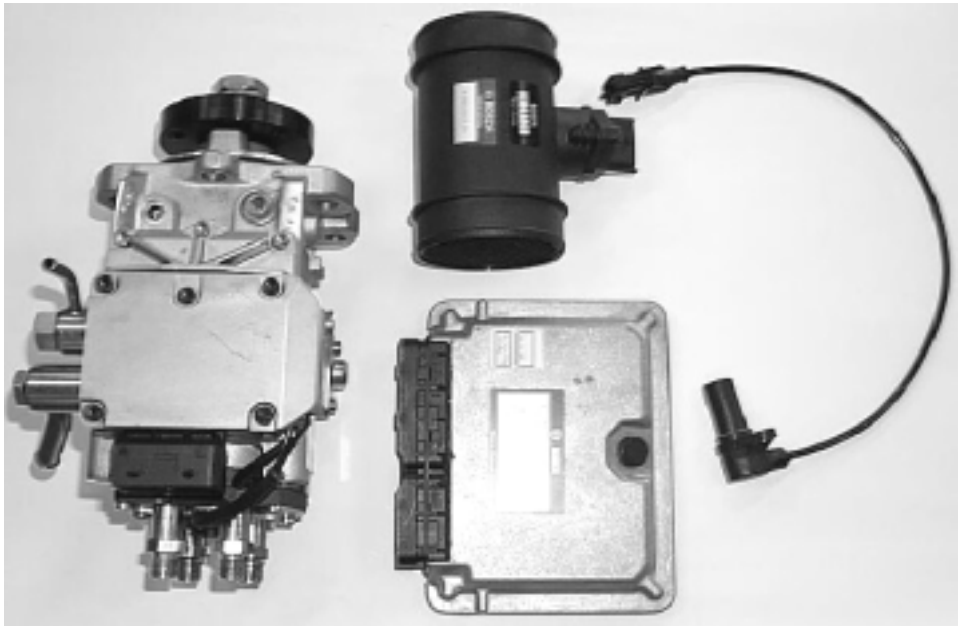
FOR SERVICE TRAINING

4JH1-TC ENGINE

Engine Management System Operation & Diagnosis



Applicable Model

Model Year	*Vehicle Model*	*Emission Regulation*
2001	*N*R 77*	*Euro 3*
2002	*N*R 77*	*Euro 3*
2003	*N*R 77*	*Euro 3 / EPA 94*

ISUZU MOTORS LIMITED

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INTRODUCTION & OUTLINE

GENERAL INFORMATION

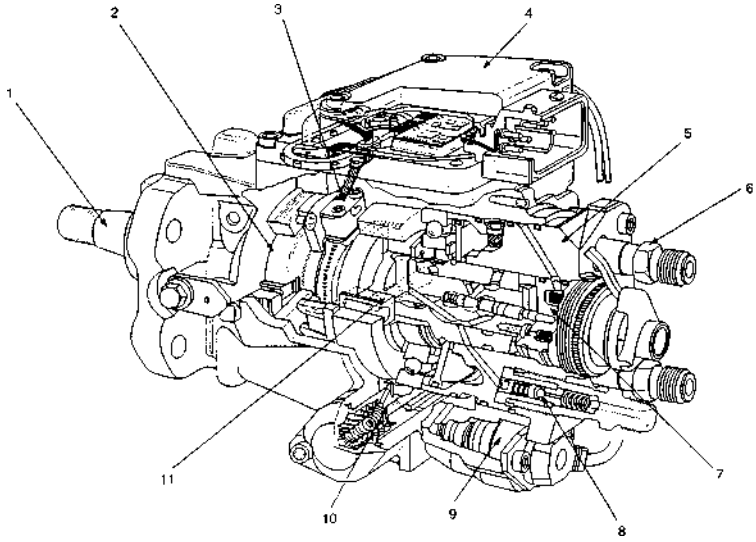
The 4JH1-TC engine with direct injection and eight overhead valves, features a fully electronically controlled Bosch engine management system.

The heart of the system is a Bosch VP44 radial plunger fuel injection pump that can deliver injection pressure of up to 100 Mpa at the delivery valves.

This engine management system in combination with EGR cooler and catalytic converter has enabled to meet Euro 3 emission regulation.

CHARACTERISTIC OF VP44 INJECTION SYSTEM

1. Driveshaft
2. Feed Pump
3. Pump Camshaft Speed Sensor
4. Pump Control Unit (PSG)
**PSG=Pumpen Steuer Great (German)*
5. Distributor Head
6. Constant Pressure Valve (CPV) Holder
7. High Pressure Solenoid Valve
8. Constant Pressure Valve (CPV)
9. Timing Control Valve
10. Timer
11. Radial Plunger High Pressure Pump

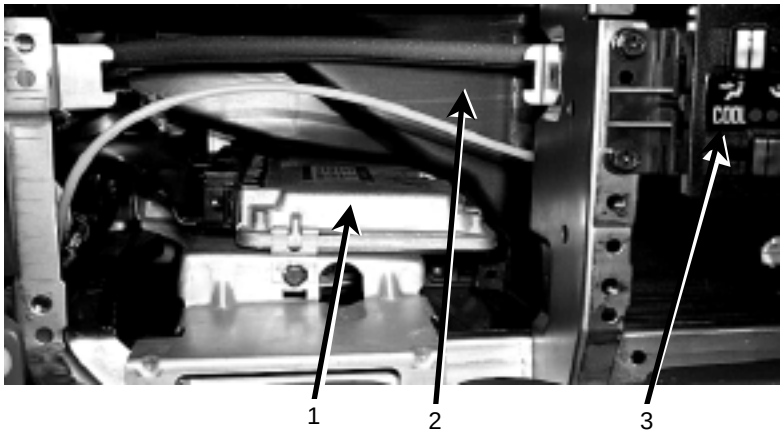


The VP44 fuel injection pump has a pump control unit (PSG: Pumpen Steuer Great) fitted on top of it, that exchanges information with the engine control module (ECM) via CAN-bus.

The engine control module (ECM) calculates the desired fuel quantity and fuel injection timing and sends this information to the pump control unit (PSG).

This pump control unit then actuates the internal actuators accordingly.

ENGINE CONTROL MODULE (ECM)



1. Engine Control Module (ECM)
2. Defroster Nozzle
3. Heater, Ventilator & A/C Control Panel

The engine control module (ECM) is located inside of instrument panel just at the back of the radio compartment.
The fuel quantity and injection timing related functions are controlled by the pump control unit (PSG).
The engine control module (ECM) performs the following functions.
-Control of the exhaust gas re-circulation (EGR)
-Control of the quick on start (QOS) glow control system
-Control of the A/C compressor
-Control of the quick warm-up system (QWS)
-Control of the exhaust brake

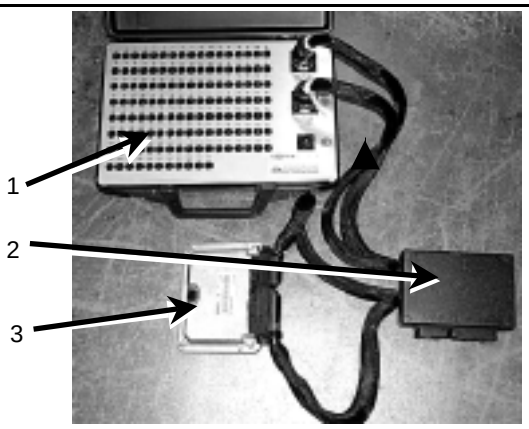
Tech 2 Information

Order	Units	Tech 2 Parameter	Explanation
25/37	Active/ Inactive	Main Relay	This displays operating status for the ECM main relay. This should display "Active" when the key switch is turned on and while engine is running.
6/37	hpa	Barometric Pressure	The barometric pressure is measured by ECM from the sensor in the ECM. This data is changing by altitude.

DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0602		ECU Programming Error	ECM memory area error.	Engine control disabled.
P0606	A	ECU Malfunction	Gate Array communication error.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.
	B	ECU Malfunction	1. Throttle position is below 1%. 2. Desired injection quantity is more than 0mg/strk.	MAB (fuel cutoff solenoid valve) is operated.
P1605	D	EEPROM Defect	Write and read from the EEPROM are failed during initialization of the ECM.	ECM uses default values from the EPROM.
	E	EEPROM Defect	EEPROM checksum does not match with the read check sum during initialization of the ECM.	
P1105	1	Barometric Pressure Sensor Circuit High Input	Barometric pressure sensor output voltage is more than 4.4V.	ECM uses 1013hpa condition as substitute.
	2	Barometric Pressure Sensor Circuit Low Input	Barometric pressure sensor output voltage is below 1.5V.	

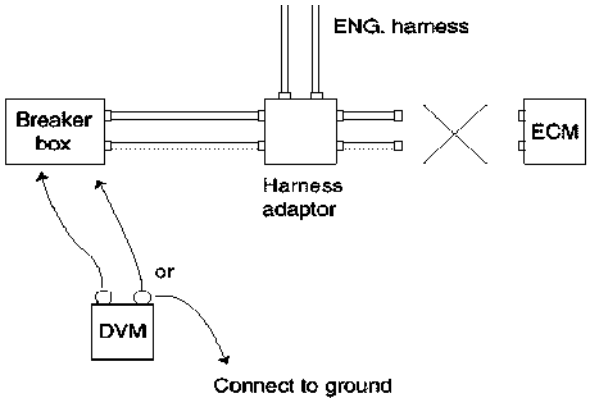
BREAKER BOX



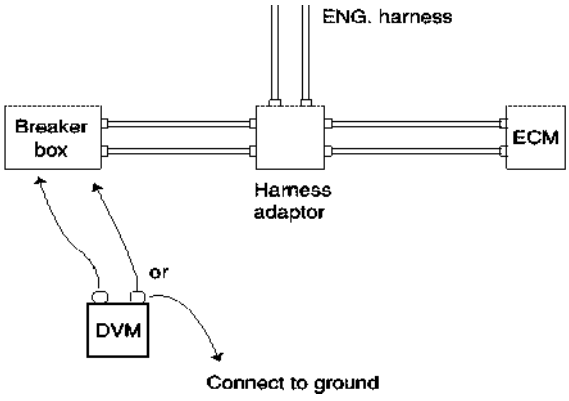
1. Breaker Box
2. Harness Adapter
3. Engine Control Module (ECM)

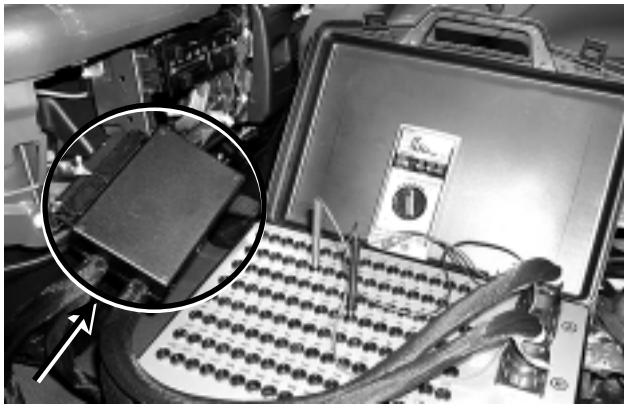
The engine control module (ECM) and other connectors have water proof connector and special terminal. Water proof terminal does not allow to use back prove. In addition, the engine control module (ECM) special terminal can not let regular digital voltage meter prove to access, because terminal shape 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.



Breaker Box Connection Type "A" for Open Circuit Check, Short to Ground Check and Short to Battery Check.





Breaker Box Connection Type "B" for Power, Signal Voltage Check Between the Engine Control Module (ECM) and Electrical Components.

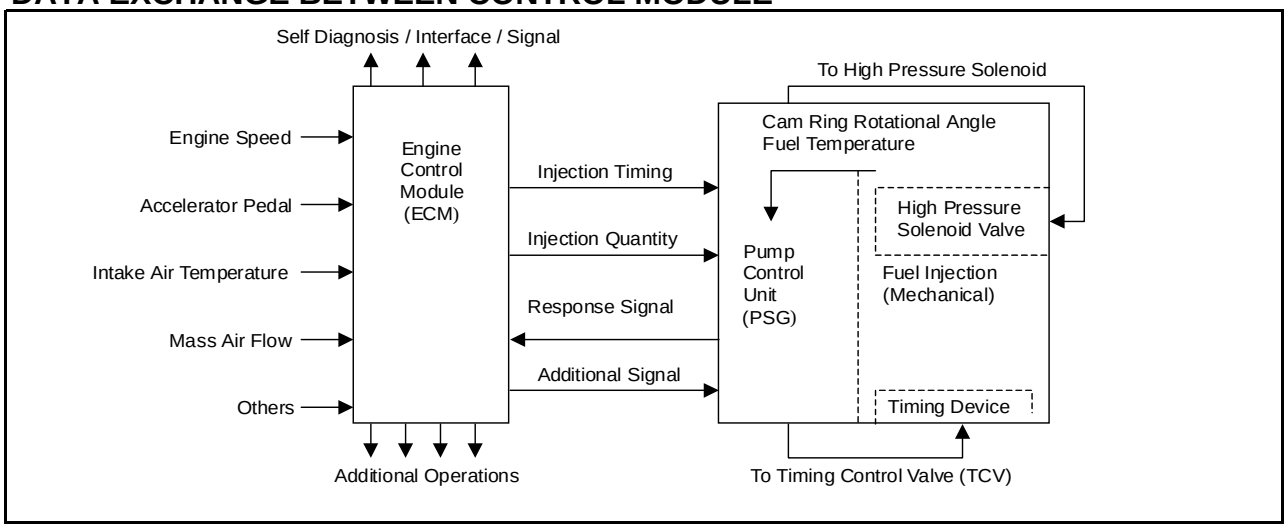
SPS (SERVICE PROGRAMMING SYSTEM)

TIS200 Screen

The engine control module (ECM) of the 4JH1-TC engine is equipped with a flash EEPROM.
This memory has the capacity to be erased and programmed with a relative low voltage (battery voltage).
This feature enables the service personnel to program new calibration software into an existing engine control module (ECM) and programs a new engine control module (ECM) by using the following hardware.
-Tech2
-Hardware Key
-PC with TIS2000 installed

The application to perform this action is called SPS (service programming system).
SPS is the software re-calibration system for engine control module (ECM).
This system can update the current module by downloading a new calibration from TIS2000 into the Tech2, which then can be uploaded into a control unit of the vehicle.
This SPS provides the following benefits.
-Not necessary to purchase a new control module.
-Save a lot of time to repair. The repair time depends highly on the availability of parts.
-The customer satisfaction can be improved because of much shorter repair time.
-Parts on stock maintain useable because SPS can change the control module on the shelf to new control module with new software.

DATA EXCHANGE BETWEEN CONTROL MODULE



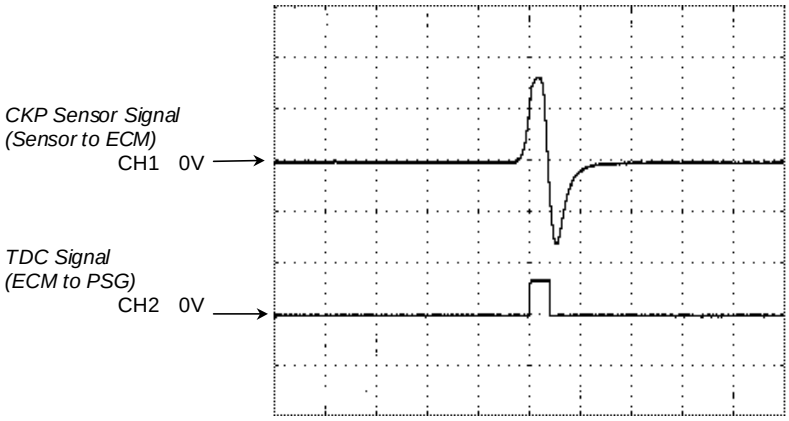
The radial plunger distributor type injection pump uses two control modules to execute full control of the engine management system.
-Engine Control Module (ECM)
-Pump Control Unit (PSG) = Pumpen Steuer Great (German)

The pump control unit (PSG) receives signals from the sensors inside the pump to determine the cam ring rotation angle, the pump speed and the fuel temperature .
These values are then compared to the desired values sent by the engine control module (ECM) such as the desired injection timing and the desired fuel injection quantity.

The engine control module (ECM) processes all engine data and data regarding the surrounding environment received from external sensors to perform any engine side adjustments.
Maps for both are encoded in both control units. The control units input circuit process sensor data.
A Microprocessor then determines the operating conditions and calculates set values for optimum running.
The interchange of data between the engine control module (ECM) and the pump control unit (PSG) is performed via a CAN-bus system. The abbreviation CAN stands for Controller Area Network. By having two separate control modules, the high pressure solenoid valve. This prevents the discharge of any disturbing signals.

The information exchange between the two control modules takes place via two means.
-Via analogue signal leads
-Via the CAN-bus

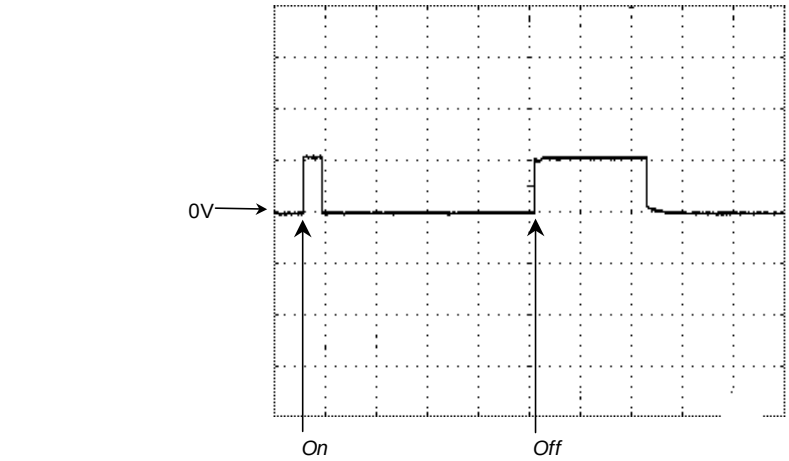
The analogue signal leads are used to exchange the following information.
-Engine speed signal (ECM terminal 91)
-Pump Speed (ECM terminal 105)
-Fuel Cutoff solenoid valve signal (MAB signal) (ECM terminal 105)



Measurement Terminal: CH1: 90(+) / CH2: 91(+) 2(-)
Measurement Scale: CH1: 20V/div / CH2: 20V/div 500 micro s/div
Measurement Condition: Approximately 2000rpm

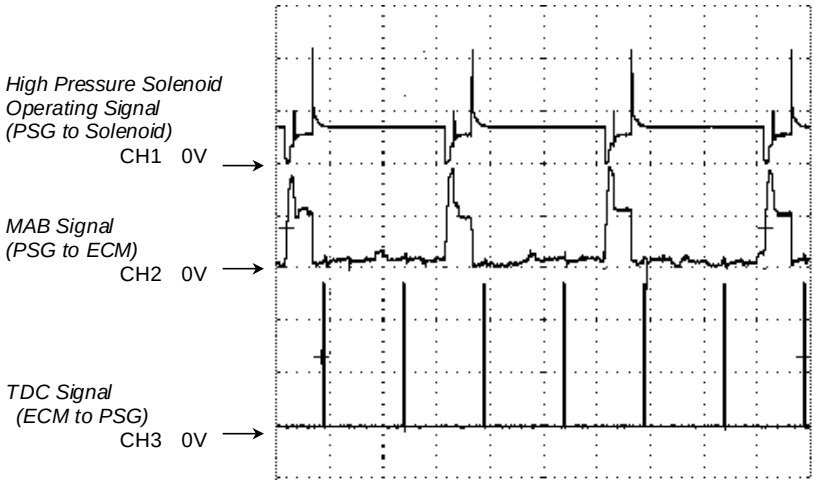
The engine speed signal is sent from the ECM to PSG based on the input from the crank shaft position (CKP) sensor.
The analogue CKP sensor signal is converted by the ECM into a square wave signal.

The fuel cutoff solenoid valve signal is also referred to as MAB signal.
MAB in this case, refers to the German abbreviation Magnet ventil ABschaltung that stands for high pressure solenoid valve cut off.
The MAB signal wire is used for two purposes.
-As a reference for the engine control module (ECM) for the pump speed (back up for the CKP sensor).
-To turn Off the engine.



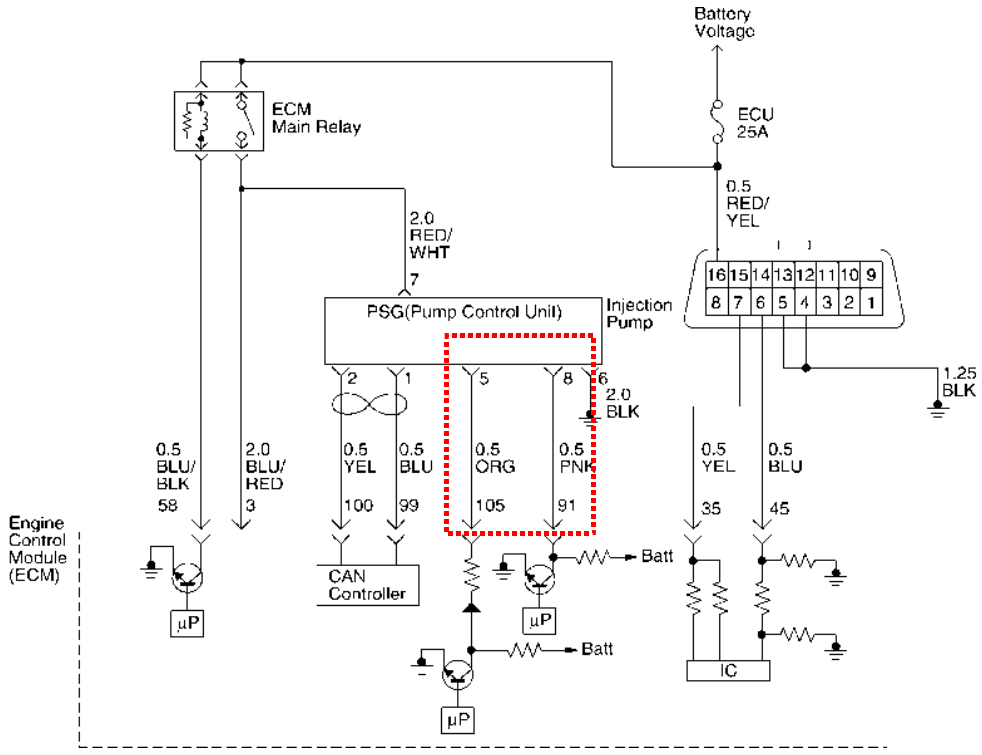
Measurement Terminal: CH1: 105(+) 2(-)
Measurement Scale: CH1: 10V/div / CH2: 20V/div 500 ms/div

When the key switch is turned On, the engine control module (ECM) supplies a pulse on the MAB signal wire.
The pulse is used by the pump control unit (PSG) to perform a self-test and determine whether:
-the end-stage to control the high pressure solenoid valve works properly.
-the fuel cutoff solenoid valve itself works properly.
When the key switch is turned Off, the engine control module (ECM) supplies a 12 V pluses to the MAB signal wire. This pulse is the command for the pump control unit (PSG) to turn Off the engine.



Measurement Terminal: CH1: Solenoid (+) / CH2: 105 (+) / CH3: 91(-) 2 (-)
Measurement Scale: CH1: 20V/div / CH2: 200mV/div / CH3: 5V 5ms/div
Measurement Condition: Approximately 2000rpm

Once the engine is running, the MAB signal wire supplies above signal.

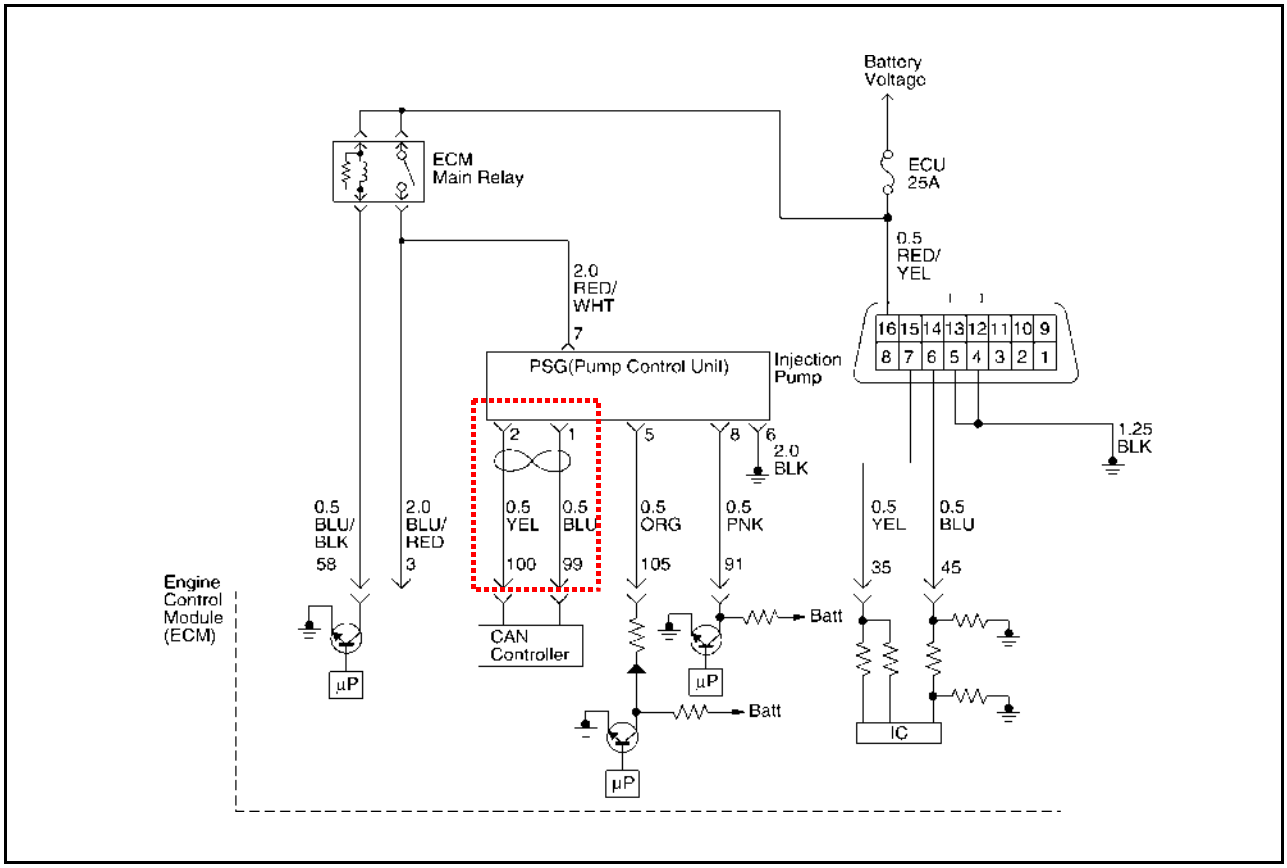


DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0215	A	Fuel Cutoff Solenoid Valve Malfunction	1. Ignition key switch off. 2. Engine speed is below 1500rpm. 3. Vehicle speed is below 1.5km/h. 4. PSG (pump control unit) recognizes MAB (fuel cutoff solenoid valve) signal from the ECM, but the MAB could not operate.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.
	B	Fuel Cutoff Solenoid Valve Circuit High Input	ECM does not command MAB (fuel cutoff solenoid valve) signal to the PSG (pump control unit), but PSG detected MAB signal line circuit is high level.	Engine does not start.
	C	Fuel Cutoff Solenoid Valve Always Active	1. Ignition key switch off. 2. Engine speed is below 1500rpm. 3. Vehicle speed is below 1.5km/h. 4. PSG (pump control unit) does not recognize MAB (fuel cutoff solenoid valve) signal from the ECM.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.
	D	Fuel Cutoff Solenoid Valve Malfunction	1. Ignition key switch off. 2. CAN controller does not operate Bus-off.	No fail-safe function.

The following signals are exchanged via the CAN-bus:
From ECM to PSG
-Desired injection quantity
-Crankshaft position set point at beginning of fuel delivery
-Pump camshaft position set point at beginning of fuel delivery
-Engine speed

From PSG to ECM
-Fuel temperature
-Pump camshaft speed
-Cylinder identifier
-Control pulse (actual injection quantity + actual injection timing)
-PSG status



Tech 2 Information

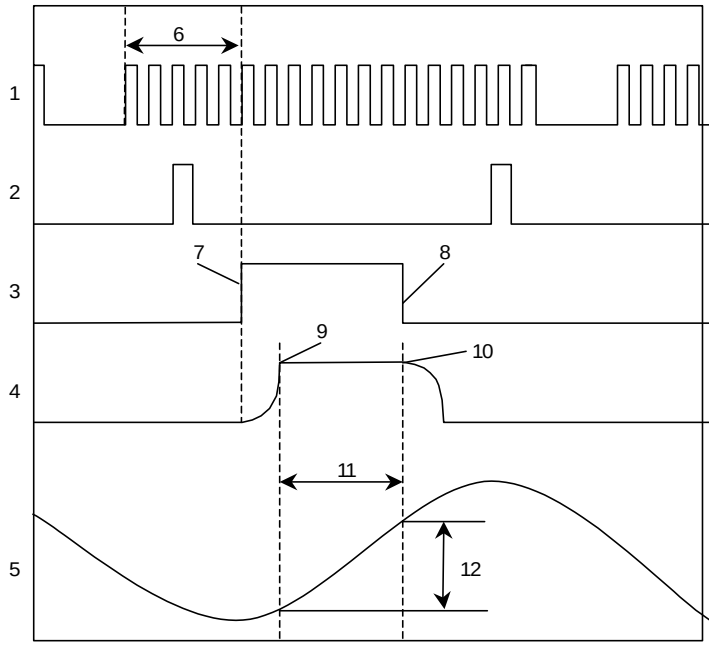
Order	Units	Tech 2 Parameter	Explanation
3/37	rpm	Pump Speed	This displays injection pump speed. The injection speed is measured by ECM from the pump cam sensor.
12/37	deg. C / deg. F	Fuel Temperature	The FT is measured by PSG from FT sensor. This data is changing by fuel temperature.

DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P1173	7	Fuel Reduction Caused By High Fuel Temperature	Fuel temperature is more than 100 deg. C.	PSG (pump control unit) controls fuel injection quantity based on engine speed and fuel temperature.
	A	Fuel Reduction Caused By Low Fuel Temperature	Excessive low fuel temperature is detected.	No fail-safe function.
P1345	A	Camshaft Speed Malfunction	The PSG (pump control unit) is recognized incorrect camshaft speed signal.	No fail-safe function.
P1650	A	CAN Device Offline	CAN controller detects Bus-off or canceling.	MAB (fuel cutoff solenoid valve) is operated.
	B	CAN Device Hang-up	CAN controller does not react under engine running.	
P1651	A	CAN Malfunction (PSG)	The PSG (pump control unit) does not recognize CAN signal from the CAN controller.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.
	B	CAN Receives Error	The ECM does not read CAN signal from the PSG (pump control unit).	

PRINCIPLE OF FUEL QUANTITY METERING & INJECTION TIMING

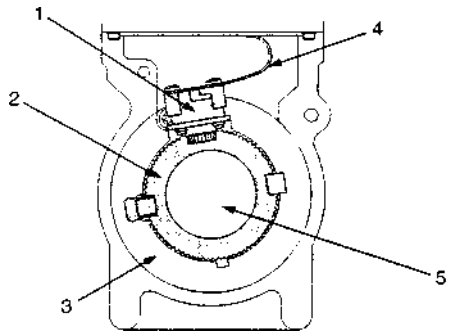
1. Pump Camshaft Sensor Signal
2. Crankshaft Position Sensor Signal
3. High Pressure Solenoid Control Pulse
4. High Pressure Solenoid Needle Valve Lift
5. Cam Lift (Cam Profile)
6. Pulse Count
7. High Pressure Solenoid Valve Close
8. High Pressure Solenoid Valve Open
9. Start of Pressure Delivery
10. End of Pressure Delivery
11. Pressure Delivery Angle
11. Effective Stroke



The fuel injection quantity metering is performed by high pressure solenoid valve in the injection pump. And it is determined depends on control duration of the high pressure solenoid valve and pump camshaft angular position.

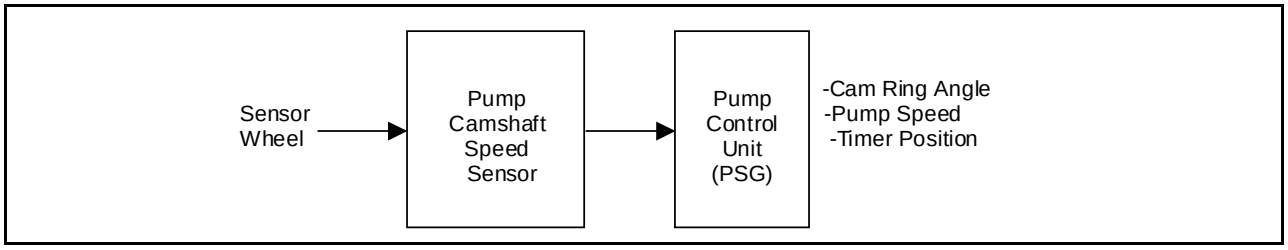
Pump Camshaft Speed Sensor

1. Pump Camshaft Speed Sensor
2. Sensor Wheel
3. Pump Camshaft Speed Sensor Retaining Ring
4. Flexible Connector Harness
5. Drive Shaft



When the drive shaft rotates, the pump camshaft speed sensor receives signal form the sensor wheel, and an electric pulse is sent through the flexible connecting harness to the pump control unit (PSG). From these signals the pump control unit (PSG) can determine the average pump speed and the momentary pump speed.
The pump camshaft speed sensor is mounted to the cam ring. Thus, the relationship between the cam ring and the pump camshaft speed sensor signal is constant.

The pump camshaft speed sensor signal is utilized for the following purposes.
To determine the momentary angular position of the cam ring.
To calculate the actual speed of the fuel injection pump.
To determine the actual timing plunger position.

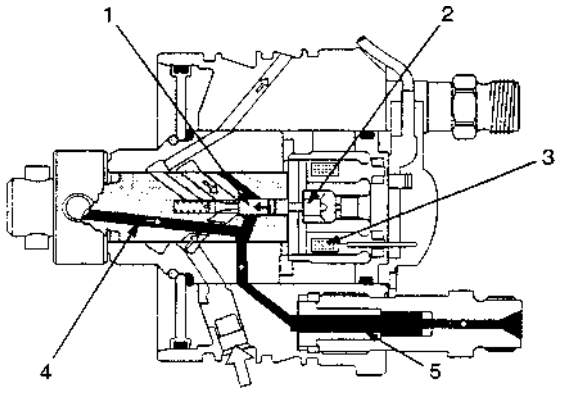


The pump camshaft sensor signal has a tooth gap, and the crankshaft position (CKP) sensor on the flywheel housing is used as a reference signal of engine top dead center (TDC) for the start timing of fuel delivery or injection which is to be set.

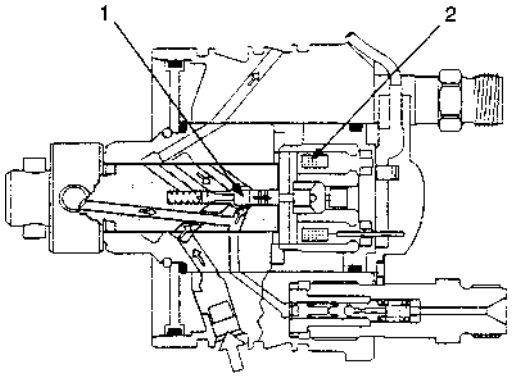
High Pressure Solenoid Valve

Fuel injection quantity control is performed from the beginning of pressure delivery at the beginning of cam lift until the high pressure solenoid valve opens at the end of pressure delivery.
This interval is called the pressure delivery interval. Accordingly, the interval that the high pressure solenoid valve is closed determines the fuel injection quantity (high pressure fuel supply ends when the high pressure solenoid valve opens).

1. Valve Needle
2. Magnet Anchor
3. Coil
4. High Pressure Passage



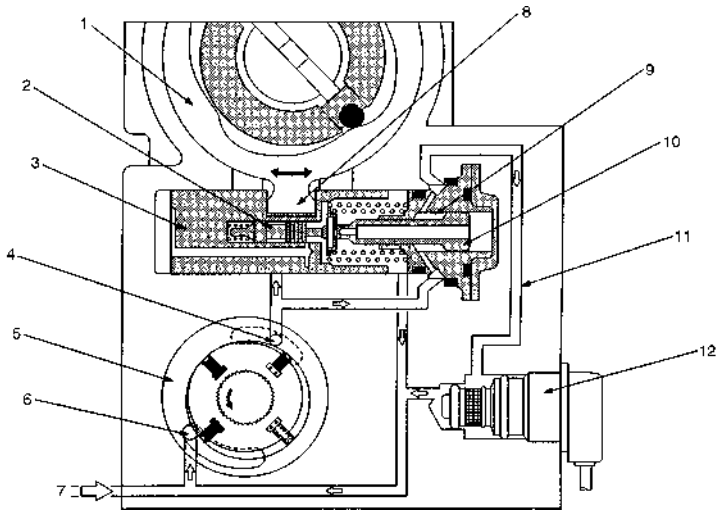
When current from the pump control unit (PSG) flows to the high pressure solenoid valve coil, the magnet anchor (a movable iron core) pushes the valve needle, toward the valve seat.
When the valve seat is completely closed by the valve needle, the way, of the fuel in the high pressure passage to the low pressure circuit is closed.
The pressure of the fuel in the high pressure passage is rapidly increased by radial plunger lift, and the high pressure fuel is delivered through the constant pressure valve (CPV) to the nozzle holder assembly and is injected into the engine cylinder.



1. Valve Needle
2. Coil

When the fuel injection quantity demanded by the engine is reached, the current to the coil is cut and the valve needle re-opens the valve seat.
As a result of this, a path is opened for the fuel in the high pressure passage to the low pressure circuit and the pressure decreases. With a decrease in injection pressure the nozzle closes and injection ends.

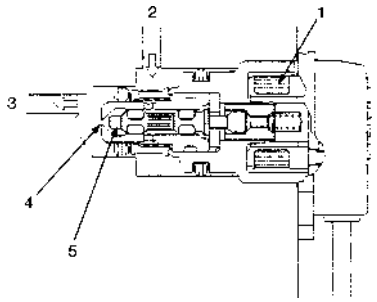
Timing Control Valve (TCV)



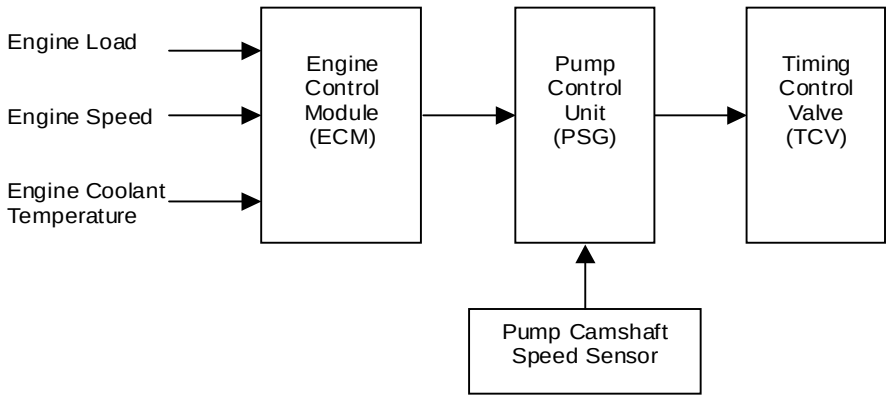
1. Cam Ring
2. Servo Valve
3. Timer Piston
4. Outlet
5. Feed Pump
6. Inlet
7. Fuel Suction
8. Ball Pin
9. Annular Chamber
10. Hydraulic Stopper
11. Return Passage
12. Timing Control Valve (TCV)

The pressure of the fuel fed from the feed pump is adjusted in accordance with speed by the regulating valve. This delivery pressure acts on the hydraulic stopper's annular chamber as control pressure.
The chamber pressure of the annular chamber is controlled by the timing control valve (TCV).
The timing plunger is connected to the cam ring by a ball pin. Axial movement of the timing plunger is transferred to the cam ring in the form of rotational movement. Movement to the right of the timing plunger (to the spring side) advances injection timing.

1. Coil
2. From Annular Chamber
3. To Feed Pump
4. Orifice
5. Valve Needle



When control current flows to the timing control valve (TCV) coil, the valve needle opens and the fuel annular chamber flows through the orifice to the feed pump inlet.
Consequently, the pressure of the annular chamber decreases and the hydraulic stopper is moved to the retard side.



The engine control module (ECM) contains characteristic maps of the start of injection, corresponding to engine operating conditions (engine load, engine speed and engine coolant temperature).
The pump control unit (PSG) is constantly comparing the set start of injection timing and the actual start of injection timing. If there is a difference, the timing control valve (TCV) is controlled by the duty ratio. (The actual start of injection timing is determined from the pump camshaft speed sensor.)

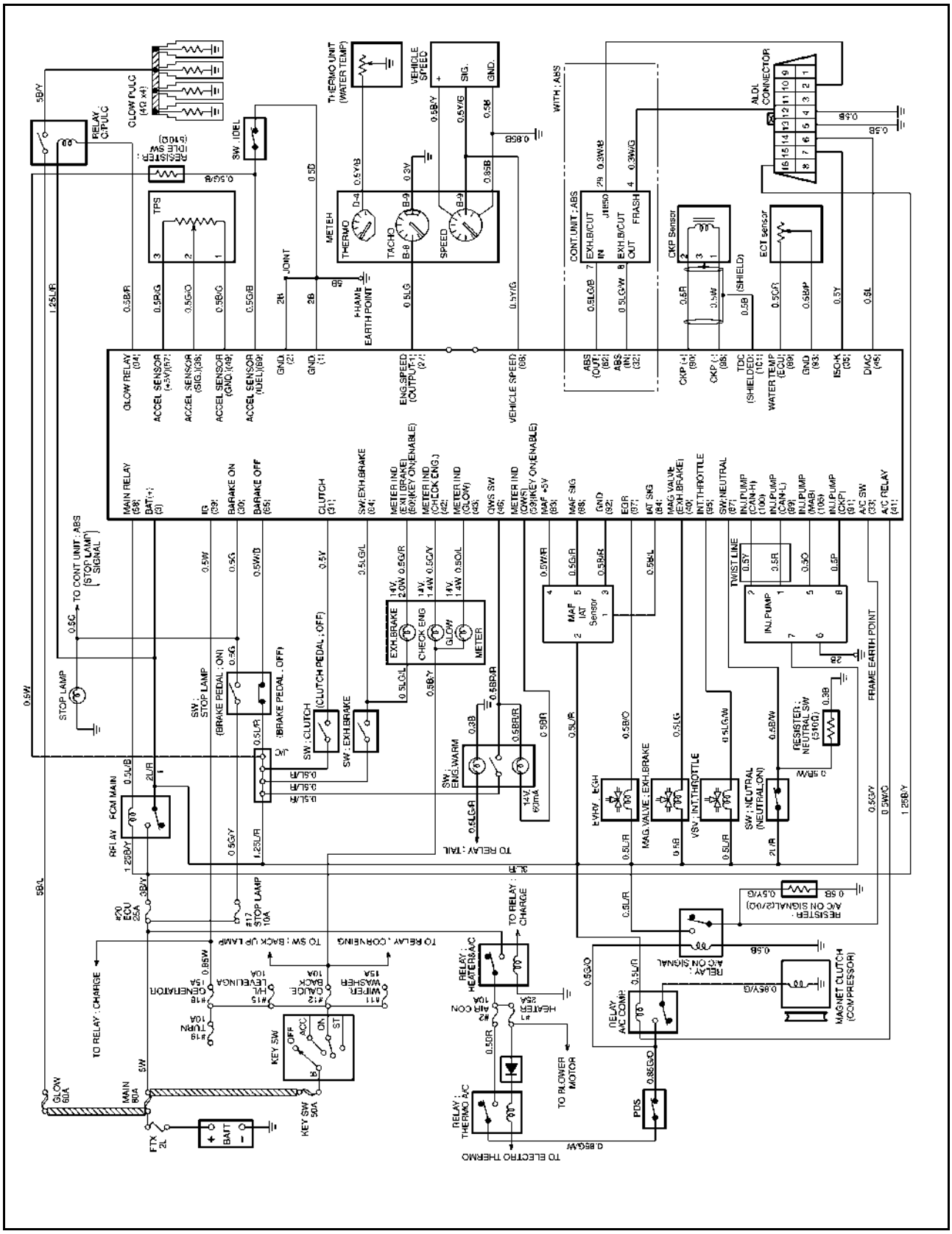
Tech 2 Information

Order	Units	Tech 2 Parameter	Explanation
7/37	mg/stk	Desired Injection Quantity	This displays desired value from the ECM. The ECM compensates for fuel rate to basic rate.
8/37	mg/stk	Injection Quantity	This displays actual fuel quantity. The PSG controls high pressure solenoid valve to meet commanded value from the ECM.
9/37	°CA	Desired Fuel Injection Start	This displays desired injection timing from the ECM. The ECM compensates for fuel injection timing by throttle position and various sensor signal.
10/37	°CA	Actual Injection Start	This displays calculated actual injection timing based on CKP signal and pump cam signal. The PSG controls TCV duty ratio to meet desired injection timing from the ECM.

DTC Information

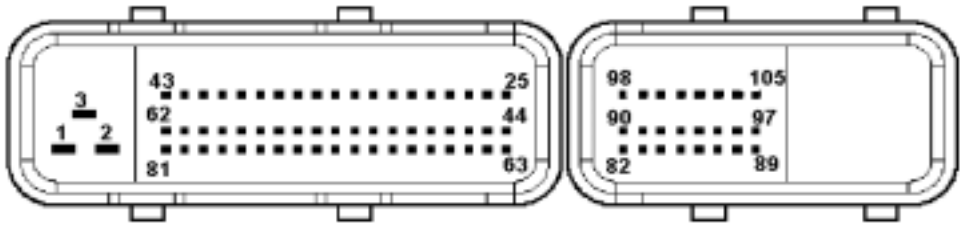
Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0216	A	Injection Timing Control Circuit Malfunction (Timer Deviation)	1. Engine speed is more than 700rpm. 2. Fuel injection quantity is more than 4mg/stk. 3. Deviation of actual injection timing and desired injection timing is more than +3 deg. CA or -6 deg. CA for 8 seconds.	Fuel injection quantity is reduced.
	B	Injection Timing Control Circuit Malfunction (Timer Fluctuation)	1. Engine speed is more than 2014rpm. 2. Fluctuation of actual injection timing is more than +-5.2 deg. CA.	
P0251	6	Injection Pump Malfunction	1. No pump camshaft speed sensor error. 2. High pressure solenoid valve control pulse width does not match with desired fuel injection quantity.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.
	7	Injection Pump Malfunction	1. No pump camshaft speed sensor error. 2. No CKP sensor error. 3. Difference of engine speed and doubled pump camshaft speed is more than 800rpm.	
	9	Injection Pump Malfunction	No pump map programmed in the PSG (pump control unit) or PSG malfunction.	
	A	Injection Pump Malfunction	EEPROM or A/D converter malfunction in the PSG (pump control unit).	Fuel injection quantity is reduced.
	B	Injection Pump Malfunction	PSG (pump control unit) recognized high pressure solenoid valve drive circuit error.	No fail-safe function.
	D	Injection Pump Malfunction	PSG (pump control unit) could not measure the high pressure solenoid valve drive voltage.	
	E	Injection Pump Malfunction	ECM could not accept PSG (pump control unit) message.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.
P1630	A	Fuel Injection Quantity Circuit Malfunction	The PSG (pump control unit) detects high pressure solenoid valve control circuit malfunction due to high current.	Fuel injection quantity is reduced.
	B	Fuel Injection Quantity Circuit Malfunction	The PSG (pump control unit) detects high pressure solenoid valve control circuit malfunction due to continuous current.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.

ECM WIRING SCHEME



ECM CONNECTOR PIN ASSIGNMENT & OUTPUT SIGNAL

View Looking Into ECM Case



				Signal or Continuity					Tester Position		
Pin No.	B/Box No.	Pin Function	Wire Color	Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM Connection	Range	(+)	(-)
1	1	ECM Ground	BLK	Continuity with ground	-	-	-	Disconnect	Ohm	1	GND
2	2	ECM Ground	BLK	Continuity with ground	-	-	-	Disconnect	Ohm	2	GND
3	3	Battery Power Supply	BLU/ RED	Less than 1V	Battery voltage			Connect	DC V	3	GND
25	25	No Connection	-	-	-	-	-	-	-	-	-
26	26	No Connection	-	-	-	-	-	-	-	-	-
27	27	Engine Speed Output (To Tacho Meter)	LGN	-	-	Approx. 23Hz by wave form or approx. 7.5V	Approx. 66Hz by wave form or approx. 7.5V	Connect	AC V	27	GND
28	28	No Connection	-	-	-	-	-	-	-	-	-
29	29	No Connection	-	-	-	-	-	-	-	-	-
30	30	Brake Switch 1 Signal	GRN	Less than 1V	Pedal is not stepped on: Less than 1V Pedal is stepped on: 10-14V			Connect	DC V	30	GND
31	31	Clutch Switch Signal	YEL	Less than 1V	Pedal is not stepped on: 10-14V Pedal is stepped on: Less than 1V			Connect	DC V	31	GND
32	32	Exhaust Brake Cut Signal (ABS C/U No.8 to ECM)	LGN/ WHT	-	-	-	-	-	-	-	-
33	33	A/C ON Signal Relay	GRN/ YEL	Less than 1V		A/C request switch is turned on: 10-14V A/C request switch is turned off: Less than 1V		Connect	DC V	33	GND
34	34	No Connection	-	-	-	-	-	-	-	-	-
35	35	To Data Link Connector No. 7	YEL	-	-	-	-	Connect	DC V	35	GND
36	36	No Connection	-	-	-	-	-	-	-	-	-
37	37	No Connection	-	-	-	-	-	-	-	-	-
38	38	Throttle Position Sensor (TPS) Output Signal	GRN/ ORG	Less than 1V	Less than 1V		Approx. 1.4V	Connect	DC V	38	49
39	39	Key Switch Input Signal Via Generator Fuse	WHT	Less than 1V	10-14V			Connect	DC V	39	GND
40	40	Exhaust Brake Magnetic Valve	LGN	Less than 1V	Magnetic Valve is turned on: Less than 1V Magnetic Valve is turned off: 10-14V			Connect	DC V	40	GND
41	41	A/C Compressor Relay	WHT/ GRN	Less than 1V	10-14V	A/C comp. is operated: Less than 1V A/C comp. is not operated: 10 - 14V		Connect	DC V	41	GND
42	42	Check Engine Lamp	GRN/ YEL	Less than 1V	Lamp is turned on: Less than 1V Lamp is turned off: 10-14V			Connect	DC V	42	GND

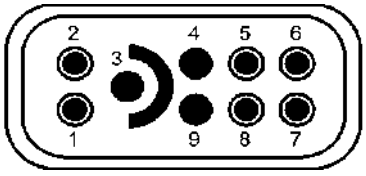
				Signal or Continuity					Tester Position		
Pin No.	B/Box No.	Pin Function	Wire Color	Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM Connection	Range	(+)	(-)
43	43	Glow Lamp	ORG/ BLU	Less than 1V	Lamp is turned on: Less than 1V Lamp is turned off: 10-14V			Connect	DC V	43	GND
44	44	No Connection	-	-	-	-	-	-	-	-	-
45	45	To Data Link Connector No. 6	BLU	Less than 1V	10-14V			Connect	DC V	45	GND
46	46	QWS Switch	BRN/ RED	Less than 1V	Less than 1V			Connect	DC V	46	GND
47	47	No Connection	-	-	-	-	-	-	-	-	-
48	48	No Connection	-	-	-	-	-	-	-	-	-
49	49	Throttle Position Sensor (TPS) Ground	BLK/ GRN	Idle: Approx. 0.6K ohm / WOT: Approx. 3.5K ohm	-	-	-	Disconnect	Ohm	38	49
50	50	No Connection	-	-	-	-	-	-	-	-	-
51	51	No Connection	-	-	-	-	-	-	-	-	-
52	52	No Connection	-	-	-	-	-	-	-	-	-
53	53	No Connection	-	-	-	-	-	-	-	-	-
54	54	No Connection	-	-	-	-	-	-	-	-	-
55	55	No Connection	-	-	-	-	-	-	-	-	-
56	56	No Connection	-	-	-	-	-	-	-	-	-
57	57	Throttle Position Sensor (TPS) Power Supply	RED/ GRN	Less than 1V	Approx. 5V			Connect	DC V	57	49
58	58	ECM Relay	BLU/ BLK	10-14V	Less than 1V			Connect	DC V	58	GND
59	59	QWS Indicator Lamp	BRN	Less than 1V	Less than 1V			Connect	DC V	59	GND
60	60	Exhaust Brake Lamp	GRN/ RED	Less than 1V	Less than 1V			Connect	DC V	60	GND
61	61	No Connection	-	-	-	-	-	-	-	-	-
62	62	Exhaust Brake Cut Signal (ECM to ABS C/U No.7)	LGN/ BLK	-	-	-	-	-	-	-	-
63	63	No Connection	-	-	-	-	-	-	-	-	-
64	64	Exhaust Brake Switch	LGN/ BLU	Less than 1V	SW is turned on: 10-14V SW is turned off: Less than 1V			Connect	DC V	64	GND
65	65	Brake Switch 2 Signal	WHT/ BLK	Less than 1V	Pedal is not stepped on: 10-14V Pedal is stepped on: Less than 1V			Connect	DC V	65	GND
66	66	No Connection	-	-	-	-	-	-	-	-	-
67	67	No Connection	-	-	-	-	-	-	-	-	-
68	68	Vehicle Speed Sensor (VSS)	YEL/ GRN	-	Approx. 14.5Hz by wave form or approx. 6.0V at vehicle speed 20km/h			Connect	AC V	68	GND

				Signal or Continuity					Tester Position		
Pin No.	B/Box No.	Pin Function	Wire Color	Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM Connection	Range	(+)	(-)
69	69	Idle Switch	GRN/ BLK	Less than 1V	Approx. 8-10V when pedal is stepped on			Connect	DC V	69	GND
70	70	No Connection	-	-	-	-	-	-	-	-	-
71	71	No Connection	-	-	-	-	-	-	-	-	-
72	72	No Connection	-	-	-	-	-	-	-	-	-
73	73	No Connection	-	-	-	-	-	-	-	-	-
74	74	No Connection	-	-	-	-	-	-	-	-	-
75	75	No Connection	-	-	-	-	-	-	-	-	-
76	76	No Connection	-	-	-	-	-	-	-	-	-
77	77	No Connection	-	-	-	-	-	-	-	-	-
78	78	No Connection	-	-	-	-	-	-	-	-	-
79	79	No Connection	-	-	-	-	-	-	-	-	-
80	80	No Connection	-	-	-	-	-	-	-	-	-
81	81	No Connection	-	-	-	-	-	-	-	-	-
82	82	No Connection	-	-	-	-	-	-	-	-	-
83	83	Mass Air Flow (MAF) Sensor Power Supply	WHT/ RED	Less than 1V	Approx. 5V			Connect	DC V	83	92
84	84	Intake Air Temperature (IAT) Sensor Signal	BLK/ BLU	Less than 1V	0 deg. C: Approx. 3.6V / 20 deg. C: Approx. 2.6V / 40 deg. C: Approx. 1.7V / 60 deg. C: 1.1V / 80 deg. C: 0.7V			Connect	DC V	84	92
85	85	No Connection	-	-	-	-	-	-	-	-	-
86	86	No Connection	-	-	-	-	-	-	-	-	-
87	87	Neutral Switch	BLK/ WHT	Less than 1V	In neutral: Less than 1V Other than neutral: 10-14V			Connect	DC V	87	GND
88	88	Mass Air Flow (MAF) Sensor Signal	GRN/ RED	Less than 1V	Approx. 1V	1.8-2.3V	2.5-3.0V	Connect	DC V	88	92
89	89	Engine Coolant Temperature (ECT) Sensor Signal	GRY	Less than 1V	0 deg. C: Approx. 4.4V / 20 deg. C: Approx. 3.8V / 40 deg. C: Approx. 2.9V / 60 deg. C: 2.1V / 80 deg. C: 1.4V			Connect	DC V	89	93
90	90	CKP Sensor Signal	RED	-	-	Approx. 47Hz by wave form	Approx. 134Hz by wave form or approx. 1.0V	Connect	AC V	90	98
91	91	CKP Sensor Output To Pump Control Unit (PSG) No.8	PNK	-	-	Approx. 47Hz by wave form	Approx. 134Hz by wave form or approx. 0.6V	-	-	-	-
92	92	Mass Air Flow (MAF) Sensor Ground	BLK/ RED	Continuity with ground	-	-	-	Connect	Ohm	92	GND
93	93	Engine Coolant Temperature (ECT) Sensor Ground	BLK/ PNK	Continuity with ground	-	-	-	Connect	Ohm	93	GND
94	94	Glow Relay	BLK/ RED	Less than 1V	Glow system is operated: Less than 1V Glow system is not operated: 10 - 14V			Connect	DC V	94	GND

				Signal or Continuity					Tester Position		
Pin No.	B/Box No.	Pin Function	Wire Color	Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM Connection	Range	(+)	(-)
95	95	Intake Throttle VSV	LGN/ WHT	Less than 1V	VSV is operated: Less than 1V VSV is not operated: 10 - 14V			Connect	DC V	95	GND
96	96	No Connection	-	-	-	-	-	-	-	-	-
97	97	EGR EVRV	BLK/ ORG	-	-	Approx. 140Hz by wave form when EVRV is operated		-	-	-	-
98	98	CKP Sensor Ground	WHT	Continuity with ground	-	-	-	Connect	Ohm	98	GND
99	99	CAN (Controller Area Network) to PSG No.1	BLU	-	-	-	-	-	-	-	-
100	100	CAN (Controller Area Network) to PSG No.2	YEL	-	-	-	-	-	-	-	-
101	101	CKP Sensor Shield Line	BLK	Continuity with ground	-	-	-	Connect	Ohm	101	GND
102	102	No Connection	-	-	-	-	-	-	-	-	-
103	103	No Connection	-	-	-	-	-	-	-	-	-
104	104	No Connection	-	-	-	-	-	-	-	-	-
105	105	Solenoid Valve Shut Off (MAB) Output Signal to PSG No.5	ORG	-	-	-	-	-	-	-	-

PSG CONNECTOR PIN ASSIGNMENT & OUTPUT SIGNAL

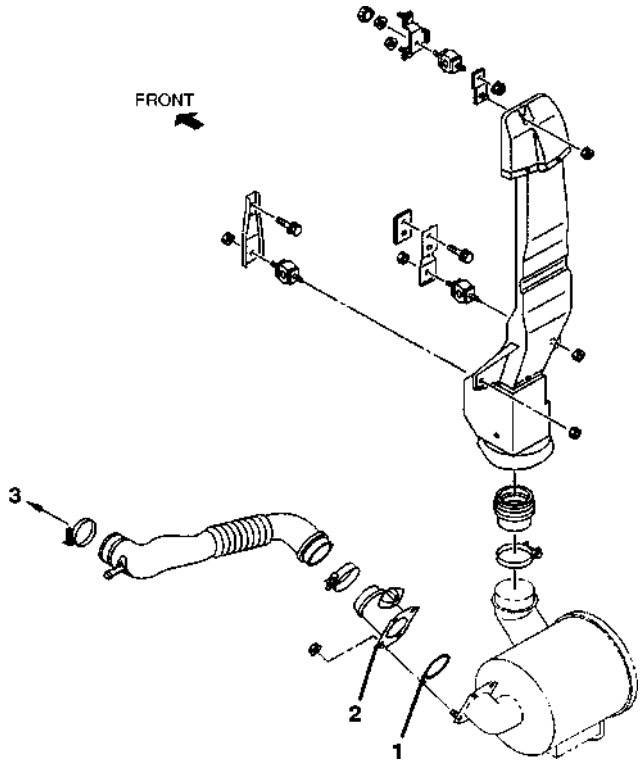
View Looking Into PSG Case



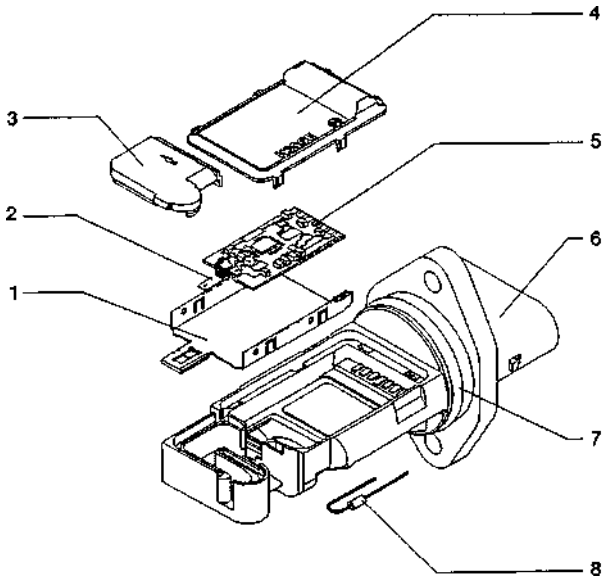
				Signal or Continuity					Tester Position		
Pin No.	B/Box No.	Pin Function	Wire Color	Key SW Off	Key SW On	Engine Idle	Engine 2000rpm	ECM & PSG Connection	Range	(+)	(-)
1	99	CAN (Controller Area Network) to ECM No.99	RED	Continuity between ECM & PSG	-	-	-	Disconnect	Ohm	1	99 (ECM)
2	100	CAN (Controller Area Network) to ECM No.100	WHT	Continuity between ECM & PSG	-	-	-	Disconnect	Ohm	2	100 (ECM)
3	-	No Connection	-	-	-	-	-	-	-	-	-
4	-	No Connection	-	-	-	-	-	-	-	-	-
5	105	Solenoid Valve Shut Off (MAB) Output Signal to ECM No.105	ORG	Continuity between ECM & PSG	-	-	-	Disconnect	Ohm	5	105 (ECM)
6	-	Ground	BLK	Continuity with ground	-	-	-	Disconnect	Ohm	6	GND
7	3	Battery Power Supply	BLU/ RED	Less than 1V	10-14V			Disconnect	Ohm	7	GND
8	91	CKP Sensor Output ECM No.91 to Pump Control Unit (PSG)	PNK	Continuity between ECM & PSG	-	-	-	Disconnect	Ohm	8	91 (ECM)
9	-	No Connection	-	-	-	-	-	-	-	-	-

ELECTRICAL COMPONENTS

MASS AIR FLOW (MAF) SENSOR & INTAKE AIR TEMPERATURE (IAT) SENSOR



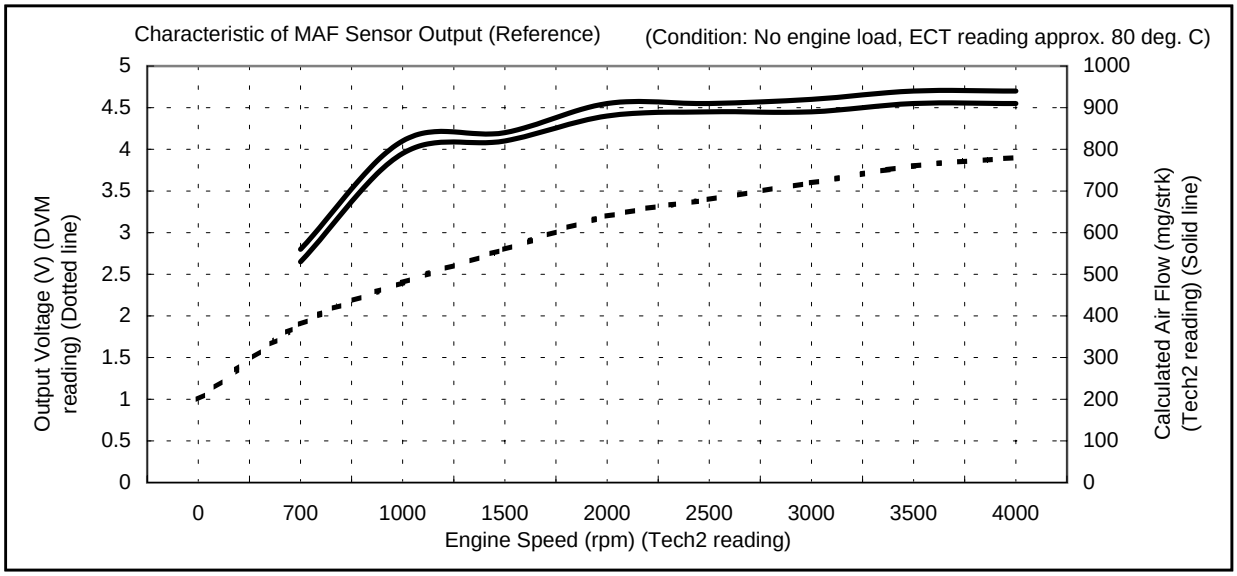
1. Mass Air Flow (MAF) Sensor
2. O-ring
3. To Turbocharger



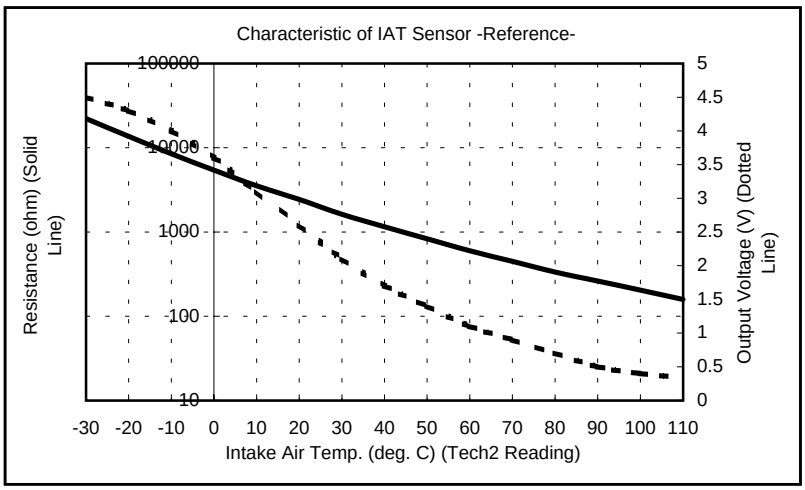
1. Steel Carrier
2. Air Mass Sensor Element
3. Cover Measurement Duct
4. Cover Hybrid Element
5. Hybrid Element
6. Connector
7. O-ring
8. Intake Air Temperature (IAT) Sensor

The mass air flow (MAF) sensor is part of the intake air system.
It is fitted between the air cleaner and turbocharger and measure the mass air flowing into the engine.
The mass air flow (MAF) sensor uses a hot film element to determine the amount of air flowing into the engine.
The mass air flow (MAF) sensor assembly consist of a mass air flow (MAF) sensor element and an intake air temperature sensor that are both exposed to the air flow to be measured.
The mass air flow (MAF) sensor element measures the partial air mass through a measurement duct on the sensor housing.
Using calibration, there is an extrapolation to the entire mass air flow to the engine.

The measuring element is fitted to the housing with two screws but is not separately replaceable.
The sensor element is only supplied as an assembly with the housing.



The characteristic of the mass air flow (MAF) sensor are displayed in the graph. These voltage can be measured on terminal 88 of the engine control module (ECM).

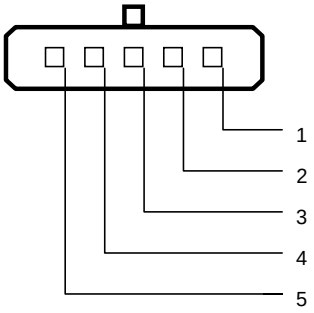


Intake Air Temp. (deg. C) (Tech2 Reading)	Output Voltage (V) (Approx.)	Resistance (ohm) (Approx.)
-20	4.3	13660
0	3.6	5430
20	2.6	2433
40	1.7	1153
60	1.1	598
80	0.7	334
100	0.4	203.5

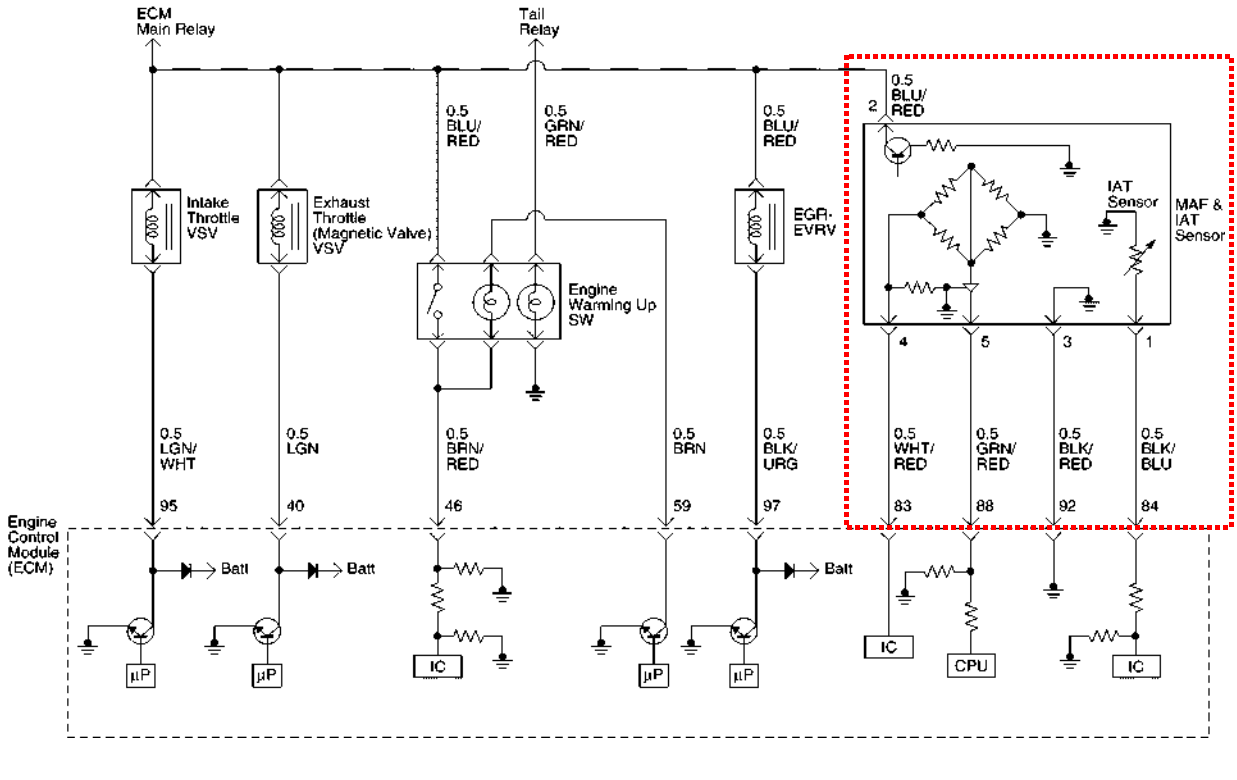
The IAT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. Low air temperature produces a high resistance.

The ECM supplies 5 volts signal to the IAT sensor through resisters 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 values for the intake air temperature (IAT) sensor can be measured on terminal 84.
20 deg. C: Approximately 2.6V
30 deg. C: Approximately 2.1V
40 deg. C: Approximately 1.7V

MAF & IAT Sensor Pin Assignment
(View Looking Sensor Side Connector)



1. IAT Sensor Output to ECM Terminal 84
2. Voltage Supply from ECM Fuse via ECM Relay
3. IAT Sensor & MAF Sensor Ground to ECM Terminal 92
4. MAF Sensor +5V Supply from ECM Terminal 83
5. MAF Sensor Signal to ECM Terminal 88



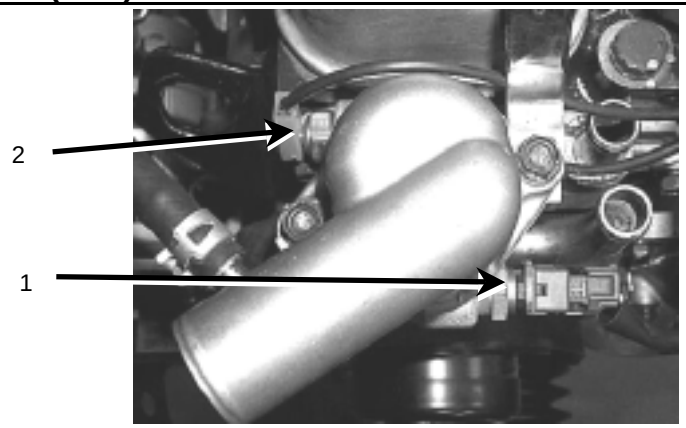
Tech 2 Information

Order	Units	Tech 2 Parameter	Explanation
5/37	mg/strk	Mass Air Flow	This displays intake air amount. The mass air flow is measured by ECM from the MAF sensor output voltage.
13/37	deg. C	Intake Air Temperature	The IAT is measured by ECM from IAT sensor output voltage. This data is changing by intake air temperature.

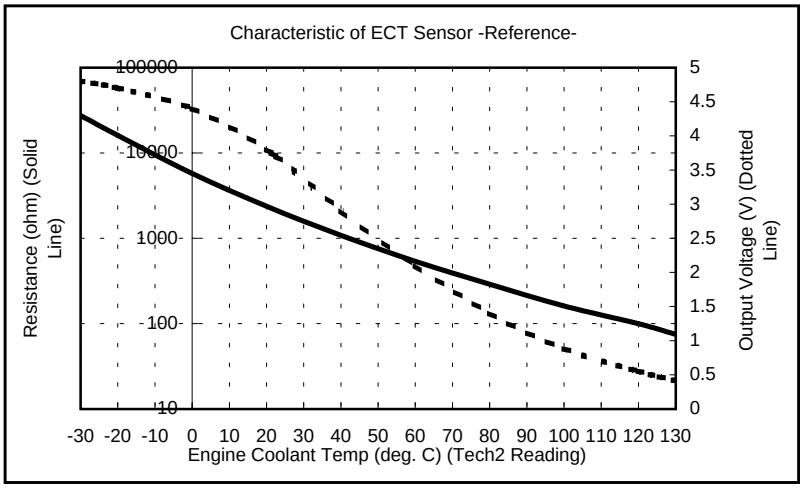
DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0100	7	Mass Air Flow (MAF) Sensor Voltage Supply Circuit High Input	MAF sensor power supply voltage is more than 5.2V.	ECM uses mass air flow 1600mg/strk & EGR 10% conditions as substitute.
	9	Mass Air Flow (MAF) Sensor Voltage Supply Circuit Low Input	MAF sensor power supply voltage is below 4.6V.	
	B	Mass Air Flow (MAF) Sensor Output Circuit Low Input	1. Engine speed is between 600rpm and 5000rpm. 2. MAF sensor output is below -33.7mg/strk.	
	C	Mass Air Flow (MAF) Sensor Output Circuit High Input	1. Engine speed is between 600rpm and 5000rpm. 2. MAF sensor output is more than 1784mg/strk.	
P0110	1	Intake Air Temperature (IAT) Sensor Circuit High Input	IAT sensor output voltage is more than 4.7V.	ECM use 0 deg. C conditions as substitute.
	2	Intake Air Temperature (IAT) Sensor Circuit Low Input	IAT sensor output voltage is below 0.3V.	

ENGINE COOLANT TEMPERATURE (ECT) SENSOR



1. Engine Coolant Temperature (ECT) Sensor
2. Thermo Unit For Water Temperature Gauge

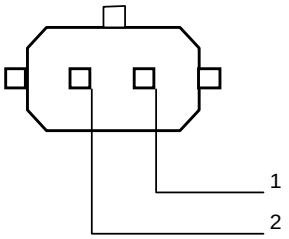


Coolant Temp. (deg. C) (Tech2 Reading)	Output Voltage (V) (Approx.)	Resistance (ohm) (Approx.)
-20	4.7	16100
0	4.4	5760
20	3.8	2370
40	2.9	1080
60	2.1	537
80	1.4	290
100	0.88	161
120	0.55	99.5

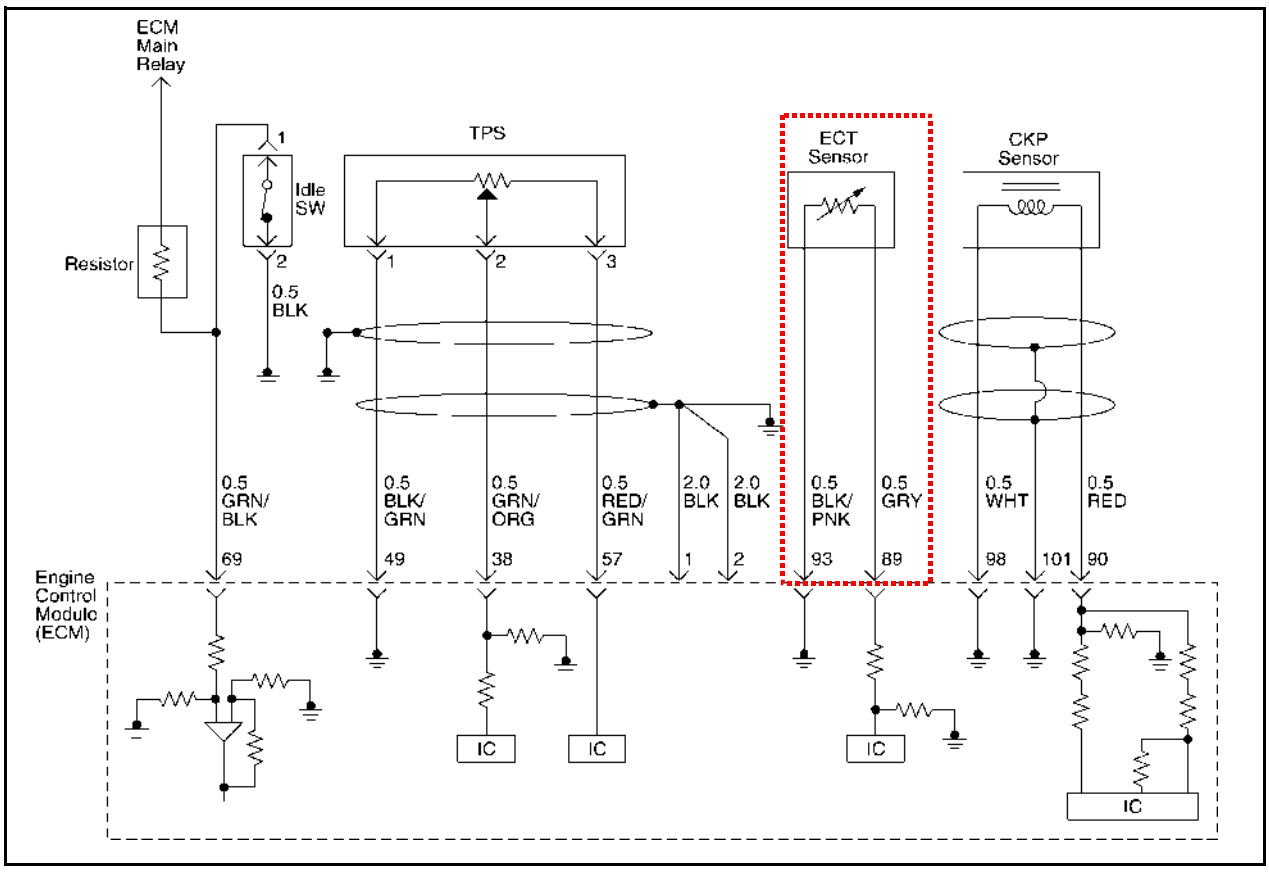
The ECT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. It is installed on the coolant stream. Low coolant temperature produces a high resistance.
The ECM supplies 5 volts signal to the ECT sensor through resisters 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. The ECM uses to this value, and calculates fuel injection timing, injection volume and an EGR control.

The signal from the engine coolant temperature (ECT) sensor can be measured using a multi meter by performing a measurement on terminal 89 of the engine control module (ECM).
20 deg. C: Approximately 3.8V
60 deg. C: Approximately 2.1V
80 deg. C: Approximately 1.4V

ECT Sensor Pin Assignment
(View Looking Sensor Side Connector)



1. ECT Sensor Output to ECM Terminal 89
2. ECT Sensor Ground to ECM Terminal 93



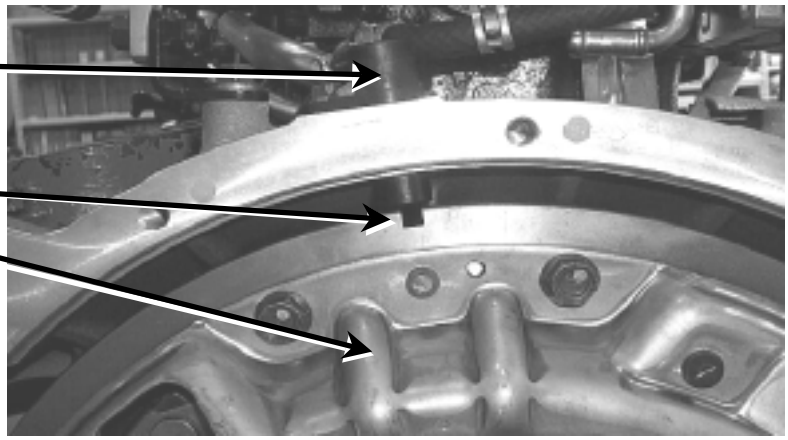
Tech 2 Information

Order	Units	Tech 2 Parameter	Explanation
11/37	deg. C	Coolant Temperature	The ECT is measured by ECM from ECT sensor output voltage. This data is changing by coolant temperature. When the engine is normally warm upped, this data displays approximately 80 deg. C.

DTC Information

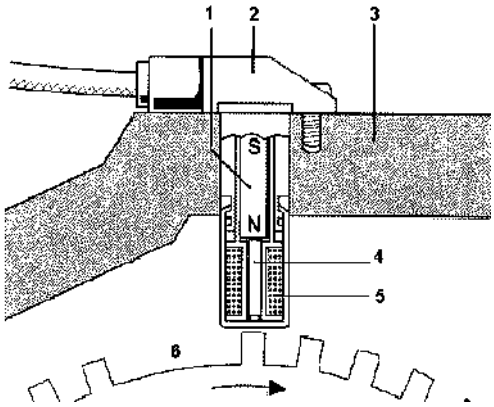
Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0115	1	Engine Coolant Temperature (ECT) Sensor Circuit High Input	ECT sensor output voltage is more than 4.7V.	1. ECM uses fuel temperature as substitute. 2. ECM uses 60 deg. C condition for injection timing control. 3. ECM uses -15 deg. C condition for glow time control.
	2	Engine Coolant Temperature (ECT) Sensor Circuit Low Input	ECT sensor output voltage is below 0.3V.	

CRANKSHAFT POSITION (CKP) SENSOR



1. Crankshaft Position (CKP) Sensor
2. Flywheel with Sensor Slot
3. Clutch Cover

The crankshaft position sensor (CKP) sensor is located on top of the flywheel housing of the flywheel and fixed with a bolt.
The flywheel is added crankshaft position (CKP) sensor pulsar function. The sensor reads the four slots that are incorporated in the flywheel. The CKP sensor located at the flywheel housing uses these slots to generate an inductive signal. This signal is required by the ECM to identify the crankshaft position and the engine speed.

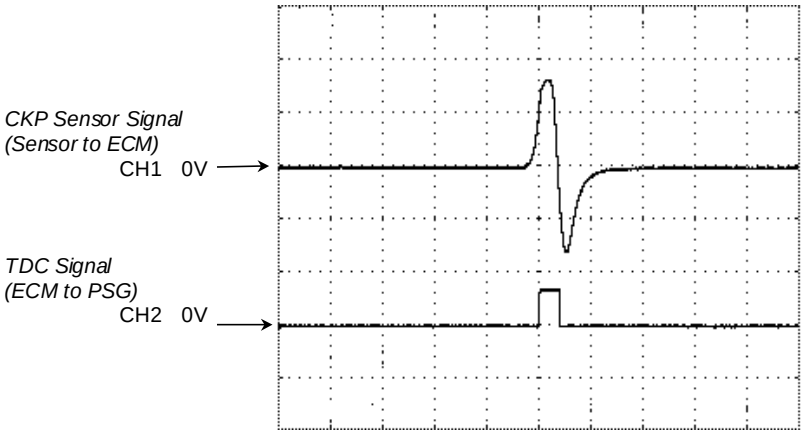


1. Permanent Magnet
2. Housing
3. Flywheel Housing
4. Soft Iron Core
5. Winding
6. Flywheel With Four Gaps

The CKP sensor is of the magnet coil type and is also called an inductive pickup. The CKP sensor consists of a soft iron core, a permanent magnet and coil. The magnetic field responds (collapses and restores) to the passing gap of the sensor disc by generating an AC voltage.
The analogue CKP sensor signal is converted by the engine control module (ECM) into a square wave signal.
The conditioned signal is then provided to the pump control unit (PSG) via engine control module (ECM) terminal 91.

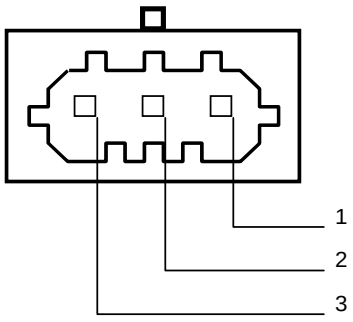
The windings of the coil have a resistance value of approximately 0.9 K ohm at a temperature of 20 deg. C.
The AC voltage generated by the CKP sensor can be measured using a multi meter on terminal 90 and 98 of the ECM. With the engine at idle, the AC voltage indicated on the multi meter is as follows.

Idel: Approximately 0.7V (AC Range)
2000rpm: Approximately 1.1V (AC Range)

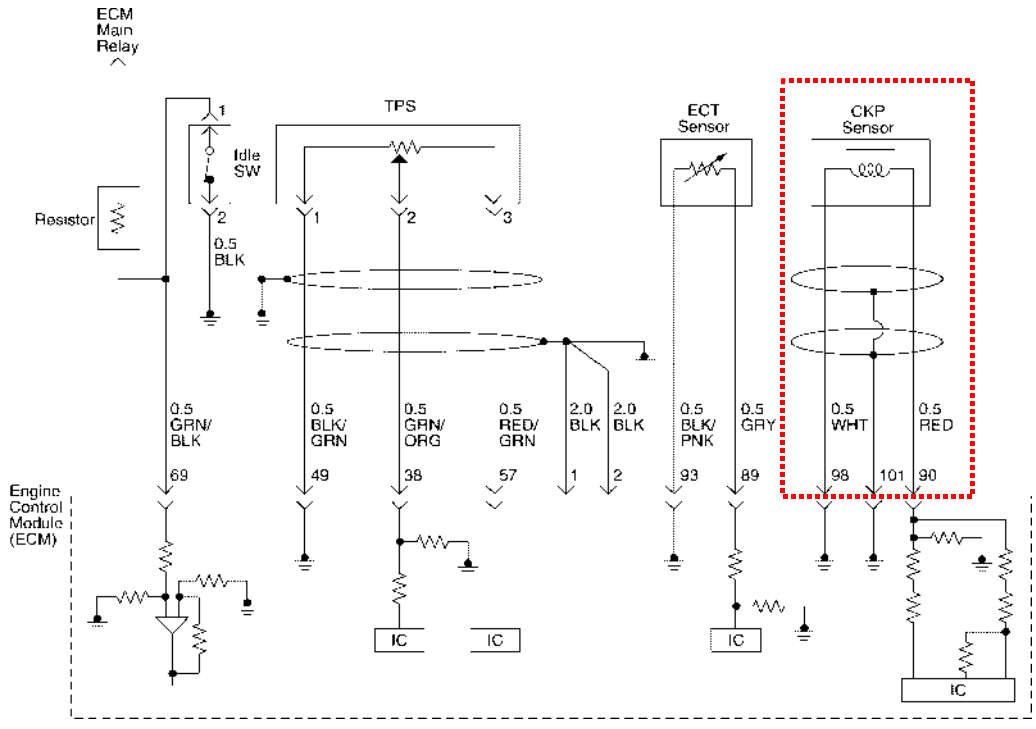


Measurement Terminal: CH1: 90(+) / CH2: 91(+) 2(-)
Measurement Scale: CH1: 20V/div / CH2: 20V/div 500 micro s/div
Measurement Condition: Approximately 2000rpm

CKP Sensor Pin Assignment
(View Looking Sensor Side Connector)



1. CKP Sensor (-) to ECM Terminal 98
2. CKP Sensor (+) to ECM Terminal 90
3. Shield Wire to ECM Terminal 101



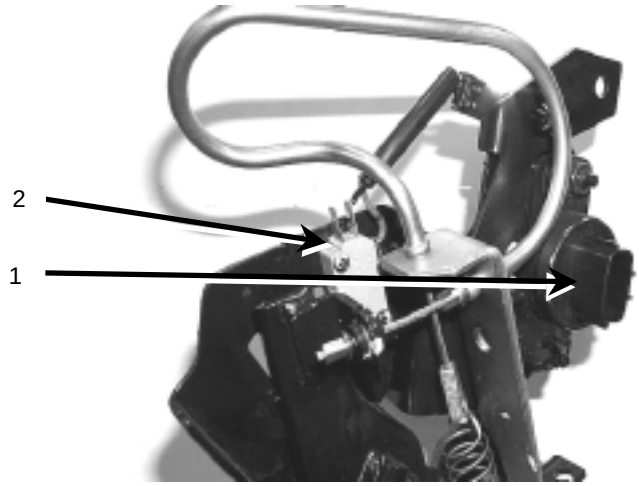
Tech 2 Information

Order	Units	Tech 2 Parameter	Explanation
1/37	rpm	Engine Speed	The engine speed is measured by ECM from the CKP sensor. In the idle, engine speed follows to the desired idle speed.

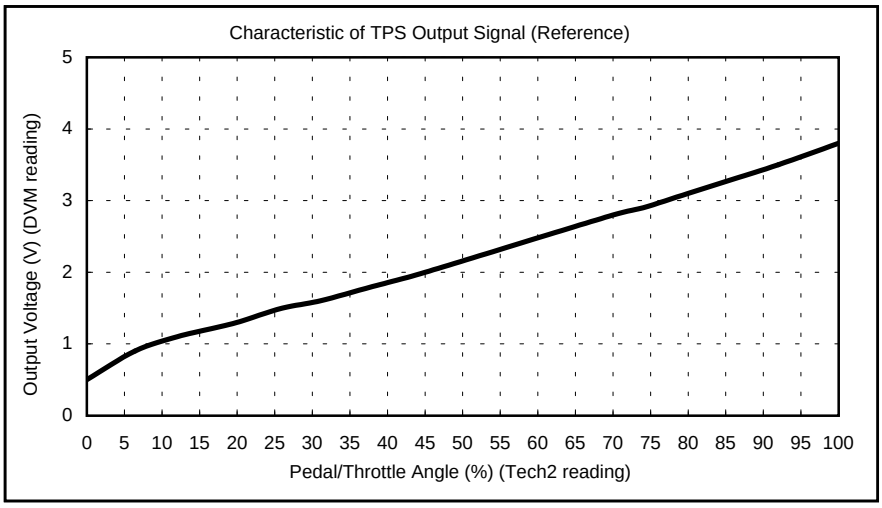
DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0335	B	Crankshaft Position Sensor Circuit Malfunction	1. Engine speed is more than 665rpm. 2. CKP sensor pulse width error.	When pump camshaft speed sensor is OK: ECM uses doubled pump camshaft speed as substitute engine speed. When pump camshaft speed sensor is not OK: 1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.
	D	Crankshaft Position Sensor Circuit Malfunction	1. No pump camshaft speed sensor error. 2. "Crankshaft Position Sensor Circuit Malfunction (Symptom Code B)" is not stored. 3. Engine speed is 0rpm. 4. Doubled pump camshaft speed is more than 50rpm.	When pump camshaft speed sensor is OK: ECM uses doubled pump camshaft speed as substitute engine speed. Other than pump camshaft speed sensor is OK: Fuel injection quantity is reduced.
	E	Engine Speed Input Circuit Range/Performance	Engine speed is more than 5700rpm.	When intermittent malfunction: 1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk. When preliminary malfunction: ECM uses doubled pump camshaft speed as substitute engine speed.
P1335	A	Engine Speed Output Circuit Malfunction	The PSG (pump control unit) is recognized defective engine speed signal form the ECM.	Fuel injection quantity is reduced.

PEDAL/THROTTLE POSITION SENSOR (TPS)



1. Pedal/Throttle Position Sensor (TPS)
2. Idle Switch

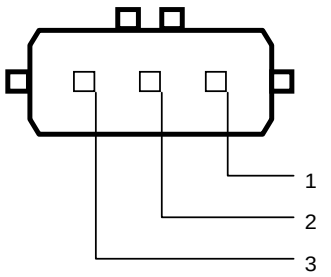


The TPS is a potentiometer connected to throttle shaft on the throttle body. It is installed to the main TPS and idle switch.

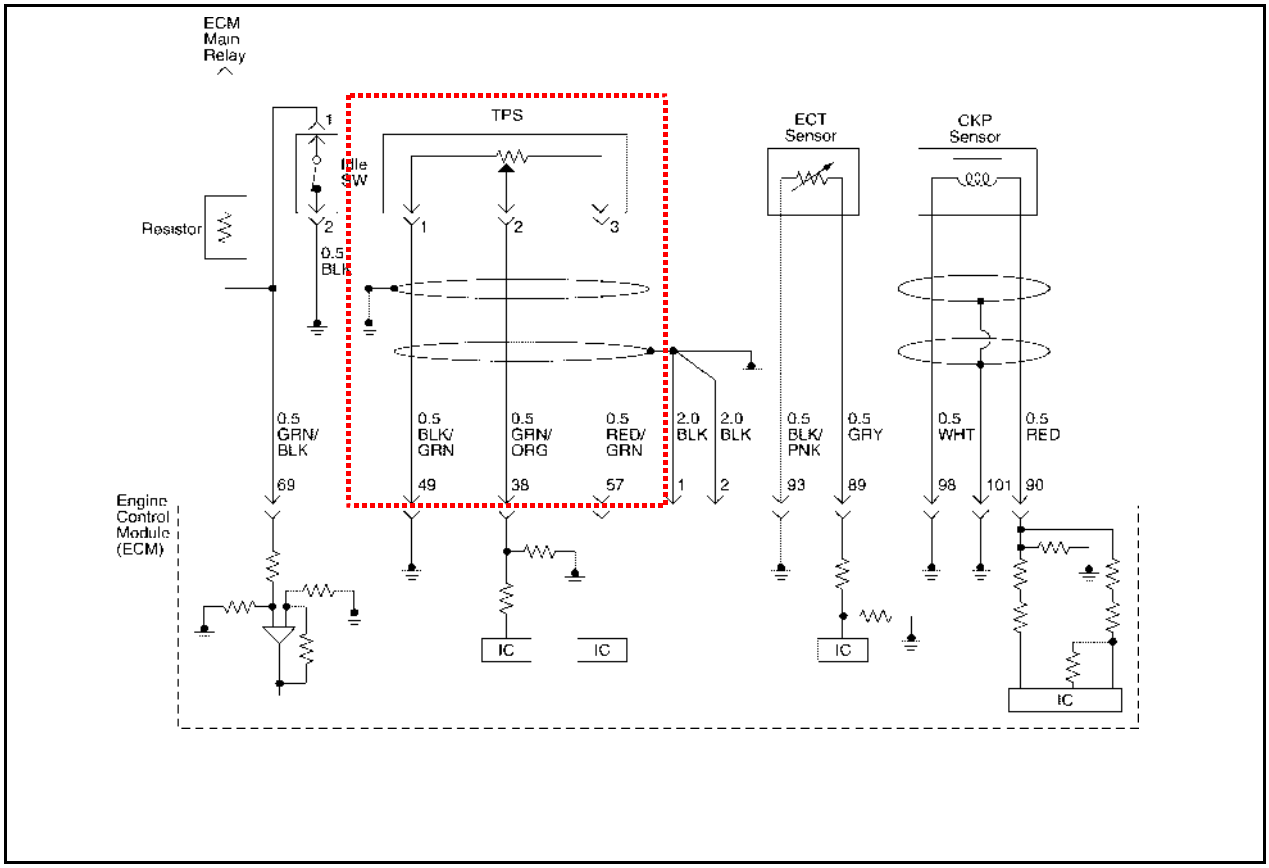
The engine control module (ECM) monitors the voltage on the signal line and calculates throttle position. As the throttle valve angle is changed when accelerator pedal moved. The TPS signal also changed at a moved throttle valve. As the throttle valve opens, the output increases so that the output voltage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

The engine control module (ECM) calculates fuel delivery based on throttle valve angle.

TPS Pin Assignment
(View Looking Sensor Side Connector)



1. TPS +5V Supply Voltage from ECM Terminal 49
2. TPS Signal Output to ECM Terminal 38
3. TPS Ground to ECM Terminal 57



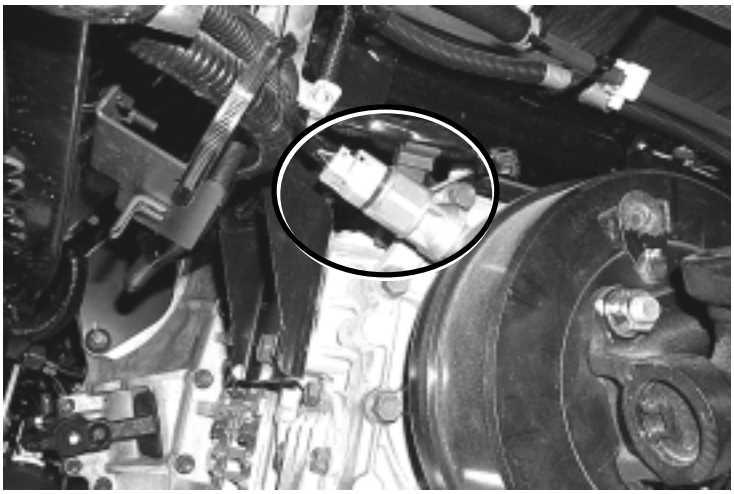
Tech 2 Information

Order	Units	Tech 2 Parameter	Explanation
4/37	%	Accelerator Position Signal	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.
15/37	Active/ Inactive	Idle Switch	This displays operating status of the idle switch. This should display "Active" when the idle condition.

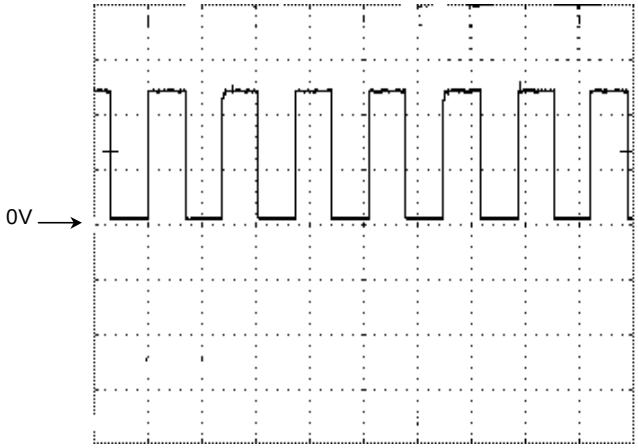
DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P1120	1	Pedal/Throttle Position Sensor Circuit High Input	Throttle position sensor output voltage is more than 4.9V.	ECM increases idle speed up to 1400rpm.
	2	Pedal/Throttle Position Sensor Circuit Low Input	Throttle position sensor output voltage is below 0.3V.	
	7	Pedal/Throttle Position Sensor Voltage Supply Circuit High Input	Throttle position sensor power supply voltage is more than 5.2V.	
	9	Pedal/Throttle Position Sensor Voltage Supply Circuit Low Input	Throttle position sensor power supply voltage is below 4.6V.	
	D	Pedal/Throttle Position Sensor Brake Switch Error	1. Engine speed is more than 1700rpm. 2. Throttle position sensor is more than 18%. 3. When brake pedal is depressed during accelerator pedal is depressing.	
	E	Pedal/Throttle Position Sensor Idle Position Switch Error	When idle switch is tuned on, throttle position sensor was more than 18%.	

VEHICLE SPEED SENSOR (VSS)



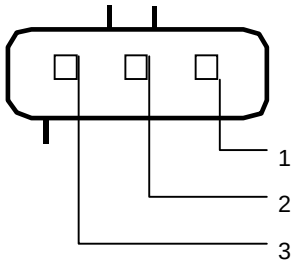
Vehicle Speed Sensor (VSS)



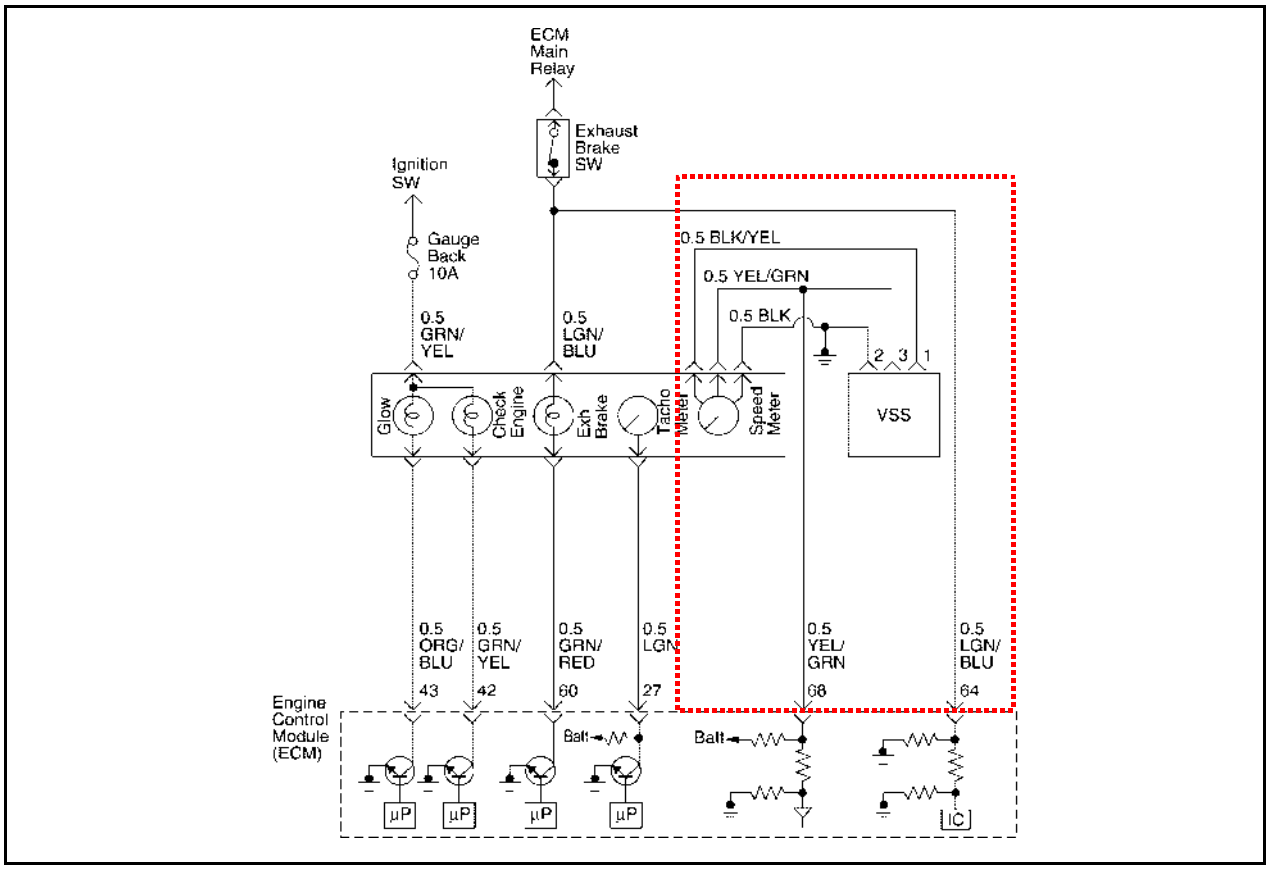
Measurement Terminal: 68(+) 1(-)
Measurement Scale: 5V/div 50ms/div
Measurement Condition: Approximately 20km/h

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 "gauge back" fuse.
The engine control module (ECM) calculates the vehicle speed by VSS.

VSS Pin Assignment
(View Looking Sensor Side Connector)



1. VSS +12V Supply from Vehicle Speed Meter
2. VSS Ground to Vehicle Speed Meter
3. VSS Output Signal to Vehicle Speed Meter & ECM Terminal 68



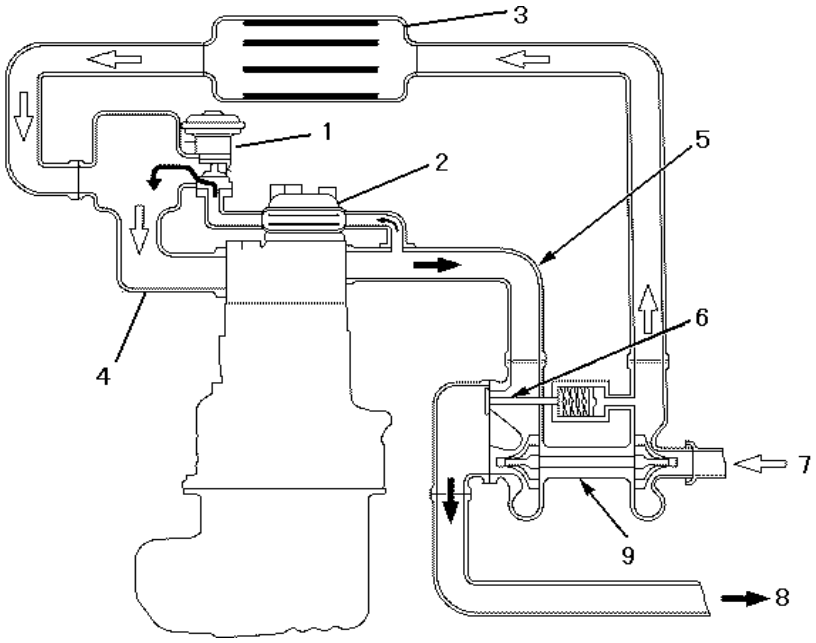
Tech 2 Information

Order	Units	Tech 2 Parameter	Explanation
2/37	km/h	Vehicle Speed	This displays vehicle speed. The vehicle speed is measured by ECM from the vehicle speed sensor.

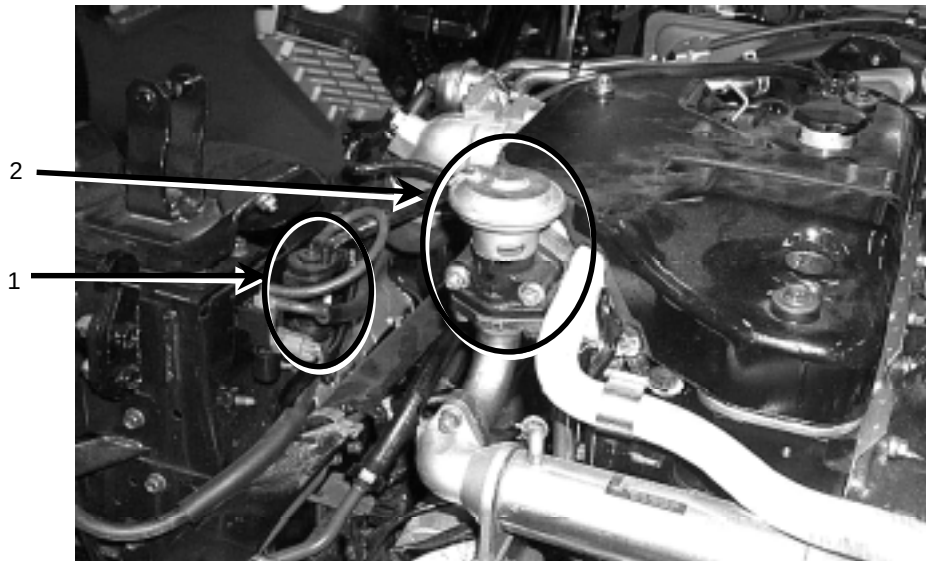
DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0500	1	Vehicle Speed Sensor Circuit High Input	Vehicle speed is more than 190km/h.	ECM uses vehicle speed 5km/h condition as substitute.
	A	Vehicle Speed Sensor Input Signal Frequency Too High	Input signal frequency is too high.	ECM uses vehicle speed 5km/h condition as substitute.
	B	Vehicle Speed Sensor Incorrect Signal	1. Engine speed is more than 3600rpm. 2. Fuel injection quantity is more than 41mg/stk. 3. Vehicle speed is below 1.5km/h.	Fuel injection quantity is reduced.

EGR (EXHAUST GAS RE-CIRCULATION)

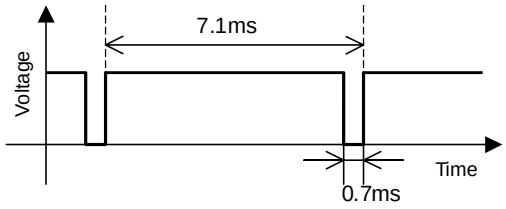


1. EGR Valve
2. EGR Cooler
3. Intercooler
4. Intake Manifold
5. Exhaust Manifold
6. Waste Gate
7. Fresh Air
8. Exhaust Gas
9. Turbocharger

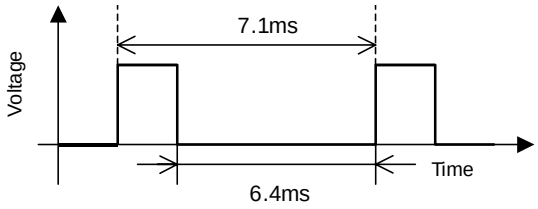


1. EGR EVRV
2. EGR Valve

The 4JH1-TC engine is equipped with the EGR cooler. The EGR cooler reduces the temperature of the air being drawn into the engine and the combustion temperature. This results in reducing nitrogen oxide (Nox) emissions.
The amount of EGR is controlled by EVRV (electrical vacuum regulating valve) via the engine control module (ECM) command signal depends on the following inputs.
-Engine speed
-Injection quantity
-Mass air flow
-Intake air temperature
-Coolant temperature
-Barometric pressure



Off duty 10% =EGR Pulse Ratio 10%

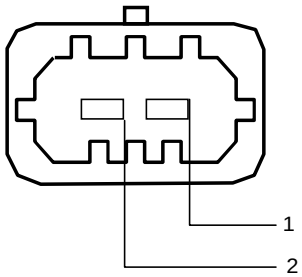


Off duty 70% =EGR Pulse Ratio 70%

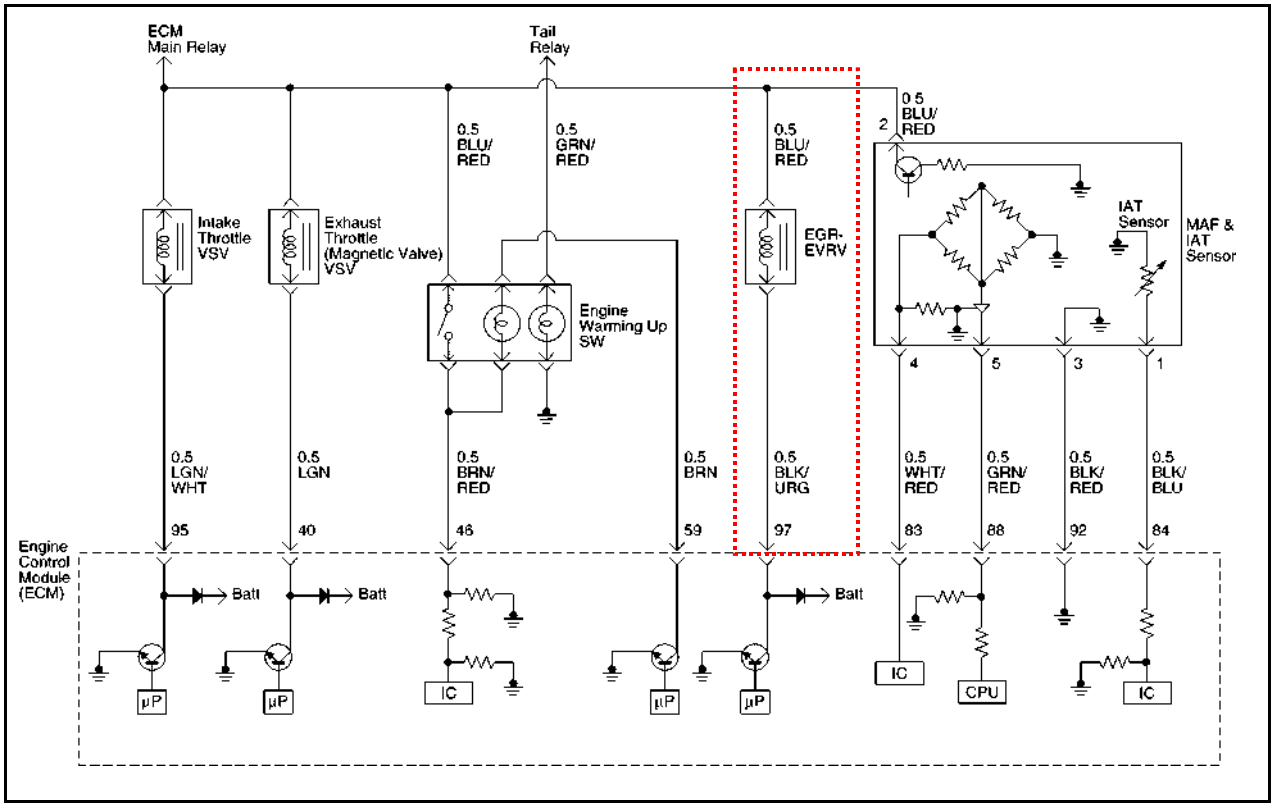
The EVRV is shaped to control vacuum applied to the diaphragm chamber of the EGR valve based on duty signal sent from the ECM. The duty ratio is the time that the EVRV is opened to one cooperate EVRV operating cycle. A duty ratio change of 70% to 10 % is EGR amount control.

The EVRV solenoid coil have a resistance value of approximately 14 ohm at a temperature of 20 deg. C.

EGR EVRV Pin Assignment
(View Looking EVRV Side Connector)



1. EVRV Signal from ECM Terminal 97
2. EVRV +12V Supply from ECM Fuse via ECM Relay



Tech 2 Information

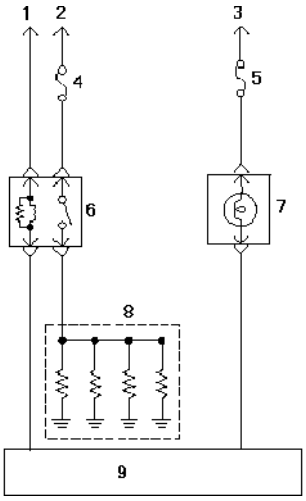
Order	Units	Tech 2 Parameter	Explanation
31/37	%	EGR Pulse Ratio	This displays the duty signal from the ECM to control the EGR flow amount.

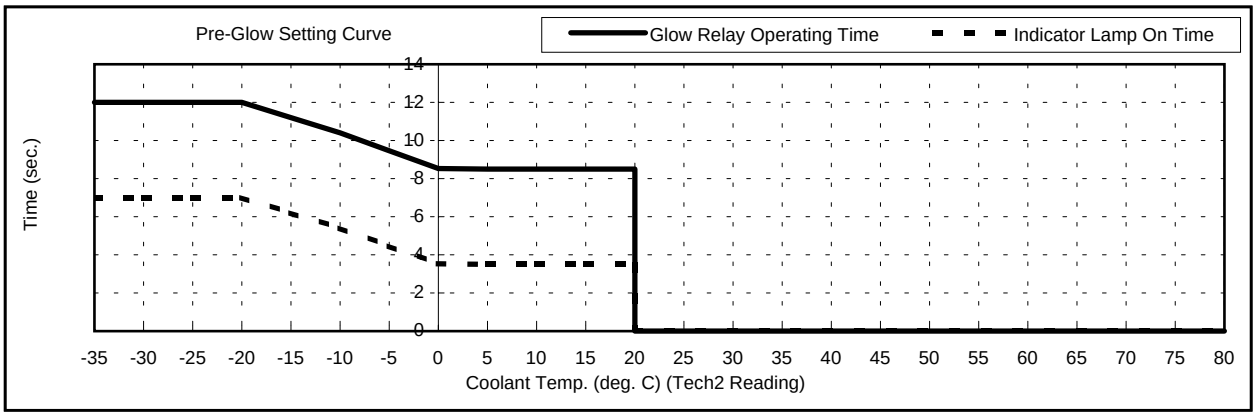
DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0400	3	Exhaust Gas Recirculation Flow Excessive Detected	1. Intake air temperature is between 16 deg. C and 34 deg. C. 2. Engine coolant temperature is between 70 deg. C and 100 deg. C. 3. Barometric pressure is between 880hpa and 1100hpa. 4. Small amount of mass air flow. (Desired mass air flow - mass air flow is more than 150mg/strk)	Fuel injection quantity is reduced.
	4	Exhaust Gas Recirculation Circuit Short to Ground or Open Circuit	EGR EVRV circuit open or short to ground circuit.	Fuel injection quantity is reduced and EGR EVRV 10% conditions as substitute.
	5	Exhaust Gas Recirculation Flow Insufficient Detected	1. Intake air temperature is between 16 deg. C and 34 deg. C. 2. Engine coolant temperature is between 70 deg. C and 100 deg. C. 3. Barometric pressure is between 880hpa and 1100hpa. 4. Large mount of mass air flow. (Desired mass air flow - mass air flow is below 150 mg/strk)	Fuel injection quantity is reduced.
	8	Exhaust Gas Recirculation Circuit Short to Battery	EGR EVRV circuit short to voltage circuit.	Fuel injection quantity is reduced & EGR EVRV 10% conditions as substitute.

QUICK ON SYSTEM 2 (QOS 2)

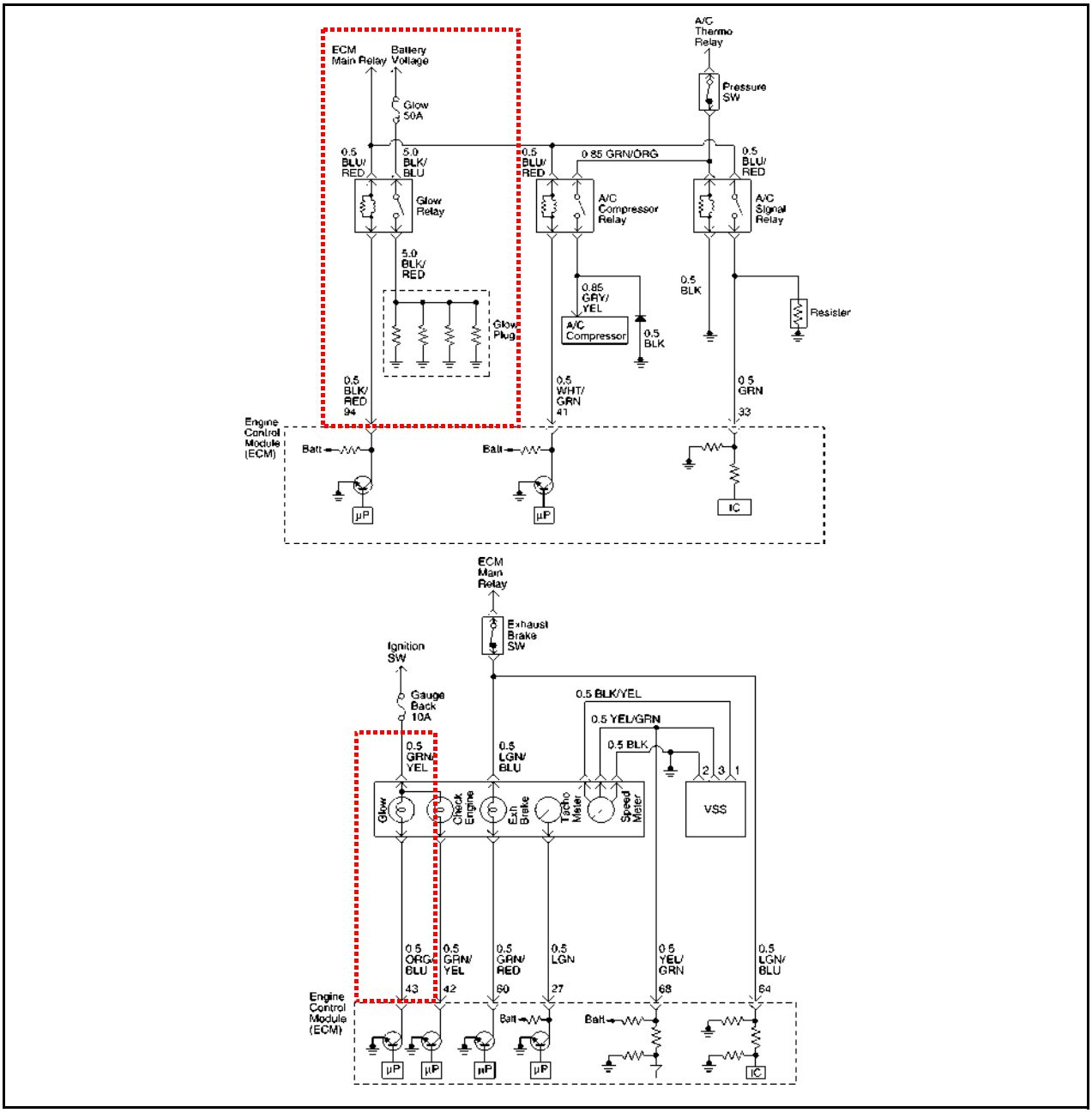
1. ECM Main Relay
2. Battery Voltage
3. Ignition Switch
4. Glow Fuse 50A
5. Gauge Back Fuse 10A
6. Glow Relay
7. Glow Indicator Lamp
8. Glow Plug
9. Engine Control Unit (ECM)





The 4JH1-TC engine is adopted with the quick on system 2 (QOS 2) preheating system which is controlled by engine control module (ECM).
The voltage on the coil of the relay glow plug is supplied by the relay engine control module (ECM) main. The ECM switches glow relay to operate glow plug depends on the coolant temperature.

The function of the glow time indicator lamp is to inform the driver whether the glow system is activated.
When the lamp extinguishes the engine can be started. This does not imply that the glow plugs are no longer activated. In the after glow phase the lamp is not illuminated but the glow plugs remain active for a certain period depending on engine coolant temperature.



Tech 2 Information

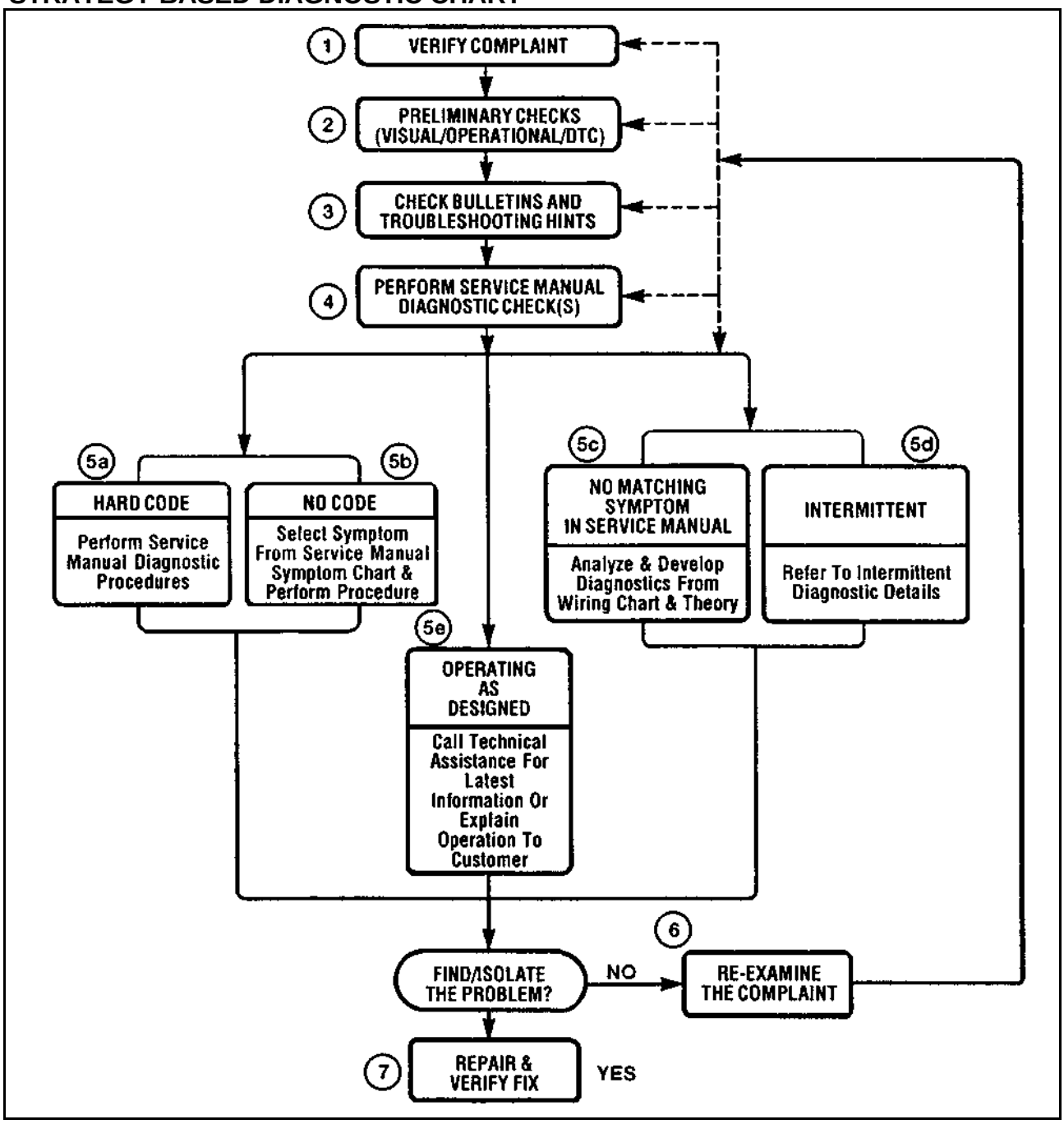
Order	Units	Tech 2 Parameter	Explanation
26/37	Active 0V/ Inactive 12V	Glow Time Relay	This displays operating status for the glow relay. This should display "Inactive 12V" when the engine is warm upped.
28/37	On/Off	Glow Time Telltale	This displays operating status for the glow indicator lamp. This should display "On" when the glow lamp is turned on.

DTC Information

Code	Symptom Code	DTC Name	DTC Setting Condition	Fail-Safe (Back-up)
P0380	4	Glow Relay Circuit Voltage Low	Glow relay circuit open or short to ground circuit.	No fail-safe function.
	8	Glow Relay Circuit Voltage High	Glow relay circuit short to voltage circuit.	
P0381	4	Glow Plug Indicator Circuit Voltage Low	Glow plug indicator circuit open or short to ground circuit.	No fail-safe function.
	8	Glow Plug Indicator Circuit Voltage High	Glow plug indicator circuit short to voltage circuit.	

STRATEGY BASED DIAGNOSTIC

STRATEGY BASED DIAGNOSTIC CHART



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 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 provides you with guidance as you create and follow a plan of action for each specific diagnostic situation.

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

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. https://www.einet.isuzu.co.jp//

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 of 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 and 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 of grounds
• Corrosion and wire damage:
– Open/high resistance in terminals, splices, connectors of 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 no 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, intermittence 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 take 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 take 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 form 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

DIAGNOSIS WITH TECH 2

IF NO CODES ARE SET

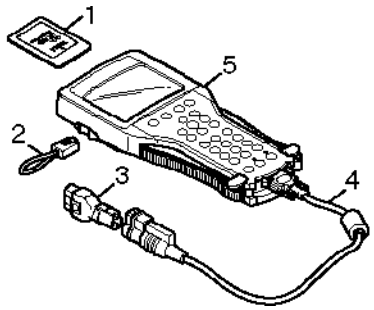
- Refer to **F1: Data Display** and identify the electrical faults that are not indicated by trouble code.
- Refer to "**SYMPTOM DIAGNOSIS"**.

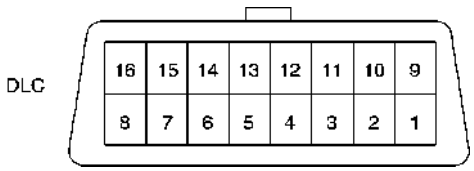
IF CODES ARE SET

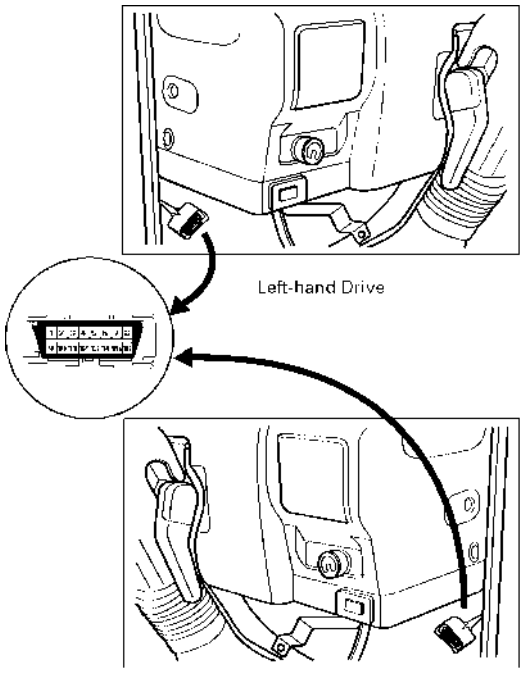
1. Record all trouble codes displayed by Tech 2 and check id the codes are intermittent.
2. Clear the codes.
3. Drive the vehicle for a test to reproduce the faulty status.
4. Check trouble codes again using the Tech 2.
5. If no codes is displayed by test driving, the fault is intermittent. In this case, 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

1. PCMCIA Card
2. Loop Back Connector
3. SAE 16/19 Connector
4. DLC Cable
5. Tech2

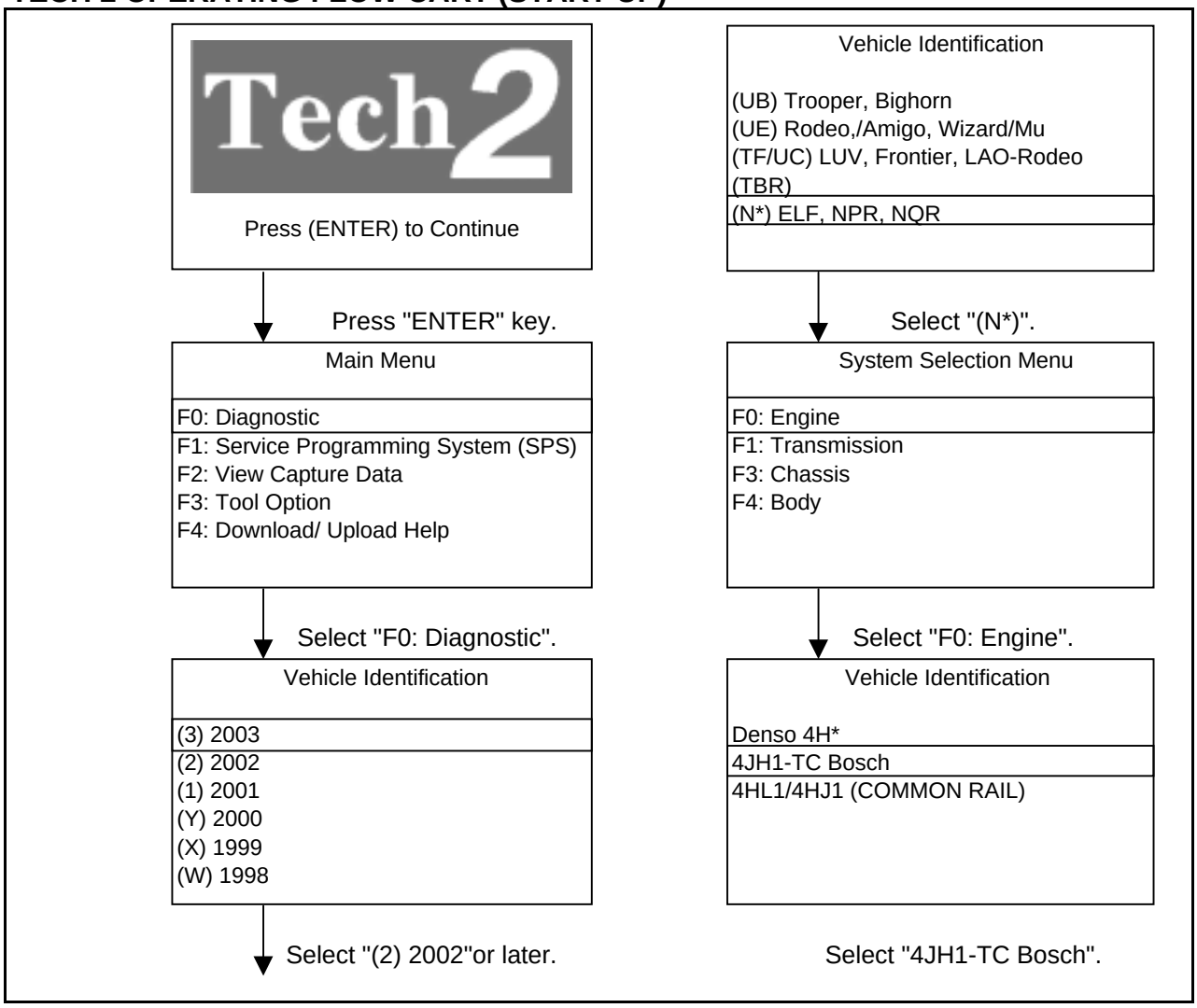






Data Link Connector Location

TECH 2 OPERATING FLOW CART (START UP)



Select "4JH1-TC Bosch" in Vehicle Identification menu and the following table is shown in the Tech 2 screen.

F0: Diagnostic Trouble Codes
- F0: Read DTC Infor As Stored By ECU
- F1: Clear DTC Information

F1: Data Display

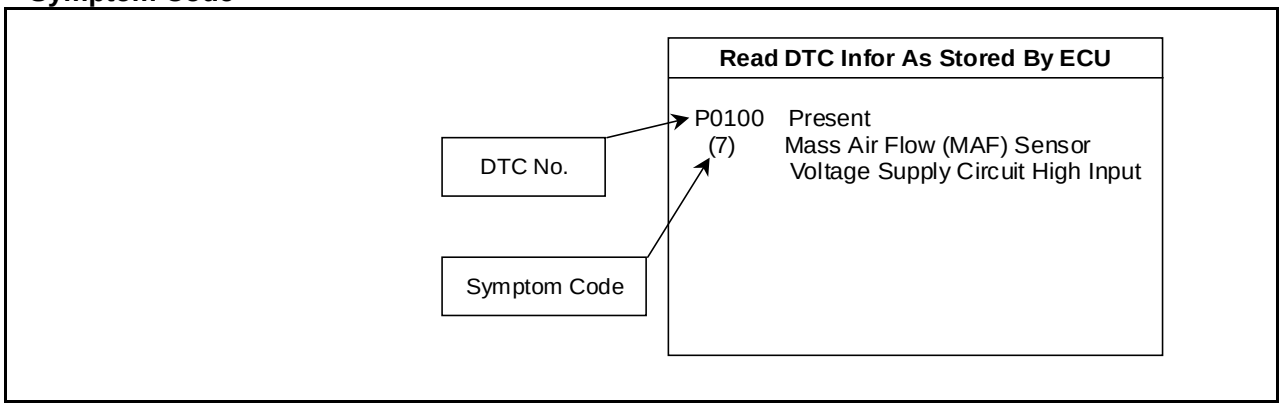
F2: Snapshot

F3: Actuator Test
- F0: Engine Telltale (Check Light) Test

F4: Programming
- F0: Program VIN
- F1: Lock ECU

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.

*** Symptom Code**



This number or alphabet means identification of the malfunction. Each DTC includes plural symptoms, such as DTC P0100 has four kinds of symptom code (7), (9), (B) and (C). DTC chart (check procedure) is separated depending on the symptom code.

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

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

	Tech 2 Parameter	Units	Idle	1500rpm	2000rpm	Definition
1	Engine Speed	rpm	675 - 725	1475 - 1525	1975 - 2025	The engine speed is measured by ECM from the CKP sensor.
2	Vehicle Speed	km/h / MPH	0	0	0	This displays vehicle speed. The vehicle speed is measured by ECM from the vehicle speed sensor.
3	Pump Speed	rpm	335 - 375	725 - 775	975 - 1025	This displays injection pump speed. The injection speed is measured by ECM from the pump cam sensor.
4	Accelerator Position Signal	%	0	17 - 21	20 - 24	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.
5	Mass Air Flow Sensor	mg/strk	520 - 600	800 - 840	860 - 900	This displays calculated intake air volume for one cylinder stroke. The mass air flow is measured by ECM from the MAF sensor output voltage.
6	Barometric Pressure	hpa	990 - 1015	990 - 1015	990 - 1015	The barometric pressure is measured by ECM from the sensor in the ECM. This data is changing by altitude.
7	Desired Injection Quantity	mg/stk	10 - 12	8 - 12	10 - 14	This displays desired value from the ECM. The ECM compensates for fuel rate to basic rate.
8	Injection Quantity	mg/stk	10 - 12	8 - 12	10 - 14	This displays actual fuel quantity. The PSG controls high pressure solenoid valve to meet commanded value from the ECM.
9	Desired Fuel Injection Start	deg. CA	3 - 5	4 - 7	5 - 8	This displays desired injection timing from the ECM. The ECM compensates for fuel injection timing by throttle position and various sensor signal.
10	Actual Injection Start	deg. CA	3 - 5	4 - 7	5 - 8	This displays calculated actual injection timing based on CKP signal and pump cam signal. The PSG controls TCV duty ratio to meet desired injection timing from the ECM.
11	Coolant Temperature	deg. C / deg. F	80 - 85	80 - 85	80 - 85	The ECT is measured by ECM from ECT sensor output voltage. This data is changing by coolant temperature. When the engine is normally warm upped, this data displays approximately 80 deg. C.
12	Fuel Temperature	deg. C / deg. F	25 - 50	25 - 50	25 - 50	The FT is measured by PSG from FT sensor. This data is changing by fuel temperature.
13	Intake Air Temperature	deg. C / deg. F	25 - 50	25 - 50	25 - 50	The IAT is measured by ECM from IAT sensor output voltage. This data is changing by intake air temperature.
14	Ignition Status	On12V/ Off0V	On 12V	On 12V	On 12V	This displays the key switch status indicated by the ECM with key switch signal. This should display "Off 0V" at key OFF and "On12V" at key ON.

	Tech 2 Parameter	Units	Idle	1500rpm	2000rpm	Definition
15	Idle Switch	Active/ Inactive	Active	Inactive	Inactive	This displays operating status of the idle switch. This should display "Active" when the idle condition.
16	Brake Switch 1	Active/ Inactive	Inactive	Inactive	Inactive	This displays operating status of the brake switch. This should display "Active" when the brake pedal is stepped on.
17	Brake Switch 2	Active/ Inactive	Inactive	Inactive	Inactive	This displays operating status of the brake switch. This should display "Active" when the brake pedal is stepped on.
18	Clutch Switch	Active/ Inactive	Inactive	Inactive	Inactive	This displays operating status of the clutch switch. This should display "Active" when the clutch pedal is stepped on.
19	Neutral Switch	On/Off	On	On	On	This displays operating status of the neutral switch. This should display "On" when the gear position is neutral.
20	A/C Information Switch	Active 12V/ Inactive 0V	Inactive 0V	Inactive 0V	Inactive 0V	This displays the air conditioner request signal. This should display "Active 12V" when the air conditioner switch is switched on.
21	Exhaust Brake Switch	On/Off	Off	Off	Off	This displays operating status of the exhaust brake switch. This should display "On" when the exhaust brake switch is turned on.
22	Diagnostic Request	Active 0V/ Inactive 12V	Inactive 12V	Inactive 12V	Inactive 12V	This displays the diagnostic request signal. This should display "Inactive 12V" when the Tech 2 is connected.
23	QWS Switch	Off 0V/ On 12V	Off 0V	Off 0V	Off 0V	This displays operating status of the QWS switch. This should display "On 12V" when the QWS is activated on.
24	System Voltage	V	11 - 14	11 - 14	11 - 14	This displays the system voltage measured by the ECM at ignition feed.
25	Main Relay	Active/ Inactive	Active	Active	Active	This displays operating status for the ECM main relay. This should display "Active" when the key switch is turned on and while engine is running.
26	Glow Time Relay	Active 0V/ Inactive12V	Inactive 12V	Inactive 12V	Inactive 12V	This displays operating status for the glow relay. This should display "Inactive 12V" when the engine is warm upped.
27	Check Engine Lamp	On/Off	Off	Off	Off	This displays operating status for the Check Engine Lamp. This should display "On" when the Check Engine Lamp is turned on.
28	Glow Time Telltale	On/Off	Off	Off	Off	This displays operating status for the glow indicator lamp. This should display "On" when the glow lamp is turned on.

	Tech 2 Parameter	Units	Idle	1500rpm	2000rpm	Definition
29	ABS Input Signal	On/Off	Off	Off	Off	
30	ABS Output Signal	On/Off	On	On	On	
31	EGR Pulse Ratio (Exhaust Gas Recirculation)	%	70	30	30	This displays the duty signal from the ECM to control the EGR flow amount.
32	EGR Command (Exhaust Gas Recirculation)	mg/strk	500	1300 - 1400	1500 - 1600	This displays calculated EGR volume for one cylinder stroke from the ECM. This data is changing with EVRV operation.
33	Intake Manifold Valve	Active/ Inactive	Inactive	Inactive	Inactive	This displays operating status of the intake throttle. This should display "Active" when the intake throttle VSV is operated.
34	Exhaust Brake Valve	Active/ Inactive	Inactive	Inactive	Inactive	This displays operating status of the exhaust throttle. This should display "Active" when the exhaust throttle VSV is operated.
35	Desired Engine Idle Speed	rpm	700	700	700	The desired engine idle speed that the ECM commanding. The ECM compensates for various engine loads based on engine coolant temperature.
36	Start of Delivery	deg. CA	22 - 26	20 - 25	22 - 26	This displays start timing of fuel delivery.
37	A/C Request	Active 0V/ Inactive 12V	Inactive 12V	Inactive 12V	Inactive 12V	This displays operating status of the A/C compressor. This should display "Active 0V" when the compressor relay is operated.

SNAPSHOT ANALYSIS

SNAPSHOT DISPLAY WITH TIS2000

TIS2000 Screen

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.

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.

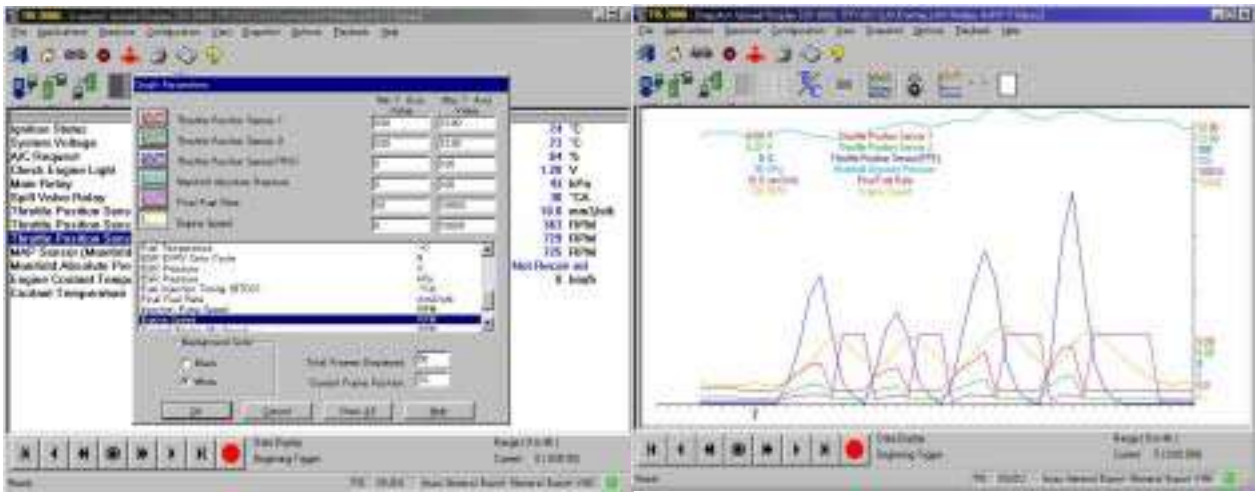
Snapshot is stored in the PC hard disk or floppy disk, and can be displayed any time.
Stored snapshot can be displayed by the below procedures.

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 nest 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, drug 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.

DIAGNOSTIC TROUBLE CODE

Flash Code	Code	Symptom Code	MIL	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
65	P0100	7	ON	Mass Air Flow (MAF) Sensor Voltage Supply Circuit High Input	MAF sensor power supply voltage is more than 5.2V.	ECM uses mass air flow 1600mg/strk & EGR 10% conditions as substitute.	MAF sensor power supply voltage is below 5.2V.	1. Sensor power supply circuit short to battery voltage circuit. 2. MAF sensor malfunction. 3. ECM malfunction.	83	-
		9	ON	Mass Air Flow (MAF) Sensor Voltage Supply Circuit Low Input	MAF sensor power supply voltage is below 4.6V.		MAF sensor power supply voltage is more than 4.6V.	1. Sensor power supply circuit short to ground circuit. 2. MAF sensor malfunction. 3. ECM malfunction.	83	-
		B	ON	Mass Air Flow (MAF) Sensor Output Circuit Low Input	1. Engine speed is between 600rpm and 5000rpm. 2. MAF sensor output is below -33.7mg/strk.		MAF sensor output is more than -27.4mg/strk.	1. Sensor power supply circuit open circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Sensor heater harness open circuit. 4. Poor connector connection. 5. MAF sensor malfunction. 6. ECM malfunction.	83/ 88	P0110(1)
		C	ON	Mass Air Flow (MAF) Sensor Output Circuit High Input	1. Engine speed is between 600rpm and 5000rpm. 2. MAF sensor output is more than 1784mg/strk.		MAF sensor output is below 1784mg/strk.	1. Sensor signal circuit short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. MAF sensor malfunction. 4. ECM malfunction.	88/ 92	P0110(1)
23	P0110	1	ON	Intake Air Temperature (IAT) Sensor Circuit High Input	IAT sensor output voltage is more than 4.7V.	ECM use 0 deg. Cconditions as substitute.	IAT sensor output voltage is below 4.7V.	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.	84/ 92	P0100(B)/ P0100(C)
		2	ON	Intake Air Temperature (IAT) Sensor Circuit Low Input	IAT sensor output voltage is below 0.3V.		IAT sensor output voltage is more than 0.3V.	1. Sensor signal circuit short to ground circuit. 2. IAT sensor malfunction. 3. ECM malfunction.	84	-
14	P0115	1	ON	Engine Coolant Temperature (ECT) Sensor Circuit High Input	ECT sensor output voltage is more than 4.7V.	1. ECM uses fuel temperature as substitute. 2. ECM uses 60 deg. C condition for injection timing control. 3. ECM uses -15 deg. C condition for glow time control.	ECT sensor output voltage is below 4.7V.	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.	89/ 93	-
		2	ON	Engine Coolant Temperature (ECT) Sensor Circuit Low Input	ECT sensor output voltage is below 0.3V.		ECT sensor output voltage is more than 0.3V.	1. Sensor signal circuit short to ground circuit. 2. ECT sensor malfunction. 3. ECM malfunction.	89	-
15	P0180	B	ON	Fuel Temperature Sensor Circuit Range/Performance	FT sensor output is high temperature (more than 150 deg. C) or low temperature (below -40 deg. C).	The ECM use 75 deg. C conditions as substitute.	FT sensor output is correct temperature range between 150 deg. C and -40 deg. C.	1. ECM malfunction. 2. PSG (pump control unit) malfunction.	-	-

Flash Code	Code	Symptom Code	MIL	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
52	P0215	A	ON at next ignition cycle	Fuel Cutoff Solenoid Valve Malfunction	1. Ignition key switch off. 2. Engine speed is below 1500rpm. 3. Vehicle speed is below 1.5km/h. 4. PSG (pump control unit) recognizes MAB (fuel cutoff solenoid valve) signal from the ECM, but the MAB could not operate.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	No recovery until condition match in the next ignition key cycle.	1. PSG (pump control unit) malfunction. 2. MAB (fuel cutoff solenoid valve) malfunction.	-	-
		B	ON	Fuel Cutoff Solenoid Valve Circuit High Input	ECM does not command MAB (fuel cutoff solenoid valve) signal to the PSG (pump control unit), but PSG detected MAB signal line circuit is high level.	Engine does not start.	No recovery.	1. MAB (fuel cutoff solenoid valve) signal circuit short to voltage circuit. 2. PSG (pump control unit) malfunction.	105	-
		C	ON	Fuel Cutoff Solenoid Valve Always Active	1. Ignition key switch off. 2. Engine speed is below 1500rpm. 3. Vehicle speed is below 1.5km/h. 4. PSG (pump control unit) does not recognize MAB (fuel cutoff solenoid valve) signal from the ECM.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	No recovery until condition match in the next ignition key cycle.	1. MAB (fuel cutoff solenoid valve) signal circuit open or short to ground circuit. 2. PSG (pump control unit) malfunction.	105	-
		D	ON	Fuel Cutoff Solenoid Valve Malfunction	1. Ignition key switch off. 2. CAN controller does not operate Bus-off.	No fail-safe function.		1. ECM malfunction. 2. PSG (pump control unit) malfunction.	-	-
54	P0216	A	ON	Injection Timing Control Circuit Malfunction (Timer Deviation)	1. Engine speed is more than 700rpm. 2. Fuel injection quantity is more than 4mg/stk. 3. Deviation of actual injection timing and desired injection timing is more than +3 deg. CA or -6 deg. CA for 8 seconds.	Fuel injection quantity is reduced.	Deviation of actual injection timing and desired injection timing is below +3 deg. CA or -6 deg. CA for 8 seconds.	1. Timing control valve malfunction. 2. Timer piston sticking. 3. Pump camshaft speed sensor malfunction.	-	-
		B	ON	Injection Timing Control Circuit Malfunction (Timer Fluctuation)	1. Engine speed is more than 2014rpm. 2. Fluctuation of actual injection timing is more than ±5.2 deg. CA.		1. Engine speed is more than 2014rpm. 2. Fluctuation of actual injection timing is below ±5.2 deg. CA.	1. Insufficient air bleeding of fuel line. 2. Fuel filter clogging. 3. Timing control valve malfunction. 4. Pump camshaft speed sensor malfunction.	-	-
53	P0251	6	ON	Injection Pump Malfunction	1. No pump camshaft speed sensor error. 2. High pressure solenoid valve control pulse width does not match with desired fuel injection quantity.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	No recovery until condition match in the next ignition key cycle.	1. PSG (pump control unit) malfunction. 2. Pump camshaft speed sensor malfunction.	-	-
		7	ON	Injection Pump Malfunction	1. No pump camshaft speed sensor error. 2. No CKP sensor error. 3. Difference of engine speed and doubled pump camshaft speed is more than 800rpm.		1. No pump camshaft speed sensor error. 2. No CKP sensor error. 3. Difference of engine speed and doubled pump camshaft speed is below 800rpm. No recovery until in the next ignition key cycle.	1. Missing CKP sensor pulses. 2. Electrical interference. 3. Magnetic interference. 4. PSG (pump control unit) malfunction.	91	-
		9	ON	Injection Pump Malfunction	No pump map programmed in the PSG (pump control unit) or PSG malfunction.		No recovery until condition match in the next ignition key cycle.	PSG (pump control unit) malfunction.	-	-
		A	ON	Injection Pump Malfunction	EEPROM or A/D converter malfunction in the PSG (pump control unit).	Fuel injection quantity is reduced.	EEPROM or A/D converter no malfunction in the PSG (pump control unit). No recovery until in the next ignition key cycle.	PSG (pump control unit) malfunction.	-	-
		B	ON	Injection Pump Malfunction	PSG (pump control unit) recognized high pressure solenoid valve drive circuit error.	No fail-safe function.	No recovery until condition match in the next ignition key cycle.	PSG (pump control unit) malfunction.	-	-
		D	ON	Injection Pump Malfunction	PSG (pump control unit) could not measure the high pressure solenoid valve drive voltage.			PSG (pump control unit) malfunction.	-	-
		E	ON	Injection Pump Malfunction	ECM could not accept PSG (pump control unit) message.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	ECM accepts PSG (pump control unit) message.	1. CAN high circuit open, short to ground or short to voltage circuit. 2. CAN low circuit open, short to ground or short to voltage circuit. 3. ECM malfunction. 4. PSG (pump control unit) malfunction.	99/ 100	P1650(A)/ P1651(B)

Flash Code	Code	Symptom Code	MIL	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
43	P0335	B	ON	Crankshaft Position Sensor Circuit Malfunction	1. Engine speed is more than 665rpm. 2. CKP sensor pulse width error.	When pump camshaft speed sensor is OK: ECM uses doubled pump camshaft speed as substitute engine speed. When pump camshaft speed sensor is not OK: 1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	ECM detects correct CKP pulse width.	During engine run: 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. Pulser malfunction. 6. Electrical interference. 7. Magnetic interference. 8. ECM malfunction.	90/ 98/ 101	P1335 (A)
		D	ON	Crankshaft Position Sensor Circuit Malfunction	1. No pump camshaft speed sensor error. 2. "Crankshaft Position Sensor Circuit Malfunction (Symptom Code B)" is not stored. 3. Engine speed is 0rpm. 4. Doubled pump camshaft speed is more than 50rpm.	When pump camshaft speed sensor is OK: ECM uses doubled pump camshaft speed as substitute engine speed. Other than pump camshaft speed sensor is OK: Fuel injection quantity is reduced.	1. Engine speed is more than 0rpm. 2. Doubled pump camshaft speed is below 100rpm.	During engine crank: 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. Pulser malfunction. 6. Electrical interference. 7. Magnetic interference. 8. ECM malfunction.	90/ 98/ 101	P1135 (A)
		E	ON	Engine Speed Input Circuit Range/Performance	Engine speed is more than 5700rpm.	When intermittent malfunction: 1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk. When preliminary malfunction: ECM uses doubled pump camshaft speed as substitute engine speed.	Engine speed is below 5700rpm.	1. Engine over-running. 2. CKP sensor malfunction. 3. Pulser malfunction. 4. ECM malfunction.	90/ 98/ 101	-
66	P0380	4	ON	Glow Relay Circuit Voltage Low	Glow relay circuit open or short to ground circuit.	No fail-safe function.	Glow relay circuit is correct condition.	1. Glow relay circuit open or short to ground circuit. 2. Glow relay malfunction. 3. ECM malfunction.	94	-
		8	ON	Glow Relay Circuit Voltage High	Glow relay circuit short to voltage circuit.			ECM malfunction.	-	-
67	P0381	4	ON	Glow Plug Indicator Circuit Voltage Low	Glow plug indicator circuit open or short to ground circuit.	No fail-safe function.	Glow plug indicator circuit is correct condition.	1. Glow plug indicator circuit open or short to ground circuit. 2. Glow plug indicator lamp malfunction. 3. ECM malfunction.	43	-
		8	ON	Glow Plug Indicator Circuit Voltage High	Glow plug indicator circuit short to voltage circuit.			ECM malfunction.	-	-
32	P0400	3	ON	Exhaust Gas Recirculation Flow Excessive Detected	1. Intake air temperature is between 16 deg. C and 34 deg. C. 2. Engine coolant temperature is between 70 deg. C and 100 deg. C. 3. Barometric pressure is between 880hpa and 1100hpa. 4. Small amount of mass air flow. (Desired mass air flow - mass air flow is more than 150mg/strk)	Fuel injection quantity is reduced.	1. Engine speed is between 2165rpm and 3160rpm. 2. Injection quantity is between 15mg/strk and 35mg/strk. 3. Correct amount of mass air flow.	1. EGR valve is stuck at open position. 2. EGR EVRV malfunction. 3. Air intake is obstructed. 4. Air intake is leaking. 5. MAF sensor malfunction. 6. ECM malfunction.	88/ 97	-
		4	ON	Exhaust Gas Recirculation Circuit Short to Ground or Open Circuit	EGR EVRV circuit open or short to ground circuit.	Fuel injection quantity is reduced and EGR EVRV 10% conditions as substitute.	EGR EVRV circuit is correct condition.	1. EGR EVRV circuit open or short to ground circuit. 2. EGR EVRV malfunction.	97	-
		5	ON	Exhaust Gas Recirculation Flow Insufficient Detected	1. Intake air temperature is between 16 deg. C and 34 deg. C. 2. Engine coolant temperature is between 70 deg. C and 100 deg. C. 3. Barometric pressure is between 880hpa and 1100hpa. 4. Large mount of mass air flow. (Desired mass air flow - mass air flow is below 150 mg/strk)	Fuel injection quantity is reduced.	1. Engine speed is between 2165rpm and 3160rpm. 2. Injection quantity is between 15mg/strk and 35mg/strk. 3. Correct amount of mass air flow.	1. EGR valve is stuck at close position. 2. EGR valve operating vacuum hose is clogged or disconnected. 3. EGR EVRV malfunction. 4. MAF sensor signal circuit short to voltage circuit. 5. MAF sensor malfunction. 6. ECM malfunction.	88/ 97	-
		8	ON	Exhaust Gas Recirculation Circuit Short to Battery	EGR EVRV circuit short to voltage circuit.	Fuel injection quantity is reduced & EGR EVRV 10% conditions as substitute.	EGR EVRV circuit is correct condition.	1. EGR EVRV circuit short to voltage circuit. 2. EGR EVRV malfunction. 3. ECM malfunction.	97	-

Flash Code	Code	Symptom Code	MIL	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
24	P0500	1	OFF	Vehicle Speed Sensor Circuit High Input	Vehicle speed is more than 190km/h.	ECM uses vehicle speed 5km/h condition as substitute.	Vehicle speed is below 190km/h.	1. VSS signal circuit open, short to ground or short to voltage circuit. 2. VSS malfunction. 3. Speed meter malfunction. 4. TCM malfunction (AT 2WD). 5. ECM malfunction.	68	-
		A	OFF	Vehicle Speed Sensor Input Signal Frequency Too High	Input signal frequency is too high.	ECM uses vehicle speed 5km/h condition as substitute.	Correct vehicle speed signal frequency.	1. VSS malfunction. 2. Speed meter malfunction. 3. Electrical interference. 4. Magnetic interference. 5. ECM malfunction.	68	-
		B	OFF	Vehicle Speed Sensor Incorrect Signal	1. Engine speed is more than 3600rpm. 2. Fuel injection quantity is more than 41mg/stk. 3. Vehicle speed is below 1.5km/h.	Fuel injection quantity is reduced.	Vehicle speed is more than 1.5km/h.	1. VSS open circuit, short to ground or short to voltage. 2. Poor connector connection. 3. VSS malfunction. 4. Speed meter malfunction. 5. ECM malfunction.	68	-
35	P0560	1	OFF	System Voltage Too High	System voltage is more than 20V.	ECM uses 9V conditions as substitute.	System voltage is below 20V.	1. Charge system malfunction. 2. Battery jump start cable misconnect. 3. ECM malfunction.	3/ 39	-
		2	OFF	System Voltage Too Low	System voltage is below 7V.		System voltage is more than 7V.	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.	3/ 39	-
		A	OFF	System Voltage Malfunction (PSG)	System voltage of PSG (pump control unit) is below 4.5V or more than 27V.	PSG uses default voltage as substitute.	System voltage of PSG is between 4.5V and 27V.	1. Battery power feed harness open circuit or short to ground circuit. 2. PSG (pump control unit) ground harness open or poor connection. 3. Poor connector connection. 4. Battery malfunction. 5. Charge system malfunction. 6. Battery jump start cable misconnect. 7. PSG (pump control unit) malfunction.	-	-
18	P0561	A	OFF	Ignition Switch Circuit Malfunction	The ECM recognized ignition switch turn off signal during ECM is activated.	ECM stops engine.	No recovery until condition match in the next ignition key cycle.	1. Ignition switch circuit open or short to ground circuit. 2. Poor connector connection. 3. Ignition switch malfunction. 4. ECM malfunction.	39	-
		B	ON	Ignition Switch Circuit Malfunction	Ignition switch circuit is malfunction.			1. Ignition switch circuit open or short to ground circuit. 2. Poor connector connection. 3. Ignition switch malfunction. 4. ECM malfunction.	39	-
-	P0602		-	ECU Programming Error	ECM memory area error.	Engine control disabled.	Memory are is OK.	ECM is not programmed.	-	-
28	P0606	A	ON	ECU Malfunction	Gate Array communication error.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	No recovery.	ECM malfunction.	-	-
		B	ON	ECU Malfunction	1. Throttle position is below 1%. 2. Desired injection quantity is more than 0mg/strk. 3. Engine speed is more than 2000rpm.	MAB (fuel cutoff solenoid valve) is operated.	Desired injection quantity is below 0mg/strk.	1. ECM malfunction. 2. PSG (pump control unit) malfunction.	-	-
46	P0645	4	ON	A/C Compressor Relay Circuit Voltage Low	A/C compressor relay circuit open or short to ground circuit.	No fail-safe function.	A/C compressor relay circuit is correct condition.	1. A/C compressor relay circuit open or short to ground circuit. 2. Poor connector connection. 3. A/C compressor relay malfunction. 4. ECM malfunction.	41	-
		8	ON	A/C Compressor Relay Circuit Voltage High	A/C compressor relay circuit short to voltage circuit.			ECM malfunction.	-	-

Flash Code	Code	Symptom Code	MIL	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
25	P0703	A	ON	Brake Switch Malfunction	1. Throttle position is more than 10%. 2. Engine speed is more than 1500rpm. 3. Vehicle speed is more than 15km/h. 4. Brake switch 1 signal and brake switch 2 signal are differently inputted to the ECM since the ignition switch was turned on.	No fail-safe function.	Brake switch 1 signal and brake switch 2 signal are correctly inputted to the ECM.	1. Brake switch 1 circuit open, short to ground or short to voltage circuit. 2. Poor connector connection. 3. Brake switch 1 malfunction. 4. ECM malfunction.	30	-
		B	ON	Brake Switch Malfunction	1. Throttle position is more than 10%. 2. Engine speed is more than 1500rpm. 3. Vehicle speed is more than 15km/h. 4. Brake switch 1 signal and brake switch 2 signal are differently inputted to the ECM.			1. Brake switch 2 circuit open or short to ground circuit. 2. Poor connector connection. 3. Brake switch 2 malfunction. 4. ECM malfunction.	65	-
57	P0704	6	ON	Clutch Switch Input Circuit Malfunction	Clutch signal does not change between vehicle speed 5km/h and 80km/h since ignition switch was tuned on.	No fail-safe function.	Clutch signal correctly changes.	1. Clutch switch circuit open, short to ground or short to voltage circuit. 2. Poor connector connection. 3. Clutch switch malfunction. 4. ECM malfunction.	31	-
86	P1105	1	ON	Barometric Pressure Sensor Circuit High Input	Barometric pressure sensor output voltage is more than 4.4V.	ECM uses 1013hpa condition as substitute.	Barometric pressure sensor output voltage is below 4.4V.	ECM malfunction.	-	-
		2	ON	Barometric Pressure Sensor Circuit Low Input	Barometric pressure sensor output voltage is below 1.5V.		Barometric pressure sensor output voltage is more than 1.5V.	ECM malfunction.	-	-
72	P1110	4	ON	Intake Vacuum Switching Valve (VSV) Low Input	Intake throttle VSV circuit open or short to ground circuit.	No fail-safe function.	Intake throttle VSV circuit is correct condition.	1. Intake throttle VSV circuit open or short to ground circuit. 2. Poor connector connection. 3. Intake throttle VSV malfunction. 4. ECM malfunction.	95	-
		8	ON	Intake Vacuum Switching Valve (VSV) High Input	Intake throttle VSV circuit short to voltage circuit.			ECM malfunction.	-	-
21	P1120	1	ON	Pedal/Throttle Position Sensor Circuit High Input	Throttle position sensor output voltage is more than 4.9V.	ECM increases idle speed up to 1400rpm.	Throttle position sensor 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.	38/ 49/ 57	-
		2	ON	Pedal/Throttle Position Sensor Circuit Low Input	Throttle position sensor output voltage is below 0.3V.		Throttle position sensor output voltage is more than 0.32V.	1. Sensor power supply circuit open circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. TPS malfunction. 6. ECM malfunction.	38/ 49/ 57	-
		7	ON	Pedal/Throttle Position Sensor Voltage Supply Circuit High Input	Throttle position sensor power supply voltage is more than 5.2V.		Throttle position sensor power supply voltage is below 5.2V.	1. Sensor power supply circuit short to battery voltage circuit. 2. TPS malfunction. 3. ECM malfunction.	57	-
		9	ON	Pedal/Throttle Position Sensor Voltage Supply Circuit Low Input	Throttle position sensor power supply voltage is below 4.6V.		Throttle position sensor power supply voltage is more than 4.6V.	1. Sensor power supply circuit short to ground circuit. 2. TPS malfunction. 3. ECM malfunction.	57	-
		D	ON	Pedal/Throttle Position Sensor Brake Switch Error	1. Engine speed is more than 1700rpm. 2. Throttle position sensor is more than 18%. 3. When brake pedal is depressed during accelerator pedal is depressing.		Throttle position is more than 20% or brake pedal is released (switch is inactive).	1. Throttle sticking. 2. TPS incorrect adjusting. 3. TPS malfunction. 4. Brake switch malfunction. 5. ECM malfunction.	30/ 38/ 65	-
		E	ON	Pedal/Throttle Position Sensor Idle Position Switch Error	When idle switch is tuned on, throttle position sensor was more than 18%.		No recovery until condition match in the next ignition key cycle.	1. TPS malfunction. 2. Idle switch malfunction. 3. ECM malfunction.	38/ 69	-

Flash Code	Code	Symptom Code	MIL	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
22	P1173	3	OFF	Fuel Reduction Caused By High Coolant Temperature	Excessive high engine coolant temperature is detected.	No fail-safe function.	Engine coolant temperature is normal range.	1. Engine overheat. 2. ECT sensor malfunction. 3. ECM malfunction.	89	-
		7	OFF	Fuel Reduction Caused By High Fuel Temperature	Fuel temperature is more than 100 deg. C.	PSG (pump control unit) controls fuel injection quantity based on engine speed and fuel temperature.	Fuel temperature is below 100 deg. C.	1. ECM malfunction. 2. PSG (pump control unit) malfunction.	-	-
		A	OFF	Fuel Reduction Caused By Low Fuel Temperature	Excessive low fuel temperature is detected.	No fail-safe function.	Fuel temperature is normal range.	1. ECM malfunction. 2. PSG (pump control unit) malfunction.	-	-
43	P1335	A	ON	Engine Speed Output Circuit Malfunction	The PSG (pump control unit) is recognized defective engine speed signal form the ECM.	Fuel injection quantity is reduced.	Correct engine speed signal.	1. CKP sensor harness open circuit, short to ground or short to voltage. 2. CKP sensor output harness open circuit, short to ground or short to voltage. 3. Poor connector connection. 4. CKP sensor malfunction. 5. Pulse sensing gap incorrect. 6. Pulser malfunction. 7. Electrical interference. 8. Magnetic interference. 9. ECM malfunction. 10. PSG (pump control unit) malfunction.	90/ 91/ 98/ 101	P0335(B)/ P0335(D)
45	P1345	A	ON	Camshaft Speed Malfunction	The PSG (pump control unit) is recognized incorrect camshaft speed signal.	No fail-safe function.	Correct camshaft speed.	1. Pump camshaft speed sensor malfunction. 2. Pulse sensing gap incorrect. 3. Pulser malfunction. 4. Electrical interference. 5. Magnetic interference. 5. ECM malfunction. 6. PSG (pump control unit) malfunction.	-	-
47	P1520	A	ON	Neutral Switch ON Error	Neutral switch signal is inputted "On" three times consecutively under driving conditions.	No fail-safe function.	Correct neutral switch signal is inputted two times consecutively under driving conditions.	1. Neutral switch circuit short to voltage circuit. 2. Neutral switch malfunction. 3. ECM malfunction.	87	-
		B	ON	Neutral Switch OFF Error	Neutral switch signal is inputted "Off" three times consecutively under driving conditions.			1. Neutral switch circuit open, short to ground circuit. 2. Poor connector connection. 3. Neutral switch malfunction. 4. ECM malfunction.	87	-
71	P1576	4	ON	Exhaust Throttle VSV 1 Circuit Voltage Low	Exhaust throttle VSV 1 circuit open or short to ground circuit.	No fail-safe function.	Exhaust throttle VSV 1 circuit is correct condition.	1. Exhaust throttle VSV 1 circuit open or short to ground circuit. 2. Poor connector connection. 3. Exhaust throttle VSV 1 malfunction. 4. ECM malfunction.	40	-
		8	ON	Exhaust Throttle VSV 1 Circuit Voltage High	Exhaust throttle VSV 1 circuit short to voltage circuit.			ECM malfunction.	-	-
	P1605	D	ON	EEPROM Defect	Write and read from the EEPROM are failed during initialization of the ECM.	ECM uses default values from the EPROM.	Write and read from the EEPROM are correct during initialization of the ECM.	ECM malfunction.	-	-
		E	ON	EEPROM Defect	EEPROM checksum does not match with the read check sum during initialization of the ECM.		EEPROM checksum match with the read check sum during initialization of the ECM.	ECM malfunction.	-	-
76	P1625	A	OFF	ECM Main Relay Switched Off Too Early	When ignition switch was turned off, timing of the ECM main relay turning off is too early.	No fail-safe function.	No recovery.	ECM malfunction.	3/ 58	-
		B	OFF	ECM Main Relay Switched Off Too Late	When ignition switch was turned off, timing of the ECM main relay turning off is too late or does not off.		No recovery.	1. ECM main relay malfunction. 2. ECM malfunction.	3/ 58	-

Flash Code	Code	Symptom Code	MIL	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.	Related Multiple DTC
51	P1630	A	ON	Fuel Injection Quantity Circuit Malfunction	The PSG (pump control unit) detects high pressure solenoid valve control circuit malfunction due to high current.	Fuel injection quantity is reduced.	The PSG (pump control unit) detects correct high pressure solenoid valve control circuit.	PSG (pump control unit) malfunction.	-	-
		B	ON	Fuel Injection Quantity Circuit Malfunction	The PSG (pump control unit) detects high pressure solenoid valve control circuit malfunction due to continuous current.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	No recovery.	PSG (pump control unit) malfunction.	-	-
44	P1650	A	ON	CAN Device Offline	CAN controller detects Bus-off or canceling.	MAB (fuel cutoff solenoid valve) is operated.	CAN controller detects correct Bus signal.	1. CAN high circuit open, short to ground or short to voltage circuit. 2. CAN low circuit open, short to ground or short to voltage circuit. 3. Poor connector connection. 4. Electrical interference. 5. ECM malfunction. 6. PSG (pump control unit) malfunction.	99/ 100	P1651(B)
		B	ON	CAN Device Hang-up	CAN controller does not react under engine running.		CAN controller reacts correctly under engine running.	1. ECM malfunction. 2. PSG (pump control unit) malfunction.	-	-
45	P1651	A	ON	CAN Malfunction (PSG)	The PSG (pump control unit) does not recognize CAN signal from the CAN controller.	1. MAB (fuel cutoff solenoid valve) is operated. 2. Desired injection quantity becomes 0mg/strk.	The PSG (pump control unit) recognizes CAN signal from the CAN controller.	1. ECM malfunction. 2. PSG (pump control unit) malfunction.	-	-
		B	ON	CAN Receives Error	The ECM does not read CAN signal from the PSG (pump control unit).		The ECM reads CAN signal from the PSG (pump control unit).	1. CAN high circuit open, short to ground or short to voltage circuit. 2. CAN low circuit open, short to ground or short to voltage circuit. 3. Poor connector connection. 4. Electrical interference. 5. ECM malfunction. 6. PSG (pump control unit) malfunction.	99/ 100	P1650(A)
77	P1690	4	OFF	Check Engine Lamp (MIL) Circuit Voltage Low	Check engine lamp circuit open or short to ground circuit.	No fail-safe function.	Check engine lamp circuit is correct condition.	1. Check engine lamp circuit open or short to ground circuit. 2. Check engine lamp malfunction. 3. ECM malfunction.	42	B****
		8	OFF	Check Engine Lamp (MIL) Circuit Voltage High	Check engine lamp circuit short to voltage circuit.			ECM malfunction.	-	-

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 check engine lamp (MIL=malfunction indicator 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. Check thoroughly for any type of leak or restriction.

-Air intake ducts for collapsed or damaged areas.

-Air leaks at throttle body mounting area, mass air flow (MAF) sensor and intake manifold sealing surfaces.

-Wiring for proper connections, pinches and cuts.

INTERMITTENT

Important: An intermittent problem may or may not turn on the check engine lamp (MIL=malfunction indicator lamp) 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 cased 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 form the connector body to check.

-Check engine lamp (MIL=malfunction indicator 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 have several features that can be used to located an intermittent condition. Use the following features to find intermittent faults:

To check for loss of diagnostic code memory, disconnect the MAF sensor and idle the engine until the check engine lamp (MIL=malfunction indicator lamp) comes on. Diagnostic Trouble Code P0100 should be stored and kept in memory when the ignition is turned OFF.

If not, the ECM is faulty. When this test is completed, make sure that you clear the Diagnostic Trouble Code P0100 from memory.

An intermittent check engine lamp (MIL=malfunction indicator lamp) with no stored Diagnostic Trouble Code may be caused by the following:
-Check engine lamp (MIL=malfunction indicator 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.
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.

FAULTY SYMPTOM & DEFINITION

1. Engine Cranks But Will Not Run

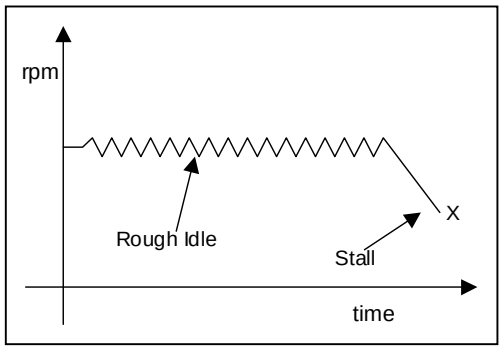
Definitions: Engine cranks, but will not run. (The engine never start.)

2. Hard Start Symptom

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

3. Rough, Unstable, or Incorrect Idle, Stalling Symptom

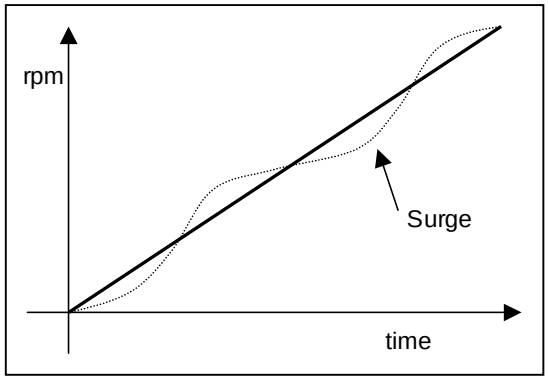
Typical Condition



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.

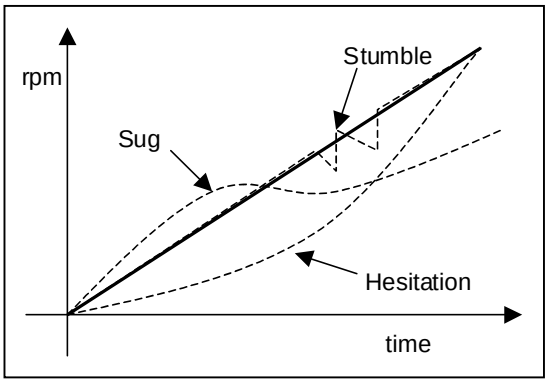
4. Surges and/or Chugs Symptom

Typical Condition



Definitions: Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no charge in the accelerator pedal.

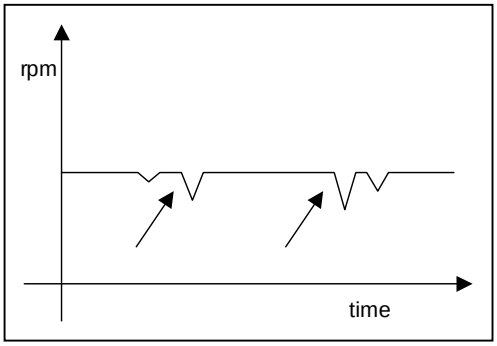
5. Hesitation, Sag, Stumble Symptom



Typical Condition

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.

6. Cuts Out, Misses Symptom



Typical Condition

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

7. 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.

8. Poor Fuel Economy Symptom

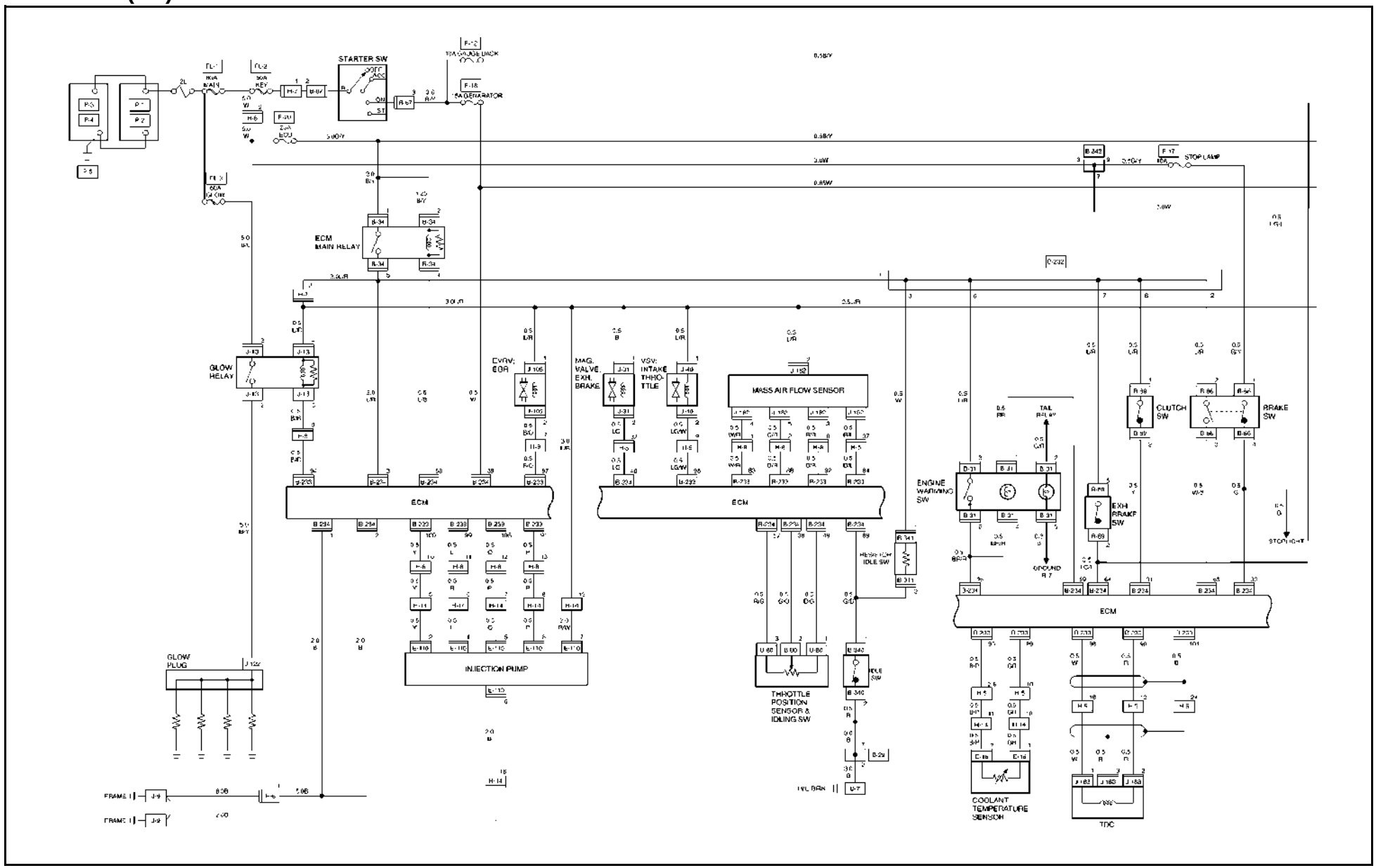
Definitions: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test. (Larger than standard tires will cause odometer readings to be incorrect, and that may cause fuel economy to appear poor when it is actually normal.)

9. Excessive White Smoke

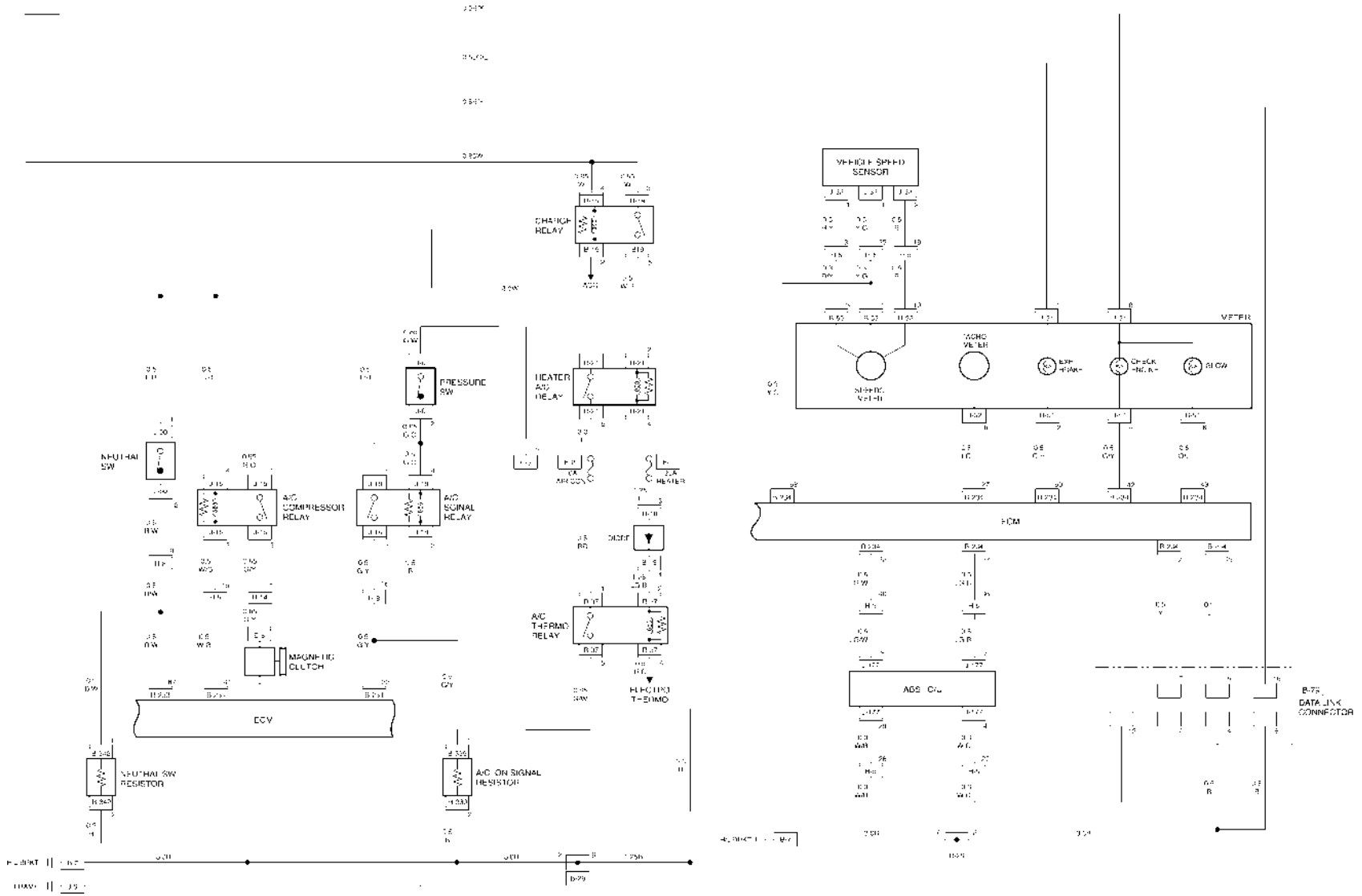
10. Excessive Black Smoke

ECM CIRCUIT DIAGRAM

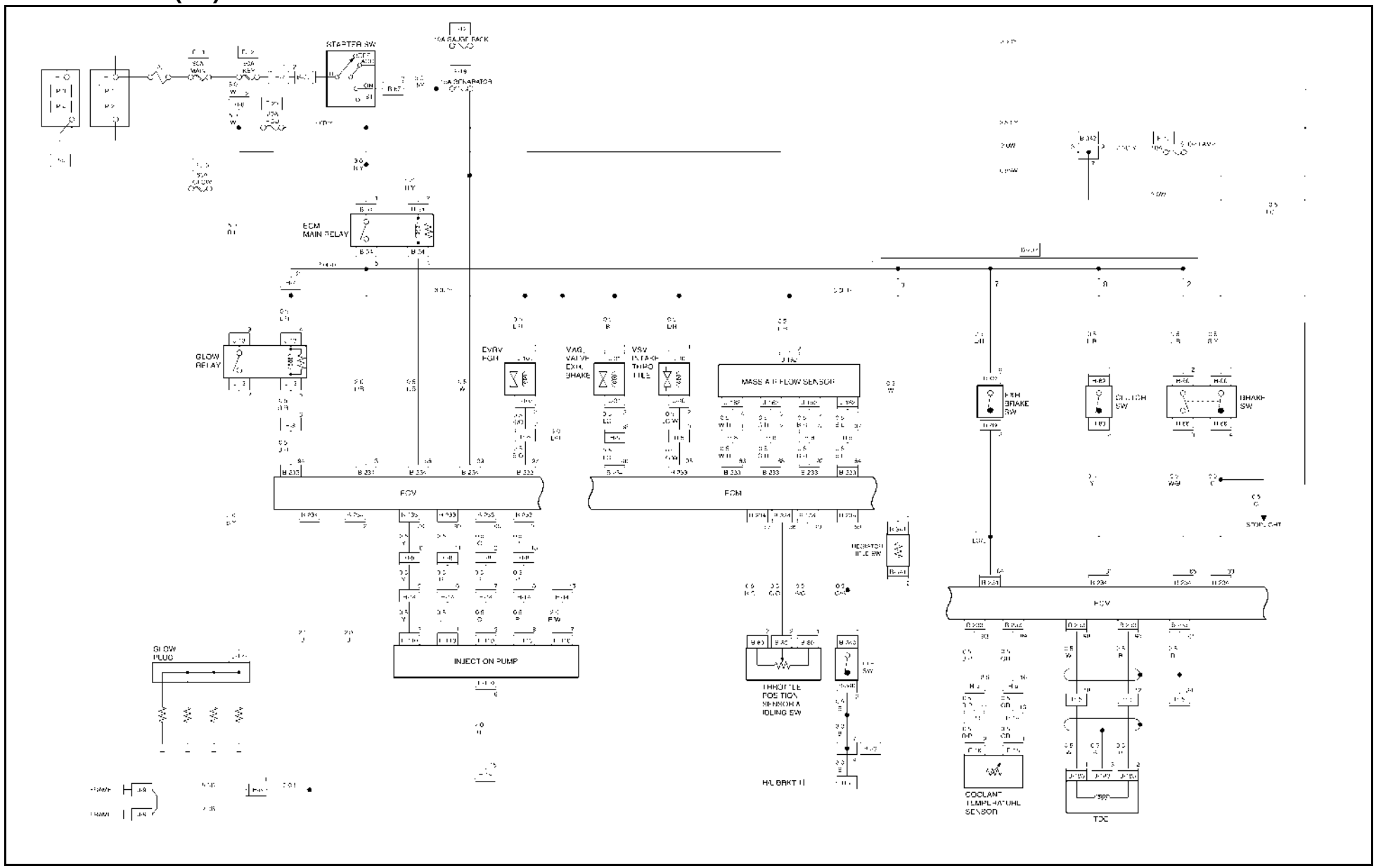
WITH ABS (1/2)



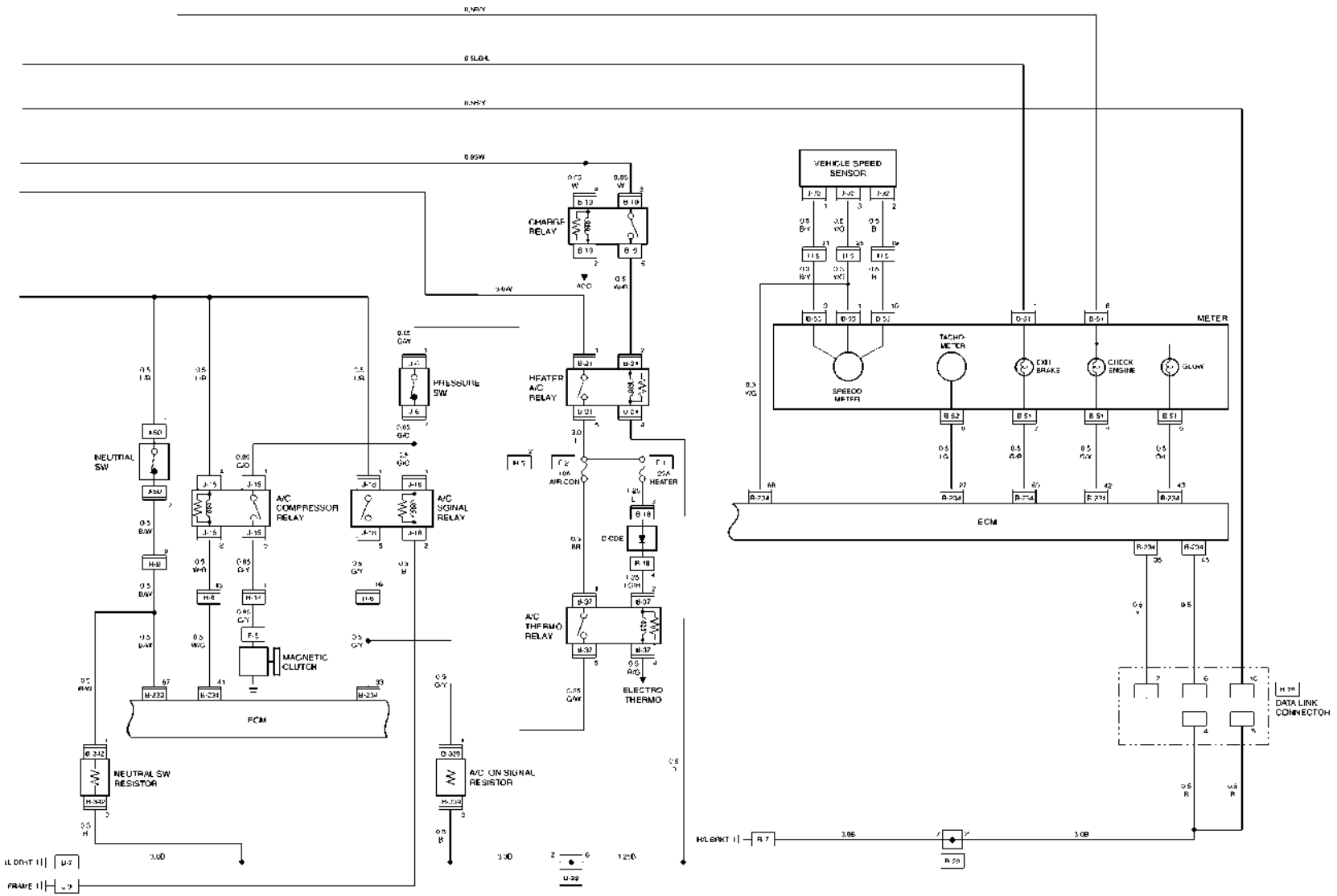
WITH ABS (2/2)


CHARGE RELAY
PRESSURE SW
HEATER A/C RELAY
NEUTRAL SW
A/C COMPRESSOR RELAY
A/C SIGNAL RELAY
A/C THERMO RELAY
MAGNETIC CLUTCH
ECV
NEUTRAL SW RESISTOR
A/C ON SIGNAL RESISTOR
ELECTRO THERMO
VEHICLE SPEED SENSOR
SPEEDO METER
WORK METER
EXP HEAT
CHECK ENG R
GLOW
ECM
ABS CM
DATA LINK CONNECTOR

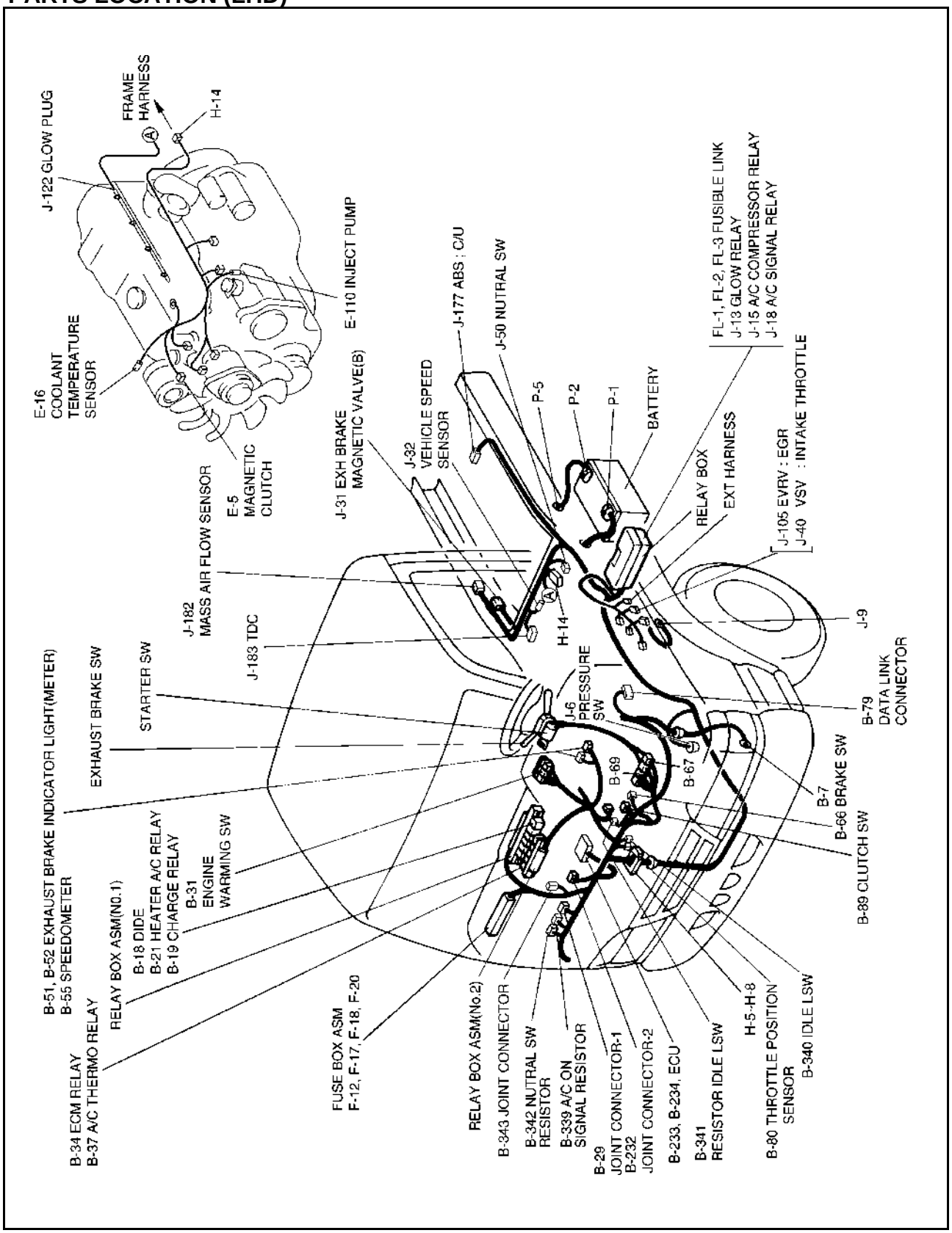
WITHOUT ABS (1/2)



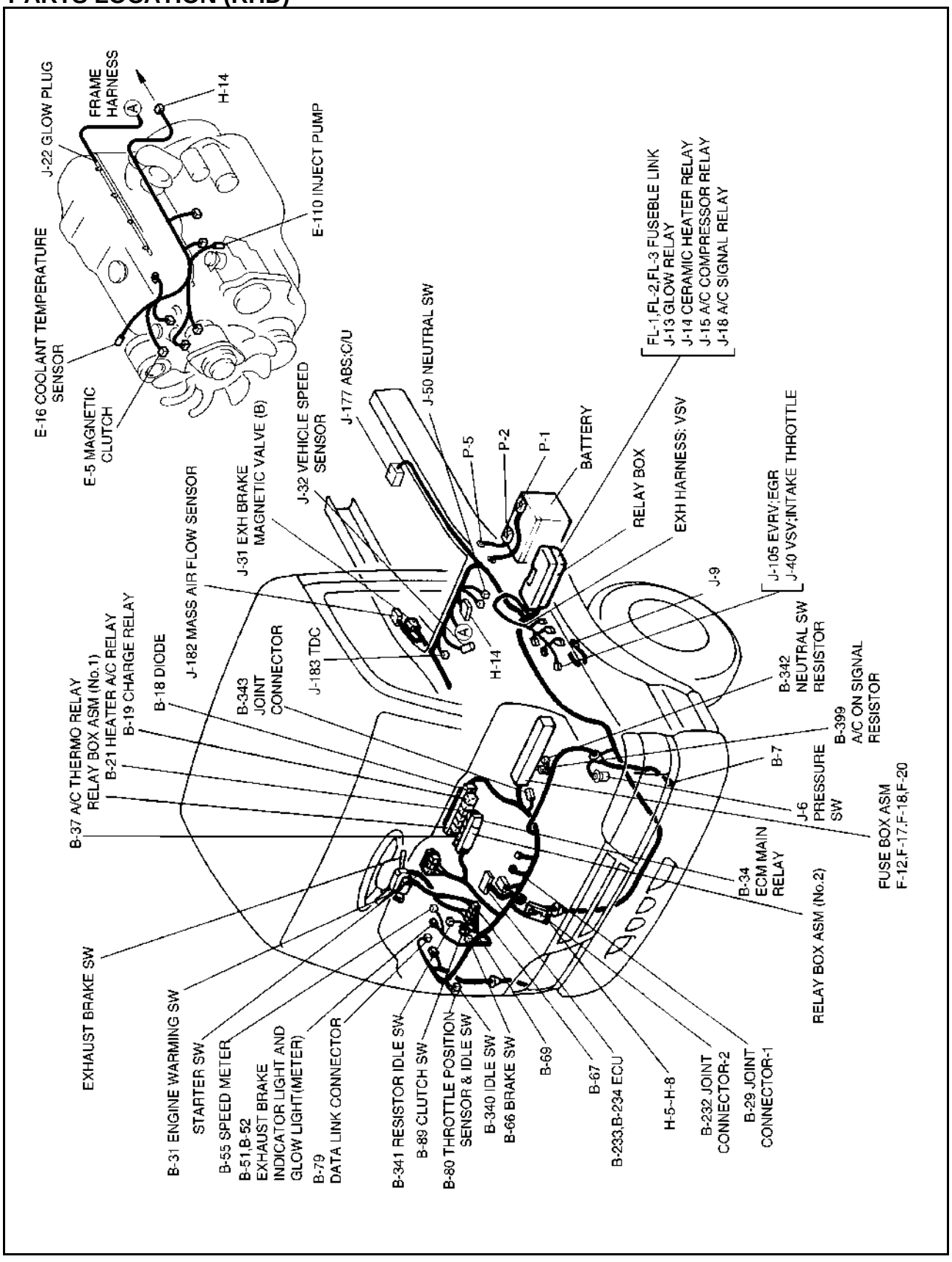
WITHOUT ABS (2/2)



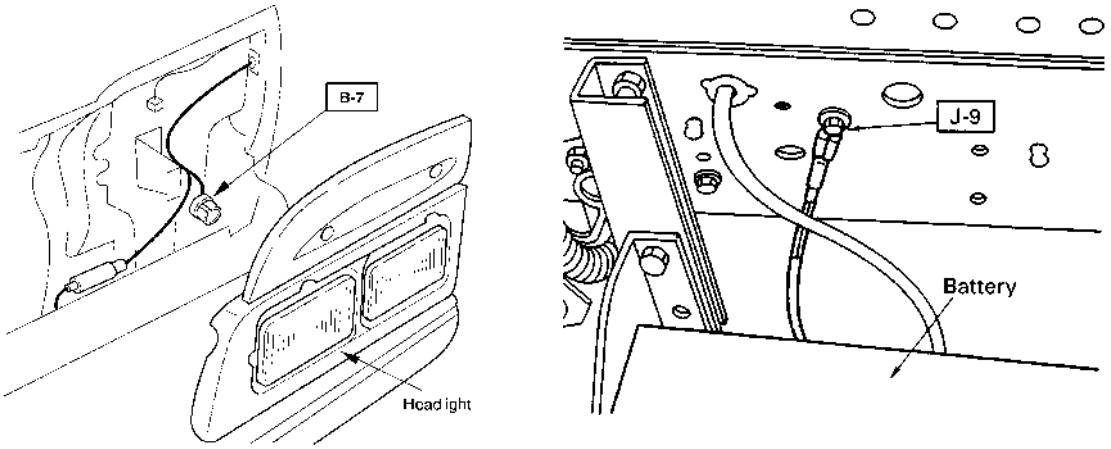
PARTS LOCATION (LHD)



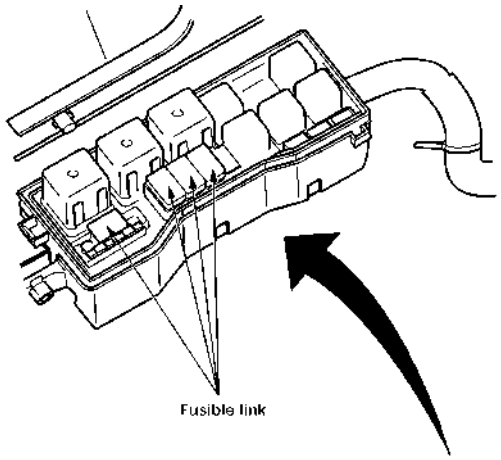
PARTS LOCATION (RHD)

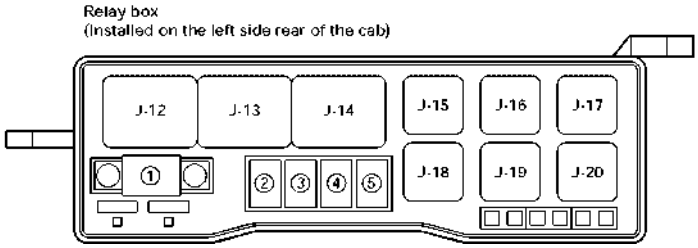


GROUND LOCATION



RELAY & FUSIBLE LINK LOCATION





RELAY

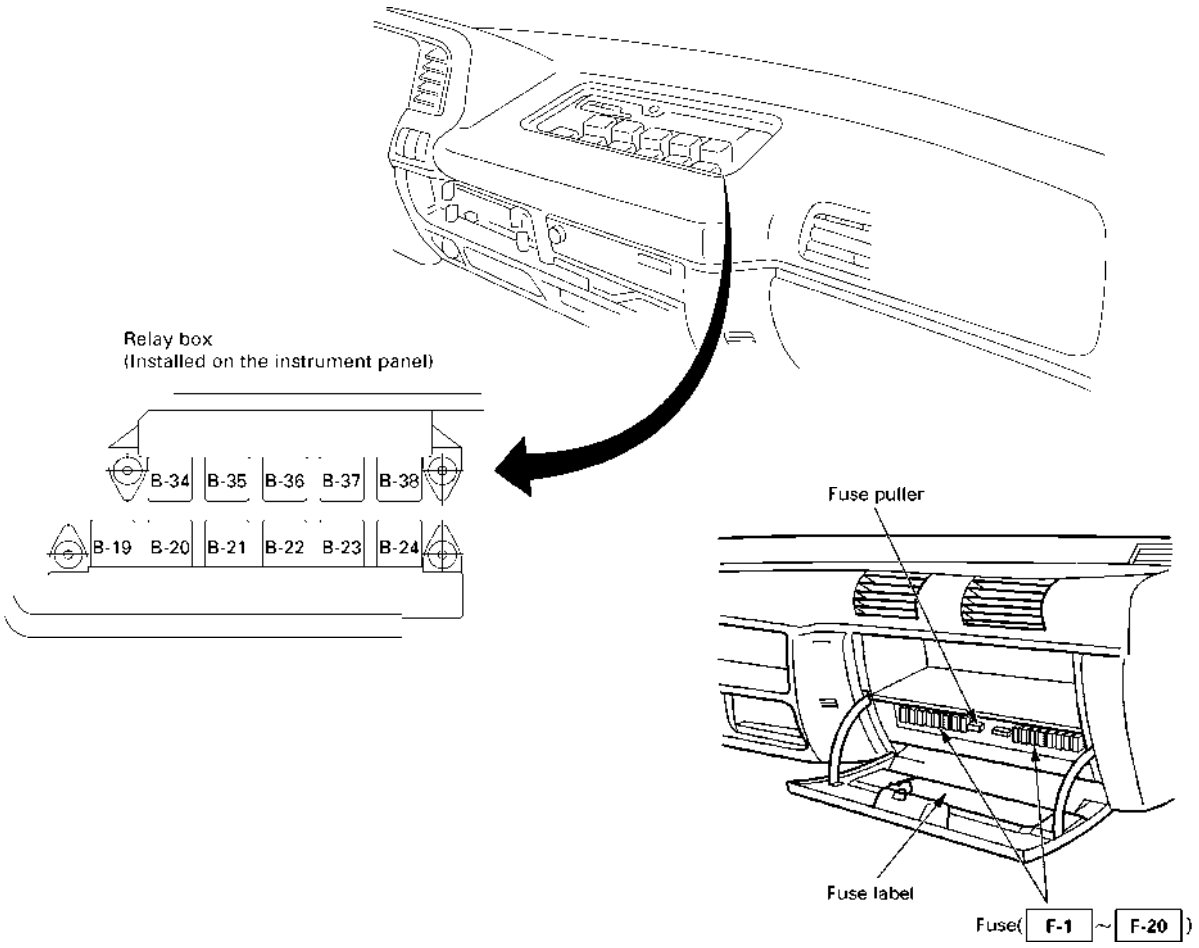
	LHD/RHD
J-12	RELAY; STARTER
J-13	RELAY; GLOW
J-14	-
J-15	RELAY; A/C COMP
J-16	-
J-17	RELAY; COND. FAN
J-18	RELAY; A/C SIGNAL
J-19	RELAY; RR FOG
J-20	RELAY; MARKER LAMP

FUSIBLE LINK

	LHD/RHD
1	80A MAIN
2	50A KEY SW
3	60A GLOW
4	60A (ABS)

( ): IF EQUIPPED

RELAY & FUSE LOCATION



RELAY

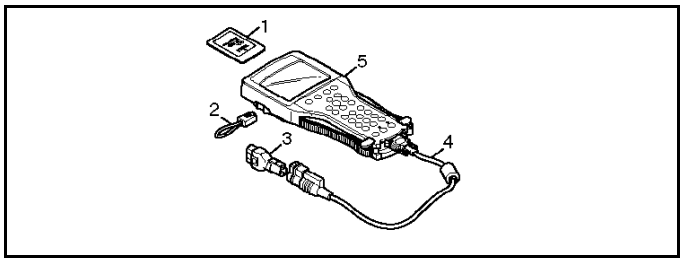
	LHD/RHD
B-19	RELAY; CHARGE
B-20	RELAY; HEAD LIGHT
B-21	RELAY; HEATER & A/C
B-22	RELAY; TAIL
B-23	RELAY; DIMMER
B-24	RELAY; HORN
B-34	RELAY; ECU
B-35	RELAY; CORNERING LIGHT
	RELAY; ABS IND.
B-36	RELAY; POWER WINDOW
B-37	RELAY; A/C THERMO
B-38	RELAY; FUEL HEATER

FUSE

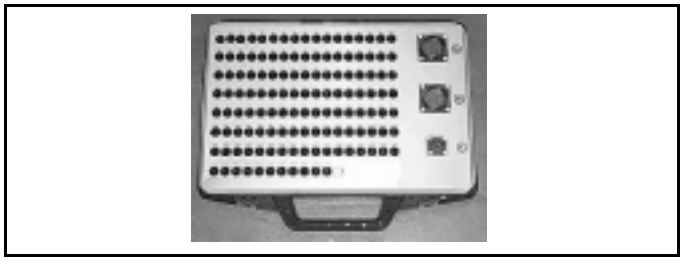
	LHD/RHD
F-1	25A HEATER
F-2	10A A/C
F-3	10A STARTER
F-4	15A CIGAR LIGHTER
F-5	10A HEAD LIGHT (RH)
F-6	10A HEAD LIGHT (LH)
F-7	15A POWER DOOR LOCK
F-8	15A HAZARD, HORN
F-9	15A TAIL LIGHT
F-10	10A FOG LIGHT
F-11	15A WIPER, WASHER
F-12	10A GAUGE, BACK
F-13	15A (REAR HEATER)
F-14	15A (FUEL HEATER)
F-15	10A (HDLP LEVELING)
F-16	25A POWER WINDOW
F-17	10A STOP LIGHT
F-18	15A GENERATOR
F-19	10A TURN S/LIGHT
F-20	25A ECU
F-21	10A MARKER LIGHT

( ): IF EQUIPPED

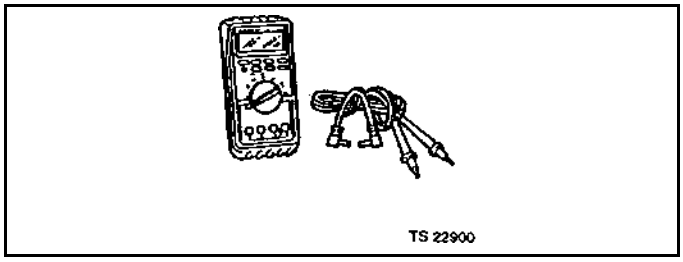
SPECIAL TOOLS



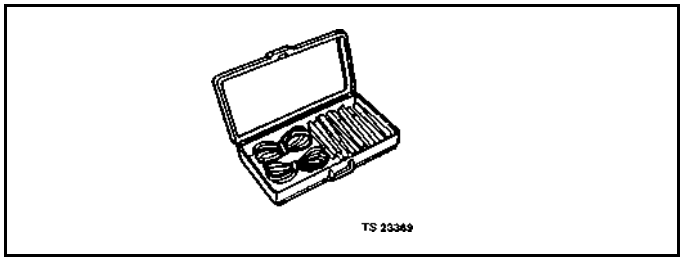
Tech2



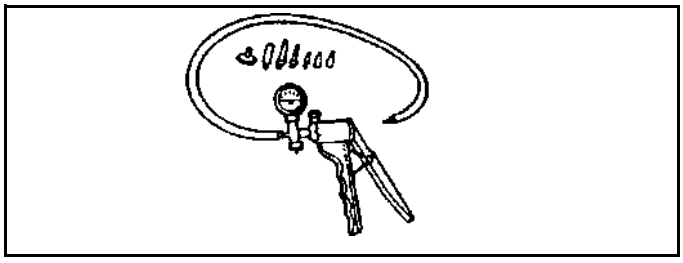
Breaker Box



5-8840-0285-0
High Impedance Multimeter



5-8840-0385-0
Connector Test Adapter Kit



5-8840-0279-0
Vacuum Pump With Gauge

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