WORKSHOP MANUAL

C&E SERIES

ENGINE CONTROL SYSTEM

(6WF1-TC, 6WG1-TC (Common Rail) models)

SECTION 1A

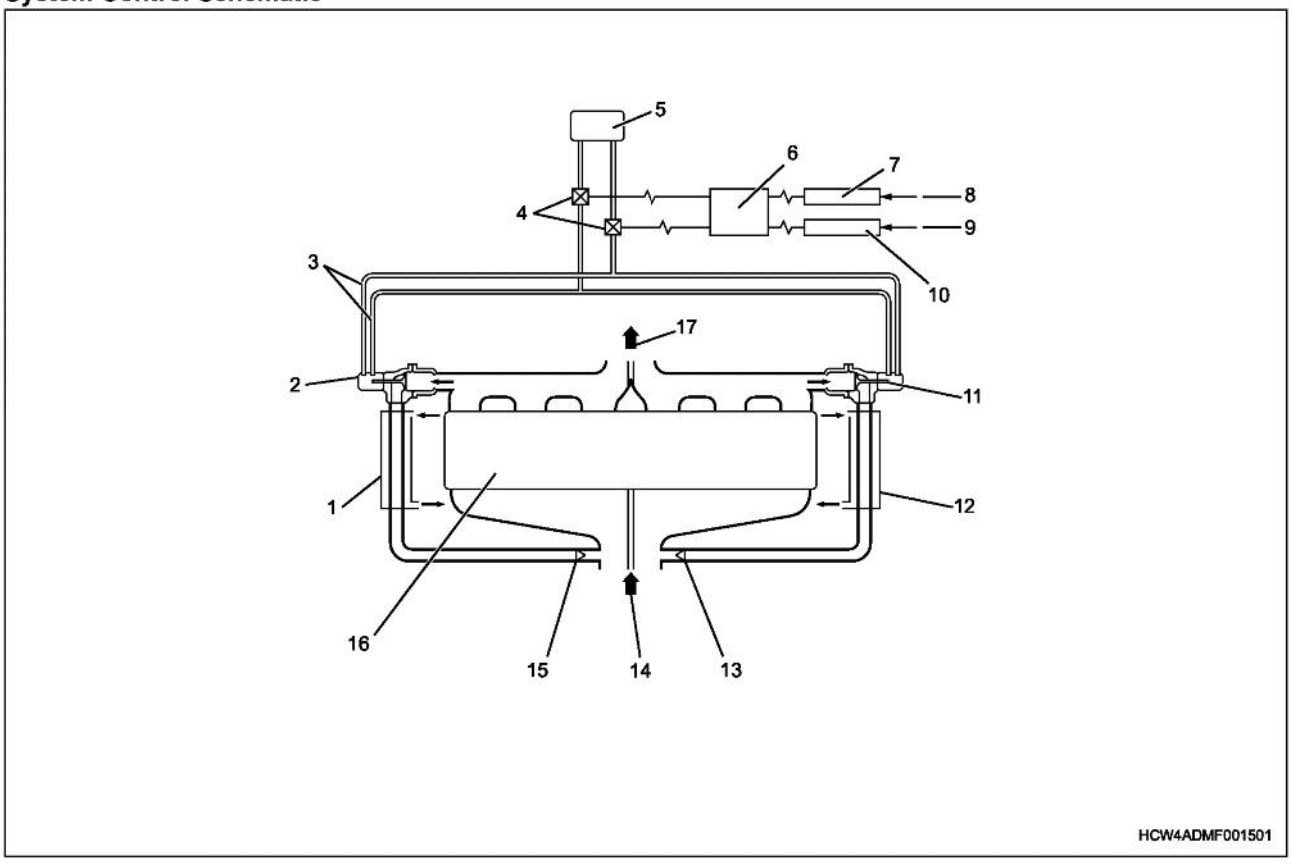
ISUZU

ISUZU
International Service & Parts
Tokyo, Japan

Exhaust Gas Recirculation (EGR)

The EGR (Exhaust Gas Recirculation) system recirculates part of the exhaust gas within the intake manifold, mixing inert gases with intake air. This lowers the combustion temperature, reducing the generation of NOx. The EGR volume is controlled by the action (opening and closing) of the EGR valve, which is situated between the exhaust manifold and the intake manifold. The EGR volume is determined according to the engine speed and engine load rate (fuel injection volume). A vehicle equipped with an intercooler turbo has a cooler built into the EGR gas channel, so that hot EGR gas is cooled by the cooler and mixed with fresh air. This achieves a greater reduction in combustion temperature than normal EGR, further reducing NOx generation (cooled EGR). Furthermore, the EGR system uses a one-way valve to restrict the backward flow of EGR gas. As one-way flow is ensured, the EGR volume can be increased.

System Control Schematic

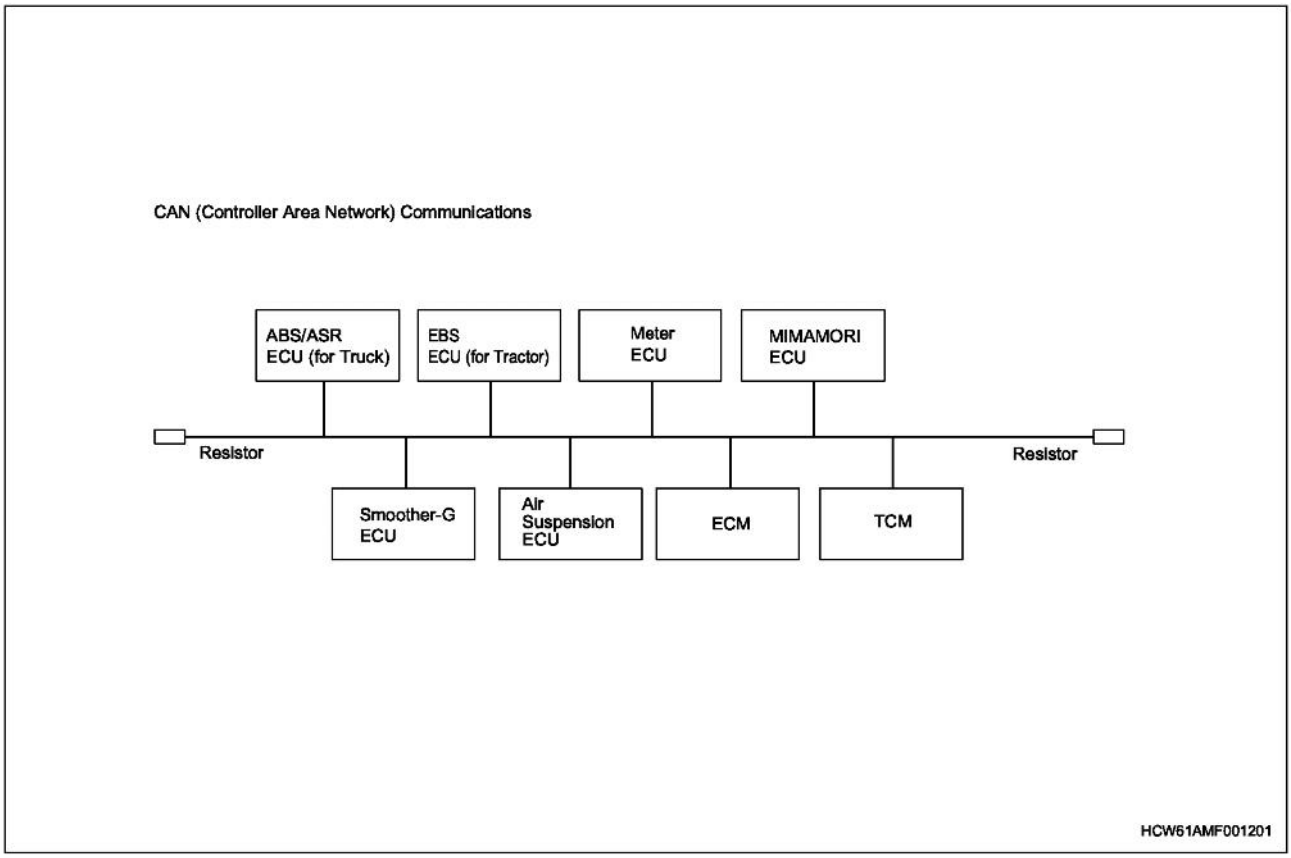


Legend

1. EGR gas cooling device
2. EGR valve
3. Air line
4. EGR magnetic valve
5. Air tank
6. Engine control module (ECM)
7. Crankshaft position (CKP) sensor
8. Engine speed
9. Engine load
10. Accelerator pedal sensor
11. EGR valve
12. EGR gas cooling device
13. Non return valve
14. Intake air
15. Non return valve
16. Engine
17. Exhaust gas

ECM Communications

The various control units are in communication and signals necessary for control functions (accelerator opening, vehicle speed, various switch signals, etc.) are sent and received.
The communications methods are Pulse Width Modulation (PWM) and Controller Area Network (CAN).

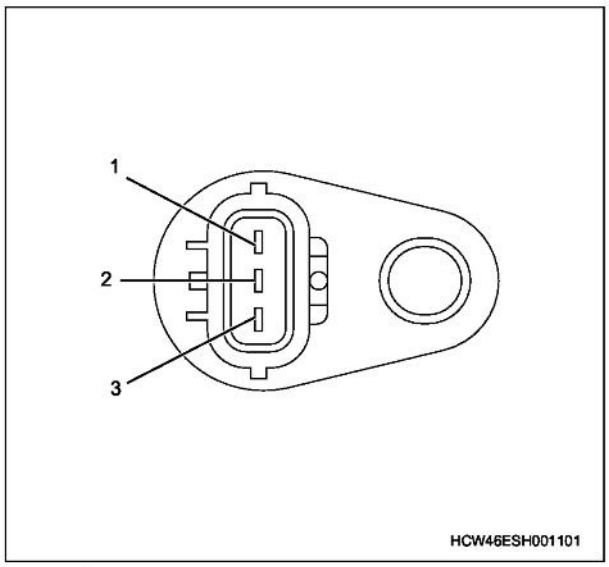


Communications Methods

- PWM (Pulse Width Modulation)
  One type of pulse modulation method, in which the frequency and amplitude are constant and the pulse width is varied according to the signal.
  The proportion of On time in one cycle is varied to create the signal.
- CAN (Controller Area Network)
  CAN communication is implemented with two wires (communication lines) to connect control units to each other for communication.
  Each control unit is able to exchange multiple data items simultaneously at different transfer rates (high/ medium/ low speed) and with the number of signals. Furthermore, signals are shared by each control unit to use for various types of control.

The engine coolant temperature (ECT) sensor is attached to the engine block thermostat housing. The resistance of its thermistor changes with temperature. The resistance value falls as the engine coolant temperature rises, and vice versa. The Engine Control Module (ECM) applies 5V to the ECT sensor through the pull-up resistance and calculates the engine coolant temperature from the change in that voltage. The result is used in fuel injection control and other control functions. The voltage is low when the resistance is low (i.e. when the temperature is high), and rises when the resistance is higher (when the temperature is lower).

Cam Shaft Position (CMP) sensor

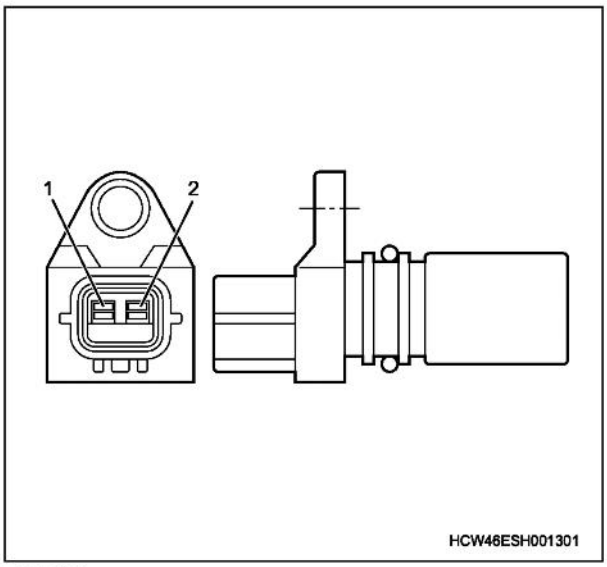


Legend

1. Signal
2. GND
3. Power supply

The cam shaft position (CMP) sensor is attached to the supply pump. A CMP signal is generated when the cam shaft inside the supply pump passes through the sensor. The Engine Control Module (ECM) identifies the cylinder from the crank shaft position (CKP) signal and the CKP signal input from the CKP sensor, determines the crank angle and uses it to calculate fuel injection control and engine speed. These control functions are usually based on the CKP signal, but if the CKP sensor malfunctions, they are based on the CMP signal.

Crankshaft position (CKP) sensor

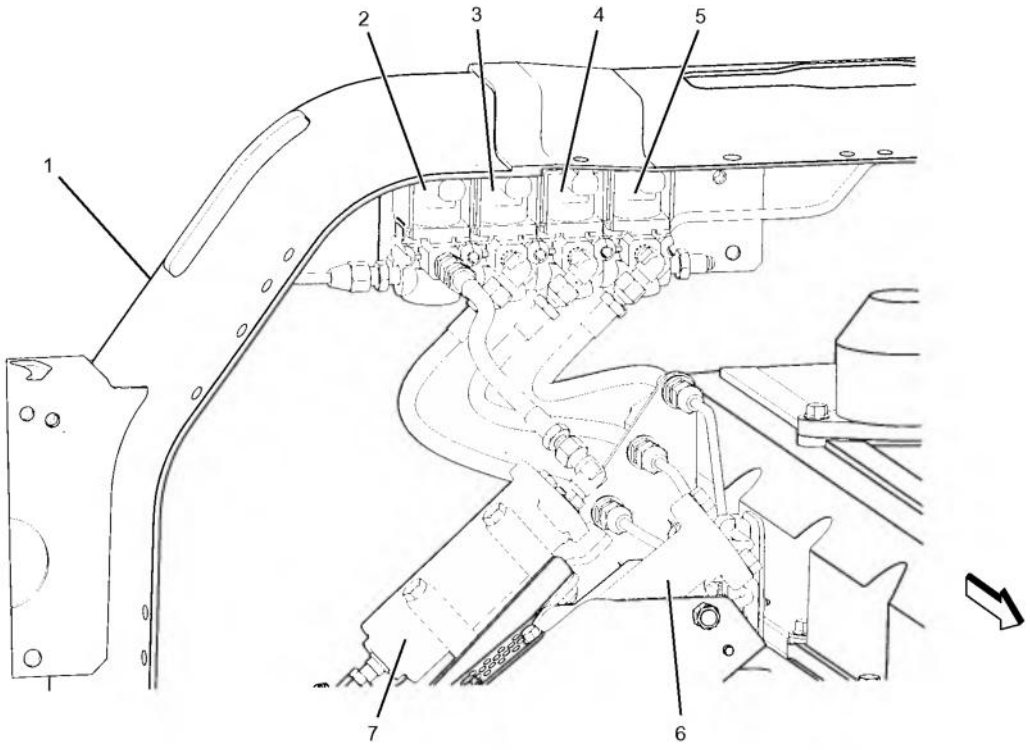


Legend

1. Signal (High)
2. Signal (Low)

The crank position (CKP) sensor is attached to the flywheel housing. A CKP signal is generated when the hole in the flywheel passes the sensor. The Engine Control Module (ECM) identifies the cylinder from the CKP signal and the CMP signal input from the cam shaft position (CMP) sensor, determines the crank angle and uses it to calculate fuel injection control and engine speed. These control functions are usually based on the CKP signal, but if the CKP sensor malfunctions, they are based on the CMP signal.

Cab Rear Member Magnetic Valve



Legend

1. Cab back member
2. Exhaust brake magnetic valve
3. VGS magnetic valve 1
4. VGS magnetic valve 2
5. VGS magnetic valve 3
6. VGS turbocharger pneumatic cylinder
7. Exhaust brake air cylinder

Terminal No.	Signal name	Terminal No.	Signal name
64	–	148	–
65	APP sensor power supply	149	–
66	–	150	Pomp control valve (PCV) 2
67	–	151	PCV 2
68	Diagnostics switch	152	PCV 1
69	–	153	PCV 1
70	–	154	Atmospheric temperature sensor signal
71	–	155	ECT sensor signal
72	ECM GND	156	–
73	ECM GND	157	–
74	ECM main relay	158	–
75	ECM main relay	159	–
76	–	160	–
77	Back lamp switch signal	161	–
78	–	162	–
79	Cruise Set switch signal	163	–
80	Stop lamp switch 2 signal	164	–
81	Idling Up switch signal	165	–
82	Check engine lamp	166	–
83	Cruise set lamp	167	–
84	Cruise main lamp	–	–

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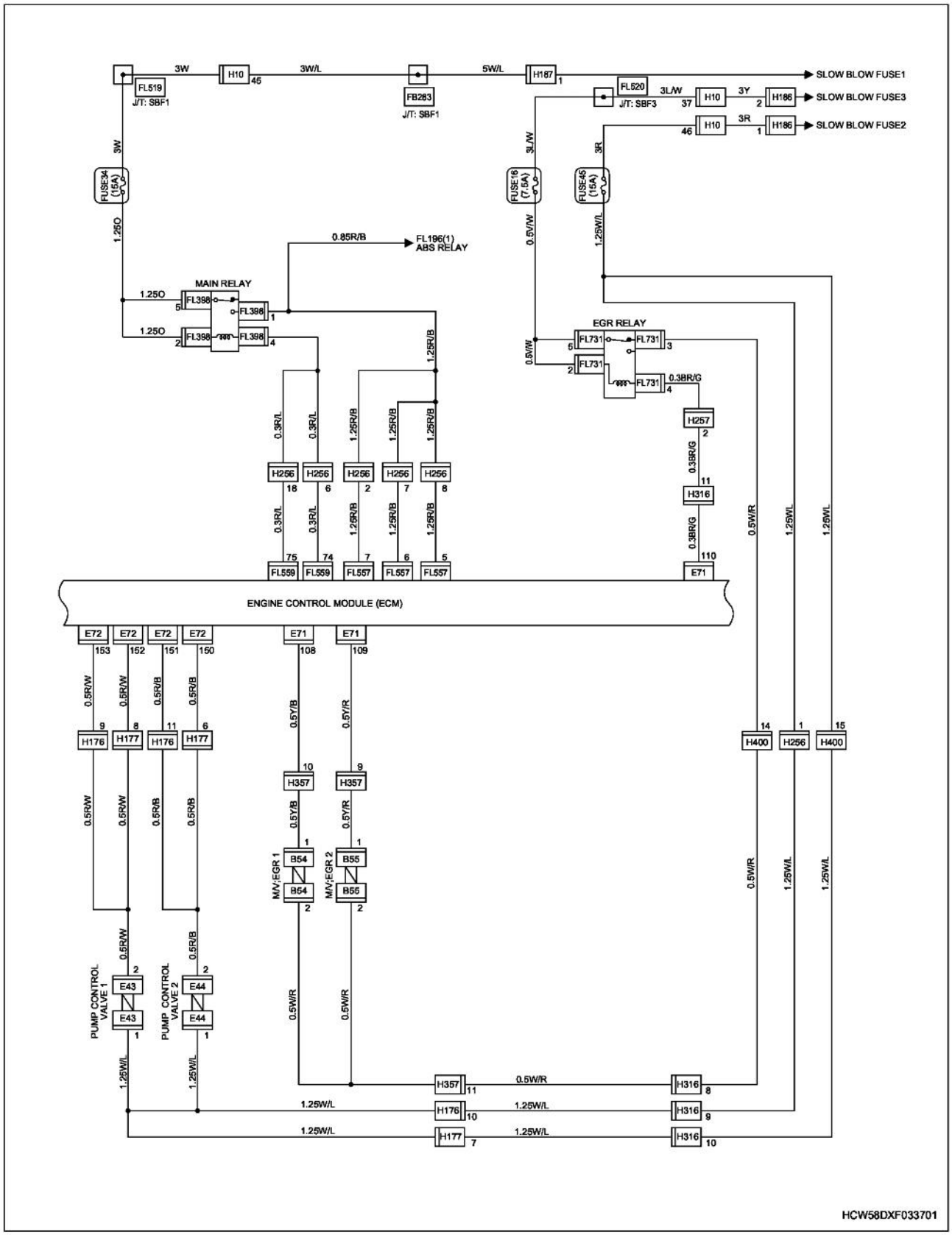
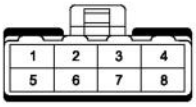
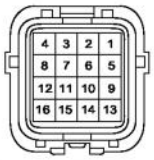
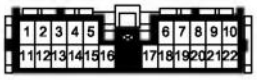
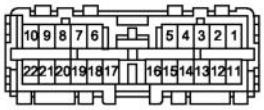
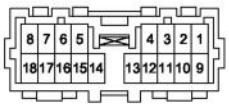
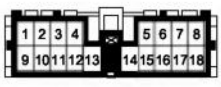
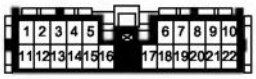
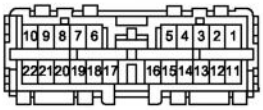
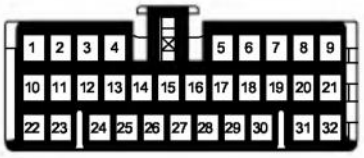
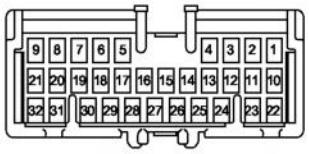
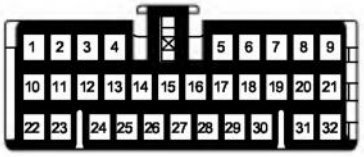
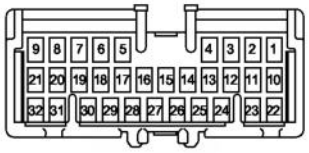

SLOW BLOW FUSE1
SLOW BLOW FUSE3
SLOW BLOW FUSE2
FL519
J/T: SBF1
FB283
J/T: SBF1
FL620
J/T: SBF3
FUSE34 (15A)
FUSE16 (7.5A)
FUSE45 (15A)
0.85R/B
FL196(1)
ABS RELAY
MAIN RELAY
EGR RELAY
ENGINE CONTROL MODULE (ECM)
PUMP CONTROL VALVE 1
PUMP CONTROL VALVE 2
M/V:EGR 1
M/V:EGR 2
HCW58DXF033701

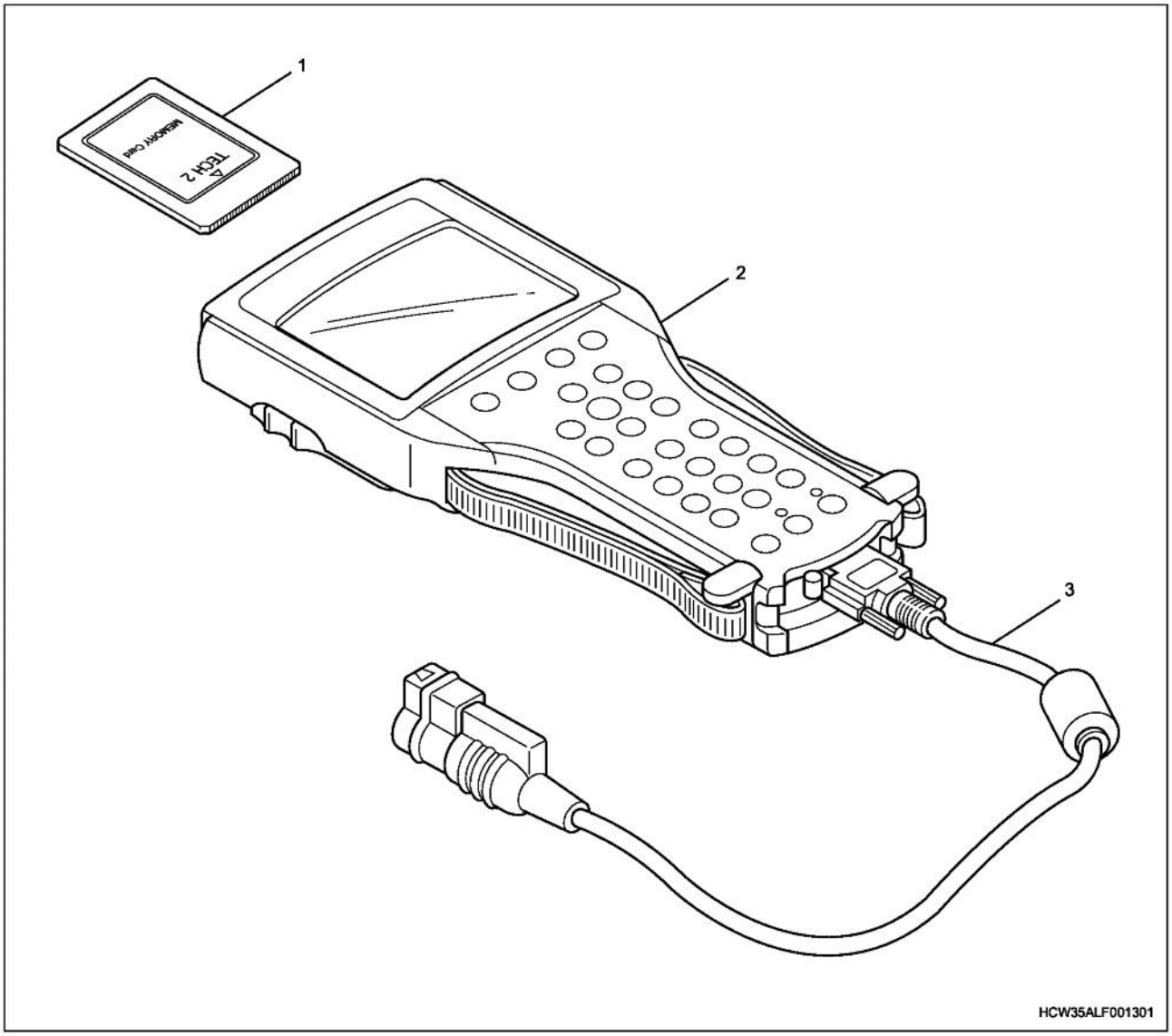
No.	Connector Face
H-187	 002-010
H-187	 008-017
H-215	 016-019
H-215	 016-020
H-256	 022-001
H-256	 022-002
H-257	 018-001
H-257	 018-002

No.	Connector Face
H-280	 022-001
H-280	 022-002
H-282	 032-014
H-282	 032-015
H-290	 032-014
H-290	 032-015
H-299	 008-005
H-299	 008-006

Breakdown diagnosis using the scan tool.

The Scan Tool (Tech2) and the Tech2 Adapter

This is an effective tool for diagnosing electrical breakdowns in the electronic control systems and carrying out system checks. If the Tech2 adapter is used to connect to the DLC on the vehicle, various diagnoses and tests can be run on the ECM and communications on the vehicle.



Legend

1. PCMCIA card (specialized)
2. Tech2 (main unit)
3. DLC cable

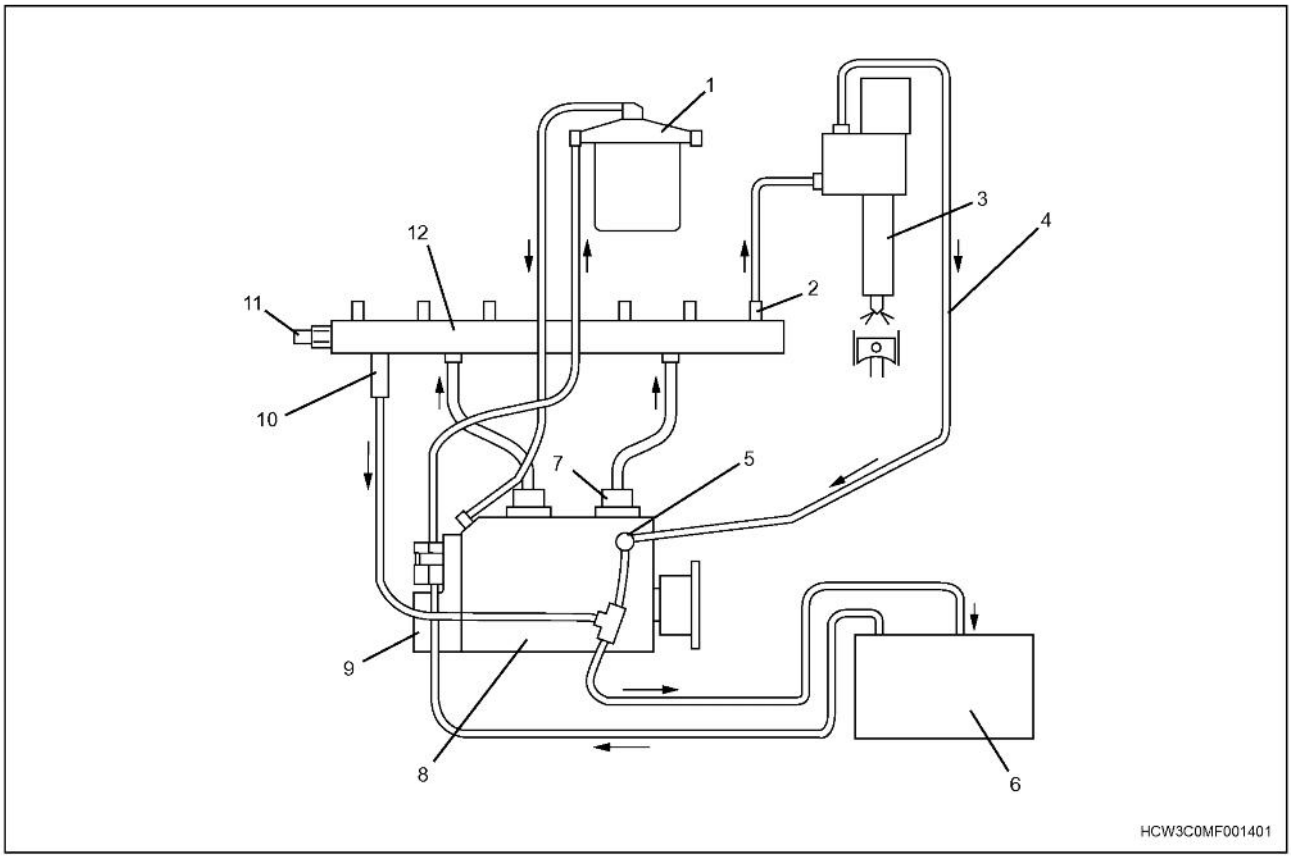
Tech2 data reference values

Data lists are for confirming the status of the vehicle and each piece of equipment.
Compares data from each vehicle to basic values and finds temporary deviations from reference values and cases where deviation is continuous. This is used for diagnostics. (This Tech2 display menu may be changed without notification.)

Data display items	Units	Idle reference values (changes caused by vehicle conditions)
System Voltage	V	more than 24
Engine Speed	RPM	With respect to goals ±25
Desired Idle Speed	RPM	475-525
APP (Accelerator Pedal Position) Sensor	V	0.25-0.75
Accelerator Opening	%	0
Accelerator Pedal Switch	On/Off	On
APP (Accelerator Pedal Position) Angle	%	0
Accelerator Position Learning Value (Idle)	V	0.25-0.75
Common Rail Pressure	MPa	
Common Rail Pressure Sensor	V	
Rail Pressure Feedback Control Timing	°CA	0
PCV (Pressure Control Valve) Closing Time	°CA	140-147
Intake Air Pressure	V	
Atmospheric Temperature Sensor	V	
Engine Coolant Temperature	V	
Fuel Temperature	V	
BARO (Barometric Pressure)	V	
Intake Air Pressure	kPa	
Atmospheric Temperature	°C	When the same as external air temperature
Engine Coolant Temperature	°C	70-85 (when fully warmed up)
Fuel Temperature	°C	
BARO (Barometric Pressure)	kPa	
Relative Boost Pressure	kPa	Approx. 2
Vehicle Speed	km/h	0
Speed Limiter Set Vehicle Speed	km/h	0
Auto Cruise Set Vehicle Speed	km/h	-
EGR Control Mode		
Injection Quantity Control Mode		-

Step	Action	Value(s)	Yes	No
1	Make sure the other lights (parking brake light, charge light, etc.) in the display turn on. 1. Turn the starter switch on. 2. Make sure the lights in the display turn on. Did the other lights turn on?	—	Go to Step 5	Go to Step 2
2	Check the power supply system of meter. 1. Turn the starter switch OFF. 2. Disconnect the meter. 3. Turn the starter switch ON, and measure the voltage between the display harness connector and GND. Is the voltage value normal?	Between connector power terminal and GND: Battery voltage	Go to Step 4	Go to Step 3
3	Inspect the power supply circuit and ground circuit of the display. When fault is detected, replace if necessary. Is the action complete?	—	Go to Step 5	—
4	Check the power supply and GND circuit for the engine control module (ECM). Go to "Engine control module (ECM) power supply and ground circuit". When fault is detected, replace if necessary. Is the action complete?	—	Go to Step 5	—
5	Make sure the MIL (check engine lamp) turns on again. 1. Connect all the harnesses. 2. Turn the starter switch ON. (At this time, engine does not start up) After staying lit for 15s, the lamp flashes 3 times on a 1s cycle, then lights again. Did the MIL (check engine lamp) turn on?	—	Verify repair and return to the OBD system check	Go to Step 6
6	Check the MIL (check engine lamp) drive circuit. 1. Turn the starter switch OFF. 2. Disconnect the harness from the ECM. 3. Turn on the starter switch and confirm that the MIL (check engine lamp) turns on when a jumper is used between the ECM harness connector and ground. Did the MIL (check engine lamp) turn on?	—	Go to Step 8	Go to Step 7
7	Repair or replace the MIL (check engine lamp) drive circuit. Is the action complete?	—	Go to Step 9	—
8	Make sure the MIL (check engine lamp) turns on again. 1. Connect all the harnesses. 2. Turn the starter switch ON. (At this time, engine does not start up) After staying lit for 15s, the lamp flashes 3 times on a 1s cycle, then lights again. Did the MIL (check engine lamp) turn on?	—	Verify repair and return to the OBD system check	Go to Step 9

Checking the fuel system



Legend

1. Fuel filter
2. Flow damper
3. Injector
4. Fuel pipe
5. Overflow valve
6. Fuel tank
7. PCV
8. Supply pump
9. Field pump
10. Pressure limiter
11. Fuel pressure sensor
12. Fuel rail

Circuit Description

The fuel system is separated into the high pressure system and the low pressure system. The high pressure system describes the area between the supply pump, the fuel rail and the injectors. The low pressure side describes the area between the tank and the supply pump as well as the fuel return. There are several filters (main, coarse filter etc.) installed in the fuel system. In addition in order to prevent discharge of fuel, there is a flow damper and a pressure limiter installed in the fuel rail and an over flow valve installed in the supply pump to prevent discharge of fuel.

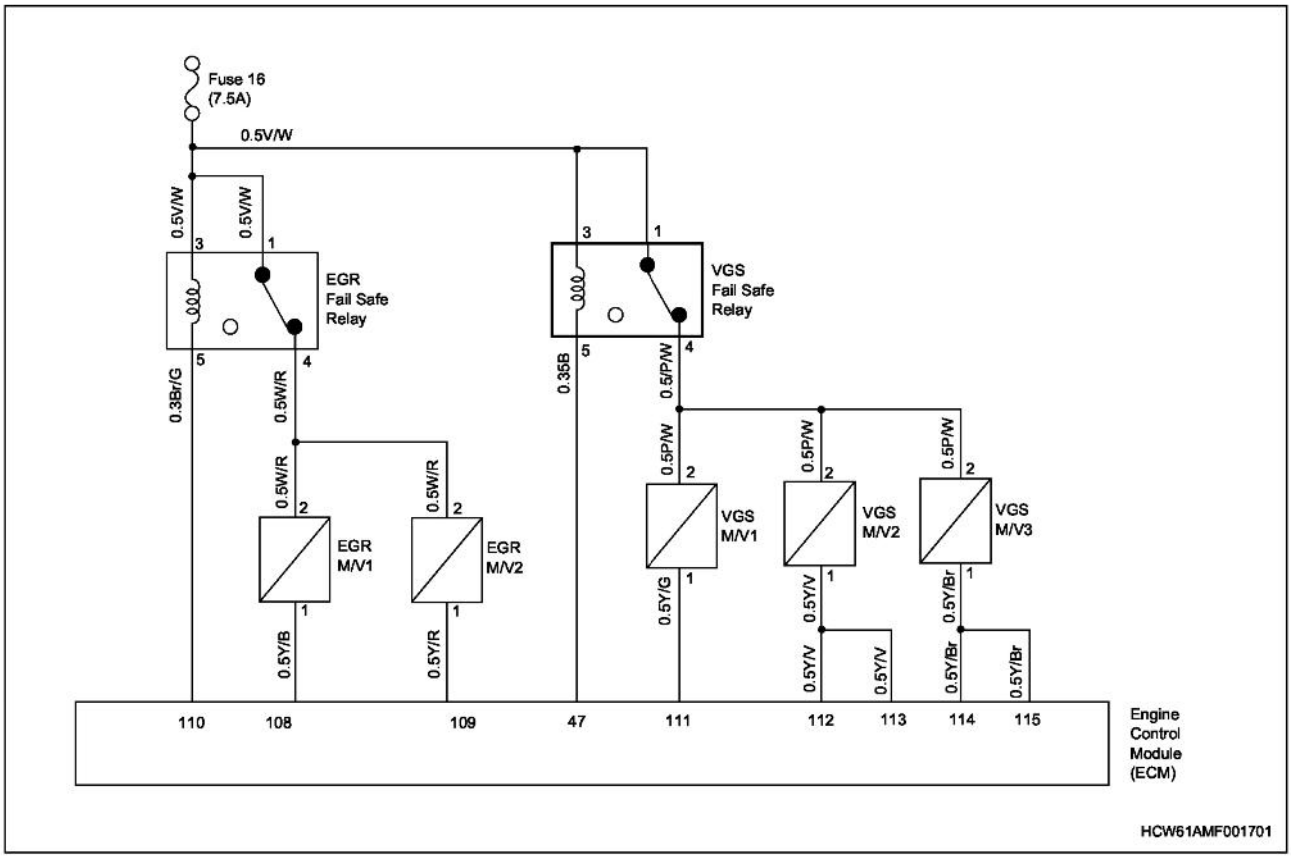
Diagnostic Aids

- Air getting into the fuel piping
- Pressure limiter, flow damper (operation, internal seal ability deterioration etc.)
- Injector internal malfunction
- Supply pump internal failure (internal seal ability deterioration etc.)
- Feed pump failure
- Fuel system pipe malfunction (fuel leak, blockage, crushed pipe etc.)
- Fuel filter abnormality (blockage, overflow valve failure etc.)
- Fuel tank malfunction (blockage, amount of fuel, additional tank etc.)
- Fuel freezing
- Amount and quality of fuel

Test Description

The following numbers show the step numbers of the diagnostic chart:

Checking the EGR



Description of circuit

EGR magnetic valves 1 and 2 are used as valves to supply air to EGR valve air cylinder. EGR valves are controlled appropriately by controlling air supply. EGR magnetic valve power is supplied through EGR magnetic valve fail safe relay, and connected to the engine control module (ECM) through the EGR magnetic valve. ECM controls individual EGR magnetic valves. If abnormalities are detected, it controls the EGR magnetic valve fail safe relay to stop power supply to individual EGR magnetic valves and stop controls.

Diagnostic aids

Check the connector for poor connection, and check to make sure that there are no abnormalities such as a frayed or broken harness, frayed wiring in the harness, or a short to another circuit. Furthermore, perform functional diagnostics to check things like operation and control of each component. Resolve any abnormality.

- EGR valve air cylinder abnormalities
- EGR pipe abnormality (loose, crushed, damaged, gas leaking, etc.)
- EGR valve, EGR magnetic valve (main body, air pipe abnormality, etc.)
- ECM malfunction

Assumed factors

- EGR valve air cylinder abnormalities
- EGR pipe abnormality (loose, crushed, damaged, gas leaking, etc.)
- EGR valve, EGR magnetic valve (main body, air pipe abnormality, etc.)
- ECM abnormalities

Step	Action	Value(s)	Yes	No
1	Use scan tool (Tech2) to inspect engine coolant temperature. If there are any abnormalities (temperature values fixed or extremely low), refer to the DCT P0023 diagnostic chart. Is the measure complete?	—	Go to Step 2	—

Table of diagnostics codes

DTC	Item	Failure details	Judgment time
P0014 Store.	CMP sensor system malfunction	One or fewer pulses per two engine rotations	Continue for one second
P0015 Store.	CKP sensor system malfunction	One or fewer pulses per one engine rotation	Continue for one second
P0022 Store.	Atmospheric temperature sensor system malfunction	Atmospheric temperature sensor output value exceeds 4.9 V or is less than 0.085 V.	Continue for 0.5 seconds
P0023 Store.	Engine coolant temperature sensor system malfunction	Engine coolant temperature sensor output value exceeds 4.9 V or is less than 0.085 V.	Continue for one second
P0024 Store.	Accelerator pedal position sensor system malfunction	Accelerator pedal position sensor output value exceeds 4.85 V or is less than 0.1 V.	Continue for one second
P0025 Store.	Vehicle speed sensor system malfunction	Vehicle speed pulse input malfunction	Continue for one second (Small pulse interval) Continue for 5 seconds (Large pulse interval)
P0032 Store.	(1) Boost sensor system malfunction or (2) High boost malfunction	(1) Boost temperature sensor output value exceeds 4.9 V or is less than 0.085 V. (2) Boost voltage is in the high boost malfunction range (according to map)	(1): Continue for one second (2): Continue for 10 seconds
P0033 Store.	Malfunction of IC for monitoring CPU	Malfunction of IC for monitoring CPU is detected. (RUN pulse reversal interval malfunction)	–
P0035 Store.	Low charge malfunction or over charge malfunction	• Low charge malfunction state detected in circuit. • Low over malfunction state detected in circuit.	Continue for one second
P0042 Store.	High boost malfunction	Boost voltage is in the high boost malfunction range (according to map)	Continue for 0.5 seconds
P0051 Store.	CPU malfunction	No RUN pulse reversal after power turned on	–

DTC	Control restore conditions	Check engine lamp display		Comments			
		DIAG SW Open (User)	DIAG SW Short (Dealer)		6WG1	6WF1 (For New Zealand)	6WF1 (For G.Exp)
P0518 Store.	When power ON is reset	Lights up	5•1•8		○	○	○
P0543 Store.	6WF1: Engine speed is 2250 rpm or less. 6WG1: Engine speed is 2600 rpm or less.	Does not light up	5•4•3		○	○	○

- Atmospheric temperature sensor malfunction (Sensor internal or detection section malfunction)
- ECM internal malfunction

- Check the connector for poor connection, and check to make sure that there are no abnormalities such as a frayed or broken harness, frayed wiring in the harness, or a short to another circuit. Furthermore, perform functional diagnostics to check things like operation and control of each component. Resolve any abnormality.

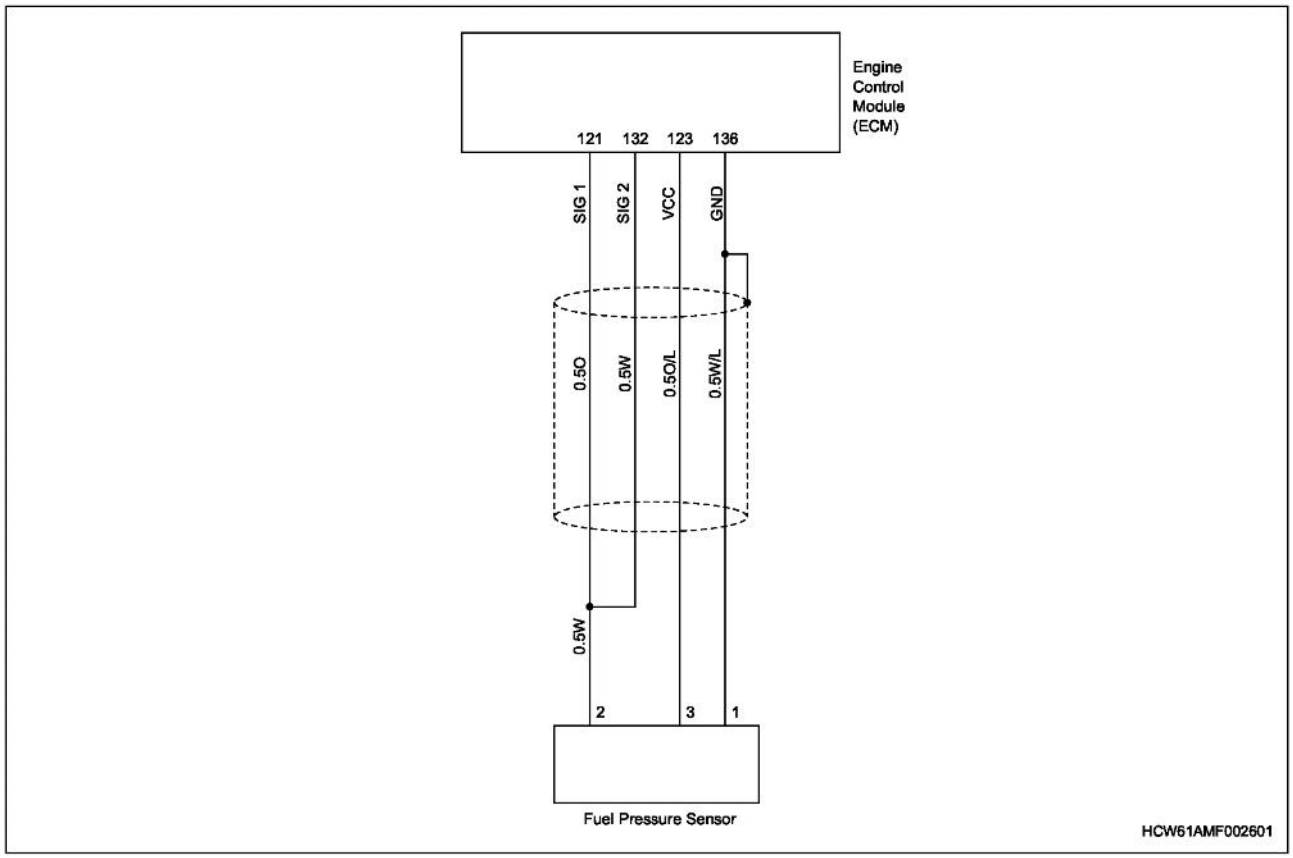
Step	Action	Value(s)	Yes	No
1	Perform an on-board diagnostic (OBD) system check. Is the procedure complete?	—	Go to Step 2	Go to "OBD system check"
2	Check the installation condition of the atmospheric temperature sensor connector. 1. Perform a visual inspection for play or slackness in the connector installation condition. 2. When fault is detected, if necessary it is corrected. Was an abnormality detected?	—	Go to Step 7	Go to Step 3
3	Inspect the atmospheric temperature sensor harness. 1. Turn the starter switch OFF. 2. Disconnect the harness from the ECM. 3. Check that there are no short circuits or broken wires in the harness between the atmospheric temperature sensor - ECM. 4. When any fault is detected, if necessary do repair or replacement. Was an abnormality detected?	—	Go to Step 7	Go to Step 4
4	Inspect the atmospheric temperature sensor circuit. 1. Turn the starter switch OFF. 2. Disconnect the harness from the atmospheric temperature sensor. 3. Turn the starter switch ON, and measure the voltage between the sensor harness connector power supply terminal and GND. Are the voltage values normal ?	Between connector power supply terminal and GND: 4.75-5.25V	Go to Step 5	Go to Step 6
5	Inspect the atmospheric temperature sensor. 1. Disconnect the harness from the atmospheric temperature sensor. 2. Measure the resistance values of sensor connector terminals. 3. When fault is detected, replace if necessary. • Between terminals: 3kΩ (20°C) • Between each terminal- GND: ∞Ω (at normal temperatures) Was an abnormality detected?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Inspect the vehicle speed sensor. 1. Turn the starter switch OFF. 2. Remove the vehicle speed sensor. 3. Check the vehicle speed sensor shaft, gears etc. for malfunctions. At this time, inspect the transmission gear section if necessary and repair any malfunctions. 4. Attach the harness to the vehicle speed sensor, and turn the starter switch ON. 5. Slowly rotate the vehicle speed sensor shaft and check the changes in voltage. Is the vehicle speed sensor normal?	Voltage changes between 1.0-3.0V and 12.0-15.0V	Go to Step 7	Go to Step 6
6	Replace the vehicle speed sensor. Is the procedure complete?	—	Go to Step 12	—
7	Inspect the speed sensor control unit for malfunctions. 1. Turn the starter switch OFF. 2. Connect to the vehicle speed sensor and harness. 3. Start the engine and drive the vehicle. 4. Check that the vehicle speed display in the scan tool is correct. Whether the numerical value is normal?	—	Go to Step 9	Go to Step 8
8	Replace the speed sensor control unit. Is the procedure complete?	—	Go to Step 12	—
9	1. Using a scan tool, operate the following switches and inspect whether the inputs are correct. • Neutral switch • Clutch switch • Parking switch Are the inputs for each switch normal?	—	Go to Step 11	Go to Step 10
10	Repair or replace the switch system in which the fault was detected. Is the procedure complete?	—	Go to Step 12	—
11	1. Replace the ECM. **IMPORTANT:** After replacing the ECM, perform the following items of programming. • Q adjustment data • Injector ID code Is the procedure complete?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
5	1. Replace the ECM. **IMPORTANT:** After replacing the ECM, perform the following items of programming. • Q adjustment data • Injector ID code Is the procedure complete?	—	Go to Step 6	—
6	Recheck the DTC. 1. Connect all harnesses. 2. Clear the DTC. 3. Turn the starter switch OFF, wait for more than 15 seconds, then turn the switch ON and start the engine. 4. Check the DTC. Was DTC P0035 detected?	—	Go to Step 2	Go to Step 7
7	Use the scan tool to check if other DTC are detected. Are other DTCs detected?	—	Go to applicable DTC	Verify repair

DTC P0115 (Flash code 115)

Fuel pressure sensor output fixed



Description of circuit

The fuel pressure sensor detects the pressure inside the fuel rail. The fuel pressure sensor is attached to the fuel rail. When the fuel pressure inside the fuel rail changes due to the condition of the engine, the output voltage of the fuel pressure sensor changes (output voltage is low when the fuel rail internal fuel pressure is low, and the output voltage increases when the pressure increases). The engine control module (ECM) reads this change in output voltage, converts it to fuel rail internal fuel pressure and uses it for control. The sensor power supply (5V), SIG, GND for fuel pressure sensor are specialized circuits connected to the ECM. Also, the sensor circuits are shielded to prevent the intrusion of electrical noise etc.

Main trouble phenomena

- White smoke/black smoke
- Lack of output
- Fluctuation of revolutions (hunting)
- Rough idling
- Start up deterioration
- PTO stop

Set conditions of DTC

If the fuel pressure is above 10Mpa and the fuel pressure sensor output value remains unchanged for approx. 8 seconds or longer, “fuel pressure sensor output fixed” is diagnosed, and [DTC P0115] is displayed.

Actions when DTC is set

- MIL (Check engine lamp) lights.
- ECM limits fuel consumption.

Clear conditions of MIL/DTC

When trouble occurs in the system and that DTC is memorized by ECM, since the fault region is not eliminated as it is by DTC, it is eliminated in the following ways. Furthermore, inspection and repair may require that you check DTCs, so be sure to note and clear the DTCs before performing inspection.

DTC deletion method

- Deleting DTC by operating the accelerator pedal (Refer to “How to delete DTCs by operating the accelerator pedal” in “Fault diagnosis process”)
- Use the scan tool (Tech2) to clear DTC.

DTC deletion method

- Deleting DTC by operating the accelerator pedal (Refer to "How to delete DTCs by operating the accelerator pedal" in "Fault diagnosis process")
- Use the scan tool (Tech2) to clear DTC.

Diagnostic aids

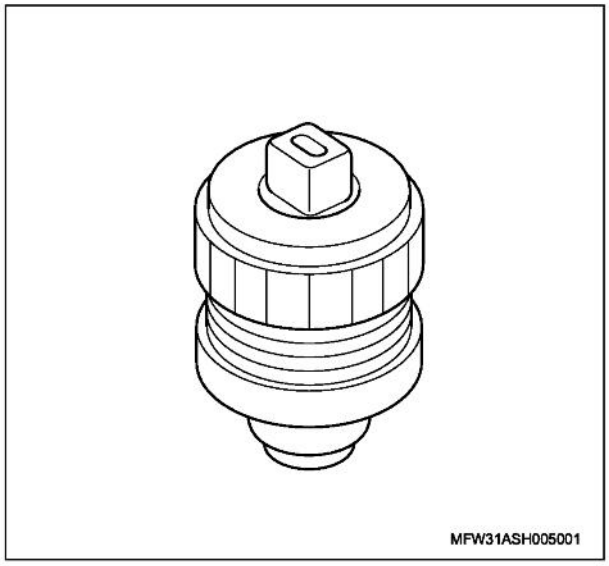
- Connector section bad connection
- Fuel pressure sensor failure (Sensor internal or detection section malfunction)
- Fuel pressure sensor installation malfunction, looseness
- Injector internal malfunction
- Supply pump internal malfunction
- Flow damper operation
- Pressure limiter not operating
- Fuel system (leak side) malfunction (blockage, crushed etc.)
- ECM internal malfunction
- To check the operation of the fuel pressure sensor at high fuel pressure (60Mpa or more), apply load on the engine with a specified loading, and check the fuel pressure changes with a scan too.
- Check the connector for poor connection, and check to make sure that there are no abnormalities such as a frayed or broken harness, frayed wiring in the harness, or a short to another circuit. Furthermore, perform functional diagnostics to check things like operation and control of each component. Resolve any abnormality.

Step	Action	Value(s)	Yes	No
1	Perform an on-board diagnostic (OBD) system check. Is the procedure complete?	—	Go to Step 2	Go to "OBD system check"
2	Perform air bleeding, and check the DTC again. 1. Connect all harnesses. 2. Clear the DTC. 3. Turn the starter switch OFF, wait for more than 15 seconds, then turn the switch ON and start the engine. 4. Check the DTC. Was DTC P0151 detected?	—	Go to Step 3	Go to Step 22
3	Check the installation condition of the fuel pressure sensor connector. 1. Perform a visual inspection for play or slackness in the connector installation condition. 2. When fault is detected, if necessary it is corrected. Was an abnormality detected?	—	Go to Step 20	Go to Step 4
4	1. Check the installation condition of the supply pump. 2. When fault is detected, repair if necessary. Was an abnormality detected?	—	Go to Step 20	Go to Step 5
5	Inspect the fuel pipe. 1. Stop the engine. 2. Check all fuel pipes for crushing, blockages and other such malfunctions. Also check the fuel filters etc. for malfunctions. 3. If fault is detected, repair or replace as necessary. Was an abnormality detected?	—	Go to Step 20	Go to Step 6

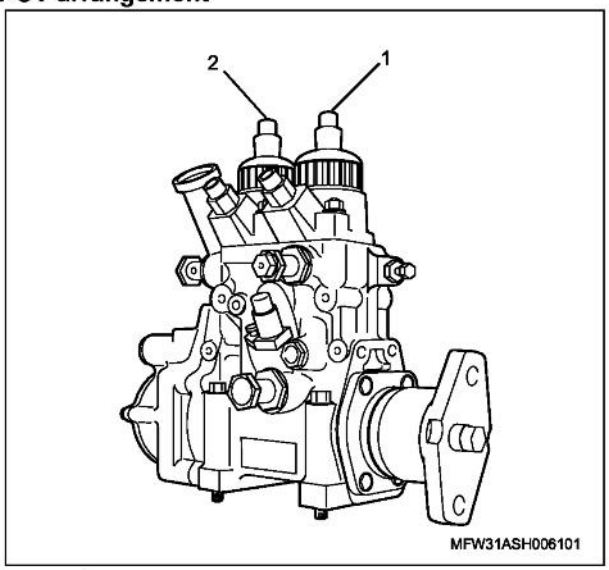
Step	Action	Value(s)	Yes	No
4	Inspect the injector power supply circuit for short circuits. 1. Disconnect the harness from the ECM. 2. Measure the voltage between ECM connector terminals. 3. If fault is detected, repair or replace as necessary. Was an abnormality detected?	Between pins 142/143 and GND: 0V	Go to Step 7	Go to Step 5
5	Inspect the injector unit. 1. Remove the harness from the injectors (2nd cylinder, 4th cylinder, 6th cylinder). 2. Measure the resistance values between injector terminals. • Between injector terminals: 0.3 - 1.3Ω • Between terminals - body: ∞Ω 3. If fault is detected, repair or replace as necessary. **IMPORTANT:** If an injector is replaced, you need to program the injector ID code. Was an abnormality detected?	—	Go to Step 7	Go to Step 6
6	1. Replace the ECM. **IMPORTANT:** After replacing the ECM, perform the following items of programming. • Q adjustment data • Injector ID code Is the procedure complete?	—	Go to Step 7	—
7	Recheck the DTC. 1. Connect all harnesses. 2. Clear the DTC. 3. Turn the starter switch OFF, wait for more than 15 seconds, then turn the switch ON and start the engine. 4. Check the DTC. Was DTC P0159 detected?	—	Go to Step 2	Go to Step 8
8	Use the scan tool to check if other DTC are detected. Are other DTCs detected?	—	Go to applicable DTC	Verify repair

Step	Action	Value(s)	Yes	No
6	Recheck the DTC. 1. Connect all harnesses. 2. Clear the DTC. 3. Turn the starter switch OFF, wait for more than 15 seconds, then turn the switch ON and start the engine. 4. Check the DTC. Was DTC P0218 detected?	—	Go to Step 2	Go to Step 7
7	Use the scan tool to check if other DTC are detected. Are other DTCs detected?	—	Go to applicable DTC	Verify repair

Pump control valve (PCV)



PCV arrangement



Legend

1. PCV1
2. PCV2

Step	Action	Value(s)	Yes	No
20	Use the scan tool to check if other DTC are detected. Are other DTCs detected?	—	Go to applicable DTC	Verify repair

Diagnostic Aids

- Connector section bad connection
- Disconnection or short of the PCV circuit
- PCV unit malfunction (internal broken wire, GND short circuit malfunction)
- ECM internal malfunction
- Check the connector for poor connection, and check to make sure that there are no abnormalities such as a frayed or broken harness, frayed wiring in the harness, or a short to another circuit. Furthermore, perform functional diagnostics to check things like operation and control of each component. Resolve any abnormality.

Step	Action	Value(s)	Yes	No
1	Perform an on-board diagnostic (OBD) system check. Is the action complete?	—	Go to Step 2	Go to "OBD system check"
2	Inspect the PCV1 unit. 1. Turn the starter switch OFF. 2. Disconnect the harness from the PCV1. 3. Measure the resistance values of the PCV1 connector terminals. • Between terminals: approx. 3.2Ω • Between each terminal - PCV1 body: ∞Ω (at normal temperatures) 4. If fault is detected, repair or replace the PCV (supply pump) as necessary. Was an abnormality detected?	—	Go to Step 7	Go to Step 3
3	Inspect the PCV1 circuit for broken wires. 1. Disconnect the harness from the ECM and PCV1. 2. Turn the starter switch ON. 3. Connect jumper wires between the PCV1 harness connector terminals, and measure the voltage on the ECM harness connector side. • Between pin 152 and GND: Battery voltage • Between pin 152 and GND: Battery voltage Is the voltage value normal?	—	Go to Step 4	Go to Step 5
4	Inspect the PCV1 circuit for a short. 1. Remove the jumper wires from between the PCV1 harness connector terminals. 2. Turn the starter switch ON, and measure the voltage on the ECM harness connector side. • Between pin 152 and GND: 0V • Between pin 153 and GND: 0V • Between pins 152 - 153: 0V Is the voltage value normal?	—	Go to Step 6	Go to Step 5
5	Inspect the PCV1 harness, and repair or replace if required. Is the action complete?	—	Go to Step 7	—

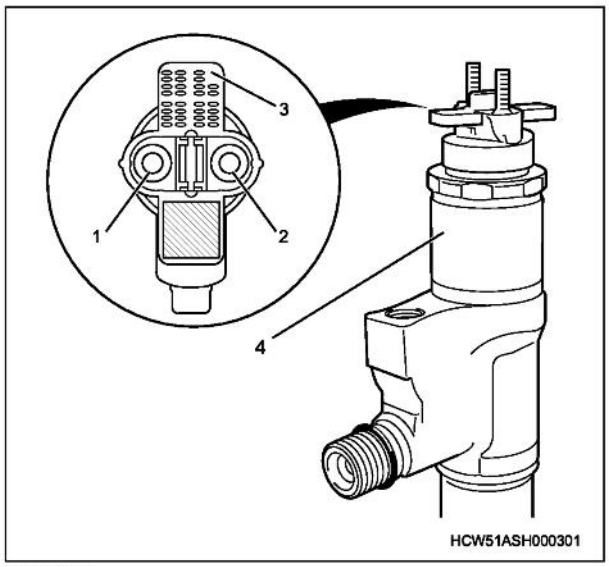
- Check the connector for poor connection, and check to make sure that there are no abnormalities such as a frayed or broken harness, frayed wiring in the harness, or a short to another circuit. Furthermore, perform functional diagnostics to check things like operation and control of each component. Resolve any abnormality.

- Injector number and cylinder number
  Injector 1 1st cylinder
  Injector 2 5th cylinder
  Injector 3 3rd cylinder
  Injector 4 6th cylinder
  Injector 5 2nd cylinder
  Injector 6 4th cylinder
  Common1: Power supply for 1st - 3rd cylinder injector
  Common2: Power supply for 4th - 6th cylinder injector

CAUTION:
Precautions to observe on injector inspection:
As the injector drive voltage is over 100V, always perform inspection and repair work with the starter switch in the OFF position to prevent electric shocks.

Step	Action	Value(s)	Yes	No
1	Perform an on-board diagnostic (OBD) system check. Is the action complete?	—	Go to Step 2	Go to "OBD system check"
2	Check whether there is a harness disconnection or short 1. Turn the starter switch OFF. 2. Disconnect the harness from the Engine Control Module (ECM). 3. Attach a digital multi meter (DMM) between the connector terminals. 4. Measure the resistance of the injector circuit. • Between pins 106 and 107: 0.5Ω or less • Between pins 105 and 106: 0.3-1.3Ω • Between pins 105 and 107: 0.3-1.3Ω • Between each connector and body (ground): ∞Ω • Between the injector body and each connector: ∞Ω(at normal temperature) Is the resistance value normal?	—	Go to Step 5	Go to Step 3
3	Inspect the injector unit. 1. Disconnect the harness from the injector (2nd cylinder). 2. Measure the resistance between injector terminals. • Between connectors: 0.3-1.3Ω • Between each connector and body: ∞Ω 3. Check the harness in the block. Is the resistance value normal?	—	Go to Step 5	Go to Step 4
4	1. Replace the injector. **IMPORTANT:** If an injector is replaced, you need to program the injector ID code. Is the action complete?	—	Go to Step 6	—

Injectors



Legend

1. Injector signal
2. Injector power supply
3. ID code plate
4. Injector

For the detection of these causes, the following kinds of inspections are required:

- Poor connection of the harness connector and ECM connector
  - Terminal breaking loose from connector
  - Inappropriate fit of terminals
  - Damage to connector lock
  - Poor connection of terminal and wire
- Damage to harness
  - Inspect for damage to the exterior of harness.
  - While moving the harness and connector related to the sensor, check the display of related items in the scan tool's engine data. The display changes show the fault region.
- Injector number and cylinder number
  - Injector 1: 1st cylinder
  - Injector 2: 5th cylinder
  - Injector 3: 3rd cylinder
  - Injector 4: 6th cylinder
  - Injector 5: 2nd cylinder
  - Injector 6: 4th cylinder
  - Common1: Power supply for 1st to 3rd cylinder injector
  - Common1: Power supply for 4th to 6th cylinder injector

CAUTION:
Precautions to observe on the injector inspection:
As the injector drive voltage is over 100V, always perform inspection and repair work with the starter switch in the OFF position to prevent electric shocks.

Step	Action	Value(s)	Yes	No
1	Perform an on-board diagnostic (OBD) system check. Is the action complete?	—	Go to Step 2	Go to "OBD system check"
2	Check the DTC. 1. Use the scan tool to check the DTC. Was DTC P0271 to P0273 or DTC P0158 detected?		Go to applicable DTC	Go to Step 3
3	Inspect for a disconnection to the injector power supply circuit (Common1). 1. Turn the starter switch OFF. 2. Remove the harness from the ECM and injectors (1st cylinder, 2nd cylinder, 3rd cylinder). 3. Measure the resistance between ECM harness connector terminals. Do the resistance values fall within the specified range?	Between pins 106 and 107: 0.5 Ω or less	Go to Step 5	Go to Step 4
4	Repair or replace the injector power supply circuit. Is the action complete?	—	Go to Step 6	—
5	Inspect for a short between the injector body terminals and ground. 1. Turn the starter switch OFF. 2. Disconnect the connector of the injector. (1st cylinder, 2nd cylinder, 3rd cylinder) 3. Measure the resistance between the each injector connector terminal and ground. Is the resistance value normal?	Between pins 1/2/3 and GND: ∞Ω	Go to Step 7	Go to Step 6
6	1. Replace any malfunctioning injector. **IMPORTANT:** If an injector is replaced, you need to program the injector ID code. Is the action complete?	—	Go to Step 8	—

For the detection of these causes, the following kinds of inspections are required:

- Poor connection of the harness connector and ECM connector
  - Terminal breaking loose from connector
  - Inappropriate fit of terminals
  - Damage to connector lock
  - Poor connection of terminal and wire
- Damage to harness
  - Inspect for damage to the exterior of harness.
  - While moving the harness and connector related to the sensor, check the display of related items in the scan tool's engine data. The display changes show the fault region.

Step	Action	Value(s)	Yes	No
1	Perform an on-board diagnostic (OBD) system check. Is the action complete?	—	Go to Step 2	Go to "OBD system check"
2	Check the DTC. 1. Use the scan tool to check the DTC. Was DTC P0418 detected?		Go to DTC P0418 diagnosis	Go to Step 3
3	Check the state of the attached VGS magnetic valve 2 connector, ECM connector, and midway connectors. 1. Inspect for play or looseness in the attached connectors. 2. Correct any detected malfunction if necessary. Was an abnormality detected?	—	Go to Step 10	Go to Step 4
4	Inspect VGS magnetic valve 2. 1. Turn the starter switch OFF. 2. Attach the VGS magnetic valve 2 connector. 3. Measure the resistance of the VGS magnetic valve 2. Do the resistance values fall within the specified range?	34-40Ω	Go to Step 6	Go to Step 5
5	Replace VGS magnetic valve 2. Is the action complete?	—	Go to Step 10	—
6	Check the harness between the VGS magnetic valve 2 and VGS fail safe relay. 1. Check for a short with the harnesses for the power supply and signals or a disconnection between the harnesses. 2. If a fault is detected, repair or replace if necessary. Was an abnormality detected?	—	Go to Step 10	Go to Step 7
7	Check the harness between the VGS magnetic valve 2 and ECM. 1. Check for a short or disconnection of the ground. 2. If a fault is detected, repair or replace if necessary. Was an abnormality detected?	—	Go to Step 10	Go to Step 8

- Terminal breaking loose from connector
- Inappropriate fit of terminals
- Damage to connector lock
- Poor connection of terminal and wire

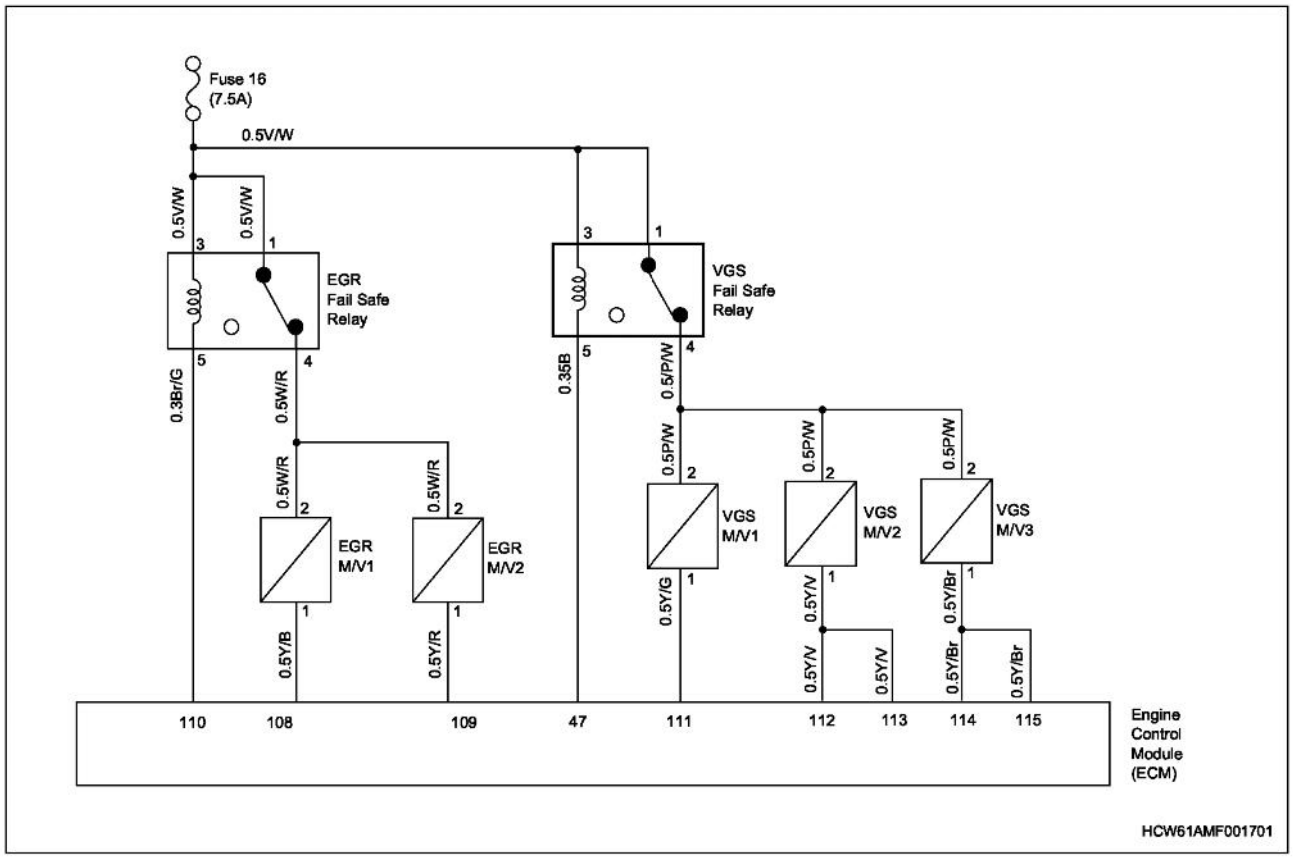
• Damage to harness

- Inspect for damage to the exterior of harness.
- While moving the harness and connector related to the sensor, check the display of related items in the scan tool's engine data. The display changes show the fault region.

Step	Action	Value(s)	Yes	No
1	Perform an on-board diagnostic (OBD) system check. Is the action complete?	—	Go to Step 2	Go to "OBD system check"
2	Check the VGS fail safe relay circuit (coil side) for a short. 1. Turn the starter switch OFF. 2. Remove the VGS fail safe relay. 3. Disconnect the harness from the Engine Control Module (ECM). 4. Turn the starter switch ON. 5. Measure the voltage between ECM harness connector terminals. Is the voltage value normal?	Between the pin 47 and body (ground): 0V	Go to Step 4	Go to Step 3
3	Repair or replace the harness between the VGS fail safe relay (coil side) and ECM. Also inspect the connector connection. Is the action complete?	—	Go to Step 4	—
4	Inspect the VGS fail safe relay. 1. Turn the starter switch OFF. 2. Attach the VGS fail safe relay. 3. Disconnect the harness from the ECM. 4. Measure the voltage when the starter switch is operated at the ECM harness connector side. • Between pin 47 and the body (ground): - Starter switch OFF: 0V - Starter switch ON: battery voltage Is the voltage value normal?	—	Go to Step 6	Go to Step 5
5	Repair or replace the VGS fail safe relay or VGS fail safe relay power supply side circuit. Is the action complete?	—	Go to Step 7	—
6	1. Replace the ECM. **IMPORTANT:** After replacing the ECM, perform the following items of programming. • Q adjustment data • Injector ID code Is the action complete?	—	Go to Step 7	—

DTC P0442 (Flash code 442)

EGR magnetic valve 2 drive error



Description of circuit

The EGR magnetic valve is attached to the right side of the cab rear member. The EGR magnetic valve controls the air supply to the EGR valve. The EGR magnetic valve is supplied power supply voltage via the battery relay and EGR fail safe relay, and is turned on by a drive signal from the ECM. The ECM turns the EGR magnetic valve on when the temperature of the engine coolant rises and the EGR operating conditions are met. A monitor circuit inside the ECM monitors magnetic valve operation.
The ECM sets a DTC when the drive voltage becomes abnormal while the EGR magnetic valve is being driven.

Main trouble phenomena

- Lack of output

DTC set conditions

- If the operating voltage of EGR magnetic valve 2 continues in an abnormal state for 1.2 seconds, an EGR magnetic valve 2 drive error is diagnosed, and “DTC P0442” is displayed.

Actions when DTC is set

- MIL (check engine lamp) lights.
- The ECM stops the control of the EGR magnetic valves 1 and 2.

Clear conditions of MIL/DTC

When trouble occurs in the system and DTC is stored in ECM, the DTC does not disappear unless the malfunction is fixed. To clear the DTC, follow the procedure below. Furthermore, inspection and repair may require that you check DTCs, so be sure to note and clear the DTCs before performing inspection.

Method of clearing DTC

- Clearing DTC by operating the accelerator pedal (Refer to “How to delete DTCs by operating the accelerator pedal” in “Fault diagnosis process”)
- Use the scan tool (Tech2) to clear DTC.

Diagnostic aids

If an intermittent problem is suspected, consider the following causes.

- Switch unit malfunction
- Switch adjustment problem
- Poor connection of harness connector
- Poor harness wiring plan
- Wearing out of harness covering

Step	Action	Value(s)	Yes	No
6	Check that there are no short circuits or broken wires between the EGR temperature sensor1 - ECM. 1. Turn the starter switch OFF. 2. Disconnect the ECM and sensor. 3. Measure the resistance value between the ECM harness connector terminals and ECM harness connectors, and GND. • Between pins 33 and 54: ∞Ω • Between pins 33/54 and GND: ∞Ω 4. If fault is detected, repair or replace as necessary. Was an abnormality detected?	—	Go to Step 15	Go to Step 7
7	Inspect 5V power of EGR gas temperature sensor1 1. Turn the starter switch OFF. 2. Disconnect the connector of the sensor. 3. Turn the starter switch ON/OFF, and measure the voltage between each sensor harness connector signal terminal and GND. • Starter switch ON: 5V • Starter switch OFF: 0V Is the voltage value normal?	—	Go to Step 8	Go to Step 14
8	Inspect the air spring beam. 1. Remove air pipe from EGR valve1. 2. Use scan tool to operate magnetic valve. (Refer to “Scan Tool” in the scan tool for fault diagnosis test mode magnetic valve operation check.) Check whether air comes from the external air pipe. • Magnetic valve ON: air emission • Magnetic valve OFF: no air emission 3. If fault is detected, repair or replace as necessary. Was an abnormality detected?	—	Go to Step 15	Go to Step 9
9	Check the functioning of EGR valve1. 1. Disconnect EGR valve1. 2. Send the default compression pressure to the air port, and check that the valve opens. Whether the operation of EGR valve1 is normal?	637.4-882.6kPa (4781-6620mmHg)	Go to Step 11	Go to Step 10
10	Replace EGR valve1. Is the action complete?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
7	Inspect the 5V power source of EGR gas temperature sensor. 1. Turn "OFF" the starter switch. 2. Remove the connector of the sensor. 3. "ON/OFF" the starter switch to measure each voltage from the sensor harness connector signal terminal to ground. • Starter switch ON: 5V • Starter switch OFF: 0V Is the voltage value correct?	—	Go to Step 8	Go to Step 14
8	Inspect the air piping. 1. Remove the air piping from EGR valve 2. 2. Operate the scan tool to activate the magnetic valve. (Refer to the fault diagnosis test mode magnetic valve operation check from the scan tool's "Scan Tool" display.) Check if the air is supplied from the disconnected air piping. • Magnetic valve ON: air emission • Magnetic valve OFF: no air emission 3. If any fault is detected, repair or replace the part as necessary. Was the fault detected?	—	Go to Step 15	Go to Step 9
9	Check the EGR valve 2 operation. 1. Remove the EGR valve 2. 2. Send the compressed air of specified pressure value into the air port, to check if the valve opens. Does the EGR valve 1 operate normally?	637.4-882.6kPa (4781-6620mmHg)	Go to Step 11	Go to Step 10
10	Replace the EGR valve 2. Was the action complete?	—	Go to Step 15	—
11	Check the operation of the EGR gas temperature sensor 2. 1. Connect all the harnesses. 2. Turn the starter switch "ON" to start the engine. 3. Warm up the engine until the engine coolant temperature reaches 80°C. 4. Using the scan tool, turn the EGR magnetic valve ON. 5. Raise the engine revs gradually, then check if the EGR gas temperature rises using the scan tool. **CAUTION:** EGR control is not performed when the exhaust brake is activated. Is the EGR gas temperature sensor 2 operating normally?	—	Go to Step 14	Go to Step 12
12	Replace the EGR gas temperature sensor 2. Was the action complete?	—	Go to Step 13	—

Engine hunting, rough idle

Preliminary Inspection

Before using this section, perform an "On-Board Diagnosis (OBD) Systems Check", then check all of the items shown below.

- The engine control module (ECM) and MIL (Check Engine lamp) are operating correctly.
- Check the DTC.
- The scan tool (Tech 2) is within the normal operating range.
- Check the customer's complaint, and find appropriate symptoms from the table of contents. Carry out the procedures shown in the symptoms chart.
- Check with the customer that the specified (correct) engine oil and fuel are being used.

Visual Inspection

Some symptom diagnosis procedures need careful visual inspection. This visual inspection helps correct the problem with no further inspection, thus saving valuable time.
This visual inspection includes the following items.

- Correct connection, loose attachments and broken wires in the electrical wiring.
- Check that Commercial accessory power supply is not using a branch of the ECM power supply.
- Check the ECM earth is not dirty, and it is firmly attached in the correct location.
- Pipes and hoses related to fuel, air and oil are not cracked or twisted, and are connected correctly. Thoroughly check for any kind of block or leakage.
- Check that there is no fuel leakage, no dents or damage to the pipes of the fuel system.
- Air intake system parts faults.
- Exhaust system parts faults.

Diagnostic Aids

- Fuel system faults (out of fuel, frozen fuel, air in the fuel line, filter faults {main, gauze filter blockage}, line/pipe fault, fuel quality, fuel tank (dirt, fuel suction fault etc.)
- Air intake system faults (filter blockage, air line faults etc.)
- Supply pump (including feed pump) fault (luck of fuel feed pressure)
- Switches input circuit system fault (PTO switch, clutch switch, harness, etc.)
- Sensor input circuit fault (sensor, harness, etc.)
- Accelerator pedal position sensor, PTO remote throttle sensor system faults (sensor, harness, etc.)
- System back up (fail safe), due to fault.
- Malfunction of the engine itself (Burning, lack of compression pressure, other mechanical failures).
- Chassis related parts (clutch, transmission, brake) faults
- Effect of newly installed electrical components (radio, lamps, etc.)
- ECM faults (ECM main body, power supply, GND etc.)
- Check for bad connector contacts, errors due to abrasion or bending of the harness and broken wires in the harness causing shorts with other circuits. Also, inspect the function diagnostics to check the action and control of each component, and make repairs if necessary.

Step	Action	Value(s)	Yes	No
1	Perform the On-Board Diagnosis (OBD) systems check. Was the action complete?	—	Go to Step 2	Go to "OBD system check"
2	Check the fuel. 1. Replace the fuel inside the fuel tank and fuel lines. 2. Start the engine and drive the vehicle to check if the same symptom is still observed. Does the engine operate normally?	—	Go to Step 22	Go to Step 3
3	Bleed air from the fuel lines and check again to see if the same symptom is still observed. Does the engine operate normal?	—	Go to Step 22	Go to Step 4
4	Check the performance of the air intake system. Was the action complete?	—	Go to Step 5	Go to "Checking the Air Intake System"
5	Check the performance of the fuel system. Was the action complete?	—	Go to Step 6	Go to "Checking the Fuel System"

Idling revolutions cannot be adjusted

Preliminary Inspection

Before using this section, perform an "On-Board Diagnosis (OBD) Systems Check", then check all of the items shown below.

- The engine control module (ECM) and MIL (Check Engine lamp) are operating correctly.
- Check the DTC.
- The scan tool (Tech 2) is within the normal operating range.
- Check the customer's complaint, and find appropriate symptoms from the table of contents. Carry out the procedures shown in the symptoms chart.
- Check with the customer that the specified (correct) engine oil and fuel are being used.

Visual Inspection

Some symptom diagnosis procedures need careful visual inspection. This visual inspection helps correct the problem with no further inspection, thus saving valuable time.
This visual inspection includes the following items.

- Correct connection, loose attachments and broken wires in the electrical wiring.
- Check that Commercial accessory power supply is not using a branch of the ECM power supply.
- Check the ECM earth is not dirty, and it is firmly attached in the correct location.

Diagnostic Aids

- Idling control switch operation, switch position
- Idling control switch (UP/DOWN) fault
- Idling control switching circuit fault
- Switch input circuit fault (idling control switch, idling control switching switch, etc.)
- Sensor input circuit fault (sensor, harness, etc.)
- Neutral position switch fault
- Vehicle speed sensor fault
- ECM faults (ECM main body, power supply, GND etc.)

Step	Action	Value(s)	Yes	No
1	Perform the On-Board Diagnosis (OBD) systems check. Was the action complete?	—	Go to Step 2	Go to "OBD system check"
2	Adjust the idling revolutions by switching the idling control switch to [MANU] (pressing the "UP" or "DOWN" side). Was idling revolutions adjusted?	—	Go to Step 7	Go to Step 3
3	Inspect the idling control switch and idling control switching switch. 1. Connect the scan tool. 2. Shift the gear position to neutral. 3. Turn "ON" the starter switch. 4. Display engine data on scan tool. 5. Operate each switch. 6. Check whether the scan tool screen display (ON, OFF) changes when the switch is operated. • Idle up switch (idling control switch) • Idle down switch (idling control switch) • Idling control switching switch If the switch input display (ON, OFF) does not change, perform repairs/replacement of the faulty switch/ circuit. Was the action complete?	—	Go to Step 4	—
4	Inspect the condition of the accelerator pedal position sensor and accelerator switch. Refer to DTC P0023, P0024 and repair or replace the affected parts if any faults are found. Was the action complete?	—	Go to Step 5	—