

Introduction

This Troubleshooting Manual describes the structure and the troubleshooting of electronic control fuel injection system (common rail type) in 4HK1 and 6HK1 industrial engines.

Use this manual sufficiently to perform service work properly and quickly.

Isuzu Motors Limited
Off-highway Powertrain
Operation Dept.

Control System

Engine Control

(Electronic control fuel injection system (Common rail type))

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How to use this manual

This manual describes about engine-related trouble diagnosis, and is closely related to the machine trouble diagnosis. Always refer to both manuals for the trouble diagnosis.

This manual consists of the following contents. This section “How to use this manual” describes about abbreviations and instructions to use this manual. Therefore, if you are familiar with Isuzu manuals, start with Precautions on service work and Basic procedure of trouble diagnosis.

How to use this manual

- Table of abbreviation
- List of parts according to engine control specifications
- Wiring color code
- How to use wiring diagram

Precautions on service work

Procedure of trouble diagnosis

How to use trouble diagnosis-related tool

- How to use scan tool
- How to use TIS 2000
- How to use injector checker
- How to use flush tool
- How to use breaker box

Engine control system

List of function checks

List of diagnostic trouble codes

List of trouble symptom

10D-5 Electronic control fuel injection system (Common rail type)

Table of abbreviation

Abbreviation	Name	Meaning and remarks
A/D	Analog/Digital	Analog/Digital
AP	Accelerator Position	Accelerator Pedal Position
CAN	Controller Area Network	Communication system used to communicate between ECM and the machine control unit
CKP	Crankshaft Position	Crankshaft (the sensor is installed onto flywheel housing) position
C/U	Control/Unit	Abbreviation of control unit
CMP	Camshaft Position	Camshaft (the sensor is installed onto the rear of cylinder head) position
DLC	Data Link Connector	Connector for scan tool (also known as: Checker connector)
EMPS	Engine Module Programming System	Rewriting of control program in ECM
DMM	Digital Multi-Meter	Diagnostic tester for electrical equipment system (5-8840-2691-0)
DTC	Diagnostic Trouble Code	Self-diagnosis code numbers which indicate trouble condition
ECT	Engine Coolant Temperature	Engine coolant temperature
ECM	Engine Control Module	Core of engine control in engine control computer
ECU	Electronic Control Unit	Computer for various control
EGR	Exhaust Gas Recirculation	Recirculation system which mixes exhaust gas from engine with intake air again to lower the combustion temperature resulting in reduction of NOx.
EMI	Electro Magnetic Interference	Electro magnetic interference
Exh	Exhaust	Exhaust
F/B	Feed/Back	Abbreviation of feedback
FT	Fuel Temperature	Fuel temperature (the sensor is installed onto supply pump.)
GND	Ground	Ground/Earth
IAT	Intake Air Temperature	Intake air temperature
J/C	Joint/Connection	Connector which connects each harness
MIL	Malfunction Indicator Lamp	Warning lamp MIL (diagnosis lamp)
PC	Pressure Control	Pressure control/Common rail pressure
SCV	Suction control valve	Valve which controls fuel flow to common rail and is installed onto supply pump
PCV	Pressure Control Valve	Valve which controls fuel flow to common rail and is installed onto supply pump
PWM	Pulse Width Modulation	Pulse width modulated wave
QOS	Quick On Start	Warming-up device
RP	Rail pressure	Pressure in common rail
SBF	Slow blow fuse	Slow-blow type fuse which protects circuits of battery, motor, etc.

Electronic control fuel injection system (Common rail type) 10D-6

Abbreviation	Name	Meaning and remarks
SIG	Signal	Signal
VSS	Vehicle Speed Sensor	Sensor used to detect vehicle speed to control meters or engine
W/S	Weld/Splice	Joint of each harness without connector

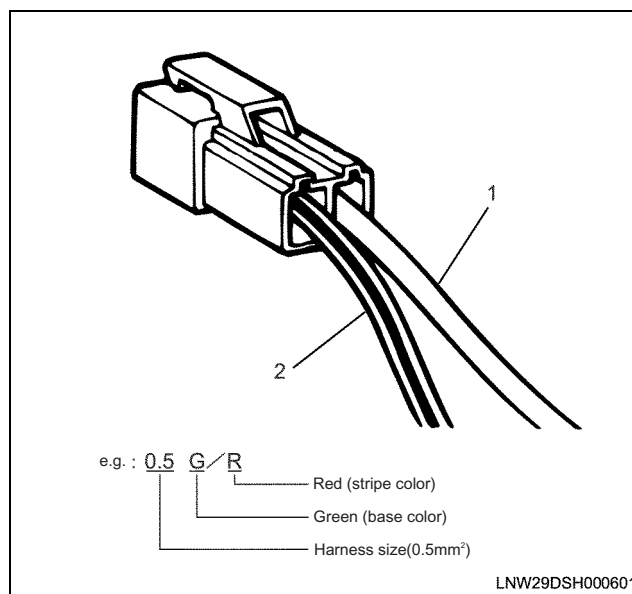
List of parts according to engine control specifications

	Engine					Function
	6W	6U	6H	4H	4J	
PCV	○	○				Controls the fuel pressure feed of supply pump.
SCV			○	○	○	Controls the fuel pressure feed of supply pump.
CMP sensor			○	○	○	Detects camshaft position of engine (used for identifying cylinder.)
G sensor	○	○				Detects cam position of supply pump (used for identifying cylinder.)
CKP sensor	○	○	○	○	○	Detects crankshaft position (used for engine control in general.)

10D-7 Electronic control fuel injection system (Common rail type)

About colors of wirings

All harnesses are identified by using different colors of claddings. The harness for the main circuit in a certain electrical system is identified by using a single color, while the harness for the sub circuit uses a color in stripes. Sizes and colors coding in a wiring diagram are as follows.

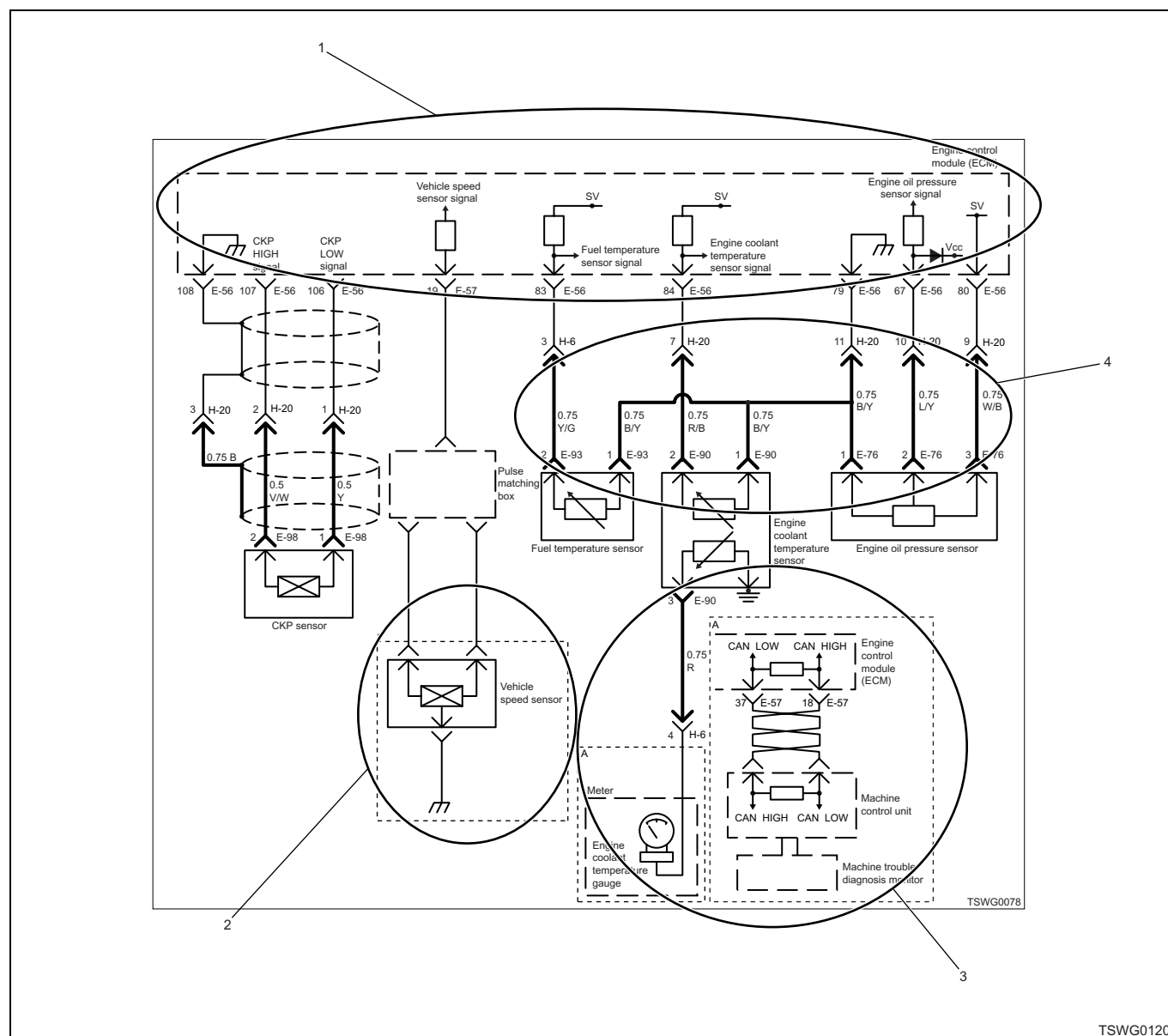


Name

1. Single color
2. Color stripe

Symbol	Color	Symbol	Color
B	Black	BR	Brown
W	White	LG	Light green
R	Red	GR	Grey
G	Green	P	Pink
Y	Yellow	SB	Sky blue
L	Blue	V	Violet
O	Orange		

About wiring diagrams

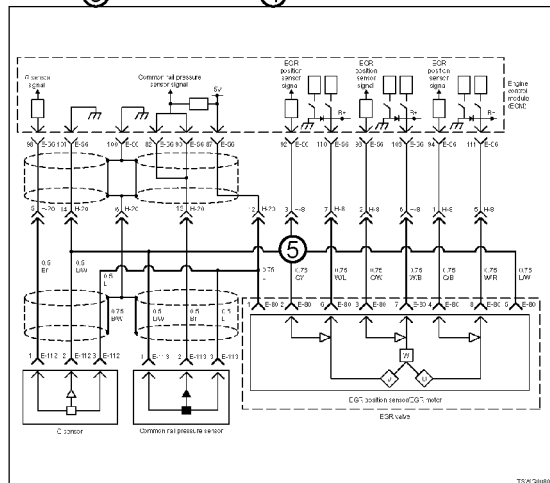


1. Sections surrounded by long broken lines are used to indicate the units, such as ECM.
2. Sections surrounded by dotted lines are used to classify or differentiate the specifications of machines. Confirmation of specifications is needed.
3. Sections surrounded by dotted lines and marked with a symbol ("A" in example) on the upper left are used to classify different wiring in the specifications of machines. Confirmation of specifications is needed.
4. Sections surrounded by heavy lines are used to differentiate engine harnesses from other harnesses. Heavy lines indicate engine harnesses, other lines indicate machine harnesses.

How to read trouble diagnosis section

The following illustration is an example for trouble diagnosis section. See this illustration and description.

DTC: ① ② (Flush code ② ⑤)
Common rail pressure sensor fault (low voltage fault) ④



Description of circuit

The common rail pressure sensor detects the common rail internal pressure. The common rail pressure sensor is installed to the common rail. As the common rail internal pressure changes depending on engine condition, output voltage of the common rail pressure sensor will change (⑥). Common rail internal fuel pressure is low, output voltage becomes low, if the pressure is high, the output voltage becomes high as well. The engine control module (ECM) reads this output voltage change, converting it into common rail internal pressure, to utilize for control. Dedicated communication circuits are used for the sensor power supply (5V), SIG and ground in the common rail pressure sensor, which are connected to the ECM. Also, the sensor circuit is shielded to avoid electrical noise etc.

Main trouble symptom

- Engine blow (⑦)
- Preconditions when DTC is set
 - Key switch input voltage is 18 V or more.
 - DTC P1630 or P1635 is not detected.

DTC set condition

- Common rail pressure sensor voltage is 0.7 V or less.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Return to normal condition

- ⑪

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from trouble).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
 - Defective harness wiring
 - Worn harness cladding
 - Wire disconnection inside harness cladding
- Following inspections are necessary to detect these causes.
- Improper connection of harness connector and ECM connector

Diagnostic aid

- Poor connection of terminal from connector
- Unmated terminals are fitted.
- Damage of connector lock
- Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

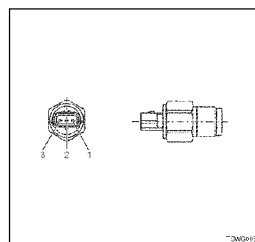
Test description

Numbers below indicate step numbers in the chart.
3. In case of current trouble, the "Common rail pressure sensor" displays more than the specified value. In this case, identify the cause by referring to "Diagnostic aid".
5. If the "Common rail pressure sensor" displays more than the specified value when the common rail pressure sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check" and Go to Step 2.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 14.
3	Check the value for common rail pressure sensor using scan tool. 1. Connect the scan tool. 2. Start the engine.	0.7V (at idle)	Go to Step 4.	Go to "Diagnostic aid"

6	Refer to "Breaker box inspection procedure". • Open circuit • High resistance			
7	Is the trouble detected? 1. Check for followings in the signal circuit between ECM and common rail pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to common rail pressure sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required.	Go to Step 12.	Go to Step 7.	
8	Is the trouble detected? Replace the common rail (common rail pressure sensor).	Go to Step 12.	Go to Step 9.	
9	Note: For work procedure, refer to "Engine repair manual."	Go to Step 12.	Go to Step 10.	Go to Step 11.

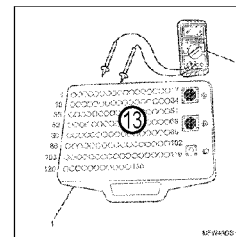
About common rail pressure sensor



Name
1. GND
2. Signal
3. Power supply

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name
1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	87 - Sensor connector power supply terminal	100Ω or less	10MΩ or more
7	Short circuit to ground circuit/ground	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	82 - 101 90 - 101 82 - Ground 90 - Ground	10MΩ or more	100Ω or less
	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	82 - Sensor connector signal terminal 90 - Sensor connector signal terminal	100Ω or less	10MΩ or more

Description of DTC diagnosis section

The following numbers correspond to those shown in the illustration. They describe each item.

1. DTC:
This indicates trouble code.
2. Flash code
Trouble code indicated by lamp flashing
3. Description of trouble symptom
4. Conditions on system that establish the codes
5. Circuit diagram
Circuit diagram related to trouble code
6. Description of circuit
System circuit principle related to trouble
7. Main trouble symptom
Expected state of engine caused by system trouble
8. Preconditions when DTC is set
Judgment is not performed unless this condition is established.
9. DTC set condition
Condition for fault judgment when preconditions are met
10. Action taken when DTC is set
Behavior of diagnosis lamp, monitor display on the machine and engine control when trouble code is set.
11. Recovery from failure
Description of recovery from failure to normal state
12. Diagnostic aid
Expected trouble causes are listed. They are important information to perform diagnosis.
Be sure to read before trouble diagnosis.
13. Breaker box inspection procedure
There is an appropriate table in diagnostic chart. It describes detailed diagnostic procedure.

Precautions on Service Work

Use of tools for circuit test

If there are no special instructions according to the diagnostic procedure, test lights must not be used in the diagnosis of electric system of powertrain. Use a connector test adaptor kit 5-8840-0385-0 when a probe connector is required during the diagnostic procedure.

Commercial electrical equipment

Commercial electrical equipment means that commercial electrical components installed to a machine after shipment from factory. Be careful that no special consideration for this equipment is taken in the design process of the machine.

Caution:

Connect commercial electrical equipment to the circuit whose power supply and ground wires are not related to the electronic control system.

Commercial electrical equipment may cause malfunction of the electronic control system even if they are installed properly. They include devices which are not connected to the electrical systems on the machine, such as mobile phones or radios. Therefore, in trouble diagnosis of powertrain, first check if this commercial electrical equipment is installed, and if so, remove it from the machine. If the trouble has not been solved after the removal, diagnose it in usual procedures.

Welding work on the machine

If performing welding on the machine, remove the battery in advance. Otherwise, the current during welding may cause system trouble or damage.

Damage caused by electrostatic discharge

The electronic components used in the electronic control systems are easy to get damaged, caused by electrostatic discharge because they are designed to operate in a very low voltage. Some kinds of electronic components may get damaged by electrostatic in even less than 100 V which human cannot feel. For reference sake, the voltage of 4,000 V is needed for human to feel the flow of electrostatic discharge.

There are several ways for human body to have electrostatic charged. The common way to be charged is caused by friction or induction.

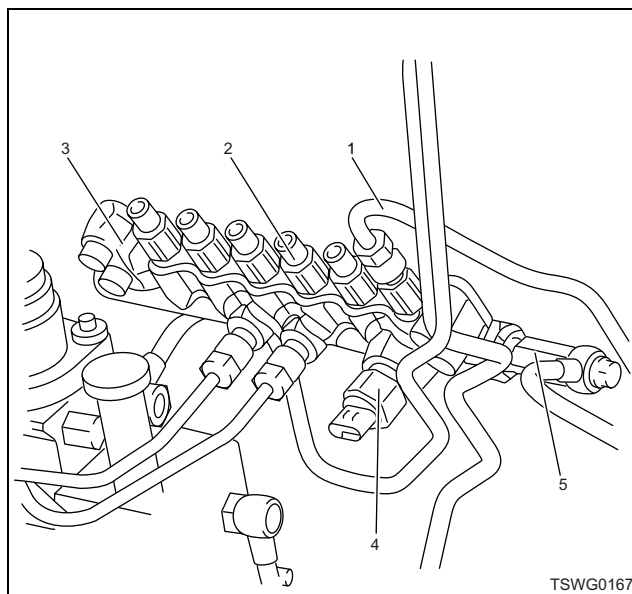
- For example, a charging by friction is caused when a person slides on the seat of the machine.
- A charging by induction occurs when a person who wears well-insulated shoes stands near the high-electrified object and then he grounds instantly. The same electric charge flows out and that person is charged in the high opposite electric charge. It is important to be careful in handling or testing the electronic components because electrostatic causes damage.

Caution:

The following guidelines should be followed to prevent the damage caused by electrostatic discharge:

- Do not touch the ECM connector pins or the electronic components soldered on to the circuit board of the ECM.
- Package of that part should not be opened until the preparation of the installation of the replacement part is completed.
- Connect that package to the normal grounding on the machine before taking out the parts from the package.
- If handling the parts with moving seats in sliding, or sitting down from the standing position, or walking for a certain distance, it is required to touch the normal grounding before the installation of the parts.

Fuel pipe



Name

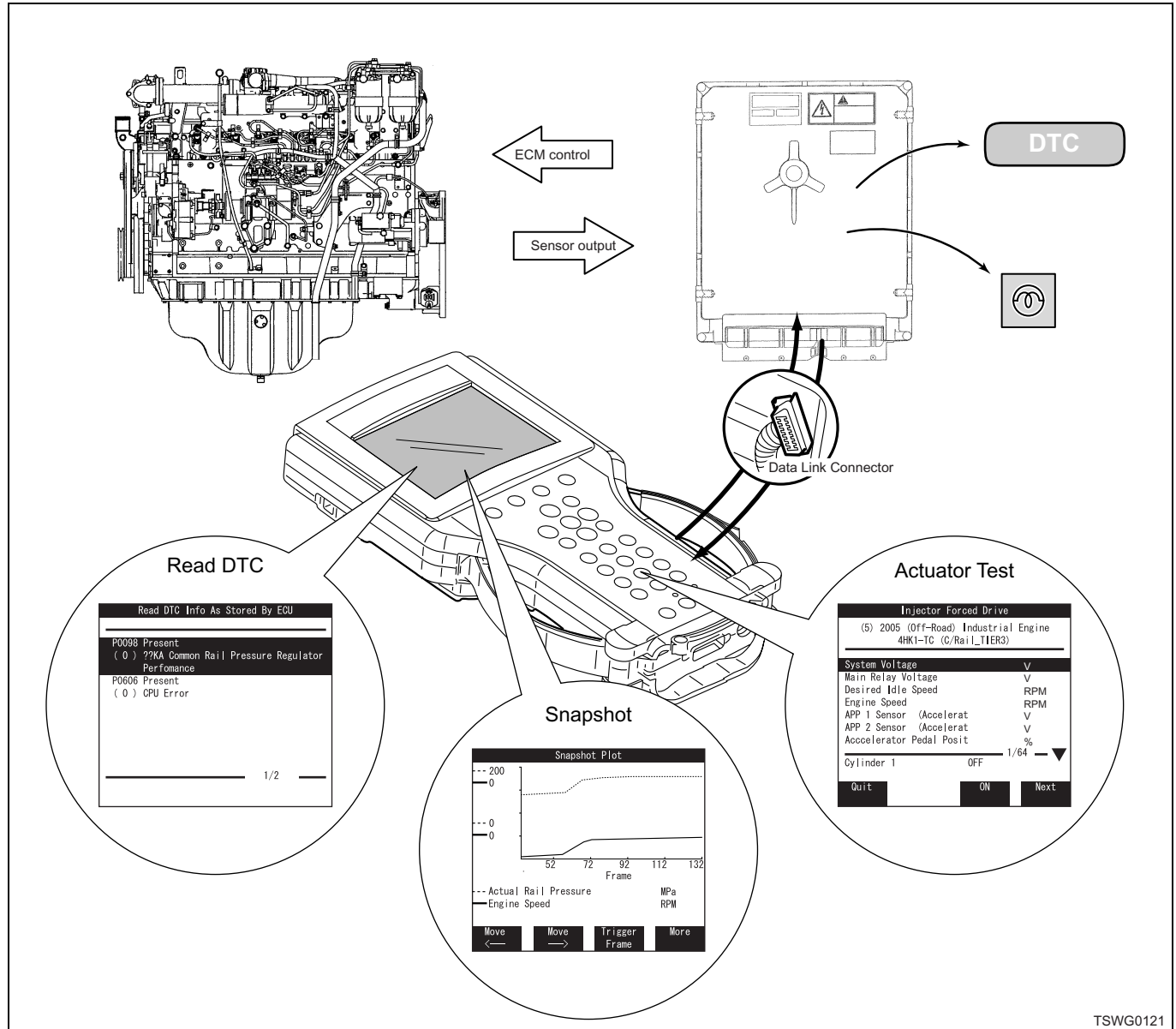
1. Injector pipe
2. Flow damper
3. Common rail
4. Fuel temperature sensor
5. Pressure limiter

- Do not reuse the high-pressure pipe and injector pipe of the fuel system. Replace with new one if it is removed.
- Never replace the pressure limiter, fuel temperature sensor, flow damper alone. If faulty, replace the common rail assembly and all the fuel pipes.

Procedure of trouble diagnosis

The following diagnostic procedure is extremely important to solve the problems of all electric/electronic (E/E) systems. Failure to perform this procedure may require unnecessary repair. Read carefully this procedure to understand, and then perform trouble diagnosis.

In addition, use the effective function or a scan tool to perform trouble diagnosis and system check.



10D-13 Electronic control fuel injection system (Common rail type)

Step 1 Confirm the user's complaint

- Organize the trouble conditions using a check list.

Step 2 Perform pre-inspection

- Perform an overall visual check.
- Confirm the service history in the past.
- Detect faulty such as noise, abnormal smell, etc.
- Collect the diagnostic trouble code (DTC) information for effective repair.
- Check for faults by comparing with the specified value.

Step 3 Check service information

- Check service letters for the market.

Step 4 Check according to each DTC

- Check the items indicated by the diagnostic trouble code (DTC)

Step 5 Perform fault inspection for each symptom

- Check the items not indicated by the diagnostic trouble code (DTC)

Control System

Engine Control (Electronic control fuel injection system (Common rail type))

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TSWG0156

Name

- Diagnosis for each DTC
- List of trouble symptom

Information:

About types of system trouble diagnosis

System diagnostic method is a standardized method to repair all the electric/electronic (E/E) systems. The faults in E/E system often occur in the following stages, different from general machine fault.

1. Early stage of fault;

- As the fault occurs for a short period and singly, a customer often does not notice and miss it. In this stage, customer's complaint is indefinite and it is impossible to reproduce the trouble. However, the engine control module (ECM) may store the fault.
=Past fault (past trouble)

2. Middle stage of fault;

- The fault occurs for a short period and singly, but repeats intermittently and definitely occurs under a specific condition. A customer's complaint (contents of the fault) is clear but description of condition of the fault is not clear. Therefore, it is possible to reproduce the trouble if a mechanic could figure out the conditions.
=Intermittent trouble (intermittent)

3. Stage that fault is real;

- The fault occurs on a steady basis and a customer's complaint is realistic and clear. Therefore, it is possible for a mechanic to reproduce the fault. However, sometimes there are multiple causes.
=Current fault (current trouble)

1. It may be impossible to reproduce the trouble symptom at a service shop.

10D-15 Electronic control fuel injection system (Common rail type)

Engine control system questionnaire

Company of inspector _____

Name of inspector _____

User	User's name	Machine application
	Address	
Machine	Date of diagnosis Year Month Date	Date of delivery Year Month Date
	Operating period Present Time (When trouble occurs Time)	Date of trouble occurrence Year Month Date
	Machine model	Machine serial No.
Engine model	Engine model	Engine serial No.

Trouble symptom	☐ Engine does not start	☐ Engine does not crank	☐ No first combustion	☐ Combustion but incomplete
	☐ Difficult starting of engine	☐ Engine cranks slowly takes more than sec.	☐ Others	
	☐ Unstable idling	☐ Abnormal idling ☐ High (r p m)	☐ Low (r p m)	
		☐ Rough idle (out of specified speed for full warm-up) ☐ Others		
	☐ Low operability of machine	☐ Surging	☐ Knocking	☐ Low output ☐ Others
	☐ Abnormal smoke	☐ Much black smoke	☐ Much white smoke	☐ Much bluish smoke ☐ Others
	☐ Noise	☐ Engine vibration sound (Circumference) ☐ Noise in engine (Circumference)		
	☐ Engine stalls	☐ Immediately after starting ☐ When accelerator pedal (lever) is released ☐ When A/C is operated		
	☐ When operating at full load ☐ At certain operation mode ☐ Others ()			
☐ Vibration at idling	☐ Vertical vibration ☐ Horizontal vibration ☐ Others ()			

Trouble condition	Frequency of trouble	☐ Always ☐ Sometimes (How many times: Date/Month) ☐ Once						
		☐ Others ()						
	Weather	☐ Fine ☐ Cloudiness ☐ Rain ☐ Snow						
		☐ After lightening ☐ Others ()						
	Ambient temperature	☐ 30°C or more ☐ Around 20°C ~ 30°C ☐ Around 10°C ~ 15°C ☐ 0°C or less (°C)						
	Season	☐ Spring ☐ Summer ☐ Autumn ☐ Winter						
	Location	☐ Outdoor ☐ Indoor ☐ General road ☐ Rough road						
		☐ Expressway ☐ Slope (grade °) ☐ Height (m above sea level) ☐ In mountain						
		☐ On the sea ☐ Harbor ☐ Construction field (Type)						
		☐ Roadworks field (Type) ☐ Others ()						
	Engine temperature	☐ Cold ☐ During warm-up ☐ After warm-up ☐ Others ()						
	Engine coolant temperature/oil temperature	☐ Engine coolant temperature (°C) ☐ Oil temperature (°C)						
	Operating condition	☐ When starting ☐ Immediately after starting(min) ☐ Idling ☐ Racing						
	☐ During operation ☐ Constant speed ☐ When engine speed rises ☐ When engine speed lowers							
	☐ A/C SW ON ☐ A/C SW OFF ☐ Others ()							
Condition when trouble occurs	☐ After engine oil is replaced ☐ After oil filter is replaced ☐ After replenishment of fuel ☐ After sedimenter is drained							
	☐ After operating on slope ☐ After out of gas ☐ After washing with high pressure ☐ Others ()							
Oil to be used	A P I	☐ CD	☐ CE	☐ CF	☐ CH	☐ CF-4	☐ CH-4	☐ CI-4
	A C E A	☐ B2	☐ B3	☐ E2	☐ E3	☐ E5		
	J A S O	☐ DH-1						
	Others	Maker () Manufacturer () Grade () Viscosity ()						
Fuel type	☐ Diesel fuel ☐ Diesel fuel No. 1 ☐ Diesel fuel special No. 1 ☐ Diesel fuel No. 2							
	☐ Diesel fuel special No. 3 ☐ Krosene ☐ A heavy oil ☐ Others ()							

Trouble code(s)	State of diag lamp	☐ ON ☐ Sometimes comes on ☐ Not come on				
	Diagnostic trouble code(s)	Current trouble	☐ _____ ☐ _____ ☐ _____ ☐ _____			
		Past trouble	☐ _____ ☐ _____ ☐ _____ ☐ _____			
	Past trouble history	Date of trouble occurrence: Year Month Date /description: /Action to be taken:				
		Date of trouble occurrence: Year Month Date /description: /Action to be taken:				

Others	

Pre-inspection

Visual inspection of engine compartment

Visual inspection of engine compartment should be carefully when performing the diagnostic procedure. This inspection can often solve the trouble with no extra steps. If performing visual inspection, follow the guideline below.

- Check all the air hoses etc. for punch hole, cut, disconnection or improper routing.
- Inspect the hoses hidden behind other components.
- Check if all the harnesses of the engine compartment are properly connected, if there are any burnout parts or worn parts, if harnesses are pinched, if there are any contacts with sharp edges, or an exhaust manifold or pipes in high temperature, etc.

Machine maintenance result check

If the maintenance of the machine is not properly performed, the diagnosis lamp comes on. Clogging in oil filter or fuel filter caused by insufficient oil change or improper oil viscosity and deposit in crankcase may cause troubles on the machine, which were not found before on-board diagnosis (OBD) system check.

Though improper maintenance of the machine is not classified as "The trouble caused by other than a machine", a maintenance schedule should be more strictly followed because of high sensitivity of the on-board diagnosis (OBD) system check.

Non-OEM parts

All the on-board diagnosis system checks are adjusted to be operated by genuine parts. Therefore, if a commercial general sensor or switch is installed, the diagnosis lamp comes on due to faulty diagnosis.

If commercial electronic devices, such as mobile phone, stereo, antitheft device, etc. are installed and their installation is not proper, EMI (electromagnetic interference) may be discharged to the control system. That leads to the generation of fault sensor information and the diagnosis lamp comes on. When performing trouble diagnosis, turn the power of all commercial parts to "OFF" or remove those parts, and check for faults again.

Information:

Fault in related system

Many on-board diagnosis (OBD) system checks enter the back-up operating mode by instruction from engine control module (ECM) when the ECM detects the fault in related systems or components. In the back-up operating mode, they lower output to protect the machine.

Trouble Diagnosis

About diagnostic trouble code (DTC)

Every time turning the key switch to ON, the ECM performs self-test of most wiring and components and stores the detected faults in memory. For some DTCs, it also performs the back-up control. If the fault which affects operation occurs, the diagnosis lamp comes on to notify an operator.

Basic knowledge for required tools

Important:

If performing the diagnostic procedure, no basic knowledge on this powertrain may lead to faulty diagnosis or damage to powertrain components. If you do not have basic knowledge, do not perform the diagnosis of the trouble relating to powertrain. Basic understanding on hand tools, such as scan tools, is required to utilize service manual effectively.

About on-board diagnosis test

Types of trouble diagnosis results are the following.

1. Past trouble
Trouble codes which occurred under the following conditions are called "Past trouble".
 - Diagnostic test was completed at previous ignition cycle.
 - Diagnosis test has accepted at current ignition cycle.
 - Faults found by the diagnostic test do not currently exist.
2. Current trouble
Trouble codes which occurred under the following conditions are called "Current trouble".
 - Diagnostic test was completed at previous ignition cycle.
 - The faults detected by the diagnostic test currently exist.
 - The faults exist at current ignition cycle.

Description of terms

Ignition cycle

Ignition cycle is defined as Key ON, Run and Key OFF so that the machine can be operated under the specified diagnostic standard.

Diagnosis lamp

Basically, the diagnosis lamp comes on when a fault is detected in electronic control, such as engine control module (ECM).

Data link connector (DLC)

The data link connector is communication device with control unit. The DLC is also used to connect a scan tool. General use of scan tool is described below.

Note:

The location of DLC and existence of DLC vary depending on each machine. Refer to the machine's manual.

- Identification of stored DTC
- Reading of serial data

About ECM OFF

The power of ECM is cut off 10 seconds after the key switch is turned to OFF, and then it will be ECM OFF condition.

Operation of comprehensive diagnosis for monitors of components

It is necessary to comprehensively diagnose components for the proper operation of the engine.

Input components:

Input components are confirmed to check if there are open circuit and the values exceed the range. Though the following does not include all input components, these sensors are included.

- Crankshaft position (CKP) sensor
- Camshaft position (CMP) sensor
- Engine coolant temperature (ECT) sensor
- Vehicle speed sensor
- Boost pressure sensor
- Common rail pressure sensor
- Accelerator position (AP) sensor

Output components:

Output components are diagnosed if their responses to commands from control units are relevant. Check whether there are open circuit and the values exceed the range.

Though the following does not include all the output components to be confirmed, these circuits are included.

- Suction control valve (SCV)
- Lamp, relay control
- Magnetic valve
- Diagnosis lamp

How to read DTC

How to read DTC by diagnosis lamp

The diagnosis lamp blinks to indicate the current and past trouble codes (DTCs) stored in ECM by connecting the diagnosis switch.

Note:

Refer to the machine's manual for the locations of diagnosis lamp.

- Turn the key switch to ON and make sure the diagnosis lamp illuminates. (Bulb check)
- Turn the key switch to ON, and the engine OFF.
- Connect the diagnosis switch (connector).
- Read the blinking pattern of the diagnosis lamp.
- Judge the contents of DTC by DTC table.

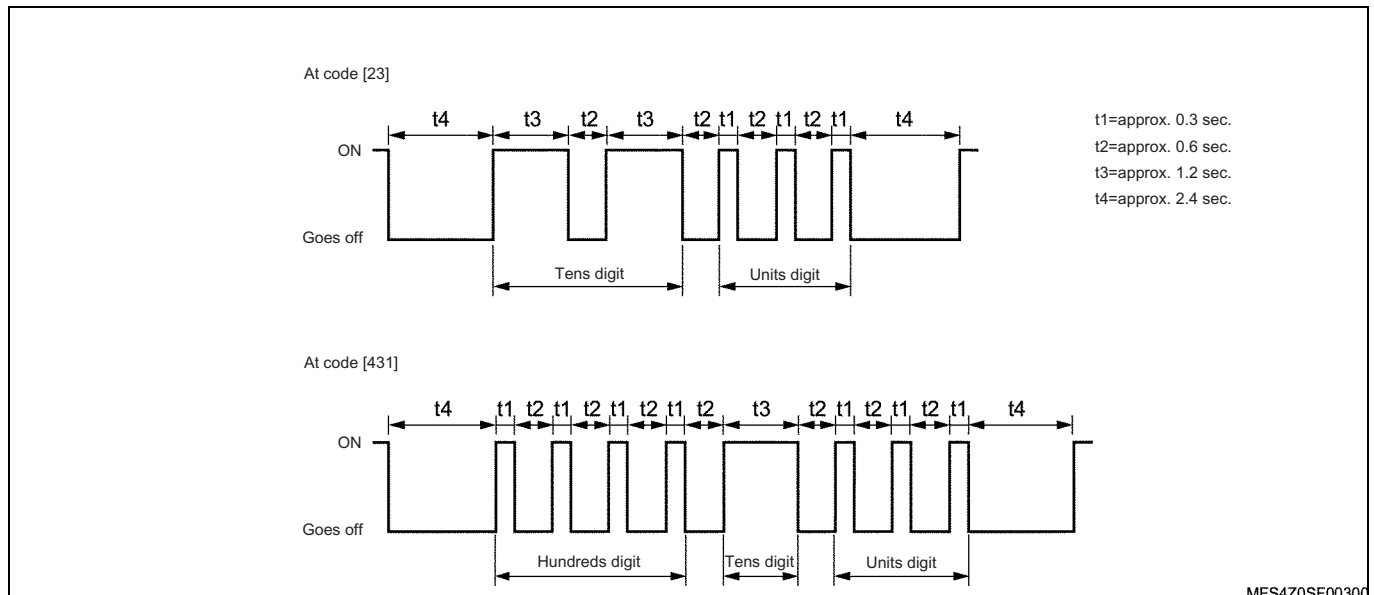
If a scan tool has been connected, it can be read using the tool.

Indication with no DTC stored

The code "1", which indicates starting of code display, is repeatedly displayed.

Indication with DTC stored

Stored trouble code is displayed three times. If more than one trouble code are stored, they are displayed in the ascending order for three times each. After taking a round, codes are repeatedly displayed in the ascending order. This will last as long as the diagnosis connector is connected.



About DTC indicated by blinking of diagnosis lamp

While the engine stops, both the current and past DTCs are displayed.

While the engine is operated, the lamp illuminates only if the current DTC occurs.

How to read DTC by trouble display monitor

When a DTC occurs, it is displayed on trouble display monitor on the machine.

How to read DTC by a scan tool

DTC can be read using a scan tool.

Note:

Refer to "Trouble diagnosis with scan tool, Operation procedure" for work procedure.

If the DTC (diagnostic trouble code) is stored

Perform service correctly according to the specified DTC chart.

If there is no DTC

Select symptom from the diagnostic chart according to symptom. Complete the service following diagnostic procedure. You may also perform inspection by referring function diagnosis.

If there is no applicable symptom

1. Confirm the complaint in detail.
2. Create diagnostic plan.
3. Use wiring diagram and principle of operation.

Ask for technical support when repair history is available for similar case. Connect technician's knowledge with the effective usage of available service information.

If there is intermittent (intermittent trouble)

The trouble situation not occurring constantly is called intermittent (intermittent trouble). Perform the following steps to solve the intermittent trouble.

1. Check the DTC information and data display.
2. Evaluate symptom and situation explained by the customer.
3. Check the circuits or the electric system components using check sheet or other methods.

If the trouble is not detected

In this case, the machine is judged as it operates properly. The condition explained by the customer may be the normal condition. Confirm the customer's complaint comparing with the condition of the machine to that of another machine. That condition may mean an intermittent trouble. Confirm the complaint in the situation the customer explains before returning the machine to the customer.

1. Confirm the complaint again.

If the complaint can not be fully detected or identified, the machine must be diagnosed again. Confirm the complaint one more time. The complaint may be an intermittent trouble as defined in "If there is intermittent", but it may also be possible that the machine is normal.

2. Repair and confirm.

If the problem is confirmed, repair it. Confirm that the machine operates properly and the symptoms are corrected. This includes test on the machine or other procedures to confirm that the trouble is solved under following conditions:

- Confirm by testing in the situation that the customer described.
- If DTC is diagnosed, reproduce the situation found while the DTC is set, and confirm the repair by checking a scan tool data.

Confirmation after repair

Confirmation of machine repair

If an electronic control system is repaired, it is necessary to confirm that repair is properly performed after the repair work. If this confirmation is not properly performed, it may happen that the diagnosis lamp comes on again or a trouble in operability occurs in the course of delivering the machine to the customer. Especially as for intermittent (trouble), it is needed to reproduce and confirm the situation according to the customer's complaint.

About confirmation of machine repair

It is effective for confirmation of machine repair to use on-board diagnosis (OBD) system check. Mechanic should perform the following steps to diagnose the machine after repair.

1. Review and record the DTC (diagnostic trouble code) or scan tool data used in diagnosis.
2. Clear the DTC.
3. Operate the machine based on scan tool data.
4. Confirm the DTC status information of specified DTC used in diagnosis until the diagnostic test relating that DTC is performed by control unit.

In the case of confirmation of repair by on-board diagnosis (OBD) system check, performing these steps is extremely important. Failure to perform these steps may require unnecessary repair.

List of final check items

No.	Item	Purpose	Method
1	Check of DTC	Confirm the DTC display after repair.	Clear previous DTC. To gain a test environment, warm-up sufficiently with idling and raise the engine speed to No Load Max. to race.
2	Confirmation of idle speed after the engine is warmed-up.	To check whether the idling control is normal or not.	Check whether the idle speed after warm-up is stable under no load condition. If the trouble is detected, refer to "Unstable idling" in symptom diagnosis.
3	Check the scan tool data list.	Check the engine control and communication status for faults at standard condition.	Monitor the scan tool data list and use a typical data sheet to perform the check. Confirm the typical data of scan tool data list.
4	Confirmation of ability of restarting	To check whether the starting control is normal.	Confirm that after the engine is warmed up. Confirm that the engine starts after less than 5 second of cranking time and becomes stable.
5	Confirmation of powerful electric wave transmitter.	If an electric wave transmitting equipment such as transceiver is additionally installed, confirm whether interfering electric wave is consequently transmitted or not.	Check if idling engine speed changes due to "ON" and "OFF" of an electric wave transmitter such as transceiver. If a fault is found, inform a customer of necessity to change the location and output of an electric wave transmitter.

Confirmation of powerful electric wave transmitter; if faults are found in these items, inform a customer of the following check items as required.

- An antenna should be installed as far away from control unit/sensors or electrical systems on the machine as possible.
- Antenna codes should be installed more than 20 cm away from control units/sensors or electrical systems on the machine as possible.
- Do not put the antenna codes and other wire together. Keep the antenna codes as far away from other wire as possible.
- When installing an additional equipment, follow its installation manual to install it securely.

- Do not install mobile communication equipment with high output.

Caution:

If confirming repair using on-board diagnosis system check, perform the following steps. If not following these steps, unnecessary repair may be needed.

- **Review and record the scan tool data related to DTC which is diagnosed.**
- **Clear the DTC.**
- **Operate the machine while checking the relevant scan tool data.**

How to clear DTC

Clear of DTC

The DTC, which have been stored in the engine control module (ECM) upon trouble occurrence, will not be erased even if the faulty parts are repaired, unless it is compulsory cleared in the following procedure.

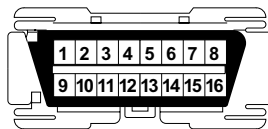
Clear with a scan tool

If a scan tool (Tech2 or scan tool with KW communication) has been connected, it can be cleared by clear operation of the scan tool (Tech2 or scan tool with KW communication).

If a scan tool with CAN communication has been connected, clear with the memory clear switch.

Clear with memory clear switch

1. Turn the key switch to ON.
2. Turn the diagnosis switch to ON.
3. Turn the memory clear switch to ON.
4. Leave as it is ON for 3 seconds.
5. Turn the memory clear switch to OFF.
6. Turn the diagnosis switch to OFF.
7. Turn the key switch to OFF.
8. Leave as it is for 10 seconds.
9. Turn the key switch to ON.
10. Turn the diagnosis switch to ON.
11. Make sure that memory is cleared.



TSWG0023

Note:

- Refer to the machine's manual for the locations of memory clear switch and diagnosis switch.
- Perform the same procedure to clear memory regardless of forms of switches (switches, connectors). (ON = Connection, OFF = Disconnection)

Clear with ECM (intermittent trouble)

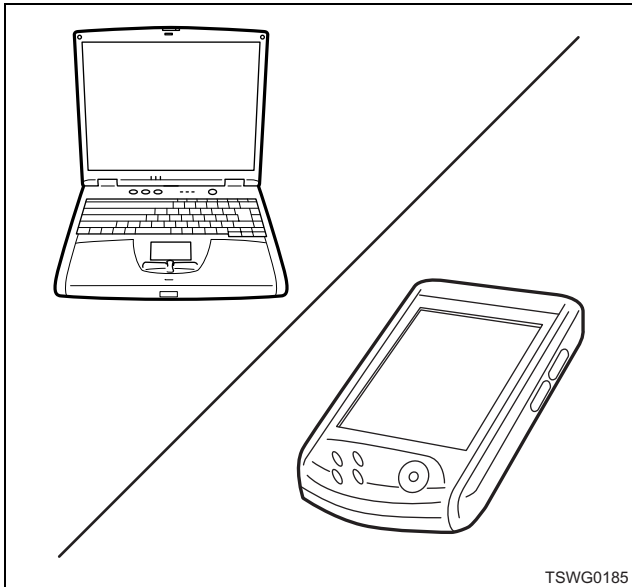
The DTC stored in ECM will be cleared if the same one is not valid within 20 ignition cycles.

Trouble diagnosis with scan tool

About scan tool

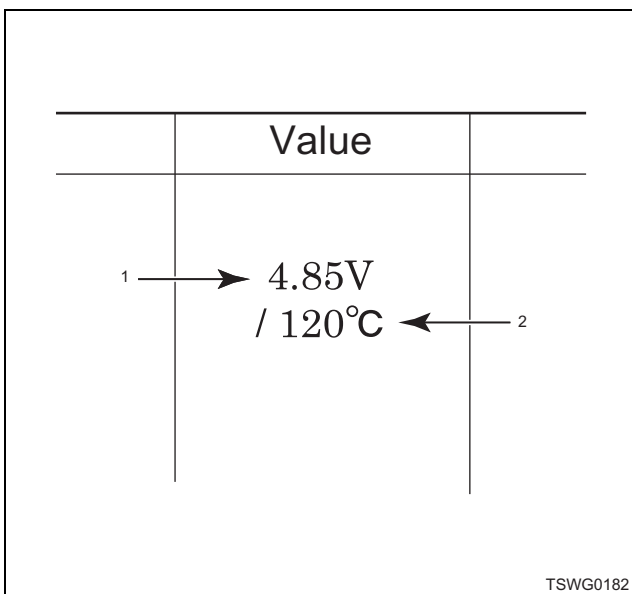
There are scan tools for each machine manufacturer and the scan tool (Tech2) for Isuzu, and they have different display method respectively.

The scan tools for the machine manufacturer with CAN communication display only the physical value in data parameters.



Isuzu scan tool (Tech2) and the scan tools with KW communication can display both the physical value and voltage value.

In some diagnostic charts, both the voltage value and physical value may be shown. Refer to the voltage value for Tech2 and the scan tools with KW communication or the physical value for the scan tools with CAN communication.



Name

1. Tech2 and scan tool with KW communication
2. Scan tool with CAN communication

About scan tool display

Refer to the relevant page by each machine manufacturer for the difference of data display in KW or CAN viewed from ECU.

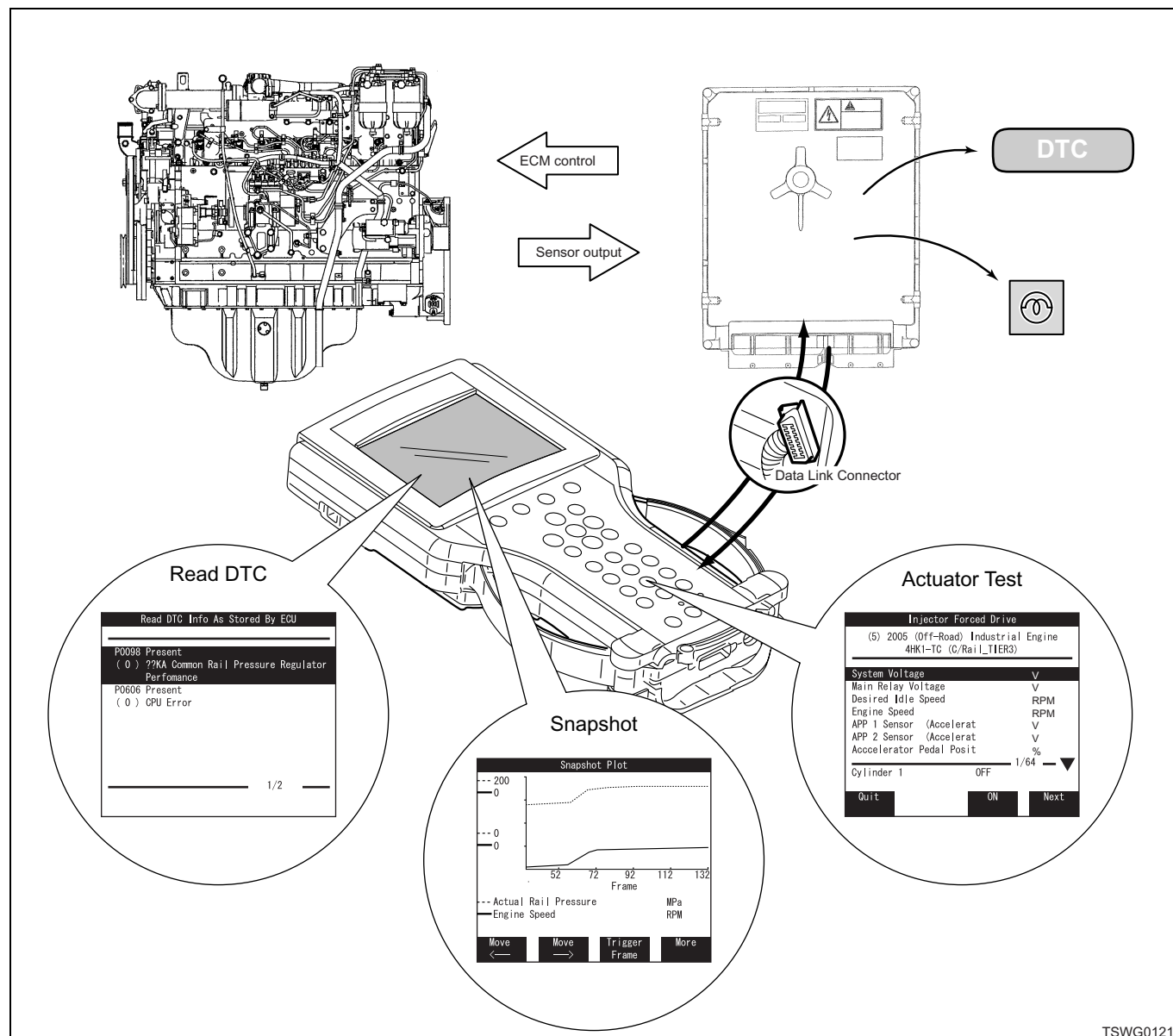
Tech2, KW display	CAN display
Engine Model (EEPROM)	Engine Model
Engine Serial Number (EEPROM)	Engine Serial Number
ECM Part No. (EEPROM)	ECM Parts Number
Software ID (EEPROM)	Software Identification
Q Resistance (EEPROM)	Q adjustment data
QR Code (EEPROM)	QR code
Starter Switch (On)	—
Starter Switch (ST)	—
EGR BLDC Position 1	—
EGR BLDC Position 2	—
EGR BLDC Position 3	—
Glow Relay Switch	—
—	Glow Signal
Accelerator Sensor 1	Act Accel position
System Voltage	—
Main Relay Voltage	—
—	Battery Voltage
Intake Air Temperature Sensor	—
Fuel Temperature Sensor	—
Engine Coolant Temperature Sensor	—
Idle Up Volume Sensor	—
Barometric Pressure Sensor	—
Differential Fuel Rail Pressure	—
Differential EGR Valve Position Sensor	—
Engine Speed	Act. Engine Speed
—	Request Engine Speed
Intake Air Temperature	Intake Air Temperature
—	Boost pressure
—	Boost Temperature
Engine Coolant Temperature	Coolant Temperature
Fuel Temperature	Fuel Temperature
Barometric Pressure	Barometric Pressure
—	Engine Oil Pressure
—	Fuel Flow
—	Engine Torque
—	Trip used fuel
—	Total used fuel
Differential EGR Position (BLDC Motor)	—
SCV Duty	—
EGR BLDC Motor Duty	—

10D-23 Electronic control fuel injection system (Common rail type)

Tech2, KW display	CAN display
EGR DC Motor Duty	—
SCV F/B	—
Desired Idle Speed	—
Common Rail Pressure F/B Mode	—
Engine Mode	—
Target Fuel Flow	—
Main Fuel Injection Timing	—
Pre-fuel Injection Amount	—
Main Fuel Injection Amount	—

About scan tool (Tech2)

This is an useful tool to diagnose the electric faults and the system check of the engine control system. The Tech2 is small and light tester. It can communicate with each control unit to perform various types of diagnosis and test by connecting it to DLC equipped to the machine using Tech2 adapter.



10D-25 Electronic control fuel injection system (Common rail type)

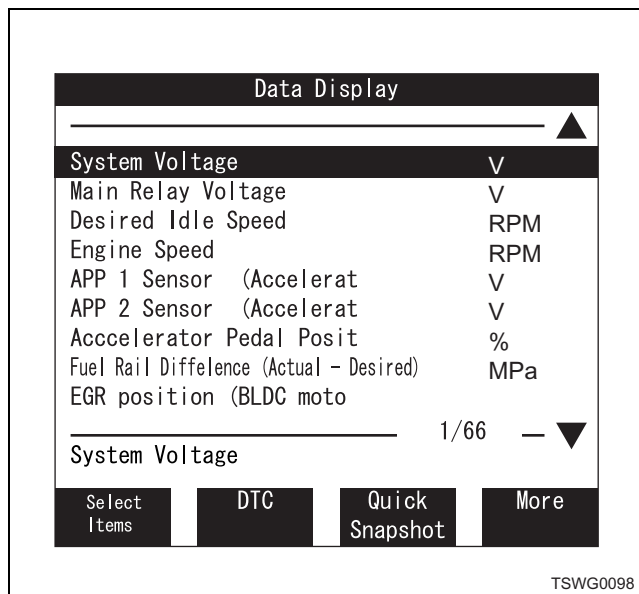
Function of Tech2

Data display

This displays conditions recognized and controlled by ECM at each items.

The values of display items is described in typical data of Tech2 data list.

The contents of display items describe about data.



This menu can be used to display the current data.

The display synchronizes with the status of the machine or equipment.

- If the data display menu cannot be selected:
Trouble occurs on the cable between ECM and DLC.
The position of select switch on Tech2 adapter is wrong.
- If the abnormal fixed value is displayed:
[Example] The data display value of engine speed, each sensor, etc. is fixed and different from actual one. Move the connector or harness by hand. If the display changes from fix to release, connection of the connector is faulty, pin tip length is uneven, or open or short circuit exists in the harness where you have moved. Therefore, repair is necessary.
- When asterisk mark (*) is displayed in place of numeric display;
The Tech2 software has problem.
If asterisk mark (*) is found on any of the data, PCMCIA card must be version-upgraded.

Snapshot

To find the cause of trouble, perform this snapshot to review the data.

- The snapshot can record the data list menu and plot a graph.

- Utilizing this mode, reproduce and record the conditions claimed by the customer to identify the data fault.
- The trigger type allows to record the data of the time when DTC is displayed.
- The stored data can be replayed with a domestic power supply.

Programming

Confirm the data history before replacement of ECM. (Data confirmation) Then, upload the data to the Tech2. After replacement of ECM, download data from Tech2 to new ECM.

Actuator test

Perform each test to check the operation or function of appropriate parts for faults.

When giving instruction to ECM from test screen, set the select switch of the Tech2 adapter to "2" position.

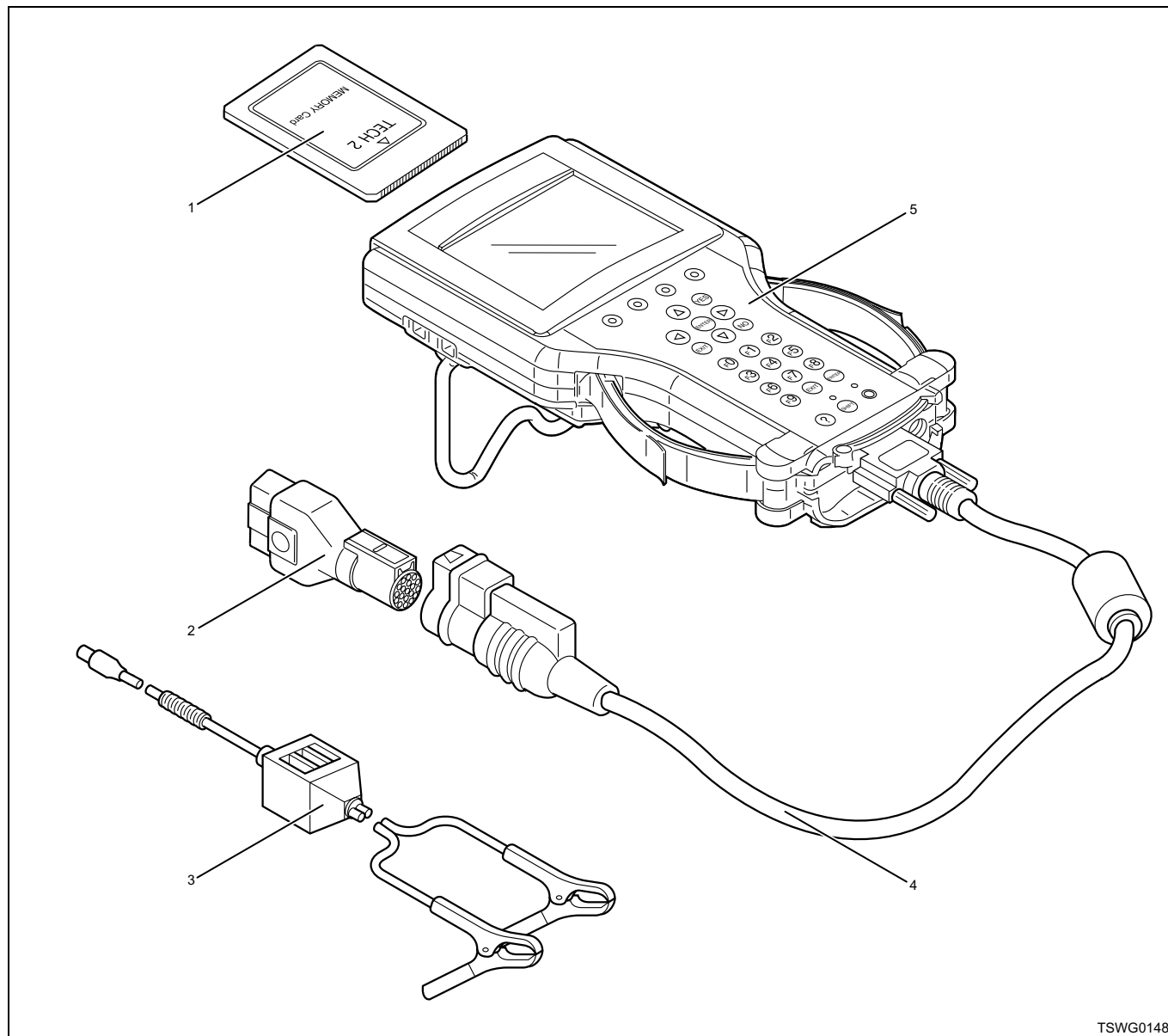
Caution:

Each test may not performed if the machine, engine operation status, coolant temperature, vehicle speed, switch status, gear position, etc. does not meet conditions or if DTC is detected.

How to use trouble diagnosis-related tool

How to use Tech2

Components of Tech2



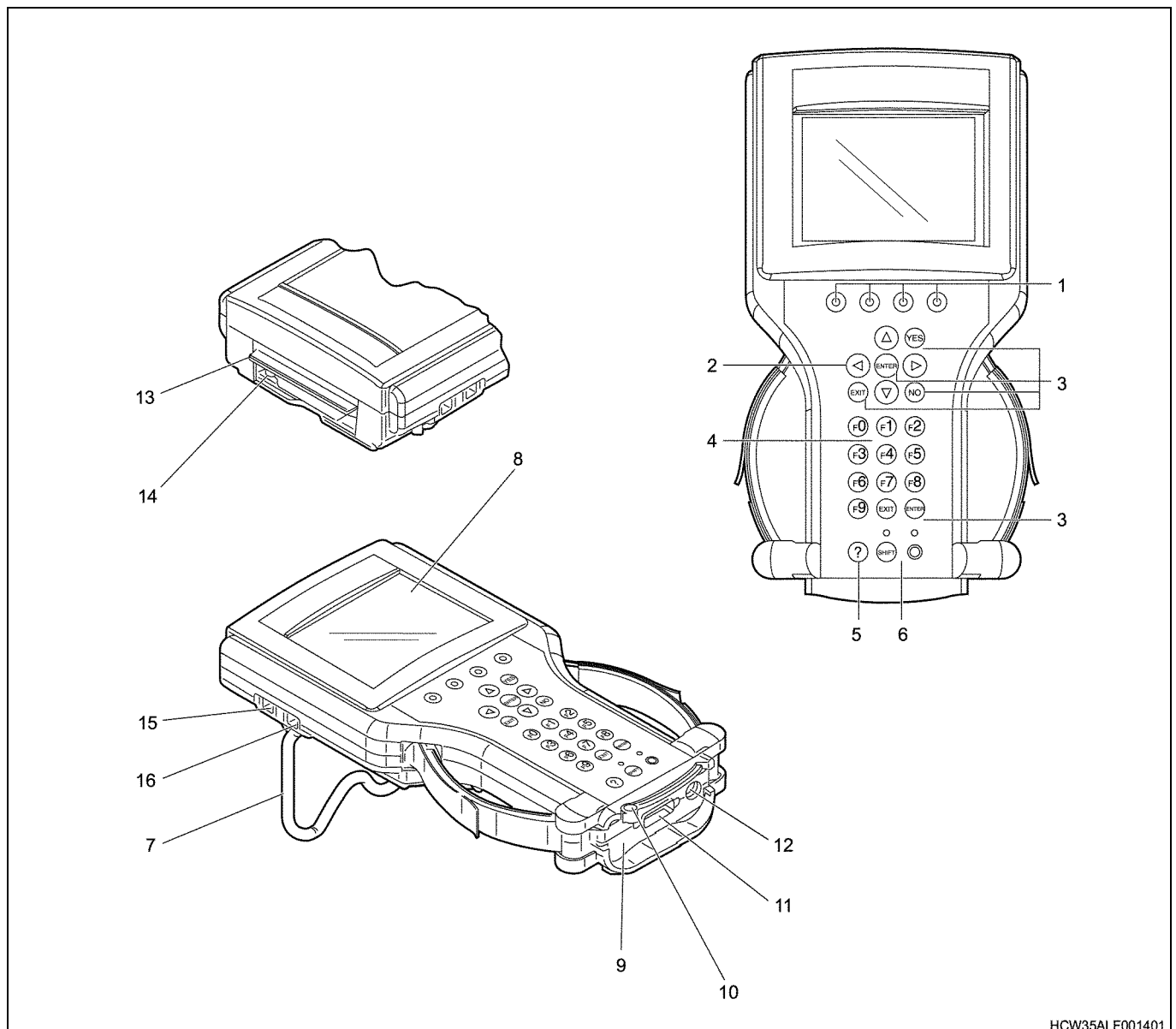
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Name

1. PCMCIA card
2. SAE 16/19 adapter
3. Power cable

4. DLC cable
5. Tech2

Each part of Tech2



HCW35ALF001401

Name

1. Softkeys	10. Fastening bar of VCI module
2. Selection keys (Arrow keys)	11. Connector of DLC cable connection
3. Action keys (YES, NO, ENTER, EXIT)	12. Connector for AC adapter connection
4. Function keys (F0 — F9)	13. PCMCIA card insertion slot with cover
5. Help key (?)	14. PCMCIA card release button
6. Control keys (PWR / SHIFT)	15. Connector for external communication (RS-232 port)
7. Wide stand	16. Connector for external communication (RS-485 port)
8. Display area (LCD)	
9. Machine communication interface (VCI) module	

1. Softkeys

While operating the Tech2, selection boxes appear on the upper part of the screen. The softkeys correspond the selection boxes. They cannot be used unless the selection boxes are displayed.

2. Selection keys (Arrow keys)

They are used to select the menu or switch the display on the screen of Tech2. Selected part is highlighted in the screen.

3. Action keys (YES, NO, ENTER, EXIT)

They are used to execute the operation of Tech2, respond to instruction/question, and switch/move to each menu screen.

4. Function keys (F0 — F9)

They are used to execute a menu function in the screen. These keys also correspond to F numbers, such as "F0", when they are displayed on the menu screen.

5. Help key (?)

Explanation of Tech2 function, which is being used at the time when the key is pressed, is displayed

6. Control keys (PWR / SHIFT)

The PWR key turns on/off the power to the Tech2. The SHIFT key is used to adjust the screen contract. When the SHIFT key is active, the orange LED illuminates. In this case, all the keys except selection keys and functions are locked. When the power is on, the green LED illuminates.

7. Wide stand

Use this as a stand. The stand opens angle of 0 — 180°.

8. Display area (LCD)

This is liquid crystal display (LCD) with contrast adjusting function. It displays ECM information and various instructions.

9. Machine communication interface (VCI) module

This is a module to communicate between the machine and Tech2.

10. Fastening bar of VCI module

The bar is used to install/fasten/remove the VCI.

11. Connector of DLC cable connection

This is used to connect the Tech2 to the machine. Connect the DLC cable.

12. Connector for AC adapter connection

This is used to connect the attached AC adapter when using Tech2 with other than the machine.

13. PCMCIA card insertion slot with cover

Open the cover when inserting the PCMCIA card into Tech2. Insert the PCMCIA card with the cover opened. Never insert/remove the PCMCIA card when the Tech2 is powered on.

14. PCMCIA card release button

This is used to remove the PCMCIA card from Tech2. Press the button to remove the PCMCIA card. Never remove the PCMCIA card when the Tech2 is powered on.

15. Connector for external communication (RS-232 port)

This is used to connect the Tech2 to a computer.

16. Connector for external communication (RS-485 port)

This is a connector for phone line connection, however it is not currently used. Do not connect the phone line etc. to this connector.

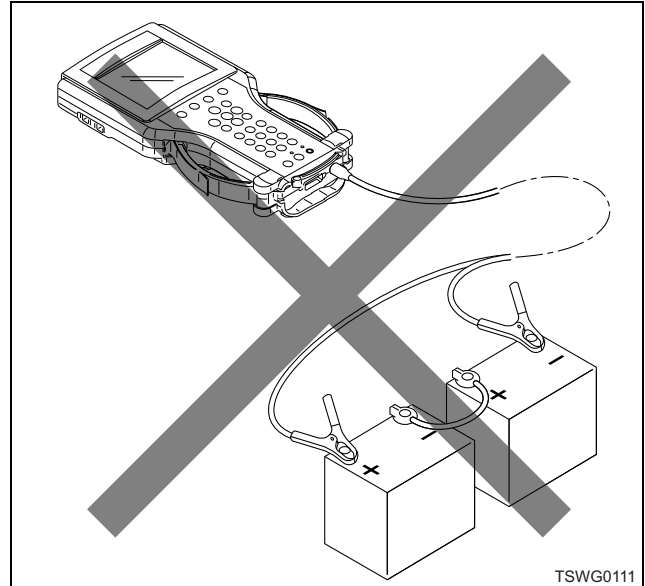
Precautions on handling Tech2

Ventilation

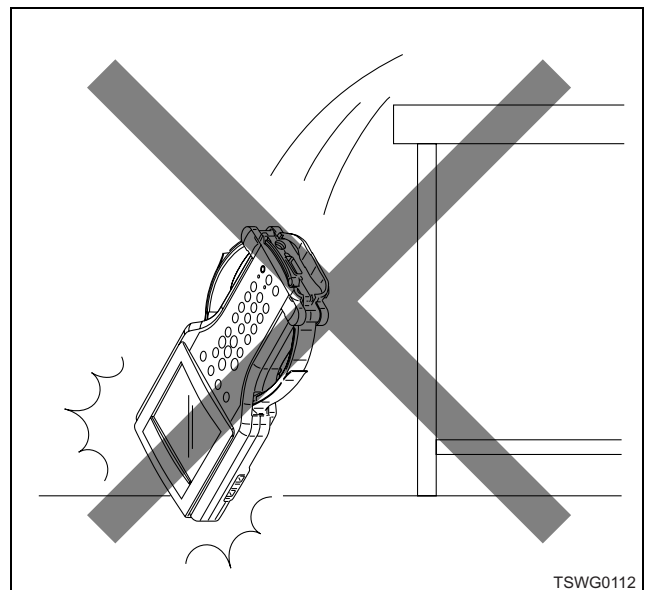
If performing inspection and test with engine running in badly ventilated area, such as garage, ventilate sufficiently. In badly ventilated area, poisoning may occur due to inhaling colorless, odorless carbon monoxide included exhaust gas.

Handling

- The Tech2 is "precision electronic device". Handle with extreme care.
- Operating voltage of Tech2 is DC 12 V. Do not energize 24 V to it.



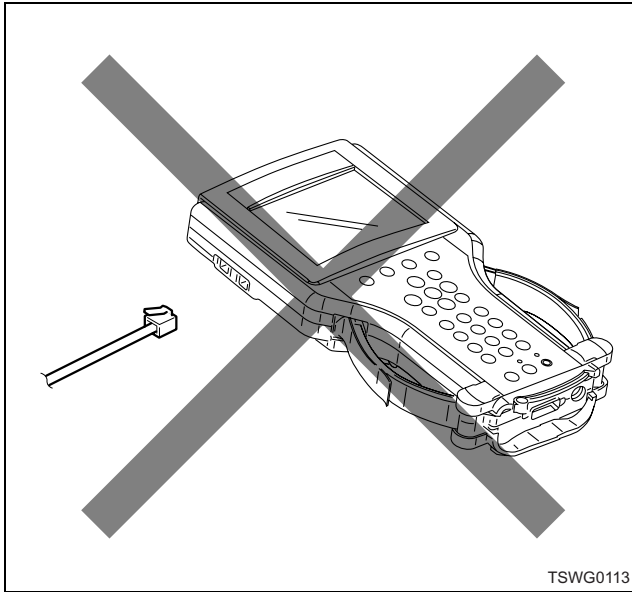
- Do not have an impact on it by dropping. It causes internal faults even no damage on appearance.



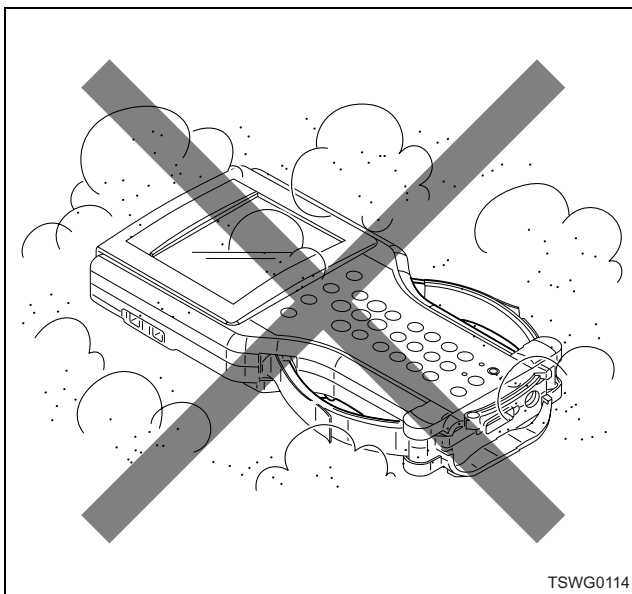
- Be sure to turn off the power of Tech2 when installing/removing the PCMCIA card. Avoid repetition of installing/removing the card as possible. Otherwise, the card may be deteriorated.
- Before turning on the Tech2, make sure that the cables and adapters are connected securely.
- Do not disconnect the cables and adapters connected to Tech2 while the key switch is ON or the engine is starting.

10D-29 Electronic control fuel injection system (Common rail type)

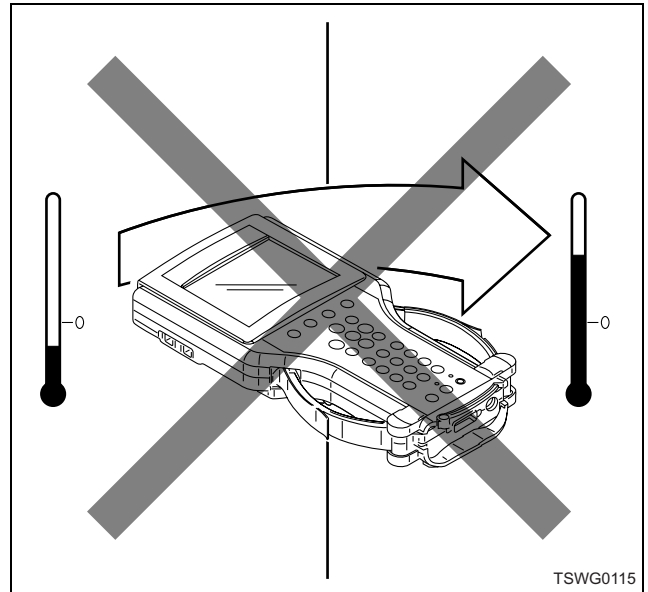
- Do not connect the phone jack to communication port on the side of Tech2.



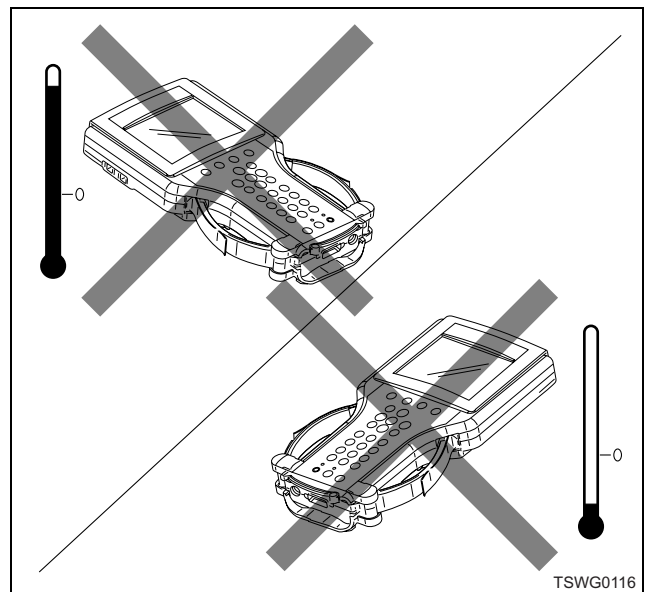
- Avoid using and storing it in dusty area. When not using it, always put it in its case to prevent the adapter from getting dust.



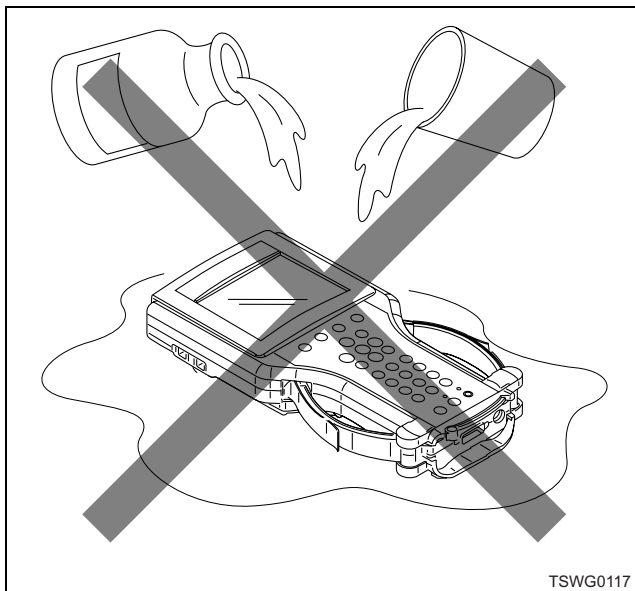
- Avoid using and storing it in a place with rapid changes of temperature. If bringing it from cold outside into warm indoor suddenly, dew condensation may occur resulting in malfunction or trouble.



- Avoid using and storing it in a place with extreme high or low temperature. Especially in summer, do not leave it in the machine exposed to direct sunlight.



- Avoid using and storing it in a place that it may contact water or chemicals. When cleaning, use cloth with mild detergent, not highly-volatile solvent such as thinner, and wipe out using dry cloth. Its display is easy to get dirty, clean periodically using antistatic cloth.



Power supply

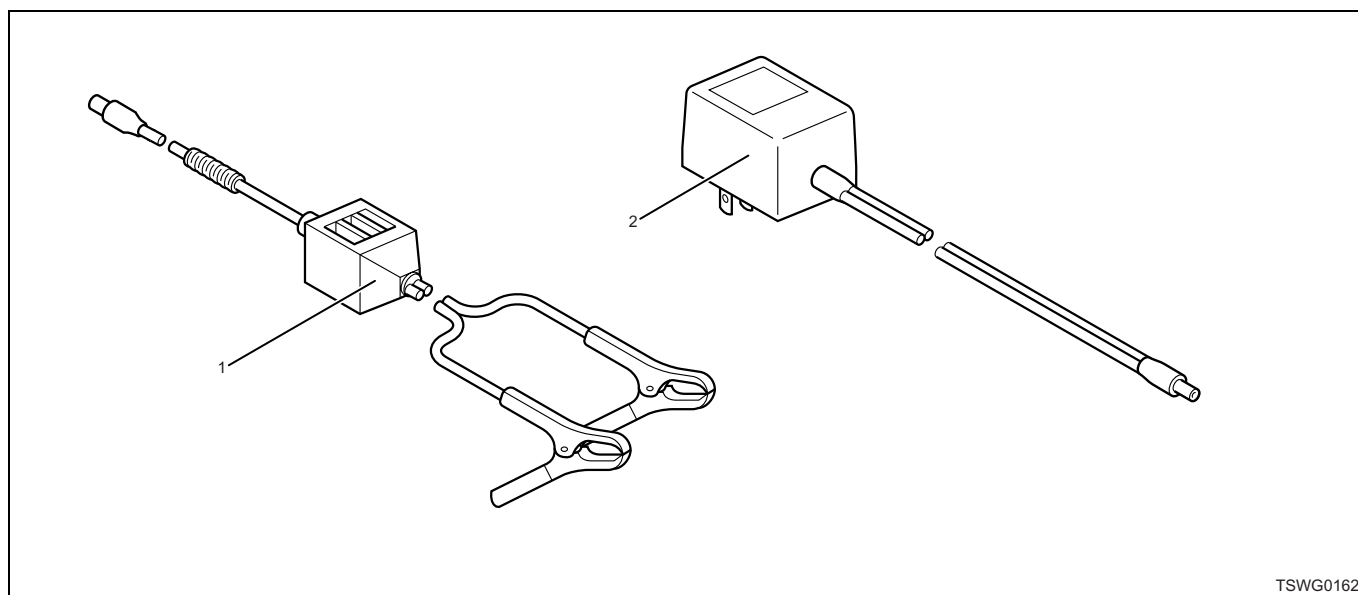
About power supply

The power supply method for the Tech2 varies depending on the voltage of the machine, shape of DLC and the situation in which the unit is used. Therefore the user will have to gain good understanding of the relevant connecting procedure. Notice that machine data and DTC will not be able to be checked if the connection is not established in accordance with the power supply of the machine.

Note:

Use of the external power (AC power) does not allow to utilize the applications.

Connection of power



Name

1. Battery cable

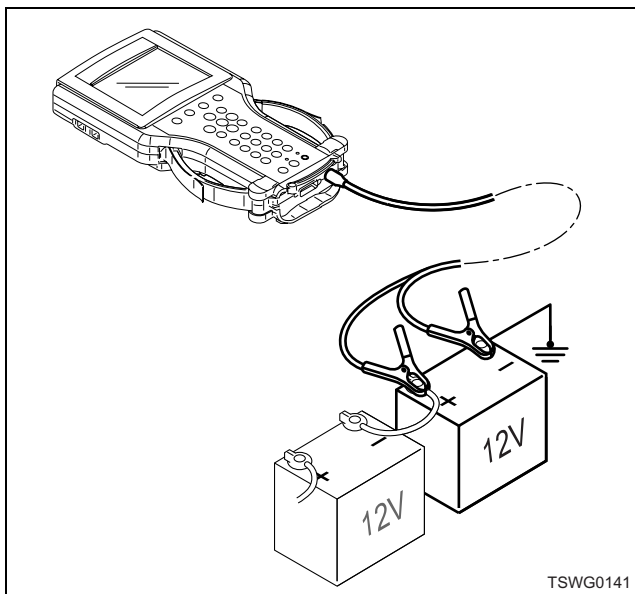
2. Power socket cable (AC/DC adapter)

Battery cable

This cable should be used, in the case where no power is supplied even when the Tech2 is connected to the machine through the machine DLC cable, or where the machine works with a higher voltage than the operating voltage of the unit. When connecting the cable, pay heed to the polarities of the clamps. (The black clip of the cable is to be connected to the negative terminal of the battery and the red clip to the positive terminal.)

Caution:

In the case of a 24-V machine, connect to battery on the body ground side to take out 12 V.



Power socket cable (AC/DC adapter)

This is used to check the captured data by operating Tech2 away from the machine.

Caution:

Be sure to use the power socket cable adapted to local standards. Otherwise, it may result in failure of Tech2 or power socket cable due to different voltage and current depending on regions.

Check items before use

VCI

Check to see whether the VCI module is securely inserted and whether the fastening latch bar of the VCI module is located on the left-hand end. Attach the DLC cable and fasten it by tightening the two lock screws.

PCMCIA Card

Check to see whether the slot (upper side) has this card inserted with its "Tech2" label side up.

Caution:

If the card is not inserted properly and the unit is switched on, "NO PCMCIA CARD INSERTED" will appear. If that is the case, turn off the power and redo the insertion of the PCMCIA Card.

Connection

Check to see whether the DLC cable is fitted with an adapter compatible with the machine.

Note:

Before connecting the cable to the machine, verify that the key switch is in the "OFF" position.

Caution:

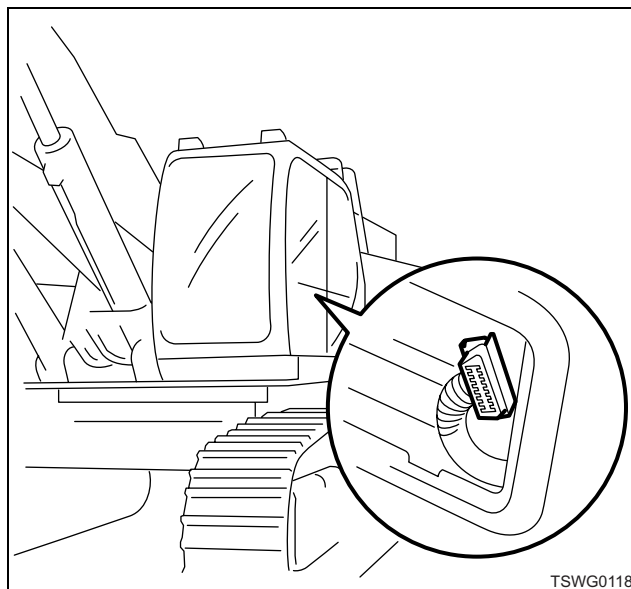
In the case of a 24-V machine, connect to battery on the body ground side to take out 12 V.

How to connect Tech2

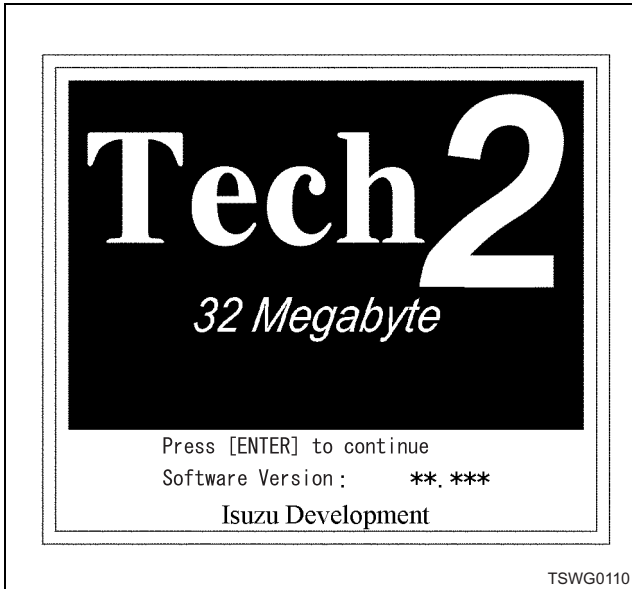
1. Insert the PCMCIA Card with the latest version of ISUZU system into the Tech2.
2. Connect the SAE 16/19 adapter to the DLC cable.
3. Connect the DLC cable to the Tech2.
4. Make sure that the key switch is OFF.
5. Connect the SAE 16/19 adapter of Tech2 to the machine DLC.

Caution:

Connecting method varies depending on each machine. Refer to the machine's manual. The following description is for the machine with DLC.



6. Turn the ignition switch to ON and press the "PWR" key of the Tech2.
7. Check the display of the Tech2.



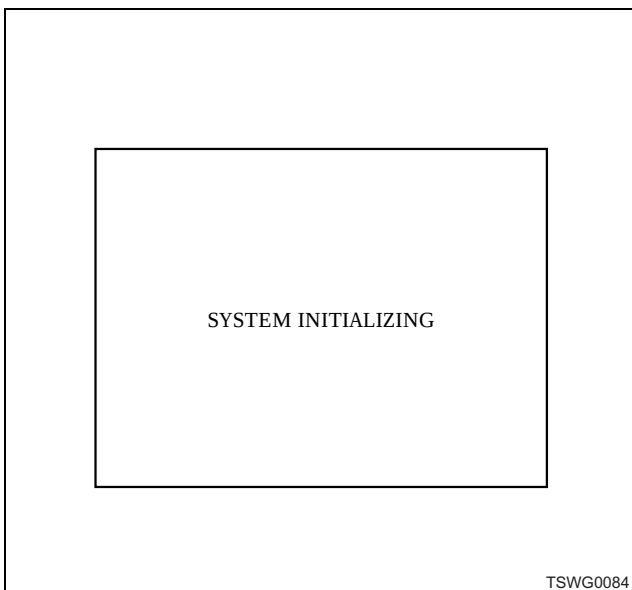
Caution:

Be sure to turn off the power of Tech2 when installing/removing the PCMCIA card.

Operation procedure

Start-up

The Tech2 is designed to automatically conduct a self-function test every time it is started. Immediately after the unit has been switched on, the "SYSTEM INITIALIZING" message will appear. During this period, POST (Power-On Self Test) is carried out, and if the test ends normally, a sound will be issued at the completion of the test. Simultaneously, the LED of the SHIFT key will momentarily come on. This is also meant to check the normality of the LED.



Display of POST results:

If the test ends normally, "Pass" will appear and one short sound will be heard.

If the test ends abnormally, "Fail" will appear and three short sounds will be heard.

Note:

- If the LED fails to come on, it means a malfunction of the LED, not a malfunction of the SHIFT key.
- Absence of sound means a malfunction of the Sound Transducer^{*1}, but the unit can be used as is, without any problem.

^{*1}. Sound Transducer: The sound is intended to indicate the completion of a data setup or an error in a setup.

001	IRAM	Pass
002	ERAM	Pass
003	UART	Pass
004	MCU	Pass
005	QSPI	Pass
006	SCI	Pass
007	TPU	Pass
008	RTC	Pass
009	CLKMEM	Pass
010	KEYPAD	Pass

TSGW0085

Pass: Normal

Fail: Abnormal

Note:

Only for UART, SCI, RTC, and CLKMEM in particular, the test result may appear as "Fail" without this meaning any trouble. For "Fail" above, refer to "Tech2 Self Test in Tool Options".

IRAM: Internal RAM

ERAM: External RAM

UART: Universal Asynchronous Receiver and Transmitter

MCU: MC68332 Microcontroller

QSPI: Queued Serial Peripheral Interface

SCI: Serial Communication Interface

TPU: Time Processor Unit

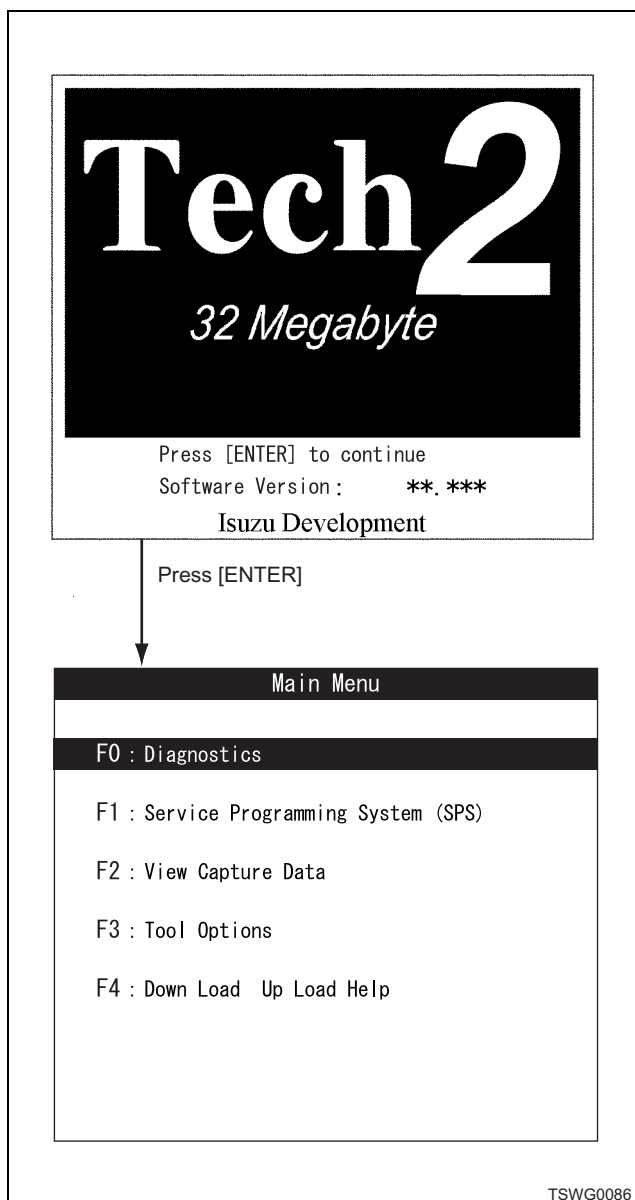
RTC: Real-Time Clock

CLKMEM: Clock Memory

KEYPAD: Keypad

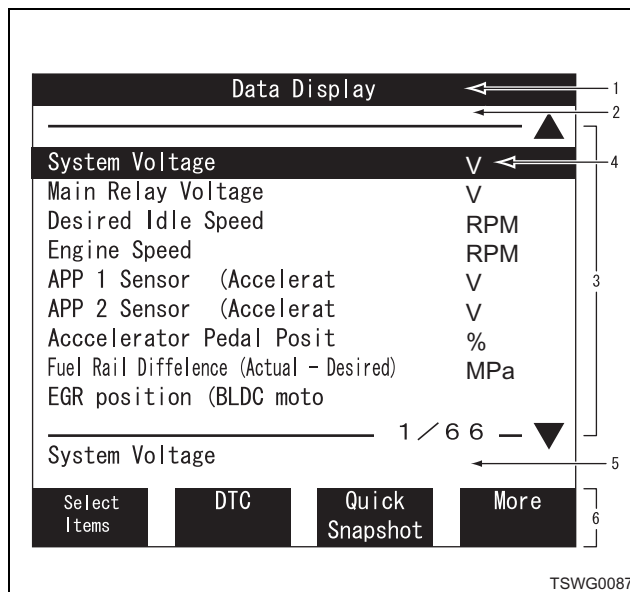
Main Menu

If all the functions are normal after the Tech2 has been switched on, the Start Up screen will open, displaying the Version No. and the applicable model year, stored on the PCMCIA card, to allow the user to verify the information. After the Start Up screen has opened, pressing the [ENTER] key will cause the "Main Menu" to appear. The Main Menu offers 4 different applications to select from. The desired menu can be executed moving the highlight bar to it with the relevant function key or selection keys and pressing the [ENTER] key.



Screen composition:

The screen for data display is composed in the following manner.



Name

1. TITLE AREA
2. MESSAGE AREA
3. DISPLAY AREA
4. Highlight bar
5. FULL TEXT AREA
6. SOFT KEY AREA

- TITLE AREA: Shows the item currently selected.
- MESSAGE AREA: Shows a supplementary explanation or instruction.
- DISPLAY AREA: Displays data parameters and values (9 lines x 23 characters).
- FULL TEXT AREA: Shows details of the parameter under the highlight bar.
- SOFT KEY AREA: The softkeys below the function item display boxes are valid.

Main Menu

F0: Diagnostics

Allows the user to check data, including Tech2-compatible DTC (Diagnostics Trouble Codes), Data Display, Snapshot, Miscellaneous Tests, etc., by selecting a machine ID and System.

- DTC: Shows the contents and situation of DTC stored in the controller of the system.
- Data Display: Shows the input/output data to/from the machine controller under test. Since the displayed data varies from a system to another, and besides, most of the items do not have their guidance standard values installed, it is necessary to first check what the displayed data means.

- Snapshot: Allows to record and display the data of malfunctions occurred. The displayed data not only includes the one corresponding to the moment when a malfunction occurred, but also those that existed before and after the occurrence of the malfunction. It also provides the function (Plot) to draw graphs.

F1: Service Programming System (SPS)

Note:

Except industrial engine.

F2: View Capture Data

Allows to review data recorded under Snapshot of "F0: Diagnostics".

F3: Tool Options

Offers the function to make settings for the Tech2 main unit, to display POST (Power On Self Test) results, and to perform detailed tests (PCB, VCI).

- Tech2 Self Test: Performs troubleshooting on the functions of the main unit.

Caution:

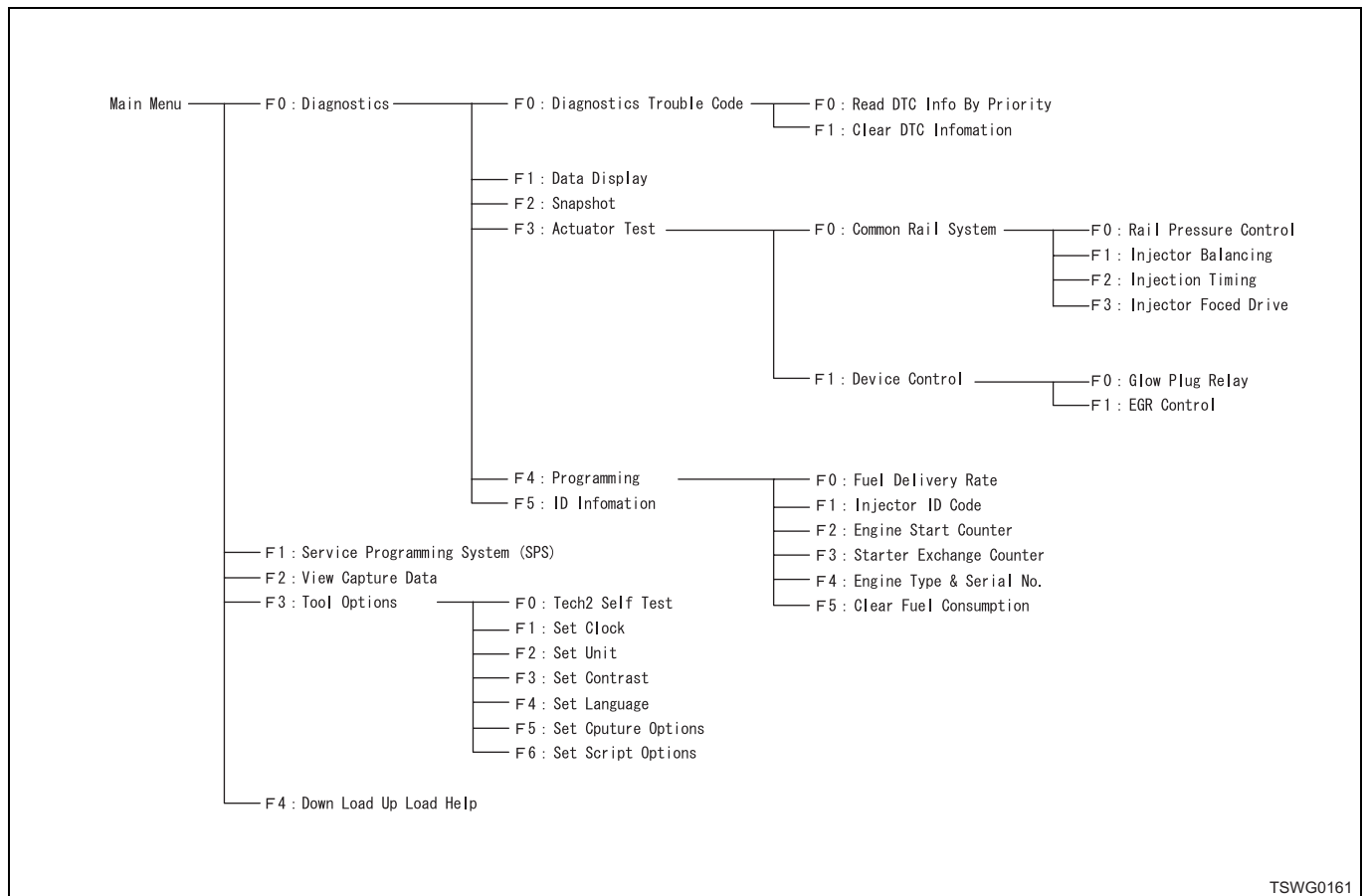
While this function is under execution, do not connect the unit to the machine!

- Set Clock: Sets the internal clock of the Tech2.
- Set Unit: Switches between the Metric system and the English system.
- Set Contrast: Adjusts the brightness of the display.

F4: Down Load Up Load Help

The function to upload/download data (DTC, Snapshot, etc.) acquired through the Tech2 to/from a PC, and the Help function to render assistance in case the operation encounters a hitch.

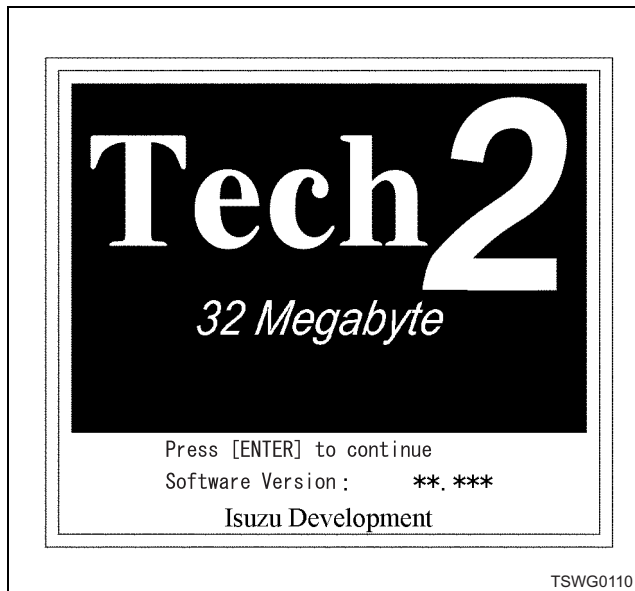
List of functions of Tech2



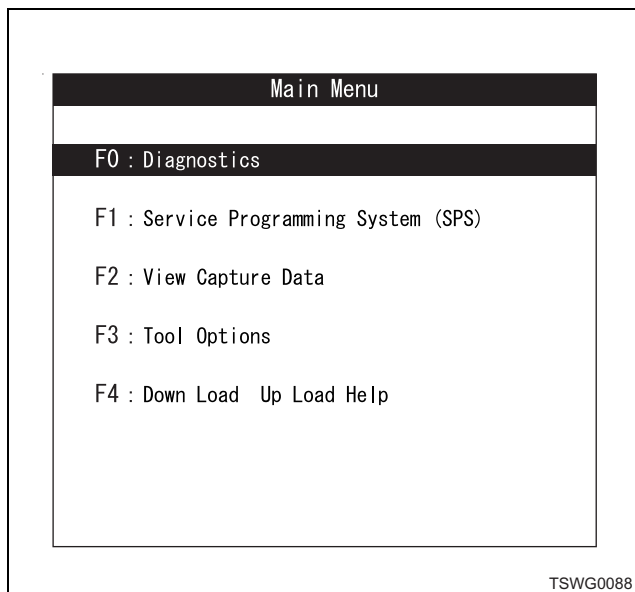
10D-35 Electronic control fuel injection system (Common rail type)

Diagnostic procedure

1. When the Tech2 is switched on, the software version and the model year applicable to the software will also be shown. Confirm the display and press [ENTER].



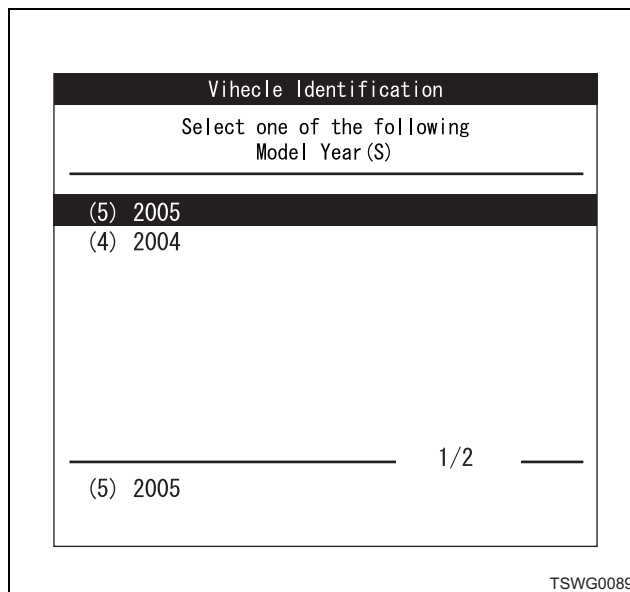
2. Press the function key [F0] or bring the cursor to [F0: Diagnostics] on the "Main Menu" screen by operating the selection keys (▲▼). And then, press the [ENTER] key.



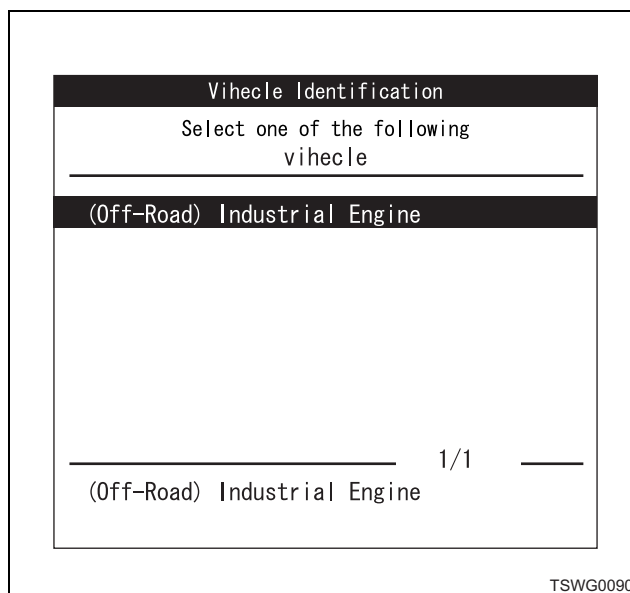
3. Select the Model Year corresponding to the desired diagnostic action on the "Vehicle Identification" screen and press the [ENTER] key.

Note:

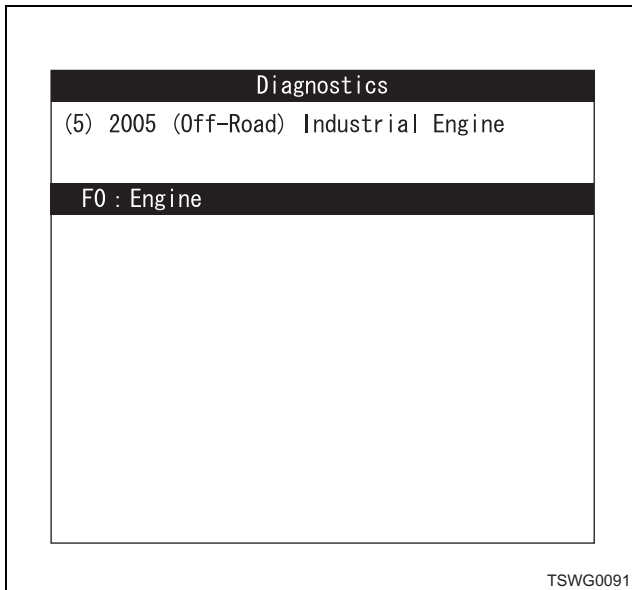
Select the model year of the relevant machine by checking VIN of each machine.



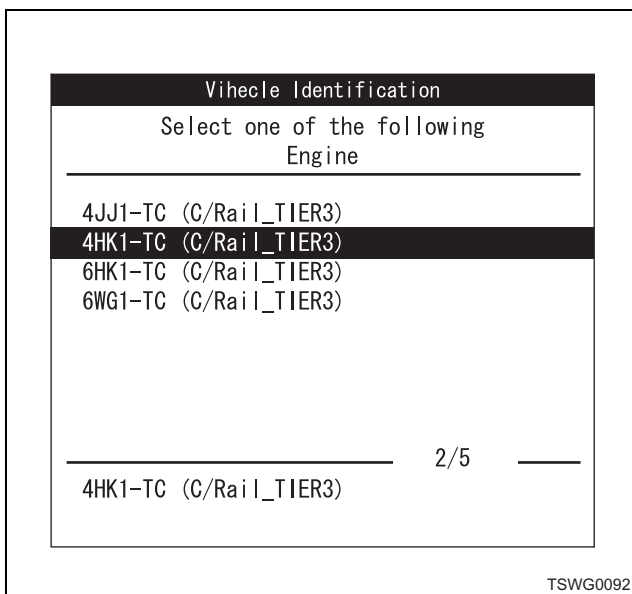
4. Select the Vehicle Type on the "Vehicle Identification" screen and press the [ENTER] key.



5. Press the function key [F0] or bring the cursor to [F0: Engine] by operating the selection keys (▲▼). And then, press the [ENTER] key.



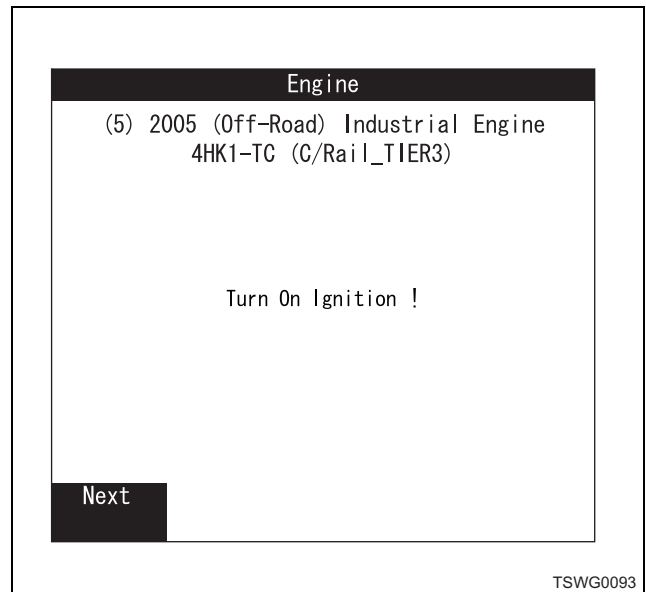
6. Select Powertrain (Eng. name) on the "Vehicle Identification" screen and press the [ENTER] key.



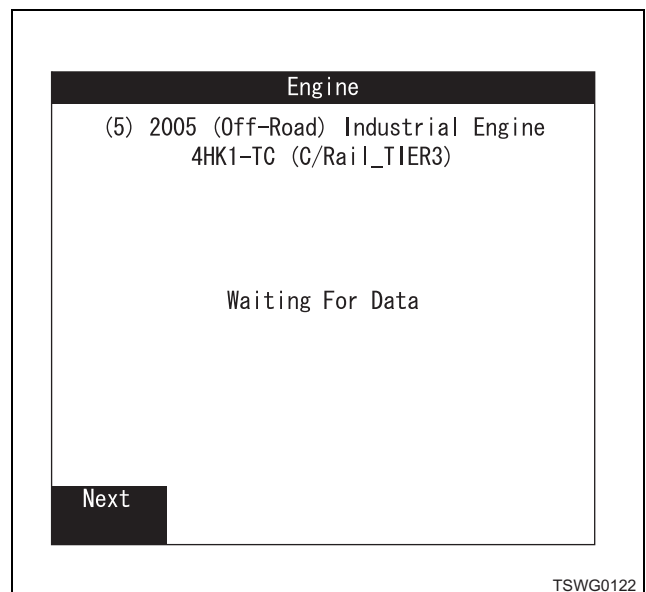
7. The items chosen in steps 3 to 6 are shown in the Message Area display section. If the identification of the machine is OK, turn the ignition key "ON" to "START" and press "Next" by following instructions given on the screen.

Note:

If you make any mistake, pressing the [EXIT] key will return you to the "Main Menu".



8. The following illustration shows the state in which the Tech2 is waiting for communication with the machine controller. If the softkey "Next" is pressed with the ignition key in "OFF", this display will stay forever. (State of communication disabled) However, turning the ignition key "ON" to "START" in this condition will place the unit in the waiting state for communication.



9. Once the communication is established, the unit will show the part No. and DDI (Diagnostic Data Identification) (which varies from a system to another). Press the softkey "Confirm" and go on to the application. If any mistake was made in the selection of the vehicle type, despite that the communication is enabled, a message to that effect will appear flashing. If that is the case, check the vehicle type again and redo the operation from step 1.

10D-37 Electronic control fuel injection system (Common rail type)

Engine

(5) 2005 (Off-Road) Industrial Engine
TIER3_TTI

Part No. *****
DDI D405

1/2

Confirm

TSWG0094

Pressing [EXIT] key in the steps 3 to 9 will return you to the "Main Menu" screen.

DTC check

1. Select "F0: Diagnostic Trouble Codes" on the "Engine" screen.

Engine

F0 : Diagnostic Troubule Codes

F1 : Data Display
F2 : Snapshot
F3 : Actuator Test
F4 : Programming
F5 : ??KA ID Infomation

TSWG0095

F0: Diagnostic Trouble Codes

This function allows the user to analyze the information on the Trouble Code related to the system currently under test.

2. Choosing "F0: Diagnostic Trouble Codes", the following menu is displayed.
F0: DTC Display
F1: DTC Clear

F0: DTC Display

Loads and displays the DTC information stored in the machine controller in a priority order.

F1: DTC Clear

Depending on a machine, DTC is not clearing by Tech2. (The memory clear harness on the machine side needs to be connected to ground.)

DTC application menu display screen

[Example] Industrial Engine

F0: DTC Display

If no DTC stored

Read DTC Info As Stored By ECU

No Diagnostic Trouble Codes Stored

TSWG0123

If DTC stored

Read DTC Info As Stored By ECU

P0098 Present
(0) ??KA Common Rail Pressure Regulator
Perfomance

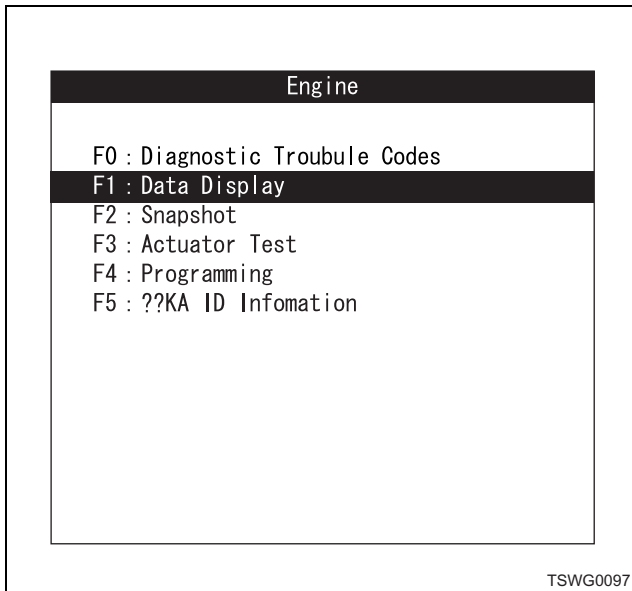
P0606 Present
(0) CPU Error

1/2

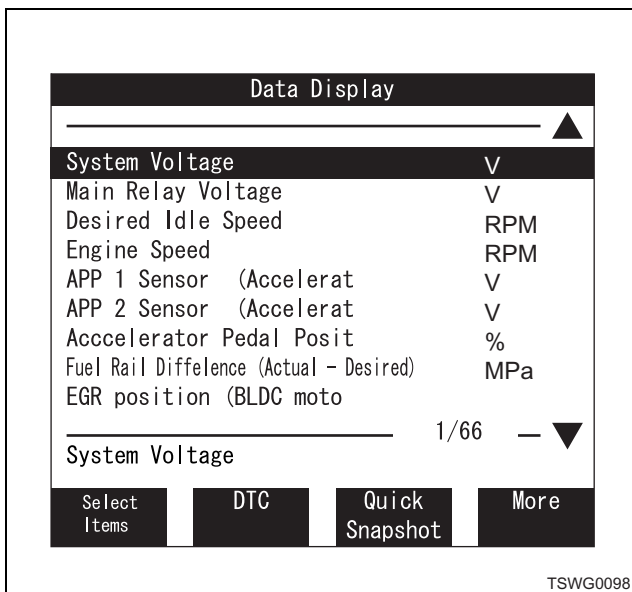
TSWG0096

Data Display

1. Select "F1: Data Display" on the "Engine" screen.
F1: Data Display
 Displays the information concerning various parts of the engine and transmission as data on the screen of the Tech2.



2. F1: Choosing "Data Display", the engine data is displayed.

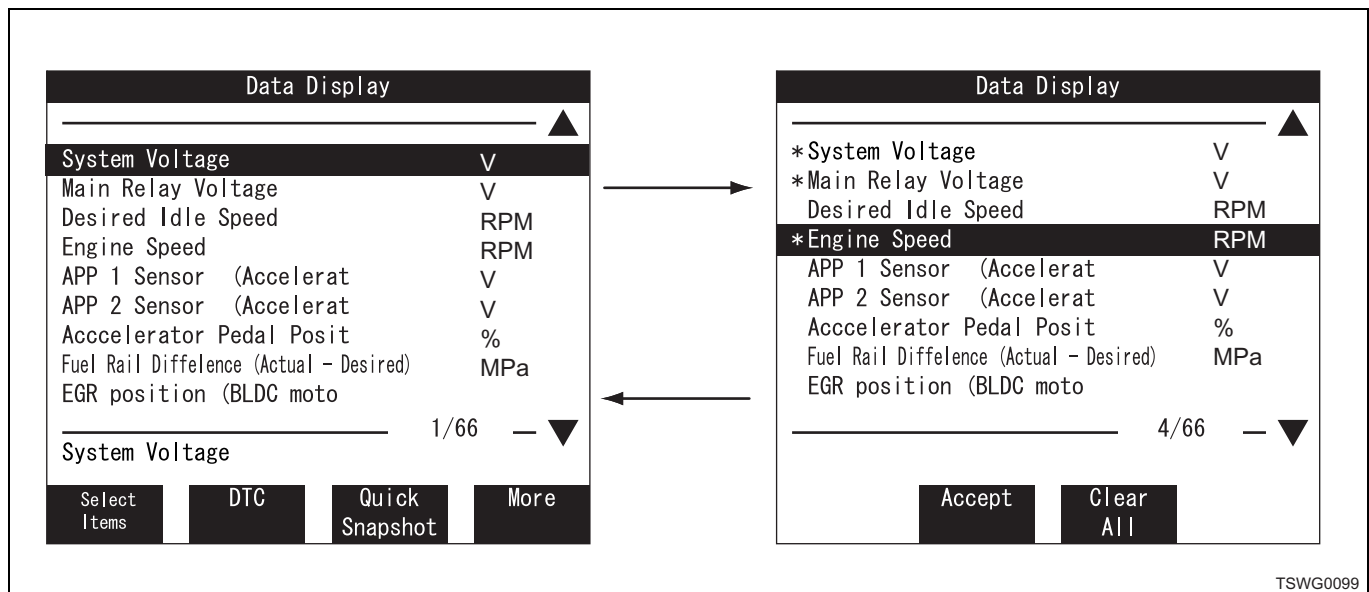
**Softkey functions**

A maximum of 5 data parameters can be fixed on the "Data Display" screen. The 5 fixed parameters will be retained at the upper part of the screen, even when the display is scrolled up or down. To fix parameters, bring the highlight bar to the desired parameter on the screen, which appears as you select the softkey "Select Items", and press the [ENTER]. The selected item can be identified by the asterisk (*) which will be placed atop the parameter. Move the highlight bar with the selection keys (▲▼), and once you have chosen all the parameters you want fixed, press the softkey "Accept". "Data Display" screen is displayed again. To modify the fixed parameter list, choose "Select Items", move the highlight bar to the parameter you want changed, and press the [ENTER] key. The parameter will be cleared. Choosing "Clear All" will clear all the fixed parameters.

If you select the softkey "DTC" while the "Data Display" function remains active, DTC will be displayed on the "Data Display" screen.

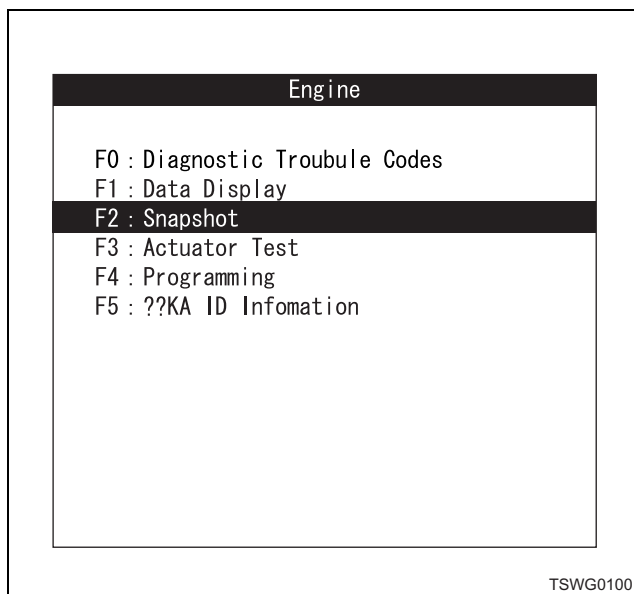
Snapshot can be used while the "Data Display" function remains active. For this, choose "Quick Snapshot." Choosing the softkey "More" allows to use additional functions.

For "Quick Snapshot," refer to "Snapshot."



Snapshot

1. Select "F2: Snapshot" on the "Engine" screen.



2. Choosing "F2: Snapshot", the following menu is displayed.
 F0: Manual Trigger
 F1: Any Code
 F2: Single Code
 F4: Beginning
 F5: Center
 F6: End

Snapshot

Snapshot is intended to save information received by the machine controller during its execution. It provides an effective means to analyze data generated when the machine encounters a trouble. Use of this function enables the user to focus on the situation in which the trouble took place, without having to view all the data for suspected malfunctions. The Tech2 is capable of holding two different Snapshot data. This ability of storing two different Snapshot data allows to compare Good and Bad machine states with each other. Since these data are saved on a first-in, first-out basis, the first Snapshot data (of older date/time) stored on the PCMCIA card will be lost as it is overwritten when a third data comes in. Therefore, be sure to set the internal clock of the Tech2 precisely before starting the Tech2. If a given data must not be erased, highlight that data and choose the softkey "Write Protect". This prevents the data from being overwritten. Pressing the softkey "Clear" cancels the protect.

Snapshot is available in the following 2 types:

- Snapshot: To be chosen in the Snapshot Menu.
- Quick Snapshot: To be chosen through the softkey on the "Data Display" screen.

The Snapshot Data will not be lost even when the Tech2 is switched off, because the data is saved on the PCMCIA card.

About trigger type:

Choosing the Trigger Type Menu allows to check the cause that triggered [Snapshot]. [Snapshot] is executed when there is one of the three causes of occurrence.

F0: Manual Trigger:

Pressing the softkey "Trigger" saves data.

F1: Any Code:

Data is saved in case any trouble code is issued.

F2: Single Code:

Data is saved in case the specified trouble code is issued.

About trigger point:

Trigger Point corresponds to the point in time where triggering is originated by a code issued or by Manual Trigger activated. This information is useful to know the time point of Snap Point and to investigate changes in the data parameter. Trigger Point can be set up at "Beginning", "Center", or "End."

F4: Beginning

Starts saving data from Trigger Point, and keeps on saving it, until the Snapshot recording area is filled up. This selection is effective when the trouble that constitutes the cause is foreseeable.

F5: Center

This function is commonly utilized, since it saves not only the data after Trigger Point, but also those prior to that. This selection allows to compare data that existed before the occurrence of a trouble, those present at the time of occurrence of the trouble, and those after the trouble, among themselves.

F6: End

Saves only the data prior to Trigger Point. This selection is useful when it is desired to terminate Snapshot after the occurrence of a trouble.

Snapshot data replay

1. Press the softkey "Review Data" on the "Snapshot Options" screen.

SnapShot Options

Trigger Type: **Manual Trigger**

F0 : Manual Trigger

F1 : Any Code

F2 : Single Code

Trigger Point: **Center**

F4 : Beginning

F5 : Center

F6 : End

Record Snapshot **Review Data**

TSWG0101

2. Move the highlight bar to the data you want replayed, and press the [ENTER] key. The data will be replayed.

Review Data

To protect Snapshot, highlight record and Press Write Protect soft key.

Snapshot	(5) 2005 Eng	(Off-Road) Industrial 4HK1-TC (C/Rail_TIER3)
//****	**:**:**	

Replay Snapshot **Write Protect**

TSWG0102

Note:

Flashing "Trigger" means that data is being recorded. Pressing the [EXIT] key in this condition will abort the recording. The recording will also be cancelled when the memory capacity is filled up. In either case, the data is saved in memory.

Plot

Snapshot can also be replayed in "View Captured Data."

Plot setup procedure

1. Pressing the softkey "Plot" switches the "Data Display" screen.

Data Display

Replay Snapshot 0:00.000 Frame : 0

Engine Speed RPM

Fuel Rail Diffelence (Actual - Desired) MPa

System Voltage V

Main Relay Voltage V

Desired Idle Speed RPM

APP 1 Sensor (Accelerat V

APP 2 Sensor (Accelerat V

Accelerator Pedal Posit %

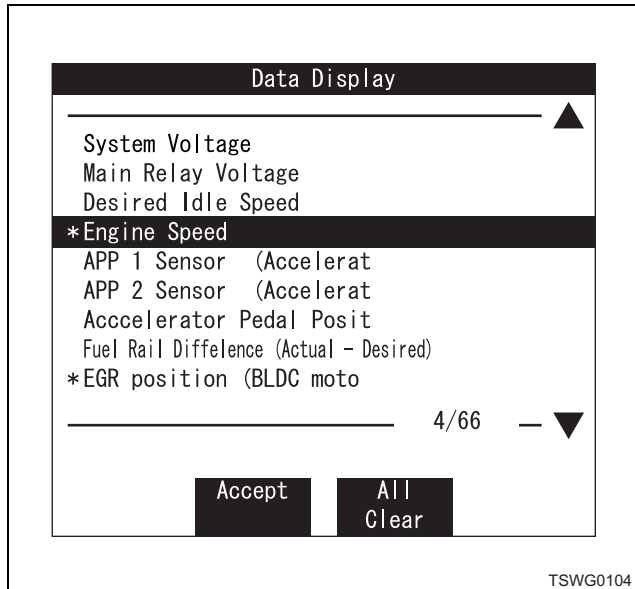
System Voltage 1/64 —

Select Items **Plot** **Select Frame** **More**

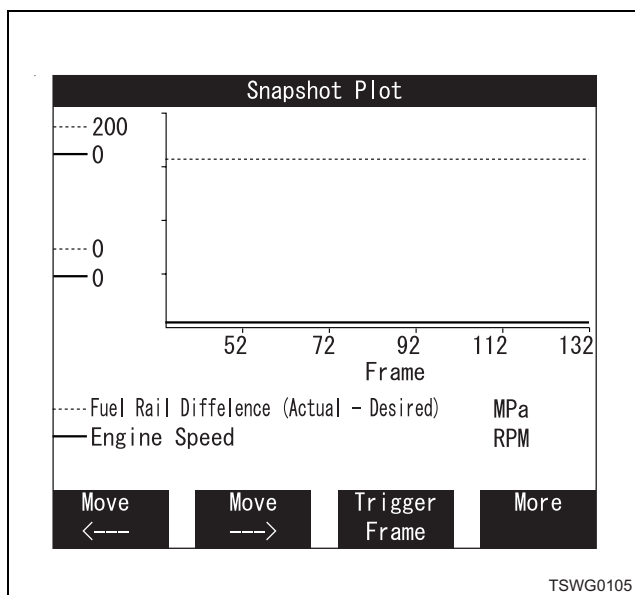
TSWG0103

10D-41 Electronic control fuel injection system (Common rail type)

- Bring the highlight bar to the parameter you want plotted in a graph, as with "Select Items", and press the [ENTER] key.
- The selected parameter can be identified by the asterisk that appears at its top. No more than 3 parameters can be displayed.



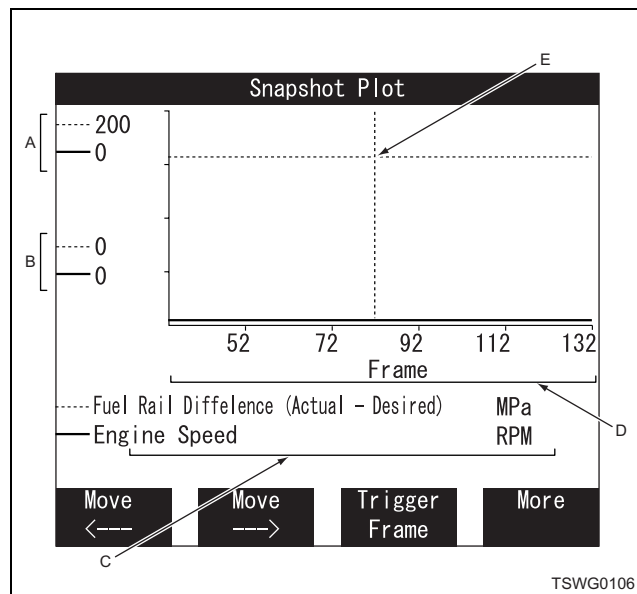
- Choosing the softkey "Accept" changes the display screen and shows a graph after a while.



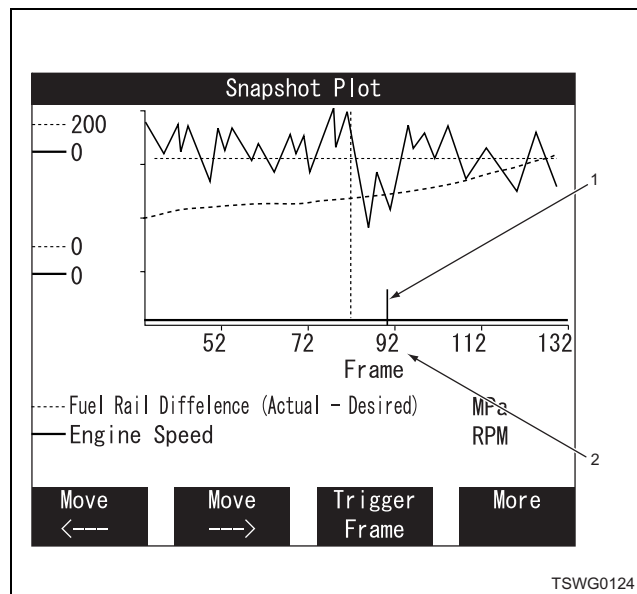
Plot cancel

To close the graph display screen, press the [ENTER] key and you will be returned to the "Data Display" screen.

Explanation of Plot data displayed



- A: Maximum values of selected parameters
B: Minimum values of selected parameters
C: Values of selected parameters and Center Point (E) in frame
D: Number of frames/time
E: Center point of graph indication



- Denotes recognition of DTC.
A vertical line appears in abscissa, if there is a Trouble Code issued in the Snapshot Data loaded. When plotting a graph, it is advisable to check for DTC through "Over View".
- DTC-recognized frame 236 (Actually issued in Frame 235.)

Softkey functions

Choose the "More" on the snapshot graph display screen.

- Move <: Allows to view changes of data preceding the display screen.

- Move →: Allows to view changes of data following the display screen.
- Trigger Frame: Displays a trigger point.
- More: Switches the displayed softkeys.

Choose the "More" on the plot display screen.

- Zoom In: Shows the abscissa by enlarging it (each press doubles the display).
- Zoom Out: Shows the abscissa by reducing it (each press halves the display).
- Over View: Shows the entire frame.
- More: Switches the displayed softkeys.

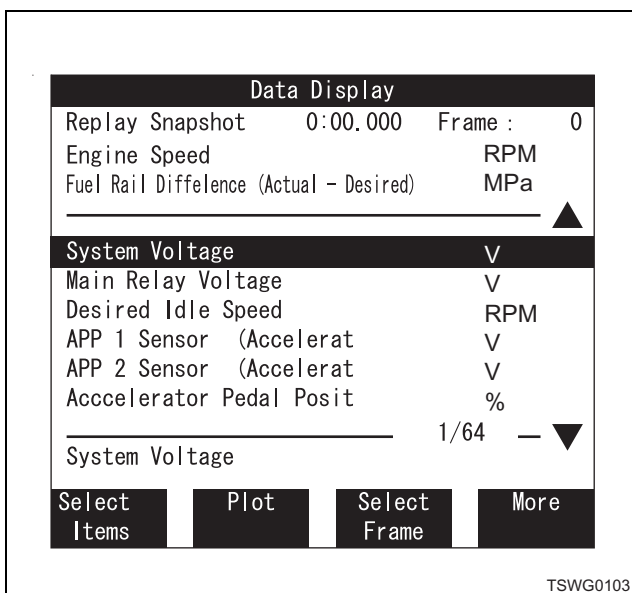
Choose the "More" on the plot display screen.

- Time / Frame conversion: Switches the value in abscissa.
- More: Switches the displayed softkeys.

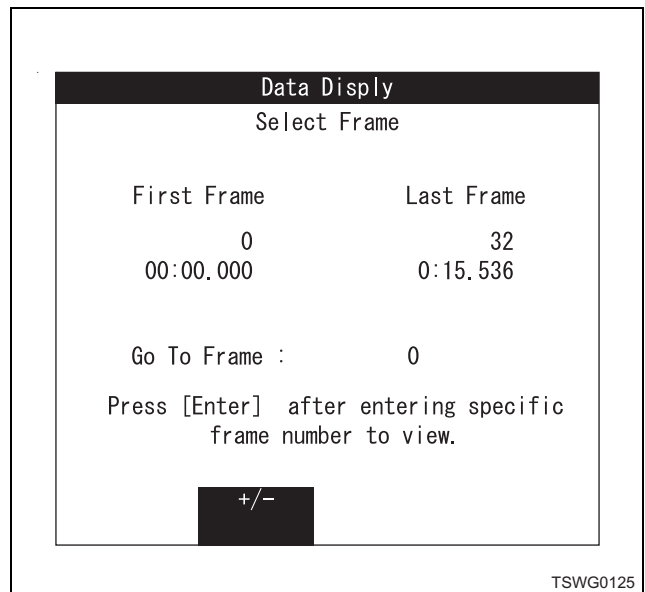
Select frame

Select frame setup procedure

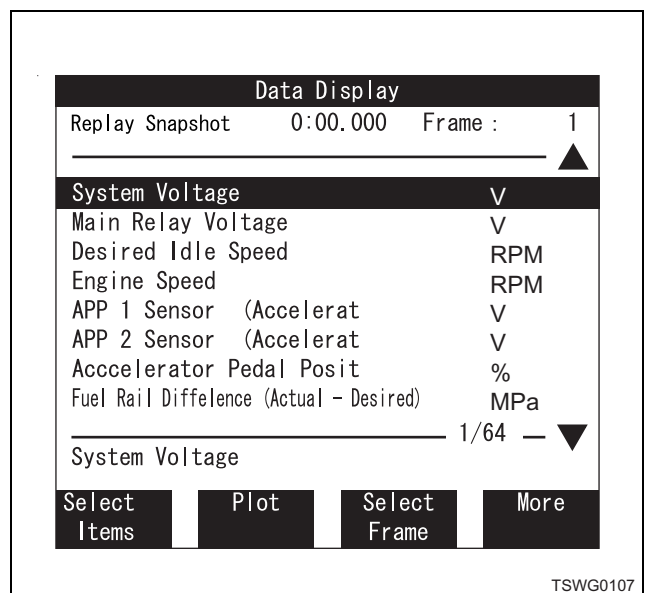
1. Press softkey "Select Frame."



2. Pressing the softkey "Select Frame" causes the following screen.

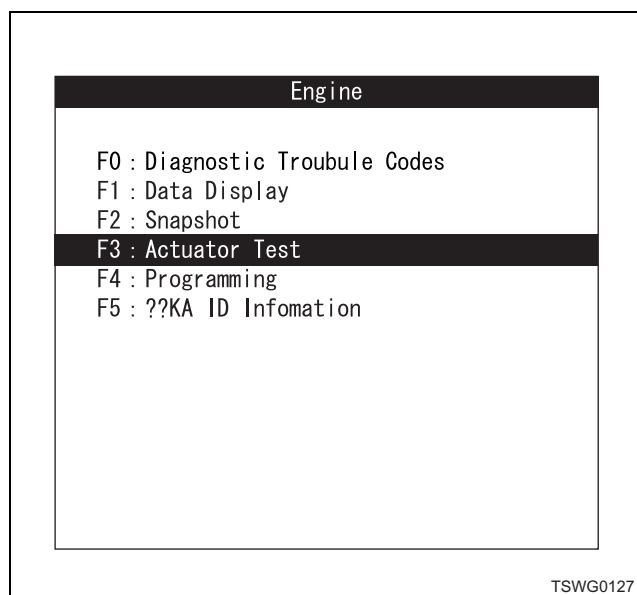


- First Frame: First frame No. and data acquisition time from Trigger Point (calculated backward).
 - Last Frame: Last frame No. and data acquisition time from Trigger Point (integrated).
 - Go To Frame: Entering a frame No. allows to view its data.
 - +/-: Only the "-" sign is displayed.
3. "1" entered via keys in the "Go To Frame" area.

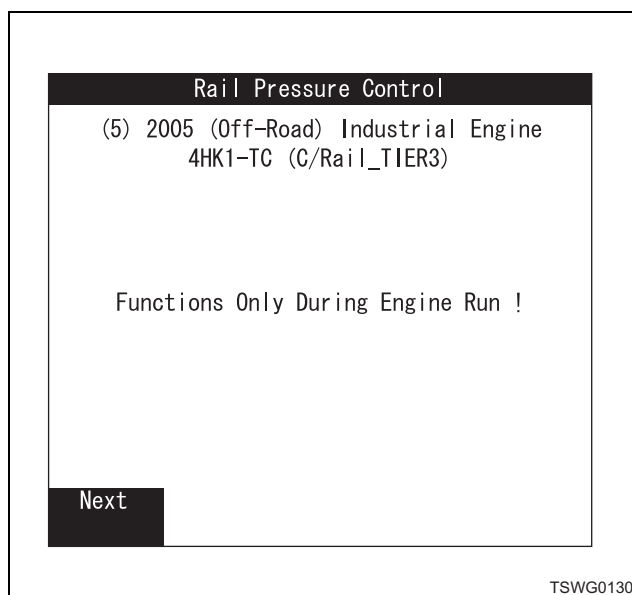


Frame No. 1 and recording time displayed, and data values in Display Area represent those of Frame 1.

Actuator test



4. Select the Rail Pressure Test.

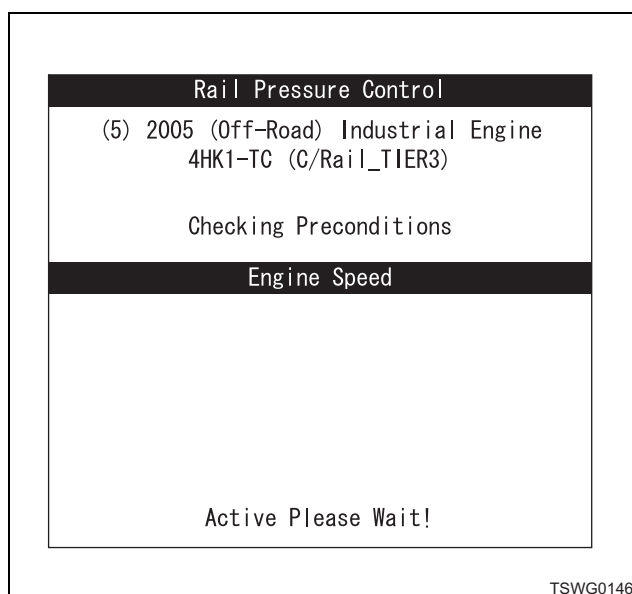
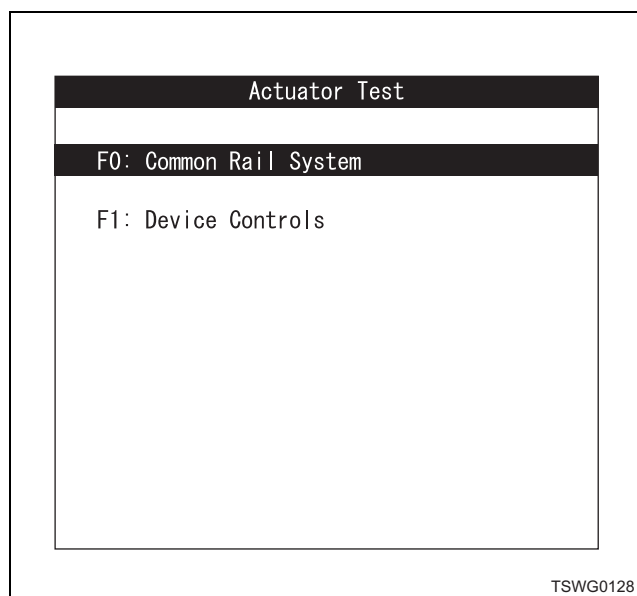


Common rail pressure control test

This test is performed to check the operation of RPCV.
The Tech2 must be used in this test.

Test procedure

1. Connect the Tech2 to the machine DLC.
2. Start the engine and run it at idle.
3. Select the Common Rail System.



5. Send the instruction to RPCV and check the data list.

Rail Pressure Control	
(5) 2005 (Off-Road) Industrial Engine 4HK1-TC (C/Rail_TIER3)	
Engine Speed	RPM
Fuel Rail Diffelence (Actual - Desired)	MPa
1/3	
Quit	Down Up

TSWG0147

6. If variation of data list is proper value, RPCV is judged as normal.

Injector balance test

This test is performed to confirm that proper electric signal is sent to injector while the engine is running.

Note:

At test, the engine is controlled to low idle speed, in order to clarify the variation of engine speed.

Test procedure

1. Connect the Tech2 to the machine DLC.
2. Start the engine and run it at idle.
3. Select the Common Rail System.
4. Select Injection Stop for Each Injector.

Injector Balancing
(5) 2005 (Off-Road) Industrial Engine 4HK1-TC (C/Rail_TIER3)
Functions Only During Engine Run !
Next

TSWG0138

5. Send instruction to each injector (set to OFF by softkey on Tech2 screen) to stop the injector, and check the variation of engine speed.

Injector Balancing	
(5) 2005 (Off-Road) Industrial Engine 4HK1-TC (C/Rail_TIER3)	
System Voltage	V
Main Relay Voltage	V
Desired Idle Speed	RPM
Engine Speed	RPM
APP 1 Sensor (Accelerat	V
APP 2 Sensor (Accelerat	V
Acccelerator Pedal Posit	%
Cylinder 1	OFF 1/64
Quit	ON Next

TSWG0139

6. If the engine speed varies when the injector stops, electrical circuit of that injector is judged as normal. If the engine speed does not vary when the injector stops, electrical circuit of that injector or injector body is judged as faulty.

Injector control test

This test is performed to confirm that proper electric signal is sent to each injector. The Tech2 must be used in this test.

Test procedure

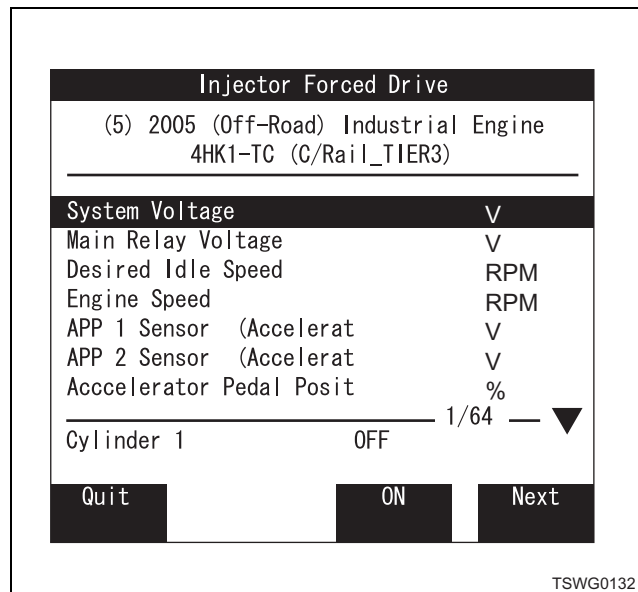
1. Connect the Tech2 to the machine DLC.
2. Turn the key switch to ON (engine is standstill).
3. Select the Common Rail System.
4. Select Compulsory Drive of Injector.

Injector Forced Drive
(5) 2005 (Off-Road) Industrial Engine 4HK1-TC (C/Rail_TIER3)
Functions Only During Engine Stop !
Next

TSWG0131

10D-45 Electronic control fuel injection system (Common rail type)

5. Send instruction to each injector (set to ON by softkey on Tech2 screen), and check the operation sound of injector.



6. If the operation sound is heard, electrical circuit of that injector is judged as normal.
If the operation sound is not heard, electrical circuit of that injector or injector body is judged as faulty.

Note:

After injector control test, the key switch must be turned to OFF once to restart.

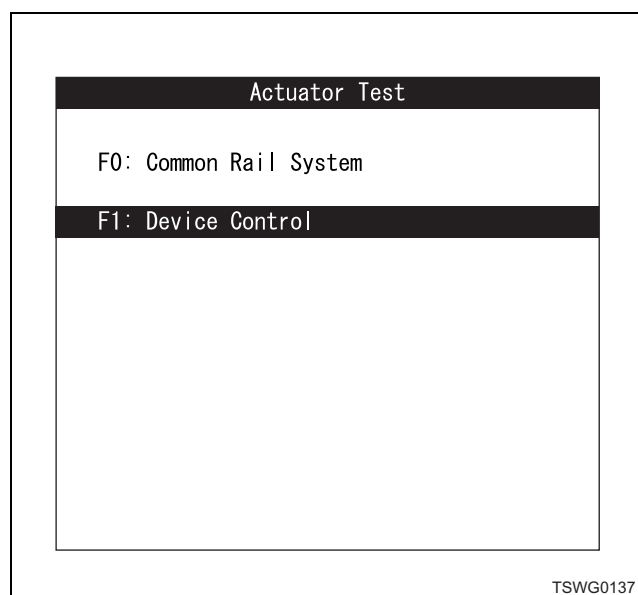
Glow time relay test

This test is performed to check the operation of QOS lamp.

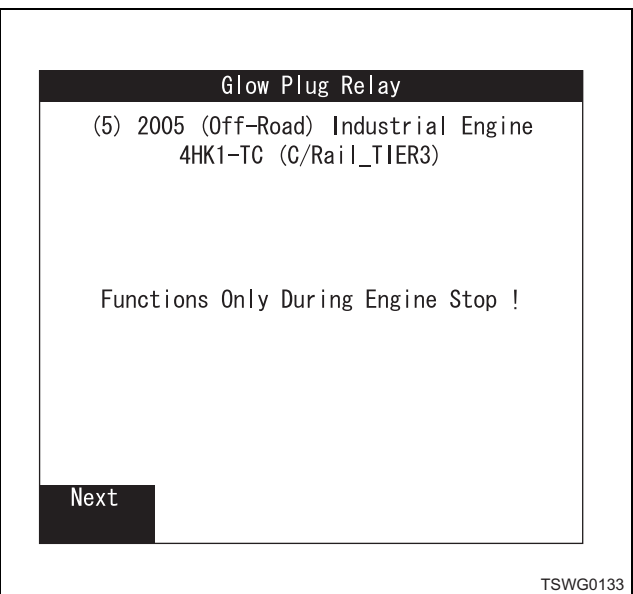
The Tech2 must be used in this test.

Test procedure

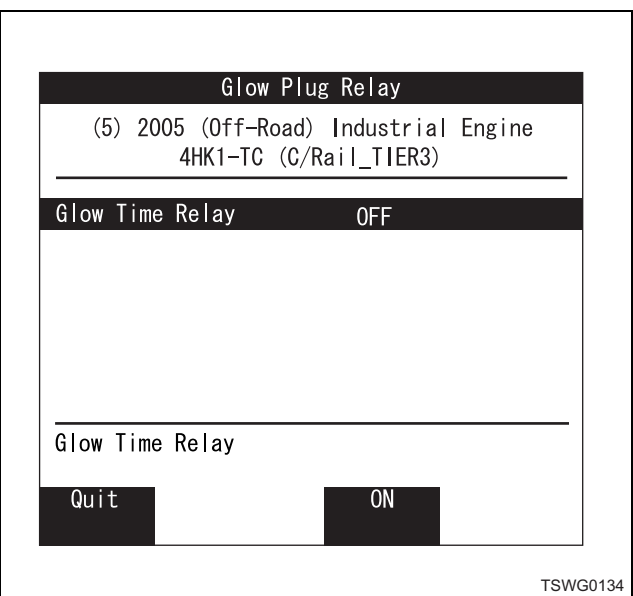
1. Connect the Tech2 to the machine DLC.
2. Turn the key switch to ON.
3. Select the Device Control.



4. Select the Glow Plug Relay.



5. Send the instruction to glow plug relay and check whether the lamp on the machine operates.



6. If the lamp operates properly, it is judged as normal.

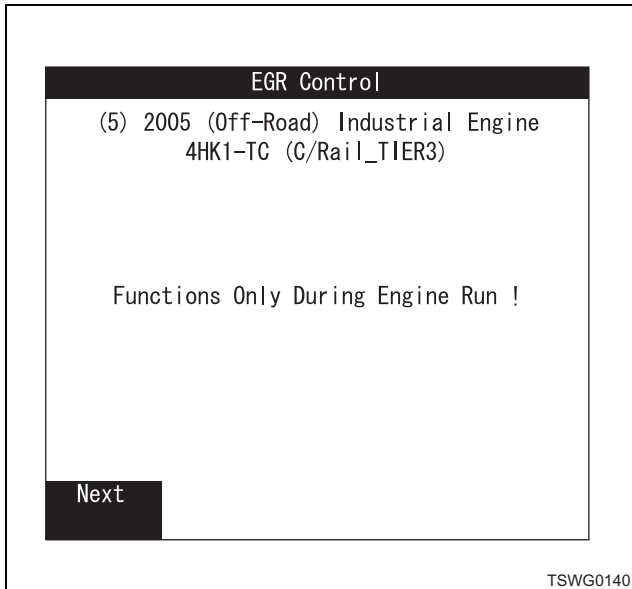
EGR regulating valve test

This test is performed to check the operation of EGR valve.

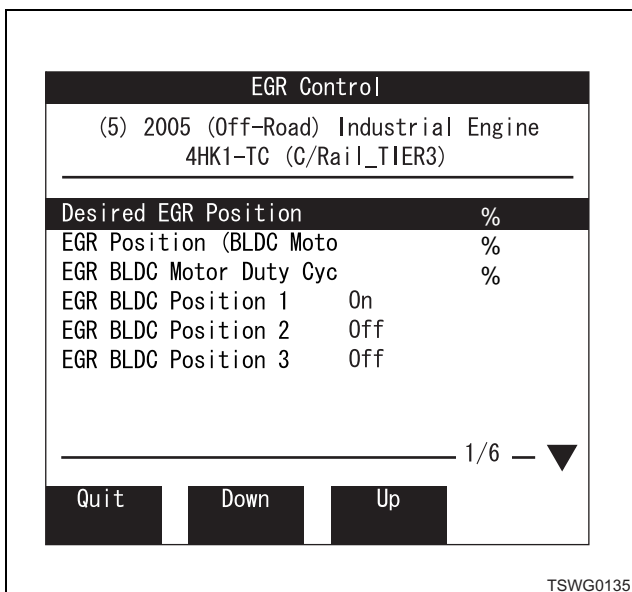
The Tech2 must be used in this test.

Test procedure

1. Connect the Tech2 to the machine DLC.
2. Start the engine and run it at idle.
3. Select the Device Control.
4. Select the EGR Control.



5. Send the instruction to EGR valve and check the data list.



6. If variation of data list is proper value, EGR valve is judged as normal.

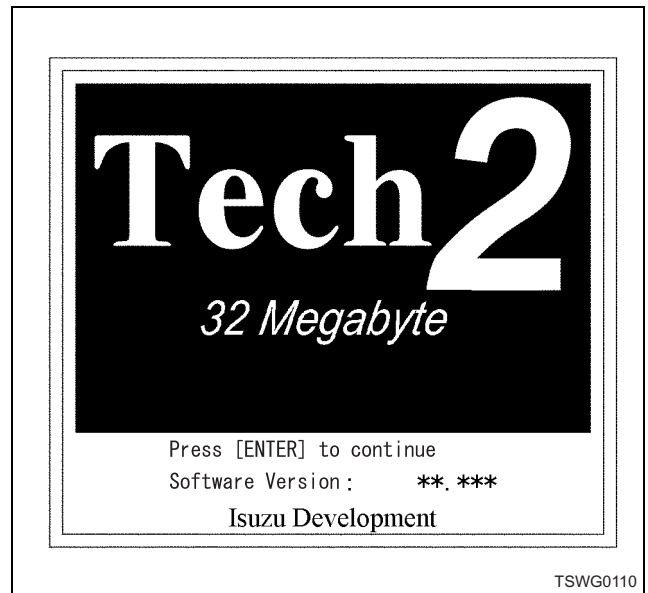
View captured data.

The Snapshot data acquired through the application menu "F2: Snapshot" under the "Main Menu, F0: Diagnostics" can be replayed.

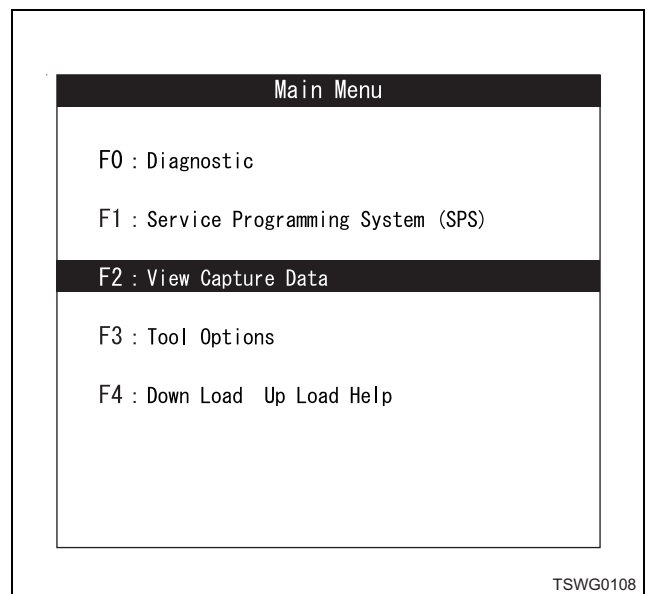
Since the data is saved on the PCMCIA card, it can be viewed after disconnecting the Tech2 (DLC) from the machine. Two data items can be saved there. The internal clock of the Tech2 needs to be set precisely, since the data are identified with dates and times.

Sample use of snapshot data replay

1. Turn on the power.

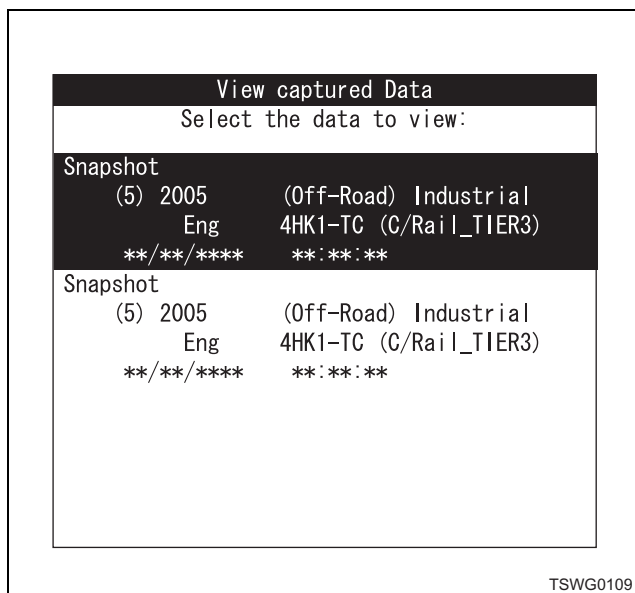


2. Press [ENTER].

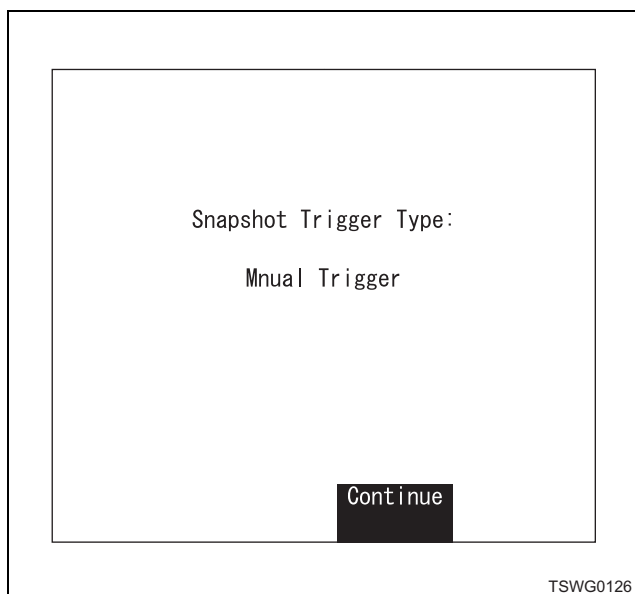


10D-47 Electronic control fuel injection system (Common rail type)

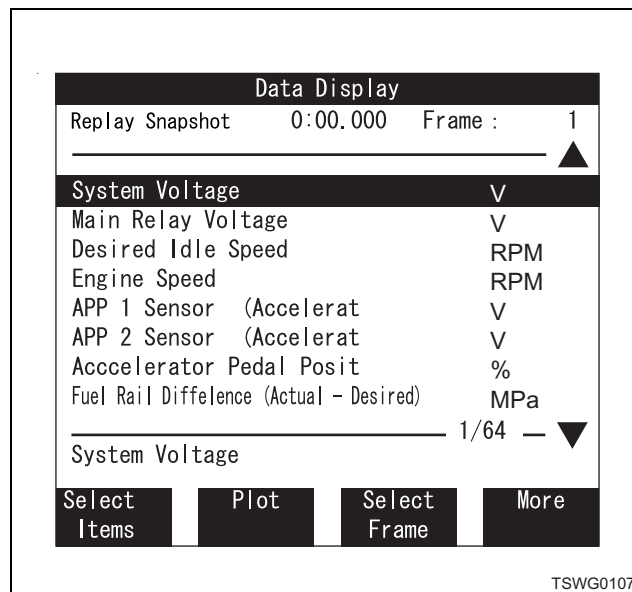
- Choose "F2: View Capture Data" and press the [ENTER] key. "View Captured Data" appears.
- Choose "Snapshot Data" with selection keys (▲▼) and press the [ENTER] key.



- Press the softkey "Continue" on the display screen.



- Snapshot Replay Screen appears.



Softkey functions

- Choose the softkey "More" on the Snapshot Replay screen
 - Select Items: Chosen to fix and display a parameter (up to 5 parameters).
 - Plot: Draws a graph (Up to 3 parameter items).
 - Select Frame: Allows to specify a frame No. and to move a parameter to the specified frame.
 - More: Switches the displayed softkeys.
- Choose "More" out of the 4 softkeys on the display screen.
 - Auto Reverse: Allows to view changes of data of each frame.
 - Stop: Stops a frame in motion.
 - Auto Forward: Allows to view changes of data of each frame.
 - More: Switches the displayed softkeys.
- Choose "More" out of the 4 softkeys on the display screen.
 - First Frame: Allows to view the top data frame.
 - Trigger Frame: Allows to view a triggered frame.
 - Last Frame: Allows to view the last data frame.
 - More: Switches the displayed softkeys.
- Choose "More" out of the 4 softkeys on the display screen.
 - Units: Changes the unit (speed/temperature).
 - Previous Frame: Allows to view changes of data by reversing it, frame No. by frame No.
 - Next Frame: Allows to view changes of data by feeding it forward, frame No. by frame No.
 - More: Switches the displayed softkeys.

5. Choose "More" out of the 4 softkeys on the display screen.
 - DTC: Shows the frames in which a Trouble Code was issued, in the range from the top frame to the displayed frame.
 - Previous DTC-Chg: Shows the frames in which a Trouble Code was issued, in the range before the displayed frame.
 - Next DTC-Chg: Shows the frames in which a Trouble Code was issued, in the range after the displayed frame.
 - More: Switches the displayed softkeys.
6. Choose "More" out of the 4 softkeys on the display screen.
The Snapshot Replay screen is restored.

Difference in operation of Snapshot Data Replay:

The operations of Snapshot Data Replay under "F2: View Captured Data" are somewhat different from those of Replay (softkey function "Review Data") under "F2: Snapshot". Be careful not to confuse them.

Tool options

Tool Options is the function to conduct a detailed test, in case communication cannot be established with the machine at the time of setup of the Tech2 or at the time of Power On Self Test (POST).

Tool option menu

F0: Tech2 Self Test

Allows to conduct a test that assists with the diagnostics of the Tech2 itself. Normally the Self Test function need not be executed, since the Tech2 conducts the Power On Self Test (POST) every time it is switched on. If the POST demonstrates any trouble, the results of the POST can be checked choosing the Self Test menu.

F1: Set Clock

Resets the date and time of the Tech2. Before exiting this menu, press the softkey "Set Clock" to save the settings.

F2: Set Unit

Switches the unit between the English and the Metric system.

F3: Set Contrast

Changes the screen contrast (lighter or darker). The change will be saved even after the Tech2 is switched off.

Tech2 self test menu

F0: Automated Main PCB and VCI

Automatically executes function tests on the Main PCB and VCI modules.

F1: Automated Main PCB

Automatically executes function tests on the Main PCB module.

F2: Automated VCI

Automatically executes function tests on the VCI module.

F3: Selectable Main PCB

Allows to check detailed information on the PCB module test items.

F4: Selectable VCI

Allows to check detailed information on the VCI module test items.

F5: Power On Self Test Results

Displays POST test results again.

Set clock

Operation procedure:

1. Choose the "F2: Tool Options" and press [ENTER].
2. Choose the "F1: Set Clock" and press [ENTER].
3. Display the "Set Real-Time Clock" screen. Move the cursor to the item you want changed by operating the selection keys (▲▼), and press the [ENTER] key.

Note:

Each press on the [ENTER] key will increment the numeric value one by one, but it will not exceed the preset maximum value.

4. After all the values have been entered, press the softkey "Set Clock" and the changes will be saved.

Set Real-Time Clock

F0: Change Month	February
F1: Change Day	Monday
F2: Change Date	07
F3: Change Year	2005
F4: Change Hour	15
F5: Change Minute	00

Use arrow keys to select field.
Press [ENTER] to change value.
Press 'Set Clock' to save changes.

Set
Clock

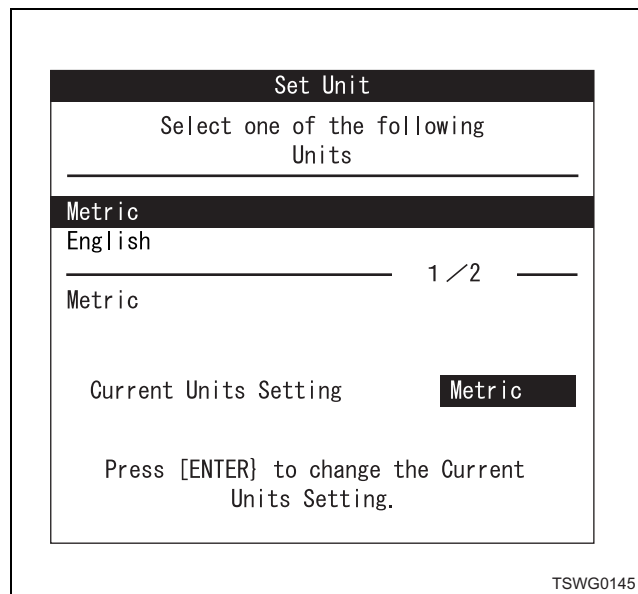
Set units

Operation procedure:

1. Choose the "F2: Tool Options" and press [ENTER].
2. Choose the "F2: Set Unit" and press [ENTER].
3. Display the "Set Unit" screen, and move the cursor to the item you want changed by operating the selection keys (▲▼), and press [ENTER] key.
4. When the setup is complete, press the [EXIT] key to save the current setting.

Note:

It will take effect next time the Tech2 is switched on.



* Metric

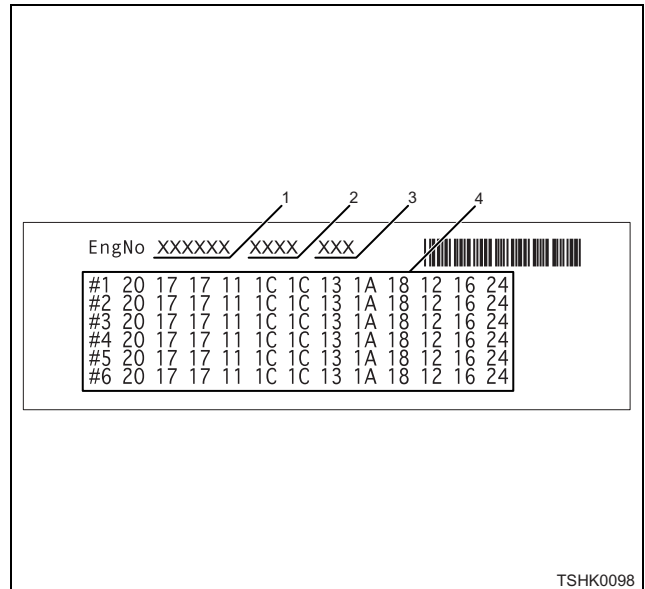
Temperature: °C Speed: km/h

* English

Temperature: °F Speed: MPH

Rewrite setting of Q-key correction data by Tech2

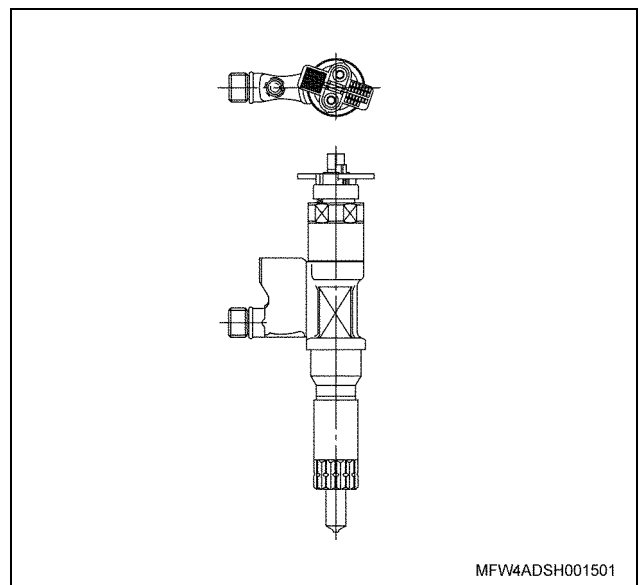
"Q-key, Injector code label" is attached to the cylinder head cover. It is used for rewriting and registering the ID.



Name

1. Engine number
2. Typical engine model
3. Q-key information
4. Injector information

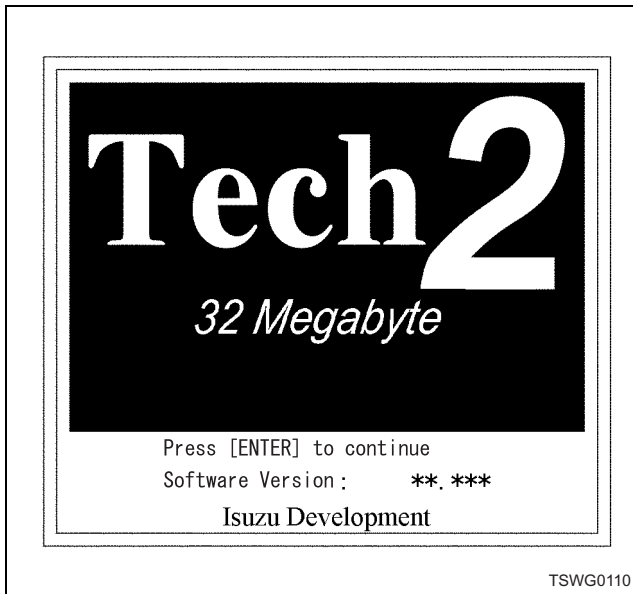
There is the injector code on the top of injector as well. When replacing the injector, register its code.



1. Refer to the following instruction for how to setup the Q-key correction data.

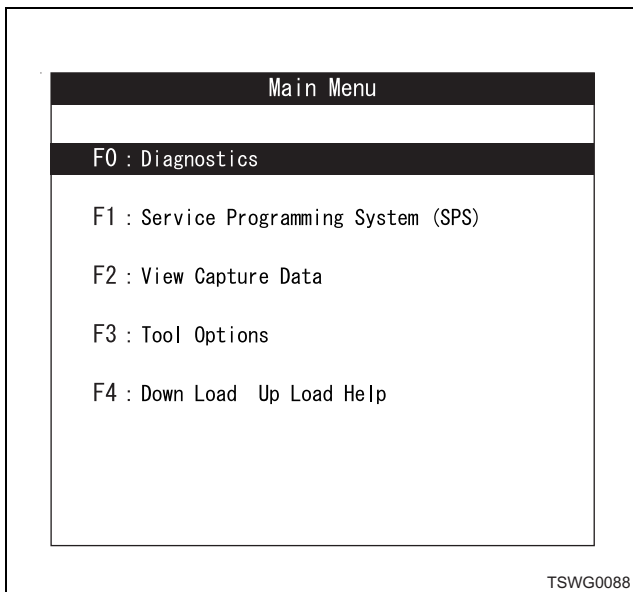
Step 1

- Press [ENTER].



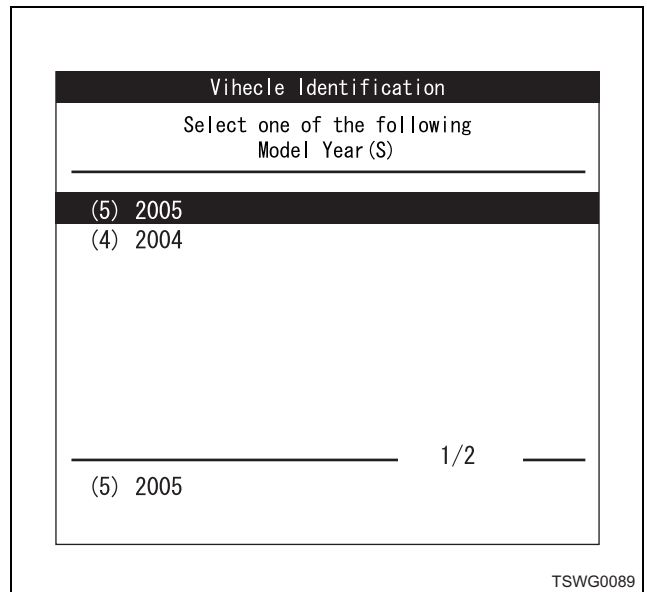
Step 2

- Choose the menu F0: Diagnostics with ▲, ▼ (up/down) keys or F0 (function) key, and press [ENTER].



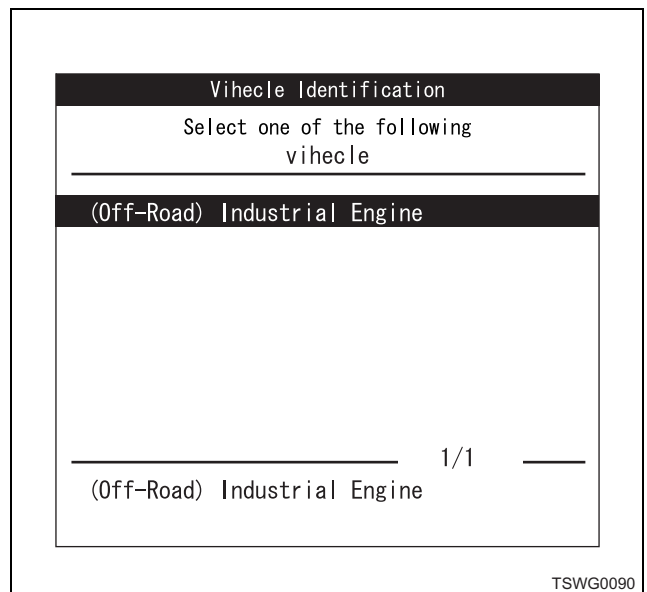
Step 3

- Choose the menu (5) 2005 with ▲, ▼ (up/down) keys, and press the [ENTER] key.
* Applicable for 2000MY or later.



Step 4

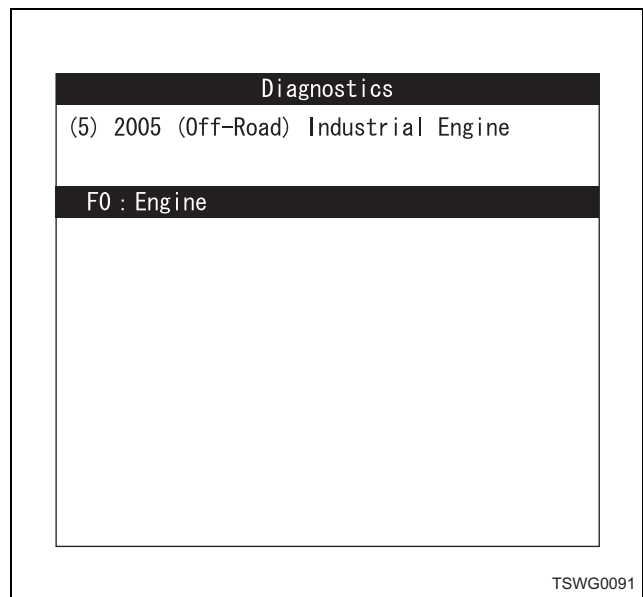
- Choose the menu (Off-Road) Industrial Engine with ▲, ▼ (up/down) keys, and press the [ENTER] key.



10D-51 Electronic control fuel injection system (Common rail type)

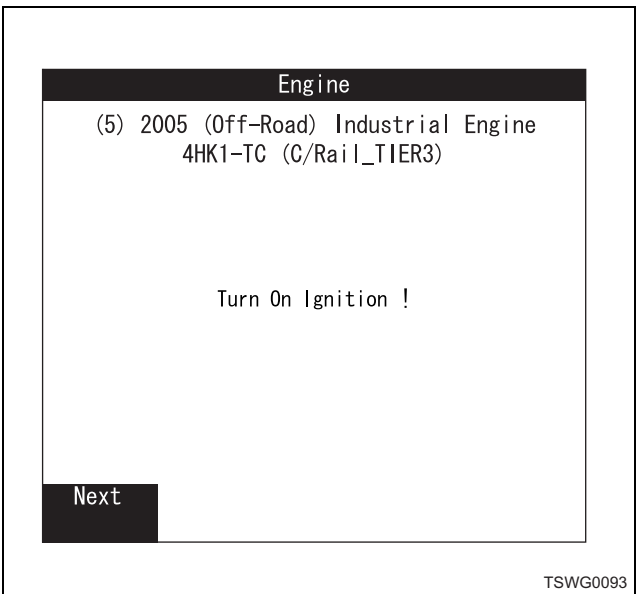
Step 5

- Choose F0: Engine in Menu with ▲, ▼ (up/down) keys or F0 (function), and press [ENTER].



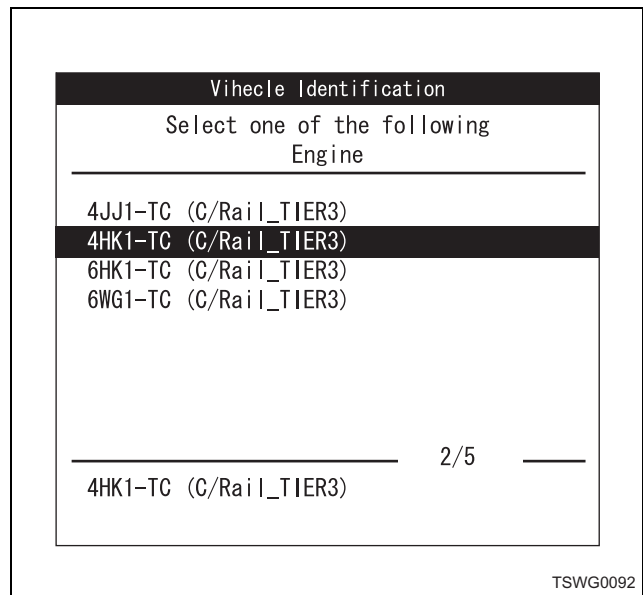
Step 7

- Press the softkey "Confirm".
- The ignition is ON at this time.

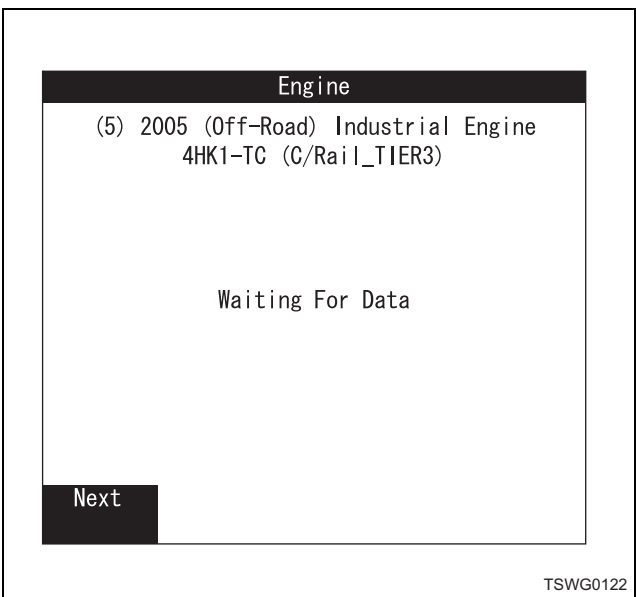


Step 6

- Choose "4HK1-TC (C/Rail_TIER3)" with ▲, ▼ (up/down) keys, and press [ENTER].



Step 7-1



Step 8

- Press the softkey "Confirm".
- This displays the ECU ID information.

The screenshot shows a menu titled "Engine". Below the title, it displays "(5) 2005 (Off-Road) Industrial Engine" and "TIER3_TTI". A horizontal line separates this from the "Part No." section, which shows "DDI" and "D405" with "*****" in between. Below this, it shows "1/2" and "Part No." with a horizontal line. At the bottom left, there is a "Confirm" button.

TSWG0094

Step 9

- Choose the menu F4: Programming with ▲, ▼ (up/down) keys or F4 (function) key, and press [ENTER].

The screenshot shows a menu titled "Engine". Below the title, it lists several options: "F0 : Diagnostic Trouble Code", "F1 : Data Display", "F2 : Snapshot", "F3 : Actuator Test", "F4 : Programing" (highlighted with a black background), and "F5 : ??KA ID Infomation".

TSHK0050

Step 10

- Choose the menu F0: Q-key correction with ▲, ▼ (up/down) keys or F0 (function) key, and press [ENTER].

The screenshot shows a menu titled "Programming". Below the title, it lists several options: "F0 : Fuel Delivery Rate" (highlighted with a black background), "F1 : Injector ID Code", "F2 : Engine Start Counter", "F3 : Starter Exchange Counter", "F4 : Engine Type & Serial No.", and "F5 : Clear Fuel Consumption".

TSHK0051

Step 11

- Choose the menu F2: Service mode with ▲, ▼ (up/down) keys or F2 (function) key, and press [ENTER].

- F0: Uploads the three-point Q-key data stored in the ECM to the Tech2.
* Registers the data when replacing ECM.
- F1: Writes the three-point Q-key data temporarily stored in the Tech2 to the ECM.
* Registers to the ECM after replacing ECM.
- F2: Any data can be written. However, password and ID are required.

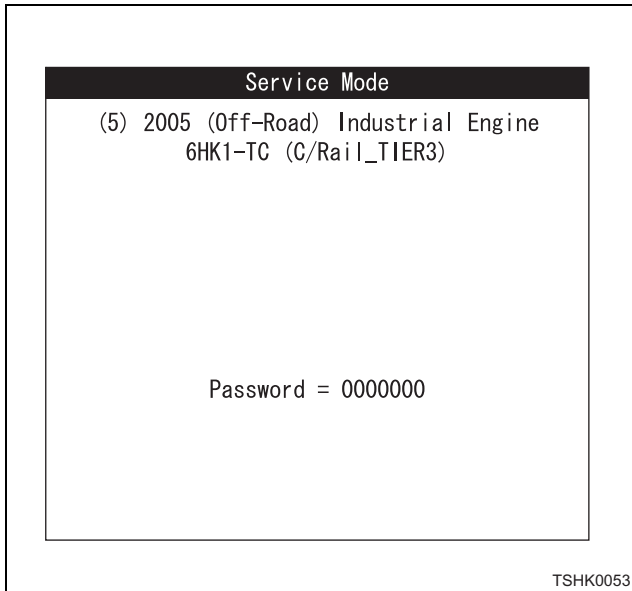
The screenshot shows a menu titled "Fuel Delivery Rate". Below the title, it lists several options: "F0 : Upload Fuel Delivery Rate", "F1 : Download Fuel Delivery Rate", and "F2 : Service Mode" (highlighted with a black background).

TSHK0052

10D-53 Electronic control fuel injection system (Common rail type)

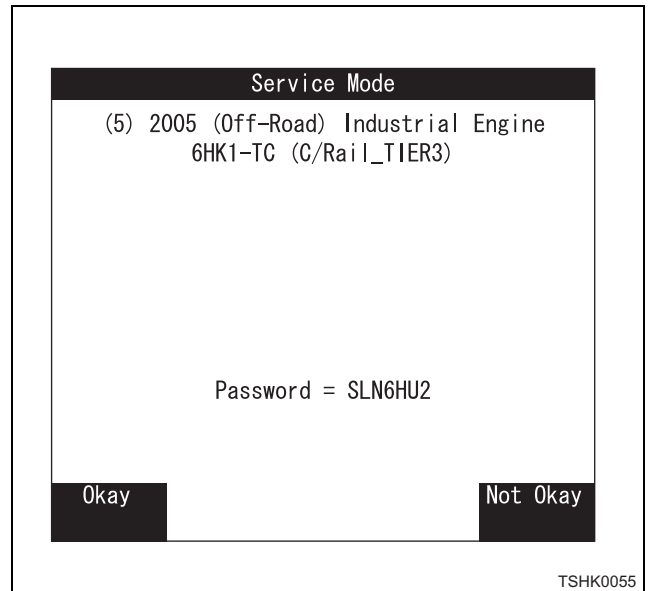
Step 12

- Password input screen
- This procedure will end automatically if the registration is not completed within 30 seconds. The message "Time Over" appears.



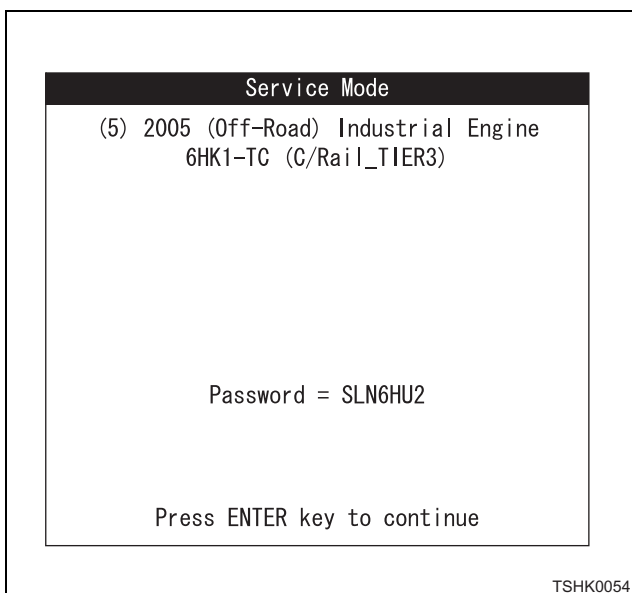
Step 12-2

- If the password you have entered is correct, press the softkey [Okay].
- Enter the password within 30 seconds. Failure to enter the password within 30 seconds will return to Step 11.



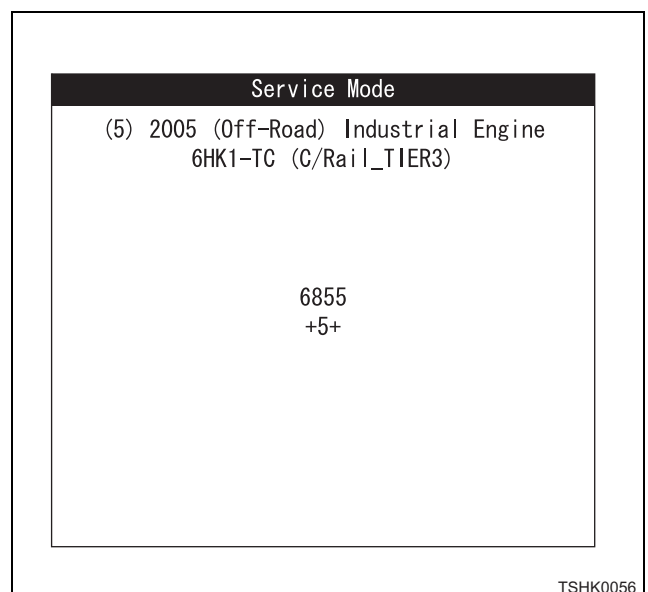
Step 12-1

- After entering the password, press [ENTER] key. The password for 04/6H is "SLN6HU2".
- Entering the password other than "SLN6HU2" will return to the previous menu.



Step 13

- After completing the password registration, ID registration will be performed.
- The value "+5+" appeared in the screen below will be counted down. Press the function key [ENTER] before the value becomes "+4+". This changes the value to "+0+".
* If the value becomes "+3+", the registration will be invalid.



Step 13-1

Ask the machine manufacturer's service center or Isuzu Industrial Engine Dept. service section for a password.

Note:

The clock of Tech2 must be correctly set.

- After entering, press [ENTER] key.

The screenshot shows a 'Service Mode' screen with the following text:

(5) 2005 (Off-Road) Industrial Engine

6HK1-TC (C/Rail_TIER3)

6855

+0+

24950

A 'Change' button is visible at the bottom left. The code TSHK0057 is at the bottom right.

Step 14

- When the ID code matches, the following screen will appear. Press the softkey "Next".
- This step can be performed only when the engine speed is 0 rpm.

The screenshot shows a 'Service Mode' screen with the following text:

(5) 2005 (Off-Road) Industrial Engine

6HK1-TC (C/Rail_TIER3)

Check Vehicle Condition!

Function Only During Engine Stop!

A 'Next' button is visible at the bottom left. The code TSHK0058 is at the bottom right.

Step 15

- Displays the three-point Q-key data in the ECM.
 - To modify the Q-key data, press the softkey "Change".

The screenshot shows a 'Service Mode' screen with the following text:

(5) 2005 (Off-Road) Industrial Engine

6HK1-TC (C/Rail_TIER3)

Current Fuel Delivery Rate

Data1	Data2	Data3
4	4	4

A 'Change' button is visible at the bottom left. The code TSHK0059 is at the bottom right.

Step 15-1

- If the Q-key correction data you have entered is correct, press [ENTER] key.
 - The entry conditions are as follows.

Conditions:

C/Rail system entry setting is "1 – 15".

TIS system entry setting is "1 – 8".

The screenshot shows a 'Service Mode' screen with the following text:

(5) 2005 (Off-Road) Industrial Engine

6HK1-TC (C/Rail_TIER3)

Use up/down arrow keys to change value.

Use left/right arrow keys to select field.

Data1	Data2	Data3
08	20	08

Press ENTER key to continue

The code TSHK0099 is at the bottom right.

10D-55 Electronic control fuel injection system (Common rail type)

Step 15-2

- If the Q-key correction data you have entered is correct, press the softkey "Program".

Service Mode

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

Use up/down arrow keys to change value.
Use left/right arrow keys to select field.

Data1	Data2	Data3
08	10	08

Program Abort

TSHK0100

Step 15-4

- To go to Step15-5, modify the Q-key data within the set value and press the softkey "Program".

Service Mode

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

Invalid Data - Please Try Again!

Data1	Data2	Data3
08	10	08

Program Abort

TSHK0102

Step 15-3

- If the Q-key correction data you have entered is off the set value, the message shown as Step 15-4 appears.

Service Mode

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

Use up/down arrow keys to change value.
Use left/right arrow keys to select field.

Data1	Data2	Data3
08	20	08

Program Abort

TSHK0101

Step 15-5

- If the entered values meet the conditions in Step 15-1 and 15-3, the status display of data registration (writing) from the Tech2 to ECM as shown below will appear.

Service Mode

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

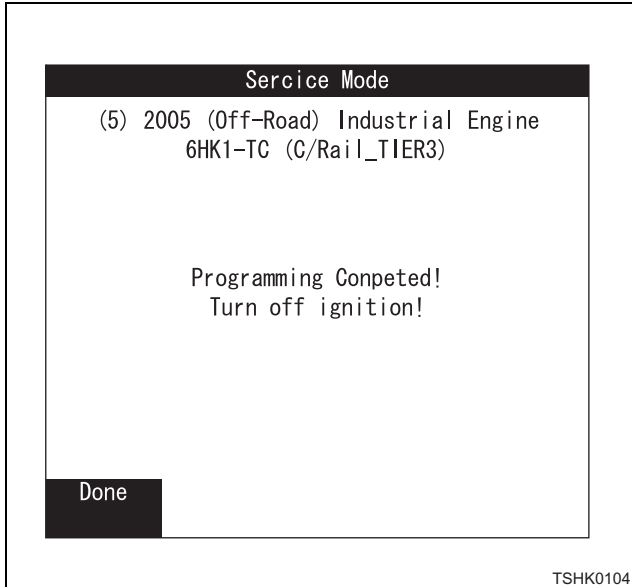
Programming in progress!

0 100 %

TSHK0103

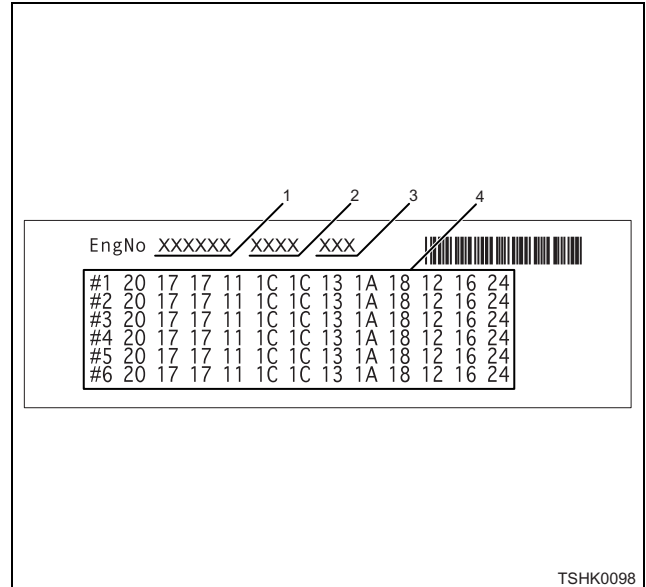
Step 17

- When the writing of data completes, the following screen will appear.
This indicates that the result of comparison of entered data with that written in the EEPROM of the ECM is in good condition.



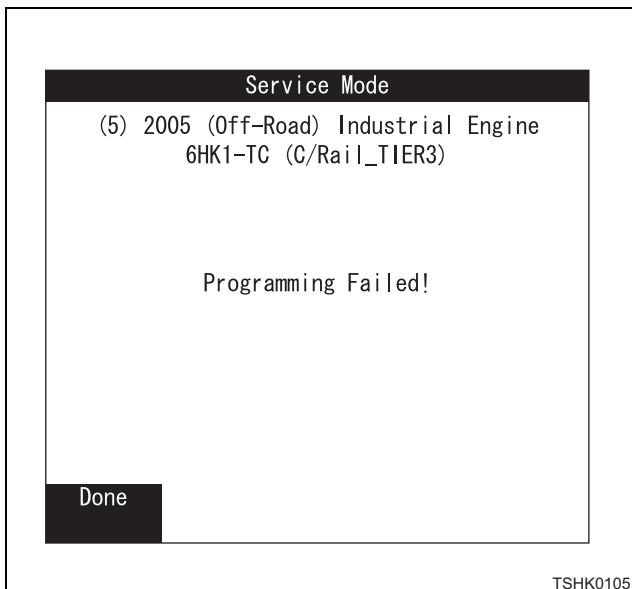
Injector ID code (No. 1 cylinder – No. 6 cylinder) registration setting using Tech2

"Q-key, Injector code label" is attached to the cylinder head cover. It is used for rewriting and registering the ID.



Step 17-1

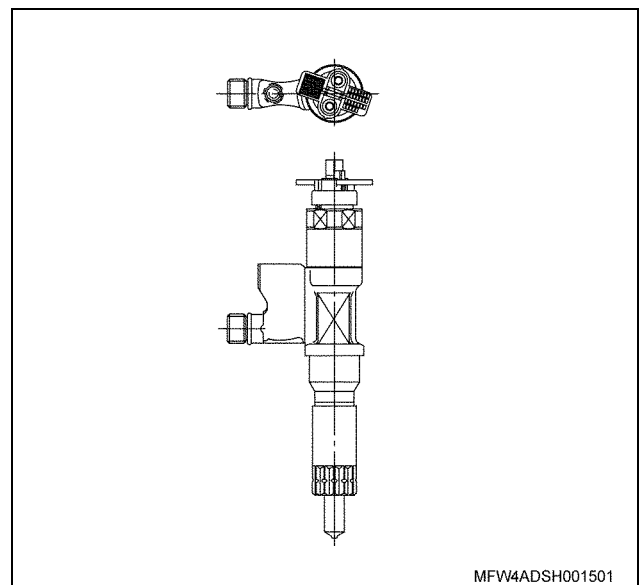
- If the entered Q-key data in Step 15-1 does not correspond to that written in the EEPROM of the ECM, the following message will appear.
Pressing the softkey [End] returns you to Step 11.



Name

- Engine number
- Typical engine model
- Q-key information
- Injector information

There is the injector code on the top of injector as well.
When replacing the injector, register its code.

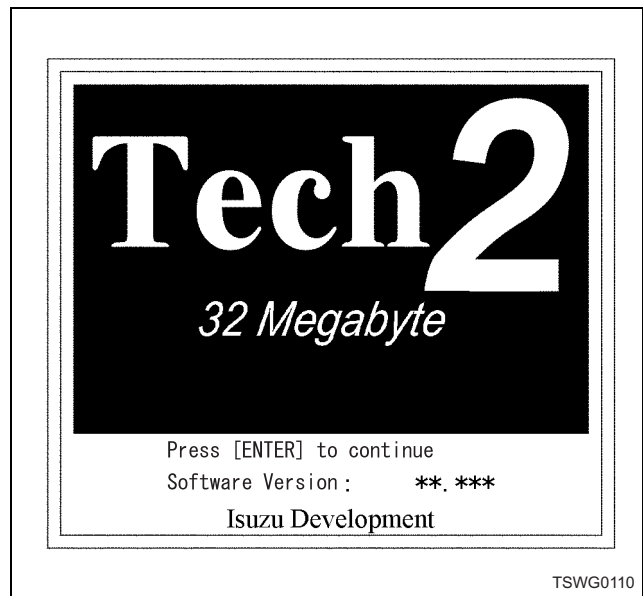


- Refer to the following instruction for how to register Injector ID code.

10D-57 Electronic control fuel injection system (Common rail type)

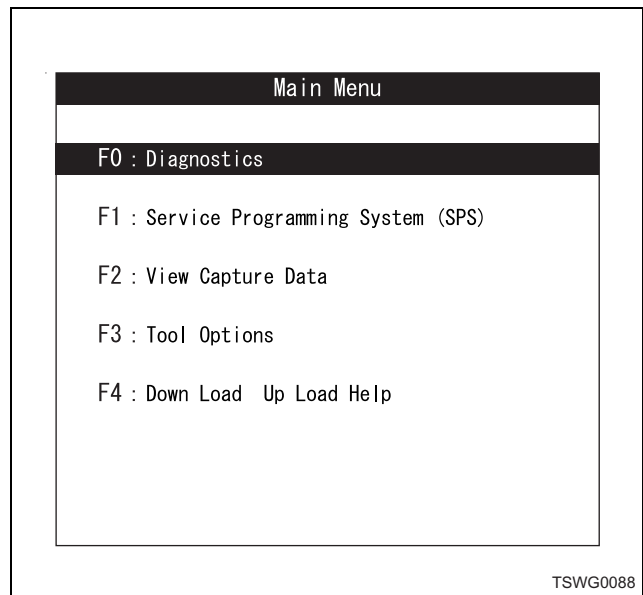
Step 1

- Press [ENTER].



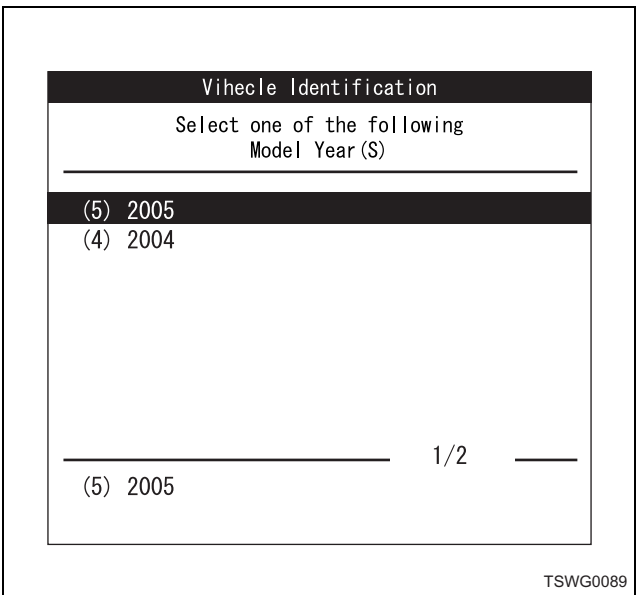
Step 2

- Choose the menu F0: Diagnostics with ▲, ▼ (up/down) keys or F0 (function) key, and press [ENTER].



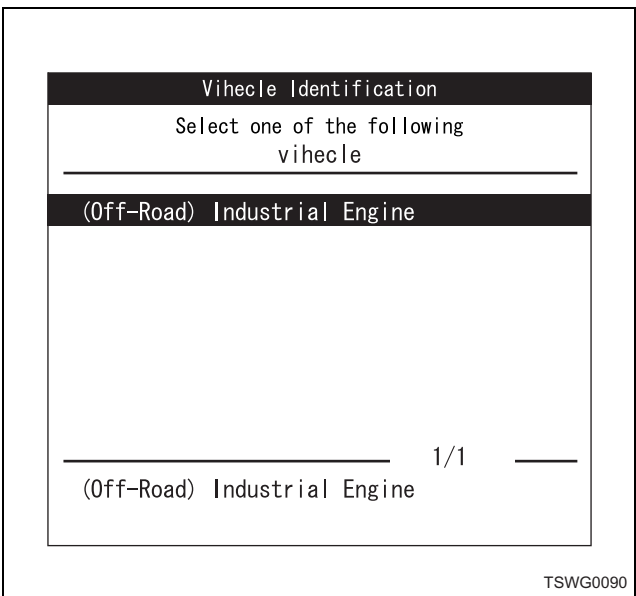
Step 3

- Choose the menu (5) 2005 with ▲, ▼ (up/down) keys, and press the [ENTER] key.



Step 4

- Choose the menu (Off-Road) Industrial Engine with ▲, ▼ (up/down) keys, and press the [ENTER] key.



Step 5

- Choose F0: Engine in Menu with ▲, ▼ (up/down) keys or F0 (function), and press [ENTER].

The screenshot shows a menu titled "Diagnostics". Below the title, it says "(5) 2005 (Off-Road) Industrial Engine". A sub-menu titled "F0 : Engine" is highlighted. The bottom right corner of the screen displays the code "TSWG0091".

Step 7

- Press the softkey "Confirm".
- The ignition is ON at this time.

The screenshot shows a menu titled "Engine". Below the title, it says "(5) 2005 (Off-Road) Industrial Engine" and "4HK1-TC (C/Rail_TIER3)". The main text in the center says "Turn On Ignition !". A softkey labeled "Next" is visible in the bottom left corner. The bottom right corner of the screen displays the code "TSWG0093".

Step 6

- Choose 6HK1-TC (C/Rail_TIER3) with ▲, ▼ (up/down) keys, and press [ENTER].

The screenshot shows a menu titled "Vehicle Identification". Below the title, it says "Select one of the following Engine". A list of engine options is shown: "4JJ1-TC (C/Rail_TIER3)", "4HK1-TC (C/Rail_TIER3)" (which is highlighted), "6HK1-TC (C/Rail_TIER3)", and "6WG1-TC (C/Rail_TIER3)". At the bottom, there is a status bar showing "4HK1-TC (C/Rail_TIER3)" on the left, "2/5" in the center, and a line on the right. The bottom right corner of the screen displays the code "TSWG0092".

Step 7-1

The screenshot shows a menu titled "Engine". Below the title, it says "(5) 2005 (Off-Road) Industrial Engine" and "4HK1-TC (C/Rail_TIER3)". The main text in the center says "Waiting For Data". A softkey labeled "Next" is visible in the bottom left corner. The bottom right corner of the screen displays the code "TSWG0122".

10D-59 Electronic control fuel injection system (Common rail type)

Step 8

- Press the softkey [Confirm].
- This displays the ECU ID information.

The screenshot shows a menu titled 'Engine'. Below the title, it displays '(5) 2005 (Off-Road) Industrial Engine' and 'TIER3_TTI'. A horizontal line separates this from the 'Part No.' section, which shows 'DDI' and 'D405'. Another horizontal line follows, then '1/2' is displayed. Below that is another 'Part No.' label. At the bottom left is a 'Confirm' button. The identifier 'TSWG0094' is at the bottom right.

Step 9

- Choose the menu F4: Programming with ▲, ▼ (up/down) keys or F4 (function) key, and press [ENTER].

The screenshot shows the 'Engine' menu with options: F0: Diagnostic Trouble Code, F1: Data Display, F2: Snapshot, F3: Actuator Test, F4: Programming (highlighted with a black bar), and F5: ??KA ID Infomation. The identifier 'TSHK0050' is at the bottom right.

Step 10

- Choose the menu F1: Injector ID code with ▲, ▼ (up/down) keys or F1 (function) key, and press [ENTER].

The screenshot shows a menu titled 'Programming'. It lists 'F0: Fuel Delivery Rate' and 'F1: Injector ID Code' (highlighted with a black bar). The identifier 'TSHK0108' is at the bottom right.

Step 11

- Choose the menu F1: ID code registration with ▲, ▼ (up/down) keys or F1 (function) key, and press [ENTER].

F0: Displays the Injector ID codes (hereinafter called ID code) of Cyl.1-Cyl.6.
Allows you to confirm the ID code after registration.

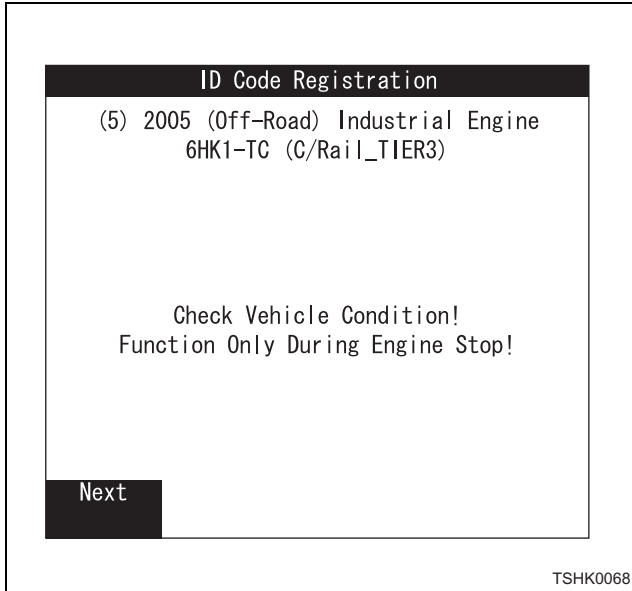
F2: Uploads (transfers) the ID code (No. 1 cylinder – No. 6 cylinder) registered in the ECM to Tech2 to store in its memory.

F3: Allows you to download (batch registration) the uploaded ID codes from Tech2 to the ECM.

The screenshot shows a menu titled 'Injector ID Code'. It lists: F0: Injector ID Code, F1: ID Code Registration (highlighted with a black bar), F2: Upload ID Code, and F3: Download ID Code. The identifier 'TSHK0067' is at the bottom right.

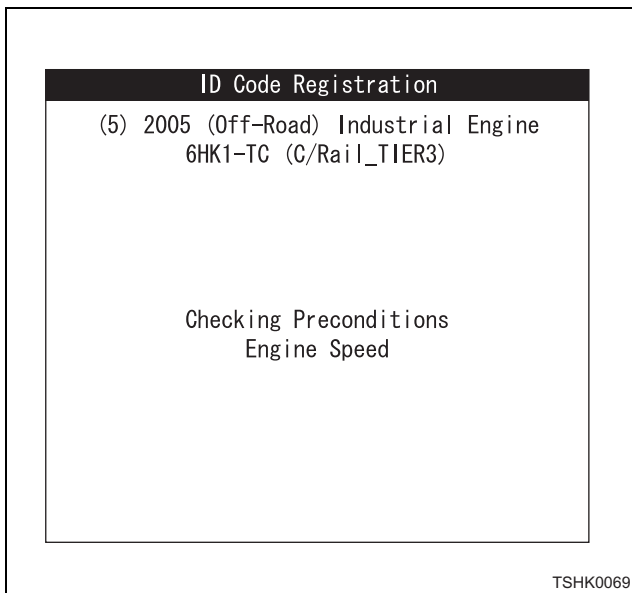
Step 12

- Press the softkey [Next].
- As an example, the vehicle will be checked whether it is in the condition (engine stopped) that the ECM requests during ID registration.

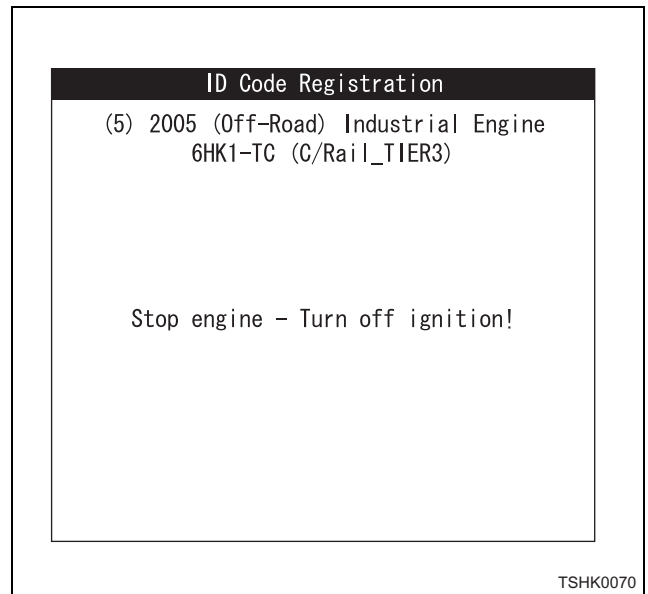


Step 12-1

- The following display appears while checking if the engine speed is 0 rpm. When the engine speed is 0 rpm, it will take you to Step 13.



Step 12-2

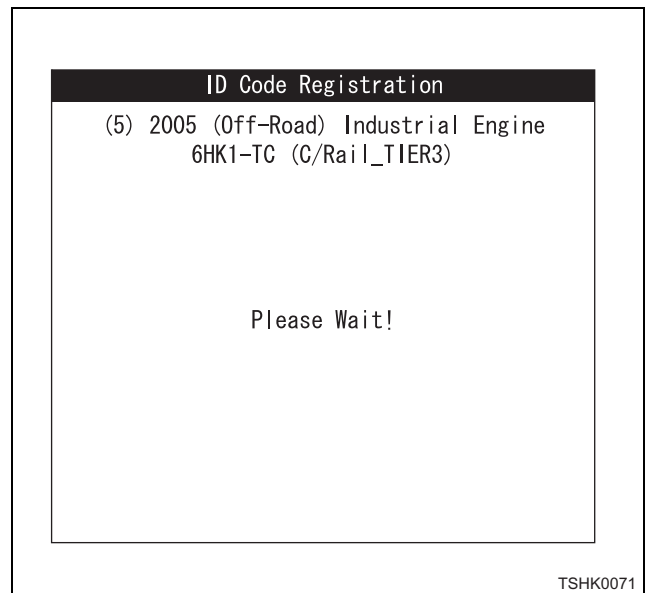


Step 12-3

- You need to enter the ID on the following display. ID code is number of year. The following conditions must be met.

Conditions:

1. The time setting of Tech2 matches with the calendar.
2. Press the function keys (F0 — F9) to enter.



10D-61 Electronic control fuel injection system (Common rail type)

Step 13

- Choose the cylinder (No. 1 cylinder – No. 6 cylinder) you want to register the ID code with ▲, ▼ (up/down) keys, and press the [ENTER] key.
- As an example, this describes about No. 1 cylinder.

The screenshot shows a terminal window titled "ID Code Registration". It displays the engine information: "(5) 2005 (Off-Road) Industrial Engine 6HK1-TC (C/Rail_TIER3)". Below this, it prompts "Please Select Cylinder." and lists six options: "Cylinder 1", "Cylinder 2", "Cylinder 3", "Cylinder 4", "Cylinder 5", and "Cylinder 6". The text "TSHK0072" is visible in the bottom right corner.

Step 14

- To register the ID code, press the softkey [Change].
- The ID code for Cylinder1 (No. 1 cylinder) selected at Step 13 is shown here.

The screenshot shows the same terminal window as Step 13. It displays the engine information and the prompt "Current Cylinder1 ID Code". Below the prompt, the ID code is shown as "59XXXXXXXXXXXXXXXXXXXX". The text "TSHK0073" is visible in the bottom right corner.

Step 15

- ID code registration (data entry)
 1. The cursor is positioned at M (model code) in the default setting.
MCD0 D1D2
 2. At this point, enter the model code (MC) and ID code (D0) in this order.
 - Entering with the function keys (F0 – F9) will automatically move the cursor to the right. However, if you enter with ▲, ▼ (up/down) keys, you need to move the cursor with the arrow (left/right) keys.
 3. Entered data must be within \$00 – \$FF.
 - You can enter 0 — 9 with the function keys (F0 – F9), or 0 — Z with ▲, ▼ (up/down) keys.
 4. For VC17 (China), BCC code needs to be entered. NK3 request
 - Tech2 calculates the entered data and displays the following message.
 - When entered ID code (QR) is out of the set value:
Writing unable
 - When entered BCC code is out of the set value:
Writing unable
 - When the ID code (QR) does not correspond to BCC code:
Writing unable

The screenshot shows a terminal window titled "ID Code Registration". It displays the engine information and instructions: "Use up/down arrow keys to change value." and "Use left/right arrow keys to select field." Below this, it prompts "Input ID Code Byte [MC-D9]" and shows the format: "MCD0 D1D2 D3D4 D5D6 D7D8 D9 BC" and "5AXX-XXXX-XXXX-XXXX-XXXX-XX*-****-***". It also says "Press ENTER key to continue". The text "TSHK0074" is visible in the bottom right corner.

Step 15-1

1. The model code (MC) for VC25 is \$5A, the Tech2 specifies to register (write) \$5A automatically. However you may also enter. Tech2 calculates the BCC code (BC) and registers automatically. Therefore, you do not need to enter.
2. After entering the ID code input data byte (MC-D9), press [ENTER] key.

ID Code Registration

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

Use up/down arrow keys to change
value.
Use left/right arrow keys to select
field.

Input ID Code Byte [MC-D9]
MCD0 D1D2 D3D4 D5D6 D7D8 D9 BC
5A01-2345-6789-ABCD-EF01-23**-****-**
Press ENTER key to continue

TSHK0075

Step 15-2

- If the ID code you have entered is correct, press the softkey [Program]. If you want to quit the program (registration), press the softkey [Abort] or press [EXIT] key.
- Quitting the registration or pressing [EXIT] key returns you to Step 11.

ID Code Registration

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

Use up/down arrow keys to change
value.
Use left/right arrow keys to select
field.

Input ID Code Byte [MC-D9]
MCD0 D1D2 D3D4 D5D6 D7D8 D9 BC
5A01-2345-6789-ABCD-EF01-23**-****-*

Program **Abort**

TSHK0076

Step 15-3

- If you have entered incorrectly (D7:\$EG), do the following.
 1. After pressing [ENTER] key as with Step 15-1, press the softkey [Program]. This cause the error message "Invalid data – Try again!" to appear.
 2. Set the data entry limit judgment.
Judgment condition: Data (1 byte) meets the following condition.
 $MSB:\$F \geq Data \leq LSB:\$F$
- The following error message will be displayed until the value that meets the condition is entered.

ID Code Registration

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

Invalid Data - Please Try Again!

Input ID Code Byte [MC-D9]
MCD0 D1D2 D3D4 D5D6 D7D8 D9 BC
5A01-2345-6789-ABCD-EG01-23**-****-*

Press ENTER key to continue

TSHK0077

Step 16

- If the entered values meet the conditions in Step 15-1 and 15-3, the status display of data registration (writing) from the Tech2 to ECM as shown below will appear.

ID Code Registration

(5) 2005 (Off-Road) Industrial Engine
6HK1-TC (C/Rail_TIER3)

Programming in progress!

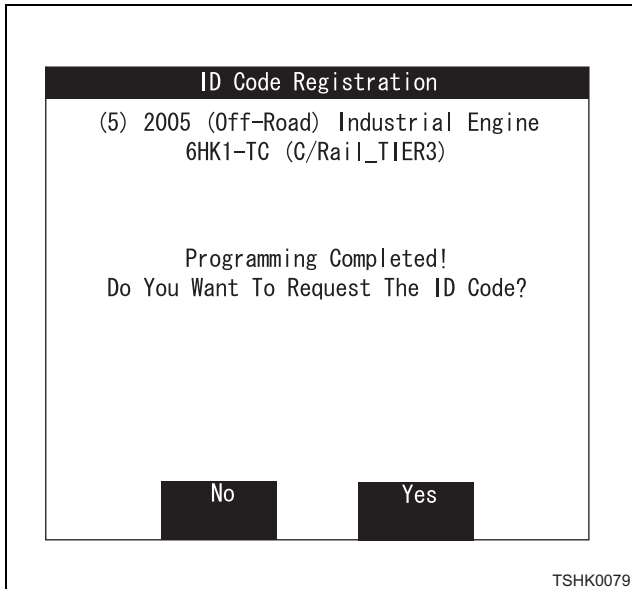
0 100

TSHK0078

10D-63 Electronic control fuel injection system (Common rail type)

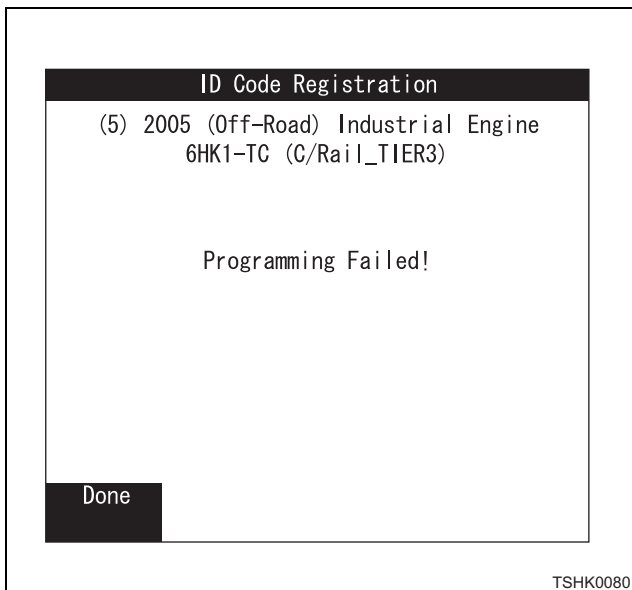
Step 17

- When the ID code entered in Steps 15-1 and 15-3 corresponds to that registered in the ECM, the following message will appear. Also, if you want to register ID again, press the softkey [Yes]. This returns you to Step 13, and allows you make registration as before. Pressing the softkey [No] will take you to Step 18. This completes the ID code registration.



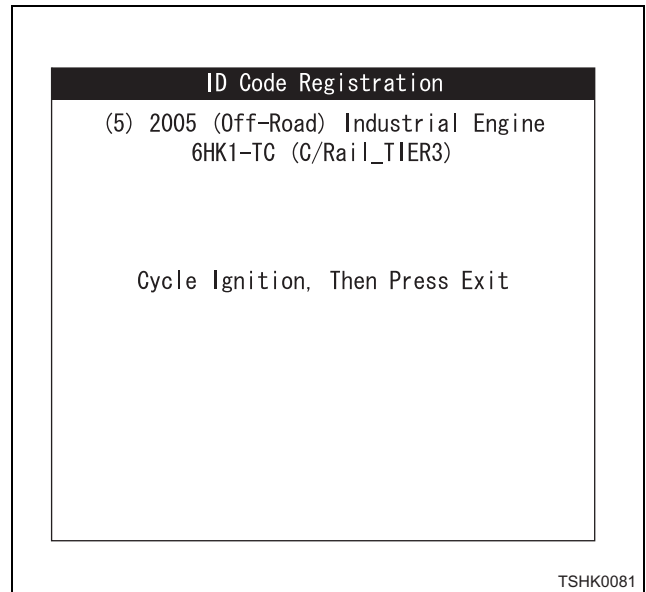
Step 17-1

- When the ID code entered in Steps 15-1 and 15-3 does not correspond to that registered in the ECM, the following message will appear. Pressing the softkey [End] returns you to Step 11.



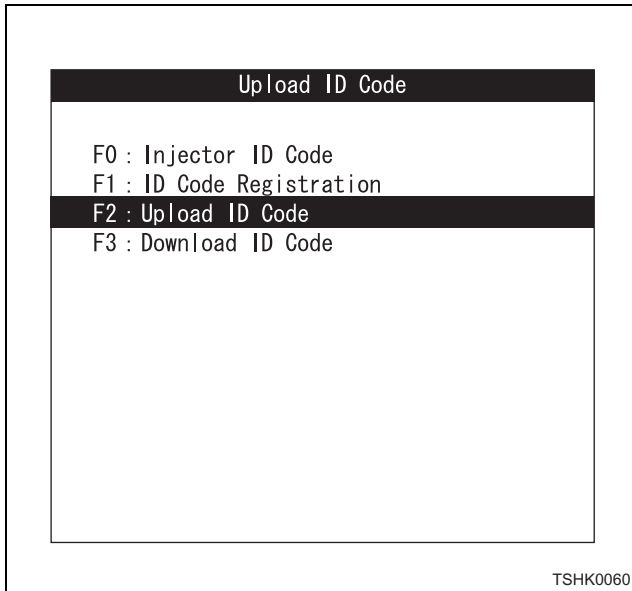
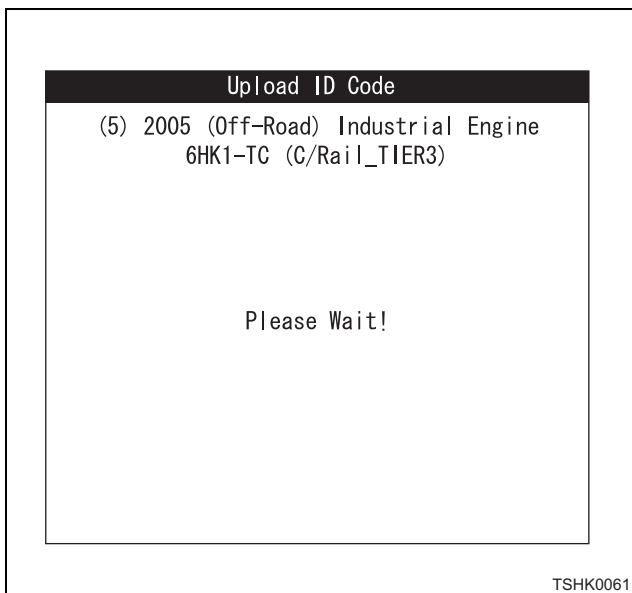
Step 18

- Pressing [EXIT] key returns you to Step 11.

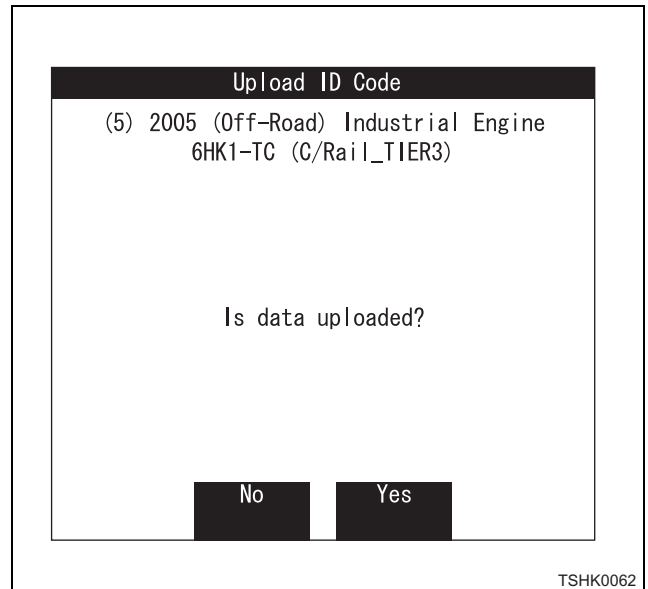
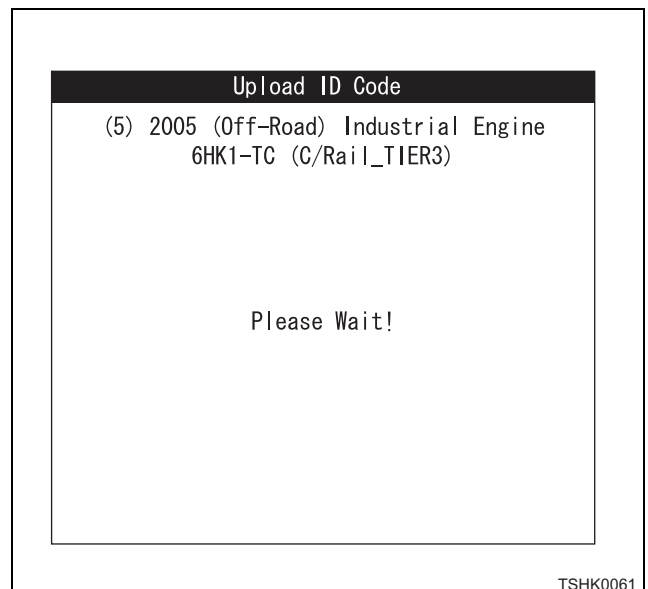


ID code upload (Tech2)**Step 11**

- This step 11 describes ID code registration continued from the step right before.
- 1. Choose the menu F2: ID code upload (Tech2) with Δ , ∇ (up/down) keys or F2 (function) key, and press [ENTER].

**Step 11-1****Step 12**

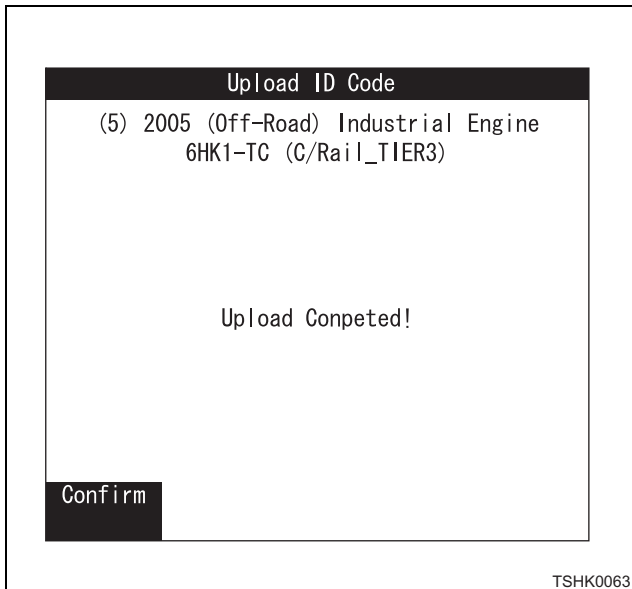
- Pressing the softkey [Yes] updates the ID codes of No. 1 cylinder – No. 6 cylinder stored in the ECM, to the Tech2.
 Pressing the softkey [No] returns you to Step 11 without uploading the data.
- Upload is the function to transfer the registered ID code from ECM to Tech2 to store the data in it.

**Step 12-1**

10D-65 Electronic control fuel injection system (Common rail type)

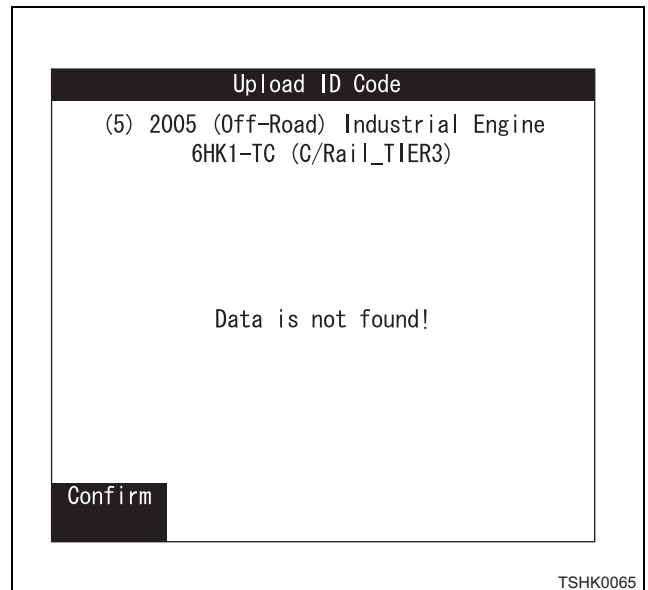
Step 12-2

- When the ID code registered in the ECM corresponds to that uploaded to the Tech2, the following message will appear.
Upload is completed.
Pressing the softkey [Confirm] returns you to Step 11.



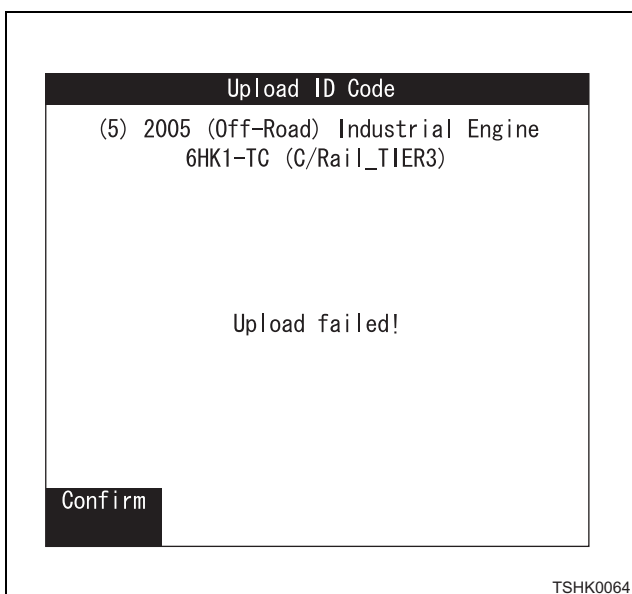
Step 12-4

- Pressing the softkey [Confirm] returns you to Step 11.



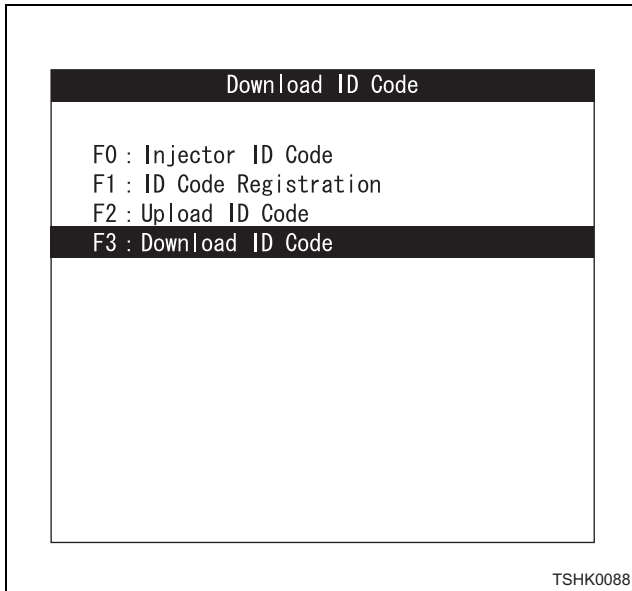
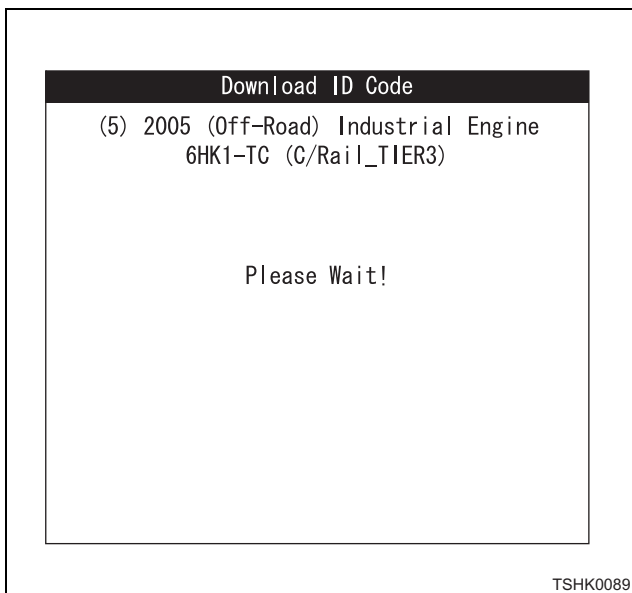
Step 12-3

- When the ID code registered in the ECM does not correspond to that uploaded to the Tech2, the following message will appear.
Pressing the softkey [Confirm] returns you to Step 11.
- In this case, the uploaded ID code will be erased. Therefore, perform upload again. The message shown in Step 12-4 will appear.

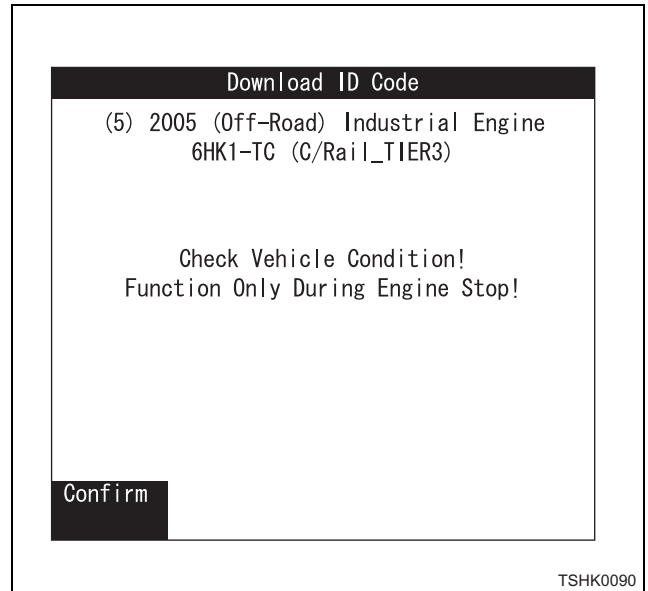


ID code download (Tech2)**Step 11**

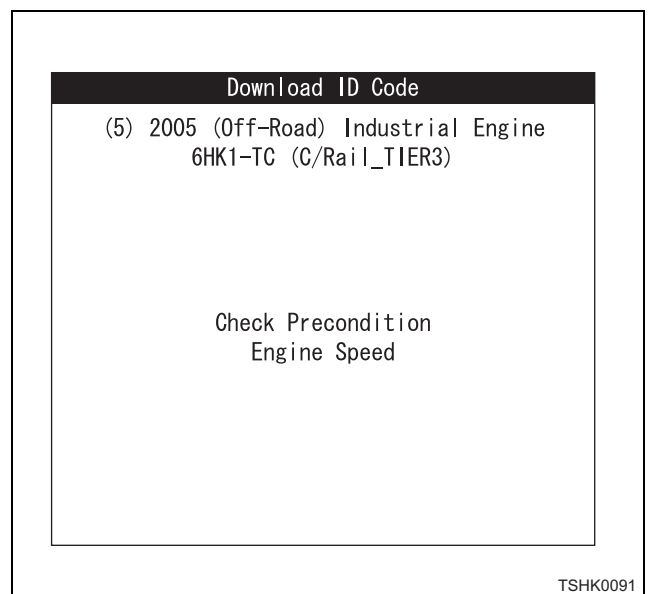
- This step 11 describes ID code registration continued from the step right before.
- 1. Choose the menu F3: ID code download (ECM) with Δ , ∇ (up/down) keys or F2 (function) key, and press [ENTER].

**Step 11-1****Step 12**

- Press the softkey "Confirm".
- As an example, the vehicle will be checked whether it is in the condition (engine stopped) that the ECM requests during ID registration.

**Step 12-1**

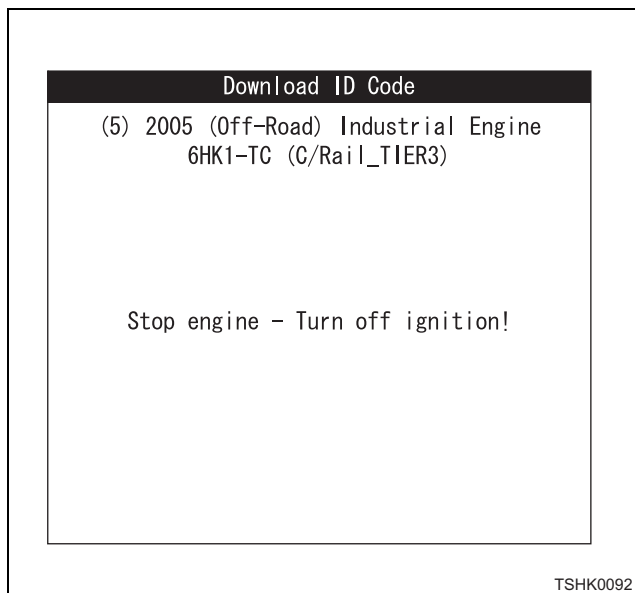
- The following display appears while checking if the engine speed is 0 rpm. When the engine speed is 0 rpm, it will take you to Step 13.



10D-67 Electronic control fuel injection system (Common rail type)

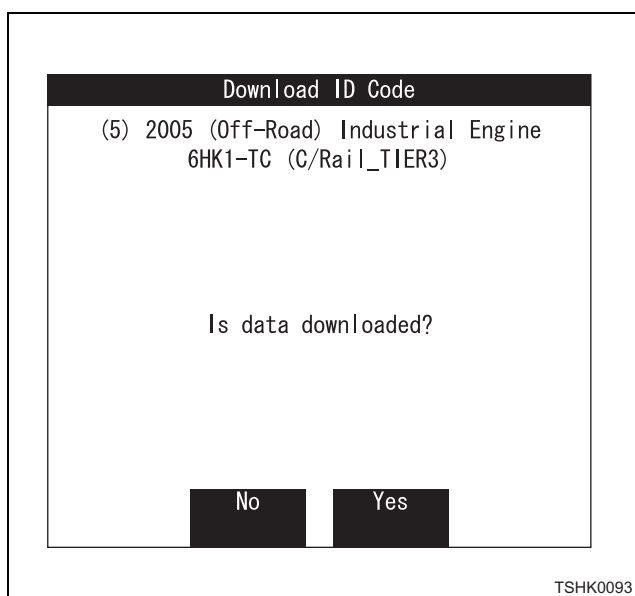
Step 12-2

- The following display appears when the engine speed is not 0 rpm.
In this case, stop the engine as instructed in the message, and try again from Step 1.



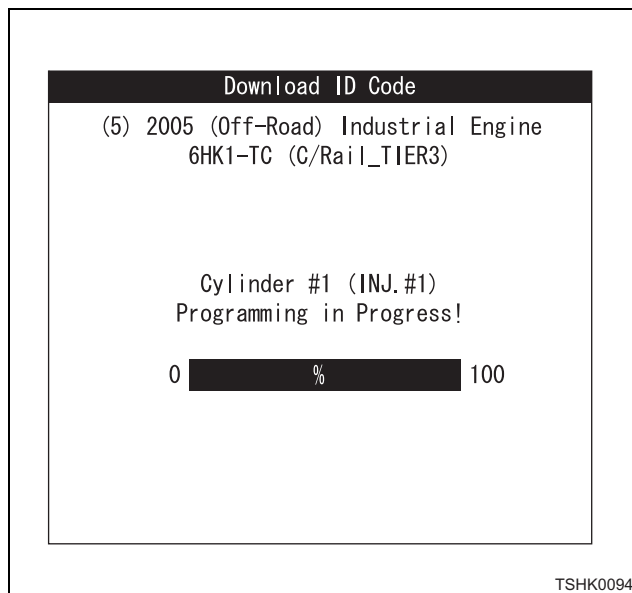
Step 13

- Pressing the softkey [Yes] downloads (registers) the uploaded ID codes (Cyl.1-Cyl.6) to the ECM. Pressing the softkey [No] returns you to Step 11.
- Download is the function to register (write) the stored (uploaded) ID codes (No. 1 cylinder – No. 6 cylinder) in the Tech2 to the ECM. ID is registered from No. 1 cylinder to No. 6 cylinder in the order.



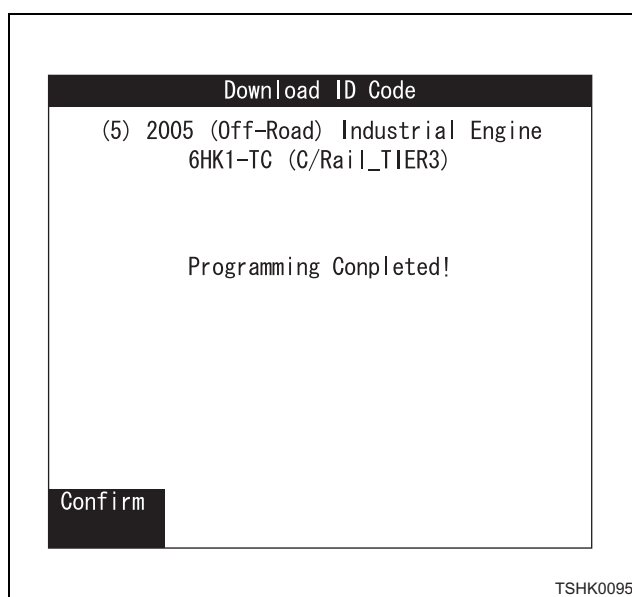
Step 13-1

- Registration is started from No. 1 cylinder (INJ.#1) to No. 2 cylinder (INJ.#5) and the ECM in the order. The status for registration (writing) of data to ECM will appear.
The message in the screen changes in the order of No. 1 cylinder (INJ.#1) and No. 2 cylinder (INJ.#5). When it is abnormal, the registration repeats 3 times.



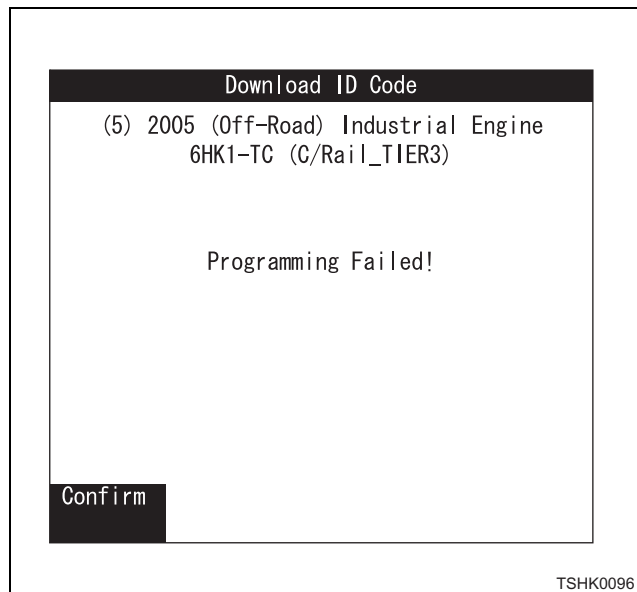
Step 13-2

- When the downloaded ID code corresponds to that registered (written) in the ECM, the following message will appear. Download (registration) is completed.
Pressing the softkey [Confirm] returns you to Step 11.



Step 13-3

- When the downloaded ID code does not correspond to that registered (written) in the ECM, the following message will appear.
Pressing the softkey [Confirm] returns you to Step 11.



How to use TIS 2000

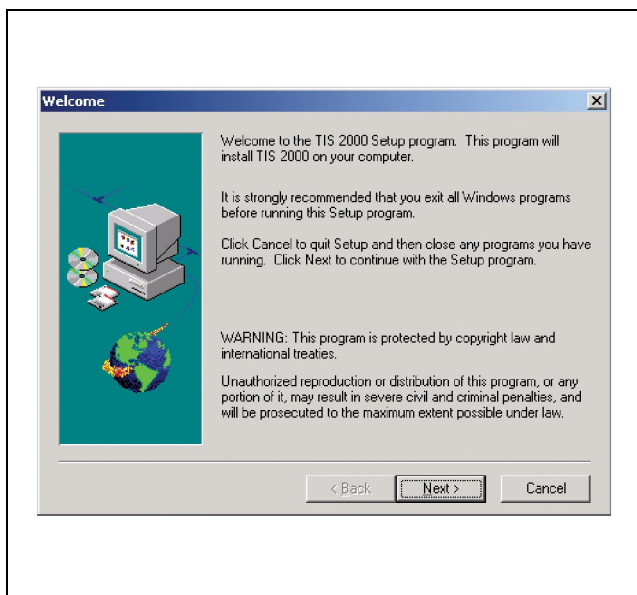
TIS 2000 installation procedure

(Time needed: 30 minutes)

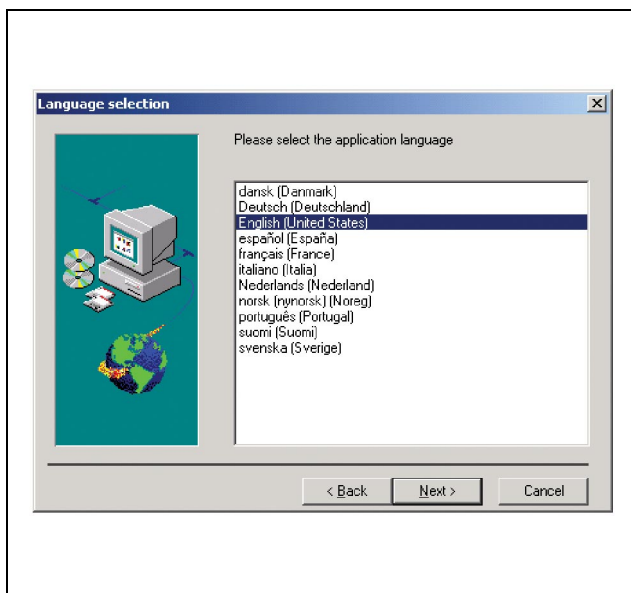
System Requirements	1. PC OS: Windows 95 or higher CD-ROM drive 2. Distribution CD-ROM	Free hard disk space: 150MB or more RS-232C connector

- * Internet Explorer version 4.01 or later is required to use TIS 2000.
- * If Internet Explorer prior to version 4.01 is installed, or it is not installed on your PC, Internet Explorer version 4.01 (English version) will be installed automatically.

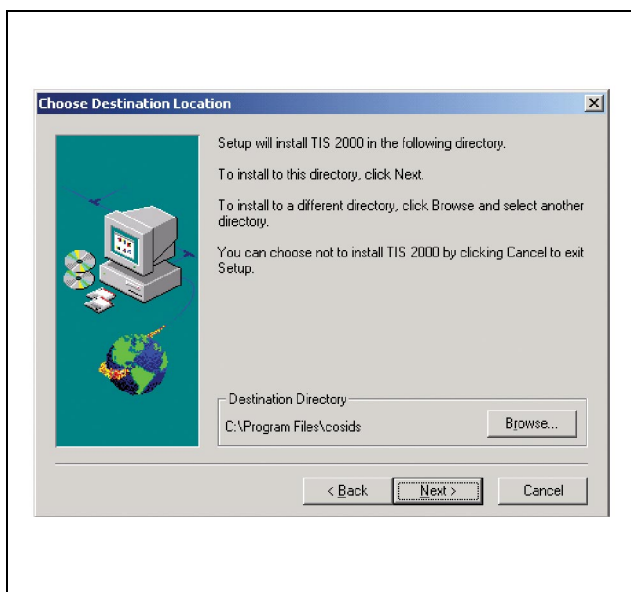
1. Turn on the power to start-up Windows.
2. Insert the distribution CD-ROM into the CD-ROM drive of PC.
3. The following screen will appear in approx. 10 seconds.
 - * If the screen does not appear, open the file of "Autorun.Exe" in the CD-ROM.
4. When the "Welcome" screen appears, click the "Next".



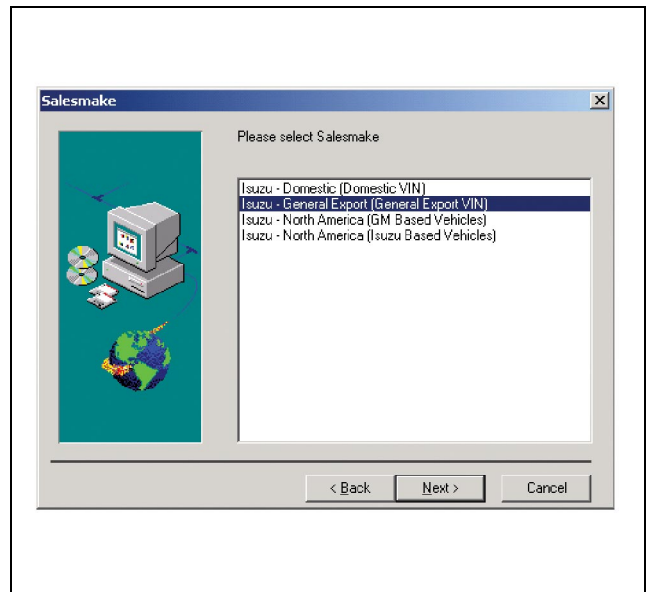
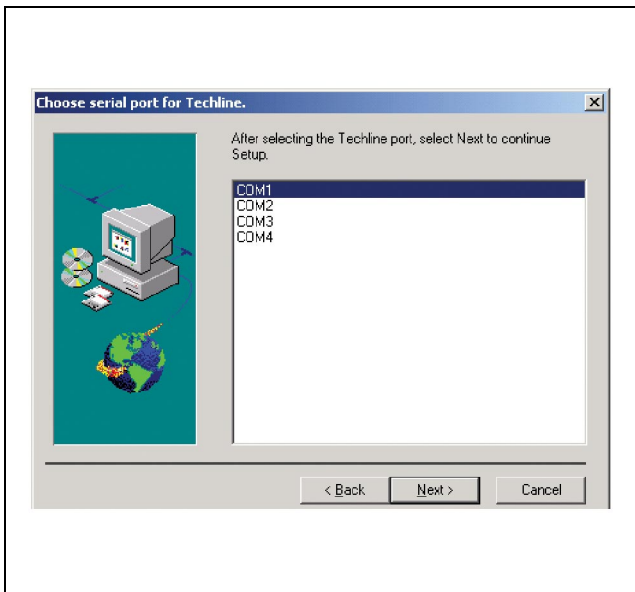
5. Select the language to be used, and click the "Next".



6. Usually, leave the "Destination Directory" as it is, and click the "Next".

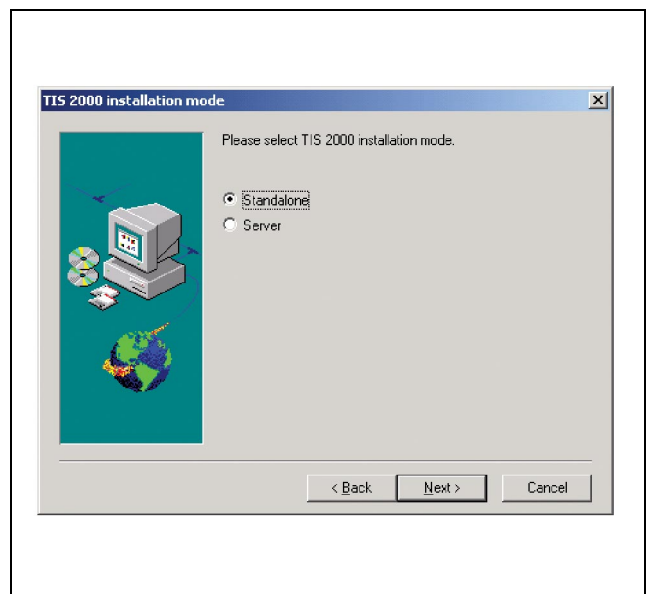
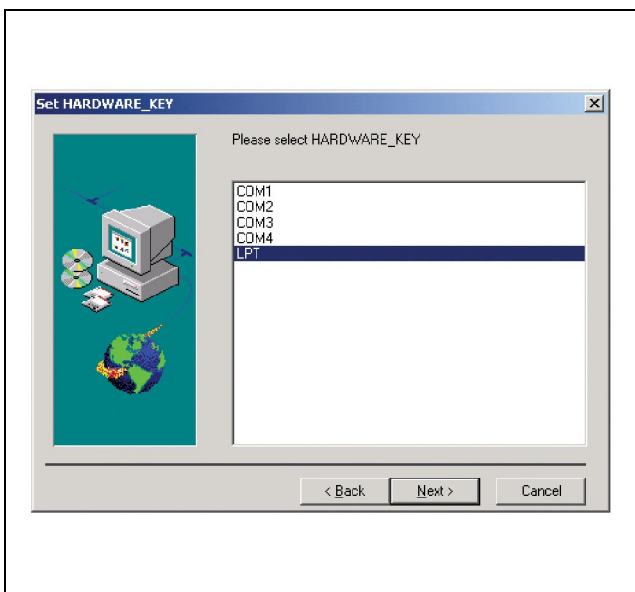


7. On the "Choose serial port for Techline." screen, select the serial port of the serial cable to connect Tech2 to the PC.
Normally, select the "COM1" and click the "Next".



10. On the "TIS 2000 installation mode", select the "Standalone" and click the "Next".

8. On the "Set HARDWARE_KEY" screen, select the "LPT" and click the "Next".



9. On the "Salesmake" screen, select either the "Isuzu - General Export (General Export VIN)" or "Isuzu US (US VIN)" and click the "Next".
[Example (UBS 6VE1 engine)]
General VIN: JACUBS26GY7100001
US VIN: JACDJ58X3Y7100001

Fig. 2: Data display (sample)

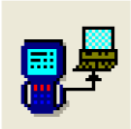
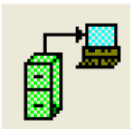
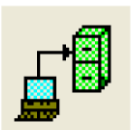
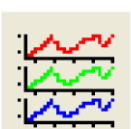
C. Display snapshot data with the “Snapshot Upload” function of TIS 2000.

Snapshot data are stored in the PC hard disk or floppy disk, and they can be displayed any time. Stored snapshot can be displayed in the following procedure.

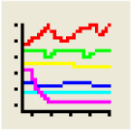
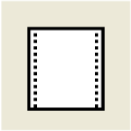
1. Startup TIS 2000.
2. Choose the “Snapshot Upload/Display” on the initial screen of TIS 2000.
3. Either select the “Open file” or click the relevant icon on the tool bar.
4. Select the “Transmitted Snapshot”.
5. When the snapshot data opens, the data parameter list will appear on the screen.

Icons to be displayed

The following icons are used for data display.

	Transmits the snapshot from Tech to PC.
	Uploads the snapshot data from the floppy disk or hard disk.
	Saves the snapshot data on the floppy disk or hard disk.
	Displays the data parameters in one frame.
	Displays the data parameters in two frames.
	Changes the unit.
	Displays the data parameters in graph and list (up to 3 parameter items for graph display).
	Selects/cancels the parameter.

10D-73 Electronic control fuel injection system (Common rail type)

	Displays the data parameters in graph only (up to 6 parameter items).
	Prints (data parameter print out).

Snapshot data replay

Snapshot data can be replayed using icons in the bottom of the screen.

	1st record: Displays the first record of the snapshot.
	Previous record: Displays the previous record of that currently displayed.
	Regeneration in reverse direction: Replays in the reverse direction.
	Trigger of record: Moves to the trigger position and displays the snapshot.
	Regeneration in forward direction: Replays all the snapshot in the forward direction.
	Next record: Displays the next record of that currently displayed.
	Last record: Displays the last record of the snapshot.
	End of regeneration: Clicking the snapshot ends the replay of record.

Graph display

Numeric value and graph (up to 3 for graph display):

1. Clicking the icon for graph display opens "Graph Parameters" window.
2. Click the 1st graph icon in the top of the window, and select one parameter from the list in the bottom of the window. Selected parameter is shown next to the graph icon. Graph category can be selected with the field located in the right hand of the parameter.
3. Perform the same procedure for the 2nd and 3rd graph icons.
4. After selecting all the parameters (up to 3 parameters) you wish to view, click the [OK] button.

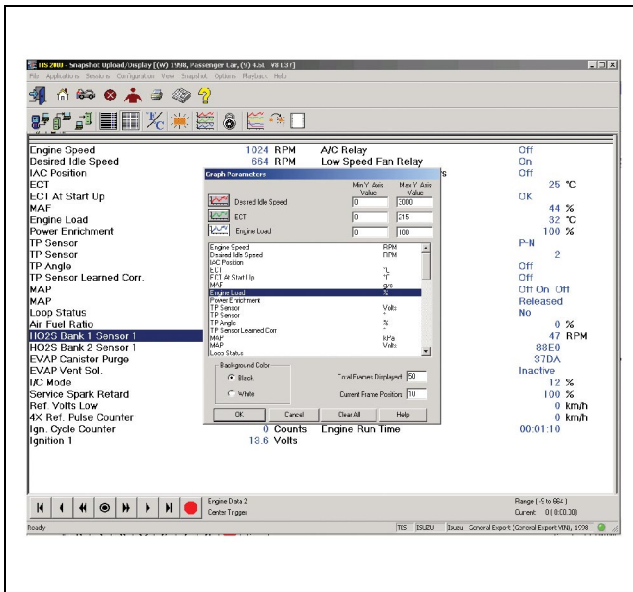


Fig. 4: "Graph Parameters" window (sample)

5. Selected parameter is shown in graph form, in the right hand of the data parameter on the screen.

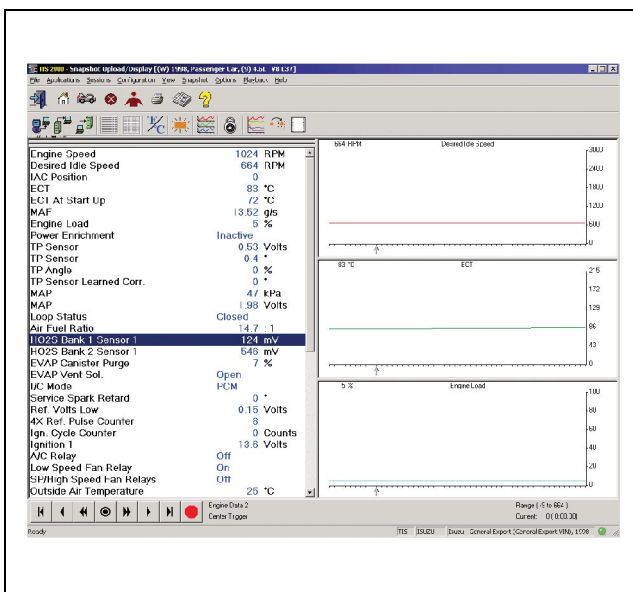


Fig. 5: Graph display screen (sample)

6. Graph display can be moved with the navigation icons.
7. If you wish to view the graph with different parameter, drag the parameter in the list onto the display screen. (Click the parameter and move the cursor with the mouse button pressed, and then release the mouse button in the display screen.) New parameter appears to replace the old one. To view the graph in full screen, move the cursor to the top of the screen, and click the screen where the cursor changes to magnifying glass icon. This will display the graph in full screen.

Graph display in one frame (up to 6 for graph display)

1. Click the "Six graph" icon. This opens "Graph Parameters" window.

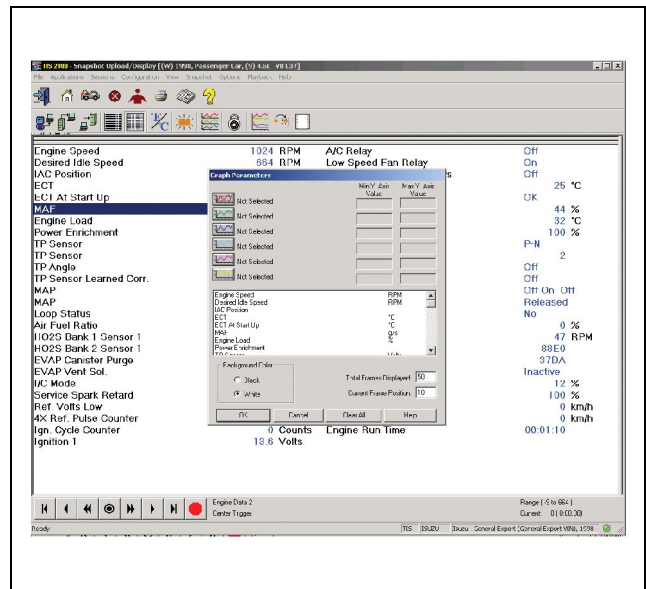


Fig. 6: "Graph Parameters" window

2. Click the graph icon, and select the parameter you wish to view from the list. Change the graph category as required.
3. Perform the same procedure for the 2nd to 6th parameters with graph icons.
4. Clicking the [OK] button displays the graph.

10D-75 Electronic control fuel injection system (Common rail type)

5. In this case, parameters are available only in graph form. All the parameters are shown in one frame.

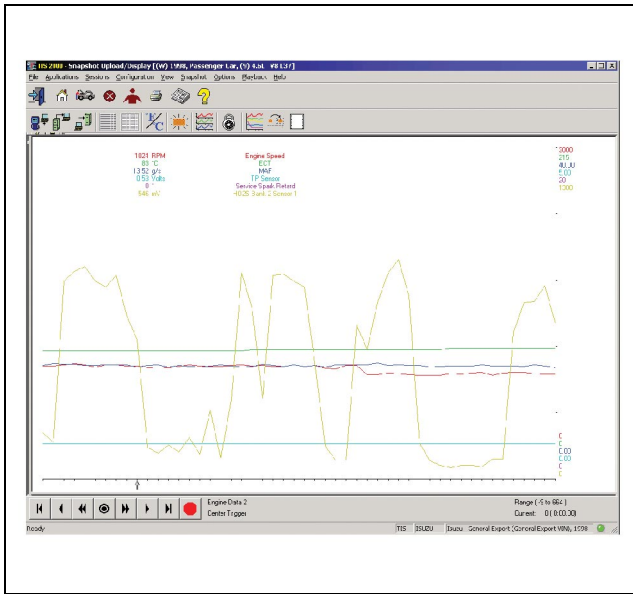


Fig. 7: Graph display screen (sample)

6. Graph display screen can be moved with the navigation icons.

Selects/cancels the parameter.

Use of parameter select/cancel function allows to select particular parameter from the list and to display it instantly. First click the parameter you want to view to mark it, then click "Select/Cancel Parameters". Selected parameter is shown in the upper area of [Lock line] on the top of the data list. Other parameters can be added in the same procedure. Use of parameter [LOCK] allows the parameters to be displayed continuously for data comparison. To eliminate a parameter from the list, click the parameter you want to eliminate to put mark on it, then click "Select/Cancel Parameters". When quitting the [Snapshot Display] application, "Do you want to save this file?" dialog box appears automatically. The file can be saved on the PC hard disk or floppy disk.

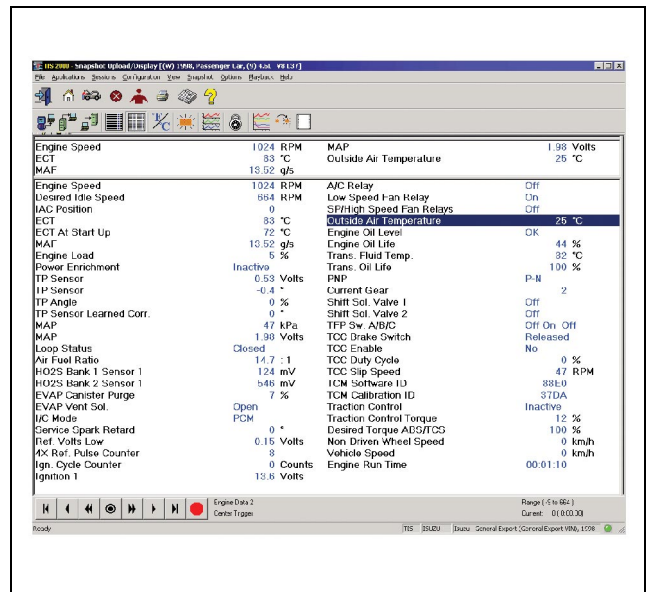


Fig. 8: Parameter selection

Directory to save data

Normally data is saved in "C:\Program Files\cosids\DATA\SNAPSHOT" folder. This directory is different if you changed installation directory when installing the application. Two sample files ("10000000SUR", "10000001.SUR") are already stored when installing the application.

TIS 2000 navigation

TIS 2000 application can be operated using the following icons.

	[TIS2000 end]: Quits all TIS 2000 applications to return to the Windows desktop screen.
	[Select page]: Returns to the initial page of TIS 2000 without quitting applications currently used. The applications currently used run in the background.
	[Vehicle data]: Starts [Vehicle data display] function. This displays all the vehicle information.
	[Executed applications end]: Quits the application currently used to return to the initial page of TIS 2000.
	[Session]: Allows to register and display user information.
	[Print]: Prints the screen.
	[Help]: Launches the integrated help function of TIS 2000.

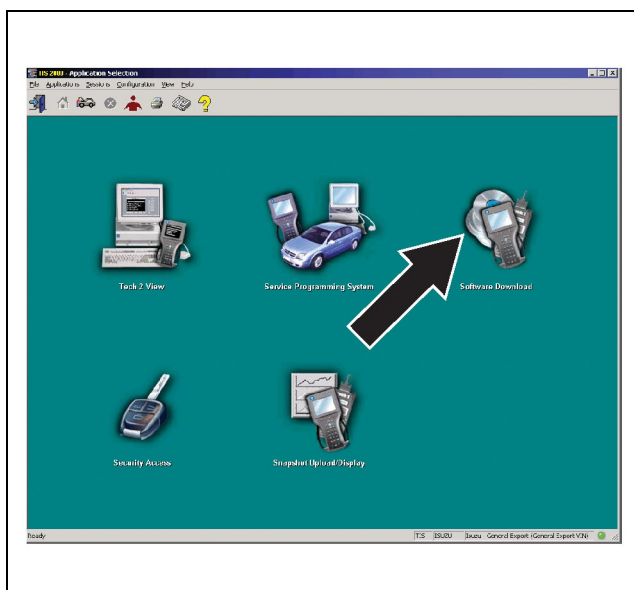
Software download

Fig. 1: "Application Selection" screen

Herein, it is described about how to update Tech2 software using "Software Download" function of TIS 2000.

Updating Tech2 (Software download)

Update the Tech2 software to the latest version using "Software Download" function of TIS 2000.

Tech2 software is updated on a regular basis to correspond to the change in vehicle specifications and diagnostic methods. Updated information includes new vehicle system, amendment of diagnostic method, update from previous version, addition of new diagnostic method, etc.

There are two kinds of download mode; "Standard" and "Custom".

10D-77 Electronic control fuel injection system (Common rail type)

Standard update (This mode is not used this time. Select the “Custom”).)

Description: Standard mode can be used only when the old version of software is installed and registered in the database. Only “Custom” mode can be used in any other cases. In “Standard” mode, the latest version will be installed for the language and the model (manufacturer) which are set in Tech2 at that time.

The procedure of Tech2 “Standard” update, using “Software Download” function, is as follows.

1. Connect the Tech2 to the PC with RS-232C cable.
2. Connect the standard accessory power cable to Tech2.
3. Startup TIS 2000 on the PC.
4. Choose “Software Download” icon on the initial screen of TIS 2000.
5. Check the selected location on the “Select Diagnostic Tool for Download” screen, and go to next.

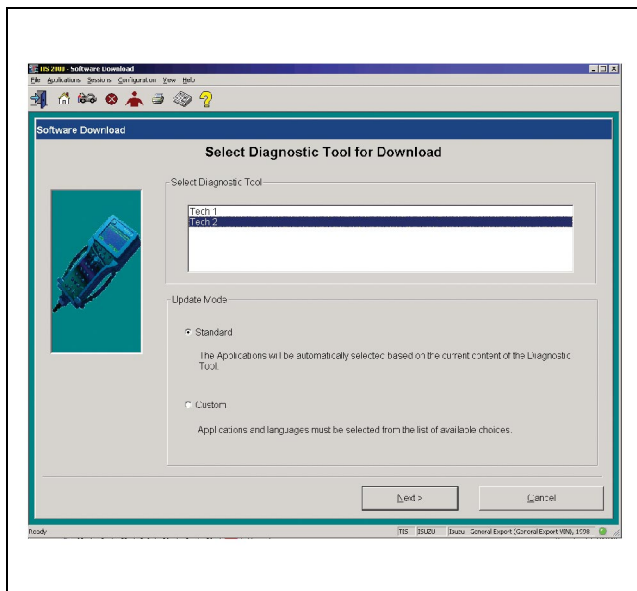


Fig. 2: Selection of diagnostic tool to be updated and update mode

- Check the selected location and click “Next”. An explanation appears as “Reading information of diagnostic tool”.
6. The “Software Update Confirmation” screen appears on the PC.
Also, the stored contents of the current Tech2 and stored data after transmitting diagnostic software appear on the screen. Click the [Continue] to go on.
 7. “Transmitting Software” appears on the screen to tell the transmission status.

8. When the transmission is completed, “Transmission is completed” will appear on the screen. Click the “Close” button to quit the application. The latest software has been transmitted to the diagnostic tool.

Custom update

Use custom update when installing the old version software, software other than Isuzu software or software with different language, or when the database cannot identify the software version being installed. After selecting “Custom” on the selection screen (See Fig. 2), perform the following procedure.

1. The “Application Selection” appears on the screen. The list of the software release No. appears on the left hand of the screen. Clicking [+] mark allows to view the list of available language of each release.

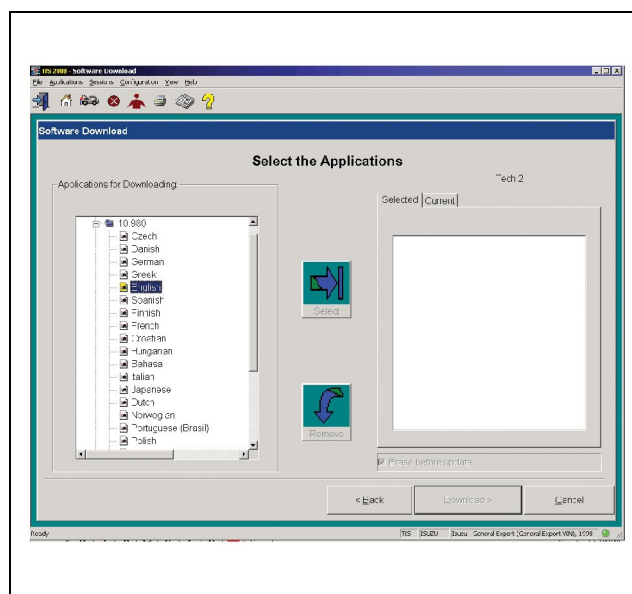


Fig. 3: Selection of application for “Custom” mode

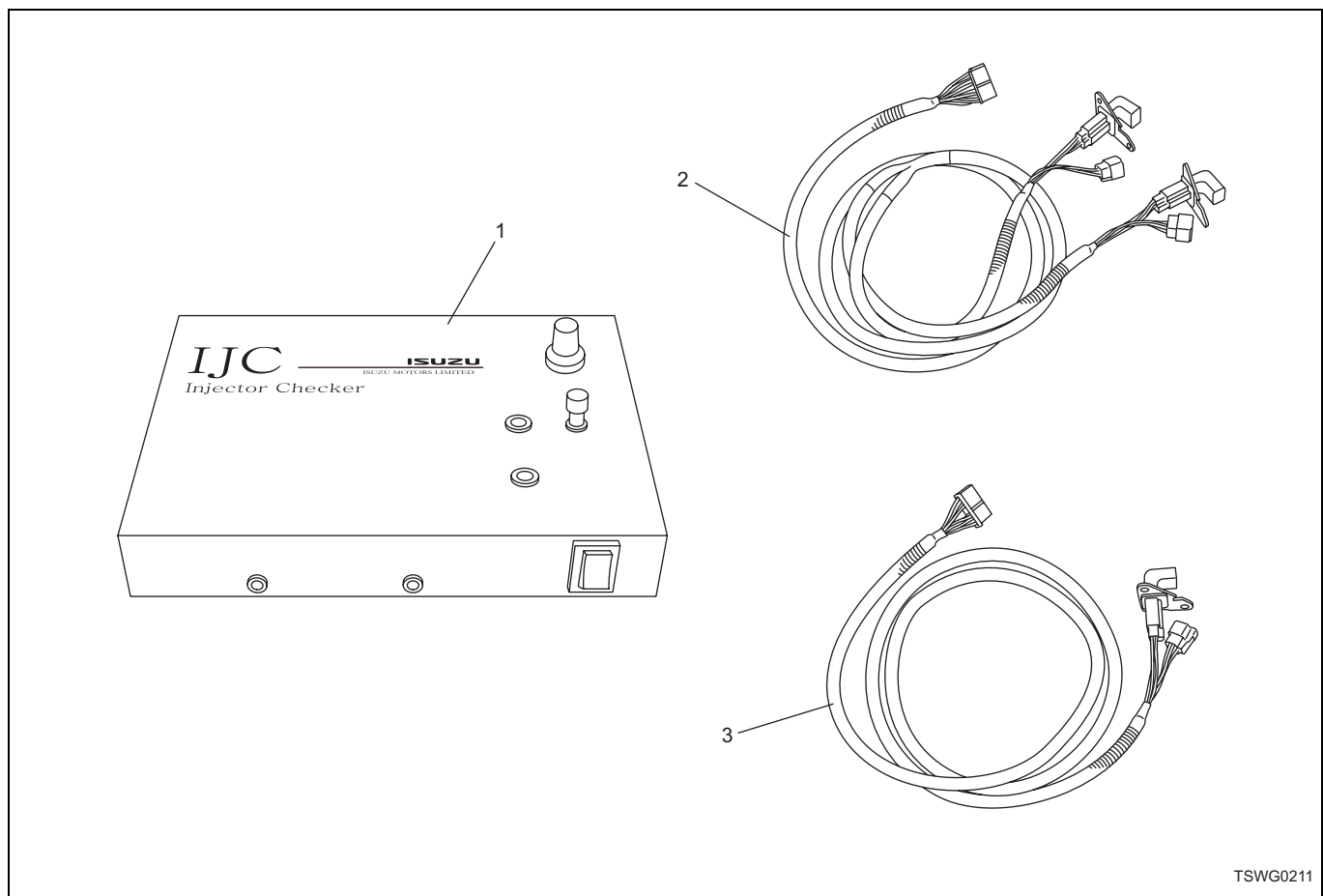
2. Either double-click the relevant software version and language, or click the “Select” button to select. The software you have chosen appears on the right hand of the screen. To compare current software with selected software of the diagnostic tool, click the mark on the right hand of the screen.
3. Clicking the [Download] button starts updating.
4. “Transmitting Software” appears on the screen to tell the transmission status.
5. When the transmission completes, “Transmission is completed” will appear on the screen. Click the “Close” button to quit the application. The selected software has been transmitted to the diagnostic tool.

TIS 2000 navigation

TIS 2000 application can be operated using the following icons.

	[TIS2000 end]: Quits all TIS 2000 applications to return to the Windows desktop screen.
	[Select page]: Returns to the initial page of TIS 2000 without quitting applications currently used. The applications currently used run in the background.
	[Vehicle data]: Starts [Vehicle data display] function. This displays all the vehicle information.
	[Executed applications end]: Quits the application currently used to return to the initial page of TIS 2000.
	[Session]: Allows to register and display user information.
	[Print]: Prints the screen.
	[Help]: Launches the integrated help function of TIS 2000.

How to use injector checker



Name

1. Injector checker body
2. Test harness for 6-cylinders

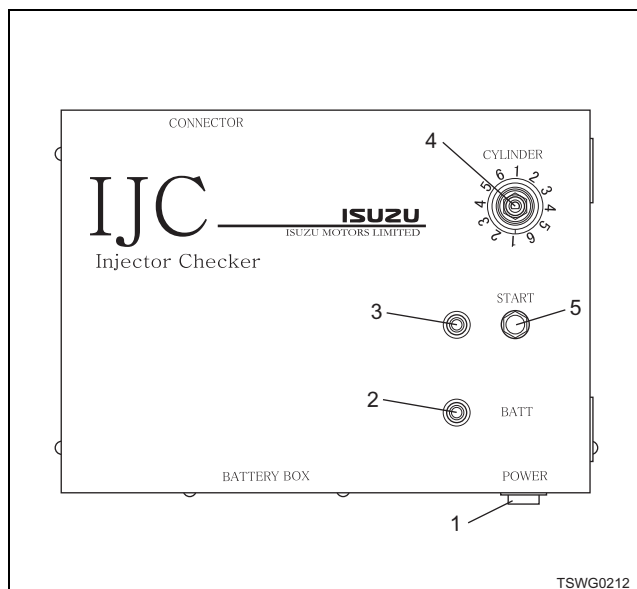
3. Test harness for 4-cylinders

* To prevent wrong connection, the end of corrugate tube of connection harness for 6-cylinders is wrapped by identification tape (red) for 4-5-6 cylinder side harness.

Name

1. Main switch
2. Battery lamp
3. Operation lamp
4. Cylinder selection switch
5. Start button

Each part of injector checker



Main switch

This is used to switch ON and OFF of injector checker function.

Note:

Be sure to turn it to OFF before removing/installing harness.

Battery lamp

This comes on when the battery (9V) in the body gets low (7.2V or less).

If the battery lamp comes on, replace the battery as soon as possible. (Refer to Battery Replacement)

Note:

When using the main switch, it comes on momentarily due to voltage change. If the battery lamp does not come on when using the main switch, check the battery. Replace it if it gets low (7.2V or less).

Cylinder selection switch

This is used to switch a cylinder to be checked. Turn it left fully before check, and then start to check clockwise (1 → 2 → 3 → 4 → 5 → 6).

Note:

- One rotation of cylinder selection switch allow to check twice for each cylinder. At the third time or later, turn the selection switch left back to the original position and start to check.
- Do not turn the selection switch excessively after it is turned to stopper.

Start switch

This is used to stop the cylinder selected by the cylinder selection switch. Injection of selected cylinder stops approx. 2.4 seconds.

Operation lamp

This comes on while injector is checked (approx. 2.4 seconds) after starting button is pressed.

Note:

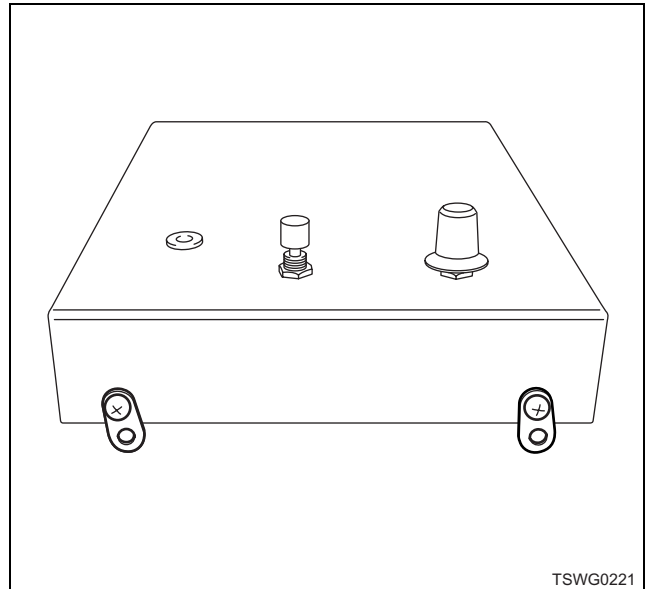
Do not use any switches and operate the machine while the lamp comes on. Otherwise, diagnosis result is not correct.

Holder

Holders are used to hang or fix the body. They are tightened on the body. To use the holders, loosen the screws to move.

Note:

- When using or storing holders, be sure to tighten them to fix.
- Be careful not to tighten screws excessively. This may damage the body.

**Precautions on handling the body**

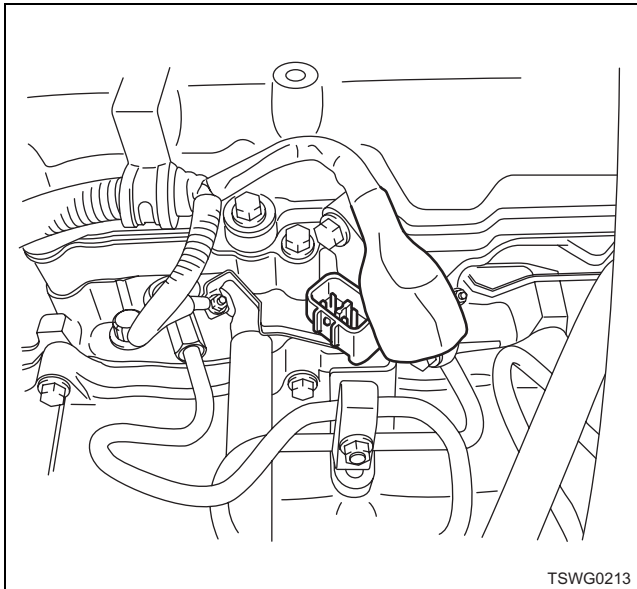
- The body is a precision equipment. Do not drop it or make a high impact on it.
- The body is drip-proof type. However, avoid using it in rainy day or operating with wet hands to prevent water from entering through connector connection.
- Power for the body must be supplied from internal battery, not from external one.
- Prevent foreign matter from entering into the body while replacing battery.
- Do not use screws to tighten battery holder except original ones. This may cause body damage or battery damage and electric leakage.
- Do not disassemble the body in any circumstances. Contact the machine manufacturer or ISUZU Industrial Engine Service Dept. if it is faulty.

Injector test

1. Check the DTC.
 - If DTC unrelated to injector is detected, repair or check to eliminate the faults before test.

10D-81 Electronic control fuel injection system (Common rail type)

2. Turn the key switch to OFF.
3. Disconnect the injector connector from engine on the machine. (4-cylinder: one, 6-cylinder: two)

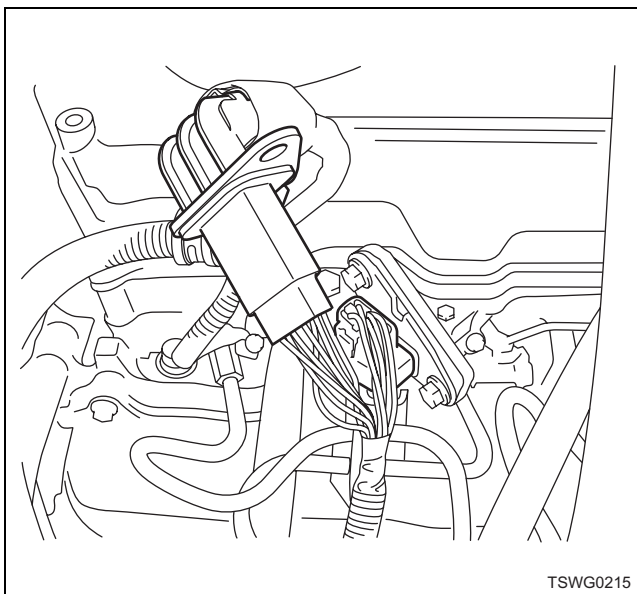


* 4HK1 is shown for illustration.

4. Connect the test harness to the engine side.

Note:

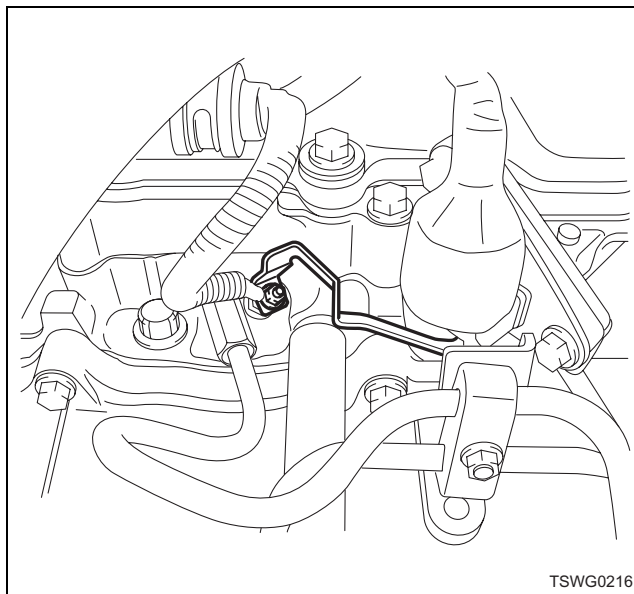
- Be careful not to let the metal parts of test harness and connector contact glow plug connector. Protect it with cloth to prevent short during test of key switch.
- Do not connect wrong connector. (Confirm the identification tape (red) before connecting.)
- DTC will be detected if disconnecting or connecting the harness with the key switch to ON. Turn it to OFF during work.



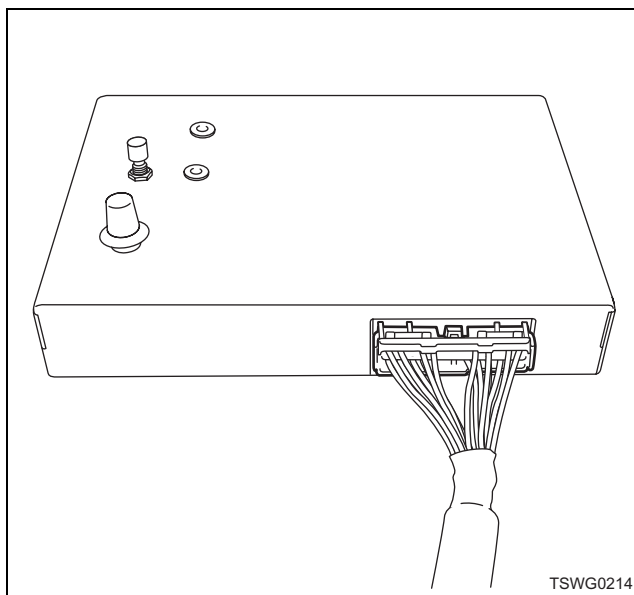
* 4HK1 is shown for illustration.

Note:

Be careful not to let the metal parts of connector contact glow plug connector while connecting the harness.



5. Connect the test harness to the body.



6. Start the engine.
7. If the machine has function to lower idle speed, lower the speed to clarify the engine reaction.
8. Set the selection switch to "1".
9. Press the start button and check the engine vibration level and change in exhaust noise.

Note:

Do not operate the body and the machine while the operation lamp comes on.

10. Confirm that the lamp goes off and repeat check of the remaining cylinders as steps 8 and 9.
11. Replace the injector in the cylinder of which engine vibration level and exhaust noise did not change.

Note:

For work procedure, refer to “Engine section” in the service manual.

12. Remove the test harness and restore the injector harness.

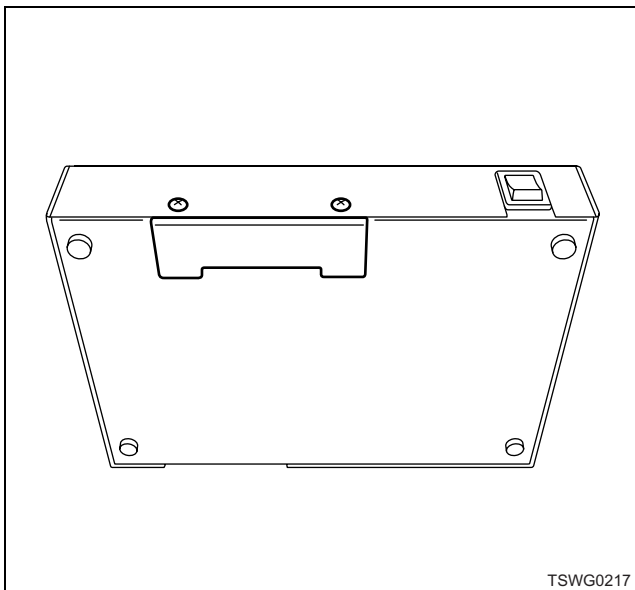
Note:

DTC will be detected if disconnecting or connecting the harness with the key switch to ON. Turn it to OFF during work.

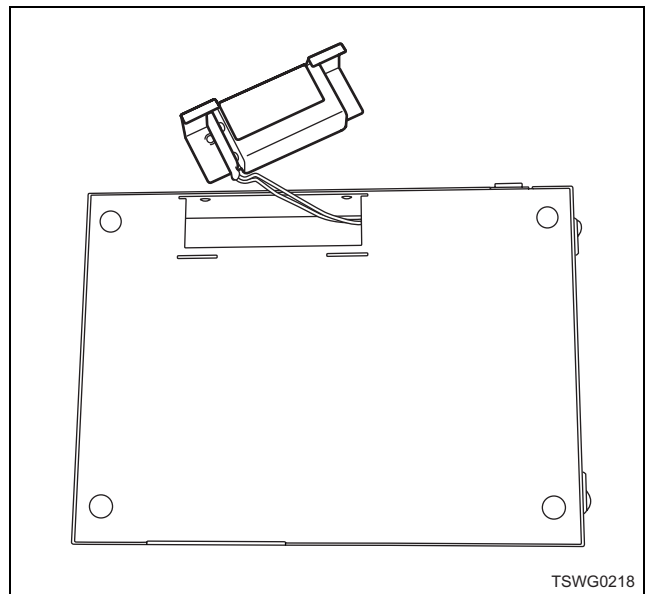
13. Start the engine and return the idle speed at specified one.
14. Clear the DTC.
15. Perform a test drive, and check that there are no faults.

Battery Replacement

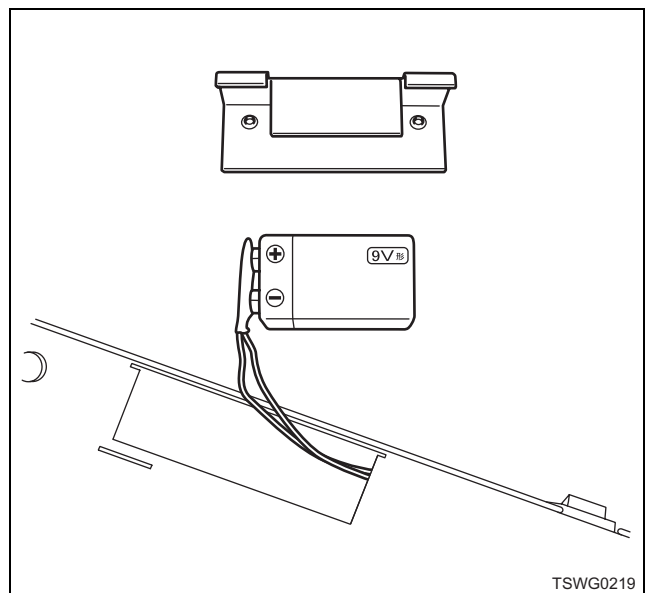
1. Remove the two screws on the side of the body.



2. Pull out the battery holder.

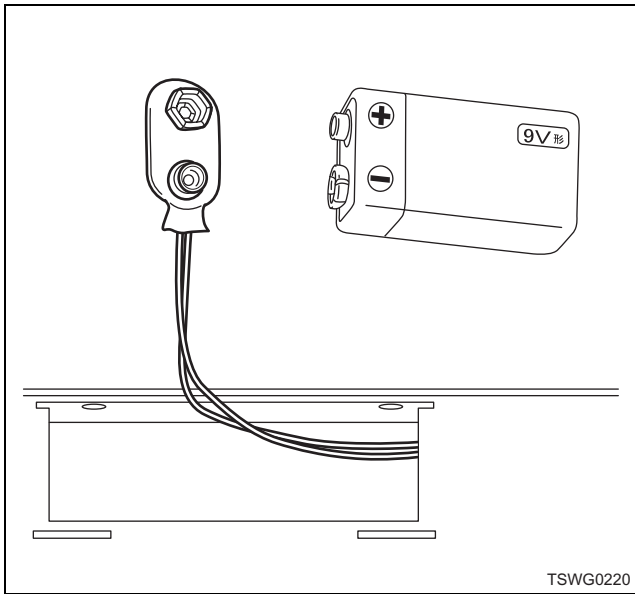


3. Remove the battery from the holder.



10D-83 Electronic control fuel injection system (Common rail type)

4. Disconnect the connector from battery, and replace the battery.



5. Restore in the reverse order.

Note:

- Prevent foreign matter from entering in while removing the battery.
- Do not tighten the battery holder screws excessively.
- Do not replace the battery holder screws with other than original ones.
- Be sure to use specified battery.

How to use flush tool

Description of function and operation

How to use breaker box

Breaker box inspection procedure

The breaker box is a tool to easily check open or short circuit in connector pin and harness between ECM and each sensor or actuator, which used to be difficult to check. Voltage and continuity on pins of ECM can be measured through breaker box using digital multi-meter (5-8840-2691-0). If a scan tool is also used, more precise inspection and service can be performed.

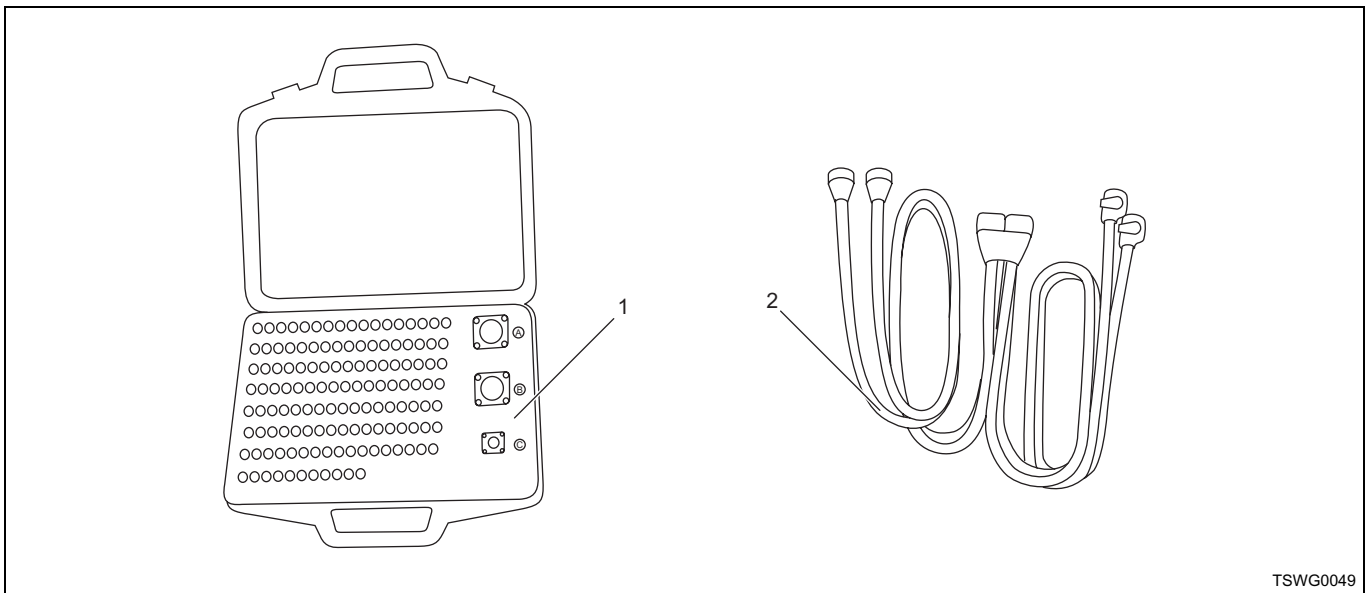
Important:

When inspecting or measuring the voltage and continuity of ECM, be sure to use a adapter harness which is appropriate to the breaker box and the inspected machine

- Before inspection and measurement of ECM are performed, confirm the pin position. Otherwise the ECM may get damaged.

Note:

The pin No. of ECM in diagnostic procedure matches with the pin No. of breaker box.



TSWG0049

Name

1. Breaker box

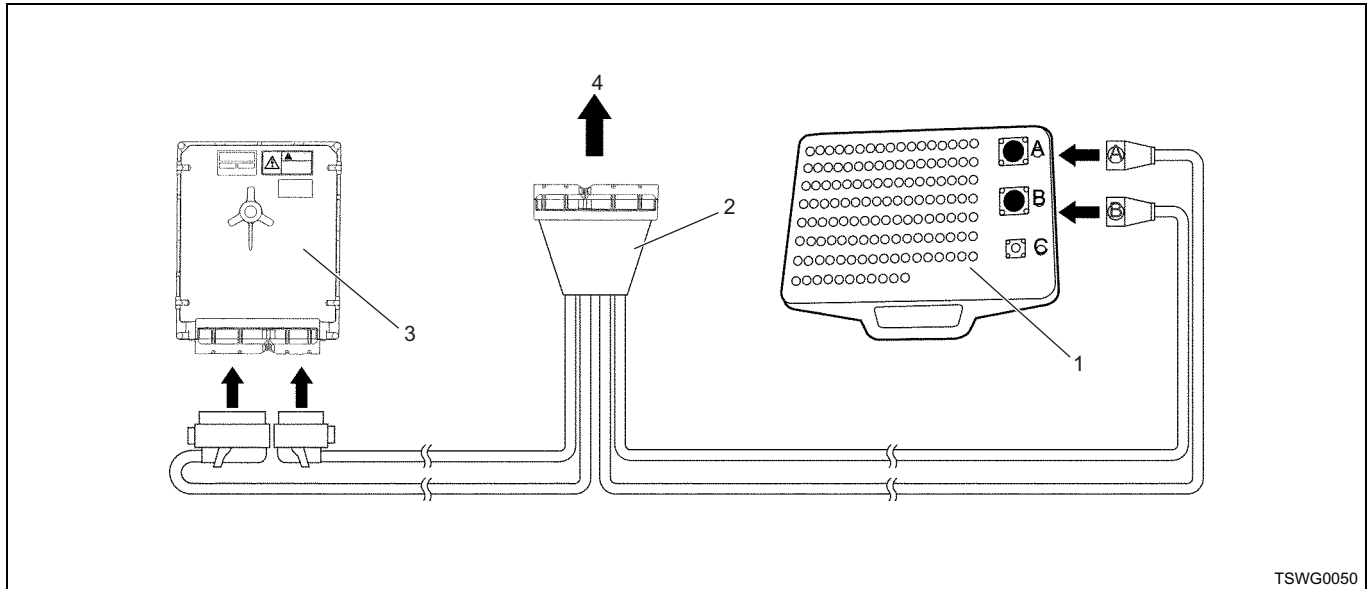
2. Adapter harness

How to connect breaker box

Caution:

Be sure to turn off the key switch before the connectors are disconnected.

1. Disconnect the ECM connector from ECM.
2. Connect the connector of adapter harness to ECM.
3. Connect the ECM connector to adapter harness.
4. Connect the adapter harness to breaker box.



Name

1. Breaker box
2. Adapter harness

3. ECM
4. To machine-side harness

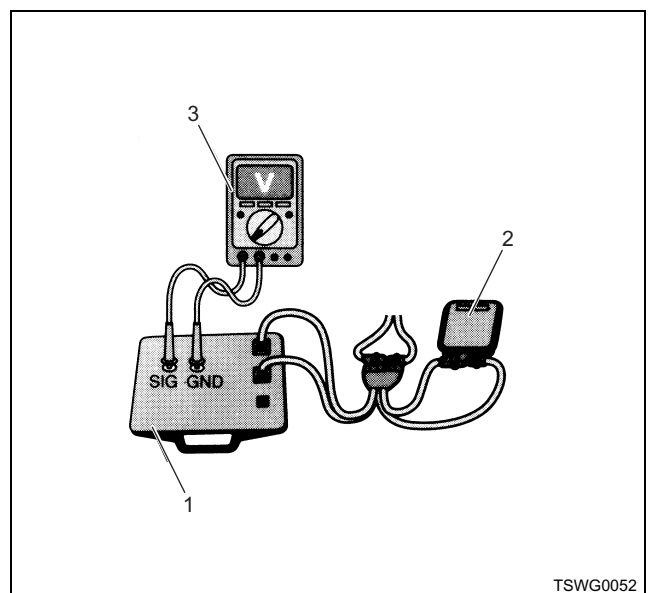
Caution:

Take care with the following items when connecting the adapter harness to breaker box. Failure to connect may damage the ECM.

- Connect the connector on adapter harness side to the connector of breaker box with the same No. each other.
- When the connecting the connector, align the cutouts of connector and breaker box each other.

Example of use for breaker box

1. Inspection and measurement of voltage
 - Accelerator position sensor
 - Engine coolant temperature sensor
 - Intake air temperature sensor etc.



Name

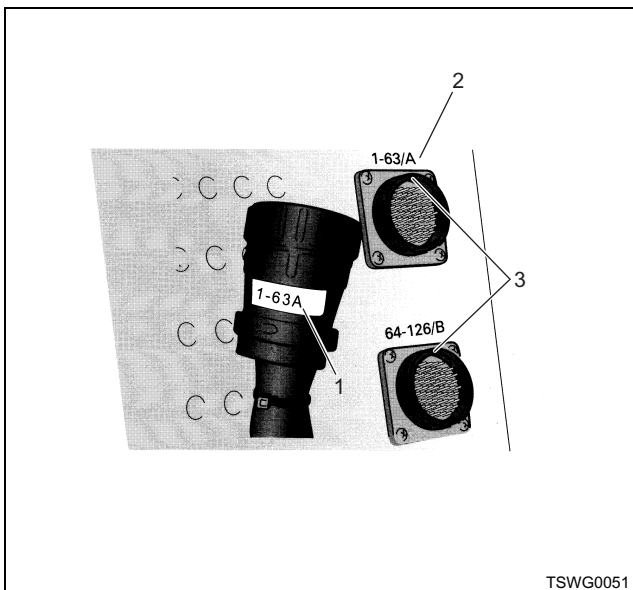
1. Breaker box
2. ECM
3. Digital multi-meter

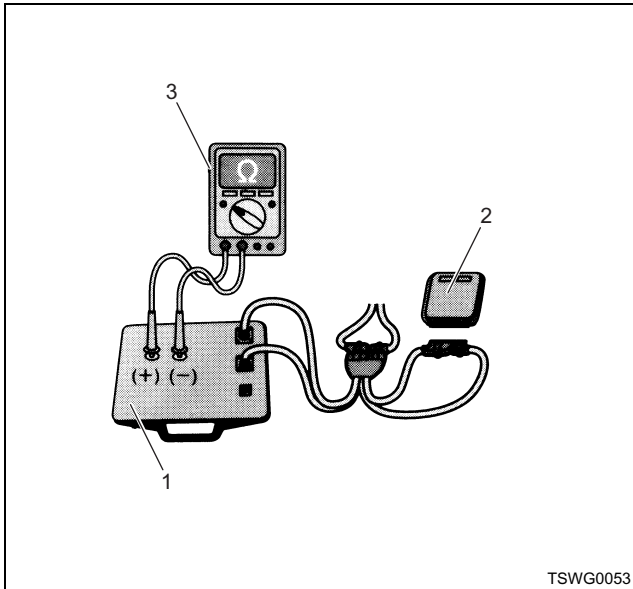
Name

1. Connector No. (Adapter harness)
2. Connector No. (Breaker box)
3. Cutout

2. Inspection and measurement of resistance

- Crankshaft position sensor
- Camshaft position sensor
- SCV etc.



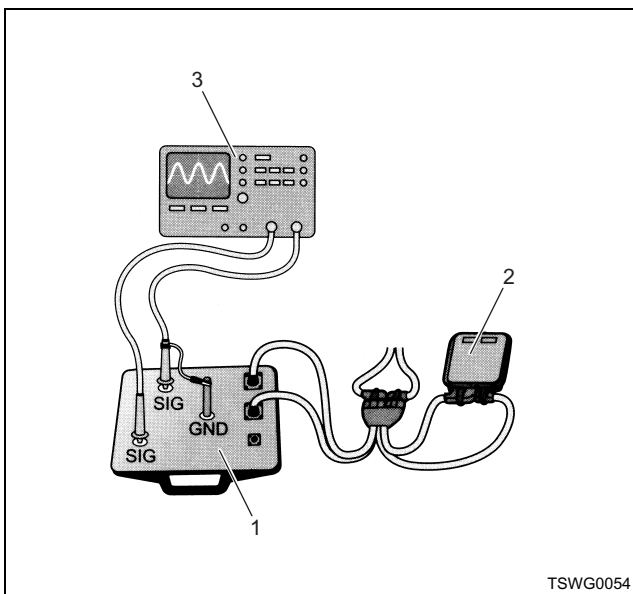


Name

1. Breaker box
2. ECM
3. Digital multi-meter

3. Inspection and measurement with oscilloscope

- Vehicle speed sensor signal
- Crankshaft position sensor signal
- Camshaft position sensor signal etc.



Name

1. Breaker box
2. ECM
3. Oscilloscope

Caution:

During inspection and measurement, interference of measurement lead on breaker box or mistaking terminal to be measured may cause damage to ECM or sensors. Work with extreme care.

Engine Control System

Description of function and operation

About engine control (common rail) system

General and detailed description in engine control system

The engine control system is electronic control system which maintains optimum combustion status of engine all the time according to operating conditions. It consists of the following components.

- Electronic control fuel injection system (Common rail type)

- EGR (Exhaust gas recirculation)

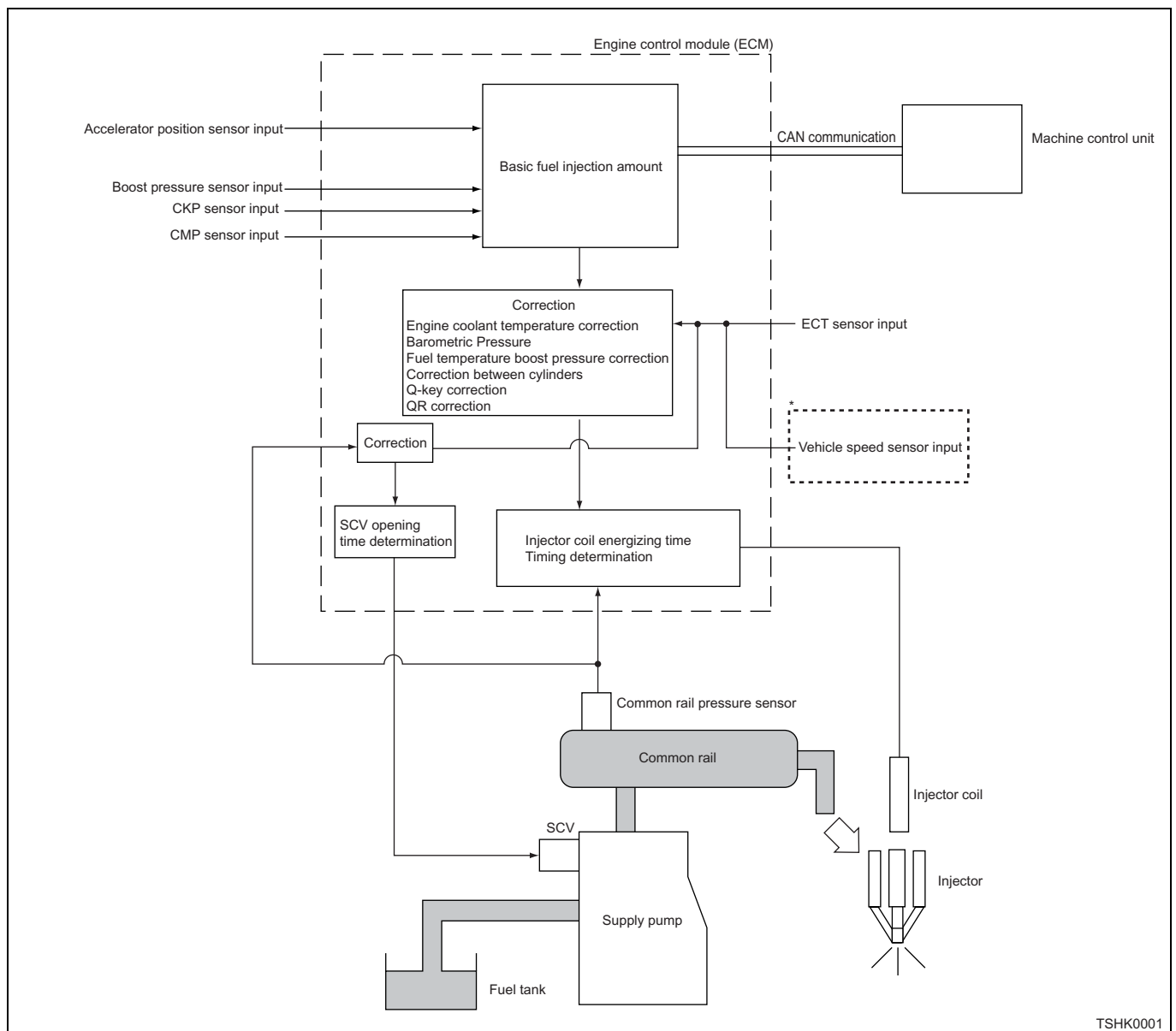
- Idle speed control

The engine control system also has the following system control functions other than engine control.

- QOS (Quick On Start) system
- Engine speed signal output
- Self-diagnosis function
- CAN (Controller Area Network) communication (SAE J1939/21, SAE J1939/11)

System control schematic diagram

(*: Specifications vary depending on each machine. Refer to the machine's manual.)



10D-89 Electronic control fuel injection system (Common rail type)

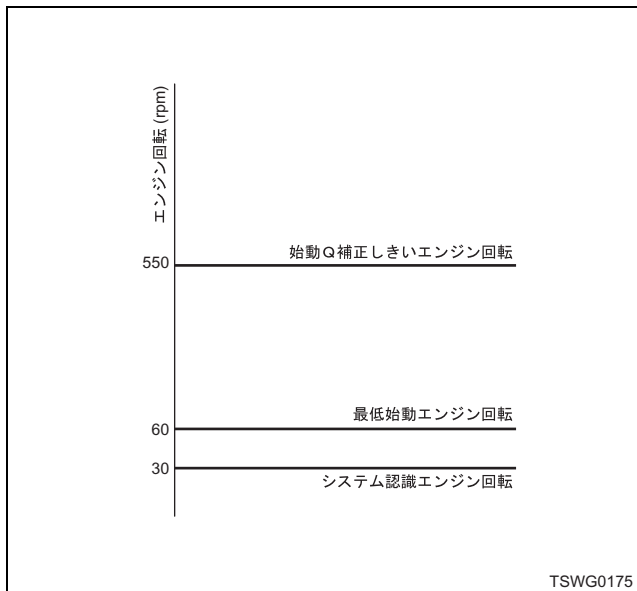
About fuel injection correction

ECM calculates the basic injection amount based on the signals from accelerator position sensor, boost pressure sensor, CKP sensor, CMP sensor, etc. It regulates the opening/closing period of SCV or electric conduction of injector according to the common rail pressure, engine coolant temperature, etc. at this time, to correct the optimum injection timing and injection amount.

About starting Q correction

ECM performs starting Q correction when the engine speed is less than the starting Q threshold value at engine starting.

Also, ECM cannot perform starting Q correction or start the engine when the engine speed is less than the lowest speed that system can recognize, since it does not recognize engine rotation.



About high-altitude correction

ECM calculates the current altitude based on the barometric pressure sensor signal.

It corrects the optimum fuel flow according to the altitude etc. at this time.

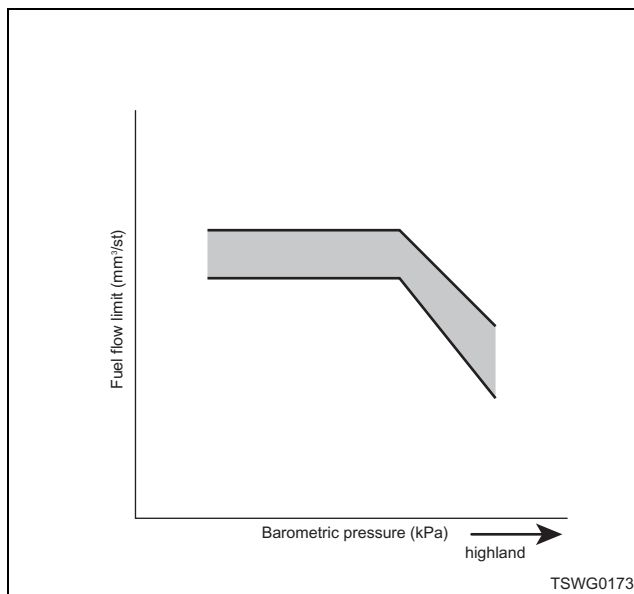
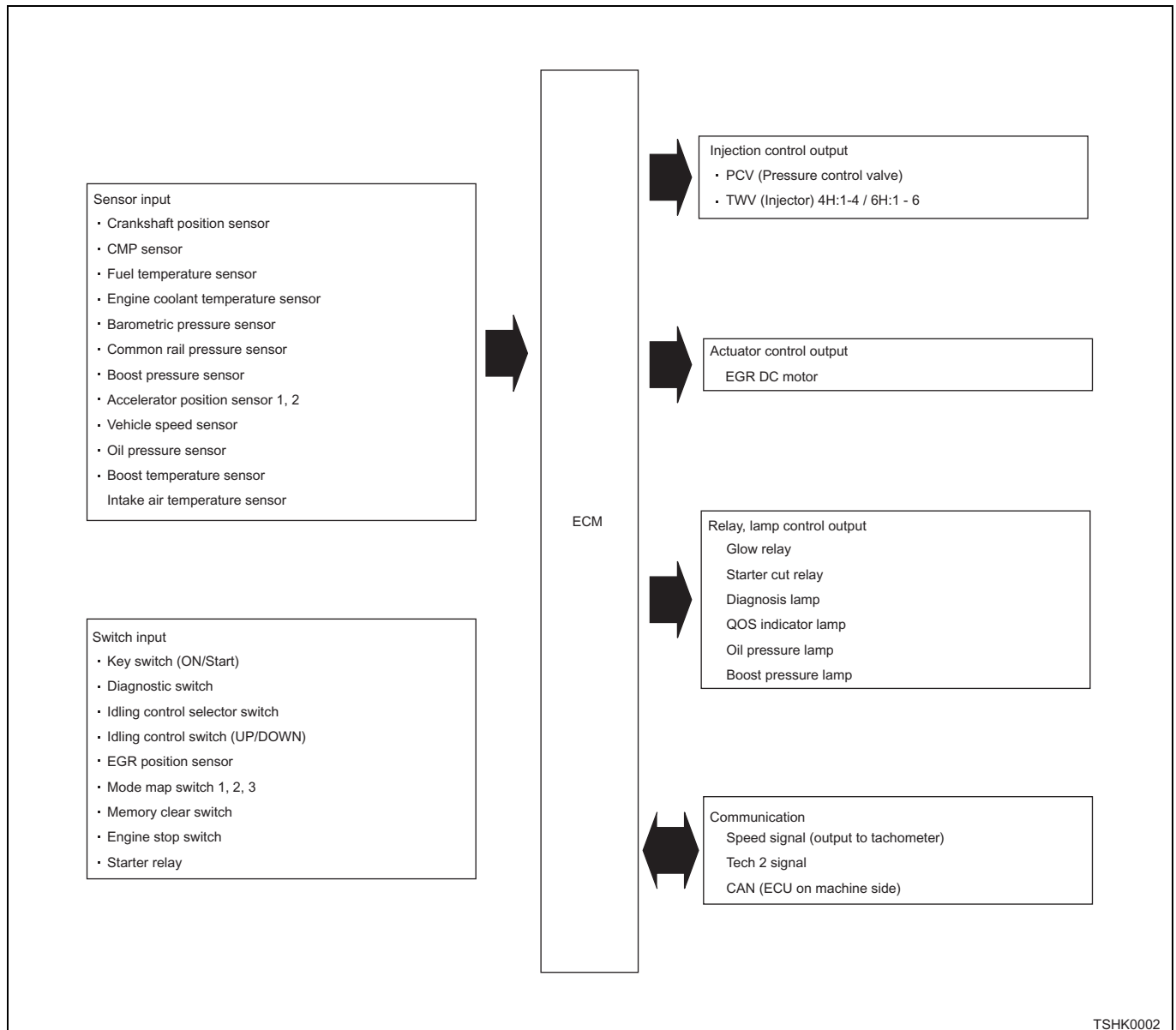


Table of Input/Output



Electronic control fuel injection system (Common rail type)

The engine control module (ECM) gets information, such as engine speed, engine load, etc. (signals from various sensors), and sends electrical signals, based on the information, to the supply pump, injector, etc. in order to properly control the fuel injection amount, injection timing, etc. in each cylinder.

Injection amount control

The system controls the injector, mainly based on the signals from engine speed and accelerator opening angle or the designated speed of machine control unit, to maintain the optimum injection amount.

Injection pressure control

The system controls the injection pressure by controlling fuel pressure in common rail. It calculates the appropriate pressure in common rail on the basis of engine speed, fuel injection amount, etc., and discharges the proper amount of fuel by operating supply pump resulting in pressure feed to common rail.

Injection timing control

This is substitute for a timer function. The system calculates the fuel injection timing on the basis of mainly engine speed, injection amount, etc. and controls the injector.

Injection rate control

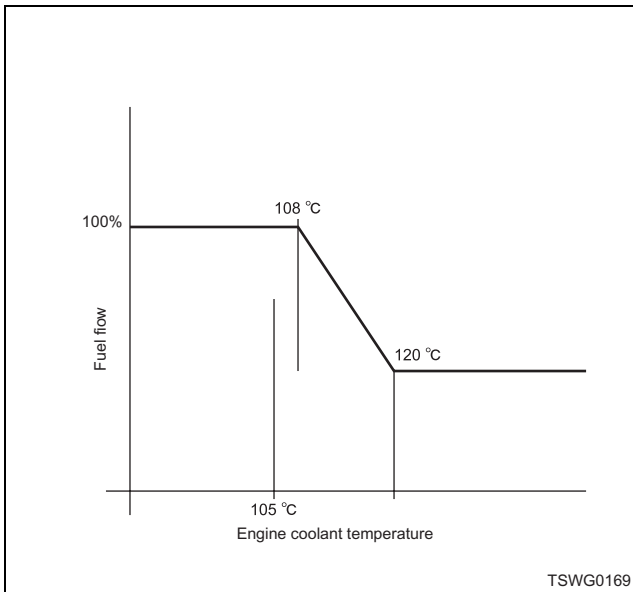
To improve combustion in cylinders, the system injects a little fuel (pre-injection) and ignites it at the beginning, then perform the second injection (main injection) after the first ignition. It controls these injection timing and injection amount by operating the injector.

10D-91 Electronic control fuel injection system (Common rail type)

Control during overheat

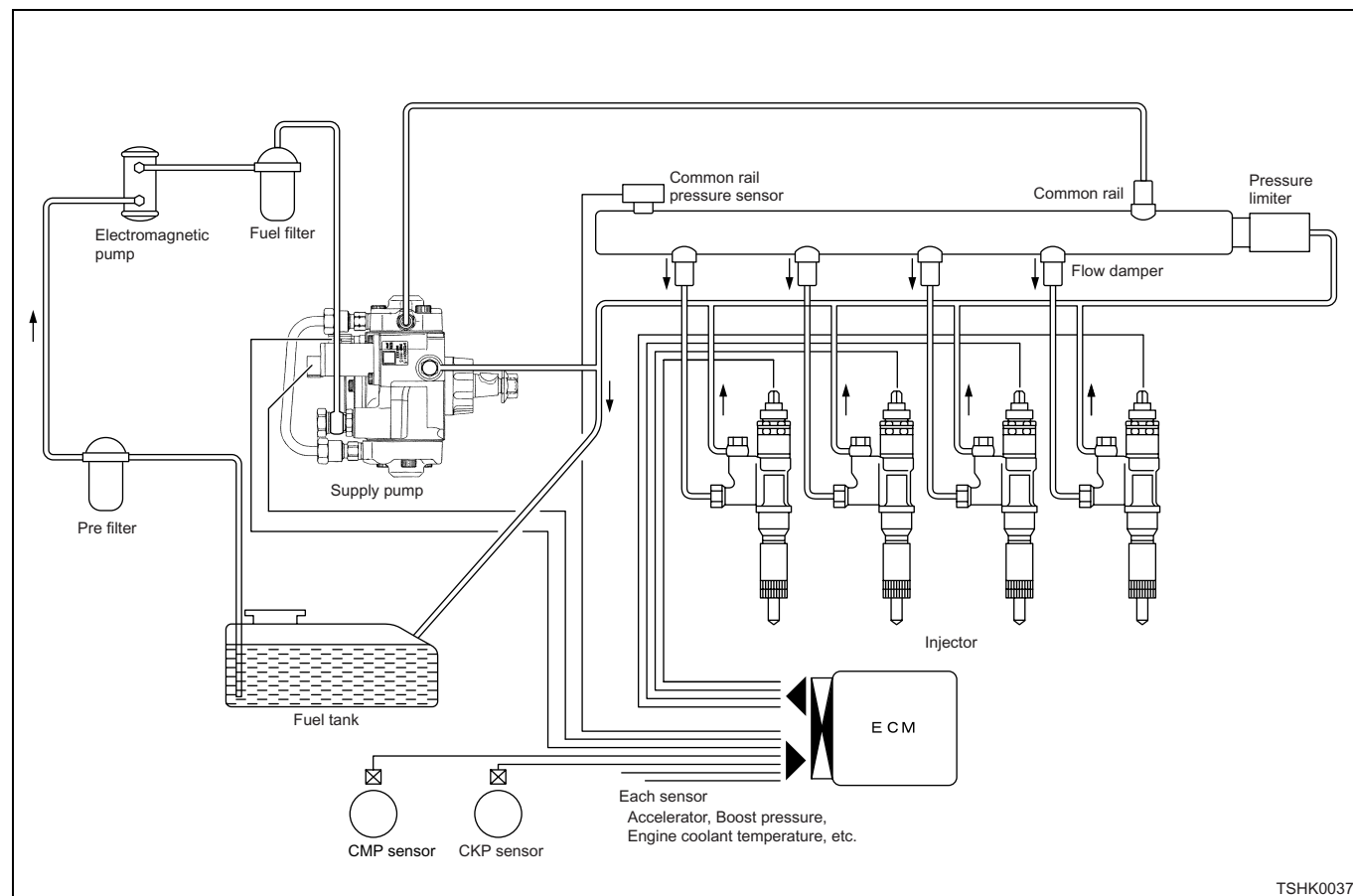
In overheating, ECM begins to limit fuel flow when the engine coolant temperature exceeds 108°C, for engine protection. It limits fuel flow further as the engine coolant temperature goes up. Fuel flow is limited to a certain level at around 120°C. (* Setting varies depending on the machine manufacturer)

The system raises an alarm from 105°C for some machines. In addition to alarm, by reducing the load to the machine, it enables to avoid such conditions that the fuel flow is limited.



System schematic diagram

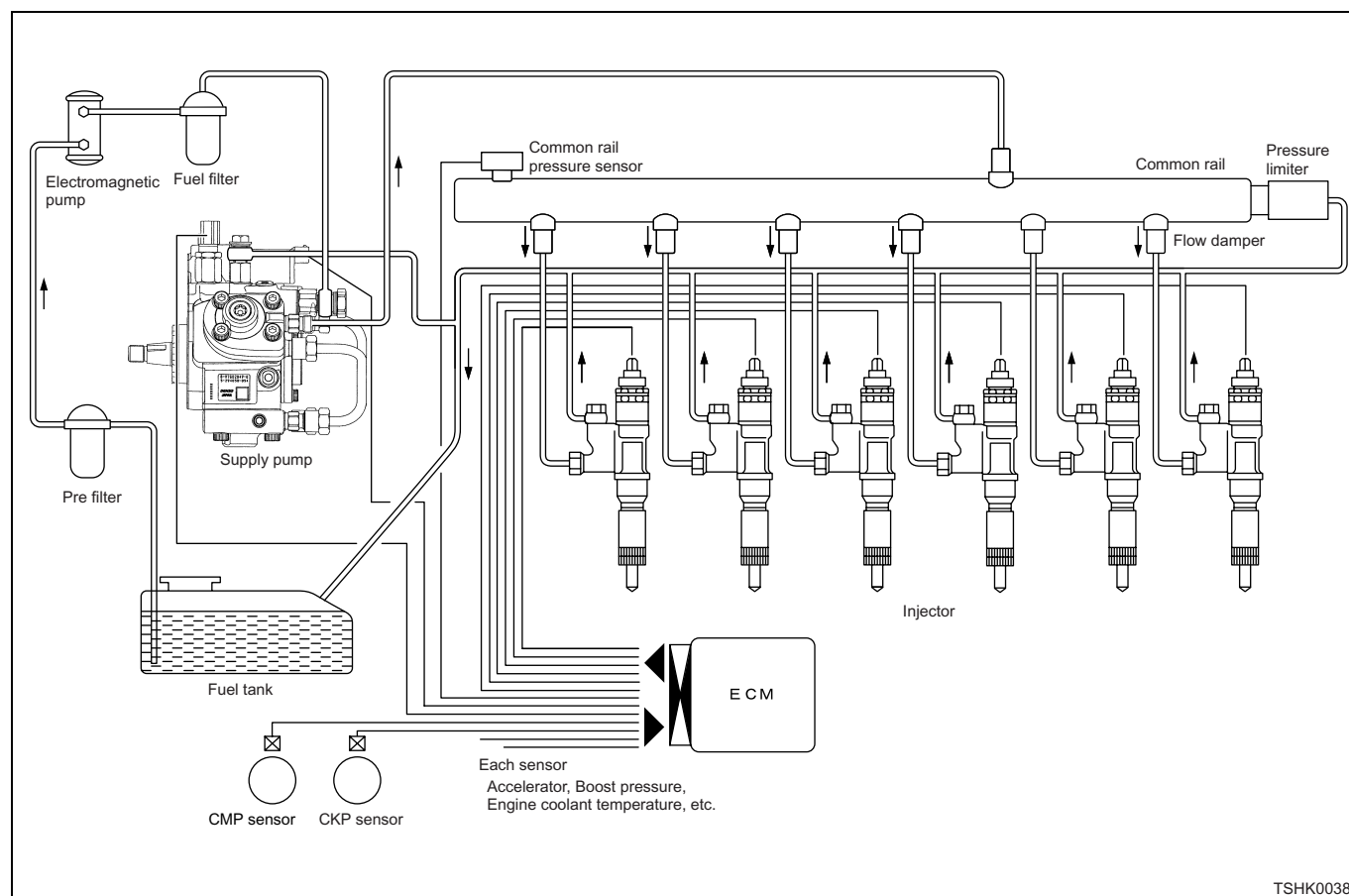
4HK1



TSHK0037

10D-93 Electronic control fuel injection system (Common rail type)

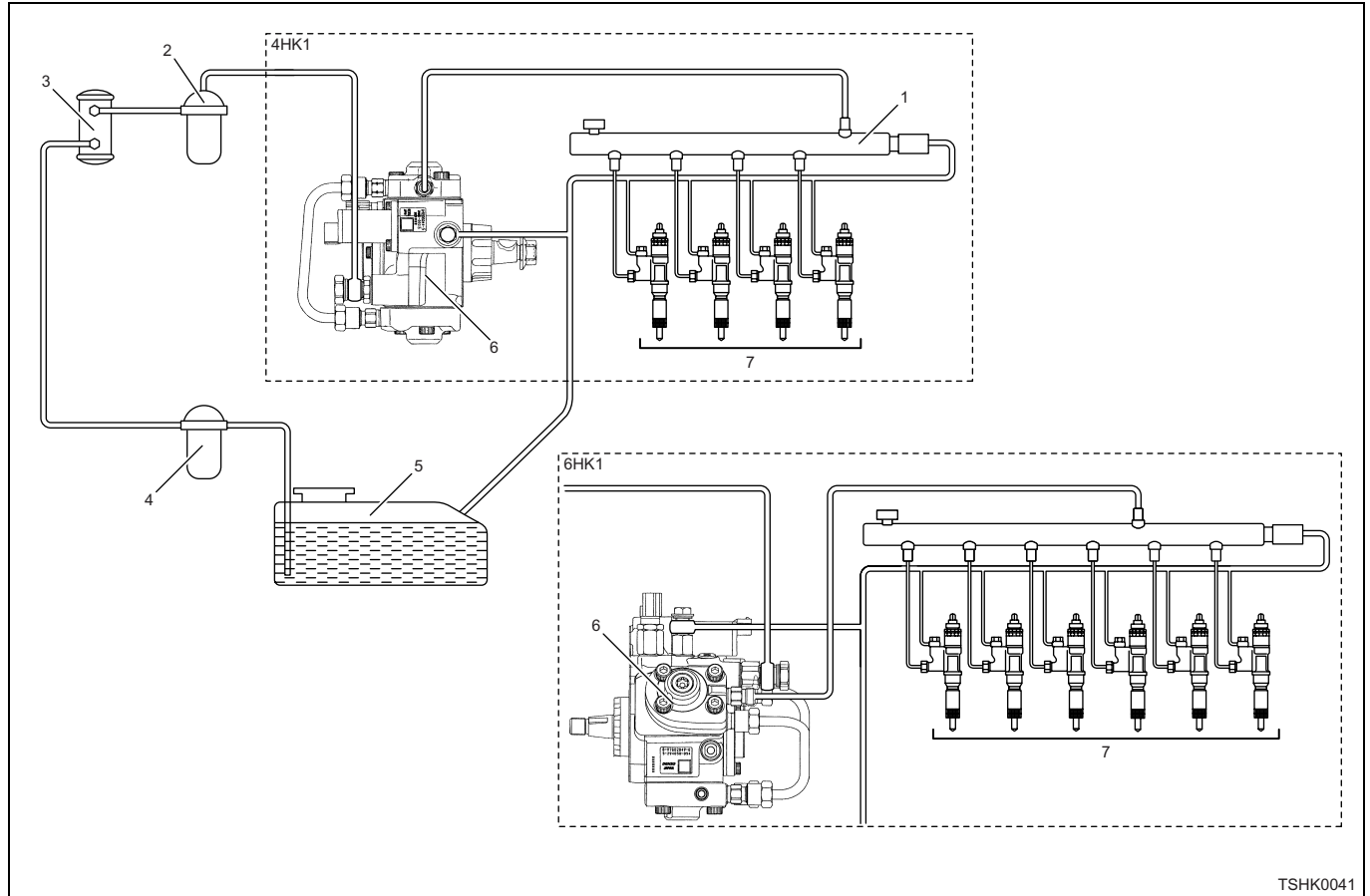
6HK1



TSHK0038

Fuel system

Fuel is supplied from fuel tank to supply pump, then supplied to common rail after pressurized by the pump. At this time, the system operates the suction control valve (SCV) by the signal from ECM to control fuel amount supplied to common rail.



TSHK0041

Name

1. Common rail	5. Fuel tank
2. Fuel filter	6. Supply pump
3. Electromagnetic Pump	7. Injector
4. Pre-filter	

EGR (Exhaust gas recirculation)

Exhaust Gas Recirculation system is abbreviated to EGR system. It recirculates part of exhaust gas into intake manifold to mix an inert gas with intake air. This leads to lower the combustion temperature to limit emissions of nitrogen oxide (NOx).

It controls amount of EGR by opening/closing the EGR valve installed between exhaust manifold and intake manifold. It determines amount of EGR, based on the engine speed and load rate on engine (fuel injection amount), and operates the EGR valve to control the amount of EGR.

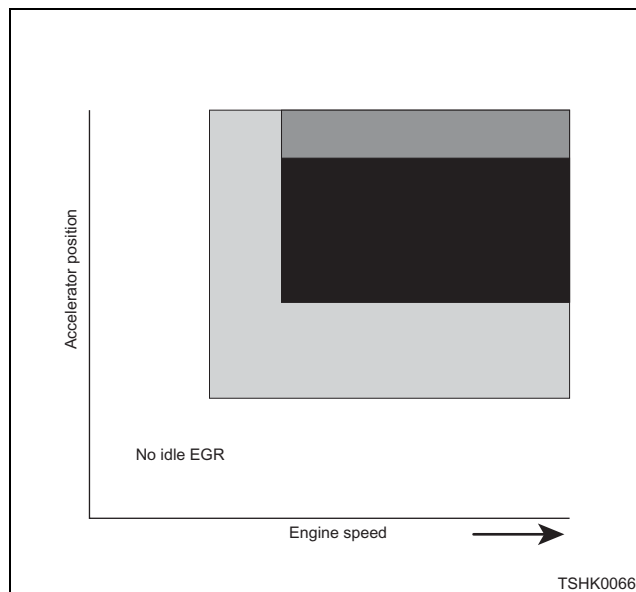
The cooling system (EGR cooler) equipped on the EGR gas passage allows to cool down high temperature EGR gas and mix it with new air to lower the combustion temperature further, resulting in limiting NOx effectively (Cooled EGR).

On 4HK1-TC and 6HK1-TC machines, the EGR system has the check valve to stop backward flow of EGR gas and flows it in one way direction, leading to increase the amount of EGR.

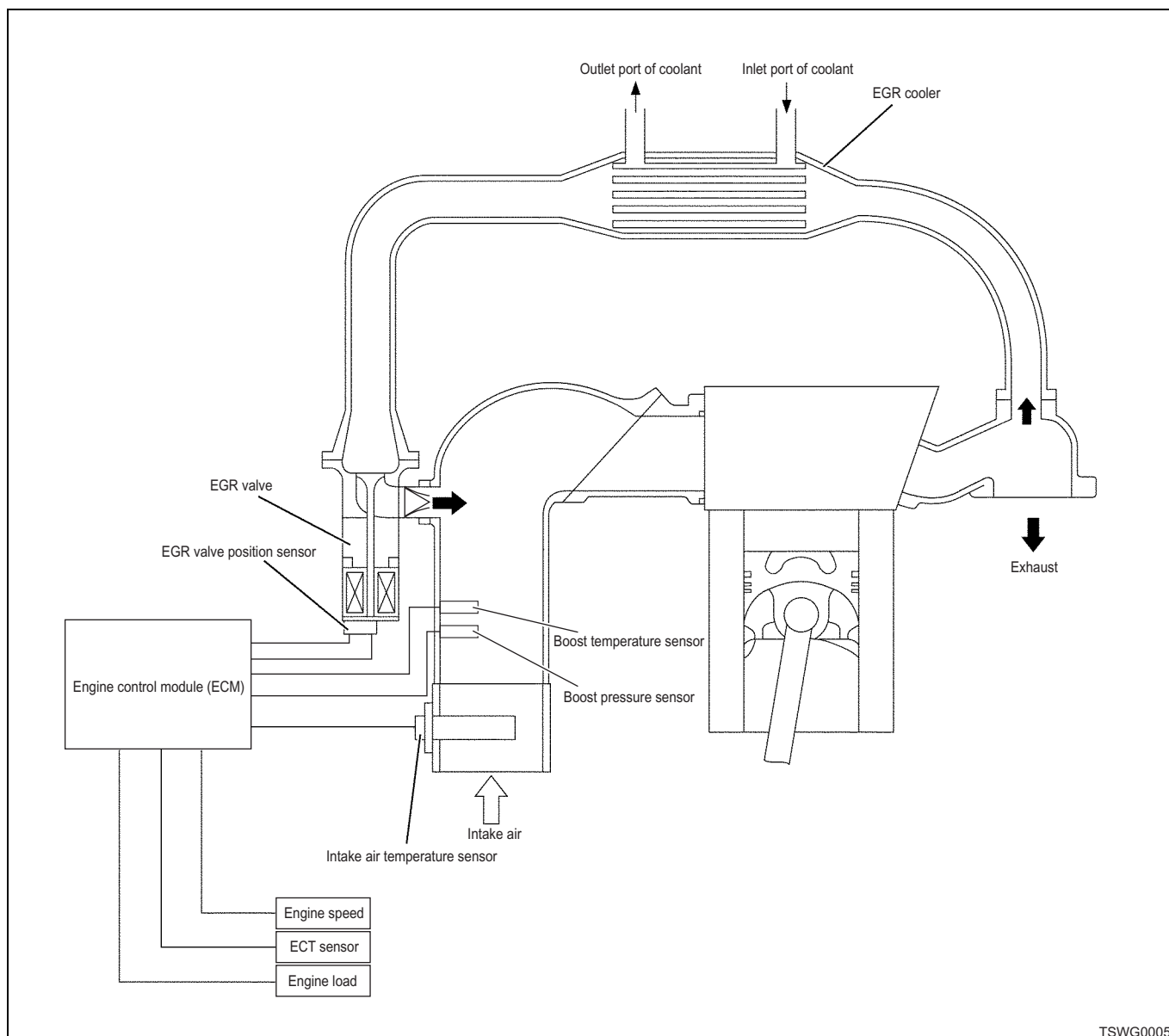
10D-95 Electronic control fuel injection system (Common rail type)

EGR control

ECM operates the motor according to engine speed, engine load, etc. to control amount of EGR valve lift. Amount of valve lift is detected by EGR position sensor. The dark color area in the figure shows that the valve lift amount is large, and the darkest color area shows that the valve lift amount is almost 100%.



EGR system schematic diagram



Idling control

At warm-up operation, using the “Idling control selector switch” allows to control the lowest idling speed. Also, using the “Idling control selector switch” allows to automatically set the lowest idling speed to the optimum value according to engine coolant temperature.

Note:

Since specifications vary depending on each machine. Available functions also vary.

Idling control selector switch

Using the “Idling control selector switch” allows to switch the idling control function.

Idling control switch

Using the “Idling control switch” allows to control the idling speed.

Note:

Refer to the machine’s manual for the locations of idling control selector switch and idling control switch.

The highest speed varies depending on engine model, machine specifications and warm-up condition of engine.

UP

While pressing the “UP” side of switch, the engine speed increases, resulting in increasing the idling speed.

DOWN

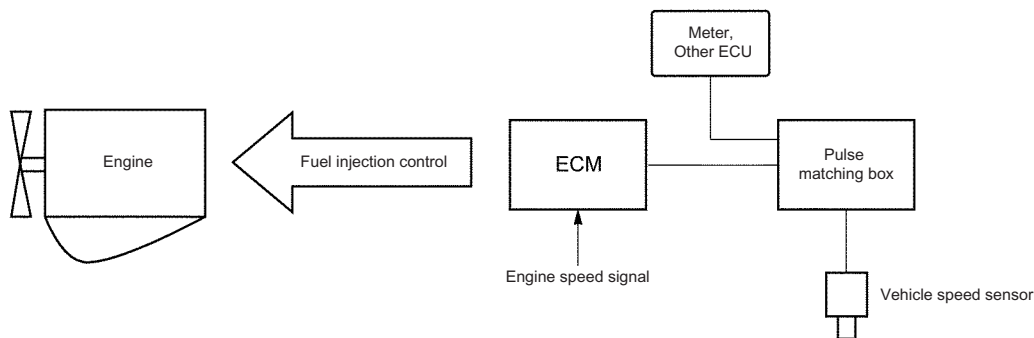
While pressing the “DOWN” side of switch, the engine speed decreases, resulting in decreasing the idling speed. However, the idling speed does not decrease below the lowest speed.

The engine speed controlled by idling control switch is stored in ECM when the key switch is turned to OFF. The same speed can be achieved at the next operation.

Speed limit control

Speed limit control means that the engine control module (ECM) controls fuel injection amount, based on vehicle speed signal and engine speed, so that the machine speed does not exceed the setting value.

The vehicle speed signal is sent from vehicle speed sensor to pulse matching box. The pulse matching box corrects the signal to match with the machine, and sends it to ECM, meter, etc. The ECM recognizes the engine speed by the signal from crankshaft position (CKP) sensor.

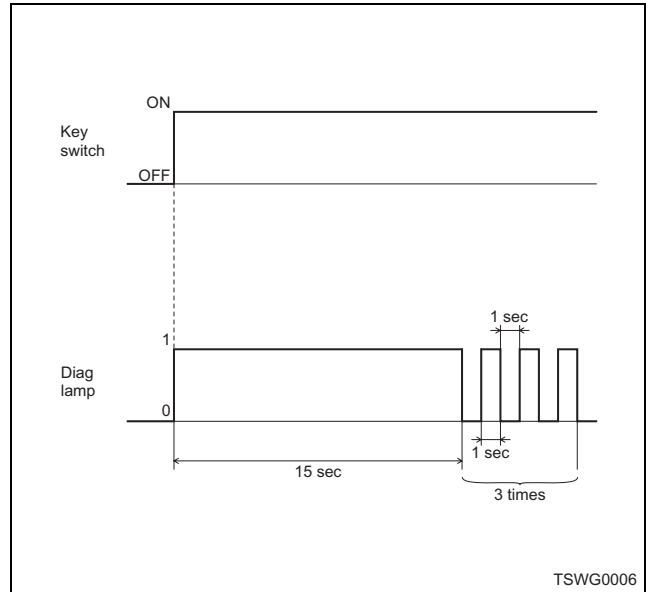


10D-97 Electronic control fuel injection system (Common rail type)

Check for speed limit control

To check whether the speed limit control on the machine is active, check blinking of diagnosis lamp.

1. Turn the key switch to OFF.
2. Turn the key switch to ON.
3. Diagnosis lamp illuminates for 15 seconds and then blinks three times.

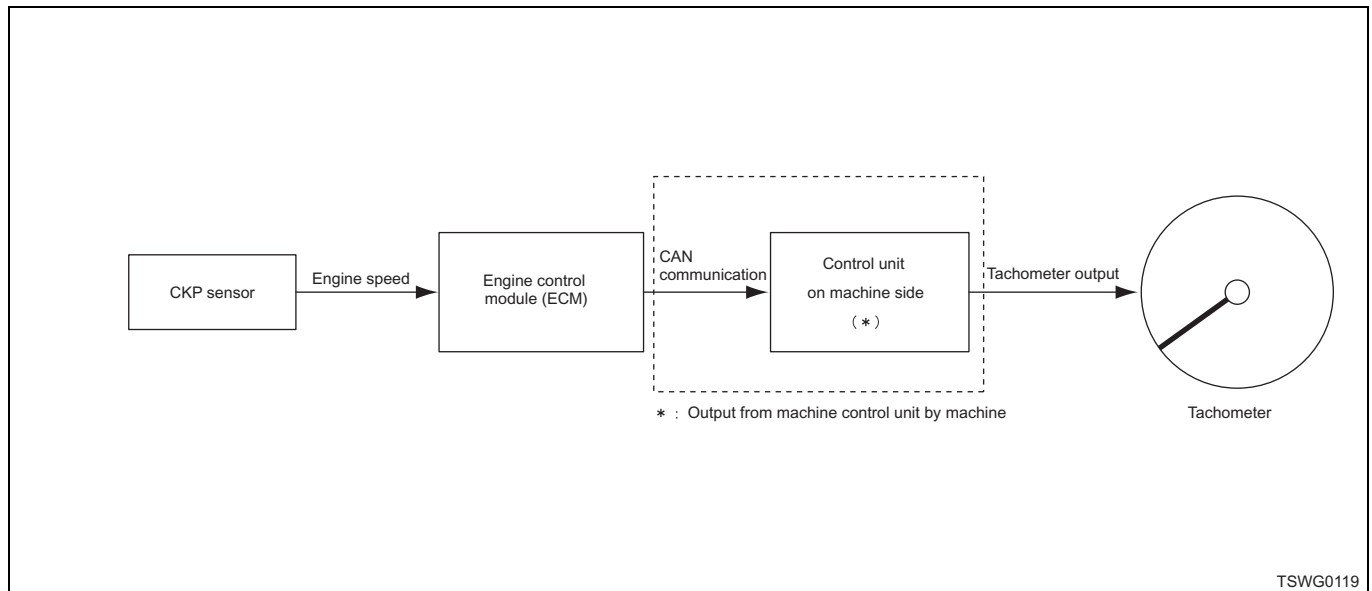


Note:

If it does not blink, the speed limit control is not active.

Engine speed output to tachometer

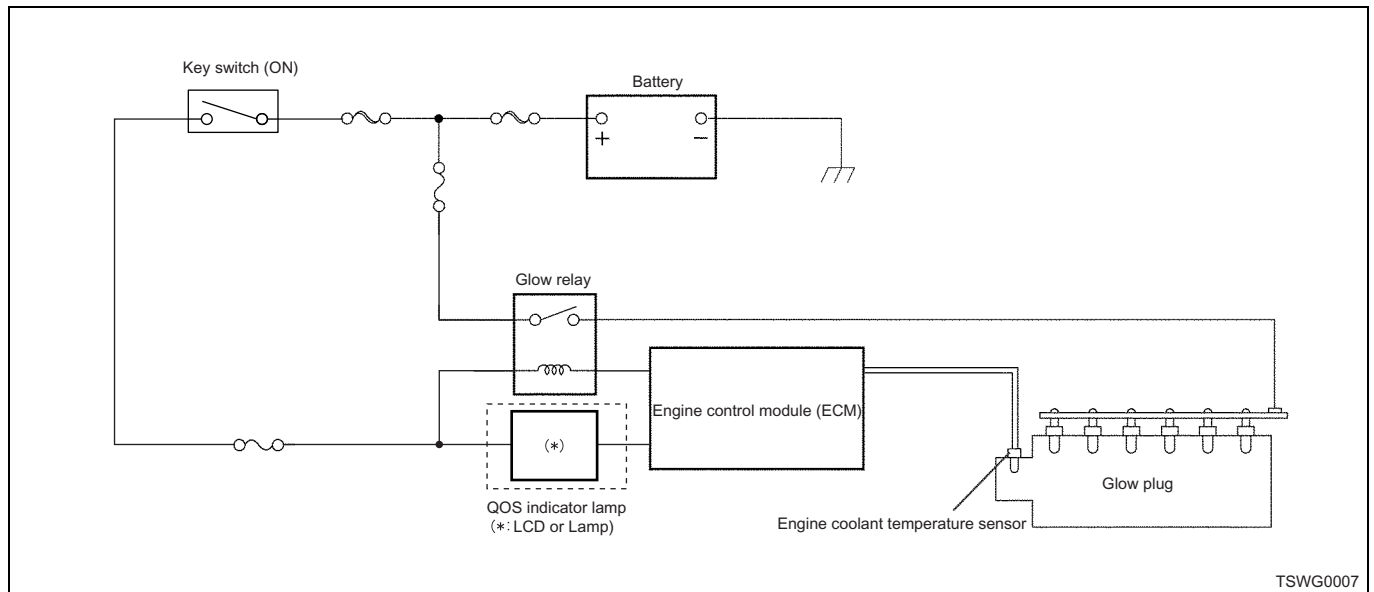
The engine control module (ECM) outputs the engine speed pulse (4 pulses per engine revolution) as a tachometer output to tachometer. Tachometer shows the engine speed using the engine speed pulse sent from ECM.



Preheating control

QOS (Quick On Start) system

The ECM determines the period required for glow (pre-glow, glow, after-glow), and operates the glow relay and QOS indicator lamp. QOS system allows to make the starting at cold weather easier and reduce white smoke and noise at starting. When turning the key switch to ON, the ECM detects the engine coolant temperature by signal from engine coolant temperature (ECT) sensor and changes the period for glow so that the proper starting conditions can be achieved all the time. Also, after-glow function allows to stabilize idling immediately after starting.

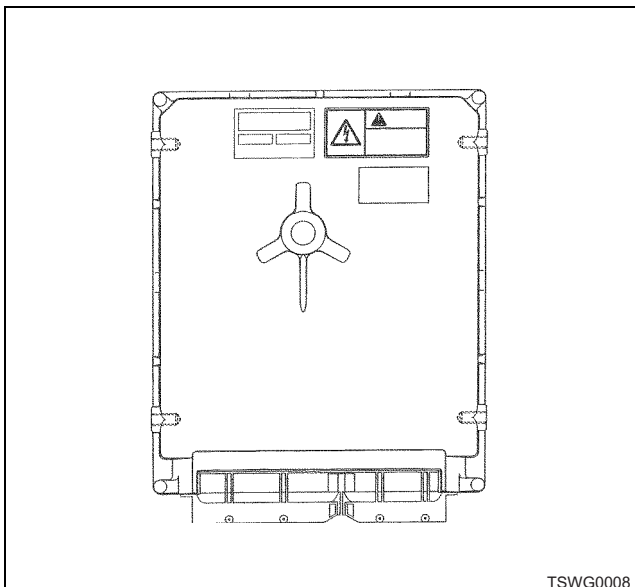


Engine Control Module (ECM)

About functions of ECM

Note:

Refer to the machine's manual for the locations of ECM.



The ECM monitors the information sent from various sensors all the time and controls each system of the powertrain. The ECM performs the diagnostic function of the system, detects operational problems of the system, gives a warning through diagnosis lamp to a driver and stores DTC (diagnostic trouble code). The area where the trouble occurred can be identified by the DTC to assist a mechanic to perform repair work. The ECM sends the voltage of 5 V to supply the power to various sensors or switches. The ECM controls the output circuits by controlling the ground or power supply circuit through a certain device.

ECM and components

The ECM is designed to maintain the level of emission as the emission control regulations and get a good performance and fuel efficiency at the same time. The ECM monitors various functions of the engine through the sensors such as crankshaft position (CKP) sensor etc.

ECM voltage

The ECM energizes standard voltage to various switches and sensors. The resistance value of the ECM is quite high so that the ECM can energize a voltage like this. The voltage actually applied to the circuit is low, and it does not sometimes come on even if the test light is connected to the circuits. The voltmeter usually used in a service shop may not indicate a correct reading because the input impedance is too low. A digital multi-meter which has an input impedance of 10 M Ω (e.g. 5-8840-2691-0) should be used to get an correct reading of the voltage.

Electrically erasable programmable read only memory (EEPROM)

EEPROM has programs which is necessary for ECM to control the operation of powertrain and information for calibration.

If fault is found in the EEPROM, replace the ECM.

Examples of programs to control powertrain and information for calibration in ECM are the following items.

- Engine model
- Engine number
- ECM part number
- DTC
- Learning value for interval correction of cylinders
- QR
- Q-key
- Learning value for EGR correction

Precautions on ECM service work

Note:

- **Be sure to use the ECM with the part number corresponding to the machine.**
- **If performing welding on the machine, disconnect the battery cable from the negative terminal beforehand.**

The ECM is designed to sustain normal consumption of current relating to the operation of the machine. Circuits should not be overloaded. In case of testing of open and short circuits, the circuits of the ECM must not be connected to the ground or be supplied with voltage except that there is such an instruction. Be sure to use a digital multi-meter (5-8840-2691-0) when performing the tests of these circuits.

Removal of ECM

1. Turn the key switch to OFF.
2. Disconnect the battery cable from negative terminal.
3. Remove the parts (relay etc.) around the ECM to facilitate removal of it.
4. Disconnect the ECM connector from ECM. (81-pin, 40-pin connectors)
5. Loosen the installing bolts (nuts) and remove the ECM.

Note:

Installation method and locations vary depending on each machine. Refer to the machine's manual.

Installation of ECM

Install the ECM in the reverse order of removal.

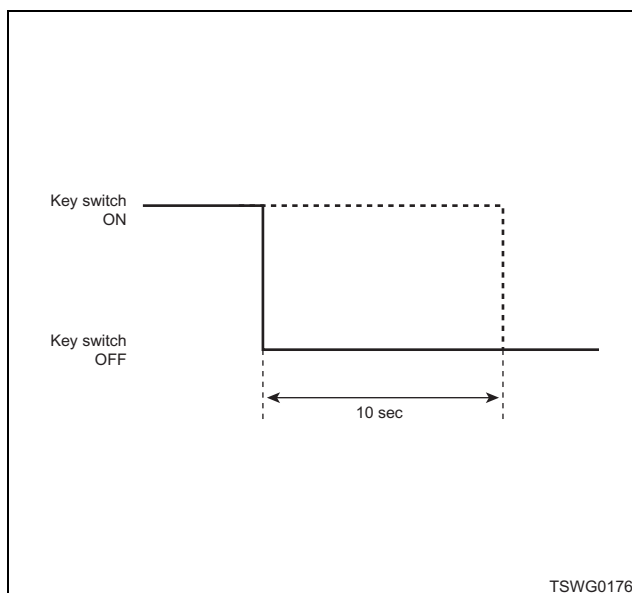
EGR valve position learning is required after replacing the ECM.

1. Turn the key switch to "ON".
2. Turn the key switch to "OFF".
3. Leave as it is for 10 seconds.

Failure to perform the EGR valve position learning may result in detection of DTC for EGR.

About ECM power off

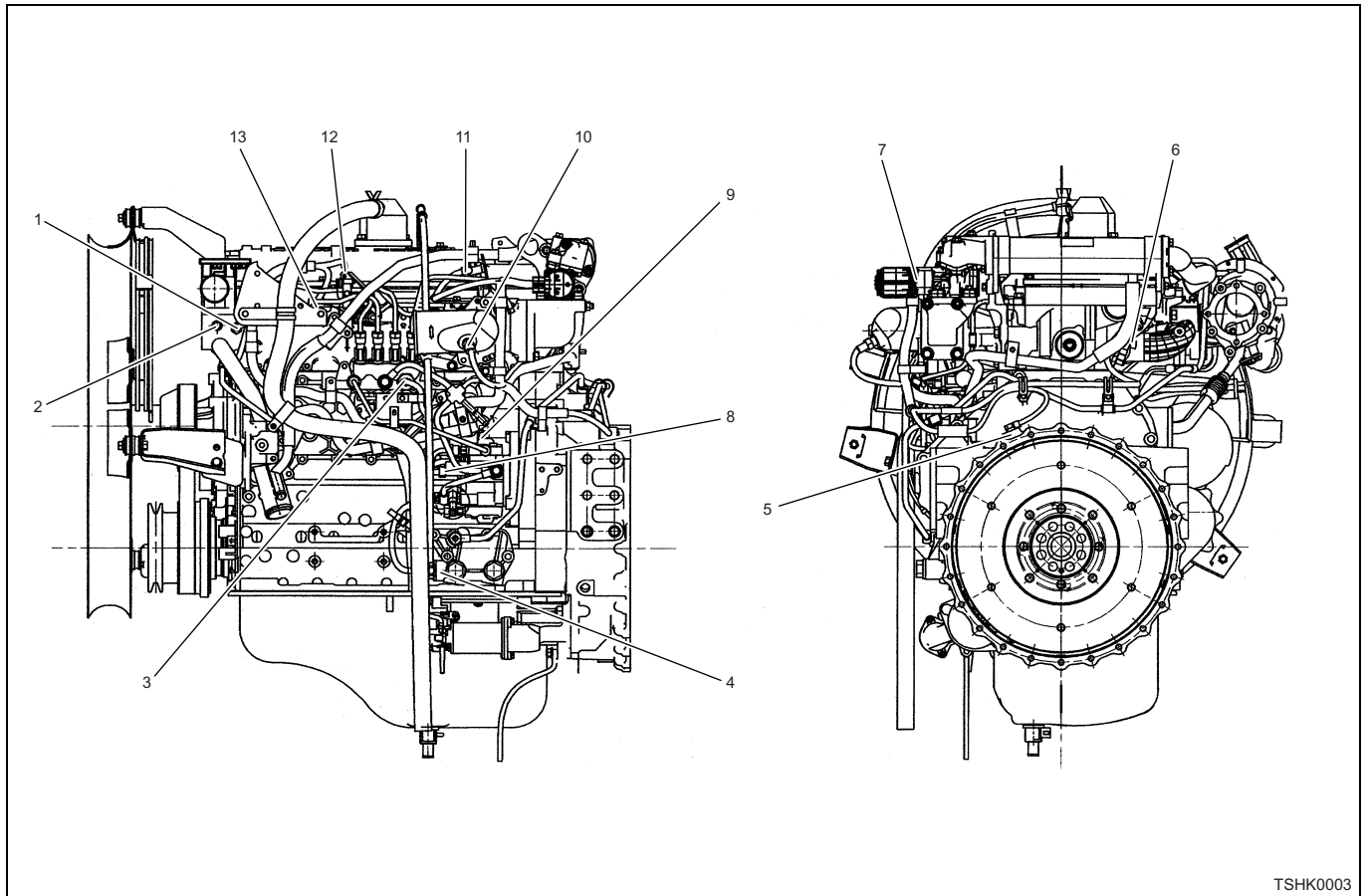
The power supply inside the ECM does not go off for about 10 seconds after turning the key switch OFF. If the ECM power needs to be off such as for memory clear, wait for more than 10 seconds after turning the key switch OFF.



Engine component location diagram

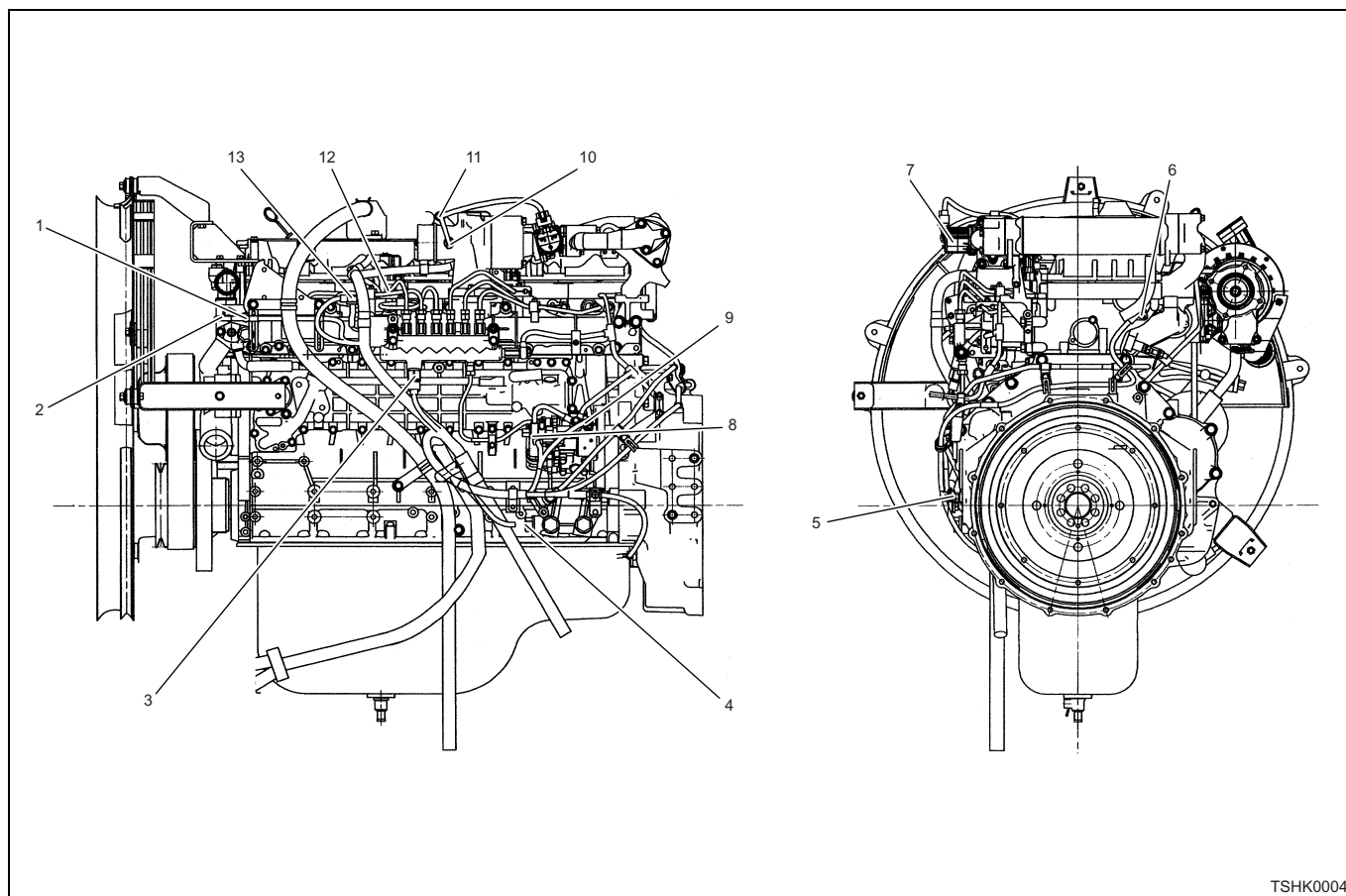
(Component location, its form and parts to be used vary depending on each machine.)

4HK1



10D-101 Electronic control fuel injection system (Common rail type)

6HK1



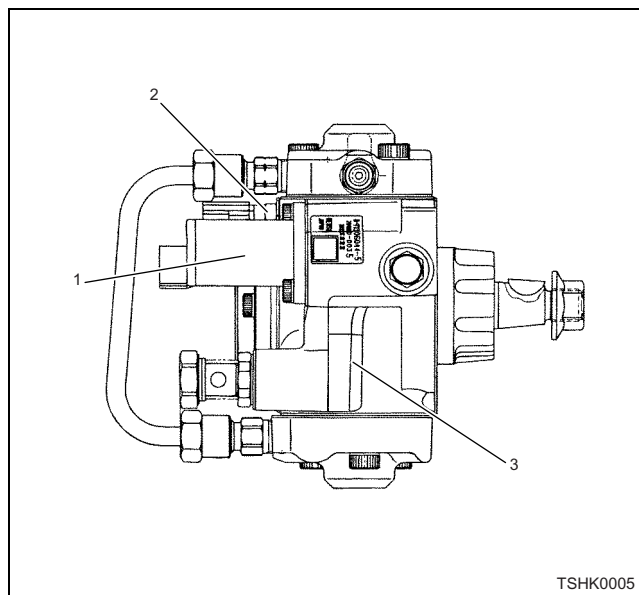
TSHK0004

Name

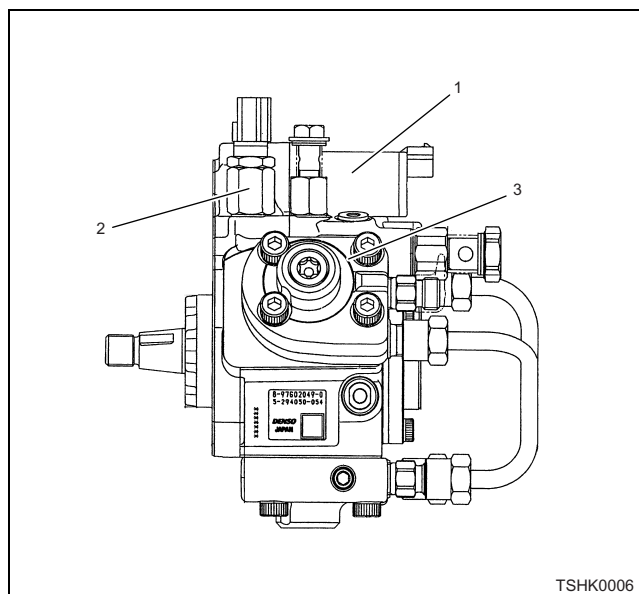
1. Engine coolant temperature (ECT) sensor	8. Suction control valve (SCV)
2. Overheating switch	9. Fuel temperature (FT) sensor
3. Common rail pressure sensor	10. Boost temperature sensor
4. Engine oil pressure sensor	11. Boost pressure sensor
5. CKP sensor	12. Injector
6. CMP sensor	13. Glow plug
7. EGR valve	

Supply pump

4HK1



6HK1



Name

1. SCV
2. Fuel temperature (FT) sensor
3. Feed pump

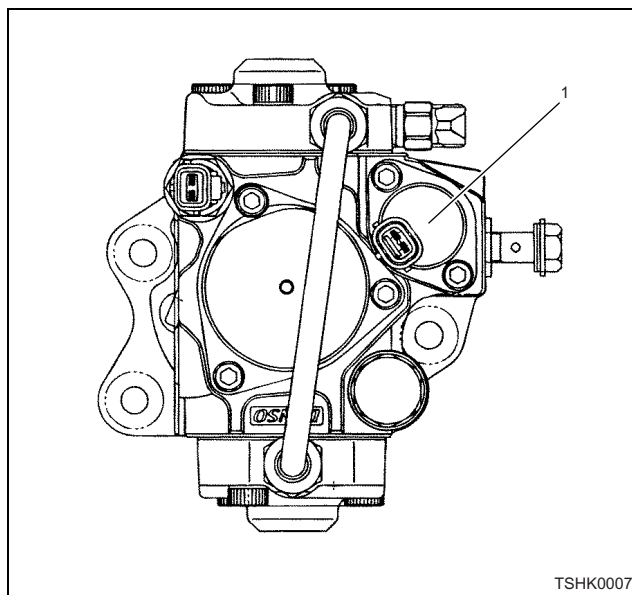
The supply pump pressurizes fuel using engine output, and pressure-feeds fuel to common rail. Supply pump has also SCV (suction control valve), fuel temperature (FT) sensor and feed pump.

Note:

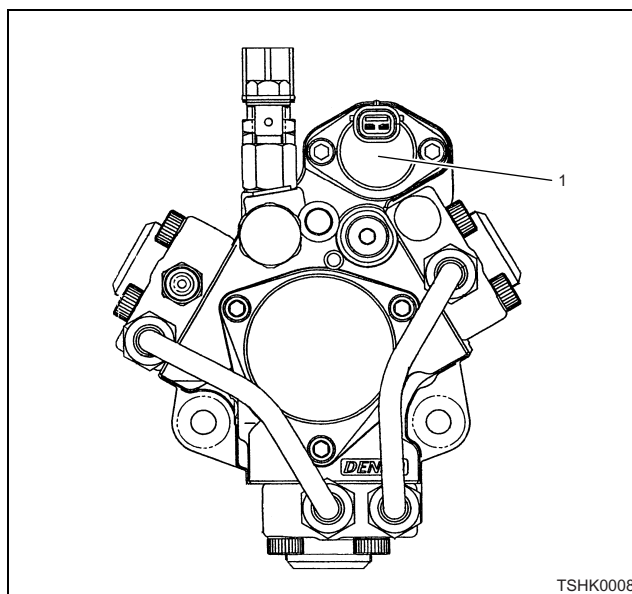
For work procedure, refer to “Engine section” in the service manual.

SCV (suction control valve)

4HK1



6HK1



Name

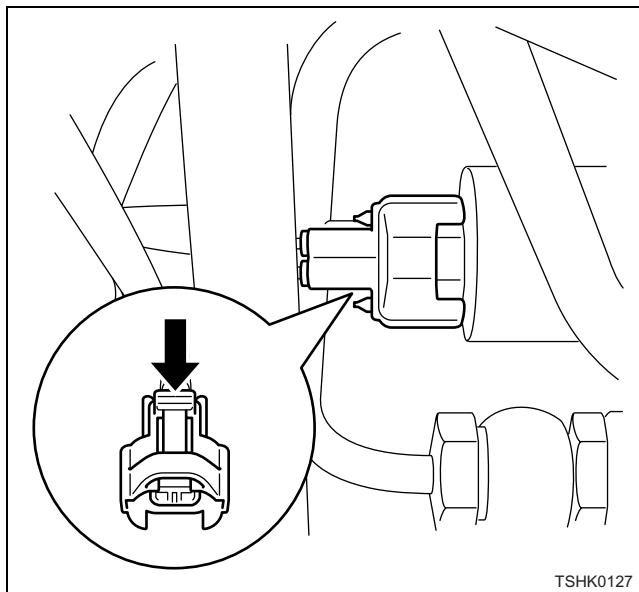
1. SCV

The SCV (suction control valve) is installed onto supply pump section and controls pressure feed of fuel (discharge amount) to common rail. The engine control module (ECM) regulates period of electric conduction of SCV to regulate the fuel discharge amount.

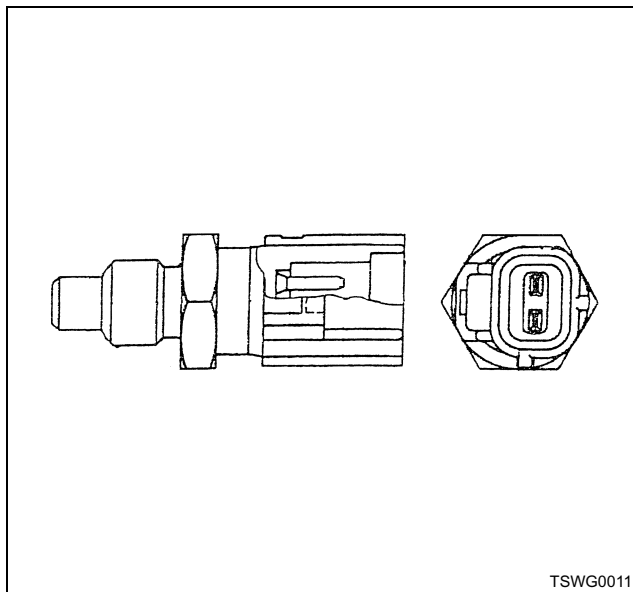
Removal

- Do not replace the SCV.
- If it is faulty, replace it as supply pump ASM.

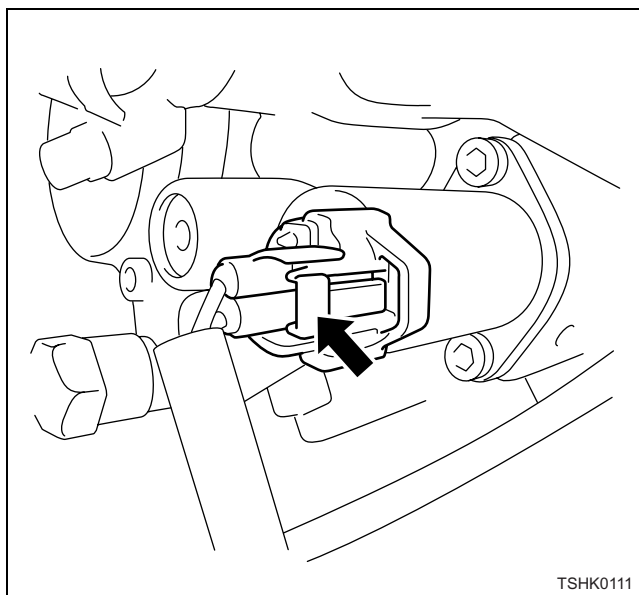
4HK1



Fuel temperature (FT) sensor



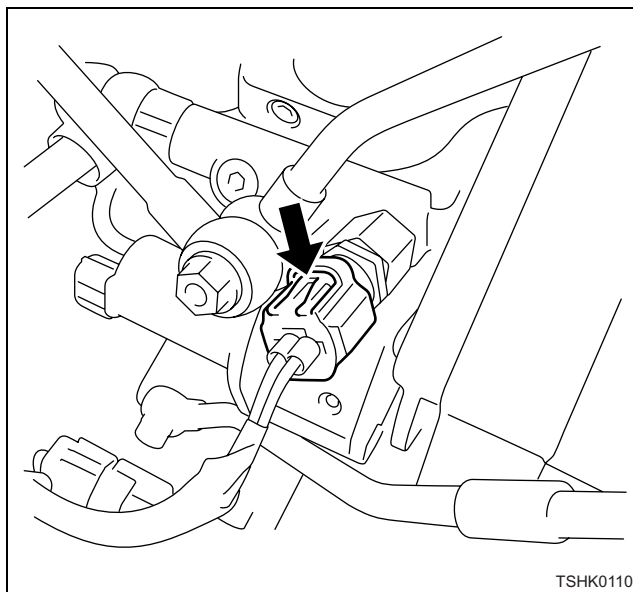
6HK1



The fuel temperature (FT) sensor is installed onto the supply pump, and the thermistor changes the resistance according to the temperature. The resistance is low when the fuel temperature is high, and is high when the temperature is low. The engine control module (ECM) energizes the voltage (5 V) to the FT sensor through pull up resistance, and calculates fuel temperature based on change of voltage to use for various controls such as supply pump control etc. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

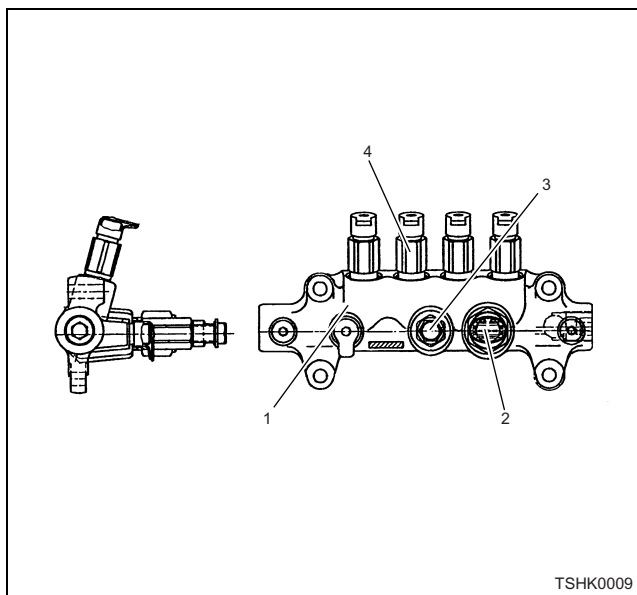
Removal

- Do not replace the FT sensor.
- If it is faulty, replace it as supply pump ASM.



Common rail

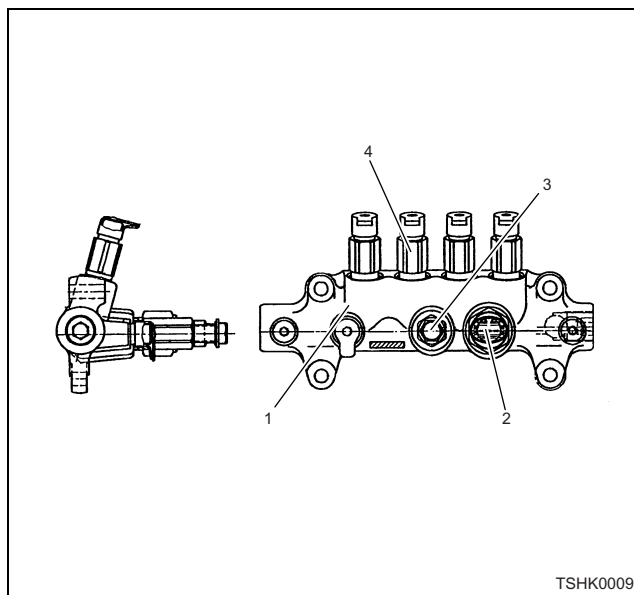
4HK1



TSHK0009

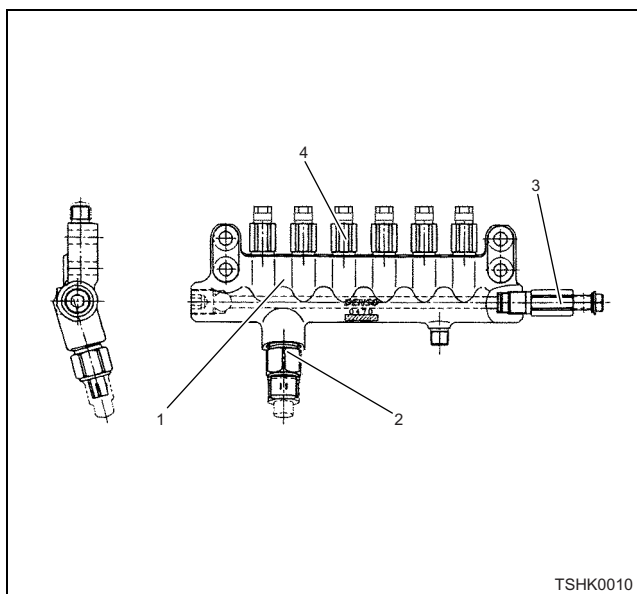
Flow damper

4HK1



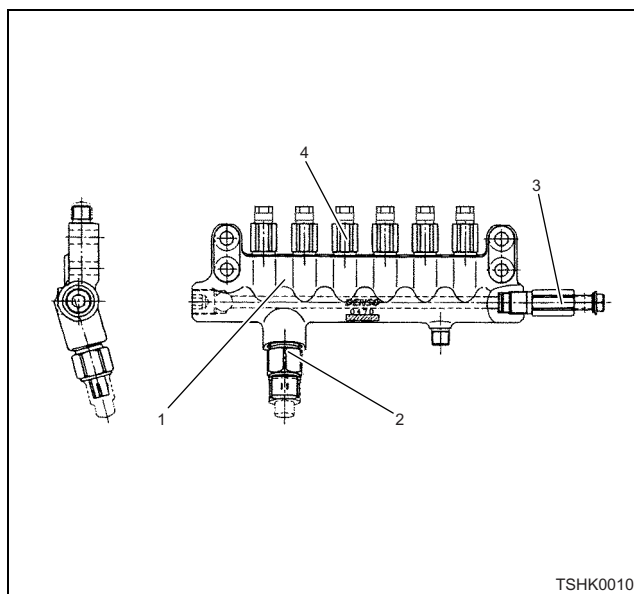
TSHK0009

6HK1



TSHK0010

6HK1



TSHK0010

Name

1. Common rail
2. Common rail pressure sensor
3. Pressure limiter
4. Flow damper

The common rail receives fuel from supply pump, holds the common rail (fuel) pressure and distributes fuel to each cylinder. The common rail has common rail pressure sensor, flow damper and pressure limiter.

Note:

For work procedure, refer to “Engine section” in the service manual.

Name

1. Common rail
2. Common rail pressure sensor
3. Pressure limiter
4. Flow damper

The flow damper is installed onto outlet port to each injector of common rail, limits pressure pulsation in common rail and prevents over-injected fuel from injector. When the flow damper operates, fuel supply to injector is stopped.

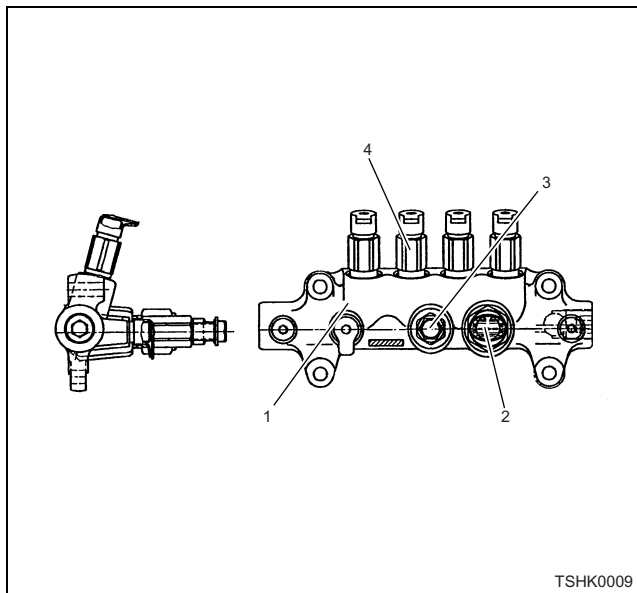
Removal

- Do not replace the flow damper.
- If it is damaged, replace it as common rail ASM.

10D-105 Electronic control fuel injection system (Common rail type)

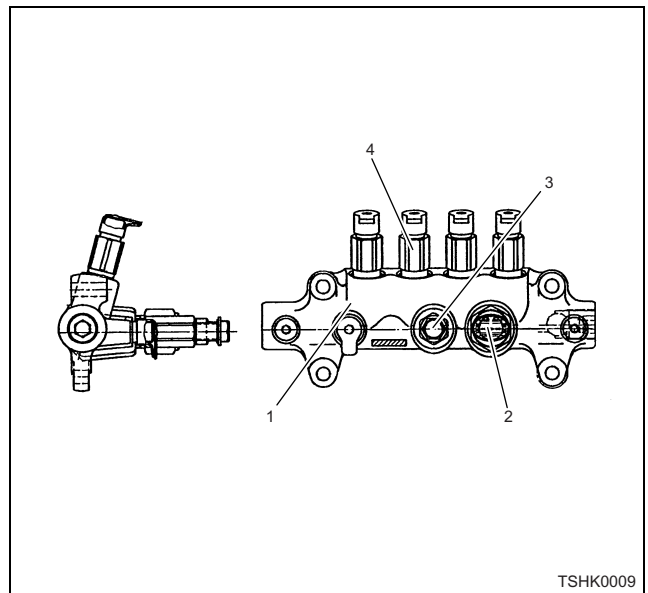
Pressure limiter

4HK1

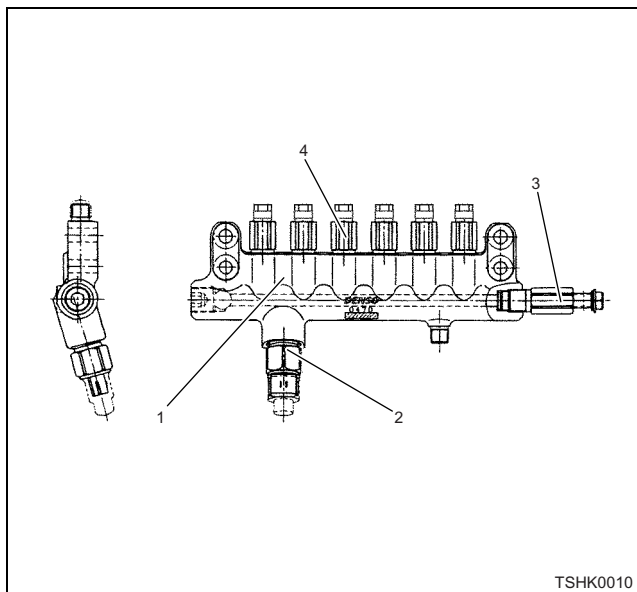


Common rail pressure sensor

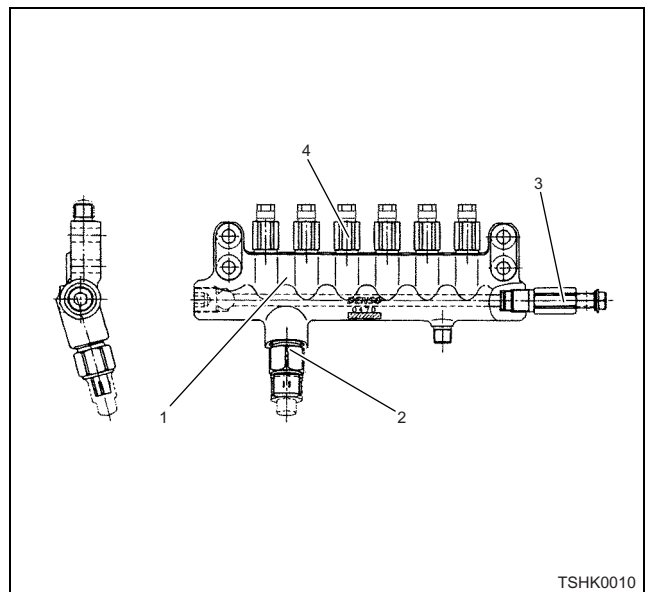
4HK1



6HK1



6HK1



Name

1. Common rail
2. Common rail pressure sensor
3. Pressure limiter
4. Flow damper

The pressure limiter operates to release the pressure in common rail when the pressure becomes extremely high.

Removal

- Do not replace the pressure limiter.
- If it is damaged, replace it as common rail ASM.

Name

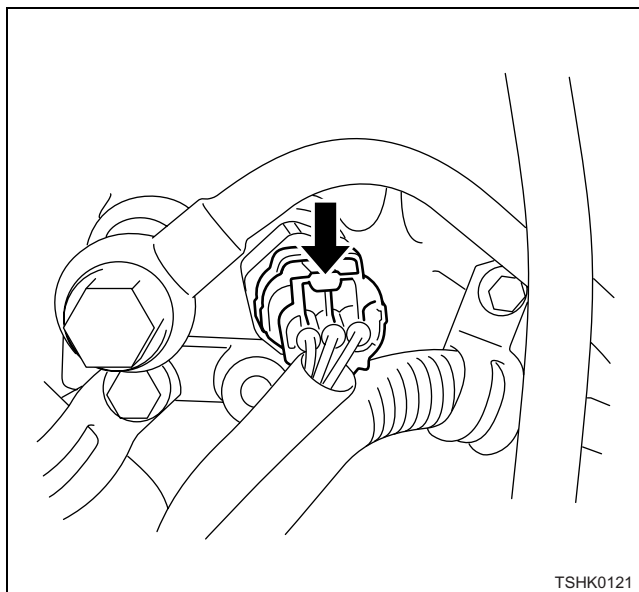
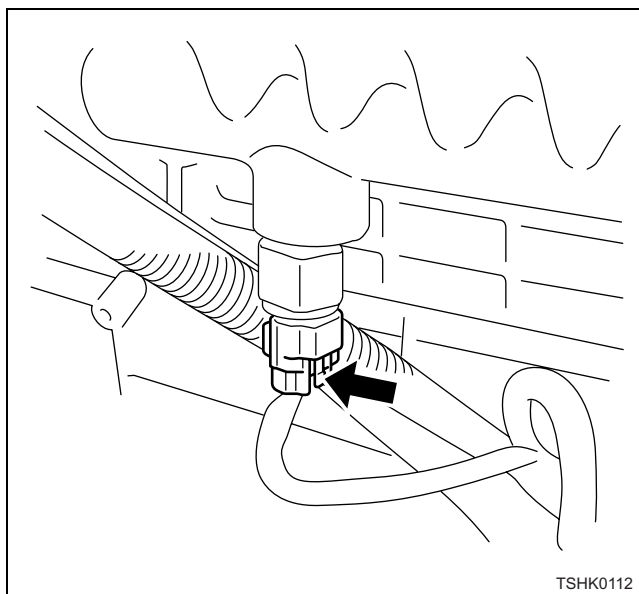
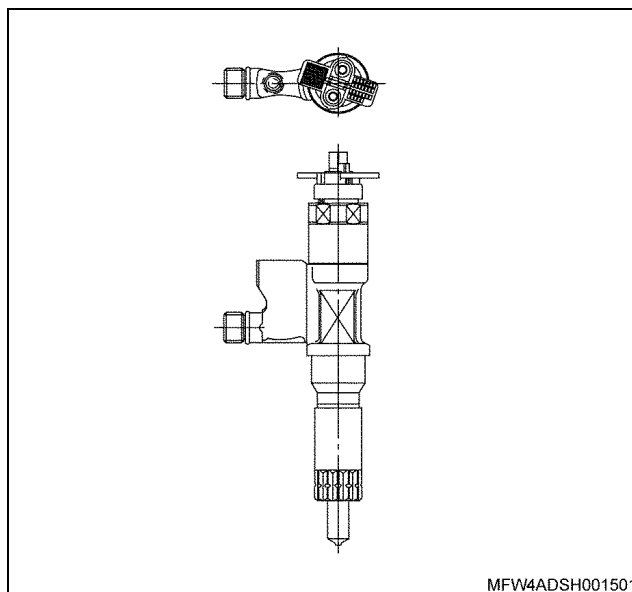
1. Common rail
2. Common rail pressure sensor
3. Pressure limiter
4. Flow damper

The common rail pressure sensor is installed onto common rail, detects fuel pressure in common rail, converts the pressure into the voltage signal and sends it to engine control module (ECM). Voltage becomes higher as pressure becomes higher, and lower as one does lower. ECM calculates the actual common rail pressure (fuel pressure) based on the voltage signal sent from sensors and uses it for fuel injection control etc.

Removal

- Do not replace the common rail pressure sensor.

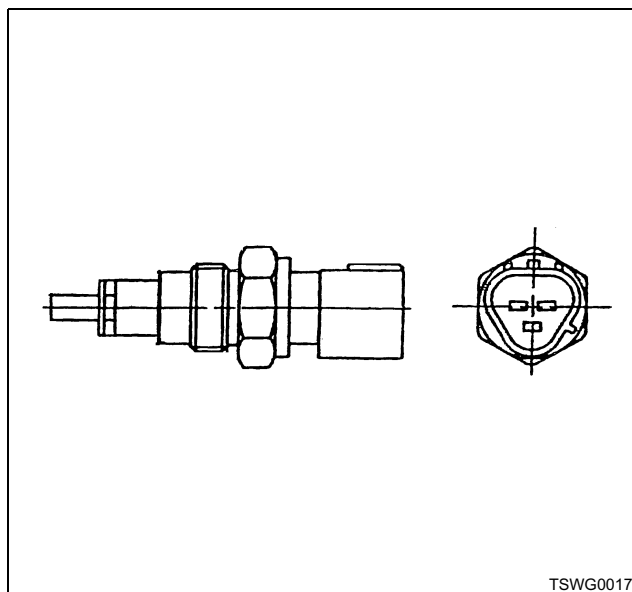
- If it is damaged, replace it as common rail ASM.

4HK1**6HK1****Injector**

The injector is installed onto cylinder head section and is controlled by engine control module (ECM) to inject fuel. The ECM raises the voltage for operating injectors internally, energizes to injector, and regulates period of electric conduction of injector to control fuel injection amount and injection timing.

Note:

For work procedure, refer to “Engine section” in the service manual.

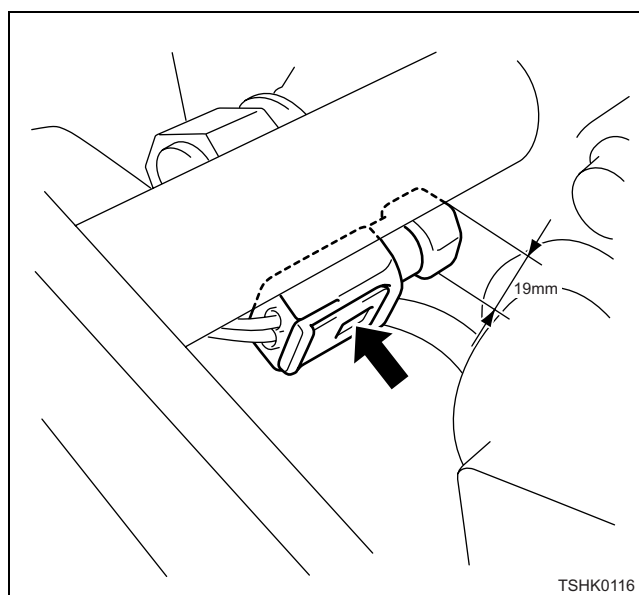
Engine coolant temperature (ECT) sensor

10D-107 Electronic control fuel injection system (Common rail type)

The engine coolant temperature (ECT) sensor is installed onto engine block, and the thermistor changes the resistance according to the temperature. Resistance is low at high engine coolant temperature and high at low engine coolant temperature. The engine control module (ECM) energizes the voltage (5 V) to the ECT sensor through pull up resistance, and calculates engine coolant temperature based on change of voltage to use for various controls such as fuel injection etc. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

Removal

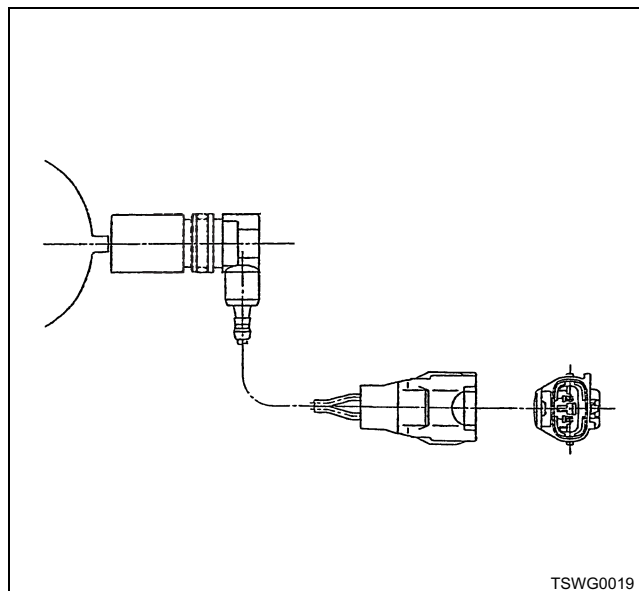
- Disconnect the connector and remove it with 19mm-wrench



Installation

- Apply Loctite 572 before installing it.
Tightening torque: 19.6 — 29.4 N·m {2 — 3 kgf·m}

Crankshaft position (CKP) sensor

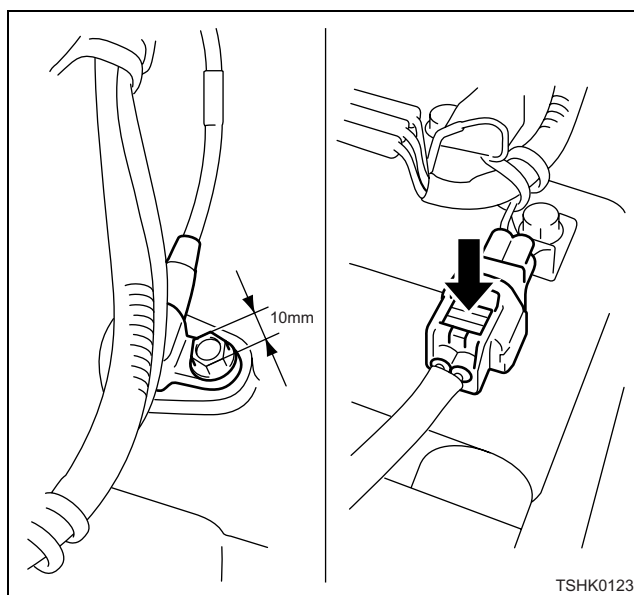


The crankshaft position (CKP) sensor is installed onto flywheel housing and produces the CKP signal when the convex portion of flywheel passes the sensor. The engine control module (ECM) distinguishes the cylinders by the CMP signal input from CMP sensor, determines the crank angle and uses it to control fuel injection and calculate the engine speed. These controls are performed, usually based on CKP signal. However it is done by CMP sensor if the CKP sensor is faulty.

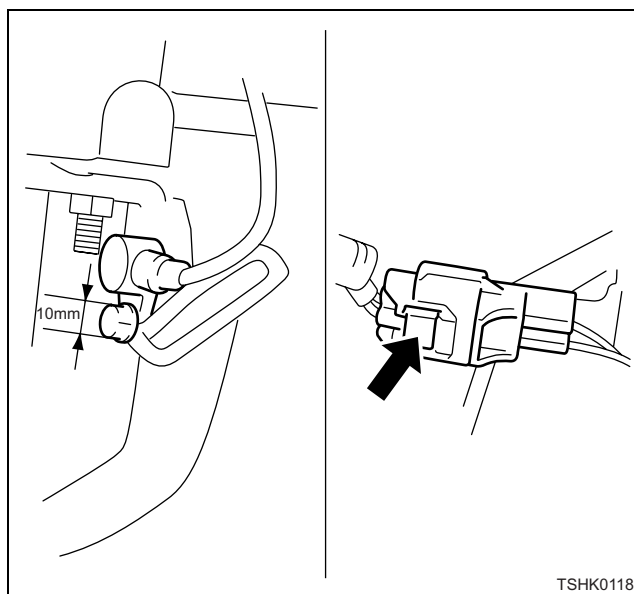
Removal

- Disconnect the connector, and remove the 10mm-mounting bolt and sensor.

4HK1

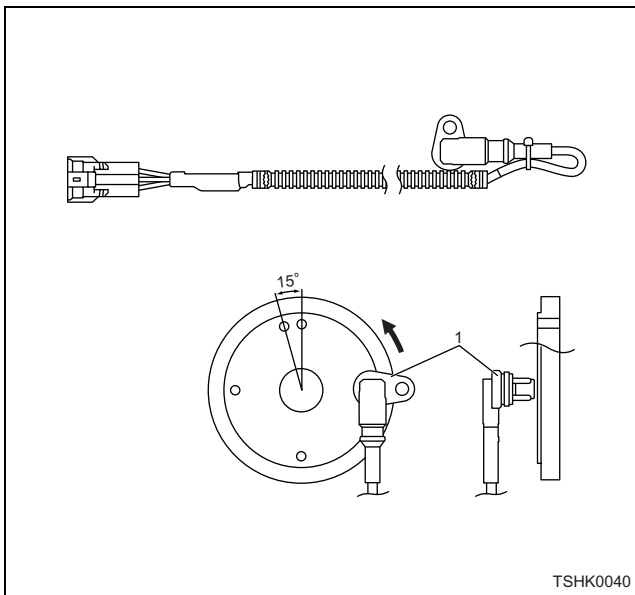
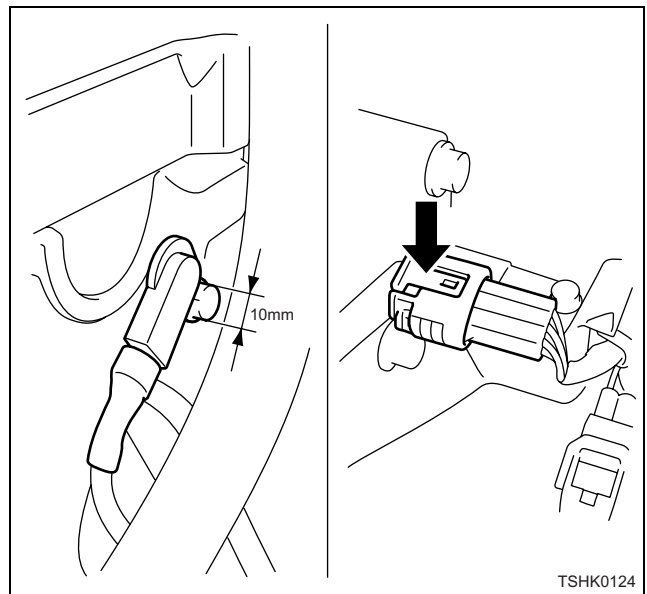
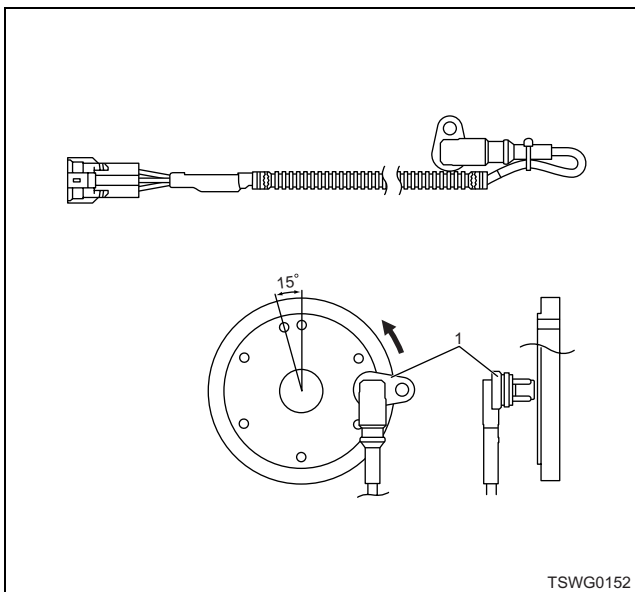
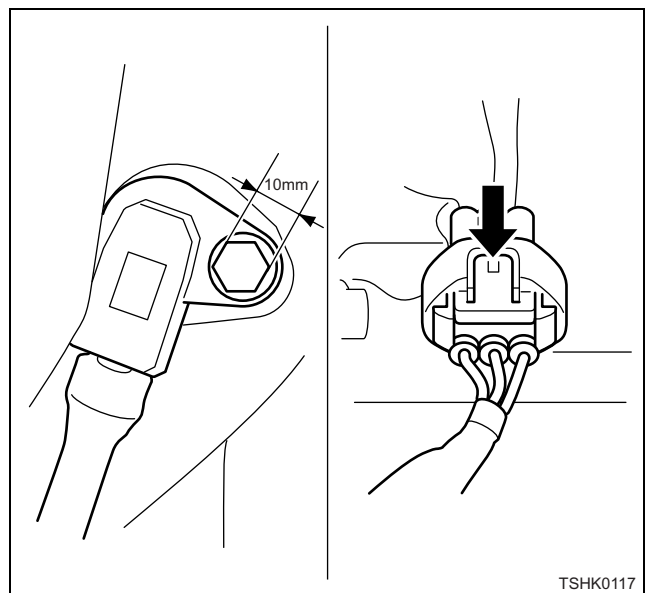


6HK1



Installation

- Tightening torque: 14.7 — 24.5 N·m {1.5 — 2.5 kgf·m}

Camshaft position (CMP) sensor**4HK1****4HK1****6HK1****6HK1**

The camshaft position sensor is installed onto the rear of cylinder head and produces the CMP signal when the cam portion of camshaft passes the sensor. The engine control module (ECM) distinguishes the cylinders by the CMP signal input from CMP sensor, determines the crank angle and uses it to control fuel injection and calculate the engine speed. These controls are performed, usually based on CKP signal. However it is done by CMP sensor if the CKP sensor is faulty.

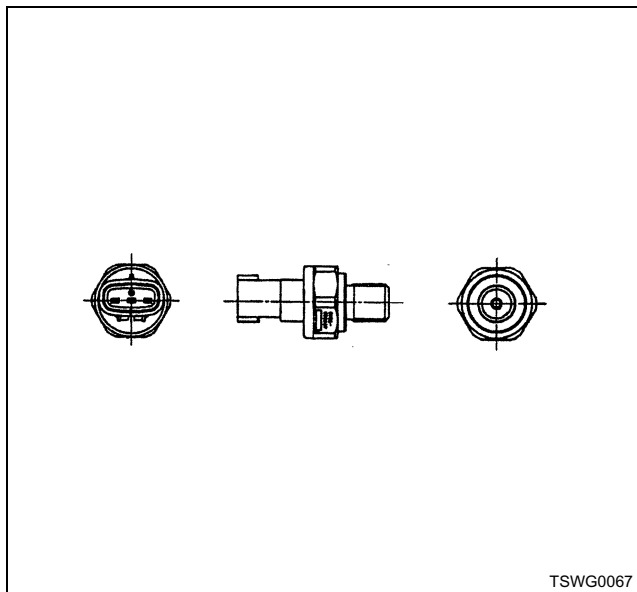
Removal

- Scissors gear is installed to the cam gear of 6HK1 engine. When the cam gear has been removed, ensure that the scissors gear is installed properly.
- Disconnect the connector, and remove the 10mm-mounting bolt and sensor.

Installation

- Apply a coat of engine oil to the O-ring.
Tightening torque: $7.8 \pm 2 \text{ N} \cdot \text{m}$ $\{0.8 \pm 0.2 \text{ kgf} \cdot \text{m}\}$

Engine oil pressure sensor

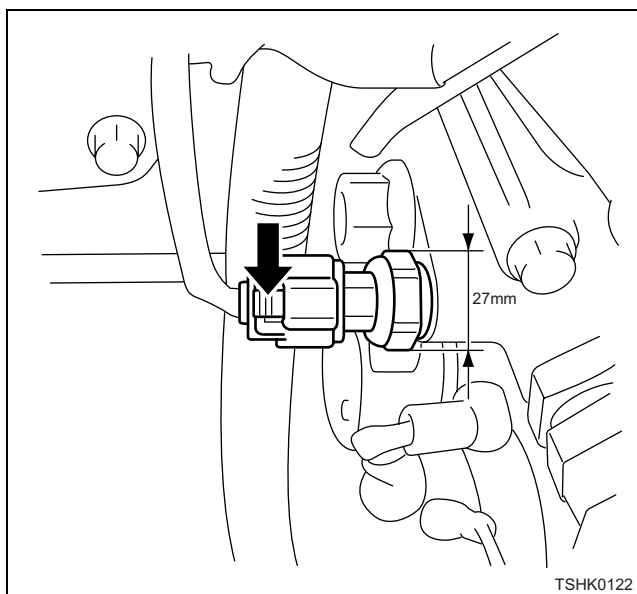


The engine oil pressure sensor is installed near the starter motor of the cylinder block; it detects engine oil pressure, converts the pressure into the voltage signal and sends it to engine control module (ECM). Voltage becomes higher as pressure becomes higher, and lower as one does lower.

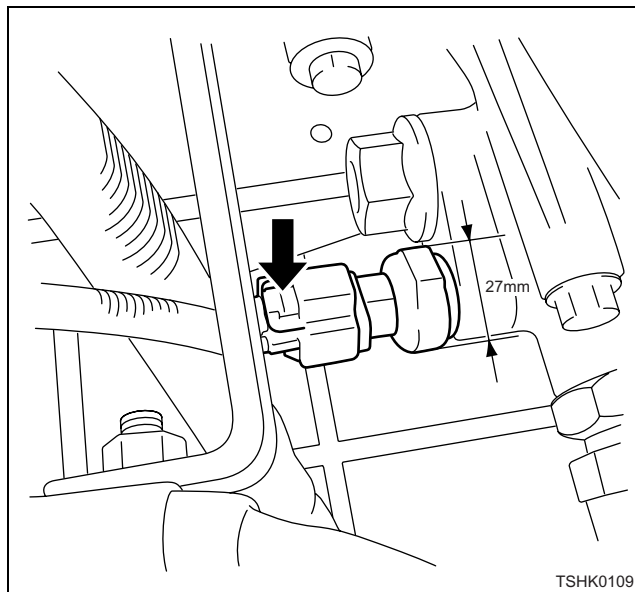
Removal

- Disconnect the connector and remove it with 27mm-wrench

4HK1



6HK1



Installation

- Tightening torque: 41 N·m {4.2 kgf·m}

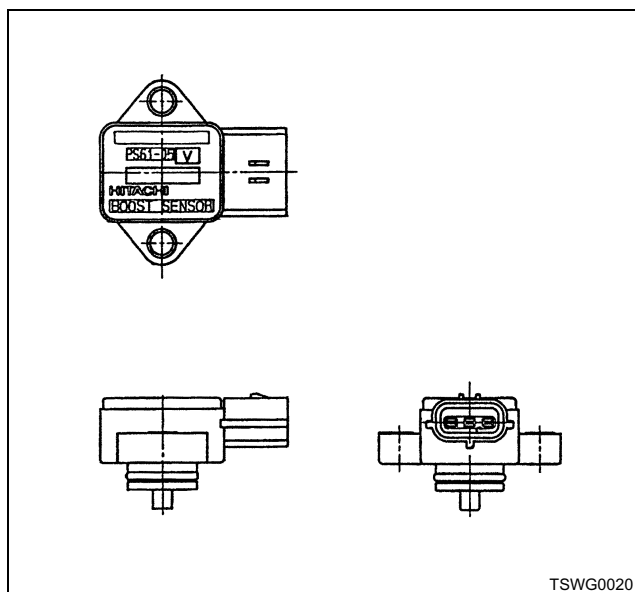
Accelerator position (AP) sensor

The accelerator position (AP) sensor is installed onto machine console panel and supplies the voltage signal, which changes according to the accelerator volume angle, to engine control module (ECM). The ECM calculates accelerator position by voltage signal and use it for various controls such as fuel injection amount control.

Note:

Refer to the machine's manual for the location of accelerator position sensor.

Barometric pressure sensor

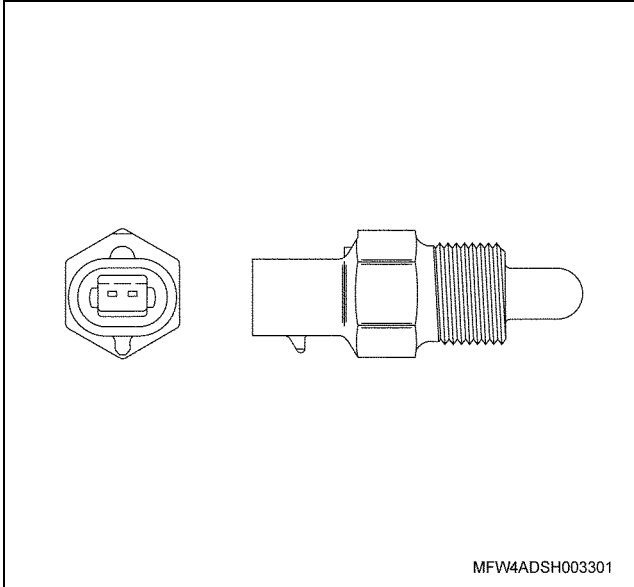


The barometric pressure sensor is installed onto the machine side and converts the barometric pressure into voltage signal. The ECM calculates barometric pressure by voltage signal and performs fuel injection amount correction (high-altitude correction) etc. by barometric pressure.

Note:

Refer to the machine's manual for the location of barometric pressure sensor.

Intake air temperature (IAT) sensor



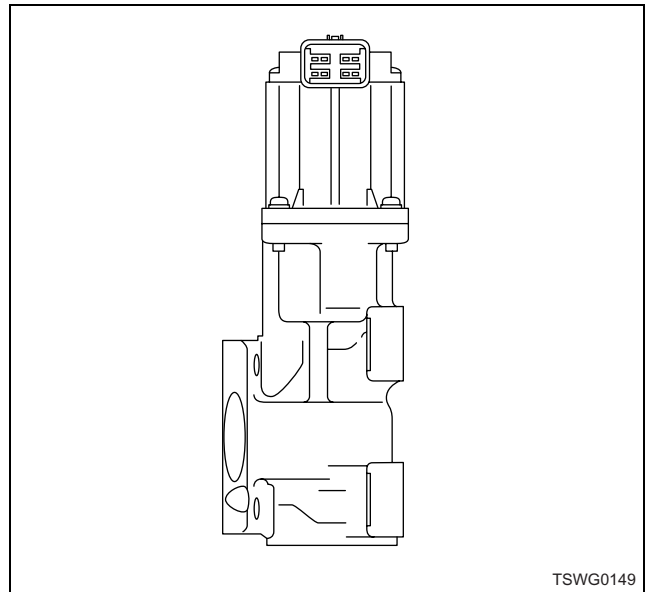
The intake air temperature (IAT) sensor is installed onto the machine side and detects the temperature of intake air for optimum fuel injection control.

Tightening torque: 10.8 — 16.3N·m {1.1 — 1.7 kgf·m}

Note:

Refer to the machine's manual for the location of intake air temperature (IAT) sensor.

EGR position sensor



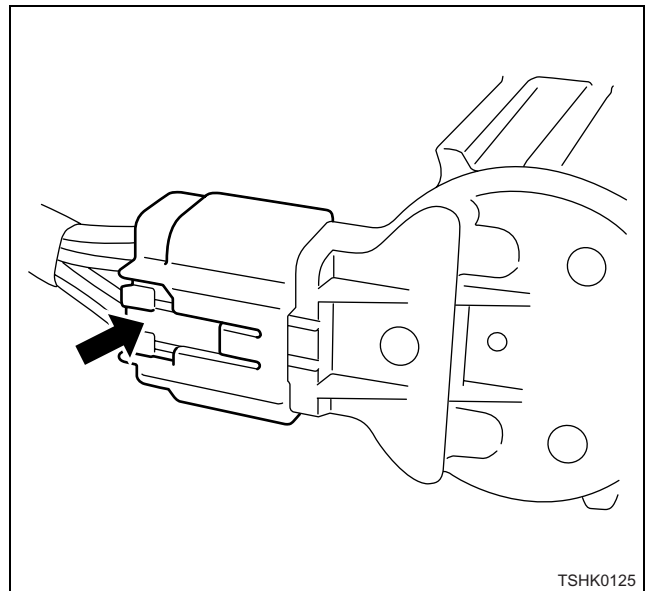
It is installed in EGR valve and detects the valve lift amount of EGR.

Note:

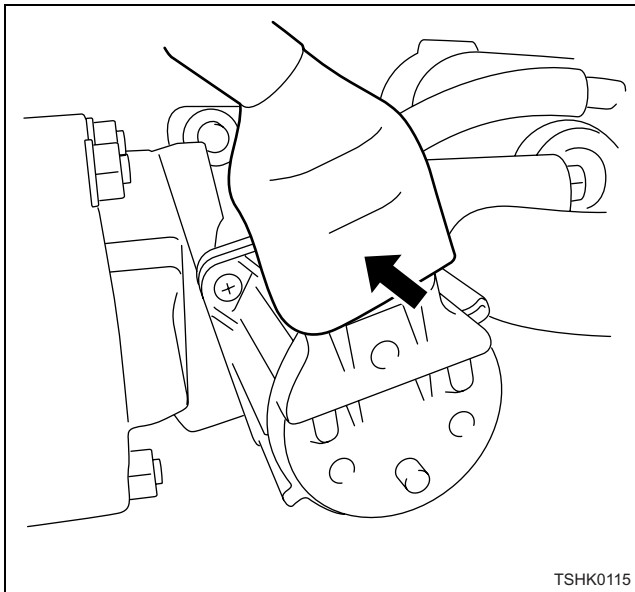
Do not disassemble the EGR position sensor. If it is faulty, replace it as EGR valve ASM.

Removal

4HK1

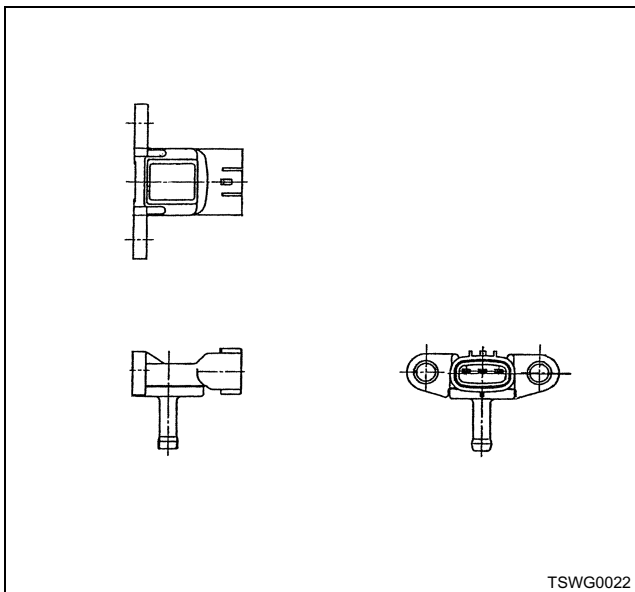


6HK1



Installation

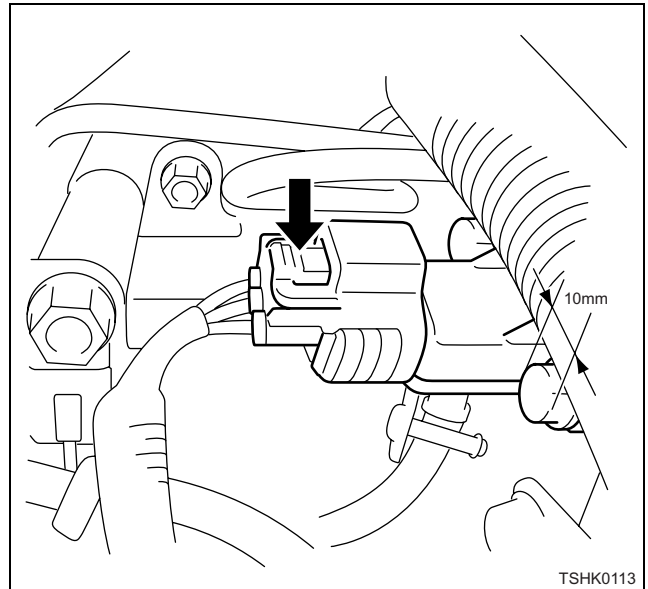
Boost pressure sensor



The boost pressure sensor uses the pressure hose between the boost pressure sensor and intake pipe, detects boost (intake air pressure), converts the pressure into the voltage signal and sends it to engine control module (ECM). Voltage becomes higher as pressure becomes higher, and lower as one does lower. ECM calculates the boost (intake air pressure) based on the voltage signal sent from sensors and uses it for fuel injection control etc.

Removal

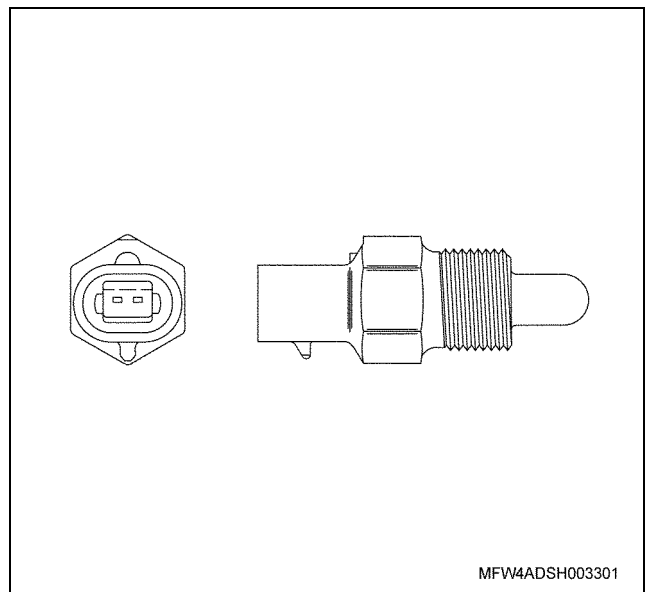
- Disconnect the connector, and remove the two 10mm-mounting bolts, hoses and sensor.



Installation

- Tightening torque: 4 — 6 N·m {0.4 — 0.6 kgf·m}

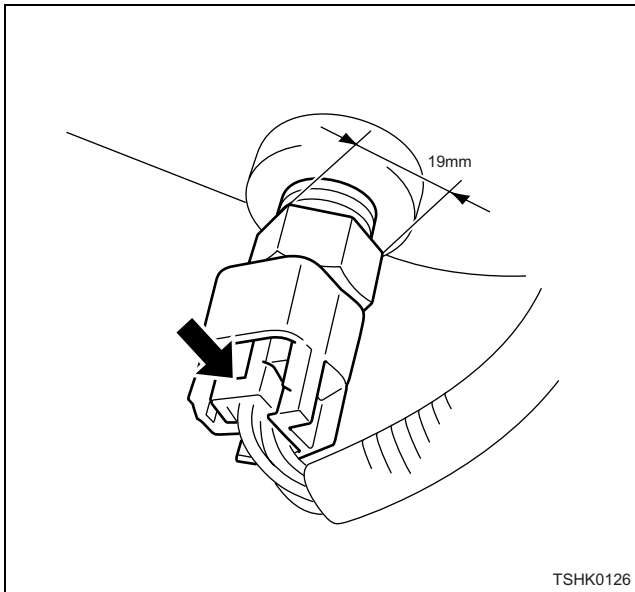
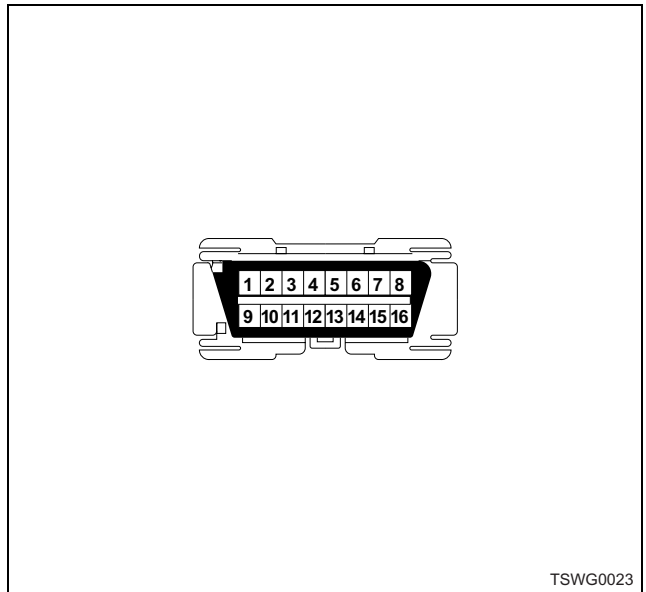
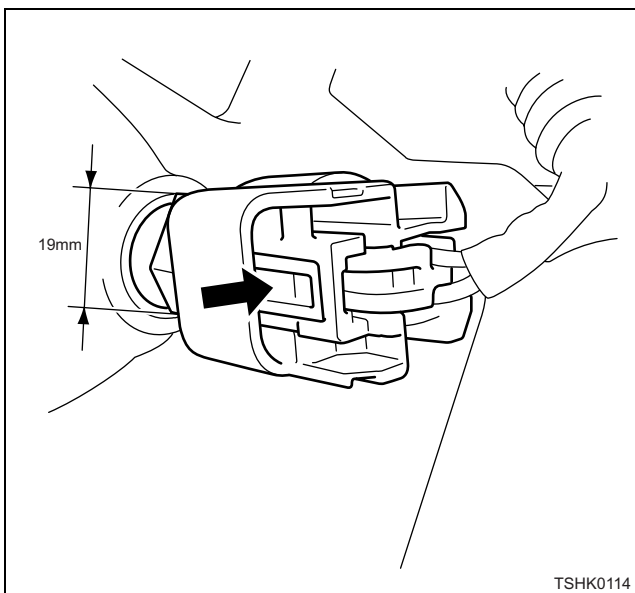
Boost temperature sensor



The boost temperature sensor is installed onto the EGR valve upstream side of intake manifold. The sensor is thermistor type. The resistance in the sensor changes as the temperature changes.

Removal

- Disconnect the connector and remove it with 19mm-wrench

4HK1**DLC (data link connector)****6HK1**

The DLC (data link connector) is a connector for communication and connection between the external diagnostic device (scan tool) and each controller.

Note:

Refer to the machine's manual for the locations of DLC.

Diagnostic switch

The diagnosis switch shorts the DLC terminals No. 1 and No. 4 (or No. 5) to make the diagnosis lamp blink to indicate DTC.

Note:

Refer to the machine's manual for the locations and form of diagnosis switch.

Memory clear switch

The diagnosis switch and memory clear switch are used to clear the DTC stored in ECM.

Note:

Refer to the machine's manual for the locations of memory clear switch.

Mode selector switch (1, 2, 3)

The mode selector switch allows to operate at the engine speed set by each mode.

Note:

Refer to the machine's manual for the locations of mode selector switch.

Installation

- Tightening torque: 10.8 — 16.3N·m {1.1 — 1.7 kgf·m}

Diagnosis lamp

It indicates DTC by blinking after the diagnosis switch is turned to ON.

Note:

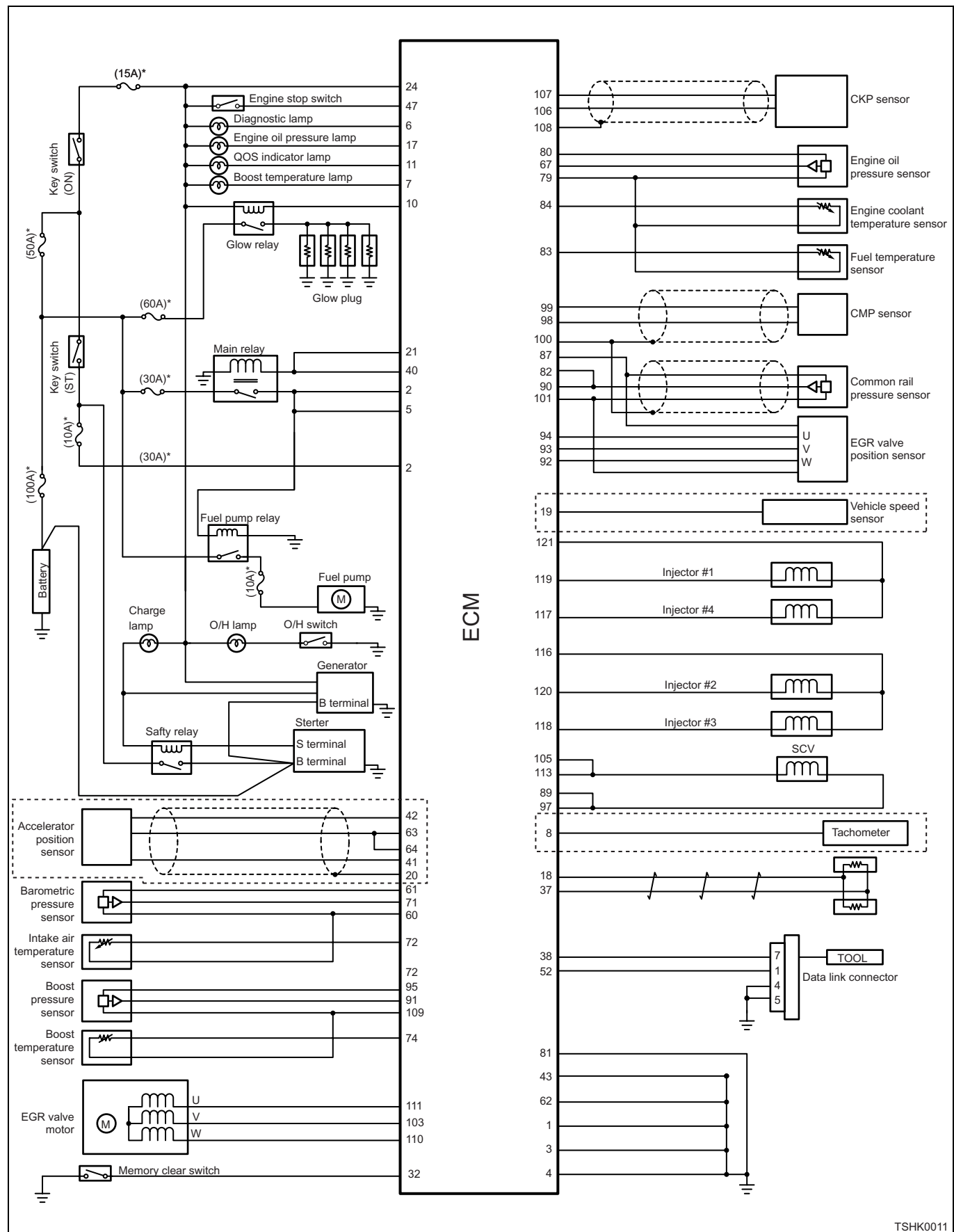
Refer to the machine's manual for the locations of diagnosis lamp.

10D-113 Electronic control fuel injection system (Common rail type)

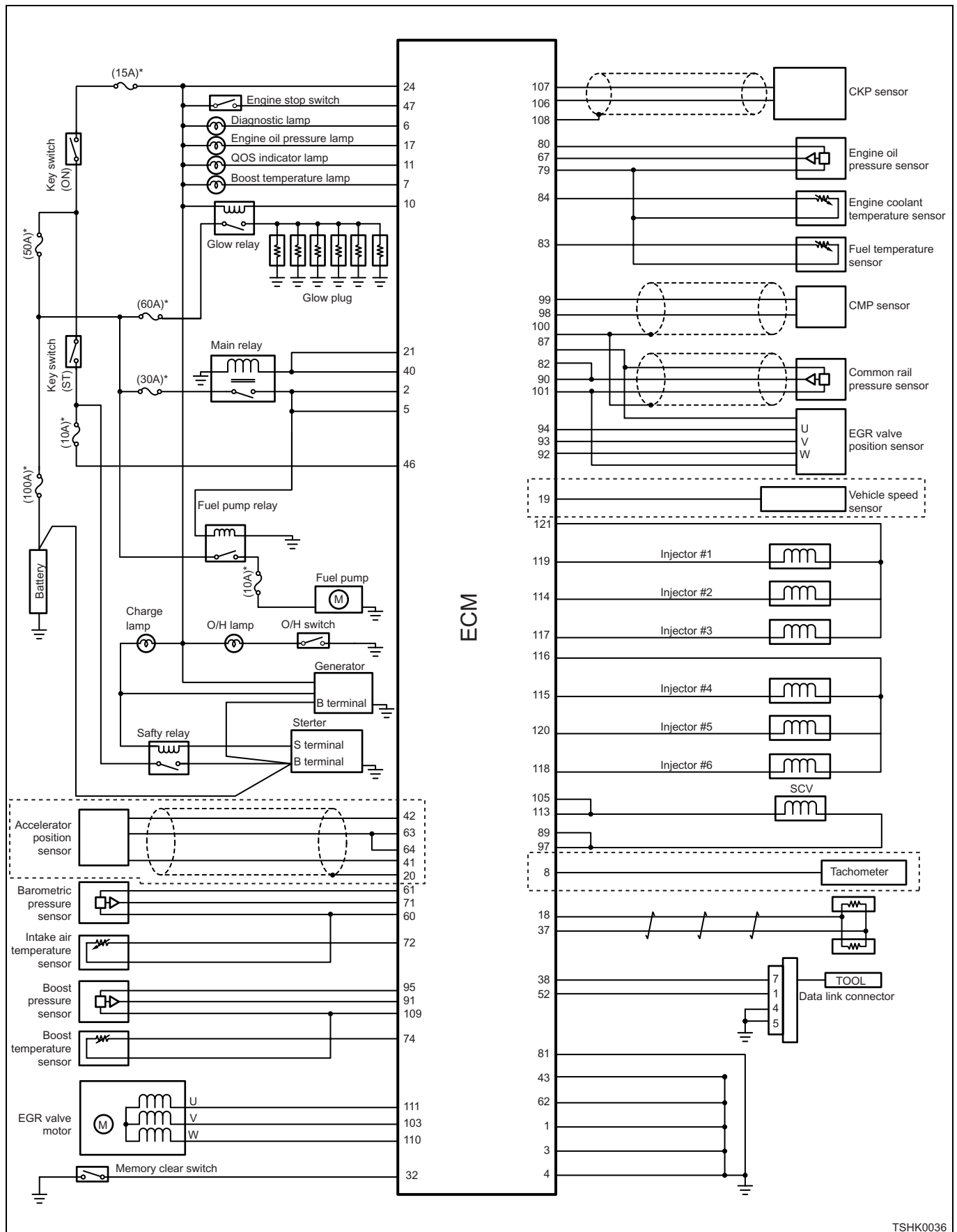
Wiring diagram of engine control module (ECM)

(*: Refer to the machine's manual for fuse capacity.)

4HK1



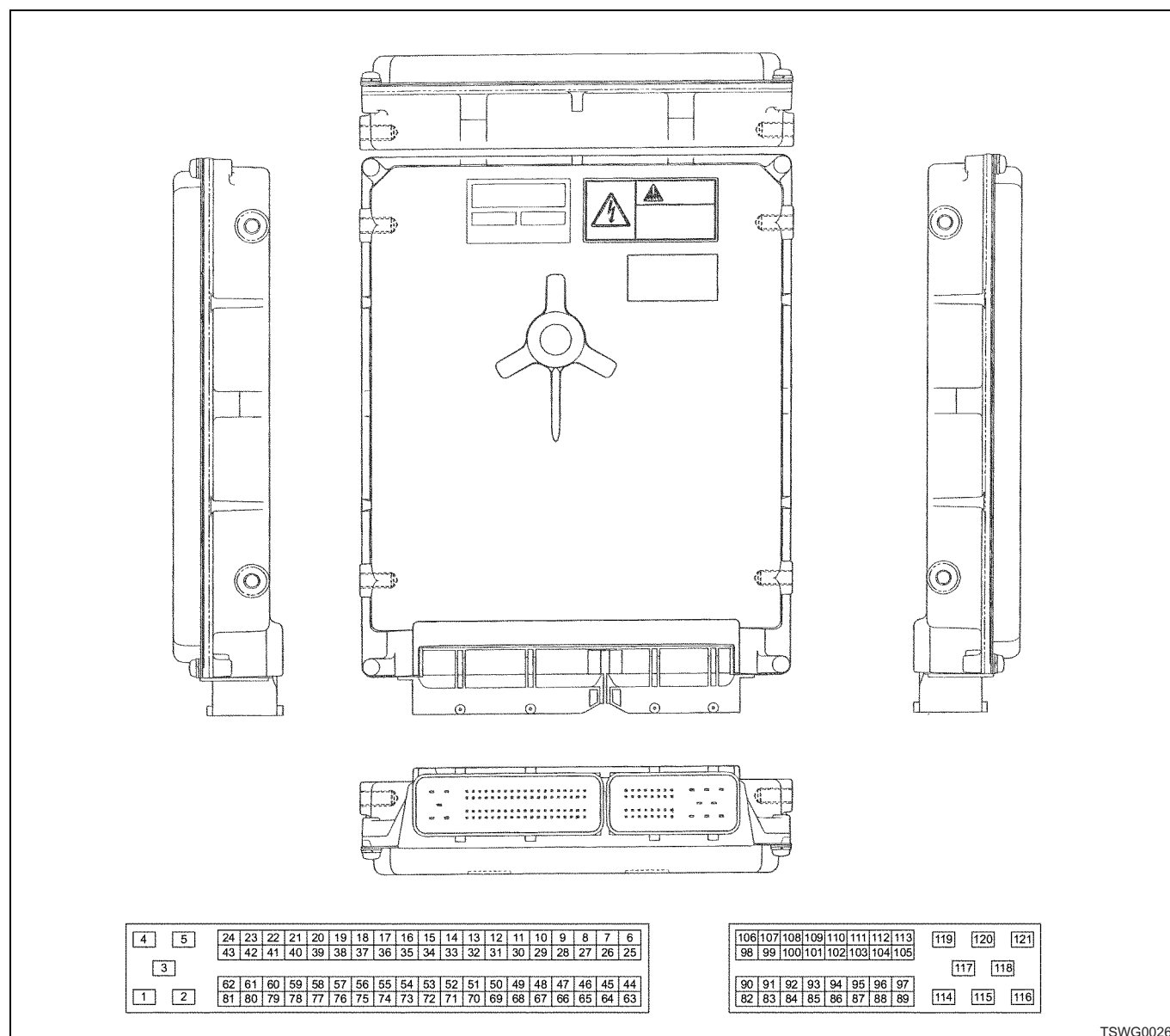
6HK1



TSHK0036

10D-115 Electronic control fuel injection system (Common rail type)

Pin arrangement of engine control module (ECM)



TSWG0026

81-pin connector

Pin No.	Terminal name	Connection
1	PG-POWER	GND
2	PS-+B	Power supply
3	PG-POWER	GND
4	PG-POWER	GND
5	PS-+B	Power supply
6	OS-DIAGL	Diagnosis lamp
7	OS-BOOSTL	Boost temperature sensor pilot lamp
8	—	—
9	—	—
10	OS-GLOWR	Glow relay
11	OS-GLOWL	QOS indicator lamp

Electronic control fuel injection system (Common rail type) 10D-116

Pin No.	Terminal name	Connection
12	—	—
13	—	—
14	—	—
15	—	—
16	—	—
17	OS-OILPL	Engine oil pressure lamp
18	CC-CAN-H	CAN-HIGH
19	IF-SPD	Vehicle speed sensor signal
20	SG-SLD1	Accelerator position sensor 1 GND
21	OS-MAINR	ECM main relay
22	—	—
23	—	—
24	IS-IGKEY	Key switch ON signal
25	—	—
26	—	—
27	—	—
28	—	—
29	—	—
30	—	—
31	—	—
32	IS-MEMCL	Memory clear switch
33	—	—
34	—	—
35	—	—
36	—	—
37	CC-CAN-L	CAN-LOW
38	CC-KW2000	Data link connector
39	—	—
40	OS-MAINR	ECM main relay
41	SG-5VRT1	Accelerator position (AP) sensor GND
42	SP-5V1	Accelerator position (AP) sensor power supply
43	PG-SIGN	GND
44	—	—
45	—	—
46	IS-START	Key switch start signal
47	ENGSTP	Engine stop switch
48	—	—
49	—	—
50	—	—

10D-117 Electronic control fuel injection system (Common rail type)

Pin No.	Terminal name	Connection
51	—	—
52	IS-DIAG	Diagnostic switch
53	—	—
54	—	—
55	—	—
56	—	—
57	—	—
58	—	—
59	—	—
60	SG-5VRT2	Barometric pressure sensor, intake air temperature (IAT) sensor GND
61	SP-5V2	Barometric pressure sensor power supply
62	PG-SIGN	GND
63	IA-ACCEL1	Accelerator position (AP) sensor 1 signal
64	IA-ACCEL2	Accelerator position (AP) sensor 2 signal
65	—	—
66	—	—
67	IA-OILPRESS	Engine oil pressure sensor signal
68	—	—
69	—	—
70	—	—
71	IA-BARO	Barometric pressure sensor signal
72	IA-IAT	Intake air temperature sensor signal
73	—	—
74	IA-THBST	Boost temperature signal
75	—	—
76	—	—
77	—	—
78	—	—
79	SG-5VRT3	Engine oil pressure sensor, fuel temperature sensor, engine coolant temperature sensor GND
80	SP-5V3	Engine oil pressure sensor power supply
81	PG-CASE	GND

40-pin connector

Pin No.	Terminal name	Connection
82	IA-PFUEL	Common rail pressure sensor signal
83	IA-THL	Fuel temperature sensor signal
84	IA-THW	Engine coolant temperature sensor signal
85	—	—

Electronic control fuel injection system (Common rail type) 10D-118

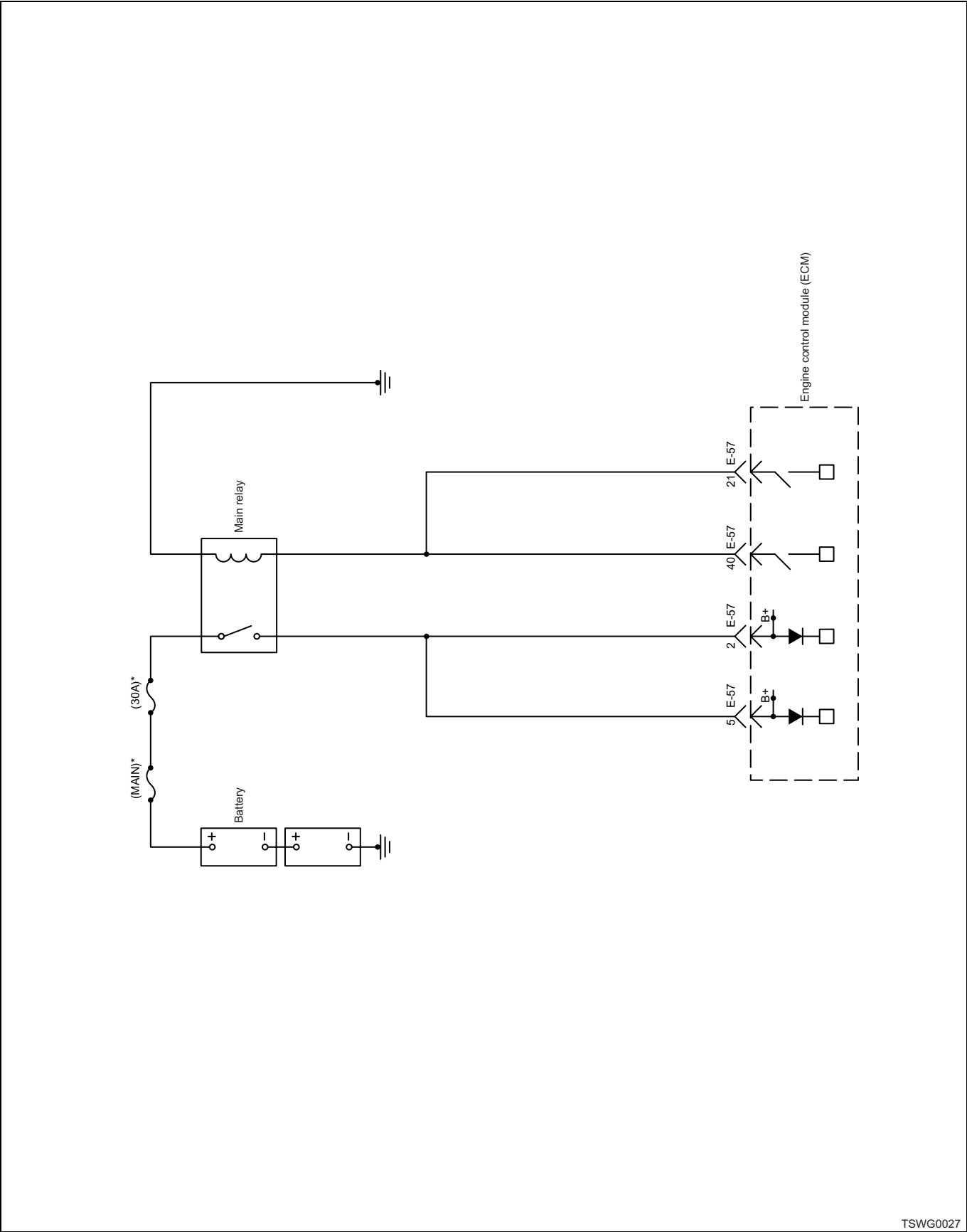
Pin No.	Terminal name	Connection
86	—	—
87	SP-5V5	Camshaft position (CMP) sensor power supply
88	—	—
89	IA-SCVLO	PCVLO drive
90	IA-PFUEL	Common rail pressure sensor signal
91	IA-BPRESS	Boost pressure sensor signal
92	IA-EBMPOS3	EGR valve EGR position sensor W
93	IA-EBMPOS2	EGR valve EGR position sensor V
94	IA-EBMPOS1	EGR valve EGR position sensor U
95	SP-5V4	Boost pressure sensor power supply
96	—	—
97	IA-SCVLO	PCVLO drive
98	IF-CAMHAL	Camshaft position (CMP) sensor signal
99	SP-CAMHAL	Camshaft position (CMP) sensor power supply
100	SG-SLD5	Camshaft position (CMP) sensor, common rail pressure sensor shield
101	SG-5VRT5	Common rail pressure sensor GND
102	—	—
103	OM-EBM2	EGR valve DC servomotor power supply input V
104	—	—
105	OS-SCVHI	SCVHI drive
106	IF-CRANK-	Crankshaft position (CKP) sensor (-)
107	IF-CRANK+	Crankshaft position (CKP) sensor (+)
108	SG-SLD4	Crankshaft position (CKP) sensor shield
109	SG-5VRT4	Boost pressure sensor, engine coolant temperature sensor, fuel temperature sensor GND
110	OM-EBM3	EGR valve DC servomotor power supply input W
111	OM-EBM1	EGR valve DC servomotor power supply input U
112	—	—
113	OS-SCVHI	SCVHI drive
114	OS-INJ5	Injector 5 (4H: —/6H: 2nd cylinder)
115	OS-INJ6	Injector 6 (4H: —/6H: 4th cylinder)
116	OP-COM2	Injector power supply 2 (4H: 3rd, 4th cylinders/6H: 4th, 5th, 6th cylinders)
117	OS-INJ3	Injector 3 (4H: 4th cylinder/6H: 3rd cylinder)
118	OS-INJ4	Injector 4 (4H: 2nd cylinder/6H: 6th cylinder)
119	OS-INJ1	Injector 1 (4H: 1st cylinder/6H: 1st cylinder)
120	OS-INJ2	Injector 2 (4H: 3rd cylinder/6H: 5th cylinder)
121	OP-COM1	Injector power supply 1 (4H: 1st, 2nd cylinders/6H: 1st, 2nd, 3rd cylinders)

Circuit diagram

(Refer to “Wiring diagrams” for a way to read the diagram.)

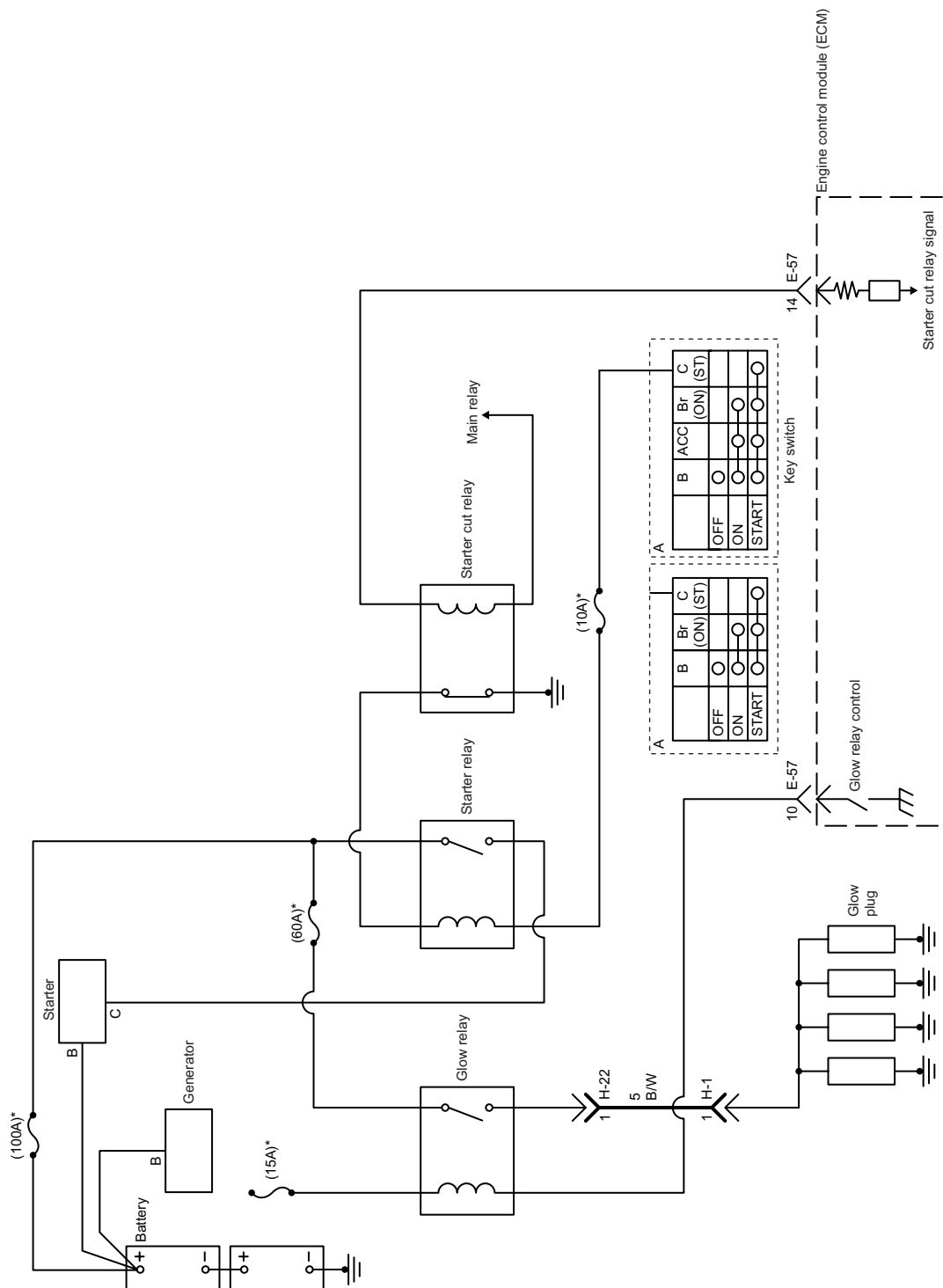
Main relay circuit

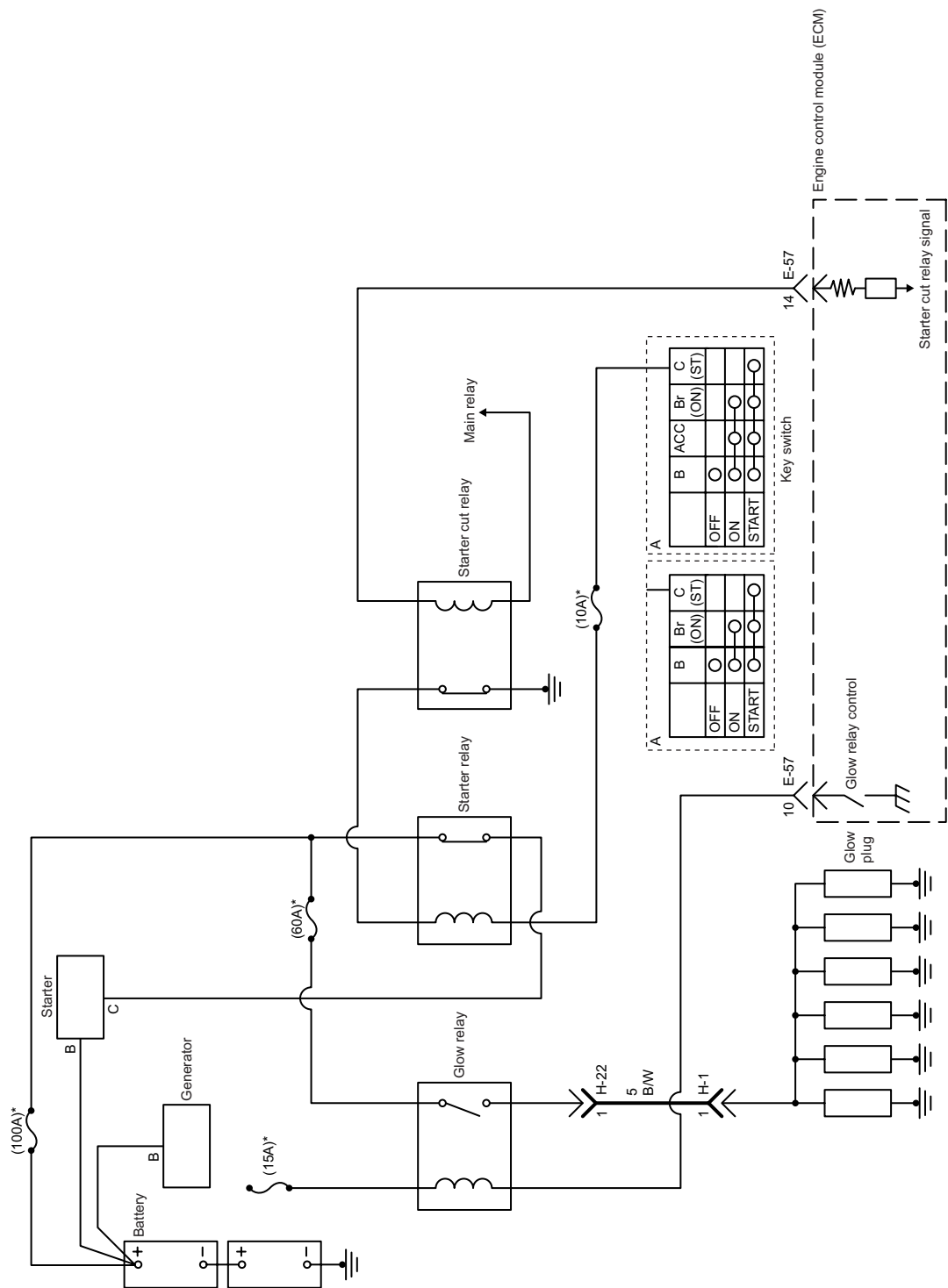
(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



Starter for ECM control, glow circuit

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)

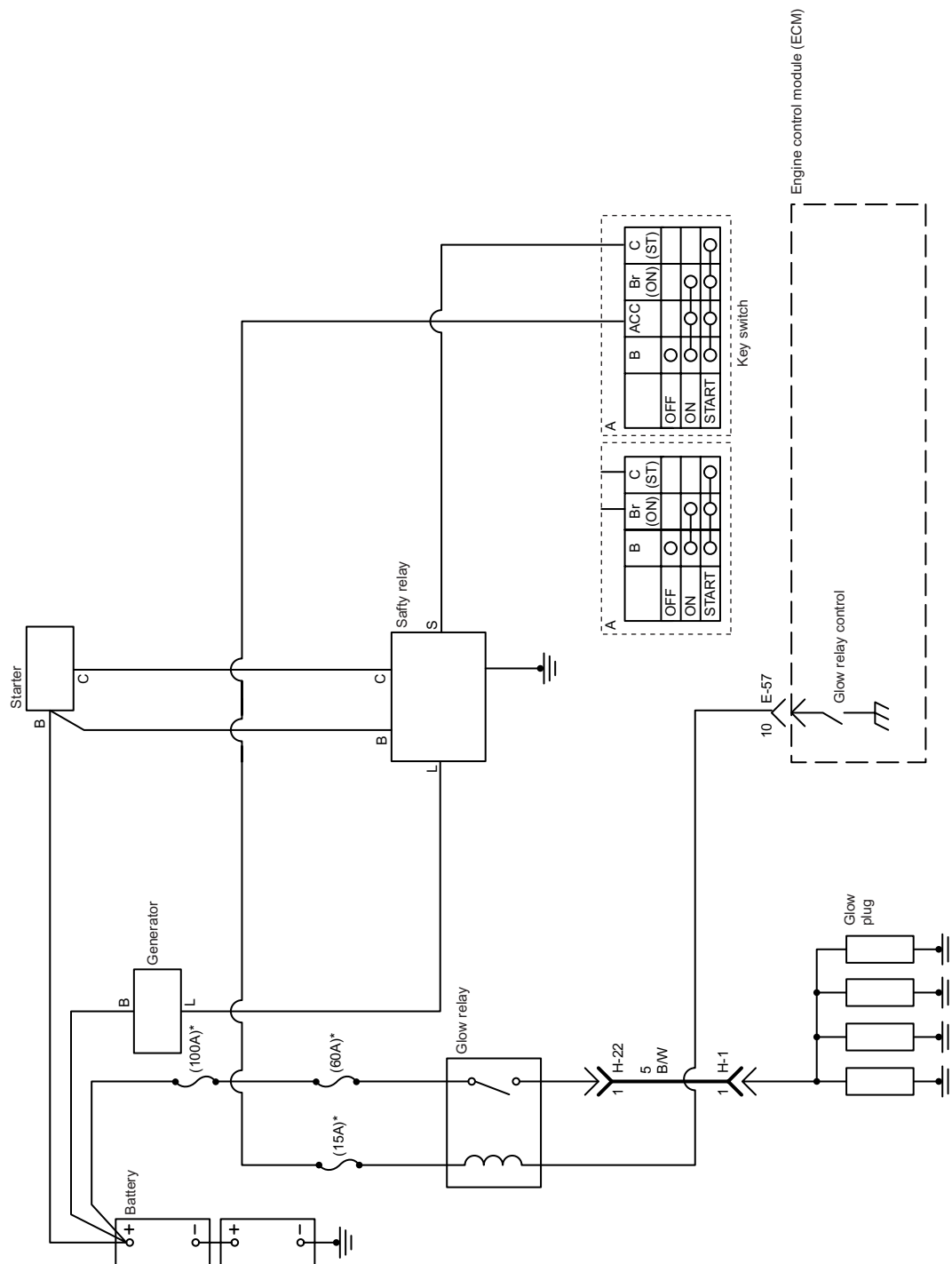
4HK1

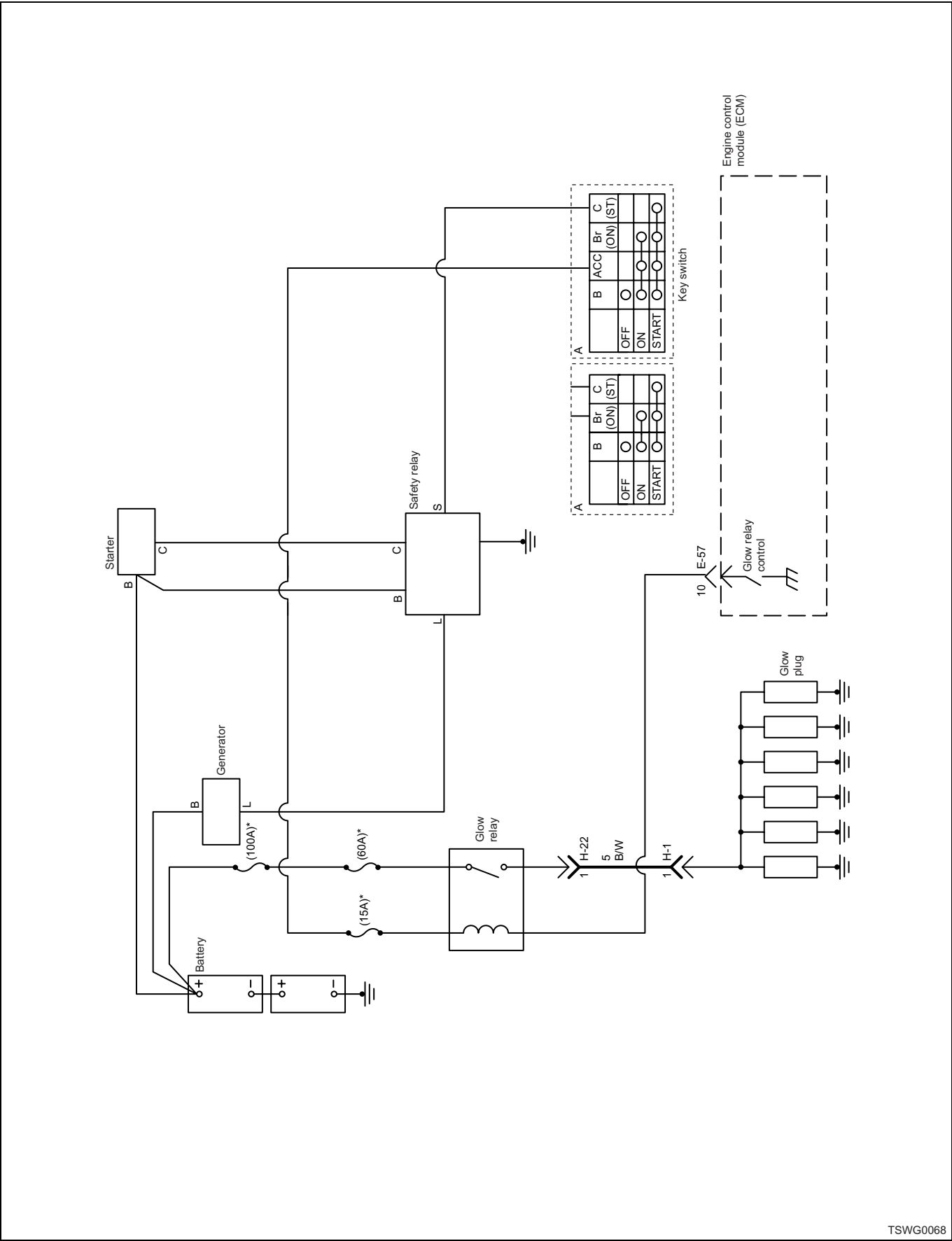


Starter for safety relay, glow circuit

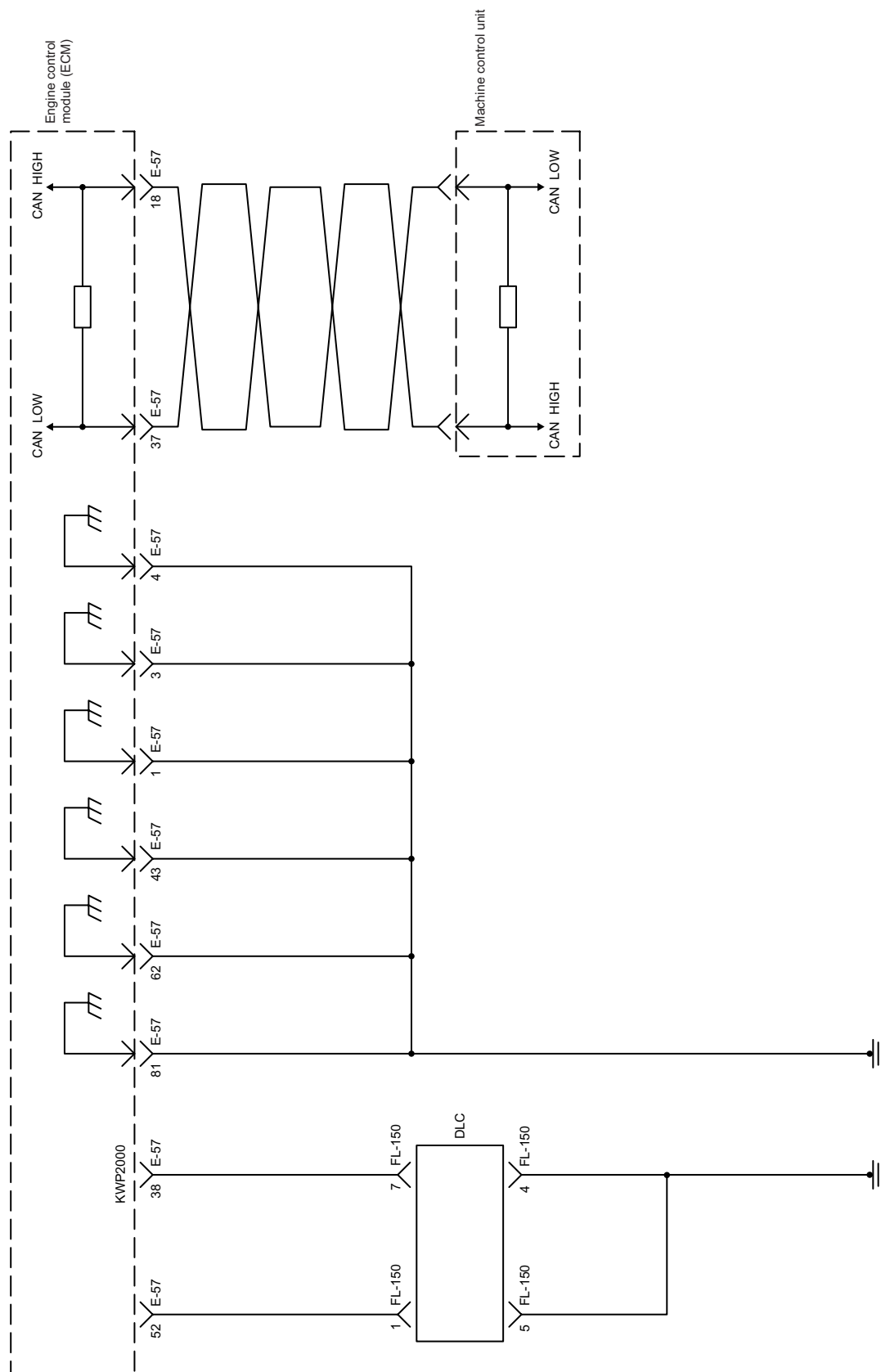
(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)

4HK1



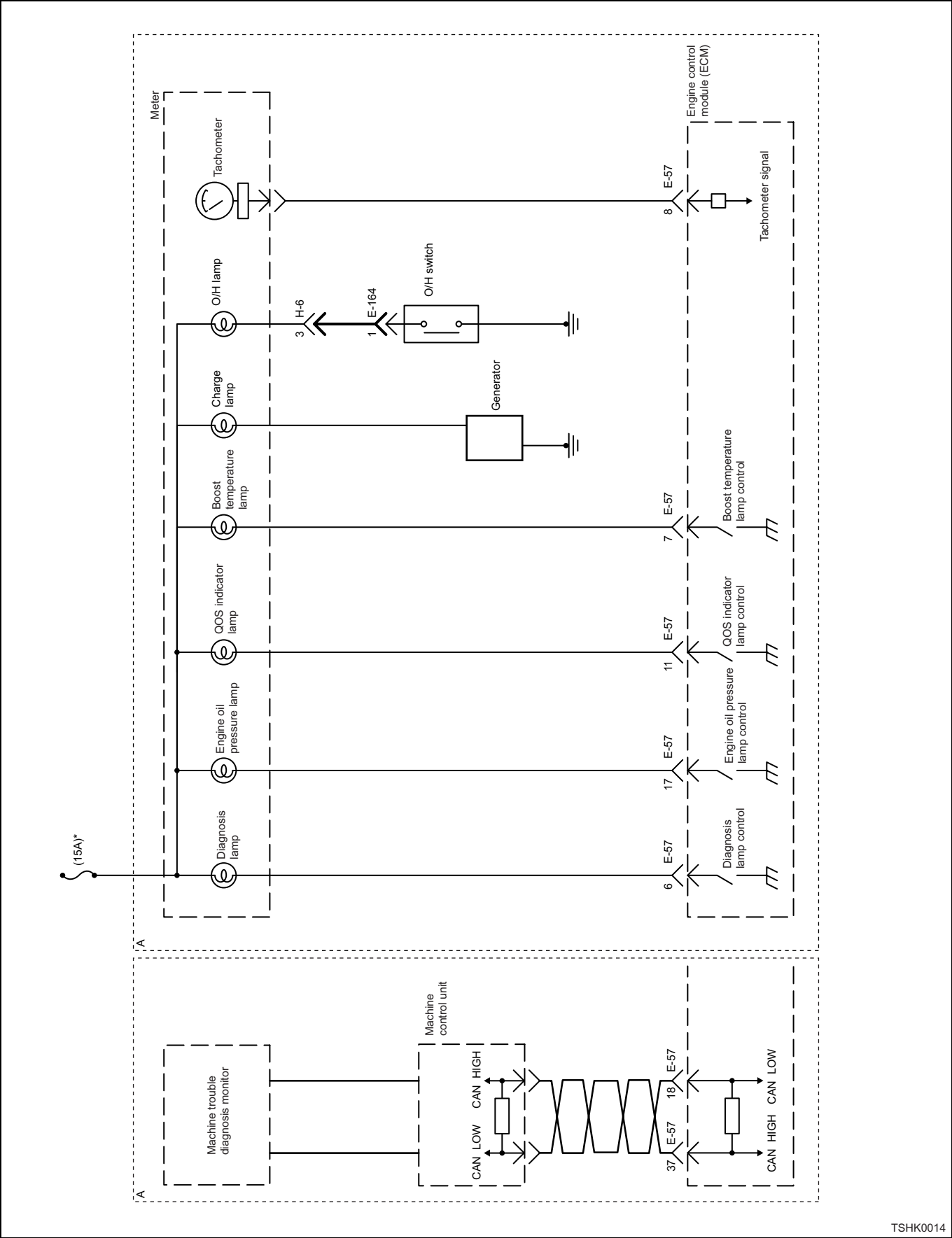


CAN, GND, DLC circuits



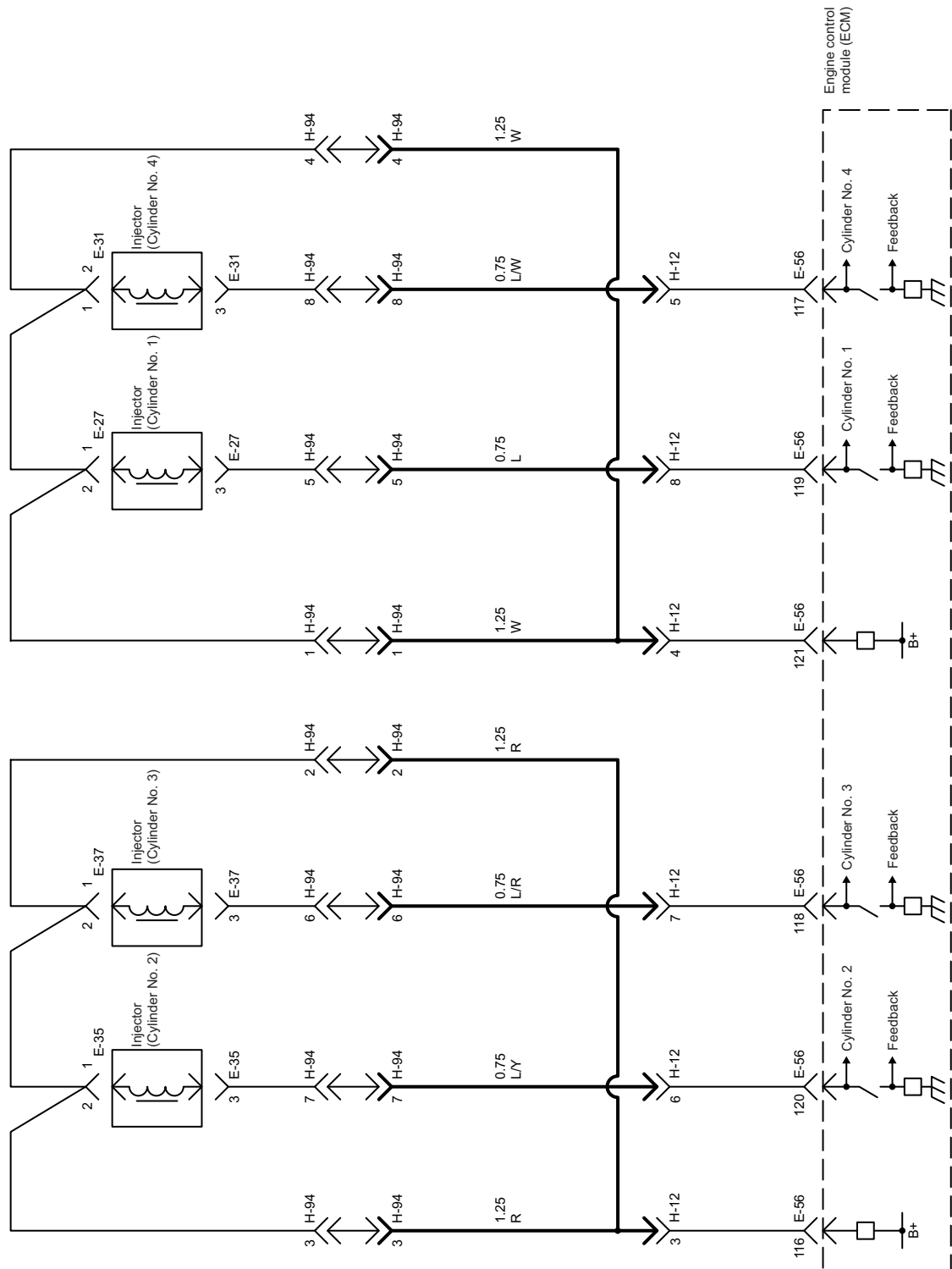
Indicator lamp, tachometer circuit

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)

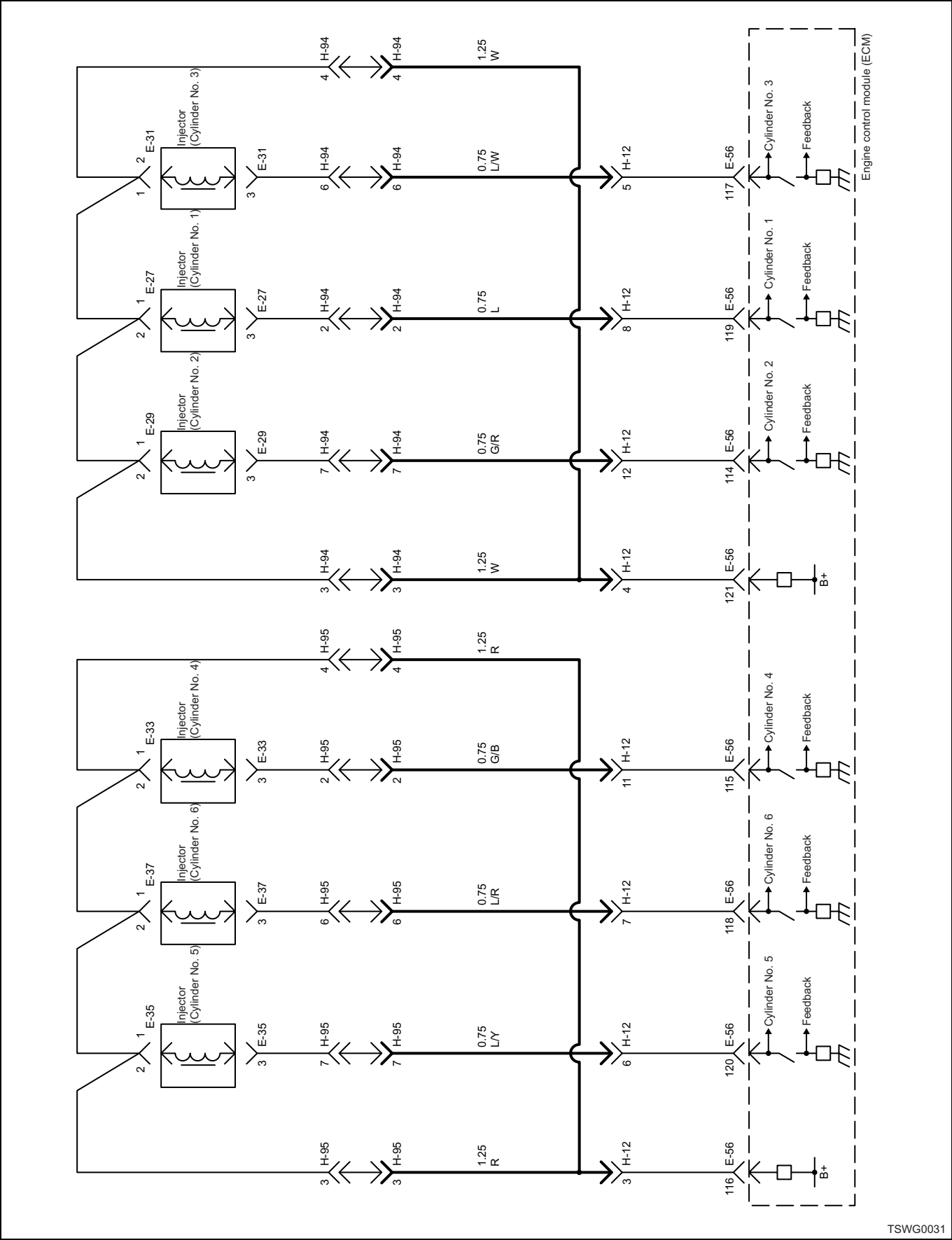


Injector circuit

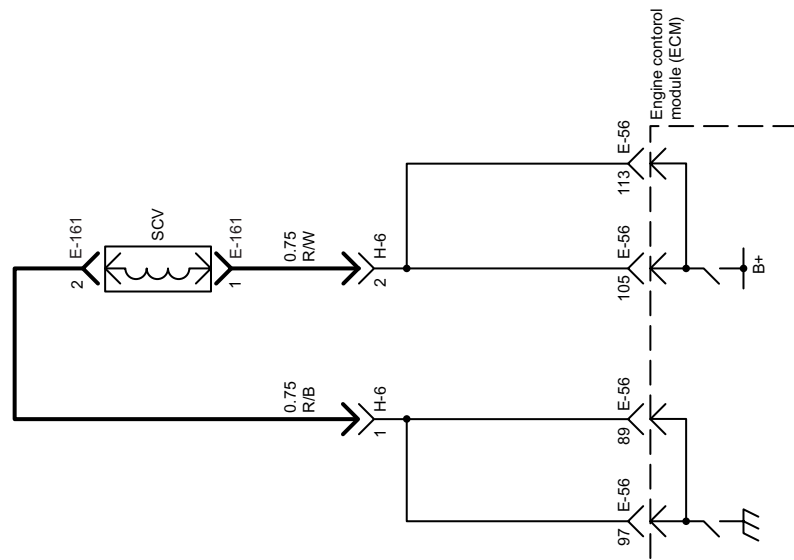
4HK1



6HK1



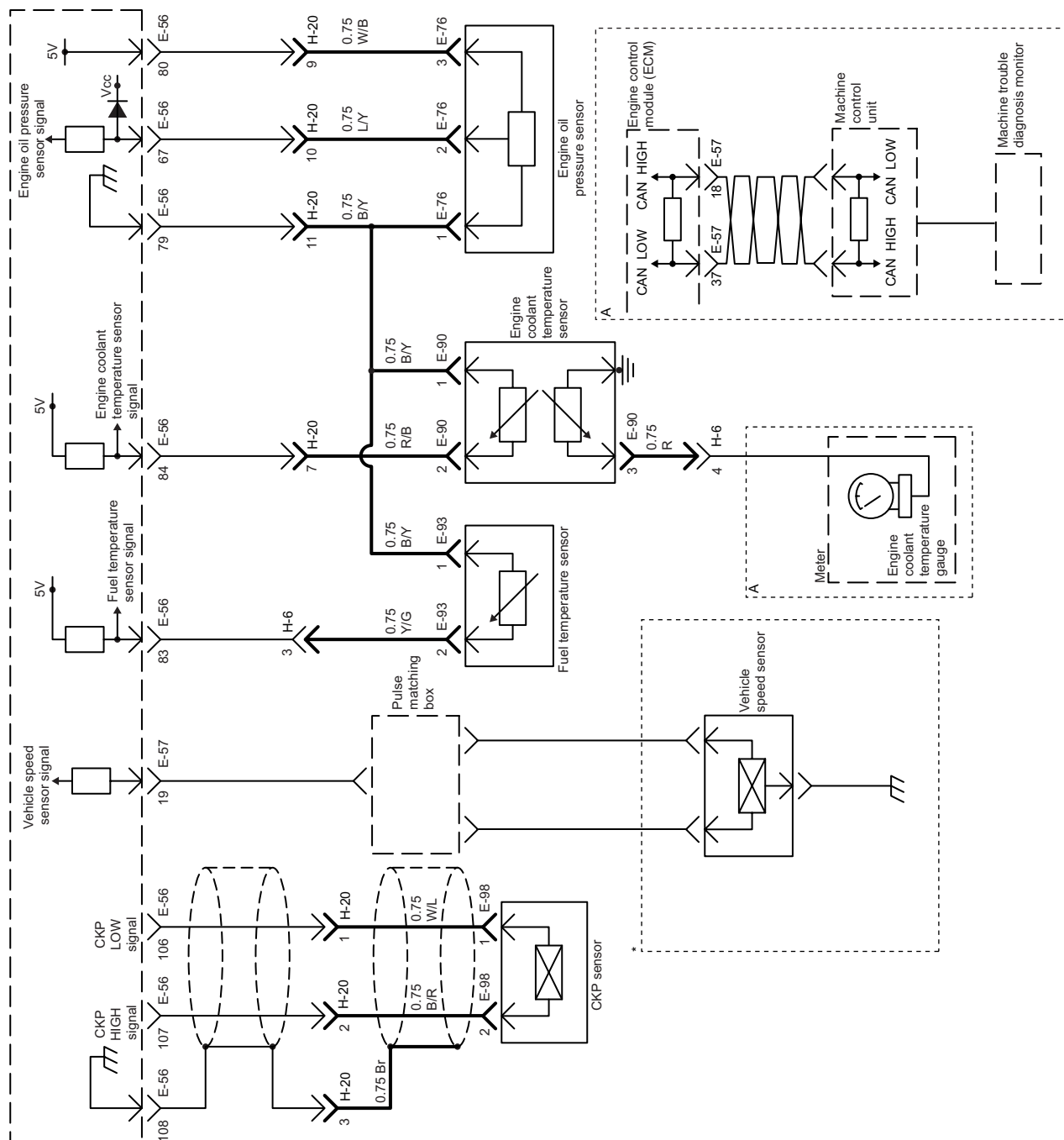
SCV circuit



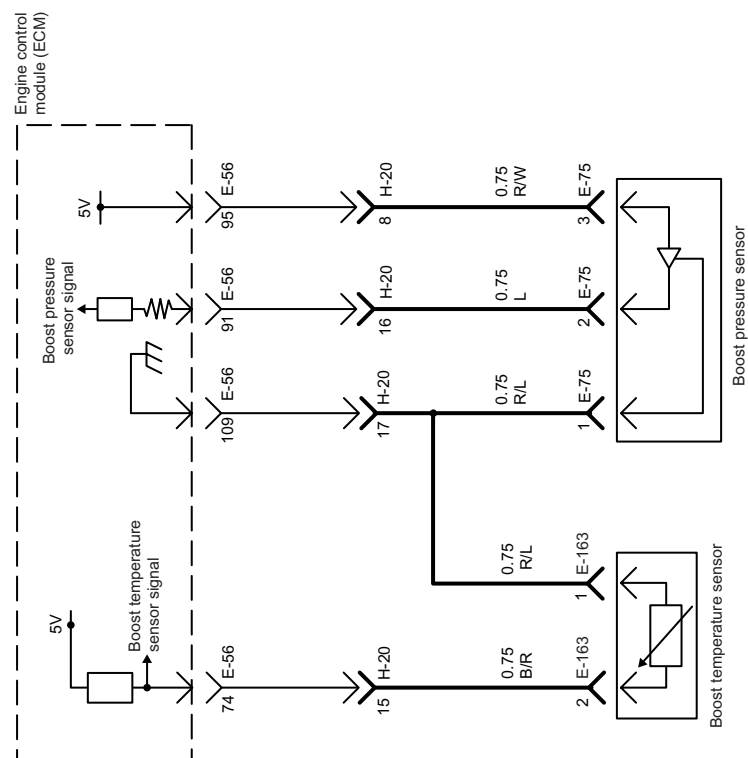
10D-129 Electronic control fuel injection system (Common rail type)

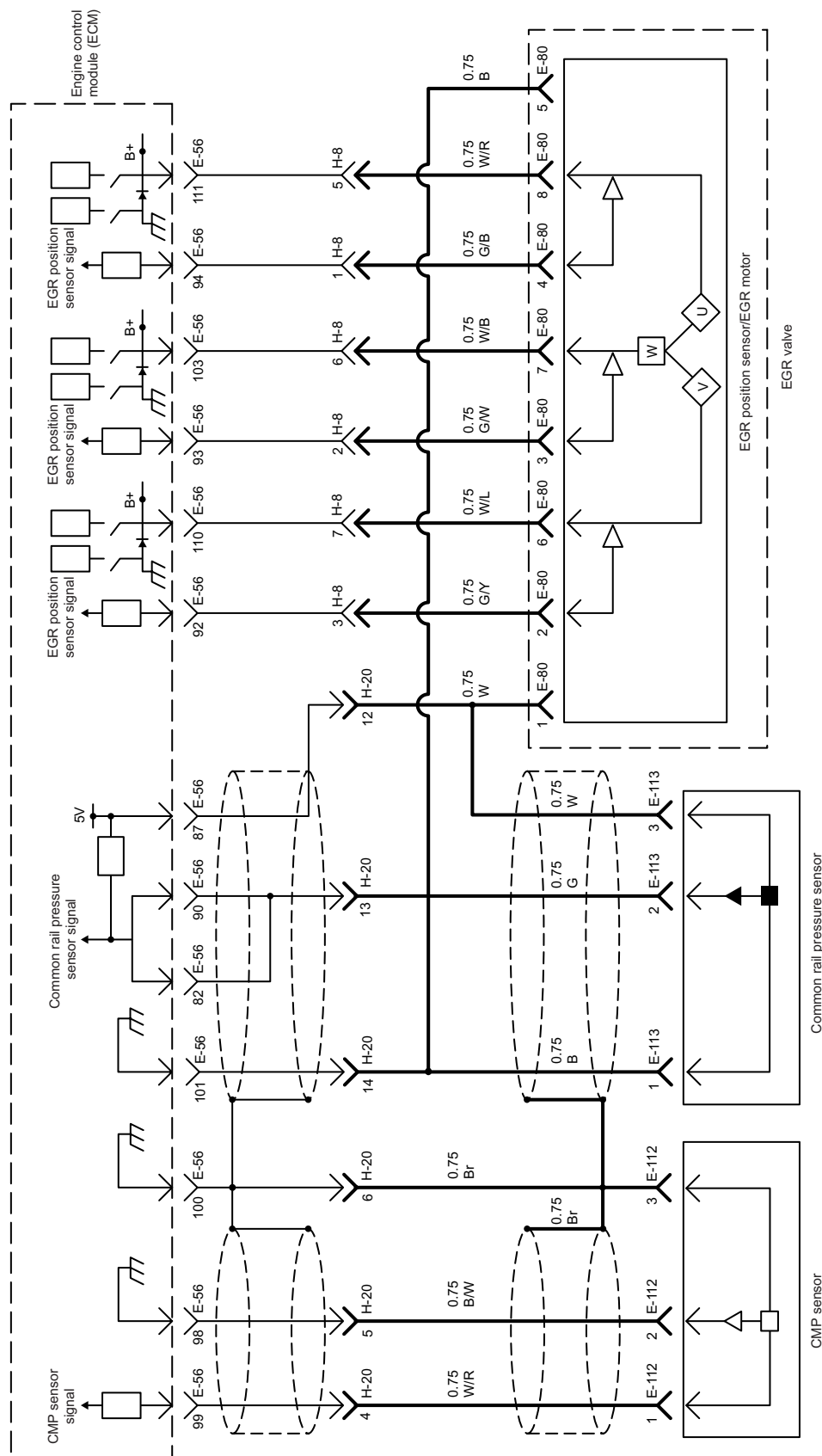
CKP sensor, vehicle speed sensor, fuel temperature sensor, engine coolant temperature sensor, engine oil pressure sensor circuit

(*: Specifications vary depending on each machine. Refer to the machine's manual.)

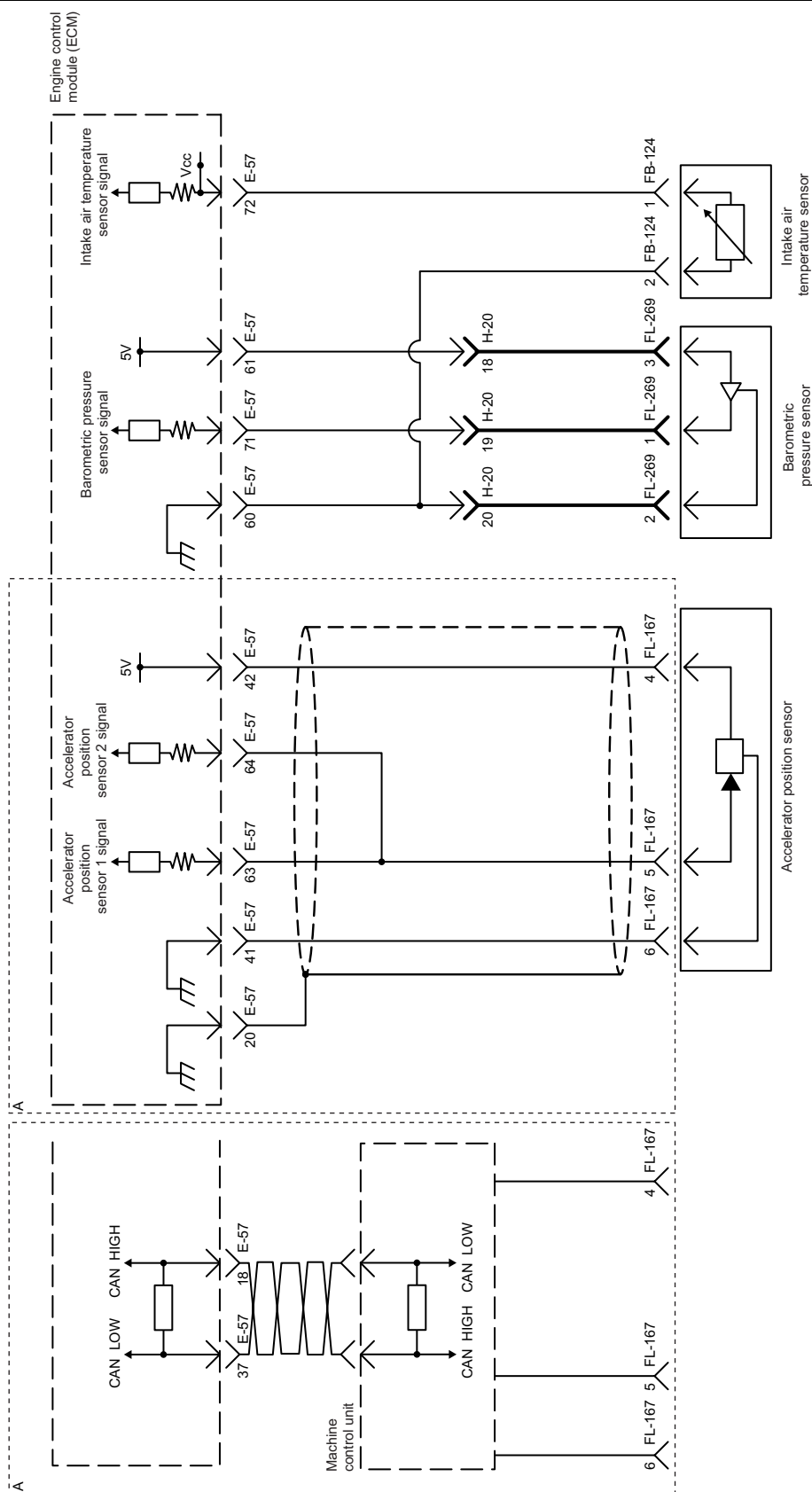


Boost temperature sensor, boost pressure sensor circuit



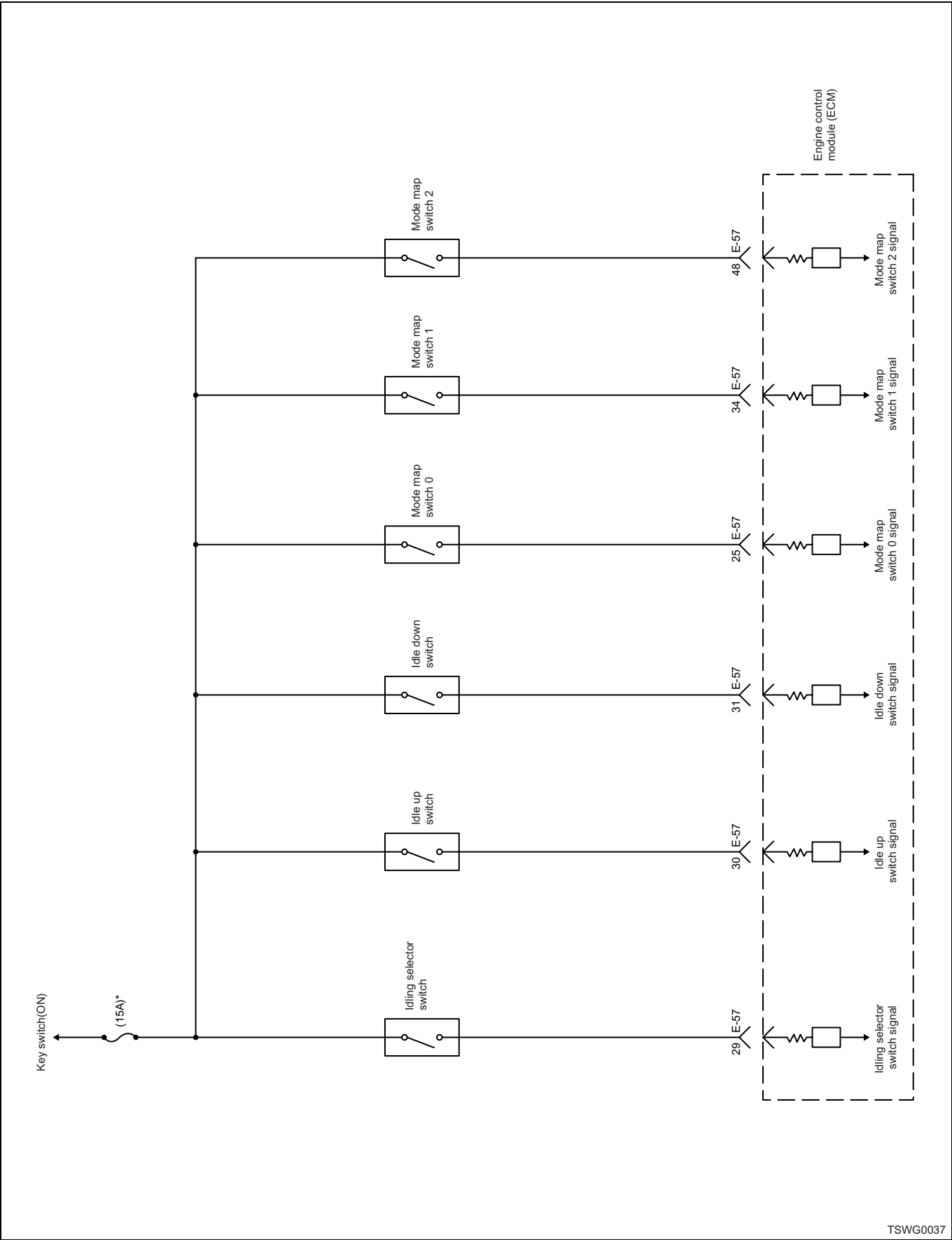
CMP sensor, common rail pressure sensor, EGR circuit


Accelerator position sensor, barometric pressure sensor, intake air temperature sensor circuit



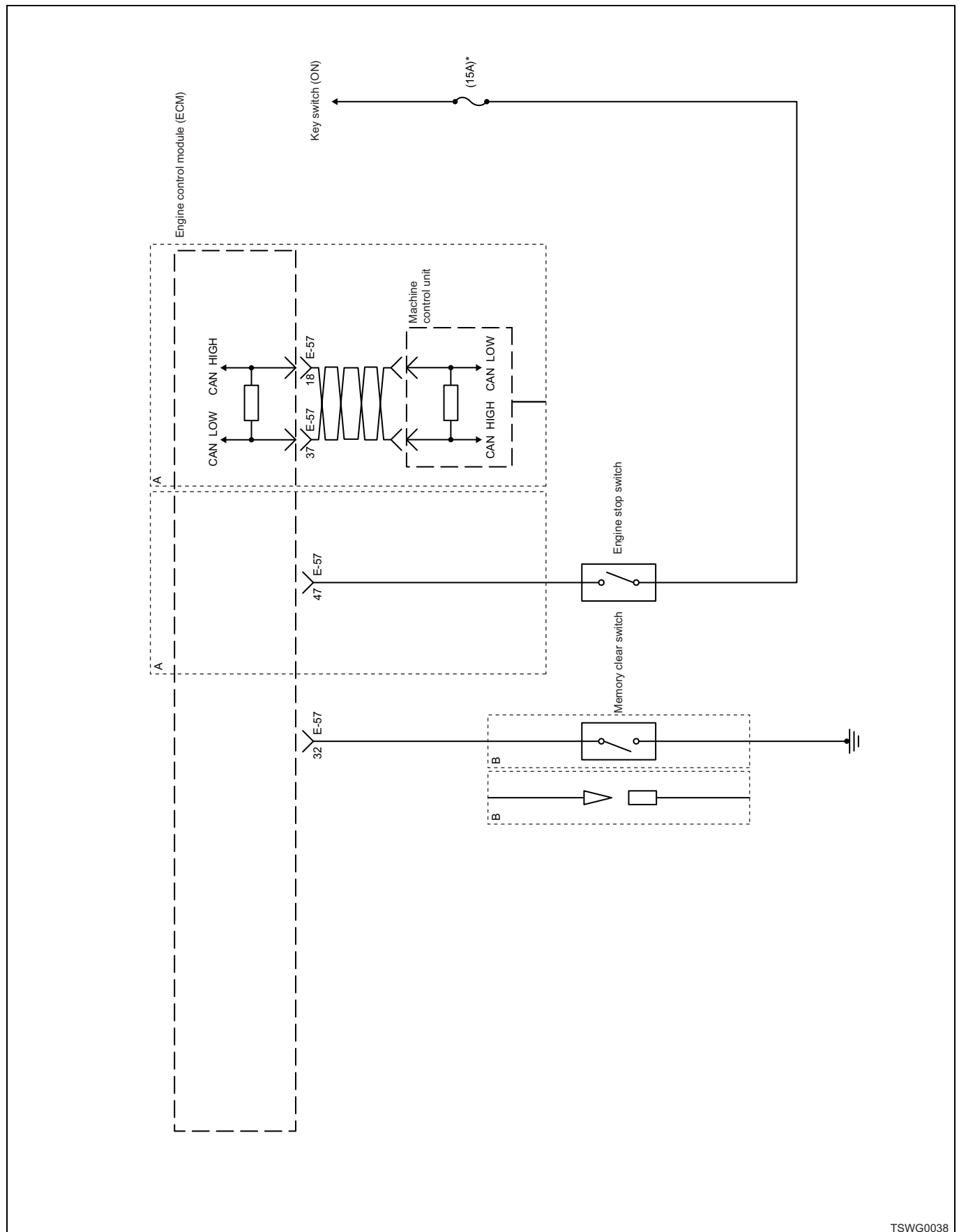
Idling selector switch, idle up switch, idle down switch, mode map switch circuit

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



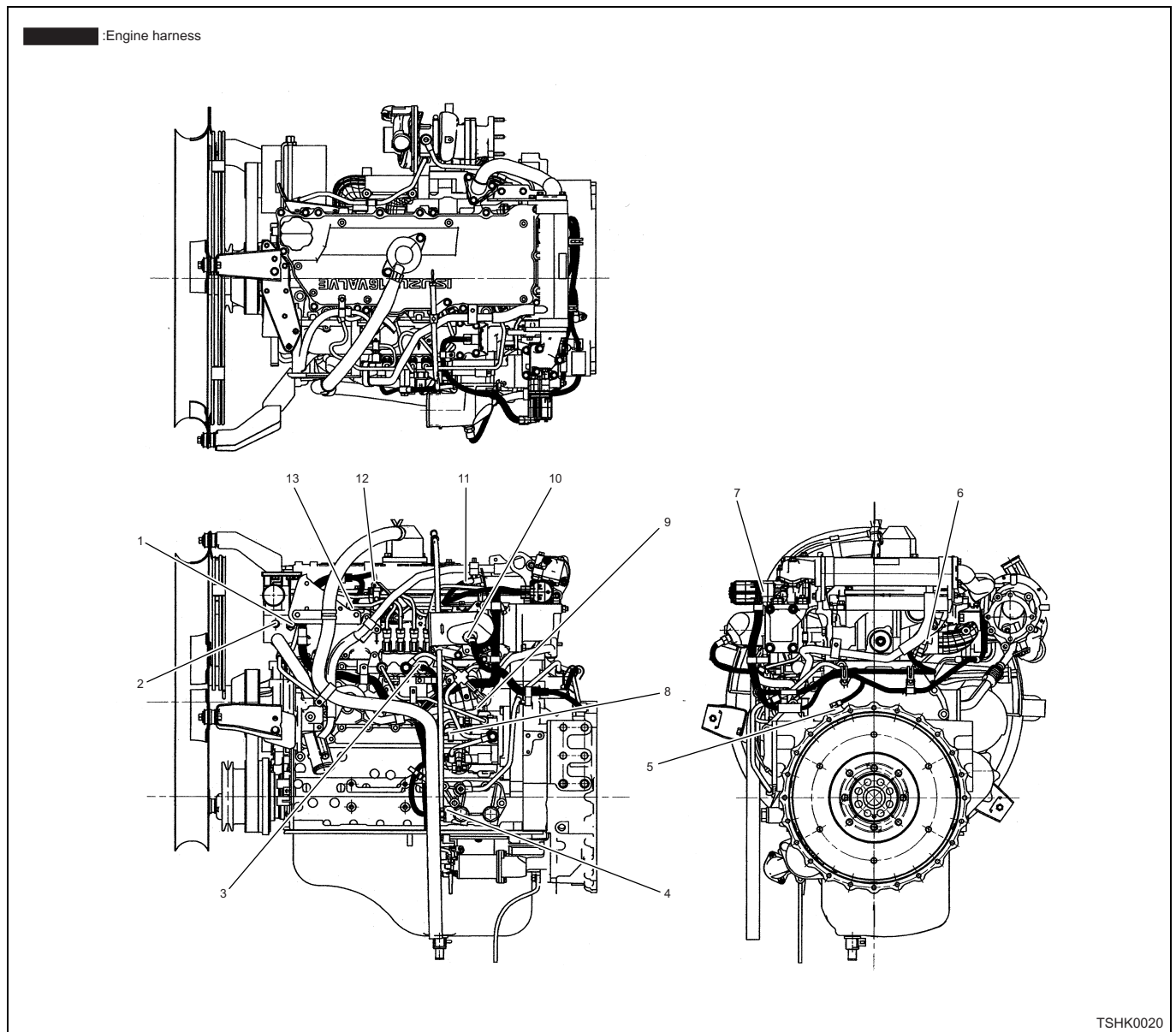
Memory clear switch, engine stop switch circuit

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



Engine harness location

4HK1



Name

1. Engine coolant temperature sensor	8. SCV
2. Overheating switch	9. Fuel temperature sensor
3. Common rail pressure sensor	10. Boost temperature sensor
4. Engine oil pressure sensor	11. Boost pressure sensor
5. CKP sensor	12. Injector
6. CMP sensor	13. Glow plug
7. EGR position sensor	

10D-137 Electronic control fuel injection system (Common rail type)

E75

Terminal Number	
1	Boost pressure sensor GND
2	Boost pressure sensor Vout
3	Boost pressure sensor Vcc

E76

Terminal Number	
1	Engine oil pressure sensor GND
2	Engine oil pressure sensor Vout
3	Engine oil pressure sensor Vcc

E80

Terminal Number	
1	EGR Vcc
2	EGR hall sensor W
3	EGR hall sensor V
4	EGR hall sensor U
5	EGR GND
6	EGR motor W
7	EGR motor V
8	EGR motor U

E90

Terminal Number	
1	ECT GND
2	ECT +
3	ECT meter

E93

Terminal Number	
1	Fuel temperature sensor GND
2	Fuel temperature sensor +

E98

Terminal Number	
1	CKP +
2	CKP GND

E112

Terminal Number	
1	CMP shield
2	CMP GND
3	CMP +

E113

Terminal Number	
1	Common rail pressure sensor GND
2	Common rail pressure sensor Vout
3	Common rail pressure sensor Vcc

E161

Terminal Number	
1	SCV — Hi
2	SCV — Lo

E163

Terminal Number	
1	Boost temperature sensor GND
2	Boost temperature sensor +

E164

Terminal Number	
1	Overheating switch

H1

Terminal Number	
1	Glow

H6

Terminal Number	
1	SCV-Lo
2	SCV-Hi
3	Fuel temperature sensor +
4	ECT meter
5	—
6	Overheating switch

H8

Terminal Number	
1	EGR hall sensor U
2	EGR hall sensor V
3	EGR hall sensor W
4	—
5	EGR motor U
6	EGR motor V
7	EGR motor W
8	—

H12

Terminal Number	
1	—
2	—
3	Injector power supply 2
4	Injector power supply 1
5	OS — INJ3 signal
6	OS — INJ2 signal
7	OS — INJ4 signal
8	OS — INJ1 signal
9	—
10	—
11	—
12	—

H20

Terminal Number	
1	CKP +
2	CKP GND
3	CKP shield
4	CMP +
5	CMP GND
6	CMP shield
7	ECT +
8	Boost pressure sensor Vcc
9	Engine oil pressure sensor Vcc
10	Engine oil pressure sensor Vout
11	Engine oil pressure sensor GND
12	Common rail pressure sensor Vcc
13	Common rail pressure sensor Vout
14	Common rail pressure sensor GND
15	Boost temperature sensor +
16	Boost pressure sensor Vout
17	Boost pressure sensor GND
18	—
19	—
20	—

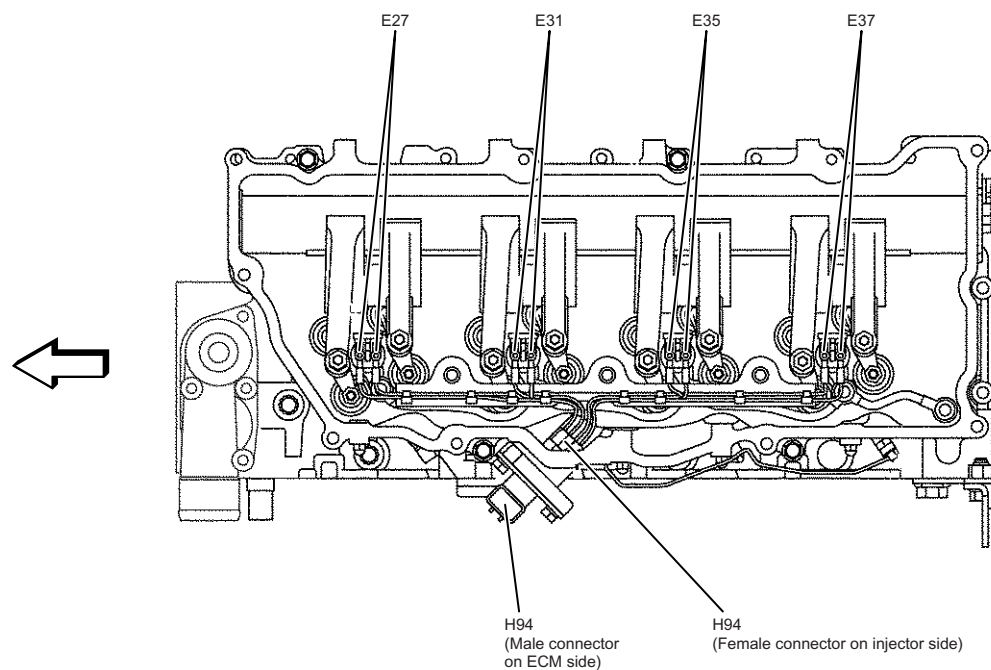
H22

Terminal Number	
1	Glow

H94

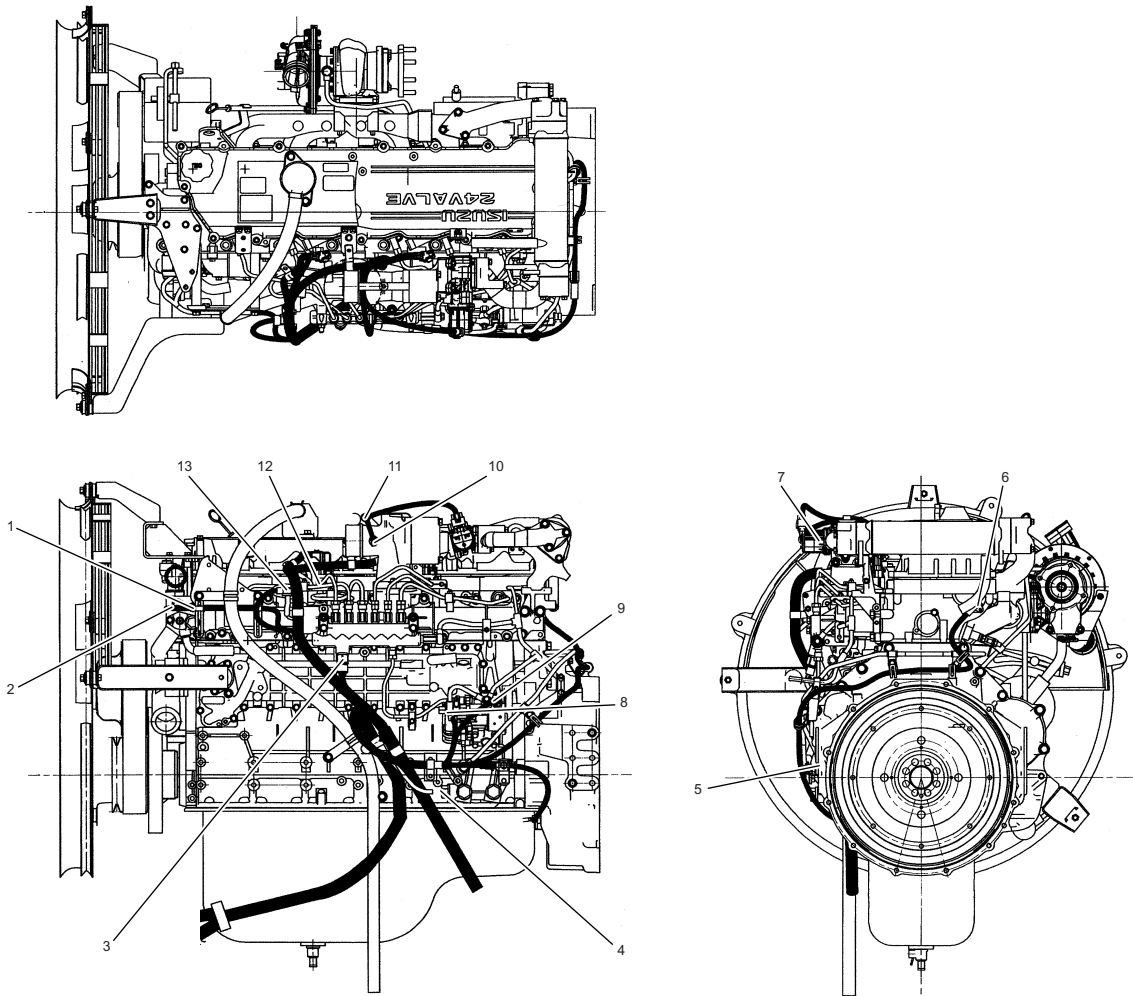
Terminal Number	
1	Injector power supply 1
2	Injector power supply 2
3	Injector power supply 2
4	Injector power supply 1
5	OS — INJ1 signal
6	OS — INJ4 signal
7	OS — INJ2 signal
8	OS — INJ3 signal

Cylinder head



6HK1

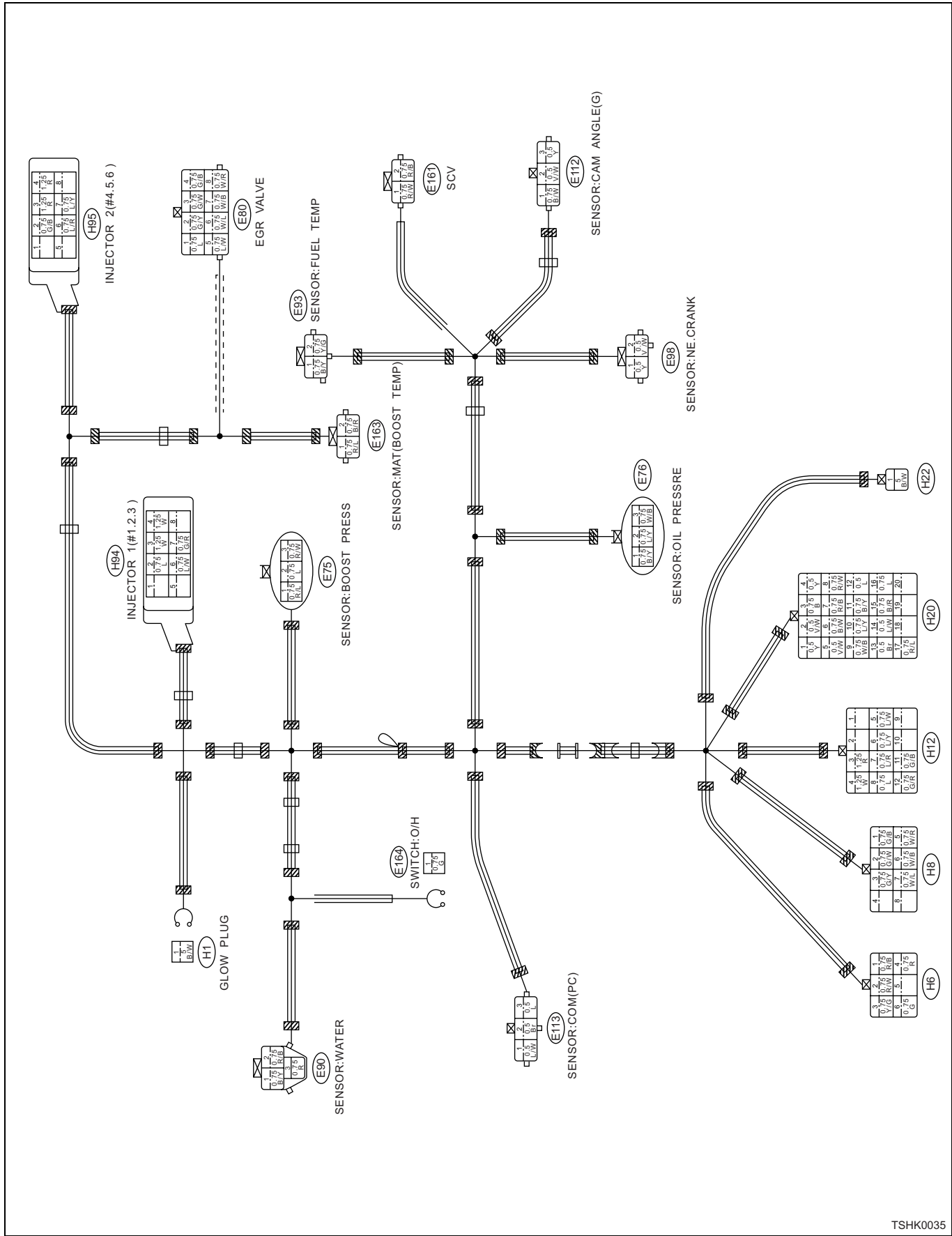
:Engine harness



TSHK0021

Name

1. Engine coolant temperature sensor	8. SCV
2. Overheating switch	9. Fuel temperature sensor
3. Common rail pressure sensor	10. Boost temperature sensor
4. Engine oil pressure sensor	11. Boost pressure sensor
5. CKP sensor	12. Injector
6. CMP sensor	13. Glow plug
7. EGR position sensor	



E75

Terminal Number	
1	Boost pressure sensor GND
2	Boost pressure sensor Vout
3	Boost pressure sensor Vcc

E76

Terminal Number	
1	Engine oil pressure sensor GND
2	Engine oil pressure sensor Vout
3	Engine oil pressure sensor Vcc

E80

Terminal Number	
1	EGR Vcc
2	EGR hall sensor W
3	EGR hall sensor V
4	EGR hall sensor U
5	EGR GND
6	EGR motor W
7	EGR motor V
8	EGR motor U

E90

Terminal Number	
1	ECT GND
2	ECT +
3	ECT meter

E93

Terminal Number	
1	Fuel temperature sensor GND
2	Fuel temperature sensor +

E98

Terminal Number	
1	CKP +
2	CKP GND

E112

Terminal Number	
1	CMP shield
2	CMP GND
3	CMP +

E113

Terminal Number	
1	Common rail pressure sensor GND
2	Common rail pressure sensor Vout
3	Common rail pressure sensor Vcc

E161

Terminal Number	
1	SCV — Hi
2	SCV — Lo

E163

Terminal Number	
1	Boost temperature sensor GND
2	Boost temperature sensor +

E164

Terminal Number	
1	Overheating switch

H1

Terminal Number	
1	Glow

10D-143 Electronic control fuel injection system (Common rail type)

H6

Terminal Number	
1	SCV-Lo
2	SCV-Hi
3	Fuel temperature sensor +
4	ECT meter
5	—
6	Overheating switch

H8

Terminal Number	
1	EGR hall sensor U
2	EGR hall sensor V
3	EGR hall sensor W
4	—
5	EGR motor U
6	EGR motor V
7	EGR motor W
8	—

H12

Terminal Number	
1	—
2	—
3	Injector power supply 2
4	Injector power supply 1
5	OS — INJ3 signal
6	OS — INJ2 signal
7	OS — INJ4 signal
8	OS — INJ1 signal
9	—
10	—
11	OS — INJ6 signal
12	OS — INJ5 signal

H20

Terminal Number	
1	CKP +
2	CKP GND
3	CKP shield
4	CMP +
5	CMP GND
6	CMP shield
7	ECT +
8	Boost pressure sensor Vcc
9	Engine oil pressure sensor Vcc
10	Engine oil pressure sensor Vout
11	Engine oil pressure sensor GND
12	Common rail pressure sensor Vcc
13	Common rail pressure sensor Vout
14	Common rail pressure sensor GND
15	Boost temperature sensor +
16	Boost pressure sensor Vout
17	Boost pressure sensor GND
18	—
19	—
20	—

H22

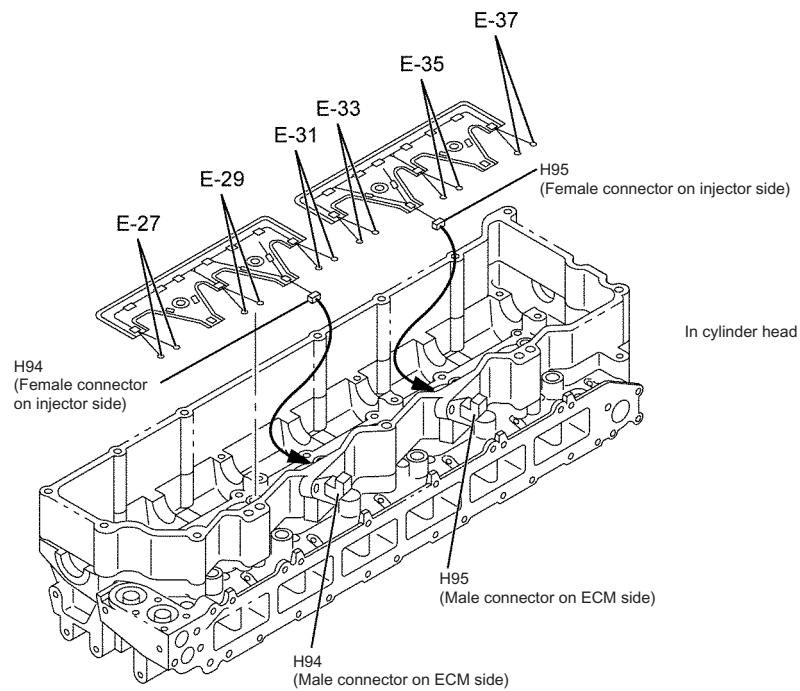
Terminal Number	
1	Glow

H94

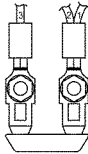
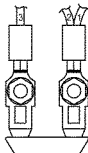
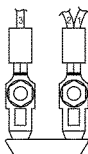
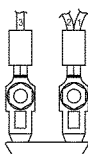
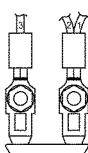
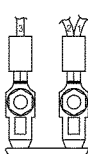
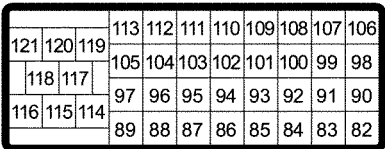
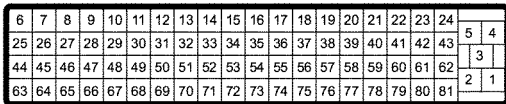
Terminal Number	
1	—
2	OS — INJ1 signal
3	Injector power supply 1
4	Injector power supply 2
5	—
6	OS-INJ3 signal
7	OS-INJ5 signal
8	—

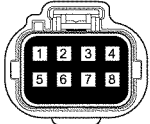
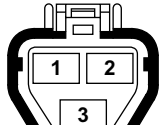
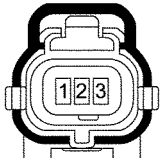
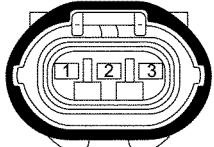
H95

Terminal Number	
1	—
2	OS-INJ6 signal
3	Injector power supply 2
4	Injector power supply 1
5	—
6	OS-INJ4 signal
7	OS-INJ2 signal
8	—

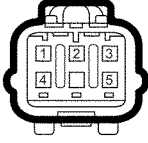
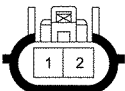
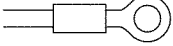
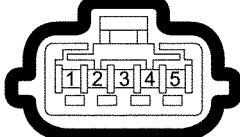
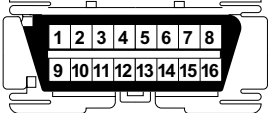
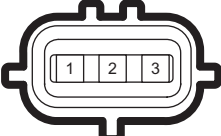


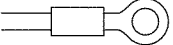
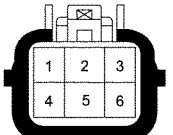
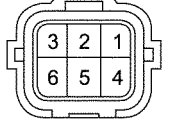
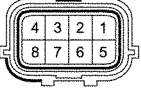
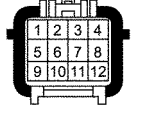
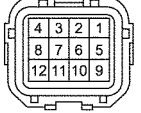
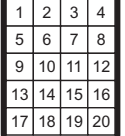
Connector list

No.	Connector Face
E-27	 #1 injector (Silver) 003-128
E-29	 #2 injector (Silver) 003-128
E-31	 #3 injector (Silver) 003-128
E-33	 #4 injector (Silver) 003-128
E-35	 #5 injector (Silver) 003-128
E-37	 #6 injector (Silver) 003-128
E-56	 (Gray) 040-004
E-57	 (Gray) 081-001

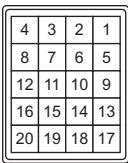
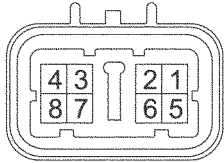
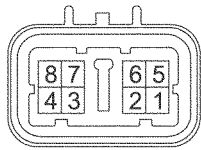
No.	Connector Face
E-75	 003-501
E-76	 (Black) 003-501
E-80	 (Black) 008-031
E-90	 (Blue) 003-500
E-93	 (Gray) 002-232
E-98	 (Black) 002-233
E-112	 (Black) 003-067
E-113	 (Gray) 003-097

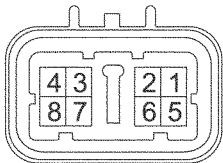
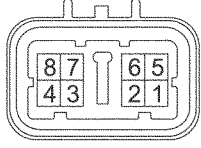
Electronic control fuel injection system (Common rail type) 10D-146

No.	Connector Face
E-114	 (Black) 005-034
E-161	 (Brown) 002-178
E-162	 (Dark gray) 002-178
E-163	 (Gray) 002-006
E-164	 000-012
FB-124	 (Black) 005-029
FL-150	 016-500
FL-269	 003-502

No.	Connector Face
H1	 (Black) 000-012
H-6	 (Gray) 006-001
H-6	 (Gray) 006-011
H-8	 (Black) 008-009
H-8	 (Black) 008-010
H-12	 (Gray) 012-013
H-12	 (Gray) 012-014
H-20	 020-500

10D-147 Electronic control fuel injection system (Common rail type)

No.	Connector Face
H-20	 020-501
H22	 (White) 001-034
H22	 (White) 001-003
H-94 (ECM side)	 (Gray) 008-046
H-94 (ECM side)	 (Gray) 008-047
H-94 (Injector side)	 (Gray) 008-052
H-94 (Injector side)	 (Gray) 008-051
H-95 (ECM side)	 (Gray) 008-046

No.	Connector Face
H-95 (ECM side)	 (Gray) 008-047
H-95 (Injector side)	 (Gray) 008-052
H-95 (Injector side)	 (Gray) 008-051

List of function checks

Interview	Inspection to comprehend the trouble symptom and diagnose properly based on a customer's complaint.
OBD system check	Inspection to identify defective point of engine control system (inspection procedure)
Diagnosis lamp illumination circuit system check	Inspection when diagnosis lamp does not come on when starter switch is turned ON.
Diagnosis lamp blinking circuit system check	Inspection when diagnosis lamp does not blink (remains on) when diagnostic switch is turned ON.
Scan tool power supply circuit system check	Inspection when scan tool (Tech2) does not operate.
Scan tool communication circuit system check	Inspection when scan tool (Tech2) cannot communicate with ECM.
Starting circuit system check	Inspection when starter does not operate.
Starting system check	Inspection when starter operates but engine does not start.
Fuel system check	Inspection when relevant points to fuel system may be faulty (inspection procedure).
Intake system check	Inspection when relevant points to intake system may be faulty (inspection procedure).
Exhaust system check	Inspection when relevant points to exhaust system may be faulty (inspection procedure).
EGR control system check	Inspection when relevant points to EGR may be faulty (inspection procedure).
QOS control system check	Inspection when relevant points to QOS (glow) may be faulty (inspection procedure).
CAN communication check	Inspection when fault relevant to machine control unit and CAN communication between scan tool and ECM may exist.
Machine-side check	Inspection when fault relevant to machine function (inspection procedure) may exist.

In the subsequent part of this manual, "scan tool" indicates scan tools including Tech2.

OBD system check

About OBD system check

OBD system check is systematic method to check the problems which caused by engine control system malfunction. It is the first procedure of all complaint diagnosis for operability. Use of this diagnostic step properly enables to shorten the diagnosis period and to prevent unnecessary replacement of proper parts.

Test description

2. Communication disability with scan tool is caused by fault in the communication circuit between each ECU and scan tool.

4. If DTC is detected, proceed to the relevant DTC diagnosis by referring to the list of DTC. If more than one DTC is detected, start with the one with smallest DTC number unless otherwise instructed in the diagnostic step.

Note for OBD system check

Important:

- If there is no complaint for operability, never perform this diagnostic step unless otherwise instructed in other items.
- Before the diagnosis, check the service information.
- Never erase DTCs unless otherwise instructed in the diagnostic step.
- If fault is found in the engine starting system, refer to "Electrical system" in the service manual "Engine section".
- Ensure the battery is fully charged.
- Make sure the battery cable is normal and securely connected.
- Make sure the ground cable of ECM is connected to the proper position securely.

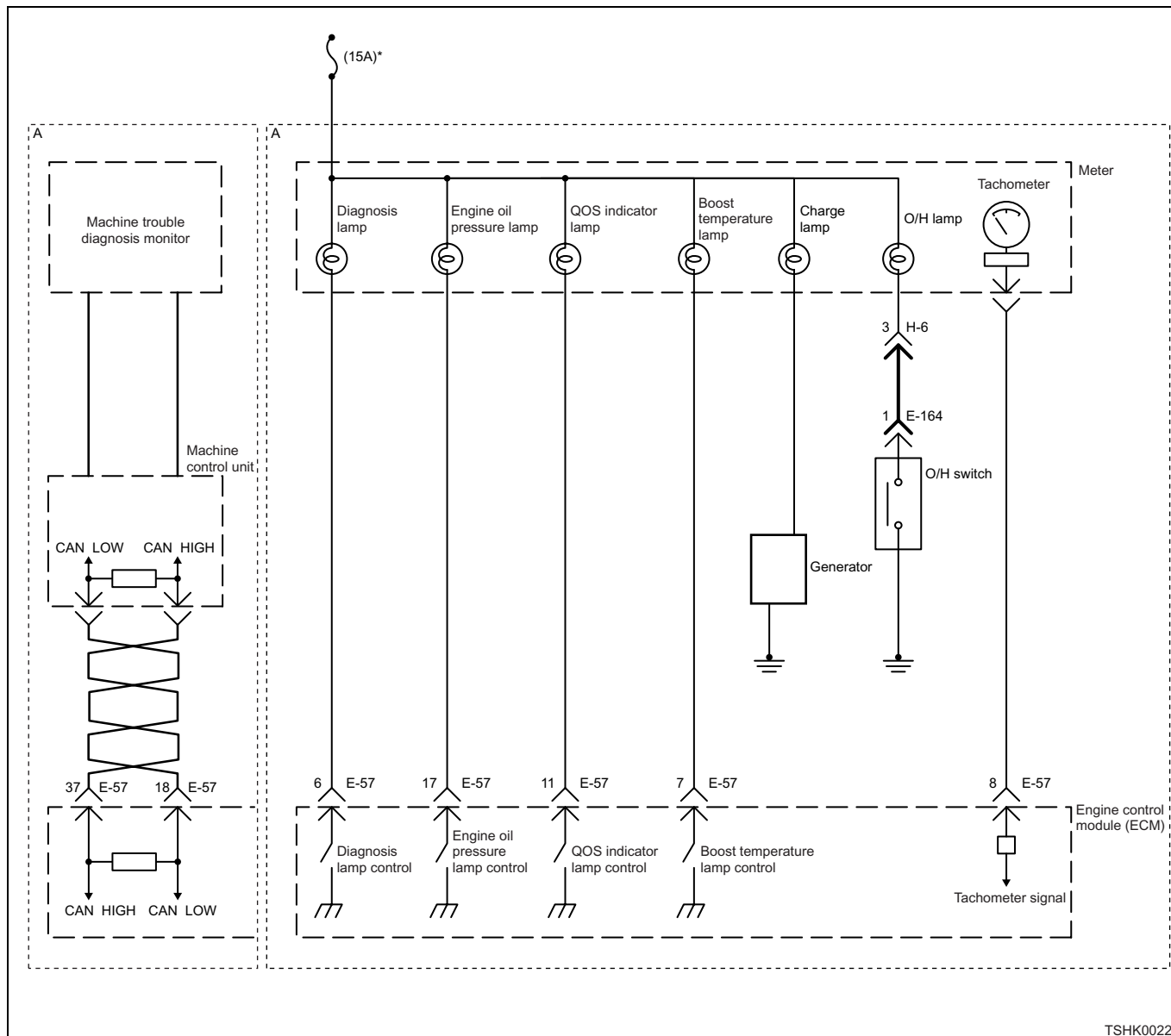
Step	Action	Value	YES	NO
1	1. Turn the key switch to "ON". 2. Check the diagnosis lamp (on the machine trouble display monitor). Does the diagnosis lamp (on the machine trouble display monitor) come on?	—	Go to Step 2.	Go to Step 2 in "Diagnosis lamp illumination circuit system check".
2	1. Connect the diagnosis connector. 2. Check the diagnosis lamp (on the machine trouble display monitor). Does the diagnosis lamp (on the machine trouble display monitor) blink?	—	Go to Step 3.	Go to Step 2 in "Diagnosis lamp blinking circuit system check".
3	Is the scan tool available?	—	Go to Step 4.	Go to Step 6.
4	1. Connect the scan tool. 2. Turn the key switch to "ON". 3. Turn the power switch of the scan tool to "ON". Does the scan tool powered "ON"?	—	Go to Step 5.	Go to "Scan tool power supply circuit system check".
5	Communicate with ECM using scan tool. Does it communicate with ECM properly?	—	Go to Step 6.	Go to Step 2 in "Scan tool communication circuit system check".
6	Turn the key switch to "START". Does the starter operate?	—	Go to Step 7.	Go to "Starting circuit system check".
7	Turn the key switch to "START". Does the engine start?	—	Go to Step 8.	Go to "Starting system check".
8	Check if DTC is detected. Is DTC detected?	—	Go to the relevant DTC diagnosis.	Go to Step 9.

Electronic control fuel injection system (Common rail type) 10D-150

Step	Action	Value	YES	NO
9	1. Check for following troubles. • Engine stall • Engine hunting, rough idling • Engine output lowering, blow up fault, engine breathing • Exhaust gas contains a lot of white smoke. • Exhaust gas contains a lot of black smoke. • Idling rotation cannot be adjusted. • Idling rotation cannot be reduced. Is the trouble detected?	—	Go to the relevant trouble symptom diagnosis.	Normal system

Diagnosis lamp illumination circuit system check

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



Description of circuit

The power supply voltage is supplied to the diagnosis lamp via key switch, and the signal from ECM will turn the lamp on. The ECM turns the diagnosis lamp on during lamp check with the key switch "ON" and when DTC is detected. Also when the diagnosis connector is connected, it blinks the diagnosis lamp according to the DTC detected. A monitor circuit is provided inside the ECM to monitor the lamp operation.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

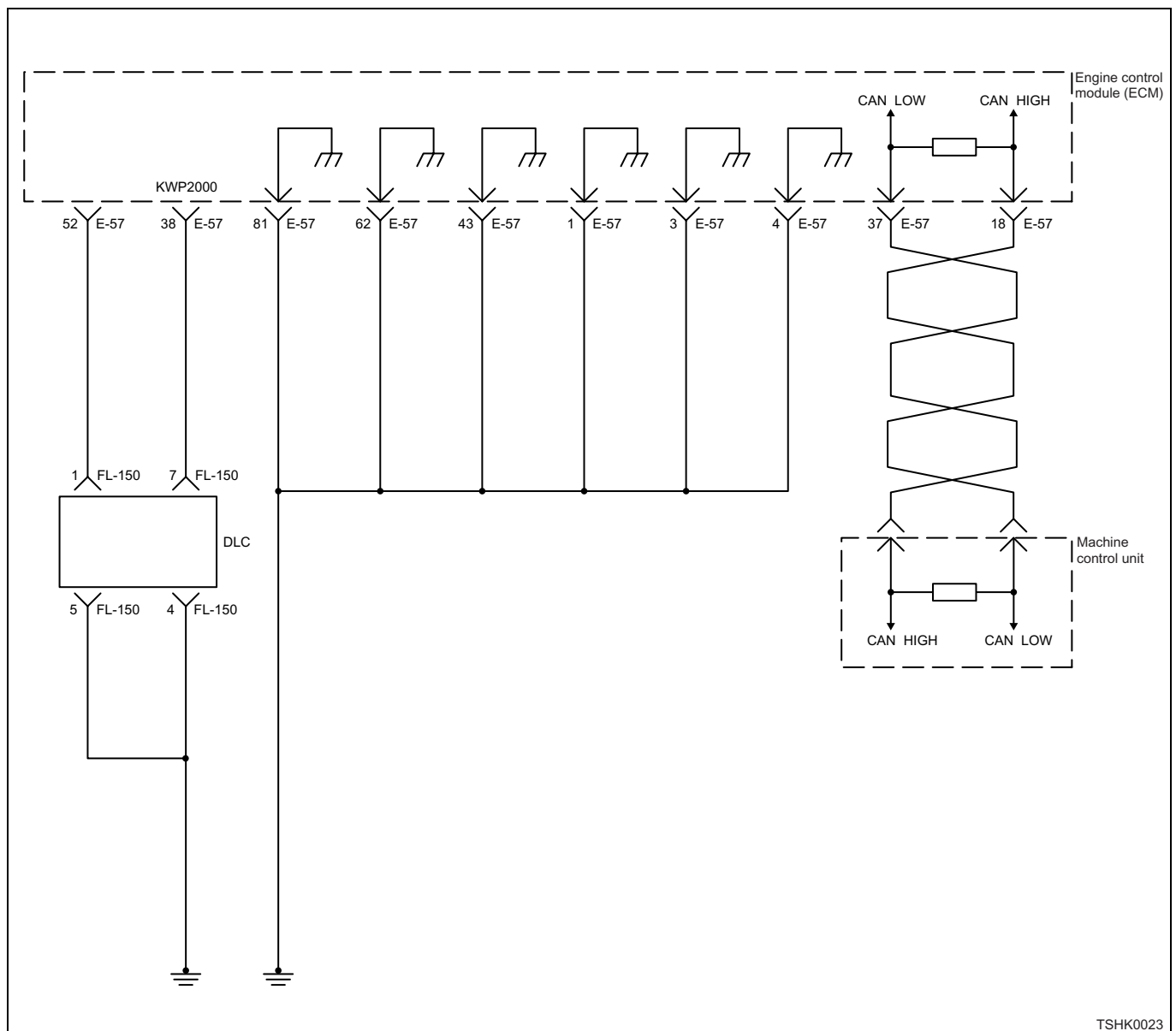
- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	1. Turn the key switch to "ON". 2. Check the diagnosis lamp. Does the diagnosis lamp come on?	—	Go to "Diagnostic aid".	Go to Step 2.
2	Remove the diagnosis lamp to check its condition. Is the trouble detected?	—	Replace the diagnosis lamp.	Go to Step 3.
3	Check for open/short circuit between the diagnosis lamp and ECM and power supply circuit using DMM. Is the trouble detected?	—	Repair the harness.	Go to Step 4.
4	Is EMPS available?	—	Go to Step 5.	Go to Step 6.
5	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Check the repair, and Go to "OBD system check".	—
6	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Check the repair, and Go to "OBD system check".	—

Diagnosis lamp blinking circuit system check



TSHK0023

Description of circuit

The power supply voltage is supplied to the diagnosis lamp via key switch, and the signal from ECM will turn the lamp on. The ECM turns the diagnosis lamp on during lamp check with the key switch "ON" and when DTC is detected. Also when the diagnosis connector is connected, it blinks the diagnosis lamp according to the DTC detected. A monitor circuit is provided inside the ECM to monitor the lamp operation.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

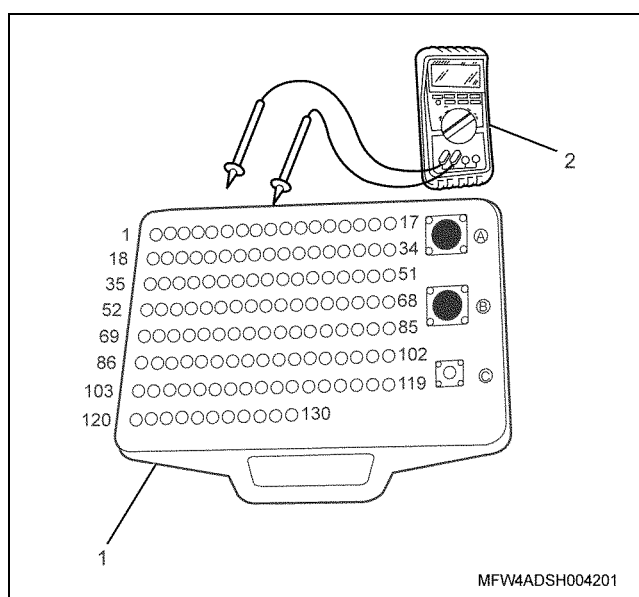
Step	Action	Value	YES	NO
1	1. Turn the key switch to "OFF". 2. Connect the DMM between the diagnosis connector (male-side) and the ground. 3. Turn the key switch to "ON". Is the DMM indication more than the specified value?	0V	Go to Step 2.	Go to Step 3.
2	Check for installation condition of the ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Verify repair.	Go to Step 3.
3	1. Check for followings in the circuit between ECM and diagnosis connector using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Verify repair.	Go to Step 4.
4	1. Check for following in the circuit between diagnosis connector and ground. • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Verify repair.	Go to Step 5.
5	Check the diagnosis lamp blinking condition again. 1. Turn the key switch to "ON". 2. Connect the diagnosis connector. 3. Check the diagnosis lamp. Does the diagnosis lamp blink?	—	Go to "Diagnostic aid".	Go to Step 6.
6	Is EMPS available?	—	Go to Step 7.	Go to Step 8.
7	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Verify repair.	Go to Step 8.

10D-155 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
8	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Verify repair.	—

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

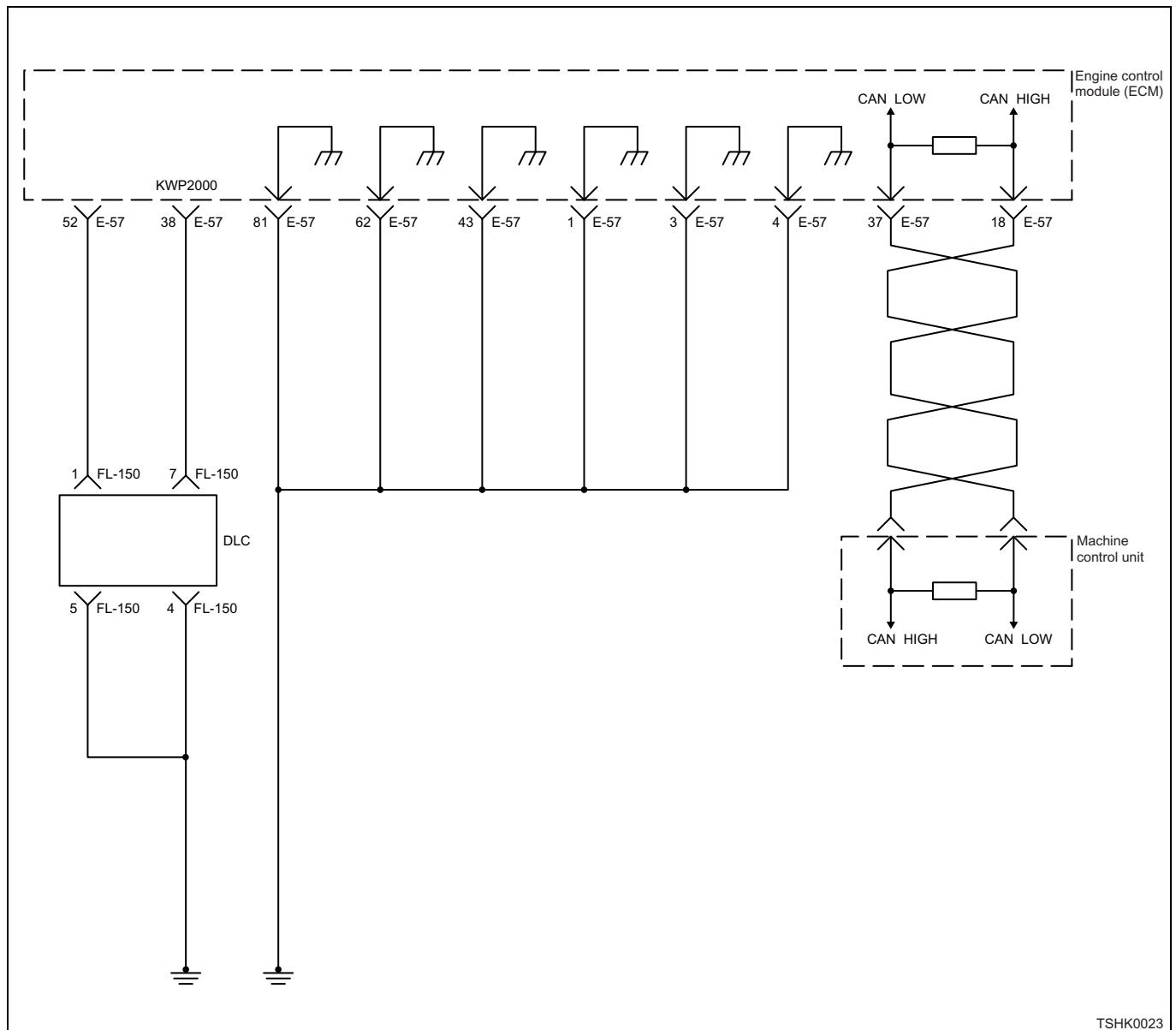


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
3	Open circuit/ high resistance	Resistance measurement	• Key switch “OFF”	52 - Diagnosis connector terminal	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	• Key switch “OFF”	52 - Ground	10MΩ or more	100Ω or less

Scan tool power supply circuit system check



TSHK0023

Circuit description

The ECM and other ECUs communicate with the scan tool via data link connector (DLC). Power supply voltage for the scan tool is provided from the battery.

Caution:

Use a 12-V battery from the chassis ground side for the power supply to the scan tool.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

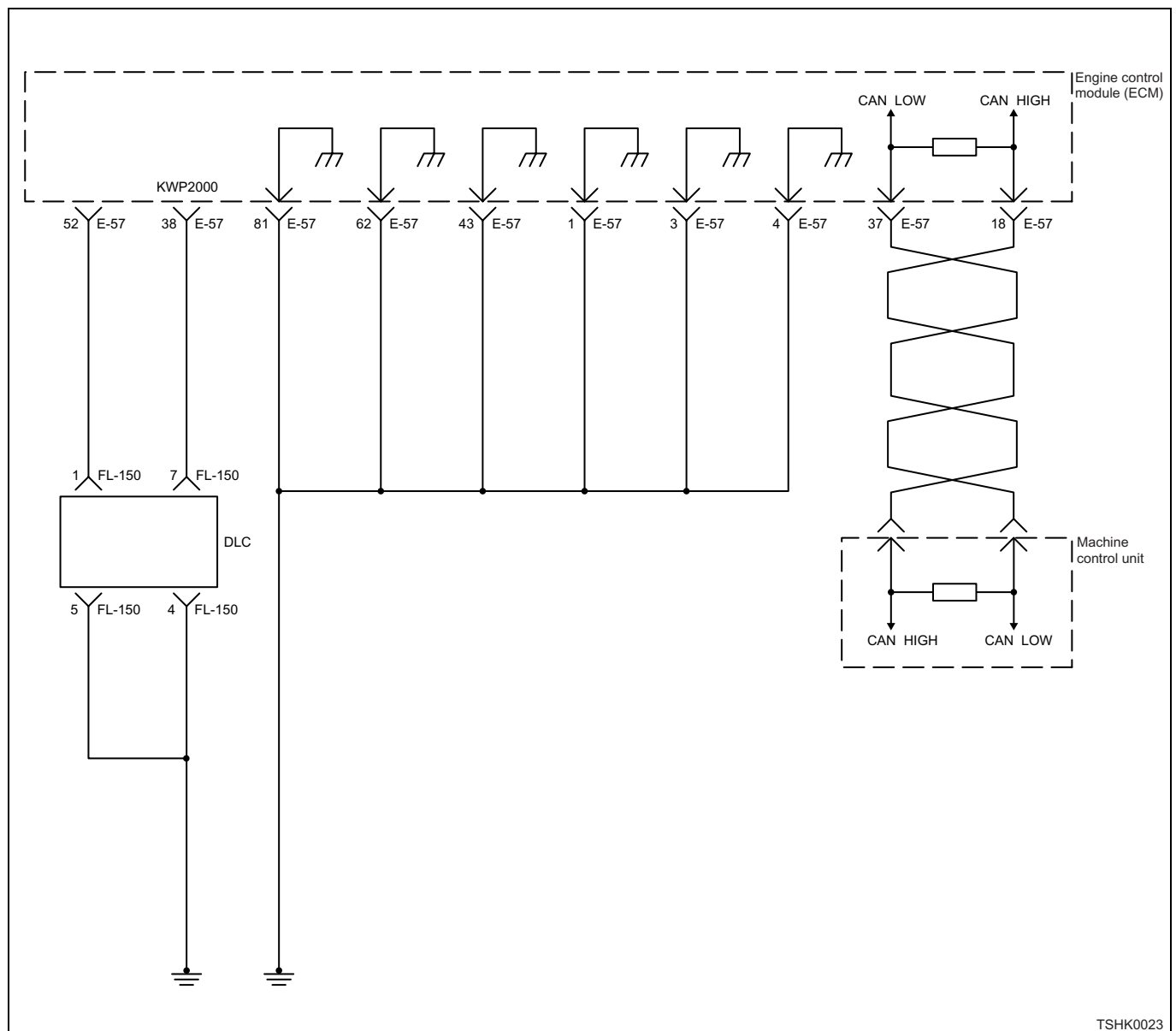
Important:

Before starting this diagnostic step, check if the scan tool operates properly on other machine.

10D-157 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
1	Check the voltage of battery on the machine using DMM. Is the voltage more than specified value?	10V	Go to Step 2.	Charge or replace the battery.
2	Check for poor contact in the scan tool-side cable. Is the trouble detected?	—	Go to Step 3.	Go to Step 4.
3	Correct the connection of the scan tool. Is the procedure completed?	—	Go to Step 4.	—
4	Check for open/short circuit in the cable between scan tool and battery. Is the trouble detected?	—	Request for repair by referring to the operation manual of the scan tool.	Go to Step 5.
5	1. Connect the scan tool to the machine. 2. Turn the power switch of the scan tool to "ON". Does the scan tool powered "ON"?	—	Check the repair, and Go to "OBD system check".	Go to Step 1.

Scan tool communication circuit system check



TSHK0023

Circuit description

The engine control module (ECM) performs KW communication with the scan tool via 16-pin data link connector (DLC).

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".

10D-159 Electronic control fuel injection system (Common rail type)

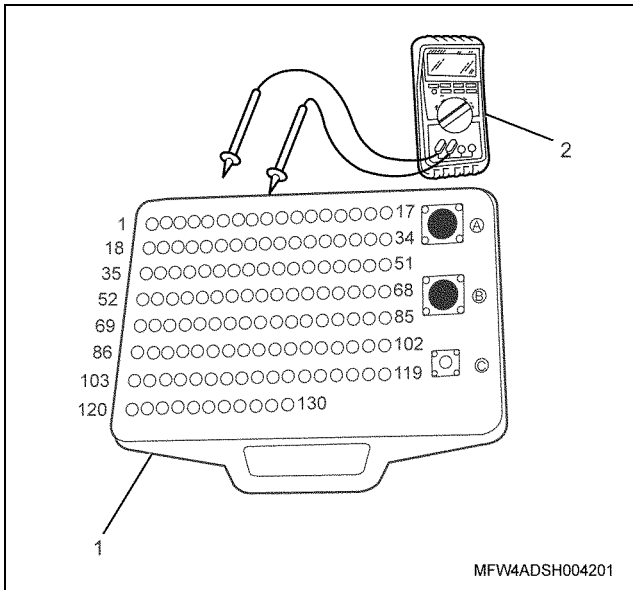
Step	Action	Value	YES	NO
2	Check for installation condition of the ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 3.
3	1. Check the DLC for following conditions. • Poor connection of terminal from connector • Poor contact between terminal and wire 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 4.
4	1. Check for followings in the circuit between ECM and DLC using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance • Short circuit to ground 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 5.
5	1. Connect the scan tool. 2. Turn the key switch to "ON". 3. Communicate with ECM using scan tool. Does it communicate with ECM properly?	—	Go to "Diagnostic aid".	Go to Step 6.
6	Is EMPS available?	—	Go to Step 7.	Go to Step 8.
7	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	Go to Step 8.
8	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	—

Electronic control fuel injection system (Common rail type) 10D-160

Step	Action	Value	YES	NO
9	1. Connect the scan tool. 2. Turn the key switch to "ON". 3. Communicate with ECM using scan tool. Does it communicate with ECM properly?	—	Verify repair.	Go to Step 2.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

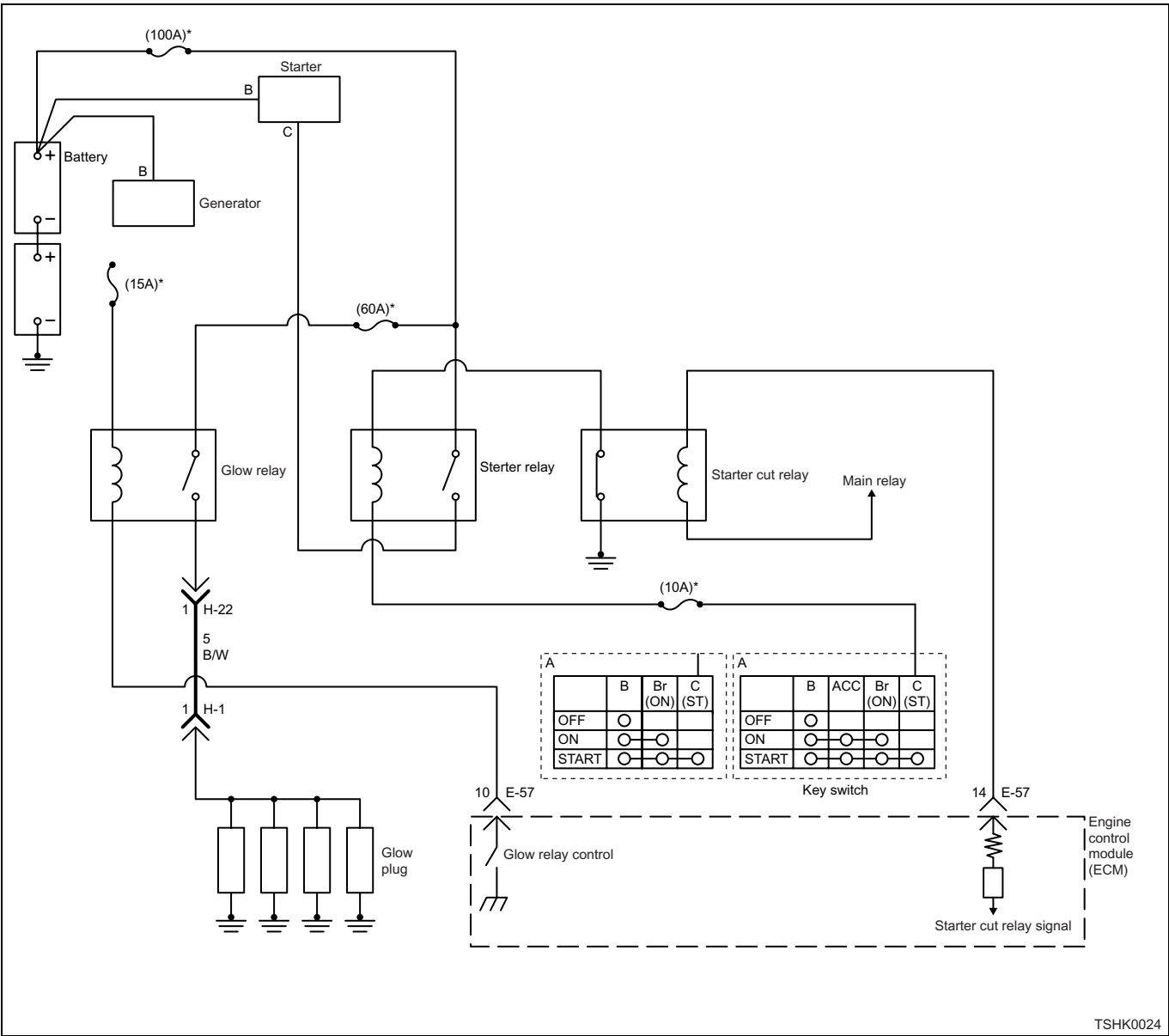
1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	• Key switch "OFF"	38 - DLC terminal No. 3	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	• Key switch "OFF"	38 - Ground	10MΩ or more	100Ω or less

Starting circuit system check

Starter ECM control

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



10D-163 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
1	Is the emergency stop switch equipped?	—	Turn the switch to "OFF", and Go to Step 2.	Go to Step 2.
2	1. Turn the key switch to "ON". 2. Check the DTC. Is the DTC P0340, P0341, P0615, P1345 or P1625 detected?	—	Go to the relevant diagnosis of DTC detected.	Go to Step 3.
3	Is the scan tool available?	—	Go to Step 4.	Go to Step 17.
4	1. Turn the key switch to "START". 2. Check for "Starter switch (ST)" on the data display using scan tool. Is the "Starter switch (ST)" displayed "ON"?	—	Go to Step 6.	Go to Step 5.
5	1. Check for followings in the circuit between key switch and ECM using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 12.
6	1. Turn the key switch to "OFF". 2. Remove the starter cut relay. 3. Check for continuity between the starter cut relay switch-side terminals. Is the trouble detected?	—	Go to Step 7.	Go to Step 8.
7	Replace the starter cut relay. Is the procedure completed?	—	Go to Step 13.	—
8	1. Turn the key switch to "OFF". 2. Remove the starter relay. 3. Connect the battery to the starter relay coil-side terminal. 4. Check for continuity between the starter relay switch-side terminals. Is the trouble detected?	—	Go to Step 9.	Go to Step 10.
9	Replace the starter relay. Is the procedure completed?	—	Go to Step 13.	—
10	Turn the key switch to "START". Does the starter operate?	—	Go to "Diagnostic aid".	Go to Step 11.

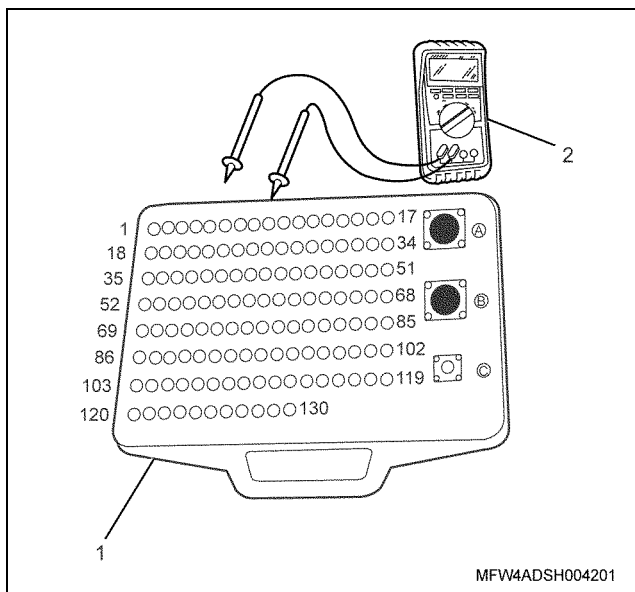
Step	Action	Value	YES	NO
11	1. Check the following circuits for open circuit or high resistance. • Between key switch and starter cut relay • Between starter cut relay and starter relay • Between starter relay and ground • Between starter relay and starter 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 12.
12	1. Inspect by referring to “Electrical system” in the service manual “Engine section” 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 13.
13	Is EMPS available?	—	Go to Step 14.	Go to Step 15.
14	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to “How to use flush tool” in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 15.
15	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	—
16	Turn the key switch to “START”. Does the starter operate?	—	Check the repair, and Go to “OBD system check”.	Go to Step 1.
17	1. Check for followings in the circuit between key switch and ECM using breaker box or DMM. Refer to “Breaker box inspection procedure”. • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 18.

10D-165 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
18	1. Turn the key switch to "OFF". 2. Remove the starter cut relay. 3. Check for continuity between the starter cut relay switch-side terminals. Is the trouble detected?	—	Go to Step 19.	Go to Step 20.
19	Replace the starter cut relay. Is the procedure completed?	—	Go to Step 13.	—
20	1. Turn the key switch to "OFF". 2. Remove the starter relay. 3. Connect the battery to the starter relay coil-side terminal. 4. Check for continuity between the starter relay switch-side terminals. Is the trouble detected?	—	Go to Step 9.	Go to Step 10.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

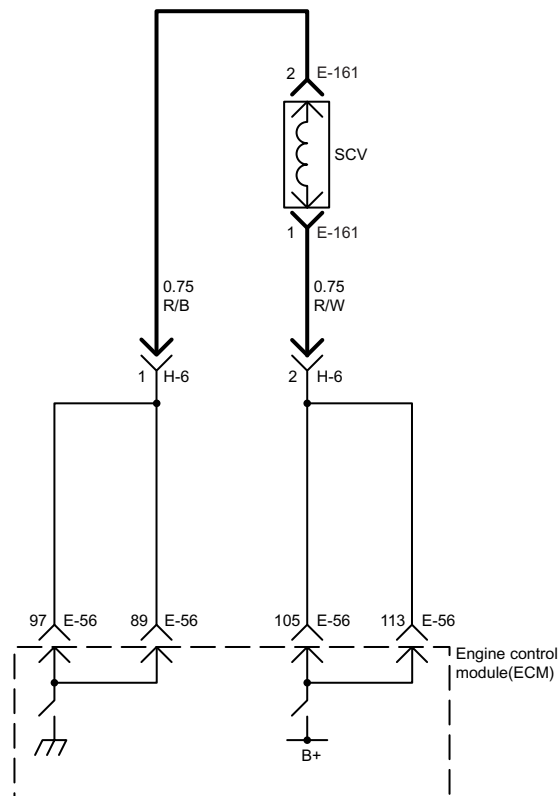
1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5, 17	Open circuit/ high resistance	Resistance measurement	• Key switch "OFF"	46 - Key switch "START" terminal	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	• Key switch "OFF"	46 - Ground	10MΩ or more	100Ω or less

Electronic control fuel injection system (Common rail type) 10D-166

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6, 18	Open circuit/ high resistance	Resistance measurement	• Key switch "OFF" • Relay alone	Starter cut relay Switch-side terminal	100Ω or less	10MΩ or more
8, 20	Open circuit/ high resistance	Resistance measurement	• Key switch "OFF" • Relay alone • Relay "ON"	Starter relay Switch-side terminal	100Ω or less	10MΩ or more

Starting system check



TSHK0027

About starting system check

Starting system check is systematic method to detect the cause of that engine does not start. Followings are the preconditions for performing this diagnosis.

- Battery is fully charged, and battery cable is securely connected.
- Engine speed at cranking is normal.
- Sufficient amount of fuel is supplied.
- No air mixed in the fuel.
- Air cleaner element and fuel filter is normal.
- Correct fuel is used.

Important:

Start with the DTC diagnosis relevant to fuel system if there is any.

Diagnostic aid

If there is relevant DTC to CKP sensor and CMP sensor, the engine will not start until memory clear is performed.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock

– Poor contact between terminal and wire

Test description

Numbers below indicate step numbers in the chart.

4. If the SCV-LOW circuit is shorted to ground, the SCV drive current will not be more than 900mA.

5. If the engine starts with the SCV connector disconnected, SCV system may be faulty. Also, if the engine does not start, the fuel system may be faulty.

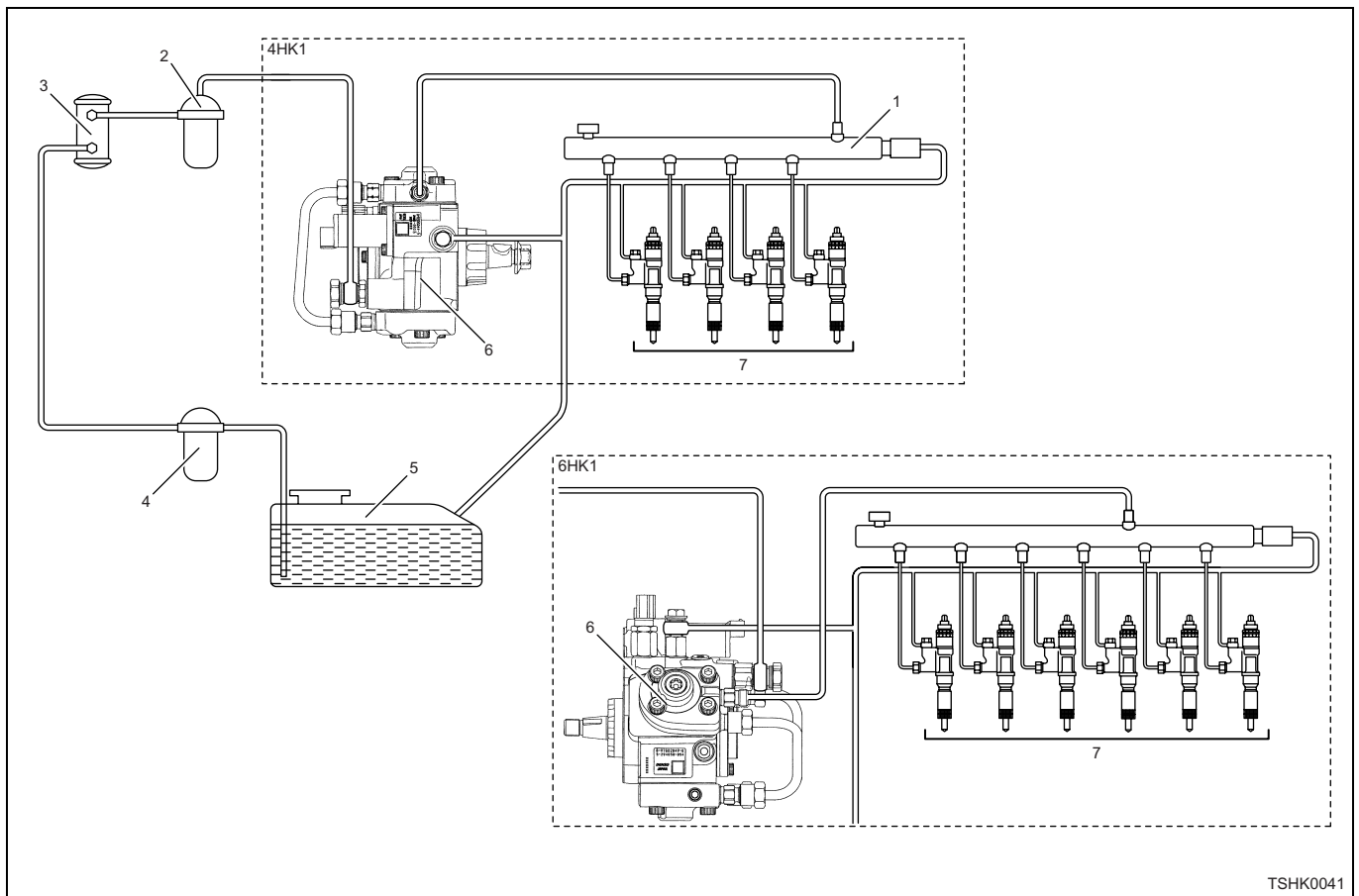
6. Check the signal and operation of each sensor and injector.

Step	Action	Value	YES	NO
1	Is the emergency stop switch equipped?	—	Turn the switch to “OFF”, and Go to Step 2.	Go to Step 2.
2	1. Turn the key switch to “ON”. 2. Crank the engine for 15 seconds. 3. Check the DTC. Is DTC detected?	—	Go to the relevant diagnosis of DTC detected.	Go to Step 3.
3	Is the scan tool (KW communication) available?	—	Go to Step 4.	Go to Step 11.
4	While cranking the engine, check for “SCV F/B” on the data display using scan tool. Is the “SCV F/B” more than the specified value?	900mA	Go to Step 5.	Go to Step 6.
5	1. Disconnect the SCV connector. 2. Crank the engine. Does the engine start?	—	Go to DTC P0090.	Go to “Fuel system check”.
6	Repair the SCV-LOW circuit between the ECM and the SCV. Is the procedure completed?	—	Go to Step 8.	—
7	1. Check the relevant items to the following using scan tool to see if the values are normal. (Refer to “Tech2 data reference value” for specified value.) • Engine coolant temperature (ECT) sensor • Common rail pressure sensor • EGR position sensor • Injector 2. If the trouble is detected, replace the circuit or sensor as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 8.

10D-169 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
8	1. Check for following faults. • Engine mechanical timing is off. • Improper installation position of flywheel • Excessive clogging in intake system • Excessive clogging in exhaust system 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	—
9	1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Turn the key switch to “OFF” for more than 10 seconds. 3. Start the engine. Is the trouble detected?	—	Go to Step 10.	Go to Step 3.
10	Check the DTC. Is DTC detected?	—	Go to the relevant diagnosis of DTC detected.	Check the repair, and Go to “OBD system check”.
11	1. Repair the SCV-LOW circuit between the ECM and the SCV. 2. If the trouble is detected, repair the circuit as required. Is the procedure completed?	—	Go to Step 12.	—
12	1. Check for following faults. • Engine mechanical timing is off. • Improper installation position of flywheel • Excessive clogging in intake system • Excessive clogging in exhaust system 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	—

Fuel system check



TSHK0041

Name

1. Common rail	5. Fuel tank
2. Fuel filter	6. Supply pump
3. Electromagnetic Pump	7. Injector
4. Pre-filter	

About fuel system

Fuel system consists of the fuel tank, fuel filter, supply pump, common rail, and injector each of which is connected by the fuel pipe.

Diagnostic aid

Followings are considered as the major possible cause of the fault in fuel system.

- Air mixed in the fuel system.
- Clogged fuel filter
- Damage, clogging, improper connection of fuel pipe
- Fuel tank fault
- Supply pump fault
- Injector fault
- Pressure limiter fault

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing

- Worn harness cladding
 - Wire disconnection inside harness cladding
- Following inspections are necessary to detect these causes.
- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire

10D-171 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
1	Check the fuel quality. 1. Drain fuel from the fuel tank. 2. Add proper fuel. 3. Bleed air from the fuel. 4. Start the engine. Does the engine start?	—	Go to Step 6.	Go to Step 2.
2	Check the fuel quantity. Is sufficient amount of fuel supplied?	—	Go to Step 3.	Supply fuel, and Go to Step 3.
3	Check if there are additional filters or parts, other than genuine fuel filter, pre-filter and electromagnetic pump, in the machine's fuel pipe. Are there any additional filters or parts?	—	Go to Step 4.	Go to Step 5.
4	1. Remove the additional filter and bleed air. • If the fuel resistance is increased, the DTC P1093 or P1094 may be detected. 2. Start the engine. Does the engine start?	—	Go to Step 6.	Go to Step 5.
5	1. Check for excessive dirt or clogging in the (main and pre-) fuel filters. 2. Check for excessive dirt or clogging in the electromagnetic pump filter. 3. If the trouble is detected, clean or replace. 4. If air is entered in the main filter, examine the cause and repair. Is the procedure completed?	—	Go to Step 6.	—
6	1. Check for damage, clogging, or improper connection in the fuel pipe. 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 7.	—
7	1. Check for following troubles in the fuel tank. • Foreign matter mixed in the fuel • Disconnection or damage in fuel supply pipe • Crush or damage in tank • Wrong assembly of fuel pipe • Clogging at filler neck • Water mixed in fuel 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 8.	—
8	Bleed air from the fuel. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Verify repair.	—

Intake system check

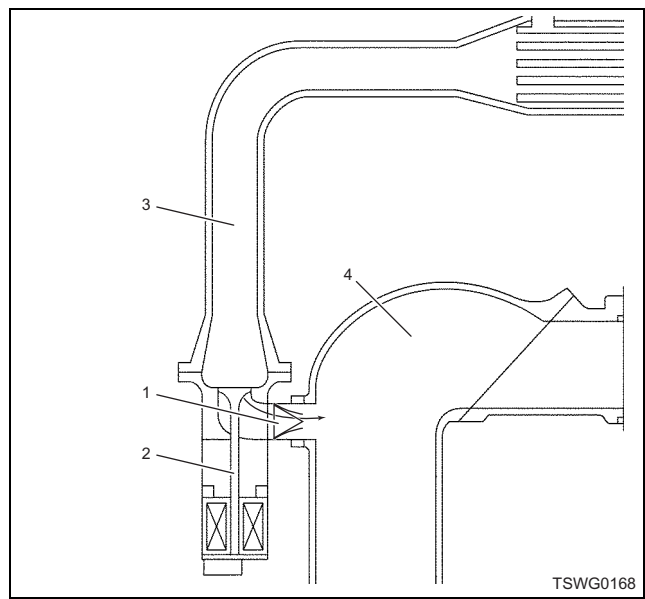
About intake system

The intake system consists of the air cleaner, intake pipe, turbocharger, etc. Intake air is supplied to the engine through the air cleaner and intake manifold.

Step	Action	Value	YES	NO
1	Check for excessive dirt or clogging in the air cleaner. Is the trouble detected?	—	Go to Step 2.	Go to Step 3.
2	Clean or replace the air cleaner. Is the procedure completed?	—	Go to Step 3.	—
3	1. Check for crush, breakage, or air leakage in the intake pipe. 2. Make sure that the intake pipe is a genuine part. • Check for bend or improper piping that may cause increasing in intake air resistance. 3. Check the reed valve for breakage. Is the trouble detected?	—	Go to Step 4.	Go to Step 5.
4	Repair or replace the intake pipe or reed valve. Is the procedure completed?	—	Go to Step 5.	—
5	Check the turbocharger. • Check for abnormal rattling in the turbine shaft. • Check for oil leakage. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 6.	Go to Step 7.
6	Repair or replace the turbocharger. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 7.	—
7	Repair the machine. Is the procedure completed?	—	Verify repair.	—

10D-173 Electronic control fuel injection system (Common rail type)

Reed valve check



If the reed valve is broken, bypass of intake air deteriorates air-fuel ratio (A/F), resulting in output lowering.
Check the reed valve for deformation or breakage.

Name

- 1. Reed valve
- 2. EGR Valve
- 3. Exhaust side
- 4. Intake side

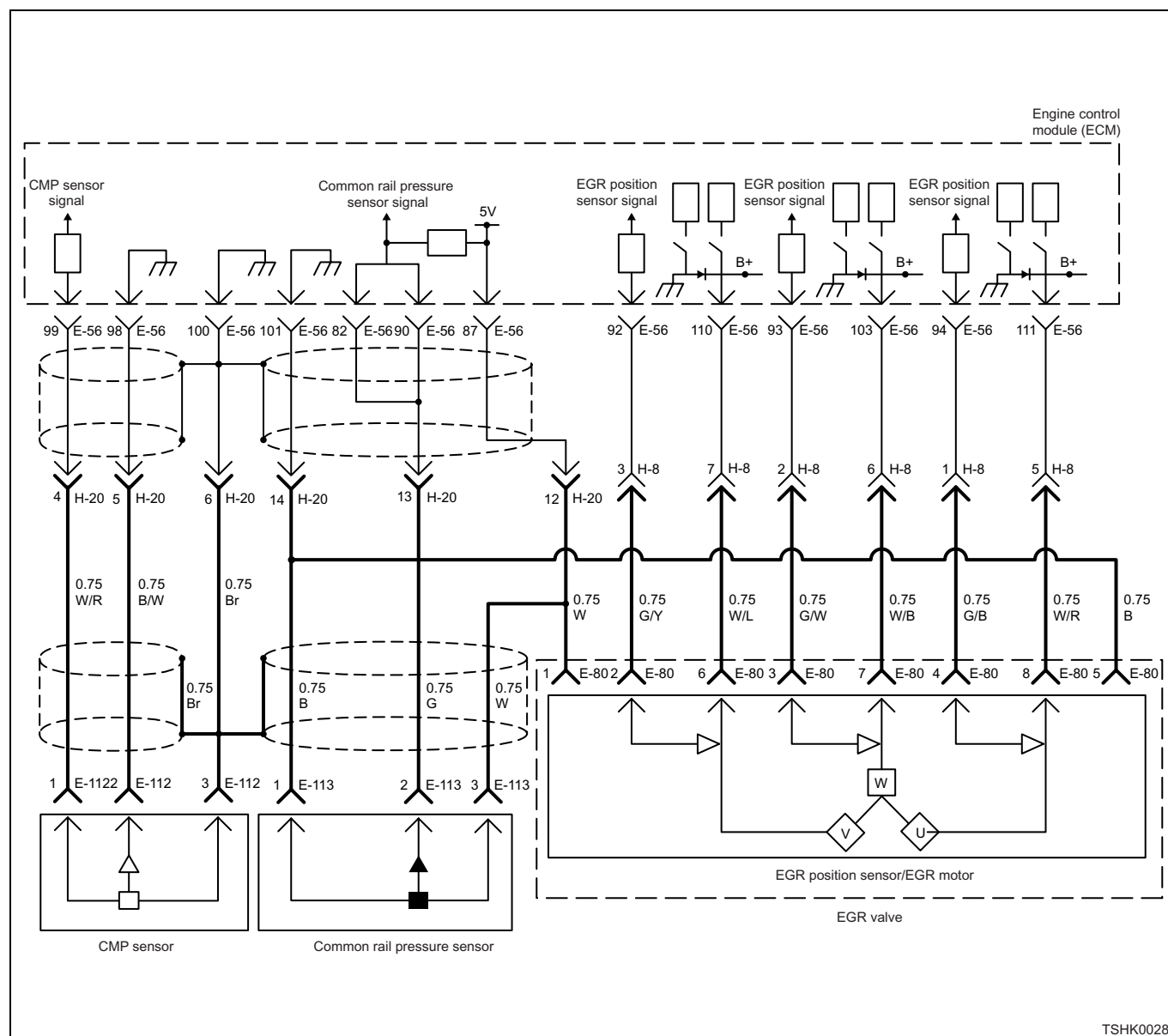
Exhaust system check

About exhaust system

The exhaust system consists of the exhaust pipe, tail pipe, etc.

Step	Action	Value	YES	NO
1	Check for crush, breakage, or exhaust leakage in the exhaust pipe and tail pipe. Is the trouble detected?	—	Go to Step 2.	Go to Step 3.
2	Repair or replace the exhaust pipe or tail pipe. Is the procedure completed?	—	Go to Step 3.	—
3	Repair the machine. Is the procedure completed?	—	Verify repair.	—

EGR control system check



TSHK0028

Circuit description

The ECM operates the EGR valve based on engine speed, engine coolant temperature, intake air temperature, fuel injection amount, and barometric pressure. The EGR motor drives the EGR valve, and the EGR position sensor detects the EGR valve opening angle.

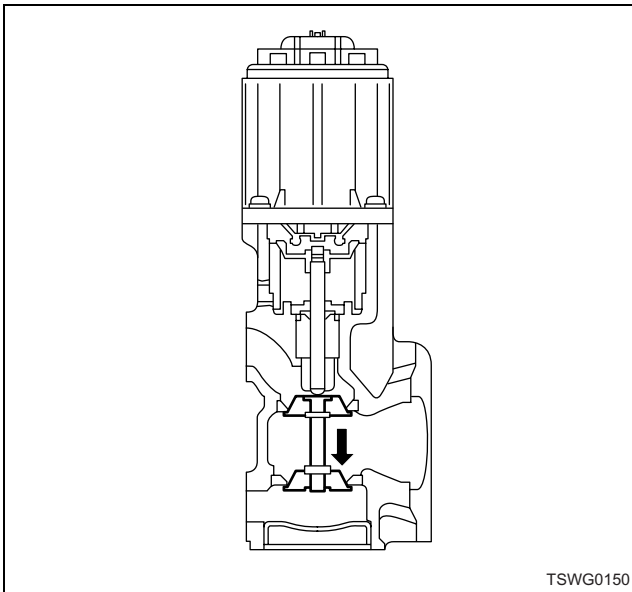
Step	Action	Value	YES	NO
1	1. Turn the key switch to "ON". 2. Check the DTC. Is DTC detected?	—	Go to the relevant diagnosis of DTC detected.	Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 8.

10D-175 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
3	1. Start the engine. 2. Warm-up the engine until the engine coolant temperature increases to 70°C. 3. Check the value for "EGR position" using scan tool. Is "EGR position" within the specified value?	±3%	Normal system	Go to Step 4.
4	1. Perform "EGR control test" using scan tool. 2. Press the "Up" "Down" soft key. 3. Check the value for "EGR position". Is "EGR position" within the specified value?	±3%	Go to Step 6.	Go to Step 5.
5	Replace the EGR valve. After replacing the EGR valve or ECM, the EGR valve position learning must be performed in the following procedure. 1. Turn the key switch to "ON". 2. Turn the key switch to "OFF". 3. Leave as it is for 10 seconds. Failure to perform above procedure may result in detection of DTC for EGR. Is the procedure completed?	—	Go to Step 6.	—
6	1. Check for damage or gas leakage in the EGR pipe. 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 7.	—
7	1. Start the engine. 2. Warm-up the engine until the engine coolant temperature increases to 80°C. 3. Check the value for "EGR position" using scan tool. Is "EGR position" within the specified value?	±3%	Verify repair.	Go to Step 3.
8	1. Remove the EGR valve. 2. Check the EGR valve for anchoring, clogging, etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Normal system
9	Replace the EGR valve. After replacing the EGR valve or ECM, the EGR valve position learning must be performed in the following procedure. 1. Turn the key switch to "ON". 2. Turn the key switch to "OFF". 3. Leave as it is for 10 seconds. Failure to perform above procedure may result in detection of DTC for EGR. Is the procedure completed?	—	Go to Step 10.	—

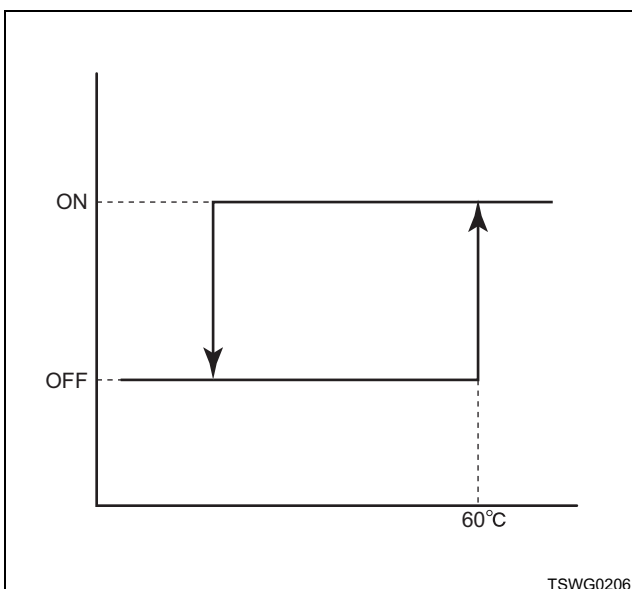
Step	Action	Value	YES	NO
10	1. Check for damage or gas leakage in the EGR pipe. 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 11.	—
11	1. Turn the key switch to "ON". 2. Check the DTC. Is DTC detected?	—	Go to the relevant diagnosis of DTC detected.	Go to Step 2.

EGR valve check



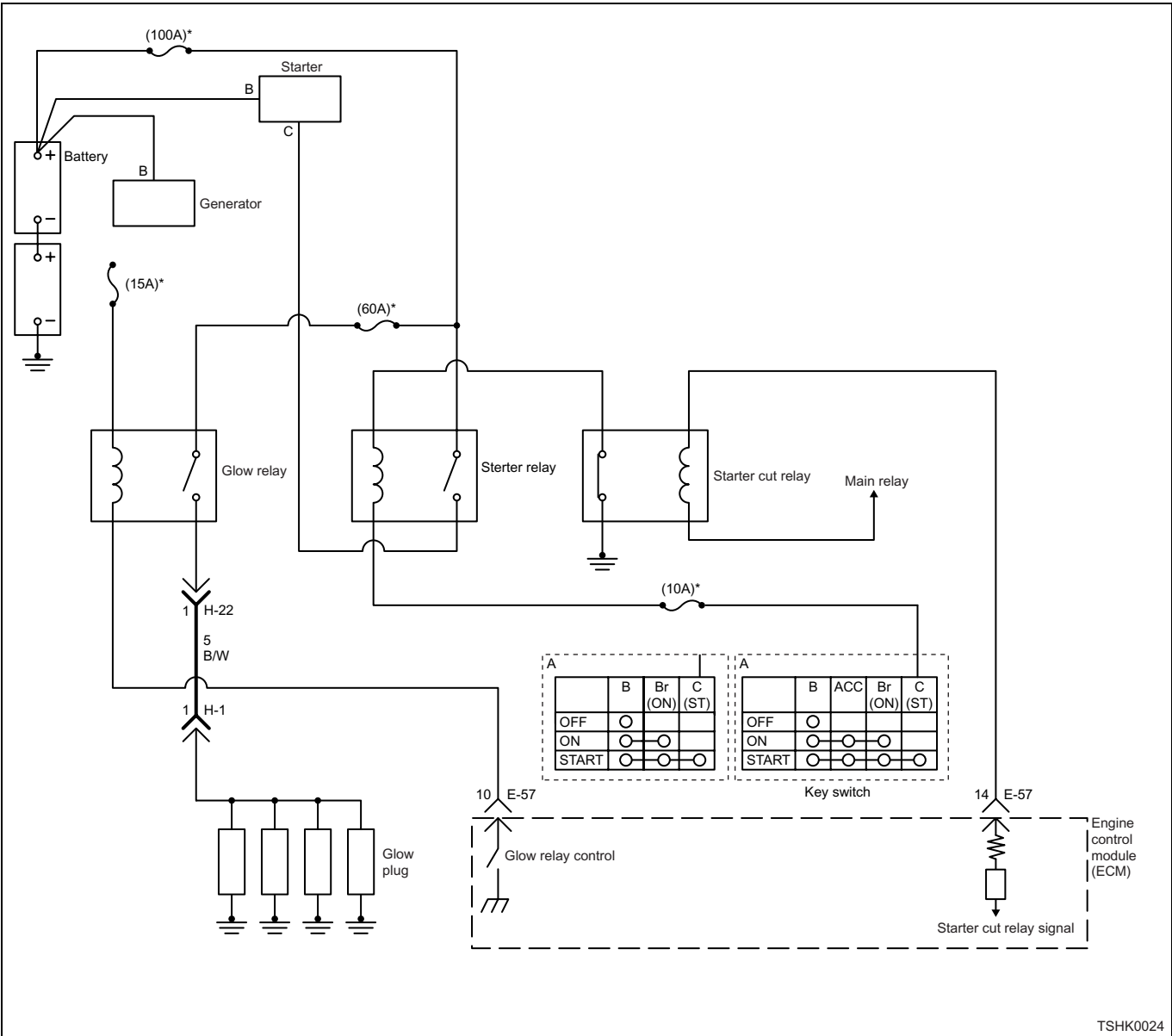
Push the EGR valve with finger to make sure it opens/closes smoothly. Also, make sure that the valve closes completely when the finger is released.

EGR hysteresis



QOS system check

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



Note:

The QOS circuit is the same for both the starter ECM control specifications and the safety relay specifications.

Circuit description

The QOS (Quick On Start) system consists of the ECM, glow relay, glow plug, and QOS indicator lamp. When the key switch is turned ON with low engine coolant temperatures, the ECM determines the glow time and operates the glow relay and QOS indicator lamp. After a certain time has elapsed, the ECM will turn the glow relay and QOS indicator lamp to "OFF".

Test description

Numbers below indicate step numbers in the chart.

7. The QOS indicator lamp turns on when the key switch is "ON" using lamp check function, even if the QOS is not operating.

12. The QOS indicator lamp goes off within maximum 10 seconds.

13. When the QOS indicator lamp does not go OFF after removing the connector from the meter, it can be judged as meter fault.

19. When the glow relay indication does not change during the glow plug test, it can be judged as ECM fault.

Step	Action	Value	YES	NO
1	Perform the OBD check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".

Step	Action	Value	YES	NO
2	1. Turn the key switch to "ON". 2. Check the DTC. Is relevant DTC to the engine coolant temperature sensor, QOS indicator lamp, or glow relay detected?	—	Go to the relevant diagnosis of DTC detected.	Go to Step 3.
3	Check the fuse. Check for blown out fuse relevant to the QOS system. Is the trouble detected?	—	Go to Step 4.	Go to Step 7.
4	Check for short circuit between the fuse, ECM, glow plug, and QOS indicator lamp. 1. Disconnect the harness from the fuse, glow relay, ECM, glow plug, and QOS indicator lamp. 2. Measure the resistance between each glow relay terminal, each QOS indicator lamp terminal, and the ground. Is the resistance specified value?	10 MΩ or more	Go to Step 6.	Go to Step 5.
5	Repair the short circuit between the fuse, ECM, glow plug, and QOS indicator lamp. Is the procedure completed?	—	Go to Step 6.	—
6	1. Replace the fuse. 2. Turn the key switch to "ON". 3. Make sure that the fuse is not blown. Is the trouble detected?	—	Go to Step 4.	Go to Step 7.
7	1. Turn the key switch to "OFF". 2. Turn the key switch to "ON". 3. Check the QOS indicator lamp. Does the QOS indicator lamp come on?	—	Go to Step 12.	Go to Step 8.
8	1. Turn the key switch to "OFF". 2. Remove the QOS indicator lamp. 3. Check the QOS indicator lamp for blow out. Is the trouble detected?	—	Go to Step 9.	Go to Step 10.
9	1. Replace the QOS indicator lamp. 2. Turn the key switch to "ON". 3. Check the QOS indicator lamp. Does the QOS indicator lamp come on?	—	Go to Step 7.	Go to Step 10.
10	1. Disconnect the ECM connector. 2. Measure the resistance between the QOS indicator lamp terminal and the harness between ECM and the ground. Is the resistance specified value?	10MΩ or more	Go to Step 7.	Go to Step 11.
11	Repair the QOS indicator lamp terminal-to-ECM harness. Is the procedure completed?	—	Go to Step 7.	—

10D-179 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
12	1. Turn the key switch to "OFF". 2. Turn the key switch to "ON". 3. Check the QOS indicator lamp. Does the QOS indicator lamp go OFF within 10 seconds?	—	Go to Step 14.	Go to Step 13.
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. If rewriting is not necessary, go to step 3. 3. Replace the ECM. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Is the procedure completed?	—	Go to Step 14.	—
14	1. Perform "Glow plug relay" test using scan tool. When the scan tool is not available, remove the relay and test it by itself. 2. Press the "ON" and "OFF" softkeys. Does the glow relay display (contact) "ON" and "OFF"?	—	Go to Step 15.	Go to Step 13.
15	1. Turn the key switch to "OFF". 2. Remove all the glow plugs. 3. Measure the resistance between each glow plug terminal and the ground. Is the resistance specified value?	6Ω (Normal temperature)	Go to Step 16.	Go to Step 20.
16	1. Turn the glow relay "ON" using the "Glow plug relay" test of the scan tool. When the scan tool is not available, remove the glow relay and short between the terminals. 2. Measure the voltage between each cylinder glow plug harness terminal and the ground using DMM. Are the voltages at all the cylinders more than specified value?	18V	Go to Step 17.	Go to Step 18.
17	1. Turn the glow relay "OFF" using the "Glow plug test" of the scan tool. When the scan tool is not available, remove the glow relay. 2. Measure the voltage between each cylinder glow plug harness terminal and the ground using DMM. Are the voltages at all the cylinders specified value?	0V	Normal system	Go to Step 19.
18	Repair the open circuit between the glow relay and the glow plug, or the short circuit to the ground circuit. Is the procedure completed?	—	Go to Step 21.	—

Electronic control fuel injection system (Common rail type) 10D-180

Step	Action	Value	YES	NO
19	Repair the power supply circuit between the glow relay and the glow plug, or the short circuit to the ignition power supply circuit. Is the procedure completed?	—	Go to Step 21.	—
20	Replace the glow plug. Is the procedure completed?	—	Go to Step 21.	—
21	1. Turn the glow relay "ON" using the "Glow plug test" of the scan tool. When the scan tool is not available, remove the glow relay and short between the terminals. 2. Measure the voltage between each cylinder glow plug harness terminal and the ground using DMM. Are the voltages at all the cylinders more than specified value?	18V	Go to Step 22.	Go to Step 16.
22	1. Turn the glow relay "OFF" using the "Glow plug test" of the scan tool. When the scan tool is not available, remove the glow relay. 2. Measure the voltage between each cylinder glow plug harness terminal and the ground using DMM. Are the voltages at all the cylinders specified value?	0V	Verify repair.	Go to Step 17.

List of diagnostic trouble code

List of diagnostic trouble codes

4HK1

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0087	227	No pump pressure feed (fuel leakage)	Common rail pressure does not increase to the required area.	900 rpm or more	Actual rail pressure is 15Mpa or less.	Approx. 3 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
P0088	118	Common rail pressure fault (1st stage)	Common rail pressure abnormal increase	• Key switch input voltage is 18V or more. • DTC P0088, P0192, P0193, or P1635 is not detected. • Actual rail pressure is 2 MPa or more, and 70 rpm or more.	Rail pressure is more than 185 MPa.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
		Common rail pressure fault (2nd stage)	Common rail pressure abnormal increase	• Key switch input voltage is 18V or more. • DTC P0088, P0192, P0193, or P1635 is not detected. • Actual rail pressure is 2 MPa or more, and 70 rpm or more.	Common rail pressure fault (1st stage) is completed, and rail pressure is more than 190 MPa.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
P0089	151	Common rail pressure fault (Excessive pressure feed in pump)	Common rail pressure abnormal increase	• Key switch input voltage is 18V or more. • DTC P0089, P0192, P0193, or P1635 is not detected. • Coolant temperature is 60°C or more, and 375 rpm or more. • Duty to SCV is 40% or more, or SCV target pressure feed is 90 mm³/sec or less.	Actual rail pressure is 40 MPa or more higher than target rail pressure.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1

Electronic control fuel injection system (Common rail type) 10D-182

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0090	247	SCV drive system open circuit, +B short or ground short	Open/short circuit of SCV/harness	• Main relay power supply voltage is 18V or more. • DTC P1630 is not detected. • SCV drive duty is between 10 — 90%.	When SCV drive current exceeds specified value for 2 seconds or more, or when difference between target and actual current exceeds specified value for 2 seconds or more.	Approx. 2 sec.	Engine stall and/or engine blow up are possible depending on the condition of open/short circuit. Black smoke emitted, excessive output Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*2
P0107	71	Barometric pressure sensor fault (low voltage fault)	Open/short circuit/deterioration of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected.	Barometric pressure sensor voltage is lower than 0.5 V.	Approx. 5 sec.	Due to back-up equivalent to 2500m • Black smoke emitted at high altitude • Output shortage at low altitude Back-up: Barometric pressure default setting (80 kPa) EGR stopped	ON	*2
P0108		Barometric pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected.	Barometric pressure sensor voltage is more than 3.8 V.	Approx. 4 sec.	Due to back-up equivalent to 2500m • Black smoke emitted at high altitude • Output shortage at low altitude Back-up: Barometric pressure default setting (80 kPa) EGR stopped	ON	*2
P0112	22	Intake air temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected.	Intake air temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Not in particular Back-up: Intake air temperature default setting (at starting: -10°C, at running: 25°C) EGR stopped	ON	*2
P0113		Intake air temperature sensor fault (high voltage fault)	Open/short circuit/deterioration of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected. • 3 minutes or more has elapsed after starting engine.	Intake air temperature sensor voltage is more than 4.95 V.	Approx. 4 sec.	Not in particular Back-up: Intake air temperature default setting (at starting: -10°C, at running: 25°C) EGR stopped	ON	*2

10D-183 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0117	23	Engine coolant temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected.	Engine coolant temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Start ability deteriorates at low temperatures or black smoke emission is possible, output lowering depending on conditions. Back-up: Coolant temperature default setting (at starting: -20°C, at driving: 80°C) EGR stopped	ON	*2
P0118		Engine coolant temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected. • 3 minutes or more has elapsed after starting engine.	Engine coolant temperature sensor voltage is more than 4.85 V.	Approx. 4 sec.	At normal temperature: Black smoke emission, greater engine combustion noise possible. During idling at low atmospheric temperatures: Rough idling, engine stall, white smoke emission possible. Back-up: Coolant temperature default setting (at starting: -20°C, at driving: 80°C) EGR stopped	ON	*2
P0182	211	Fuel temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected.	Combustion temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Operationality is affected. Back-up: Fuel temperature default setting (at starting: -20°C, at running: 70°C)	ON	*2
P0183		Fuel temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected. • 3 minutes or more has elapsed after starting engine.	Combustion temperature sensor voltage is more than 4.85 V.	Approx. 4 sec.	Not in particular Back-up: Fuel temperature default setting (at starting: -20°C, at running: 70°C)	ON	*2
P0192	245	Common rail pressure sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is less than 0.7 V.	Nearly simultaneous to fault occurrence	Engine blow up Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2
P0193		Common rail pressure sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is more than 4.5 V.	Nearly simultaneous to fault occurrence	Engine stall possible Output lowering Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2

Electronic control fuel injection system (Common rail type) 10D-184

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0201	271	Open circuit in injection nozzle #1 drive system	Open/short circuit in electrical wiring No. 1 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0611, P126 or P0201 is not detected.	No injector 1 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #1 stopped, EGR stopped	ON	*1
P0202	272	Open circuit in injection nozzle #2 drive system	Open/short circuit in electrical wiring No. 2 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0611, P1261 or P0202 is not detected.	No injector 2 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #2 stopped, EGR stopped	ON	*1
P0203	273	Open circuit in injection nozzle #3 drive system	Open/short circuit in electrical wiring No. 3 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0611, P1261 or P0203 is not detected.	No injector 3 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #3 stopped, EGR stopped	ON	*1
P0204	274	Open circuit in injection nozzle #4 drive system	Open/short circuit in electrical wiring No. 4 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0612, P1262 or P0204 is not detected.	No injector 4 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #4 stopped, EGR stopped	ON	*1
P0219	543	Overrun	Engine speed abnormally high	Key switch input voltage is 18V or more.	When the engine speed exceeds setting value (depending on the machine manufacturer)	Approx. 1 sec.	Output lowering Back-up: Limited injection amount 1 Limitation is lifted if the speed decreases	ON	*2
P0237	32	Boost pressure sensor fault (low voltage fault)	Open/short circuit/ breakage of sensor or harness	- Key switch input voltage is 18V or more. - DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is less than 0.1V.	Approx. 3 sec.	Operationality is affected. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2
P0238		Boost pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	- Key switch input voltage is 18V or more. - DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is more than 4.9V.	Approx. 3 sec.	Black smoke emitted Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2

10D-185 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0335	15	Crank sensor fault (no signal)	Open circuit in sensor/wiring	• CMP sensor pulse is normal. • DTC P0335, P0336, P0340, P0341 or P1345 is not detected. • Engine is running.	Cam signal exists but no crank signal.	When trouble occurs 14 out of 21 samples.	• Output lowering, white smoke emission, intense engine vibration possible • Engine stall possible (restart is possible when cam sensor is normal.) Back-up: Control based on cam when cam sensor is normal	ON	*1
P0336		Crank sensor fault (signal fault)	Broken teeth/unnecessary signal mixed (such as short circuit with other wiring)	• CMP sensor pulse is normal. • DTC P0335, P0336, P0340, P0341 or P1345 is not detected. • Engine is running.	Number of pulse for crank signal is mismatched.	When trouble occurs 14 out of 21 samples.	• Output lowering, white smoke emission, intense engine vibration possible • Engine stall possible (restart is possible when cam sensor is normal.) Back-up: Control based on cam when cam sensor is normal	ON	*1
P0340	14	Cam sensor fault (no signal)	Open circuit in sensor/wiring	• Key switch input voltage is 18V or more. • Crank pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • Engine is running.	Crank signal exists but no cam signal.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Engine running based on crank when it is normal After engine stops: Unable to identify cylinder (unable to restart)	ON	*1
P0341		Cam sensor fault (signal fault)	Broken teeth/unnecessary signal mixed (such as short circuit with other wiring)	• Key switch input voltage is 18V or more. • Crank pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • Engine is running.	Number of pulse for cam signal is mismatched.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Engine running based on crank when it is normal After engine stops: Unable to identify cylinder (unable to restart)	ON	*1
P0380	66	Glow relay fault	Open/short circuit/damage of relay or harness	• Key switch input power supply voltage is higher than 16 V but lower than 32 V.	No glow relay monitor signal exists against glow relay drive indication.	When trouble occurs 25 out of 30 samples.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*1
P0381	67	Glow lamp fault	Open/short circuit/damage of lamp or harness	• Key switch input voltage is 18 V or more. • DTC P0381 is not detected.	Glow lamp drive indication signal is unmatched with glow lamp monitor signal.	When trouble occurs 25 out of 30 samples.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	

Electronic control fuel injection system (Common rail type) 10D-186

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0487	44	EGR position fault (Brushless specification)	Open/short circuit/ damage of sensor harness	• Main relay input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	EGR position output signal is abnormal.	Approx. 3 sec.	Operationality is not affected. Back-up: Instruction to fully close EGR valve	ON	*1
P0488	45	EGR valve control fault	Trouble/ open circuit or valve engage/ stuck in drive motor side	• DTC P1630, P1635, P0487, P0488, or P1635 is not detected. • Main relay voltage is between 20 — 32 V. • Difference between target EGR opening angle and actual one is 20% or less.	Difference between target valve lift and actual position is more than 20%.	Approx. 10 sec.	Operationality is not affected. Back-up: Instruction to fully close EGR valve	ON	*2
P0522	294	Engine oil pressure sensor fault (low voltage fault)	Open/short circuit/ breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1633 is not detected.	Engine oil pressure sensor voltage is less than 0.1V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*1
P0523		Engine oil pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1633 is not detected.	Engine oil pressure sensor voltage is more than 4.85V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P0601	53	ROM fault	ROM fault	—	ROM is faulty.	—	Engine stopped Back-up: Engine stopped	ON	*2
P0603	54	EEPROM fault	EEPROM fault	—	EEPROM is faulty.	—	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P0606	51	CPU fault	CPU fault	—	Sub-CPU detects main CPU fault in 100 msec after key switch ON. (SUB-CPU resets CPU.)	Nearly simultaneous to fault occurrence	Output lowering Back-up: Limited injection amount 2 (multi-injection stopped) SUB-CPU stops CPU.	ON	*2
					Sub-CPU detects main CPU fault in 100 msec after key switch ON. (SUB-CPU resets CPU.)	Nearly simultaneous to fault occurrence	Unable to start Back-up: Limited injection amount 2 (multi-injection stopped) SUB-CPU stops CPU.	ON	Diagnosed for 100msec only after KEY-ON.
	52	CPU monitoring IC fault	Sub-CPU fault	• 480 msec or more has elapsed after key switch ON. • Key switch input power supply voltage is higher than 16 V.	RUN-SUB pulse does not change for 20 msec or more.	Nearly simultaneous to fault occurrence	Output lowering Back-up: Limited injection amount 1	ON	*2

10D-187 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0611	34	Charge circuit fault (bank 1)	ECU charge circuit 1 fault (internal burnout, open circuit, etc.)	Main relay power supply voltage is 18V or more.	When charge circuit bank 1 voltage inside ECU is low.	Approx. 1.5 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault, engine stall are possible. Back-up: Common 1 stop (#1, #4 cylinders stopped), EGR stopped	ON	*2
P0612		Charge circuit fault (bank 2)	ECU charge circuit 2 fault (internal burnout, open circuit, etc.)		When charge circuit bank 2 voltage inside ECU is low.	Approx. 1.5 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault, engine stall are possible. Back-up: Common 2 stop (#2, #3 cylinders stopped), EGR stopped	ON	
P0650	77	Check engine lamp fault	Lamp fault	- Key switch input voltage is 18V or more. - DTC P0650 is not detected.	No check engine lamp monitor signal exists.	Approx. 1.5 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	Does not come on.	*2
P1093	227	No pump pressure feed (fuel leakage)	Fuel leakage (large amount)	- Key switch input voltage is 18V or more. 1200 rpm or more - Duty to SCV is 33% or less, or pressure feed is 28000mm³/sec or more. - DTC P0192, P0193, P1093, P0090, P1291, P1292, or P1635 is not detected.	Actual rail pressure is 50 MPa or more lower than target rail pressure.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, engine stall, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
P1095	225	Pressure limiter open	Pressure limiter is opened.	- Key switch input voltage is 18V or more. - DTC P1095, P0192, P0193, P1630, or P1635 is not detected. 50 rpm or more	Pressure limiter is opened.	Approx. 1 sec.	Output lowering, hunting Back-up: Limited injection amount 1	ON	*1

Electronic control fuel injection system (Common rail type) 10D-188

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1112	295	Boost temperature sensor fault (low voltage fault)	Open/short circuit/ breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1634 is not detected.	Boost temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P1113		Boost temperature sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • Coolant temperature is 50°C or more. • 3 (or 5) minutes have passed after engine starting (depending on the machine manufacturer) • DTC P1634 is not detected.	Boost temperature sensor voltage is more than 4.95V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P1173	542	Overheat	Overheat condition	• Key switch input voltage is 18V or more. • DTC P1630, P1633, P0117, or P0118 is not detected. • Under operation	• Coolant temperature is more than 120°C.	Approx. 5 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	Does not come on.	*2
P1261	158	Injection nozzle common 1 drive system fault	Open/short circuit in injector common 1-side electrical wiring, EDU output part fault	• Main relay power supply voltage is 18V or more. • 70 rpm or more • None of the following DTC sets are detected; DTC P0611, P1261 and P0201; DTC P0611, P1261 and P0202; DTC P0611, P1261 and P0203.	No injector 1 and 4 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Engine stall is possible. Back-up: Common 1 stop (#1, #4 cylinders stopped), EGR stopped	ON	*1
P1262	159	Injection nozzle common 2 drive system fault	Open/short circuit in injector common 2-side electrical wiring, EDU output part fault	• Main relay power supply voltage is 18V or more. • 70 rpm or more • None of the following DTC sets are detected; DTC P0612, P1262 and P0204; DTC P0612, P1262 and P0205; DTC P0612, P1262 and P0206.	No injector 2 and 3 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Engine stall is possible. Back-up: Common 2 stop (#2, #3 cylinders stopped), EGR stopped	ON	*1

10D-189 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1271	24	Accelerator sensor 1-2 comparison fault	Difference in opening angle between accelerator sensors 1-2 is 45% or more.	- Key switch input voltage is 18V or more. - DTC P1630, P1631, P1271, P1277, P1278, P1282, or P1283 is not detected.	Difference in opening angle between accelerator sensors 1 and 2 is 45% or more.	Approx. 3 sec.	1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1277		Accelerator sensor 1 fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	- Key switch input voltage is 18V or more. - DTC P1630, P1277, or P1631 is not detected.	Accelerator sensor 1 voltage is lower than 0.2 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1278		Accelerator sensor 1 fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	- Key switch input voltage is 18V or more. - DTC P1630, P1278, or P1631 is not detected.	Accelerator sensor 1 voltage is more than 4.9 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1282		Accelerator sensor 2 fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	- Key switch input voltage is 18V or more. - DTC P1630, P1282, or P1631 is not detected.	Accelerator sensor 2 voltage is lower than 0.2 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1283		Accelerator sensor 2 fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	- Key switch input voltage is 18V or more. - DTC P1630, P1283, or P1631 is not detected.	Accelerator sensor 2 voltage is more than 4.9 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%.	Does not come on.	*1

Electronic control fuel injection system (Common rail type) 10D-190

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1345	16	Cam sensor out of phase	Camshaft gear/ crankshaft gear installing angle is out of phase, or damage in gear.	• Key switch input voltage is 18V or more. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • CMP sensor pulse is normal. • Crank pulse is normal.	Correct cam pulse does not exist in crank gap position.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*1
P1625	416	Main relay system fault (Not enter)	Open/ ground short circuit in harness, relay OFF anchoring	• Key switch input voltage is 18V or more. • DTC P1630 is not detected. • 3 seconds or more has elapsed after key switch ON. • Main relay drive indication ON	Main relay system voltage is 1V or less with main relay coil output ON.	Approx. 2 sec.	Engine does not start. Back-up: Back-up: No back-up action	ON	*2
			Harness +B short, relay ON anchoring	• DTC P1625 or P0606 is not detected.	Relay does not cut off despite of main relay coil output OFF indication.	Approx. 5 sec.	Vehicle power supply cannot be shut off. Back-up: Back-up: No back-up action	ON	*1
P1630	36	A/D conversion fault	A/D conversion fault	—	A/D conversion failure	Immediately	Output lowering, Black smoke emitted Back-up: Analog sensor system default processing Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*2

10D-191 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1631	55	Voltage fault in 5-V power supply 1	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM.	• DTC P1630 is not detected. • Key switch input power supply voltage is between 16 — 32 V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less, when battery voltage is between 16V — 32V.	Approx. 0.5 sec.	Accelerator opening angle is controlled to 0%. Back-up: Same to accelerator sensor fault	ON	*2
P1632		Voltage fault in 5-V power supply 2		• DTC P1630 is not detected. • Key switch input power supply voltage is between 16 — 32 V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less, when battery voltage is between 16V — 32V.	Approx. 0.5 sec.	Due to back-up equivalent to 2500m • Black smoke emitted at high altitude • Output shortage at low altitude Back-up: Same to barometric pressure and intake air temperature sensor fault	ON	*2
P1633		Voltage fault in 5-V power supply 3		• DTC P1630 is not detected. • Key switch input power supply voltage is between 16 — 32 V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less, when battery voltage is between 16V — 32V.	Approx. 0.5 sec.	Startability deteriorates at low temperatures or black smoke emission is possible, output lowering or operability is affected depending on conditions. Back-up: Same to coolant temperature, fuel temperature, and oil pressure sensor fault	ON	*2
P1634		Voltage fault in 5-V power supply 4		• DTC P1630 is not detected. • Key switch input power supply voltage is between 16 — 32 V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less, when battery voltage is between 16V — 32V.	Approx. 0.5 sec.	Operability is affected. Back-up: Same to boost pressure and boost temperature sensor fault	ON	*2
P1635		Voltage fault in 5-V power supply 5		• DTC P1630 is not detected. • Key switch input power supply voltage is between 16 — 32 V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less, when battery voltage is between 16V — 32V.	Approx. 0.5 sec.	Engine blow up, output lowering, black smoke emission, engine stall are possible. Back-up: Same to rail pressure sensor fault and EGR position sensor fault	ON	*2
U2104	84	CAN Bus fault	CAN communication fault	• Key switch input voltage is 12V or more.	Bus-off is detected.	At 3 sec. continuously	Set to idle speed. Back-up: Running at 1500 rpm.	ON	*3

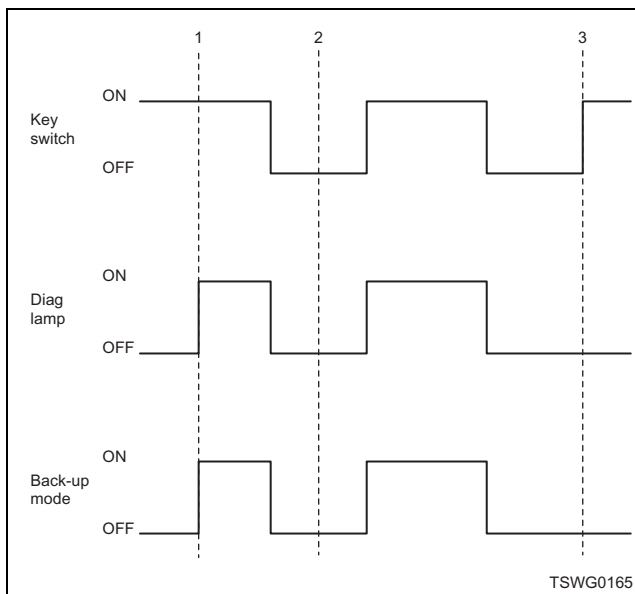
DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
U2106	85	CAN timeout fault	CAN communication fault	- DTC U2104 is not detected. - Key switch input voltage is 12V or more.	CAN data reception does not complete at a set time.	At 1 sec. continuously	Set to idle speed. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*3

About recovery from failure

There are three modes for recovery from failure. To clear the fault indication displayed on the monitor of the machine, one more ignition cycle may be needed after the following ignition cycle.

*1

Even if the DTC has restored normally, the diagnosis lamp and back-up mode are not restored in the ignition cycle that the DTC is detected. After turning the key switch OFF, DTC diagnosis is performed when the vehicle starts again. If it is judged as normal, everything will be recovered to normal from the next ignition cycle.

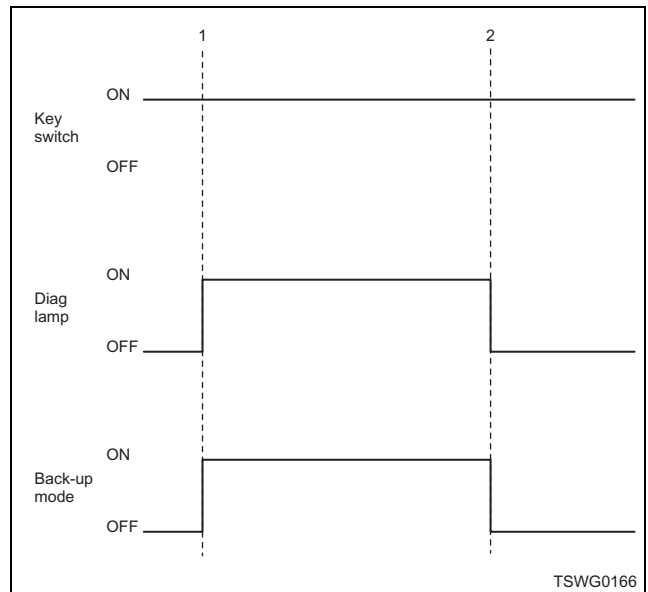


Name _____

1. DTC is detected.
2. Repair and inspection
3. Returned to normal.

*2

When the DTC has recovered to normal condition in the ignition cycle that the DTC is detected, the diagnosis lamp and back up mode will also be recovered.



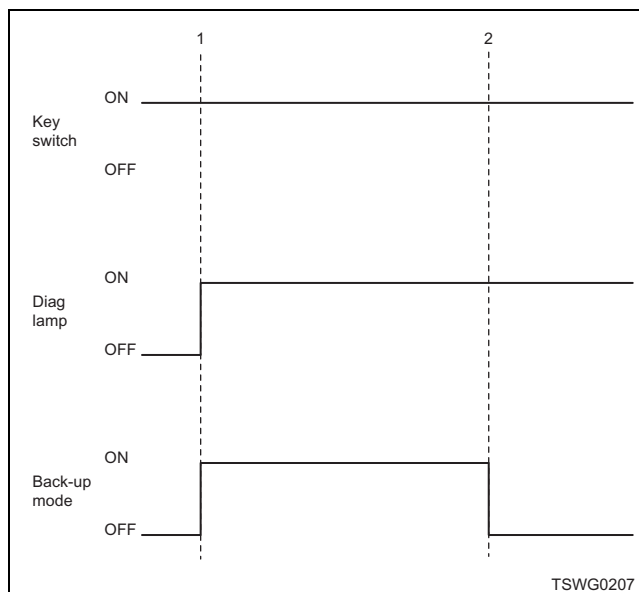
Name _____

1. DTC is detected.
2. Returned to normal.

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*3

When the DTC has recovered to normal in the ignition cycle that the DTC is detected, the back-up mode will be recovered normally, but the diagnosis lamp does not go off.



Name

1. DTC is detected.
 2. Returned to normal.
-

6HK1

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0087	227	No pump pressure feed (fuel leakage)	Common rail pressure does not increase to the required area.	900 rpm or more	Actual rail pressure is 15MPa or less at 900rpm or more.	Approx. 3 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
P0088	118	Common rail pressure fault (1st stage)	Common rail pressure abnormal increase	• Key switch input voltage is 18V or more. • DTC P0088, P0192, P0193, or P1635 is not detected. • Actual rail pressure is 2 MPa or more, and 70 rpm or more.	Rail pressure is more than 185 MPa.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
		Common rail pressure fault (2nd stage)	Common rail pressure abnormal increase	• Key switch input voltage is 18V or more. • DTC P0088, P0192, P0193, or P1635 is not detected. • Actual rail pressure is 2 MPa or more, and 70 rpm or more.	Common rail pressure fault (1st stage) is completed, and rail pressure is more than 190 MPa.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
P0089	151	Common rail pressure fault (Excessive pressure feed in pump)	Common rail pressure abnormal increase	• Key switch input voltage is 18V or more. • DTC P0089, P0192, P0193, or P1635 is not detected. • Coolant temperature is 60°C or more, and 375 rpm or more. • Duty to SCV is 40% or more, or SCV target pressure feed is 90 mm³/sec or less.	Actual rail pressure is 40 MPa or more higher than target rail pressure.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1

10D-195 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0090	247	SCV drive system open circuit, +B short or ground short	Open/short circuit of SCV/harness	• Main relay power supply voltage is 18V or more. • DTC P1630 is not detected. • SCV drive duty is between 10 — 90%.	When SCV drive current exceeds specified value for 2 seconds or more, or when difference between target and actual current exceeds specified value for 2 seconds or more.	Approx. 2 sec.	Engine stall and/or engine blow up are possible depending on the condition of open/short circuit. Black smoke emitted, excessive output Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*2
P0107	71	Barometric pressure sensor fault (low voltage fault)	Open/short circuit/deterioration of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected.	Barometric pressure sensor voltage is lower than 0.5 V.	Approx. 5 sec.	Due to back-up equivalent to 2500m • Black smoke emitted at high altitude • Output shortage at low altitude Back-up: Barometric pressure default setting (80 kPa) EGR stopped	ON	*2
P0108		Barometric pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected.	Barometric pressure sensor voltage is more than 3.8 V.	Approx. 5 sec.	Due to back-up equivalent to 2500m • Black smoke emitted at high altitude • Output shortage at low altitude Back-up: Barometric pressure default setting (80 kPa) EGR stopped	ON	*2
P0112	22	Intake air temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected.	Intake air temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Not in particular Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2
P0113		Intake air temperature sensor fault (high voltage fault)	Open/short circuit/deterioration of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected. • 3 minutes or more has elapsed after starting engine.	Intake air temperature sensor voltage is more than 4.95 V when 3 minutes or more has elapsed after starting engine.	Approx. 4 sec.	Not in particular Back-up: Intake air temperature default setting (at starting: -10°C, at running: 25°C) EGR stopped	ON	*2

Electronic control fuel injection system (Common rail type) 10D-196

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0117	23	Engine coolant temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected.	Engine coolant temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Start ability deteriorates at low temperatures or black smoke emission is possible, output lowering depending on conditions. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2
P0118		Engine coolant temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected. • 3 minutes or more has elapsed after starting engine.	Engine coolant temperature sensor voltage is more than 4.85 V.	Approx. 4 sec.	At normal temperature: Black smoke emission, greater engine combustion noise possible. During idling at low atmospheric temperatures: Rough idling, engine stall, white smoke emission possible. Back-up: Coolant temperature default setting (at starting: -20°C, at driving: 80°C) EGR stopped	ON	*2
P0182	211	Fuel temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected.	Combustion temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Operationality is affected. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2
P0183		Fuel temperature sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected. • 3 minutes or more has elapsed after starting engine.	Combustion temperature sensor voltage is more than 4.85 V.	Approx. 4 sec.	Not in particular Back-up: Fuel temperature default setting (at starting: -20°C, at running: 70°C)	ON	*2
P0192	245	Common rail pressure sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is less than 0.7 V.	Nearly simultaneous to fault occurrence	Engine blow up Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2
P0193		Common rail pressure sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is more than 4.5 V.	Nearly simultaneous to fault occurrence	Engine stall possible Output lowering Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*2

10D-197 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0201	271	Open circuit in injection nozzle #1 drive system	Open/short circuit in electrical wiring No. 1 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0611, P126 or P0201 is not detected.	No injector 1 monitor input signal exists.	Approx. 3 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, output lowering Back-up: Injection for cylinder #1 stopped, EGR stopped	ON	*1
P0202	272	Open circuit in injection nozzle #2 drive system	Open/short circuit in electrical wiring No. 2 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0611, P1261 or P0202 is not detected.	No injector 2 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #2 stopped, EGR stopped	ON	*1
P0203	273	Open circuit in injection nozzle #3 drive system	Open/short circuit in electrical wiring No. 3 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0611, P1261 or P0203 is not detected.	No injector 3 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #3 stopped, EGR stopped	ON	*1
P0204	274	Open circuit in injection nozzle #4 drive system	Open/short circuit in electrical wiring No. 4 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0612, P1262 or P0204 is not detected.	No injector 4 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #4 stopped, EGR stopped	ON	*1
P0205	275	Open circuit in injection nozzle #5 drive system	Open/short circuit in electrical wiring No. 5 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0612, P1262 or P0205 is not detected.	No injector 5 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #5 stopped, EGR stopped	ON	*1
P0206	276	Open circuit in injection nozzle #6 drive system	Open/short circuit in electrical wiring No. 6 cylinder injector	- Main relay power supply voltage is 18V or more. 70 rpm or more - DTC P0612, P1262 or P0206 is not detected.	No injector 6 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Back-up: Injection for cylinder #6 stopped, EGR stopped	ON	*1
P0219	543	Overrun	Engine speed abnormally high	Key switch input voltage is 18V or more.	When the engine speed exceeds setting value (depending on the machine manufacturer)	Approx. 1 sec.	Output lowering Back-up: Limited injection amount 1 Limitation is lifted if the speed decreases	ON	*2

Electronic control fuel injection system (Common rail type) 10D-198

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0237	32	Boost pressure sensor fault (low voltage fault)	Open/short circuit/ breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is less than 0.1V.	Approx. 3 sec.	Operationality is affected. Back-up: Boost pressure default setting (150kPa) Boost pressure correction/EGR stopped	ON	*2
P0238		Boost pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is more than 4.9V.	Approx. 3 sec.	Black smoke emitted Back-up: Boost pressure default setting (150kPa) Boost pressure correction/EGR stopped	ON	*2
P0335	15	Crank sensor fault (no signal)	Open circuit in sensor/ wiring	• CMP sensor pulse is normal. • DTC P0335, P0336, P0340, P0341 or P1345 is not detected. • Engine is running.	Cam signal exists but no crank signal.	When trouble occurs 14 out of 21 samples.	• Output lowering, white smoke emission, intense engine vibration possible • Engine stall possible (restart is possible when cam sensor is normal.) Back-up: Control based on cam when cam sensor is normal	ON	*1
P0336		Crank sensor fault (signal fault)	Broken teeth/ unnecessary signal mixed (such as short circuit with other wiring)	• CMP sensor pulse is normal. • DTC P0335, P0336, P0340, P0341 or P1345 is not detected. • Engine is running.	Number of pulse for crank signal is mismatched.	When trouble occurs 14 out of 21 samples.	• Output lowering, white smoke emission, intense engine vibration possible • Engine stall possible (restart is possible when cam sensor is normal.) Back-up: Control based on cam when cam sensor is normal	ON	*1

10D-199 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0340	14	Cam sensor fault (no signal)	Open circuit in sensor/wiring	• Key switch input voltage is 18V or more. • Crank pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • Engine is running.	Crank signal exists but no cam signal.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Engine running based on crank when it is normal After engine stops: Unable to identify cylinder (unable to restart)	ON	*1
P0341		Cam sensor fault (signal fault)	Broken teeth/unnecessary signal mixed (such as short circuit with other wiring)	• Key switch input voltage is 18V or more. • Crank pulse is normal. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • Engine is running.	Number of pulse for cam signal is mismatched.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Engine running based on crank when it is normal After engine stops: Unable to identify cylinder (unable to restart)	ON	*1
P0380	66	Glow relay fault	Open/short circuit/damage of relay or harness	• Key switch input power supply voltage is higher than 16 V but lower than 32 V.	No glow relay monitor signal exists against glow relay drive indication.	When trouble occurs 25 out of 30 samples.	Operationality is not affected. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*1
P0381	67	Glow lamp fault	Open/short circuit/damage of lamp or harness	• Key switch input voltage is 18 V or more. • DTC P0381 is not detected.	Glow lamp drive indication signal is unmatched with glow lamp monitor signal.	When trouble occurs 25 out of 30 samples.	Operationality is not affected. Back-up: Back-up: No back-up action		
P0487	44	EGR position fault (Brushless specification)	Open/short circuit/damage of sensor harness	• Main relay input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	EGR position output signal is abnormal.	Approx. 3 sec.	Exhaust gas is affected. Back-up: Instruction to fully close EGR valve	ON	*1
P0488	45	EGR valve control fault	Trouble/open circuit or valve engage/stuck in drive motor side	• DTC P1630, P1635, P0487, P0488, or P1635 is not detected. • Main relay voltage is between 20 — 32 V. • Difference between target EGR opening angle and actual one is 20% or less.	Difference between target valve lift and actual position is more than 20%.	Approx. 10 sec.	Exhaust gas is affected. Back-up: Instruction to fully close EGR valve	ON	*2
P0522	294	Engine oil pressure sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1633 is not detected.	Engine oil pressure sensor voltage is less than 0.098 V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*1

Electronic control fuel injection system (Common rail type) 10D-200

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0523	294	Engine oil pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1633 is not detected.	Engine oil pressure sensor voltage is more than 4.85 V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P0601	53	ROM fault	ROM fault	—	ROM is faulty.	—	Engine stopped Back-up: Engine stopped	ON	*2
P0603	54	EEPROM fault	EEPROM fault	—	EEPROM is faulty.	—	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P0606	51	CPU fault	CPU fault	—	Sub-CPU detects main CPU fault in 100 msec after key switch ON. (SUB-CPU resets CPU.)	Nearly simultaneous to fault occurrence	Output lowering, hunting Back-up: Limited injection amount 2 (multi-injection stopped) SUB-CPU stops CPU.	ON	*2
					Sub-CPU detects main CPU fault in 100 msec after key switch ON. (SUB-CPU resets CPU.)	Nearly simultaneous to fault occurrence	Unable to start Back-up: Limited injection amount 2 (multi-injection stopped) SUB-CPU stops CPU.		Diagnosed for 100msec only after KEY-ON.
	52	CPU monitoring IC fault	Sub-CPU fault	• 480 msec or more has elapsed after key switch ON. • Key switch input power supply voltage is higher than 16 V.	RUN-SUB pulse does not change for 20 msec or more.	Nearly simultaneous to fault occurrence	Output lowering Back-up: Limited injection amount 1	ON	*2
P0611	34	Charge circuit fault (bank 1)	ECU charge circuit 1 fault (internal burnout, open circuit, etc.)	• Main relay power supply voltage is 18V or more.	When charge circuit bank 1 voltage inside ECU is low.	Approx. 1.5 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault, engine stall are possible. Back-up: Common 1 stop (#1, #2, #3 cylinders stopped), EGR stopped	ON	*2
P0612	34	Charge circuit fault (bank 2)	ECU charge circuit 2 fault (internal burnout, open circuit, etc.)		When charge circuit bank 2 voltage inside ECU is low.	Approx. 1.5 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault, engine stall are possible. Back-up: Common 2 stop (#4, #5, #6 cylinders stopped), EGR stopped	ON	
P0650	77	Check engine lamp fault	Lamp fault	• Key switch input voltage is 18V or more. • DTC P0650 is not detected.	No check engine lamp monitor signal exists.	Approx. 1.5 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	Does not come on.	*2

10D-201 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1093	227	No pump pressure feed (fuel leakage)	Fuel leakage (large amount)	• Key switch input voltage is 18V or more. • 1200 rpm or more • Duty to SCV is 33% or less, or pressure feed is 28000mm³/sec or more. • DTC P0192, P0193, P1093, P0091, P0092, P1291, P1292, or P1635 is not detected.	Actual rail pressure is 50 MPa or more lower than target rail pressure.	Approx. 5 sec.	Intense engine vibration, rough idling, output lowering, blow up fault, black smoke emitted, engine stall, and excessive output are possible. Back-up: Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*1
P1095	225	Pressure limiter open	Pressure limiter is opened.	• Key switch input voltage is 18V or more. • DTC P1095, P0192, P0193, P1630, or P1635 is not detected. • 50 rpm or more	Pressure limiter is opened.	Approx. 1 sec.	Output lowering Back-up: Limited injection amount 1	ON	*1
P1112	295	Boost temperature sensor fault (low voltage fault)	Open/short circuit/ breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1634 is not detected.	Boost temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P1113		Boost temperature sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • Coolant temperature 50°C or more, or 3 (or 5) minutes have passed after engine starting (depending on the machine manufacturer) • DTC P1634 is not detected.	Boost temperature sensor voltage is more than 4.95V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P1173	542	Overheat	Overheat condition	• Key switch input voltage is 18V or more. • DTC P1630, P1633, P0117, or P0118 is not detected. • Under operation	• Coolant temperature is more than 120°C while engine is operated.	Approx. 5 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	Does not come on.	*2
P1261	158	Injection nozzle common 1 drive system fault	Open/short circuit in injector common 1-side electrical wiring, EDU output part fault	• Main relay power supply voltage is 18V or more. • 70 rpm or more • None of the following DTC sets are detected; DTC P0611, P1261 and P0201; DTC P0611, P1261 and P0202; DTC P0611, P1261 and P0203.	No injector 1, 3, 5 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Engine stall is possible. Back-up: Common 1 stop (#1, #2, #3 cylinders stopped), EGR stopped	ON	*1

Electronic control fuel injection system (Common rail type) 10D-202

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1262	159	Injection nozzle common 2 drive system fault	Open/short circuit in injector common 2-side electrical wiring, EDU output part fault	• Main relay power supply voltage is 18V or more. • 70 rpm or more • None of the following DTC sets are detected; DTC P0612, P1262 and P0204; DTC P0612, P1262 and P0205; DTC P0612, P1262 and P0206.	No injector 2, 4, 6 monitor input signal exists.	Approx. 3 sec.	Intensive engine vibration, rough idling, output lowering, blow up fault Engine stall is possible. Back-up: Common 2 stop (#4, #5, #6 cylinders stopped), EGR stopped	ON	*1
P1271	24	Accelerator sensor 1-2 comparison fault	Difference in opening angle between accelerator sensors 1-2 is 45% or more.	• Key switch input voltage is 18V or more. • DTC P1630, P1631, P1271, P1277, P1278, P1282, or P1283 is not detected.	Difference in opening angle between accelerator sensors 1 and 2 is 45% or more.	Approx. 3 sec.	1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1277		Accelerator sensor 1 fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630, P1277, or P1631 is not detected.	Accelerator sensor 1 voltage is lower than 0.2 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1278		Accelerator sensor 1 fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630, P1278, or P1631 is not detected.	Accelerator sensor 1 voltage is more than 4.9 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1282		Accelerator sensor 2 fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630, P1282, or P1631 is not detected.	Accelerator sensor 2 voltage is lower than 0.2 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault... Accelerator opening angle is controlled to 0%.	Does not come on.	*1

10D-203 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1283	24	Accelerator sensor 2 fault (high voltage fault)	Open/short circuit/ breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630, P1283, or P1631 is not detected.	Accelerator sensor 2 voltage is more than 4.9 V.	Approx. 1 sec.	1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%. Back-up: 1 system fault...No back-up 2 system fault...Accelerator opening angle is controlled to 0%.	Does not come on.	*1
P1345	16	Cam sensor out of phase	Camshaft gear/ crankshaft gear installing angle is out of phase, or damage in gear.	• Key switch input voltage is 18V or more. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • CMP sensor pulse is normal. • Crank pulse is normal.	Correct cam pulse does not exist in crank gap position.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*1
P1625	416	Main relay system fault (Not enter)	Open/ ground short circuit in harness, relay OFF anchoring	• Key switch input voltage is 18V or more. • DTC P1630 is not detected. • 3 seconds or more has elapsed after key switch ON. • Main relay drive indication ON	Main relay system voltage is 1V or less with main relay coil output ON.	Approx. 2 sec.	Engine does not start. Back-up: Back-up: No back-up action	ON	*2
			Harness +B short, relay ON anchoring	• DTC P1625 or P0606 is not detected.	Relay does not cut off despite of main relay coil output OFF indication.	Approx. 5 sec.	Vehicle power supply cannot be shut off. Back-up: Back-up: No back-up action	ON	*1
P1630	36	A/D conversion fault	A/D conversion fault	—	A/D conversion failure	Immediately	Output lowering, Black smoke emitted Back-up: Analog sensor system default processing Limited injection amount 3 (multi-injection stopped) Target RP upper limit (80MPa)	ON	*2

Electronic control fuel injection system (Common rail type) 10D-204

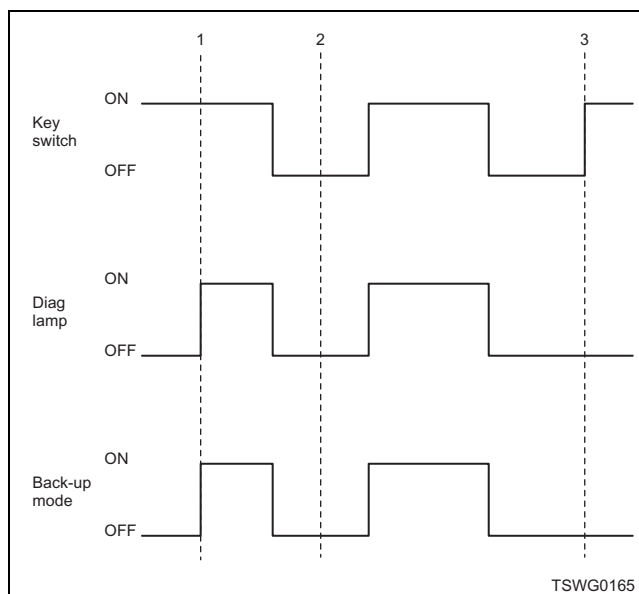
DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Fault judgment period	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1631	55	Voltage fault in 5-V power supply 1	Power supply wiring short to sensor, or breakage in element/circuit for power supply regulation inside ECM.	• DTC P1630 is not detected. • Battery voltage is between 16V — 32V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less.	Approx. 0.5 sec.	Accelerator opening angle is controlled to 0%. Back-up: Same to accelerator sensor fault	ON	*2
P1632		Voltage fault in 5-V power supply 2		• DTC P1630 is not detected. • Battery voltage is between 16V — 32V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less.	Approx. 0.5 sec.	Due to back-up equivalent to 2500m • Black smoke emitted at high altitude • Output shortage at low altitude Back-up: Same to barometric pressure and intake air temperature sensor fault	ON	*2
P1633		Voltage fault in 5-V power supply 3		• DTC P1630 is not detected. • Battery voltage is between 16V — 32V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less.	Approx. 0.5 sec.	Startability deteriorates at low temperatures or black smoke emission is possible, output lowering or operability is affected depending on conditions. Back-up: Same to coolant temperature, fuel temperature, and oil pressure sensor fault	ON	*2
P1634		Voltage fault in 5-V power supply 4		• DTC P1630 is not detected. • Battery voltage is between 16V — 32V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less.	Approx. 0.5 sec.	Operability is affected. Back-up: Same to boost pressure and boost temperature sensor fault	ON	*2
P1635		Voltage fault in 5-V power supply 5		• DTC P1630 is not detected. • Battery voltage is between 16V — 32V.	Key switch power supply voltage is 5.5V or more, or 4.5V or less.	Approx. 0.5 sec.	Engine blow up, output lowering, black smoke emission, engine stall are possible. Back-up: Same to rail pressure sensor fault and EGR position sensor fault	ON	*2
U2104	84	CAN Bus fault	CAN communication fault	• Key switch input voltage is 20V or more.	Bus-off is detected.	At 3 sec. continuously	Set to idle speed. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*3
U2106	85	CAN timeout fault	CAN communication fault	• DTC U2104 is not detected. • Key switch input voltage is 20V or more.	CAN data reception does not complete at a set time.	At 1 sec. continuously	Set to idle speed. Back-up: Specified back-up value (depending on the machine manufacturer)	ON	*3

About recovery from failure

There are three modes for recovery from failure. To clear the fault indication displayed on the monitor of the machine, one more ignition cycle may be needed after the following ignition cycle.

*1

Even if the DTC has restored normally, the diagnosis lamp and back-up mode are not restored in the ignition cycle that the DTC is detected. After turning the key switch OFF, DTC diagnosis is performed when the vehicle starts again. If it is judged as normal, everything will be recovered to normal from the next ignition cycle.

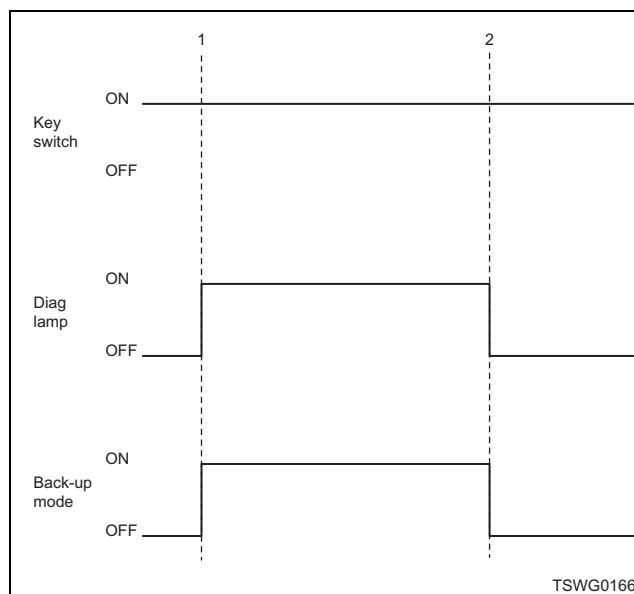


Name

1. DTC is detected.
2. Repair and inspection
3. Returned to normal.

*2

When the DTC has recovered to normal condition in the ignition cycle that the DTC is detected, the diagnosis lamp and back up mode will also be recovered.

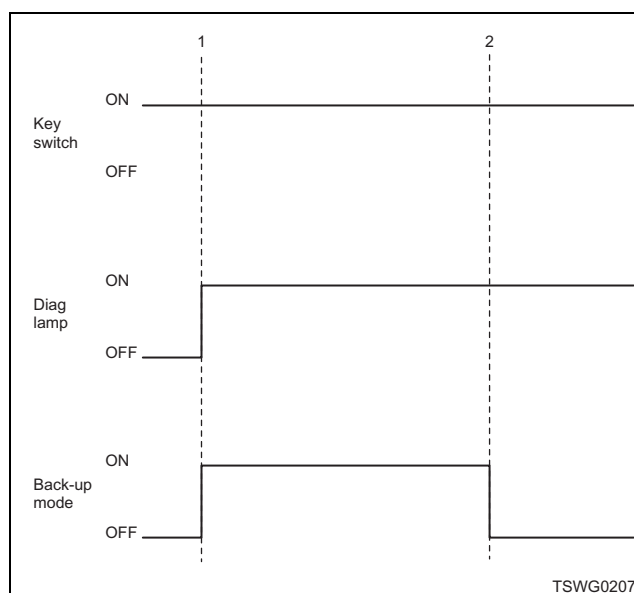


Name

1. DTC is detected.
2. Returned to normal.

*3

When the DTC has recovered to normal in the ignition cycle that the DTC is detected, the back-up mode will be recovered normally, but the diagnosis lamp does not go off.

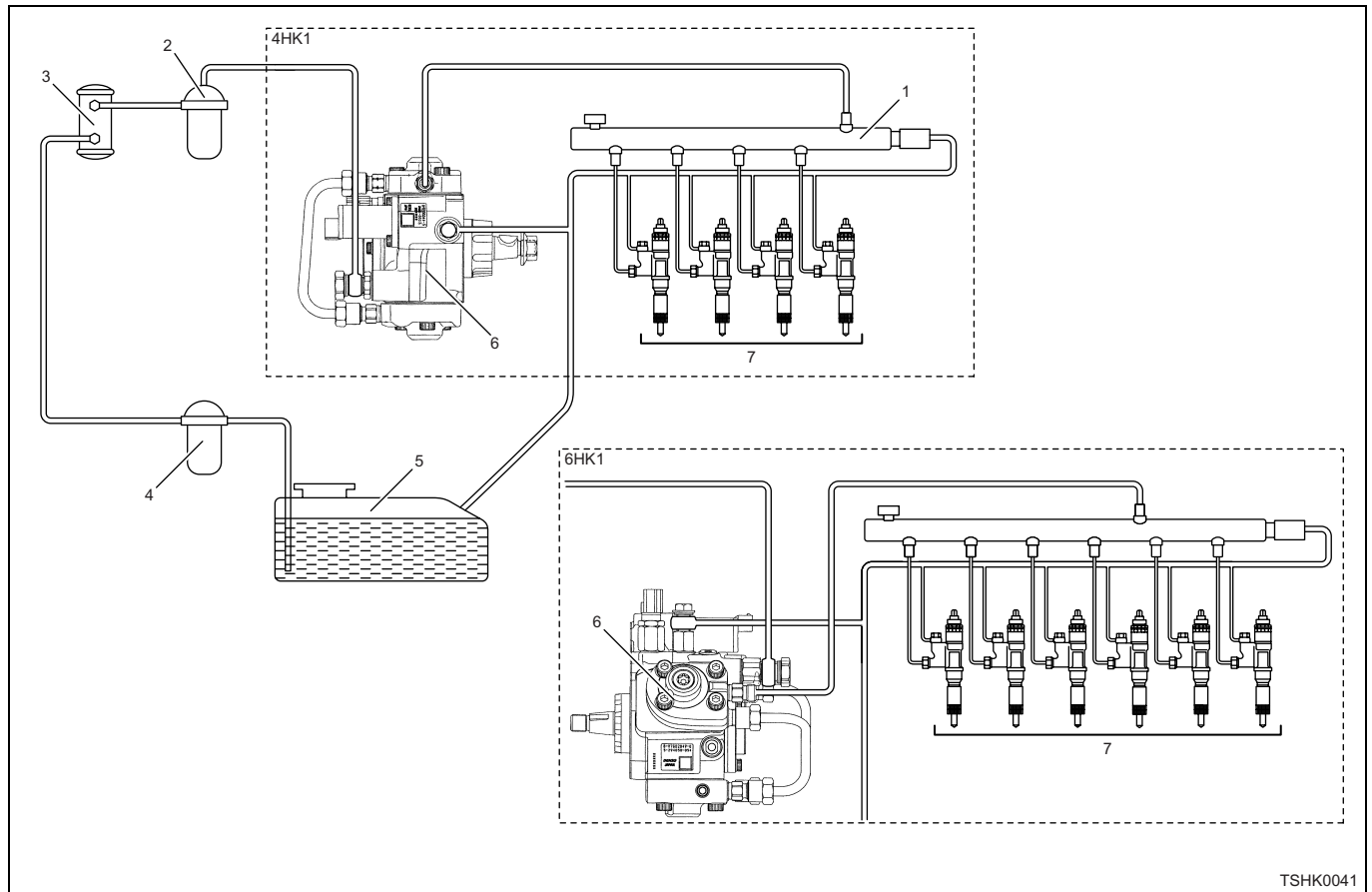


Name

1. DTC is detected.
2. Returned to normal.

DTC: P0087 (Flash code 227)

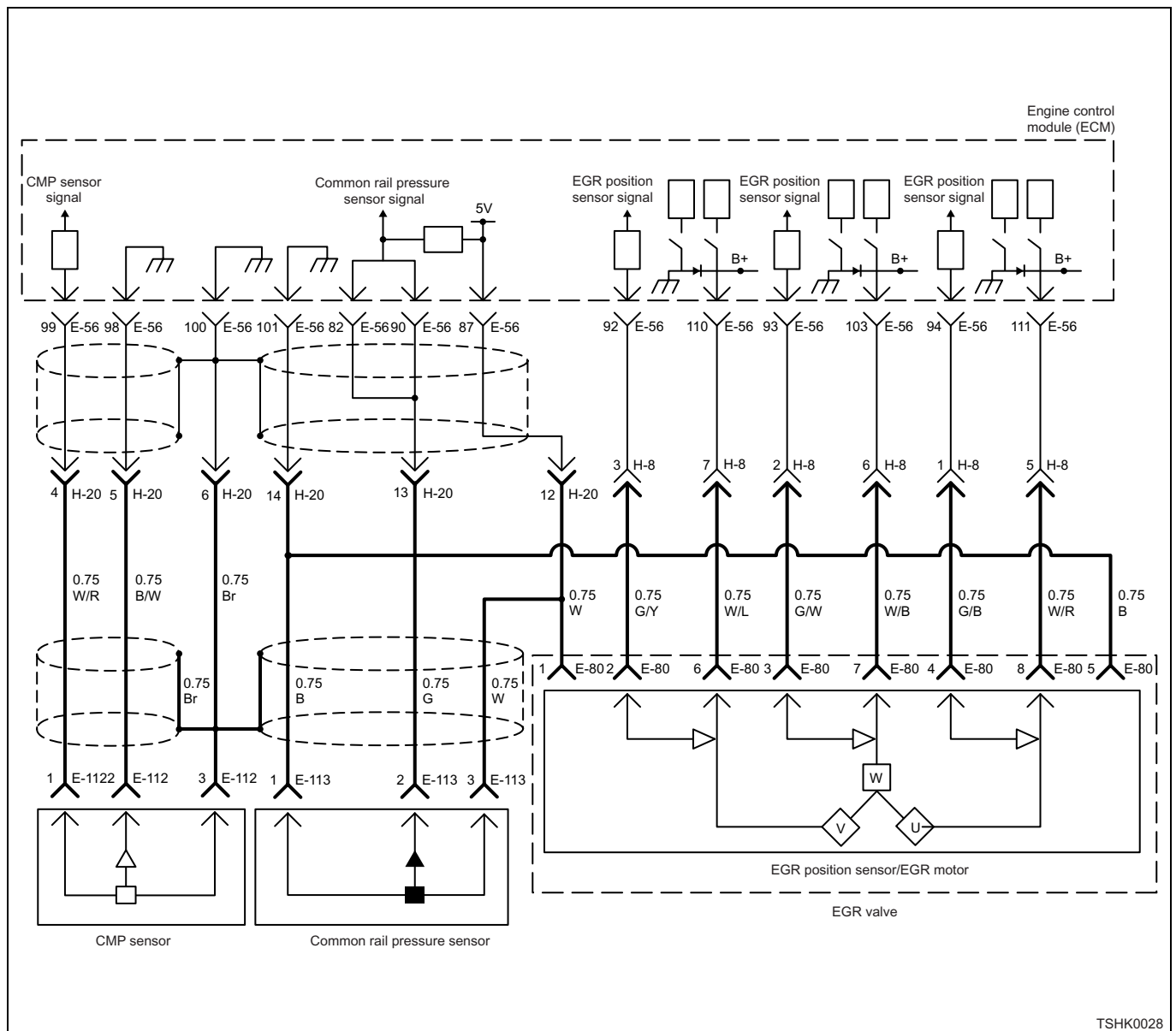
Common rail low pressure fault (No pressure feed in supply pump)



TSHK0041

Name

1. Common rail	5. Fuel tank
2. Fuel filter	6. Supply pump
3. Electromagnetic Pump	7. Injector
4. Pre-filter	

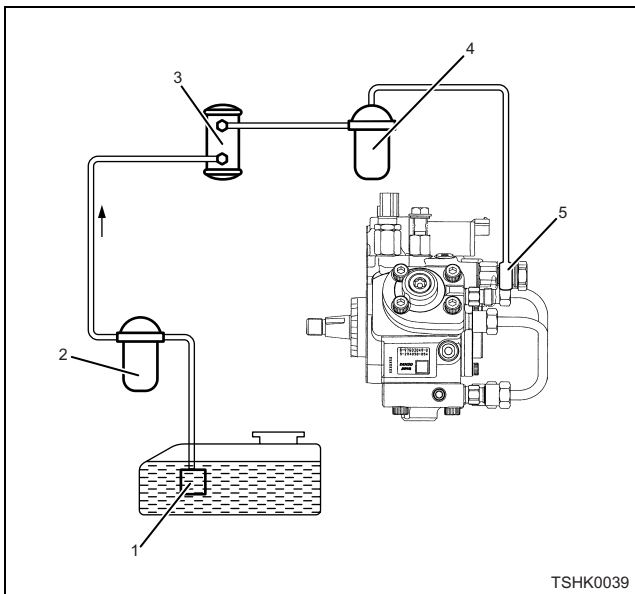


Description of circuit

The engine control module (ECM) monitors the pressure inside of common rail based on the signal from common rail pressure sensor. If the pressure is low, ECM controls the SCV of supply pump to increase the pressure inside of common rail. If fuel supply to the supply pump is insufficient or the supply pump is faulty, the pressure inside of common rail cannot be increased.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Black smoke emitted
- Excessive output is possible.

Fuel system filter**Name**

1. Fuel pump strainer
2. Pre-fuel filter
3. Electromagnetic pump filter
4. Main fuel filter
5. Gauze filter

Filter clogging in the fuel system may establish the DTC set condition. Check as required.

Preconditions when DTC is set

900 rpm or more

DTC set condition

Actual rail pressure is 15MPa or less for 3 seconds or more.

Action taken when DTC is set

Check engine lamp comes on.

Back-up mode

- Limited injection amount 3 (multi-injection stopped)

- Target RP upper limit (80MPa)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The check engine lamp will go off after the code turns to past trouble and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

Followings are suspected as the cause.

- Injector internal trouble
- Supply pump internal trouble
- Fuel system pipe fault (fuel leakage, clogging, crush, etc.)
- Fuel filter fault (clogging)
- Fuel tank fault (clogging)
- Pressure limiter trouble (operation under specified pressure, degradation of sealability)
- ECM trouble
- Common rail pressure sensor trouble

Test description

Numbers below indicate step numbers in the chart.

5. When rise of fuel level or diesel fuel odor is confirmed, fuel leakage in the injector portion may be the cause of the DTC detection.

9. If the "Common rail pressure sensor" displays more than the specified value when the common rail pressure sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".

10D-209 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
2	Check the fuel system in the following procedure. 1. Check the high pressure pipe and low pressure pipe for looseness in the connection (fuel leakage), crush or clogging. 2. Check the fuel pipe, fuel filter, and inside of the fuel tank for freeze or waxing. (at cold temperature) 3. Check the feed pipe inside the fuel tank for clogging of foreign matter. Is the fuel system normal?	—	Go to Step 4.	Go to Step 3.
3	Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 18.	—
4	Check for rise of fuel level in the oil level gauge or light oil odor. Is the trouble detected?	—	Go to Step 5.	Go to Step 6.
5	Check the connection of the fuel pipe in each injector, and replace the injector if oil leakage is confirmed. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 18.	—
6	Is the scan tool (KW communication) available?	—	Go to Step 7.	Go to Step 20.
7	Check the injector. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Start the engine. 3. Select the “Actuator test” from the menu. 4. Select the “Injection stop at each injector” in the “Common rail system”. 5. Press the “OFF” soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 9.	Go to Step 8.
8	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 18.	—

Electronic control fuel injection system (Common rail type) 10D-210

Step	Action	Value	YES	NO
9	Check the common rail pressure. 1. Turn the key switch to "ON". 2. Check for "Common rail pressure" on the data display using scan tool. 3. Start the engine and run it at idle. 4. Check for "Differential fuel rail pressure" on the data display using scan tool. 5. Race it quickly for about 5 times. 6. Check for "Differential fuel rail pressure" on the data display using scan tool. Is each value of "Fuel rail pressure" (at engine stopped, idling and racing) around the specified value?	At engine stopped: Differential pressure -30 MPa; At idling, racing: ± 5 MPa	Go to Step 16.	Go to Step 10.
10	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Turn the key switch to "ON". 4. Check for "Common rail pressure sensor" on the data display using scan tool. Is the "Common rail pressure sensor" more than the specified value?	4.8V	Go to Step 13.	Go to Step 11.
11	1. Check the signal circuit between common rail pressure sensor and ECM for short circuit to signal circuits of other sensors using breaker box or DMM. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 18.	Go to Step 12.
12	Is EMPS available?	—	Go to Step 13.	Go to Step 14.
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 1.	Go to Step 14.

10D-211 Electronic control fuel injection system (Common rail type)

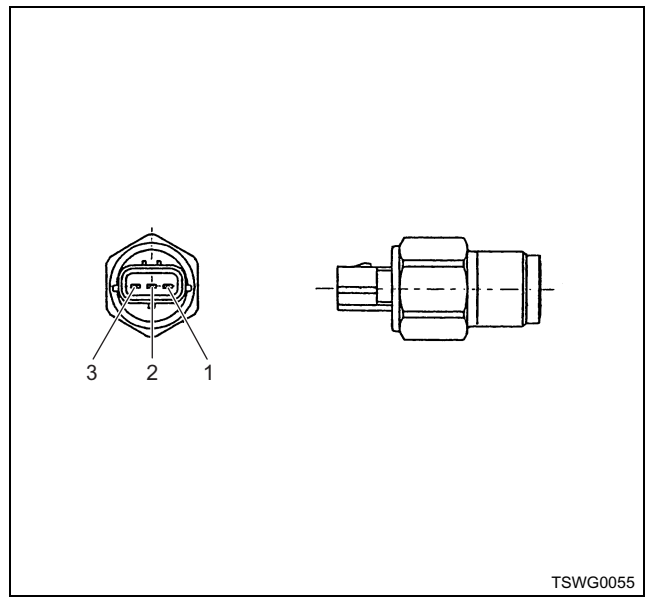
Step	Action	Value	YES	NO
14	Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 15.
15	Replace the common rail (common rail pressure sensor). Is the procedure completed?	—	Go to Step 18.	—
16	1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Start the engine. 3. Select the "Actuator test" from the menu. 4. Select the "Rail pressure control" in the "Common rail system". 5. Press the "Up" soft key to check the value of "Differential fuel pressure". Is "Differential fuel rail pressure" within the specified value?	±5MPa	Go to Step 18.	Go to Step 17.
17	Replace the supply pump. Is the procedure completed?	—	Go to Step 18.	—
18	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0087 detected?	—	Go to Step 2.	Go to Step 19.
19	Check if DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
20	Use the injector checker to stop injection in the injector, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 22.	Go to Step 21.

Electronic control fuel injection system (Common rail type) 10D-212

Step	Action	Value	YES	NO
21	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 18.	—
22	1. Turn the key switch to OFF. 2. Disconnect the common rail pressure sensor connector. 3. Measure the voltage between the common rail pressure sensor power supply terminal and the ground. Is the DMM indication more than the specified value?	4.8V	Go to Step 24.	Go to Step 23.
23	1. Check the signal circuit between common rail pressure sensor and ECM for short circuit to signal circuits of other sensors using breaker box or DMM. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 18.	Go to Step 12.
24	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0087 detected?	—	Go to Step 17.	Go to Step 19.

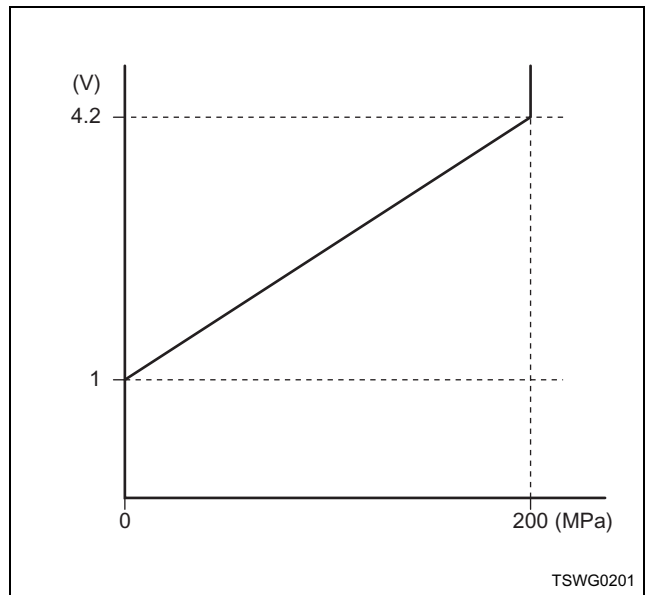
10D-213 Electronic control fuel injection system (Common rail type)

About common rail pressure sensor



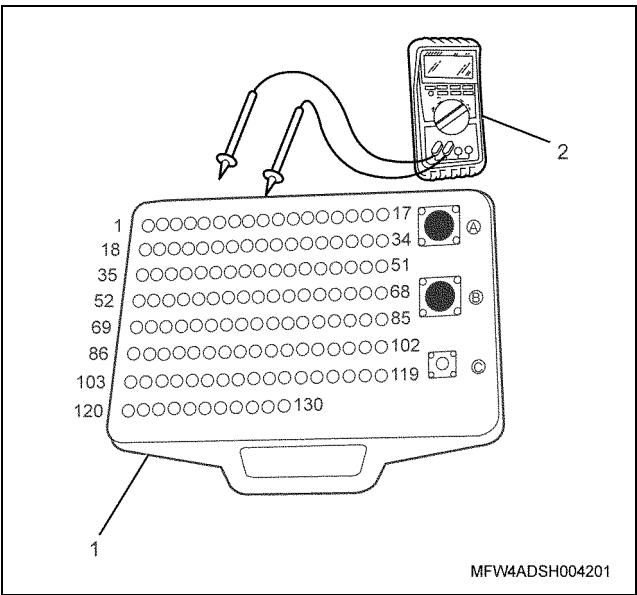
- Name
1. Sensor ground
 2. Sensor signal
 3. Sensor power supply

Characteristics of common rail pressure sensor



Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

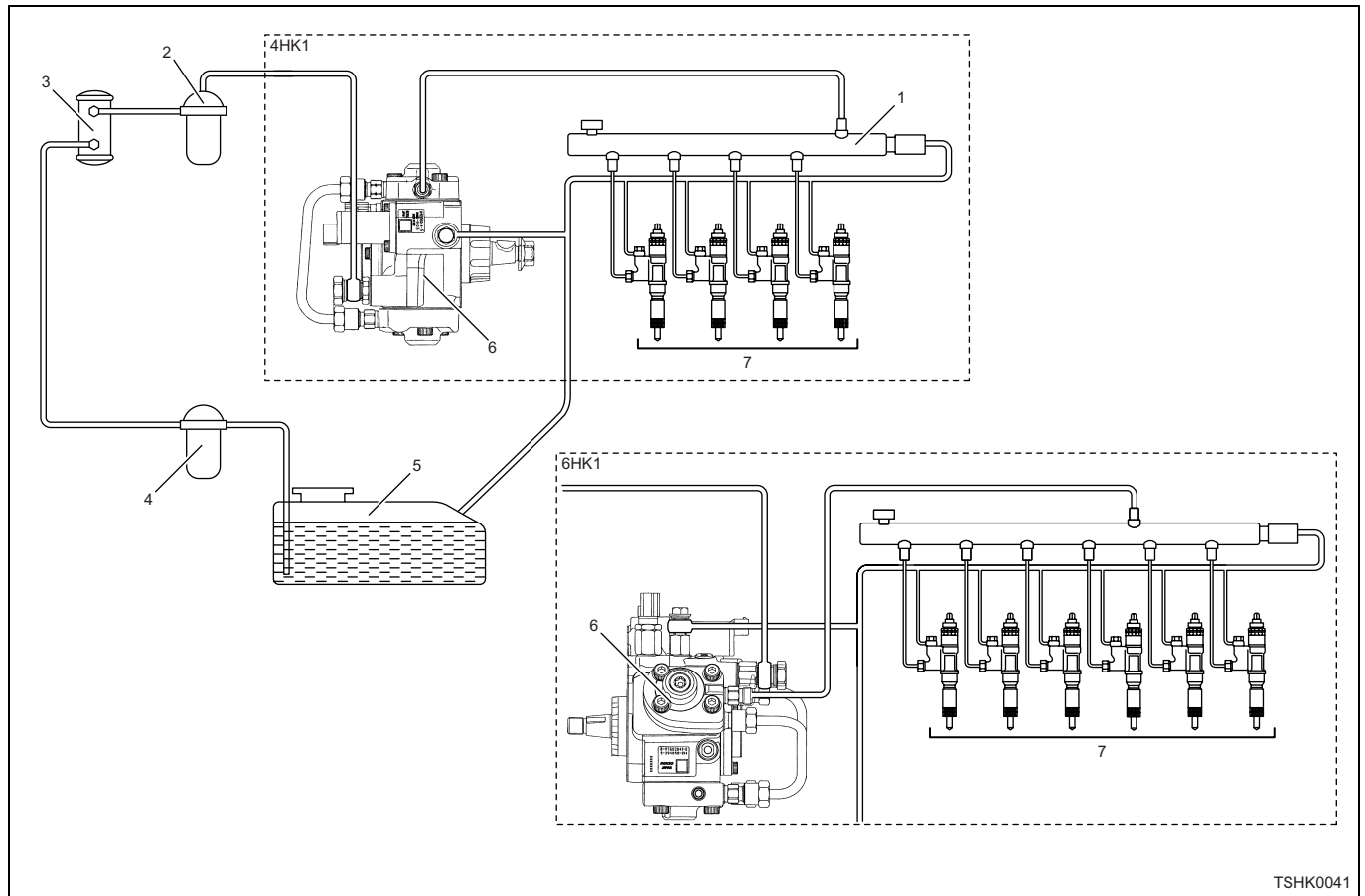


- Name
1. Breaker box
 2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
11, 23	Short circuit to other signal circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	82 - Ground 90 - Ground	0V	1V or more

DTC: P0088 (Flash code 118)

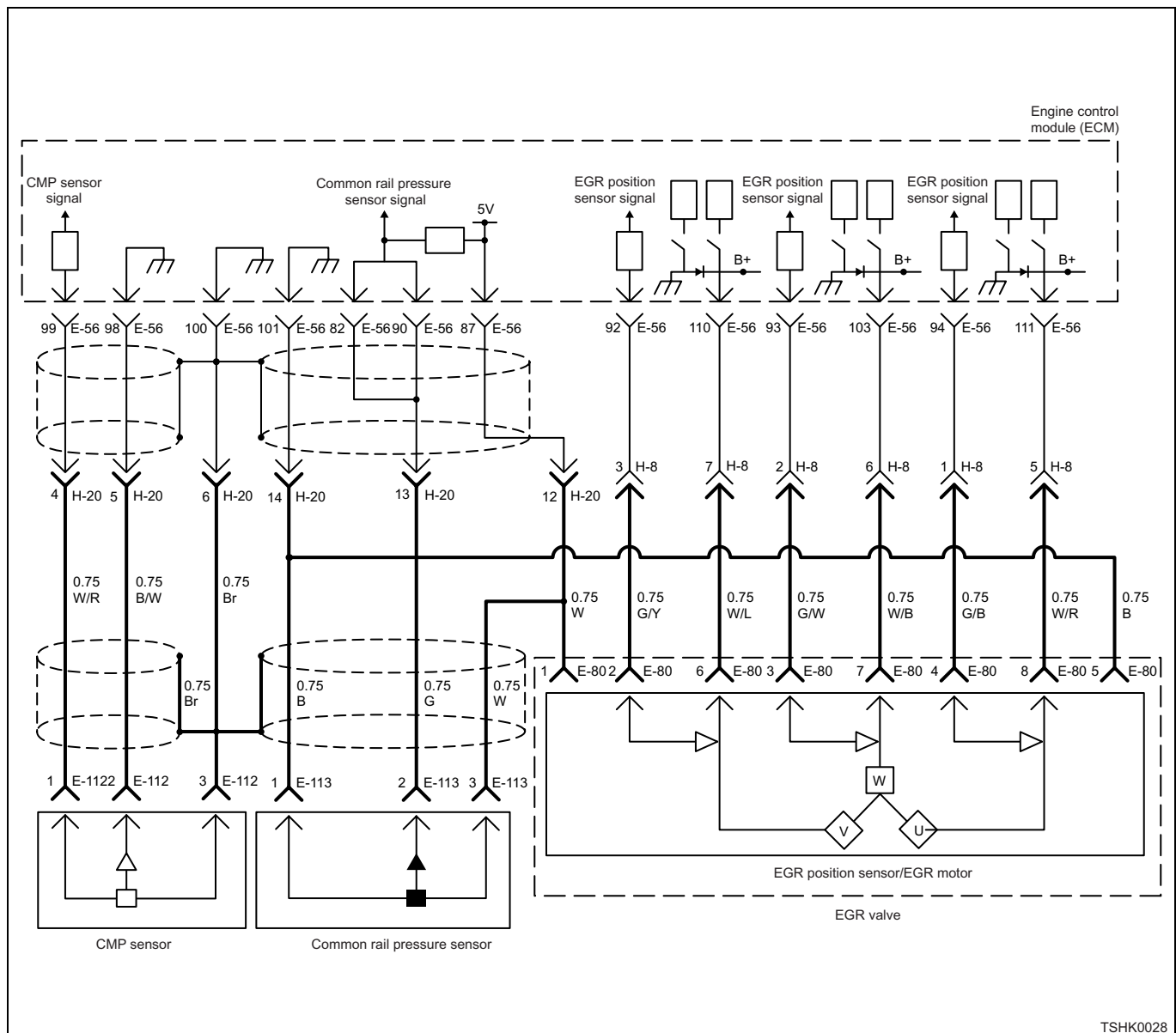
Common rail pressure is abnormally high (1st or 2nd stage).



TSHK0041

Name

1. Common rail	5. Fuel tank
2. Fuel filter	6. Supply pump
3. Electromagnetic Pump	7. Injector
4. Pre-filter	



TSHK0028

Description of circuit

The common rail pressure sensor detects the common rail internal pressure. The common rail pressure sensor is installed to the common rail. As the common rail internal pressure changes depending on engine condition, output voltage of the common rail pressure sensor will change (if the common rail internal fuel pressure is low, output voltage becomes low, if the pressure is high, the output voltage becomes high as well). The engine control module (ECM) reads this output voltage change, converting it into common rail internal pressure, to utilize for control. Dedicated communication circuits are used for the sensor power supply (5V), SIG, and ground in the common rail pressure sensor, which are connected to the ECM. Also, the sensor circuit is shielded to avoid electrical noise etc.

Main trouble symptom

- Intense engine vibration

- Rough idling
- Output lowering
- Engine blow up fault
- Black smoke emitted
- Excessive output possible

Preconditions when DTC is set

1st step

- Key switch input voltage is 18V or more.
- DTC P0088, P0192, P0193, or P1635 is not detected.
- Actual rail pressure is 2 MPa or more, and 70 rpm or more.

2nd step

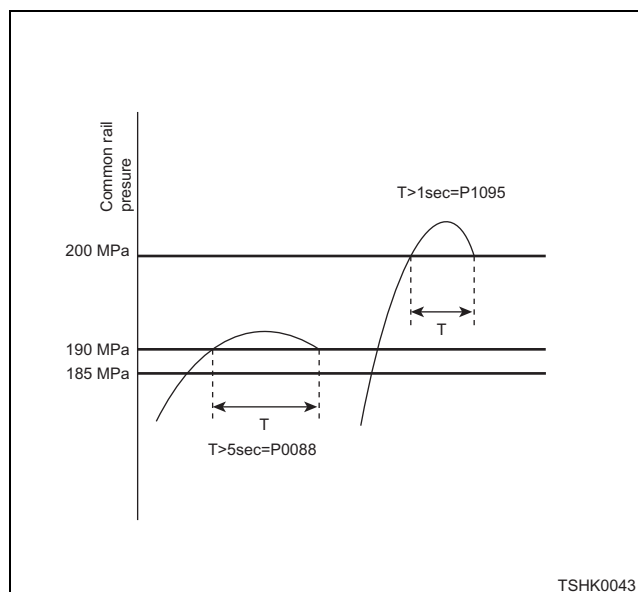
- Battery voltage is normal.
- DTC P0088, P0192, P0193, or P1635 is not detected.
- Actual rail pressure is 2 MPa or more, and 70 rpm or more.

DTC set condition**1st step**

- Rail pressure is more than 185MPa for 5 seconds or more.
- Common rail pressure sensor voltage is 3.9 V or more.

2nd step

- 1st stage is completed, and rail pressure is more than 190MPa for 5 seconds or more.
- Common rail pressure sensor voltage is 4.0 V or more.

**Action taken when DTC is set**

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Limited injection amount 3 (multi-injection stopped)

- Target RP upper limit (80MPa)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

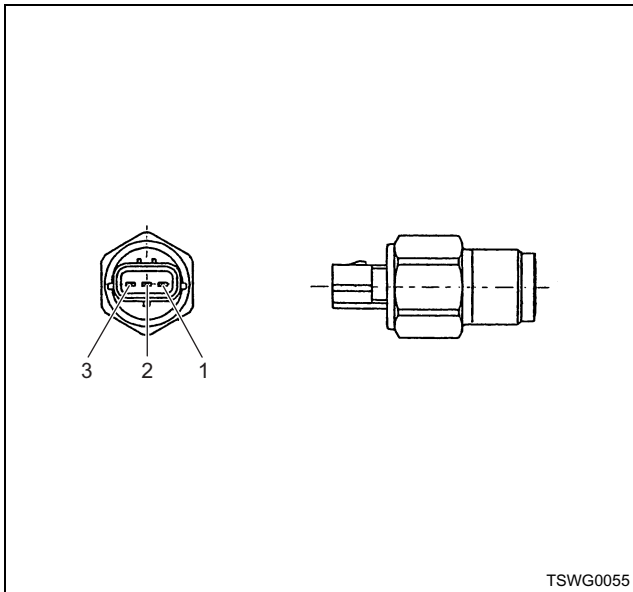
- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	1. Start the engine. 2. Check the DTC. 3. Are the fuel-related parts only just replaced? Air bleeding may not be performed sufficiently after replacing fuel-related parts. Bleed air again. Check the DTC after bleeding air. Is any of the P0088, P0192, P0193, or P1635 detected?	—	Go to the relevant DTC detected.	Go to Step 3.
3	Is the scan tool (KW communication) available?	—	Go to Step 4.	Go to Step 5.

10D-217 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
4	1. Turn the key switch to "OFF" for more than 30 seconds. 2. Start the engine. 3. Check for "Differential fuel rail pressure" on the data display using scan tool. Is "Differential fuel rail pressure" within the specified value?	Differential pressure ±5MPa (at idle)	Go to Step 5.	Go to "Diagnostic aid".
5	1. Check the fuel return pipe between the supply pump and the fuel tank for breakage, twist, etc. 2. Check for clogging or twisting in the vent hose of the fuel tank. 3. Check for foreign matter in the fuel tank. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 8.	Go to Step 6.
6	1. Replace the common rail (common rail pressure sensor) since it seems that abnormal value of the pressure sensor is detected. Note: For work procedure, refer to "Engine section" in the service manual. 2. Check the DTC. Is the trouble detected?	—	Go to Step 7.	Go to Step 8.
7	Replace the supply pump. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 8.	—
8	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0088 detected?	—	Go to Step 2.	Go to Step 9.
9	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

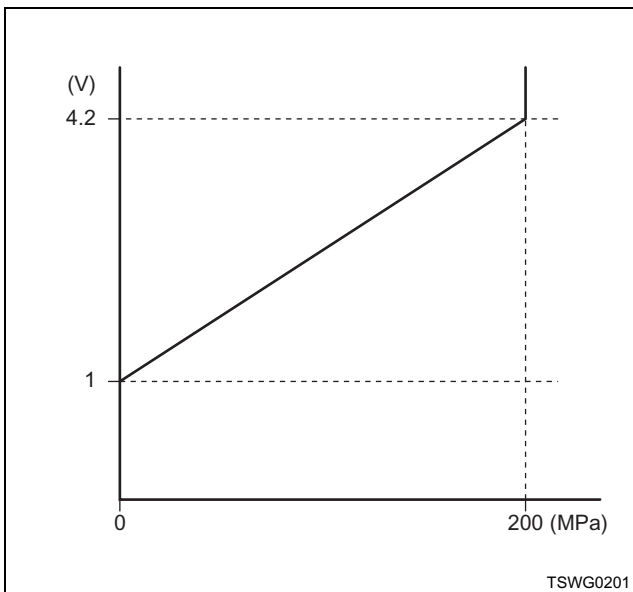
About common rail pressure sensor



Name

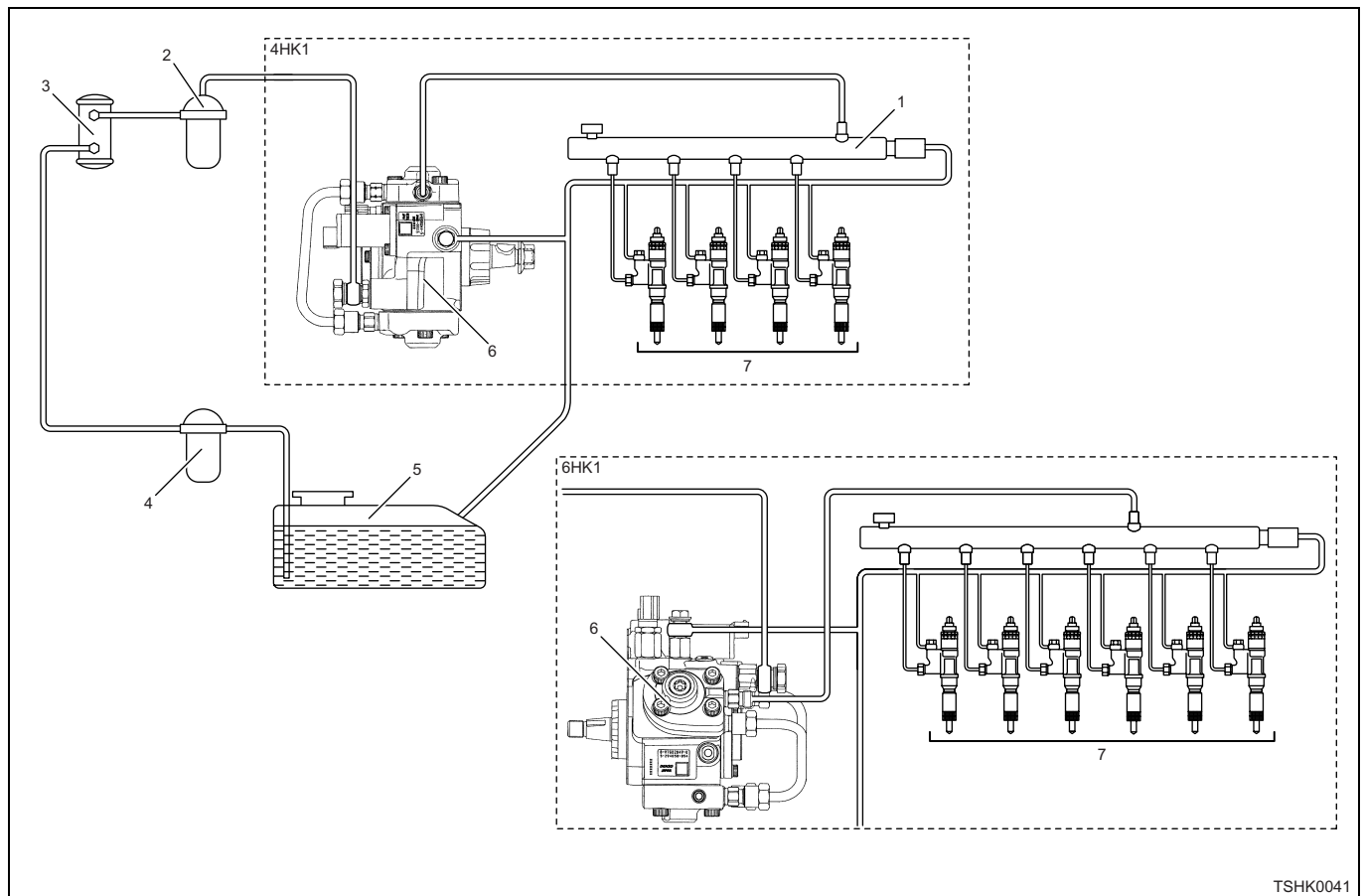
1. Sensor ground
2. Sensor signal
3. Sensor power supply

Characteristics of common rail pressure sensor



DTC: P0089 (Flash code 151)

Common rail pressure fault (Excessive pressure feed in supply pump)

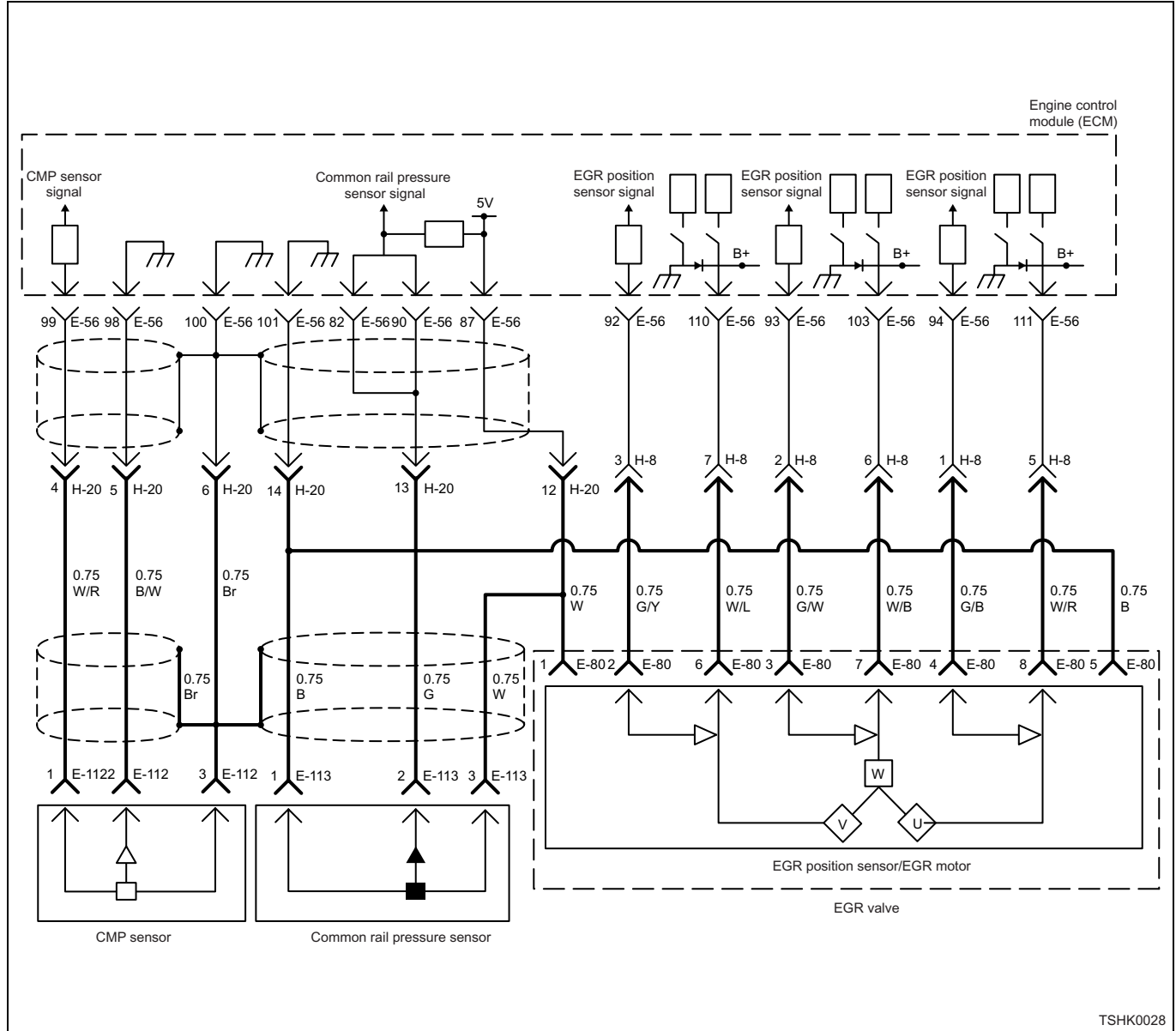


TSHK0041

Name

- 1. Common rail
- 2. Fuel filter
- 3. Electromagnetic Pump
- 4. Pre-filter

- 5. Fuel tank
- 6. Supply pump
- 7. Injector



Description of circuit

The common rail pressure sensor detects the common rail internal pressure. The common rail pressure sensor is installed to the common rail. As the common rail internal pressure changes depending on engine condition, output voltage of the common rail pressure sensor will change (if the common rail internal fuel pressure is low, output voltage becomes low, if the pressure is high, the output voltage becomes high as well). The engine control module (ECM) reads this output voltage change, converting it into common rail internal pressure, to utilize for control. Dedicated communication circuits are used for the sensor power supply (5V), SIG, and ground in the common rail pressure sensor, which are connected to the ECM. Also, the sensor circuit is shielded to avoid electrical noise etc.

Main trouble symptom

- Intense engine vibration

- Rough idling
- Output lowering
- Engine blow up fault
- Black smoke emitted
- Excessive output possible

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P0089, P0192, P0193, or P1635 is not detected.
- Coolant temperature is 60°C or more, and 375 rpm or more.
- Duty to SCV is 40% or less, or target pressure feed to SCV is 90 mm³/sec or less.

DTC set condition

- Actual rail pressure is 40MPa or more higher than target rail pressure for 5 seconds or more.

10D-221 Electronic control fuel injection system (Common rail type)

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Limited injection amount 3 (multi-injection stopped)
- Target RP upper limit (80MPa)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

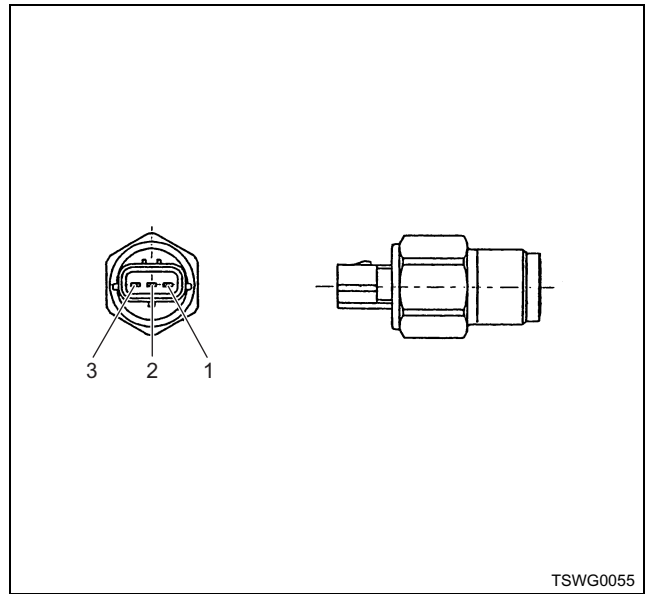
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Start the engine. 2. Check the DTC. Is any of the P0089, P0192, P0193, or 1635 detected?	—	Go to the relevant DTC detected.	Go to Step 3.
3	Is the scan tool (KW communication) available?	—	Go to Step 4.	Go to Step 12.
4	1. Turn the key switch to "OFF" for more than 30 seconds. 2. Start the engine. 3. Check for "Differential fuel rail pressure" on the data display using scan tool. Is "Differential fuel rail pressure" within the specified value?	Differential pressure ±5MPa	Go to "Diagnostic aid".	Go to Step 5.
5	1. Turn the key switch to "OFF". 2. Wait for 2 minutes before the common rail internal pressure goes down. 3. Turn the key switch to "ON". Do not start engine. 4. Check for "Differential fuel rail pressure" on the data display using scan tool. Is "Differential fuel rail pressure" the specified value?	Differential pressure -30MPa	Go to Step 6.	Go to Step 7.

Step	Action	Value	YES	NO
6	1. Turn the key switch to "OFF". 2. Disconnect the SCV connector. 3. Check the SCV harness connector terminal for poor contact, intermittent trouble, etc. 4. Disconnect the ECM harness connector. 5. Check the ECM harness connector terminal for poor contact, intermittent trouble, etc. 6. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 9.
7	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Check the common rail pressure sensor harness connector terminal for poor contact, intermittent trouble, etc. 4. Disconnect the ECM harness connector. 5. Check the ECM harness connector terminal for poor contact, intermittent trouble, etc. 6. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 8.
8	Replace the common rail (common rail pressure sensor). Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 10.	—
9	Replace the supply pump. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 10.	—
10	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is the DTC P1093 detected?	—	Go to Step 2.	Go to Step 11.

10D-223 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
11	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
12	1. Visually check the harness between the ECM and the common rail pressure sensor for damage. 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 5.	Go to Step 6.

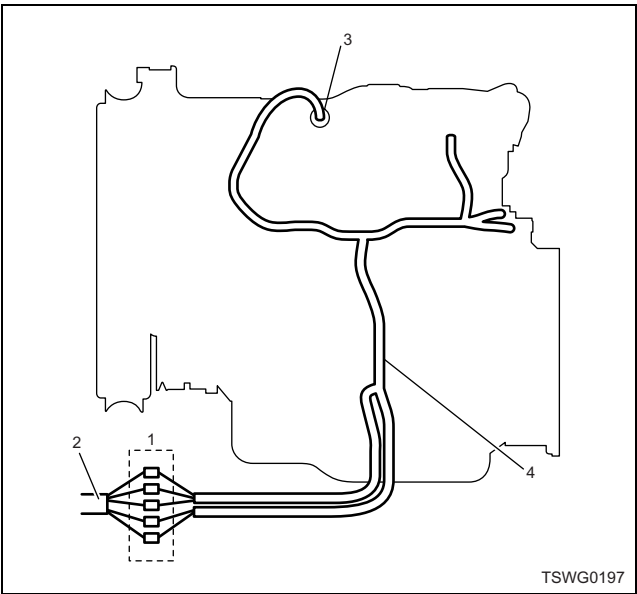
About common rail pressure sensor



Name

1. Power supply
2. Signal
3. GND

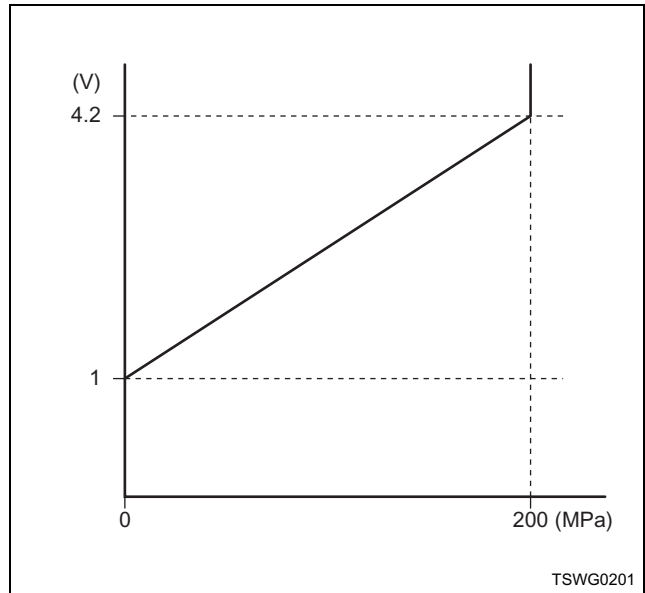
On-board check of sensors



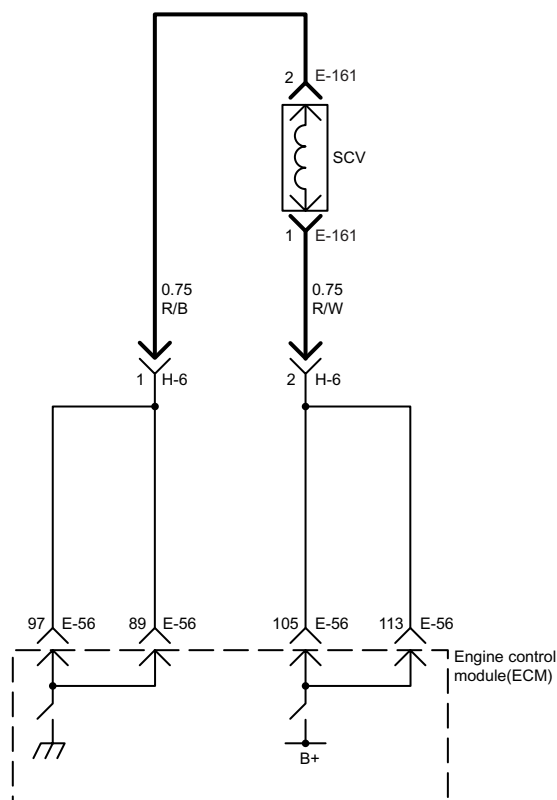
Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

Characteristics of common rail pressure sensor



1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0090 (Flash code 247)**SCV drive system open circuit, +B short or ground short**

TSHK0027

Description of circuit

The suction control valve (SCV) controls the fuel feed pressure amount to the common rail. Once the SCV installed to the supply pump receives the signal (voltage), the SCV closes the valve and pressure-feeds fuel from the supply pump to the common rail. The engine control module (ECM) operates the SCV to adjust the common rail pressure.

Main trouble symptom

- Engine stall and/or engine blow up are possible depending on the condition of open/short circuit.
- Black smoke emitted
- Excessive output

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- DTC P0090 is not detected.
- 300 rpm or more, or actual rail pressure exceeds target rail pressure.

DTC set condition

- When SCV drive current exceeds specified value for 2 seconds or more.
- When the difference between target and actual current exceeds specified value for 2 seconds or more.

10D-225 Electronic control fuel injection system (Common rail type)

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Limited injection amount 3 (multi-injection stopped)
- Target RP upper limit (80MPa)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 4.
3	1. Connect the scan tool. 2. Start the engine. 3. Check for "SCV F/B" on the data display using scan tool. Is the value of "SCV F/B" less than the specified value?	50mA	Go to Step 4.	Go to Step 5.
4	1. Check for followings in the circuit between SCV and ECM using breaker box or DMM. Refer to "Breaker box inspection procedure". - Short circuit to ground - Open circuit - High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 6.

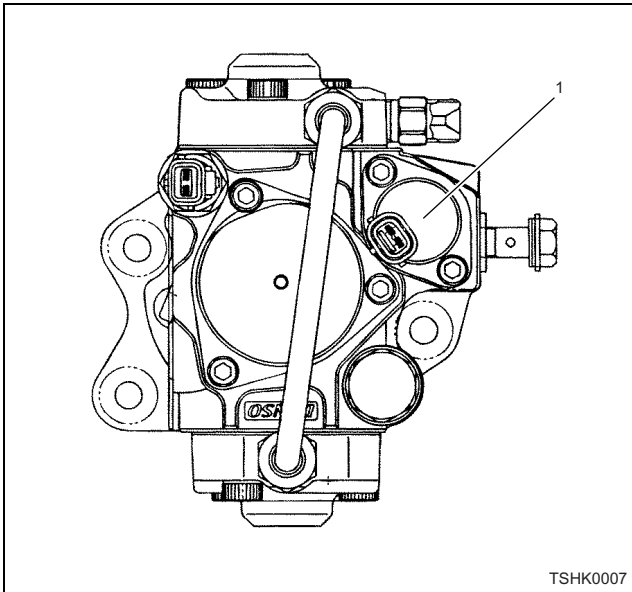
Step	Action	Value	YES	NO
5	1. Check for followings in the circuit between SCV and ECM using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit between terminals • Short circuit to power supply circuit or ignition power supply circuit • Short circuit to other signal circuit 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 6.
6	Check the SCV body. 1. Turn the key switch to "OFF". 2. Disconnect the harness from the SCV. 3. Measure the resistance between the SCV connector terminals. Is the resistance specified value?	Between terminals: $3.2 \pm 0.3 \Omega$; Each terminal to SCV body: $\infty \Omega$ (at normal temperature)	Go to Step 8.	Go to Step 7.
7	Replace the supply pump (SCV). Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 12.	—
8	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Start the engine, and test run with the "Preconditions when DTC is set". 5. Check the DTC. Is the DTC P0090 detected?	—	Go to Step 9.	Go to "Diagnostic aid".
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.

10D-227 Electronic control fuel injection system (Common rail type)

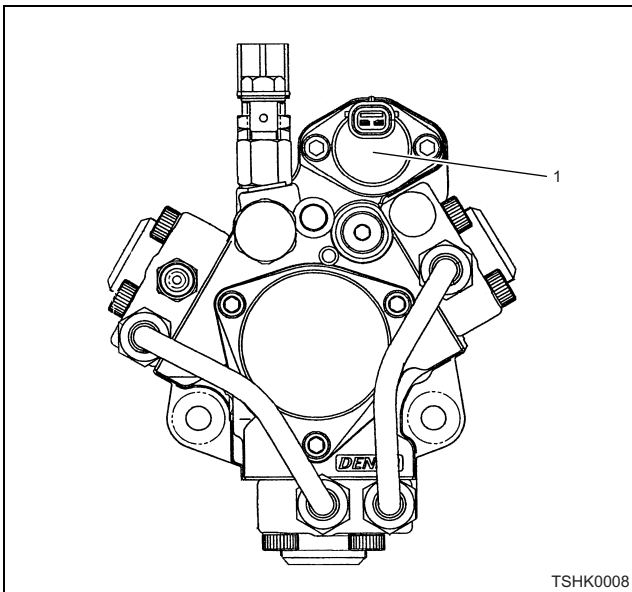
Step	Action	Value	YES	NO
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Start the engine, and test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is the DTC P0090 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

About SCV

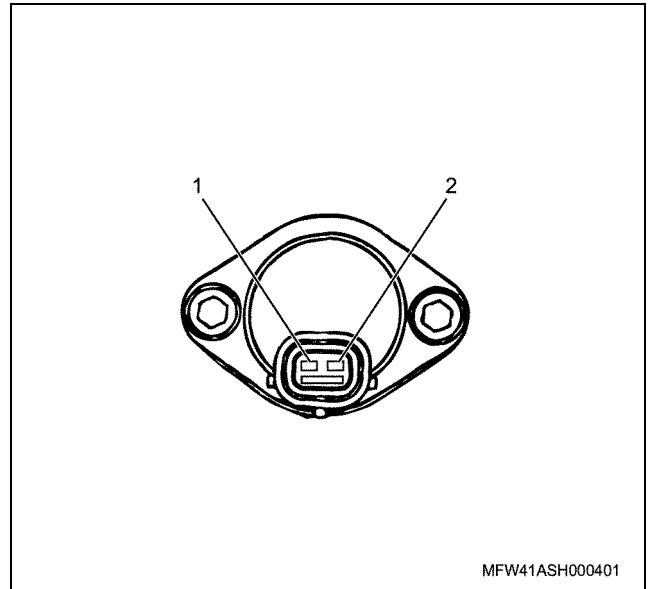
4HK1



6HK1



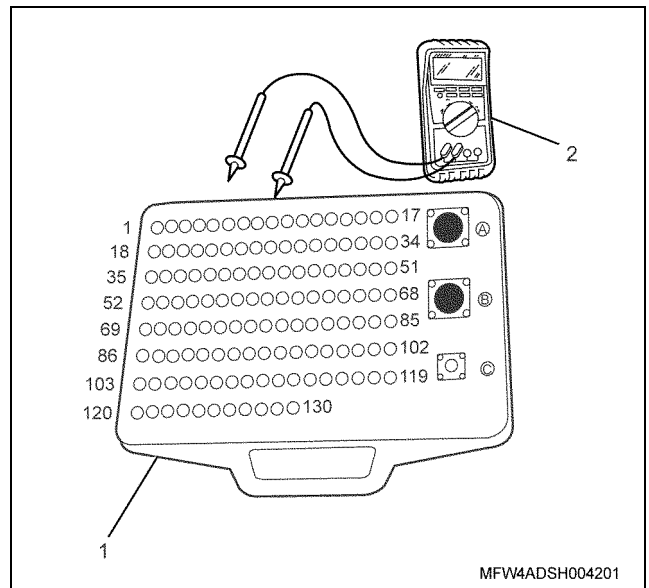
Name
1. SCV



Name
1. SCV-HI
2. SCV-LO

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

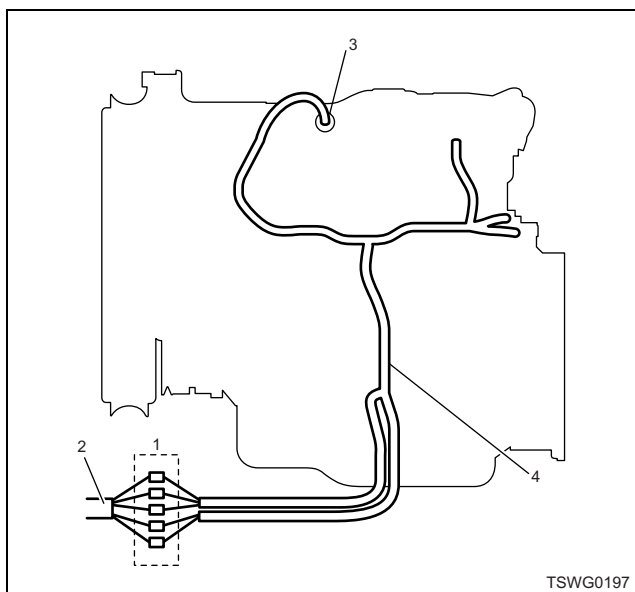


Name
1. Breaker box
2. DMM

10D-229 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Disconnect the SCV connector. - Key switch "OFF"	105 - SCV terminal 113 - SCV terminal 89 - SCV terminal 97 - SCV terminal	5Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	- Disconnect the SCV connector. - Key switch "OFF"	105 - Ground 113 - Ground 89 - Ground 97 - Ground	10MΩ or more	100Ω or less
5	Short circuit between terminals	Resistance measurement	- Disconnect the SCV connector. - Key switch "OFF"	105 - 89 105 - 97 113 - 89 113 - 97	10MΩ or more	100Ω or less
	Short circuit to power supply circuit	Voltage measurement	- Disconnect the SCV connector. - Key switch "ON"	105 - Ground 113 - Ground 89 - Ground 97 - Ground	0V	18V or more
	Short circuit to other signal circuit	Voltage measurement	- Disconnect the SCV connector. - Key switch "ON"	105 - Ground 113 - Ground 89 - Ground 97 - Ground	0V	1V or more

On-board check of sensors

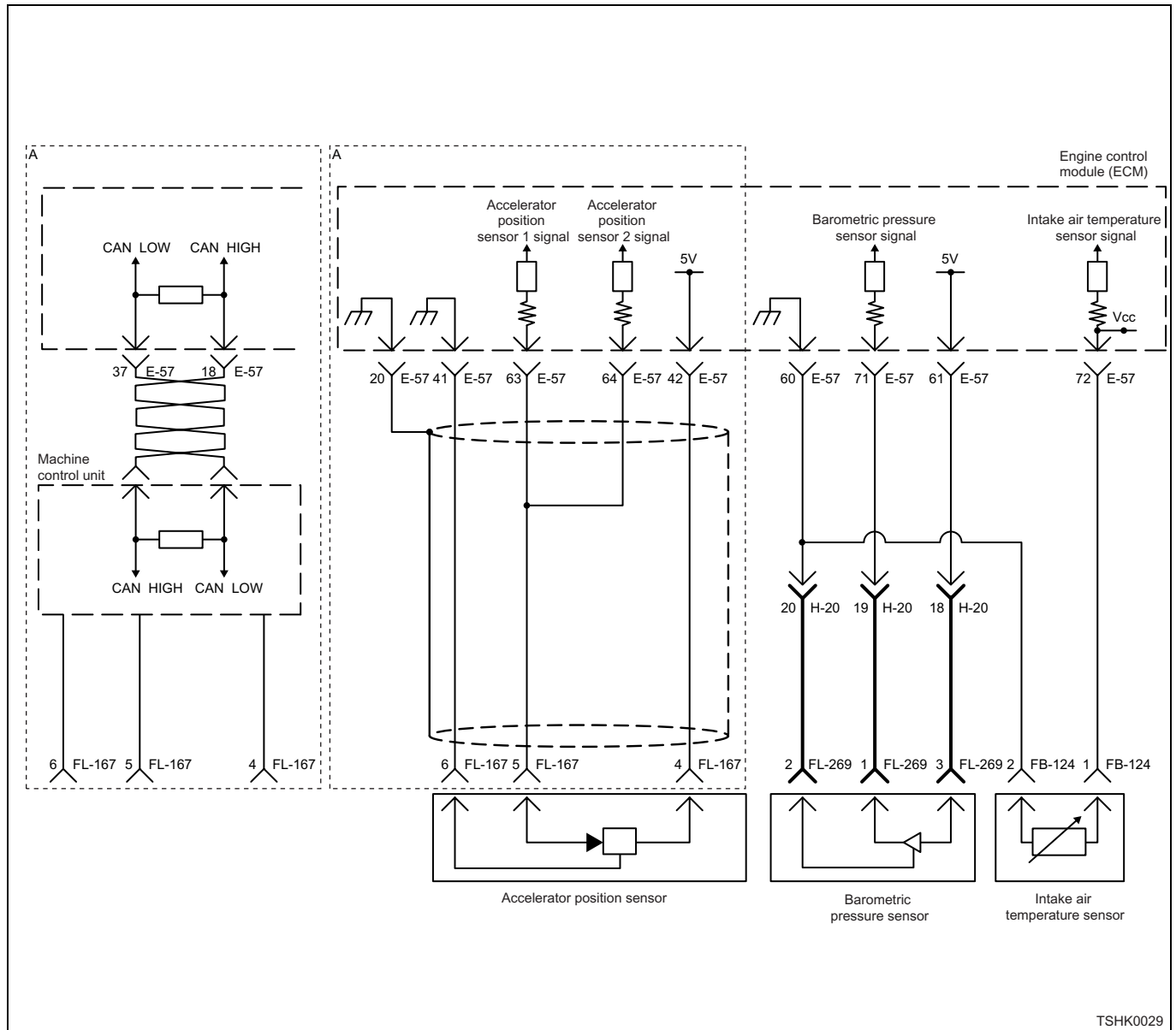


Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

- If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
- If only step 1 is faulty, replace the sensor.

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.

DTC: P0107 (Flash code 71)**Barometric pressure sensor circuit input is low (open circuit or ground short).**

TSHK0029

Description of circuit

The barometric pressure sensor detects the barometric pressure. The barometric pressure sensor is installed to the machine. As the barometric pressure changes depending on altitude and weather condition, output voltage of the barometric pressure sensor will change (if the barometric pressure is low, output voltage becomes low, if the barometric pressure is high, the output voltage becomes high as well). The engine control module (ECM) reads this output voltage change, converting it into barometric pressure, to utilize for optimizing the fuel injection control and for calculating the relative boost pressure.

Main trouble symptom

Due to back-up equivalent to 2500m

- Black smoke emitted at high altitude

- Output shortage at low altitude

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1632 is not detected.

DTC set condition

- Barometric pressure sensor voltage is 0.5V or less for 5 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

10D-231 Electronic control fuel injection system (Common rail type)

Back-up mode

- Barometric pressure default setting (80 kPa)
- EGR stopped

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

2. In case of current trouble, the “Barometric pressure sensor” displays less than the specified value. If more than the specified value, identify the cause by referring to “Diagnostic aid”.

4. If the “Barometric pressure sensor” displays more than the specified value when terminals between the barometric pressure sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 14.
3	Check the value for barometric pressure sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Barometric pressure sensor” using scan tool. Is the “Barometric pressure sensor” less than the specified value?	0.5V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the barometric pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 5.

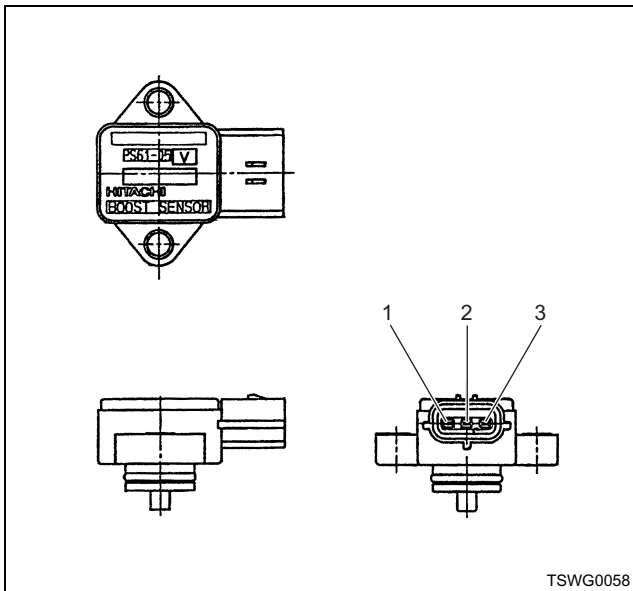
Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the barometric pressure sensor connector. 3. Short between the barometric pressure sensor connector power supply terminal and the signal terminal using jump cable. 4. Turn the key switch to "ON". 5. Check the value for "Barometric pressure sensor" using scan tool. Is the "Barometric pressure sensor" more than the specified value?	4.8V	Go to Step 8.	Go to Step 6.
6	1. Check for followings in the power supply circuit between ECM and barometric pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and barometric pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to barometric pressure sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the barometric pressure sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.

10D-233 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0107 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Start the engine. 2. Check the display of barometric pressure. Does the display of “Barometric pressure” show error value?	127kPa (Displayed error value)	Go to Step 15.	Go to “Diagnostic aid”.
15	Check for installation condition of the barometric pressure sensor, ECM and coupling connector. (Check the barometric pressure sensor circuit for open circuit or ground short.) 1. Check for disconnection, play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 16.
16	1. Check for followings in the power supply circuit between ECM and barometric pressure sensor using breaker box or DMM. Refer to “Breaker box inspection procedure”. • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 17.

Step	Action	Value	YES	NO
17	1. Check for followings in the signal circuit between ECM and barometric pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to barometric pressure sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 8.

About barometric pressure sensor



Name

1. Power supply
2. GND
3. Signal

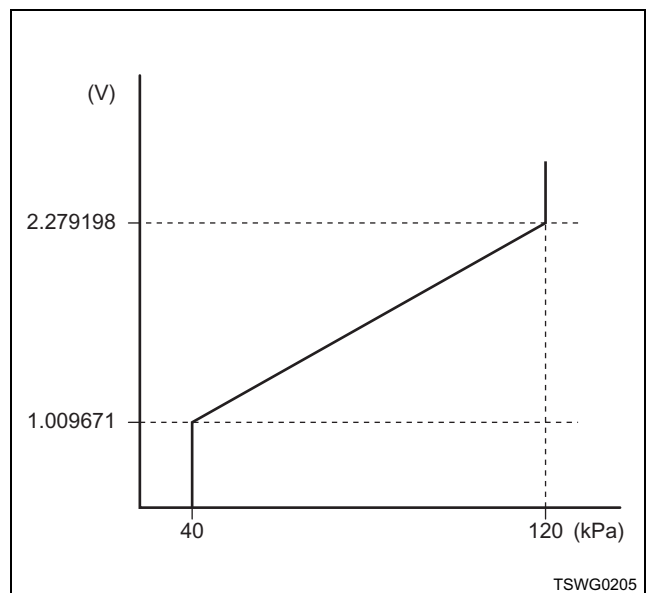
Characteristics of barometric pressure sensor

The output voltage of barometric pressure sensor changes according to the barometric pressure.

The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of 40kPa or 127kPa is not changed.

When error occurs, error value (127kPa) is displayed. The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

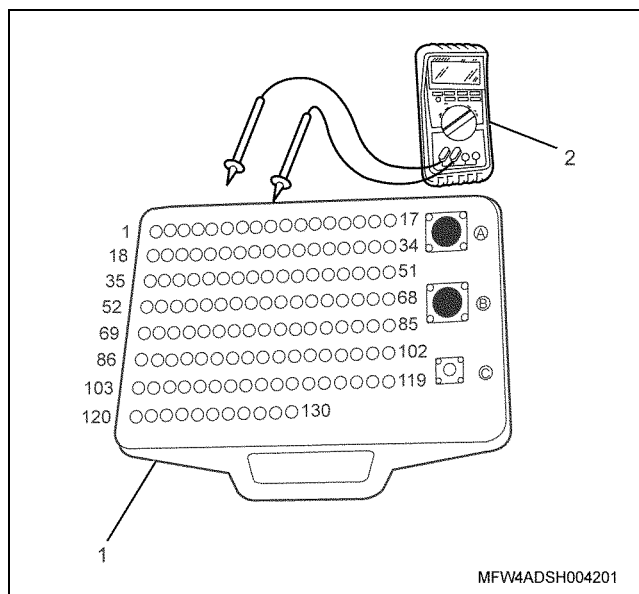
Tech2 and scan tools with KW communication can display both voltage and physical value.



10D-235 Electronic control fuel injection system (Common rail type)

Breaker box inspection procedure

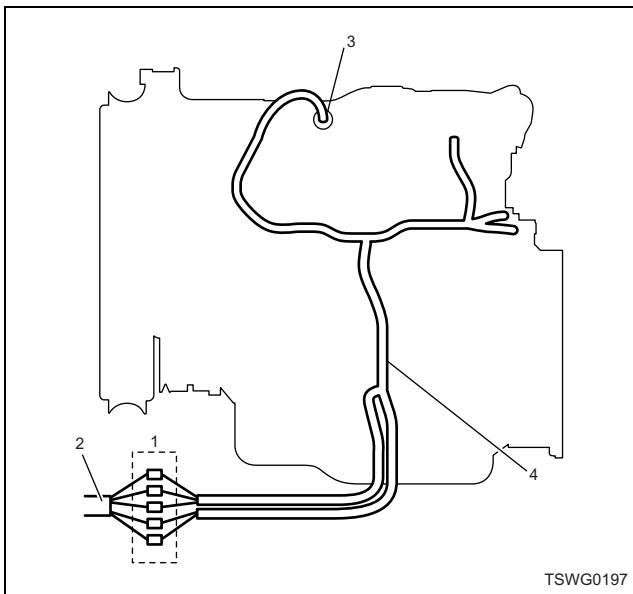
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

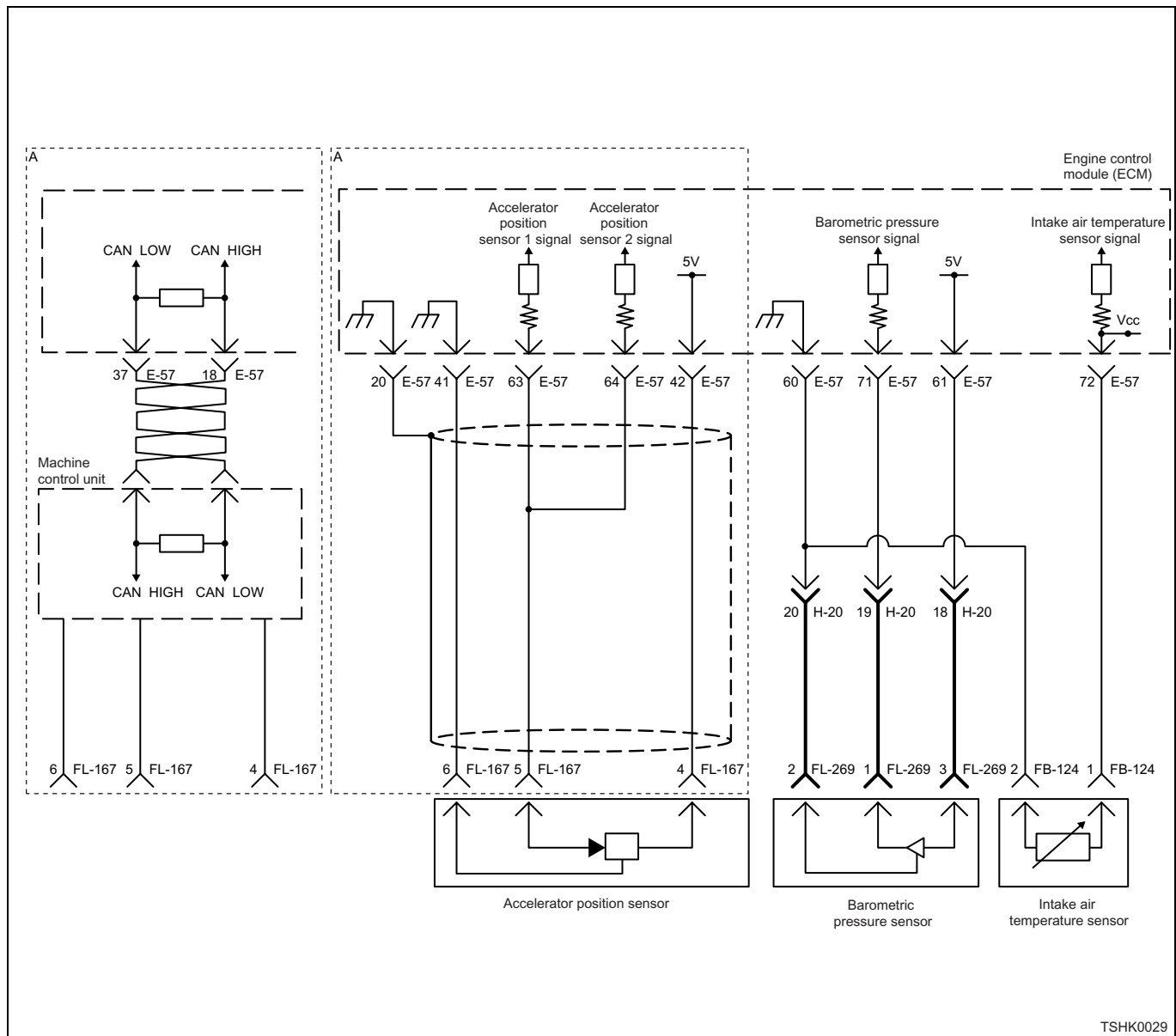
1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	61 - Sensor connector power supply terminal	100Ω or less	10MΩ or more
7	Short circuit to ground circuit/ ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	71 - 60 71 - Ground	10MΩ or more	100Ω or less
	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	71 - Sensor connector signal terminal	100Ω or less	10MΩ or more

On-board check of sensors**Name**

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness.
 - If only step 1 is faulty, replace the sensor.

DTC: P0108 (Flash code 71)**Barometric pressure sensor circuit input is high (+5V short circuit).****Description of circuit**

The barometric pressure sensor detects the barometric pressure. The barometric pressure sensor is installed to the machine. As the barometric pressure changes depending on altitude and weather condition, output voltage of the barometric pressure sensor will change (if the barometric pressure is low, output voltage becomes low, if the barometric pressure is high, the output voltage becomes high as well). The engine control module (ECM) reads this output voltage change, converting it into barometric pressure, to utilize for optimizing the fuel injection control and for calculating the relative boost pressure.

Main trouble symptom

Due to back-up equivalent to 2500m

- Black smoke emitted at high altitude

- Output shortage at low altitude

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1632 is not detected.

DTC set condition

- Barometric pressure sensor voltage is 3.8 V or more for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

TSHK0029

Back-up mode

- Barometric pressure default setting (80 kPa)
- EGR stopped

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Barometric pressure sensor” displays more than the specified value. If less than the specified value, identify the cause by referring to “Diagnostic aid”.

5. If the “Barometric pressure sensor” displays more than the specified value when the barometric pressure sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 14.
3	Check the value for barometric pressure sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Barometric pressure sensor” using scan tool. Is the “Barometric pressure sensor” more than the specified value?	3.8V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the barometric pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.

10D-239 Electronic control fuel injection system (Common rail type)

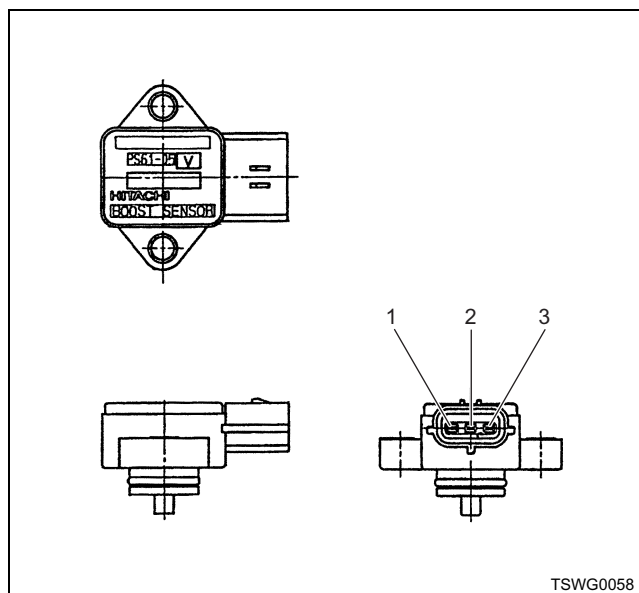
Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the barometric pressure sensor connector. 3. Turn the key switch to "ON". 4. Check the value for "Barometric pressure sensor" using scan tool. Is the "Barometric pressure sensor" less than the specified value?	0V	Go to Step 8.	Go to Step 6.
6	1. Check the signal circuit between ECM and barometric pressure sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the barometric pressure sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the ground circuit between ECM and barometric pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the barometric pressure sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.

Step	Action	Value	YES	NO
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0108 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Start the engine. 2. Check the display of barometric pressure. Does the display of “Barometric pressure” show more than error value?	127kPa (Displayed error value)	Go to Step 15.	Go to “Diagnostic aid”.
15	Check for installation condition of the barometric pressure sensor, ECM and coupling connector. (Check the barometric pressure sensor circuit for short to +5V line or battery power supply circuit.) 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 16.

10D-241 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
16	1. Check the signal circuit between ECM and barometric pressure sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the barometric pressure sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 17.
17	1. Check for followings in the ground circuit between ECM and barometric pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 8.

About barometric pressure sensor



Name

1. Power supply
2. GND
3. Signal

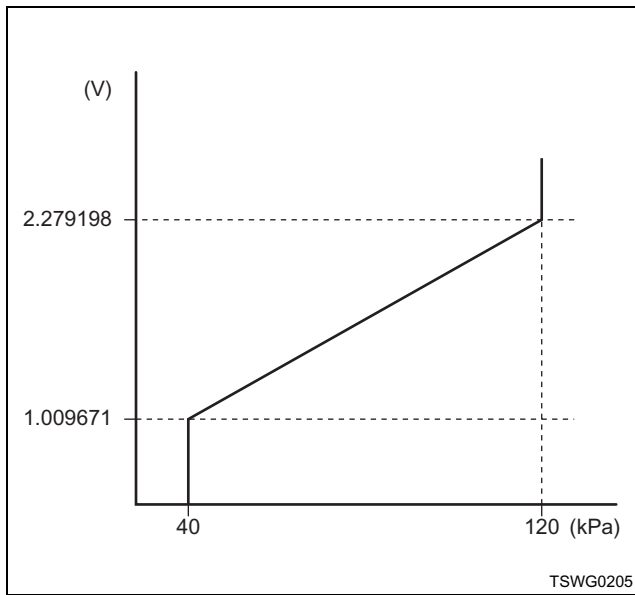
Characteristics of barometric pressure sensor

The output voltage of barometric pressure sensor changes according to the barometric pressure.

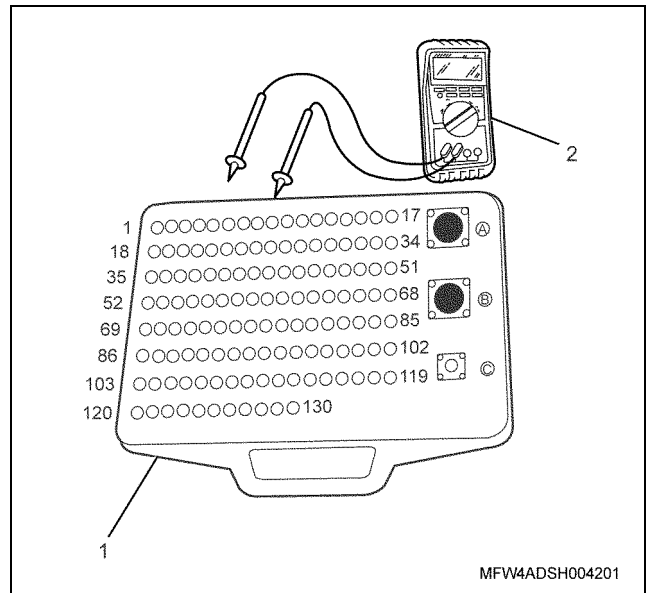
The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of 40kPa or 127kPa is not changed.

When error occurs, error value (127kPa) is displayed. The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

Tech2 and scan tools with KW communication can display both voltage and physical value.

**Breaker box inspection procedure**

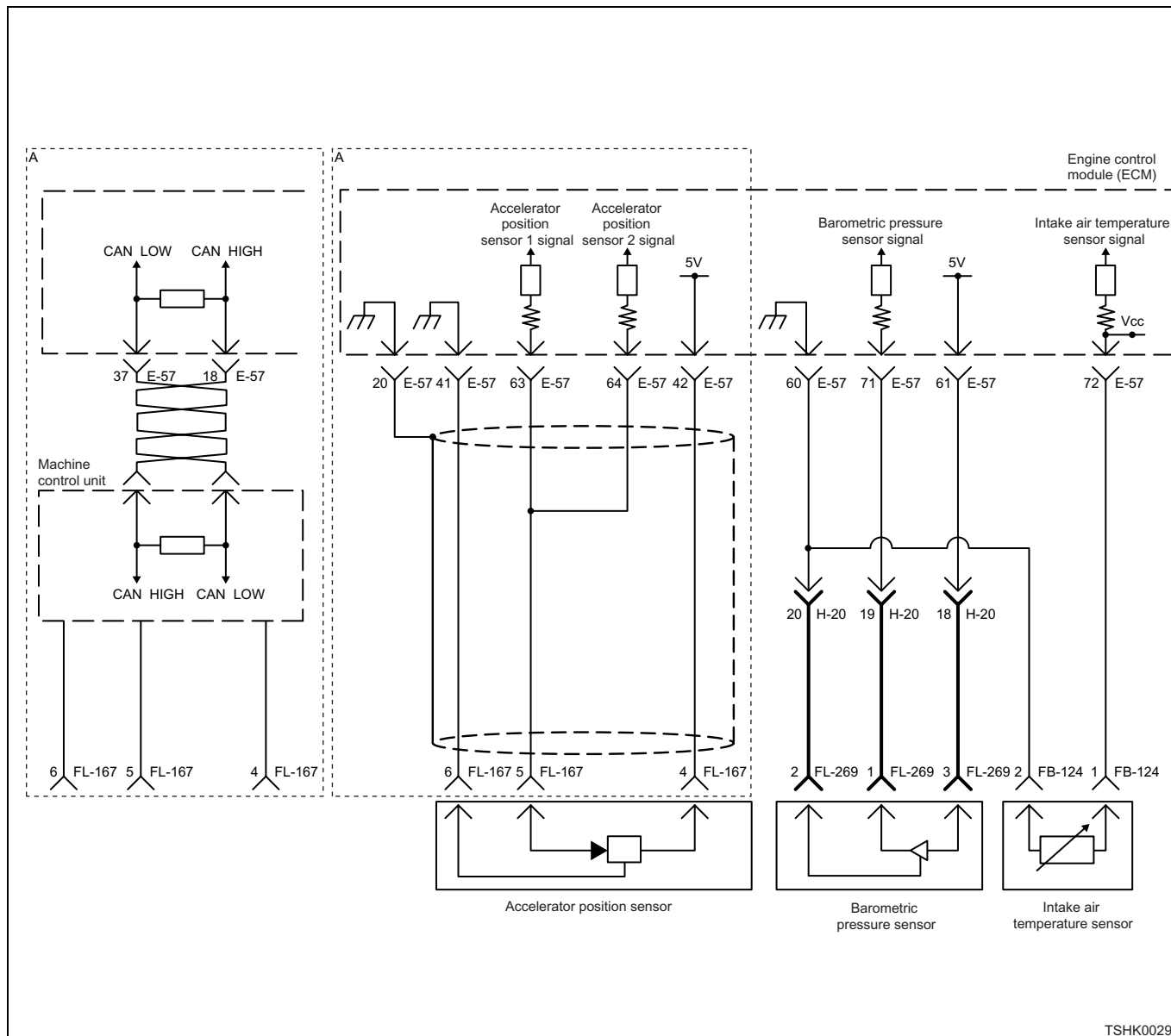
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name _____

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	71 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	60 - Sensor connector ground terminal	100Ω or less	10MΩ or more

DTC: P0112 (Flash code 22)**Intake air temperature sensor fault (low voltage fault, ground short, short circuit)**

TSHK0029

Description of circuit

The intake air temperature (IAT) sensor is the thermistor type and the value of resistance changes according to the temperature. The resistance is low when the intake air temperature is high, and is high when the temperature is low. The ECM energizes 5 V to the IAT sensor through the pull up resistance, and calculate the intake air temperature from the change in voltage, to utilize various control such as fuel injection control. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

Main trouble symptom

- White smoke emission possible when starting at low temperatures

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1632 is not detected.

DTC set condition

- IAT sensor voltage is 0.1V or less for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Intake air temperature default setting
- (at starting: -10°C , at running: 25°C)

- EGR stopped

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

- To make sure the correct performance of the IAT sensor, check with various temperatures using the reckoner table between temperature and resistance. If the sensor is faulty, operability may be affected.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding

• Wire disconnection inside harness cladding
Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Intake air temperature sensor” displays less than the specified value. If more than the specified value, identify the cause by referring to “Diagnostic aid”.

5. If the “Intake air temperature sensor” displays more than the specified value when the IAT sensor connector is removed, the circuit beyond the sensor is normal including ECM.

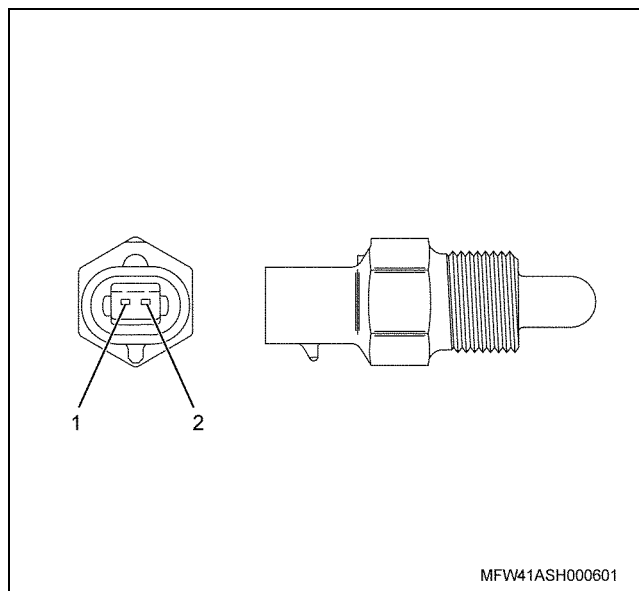
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 13.
3	Check the value for IAT sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Intake air temperature sensor” using scan tool. Is the “Intake air temperature sensor” less than the specified value?	0.1V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the IAT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 5.
5	1. Turn the key switch to “OFF”. 2. Disconnect the IAT sensor connector. 3. Turn the key switch to “ON”. 4. Check the value for “Intake air temperature sensor” using scan tool. Is the “Intake air temperature sensor” more than the specified value?	4.8V	Go to Step 7.	Go to Step 6.

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Step	Action	Value	YES	NO
6	1. Check for followings in the signal circuit between ECM and IAT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to IAT sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 8.
7	Replace the IAT sensor. Is the procedure completed?	—	Go to Step 11.	—
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0112 detected?	—	Go to Step 3.	Go to Step 12.
12	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Step	Action	Value	YES	NO
13	1. Start the engine. 2. Check the display of intake air temperature. Does the display of "Intake air temperature" show error value?	214°C (Displayed error value)	Go to Step 14.	Go to "Diagnostic aid".
14	Check for installation condition of the IAT sensor, ECM and coupling connector. (Check the IAT sensor circuit for ground short.) 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 15.
15	1. Check for followings in the signal circuit between ECM and IAT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to IAT sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 7.

About IAT sensor



Name

1. Signal
2. GND

Characteristics of intake air temperature sensor

The output voltage of IAT sensor changes according to the intake air.

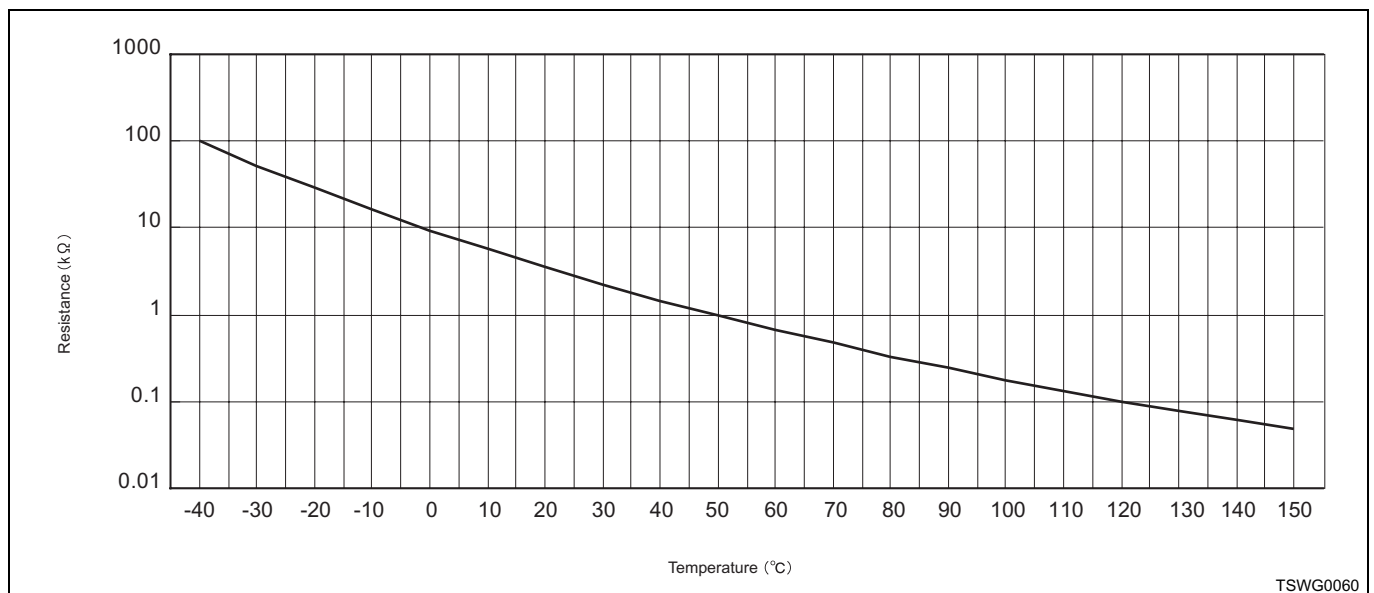
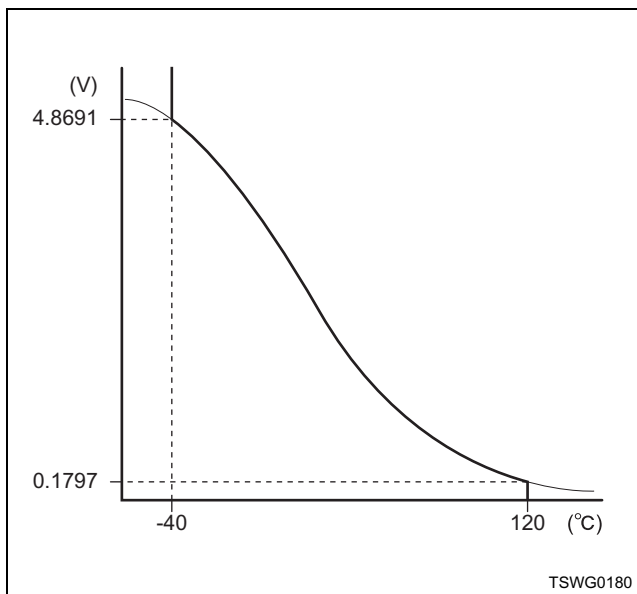
The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage.

Therefore, judge as it is more than the threshold value if the value of -40°C or 120°C is not changed.

When error occurs, error value (214°C) is displayed.

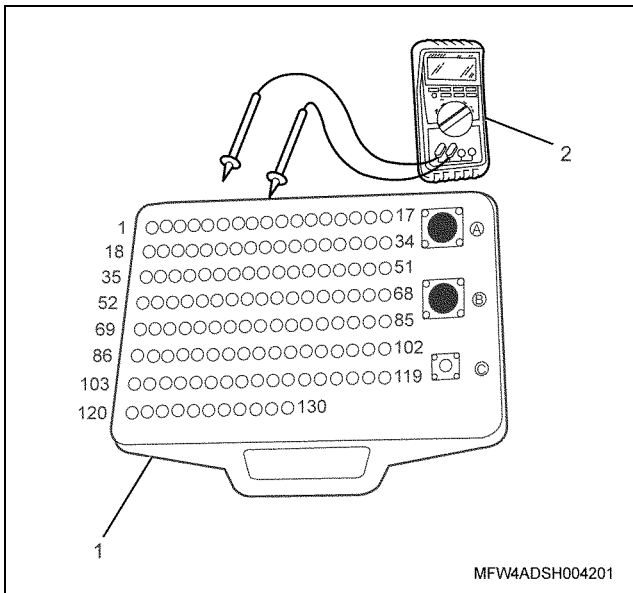
The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

Tech 2 and scan tools with KW communication can display both voltage and physical value.



Breaker box inspection procedure

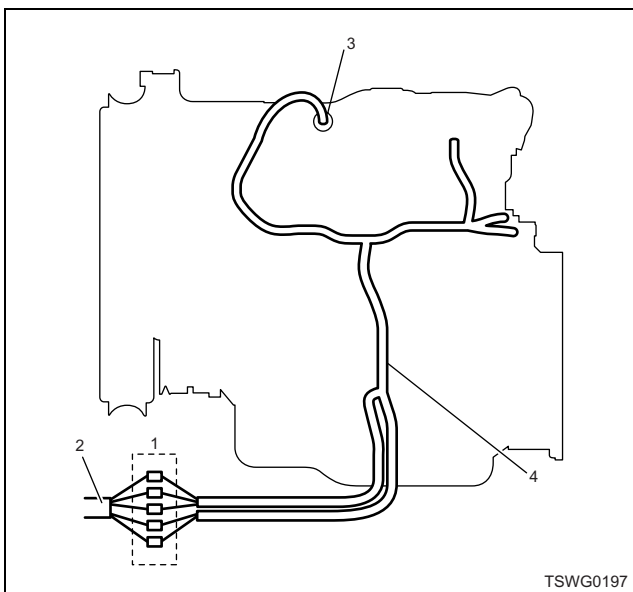
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

1. Breaker box
2. DMM

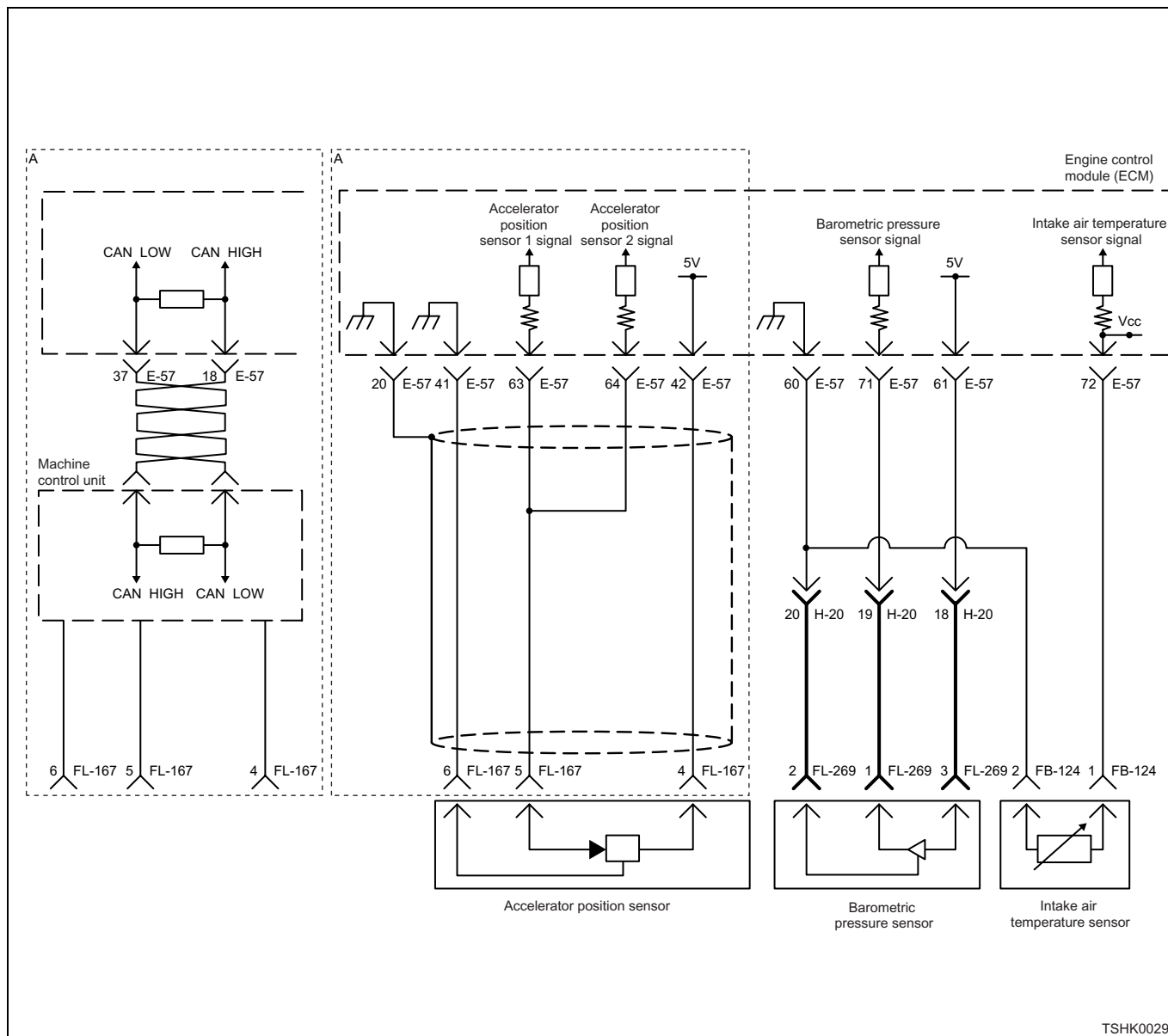
Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to ground circuit/ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	72 - 60 72 - Ground	10M Ω or more	100 Ω or less

On-board check of sensors

Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0113 (Flash code 22)**Intake air temperature sensor fault (high voltage fault, open circuit or short to power supply circuit)****Description of circuit**

The intake air temperature (IAT) sensor is the thermistor type and the value of resistance changes according to the temperature. The resistance is low when the intake air temperature is high, and is high when the temperature is low. The ECM energizes 5 V to the IAT sensor through the pull up resistance, and calculate the intake air temperature from the change in voltage, to utilize various control such as fuel injection control. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

Main trouble symptom

- White smoke emission possible when starting at low temperatures

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1632 is not detected.
- 3 minutes or more has elapsed after starting engine.

DTC set condition

- IAT sensor voltage is 4.95V or more for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Intake air temperature default setting
- (at starting: -10°C , at running: 25°C)
- EGR stopped

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

- To make sure the correct performance of the IAT sensor, check with various temperatures using the reckoner table between temperature and resistance. If the sensor is faulty, operability may be affected.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector

- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In case of current trouble, the “Intake air temperature sensor” displays more than the specified value. In this case, identify the cause by referring to “Diagnostic aid”.

5. If the “Intake air temperature sensor” displays less than the specified value when terminals between the IAT sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 15.
3	Check the value for IAT sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Intake air temperature sensor” using scan tool. Is the “Intake air temperature sensor” more than the specified value?	4.95V/ 120°C	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the IAT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 5.

10D-251 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the IAT sensor connector. 3. Short the IAT sensor connector signal terminal to the ground terminal using jump cable. 4. Turn the key switch to "ON". 5. Check the value for "Intake air temperature sensor" using scan tool. Is the "Intake air temperature sensor" less than the specified value?	0V/-40°C	Go to Step 9.	Go to Step 6.
6	1. Check the signal circuit between ECM and IAT sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the IAT sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and IAT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
8	1. Check for followings in the ground circuit between ECM and IAT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	Replace the IAT sensor. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.

Step	Action	Value	YES	NO
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0113 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
15	1. Start the engine. 2. Check the display of intake air temperature. Is the "Intake air temperature" more than the specified value?	−40°C	Go to Step 16.	Go to "Diagnostic aid".
16	Check for installation condition of the IAT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 17.

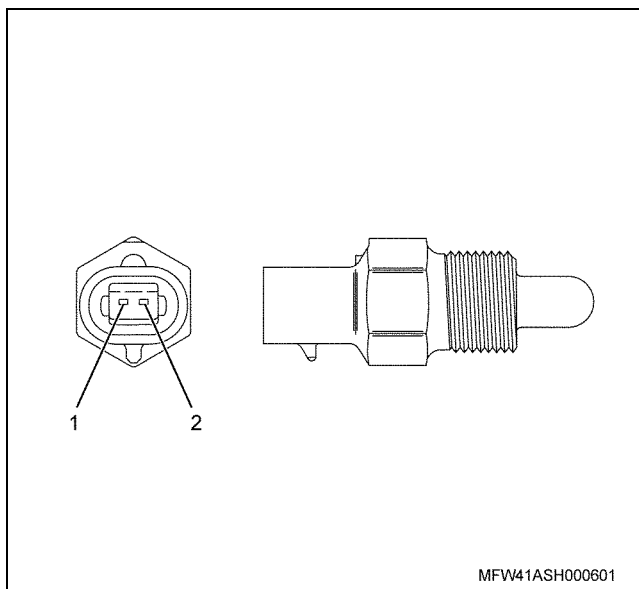
10D-253 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
17	1. Check the signal circuit between ECM and IAT sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the IAT sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 18.
18	1. Check for followings in the signal circuit between ECM and IAT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 19.
19	1. Check for followings in the ground circuit between ECM and IAT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 9.

About IAT sensor

Name

1. Signal
2. GND



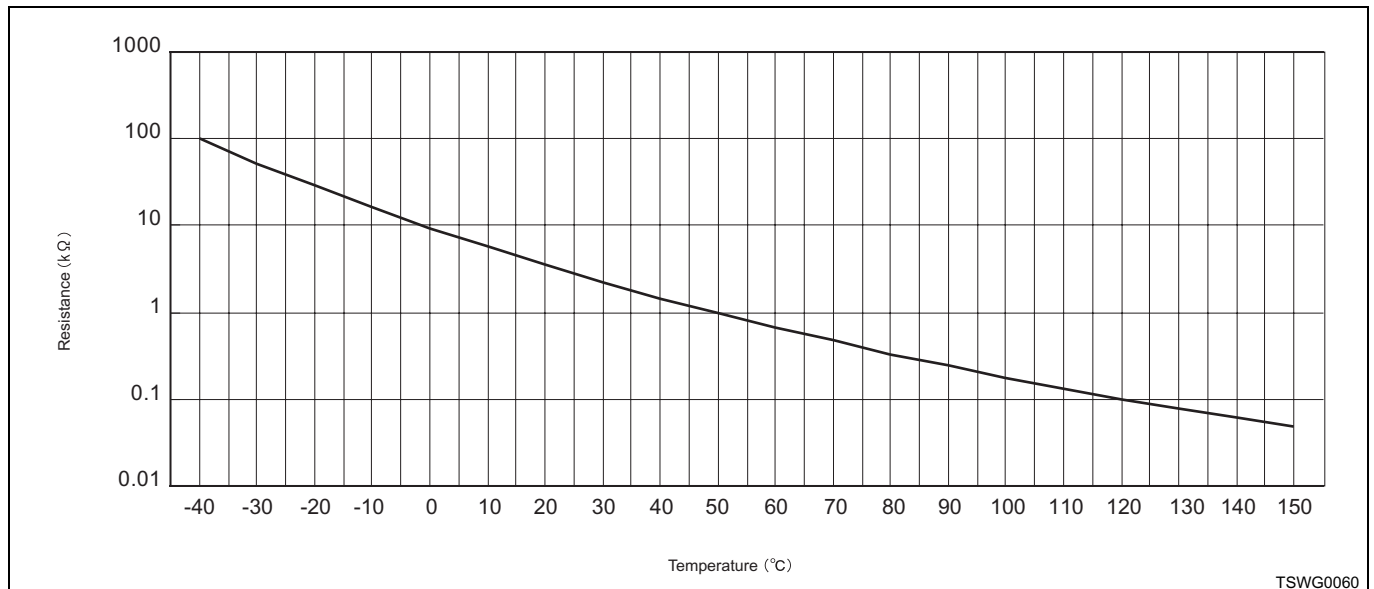
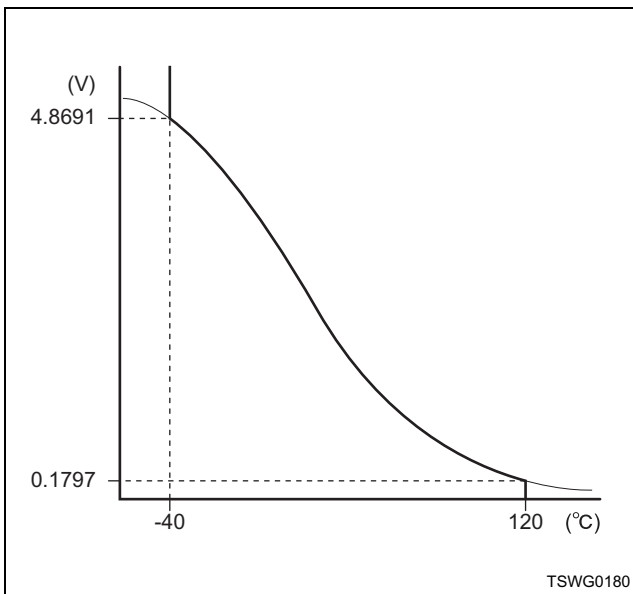
Characteristics of intake air temperature sensor

The output voltage of IAT sensor changes according to the intake air.

The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of -40°C or 120°C is not changed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

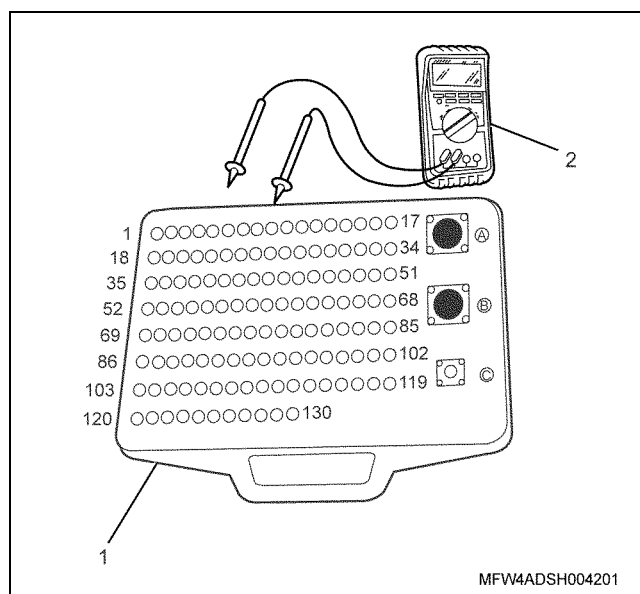
Tech 2 and scan tools with KW communication can display both voltage and physical value.



10D-255 Electronic control fuel injection system (Common rail type)

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

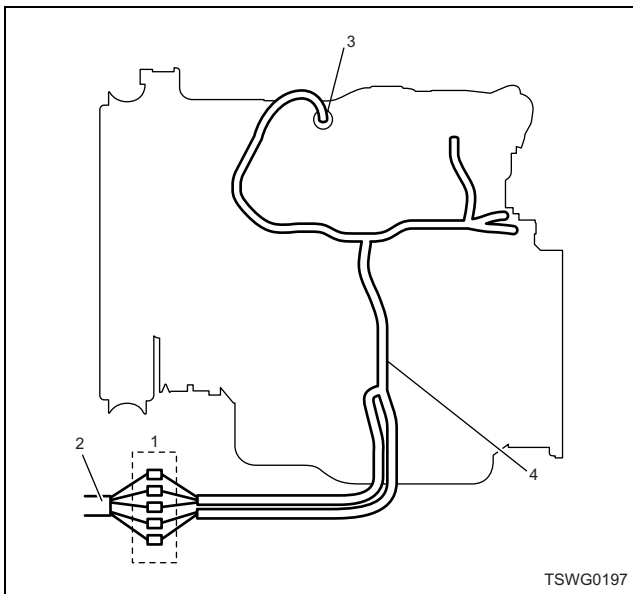


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	72 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	72 - Sensor connector signal terminal	100Ω or less	10MΩ or more
8	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	60 - Sensor connector ground terminal	100Ω or less	10MΩ or more

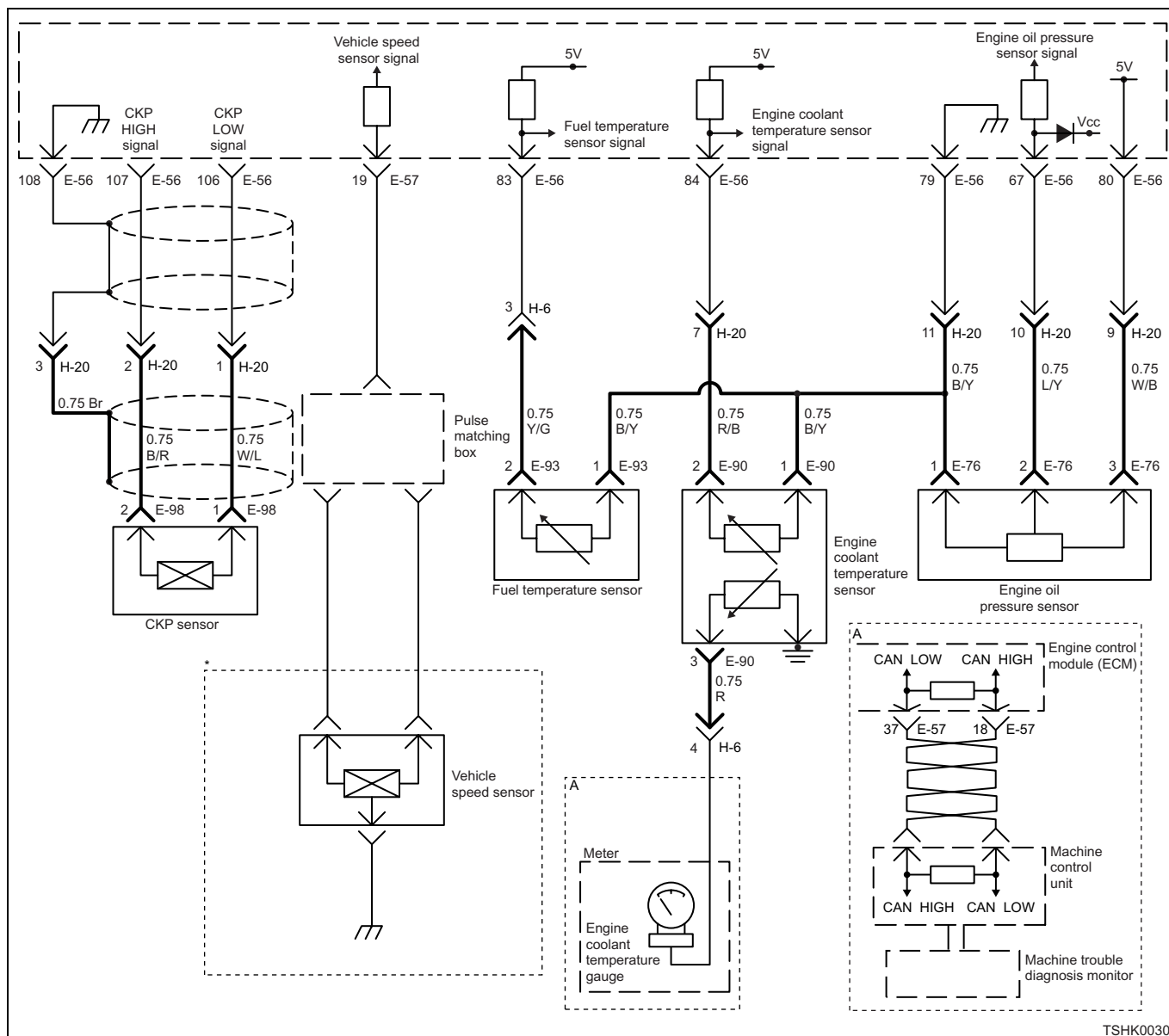
On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0117 (Flash code 23)**Engine coolant temperature sensor fault (low voltage fault, ground short)**

TSHK0030

Description of circuit

The engine coolant temperature (ECT) sensor detects the engine coolant temperature. The ECT sensor is installed near the thermostat housing. The ECT sensor is the thermistor type and the value of resistance inside the sensor changes according to the temperature. If the temperature is high, the resistance becomes low; if the temperature is low, the resistance becomes high. The engine control module (ECM) is connected to the ECT sensor via signal circuit and ground circuit, and energizes +5 V power supply to the signal circuit. ECM recognizes the applied voltage, which varies with change in the resistance of ECT sensor according to temperature (If the temperature is high, the voltage becomes low; if the temperature is low, the voltage becomes high), as an input signal.

Main trouble symptom

- Deterioration of startability at low temperatures
- Black smoke emitted
- Output lowering depending on conditions

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1633 is not detected.

DTC set condition

- ECT sensor voltage is 0.1V or less for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Coolant temperature default setting
- (at starting: -20°C, at driving: 80°C)
- EGR stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

- DTC may be set at a overheat condition.
- After starting the engine, the thermostat begins to open when the engine coolant temperature rises (4H: 85°C, 6H: 82°C), and the engine coolant temperature is stabilized.
- To make sure the correct performance of the ECT sensor, check with various temperatures using the reckoner table between temperature and resistance. If the sensor is faulty, operability may be affected.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In case of current trouble, the "Engine coolant temperature sensor" displays more than the specified value. In this case, identify the cause by referring to "Diagnostic aid".

5. If the "Engine coolant temperature sensor" displays more than the specified value when the ECT sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 13.
3	Check the value for ECT sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for "Engine coolant temperature sensor" using scan tool. Is the "Engine coolant temperature sensor" less than the specified value?	0.1V	Go to Step 4.	Go to "Diagnostic aid".

10D-259 Electronic control fuel injection system (Common rail type)

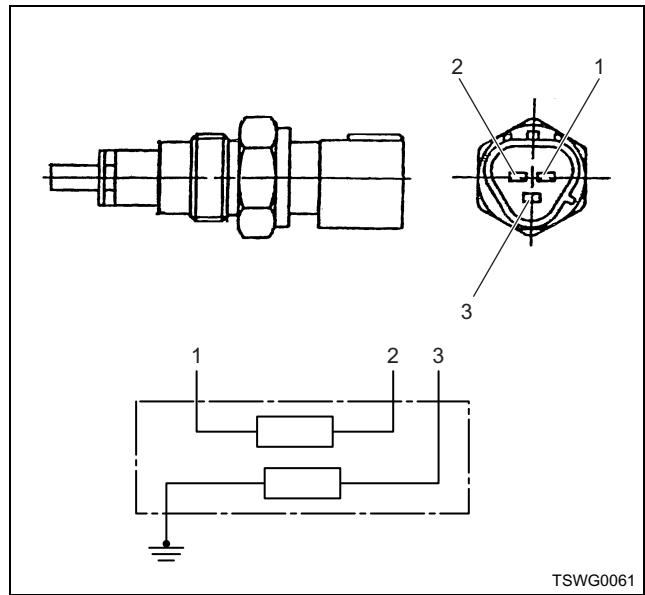
Step	Action	Value	YES	NO
4	Check for installation condition of the ECT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 6.
5	1. Turn the key switch to "OFF". 2. Disconnect the ECT sensor connector. 3. Turn the key switch to "ON". 4. Check the value for "Engine coolant temperature sensor" using scan tool. Is the "Engine coolant temperature sensor" more than the specified value?	4.8V	Go to Step 7.	Go to Step 6.
6	1. Check for followings in the signal circuit between ECM and ECT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to ECT sensor ground circuit • Short circuit to ground 2. Measure the resistance of ECT sensor, and check if the measured value is within the normal range. 3. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 8.
7	Replace the ECT sensor. Is the procedure completed?	—	Go to Step 11.	—
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.

Step	Action	Value	YES	NO
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0117 detected?	—	Go to Step 2.	Go to Step 12.
12	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
13	1. Start the engine. 2. Check the display of the engine coolant temperature. Display of engine coolant temperature is 214°C due to back-up mode after fault judgment. Does the display of “Engine coolant temperature” show error value?	214°C (Displayed error value)	Go to Step 11.	Go to Step 14.
14	Check for installation condition of the ECT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 15.

10D-261 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
15	1. Check for followings in the signal circuit between ECM and ECT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to ECT sensor ground circuit • Short circuit to ground 2. Measure the resistance of ECT sensor, and check if the measured value is within the normal range. 3. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 7.

About ECT sensor



Name

- 1. Sensor ground (for engine control)
- 2. Sensor signal (for engine control)
- 3. Sensor signal (for meter)

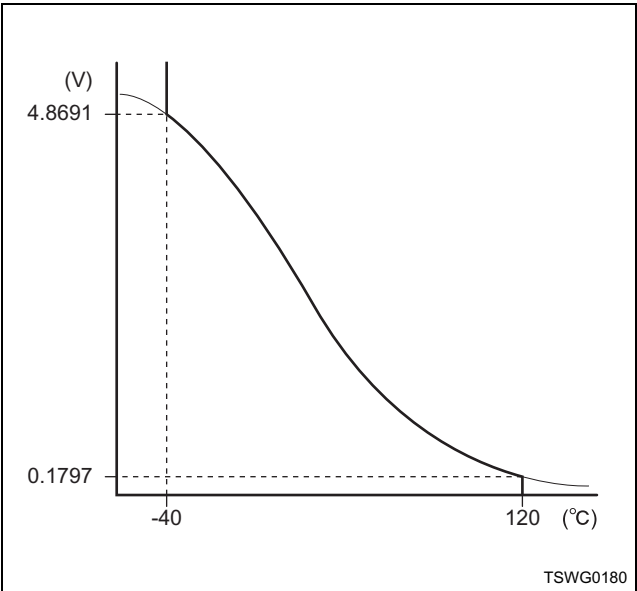
Characteristics of ECT sensor

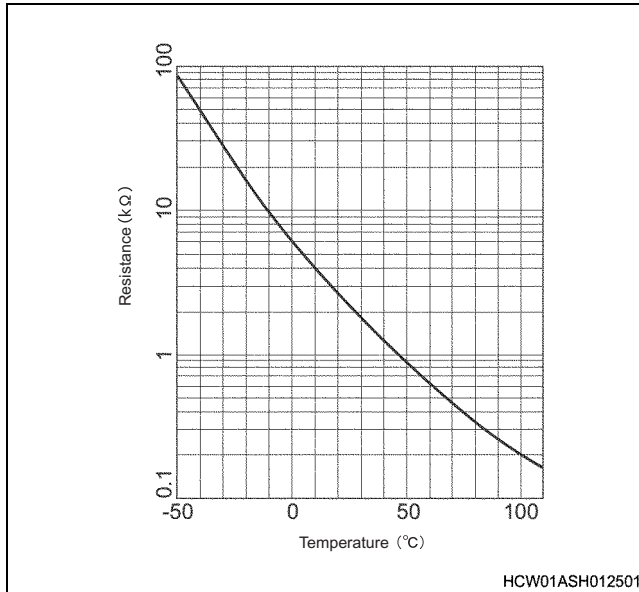
The output voltage of ECT sensor changes according to the engine coolant temperature. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of -40°C or 120°C is not changed.

When error occurs, error value (214°C) is displayed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

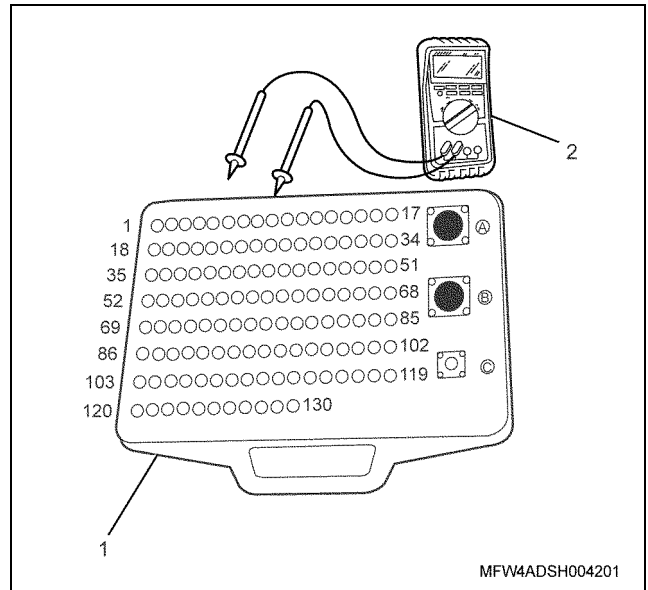
Tech2 and scan tools with KW communication can display both voltage and physical value.





Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

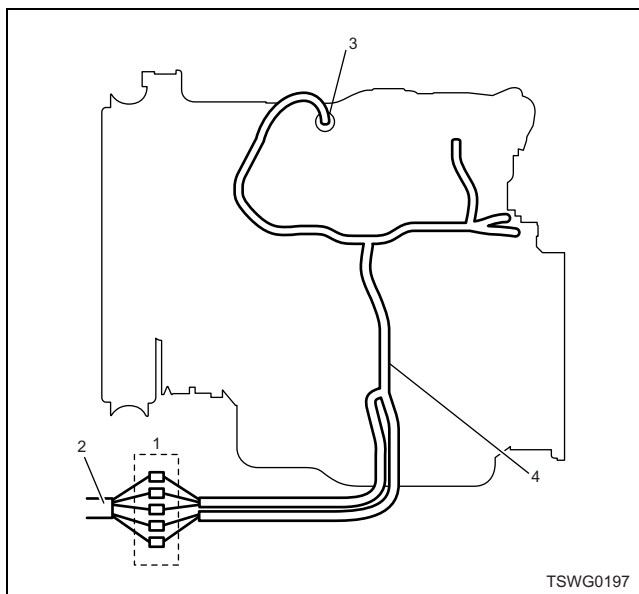


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to ground circuit/ground	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	84 - 79 84 - Ground	10MΩ or more	100Ω or less

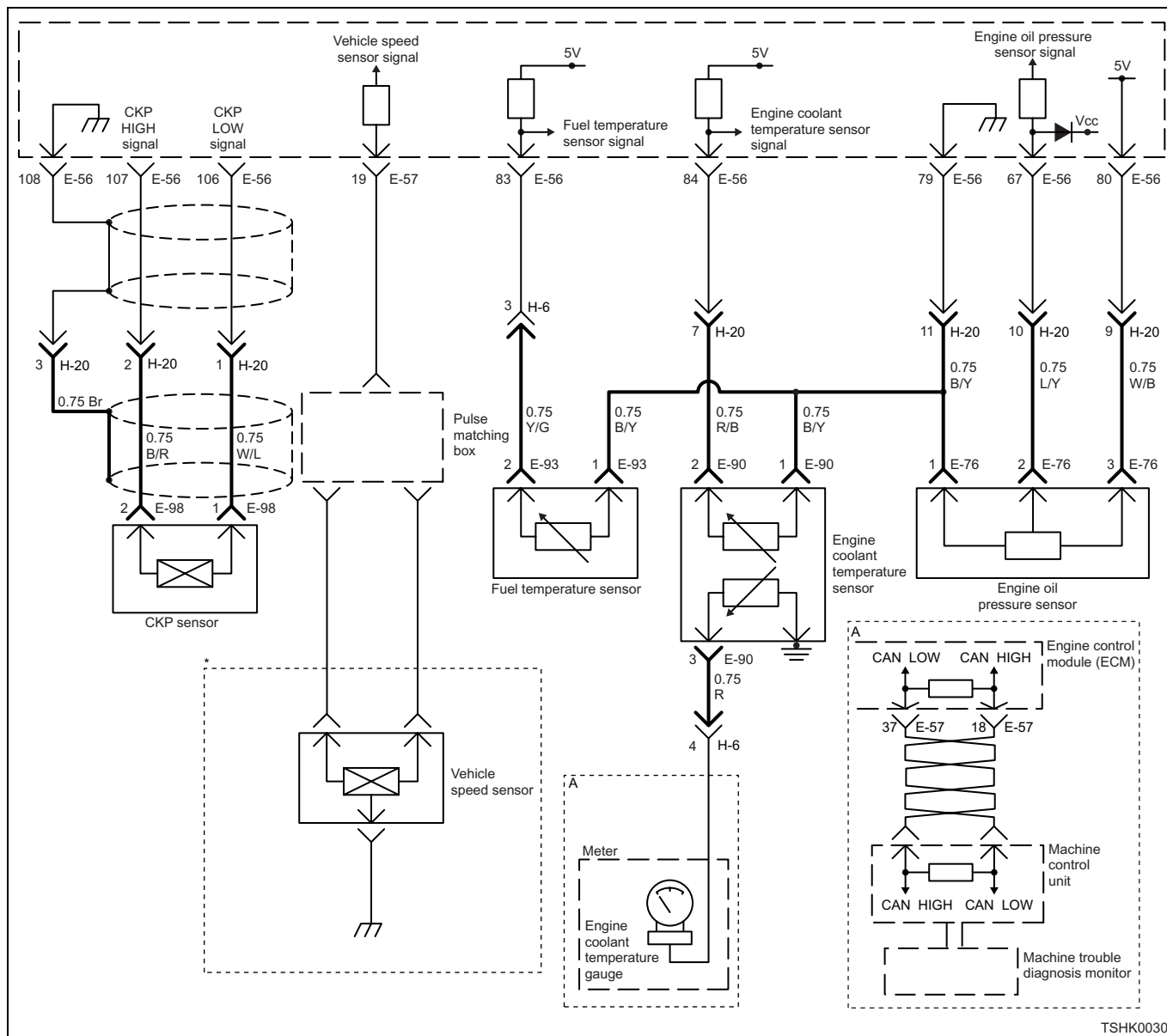
On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0118 (Flash code 23)**Engine coolant temperature sensor input is high (open circuit and short to power supply).****(*: Specifications vary depending on each machine. Refer to the machine's manual.)**

TSHK0030

Description of circuit

The engine coolant temperature (ECT) sensor detects the engine coolant temperature. The ECT sensor is installed near the thermostat housing. The ECT sensor is the thermistor type and the value of resistance inside the sensor changes according to the temperature. If the temperature is high, the resistance becomes low; if the temperature is low, the resistance becomes high. The engine control module (ECM) is connected to the ECT sensor via signal circuit and ground circuit, and energizes +5 V power supply to the signal circuit. ECM recognizes the applied voltage, which varies with change in the resistance of ECT sensor according to temperature (If the temperature is high, the voltage becomes low; if the temperature is low, the voltage becomes high), as an input signal.

Main trouble symptom

- Noise deteriorates.
- White smoke emitted at low temperatures.
- Rough idling

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1633 is not detected.
- 3 minutes or more has elapsed after starting engine.

DTC set condition

- ECT sensor voltage is 4.85V or more for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Coolant temperature default setting
- (at starting: -20°C, at driving: 80°C)
- EGR stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

- After starting the engine, the thermostat begins to open when the engine coolant temperature rises (4H: 85°C, 6H: 82°C), and the engine coolant temperature is stabilized.
- To make sure the correct performance of the ECT sensor, check with various temperatures using the reckoner table between temperature and resistance. If the sensor is faulty, operability may be affected.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In case of current trouble, the "Engine coolant temperature sensor" displays more than the specified value. In this case, identify the cause by referring to "Diagnostic aid".

5. If the "Engine coolant temperature sensor" displays less than the specified value when terminals between the ECT sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 15.
3	Check the value for ECT sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for "Engine coolant temperature sensor" using scan tool. Is the "Engine coolant temperature sensor" more than the specified value?	4.85V	Go to Step 4.	Go to "Diagnostic aid".
4	Check for installation condition of the ECT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 5.

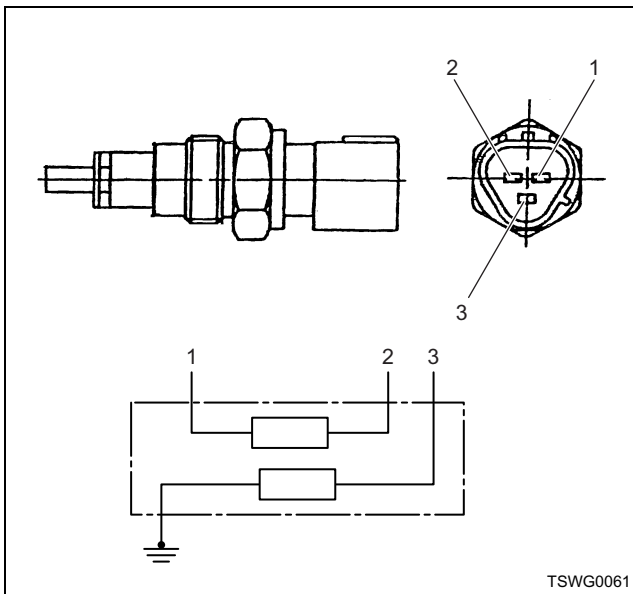
10D-265 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the ECT sensor connector. 3. Short the ECT sensor connector signal terminal to the ground terminal using jump cable. 4. Turn the key switch to "ON". 5. Check the value for "Engine coolant temperature sensor" using scan tool. Is the "Engine coolant temperature sensor" less than the specified value?	0V	Go to Step 9.	Go to Step 6.
6	1. Check the signal circuit between ECM and ECT sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the ECT sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and ECT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
8	1. Check for followings in the ground circuit between ECM and ECT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	Replace the ECT sensor. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 10.	Go to Step 11.

Step	Action	Value	YES	NO
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 11.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0118 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
15	1. Start the engine. 2. Check the display of the "Engine coolant temperature". Is the "Engine coolant temperature" more than the specified value?	−40°C	Go to Step 16.	Go to "Diagnostic aid".
16	Check for installation condition of the ECT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 17.

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Step	Action	Value	YES	NO
17	1. Check the signal circuit between ECM and ECT sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the ECT sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 18.
18	1. Check for followings in the signal circuit between ECM and ECT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 19.
19	1. Check for followings in the ground circuit between ECM and ECT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 9.

About ECT sensor**Name**

1. Sensor GND (for engine control)
2. Sensor signal (for engine control)
3. Sensor signal (for meter)

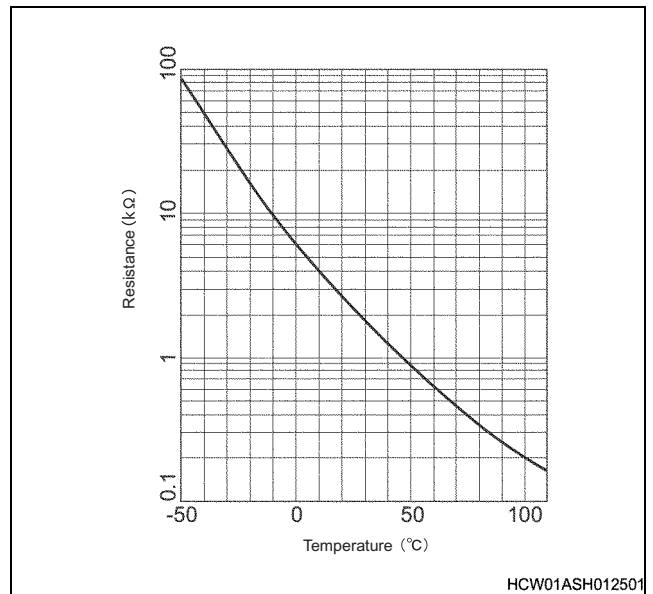
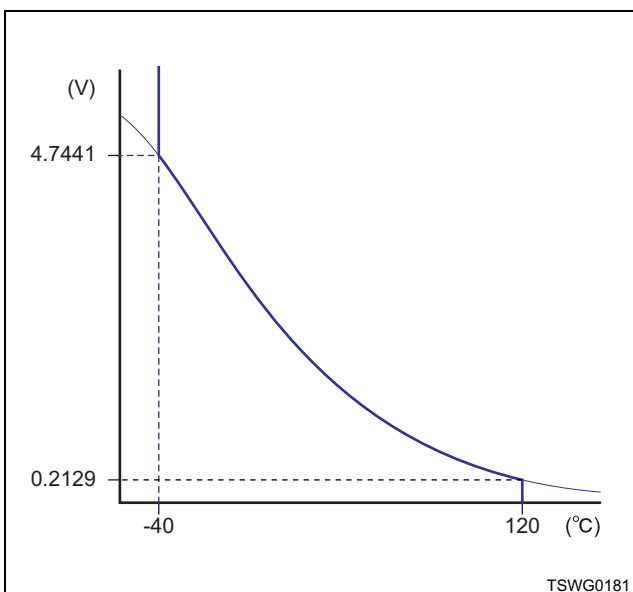
Characteristics of ECT sensor

The output voltage of ECT sensor changes according to the engine coolant temperature. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of -40°C or 120°C is displayed.

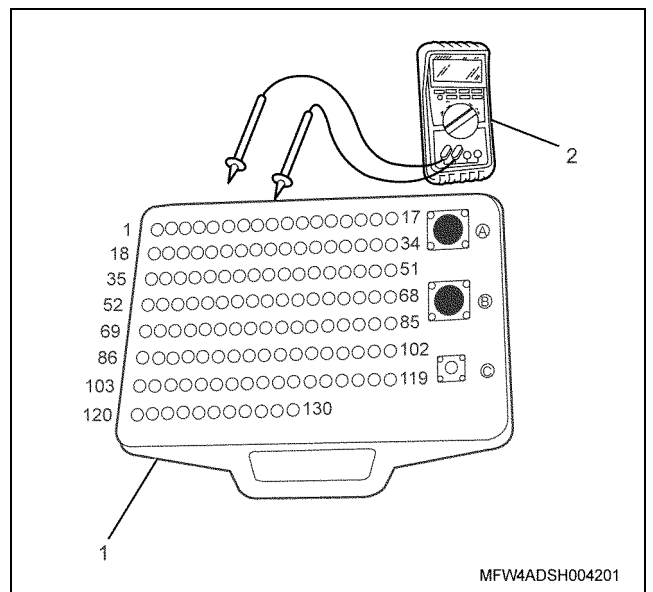
When error occurs, error value (214°C) is displayed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

Tech2 and scan tools with KW communication can display both voltage and physical value.

**Breaker box inspection procedure**

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

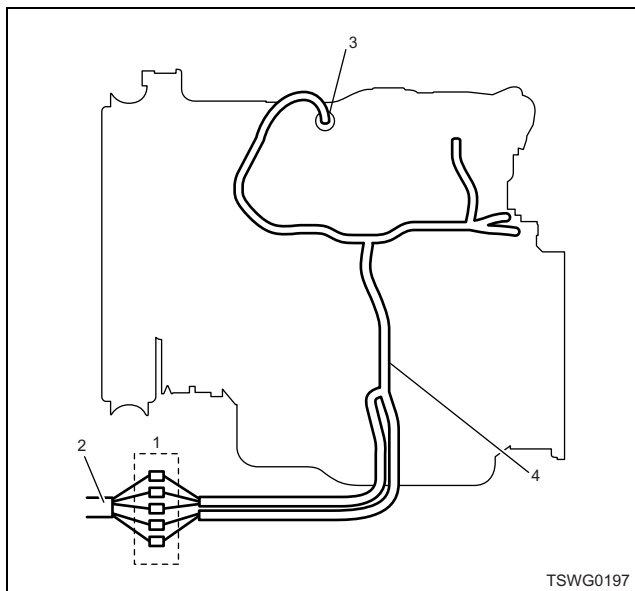
**Name**

1. Breaker box
2. DMM

10D-269 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	84 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	84 - Sensor connector signal terminal	100Ω or less	10MΩ or more
8	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	79 - Sensor connector ground terminal	100Ω or less	10MΩ or more

On-board check of sensors



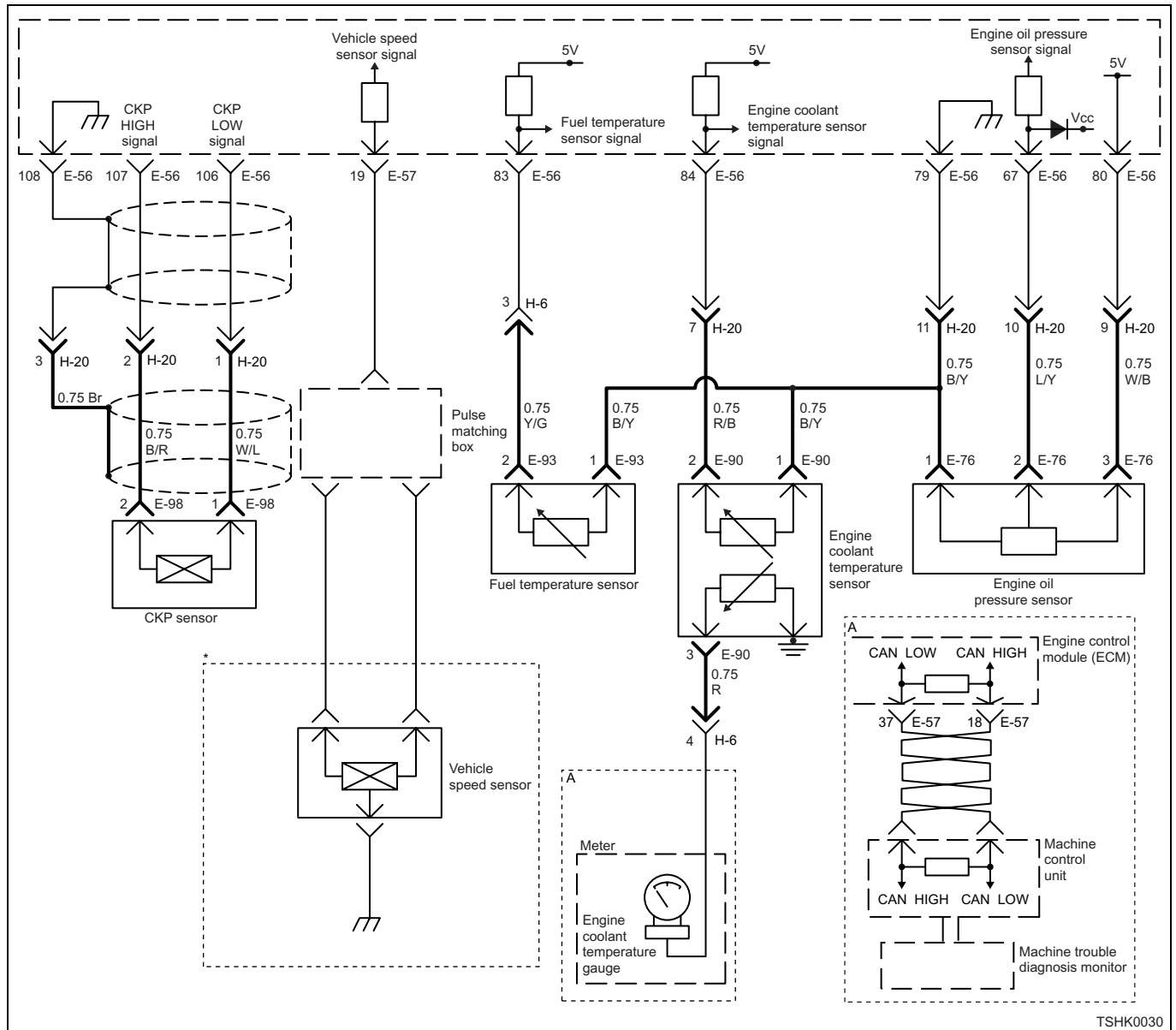
Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0182 (Flash code 211)**Fuel temperature sensor fault (low voltage fault, ground short)**

(*: Specifications vary depending on each machine. Refer to the machine's manual.)

**Description of circuit**

The fuel temperature (FT) sensor is the thermistor type and the value of resistance changes according to the temperature. The fuel temperature (FT) sensor is installed near the fuel inlet duct in the supply pump. The resistance is low when the fuel temperature is high, and is high when the temperature is low. The ECM energizes 5 V to the FT sensor through the pull up resistance, and calculates the fuel temperature from the change in voltage, to utilize for supply control etc. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

Main trouble symptom

Operationality is affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1633 is not detected.

DTC set condition

- FT sensor voltage is 0.1V or less for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

10D-271 Electronic control fuel injection system (Common rail type)

Back-up mode

- Fuel temperature default setting
(at starting: -20°C, at running: 70°C)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

- When the engine cold (before starting engine), check if the temperatures of the FT sensor and IAT sensor are close.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding

- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Fuel temperature sensor” displays more than the specified value. In this case, identify the cause by referring to “Diagnostic aid”.

5. If the “Fuel temperature sensor” displays more than the specified value when the FT sensor connector is removed, the circuit beyond the sensor is normal including ECM.

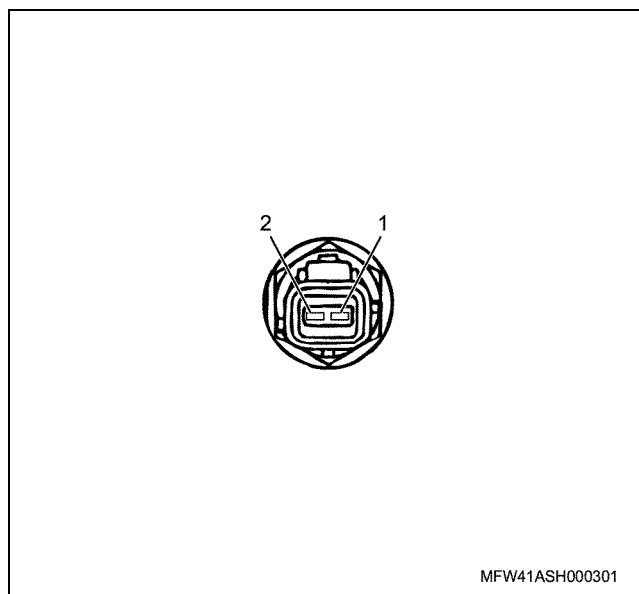
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 13.
3	Check the value for FT sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Fuel temperature sensor” using scan tool. Is the “Fuel temperature sensor” less than the specified value?	0.1V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the FT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 5.
5	1. Turn the key switch to “OFF”. 2. Disconnect the FT sensor connector. 3. Turn the key switch to “ON”. 4. Check the value for “Fuel temperature sensor” using scan tool. Is the “Fuel temperature sensor” more than the specified value?	4.8V	Go to Step 7.	Go to Step 6.

Step	Action	Value	YES	NO
6	1. Check for followings in the signal circuit between ECM and FT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to FT sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 8.
7	Replace the supply pump (FT sensor). Is the procedure completed?	—	Go to Step 11.	—
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0182 detected?	—	Go to Step 2.	Go to Step 12.
12	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

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Step	Action	Value	YES	NO
13	1. Start the engine. 2. Check the display of "Fuel temperature". Does the display of "Fuel temperature" show error value?	214°C (Displayed error value)	Go to Step 14.	Go to "Diagnostic aid".
14	Check for installation condition of the FT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 15.
15	1. Check for followings in the signal circuit between ECM and FT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to FT sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 6.

About FT sensor



Name

1. GND
2. Signal

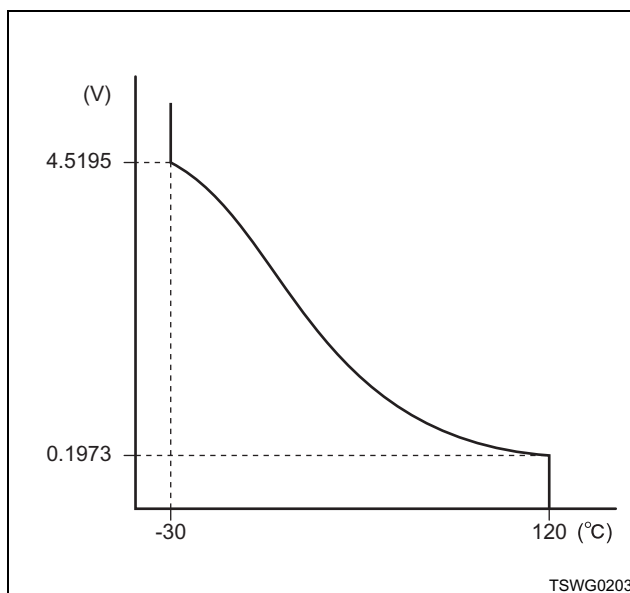
Characteristics of FT sensor

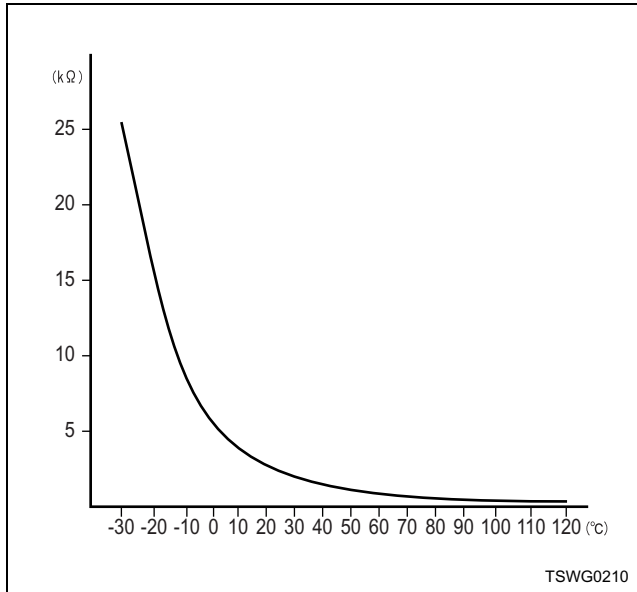
The output voltage of FT sensor changes according to the fuel temperature. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of -30°C or 120°C is not changed.

When error occurs, error value (214°C) is displayed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

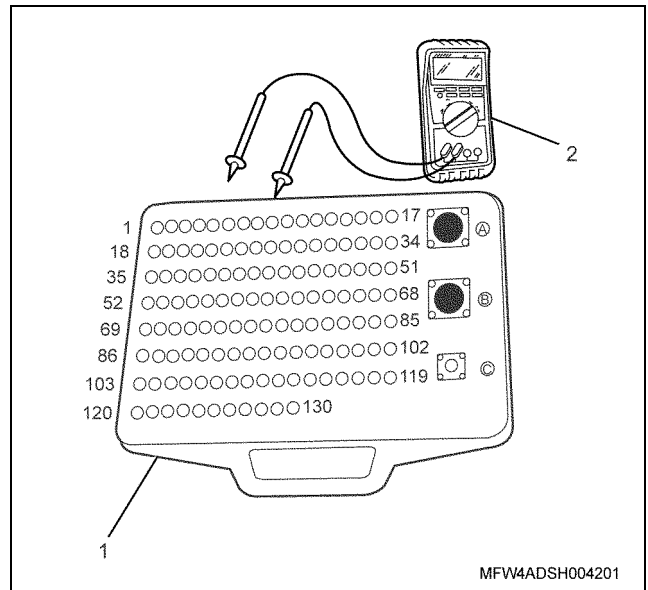
Tech2 and scan tools with KW communication can display both voltage and physical value.





Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

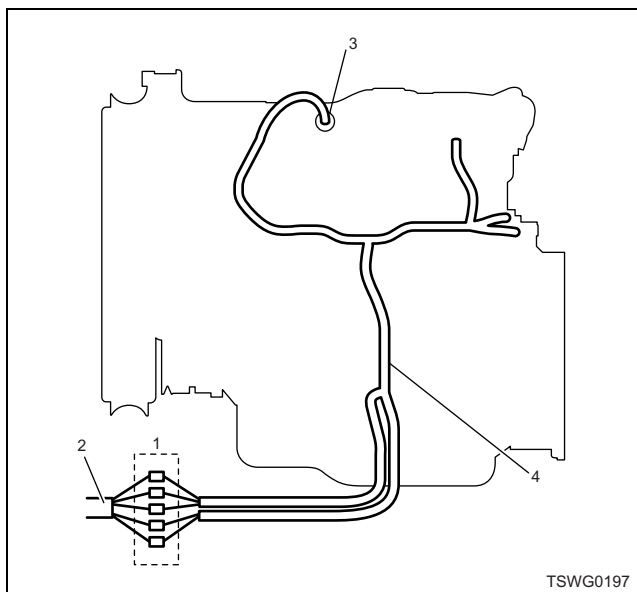


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to ground circuit/ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	83 - 109 83 - Ground	10MΩ or more	100Ω or less

On-board check of sensors



2. Machine harness
3. Sensor connector
4. Engine harness

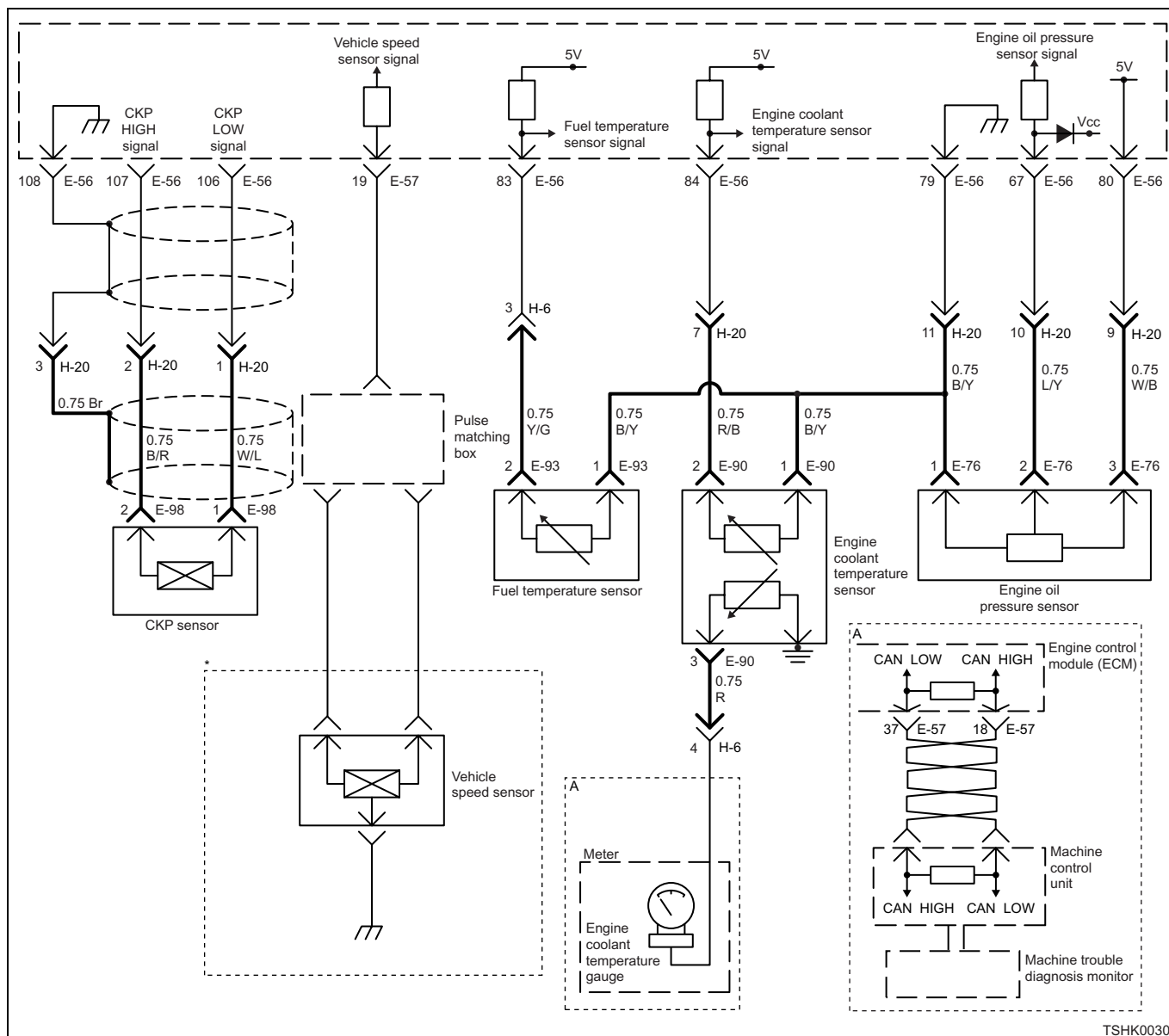
1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

Name

1. Coupling connector between engine — the machine

DTC: P0183 (Flash code 211)**Fuel temperature sensor fault (high voltage fault, open circuit or short to power supply circuit)**

(*: Specifications vary depending on each machine. Refer to the machine's manual.)



TSHK0030

Description of circuit

The fuel temperature (FT) sensor is the thermistor type and the value of resistance changes according to the temperature. The fuel temperature (FT) sensor is installed near the fuel inlet duct in the supply pump. The resistance is low when the fuel temperature is high, and is high when the temperature is low. The ECM energizes 5 V to the FT sensor through the pull up resistance, and calculates the fuel temperature from the change in voltage, to utilize for supply control etc. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

Main trouble symptom

Not in particular

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1633 is not detected.
- 3 minutes or more has elapsed after starting engine.

DTC set condition

- FT sensor voltage is 4.85V or more for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Fuel temperature default setting
(at starting: -20°C, at running: 70°C)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

- When the engine cold (before starting engine), check if the temperatures of the FT sensor and IAT sensor are close.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding

- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Fuel temperature sensor” displays more than the specified value. In this case, identify the cause by referring to “Diagnostic aid”.

5. If the “Fuel temperature sensor” displays less than the specified value when terminals between the FT sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 15.
3	Check the value for FT sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Fuel temperature sensor” using scan tool. Is the “Fuel temperature sensor” more than the specified value?	4.85V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the FT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 5.

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Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the FT sensor connector. 3. Short the FT sensor connector signal terminal to the ground terminal using jump cable. 4. Turn the key switch to "ON". 5. Check the value for "Fuel temperature sensor" using scan tool. Is the "Fuel temperature sensor" less than the specified value?	0V	Go to Step 9.	Go to Step 6.
6	1. Check the signal circuit between ECM and FT sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the FT sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and FT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
8	1. Check for followings in the ground circuit between ECM and FT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	Replace the supply pump (FT sensor). Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.

Step	Action	Value	YES	NO
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0183 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
15	1. Start the engine. 2. Check the display of "Fuel temperature". Is the "Fuel temperature" more than the specified value?	-30°C	Go to Step 16.	Go to "Diagnostic aid".
16	Check for installation condition of the FT sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 17.

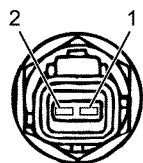
10D-279 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
17	1. Check the signal circuit between ECM and FT sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the FT sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 18.
18	1. Check for followings in the signal circuit between ECM and FT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 19.
19	1. Check for followings in the ground circuit between ECM and FT sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 9.

About FT sensor

Name

1. GND
2. Signal



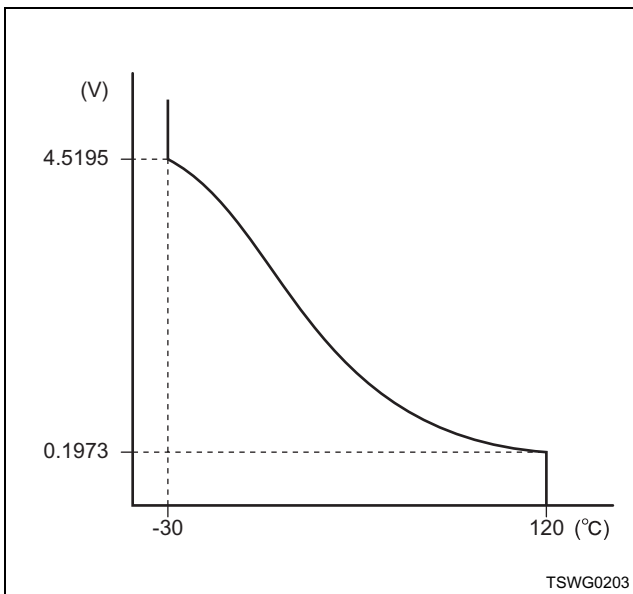
Characteristics of FT sensor

The output voltage of FT sensor changes according to the fuel temperature. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage.

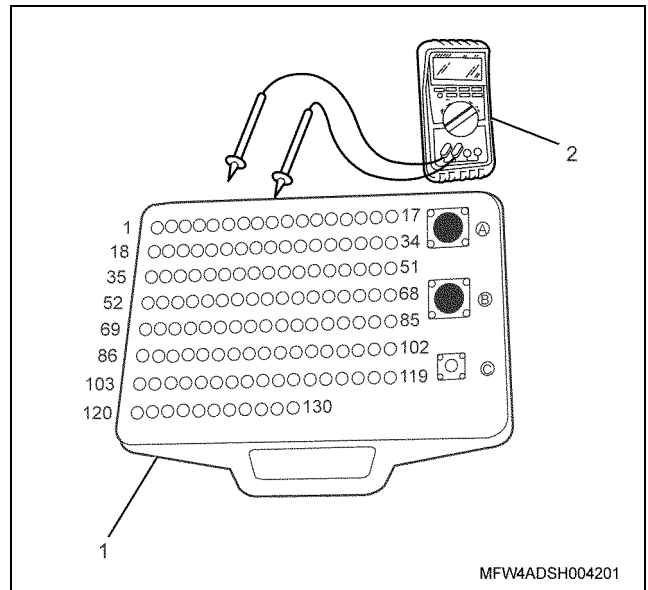
Therefore, judge as it is more than the threshold value if the value of -30°C or 120°C is not changed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

Tech2 and scan tools with KW communication can display both voltage and physical value.

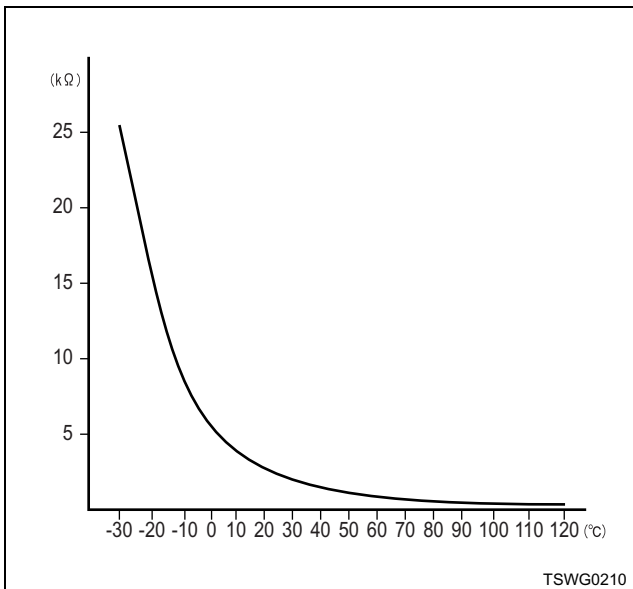
**Breaker box inspection procedure**

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

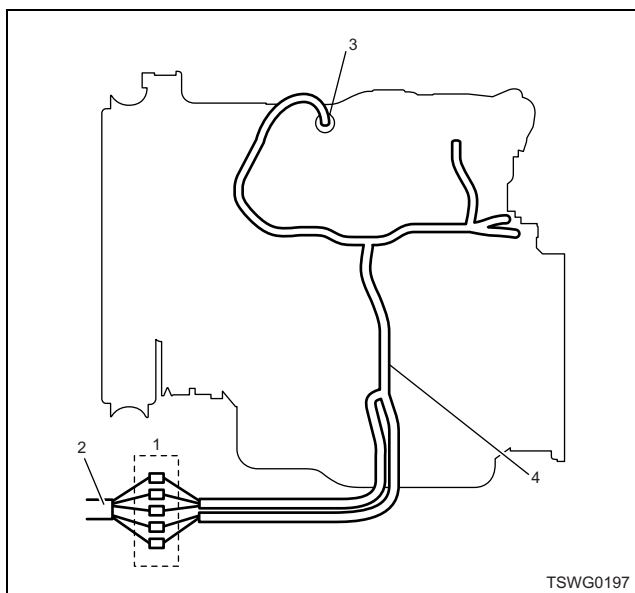
1. Breaker box
2. DMM



10D-281 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	83 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	83 - Sensor connector signal terminal	100Ω or less	10MΩ or more
8	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	109 - Sensor connector ground terminal	100Ω or less	10MΩ or more

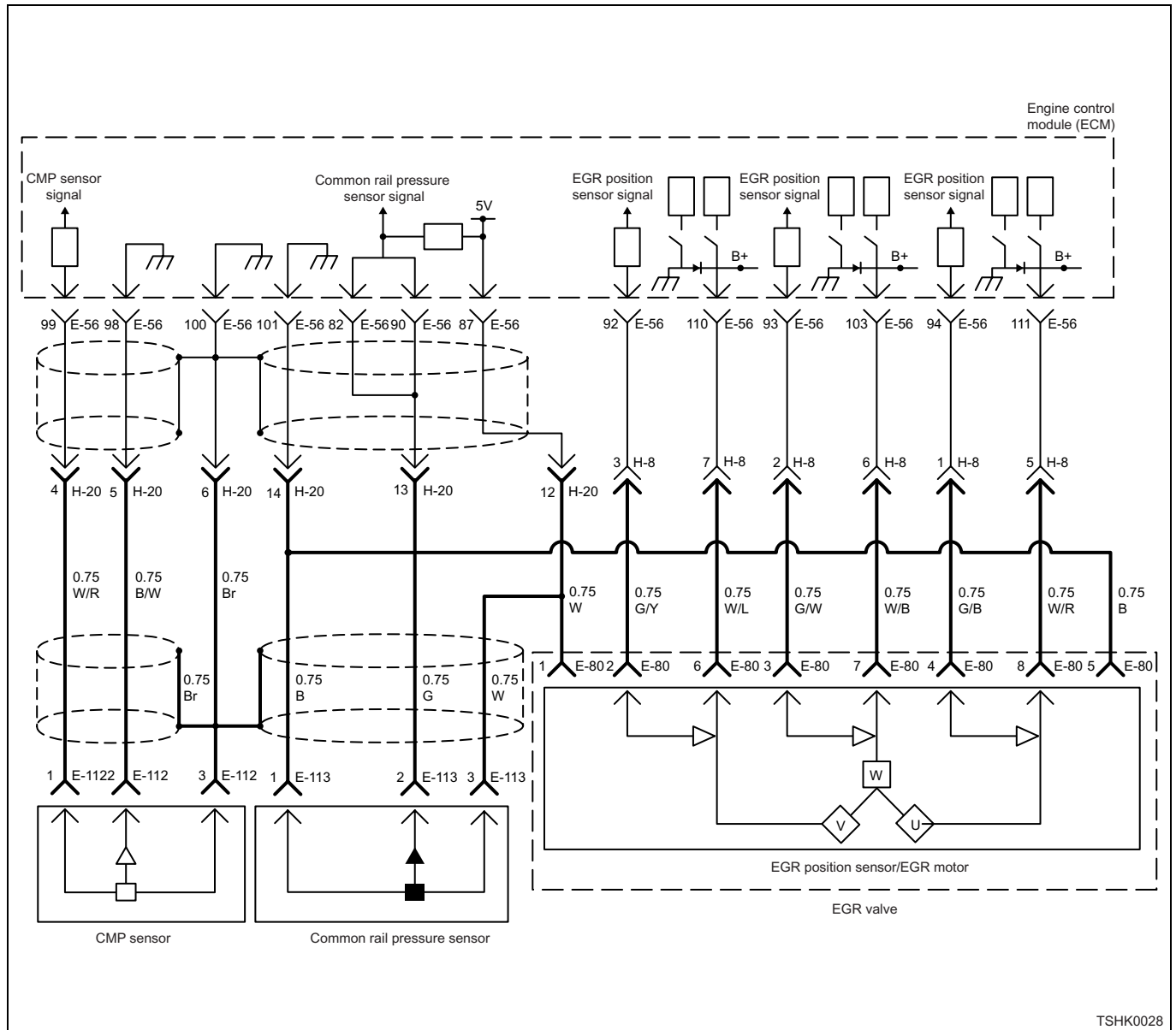
On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0192 (Flash code 245)**Common rail pressure sensor fault (low voltage fault)****Description of circuit**

The common rail pressure sensor detects the common rail internal pressure. The common rail pressure sensor is installed to the common rail. As the common rail internal pressure changes depending on engine condition, output voltage of the common rail pressure sensor will change (if the common rail internal fuel pressure is low, output voltage becomes low, if the pressure is high, the output voltage becomes high as well). The engine control module (ECM) reads this output voltage change, converting it into common rail internal pressure, to utilize for control. Dedicated communication circuits are used for the sensor power supply (5V), SIG, and ground in the common rail pressure sensor, which are connected to the ECM. Also, the sensor circuit is shielded to avoid electrical noise etc.

Main trouble symptom

- Engine blow up

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1635 is not detected.

DTC set condition

- Common rail pressure sensor voltage becomes 0.7V or less.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

TSHK0028

10D-283 Electronic control fuel injection system (Common rail type)

Back-up mode

- Specified back-up value (depending on the machine manufacturer)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding

• Wire disconnection inside harness cladding
Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Common rail pressure sensor” displays more than the specified value. If more than the specified value, identify the cause by referring to “Diagnostic aid”.

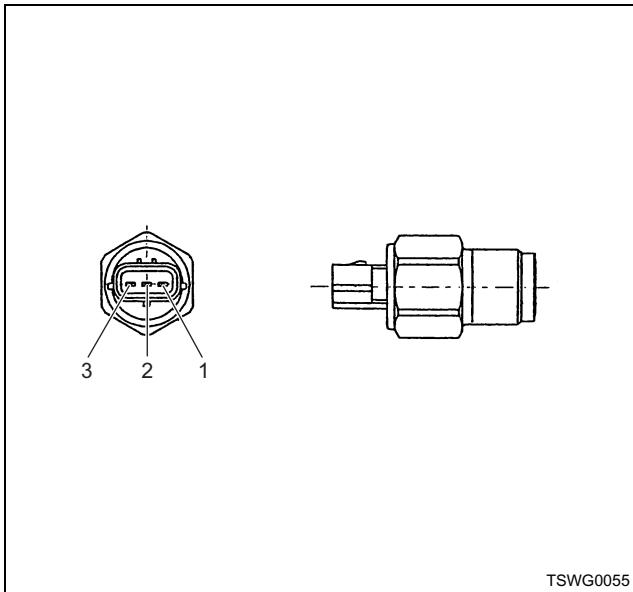
5. If the “Common rail pressure sensor” displays more than the specified value when the common rail pressure sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 14.
3	Check the value for common rail pressure sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Common rail pressure sensor” using scan tool. Is the “Common rail pressure sensor” output voltage less than the specified value?	0.7V (at idle)	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the common rail pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.

Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Turn the key switch to "ON". 4. Check the value for "Common rail pressure sensor" using scan tool. Is the "Common rail pressure sensor" output voltage specified value?	0V	Go to Step 8.	Go to Step 6.
6	1. Check for followings in the power supply circuit between ECM and common rail pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and common rail pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to common rail pressure sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the common rail (common rail pressure sensor). Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.

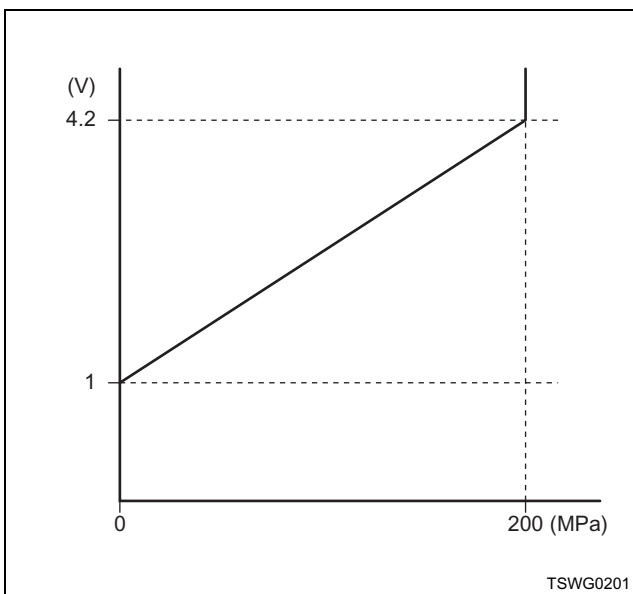
10D-285 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0192 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	Check for installation condition of the common rail pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 15.
15	1. Turn the key switch to “OFF”. 2. Disconnect the common rail pressure sensor connector. 3. Turn the key switch to “ON”. 4. Connect the DMM between the common rail pressure sensor signal terminal and the ground. Does the DMM indicate the specified value?	0V	Go to Step 8.	Go to Step 6.

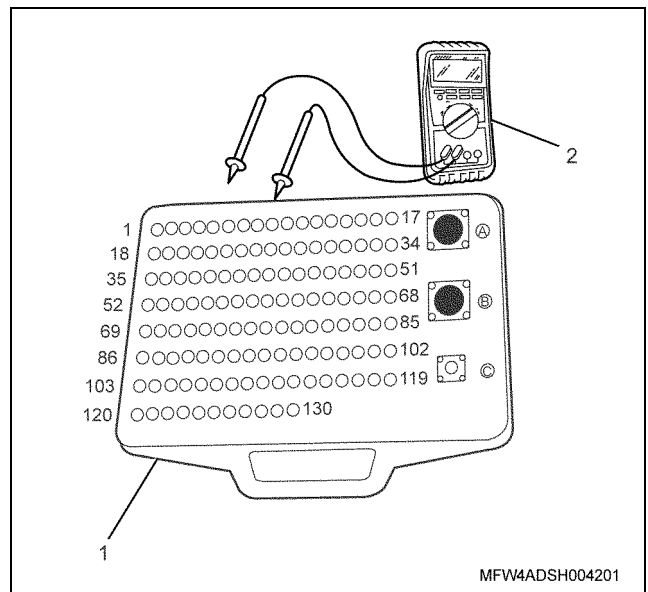
About common rail pressure sensor

Name

1. GND
2. Signal
3. Power supply

About common rail pressure sensor**Breaker box inspection procedure**

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



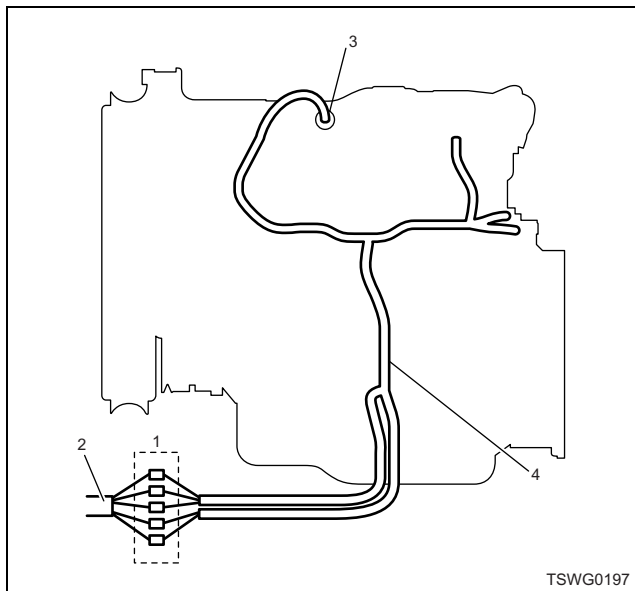
Name

1. Breaker box
2. DMM

10D-287 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	87 - Sensor connector power supply terminal	100Ω or less	10MΩ or more
7	Short circuit to ground circuit/ ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	82 - 101 90 - 101 82 - Ground 90 - Ground	10MΩ or more	100Ω or less
	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	82 - Sensor connector signal terminal 90 - Sensor connector signal terminal	100Ω or less	10MΩ or more

On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

10D-289 Electronic control fuel injection system (Common rail type)

Back-up mode

- Specified back-up value (depending on the machine manufacturer)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding

• Wire disconnection inside harness cladding
Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the "Common rail pressure sensor" displays more than the specified value. If more than the specified value, identify the cause by referring to "Diagnostic aid".

5. If the "Common rail pressure sensor" displays less than the specified value when terminals between the common rail pressure sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 15.
3	Check the value for common rail pressure sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for "Common rail pressure sensor" using scan tool. Is the "Common rail pressure sensor" more than the specified value?	4.5V	Go to Step 4.	Go to "Diagnostic aid".
4	Check for installation condition of the common rail pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 5.

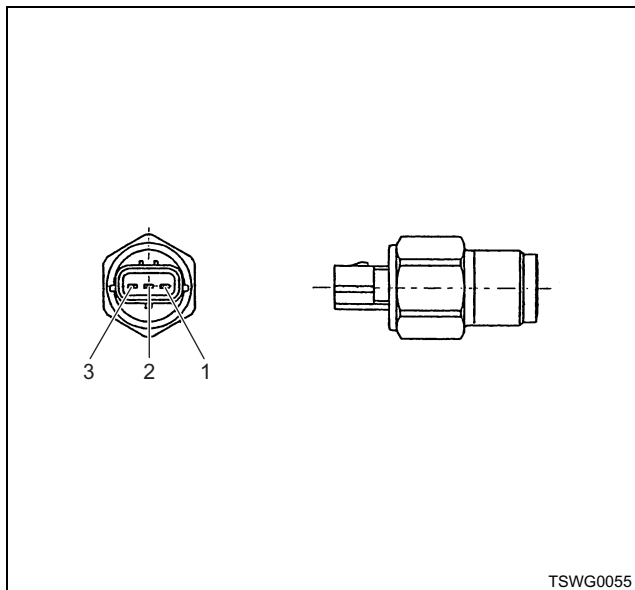
Electronic control fuel injection system (Common rail type) 10D-290

Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Short the common rail pressure sensor connector power supply terminal and the signal terminal using jump cable. 4. Turn the key switch to "ON". 5. Check the value for "Common rail pressure sensor" using scan tool. Is the "Common rail pressure sensor" less than the specified value?	4.8V	Go to Step 9.	Go to Step 6.
6	1. Check the signal circuit between ECM and common rail pressure sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the common rail pressure sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and common rail pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
8	1. Check for followings in the ground circuit between ECM and common rail pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.

10D-291 Electronic control fuel injection system (Common rail type)

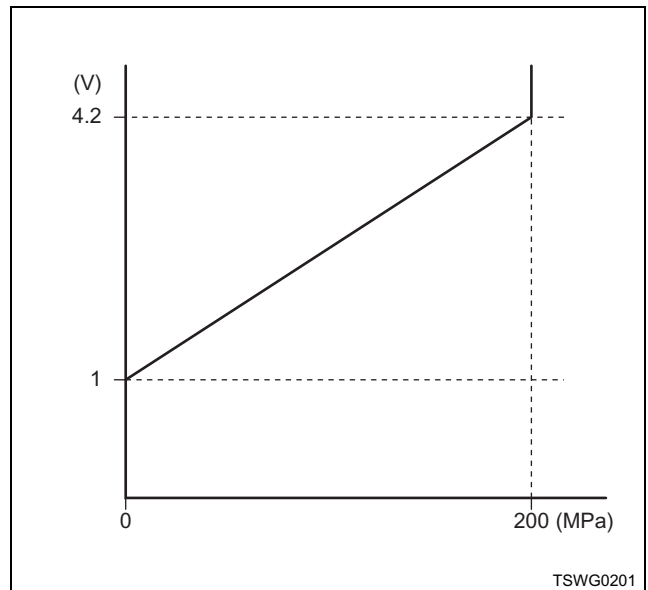
Step	Action	Value	YES	NO
9	Replace the common rail (common rail pressure sensor). Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to “How to use flush tool” in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0193 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Step	Action	Value	YES	NO
15	Check for installation condition of the common rail pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 16.
16	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Turn the key switch to "ON". 4. Connect the DMM between the common rail pressure sensor power supply terminal and the signal terminal. Is the DMM indication less than the specified value?	4.8V	Go to Step 9.	Go to Step 6.

About common rail pressure sensor

Name

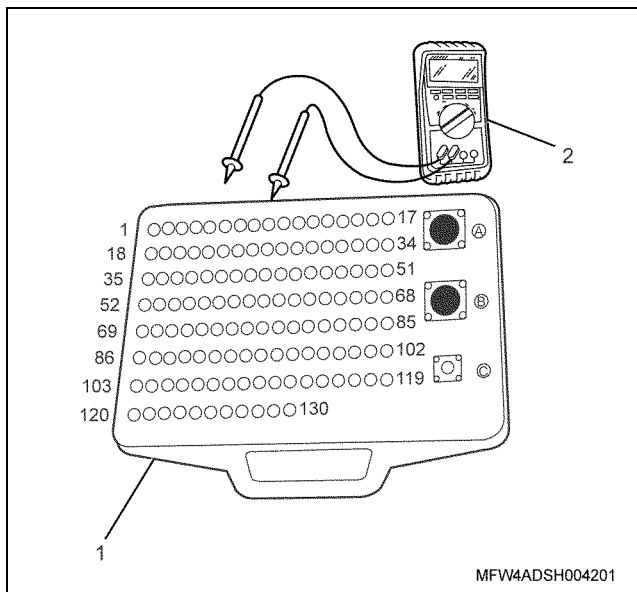
1. GND
2. Signal
3. Power supply

About common rail pressure sensor

10D-293 Electronic control fuel injection system (Common rail type)

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

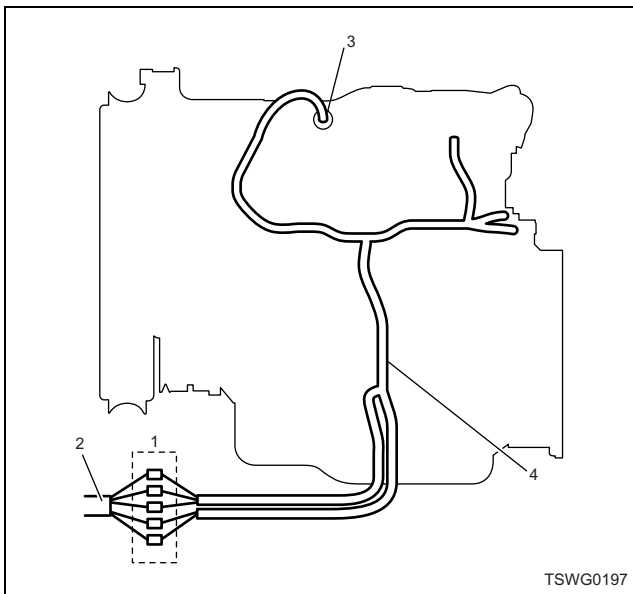


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	82 - Ground 90 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	82 - Sensor connector signal terminal 90 - Sensor connector signal terminal	100Ω or less	10MΩ or more
8	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	101 - Sensor connector ground terminal	100Ω or less	10MΩ or more

On-board check of sensors



Name

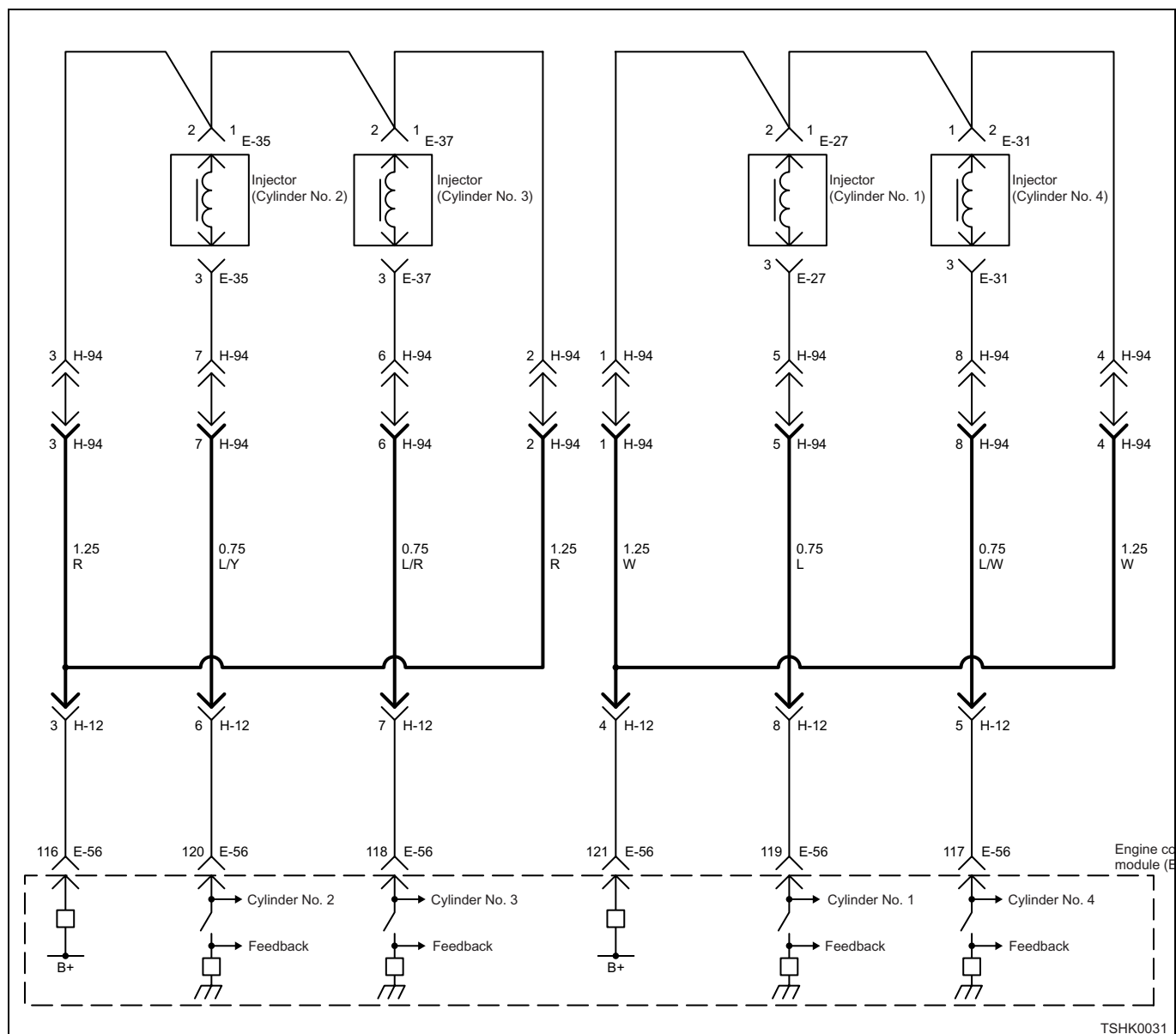
1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

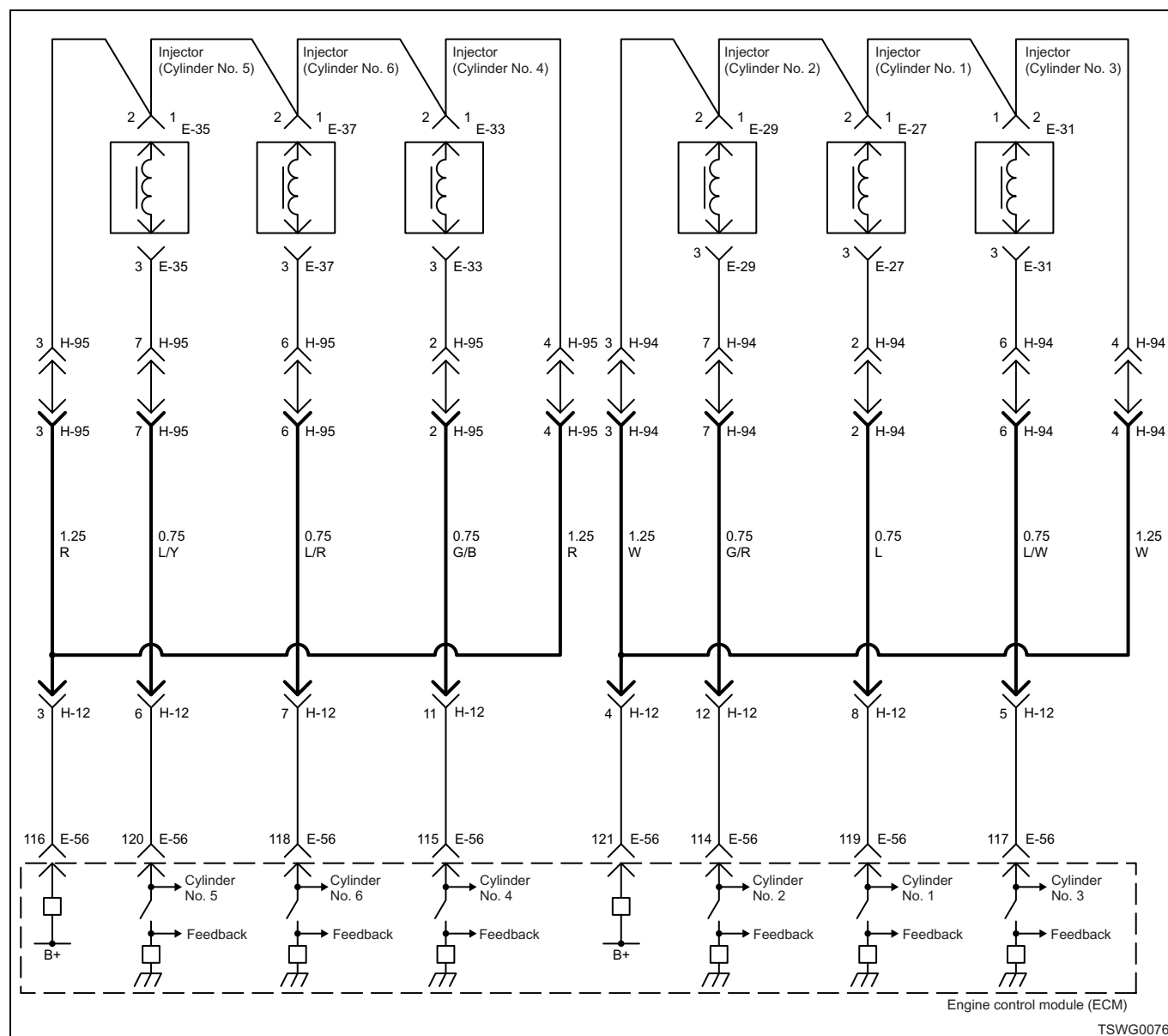
DTC: P0201 (Flash code 271)

Open circuit in injection nozzle #1 drive system

4HK1



6HK1

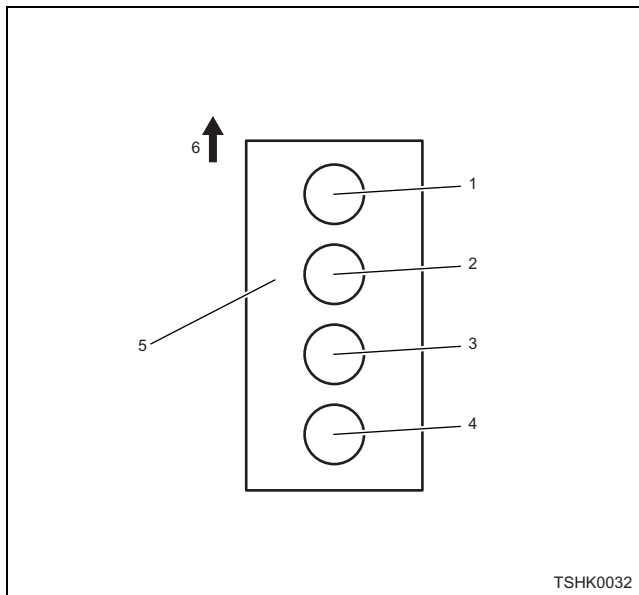


Description of circuit

The injector performs fuel injection. The injector is installed in the engine head. The engine control module (ECM) controls the fuel injection amount and timing by controlling the energizing time to the injector. Also, it generates the voltage for injector operation and energizes the pressurized voltage (more than 100 V) to the injector. For injector operation, the voltage applied to the injector will be sent back to the ECM through injector as a signal, and the ECM controls this signal.

Cylinder No. and injection order

4HK1

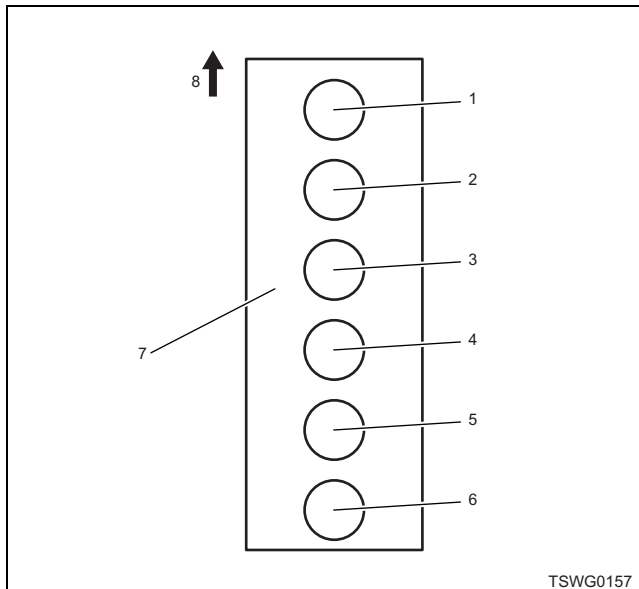


Name

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder block
6. Engine front

Fuel injection order is 1 — 3 — 4 — 2.

6HK1



Name

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder No. 5
6. Cylinder No. 6
7. Cylinder block
8. Engine front

Fuel injection is performed to each cylinder in the order of 1 — 5 — 3 — 6 — 2 — 4.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- DTC P0611, P1261, or P0201 is not detected.

DTC set condition

- Open/short circuit is detected in No. 1 cylinder injector drive circuit.
- No. 1 cylinder injector monitor input signal does not exist for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Injection for cylinder #1 stopped, EGR stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector

- Poor connection of terminal from connector
- Unmatched terminals are fitted.
- Damage of connector lock
- Poor contact between terminal and wire

- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Check the DTC. 1. Turn the key switch to "OFF" for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	1. Turn the key switch to "OFF". 2. Remove the coupling connector (H-94) from the cylinder head cover case. 3. Measure the resistance between the coupling connector terminals (power supply terminal — No. 1 cylinder injector drive signal terminal). Is the resistance less than the specified value?	$0.45 \pm 0.1 \Omega$ (20°C)	Go to Step 4.	Go to Step 5.
4	1. Check for followings in the circuit between ECM and coupling connector (H-94) using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
5	Check for installation condition of the injector terminal nut. 1. Remove the cylinder head cover. 2. Check the injector terminal nut for looseness etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 6.

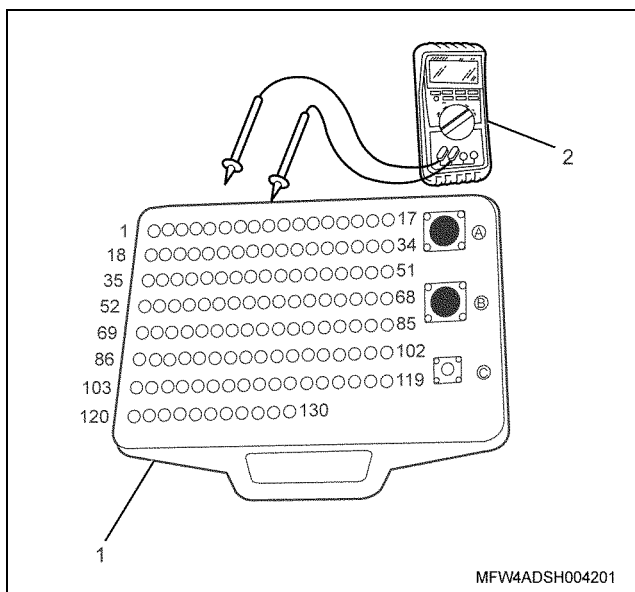
10D-299 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
6	Check for installation condition of the coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for following in the circuit between injector terminal and coupling connector. • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is there any trouble in the circuit?	—	Go to Step 13.	Go to Step 9.
8	Check for installation condition of the ECM connector. 1. Turn the key switch to "OFF". 2. Remove the ECM. 3. Check for play or looseness in the connection. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	1. Replace the No. 1 cylinder injector. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.

Step	Action	Value	YES	NO
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0201 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

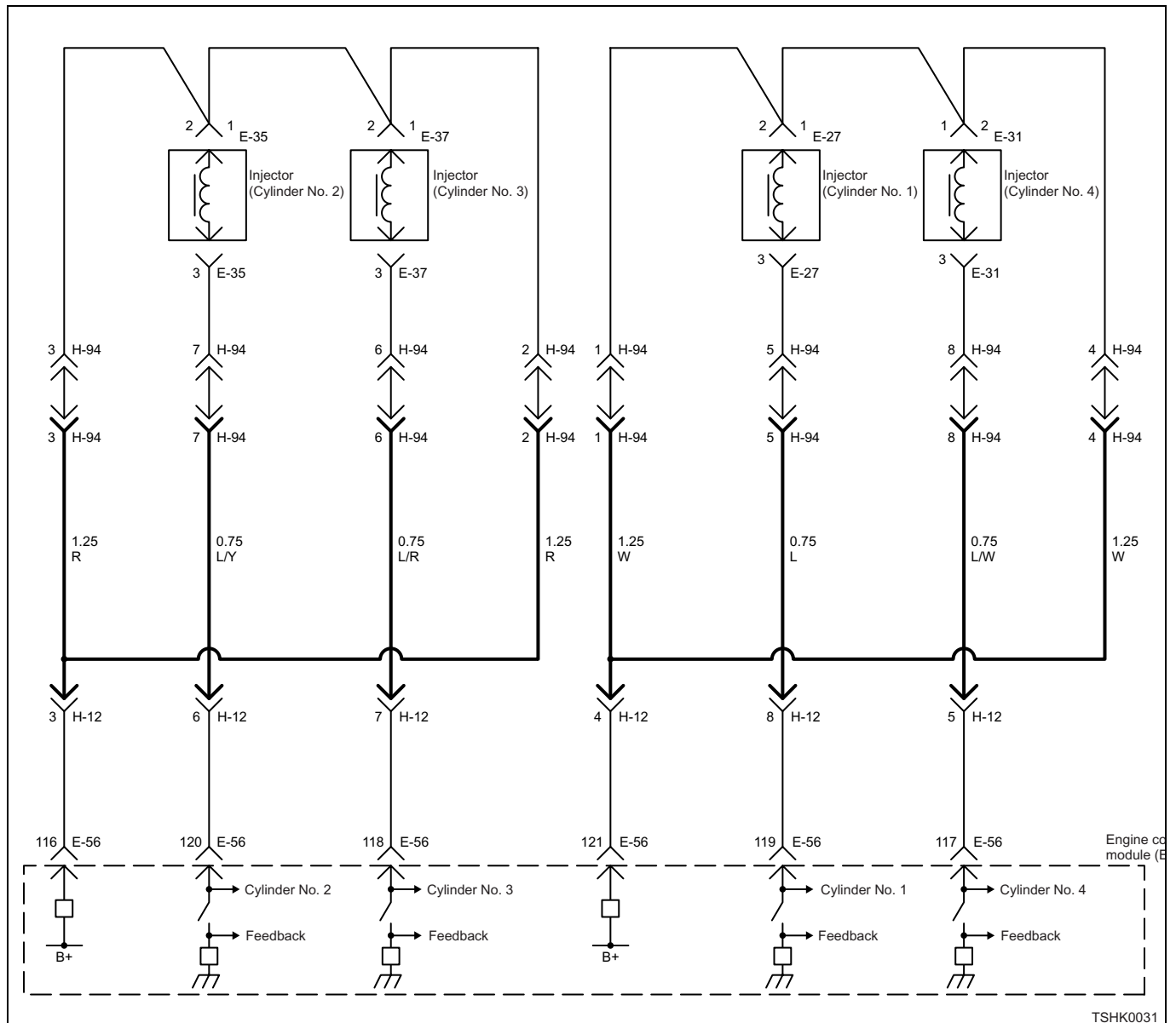


Name

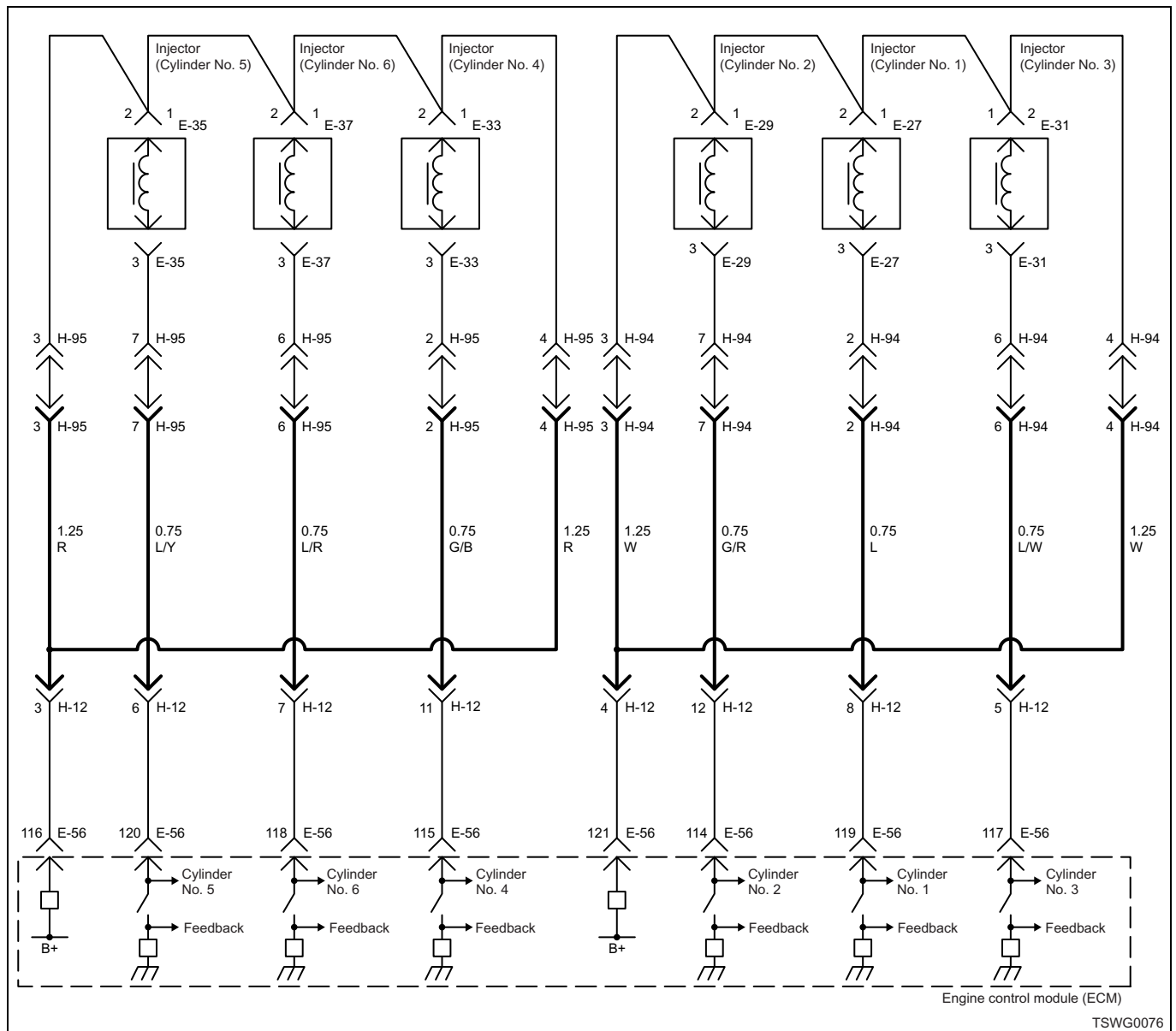
1. Breaker box
2. DMM

10D-301 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Remove the coupling connector. - Key switch "OFF"	119 - Coupling connector terminal (H-94) (4H: No. 5, 6H: No. 2)	100Ω or less	10MΩ or more

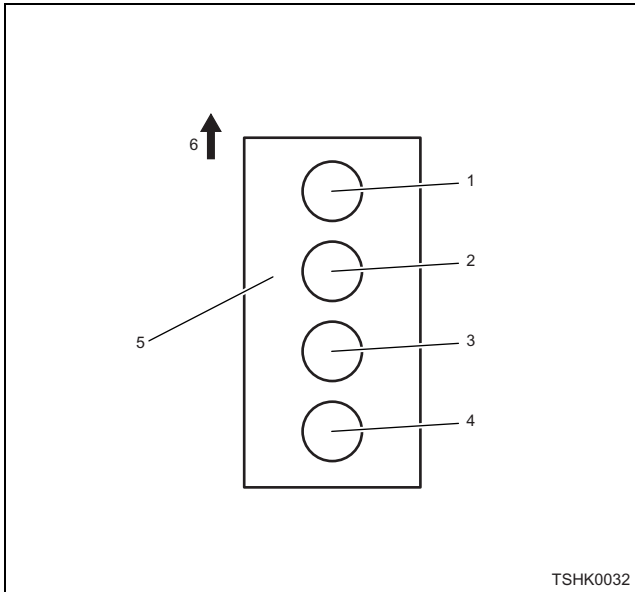
DTC: P0202 (Flash code 272)**Open circuit in injection nozzle #2 drive system****4HK1**

6HK1



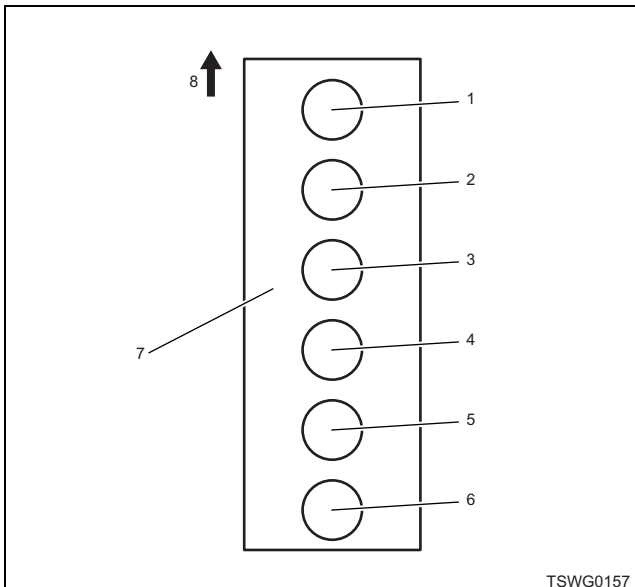
Description of circuit

The injector performs fuel injection. The injector is installed in the engine head. The engine control module (ECM) controls the fuel injection amount and timing by controlling the energizing time to the injector. Also, it generates the voltage for injector operation and energizes the pressurized voltage (more than 100 V) to the injector. For injector operation, the voltage applied to the injector will be sent back to the ECM through injector as a signal, and the ECM controls this signal.

Cylinder No. and injection order**4HK1****Name**

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder block
6. Engine front

Fuel injection order is 1 — 3 — 4 — 2.

6HK1**Name**

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder No. 5
6. Cylinder No. 6
7. Cylinder block
8. Engine front

Fuel injection is performed to each cylinder in the order of 1 — 5 — 3 — 6 — 2 — 4.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- DTC P0611, P1261, or P0202 is not detected.

DTC set condition

- Open/short circuit is detected in No. 2 cylinder injector drive circuit.
- No. 2 cylinder injector monitor input signal does not exist for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Injection for cylinder #2 stopped, EGR stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

10D-305 Electronic control fuel injection system (Common rail type)

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector

- Poor connection of terminal from connector
- Unmatched terminals are fitted.
- Damage of connector lock
- Poor contact between terminal and wire

- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Check the DTC. 1. Turn the key switch to "OFF" for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	1. Turn the key switch to "OFF". 2. Remove the coupling connector (H-94) from the cylinder head cover case. 3. Measure the resistance between the coupling connector terminals (power supply terminal — No. 2 cylinder injector drive signal terminal). Is the resistance less than the specified value?	$0.45 \pm 0.1 \Omega$ (20°C)	Go to Step 4.	Go to Step 5.
4	1. Check for followings in the circuit between ECM and coupling connector (H-94) using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
5	Check for installation condition of the injector terminal nut. 1. Remove the cylinder head cover. 2. Check the injector terminal nut for looseness etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 6.

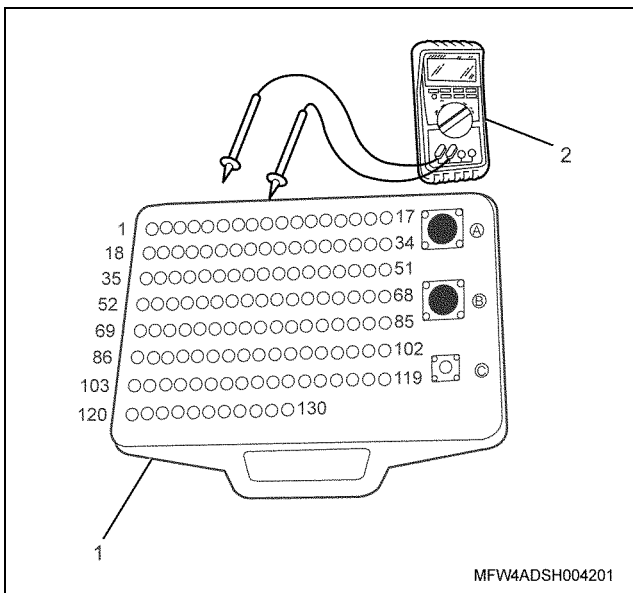
Step	Action	Value	YES	NO
6	Check for installation condition of the coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for following in the circuit between injector terminal and coupling connector. • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is there any trouble in the circuit?	—	Go to Step 13.	Go to Step 9.
8	Check for installation condition of the ECM connector. 1. Turn the key switch to "OFF". 2. Remove the ECM. 3. Check for play or looseness in the connection. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	1. Replace the No. 2 cylinder injector. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.

10D-307 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0202 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

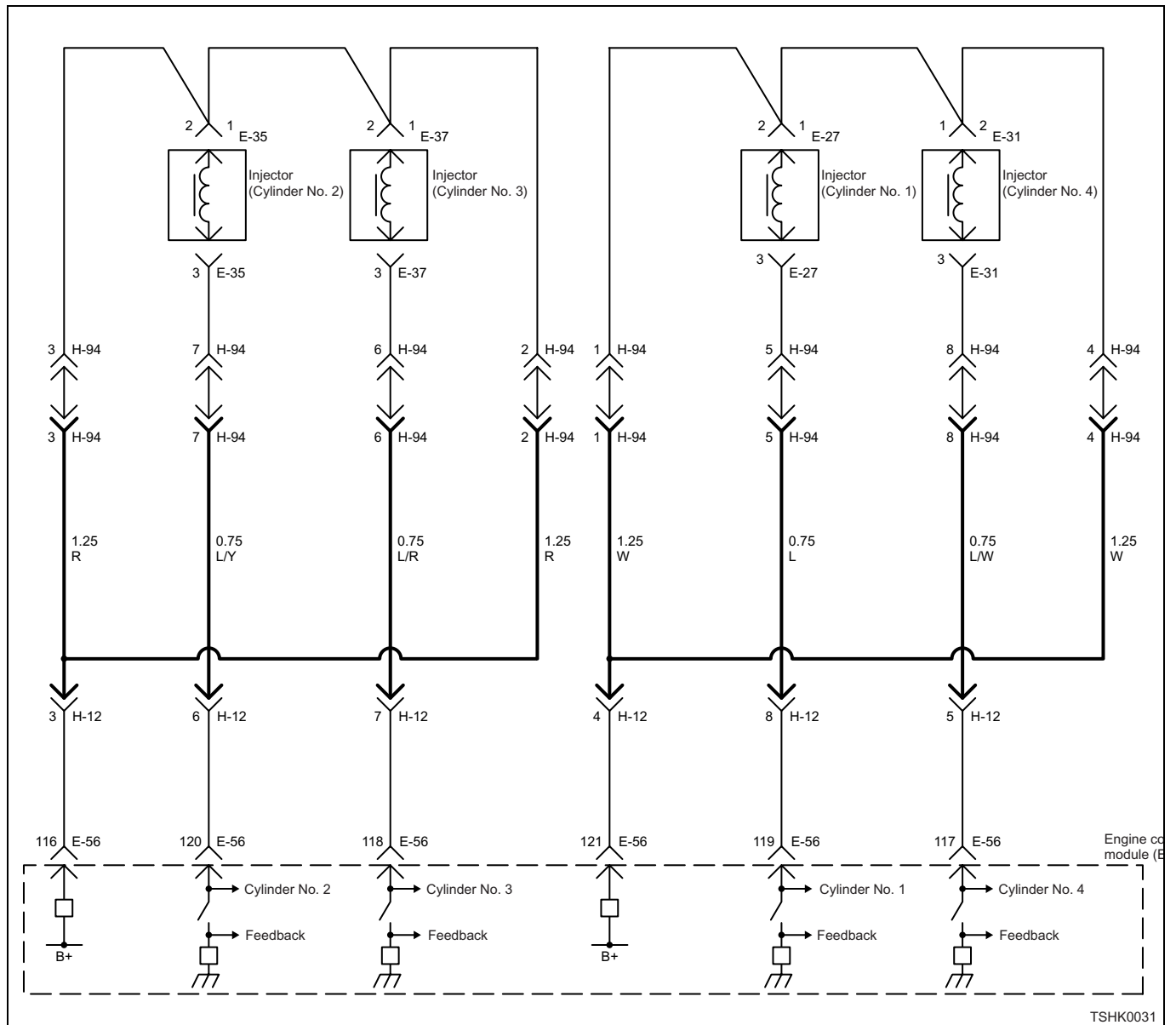
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



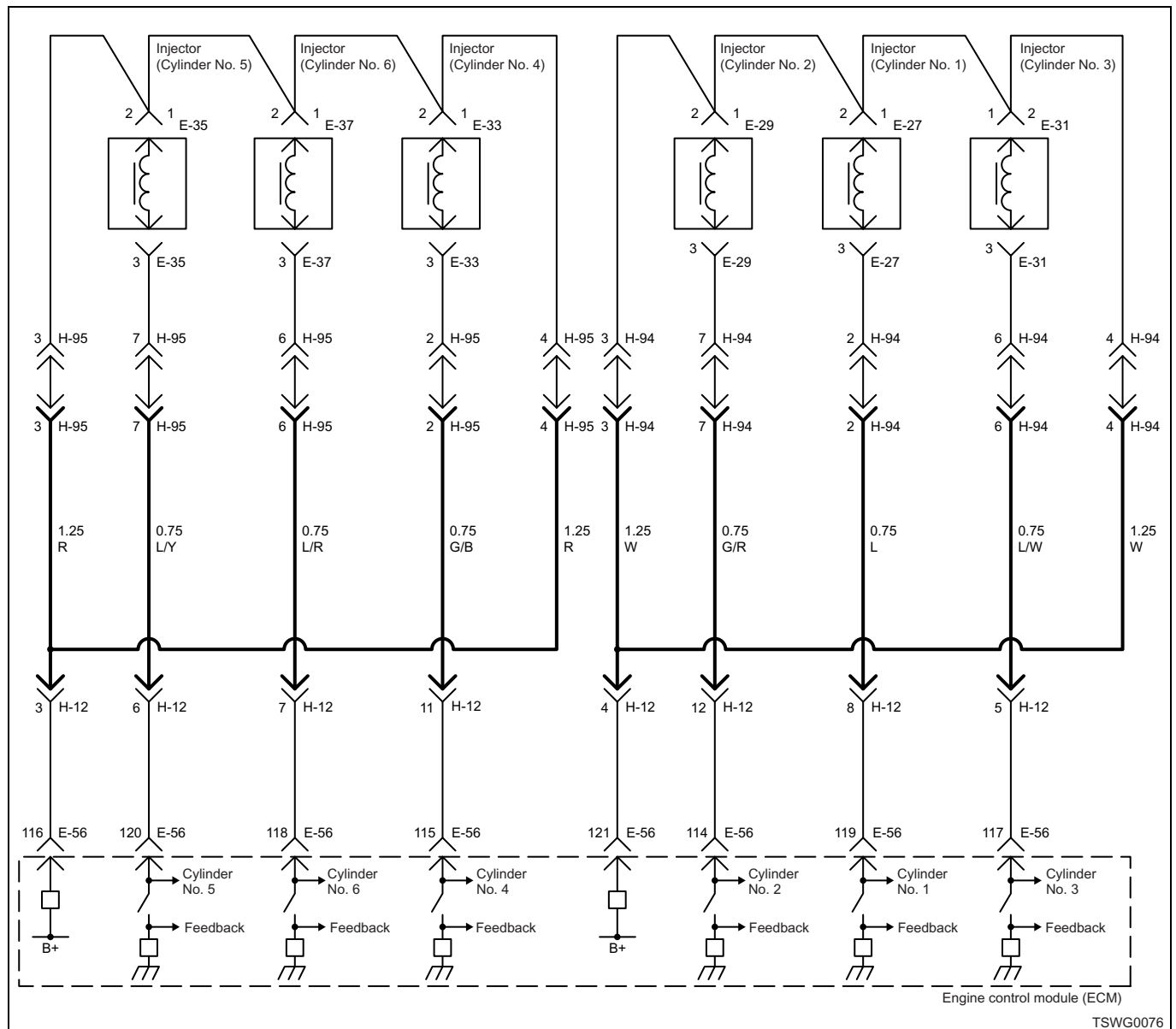
Name _____

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Remove the coupling connector. - Key switch "OFF"	114 - Coupling connector (H-94) terminal (4H: No.7, 6H: No.7)	100Ω or less	10MΩ or more



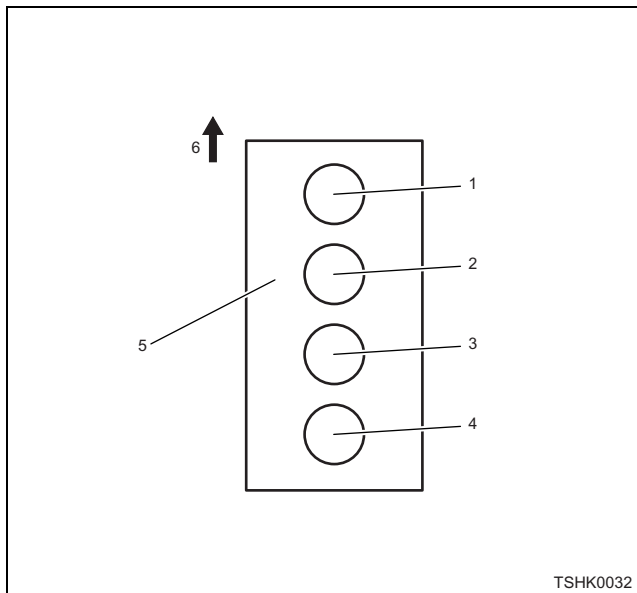
6HK1

**Description of circuit**

The injector performs fuel injection. The injector is installed in the engine head. The engine control module (ECM) controls the fuel injection amount and timing by controlling the energizing time to the injector. Also, it generates the voltage for injector operation and energizes the pressurized voltage (more than 100 V) to the injector. For injector operation, the voltage applied to the injector will be sent back to the ECM through injector as a signal, and the ECM controls this signal.

Cylinder No. and injection order

4HK1

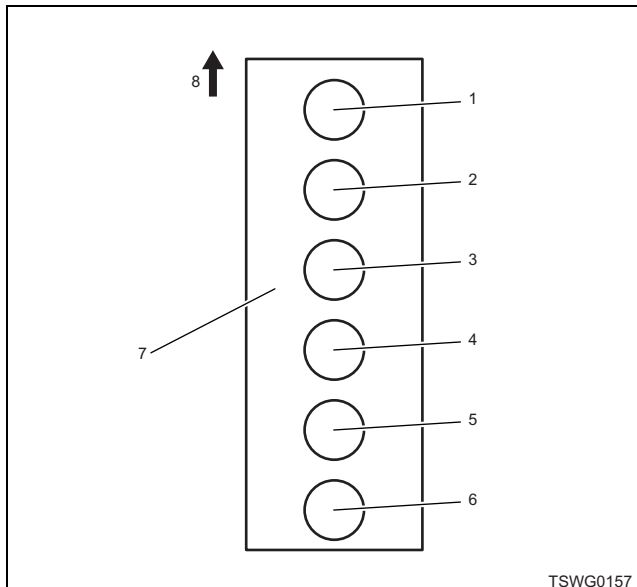


Name

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder block
6. Engine front

Fuel injection order is 1 — 3 — 4 — 2.

6HK1



Name

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder No. 5
6. Cylinder No. 6
7. Cylinder block
8. Engine front

Fuel injection is performed to each cylinder in the order of 1 — 5 — 3 — 6 — 2 — 4.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- DTC P0611, P1261, or P0203 is not detected.

DTC set condition

- Open/short circuit is detected in No. 3 cylinder injector drive circuit.
- No. 3 cylinder injector monitor input signal does not exist for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Injection for cylinder #3 stopped, EGR stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector

- Poor connection of terminal from connector
- Unmatched terminals are fitted.
- Damage of connector lock
- Poor contact between terminal and wire

- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Check the DTC. 1. Turn the key switch to "OFF" for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	1. Turn the key switch to "OFF". 2. Remove the coupling connector (H-94) from the cylinder head cover case. 3. Measure the resistance between the coupling connector terminals (power supply terminal — No. 3 cylinder injector drive signal terminal). Is the resistance less than the specified value?	$0.45 \pm 0.1 \Omega$ (20°C)	Go to Step 4.	Go to Step 5.
4	1. Check for followings in the circuit between ECM and coupling connector (H-94) using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
5	Check for installation condition of the injector terminal nut. 1. Remove the cylinder head cover. 2. Check the injector terminal nut for looseness etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 6.

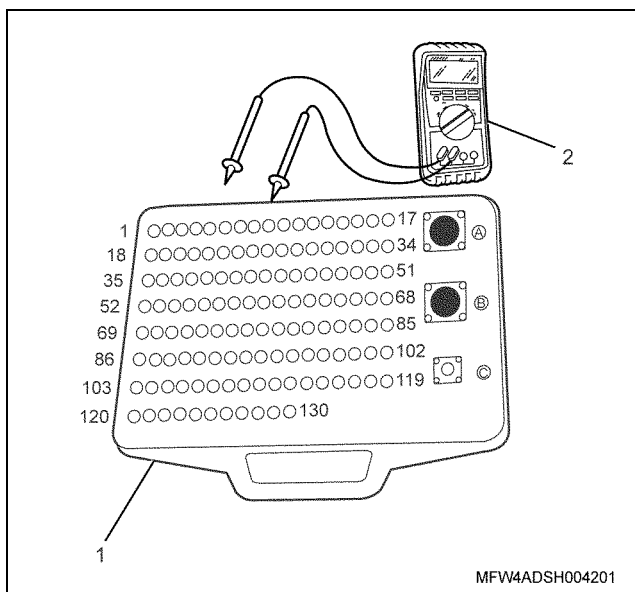
10D-313 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
6	Check for installation condition of the coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for following in the circuit between injector terminal and coupling connector. • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is there any trouble in the circuit?	—	Go to Step 13.	Go to Step 9.
8	Check for installation condition of the ECM connector. 1. Turn the key switch to “OFF”. 2. Remove the ECM. 3. Check for play or looseness in the connection. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	1. Replace the No. 3 cylinder injector. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to “How to use flush tool” in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.

Step	Action	Value	YES	NO
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0203 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

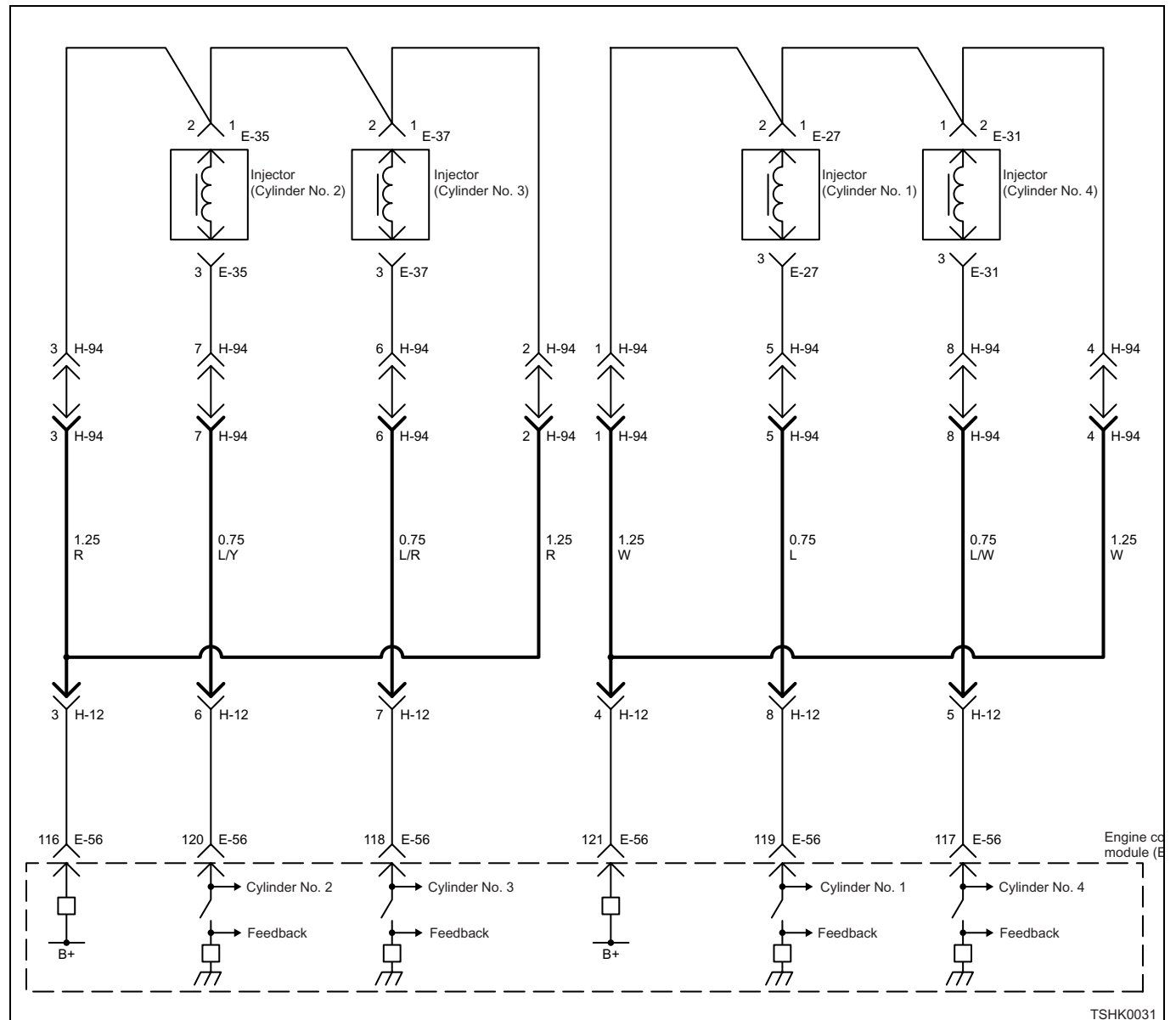


Name _____

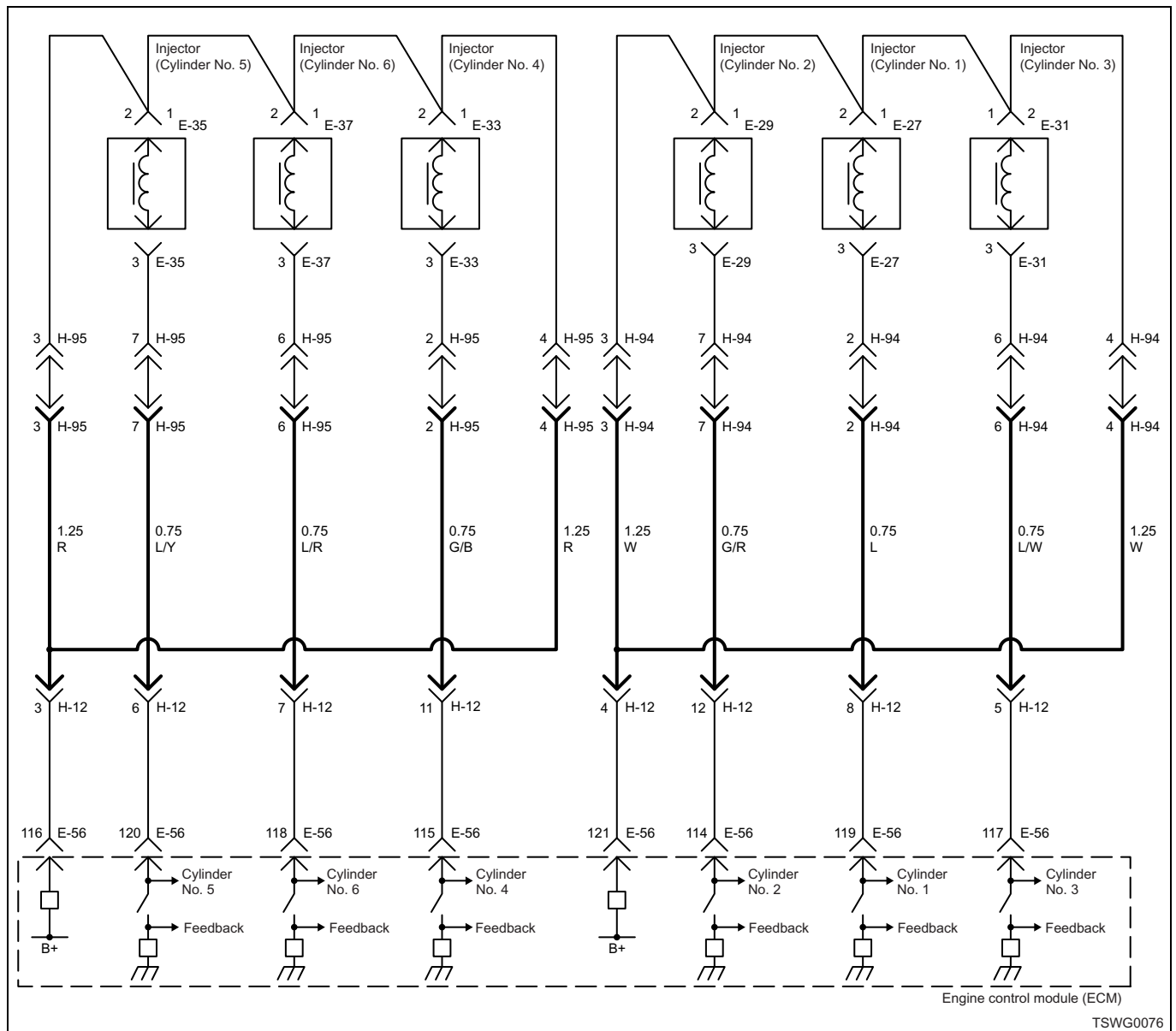
1. Breaker box
2. DMM

10D-315 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Remove the coupling connector. - Key switch "OFF"	117 - Coupling connector (H-94) terminal (4H: No. 6, 6H: No. 6)	100Ω or less	10MΩ or more

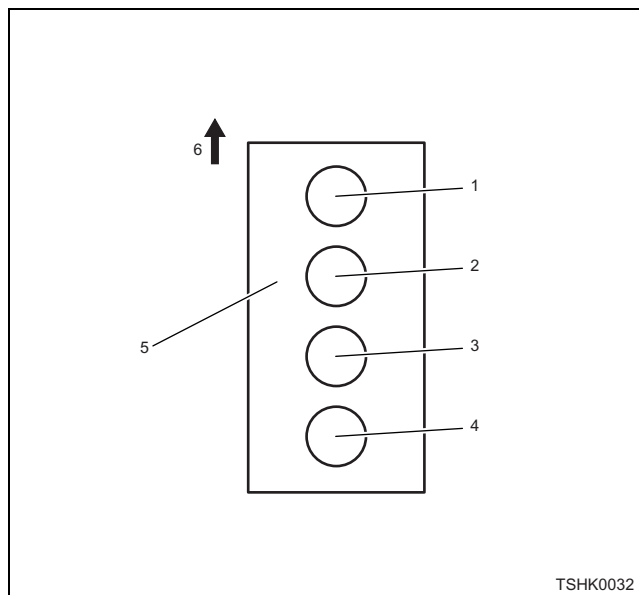
DTC: P0204 (Flash code 274)**Open circuit in injection nozzle #4 drive system****4HK1**

6HK1



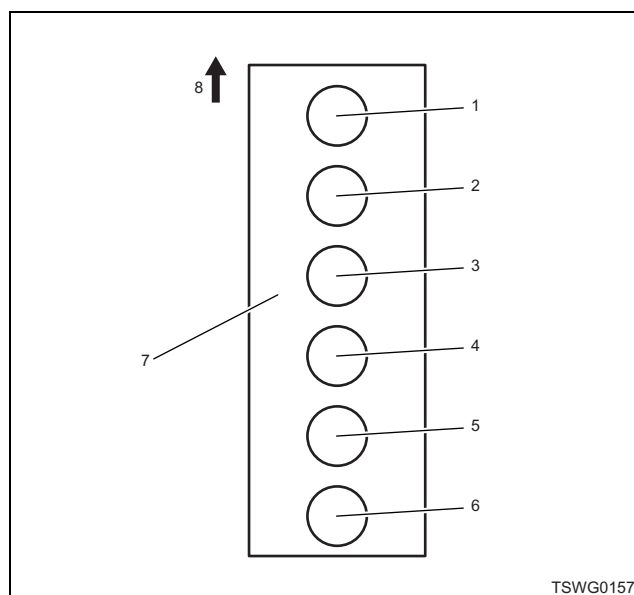
Description of circuit

The injector performs fuel injection. The injector is installed in the engine head. The engine control module (ECM) controls the fuel injection amount and timing by controlling the energizing time to the injector. Also, it generates the voltage for injector operation and energizes the pressurized voltage (more than 100 V) to the injector. For injector operation, the voltage applied to the injector will be sent back to the ECM through injector as a signal, and the ECM controls this signal.

Cylinder No. and injection order**4HK1****Name**

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder block
6. Engine front

Fuel injection order is 1 — 3 — 4 — 2.

6HK1**Name**

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder No. 5
6. Cylinder No. 6
7. Cylinder block
8. Engine front

Fuel injection is performed to each cylinder in the order of 1 — 5 — 3 — 6 — 2 — 4.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- DTC P0612, P1262, or P0204 is not detected.

DTC set condition

- Open/short circuit is detected in No. 4 cylinder injector drive circuit.
- No. 4 cylinder injector monitor input signal does not exist for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

10D-319 Electronic control fuel injection system (Common rail type)

Back-up mode

- Injection for cylinder #4 stopped, EGR stopped

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
 - Defective harness routing
 - Worn harness cladding
 - Wire disconnection inside harness cladding
- Following inspections are necessary to detect these causes.
- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
 - Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Check the DTC. 1. Turn the key switch to “OFF” for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC detected?	—	Go to Step 3.	Go to “Diagnostic aid”.
3	1. Turn the key switch to “OFF”. 2. Remove the coupling connector (4H: H-94, 6H: H-95) from the cylinder head cover case. 3. Measure the resistance between the coupling connector terminals (power supply terminal — No. 4 cylinder injector drive signal terminal). Is the resistance less than the specified value?	0.45±0.1Ω (20°C)	Go to Step 4.	Go to Step 5.
4	1. Check for followings in the circuit between ECM and coupling connector (4H: H-94, 6H: H-94) using breaker box or DMM. Refer to “Breaker box inspection procedure”. • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.

Electronic control fuel injection system (Common rail type) 10D-320

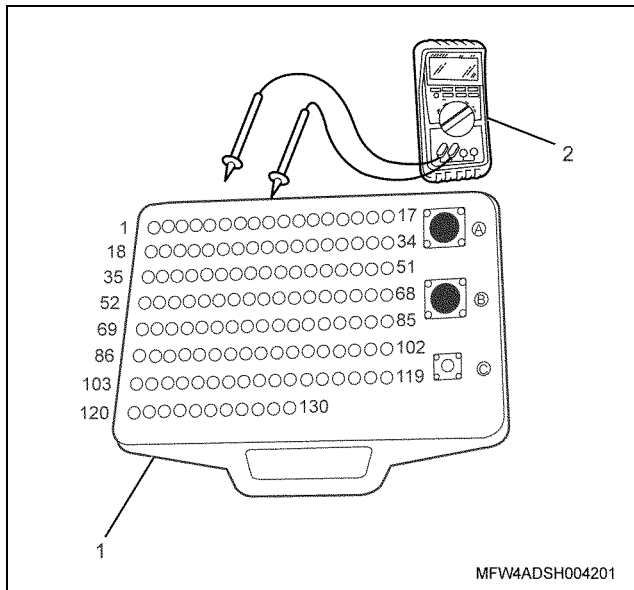
Step	Action	Value	YES	NO
5	Check for installation condition of the injector terminal nut. 1. Remove the cylinder head cover. 2. Check the injector terminal nut for looseness etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 6.
6	Check for installation condition of the coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for following in the circuit between injector terminal and coupling connector. • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is there any trouble in the circuit?	—	Go to Step 13.	Go to Step 9.
8	Check for installation condition of the ECM connector. 1. Turn the key switch to "OFF". 2. Remove the ECM. 3. Check for play or looseness in the connection. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	1. Replace the No. 4 cylinder injector. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.

10D-321 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0204 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

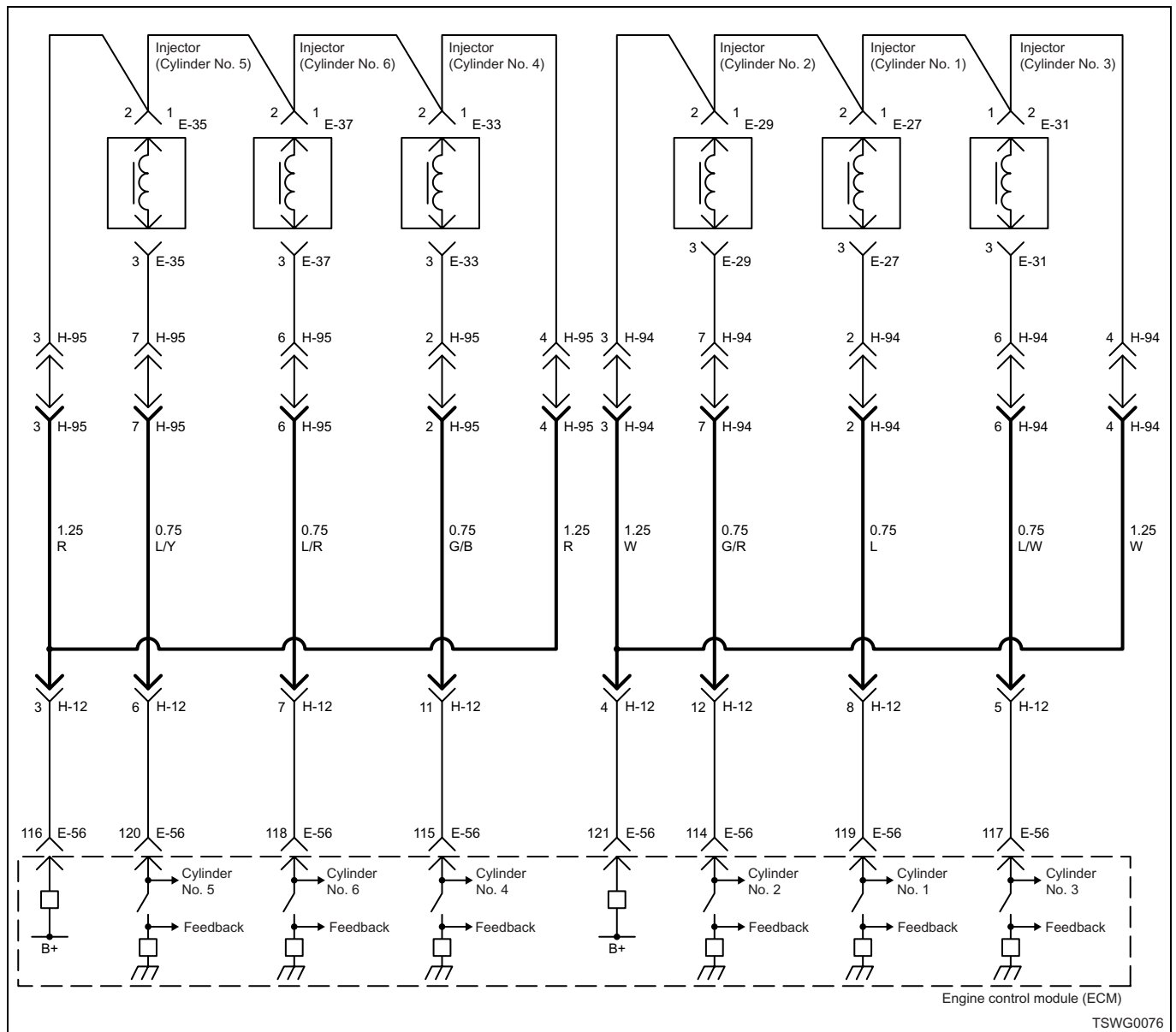
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



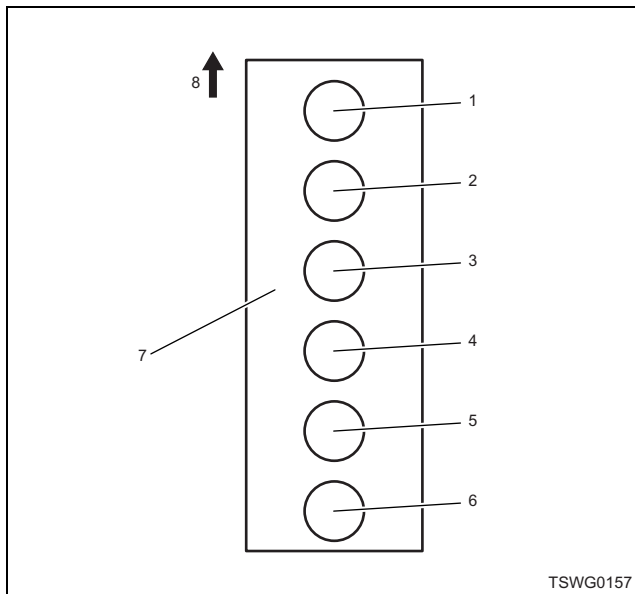
Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Remove the coupling connector. - Key switch "OFF"	115 - Coupling connector terminal (4H: H-94 No. 8, 6H: H-95 No. 2)	100Ω or less	10MΩ or more

DTC: P0205 (Flash code 275)**Open circuit in injection nozzle #5 drive system****Description of circuit**

The injector performs fuel injection. The injector is installed in the engine head. The engine control module (ECM) controls the fuel injection amount and timing by controlling the energizing time to the injector. Also, it generates the voltage for injector operation and energizes the pressurized voltage (more than 100 V) to the injector. For injector operation, the voltage applied to the injector will be sent back to the ECM through injector as a signal, and the ECM controls this signal.

Cylinder No. and injection order**Name**

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder No. 5
6. Cylinder No. 6
7. Cylinder block
8. Engine front

Fuel injection is performed to each cylinder in the order of 1 — 5 — 3 — 6 — 2 — 4.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- DTC P0612, P1262, or P0205 is not detected.

DTC set condition

- Open/short circuit is detected in No. 5 cylinder injector drive circuit.
- No. 5 cylinder injector monitor input signal does not exist for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Injection for cylinder #5 stopped, EGR stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

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Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Check the DTC. 1. Turn the key switch to "OFF" for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	1. Turn the key switch to "OFF". 2. Remove the coupling connector (H-95) from the cylinder head cover case. 3. Measure the resistance between the coupling connector terminals (power supply terminal — No. 5 cylinder injector drive signal terminal). Is the resistance less than the specified value?	0.45±0.1Ω (20°C)	Go to Step 4.	Go to Step 5.
4	1. Check for followings in the circuit between ECM and coupling connector (H-95) using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
5	Check for installation condition of the injector terminal nut. 1. Remove the cylinder head cover. 2. Check the injector terminal nut for looseness etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 6.
6	Check for installation condition of the coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for following in the circuit between injector terminal and coupling connector. • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is there any trouble in the circuit?	—	Go to Step 13.	Go to Step 9.

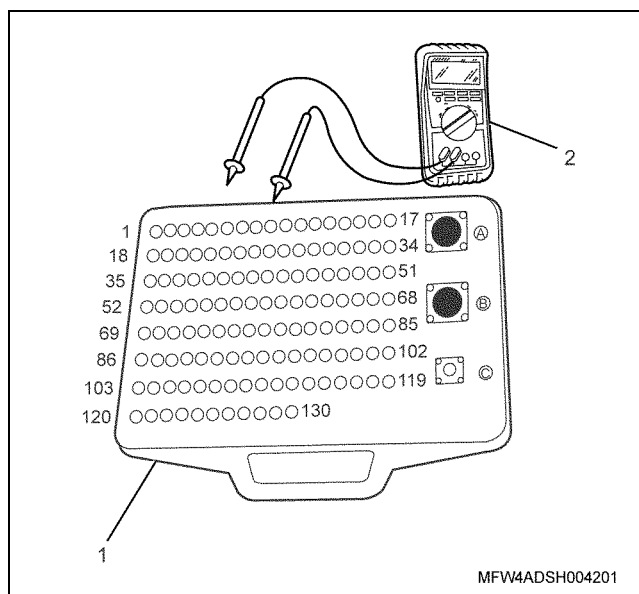
Step	Action	Value	YES	NO
8	Check for installation condition of the ECM connector. 1. Turn the key switch to "OFF". 2. Remove the ECM. 3. Check for play or looseness in the connection. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	1. Replace the No. 5 cylinder injector. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0205 detected?	—	Go to Step 2.	Go to Step 14.

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Step	Action	Value	YES	NO
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

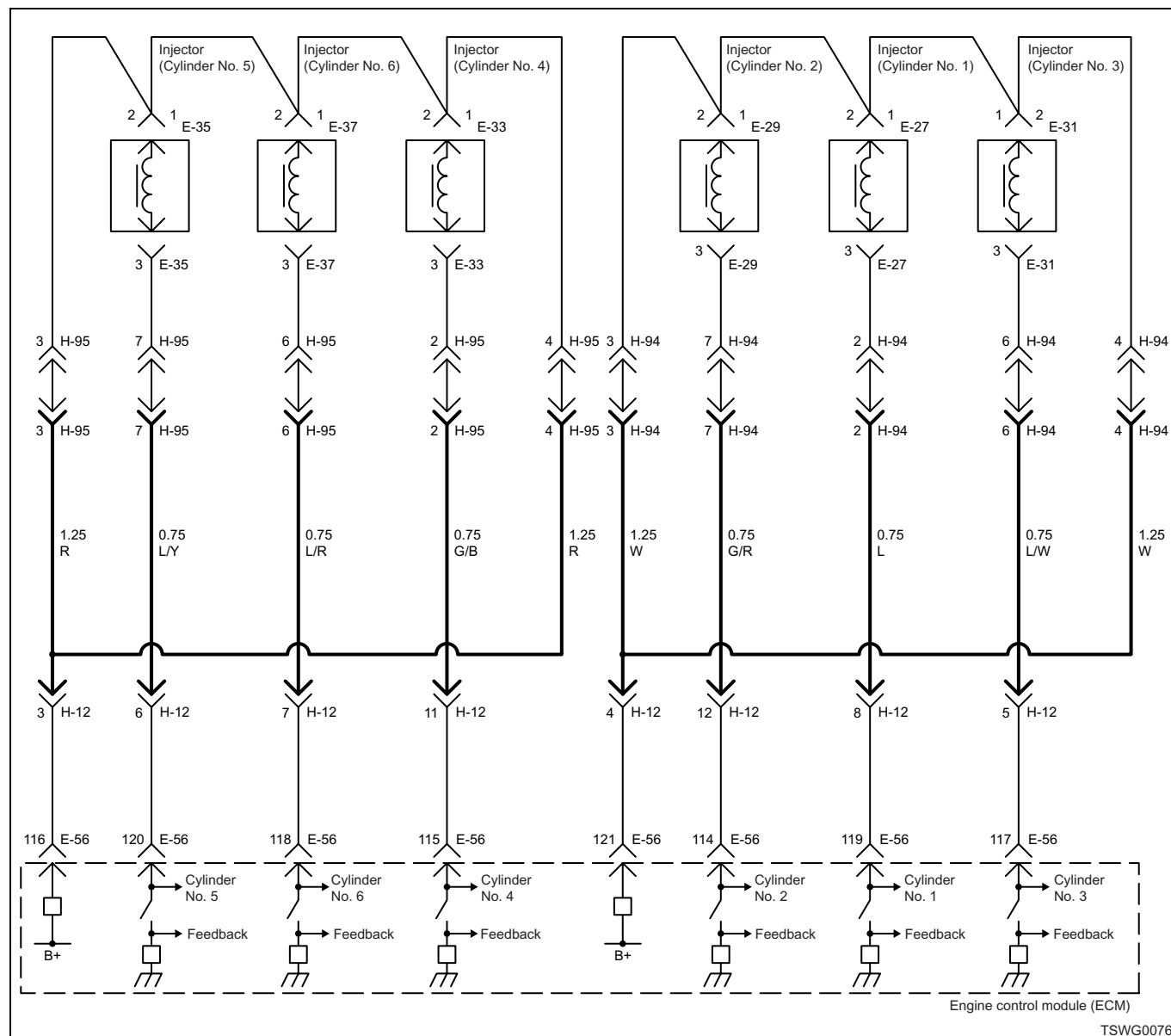
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Remove the coupling connector. - Key switch "OFF"	120 - Coupling connector (H-95) No. 7 terminal	100Ω or less	10MΩ or more

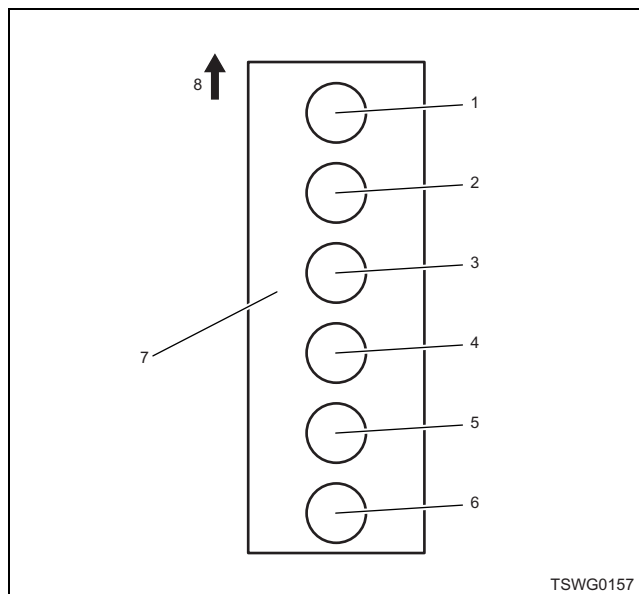
DTC: P0206 (Flash code 276)**Open circuit in injection nozzle #6 drive system**

TSWG0076

Description of circuit

The injector performs fuel injection. The injector is installed in the engine head. The engine control module (ECM) controls the fuel injection amount and timing by controlling the energizing time to the injector. Also, it generates the voltage for injector operation and energizes the pressurized voltage (more than 100 V) to the injector. For injector operation, the voltage applied to the injector will be sent back to the ECM through injector as a signal, and the ECM controls this signal.

Cylinder No. and injection order



Name

1. Cylinder No. 1
2. Cylinder No. 2
3. Cylinder No. 3
4. Cylinder No. 4
5. Cylinder No. 5
6. Cylinder No. 6
7. Cylinder block
8. Engine front

Fuel injection is performed to each cylinder in the order of 1 — 5 — 3 — 6 — 2 — 4.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- DTC P0612, P1262, or P0206 is not detected.

DTC set condition

- Open/short circuit is detected in No. 6 cylinder injector drive circuit.
- No. 6 cylinder injector monitor input signal does not exist for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Injection for cylinder #6 stopped, EGR stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Check the DTC. 1. Turn the key switch to "OFF" for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	1. Turn the key switch to "OFF". 2. Remove the coupling connector (H-95) from the cylinder head cover case. 3. Measure the resistance between the coupling connector terminals (power supply terminal — No. 6 cylinder injector drive signal terminal). Is the resistance less than the specified value?	$0.45 \pm 0.1 \Omega$ (20°C)	Go to Step 4.	Go to Step 5.
4	1. Check for followings in the circuit between ECM and coupling connector (H-95) using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
5	Check for installation condition of the injector terminal nut. 1. Remove the cylinder head cover. 2. Check the injector terminal nut for looseness etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 6.
6	Check for installation condition of the coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for following in the circuit between injector terminal and coupling connector. • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is there any trouble in the circuit?	—	Go to Step 13.	Go to Step 9.

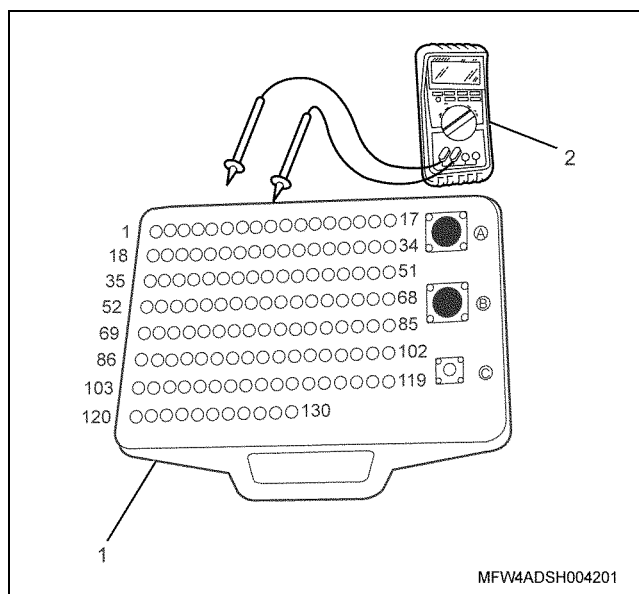
10D-331 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
8	Check for installation condition of the ECM connector. 1. Turn the key switch to "OFF". 2. Remove the ECM. 3. Check for play or looseness in the connection. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	1. Replace the No. 6 cylinder injector. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0206 detected?	—	Go to Step 2.	Go to Step 14.

Step	Action	Value	YES	NO
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



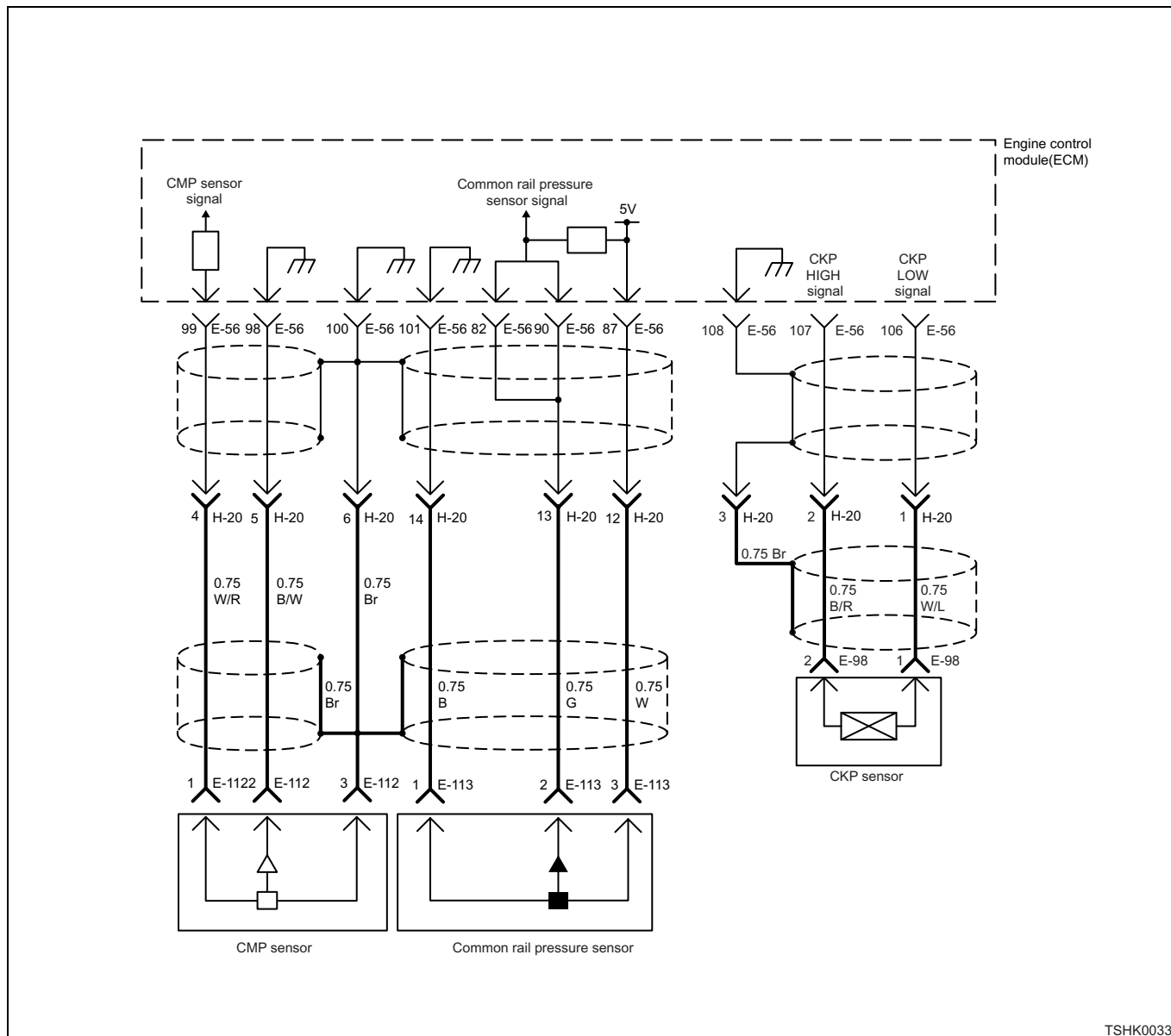
Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Remove the coupling connector. - Key switch "OFF"	118 - Coupling connector (H-95) No. 6 terminal	100Ω or less	10MΩ or more

DTC: P0219 (Flash code 543)

Overrun



Description of circuit

The engine control module (ECM) detects the engine speed based on the crankshaft position (CKP) sensor signal. The ECM stops the fuel injection to lower the engine speed when the engine speed exceeds the specified value.

Main trouble symptom

Output lowering

Preconditions when DTC is set

- Key switch input voltage is 18V or more.

DTC set condition

- The engine speed exceeds setting value* for 1 second or more (* depending on the machine manufacturer)

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Limited injection amount 1
- Limitation is lifted if the speed decreases

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

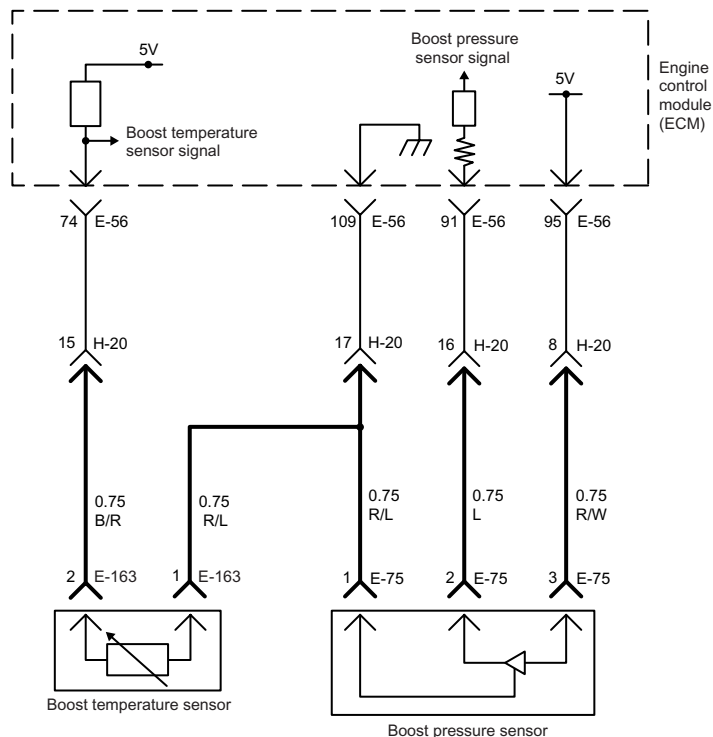
The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

- Load (fluid pressure pump etc.) is light.
- Crankshaft position (CKP) sensor, camshaft position (CMP) sensor fault (signal fault etc.)
- Engine body fault (supply pump, injector, body, etc.)
- ECM internal trouble
- Check the connector for poor contact, the harness for fault such as wear or bend, and the wire inside the harness for loosened wire causing short circuit to other circuits. Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.
- When this DTC is detected, check the engine body for trouble such as seizure and breakage.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Confirm the driving status (improper operation of the vehicle due to engine over speed). (Interview the operator for driving status in the past.) Has the vehicle been operated improperly?	—	Go to Step 3.	Go to Step 4.
3	Tell the operator that it is the over speed caused by improper operation, and give a driving instruction. Is the procedure completed?	—	Go to Step 4.	—
4	Check for adverse effect (fault in the engine body) caused by the engine over speed. Repair or replace if fault is found. Is the procedure completed?	—	Go to Step 5.	—
5	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 10 seconds. 3. Test run with the "Preconditions when DTC is set". 4. Check the DTC. Is DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P0237 (Flash code 32)**Boost sensor pressure fault (low voltage fault, open circuit)**

TSWG0079

Description of circuit

The boost pressure sensor is installed to the intake manifold. The boost pressure sensor outputs the voltage corresponding to the internal pressure of the intake manifold, and the ECM detects the boost by this signal. The boost pressure sensor includes following circuits.

- 5-V power supply circuit
- Ground circuit
- Boost pressure sensor signal circuit

The ECM provides 5 V to the boost pressure sensor through 5-V power supply circuit, and grounds to the inside of the ECM through ground circuit. Also, the boost pressure sensor outputs the signal voltage to the ECM through boost pressure sensor signal circuit. The ECM detects a low boost condition (the engine load is low) when the signal voltage from the boost pressure sensor is low, and a high boost condition (the engine load is high) when the signal voltage from the boost pressure sensor is high.

The ECM sets the DTC when the signal voltage from the boost pressure sensor is less than the normal range.

Main trouble symptom

Operationality is affected.

- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1634 is not detected.

DTC set condition

- Boost pressure sensor voltage is 0.1V or less for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Specified back-up value (depending on the machine manufacturer) (4HK1)
- Boost pressure default setting (150kPa) (6HK1)
- Boost pressure correction/EGR stopped (6HK1)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the "MAP (manifold absolute pressure) sensor" displays less than the specified value. If more than the specified value, identify the cause by referring to "Diagnostic aid".

5. If "MAP (manifold absolute pressure) sensor" displays more than the specified value when terminals between the boost pressure sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to "ON". 2. Check for "MAP (manifold absolute pressure) sensor" on the data display using scan tool. Is the "MAP (manifold absolute pressure) sensor" less than the specified value?	0.18V	Go to Step 4.	Go to "Diagnostic aid".

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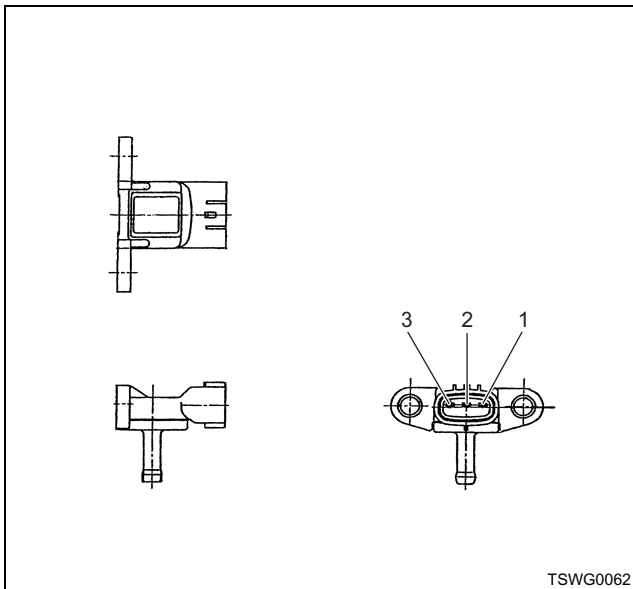
Step	Action	Value	YES	NO
4	Check for installation condition of the boost pressure sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.
5	1. Turn the key switch to "OFF". 2. Disconnect the boost pressure sensor connector. 3. Short between the boost pressure sensor connector power supply terminal and the signal terminal using jump cable. 4. Turn the key switch to "ON". 5. Check for "MAP (manifold absolute pressure) sensor" on the data display using scan tool. Is the "MAP (manifold absolute pressure) sensor" more than the specified value?	4.8V	Go to Step 8.	Go to Step 9.
6	1. Check for followings in the power supply circuit between ECM and boost pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and boost pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to boost pressure sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the boost pressure sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.

Step	Action	Value	YES	NO
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0237 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Start the engine. 2. Check the display of boost pressure sensor. Does the display of "Boost pressure sensor" show error value?	508kPa (Displayed error value)	Go to Step 15.	Go to "Diagnostic aid".
15	Check for installation condition of the boost pressure sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 16.

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Step	Action	Value	YES	NO
16	1. Check for followings in the power supply circuit between ECM and boost pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
17	1. Check for followings in the signal circuit between ECM and boost pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to boost pressure sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 8.

About boost pressure sensor



Name

1. Sensor ground
2. Sensor signal
3. Sensor power supply

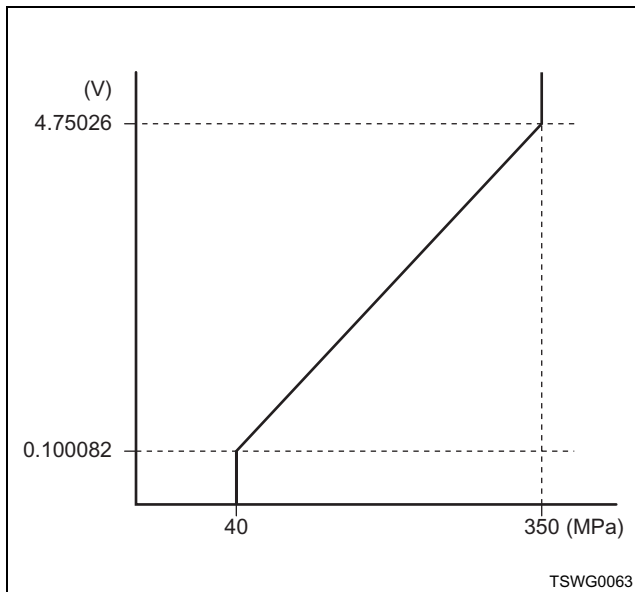
Characteristics of boost pressure sensor

The output voltage of boost pressure sensor changes according to the boost pressure. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of 40MPa or 350MPa is not changed.

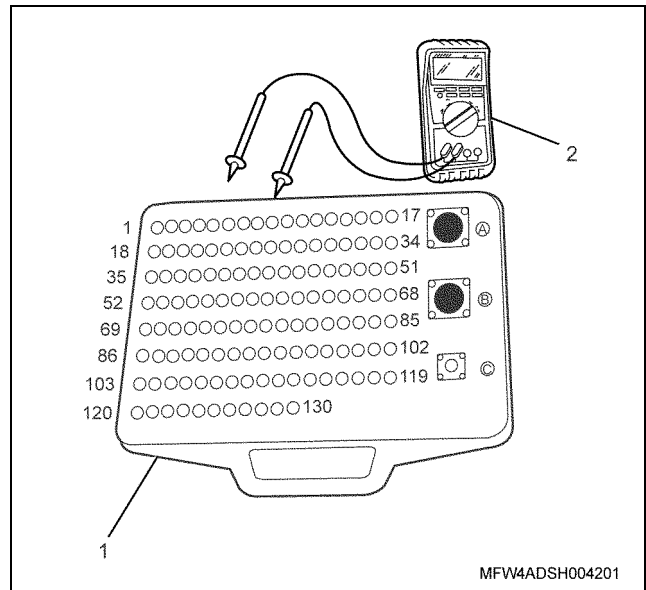
When error occurs, error value (508MPa) is displayed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

Tech2 and scan tools with KW communication can display both voltage and physical value.

**Breaker box inspection procedure**

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

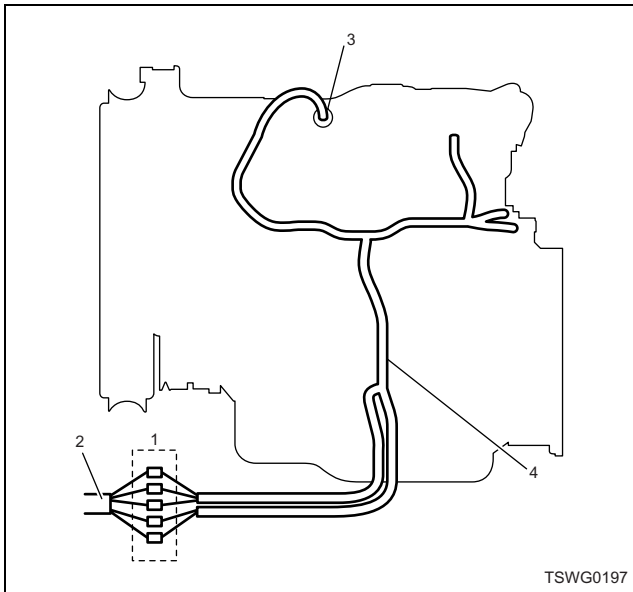


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	95 - Sensor connector power supply terminal	100Ω or less	10MΩ or more
7	Short circuit to ground circuit/ ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	91 - 109 91 - Ground	10MΩ or more	100Ω or less
	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	91 - Sensor connector signal terminal	100Ω or less	10MΩ or more

On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

Black smoke emitted

10D-343 Electronic control fuel injection system (Common rail type)

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 or P1634 is not detected.

DTC set condition

- Boost pressure sensor voltage is 4.9V or more for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Specified back-up value (depending on the machine manufacturer) (4HK1)
- Boost pressure default setting (150kPa) (6HK1)
- Boost pressure correction/EGR stopped (6HK1)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp turns off when the trouble code turns to the past trouble.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear past trouble (history).

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the "MAP (manifold absolute pressure) sensor" displays more than the specified value. If less than the specified value, identify the cause by referring to "Diagnostic aid".

5. If "MAP (manifold absolute pressure) sensor" displays less than the specified value when the boost pressure sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to "ON". 2. Check for "MAP (manifold absolute pressure) sensor" on the data display using scan tool. Is the "MAP (manifold absolute pressure) sensor" more than the specified value?	4.9V	Go to Step 4.	Go to "Diagnostic aid".
4	Check for installation condition of the boost pressure sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.

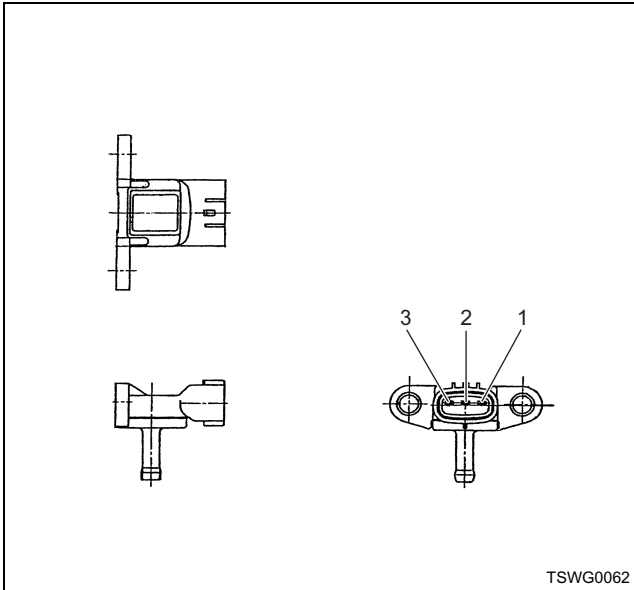
Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the boost pressure sensor connector. 3. Turn the key switch to "ON". 4. Check for "MAP (manifold absolute pressure) sensor" on the data display using scan tool. Is the "MAP (manifold absolute pressure) sensor" less than the specified value?	0.1V	Go to Step 8.	Go to Step 6.
6	1. Check the signal circuit between ECM and boost pressure sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the boost pressure sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the ground circuit between ECM and boost pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the boost pressure sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.

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Step	Action	Value	YES	NO
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0238 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Start the engine. 2. Check the display of boost pressure sensor. Does the display of “Boost pressure sensor” show error value?	508kPa (Displayed error value)	Go to Step 15.	Go to “Diagnostic aid”.
15	Check for installation condition of the boost pressure sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 16.
16	1. Check the signal circuit between ECM and boost pressure sensor for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to “Breaker box inspection procedure”. Important: If the boost pressure sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 17.

Step	Action	Value	YES	NO
17	1. Check for followings in the ground circuit between ECM and boost pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 8.

About boost pressure sensor



Name

1. Sensor ground
2. Sensor signal
3. Sensor power supply

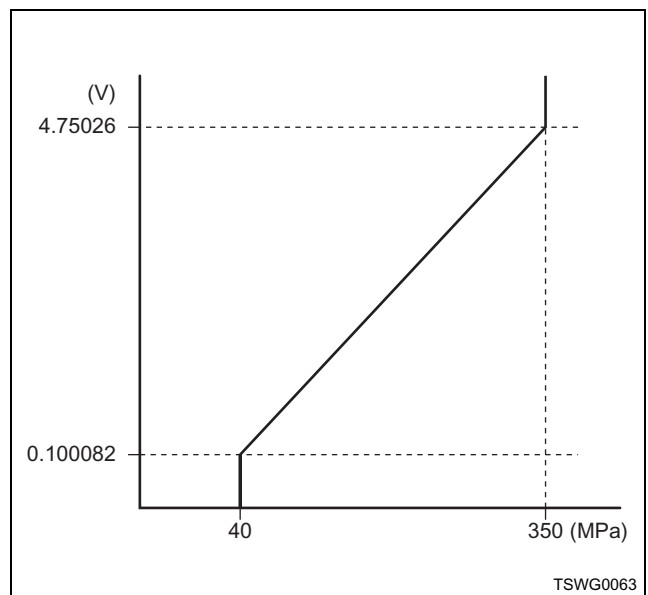
Characteristics of boost pressure sensor

The output voltage of boost pressure sensor changes according to the boost pressure. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of 40MPa or 350MPa is not changed.

When error occurs, error value (508MPa) is displayed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

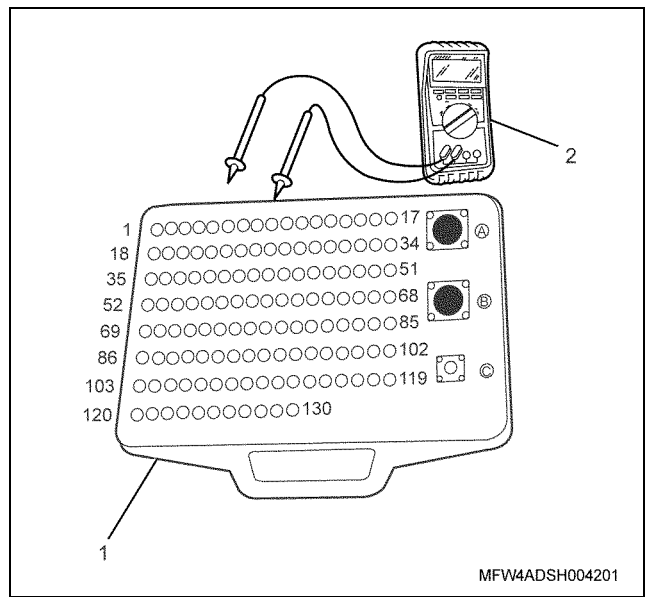
Tech2 and scan tools with KW communication can display both voltage and physical value.



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Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

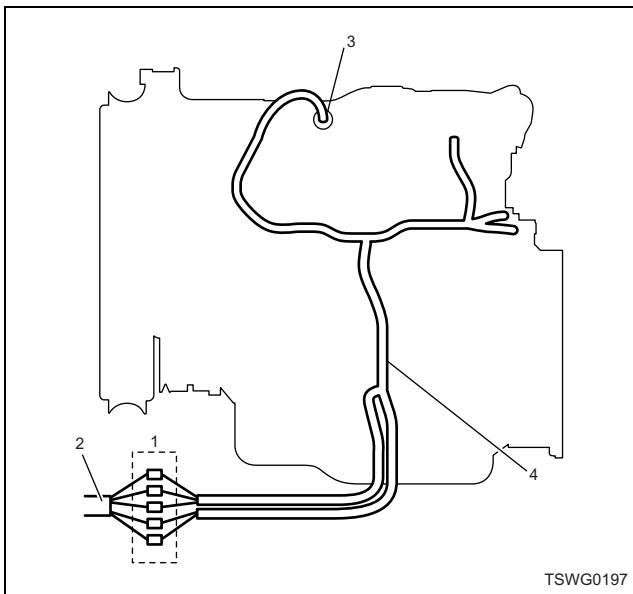


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	91 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	109 - Sensor connector ground terminal	100Ω or less	10MΩ or more

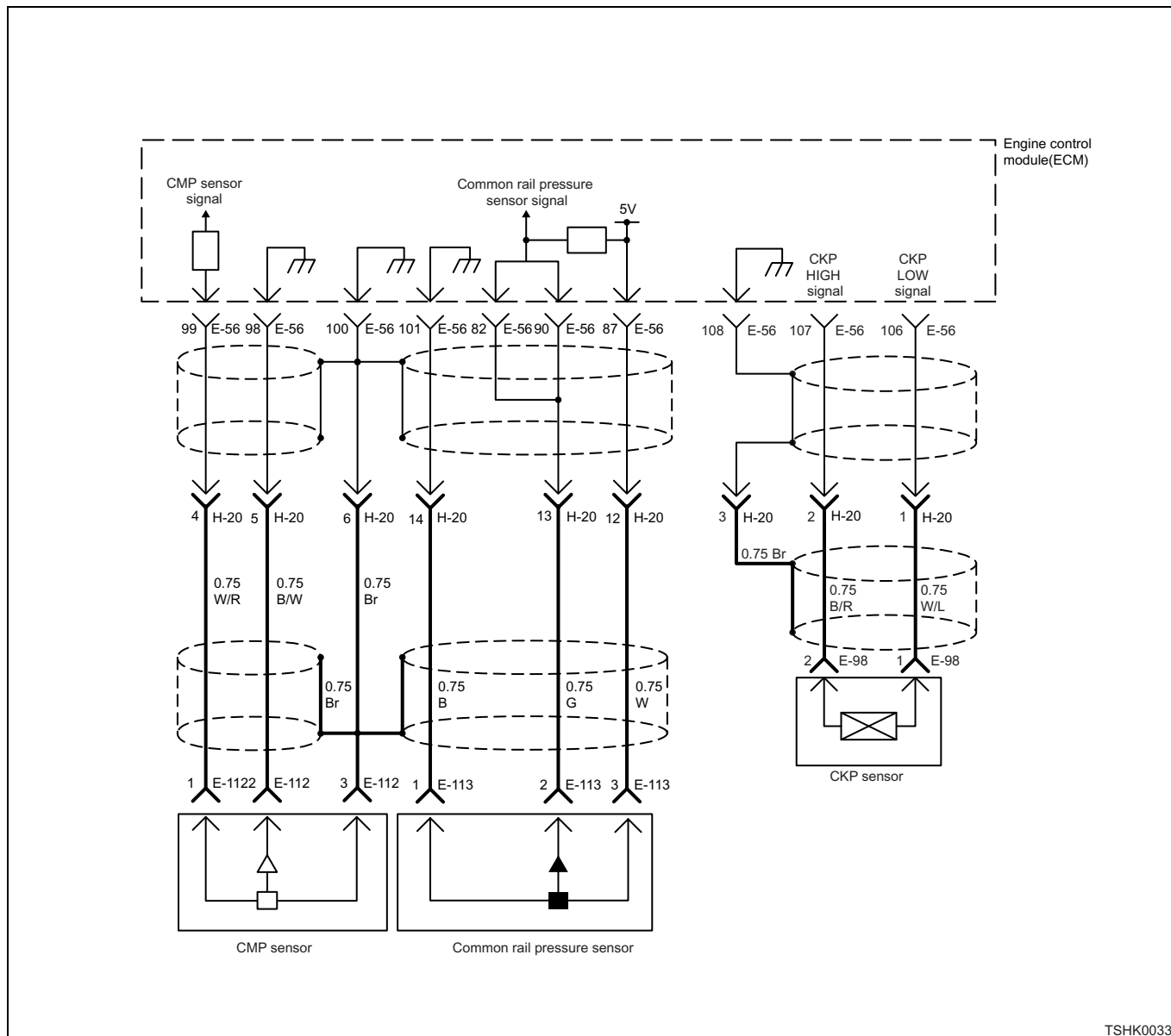
On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0335 (Flash code 15)**Crank sensor fault (no signal)**

TSHK0033

Description of circuit

The crankshaft position (CKP) sensor detects the engine speed. When the sensing hole installed in the flywheel passes the tip of the CKP sensor, a voltage is generated and turned into a pulse signal. The engine control module (ECM) reads this pulse signal, and obtains the engine speed and injection timing based on the signal.

Main trouble symptom

- Output lowering
- White smoke emitted
- Intense engine vibration possible
- Engine stall possible (restart is possible when camshaft position sensor is normal.)

Preconditions when DTC is set

- Cam pulse is normal.
- DTC P0335, P0336, P0340, P0341, or P1345 is not detected.
- Engine under operation

DTC set condition

- Cam signal exists but no crank signal.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Control based on cam when cam sensor is normal

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

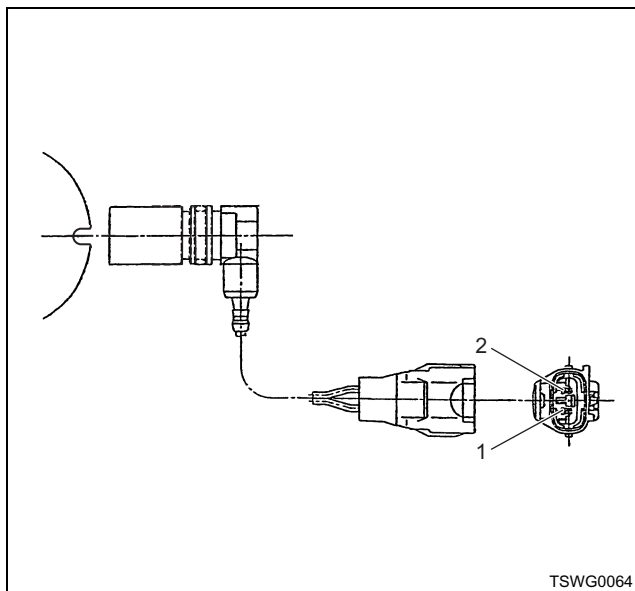
- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check for installation condition of the crankshaft position (CKP) sensor. 1. Turn the key switch to “OFF”. 2. Visually check the sensor for installation condition such as play or looseness. 3. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 3.	—
3	Check for installation condition of the CKP sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the procedure completed?	—	Go to Step 4.	—
4	Check the DTC again. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Turn the key switch to “OFF” for more than 10 seconds. 3. Start the engine, and test run with the “Preconditions when DTC is set”. 4. Check the DTC. Is DTC detected?	—	Go to Step 5.	Go to Step 12.

10D-351 Electronic control fuel injection system (Common rail type)

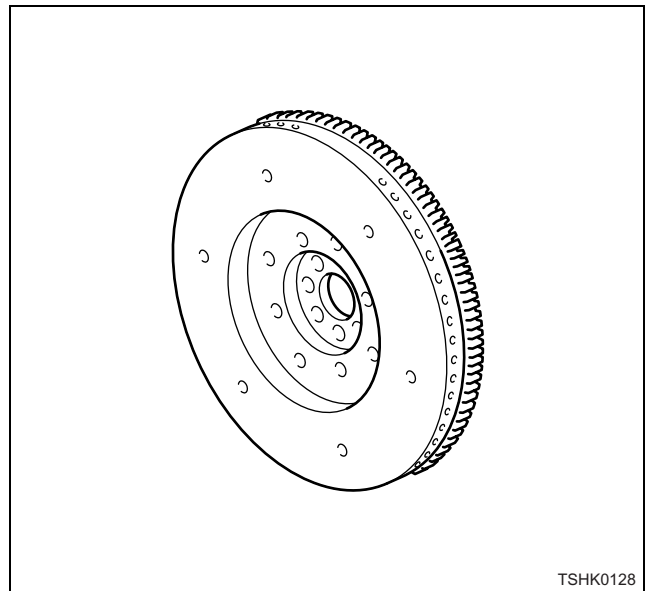
Step	Action	Value	YES	NO
5	Check the CKP sensor body. 1. Turn the key switch to "OFF". 2. Remove the harness from the CKP sensor. 3. Measure the resistance between the sensor connector terminals. Is the resistance within the specified value?	Between terminals: 108.5 — 142.5Ω; Each terminal — ground: ∞Ω (at normal temperature)	Go to Step 6.	Go to Step 7.
6	1. Check for followings in the circuit between ECM and CKP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance • Short circuit to ground • Short circuit between terminals • Short circuit to power supply circuit or ignition power supply circuit 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 8.
7	Replace the CKP sensor. Is the procedure completed?	—	Go to Step 11.	—
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—

Step	Action	Value	YES	NO
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0335 detected?	—	Go to Step 2.	Go to Step 12.
12	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

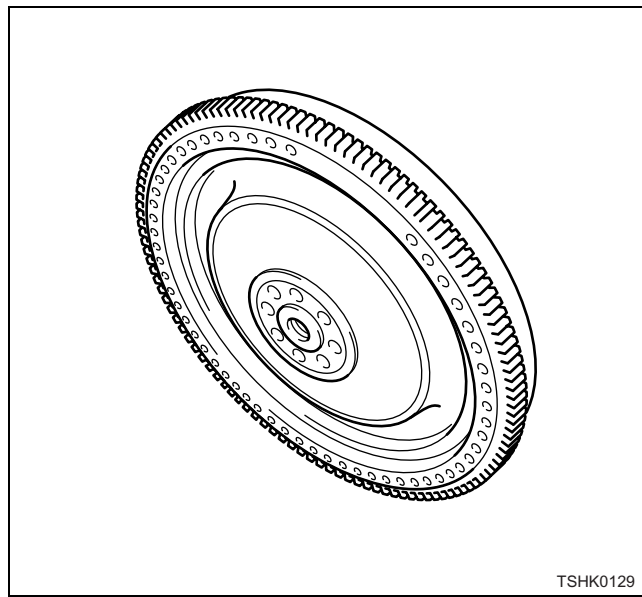
About CKP sensor

Name

1. GND
2. Power supply

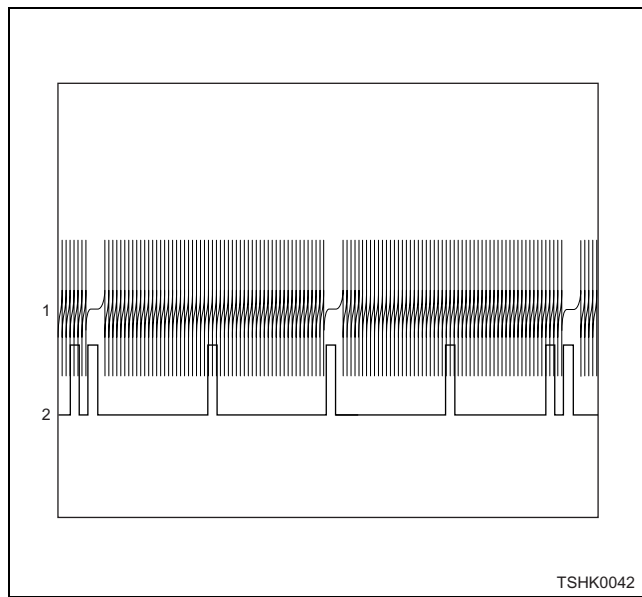
4HK1

6HK1

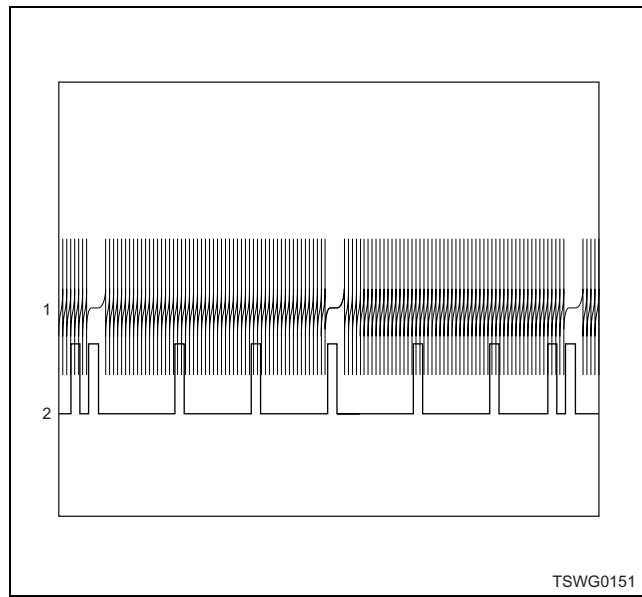


About CKP sensor and CMP sensor signals

4HK1



6HK1

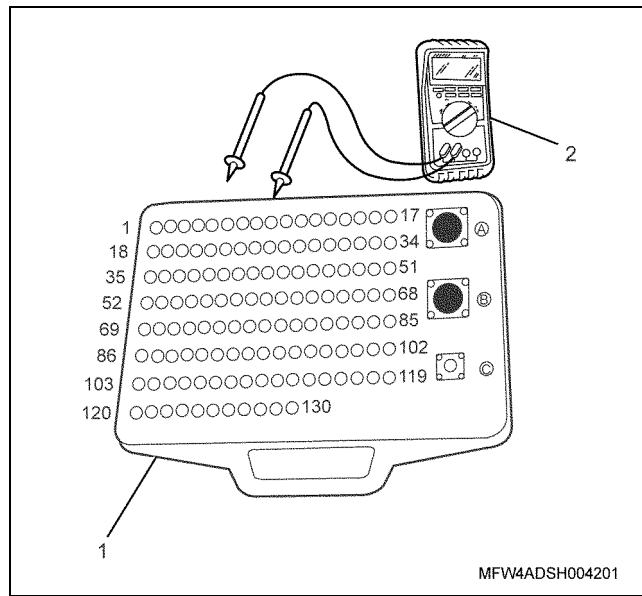


Name

- 1. CKP signal
- 2. CMP signal

Breaker box inspection procedure

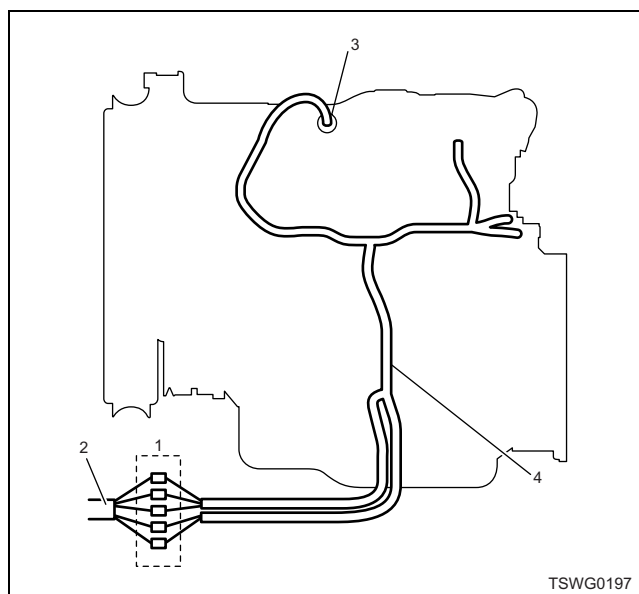
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

- 1. Breaker box
- 2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	106 - Sensor connector (-) terminal 107 - Sensor connector (+) terminal	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	106 - Ground 107 - Ground	10MΩ or more	100Ω or less
	Short circuit between terminals	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	106 - 107	10MΩ or more	100Ω or less
	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	106 - Ground 107 - Ground	0V	18V or more

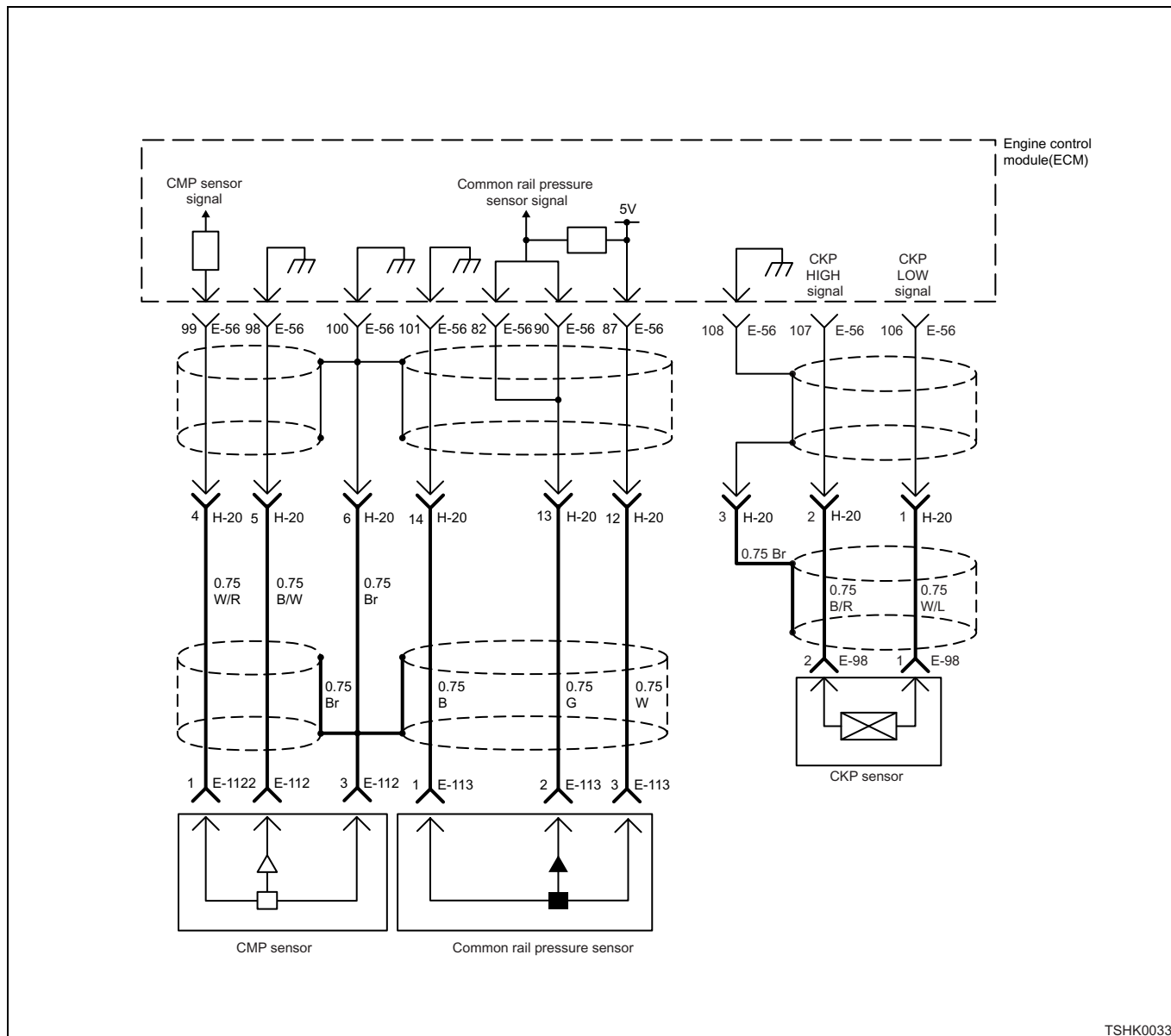
On-board check of sensors

Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

- If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
- If only step 1 is faulty, replace the sensor.

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.

DTC: P0336 (Flash code 15)**Crank sensor fault (signal fault)**

TSHK0033

Description of circuit

The crankshaft position (CKP) sensor detects the engine speed. When the sensing hole installed in the flywheel housing passes the tip of the CKP sensor, a voltage is generated and turned into a pulse signal. The engine control module (ECM) reads this pulse signal, and obtains the engine speed and injection timing based on the signal.

Main trouble symptom

- Output lowering
- White smoke emitted
- Intense engine vibration possible
- Engine stall possible (restart is possible when camshaft position sensor is normal.)

Preconditions when DTC is set

- Cam pulse is normal.
- DTC P0335, P0336, P0340, P0341, or P1345 is not detected.
- Engine under operation

DTC set condition

- Number of pulse for crank signal is mismatched.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Control based on cam when cam sensor is normal

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

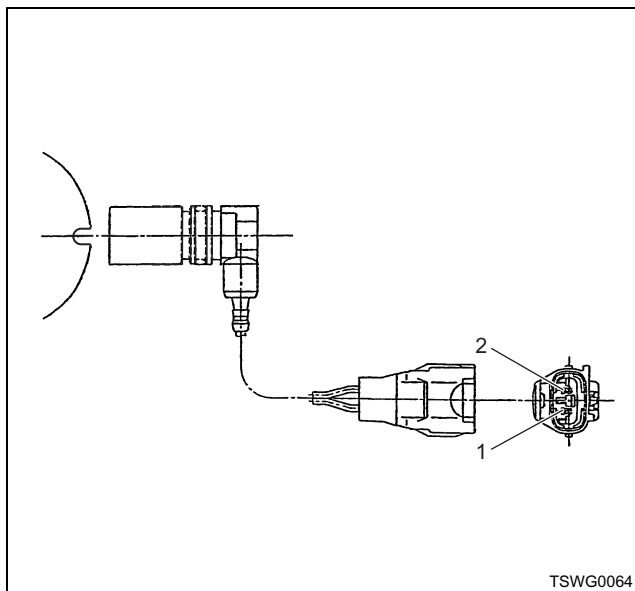
- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check for installation condition of the crankshaft position (CKP) sensor. 1. Turn the key switch to “OFF”. 2. Visually check the sensor for installation condition such as play or looseness. 3. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 3.	—
3	Check for installation condition of the CKP sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the procedure completed?	—	Go to Step 4.	—
4	Check the DTC again. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Turn the key switch to “OFF” for more than 10 seconds. 3. Start the engine, and test run with the “Preconditions when DTC is set”. 4. Check the DTC. Is DTC detected?	—	Go to Step 5.	Go to Step 12.

10D-357 Electronic control fuel injection system (Common rail type)

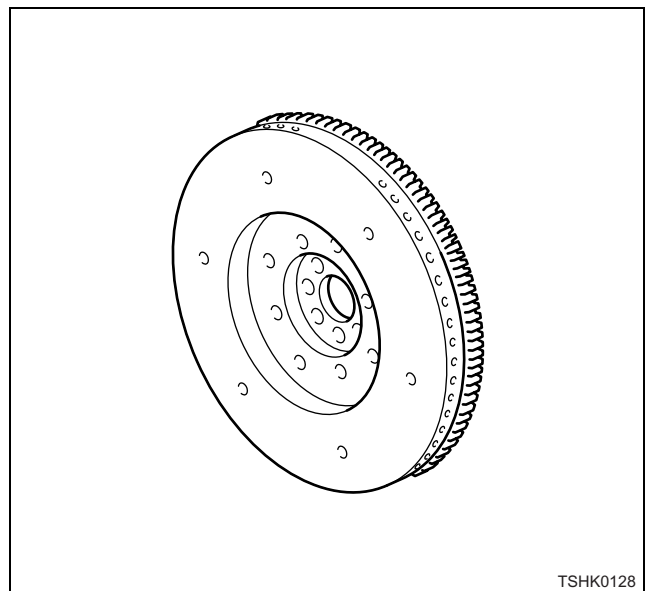
Step	Action	Value	YES	NO
5	1. Check the CKP sensor circuit for short circuit to other signal circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 6.
6	Check the CKP sensor body. 1. Turn the key switch to "OFF". 2. Remove the harness from the CKP sensor. 3. Measure the resistance between the sensor connector terminals. 4. Remove the CKP sensor, and check the sensor tip for scratch or damage. Is the CKP sensor normal?	Between terminals: 108.5 — 142.5Ω; Each terminal — ground: ∞Ω (at normal temperature)	Go to Step 8.	Go to Step 7.
7	Replace the CKP sensor. Is the procedure completed?	—	Go to Step 12.	—
8	1. Visually check the flywheel for chipped tooth. 2. If the trouble is detected, replace it. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—

Step	Action	Value	YES	NO
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0336 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

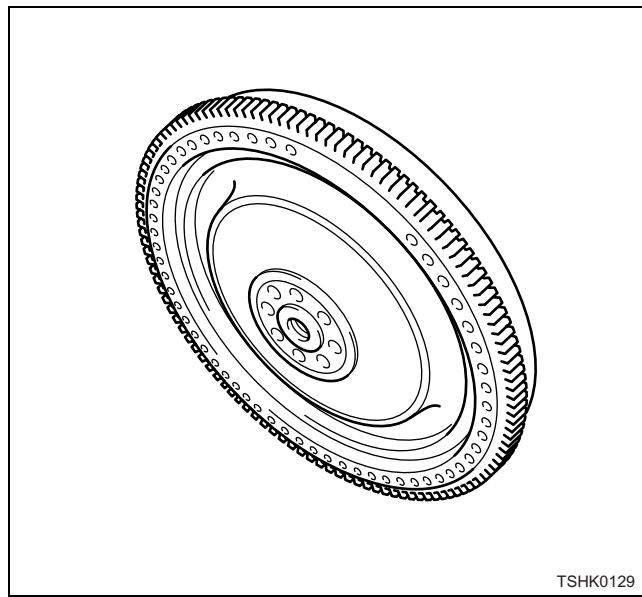
About CKP sensor

Name

1. GND
2. Power supply

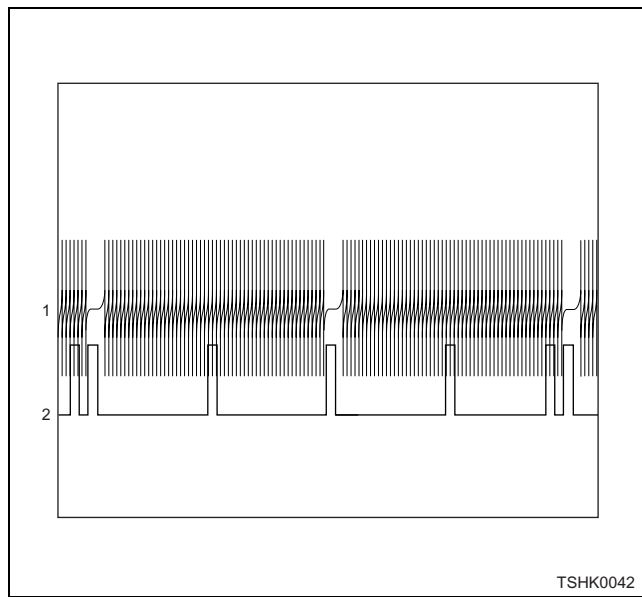
4HK1

6HK1

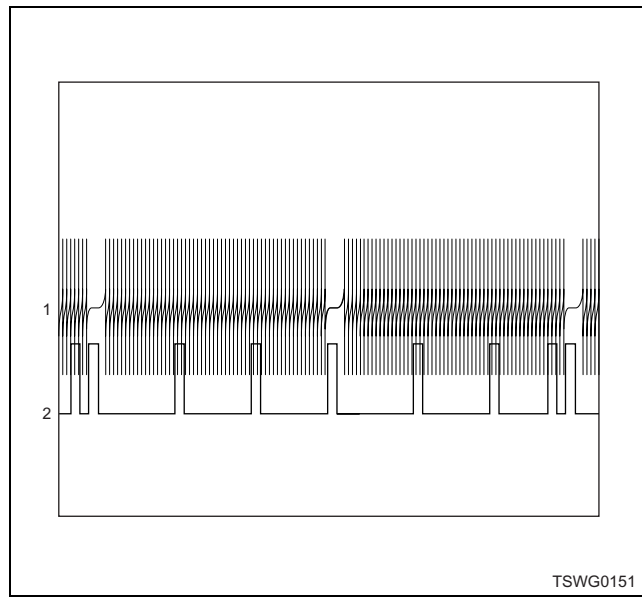


About CKP sensor and CMP sensor signals

4HK1



6HK1

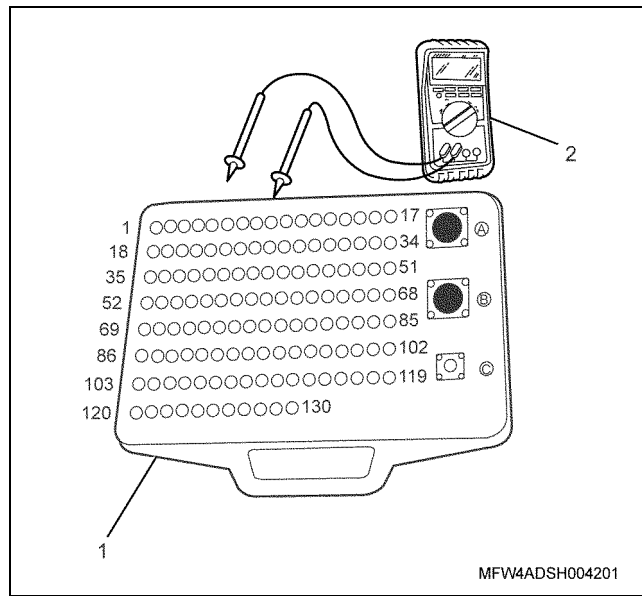


Name

- 1. CKP signal
- 2. CMP signal

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

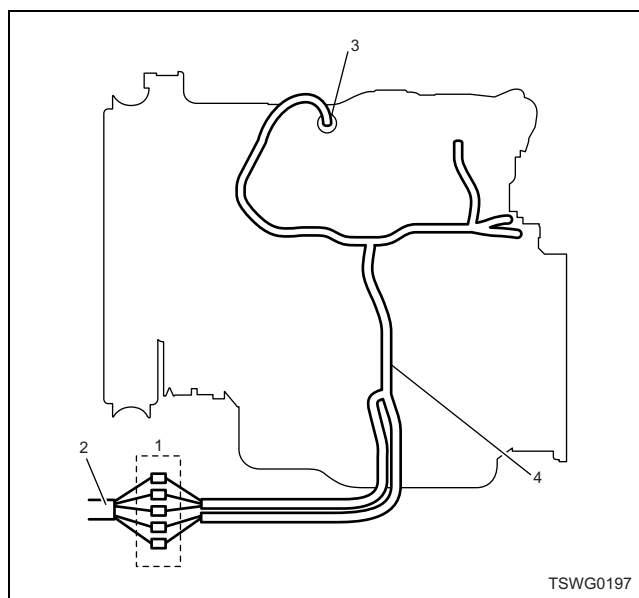


Name

- 1. Breaker box
- 2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5	Short circuit to other signal circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	106 - Ground 107 - Ground	0V	1V or more

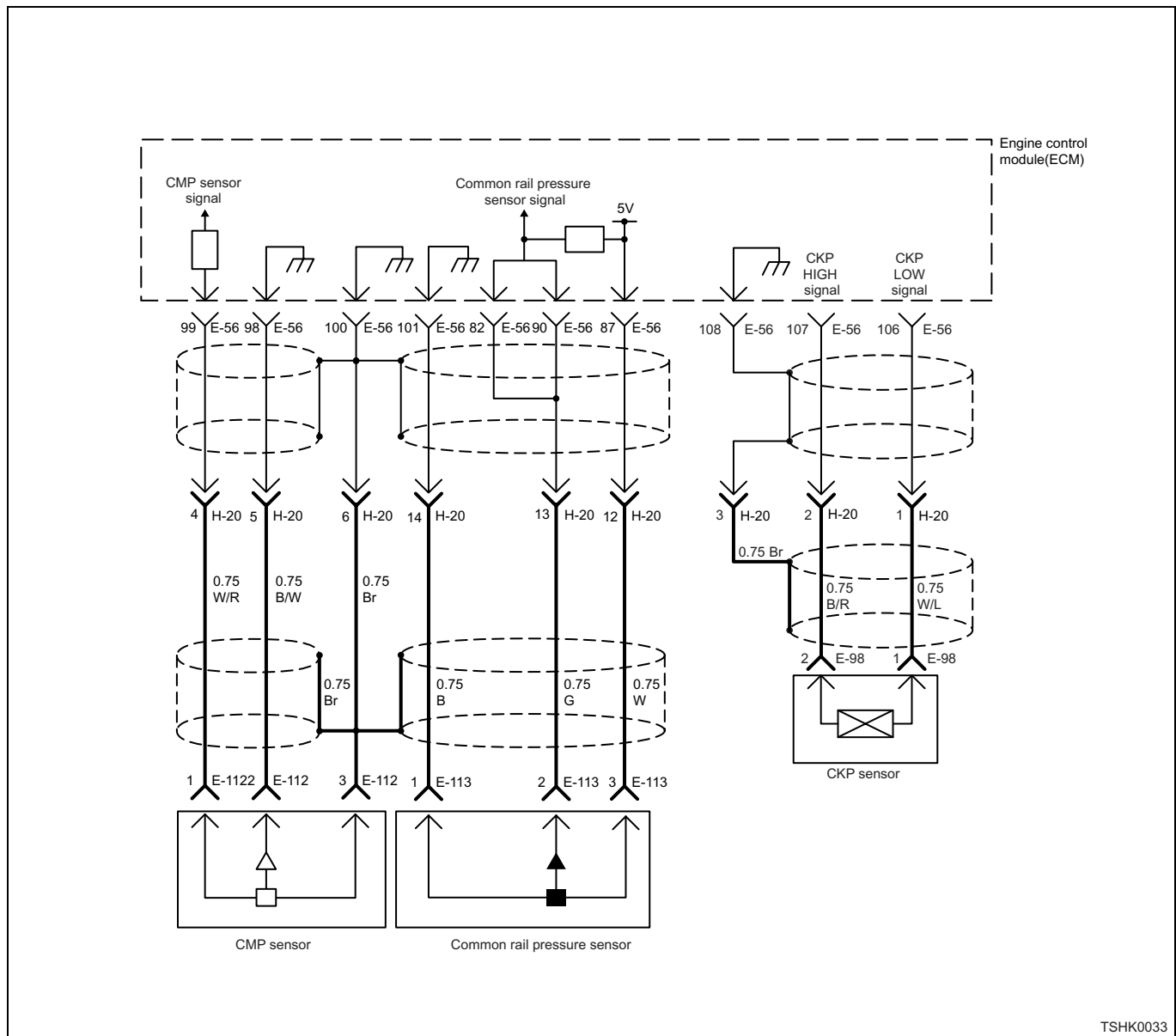
On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0340 (Flash code 14)**Cam sensor fault (no signal)****Description of circuit**

The camshaft position (CMP) sensor detects the camshaft rotation and identifies the cylinder. When the pulsar installed in the camshaft passes the tip of the camshaft position (CMP) sensor, a voltage is generated and turned into a pulse signal. The engine control module (ECM) reads this pulse signal, and identifies the cylinder based on the signal.

Main trouble symptom

- Engine does not start (restart).
- Behavior does not change during engine running.

Preconditions when DTC is set

- Crank pulse is normal.
- DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected.

- Engine under operation

DTC set condition

- Crank signal exists but no cam signal.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Engine running based on crank when it is normal
- After engine stops: Unable to identify cylinder (unable to restart)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
 - Defective harness routing
 - Worn harness cladding
 - Wire disconnection inside harness cladding
- Following inspections are necessary to detect these causes.
- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
 - Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

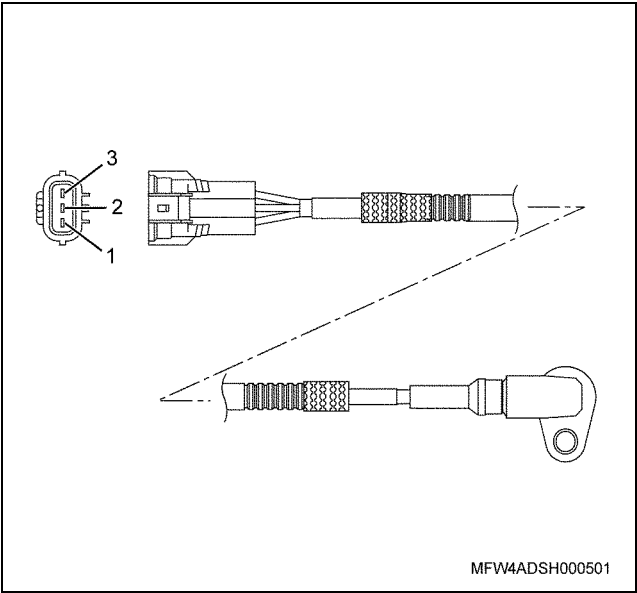
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check for installation condition of the CMP sensor. 1. Turn the key switch to “OFF”. 2. Visually check the sensor for installation condition such as play or looseness. 3. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 3.	—
3	Check for installation condition of the CMP sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the procedure completed?	—	Go to Step 4.	—
4	Check the DTC again. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Turn the key switch to “OFF” for more than 10 seconds. 3. Start the engine, and test run with the “Preconditions when DTC is set”. 4. Check the DTC. Is DTC detected?	—	Go to Step 5.	Go to Step 15.
5	Remove the CMP sensor, and check the sensor tip for scratch or damage. Is the CMP sensor normal?	—	Go to Step 6.	Go to Step 9.

10D-363 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
6	1. Check for followings in the power supply circuit between ECM and CMP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 15.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and CMP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance • Short circuit to power supply circuit or ignition power supply circuit 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 15.	Go to Step 8.
8	1. Check for followings in the shield circuit between ECM and CMP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance • Short circuit to power supply circuit or ignition power supply circuit 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 15.	Go to Step 10.
9	Replace the CMP sensor. Is the procedure completed?	—	Go to Step 10.	—
10	1. Visually check the camshaft gear for fault. 2. Check the alignment mark in the timing gear. 3. If the trouble is detected, repair or replace it. Is the trouble detected?	—	Go to Step 15.	Go to Step 11.
11	Replace the supply pump. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 14.	—
12	Is EMPS available?	—	Go to Step 13.	Go to Step 14.

Step	Action	Value	YES	NO
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 15.	Go to Step 14.
14	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 15.	—
15	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0340 detected?	—	Go to Step 2.	Go to Step 16.
16	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

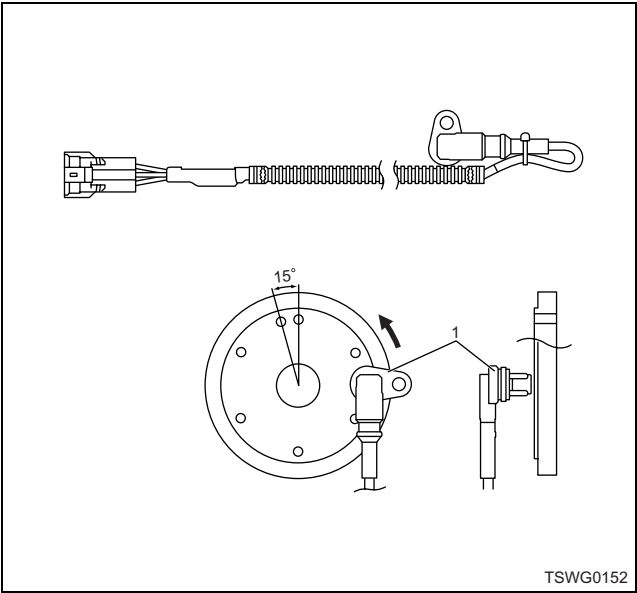
About camshaft position (CMP) sensor



Name

- 1. Shield
- 2. -
- 3. +

6HK1

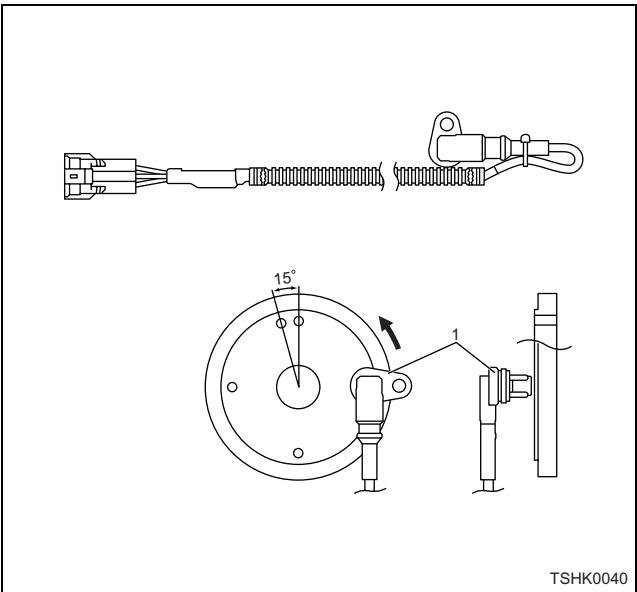


Name

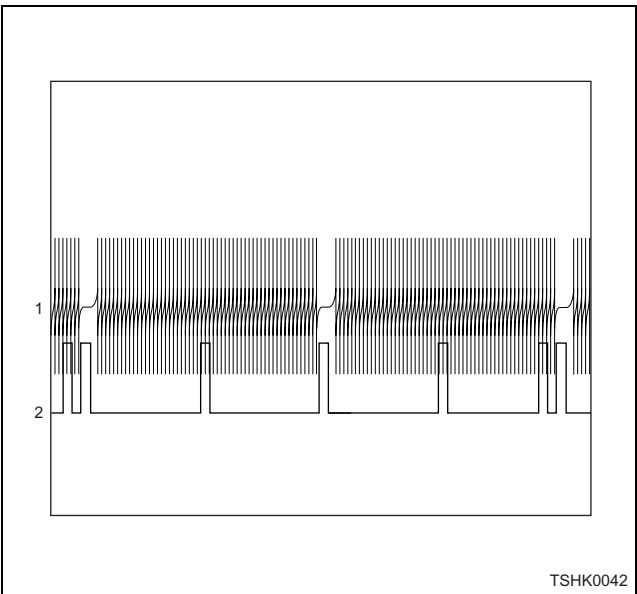
- 1. CMP sensor

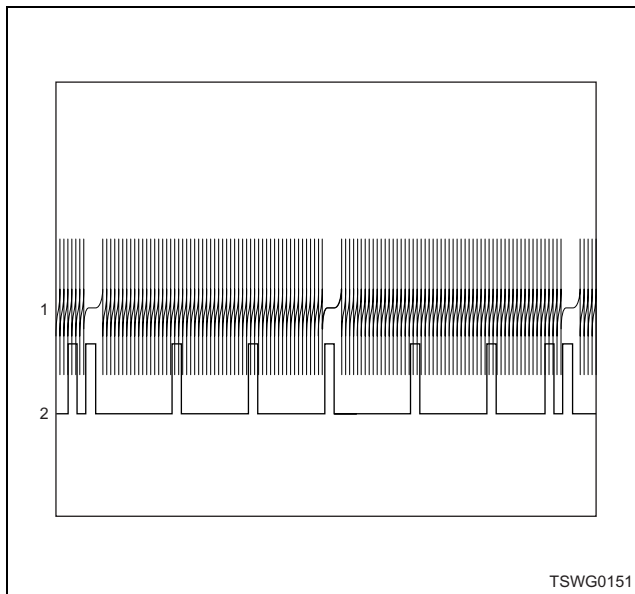
About CKP sensor and CMP sensor signals

4HK1



4HK1

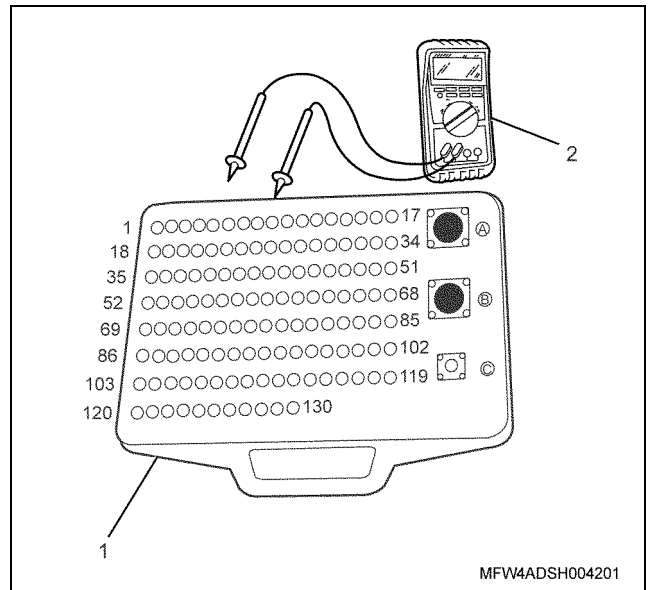


6HK1**Name**

1. CKP signal
2. CMP signal

Breaker box inspection procedure

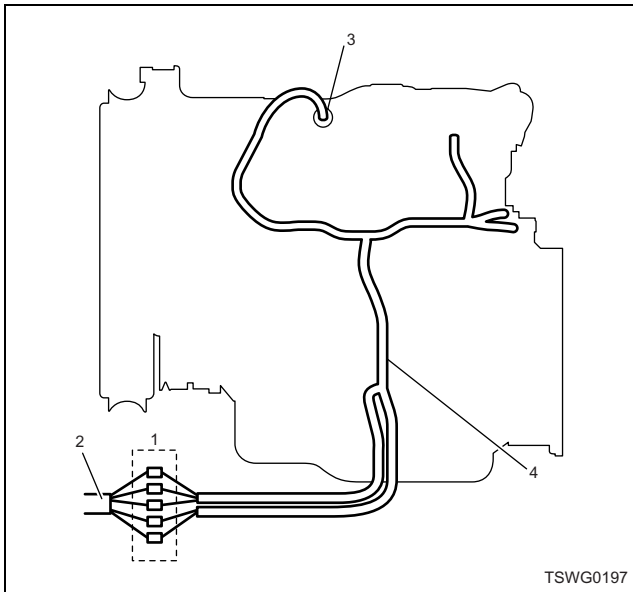
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

**Name**

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	99 - Sensor connector power supply terminal	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	99 - Ground	10MΩ or more	100Ω or less
7	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	98 - Sensor connector signal terminal	100Ω or less	10MΩ or more
	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	98 - Ground	0V	18V or more
8	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	100 - Sensor connector shield terminal	100Ω or less	10MΩ or more
	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	100 - Ground	0V	18V or more

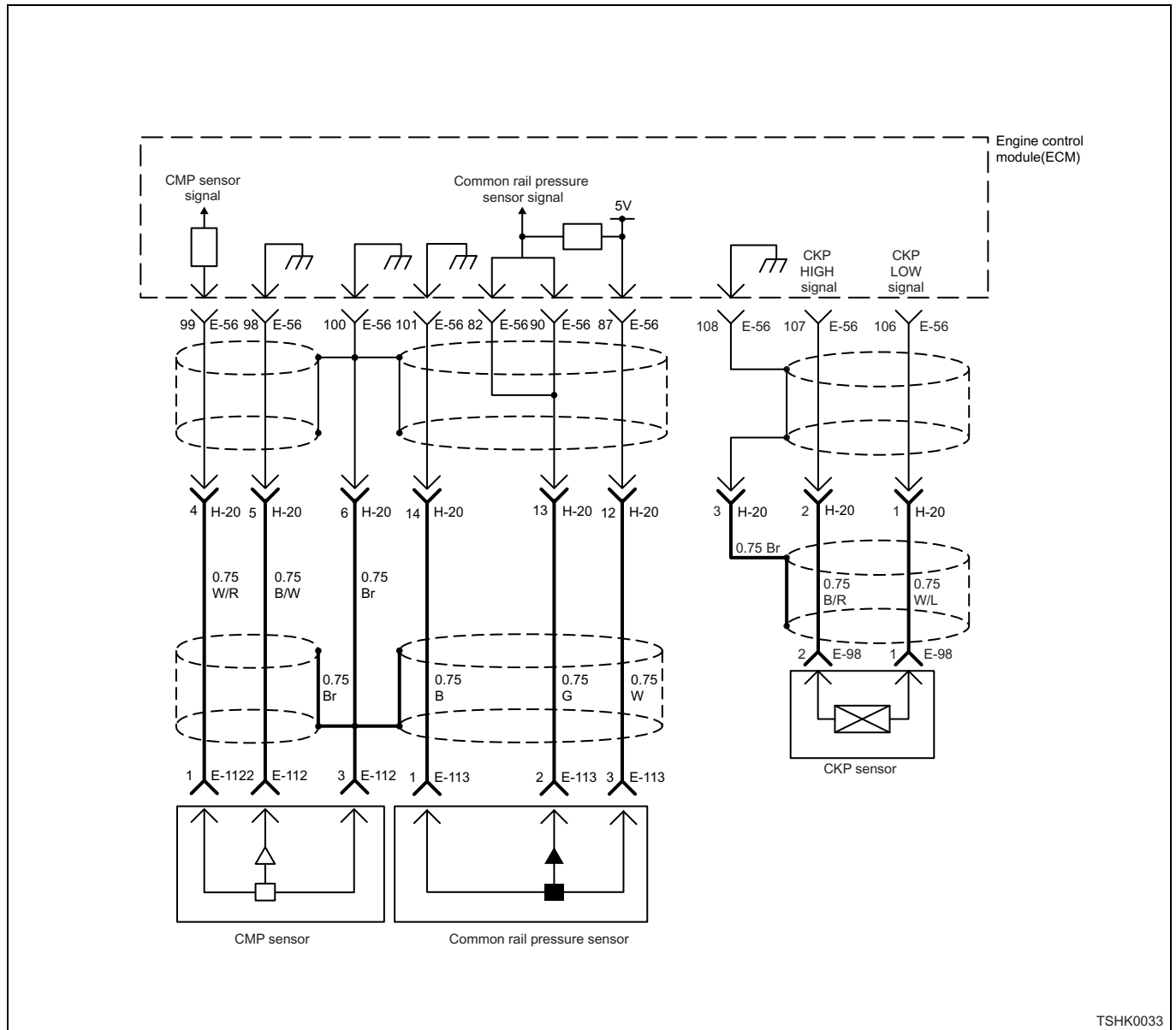
On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0341 (Flash code 14)**Cam sensor fault (signal fault)**

TSHK0033

Description of circuit

The camshaft position (CMP) sensor detects the camshaft rotation and identifies the cylinder. When the pulsar installed in the camshaft passes the tip of the CMP sensor, a voltage is generated and turned into a pulse signal. The engine control module (ECM) reads this pulse signal, and identifies the cylinder based on the signal.

Main trouble symptom

- Engine does not start (restart).
- Behavior does not change during engine running.

Preconditions when DTC is set

- Crank pulse is normal.
- DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected.

- Engine under operation

DTC set condition

- When unnecessary G sensor pulse is detected, or when shortage of G sensor pulse is detected.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Engine running based on crank when it is normal
- After engine stops: Unable to identify cylinder (unable to restart)

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Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
 - Defective harness routing
 - Worn harness cladding
 - Wire disconnection inside harness cladding
- Following inspections are necessary to detect these causes.
- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
 - Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

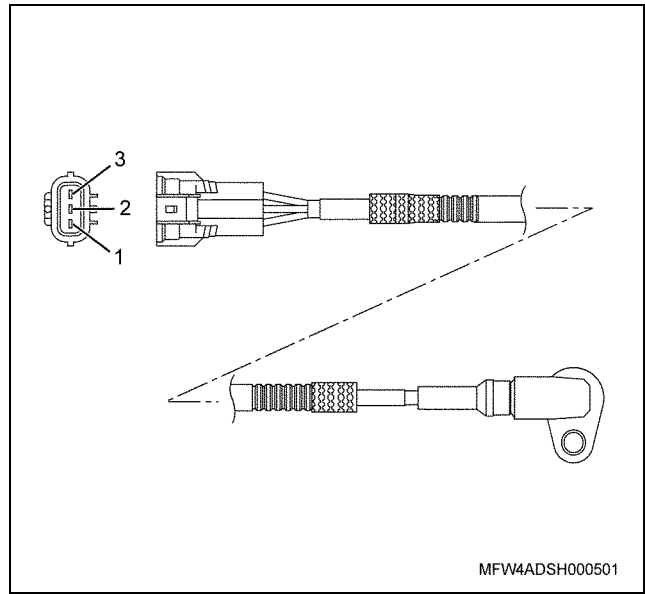
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check for installation condition of the CMP sensor. 1. Turn the key switch to “OFF”. 2. Visually check the sensor for installation condition such as play or looseness. 3. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 3.	—
3	Check for installation condition of the CMP sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the procedure completed?	—	Go to Step 4.	—
4	Check the DTC again. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Turn the key switch to “OFF” for more than 10 seconds. 3. Start the engine, and test run with the “Preconditions when DTC is set”. 4. Check the DTC. Is DTC detected?	—	Go to Step 5.	Go to Step 11.
5	Remove the CMP sensor, and check the sensor tip for scratch or damage. Is the CMP sensor normal?	—	Go to Step 6.	Go to Step 8.

Step	Action	Value	YES	NO
6	1. Turn the key switch to "OFF". 2. Remove the harness from the CMP sensor. 3. Connect the breaker box or DMM between the CMP sensor terminals. Refer to "Breaker box inspection procedure". 4. Turn the key switch to "ON". Is the DMM indication specified value?	0V	Go to Step 8.	Go to Step 7.
7	1. Check the CMP sensor circuit for short circuit to other signal circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 14.	Go to Step 9.
8	Replace the CMP sensor. Is the procedure completed?	—	Go to Step 14.	—
9	1. Visually check the camshaft gear for fault. 2. Check the alignment mark in the timing gear. 3. If the trouble is detected, repair or replace it. Is the trouble detected?	—	Go to Step 14.	Go to Step 10.
10	Replace the supply pump. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 11.	—
11	Is EMPS available?	—	Go to Step 12.	Go to Step 13.
12	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 14.	Go to Step 13.

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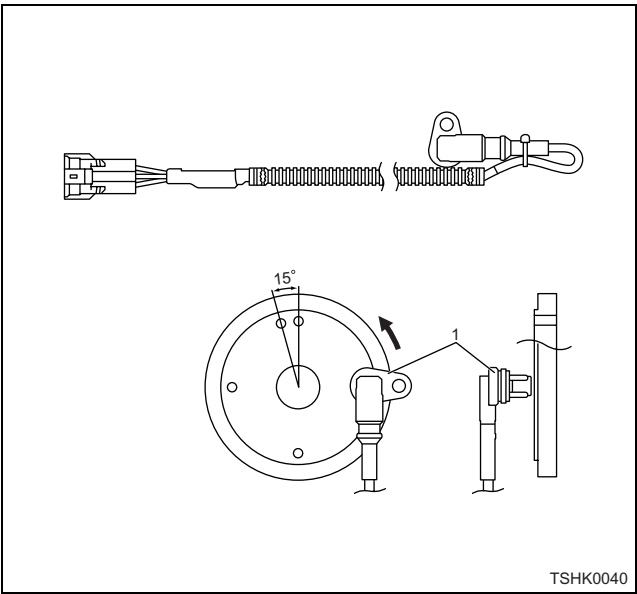
Step	Action	Value	YES	NO
13	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 14.	—
14	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P0341 detected?	—	Go to Step 2.	Go to Step 15.
15	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

About CMP sensor

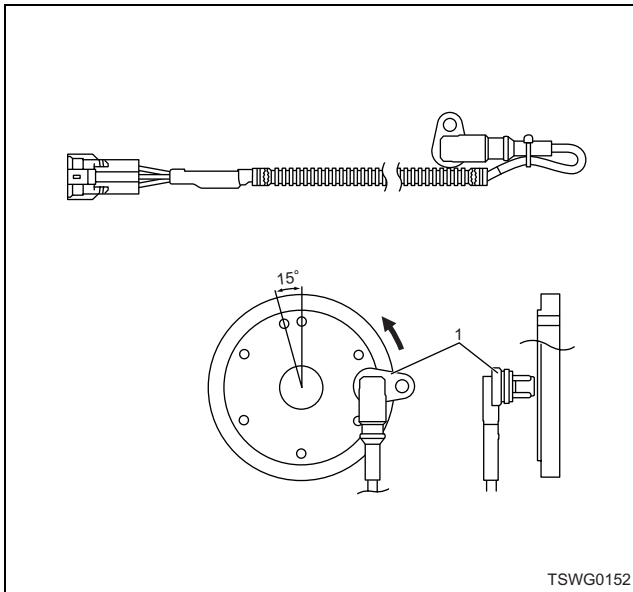


- Name
1. Shield
 2. —
 3. +

4HK1



6HK1

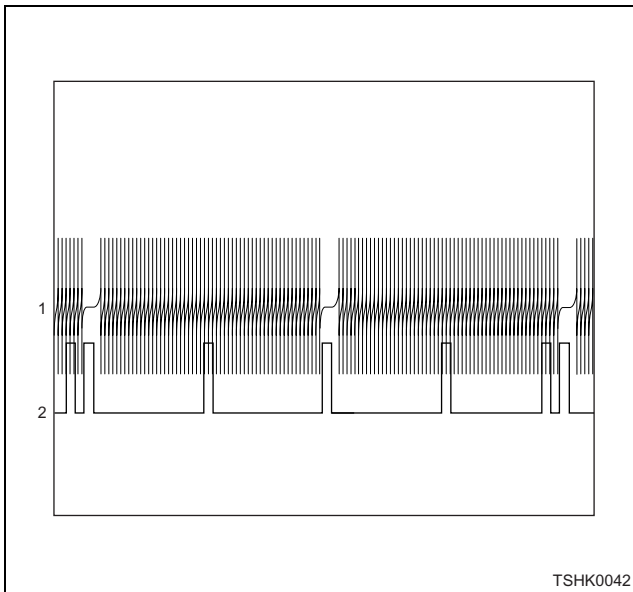


Name

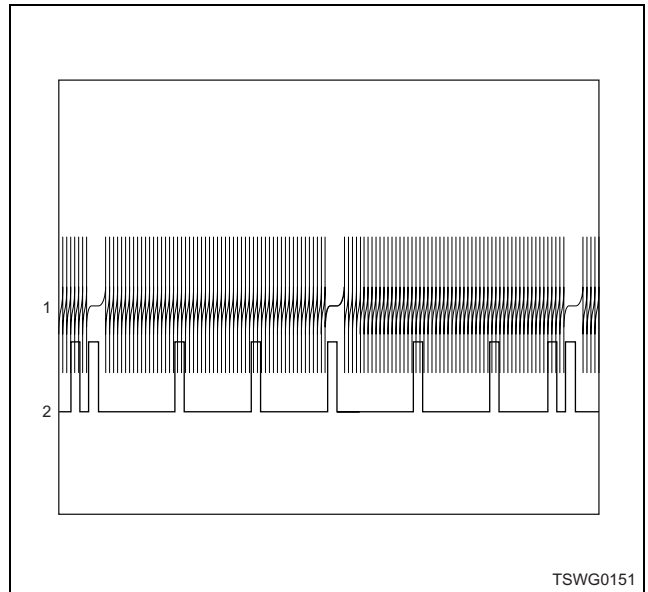
1. CMP sensor

About CKP sensor and CMP sensor signals

4HK1



6HK1

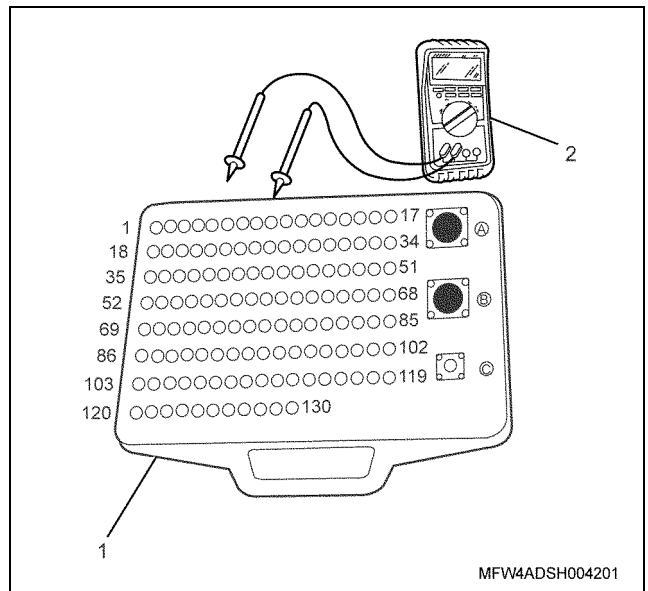


Name

1. CKP signal
2. CMP signal

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



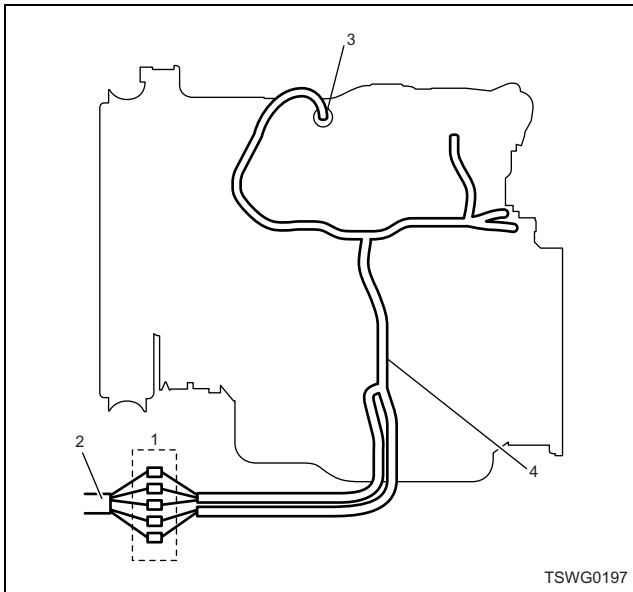
Name

1. Breaker box
2. DMM

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Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
7	Short circuit to other signal circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	98 - Ground	0V	1V or more

On-board check of sensors



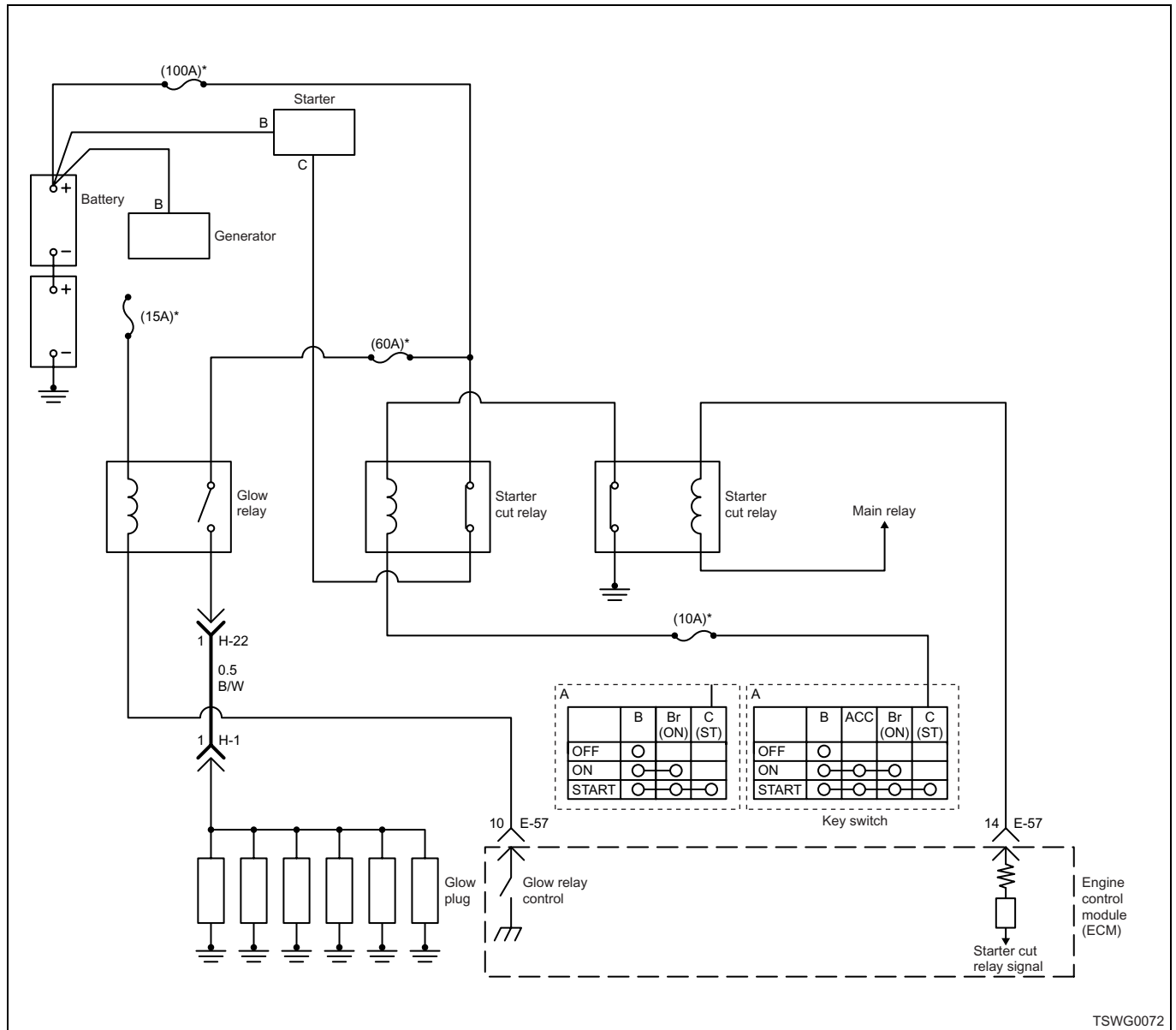
Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0380 (Flash code 66)**Glow relay circuit fault**

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



TSWG0072

Note:

The QOS circuit is the same for both the starter ECM control specifications and the safety relay specifications.

Description of circuit

The glow relay cuts off the power supply voltage (24 V) to the glow plug, and turns "ON" when the signal from ECM is input. The ECM recognizes the starter switch "ON" signal, and outputs the "ON" signal to the glow relay.

Main trouble symptom

- Startability deteriorates at low temperatures.

Preconditions when DTC is set

- Key switch input power supply voltage is 16 V or more and 32 V or less.

DTC set condition

- Glow relay drive indication signal is unmatched with glow relay monitor signal.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- No back-up operation (4HK1)

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- Specified back-up value (depending on the machine manufacturer) (6HK1)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp turns off when the trouble code turns to the past trouble.
- Using the scan tool, or accelerator pedal operation enables to clear past trouble (history).

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding

Wire disconnection inside harness cladding
Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

6. If the “Glow relay” displays “ON” when terminals between the glow relay are shorted, the circuit beyond the relay is normal including ECM.

9. If the “Glow relay” displays “OFF” when the glow relay is removed, the circuit beyond the relay is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 17.
3	1. Turn the key switch to ON position. 2. Check for “Glow relay” on the data display using scan tool. Is the “Glow relay” displayed “ON”?	—	Go to Step 4.	Go to Step 5.
4	1. Turn the key switch to ON position. 2. Hold it for more than 10 seconds. 3. Check for “Glow relay” on the data display using scan tool. Is the “Glow relay” displayed “OFF”?	—	Go to “Diagnostic aid”.	Go to Step 9.
5	Check for installation condition of the glow relay, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 6.

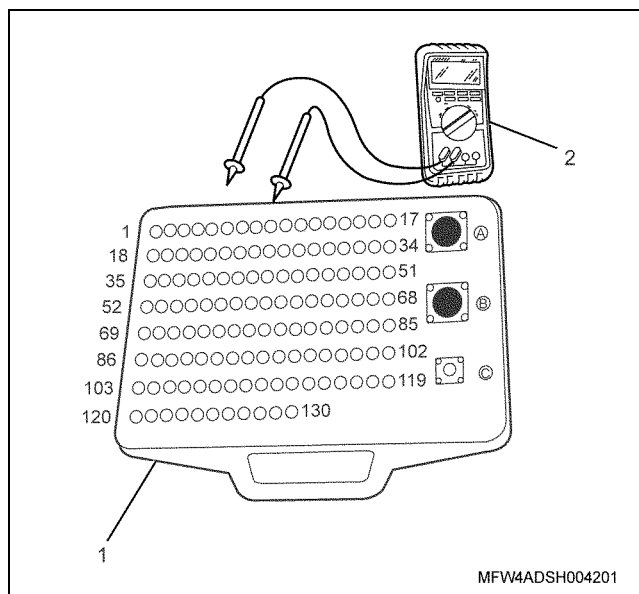
Step	Action	Value	YES	NO
6	1. Turn the key switch to "OFF". 2. Remove the glow relay. 3. Short between the terminals 2 - 4 in the glow relay installing portion using jump cable. 4. Turn the key switch to "ON". 5. Check for "Glow relay" on the data display using scan tool. Is the "Glow relay" displayed "ON"?	—	Go to Step 11.	Go to Step 7.
7	1. Check for following in the circuit between the fuse and the glow relay. • Open circuit • Short circuit to ground circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 8.
8	1. Check for followings in the circuit between glow relay and ECM using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • Short circuit to ground circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
9	1. Turn the key switch to "OFF". 2. Remove the glow relay. 3. Turn the key switch to "ON". 4. Check for "Glow relay" on the data display using scan tool. Is the "Glow relay" displayed "OFF"?	—	Go to Step 11.	Go to Step 10.
10	1. Check the circuit between glow relay and ECM for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 11.
11	Replace the glow relay. Is the procedure completed?	—	Go to Step 12.	—
12	Is EMPS available?	—	Go to Step 13.	Go to Step 14.

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Step	Action	Value	YES	NO
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 15.	Go to Step 14.
14	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 15.	—
15	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0380 detected?	—	Go to Step 2.	Go to Step 16.
16	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
17	Check for installation condition of the glow relay, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



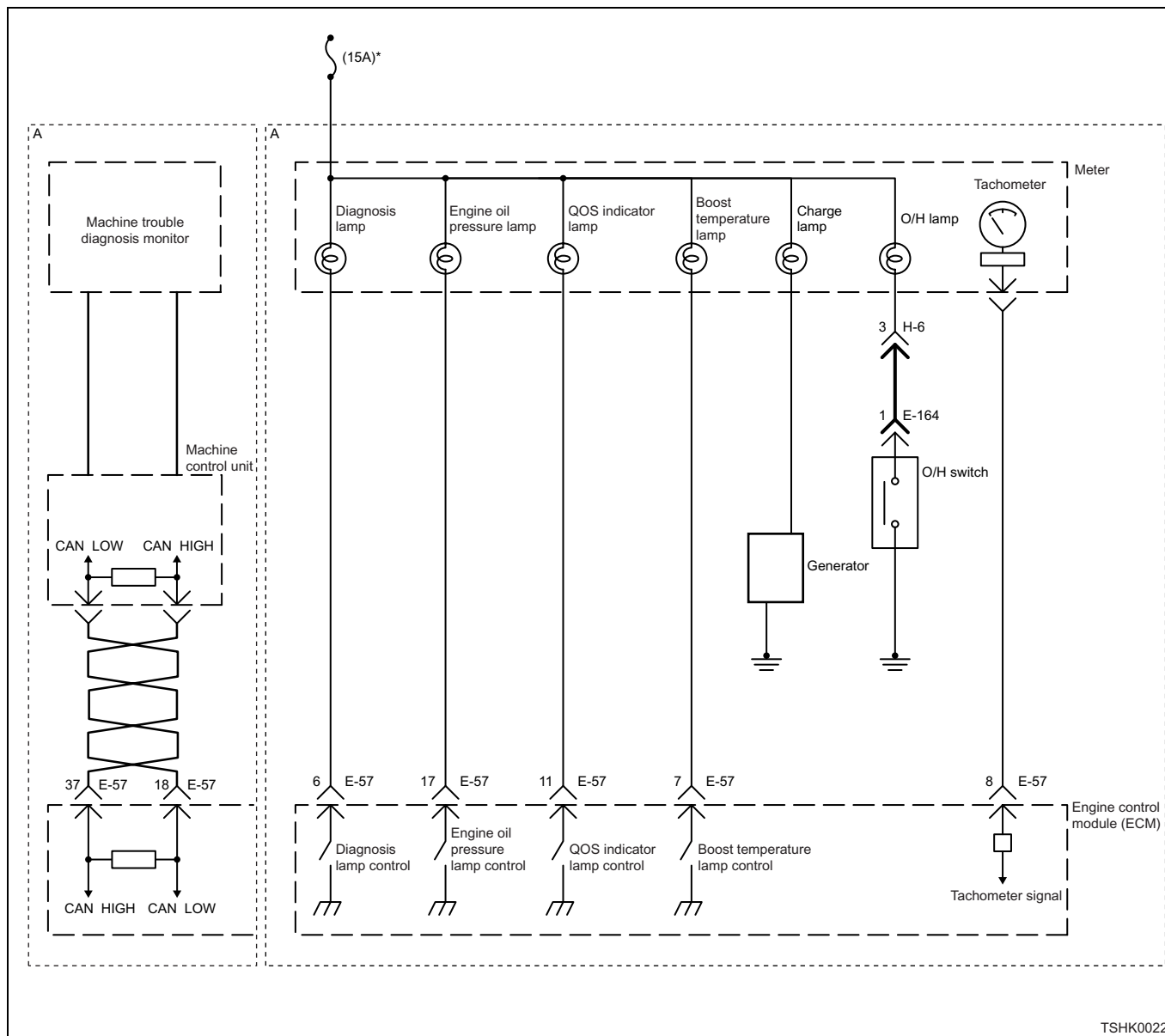
Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
8	Open circuit/ high resistance	Resistance measurement	- Disconnect the relay. - Key switch "OFF"	10 - FL 12 connector terminal No. 1	10M Ω or less	10M Ω or more
	Short circuit to ground	Resistance measurement	- Disconnect the relay. - Key switch "OFF"	10 - Ground	10M Ω or more	10M Ω or less
10	Short circuit to power supply circuit	Voltage measurement	- Disconnect the relay. - Key switch "ON"	10 - Ground	0V	18V or more

DTC: P0381 (Flash code 67)
Glow plug lamp circuit fault

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)


Description of circuit

The QOS indicator lamp is installed in the meter. The engine control module (ECM) turns the QOS indicator lamp on to tell the glow plug operation when the key switch is turned "ON". The ECM detects the glow plug operating condition, and turns the lamp off upon completion of preheat.

Main trouble symptom

Operationality is not affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P0381 is not detected.

DTC set condition

- Glow lamp indication signal is unmatched with glow lamp monitor signal.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Blown lamp bulb
- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector

- Poor connection of terminal from connector
- Unmatched terminals are fitted.
- Damage of connector lock
- Poor contact between terminal and wire

• **Damaged harness**

- Visually check the harness for damage.
- Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

2. If the lamp does not come on with the key switch “ON”, open circuit, short circuit to the ground circuit, blown light bulb, or ECM fault is suspected.

2. If the lamp does not go OFF, short circuit to the ground circuit, meter circuit fault, or ECM fault is suspected.

4. If the lamp goes off when the ECM connector is removed, the circuit beyond the ECM is normal including meter.

7. If the lamp comes on when the lamp control terminal is shorted to the ground, the circuit beyond the ECM is normal including meter.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	1. Turn the key switch to “ON”. 2. Check if the QOS indicator lamp is ON. Does the QOS indicator lamp come on?	—	Go to Step 3.	Go to Step 7.
3	Turn the key switch “ON” and wait for 10 seconds. Does the QOS indicator lamp go OFF?	—	Go to “Diagnostic aid”.	Go to Step 4.
4	1. Turn the key switch to “OFF”. 2. Remove the connector from the ECM. 3. Turn the key switch to “ON”. 4. Check if the QOS indicator lamp is ON. Does the QOS indicator lamp go OFF?	—	Go to Step 12.	Go to Step 5.
5	Check for installation condition of the meter, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 14.	Go to Step 6.

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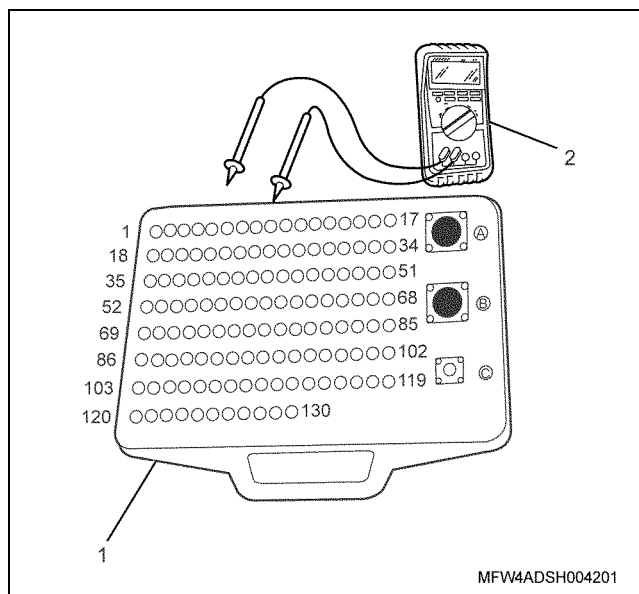
Step	Action	Value	YES	NO
6	1. Check the circuit between QOS indicator lamp and ECM for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 14.	Go to Step 11.
7	1. Turn the key switch to "OFF". 2. Remove the connector from the ECM. 3. Short between the QOS indicator lamp control terminal of the ECM and the ground using breaker box. Refer to "Breaker box inspection procedure". 4. Turn the key switch to "ON". 5. Check if the QOS indicator lamp is ON. Does the QOS indicator lamp come on?	—	Go to Step 13.	Go to Step 8.
8	Check for installation condition of the meter, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 14.	Go to Step 9.
9	1. Check for following in the circuit between the fuse and the QOS indicator lamp. • Open circuit • Short circuit to ground circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 14.	Go to Step 10.
10	1. Check for followings in the circuit between QOS indicator lamp and ECM using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 14.	Go to Step 12.
11	Replace the meter. Is the procedure completed?	—	Go to Step 14.	—
12	Replace the QOS indicator lamp bulb. Is the procedure completed?	—	Go to Step 14.	—
13	Is EMPS available?	—	Go to Step 14.	Go to Step 15.

Step	Action	Value	YES	NO
14	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 15.
15	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 16.
16	Check if DTC is not detected again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is the procedure completed?	—	Go to Step 17.	—
17	Check if DTC is detected. (DTC for entire engine control) Is DTC detected?	—	Go to the related "Inspection method by DTC".	Verify repair.

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Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to ground	Resistance measurement	- Remove the meter connector. - Key switch "OFF"	11 - Ground	10M Ω or more	10M Ω or less
10	Open circuit/high resistance	Resistance measurement	- Remove the meter connector. - Key switch "OFF"	11 - Meter connector QOS indicator lamp terminal	10M Ω or less	10M Ω or more

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DTC set condition

- Input signals from EGR position sensors U, V, and W are all ON or all OFF for 3 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Instruction to fully close EGR valve

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. Check all the signal circuits of the EGR position sensors U, V, and W.

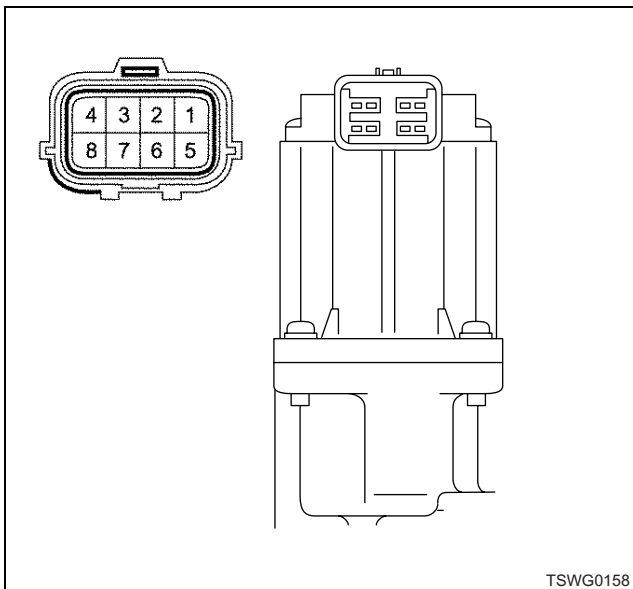
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Check for installation condition of the EGR valve connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 3.
3	1. Check for followings in the circuit between ECM and EGR position sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to EGR position sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 4.

Step	Action	Value	YES	NO
4	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds, and then start the engine. 4. Warm-up the engine until the engine coolant temperature exceeds 80°C. 5. Check the DTC. Is DTC P0487 detected?	—	Go to Step 5.	Go to "Diagnostic aid".
5	Replace the EGR valve (EGR position sensor). Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 6.	—
6	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds, and then start the engine. 4. Warm-up the engine until the engine coolant temperature exceeds 80°C. 5. Check the DTC. Is DTC P0487 detected?	—	Go to Step 7.	Go to Step 11.
7	Is EMPS available?	—	Go to Step 8.	Go to Step 9.
8	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	Go to Step 9.

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Step	Action	Value	YES	NO
9	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	—
10	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Warm-up the engine until the engine coolant temperature exceeds 80°C. 5. Check the DTC. Is DTC P0487 detected?	—	Go to Step 2.	Go to Step 11.
11	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

About EGR position sensor

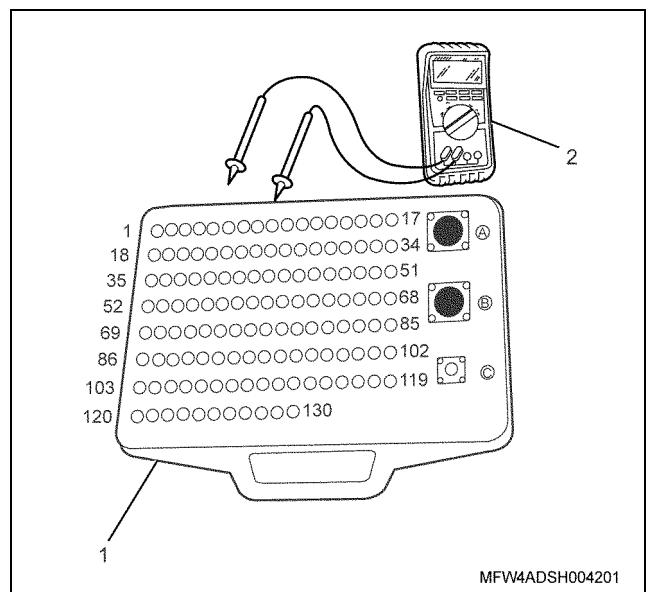


Name

1. Position sensor power supply (5 V)
2. Position sensor signal W
3. Position sensor signal V
4. Position sensor signal U
5. Position sensor ground
6. Motor drive W
7. Motor drive V
8. Motor drive U

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

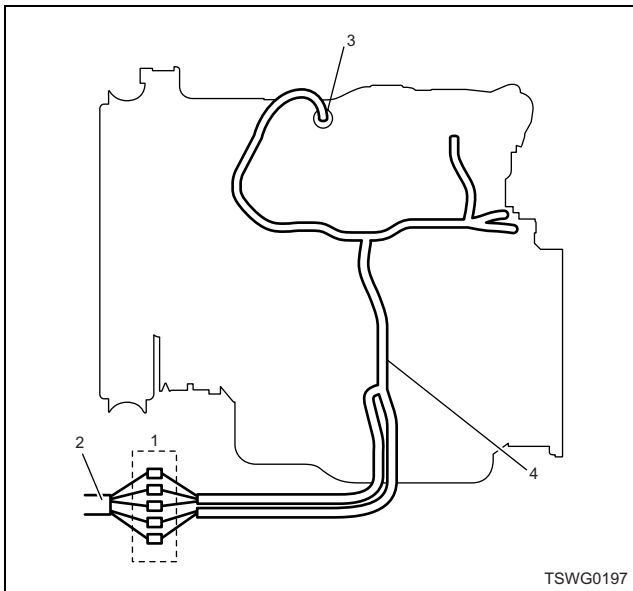


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
3	Open circuit/ high resistance	Resistance measurement	- Disconnect the EGR valve connector. - Key switch "OFF"	87 - EGR valve connector sensor power supply terminal	100Ω or less	10MΩ or more
4	Short circuit to ground circuit/ ground	Resistance measurement	- Disconnect the EGR valve connector. - Key switch "OFF"	92 - 101 93 - 101 94 - 101 92 - Ground 93 - Ground 94 - Ground	10MΩ or more	100Ω or less
	Open circuit/ high resistance	Resistance measurement	- Disconnect the EGR valve connector. - Key switch "OFF"	92 - EGR valve connector position sensor signal W terminal 93 - EGR valve connector position sensor signal V terminal 94 - EGR valve connector position sensor signal U terminal	100Ω or less	10MΩ or more

On-board check of sensors



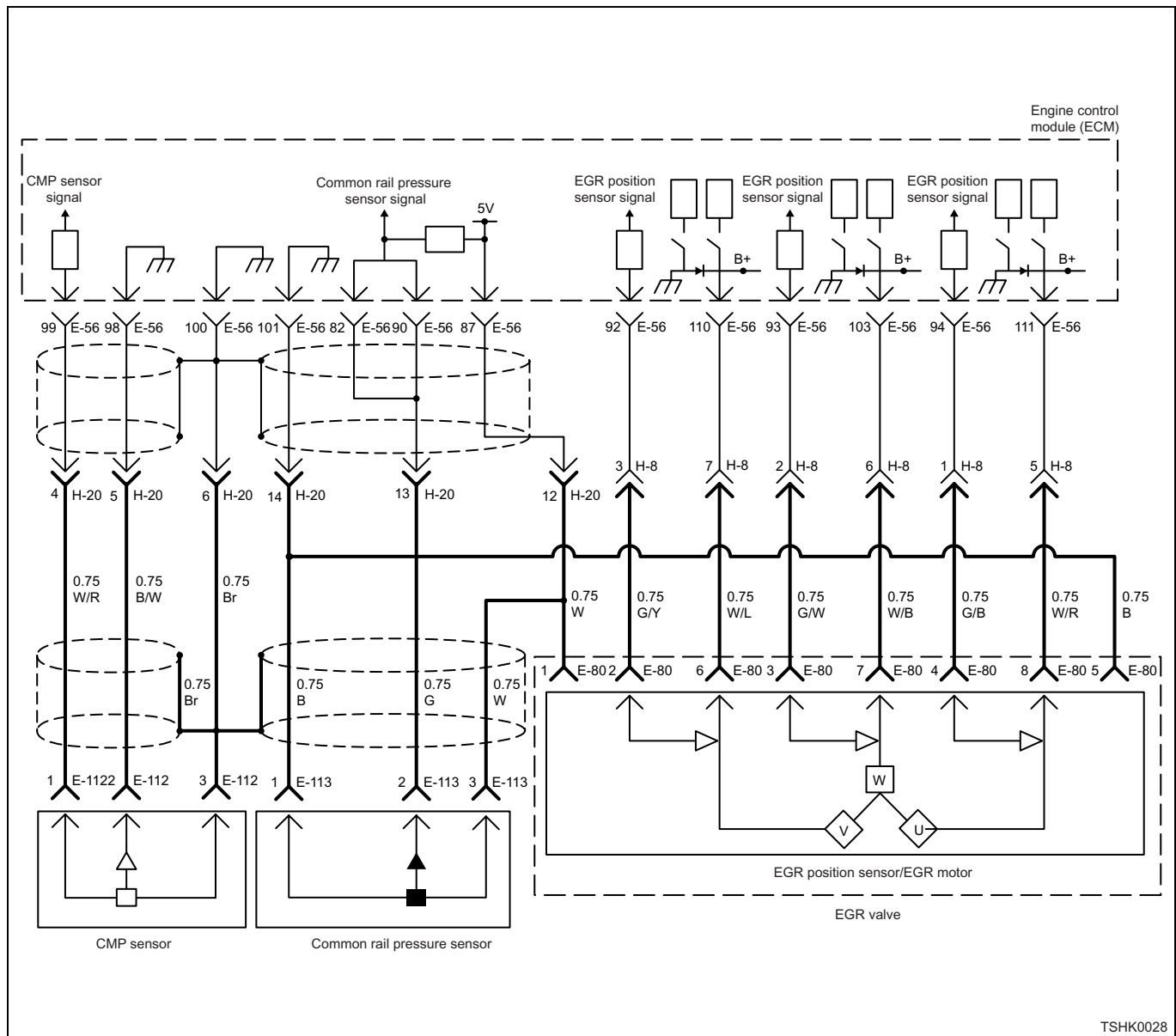
Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

3. Check the harness from coupling connector for open circuit.

- If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
- If only step 1 is faulty, replace the sensor.

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.

DTC: P0488 (Flash code 45)**EGR valve control fault****Description of circuit**

The EGR motor is installed inside the EGR valve. The EGR motor is the brushless DC motor, and is driven by three phases. The EGR position sensor includes following circuits.

- EGR motor drive circuit U
- EGR motor drive circuit V
- EGR motor drive circuit W

The ECM drives the EGR motor through the EGR motor drive circuits U, V, and W. The ECM outputs drive signals by the switching inside the ECM, and the motor rotates with the combination of three-phase signals. Also, the valve opening angle is controlled by duty. The ECM sets the DTC when the EGR motor drive duty is high and the difference between the target EGR position and actual EGR position is large.

Main trouble symptom

Operability is not affected.

Preconditions when DTC is set

- DTC P1630, P1635, P0487, P0488, or P1635 is not detected.
- Main relay input power supply voltage is higher than 20 V but lower than 32 V.
- Difference between target EGR opening angle and actual one is 20% or less.

DTC set condition

- Difference between target valve lift and actual position is more than 20% for 10 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Instruction to fully close EGR valve

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

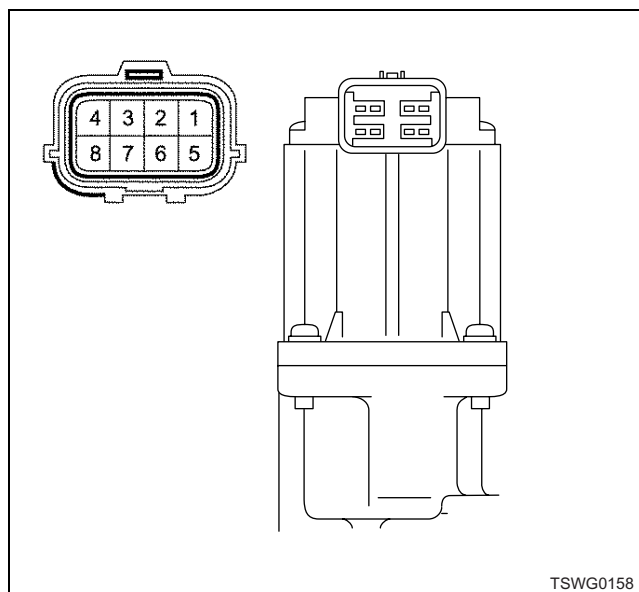
5. Check all the EGR motor drive circuits U, V, and W.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 13.
3	1. Perform "EGR control test" using scan tool. 2. Press the "Up" "Down" soft key. 3. Check the value for "EGR position". Is "EGR position" within the specified value?	$\pm 3\%$	Go to Step 4.	Go to Step 5.
4	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 10 seconds, and then start the engine. 3. Warm-up the engine until the engine coolant temperature exceeds 80°C. 4. Check the DTC. Is DTC P0488 detected?	—	Go to Step 8.	Go to "Diagnostic aid".

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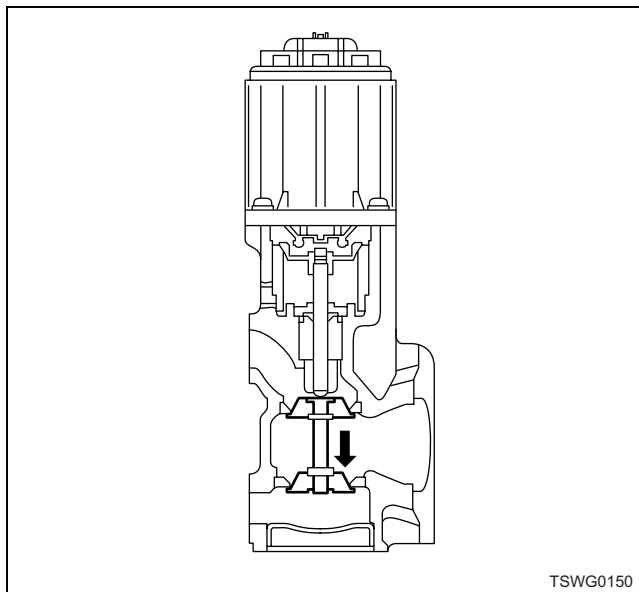
Step	Action	Value	YES	NO
5	1. Check for followings in the motor drive circuit between ECM and EGR motor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • Short circuit to ground • Short circuit to power supply circuit or ignition power supply circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 6.
6	Replace the EGR valve. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 7.	—
7	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds, and then start the engine. 4. Warm-up the engine until the engine coolant temperature exceeds 80°C. 5. Check the DTC. Is DTC P0488 detected?	—	Go to Step 8.	Go to Step 12.
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.

Step	Action	Value	YES	NO
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Warm-up the engine until the engine coolant temperature exceeds 80°C. 5. Check the DTC. Is DTC P0488 detected?	—	Go to Step 2.	Go to Step 12.
12	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
13	1. Remove the EGR valve. 2. Check the EGR valve for anchoring, clogging, etc. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 5.	Go to Step 4.

About EGR valve**Name**

1. Position sensor power supply (5 V)
2. Position sensor signal W
3. Position sensor signal V
4. Position sensor signal U
5. Position sensor ground
6. Motor drive W
7. Motor drive V
8. Motor drive U

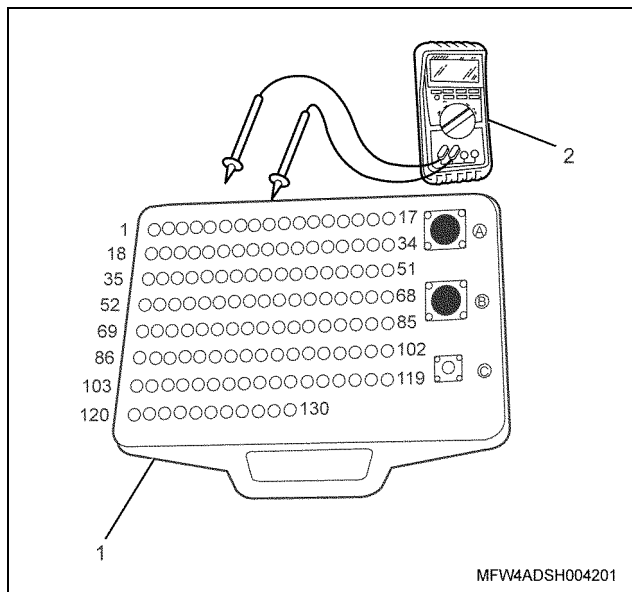
EGR valve check



Push the EGR valve with finger to make sure it opens/closes smoothly. Also, make sure that the valve closes completely when the finger is released.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

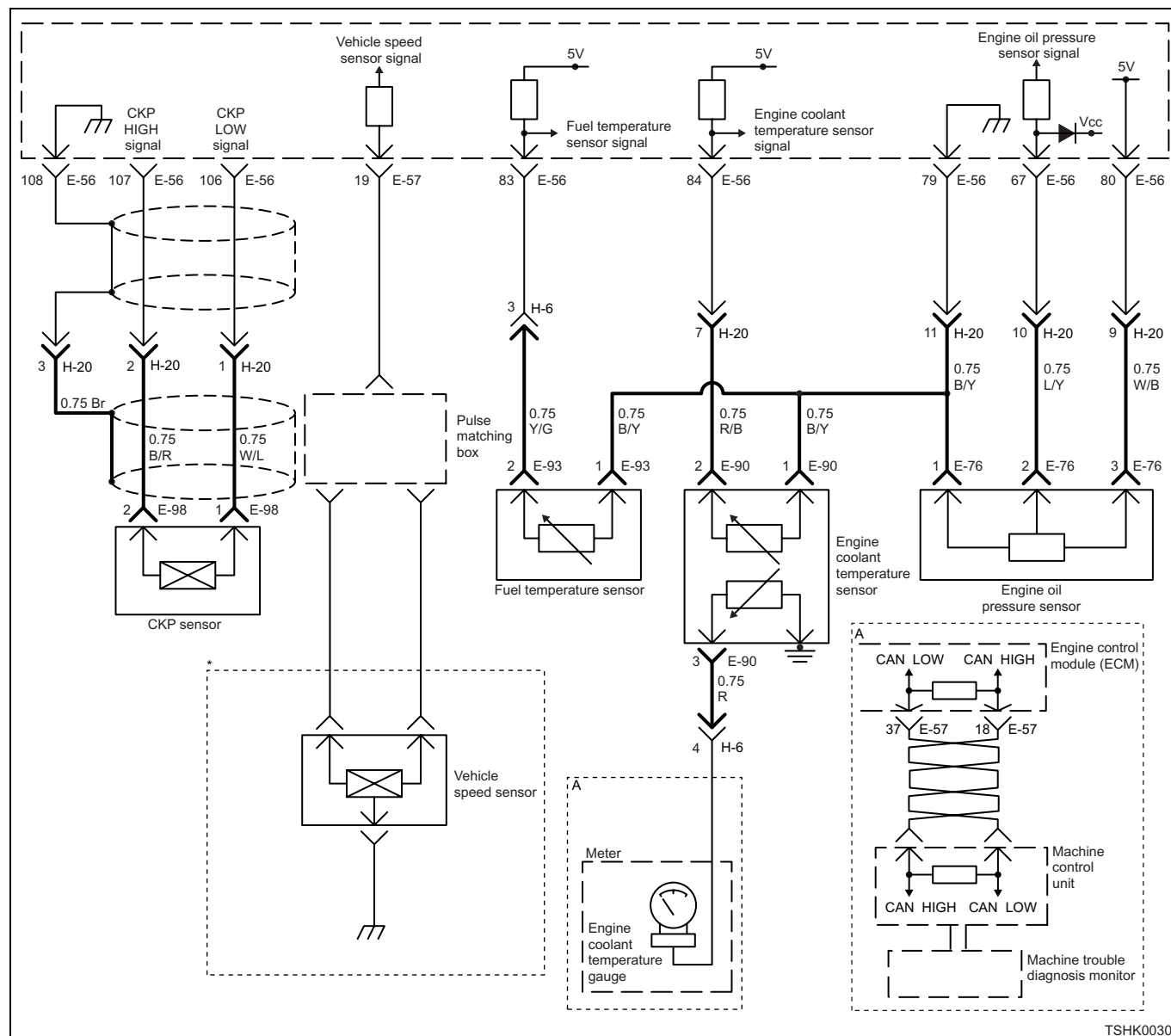


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5	Short circuit to power supply circuit	Voltage measurement	- Disconnect the EGR valve connector. - Key switch "ON"	111 - Ground 103 - Ground 110 - Ground	0V	18V or more
	Short circuit to ground	Resistance measurement	- Disconnect the EGR valve connector. - Key switch "OFF"	111 - Ground 103 - Ground 110 - Ground	10MΩ or more	100Ω or less
	Open circuit/high resistance	Resistance measurement	- Disconnect the EGR valve connector. - Key switch "OFF"	111 - EGR valve connector motor drive U terminal 103 - EGR valve connector motor drive V terminal 110 - EGR valve connector motor drive W terminal	100Ω or less	10MΩ or more

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0522 (Flash code 294)**Engine oil pressure sensor fault (low voltage fault, open circuit, ground short)****Description of circuit**

The engine oil pressure sensor detects the engine oil pressure. The engine oil pressure sensor is installed near the starter motor of the cylinder block. The resistance value in the engine oil pressure sensor changes according to the pressure. If the pressure is high, the resistance becomes low; if the pressure is low, the resistance becomes high.

The engine control module (ECM) is connected to the engine pressure sensor via power supply circuit, signal circuit and ground circuit, and energizes +5 V power supply to the power supply circuit. The ECM detects the signal voltage change in response to the change in resistance according to the engine pressure sensor pressure (If the pressure is high, the voltage becomes high; if the pressure is low, the voltage becomes low) as a signal.

Main trouble symptom

Operability is not affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1633 is not detected.

DTC set condition

- Engine oil pressure sensor voltage is 0.1V or less for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Engine oil pressure sensor” displays more than the specified value. In this case, identify the cause by referring to “Diagnostic aid”.

5. If the “Engine oil pressure sensor” displays more than the specified value when the ECT sensor connector is removed, the circuit beyond the sensor is normal including ECM.

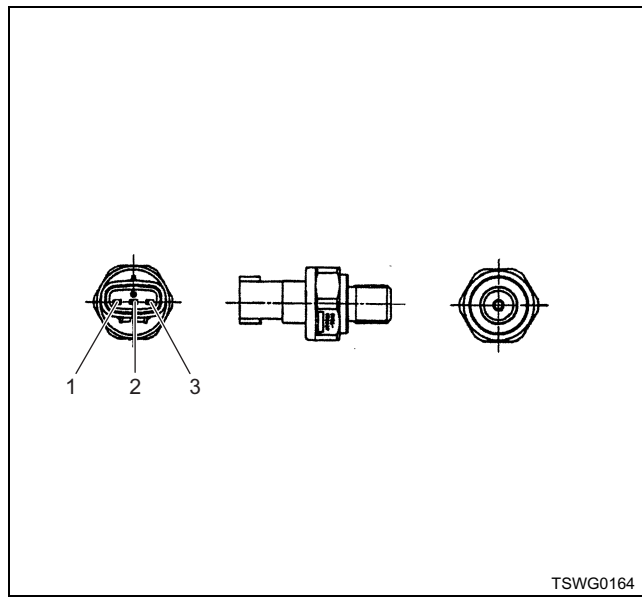
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform “OBD system check”, and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 6.
3	Check the value for engine oil pressure sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for “Engine oil pressure sensor” using scan tool. Is the “Engine oil pressure sensor” less than the specified value?	0.1V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the engine oil pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 5.

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Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the engine oil pressure sensor connector. 3. Turn the key switch to "ON". 4. Check the value for "Engine oil pressure sensor" using scan tool. Is the "Engine oil pressure sensor" more than the specified value?	0V	Go to Step 7.	Go to Step 6.
6	1. Check for followings in the signal circuit between ECM and engine oil pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to engine oil pressure sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 8.
7	Replace the engine oil pressure sensor. Is the procedure completed?	—	Go to Step 11.	—
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—

Step	Action	Value	YES	NO
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is the DTC P0522 detected?	—	Go to Step 2.	Go to Step 12.
12	1. Start the engine. 2. Check the display of engine oil pressure. Does the display of engine oil pressure show error value?	1016kPa (Displayed error value)	Go to Step 13.	Go to "Diagnostic aid".
13	Check for installation condition of the engine oil pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 14.
14	1. Check for followings in the signal circuit between ECM and engine oil pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to engine oil pressure sensor ground circuit • Short circuit to ground 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 7.

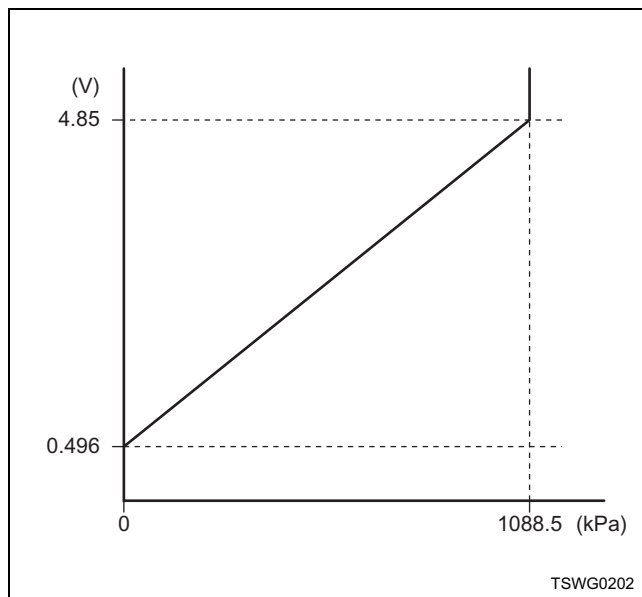
About engine oil pressure sensor



- Name
- 1. Sensor ground
 - 2. Sensor signal
 - 3. Sensor power supply

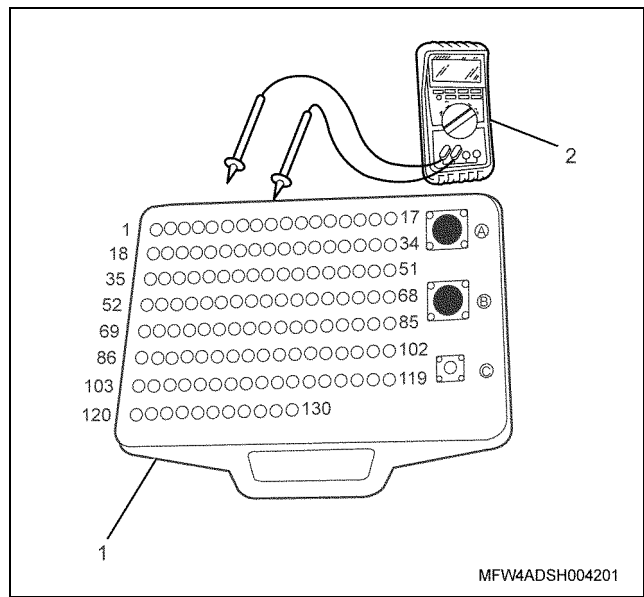
Characteristics of engine oil pressure sensor

The output voltage of engine oil pressure sensor changes according to the engine oil pressure. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of 0kPa or 1088.5kPa is not changed. When error occurs, error value (1016kPa) is displayed. The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication. Tech2 and scan tools with KW communication can display both physical value and voltage.



Breaker box inspection procedure

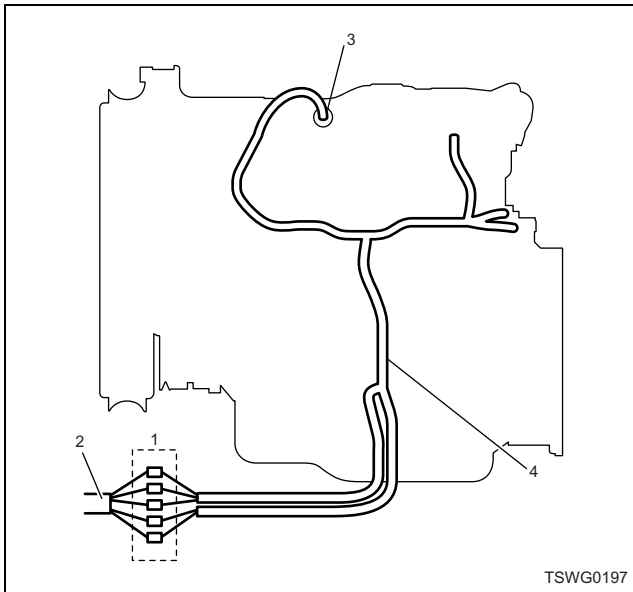
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



- Name
- 1. Breaker box
 - 2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to ground circuit/ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	67 - 79 67 - GND 80 - 79 80 - GND	10MΩ or more	100Ω or less

On-board check of sensors



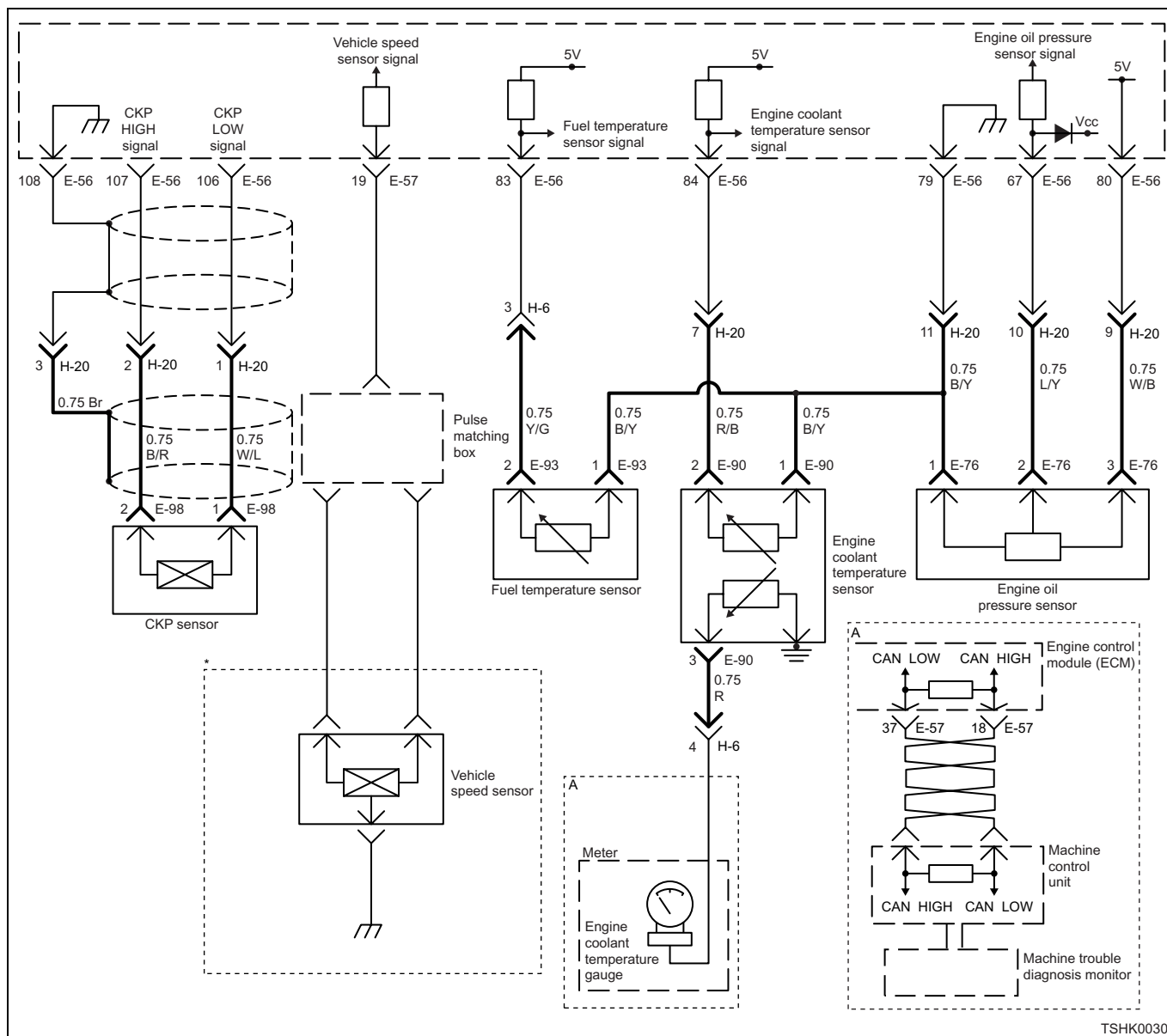
Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0523 (Flash code 295)**Engine oil pressure sensor fault (high voltage fault, short to power supply, open ground circuit)**

(*: Specifications vary depending on each machine. Refer to the machine's manual.)

**Description of circuit**

The engine oil pressure sensor detects the engine oil pressure. The engine oil pressure sensor is installed near the starter motor of the cylinder block. The resistance value in the engine oil pressure sensor changes according to the pressure. If the pressure is high, the resistance becomes low; if the pressure is low, the resistance becomes high.

The engine control module (ECM) is connected to the engine pressure sensor via power supply circuit, signal circuit and ground circuit, and energizes +5 V power supply to the power supply circuit. The ECM detects the signal voltage change in response to the change in resistance according to the engine pressure sensor pressure (If the pressure is high, the voltage becomes high; if the pressure is low, the voltage becomes low) as a signal.

Main trouble symptom

Operationality is not affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.

- DTC P1633 is not detected.

DTC set condition

- Engine oil pressure sensor voltage is 4.85V or more for 4 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the "Engine oil pressure sensor" displays more than the specified value. In this case, identify the cause by referring to "Diagnostic aid".

5. If the "Engine oil pressure sensor" displays less than the specified value when terminals between the engine oil pressure sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 15.
3	Check the value for engine oil pressure sensor using scan tool. 1. Connect the scan tool. 2. Start the engine. 3. Check the value for "Engine oil pressure sensor" using scan tool. Is the "Engine oil pressure sensor" more than the specified value?	4.85V	Go to Step 4.	Go to "Diagnostic aid".
4	Check for installation condition of the engine oil pressure sensor, ECM and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 5.

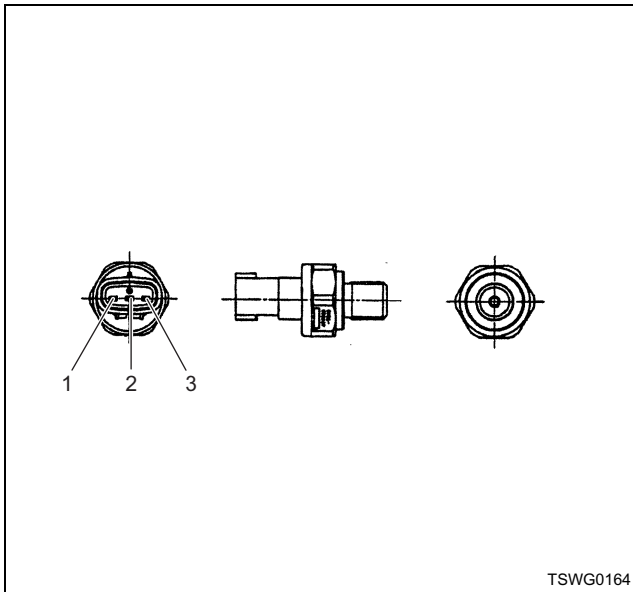
10D-403 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the engine oil pressure sensor connector. 3. Short the engine oil pressure sensor connector signal terminal to the ground terminal using jump cable. 4. Turn the key switch to "ON". 5. Check the value for "Engine oil pressure sensor" using scan tool. Is the "Engine oil pressure sensor" less than the specified value?	0V	Go to Step 9.	Go to Step 6.
6	1. Check the signal circuit between ECM and engine oil pressure sensor for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the engine oil pressure sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and engine oil pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
8	1. Check for followings in the ground circuit between ECM and engine oil pressure sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
9	Replace the engine oil pressure sensor. Is the procedure completed?	—	Go to Step 13.	—
10	Is EMPS available?	—	Go to Step 10.	Go to Step 11.

Step	Action	Value	YES	NO
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 11.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is the DTC P0523 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
15	1. Start the engine. 2. Check the display of engine oil pressure. Does the display of engine oil pressure show error value?	1016 kPa (Displayed error value)	Go to Step 16.	Go to "Diagnostic aid".

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Step	Action	Value	YES	NO
16	1. Check the signal circuit between ECM and engine oil pressure sensor for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the engine oil pressure sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 17.
17	1. Check for followings in the signal circuit between ECM and engine oil pressure sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 18.
18	1. Check for followings in the ground circuit between ECM and engine oil pressure sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 9.

About engine oil pressure sensor**Name**

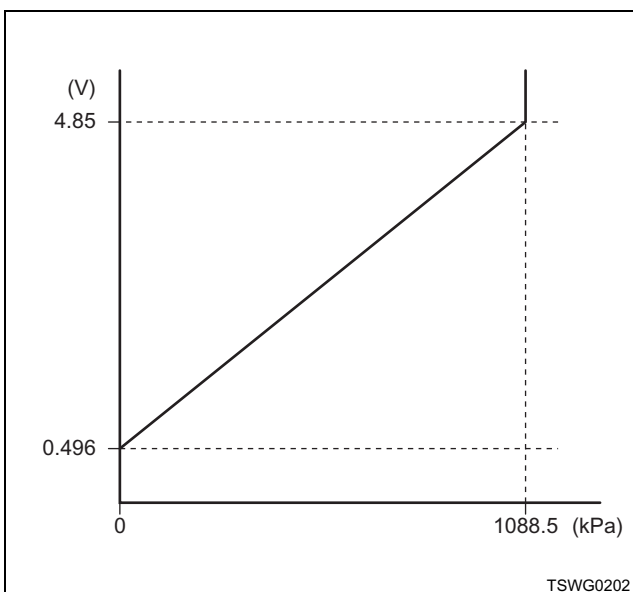
1. Sensor GND
2. Sensor signal
3. Sensor power supply

Characteristics of engine oil pressure sensor

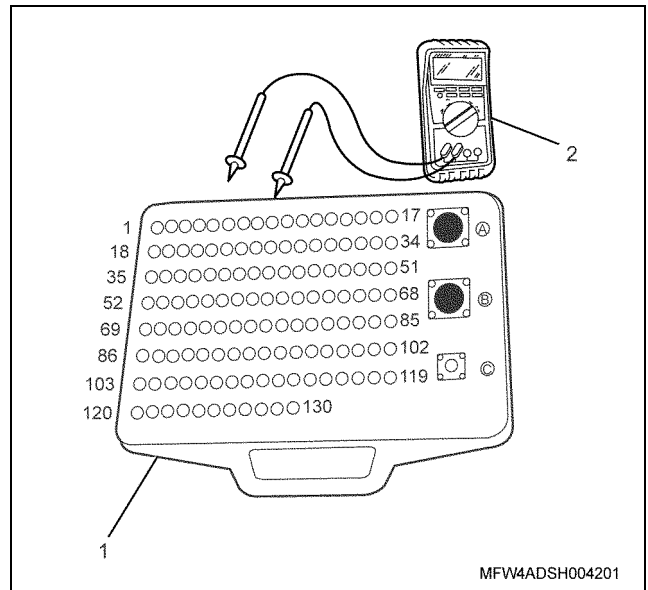
The output voltage of engine oil pressure sensor changes according to the engine oil pressure. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of 0kPa or 1088.5kPa is not changed.

When error occurs, error value (1016kPa) is displayed. The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

Tech2 and scan tools with KW communication can display both physical value and voltage.

**Breaker box inspection procedure**

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

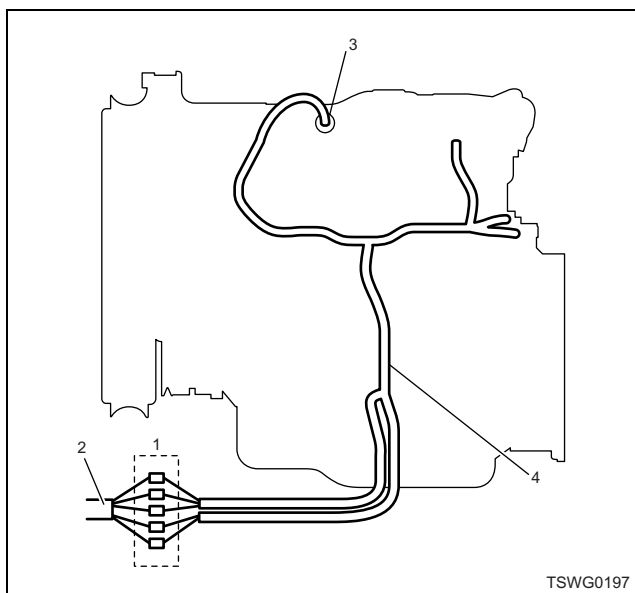
**Name**

1. Breaker box
2. DMM

10D-407 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	67 - GND	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	67 - Sensor connector signal terminal	100Ω or less	10MΩ or more
8	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	79 - Sensor connector ground terminal	100Ω or less	10MΩ or more

On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P0601 (Flash code 53)**ROM fault****Description of circuit**

The internal part of the ECM consists of ROM, EEPROM, CPU, and Sub-CPU, which perform data storage, data clear and various controls.

The ECM sets the DTC when the ROM fault inside the ECM is detected.

Main trouble symptom

Engine stopped

DTC set condition

- ROM fault is detected.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Engine stopped

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 10 seconds. 3. Test run with the "Preconditions when DTC is set". 4. Check the DTC. Is DTC P0601 detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	Is EMPS available?	—	Go to Step 4.	Go to Step 5.
4	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	Go to Step 5.

10D-409 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
5	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	—
6	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P0603 (Flash code 54)**EEPROM fault****Description of circuit**

The internal part of the ECM consists of ROM, EEPROM, CPU, and Sub-CPU, which perform data storage, data clear and various controls.

The ECM sets the DTC when the EEPROM fault inside the ECM is detected.

Main trouble symptom

Operationality is not affected.

DTC set condition

- EEPROM fault is detected.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 10 seconds. 3. Test run with the "Preconditions when DTC is set". 4. Check the DTC. Is DTC P0603 detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	Is EMPS available?	—	Go to Step 4.	Go to Step 5.
4	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	Go to Step 5.

10D-411 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
5	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	—
6	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P0606 (Flash code 51/52)**CPU fault****Description of circuit**

The internal part of the ECM consists of ROM, EEPROM, CPU, and Sub-CPU, which perform data storage, data clear and various controls. The ECM sets the DTC when the CPU fault or Sub-CPU fault inside the ECM is detected.

Main trouble symptom

- Output lowering
- Unable to start

Preconditions when DTC is set

- 480 msec or more has elapsed after key switch ON.
- Key switch input power supply voltage is higher than 16 V.

DTC set condition

- Sub-CPU detects main CPU fault in 100 msec after key switch ON.
- RUN-SUB pulse does not change for 20 msec or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Limited injection amount 2 (multi-injection stopped)
- SUB-CPU stops CPU.
- Limited injection amount 1

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

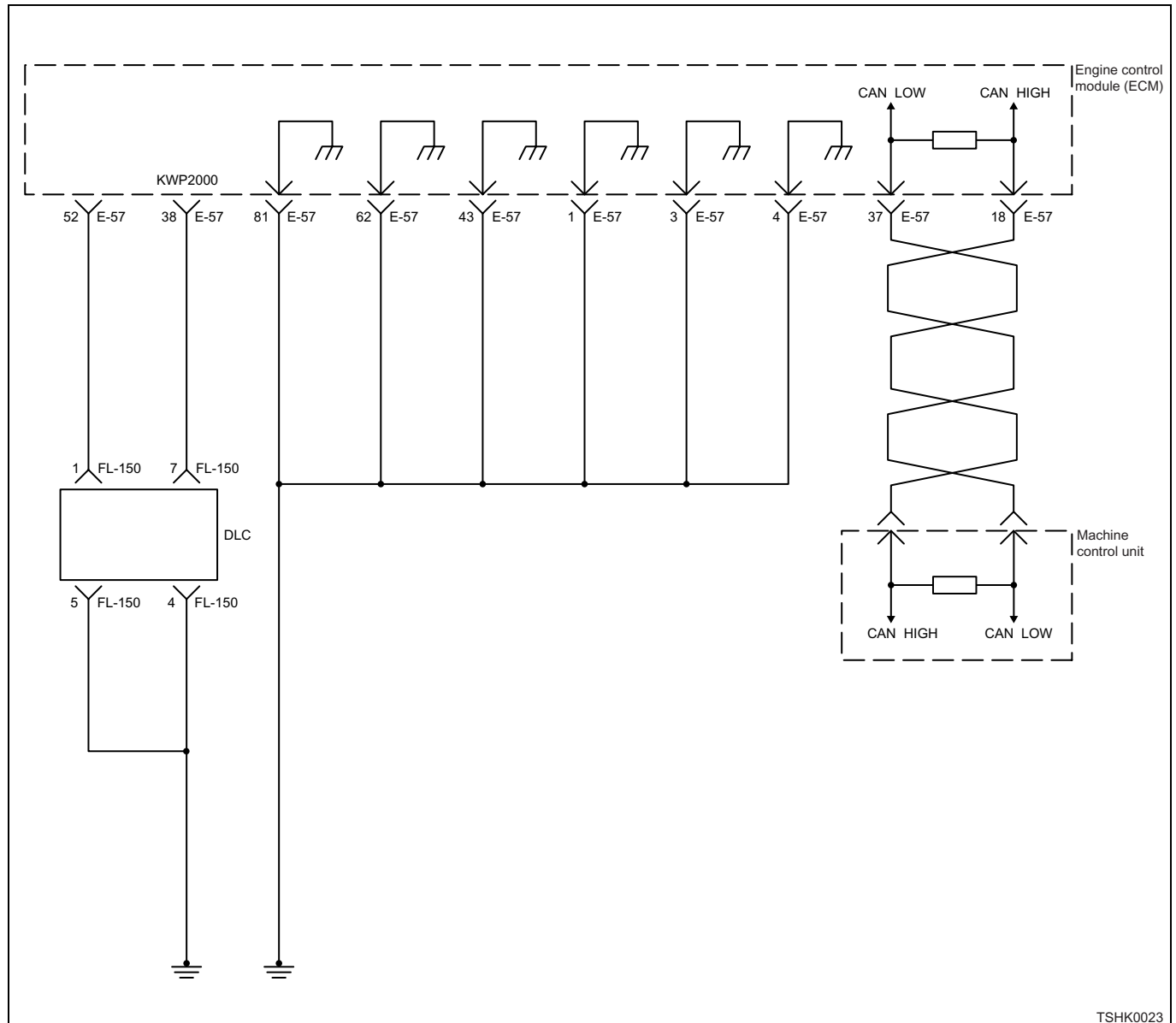
The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 10 seconds. 3. Test run with the "Preconditions when DTC is set". 4. Check the DTC. Is DTC P0606 detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	Is EMPS available?	—	Go to Step 4.	Go to Step 5.

10D-413 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
4	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	Go to Step 5.
5	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	—
6	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P0611 (Flash code 34)**Charge circuit fault (bank 1)**

TSHK0023

Description of circuit

The charge circuit inside the ECM is the voltage pressurizing circuit to apply voltage to the injector, and is divided into two systems (4H: 2 cylinders each, 6H: 3 cylinders each). The charge circuit 1 supplies the power supply voltage to the injectors (4H: No. 1, 2 cylinders, 6H: No. 1, 2, 3 cylinders). The ECM sets the DTC when the voltage in the charge circuit 1 is excessively high or excessively low.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault
- Engine stall possible

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.

DTC set condition

- When charge circuit bank 1 voltage inside ECU is low for 1.5 seconds or more.

Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Common 1 stop (#1, #4 cylinders stopped), EGR stopped (4HK1)

10D-415 Electronic control fuel injection system (Common rail type)

- Common 1 stop (#1, #2, #3 cylinders stopped), EGR stopped (6HK1)

Recovery from failure

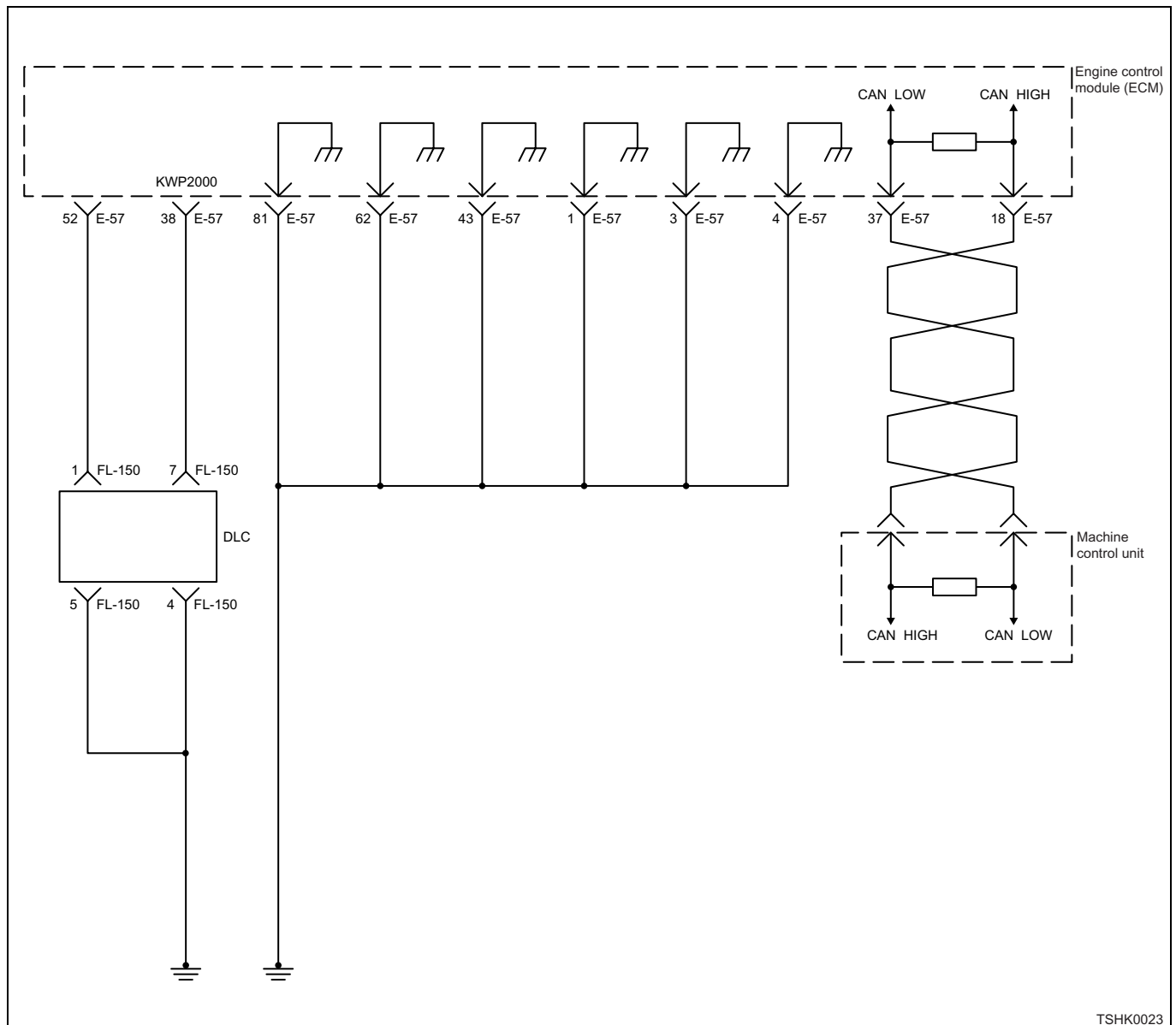
Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 12.
3	1. Make sure all the communication between ECU and scan tool is normal. 2. Make sure the system which require programming operates normally. 3. Check the DTC. Is DTC P0611 detected?	—	Go to Step 4.	Go to Step 10.
4	1. Check for followings in the ground circuit between ECM terminals (1, 3, 4, 43, 62, 81) and ECM ground terminal (E2) using breaker box or DMM. • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 5.
5	1. Turn the key switch to “OFF”. 2. Remove the ECM ground terminal (E2). 3. Check the ECM ground terminal (E2) for intermittent trouble or poor contact. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 6.
6	1. Turn the key switch to “OFF”. 2. Remove the ECM. 3. Check the ECM terminals (1, 3, 4, 43, 62, 81) for intermittent trouble or poor contact. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 7.
7	Is EMPS available?	—	Go to Step 8.	Go to Step 9.

Step	Action	Value	YES	NO
8	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	Go to Step 9.
9	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	—
10	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0611 detected?	—	Go to Step 2.	Go to Step 11.
11	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
12	Is DTC P0611 detected?	—	Go to Step 4.	Go to Step 10.

DTC: P0612 (Flash code 34)
Charge circuit fault (bank 2)


TSHK0023

Description of circuit

The charge circuit inside the ECM is the voltage pressurizing circuit to apply voltage to the injector, and is divided in to two systems (4H: 2 cylinders each, 6H: 3 cylinders each). The charge circuit 2 supplies the power supply voltage to the injectors (4H: No. 3, 4 cylinders, 6H: No. 4, 5, 6 cylinders). The ECM sets the DTC when the voltage in the charge circuit 2 is excessively high or excessively low.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault
- Engine stall possible

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.

DTC set condition

- When ECU charge circuit bank 2 voltage is low for 1.5 seconds or more.

Action taken when DTC is set

- ECM turns the diagnosis lamp ON.

Back-up mode

- Common 2 stop (#2, #3 cylinders stopped), EGR stopped (4HK1)
- Common 2 stop (#4, #5, #6 cylinders stopped), EGR stopped (6HK1)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).

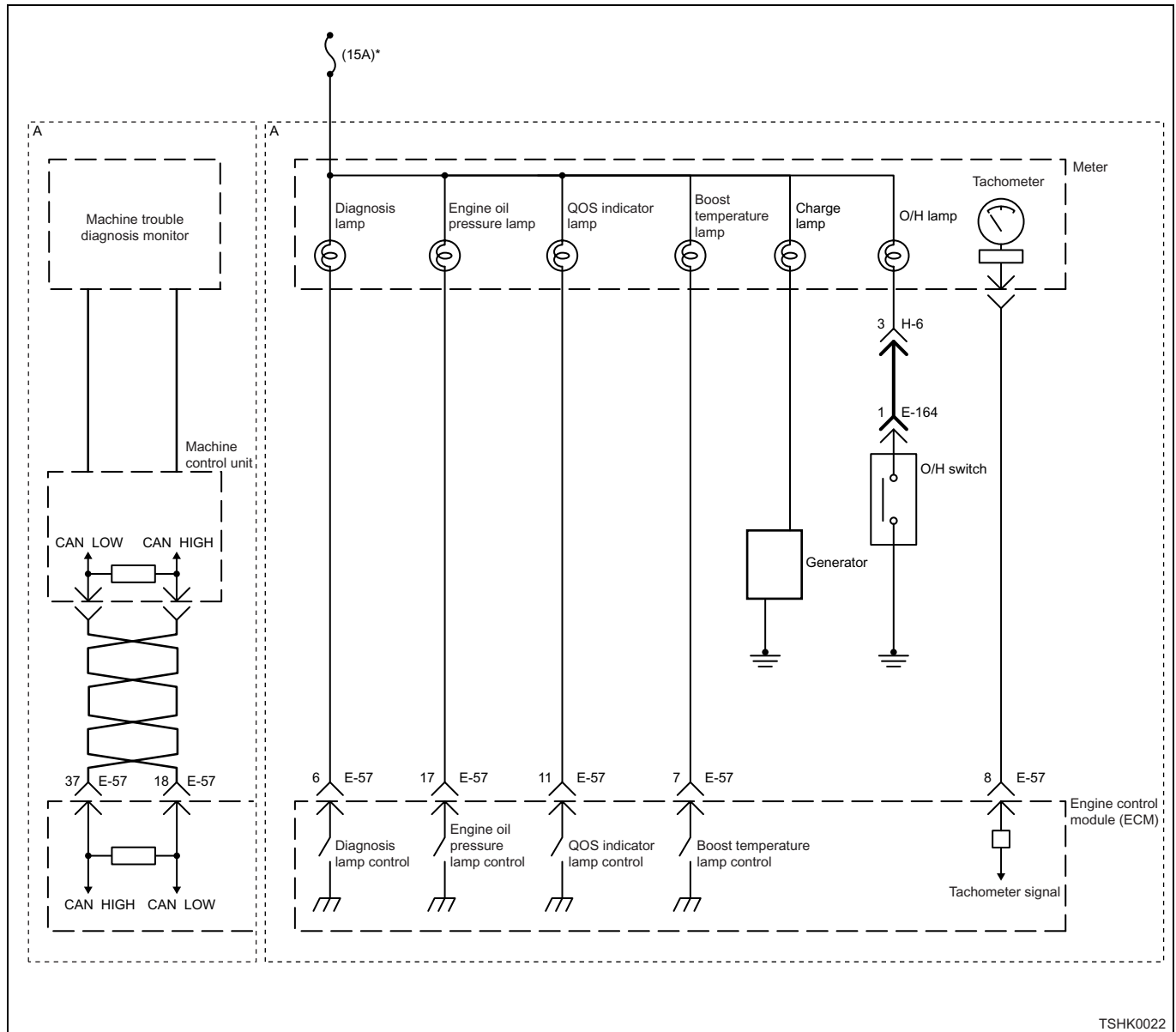
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 12.
3	1. Make sure all the communication between ECU and scan tool is normal. 2. Make sure the system which require programming operates normally. 3. Check the DTC. Is DTC P0612 detected?	—	Go to Step 4.	Go to Step 10.
4	1. Check for followings in the ground circuit between ECM terminals (1, 3, 4, 43, 62, 81) and ECM ground terminal (E2) using breaker box or DMM. • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 5.
5	1. Turn the key switch to “OFF”. 2. Remove the ECM ground terminal (E2). 3. Check the ECM ground terminal (E2) for intermittent trouble or poor contact. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 6.
6	1. Turn the key switch to “OFF”. 2. Remove the ECM. 3. Check the ECM terminals (1, 3, 4, 43, 62, 81) for intermittent trouble or poor contact. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 7.
7	Is EMPS available?	—	Go to Step 8.	Go to Step 9.

10D-419 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
8	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	Go to Step 9.
9	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	—
10	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0612 detected?	—	Go to Step 2.	Go to Step 11.
11	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
12	Is DTC P0612 detected?	—	Go to Step 4.	Go to Step 10.

DTC: P0650 (Flash code 77)**Check engine lamp circuit fault**

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



TSHK0022

Description of circuit

The power supply voltage is supplied to the diagnosis lamp via key switch, and the signal from ECM will turn the lamp on. The ECM turns the diagnosis lamp on during lamp check with the key switch "ON" and when DTC is detected. Also when the diagnosis connector is connected, it blinks the diagnosis lamp according to the DTC detected. A monitor circuit is provided inside the ECM to monitor the lamp operation.

The ECM sets the DTC when the output to the diagnosis lamp does not match with the check engine lamp operation.

Main trouble symptom

Operationality is not affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P0650 is not detected.

DTC set condition

- No diagnosis lamp monitor signal exists for 1.5 seconds or more.

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

10D-421 Electronic control fuel injection system (Common rail type)

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.

- Damage of connector lock
- Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

2. If the lamp does not come on with the key switch "ON", open circuit, short circuit to the ground circuit, blown light bulb, or ECM fault is suspected.

2. If the lamp does not go OFF, short circuit to the ground circuit, meter circuit fault, or ECM fault is suspected.

4. If the lamp goes off when the ECM connector is removed, the circuit beyond the ECM is normal including meter.

7. If the lamp comes on when the lamp control terminal is shorted to the ground, the circuit beyond the ECM is normal including meter.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Perform "OBD system check", and Go to Step 2.
2	1. Turn the key switch to "ON". 2. Check if the diagnosis lamp is ON. Does the diagnosis lamp come on?	—	Go to Step 3.	Go to Step 7.
3	Turn the key switch "ON" and wait for 30 seconds. Does the diagnosis lamp go OFF?	—	Go to "Diagnostic aid".	Go to Step 4.
4	1. Turn the key switch to "OFF". 2. Remove the connector from the ECM. 3. Turn the key switch to "ON". 4. Check if the diagnosis lamp is ON. Does the diagnosis lamp go OFF?	—	Go to Step 12.	Go to Step 5.
5	Check for installation condition of the meter, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 6.
6	1. Check the circuit between diagnosis lamp and ECM for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 11.

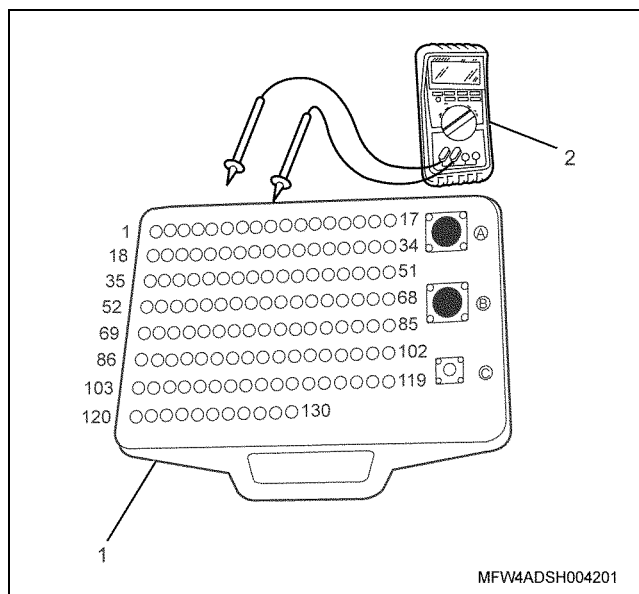
Step	Action	Value	YES	NO
7	1. Turn the key switch to "OFF". 2. Remove the connector from the ECM. 3. Short between the diagnosis lamp control terminal of the ECM and the ground using breaker box or DMM. Refer to "Breaker box inspection procedure". 4. Turn the key switch to "ON". 5. Check if the diagnosis lamp is ON. Does the diagnosis lamp come on?	—	Go to Step 13.	Go to Step 8.
8	Check for installation condition of the meter, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 9.
9	1. Check for following in the circuit between the fuse and the diagnosis lamp. • Open circuit • Short circuit to ground circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 10.
10	1. Check for followings in the circuit between diagnosis lamp and ECM using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 12.
11	Replace the meter. Is the procedure completed?	—	Go to Step 16.	—
12	Replace the diagnosis lamp bulb. Is the procedure completed?	—	Go to Step 16.	—
13	Is EMPS available?	—	Go to Step 14.	Go to Step 15.

10D-423 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
14	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 15.
15	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	—
16	Check if DTC is not detected again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is the procedure completed?	—	Go to Step 17.	—
17	Check if DTC is detected. (DTC for entire engine control) Is DTC detected?	—	Go to the related "Inspection method by DTC".	Verify repair.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



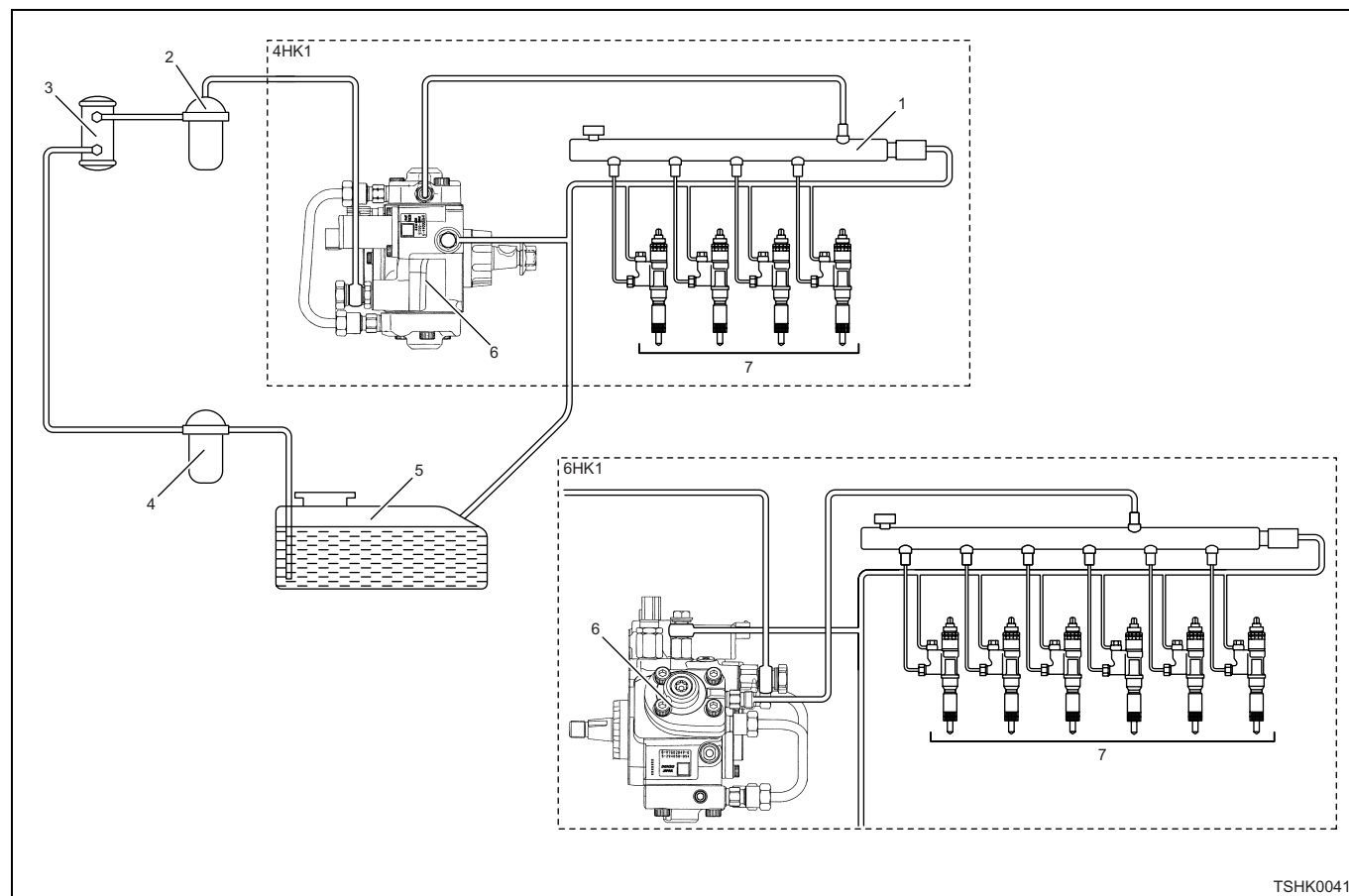
Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to ground	Resistance measurement	- Remove the meter connector. - Key switch "OFF"	6 - Ground	10M Ω or more	100 Ω or less
10	Open circuit/high resistance	Resistance measurement	- Remove the meter connector. - Key switch "OFF"	6 - Meter connector diagnosis lamp terminal	100 Ω or less	10M Ω or more

DTC: P1093 (Flash code 227)

No pump pressure feed (2nd stage)

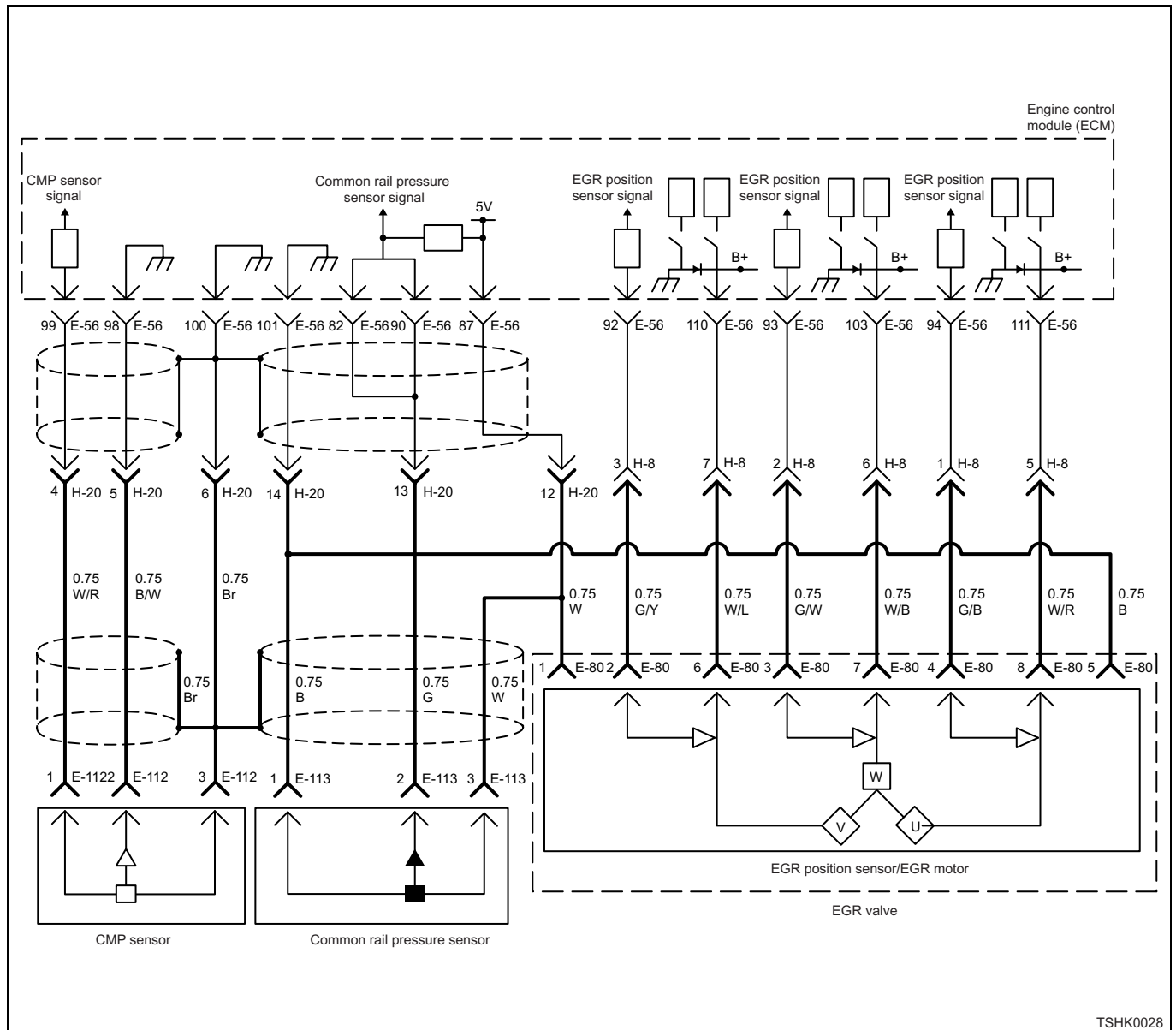


TSHK0041

Name

- 1. Common rail
- 2. Fuel filter
- 3. Electromagnetic pump
- 4. Pre-filter

- 5. Fuel tank
- 6. Supply pump
- 7. Injector



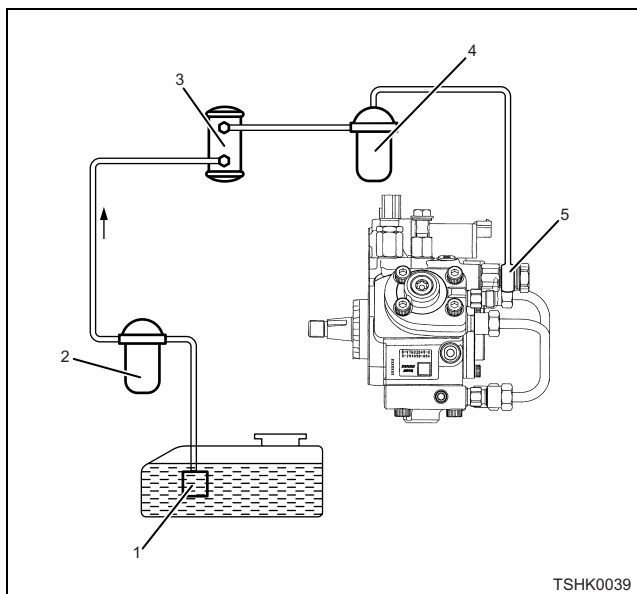
Description of circuit

The supply pump sucks fuel from the fuel tank using the trochoid-type feed pump located inside of the supply pump. The sucked fuel is sent through the SCV to the two plungers located inside the supply pump, and is pressurized and sent to the common rail. The SCV opening angle controls the fuel flow; if the SCV drive duty is large, the SCV opening angle becomes small resulting in less fuel flow. The ECM drives the SCV by calculating the target common rail pressure, target fuel flow, etc. based on the information from each sensor. The ECM sets the DTC when the SCV drive duty, or the target fuel flow and target common rail pressure exceed certain amount.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault
- Black smoke emitted
- Engine stall

Fuel system filter



Name

1. Fuel pump strainer
2. Pre-fuel filter
3. Electromagnetic pump filter
4. Main fuel filter
5. Gauze filter

Filter clogging in the fuel system may establish the DTC set condition. Check as required.

Preconditions when DTC is set

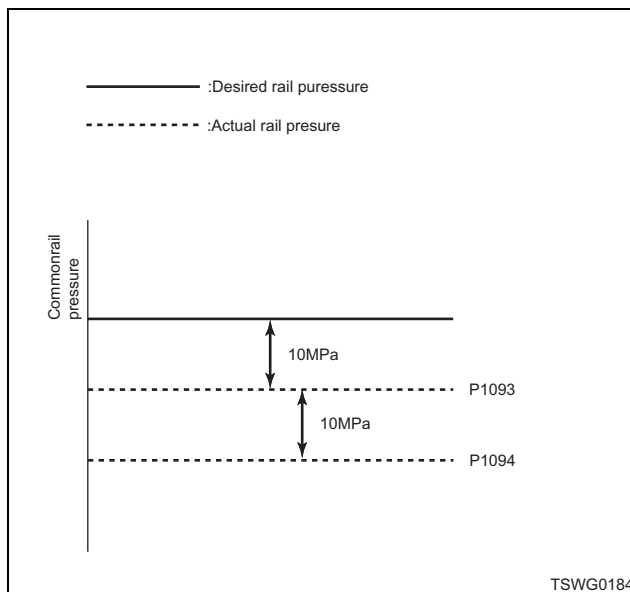
- Key switch input voltage is 18V or more.
- DTC P0192, P0193, P1093, P0090, P1291, P1292, or P1635 is not detected.
- Coolant temperature is 60°C or more, and 375 rpm or more.

DTC set condition

- Duty to SCV is 33% or less.
- Differential pressure feed is 28000mm³/sec or more.

Either of the above conditions and the following condition

At 1200rpm or more, actual rail pressure is 50MPa or more higher than target rail pressure for 5 seconds or more.



Action taken when DTC is set

- Fault indication* is displayed on the monitor of the machine or diagnosis lamp comes on. (* Nothing is displayed depending on the machine manufacturer)

Back-up mode

- Limited injection amount 3 (multi-injection stopped)
- Target RP upper limit (80MPa)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

Followings are suspected as the cause.

- Injector internal trouble
- Supply pump internal trouble
- Fuel system pipe fault (fuel leakage, clogging, crush, etc.)
- Fuel filter fault (clogging)
- Fuel tank fault (clogging)
- Pressure limiter trouble (operation under specified pressure, degradation of sealability)
- ECM trouble
- Common rail pressure sensor trouble

Test description

Numbers below indicate step numbers in the chart.

5. When rise of fuel level or diesel fuel odor is confirmed, fuel leakage in the injector portion may be the cause of the DTC detection.

9. If the "Common rail pressure sensor" displays more than the specified value when the common rail pressure sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Check the fuel system in the following procedure. 1. Check the high pressure pipe and low pressure pipe for looseness in the connection (fuel leakage), crush or clogging. Check the clogging in the following procedure. • Fuel filter (main fuel filter, pre-fuel filter, gauze filter) • Fuel tank (pump strainer) • Fuel system pipe 2. Check the fuel pipe, fuel filter, and inside of the fuel tank for freeze or waxing. (at cold temperature) 3. Check the feed pipe inside the fuel tank for clogging of foreign matter. Is the fuel system normal?	—	Go to Step 4.	Go to Step 3.
3	Check the electromagnetic pump. 1. Inspect the electromagnetic pump by referring to the "Electromagnetic pump inspection procedure". 2. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 5.	—
4	Check for rise of fuel level in the oil level gauge or light oil odor. Is the trouble detected?	—	Go to Step 5.	Go to Step 6.
5	Check the connection of the fuel pipe in each injector, and replace the injector if oil leakage is confirmed. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 17.	—
6	Is the scan tool (KW communication) available?	—	Go to Step 7.	Go to Step 20.

10D-429 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
7	Check the injector. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Start the engine. 3. Select the "Actuator test" from the menu. 4. Select the "Injection stop at each injector" in the "Common rail system". 5. Press the "OFF" soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 8.	Go to Step 9.
8	1. Replace the injector in the cylinder of which engine sound did not change when it is stopped in step 9. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 18.	—
9	Check the common rail pressure. 1. Turn the key switch to "ON". 2. Check for "Common rail pressure" on the data display using scan tool. 3. Start the engine and run it at idle. 4. Check for "Common rail pressure" on the data display using scan tool. 5. Race it quickly for about 5 times. 6. Check for "Common rail pressure" on the data display using scan tool. Is each value of "Common rail pressure" (at engine stopped, idling and racing) around specified value?	At engine stopping: -30 MPa; At idling, racing: ±5 MPa	Go to Step 16.	Go to Step 10.
10	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Turn the key switch to "ON". 4. Check for "Common rail pressure sensor" on the data display using scan tool. Is the "Common rail pressure sensor" more than the specified value?	4.8V	Go to Step 15.	Go to Step 11.

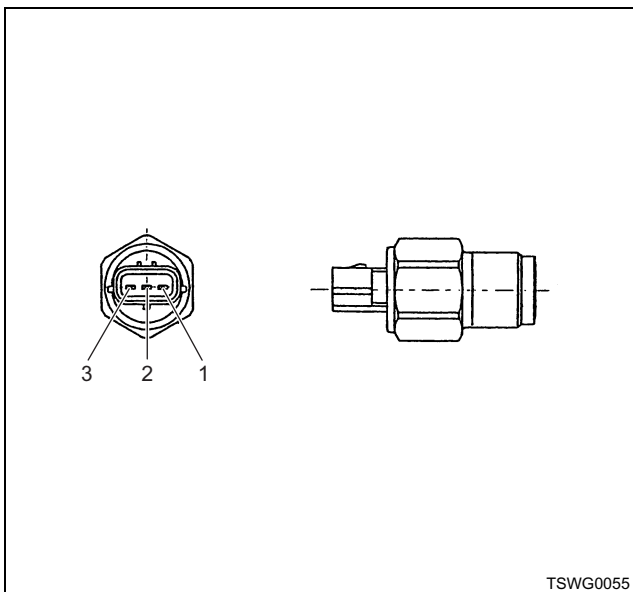
Electronic control fuel injection system (Common rail type) 10D-430

Step	Action	Value	YES	NO
11	1. Check the signal circuit between common rail pressure sensor and ECM for short circuit to signal circuits of other sensors using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 18.	Go to Step 12.
12	Is EMPS available?	—	Go to Step 13.	Go to Step 14.
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 18.	Go to Step 14.
14	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 18.	—
15	Replace the common rail (common rail pressure sensor). Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 18.	—
16	1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Start the engine. 3. Select the "Actuator test" from the menu. 4. Select the "Rail pressure control" in the "Common rail system". 5. Press the "Up" soft key to check the value of "Common rail pressure". Is "Common rail pressure" within the specified value?	±5MPa	Go to Step 18.	Go to Step 17.

10D-431 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
17	Replace the supply pump. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 18.	—
18	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P1093 detected?	—	Go to Step 2.	Go to Step 19.
19	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
20	Check the injector using injector checker. Refer to “How to use injector checker” in this section for how to use injector checker. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 8.	Go to Step 11.

About common rail pressure sensor

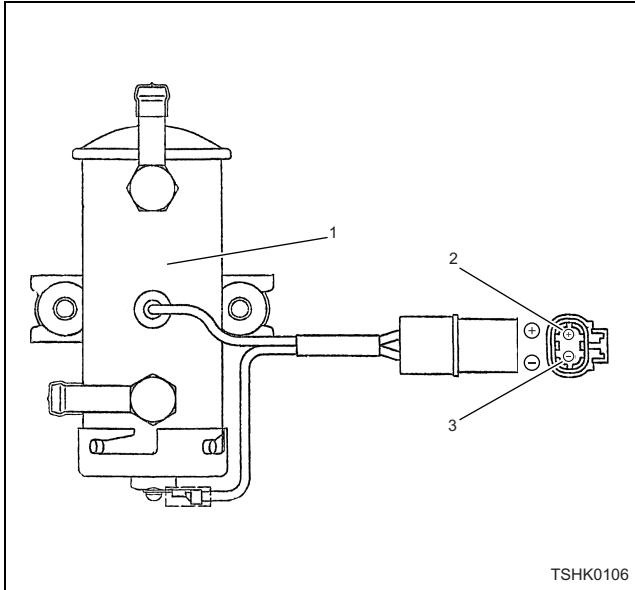


Name

1. Sensor ground
2. Sensor signal
3. Sensor power supply

Electromagnetic pump inspection procedure

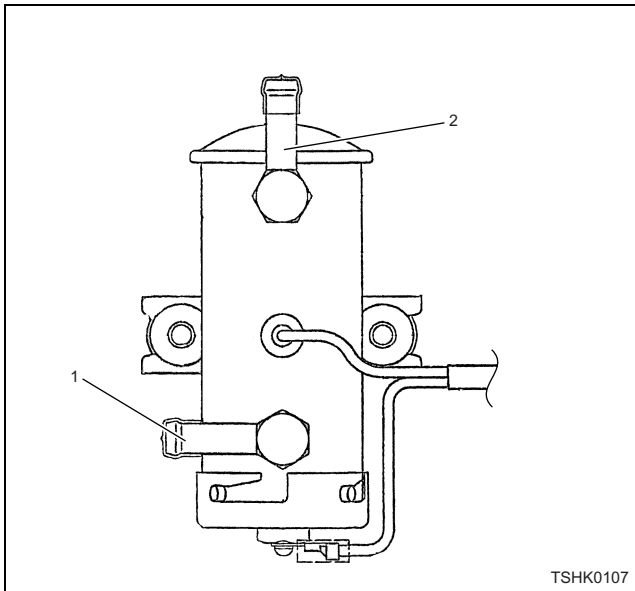
1. Turn the key switch to ON, and check for pulsation in the fuel hose.
 - It is normal if pulsation exists.
2. Disconnect the electromagnetic pump connector, and connect 24V power supply to the electromagnetic pump side to check if the pump operates.
 - If it operates properly, there may be open circuit, short circuit or poor contact in the machine-side harness. Repair the faulty part, and check again from Step 1.
 - If the electromagnetic pump does not operate, replace the pump.



Name

1. Electromagnetic Pump
2. + terminal
3. - terminal

3. Blow air into the inlet of the electromagnetic pump with your mouth.
 - The internal seal may be stuck. Blow air to eliminate sticking.



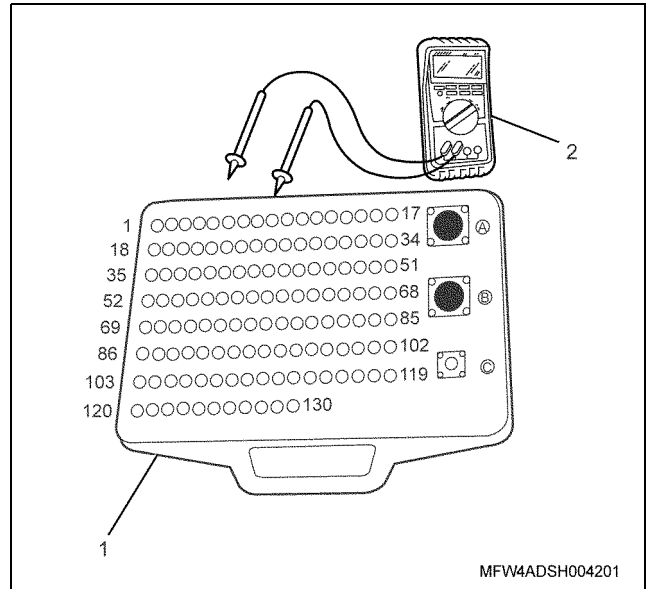
Name

1. Fuel inlet port
2. Fuel outlet port

4. Install the removed parts, and check again from Step 1.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

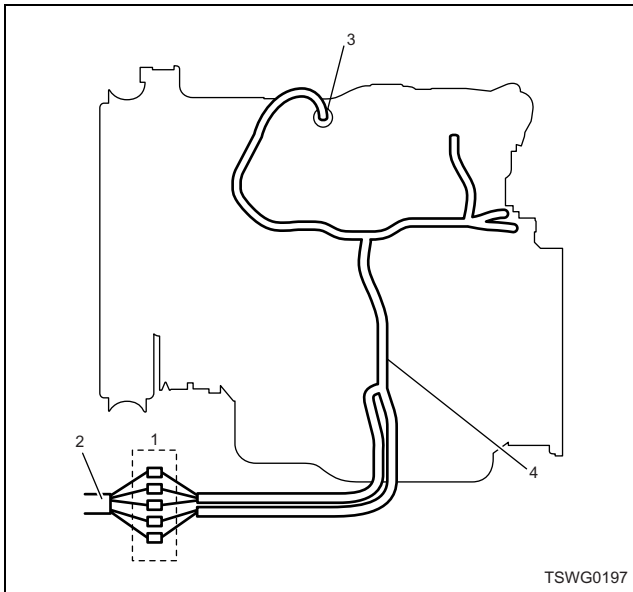


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
11	Short circuit to other signal circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	82 - Ground 90 - Ground	0V	1V or more

On-board check of sensors



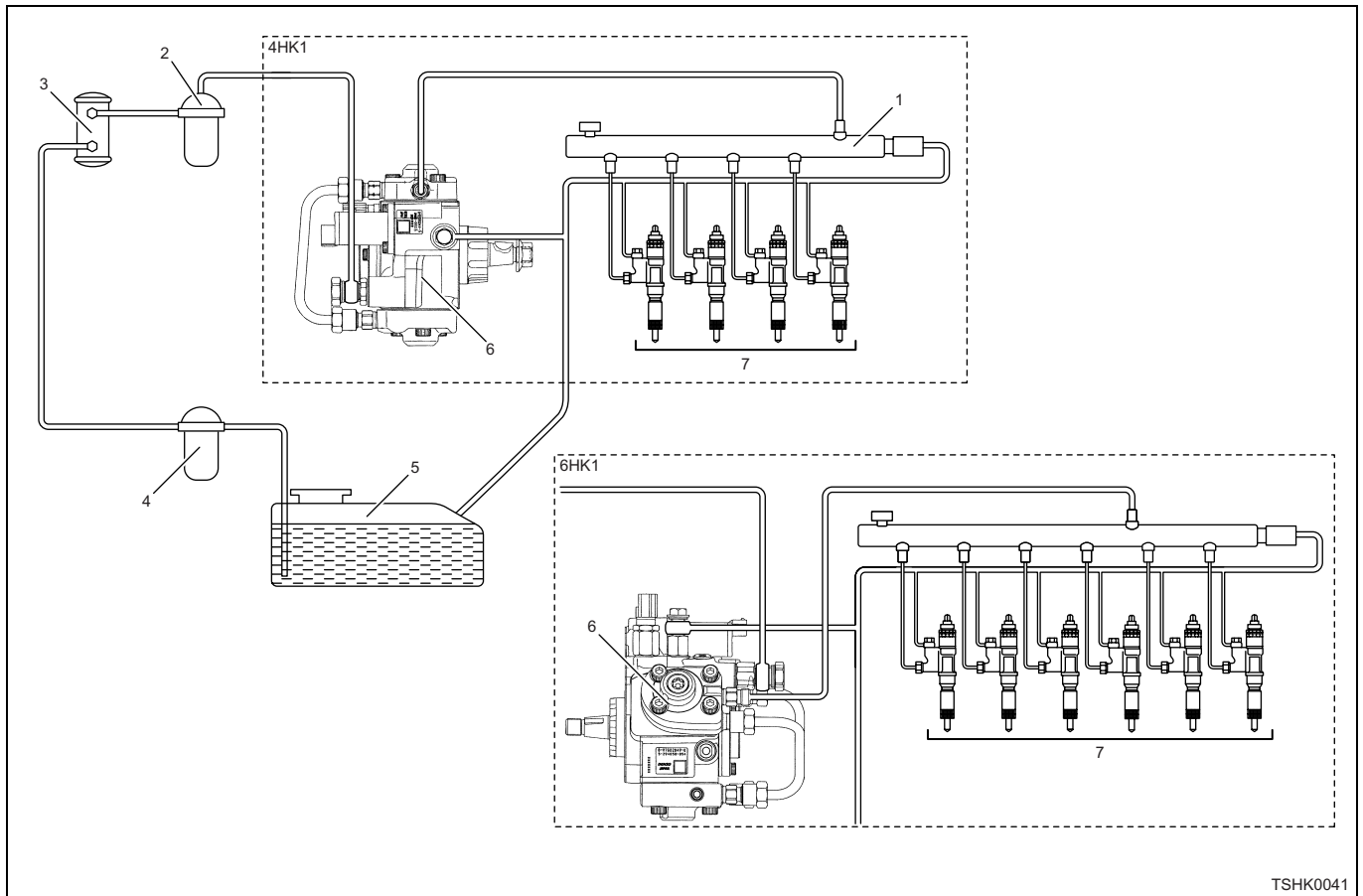
Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P1095 (Flash code 225)

Pressure limiter open



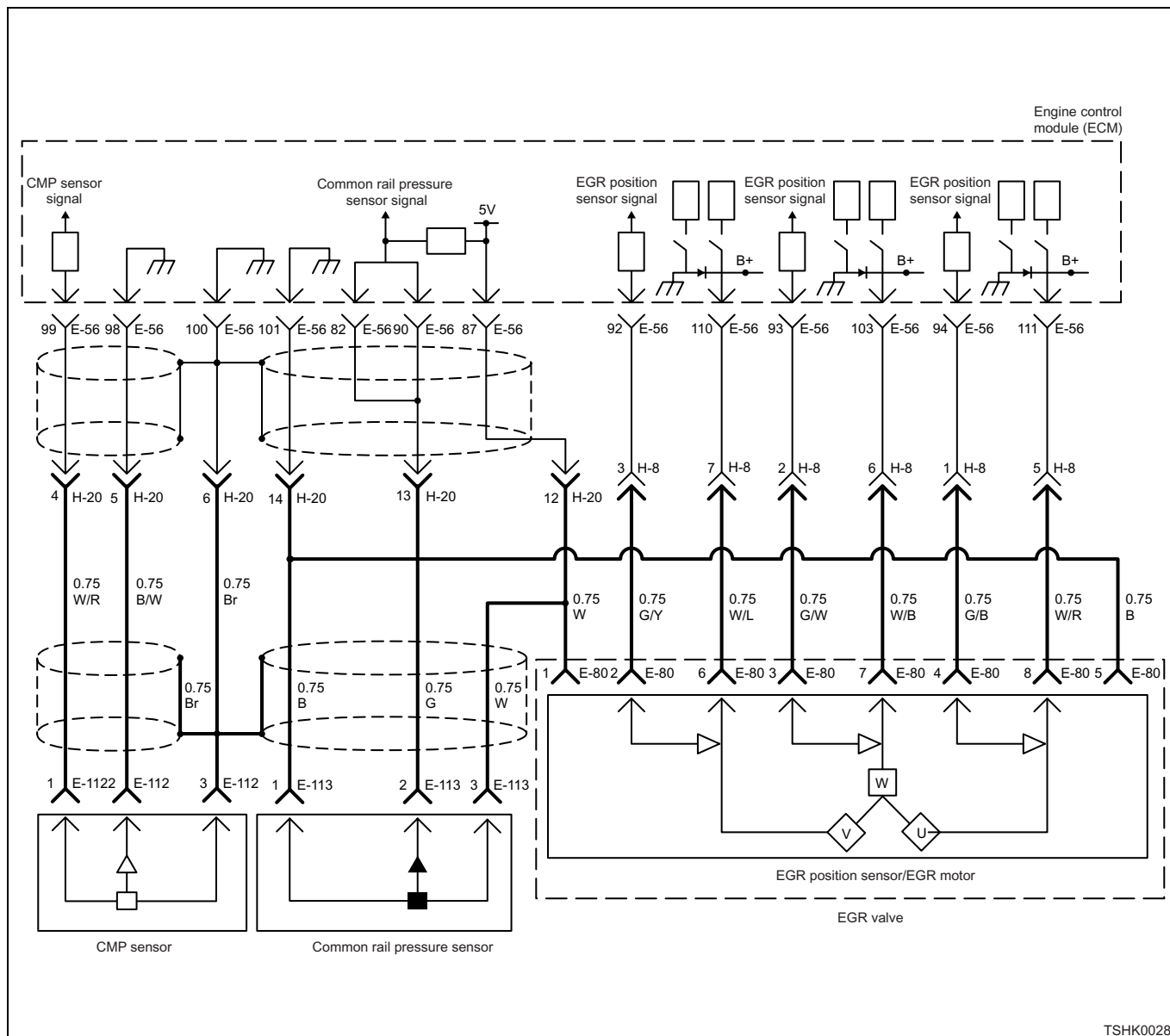
TSHK0041

Name

- 1. Common rail
- 2. Fuel filter
- 3. Electromagnetic Pump
- 4. Pre-filter

- 5. Fuel tank
- 6. Supply pump
- 7. Injector

10D-435 Electronic control fuel injection system (Common rail type)



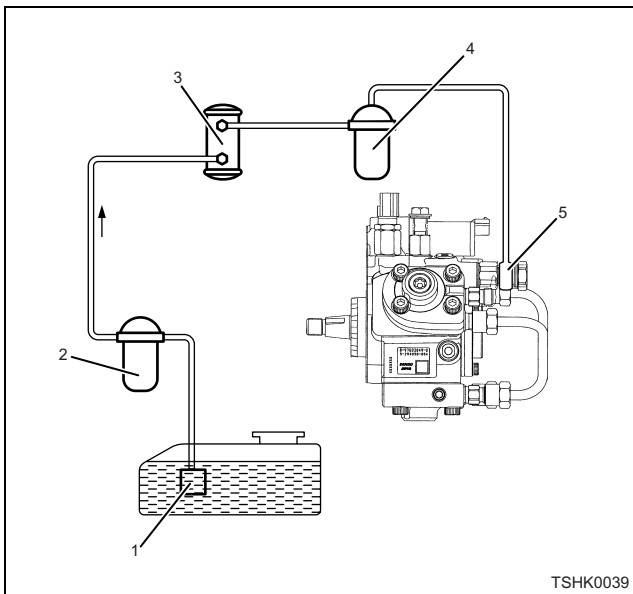
TSHK0028

Description of circuit

The supply pump sucks fuel from the fuel tank using the trochoid-type feed pump located inside of the supply pump. The sucked fuel is sent through the SCV to the two plungers located inside the supply pump, and is pressurized and sent to the common rail. The SCV opening angle controls the fuel flow; if the SCV drive duty is large, the SCV opening angle becomes small resulting in less fuel flow. The ECM drives the SCV by calculating the target common rail pressure, target fuel flow, etc. based on the information from each sensor. The ECM sets the DTC when the common rail pressure increases to certain level then lowers sharply, as it recognizes that the pressure limiter is activated.

Main trouble symptom

- Output lowering
- Hunting

Fuel system filter**Name**

1. Fuel pump strainer
2. Pre-fuel filter
3. Electromagnetic pump filter
4. Main fuel filter
5. Gauze filter

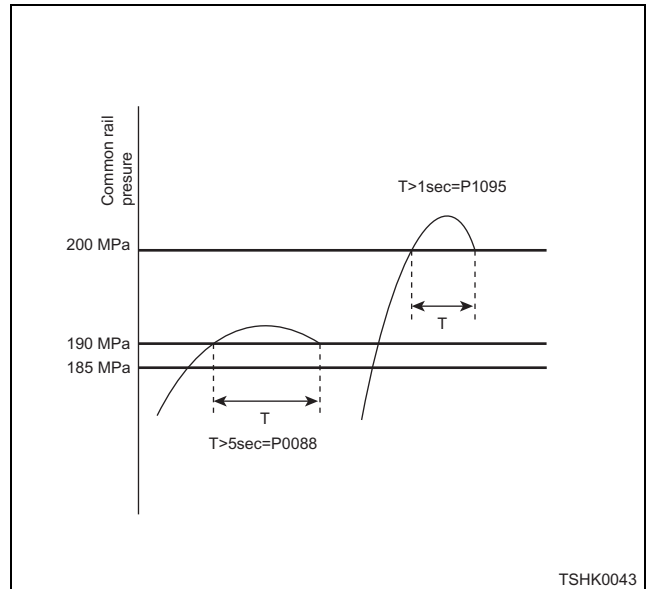
Filter clogging in the fuel system may establish the DTC set condition. Check as required.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1095, P0192, P0193, P1630, or P1635 is not detected.
- 50 rpm or more

DTC set condition

- When pressure limiter is opened.
- When the common rail pressure is more than 200MPa for 1 second or more.
- DTC set condition in the case of high common rail pressure is described below.
Only P1095 is detected if the fuel pressure overshoots due to entry of air.

**Action taken when DTC is set**

- Turns the diagnosis lamp ON.

Back-up mode

- Limited injection amount 1
- Output goes down to about 50% since fuel flow is limited.

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

Followings are suspected as the cause.

- Air mixed in the high-pressure fuel pipe.
- Injector internal trouble
- Supply pump internal trouble
- Fuel system pipe fault (clogging etc.)

10D-437 Electronic control fuel injection system (Common rail type)

- Fuel filter fault (temporary clogging due to waxing at low temperatures, improper tightening of filter cartridge, etc.)
- Fuel tank fault (temporary clogging, air mixed due to fuel shortage, air mixed due to modified fuel pipe for additional tank etc.)
- Pressure limiter trouble (operation under specified pressure, degradation of sealability)
- ECM trouble
- Common rail pressure sensor trouble
- Running out of fuel

Test description

Numbers below indicate step numbers in the chart.
 7. When rise of fuel level or diesel fuel odor is confirmed, fuel leakage in the injector portion may be the cause of the DTC detection.
 11. If the "Common rail pressure sensor" displays more than the specified value when the common rail pressure sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Check the DTC again. 1. Check and record the DTC. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Check the fuel amount, and add fuel as required. If fuel is low, P1095 may be detected due to entry of air. Note: • Bleeding air from fuel must be performed correctly, following the procedure. • For work procedure, refer to "Engine section" in the service manual. 4. Bleed air from the fuel. 5. Race it quickly for about 5 times. 6. Check the DTC. Is DTC P1095 detected?	—	Go to Step 3.	Refer to "Diagnostic aid" and Go to Step 4.
3	Narrow down the cause. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Connect another pipe to the supply pump inlet duct, and test run while supplying fuel. (At this time, replace the fuel hose with a transparent hose to visually check for air mixture in the fuel.) 3. Check the DTC. Is DTC P1095 detected?	—	Go to Step 16.	Go to Step 4.

Step	Action	Value	YES	NO
4	Check the fuel system in the following procedure. 1. Check the high pressure pipe and low pressure pipe for looseness in the connection (fuel leakage), crush or clogging. Check the clogging in the following procedure. • Fuel filter (main fuel filter, pre-fuel filter, gauze filter) • Fuel tank (pump strainer) • Fuel system pipe 2. Check the fuel pipe, fuel filter, and inside of the fuel tank for freeze or waxing. (at cold temperature) 3. Check the feed pipe inside the fuel tank for clogging of foreign matter. Is the fuel system normal?	—	Go to Step 6.	Go to Step 5.
5	Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 17.	—
6	Is the scan tool (KW communication) available?	—	Go to Step 7.	Go to Step 20.
7	Check the common rail pressure. 1. Turn the key switch to "ON". 2. Check for "Differential fuel rail pressure" on the data display using scan tool. 3. Start the engine and run it at idle. 4. Check for "Differential fuel rail pressure" on the data display using scan tool. 5. Race it quickly for about 5 times. 6. Check for "Differential fuel rail pressure" on the data display using scan tool. Is each value of "Fuel rail pressure" (at engine stopped, idling and racing) around the specified value?	At engine stopping: -30 MPa, At idling, racing: ±5 MPa	Go to Step 14.	Go to Step 8.
8	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Turn the key switch to "ON". 4. Check for "Common rail pressure sensor" on the data display using scan tool. Is the "Common rail pressure sensor" specified value?	0V	Go to Step 13.	Go to Step 9.

10D-439 Electronic control fuel injection system (Common rail type)

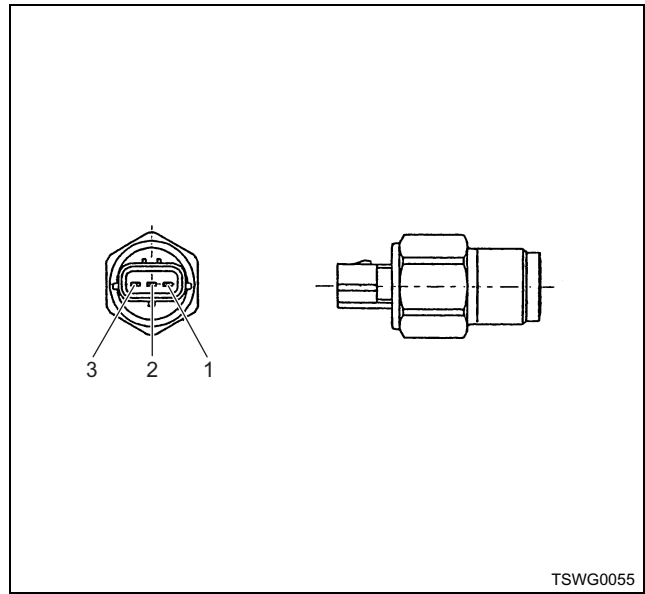
Step	Action	Value	YES	NO
9	1. Check the signal circuit between common rail pressure sensor and ECM for short circuit to signal circuits of other sensors using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 18.	Go to Step 10.
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Replace the common rail (common rail pressure sensor). Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 18.	—
14	Check the DTC again. 1. Restore the machine. 2. Bleed air from the fuel. 3. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1095 detected?	—	Go to Step 15.	Go to Step 19.

Step	Action	Value	YES	NO
15	1. Replace the common rail. Note: For work procedure, refer to “Engine section” in the service manual. 2. Bleed air from the fuel. 3. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P1095 detected?	—	Go to Step 16.	Go to Step 18.
16	1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Start the engine. If Tech2 is available, go to step 3. If Tech2 is not available, go to step 17. 3. Select the “Actuator test” from the menu. 4. Select the “Rail pressure control” in the “Common rail system”. 5. Press the “Up” soft key to check the value of “Differential fuel pressure”. Is “Differential fuel rail pressure” within the specified value?	±5MPa	Go to Step 18.	Go to Step 17.
17	Replace the supply pump. Note: • Bleed air completely after the parts are replaced. If air bleeding is not sufficient, P1095 may be detected due to overshoot of fuel pressure. • For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 18.	—

10D-441 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
18	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1095 detected?	—	Go to Step 2.	Go to Step 19.
19	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
20	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Turn the key switch to "ON". 4. Connect the DMM between the common rail pressure sensor connector signal terminal and the ground. Is the DMM indication specified value? Note: If the display of DMM is not specified value, ECM side wiring, wrap-around in ECM or short circuit may be the cause. If it is specified value, ECM side wiring is normal.	0V	Go to Step 13.	Go to Step 9.

About common rail pressure sensor

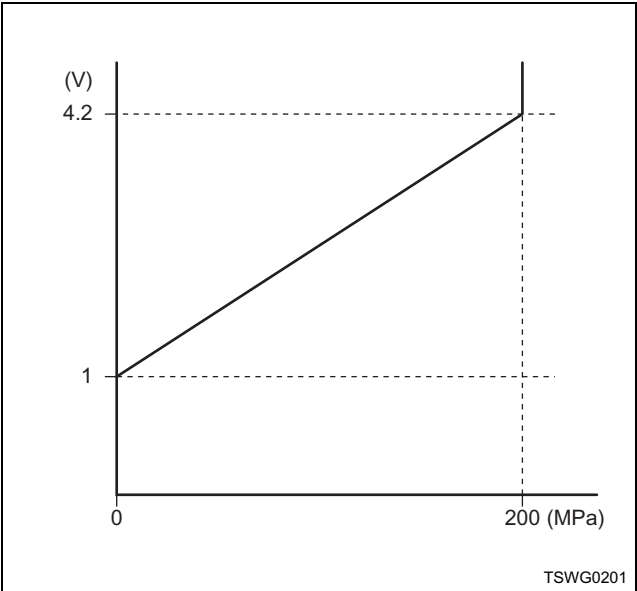


Name

1. Sensor ground
2. Sensor signal

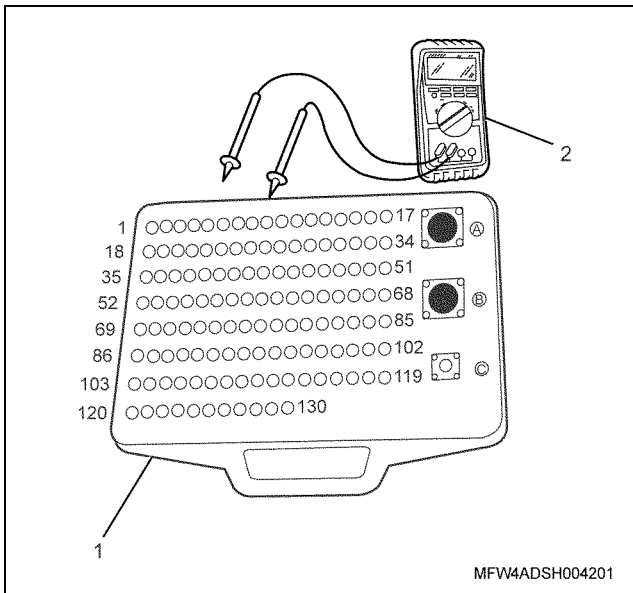
3. Sensor power supply

Characteristics of common rail pressure sensor



Breaker box inspection procedure

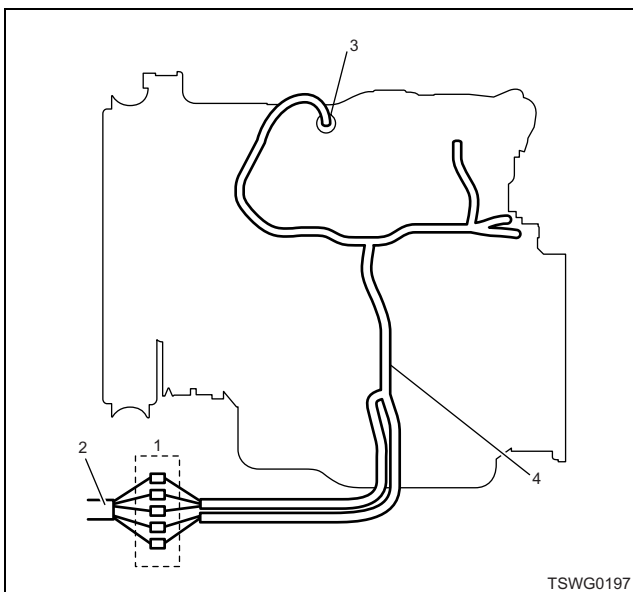
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

1. Breaker box
2. DMM

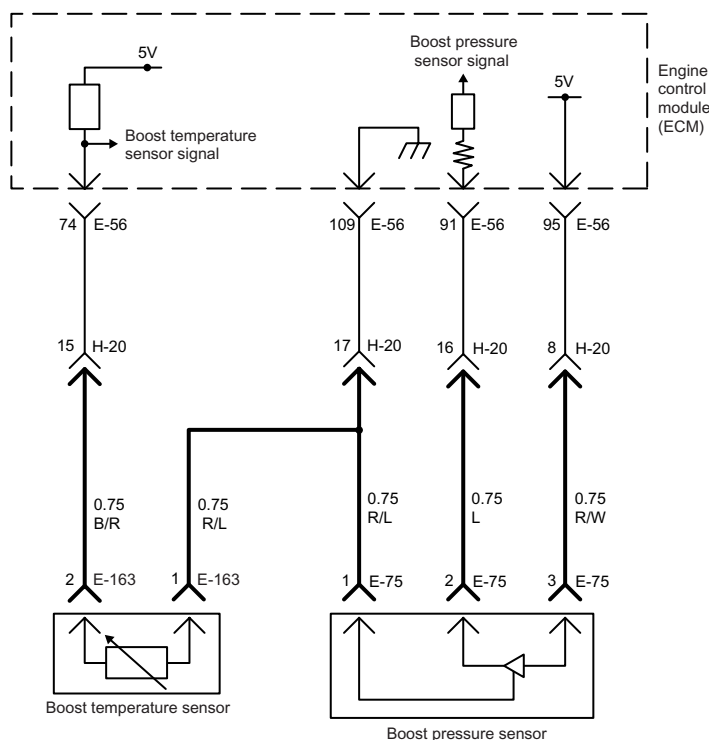
Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
9	Short circuit to other signal circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	82 - Ground 90 - Ground	0V	1V or more

On-board check of sensors

Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P1112 (Flash code 295)
Boost temperature sensor fault (low voltage fault, ground short)


TSWG0079

Description of circuit

The boost temperature sensor is installed to the intake manifold. The resistance value of boost temperature sensor changes according to the temperature in intake manifold.

The resistance is low when the intake air temperature is high, and is high when the temperature is low. The ECM energizes 5 V to the boost temperature sensor through the pull up resistance, and calculates the boost temperature from the change in voltage, to utilize various control such as fuel injection control. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

Main trouble symptom

Operationality is not affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1634 is not detected.

DTC set condition

- Boost temperature sensor voltage is 0.1V or less for 4 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

10D-445 Electronic control fuel injection system (Common rail type)

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector

- Poor connection of terminal from connector
- Unmatched terminals are fitted.
- Damage of connector lock
- Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the "Boost temperature sensor" displays less than the specified value. If more than the specified value, identify the cause by referring to "Diagnostic aid".

5. If the "Boost temperature sensor" displays more than the specified value when terminals between the boost temperature sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to "ON". 2. Check for "Boost temperature sensor" on the data display using scan tool. Is the "Boost temperature sensor" less than the specified value?	0.1V	Go to Step 4.	Go to "Diagnostic aid".
4	Check for installation condition of the boost temperature sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.
5	1. Turn the key switch to "OFF". 2. Disconnect the boost temperature sensor connector. 3. Short between the boost temperature sensor connector ground terminal and the signal terminal using jump cable. 4. Turn the key switch to "ON". 5. Check for "Boost temperature" on the data display using scan tool. Is the "Boost temperature" more than the specified value?	4.8V	Go to Step 8.	Go to Step 9.

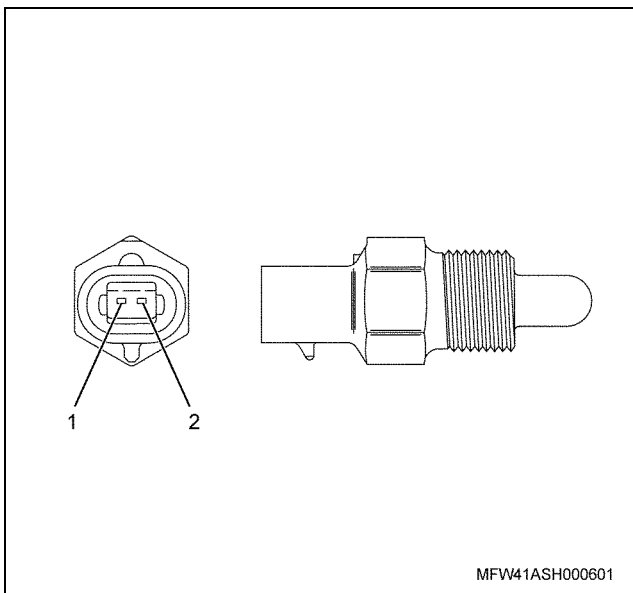
Step	Action	Value	YES	NO
6	1. Check for followings in the power supply circuit between ECM and boost temperature sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and boost temperature sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to boost temperature sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the boost temperature sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—

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Step	Action	Value	YES	NO
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is the DTC P1112 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Start the engine. 2. Check the display of boost temperature. Does the display of "Boost temperature" show error value?	214°C (Displayed error value)	Go to Step 15.	Go to "Diagnostic aid".
15	Check for installation condition of the boost temperature sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 16.
16	1. Check for followings in the power supply circuit between ECM and boost temperature sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 17.

Step	Action	Value	YES	NO
17	1. Check for followings in the signal circuit between ECM and boost temperature sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to boost temperature sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 8.

About boost temperature sensor

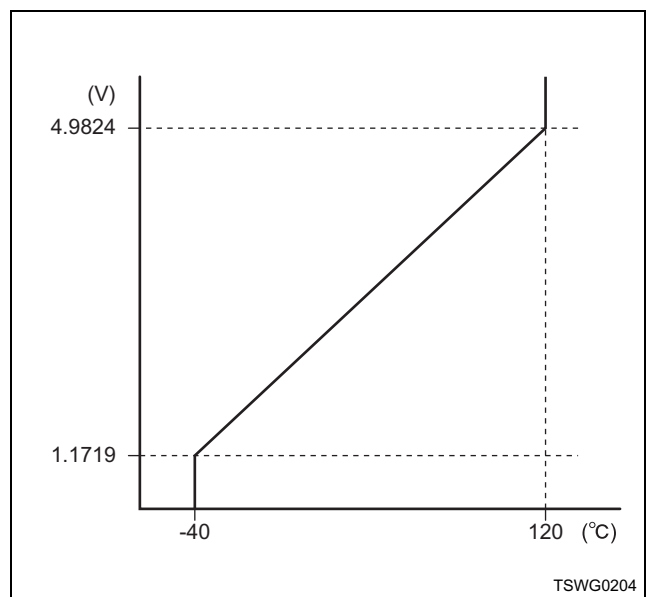


Name

1. Signal
2. GND

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

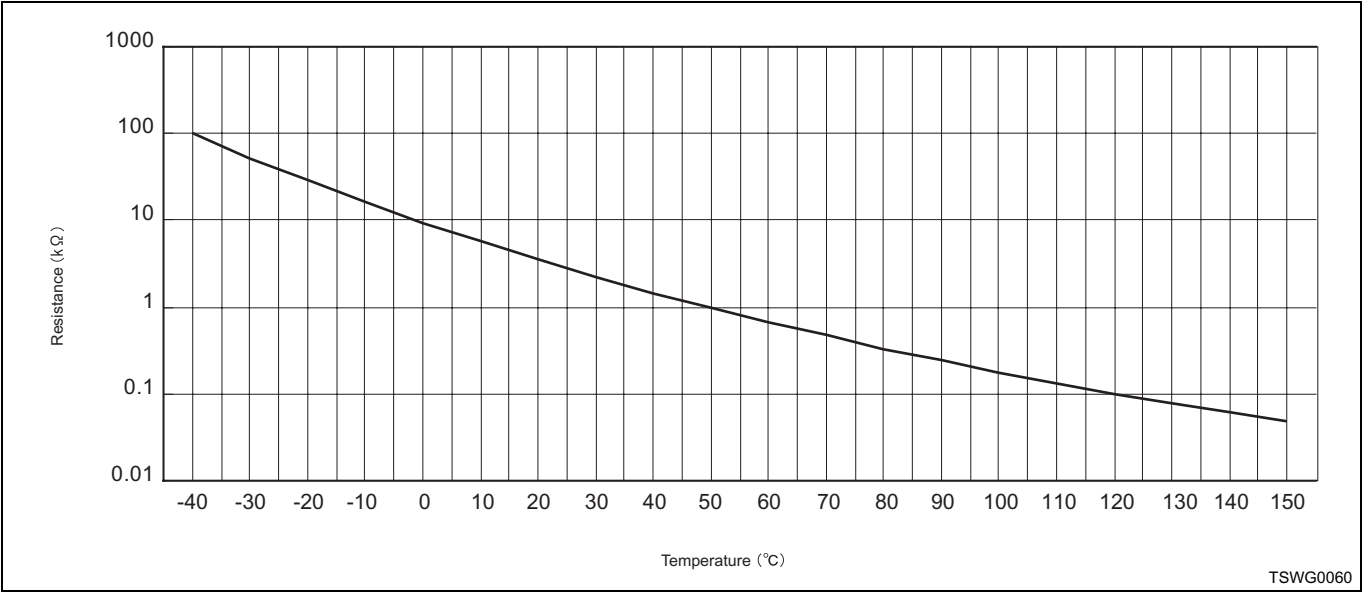
Tech2 and scan tools with KW communication can display both physical value and voltage.



Characteristics of boost temperature sensor

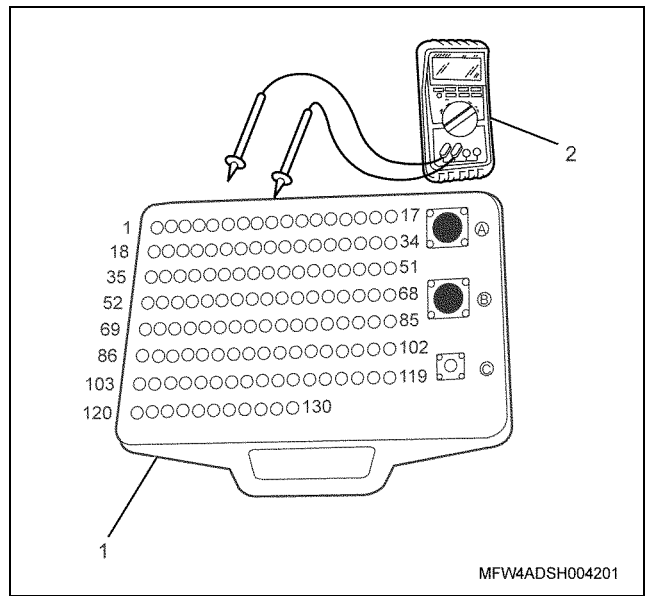
The output voltage of boost temperature sensor changes according to the boost temperature. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of -40°C or 120°C is not changed. When error occurs, error value (214°C) is displayed.

10D-449 Electronic control fuel injection system (Common rail type)



Breaker box inspection procedure

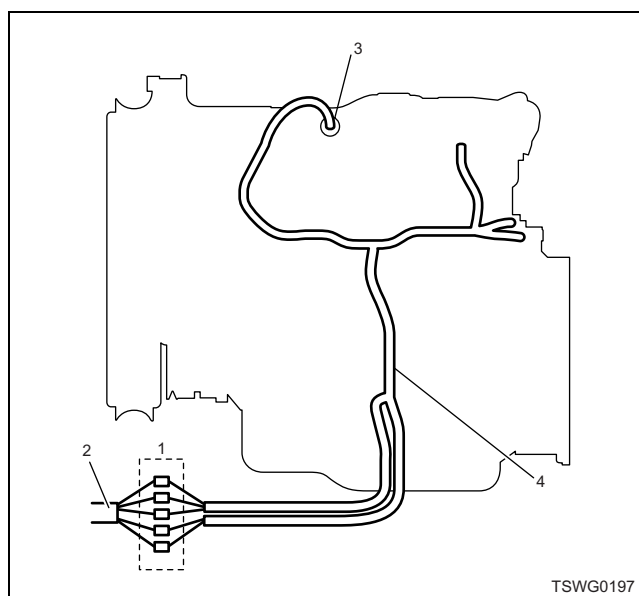
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



- Name
1. Breaker box
 2. DMM

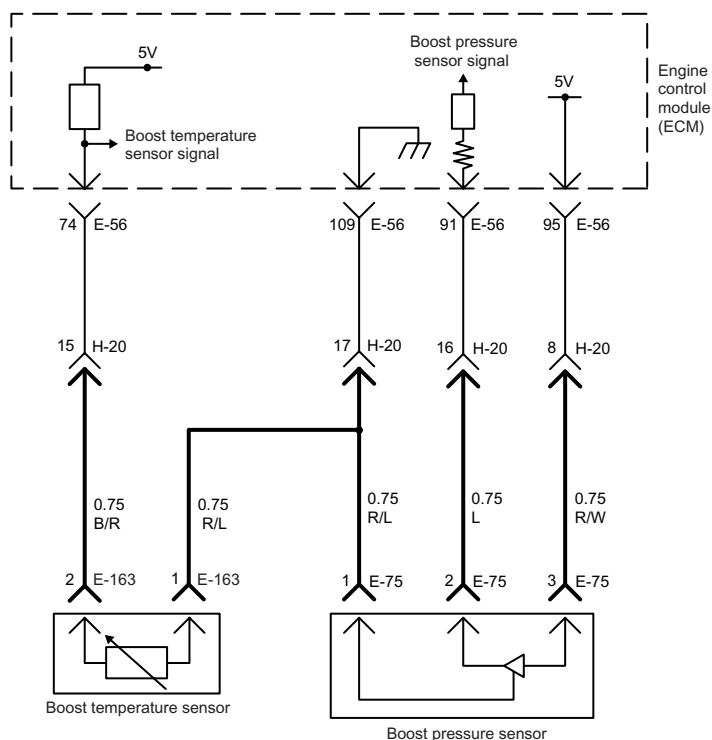
Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	74 - Sensor connector signal terminal	100Ω or less	10MΩ or more

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
7	Short circuit to ground circuit/ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	74 - 109 74 - GND	10M Ω or more	100 Ω or less
	Open circuit/high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	74 - Sensor connector signal terminal	100 Ω or less	10M Ω or more

On-board check of sensors**Name**

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P1113 (Flash code 295)**Boost temperature sensor fault (high voltage fault)**

TSWG0079

Description of circuit

The boost temperature sensor is installed to the intake manifold. The resistance value of boost temperature sensor changes according to the temperature in intake manifold.

The resistance is low when the intake air temperature is high, and is high when the temperature is low. The ECM energizes 5 V to the boost temperature sensor through the pull up resistance, and calculates the boost temperature from the change in voltage, to utilize various control such as fuel injection control. If the resistance is low (temperature is high), the voltage becomes low; if the resistance is high (temperature is low), the voltage becomes high.

Main trouble symptom

Operationality is not affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1634 is not detected.
- Coolant temperature is 50°C or more.
- 3 (or 5) minutes have passed after engine starting (depending on the machine manufacturer)

DTC set condition

- Boost temperature sensor voltage is 4.95V or more for 4 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp turns off when the trouble code turns to the past trouble.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Boost temperature sensor” displays more than the specified value. If less than the specified value, identify the cause by referring to “Diagnostic aid”.

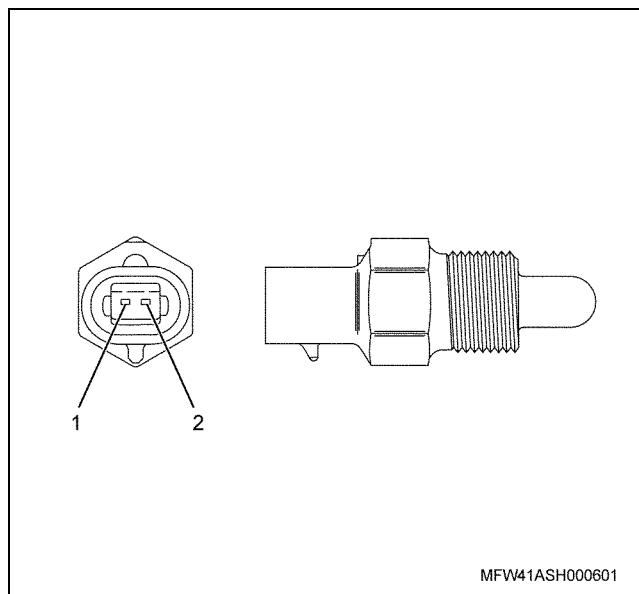
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to “ON”. 2. Check for “Boost temperature sensor” on the data display using scan tool. Is the “Boost temperature sensor” more than the specified value?	4.95V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the boost temperature sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.

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Step	Action	Value	YES	NO
5	1. Check the signal circuit between ECM and boost temperature sensor for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the boost temperature sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 6.
6	1. Check for followings in the ground circuit between ECM and boost temperature sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 8.
7	Replace the boost temperature sensor. Is the procedure completed?	—	Go to Step 11.	—
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—

Step	Action	Value	YES	NO
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P0238 detected?	—	Go to Step 2.	Go to Step 12.
12	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
13	1. Start the engine. 2. Check the display of boost temperature. Does the display of "Boost temperature" show error value?	214°C (Displayed error value)	Go to Step 14.	Go to "Diagnostic aid".
14	Check for installation condition of the boost temperature sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 48.
15	1. Check for followings in the ground circuit between ECM and boost temperature sensor, using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 7.

About boost temperature sensor



Name

1. Signal
 2. GND
-

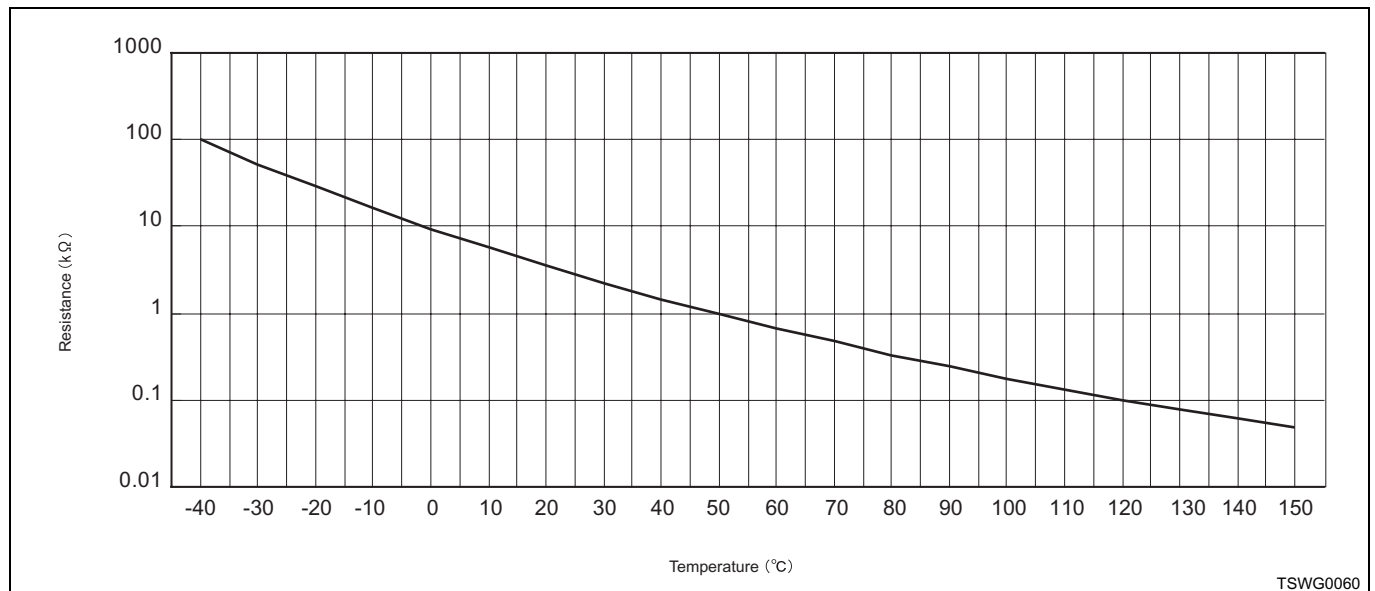
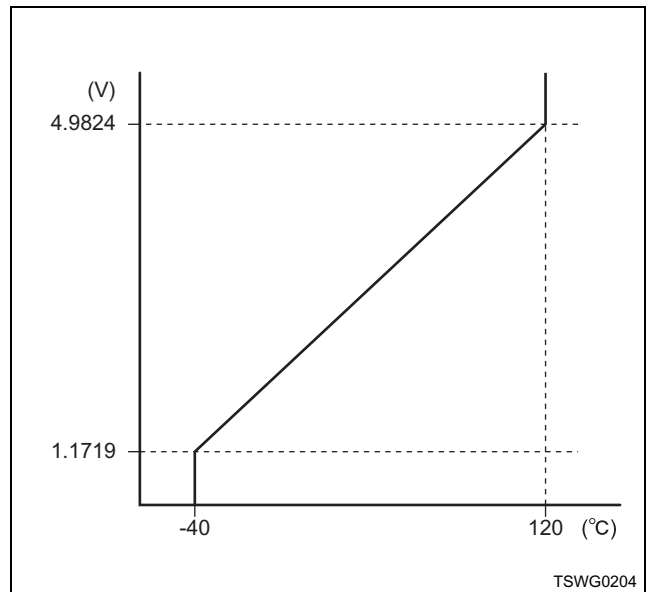
Characteristics of boost temperature sensor

The output voltage of boost temperature sensor changes according to the boost temperature. The scan tool with CAN communication displays a fixed value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if the value of -40°C or 120°C is not changed.

When error occurs, error value (214°C) is displayed.

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

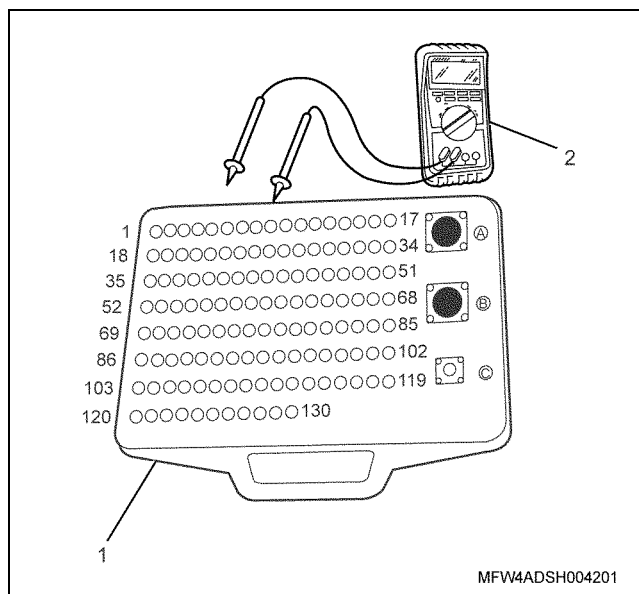
Tech2 and scan tools with KW communication can display both physical value and voltage.



10D-457 Electronic control fuel injection system (Common rail type)

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



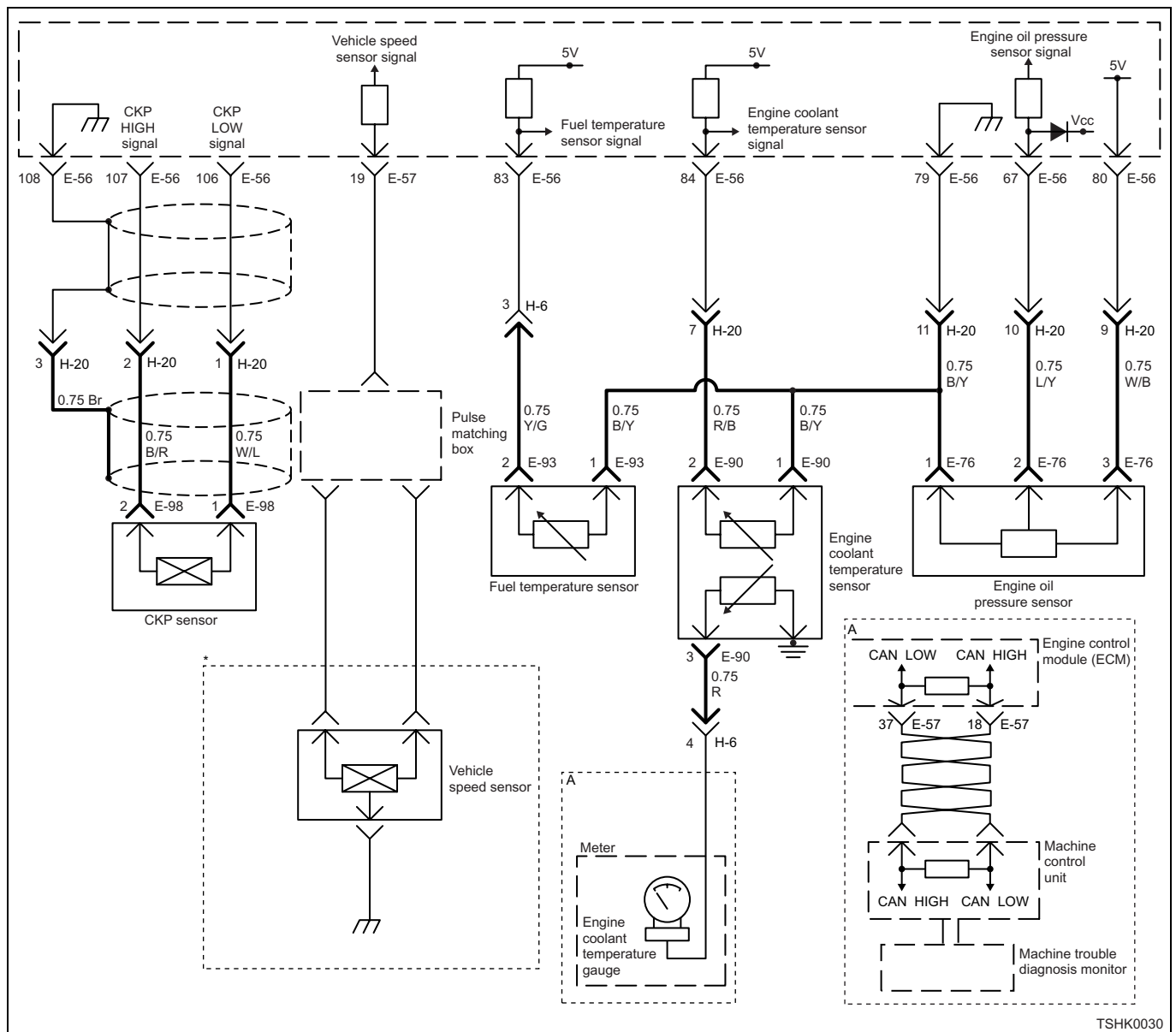
Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5	Short circuit to power supply circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	74 - GND	0V	18V or more
6	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	109 - Sensor connector ground terminal	100Ω or less	10MΩ or more

DTC: P1173 (Flash code 542)**Overheat**

(*: Specifications vary depending on each machine. Refer to the machine's manual.)

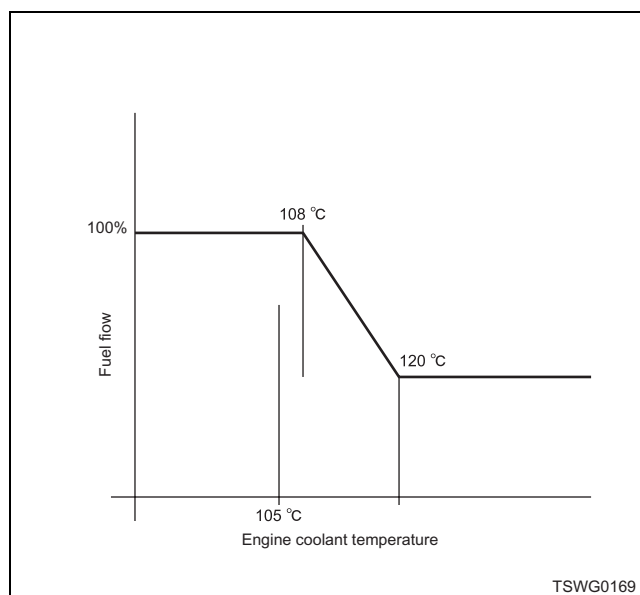
**Description of circuit**

The engine coolant temperature (ECT) sensor is installed in the thermostat housing. The ETC sensor is the thermistor-type sensor, and the value of resistance and output voltage change according to the engine coolant temperature. As the engine coolant temperature increases, the resistance becomes small, and the voltage lowers. The ECM detects the engine coolant temperature based on the signal from the ECT sensor to perform various controls.

The ECM sets the DTC when it judges that the engine coolant temperature exceed certain level based on the signal from the ECT sensor.

Main trouble symptom

- Output lowering
- Fuel flow is regulated during overheat when the temperature exceeds 108°C.

**Preconditions when DTC is set**

- Key switch input voltage is 18V or more.
- DTC P1630, P1633, P0117, or P0118 is not detected.
- Engine under operation

DTC set condition

- Engine coolant temperature is more than 120°C for 5 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

4. If the "Engine coolant temperature sensor" displays less than the specified value when the ECT sensor connector is removed, the sensor is faulty.

9. If no DTC is detected, intermittent trouble is suspected. Identify the cause by referring to "Diagnostic aid".

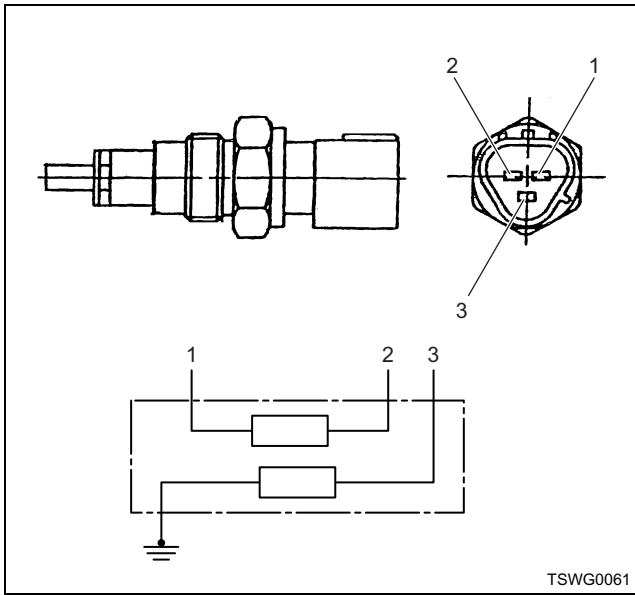
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Start the engine. 2. Check the DTC. Is DTC P0088, or P1093 detected?	—	Go to the relevant DTC detected.	Go to Step 3.
3	Is the scan tool available?	—	Go to Step 4.	Go to Step 14.

Electronic control fuel injection system (Common rail type) 10D-460

Step	Action	Value	YES	NO
4	1. Turn the key switch to "OFF". 2. Disconnect the ECT sensor connector. 3. Turn the key switch to "ON". 4. Check for "Engine coolant temperature sensor" on the data display using scan tool. Is the "Engine coolant temperature sensor" more than the specified value?	4.9V/-40°C	Go to Step 6.	Go to Step 5.
5	1. Check the signal circuit between ECT sensor and ECM for short circuit to signal circuits of other sensors using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 10.
6	1. Check the engine coolant amount. 2. If insufficient, add engine coolant. 3. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 4. Turn the key switch to "OFF" for more than 10 seconds. 5. Start the engine, and check the DTC. Is DTC P1173 detected?	—	Go to Step 7.	Go to Step 13.
7	1. Check for following mechanical defects. (Refer to "Cooling system" of "Engine section" in the service manual.) • Clogging of radiator • Defective radiator cap • Loose fan belt • Defective thermostat • Defective water pump • Defective cylinder head gasket 2. If the trouble is detected, adjust or replace as required. Is the trouble detected?	—	Go to Step 13.	Go to Step 8.
8	Replace the ECT sensor. Is the procedure completed?	—	Go to Step 13.	—

10D-461 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
9	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 10 seconds. 3. Test run with the "Preconditions when DTC is set". 4. Check the DTC. Is DTC P1173 detected?	—	Go to Step 10.	Go to "Diagnostic aid".
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Turn the key switch to "OFF". 2. Disconnect the ECT sensor connector. 3. Turn the key switch to "ON". 4. Check the display of the "Engine coolant temperature". Is the "Engine coolant temperature" more than the specified value?	−40°C	Go to Step 6.	Go to Step 5.

About ECT sensor**Name**

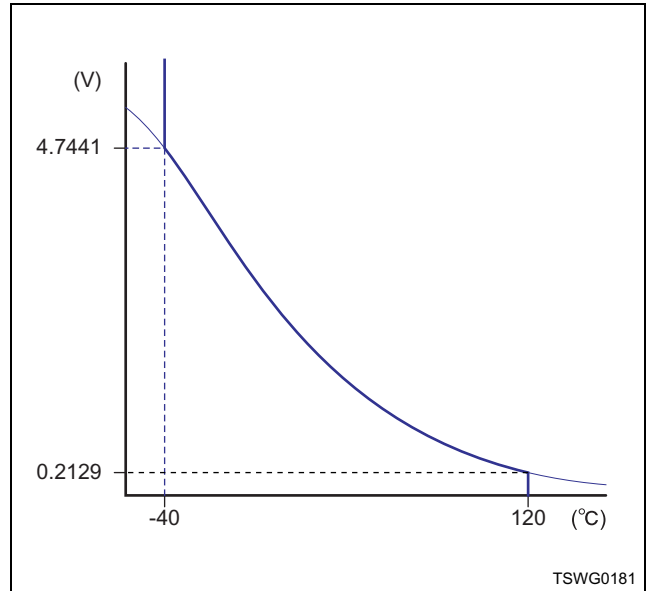
1. Sensor GND (for engine control)
2. Sensor signal (for engine control)
3. Sensor signal (for meter)

Characteristics of ECT sensor

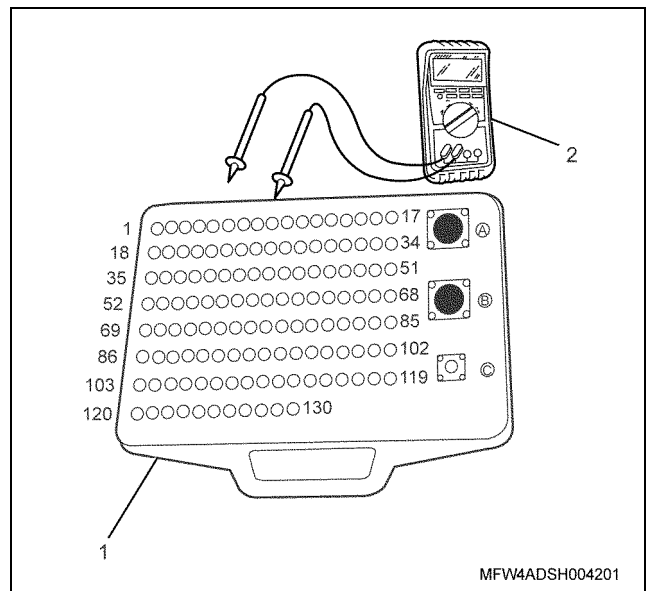
The output voltage of ECT sensor changes according to the engine coolant temperature. The scan tool with CAN communication displays a constant value when the value exceeds the threshold voltage. Therefore, judge as it is more than the threshold value if shown as -40°C or 120°C .

The following illustration shows the correlation between physical value and voltage displayed in the scan tools with CAN communication.

Tech2 and scan tools with KW communication can display both physical value and voltage.

**Breaker box inspection procedure**

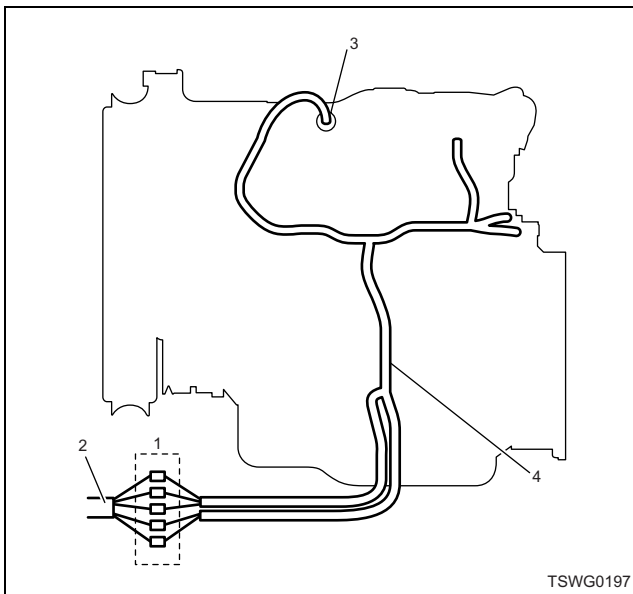
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

**Name**

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5	Short circuit to other signal circuit	Voltage measurement	- Disconnect the sensor connector. - Key switch "ON"	84 - Ground	0V	1V or more

On-board check of sensors



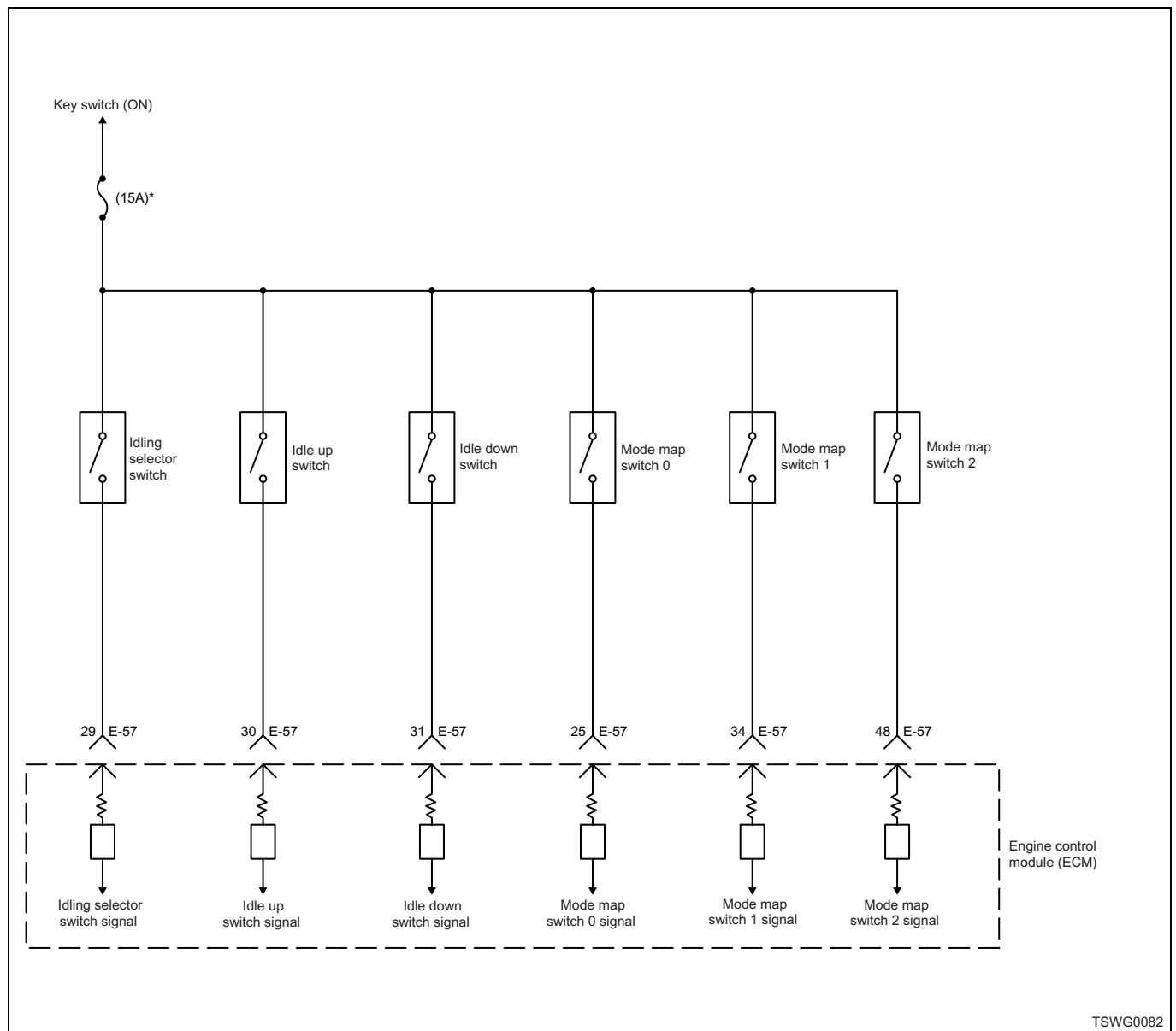
Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P1225 (Flash code 31)**Idle UP/DOWN switch fault**

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)

**Description of circuit**

The idling control switch is provided to adjust idle speed during warming-up, and is available for use when the idling control selector switch is in "Manual". The power supply voltage is supplied to the idling control switch through the key switch. By pressing the "Up" or "Down", each ground circuit is completed and the signal is input to the ECM.

The ECM sets the DTC when the signal inputs are detected for idling control switch "Up" side and "Down" side at the same time.

Main trouble symptom

Operationality is not affected.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.

DTC set condition

- When both of idling control up signal and idling control down signal are ON.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Unable to change the speed in mode driving

10D-465 Electronic control fuel injection system (Common rail type)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Fault in switch body
- Improper adjustment of switch
- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. If the “Idle up switch” and “Idle down switch” display “OFF” when the idling control switch connector is removed, the circuit is shorted between idle up circuit and idle down circuit, or the switch is faulty.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 4.
3	1. Turn the key switch to “OFF”. 2. Disconnect the idling control switch connector. 3. Turn the key switch to “ON”. 4. Check for “Idle up switch” and “Idle down switch” on the data display using scan tool. Are the “Idle up switch” and “Idle down switch” displayed “OFF”?	—	Go to Step 6.	Go to Step 4.
4	1. Check the idle up-side circuit between idling control switch and ECM for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to “Breaker box inspection procedure”. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 5.

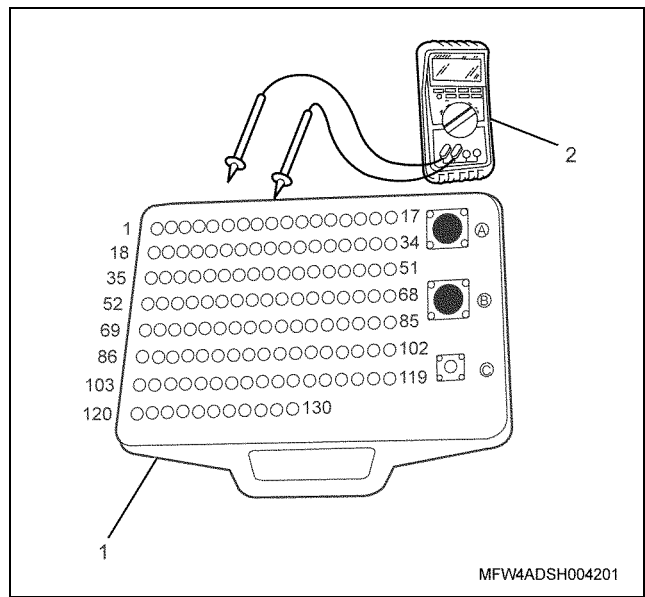
Step	Action	Value	YES	NO
5	1. Check the idle down-side circuit between idling control switch and ECM for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 10.	Go to Step 7.
6	Replace the idling control switch. Is the procedure completed?	—	Go to Step 10.	—
7	Is EMPS available?	—	Go to Step 8.	Go to Step 9.
8	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	Go to Step 9.
9	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 10.	—
10	Check if DTC is not detected again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 15 seconds, and then start the engine. 4. Check the DTC. Is the procedure completed?	—	Go to Step 11.	—
11	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

About idling control switch

Note:
Refer to the machine's manual for installing position of the idling control switch.

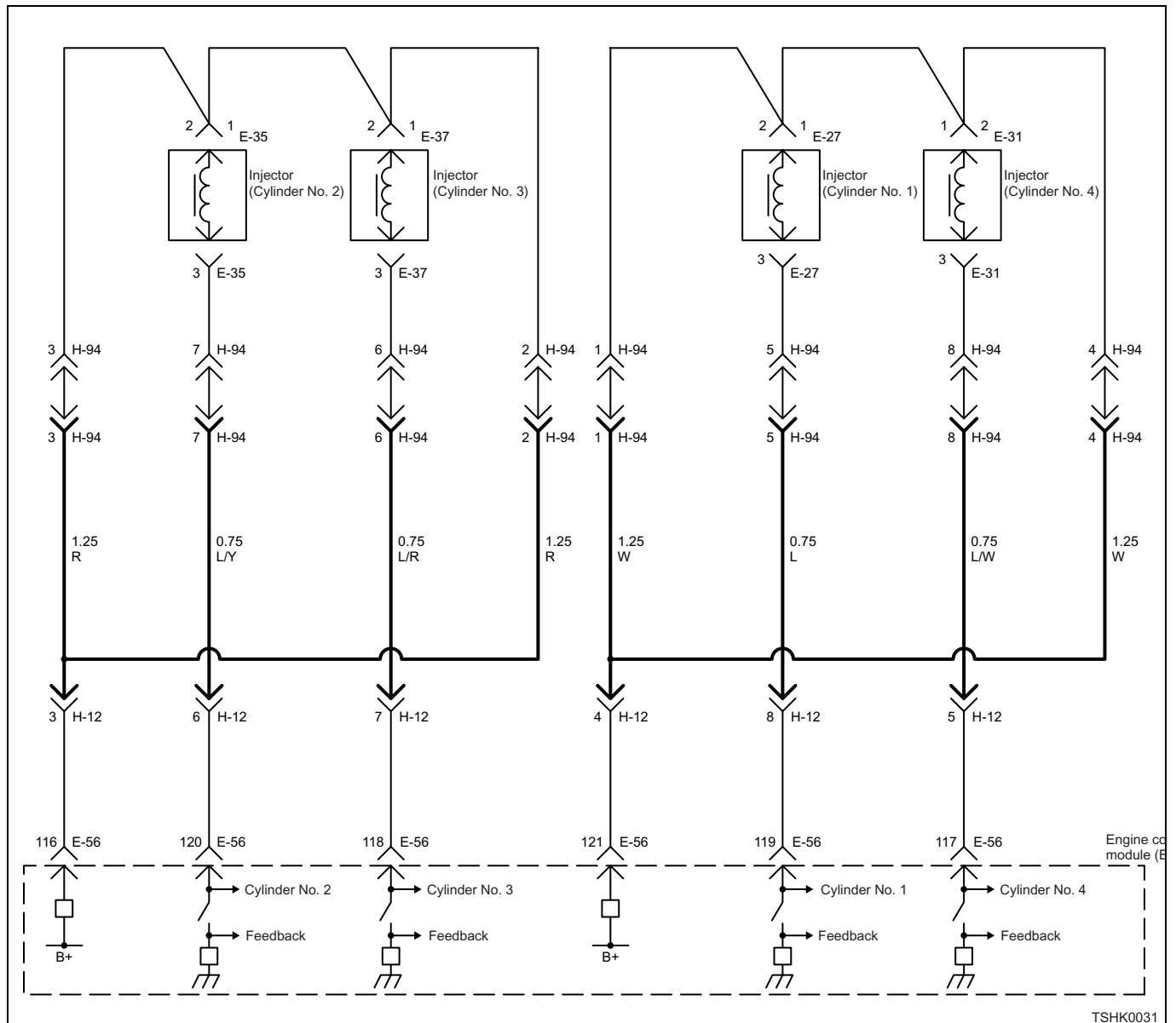
Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

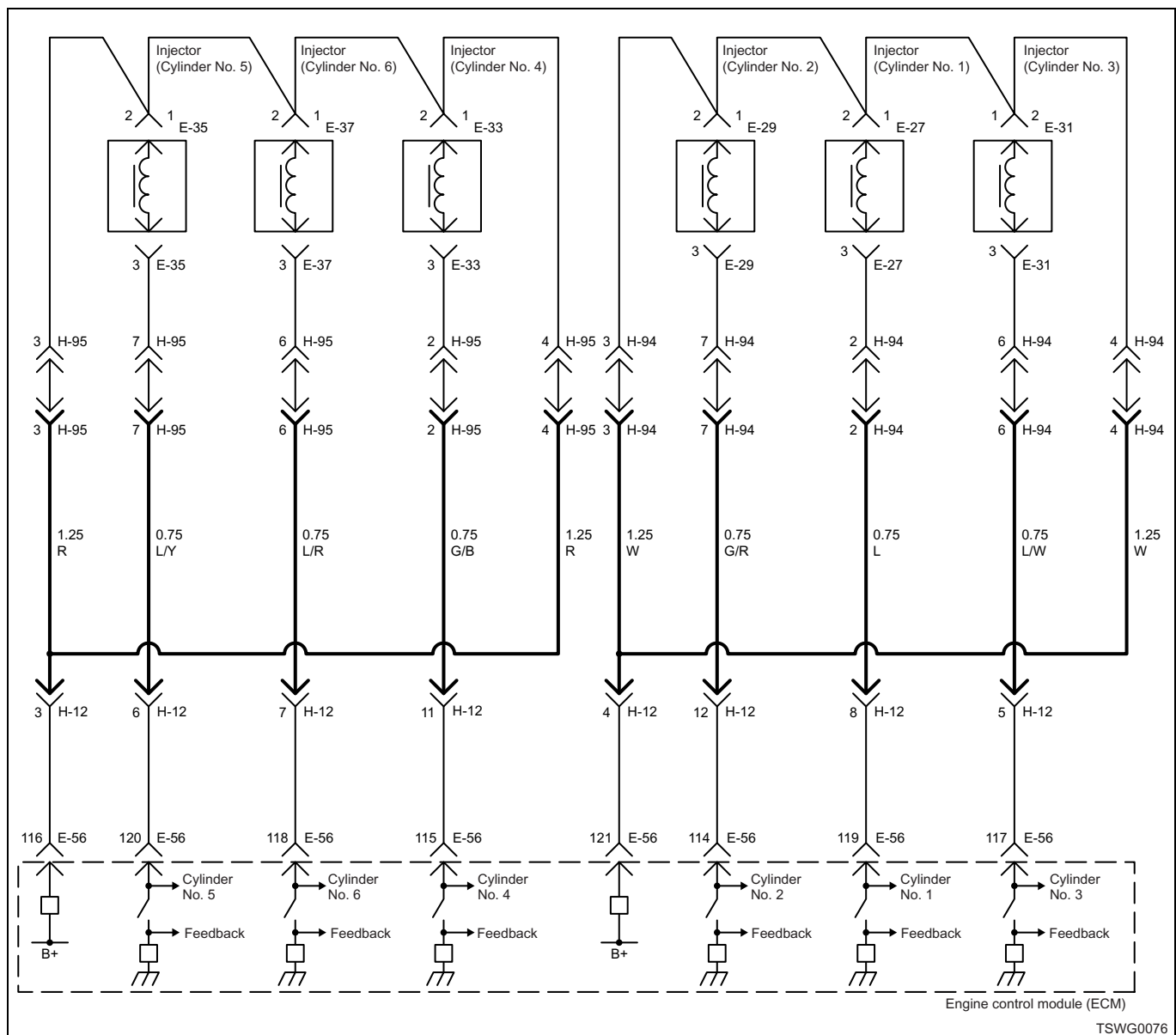


- Name
1. Breaker box
 2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Short circuit to power supply circuit	Voltage measurement	• Disconnect the switch connector. • Key switch "ON"	30 - Ground	0V	18V or more
5	Short circuit to power supply circuit	Voltage measurement	• Disconnect the switch connector. • Key switch "ON"	31 - Ground	0V	18V or more

DTC: P1261 (Flash code 158)**Injection nozzle common 1 drive system fault****4HK1**

6HK1



TSWG0076

Description of circuit

The COMMON circuit is provided to supply the power supply voltage pressurized in the charge circuit inside the ECM to the injector, and is divided in to two systems (4H: 2 cylinders each, 6H: 3 cylinders each). The COMMON 1 circuit supplies the power supply voltage to the injectors (4H: No. 1, No. 2 cylinders, 6H: No. 1, No. 2, No. 3 cylinders). The ECM sets the DTC when faults are detected simultaneously for all the injector drive circuits of COMMON 1 system.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault
- Engine stall possible

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- None of the following DTC sets are detected; DTC P0611 and P1261 and P201; DTC P0611 and P1261 and P0202; DTC P0611 and P1261 and P0203.

DTC set condition

- None of injector monitor input signal for COMMON 1 system exists for 3 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

Common 1 stop (#1, #4 cylinders stopped), EGR stopped (4HK1)

Common 1 stop (#1, #2, #3 cylinders stopped), EGR stopped (6HK1)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF". 2. Remove the ECM-side harness connector from the coupling connector (H-94). 3. Connect the DMM between the injector power supply 1 circuit and the ground. 4. Turn the key switch to "ON". 4H: H94 female-side No. 1 6H: H94 female-side No. 3 Is the DMM indication more than the specified value?	7.0V	Go to Step 3.	Go to Step 4.
3	1. Turn the key switch to "OFF". 2. Remove the ECM-side harness connector from the coupling connector (H-94). 3. Measure the resistance between the injector harness connector terminals. 4H: H94 male-side No. 1 and No. 4 6H: H94 male-side No. 3 and No. 4 Is the resistance less than the specified value?	1.0Ω	Go to Step 6.	Go to Step 22.
4	Check for installation condition of the injector harness connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 5.

10D-471 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
5	1. Check for followings in the injector power supply 1 circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance • Short circuit to ground 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
6	1. Turn the key switch to "OFF". 2. Remove the ECM-side harness connector from the coupling connector (H-94). 3. Measure the resistance between the No. 1 cylinder injector drive circuit and the ground. 4H: H94 male-side No. 5 6H: H94 male-side No. 2 Is the resistance more than the specified value?	10MΩ	Go to Step 7.	Go to Step 9.
7	1. Turn the key switch to "OFF". 2. Remove the ECM-side harness connector from the coupling connector (H-94). 3. Measure the resistance between the No. 2 cylinder (4H: No. 4 cylinder) injector drive circuit and the ground. 4H: H94 male-side No. 8 6H: H94 male-side No. 7 Is the resistance more than the specified value?	10MΩ	4H: Go to Step 12. 6H: Go to Step 8.	Go to Step 10.
8	1. Turn the key switch to "OFF". 2. Remove the ECM-side harness connector from the coupling connector (H-94). 3. Measure the resistance between the No. 3 cylinder injector drive circuit and the ground. 6H: H94 male-side No. 6 Is the resistance more than the specified value?	10MΩ	Go to Step 12.	Go to Step 11.
9	1. Check the No. 1 cylinder injector drive circuit between ECM and coupling connector (H-94) for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.

Electronic control fuel injection system (Common rail type) 10D-472

Step	Action	Value	YES	NO
10	1. Check the No. 2 cylinder (4H: No. 4 cylinder) injector drive circuit between ECM and coupling connector (H-94) for ground short circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
11	1. Check the No. 3 cylinder injector drive circuit between ECM and coupling connector (H-94) for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
12	1. Remove the cylinder head cover. 2. Check for installation condition of the injector harness. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 13.
13	1. Remove the injector harness from the injector. 4H: No. 1 cylinder, No. 4 cylinder 6H: No. 1 cylinder, No. 2 cylinder, No. 3 cylinder 2. Measure the resistance between each injector terminal and the ground. Is the resistance more than the specified value?	10MΩ	Go to Step 14.	Go to Step 23.
14	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (H-94). 3. Connect the DMM between the No. 1 cylinder injector drive circuit and the ground. 4H: H94 female-side No. 5 6H: H94 female-side No. 2 4. Turn the key switch to "ON". Is the DMM indication specified value?	0V	Go to Step 18.	Go to Step 15.

10D-473 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
15	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (H-94). 3. Connect the DMM between the No. 2 cylinder (4H: No. 4 cylinder) injector drive circuit and the ground. 4H: H94 female-side No. 8 6H: H94 female-side No. 7 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	0V	Go to Step 19.	4H: Go to Step 17. 6H: Go to Step 16.
16	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (H-94). 3. Connect the DMM between the No. 3 cylinder injector drive circuit and the ground. 6H: H94 female-side No. 6 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	0V	Go to Step 20.	Go to Step 17.
17	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (H-94). 3. Connect the DMM between the injector power supply 1 circuit and the ground. 4H: H94 female-side No. 1 6H: H94 female-side No. 3 4. Turn the key switch to "ON". Is the DMM indication less than the specified value?	7.0V	Go to Step 22.	Go to Step 21.
18	1. Check the No. 1 cylinder injector drive circuit between ECM and coupling connector (H-94) for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.

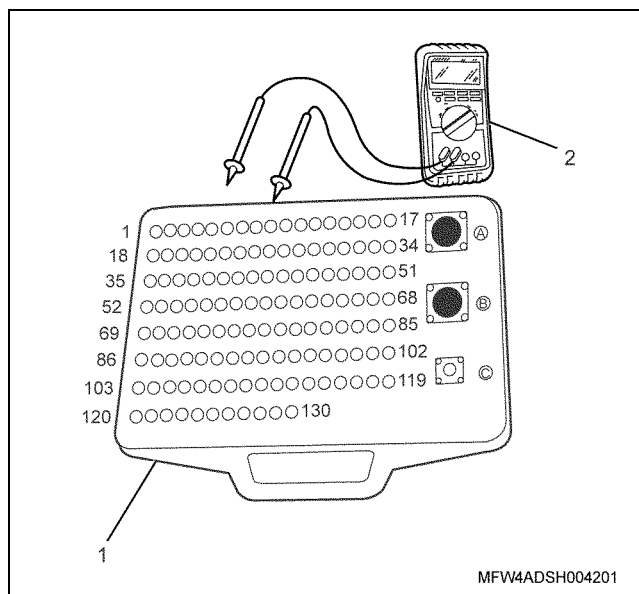
Step	Action	Value	YES	NO
19	1. Check the No. 2 cylinder (4H: No. 4 cylinder) injector drive circuit between ECM and coupling connector (H-94) for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
20	1. Check the No. 3 cylinder injector drive circuit between ECM and coupling connector (H-94) for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
21	1. Check the injector power supply 1 circuit between ECM and coupling connector (H-94) for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
22	Replace the injector harness. Is the procedure completed?	—	Go to Step 27.	—
23	Replace the injector. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 27.	—
24	Is EMPS available?	—	Go to Step 25.	Go to Step 26.

10D-475 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
25	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 27.	Go to Step 26.
26	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 27.	—
27	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1261 detected?	—	Go to Step 2.	Go to Step 28.
28	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

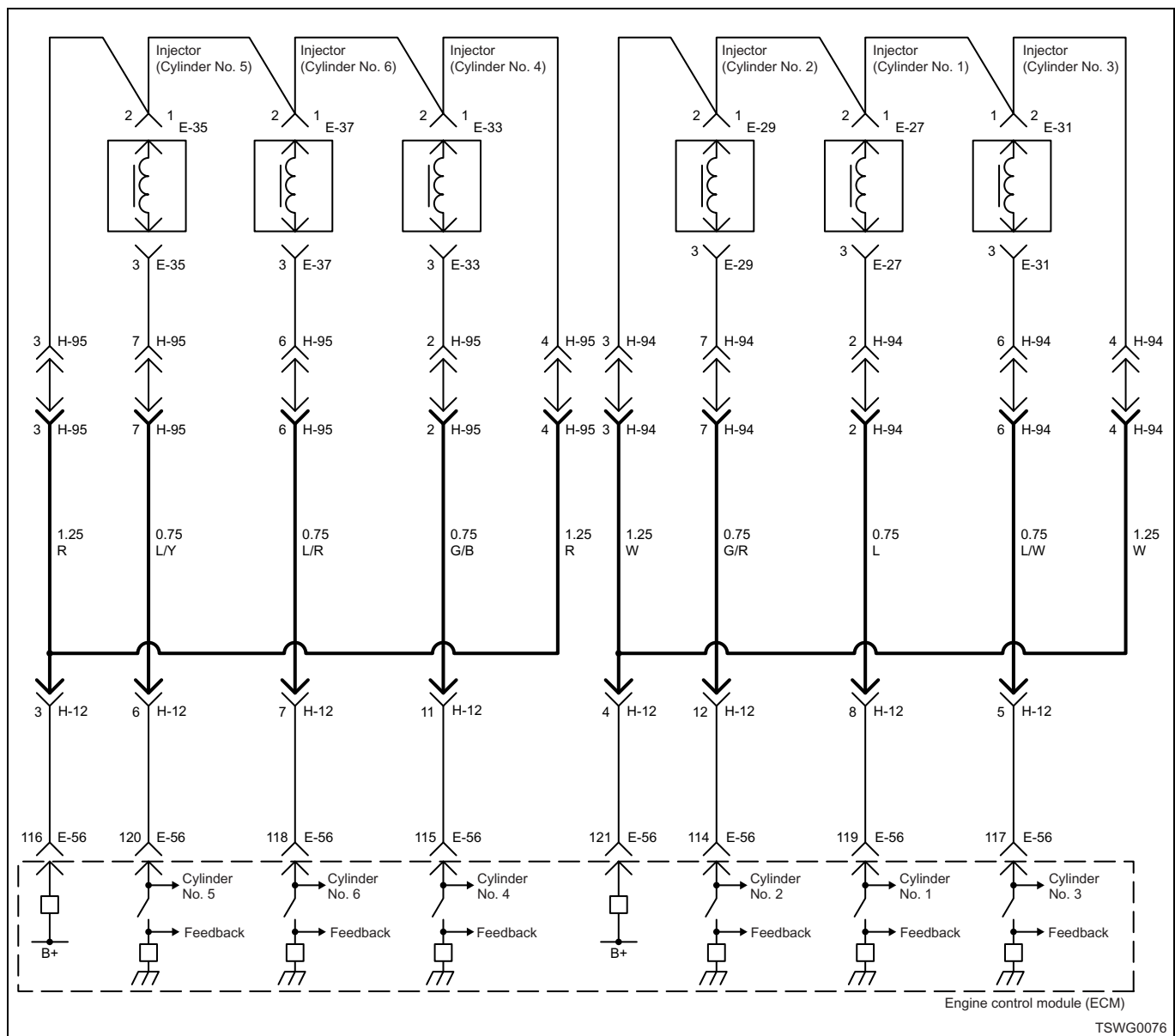
1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5	Open circuit/ high resistance	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	121 - Female-side terminal (4H: No. 1, 6H: No. 3)	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	121 - Ground	10MΩ or more	100Ω or less
9	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	119 - Ground	10MΩ or more	100Ω or less

10D-477 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
10	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	114 - Ground	10MΩ or more	100Ω or less
11	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	117 - Ground	10MΩ or more	100Ω or less
18	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	119 - Ground	0V	18V or more
19	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	114 - Ground	0V	18V or more
20	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	117 - Ground	0V	18V or more
21	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	121 - Ground	0V	18V or more

6HK1



Description of circuit

The COMMON circuit is provided to supply the power supply voltage pressurized in the charge circuit inside the ECM to the injector, and is divided in to two systems (4H: 2 cylinders each, 6H: 3 cylinders each). The COMMON 2 circuit supplies the power supply voltage to the injectors (4H: No. 3, No. 4 cylinders, 6H: No. 4, No. 5, No. 6 cylinders). The ECM sets the DTC when faults are detected simultaneously for all the injector drive circuits of COMMON 2 system.

Main trouble symptom

- Intense engine vibration
- Rough idling
- Output lowering
- Engine blow up fault
- Engine stall possible

Preconditions when DTC is set

- Main relay power supply voltage is 18V or more.
- 70 rpm or more
- None of the following DTC sets are detected; P0612, P1262 and P0204; P0612, P1262 and P0205; P0612, P1262 and P0206.

DTC set condition

- None of injector monitor input signal for COMMON 2 system exists for 3 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

Common 2 stop (#2, #3 cylinders stopped), EGR stopped (4HK1)

Common 2 stop (#4, #5, #6 cylinders stopped), EGR stopped (6HK1)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF". 2. Disconnect the ECM-side harness connector from the coupling connector (4H: H-94, 6H: H-95). 3. Connect the DMM between the injector power supply 2 circuit and the ground. 4. Turn the key switch to "ON". 4H: H94 female-side No. 3 6H: H95 female-side No. 3 Is the DMM indication more than the specified value?	7.0V	Go to Step 3.	Go to Step 4.
3	1. Turn the key switch to "OFF". 2. Disconnect the ECM-side harness connector from the coupling connector (4H: H-94, 6H: H-95). 3. Measure the resistance between the injector harness connector terminals. 4H: H94 male-side No. 3 and No. 2 6H: H95 male-side No. 3 and No. 4 Is the resistance less than the specified value?	1.0Ω	Go to Step 6.	Go to Step 22.
4	Check for installation condition of the injector harness connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 5.

10D-481 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
5	- Check for followings in the injector power supply 2 circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". - Open circuit - High resistance - Short circuit to ground - If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
6	- Turn the key switch to "OFF". - Disconnect the ECM-side harness connector from the coupling connector (4H: H-94, 6H: H-95). - Measure the resistance between the No. 4 cylinder (4H: No. 2 cylinder) injector drive circuit and the ground. 4H: H94 male-side No. 7 6H: H95 male-side No. 2 Is the resistance more than the specified value?	10MΩ	Go to Step 7.	Go to Step 9.
7	- Turn the key switch to "OFF". - Disconnect the ECM-side harness connector from the coupling connector (4H: H-94, 6H: H-95). - Measure the resistance between the No. 5 cylinder (4H: No. 3 cylinder) injector drive circuit and the ground. 4H: H94 male-side No. 6 6H: H95 male-side No. 7 Is the resistance more than the specified value?	10MΩ	4H: Go to Step 12. 6H: Go to Step 8.	Go to Step 10.
8	- Turn the key switch to "OFF". - Remove the ECM-side harness connector from the coupling connector (H-95). - Measure the resistance between the No. 6 cylinder injector drive circuit and the ground. 6H: H95 male-side No. 6 Is the resistance more than the specified value?	10MΩ	Go to Step 12.	Go to Step 11.
9	- Check the No. 4 cylinder (4H: No. 2 cylinder) injector drive circuit between ECM and coupling connector (4H: H-94, 6H: H-95) for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". - If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.

Electronic control fuel injection system (Common rail type) 10D-482

Step	Action	Value	YES	NO
10	1. Check the No. 5 cylinder (4H: No. 3 cylinder) injector drive circuit between ECM and coupling connector (4H: H-94, 6H: H-95) for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
11	1. Check the No. 6 cylinder injector drive circuit between ECM and coupling connector (H-95) for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
12	1. Remove the cylinder head cover. 2. Check for installation condition of the injector harness. 3. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 13.
13	1. Remove the injector harness from the injector. 4H: No. 2 cylinder, No. 3 cylinder 6H: No. 4 cylinder, No. 5 cylinder, No. 6 cylinder 2. Measure the resistance between each injector terminal and the ground. Is the resistance more than the specified value?	10MΩ	Go to Step 14.	Go to Step 23.
14	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (4H: H-94, 6H: H-95). 3. Connect the DMM between the No. 4 cylinder (4H: No. 2 cylinder) injector drive circuit and the ground. 4H: H94 female-side No. 7 6H: H95 female-side No. 2 4. Turn the key switch to "ON". Is the DMM indication specified value?	0V	Go to Step 18.	Go to Step 15.

10D-483 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
15	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (4H: H-94, 6H: H-95). 3. Connect the DMM between the No. 5 cylinder (4H: No. 3 cylinder) injector drive circuit and the ground. 4H: H94 female-side No. 6 6H: H95 female-side No. 7 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	0V	Go to Step 19.	4H: Go to Step 17. 6H: Go to Step 16.
16	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (H-95). 3. Connect the DMM between the No. 6 cylinder injector drive circuit and the ground. 6H: H95 female-side No. 6 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	0V	Go to Step 20.	Go to Step 17.
17	1. Turn the key switch to "OFF". 2. Remove the injector-side harness connector from the coupling connector (4H: H-94, 6H: H-95). 3. Connect the DMM between the injector power supply 2 circuit and the ground. 4H: H94 female-side No. 3 6H: H95 female-side No. 3 4. Turn the key switch to "ON". Is the DMM indication less than the specified value?	7.0V	Go to Step 22.	Go to Step 21.
18	1. Check the No. 4 cylinder (4H: No. 2 cylinder) injector drive circuit between ECM and coupling connector (4H: H-94, 6H: H-95) for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.

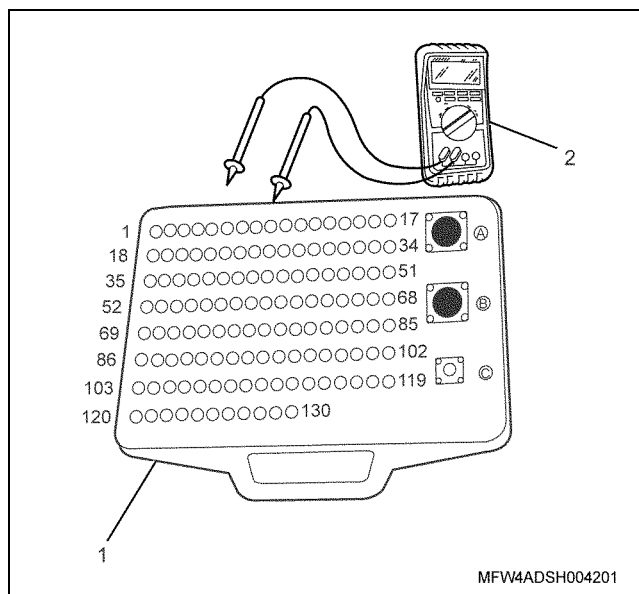
Step	Action	Value	YES	NO
19	1. Check the No. 5 cylinder (4H: No. 4 cylinder) injector drive circuit between ECM and coupling connector (4H: H-94, 6H: H-95) for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
20	1. Check the No. 6 cylinder injector drive circuit between ECM and coupling connector (H-95) for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
21	1. Check the injector power supply 2 circuit between ECM and coupling connector (4H: H-94, 6H: H-95) for short circuit to the power supply circuit or ignition power supply circuit, using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 27.	Go to Step 24.
22	Replace the injector harness. Is the procedure completed?	—	Go to Step 27.	—
23	Replace the injector. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 27.	—
24	Is EMPS available?	—	Go to Step 25.	Go to Step 26.

10D-485 Electronic control fuel injection system (Common rail type)

Step	Action	Value	YES	NO
25	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 27.	Go to Step 26.
26	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 27.	—
27	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1262 detected?	—	Go to Step 2.	Go to Step 28.
28	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



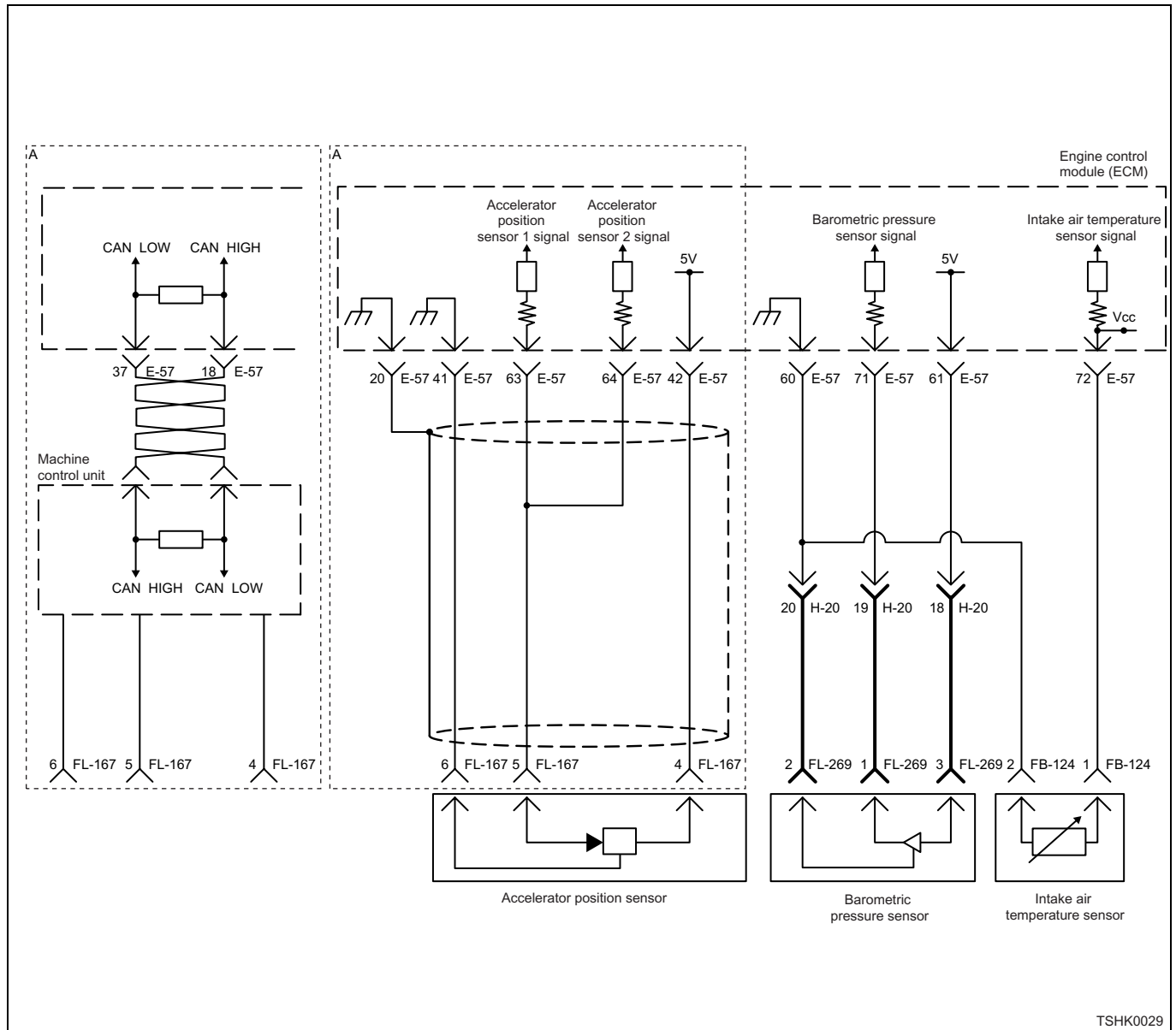
Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5	Open circuit/ high resistance	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	116 - Female-side terminal (4H: H94 No.3, 6H: H95 No.3)	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	116 - Ground	10MΩ or more	100Ω or less
9	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	115 - Ground	10MΩ or more	100Ω or less

10D-487 Electronic control fuel injection system (Common rail type)

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
10	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	120 - Ground	10MΩ or more	100Ω or less
11	Short circuit to ground	Resistance measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	118 - Ground	10MΩ or more	100Ω or less
18	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	115 - Ground	0V	18V or more
19	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	120 - Ground	0V	18V or more
20	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	118 - Ground	0V	18V or more
21	Short circuit to power supply circuit	Voltage measurement	- Remove the ECM-side harness connector from the coupling connector. - Key switch "OFF"	116 - Ground	0V	18V or more

DTC: P1271 (Flash code 24)**Accelerator sensor 1-2 comparison fault****Description of circuit**

The accelerator position (AP) sensor is installed to the accelerator pedal. The AP sensor is the potentiometer-type sensor, and the value of output voltage changes according to the accelerator opening angle. Two AP sensors are installed, each of which includes following circuits.

- 5-V power supply circuit
- Ground circuit
- AP sensor signal circuit

The ECM provides 5 V to the AP sensor through 5-V power supply circuit, and grounds to the inside of the ECM through ground circuit. Also, the AP sensor outputs the signal voltage to the ECM through AP sensor signal circuit. When the accelerator opening angle is large, the AP sensor 1 outputs high voltage, whereas the AP sensor 2 outputs low voltage.

The ECM sets the DTC when the difference in the accelerator opening angle is large between which is detected based on the AP sensor 1 signal, and which is detected based on the AP sensor 2 signal.

Main trouble symptom

1 system fault: No backup

2 systems fault: Accelerator opening angle is controlled to 0%.

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Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630, P1631, P1271, P1277, P1278, P1282, or P1283 is not detected.

DTC set condition

Difference in opening angle between accelerator sensors 1 and 2 is 45% or more for 3 seconds or more.

- [Accelerator sensor 1 voltage + Accelerator sensor 2 voltage] is higher than 6.4 V.
- [Accelerator sensor 1 voltage + Accelerator sensor 2 voltage] is lower than 3.6 V.

Action taken when DTC is set

- The diagnosis lamp does not come on.

Back-up mode

- 1 system fault...No back-up
- 2 system fault...Accelerator opening angle is controlled to 0%.

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).

- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.
3. Measure at the harness connector-side.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF" for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC P1271 detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Connect the DMM between the sensor power supply terminal of the AP sensor connector and the ground. 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	4.7V	Go to Step 5.	Go to Step 6.
4	Is the scan tool available?	—	Go to Step 5.	Go to Step 18.

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Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Short between the sensor power supply terminal of the AP sensor connector and the signal terminal using jump cable. 4. Turn the key switch to "ON". 5. Check for "Accelerator sensor 1" on the data display using scan tool. Is the "Accelerator sensor 1" more than the specified value?	4.7V	Go to Step 8.	Go to Step 7.
6	1. Check for high resistance in the power supply circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 11.
7	1. Check for high resistance in the signal circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 11.
8	1. Check for high resistance in the ground circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 11.
9	1. Check for high resistance in the signal circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 11.
10	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Check the AP sensor connector terminal for intermittent trouble or poor contact. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 12.

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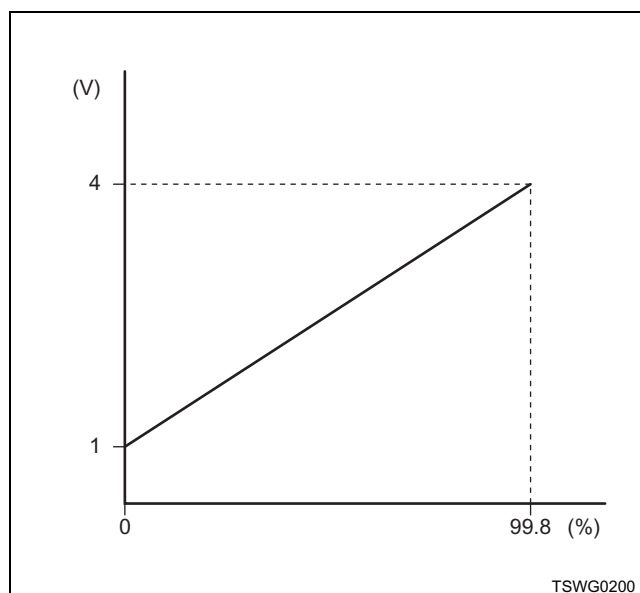
Step	Action	Value	YES	NO
11	1. Turn the key switch to "OFF". 2. Remove the ECM. 3. Check the ECM terminals (41, 63, 42, 60, 64, 61) for intermittent trouble or poor contact. 4. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 16.	Go to Step 13.
12	Replace the AP sensor. Is the procedure completed?	—	Go to Step 16.	—
13	Is EMPS available?	—	Go to Step 14.	Go to Step 15.
14	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 15.
15	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	—
16	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1271 detected?	—	Go to Step 2.	Go to Step 17.
17	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Step	Action	Value	YES	NO
18	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Turn the key switch to "ON". 4. Connect the DMM between the sensor power supply terminal of the AP sensor connector and the signal circuit. Is the DMM indication more than the specified value?	4.7V	Go to Step 8.	Go to Step 7.

About AP sensor

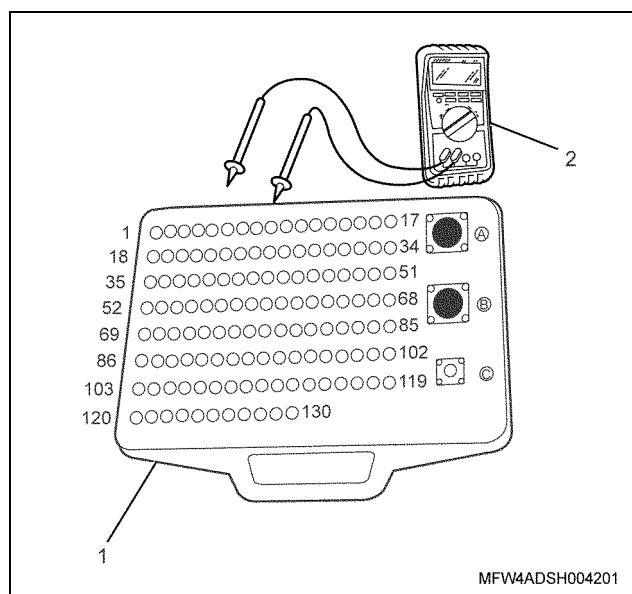
Refer to the machine's manual for installing position of the AP sensor.

Characteristics of AP sensor



Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



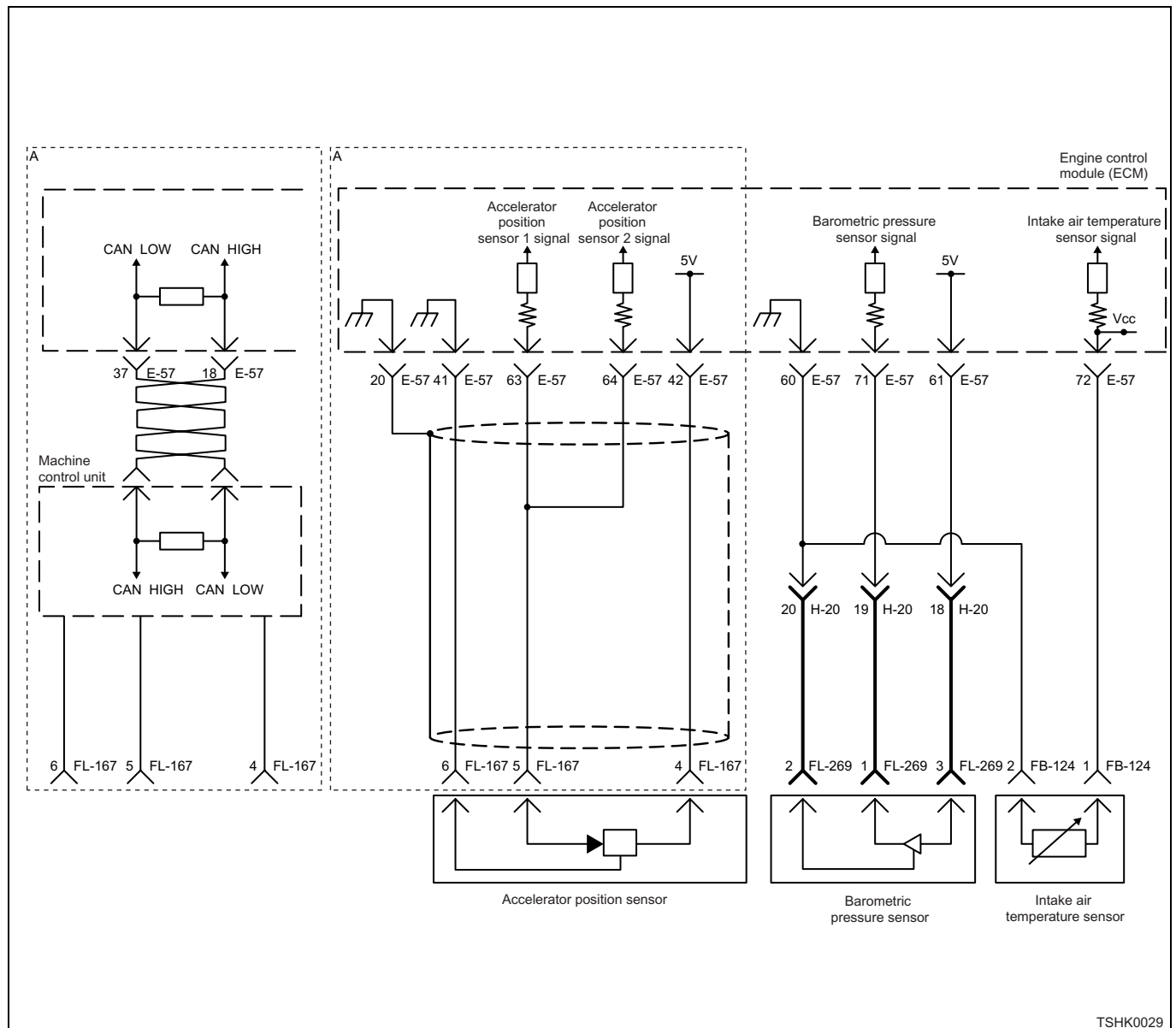
Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	42 - Sensor connector sensor power supply terminal	100Ω or less	10MΩ or more
7	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	41 - Sensor connector sensor ground terminal	100Ω or less	10MΩ or more
8	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	63 - Sensor connector sensor signal terminal	100Ω or less	10MΩ or more

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Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
9	Open circuit/ high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	64 - Sensor connector sensor signal terminal	100Ω or less	10MΩ or more

DTC: P1277 (Flash code 24)**Accelerator sensor 1 fault (low voltage fault)****Description of circuit**

The accelerator position (AP) sensor is installed to the accelerator pedal. The AP sensor is the potentiometer-type sensor, and the value of output voltage changes according to the accelerator opening angle. The AP sensor includes following circuits.

- 5-V power supply circuit
- Ground circuit
- AP sensor signal circuit

The ECM provides 5 V to the AP sensor through 5-V power supply circuit, and grounds to the inside of the ECM through ground circuit. Also, the AP sensor outputs the signal voltage to the ECM through AP sensor signal circuit. The AP sensor 1 outputs high voltage when the accelerator opening angle is large. The ECM sets the DTC when the signal voltage from the AP sensor 1 is less than the normal range.

Main trouble symptom

- 1 system fault: No backup
- 2 systems fault: Accelerator opening angle is controlled to 0%.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630, P1277, or P1631 is not detected.

DTC set condition

- AP sensor 1 voltage is 0.2V or less for 1 second or more.

Action taken when DTC is set

- The diagnosis lamp does not come on.

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Back-up mode

- 1 system fault...No back-up
- 2 system fault...Accelerator opening angle is controlled to 0%.

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

When the DTC P1282 is detected at the same time, the accelerator pedal position sensor and the accelerator pedal position sensor signal circuit (before the bifurcation point) may be faulty.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector

- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Accelerator sensor 1” displays less than the specified value. If more than the specified value, identify the cause by referring to “Diagnostic aid”.

5. If the “Accelerator sensor 1” displays more than the specified value when terminals between the AP sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to “ON”. 2. Check for “Accelerator sensor 1” on the data display using scan tool. Is the “Accelerator sensor 1” less than the specified value?	0.2V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.

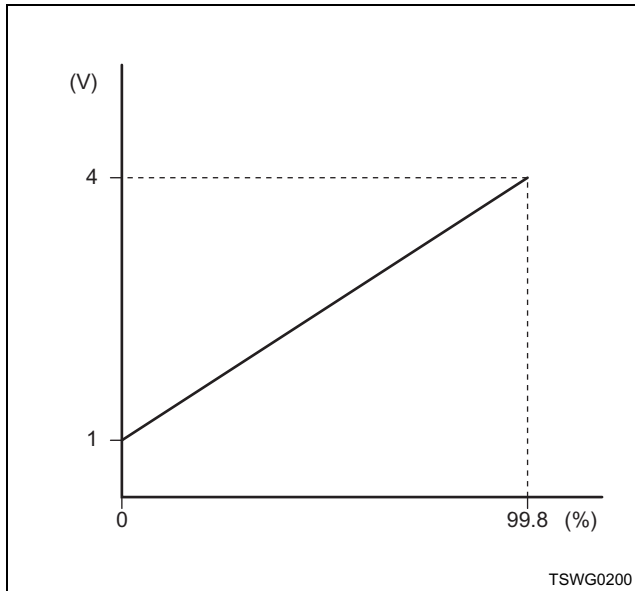
Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Short between the sensor power supply terminal of the AP sensor connector and the sensor 1 signal terminal using jump cable. 4. Turn the key switch to "ON". 5. Check for "Accelerator sensor 1" on the data display using scan tool. Is the "Accelerator sensor 1" more than the specified value?	4.8V	Go to Step 8.	Go to Step 6.
6	1. Check for followings in the power supply circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to AP sensor ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the AP sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.

10D-497 Electronic control fuel injection system (Common rail type)

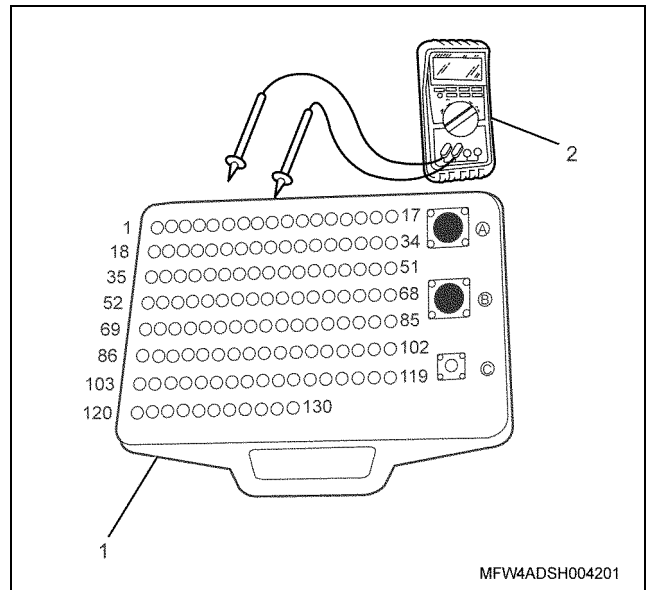
Step	Action	Value	YES	NO
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P1277 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Turn the key switch to “ON”. 2. Check for “Accelerator sensor 1” on the data display. Is the “Accelerator sensor 1” less than the specified value?	0.2V	Go to Step 15.	Go to “Diagnostic aid”.
15	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 16.
16	1. Turn the key switch to “OFF”. 2. Disconnect the AP sensor connector. 3. Short between the sensor power supply terminal of the AP sensor connector and the sensor 1 signal terminal using jump cable. 4. Turn the key switch to “ON”. 5. Check for “Accelerator sensor 1” on the data display. Is the “Accelerator sensor 1” more than the specified value?	4.8V	Go to Step 8.	Go to Step 6.

About AP sensor

Refer to the machine's manual for installing position of the AP sensor.

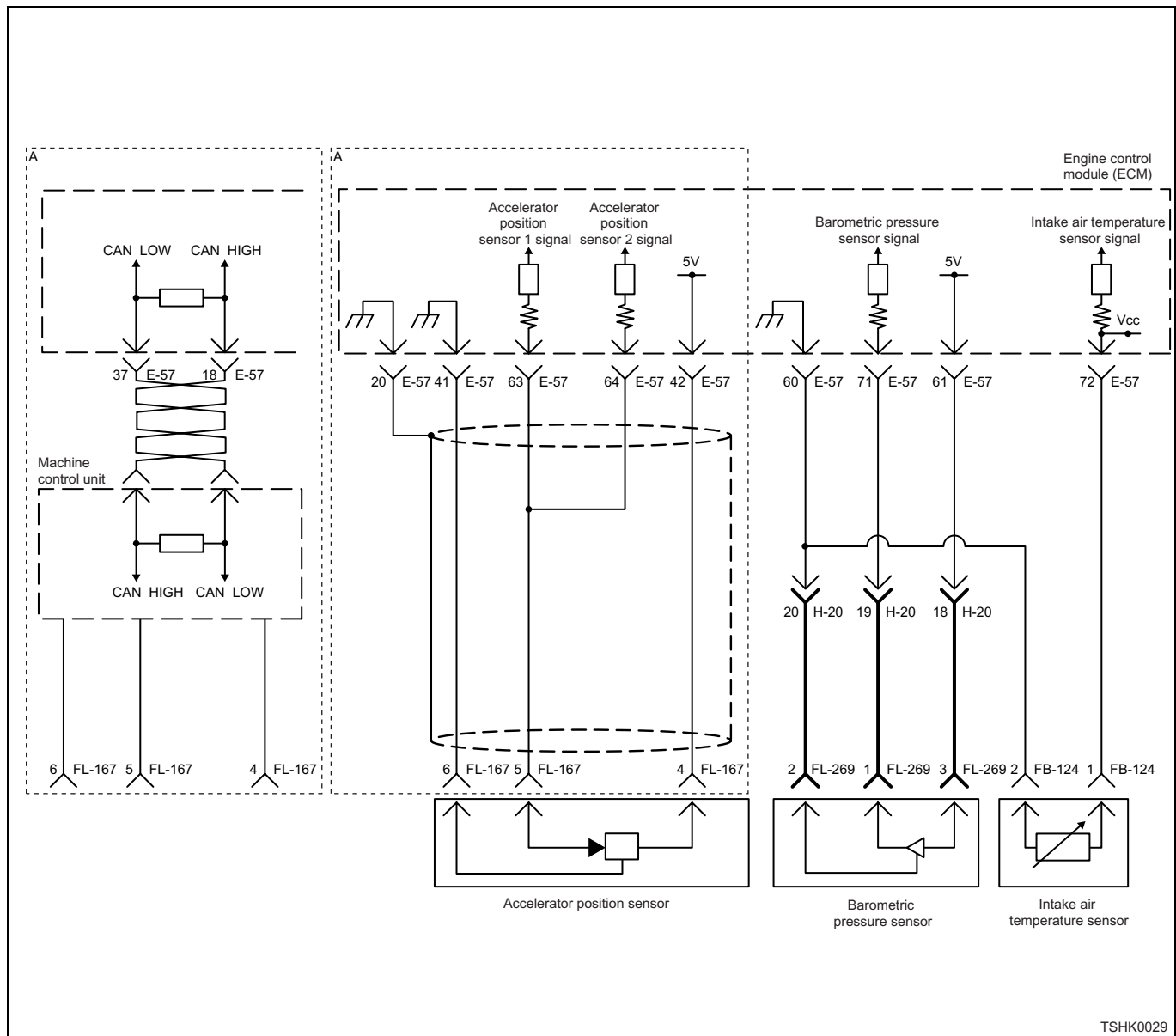
Characteristics of AP sensor**Breaker box inspection procedure**

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

**Name**

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	42 - Sensor connector sensor 1 power supply terminal	100Ω or less	10MΩ or more
7	Short circuit to ground circuit/ ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	63 - 41 63 - Ground	10MΩ or more	100Ω or less
	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	63 - Sensor connector sensor 1 signal terminal	100Ω or less	10MΩ or more

DTC: P1278 (Flash code 24)**Accelerator sensor 1 fault (high voltage fault)****Description of circuit**

The accelerator position (AP) sensor is installed to the accelerator pedal. The AP sensor is the potentiometer-type sensor, and the value of output voltage changes according to the accelerator opening angle. The AP sensor includes following circuits.

- 5-V power supply circuit
- Ground circuit
- AP sensor signal circuit

The ECM provides 5 V to the AP sensor through 5-V power supply circuit, and grounds to the inside of the ECM through ground circuit. Also, the AP sensor outputs the signal voltage to the ECM through AP sensor signal circuit. The AP sensor 1 outputs high voltage when the accelerator opening angle is large. The ECM sets the DTC when the signal voltage from the AP sensor 1 is more than the normal range.

Main trouble symptom

- 1 system fault: No backup
- 2 systems fault: Accelerator opening angle is controlled to 0%.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630, P1278, or P1631 is not detected.

DTC set condition

- AP sensor 1 voltage is 4.9V or more for 1 second or more.

Action taken when DTC is set

- The diagnosis lamp does not come on.

Back-up mode

- 1 system fault...No back-up
- 2 system fault...Accelerator opening angle is controlled to 0%.

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

When the DTC P1283 is detected at the same time, the accelerator pedal position sensor and accelerator pedal position sensor signal circuit (before the bifurcation point) may be faulty.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector

- Defective harness routing
 - Worn harness cladding
 - Wire disconnection inside harness cladding
- Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the "Accelerator sensor 1" displays more than the specified value. If less than the specified value, identify the cause by referring to "Diagnostic aid".

5. If the "Accelerator sensor 1" displays less than the specified value when the AP sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to "ON". 2. Check for "Accelerator sensor 1" on the data display using scan tool. Is the "Accelerator sensor 1" more than the specified value?	4.9V	Go to Step 4.	Go to "Diagnostic aid".
4	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.
5	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Turn the key switch to "ON". 4. Check for "Accelerator sensor 1" on the data display using scan tool. Is the "Accelerator sensor 1" less than the specified value?	0.1V	Go to Step 8.	Go to Step 6.

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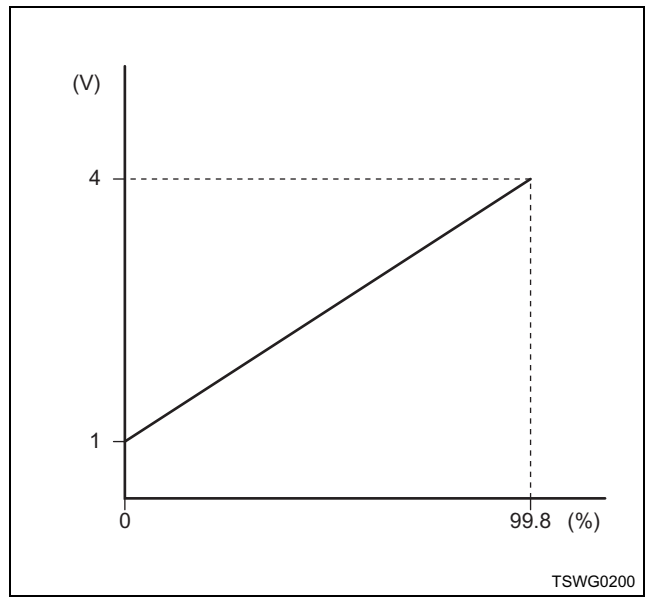
Step	Action	Value	YES	NO
6	1. Check the signal circuit between ECM and AP sensor 1 for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the AP sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the ground circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the AP sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—

Step	Action	Value	YES	NO
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1278 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Turn the key switch to "ON". 2. Check for "Accelerator sensor 1" on the data display. Is the "Accelerator sensor 1" more than the specified value?	4.9V	Go to Step 15.	Go to "Diagnostic aid".
15	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 16.
16	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Turn the key switch to "ON". 4. Check for "Accelerator sensor 1" on the data display. Is the "Accelerator sensor 1" less than the specified value?	0.1V	Go to Step 8.	Go to Step 6.

About AP sensor

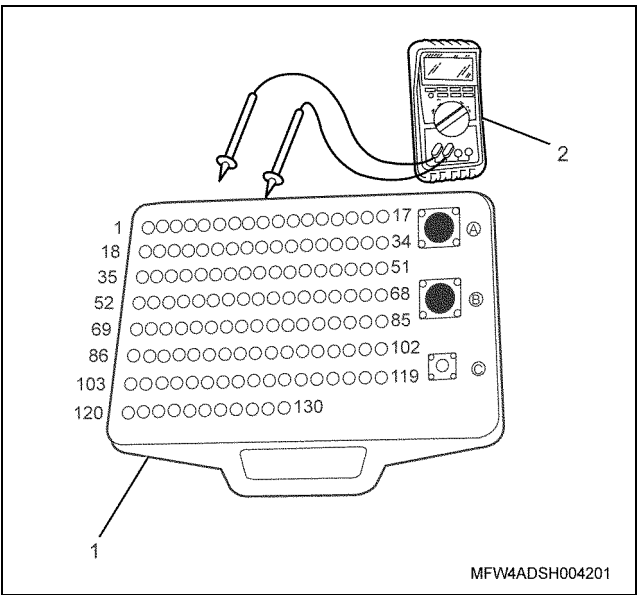
Refer to the machine's manual for installing position of the AP sensor.

Characteristics of AP sensor



Breaker box inspection procedure

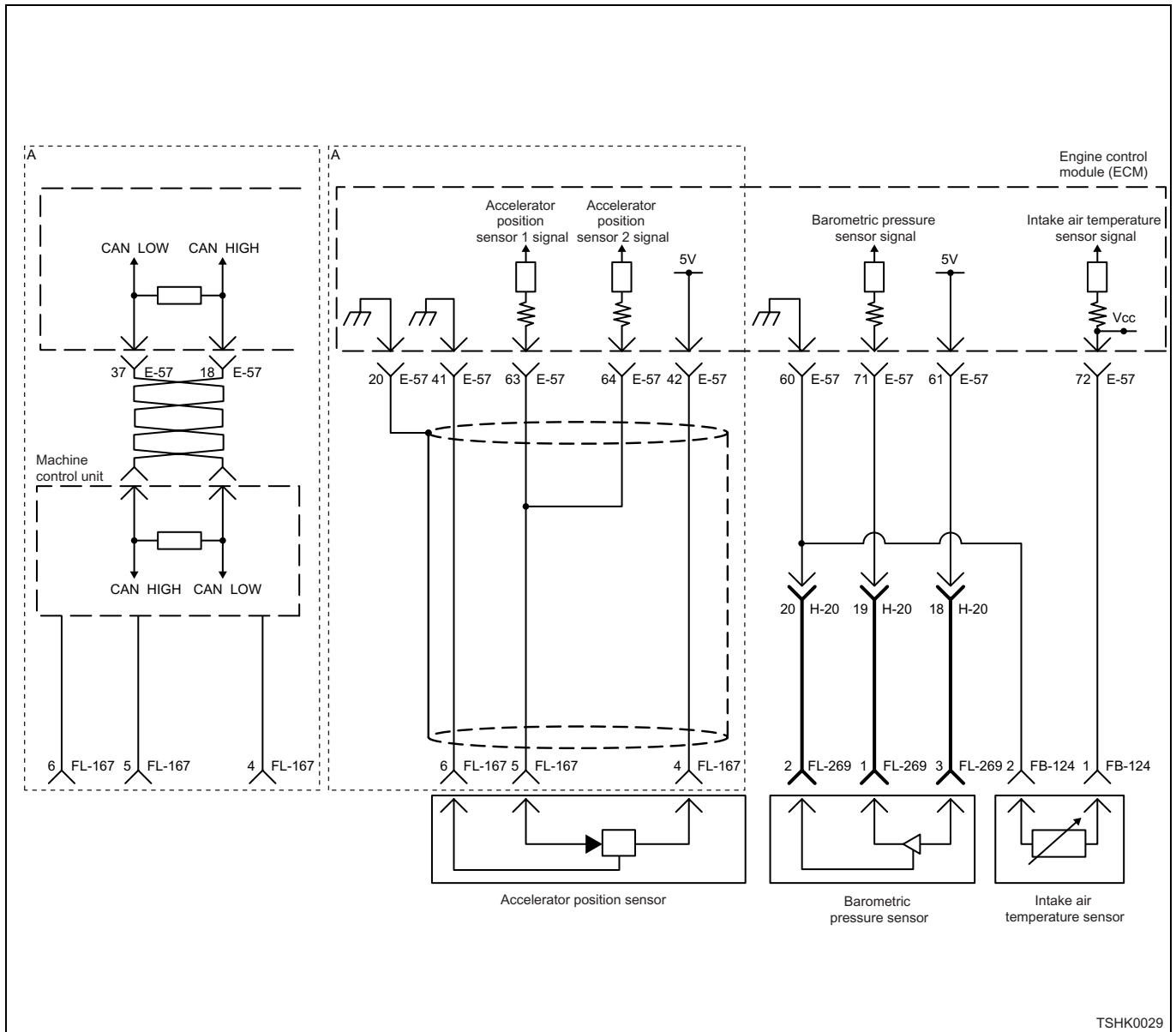
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	63 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	41 - Sensor connector sensor 1 ground terminal	100Ω or less	10MΩ or more

DTC: P1282 (Flash code 24)**Accelerator sensor 2 fault (low voltage fault)**

TSHK0029

Description of circuit

The accelerator position (AP) sensor is installed to the accelerator pedal. The AP sensor is the potentiometer-type sensor, and the value of output voltage changes according to the accelerator opening angle. The AP sensor includes following circuits.

- 5-V power supply circuit
- Ground circuit
- AP sensor signal circuit

The ECM provides 5 V to the AP sensor through 5-V power supply circuit, and grounds to the inside of the ECM through ground circuit. Also, the AP sensor outputs the signal voltage to the ECM through AP sensor signal circuit. The AP sensor 1 outputs high voltage when the accelerator opening angle is large. The ECM sets the DTC when the signal voltage from the AP sensor 2 is less than the normal range.

Main trouble symptom

- 1 system fault: No backup
- 2 systems fault: Accelerator opening angle is controlled to 0%.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630, P1282, P1631 is not detected.

DTC set condition

- AP sensor 2 voltage is 0.2V or less for 1 second or more.

Action taken when DTC is set

- The diagnosis lamp does not come on.

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Back-up mode

- 1 system fault...No back-up
- 2 system fault...Accelerator opening angle is controlled to 0%.

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

When the DTC P1277 is detected at the same time, the accelerator pedal position sensor and accelerator pedal position sensor signal circuit (before the bifurcation point) may be faulty.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector

- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the “Accelerator sensor 2” displays less than the specified value. If more than the specified value, identify the cause by referring to “Diagnostic aid”.

5. If the “Accelerator sensor 2” displays more than the specified value when terminals between the AP sensor connector are shorted, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to “ON”. 2. Check for “Accelerator sensor 2” on the data display using scan tool. Is the “Accelerator sensor 2” less than the specified value?	0.2V	Go to Step 4.	Go to “Diagnostic aid”.
4	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.

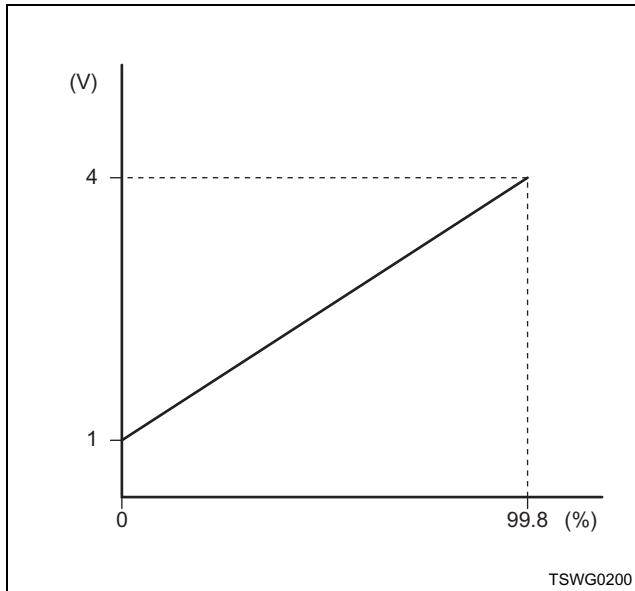
Step	Action	Value	YES	NO
5	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Short between the sensor power supply terminal of the AP sensor connector and the sensor 2 signal terminal using jump cable. 4. Turn the key switch to "ON". 5. Check for "Accelerator sensor 2" on the data display using scan tool. Is the "Accelerator sensor 2" more than the specified value?	4.8V	Go to Step 8.	Go to Step 6.
6	1. Check for followings in the power supply circuit between ECM and AP sensor 1 using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the signal circuit between ECM and AP sensor 1 using breaker box or DMM. Refer to "Breaker box inspection procedure". • Short circuit to AP sensor 1 ground circuit • Short circuit to ground • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the AP sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.

10D-507 Electronic control fuel injection system (Common rail type)

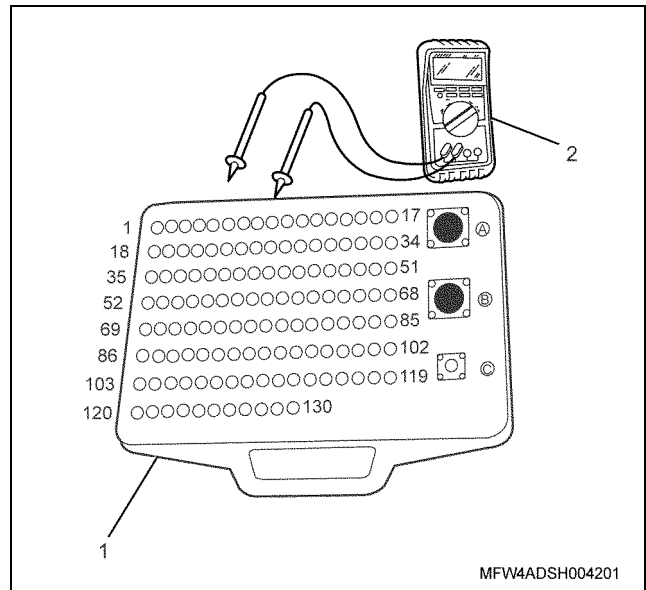
Step	Action	Value	YES	NO
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 3. Turn the key switch to “OFF” for more than 10 seconds. 4. Test run with the “Preconditions when DTC is set”. 5. Check the DTC. Is DTC P1282 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Turn the key switch to “ON”. 2. Check for “Accelerator sensor 2” on the data display. Is the “Accelerator sensor 2” less than the specified value?	0.2V	Go to Step 15.	Go to “Diagnostic aid”.
15	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 16.
16	1. Turn the key switch to “OFF”. 2. Disconnect the AP sensor connector. 3. Short between the sensor power supply terminal of the AP sensor connector and the sensor 2 signal terminal using jump cable. 4. Turn the key switch to “ON”. 5. Check for “Accelerator sensor 2” on the data display. Is the “Accelerator sensor 2” more than the specified value?	4.8V	Go to Step 8.	Go to Step 6.

About AP sensor

Refer to the machine's manual for installing position of the AP sensor.

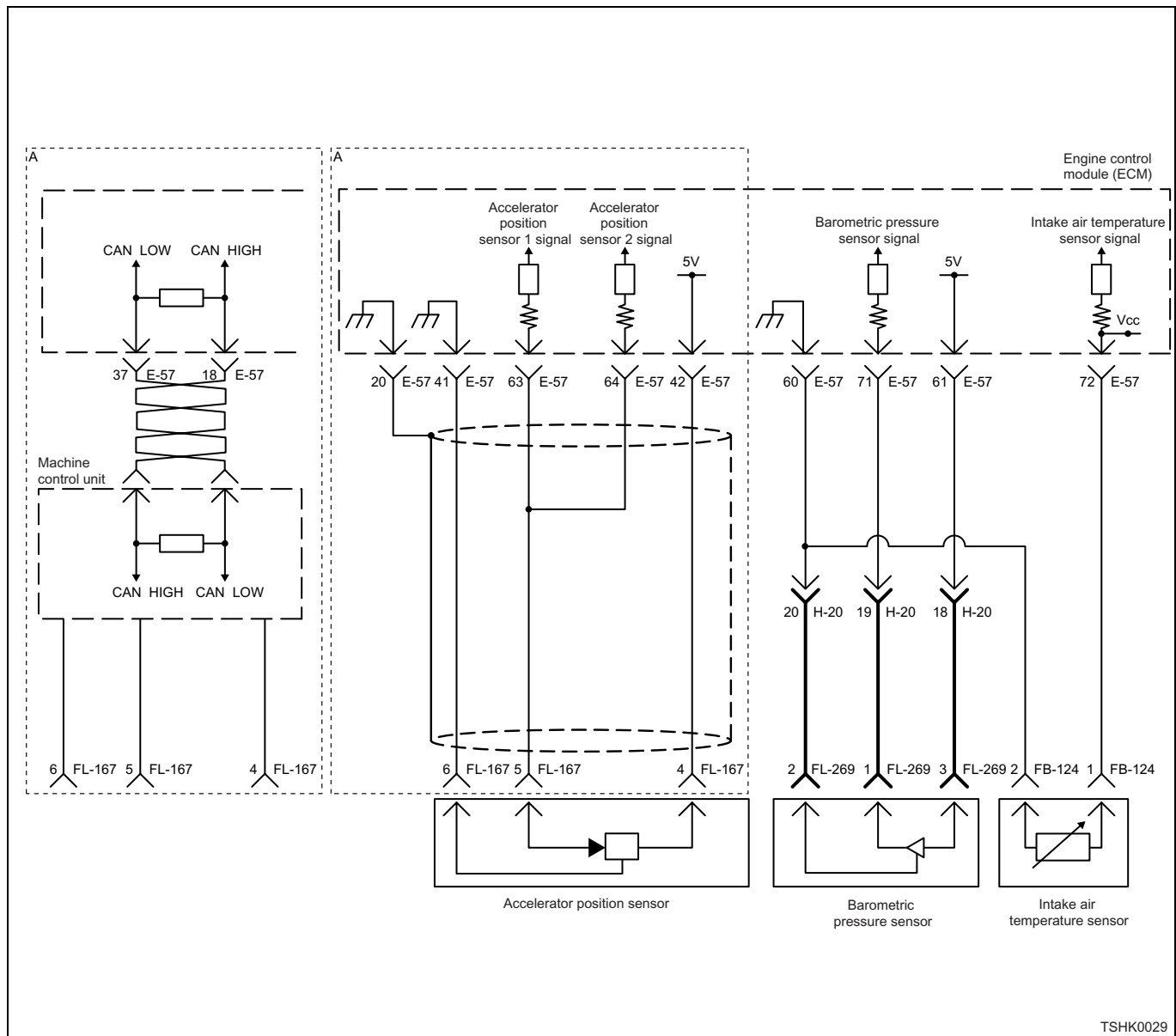
Characteristics of AP sensor**Breaker box inspection procedure**

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

**Name**

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	61 - Sensor connector sensor 1 power supply terminal	100Ω or less	10MΩ or more
7	Short circuit to ground circuit/ ground	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	64 - 61 64 - Ground	10MΩ or more	100Ω or less
	Open circuit/ high resistance	Resistance measurement	- Disconnect the sensor connector. - Key switch "OFF"	64 - Sensor connector sensor 1 signal terminal	100Ω or less	10MΩ or more

DTC: P1283 (Flash code 24)**Accelerator sensor 2 fault (high voltage fault)****Description of circuit**

The accelerator position (AP) sensor is installed to the accelerator pedal. The AP sensor is the potentiometer-type sensor, and the value of output voltage changes according to the accelerator opening angle. The AP sensor includes following circuits.

- 5-V power supply circuit
- Ground circuit
- AP sensor signal circuit

The ECM provides 5 V to the AP sensor through 5-V power supply circuit, and grounds to the inside of the ECM through ground circuit. Also, the AP sensor outputs the signal voltage to the ECM through AP sensor signal circuit. The AP sensor 1 outputs high voltage when the accelerator opening angle is large. The ECM sets the DTC when the signal voltage from the AP sensor 2 is more than the normal range.

Main trouble symptom

- 1 system fault: No backup
- 2 systems fault: Accelerator opening angle is controlled to 0%.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630, P1283, or P1631 is not detected.

DTC set condition

- AP sensor 2 voltage is 4.9V or more for 1 second or more.

Action taken when DTC is set

- The diagnosis lamp does not come on.

Back-up mode

- 1 system fault...No back-up
- 2 system fault...Accelerator opening angle is controlled to 0%.

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

When the DTC P1278 is detected at the same time, the accelerator pedal position sensor and accelerator pedal position sensor signal circuit (before the bifurcation point) may be faulty.

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector

- Defective harness routing
 - Worn harness cladding
 - Wire disconnection inside harness cladding
- Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. In the case of current trouble, the "Accelerator sensor 2" displays more than the specified value. If less than the specified value, identify the cause by referring to "Diagnostic aid".

5. If the "Accelerator sensor 2" displays less than the specified value when the AP sensor connector is removed, the circuit beyond the sensor is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 14.
3	1. Turn the key switch to "ON". 2. Check for "Accelerator sensor 2" on the data display using scan tool. Is the "Accelerator sensor 2" more than the specified value?	4.9V	Go to Step 4.	Go to "Diagnostic aid".
4	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 5.
5	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Turn the key switch to "ON". 4. Check for "Accelerator sensor 2" on the data display using scan tool. Is the "Accelerator sensor 2" less than the specified value?	0.1V	Go to Step 8.	Go to Step 6.

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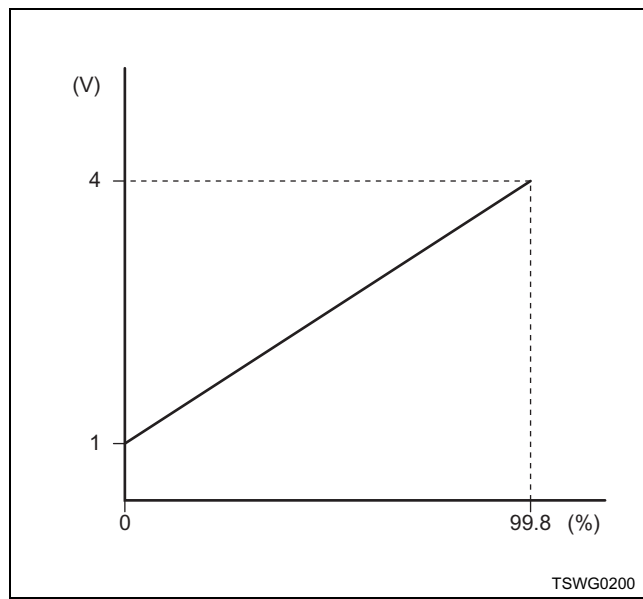
Step	Action	Value	YES	NO
6	1. Check the signal circuit between ECM and AP sensor 1 for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". Important: If the AP sensor circuit is shorted to the power supply circuit, the sensor may be broken. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 7.
7	1. Check for followings in the ground circuit between ECM and AP sensor using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 9.
8	Replace the AP sensor. Is the procedure completed?	—	Go to Step 12.	—
9	Is EMPS available?	—	Go to Step 10.	Go to Step 11.
10	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	Go to Step 11.
11	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 12.	—

Step	Action	Value	YES	NO
12	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1283 detected?	—	Go to Step 2.	Go to Step 13.
13	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
14	1. Turn the key switch to "ON". 2. Check for "Accelerator sensor 2" on the data display. Is the "Accelerator sensor 2" more than the specified value?	4.9V	Go to Step 15.	Go to "Diagnostic aid".
15	Check for installation condition of the AP sensor connector, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 16.
16	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Turn the key switch to "ON". 4. Check for "Accelerator sensor 2" on the data display. Is the "Accelerator sensor 2" less than the specified value?	0.1V	Go to Step 8.	Go to Step 6.

About AP sensor

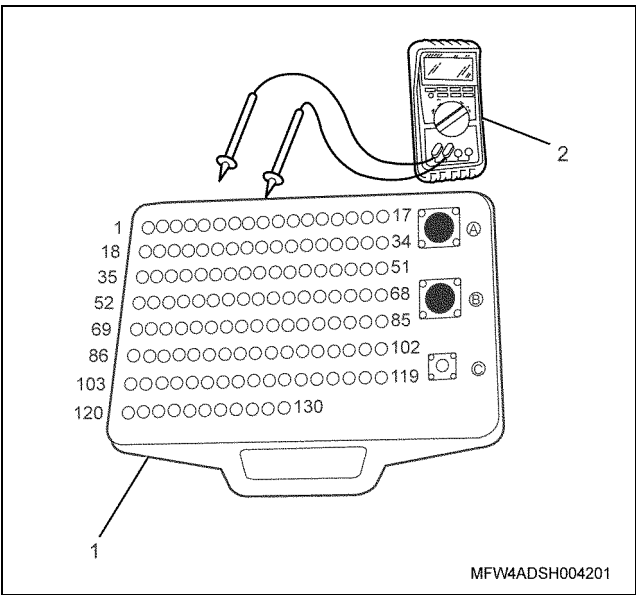
Refer to the machine's manual for installing position of the AP sensor.

Characteristics of AP sensor



Breaker box inspection procedure

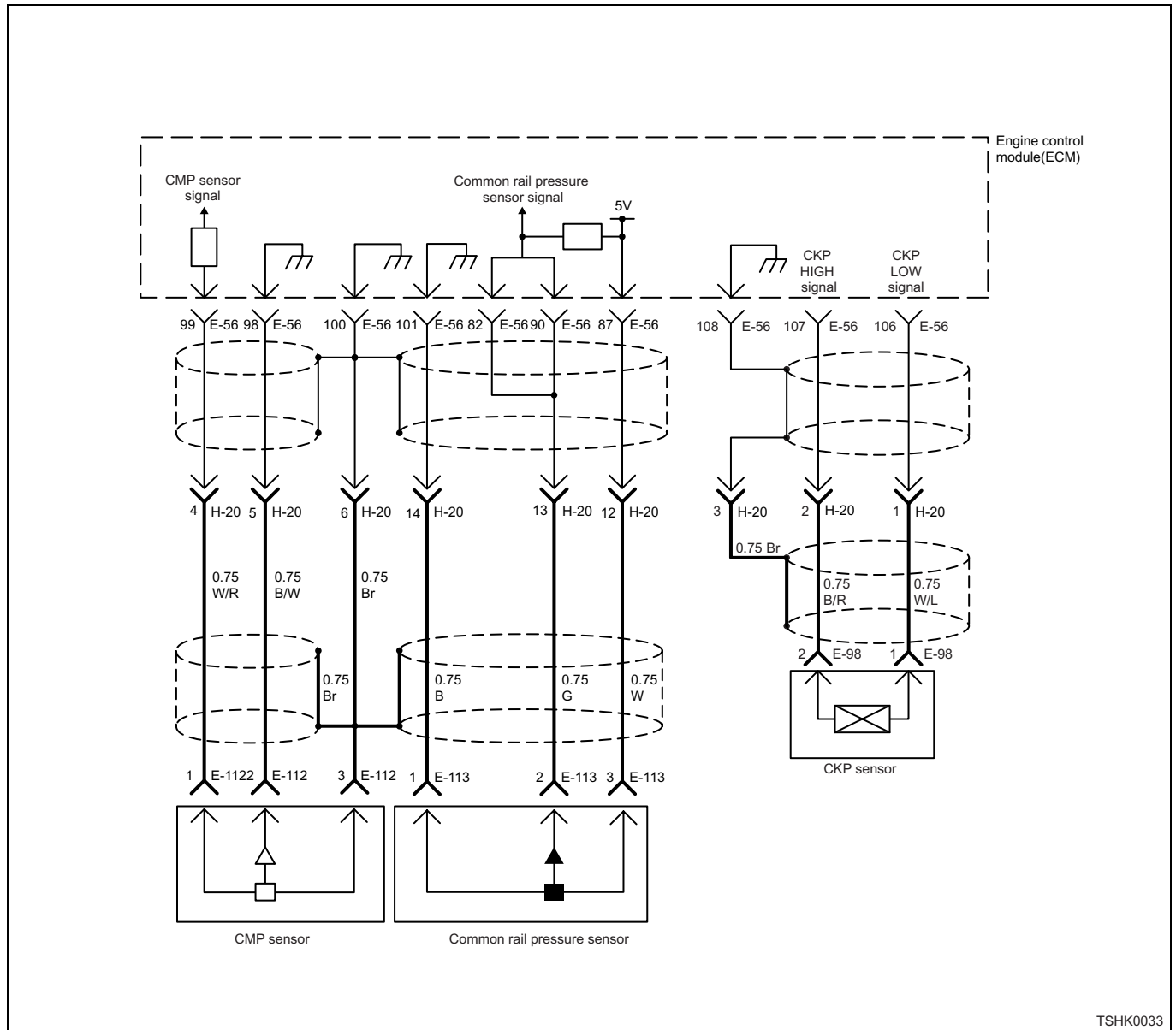
Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	• Disconnect the sensor connector. • Key switch "ON"	64 - Ground	0V	18V or more
7	Open circuit/high resistance	Resistance measurement	• Disconnect the sensor connector. • Key switch "OFF"	60 - Sensor connector sensor 1 ground terminal	100Ω or less	10MΩ or more

DTC: P1345 (Flash code 16)**Cam sensor out of phase**

TSHK0033

Description of circuit

The crankshaft position (CKP) sensor generates pulse when the tooth of the flywheel passes the sensor. Also, the camshaft position (CMP) sensor, the same as CKP sensor, generates pulse when the sensing hole for signal detection installed in the supply pump camshaft gear passes the sensor.

The ECM sets the DTC when the number of pulses for CKP sensor and CMP sensor are normal but mutual pulses do not synchronize.

Main trouble symptom

- Behavior does not change during engine running.
- After engine stalls, engine will not start.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.

- DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected.
- Cam pulse is normal.
- Crank pulse is normal.

DTC set condition

- Correct CMP sensor pulse does not exist in crank gap position.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

Specified back-up value (depending on the machine manufacturer)

10D-515 Electronic control fuel injection system (Common rail type)

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector

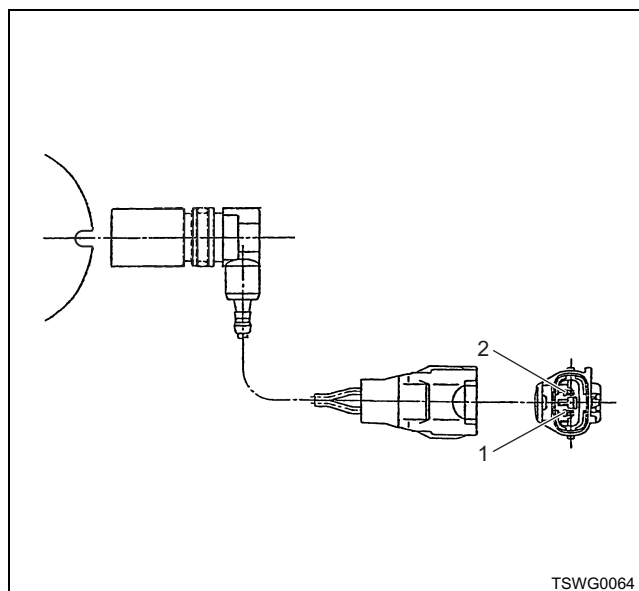
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding
- Excessive air mixed in the fuel.

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

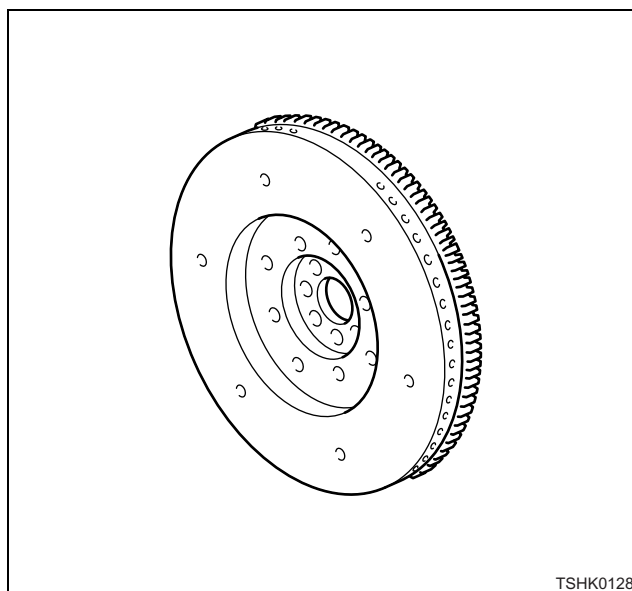
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	1. Check the CMP sensor condition. • Improper connection of harness connector • Loose installation and rattling of sensor 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 3.	—
3	1. Check for the condition of the CKP sensor. • Improper connection of harness connector • Loose installation and rattling of sensor 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 4.	—
4	Check the DTC again. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Turn the key switch to “OFF” for more than 10 seconds. 3. Test run with the “Preconditions when DTC is set”. 4. Check the DTC. Is DTC P1345 detected?	—	Go to Step 5.	Go to Step 8.

Step	Action	Value	YES	NO
5	1. Check that the camshaft gear is installed properly. 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 6.	—
6	1. Check that the flywheel is installed properly. 2. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 7.	—
7	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 15 seconds. 3. Test run with the "Preconditions when DTC is set". 4. Check the DTC. Is DTC P1345 detected?	—	Go to Step 2.	Go to Step 8.
8	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

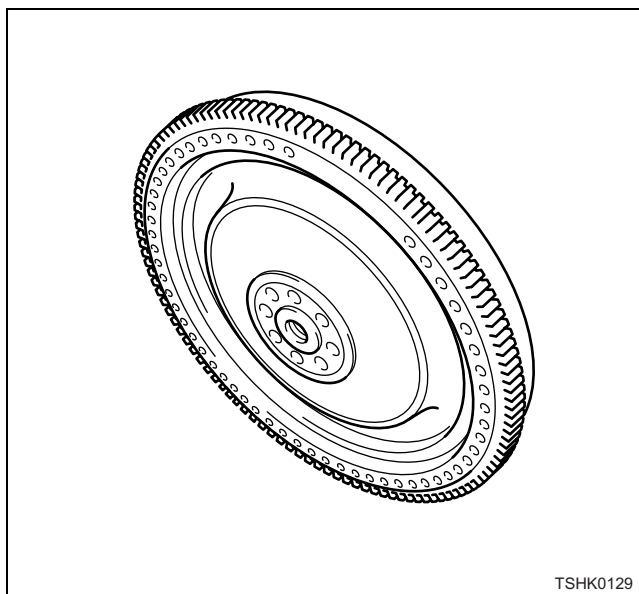
About CKP sensor

Name

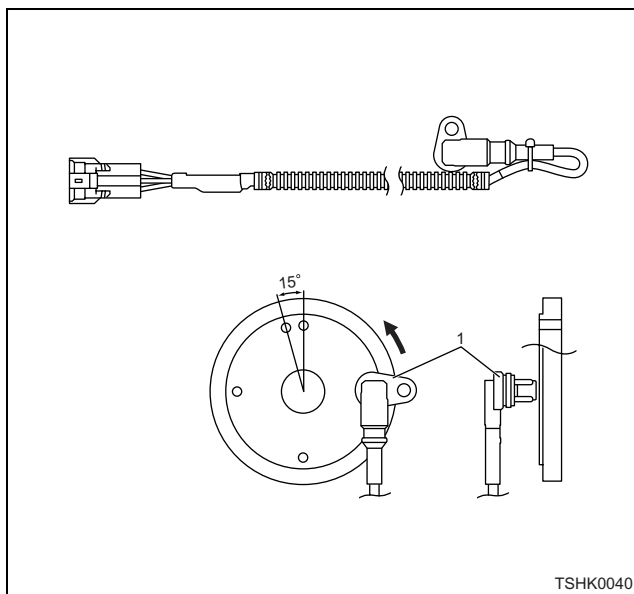
1. GND
2. Power supply

4HK1

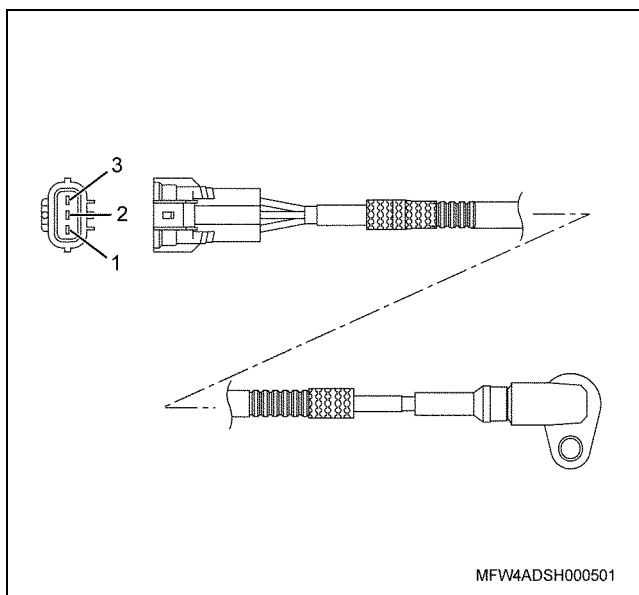
6HK1



4HK1



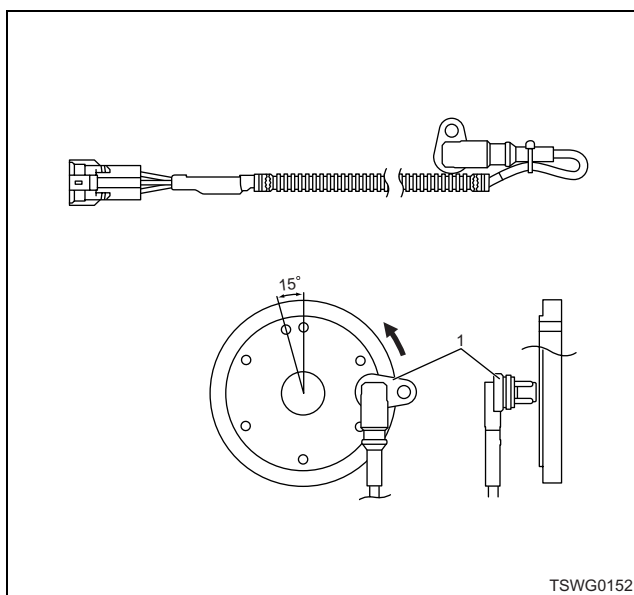
About CMP sensor



Name

1. Signal
2. GND
3. Power supply

6HK1

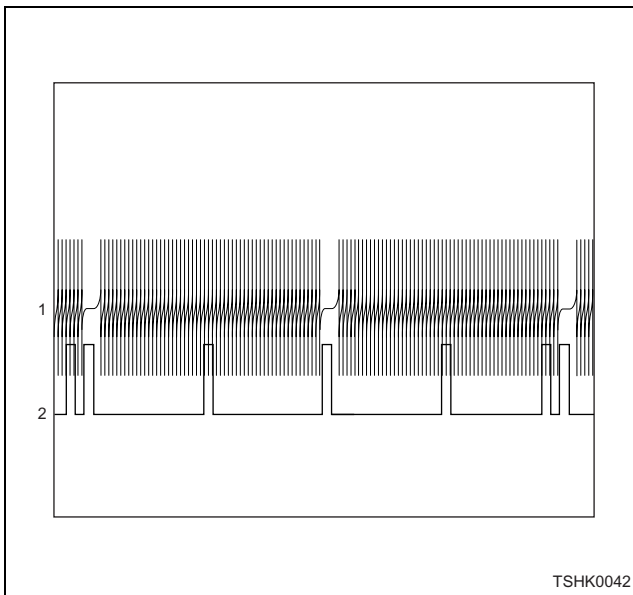


Name

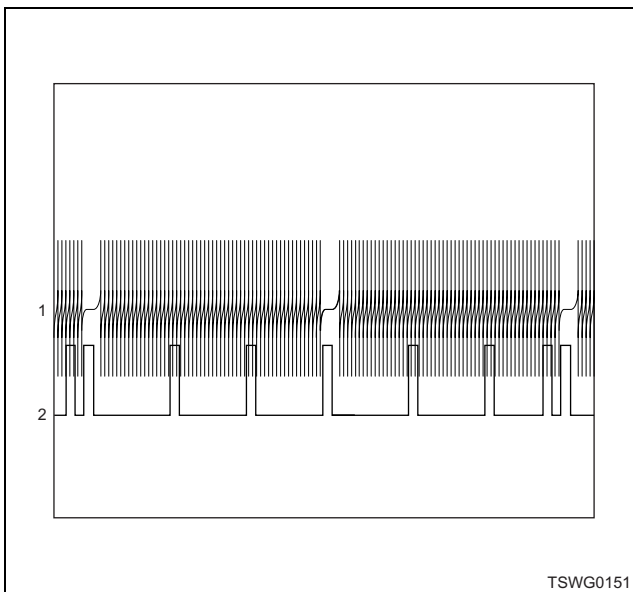
1. CMP sensor

About CKP sensor and CMP sensor signals

4HK1



6HK1



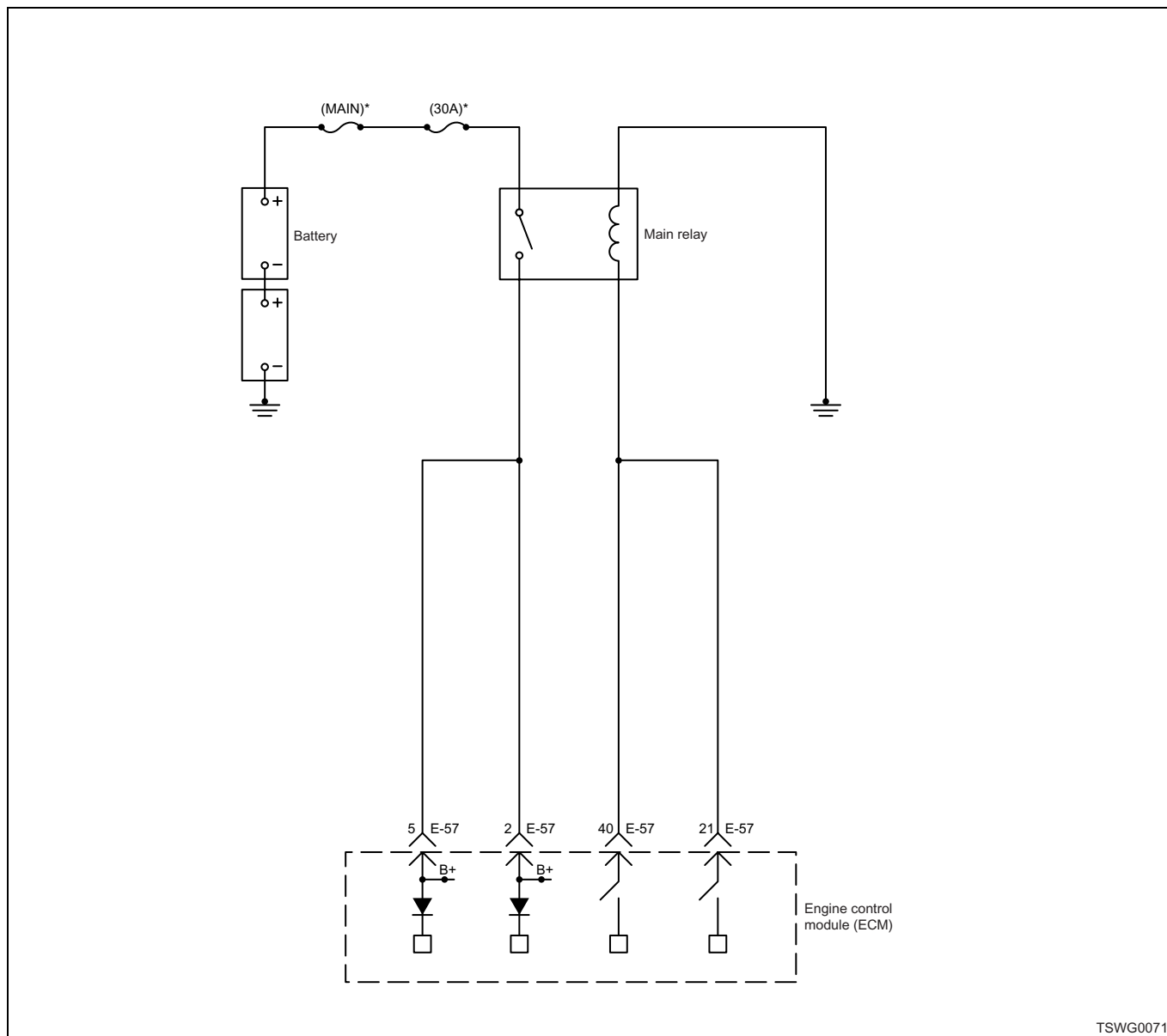
Name

1. CKP signal
2. CMP signal

DTC: P1625 (Flash code 416)

Main relay fault

(*: Specifications (fuse current value etc.) vary depending on each machine. Refer to the machine manual.)



TSWG0071

Description of circuit

The main relay is installed near the blower motor inside the instrument panel. The ECM turns the main relay "ON" when the key switch inputs "ON" signal, and turns the main relay "OFF" when the key switch is "OFF". The battery voltage is supplied to the main relay via fuse, and turning the main relay "ON" will supply the power supply voltage to the ECM.

The ECM sets the DTC when the output to/input from the main relay do not match.

Main trouble symptom

Engine does not start or power supply cannot be shut off.

Preconditions when DTC is set

- Key switch input voltage is 18V or more.
- DTC P1630 is not detected.
- 3 seconds or more has elapsed after key switch ON.
- Main relay drive indication ON
- DTC P1625, or P0606 is not detected.

DTC set condition

- Main relay input power supply voltage is 1 V or less for 2 seconds or more.
- Relay does not cut off for 5 seconds or more even after the main relay coil OFF command is sent.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Back-up: No back-up action

Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned “OFF” then “ON” again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Fault in switch body
- Improper adjustment of switch
- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.

3. If the main relay is stuck closed, it is possible to communicate with ECM using scan tool even with the key switch “OFF”.

5. If it is still possible to communicate with ECM using scan tool and the DTC is detected when the main relay is removed, the circuit beyond the relay or ECM is faulty.

8. If the “Main relay voltage” displays more than the specified value when terminals between the main relay installing portion are shorted, the circuit beyond the relay is normal including ECM.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Is the scan tool (KW communication) available?	—	Go to Step 3.	Go to Step 17.
3	1. Turn the key switch to “ON”. 2. Check for “Main relay voltage” on the data display using scan tool. Is the “Main relay voltage” more than the specified value?	1V	Go to Step 4.	Go to Step 7.
4	1. Turn the key switch to “OFF”. 2. Check the DTC. Is DTC P1625 detected?	—	Go to Step 5.	Go to “Diagnostic aid”.
5	1. Remove the main relay. 2. Check the DTC. Note: Refer to the machine’s manual for installing position and installation/removal procedures of the main relay. Is DTC P1625 detected?	—	Go to Step 6.	Go to Step 11.

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Step	Action	Value	YES	NO
6	1. Check the circuit (contact point side) between main relay and ECM for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 15.
7	Check for installation condition of the main relay, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 15.	Go to Step 8.
8	1. Turn the key switch to "OFF". 2. Remove the main relay. 3. Short between the terminals 1 - 2 and 3 - 5 in the main relay installing portion respectively using jump cable. 4. Turn the key switch to "ON". 5. Check for "Main relay voltage" on the data display using scan tool. Is the "Main relay voltage" more than the specified value?	24V	Go to Step 11.	Go to Step 9.
9	1. Check for following in the circuit between slow-blow fuse and main relay. • Open circuit • Short circuit to ground circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 15.	Go to Step 10.
10	1. Check for followings in the circuit between main relay and ECM using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • Short circuit to ground circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 15.	Go to Step 12.
11	Replace the main relay. Is the procedure completed?	—	Go to Step 15.	—
12	Is EMPS available?	—	Go to Step 13.	Go to Step 14.

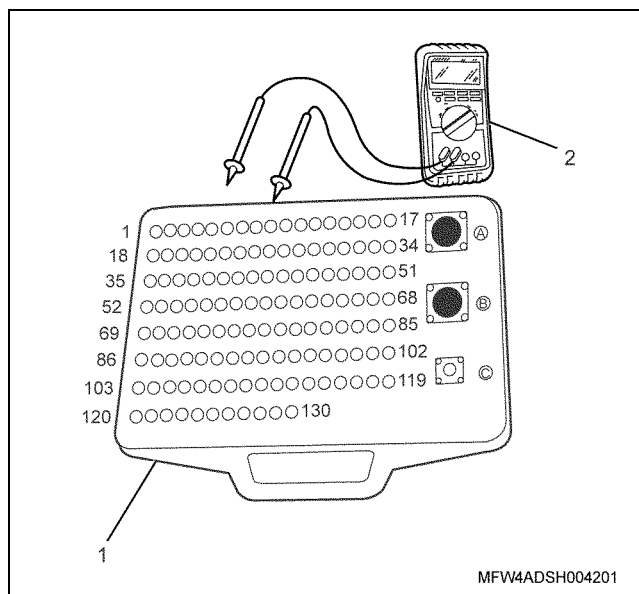
Step	Action	Value	YES	NO
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 15.	Go to Step 14.
14	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 15.	—
15	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1625 detected?	—	Go to Step 2.	Go to Step 15.
16	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
17	1. Turn the key switch to "OFF". 2. Remove the main relay. 3. Turn the key switch to "ON". 4. Connect the DMM between the main relay connector coil-side terminal and the ground. Is the DMM indication more than the specified value?	1V	Go to Step 18.	Go to Step 21.
18	1. Turn the key switch to "OFF". 2. Check the DTC. Is DTC P1625 detected?	—	Go to Step 19.	Go to "Diagnostic aid".

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Step	Action	Value	YES	NO
19	1. Remove the main relay. 2. Check the DTC. Note: Refer to the machine's manual for installing position and installation/removal procedures of the main relay. Is DTC P1625 detected?	—	Go to Step 20.	Go to Step 11.
20	1. Check the circuit (contact point side) between main relay and ECM for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 12.	Go to Step 15.
21	Check for installation condition of the main relay, ECM connector and coupling connector. 1. Check for play or looseness in the connection. 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 15.	Go to Step 22.
22	1. Turn the key switch to "OFF". 2. Remove the main relay. 3. Turn the key switch to "ON". 4. Connect the DMM between the main relay connector terminal (contact point side) and the ground.	24V	Go to Step 11.	Go to Step 9.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

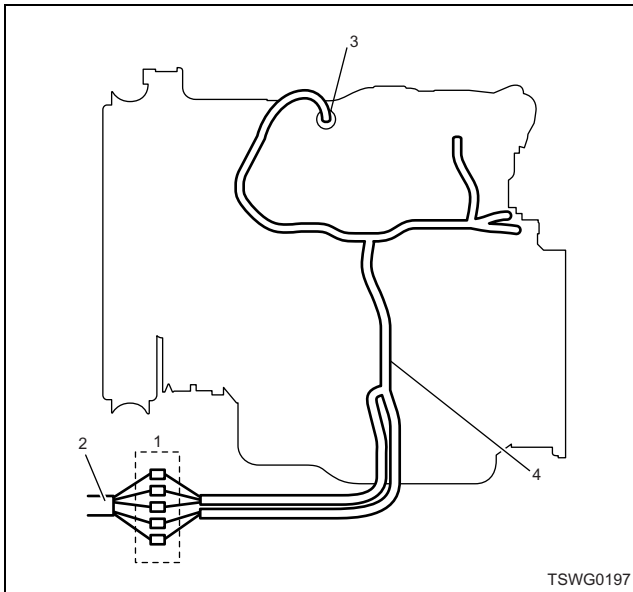


Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
6	Short circuit to power supply circuit	Voltage measurement	- Disconnect the relay. - Key switch "ON"	2 - Ground 5 - Ground	0V	18V or more
10	Open circuit/high resistance	Resistance measurement	- Disconnect the relay. - Key switch "OFF"	2 - Relay installing terminal No. 2 5 - Relay installing terminal No. 2 21 - Relay installing terminal No. 5 40 - Relay installing terminal No. 5	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	- Disconnect the relay. - Key switch "OFF"	2 - Ground 5 - Ground 21 - Ground 40 - Ground	10MΩ or more	100Ω or less

On-board check of sensors



Name

1. Coupling connector between engine — the machine
2. Machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the coupling connector, and check the sensor from engine harness connector.
2. Disconnect the connector from sensor, and short the wiring of sensor connector.
3. Check the harness from coupling connector for open circuit.
 - If both steps 1 and 2 are faulty, repair the harness. Check from step 1 again.
 - If only step 1 is faulty, replace the sensor.

DTC: P1630 (Flash code 36)**A/D conversion fault****Description of circuit**

The ECM processes the analog signals (voltage signal etc.) which are input from each sensor into digital signals, to perform various controls and calculations. The ECM sets the DTC when the fault is detected for the analog-digital conversion.

Main trouble symptom

- Output lowering
- Black smoke emitted

DTC set condition

- Analog/digital conversion failure

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Analog sensor system default processing
- Limited injection amount 3 (multi-injection stopped)
- Target RP upper limit (80MPa)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

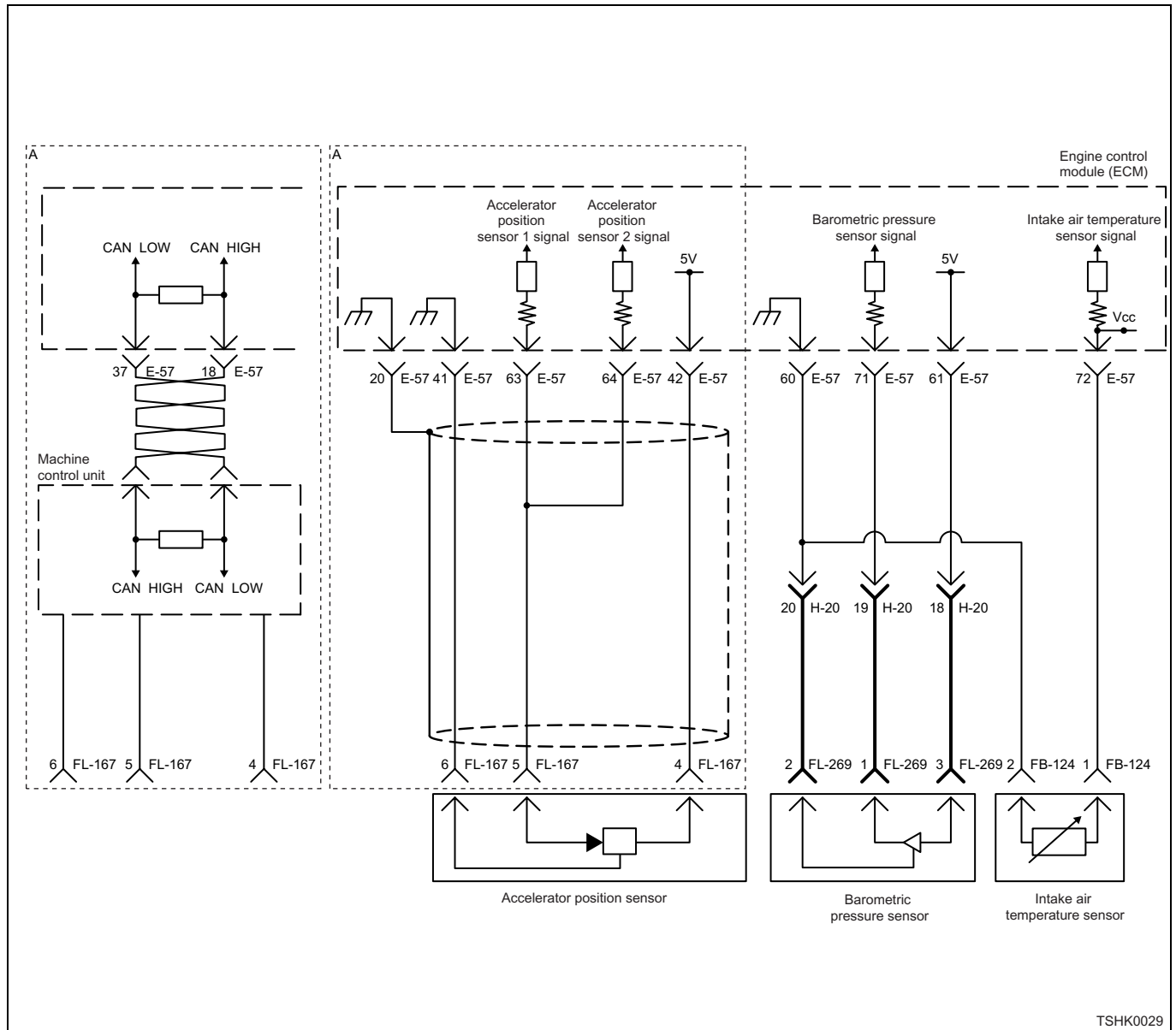
The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	Check the DTC again. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Turn the key switch to "OFF" for more than 10 seconds. 3. Test run with the "Preconditions when DTC is set". 4. Check the DTC. Is DTC P1630 detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	Is EMPS available?	—	Go to Step 4.	Go to Step 5.
4	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	Go to Step 5.

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Step	Action	Value	YES	NO
5	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 6.	—
6	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P1631 (Flash code 55)**Voltage fault in 5-V power supply 1**

TSHK0029

Description of circuit

The 5-V power supply circuit is provided to the ECM for 5 systems. The 5-V power supply circuit 1 supplies power to the accelerator position (AP) sensor.

The ECM sets the DTC when the voltage in the 5-V power supply circuit 1 is higher or lower than the normal range.

Main trouble symptom

Accelerator opening angle is controlled to 0%.

Preconditions when DTC is set

- DTC P1630 is not detected.
- Key switch input power supply voltage is higher than 16 V but lower than 32 V.

DTC set condition

- Key switch power supply voltage is 5.5 V or more, or 4.5 V or less for 0.5 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Same to accelerator sensor fault

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

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The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.

- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Test description

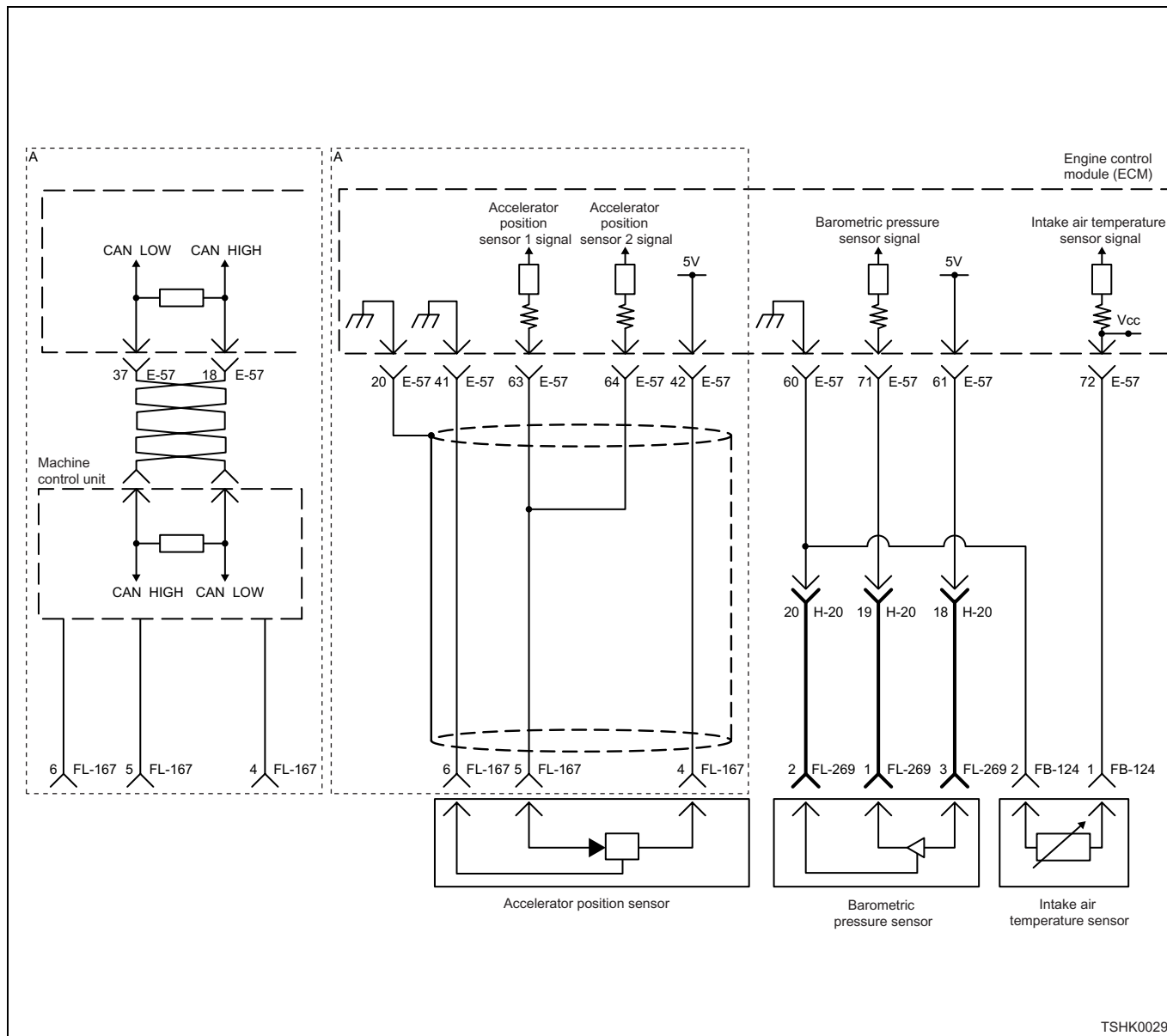
Numbers below indicate step numbers in the chart.
 2. Measure at the harness connector-side.
 3. Measure at the harness connector-side.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Connect the DMM between the AP sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	5.5V	Go to Step 4.	Go to Step 3.
3	1. Turn the key switch to "OFF". 2. Disconnect the AP sensor connector. 3. Connect the DMM between the AP sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication less than the specified value?	4.5V	Go to Step 5.	Go to Step 9.
4	1. Check the power supply circuit between AP sensor 1 and ECM for short circuit to the battery power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
5	1. Check the power supply circuit between AP sensor 1 and ECM for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
6	Is EMPS available?	—	Go to Step 7.	Go to Step 8.

Step	Action	Value	YES	NO
7	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	Go to Step 8.
8	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	—
9	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1631 detected?	—	Go to Step 2.	Go to Step 10.
10	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P1632 (Flash code 55)

Voltage fault in 5-V power supply 2



Description of circuit

The 5-V power supply circuit is provided to the ECM for 5 systems. The 5-V power supply circuit 2 supplies power to the barometric pressure sensor. The ECM sets the DTC when the voltage in the 2-V power supply circuit 5 and 5 is higher or lower than the normal range.

Main trouble symptom

Due to back-up equivalent to 2500m

- Black smoke emitted at high altitude
- Output shortage at low altitude

Preconditions when DTC is set

- DTC P1630 is not detected.
- Key switch input power supply voltage is higher than 16 V but lower than 32 V.

DTC set condition

- Key switch power supply voltage is 5.5 V or more, or 4.5 V or less for 0.5 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Same to barometric pressure and intake air temperature sensor fault

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

TSHK0029

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.

- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Test description

Numbers below indicate step numbers in the chart.

2. Measure at the harness connector-side.

3. Measure at the harness connector-side.

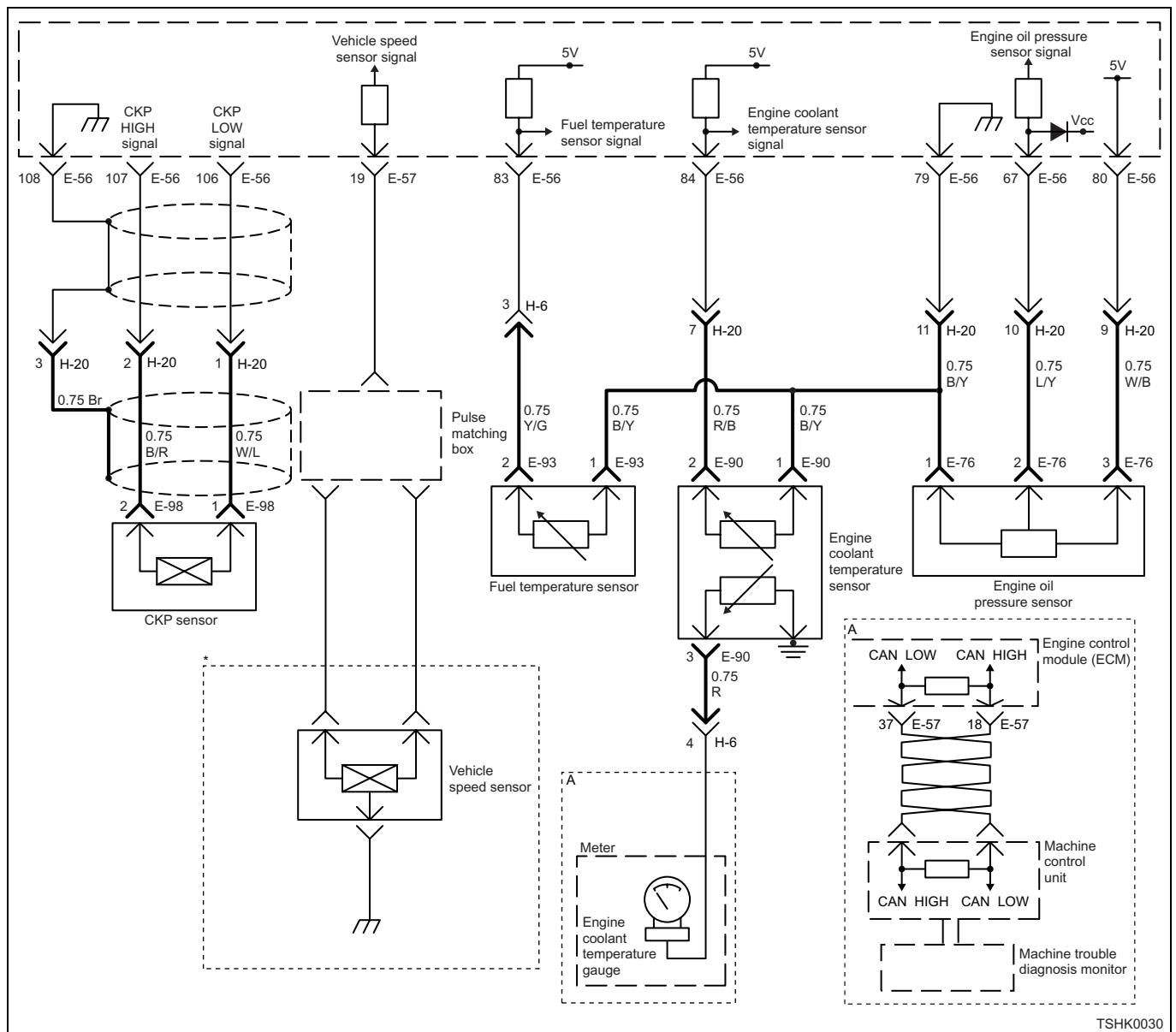
Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF". 2. Disconnect the barometric pressure sensor connector. 3. Connect the DMM between the barometric pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	5.5V	Go to Step 4.	Go to Step 3.
3	1. Turn the key switch to "OFF". 2. Disconnect the barometric pressure sensor connector. 3. Connect the DMM between the barometric pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication less than the specified value?	4.5V	Go to Step 5.	Go to "Diagnostic aid".
4	1. Check the power supply circuit between barometric pressure sensor and ECM for short circuit to the battery power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
5	1. Check the power supply circuit between barometric pressure sensor and ECM for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
6	Is EMPS available?	—	Go to Step 7.	Go to Step 8.

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Step	Action	Value	YES	NO
7	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	Go to Step 8.
8	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	—
9	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1632 detected?	—	Go to Step 2.	Go to Step 10.
10	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P1633 (Flash code 55)**Voltage fault in 5-V power supply 3**

(*: Specifications vary depending on each machine. Refer to the machine's manual.)

**Description of circuit**

The 5-V power supply circuit is provided to the ECM for 5 systems. The 5-V power supply circuit 3 supplies power to the engine oil pressure sensor.

The ECM sets the DTC when the voltage in the 5-V power supply circuit 3 is higher or lower than the normal range.

Main trouble symptom

- Startability deteriorates at low temperatures.
- Black smoke emission possible
- Operability is affected.

Preconditions when DTC is set

- DTC P1630 is not detected.

- Key switch input power supply voltage is higher than 16 V but lower than 32 V.

DTC set condition

- Key switch power supply voltage is 5.5 V or more, or 4.5 V or less for 0.5 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Same to coolant temperature, fuel temperature, and oil pressure sensor fault

10D-535 Electronic control fuel injection system (Common rail type)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

The conditions to clear the MIL/DTC

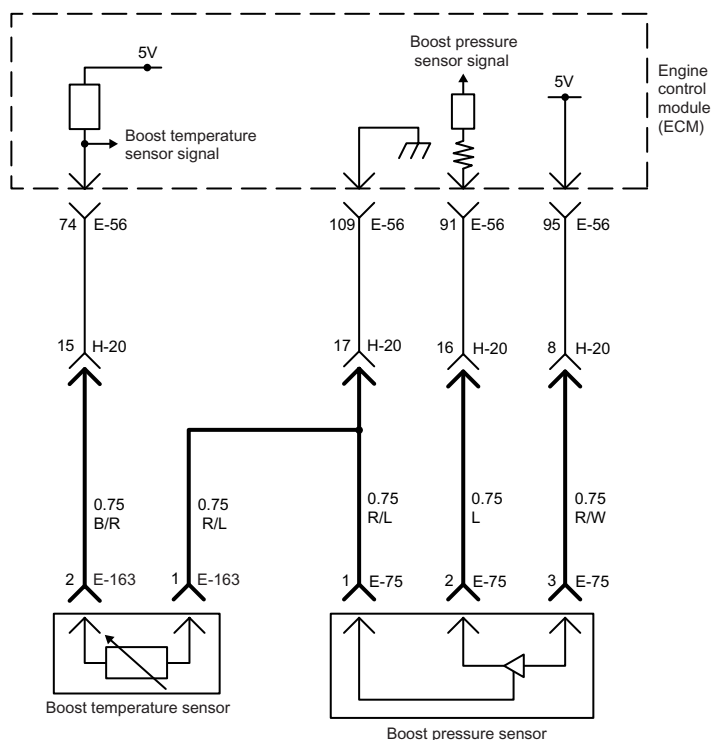
- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).

Test description

Numbers below indicate step numbers in the chart.
2. Measure at the harness connector-side.
3. Measure at the harness connector-side.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF". 2. Disconnect the engine oil pressure sensor connector. 3. Connect the DMM between the engine oil pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	5.5V	Go to Step 4.	Go to Step 3.
3	1. Turn the key switch to "OFF". 2. Disconnect the engine oil pressure sensor connector. 3. Connect the DMM between the engine oil pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication less than the specified value?	4.5V	Go to Step 5.	Go to "Diagnostic aid".
4	1. Check the power supply circuit between engine oil pressure sensor and ECM for short circuit to the battery power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
5	1. Check the power supply circuit between engine oil pressure sensor and ECM for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
6	Is EMPS available?	—	Go to Step 7.	Go to Step 8.

Step	Action	Value	YES	NO
7	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	Go to Step 8.
8	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	—
9	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1633 detected?	—	Go to Step 2.	Go to Step 10.
10	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P1634 (Flash code 55)
Voltage fault in 5-V power supply 4


TSWG0079

Description of circuit

The 5-V power supply circuit is provided to the ECM for 5 systems. The 5-V power supply circuit 4 supplies power to the boost pressure sensor.

The ECM sets the DTC when the voltage in the 5-V power supply circuit 4 and 3 is higher or lower than the normal range.

Main trouble symptom

Operationality is affected.

Preconditions when DTC is set

- DTC P1630 is not detected.
- Key switch input power supply voltage is higher than 16 V but lower than 32 V.

DTC set condition

- Key switch power supply voltage is 5.5 V or more, or 4.5 V or less for 0.5 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Same to boost pressure and boost temperature sensor fault

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.

- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Test description

Numbers below indicate step numbers in the chart.

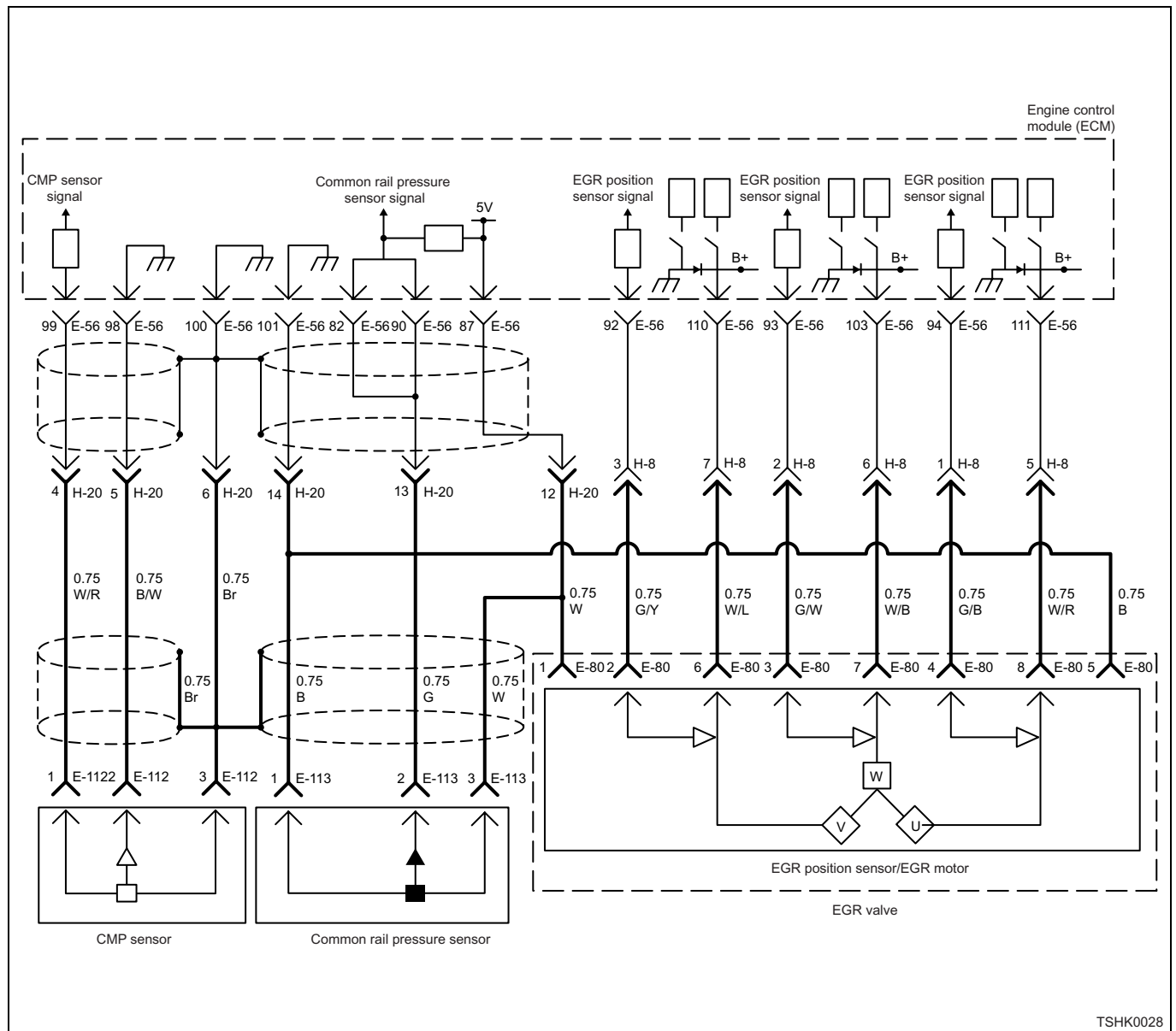
2. Measure at the harness connector-side.

3. Measure at the harness connector-side.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF". 2. Disconnect the boost pressure sensor connector. 3. Connect the DMM between the boost pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	5.5V	Go to Step 4.	Go to Step 3.
3	1. Turn the key switch to "OFF". 2. Disconnect the boost pressure sensor connector. 3. Connect the DMM between the boost pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication less than the specified value?	4.5V	Go to Step 5.	Go to "Diagnostic aid".
4	1. Check the power supply circuit between boost pressure sensor and ECM for short circuit to the battery power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
5	1. Check the power supply circuit between boost pressure sensor and ECM for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
6	Is EMPS available?	—	Go to Step 7.	Go to Step 8.

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Step	Action	Value	YES	NO
7	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	Go to Step 8.
8	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	—
9	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1634 detected?	—	Go to Step 2.	Go to Step 10.
10	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: P1635 (Flash code 55)**Voltage fault in 5-V power supply 5****Description of circuit**

The 5-V power supply circuit is provided to the ECM for 5 systems. The 5-V power supply circuit 5 supplies power to the common rail pressure sensor and the EGR position sensor.

The ECM sets the DTC when the voltage in the 5-V power supply circuit 5 and 2 is higher or lower than the normal range.

Main trouble symptom

- Engine blow up
- Output lowering
- Black smoke emitted
- Engine stall possible

Preconditions when DTC is set

- DTC P1630 is not detected.
- Key switch input power supply voltage is higher than 16 V but lower than 32 V.

DTC set condition

- Key switch power supply voltage is 5.5 V or more, or 4.5 V or less for 0.5 seconds or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Same to rail pressure sensor fault and EGR position sensor fault

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Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

- The diagnosis lamp will go off after the code turns to history code and the key switch is turned "OFF" then "ON" again.
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

The conditions to clear the MIL/DTC

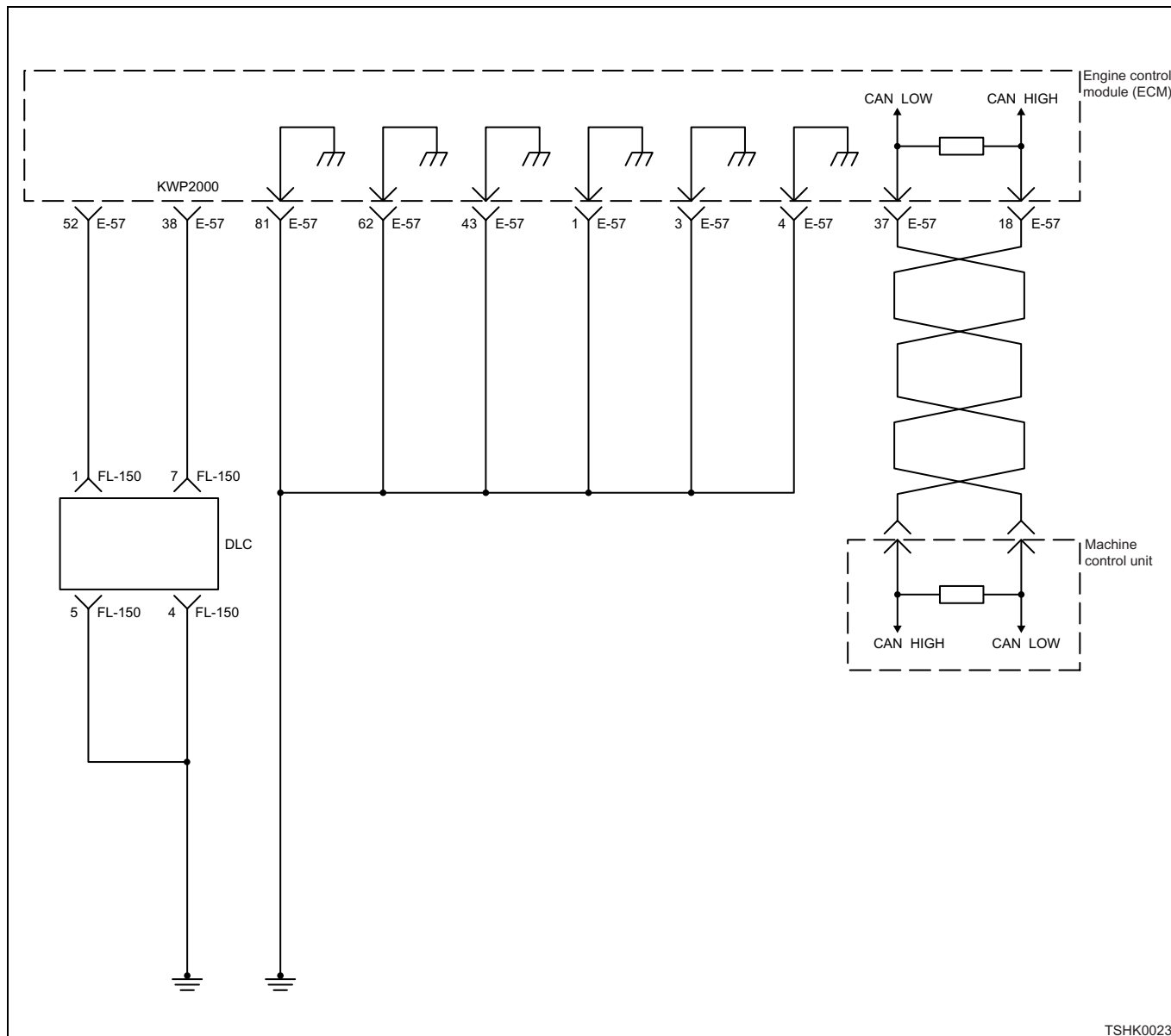
- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).

Test description

Numbers below indicate step numbers in the chart.
2. Measure at the harness connector-side.
3. Measure at the harness connector-side.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Connect the DMM between the common rail pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication more than the specified value?	5.5V	Go to Step 4.	Go to Step 3.
3	1. Turn the key switch to "OFF". 2. Disconnect the common rail pressure sensor connector. 3. Connect the DMM between the common rail pressure sensor power supply terminal and the ground. 4. Turn the key switch to "ON". Is the DMM indication less than the specified value?	4.5V	Go to Step 5.	Go to "Diagnostic aid".
4	1. Check the power supply circuit between common rail pressure sensor and ECM for short circuit to the battery power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 6.
5	1. Check the power supply circuit between common rail pressure sensor and ECM for ground short circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 9.	Go to Step 61.
6	Is EMPS available?	—	Go to Step 7.	Go to Step 8.

Step	Action	Value	YES	NO
7	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	Go to Step 8.
8	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 9.	—
9	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC P1635 detected?	—	Go to Step 2.	Go to Step 10.
10	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

DTC: U2104 (Flash code 84)
CAN Bus fault


TSHK0023

Description of circuit

The ECM communicates with the machine control unit (ECU) through CAN communication circuit. The ECM data outputs through the CAN-High circuit, and other ECU data inputs through the CAN-Low circuit. The CAN communication performs at a constant speed without interruption, and the number of data outputs and inputs must always be the same. The ECM sets the DTC when the fault is detected for the CAN communication.

Main trouble symptom

Vary depending on setting.

DTC set condition

- Revolution command message of CAN communication is disrupted for 1 second or more.

Preconditions when DTC is set

- Key switch input voltage is 12V or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Specified back-up value (depending on the machine manufacturer)

Recovery from failure

Refer to "List of diagnostic trouble code" and "About recovery from failure" in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Test description

Numbers below indicate step numbers in the chart.
 2. If no DTC is detected, intermittent trouble is suspected. Identify the cause by referring to "Diagnostic aid".
 5. Measure at the harness connector-side.
 6. Measure at the TCM harness connector-side.

Step	Action	Value	YES	NO
1	Perform the OBD check. Is the procedure completed?	—	Go to Step 2.	Go to "OBD system check".
2	1. Turn the key switch to "OFF" for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC U2104 detected?	—	Go to Step 3.	Go to "Diagnostic aid".
3	Is DTC U2106 detected?	—	Go to DTC U2106.	Go to Step 4.
4	Is the breaker box available?	—	Go to Step 5.	Go to Step 15.
5	1. Turn the key switch to "OFF". 2. Remove the ECM. 3. Connect the breaker box to the ECM. 4. Connect the breaker box with the ECM harness. 5. Measure the resistance between the CAN-High-side terminal and CAN-Low-side terminal using breaker box. Refer to "Breaker box inspection procedure". Is the resistance within the specified value?	50 — 70Ω	Go to Step 13.	Go to Step 6.
6	1. Remove the ECM from the breaker box. 2. Measure the resistance between the CAN-High-side terminal and CAN-Low-side terminal using breaker box. Refer to "Breaker box inspection procedure". Is the resistance specified value?	Approx. 120Ω	Go to Step 7.	Go to Step 8.
7	1. Connect the ECM to the breaker box. 2. Remove the machine control unit and the harness. 3. Measure the resistance between the CAN-High-side terminal and CAN-Low-side terminal using breaker box. Refer to "Breaker box inspection procedure". Is the resistance specified value?	Approx. 120Ω	Go to Step 13.	Go to Step 10.

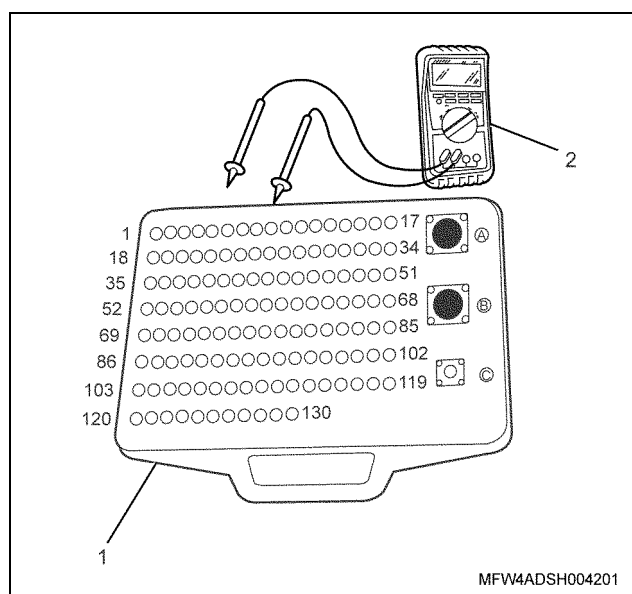
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Step	Action	Value	YES	NO
8	1. Check the CAN-Low circuit and CAN-High circuit between ECM and machine control unit for short circuit to the power supply circuit or ignition power supply circuit using breaker box or DMM. Refer to "Breaker box inspection procedure". 2. If the trouble is detected, replace the harness. Is the trouble detected?	—	Go to Step 2.	Go to Step 9.
9	1. Check for followings in the CAN-Low circuit and CAN-High circuit between ECM and machine control unit using breaker box or DMM. Refer to "Breaker box inspection procedure". • Open circuit • High resistance • Short circuit to ground 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 2.	Replace the machine control unit.
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Verify repair.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—

Step	Action	Value	YES	NO
13	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC U2104 detected?	—	Go to Step 2.	Go to Step 14.
14	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.
15	Remove the ECM, and measure the resistance between the CAN-High-side terminal and CAN-Low-side terminal of the ECM connector. Is the resistance specified value?	Approx. 120Ω	Go to Step 16.	Go to Step 8.
16	1. Install the ECM, and remove the machine control unit. 2. Measure the resistance between the CAN-High-side terminal and CAN-Low-side terminal of the machine control unit connector. Is the resistance specified value?	Approx. 120Ω	Go to Step 13.	Go to Step 10.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.

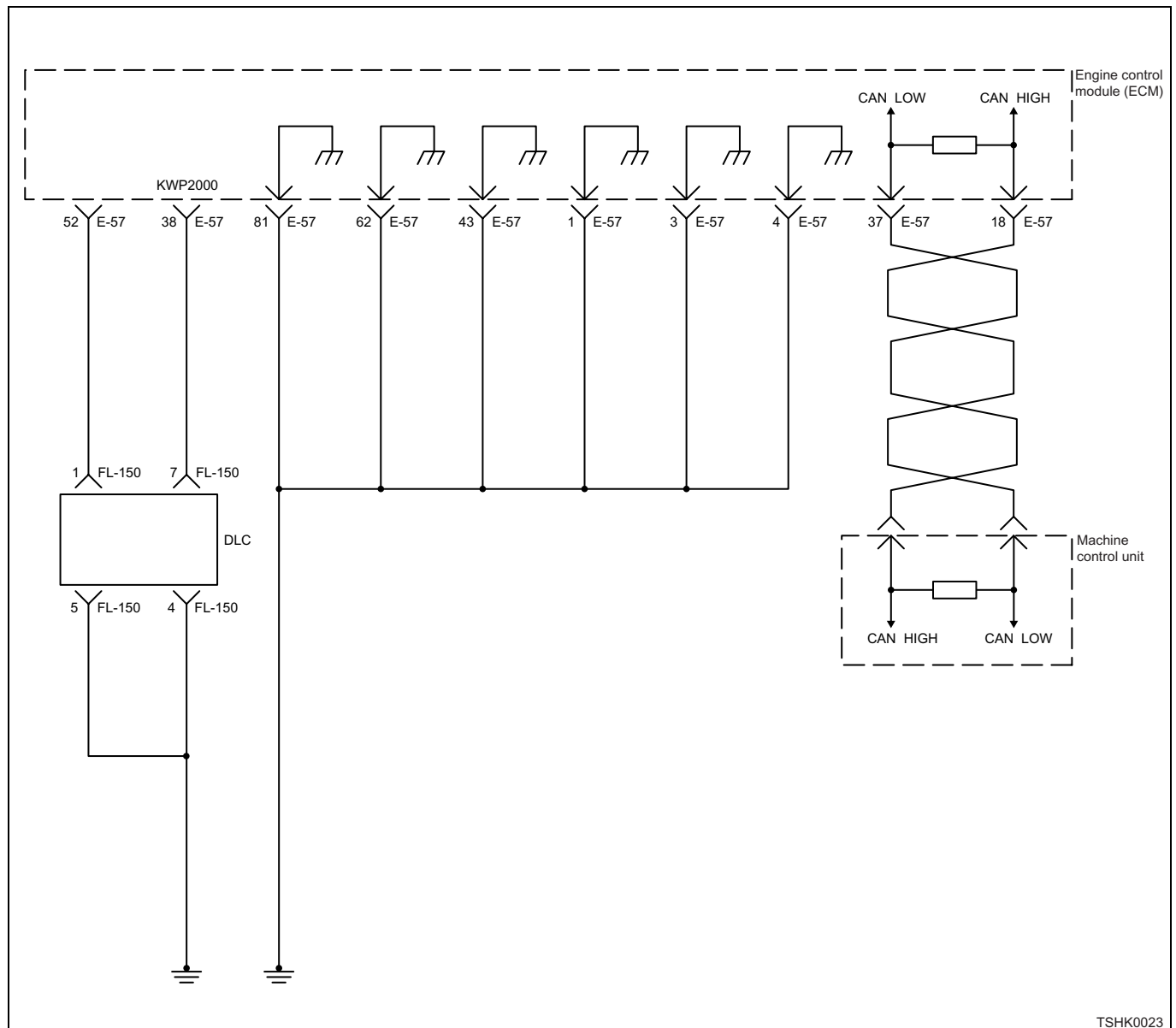


Name _____

1. Breaker box
2. DMM

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Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
8	Short circuit to power supply circuit	Voltage measurement	- Remove all the relevant ECU connectors. - Key switch "ON"	18 - Ground 37 - Ground	0V	18V or more
9	Open circuit/high resistance	Resistance measurement	- Remove all the relevant ECU connectors. - Key switch "OFF"	37 - Machine control unit 18 - Machine control unit	100Ω or less	10MΩ or more
	Short circuit to ground	Resistance measurement	- Remove all the relevant ECU connectors. - Key switch "OFF"	18 - Ground 37 - Ground	10MΩ or more	100Ω or less

DTC: U2106 (Flash code 85)**CAN timeout fault**

TSHK0023

Description of circuit

The ECM communicates with the machine control unit (ECU) through CAN communication circuit. The ECM data outputs through the CAN-High circuit, and other ECU data inputs through the CAN-Low circuit. The CAN communication performs at a constant speed without interruption, and the number of data outputs and inputs must always be the same. The ECM sets the DTC when the CAN communication is disrupted with the machine control unit (ECU).

Main trouble symptom

- Vary depending on setting.
- It cannot be controlled from the machine side since CAN communication is disabled. The engine speed becomes back-up speed specified by each machine manufacturer.

DTC set condition

- Instruction message on CAN communication to run is disrupted for 1 second or more.

Preconditions when DTC is set

- DTC U2104 is not detected.
- Key switch input voltage is 20 V or more.

Action taken when DTC is set

- Turns the diagnosis lamp ON.

Back-up mode

- Specified back-up value (depending on the machine manufacturer)

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Recovery from failure

Refer to “List of diagnostic trouble code” and “About recovery from failure” in this section for recovery from failure.

The conditions to clear the MIL/DTC

- The current trouble turns to past trouble (history) when the condition is out of the range from DTC set condition (recovery from failure).
- Using the scan tool, or memory clear switch and diagnostic switch operation enables to clear DTCs.

Diagnostic aid

If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector
- Defective harness routing
- Worn harness cladding
- Wire disconnection inside harness cladding

Following inspections are necessary to detect these causes.

- Improper connection of harness connector and ECM connector
 - Poor connection of terminal from connector
 - Unmatched terminals are fitted.
 - Damage of connector lock
 - Poor contact between terminal and wire
- Damaged harness
 - Visually check the harness for damage.
 - Check the relevant items on the scan tool data display while moving the connector and the harness which are related to the sensor. The variation of the display indicates the faulty part.

Test description

Numbers below indicate step numbers in the chart.
2. If no DTC is detected, intermittent trouble is suspected. Identify the cause by referring to “Diagnostic aid”.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	1. Turn the key switch to “OFF” for more than 10 seconds. 2. Start the engine. 3. Check the DTC. Is DTC U2106 detected?	—	Go to Step 3.	Go to “Diagnostic aid”.
3	1. Check for followings in the CAN-Low circuit and CAN-High circuit between ECM and machine control unit (ECU) using breaker box or DMM. Refer to “Breaker box inspection procedure”. • Open circuit • High resistance 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 4.
4	1. Check for followings in the CAN-Low circuit and CAN-High circuit between ECM and machine control unit (ECU) using breaker box or DMM. Refer to “Breaker box inspection procedure”. • Short circuit to ground circuit • Short circuit to power supply circuit or ignition power supply circuit 2. If the trouble is detected, repair as required. Is the trouble detected?	—	Go to Step 11.	Go to Step 5.

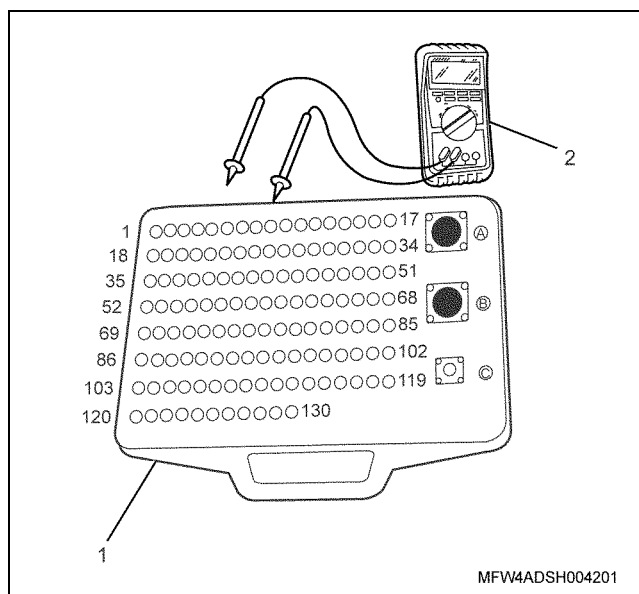
Step	Action	Value	YES	NO
5	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC U2106 detected?	—	Go to Step 6.	Go to "Diagnostic aid".
6	Is DTC U2104 detected at the same time?	—	Go to Step 8.	Go to Step 7.
7	Replace the machine control unit. Is the procedure completed?	—	Go to Step 11.	—
8	Is EMPS available?	—	Go to Step 9.	Go to Step 10.
9	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	Go to Step 10.
10	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 11.	—

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Step	Action	Value	YES	NO
11	Check the DTC again. 1. Connect all the harnesses. 2. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 3. Turn the key switch to "OFF" for more than 10 seconds. 4. Test run with the "Preconditions when DTC is set". 5. Check the DTC. Is DTC U2106 detected?	—	Go to Step 2.	Go to Step 12.
12	Check if other DTC is detected. Is other DTC detected?	—	Go to each DTC diagnosis.	Verify repair.

Breaker box inspection procedure

Perform the inspection in the following procedure if there is such an instruction to use breaker box in the step. After inspection, return to the diagnostic step.



Name

1. Breaker box
2. DMM

Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
4	Open circuit/ high resistance	Resistance measurement	- Remove the machine control unit (ECU) connector. - Key switch "OFF"	18 - Machine control unit (ECU) connector terminal 37 - Machine control unit (ECU) connector terminal	100Ω or less	10MΩ or more

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Step	Item to be checked	Inspection method	Measuring condition	Terminal No.	Normal value	Abnormal value
5	Short circuit to ground	Resistance measurement	- Remove the machine control unit (ECU) connector. - Key switch "OFF"	18 - Ground 37 - Ground	10M Ω or more	100 Ω or less
	Short circuit to power supply circuit	Voltage measurement	- Remove the machine control unit (ECU) connector. - Key switch "ON"	18 - Ground 37 - Ground	0V	18V or more

List of trouble symptom

Symptom	Description
Engine start failure	Crank speed is slow. Crank speed is normal but engine does not start (no first combustion). Engine starts (first combustion exists) but cannot maintain stable engine speed, or no blow up.
Engine stall	Engine cranks but take long time before start. It operates eventually, or starts but stops immediately.
Engine hunting, rough idling	Engine idle speed is rough, or idle speed changes. In a more severe case, engine or machine vibrates. In any serious situations, the engine stalls.
Engine output shortage, lag down	Engine output is lower than expected, and output does not change with the accelerator lever (throttle lever) released, engine response deteriorates.
Exhaust gas contains a lot of white smoke.	A lot of white smoke emitted while running.
Exhaust gas contains a lot of black smoke.	A lot of black smoke emitted while running.
Noise	Abnormal sound occurs from the engine.
Fuel consumption deteriorates.	Fuel consumption is remarkably more than that indicated in the machine's manual. The situation shown here is that the problem is not found on the machine side and the engine needs to be checked.
Oil consumption deteriorates.	Oil consumption is remarkably lower than that indicated in the machine's manual. The situation shown here is that the problem is not found on the machine side and the engine needs to be checked.

Engine start failure

Pre-inspection

Before using this paragraph, perform the "OBD system check" and check all the following items.

- Check if excessive load is applied to the machine side.
- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Scan tool data shows normal operating range.
- Check the condition of the machine to identify the applicable symptom from "List of trouble symptom". Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved.

This inspection includes the following items.

This inspection includes the following items.

- There is no dirt or clogging in fuel filter.
- There is no poor contact in connector (it must be connected with click sound). Especially for CKP sensor and CMP sensor.
- The terminal voltage of battery is not low.
- Wire is connected, tightened or cut properly.
- Commercial accessory power supply is not bifurcated from ECM power supply.
- ECM ground is not contaminated and installed to the proper position securely.
- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.

- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault.
- Exhaust system parts for fault.

Diagnostic aid

- If the crank sensor is faulty, crank more than 60rpm for 14 seconds or more since it is not judged on cranking for less than 14 seconds.
- Fuel system fault (run out of fuel, frozen fuel, air mixed in fuel pipe, faulty filter [clog in main filter, gauze filter], pipe fault, fuel quality, fuel tank [foreign matter, fuel suction fault])
- Intake system fault (clogging in filter, intake pipe fault, etc.)
- Supply pump fault (no fuel pressure feed)
- Common rail fault (flow damper or pressure limiter is activated, degradation of sealability)
- Injector fault (no fuel injection)
- System down due to trouble
- Engine body fault (seizure, compression pressure shortage, other mechanical trouble)
- ACG trouble
- Machine side related equipment trouble (oil pressure pump etc.)
- Effect of commercial electrical equipment (radio, lamp, etc.)
- ECM trouble (body, power supply, ground, etc.)
- Check the connector for poor contact, the harness for fault such as wear or bend, and the wire inside the harness for loosened wire causing short circuit to other circuits. Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.

Step	Action	Value	YES	NO
1	Is the emergency stop switch equipped?	—	Turn the switch to "OFF", and Go to Step 2.	Go to Step 2.
2	Perform the OBD system check. Is the procedure completed?	—	Go to Step 3.	Go to "OBD system check".
3	Check if DTC is detected. Check if following DTCs are detected. DTC: P0335, P0336, P0340, P0341, P0601, P1261, P1262 Is DTC detected?	—	Go to the related "Inspection method by DTC".	Go to Step 4.
4	Check the crank speed. Check if the crank speed is more than the necessary speed for ECM to identify engine rotation. Is the crank speed more than specified value?	60 rpm	Go to Step 5.	Go to Step 6.

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Step	Action	Value	YES	NO
5	Check the crank speed. Check if the crank speed is more than the necessary speed to start the engine (first combustion). Is the crank speed more than specified value?	80 rpm	Go to Step 7.	Go to Step 6.
6	Check the starting system. Is the procedure completed?	—	Go to Step 7.	Go to “Starting system check”.
7	Check the fuel system in the following procedure. 1. Check the high pressure pipe and low pressure pipe for looseness in the connection (fuel leakage), crush or clogging. Check the clogging in the following procedure. • Fuel filter (main fuel filter, pre-fuel filter, gauze filter) • Fuel tank (pump strainer) • Fuel system pipe 2. Check the fuel pipe, fuel filter, and inside of the fuel tank for freeze or waxing. (at cold temperature) • If opaque frosty object is found in the filter part of the main filter, waxing may occurs. Replace fuel. 3. Check the feed pipe inside the fuel tank for clogging of foreign matter. 4. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 8.	—
8	Check the injector. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Start the engine. 3. Select the “Actuator test” from the scan tool menu. When the scan tool is not available, use the injector checker. Refer to “How to use injector checker” in this section for how to use injector checker. 4. Select the “Injection stop at each injector” in the “Common rail system”. 5. Press the “OFF” soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 9.	Go to Step 10.

Step	Action	Value	YES	NO
9	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 10.	—
10	Check the ACG. Check if the charge warning lamp turns on while engine is running. Note: Refer to the machine’s manual for charge warning. Does the charge warning operate?	—	Go to Step 17.	Go to Step 11.
11	Replace the ACG. Also, check the charge warning system, and repair or replace if faulty. Is the procedure completed?	—	Go to Step 12.	—
12	Check the condition of commercial electrical equipment such as radio and lights. Does the engine start when the commercial electrical equipment is powered OFF?	—	Go to Step 13.	Go to Step 14.
13	Correct the installation condition of the electrical equipment, or remove the electrical equipment. Is the procedure completed?	—	Go to Step 14.	—
14	Check the mechanical part of the engine, and repair if faulty. • Compression pressure • Valve system • Injector • Timing gear • Related part of piston/crank Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 15.	—
15	Is EMPS available?	—	Go to Step 16.	Go to Step 17.

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Step	Action	Value	YES	NO
16	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to “How to use flush tool” in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Verify repair.	Go to Step 16.
17	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Verify repair.	Go to Step 3.

Engine stall

Pre-inspection

Before using this paragraph, perform the “OBD system check” and check all the following items.

- Check if excessive load is applied to the machine side.
- ECM and diagnosis lamp operate properly.
- Check the DTC.
- To detect crank sensor fault, crank more than 60rpm for 14 seconds or more since it is not judged on cranking for less than 14 seconds.
- Scan tool data shows normal operating range.
- Check the condition of the machine to identify the applicable symptom from “List of trouble symptom”. Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved.

This inspection includes the following items.

- There is no poor contact in connector (it must be connected with click sound). Especially for CKP sensor and G sensor.
- Wire is connected, tightened or cut properly.
- Commercial accessory power supply is not bifurcated from ECM power supply.
- ECM ground is not contaminated and installed to the proper position securely.
- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.

- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault.
- Exhaust system parts for fault.

Diagnostic aid

- Fuel system fault (run out of fuel, frozen fuel, air mixed in fuel pipe, faulty filter [clog in main filter, gauze filter], pipe fault, fuel quality, fuel tank [foreign matter, fuel suction fault])
- Intake system fault (clogging in filter, intake pipe fault, etc.)
- Supply pump fault (no fuel pressure feed)
- Common rail fault (flow damper or pressure limiter is activated, degradation of sealability)
- Injector fault (no fuel injection)
- System down due to trouble
- Engine body fault (seizure, compression pressure shortage, other mechanical trouble)
- ACG trouble
- Machine side related equipment trouble (oil pressure pump etc.)
- Effect of commercial electrical equipment (radio, lamp, etc.)
- ECM trouble (body, power supply, ground, etc.)
- Check the connector for poor contact, the harness for fault such as wear or bend, and the wire inside the harness for loosened wire causing short circuit to other circuits. Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check if excessive load is applied to the machine side. Repair or replace the faulty part. Note: Refer to the machine’s manual for check and repair. Is the procedure completed?	—	Go to Step 3.	—

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Step	Action	Value	YES	NO
3	Check the electrical system. 1. To detect crank sensor fault, crank more than 60rpm for 14 seconds or more and check the DTC since it is not judged on cranking for less than 14 seconds. 2. Check the connectors of the ECM, fuel pump, ACG and electronic governor for poor contact or play. Note: Poor contact in the connector, especially CKP sensor and CMP sensor, causes engine stall. It must be connected with click sound. 3. Check the harness for open or short circuit. 4. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 4.	—
4	Check the ACG. Check if the charge warning lamp turns on while engine is running. Note: Refer to the machine's manual for charge warning. Does the charge warning operate?	—	Go to Step 6.	Go to Step 5.
5	Replace the ACG. Also, check the charge warning system, and repair or replace if faulty. Is the procedure completed?	—	Go to Step 6.	—
6	Check the condition of commercial electrical equipment such as radio and lights. Does the engine stall when the commercial electrical equipment is powered OFF?	—	Go to Step 7.	Go to Step 8.
7	Correct the installation condition of the electrical equipment, or remove the electrical equipment. Is the procedure completed?	—	Go to Step 8.	—

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Step	Action	Value	YES	NO
8	Check the fuel system in the following procedure. 1. Check the high pressure pipe and low pressure pipe for looseness in the connection (fuel leakage), crush or clogging. Check the clogging in the following procedure. • Fuel filter (main fuel filter, pre-fuel filter, gauze filter) • Fuel tank (pump strainer) • Fuel system pipe 2. Check the fuel pipe, fuel filter, and inside of the fuel tank for freeze or waxing. (at cold temperature) 3. Check the feed pipe inside the fuel tank for clogging of foreign matter. 4. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 9.	—
9	Check the intake system. Is the procedure completed?	—	Go to Step 10.	Go to "Intake system check".
10	Check the exhaust system. Is the procedure completed?	—	Go to Step 11.	Go to "Exhaust system check".
11	Check the mechanical part of the engine, and repair if faulty. • Compression pressure • Valve system • Injector • Timing gear • Related part of piston/crank Is the procedure completed?	—	Go to Step 12.	—
12	Is EMPS available?	—	Go to Step 13.	Go to Step 14.
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Verify repair.	Go to Step 14.

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Step	Action	Value	YES	NO
14	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR.	—		
	Is the procedure completed?		Verify repair.	—

Engine hunting, rough idling

Pre-inspection

Before using this paragraph, perform the “OBD system check” and check all the following items.

- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Scan tool data shows normal operating range.
- Check the condition of the machine to identify the applicable symptom from “List of trouble symptom”. Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved.

This inspection includes the following items.

- There is no poor contact in connector (it must be connected with click sound).
- The terminal voltage of battery is not low.
- Wire is connected, tightened or cut properly.
- Commercial accessory power supply is not bifurcated from ECM power supply.
- ECM ground is not contaminated and installed to the proper position securely.
- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.

- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault.
- Exhaust system parts for fault.

Diagnostic aid

- Fuel system fault (run out of fuel, frozen fuel, air mixed in fuel pipe, faulty filter [clog in main filter, gauze filter], pipe fault, fuel quality, fuel tank [foreign matter, fuel suction fault])
- Intake system fault (clogging in filter, intake pipe fault, etc.)
- Supply pump (including feed pump) fault (no fuel pressure feed)
- Switch input circuit system fault
- Sensor input circuit system fault (accelerator position (AP) sensor, harness, engine coolant temperature (ECT) sensor, etc.)
- AP sensor system fault (sensor, harness, etc.)
- Engine body fault (seizure, compression pressure shortage, other mechanical trouble)
- Machine side related equipment trouble (oil pressure pump etc.)
- Effect of commercial electrical equipment (radio, lamp, etc.)
- Check the connector for poor contact, the harness for fault such as wear or bend, and the wire inside the harness for loosened wire causing short circuit to other circuits. Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check if excessive load is applied to the machine side. Repair or replace the faulty part. Note: Refer to the machine’s manual for check and repair. Is the procedure completed?	—	Go to Step 3.	—
3	Check the fuel. 1. Supply fuel from a container other than the fuel tank. 2. Start the engine, operate the machine, and check for trouble symptom. 3. Replace the fuel in the fuel tank and pipe. Is the engine symptom corrected?	—	Go to Step 24.	Go to Step 4.

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Step	Action	Value	YES	NO
4	Bleed air from fuel, and check for trouble symptom again. Note: For work procedure, refer to “Engine section” in the service manual. Is the engine symptom corrected?	—	Go to Step 24.	Go to Step 5.
5	Check the intake system. Is the procedure completed?	—	Go to Step 6.	Go to “Intake system check”.
6	Check the fuel system. Is the procedure completed?	—	Go to Step 7.	Go to “Fuel system check”.
7	Check the injector. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Start the engine. 3. Select the “Actuator test” from the scan tool menu. When the scan tool is not available, use the injector checker. Refer to “How to use injector checker” in this section for how to use injector checker. 4. Select the “Injection stop at each injector” in the “Common rail system”. 5. Press the “OFF” soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 9.	Go to Step 8.
8	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 9.	—
9	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 22.	Go to Step 10.
10	Check the condition of commercial electrical equipment such as radio and lights. Does the engine symptom change when the commercial electrical equipment is powered OFF?	—	Go to Step 11.	Go to Step 12.
11	Correct the installation condition of the electrical equipment, or remove the electrical equipment. Is the procedure completed?	—	Go to Step 12.	—

Step	Action	Value	YES	NO
12	Check for installation condition of the crankshaft position (CKP) sensor and camshaft position (CMP) sensor. Check the CKP sensor and CMP sensor for improper installation such as play. Is it properly installed?	—	Go to Step 14.	Go to Step 13.
13	Correct the installation conditions of the CKP sensor and CMP sensor. Is the procedure completed?	—	Go to Step 14.	—
14	Is the scan tool available?	—	Go to Step 15.	Go to Step 16.
15	Check the signal conditions of CKP sensor and CMP sensor using scan tool. 1. Connect the scan tool. 2. Crank the engine. 3. Correct the data list on the scan tool. Is the speed displayed?	—	Go to Step 18.	Go to Step 16.
16	Check for signal detection condition of the CKP sensor. 1. Start the engine. 2. Remove the harness from the CMP sensor. (The DTC is detected when this procedure is performed. Be sure to clear the DTC after repairing the machine.) Is the idle condition normal?	—	Go to Step 23.	Go to Step 17.
17	Check for signal detection condition of the CMP sensor. 1. Start the engine. 2. Remove the harness from the CKP sensor. (The DTC is detected when this procedure is performed. Be sure to clear the DTC after repairing the machine.) Is the idle condition normal?	—	Go to Step 23.	Go to Step 18.
18	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 24.	Go to Step 19.
19	Is EMPS available?	—	Go to Step 20.	Go to Step 21.
20	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 24.	Go to Step 21.

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Step	Action	Value	YES	NO
21	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 24.	Go to Step 22.
22	Restore the ECM to its original condition of before replacement. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 23.	—
23	Check the mechanical part of the engine, and repair if faulty. • ompression pressure • Valve system • Flywheel • Camshaft gear • Timing gear • Related part of piston/crank Is the procedure completed?	—	Go to Step 24.	Go to Step 2.
24	Repair the machine, and check the repair. Is the procedure completed?	—	Verify repair.	—

Engine output shortage

Pre-inspection

Before using this paragraph, perform the "OBD system check" and check all the following items.

- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Scan tool data shows normal operating range.
- Check the condition of the machine to identify the applicable symptom from "List of trouble symptom". Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Various kinds of causes are assumed for output shortage, therefore thoroughly investigate the relation between engine body and machine.

- Check what operation triggers the output shortage. If hesitations or lag down is included in the symptom of the output shortage, the fault is related to the machine-side control. Contact with the machine manufacturer.

If Tech2 is available, checking the boost of Q enables to check the engine output at rated point as a simplified method.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved.

This inspection includes the following items.

- There is no dirt or clogging in air cleaner element.
- Wire is connected, tightened or cut properly.
- Commercial accessory power supply is not bifurcated from ECM power supply.
- ECM ground is not contaminated and installed to the proper position securely.
- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.
- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Increase in resistance due to dirt or clogging in intake system parts (especially air cleaner element) and crushed intake pipes
- Exhaust system parts for fault.

Diagnostic aid

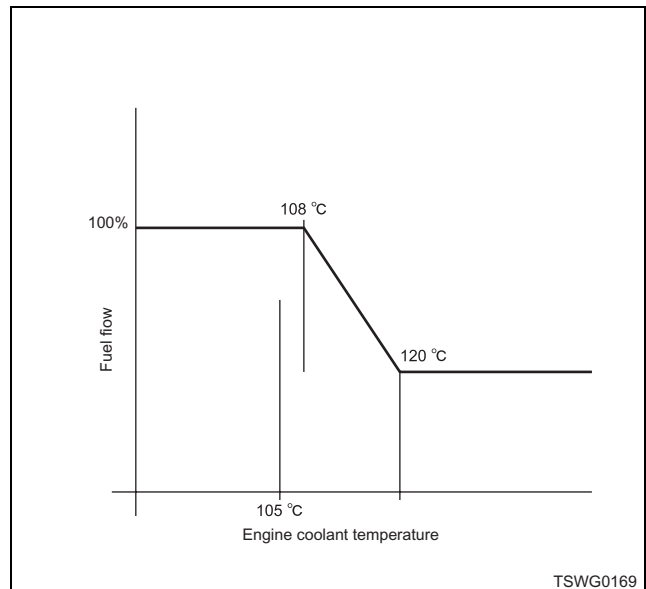
- Fuel system fault (run out of fuel, frozen fuel, air mixed in fuel pipe, faulty filter [clog in main filter, gauze filter], pipe fault, fuel quality, fuel tank [foreign matter, fuel suction fault])
- Intake system fault (clogging in filter, intake pipe fault, etc.)
- Exhaust system fault (exhaust brake, exhaust pipe fault, etc.)

- Sensor input circuit system fault (accelerator position (AP) sensor, harness, etc.)
- Switch input circuit system fault
- Engine body fault (compression pressure, valve clearance, turbocharger, supply pump, injector, common rail and other mechanical trouble, etc.)
- Machine side related equipment trouble (oil pressure pump etc.)
- Effect of commercial electrical equipment (radio, lamp, etc.)
- Check the connector for poor contact, the harness for fault such as wear or bend, and the wire inside the harness for loosened wire causing short circuit to other circuits. Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.
- Output lowering due to regulated fuel flow during overheat

Control during overheat

In overheating, ECM begins to limit fuel flow when the engine coolant temperature exceeds 108°C, for engine protection. It limits fuel flow further as the engine coolant temperature goes up. Fuel flow is limited to a certain level at around 120°C*. (* Setting varies depending on the machine manufacturer)

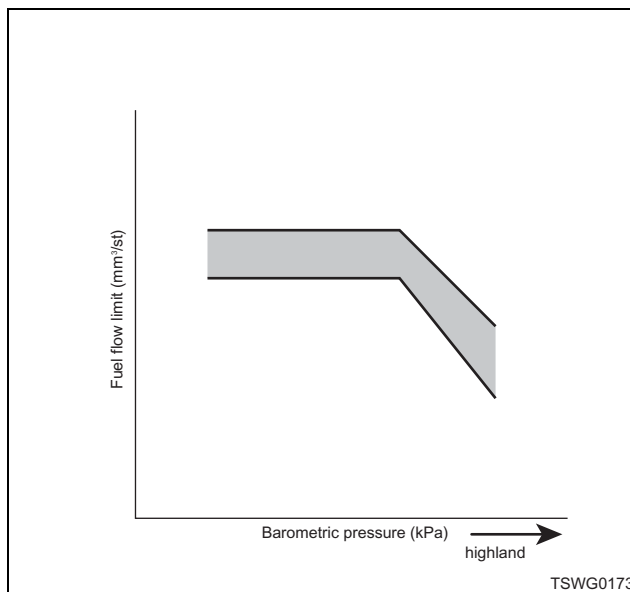
The system raises an alarm from 105°C for some machines. In addition to alarm, by reducing the load to the machine, it enables to avoid such conditions that the fuel flow is limited.



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About high-altitude correction

ECM calculates the current altitude based on the barometric pressure sensor signal. It regulates the opening/closing period of PCV or electric conduction of injector according to the altitude etc. at this time, to correct the optimum fuel flow.



Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	1. Make sure that the engine coolant temperature does not exceed 108°C. 2. Examine and repair the cause of overheat. 3. Lower the engine coolant temperature to make sure that the output lowering has corrected. Is the procedure completed?	—	Go to Step 22.	Go to Step 3.
3	Check driving environment. Fuel flow may be limited by correction when driving at high altitude. Did you drive at high altitude?	—	Contact the machine manufacturer for countermeasure.	Go to Step 4.
4	Check if excessive load is applied to the machine side. Repair or replace the faulty part. Note: Refer to the machine's manual for check and repair. Is the procedure completed?	—	Go to Step 5.	—
5	Check the fuel. 1. Replace the fuel in the fuel tank and pipe. 2. Start the engine, operate the machine, and check for trouble symptom. Is the engine symptom corrected?	—	Go to Step 22.	Go to Step 6.
6	Bleed air from fuel, and check for trouble symptom again. Note: For work procedure, refer to “Engine section” in the service manual. Is the engine symptom corrected?	—	Go to Step 22.	Go to Step 7.

Step	Action	Value	YES	NO
7	Check the fuel system. Is the procedure completed?	—	Go to Step 8.	Go to “Fuel system check”.
8	Check the intake system. Is the procedure completed?	—	Go to Step 9.	Go to “Intake system check”.
9	Check the exhaust system. Is the procedure completed?	—	Go to Step 10.	Go to “Exhaust system check”.
10	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 22.	Go to Step 11.
11	Check the condition of commercial electrical equipment such as radio and lights. Does the engine symptom change when the commercial electrical equipment is powered OFF?	—	Go to Step 12.	Go to Step 13.
12	Correct the installation condition of the electrical equipment, or remove the electrical equipment. Is the procedure completed?	—	Go to Step 13.	—
13	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 22.	Go to Step 14.
14	Check the injector. 1. Clear the DTC. Refer to “How to clear diagnosis trouble code (DTC)” of “Procedure of trouble diagnosis” in this section for how to clear DTCs. 2. Start the engine. 3. Select the “Actuator test” from the scan tool menu. When the scan tool is not available, use the injector checker. Refer to “How to use injector checker” in this section for how to use injector checker. 4. Select the “Injection stop at each injector” in the “Common rail system”. 5. Press the “OFF” soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 15.	Go to Step 16.
15	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Go to Step 15.	—
16	Is EMPS available?	—	Go to Step 17.	Go to Step 18.

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Step	Action	Value	YES	NO
17	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to “How to use flush tool” in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 20.	Go to Step 18.
18	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 20.	Go to Step 19.
19	Restore the ECM to its original condition of before replacement. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to “Engine Control System, Engine control module (ECM), Installation of ECM” in this section for learning of EGR. Is the procedure completed?	—	Go to Step 20.	—
20	Check the mechanical part of the engine, and repair if faulty. • Compression pressure • Valve system • Injector • Timing gear • Related part of piston/crank Is the procedure completed?	—	Go to Step 21.	—
21	Check the machine-side equipment (trouble of oil pressure pump etc.), and repair if faulty. Is the procedure completed?	—	Go to Step 22.	—
22	Repair the machine, and check the repair. Is the procedure completed?	—	Verify repair.	—

Exhaust gas contains a lot of white smoke.**Pre-inspection**

Before using this paragraph, perform the “OBD system check” and check all the following items.

- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Scan tool data shows normal operating range.
- Check the condition of the machine to identify the applicable symptom from “List of trouble symptom”. Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved.

This inspection includes the following items.

- There is no poor contact in injector connector (it must be connected with click sound).
- Wire is connected, tightened or cut properly.

- Commercial accessory power supply is not bifurcated from ECM power supply.
- ECM ground is not contaminated and installed to the proper position securely.
- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.
- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault.
- Exhaust system parts for fault.

Diagnostic aid

- Fuel quality (use of fuel other than specified)
- Long-term idling
- Trouble of engine coolant temperature (ECT) sensor, fuel temperature (FT) sensor, intake air temperature (IAT) sensor, boost pressure sensor, or barometric pressure sensor.
- Engine body trouble (compression pressure shortage, related to piston, turbocharger, rise/decline of oil, etc.)
- ECM trouble (body, power supply, ground, etc.)

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check the fuel. 1. Replace the fuel tank and the fuel in the pipe, or supply the specified oil suitable for current environment from the fuel container. 2. Start the engine, operate the machine, and check for trouble symptom. Is the engine symptom corrected?	—	Go to Step 17.	Go to Step 3.
3	Check the fuel system. Is the procedure completed?	—	Go to Step 4.	Go to “Fuel system check”.
4	Check if oil is mixed in the intake air. 1. Is the blow-by emitted excessively? • Excessive engine oil • Clogged or deformed oil return pipe • Clogged or crushed breather hose 2. Wear of turbocharger seal ring 3. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 5.	—
5	Is the scan tool available?	—	Go to Step 6.	Go to Step 8.

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Step	Action	Value	YES	NO
6	Check the injector. 1. Clear the DTC. Refer to "How to clear diagnosis trouble code (DTC)" of "Procedure of trouble diagnosis" in this section for how to clear DTCs. 2. Start the engine. 3. Select the "Actuator test" from the scan tool menu. 4. Select the "Injection stop at each injector" in the "Common rail system". 5. Press the "OFF" soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 9.	Go to Step 7.
7	Perform the pre-injection stop test. Select the "Stop pre-injection" from the scan tool menu to perform the test. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 9.	Go to Step 10.
8	Check the injector using injector checker. Refer to "How to use injector checker" in this section for how to use injector checker. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 9.	Go to Step 10.
9	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 10.	—
10	Check the coupling of the supply pump for damage. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 11.	—
11	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 17.	Go to Step 12.
12	Is EMPS available?	—	Go to Step 13.	Go to Step 14.

Step	Action	Value	YES	NO
13	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 14.
14	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 16.	Go to Step 15.
15	Restore the ECM to its original condition of before replacement. Is the procedure completed?	—	Go to Step 16.	—
16	Check the mechanical part of the engine, and repair if faulty. • Compression pressure • Valve system • Injector • Timing gear • Related part of piston/crank Is the procedure completed?	—	Go to Step 17.	—
17	Repair the machine, and check the repair. Is the procedure completed?	—	Verify repair.	Go to Step 2.

Exhaust gas contains a lot of black smoke.**Pre-inspection**

Before using this paragraph, perform the “OBD system check” and check all the following items.

- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Scan tool data shows normal operating range.
- Check the condition of the machine to identify the applicable symptom from “List of trouble symptom”. Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved.

This inspection includes the following items.

- There is no dirt or clogging in air cleaner element.
- Wire is connected, tightened or cut properly.
- Commercial accessory power supply is not bifurcated from ECM power supply.

- ECM ground is not contaminated and installed to the proper position securely.
- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.
- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault.
- Exhaust system parts for fault.

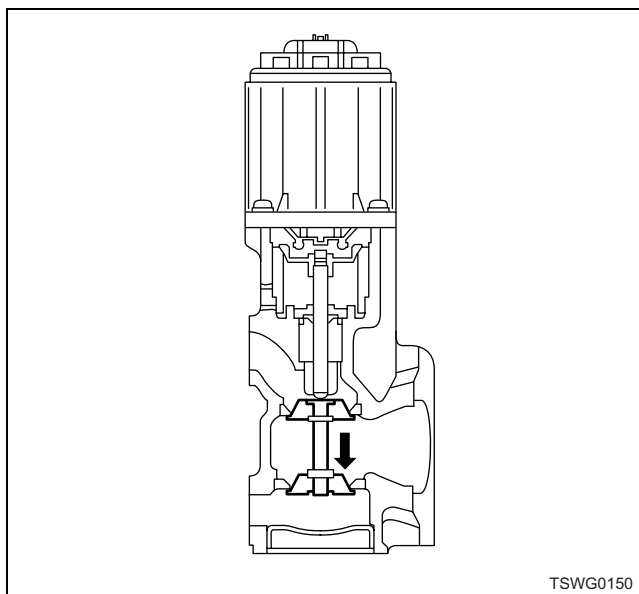
Diagnostic aid

- Fuel quality (use of fuel other than specified)
- Intake system fault (clogging in filter, intake pipe fault, etc.)
- EGR control system fault
- Exhaust system fault (exhaust pipe fault etc.)
- Engine coolant temperature (ECT) sensor fault
- Boost pressure sensor fault (sensor, pipe, etc.)
- Engine body trouble (compression pressure shortage, related to the piston, turbocharger, rise of oil)

Step	Action	Value	YES	NO
1	Perform the OBD system check. Is the procedure completed?	—	Go to Step 2.	Go to “OBD system check”.
2	Check the intake system. Is the procedure completed?	—	Go to Step 3.	Go to “Intake system check”.
3	Check the EGR control system. Is the procedure completed?	—	Go to Step 4.	Go to “EGR control system check”.
4	Check the reed valve of the EGR. If the trouble is detected, repair as required. Is the procedure completed?	—	Go to Step 5.	—
5	Check the fuel system. Is the procedure completed?	—	Go to Step 6.	Go to “Fuel system check”.
6	Check the exhaust system. Is the procedure completed?	—	Go to Step 7.	Go to “Exhaust system check”.
7	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 15.	Go to Step 8.
8	Check the mechanical part of the engine, and repair if faulty. • Valve system (valve clearance) Is the procedure completed?	—	Go to Step 9.	—
9	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 15.	Go to Step 10.
10	Is EMPS available?	—	Go to Step 11.	Go to Step 12.

Step	Action	Value	YES	NO
11	1. Check the version of ECM software. 2. Rewrite the software if version upgraded is necessary. Refer to "How to use flush tool" in this section for check and rewriting of ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	Go to Step 12.
12	Replace the ECM. Note: EGR valve position learning is required after replacing or rewriting the ECM. Refer to "Engine Control System, Engine control module (ECM), Installation of ECM" in this section for learning of EGR. Is the procedure completed?	—	Go to Step 13.	—
13	Check for the engine symptom again. Is the engine symptom corrected?	—	Go to Step 15.	Go to Step 14.
14	Check the mechanical part of the engine, and repair if faulty. • Compression pressure • Valve system • Injector • Timing gear • Related part of piston/crank Is the procedure completed?	—	Go to Step 15.	—
15	Repair the machine, and check the repair. Is the procedure completed?	—	Verify repair.	—

EGR valve check



Push the EGR valve with finger to make sure it opens/closes smoothly. Also, make sure that the valve closes completely when the finger is released.

Noise

Pre-inspection

Before using this paragraph, perform the “OBD system check” and check all the following items.

- Check for noise by referring to the machine's manual.
- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Scan tool data shows normal operating range.
- Check the condition of the machine to identify the applicable symptom from the table of contents. Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved. This inspection includes the following items.

- Wire is connected, tightened or cut properly.
- ECM ground is not contaminated and installed to the proper position securely.

- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.
- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault.
- Exhaust system parts for fault.

Diagnostic aid

- Fuel system fault (run out of fuel, frozen fuel, air mixed in fuel pipe, faulty filter [clog in main filter, gauze filter], pipe fault, fuel quality, fuel tank [foreign matter, fuel suction fault])
- Intake system fault (EGR valve fault)
- Injector fault (no fuel injection)
- Engine body fault (seizure, compression pressure shortage, other mechanical trouble)
- Machine side related equipment trouble (oil pressure pump etc.)
- ECM trouble (body, power supply, ground, etc.)
- Check the connector for poor contact, the harness for fault such as wear or bend, and the wire inside the harness for loosened wire causing short circuit to other circuits. Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.

Step	Action	Value	YES	NO
1	Identify the source of the noise and confirm the noise. Is the noise metallic noise?	—	Repair or replace the faulty parts.	Go to Step 2.
2	Is the scan tool available?	—	Go to Step 3.	Go to Step 8.
3	Perform the pre-injection stop test. Select the “Stop pre-injection” from the scan tool menu to perform the test. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 5.	Go to Step 4.
4	Perform “Injection Stop for Each Injector”. 1. Select the “Actuator test” from the scan tool menu. 2. Select the “Injection stop at each injector” in the “Common rail system”. 3. Press the “OFF” soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 5.	Go to Step 6.

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Step	Action	Value	YES	NO
5	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Verify repair.	—
6	Check the EGR valve. • Fault in reed valve • Fault in EGR valve body Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	Go to Step 7.
7	Refer to “Engine section” in the service manual to check the engine trouble. Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	—
8	Check the injector using injector checker. Refer to “How to use injector checker” in this section for how to use injector checker. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 5.	Go to Step 6.

Fuel consumption deteriorates.**Pre-inspection**

Before using this paragraph, perform the “OBD system check” and check all the following items.

- Fuel consumption varies depending on handling of each machine. Check the machine manufacturer's measure of fuel consumption (A).
Measure of fuel consumption (ℓ /hour)
- Check the actual fuel consumption (B).
Actual fuel consumption (ℓ /hour)
- If B is bigger than A, check the machine's setting by referring to the machine's manual.
- Check if excessive load is applied to the machine.
- Refer to the list of inspection and maintenance items of the operation manual for proper inspection depending on the operation time.
- If the operation time exceeds 3000 hours, inspect by referring to the machine's manual.
- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Check the condition of the machine to identify the applicable symptom from “List of trouble symptom”. Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.
- Check if periodic maintenance has been performed for engine oil replacement, air cleaner filter, fuel filter, etc.

- Wire is connected, tightened or cut properly.
- ECM ground is not contaminated and installed to the proper position securely.
- Pipes and hoses relevant to fuel, air and oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.
- Fuel system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault.
- Exhaust system parts for fault.

Diagnostic aid

- Fuel system fault (run out of fuel, frozen fuel, air mixed in fuel pipe, faulty filter [clog in main filter, gauze filter], pipe fault, fuel quality, fuel tank [foreign matter, fuel suction fault])
- Intake system fault (EGR valve fault)
- Injector fault (excessive fuel injection etc.)
- Engine body fault (seizure, compression pressure shortage, other mechanical trouble)
- Machine side related equipment trouble (oil pressure pump etc.)
- ECM trouble (body, power supply, ground, etc.)
- Check the connector for poor contact, the harness for fault such as wear or bend, and the wire inside the harness for loosened wire causing short circuit to other circuits. Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved. This inspection includes the following items.

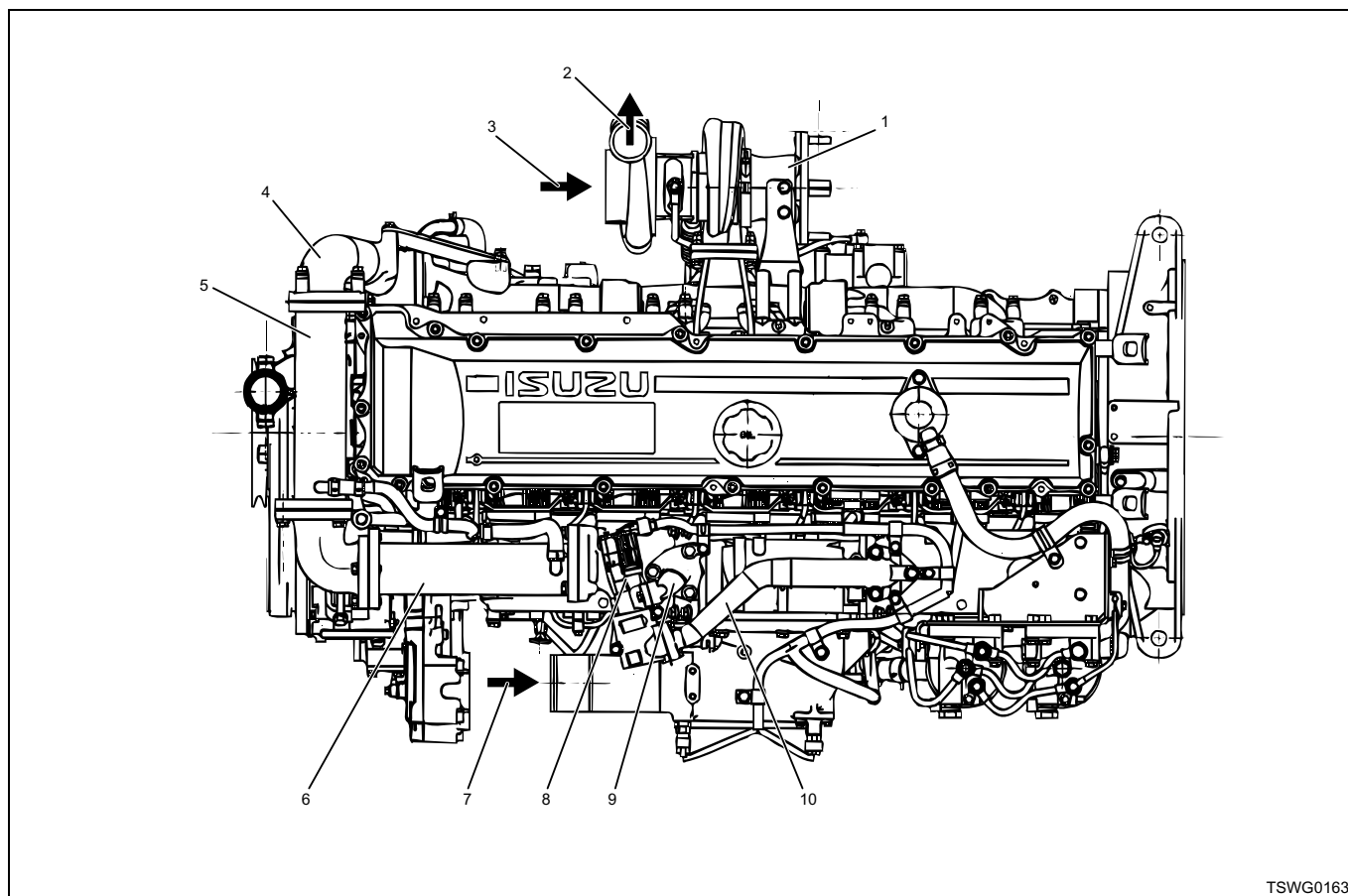
Step	Action	Value	YES	NO
1	1. Compare the measure of fuel consumption with the actual fuel consumption. A: Measure of fuel consumption (ℓ /hour) B: Actual fuel consumption (ℓ /hour) 2. If B is bigger than A, check the machine's setting or if excessive load is applied to the machine by referring to the machine's manual. 3. Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	Go to Step 2.
2	Check for fuel leakage. Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	Go to Step 3.

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Step	Action	Value	YES	NO
3	Check if periodic maintenance has been performed for engine oil replacement, air cleaner filter, fuel filter, etc. Is the procedure completed?	—	Perform maintenance for the machine.	Go to Step 4.
4	Check the intake system and intercooler for water accumulation. Is the procedure completed?	—	Go to Step 5.	Go to "Intake system check".
5	Check the exhaust system for crush, bent or clogging. Is the procedure completed?	—	Go to Step 6.	Go to "Exhaust system check".
6	Check for output shortage. Is the procedure completed?	—	Go to Step 7.	Go to "Output shortage, lag down".
7	1. Check the coupling of the supply pump for damage. 2. Check the coupling of the supply pump for worn out of alignment mark. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 8.	—
8	Check if the engine oil of viscosity mentioned in the operation manual is used. Is the appropriate oil used?	—	Go to Step 9.	Replace with the appropriate oil, and Go to Step 1.
9	Check the cooling fan for fault. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 10.	—
10	Is the scan tool (KW communication) available?	—	Go to Step 11.	Go to Step 16.
11	Perform "Injection Stop for Each Injector". 1. Select the "Actuator test" from the scan tool menu. 2. Select the "Injection stop at each injector" in the "Common rail system". 3. Press the "OFF" soft key to stop the fuel injection in the cylinder one by one, and check the change in engine sound. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 12.	Go to Step 13.
12	Replace the injector in the cylinder of which engine sound did not change when it is stopped. Note: For work procedure, refer to "Engine section" in the service manual. Is the procedure completed?	—	Go to Step 13.	—
13	Check the engine compression pressure. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 14.	—

Step	Action	Value	YES	NO
14	Check the valve clearance. Repair or replace the faulty part. Is the procedure completed?	—	Go to Step 15.	—
15	Has the engine operated for more than 3000 hours? If more than 3000 hours, check or repair the engine friction by referring to "Engine section" in the service manual. Is the procedure completed?	—	Verify repair.	—
16	Check the injector using injector checker. Refer to "How to use injector checker" in this section for how to use injector checker. Is there any cylinder of which engine sound did not change when it is stopped?	—	Go to Step 12.	Go to Step 13.

Inspection location of engine intake/exhaust system



TSWG0163

Name

1. Exhaust pipe	6. Secondary EGR cooler
2. To intercooler	7. From intercooler
3. From air cleaner	8. EGR valve
4. EGR duct	9. EGR duct
5. Primary EGR cooler	10. EGR duct

Check the above intake/exhaust system for fault such as clogging, crush or breakage.
Besides the inspection location of engine body, check the air cleaner, intercooler and muffler.

Oil consumption deteriorates.**Pre-inspection**

Before using this paragraph, perform the “OBD system check” and check all the following items.

- Oil consumption varies depending on handling of each machine. Check the machine manufacturer's measure of oil consumption (A).
Measure of oil consumption/hour
Measure of oil consumption for engine alone:
4 ℓ /100 hours
- Check the actual oil consumption (B).
Actual oil consumption /hour
- Refer to the list of inspection and maintenance items of the operation manual for proper inspection depending on the operation time.
- If the operation time exceeds 3000 hours, inspect by referring to the machine's manual.
- ECM and diagnosis lamp operate properly.
- Check the DTC.
- Check the condition of the machine to identify the applicable symptom from the table of contents. Perform the procedure described in the symptom chart.
- Check with the customer if correct engine oil and fuel are used.

Visual check

Careful visual check is required for some symptom procedures. By this inspection, the problem can be corrected without performing further inspection, and time can be saved. This inspection includes the following items.

- If bluish-white smoke is emitted continuously while engine running.
- If blow-by gas is emitted.
- If oil is mixed in the coolant.
- Pipes and hoses relevant to oil are free of crack or twist, and are properly connected. Thoroughly check for any oil leakage and clogging.
- Lubrication system is free from oil leakage, and pipe is not damaged or dent.
- Intake system parts for fault (turbocharger check).

Diagnostic aid

- Intake system fault (rise/decline of oil, excessive blow-by gas)
- Engine body fault (oil combustion, excessive blow-by gas)

Also, perform the function diagnosis to check the operation and control of each part. Repair if faulty.

Step	Action	Value	YES	NO
1	Check the following for trouble occurrence: - Engine speed - Operational pattern (continuous/intermittent) - Operating load (mode in use) - Oil consumption /hour - If more than 100 hours has elapsed since initial operation. Compare with the specified value of oil consumption by referring to the machine's manual. Note: Use the operation mode mentioned in the machine's manual to make comparison. Is the oil consumption within specified value?	—	Explain this to the customer.	Go to Step 2.
2	Check for oil leakage. Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	Go to Step 3.
3	Check if bluish-white smoke is emitted while engine running. If it is emitted only at the starting, go to “Exhaust gas contains a lot of white smoke.” Is bluish-white smoke emitted?	—	Go to Step 4.	Go to Step 6.
4	Check the blow-by gas quantity. Is it more than the specified value?	—	Go to Step 7.	Go to Step 5.

Step	Action	Value	YES	NO
5	Check for oil leakage from the turbocharger. Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	Go to Step 6.
6	Check if oil is mixed in the coolant. Is oil mixed in the coolant?	—	Go to Step 10.	Go to Step 11.
7	Check the engine compression pressure. Repair or replace the faulty part. Is the trouble detected?	—	Go to Step 8.	Go to Step 9.
8	Check the engine for wear around the piston or wear of the cylinder liner. Note: For work procedure, refer to “Engine section” in the service manual. Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	Go to Step 9.
9	Check for oil decline from the valve stem or oil seal. Note: For work procedure, refer to “Engine section” in the service manual. Repair or replace the faulty part. Is the procedure completed?	—	Verify repair.	Go to Step 10.
10	Overhaul the water pump. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Verify repair.	—
11	Check for oil leakage from the engine external/internal. Repair or replace the faulty part. Note: For work procedure, refer to “Engine section” in the service manual. Is the procedure completed?	—	Verify repair.	—

Special tool

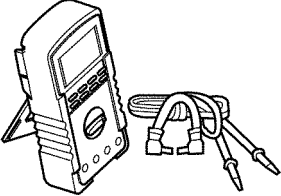
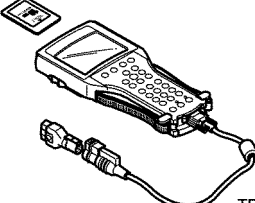
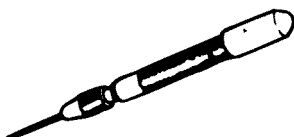
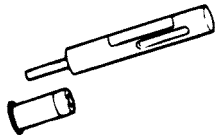
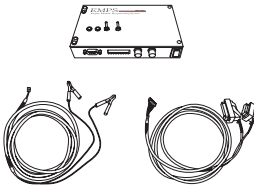
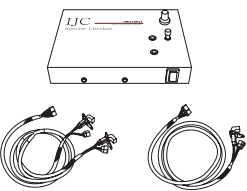
Illustration	Tool No. Tool name
 5884026910	5-8840-2691-0 Digital multimeter
 TECH2	Tech2 Scan tool
 5884006320	5-8840-0632-0 Terminal remover
 5884003880	5-8840-0388-0 Weather pack terminal remover
 5884003850	5-8840-0385-0 Breaker box
 EMPS	Engine module programming system

Illustration	Tool No. Tool name
 IJC	Injector checker

Difference by each machine manufacturer

JCB

List of DTC

JCB P Code	ISUZU P Code	DTC description	Fault indication on monitor
P0340	P0340	Camshaft position sensor circuit fault	○
P0341	P0341	Camshaft position sensor fault	—
P0335	P0335	Crankshaft position sensor circuit fault	○
P0336	P0336	Crankshaft position sensor fault	—
P1345	P1345	Injection pump — Camshaft positional correlation fault	○
P0113	P0113	Intake air temperature sensor circuit high input	○
P0112	P0112	Intake air temperature sensor circuit low input	○
P0118	P0118	Engine coolant temperature sensor input is high.	○
P0117	P0117	Engine coolant temperature sensor low input	○
P1277	P1277	Accelerator sensor 1 low input	—
P1283	P1283	Accelerator sensor 2 high input	—
P1282	P1282	Accelerator sensor 2 low input	—
P1287	P1287	Accelerator sensor 3 low input	—
P1271	P1271	Accelerator sensor 1 — 2 positional correlation fault	—
P0238	P0238	Turbocharger boost sensor circuit high input	○
P0237	P0237	Turbocharger boost sensor circuit low input	○
P0611	P0611	EDU charge circuit 1 low voltage	○
P0612	P0612	EDU charge circuit 2 low voltage	○

JCB P Code	ISUZU P Code	DTC description	Fault indication on monitor
P1630	P1630	Analog/digital signal conversion fault	○
P0234	P0234	High boost fault	—
P0487	P0487	EGR valve BLDC position circuit fault	○
P0488	P0488	EGR valve fault	○
P0606	P0606	ECM internal trouble (CPU fault)	○
P1631	P1631	5V #1 circuit fault	—
P1632	P1632	5V #2 circuit fault	○
P1633	P1633	5V #3 circuit fault	○
P1634	P1634	5V #4 circuit fault	○
P1635	P1635	5V #5 circuit fault	○
P1636	P1636	12V circuit fault	—
P0236	P0236	Low boost fault	—
P0380	P0380	Glow relay circuit fault	○
P0381	P0381	Glow plug lamp circuit fault	—
P0108	P0108	Barometric pressure sensor circuit high input	○
P0107	P0107	Barometric pressure sensor circuit low input	○
P0650	P0650	Check engine control circuit fault	—
P2104	U2104	CAN communication fault	○
P2106	U2106	Communication fault with TCM (Transmission control module)	○
P0088	P0088	Common rail pressure abnormally high (1st or 2nd stage)	○
P0089	P0089	Common rail pressure fault (Excessive pressure feed in supply pump)	○
P1261	P1261	COMMON1 (Harness or injector harness)	○

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JCB P Code	ISUZU P Code	DTC description	Fault indication on monitor
P1262	P1262	COMMON2 (Harness or injector harness) circuit fault	○
P0183	P0183	Fuel temperature sensor circuit high input	—
P0182	P0182	Fuel temperature sensor circuit low input	—
P1095	P1095	Pressure limiter is operated.	○
P1094	P1094	Fuel leakage (small amount) or (supply pump or injection system) control malfunction	—
P1093	P1093	Fuel leakage (large amount)	○
P0087	P0087	Common rail pressure low pressure fault (No pressure feed in supply pump)	○
P0193	P0193	Common rail pressure sensor circuit high input	○
P0192	P0192	Common rail pressure sensor circuit low input	○
P0090	P0090	Common rail pressure control adjusting valve circuit fault	○
P0201	P0201	No. 1 injector — injector circuit fault	○
P0202	P0202	No. 2 injector — injector circuit fault	○
P0203	P0203	No. 3 injector — injector circuit fault	○
P0204	P0204	No. 4 injector — injector circuit fault	○
P0205	P0205	No. 5 injector — injector circuit fault	○
P0206	P0206	No. 6 injector — injector circuit fault	○
P1625	P1625	Main relay circuit stuck open or stuck closed	○
P0522	P0522	Oil pressure circuit open circuit	○
P0523	P0523	Oil pressure circuit short circuit	○

JCB P Code	ISUZU P Code	DTC description	Fault indication on monitor
P1113	P1113	Boost temperature sensor open circuit	—
P1112	P1112	Boost temperature sensor short circuit	—
P0219	P0219	Overrun	○
P1173	P1173	Overheat	—
P0603	P0603	EEPROM fault	○
P0601	P0601	ROM fault	—
P0606	P0606	CPU monitoring IC fault	○

List of DTC that vary depending on the machine manufacturer

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Judgment Time	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0192	245	Common rail pressure sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is less than 0.7 V.	Nearly simultaneous to fault occurrence	Engine blow up Back-up: Rail pressure feedback control stopped Limited injection amount 2 (multi-injection stopped) EGR stopped Switches the control to SCV compulsory drive.	ON	*2
P0193		Common rail pressure sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is more than 4.5 V.	Nearly simultaneous to fault occurrence	Engine stall possible Output lowering Back-up: Rail pressure feedback control stopped Limited injection amount 2 (multi-injection stopped) EGR stopped Switches the control to SCV compulsory drive.	ON	*2
P0219	543	Overrun	Engine speed abnormally high	• Key switch input voltage is 18V or more.	When engine speed is more than 210 rpm.	Approx. 1 sec.	Output lowering Back-up: Limited injection amount 1 Limitation is lifted if the speed decreases	ON	*2
P0237	32	Boost pressure sensor fault (low voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is less than 0.1V.	Approx. 3 sec.	Operationality is affected. Back-up: Boost pressure default setting (150 kPa) Boost pressure correction/ EGR stopped	ON	*2
P0238		Boost pressure sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1634 is not detected.	Boost pressure sensor voltage is more than 4.9V.	Approx. 3 sec.	Black smoke emitted Back-up: Boost pressure default setting (150 kPa) Boost pressure correction/ EGR stopped	ON	*2
P1113	295	Boost temperature sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • Coolant temperature is 50°C or more. • 5 minutes or more has elapsed after starting engine. • DTC P1634 is not detected.	Boost temperature sensor voltage is more than 4.95V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2

10D-587 Electronic control fuel injection system (Common rail type)

DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Judgment Time	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P1345	16	Cam sensor out of phase	Camshaft gear/ crankshaft gear installing angle is out of phase, or damage in gear.	• Key switch input voltage is 18V or more. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • CMP sensor pulse is normal. • Crank pulse is normal.	Correct cam pulse does not exist in crank gap position.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Engine running based on crank when it is normal After engine stops: Unable to identify cylinder (unable to restart)	ON	*1
U2104	84	CAN Bus fault	CAN communication fault	• Key switch input voltage is 20V or more.	Bus-off is detected.	At 3 sec. continuously	Set to idle speed. Back-up: Running at 1500 rpm.	ON	*3
U2106	85	CAN timeout fault	CAN communication fault	• DTC U2104 is not detected. • Key switch input voltage is 20V or more.	CAN data reception does not complete at a set time.	At 1 sec. continuously	Set to idle speed. Back-up: Running at 1500 rpm.	ON	*3

*1, *2, *3: Refer to "About failure restoration" in "List of diagnostic trouble code".

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Judgment Time	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0112	22	Intake air temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1632 is not detected.	Intake air temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Not in particular Back-up: Intake air temperature default setting (at starting: -10°C, at running: 25°C) EGR stopped	ON	*2
P0117	23	Engine coolant temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected.	Engine coolant temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Start ability deteriorates at low temperatures or black smoke emission is possible, output lowering depending on conditions. Back-up: Coolant temperature default setting (at starting: -20°C, at running: 80°C) EGR stopped	ON	*2
P0182	211	Fuel temperature sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1633 is not detected.	Combustion temperature sensor voltage is less than 0.1 V.	Approx. 4 sec.	Operationality is affected. Back-up: Fuel temperature default setting (at starting: -20°C, at running: 70°C)	ON	*2

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DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Judgment Time	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
P0192	245	Common rail pressure sensor fault (low voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is less than 0.7 V.	Nearly simultaneous to fault occurrence	Engine blow up Back-up: Rail pressure feedback control stopped Limited injection amount 2 (multi-injection stopped) EGR stopped Switches the control to SCV compulsory drive.	ON	*2
P0193		Common rail pressure sensor fault (high voltage fault)	Open/short circuit/breakage of sensor or harness	• Key switch input voltage is 18V or more. • DTC P1630 or P1635 is not detected.	Common rail pressure sensor voltage is more than 4.5 V.	Nearly simultaneous to fault occurrence	Engine stall possible Output lowering Back-up: Rail pressure feedback control stopped Limited injection amount 2 (multi-injection stopped) EGR stopped Switches the control to SCV compulsory drive.	ON	*2
P0219	543	Overrun	Engine speed abnormally high	• Key switch input voltage is 18V or more.	When engine speed is more than 2300 rpm.	Approx. 1 sec.	Output lowering Back-up: Limited injection amount 1 Limitation is lifted if the speed decreases	ON	*2
P0380	66	Glow relay fault	Open/short circuit/damage of relay or harness	• Key switch input power supply voltage is higher than 16 V but lower than 32 V.	No glow relay monitor signal exists against glow relay drive indication.	When trouble occurs 25 out of 30 samples.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*1
P1113	295	Boost temperature sensor fault (high voltage fault)	Short circuit in sensor or harness	• Key switch input voltage is 18V or more. • Coolant temperature is 50°C or more, or 3 minutes or more has elapsed after starting engine. • DTC P1634 is not detected.	Boost temperature sensor voltage is more than 4.95V.	Approx. 4 sec.	Operationality is not affected. Back-up: Back-up: No back-up action	ON	*2
P1345	16	Cam sensor out of phase	Camshaft gear/crankshaft gear installing angle is out of phase, or damage in gear.	• Key switch input voltage is 18V or more. • DTC P0335, P0336, P0340, P0341, P1345, or P1635 is not detected. • CMP sensor pulse is normal. • Crank pulse is normal.	Correct cam pulse does not exist in crank gap position.	When trouble occurs 7 out of 8 samples.	• Behavior does not change during engine running. • After engine stalls, engine will not start. Back-up: Engine running based on crank when it is normal After engine stops: Unable to identify cylinder (unable to restart)	ON	*1

10D-589 Electronic control fuel injection system (Common rail type)

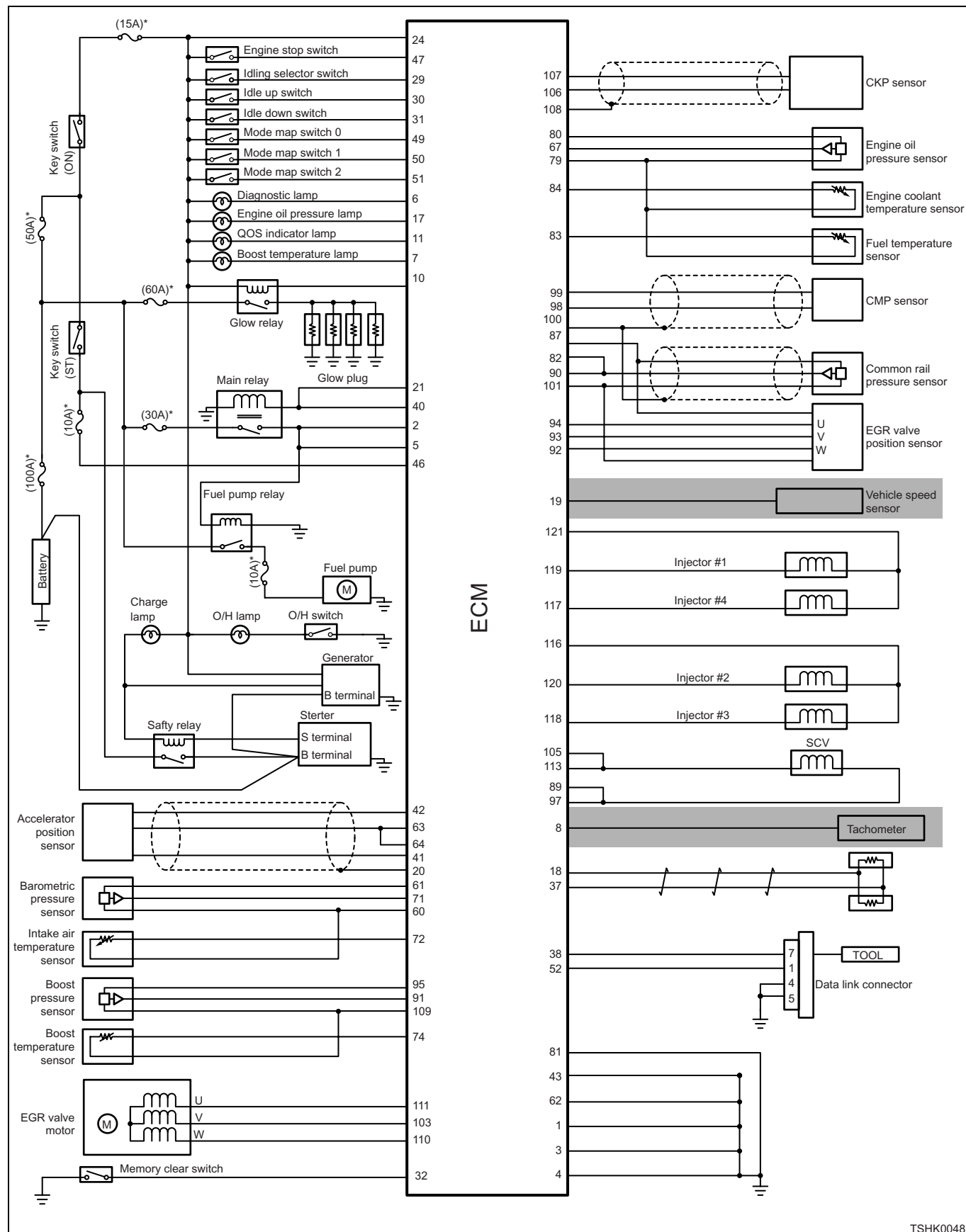
DTC	Flash code	DTC description	Item to be detected	Preconditions when DTC is set	DTC set condition	Judgment Time	Behavior when trouble occurs	Diagnosis lamp	Recovery from failure
U2104	84	CAN Bus fault	CAN communication fault	• Key switch input voltage is 20V or more.	Bus-off is detected.	At 3 sec. continuously	Set to idle speed. Back-up: Running at 1350 rpm.	ON	*3
U2106	85	CAN timeout fault	CAN communication fault	• DTC U2104 is not detected. • Key switch input voltage is 20V or more.	CAN data reception does not complete at a set time.	At 1 sec. continuously	Set to idle speed. Back-up: Running at 1350 rpm.	ON	*3

*1, *2, *3: Refer to "About failure restoration" in "List of diagnostic trouble code".

About wiring diagrams

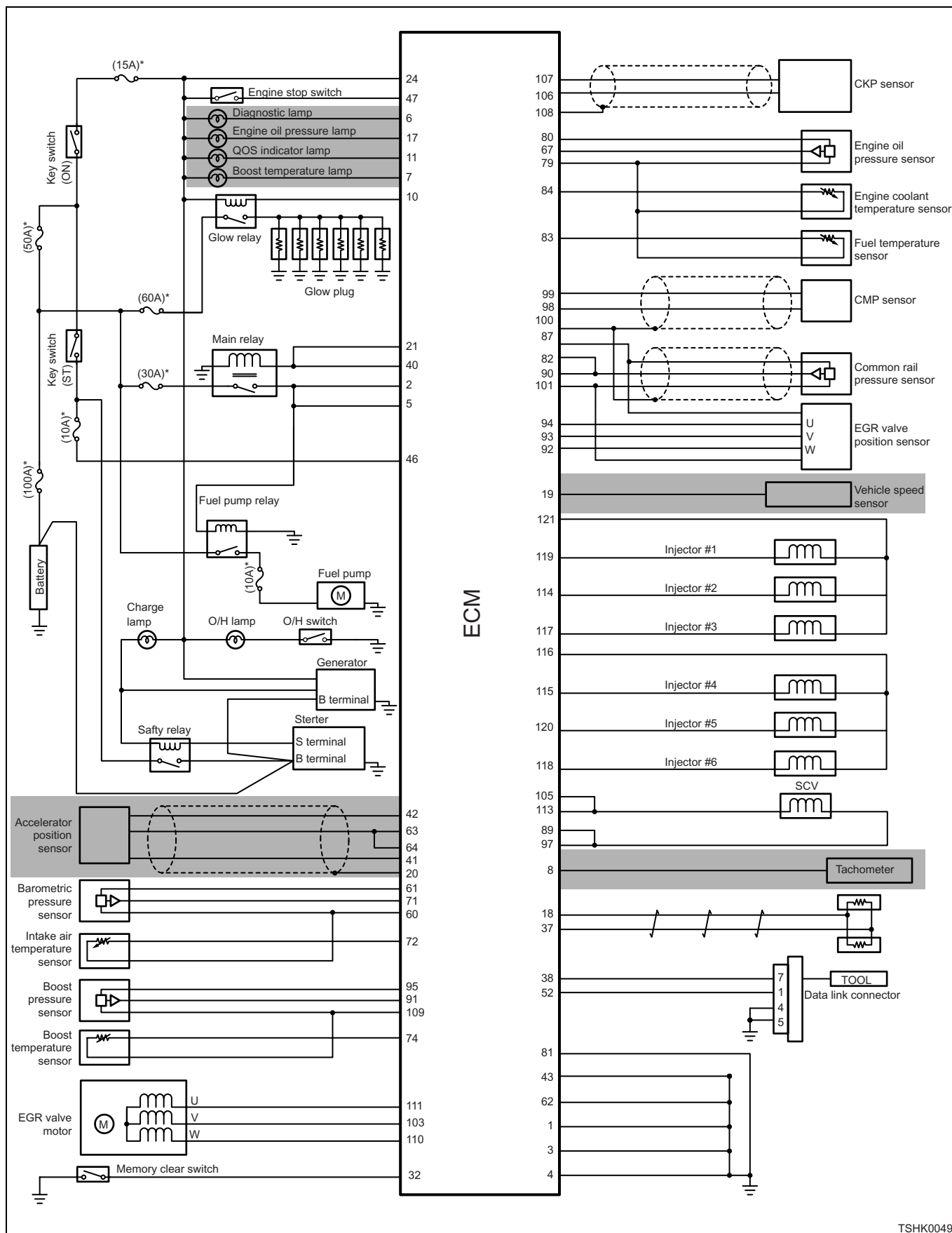
- There are some sensors which are not connected to the ECM depending on the machine.
 - Check the specifications of the machine, since some sensors input/output to ECM via CAN communication.
- The areas with screening indicate that are not connected to the ECM.

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10D-591 Electronic control fuel injection system (Common rail type)

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