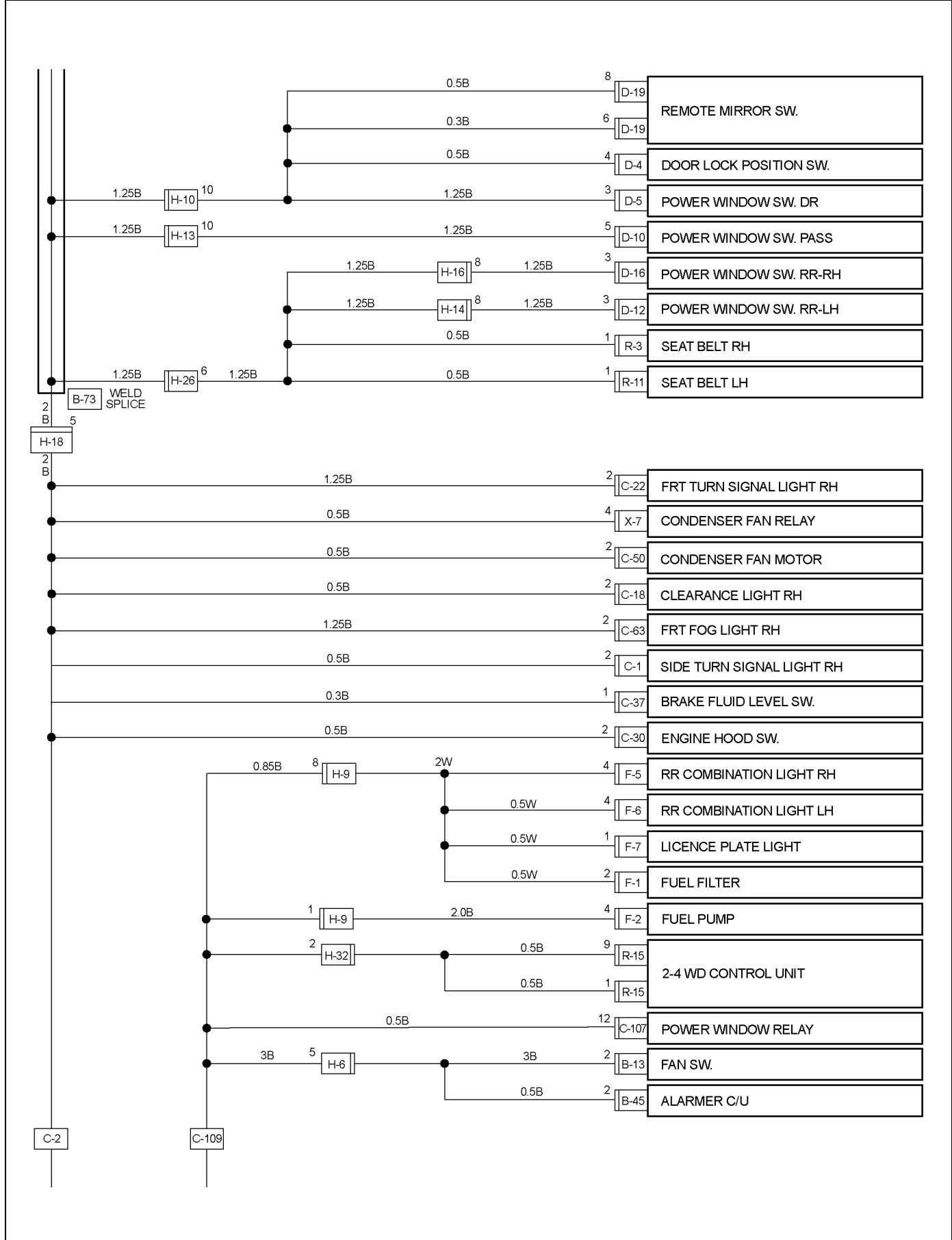
(1) Power Steering Pressure Switch
(2) Power Steering Oil Pump Assembly



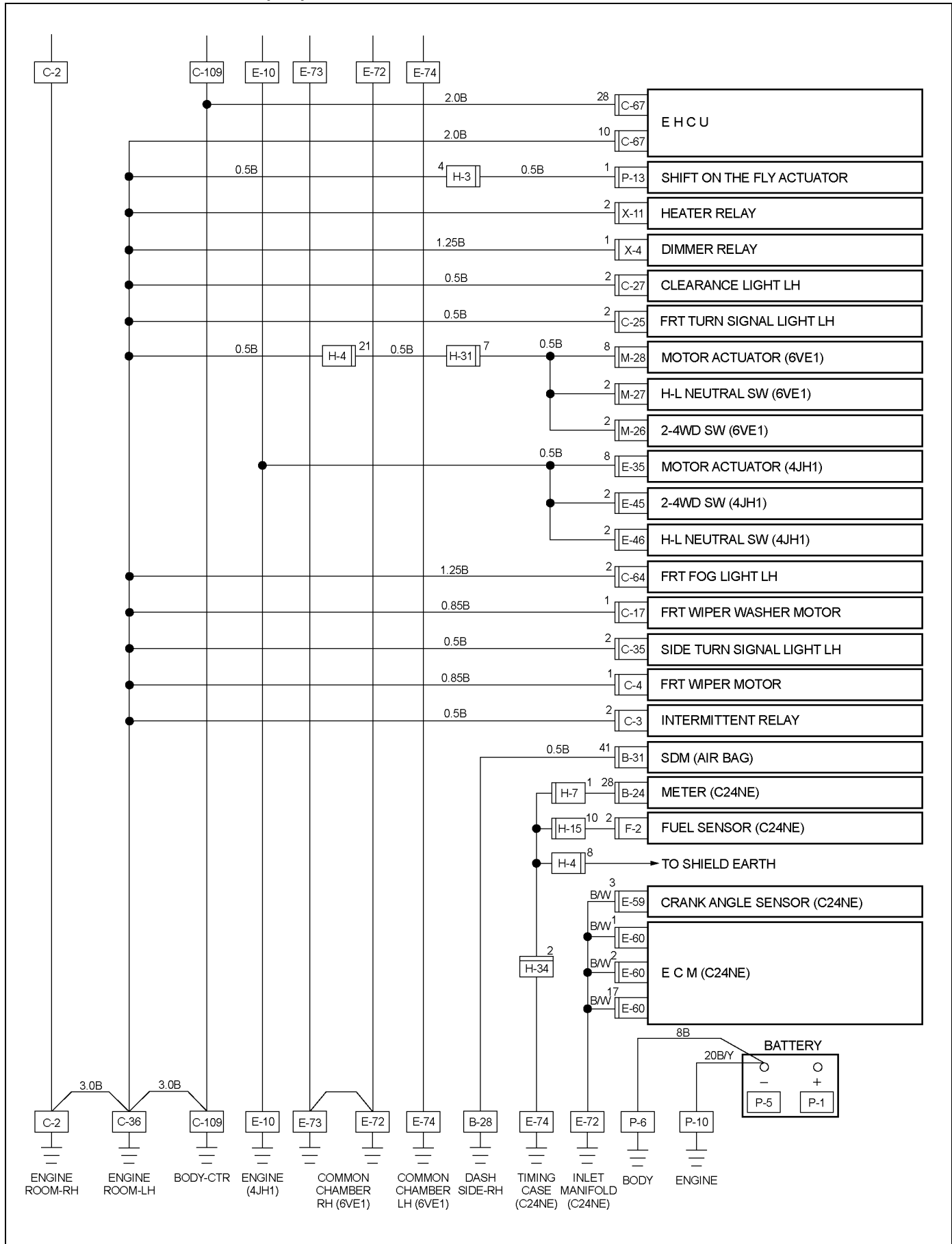
GROUND POINT CHART (1/4)



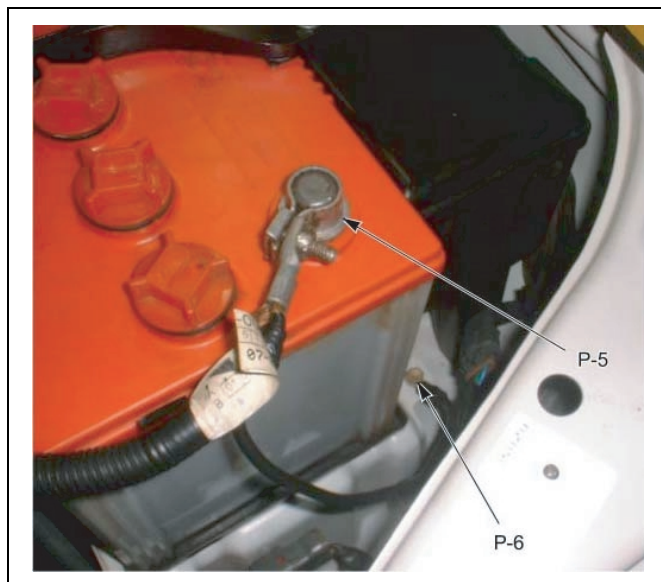
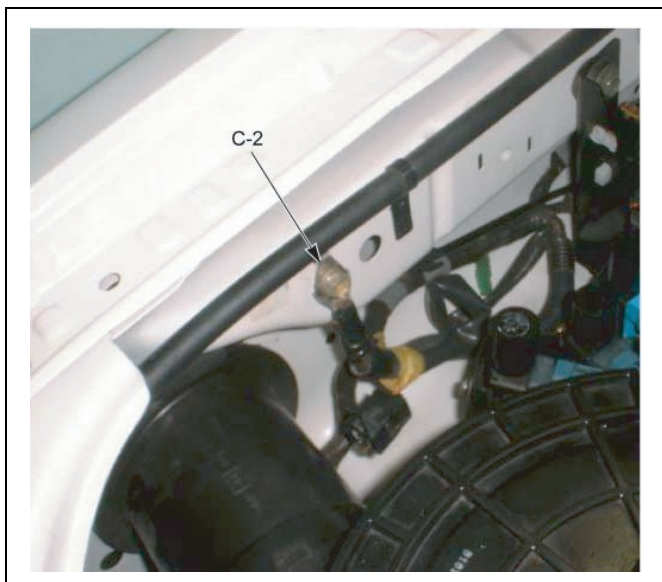
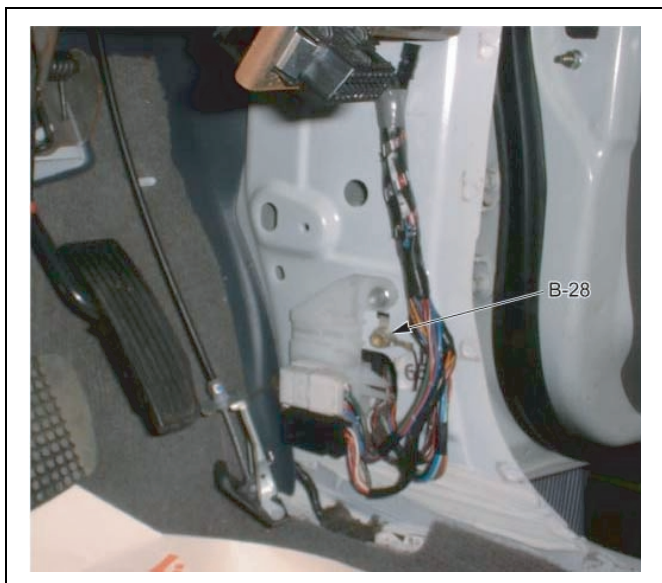
GROUND POINT CHART (2/4)

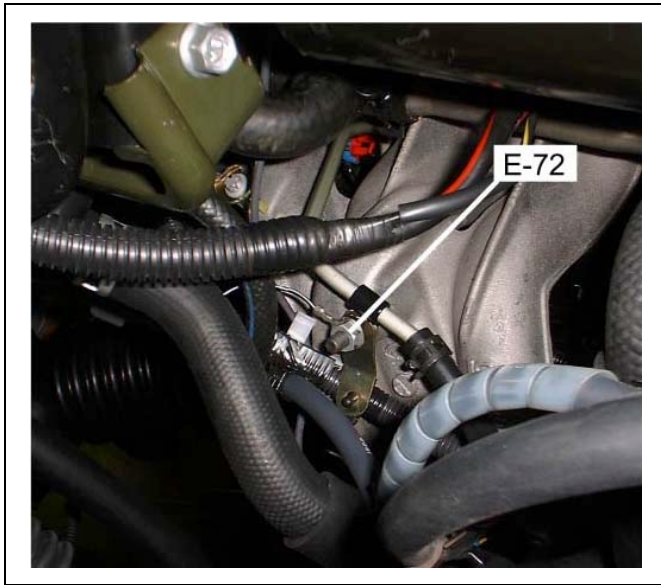


GROUND POINT CHART (4/4)

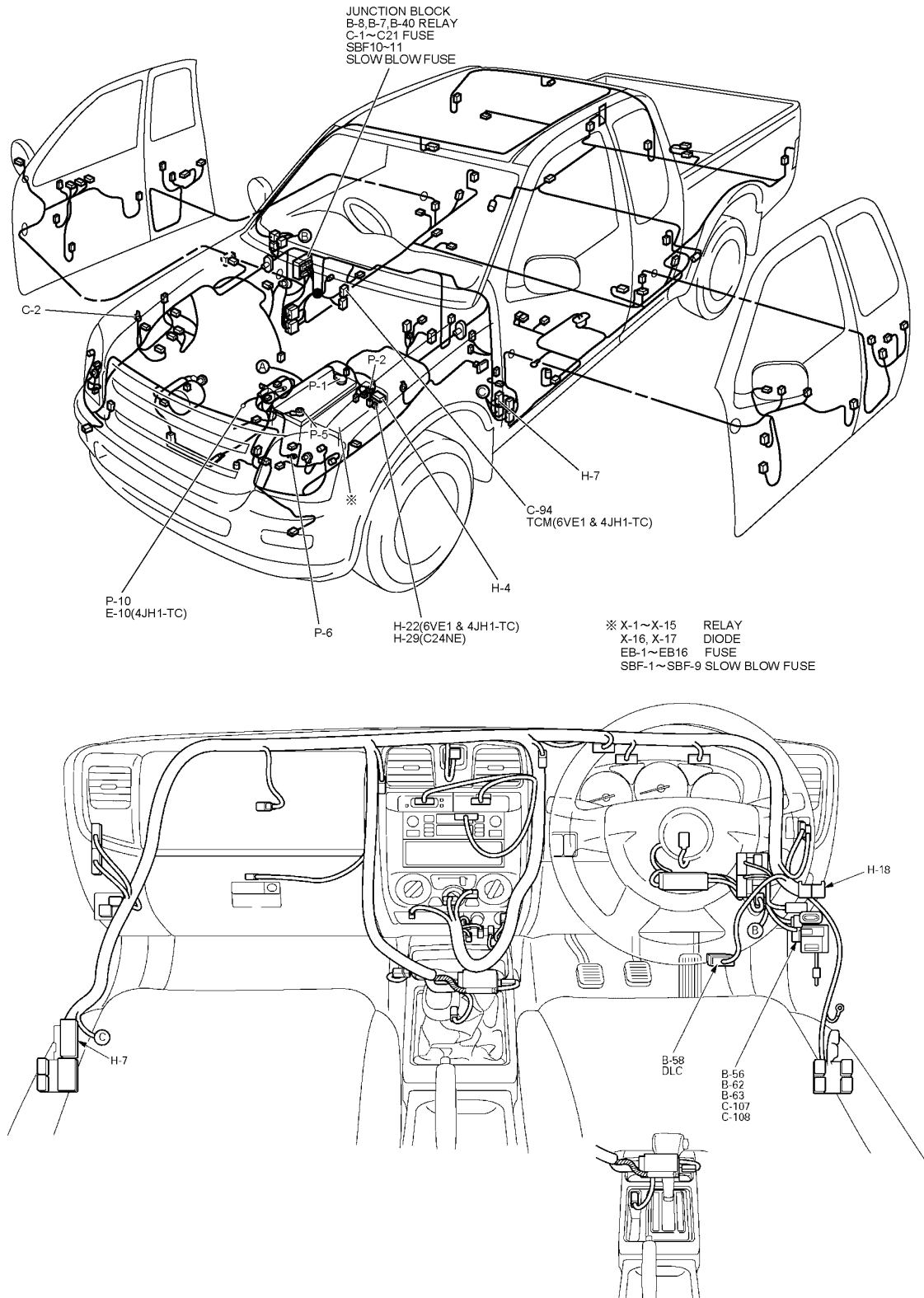


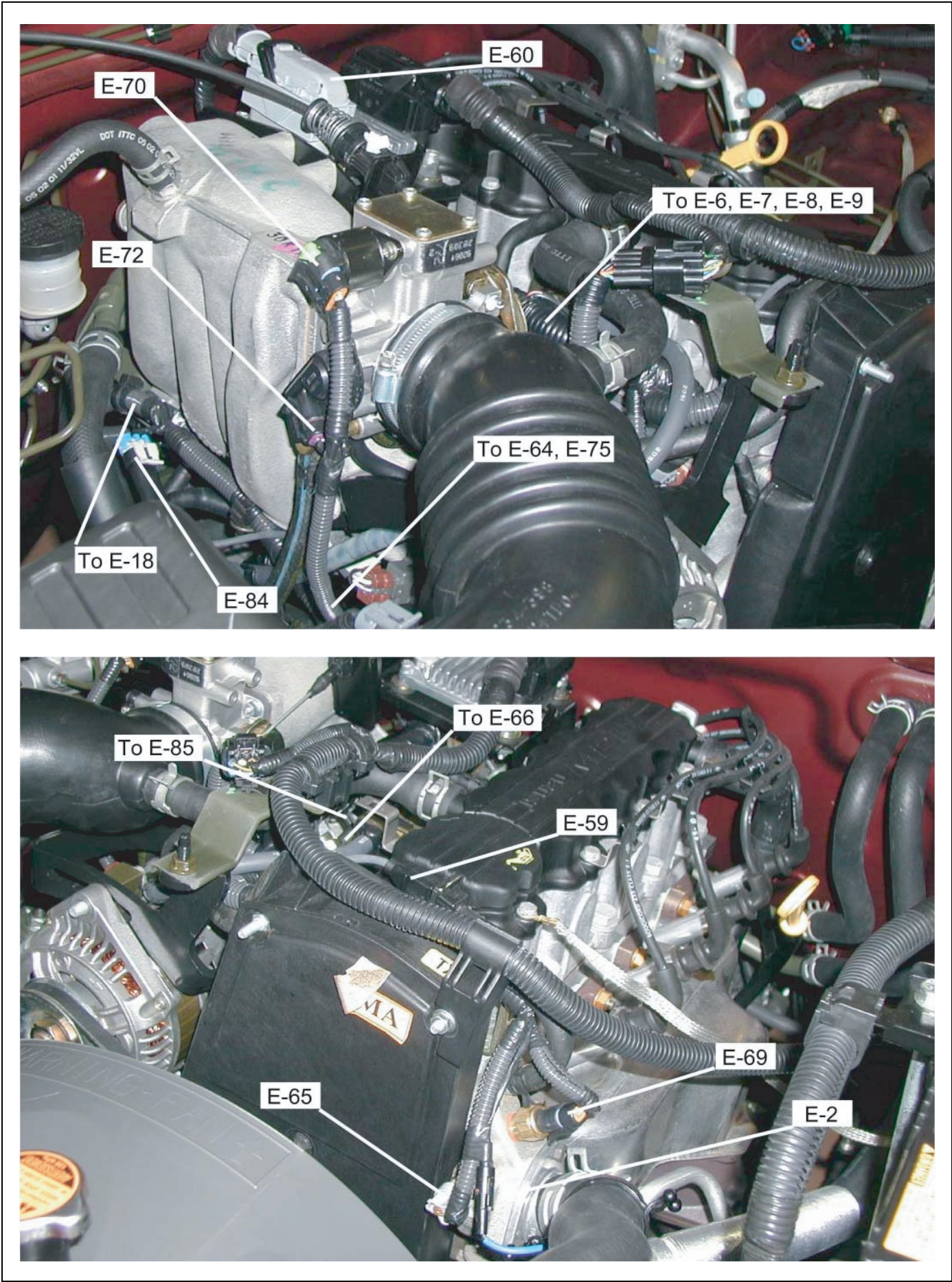
LOCATION

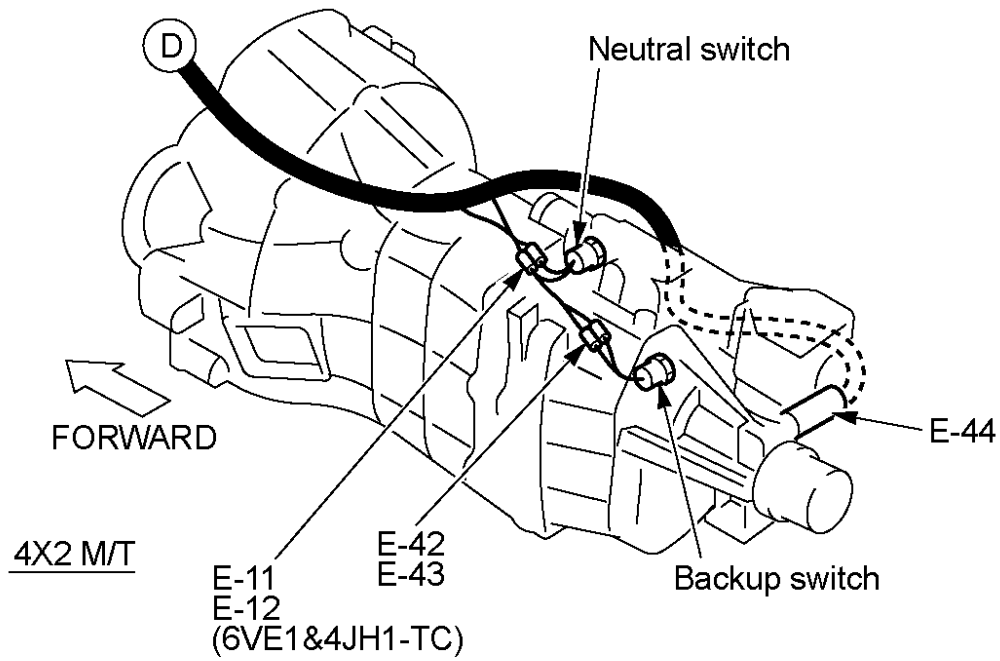




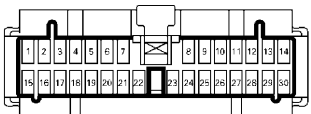
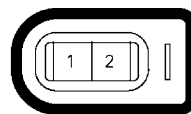
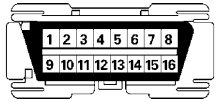
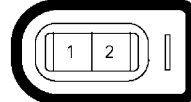
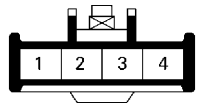
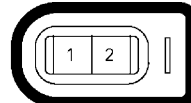
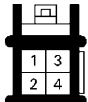
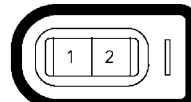
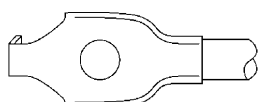
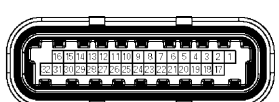
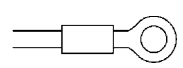
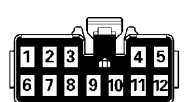
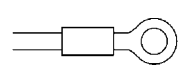
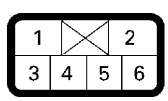
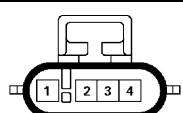
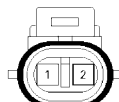
CABLE HARNESS & CONNECTOR LOCATION

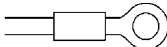
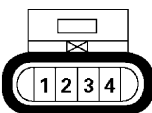
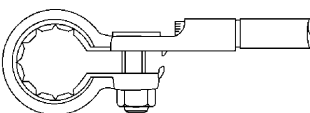
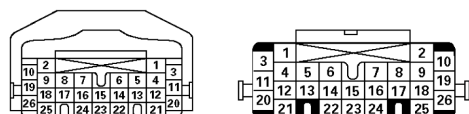
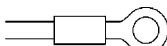
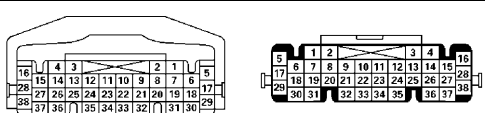
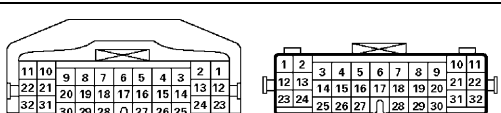
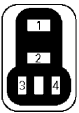
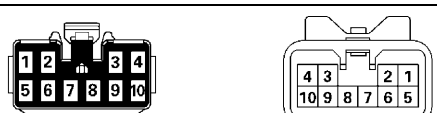
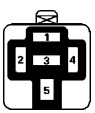
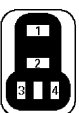
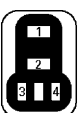
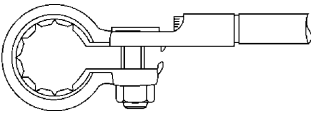






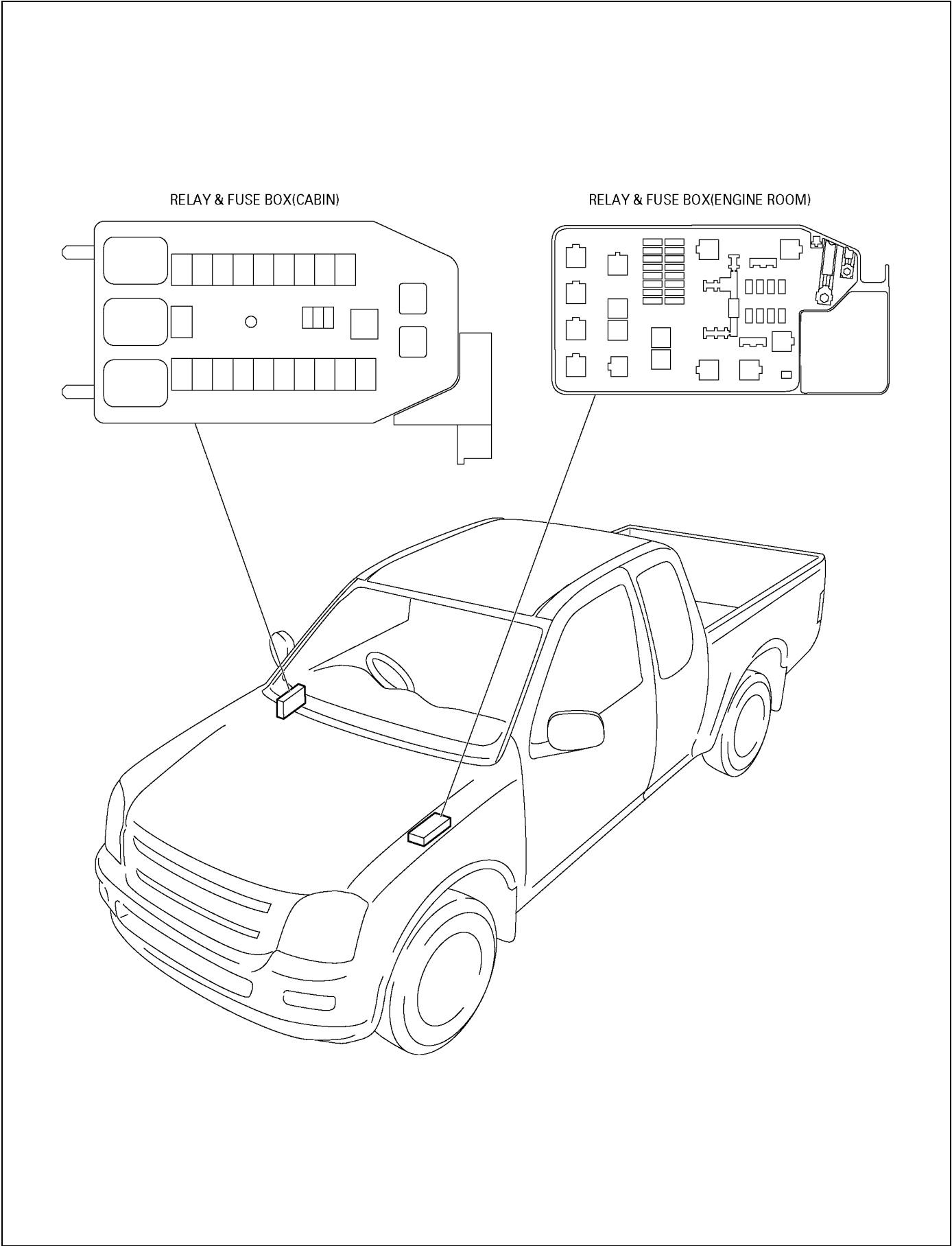
CONNECTOR LIST

No.	Connector face	No.	Connector face
B-24		E-6	
Green	Meter-B		Injector pump
B-58		E-7	
Black	Check connector		Fuel injector
B-62		E-8	
White	Ignition switch (IGSUB : G1)		Fuel injector
B-63		E-9	
White	Ignition switch (IGSUB : G2)		Fuel injector
B-68		E-18	
	Immobiliser		Ignition coil
C-2		E-60	
Silver	Engine room-RH ground		ECM
C-56		E-72	
	ECM		Engine earth-A
C-107		E-74	
White	J/B E2		Engine earth-B
C-108		E-77	
White	J/B E1		O ₂ sensor
C-121		E-84	
	IAT sensor		Knock sensor

No.	Connector face	No.	Connector face
E-85	 MAP sensor	P-2	 Relay & Fuse box
F-2	 Fuel pump & sensor	P-5	 Battery (-)
H-4	 Engine room ~ Mission	P-6	 Body earth (Ground)
H-6	 Engine room ~ INST	P-10	 Engine ground
H-7	 Engine room ~ INST	X-2	 Relay; Fuel pump
H-9	 Engine room ~ Chassis	X-11	 Relay; Heater
H-18	 Engine room ~ INST	X-14	 Relay; A/C Compressor
H-31	 Engine room ~ Mission	X-15	 Relay; Thermo
H-34	 Engine ~ Engine room		
P-1	 Battery (+)		

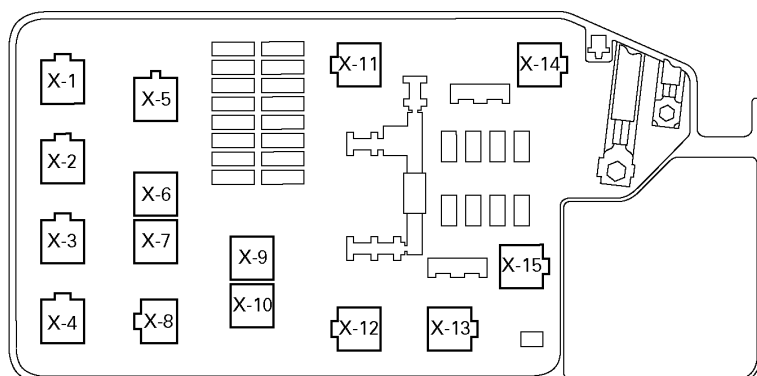
RELAY AND FUSE

RELAY AND FUSE BOX LOCATION



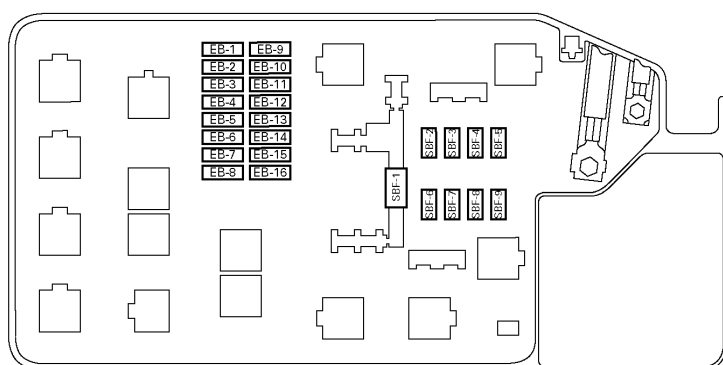
RELAY AND FUSE BOX LOCATION

RELAY & FUSE BOX



RELAY

No.	RELAY (C24SE)
X-1	RELAY; TAIL LIGHT
X-2	RELAY; FUEL PUMP
X-3	RELAY; HORN
X-4	RELAY; DIMMER
X-5	—
X-6	RELAY; STARTER
X-7	RELAY; COND, FAN
X-8	RELAY; —
X-9	—
X-10	—
X-11	RELAY; HEATER
X-12	RELAY; HEAD LIGHT
X-13	—
X-14	RELAY; A/C COMP
X-15	RELAY; THERMO



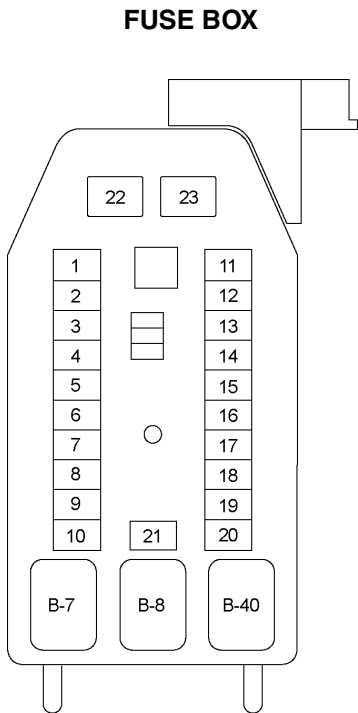
FUSE

FUSE NO.	ENGINE MODEL
	C24SE
EB-1	15A ECM
EB-2	—
EB-3	—
EB-4	15A ACG (S)
EB-5	10A ILLUMI
EB-6	10A TAIL
EB-7	10A H/LIGHT-RH
EB-8	10A H/LIGHT-LH
EB-9	20A FUEL PUMP
EB-10	10A O ₂ SENSOR
EB-11	—
EB-12	—
EB-13	10A A/C
EB-14	—
EB-15	10A HORN
EB-16	10A HAZARD

SLOW BLOW FUSE

FUSE NO.	ENGINE MODEL
	C24SE
SBF-1	100A MAIN
SBF-2	—
SBF-3	—
SBF-4	20A COND, FAN
SBF-5	40A IG 1
SBF-6	—
SBF-7	—
SBF-8	30A BLOWER
SBF-9	50A IG 2

FUSE AND RELAY LOCATION



FUSE

No.	Capacity	Indication on label	No.	Capacity	Indication on label
1	—	—	12	15A	CIGER
2	10A	ABS	13	15A	AUDIO (+B)
3	—	—	14	20A	DOOR LOCK
4	15A	BACK UP	15	10A	METER (+B)
5	15A	METER	16	10A	ROOM
6	10A	TURN	17	10A	ANTI THEFT
7	15A	ELEC.IG	18	15A	STOP
8	15A	ENGINE	19	15A	ACC SOCKET
9	20A	FRT WIPER	20	10A	STARTER
10	15A	EGR	21	10A	SRS
11	10A	AUDIO			

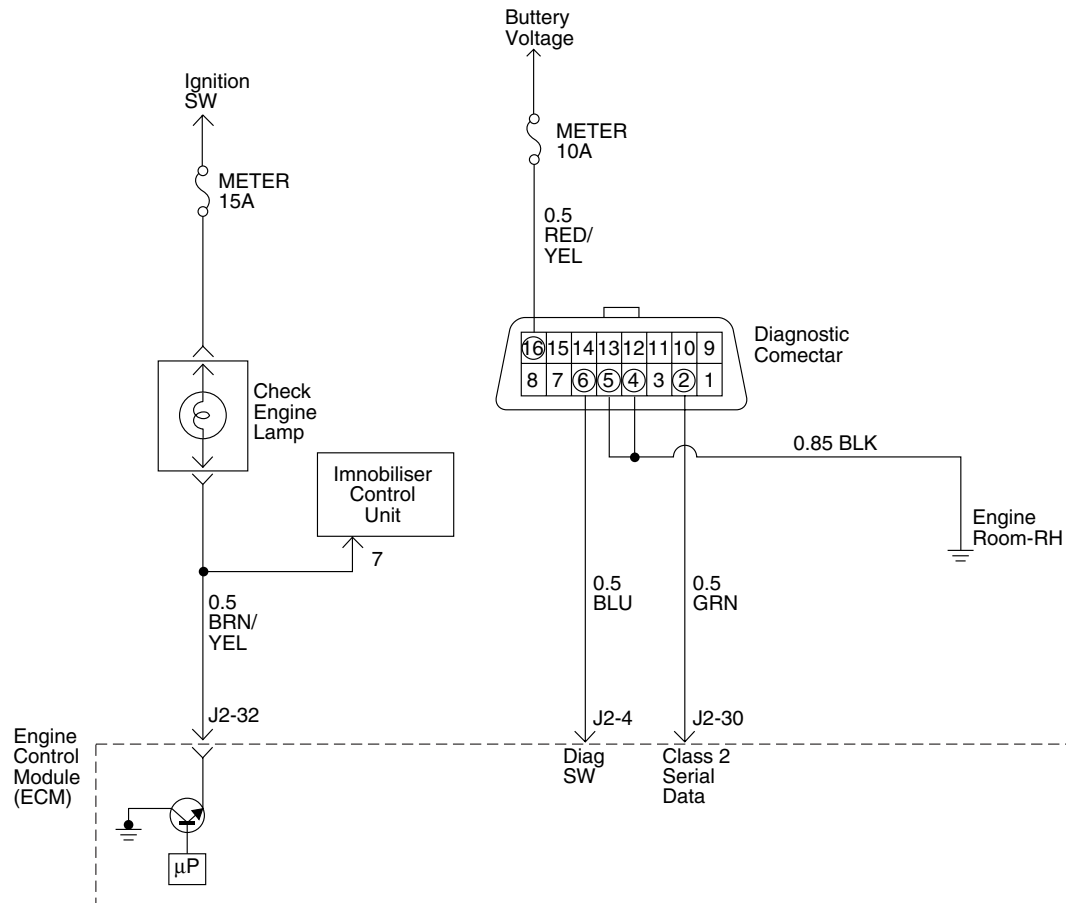
SLOW BLOW FUSE

No.	Capacity	Indication on label
22	20A	RR DEF
23	20A	POWER WINDOW

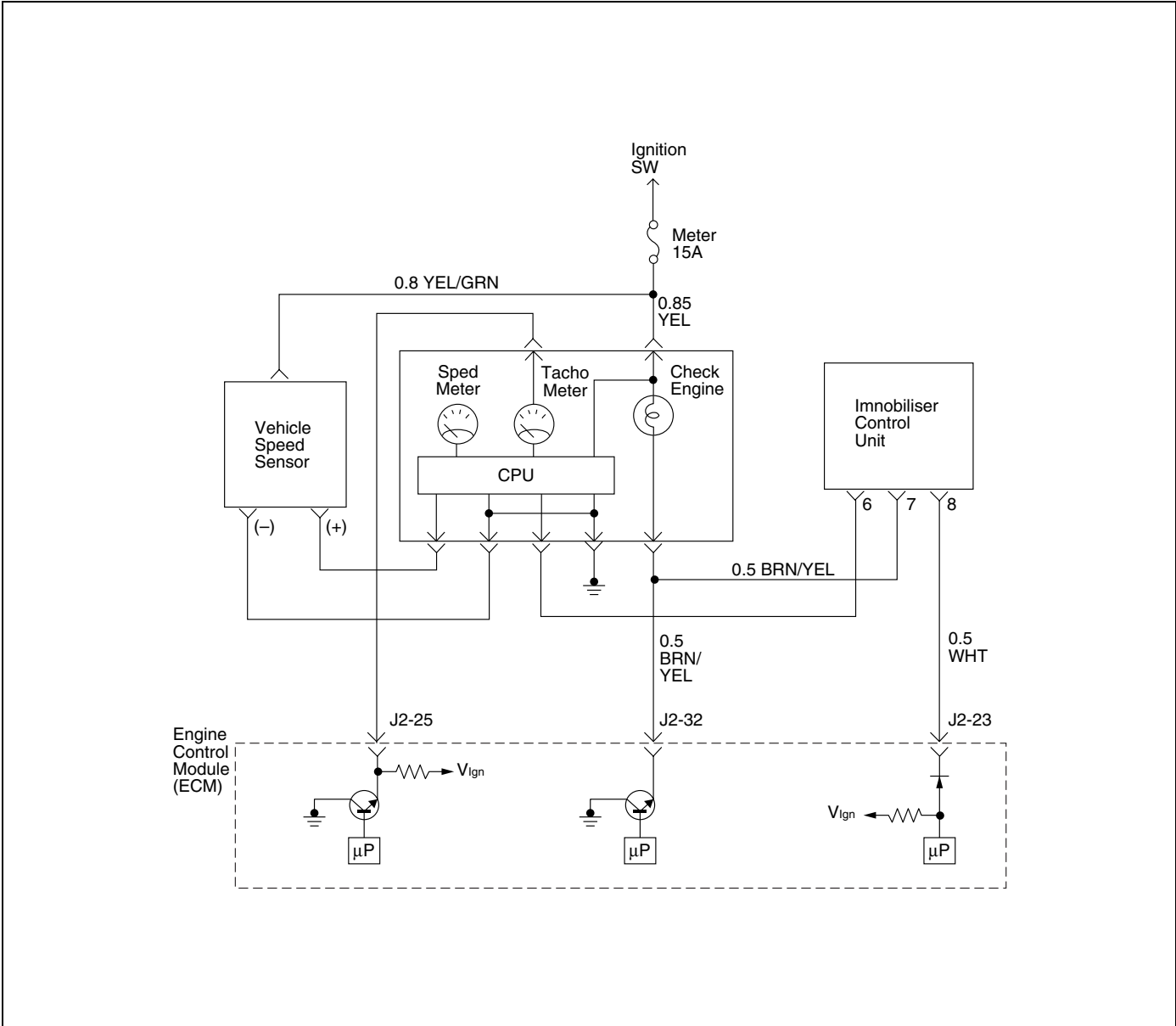
RELAY

Connector No.	B-7	B-8	B-40
C24SE	REAR DEFOGGER	POWER WINDOW	ACC SOCKET

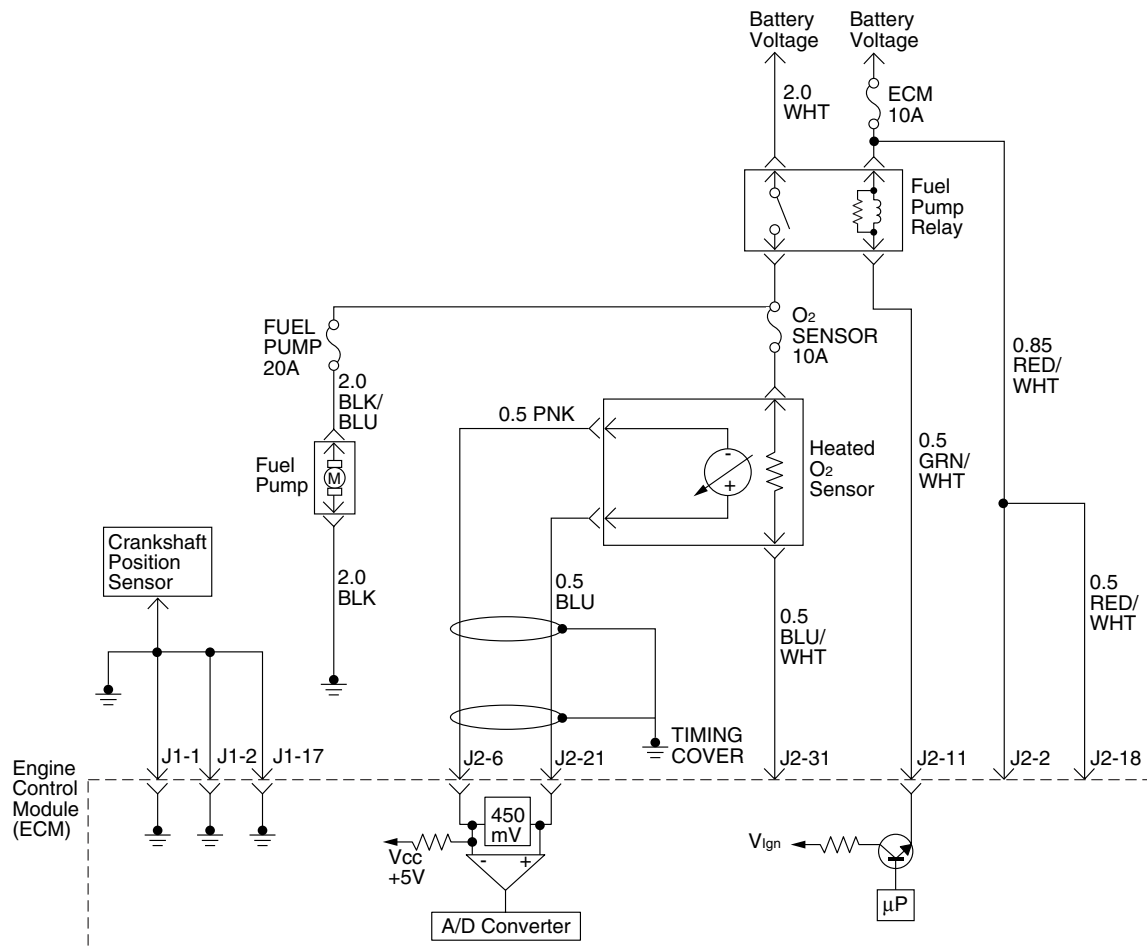
ECM WIRING DIAGRAM (1/9)



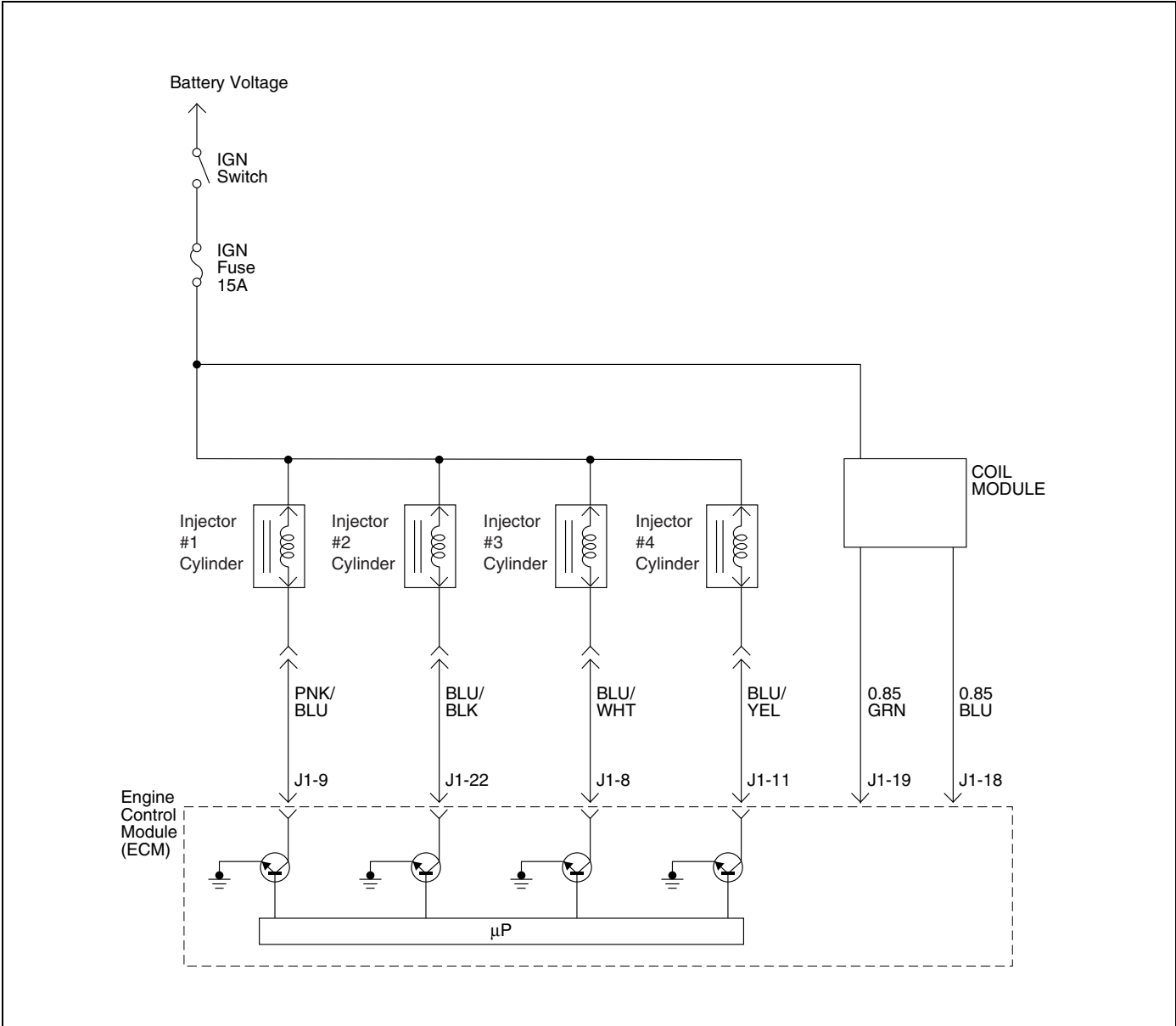
ECM WIRING DIAGRAM (2/9)



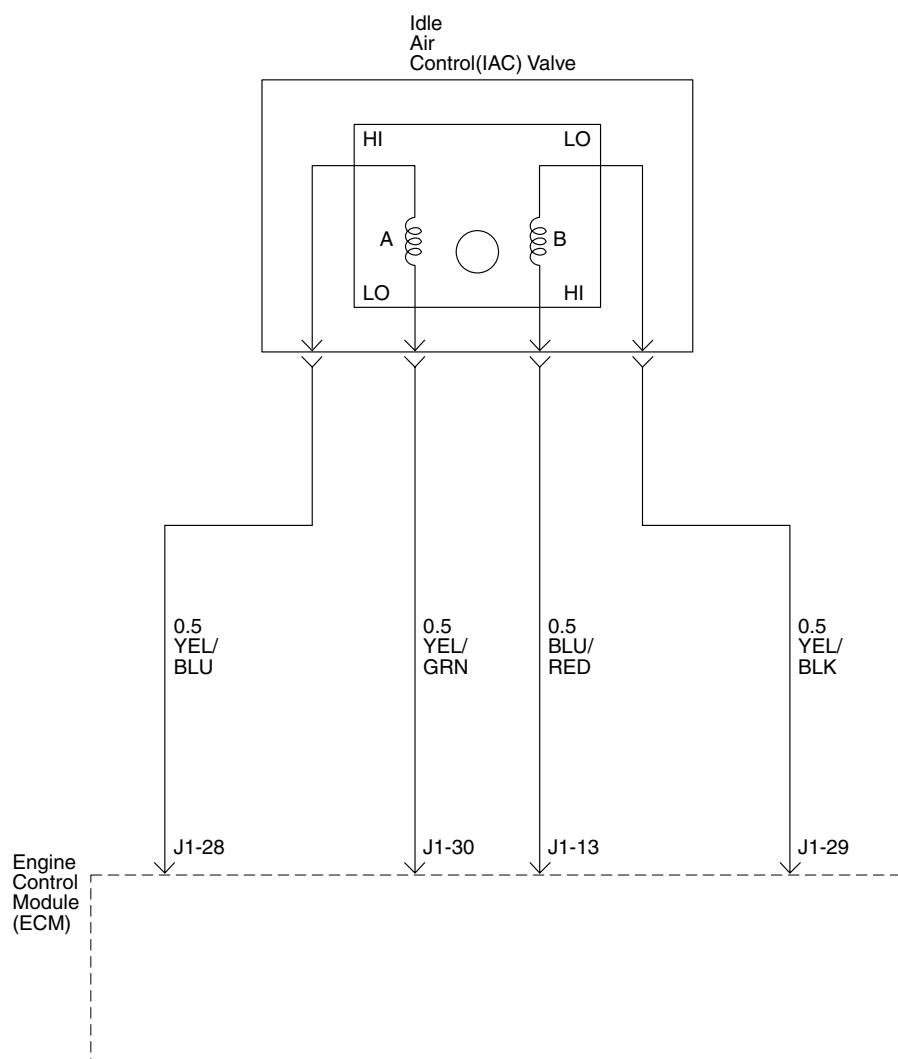
ECM WIRING DIAGRAM (3/9)



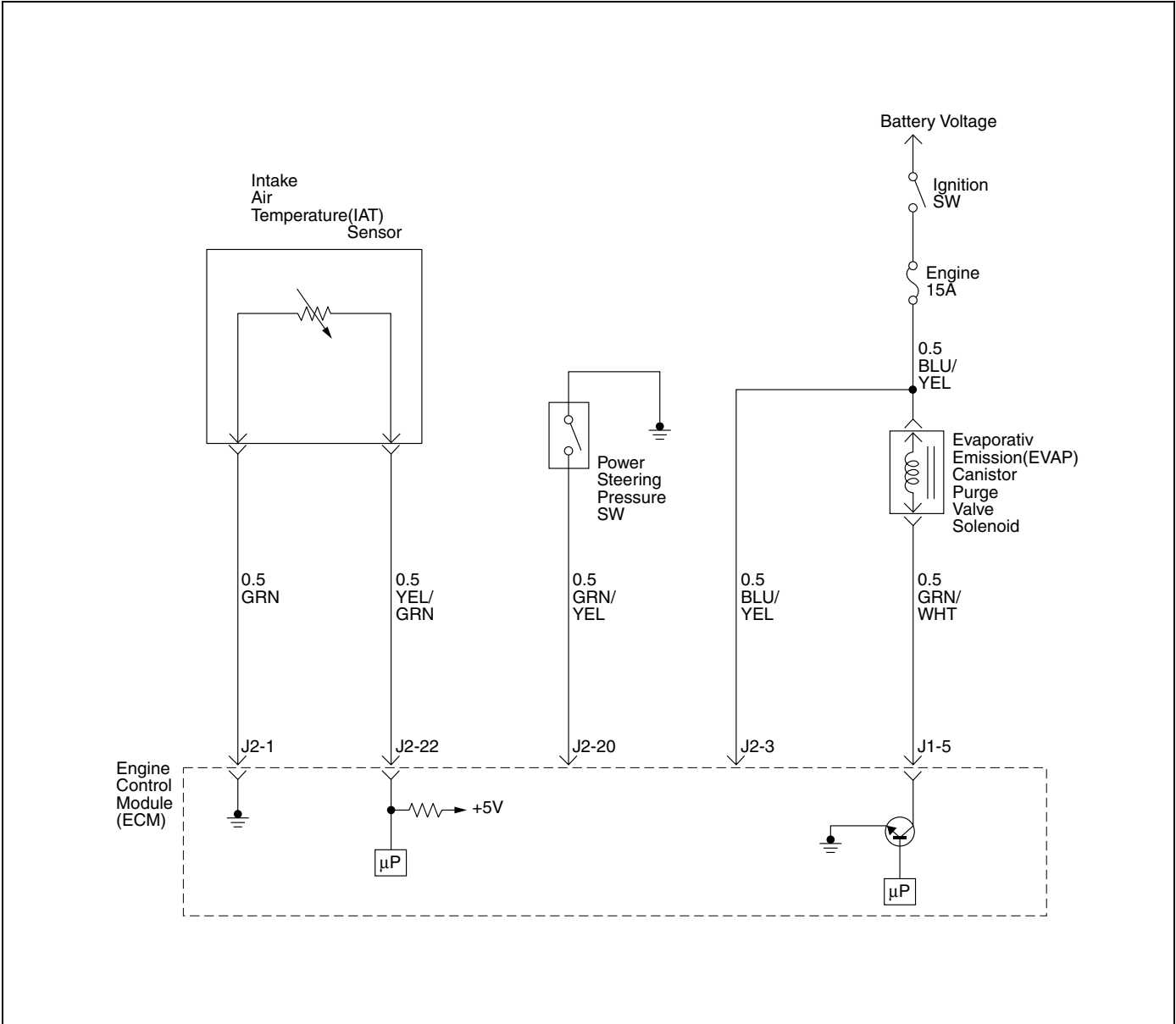
ECM WIRING DIAGRAM (4/9)



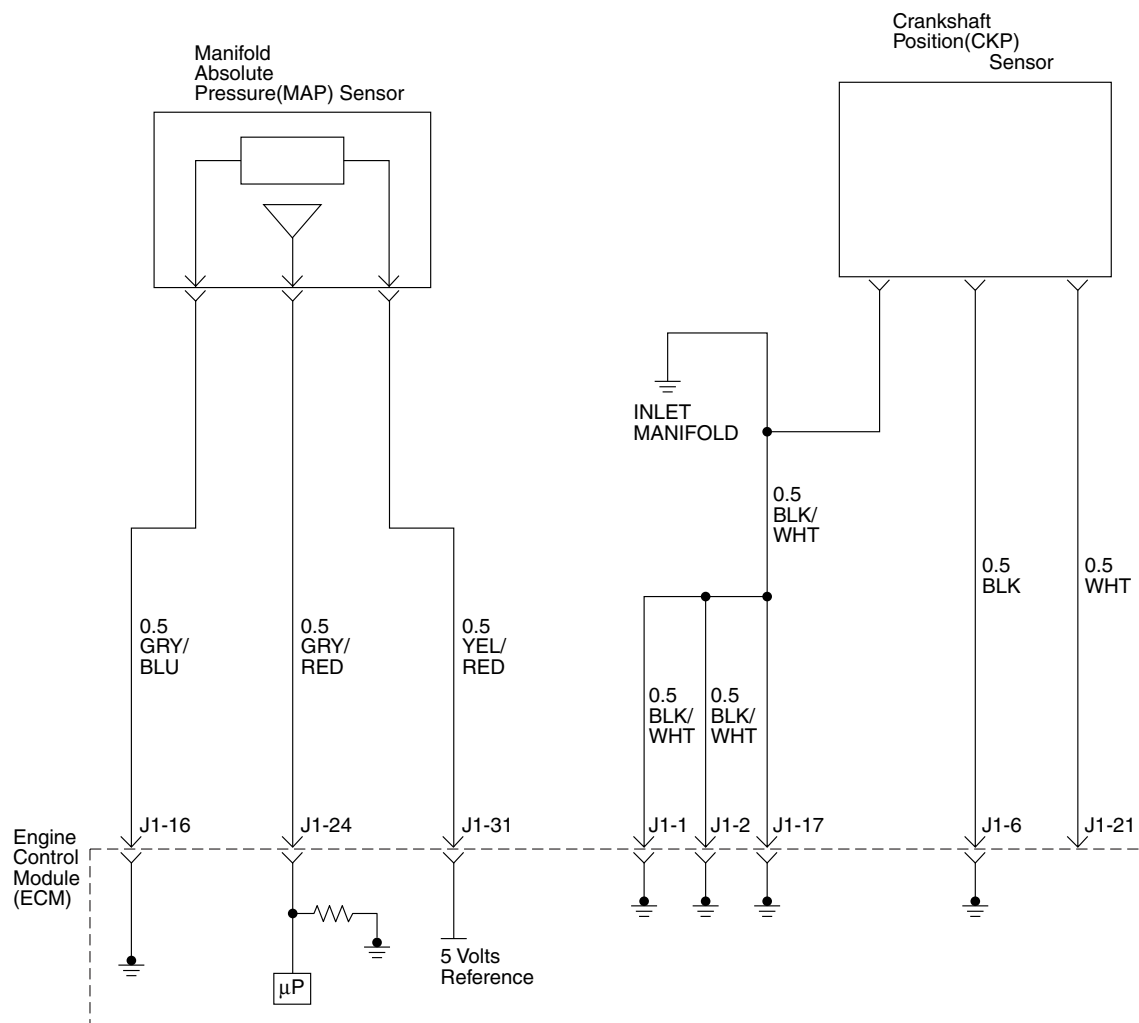
ECM WIRING DIAGRAM (5/9)



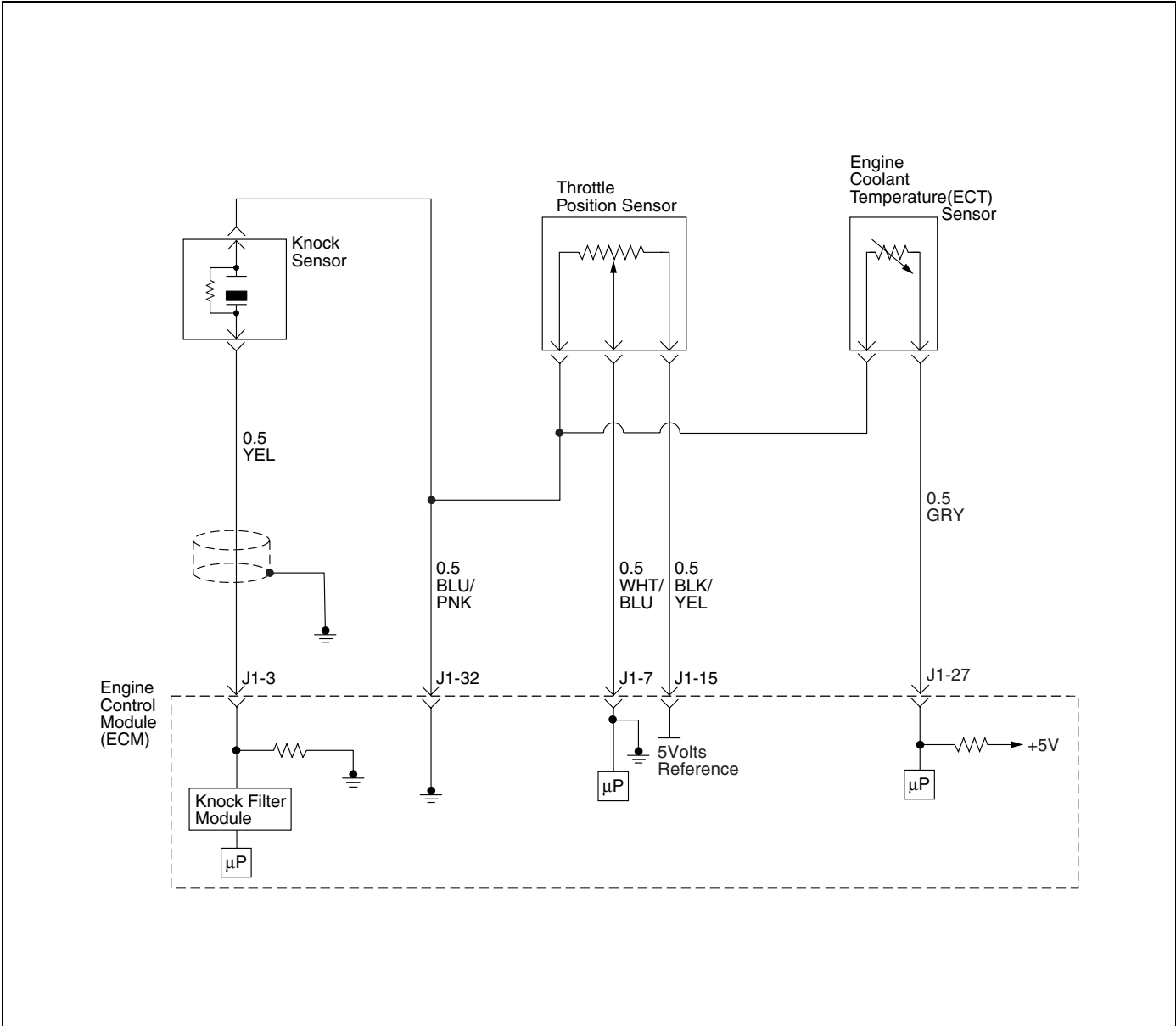
ECM WIRING DIAGRAM (6/9)



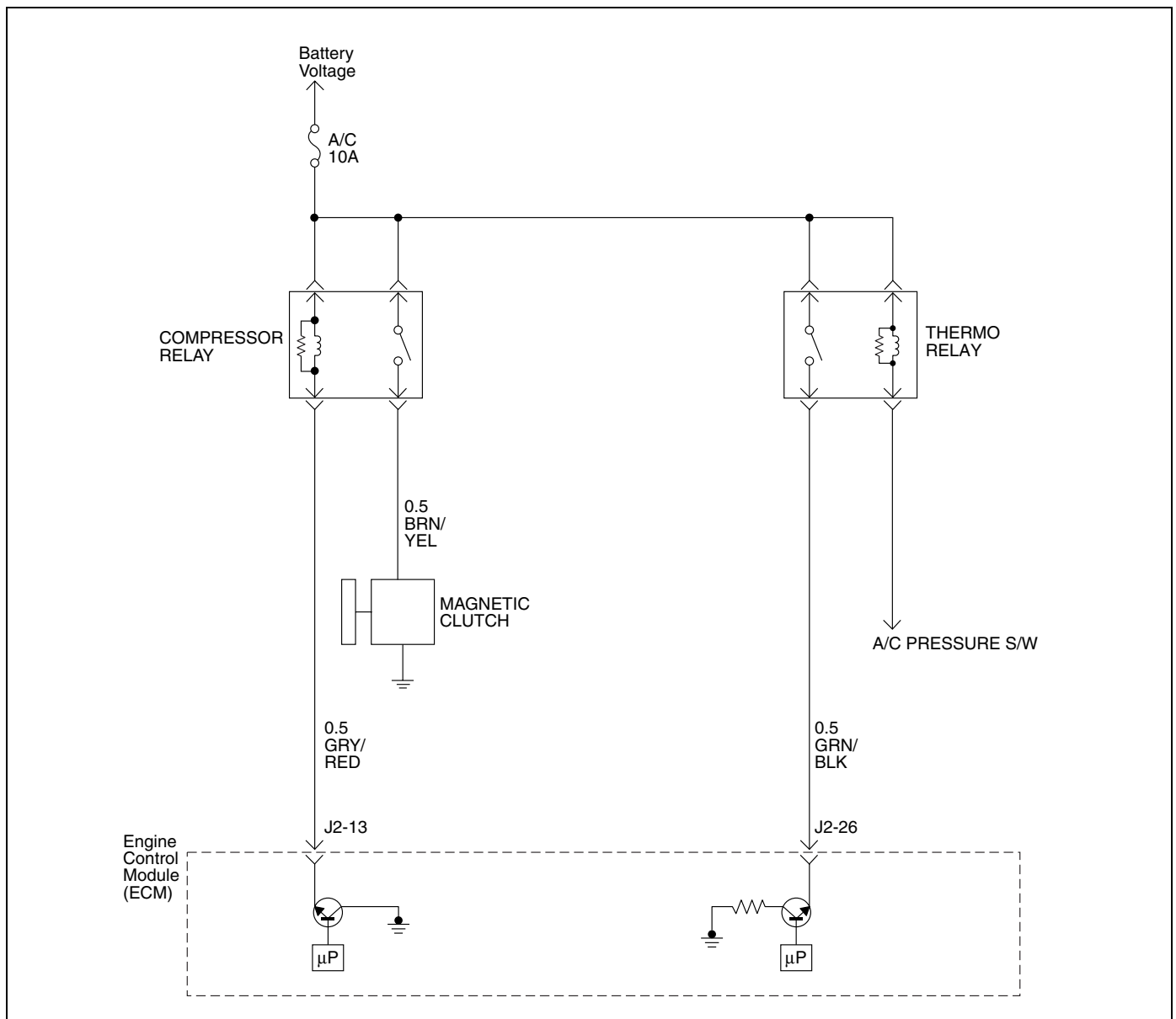
ECM WIRING DIAGRAM (7/9)



ECM WIRING DIAGRAM (8/9)

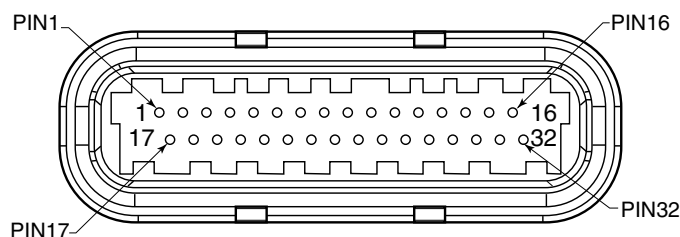


ECM WIRING DIAGRAM (9/9)



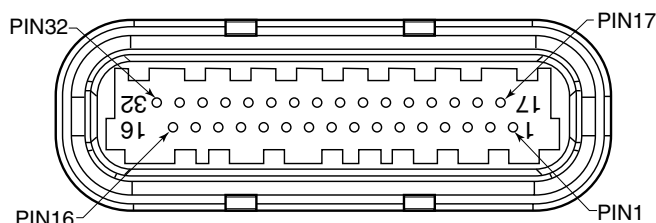
ECM CONNECTOR PIN ASSIGNMENT & OUTPUT SIGNAL

Connector J1 Port: View Looking Into ECM Case



Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J1-1	1	Ground	BLK/WHT	Continuity with ground	-	-	-	Disconnect	Ω	1	GND
J1-2	2	Ground	BLK/WHT	Continuity with ground	-	-	-	Disconnect	Ω	2	GND
J1-3	3	Knock Sensor Signal	YEL	-	-	-	-	-	-	-	-
J1-4	4	No Connection	-	-	-	-	-	-	-	-	-
J1-5	5	Canister Purge Solenoid Valve	GRN/ WHT	Less than 1V	Battery voltage	Wave form/ battery voltage while solenoid is not activated		Connect	DC V	5	GND
J1-6	6	Crankshaft Position (CKP) Sensor (Ground)	BLK	Continuity with ground	-	-	-	Connect	Ω	6	GND
J1-7	7	Throttle Position Sensor (TPS) Output Signal	WHT/BLU	Approx. 6.0k Ω at idle / Approx. 1.7k Ω at WOT Approx. 2.3k Ω at idle / Approx. 6.6k Ω at WOT		-	-	Disconnect	Ω	7	15/ 32
J1-8	8	No. 3 Injector	BLU/WHT	Less than 1V	Battery voltage	Wave form		Connect	DC V	8	GND
J1-9	9	No. 1 Injector	PNK/BLU	Less than 1V	Battery voltage	Wave form		Connect	DC V	9	GND
J1-10	10	No Connection	-	-	-	-	-	-	-	-	-
J1-11	11	No. 4 Injector	BLU/YEL	Less than 1V	Battery voltage	Wave form		Connect	DC V	11	GND
J1-12	12	No Connection	-	-	-	-	-	-	-	-	-
J1-13	13	Idle Air Control Valve (IACV) Coil B High	YEL/BLU	Less than 1V	Less than 1V / Battery voltage			Connect	DC V	13	GND
J1-14	14	No Connection	-	-	-	-	-	-	-	-	-
J1-15	15	Throttle Position Sensor (TPS) Power Supply	BLK/YEL	Less than 1V	Approx. 5V			Connect	DC V	15	32
J1-16	16	MAP Sensor Ground	GRY/BLU	Continuity with ground	-	-	-	Connect	Ω	16	GND
J1-17	17	Ground	BLK/WHT	Continuity with ground	-	-	-	Connect	Ω	17	GND
J1-18	18	Coil Module No. 1 & No.4	BLU	Less than 1V	Battery voltage	Wave form		Connect	DC V	18	GND
J1-19	19	Coil Module No. 2 & No. 3	GRN	Less than 1V	Battery voltage	Wave form		Connect	DC V	19	GND

Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J1-20	20	No Connection	-	-	-	-	-	-	-	-	-
J1-21	21	Crankshaft Position (CKP) Sensor Signal	WHT	-	-	Wave form or approx. 3.7V	Wave form or approx. 7.7V	Connect	AC V	21	6
J1-22	22	No.2 Injector	BLU/BLK	Less than 1V	Battery voltage	Wave form		Connect	DC V	22	GND
J1-23	23	No Connection	-	-	-	-	-	-	-	-	-
J1-24	24	MAP Sensor Signal	GRY/RED	Less than 1V	Approx. 4.8V	Approx. 1.3V	Approx. 0.9V	Connect	DC V	24	16
J1-25	25	No Connection	-	-	-	-	-	-	-	-	-
J1-26	26	No Connection	-	-	-	-	-	-	-	-	-
J1-27	27	Engine Coolant Temp. (ECT) Sensor Signal	GRY	Less than 1V	Approx. 2.5V at ECT 80°C			Connect	DC V	27	32
J1-28	28	Idle Air Control Valve (IACV) Coil A High	YEL/BLK	Less than 1V	Less than 1V / Battery voltage			Connect	DC V	28	GND
J1-29	29	Idle Air Control Valve (IACV) Coil B Low	YEL/GRN	Less than 1V	Less than 1V / Battery voltage			Connect	DC V	29	GND
J1-30	30	Idle Air Control Valve (IACV) Coil A Low	BLU/WHT	Less than 1V	Less than 1V / Battery voltage			Connect	DC V	30	GND
J1-31	31	MAP Sensor Power Supply	YEL/RED	Less than 1V	Approx.. 5V			Connect	DC V	31	16
J1-32	32	ECT Sensor, Knock Sensor, Throttle Position Sensor Ground	BLU/PNK	Continuity with ground	-	-	-	Connect	Ω	32	GND

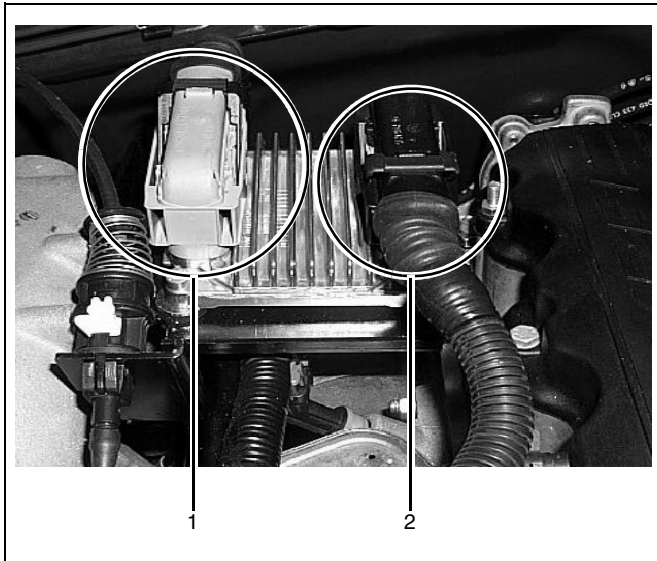
Connector J2 Port: View Looking Into ECM Case


Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J2-1	33	Intake Air Temp. (IAT) Sensor Ground	GRN	Continuity with ground	-	-	-	Disconnect	Ω	33	GND
J2-2	34	Battery Power Supply	RED/ WHT	Battery voltage				Connect	DC V	34	GND
J2-3	35	Ignition Power Supply	BLU/YEL	Less than 1V	Battery voltage			Connect	DC V	35	GND
J2-4	36	To Data Link Connector No. 6	BLU	Less than 1V	Approx. 5V			Connect	DC V	36	GND
J2-5	37	No Connection	-	-	-	-	-	-	-	-	-
J2-6	38	Oxygen Sensor (Ground)	PNK	Continuity with ground	-	-	-	Connect	Ω	38	GND
J2-7	39	No Connection	-	-	-	-	-	-	-	-	-
J2-8	40	No Connection	-	-	-	-	-	-	-	-	-
J2-9	41	No Connection	-	-	-	-	-	-	-	-	-
J2-10	42	No Connection	-	-	-	-	-	-	-	-	-
J2-11	43	Fuel Pump Relay	GRN/ WHT	Less than 1V	Less than 1V / Battery voltage while fuel pump is activated	Battery voltage		Connect	DC V	43	GND
J2-12	44	No Connection	-	-	-	-	-	-	-	-	-
J2-13	45	A/C Compressor Relay	GRY/RED	Less than 1V	Battery voltage	Less than 1V		Connect	DC V	45	GND
J2-14	46	No Connection	-	-	-	-	-	-	-	-	-
J2-15	47	No Connection	-	-	-	-	-	-	-	-	-
J2-16	48	No Connection	-	-	-	-	-	-	-	-	-
J2-17	49	No Connection	-	-	-	-	-	-	-	-	-
J2-18	50	Battery Power Supply	RED/ WHT	Battery voltage				Connect	DC V	50	GND
J2-19	51	No Connection	-	-	-	-	-	-	-	-	-
J2-20	52	Power Steering Pressure Switch	GRN/YEL	Less than 1V	Less than 1V when switch is turned on / Battery voltage when switch is turned off			Connect	DC V	52	GND
J2-21	53	Oxygen Sensor	BLU	Less than 1V	Approx. 0.4V	0.1 - 0.9V		Connect	DC V	53	38
J2-22	54	Intake Air Temp. (IAT) Sensor (Signal)	YEL/GRN	Less than 1V	Approx. 1.8V at IAT 30°C			Connect	DC V	54	33

Pin No.	B/Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J2-23	55	Vehicle Speed Signal (Immobiliser Control Unit Terminal B8)	WHT	-	-	Approx. 16Hz by wave form or approx. 4.8V at 20km/h		Connect	AC V	55	GND
J2-24	56	No Connection	-	-	-	-	-	-	-	-	-
J2-25	57	Tachometer Output Signal	BLK/RED	-	Wave form			-	-	-	-
J2-26	58	Thermo Relay	GRN/BLK	Less than 1V	Battery voltage when A/C request is activated			Connect	DC V	58	GND
J2-27	59	No Connection	-	-	-	-	-	-	-	-	-
J2-28	60	No Connection	-	-	-	-	-	-	-	-	-
J2-29	61	No Connection	-	-	-	-	-	-	-	-	-
J2-30	62	To Data Link Connector No. 2	GRN	-	-	-	-	-	-	-	-
J2-31	63	Oxygen Sensor Heater	BLU/WHT	Continuity with ground	-	-	-	Connect	Ω	63	GND
J2-32	64	Check Engine Lamp (Immobiliser Control Unit Terminal B7)	BRN/YEL	Less than 1V	Less than 1V	Battery voltage while lamp is turned off		Connect	DC V	64	GND

GENERAL DESCRIPTION FOR ECM AND SENSORS

Engine Control Module (ECM)



(1) J1 Port
(2) J2 Port

The engine control module (ECM) is located on the intake manifold. The ECM controls the following.

- Fuel metering system
- Ignition timing
- On-board diagnostics for electrical functions.

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. And it performs the diagnostic function of the system.

The function can recognize operational problems, and warn to the driver through the check engine lamp, and store diagnostic trouble code (DTC). DTCs identify the problem areas to aid the technician in marking repairs.

The input / output devices in the ECM include analog to digital converts, signal buffers, counters and drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned on.

Inputs (Operating condition read):

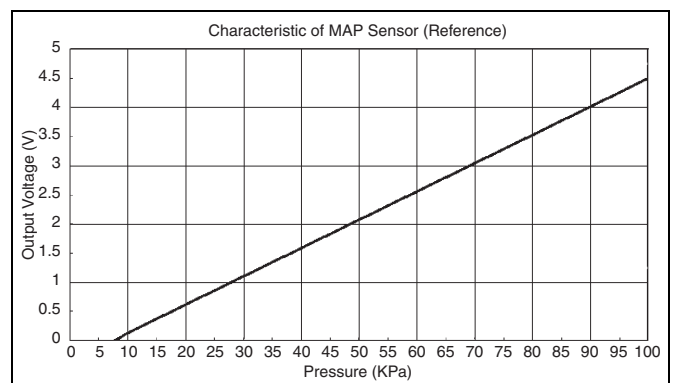
- Battery voltage
- Electrical ignition
- Exhaust oxygen content
- Intake manifold pressure
- Intake air temperature
- Engine coolant temperature
- Crankshaft position

- Knock signal
- Throttle position
- Vehicle speed
- Power steering pressure
- Air conditioning request on or off

Outputs (Systems controlled):

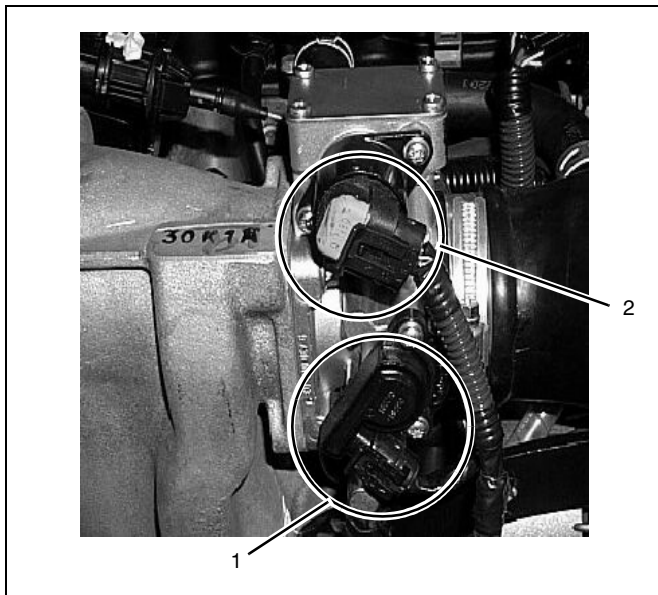
- Ignition control
- Fuel control
- Idle air control
- Fuel pump
- EVAP canister purge
- Air conditioning
- Diagnostics functions

Manifold Absolute Pressure (MAP) Sensor

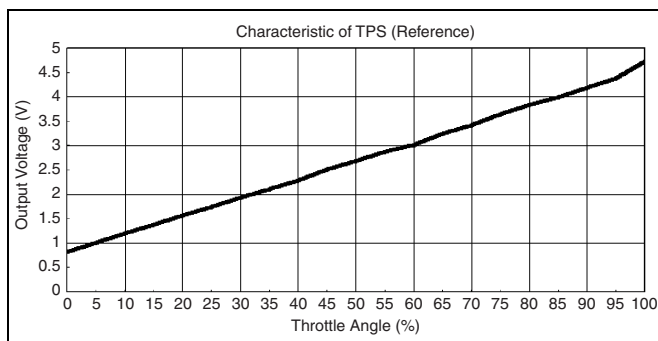


The MAP sensor is a strain gage. A pressure strains the resistance on the silicon base. At that time the resistance value changes. And it changes voltage. In other words it measures a pressure value. It is installed to the intake manifold. Output voltage of the MAP sensor is low as pressure is low.

Throttle Position Sensor (TPS)



- (1) Throttle Position Sensor
(2) Idle Air Control (IAC) Valve



The TPS is a potentiometer connected to throttle shaft on the throttle body.

The engine control module (ECM) monitors the voltage on the signal line and calculates throttle position. As the throttle valve angle is changed when accelerator pedal moved. The TPS signal also changed at a moved throttle valve. As the throttle valve opens, the output increases so that the output voltage should be high.

Idle Air Control (IAC) Valve

Step	A	B	C	D
Coil A High (ECM J1-28)	On			On
Coil A Low (ECM J1-30)		On	On	
Coil B High (ECM J1-13)	On	On		
Coil B Low (ECM J1-29)			On	On

(IAC Valve Close Direction) ←
 → (IAC Valve Open Direction)

The idle air control valve (IAC) valve is two directional and gives 2-way control. With power supply to the coils

controlled steps by the engine control module (ECM), the IAC valve's pintle is moved to adjust idle speed, raising it for fast idle when cold or there is extra load from the air conditioning or power steering.

By moving the pintle in (to decrease air flow) or out (to increase air flow), a controlled amount of the air can move around the throttle plate. If the engine speed is too low, the engine control module (ECM) will retract the IAC pintle, resulting in more air moving past the throttle plate to increase the engine speed.

If the engine speed is too high, the engine control module (ECM) will extend the IAC pintle, allowing less air to move past the throttle plate, decreasing the engine speed.

The IAC pintle valve moves in small step called counts. During idle, the proper position of the IAC pintle is calculated by the engine control module (ECM) based on battery voltage, coolant temperature, engine load, and engine speed.

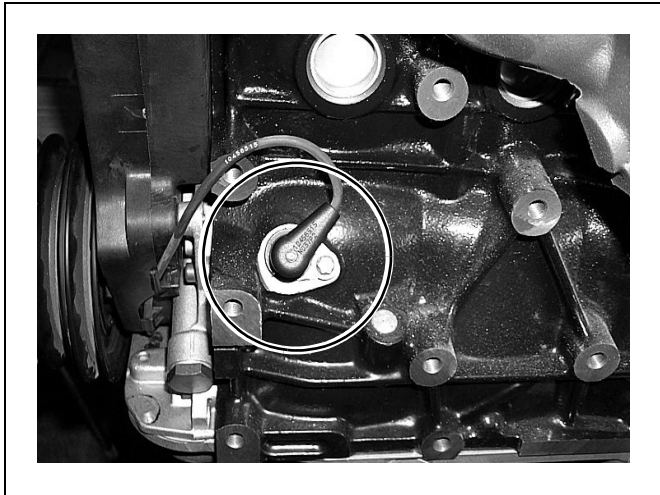
If the engine speed drops below a specified value, and the throttle plate is closed, the engine control module (ECM) senses a near-stall condition. The engine control module (ECM) will then calculate a new IAC pintle valve position to prevent stalls.

If the IAC valve is disconnected and reconnected with the engine running, the idle speed will be wrong. In this case, the IAC must be reset. The IAC resets when the key is cycled "On" then "Off". When servicing the IAC, it should only be disconnected or connected with the ignition "Off".

The position of the IAC pintle valve affects engine start-up and the idle characteristic of the vehicle.

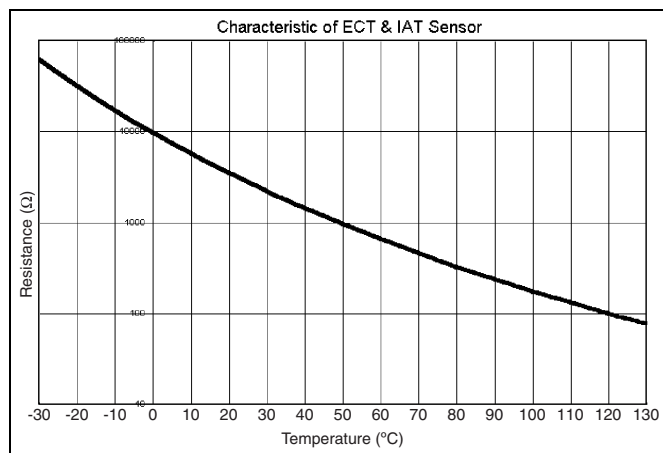
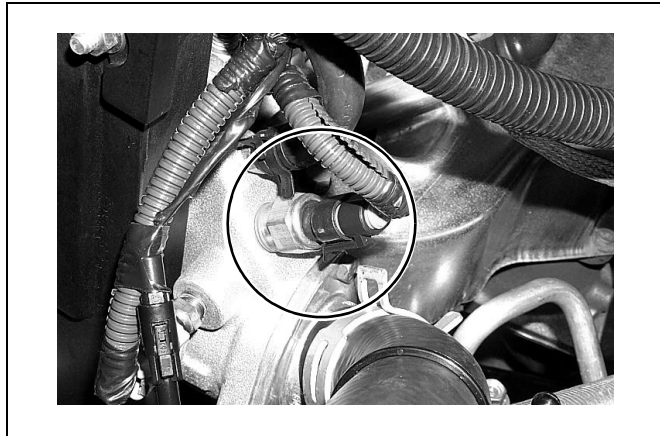
If the IAC pintle is fully open, too much air will be allowed into the manifold. This results in high idle speed, along with possible hard starting and lean air/fuel ratio.

Crankshaft Position (CKP) Sensor



The crankshaft position (CKP) sensor, which sends a signal necessary for deciding on injection timing to the ECM, is mounted on the left-hand side of the cylinder block just back of the A/C compressor. The crankshaft has a 58 teeth press-fit timing disc, from which the CKP sensor reads the position of the crankshaft at all the times. It converts this to an electrical signal, which it sends to the ECM. Using the 58 X signals per rotation and the timing-mark signal sent by the CKP sensor, the ECM is able to accurately calculate engine speed and crank position. The ECM converts the 58 X signals into square signals. This converted signal is sent from the ECM terminal J2-25 to the tachometer.

Engine Coolant Temperature (ECT) Sensor



The ECT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. It is installed on the coolant stream. Low coolant temperature produces a high resistance.

The ECM supplies 5 volts signal to the ECT sensor through resisters in the ECM and measures the voltage. The signal voltage will be high when the engine temperature is cold, and it will be low when the engine temperature is hot.

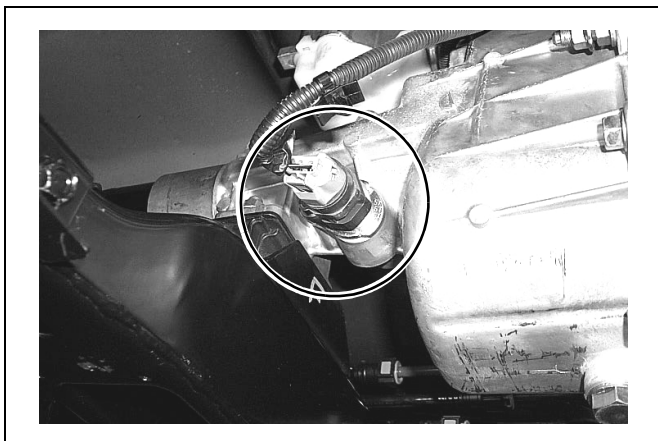
Intake Air Temperature (IAT) Sensor



The IAT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. Low air temperature produces a high resistance.

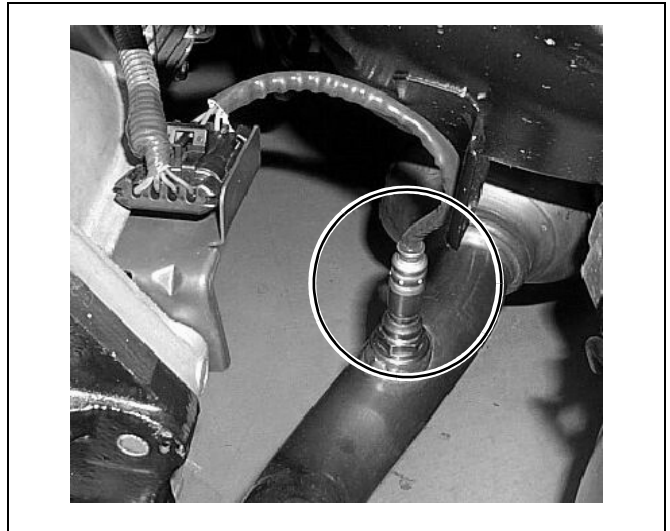
The ECM supplies 5 volts signal to the IAT sensor through resistors in the ECM and measures the voltage. The signal voltage will be high when the air temperature is cold, and it will be low when the air temperature is hot. The ECM uses to this value

Vehicle Speed Sensor (VSS)



The VSS is a magnet rotated by the transmission output shaft. The VSS uses a hall element. It interacts with the magnetic field treated by the rotating magnet. It outputs pulse signal. The 12 volts operating supply from the meter fuse.

Heated Oxygen (O₂) Sensor



The heated oxygen sensor consists of a 4-wire low temperature activated zirconia oxygen analyzer element with heater for operating temperature of 315°C, and there is one mounted on each exhaust pipe.

A constant 450millivolt is supplied by the ECM between the two supply terminals, and oxygen concentration in the exhaust gas is reported to the ECM as returned signal voltage.

The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100mV to 1000mV and the ECM calculates the pulse width commanded for the injectors to produce the proper combustion chamber mixture.

Low oxygen sensor output voltage is a lean mixture which will result in a rich commanded to compensate.

High oxygen sensor output voltage is a rich mixture which result in a lean commanded to compensate.

When the engine is first started the system is in "Open Loop" operation. In "Open Loop", the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters "Closed Loop" operation. In "Closed Loop", the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.

GENERAL DESCRIPTION FOR FUEL METERING

The fuel metering system starts with the fuel in the fuel tank. An electric fuel pump, located in the fuel tank, pumps fuel to the fuel rail through an in-line fuel filter. The pump is designed to provide fuel at a pressure above the pressure needed by the injectors.

A fuel pressure regulator in the fuel rail keeps fuel available to the fuel injectors at a constant pressure.

A return line delivers unused fuel back to the fuel tank.

The basic function of the air/fuel metering system is to control the air/fuel delivery to the engine. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold.

The main control sensor is the heated oxygen sensor located in the exhaust system. The heated oxygen sensor reports to the ECM how much oxygen is in the exhaust gas. The ECM changes the air/fuel ratio to the engine by controlling the amount of time that fuel injector is "On".

The best mixture to minimize exhaust emissions is 14.7 parts of air to 1 part of gasoline by weight, which allows the catalytic converter to operate most efficiently.

Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "closed loop" system.

The ECM monitors signals from several sensors in order to determine the fuel needs of the engine. Fuel is delivered under one of several conditions called "mode". All modes are controlled by the ECM.

Battery Voltage Correction Mode

When battery voltage is low, the ECM will compensate for the weak spark by increasing the following:

- The amount of fuel delivered.
- The idle RPM.

Clear Flood Mode

Clear a flooded engine by pushing the accelerator pedal down all the way. The ECM then de-energizes the fuel injectors. The ECM holds the fuel injectors de-energized as long as the throttle remains above 75% and the engine speed is below 800 RPM. If the throttle position becomes less than 75%, the ECM again begins to pulse the injectors ON and OFF, allowing fuel into the cylinders.

Deceleration Fuel Cutoff (DFCO) Mode

The ECM reduces the amount of fuel injected when it detects a decrease in the throttle position and the air flow. When deceleration is very fast, the ECM may cut off fuel completely. Until enable conditions meet the engine revolution less 1000 rpm or manifold absolute pressure less than 10 kpa.

Engine Speed/ Vehicle Speed/ Fuel Disable Mode

The ECM monitors engine speed. It turns off the fuel injectors when the engine speed increases above 6000 RPM. The fuel injectors are turned back on when engine speed decreases below 3500 RPM.

Acceleration Mode

The ECM provides extra fuel when it detects a rapid increase in the throttle position and the air flow.

Fuel Cutoff Mode

No fuel is delivered by the fuel injectors when the ignition is OFF. This prevents engine run-on. In addition, the ECM suspends fuel delivery if no reference pulses are detected (engine not running) to prevent engine flooding.

Starting Mode

When the ignition is first turned ON, the ECM energizes the fuel pump relay for two seconds to allow the fuel pump to build up pressure. The ECM then checks the engine coolant temperature (ECT) sensor and the throttle position sensor to determine the proper air/fuel ratio for starting.

The ECM controls the amount of fuel delivered in the starting mode by adjusting how long the fuel injectors are energized by pulsing the injectors for very short times.

Run Mode

The run mode has the following two conditions:

- Open loop
- Closed loop

When the engine is first started, the system is in "open loop" operation. In "Open Loop," the ECM ignores the signal from the heated oxygen sensor (HO2S). It calculates the air/fuel ratio based on inputs from the TP, ECT, and MAP sensors.

The system remains in "Open Loop" until the following conditions are met:

- The HO2S has a varying voltage output showing that it is hot enough to operate properly (this depends on temperature).
- The ECT has reached a specified temperature.
- A specific amount of time has elapsed since starting the engine.
- Engine speed has been greater than a specified RPM since start-up.

The specific values for the above conditions vary with different engines and are stored in the programmable read only memory (PROM). When these conditions are met, the system enters "closed loop" operation. In "closed loop," the ECM calculates the air/fuel ratio (injector on-time) based on the signal from the HO2S. This allows the air/fuel ratio to stay very close to 14.7:1.

Fuel Metering System Components

The fuel metering system is made up of the following parts.

- Fuel injector
- Throttle body
- Fuel rail
- Fuel pressure regulator
- ECM
- Crankshaft position (CKP) sensor
- Idle air control (IAC) valve
- Fuel pump

Fuel Injector

The group fuel injection fuel injector is a solenoid operated device controlled by the ECM. The ECM energizes the solenoid, which opens a valve to allow fuel delivery.

The fuel is injected under pressure in a conical spray pattern at the opening of the intake valve. Excess fuel not used by the injectors passes through the fuel pressure regulator before being returned to the fuel tank.

Fuel Pressure Regulator

The fuel pressure regulator is a diaphragm-operated relief valve mounted on the fuel rail with fuel pump pressure on one side and manifold pressure on the other side. The fuel pressure regulator maintains the fuel pressure available to the injector at three times barometric pressure adjusted for engine load. It may be serviced separately.

If the pressure is too low or poor performance, DTC P0131 or P1171 will be the result. If the pressure is too high, DTC P0132 or P1167 will be the result. Refer to *Fuel System Diagnosis* for information on diagnosing fuel pressure conditions.

Fuel Rail

The fuel rail is mounted to the top of the engine and distributes fuel to the individual injectors. Fuel is delivered to the fuel inlet tube of the fuel rail by the fuel lines. The fuel goes through the fuel rail to the fuel pressure regulator. The fuel pressure regulator maintains a constant fuel pressure at the injectors. Remaining fuel is then returned to the fuel tank.

Fuel Pump Electrical Circuit

When the key is first turned ON, the ECM energizes the fuel pump relay for two seconds to build up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump off and waits until the engine is cranked. When the engine is cranked and the 58X crankshaft position signal has been detected by the ECM, the ECM supplies 12 volts to the fuel pump relay to energize the electric in-tank fuel pump.

An inoperative fuel pump will cause a “no-start” condition. A fuel pump which does not provide enough

pressure will result in poor performance.

Throttle Body Unit

The throttle body has a throttle plate to control the amount of air delivered to the engine. The Throttle position sensor and IAC valve are also mounted on the throttle body.

Vacuum ports located behind the throttle plate provide the vacuum signals needed by various components. Engine coolant is directed through a coolant cavity in the throttle body to warm the throttle valve and to prevent icing.

GENERAL DESCRIPTION FOR ELECTRIC IGNITION SYSTEM

The engine use two ignition coils, one per two cylinders. A two wire connector provides a battery voltage primary supply through the ignition fuse.

The ignition control spark timing is the ECM's method of controlling the spark advance and the ignition dwell.

The ignition control spark advance and the ignition dwell are calculated by the ECM using the following inputs.

- Engine speed
- Crankshaft position (CKP) sensor
- Engine coolant temperature (ECT) sensor
- Throttle position sensor
- Vehicle speed sensor
- ECM and ignition system supply voltage

Ignition coil works to generate only the secondary voltage be receiving the primary voltage from ECM.

The primary voltage is generated at the coil driver located in the ECM. The coil driver generate the primary voltage based on the crankshaft position signal. In accordance with the crankshaft position signal, ignition coil driver determines the adequate ignition timing and also cylinder number to ignite.

Ignition timing is determined the coolant temperature, intake air temperature, engine speed, engine load, knock sensor signal, etc.

Spark Plug

Although worn or dirty spark plugs may give satisfactory operation at idling speed, they frequently fail at higher engine speeds. Faulty spark plugs may cause poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance. Follow the scheduled maintenance service recommendations to ensure satisfactory spark plug performance. Refer to *Maintenance and Lubrication*.

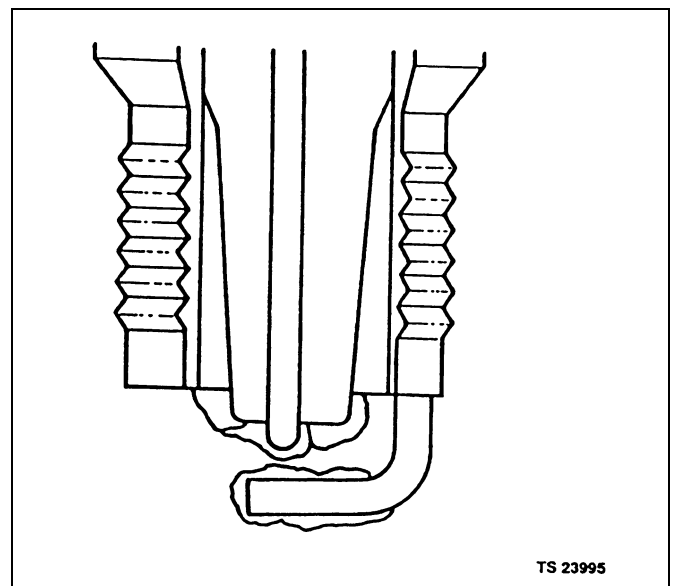
Normal spark plug operation will result in brown to grayish-tan deposits appearing on the insulator portion of the spark plug. A small amount of red-brown, yellow, and white powdery material may also be present on the insulator tip around the center electrode. These deposits are normal combustion by-products of fuels and lubricating oils with additives. Some electrode wear will also occur. Engines which are not running properly are often referred to as "misfiring." This means the ignition spark is not igniting the air/fuel mixture at the proper time. While other ignition and fuel system causes must also be considered, possible causes include ignition system conditions which allow the spark voltage to reach ground in some other manner than by jumping across the air gap at the tip of the spark plug, leaving the air/fuel mixture unburned. Misfiring may also occur when the tip of the spark plug becomes overheated and ignites the mixture before the spark jumps. This is referred to as "pre-ignition."

Spark plugs may also misfire due to fouling, excessive

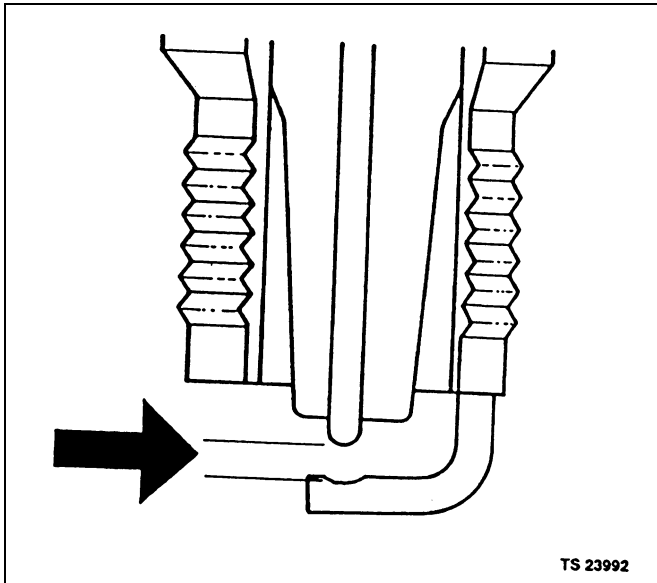
gap, or a cracked or broken insulator. If misfiring occurs before the recommended replacement interval, locate and correct the cause.

Carbon fouling of the spark plug is indicated by dry, black carbon (soot) deposits on the portion of the spark plug in the cylinder. Excessive idling and slow speeds under light engine loads can keep the spark plug temperatures so low that these deposits are not burned off. Very rich fuel mixtures or poor ignition system output may also be the cause. Refer to *DTC P1167*.

Oil fouling of the spark plug is indicated by wet oily deposits on the portion of the spark plug in the cylinder, usually with little electrode wear. This may be caused by oil during break-in of new or newly overhauled engines. Deposit fouling of the spark plug occurs when the normal red-brown, yellow or white deposits of combustion by-products become sufficient to cause misfiring. In some cases, these deposits may melt and form a shiny glaze on the insulator around the center electrode. If the fouling is found in only one or two cylinders, valve stem clearances or intake valve seals may be allowing excess lubricating oil to enter the cylinder, particularly if the deposits are heavier on the side of the spark plug facing the intake valve.



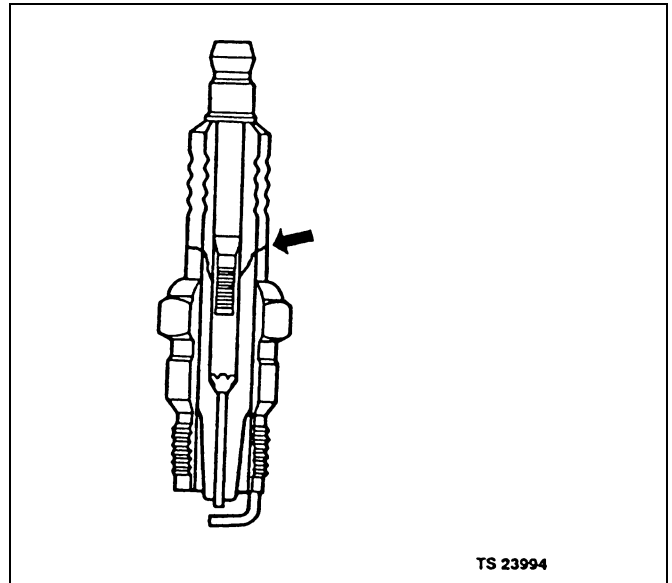
Excessive gap means that the air space between the center and the side electrodes at the bottom of the spark plug is too wide for consistent firing. This may be due to improper gap adjustment or to excessive wear of the electrode during use. A check of the gap size and comparison to the gap specified for the vehicle in *Maintenance and Lubrication* will tell if the gap is too wide. A spark plug gap that is too small may cause an unstable idle condition. Excessive gap wear can be an indication of continuous operation at high speeds or with engine loads, causing the spark to run too hot. Another possible cause is an excessively lean fuel mixture.



TS 23992

Low or high spark plug installation torque or improper seating can result in the spark plug running too hot and can cause excessive center electrode wear. The plug and the cylinder head seats must be in good contact for proper heat transfer and spark plug cooling. Dirty or damaged threads in the head or on the spark plug can keep it from seating even though the proper torque is applied. Once spark plugs are properly seated, tighten them to the torque shown in the Specifications Table. Low torque may result in poor contact of the seats due to a loose spark plug. Over tightening may cause the spark plug shell to be stretched and will result in poor contact between the seats. In extreme cases, exhaust blow-by and damage beyond simple gap wear may occur.

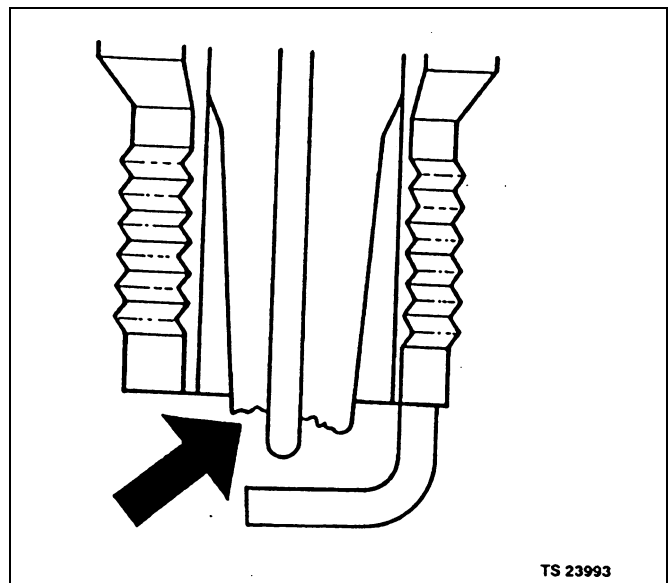
Cracked or broken insulators may be the result of improper installation, damage during spark plug re-gapping, or heat shock to the insulator material. Upper insulators can be broken when a poorly fitting tool is used during installation or removal, when the spark plug is hit from the outside, or is dropped on a hard surface. Cracks in the upper insulator may be inside the shell and not visible. Also, the breakage may not cause problems until oil or moisture penetrates the crack later.



TS 23994

A broken or cracked lower insulator tip (around the center electrode) may result from damage during re-gapping or from "heat shock" (spark plug suddenly operating too hot).

- Damage during re-gapping can happen if the gapping tool is pushed against the center electrode or the insulator around it, causing the insulator to crack. When re-gapping a spark plug, make the adjustment by bending only the ground side terminal, keeping the tool clear of other parts.



TS 23993

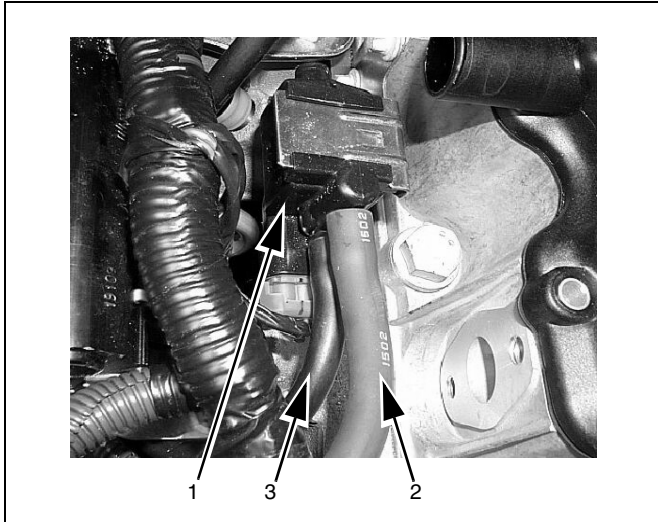
- "Heat shock" breakage in the lower insulator tip generally occurs during several engine operating conditions (high speeds or heavy loading) and may be caused by over-advanced timing or low grade fuels. Heat shock refers to a rapid increase in the tip temperature that causes the insulator material to crack.

Spark plugs with less than the recommended amount of service can sometimes be cleaned and re-gapped, then

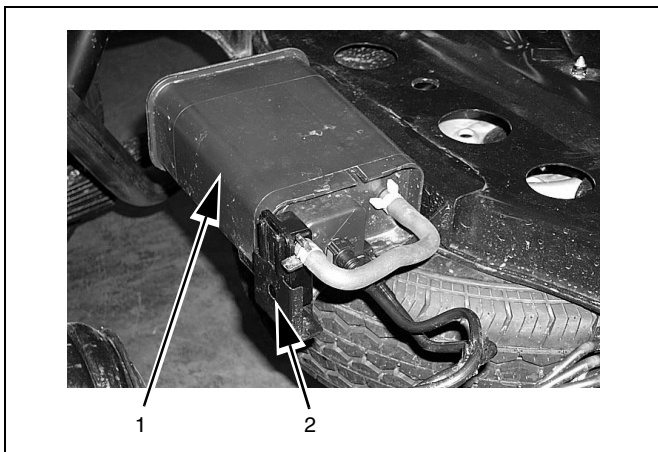
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returned to service. However, if there is any doubt about the serviceability of a spark plug, replace it. Spark plugs with cracked or broken insulators should always be replaced.

GENERAL DESCRIPTION FOR EVAPORATIVE EMISSION SYSTEM



- (1) Purge Solenoid Valve
- (2) From Canistor to Purge Solenoid
- (3) From Purge Solenoid to Intake



- (1) Canistor
- (2) Air Separator

EVAP Emission Control System Purpose

The basic evaporative emission control system used on the charcoal canister storage method. The method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage devise to hold the vapors when the vehicle is not operating.

The canister is located on the rear axle housing by the frame cross-member.

When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

EVAP Emission Control System Operation

The EVAP canister purge is controlled by a solenoid valve that allows the manifold vacuum to purge the canister. The engine control module (ECM) supplies a ground to energize the solenoid valve (purge on). The EVAP purge solenoid control is pulse-width modulated (PWM) (turned on and off several times a second). The duty cycle (pulse width) is determined by engine operating conditions including load, throttle position, coolant temperature and ambient temperature. The duty cycle is calculated by the ECM. the output is commanded when the appropriate conditions have been met. These conditions are:

- The engine is fully warmed up.
- The engine has been running for a specified time.
- The IAT reading is above 10°C (50°F).
- Purge/Vacuum Hoses. Made of rubber compounds, these hoses route the gasoline fumes from their sources to the canister and from the canister to the intake air flow.
- EVAP Canister. Mounted on a bracket ahead of the fuel tank, the canister stores fuel vapors until the ECM determined that engine conditions are right for them to be removed and burned.

Poor idle, stalling and Poor driveability can be caused by:

- A malfunctioning purge solenoid.
- A damaged canister.
- Hoses that are split, cracked, or not connected properly.

System Fault Detection

The EVAP leak detection strategy is based on applying vacuum to the EVAP system and monitoring vacuum decay. At an appropriate time, the EVAP purge solenoid is turned "ON," allowing the engine vacuum to draw a small vacuum on the entire evaporative emission system.

After the desired vacuum level has been achieved, the EVAP purge solenoid is turned "OFF," sealing the system. A leak is detected by monitoring for a decrease in vacuum level over a given time period, all other variables remaining constant.

If the desired vacuum level cannot be achieved in the test described above, a large leak or a faulty EVAP purge control solenoid valve is indicated.

Leaks can be caused by the following conditions:

- Missing or faulty fuel cap
- Disconnected, damaged, pinched, or blocked EVAP purge line
- Disconnected, damaged, pinched, or blocked fuel tank vapor line
- Disconnected or faulty EVAP purge control solenoid valve
- Open ignition feed circuit to the purge solenoid

- Damaged EVAP canister
- Leaking fuel sender assembly O-ring
- Leaking fuel tank or fuel filler neck

The ECM supplies a ground to energize the purge control solenoid valve (purge “ON”). The EVAP purge control is turned “ON” and “OFF” several times a second. The duty cycle (pulse width) is determined by engine operating conditions including load, throttle position, coolant temperature and ambient temperature. The duty cycle is calculated by the ECM and the output is commanded when the appropriate conditions have been met.

The system checks for conditions that cause the EVAP system to purge continuously by commanding the EVAP purge solenoid “OFF”, EVAP purge solenoid duty ratio “0%”. If fuel tank vacuum level increases during the test, a continuous purge flow condition is indicated. This can be caused by the following conditions:

- EVAP purge solenoid leaking
- EVAP purge and engine vacuum lines switched at the EVAP purge control solenoid valve
- EVAP purge control solenoid valve driver circuit grounded

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

Crankcase Ventilation System Purpose

The crankcase ventilation system is used to consume crankcase vapors in the combustion process instead of venting them to the atmosphere. Fresh air from the throttle body is supplied to the crankcase and mixed with blow-by gases. This mixture is then passed through the positive crankcase ventilation (PCV) port into the intake manifold.

While the engine is running, exhaust gases and small amounts of the fuel/air mixture escape past the piston rings and enter the crankcase. These gases are mixed with clean air entering through a tube from the air intake duct.

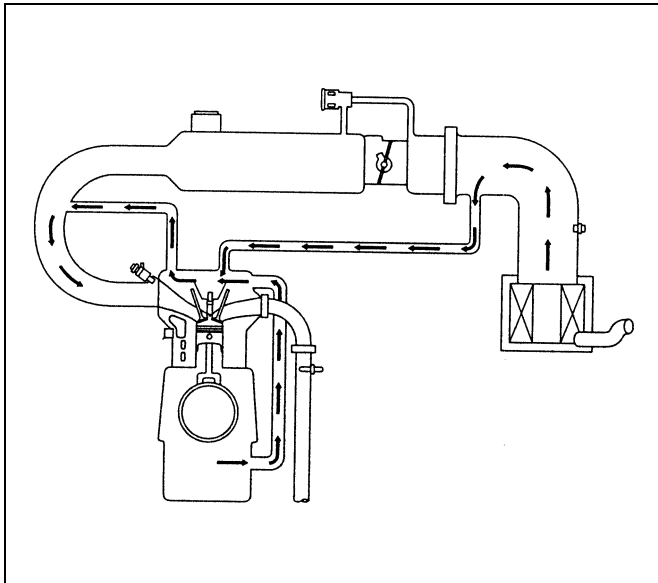
During normal, part-throttle operation, the system is designed to allow crankcase gases to flow through the PCV hose into the intake manifold to be consumed by normal combustion.

A plugged positive crankcase ventilation port or PCV hose may cause the following conditions:

- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in the engine.

A leaking PCV hose would cause:

- Rough idle.
- Stalling.
- High idle speed.



A/C CLUTCH DIAGNOSIS

A/C Clutch Circuit Operation

A 12-volt signal is supplied to the A/C request input of the ECM when the A/C is selected through the A/C control switch.

The A/C compressor clutch relay is controlled through the ECM. This allows the ECM to modify the idle air control position prior to the A/C clutch engagement for better idle quality. If the engine operating conditions are within their specified calibrated acceptable ranges, the ECM will enable the A/C compressor relay. This is done by providing a ground path for the A/C relay coil within the ECM. When the A/C compressor relay is enabled, battery voltage is supplied to the compressor relay is enabled, battery voltage is supplied to the compressor clutch coil.

The ECM will enable the A/C compressor clutch whenever the engine is running and the A/C has been requested. The ECM will not enable the A/C compressor clutch if any of the following conditions are met:

- The engine speed is greater than 6000 RPM.
- The ECT is greater than 122°C (251°F).
- The throttle is more than 95% open.

A/C Clutch Circuit Purpose

The A/C compressor operation is controlled by the engine control module (ECM) for the following reasons:

- It improves idle quality during compressor clutch engagement.
- It improves wide open throttle (WOT) performance.
- It provides A/C compressor protection from operation with incorrect refrigerant pressures.

The A/C electrical system consists of the following components:

- The A/C control switch.
- The A/C refrigerant pressure switches.
- The A/C compressor clutch.
- The A/C compressor clutch relay.
- The ECM.

A/C Request Signal

This signal tells the ECM when the A/C mode is selected at the A/C control switch. The ECM uses this input to adjust the idle speed before turning on the A/C clutch. The A/C compressor will be inoperative if this signal is not available to the ECM.

Refer to *A/C Clutch Circuit Diagnosis* for A/C wiring diagrams and diagnosis for the A/C electrical system.

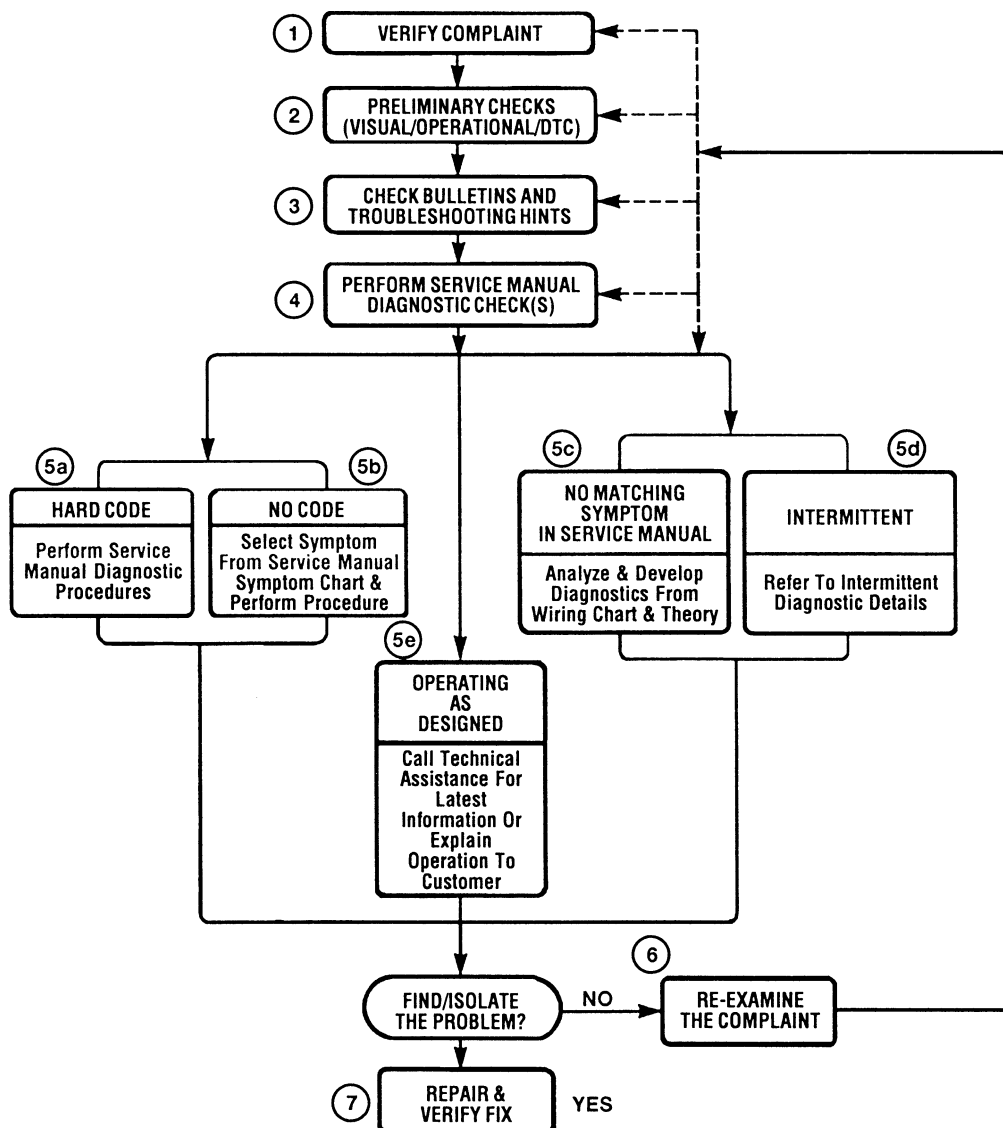
ISUZU STRATEGY BASED DIAGNOSTICS

Overview

As a retail service technician, you are part of the ISUZU service team. The team goal is **FIX IT RIGHT THE FIRST TIME** for the satisfaction of every customer. You are a very important member of the team as you diagnose and repair customer vehicles.

You have maximum efficiency in diagnosis when you have an effective, organized plan for your work. Strategy Based Diagnostics (refer to Figure 1) provides you with guidance as you create and follow a plan of action for each specific diagnostic situation.

STRATEGY BASED DIAGNOSTICS CHART



Diagnostic Thought Process

As you follow a diagnostic plan, every box on the Strategy Based Diagnostics chart requires you to use the diagnostic thought process. This method of thinking optimizes your diagnosis in the following ways:

- Improves your understanding and definition of the customer complaint
- Saves time by avoiding testing and/or replacing good parts
- Allows you to look at the problem from different perspectives
- Guides you to determine what level of understanding about system operation is needed:
 - Owner's manual level
 - Service manual level
 - In-depth (engineering) level
 - Owner's manual level
 - Service manual level
 - In-depth (engineering) level

1. Verify the Complaint

What you should do

To verify the customer complaint, you need to know the correct (normal) operating behavior of the system and verify that the customer complaint is a valid failure of the system.

The following information will help you verify the complaint:

- WHAT the vehicle model/options are
- WHAT aftermarket and dealer-installed accessories exist
- WHAT related system(s) operate properly
- WHEN the problem occurs
- WHERE the problem occurs
- HOW the problem occurs
- HOW LONG the condition has existed (and if the system ever worked correctly)
- HOW OFTEN the problem occurs
- Whether the severity of the problem has increased, decreased or stayed the same

What resources you should use

Whenever possible, you should use the following resources to assist you in verifying the complaint:

- Service manual Theory or Circuit Description sections
- Service manual "System Performance Check"
- Owner manual operational description
- Technician experience
- Identical vehicle for comparison

- Circuit testing tools
- Vehicle road tests
- Complaint check sheet
- Contact with the customer

2. Perform Preliminary Checks

NOTE: An estimated 10 percent of successful vehicle repairs are diagnosed with this step!

What you should do

You perform preliminary checks for several reasons:

- To detect if the cause of the complaint is VISUALLY OBVIOUS
- To identify parts of the system that work correctly
- To accumulate enough data to correctly and accurately search for a ISUZU Service Bulletin on ISUZU Web site.

The initial checks may vary depending on the complexity of the system and may include the following actions:

- Operate the suspect system
- Make a visual inspection of harness routing and accessible/visible power and ground circuits
- Check for blown fuses
- Make a visual inspection for separated connectors
- Make a visual inspection of connectors (includes checking terminals for damage and tightness)
- Check for any DTCs stored by the on-board computers
- Sense unusual noises, smells, vibrations or movements
- Investigate the vehicle service history (call other dealerships, if appropriate)

What resources you should use

Whenever appropriate, you should use the following resources for assistance in performing preliminary checks:

- Tech II or other technical equipment for viewing DTCs
- Service manual information:
 - Component locations
 - Harness routing
 - Wiring schematics
 - Procedures for viewing DTCs
- Dealership service history file
- Vehicle road test
- Identical vehicle or system for comparison

3. Check Bulletins and Troubleshooting Hints

NOTE: As estimated 30 percent of successful vehicle repairs are diagnosed with this step!

What you should do

You should have enough information gained from preliminary checks to accurately search for a bulletin and other related service information. Some service manual sections provide troubleshooting hints that match symptoms with specific complaints.

What resources you should use

You should use the following resources for assistance in checking for bulletins and troubleshooting hints:

- Printed bulletins
- Access ISUZU Bulletin Web site, <https://www.einet.isuzu.co.jp//>
- Videotapes
- Service manual

4. Perform Service Manual Diagnostic Checks

What you should do

The “System Checks” in most service manual sections and in most cells of section 8A (electrical) provide you with:

- A systematic approach to narrowing down the possible causes of a system fault
- Direction to specific diagnostic procedures in the service manual
- Assistance to identify what systems work correctly

What resources you should use

Whenever possible, you should use the following resources to perform service manual checks:

- Service manual
- Technical equipment (for viewing DTCs and analyzing data)
- Digital multimeter and circuit testing tools
- Other tools as needed

5a and 5b. Perform Service Manual Diagnostic Procedures

NOTE: An estimated 40 percent of successful vehicle repairs are diagnosed with these steps!

What you should do

When directed by service manual diagnostic checks, you must then carefully and accurately perform the

steps of diagnostic procedures to locate the fault related to the customer complaint.

What resources you should use

Whenever appropriate, you should use the following resources to perform service manual diagnostic procedures:

- Service manual
- Technical equipment (for analyzing diagnostic data)
- Digital multimeter and circuit testing tools
- Essential and special tools

5c. Technician Self Diagnoses

When there is no DTC stored and no matching symptom for the condition identified in the service manual, you must begin with a thorough understanding of how the system(s) operates. Efficient use of the service manual combined with you experience and a good process of elimination will result in accurate diagnosis of the condition.

What you should do

Step 1: Identify and understand the suspect circuit(s)

Having completed steps 1 through 4 of the Strategy Based Diagnostics chart, you should have enough information to identify the system(s) or sub-system(s) involved. Using the service manual, you should determine and investigate the following circuit characteristics:

- Electrical:
 - How is the circuit powered (power distribution charts and/or fuse block details)?
 - How is the circuit grounded (ground distribution charts)?
 - How is the circuit controlled or sensed (theory of operation):
 - If it is a switched circuit, is it normally open or normally closed?
 - Is the power switched or is the ground switched?
 - Is it a variable resistance circuit (ECT sensor or TP sensor, for example)?
 - Is it a signal generating device (MAF sensor or VSS, for example)?
 - Does it rely on some mechanical/vacuum device to operate?
- Physical:
 - Where are the circuit components (component locators and wire harness routing diagrams):
 - Are there areas where wires could be chafed or pinched (brackets or frames)?
 - Are there areas subjected to extreme

temperatures?

- Are there areas subjected to vibration or movement (engine, transmission or suspension)?
- Are there areas exposed to moisture, road salt or other corrosives (battery acid, oil or other fluids)?
- Are there common mounting areas with other systems/components?
- Have previous repairs been performed to wiring, connectors, components or mounting areas (causing pinched wires between panels and drivetrain or suspension components without causing an immediate problem)?
- Does the vehicle have aftermarket or dealer-installed equipment (radios, telephone, etc.)

Step 2: Isolate the problem

At this point, you should have a good idea of what could cause the present condition, as well as could not cause the condition. Actions to take include the following:

- Divide (and separate, where possible) the system or circuit into smaller sections
- Confine the problem to a smaller area of the vehicle (start with main harness connections while removing panels and trim as necessary in order to eliminate large vehicle sections from further investigation)
- For two or more circuits that do not share a common power or ground, concentrate on areas where harnesses are routed together or connectors are shared (refer to the following hints)

Hints

Though the symptoms may vary, basic electrical failures are generally caused by:

- Loose connections:
 - Open/high resistance in terminals, splices, connectors or grounds
- Incorrect connector/harness routing (usually in new vehicles or after a repair has been made):
 - Open/high resistance in terminals, splices, connectors or grounds
- Corrosion and wire damage:
 - Open/high resistance in terminals, splices, connectors or grounds
- Component failure:
 - Opens/short and high resistance in relays, modules, switches or loads
- Aftermarket equipment affecting normal operation of other systems

You may isolate circuits by:

- Unplugging connectors or removing a fuse to separate one part of the circuit from another part
- Operating shared circuits and eliminating those that function normally from the suspect circuit

- If only one component fails to operate, begin testing at the component
- If a number of components do not operate, begin tests at the area of commonality (such as power sources, ground circuits, switches or major connectors)

What resources you should use

Whenever appropriate, you should use the following resources to assist in the diagnostic process:

- Service manual
- Technical equipment (for data analysis)
- Experience
- Technical Assistance
- Circuit testing tools

5d. Intermittent Diagnosis

By definition, an intermittent problem is one that does not occur continuously and will occur when certain conditions are met. All these conditions, however, may not be obvious or currently known. Generally, intermittents are caused by:

- Faulty electrical connections and wiring
- Malfunctioning components (such as sticking relays, solenoids, etc.)
- EMI/RFI (Electromagnetic/radio frequency interference)
- Aftermarket equipment

Intermittent diagnosis requires careful analysis of suspected systems to help prevent replacing good parts. This may involve using creativity and ingenuity to interpret customer complaints and simulating all external and internal system conditions to duplicate the problem.

What you should do

Step 1: Acquire information

A thorough and comprehensive customer check sheet is critical to intermittent problem diagnosis. You should require this, since it will dictate the diagnostic starting point. The **vehicle service history** file is another source for accumulating information about the complaint.

Step 2: Analyze the intermittent problem

Analyze the customer check sheet and service history file to determine conditions relevant to the suspect system(s).

Using service manual information, you must identify, trace and locate all electrical circuits related to the malfunctioning system(s). If there is more than one system failure, you should identify, trace and locate areas of commonality shared by the suspect circuits.

Step 3: Simulate the symptom and isolate the problem

Simulate the symptom and isolate the system by reproducing all possible conditions suggested in Step 1 while monitoring suspected circuits/components/systems to isolate the problem symptom. Begin with the most logical circuit/component.

Isolate the circuit by dividing the suspect system into simpler circuits. Next, confine the problem into a smaller area of the system. Begin at the most logical point (or point of easiest access) and thoroughly check the isolated circuit for the fault, using basic circuit tests.

Hints

You can isolate a circuit by:

- Unplugging connectors or removing a fuse to separate one part of the circuit from another
- If only component fails to operate, begin testing the component
- If a number of components do not operate, begin test at areas of commonality (such as power sources, ground circuits, switches, main connectors or major components)
- Substitute a known good part from the parts department or the vehicle system
- Try the suspect part in a known good vehicle

See **Symptom Simulation Tests** on the next page for problem simulation procedures. Refer to service manual sections 6E and 8A for information about intermittent diagnosis. Follow procedures for basic circuit testing in service manual section 8A.

What resources you should use

Whenever appropriate, you should use the following resources to assist in the diagnostic process:

- Service manual
- Bulletins
- Digital multimeter (with a MIN/MAX feature)
- Tech II and Tech II upload function
- Circuit testing tools (including connector kits/harnesses and jumper wires)
- Experience
- Intermittent problem solving simulation methods
- Customer complaint check sheet

Symptom Simulation Tests**1. Vibration**

This method is useful when the customer complaint analysis indicates that the problem occurs when the vehicle/system undergoes some form of vibration.

For connectors and wire harness, slightly shake vertically and horizontally. Inspect the connector joint and body for damage. Also, tapping lightly along a suspected circuit may be helpful.

For parts and sensors, apply slight vibration to the part with a light tap of the finger while monitoring the system for a malfunction.

2. Heat

This method is important when the complaint suggests that the problem occurs in a heated environment. Apply moderate heat to the component with a hair drier or similar tool while monitoring the system for a malfunction.

CAUTION: Care must be taken to avoid overheating the component.

3. Water and Moisture

This method may be used when the complaint suggests that the malfunction occurs on a rainy day or under conditions of high humidity. In this case, apply water in a light spray on the vehicle to duplicate the problem.

CAUTION: Care must be taken to avoid directly exposing electrical connections to water.

4. Electrical loads

This method involves turning systems ON (such as the blower, lights or rear window defogger) to create a load on the vehicle electrical system at the same time you are monitoring the suspect circuit/component.

5e. Vehicle Operates as Designed

This condition refers to instances where a system operating as designed is perceived to be unsatisfactory or undesirable. In general, this is due to:

- A lack of understanding by the customer
- A conflict between customer expectations and vehicle design intent
- A system performance that is unacceptable to the customer

What you should do

You can verify that a system is operating as designed by:

- Reviewing service manual functional/diagnostic checks
- Examining bulletins and other service information for supplementary information
- Compare system operation to an identical vehicle

If the condition is due to a customer misunderstanding or a conflict between customer expectation and system operation, you should explain the system operation to the customer.

If the complaint is due to a case of unsatisfactory system performance, you should contact Technical Assistance for the latest information.

What resources you should use

Whenever possible, you should use the following resources to facilitate the diagnostic process:

- Vehicle service information (service manual, etc.)
- ISUZU field support
- Experience
- Identical vehicle or system for comparison

6. Re-examine the complaint

When you do not successfully find/isolate the problem after executing a diagnostic path, you should re-examine the complaint.

What you should do

In this case, you will need to backtrack and review information accumulated from step 1 through 4 of Strategy Based Diagnostics. You also should repeat any procedures that require additional attention.

A previous path may be eliminated from consideration only if you are certain that all steps were executed as directed. You must then select another diagnostic path (step 5a, 5b, 5c or 5d). If all possible options have been explored, you may call or seek ISUZU field support.

What resources you should use

Whenever possible, you should use the following resources to facilitate the diagnostic process:

- Service manual
- Accumulated information from a previous diagnostic path
- Service information and publications
- ISUZU field support

7. Repair and Verify Fix

What you should do

After you have located the cause of the problem, you must execute a repair by following recommended service manual procedures.

When the repair is completed, you should verify the fix by performing the system checks under the conditions listed in the customer complaint.

If applicable, you should carry out preventive measures to avoid a repeat complaint.

What resources you should use

Whenever possible, you should use the following resources to facilitate the repair process:

- Electrical repair procedures
- Service manual information and publications

GENERAL SERVICE INFORMATION

Aftermarket Electrical and Vacuum Equipment

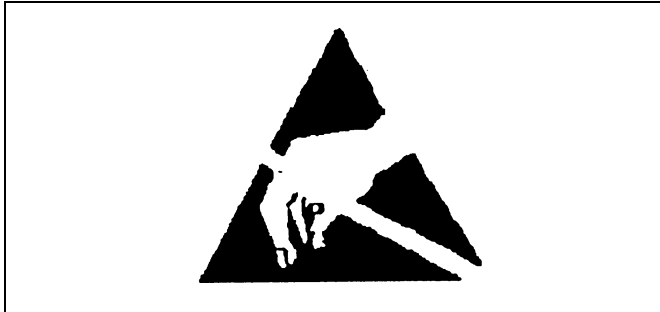
Aftermarket (add-on) electrical and vacuum equipment is defined as any equipment which connects to the vehicle's electrical or vacuum systems that is installed on a vehicle after it leaves the factory. No allowances have been made in the vehicle design for this type of equipment.

NOTE: No add-on vacuum equipment should be added to this vehicle.

NOTE: Add-on electrical equipment must only be connected to the vehicle's electrical system at the battery (power and ground).

Add-on electrical equipment, even when installed to these guidelines, may still cause the electric system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and radios. Therefore, the first step in diagnosing any electric problem is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, it may be diagnosed in the normal manner.

Electrostatic Discharge Damage



Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4000 volts for a person to feel even the zap of a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

- An example of charging by friction is a person sliding across a vehicle seat.
- Charge by induction occurs when a person with well-insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore it is important to use care when handling and testing electronic components.

Non-OEM Parts

All of the OBD diagnostics have been calibrated to run with OEM parts. Accordingly, if commercially sold sensor or switch is installed, it makes a wrong diagnosis and turns on the check engine lamp.

Aftermarket electronics, such as cellular phones, stereos, and anti-theft devices, may radiate EMI into the control system if they are improperly installed. This may cause a false sensor reading and turn on the check engine lamp.

Poor Vehicle Maintenance

The sensitivity of OBD diagnostics will cause the check engine lamp to turn on if the vehicle is not maintained properly. Restricted oil filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to OBD. Poor vehicle maintenance can not be classified as a "non-vehicle fault", but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Related System Faults

Many of the OBD system diagnostics will not run if the ECM detects a fault on a related system or component.

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspect all vacuum hoses for punches, cuts, disconnects, and correct routing.
- Inspect hoses that are difficult to see behind other components.
- Inspect all wires in the engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

NOTE: Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary to effectively use this section of the Service Manual.

On-Board Diagnostic (OBD)

On-Board Diagnostic Tests

A diagnostic test is a series of steps, the result of which is a pass or fail reported to the diagnostic executive. When a diagnostic test reports a pass result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The diagnostic test has passed during the current ignition cycle.
- The fault identified by the diagnostic test is not currently active.

When a diagnostic test reports a fail result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The fault identified by the diagnostic test is currently active.
- The fault has been active during this ignition cycle.
- The operating conditions at the time of the failure.

The Diagnostic Executive

The Diagnostic Executive is a unique segment of software which is designed to coordinate and prioritize the diagnostic procedures as well as define the protocol for recording and displaying their results. The main responsibilities of the Diagnostic Executive are listed as follows:

- Commanding the check engine lamp on and off
- DTC logging and clearing
- Current status information on each diagnostic

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code is set and the check engine lamp is illuminated.

Check Engine Lamp

The check engine lamp looks the same as the check engine lamp you are already familiar with, the “Check Engine” lamp.

Basically, the check engine lamp is turned on when the ECM detects a DTC that will impact the vehicle emissions.

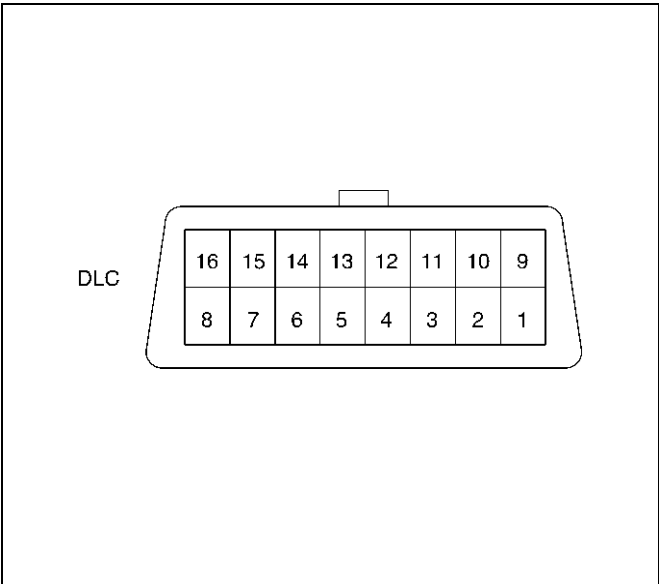
- When the check engine lamp remains “ON” while the engine is running, or when a malfunction is

suspected due to a driveability or emissions problem, a Powertrain On-Board Diagnostic (OBD) System Check must be performed. The procedures for these checks are given in On-Board Diagnostic (OBD) System Check. These checks will expose faults which may not be detected if other diagnostics are performed first.

Data Link Connector (DLC)

The provision for communication with the control module is the Data Link Connector (DLC). It is located behind the lower front instrument panel. The DLC is used to connect to a Tech2. Some common uses of the Tech2 are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Reading serial data.



Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicles with OBD system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record the Fail Records for the DTC which has been diagnosed.
2. Clear DTC(s).
3. Operate the vehicle within conditions noted in the Fail Records.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps is very important in verifying repairs on OBD systems. Failure to follow these steps could result in unnecessary repairs.

Reading Diagnostic Trouble Codes Using a Tech 2

The procedure for reading diagnostic trouble code(s) is to use a diagnostic Tech2. When reading DTC(s), follow instructions supplied by Tech2 manufacturer.

Clearing Diagnostic Trouble Codes

To clear Diagnostic Trouble Codes (DTCs), use the Tech2 "clear DTCs" or "clear information" function. When clearing DTCs follow instructions supplied by the Tech2 manufacturer.

Diagnosis With Tech 2

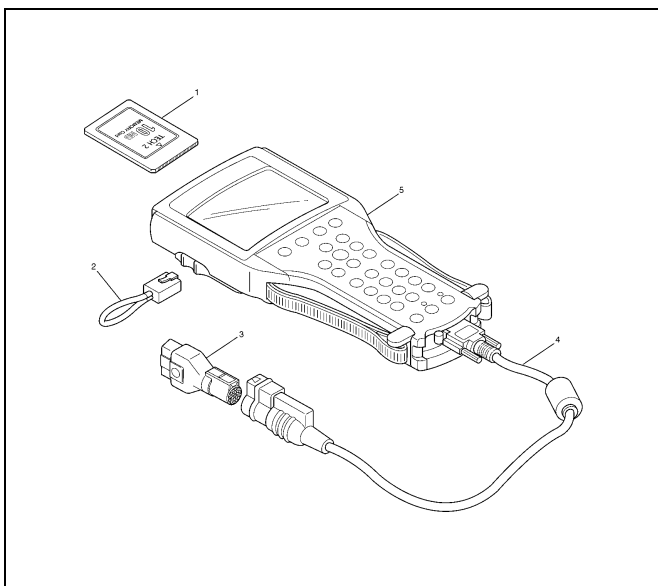
If no codes are set:

- Refer to **F1: Data Display** and identify the electrical faults that are not indicated by trouble code.
- Refer to "**SYMPTOM DIAGNOSIS**".

If codes are set:

1. Record all trouble codes displayed by Tech 2 and check if the codes are intermittent.
2. Clear the codes.
3. Drive the vehicle for a test to reproduce the faulty status.
4. Check trouble codes again using the Tech 2.
5. If no codes are displayed by test driving, the fault is intermittent. In this case, refer to "DIAGNOSIS AIDS".
6. If a code is present, refer to DTC Chart for diagnosis.
7. Check trouble codes again using the Tech 2.

Tech 2 CONNECTION



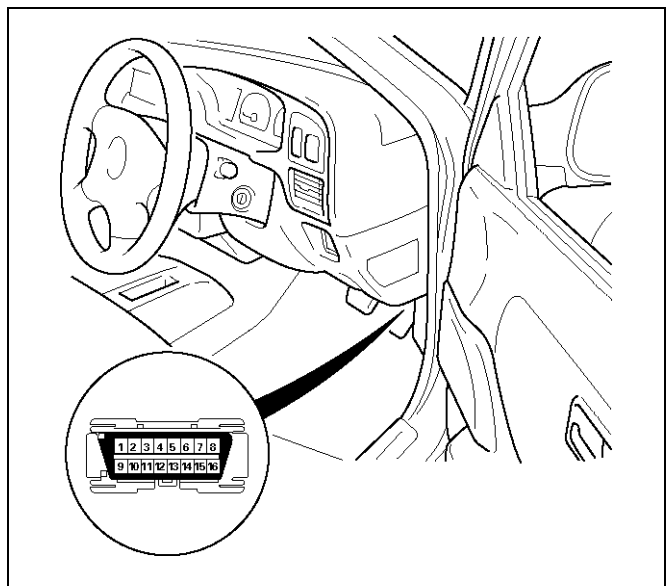
Tech 2 scan tool is used to electrically diagnose the automatic transmission system and to check the system. The Tech 2 enhances the diagnosis efficiency though all the troubleshooting can be done without the Tech 2.

1. Configuration of Tech 2

- Tech 2 scan tool kit (No. 7000086), Tech 2 scan tool (No. 7000057) and DLC cable (No. 3000095).
- SAE 16/19 adapter (No. 3000098) (3), RS232 loop back connector (No. 3000112) (2) and PCMCIA card (No. 3000117) (1).

2. Tech 2 Connection

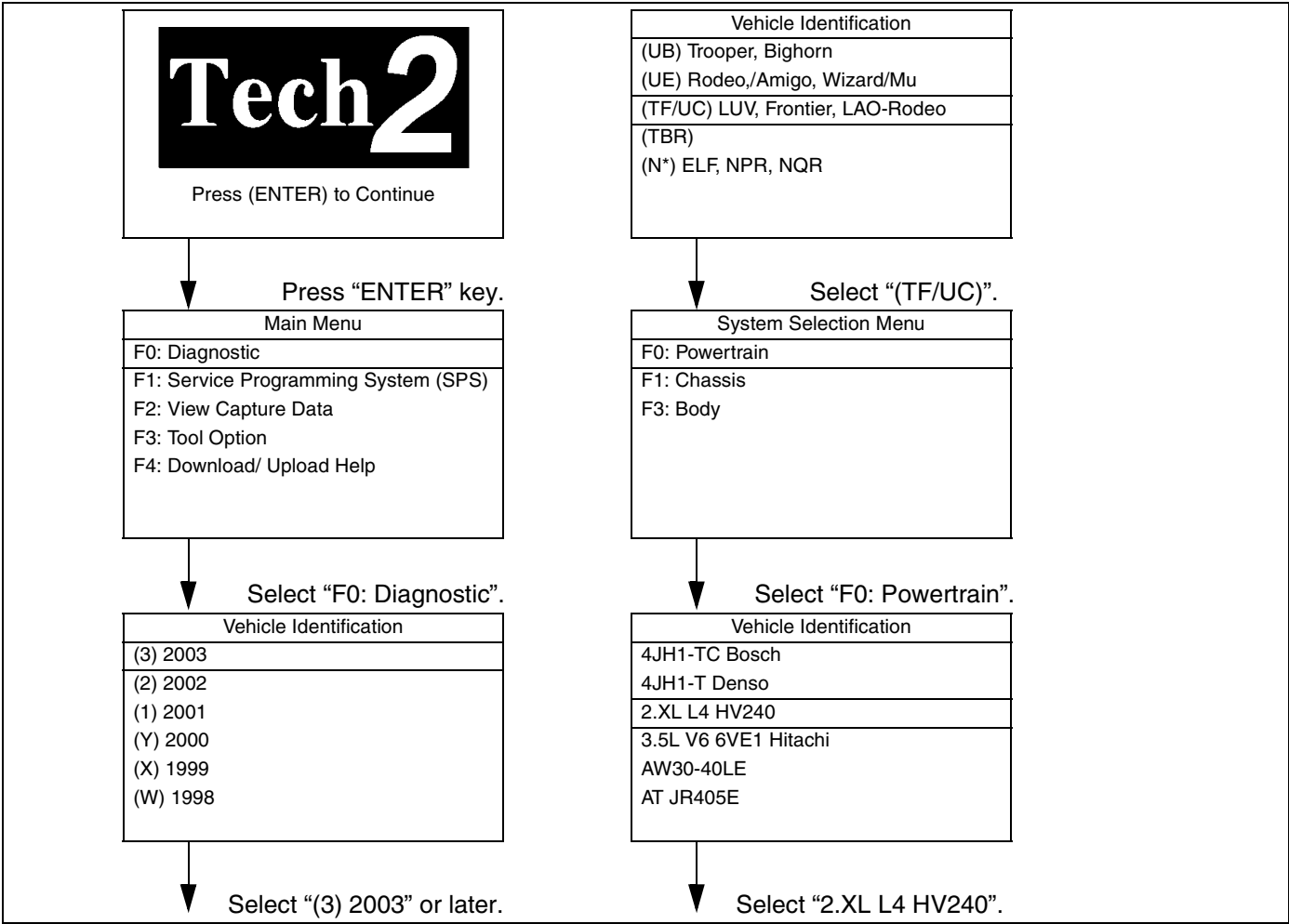
- Check the key switch is turn OFF.
- Insert the PCMCIA card (1) into the Tech 2 (5).
- Connect the SAE 16/19 adapter (3) to the DLC cable (4).
- Connect the DLC cable (4) to the Tech 2 (5).
- Connect the SAE 16/19 adapter (3) to the data link connector of the vehicle.



- Turn the key switch of the vehicle ON and press the "PWR" key of the Tech 2.
- Check the display of the Tech 2.

NOTE: Be sure to check that the power is not supplied to the Tech 2 when attaching or removing the PCMCIA card.

Tech 2 Operating Flow Cart (Start Up)



Select "2.XL L4 HV240" in Vehicle Identification menu and the following table is shown in the Tech 2 screen.

F0: Diagnostic Trouble Code

F0: Read DTC Infor By Priority

F1: Clear DTC Information

F2: DTC Information

F0: History

F1: MIL SVS or Message Requested

F2: Last Test Failed

F3: Test Failed Since Code Cleared

F4: Not Run Since Code Cleared

F5: Failed This Ignition

F1: Data Display

F0: Engine Data

F1: O₂ Sensor Data**F2: Snapshot****F3: Miscellaneous Test**

F0: Lamps

F0: Malfunction Indicator Lamps

F1: Relays

F0: Fuel Pump Relay

F1: A/C Clutch Relay

F2: EVAP

F0: Purge Solenoid

F3: IAC System

F0: IAC Control

F1: IAC Reset

F4: Injector Balance Test

F4: Programming

F0: Program VIN

F0: Diagnostic Trouble Code

The purpose of the "Diagnostic Trouble Codes" mode is to display stored trouble code in the ECM.

When "Clear DTC Information" is selected, a "Clear DTC Information", warning screen appears.

This screen informs you that by cleaning DTC's "all stored DTC information in the ECM will be erased".

After clearing codes, confirm system operation by test driving the vehicle.

Use the "DTC Information" mode to search for a specific type of stored DTC information.

History

This selection will display only DTCs that are stored in the ECM's history memory. It will not display Type B DTCs that have not requested the MIL ("Check Engine Lamp"). It will display all type A and B DTCs that requested the MIL and have failed within the last 40 warm-up cycles. In addition, it will display all type C and D DTCs that have failed within the last 40 warm-up cycles.

MIL SVC or Message Request

This selection will display only DTCs that are requesting the MIL. Type C and Type D DTCs cannot be displayed using the MIL. Type C and D DTCs cannot be displayed using this option.

This selection will report type B DTCs only after the MIL has been requested.

Last Test Failed

This selection will display only DTCs that have failed the last time the test run. The last test may have run during a previous ignition cycle of a type A or type B DTC is displayed. For type C and type D DTCs, the last failure must have occurred during the current ignition cycle to appear as last test fail.

Test Failed Since Code Cleared

The selection will display all active and history DTCs that have reported a test failure since the last time DTCs were cleared. DTCs that last failed more than 40 warm-up cycles before this option is selected will not be displayed.

Failed This Ignition

This selection will display all DTCs that have failed during the present ignition cycle.

F1: Data Display

The purpose of the "Data Display" mode is to continuously monitor data parameters.

The current actual values of all important sensors and signals in the system are display through F1 mode.

See the "Typical Scan Data" section.

F2: Snapshot

"Snapshot" allows you to focus on making the condition occur, rather than trying to view all of the data in anticipation of the fault.

The snapshot will collect parameter information around a trigger point that you select.

F3: Miscellaneous Test:

The purpose of "Miscellaneous Test" mode is to check for correct operation of electronic system actuators.

F4: Programming (Factory Use Only)

The purpose of "Programming" is to program VIN in the ECM and lock the programmed data.

TYPICAL SCAN DATA & DEFINITIONS (ENGINE DATA)

Use the Typical Values Table only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly. Tech 2 values from a properly-running engine may be used for comparison with the engine you are diagnosing.

Condition : Vehicle stopping, engine running, air conditioning off & after warm-up (Coolant temperature approximately 80 deg.)

	Tech 2 Parameter	Units	Idle	2000rpm	Description
1	Engine Speed	rpm	775 - 875	1950 - 2050	The actual engine speed is measured by ECM from the CKP sensor 58X signal.
2	Desired Idle Speed	rpm	825	800 - 850	The desired engine idle speed that the ECM commanding. The ECM compensates for various engine loads.
3	Engine Coolant Temperature	°C or °F	80 - 90	80 - 90	The ECT is measured by ECM from ECT sensor output voltage. When the engine is normally warm upped, this data displays approximately 80 °C or more.
4	Start Up ECT (Engine Coolant Temperature)	°C or °F	Depends on engine coolant temp. at time of start-up	Depends on engine coolant temp. at time of start-up	Start-up ECT is measured by ECM from ECT sensor output voltage when engine is started.
5	Intake Air Temperature	°C or °F	Depends on ambient temp.	Depends on ambient temp.	The IAT is measured by ECM from IAT sensor output voltage. This data is changing by intake air temperature.
6	Start Up IAT (Intake Air Temperature)	°C or °F	Depends on ambient temp. at start-up	Depends on ambient temp. at start-up	Start-up IAT is measured by ECM from IAT sensor output voltage when engine is started.
7	Manifold Absolute Pressure	Kpa	33 - 38	26 - 30	The MAP (Kpa) is measured by ECM from MAP output voltage. This data is changing by inlet manifold pressure.
8	Throttle Position	%	0	2 - 5	Throttle position operating angle is measured by the ECM from throttle position output voltage. This should display 0% at idle and 99 - 100% at full throttle.
9	Barometric Pressure	Kpa	Depends on altitude	Depends on altitude	The barometric pressure is measured by ECM from the MAP sensor output voltage monitored during key up and wide open throttle. This data is changing by altitude.
10	Calculated Air Flow	g/s	4.0 - 5.0	8.0 - 10.0	
11	Air Fuel Ratio		14.6:1	14.6:1	This displays the ECM commanded value. In closed loop, this should normally be displayed around 14.2:1 - 14.7:1.
12	Spark Advance	°CA	10 - 15	25 - 32	This displays the amount of spark advance being commanded by the ECM.
13	Engine Load	%	2 - 5	5 - 10	This displays is calculated by the ECM from engine speed and MAF sensor reading. Engine load should increase with an increase in engine speed or air flow amount.
14	Injection Pulse Width	ms	3.0 - 4.5	3.0 - 4.0	This displays the amount of time the ECM is commanding each injector On during each engine cycle. A longer injector pulse width will cause more fuel to be delivered. Injector pulse width should increase with increased engine load.
15	Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	When the engine is first started the system is in "Open Loop" operation. In "Open Loop", the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters "Closed Loop" operation. In "Closed Loop", the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
16	Knock Present	Yes/No	No	No	
17	Knock Counter		-	-	
18	Knock Retard	°CA	0	0	This displays the commanded ignition spark timing retard timing based on the signal from the knock sensor.
19	A/C Clutch Relay	On/Off	Off	Off	This displays whether the ECM has commanded the A/C compressor clutch "On" or "Off".

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	Tech 2 Parameter	Units	Idle	2000rpm	Description
20	A/C Request	Yes/No	Off	Off	This displays the air conditioner request signal. This should display "On" when the air conditioner switch is switched on.
21	EVAP Purge Solenoid (Evaporative Emission)	%	0 - 10	0 - 10	This displays the duty signal from the ECM to control the canister purge solenoid valve.
22	Deceleration Fuel Cutoff	Active/ Inactive	Inactive	Inactive	The ECM reduces the amount of fuel injected when it detects a decrease in the throttle position and the air flow. When deceleration is very fast, the ECM may cut off fuel completely. Until enable conditions meet the engine revolution less than 1000rpm or MAP less than 10KPa.
23	Fuel Pump	On/Off	On	On	This displays operating status for the fuel pump main relay. This should display "On" when the key switch is turned on and while engine is running.
24	Idle Air Control	Steps	20 - 30	65 - 75	This displays the ECM commanded position of the idle air control valve pintle. A larger number means that more air is being commanded through the idle air passage.
25	Idle Speed Variation	rpm	-25 - 0	1125 - 1225	
26	Vehicle Speed	km/h or mph	0	0	This displays vehicle speed. The vehicle speed is measured by ECM from the vehicle speed sensor.
27	Ignition Voltage	V	11.0 - 14.5	11.0 - 14.5	This displays the system voltage measured by the ECM at ignition feed.
28	Reference Voltage	V	5.00	5.00	
29	Malfunction Indicator Lamp	On/Off	Off	Off	This displays operating status for the Check Engine Lamp. This should display "On" when the Check Engine Lamp is turned on.
30	Time From Start		-	-	This displays the engine time elapsed since the engine was started. If the engine is stopped, engine run time will be reset to 00:00:00

TYPICAL SCAN DATA & DEFINITIONS (O₂ SENSOR DATA)

Use the Typical Values Table only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly. Tech 2 values from a properly-running engine may be used for comparison with the engine you are diagnosing.

Condition : Vehicle stopping, engine running, air conditioning off & after warm-up (Coolant temperature approximately 80 deg.)

	Tech 2 Parameter	Units	Idle	2000rpm	Description
1	Engine Speed	rpm	710 - 860	1950 - 2050	The actual engine speed is measured by ECM from the CKP sensor 58X signal.
2	Desired Idle Speed	rpm	800 - 850	800 - 850	The desired engine idle speed that the ECM commanding. The ECM compensates for various engine loads.
3	Engine Coolant Temperature	°C or °F	80 - 90	80 - 90	The ECT is measured by ECM from ECT sensor output voltage. When the engine is normally warm upped, this data displays approximately 80 °C or more.
4	Start Up ECT (Engine Coolant Temperature)	°C or °F	Depends on engine coolant temp. at time of start-up	Depends on engine coolant temp. at time of start-up	Start-up ECT is measured by ECM from ECT sensor output voltage when engine is started.
5	Intake Air Temperature	°C or °F	Depends on ambient temp.	Depends on ambient temp.	The IAT is measured by ECM from IAT sensor output voltage. This data is changing by intake air temperature.
6	Start Up IAT (Intake Air Temperature)	°C or °F	Depends on ambient temp. at start-up	Depends on ambient temp. at start-up	Start-up IAT is measured by ECM from IAT sensor output voltage when engine is started.
7	Manifold Absolute Pressure	Kpa	33 - 38	26 - 30	The MAP (Kpa) is measured by ECM from MAP output voltage. This data is changing by inlet manifold pressure.
8	Barometric Pressure	Kpa	Depends on altitude	Depends on altitude	The barometric pressure is measured by ECM from the MAP sensor output voltage monitored during key up and wide open throttle. This data is changing by altitude.
9	Throttle Position	%	0	2 - 5	Throttle position operating angle is measured by the ECM from throttle position output voltage. This should display 0% at idle and 99 - 100% at full throttle.
10	Calculated Air Flow	g/s	4.0 - 5.0	8.0 - 10.0	This displays intake air amount. The mass air flow is measured by ECM from the MAF sensor output voltage.
11	Air Fuel Ratio		14.6:1	14.6:1	This displays the ECM commanded value. In closed loop, this should normally be displayed around 14.2:1 - 14.7:1.
12	Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	When the engine is first started the system is in "Open Loop" operation. In "Open Loop", the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters "Closed Loop" operation. In "Closed Loop", the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
13	Engine Load	%	2 - 5	5 - 10	This displays is calculated by the ECM form engine speed and MAF sensor reading. Engine load should increase with an increase in engine speed or air flow amount.
14	B1 O ₂ Sensor Ready (Bank 1)	Yes/No	Yes	Yes	This displays the status of the exhaust oxygen sensor. This display will indicate "Yes" when the ECM detects a fluctuating oxygen sensor output voltage sufficient to allow closed loop operation. This will not occur unless the oxygen sensor is warmed up.
15	B1S1 Status (Bank 1 Sensor 1)	Rich / Lean	Rich / Lean	Rich / Lean	This displays dependent on the exhaust oxygen sensor output voltage. Should fluctuate constantly "Rich" and "Lean" in closed loop.
16	Fuel Trim Learned	Yes/No	Yes	Yes	When conditions are appropriate for enabling long term fuel trim corrections, fuel trim learn will display "Yes". This indicates that the long term fuel trim is responding to the short term fuel trim. If the fuel trim lean displays "No", then long term fuel trim will not respond to changes in short term fuel trim.

	Tech 2 Parameter	Units	Idle	2000rpm	Description
17	Fuel Trim Cell		15 - 20	1	This displays dependent on engine speed and calculated intake air flow reading. A plot of engine speed versus intake air flow amount is divided into the cells. Fuel trim cell indicates which cell is currently active.
18	B1S1 O ₂ Sensor (Bank1 Sensor 1)	mV	50 - 950	50 -950	This displays the exhaust oxygen sensor output voltage. Should fluctuate constantly within a range between 10mV (lean exhaust) and 1000mV (rich exhaust) while operating in closed loop.
19	B1 Short Term Fuel Trim (Bank 1)	%	-3 - 0	-10 - 14	The short term fuel trim to a bank represents a short term correction to the bank fuel delivery by the ECM in response to the amount of time the bank fuel control oxygen sensor voltage spends above or below the 450mV threshold. If the oxygen sensor voltage has mainly remained less than 450mV, indicating a lean air/fuel, short term fuel trim will increase into the positive range above 0% and the ECM will pass fuel. If the oxygen sensor voltage stays mainly above the threshold, short term fuel trim will decrease below 0% into the negative range while the ECM reduces fuel delivery to compensate for the indicated rich condition. Under certain conditions such as extended idle and high ambient temperatures, canister purge may cause short term fuel trim to read in the negative range during normal operation. Fuel trim values at maximum authority may indicate an excessively rich or lean system.
20	B1 Long Term Fuel Trim (Bank 1)	%	-10 - 0	0	The long term fuel trim is delivered from the short term fuel term values and represents a long term correction of fuel delivery for bank in question. A value of 0% indicates that fuel delivery requires no compensation to maintain the ECM commanded air fuel ratio. A negative value indicates that the fuel system is rich and fuel delivery is being reduced (decreased injector pulse width). A positive value indicates that a lean condition exists and the ECM is compensating by add fuel (increased injector pulse width). Because long term fuel trim tends to follow short term fuel trim, a value in the negative range due to canister purge at idle should not be considered unusual. Fuel trim values at maximum authority may indicate an excessively rich or lean system.
21	Power Enrichment	Yes/No	No	No	The ECM provides the extra amount of fuel when it detects a rapid increase in the throttle position and air flow (Power Enrichment). Under this condition the ECM should detect a "rich condition (high oxygen sensor voltage).
22	Time From Start		-	-	This displays the engine time elapsed since the engine was started. If the engine is stopped, engine run time will be reset to 00:00:00

MISCELLANEOUS TEST

The state of each circuit can be tested by using miscellaneous test menus. Especially when DTC cannot be detected, a faulty circuit can be diagnosed by testing each circuit by means of these menus.
 Even DTC has been detected, the circuit tests using these menus could help discriminate between a mechanical trouble and an electrical trouble.
 Connect Tech 2 and select “Powertrain”, “2.XL L4 HV240” & “Miscellaneous Test”.

F0: Lamps
 F0: Malfunction Indicator Lamp

When the Tech 2 is operated, “Malfunction Indicator Lamp (Check Engine Lamp)” is turned on or off.
 The circuit is normal if the “Malfunction Indicator Lamp (Check Engine Lamp)” in the instrument panel is turned on or off in accordance with this operation.

F1: Relays
 F0: Fuel Pump Relay

When the Tech 2 is operated, fuel pump relay signal turns ON or OFF.
 The circuit is normal if fuel pump sound is generated in accordance with this operation when key switch is turned ON.

F1: A/C Clutch Relay

When the Tech 2 is operated, A/C clutch relay signal turns ON or OFF.
 The circuit is normal if A/C compressor clutch is energized in accordance with this operation when the engine is running.

F2: EVAP
 F0: Purge Solenoid

When the Tech 2 is operated, duty ratio of EVAP purge solenoid is changed 10%-by-10%.

Purge Solenoid	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Start Up IAT	25 °C
Manifold Absolute Pressure	35KPa
EVAP Purge Solenoid	30 %

- Press “Increase” key.
 Then, EVAP Purge Solenoid is increases 10%-by-10%.
- Press “Quit” Key.

F3: IAC System
 F0: IAC Control

When the Tech 2 is operated, “Idle Air Control” increases or decreases 5steps-by-5steps up to 150steps.
 The circuit is normal if idle engine speed is changed in accordance with this operation.

IAC Control	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Start Up IAT	25 °C
Manifold Absolute Pressure	35KPa
Idle Air Control	30 Steps

- Press “Increase” key.
 Then, Idle Air Control is increases 10steps-by-10steps up to 160steps. Engine speed is also changed by this operation.
- Press “Quit” Key.

F1: IAC Reset

When the Tech 2 is operated, “Idle Air Control” resets.
 The circuit is normal if idle engine speed is dropped in accordance with this operation.

IAC Reset	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Start Up IAT	25 °C
Manifold Absolute Pressure	35KPa
Idle Air Control	30 Steps

- Press “Increase” key.
 Then, Desired Idle speed is increases 50rpm-by-50rpm up to 1550rpm. Engine speed is also changed by this operation.
- Press “Quit” Key.

F4: Injector Balance Test

When the Tech 2 is operated, selected injector turns ON or OFF.

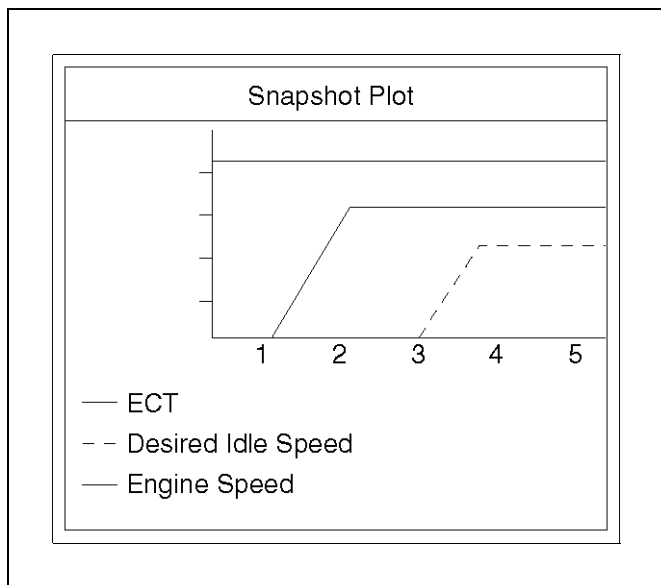
The circuit is normal if engine vibration is changed at selected cylinder in accordance with this operation when engine is idling.

Injector Balance Test	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80
Start Up ECT	50
Intake Air Temperature	30
Start Up IAT	25
Manifold Absolute Pressure	35KPa
Injector 1	On

- Press “Injector Off” key.
Then, engine speed drops and vibration occurs when a cylinder is selected.
- Press “Quit” Key.

PLOTTING SNAPSHOT GRAPH

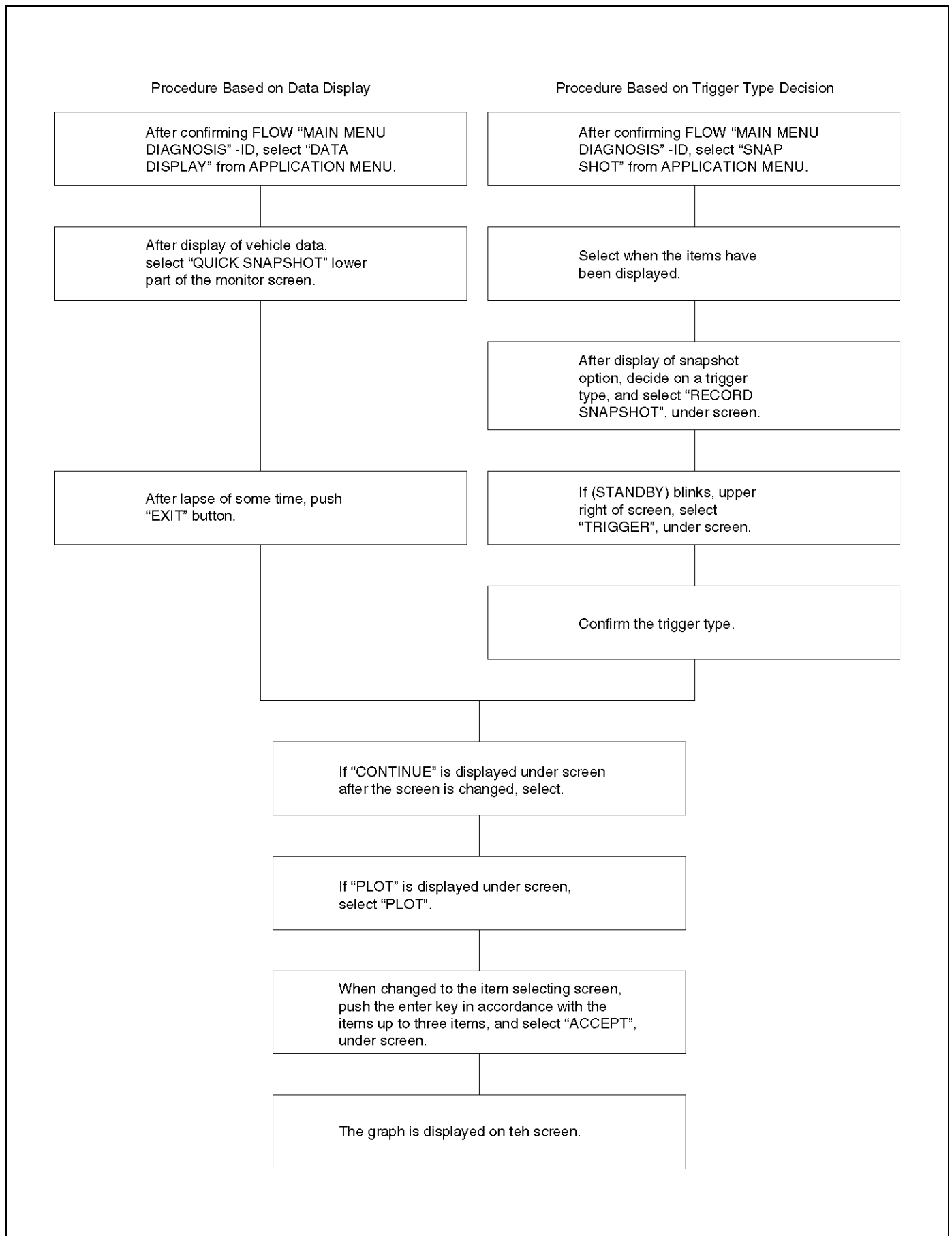
This test selects several necessary items from the data list to plot graphs and makes data comparison on a long term basis. It is an effective test particularly in emission related evaluations.



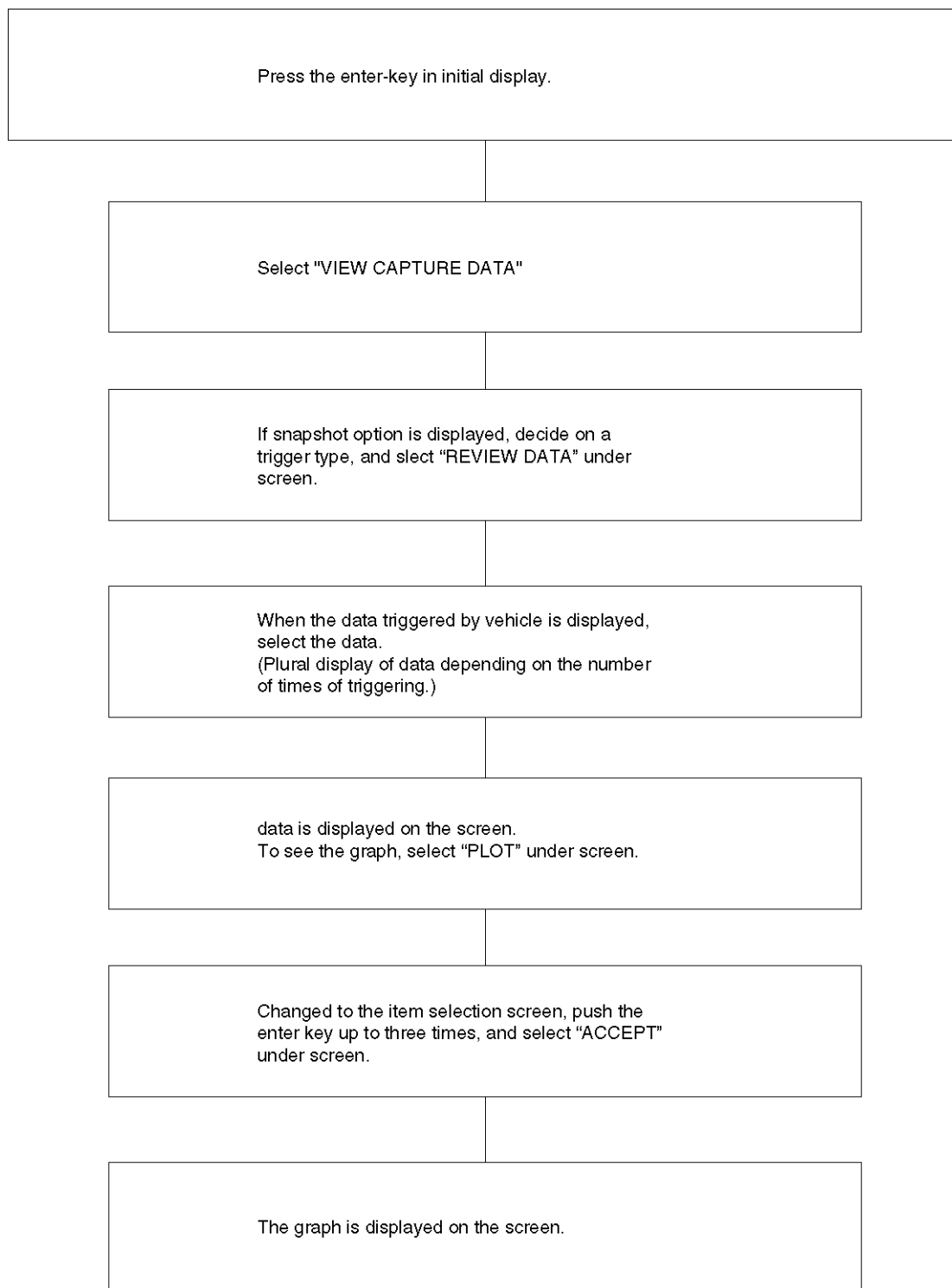
For trouble diagnosis, you can collect graphic data (snap shot) directly from the vehicle.

You can replay the snapshot data as needed. Therefore, accurate diagnosis is possible, even though the vehicle is not available.

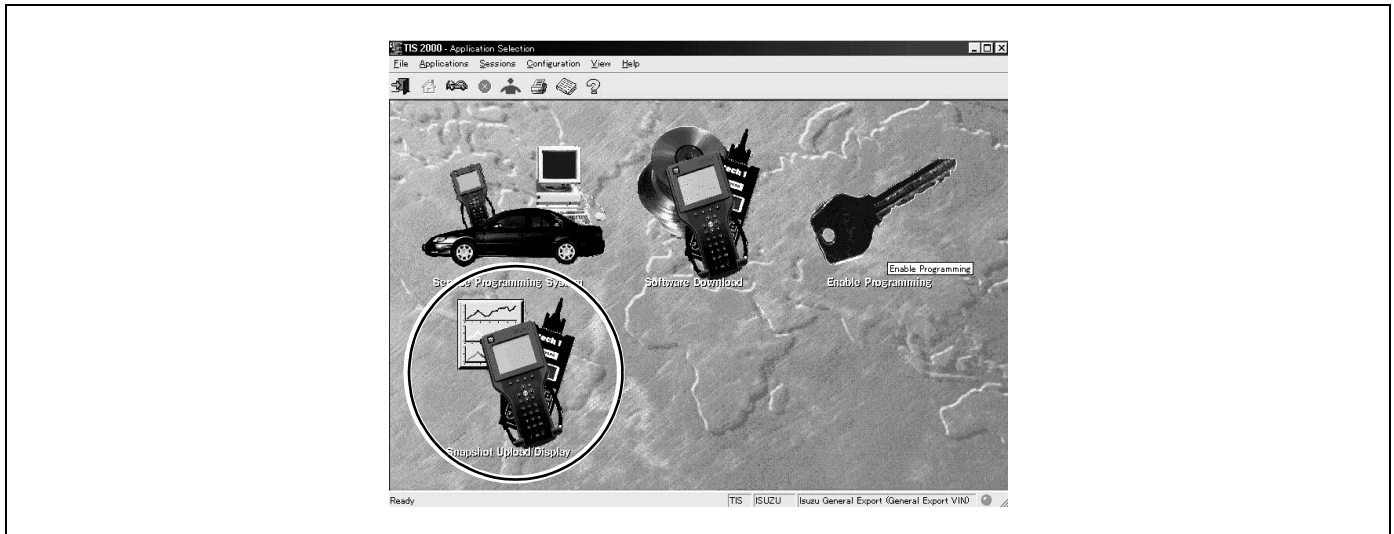
Plotting Graph Flow Chart (Plotting graph after obtaining vehicle information)



Flow Chart for Snapshot Replay (Plotting Graph)



SNAPSHOT DISPLAY WITH TIS2000



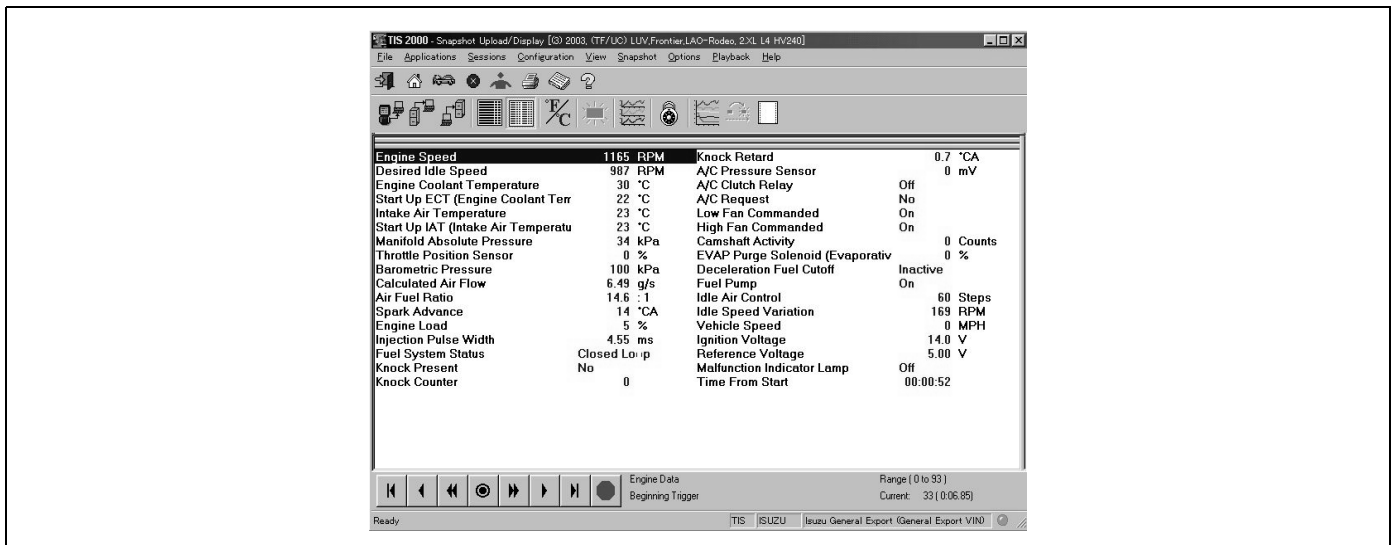
Procedures for transferring and displaying Tech2 snapshot data by using TIS2000 [Snapshot Upload] function is described below.

Snapshot data can be displayed with [Snapshot Upload] function included in TIS2000.

By analyzing these data in various methods, trouble conditions can be checked.

Snapshot data is displayed by executing the three steps below shown:

1. Record the snapshot data, in Tech2.
2. Transfer the snapshot data to PC.



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After recording the snapshot in Tech2, transfer the data from Tech2 to PC by the below procedures.

1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Upload from trouble diagnosis tool (transfer from diagnosis tester)] or click the corresponding icon of the tool bar.
4. Select Tech2, and transfer the recorded snapshot information.
5. Select the transferred snapshot.
6. After ending transfer of the snapshot, data parameter list is displayed on the screen.

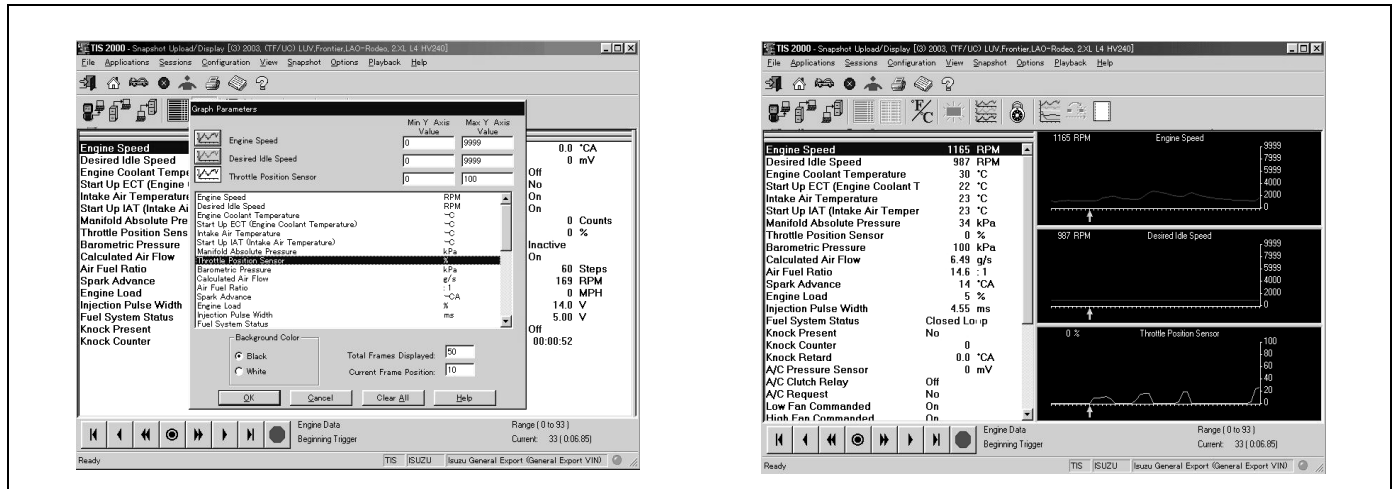
3. Snapshot data is displayed with TIS2000 [Snapshot Upload] function.

Snapshot is stored in the PC hard disk or floppy disk, and can be displayed any time.

Stored snapshot can be displayed by the below procedures.

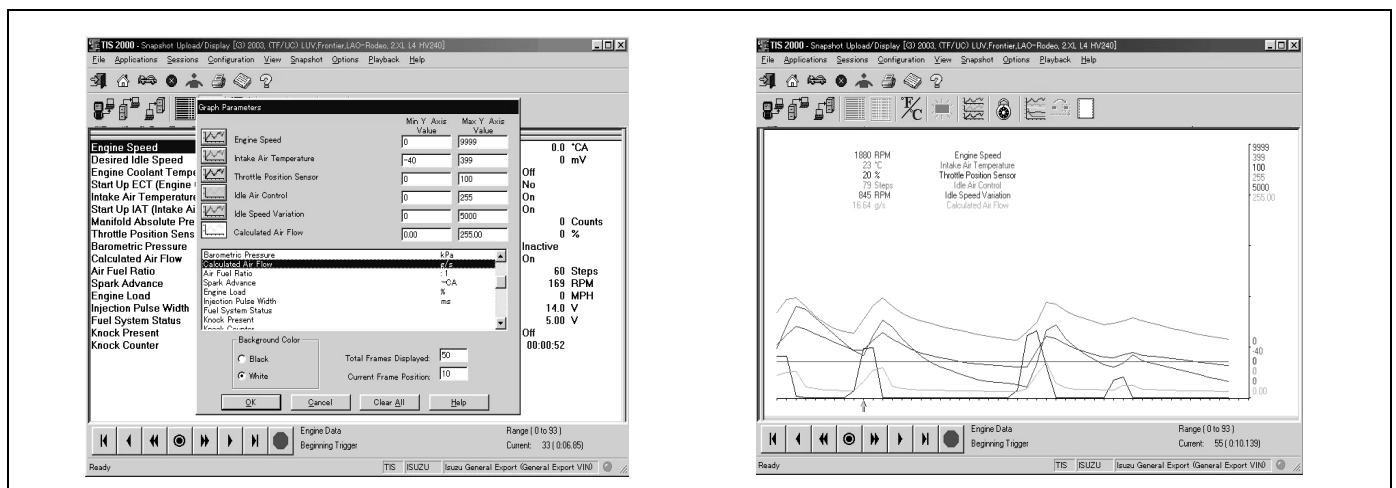
1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Open the existing files] or click the corresponding icon of the tool bar.
4. Select the transferred snapshot.
5. Open the snapshot, to display the data parameter list on the screen.

Graph display Values and graphs (Max. 3 graphs):



1. Click the icon for graph display. [Graph Parameter] window opens.
2. Click the first graph icon of the window upper part, and select one parameter from the list of the window lower part. Selected parameter is displayed next to the graph icon. Graph division can be selected in the field on the parameter right side.
3. Repeat the same procedures with the 2nd and 3rd icons.
4. After selecting all parameters to be displayed (Max. 3 parameters), click [OK] button.
5. Parameter selected is displayed in graph form on the right of the data parameter on the screen.
6. Graph display can be moved with the navigation icon.
7. For displaying another parameter by graph, click the parameter of the list, drag the mouse to the display screen while pressing the mouse button and release the mouse button. New parameter is displayed at the position of the previous parameter. For displaying the graph display screen in full size, move the cursor upward on the screen. When the cursor is changed to the magnifying glass form, click the screen. Graph screen is displayed on the whole screen.

Display of graphs on one screen (Max. 6 graphs):



1. Click the 6 graph icon. [Graph Parameter] window opens.
2. Click the graph icon, select the parameter to be displayed from the list and change divisions according to necessity.
3. Repeat the same procedures with the graph icons, from the 2nd to 6th.
4. Click the [OK] button to display.
5. In this case, parameters are displayed only in graph form. All parameters are displayed in one graph.
6. The graph display screen can be moved with the navigation icon.

SERVICE PROGRAMMING SYSTEM (SPS)

The procedure to program the control unit by using the Service Programming System (SPS) software contained in TIS2000 is explained below.

NOTE:

- If the Engine Control Module (ECM) was programmed, the Immobiliser System must be linked to the ECM: Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.

Important: Perform the following checks before attempting to program the control unit:

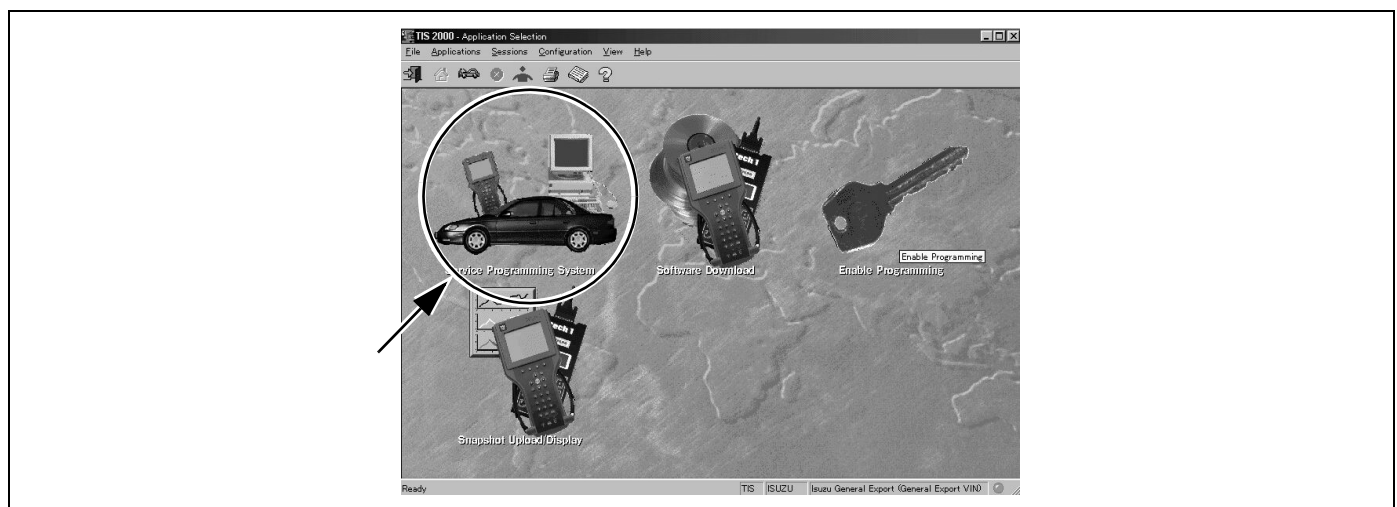
- The Tech2 PCMCIA card is programmed with The

latest software release.

- The latest release of TIS2000 is loaded on the PC.
- The vehicle battery is fully charged.
- The control unit to be programmed is connected to the vehicle.

1. Preparations of TIS 2000

1. Connect Tech 2 to P/C.
2. Check to see if Hardware Key is plugged into Port.
3. Activate TIS 2000 by P/C.
4. On the activating screen of TIS2000, choose "Service Programming System"



5. On the screen of "Diagnostic Tester and Processing Program Selection", choose the one that will comply with the following.

- Diagnostic tester in use
- New programming by the existing module or new programming by the replaced/new module.
- Fixing position of the control unit.

6. Upon completion of the selection, push the button of "Continue".

2. Demand of Data

1. Connect Tech-2 to the vehicle. When activated by turning on the power of Tech-2, push the "Enter" switch.
2. Turn on the ignition switch (without starting the engine)
3. In the main menu of Diagnostic Tester, push "F1: Service Programming System (SPS)".
4. Push "F0: Request Info" of Tech-2.
5. Where vehicle data has been already saved in Tech 2, the existing data come on display. In this instance, as Tech-2 starts asking whether to keep the data or to continue obtaining anew data from the control unit, choose either of them.



6. If you select "continue", you have to select "Model Year", "Vehicle Type", "Controller Type (Engine)".
7. After that, then push button and turn Ignition switch tuned on, off, on following Tech-2 display. Tech-2 will read information from controller after this procedure.
8. During obtaining information, Tech-2 is receiving information from the control unit chosen. In replacing the control unit, please be sure to undertake "Obtaining Information" from the new unit. With VIN not being programmed into the new control unit at the time of shipment, "obtaining information" is not complete (because the vehicle model, engine model and model year are specified from VIN). For the procedure get additional information on vehicles, instruction will be provided in dialog form, when TIS2000 is in operation.
9. Following instructions by Tech-2, push the "Exit" switch of Tech-2, turn off the ignition of the vehicle and turn off the power of Tech-2, thereby removing from the vehicle.

3. Data Exchange

1. Connect Tech-2 to P/C, turn on the power and click the "Next" button of P/C.
2. Check VIN of the vehicle and choose "Next".
3. When a lack of data is asked from among the following menu, enter accordingly.
Select following Menu
 - Model Year
 - Model
 - Engine type
 - Transmission type
 - Destination code (vehicles for general export)*1
 - Immobiliser

* 1: How to read the destination code

Destination code can be read from ID Plate affixed on vehicles, while on VIN plate the destination code is described at the right-hand edge of Body Type line. In Fig.-3, the destination code can be read as "EK4 (Europe)".



4. After choosing the data, click the "Next" button.
5. When all the necessary information is entered, the "details" of software within the database that match the entered data will appear for confirmation. Click

the "Program" switch and then download the new software onto Tech-2.

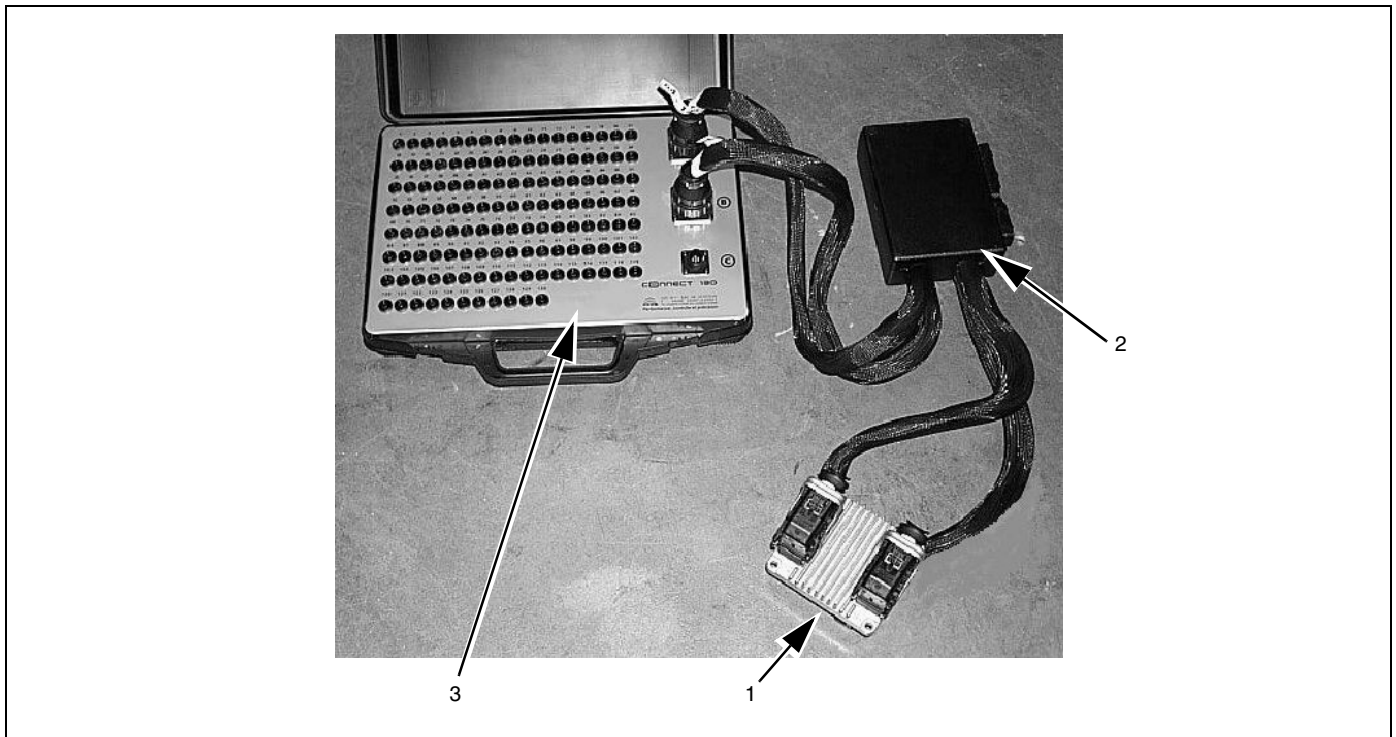
6. "Data Transfer" comes on display. The progress of downloading will be displayed on the screen in the

form of bar graph.

7. Upon finishing the data transfer, turn off the power of Tech-2, removing from P/C.

4. Programming of ECM

1. Check to see if batteries are fully charged, while ABS connectors shall be removed from the vehicle.
2. Connect Tech-2 to Vehicle Diagnostic Connectors.
3. Turn on the power of Tech-2 and the title screen comes on display.
4. Turn on the ignition (without allowing the engine to start)
5. On the title screen of Tech-2, push the "Enter" button.
6. Choose "F: Service Programming System" on the main screen and then choose "FI: Programming".
7. While data is being transferred, "Downloading" will be displayed on the Tech-2 screen.
8. Upon finishing the data transfer, Tech-2 will display "Reprogramming Successful". Push the "Exit" button to bring program to completion.
9. Following "Procedure 2: Demand of Data", try over again "Information Obtaining" and check to confirm if the data has been correctly re-loaded.
10. Upon finishing confirmation, turn off the ignition of the vehicle and then turn off the power of Tech-2, removing from the vehicle.

HOW TO USE BREAKER BOX

(1) Engine Control Module (ECM)

(3) Breaker Box

(2) Harness Adapter

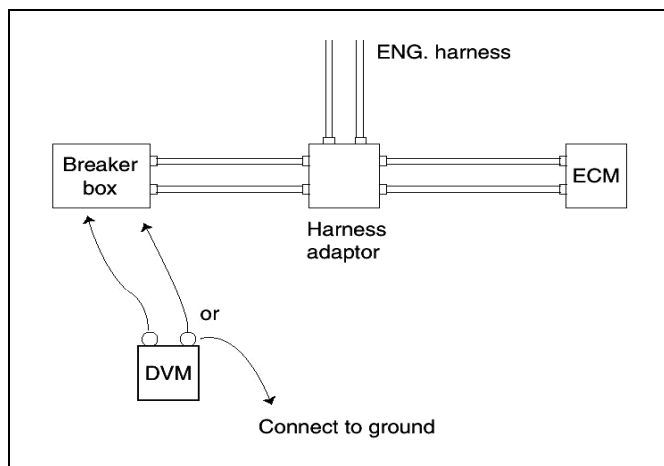
The engine control module (ECM) and other connectors have water proof connector and special terminal. Water proof terminal does not allow to use back prove. In addition, the engine control module (ECM) special terminal can not let regular digital voltage meter prove to access, because terminal shape is very fin pin type. In order to prevent damage of female terminal and connector itself, the breaker box and adapter is the most suitable special tool.



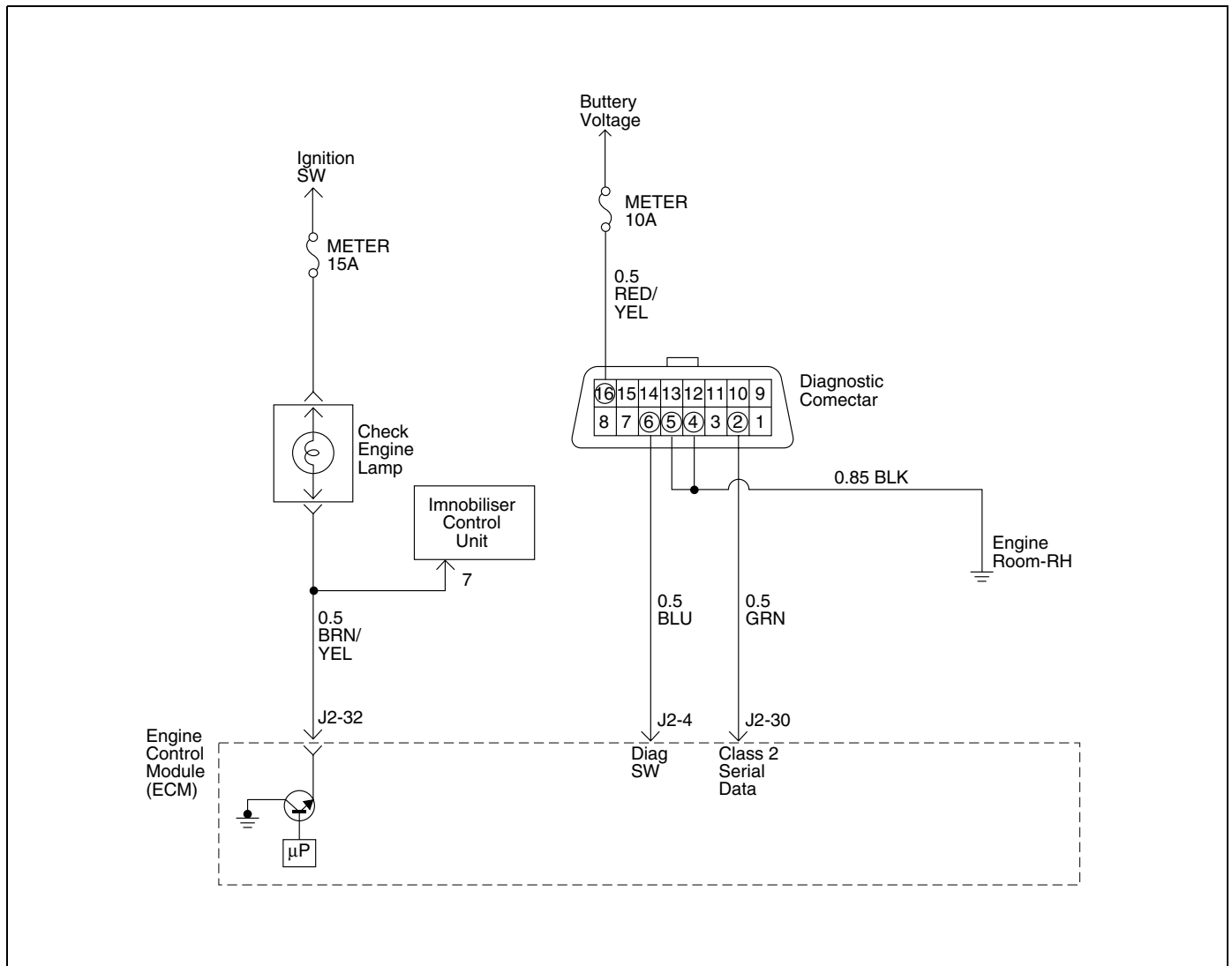
Diagram illustrating the connection of the Breaker box, Harness adaptor, and ECM. The Breaker box is connected to the Harness adaptor, which is connected to the ECM. A DVM is connected to the Breaker box and the Harness adaptor, with a note "Connect to ground".

- (1) Engine Control Module (ECM)
- (2) Harness Adapter
- (3) Breaker Box
- (4) Digital Voltage Meter
- (5) ECM - Harness Adapter Connection

The diagram illustrates the connection of an engine harness to a Breaker box and an ECM. The engine harness, labeled "ENG. harness", is connected to a central "Harness adaptor". The Breaker box is connected to the left side of the harness adaptor, and the ECM is connected to the right side. A DVM (Digital Voltmeter) is connected to the Breaker box and the Harness adaptor, with a label "or" indicating an alternative connection point. The DVM is also connected to ground, labeled "Connect to ground".



ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK



Circuit Description

The on-board diagnostic system check is the starting point for any driveability complaint diagnosis. Before using this procedure, perform a careful visual/physical check of the ECM and engine grounds for cleanliness and tightness.

The on-board diagnostic system check is an organized approach to identifying a problem created by an electronic engine control system malfunction.

Diagnostic Aids

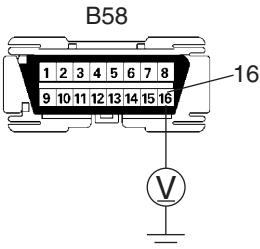
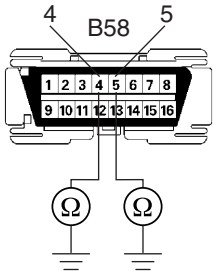
An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

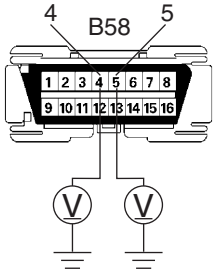
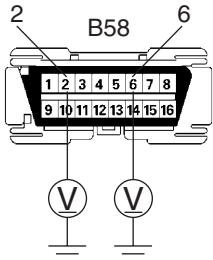
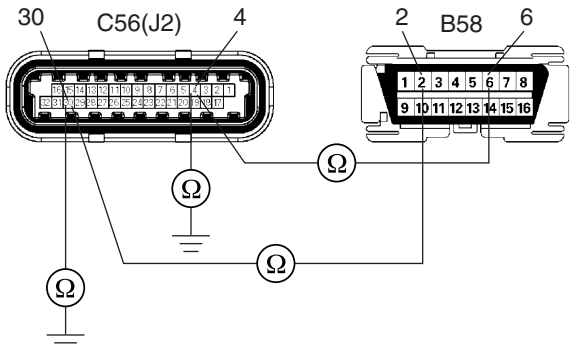
Number(s) below refer the step number(s) on the Diagnostic Chart:

1. The Check Engine Lamp (MIL) should be ON steady with the ignition "On", engine "Off". If not, "No Check Engine Lamp (MIL)" chart should be used to isolate the malfunction.
2. Checks the Class 2 data circuit and ensures that the ECM is able to transmit serial data.
3. This test ensures that the ECM is capable of controlling the Check Engine Lamp (MIL) and the Check Engine Lamp (MIL) driver circuit is not shorted to ground circuit.
4. If the engine will not start, "Engine Cranks But Will Not Run" chart should be used to diagnose the fault.
6. The Tech2 parameters which is not within the typical range may help to isolate the area which is causing the problem.
12. This vehicle is equipped with ECM which utilizes an electrically erasable programmable read only memory (EEPROM).

ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK

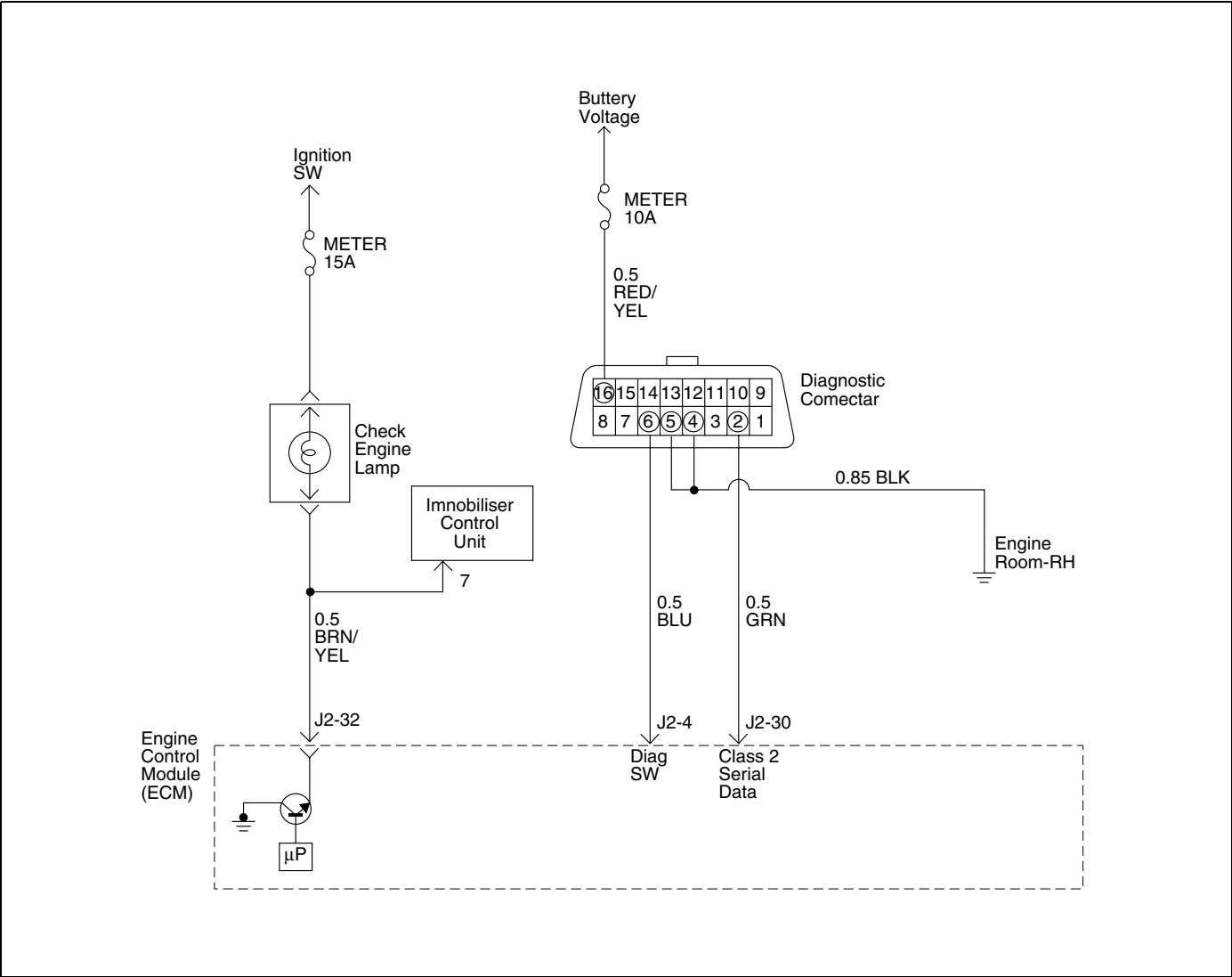
Step	Action	Value(s)	Yes	No
1	1. Ignition "On", engine "Off". 2. Check the "CHECK ENGINE" lamp (MIL). Does the "CHECK ENGINE" lamp turn "On"?	—	Go to Step 2	Go to No CHECK ENGINE Lamp
2	1. Using the Tech 2, ignition "On" and engine "Off". 2. Attempt to display "Engine Data" with the Tech 2. Does the Tech 2 display "Engine Data" and "O ₂ Sensor Data"?	—	Go to Step 3	Go to Step 7
3	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select the "Miscellaneous Test" and perform the "Malfunction Indicator Lamp" in "Lamps". 3. Operate the Tech 2 in accordance with the Tech 2 instructions. Does the "CHECK ENGINE" lamp turn "Off"?	—	Go to Step 4	Go to CHECK ENGINE LAMP On Steady
4	Attempt to start the engine. Does the engine start and continue to "Run"?	—	Go to Step 5	Go to Engine Cranks But Will Not Run
5	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select the "Read DTC Infor By Priority" in "Diagnostic Trouble Code". 3. Are any DTCs stored?	—	Go to DTC Chart	Go to Step 6
6	Compare typical scan data values displayed on the Tech 2 "Engine Data" and "O ₂ Sensor Data". Are the displayed values within the range?	—	Refer to SYMPTOM DIAGNOSIS	Refer to TYPICAL SCAN DATA
7	Using the DVM and check the data link connector power supply circuit. 1. Ignition "Off", engine "Off". 2. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 8
8	Using the DVM and check the data link connector ground circuit. 1. Ignition "Off", engine "Off". 2. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 9

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Step	Action	Value(s)	Yes	No
9	Using the DVM and check the data link connector ground circuit. 1. Ignition "On", engine "Off". 2. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 10</i>	Repair faulty harness and verify repair
10	Using the DVM and check the data link connector communication circuit. 1. Ignition "On", engine "Off". 2. Check the circuit for short to power supply circuit. Was the DVM indicated battery voltage? 	—	Repair faulty harness and verify repair	Go to <i>Step 11</i>
11	Using the DVM and check the data link connector communication circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 12</i>
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 13</i>

Step	Action	Value(s)	Yes	No
13	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

NO CHECK ENGINE LAMP (MIL)



Circuit Description

The check engine lamp should be illuminated and steady for about five seconds with the ignition “ON” and the engine stopped. Ignition feed voltage is supplied to the check engine lamp bulb through the meter fuse. The Engine Control Module (ECM) turns the check engine lamp “ON” by grounding the check engine lamp driver circuit.

Diagnostic Aids

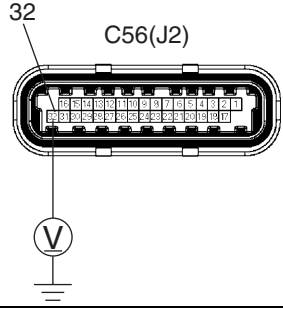
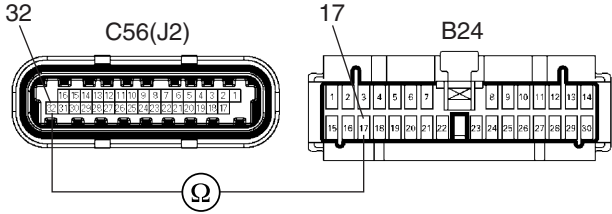
An intermittent check engine lamp may be caused by a poor connection, rubbed-through wire insulation, or a

wire broken inside the insulation. Check for the following items:

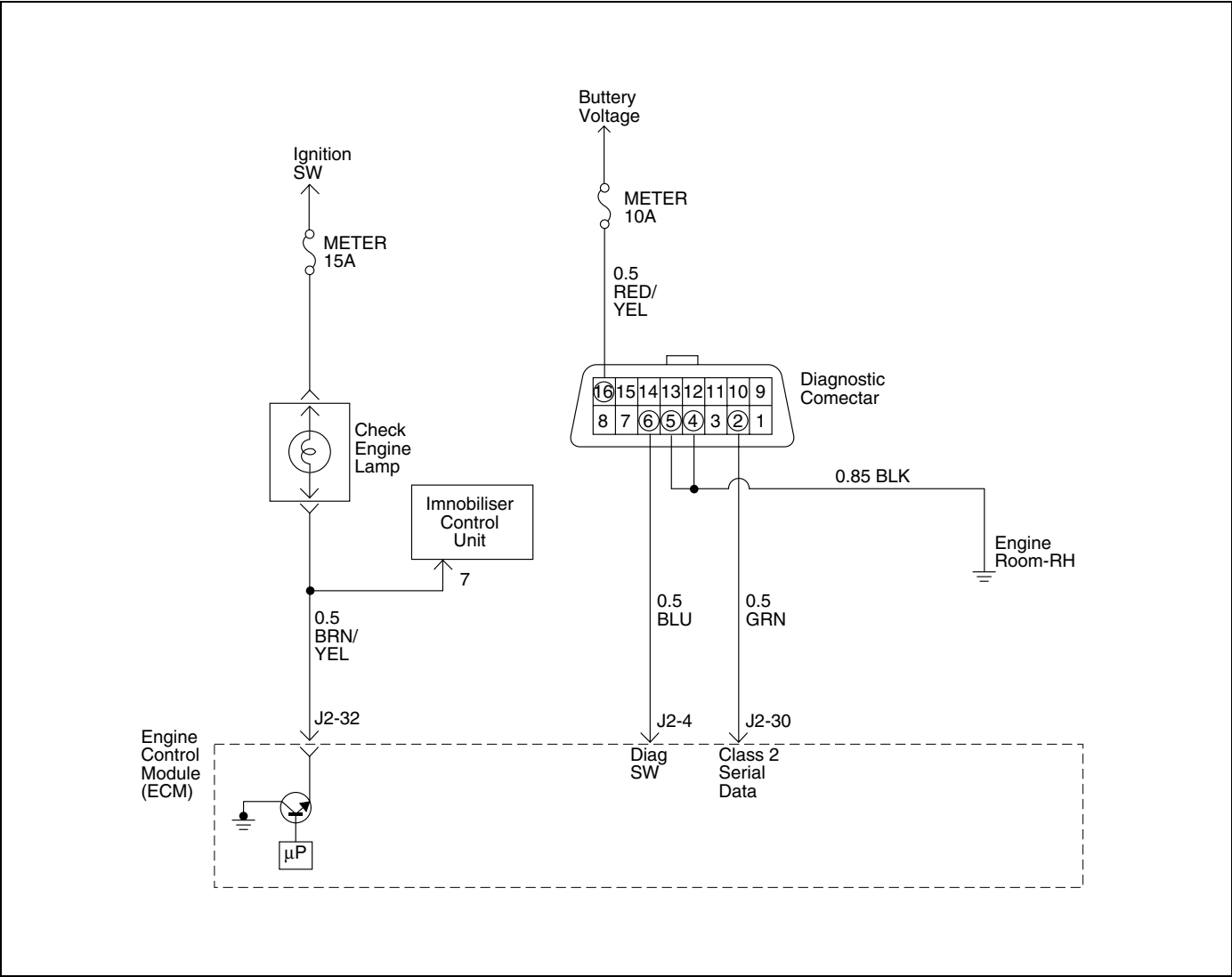
- Inspect the ECM harness and connections for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.
- If the engine runs OK, check for a faulty light bulb, an open in the check engine lamp driver circuit, or an open in the instrument cluster ignition feed.
- If the engine cranks but will not run, check for an open ECM ignition or battery feed, or a poor ECM to engine ground.

No Check Engine Lamp (MIL)

Step	Action	Value(s)	Yes	No
1	Check the “Meter” fuse (15A). If the fuse is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 2</i>

Step	Action	Value(s)	Yes	No
2	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Ignition "On". 4. Check the circuit for open circuit. Was the DVM indicated specified value? 	Battery voltage	Go to Step 5	Go to Step 3
3	Check the "CHECK ENGINE" lamp bulb. If the bulb is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 4
4	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the meter connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Verify repair	Go to Step 5
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to Step 6
6	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

CHECK ENGINE LAMP (MIL) “ON” STEADY



Circuit description

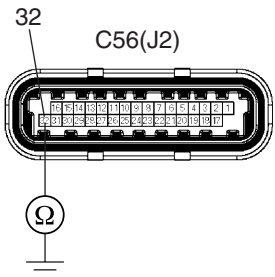
The check engine lamp should always be illuminated and steady for about five seconds with ignition “ON” and the engine stopped. Ignition feed voltage is supplied directly to the check engine lamp indicator. The Engine Control Module (ECM) turns the check engine lamp “ON” by grounding the check engine lamp driver circuit. The check engine lamp should not remain “ON” with the engine running and no DTC(s) set. A steady check engine lamp with the engine running and no DTC(s) suggests a short to ground in the check engine lamp driver circuit.

Diagnostic Aids

- An intermittent may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:
- Poor connection or damaged harness - Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Check Engine Lamp (MIL) “ON” Steady

Step	Action	Value(s)	Yes	No
1	1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Ignition “On”. Was the “CHECK ENGINE” lamp turned on?	—	Go to Step 2	Go to Step 4

Step	Action	Value(s)	Yes	No
2	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the meter connector and ECM connector. 3. Check the circuit for short to ground circuit. Was the problem found? 	—	Verify repair	Go to <i>Step 3</i>
3	Replace the meter assembly. Is the action complete?	—	Verify repair	—
4	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 5</i>
5	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

FUEL METERING SYSTEM CHECK

Some failures of the fuel metering system will result in an “Engine Cranks But Will Not Run” symptom. If this condition exists, refer to *the Cranks But Will Not Run* chart. This chart will determine if the problem is caused by the ignition system, the ECM, or the fuel pump electrical circuit.

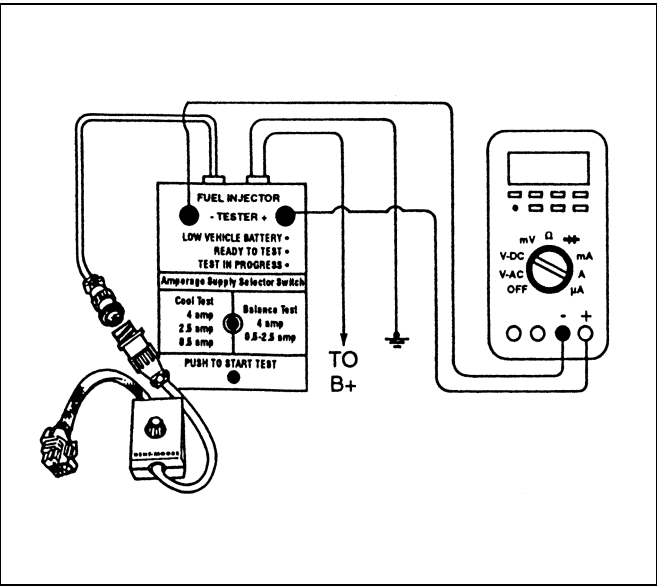
Refer to *Fuel System Electrical Test* for the fuel system wiring schematic.

If there is a fuel delivery problem, refer to *Fuel System Diagnosis*, which diagnoses the fuel injectors, the fuel pressure regulator, and the fuel pump.

Followings are applicable to the vehicles with closed Loop System:

If a malfunction occurs in the fuel metering system, it usually results in either a rich HO2S signal or a lean HO2S signal. This condition is indicated by the HO2S voltage, which causes the ECM to change the fuel calculation (fuel injector pulse width) based on the HO2S reading. Changes made to the fuel calculation will be indicated by a change in the long term fuel trim values which can be monitored with a Scan Tool. Ideal long term fuel trim values are around 0%; for a lean HO2S signal, the ECM will add fuel, resulting in a fuel trim value above 0%. Some variations in fuel trim values are normal because all engines are not exactly the same. If the evaporative emission canister purge is 02 status may be rich condition. 02 status indicates the lean condition, refer to *DTC P1171* for items which can cause a lean HO2S signal.

FUEL INJECTOR COIL TEST PROCEDURE
AND FUEL INJECTOR BALANCE TEST
PROCEDURE



Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart:

- 2. Relieve the fuel pressure by connecting 5-8840-0378-0 T-Joint to the fuel pressure connection on the fuel rail.

Caution: *In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.*

Place the fuel pressure gauge bleed hose in an approved gasoline container. With the ignition switch OFF open the valve on the fuel pressure gauge.

- 3. Record the lowest voltage displayed by the DVM after the first second of the test. (During the first second, voltage displayed by the DVM may be inaccurate due to the initial current surge.)

Injector Specifications:

Resistance Ohms	Voltage Specification at 10°C-35°C (50°F-95°F)
11.8-12.6	5.7-6.6

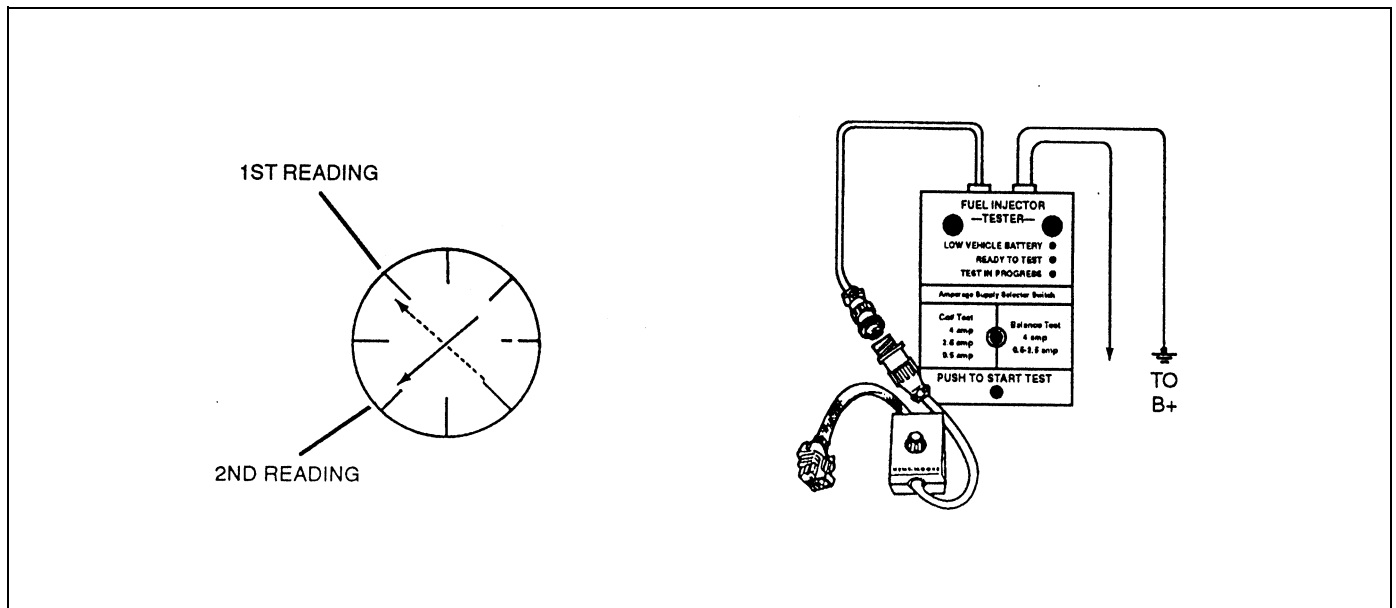
- The voltage displayed by the DVM should be within the specified range.
- The voltage displayed by the DVM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes.

- An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector.
5. Injector Specifications:

Highest Acceptable Voltage Reading Above/Below 35°C/10°C (95°F/50°F)	Acceptable Subtracted Value
9.5Volts	0.6Volt

7. The Fuel Injector Balance Test portion of this chart (Step 7 through Step 11) checks the mechanical (fuel delivery) portion of the fuel injector. An engine cooldown period of 10 minutes is necessary in order to avoid irregular fuel pressure readings due to "Hot Soak" fuel boiling.

Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11)



	CYLINDER			
	1	2	3	4
1st Reading (1)	296kPa (43psi)	296kPa (43psi)	296kPa (43psi)	296kPa (43psi)
2nd Reading (2)	205kPa (29psi)	205kPa (29psi)	196kPa (28psi)	274kPa (39psi)
Amount of Drop (1st Reading-2nd Reading)	91kPa (14psi)	91kPa (14psi)	100kPa (15psi)	22kPa (4psi)
Av. Drop = 166kPa/24psi ±10kPa/1.5psi = 156 - 176kPa or 22.5 - 25.5psi	Faulty, Lean (Too Little Fuel Drop)	Faulty, Lean (Too Little Fuel Drop)	Faulty, Lean (Too Little Fuel Drop)	Faulty, Lean (Too Little Fuel Drop)

NOTE: These figures are examples only.

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Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11)

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Turn the engine OFF. NOTE: In order to prevent flooding of a single cylinder and possible engine damage, relieve the fuel pressure before performing the fuel injector coil test procedure. 2. Relieve the fuel pressure. Refer to Test Description Number 2. 3. Connect the 5-8840-2618-0 Fuel Injector Tester to B+ and ground, and to the 5-8840-2589-0 Injector Adapter Cable. 4. Remove the harness connector of the Fuel Injector and connect the 5-8840-2589-0 Injector Adapter Cable for F/I check. 5. Set the amperage supply selector switch on the fuel injector tester to the "Coil Test" 0.5 amp position. 6. Connect the leads from the 5-8840-2392-0 Digital Voltmeter (DVM) to the fuel injector tester. Refer to the illustrations associated with the test description. 7. Set the DVM to the tenths scale (0.0). 8. Observe the engine coolant temperature. Is the engine coolant temperature within the specified values?	10°C (50°F) to 35°C (95°F)	Go to <i>Step 3</i>	Go to <i>Step 5</i>
3	1. Set the injector adapter cable to injector #1. 2. Press the "Push to Start Test" button on the fuel injector tester. 3. Observe the voltage reading on the DVM. Important: The voltage reading may rise during the test. 4. Record the lowest voltage observed after the first second of the test. 5. Set the injector adapter cable to the next injector and repeat steps 2, 3, and 4. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilize) or a voltage reading outside of the specified values?	5.7-6.6V	Go to <i>Step 4</i>	Go to <i>Step 7</i>
4	Replace the faulty fuel injector(S). Refer to <i>Fuel Injector</i>. Is the action complete?	—	Go to <i>Step 7</i>	—

Step	Action	Value(s)	Yes	No
5	1. Set the Injector Adapter Cable to injector #1. 2. Press the "Push to Start Test" button on the fuel injector tester. 3. Observe the voltage reading on the DVM. Important: The voltage reading may rise during the test. 4. Record the lowest voltage observed after the first second of the test. 5. Set the Injector Adapter Cable to the next injector and repeat steps 2, 3, and 4. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilize) or a voltage reading above the specified value?	9.5V	Go to Step 4	Go to Step 6
6	1. Identify the highest voltage reading recorded (other than those above 9.5V). 2. Subtract the voltage reading of each injector from the highest voltage selected in step 1. Repeat until you have a subtracted value for each injector. For any injector, is the subtracted value in step 2 greater than the specified value?	0.6V	Go to Step 4	Go to Step 7
7	Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the Towel in an approved container when the connection of the fuel pressure gauge is complete. 1. Connect the 5-8840-0378-0 Fuel Pressure Gauge to the fuel pressure test port. 2. Energize the fuel pump using the Scan Tool. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Bleed the air out of the fuel pressure gauge. 5. With the fuel pump running, observe the reading on the fuel pressure gauge. Is the fuel pressure within the specified values?	296kPa- 376kPa (43-55psi)	Go to Step 8	Go to Fuel System Diagnosis
8	Turn the fuel pump OFF. Does the fuel pressure remain constant?	—	Go to Step 9	Go to Fuel System Diagnosis

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Step	Action	Value(s)	Yes	No
9	1. Connect the 5-8840-0378-0 Fuel Injector Tester and 5-8840-2589-0 Injector Adapter Cable to the fuel injector harness connector. 2. Set the amperage supply selector switch on the fuel injector tester to the "Balance Test" 0.5-2.5 amp position. 3. Using the Scan Tool turn the fuel pump ON then OFF in order to pressurize the fuel system. 4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the first pressure reading. 5. Energize the fuel injector by depressing the "Push to Start Test" button on the fuel injector tester. 6. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the second pressure reading. 7. Repeat steps 1 through 6 for each fuel injector. 8. Subtract the second pressure reading from the first pressure reading for one fuel injector. The result is the pressure drop value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10kPa (1.5psi)	Go to Step 10	Go to OBD System Check
10	Re-test any fuel injector that does not meet the specification. Refer to the procedure in Step 11. NOTE: Do not repeat any portion of this test before running the engine in order to prevent the engine from flooding. Does any fuel injector still have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10kPa (1.5psi)	Go to Step 11	Go to Symptoms
11	1. Replace the faulty fuel injector(s). Refer to <i>Fuel Injector</i>. 2. Disconnect the 5-8840-2589-0 Injector Adapter Cable for F/I check and re-connect the original F/I check connector. Is the action complete?	—	Verify repair	—

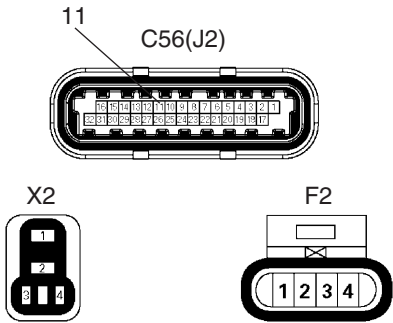
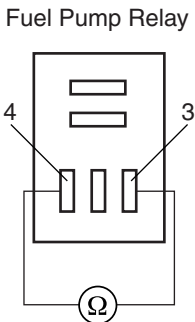
Fuel Pressure Relief Procedure

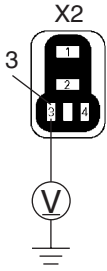
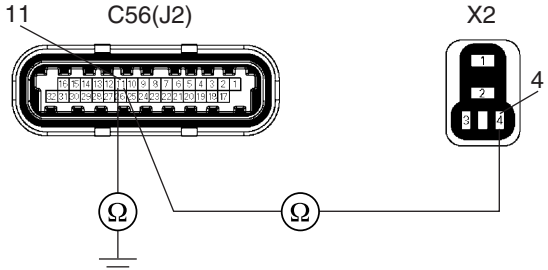
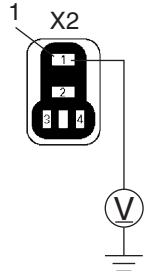
1. Remove the fuel cap.
2. Remove the fuel pump relay from the underhood relay center.
3. Start the engine and allow it to stall.
4. Crank the engine for an additional 3 seconds.

Fuel Pressure Gauge Installation

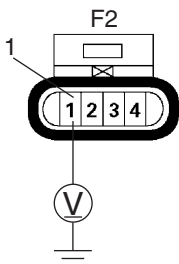
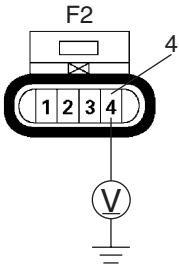
1. Remove the fuel pressure fitting cap.
2. Install fuel pressure gauge 5-8840-0378-0 to the fuel feed line located in front of and above the right side valve cover.
3. Reinstall the fuel pump relay.

Fuel System Electrical Test

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to On Board Diagnostic (OBD) System Check
2	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “Fuel Pump Relay” in the “Relays”. 3. Operate the Tech 2 in accordance with procedure. Was the fuel pump operated, when the Tech 2 is operated?	—	Go to Fuel System Diagnosis	Go to Step 3
3	Check the “Fuel Pump” fuse (20A). If the fuse is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 4
4	Check for poor/faulty connection at the fuel pump, fuel pump relay or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 5
5	Using the DVM and check the fuel pump relay. 1. Ignition “Off”, engine “Off”. 2. Remove the fuel pump relay from the relay box. 3. Check the relay coil. Was the DVM indicated specified value? 	Continuity	Go to Step 6	Replace fuel pump relay and verify repair

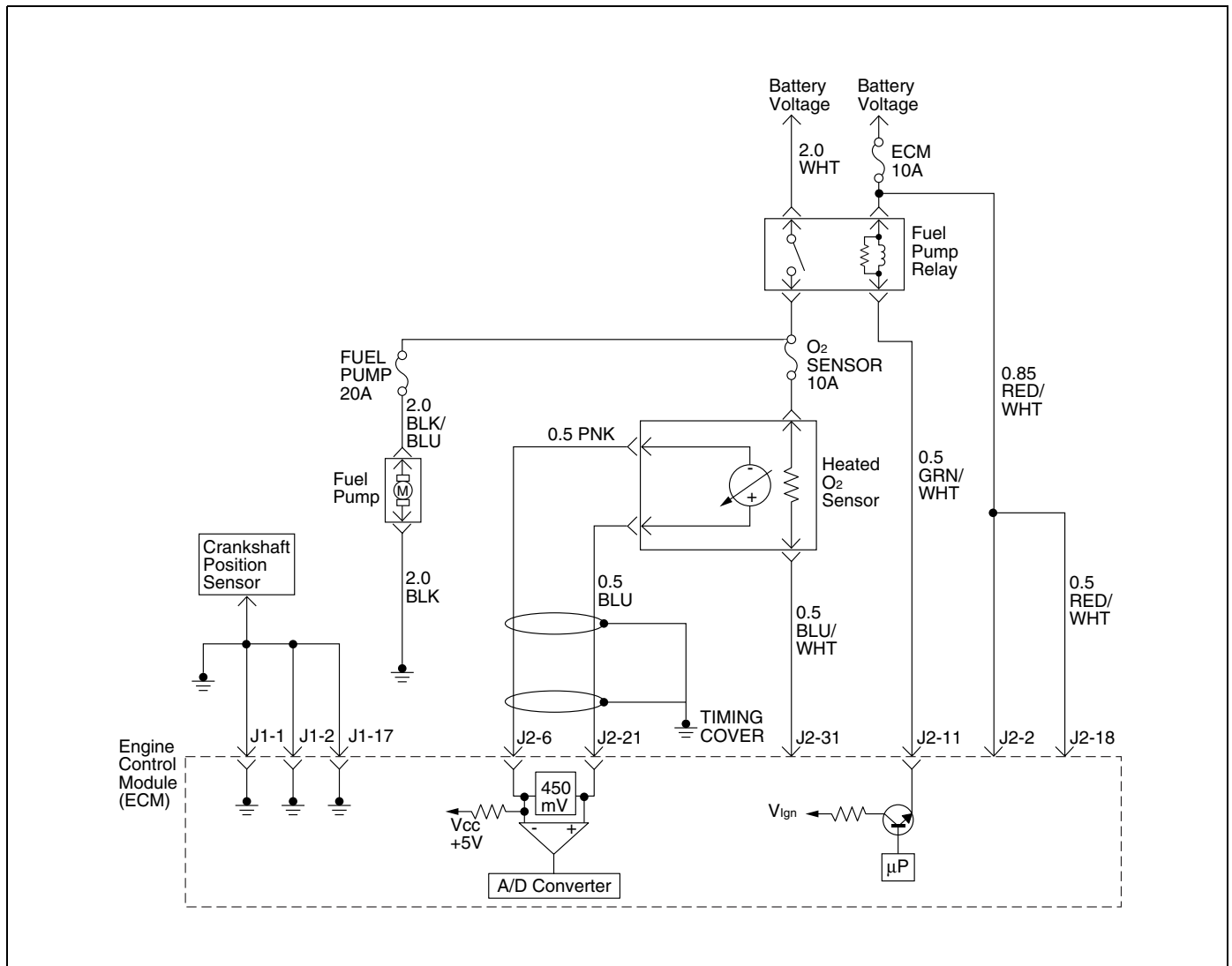
Step	Action	Value(s)	Yes	No
6	Using the DVM and check the fuel pump relay power supply circuit. 1. Ignition "On", engine "Off". 2. Remove the fuel pump relay from the relay box. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Battery voltage	Go to Step 8	Go to Step 7
7	Repair the open or short to ground circuit between the "ECM" fuse (15A) and fuel pump relay. Is the action complete?	—	Verify repair	—
8	Using the DVM and check the fuel pump relay ground circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Remove the fuel pump relay from the relay box. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 9
9	Using the DVM and check the fuel pump relay power supply circuit. 1. Ignition "Off", engine "Off". 2. Remove the fuel pump relay from the relay box. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Battery voltage	Go to Step 11	Go to Step 10

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Step	Action	Value(s)	Yes	No
10	Repair the open circuit between the fuel pump relay and battery. Is the action complete?	—	Verify repair	—
11	Using the DVM and check the fuel pump power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the fuel pump connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Battery voltage	Go to Step 13	Go to Step 12
12	Repair the open or short to ground circuit between the fuel pump relay and fuel pump. Is the action complete?	—	Verify repair	—
13	Using the DVM and check the fuel pump ground circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the fuel pump connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Continuity	Go to Step 15	Go to Step 14
14	Repair the open circuit between the fuel pump and body ground. Is the action complete?	—	Verify repair	—
15	Replace the fuel pump. Was the problem solved?	—	Verify repair	Go to Step 16
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to Step 17

Step	Action	Value(s)	Yes	No
17	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

FUEL SYSTEM DIAGNOSIS



Circuit Description

When the ignition switch is turned ON, the engine control module (ECM) will turn ON the in-tank fuel pump. The in-tank fuel pump will remain ON as long as the engine is cranking or running and the ECM is receiving 58X crankshaft position pulses. If there are no 58X crankshaft position pulses, the ECM will turn the in-tank fuel pump OFF 2 seconds after the ignition switch is turned ON or 2 seconds after the engine stops running.

The in-tank fuel pump is an electric pump within an integral reservoir. The in-tank fuel pump supplies fuel through an in-line fuel filter to the fuel rail assembly. The fuel pump is designed to provide fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate fuel return line.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Connect the fuel pressure gauge to the fuel feed line as shown in the fuel system illustration. Wrap a shop towel around the fuel pressure connection in order to absorb any fuel leakage that may occur when installing the fuel pressure gauge. With the ignition switch ON and the fuel pump running, the fuel pressure indicated by the fuel pressure gauge should be 283-376 kPa (41-55 psi). This pressure is controlled by the amount of pressure the spring inside the fuel pressure regulator can provide.
3. A fuel system that cannot maintain a constant fuel pressure has a leak in one or more of the following areas:
 - The fuel pump check valve.
 - The fuel pump flex line.
 - The valve or valve seat within the fuel pressure regulator.

- The fuel injector(s).
4. Fuel pressure that drops off during acceleration, cruise, or hard cornering may cause a lean condition. A lean condition can cause a loss of power, surging, or misfire. A lean condition can be diagnosed using a Tech 2 Scan Tool.

Following are applicable to the vehicle with closed Loop System:

If an extremely lean condition occurs, the oxygen sensor(s) will stop toggling. The oxygen sensor output voltage(s) will drop below 500 mV. Also, the fuel injector pulse width will increase.

Important: Make sure the fuel system is not operating in the "Fuel Cut-Off Mode."

When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in step 2 with the engine OFF.

16. Check the spark plug associated with a particular fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure:

- Remove the fuel rail, but leave the fuel lines and injectors connected to the fuel rail. Refer to *Fuel Rail Assembly in On-Vehicle Service*.
- Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

Caution: In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports and verify that the fuel injector retaining clips are intact.

- **Pressurize the fuel system by connecting a 20 amp fused jumper between B+ and the fuel pump relay connector.**
 - **Visually and physically inspect the fuel injector nozzles for leaks.**
17. A rich condition may result from the fuel pressure being above 376 kPa (55 psi). A rich condition may cause a 45 to set. Driveability conditions associated

with rich conditions can include hard starting (followed by black smoke) and a strong sulfur smell in the exhaust.

20. This test determines if the high fuel pressure is due to a restricted fuel return line or if the high fuel pressure is due to a faulty fuel pressure regulator.
21. A lean condition may result from fuel pressure below 333 kPa (48 psi). A lean condition may cause a 44 to set. Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging, and misfiring.
22. Restricting the fuel return line causes the fuel pressure to rise above the regulated fuel pressure. Command the fuel pump ON with the scan tool. The fuel pressure should rise above 376 kPa (55 psi) as the fuel return line becomes partially closed.

NOTE: Do not allow the fuel pressure to exceed 414 kPa (60 psi). Fuel pressure in excess of 414 kPa (60 psi) may damage the fuel pressure regulator.

Caution: To reduce the risk of fire and personal injury:

- **It is necessary to relieve fuel system pressure before connecting a fuel pressure gauge. Refer to Fuel Pressure Relief Procedure, below.**
- **A small amount of fuel may be released when disconnecting the fuel lines. Cover fuel line fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when the disconnect is completed.**

Fuel Pressure Relief Procedure

1. Remove the fuel cap.
2. Located on the intake manifold which is at the top right part of the engine.
3. Start the engine and allow it to stall.
4. Crank the engine for an additional 3 seconds.

Fuel Pressure Gauge Installation

1. Remove the fuel pressure fitting cap.
2. Install fuel pressure gauge 5-8840-0378-0 to the fuel feed line located on the upper right side of the engine.
3. Reinstall the fuel pump relay.

Fuel System Diagnosis

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Turn the ignition OFF. 2. Turn the air conditioning system OFF. 3. Relieve fuel system pressure and install the fuel pressure gauge. 4. Turn the ignition ON. NOTE: The fuel pump will run for approximately 2 seconds. Use the Scan Tool to command the fuel pump ON. 5. Observe the fuel pressure indicated by the fuel pressure gauge with the fuel pump running. Is the fuel pressure within the specified limits?	283-376 kPa (41-55 psi)	Go to <i>Step 3</i>	Go to <i>Step 17</i>
3	Does the fuel pressure indicated by the fuel pressure gauge remain constant? NOTE: The fuel pressure will drop when the fuel pump stops running, then it should stabilize and remain constant.	—	Go to <i>Step 4</i>	Go to <i>Step 12</i>
4	1. When the vehicle is at normal operating temperature, turn the ignition ON to build fuel pressure and observe the measurement on the gauge. 2. Start the engine and observe the fuel pressure gauge. Did the reading drop by the amount specified after the engine was started?	21-105 kPa (3-15 psi)	Go to <i>Step 5</i>	Go to <i>Step 9</i>
5	Is fuel pressure dropping off during acceleration, cruise, or hard cornering?	—	Go to <i>Step 6</i>	Check for improper fuel
6	Visually and physically inspect the following items for a restriction: • The in-line fuel filter. • The fuel feed line. Was a restriction found?	—	Verify repair	Go to <i>Step 7</i>
7	Remove the fuel tank and visually and physically inspect the following items: • The fuel pump strainer for a restriction. • The fuel line for a leak. • Verify that the correct fuel pump is in the vehicle. Was a problem found in any of these areas?	—	Verify repair	Go to <i>Step 8</i>
8	Replace the fuel pump. Is the action complete?	—	Verify repair	—
9	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12-14 inches of vacuum to the fuel pressure regulator. Does the fuel pressure indicated by the fuel pressure gauge drop by the amount specified?	21-105 kPa (3-15 psi)	Go to <i>Step 10</i>	Go to <i>Step 11</i>

Step	Action	Value(s)	Yes	No
10	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	Verify repair	—
11	Replace the fuel pressure regulator. Is the action complete?	—	Verify repair	—
12	1. Run the fuel pump with the Scan Tool. 2. After pressure has built up, turn off the pump and clamp the supply hose shut with suitable locking pliers. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to <i>Step 13</i>	Go to <i>Step 15</i>
13	Visually inspect the fuel supply line and repair any leaks. Was a problem found?	—	Verify repair	Go to <i>Step 14</i>
14	Remove the fuel tank and inspect for leaky hose or in-tank fuel line. Was a problem found?	—	Verify repair	Go to <i>Step 8</i>
15	1. If the pliers are still clamped to the fuel supply hose, remove the locking pliers. 2. With suitable locking pliers, clamp the fuel return line to prevent fuel from returning to the fuel tank. 3. Run the fuel pump with the Scan Tool. 4. After pressure has built up, remove power to the pump. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to <i>Step 11</i>	Go to <i>Step 16</i>
16	Locate and replace any leaking fuel injector(s). Is the action complete?	—	Verify repair	—
17	Is the fuel pressure indicated by the fuel pressure gauge above the specified limit?	376 kPa (55 psi)	Go to <i>Step 18</i>	Go to <i>Step 21</i>
18	1. Relieve the fuel pressure. Refer to the <i>Fuel Pressure Relief</i> . 2. Disconnect the fuel return line from the fuel rail. 3. Attach a length of flexible hose to the fuel rail return outlet passage. 4. Place the open end of the flexible hose into an approved gasoline container. 5. Run the fuel pump with the Scan Tool. 6. Observe the fuel pressure indicated by the fuel pressure gauge with the fuel pump running. Is the fuel pressure within the specified limits?	290-376 kPa (42-55 psi)	Go to <i>Step 19</i>	Go to <i>Step 20</i>
19	Locate and correct the restriction in the fuel return line. Is the action complete?	—	Verify repair	—
20	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	Verify repair	Go to <i>Step 11</i>
21	Is the fuel pressure indicated by the fuel pressure gauge above the specified value?	0 kPa (0 psi)	Go to <i>Step 22</i>	Go to <i>Step 23</i>

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Step	Action	Value(s)	Yes	No
22	1. Command the fuel pump ON with the Scan Tool. 2. Using suitable pliers which will not damage the fuel hose, gradually apply pressure with the pliers to pinch the flexible fuel return hose closed. Does the fuel pressure indicated by the fuel pressure gauge rise above the first specified value? Caution: Do not let the fuel pressure exceed the second specified value.	376 kPa (55 psi) 414 kPa (60 psi)	Go to Step 11	Go to Step 7
23	1. Command the fuel pump ON with the Scan Tool. 2. Remove the fuel filler cap and listen for the sound of the fuel pump running. 3. Turn the pump off. Was the fuel pump running?	—	Go to Step 7	Go to Fuel System Electrical Test Chart

ECM DIAGNOSTIC TROUBLE CODES (DTC)

Type A

- Emission related.
- Requests illumination of the MIL (Malfunction Indicator Lamp = Check Engine Lamp) of the first trip with a fail.
- Stores a history DTC on the first trip.
- Stores a freeze frame (If empty).
- Stores a fail record.
- Updates the fail record each time the diagnostic test fails.

Type B

- Emission related.
- “Armed” after one trip with fail.
- “Disarmed” after one trip with a pass.
- Requests illumination of the MIL on the second consecutive trip with a fail.
- Store a history DTC on the second consecutive trip with a fail. (The DTC will be armed after the first fail.)
- Stores a freeze frame on the second consecutive trip with a fail (If empty).
- Stores a fail record when the first test fails (not dependent on consecutive trip).
- Updates the fail record each time the diagnostic test fails.

Type D

- Non emission related.
- Does not request illumination of any lamp.
- Stores a history DTC on the first trip.
- Does not store a freeze frame.
- Stores fail record when test fails.
- Updates the fail record each time the diagnostic test fails.

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Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0107	A	Manifold Absolute Pressure Circuit Low Input	1. No DTC relating to TPS. 2. Throttle position is more than 0% if engine speed is below 1000rpm, or throttle position more than 5% if engine speed is more than 1000rpm. 3. MAP sensor output is below 12KPa.	The ECM uses default manifold absolute pressure value based on engine speed and throttle position.	MAP sensor output is more than 12KPa.	1. Sensor power supply circuit open or short to ground circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. MAP sensor malfunction. 5. ECM malfunction.	J1-24/ J1-31
P0108	A	Manifold Absolute Pressure Circuit High Input	1. No DTC relating to TPS. 2. Throttle position is below 15% if engine speed is below 2500rpm, or throttle position is below 35% if engine speed is more than 2500rpm. 3. Engine run time is longer than 10 seconds. 4. MAP sensor output is more than 103KPa.		MAP sensor output is below 103KPa.	1. Sensor power supply circuit short to voltage circuit. 2. Sensor signal circuit short to voltage circuit. 3. Sensor ground circuit open or short to voltage circuit. 4. Poor connector connection. 5. MAP sensor malfunction. 6. ECM malfunction.	J1-16/ J1-24/ J1-31
P0112	A	Intake Air Temperature Sensor Low Input	1. No DTC relating to VSS. 2. Vehicle speed is more than 25km/h. 3. Engine run time is longer than 120 seconds. 4. IAT sensor output is more than 149°C.	The ECM uses 20°C condition as substitute.	IAT sensor output is below 149°C	1. Sensor signal circuit short to ground circuit. 2. IAT sensor malfunction. 3. ECM malfunction.	J2-22
P0113	A	Intake Air Temperature Sensor High Input	1. No DTC relating to VSS & ECT sensor. 2. Vehicle speed is below 70km/h. 3. Engine coolant temperature is more than -8°C. 4. Engine run time is longer than 120 seconds. 5. Mass air flow is below 30g/s. 6. IAT sensor output is below -38°C.		IAT sensor output is more than -38°C.	1. Sensor signal circuit open or short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. Poor connector connection 4. IAT sensor malfunction. 5. ECM malfunction.	J2-1/ J2-22
P0117	A	Engine Coolant Temperature Sensor Low Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is more than 149°C.	The ECM uses default engine coolant temperature value based on intake air temperature and engine run time.	ECT sensor output is below 149°C.	1. Sensor signal circuit short to ground circuit. 2. ECT sensor malfunction. 3. ECM malfunction.	J1-27
P0118	A	Engine Coolant Temperature Sensor High Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is below -38°C.		ECT sensor output is more than -38°C.	1. Sensor signal circuit open or short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. Poor connector connection 4. ECT sensor malfunction. 5. ECM malfunction.	J1-27/ J1-32

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0122	A	Throttle Position Sensor Low Input	TPS output voltage is below 0.14V.	The ECM uses 0% condition as substitute.	TPS output voltage is more than 0.14V.	1. Sensor power supply circuit open or short to ground circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. TPS malfunction. 5. ECM malfunction.	J1-7/ J1-15/
P0123	A	Throttle Position Sensor High Input	TPS output voltage is more than 4.9V.		TPS output voltage is below 4.9V.	1. Sensor power supply circuit short to voltage circuit. 2. Sensor signal circuit short to voltage circuit. 3. Sensor ground circuit open or short to voltage circuit. 4. Poor connector connection. 5. TPS malfunction. 6. ECM malfunction.	J1-7/ J1-15/ J1-32
P0131	A	O ₂ Sensor Circuit Low Voltage (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60°C. 3. O ₂ sensor bank 1 output voltage is below 50mV in "Closed Loop" condition.	"Open Loop" fuel control.	O ₂ sensor bank 1 output voltage is more than 50mV.	1. Sensor harness short to ground circuit. 2. O ₂ sensor malfunction. 3. ECM malfunction.	J2-6/ J2-21
P0132	A	O ₂ Sensor Circuit High Voltage (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60°C. 3. O ₂ sensor bank 1 output voltage is more than 952mV in "Closed Loop" condition.	"Open Loop" fuel control.	O ₂ sensor bank 1 output voltage is below 952mV.	1. Sensor harness short to voltage circuit. 2. O ₂ sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Incorrect fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	J2-6/ J2-21
P0134	A	O ₂ Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60°C. 3. Engine run time is longer than 40 seconds. 4. Mass air flow is more than 7g/s. 5. O ₂ sensor bank 1 output voltage is between 300mV and 600mV.	"Open Loop" fuel control.	O ₂ sensor bank 1 output voltage is below 300mV consecutively. OR O ₂ sensor bank 1 output voltage is more than 600mV consecutively.	1. Sensor harness open circuit. 2. O ₂ sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Incorrect fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	J2-6/ J2-21

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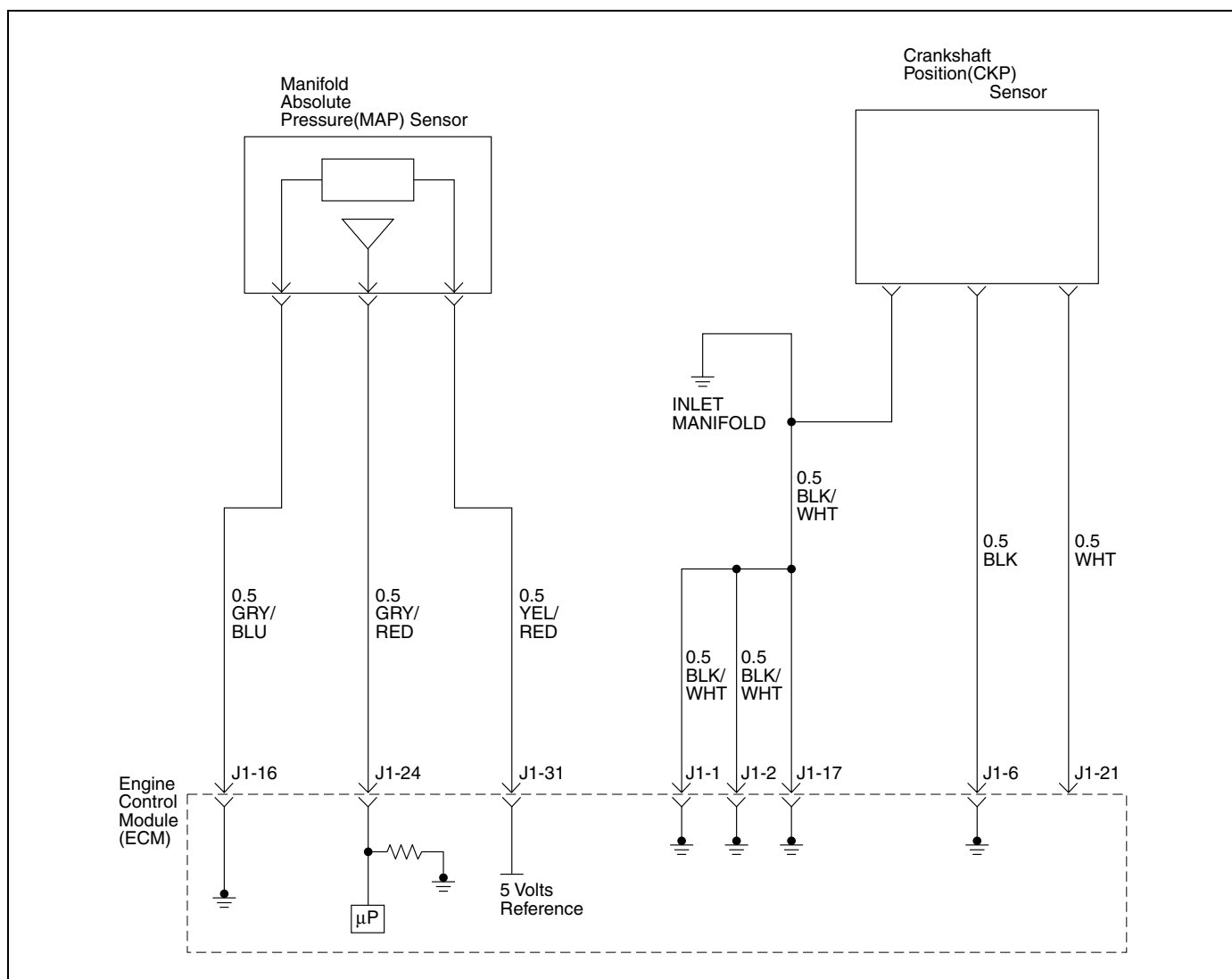
Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0135	A	O ₂ Sensor Heater Circuit (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor and ECT sensor. 2. Engine coolant temperature is more than 60°C. 3. Engine run time is longer than 20 seconds. 4. MAP sensor output is more than 70KPa. 5. O ₂ sensor bank 1 heater current more than 10mA.	No fail-safe function.	O ₂ sensor bank 1 heater circuit is correct condition.	1. Heater harness open, short to ground or short to voltage circuit. 2. O ₂ sensor heater malfunction. 3. ECM malfunction.	J2-31
P0201	A	Injector 1 Control Circuit	1. Engine is running. 2. Engine speed is more than 1000rpm. 3. Injector voltage does not meet to the battery voltage when the injector is commanded Off or does not meet to the 0V when the injector is commanded On.	No fail-safe function.	Injector circuit is correct condition.	1. Injector harness open circuit, short to ground or short to voltage circuit. 2. Injector malfunction. 3. ECM malfunction.	J1-9
P0202	A	Injector 2 Control Circuit					J1-22
P0203	A	Injector 3 Control Circuit					J1-8
P0204	A	Injector 4 Control Circuit					J1-11
P0325	B	Knock Sensor Module Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50°C. 3. Engine speed is more than 1600rpm. 4. Knock sensor filter module integrated circuit malfunction.	ECM retards ignition timing 4°C.	Knock sensor is correct condition.	1. KS harness open circuit. 2. Poor connector connection. 3. KS sensor malfunction. 4. ECM malfunction.	J1-3/ J1-32
P0327	A	Knock Sensor Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50°C. 3. Engine speed is more than 1600rpm. 4. Knock sensor harness short to ground or short to voltage circuit.			1. KS harness short to ground or short to voltage circuit. 2. Poor connector connection. 3. KS sensor malfunction. 4. ECM malfunction.	J1-3/ J1-32
P0336	B	Crankshaft Position Sensor Circuit Range/Performance (58X)	1. Engine is running. 2. Extra or missing pulse is detected consecutively.	No fail-safe function.	Correct pulse is detected consecutively.	1. CKP sensor harness open circuit, short to ground or short to voltage circuit. 2. Poor connector connection. 3. CKP sensor malfunction. 4. Pulse sensing gap incorrect. 5. Pluser malfunction. 6. Electrical interference. 7. Magnetic interference. 8. ECM malfunction.	J1-6/ J1-21
P0337	B	Crankshaft Position Sensor Circuit Low Input (58X)	No pulse is detected during engine cranking.			1. CKP sensor harness open circuit, short to ground or short to voltage. 2. Poor connector connection. 3. CKP sensor malfunction. 4. Pulse sensing gap incorrect. 5. Pluser malfunction. 6. Electrical interference. 7. Magnetic interference. 8. ECM malfunction.	J1-6/ J1-21

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0351	A	Ignition 1 Control Circuit	#2 or #3cylinder ignition signals are not detected consecutively.	No fail-safe function.	Consecutive ignition signals are detected.	1. Ignition coil module 1 harness open circuit, short to ground or short to voltage circuit. 2. Ignition coil module malfunction. 3. ECM malfunction.	J1-19
P0352	A	Ignition 2 Control Circuit	#1 or #4 cylinder ignition signals are not detected consecutively.			1. Ignition coil module 2 harness open circuit, short to ground or short to voltage circuit. 2. Ignition coil module malfunction. 3. ECM malfunction.	J1-18
P0443	B	EVAP Emission Control System Purge Control Circuit	EVAP purge solenoid circuit open, short to ground or short to voltage circuit.	No fail-safe function.	EVAP purge solenoid circuit is correct condition.	1. Solenoid harness open circuit, short to ground or short to voltage circuit. 2. Solenoid malfunction. 3. ECM malfunction.	J1-5
P0502	B	Vehicle Speed Sensor Circuit Low Input	1. No DTC relating to MAP sensor, TPS, ECT sensor, injector control circuit and ignition control circuit. 2. Engine is running. 3. Vehicle speed is below 3km/h in power condition or 2km/h in deceleration condition.	ECM uses 0km/h condition as substitute.	VSS circuit correct condition.	1. Sensor harness open circuit, short to ground circuit or short to voltage circuit. 2. Poor connector connection. 3. VSS malfunction. 4. ECM malfunction.	J2-23
P0562	D	System Voltage Low	Battery voltage is below 11V.	No fail-safe function.	Battery voltage is between 11V and 16V.	1. Battery power feed harness open circuit or short to ground circuit. 2. ECM ground harness open or poor connection. 3. Poor connector connection. 4. Battery malfunction. 5. Charge system malfunction. 6. ECM malfunction.	-
P0563	A	System Voltage High	Battery voltage is above 16V.			1. Charge system malfunction. 2. Battery jump start cable misconnect. 3. ECM malfunction.	-
P0601	A	ECM Memory Checksum	ECM memory area error.	Engine control disabled.	Memory are is OK.	ECM malfunction.	-
P0602	-	Programming Error	ECM memory area error.	Engine control disabled.	Memory are is OK.	ECM is not programmed.	-
P0650	A	Malfunction Indicator Lamp (MIL) Control Circuit Malfunction	Check engine lamp circuit open, short to ground or short to voltage circuit.	No fail-safe function.	Check engine lamp circuit is correct condition.	1. Solenoid harness open circuit, short to ground or short to voltage circuit. 2. Solenoid malfunction. 3. ECM malfunction.	J2-32

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Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P1167	D	Fuel Supply System Rich During Deceleration Fuel Cutoff	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. O ₂ sensor bank 1 output voltage is more than 550mV in deceleration fuel cutoff mode.	No fail-safe function.	O ₂ sensor output voltage is below 550mV.	1. Sensor harness open or short to ground circuit. 2. O ₂ sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. EVAP purge solenoid valve malfunction. 9. Ignition system malfunction. 10. Spark plug malfunction. 11. ECM malfunction.	J2-6/ J2-21
P1171	D	Fuel Supply System Lean During Power Enrichment	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60°C. 3. Mass air flow is below 13.5m/s. 4. O ₂ sensor bank 1 output voltage is below 350mV in power enrichment mode.	No fail-safe function.	O ₂ sensor output voltage is more than 350mV.	1. Sensor harness open or short to ground circuit. 2. O ₂ sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	J2-6/ J2-21
P1625	B	ECM System Reset	ECM reset has occurred other than "On".	Engine control disabled.	Memory are is OK.	1. Electrical interference. 2. Magnetic interference. 3. ECM malfunction.	-
P1626	-	Immobiliser No Signal	No response from immobiliser control unit.	1. Engine does not start. 2. Check engine lamp flash.	No recovery.	1. ECM and immobiliser control unit communication circuit open circuit, short to ground circuit or short to voltage circuit. 2. ECM malfunction. 3. Immobiliser control unit malfunction. 4. Transponder key malfunction.	J2-23/ J2-32
P1631	-	Immobiliser Wrong Signal	Received response is not correct.			1. ECM malfunction. 2. Immobiliser control unit malfunction. 3. Transponder key malfunction.	-
P1648	-	Wrong Security Code Entered	Received incorrect security code.			1. ECM malfunction. 2. Immobiliser control unit malfunction. 3. Transponder key malfunction.	-
P1649	-	Immobiliser Function Not Programmed	Immobiliser function is not programmed in the ECM.			ECM malfunction.	-
P1693	B	Tachometer Output Low Voltage	Tacho output circuit short to ground circuit.	No fail-safe function.	Tacho output circuit is correct condition.	1. Tacho output circuit short to ground circuit. 2. Poor connector connection. 3. ECM malfunction.	J2-25

DIAGNOSTIC TROUBLE CODE (DTC) P0107 MANIFOLD ABSOLUTE PRESSURE CIRCUIT LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0107	A	Manifold Absolute Pressure Circuit Low Input	1. No DTC relating to TPS. 2. Throttle position is more than 0% if engine speed is below 1000rpm, or throttle position more than 5% if engine speed is more than 1000rpm. 3. MAP sensor output is below 12KPa.	The ECM uses default manifold absolute pressure value based on engine speed and throttle position.

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure. The MAP sensor signal voltage to the engine control module (ECM) varies from below 2 volts at idle (low manifold pressure) to above 4 volts with the ignition ON, engine not running or at wide-open throttle (high manifold pressure).

A "speed density" method of determining engine load is used on the 2.4L engine. This is calculated using inputs from the MAP sensor, the CKP Sensor, and the Intake

Air Temperature (IAT) sensor. The MAP sensor is the main sensor used in this calculation, and measuring engine load is its main function.

The ECM monitors the MAP signals for voltages outside the normal range (10-104 kpa) of the MAP sensor. If the ECM detects a MAP signal voltage that is excessively low, Diagnostic Trouble Code P0107 will be set.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM - Inspect harness

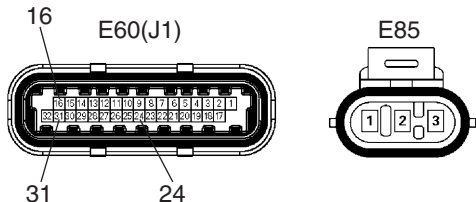
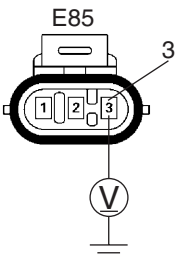
6E-112 ENGINE DRIVEABILITY AND EMISSIONS

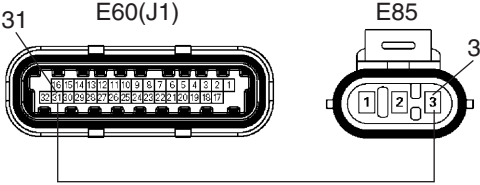
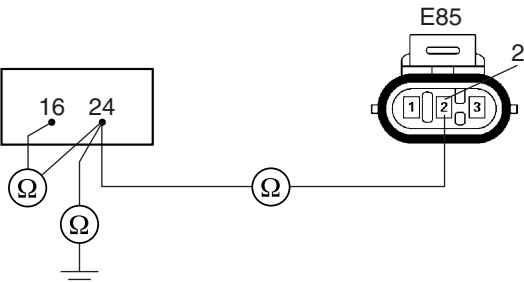
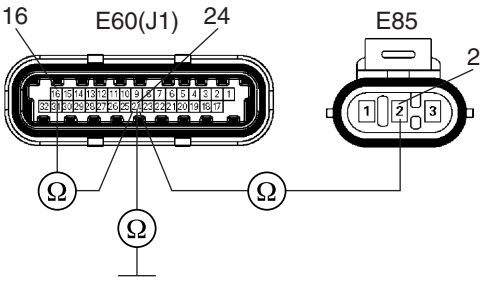
connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

- If these codes are also set, it could indicate a problem with the 5 Volt reference circuit.
- Damaged harness - Inspect the wiring harness for

damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the MAP display on the Tech 2 while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0107 Manifold Absolute Pressure Circuit Low Input

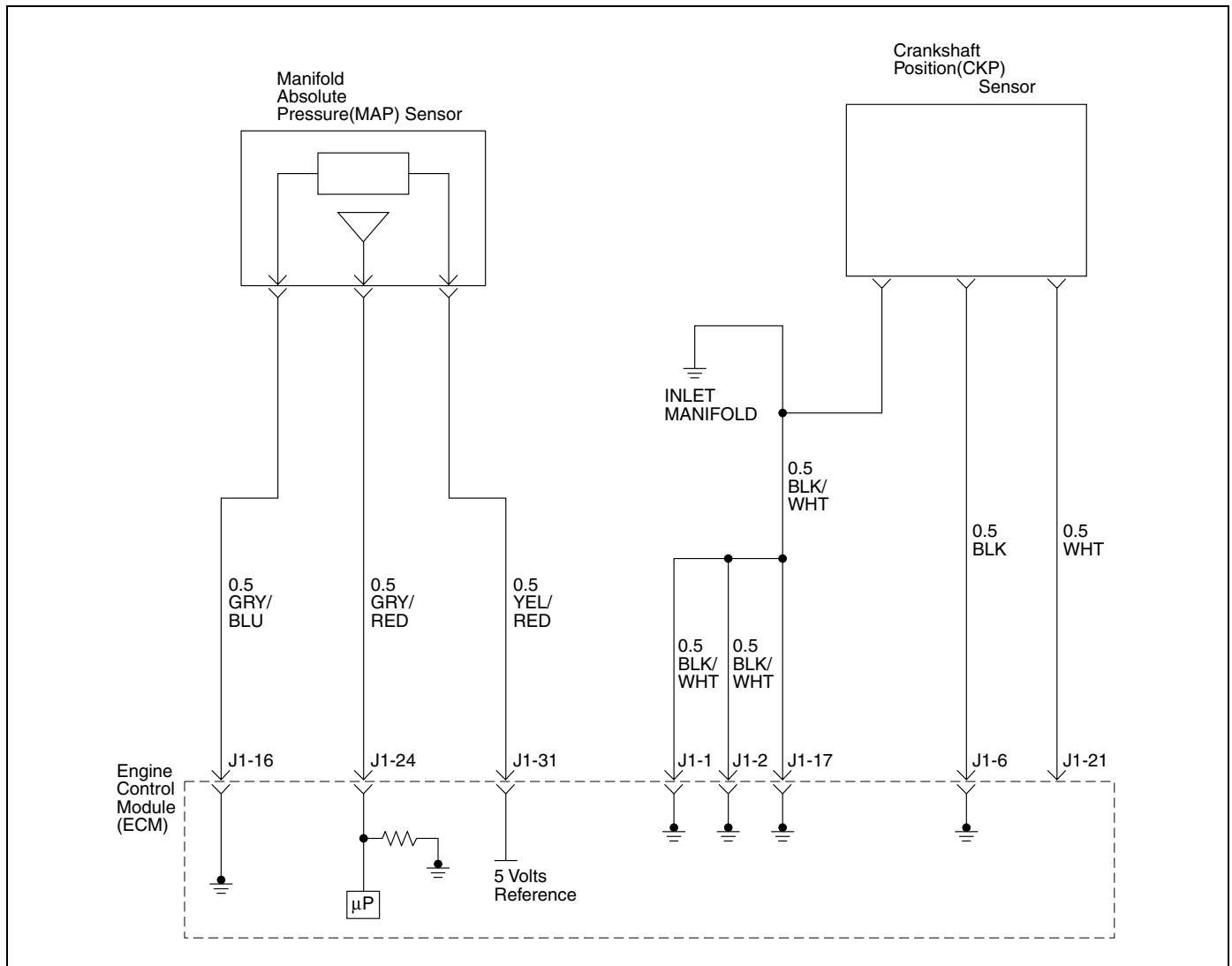
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0107 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0107 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the MAP sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 5
5	Visually check the MAP. Was the problem found?	—	Go to Step 9	Go to Step 6
6	Using the DVM and check the MAP sensor power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the MAP sensor connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to Step 8	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Repair the open or short to ground circuit between the ECM and MAP sensor Was the problem solved? 	—	Verify repair	Go to <i>Step 11</i>
8	Using the DVM and check the MAP sensor signal circuit. Breaker box is available: - Ignition "Off", engine "Off". - Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. - Disconnect MAP sensor connector. - Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  Breaker box is not available: - Ignition "Off", engine "Off". - Disconnect the MAP sensor connector and ECM connector. - Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 9</i>
9	Substitute a known good MAP sensor and recheck. Was the problem solved?	—	Go to <i>Step 10</i>	Go to <i>Step 11</i>
10	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to <i>Step 12</i>

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Step	Action	Value(s)	Yes	No
12	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0108 MANIFOLD ABSOLUTE PRESSURE CIRCUIT HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0108	A	Manifold Absolute Pressure Circuit High Input	1. No DTC relating to TPS. 2. Throttle position is below 15% if engine speed is below 2500rpm, or throttle position is below 35% if engine speed is more than 2500rpm. 3. Engine run time is longer than 10 seconds. 4. MAP sensor output is more than 103KPa.	The ECM uses default manifold absolute pressure value based on engine speed and throttle position.

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure. The MAP sensor signal voltage to the engine control module (ECM) varies from below 2 volts at idle (low manifold pressure) to above 4 volts with the ignition ON, engine not running or at wide-open throttle (high manifold pressure).

A "speed density" method of determining engine load is used on the 2.4L engine. This is calculated using inputs

from the MAP sensor, RPM, CKP Sensor, and the Intake Air Temperature (IAT) sensor. The MAP sensor is the main sensor used in this calculation, and measuring engine load is its main function.

The ECM monitors the MAP signals for voltages outside the normal range (10-104 kpa) of the MAP sensor. If the ECM detects a MAP signal voltage that is excessively high, Diagnostic Trouble Code P0108 will be set.

Diagnostic Aids

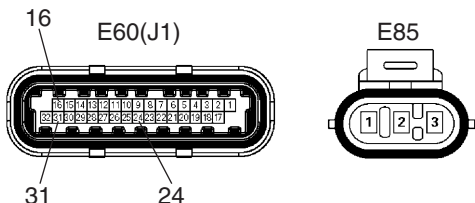
Check for the following conditions:

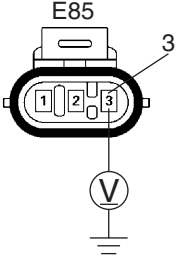
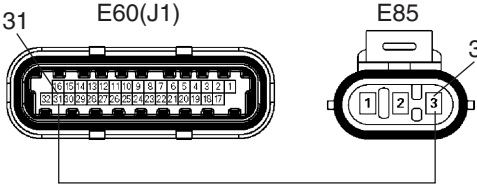
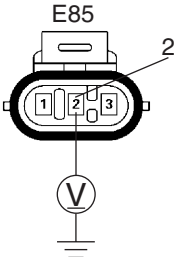
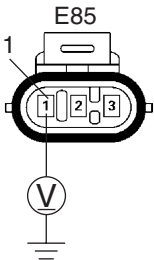
- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- If these codes are also set, it could indicate a

problem with the 5 Volt reference circuit.

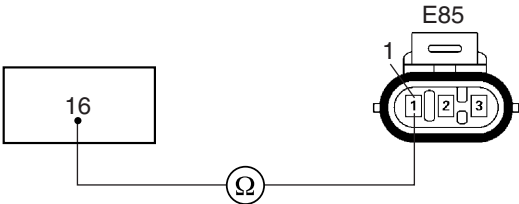
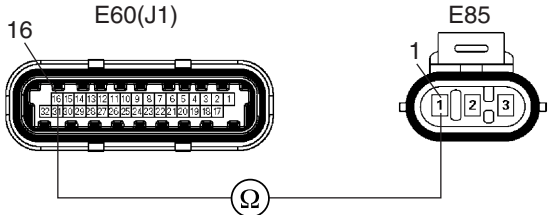
- Damaged harness - Inspect the wiring harness for damage; an open circuit, a short to ground, or a short to voltage. If the harness appears to be OK, observe the MAP display on the Tech 2 while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0108 Manifold Absolute Pressure Circuit High Input

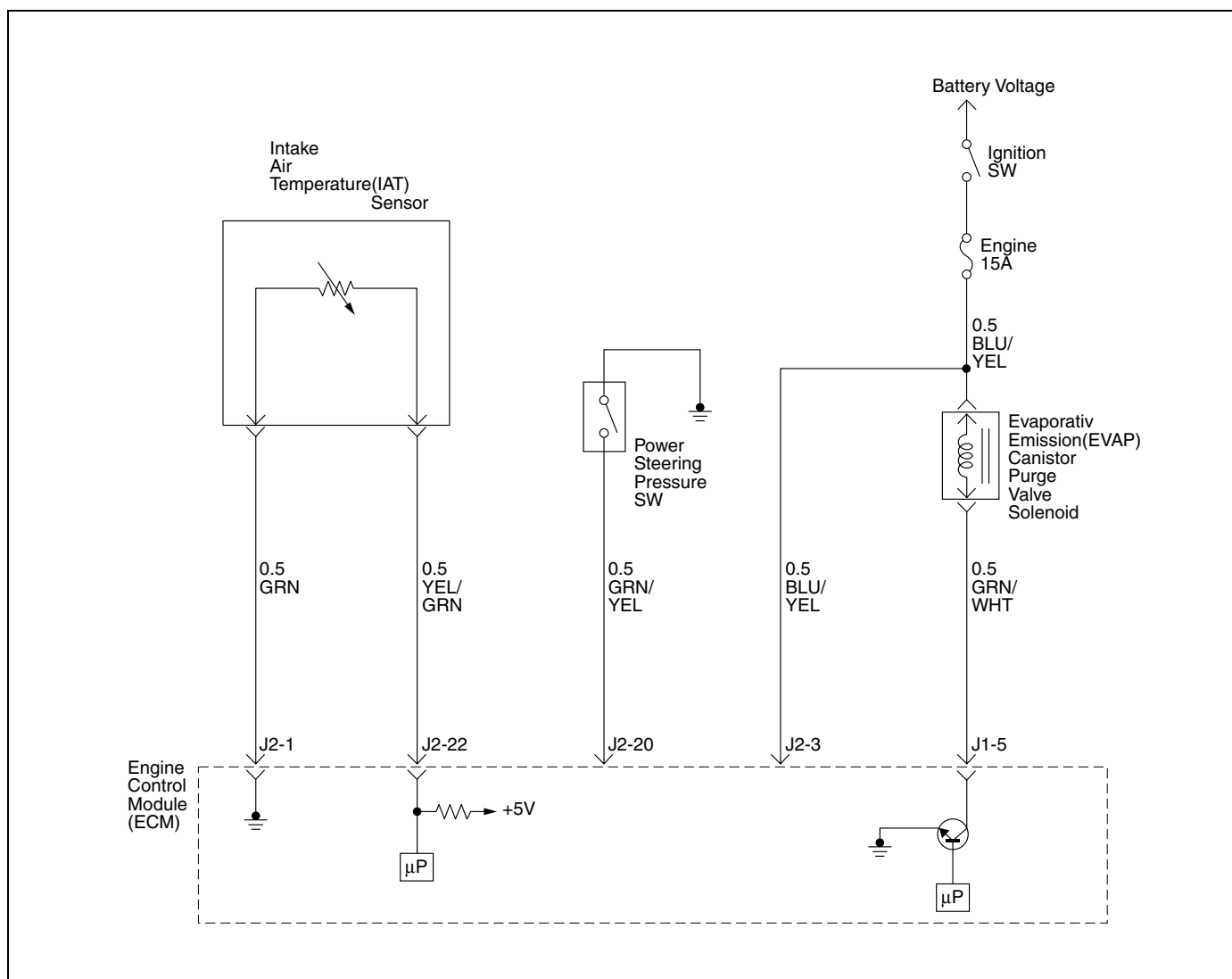
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0108 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 3</i>
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0108 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 4</i>
4	Check for poor/faulty connection at the MAP sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to <i>Step 5</i>
5	Visually check the MAP sensor. Was the problem found?	—	Go to Step 11	Go to <i>Step 6</i>

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the MAP sensor power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the MAP sensor connector. 3. Check the circuit for short to voltage circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to Step 8	Go to Step 7
7	Repair the short to voltage circuit between the ECM and MAP sensor. Was the problem solved? 	—	Verify repair	Go to Step 13
8	Using the DVM and check the MAP sensor signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the MAP sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to Step 9	Repair faulty harness and verify repair
9	Using the DVM and check the MAP sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the MAP sensor connector . 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to Step 10	Repair faulty harness and verify repair

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Step	Action	Value(s)	Yes	No
10	Using the DVM and check the MAP sensor ground circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the MAP sensor connector. 4. Check the circuit for open circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the MAP sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 11</i>
11	Substitute a known good MAP sensor and recheck. Was the problem solved?	—	Go to Step 12	Go to <i>Step 13</i>
12	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 14</i>
14	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0112 INTAKE AIR TEMPERATURE SENSOR LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0112	A	Intake Air Temperature Sensor Low Input	1. No DTC relating to VSS. 2. Vehicle speed is more than 25km/h. 3. Engine run time is longer than 120 seconds. 4. IAT sensor output is more than 149°C.	The ECM uses 20°C condition as substitute.

Circuit Description

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The engine control module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the sensor resistance is high and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage. Diagnostic Trouble Code P0112 will set when the ECM detects an excessively low signal voltage

(short to ground) on the intake air temperature sensor signal circuit.

Diagnostic Aids

Check for the following conditions:

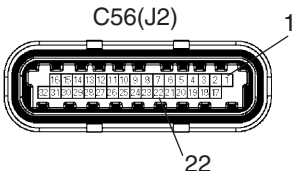
- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery and open

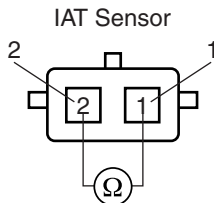
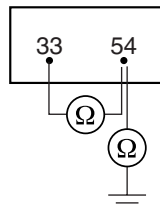
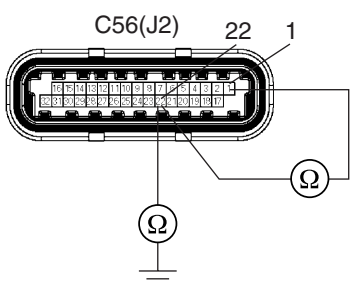
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circuit. If the harness appears to be OK, observe the IAT display on the Tech 2 while moving connectors and wiring harnesses related to the IAT sensor. A

change in the IAT display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0112 Intake Air Temperature Sensor Low Input

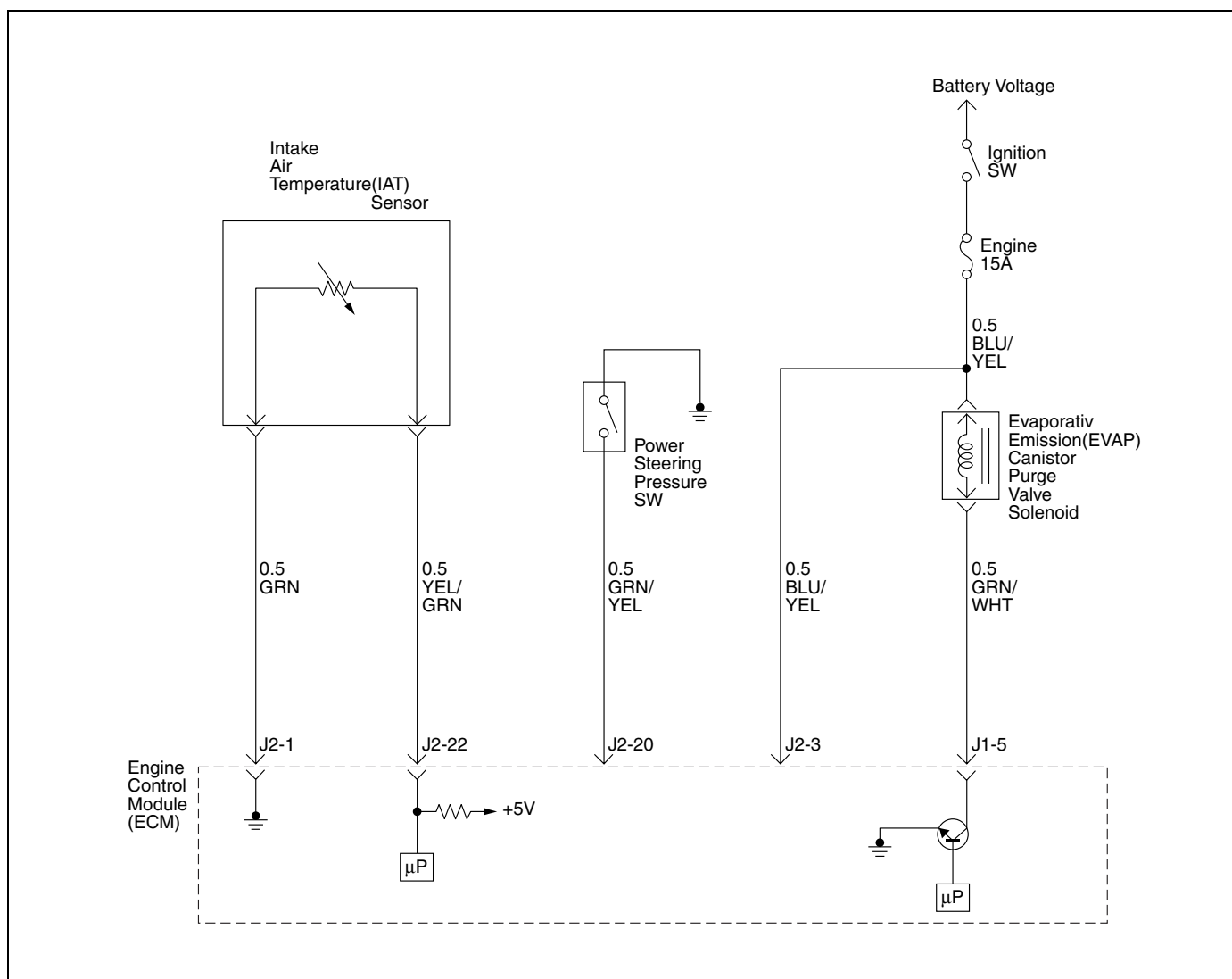
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to <i>Step 2</i>	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0112 stored as "Present Failure"?	—	Go to <i>Step 3</i>	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 3</i>
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0112 stored in this ignition cycle?	—	Go to <i>Step 4</i>	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 4</i>
4	Check for poor/faulty connection at the IAT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  	—	Verify repair	Go to <i>Step 5</i>
5	Remove the IAT sensor and visually check. Was the problem found?	—	Go to <i>Step 8</i>	Go to <i>Step 6</i>

Step	Action	Value(s)	Yes	No																
6	Using the DVM and check the IAT sensor. 1. Ignition “Off”, engine “Off”. 2. Disconnect IAT sensor connector. 3. Measure the resistance of IAT sensor. Does the tester indicate standard resistance as shown in the following table? <table><thead><tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr></thead><tbody><tr><td>-20</td><td>32040</td></tr><tr><td>0</td><td>9788</td></tr><tr><td>20</td><td>3516</td></tr><tr><td>40</td><td>1439</td></tr><tr><td>60</td><td>656</td></tr><tr><td>80</td><td>327</td></tr><tr><td>100</td><td>175</td></tr></tbody></table> IAT Sensor 	Temperature (°C)	Resistance (Ω) (Approximately)	-20	32040	0	9788	20	3516	40	1439	60	656	80	327	100	175	Standard resistance	Go to Step 7	Go to Step 8
Temperature (°C)	Resistance (Ω) (Approximately)																			
-20	32040																			
0	9788																			
20	3516																			
40	1439																			
60	656																			
80	327																			
100	175																			
7	Using the DVM and check the IAT sensor signal circuit. Breaker box is available: 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the IAT sensor connector. 4. Check the circuit for short to sensor ground or ground circuit. Was the problem found? 																			
	Breaker box is not available: 1. Ignition “Off”, engine “Off”. 2. Disconnect the IAT sensor connector. 3. Check the circuit for short to sensor ground or ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 10																

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Step	Action	Value(s)	Yes	No
8	Substitute a known good IAT sensor assembly and recheck. Was the problem solved?	—	Go to <i>Step 9</i>	Go to <i>Step 10</i>
9	Replace the IAT sensor assembly. Is the action complete?	—	Verify repair	—
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 11</i>
11	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0113 INTAKE AIR TEMPERATURE SENSOR HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0113	A	Intake Air Temperature Sensor High Input	1. No DTC relating to VSS & ECT sensor. 2. Vehicle speed is below 70km/h. 3. Engine coolant temperature is more than -8°C. 4. Engine run time is longer than 120 seconds. 5. Mass air flow is below 30g/s. 6. IAT sensor output is below -38°C.	The ECM uses 20°C condition as substitute.

Circuit Description

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The engine control module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the sensor resistance is high and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower causing the ECM to monitor a lower

voltage. Diagnostic Trouble Code P0113 will set when the ECM detects an excessively high signal voltage on the intake air temperature sensor signal circuit.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged

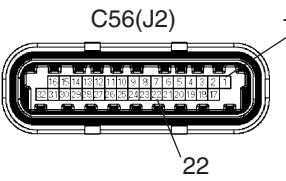
6E-124 ENGINE DRIVEABILITY AND EMISSIONS

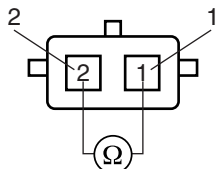
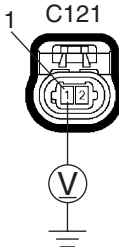
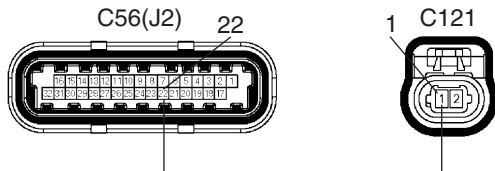
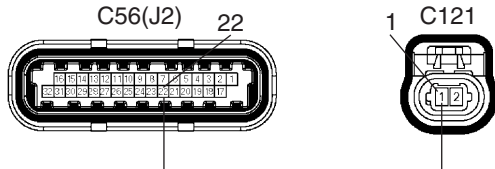
terminals, and poor terminal-to-wire connection.

- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK,

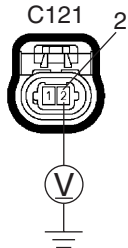
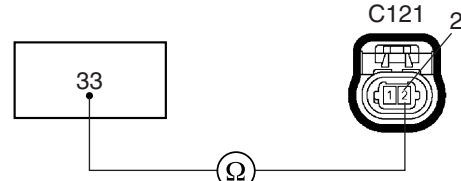
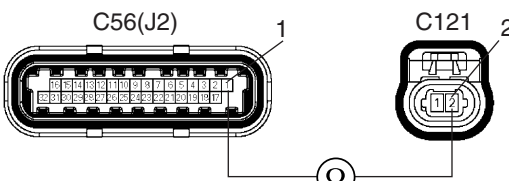
observe the IAT display on the Tech 2 while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0113 Intake Air Temperature Sensor High Input

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0113 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 3</i>
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0113 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 4</i>
4	Check for poor/faulty connection at the IAT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  C56(J2) 1 22  C121	—	Verify repair	Go to Step 5
5	Visually check the IAT sensor. Was the problem found?	—	Go to Step 12	Go to Step 6

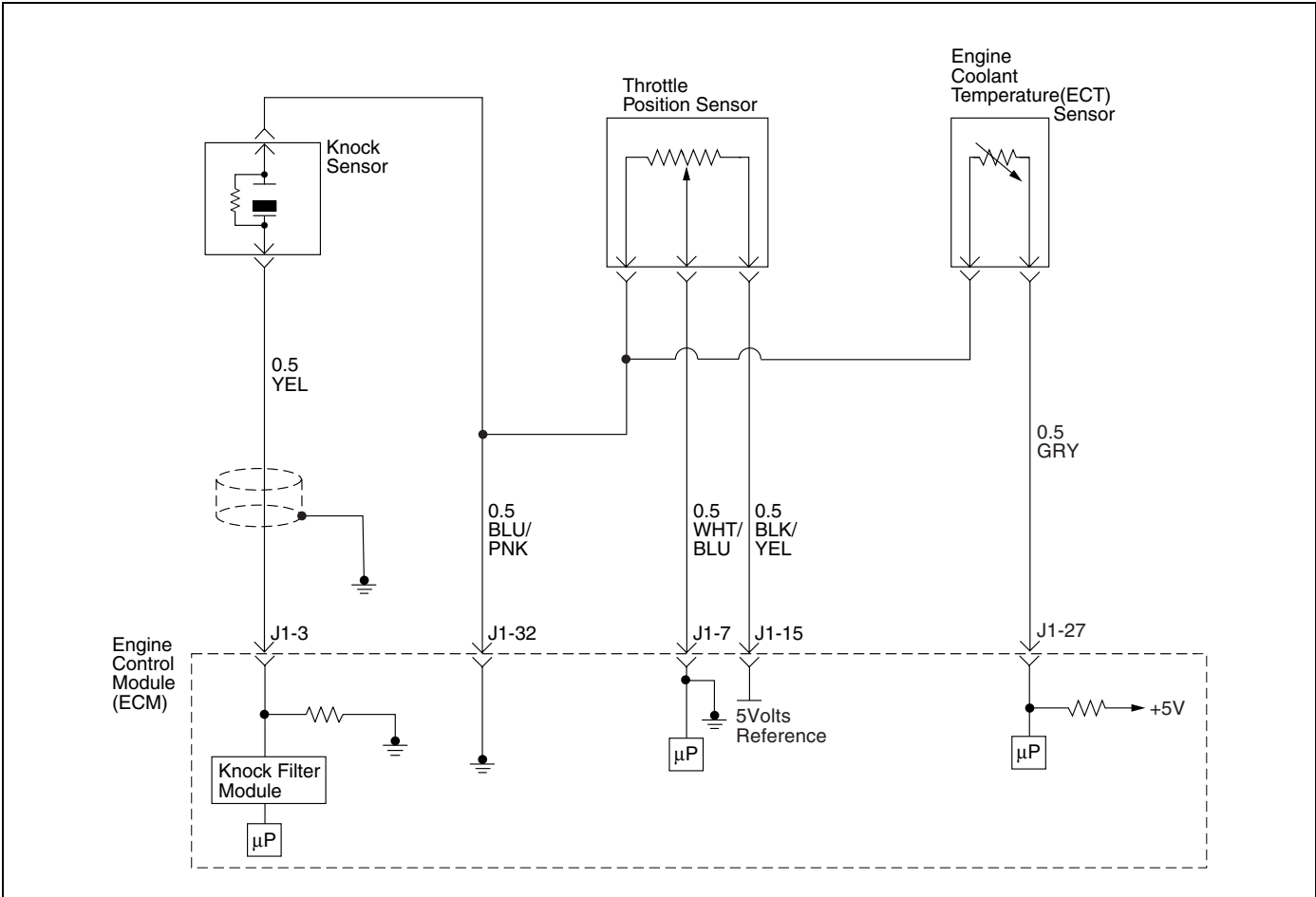
Step	Action	Value(s)	Yes	No																
6	Using the DVM and check the IAT sensor. 1. Ignition “Off”, engine “Off”. 2. Disconnect IAT sensor connector. 3. Measure the resistance of IAT sensor. Does the tester indicate standard resistance as shown in the following table? <table><tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr><tr><td>-20</td><td>32040</td></tr><tr><td>0</td><td>9788</td></tr><tr><td>20</td><td>3516</td></tr><tr><td>40</td><td>1439</td></tr><tr><td>60</td><td>656</td></tr><tr><td>80</td><td>327</td></tr><tr><td>100</td><td>175</td></tr></table> IAT Sensor 	Temperature (°C)	Resistance (Ω) (Approximately)	-20	32040	0	9788	20	3516	40	1439	60	656	80	327	100	175	Standard resistance	Go to <i>Step 7</i>	Go to <i>Step 12</i>
Temperature (°C)	Resistance (Ω) (Approximately)																			
-20	32040																			
0	9788																			
20	3516																			
40	1439																			
60	656																			
80	327																			
100	175																			
7	Using the DVM and check the IAT sensor signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the IAT sensor connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to <i>Step 10</i>	Less than 1V: Goto <i>Step 8</i> More than specified value: Go to <i>Step 9</i>																
8	Repair the open circuit between the ECM and IAT sensor. Was the problem solved? 	—	Verify repair	Go to <i>Step 14</i>																
9	Repair the short to voltage circuit between the ECM and IAT sensor. Was the problem solved? 	—	Verify repair	Go to <i>Step 14</i>																

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Step	Action	Value(s)	Yes	No
10	Using the DVM and check the IAT sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the IAT sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 11</i>	Repair faulty harness and verify repair
11	Using the DVM and check the IAT sensor ground circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the IAT sensor connector. 4. Check the circuit for open circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the IAT sensor connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 14</i>
12	Substitute a known good IAT sensor assembly and recheck. Was the problem solved?	—	Go to <i>Step 13</i>	Go to <i>Step 14</i>
13	Replace the IAT sensor assembly. Is the action complete?	—	Verify repair	—
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 15</i>

Step	Action	Value(s)	Yes	No
15	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0117 ENGINE COOLANT TEMPERATURE SENSOR LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0117	A	Engine Coolant Temperature Sensor Low Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is more than 149°C.	The ECM uses default engine coolant temperature value based on intake air temperature and engine run time.

Circuit Description

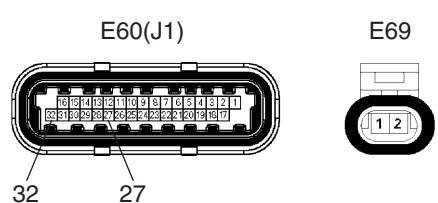
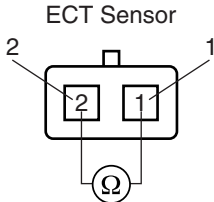
The engine coolant temperature (ECT) sensor is a thermistor mounted in the engine coolant stream. The engine control module (ECM) applies a voltage (about 5 volts) through a pull-up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore the ECM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes lower, and the ECT signal voltage measured at the ECM drops. Diagnostic Trouble code P0117 set when the ECM detects an excessively low signal voltage on the engine coolant temperature sensor signal circuit.

Diagnostic Aids

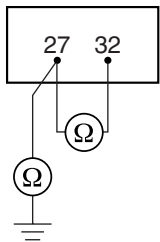
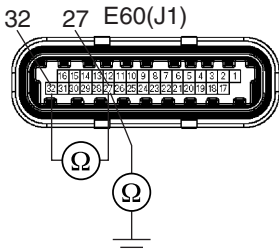
- Check for the following conditions:
- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
 - Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the ECT display on the Tech 2 while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0117

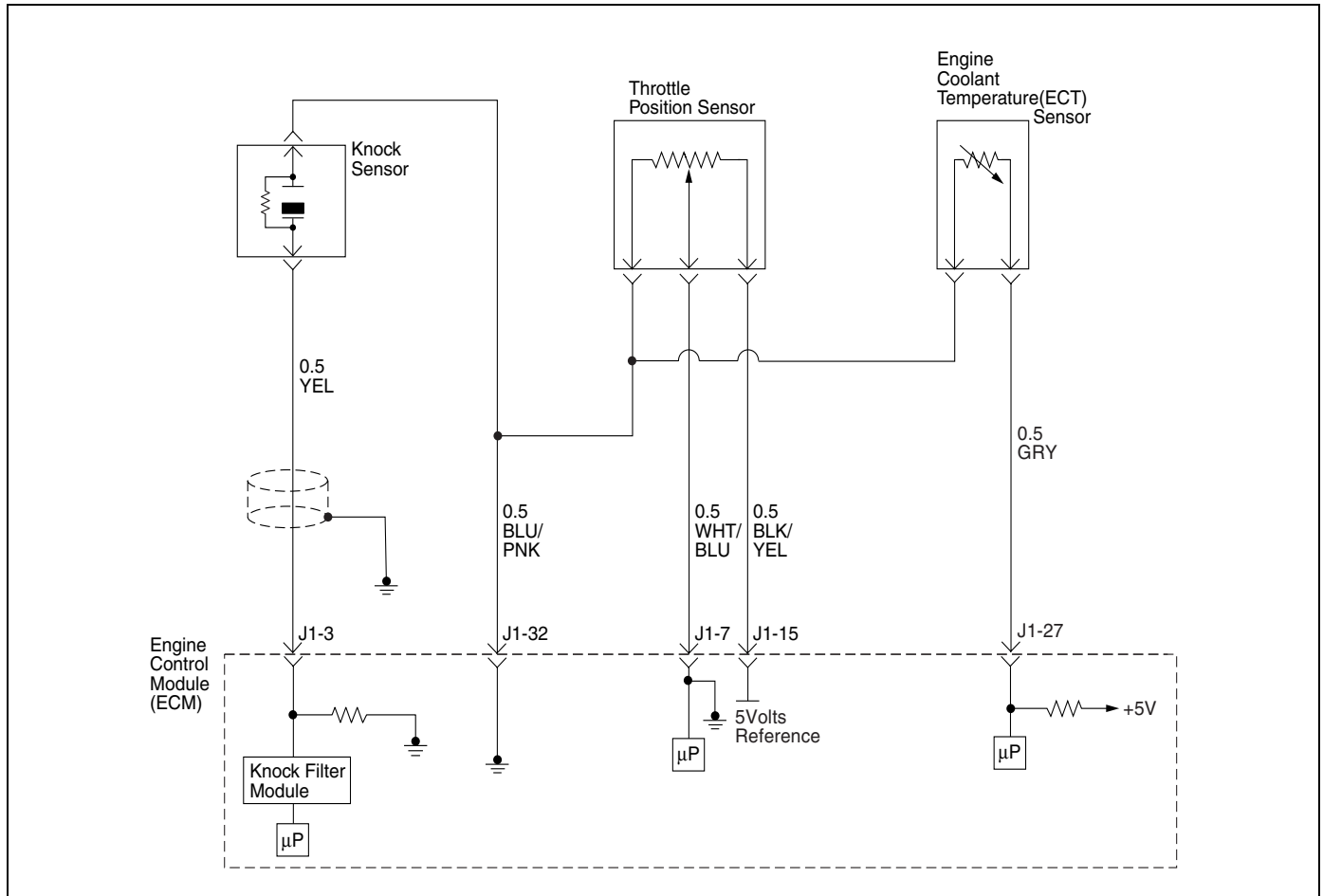
Engine Coolant Temperature Sensor Low Input

Step	Action	Value(s)	Yes	No																		
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>																		
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0117 stored as “Present Failure”?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3																		
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0117 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4																		
4	Check for poor/faulty connection at the ECT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E60(J1) E69 	—	Verify repair	Go to Step 5																		
5	Visually check the ECT sensor. Was the problem found?	—	Go to Step 8	Go to Step 6																		
6	Using the DVM and check the ECT sensor. 1. Ignition “Off”, engine “Off”. 2. Disconnect ECT sensor connector. 3. Measure the resistance of ECT sensor. Does the tester indicate standard resistance as shown in the following table? <table><tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr><tr><td>-20</td><td>32040</td></tr><tr><td>0</td><td>9788</td></tr><tr><td>20</td><td>3516</td></tr><tr><td>40</td><td>1439</td></tr><tr><td>60</td><td>656</td></tr><tr><td>80</td><td>327</td></tr><tr><td>100</td><td>175</td></tr><tr><td>120</td><td>100</td></tr></table> ECT Sensor 	Temperature (°C)	Resistance (Ω) (Approximately)	-20	32040	0	9788	20	3516	40	1439	60	656	80	327	100	175	120	100	Standard resistance	Go to Step 7	Go to Step 8
Temperature (°C)	Resistance (Ω) (Approximately)																					
-20	32040																					
0	9788																					
20	3516																					
40	1439																					
60	656																					
80	327																					
100	175																					
120	100																					

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Step	Action	Value(s)	Yes	No
7	Using the DVM and check the ECT sensor signal circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the ECT sensor connector. 4. Check the circuit for short to sensor ground or ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the ECT sensor connector. 3. Check the circuit for short to sensor ground or ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 10
8	Substitute a known good ECT sensor assembly and recheck. Was the problem solved?	—	Go to Step 9	Go to Step 10
9	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to Step 11
11	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0118 ENGINE COOLANT TEMPERATURE SENSOR HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0118	A	Engine Coolant Temperature Sensor High Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is below -38°C.	The ECM uses default engine coolant temperature value based on intake air temperature and engine run time.

Circuit Description

The engine coolant temperature (ECT) sensor is a thermistor mounted in the engine coolant stream. The engine control module (ECM) applies a voltage (about 5 volts) through a pull-up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore the ECM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes less, and the ECT signal voltage measured at the ECM drops. Diagnostic Trouble code P0118 set when the ECM detects an excessively high signal voltage on the engine coolant temperature sensor signal circuit.

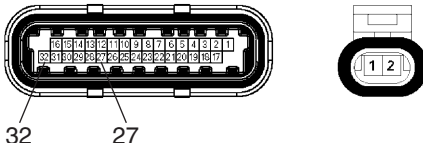
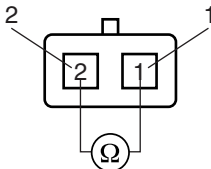
Diagnostic Aids

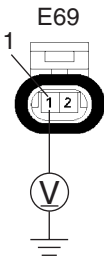
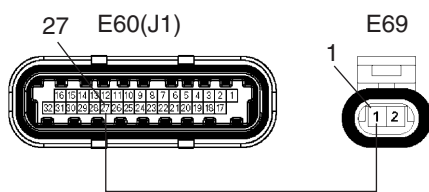
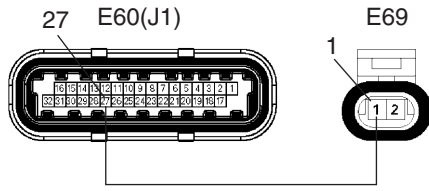
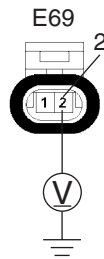
Check for the following conditions:

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the ECT display on the Tech 2 while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

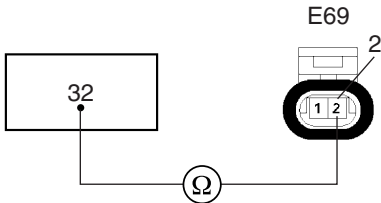
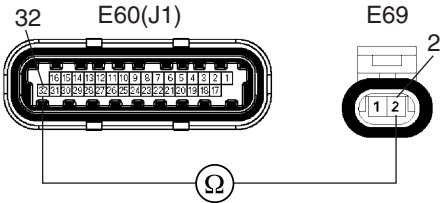
Diagnostic Trouble Code (DTC) P0118

Engine Coolant Temperature Sensor High Input

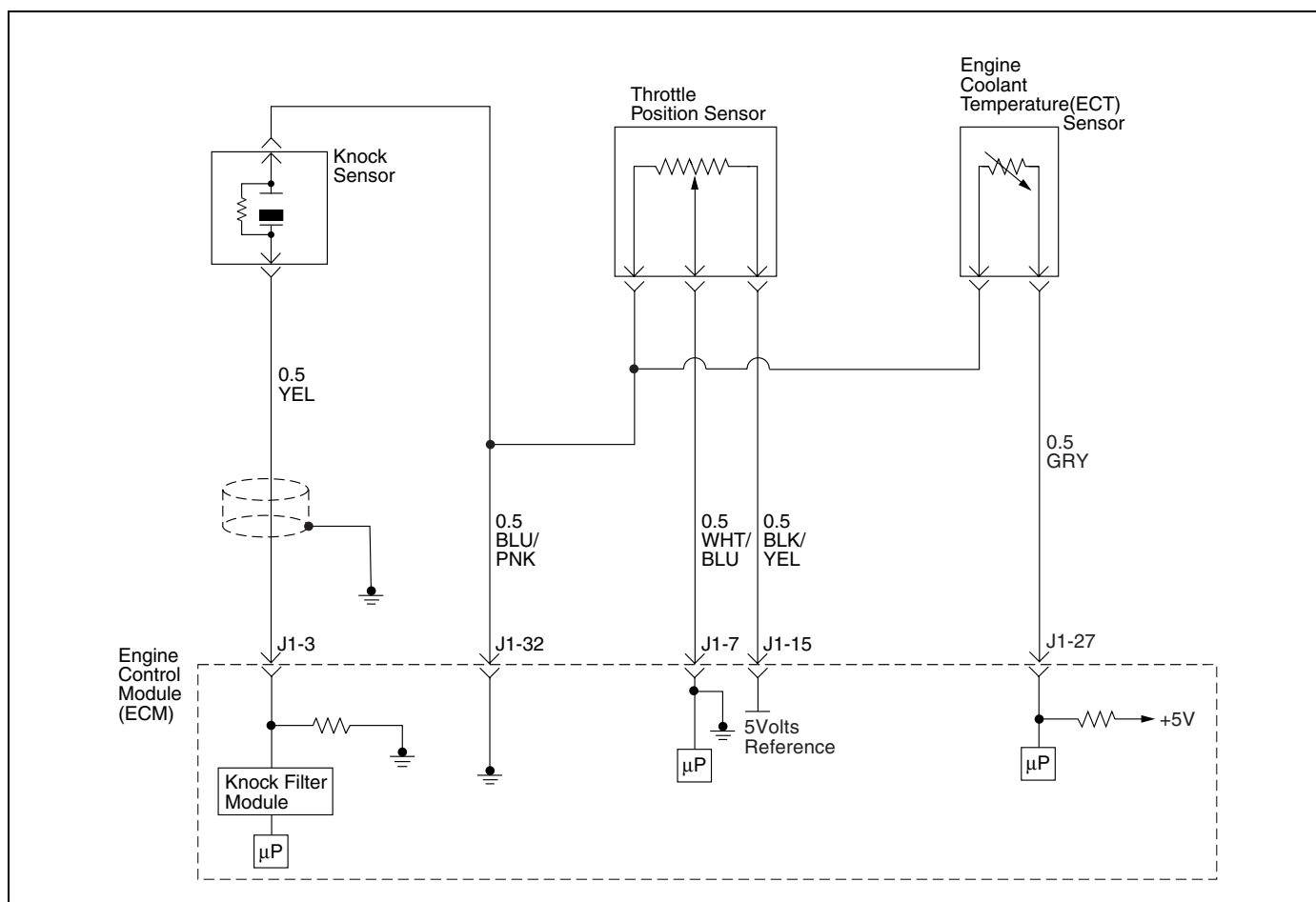
Step	Action	Value(s)	Yes	No																		
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>																		
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0118 stored as “Present Failure”?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3																		
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0118 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4																		
4	Check for poor/faulty connection at the ECT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E60(J1) E69 	—	Verify repair	Go to Step 5																		
5	Visually check the ECT sensor. Was the problem found?	—	Go to Step 12	Go to Step 6																		
6	Using the DVM and check the ECT sensor. 1. Ignition “Off”, engine “Off”. 2. Disconnect ECT sensor connector. 3. Measure the resistance of ECT sensor. Does the tester indicate standard resistance as shown in the following table? <table><tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr><tr><td>-20</td><td>32040</td></tr><tr><td>0</td><td>9788</td></tr><tr><td>20</td><td>3516</td></tr><tr><td>40</td><td>1439</td></tr><tr><td>60</td><td>656</td></tr><tr><td>80</td><td>327</td></tr><tr><td>100</td><td>175</td></tr><tr><td>120</td><td>100</td></tr></table> ECT Sensor 	Temperature (°C)	Resistance (Ω) (Approximately)	-20	32040	0	9788	20	3516	40	1439	60	656	80	327	100	175	120	100	Standard resistance	Go to Step 7	Go to Step 12
Temperature (°C)	Resistance (Ω) (Approximately)																					
-20	32040																					
0	9788																					
20	3516																					
40	1439																					
60	656																					
80	327																					
100	175																					
120	100																					

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the ECT sensor signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the ECT sensor connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to Step 10	Less than 1V: Goto Step 8 More than specified value: Go to Step 9
8	Repair the open circuit between the ECM and ECT sensor. Was the problem solved? 	—	Verify repair	Go to Step 14
9	Repair the short to voltage circuit between the ECM and ECT sensor. Was the problem solved? 	—	Verify repair	Go to Step 14
10	Using the DVM and check the ECT sensor ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the ECT sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to Step 11	Repair faulty harness and verify repair

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Step	Action	Value(s)	Yes	No
11	Using the DVM and check the ECT sensor ground circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the ECT sensor connector. 4. Check the circuit for open circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the ECT sensor connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 14
12	Substitute a known good ECT sensor assembly and recheck. Was the problem solved?	—	Go to Step 13	Go to Step 14
13	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to Step 15
15	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0122 THROTTLE POSITION SENSOR LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0122	A	Throttle Position Sensor Low Input	TPS output voltage is below 0.14V.	The ECM uses 0% condition as substitute.

Circuit Description

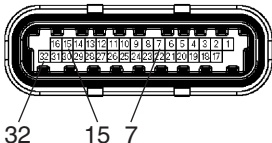
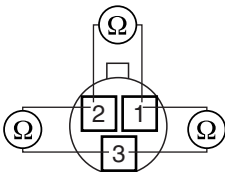
The throttle position sensor circuit provides a signal voltage that changes relative to throttle blade angle. The signal voltage will vary from below 1 volt at closed throttle to about 4 volts at wide open throttle (WOT).

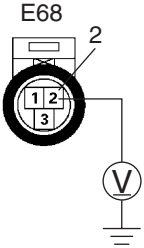
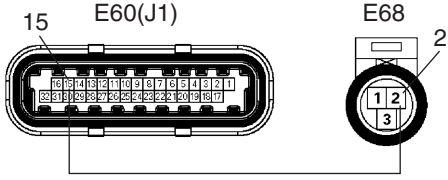
The TPS signal is used by the engine control module (ECM) for fuel control and most of the ECM-controlled outputs. If the ECM detect a continuous short to ground in the TPS or circuit, then a code P0122 will set.

Diagnostic Aids

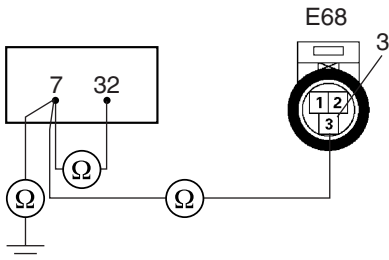
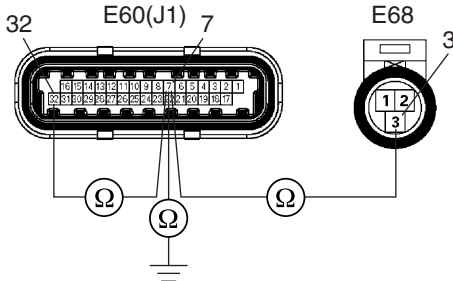
- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the throttle position display on the Tech 2 while moving connectors and wiring harnesses related to the TPS. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0122 Throttle Position Sensor Low Input

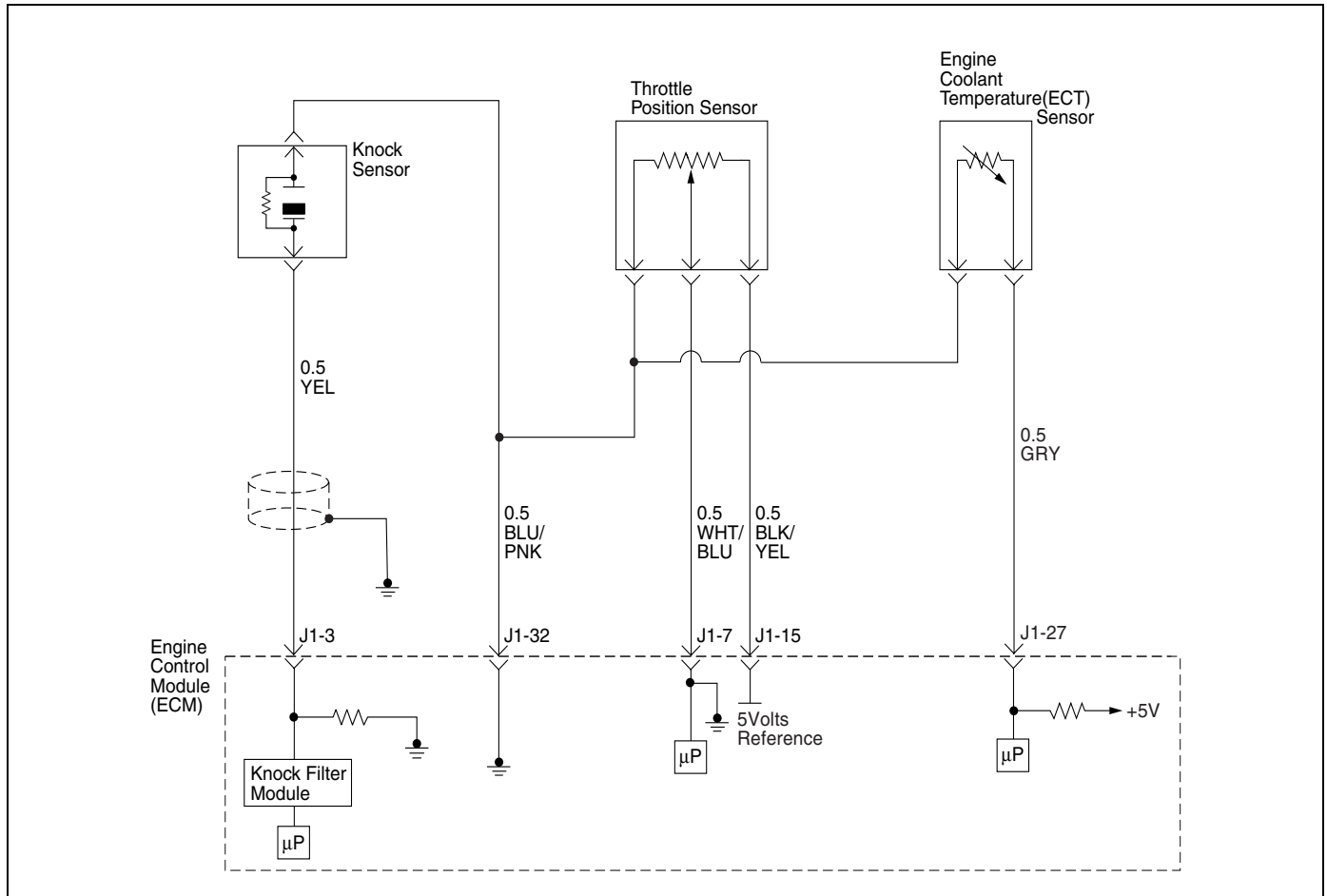
Step	Action	Value(s)	Yes	No										
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>										
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0122 stored as “Present Failure”?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3										
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0122 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4										
4	Check for poor/faulty connection at the TPS or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E60(J1)  E68 	—	Verify repair	Go to Step 5										
5	Visually check the TPS. Was the problem found?	—	Go to Step 10	Go to Step 6										
6	Using the DVM and check the TPS. 1. Ignition “Off”, engine “Off”. 2. Disconnect TPS connector. 3. Measure the resistance of TPS. Does the tester indicate standard resistance as shown in the following table? <table><tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr><tr><td>1 - 2</td><td>Approximately 5.6kΩ at idle position & WOT</td></tr><tr><td rowspan="2">2 - 3</td><td>Approximately 6.0kΩ at idle position</td></tr><tr><td>Approximately 1.7kΩ at WOT</td></tr><tr><td rowspan="2">1 - 3</td><td>Approximately 2.3kΩ at idle position & WOT</td></tr><tr><td>Approximately 6.6kΩ at WOT</td></tr></table> TPS 	Measurement Terminal	Resistance (Ω)	1 - 2	Approximately 5.6kΩ at idle position & WOT	2 - 3	Approximately 6.0kΩ at idle position	Approximately 1.7kΩ at WOT	1 - 3	Approximately 2.3kΩ at idle position & WOT	Approximately 6.6kΩ at WOT	Standard resistance	Go to Step 7	Go to Step 10
Measurement Terminal	Resistance (Ω)													
1 - 2	Approximately 5.6kΩ at idle position & WOT													
2 - 3	Approximately 6.0kΩ at idle position													
	Approximately 1.7kΩ at WOT													
1 - 3	Approximately 2.3kΩ at idle position & WOT													
	Approximately 6.6kΩ at WOT													

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the TPS power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to <i>Step 9</i>	Go to <i>Step 8</i>
8	Repair the open or short to ground circuit between the ECM and TPS. Was the problem solved? 	—	Verify repair	Go to <i>Step 12</i>

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Step	Action	Value(s)	Yes	No
9	Using the DVM and check the TPS signal circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect TPS connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the TPS connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 12
10	Substitute a known good TPS and recheck. Was the problem solved?	—	Go to Step 11	Go to Step 12
11	Replace the TPS. Is the action complete?	—	Verify repair	-
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to Step 12
13	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0123 THROTTLE POSITION SENSOR HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0123	A	Throttle Position Sensor High Input	TPS output voltage is more than 4.9V.	The ECM uses 0% condition as substitute.

Circuit Description

The throttle position sensor circuit provides a voltage signal that changes relative to throttle blade angle. The signal voltage will vary from below 1 volt at closed throttle to about 4 volts at wide open throttle (WOT). The TPS is used by the engine control module (ECM) for fuel control and most of the ECM-controlled outputs. If the ECM detect a continuous short voltage in the TPS or circuit, then a code P0123 will set.

Diagnostic Aids

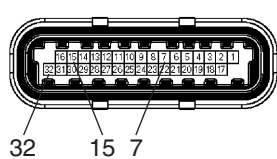
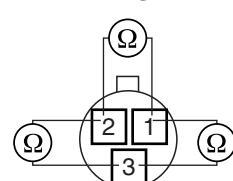
Check for the following conditions:

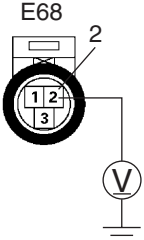
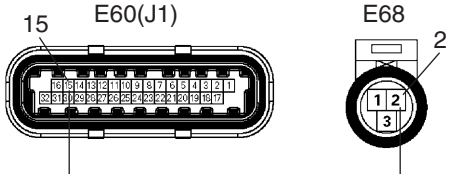
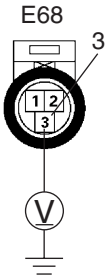
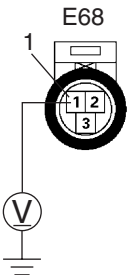
- Poor connection at ECM - Inspect harness

connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

- If these codes are also set, it could indicate a problem with the 5 Volt reference circuit or components itself.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive and open circuit. If the harness appears to be OK, observe the Throttle Position sensor display on the Tech 2 while moving connectors and wiring harnesses related to the TP sensor. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0123 Throttle Position Sensor High Input

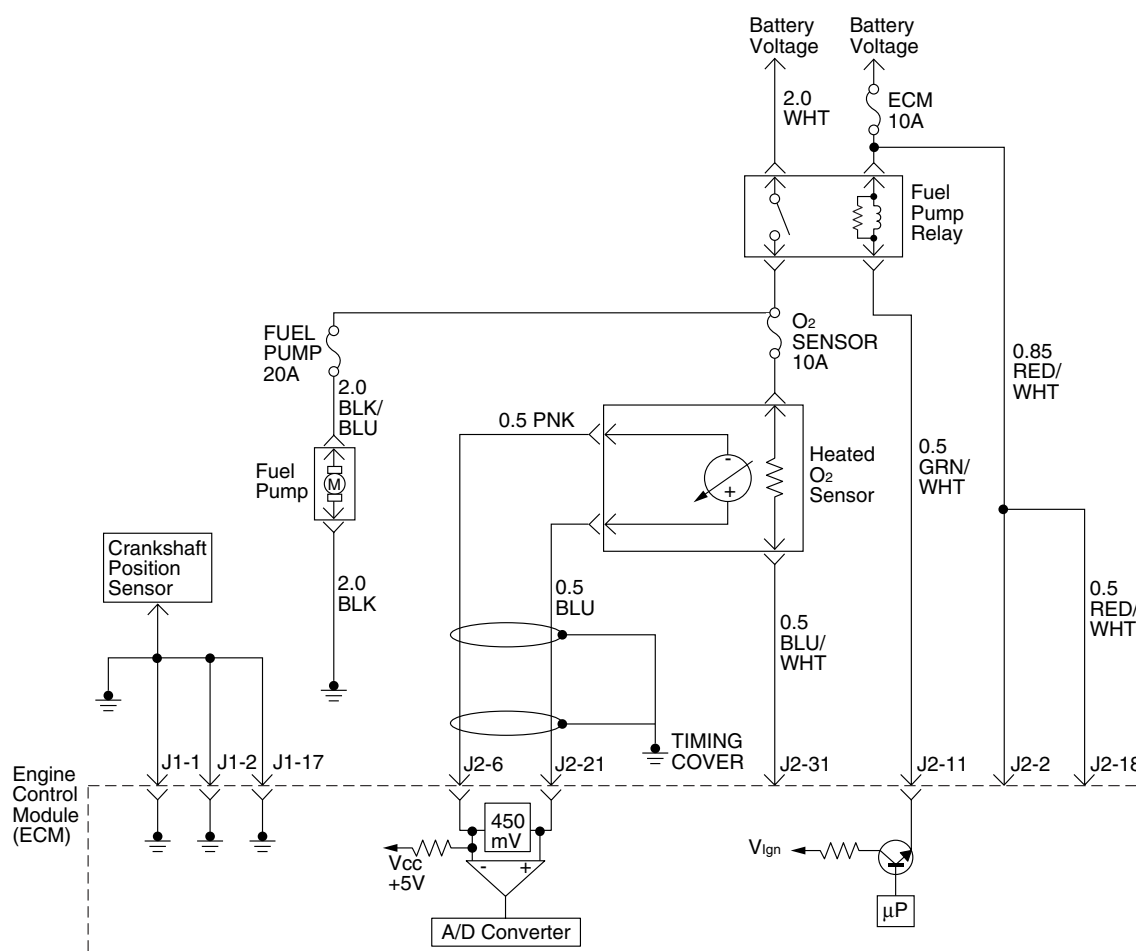
Step	Action	Value(s)	Yes	No										
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to <i>Step 2</i>	Go to <i>On Board Diagnostic (OBD) System Check</i>										
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0123 stored as “Present Failure”?	—	Go to <i>Step 3</i>	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 3</i>										
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0123 stored in this ignition cycle?	—	Go to <i>Step 4</i>	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 4</i>										
4	Check for poor/faulty connection at the TPS or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E60(J1)  E68 	—	Verify repair	Go to <i>Step 5</i>										
5	Visually check the TPS. Was the problem found?	—	Go to <i>Step 12</i>	Go to <i>Step 6</i>										
6	Using the DVM and check the TPS. 1. Ignition “Off”, engine “Off”. 2. Disconnect TPS connector. 3. Measure the resistance of TPS. Does the tester indicate standard resistance as shown in the following table? <table><tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr><tr><td>1 - 2</td><td>Approximately 5.6kΩ at idle position & WOT</td></tr><tr><td rowspan="2">2 - 3</td><td>Approximately 6.0kΩ at idle position</td></tr><tr><td>Approximately 1.7kΩ at WOT</td></tr><tr><td rowspan="2">1 - 3</td><td>Approximately 2.3kΩ at idle position & WOT</td></tr><tr><td>Approximately 6.6kΩ at WOT</td></tr></table> TPS 	Measurement Terminal	Resistance (Ω)	1 - 2	Approximately 5.6kΩ at idle position & WOT	2 - 3	Approximately 6.0kΩ at idle position	Approximately 1.7kΩ at WOT	1 - 3	Approximately 2.3kΩ at idle position & WOT	Approximately 6.6kΩ at WOT	Standard resistance	Go to <i>Step 7</i>	Go to <i>Step 12</i>
Measurement Terminal	Resistance (Ω)													
1 - 2	Approximately 5.6kΩ at idle position & WOT													
2 - 3	Approximately 6.0kΩ at idle position													
	Approximately 1.7kΩ at WOT													
1 - 3	Approximately 2.3kΩ at idle position & WOT													
	Approximately 6.6kΩ at WOT													

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the TPS power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS connector. 3. Check the circuit for short to voltage circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to <i>Step 9</i>	Go to <i>Step 8</i>
8	Repair the short to voltage circuit between the ECM and TPS. Was the problem solved? 	—	Verify repair	Go to <i>Step 14</i>
9	Using the DVM and check the TPS signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 10</i>	Repair faulty harness and verify repair
10	Using the DVM and check the TPS ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the TPS connector . 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 11</i>	Repair faulty harness and verify repair

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Step	Action	Value(s)	Yes	No
11	Using the DVM and check the TPS ground circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the TPS connector. 4. Check the circuit for open circuit. Was the problem found? Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the TPS connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found?	—	Repair faulty harness and verify repair	Go to <i>Step 14</i>
12	Substitute a known good TPS and recheck. Was the problem solved?	—	Go to <i>Step 13</i>	Go to <i>Step 14</i>
13	Replace the TPS. Is the action complete?	—	Verify repair	—
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 14</i>
15	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0131 O₂ SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 1)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0131	A	O ₂ Sensor Circuit Low Voltage (Bank 1 Sensor 1)	- No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. - Engine coolant temperature is more than 60°C. - O₂ sensor bank 1 output voltage is below 50mV in "Closed Loop" condition.	"Open Loop" fuel control.

Circuit Description

The engine control module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO₂S) signal and low circuits. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The ECM constantly monitors the HO₂S signal during "Closed Loop" operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the

Bank 1 HO₂S 1 voltage remains excessively low for an extended period of time, Diagnostic Trouble Code P0131 will be set.

Diagnostic Aids

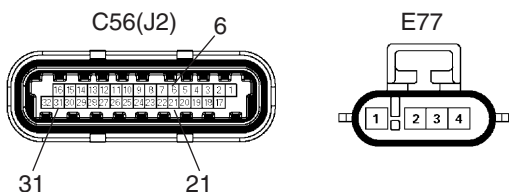
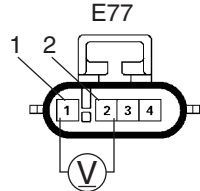
Check for the following conditions:

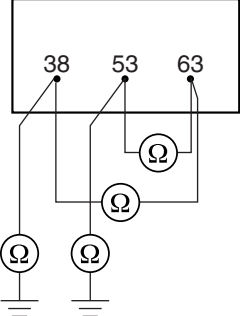
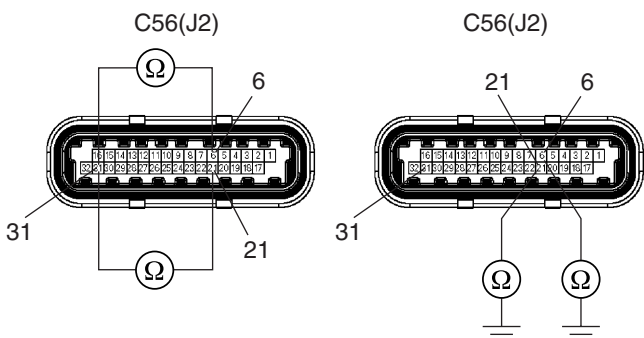
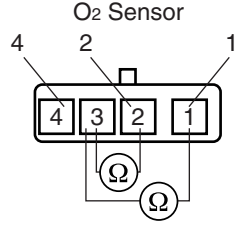
- Heated oxygen sensor wiring - The sensor pigtail may be routed incorrectly and/or contacting the exhaust system. Also, check for shorts to ground, shorts to battery positive and open circuits.

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- Poor ECM to engine block grounds.
- Fuel pressure - The system will go lean if pressure is too low. The ECM can compensate for some decrease. However, if fuel pressure is too low, a Diagnostic Trouble Code P0131 may be set. Refer to Fuel System Diagnosis.
- Lean injector(s) - Perform "Injector Balance Test."
- Vacuum leaks - Check for disconnected or damaged vacuum hoses and for vacuum leaks at the intake manifold, throttle body, EGR system, and PCV system.
- Exhaust leaks - An exhaust leak may cause outside air to be pulled into the exhaust gas stream past the HO2S, causing the system to appear lean. Check for exhaust leaks that may cause a false lean condition to be indicated.
- Fuel contamination - Water, even in small amounts, can be delivered to the fuel injectors. The water can cause a lean exhaust to be indicated. Excessive alcohol in the fuel can also cause this condition. For the procedure to check for fuel contamination, Refer to Fuel System Diagnosis.

Diagnostic Trouble Code (DTC) P0131 O₂ Sensor Circuit Low Voltage (Bank 1 Sensor 1)

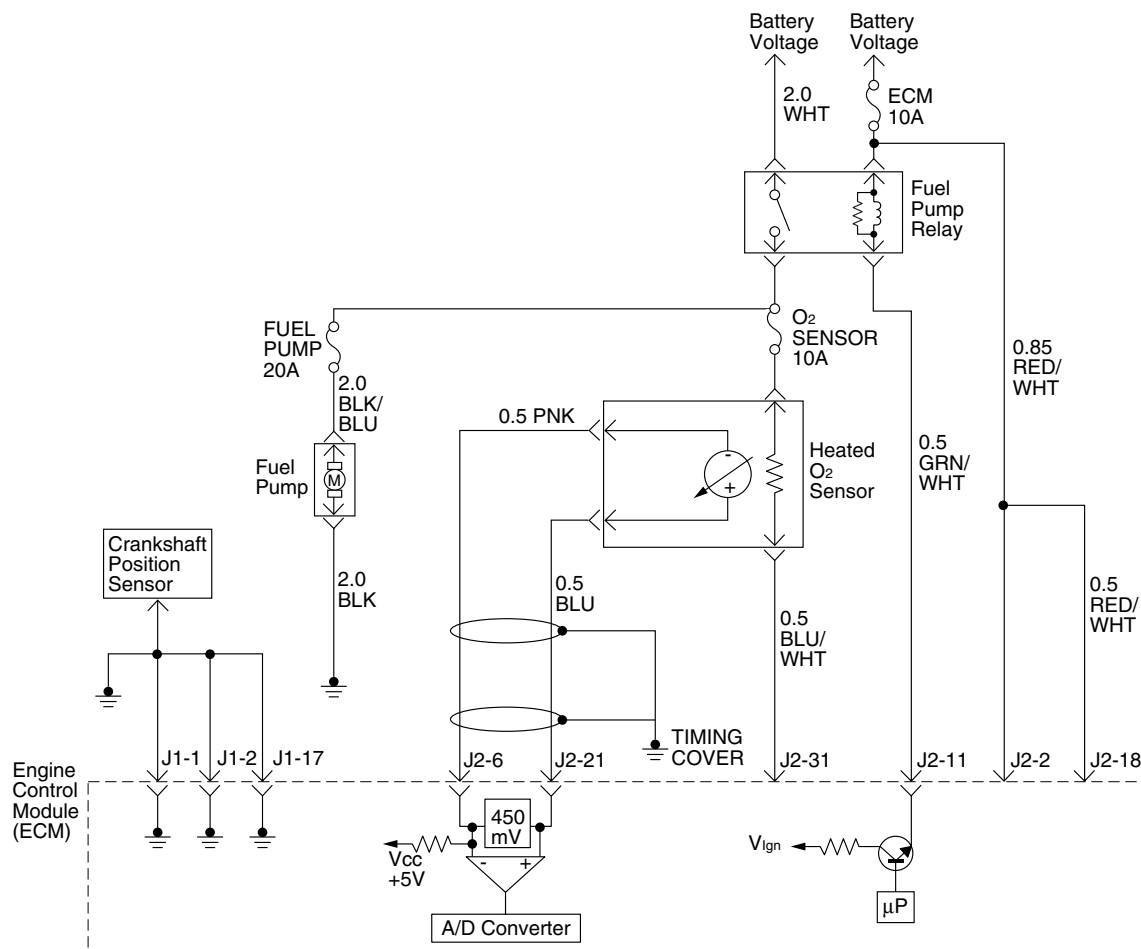
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0131 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0131 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the O ₂ sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 5
5	Using the DVM and check the O ₂ sensor circuit. 1. Ignition "On", engine "Off". 2. Disconnect the O ₂ sensor connector. 3. Check the circuit for short to heater ground or ground circuit. Was the DVM indicated specified value? 	Approximately 450mV	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the O₂ sensor circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the O₂ sensor. 4. Check the circuit for short to heater ground or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the O₂ sensor connector and ECM connector. 3. Check the circuit for short to heater ground or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 15
7	Using the DVM and check the O₂ sensor circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the the O₂ sensor connector. 3. Check the circuit for short to heater ground circuit. Was the DVM indicated specified value? 	No continuity	Go to Step 9	Go to Step 8
8	Repair the short to heater ground circuit. Was the problem found?	—	Verify repair	Go to Step 15

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Step	Action	Value(s)	Yes	No
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Manifold Absolute Pressure" in the data display. Does the Tech 2 indicate correct "Manifold Absolute Pressure" in accordance with engine speed or acceleration?	—	Go to <i>Step 11</i>	Go to <i>Step 10</i>
10	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 11</i>
11	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to <i>Step 13</i>	Go to <i>Step 12</i>
12	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 13</i>
13	Check for injector for the affected bank. Refer to " <i>Injector Coil Test & Injector Balance Test Procedure</i> ". Was the injector operation correct?	—	Go to <i>Step 14</i>	Refer to <i>Injector Coil Test & Injector Balance Test Procedure</i>
14	Check for fuel pressure. Refer to " <i>Fuel System Diagnosis</i> ". Was the fuel pressure correct?	—	Go to <i>Step 15</i>	Refer to <i>Fuel System Diagnosis</i>
15	Replace the O ₂ sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 16</i>
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to <i>Step 17</i>
17	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0132 O₂ SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 1)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0132	A	O ₂ Sensor Circuit High Voltage (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60°C. 3. O₂ sensor bank 1 output voltage is more than 952mV in "Closed Loop" condition.	"Open Loop" fuel control.

Circuit Description

The engine control module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO₂S) signal and low circuits. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The ECM constantly monitors the HO₂S signal during "Closed Loop" operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the

Bank 1 HO₂S 1 voltage remains excessively high for an extended period of time, Diagnostic Trouble Code P0132 will be set.

Diagnostic Aids

Check the following items:

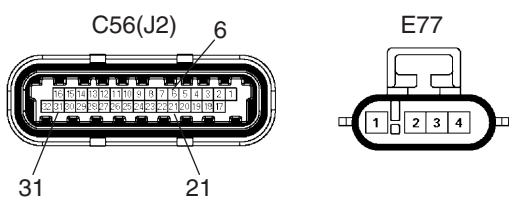
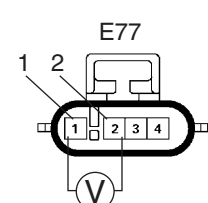
- Fuel pressure - The system will go rich if pressure is too high. The ECM can compensate for some increase. However, if fuel pressure is too high, a Diagnostic Trouble Code P0132 may be set. Refer to

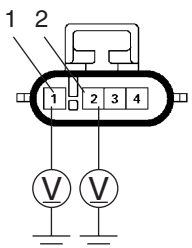
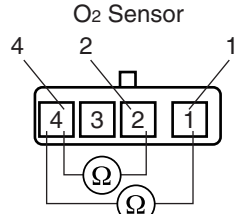
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Fuel System Diagnosis.

- Perform "Injector Balance Test" - Refer to Fuel System Diagnosis.
- Check the EVAP canister for fuel saturation - If full of fuel, check canister control and hoses. Refer to Evaporative (EVAP) Emission Control System.
- Check for a leak in the fuel pressure regulator diaphragm by checking the vacuum line to the regulator for the presence of fuel.
- An intermittent TPS output will cause the system to go rich due to a false indication of the engine accelerating.
- Silicon contamination of the HO2S can also cause a high HO2S voltage to be indicated. This condition is indicated by a powdery white deposit on the portion of the HO2S exposed to the exhaust stream. If contamination is noticed, replace the affected HO2S.

Diagnostic Trouble Code (DTC) P0132 O₂ Sensor Circuit High Voltage (Bank 1 Sensor 1)

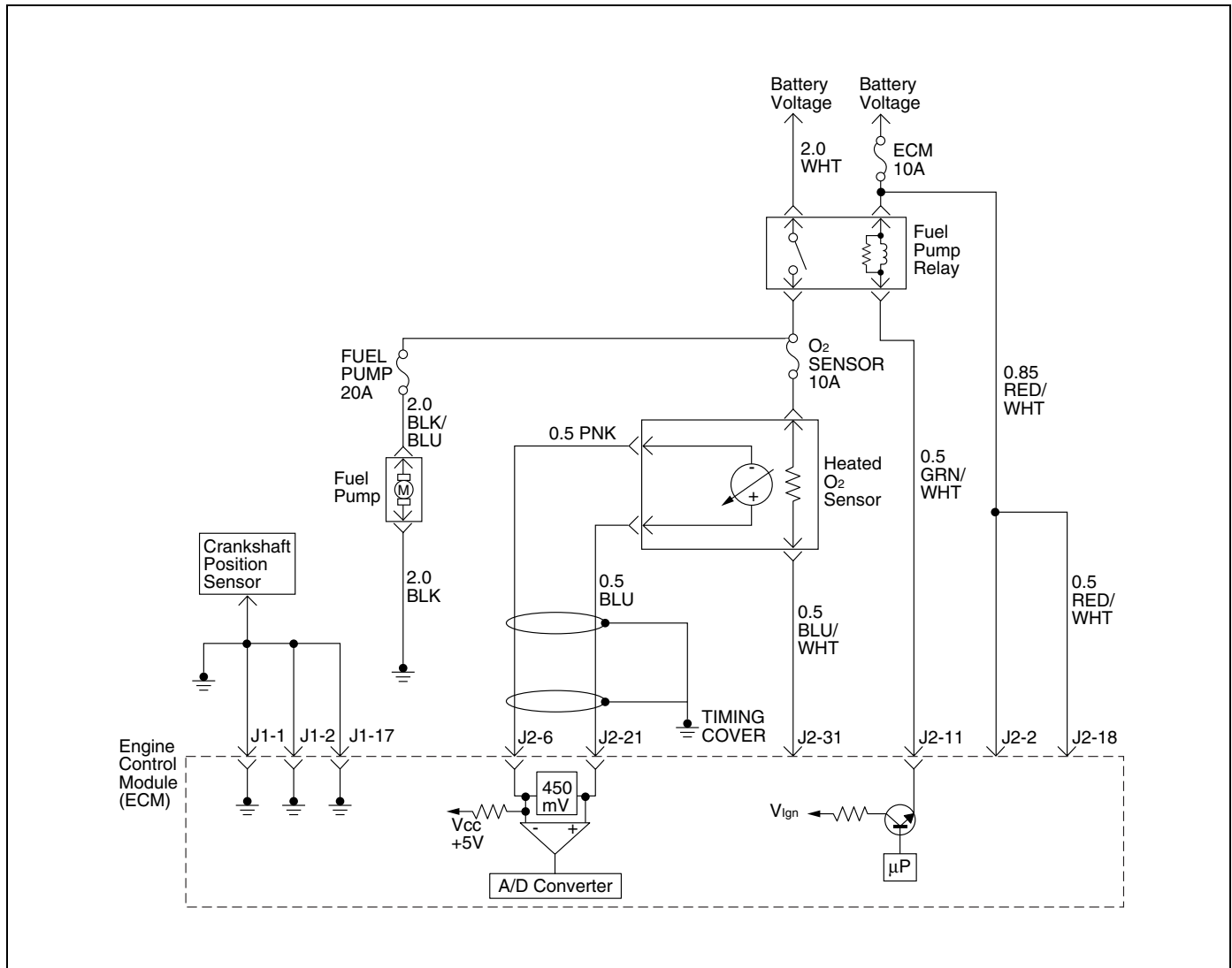
Step	Action	Value(S)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0132 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0132 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the O ₂ sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 5
5	Using the DVM and check the O ₂ sensor circuit. 1. Ignition "On", engine "Off". 2. Disconnect the the O ₂ sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Approximatly 450mV	Go to Step 7	Go to Step 6

Step	Action	Value(S)	Yes	No
6	Using the DVM and check the O₂ sensor circuit. 1. Ignition "On", engine "Off". 2. Disconnect the O₂ sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? E77 	Less than 1V	Go to <i>Step 15</i>	Repair faulty harness and verify repair
7	Using the DVM and check the O₂ sensor circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the the O₂ sensor connector. 3. Check the circuit for short to heater power supply circuit. Was the DVM indicated specified value? O₂ Sensor 	No continuity	Go to <i>Step 9</i>	Go to <i>Step 8</i>
8	Repair the short to heater power supply circuit. Was the problem found?	—	Verify repair	Go to <i>Step 15</i>
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Manifold Absolute Pressure" in the data display. Does the Tech 2 indicate correct "Manifold Absolute Pressure" in accordance with engine speed or acceleration?	—	Go to <i>Step 11</i>	Go to <i>Step 10</i>
10	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 11</i>
11	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to <i>Step 13</i>	Go to <i>Step 12</i>

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Step	Action	Value(S)	Yes	No
12	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 13</i>
13	Check for injector for the affected bank. Refer to <i>“Injector Coil Test & Injector Balance Test Procedure”</i> . Was the injector operation correct?	—	Go to <i>Step 14</i>	Refer to <i>Injector Coil Test & Injector Balance Test Procedure</i>
14	Check for fuel pressure. Refer to <i>“Fuel System Diagnosis”</i> . Was the fuel pressure correct?	—	Go to <i>Step 15</i>	Refer to <i>Fuel System Diagnosis</i>
15	Replace the O ₂ sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 16</i>
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “SPS (Service Programming System)” . Was the problem solved?	—	Verify repair	Go to <i>Step 17</i>
17	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0134 O₂ SENSOR NO ACTIVITY DEFECTED CIRCUIT (BANK 1 SENSOR 1)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0134	A	O ₂ Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60°C. 3. Engine run time is longer than 40 seconds. 4. Mass air flow is more than 7g/s. 5. O₂ sensor bank 1 output voltage is between 300mV and 600mV.	"Open Loop" fuel control.

Circuit Description

The engine control module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO₂S) high and low circuits. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The ECM constantly monitors the HO₂S signal during "Closed Loop" operation and

compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the Bank 1 HO₂S 1 voltage remains at or near the 450 mV bias for an extended period of time, Diagnostic Trouble Code P0134 will be set, indicating an open sensor signal or sensor low circuit.

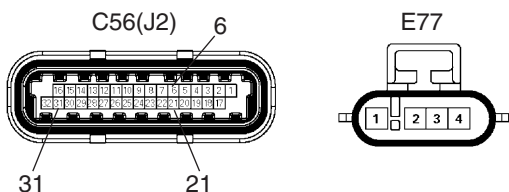
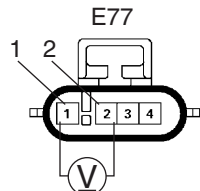
Diagnostic Aids

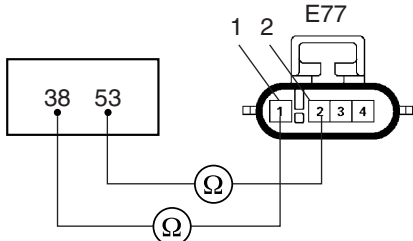
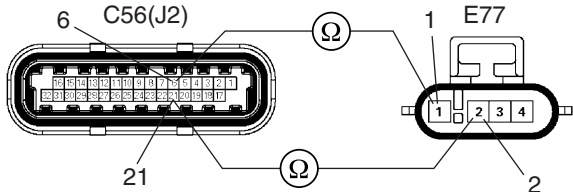
Check for the following conditions:

- Poor connection or damaged harness - Inspect the

harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Diagnostic Trouble Code (DTC) P0134 O₂ Sensor Circuit No Activity Detected (Bank 1 Sensor 1)

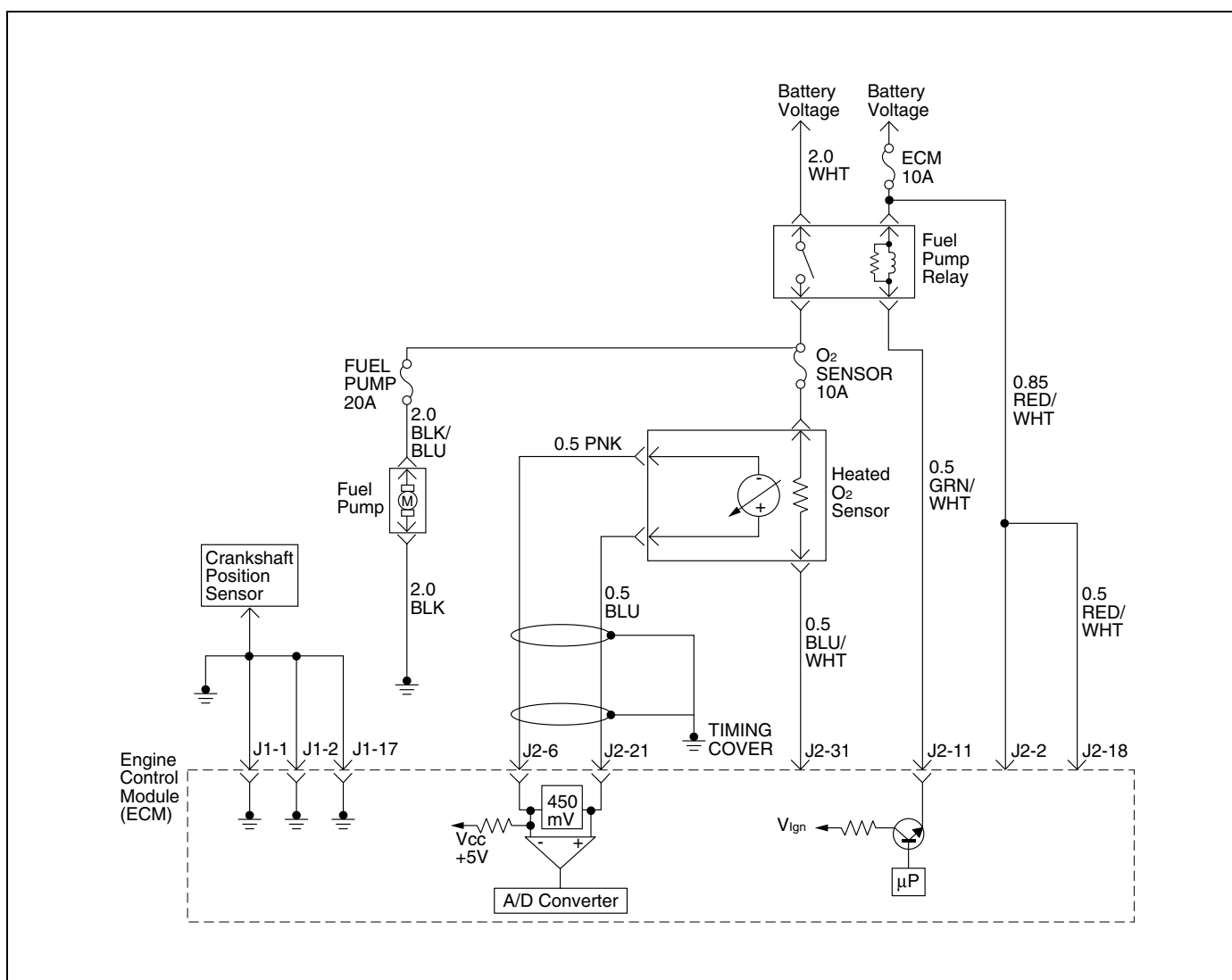
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0134 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0134 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the O ₂ sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 5
5	Using the DVM and check the O ₂ sensor circuit. 1. Ignition "On", engine "Off". 2. Disconnect the O ₂ sensor connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Approximately 450mV	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the O₂ sensor circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the O₂ sensor. 4. Check the circuit for open circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the O₂ sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 13
7	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Manifold Absolute Pressure" in the data display. Does the Tech 2 indicate correct "Manifold Absolute Pressure" in accordance with engine speed or acceleration?	—	Go to Step 9	Go to Step 8
8	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 9
9	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to Step 11	Go to Step 10

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Step	Action	Value(s)	Yes	No
10	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 11</i>
11	Check for injector for the affected bank. Refer to <i>“Injector Coil Test & Injector Balance Test Procedure”</i> . Was the injector operation correct?	—	Go to <i>Step 12</i>	Refer to <i>Injector Coil Test & Injector Balance Test Procedure</i>
12	Check for fuel pressure. Refer to <i>“Fuel System Diagnosis”</i> . Was the fuel pressure correct?	—	Go to <i>Step 13</i>	Refer to <i>Fuel System Diagnosis</i>
13	Replace the O ₂ sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 14</i>
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the <i>“SPS (Service Programming System)”</i> . Was the problem solved?	—	Verify repair	Go to <i>Step 15</i>
15	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0135 O₂ SENSOR HEATER CIRCUIT (BANK 1 SENSOR 1)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0135	A	O ₂ Sensor Heater Circuit (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor and ECT sensor. 2. Engine coolant temperature is more than 60°C. 3. Engine run time is longer than 20 seconds. 4. MAP sensor output is more than 70KPa. 5. O₂ sensor bank 1 heater current more than 10mA.	No fail-safe function.

Circuit Description

Heated oxygen sensors are used to minimize the amount of time required for "Closed Loop" fuel control operation and to allow accurate catalyst monitoring. The oxygen sensor heater greatly decreases the amount of time required for fuel control sensors Bank 1 HO2S 1 1 to become active. Oxygen sensor heaters are required by catalyst monitor sensors Bank 1 HO2S 2 to maintain a sufficiently high temperature which allows accurate exhaust oxygen content readings further from the

engine.

The engine control module (ECM) will run the heater test only after a cold start (determined by engine coolant and intake air temperature at the time of start-up) and only once during an ignition cycle. When the engine is started the ECM will monitor the HO2S voltage. When the HO2S voltage indicates a sufficiently active sensor, the ECM looks at how much time has elapsed since start-up. If the ECM determines that too much time was required for the Bank 1 HO2S 1 to

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become active, a Diagnostic Trouble Code P0135 will set.

Diagnostic Aids

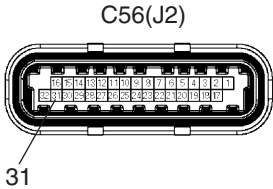
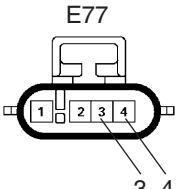
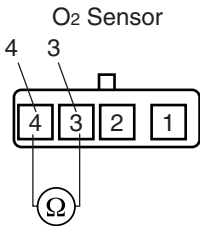
Check for the following conditions:

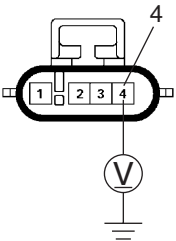
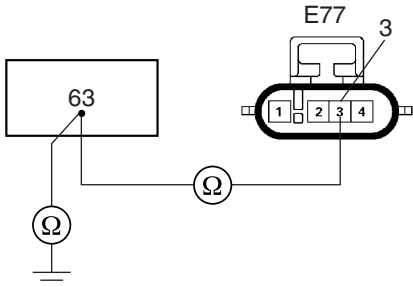
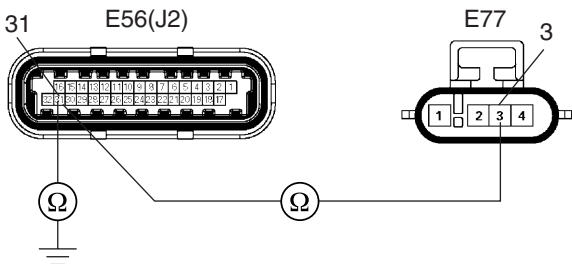
- Poor connection at ECM - Inspect harness

connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

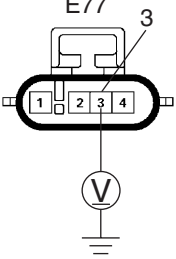
- Damaged harness - Inspect the wiring harness for damage; shorts to ground, shorts to battery positive and open circuits.

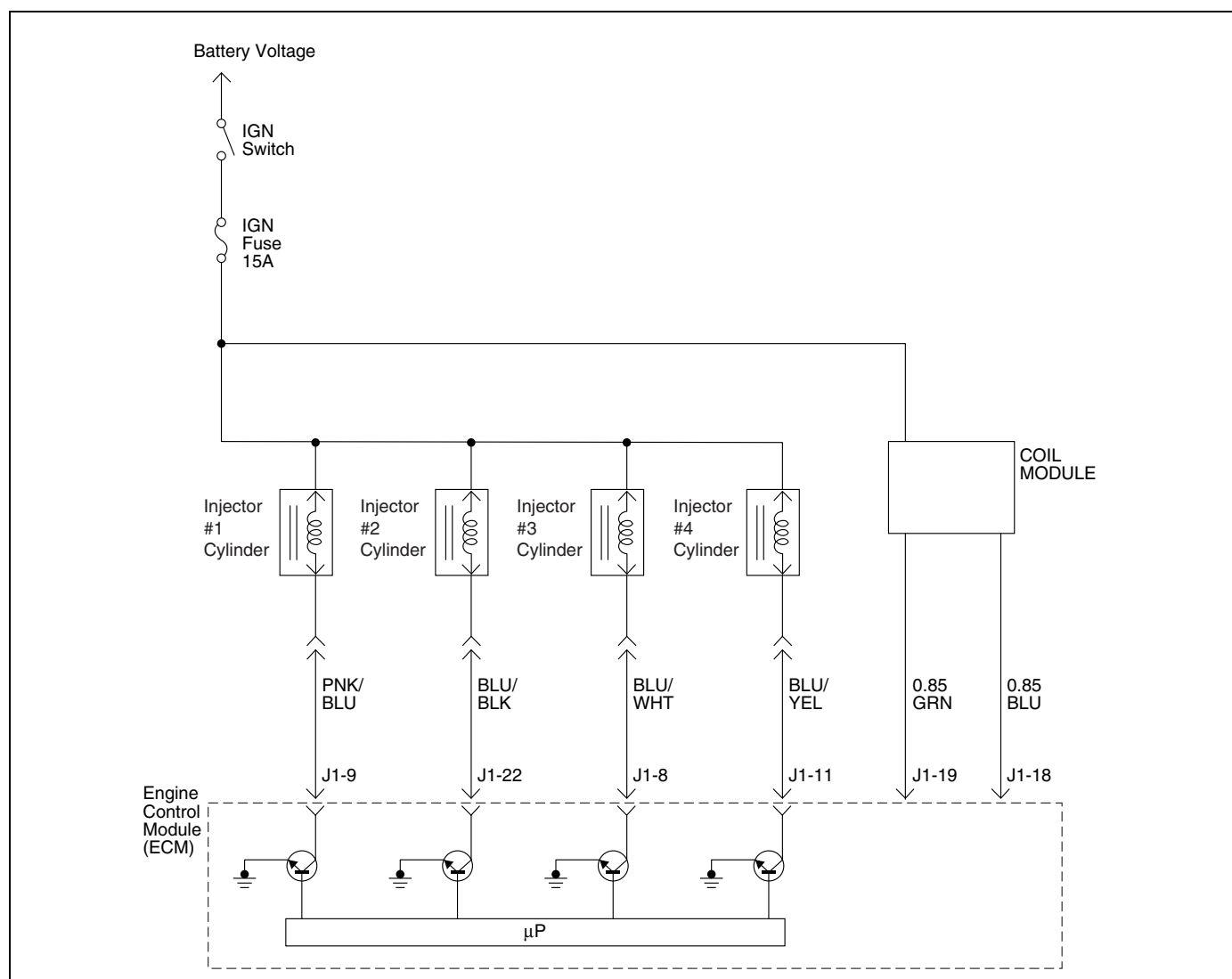
Diagnostic Trouble Code (DTC) P0135 O₂ Sensor Heater Circuit (Bank 1 Sensor 1)

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0135 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0135 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the O ₂ sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  C56(J2) 31  E77 1 2 3 4	—	Verify repair	Go to Step 5
5	Visually check the O ₂ sensor. Was the problem found?	—	Go to Step 11	Go to Step 6
6	Using the DVM and check the O ₂ sensor. 1. Ignition "Off", engine "Off". 2. Disconnect O ₂ sensor connector 3. Measure the resistance of heater. Was the tester indicated specified value?  O₂ Sensor 4 3 2 1 Ω	Approximately 12.5Ω at 20°C	Go to Step 7	Go to Step 11

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the heater power supply circuit for the affected cylinder. 1. Ignition "On", engine "Off". 2. Disconnect the O₂ sensor connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? E77 	Battery voltage	Go to Step 9	Go to Step 8
8	Repair the open or short to ground circuit between the "O₂ Sensor" fuse (10A) and O₂ sensor. Is the action complete?	—	Verify repair	—
9	Using the DVM and check the heater ground circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the O₂ sensor connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the O₂ sensor connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 10

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Step	Action	Value(s)	Yes	No
10	Using the DVM and check the heater ground circuit. 1. Ignition "On", engine "Off". 2. Disconnect the O₂ sensor connector. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated voltage? 	—	Repair faulty harness and verify repair	Go to <i>Step 12</i>
11	Replace the O₂ sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 12</i>
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 13</i>
13	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0201 INJECTOR 1 CONTROL CIRCUIT**DIAGNOSTIC TROUBLE CODE (DTC) P0202 INJECTOR 2 CONTROL CIRCUIT****DIAGNOSTIC TROUBLE CODE (DTC) P0203 INJECTOR 3 CONTROL CIRCUIT****DIAGNOSTIC TROUBLE CODE (DTC) P0204 INJECTOR 4 CONTROL CIRCUIT****Condition for setting the DTC and action taken when the DTC sets**

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0201	A	Injector 1 Control Circuit	1. Engine is running. 2. Engine speed is more than 1000rpm. 3. Injector voltage does not meet to the battery voltage when the injector is commanded Off or does not meet to the 0V when the injector is commanded On.	No fail-safe function.
P0202	A	Injector 2 Control Circuit		
P0203	A	Injector 3 Control Circuit		
P0204	A	Injector 4 Control Circuit		

Circuit Description

The engine control module (ECM) has four individual injector driver circuits. Each controls an injector. When a driver circuit is grounded by the ECM, the injector is

activated. The ECM monitors the current in each driver circuit. The ECM measures a voltage drop through a fixed resistor and controls it. The voltage on each driver is monitored to detect a fault. If the voltage is not what the ECM expects to monitor on the circuit, a Diagnostic

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Trouble Code is set. This Diagnostic Trouble Code is also set if an injector driver is shorted to voltage.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a Diagnostic Trouble Code P0201 to set. It will also cause a misfire due to an inoperative

injector. A misfire Diagnostic Trouble Code will also be set indicating which cylinder is inoperative.

Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty.

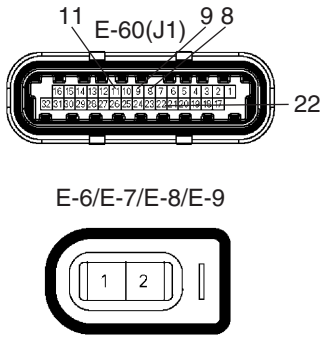
Use Fuel Injector Coil Test Procedure to check for faulty injectors.

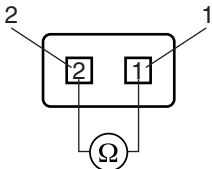
Diagnostic Trouble Code (DTC) P0201 Injector 1 Control Circuit

Diagnostic Trouble Code (DTC) P0202 Injector 2 Control Circuit

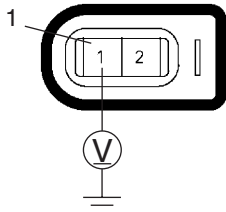
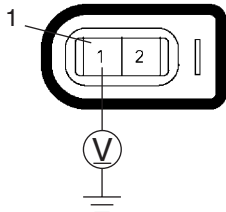
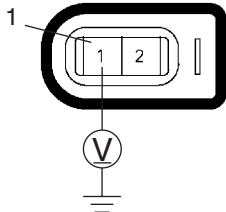
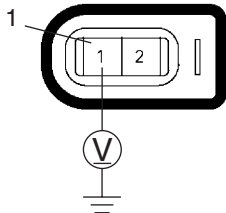
Diagnostic Trouble Code (DTC) P0203 Injector 3 Control Circuit

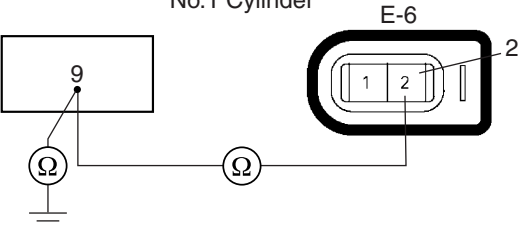
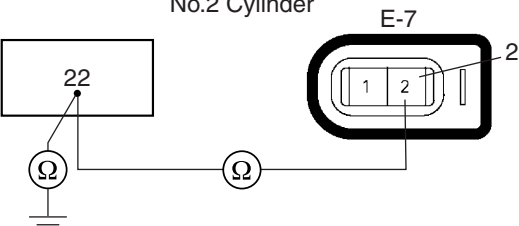
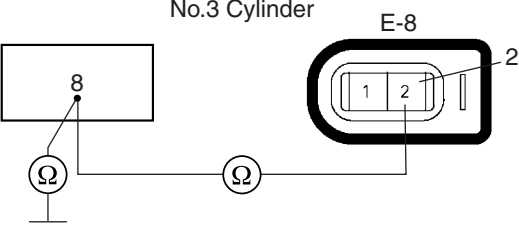
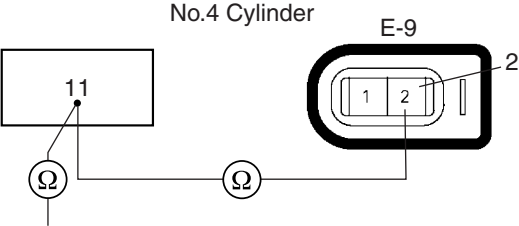
Diagnostic Trouble Code (DTC) P0204 Injector 4 Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0201, P0202, P0203 or P0204 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0201, P0202, P0203 or P0204 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the injector or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 5
5	Visually check the injector for the affected cylinder. Was the problem found?	—	Go to Step 11	Go to Step 6

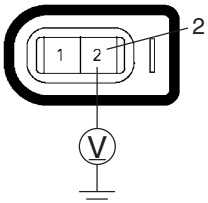
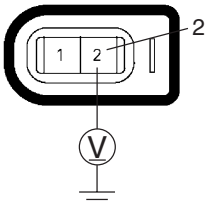
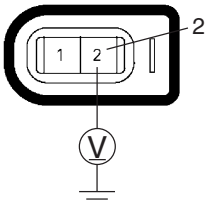
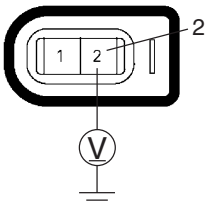
Step	Action	Value(s)	Yes	No
6	Using the DVM and check the injector coil for the affected cylinder. 1. Ignition "Off", engine "Off". 2. Disconnect injector connector for the affected cylinder. 3. Measure the resistance of injector coil. Was the tester indicated specified value? Injector 	Approximately 12.5Ω at 20°C	Go to <i>Step 7</i>	Go to <i>Step 11</i>

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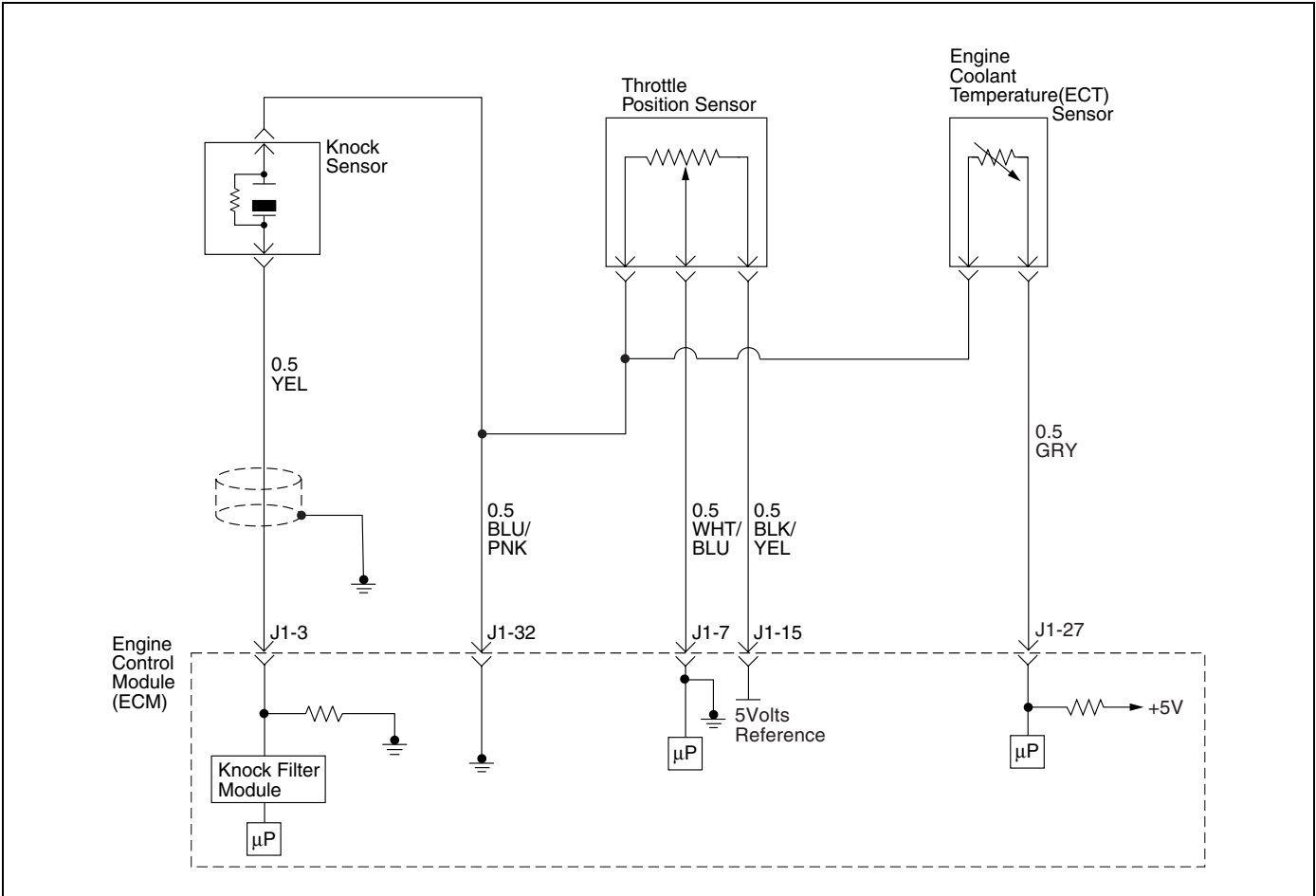
Step	Action	Value(s)	Yes	No
7	Using the DVM and check the injector power supply circuit for the affected cylinder. 1. Ignition “On”, engine “Off”. 2. Disconnect the injector connector for the affected cylinder. 3. Check the circuit for open circuit. Was the DVM indicated specified value? No.1 Cylinder E-6  No.2 Cylinder E-7  No.3 Cylinder E-8  No.4 Cylinder E-9 	Battery voltage	Go to Step 9	Go to Step 8
8	Repair the open or short to ground circuit between the “IGN” fuse (15A) and injector for the affected cylinder. Is the action complete?	—	Verify repair	—

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the injector signal circuit for the affected cylinder. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the injector connector for the affected cylinder. 4. Check the circuit for open or short to ground circuit. Was the problem found? No.1 Cylinder  No.2 Cylinder  No.3 Cylinder  No.4 Cylinder  — Repair faulty harness and verify repair Go to <i>Step 10</i>			

Step	Action	Value(s)	Yes	No
9	Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the injector connector for the affected cylinder and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? No.1 Cylinder No.2 Cylinder No.3 Cylinder No.4 Cylinder	—	Repair faulty harness and verify repair	Go to <i>Step 10</i>

Step	Action	Value(s)	Yes	No
10	Using the DVM and check the injector signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the injector connector for the affected cylinder. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated battery voltage? No.1 Cylinder E-6  No.2 Cylinder E-7  No.3 Cylinder E-8  No.4 Cylinder E-9 	—	Repair faulty harness and verify repair	Go to <i>Step 12</i>
11	Replace the injector for the affected cylinder. Was the problem solved?	—	Verify repair	Go to <i>Step 12</i>
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 13</i>
13	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0325 KNOCK SENSOR (KS) CIRCUIT MALFUNCTION



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0325	B	Knock Sensor Module Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50°C. 3. Engine speed is more than 1600rpm. 4. Knock sensor filter module integrated circuit malfunction.	ECM retards ignition timing 4°C.

Circuit Description

The knock sensor (KS) system is used to detect engine detonation. The knock sensor produced an AC voltage signal. The knock sensor sends this signal to the ECM. The amplitude and the frequency of the AC voltage signal depends upon the knock level being detected. The ECM will then retard the spark timing based on the

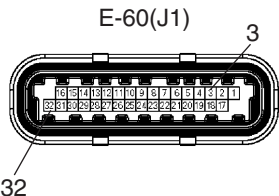
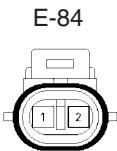
signals from the Knock Sensor.

Diagnostic Aids

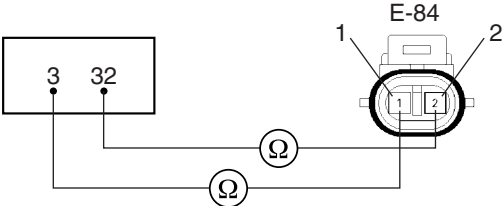
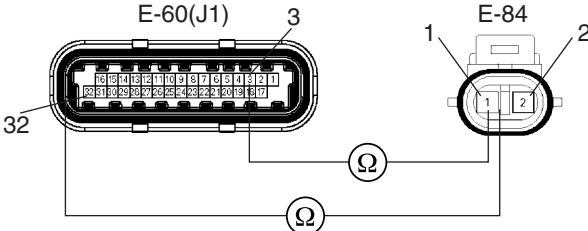
Correct any abnormal engine noise before using the diagnostic table.
Check for an open circuit.

Diagnostic Trouble Code (DTC) P0325 Knock Sensor Module Circuit

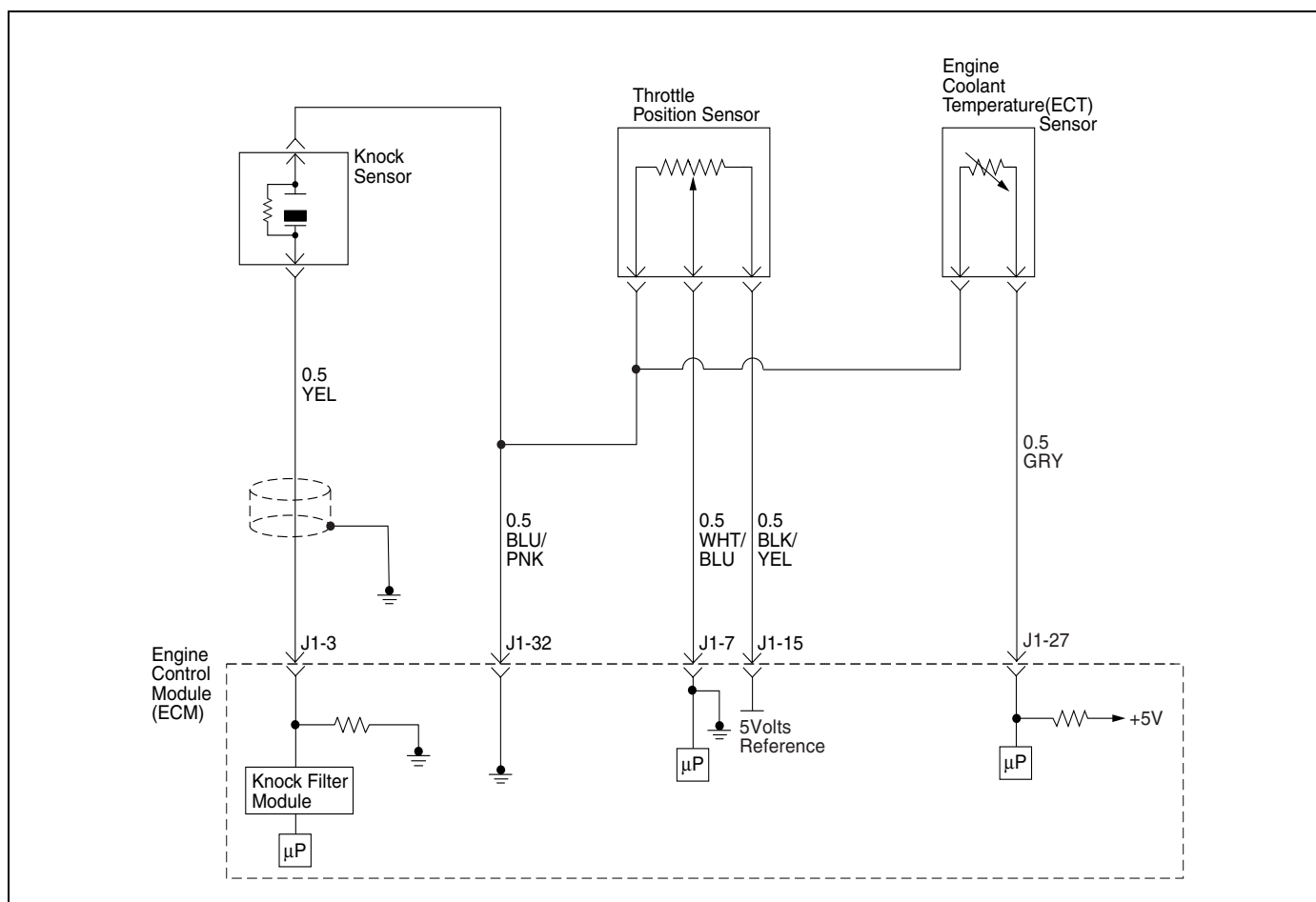
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to On Board Diagnostic (OBD) System Check

Step	Action	Value(s)	Yes	No
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0325 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0325 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the knock sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  E-60(J1) 32  E-84	—	Verify repair	Go to Step 5
5	Visually check the knock sensor. Was the problem found?	—	Go to Step 10	Go to Step 6
6	Listen to the engine noise while raising and lowering the engine speed. Is a knock or audible noise present?	—	Go to Step 7	Go to Step 8
7	Repair the mechanical engine problem or a loose bracket or component. Is the action complete?	—	Verify repair	—

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Step	Action	Value(s)	Yes	No
8	Using the DVM and check the knock sensor circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the knock sensor. 4. Check the circuit for open circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the knock sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 9</i>
9	Substitute a known good knock sensor and recheck. Was the problem solved?	—	Go to Step 10	Go to <i>Step 11</i>
10	Replace the knock sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 11</i>
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 12</i>
12	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0327 KNOCK SENSOR (KS) CIRCUIT LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0327	A	Knock Sensor Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50°C. 3. Engine speed is more than 1600rpm. 4. Knock sensor harness short to ground or short to voltage circuit.	ECM retards ignition timing 4°C.

Circuit Description

The ECM uses the Knock Sensor (KS) in order to detect engine detonation. This allows the ECM to retard the Ignition Control (IC) spark timing based on the KS signal the ECM receives. The knock sensors produce an AC signal that rides on the 1.3 volts DC. The signal's amplitude and frequency are dependent upon the amount of the knock being experienced.

The ECM determines whether the knock is occurring by comparing the signal level on the KS circuit with a voltage level on the noise channel. The normal engine noise varies depending on the engine speed and load. Then the ECM determines that an abnormally high noise channel voltage level is being experienced, a Diagnostic Trouble Code P0327 sets.

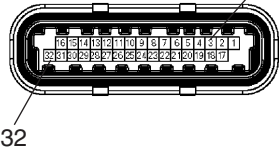
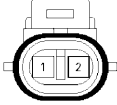
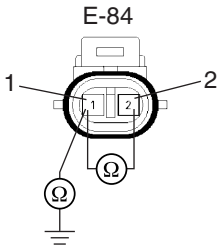
Diagnostic Aids

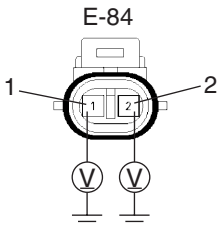
Check for the following conditions:

A poor connection at the ECM. Inspect the knock sensor and the ECM connectors for: , broken locks, improperly formed or damaged terminals.

- Backed out terminals
 - Broken locks
 - Improperly formed or damaged terminals
- Also, check the wiring harness for: shorts to ground, shorts to battery positive, and open circuits.
- A misrouted harness. Inspect the knock sensor harness in order to ensure that it is not routed too close to high voltage wires such as spark plug leads.

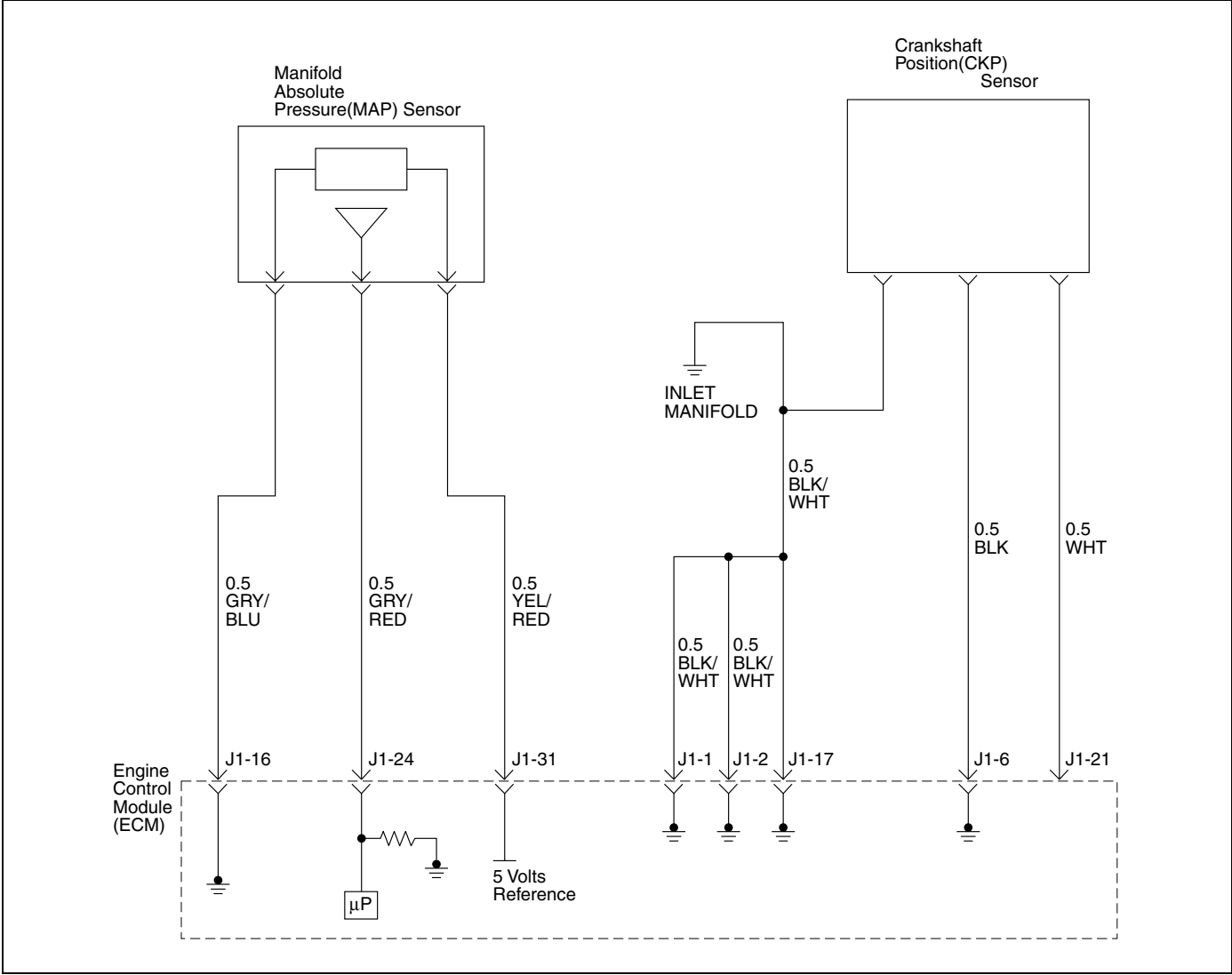
Diagnostic Trouble Code (DTC) P0327 Knock Sensor Circuit

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0327 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0327 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the knock sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E-60(J1)  32 E-84 	—	Verify repair	Go to Step 5
5	Visually check the knock sensor. Was the problem found?	—	Go to Step 9	Go to Step 6
6	Using the DVM and check the knock sensor circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the knock sensor connector and ECM connector. 3. Check the circuit for short to sensor ground or ground circuit. Was the problem found? E-84 	—	Repair faulty harness and verify repair	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the knock sensor circuit. 1. Ignition "On", engine "Off". 2. Disconnect the knock sensor connector. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated battery voltage? 	—	Repair faulty harness and verify repair	Go to <i>Step 8</i>
8	Substitute a known good knock sensor and recheck. Was the problem solved?	—	Go to <i>Step 9</i>	Go to <i>Step 10</i>
9	Replace the knock sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 10</i>
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 11</i>
11	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0336 CRANKSHAFT POSITION (CKP) SENSOR CIRCUIT RANGE/PERFORMANCE (58X)

DIAGNOSTIC TROUBLE CODE (DTC) P0337 CRANKSHAFT POSITION (CKP) SENSOR CIRCUIT LOW INPUT (58X)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0336	B	Crankshaft Position Sensor Circuit Range/Performance (58X)	1. Engine is running. 2. Extra or missing pulse is detected consecutively.	No fail-safe function.
P0337	B	Crankshaft Position Sensor Circuit Low Input (58X)	No pulse is detected during engine cranking.	

Circuit Description

The 58X reference signal is produced by the crankshaft position (CKP) sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The engine control module (ECM) uses the 58X reference signal to calculate engine RPM and crankshaft position. The ECM constantly monitors the number of pulses on the

58X reference circuit. If the ECM receives an incorrect number of pulses on the 58X reference circuit, Diagnostic Trouble Code P0336 will set. If the ECM does not receive pluses on the 58X reference circuit, Diagnostic Trouble Code P0337 will set.

Diagnostic Aids

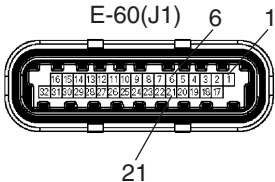
An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for:

- Poor connection - Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

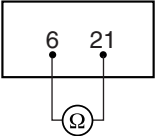
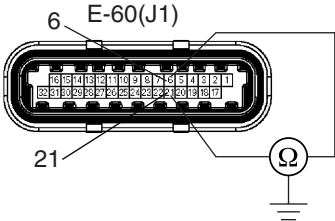
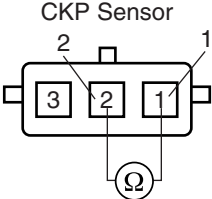
- Damaged harness - Inspect the wiring harness for damage; shorts to ground, shorts to battery positive and open circuits. If the harness appears to be OK, disconnect the ECM, turn the ignition on and observe a voltmeter connected to the 58X reference circuit at the ECM harness connector while moving connectors and wiring harnesses related to the ECM. A change in voltage will indicate the location of the fault.

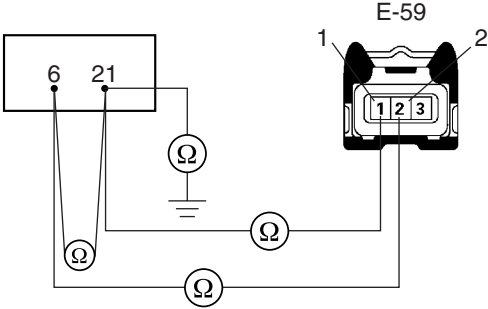
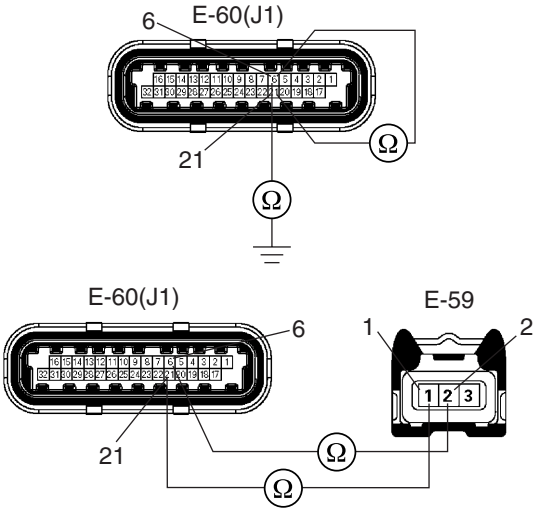
Diagnostic Trouble Code (DTC) P0336 Crankshaft Position Sensor Circuit Range/performance (58x)

Diagnostic Trouble Code (DTC) P0337 Crankshaft Position Sensor Circuit Low Input (58x)

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0336 or P0337 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0336 or P0337 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the CKP sensor or ECM connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found?  	—	Verify repair	Go to Step 5
5	Visually check the CKP sensor. If a faulty installation is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 6

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Step	Action	Value(s)	Yes	No
6	Using the DVM and check the CKP sensor circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Check the resistance of the CKP sensor. Was the DVM indicated specified value?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Check the resistance of the CKP sensor. Was the DVM indicated specified value? 	Approximately 0.55kΩ at 20°C	Go to Step 10	Go to Step 7
7	Using the DVM and check the CKP sensor circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the CKP sensor connector. 3. Check the resistance of the CKP sensor. Was the DVM indicated specified value? 	Approximately 0.55kΩ at 20°C	Go to Step 8	Go to Step 14

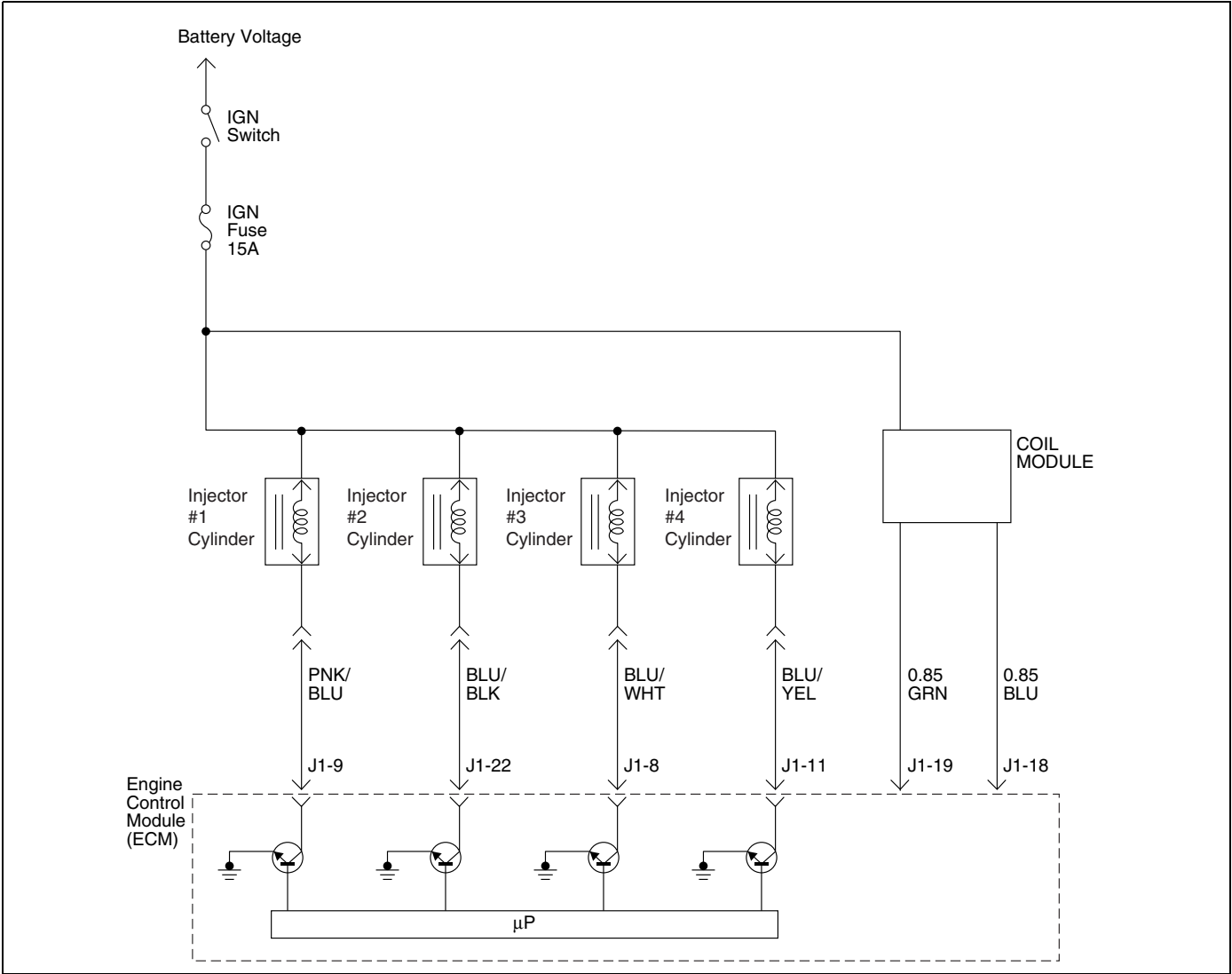
Step	Action	Value(s)	Yes	No
8	Using the DVM and check the CKP sensor circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the CKP sensor connector. 4. Check the circuit for open, short to sensor wire or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Disconnect the CKP sensor connector. 4. Check the circuit for open, short to sensor wire or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 9</i>

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Step	Action	Value(s)	Yes	No						
9	Using the DVM and check the CKP sensor circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the CKP sensor connector. 3. Check the circuit for short to power supply circuit. If the DVM indicated out of specified value, repair faulty harness and verify repair. Is the action complete?	Less than 1V	Verify repair	—						
10	Using the DVM and check the CKP sensor signal. 1. Ignition “On”, engine “On”. 2. Measure the CKP output voltage at the sensor and ECM. Does the tester indicate standard voltage? <table><tr><th>Measurement Point</th><th>Voltage (V) (AC Range)</th></tr><tr><td>At CKP sensor terminal 1 & 2</td><td>Approx. 3.7V in engine idle</td></tr><tr><td>At ECM E60 (J1) connector 21 & 6</td><td>Approx. 7.7V at 2000rpm</td></tr></table> If a oscilloscope is available, monitor the CKP sensor signal. Does the oscilloscope indicate correct wave form? CKP Sensor Signal Reference Wave Form Measurement Terminal: J1-21 (+) J1-6 (-) Measurement Scale: 10V/div 5.0ms/div Measurement Condition: Engine speed at 2000rpm	Measurement Point	Voltage (V) (AC Range)	At CKP sensor terminal 1 & 2	Approx. 3.7V in engine idle	At ECM E60 (J1) connector 21 & 6	Approx. 7.7V at 2000rpm		Go to Step 13	Go to Step 11
Measurement Point	Voltage (V) (AC Range)									
At CKP sensor terminal 1 & 2	Approx. 3.7V in engine idle									
At ECM E60 (J1) connector 21 & 6	Approx. 7.7V at 2000rpm									
11	Remove the CKP sensor from the flywheel housing and visually check. Check for the following conditions. • Objects sticking the CKP sensor. • Objects sticking the CKP sensor pulser. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 12						
12	Check the CKP sensor shield wire for open or short circuit. Was the problem found?	—	Repair faulty harness and verify repair	Go to Step 13						

Step	Action	Value(s)	Yes	No
13	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	—	Remove the accessory parts and verify repair	Go to <i>Step 14</i>
14	Substitute a known good CKP sensor and recheck. Was the problem solved?	—	Go to <i>Step 15</i>	Go to <i>Step 16</i>
15	Replace the CKP sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 16</i>
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 17</i>
17	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0351 IGNITION 1 CONTROL CIRCUIT
DIAGNOSTIC TROUBLE CODE (DTC) P0352 IGNITION 2 CONTROL CIRCUIT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0351	A	Ignition 1 Control Circuit	#2 or #3 cylinder ignition signals are not detected consecutively.	No fail-safe function.
P0352	A	Ignition 2 Control Circuit	#1 or #4 cylinder ignition signals are not detected consecutively.	

Circuit Description

The ignition control circuit provides a zero volt or a 5 volt signal to the ignition control module. The normal circuit voltage is zero volts. When the module receives the 5 volt signal from the ECM, it provides a ground path for the B+ voltage supplied to the ignition primary coil. When the ECM turns off the 5 volts to the module, the module will remove the ground path of the ignition primary coils; causing the magnetic field produces a voltage in the secondary coils which fires the spark plug.

The circuit between the ECM and the ignition control module is monitored for an open circuit, short to voltage, and short to ground. When the ECM detects a problem in the ignition control circuit, it will set DTC P0351 or P0352.

Diagnostic Aids

- Check for the following conditions:
- Poor connection at the ECM - Inspect the harness connectors for backed-out terminals, improper plug.

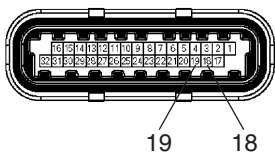
mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connections.

- Damaged harness - Inspect the wiring harness for damage; Open circuits, shorts to ground, or shorts to Voltage. If the harness appears to be OK, observe

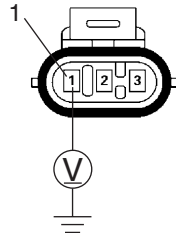
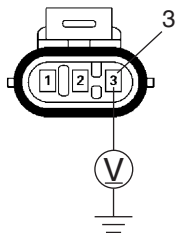
the Tech 2 display related to DTC P0351 or P0352 while moving the connector and wiring related to the ignition system. A change in the display will indicate the location of the fault.

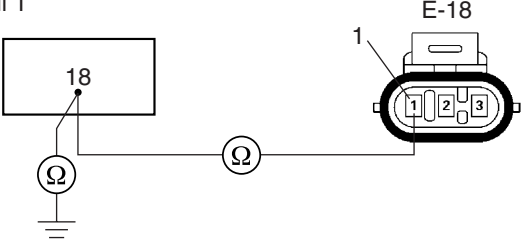
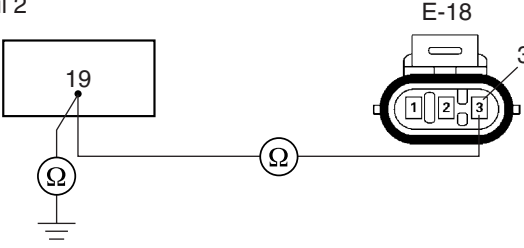
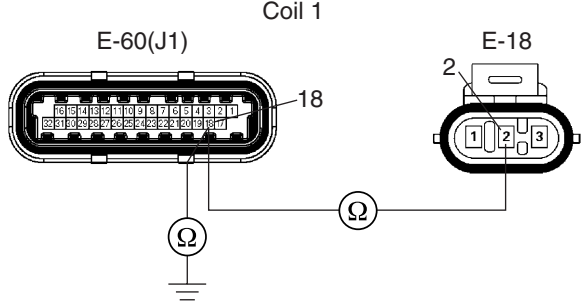
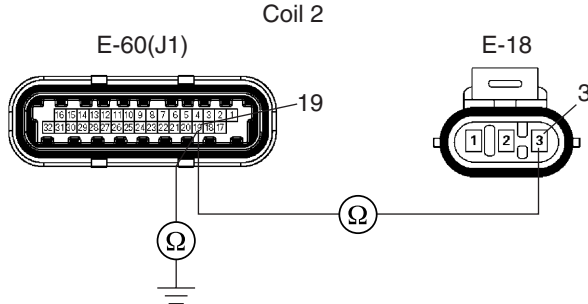
Diagnostic Trouble Code (DTC) P0351 Ignition 1 Control Circuit

Diagnostic Trouble Code (DTC) P0352 Ignition 2 Control Circuit

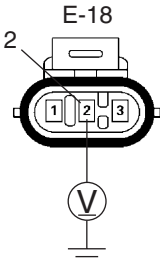
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0351 or P0352 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0351 or P0352 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the ignition coil module or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E-60(J1)  19 18 E-18  1 2 3	—	Verify repair	Go to Step 5
5	Visually check the ignition coil module. Was the problem found?	—	Go to Step 12	Go to Step 6

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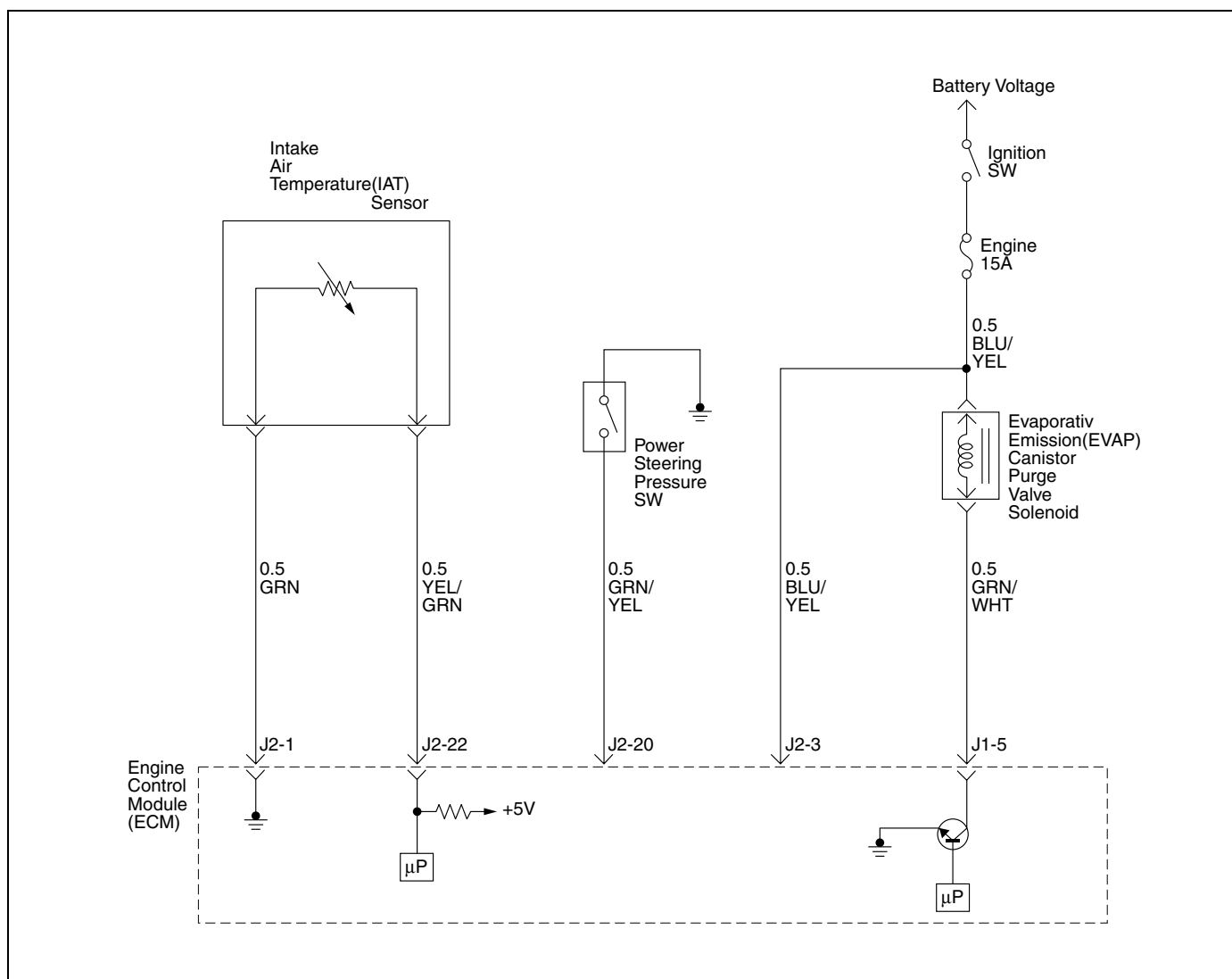
Step	Action	Value(s)	Yes	No
6	Using the DVM and check the ignition coil module signal circuit for the affected coil. 1. Ignition “On”, engine “Off”. 2. Disconnect the ignition coil module connector. 3. Check the circuit for short to battery voltage circuit for the affected coil. Was the DVM indicated battery voltage? Coil 1 E-18  Coil 2 E-18 	—	Repair faulty harness and verify repair	Go to <i>Step 7</i>

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the ignition coil signal circuit for the affected coil. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the ignition coil module connector. 4. Check the circuit for open or short to ground circuit for the affected coil. Was the problem found? Coil 1  Coil 2  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the ignition coil module connector and ECM connector. 3. Check the circuit for open or short to ground circuit for the affected coil. Was the problem found? Coil 1  Coil 2 	—	Repair faulty harness and verify repair	Go to <i>Step 8</i>

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Step	Action	Value(s)	Yes	No
8	Using the DVM and check the ignition coil module power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the ignition coil module connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Battery voltage	Go to <i>Step 10</i>	Go to <i>Step 9</i>
9	Repair the open or short to ground circuit between the "IGN. Coil" fuse (15A) and ignition coil module. Is the action complete?	—	Verify repair	—
10	Replace the ignition coil module. Was the problem solved?	—	Verify repair	Go to <i>Step 11</i>
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 12</i>
12	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0443 EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM PURGE CONTROL VALVE CIRCUIT MALFUNCTION



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0443	B	EVAP Emission Control System Purge Control Circuit	EVAP purge solenoid circuit open, short to ground or short to voltage circuit.	No fail-safe function.

Circuit Description

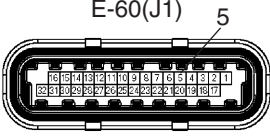
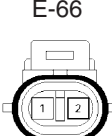
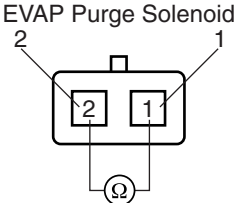
The Engine Control Module (ECM) controls the Evaporative Emission (EVAP) Canister Purge Solenoid Valve through the use of a control (ground) circuit. If the ECM commands the Purge solenoid to maximum duty cycle (100%) but the voltage remains High (12 Volts); or, if the ECM commands the Purge solenoid to minimum duty cycle (0%) but the voltage remains Low (0 volts), then DTC P0443 will set.

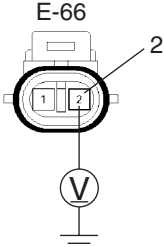
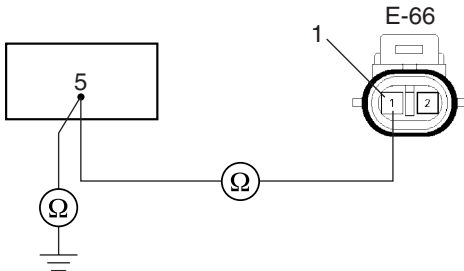
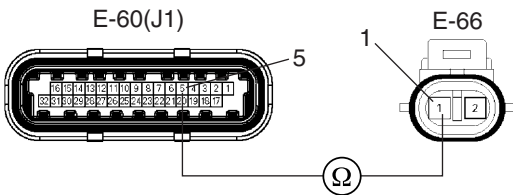
Diagnostic Aids

- Poor connections, or a damaged harness - Inspect the harness connectors for: backed-out terminals, improper mating or damaged terminals. Also check for open circuits, shorts to ground, and shorts to voltage.

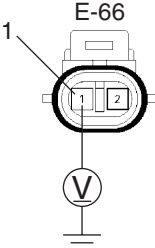
Diagnostic Trouble Code (DTC) P0443

Evap Emission Control System Purge Control Circuit

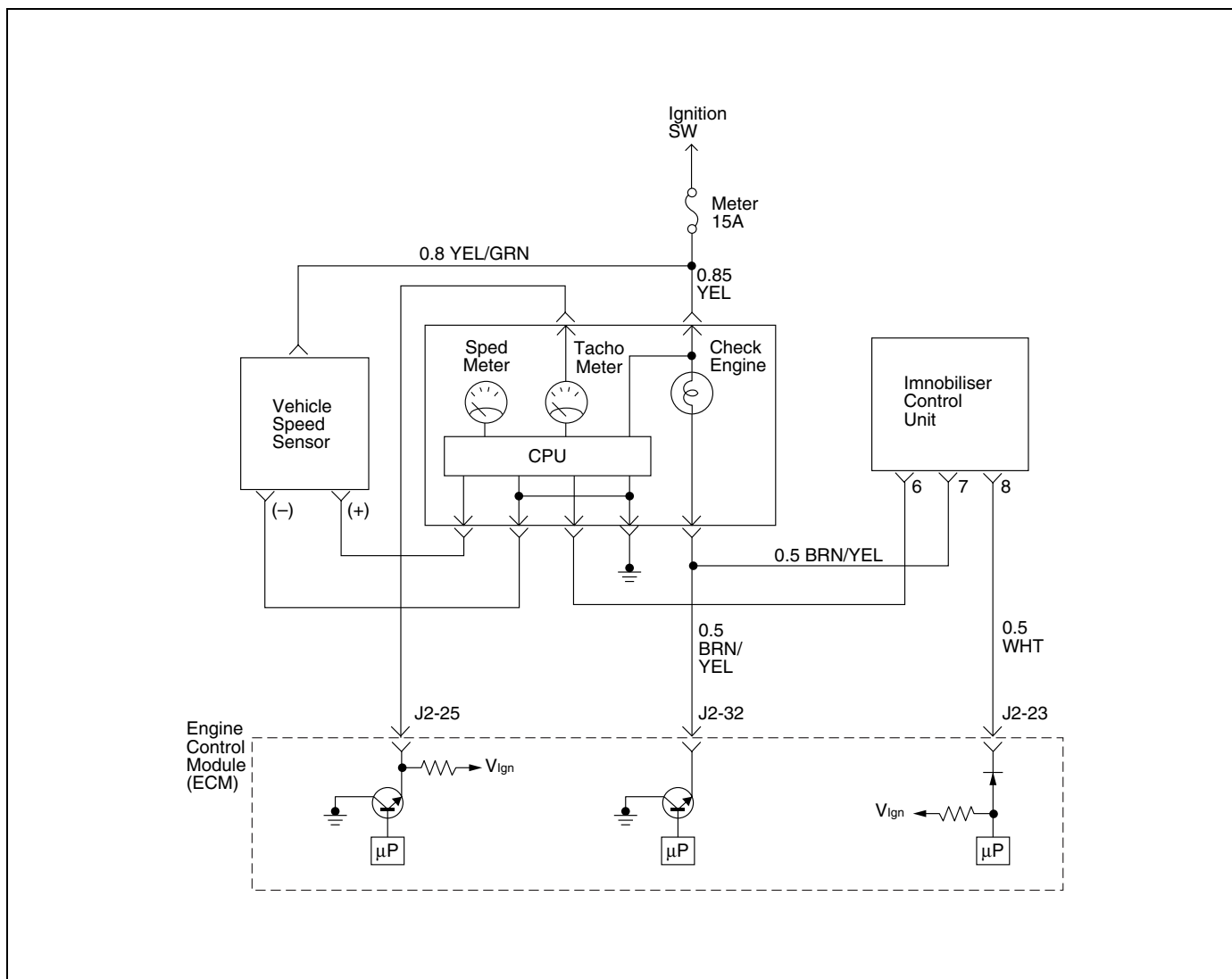
Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0443 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0443 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the purge solenoid valve or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  E-60(J1) 5  E-66	—	Verify repair	Go to Step 5
5	Using the DVM and check the purge solenoid valve. 1. Ignition "Off", engine "Off". 2. Disconnect purge solenoid valve connector. 3. Measure the resistance of purge solenoid valve coil. Does the tester indicate standard resistance?  EVAP Purge Solenoid	25 - 30Ω at 20°C	Go to Step 6	Go to Step 9

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the purge solenoid valve power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the purge solenoid valve connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Battery voltage	Go to <i>Step 8</i>	Go to <i>Step 7</i>
7	Repair the open or short to ground circuit between the "Engine" fuse (15A) and purge solenoid valve. Is the action complete?	—	Verify repair	-
8	Using the DVM and check the purge solenoid valve solenoid signal circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the purge solenoid valve connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the purge solenoid valve connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 9</i>

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Step	Action	Value(s)	Yes	No
9	Using the DVM and check the purge solenoid valve signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the purge solenoid valve connector. 3. Check the circuit for short to battery voltage circuit. Was the DVM indicated battery voltage? 	—	Repair faulty harness and verify repair	Go to <i>Step 10</i>
10	Substitute a known good purge solenoid valve and recheck. Was the problem solved?	—	Go to Step 11	Go to <i>Step 12</i>
11	Replace the purge solenoid valve. Was the problem solved?	—	Verify repair	Go to <i>Step 12</i>
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 13</i>
13	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0502 VEHICLE SPEED SENSOR (VSS) CIRCUIT LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0502	B	Vehicle Speed Sensor Circuit Low Input	1. No DTC relating to MAP sensor, TPS, ECT sensor, injector control circuit and ignition control circuit. 2. Engine is running. 3. Vehicle speed is below 3km/h in power condition or 2km/h in deceleration condition.	ECM uses 0km/h condition as substitute.

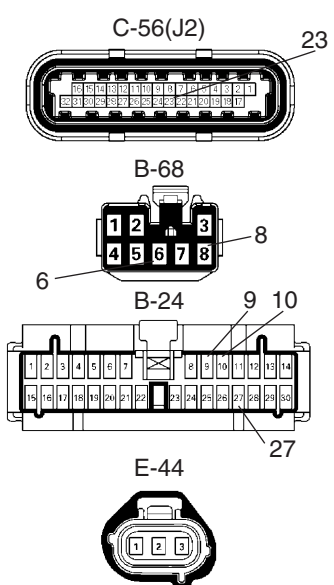
Circuit Description

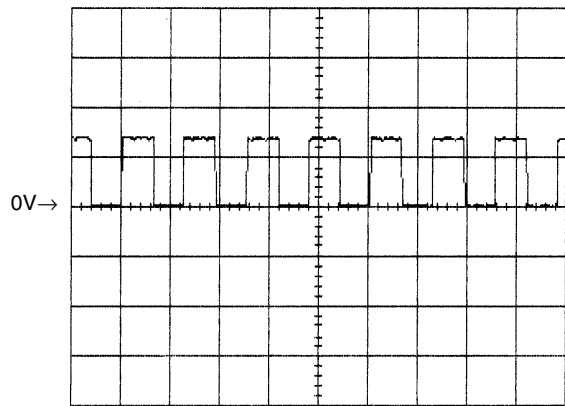
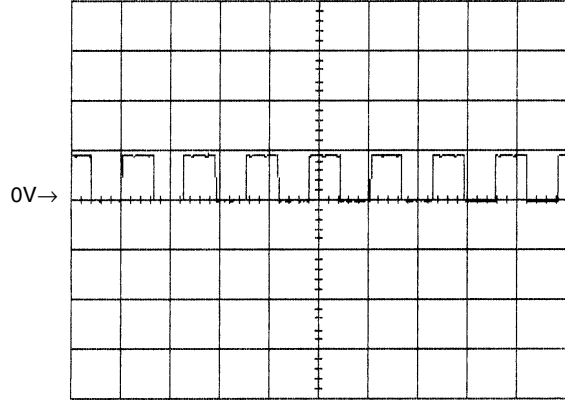
The vehicle speed sensor has a magnet rotated by the transmission output shaft. Attached to the sensor is a hall effect circuit that interacts with the magnetic field created by the rotating magnet. A 12-volt operating supply for the speed sensor hall circuit is supplied from the meter fuse.

Diagnostic Aids

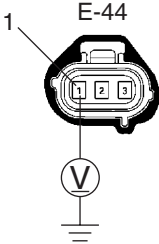
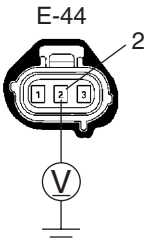
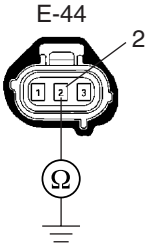
- Poor connection at ECM: Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

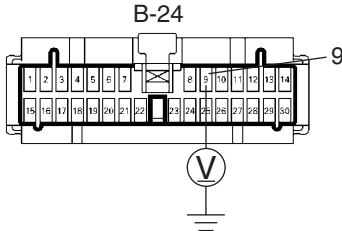
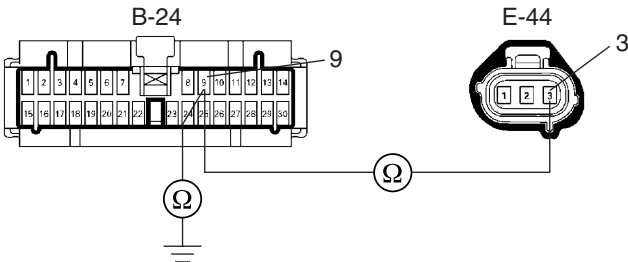
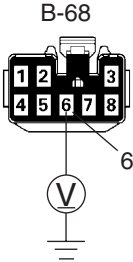
Diagnostic Trouble Code (DTC) P0502 Vehicle Speed Sensor Circuit Low Input

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0502 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0502 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the VSS, meter, immobiliser control unit (if equipped), ECM and other connectors. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? 	—	Verify repair	Go to Step 5
5	Remove the VSS from the housing case and visually check. Was the problem found?	—	Go to Step 19	Go to Step 6

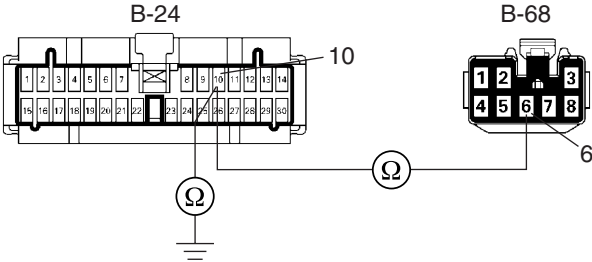
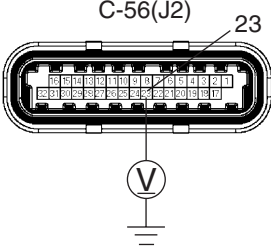
Step	Action	Value(s)	Yes	No																	
6	Using the DVM and check the VSS signal. 1. Ignition “On”, vehicle “Run (lift up)”. 2. Measure the VSS output voltage at sensor, meter, immobiliser control unit (if equipped) and ECM. Does the tester indicate specified value? <table><tr><th>Measurement Position</th><th>Voltage (V) (AC Range)</th><th>If No Good</th></tr><tr><td>VSS terminal 3 & GND</td><td rowspan="4">Approximately 7.0 V at 20km/h</td><td>Go to Step 7</td></tr><tr><td>Meter B24 connector 9 & GND</td><td>Go to Step 11</td></tr><tr><td>Meter B24 connector 10 & GND</td><td>Go to Step 13</td></tr><tr><td>Immobiliser control unit B68 connector 6 & GND</td><td>Go to Step 14</td></tr><tr><td>Immobiliser control unit B68 connector 8 & GND</td><td rowspan="2">Approximately 4.8 V at 20km/h</td><td>Go to Step 16</td></tr><tr><td>ECM C56 (J2) connector 23 & GND</td><td>Go to Step 17</td></tr></table> If a oscilloscope is available, monitor the VSS signal. Does the oscilloscope indicate correct wave form? Vehicle Speed Sensor Reference Wave Form  Measurement Scale: 10V/div 50ms/div Measurement Condition: Vehicle speed 20km/h Measurement Terminal: At Vehicle Speed Sensor Vehicle Speed Sensor Reference Wave Form  Measurement Scale: 10V/div 50ms/div Measurement Condition: Vehicle speed 20km/h Measurement Terminal: At Engine Control Module	Measurement Position	Voltage (V) (AC Range)	If No Good	VSS terminal 3 & GND	Approximately 7.0 V at 20km/h	Go to Step 7	Meter B24 connector 9 & GND	Go to Step 11	Meter B24 connector 10 & GND	Go to Step 13	Immobiliser control unit B68 connector 6 & GND	Go to Step 14	Immobiliser control unit B68 connector 8 & GND	Approximately 4.8 V at 20km/h	Go to Step 16	ECM C56 (J2) connector 23 & GND	Go to Step 17			
Measurement Position	Voltage (V) (AC Range)	If No Good																			
VSS terminal 3 & GND	Approximately 7.0 V at 20km/h	Go to Step 7																			
Meter B24 connector 9 & GND		Go to Step 11																			
Meter B24 connector 10 & GND		Go to Step 13																			
Immobiliser control unit B68 connector 6 & GND		Go to Step 14																			
Immobiliser control unit B68 connector 8 & GND	Approximately 4.8 V at 20km/h	Go to Step 16																			
ECM C56 (J2) connector 23 & GND		Go to Step 17																			
			Refer to Diagnostic Aids and Go to Step 21	Refer the table																	

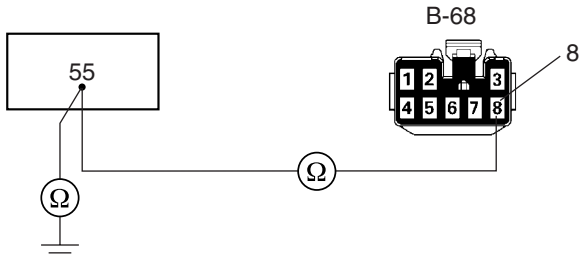
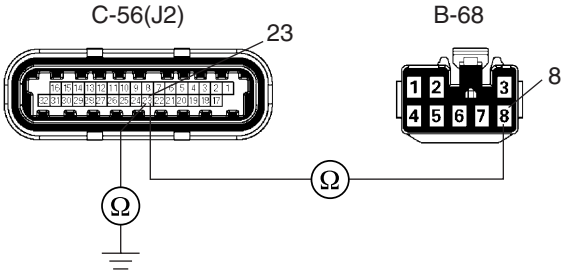
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Step	Action	Value(s)	Yes	No
7	Using the DVM and check the VSS power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the VSS connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Battery voltage	Go to <i>Step 9</i>	Go to Step 8
8	Repair the open circuit between the VSS and meter fuse. Is the action complete?	—	Verify repair	—
9	Using the DVM and check the VSS ground circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the VSS connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 10</i>	Repair faulty harness and verify repair
10	Using the DVM and check the VSS ground circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the VSS connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 19</i>

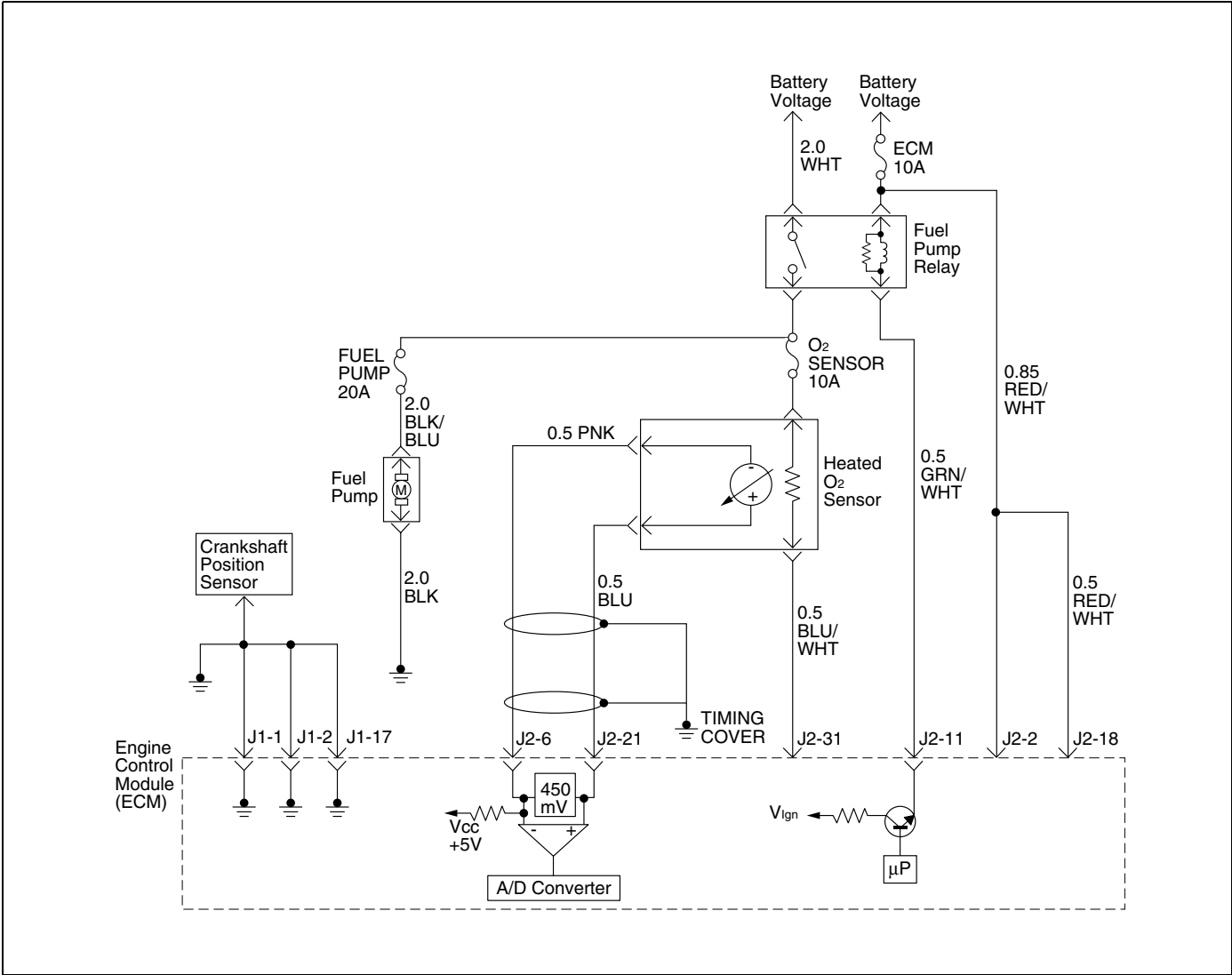
Step	Action	Value(s)	Yes	No
11	Using the DVM and check the VSS signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the VSS connector and meter connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 12</i>	Repair faulty harness and verify repair
12	Using the DVM and check the VSS signal circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the VSS connector and meter connector. 3. Check the circuit for open or short to ground circuit. If a open or short to ground circuit is found, repair the faulty harness and verify repair. Is the action complete? 	—	Verify repair	—
13	Replace the speed meter. Is the action complete?	—	Verify repair	—
14	Using the DVM and check the VSS signal circuit. 1. Ignition "On", engine "Off". 2. Disconnect the meter connector and immobiliser control unit connector (if equipped). 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 15</i>	Repair faulty harness and verify repair

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Step	Action	Value(s)	Yes	No
15	Using the DVM and check the VSS signal circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the meter connector and immobiliser control unit connector (if equipped). 3. Check the circuit for open or short to ground circuit. If a open or short to ground circuit is found, repair the faulty harness and verify repair. Is the action complete? 	—	Verify repair	—
16	Replace the immobiliser control unit (if equipped). Is the action complete?	—	Verify repair	—
17	Using the DVM and check the VSS signal circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the immobiliser control unit connector (if equipped) and ECM connector. 3. Ignition “On”. 4. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 18</i>	Repair faulty harness and verify repair

Step	Action	Value(s)	Yes	No
18	Using the DVM and check the VSS signal circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the immobiliser control unit connector (if equipped). 4. Check the circuit for open or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the immobiliser control unit connector (if equipped) and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to Step 21
19	Substitute a known good VSS and recheck. Was the problem solved?	—	Go to Step 20	Go to Step 21
20	Replace the VSS. Was the problem solved?	—	Verify repair	Go to Step 21
21	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to Step 22
22	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0562 SYSTEM VOLTAGE LOW



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0562	D	System Voltage Low	Battery voltage is below 11V.	No fail-safe function.

Circuit Description

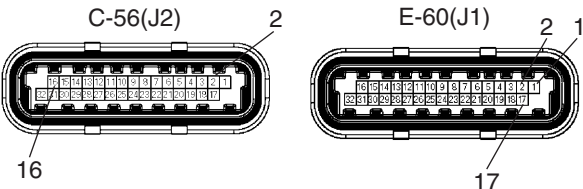
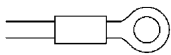
The engine control module (ECM) monitors the system voltage on the ignition feed terminal to the ECM. A system voltage Diagnostic Trouble Code will set whenever the voltage is below a calibrated value.

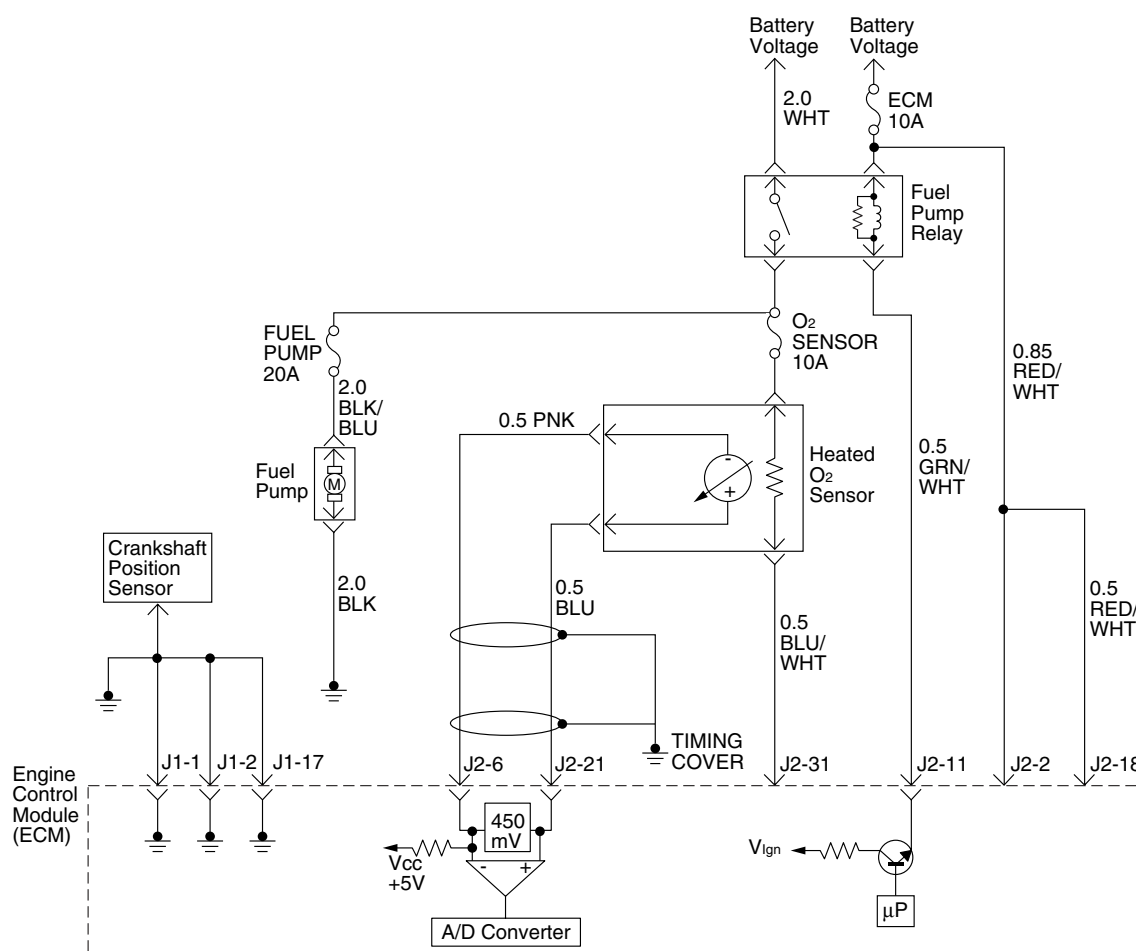
Diagnostic Aids

- If the Diagnostic Trouble Code sets when an accessory is operated, check for a poor connection or excessive current draw.
- Check for open circuits or shorts to ground on the ECM's battery or ignition inputs.

Diagnostic Trouble Code (DTC) P0562 System Voltage Low

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to On Board Diagnostic (OBD) System Check

Step	Action	Value(s)	Yes	No
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0562 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0562 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Ignition Voltage" in the data display. 3. Load the electrical system by turning on the headlights, etc.. Does the Tech 2 indicate enough ignition voltage?	10 - 14V	Go to Step 6	Go to Step 5
5	Using the DVM and check the battery voltage at the battery terminal. Does the tester indicate enough battery voltage?	10 - 14V	Go to Step 6	Check the charging system, charge or replace the battery
6	Check for poor/faulty connection at the ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 7
7	Check for poor/faulty connection of the ECM ground at the inlet manifold. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to Step 8
8	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to Step 9
9	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—



Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0563	A	System Voltage High	Battery voltage is above 16V.	No fail-safe function.

The engine control module (ECM) monitors the system voltage on the ignition feed terminals to the ECM. A system voltage Diagnostic Trouble Code will set

Check for a faulty charging system components.

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to <i>Step 2</i>	Go to <i>On Board Diagnostic (OBD) System Check</i>

Step	Action	Value(s)	Yes	No
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0563 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0563 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Ignition Voltage" in the data display. 3. Load the electrical system by turning on the headlights, etc.. Does the Tech 2 indicate correct ignition voltage?	10 - 14V	Go to Step 5	Check the charging system and Go to Step 5
5	Is the battery jump start cable incorrectly connecting?	—	Verify procedure	Go to Step 6
6	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to Step 7
7	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0601 ECM MEMORY CHECKSUM

Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0601	A	ECM Memory Checksum	ECM memory area error.	Engine control disabled.

Circuit Description

The engine control module (ECM) used in this vehicle utilizes an electrically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine, transmission, and powertrain diagnostics operation. Unlike the PROM used in past applications, the EEPROM is not replaceable. When the ECM is replaced or a calibration update is required, the ECM must be

programmed using a Tech 2.

Diagnostic Aids

- Diagnostic Trouble Code P0601 indicates that the contents of the EEPROM have changed since the ECM was programmed. The only possible repair is ECM reprogramming or replacement. Check service bulletins to program the replacement ECM with the correct software and calibration for the vehicle.

Diagnostic Trouble Code (DTC) P0601 ECM Memory Checksum

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0601 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0601 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i>
4	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to Step 5
5	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0602 PROGRAMMING ERROR**Condition for setting the DTC and action taken when the DTC sets**

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0602	-	Programming Error	ECM memory area error.	Engine control disabled.

Circuit Description

The engine control module (ECM) used in this vehicle utilizes an electrically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine, transmission, and powertrain diagnostics operation. Unlike the PROM used in past applications, the EEPROM is not replaceable. When the ECM is replaced

or a calibration update is required, the ECM must be programmed using a Tech 2.

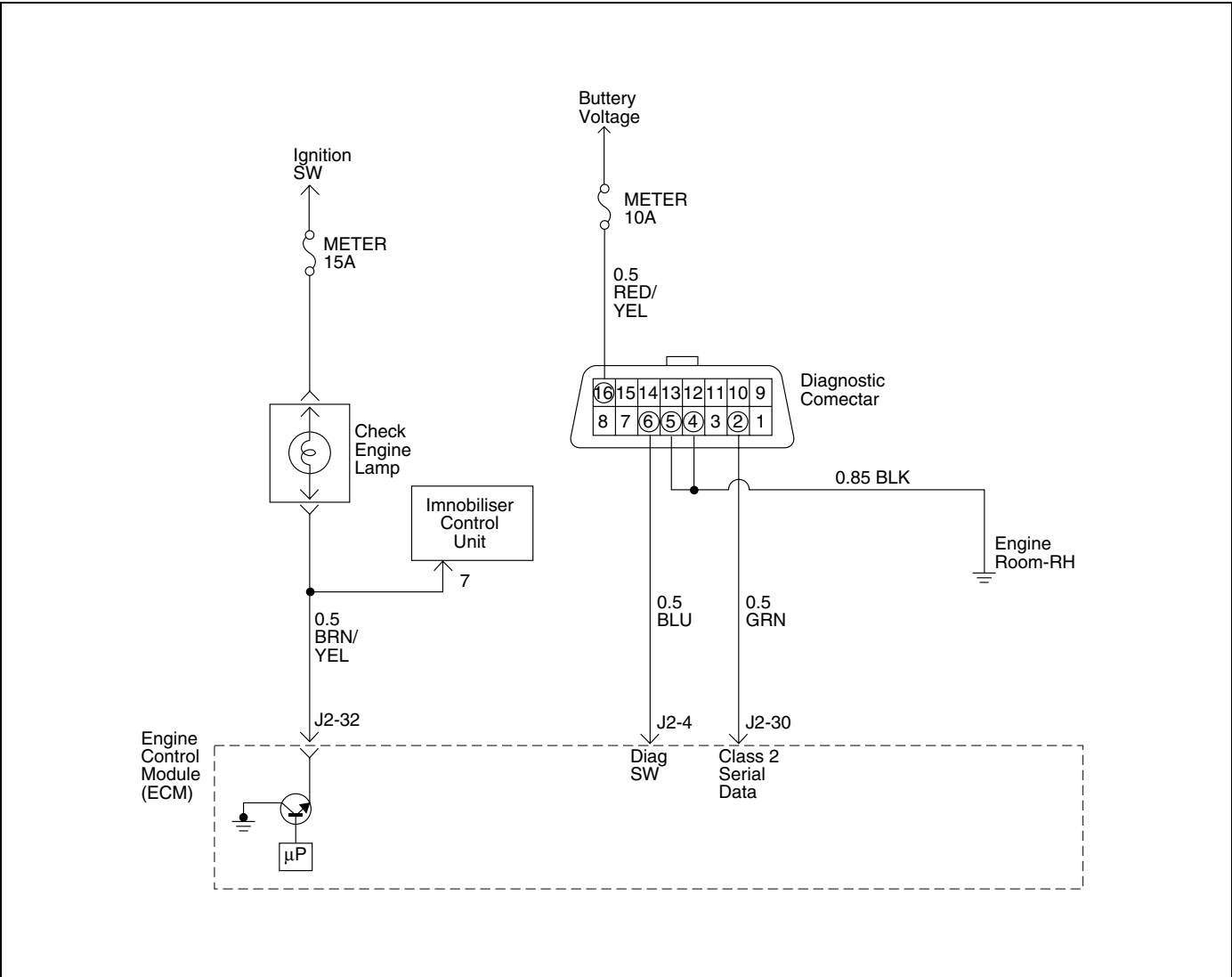
Diagnostic Aids

- Diagnostic Trouble Code P0602 indicates when non programmed ECM is used without service programming system (SPS). The replacement ECM must be programmed.

Diagnostic Trouble Code (DTC) P0602 Programming Error

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0602 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i>
3	Download the latest software to the ECM using the " SPS (Service Programming System) ". Is the action complete?	—	Verify repair	—

DTC P0650 MALFUNCTION INDICATOR LAMP (MIL) CONTOROL CIRCUIT MALFUNCTION



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0650	A	Malfunction Indicator Lamp (MIL) Control Circuit Malfunction	Check engine lamp circuit open, short to ground or short to voltage circuit.	No fail-safe function.

Circuit Description

The check engine lamp should always be illuminated and steady with ignition “ON” and the engine stopped. Ignition feed voltage is supplied directly to the check engine lamp indicator. The Engine Control Module (ECM) turns the check engine lamp “ON” by grounding the check engine lamp driver circuit. The check engine lamp should not remain “ON” with the engine running and no DTC(s) set. A steady check engine lamp with the engine running and no DTC(s) suggests a short to ground in the check engine lamp driver circuit.

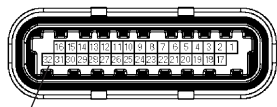
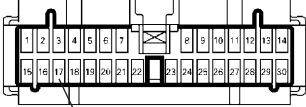
Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:

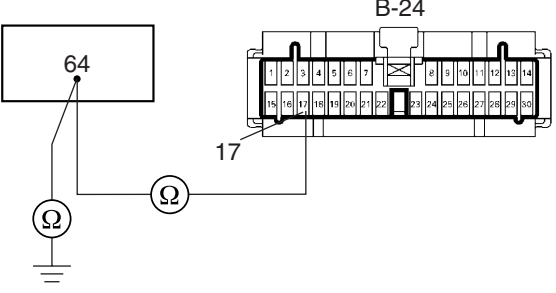
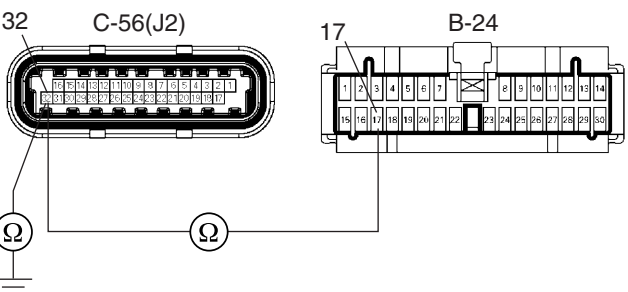
- Poor connection or damaged harness - Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Diagnostic Trouble Code (DTC) P0650

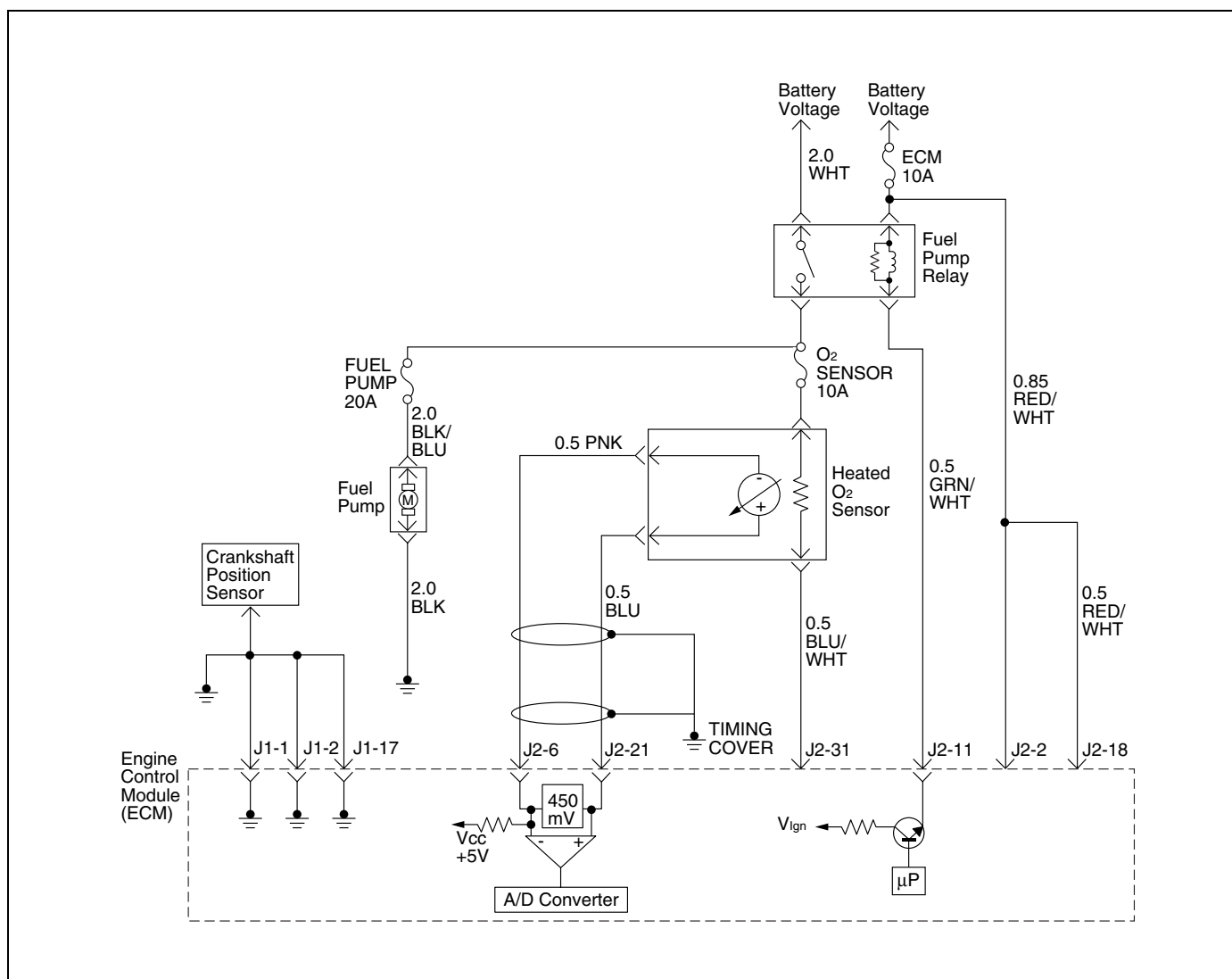
Malfunction Indicator Lamp (MIL) Control Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0650 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0650 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	1. Ignition "On", engine "Off". 2. Check the "Check Engine" lamp. Does the lamp turn "On"?	—	Go to Step 5	Go to Step 6
5	1. Ignition "On", engine "Off". 2. Check the "Check Engine" lamp. Does the lamp turn "Off"?	—	Go to Step 9	Go to Step 7
6	Check the "Check Engine" lamp bulb. If the bulb is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 7
7	Check for poor/faulty connection at the meter connector and ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? C-56(J2)  32 B-24  17	—	Verify repair	Go to Step 8

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Step	Action	Value(s)	Yes	No
8	Using the DVM and check the “Check Engine” lamp circuit. Breaker box is available: 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Remove the meter connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Remove the meter connector. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 9</i>
9	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “SPS (Service Programming System)”. Was the problem solved?	—	Verify repair	Go to <i>Step 10</i>
10	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1167 FUEL SUPPLY SYSTEM RICH DURING DECELERATION FUEL CUT OFF



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1167	D	Fuel Supply System Rich During Deceleration Fuel Cutoff	- No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. - O₂ sensor bank 1 output voltage is more than 550mV in deceleration fuel cutoff mode.	No fail-safe function.

Circuit Description

The engine control module (ECM) internal circuitry can identify if the vehicle fuel system is capable of supplying adequate amounts of fuel during deceleration (fuel cut off). The ECM monitors the voltage of the oxygen sensor during fuel cut off. When a fuel cut off mode of operation is requested during "Closed Loop" operation (by deceleration), the ECM will provide more fuel to the engine. Under these conditions the ECM should detect a "lean" condition (low oxygen sensor voltage). If this

"lean" exhaust is not detected at this time, a Diagnostic Trouble Code P1167 will set.

Diagnostic Aids

Check the following items:

- Fuel pressure - The system will go rich if pressure is too high. The ECM can compensate for some increase. However, if fuel pressure is too high, a Diagnostic Trouble Code P1167 may be set. Refer to *Fuel System Diagnosis*.

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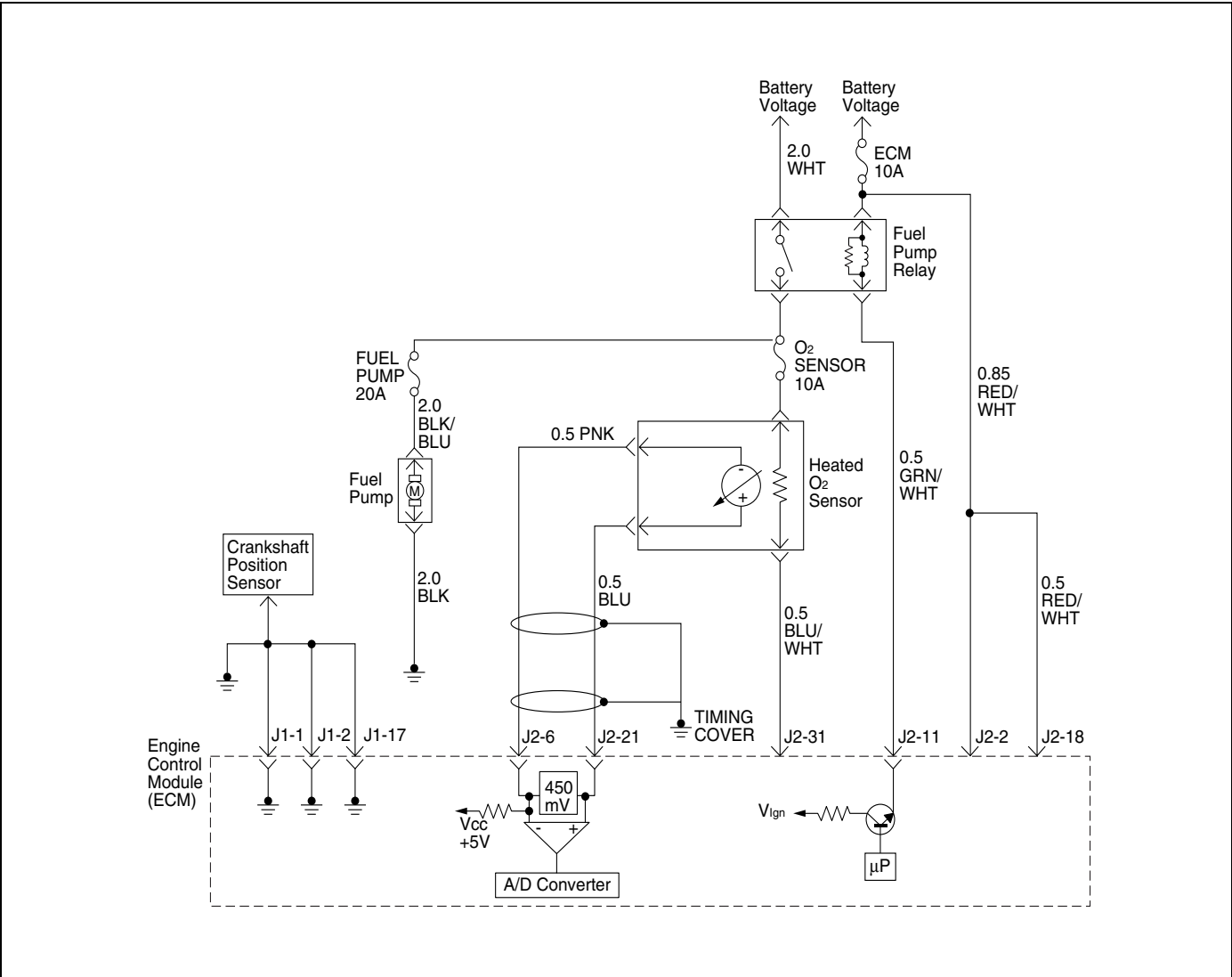
- Perform "Injector Balance Test" - Refer to *Fuel System Diagnosis*.
- Check the EVAP canister for fuel saturation - If full of fuel, check canister control and hoses. Refer to *Evaporative (EVAP) Emission Control System*.
- Check for a leak in the fuel pressure regulator diaphragm by checking the vacuum line to toe regulator for the presence of fuel.
- An intermittent TP sensor output will cause the system to go rich due to a false indication of the engine accelerating.
- Silicon contamination of the HO2S can also cause a high HO2S voltage to be indicated. This condition is indicated by a powdery white deposit on the portion of the HO2S exposed to the exhaust stream. If contamination is noticed, replace the affected HO2S.

Diagnostic Trouble Code (DTC) P1167 Fuel Supply System Rich During Deceleration Fuel Cutoff

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1167 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1167 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" in accordance with accelerator pedal operation?	—	Go to Step 6	Go to Step 5
5	Check for the following conditions. • Objects blocking the throttle valve. • Incorrectly installed. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 12
6	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Manifold Absolute Pressure" in the data display. Does the Tech 2 indicate correct "Manifold Absolute Pressure" in accordance with engine speed or acceleration?	—	Go to Step 8	Go to Step 7
7	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 13

Step	Action	Value(s)	Yes	No
8	1. Using the Tech 2, ignition "On" and engine "On". 2. Select the "Miscellaneous Test" and perform the "IAC Control" in the "IAC System". 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to Step 10	Go to Step 9
9	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 14
10	Check for injector for the affected bank. Refer to "Injector Coil Test & Injector Balance Test Procedure". Was the injector operation correct?	—	Go to Step 11	Refer to <i>Injector Coil Test & Injector Balance Test Procedure</i>
11	Check for fuel pressure. Refer to "Fuel System Diagnosis". Was the fuel pressure correct?	—	Go to Step 15	Refer to <i>Fuel System Diagnosis</i>
12	Replace the TPS. Is the action complete?	—	Verify repair	—
13	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
14	Replace the IAC valve. Is the action complete?	—	Verify repair	—
15	Replace the O ₂ sensor. Was the problem solved?	—	Verify repair	Go to Step 16
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to Step 17
17	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1171 FUEL SUPPLY SYSTEM LEAN DURING POWER ENRICHMENT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1171	D	Fuel Supply System Lean During Power Enrichment	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60°C. 3. Mass air flow is below 13.5m/s. 4. O ₂ sensor bank 1 output voltage is below 350mV in power enrichment mode.	No fail-safe function.

Circuit Description

The engine control module (ECM) internal circuitry can identify if the vehicle fuel system is capable of supplying adequate amounts of fuel during heavy acceleration (power enrichment). The ECM monitors the voltage of the oxygen sensor during power enrichment. When a power enrichment mode of operation is requested during “Closed Loop” operation (by heavy acceleration),

the ECM will provide more fuel to the engine. Under these conditions the ECM should detect a “rich” condition (high oxygen sensor voltage). If this “rich” exhaust is not detected at this time, a Diagnostic Trouble Code P1171 will set. A plugged fuel filter or restricted fuel line can prevent adequate amounts of fuel from being supplied during power enrichment mode.

Diagnostic Aids

Check for the following conditions:

- Heated oxygen sensor wiring - The sensor pigtail may be routed incorrectly and contacting the exhaust system.
- Poor ECM to engine block ground.
- Fuel pressure - The system will go lean if pressure is too low. The ECM can compensate for some decrease. However, if fuel pressure is too low, a diagnostic Trouble Code P1171 may be set. Refer to *Fuel System Diagnosis*.
- Lean injector(s) - Perform "Injector Balance Test."
- Vacuum leaks - Check for disconnected or damaged vacuum hoses and for vacuum leaks at the intake manifold, throttle body, and PCV system.
- Exhaust leaks - An exhaust leak may cause outside air to be pulled into the exhaust gas stream past the HO2S, causing the system to appear lean. Check for exhaust leaks that may cause a false lean condition to be indicated.
- Fuel contamination - Water, even in small amounts, can be delivered to the fuel injectors. The water can cause a lean exhaust to be indicated. Excessive alcohol in the fuel can also cause this condition. Refer to *Fuel System Diagnosis* for the procedure to check for fuel contamination.

Diagnostic Trouble Code (DTC) P1171 Fuel Supply System Lean During Power Enrichment

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1171 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1171 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" in accordance with accelerator pedal operation?	—	Go to Step 6	Go to Step 5
5	Check for the following conditions. • Objects blocking the throttle valve. • Incorrectly installed. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 12
6	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Manifold Absolute Pressure" in the data display. Does the Tech 2 indicate correct "Manifold Absolute Pressure" in accordance with engine speed or acceleration?	—	Go to Step 8	Go to Step 7

6E-208 ENGINE DRIVEABILITY AND EMISSIONS

Step	Action	Value(s)	Yes	No
7	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 13</i>
8	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “IAC Control” in the “IAC System”. 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to <i>Step 10</i>	Go to <i>Step 9</i>
9	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to <i>Step 14</i>
10	Check for injector for the affected bank. Refer to “ <i>Injector Coil Test & Injector Balance Test Procedure</i> ”. Was the injector operation correct?	—	Go to <i>Step 11</i>	Refer to <i>Injector Coil Test & Injector Balance Test Procedure</i>
11	Check for fuel pressure. Refer to “ <i>Fuel System Diagnosis</i> ”. Was the fuel pressure correct?	—	Go to <i>Step 15</i>	Refer to <i>Fuel System Diagnosis</i>
12	Replace the TPS. Is the action complete?	—	Verify repair	—
13	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
14	Replace the IAC valve. Is the action complete?	—	Verify repair	—
15	Replace the O ₂ sensor. Was the problem solved?	—	Verify repair	Go to <i>Step 16</i>
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 17</i>
17	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1625 ECM SYSTEM RESET

Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1625	B	ECM System Reset	ECM reset has occurred other than "On".	Engine control disabled.

Circuit Description

The powertrain control module (ECM) monitors unexpected ECM reset. This will not turn on MIL light on, only records code DTC P1625.

Diagnostic Aids

Check for the following conditions:

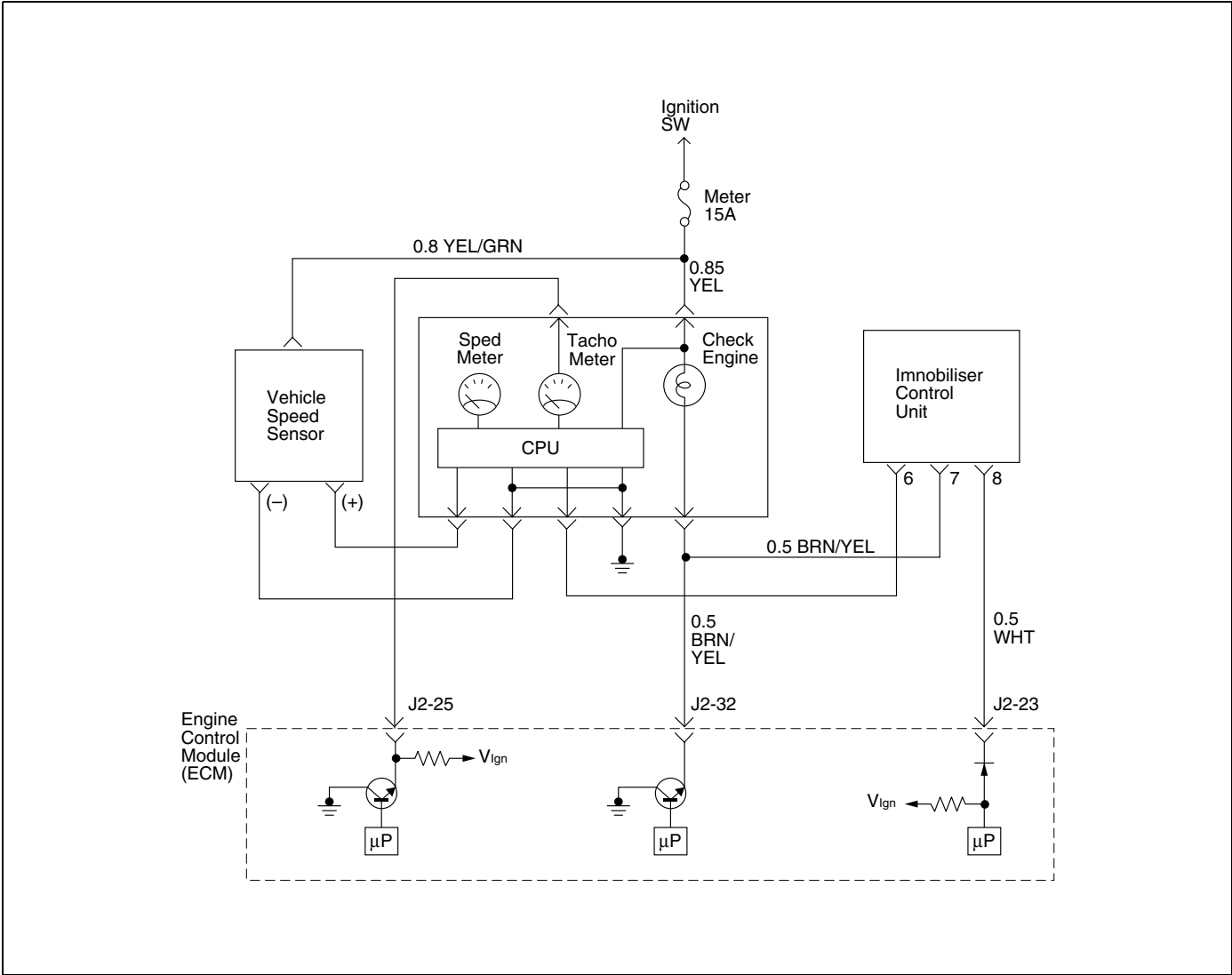
- P1625 alone stored does not need diagnosis. Clear DTC code.

NOTE: DTC P1625 is a DTC to record a ECM reset history. If DTC P1625 is not reset and no engine abnormality occurs after learning the DTC, no farther diagnostic procedures are required.

Diagnostic Trouble Code (DTC) P1625 ECM System Reset

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1625 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1625 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	—	Remove the accessory parts and verify repair	Go to Step 5
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to Step 6
6	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1626 IMMOBILISER NO SIGNAL



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1626	-	Immobiliser No Signal	No response from immobiliser control unit.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

The ECM decides whether that is an abnormality in the immobiliser control system. DTC P1626 is recorded by the ECM when no response from immobiliser.

Diagnostic Aids

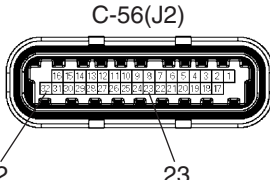
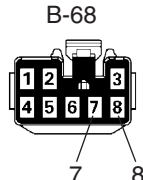
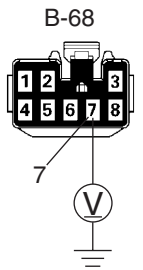
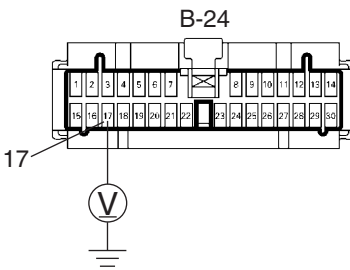
Check for the following conditions:

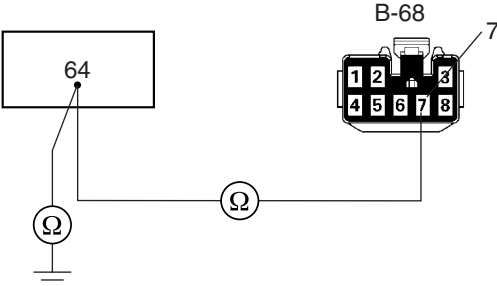
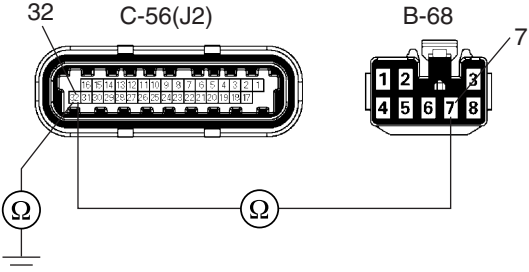
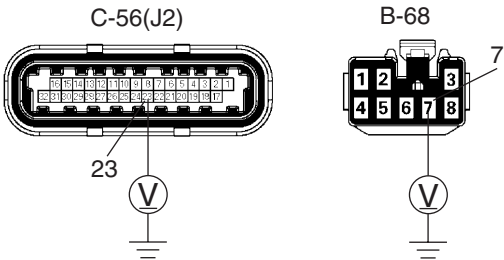
- Poor connection at ECM and Immobiliser-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or

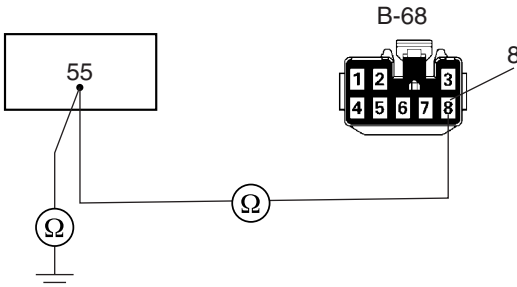
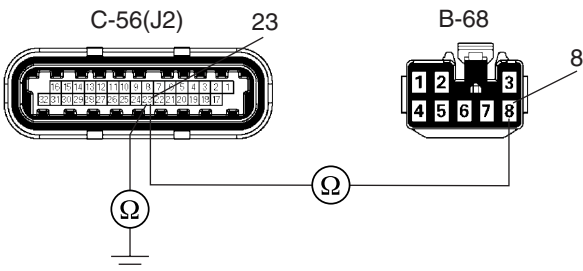
damaged terminals, and poor terminal to wire connection.

- Damaged harness Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobiliser, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobiliser harness connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

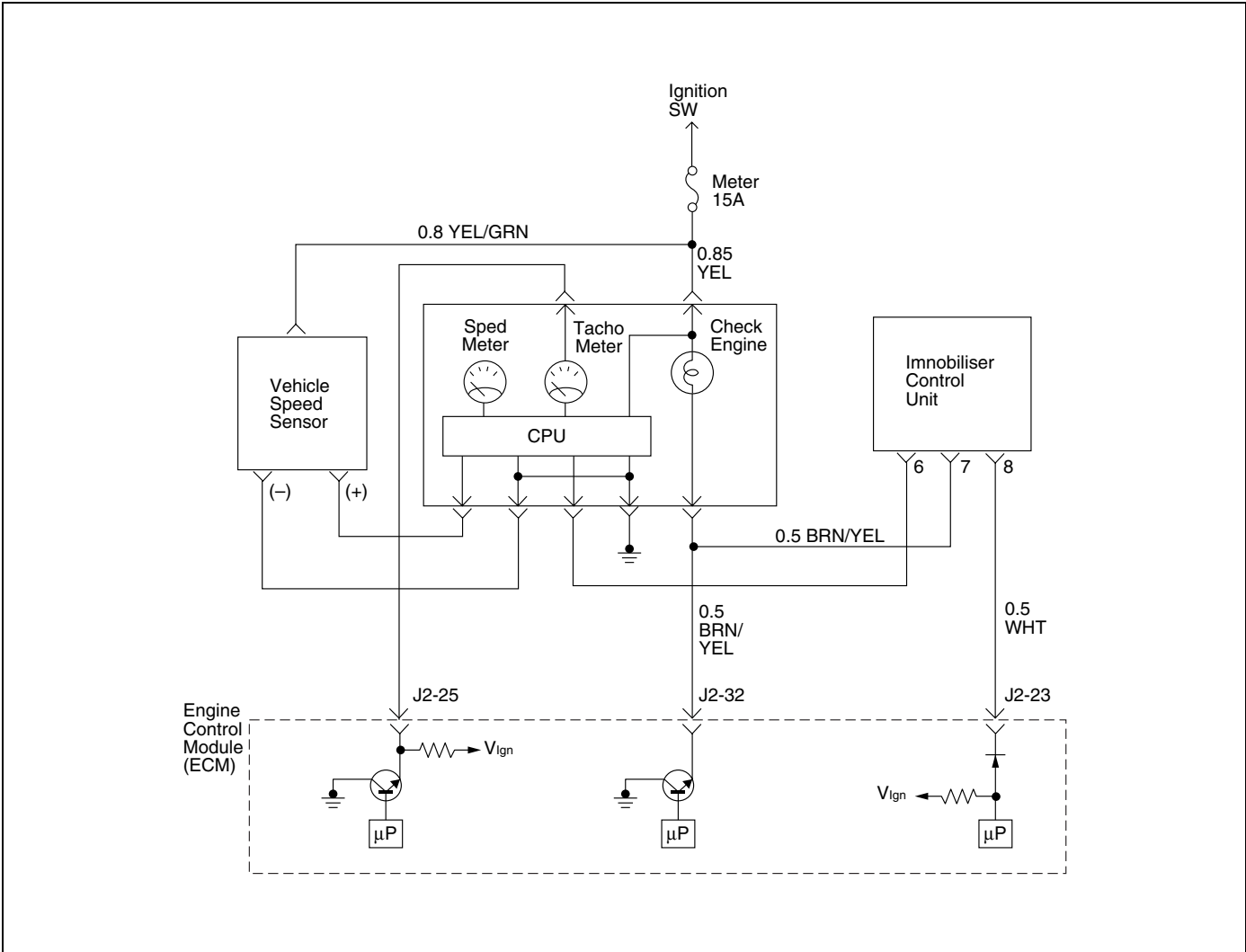
Diagnostic Trouble Code (DTC) P1626 Immobiliser No Signal

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1626 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1626 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobiliser" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnostic Trouble Code". Was the any DTC's B**** stored in this ignition cycle?	—	Refer to <i>"Immobiliser Workshop Manual" & Go to DTC Chart B****</i>	Go to Step 5
5	Check for poor/faulty connection at the immobiliser control unit connector or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?	—	Verify repair	Go to Step 6
 		—	Verify repair	Go to Step 6
6	Using the DVM and check the "CHECK ENGINE" lamp circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the meter connector and immobiliser control unit connector. 3. Ignition "On". 4. Check the circuit for short to power supply circuit. Was the problem found?	—	Repair faulty harness and verify repair	Go to Step 7
 		—	Repair faulty harness and verify repair	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the “CHECK ENGINE” lamp circuit. Breaker box is available: 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the immobiliser control unit connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition “Off”, engine “Off”. 2. Disconnect the the immobiliser control unit connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 8</i>
8	Using the DVM and check the VSS signal circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the immobiliser control unit connector and ECM connector. 3. Ignition “On”. 4. Check the circuit for short to power supply circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 9</i>

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the VSS signal circuit. Breaker box is available: 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. 3. Disconnect the immobiliser control unit connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  Breaker box is not available: 1. Ignition "Off", engine "Off". 2. Disconnect the immobiliser control unit connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 10</i>
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)". Was the problem solved?	—	Verify repair	Go to <i>Step 11</i>
11	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1631
IMMOBILISER WRONG SIGNAL



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1631	-	Immobiliser Wrong Signal	Received response is not correct.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

The ECM decides whether that is an abnormality in the immobiliser control system. DTC P1631 is recorded by the ECM when received response was not correct.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM and Immobiliser-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or

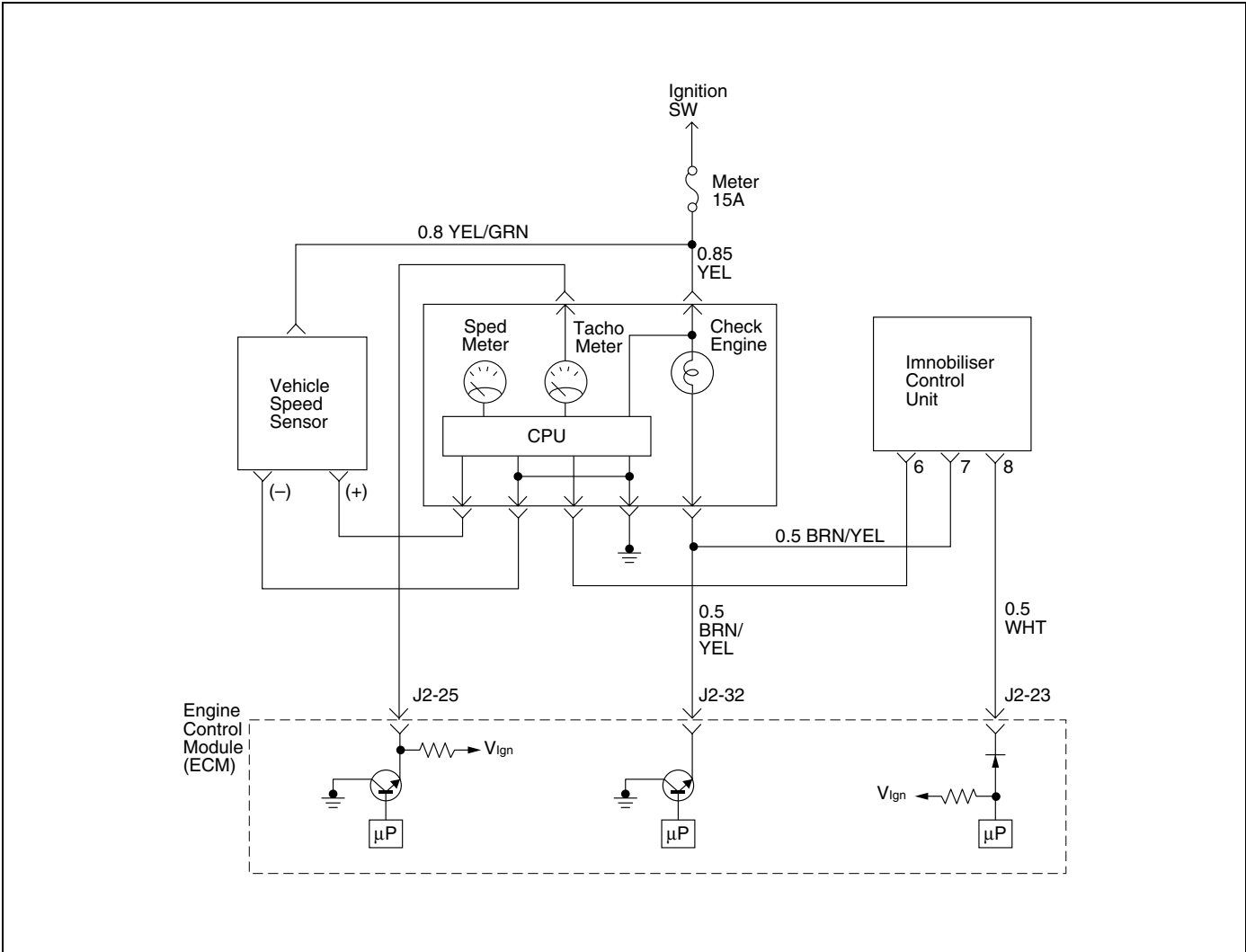
damaged terminals, and poor terminal to wire connection.

- Damaged harness-Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobiliser, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobiliser harness connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1631 Immobiliser Wrong Signal

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1631 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 3</i>
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1631 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 4</i>
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobiliser" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnostic Trouble Code". Was the any DTC's B**** stored in this ignition cycle?	—	Refer to <i>"Immobiliser Workshop Manual" & Go to DTC Chart B****</i>	Go to <i>Step 5</i>
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to <i>Step 6</i>
6	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1648
WRONG SECURITY CODE ENTERED



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1648	-	Wrong Security Code Entered	Received incorrect security code.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

The ECM decides whether that is an abnormality in the immobiliser control system. DTC P1648 is recorded by the ECM when received incorrect security code.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM and Immobiliser-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or

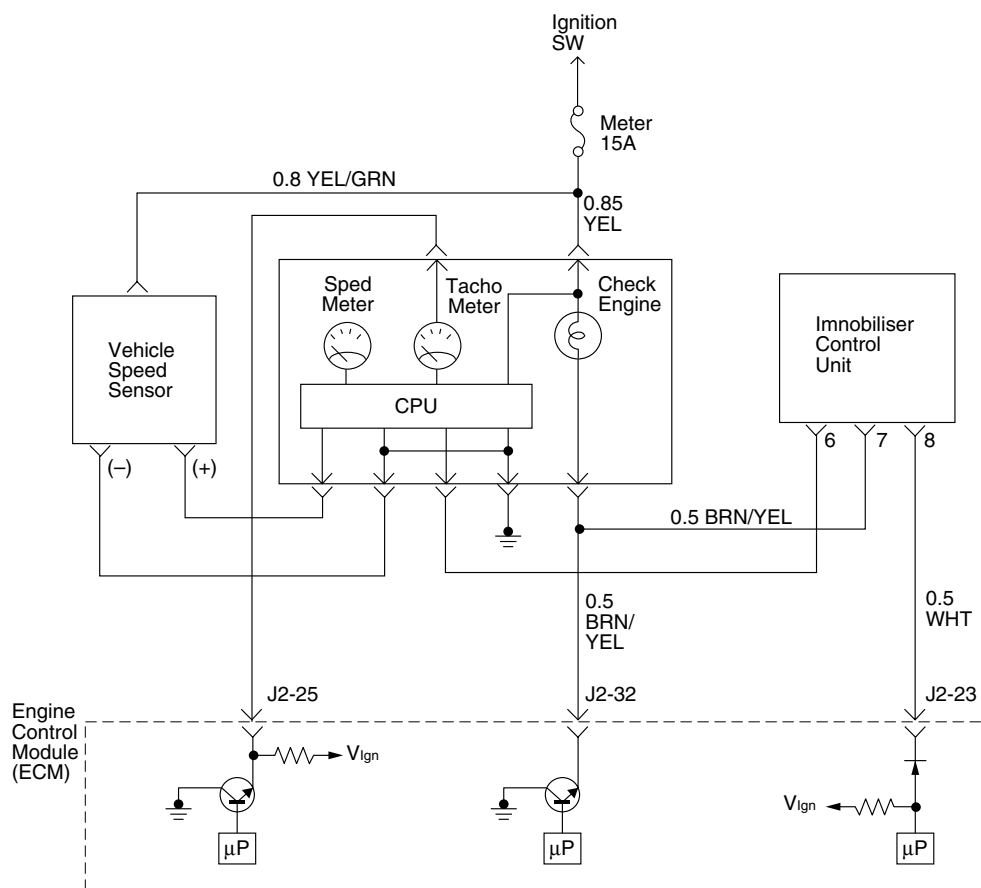
damaged terminals, and poor terminal to wire connection.

- Damaged harness Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobiliser, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobiliser harness connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1648 Wrong Security Code Entered

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1648 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 3</i>
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1648 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 4</i>
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobiliser" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnostic Trouble Code". Was the any DTC's B**** stored in this ignition cycle?	—	Refer to <i>"Immobiliser Workshop Manual" & Go to DTC Chart B****</i>	Go to <i>Step 5</i>
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " SPS (Service Programming System) ". Was the problem solved?	—	Verify repair	Go to <i>Step 6</i>
6	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1649 IMMOBILISER FUNCTION NOT PROGRAMMED



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1649	-	Immobiliser Function Not Programmed	Immobiliser function is not programmed in the ECM.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

The ECM decides whether that is an abnormality in the immobiliser control system. DTC P1649 is recorded by the ECM when security code & secret key not programmed.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM and Immobiliser-Inspect harness connectors for backed out terminals.

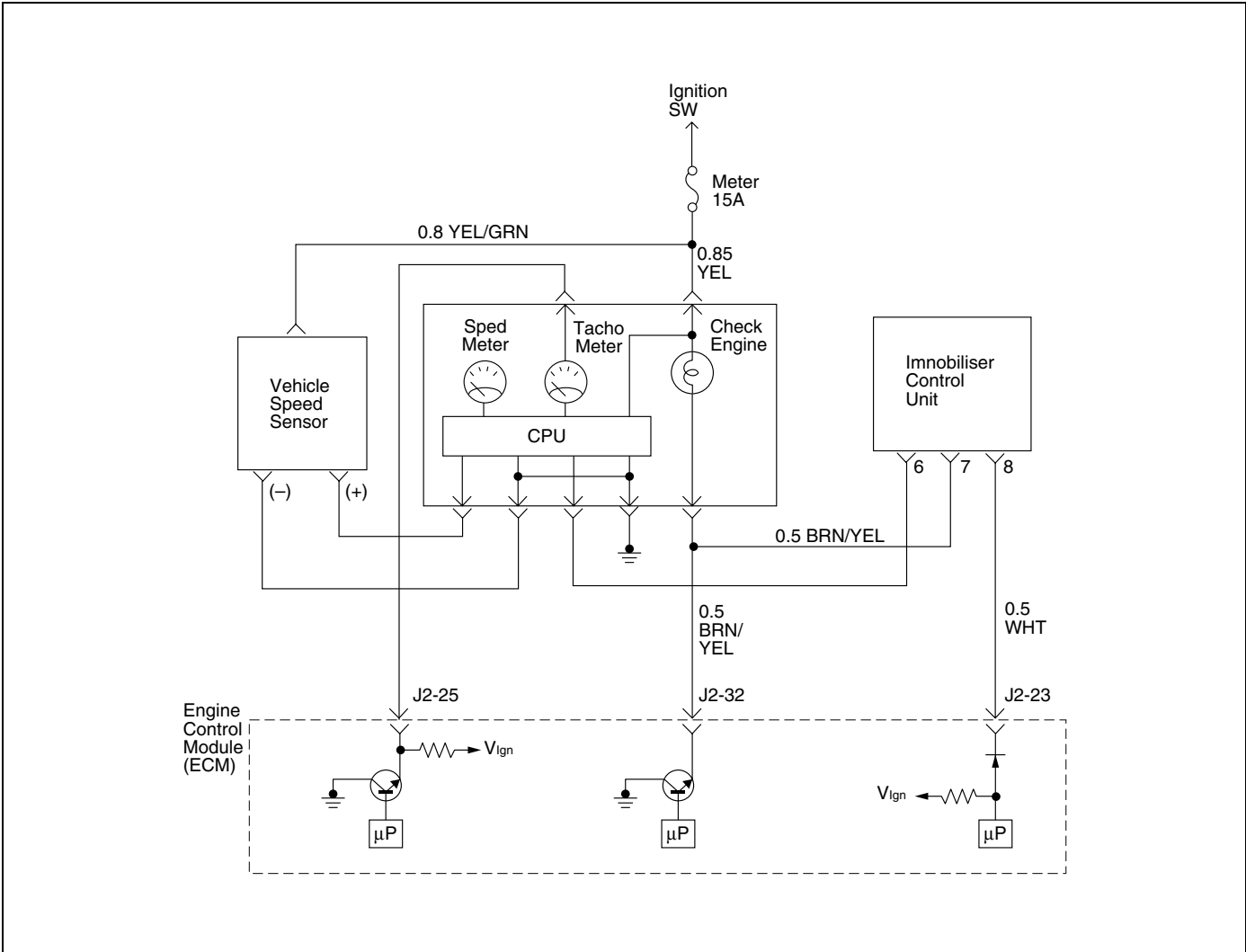
improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

- **Damaged harness** Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobiliser, turn the ignition “ON” and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobiliser harness connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1649 Immobiliser Function Not Programmed

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1649 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 3</i>
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1649 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to <i>Step 4</i>
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobiliser" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnostic Trouble Code". Was the any DTC's B**** stored in this ignition cycle?	—	Refer to <i>"Immobiliser Workshop Manual" & Go to DTC Chart B****</i>	Go to <i>Step 5</i>
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the "SPS (Service Programming System)" . Was the problem solved?	—	Verify repair	Go to <i>Step 6</i>
6	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1693
TACHOMETER OUTPUT LOW VOLTAGE



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1693	B	Tachometer Output Low Voltage	Tacho output circuit short to ground circuit.	No fail-safe function.

Circuit Description

Based on the information from the Crank Position Sensor (CKP), X58 reference signal is generated at each rotation of the crankshaft.

Engine Control Module (ECM) converts X58 reference signal into the square wave signal which is used to drive the pulse generator of the tachometer.

When the wave length of the output signal is long, the tacho meter indicates the engine speed is low, and vise versa.

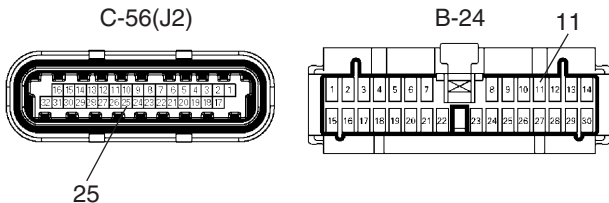
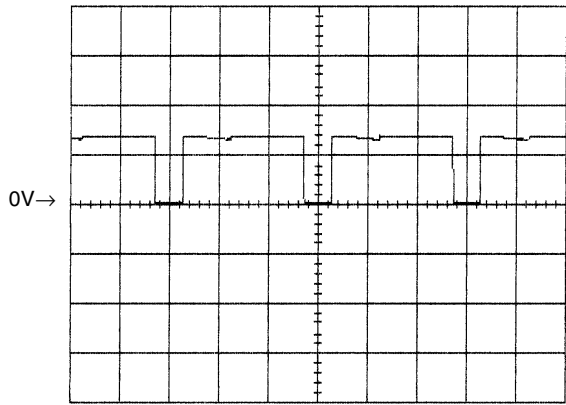
This malfunction detects a low impedance short to

ground or open contact on the Tacho output, the Diagnostic Trouble Code P1693 will be set.

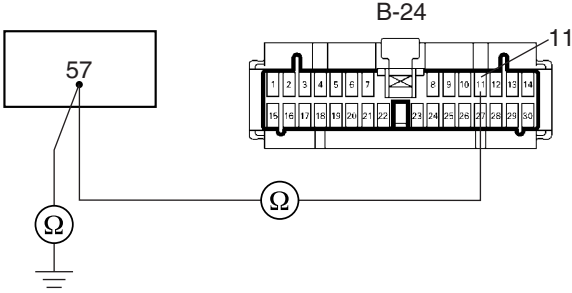
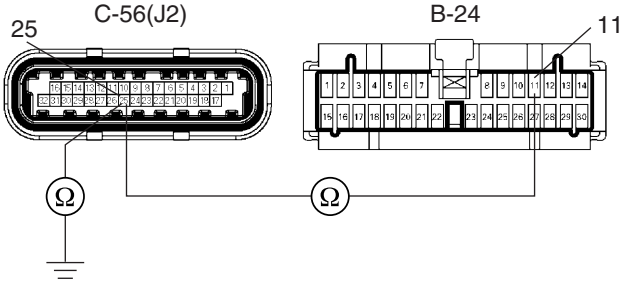
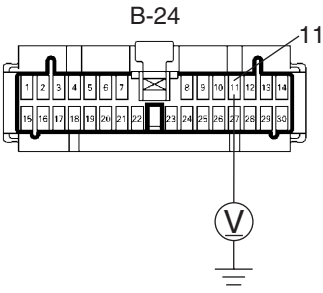
Diagnostic Aids

- Poor connections or a damaged harness - Inspect the harness connections for: backed out terminals, impropo, mating or damaged terminals. Also check for open circuit, short to ground, and short to voltage.
- This malfunction detects a low impedance short to ground or open contact on the ECM out put circuit.

Diagnostic Trouble Code (DTC) P1693 Tachometer Output Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to <i>On Board Diagnostic (OBD) System Check</i>
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1693 stored as "Present Failure"?	—	Go to Step 3	Refer to <i>Diagnostic Aids</i> and Go to Step 3
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1693 stored in this ignition cycle?	—	Go to Step 4	Refer to <i>Diagnostic Aids</i> and Go to Step 4
4	Check for poor/faulty connection at the ECM or meter connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? 	—	Verify repair	Go to Step 5
5	If an oscilloscope is available, monitor the Tachometer output signal. Does the oscilloscope indicate correct wave form? Tachometer Output Signal Reference Wave Form  Measurement Terminal: J2-25 (+) J1-1 (-) Measurement Scale: 10V/div 5.0ms/div Measurement Condition: Engine Speed at 2000rpm	—	Go to Step 10	Not available: Goto Step 6 Fixed at low: Go to Step 6 Fixed at High: Go to Step 7

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Step	Action	Value(s)	Yes	No
6	Using the DVM and check the Tacho output circuit. Breaker box is available: - Ignition "Off", engine "Off". - Install the breaker box as type A. (ECM disconnected) Ref. 6E-80. - Disconnect the meter connector. - Check the circuit for open or short to ground circuit. Was the problem found?  Breaker box is not available: - Ignition "Off", engine "Off". - Disconnect the ECM connector. - Disconnect the meter connector. - Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to <i>Step 7</i>
7	Using the DVM and check the Tacho output circuit. - Ignition "On", engine "Off". - Disconnect the meter connector. - Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to <i>Step 8</i>	Repair faulty harness and verify repair
8	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	—	Remove the accessory parts and verify repair	Go to <i>Step 9</i>

Step	Action	Value(s)	Yes	No
9	Replace the Tacho meter. Was the problem solved?	—	Verify repair	Go to <i>Step 10</i>
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 11</i>
11	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

SYMPTOM DIAGNOSIS

PRELIMINARY CHECKS

Before using this section, perform the “On-Board Diagnostic (OBD) System Check” and verify all of the following items:

- The engine control module (ECM) and malfunction indicator lamp (MIL = Check Engine Lamp) are operating correctly.
- There are no Diagnostic Trouble Code(s) stored.
- Tech 2 data is within normal operating range. Refer to Typical Scan Data Values.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom chart.

VISUAL/PHYSICAL CHECK

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time. This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connection, shown on the “Emission Control System Schematics”. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Air leaks at throttle body mounting area, manifold absolute pressure (MAP) sensor and intake manifold sealing surfaces.
- Ignition wires for cracking, harness, and carbon tracking.
- Wiring for proper connections, pinches and cuts.

INTERMITTENT

Important: An intermittent problem may or may not turn on the malfunction indicator lamp (MIL) or store a Diagnostic Trouble Code. Do NOT use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problem. Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions.

- Poor mating of the connector halves or a terminal not fully seated in the connector (backed out).
- Improperly formed or damaged terminal.
- All connector terminals in the problem circuit should be carefully checked for proper contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal from the connector body to check.
- Ignition coils shorted to ground and arcing at ignition wires or plugs.

- MIL (Check Engine Lamp) wire to ECM shorted to ground.
- Poor ECM grounds. Refer to the ECM wiring diagrams.

Road test the vehicle with a Digital Multimeter connected to a suspected circuit. An abnormal voltage when the malfunction occurs is a good indication that there is a fault in the circuit being monitored.

Using Tech 2 to help detect intermittent conditions. The Tech 2 has several features that can be used to locate an intermittent condition.

An intermittent MIL (Check Engine Lamp) with no stored Diagnostic Trouble Code may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- MIL (Check Engine Lamp) wire to ECM short to ground.
- Poor ECM grounds. Refer to the ECM wiring diagrams.

Check for improper installation of electrical options such as light, cellular phones, etc. Check all wires from ECM to the ignition control module for poor connections.

Check for an open diode across the A/C compressor clutch and check for other open diodes (refer to wiring diagrams in Electrical Diagnosis).

If problem has not been found, refer to ECM connector symptom tables.

- Check the “Broadcast Code” of the ECM, and compare it with the latest Isuzu service bulletins and/or Isuzu EEPROM reprogramming equipment to determine if an update to the ECM’s reprogrammable memory has been released.

To check the “Broadcast Code”, connect the Tech 2, then look for “ID info.” then select “Broadcast Code”. This should display a 4 character code, such as “XBYA” (example only).

This identifies the contents of the reprogrammable software and calibration contained in the ECM.

If the “Broadcast Code” is not the most current available, it is advisable to reprogram the ECM’s EEPROM memory, which may either help identify a hard-to find problem or may fix the problem.

The Service Programming System (SPS) will not allow incorrect software programming or incorrect calibration changes.

ENGINE CRANKS BUT WILL NOT RUN

DEFINITIONS: Engine cranks, but will not run. (The engine never start.)

NOTE: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM.

Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.

NOTE: The vehicle with immobiliser system, this system may be activated. Check the immobiliser system diagnosis.

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visually/physical check performed?	—	Go to Step 4	Go to Visual / physical Check.
4	Check the "Ignition coil" fuse (15A) and "ECM" fuse (15A). Was a fuse blown?	—	Verify repair	Go to Step 5
5	1. Ignition ON 2. Use a DVM to verify that battery voltage at the ignition coil fuse, and the ECM fuse. Was battery voltage presented at the fuses?	—	Go to Step 6	Verify & repair
6	1. Visually/physically inspect for the following conditions: • Restriction of air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to Step 7
7	1. Using a Tech 2, display the IAC value. 2. Check for a faulty, plugged, or sticking IAC operation. Was the problem found?	—	Verify repair	Go to Step 8
8	1. Using a Tech 2, display the MAP sensor value. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to Step 9
9	If oscilloscope is available, check the wave form of the CKP signal. Was the correct wave form found?	—	Go to Step 12	Go to Step 10
10	Check the CKP sensor wire for open or short circuit. Was a problem found?	—	Verify repair	Go to Step 11
11	Replace CKP sensor. Is there still problem?	—	Replace pulsar ring.	Verify repair

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Step	Action	Value(s)	Yes	No
12	Visually/physically inspect the secondary ignition wires. Check for the following conditions: • Verify that all ignition wire resistance are less than the specified value. • Verify that ignition wires are correctly routed to eliminate cross-fitting. • Verify that ignition wires are not arcing to ground. Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to <i>Step 13</i>
13	1. Disconnect the spark plug high tension cable from No.1 spark plug. 2. Install a spark tester at the end of the disconnected ignition coil. 3. Clip the spark tester to a good ground. 4. Observe the spark tester while the engine is cranking. Was a crisp blue spark observed? (Only one or two sparks followed by no result is considered the same as "No Spark".)	—	Go to <i>Step 21</i>	Go to <i>Step 14</i>
14	1. Disconnect the ignition coil harness connector. 2. Check for an open or short circuit between the ignition coil and the ECM. Was a problem found?	—	Verify repair	Go to <i>Step 15</i>
15	1. Ignition "On". 2. Using a Digital Voltmeter (DVM) check the ignition wire coil at the ignition coil harness connector. Was the voltage equal to the specified value?	Battery voltage	Go to <i>Step 16</i>	Verify repair
16	1. Ignition "Off". 2. With DVM, check for an open in the ground wire at the ignition coil harness connector. Was the ground wire OK?	—	Go to <i>Step 17</i>	Verify repair
17	Replace the ignition coil, verify the repair. Attempt to start the engine. Is there still a problem?	—	Go to <i>Step 18</i>	Verify repair
18	Use an ohmmeter to check the ignition coil primary winding resistance. Was the primary winding resistance approximately equal to the specified value?	0.8-18k Ω	Go to <i>Step 19</i>	Go to <i>Step 20</i>
19	Use an ohmmeter to check the ignition coil secondary winding resistance. Was the primary winding resistance hear around the to the specified value?	2.5k Ω	Go to <i>Step 21</i>	Go to <i>Step 20</i>
20	Replace the ignition coil.	—	Verify repair	—
21	1. Remove the spark plugs from all cylinders. 2. Visually inspect the spark plug electrodes. 3. Replace any spark plugs with loose or missing electrodes or cracked insulators. Did your inspection reveal any spark plugs exhibiting excessive fouling?	—	Correct the fouling condition	Go to <i>Step 22</i>

Step	Action	Value(s)	Yes	No
22	Perform the procedure in <i>Fuel System Pressure Test</i> to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to <i>Step 23</i>
23	Refer to <i>Fuel System Diagnosis</i> to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to <i>Step 24</i>
24	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to <i>Step 25</i>
25	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 26</i>
26	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 27</i>
27	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

HARD START SYMPTOM

DEFINITIONS: Engine cranks, but does not start for a long time. Does eventually start, or may start and then immediately stall.

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visually/physical check performed?	—	Go to Step 4	Go to Visual / physical Check.
4	1. Visually/physically inspect for the following conditions: • Restriction of air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to Step 5
5	1. Using a Tech 2, display the IAC value. 2. Check for a faulty, plugged, or sticking IAC operation. Was the problem found?	—	Verify repair	Go to Step 6
6	Check engine coolant temperature (ECT) sensor for shift in value. 1. After 8 hours with hood up and the engine not running, connect the Tech 2. 2. Ignition On, engine not running. 3. Using Tech 2, compare Engine Coolant Temperature to Intake Air Temperature. Are ECT and IAT within the specified value of each other?	±5°C	Go to Step 8	Go to Step 7

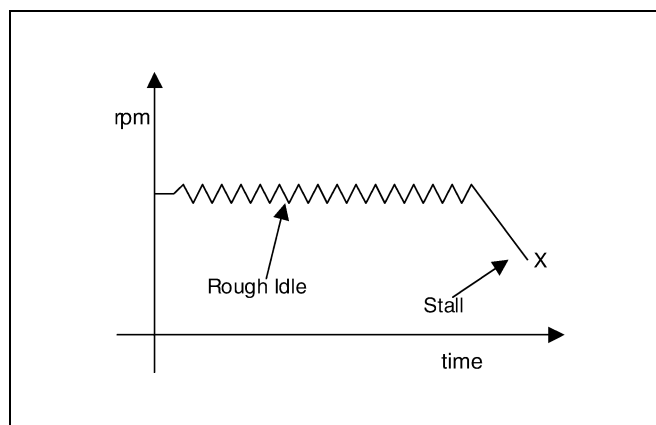
Step	Action	Value(s)	Yes	No																		
7	1. Using a Tech 2, display the engine coolant temperature and note the value. 2. Check the resistance of the engine coolant temperature sensor. Is the actual resistance near the resistance value in the chart for the temperature that was noted? <table><tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr><tr><td>-20</td><td>32040</td></tr><tr><td>0</td><td>9788</td></tr><tr><td>20</td><td>3516</td></tr><tr><td>40</td><td>1439</td></tr><tr><td>60</td><td>656</td></tr><tr><td>80</td><td>327</td></tr><tr><td>100</td><td>175</td></tr><tr><td>120</td><td>100</td></tr></table>	Temperature (°C)	Resistance (Ω) (Approximately)	-20	32040	0	9788	20	3516	40	1439	60	656	80	327	100	175	120	100	—	Go to <i>Step 8</i>	Replace the ECT sensor. Verify repair
Temperature (°C)	Resistance (Ω) (Approximately)																					
-20	32040																					
0	9788																					
20	3516																					
40	1439																					
60	656																					
80	327																					
100	175																					
120	100																					
8	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to <i>Step 9</i>																		
9	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to <i>Step 10</i>																		
10	Check for proper ignition voltage output with a spark tester. Was the problem found?	—	Verify repair	Go to <i>Step 11</i>																		
11	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to <i>Step 12</i>																		
12	Check for a loose ignition control module ground. Was a problem found?	—	Verify repair	Go to <i>Step 13</i>																		
13	1. Check the ignition coil secondary resistance. 2. Replace the coil if it is greater than the specified resistance. Did the coil require replacement?	2.5kΩ	Verify repair	Go to <i>Step 14</i>																		

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Step	Action	Value(s)	Yes	No
14	Drain sample fuel, visual inspection. Any suspicion about the fuel, such as discoloration, particle, contamination, water, unusual smell, then drain the fuel from fuel tank. Replace the fuel from know vehicle source. If any suspicion of alcohol contamination, completely drain the fuel, replace by fuel from known vehicle source.	—	Verify repair	Go to <i>Step 15</i>
15	Perform the procedure in Fuel System Pressure Test to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to <i>Step 16</i>
16	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	—	Verify repair	Go to <i>Step 17</i>
17	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to <i>Step 18</i>
18	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 19</i>
19	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 20</i>
20	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING SYMPTOM

DEFINITIONS: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.



Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual / physical Check.
4	1. Check for faulty, plugged or incorrectly installed PCV valve. 2. Verify that the PCV system is not plugged. Was a problem found?	—	Verify repair	Go to Step 5
5	1. Check for incorrect idle speed. Ensure that the following conditions are present. • Engine fully warm • Accessories are "Off" 2. Using a Tech 2, monitor IAC position. Is the IAC position within the specified values?	20-30 Steps	Go to Step 7	Go to Step 6
6	1. Visually/physically inspect for the following conditions: • Restriction of the air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to Step 7

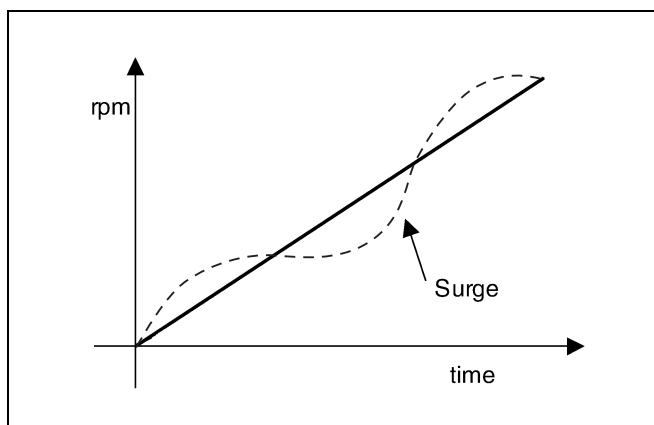
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Step	Action	Value(s)	Yes	No																		
7	1. Using a Tech 2, display the engine coolant temperature and note the value. 2. Check the resistance of the engine coolant temperature sensor. Is the actual resistance near the resistance value in the chart for the temperature that was noted? <table><tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr><tr><td>-20</td><td>32040</td></tr><tr><td>0</td><td>9788</td></tr><tr><td>20</td><td>3516</td></tr><tr><td>40</td><td>1439</td></tr><tr><td>60</td><td>656</td></tr><tr><td>80</td><td>327</td></tr><tr><td>100</td><td>175</td></tr><tr><td>120</td><td>100</td></tr></table>	Temperature (°C)	Resistance (Ω) (Approximately)	-20	32040	0	9788	20	3516	40	1439	60	656	80	327	100	175	120	100	—	Go to <i>Step 8</i>	Replace the ECT sensor. Verify repair
Temperature (°C)	Resistance (Ω) (Approximately)																					
-20	32040																					
0	9788																					
20	3516																					
40	1439																					
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80	327																					
100	175																					
120	100																					
8	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to <i>Step 9</i>																		
9	Using Tech 2, monitor throttle position with the engine idling. Is the throttle position at the specified value and steady?	0%	Go to <i>Step 10</i>	Refer to Diagnostic Trouble Code P0123 for further diagnosis																		
10	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to <i>Step 11</i>																		
11	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to <i>Step 12</i>																		
12	Check for a loose ignition control module ground. Was a problem found?	—	Verify repair	Go to <i>Step 13</i>																		
13	Check items that can cause the engine to run rich. Refer to DTC P1167 “Fuel Supply System Rich During Deceleration Fuel Cut Off”. Was a problem found?	—	Verify repair	Go to <i>Step 14</i>																		
14	Check items that can cause the engine to run lean. Refer to DTC P1171 “Fuel Supply System Lean During Power Enrichment”. Was a problem found?	—	Verify repair	Go to <i>Step 15</i>																		
15	Check the injector connectors, if any of the injectors are connected any incorrect cylinder, correct as necessary. Was a problem found?	—	Verify repair	Go to <i>Step 16</i>																		
16	1. Check for faulty engine mounts. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to <i>Step 17</i>																		

Step	Action	Value(s)	Yes	No
17	Perform the procedure in <i>Fuel System Pressure Test</i> to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to <i>Step 18</i>
18	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to <i>Step 19</i>
19	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 20</i>
20	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 21</i>
21	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

SURGES AND/OR CHUGS SYMPTOM

DEFINITIONS: See the illustration below. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal.



Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual / physical Check.
4	Be sure that the driver understands A/C compressor operation as explained in the owner's manual. Inform the customer how the A/C clutch operate. Is the customer experiencing a normal condition?	—	System OK	Go to Step 5
5	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to Step 6
6	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Is the throttle position at the specified value and steady in any position?	—	Go to Step 7	Refer to Diagnostic Trouble Code P0123 for further diagnosis
7	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to Step 8
8	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command an excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to Step 9

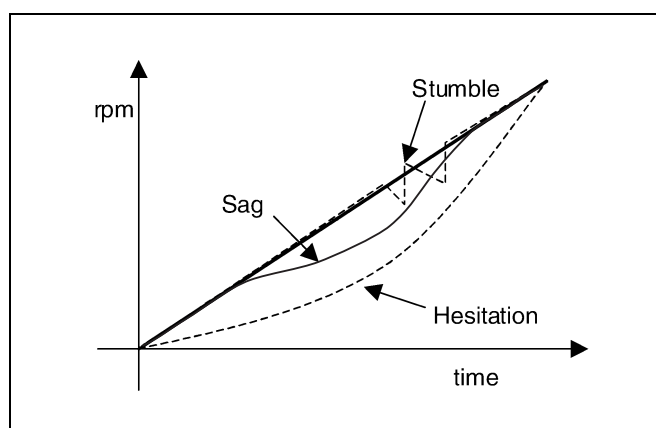
Step	Action	Value(s)	Yes	No
9	Check the fuel pressure. Refer to Fuel System Diagnosis. Was a problem found?	—	Verify repair	Go to <i>Step 10</i>
10	Monitor “ <i>B1S1 (Bank 1 Sensor 1) Status</i> ” on the Tech 2. Is the “ <i>B1S1 (Bank 1 Sensor 1) Status</i> ” in the rich condition?	—	Verify repair	Go to <i>Step 11</i>
11	Check items that can cause the engine to run rich. Refer to DTC P1167 “Fuel Supply System Rich During Deceleration Fuel Cut Off”. Was a problem found?	—	Verify repair	Go to <i>Step 12</i>
12	Check items that can cause the engine to run lean. Refer to DTC P1171 “Fuel Supply System Lean During Power Enrichment”. Was a problem found?	—	Verify repair	Go to <i>Step 13</i>
13	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to <i>Step 14</i>
14	Check for a loose ignition control module ground. Was a problem found?	—	Verify repair	Go to <i>Step 15</i>
15	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to <i>Step 16</i>
16	1. Check the ignition coil secondary resistance. 2. Replace the coil if it is greater than the specified resistance. Did the coil require replacement?	2.5kΩ	Verify repair	Go to <i>Step 17</i>
17	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to <i>Step 18</i>
18	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	—	Verify repair	Go to <i>Step 19</i>
19	Check the ECM grounds to verify that they are clean and tight. Refer to the <i>ECM wiring diagrams</i> . Was a problem found?	—	Verify repair	Go to <i>Step 20</i>
20	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	—	Verify repair	Go to <i>Step 21</i>

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Step	Action	Value(s)	Yes	No
21	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes • Internal muffler failure Was a problem found?	—	Verify repair	Go to <i>Step 22</i>
22	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 23</i>
23	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 24</i>
24	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

HESITATION, SAG, STUMBLE SYMPTOM

DEFINITIONS: Momentary lack of response as the accelerator is pushed down. Can occur at any vehicle speed. Usually most pronounced when first trying to make the vehicle move, as from a stop sign. May cause the engine to stall if severe enough.



Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual / physical Check.
4	Check the fuel quality. Is the customer using improper fuel or degraded fuel?	—	Replace fuel	Go to Step 5
5	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to Step 6
6	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Does the throttle position increase steady with increasing smoothly?	—	Go to Step 7	Refer to Diagnostic Trouble Code P0123 for further diagnosis
7	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to Step 8
8	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to Step 9
9	Check the fuel pressure. Refer to <i>Fuel System Diagnosis</i> . Was a problem found?	—	Verify repair	Go to Step 10

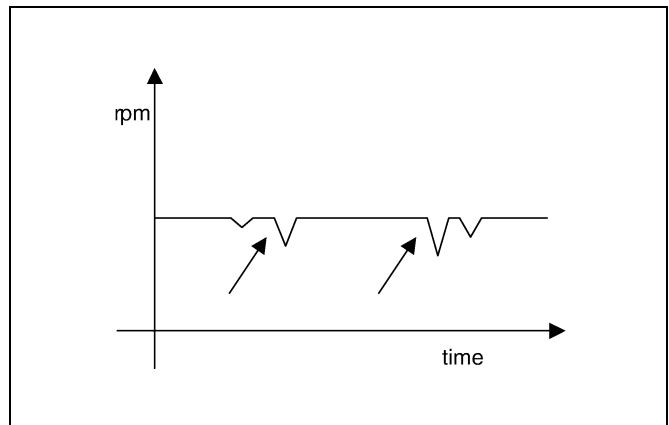
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Step	Action	Value(s)	Yes	No
10	Monitor "B1S1 (Bank 1 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" in the rich condition?	—	Go to Step 11	Go to Step 12
11	Check items that can cause the engine to run rich. Refer to DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off". Was a problem found?	—	Verify repair	Go to Step 12
12	Check items that can cause the engine to run lean. Refer to DTC P1171 "Fuel Supply System Lean During Power Enrichment". Was a problem found?	—	Verify repair	Go to Step 13
13	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to Step 14
14	Check for a loose ignition control module ground. Was a problem found?	—	Verify repair	Go to Step 15
15	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to Step 16
16	1. Check the ignition coil secondary resistance. 2. Replace the coil if it is greater than the specified resistance. Did the coil require replacement?	2.5kΩ	Verify repair	Go to Step 17
17	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to Step 18
18	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	—	Verify repair	Go to Step 19
19	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	—	Verify repair	Go to Step 20

Step	Action	Value(s)	Yes	No
20	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 21</i>
21	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “SPS (Service Programming System)” . Was the problem solved?	—	Verify repair	Go to <i>Step 22</i>
22	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

CUTS OUT, MISSES SYMPTOM

DEFINITIONS: Steady pulsation or jerking that follows engine speed; usually more pronounced as engine load increases.



Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to Step 3
3	Was a visual/physical check performed?	—	Go to Step 4	Go to Visual / physical Check.
4	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams in <i>Electrical Diagnosis</i> . Was a problem found?	—	Verify repair	Go to Step 5
5	Check for a loose or short circuit of ignition coil module voltage feed. Was a problem found?	—	Verify repair	Go to Step 6
6	Check for a loose or short circuit of ignition coil module ground. Was a problem found?	—	Verify repair	Go to Step 7
7	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to Step 7
8	Check the CKP sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to Step 9
9	Monitor "B1S1 (Bank 1 Sensor 1) Status" on the Tech 2. Is the "B1S1 (Bank 1 Sensor 1) Status" in the rich condition?	—	Go to Step 10	Go to Step 11

Step	Action	Value(s)	Yes	No
10	Check items that can cause the engine to run rich. Refer to <i>DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off"</i> . Was a problem found?	—	Verify repair	Go to <i>Step 11</i>
11	Monitor " <i>B1S1 (Bank 1 Sensor 1) Status</i> " on the Tech 2. Is the " <i>B1S1 (Bank 1 Sensor 1) Status</i> " in the lean condition?	—	Go to <i>Step 12</i>	Go to <i>Step 13</i>
12	Check items that can cause the engine to run lean. Refer to <i>DTC P1171 "Fuel Supply System Lean During Power Enrichment"</i> . Was a problem found?	—	Verify repair	Go to <i>Step 13</i>
13	1. Visually/physically inspect for the following conditions: • Restriction of air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to <i>Step 14</i>
14	Check the injector connectors, if any of the injectors are connected an incorrect cylinder, correct as necessary. Was a problem found?	—	Verify repair	Go to <i>Step 15</i>
15	Perform the <i>Injector Coil/Balance Test</i> . Was a problem found.	—	Verify repair	Go to <i>Step 16</i>
16	1. Check for fuel in the pressure regulator vacuum hose. 2. If fuel is present, replace the fuel pressure regulator assembly. Was a problem found?	—	Verify repair	Go to <i>Step 17</i>
17	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to <i>Step 18</i>
18	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to <i>Step 19</i>

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Step	Action	Value(s)	Yes	No
19	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to <i>Step 20</i>
20	1. Check for faulty engine mounts. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to <i>Step 21</i>
21	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 22</i>
22	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “SPS (Service Programming System)”. Was the problem solved?	—	Verify repair	Go to <i>Step 23</i>
23	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

LACK OF POWER, SLUGGISH OR SPONGY SYMPTOM

DEFINITIONS: Engine delivers less than expected power. Attempting part-throttle acceleration results in little or no increase in vehicle speed.

Step	Action	Value(s)	Yes	No
1	Was the “ <i>On-Board Diagnostic (OBD) System Check</i> ” performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to <i>Step 3</i>
3	Was a visual/physical check performed?	—	Go to <i>Step 4</i>	Go to Visual / physical Check.
4	1. Remove and check the air filter element for dirt or restrictions. 2. Replace the air filter element if necessary. Was a repair required?	—	Verify repair	Go to <i>Step 5</i>
5	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	—	Verify repair	Go to <i>Step 6</i>
6	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to <i>Step 7</i>
7	1. Using a Tech 2, display the ECT sensor and IAT sensor value and warm up condition compared with the typical data. 2. Check the specified value or wire. Was the problem found?	—	Verify repair	Go to <i>Step 8</i>
8	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Does the throttle position increase steady with increasing smoothly?	—	Go to <i>Step 9</i>	Refer to Diagnostic Trouble Code P0123 for further diagnosis
9	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to <i>Step 10</i>
10	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to <i>Step 11</i>
11	Check the fuel pressure. Refer to <i>Fuel System Diagnosis</i> . Was a problem found?	—	Verify repair	Go to <i>Step 12</i>

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Step	Action	Value(s)	Yes	No
12	Monitor " <i>B1S1 (Bank 1 Sensor 1) Status</i> " on the Tech 2. Is the " <i>B1S1 (Bank 1 Sensor 1) Status</i> " in the rich condition?	—	Verify repair	Go to <i>Step 13</i>
13	Check items that can cause the engine to run rich. Refer to DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off". Was a problem found?	—	Verify repair	Go to <i>Step 14</i>
14	Check items that can cause the engine to run lean. Refer to DTC P1171 "Fuel Supply System Lean During Power Enrichment". Was a problem found?	—	Verify repair	Go to <i>Step 15</i>
15	Check for proper ignition voltage output with a spark tester. Was the problem found?	—	Verify repair	Go to <i>Step 16</i>
16	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to <i>Step 17</i>
17	Drain sample fuel, visual inspection. Any suspicion about the fuel, such as discoloration, particle, contamination, water, unusual smell, then drain the fuel from fuel tank. Replace the fuel from know vehicle source. If any suspencion of alcohol contamination, completely drain the fuel, replace by fuel from known vehicle source.	—	Verify repair	Go to <i>Step 18</i>
18	Check the exhaust system for a possible restriction: - Damaged or collapsed pipes - Internal muffler failure Was a problem found?	—	Verify repair	Go to <i>Step 19</i>
19	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): - Low compression - Leaking cylinder head gaskets - Worn camshaft - Loose timing belt Was a problem found?	—	Verify repair	Go to <i>Step 20</i>
20	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: - Visual/physical inspection - Tech 2 data - All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 21</i>

Step	Action	Value(s)	Yes	No
21	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “SPS (Service Programming System)” . Was the problem solved?	—	Verify repair	Go to <i>Step 22</i>
22	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

DETONATION/SPARK KNOCK SYMPTOM

DEFINITIONS: A mild to severe ping, usually worse under acceleration. The engine makes a sharp metallic knocking sound that changes with throttle opening. Prolonged detonation may lead to complete engine failure.

Step	Action	Value(s)	Yes	No
1	Was the “ <i>On-Board Diagnostic (OBD) System Check</i> ” performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to <i>Step 3</i>
3	Was a visual/physical check performed?	—	Go to <i>Step 4</i>	Go to Visual / physical Check.
4	1. If Tech 2 readings are normal (refer to Typical Scan Data Values) and there are no engine mechanical faults, fill the fuel tank with a known quality gasoline. 2. Re-evaluate the vehicle performance. Is detonation present?	—	Go to <i>Step 5</i>	Verify repair
5	1. Check for obvious overheating problems: • Low engine coolant • Restricted air flow to radiator • Incorrect coolant solution 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to <i>Step 6</i>
6	Check the fuel pressure. Refer to <i>Fuel System Diagnosis</i> . Was a problem found?	—	Verify repair	Go to <i>Step 7</i>
7	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to <i>Step 8</i>
8	1. Using a Tech 2, display the ECT sensor and IAT sensor value and warm up condition compared with the typical data. 2. Check the specified value or wire. Was the problem found?	—	Verify repair	Go to <i>Step 9</i>
9	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Does the throttle position increase steady with increasing smoothly?	—	Go to <i>Step 10</i>	Refer to Diagnostic Trouble Code P0123 for further diagnosis
10	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to <i>Step 11</i>
11	Check items that can cause the engine to run lean. Refer to DTC P1171 “Fuel Supply System Lean During Power Enrichment”. Was a problem found?	—	Verify repair	Go to <i>Step 12</i>

Step	Action	Value(s)	Yes	No
12	Check spark plugs for proper heat range. Were incorrect spark plugs installed?	—	Verify repair	Go to <i>Step 13</i>
13	1. Remove excessive carbon buildup with a top engine cleaner. 2. Re-evaluate vehicle performance. Is detonation still present?	—	Verify repair	Go to <i>Step 14</i>
14	Check for an engine mechanical problem. Perform a cylinder compression check. Refer to <i>Engine Mechanical</i> . Was a problem found?	—	Verify repair	Go to <i>Step 15</i>
15	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 16</i>
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ SPS (Service Programming System) ”. Was the problem solved?	—	Verify repair	Go to <i>Step 17</i>
17	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

POOR FUEL ECONOMY SYMPTOM

DEFINITIONS: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Step	Action	Value(s)	Yes	No
1	Was the “ <i>On-Board Diagnostic (OBD) System Check</i> ” performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to <i>Step 3</i>
3	Was a visual/physical check performed?	—	Go to <i>Step 4</i>	Go to Visual / physical Check.
4	Check owner’s driving habits. • Is the A/C On full time (defroster mode On)? • Are tires at the correct pressure? • Are excessively heavy loads being carried? • Is acceleration too much, too often?	—	Go to <i>Step 5</i>	Go to <i>Step 6</i>
5	Review the items in Step 4 with the customer and advise as necessary. Is the action complete?	—	System OK	—
6	Visually/physically check: Vacuum hoses for splits, kinks, and improper connections and routing as shown on the “Emission Control System Schematics”. Was a problem found?	—	Verify repair	Go to <i>Step 7</i>
7	Check for low engine coolant level. Was a problem found?	—	Verify repair	Go to <i>Step 8</i>
8	Check for incorrect or faulty engine thermostat. Refer to <i>Engine Cooling</i> . Was a problem found?	—	Verify repair	Go to <i>Step 9</i>
9	Remove and check the air filter element for dirt or for restrictions. Was a problem found?	—	Verify repair	Go to <i>Step 10</i>
10	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to <i>Step 11</i>
11	1. Using a Tech 2, display the ECT sensor and IAT sensor value and warm up condition compared with the typical data. 2. Check the specified value or wire. Was the problem found?	—	Verify repair	Go to <i>Step 12</i>
12	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to <i>Step 13</i>
13	Check the fuel pressure. Refer to <i>Fuel System Diagnosis</i> . Was a problem found?	—	Verify repair	Go to <i>Step 14</i>

Step	Action	Value(s)	Yes	No
14	Monitor " <i>B1S1 (Bank 1 Sensor 1) Status</i> " on the Tech 2. Is the " <i>B1S1 (Bank 1 Sensor 1) Status</i> " in the rich condition?	—	Verify repair	Go to <i>Step 15</i>
15	Check items that can cause the engine to run rich. Refer to DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off". Was a problem found?	—	Verify repair	Go to <i>Step 16</i>
16	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to <i>Step 17</i>
17	Check for proper calibration of the speedometer. Does the speed indicated on the speed meter closely match the vehicle speed displayed on the Tech 2?	—	Go to <i>Step 19</i>	Go to <i>Step 18</i>
17B	Check the vehicle speed on accurate chassis dynamometer on check number of pulse per revolution speed sensor. See typical data below.			
18	Diagnose and repair the inaccurate speedometer condition as necessary. Refer to <i>Vehicle Speed Sensor in Electrical Diagnosis</i> .	—	Verify Repair	—
19	Check for proper calibration of the fuel gauge. Was a problem found?	—	Verify repair	Go to <i>Step 20</i>
20	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): • Low compression • Worn camshaft • Sticking or leaking valves • Valve timing Was a problem found?	—	Verify repair	Go to <i>Step 21</i>
21	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 22</i>
22	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the " <i>SPS (Service Programming System)</i> ". Was the problem solved?	—	Verify repair	Go to <i>Step 23</i>

6E-250 ENGINE DRIVEABILITY AND EMISSIONS

Step	Action	Value(s)	Yes	No
23	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 "Immobiliser System-ECM replacement" for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

EXCESSIVE EXHAUST EMISSIONS OR ODORS SYMPTOM

DEFINITIONS: Vehicle fails an emission test. There is excessive “rotten egg” smell. (Excessive odors do not necessarily indicate excessive emissions.)

Step	Action	Value(s)	Yes	No
1	Was the “ <i>On-Board Diagnostic (OBD) System Check</i> ” performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to <i>Step 3</i>
3	Was a visual/physical check performed?	—	Go to <i>Step 4</i>	Go to Visual / physical Check.
4	Does the customer continual accelerate On/Off during cold condition?	—	System OK	Go to <i>Step 5</i>
5	Is the customer using the incorrect fuel type?	—	Replace with unleaded fuel	Go to <i>Step 6</i>
6	Check for vacuum leaks (vacuum lines, intake manifold, throttle body, etc.) Were any vacuum leaks found?	—	Go to <i>Step 17</i>	Go to <i>Step 7</i>
7	1. Check fuel cap for proper installation. 2. Secure the fuel cap if necessary. Was a problem found?	—	Go to <i>Step 17</i>	Go to <i>Step 8</i>
8	Check the fuel pressure. Refer to <i>Fuel System Pressure Test</i> . Was a problem found?	—	Go to <i>Step 17</i>	Go to <i>Step 9</i>
9	1. Check for faulty, plugged or incorrectly installed PCV valve. 2. Verify that the PCV system is not plugged. Was a problem found?	—	Go to <i>Step 17</i>	Go to <i>Step 10</i>
10	Check the injector connectors, if any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Go to <i>Step 17</i>	Go to <i>Step 11</i>
11	Perform the <i>Injector Coil/Balance Test</i> . Was a problem found.	—	Go to <i>Step 17</i>	Go to <i>Step 12</i>
12	Check for a problem with the engine cooling system. Was a problem found?	—	Go to <i>Step 17</i>	Go to <i>Step 13</i>
13	Check EVAP canister for fuel loading. Refer to Evaporative Emission Control System. Was a problem found?	—	Go to <i>Step 17</i>	Go to <i>Step 14</i>
14	Check the EVAP purge solenoid valve operation. Is the valve operated normally?	—	Go to <i>Step 17</i>	Verify repair & Go to <i>Step 15</i>
15	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes • Internal catalytic converter failure Was a problem found?	—	Verify repair & Go to <i>Step 16</i>	Go to <i>Step 17</i>

6E-252 ENGINE DRIVEABILITY AND EMISSIONS

Step	Action	Value(s)	Yes	No
16	1. Remove excessive carbon buildup with a top engine cleaner. Refer to the instructions on the top engine cleaner can. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to <i>Step 18</i>
17	Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to <i>Step 18</i>
18	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminants from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to <i>Step 19</i>
19	Monitor " <i>B1S1 (Bank 1 Sensor 1) Status</i> " on the Tech 2. Is the " <i>B1S1 (Bank 1 Sensor 1) Status</i> " in the rich condition?	—	Go to <i>Step 20</i>	Go to <i>Step 21</i>
20	1. Check items that can cause the engine to run rich. Refer to <i>Diagnostic Aids in DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off"</i> . Make any necessary repairs. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to <i>Step 22</i>
21	1. Check items that can cause the engine to run lean. Refer to <i>Diagnostic Aids in DTC P1171 "Fuel Supply System Lean During Power Enrichment"</i> . Make any necessary repairs. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to <i>Step 22</i>
22	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs Was a problem found?	—	Verify repair	Go to <i>Step 23</i>
23	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 24</i>

Step	Action	Value(s)	Yes	No
24	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “SPS (Service Programming System)” . Was the problem solved?	—	Verify repair	Go to <i>Step 25</i>
25	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify Repair	—

DIESELING, RUN-ON SYMPTOM

DEFINITIONS: Engine continues to run after key is turned OFF, but runs very rough. If engine runs smoothly, check the ignition switch and adjustment.

Step	Action	Value(s)	Yes	No
1	Was the “ <i>On-Board Diagnostic (OBD) System Check</i> ” performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to <i>Step 3</i>
3	Was a visual/physical check performed?	—	Go to <i>Step 4</i>	Go to Visual / physical Check.
4	Check for a short between battery voltage and the ignition feed circuit. Was a problem found?	—	Verify repair	Go to <i>Step 5</i>
5	Check the fuel leaking from injector. Refer to Fuel System Diagnostic. Was the problem found?	—	Verify repair	Go to <i>Step 6</i>
6	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 7</i>
7	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “ <i>SPS (Service Programming System)</i> ”. Was the problem solved?	—	Verify repair	Go to <i>Step 8</i>
8	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

BACKFIRE SYMPTOM

DEFINITIONS: Fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.

Step	Action	Value(s)	Yes	No
1	Was the “ <i>On-Board Diagnostic (OBD) System Check</i> ” performed?	—	Go to <i>Step 2</i>	Go to <i>OBD System Check</i>
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to <i>Step 3</i>
3	Was a visual/physical check performed?	—	Go to <i>Step 4</i>	Go to Visual / physical Check.
4	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to <i>Step 5</i>
5	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to <i>Step 6</i>
6	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to <i>Step 7</i>
7	Check the fuel pressure. Refer to <i>Fuel System Pressure Test</i> . Was a problem found?	—	Verify repair	Go to <i>Step 8</i>
8	Check for an intermittent ignition system malfunction: • Intermittent CKP 58X signal • Intermittent ignition feed circuit or sensor ground circuit to the crankshaft position sensor. Was a problem found?	—	Verify repair	Go to <i>Step 9</i>
9	Refer to <i>Fuel System Diagnosis</i> to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to <i>Step 10</i>

6E-256 ENGINE DRIVEABILITY AND EMISSIONS

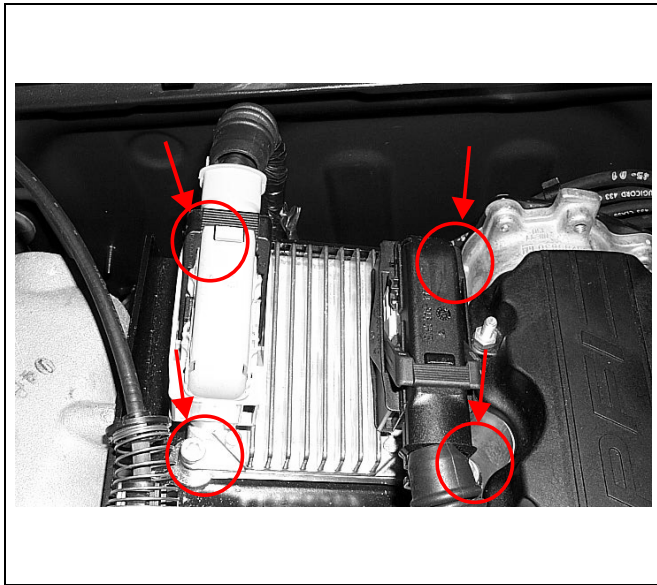
Step	Action	Value(s)	Yes	No
10	Check for the following engine mechanical problems (refer to <i>Engine Mechanical</i>): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to <i>Step 11</i>
11	Check leakage at exhaust system. Check the intake and exhaust manifold for casting flash. Refer to <i>Engine Mechanical</i>. Was a problem found?	—	Verify repair	Go to <i>Step 12</i>
12	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to <i>Step 13</i>
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the “SPS (Service Programming System)”. Was the problem solved?	—	Verify repair	Go to <i>Step 14</i>
14	Replace the ECM. Is the action complete? IMPORTANT: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobiliser system (if equipped) must be linked to the ECM. Refer to section 11 “Immobiliser System-ECM replacement” for the ECM/Immobiliser linking procedure.	—	Verify repair	—

ON-VEHICLE SERVICE PROCEDURE**ENGINE CONTROL MODULE (ECM)****Location**

On the intake manifold.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the two connectors from the ECM.
3. Remove four bolts.
4. Remove the ECM from bracket.

**Installation Procedure**

1. Put on the ECM to the bracket.
2. Tighten the ECM by four bolts with specified tightening torque.

Tightening torque

- Bolts: 8.0 - 12.0 N·m (0.8 - 1.2 kgf·m)
3. Connect the two connectors to the ECM.
 4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

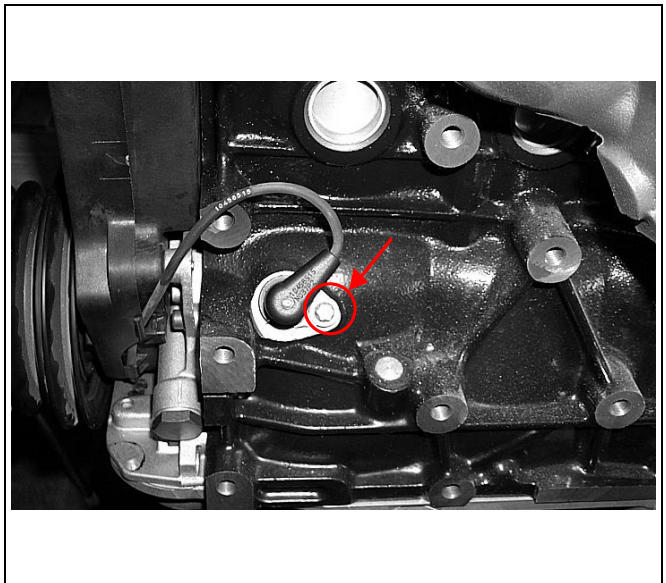
CRANKSHAFT POSITION (CKP) SENSOR**Location**

Left-hand side of the cylinder block. (Back of the A/C compressor)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the drive belt. Refer to Engine Mechanical Section.
3. Remove the A/C compressor from engine. Refer to Engine Mechanical Section.
4. Disconnect connector from the CKP sensor.
5. Loosen a bolt and remove the CKP sensor from the cylinder block.

NOTE: Use caution to avoid any hot oil that might drip out.

**Installation Procedure**

1. Install the CKP sensor to the cylinder block.
2. Tighten CKP sensor by a bolt with specified tightening torque.

Tightening Torque

- Bolt: 6N·m (0.6kgf·m)
3. Reinstall the A/C compressor to the engine.
 4. Reinstall the accessory drive belt.
 5. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

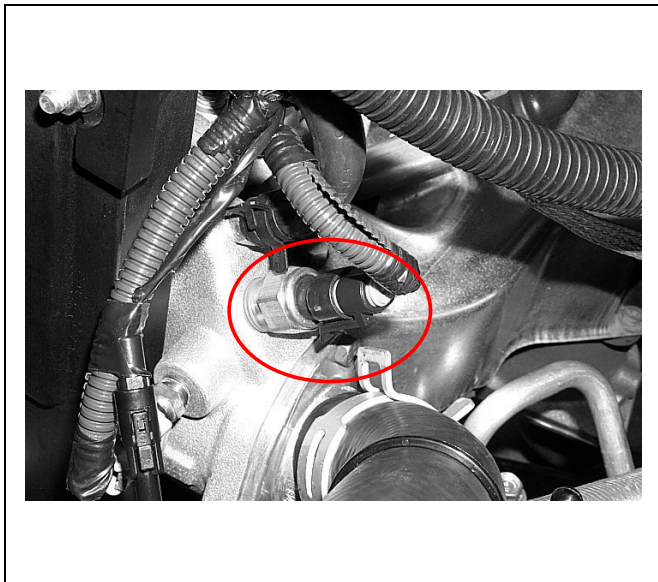
Location

Installed to the thermostat housing.

Removal Procedure

1. Disconnect the negative battery cable.
2. Drain enough engine coolant so that the coolant level will be below the ECT sensor.
3. Disconnect connector from the ECT sensor.
4. Loosen and remove the ECT sensor from the thermostat housing.

NOTE: Cool down the engine before above procedures are carried out.



Installation Procedure

1. Apply sealer to threads of screw at the ECT sensor.
2. Tighten the ECT sensor with specified tightening torque.

Tightening Torque

- Bolt: 13N·m (1.3kgf·m)
3. Connect a ECT sensor connector to the ECT sensor.
 4. Fill the engine coolant.
 5. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement. Verify no engine coolant leaking from the sensor threads after replacement.

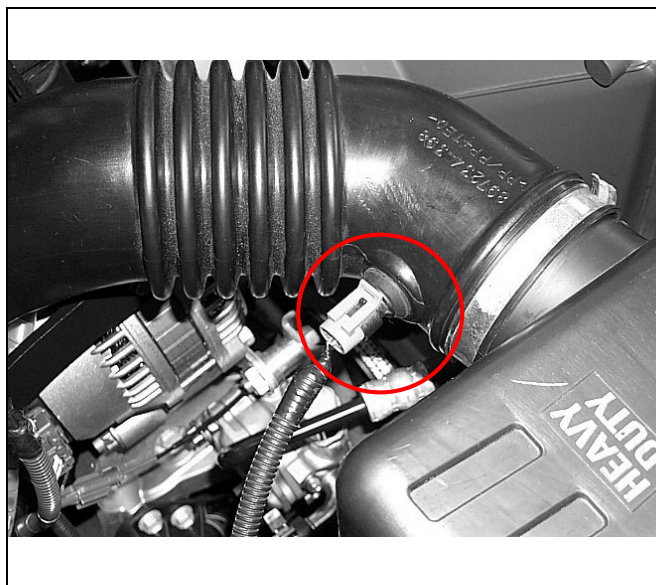
INTAKE AIR TEMPERATURE (IAT) SENSOR

Location

Installed to the intake duct housing.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a IAT sensor connector from the IAT sensor.
3. Remove the IAT sensor from the intake duct.



Installation Procedure

1. Install the IAT sensor into intake air duct.
2. Connect a IAT sensor connector to the IAT sensor.
3. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

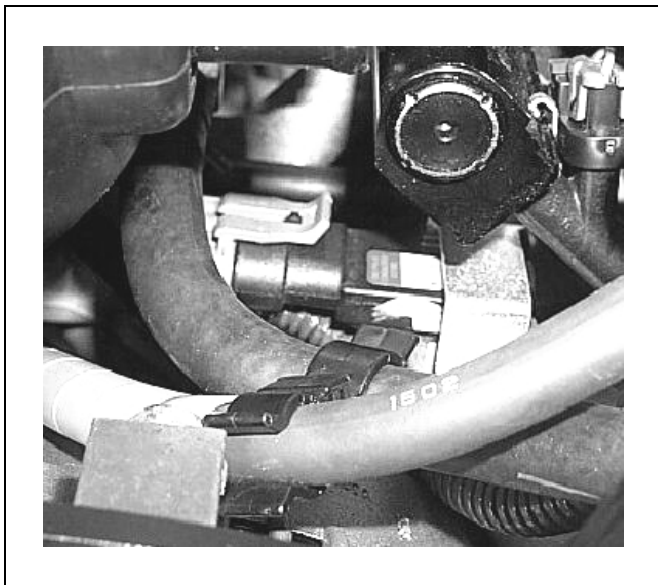
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

Location

Installed on the intake manifold.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a MAP sensor connector from the MAP sensor.
3. Loosen a bolt and remove the MAP sensor from the intake manifold.
4. Remove the MAP sensor from the bracket.



Installation Procedure

1. Tighten the MAP sensor by a bolt with specified tightening torque.

Tightening Torque

- Bolt: 8N·m (0.8kgf·m)
2. Connect a MAP sensor connector to the MAP sensor.
 3. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

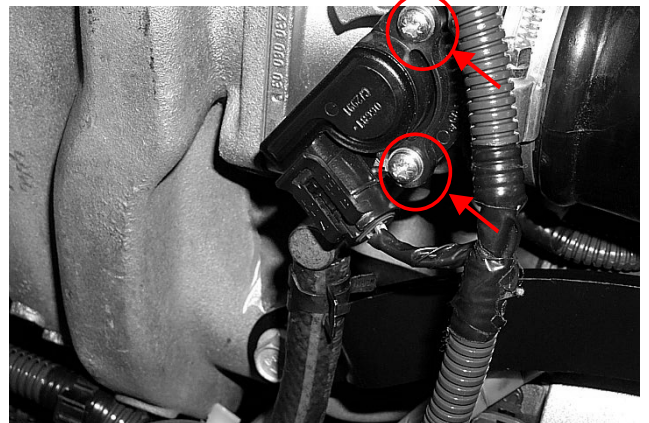
THROTTLE POSITION SENSOR (TPS)

Location

Installed on the throttle body.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the TPS connector.
3. Loosen two screws and remove TPS from the throttle body.



Installation Procedure

1. Temporarily tighten the TPS by two screws.
2. Connect a TPS connector to the TPS.
3. Connect the Tech2 to the vehicle.
4. Connect the negative battery cable.
5. Select "Data Display" with the Tech2.
6. Check the throttle position data and adjust the TPS position.
7. Tighten two screws.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

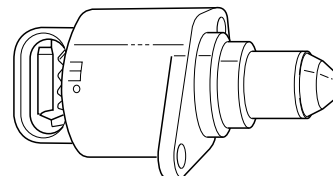
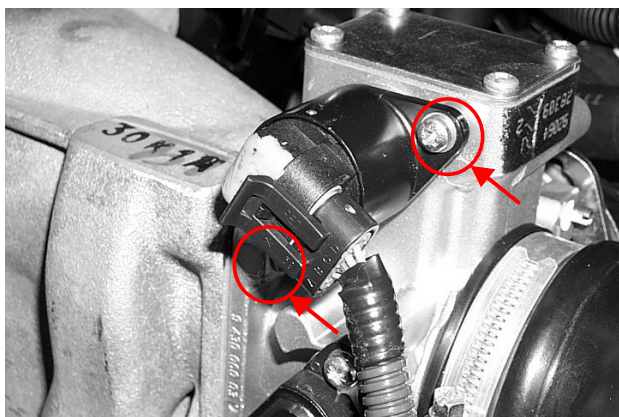
IDLE AIR CONTROL (IAC) VALVE

Location

Installed on the throttle body.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the IAC valve connector.
3. Loosen two screws and remove IAC valve from the throttle body.



Installation Procedure

1. Tighten the IAC valve by two screws.
2. Connect a IAC valve connector to the MAP sensor.
3. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

Cleaning and Inspection

1. Clean the IAC valve O-ring sealing surface, pintle valve seat and air passage.
2. Use carburetor cleaner and a parts cleaning brush to remove carbon deposit.
Do not use a cleaner that contain methyl ethyl ketone. This is an extremely strong solvent and not necessary for this type of deposit.
3. Shiny spots on the pintle are normal and do not indicate misalignment or a bent pintle shaft.
4. Inspect the IAC valve O-ring for cuts, cracks or distortion.

Measurement

- Clean the IAC valve O-ring sealing surface, pintle valve seat and air passage.
- Use carburetor cleaner and a parts cleaning brush to remove carbon deposit. Do not use a cleaner that contain methyl ethyl ketone. This is an extremely strong solvent and not necessary for this type of deposit.
- Shiny spots on the pintle are normal and do not indicate misalignment or a bent pintle shaft.
- Inspect the IAC valve O-ring for cuts, cracks or distortion. Replace the O-ring if damaged.

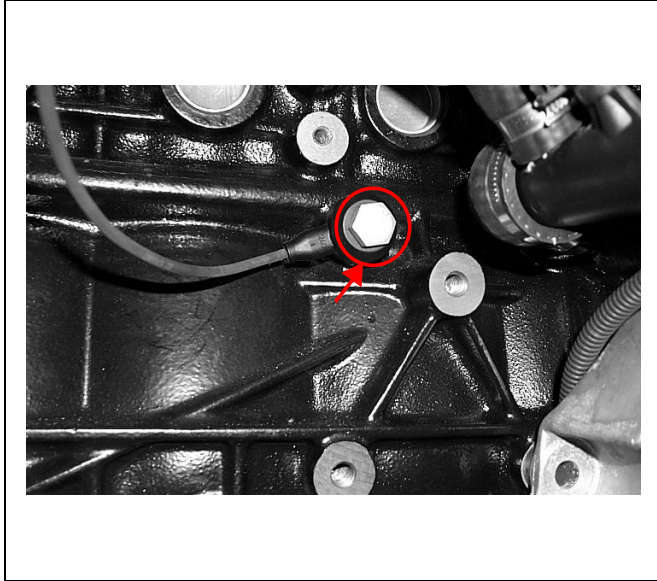
KNOCK SENSOR

Location

Right-hand side of the cylinder block.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the knock sensor connector.
3. Loosen a bolt and remove knock sensor from the cylinder block.



Installation Procedure

1. Tighten the knock sensor by a bolt with specified tightening torque.

Tightening Torque

- Bolt: 20N·m (2.0kgf·m)
2. Connect a knock sensor connector to the knock sensor.
 3. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

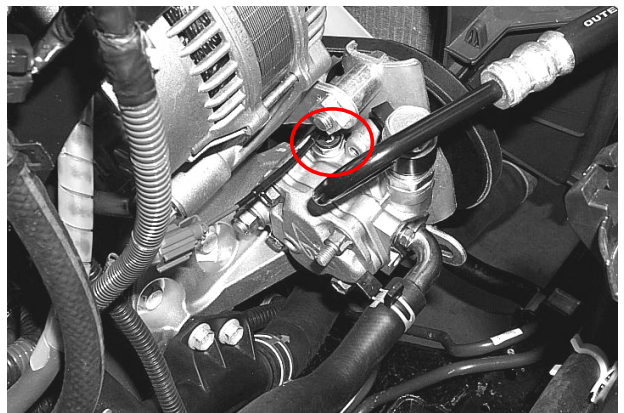
POWER STEERING PRESSURE (PSP) SWITCH

Location

Installed on the power steering pump assembly.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the power steering pressure switch connector.
3. Loosen and remove the power steering pressure switch from the power steering pump.



Installation Procedure

1. Install the power steering pressure switch to the power steering pump.
2. Tighten the power steering pressure switch.
3. Connect a connector to the power steering pressure switch.
4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

Verify no power steering fluid leaking from the sensor threads after replacement.

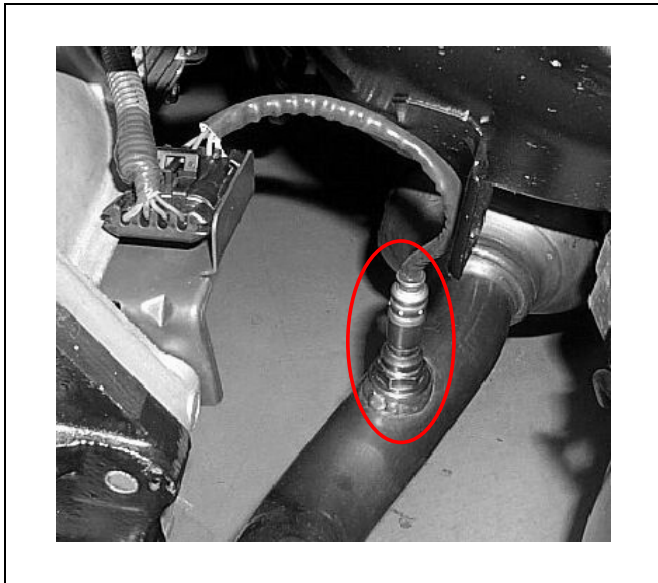
HEATED OXYGEN SENSOR (HO2S)

Location

Installed on the exhaust pipe.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the O₂ sensor connector.
3. Loosen and remove the O₂ sensor from the exhaust pipe.



Inspection

Inspect the louvered end of the sensor for grease, dirt, excessive carbon build up or other contamination.

Installation Procedure

1. Install the O₂ sensor to the exhaust pipe.
2. Tighten the O₂ sensor with specified tightening torque.

Tightening Torque

- Bolt: 42N·m (4.3kgf·m)
3. Connect a O₂ sensor connector to the O₂ sensor.
 4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify no exhaust gas leaking from the sensor threads after replacement.

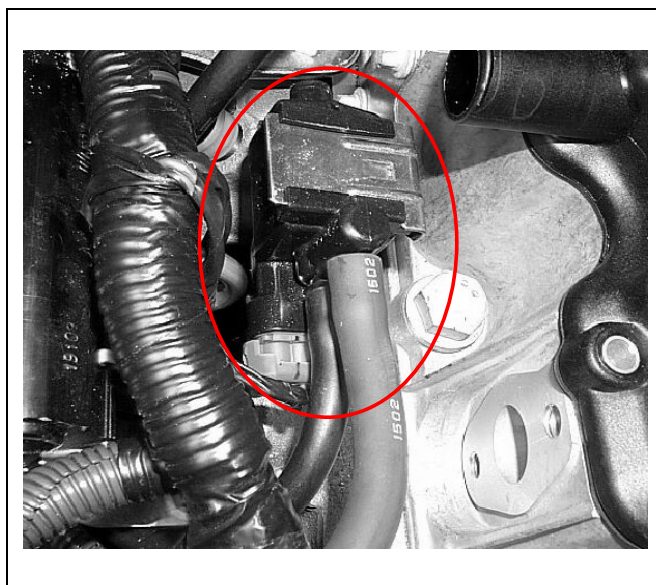
EVAP CANISTER PURGE VALVE SOLENOID

Location

On the intake manifold.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a purge solenoid connector from the purge solenoid.
3. Disconnect two hoses from the purge solenoid valve.
4. Slide from the bracket and remove the purge solenoid.



Installation Procedure

1. Insert EVAP purge solenoid valve onto the bracket.
2. Connect two hoses to the purge solenoid valve.
3. Connect a purge solenoid connector to the purge solenoid.
4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify proper connection of two hoses.

FUEL PRESSURE RELIEF

Caution: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

Caution: After relieving the fuel system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fitting with a short towel before disconnecting the fittings. The towel will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

1. Remove the fuel filler cap.
2. Remove the fuel pump relay from the underhood relay box.
3. Start the engine and allow it to stall.
4. Crank the engine for about 30 seconds.
5. Disconnect the negative battery cable.

FUEL RAIL ASSEMBLY

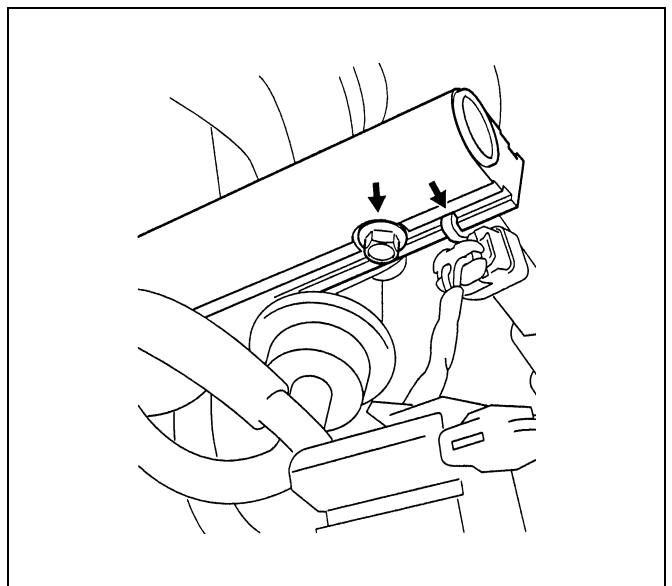
Removal Procedure

NOTE:

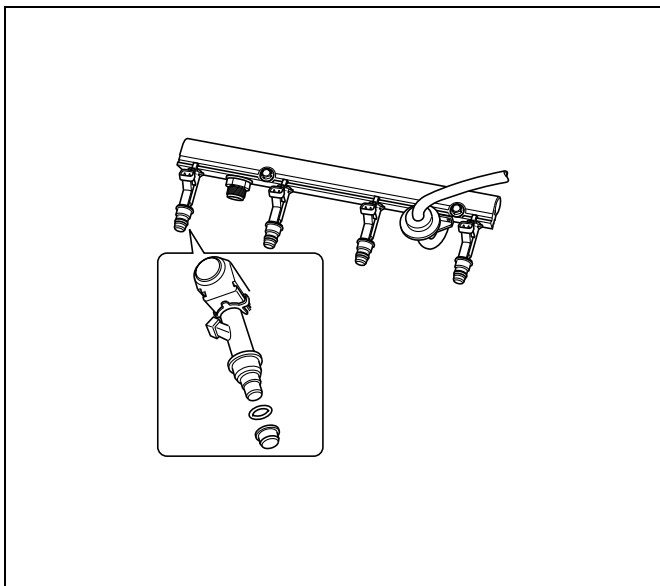
- Use care when removing the fuel rail assembly in order to prevent damage to the injector al connector terminal and the injector spray tips.
- Fitting should be capped and holes plugged during servicing to prevent dirt and other contaminants from entering open lines and passage.

Important: An eight-digit identification number is stamped on side of the fuel injector. Refer to this number when you service the fuel rail or when a replacement part is required.

1. Disconnect 4 injector connectors.
2. Lift side-clip up on the fuel rail.
3. Disconnect fuel pressure regulator hose.
4. Disconnect wiring harness from the bands on the fuel rail.
5. Remove the intake pipe.
6. Loosen flare nut.
 - A. Lift up the injectors carefully to separate them from intake manifold.
 - B. Lift up the fuel rail with injectors as assembly. Do not separate the fuel injectors from fuel rail.
 - C. If an injector become separated from fuel rail, injector backup O-ring and injector retainer clip must be replaced.
 - D. Drain residual fuel from fuel rail into an approved container.

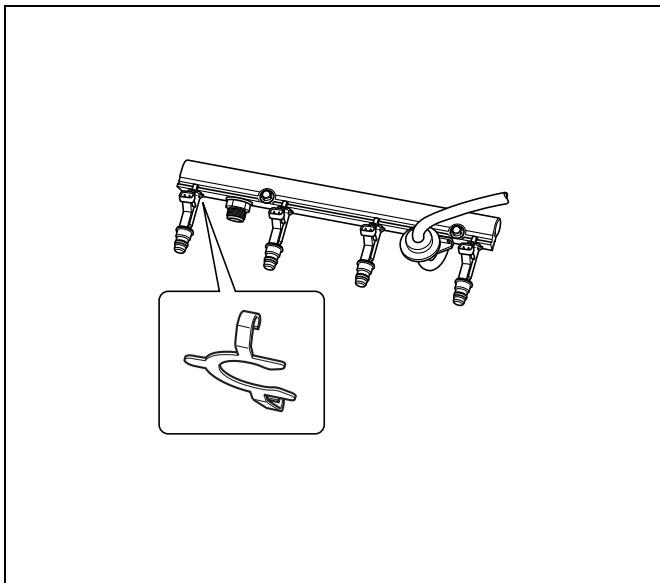


7. If removal of fuel pressure regulator is necessary, Refer to *Fuel Pressure Regulator Removal Procedure*.
8. If removal of fuel injector is necessary, Refer to *Fuel Injectors Removal Procedure*.



Installation Procedure

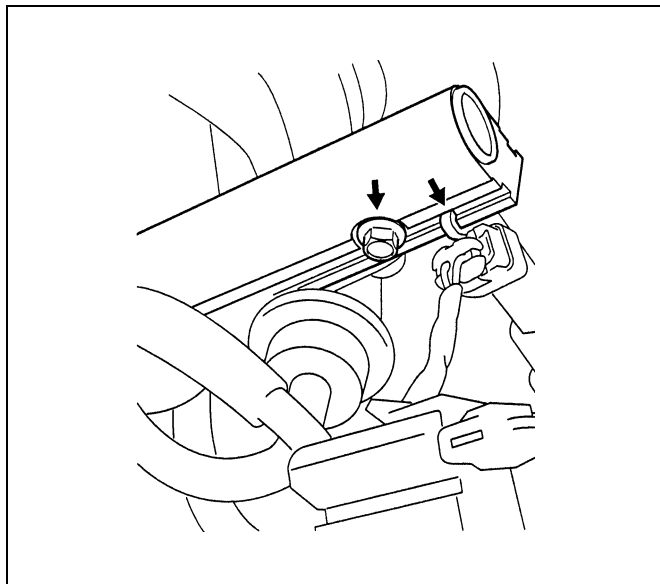
1. Install the fuel injectors if necessary. Refer to Fuel Injector Installation Procedure.
2. Install the fuel pressure regulator if necessary. Refer to *Fuel Pressure Regulator Installation Procedure*.
3. Place the fuel injector rail assembly on the manifold and insert the injectors into each port by pushing fuel rail.



4. Install two fuel rail retaining bolts. Tighten fuel rail retaining bolt to 19 N·m (1.9kgf·m)
5. Place wiring harness in its place and secure it with two nuts.
6. Connect all connector to each fuel injector.
7. Connect the fuel supply line securely. Do not over tighten.
8. Connect the fuel return line securely. Do not over tighten.

9. Connect the negative battery cable.

10. Crank the engine until it starts. Cranking the engine may take longer than usual due to trapped air in the fuel system. Check for leak. If fuel leak is observed, stop engine immediately. Before correcting fuel leak, be sure to depressurize system again.

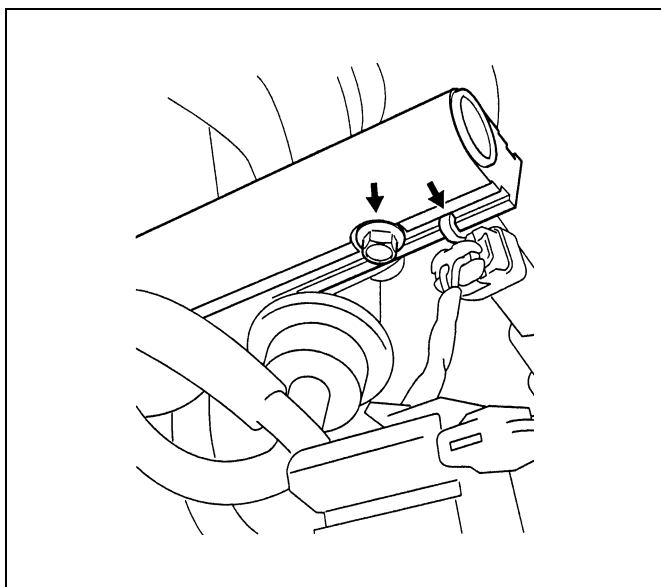


FUEL INJECTOR

Removal Procedure

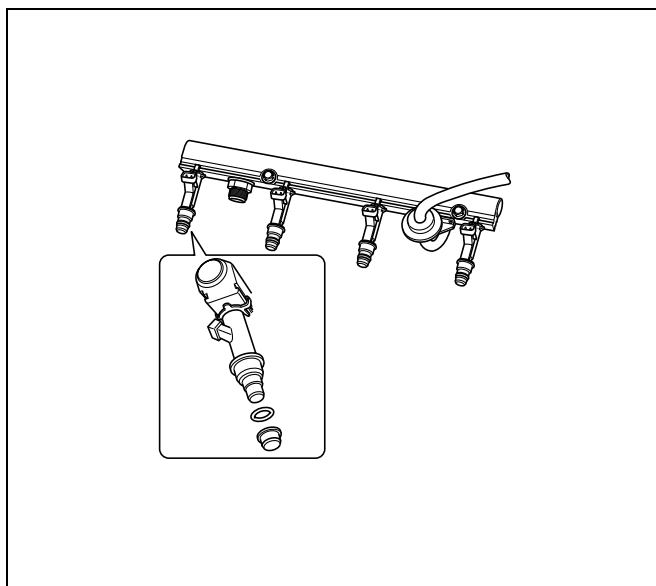
NOTE: If the fuel injectors are leaking, the engine oil may be contaminated with fuel. Check the oil for signs of contamination and change the oil and filter if necessary.

NOTE: Use care in removing the fuel injector in order to prevent damage to the fuel injector al connector pins or fuel injector nozzles. The fuel injector is an al component and should not be immersed in any type of cleaner as this may damage the fuel injector.



Important: Fuel injectors are serviced as complete assembly only.

1. Disconnect the negative battery cable.
2. Disconnect al connector from fuel injector.
3. Remove the fuel rail. Refer to *Fuel Rail Removal Procedure*.
4. Remove the fuel injector retainer clip.
5. Remove the fuel injector assembly from fuel rail.
6. Remove O-ring from the fuel injector.
7. Remove O-ring backup from fuel injector.

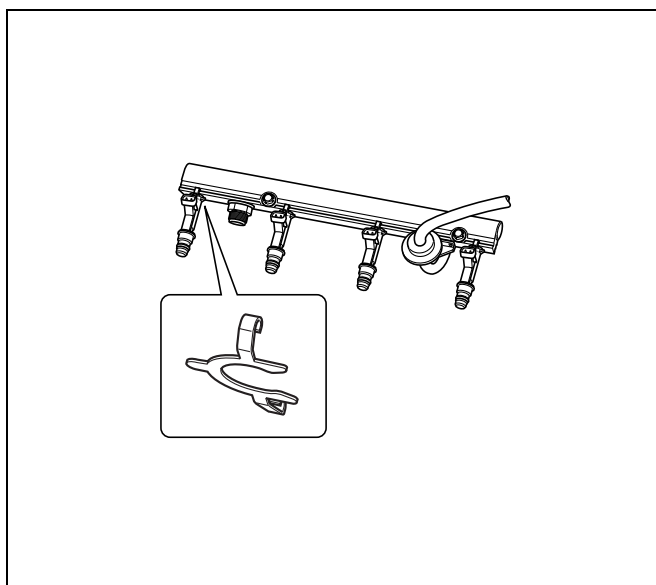


Inspection

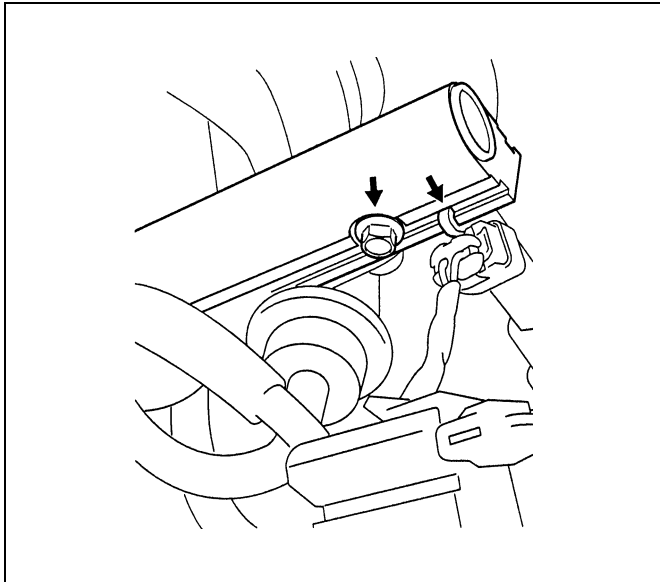
1. Inspect O-ring for crack, damage or leaks.
2. Replace worn or damaged O-ring.
3. Lubricate the new O-rings with engine oil before installation.

Installation Procedure

1. Lubricate the new O-ring with engine oil.
2. Install the O-ring backup on the fuel injector.
3. Install new O-ring on the fuel injector.
4. Install all four injector on the fuel rail.
5. Use new injector retainer clip to retain the injetor to the fuel rail.
6. Coat the end of the fuel injector with engine oil.



7. Install fuel rail assembly. Tighten the nuts to 19 N·m (1.9 kgf·m). Refer to *Fuel Rail Installation Procedure*.
Tighten the flare nut to 27 - 33 N·m (2.8 - 3.4 kgf·m).
8. Connect the negative battery cable.



FUEL PRESSURE REGULATOR

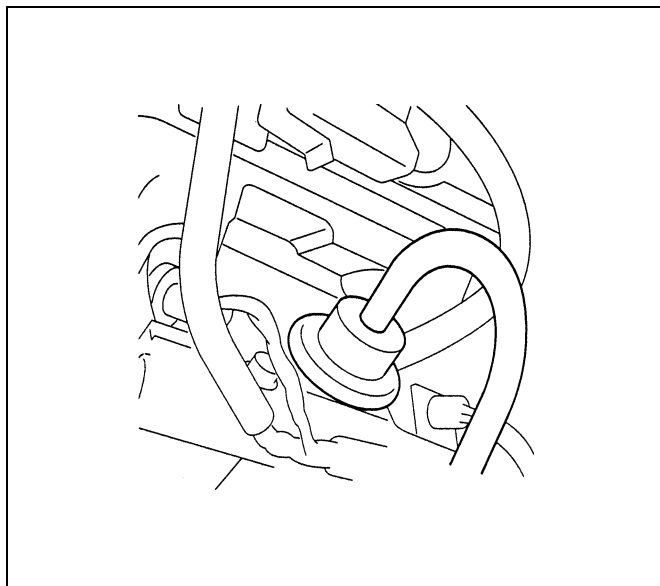
Removal Procedure

Caution: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

Caution: After relieving the fuel system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fitting with a shop towel before disconnecting the fittings. The towel will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

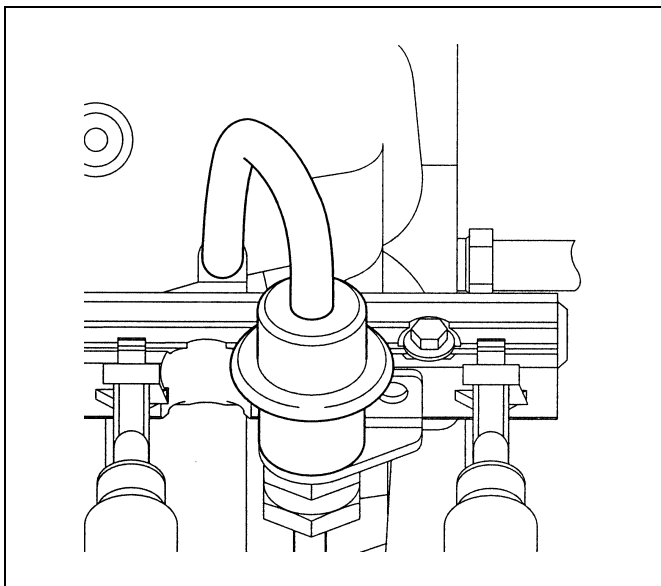
NOTE: Compressed air must never be used to test or clean a fuel pressure regulator, as damage to the fuel pressure regulator may occur.

NOTE: To prevent damage to the fuel pressure regulator, do not immerse the pressure regulator in solvent.

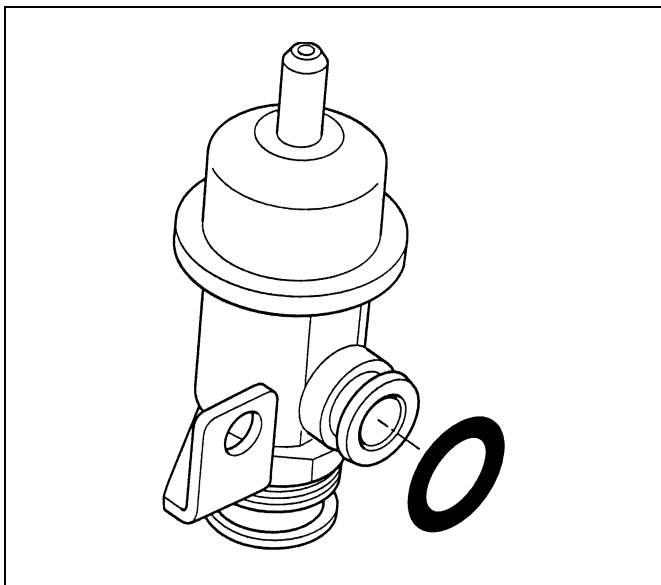


Removal Procedure

1. Depressurize the fuel system. Refer to Fuel Pressure Relief Procedure.
2. Disconnect the negative battery cable.
3. Remove the fuel pump relay.
4. Disconnect the vacuum line from fuel pressure regulator.

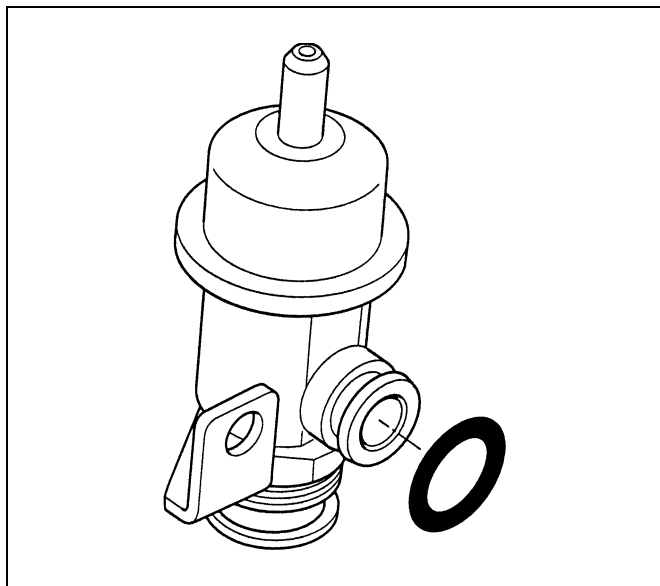


5. Remove the fuel pressure regulator retaining screw.
6. Remove the fuel pressure regulator from fuel rail.

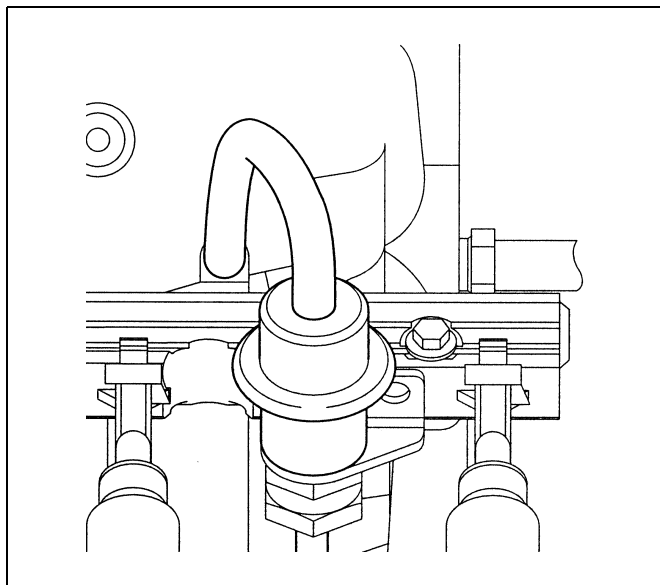


Installation Procedure

1. Insert the fuel pressure regulator into the fuel rail.



2. Install the fuel pressure regulator retaining bracket and tighten with a screw.
3. Connect vacuum line onto the fuel pressure regulator.



4. Install the fuel pump relay.
5. Connect the negative battery cable.
6. Crank the engine until it starts. Cranking the engine may take longer than usual due to trapped air in the fuel line.
7. Tighten the flare nut to 27 - 33 N·m (2.8 - 3.4 kgf·m).

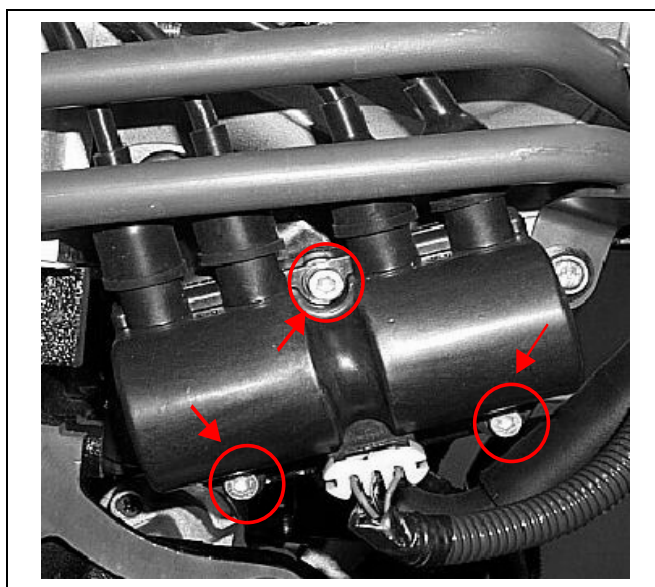
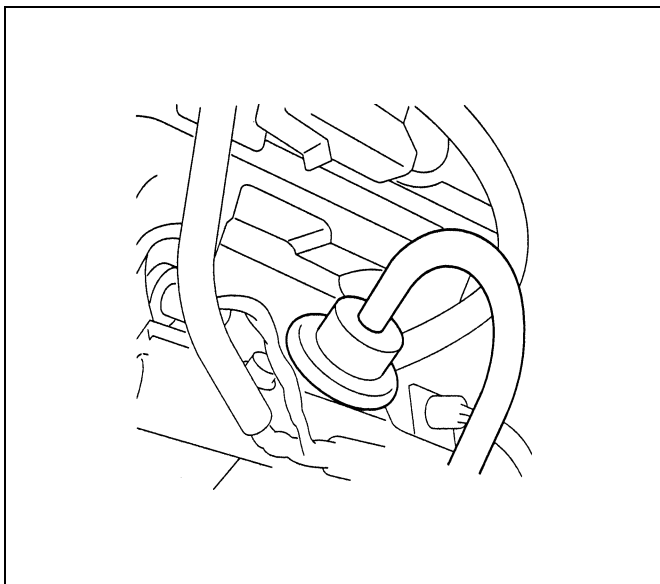
IGNITION COIL

Location

Back of the engine right-hand side.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the ignition coil connector.
3. Disconnect four spark plug cables from the ignition coil.
4. Loosen three bolts and remove ignition coil from the bracket.



Installation Procedure

1. Tighten the ignition coil by three bolts.
2. Connect four spark plug cables to the ignition coil.
3. Connect a ignition coil connector to the ignition coil.
4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify proper connection of spark plug cables for each cylinders.

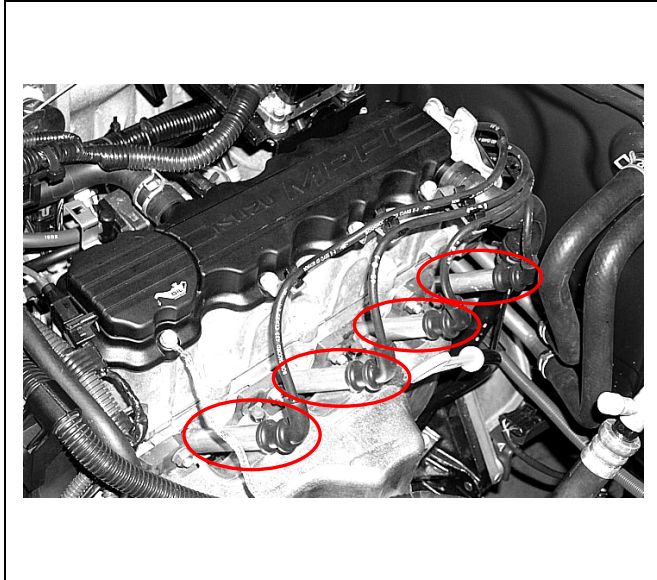
SPARK PLUGS

Location

Installed on the left-hand side of cylinder head.

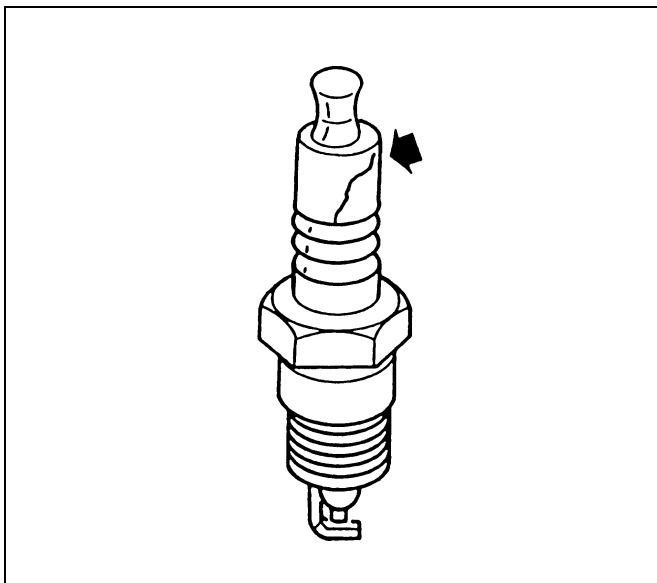
Removal Procedure

1. Disconnect the negative battery cable
2. Remove the spark plug cable.
3. Remove the spark plug.



Inspection

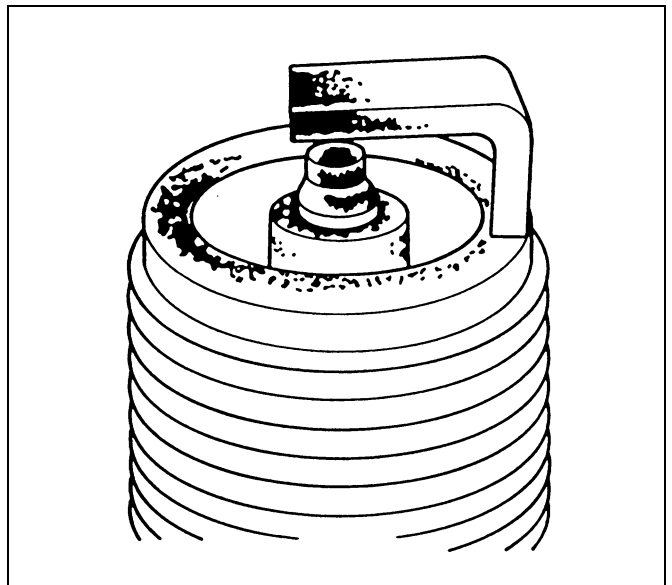
1. Check the insulator for cracks. Replace the spark plug if cracks are present.
2. Check the electrode condition and replace the spark plug if necessary.



If the spark plug electrodes and insulators are fouled with carbon or oil, the engine will not operate efficiently. There are a number of possible causes:

- Fuel mixture is too rich.

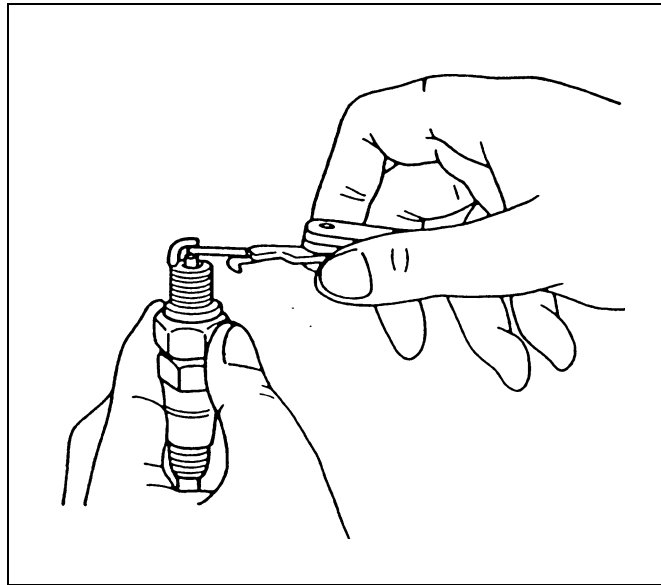
- Oil in the combustion chamber.
 - The spark plug gap is not set correctly.
- If spark plug fouling is excessive, check the fuel and air system for possible causes of trouble. If fuel and air system are normal, install spark plugs of a higher heat range which have the same physical dimensions as the original equipment spark plugs.
- The following symptoms are characteristics of spark plugs that are running too hot:
- Fuel mixture is too lean.
 - Heat range is incorrect.



If vehicle usage does not conform to normal driving conditions, a more suitable spark plug may be substituted.

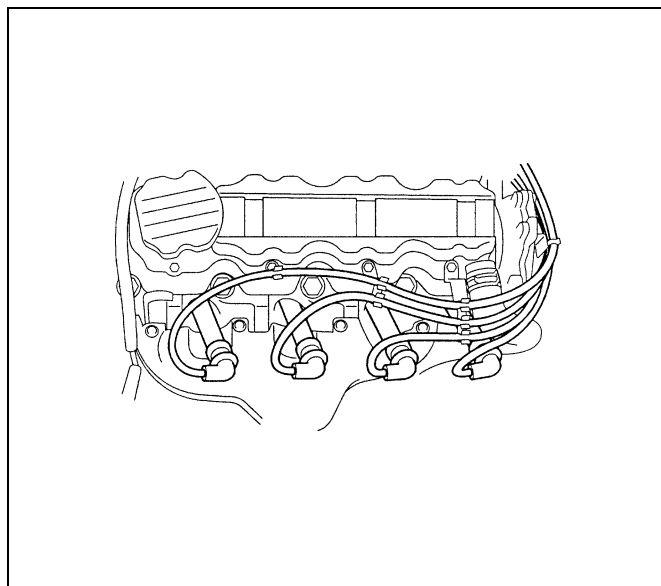
If fuel and air system are normal, in most cases of this sort, the problem can be corrected by using a colder type spark plug with the same physical dimensions as the original equipment spark plug.

3. Check the gaskets for damage and replace if necessary.
4. Measure the spark plug gap. The specification is 1.0 to 1.1mm (0.039 to 0.043").
5. Adjust the spark gap by bending the grounded electrode.



Installation

1. Tighten the spark plug to the 25N·m (2.5kgf·m).
2. Push the spark plug cable in until it snaps in.



Installation Procedure

1. Install the spark plug to the cylinder head.
2. Tighten the spark plug with specified tightening torque.

Tightening Torque

- Bolt: 25N·m (2.5kgf·m)
3. Connect the spark plug cable to the spark plug.
 4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify proper connection of spark plug cables for each cylinders.

SPARK PLUG CABLES

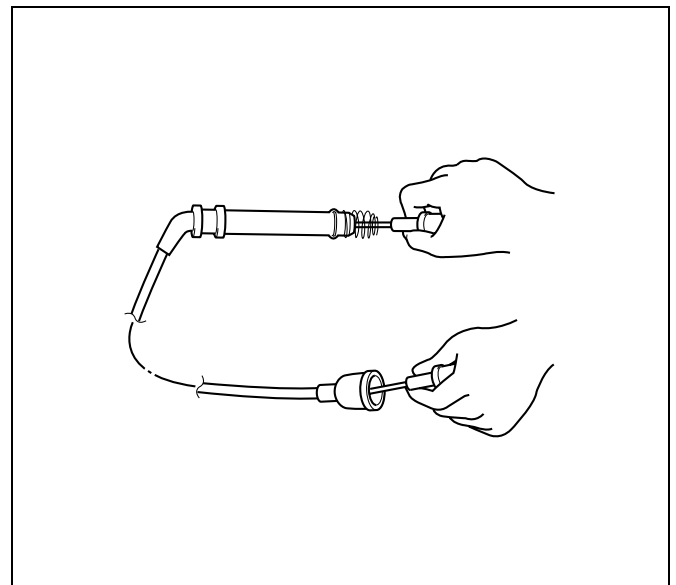
The cable contains a synthetic conductor which is easily damaged. Never stretch or kink the cable. Disconnect the cable from spark plug and the ignition coil.

The original equipment cables and the ignition coil are marked to show correct location of the cables. If spark plug cables or the ignition coil are replaced previously, before cables are removed from the ignition coil, mark the cables and the coil so they can be reconnected in the same position.

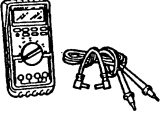
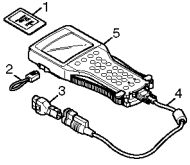
Inspection

NOTE: Never puncture the spark plug cable's insulation with a needle or the pointed end of a probe into the cable. An increase in resistance would be created which would cause the cable to become defective.

1. If the cable has broken or cracked insulation, it must be replaced.
2. If the terminals are corroded or loose, the cable must be replaced.
3. Check that the cable resistance does not exceed specified value.
 #1 cylinder: 3.50k Ω - 5.24k Ω
 #2 cylinder: 2.89k Ω - 4.33k Ω
 #3 cylinder: 2.49k Ω - 3.73k Ω
 #4 cylinder: 2.22k Ω - 3.32k Ω



SPECIAL SERVICE TOOLS

ILLUSTRATION	TOOL NO. TOLL NAME
 TS 22900	5-8840-0285-0 (J 39200) High Impedance Multimeter (Digital Voltmeter -DVM)
	(1) PCMCIA Card (2) RS232 Loop Back Connector (3) SAE 16/19 Adapter (4) DLC Cable (5) TECH 2
 TS 23369	5-8840-0385-0 (J 35616-A/BT-8637) Connector Test Adapter Kit
	5-8840-0378-0 (J34730-E) Port Fuel Injection Diagnostic Kit
	Breaker Box
	5-8840-2589-0 Injector Adapter Cable

HECED-WE-0321

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Issued by

ISUZU MOTORS LIMITED

INTERNATIONAL SERVICE DEPARTMENT

Tokyo, Japan

First edition Oct., 2002

