GROUP 13B

MULTIPORT FUEL INJECTION (MFI) <3.0L ENGINE>

CONTENTS

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GENERAL INFORMATION

M1131000105085

The Multiport Fuel Injection System consists of sensors which detect the engine conditions, the ENGINE CONTROL MODULE (ECM) which controls the system based on signals from these sensors, and actuators which operate under the control of the ECM. The ECM carries out activities such as fuel injection control, idle air control, and ignition timing control. In addition, the ECM is equipped with several diagnostic test modes which simplify troubleshooting when a problem develops.

FUEL INJECTION CONTROL

The injector drive times and injection timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions.
A single injector is mounted at the intake port of each cylinder. Fuel is sent under pressure from the fuel tank to the fuel injectors by the fuel pump, with the pressure being regulated by the fuel pressure regulator. The regulated fuel is distributed to each of the injectors.
Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The firing order is 1-2-3-4-5-6. Each cylinder has a dedicated fuel injector. This is called multiport.
The ECM provides a richer air/fuel mixture by carrying out "open-loop" control when the engine is cold or operating under high load conditions in order to maintain engine performance.In addition, when the engine is under normal operating temperature after warming-up, the ECM controls the air/fuel mixture by using the heated oxygen sensor signal to carry out "closed-loop" control. The closed-loop control achieves the theoretical air/fuel mixture ratio where the catalytic converter can obtain the maximum cleaning performance.

THROTTLE VALVE OPENING CONTROL

This system electrically controls the opening of the throttle valve. The ECM detects the amount of travel of the accelerator pedal via the accelerator pedal position sensor, and controls the actuation of the throttle actuator control motor, which is mounted on the throttle body, in order to attain the target throttle valve opening that has been predetermined in accordance with driving conditions.

IDLE AIR CONTROL

The idle speed is kept at the optimum speed by controlling the amount of air that passes through the throttle valve in accordance with changes in idling conditions and engine load during idling.
The ECM drives the throttle actuator control motor to keep the engine running at the pre-set idle target speed in accordance with the engine coolant temperature and A/C and other electrical load. In addition, when the air conditioning switch is turned off and on while the engine is idling, the throttle actuator control motor adjusts the throttle valve pass-through air amount according to the engine load conditions to avoid fluctuations in the engine speed.

IGNITION TIMING CONTROL

The ignition power transistor located in the ignition primary circuit turns ON and OFF to control the primary current flow to the ignition coil. This controls the ignition timing to provide the optimum ignition timing with respect to the engine operating conditions. The ignition timing is determined by the ECM from engine speed, intake air volume, engine coolant temperature, and atmospheric pressure.

DIAGNOSTIC TEST MODE

- When a fault is detected in one of the sensors or actuators related to emission control, the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) illuminates to warn the driver.
- When a fault is detected in one of the sensors or actuators, a diagnostic trouble code corresponding to the fault is stored in the ECM.
- The RAM data inside the ECM that is related to the sensors and actuators can be read with the scan tool. In addition, the actuators can be controlled by scan tool MB991958 (M.U.T.-III sub assembly) under certain circumstances.

OTHER CONTROL FUNCTIONS

Fuel Pump Control

- Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking or running.

A/C Compressor Clutch Relay Control

- Turns the compressor clutch of the A/C ON and OFF.

Generator Output Current Control

- Prevent generator output current from increasing suddenly and idle speed from dropping at times such as when the headlights are turned on.

Evaporative Emission Purge Control

- (Refer to GROUP 17, Emission Control – Evaporative Emission Control System – General Information (Evaporative Emission System) P.17-75.)

EGR Control

- (Refer to GROUP 17, Emission Control – Exhaust Gas Recirculation (EGR) System – General Information (Exhaust Gas Recirculation System) P.17-80.)

MULTIPORT FUEL INJECTION (MFI) SYSTEM DIAGRAM

Sense

★1 Mass airflow sensor
★2 Intake air temperature sensor
★3 Throttle position sensor (main/sub)
★4 Manifold absolute pressure sensor
★5 Engine coolant temperature sensor
★6 Engine oil pressure switch (for MIVEC)
★7 Camshaft position sensor
★8 Crankshaft position sensor
★9 Right bank knock sensor
★10 Left bank knock sensor
★11 Right bank heated oxygen sensor (front)
★12 Right bank heated oxygen sensor (rear)
★13 Left bank heated oxygen sensor (front)
★14 Left bank heated oxygen sensor (rear)
★15 Fuel tank differential pressure sensor
★16 Fuel tank temperature sensor

- Accelerator pedal position sensor (main/sub)
- Power steering pressure switch
- Generator FR terminal
- Generator L terminal
- Ignition switch-IG
- Ignition switch-ST
- Power supply
- CAN communication (input signal)

⇨

Decide

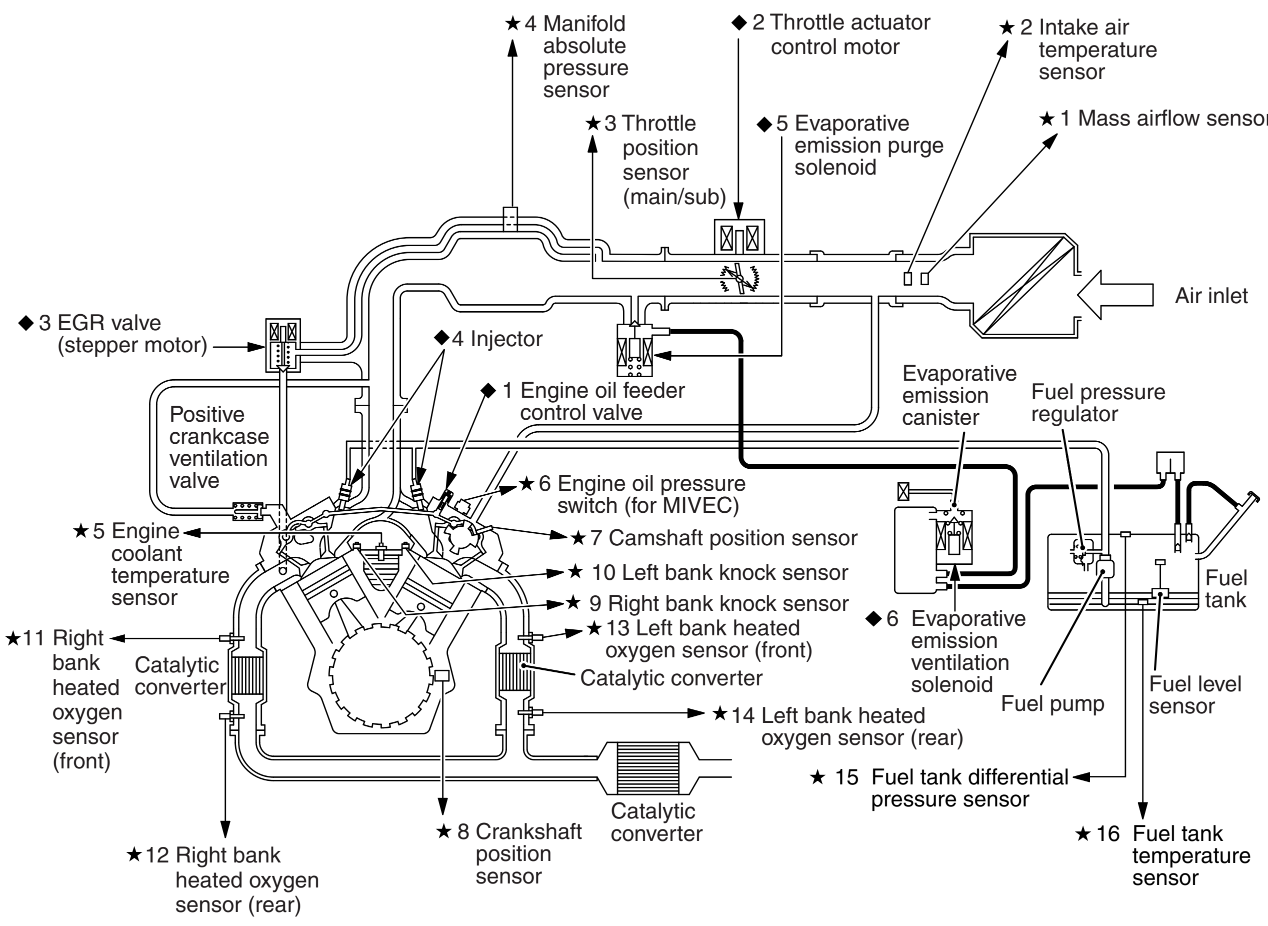
ECM
(with barometric pressure sensor)

⇨

Act

◆1 Engine oil control valve
◆2 Throttle actuator control motor
◆3 EGR valve (stepper motor)
◆4 Injector
◆5 Evaporative emission purge solenoid
◆6 Evaporative emission ventilation solenoid

- Ignition coil, ignition power transistor
- Multiport fuel injection (MFI) relay
- Fuel pump relay
- Starter relay
- Throttle actuator control motor relay
- Generator G terminal
- Heated oxygen sensor heater
- A/C compressor relay
- Diagnostic output
- CAN communication (out put signal)



AK901210AB

NOTE: For the vacuum routing, refer to GROUP 17, Emission Control – Vacuum Hoses – Vacuum Hose Routing *P.17-68*

GENERAL SPECIFICATIONS

M1131000201819

ITEMS		SPECIFICATIONS
Throttle body	Throttle bore mm (in.)	65 (2.56)
	Throttle position sensor	Hall element type
	Throttle actuator control motor	DC motor type, having brushes
Engine control module (ECM)	Identification model No.	E6T77182
Sensors	Mass airflow sensor	Heat sensitizing type
	Barometric pressure sensor	Semiconductor diffused pressure type
	Intake air temperature sensor	Thermistor type
	Engine coolant temperature sensor	Thermistor type
	Heated oxygen sensor	Zirconia type
	Accelerator pedal position sensor	Hall element type
	Camshaft position sensor	Magneto resistance element type
	Crankshaft position sensor	Magneto resistance element type
	Knock sensor	Piezoelectric element type
	Power steering pressure switch	Contact switch type
	Manifold absolute pressure sensor	Piezo resistive semiconductor type
	Fuel tank differential pressure sensor	Piezo resistive semiconductor type
	Fuel tank temperature sensor	Thermistor type
Actuators	Multiport fuel injection (MFI) relay	Contact switch type
	Fuel pump relay	Contact switch type
	Throttle actuator control motor relay	Contact switch type
	Starter relay	Contact switch type
	A/C compressor clutch relay	Contact switch type
	Injector relay	Contact switch type
	Injector type and number	Electromagnetic type, 6
	Injector identification mark	JLN240B
	Engine oil control valve	Duty cycle type solenoid valve
	Exhaust gas recirculation (EGR) valve	Stepper motor type
	Evaporative emission purge solenoid	Duty cycle type solenoid valve
	Evaporative emission ventilation solenoid	ON/OFF control type solenoid valve

SERVICE SPECIFICATIONS

M1131000302411

ITEMS		STANDARD VALUE
Fuel pressure kPa (psi)		Approximately 324 (47) at curb idle
Intake air temperature sensor resistance kΩ	–20°C (–4°F)	13 – 17
	0°C (32°F)	5.3 – 6.7
	20°C (68°F)	2.3 – 3.0
	40°C (104°F)	1.0 – 1.5
	60°C (140°F)	0.56 – 0.76
	80°C (176°F)	0.30 – 0.45
Engine coolant temperature sensor resistance kΩ	–20°C (–4°F)	14 – 17
	0°C (32°F)	5.1 – 6.5
	20°C (68°F)	2.1 – 2.7
	40°C (104°F)	0.9 – 1.3
	60°C (140°F)	0.48 – 0.68
	80°C (176°F)	0.26 – 0.36
Heated oxygen sensor output voltage V		0.6 – 1.0
Heated oxygen sensor heater resistance Ω	Front	4.5 – 8.0 [at 20°C (68°F)]
	Rear	11 – 18 [at 20°C (68°F)]
Injector coil resistance Ω		10.5 – 13.5 [at 20°C (68°F)]
Throttle actuator control motor coil resistance Ω		0.3 – 80 [at 20°C (68°F)]
Engine oil control valve coil resistance Ω		6.9 – 7.9 [at 20°C (68°F)]

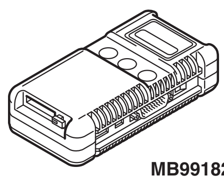
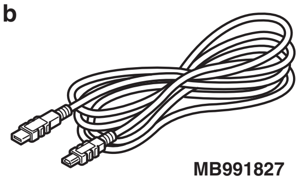
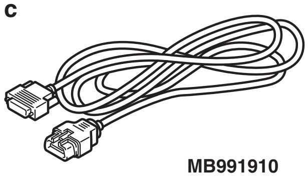
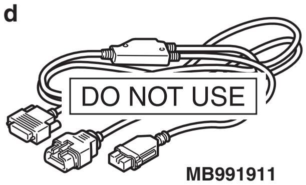
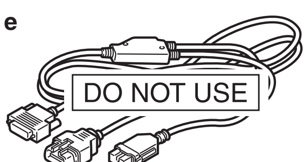
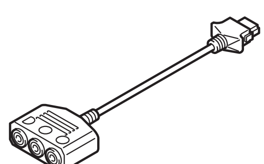
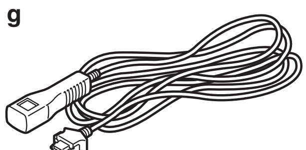
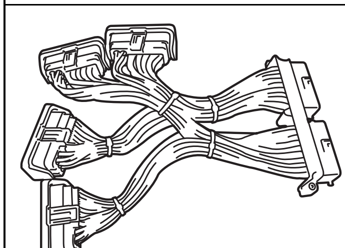
SEALANT AND ADHESIVE

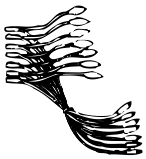
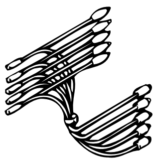
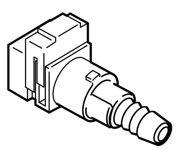
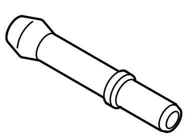
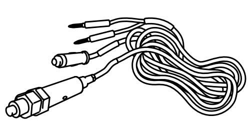
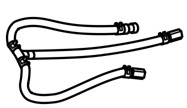
M1131000501230

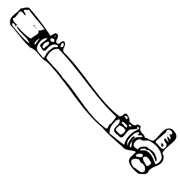
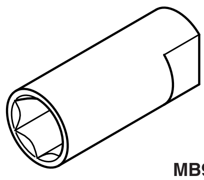
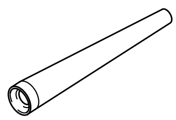
ITEM	SPECIFIED SEALANT
Engine coolant temperature sensor threaded portion	3M™ AAD part number 8731or equivalent

SPECIAL TOOL

M1131000604054

Tool	Tool number and name	Supersession	Application
a  MB991824 b  MB991827 c  MB991910 d  MB991911 e  MB991914 f  MB991825 g  MB991826 MB991958	MB991958 Scan tool (M.U.T.-III sub assembly) a: MB991824 Vehicle communication interface (V.C.I.) b: MB991827 M.U.T.-III USB cable c: MB991910 M.U.T.-III main harness A (Vehicles with CAN communication system) d: MB991911 M.U.T.-III main harness B (Vehicles without CAN communication system) e: MB991914 M.U.T.-III main harness C (for Daimler Chrysler models only) f: MB991825 M.U.T.-III adapter harness g: MB991826 M.U.T.-III trigger harness	MB991824-KIT *NOTE: MB991826 M.U.T.-III Trigger Harness is not necessary when pushing V.C.I. ENTER key.*	⚠ CAUTION **For vehicles with CAN communication, use M.U.T.-III main harness A to send simulated vehicle speed. If you connect M.U.T.-III main harness B instead, the CAN communication does not function correctly.** • Reading diagnostic trouble code • MFI system inspection • Measurement of fuel pressure
 MB992110	MB992110 Power plant ECU check harness	–	• Inspection using an oscilloscope • Inspection of the engine control module (ECM) terminal voltage check

Tool	Tool number and name	Supersession	Application
	MB991709 Test harness	MB991709-01	Inspection using an oscilloscope
 MB991658	MB991658 Test harness	Tool not available	• Inspection using an oscilloscope • Inspection of heated oxygen sensor • Inspection of engine oil control valve
	MD998464 Test harness (4 pin, square)	MD998464-01	Inspection of heated oxygen sensor
	MB991316 Test harness (4 pin, square)	Tool not available	Inspection of heated oxygen sensor
 MB992049	MB992049	MB992049-01	Measurement of fuel pressure
 MB992001	MB992001 Hose adaptor	-	Measurement of fuel pressure
 MB991981	MB991981 Fuel pressure gauge set	Tool not available	Measurement of fuel pressure
 MB992076	MB992076 Injector test set	-	Measurement of fuel pressure

Tool	Tool number and name	Supersession	Application
	MD998709	Hose adapter	Measurement of fuel pressure
 MB992042	MB992042 Engine coolant temperature sensor wrench	-	Removal and installation of the engine coolant temperature sensor
 B992106	MB992106 O-ring installer	-	Installation of O-ring on fuel injector injection nozzle side

MULTIPORT FUEL INJECTION (MFI) DIAGNOSIS

TROUBLESHOOTING STRATEGY

M1131150002348

NOTE: If a DTC is erased, its "freeze frame" data will be also erased and system readiness test status will be reset. Store the "freeze frame" data before erasing the DTC.

Use these steps to plan your diagnostic strategy. If you follow them carefully, you will be sure to have exhausted most of the possible ways to find an MFI fault.

1. Gather as much information as possible about the complaint from the customer.
2. Verify that the condition described by the customer exists.
3. Check the vehicle for any MFI Diagnostic Trouble Code (DTC).
4. If you cannot verify the condition and there are no DTCs, the malfunction is intermittent. For information on how to cope with intermittent malfunctions, refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.
5. If you can verify the condition but there are no DTCs, or the system cannot communicate with the scan tool, refer to the trouble symptom classification table.
6. If there is a DTC, record the number of the code, then erase the code from the memory using the scan tool.
7. Reconfirm the malfunction symptom and carry out a test drive with the drive cycle pattern.
8. If DTC is set again, carry out an inspection with appropriate diagnostic trouble code procedures.

9. If DTC is not set again, the malfunction is intermittent. For information on how to cope with intermittent malfunctions, refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.
10. After repairs are completed, conduct a road test duplicating the complaint set conditions to confirm the malfunction has been corrected.
11. Erase the permanent DTC. (Refer to DIAGNOSTIC FUNCTION – PERMANENT DTC for the procedures of erasing the permanent DTC P.13B-11.)

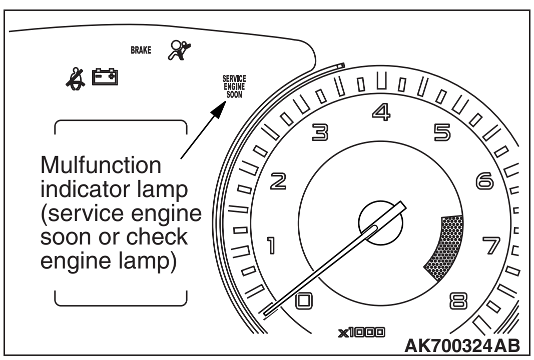
    NOTE: This is carried out to prevent the failure to pass the Inspection and Maintenance (I/M) test in the states checking whether the permanent DTC is stored or not.

NOTE: If the engine control module (ECM) is replaced, Immobilizer Encrypted Code Registration should be carried out, Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.

DIAGNOSTIC FUNCTION

M1131155504593

MALFUNCTION INDICATOR LAMP (SERVICE ENGINE SOON OR CHECK ENGINE LAMP)



Among the on-board diagnostic items, Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) illuminates to notify the driver of an emission control malfunction. However, when an irregular signal returns to normal and the engine control module judges that it has returned to normal, the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) will switch off.

There are two methods for checking the indicator lamp burn out: When the ignition switch is in ON position, the indicator lamp is illuminated, and then extinguished few seconds later. When the ignition switch is in ON position and the engine starts, the indicator lamp is extinguished.

NOTE: When the Transmission Control Module (TCM) detects malfunctions related to the automatic transaxle, the Malfunction indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) is also illuminated.

Items Indicated by the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp)

DTC	ITEM
P001A	Camshaft profile control (engine oil control valve) circuit
P0031	Heated oxygen sensor heater circuit low (bank 1 sensor 1)
P0032	Heated oxygen sensor heater circuit high (bank 1 sensor 1)
P0037	Heated oxygen sensor heater circuit low (bank 1 sensor 2)
P0038	Heated oxygen sensor heater circuit high (bank 1 sensor 2)
P003C	Mitsubishi innovative valve timing electronic control system (MIVEC) performance problem
P0051	Heated oxygen sensor heater circuit low (bank 2 sensor 1)
P0052	Heated oxygen sensor heater circuit high (bank 2 sensor 1)
P0053	Heated oxygen sensor heater resistance (bank 1 sensor 1)
P0057	Heated oxygen sensor heater circuit low (bank 2 sensor 2)
P0058	Heated oxygen sensor heater circuit high (bank 2 sensor 2)
P0059	Heated oxygen sensor heater resistance (bank 2 sensor 1)
P0068[*1]	Mass airflow sensor plausibility
P0069	Abnormal correlation between manifold absolute pressure sensor and barometric pressure sensor
P0101[*1]	Mass airflow circuit range/performance problem
P0102[*1]	Mass airflow circuit low input
P0103[*1]	Mass airflow circuit high input
P0106	Manifold absolute pressure circuit range/performance problem
P0107	Manifold absolute pressure circuit low input
P0108	Manifold absolute pressure circuit high input
P0111[*1]	Intake air temperature circuit range/performance problem
P0112[*1]	Intake air temperature circuit low input
P0113[*1]	Intake air temperature circuit high input
P0116[*1]	Engine coolant temperature circuit range/performance problem
P0117[*1]	Engine coolant temperature circuit low input
P0118[*1]	Engine coolant temperature circuit high input
P0121[*1]	Throttle position sensor (main) plausibility
P0122[*1]	Throttle position sensor (main) circuit low input
P0123[*1]	Throttle position sensor (main) circuit high input
P0125[*1]	Insufficient coolant temperature for closed loop fuel control
P0128	Coolant thermostat (coolant temperature below thermostat regulating temperature)
P0131	Heated oxygen sensor circuit low voltage (bank 1 sensor 1)
P0132	Heated oxygen sensor circuit high voltage (bank 1 sensor 1)
P0133	Heated oxygen sensor circuit slow response (bank 1 sensor 1)
P0134[*1]	Heated oxygen sensor circuit no activity detected (bank 1 sensor 1)

DTC	ITEM
P0137	Heated oxygen sensor circuit low voltage (bank 1 sensor 2)
P0138	Heated oxygen sensor circuit high voltage (bank 1 sensor 2)
P0139	Heated oxygen sensor circuit slow response (bank 1 sensor 2)
P0140	Heated oxygen sensor circuit no activity detected (bank 1 sensor 2)
P0151	Heated oxygen sensor circuit low voltage (bank 2 sensor 1)
P0152	Heated oxygen sensor circuit high voltage (bank 2 sensor 1)
P0153	Heated oxygen sensor circuit slow response (bank 2 sensor 1)
P0154[*1]	Heated oxygen sensor circuit no activity detected (bank 2 sensor 1)
P0157	Heated oxygen sensor circuit low voltage (bank 2 sensor 2)
P0158	Heated oxygen sensor circuit high voltage (bank 2 sensor 2)
P0159	Heated oxygen sensor circuit slow response (bank 2 sensor 2)
P0160	Heated oxygen sensor circuit no activity detected (bank 2 sensor 2)
P0171	System too lean (bank 1)
P0172	System too rich (bank 1)
P0174	System too lean (bank 2)
P0175	System too rich (bank 2)
P0181	Fuel tank temperature sensor circuit range/performance
P0182	Fuel tank temperature sensor circuit low input
P0183	Fuel tank temperature sensor circuit high input
P0201	Injector circuit – cylinder 1
P0202	Injector circuit – cylinder 2
P0203	Injector circuit – cylinder 3
P0204	Injector circuit – cylinder 4
P0205	Injector circuit – cylinder 5
P0206	Injector circuit – cylinder 6
P0221[*1]	Throttle position sensor (sub) plausibility
P0222[*1]	Throttle position sensor (sub) circuit low input
P0223[*1]	Throttle position sensor (sub) circuit high input
P0300[*2]	Random/multiple cylinder misfire detected
P0301[*2]	Cylinder 1 misfire detected
P0302[*2]	Cylinder 2 misfire detected
P0303[*2]	Cylinder 3 misfire detected
P0304[*2]	Cylinder 4 misfire detected
P0305[*2]	Cylinder 5 misfire detected
P0306[*2]	Cylinder 6 misfire detected
P0327	Knock sensor circuit low (bank 1)
P0328	Knock sensor circuit high (bank 1)
P0332	Knock sensor circuit low (bank 2)

DTC	ITEM
P0333	Knock sensor circuit high (bank 2)
P0335*1	Crankshaft position sensor circuit
P0340*1	Camshaft position sensor circuit
P0401	Exhaust gas recirculation flow insufficient detected
P0421	Warm up catalyst efficiency below threshold (bank 1)
P0431	Warm up catalyst efficiency below threshold (bank 2)
P0441	Evaporative emission control system incorrect purge flow
P0442	Evaporative emission control system leak detected (small leak)
P0443	Evaporative emission control system purge control valve circuit
P0446	Evaporative emission control system vent control circuit
P0450	Evaporative emission control system pressure sensor malfunction
P0451	Evaporative emission control system pressure sensor range/performance
P0452	Evaporative emission control system pressure sensor low input
P0453	Evaporative emission control system pressure sensor high input
P0455	Evaporative emission control system leak detected (gross leak)
P0456	Evaporative emission control system leak detected (very small leak)
P0461	Fuel level sensor <FWD> or fuel level sensor (main) <AWD> circuit range/performance
P0462	Fuel level sensor <FWD> or fuel level sensor (main) <AWD> circuit low input
P0463	Fuel level sensor <FWD> or fuel level sensor (main) <AWD> circuit high input
P0489	EGR valve (stepper motor) circuit malfunction (ground short)
P0490	EGR valve (stepper motor) circuit malfunction (battery short)
P0506	Idle control system RPM lower than expected
P0507	Idle control system RPM higher than expected
P050B	Ignition timing retard insufficient
P0551	Power steering pressure switch circuit range/performance
P0554	Power steering pressure switch circuit intermittent
P0602*1	Control module programming error
P0606*1	Engine control module main processor malfunction
P060B*1	Internal control module A/D processing performance problem
P060D*1	Internal control module accelerator pedal position performance problem
P061A*1	Internal control module torque performance problem
P061C*1	Internal control module engine RPM performance problem
P062F*1	Internal control module EEPROM error
P0630*1	Vehicle Identification Number (VIN) malfunction
P0638*1	Throttle actuator control motor circuit range/ performance problem
P0642*1	Throttle position sensor power supply
P0657*1	Throttle actuator control motor relay circuit malfunction
P1238*1	Mass airflow sensor plausibility (torque monitor)

DTC	ITEM
P1506	Idle control system RPM lower than expected at low temperature
P1507	Idle control system RPM higher than expected at low temperature
P1590[*1]	TCM to ECM communication error in torque reduction request
P1603[*1]	Battery backup line malfunction
P2066	Fuel level sensor (sub) circuit range/performance <AWD>
P2100[*1]	Throttle actuator control motor circuit (open)
P2101[*1]	Throttle actuator control motor magneto malfunction
P2122[*1]	Accelerator pedal position sensor (main) circuit low input
P2123[*1]	Accelerator pedal position sensor (main) circuit high input
P2127[*1]	Accelerator pedal position sensor (sub) circuit low input
P2128[*1]	Accelerator pedal position sensor (sub) circuit high input
P2135[*1]	Throttle position sensor (main and sub) range/performance problem
P2138[*1]	Accelerator pedal position sensor (main and sub) range/performance problem
P2195	Heated oxygen sensor inactive (bank 1 sensor 1)
P2197	Heated oxygen sensor inactive (bank 2 sensor 1)
P2228[*1]	Barometric pressure circuit low input
P2229[*1]	Barometric pressure circuit high input
P2252	Heated oxygen sensor offset circuit low voltage
P2253	Heated oxygen sensor offset circuit high voltage
U0101[*1]	Transmission control module time-out
U0141[*1]	ETACS-ECU time-out
U1180[*1]	Combination meter time-out

*NOTE: After the ECM has detected a malfunction, the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) illuminates when the engine is next turned on and the same malfunction is re-detected. However, for items marked with a "*1" in the DTC NO. column, the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) illuminates only on the first detection of the malfunction.*

*NOTE: The codes marked with a "*2" in the diagnosis code number column have the following two conditions for illuminating the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp).*

- *In case that the misfire causing the damaged catalyst is detected, the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) is illuminated at the time.*
- *In case that the misfire deteriorating the exhaust gas is detected, the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) is illuminated when the same malfunction is redetected after the next engine start.*

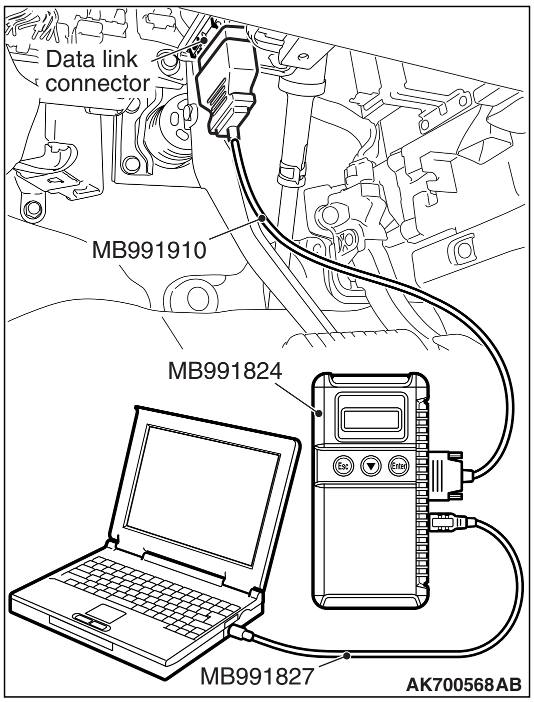
NOTE: After the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) illuminates, it will be switched off under the following conditions.

- When the ECM monitored the powertrain malfunction three times* and met set condition requirements, it detected no malfunction. *: In this case, "one time" indicates from engine start to next engine start.
- For misfiring or a fuel trim malfunction, when driving conditions (engine speed, engine coolant temperature, etc.) are similar to those when the malfunction was first recorded.

NOTE: Sensor 1 indicates the sensor mounted at a position closest to the engine, and sensor 2 indicates the sensor mounted at the position second closest to the engine.

NOTE: Bank 1 indicates the right bank side cylinder, and bank 2 indicates the left bank side cylinder.

HOW TO CONNECT THE SCAN TOOL (M.U.T.-III)



Required Special Tools:
- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

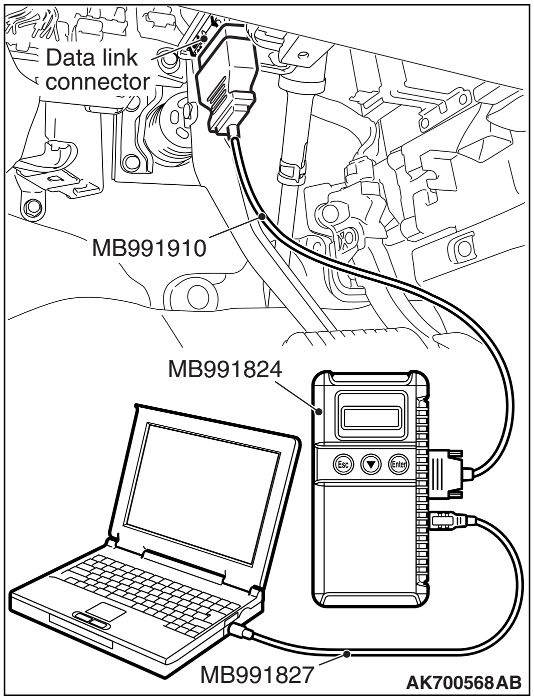
1. Ensure that the ignition switch is at the "LOCK" (OFF) position.
2. Start up the personal computer.
3. Connect special tool MB991827 to special tool MB991824 and the personal computer.
4. Connect special tool MB991910 to special tool MB991824.
5. Connect special tool MB991910 to the data link connector.
6. Turn the power switch of special tool MB991824 to the "ON" position.

   NOTE: When the special tool MB991824 is energized, special tool MB991824 indicator light will be illuminated in a green color.
7. Start the M.U.T.-III system on the personal computer.

   NOTE: Disconnecting the scan tool MB991958 is the reverse of the connecting sequence, making sure that the ignition switch is at the "LOCK" (OFF) position.

HOW TO READ AND ERASE DIAGNOSTIC TROUBLE CODES.

Required Special Tools:
- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



⚠ CAUTION

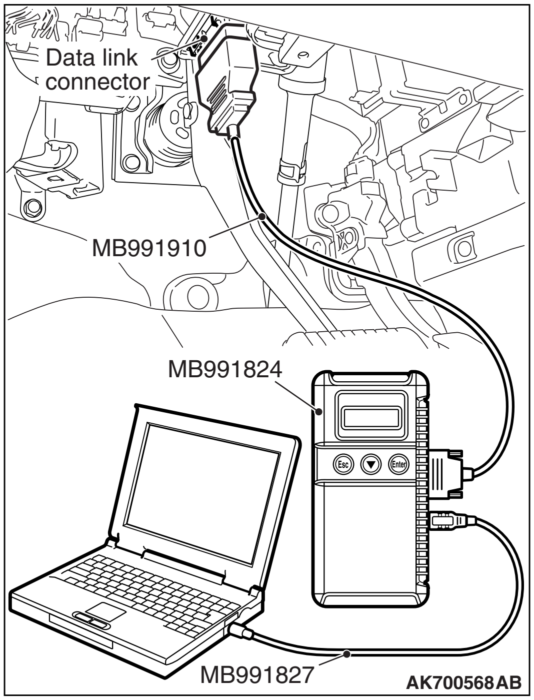
To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

1. Connect scan tool MB991958 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Select "System select."
4. Choose "from 2006 MY" under "MODEL YEAR".
5. Check that "Vehicle Information" contents are correct.
6. Choose "MFI".
7. Select "Diagnostic Trouble Code"
8. If a DTC is set, it is shown.
9. Choose "Erase DTCs" to erase the DTC.

HOW TO READ DATA LIST

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
    - MB991824: V.C.I.
    - MB991827: USB Cable
    - MB991910: Main Harness A



⚠ CAUTION

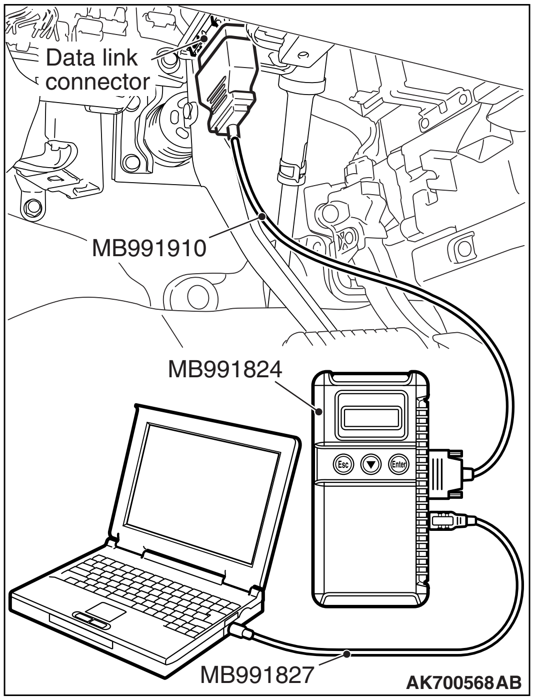
To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

1. Connect scan tool MB991958 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Select "System select."
4. Choose "from 2006 MY" under "MODEL YEAR".
5. Check that "Vehicle Information" contents are correct.
6. Choose "MFI".
7. Select "Data List."
8. Choose an appropriate item and select the "OK" button.

HOW TO PERFORM ACTUATOR TEST

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



⚠ CAUTION

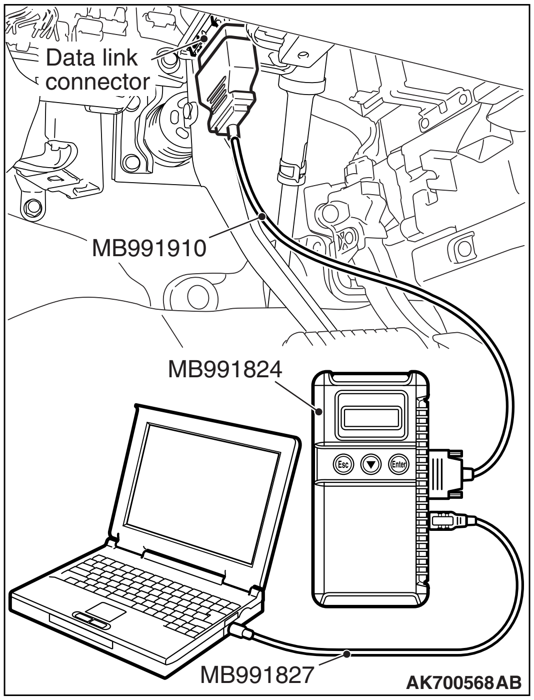
To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

1. Connect scan tool MB991958 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Select "System select."
4. Choose "from 2006 MY" under "MODEL YEAR".
5. Check that "Vehicle Information" contents are correct.
6. Choose "MFI".
7. Select "Actuator Test."
8. Choose an appropriate item and select the "OK" button.

HOW TO DIAGNOSE THE CAN BUS LINES

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

1. Connect scan tool MB991958 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Select "CAN bus diagnosis" from the start-up screen.
4. When the vehicle information is displayed, confirm that it matches the vehicle whose CAN bus lines will be diagnosed.
   - If they matches, go to step 8.
   - If not, go to step 5.
5. Select the "view vehicle information" button.
6. Enter the vehicle information and select the "OK" button.
7. When the vehicle information is displayed, confirm again that it matches the vehicle whose CAN bus lines will be diagnosed.
   - If they matches, go to step 8.
   - If not, go to step 5.
8. Select the "OK" button.
9. When the optional equipment screen is displayed, choose the one which the vehicle is fitted with, and then select the "OK" button.

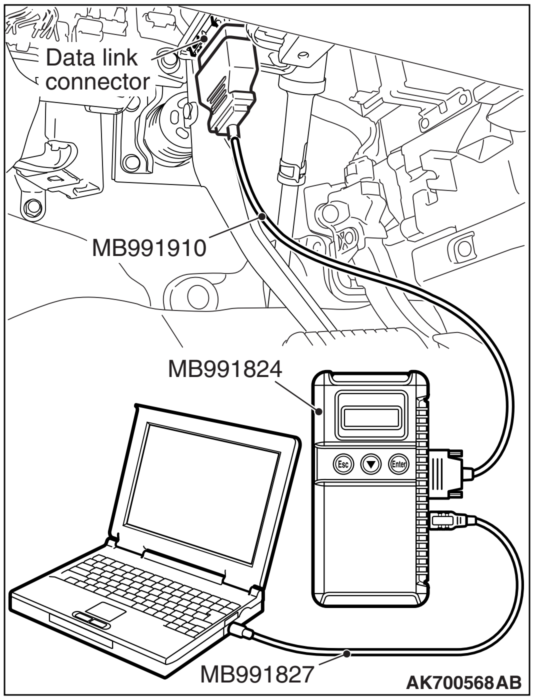
HOW TO READ PROVISIONAL DIAGNOSTIC TROUBLE CODES

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A

If detecting the malfunction during the first drive cycle, the ECM temporarily stores the diagnosis code as the provisional diagnosis code. If detecting the same malfunction during the next drive cycle, the ECM determines that the malfunction exists. The ECM outputs the diagnosis code. On Scan Tool MB991958, it is possible to display the stored provisional diagnosis code which the ECM had detected during the first drive cycle. This makes it possible to confirm in one drive cycle whether the malfunction could happen again after the repair.

CONFIRMATION METHOD



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

1. Connect scan tool MB991958 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Select "System select."
4. Choose "from 2006 MY" under "MODEL YEAR".
5. Check that "Vehicle Information" contents are correct.
6. Choose "MFI".
7. Select "Special Function" from MFI Screen.
8. Select "Provisional DTCs" from Special Function Screen.

PERMANENT DTC

The permanent DTC(PDTC) is stored in the EEPROM of the engine control module (ECM) as the permanent status, which checks that the malfunction of the emission related components/ the system has not been repaired yet. When detecting the malfunction necessary to illuminate the malfunction indicator lamp (SERVICE ENGINE SOON or Check Engine Lamp), the ECM illuminates the MIL and stores the appropriate DTC as the permanent DTC in the EEPROM concurrently. The usual DTC is stored in the EEPROM aside from this. The ECM can store up to 6 PDTCs. The ECM, therefore, cannot store the 7th and subsequent PDTCs. If the temporary malfunction causes the malfunction indicator lamp to be illuminated and then the reinstatement during the subsequent driving causes it to be extinguished, the PDTC is erased. Also if the ECM checks that the DTC malfunction is fixed during the driving after the DTC repair is completed, the PDTC is erased. The permanent DTC, however, is not erased by disconnecting the battery terminal or erasing with the scan tool (M.U.T-III). The permanent DTC can be erased if all readiness statuses are erased or not completed at the time of reprogramming the ECM. If must be erased while the vehicle is repaired, the PDTC can be erased by the procedures shown below. If must be erased because of the failure to pass the Inspection and Maintenance (I/M) test, the permanent DTC can also be erased by the following procedure:

PROCEDURES FOR ERASING PERMANENT DTC

1. Check that the DTC is not stored. If the DTC is stored, perform the DTC troubleshooting, then repair the DTC.

   NOTE: The order of step 2 and 3 can be exchanged.

2. Drive the vehicle at least once under the conditions satisfying all the following requirements:
   - The total driving (engine running) time must be more than 10 consecutive minutes.
   - More than 30 seconds of idling must be included in the driving
   - More than 5 consecutive minutes of driving at more than 40 km/h (25 mph) must be included in the driving.
3. Drive the vehicle at least two times in the drive cycle pattern suitable for the permanent DTC. (Refer to OBD-II DRIVE CYCLE for the drive cycle pattern.) If the DTC does not have the drive cycle pattern, start and stop the engine. Wait 15 seconds or more to start again after the stop. Repeat at least 2 times.
4. Restart and stop the engine.
5. Check that the permanent DTC is erased. If the permanent DTC is not erased, check the DTC or the provisional DTC. If the malfunction code is stored, repair the DTC. Try to erase the permanent DTC again (from Step 1 to 5). If the malfunction code is not stored, the drive cycle pattern (Step 3) monitoring the malfunction can possibly be insufficient.

MODE 6 REFERENCE TABLE

The engine control module (ECM) monitors the condition of emission control system.
By selecting MODE 6 using scan tool, Test Result and Limit Value (minimum) *1 or (maximum) *2 about the main items of emission control system which ECM monitors can be confirmed. The value at the last monitoring is output by ECM as a test result.

ON-BOARD DIAGNOSTIC MONITOR ID	STANDARDIZED / MANUFACTURER DEFIND TEST ID	MONITORING ITEM	SIMPLE TECHNICAL DESCRIPTION	CONVERSION COEFFICIENT IN USING GENERAL SCAN TOOL
01	81	Oxygen Sensor Monitor Bank 1 – Sensor 1 Rich/Lean Switching frequency	ECM monitors the deteriorated condition of the right bank heated oxygen sensor (front) by checking the rich/lean switching frequency of the right bank heated oxygen sensor (front).	× 1 count
02	08	Oxygen Sensor Monitor Bank 1 – Sensor 2 Maximum Sensor Voltage for Test Cycle	ECM checks the output voltage of the right bank heated oxygen sensor (rear) in order to monitor whether the right bank heated oxygen sensor (rear) outputs the rich signal.	× 0.122 mV
	82	Oxygen Sensor Monitor Bank 1 – Sensor 2 Output Voltage change	ECM checks the output voltage of the right bank heated oxygen sensor (rear) in order to monitor whether the right bank heated oxygen sensor (rear) output is stuck.	× 0.122 mV
	05	Oxygen Sensor Monitor Bank 1 – Sensor 2 Rich To Lean Sensor Switch Time	ECM checks the rich to lean switching time of the right bank heated oxygen sensor (rear) in order to monitor the response of the right bank heated oxygen sensor (rear).	× 1 msec
	88	Oxygen Sensor Monitor Bank 1 – Sensor 2 Output Voltage drop slope	ECM checks the output voltage drop slope of the right bank heated oxygen sensor (rear) in order to monitor the response of the right bank heated oxygen sensor (rear).	× 1 msec

ON-BOARD DIAGNOSTIC MONITOR ID	STANDARDIZED / MANUFACTURER DEFIND TEST ID	MONITORING ITEM	SIMPLE TECHNICAL DESCRIPTION	CONVERSION COEFFICIENT IN USING GENERAL SCAN TOOL
05	81	Oxygen Sensor Monitor Bank 2 – Sensor 1 Rich/Lean Switching frequency	ECM monitors the deteriorated condition of the left bank heated oxygen sensor (front) by checking the rich/lean switching frequency of the left bank heated oxygen sensor (front).	× 1 count
06	08	Oxygen Sensor Monitor Bank 2 – Sensor 2 Maximum Sensor Voltage for Test Cycle	ECM checks the output voltage of the left bank heated oxygen sensor (rear) in order to monitor whether the left bank heated oxygen sensor (rear) outputs the rich signal.	× 0.122 mV
	82	Oxygen Sensor Monitor Bank 2 – Sensor 2 Output Voltage change	ECM checks the output voltage of the left bank heated oxygen sensor (rear) in order to monitor whether the left bank heated oxygen sensor (rear) output is stuck.	× 0.122 mV
	05	Oxygen Sensor Monitor Bank 2 – Sensor 2 Rich To Lean Sensor Switch Time	ECM checks the rich to lean switching time of the left bank heated oxygen sensor (rear) in order to monitor the response of the left bank heated oxygen sensor (rear).	× 1 msec
	88	Oxygen Sensor Monitor Bank 2 – Sensor 2 Output Voltage drop slope	ECM checks the output voltage drop slope of the left bank heated oxygen sensor (rear) in order to monitor the response of the left bank heated oxygen sensor (rear).	× 1 msec
21	83	Catalyst Monitor Bank 1 Frequency ratio between Front- and Rear-Oxygen Sensors	ECM monitors the deterioration of catalyst at right bank side by the output frequency ratio between right bank heated oxygen sensor (front) and right bank heated oxygen sensor (rear).	× 0.0039

ON-BOARD DIAGNOSTIC MONITOR ID	STANDARDIZED / MANUFACTURER DEFIND TEST ID	MONITORING ITEM	SIMPLE TECHNICAL DESCRIPTION	CONVERSION COEFFICIENT IN USING GENERAL SCAN TOOL
22	83	Catalyst Monitor Bank 2 Frequency ratio between Front- and Rear-Oxygen Sensors	ECM monitors the deterioration of catalyst at left bank side by the output frequency ratio between left bank heated oxygen sensor (front) and left bank heated oxygen sensor (rear).	× 0.0039
31	84	EGR Monitor Difference of manifold pressure before and after EGR activation	ECM monitors the operation of EGR system by the pressure difference of intake manifold between before and after introduction of EGR using the manifold absolute pressure sensor.	× 0.0117 kPa
39	85	EVAP Monitor (Cap off) Pressure drop during de-pressurizing	ECM monitors the leak of fuel evaporation gas by checking whether the pressure can be reduced (the amount of pressure reduction) using the fuel tank differential pressure sensor after sealing the fuel tank and the fuel line.	× 0.0117 kPa
3B	85	EVAP Monitor (0.040") Pressure rise during airtight condition	After ECM vacuumizes the fuel tank and the fuel line and then the specified time is passed, ECM monitors the leak of fuel evaporation gas through the fuel tank differential pressure sensor to check the reduction of vacuum in the fuel tank.	× 0.0117 kPa
3C	85	EVAP Monitor (0.020") Pressure rise during airtight condition	After ECM vacuumizes the fuel tank and the fuel line and then the specified time is passed, ECM monitors the leak of fuel evaporation gas through the fuel tank differential pressure sensor to check the reduction of vacuum in the fuel tank.	× 0.0117 kPa
41	86	Oxygen Sensor Heater Monitor Bank 1 – Sensor 1 Heater Monitoring Current	ECM checks the amperage of the right bank heated oxygen sensor (front) heater.	× 0.001 A

ON-BOARD DIAGNOSTIC MONITOR ID	STANDARDIZED / MANUFACTURER DEFIND TEST ID	MONITORING ITEM	SIMPLE TECHNICAL DESCRIPTION	CONVERSION COEFFICIENT IN USING GENERAL SCAN TOOL
45	86	Oxygen Sensor Heater Monitor Bank 2 – Sensor 1 Heater Monitoring Current	ECM checks the amperage of the left bank heated oxygen sensor (front) heater.	× 0.001 A
A2	0B	Mis-Fire Cylinder 1 Data EWMA Misfire Counts For Last 10 Driving Cycles	ECM monitors angular acceleration of crankshaft and detect misfire. EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles.	× 1 count
	0C	Mis-Fire Cylinder 1 Data Misfire Counts For Last/Current Driving Cycle	ECM monitors angular acceleration of crankshaft and detect misfire. Misfire counts for last/current driving cycle.	× 1 count
A3	0B	Mis-Fire Cylinder 2 Data EWMA Misfire Counts For Last 10 Driving Cycles	ECM monitors angular acceleration of crankshaft and detect misfire. EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles.	× 1 count
	0C	Mis-Fire Cylinder 2 Data Misfire Counts For Last/Current Driving Cycle	ECM monitors angular acceleration of crankshaft and detect misfire. Misfire counts for last/current driving cycle.	× 1 count
A4	0B	Mis-Fire Cylinder 3 Data EWMA Misfire Counts For Last 10 Driving Cycles	ECM monitors angular acceleration of crankshaft and detect misfire. EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles.	× 1 count
	0C	Mis-Fire Cylinder 3 Data Misfire Counts For Last/Current Driving Cycle	ECM monitors angular acceleration of crankshaft and detect misfire. Misfire counts for last/current driving cycle.	× 1count

ON-BOARD DIAGNOSTIC MONITOR ID	STANDARDIZED / MANUFACTURER DEFIND TEST ID	MONITORING ITEM	SIMPLE TECHNICAL DESCRIPTION	CONVERSION COEFFICIENT IN USING GENERAL SCAN TOOL
A5	0B	Mis-Fire Cylinder 4 Data EWMA Misfire Counts For Last 10 Driving Cycles	ECM monitors angular acceleration of crankshaft and detect misfire. EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles.	× 1 count
	0C	Mis-Fire Cylinder 4 Data Misfire Counts For Last/Current Driving Cycle	ECM monitors angular acceleration of crankshaft and detect misfire. Misfire counts for last/current driving cycle.	× 1 count
A6	0B	Mis-Fire Cylinder 5 Data EWMA Misfire Counts For Last 10 Driving Cycles	ECM monitors angular acceleration of crankshaft and detect misfire. EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles.	× 1 count
	0C	Mis-Fire Cylinder 5 Data Misfire Counts For Last/Current Driving Cycle	ECM monitors angular acceleration of crankshaft and detect misfire. Misfire counts for last/current driving cycle.	× 1 count
A7	0B	Mis-Fire Cylinder 6 Data EWMA Misfire Counts For Last 10 Driving Cycles	ECM monitors angular acceleration of crankshaft and detect misfire. EWMA (Exponential Weighted Moving Average) misfire counts for last 10 driving cycles.	× 1 count
	0C	Mis-Fire Cylinder 6 Data Misfire Counts For Last/Current Driving Cycle	ECM monitors angular acceleration of crankshaft and detect misfire. Misfire counts for last/current driving cycle.	× 1 count

*NOTE: *1: Minimum value: The test fails if test value is less than this value.*

*NOTE: *2: Maximum value: The test fails if test value is greater than this value.*

NOTE: When not finishing the monitor of the driving cycle for the request of On-Board Monitoring Test Request, the ECM outputs the stored latest monitor test result.

NOTE: When the monitored test results are erased by the battery disconnection and so on, the ECM outputs the values in hexadecimal of "0000" or "FFFF", otherwise it outputs abnormal values and so on. In case of this, the ECU outputs are handled as invalid-values. When the first monitor (Readiness Status) is completed after this, the ECM outputs the valid-values.

NOTE: "Test Limit Type & Component ID byte" output from the ECM is given in hexadecimal of "00" or "80". "00" means the maximum value and "80" means the minimum value.

ON-BOARD DIAGNOSTICS

The engine control module (ECM) monitors the input/output signals (some signals all the time and others under specified conditions) of the ECM. When a malfunction continues for a specified time or longer after the irregular signal is initially monitored, the ECM judges that a malfunction has occurred. After the ECM first detects a malfunction, a diagnostic trouble code is recorded when the engine is restarted and the same malfunction is re-detected. However, for items marked with a "*1", a diagnostic trouble code is recorded on the first detection of the malfunction. There are 149 diagnostic items. The diagnostic results can be read out with a scan tool. Since memorization of the diagnostic trouble codes is backed up directly by the battery, the diagnostic results are memorized even if the ignition key is turned off. The diagnostic trouble codes will, however, be erased when the battery terminal or the ECM connector is disconnected. In addition, the diagnostic trouble code can also be erased by turning the ignition switch to ON and sending the diagnostic trouble code erase signal from scan tool MB991958 to the ECM.

NOTE: If the sensor connector is disconnected with the ignition switch turned on, the diagnostic trouble code is memorized. In this case, send the diagnostic trouble code erase signal to the ECM in order to erase the diagnostic memory. The 149 diagnostic items are all indicated sequentially from the smallest code number. The ECM records the engine operating condition when the diagnostic trouble code is set. This data is called "Freeze-frame" data. This data can be read by using the scan tool, and can then be used in simulation tests for troubleshooting. Data items are as follows:

NOTE: If the ECM detects multiple malfunctions, the ECM stores the "Freeze-frame" data for only the first item that was detected. However, if the ECM detects a misfire or a fuel system malfunction, the ECM stores the data by giving priority to the misfire or fuel system malfunction, regardless of the order in which the malfunction was detects.

NOTE: As for Diagnostic trouble code P1603, "Freeze-frame" data is not memorized.

Freeze Frame Data for M.U.T.-III

ITEM NO.	M.U.T.-III SCAN TOOL DISPLAY	DATA ITEM	UNIT or STATE
1	Odometer	Odometer	km or mile
2	Ignition cycle (Warm up cycle)	Ignition cycle (Warm up cycle)	–
4	Accumulated minute*1	Accumulated minute	min

Freeze Frame Data (OBD) for M.U.T.-III

ITEM NO.	M.U.T.-III SCAN TOOL DISPLAY	DATA ITEM	UNIT or STATE
AA	Airflow sensor	Mass airflow sensor	g/s
AB	TP sensor (main)	Throttle position sensor (main)	%
BA	Target EGR	Target EGR stepper motor	%
BB	Barometric pressure sensor	Barometric pressure sensor	kPa or in.Hg
BC	Relative TP sensor	Relative throttle position sensor	%
BD	TP sensor (sub)	Throttle position sensor (sub)	%
BE	APP sensor (main)	Accelerator pedal position sensor (main)	%
BF	APP sensor (sub)	Accelerator pedal position sensor (sub)	%
C0	Fuel system status (bank 1)	Fuel control system status (bank 1)	• Open loop
			• Closed loop
			• Open loop-drive condition
			• Open loop-DTC set
			• Closed loop-O2 (rear) failed
C1	Fuel system status (bank 2)	Fuel control system status (bank 2)	• Open loop
			• Closed loop
			• Open loop-drive condition
			• Open loop-DTC set
			• Closed loop-O2 (rear) failed
C2	Calculated load value	Calculated load value	%
C3	ECT sensor	Engine coolant temperature sensor	°C or °F
C4	Short term fuel trim (bank 1)	Short term fuel trim (bank 1)	%
C5*2	Short term fuel trim (bank 3)	Short term fuel trim (bank 3)	%
C6	Long term fuel trim (bank 1)	Long term fuel trim (bank 1)	%
C7*2	Long term fuel trim (bank 3)	Long term fuel trim (bank 3)	%
C8	Short term fuel trim (bank 2)	Short term fuel trim (bank 2)	%
C9*2	Short term fuel trim (bank 4)	Short term fuel trim (bank 4)	%
CA	Long term fuel trim (bank 2)	Long term fuel trim (bank 2)	%
CB*2	Long term fuel trim (bank 4)	Long term fuel trim (bank 4)	%
CC	MAP sensor	Manifold absolute pressure sensor	kPa or in.Hg

ITEM NO.	M.U.T.-III SCAN TOOL DISPLAY	DATA ITEM	UNIT or STATE
CD	Crankshaft position sensor	Crankshaft position sensor	r/min
CE	Vehicle speed	Vehicle speed	km/h or mph
CF	Spark advance	Spark advance	°CA
D0	Intake air temperature sensor 1	Intake air temperature sensor	°C or °F
D1	Time since engine running	Time since engine running	sec
D6	EVAP. emission purge SOL. duty	Evaporative emission purge solenoid duty	%
D7	Fuel level gauge	Fuel level gauge	%
D8	Power supply voltage	Power supply voltage	V
D9	Absolute load value	Absolute load value	%
DA	Target equivalence ratio	Target equivalence ratio	–
DB	Intake air temperature sensor 1	Intake air temperature sensor (ambient air temperature)	°C or °F
DC	Throttle actuator	Throttle actuator control motor	%
DD	Relative APP sensor	Relative accelerator pedal position sensor	%
242	Fuel tank differential PRS. SNSR	Fuel tank differential pressure sensor	Pa

*NOTE: *1: Accumulated time of current malfunction from time point when malfunction is detected.*

*NOTE: *2: Data items are displayed on M.U.T.-III display, but the V-type 6-cylinder engine is not applicable and its data is displayed as "*****".*

Freeze Frame Data for General Scan Tool

COMMON EXAMPLE of GENERAL SCAN TOOL DISPLAY	PRAMETER IDENTIFICATION (PID)	DESCRIPTION	UNIT or STATE
DTCFRZF	02	DTC that caused required freeze frame data storage	Pxxxx, Uxxxx
FUELSYS 1	03	See M.U.T.-III Item No. C0	
FUELSYS 2		See M.U.T.-III Item No. C1	
LOAD_PCT	04	See M.U.T.-III Item No. C2	
ECT	05	See M.U.T.-III Item No. C3	
SHRTFT 1	06	See M.U.T.-III Item No. C4	
LONGFT 1	07	See M.U.T.-III Item No. C6	
SHRTFT 2	08	See M.U.T.-III Item No. C8	
LONGFT 2	09	See M.U.T.-III Item No. CA	
MAP	0B	See M.U.T.-III Item No. CC	
RPM	0C	See M.U.T.-III Item No. CD	
VSS	0D	See M.U.T.-III Item No. CE	
SPARKADV	0E	See M.U.T.-III Item No. CF	
IAT	0F	See M.U.T.-III Item No. D0	
MAF	10	See M.U.T.-III Item No. AA	
TP	11	See M.U.T.-III Item No. AB	
RUNTM	1F	See M.U.T.-III Item No. D1	
EGR_PCT	2C	See M.U.T.-III Item No. BA	
EVAP_PCT	2E	See M.U.T.-III Item No. D6	
FLI	2F	See M.U.T.-III Item No. D7	
EVAP_VP	32	See M.U.T.-III Item No. 242	
BARO	33	See M.U.T.-III Item No. BB	
VPWR	42	See M.U.T.-III Item No. D8	
LOAD_ABS	43	See M.U.T.-III Item No. D9	
EQ_RAT	44	See M.U.T.-III Item No. DA	
TP_R	45	See M.U.T.-III Item No. BC	
AAT	46	See M.U.T.-III Item No. DB	
TP_B	47	See M.U.T.-III Item No. BD	
APP_D	49	See M.U.T.-III Item No. BE	
APP_E	4A	See M.U.T.-III Item No. BF	
TAC_PCT	4C	See M.U.T.-III Item No. DC	
APP_R	5A	See M.U.T.-III Item No. DD	

OBD- II DRIVE CYCLE

All kinds of diagnostic trouble codes (DTCs) can be monitored by carrying out a short drive according to the following 23 drive cycle patterns. In other words, doing such a drive regenerates any kind of trouble which involves illuminating the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) and verifies the repair procedure has eliminated [the trouble the Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) is no longer illuminated].

⚠ CAUTION

Two technicians should always be in the vehicle when carrying out a test.

NOTE: Check that the diagnosis trouble code (DTC) is not output before driving the OBD-II drive cycle. Erase the DTC if it has been output.

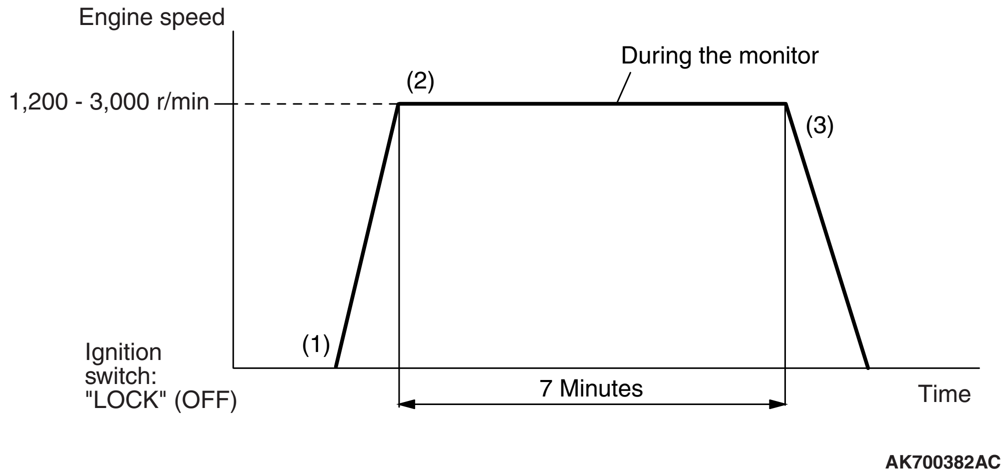
NOTE: Drive cycle patterns are not established for Power steering pressure sensor monitor (DTC P0551), and Fuel level sensor monitor (DTC P0461, P2066). Please reference the M.U.T. data list to judge whether these monitor items are normal.

DRIVE CYCLE PATTERN LIST

MONITOR ITEM	DIAGNOSTIC TROUBLE CODE (DTC)	PATTERN
Heated oxygen sensor (front) monitor <Readiness test item>	P0133, P0153	1
Heated oxygen sensor heater monitor <Readiness test item>	P0031, P0037, P0051, P0053, P0057, P0059	2
Heated oxygen sensor heater monitor	P0032, P0038, P0052, P0058	
Exhaust gas recirculation (EGR) system monitor <Readiness test item>	P0401, P0489, P0490	3
Catalytic converter monitor <Readiness test item>	P0421, P0431	4
Evaporative emission system leak monitor (small leak and gross leak) <Readiness test item>	P0442, P0455	5
Evaporative purge system monitor	P0441	
Fuel tank pressure sensor monitor	P0450	
Evaporative emission system leak monitor (very small leak) <Readiness test item>	P0456	6
Mass airflow sensor monitor	P0101	7
Manifold absolute pressure (MAP) sensor monitor	P0106, P0107	
Intake air temperature sensor monitor	P0111	8
Engine coolant temperature sensor monitor	P0116, P0125	9
Thermostat monitor	P0128	10
Heated oxygen sensor (rear) monitor <Readiness test item>	P0139, P0159	11
Air fuel ratio feedback monitor	P0134, P0154	12
Heated oxygen sensor (rear) monitor <Readiness test item>	P0140, P0160	13
Fuel tank temperature sensor monitor	P0181	14
Misfire monitor	P0300, P0301, P0302, P0303, P0304, P0305, P0306	15

MONITOR ITEM	DIAGNOSTIC TROUBLE CODE (DTC)	PATTERN
Fuel tank pressure sensor monitor	P0451	16
Power steering pressure switch monitor	P0554	17
Throttle position sensor plausibility monitor	P0121, P0221	
Mass airflow sensor plausibility monitor	P0068, P1238	
Torque monitor	P061A	
Idle speed control system monitor	P0506, P0507	18
MIVEC system monitor	P003C	19
Fuel trim monitor	P0171, P0172, P0174, P0175	20
Heated oxygen sensor monitor	P0131, P0137, P0151, P0157, P2195, P2197	21
Mass airflow sensor monitor	P0102, P0103	22
Manifold absolute pressure (MAP) sensor monitor	P0108	
Intake air temperature sensor monitor	P0112, P0113	
Engine coolant temperature sensor monitor	P0117, P0118	
Heated oxygen sensor monitor	P0132, P0138, P0152, P0158, P2252, P2253	
Fuel tank temperature sensor monitor	P0182, P0183	
Injector monitor	P0201, P0202, P0203, P0204, P0205, P0206	
Knock sensor monitor	P0327, P0328, P0332, P0333	
Crankshaft position sensor monitor	P0335	
Camshaft position sensor monitor	P0340	
Evaporative emission purge solenoid monitor	P0443	
Evaporative emission ventilation solenoid monitor	P0446	
Fuel tank pressure sensor monitor	P0452, P0453	
Fuel level sensor monitor	P0462, P0463	
Engine oil control valve monitor	P001A	
Engine RPM plausibility monitor	P061C	
Barometric pressure sensor monitor	P2228, P2229	
Ignition timing retard control (cold start strategy) monitor	P050B	23
Idle speed control system monitor	P1506, P1507	

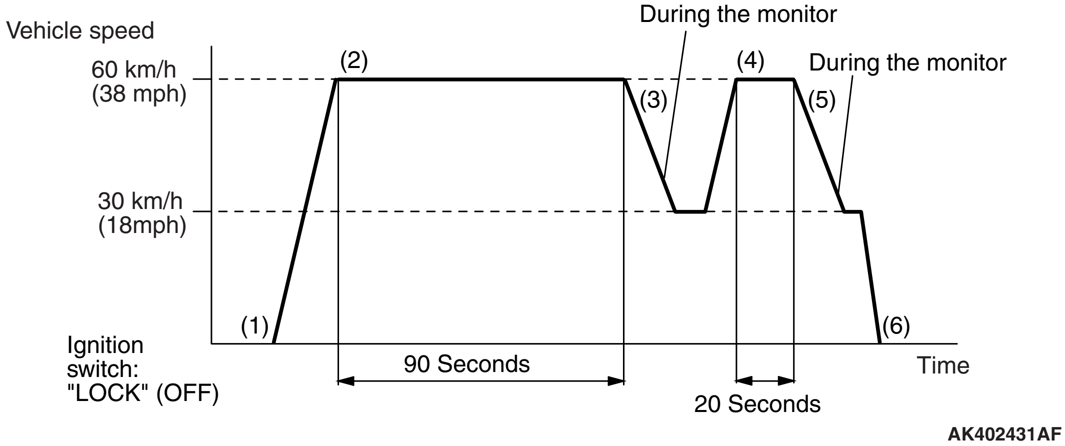
PATTERN 1

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than 60°C (140°F) • Intake air temperature: More than –10°C (14°F) • Barometric pressure: More than 76 kPa (22.5 inHg) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle for 7 minutes at the following conditions. (During the monitor) *NOTE: When the system is normal, the monitor is completed earlier.* • Vehicle speed: More than 30 km/h (19 mph) • Engine speed: More than 1,200 r/min, less than 3,000 r/min • Engine load: More than 30 %, less than 60 % • Without rapid accelerator pedal movement 3. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. *NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.* 5. Confirm that the diagnostic trouble code (DTC) is not output.

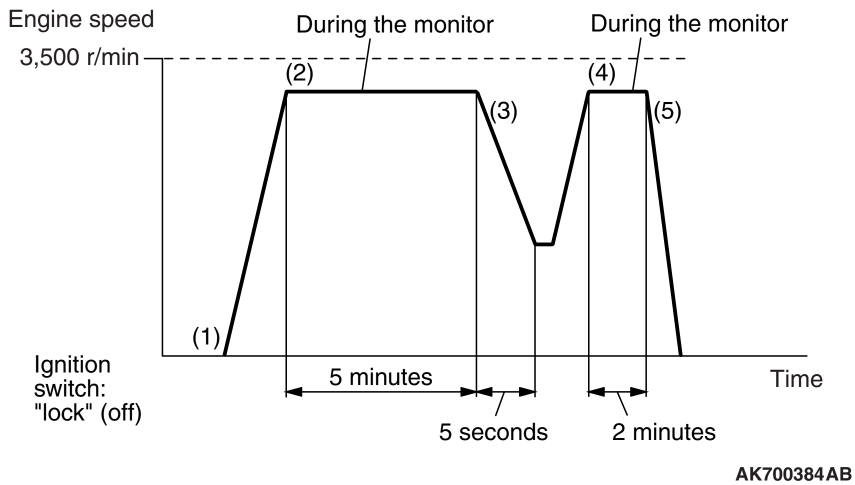
PATTERN 2

Inspection conditions	Intake air temperature: More than –10°C (14°F)
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 2 minutes. (During the monitor) 3. Turn the ignition switch to the "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. *NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.* 5. Confirm that the diagnostic trouble code (DTC) is not output.

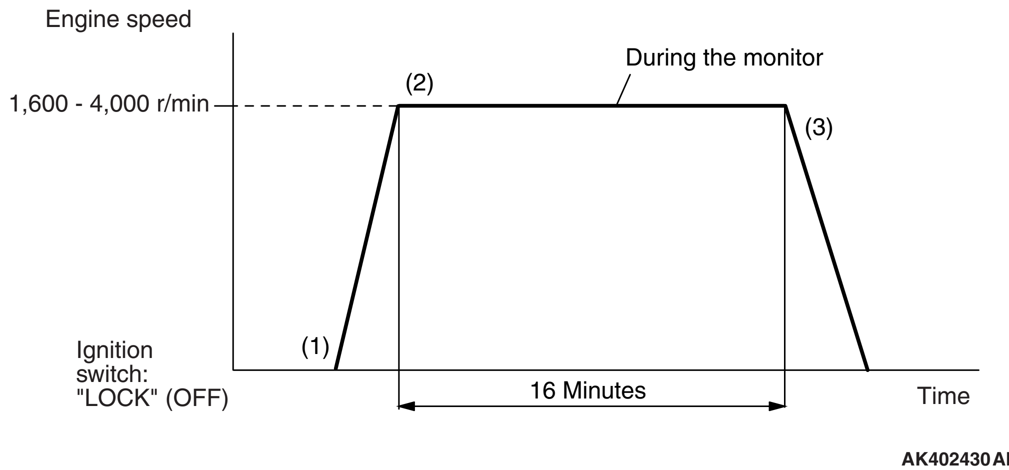
PATTERN 3

<table>
<tr><td>Drive cycle pattern</td><td>
</td></tr>
<tr><td>Inspection conditions</td><td>• Engine coolant temperature: More than 76°C (169°F)
• Intake air temperature: More than –10°C (14°F)
• Barometric pressure: More than 76 kPa (22.4 in.Hg)
• Condition of A/T: Selector lever "D" range</td></tr>
<tr><td>Test procedure</td><td>1. Start the engine with all the accessories switched OFF.
2. Accelerate until the vehicle speed is 60 km/h (38 mph) and then drive the vehicle for 90 seconds.
3. Release the accelerator pedal and reduce vehicle speed to 30 km/h (18 mph). (During the monitor)
4. Accelerate until the vehicle speed is 60 km/h (38 mph) and then drive the vehicle for 20 seconds.
5. Release the accelerator pedal and reduce vehicle speed to 30 km/h (18 mph). (During the monitor)
6. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position.
7. Start the engine and do Steps 1 to 6 again.
NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.
8. Confirm that the diagnostic trouble code (DTC) is not output.</td></tr>
</table>

PATTERN 4

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than 7°C (45°F) • Intake air temperature: More than –10°C (14°F) • Barometric pressure: More than 76 kPa (22.4 in.Hg) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all accessories switched OFF. 2. Drive the vehicle for 5 minutes at the following conditions. (During the monitor) • Engine speed: Less than 3,500 r/min • Airflow rate: More than 14 g/sec, less than 41 g/sec • Accelerator pedal: Except full close • Without rapid accelerator pedal movement 3. Release the accelerator pedal for 5 seconds. 4. Drive the vehicle for 2 minutes at the following conditions. (During the monitor) • Engine speed: Less than 3,500 r/min • Airflow rate: More than 14 g/sec, less than 41 g/sec • Accelerator pedal: Except full close • Without rapid accelerator pedal movement *NOTE: When the system is normal, the monitor is completed earlier.* 5. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 6. Start the engine and do Steps 1 to 5 again. *NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.* 7. Confirm that the diagnostic trouble code (DTC) is not output.

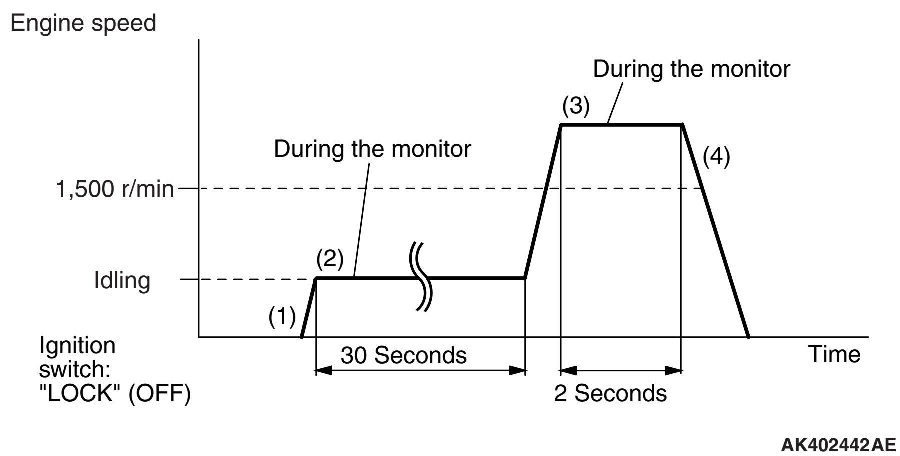
PATTERN 5

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature at engine start: Less than 36°C (96°F) • Intake air temperature at engine start: Less than 36°C (96°F) • Fuel amount at engine start: More than 15%, less than 40% • Engine coolant temperature: More than 60°C (140°F) • Intake air temperature: More than 5°C (41°F), less than 45°C (113°F) • Barometric pressure: More than 76 kPa (22.4 in.Hg) • Fuel temperature: Less than 36°C (96°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle for 16 minutes at the following conditions. (During the monitor) • Engine speed: More than 1,600 r/min, less than 4,000 r/min • Vehicle speed: More than 20 km/h (12 mph) • Engine load: More than 20 %, less than 70 % • Without rapid accelerator pedal movement *NOTE: Keep running as long as possible with the power steering pressure switch in the OFF position.* *NOTE: When the system is normal, the monitor is completed earlier.* 3. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. *NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.* 5. Confirm that the diagnostic trouble code (DTC) is not output.

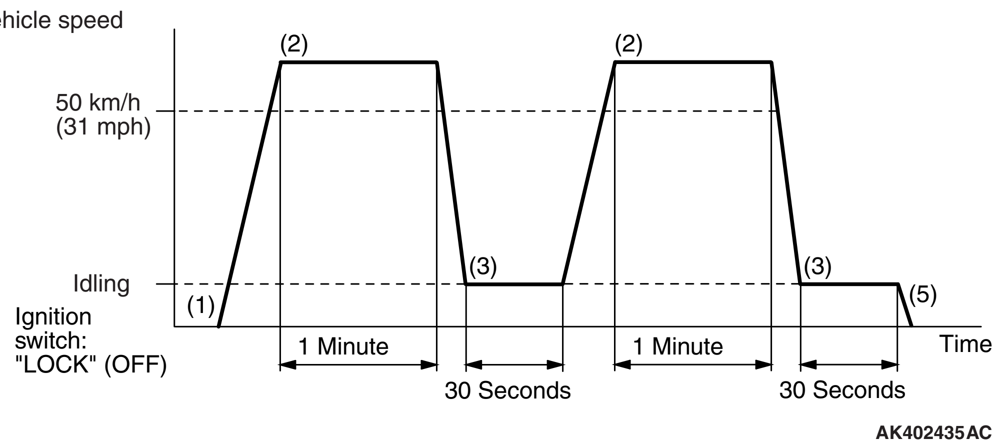
PATTERN 6

Inspection conditions	• Engine coolant temperature at engine start: Less than 36°C (96°F) • Intake air temperature at engine start: Less than 36°C (96°F) • Fuel amount at engine start: More than 40 %, less than 85 % • Engine coolant temperature: More than 20°C (68°F) • Intake air temperature: More than –10°C (14°F) • Barometric pressure: More than 76 kPa (22.4 in.Hg) • Fuel temperature: Less than 33°C (91°F)
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 16 minutes. (During the monitor) *NOTE: When the system is normal, the monitor is completed earlier.* 3. Turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. *NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.* 5. Confirm that the diagnostic trouble code (DTC) is not output.

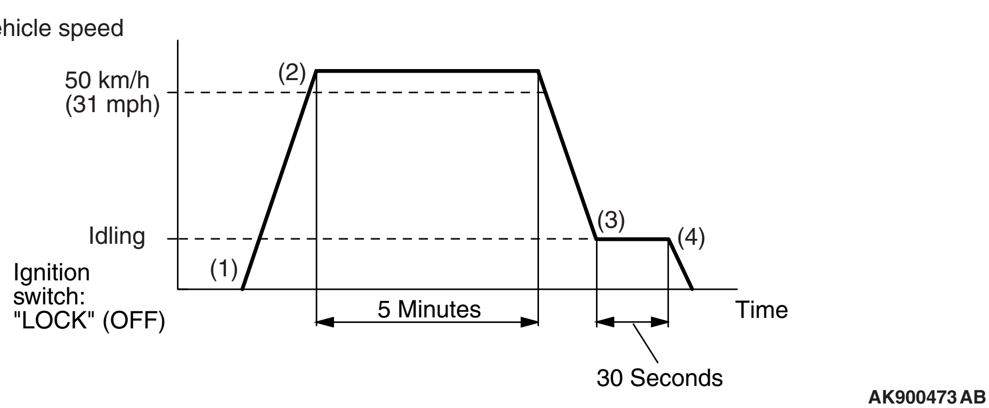
PATTERN 7

Drive cycle pattern	
Inspection condition	• Engine coolant temperature at engine start: More than 0°C (32°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 30 seconds. (During the monitor) 3. Accelerate the vehicle for 2 seconds at the following conditions. (During the monitor) • Engine speed: More than 1,500 r/min • Engine load: More than 20 % • Throttle position sensor output voltage: More than 3.5 volts 4. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 5. Start the engine and do Steps 1 to 4 again. 6. Confirm that the diagnostic trouble code (DTC) is not output.

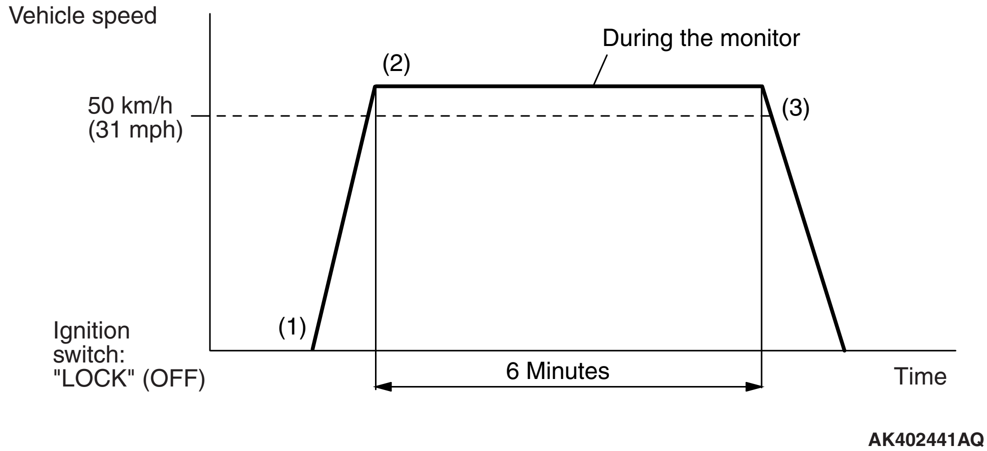
PATTERN 8

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than 76°C (169°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle at more than 50 km/h (31 mph) for 1 minute. 3. Stop the vehicle in a safe place and let the engine idle for 30 seconds. 4. Repeat Steps 2 and 3 again. 5. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 6. Confirm that the diagnostic trouble code (DTC) is not output.

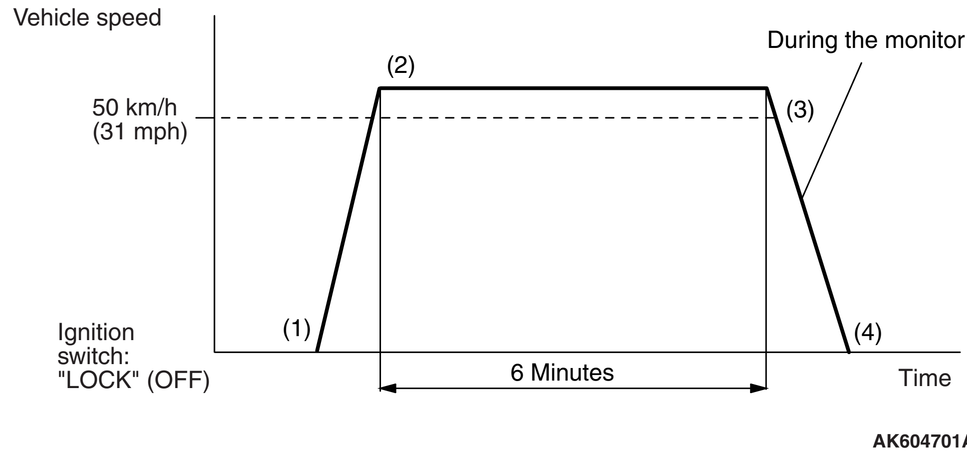
PATTERN 9

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature at engine start: More than 7°C (45°F) • Intake air temperature: Less than 60°C (140°F) • Engine coolant temperature: More than 40°C (104°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle for 5 minutes at the following condition. • Vehicle speed: More than 50 km/h (31 mph) • Airflow rate: More than 12 g/sec • Except fuel cut 3. Stop the vehicle in a safe place and let the engine idle for 30 seconds. 4. Turn the ignition switch to "LOCK" (OFF) position. 5. Confirm that the diagnostic trouble code (DTC) is not output.

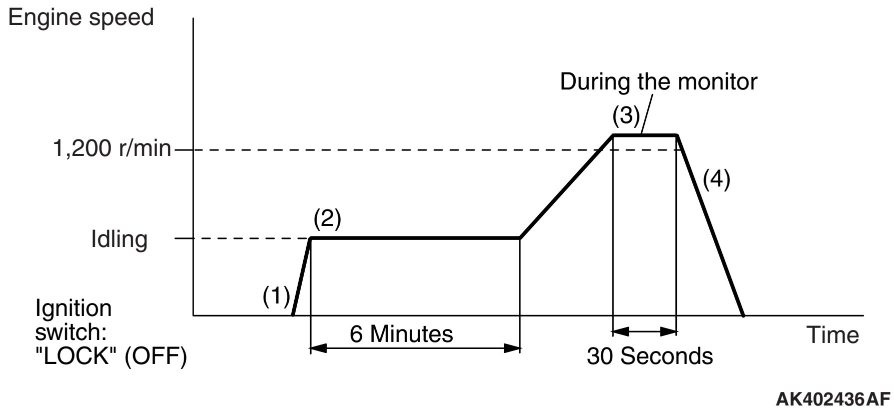
PATTERN 10

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature at engine start: More than –10°C (14°F), less than 60°C (140°F) • Intake air temperature: More than –10°C (14°F) • Dropping of intake air temperature since engine start: Less than 10°C (18°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle for 6 minutes at the following conditions. (During the monitor) • Vehicle speed: More than 50 km/h (31 mph) • Airflow rate: More than 10 g/sec • Except fuel cut *NOTE: The system is normal if engine coolant temperature will rise more than 77°C (171°F) within 6 minutes.* 3. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

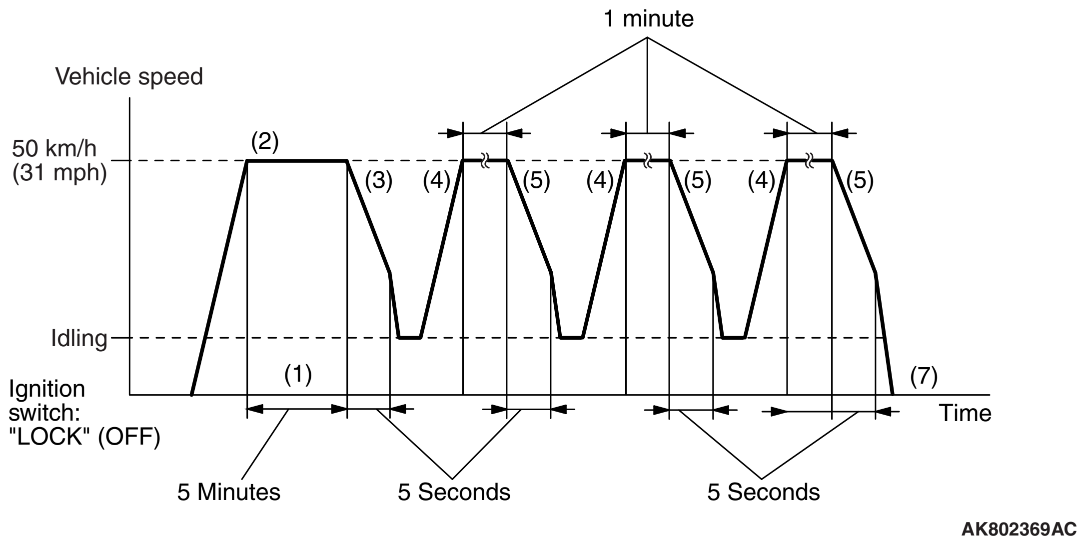
PATTERN 11

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than 76°C (169°F) • Barometric pressure: More than –76 kPa (22.4 in.Hg) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle at 50 km/h (31 mph) for 6 minutes. 3. Release the accelerator pedal for 10 seconds then stop the vehicle in a safe place. (During the monitor) 4. Turn the ignition switch to "LOCK" (OFF) position. 5. Start the engine and do Steps 1 to 4 again. *NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.* 6. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 12

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than 7°C (45°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 6 minutes. 3. Drive the vehicle for 30 seconds at the following conditions. (During the monitor) • Engine speed: More than 1,200 r/m • Engine load: More than 30 % • Throttle position sensor output: Less than 4.0 volts • Except fuel cut 4. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 5. Confirm that the diagnostic trouble code (DTC) is not output.

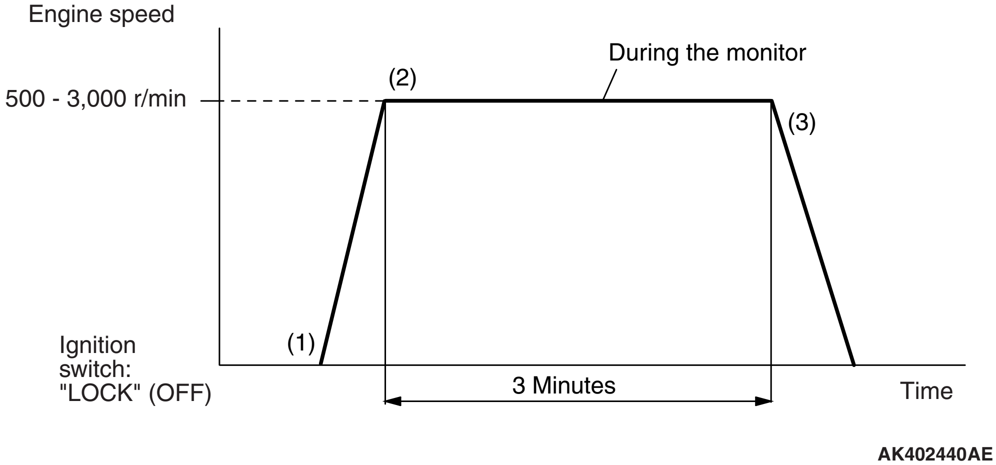
PATTERN 13

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than 76°C (169°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle at 50 km/h (31 mph) for 5 minutes. 3. Release the accelerator pedal for 5 seconds then stop the vehicle in a safe place. 4. Increase the speed of the vehicle to 50 km/h (31 mph) under the following condition, and then drive the vehicle for 1 minute. • Engine speed: More than 1,500 r/min • Engine load: More than 40 % 5. Release the accelerator pedal for 5 seconds then stop the vehicle in a safe place. 6. Repeat Steps 4 and 5 for 2 times. 7. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 8. Start the engine and do Steps 1 to 7 again. *NOTE: When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. The second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle.* 9. Confirm that the diagnostic trouble code (DTC) is not output.

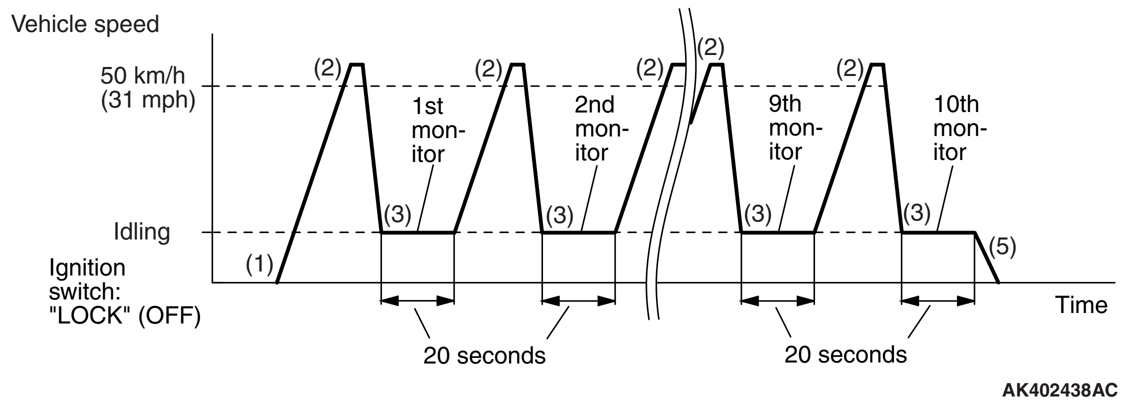
PATTERN 14

Inspection conditions	• Engine coolant temperature at engine start: More than –10°C (14°F), less than 36°C (97°F) • Difference between engine coolant temperature and intake air temperature at engine start: Less than 5°C (9°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle at more than 30 km/h (19 mph) until engine coolant temperature rises more than 60°C (140°F). (During the monitor) 3. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

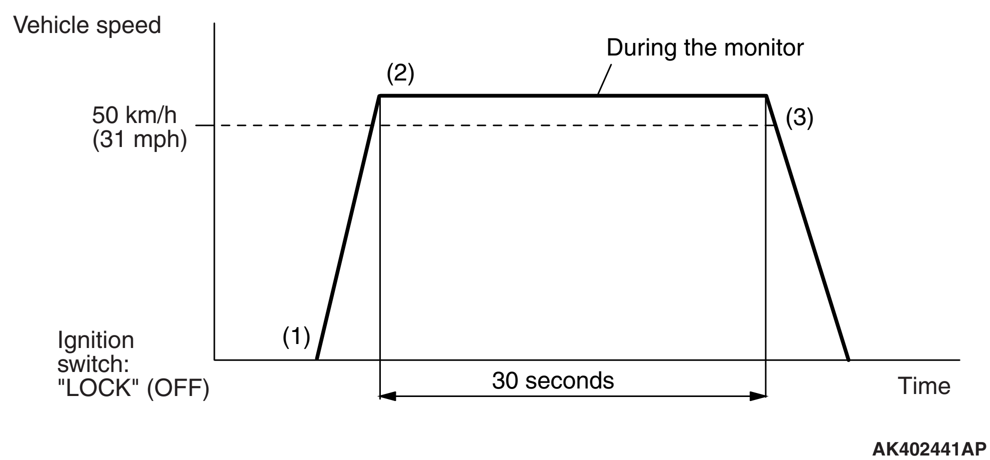
PATTERN 15

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than –10°C (14°F) • Barometric pressure: More than 76 kPa (22.4 in.Hg) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle for 3 minutes at the following conditions. (During the monitor) • Engine speed: More than 500 r/min, less than 3,000 r/min • Engine load: More than 25 % • Without rapid accelerator pedal change • Except fuel cut 3. Stop the vehicle in a the safe place and turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 16

Drive cycle pattern	
Inspection condition	Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Accelerate until the vehicle speed is more than 50 km/h (31 mph). 3. Stop the vehicle in a safe place and let the engine idle for 20 seconds. (During the monitor) 4. Repeat Steps 2 and 3 for 10 times. 5. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 6. Start the engine and do Steps 1 to 5 again. 7. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 17

Drive cycle pattern	
Inspection conditions	• Engine coolant temperature: More than 20°C (68°F) • Condition of A/T: Selector lever "D" range
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Drive the vehicle at more than 50 km/h (31 mph) for 30 seconds. (During the monitor) 3. Stop the vehicle in a safe place and turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 18

Inspection conditions	• Engine coolant temperature: More than 41°C (106°F) • Intake air temperature: More than –10°C (14°F) • Barometric pressure: More than 76 kPa (22.4 in.Hg)
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 1 minute. (During the monitor) 3. Turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 19

Inspection condition	Engine coolant temperature: More than 77°C (171°F)
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 40 seconds. 3. Drive the engine at more than 5,200 r/min for 5 seconds. (During the monitor) 4. Turn the ignition switch to "LOCK" (OFF) position. 5. Start the engine and do Steps 1 to 4 again. 6. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 20

Inspection conditions	Engine coolant temperature: More than 76°C (169°F)
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 15 minutes. (During the monitor) 3. Turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 21

Inspection conditions	• Intake air temperature: More than –10°C (14°F) • Engine coolant temperature: More than 7°C (45°F)
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 8 minutes. (During the monitor) 3. Turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

PATTERN 22

Inspection conditions	• Engine coolant temperature: More than 0°C (32°F) <Mainfold absolute pressure sensor monitor> • Fuel amount at engine start: Less than 80 % <Fuel tank pressure sensor monitor>
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle at the engine speed less than 1,000 r/min for 15 seconds. (During the monitor) 3. Turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

PTTERN 23

Inspection conditions	• Engine coolant temperature: More than 7 °C (45 °F), less than 41 °C (106 °F) • Intake air temperature: More than –10 °C (14 °F) • Barometric pressure: More than 76 kPa (22.4 in.Hg)
Test procedure	1. Start the engine with all the accessories switched OFF. 2. Let the engine idle for 1 minute. (During the monitor) 3. Turn the ignition switch to "LOCK" (OFF) position. 4. Start the engine and do Steps 1 to 3 again. 5. Confirm that the diagnostic trouble code (DTC) is not output.

SYSTEM READINESS TEST STATUS

PURPOSE

The Readiness function (also referred to as I/M Readiness or I/M Flags) indicates if a full diagnostic check has been "Completed" (is "Ready") for each non-continuous monitor. Enhanced I/M State Emission Programs will use the Readiness status (Codes) to see if the vehicle is ready for OBD-II testing. "Incomplete" (Not Ready) codes will be one of the triggers for I/M failure.

OVERVIEW

The ECM monitors the following main diagnosis items and records whether the evaluation was completed or is incomplete. The Readiness Codes are established for the I/M programs, thereby confirming that the vehicles have not been tampered with by erasing the diagnostic trouble code(s) (DTCs) before I/M testing. The Readiness Codes and DTCs can be reset by disconnecting the battery or by erasing the codes with a scan tool MB991958 (M.U.T.-III sub assembly). For this reason, all the Readiness Codes must be displayed "Complete" before I/M testing.

When the monitors run and complete, the scan tool MB991958 (M.U.T.-III sub assembly) will display the Readiness Codes as "Complete" (General Scan Tools display as "Ready"). When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, the Readiness Codes will be set as "Complete" on the first drive cycle. For DTCs requiring two drive cycles to detect a fault, the second drive cycle is required to set the Readiness Codes as "Complete" if a fault is detected during the first drive cycle. If the fault is still there after the second drive cycle, a DTC will be set.

- Catalyst: P0421, P0431
- Evaporative system: P0442, P0455, P0456
- Heated oxygen sensor: P0133, P0139, P0140, P0153, P0159, P0160
- Heated oxygen sensor heater: P0031, P0037, P0051, P0053, P0057, P0059
- EGR system: P0401

After all the Readiness Codes are displayed as "Complete", the technician is assured that any DTCs related to the monitor will be displayed if the system has a problem. That is why some State's I/M programs require the Readiness Code as "Complete" before they check for DTCs.

NOTE: After a repair is made for a DTC, the technician should drive the OBD-II Drive Cycle checking that the scan tool MB991958 (M.U.T.-III Sub Assembly) displays all the Readiness Codes as "Complete".

FAIL-SAFE FUNCTION REFERENCE TABLE

M1131153000802

When the main sensor malfunctions are detected by the diagnostic test mode, the vehicle is controlled by means of the following defaults.

MALFUNCTION ITEM	CONTROL CONTENTS DURING MALFUNCTION
Mass airflow sensor	• Uses the throttle position sensor signal and engine speed signal (crankshaft position sensor signal) for basic injector drive time and basic ignition timing from the pre-set mapping.
Intake air temperature sensor	Controls as if the intake air temperature is 25°C (77°F).
Engine coolant temperature sensor	Controls as if the engine coolant temperature is 80°C (176°F). (This control will be continued until the ignition switch is turned to "LOCK" (OFF) position even though the sensor signal returns to normal.)
Camshaft position sensor	Injects fuel simultaneously into all cylinders. (After the ignition switch is turned to "ON" position, the No.1 cylinder top dead center is not detected at all.)
Barometric pressure sensor	Controls as if the barometric pressure is 101 kPa (30 in.Hg).
Knock sensor	Switches the ignition timing from ignition timing for high octane to ignition timing for standard octane fuel.
Heated oxygen sensor front	Air/fuel ratio closed loop control is not performed.
Heated oxygen sensor rear	Performs the closed loop control of the air/fuel ratio by using only the signal of the heated oxygen sensor (front) installed on the front side of the catalytic converter.
Generator FR terminal	No generator output suppression control is performed for the electrical load (to be operated as an ordinary generator).
Misfire detection	The ECM stops supplying fuel to the cylinder with the highest misfire rate if a misfire that could damage the catalytic converter is detected.
Accelerator pedal position sensor (main)	• Detects the amount of the accelerator pedal travel through the use of the accelerator pedal position sensor (sub) signal, but rendering it only as being approximately one-half the normal opening angle. • Prohibits the operation of the auto-cruise control. • Cuts off fuel when the engine speed exceeds 3,000 r/min. • Suppresses the engine output by stopping the electronically controlled throttle valve system if the accelerator pedal position sensor (sub) is also malfunctioning.
Accelerator pedal position sensor (sub)	• Detects the amount of the accelerator pedal travel through the use of the accelerator pedal position sensor (main) signal, but rendering it only as being approximately one-half the normal opening angle. • Prohibits the operation of the auto-cruise control. • Cuts off fuel when the engine speed exceeds 3,000 r/min. • Suppresses the engine output by stopping the electronically controlled throttle valve system if the accelerator pedal position sensor (main) is also malfunctioning.

MALFUNCTION ITEM	CONTROL CONTENTS DURING MALFUNCTION
Throttle position sensor (main)	• Controls the throttle valve position through the use of the throttle position sensor (sub) signal. • Renders the amount of accelerator pedal travel as being approximately one-half the normal opening angle. • Prohibits the operation of the engine speed feedback control. • Prohibits the operation of the auto-cruise control. • Cuts off fuel when the engine speed exceeds 3,000 r/min. • Suppresses the engine output by stopping the electronically controlled throttle valve system if the throttle position sensor (sub) is also malfunctioning.
Throttle position sensor (sub)	• Controls the throttle valve position through the use of the throttle position sensor (main) signal. • Renders the amount of accelerator pedal travel as being approximately one-half the normal opening angle. • Prohibits the operation of the auto-cruise control. • Cuts off fuel when the engine speed exceeds 3,000 r/min. • Prohibits the idle speed control from learning. • Suppresses the engine output by stopping the electronically controlled throttle valve system if the throttle position sensor (main) is also malfunctioning.
Throttle valve position feedback	• Suppresses the engine output by stopping the electronically controlled throttle valve system. • Prohibits the operation of the auto-cruise control. • Prohibits the operation of the engine speed feedback control.
Throttle actuator control motor	• Suppresses the engine output by stopping the electronically controlled throttle valve system. • Prohibits the operation of the auto-cruise control. • Prohibits the operation of the engine speed feedback control.
Switching to high-speed cam in Mitsubishi Innovative Valve timing Electronic Control (MIVEC)	• Does not switch to high-speed cam. • Cut off fuel when the engine speed exceeds 5,000 r/min.

DIAGNOSTIC TROUBLE CODE CHART

M1131151005704

⚠ WARNING

When touching the throttle valve, surely shut off the driving circuits of the throttle valve. In the event that the throttle valve is operated, a finger might be injured as the result of being caught by the throttle valve.

⚠ CAUTION

During diagnosis, a DTC code associated with other system may be set when the ignition switch is turned on with connector(s) disconnected. On completion, confirm all systems for DTC(s). If DTC(s) are set, erase them all.

DTC	DIAGNOSTIC ITEM	REFERENCE PAGE
P001A	Camshaft profile control (engine oil control valve) circuit	P.13B-58
P0031	Heated oxygen sensor heater circuit low (bank 1 sensor 1)	P.13B-64
P0032	Heated oxygen sensor heater circuit high (bank 1 sensor 1)	P.13B-70
P0037	Heated oxygen sensor heater circuit low (bank 1 sensor 2)	P.13B-74
P0038	Heated oxygen sensor heater circuit high (bank 1 sensor 2)	P.13B-80
P003C	Mitsubishi innovative valve timing electronic control system (MIVEC) performance problem	P.13B-84
P0051	Heated oxygen sensor heater circuit low (bank 2 sensor 1)	P.13B-92
P0052	Heated oxygen sensor heater circuit high (bank 2 sensor 1)	P.13B-98
P0053	Heated oxygen sensor heater resistance (bank 1 sensor 1)	P.13B-102
P0057	Heated oxygen sensor heater circuit low (bank 2 sensor 2)	P.13B-108
P0058	Heated oxygen sensor heater circuit high (bank 2 sensor 2)	P.13B-114
P0059	Heated oxygen sensor heater resistance (bank 2 sensor 1)	P.13B-118
P0068[*1]	Mass airflow sensor plausibility	P.13B-123
P0069	Abnormal correlation between manifold absolute pressure sensor and barometric pressure sensor	P.13B-127
P0101[*1]	Mass airflow circuit range/performance problem	P.13B-132
P0102[*1]	Mass airflow circuit low input	P.13B-139
P0103[*1]	Mass airflow circuit high input	P.13B-145
P0106	Manifold absolute pressure circuit range/performance problem	P.13B-150
P0107	Manifold absolute pressure circuit low input	P.13B-156
P0108	Manifold absolute pressure circuit high input	P.13B-162
P0111[*1]	Intake air temperature circuit range/performance problem	P.13B-167
P0112[*1]	Intake air temperature circuit low input	P.13B-171
P0113[*1]	Intake air temperature circuit high input	P.13B-175
P0116[*1]	Engine coolant temperature circuit range/performance problem	P.13B-180
P0117[*1]	Engine coolant temperature circuit low input	P.13B-185
P0118[*1]	Engine coolant temperature circuit high input	P.13B-189

DTC	DIAGNOSTIC ITEM	REFERENCE PAGE
P0121*1	Throttle position sensor (main) plausibility	P.13B-195
P0122*1	Throttle position sensor (main) circuit low input	P.13B-199
P0123*1	Throttle position sensor (main) circuit high input	P.13B-207
P0125*1	Insufficient coolant temperature for closed loop fuel control	P.13B-212
P0128	Coolant thermostat (coolant temperature below thermostat regulating temperature)	P.13B-219
P0131	Heated oxygen sensor circuit low voltage (bank 1 sensor 1)	P.13B-222
P0132	Heated oxygen sensor circuit high voltage (bank 1 sensor 1)	P.13B-228
P0133	Heated oxygen sensor circuit slow response (bank 1 sensor 1)	P.13B-232
P0134*1	Heated oxygen sensor circuit no activity detected (bank 1 sensor 1)	P.13B-236
P0137	Heated oxygen sensor circuit low voltage (bank 1 sensor 2)	P.13B-244
P0138	Heated oxygen sensor circuit high voltage (bank 1 sensor 2)	P.13B-250
P0139	Heated oxygen sensor circuit slow response (bank 1 sensor 2)	P.13B-254
P0140	Heated oxygen sensor circuit no activity detected (bank 1 sensor 2)	P.13B-259
P0151	Heated oxygen sensor circuit low voltage (bank 2 sensor 1)	P.13B-263
P0152	Heated oxygen sensor circuit high voltage (bank 2 sensor 1)	P.13B-269
P0153	Heated oxygen sensor circuit slow response (bank 2 sensor 1)	P.13B-273
P0154*1	Heated oxygen sensor circuit no activity detected (bank 2 sensor 1)	P.13B-277
P0157	Heated oxygen sensor circuit low voltage (bank 2 sensor 2)	P.13B-284
P0158	Heated oxygen sensor circuit high voltage (bank 2 sensor 2)	P.13B-290
P0159	Heated oxygen sensor circuit slow response (bank 2 sensor 2)	P.13B-294
P0160	Heated oxygen sensor circuit no activity detected (bank 2 sensor 2)	P.13B-299
P0171	System too lean (bank 1)	P.13B-303
P0172	System too rich (bank 1)	P.13B-310
P0174	System too lean (bank 2)	P.13B-316
P0175	System too rich (bank 2)	P.13B-323
P0181	Fuel tank temperature sensor circuit range/performance	P.13B-329
P0182	Fuel tank temperature sensor circuit low input	P.13B-334
P0183	Fuel tank temperature sensor circuit high input	P.13B-339
P0201	Injector circuit-cylinder 1	P.13B-345
P0202	Injector circuit-cylinder 2	P.13B-353
P0203	Injector circuit-cylinder 3	P.13B-360
P0204	Injector circuit-cylinder 4	P.13B-368
P0205	Injector circuit-cylinder 5	P.13B-375
P0206	Injector circuit-cylinder 6	P.13B-383
P0221*1	Throttle position sensor (sub) plausibility	P.13B-390

DTC	DIAGNOSTIC ITEM	REFERENCE PAGE
P0222[*1]	Throttle position sensor (sub) circuit low input	P.13B-393
P0223[*1]	Throttle position sensor (sub) circuit high input	P.13B-400
P0300[*2]	Random/multiple cylinder misfire detected	P.13B-406
P0301[*2]	Cylinder 1 misfire detected	P.13B-411
P0302[*2]	Cylinder 2 misfire detected	P.13B-414
P0303[*2]	Cylinder 3 misfire detected	P.13B-417
P0304[*2]	Cylinder 4 misfire detected	P.13B-420
P0305[*2]	Cylinder 5 misfire detected	P.13B-423
P0306[*2]	Cylinder 6 misfire detected	P.13B-426
P0327	Knock sensor circuit low (bank 1)	P.13B-430
P0328	Knock sensor circuit high (bank 1)	P.13B-433
P0332	Knock sensor circuit low (bank 2)	P.13B-437
P0333	Knock sensor circuit high (bank 2)	P.13B-441
P0335[*1]	Crankshaft position sensor circuit	P.13B-445
P0340[*1]	Camshaft position sensor circuit	P.13B-452
P0401	Exhaust gas recirculation flow insufficient detected	P.13B-460
P0421	Warm up catalyst efficiency below threshold (bank 1)	P.13B-463
P0431	Warm up catalyst efficiency below threshold (bank 2)	P.13B-465
P0441	Evaporative emission control system incorrect purge flow	P.13B-467
P0442	Evaporative emission control system leak detected (small leak)	P.13B-471
P0443	Evaporative emission control system purge control valve circuit	P.13B-483
P0446	Evaporative emission control system vent control circuit	P.13B-490
P0450	Evaporative emission control system pressure sensor malfunction	P.13B-497
P0451	Evaporative emission control system pressure sensor range/performance	P.13B-506
P0452	Evaporative emission control system pressure sensor low input	P.13B-515
P0453	Evaporative emission control system pressure sensor high input	P.13B-525
P0455	Evaporative emission control system leak detected (gross leak)	P.13B-532
P0456	Evaporative emission control system leak detected (very small leak)	P.13B-544
P0461	Fuel level sensor <FWD> or fuel level sensor (main) <AWD> circuit range/performance	P.13B-556
P0462	Fuel level sensor <FWD> or fuel level sensor (main) <AWD> circuit low input	P.13B-559
P0463	Fuel level sensor <FWD> or fuel level sensor (main) <AWD> circuit high input	P.13B-561
P0489	EGR valve (stepper motor) circuit malfunction (ground short)	P.13B-564
P0490	EGR valve (stepper motor) circuit malfunction (battery short)	P.13B-570
P0506	Idle control system RPM lower than expected	P.13B-574

DTC	DIAGNOSTIC ITEM	REFERENCE PAGE
P0507	Idle control system RPM higher than expected	P.13B-577
P050B	Ignition timing retard insufficient	P.13B-580
P0513	Immobilizer malfunction	P.13B-583
P0551	Power steering pressure switch circuit range/performance	P.13B-585
P0554	Power steering pressure switch circuit intermittent	P.13B-591
P0602*1	Control module programming error	P.13B-595
P0604	Internal control module random access memory (RAM) error	P.13B-597
P0606*1	Engine control module main processor malfunction	P.13B-598
P060B*1	Internal control module A/D processing performance problem	P.13B-602
P060D*1	Internal control module accelerator pedal position performance problem	P.13B-603
P061A*1	Internal control module torque performance problem	P.13B-606
P061C*1	Internal control module engine RPM performance problem	P.13B-611
P061F	Internal control module throttle actuator controller performance problem	P.13B-614
P0622	Generator FR terminal circuit malfunction	P.13B-616
P062F*1	Internal control module EEPROM error	P.13B-621
P0630*1	Vehicle Identification Number (VIN) malfunction	P.13B-623
P0638*1	Throttle actuator control motor circuit range/ performance problem	P.13B-626
P0642*1	Throttle position sensor power supply	P.13B-628
P0657*1	Throttle actuator control motor relay circuit malfunction	P.13B-630
P1231	Active stability control plausibility <Vehicles with ASC>	P.13B-635
P1238*1	Mass airflow sensor plausibility (torque monitor)	P.13B-636
P1240	Ignition angle	P.13B-640
P1242	Fail safe control monitor	P.13B-641
P1243	Inquiry/response error	P.13B-642
P1247	A/T plausibility	P.13B-643
P1248	AWD plausibility <AWD>	P.13B-645
P1506	Idle control system RPM lower than expected at low temperature	P.13B-646
P1507	Idle control system RPM higher than expected at low temperature	P.13B-649
P1590*1	TCM to ECM communication error in torque reduction request	P.13B-652
P1603*1	Battery backup line malfunction	P.13B-655
P2066	Fuel level sensor (sub) circuit range/performance <AWD>	P.13B-659
P2100*1	Throttle actuator control motor circuit (open)	P.13B-663
P2101*1	Throttle actuator control motor magneto malfunction	P.13B-667
P2122*1	Accelerator pedal position sensor (main) circuit low input	P.13B-670
P2123*1	Accelerator pedal position sensor (main) circuit high input	P.13B-675

DTC	DIAGNOSTIC ITEM	REFERENCE PAGE
P2127*1	Accelerator pedal position sensor (sub) circuit low input	P.13B-679
P2128*1	Accelerator pedal position sensor (sub) circuit high input	P.13B-683
P2135*1	Throttle position sensor (main and sub) range/performance problem	P.13B-686
P2138*1	Accelerator pedal position sensor (main and sub) range/performance problem	P.13B-691
P2195	Heated oxygen sensor inactive (bank 1 sensor 1)	P.13B-695
P2197	Heated oxygen sensor inactive (bank 2 sensor 1)	P.13B-698
P2228*1	Barometric pressure circuit low input	P.13B-700
P2229*1	Barometric pressure circuit high input	P.13B-702
P2252	Heated oxygen sensor offset circuit low voltage	P.13B-704
P2253	Heated oxygen sensor offset circuit high voltage	P.13B-713
P2530	Ignition switch run position circuit	P.13B-723
U0001	Bus off	P.13B-726
U0101*1	Transmission control module time-out	P.13B-728
U0114	AWD-ECU time-out <AWD>	P.13B-731
U0121	ABS-ECU/ASC-ECU time-out	P.13B-734
U0141*1	ETACS-ECU time-out	P.13B-737
U0167	KOS-ECU/WCM communication error	P.13B-741
U0415	Invalid data received from ASC-ECU <Vehicles with ASC>	P.13B-744
U1180*1	Combination meter time-out	P.13B-746

NOTE: Do not replace the engine control module (ECM) until a through terminal check reveals there are no short/open circuits.

NOTE: Check that the ECM ground circuit is normal before checking for the cause of the problem.

*NOTE: After the ECM detects a malfunction, a diagnostic trouble code is recorded the next time the engine is started and the same malfunction is re-detected. However, for items marked with a "*1", the diagnostic trouble code is recorded on the first detection of the malfunction.*

*NOTE: The codes marked with a "*2" in the diagnosis code number column have the following two conditions for recording the diagnostic trouble code.*

- In case that the misfire causing the damaged catalyst is detected, the diagnostic trouble code is recorded at the time.
- In case that the misfire deteriorating the exhaust gas is detected, the diagnostic trouble code is recorded when the same malfunction is redetected after the next engine start.

NOTE: Sensor 1 indicates the sensor mounted at a position closest to the engine, and sensor 2 indicates the sensor mounted at the position second closest to the engine.

NOTE: Bank 1 indicates the right bank side cylinder, and Bank 2 indicates the left bank side cylinder.

SYMPTOM CHART

M1131151502302

⚠ ***WARNING***

When touching the throttle valve, surely shut off the driving circuits of the throttle valve. In the event that the throttle valve is operated, a finger might be injured as the result of being caught by the throttle valve.

⚠ **CAUTION**

During diagnosis, a DTC associated with other systems may be set when the ignition switch is turned on with connector(s) disconnected. On completion, confirm all systems for DTC(s). If DTC(s) are set, erase them all.

⚠ **CAUTION**

Disconnecting the battery cables or removing the combination meter will erase the learned value of the fuel gauge. To recover the learned value, input a vehicle speed (by actually driving the vehicle or inputting a simulated vehicle speed), and stop the vehicle. This will complete the learning process.

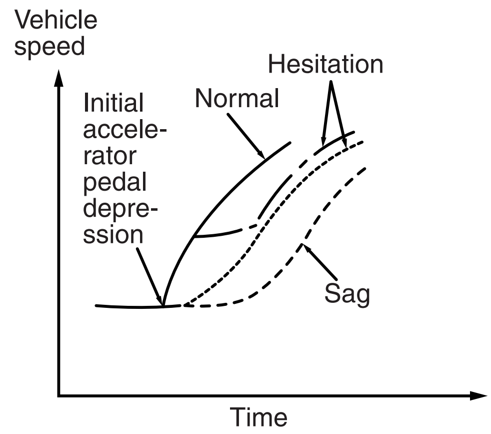
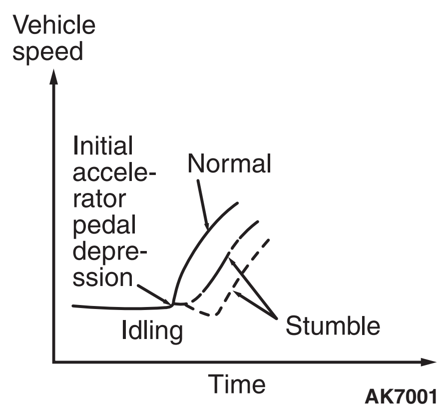
NOTE: Check that the ECM ground circuit is normal before checking for the cause of the problem.

TROUBLE SYMPTOMS		INSPECTION PROCEDURE	REFERENCE PAGE
Communication with scan tool is impossible	Communication with ECM only is not possible	1	P.13B-750
Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) and related parts	The Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) does not illuminate right after the ignition switch is turned to the "ON" position	2	P.13B-753
	The Malfunction Indicator Lamp (SERVICE ENGINE SOON or Check Engine Lamp) remains illuminated and never goes out	3	P.13B-754
Starting	Cranks, won't start	4	P.13B-755
	Starts up and dies	5	P.13B-763
	Hard starting	6	P.13B-767
Idling stability (improper idling)	Unstable idle (rough idle, hunting)	7	P.13B-773
	Idle speed is high (improper idle speed)	8	P.13B-776
	Idle speed is low (improper idle speed)	9	P.13B-778
Idling stability (engine stalls)	When the engine is cold, it stalls at idle (die out)	10	P.13B-779
	When the engine is hot, it stalls at idle (die out)	11	P.13B-781
	The engine stalls when accelerating (pass out)	12	P.13B-784
	The engine stalls when decelerating	13	P.13B-786

TROUBLE SYMPTOMS		INSPECTION PROCEDURE	REFERENCE PAGE
Driving	Hesitation, sag, stumble, poor acceleration or surge	14	P.13B-788
	Acceleration shock	15	P.13B-791
	Knocking	16	P.13B-792
Too high CO and HC concentration when idling		17	P.13B-794
IM240 test failure	Transient, mass emission tailpipe test failure	18	P.13B-797
	Purge flow test of the evaporative emission canister failure	19	P.13B-801
	Pressure test of the evaporative system failure	20	P.13B-802
Power supply system and ignition switch-IG system		21	P.13B-804
Fuel pump system		22	P.13B-810
Ignition switch-ST system and transmission range switch system		23	P.13B-816
Ignition circuit system		24	P.13B-823
A/C system		25	P.13B-829
Engine oil pressure switch (for warning lamp) system		26	P.13B-832

PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

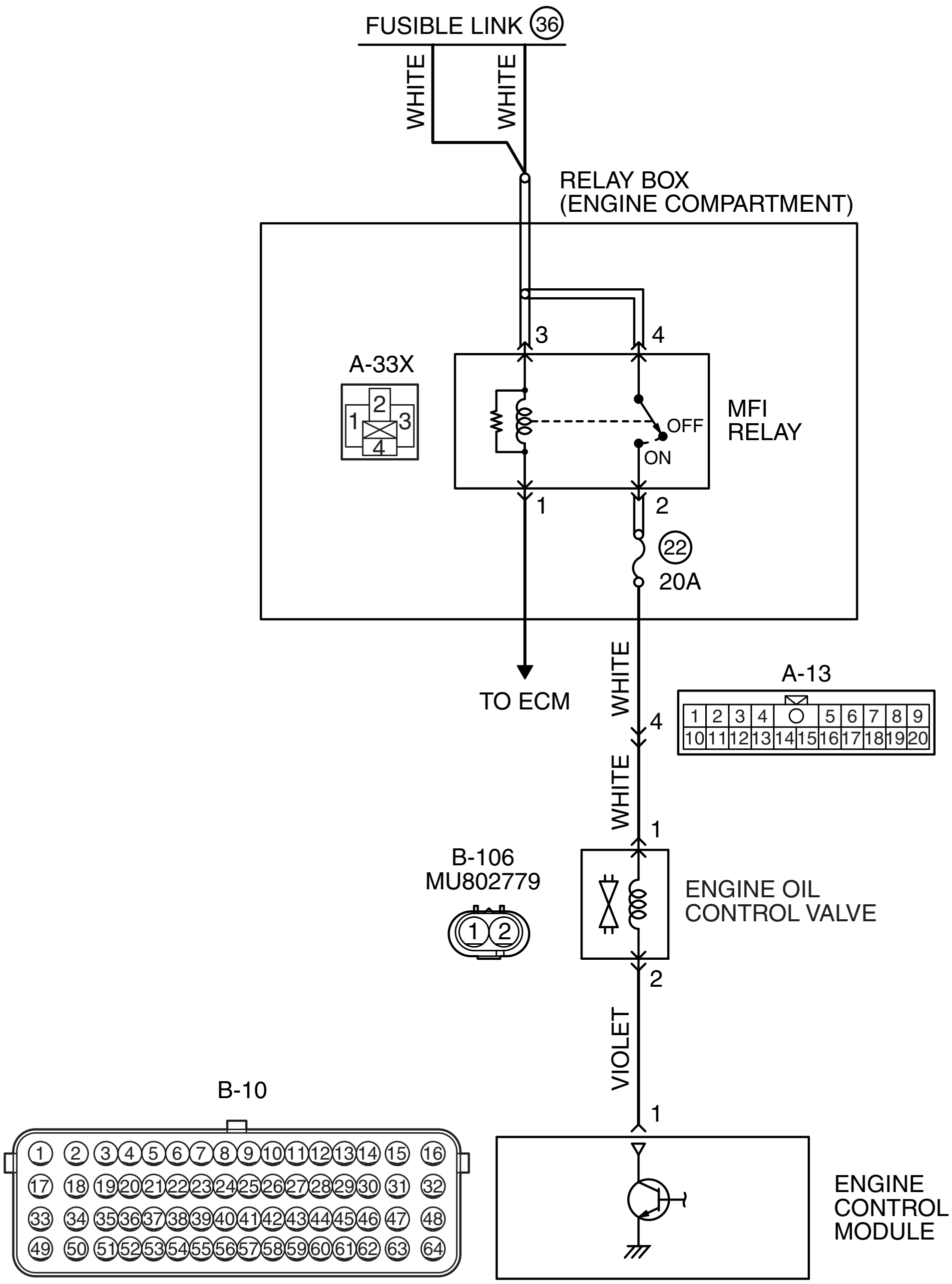
ITEMS		SYMPTOM
At starting	Won't start	The starter cranks the engine, but there is no combustion within the cylinders, and the engine won't start.
	Starts up and dies	The engine starts, but then engine soon stalls.
	Hard starting	Engine starts after cranking a while.
Idling stability	Hunting	Engine speed doesn't remain constant; changes at idle.
	Rough idle	Usually, a judgement can be based upon the movement of the tachometer pointer, and the vibration transmitted to the steering wheel, shift lever, body, etc.
	Incorrect idle speed	The engine doesn't idle at the correct speed.
	Engine stall (die out)	The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicle is moving or not.
	Engine stall (pass out)	The engine stalls when the accelerator pedal is depressed.

ITEMS		SYMPTOM	
At driving	Hesitation Sag	"Hesitation" is the delay in response of the vehicle speed (engine speed). This occurs when the accelerator is depressed in order to accelerate from the speed at which the vehicle is now traveling, or a temporary drop in vehicle speed (engine speed) during such acceleration. Serious hesitation is called "sag".	 AK700112AB
	Poor acceleration	Poor acceleration is inability to obtain an acceleration corresponding to the degree of throttle opening, even though acceleration is smooth. Also the inability to reach maximum speed.	
	Stumble	Engine speed increase is delayed when the accelerator pedal is initially depressed for acceleration.	 AK700113AB
	Shock	The feeling of a comparatively large impact or vibration when the engine is accelerated or decelerated.	
	Surge	This is slight acceleration and deceleration feel usually felt during steady, light throttle cruise. Most notable under light loads.	
	Knocking	A sharp sound during driving, which sounds like a hammer striking the cylinder walls. It makes poor driveability.	
At stopped	Run on ("Dieseling")	The condition in which the engine continues to run after the ignition switch is turned to the "LOCK" (OFF) position. Also called "dieseling".	

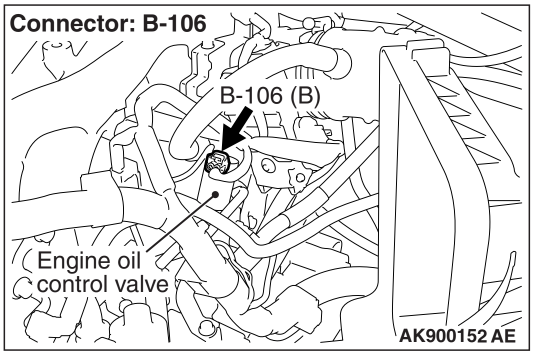
DIAGNOSTIC TROUBLE CODE PROCEDURES

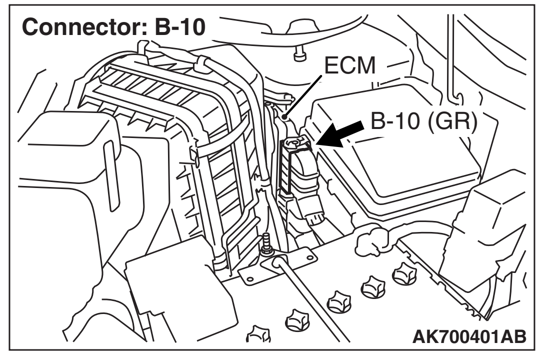
DTC P001A: Camshaft Profile Control (Engine Oil Control Valve) Circuit

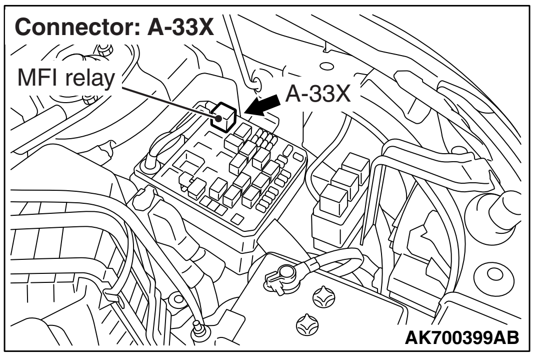
ENGINE OIL CONTROL VALVE CIRCUIT

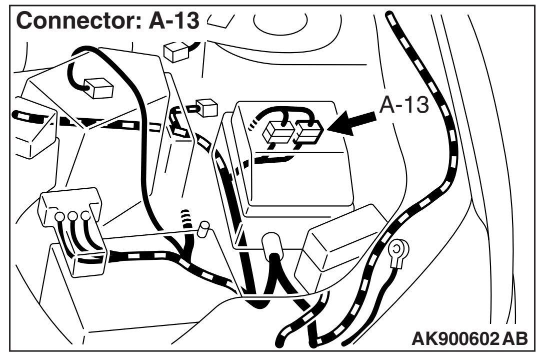


AK700159 AB









CIRCUIT OPERATION

- The engine oil control valve power is supplied from the MFI relay (terminal No. 2).
- The ECM controls ground engine oil control valve by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The engine oil pressure switches the cams to operate the MIVEC system in the low-speed or high-speed mode in accordance with the signals from the ECM.

DESCRIPTIONS OF MONITOR METHODS

Circuit voltage stays low when solenoid status is off.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

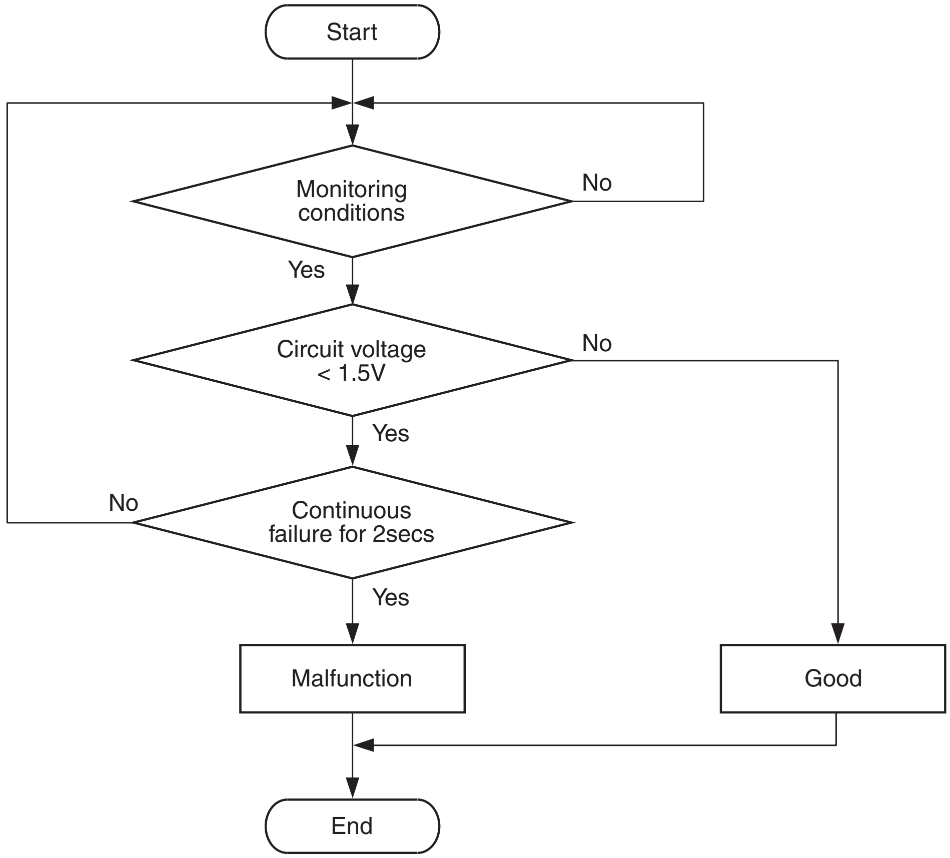
- Not applicable

Sensor (The sensor below is determined to be normal)

- Camshaft position sensor
- Mass airflow sensor
- Engine coolant temperature sensor
- Throttle position sensor
- Injection valve

DTC SET CONDITIONS

Logic Flow Chart



AK700498

Check Conditions

- Ignition switch: "ON"
- Engine oil control valve is OFF.
- Battery positive voltage is between10 and 16.5 volts.
- 0.1 seconds has elapsed after the above mentioned conditions have been met.

Judgment Criterion

- The ECM terminal voltage of engine oil control valve circuit is less than 1.5 volts for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

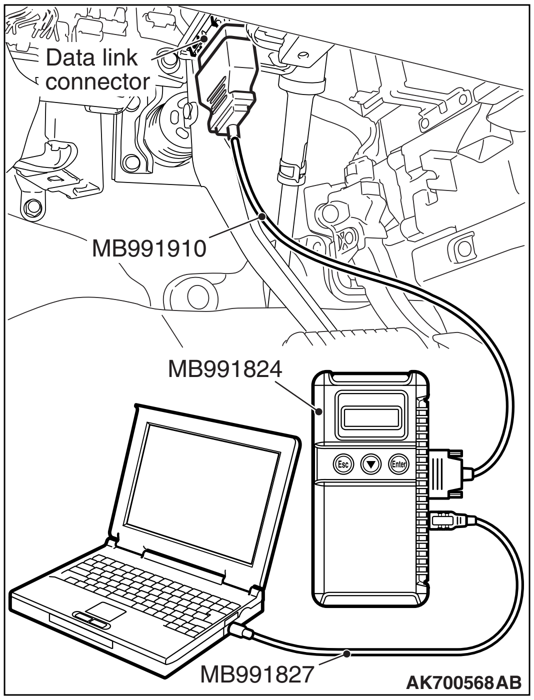
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Connector damage.
- Harness damage.
- Engine oil control valve failed.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data item 98: Oil control valve.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 98, Oil control valve.
- An operation sound should be heard and vibration should be felt when the engine oil control valve is operated.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the engine oil control valve operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

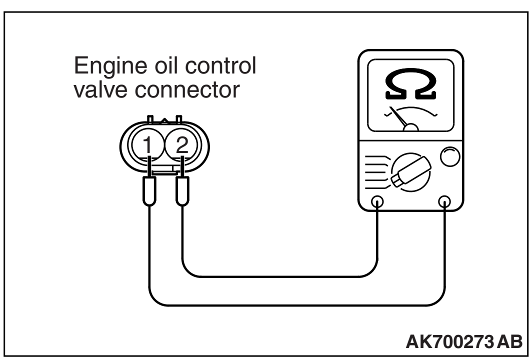
NO : Then go to Step 2.

STEP 2. Check harness connector B-106 engine oil control valve and harness connector B-10 at ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 7.



STEP 3. Check the engine oil control valve.

(1) Disconnect the engine oil control valve connector B-106.
(2) Measure the resistance between engine oil control valve side connector terminal No. 1 and No. 2.

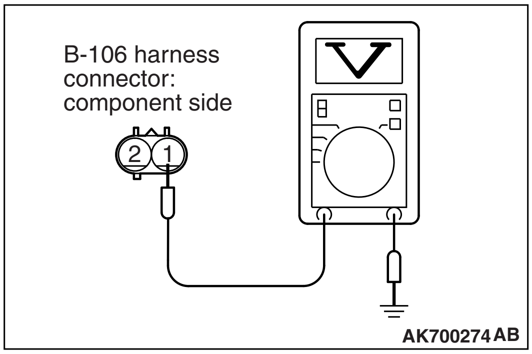
Standard value: 6.9 – 7.9 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 6.9 and 7.9 ohms [at 20°C (68°F)]?

YES : Go to Step 4.

NO : Replace the engine oil control valve. Then go to Step 7.

STEP 4. Measure the power supply voltage at engine oil control valve harness side connector B-106.



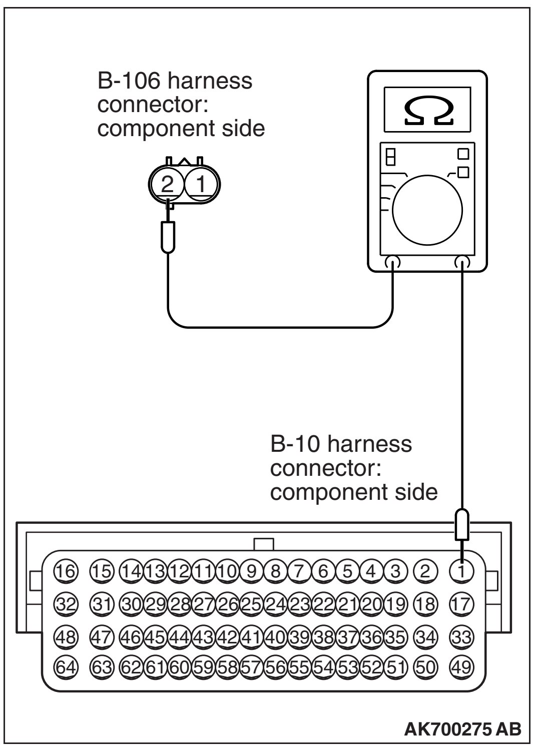
(1) Disconnect the connector B-106 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 1 and ground.
- Voltage should be battery positive voltage.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

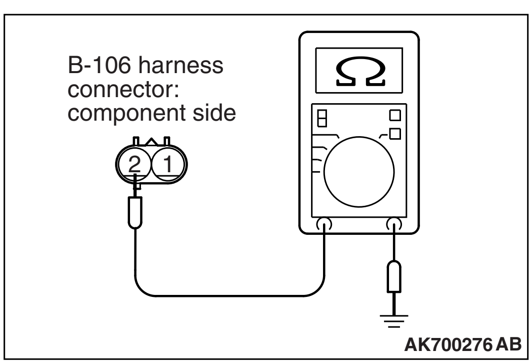
Q: Is battery positive voltage (approximately 12 volts) present?

YES : Go to Step 5.
NO : Repair it because of open circuit or harness damage between relay box (fuse No. 22) and engine oil control valve connector B-106 (terminal No. 1). Then go to Step 7.

STEP 5. Check for open circuit and short circuit to ground and harness damage between engine oil control valve connector B-106 and ECM connector B-10.



(1) Disconnect the connector B-106 and B-10 measure at the harness side.
(2) Measure the resistance between connector B-106 (terminal No. 2) and connector B-10 (terminal No. 1).
- Should be less than 2 ohms.



(3) Check for the continuity between connector B-106 (terminal No. 2) and ground.
- Not continuity.

Q: Is the harness wire in good condition?

YES : Then go to Step 6.
NO : Repair it. Then go to Step 7.

STEP 6. Test the OBD-II Drive Cycle.

(1) Carry out test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P001A set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 7.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 7. Test the OBD-II Drive Cycle.

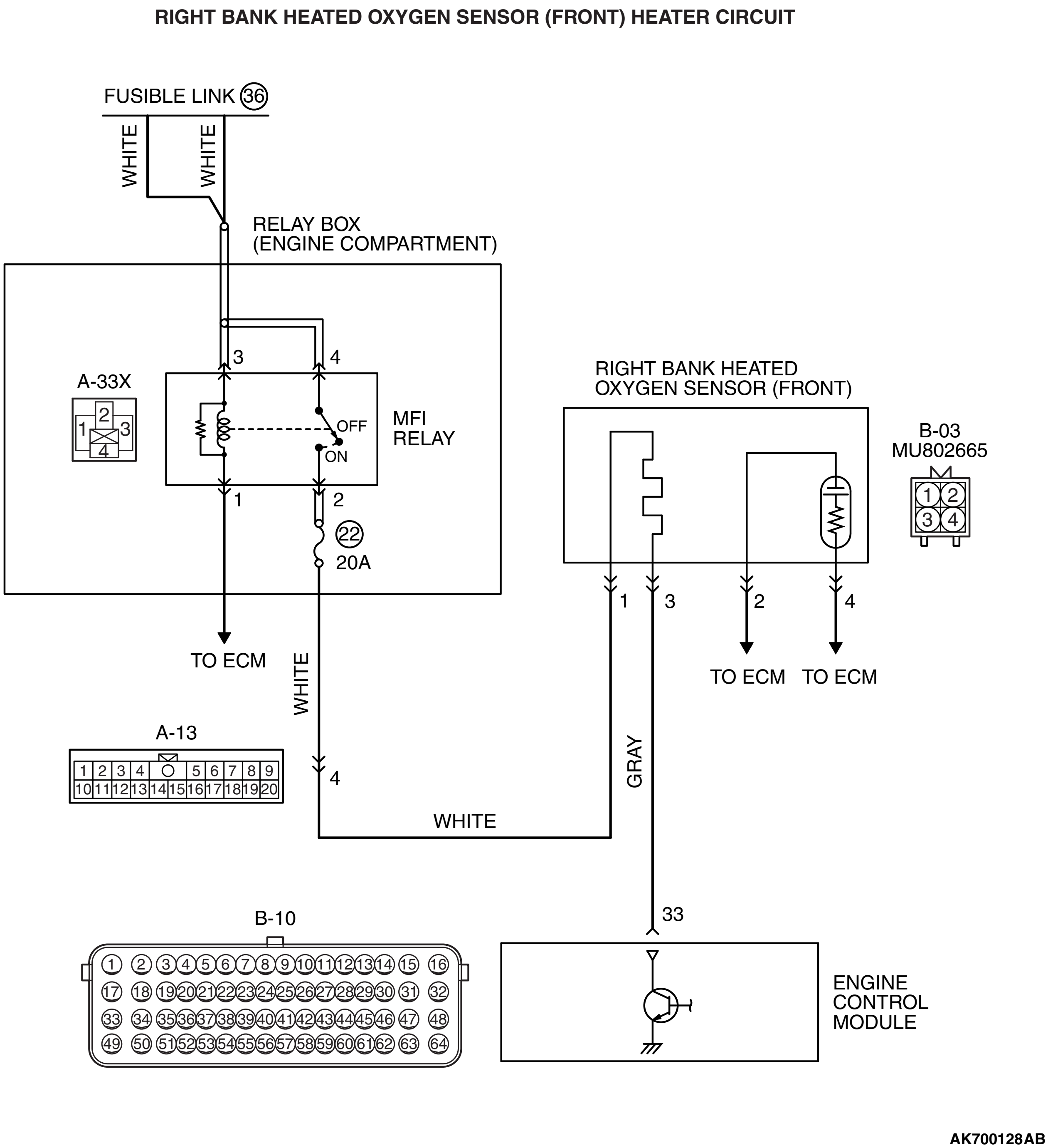
(1) Carry out test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

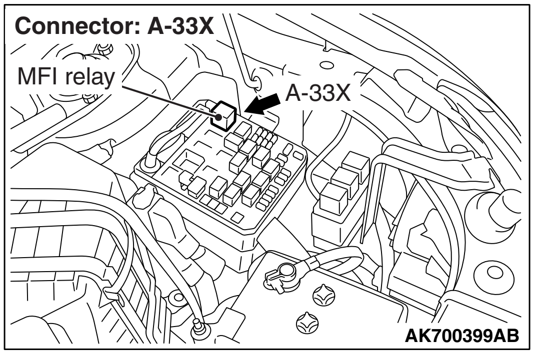
Q: Is DTC P001A set?

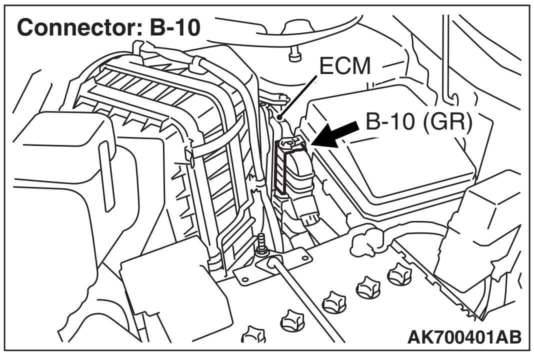
YES : Retry the troubleshooting.

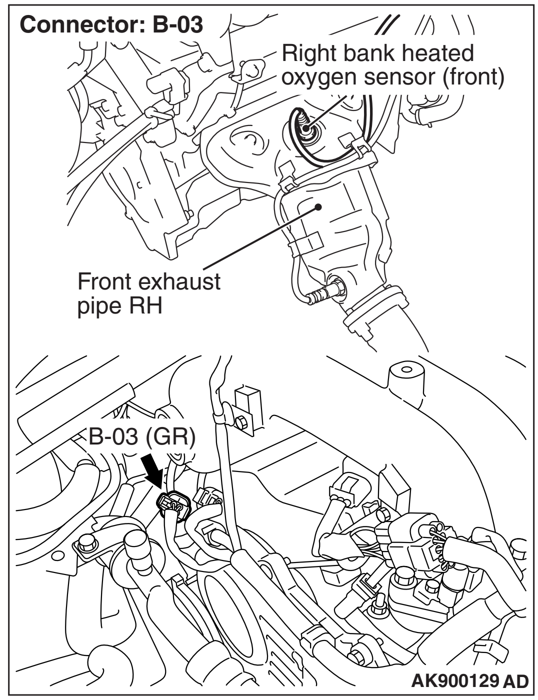
NO : The inspection is complete.

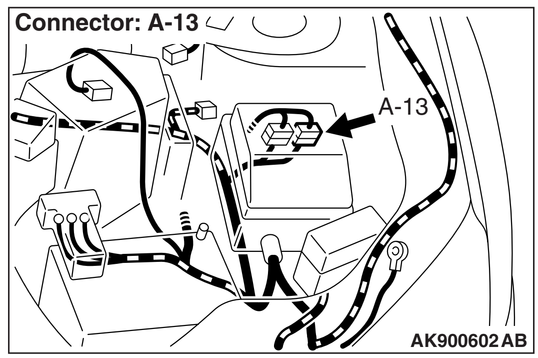
DTC P0031: Heated Oxygen Sensor Heater Circuit Low (bank 1, sensor 1)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the right bank heated oxygen sensor (front) heater.
- The ECM (terminal No. 33) controls continuity to the right bank heated oxygen sensor (front) heater by turning the power transistor in the PCM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.
- The ECM checks whether the heater voltage is within a specified range when the heater is not energized.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor heater (front) current or voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

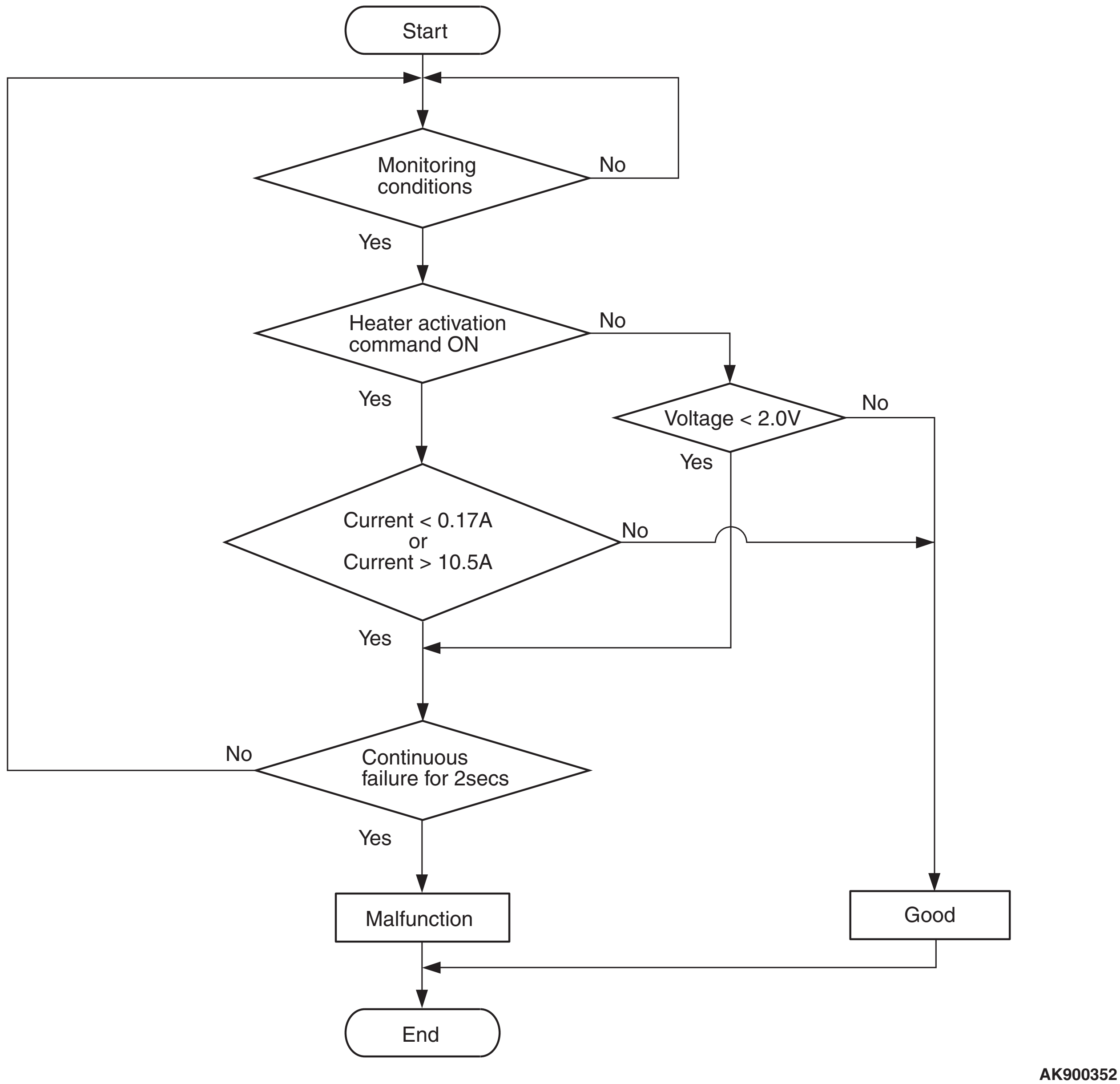
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the right bank heated oxygen sensor (front) heater is on.
- Battery positive voltage is between 11 and 16.5 volts.

Judgement Criterion

- The right bank heated oxygen sensor (front) heater current has continued to be lower than 0.17 ampere for 2 seconds.

Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the right bank heated oxygen sensor (front) heater is off.
- Battery positive voltage is between 11 and 16.5 volts.

Judgement Criterion

- The right bank heated oxygen sensor (front) heater voltage has continued to be lower than 2.0 volts for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Connector damage.
- Right bank heated oxygen sensor (front) heater.
- Harness damage
- ECM failed.

DIAGNOSIS

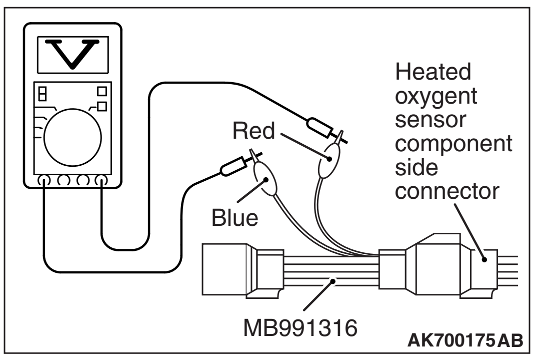
Required Special Tools:

- MB991316: Test Harness

STEP 1. Check harness connector B-03 at the right bank heated oxygen sensor (front) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.



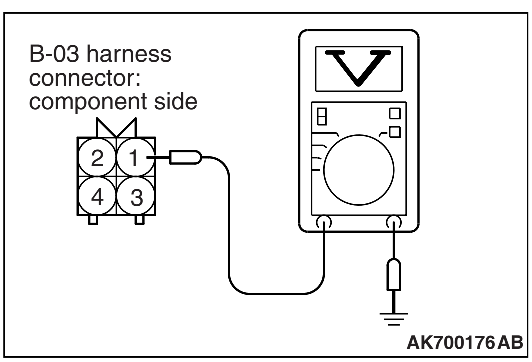
STEP 2. Check the right bank heated oxygen sensor (front).

(1) Disconnect right bank heated oxygen sensor (front) connector B-03 and connect test harness special tool, MB991316, to the connector on the right bank heated oxygen (front) sensor side.
(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 4.5 – 8.0 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 4.5 and 8.0 ohms [at 20°C (68°F)]?

YES : Go to Step 3.
NO : Replace the right bank heated oxygen sensor (front). Then go to Step 6.



STEP 3. Measure the power supply voltage at right bank heated oxygen sensor (front) and harness side connector B-03.

(1) Disconnect the connector B-03 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 1 and ground.
- Voltage should be battery positive voltage.

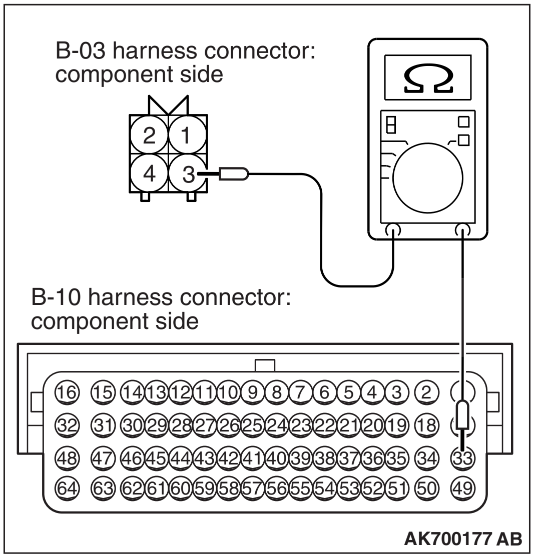
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is battery positive voltage (approximately 12 volts) present?

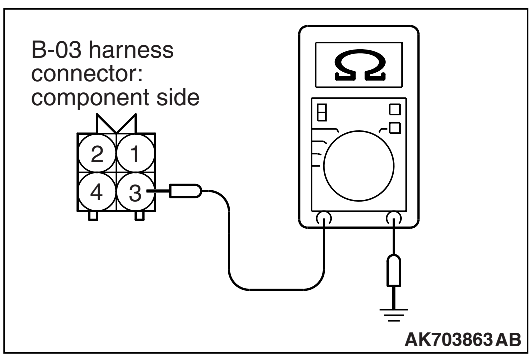
YES : Go to Step 4.
NO : Repair harness wire between the MFI relay connector A-33X (terminal No. 2) and the right bank heated oxygen sensor (front) connector B-03 (terminal No. 1) because of open circuit or harness damage. Then go to step 6.

STEP 4.Check for open circuit to ground or harness damage between right bank heated oxygen sensor (front) connector B-03 and ECM connector B-10.

(1) Disconnect the right bank heated oxygen sensor (front) connector B-03 and the ECM connector B-10.



(2) Measure the resistance between the heated oxygen sensor connector B-03 (terminal No. 3) and the ECM connector B-10 (terminal No. 33).
- Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-03 (terminal No. 3) and ground.
- Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0031 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

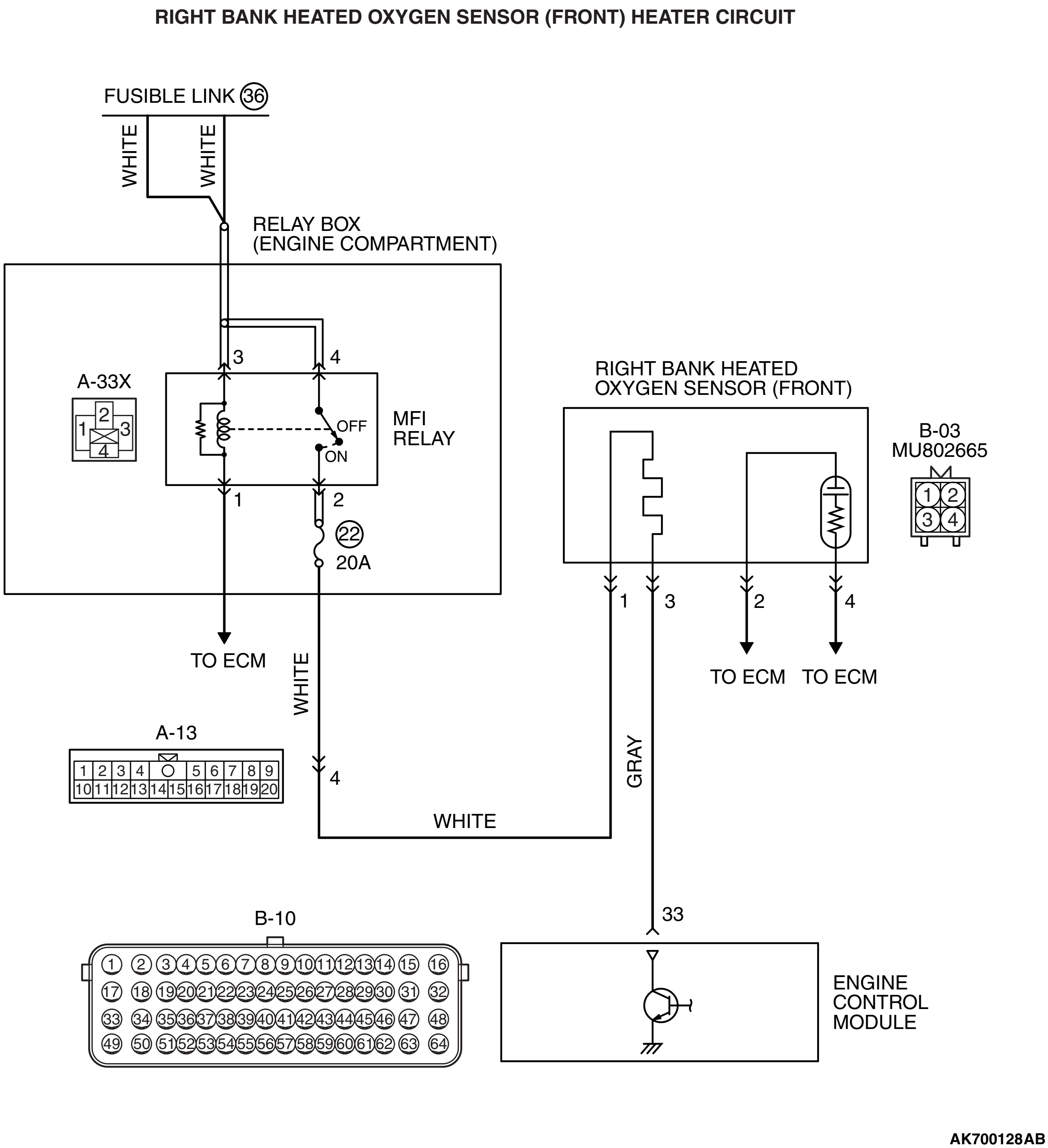
(2) Check the diagnostic trouble code (DTC).

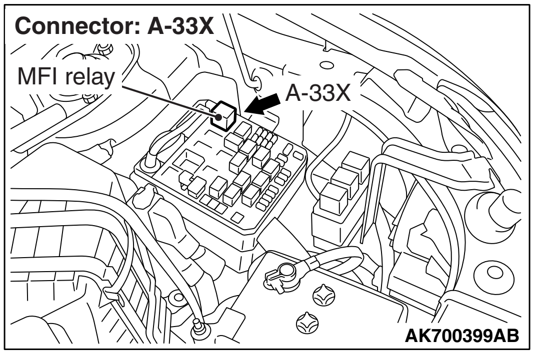
Q: Is DTC P0031 set?

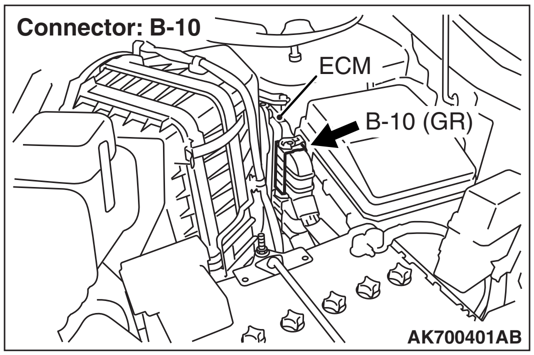
YES : Retry the troubleshooting.

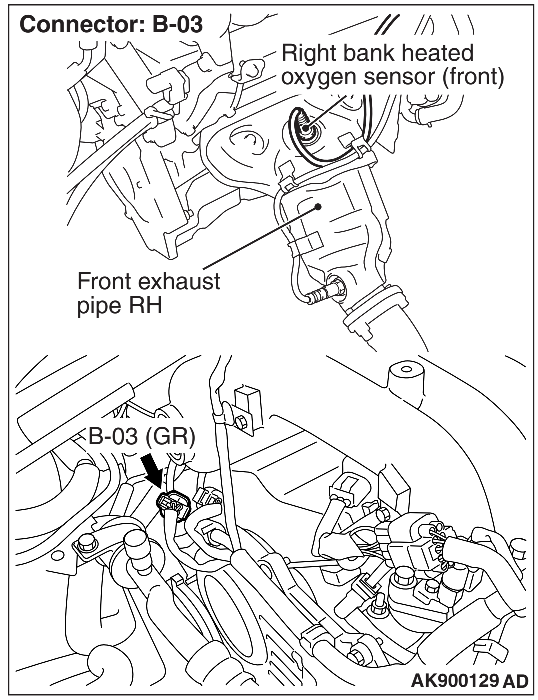
NO : The inspection is complete.

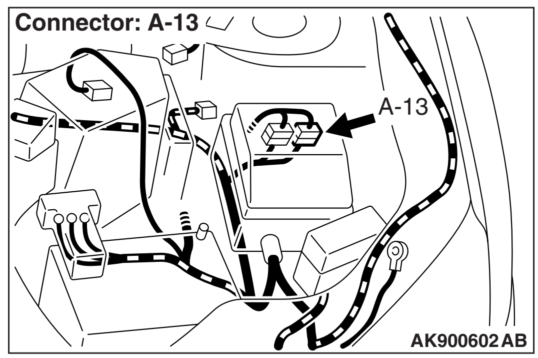
DTC P0032: Heated Oxygen Sensor Heater Circuit High (bank 1, sensor 1)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the right bank heated oxygen sensor (front) heater.
- The ECM (terminal No. 33) controls continuity to the right bank heated oxygen sensor (front) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor heater (front) current or voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

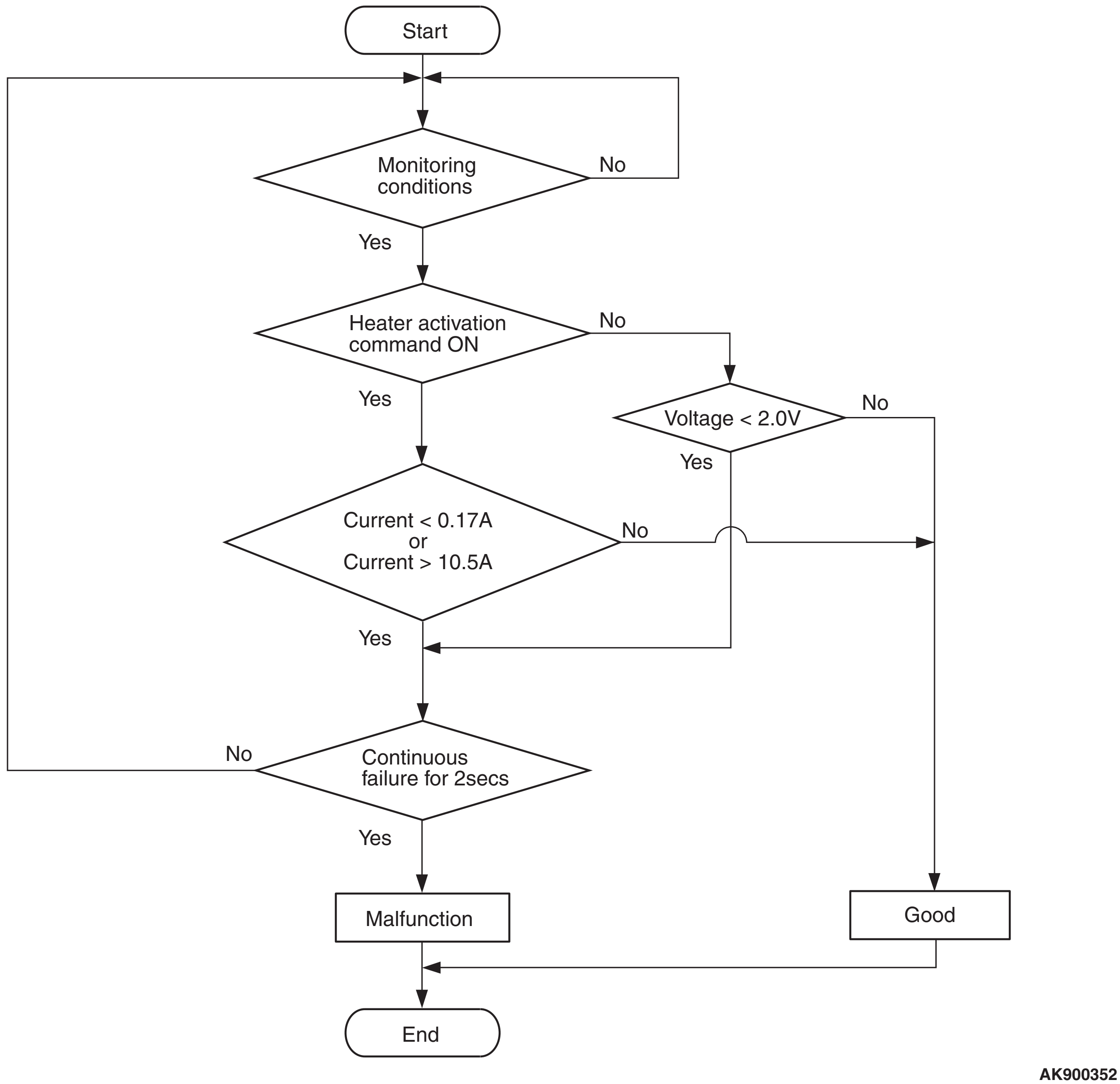
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the right bank heated oxygen sensor (front) heater is on.
- Battery positive voltage is between 11 and 16.5 volts.

Judgement Criterion

- The right bank heated oxygen sensor (front) heater current has continued to be higher than 10.5 ampere for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

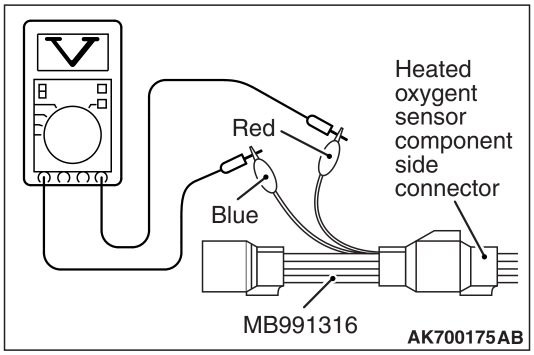
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (front) heater.
- ECM failed.

DIAGNOSIS

Required Special Tool:

- MB991316: Test Harness



STEP 1. Check the right bank heated oxygen sensor (front).

(1) Disconnect right bank heated oxygen sensor (front) connector B-03 and connect test harness special tool, MB991316, to the connector on the right bank heated oxygen (front) sensor side.

(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 4.5 – 8.0 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 4.5 and 8.0 ohms [at 20°C (68°F)]?

YES : Go to Step 2.

NO : Replace the right bank heated oxygen sensor (front). Then go to Step 3.

STEP 2. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0032 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 3.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 3. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

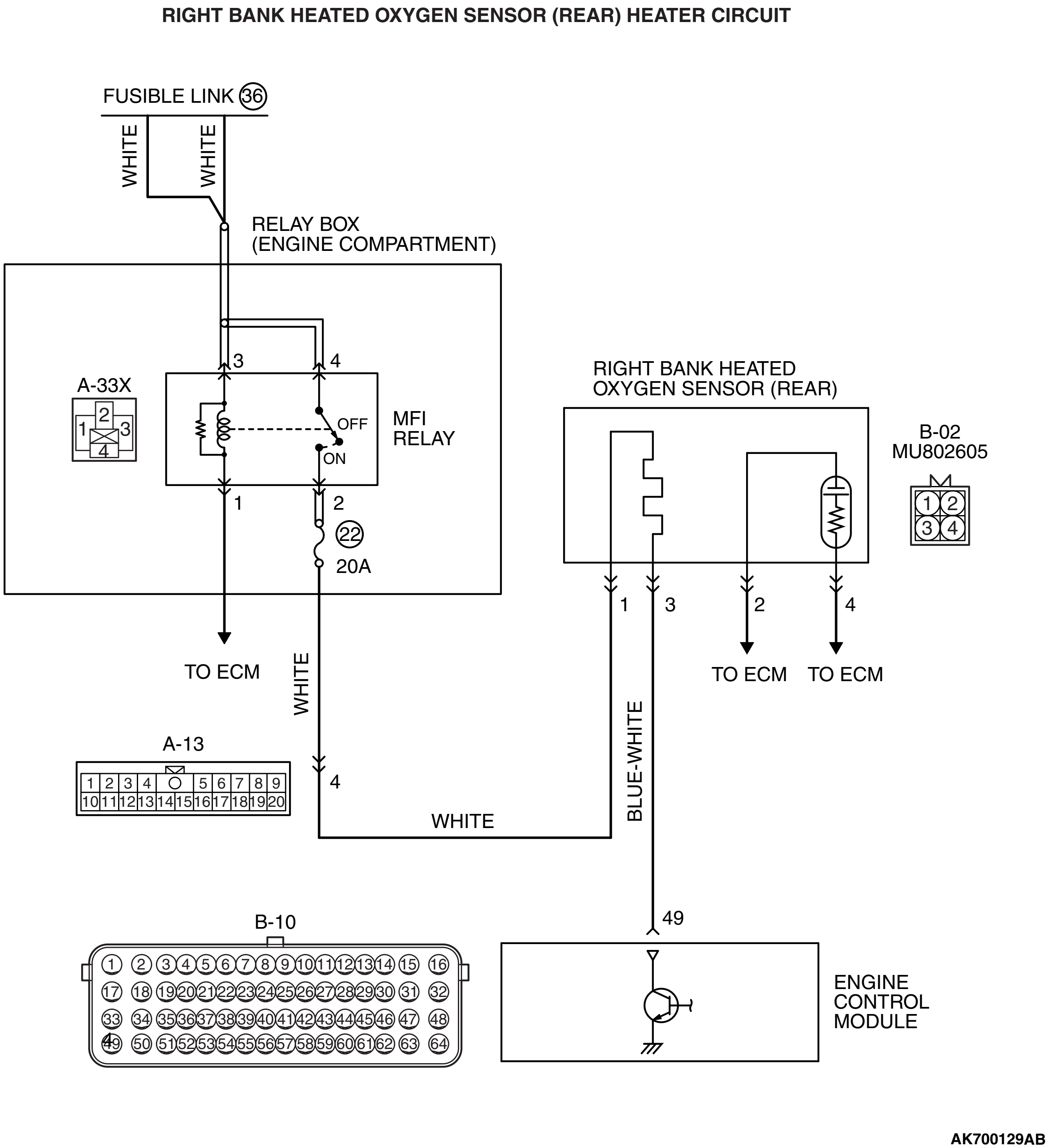
(2) Check the diagnostic trouble code (DTC).

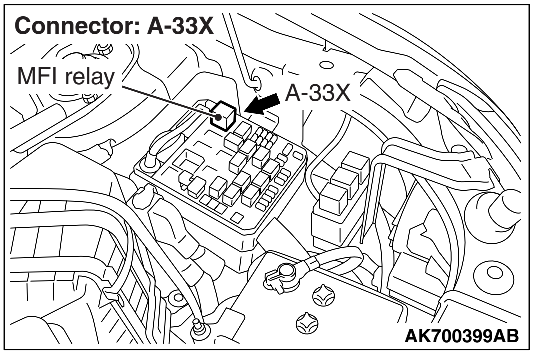
Q: Is DTC P0032 set?

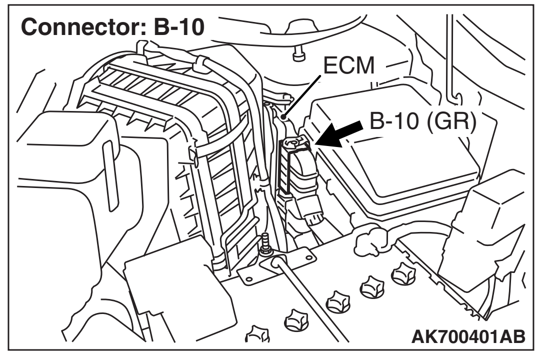
YES : Retry the troubleshooting.

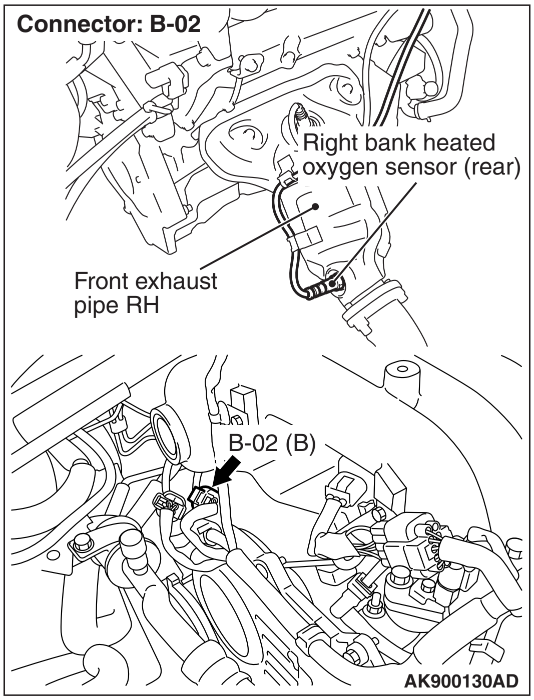
NO : The inspection is complete.

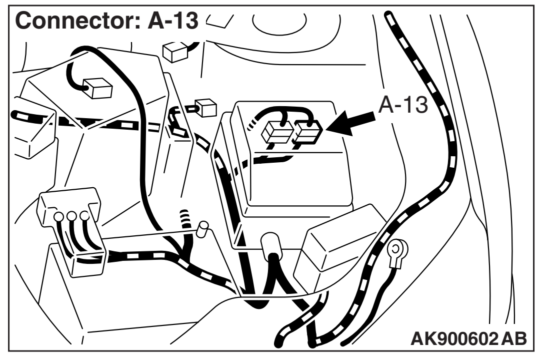
DTC P0037: Heated Oxygen Sensor Heater Circuit Low (bank 1, sensor 2)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the right bank heated oxygen sensor (rear) heater.
- The ECM (terminal No. 49) controls continuity to the right bank heated oxygen sensor (rear) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.
- The ECM checks whether the heater voltage is within a specified range when the heater is not energized.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor heater (rear) current or voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

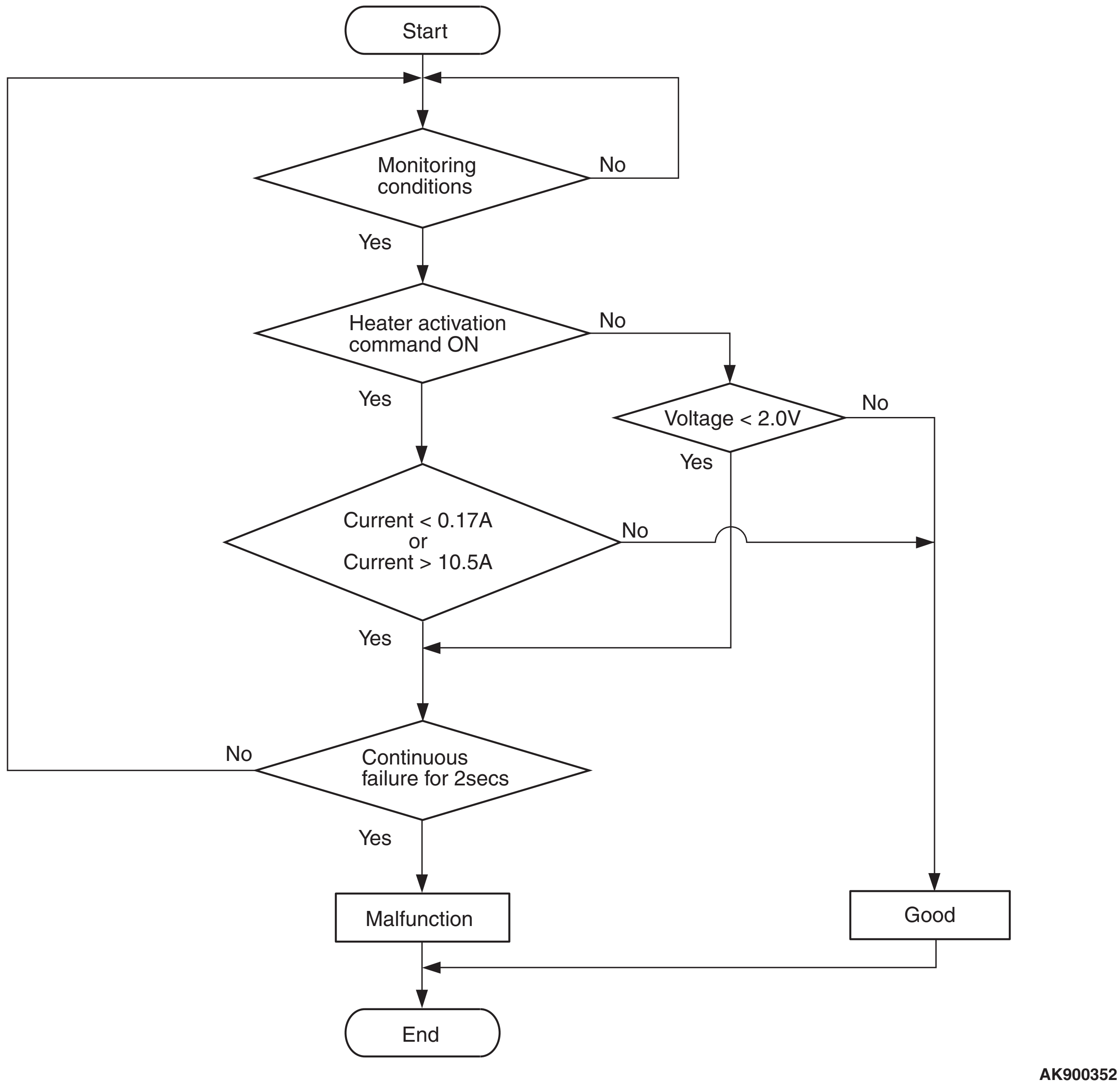
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the right bank heated oxygen sensor (rear) heater is on.
- Battery positive voltage is at between 11 and 16.5 volts.

Judgement Criterion

- The right bank heated oxygen sensor (rear) heater current has continued to be lower than 0.17 ampere for 2 seconds.

Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the right bank heated oxygen sensor (rear) heater is off.
- Battery positive voltage is at between 11 and 16.5 volts.

Judgement Criterion

- The right bank heated oxygen sensor (rear) heater voltage has continued to be lower than 2.0 volts for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (rear) heater failed.
- Connector damage.
- Harness damage
- ECM failed.

DIAGNOSIS

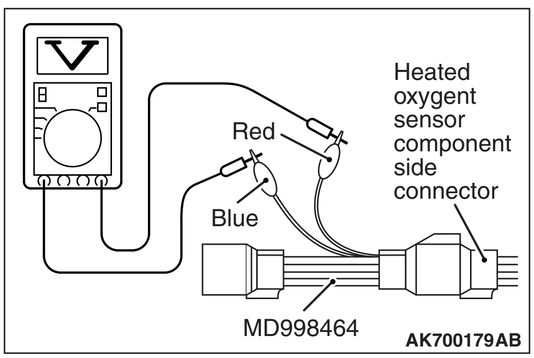
Required Special Tools:

- MB998464: Test Harness

STEP 1. Check harness connector B-02 at the right bank heated oxygen sensor (rear) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.



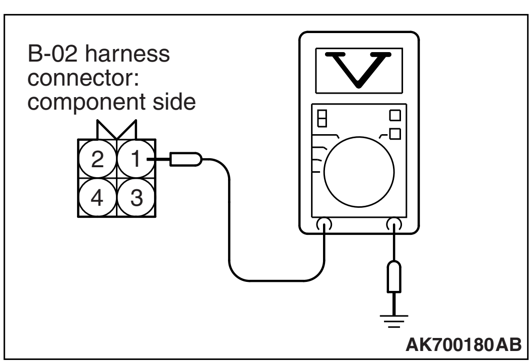
STEP 2. Check the right bank heated oxygen sensor (rear).

(1) Disconnect the right bank heated oxygen sensor (rear) connector B-02 and connect test harness special tool, MD998464, to the connector on the right bank heated oxygen (rear) sensor side.
(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 11 – 18 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 11 and 18 ohms [at 20°C (68°F)]?

YES : Go to Step 3.
NO : Replace the right bank heated oxygen sensor (rear). Then go to Step 6.



STEP 3. Measure the power supply voltage at right bank heated oxygen sensor (rear) and harness side connector B-02.

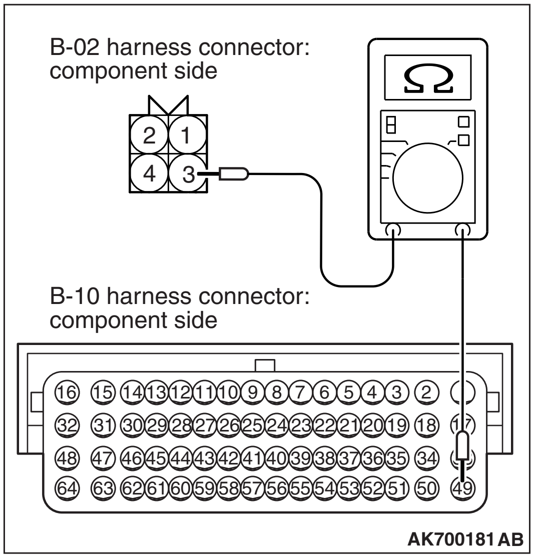
(1) Disconnect the connector B-02 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 1 and ground.
- Voltage should be battery positive voltage.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

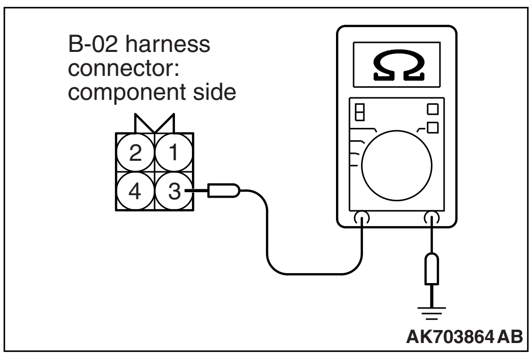
Q: Is battery positive voltage (approximately 12 volts) present?

YES : Go to Step 4.
NO : Repair harness wire between the MFI relay connector A-33X (terminal No. 2) and the right bank heated oxygen sensor (rear) connector B-02 (terminal No. 1) because of open circuit or harness damage. Then go to step 6.

STEP 4.Check for open circuit to ground or harness damage between right bank heated oxygen sensor (rear) connector B-02 and ECM connector B-10.



(1) Disconnect the right bank heated oxygen sensor (rear) connector B-02 and the ECM connector B-10.
(2) Measure the resistance between the heated oxygen sensor connector B-02 (terminal No. 3) and ECM connector B-10 (terminal No. 49).
- Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-02 (terminal No. 3) and ground.
- Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0037 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

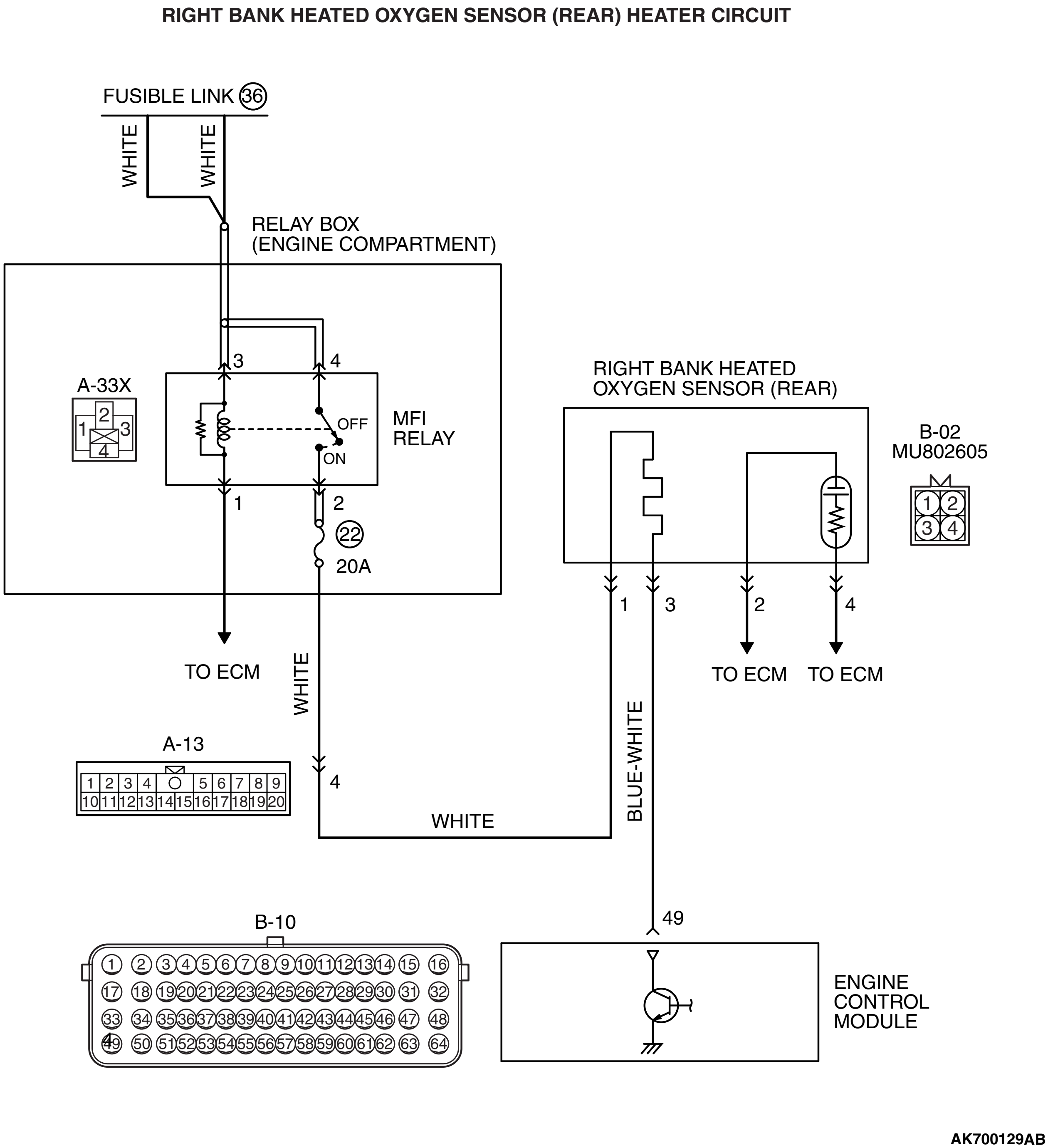
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

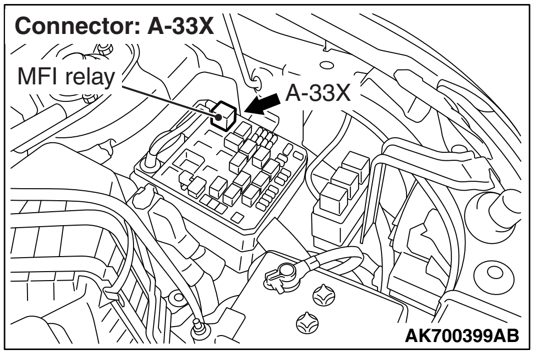
(2) Check the diagnostic trouble code (DTC).

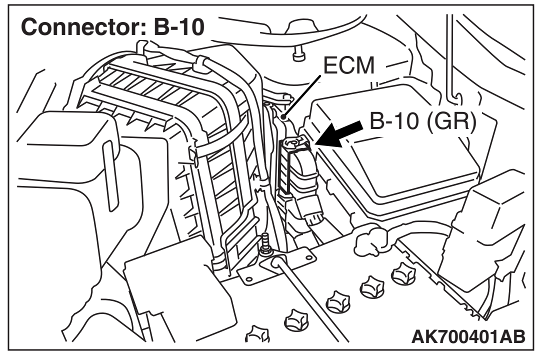
Q: Is DTC P0037 set?

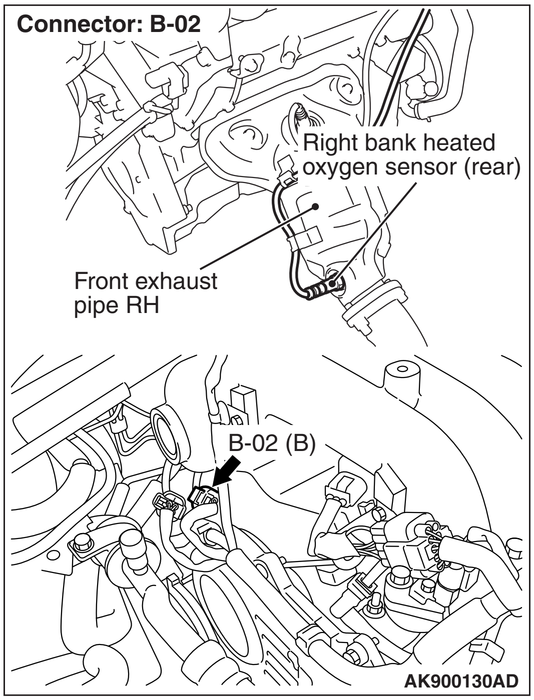
YES : Retry the troubleshooting.
NO : The inspection is complete.

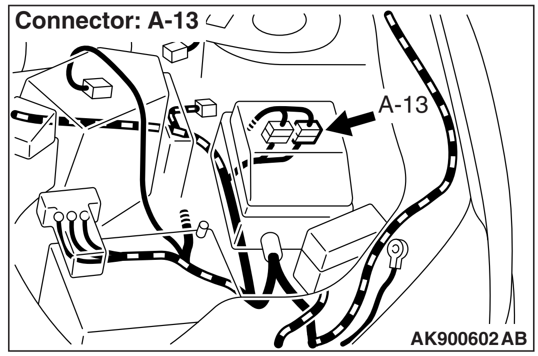
DTC P0038: Heated Oxygen Sensor Heater Circuit High (bank 1, sensor 2)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the right bank heated oxygen sensor (rear) heater.
- The ECM (terminal No. 49) controls continuity to the right bank heated oxygen sensor (rear) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor heater (rear) current is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

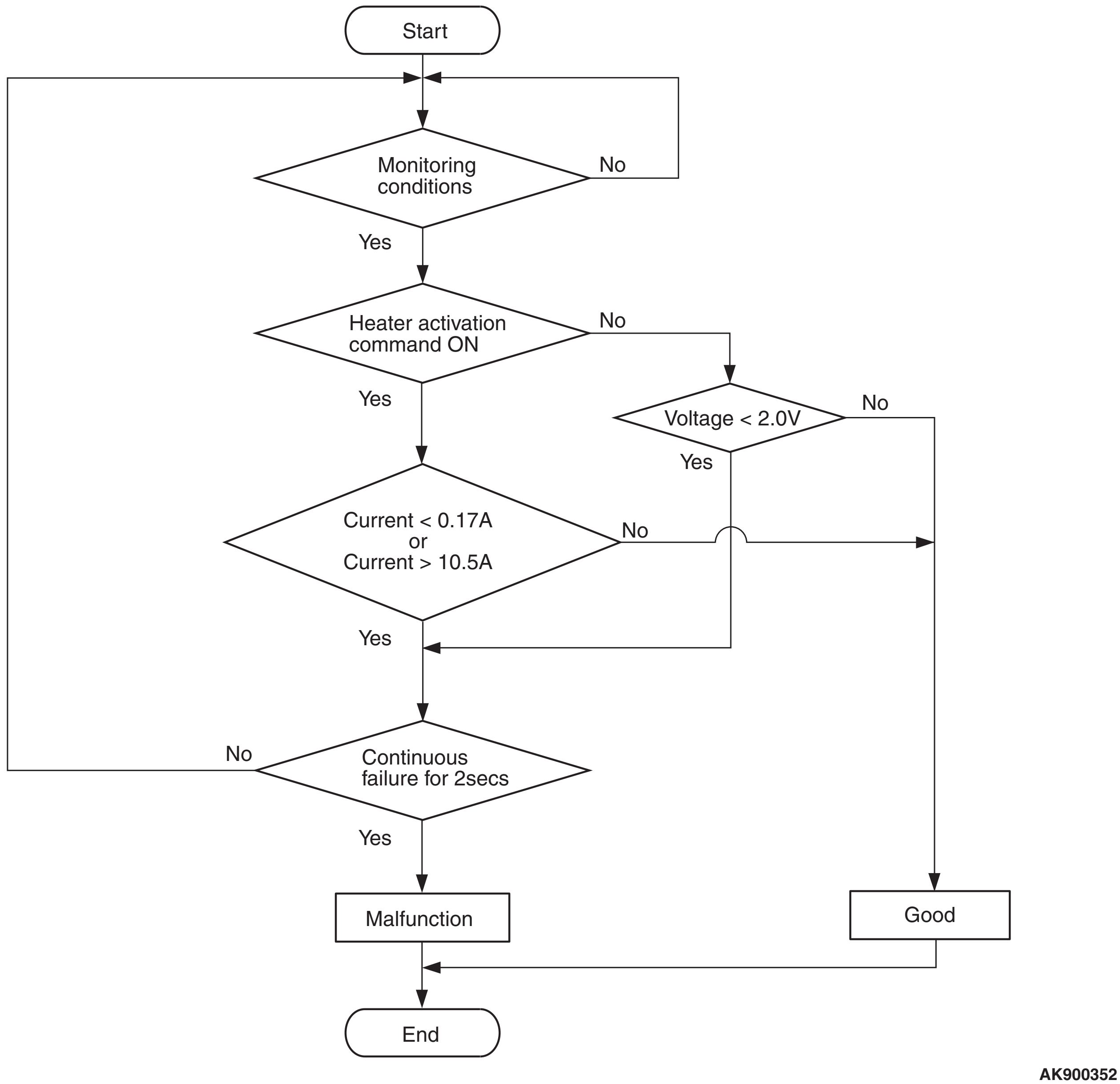
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the right bank heated oxygen sensor (rear) heater is on.
- Battery positive voltage is at between 11 and 16.5 volts.

Judgement Criterion

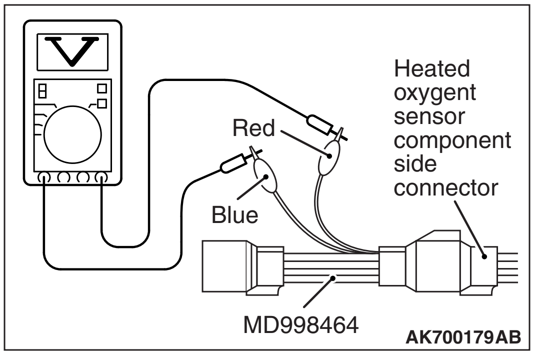
- The right bank heated oxygen sensor (rear) heater current has continued to be higher than 10.5 ampere for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (rear) failed.
- ECM failed.



DIAGNOSIS

Required Special Tool:

- MB991316: Test Harness

STEP 1. Check the right bank heated oxygen sensor (rear).

(1) Disconnect right bank heated oxygen sensor (rear) connector B-02 and connect test harness special tool, MD998464, to the connector on the right bank heated oxygen (rear) sensor side.

(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 11 – 18 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 11 and 18 ohms [at 20°C (68°F)]?

YES : Go to Step 2.

NO : Replace the right bank heated oxygen sensor (rear). Then go to Step 3.

STEP 2. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0038 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 3.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 3. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

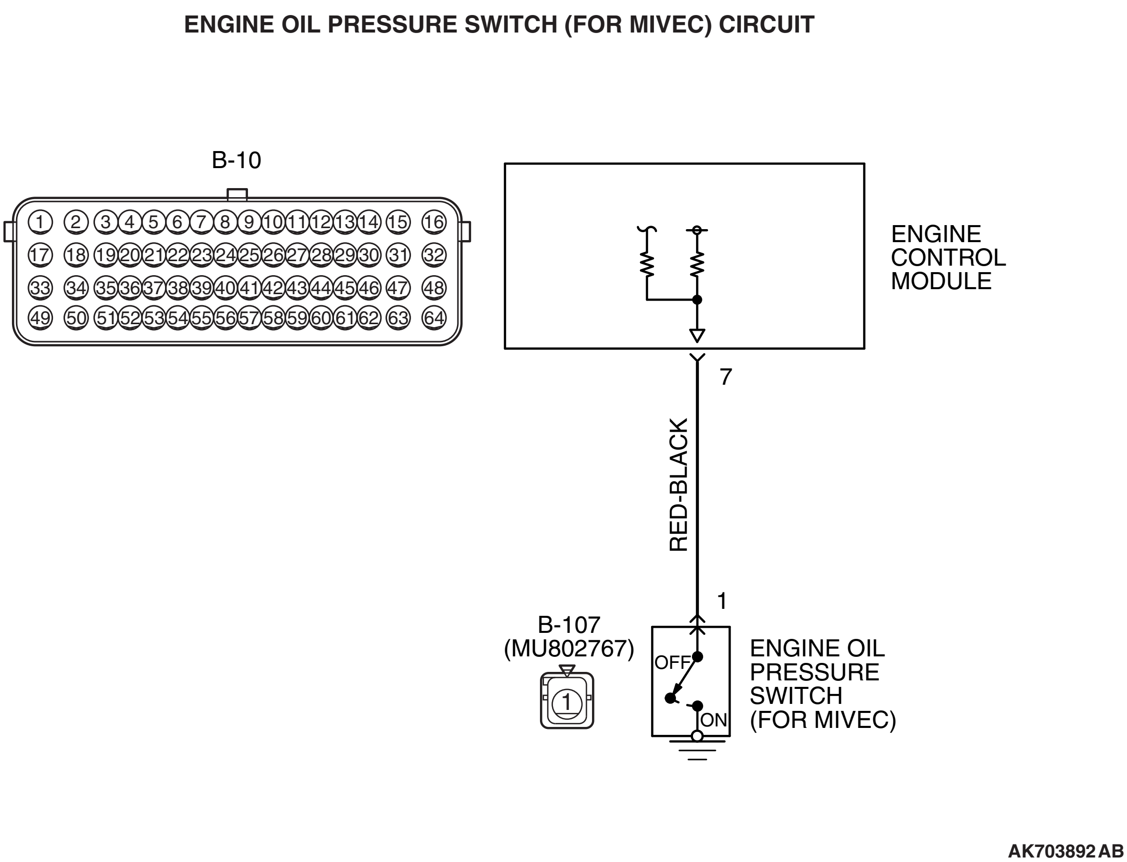
(2) Check the diagnostic trouble code (DTC).

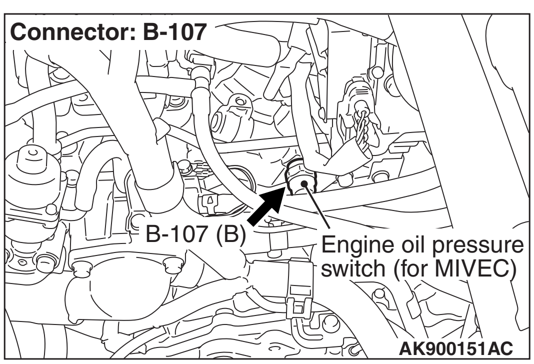
Q: Is DTC P0038 set?

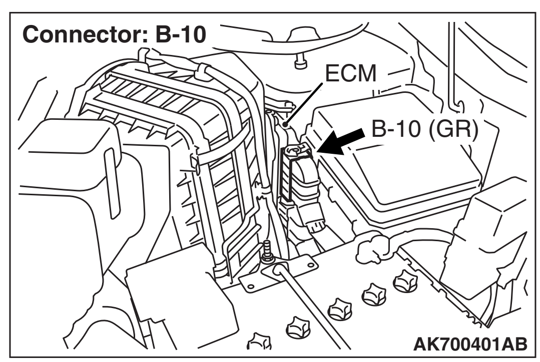
YES : Retry the troubleshooting.

NO : The inspection is complete.

DTC P003C: Mitsubishi Innovative Valve Timing Electronic Control System (MIVEC) Performance Problem







CIRCUIT OPERATION

- A battery positive voltage is applied to the engine oil pressure switch output terminal (terminal No. 1) from the ECM (terminal No. 7) via the resistor in the ECM.

TECHNICAL DESCRIPTION

- The engine oil pressure switch converts the existence of a engine oil pressure into a high/low voltage, and inputs it into the ECM.
- When the engine oil control valve operates, the engine oil pressure in the MIVEC system rises. The engine oil pressure switch opens, thus interrupting the application of the battery positive voltage. As a result, the output voltage of the engine oil pressure switch will fluctuate between 0 and 12 volts.
- The ECM checks whether the engine oil pressure switch "OFF" or "ON" during driving.

DESCRIPTIONS OF MONITOR METHODS

Compare engine oil pressure switch status with engine operating condition.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

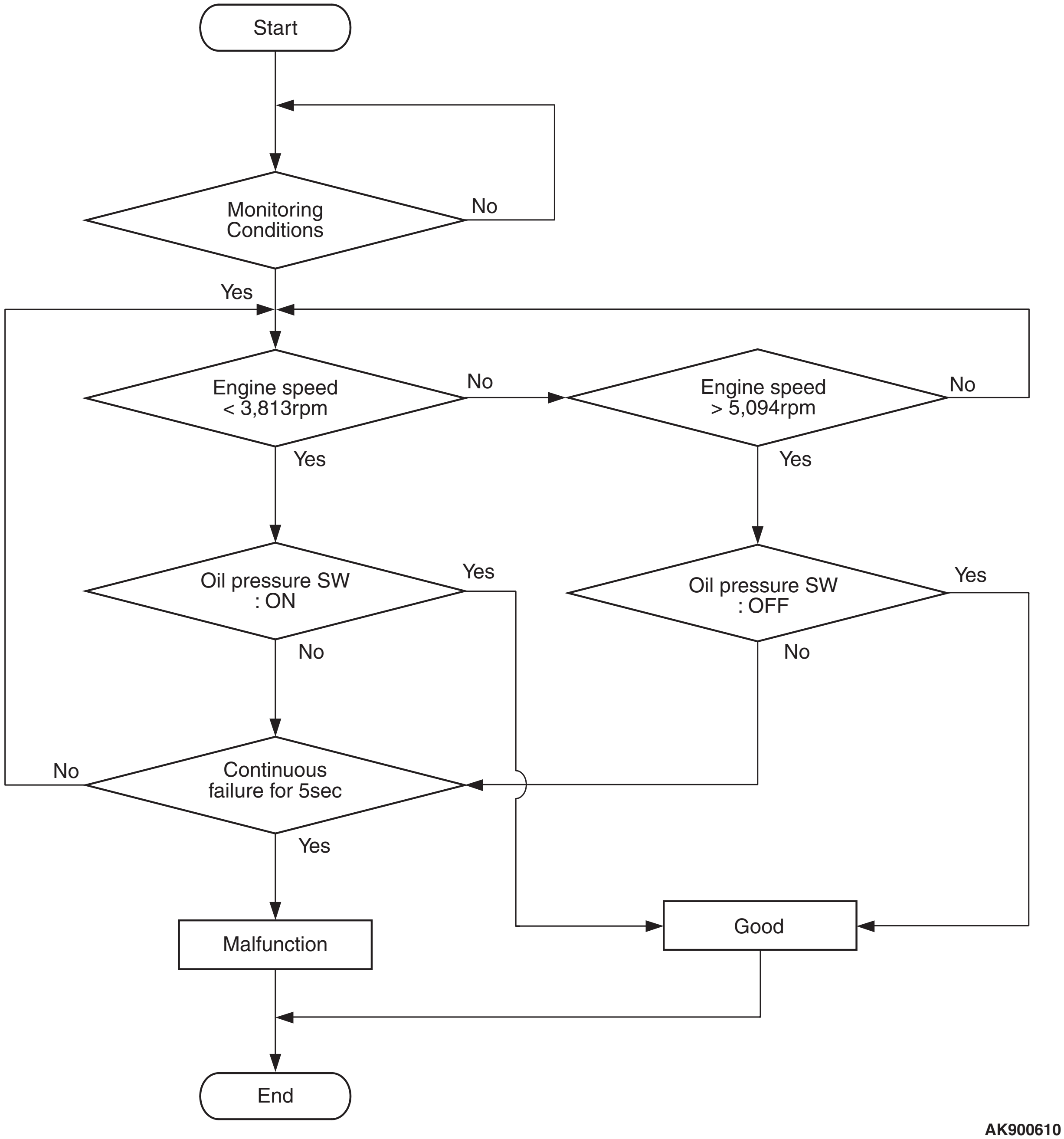
- Not applicable

Sensor (The sensor below is determined to be normal)

- Camshaft position sensor
- Mass airflow sensor
- Engine coolant temperature sensor
- Throttle position sensor
- Injection valve

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- Engine speed is less than 3,813 r/min.
- Engine coolant temperature is 77°C (171 °F) or more.
- Battery positive voltage is between 10 and 16.5 volts.
- 30 seconds or more have passed since the engine starting sequence was completed.

- 30 seconds or more have passed since the

Judgment Criterion

- Engine oil pressure switch (for MIVEC) has been OFF for 5 seconds.

Check Conditions

- Engine speed is more than 5,094 r/min.
- Engine coolant temperature is 77°C (171 °F) or more.
- Battery positive voltage is between 10 and 16.5 volts.

  engine starting sequence was completed.

Judgment Criterion

- Engine oil pressure switch (for MIVEC) has been ON for 5 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 19 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Connector damage.
- Harness damage.
- Engine oil pressure switch failed.
- Engine oil control valve failed.
- ECM failed.

DIAGNOSIS

Required Special Tools:

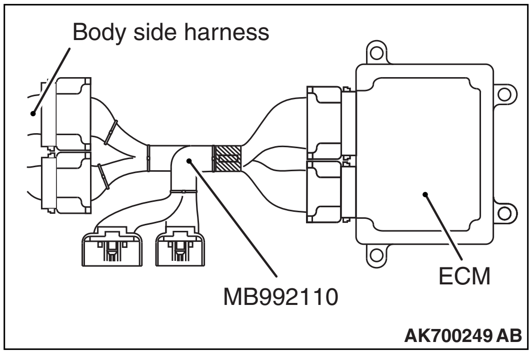
- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
    - MB991824: V.C.I.
    - MB991827: USB Cable
    - MB991910: Main Harness A
- MB992110: Power Plant ECU Check Harness

STEP 1. Check harness connector B-107 at engine oil pressure switch and harness connector B-10 at ECM for damage.

Q: Is the harness connector in good condition?

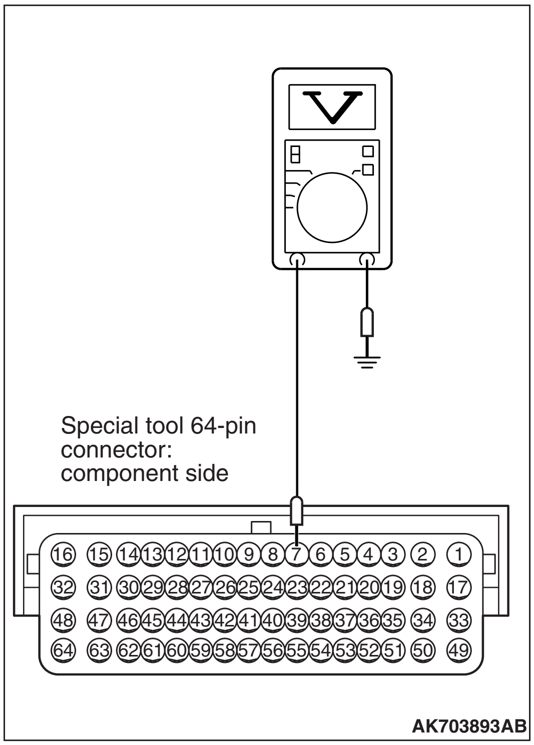
YES : Go to Step 2.

NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 8.



STEP 2. Measure the power supply voltage at ECM connector B-10 by using power plant ECU check harness special tool MB992110.

(1) Disconnect all ECM connectors. Connect the power plant ECU check harness special tool MB992110 between the separated connectors.
(2) Start the engine and run at idle.



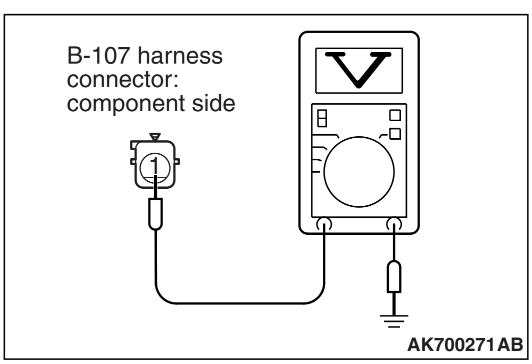
(3) Measure the voltage between terminal No. 7 and ground.
- Voltage should be 1 volt or less when engine is idling.
- Voltage should be battery positive voltage when engine speed is higher than 5,200 r/min.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the measured voltage normal?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Go to Step 3.



STEP 3. Measure the power supply voltage at engine oil pressure switch connector B-107.

(1) Disconnect the connector B-107 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 1 and ground.
- Voltage should be battery positive voltage.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is battery positive voltage (approximately 12 volts) present?

YES : Go to Step 5.

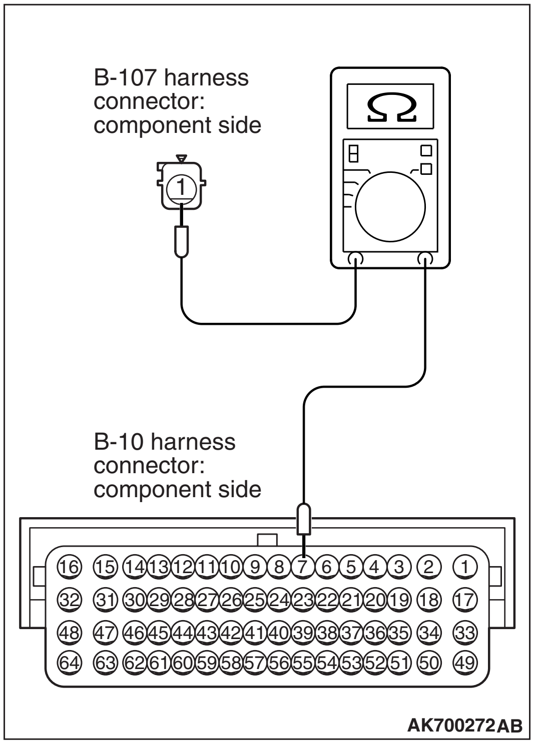
NO : Go to Step 4.

STEP 4. Check for open circuit and short circuit to ground between engine oil pressure switch connector B-107 and ECM connector B-10.

(1) Disconnect the connector B-107 and B-10 measure at the harness side.

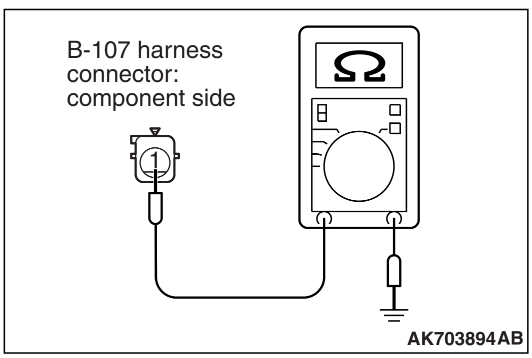
(2) Measure the resistance between connector B-107 (terminal No. 1) and connector B-10 (terminal No. 7).

- Should be less than 2 ohms.



(3) Check for the continuity between connector B-107 (terminal No. 1) and ground.

- Not continuity.

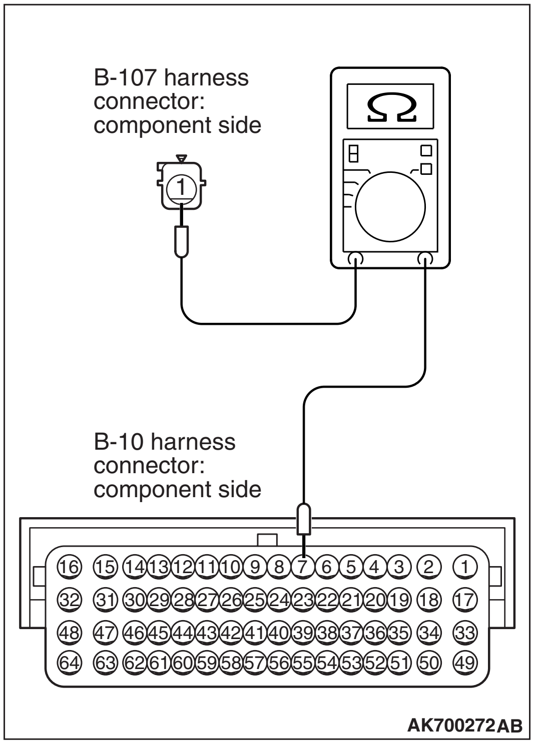


Q: Is the harness wire in good condition?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 7.

NO : Repair it. Then go to Step 8.

STEP 5. Check for harness damage between engine oil pressure switch connector B-107 and ECM connector B-10.

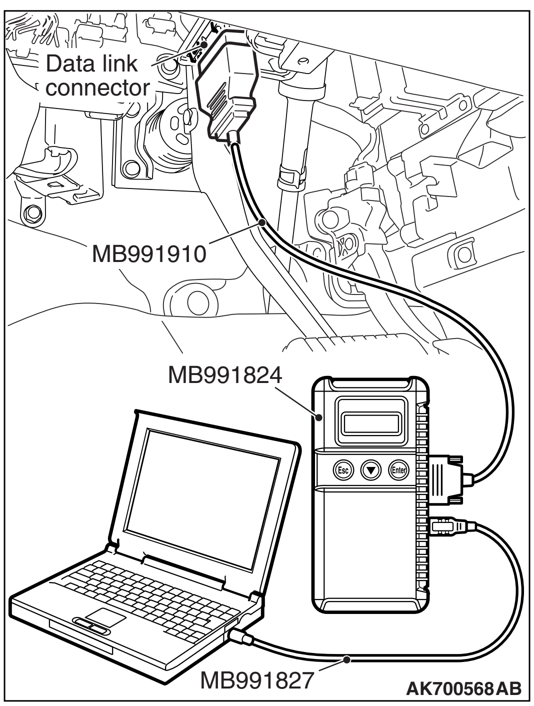


(1) Disconnect the connector B-107 and B-10 measure at the harness side.
(2) Measure the resistance between B-107 connector (terminal No. 1) and B-10 (terminal No. 7) connector.
- Should be less than 2 ohms.

Q: Is the measured resistance less than 2 ohms?

YES : Then go to Step 6.
NO : Repair it. Then go to Step 8.

STEP 6. Using scan tool MB991958, check data item 98: Oil control valve.



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 98, Oil control valve.
- An operation sound should be heard and vibration should be felt when the engine oil control valve is operated.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the right bank engine oil control valve operating properly?

YES : Then go to Step 7.
NO : Replace the engine oil control valve. Then go to Step 8.

STEP 7. Replace the engine oil pressure switch

(1) Carry out test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 19 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P003C set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 8.

NO : The Inspection is complete.

STEP 8. Test the OBD-II Drive Cycle.

(1) Carry out test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 19 P.13B-11.

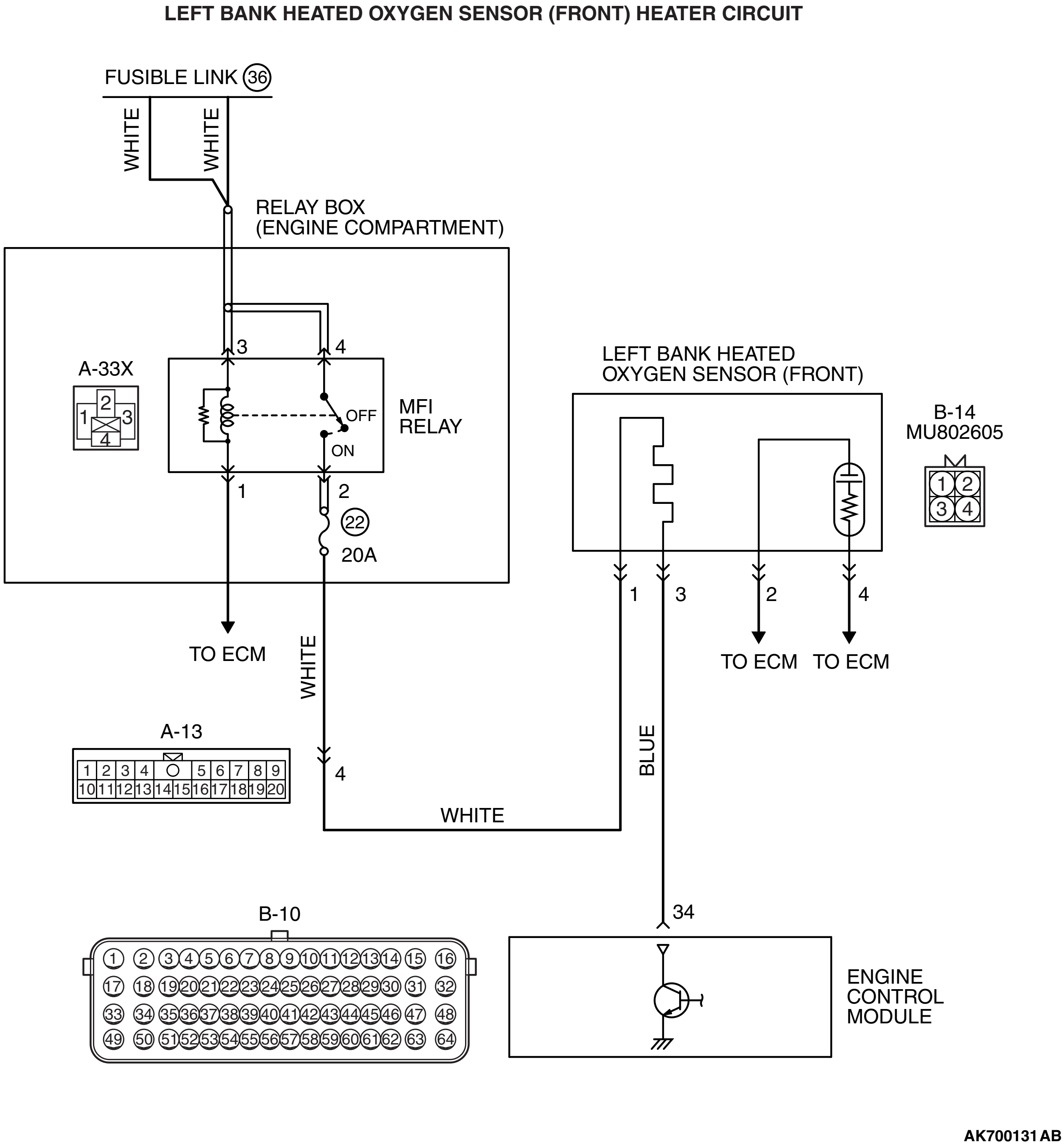
(2) Check the diagnostic trouble code (DTC).

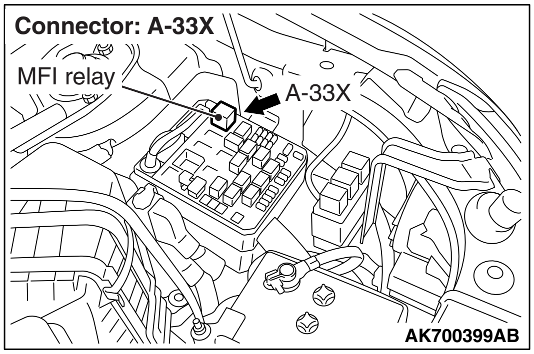
Q: Is DTC P003C set?

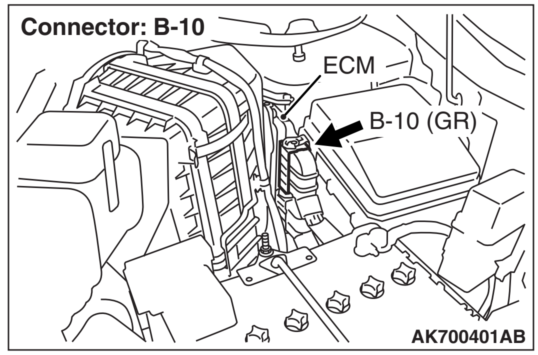
YES : Retry the trouble shooting.

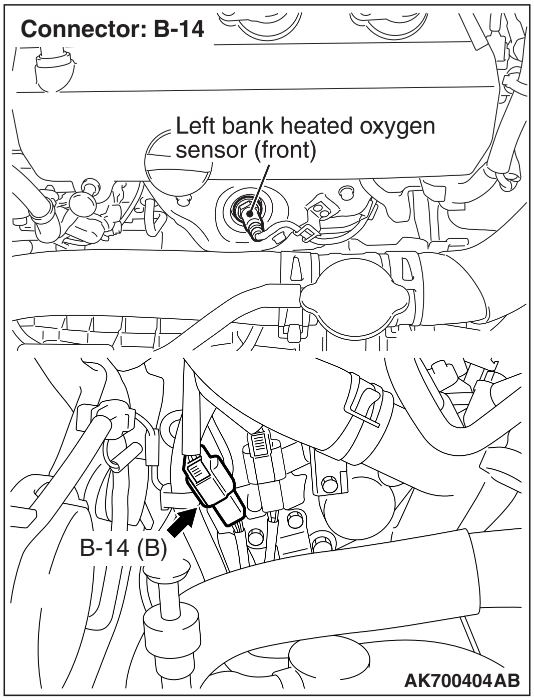
NO : The Inspection is complete.

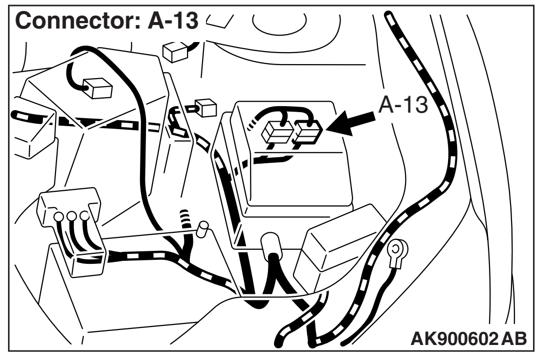
DTC P0051: Heated Oxygen Sensor Heater Circuit Low (bank 2, sensor 1)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the left bank heated oxygen sensor (front) heater.
- The ECM (terminal No. 34) controls continuity to the left bank heated oxygen sensor (front) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.
- The ECM checks whether the heater voltage is within a specified range when the heater is not energized.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor heater (front) current or voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

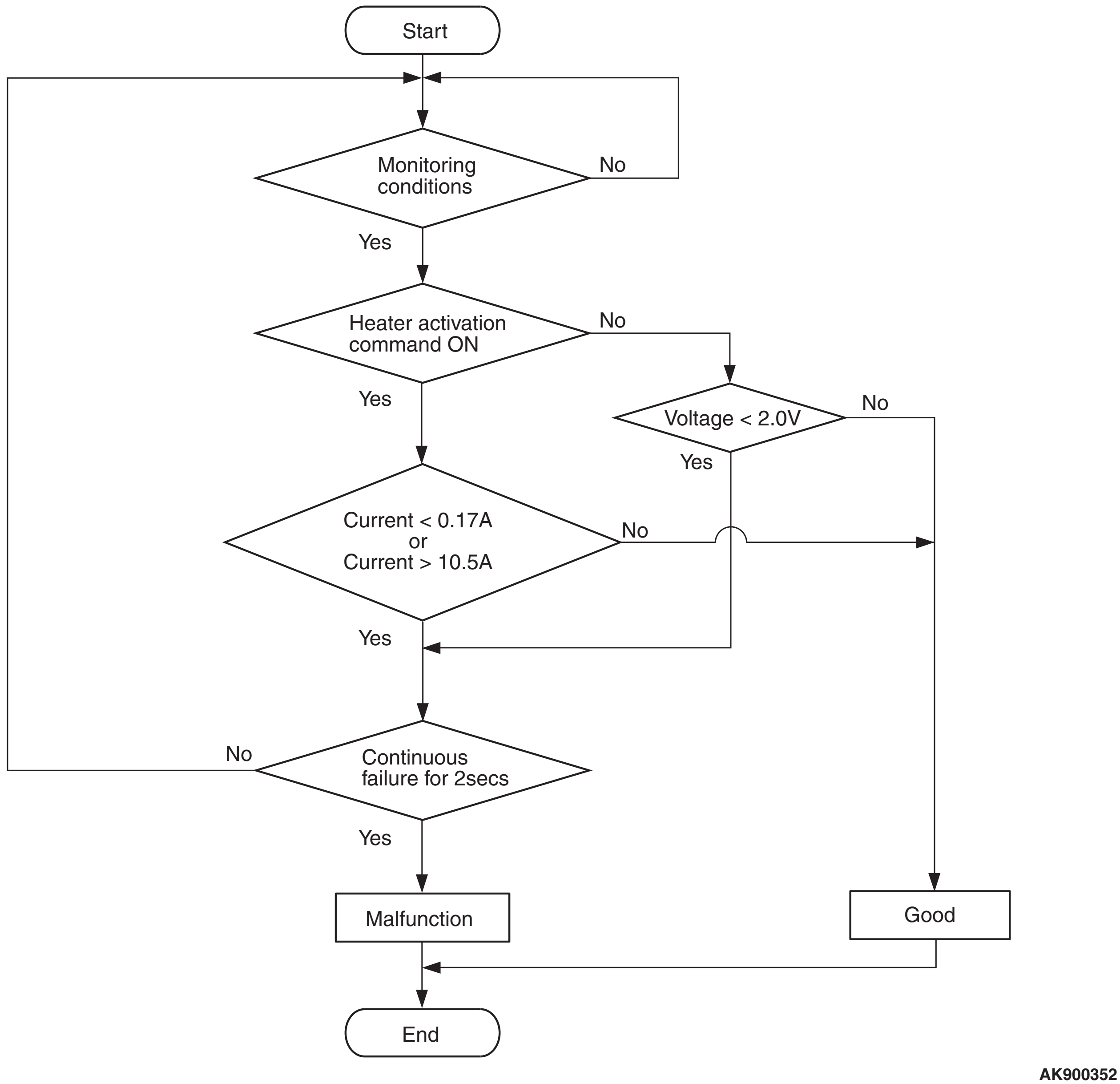
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions
- More than 2 seconds have passed since the engine starting sequence was completed.
- While the left bank heated oxygen sensor (front) heater is on.
- Battery positive voltage is at between 11 and 16.5 volts.

Judgement Criterion
- The left bank heated oxygen sensor (front) heater current has continued to be lower than 0.17 ampere for 2 seconds.

Check Conditions
- More than 2 seconds have passed since the engine starting sequence was completed.
- While the left bank heated oxygen sensor (front) heater is off.
- Battery positive voltage is at between 11 and 16.5 volts.

Judgement Criterion
- The left bank heated oxygen sensor (front) heater voltage has continued to be lower than 2.0 volts for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (front) heater.
- Connector damage.
- Harness damage
- ECM failed.

DIAGNOSIS

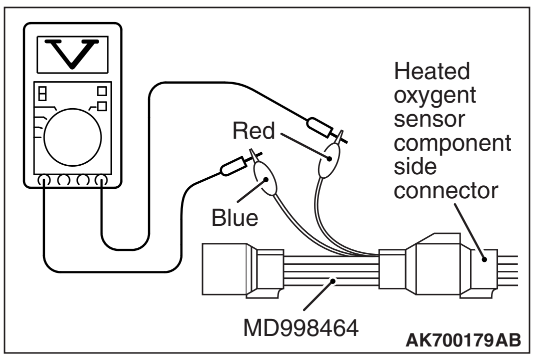
Required Special Tools:

- MD998464: Test Harness

STEP 1. Check harness connector B-14 at the left bank heated oxygen sensor (front) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.



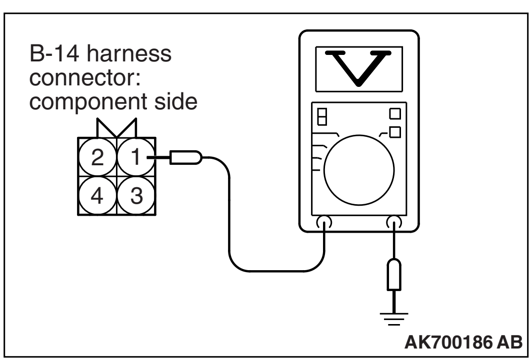
STEP 2. Check the left bank heated oxygen sensor (front).

(1) Disconnect left bank heated oxygen sensor (front) connector B-14 and connect test harness special tool, MD998464, to the connector on the left bank heated oxygen (front) sensor side.
(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 4.5 – 8.0 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 4.5 and 8.0 ohms [at 20°C (68°F)]?

YES : Go to Step 3.
NO : Replace the left bank heated oxygen sensor (front). Then go to Step 6.



STEP 3. Measure the power supply voltage at left bank heated oxygen sensor (front) harness side connector B-14.

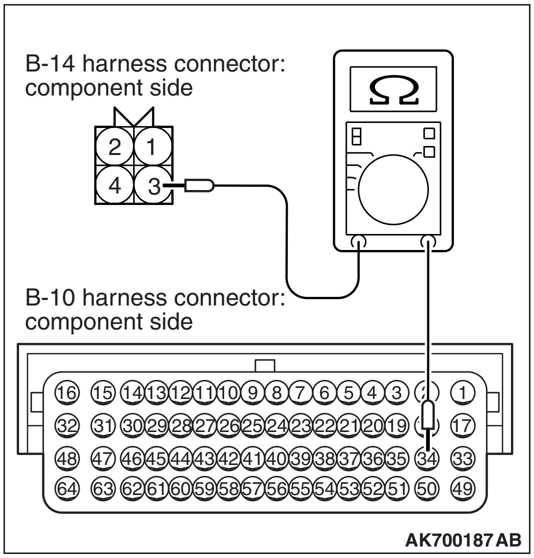
(1) Disconnect the connector B-14 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 1 and ground.
  - Voltage should be battery positive voltage.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is battery positive voltage (approximately 12 volts) present?

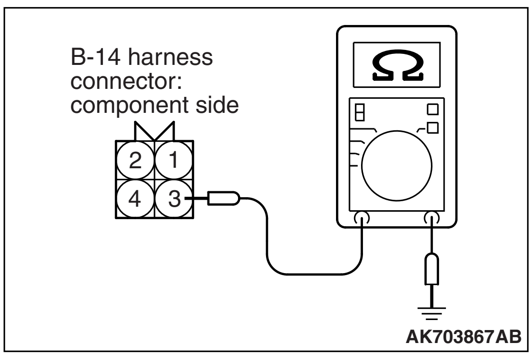
YES : Go to Step 4.
NO : Repair harness wire between the MFI relay connector A-33X (terminal No. 2) and the left bank heated oxygen sensor (front) connector B-14 (terminal No. 1) because of open circuit or harness damage. Then go to step 6.

STEP 4.Check for open circuit to ground or harness damage between left bank heated oxygen sensor (front) connector B-14 and ECM connector B-10 (terminal No. 125).

(1) Disconnect the left bank heated oxygen sensor (front) connector B-14 and ECM connector B-10.



(2) Measure the resistance between heated oxygen sensor connector B-14 (terminal No. 3) and the ECM connector B-10 (terminal No. 34).
- Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-14 (terminal No. 3) and ground.
- Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0051 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

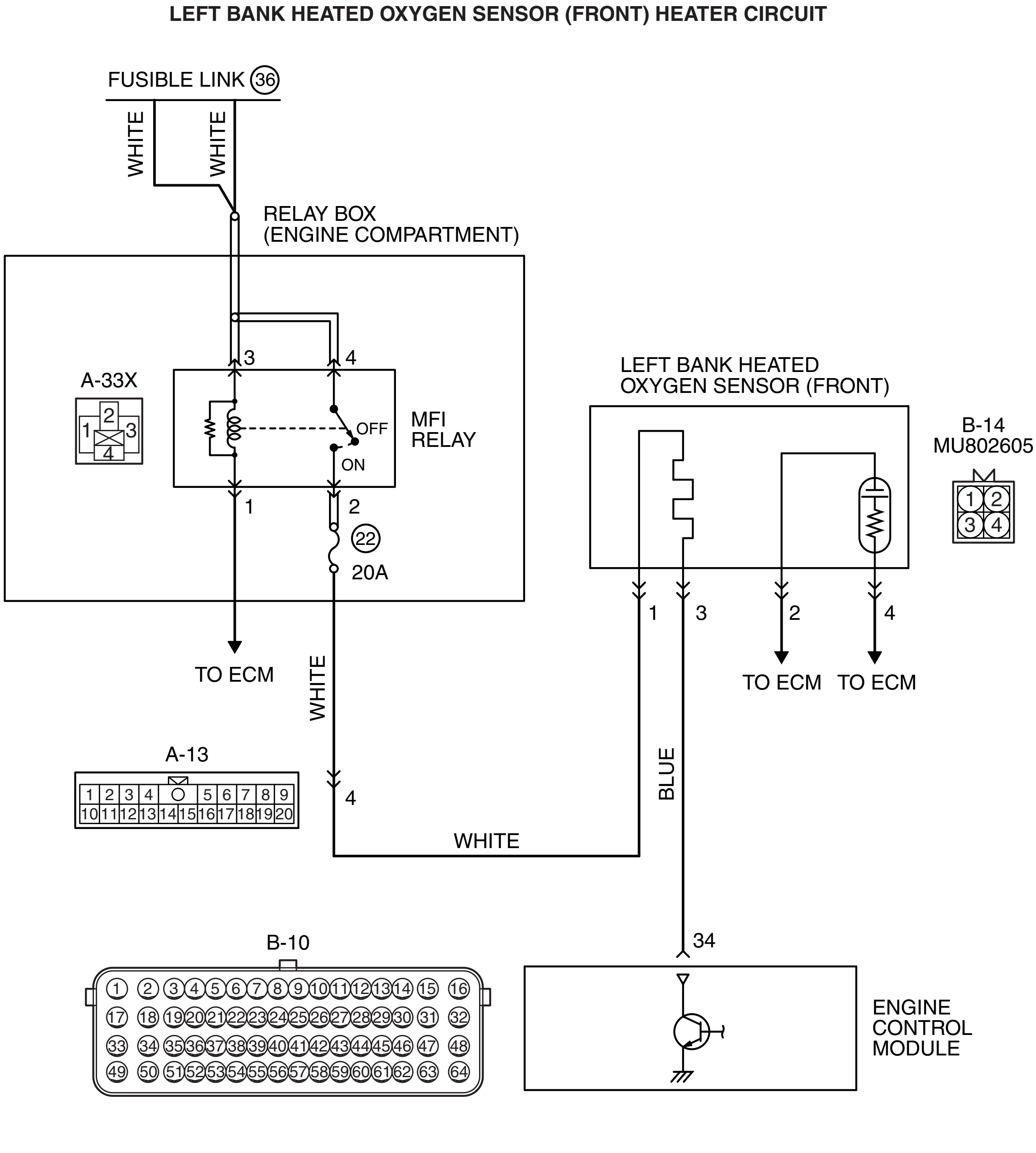
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0051 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0052: Heated Oxygen Sensor Heater Circuit High (bank 2, sensor 1)



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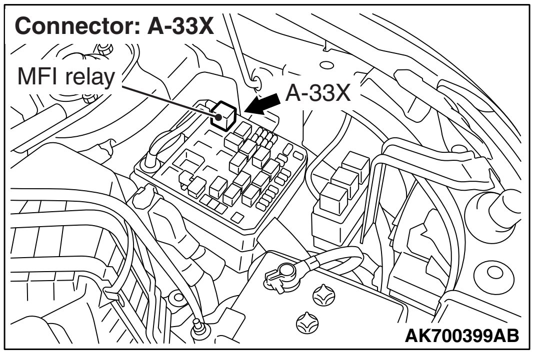
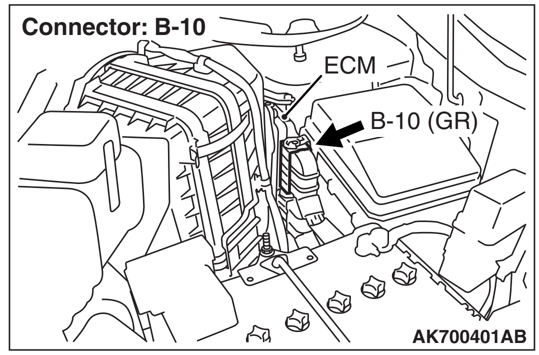
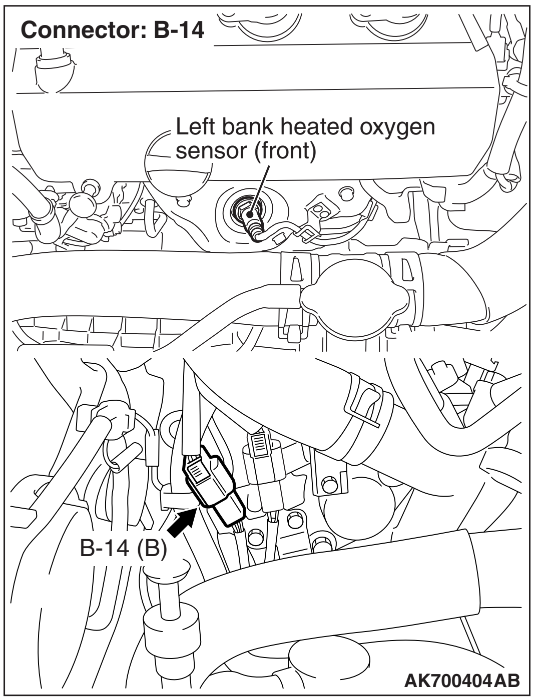
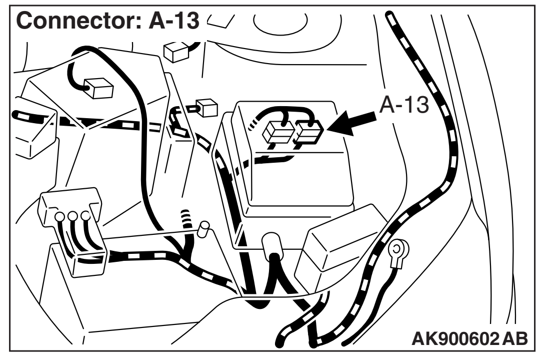








CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the left bank heated oxygen sensor (front) heater.
- The ECM (terminal No. 34) controls continuity to the left bank heated oxygen sensor (front) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor heater (front) current is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

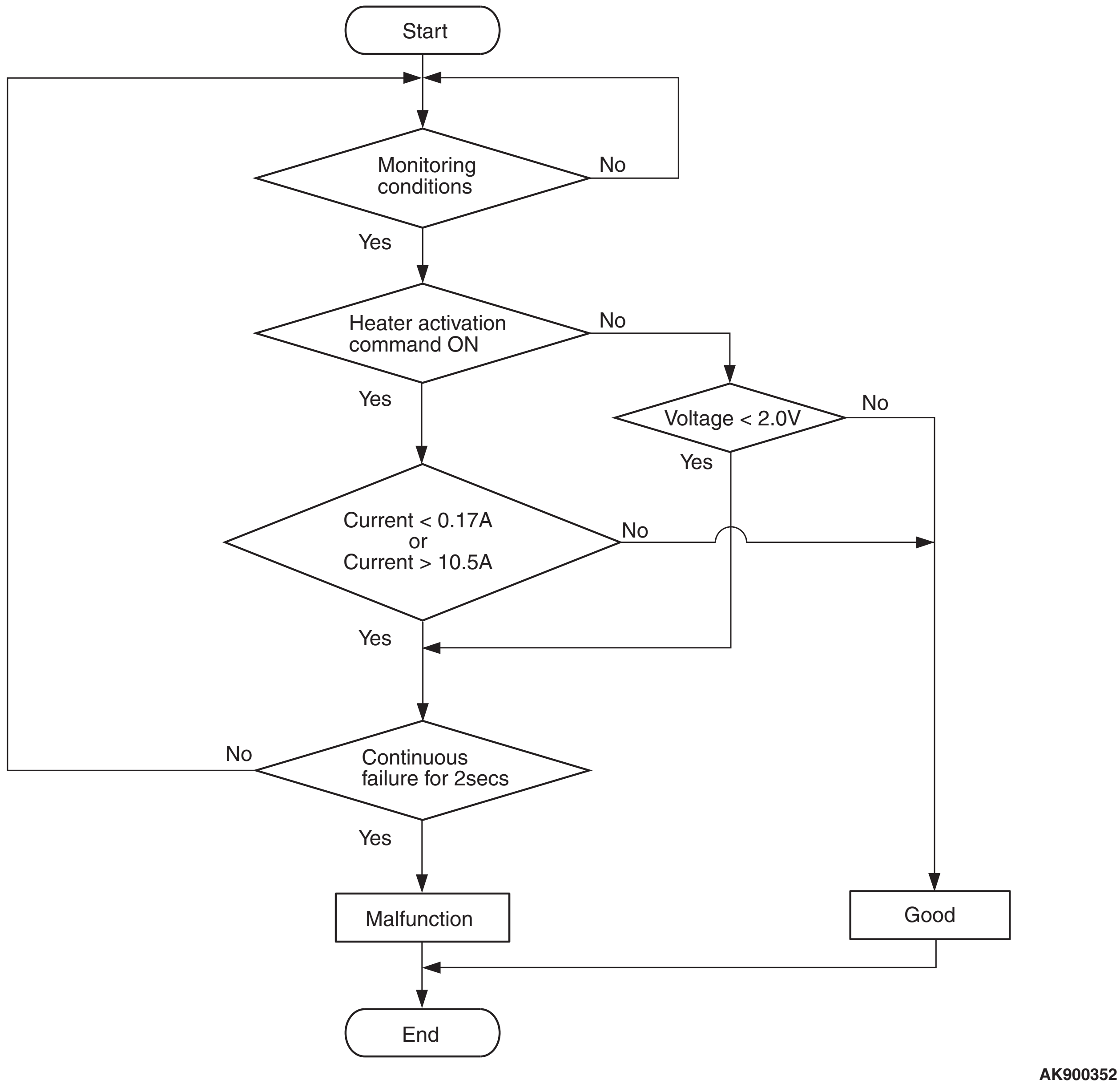
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the left bank heated oxygen sensor (front) heater is on.
- Battery positive voltage is at between 11 and 16.5 volts.

Judgement Criterion

- The left bank heated oxygen sensor (front) heater current has continued to be higher than 10.5 ampere for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

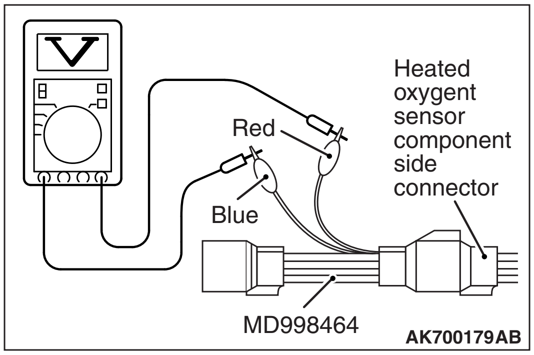
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (front) heater failed.
- ECM failed.

DIAGNOSIS

Required Special Tool:

- MD998464: Test Harness



STEP 1. Check the left bank heated oxygen sensor (front).

(1) Disconnect left bank heated oxygen sensor (front) connector B-14 and connect test harness special tool, MD998464, to the connector on the left bank heated oxygen (front) sensor side.

(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 4.5 – 8.0 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 4.5 and 8.0 ohms [at 20°C (68°F)]?

YES : Go to Step 2.

NO : Replace the left bank heated oxygen sensor (front). Then go to Step 3.

STEP 2. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0052 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 3.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 3. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

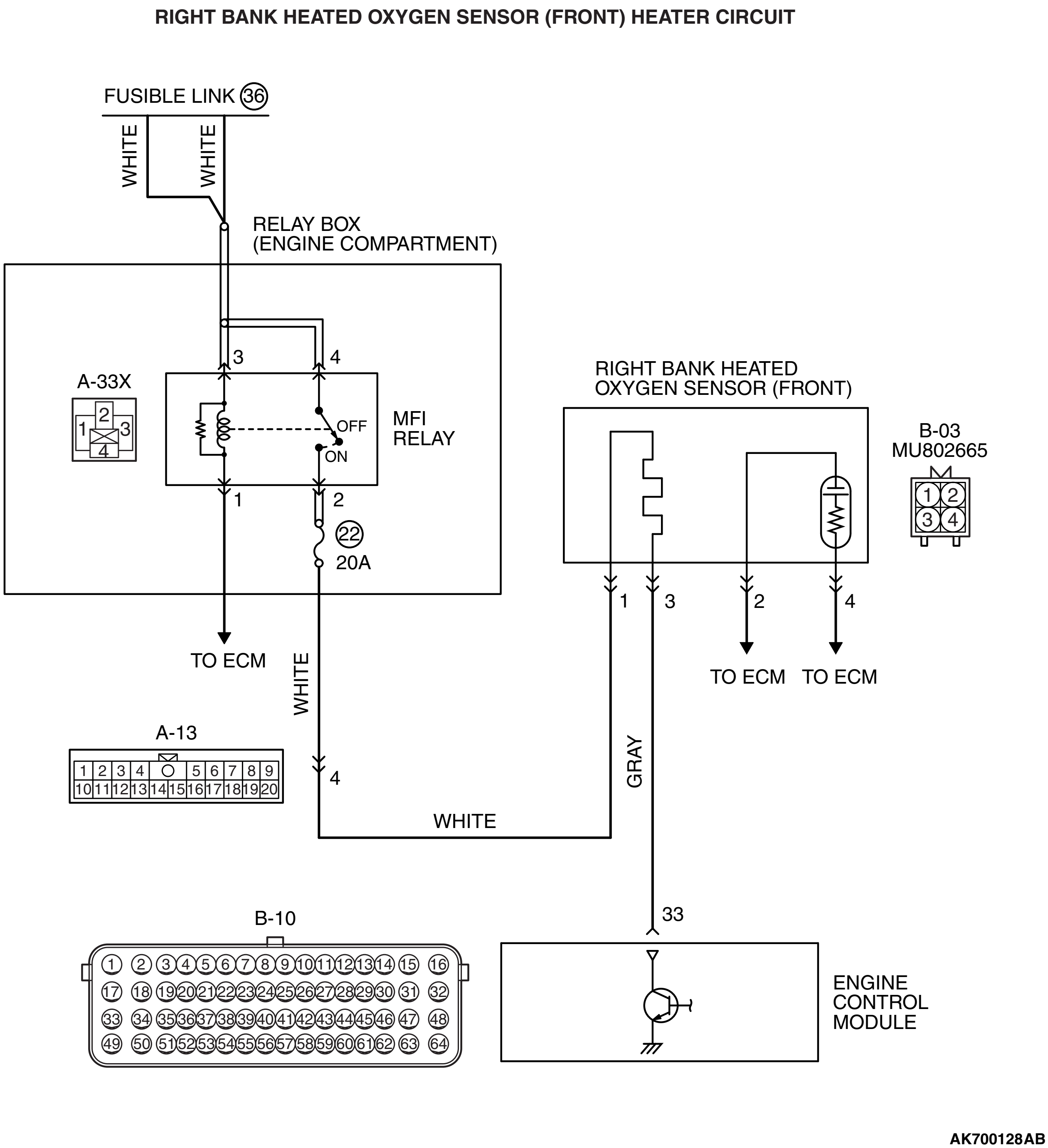
(2) Check the diagnostic trouble code (DTC).

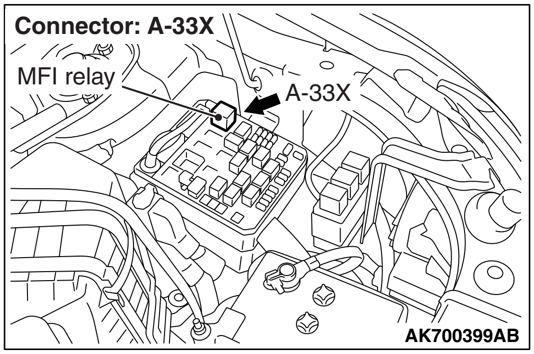
Q: Is DTC P0052 set?

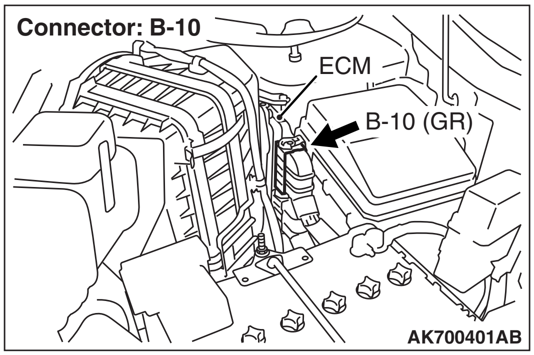
YES : Retry the troubleshooting.

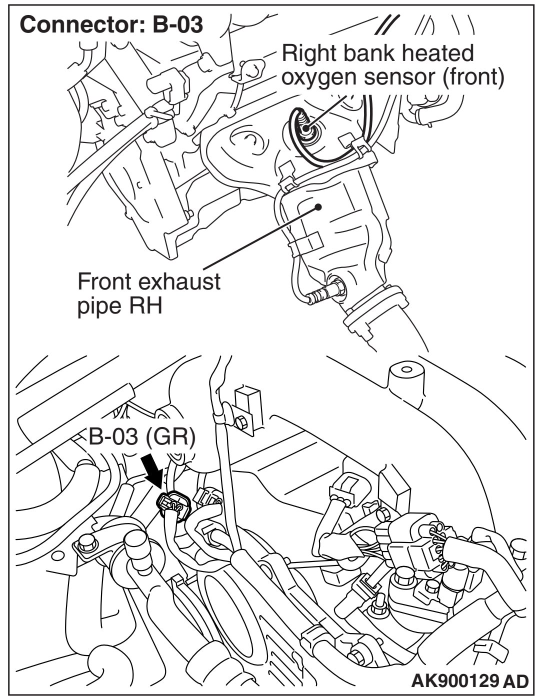
NO : The inspection is complete.

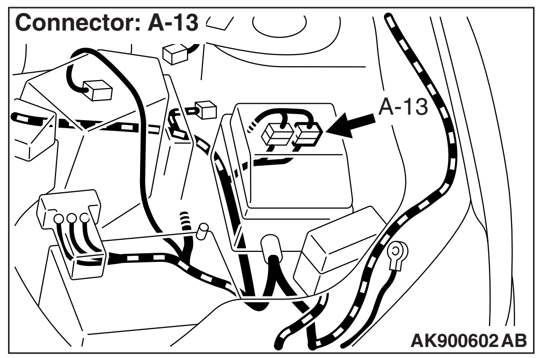
DTC P0053: Heated Oxygen Sensor Heater Resistance (bank 1, sensor 1)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the right bank heated oxygen sensor (front) heater.
- The ECM (terminal No. 33) controls continuity to the right bank heated oxygen sensor (front) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor heater (front) current is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

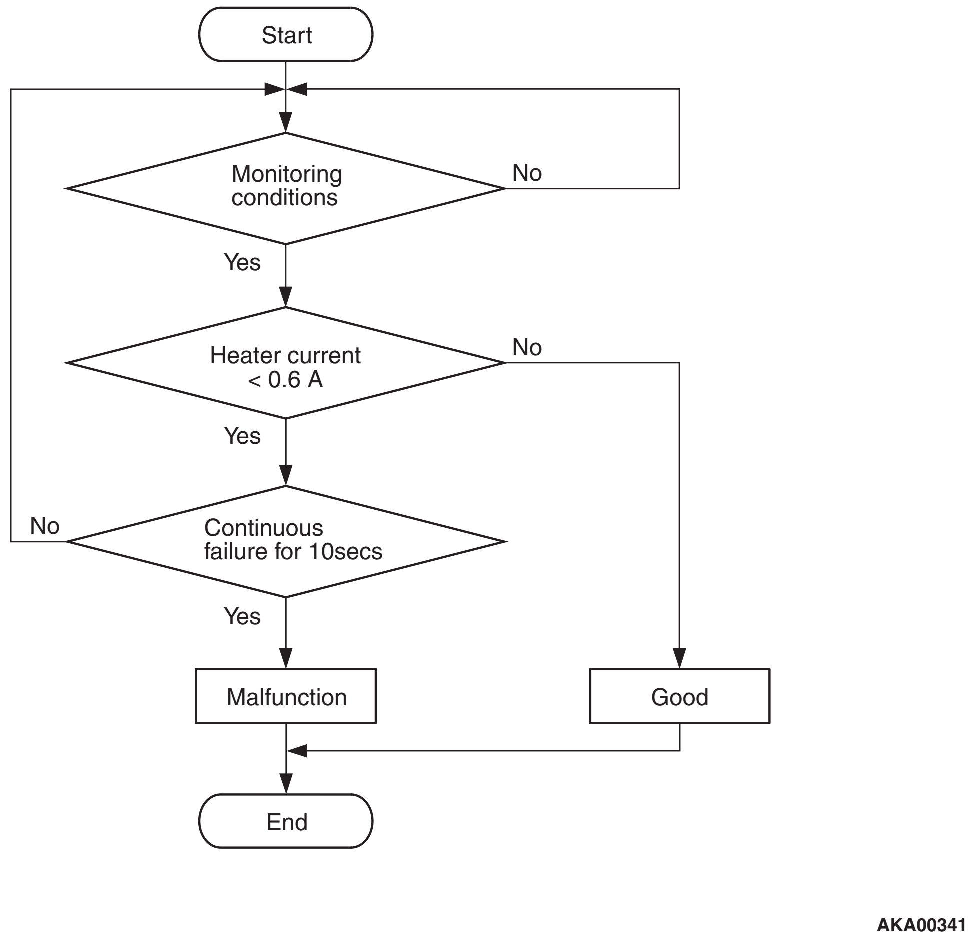
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 60 seconds have passed since the engine starting sequence was completed.
- While the right bank heated oxygen sensor (front) heater is on.
- Battery positive voltage is between 11 and 16.5 volts.
- Intake air temperature is more than –10°C (14°F).
- On duty cycle of the right bank heated oxygen sensor (front) heater is between 3 and 97 percent.

Judgement Criterion

- The right bank heated oxygen sensor (front) heater current has continued to be lower than average 0.6 ampere for 10 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Connector damage.
- Right bank heated oxygen sensor (front) heater failed.
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991316: Test Harness

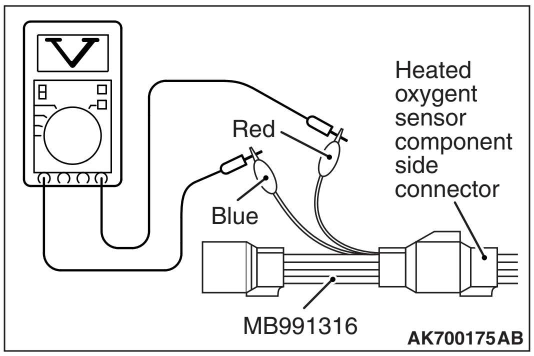
STEP 1. Check harness connector A-33X at the MFI relay, harness connector B-03 at the right bank heated oxygen sensor (front) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.

NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.

STEP 2. Check the right bank heated oxygen sensor (front).



(1) Disconnect right bank heated oxygen sensor (front) connector B-03 and connect test harness special tool, MB991316, to the connector on the right bank heated oxygen sensor (front) side.

(2) Measure the resistance between right bank heated oxygen sensor (front) connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 4.5 – 8.0 Ω [at 20°C (68°F)]

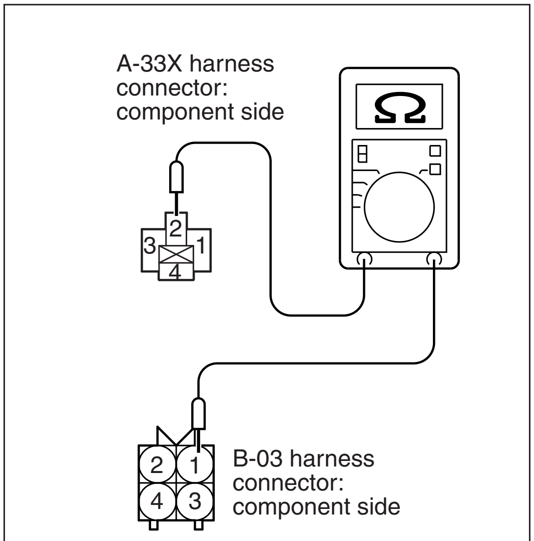
Q: Is the measured resistance between 4.5 and 8.0 ohms [at 20°C (68°F)]?

YES : Go to Step 3.

NO : Replace the right bank heated oxygen sensor (front). Then go to Step 6.

STEP 3.Check for harness damage between MFI relay connector A-33X and right bank heated oxygen sensor (front) connector B-03.

NOTE: Check harness after checking intermediate connector A-13. If intermediate connector is damaged, repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6 .



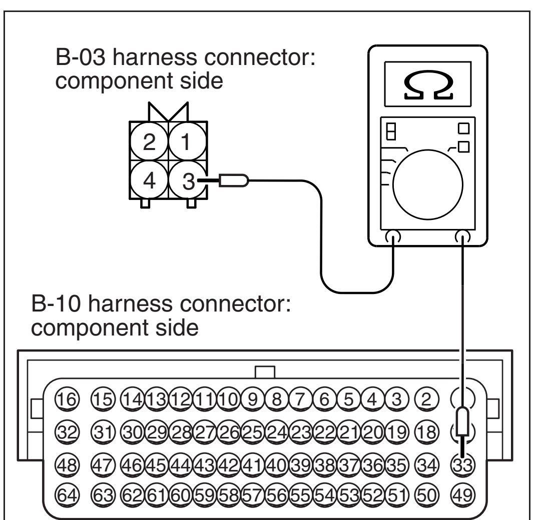
AKA00833 AB

(1) Disconnect the MFI relay connector A-33X and the right bank heated oxygen sensor (front) connector B-03.
(2) Measure the resistance between the MFI relay connector A-33X (terminal No. 2) and the right bank heated oxygen sensor (front) connector B-03 (terminal No. 1).
- Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Then go to Step 6.

STEP 4.Check for harness damage between right bank heated oxygen sensor (front) connector B-03 and ECM connector B-10.



AK700177 AB

(1) Disconnect the right bank heated oxygen sensor (front) connector B-03 and the ECM connector B-10.
(2) Measure the resistance between the right bank heated oxygen sensor (front) connector B-03 (terminal No. 3) and the ECM connector B-10 (terminal No. 33).
- Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0053 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

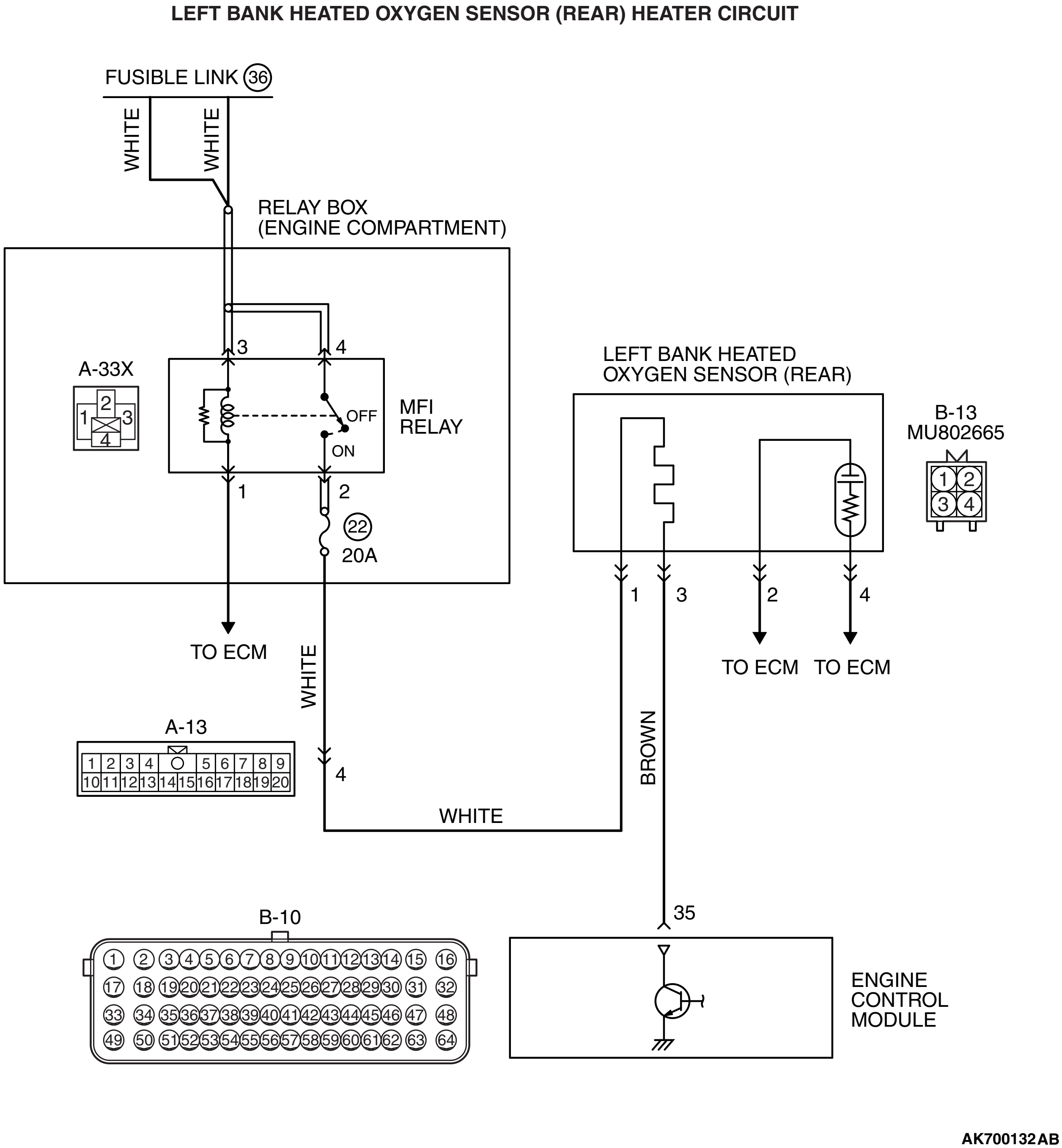
(2) Check the diagnostic trouble code (DTC).

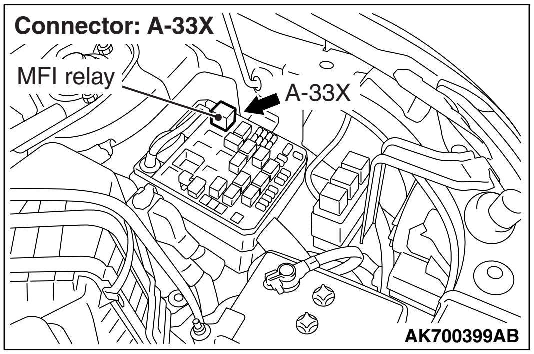
Q: Is DTC P0053 set?

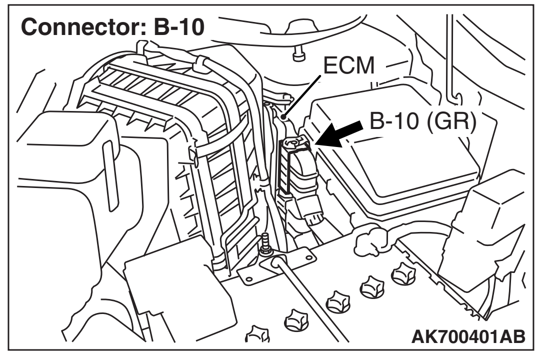
YES : Retry the troubleshooting.

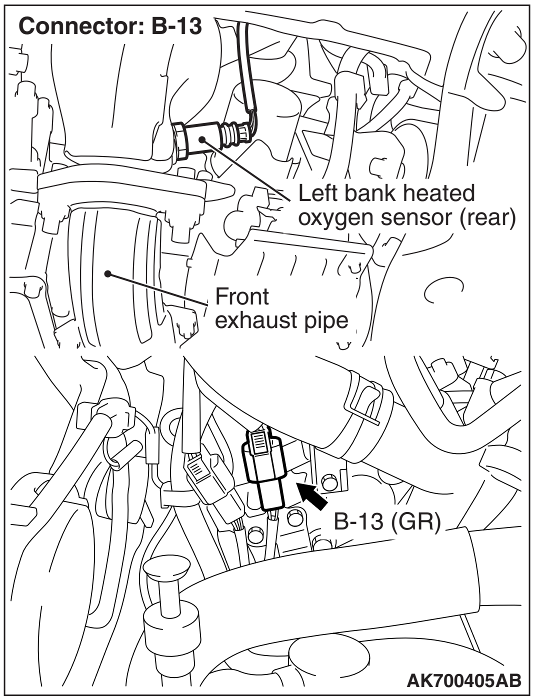
NO : The inspection is complete.

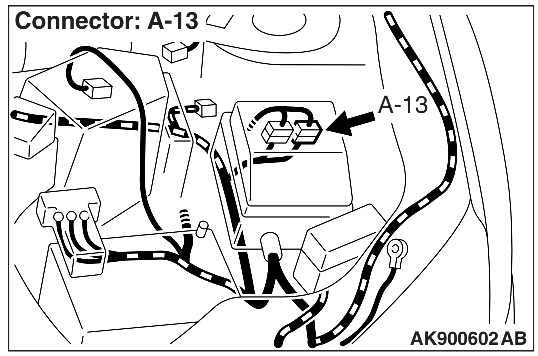
DTC P0057: Heated Oxygen Sensor Heater Circuit Low (bank 2, sensor 2)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the left bank heated oxygen sensor (rear) heater.
- The ECM (terminal No. 35) controls continuity to the left bank heated oxygen sensor (rear) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.
- The ECM checks whether the heater voltage is within a specified range when the heater is not energized.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor heater (rear) current or voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

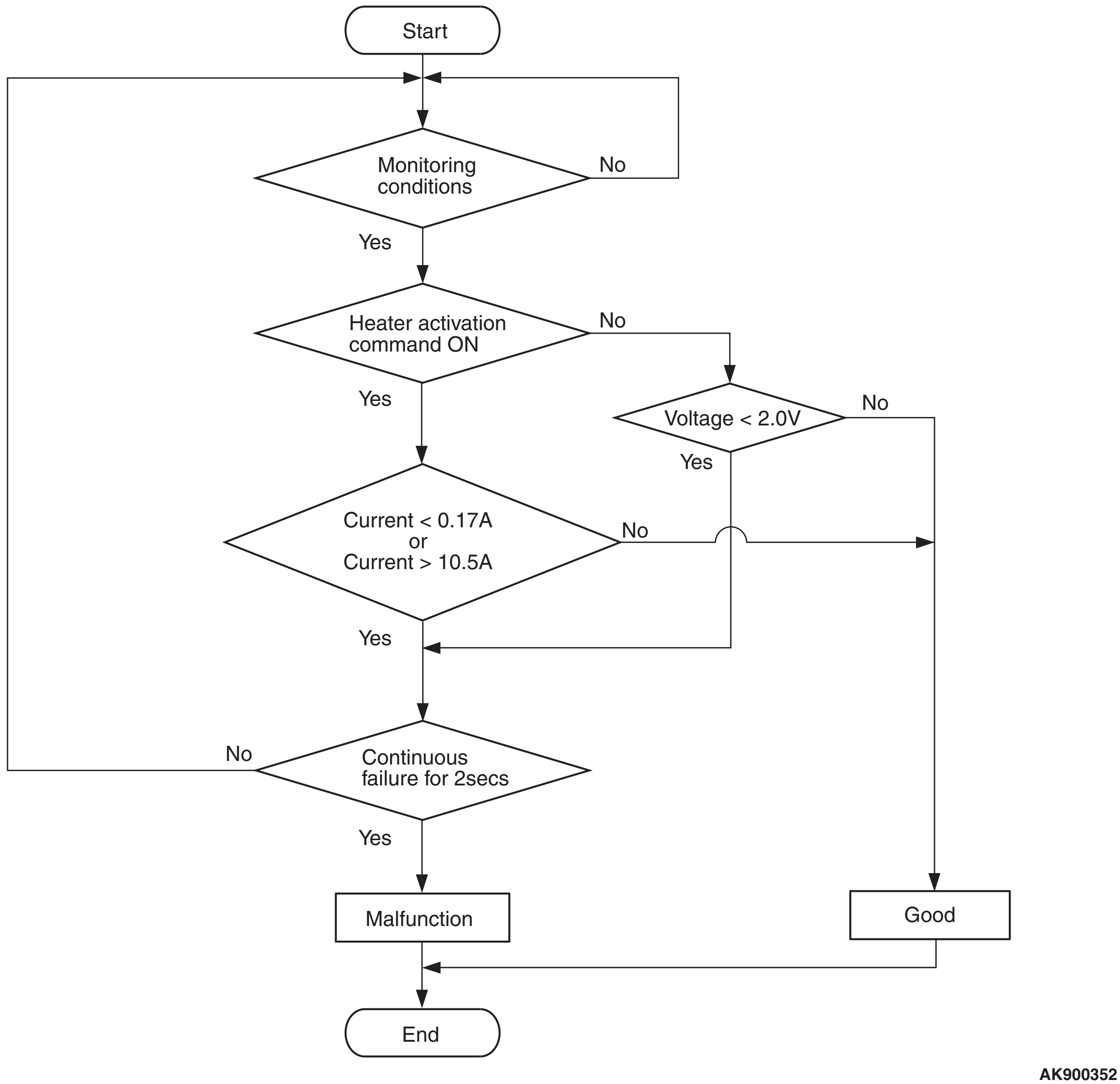
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the left bank heated oxygen sensor (rear) heater is on.
- Battery positive voltage is between 11 and 16.5 volts.

Judgement Criterion

- The left bank heated oxygen sensor (rear) heater current has continued to be lower than 0.17 ampere for 2 seconds.

Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the left bank heated oxygen sensor (rear) heater is off.
- Battery positive voltage is between 11 and 16.5 volts.

Judgement Criterion

- The left bank heated oxygen sensor (rear) heater voltage has continued to be lower than 2.0 volts for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (rear) heater failed.
- Connector damage.
- Harness damage
- Left bank heated oxygen sensor (rear) failed.
- ECM failed.

DIAGNOSIS

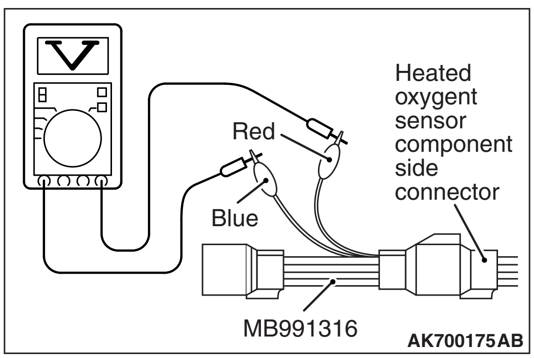
Required Special Tools:

- MB991316: Test Harness

STEP 1. Check harness connector B-13 at the left bank heated oxygen sensor (rear) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.



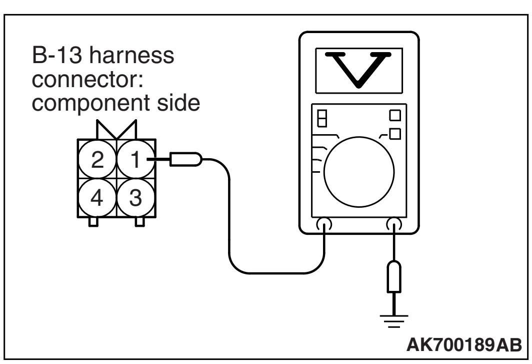
STEP 2. Check the left bank heated oxygen sensor (rear).

(1) Disconnect left bank heated oxygen sensor (rear) connector B-13 and connect test harness special tool, MB991316, to the connector on the left bank heated oxygen (rear) sensor side.
(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 11 – 18 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 11 and 18 ohms [at 20°C (68°F)]?

YES : Go to Step 3.
NO : Replace the left bank heated oxygen sensor (rear). Then go to Step 6.



STEP 3. Measure the power supply voltage at left bank heated oxygen sensor (rear) harness side connector B-13.

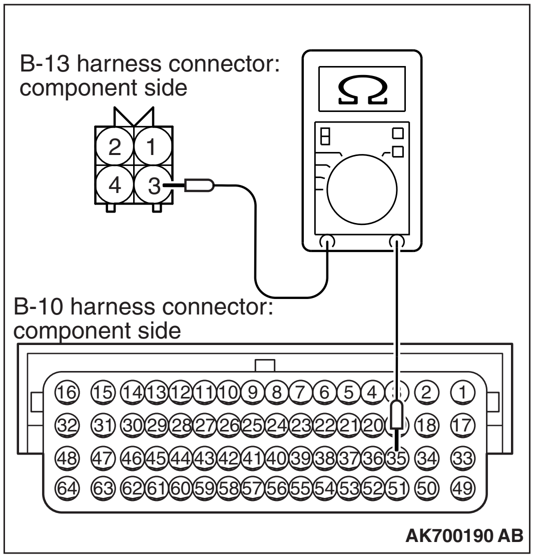
(1) Disconnect the connector B-13 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 1 and ground.
- Voltage should be battery positive voltage.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

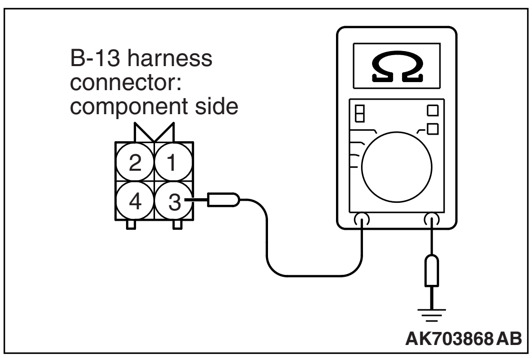
Q: Is battery positive voltage (approximately 12 volts) present?

YES : Go to Step 4.
NO : Repair harness wire between the MFI relay connector A-33X (terminal No. 2) and the left bank heated oxygen sensor (rear) connector B-13 (terminal No. 1) because of open circuit or harness damage. Then go to step 6.

STEP 4.Check for open circuit to ground or harness damage between left bank heated oxygen sensor (rear) connector B-13 and ECM connector B-10.



(1) Disconnect the left bank heated oxygen sensor (rear) connector B-13 and the ECM connector B-10.
(2) Measure the resistance between the heated oxygen sensor connector B-13 (terminal No. 3) and the ECM connector B-10 (terminal No. 35).
- Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-13 (terminal No. 3) and ground.
- Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0057 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

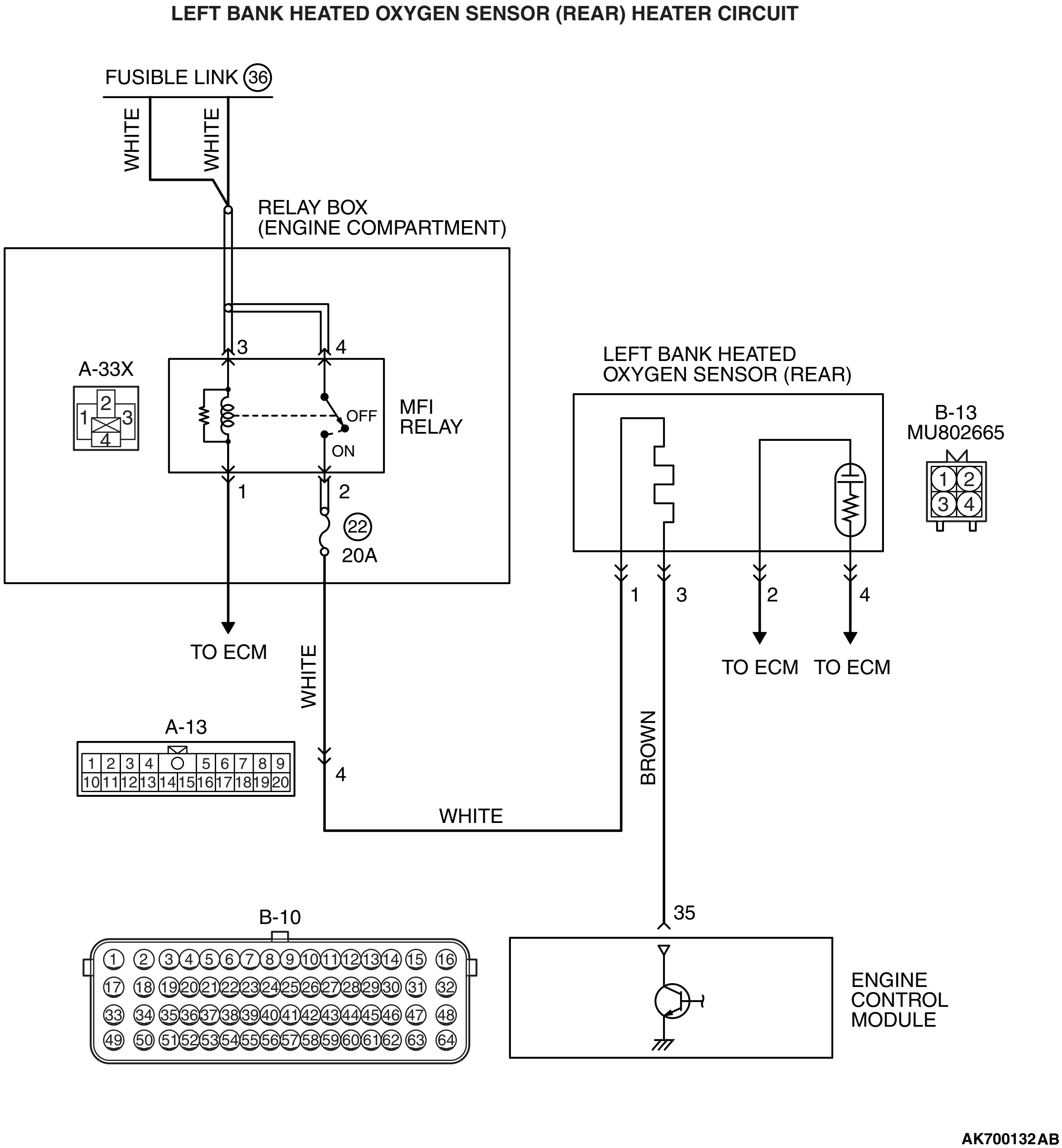
(2) Check the diagnostic trouble code (DTC).

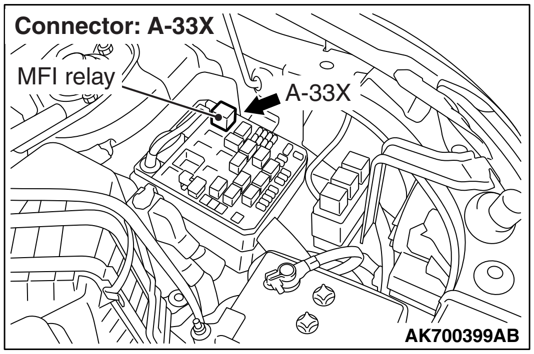
Q: Is DTC P0057 set?

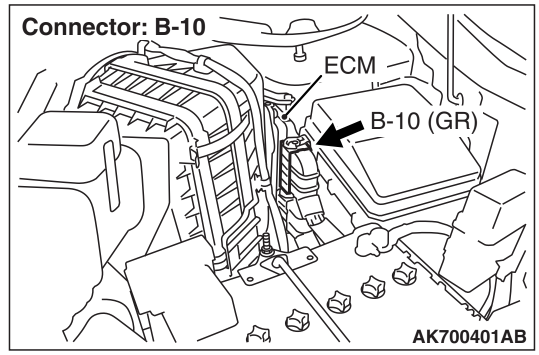
YES : Retry the troubleshooting.

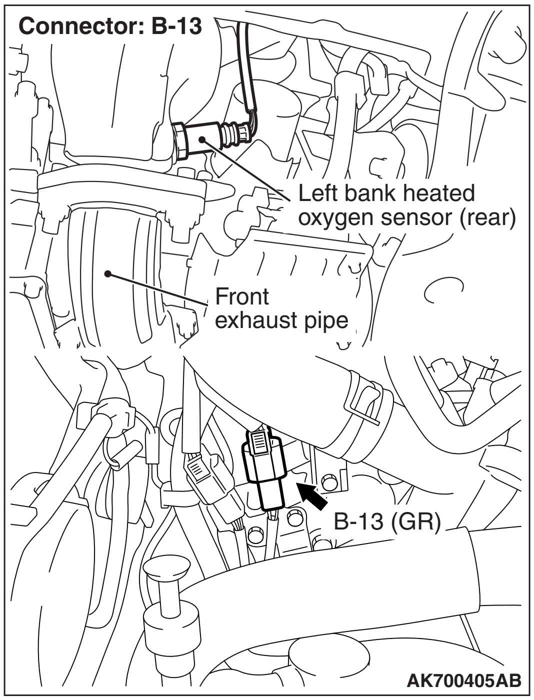
NO : The inspection is complete.

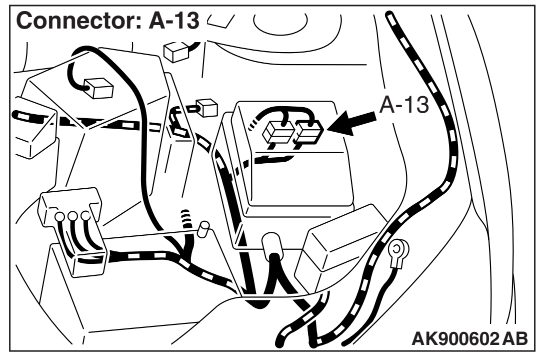
DTC P0058: Heated Oxygen Sensor Heater Circuit High (bank 2, sensor 2)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the left bank heated oxygen sensor (rear) heater.
- The ECM (terminal No. 35) controls continuity to the left bank heated oxygen sensor (rear) heater by turning the power transistor in the ECM "ON" and "OFF".

BACKGROUND

- The ECM checks whether the heater current is within a specified range when the heater is energized.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor heater (rear) current is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

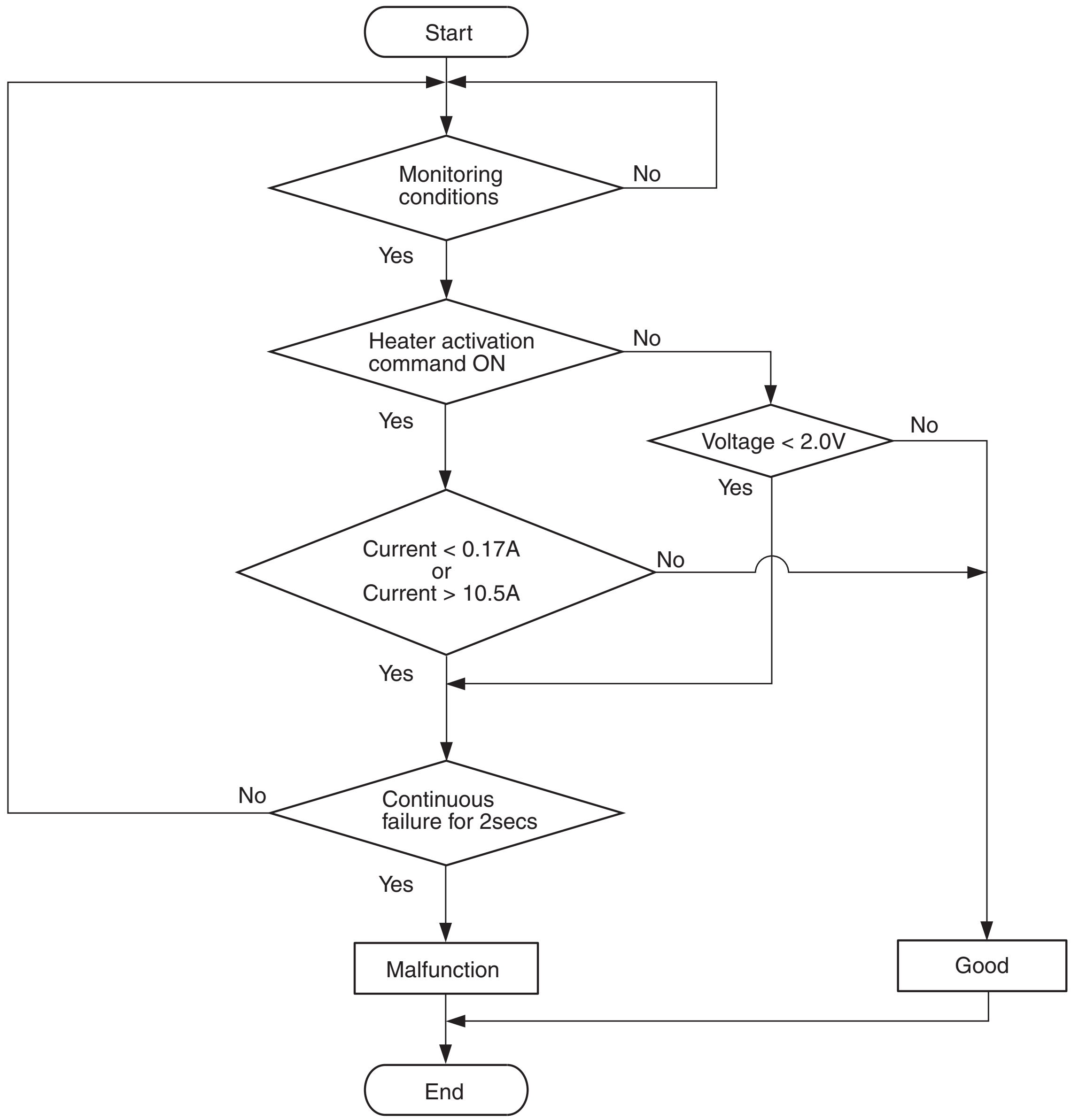
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



AK900352

Check Conditions

- More than 2 seconds have passed since the engine starting sequence was completed.
- While the left bank heated oxygen sensor (rear) heater is on.
- Battery positive voltage is between 11 and 16.5 volts.

Judgement Criterion

- The left bank heated oxygen sensor (rear) heater current has continued to be higher than 10.5 ampere for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

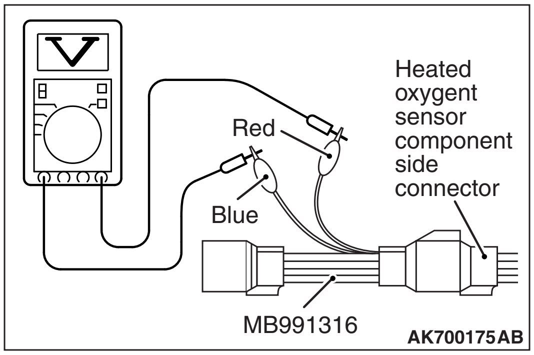
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (rear) heater failed.
- Left bank heated oxygen sensor (rear) failed.
- ECM failed.

DIAGNOSIS

Required Special Tool:

- MB991316: Test Harness



STEP 1. Check the left bank heated oxygen sensor (rear).

(1) Disconnect left bank heated oxygen sensor (rear) connector B-13 and connect test harness special tool, MB991316, to the connector on the left bank heated oxygen (rear) sensor side.

(2) Measure the resistance between heated oxygen sensor connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 11 – 18 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 11 and 18 ohms [at 20°C (68°F)]?

YES : Go to Step 2.

NO : Replace the left bank heated oxygen sensor (rear). Then go to Step 3.

STEP 2. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0058 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 3.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 3. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

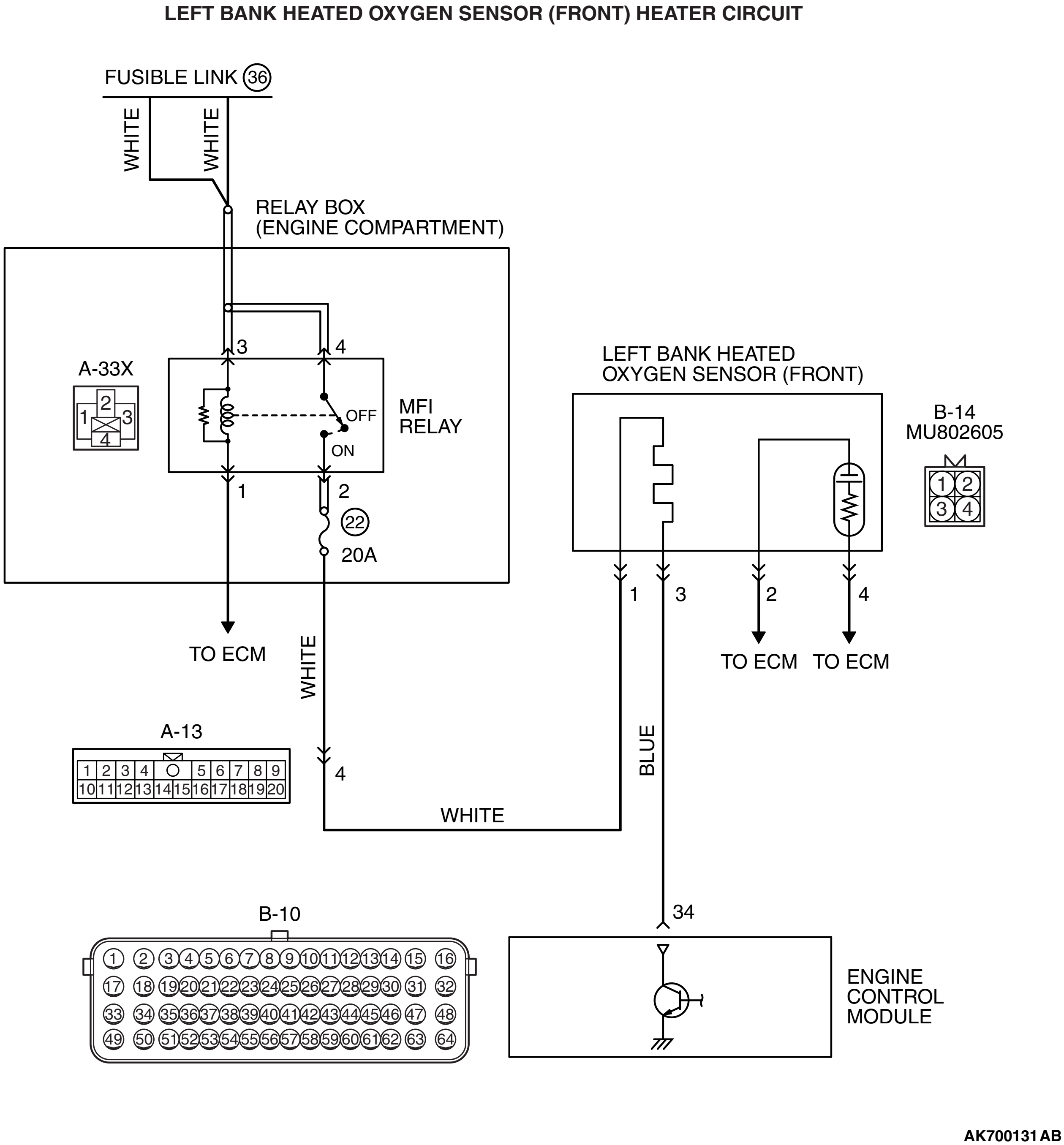
(2) Check the diagnostic trouble code (DTC).

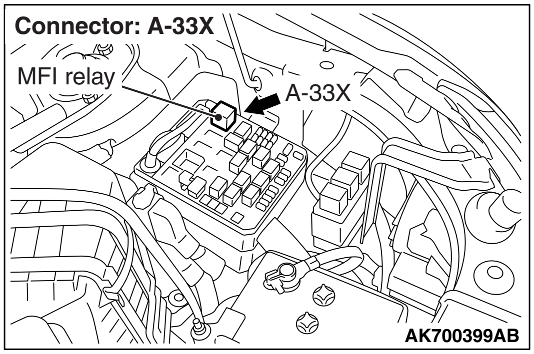
Q: Is DTC P0058 set?

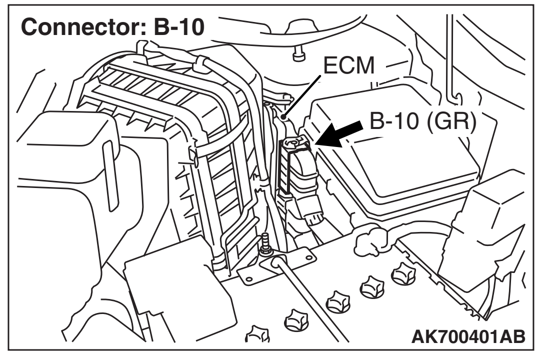
YES : Retry the troubleshooting.

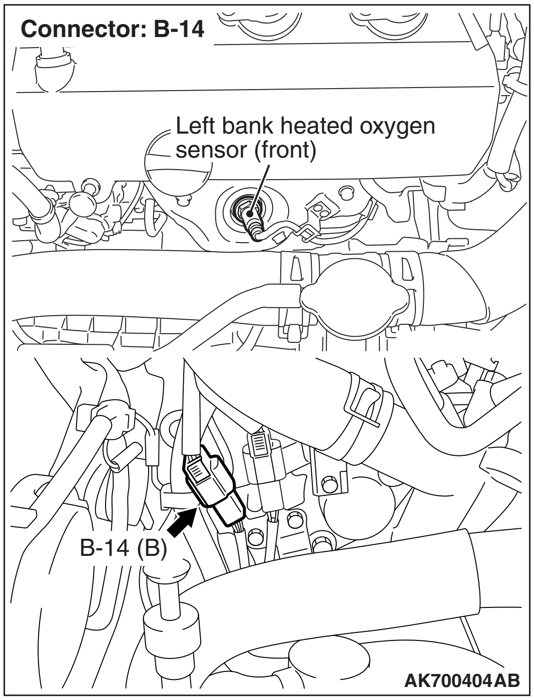
NO : he inspection is complete.

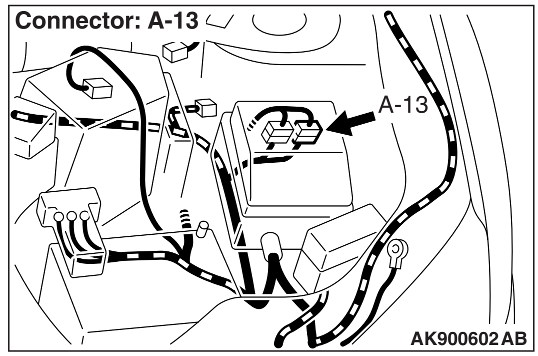
DTC P0059: Heated Oxygen Sensor Heater Resistance (bank 2, sensor 1)











CIRCUIT OPERATION

- Power is supplied from the MFI relay (terminal No. 2) to the left bank heated oxygen sensor (front) heater.
- The ECM (terminal No. 34) controls continuity to the left bank heated oxygen sensor (front) heater by turning the power transistor in the ECM "ON" and "OFF".

TECHNICAL DESCRIPTION

- The ECM checks whether the heater current is within a specified range when the heater is energized.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor heater (front) current is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

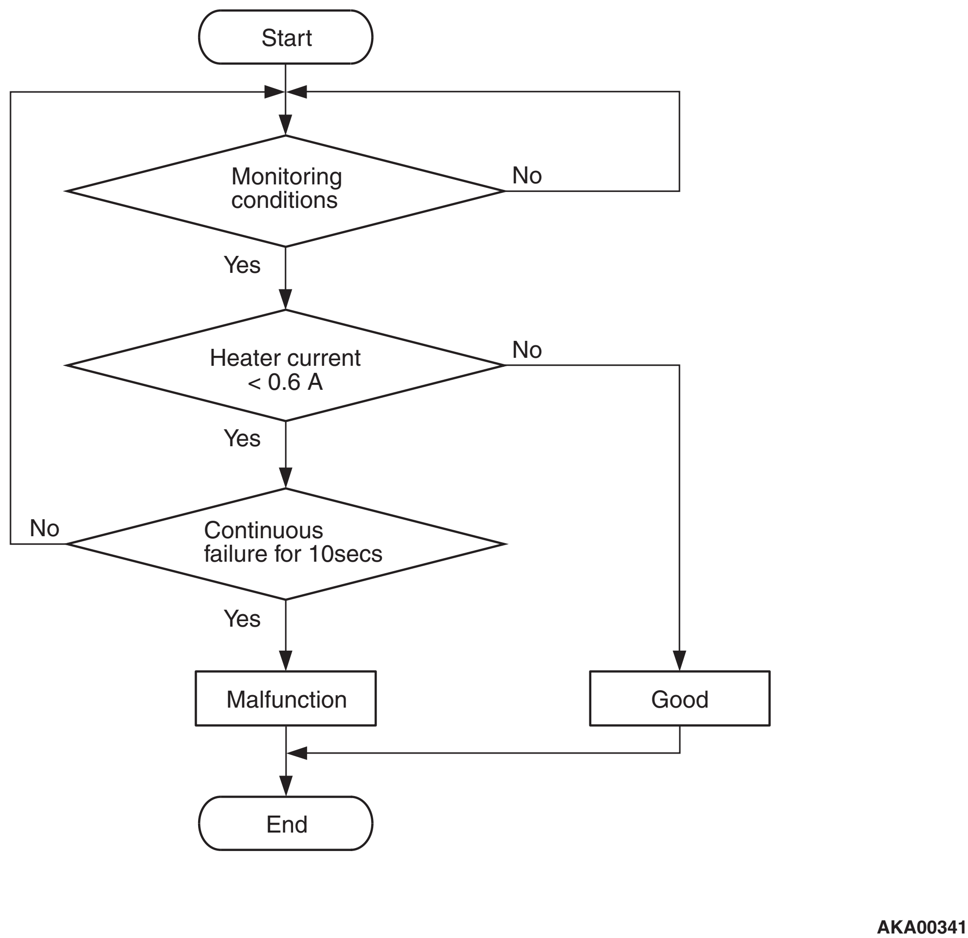
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- More than 60 seconds have passed since the engine starting sequence was completed.
- While the left bank heated oxygen sensor (front) heater is on.
- Battery positive voltage is at between 11 and 16.5 volts.
- Intake air temperature is more than –10°C (14°F).
- On duty cycle of the left bank heated oxygen sensor (front) heater is between 3 and 97 percent.

Judgement Criterion

- The left bank heated oxygen sensor (front) heater current has continued to be lower than average 0.6 ampere for 10 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (front) heater failed.
- Connector damage.
- Harness damage
- ECM failed.

DIAGNOSIS

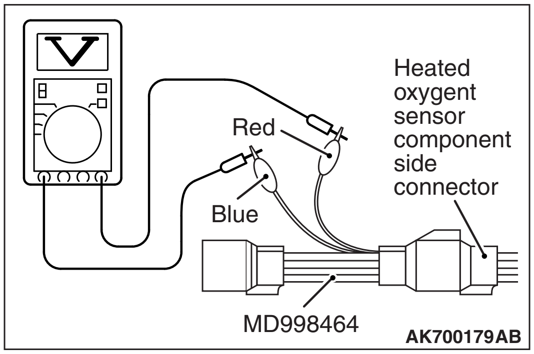
Required Special Tools:

- MD998464: Test Harness

STEP 1. Check harness connector A-33X at the MFI relay, harness connector B-14 at the left bank heated oxygen sensor (front) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.



STEP 2. Check the left bank heated oxygen sensor (front).

(1) Disconnect left bank heated oxygen sensor (front) connector B-14 and connect test harness special tool, MD998464, to the connector on the left bank heated oxygen sensor (front) side.
(2) Measure the resistance between left bank heated oxygen sensor (front) connector terminal No. 1 (red clip) and terminal No. 3 (blue clip).

Standard value: 4.5 – 8.0 Ω [at 20°C (68°F)]

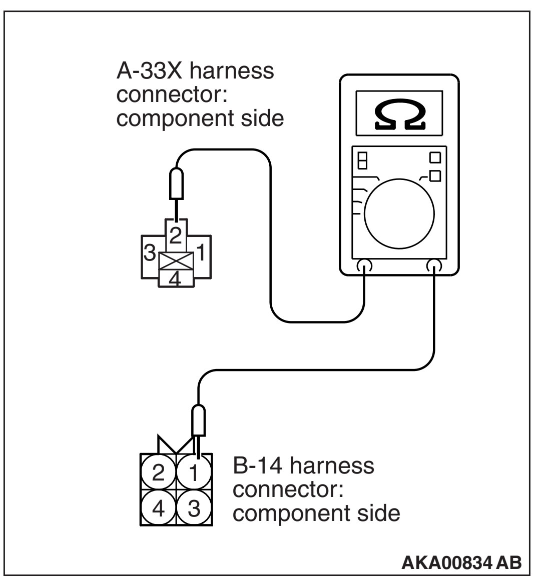
Q: Is the measured resistance between 4.5 and 8.0 ohms [at 20°C (68°F)]?

YES : Go to Step 3.
NO : Replace the left bank heated oxygen sensor (front). Then go to Step 6.

STEP 3. Check for harness damage between MFI relay connector A-33X and left bank heated oxygen sensor (front) connector B-14.

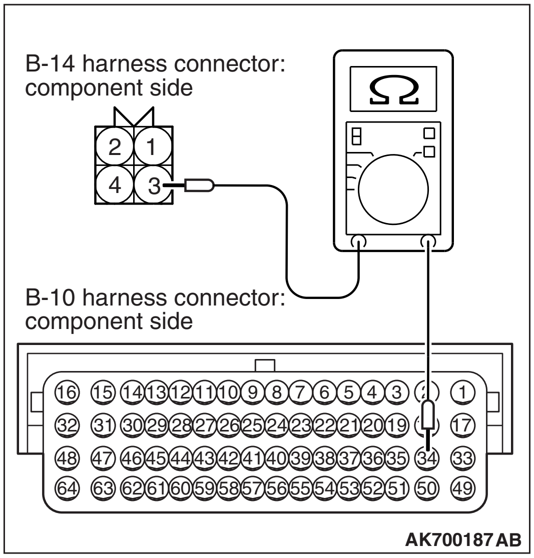
NOTE: Check harness after checking intermediate connector A-13. If intermediate connector is damaged, repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6 .

(1) Disconnect the MFI relay connector A-33X and the left bank heated oxygen sensor (front) connector B-14.
(2) Measure the resistance between the MFI relay connector A-33X (terminal No. 2) and the left bank heated oxygen sensor (front) connector B-14 (terminal No. 1).
- Should be less than 2 ohms.



Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Then go to Step 6.



STEP 4. Check for harness damage between left bank heated oxygen sensor (front) connector B-14 and ECM connector B-10.

(1) Disconnect the left bank heated oxygen sensor (front) connector B-14 and the ECM connector B-10.
(2) Measure the resistance between the left bank heated oxygen sensor (front) connector B-14 (terminal No. 3) and the ECM connector B-10 (terminal No. 34).
- Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0059 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 2 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0059 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0068: Mass Airflow Sensor Plausibility

TECHNICAL DESCRIPTION

Compare the actual measurement of volumetric efficiency by a mass airflow sensor signal with volumetric efficiency estimated from a throttle position sensor (main or sub) signal.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

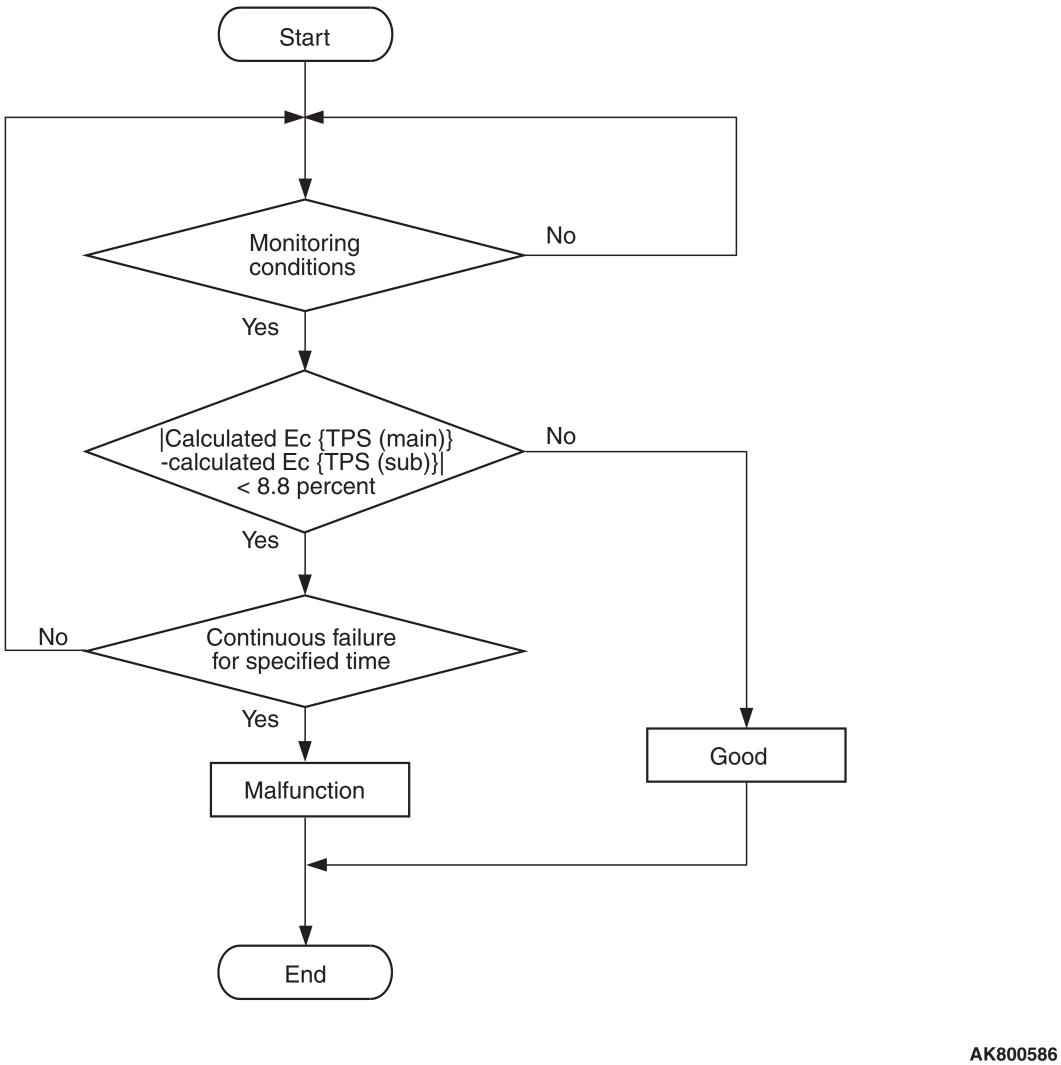
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- The plausibility error of the throttle position sensor (main) is detected.
- The plausibility error of the throttle position sensor (sub) is detected.

Judgment Criterion

- For 0.36 second, the difference between the volumetric efficiency estimated by the (main) throttle position sensor and the volumetric efficiency estimated by the (sub) throttle position sensor is 8.8 % or less.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle Pattern 17 P.13B-11.

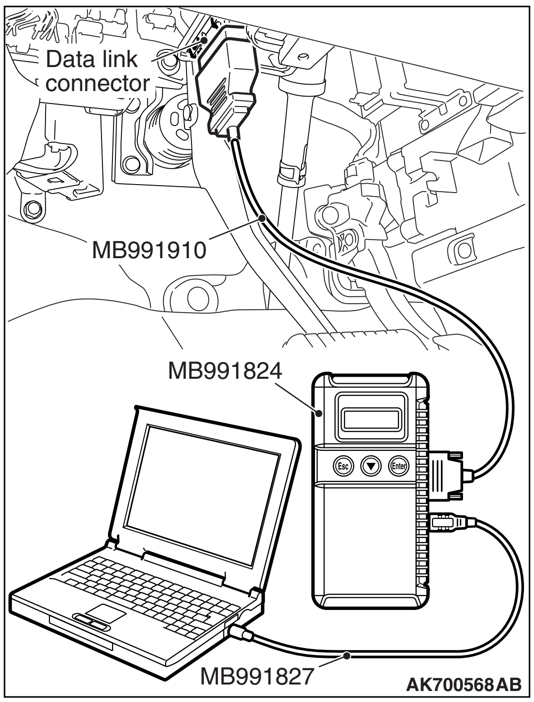
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Mass airflow sensor system failed.
- Intake system vacuum leak.
- There is some foreign matter around mass airflow sensor.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
    - MB991824: V.C.I.
    - MB991827: USB Cable
    - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, read the diagnostic trouble code (DTC).

⚠ **CAUTION**

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Read the DTC.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the diagnostic trouble code other than P0068 set?

YES : Refer to Diagnostic Trouble Code Chart P.13B-50.
NO : Go to Step 2.

STEP 2. Check for intake system vacuum leak.

Q: Are there any abnormalities?

YES : Repair it. Then go to Step 6.
NO : Go to Step 3.

STEP 3. Check for foreign matter being around the mass airflow sensor.

Q: Are there any foreign matter?

YES : Repair it. Then go to Step 6.
NO : Go to Step 4.

STEP 4. Using scan tool MB991958, check data list item 10: Mass Airflow Sensor.

(1) Start the engine and run at idle.
(2) Set scan tool MB991958 to the data reading mode for item 10, Mass Airflow Sensor.
(3) Warm up the engine to normal operating temperature: 80°C to 95°C (176°F to 203°F).
- The standard value during idling should be between 1,350 and 1,670 millivolts.
- When the engine is revved, the mass airflow rate should increase according to the increase in engine speed.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : Go to Step 5.
NO : Refer to DTC P0101 – Mass Airflow Circuit Range/Performance Problem P.13B-132, DTC P0102 – Mass Airflow Circuit Low Input P.13B-139, DTC P0103 – Mass Airflow Circuit High Input P.13B-145.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle Pattern 17 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0068 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle Pattern 17 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0068 set?

YES : Retry the troubleshooting.
NO : The procedure is complete.

DTC P0069: Abnormal Correlation Between Manifold Absolute Pressure Sensor And Barometric Pressure Sensor

TECHNICAL DESCRIPTION

- The ECM detects abnormality in the sensor by comparing the manifold absolute pressure sensor output with the barometric pressure sensor output.

DESCRIPTIONS OF MONITOR METHODS

The ECM compares the manifold absolute pressure sensor output with the barometric pressure sensor output while the engine control relay is in "ON" position after the ignition switch is in "LOCK" (OFF) position. When the difference exceeds the specified value between them, the ECM determines whether the manifold absolute pressure sensor / the barometric pressure sensor has malfunction or not.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

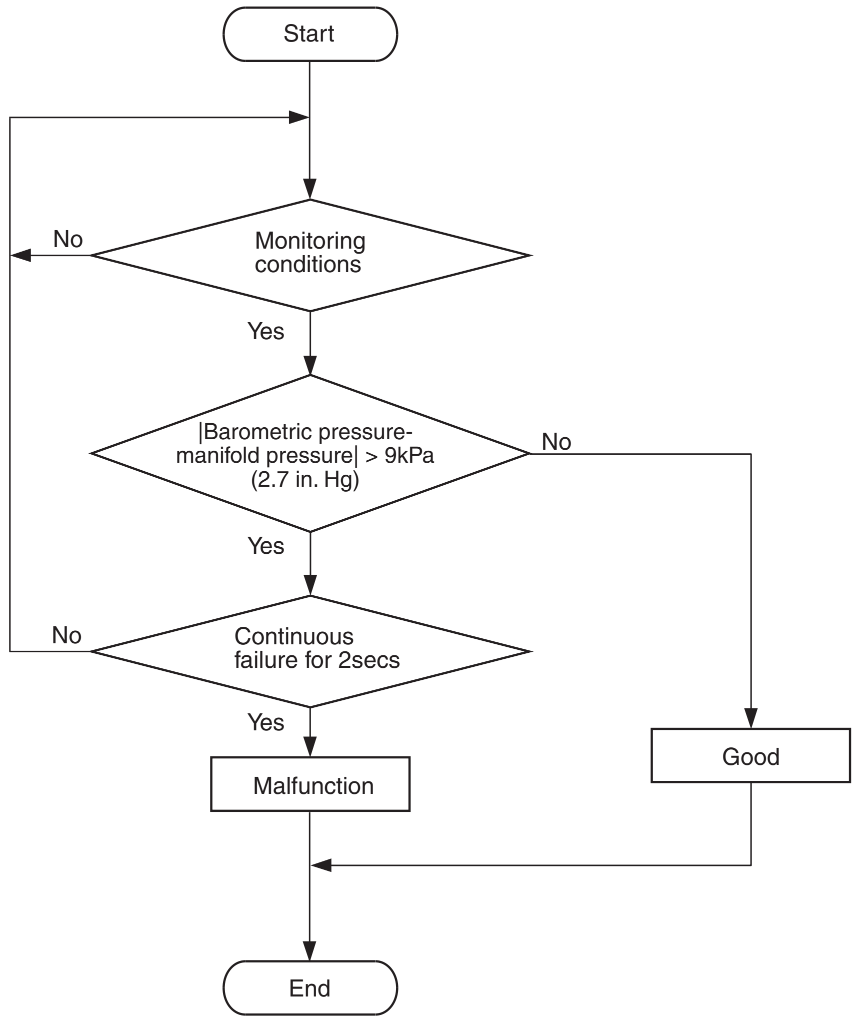
- Not applicable

Sensor (The sensor below is determined to be normal)

- Engine coolant temperature sensor
- Manifold absolute pressure sensor

DTC SET CONDITION

Logic Flow Chart



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Check Conditions

- Ignition switch is in "LOCK" (OFF) position.
- After 2 seconds pass from the time when the engine is stopped.
- Engine coolant temperature is higher than 0°C (32°F).

Judgement Criterion

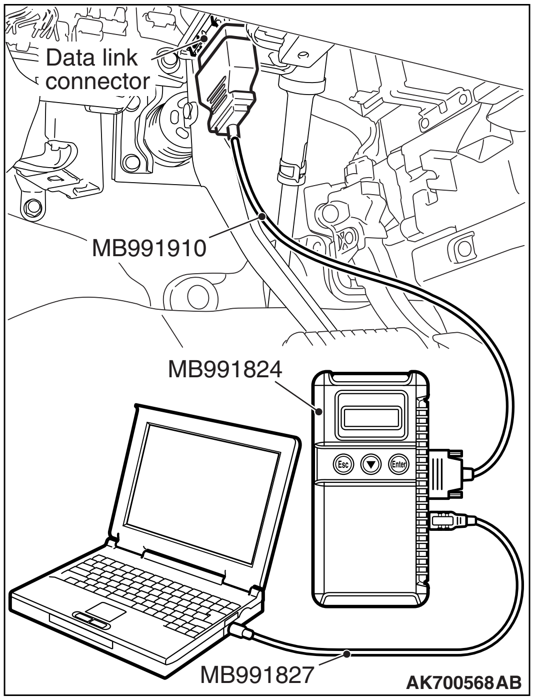
- Difference between manifold absolute pressure sensor output and barometric pressure sensor output is more than 9 kPa (2.7 in.Hg) for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

None.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Manifold absolute pressure sensor failed.
- Barometric pressure sensor failed.
- ECM failed.



DIAGNOSIS

Required Special Tools:

- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A

STEP 1. Using scan tool MB991958, read the diagnostic trouble code (DTC).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958, read the DTC.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the diagnostic trouble code other than P0069 set?

YES : Refer to Diagnostic Trouble Code Chart P.13B-50.
NO : Go to Step 2.

STEP 2. Using scan tool MB991958, check data list item 8: Manifold Absolute Pressure Sensor.

(1) Turn the ignition switch to the "ON" position.
(2) Set scan tool MB991958 to the data reading mode for item 8, Manifold Absolute Pressure Sensor.
- When altitude is 0 m (0 foot), 101 kPa (29.8 in.Hg).
- When altitude is 600 m (1,969 feet), 95 kPa (28.1 in.Hg).
- When altitude is 1,200 m (3,937 feet), 88 kPa (26.0 in.Hg).
- When altitude is 1,800 m (5,906 feet), 81 kPa (23.9 in.Hg).

(3) Start the engine.
- When the engine is idling, 16 – 36 kPa (4.7 – 10.6 in.Hg).
- When the engine is suddenly revved, manifold absolute pressure varies.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : Go to Step 3.
NO : Refer to DTC P0106 – Manifold Absolute Pressure Circuit Range/Performance Problem P.13B-150, DTC P0107 – Manifold Absolute Pressure Circuit Low Input P.13B-156, DTC P0108 – Manifold Absolute Pressure Circuit High Input P.13B-162.

STEP 3. Using scan tool MB991958, read the diagnostic trouble code (DTC).

(1) Turn the ignition switch to the "ON" position.
(2) Erase the DTC.
(3) Start the engine.
(4) Turn the ignition switch to "LOCK" (OFF) position and then wait 2 seconds.
(5) Turn the ignition switch to the "ON" position.
(6) Set scan tool MB991958, read the DTC.
(7) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is DTC P0069 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 4.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 4. Using scan tool MB991958, read the diagnostic trouble code (DTC).

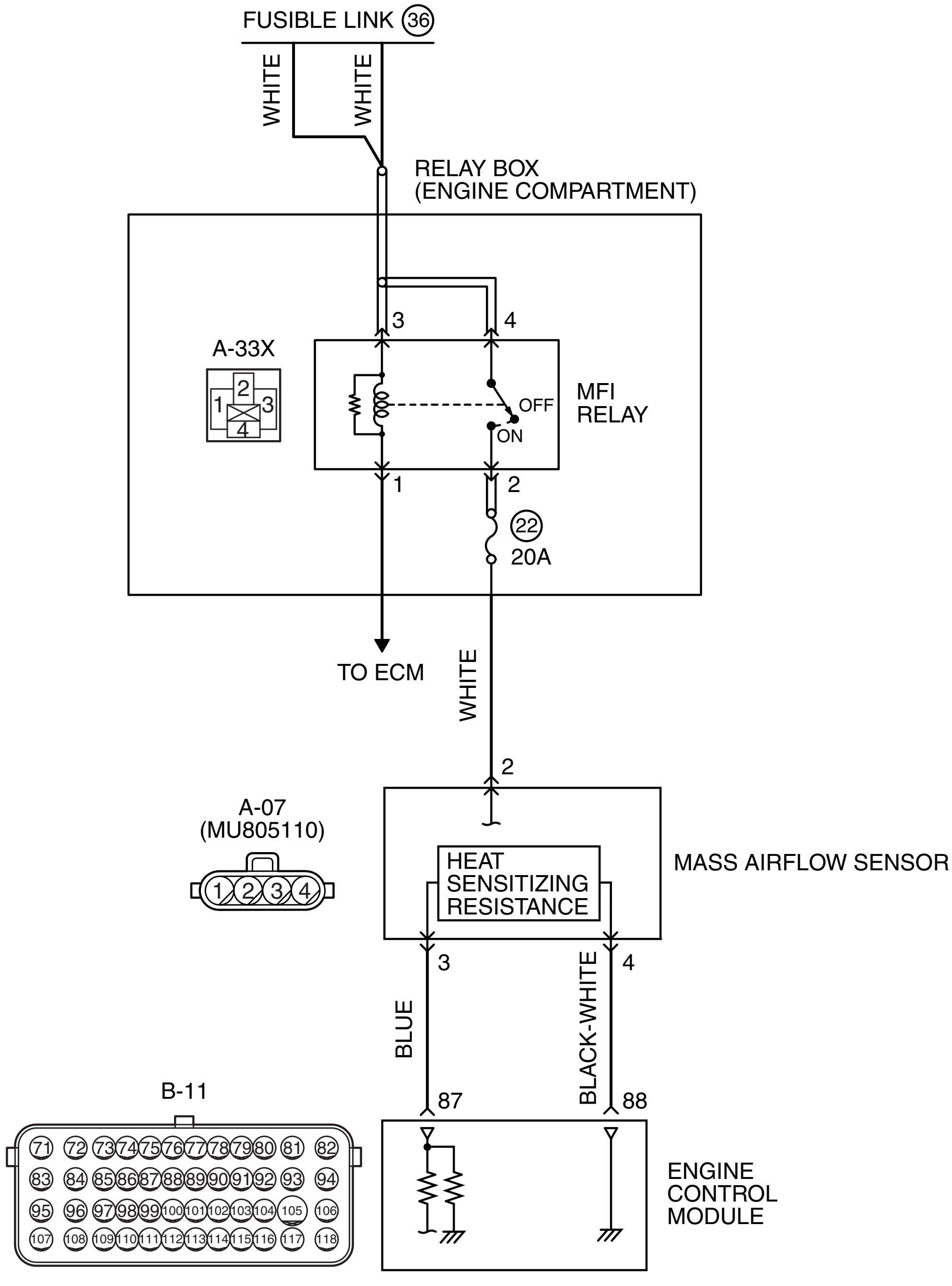
(1) Turn the ignition switch to the "ON" position.
(2) Erase the DTC.
(3) Start the engine.
(4) Turn the ignition switch to "LOCK" (OFF) position and then wait 2 seconds.
(5) Turn the ignition switch to the "ON" position.
(6) Set scan tool MB991958, read the DTC.
(7) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is DTC P0069 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0101: Mass Airflow Circuit Range/Performance Problem

MASS AIRFLOW SENSOR CIRCUIT



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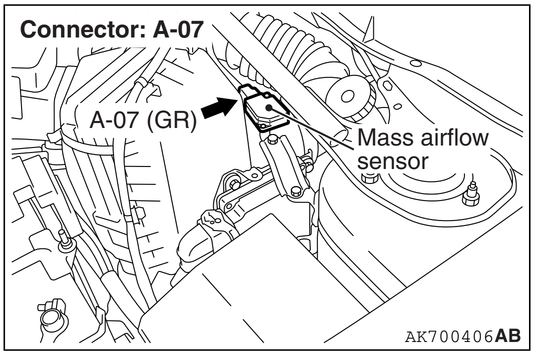
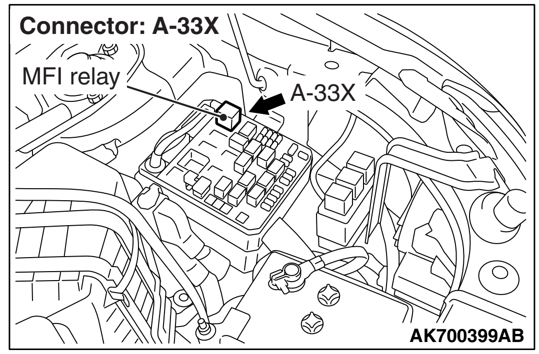
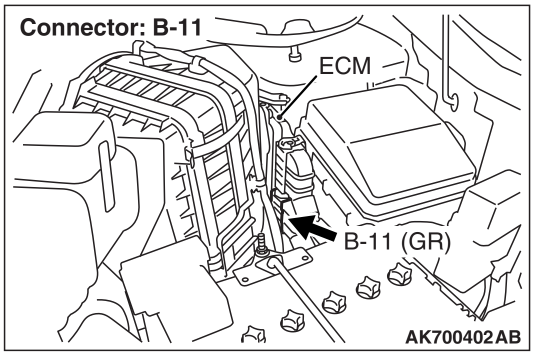






CIRCUIT OPERATION

- The mass airflow sensor power is supplied from the MFI relay (terminal No. 2), and the ground is provided on the ECM (terminal No. 88).
- A voltage that is according to the mass airflow rate is sent to the ECM (terminal No. 87) from the mass airflow sensor output terminal (terminal No. 3).

TECHNICAL DESCRIPTION

- While the engine is running, the mass airflow sensor outputs voltage which corresponds to the mass airflow rate.
- The ECM checks whether the voltage output by the mass airflow sensor while the engine is running is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Compare load value with mass airflow sensor output voltage.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

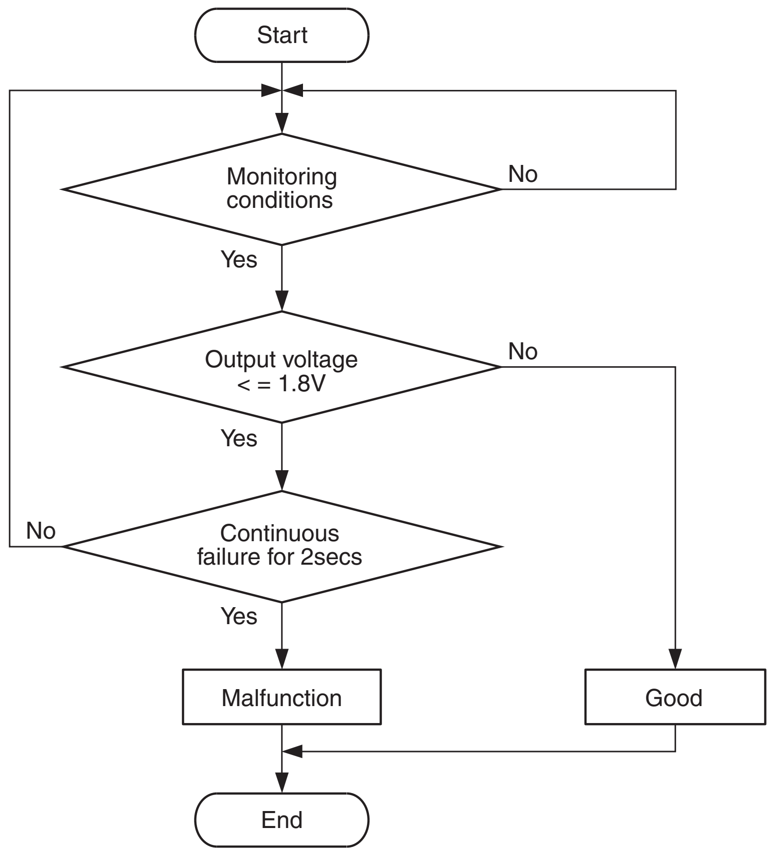
- Not applicable

Sensor (The sensor below is determined to be normal)

- Throttle position sensor

DTC SET CONDITIONS <Range/Performance problem - low input>

Logic Flow Chart



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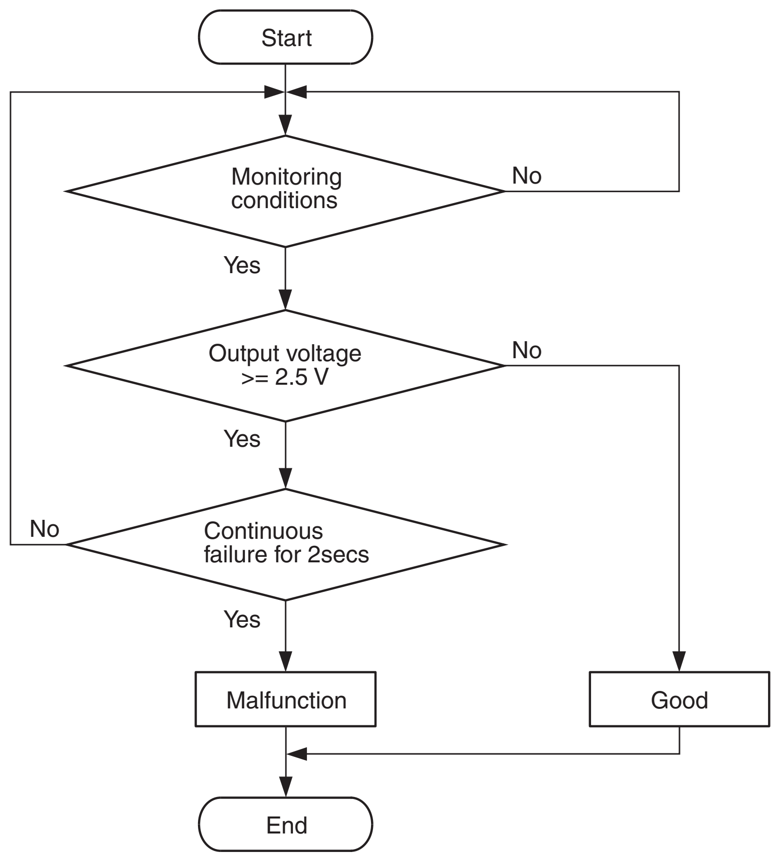
Check Conditions
- Engine speed is 1,500 r/min or higher.
- Throttle position sensor output voltage is 1.5 volts or higher.
- Mass airflow sensor output voltage is 0.2 volt or higher.

Judgement Criterion
- Mass airflow sensor output voltage has continued to be 1.8 volts or lower for 2 seconds.

DTC SET CONDITIONS <Range/Performance problem - high input>

Logic Flow Chart



AK900353

Check Conditions

- Throttle position sensor output voltage is 0.8 volt or lower.
- Mass airflow sensor output voltage is 4.9 volts or lower.

Judgement Criterion

- Mass airflow sensor output voltage has continued to be 2.5 volts or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.

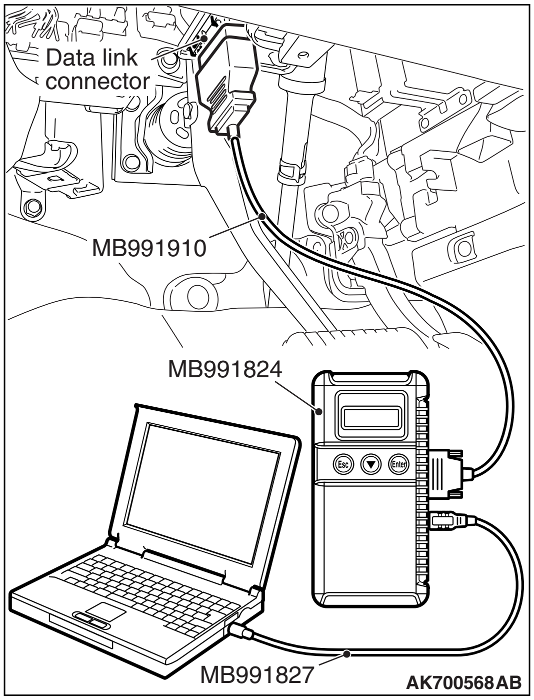
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Mass airflow sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 10: Mass Airflow Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item 10, Mass Airflow Sensor.
(4) Warm up the engine to normal operating temperature: 80°C to 95°C (176°F to 203°F).
- The standard value during idling should be between 1,350 and 1,670 millivolts.
- When the engine is revved, the mass airflow rate should increase according to the increase in engine speed.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

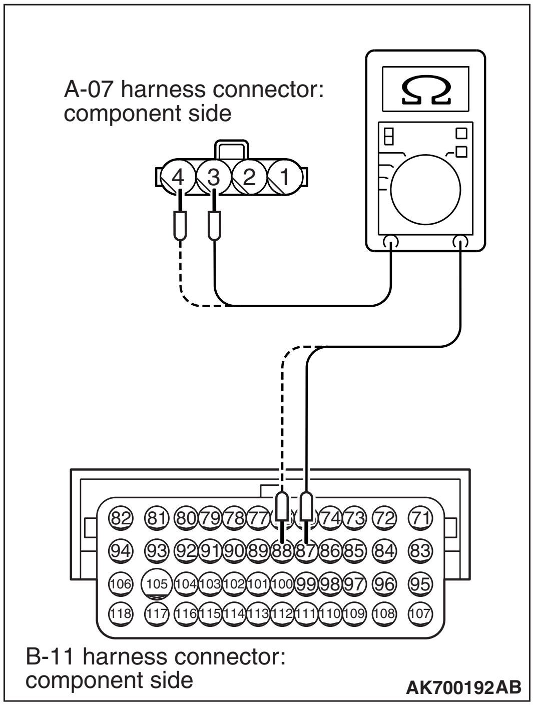
NO : Go to Step 2.

STEP 2. Check harness connector A-07 at the mass airflow sensor and harness connector B-11 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.

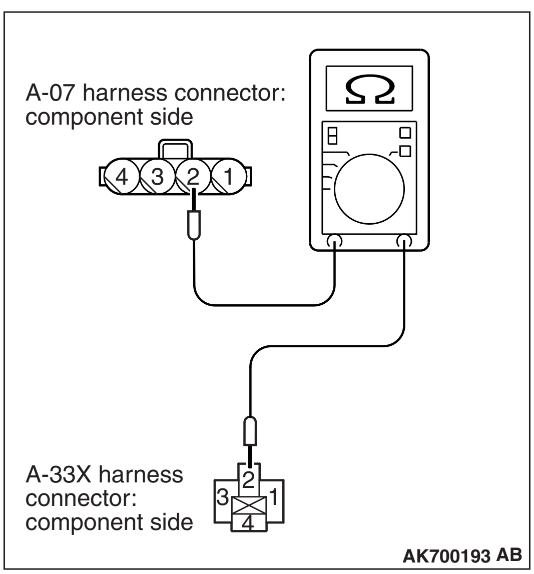


STEP 3. Check for harness damage between the mass airflow sensor connector A-07 and the ECM connector B-11.

(1) Disconnect the mass airflow sensor connector A-07 and the ECM connector B-11.
(2) Measure the resistance between the mass airflow sensor connector A-07 and the ECM connector B-11.
  a. Connector A-07 (terminal No. 3) and Connector B-11 (terminal No. 87).
  b. Connector A-07 (terminal No. 4) and Connector B-11 (terminal No. 88).
    - Should be less than 2 ohms.

Q: Is the measured resistance less than 2 ohms?

YES : Go to Step 4.
NO : Repair it. Then go to Step 6.



STEP 4. Check for harness the MFI relay connector A-33X (terminal No. 2) and the mass airflow sensor connector A-07 (terminal No. 2).

(1) Disconnect the MFI relay connector A-33X and the mass airflow sensor connector A-07.
(2) Measure the resistance between the MFI relay connector A-33X (terminal No. 2) and the mass airflow sensor A-07 (terminal No. 2).
  - Should be less than 2 ohms.

Q: Is the measured resistance less than 2 ohms?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Replace the mass airflow sensor.

(1) Replace the mass airflow sensor.
(2) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.
(3) Check the diagnostic trouble code (DTC).

Q: Is DTC P0101 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : The inspection is complete.

STEP 6. Test the OBD-II drive cycle.

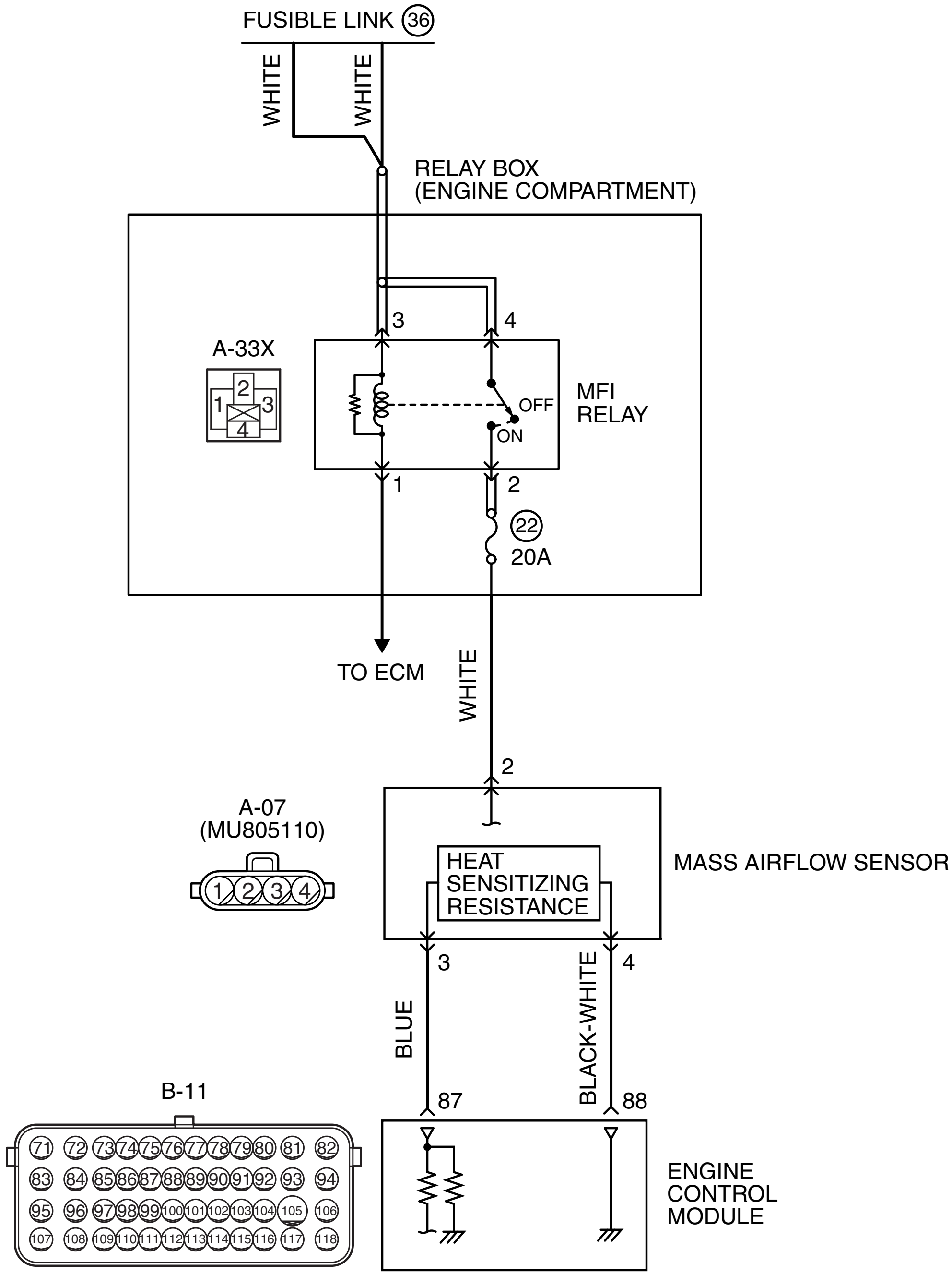
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0101 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0102: Mass Airflow Circuit Low Input

MASS AIRFLOW SENSOR CIRCUIT



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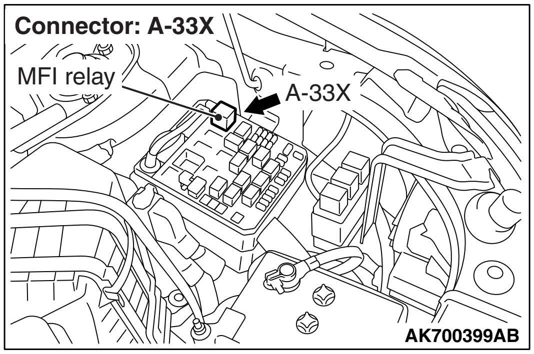
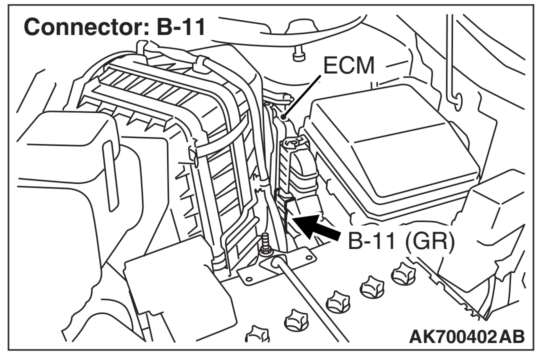
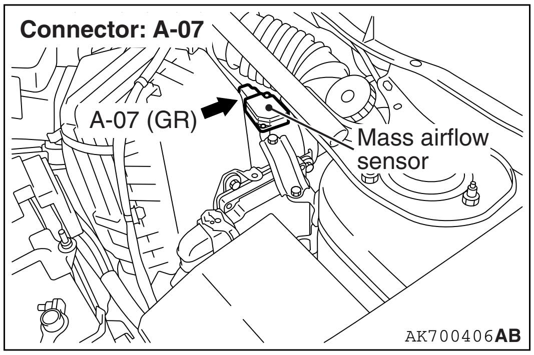






CIRCUIT OPERATION

- The mass airflow sensor power is supplied from the MFI relay (terminal No. 2), and the ground is provided on the ECM (terminal No. 88).
- A voltage that is according to the mass airflow rate is sent to the ECM (terminal No. 87) from the mass airflow sensor output terminal (terminal No. 3).

TECHNICAL DESCRIPTION

- While the engine is running, the mass airflow sensor outputs voltage which corresponds to the mass airflow rate.
- The ECM checks whether the voltage output by the mass airflow sensor while the engine is running is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Mass airflow sensor output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

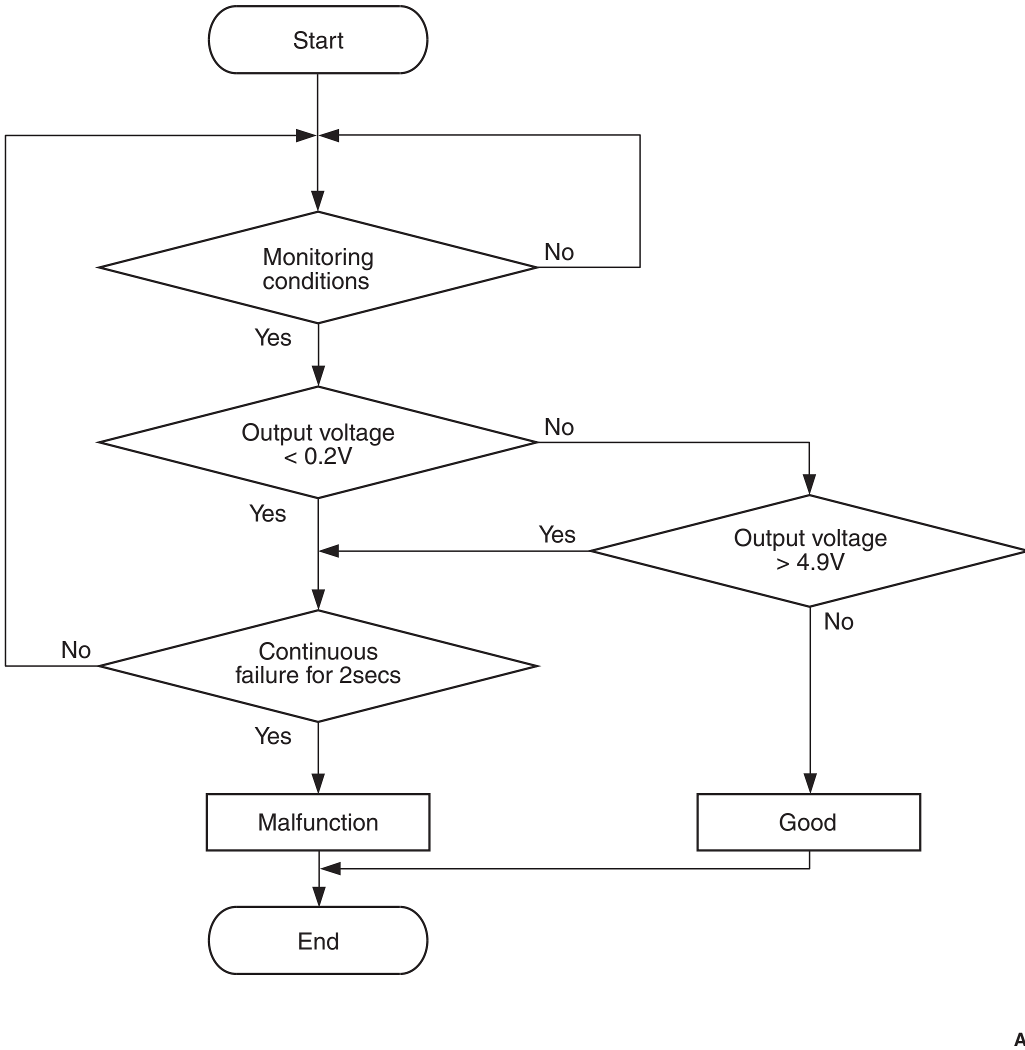
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- 3 seconds or more have passed since the ignition switch was turned to "ON" position.

Judgement Criterion

- Mass airflow sensor output voltage has continued to be 0.2 volt or lower for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

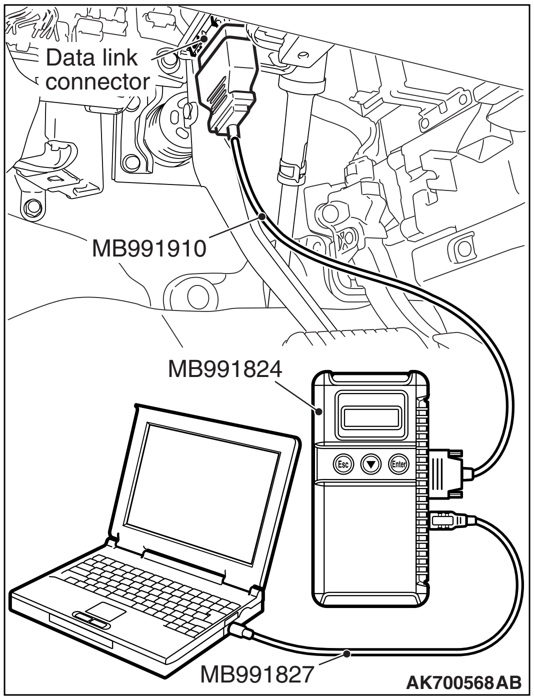
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Mass airflow sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 10: Mass Airflow Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item 10, Mass Airflow Sensor.
(4) Warm up the engine to normal operating temperature: 80°C to 95°C (176°F to 203°F).
- The standard value during idling should be between 1,350 and 1,670 millivolts.
- When the engine is revved, the mass airflow rate should increase according to the increase in engine speed.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

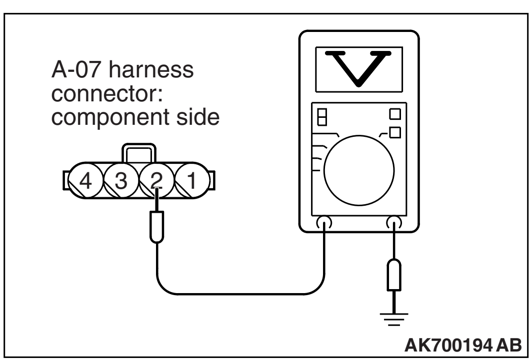
NO : Go to Step 2.

STEP 2. Check harness connector A-07 at the mass airflow sensor and harness connector B-11 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.



STEP 3. Measure the power supply voltage at the mass airflow sensor harness side connector A-07.

(1) Disconnect the connector A-07 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 2 and ground.
- Voltage should be battery positive voltage.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

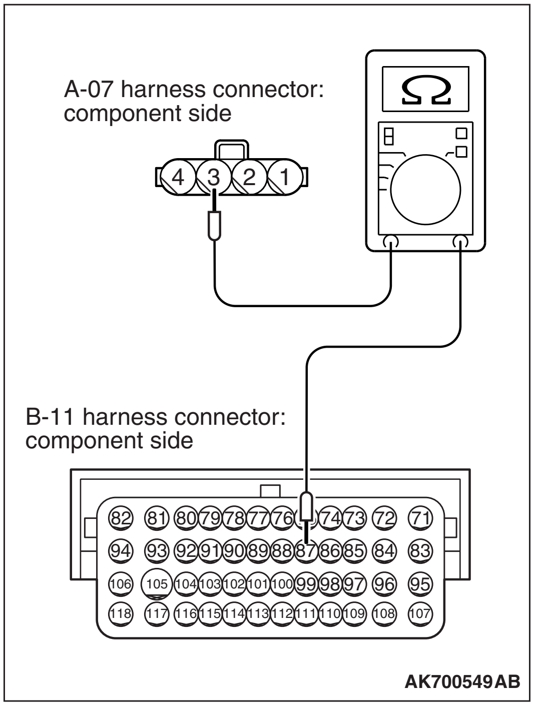
Q: Is battery positive voltage (approximately 12 volts) present?

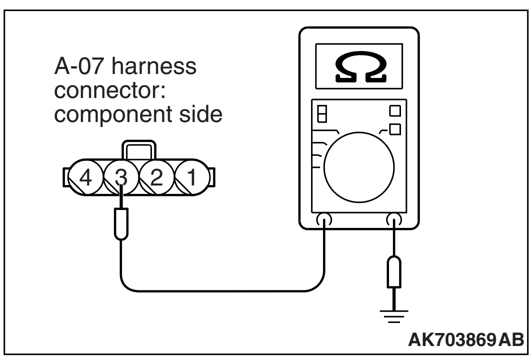
YES : Go to Step 4.

NO : Repair harness wire between the MFI relay connector A-33X (terminal No. 2) and the mass airflow sensor A-07 (terminal No. 2) because of open circuit or short circuit to ground. Then go to step 6.

STEP 4. Check for open circuit or short circuit to ground between the mass airflow sensor connector A-07 and ECM connector B-11.

(1) Disconnect the mass airflow sensor A-07 and the ECM connector B-11.
(2) Measure the resistance between the mass airflow sensor connector A-07 (terminal No. 3) and ECM connector B-11 (terminal No. 87).
- Should be less than 2 ohms.





(3) Check for the continuity between the mass airflow sensor A-07 (terminal No. 3) and ground.
- Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 6.

STEP 5. Replace the mass airflow sensor.

(1) Replace the mass airflow sensor.
(2) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(3) Check the diagnostic trouble code (DTC).

Q: Is DTC P0102 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : The inspection is complete.

STEP 6. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

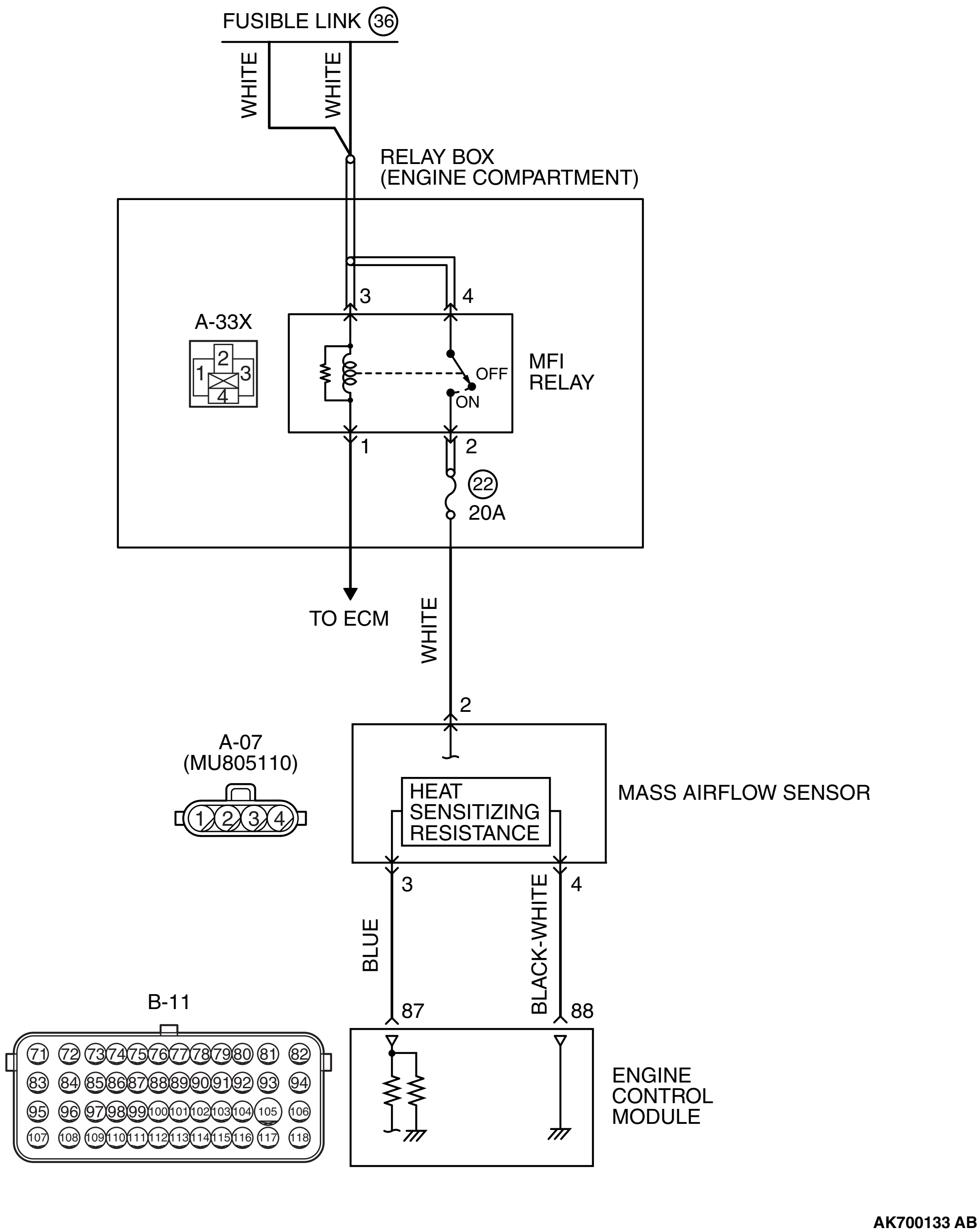
Q: Is DTC P0102 set?

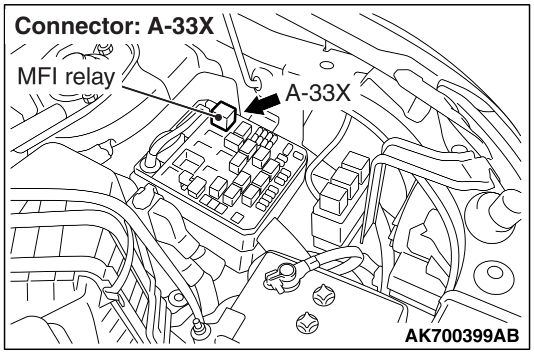
YES : Retry the troubleshooting.

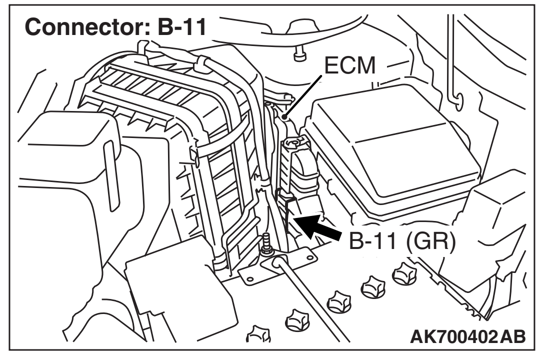
NO : The inspection is complete.

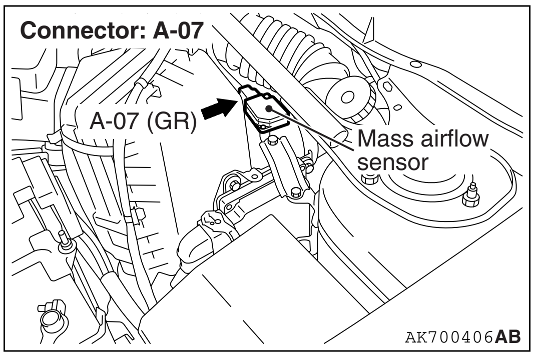
DTC P0103: Mass Airflow Circuit High Input

MASS AIRFLOW SENSOR CIRCUIT









CIRCUIT OPERATION

- The mass airflow sensor power is supplied from the MFI relay (terminal No. 2), and the ground is provided on the ECM (terminal No. 88).
- A voltage that is according to the mass airflow rate is sent to the ECM (terminal No. 87) from the mass airflow sensor output terminal (terminal No. 3).

TECHNICAL DESCRIPTION

- While the engine is running, the mass airflow sensor outputs voltage which corresponds to the mass airflow rate.
- The ECM checks whether the voltage output by the mass airflow sensor while the engine is running is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Compare load value with mass airflow sensor output voltage.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

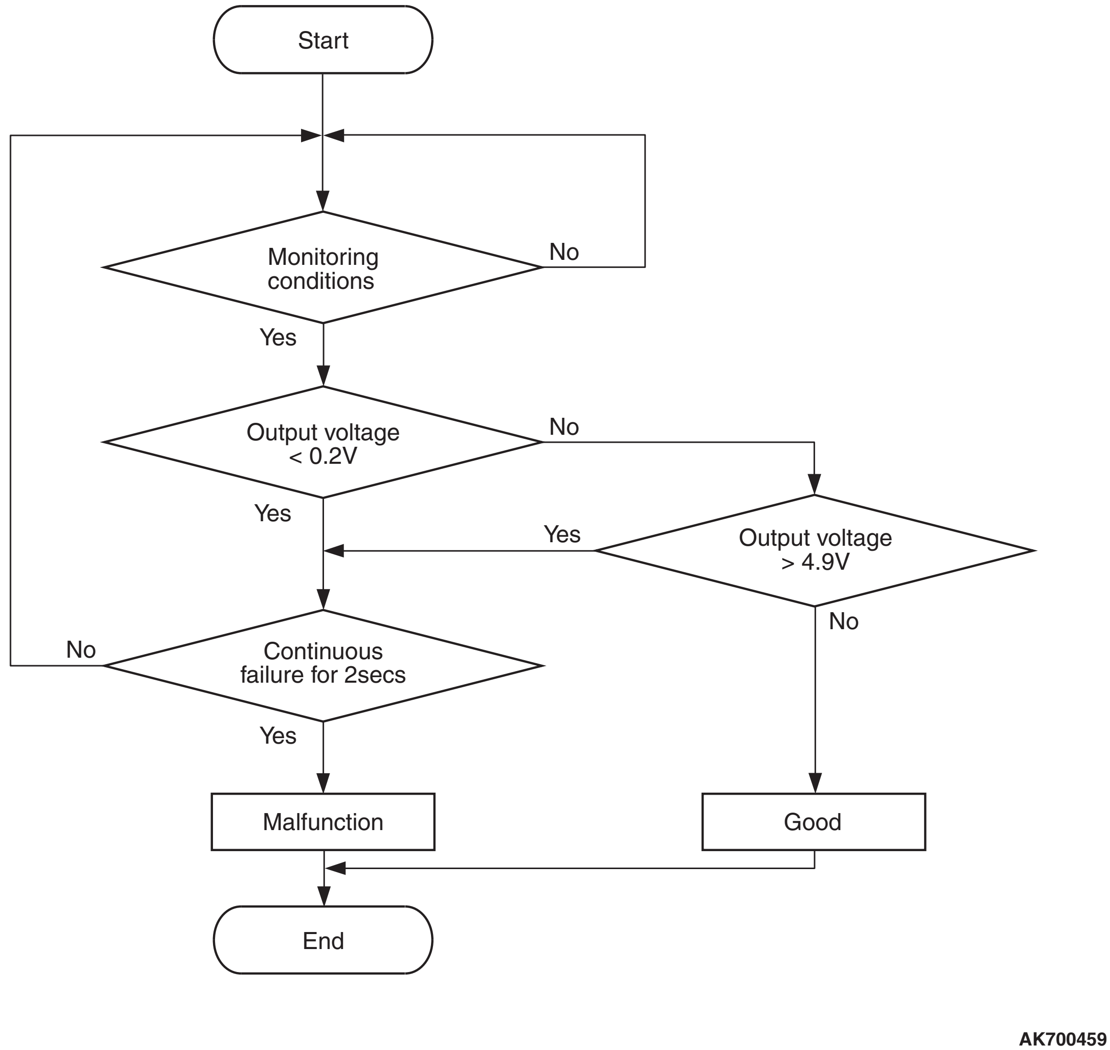
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- 3 seconds or more have passed since the ignition switch was turned to "ON" position.

Judgement Criterion

- Mass airflow sensor output voltage has continued to be higher than 4.9 volts for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

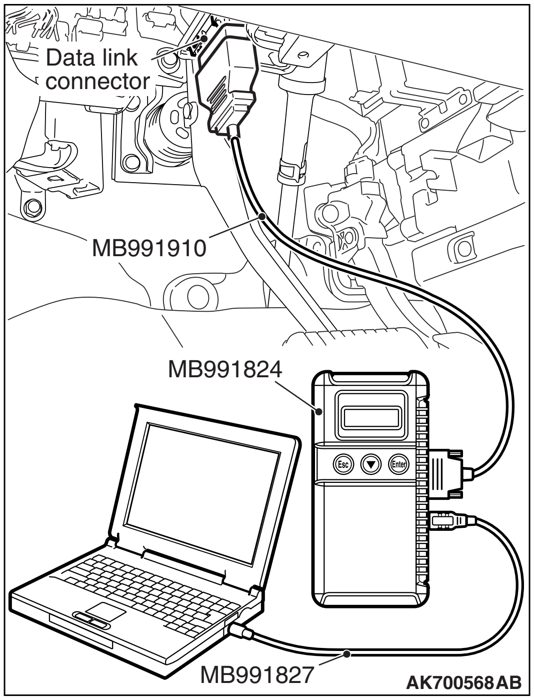
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Mass airflow sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 10: Mass Airflow Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item 10, Mass Airflow Sensor.
(4) Warm up the engine to normal operating temperature: 80°C to 95°C (176°F to 203°F).
- The standard value during idling should be between 1,350 and 1,670 millivolts.
- When the engine is revved, the mass airflow rate should increase according to the increase in engine speed.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

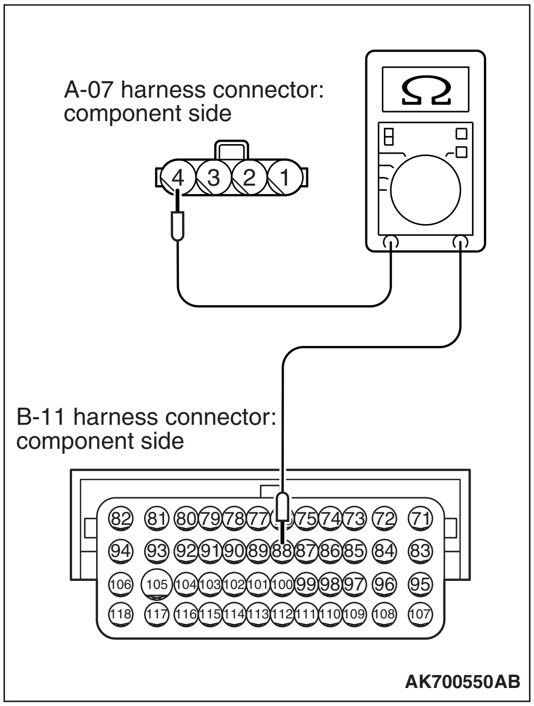
NO : Go to Step 2.

STEP 2. Check harness connector A-07 at the mass airflow sensor and harness connector B-11 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.



STEP 3. Check for the continuity between the mass airflow sensor connector A-07 and the ECM connector B-11.

(1) Disconnect the mass airflow sensor connector A-07 and the ECM connector B-11.

(2) Check for the continuity between the mass airflow sensor connector A-07 (terminal No. 4) and the ECM connector B-11 (terminal No. 88).

- Should be less than 2 ohms.

Q: Does continuity exist?

YES : Go to Step 4.

NO : Repair it. Then go to Step 5.

STEP 4. Replace the mass airflow sensor.

(1) Replace the mass airflow sensor.

(2) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

(3) Check the diagnostic trouble code (DTC).

Q: Is DTC P0102 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 5.

NO : The inspection is complete.

STEP 5. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

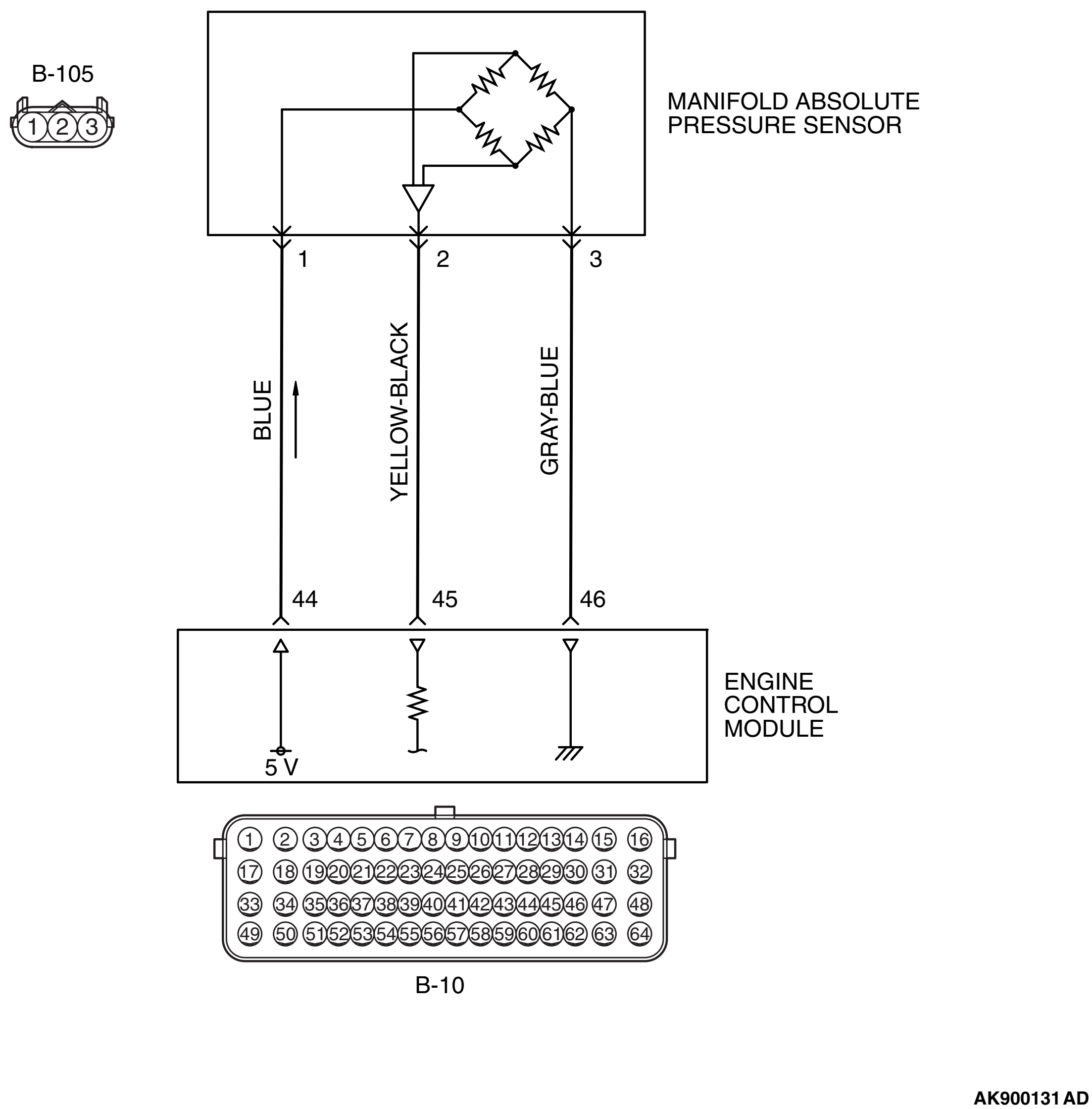
Q: Is DTC P0103 set?

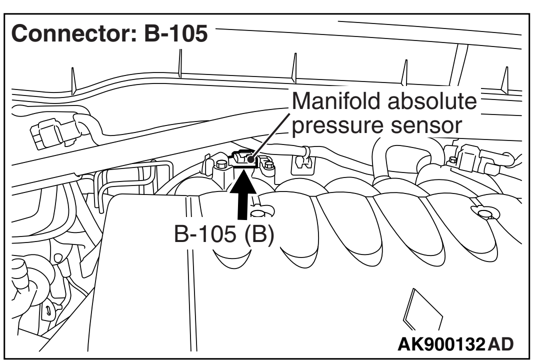
YES : Retry the troubleshooting.

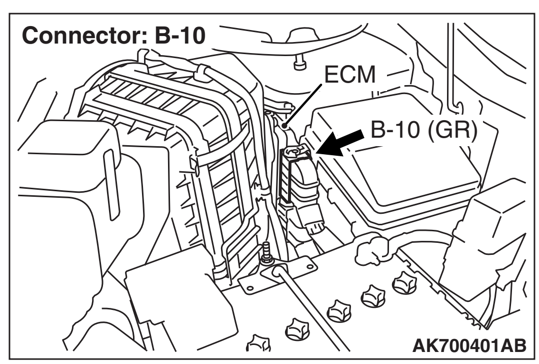
NO : The inspection is complete.

DTC P0106: Manifold Absolute Pressure Circuit Range/Performance Problem

MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT







CIRCUIT OPERATION

- A 5-volt voltage is supplied to the manifold absolute pressure sensor power terminal (terminal No. 3) from the ECM (terminal No. 44). The ground terminal (terminal No. 2) is grounded with ECM (terminal No. 46).
- A voltage that is proportional to the intake manifold pressure is sent to the ECM (terminal No. 45) from the manifold absolute pressure sensor output terminal (terminal No. 1).

TECHNICAL DESCRIPTION

- The manifold absolute pressure sensor outputs a voltage which corresponds to the intake manifold pressure.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Compare load value with manifold absolute pressure sensor output voltage.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

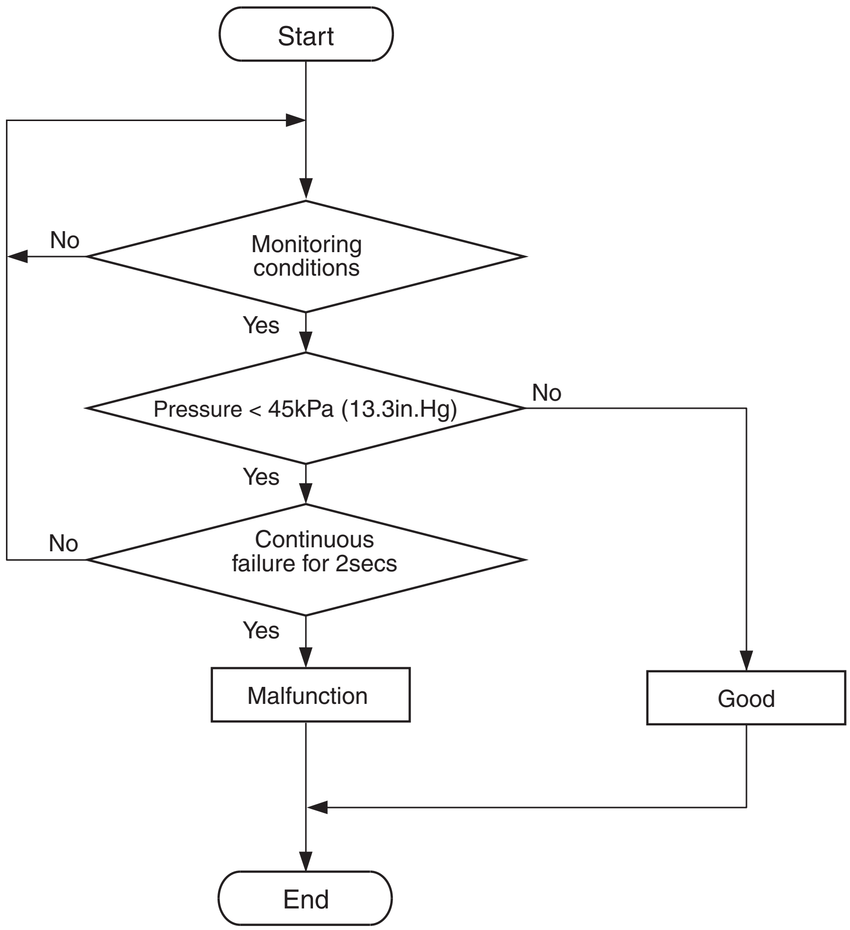
- Not applicable

Sensor (The sensor below is determined to be normal)

- Engine coolant temperature sensor
- Throttle position sensor
- Mass airflow sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITIONS <Range/Performance problem - low input>

Logic Flow Chart



Check Conditions

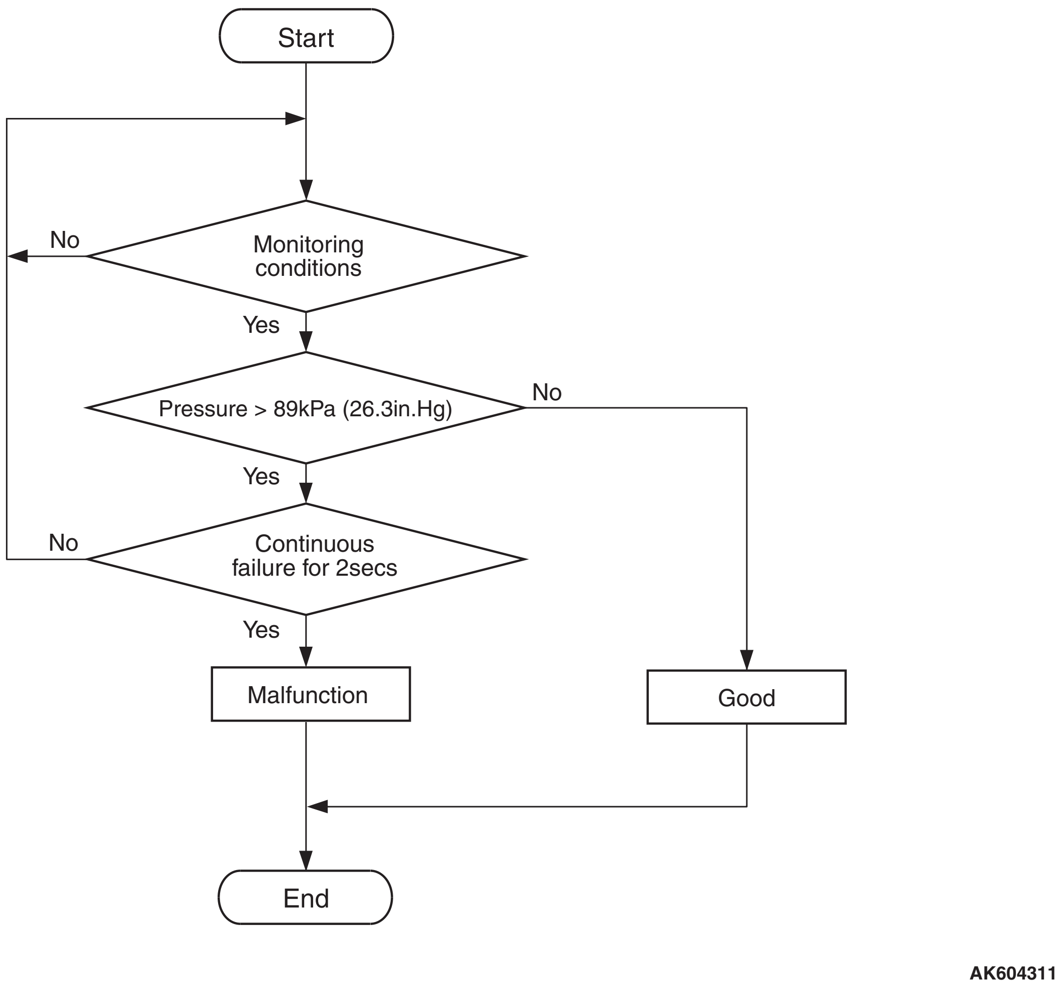
- 8 minutes or more have passed since the engine starting sequence was completed, when the engine coolant temperature at engine start is 0°C (32°F) or lower.
- Engine speed is higher than 1,500 r/min.
- Throttle position sensor output voltage is higher than 3.5 volts.

Judgement Criterion

- Manifold absolute pressure is 45 kPa (13.3 in.Hg) or lower for 2 seconds.

DTC SET CONDITIONS <Range/Performance problem - high input>

Logic Flow Chart



Check Conditions

- 8 minutes or more have passed since the engine starting sequence was completed, when the engine coolant temperature at engine start is 0°C (32°F) or lower.
- Engine speed is between 500 and 1,500 r/min.
- Throttle position sensor output voltage is lower than 0.9 volt.

Judgement Criterion

- Manifold absolute pressure is 89 kPa (26.3 in.Hg) or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

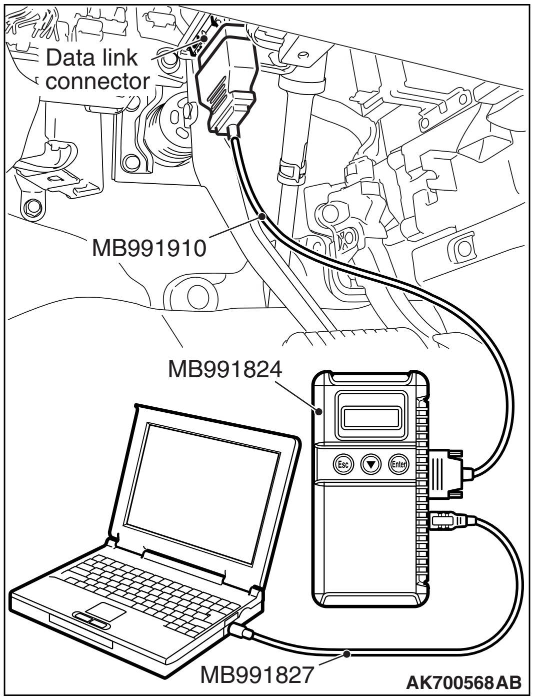
- Manifold absolute pressure sensor failed.
- Harness damage.
- Connector damage.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A

STEP 1. Using scan tool MB991958, check data list item 8: Manifold Absolute Pressure Sensor.



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 8, Manifold Absolute Pressure Sensor.
- When altitude is 0 m (0 foot), 101 kPa (29.8 in.Hg).
- When altitude is 600 m (1,969 feet), 95 kPa (28.1 in.Hg).
- When altitude is 1,200 m (3,937 feet), 88 kPa (26.0 in.Hg).
- When altitude is 1,800 m (5,906 feet), 81 kPa (23.9 in.Hg).

(4) Start the engine.
- When the engine is idling, 16 – 36 kPa (4.7 – 10.6 in.Hg).
- When the engine is suddenly revved, manifold absolute pressure varies.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

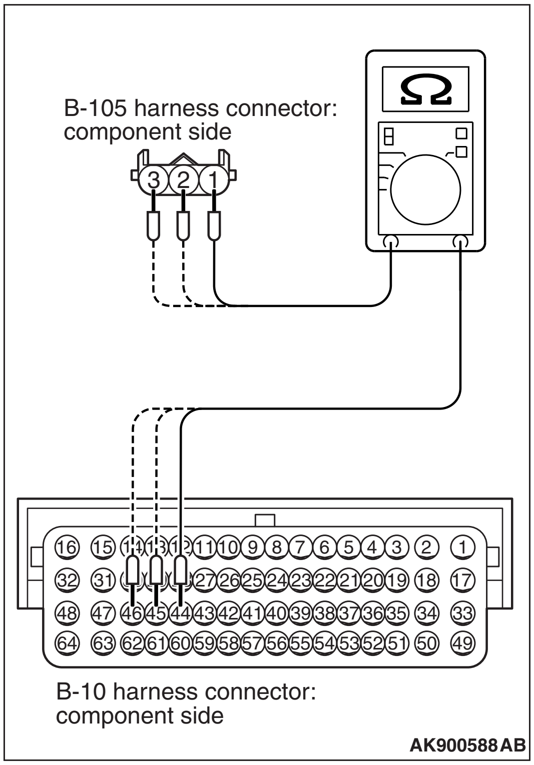
NO : Go to Step 2.

STEP 2. Check harness connector B-105 at the manifold absolute pressure sensor and harness connector B-10 at ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.



STEP 3. Check harness connector B-105 at the manifold absolute pressure sensor and harness connector B-10 at ECM for damage.

(1) Disconnect the manifold absolute pressure sensor connector B-105 between the ECM connector B-10.

a. Measure the resistance between the manifold absolute pressure sensor connector B-105 (terminal No. 1) and the ECM connector B-10 (terminal No. 44).

b. Measure the resistance between the manifold absolute pressure sensor connector B-105 (terminal No. 2) and the ECM connector B-10 (terminal No. 45).

c. Measure the resistance between the manifold absolute pressure sensor connector B-105 (terminal No. 3) and the ECM connector B-10 (terminal No. 46).

- Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Go to step 4.
NO : Repair it. Then go to Step 5.

STEP 4. Replace the manifold absolute pressure sensor.

(1) Replace the manifold absolute pressure sensor.
(2) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.
(3) Check the diagnostic trouble code (DTC).

Q: Is DTC P0106 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 5.
NO : The inspection is complete.

STEP 5. Test the OBD-II drive cycle.

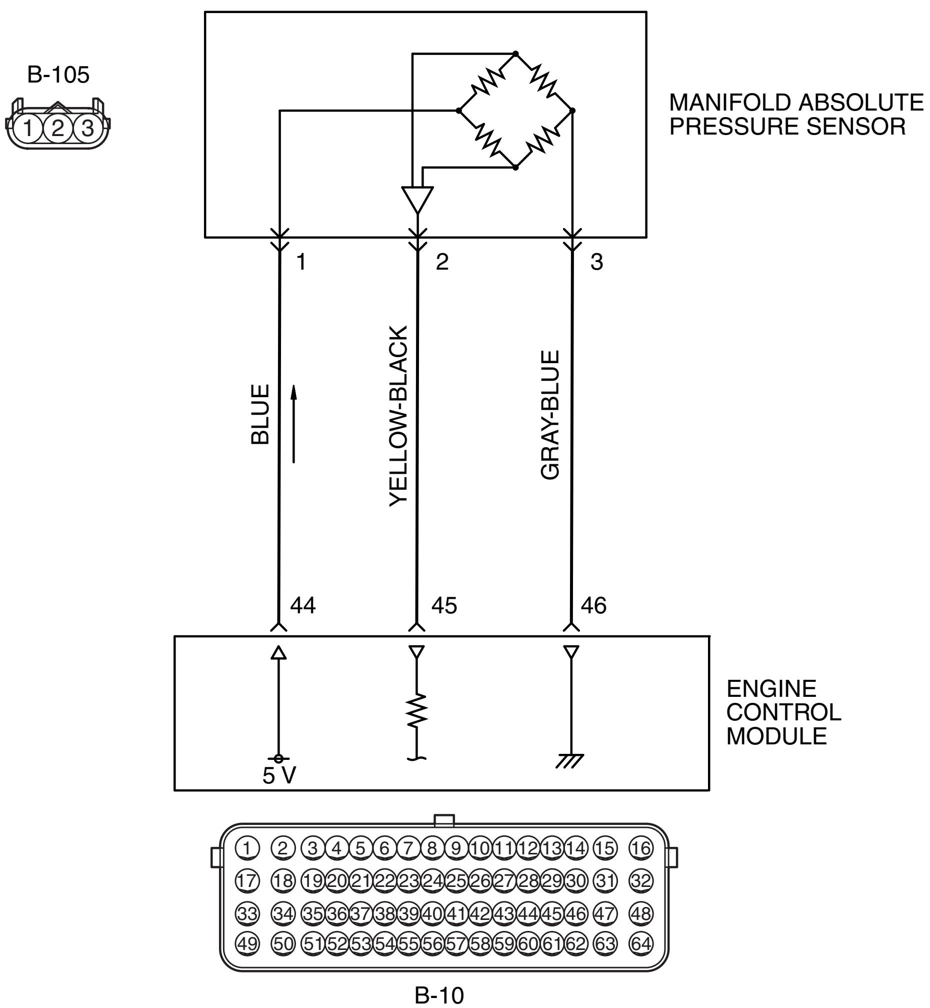
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0106 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0107: Manifold Absolute Pressure Circuit Low Input

MANIFOLD ABSOLUTE PRESSURE SENSOR CIRCUIT



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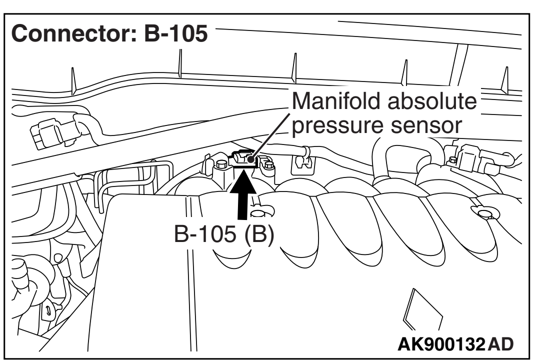
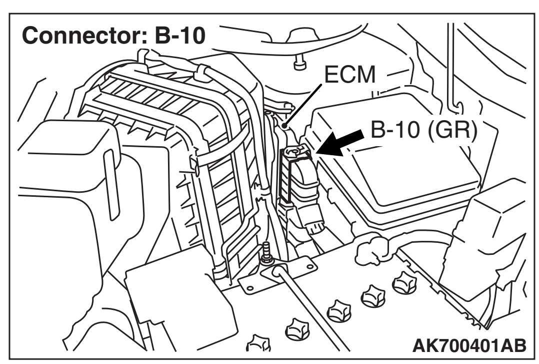




CIRCUIT OPERATION

- A 5-volt voltage is supplied to the manifold absolute pressure sensor power terminal (terminal No. 3) from the ECM (terminal No. 44). The ground terminal (terminal No. 2) is grounded with ECM (terminal No. 46).
- A voltage that is proportional to the intake manifold pressure is sent to the ECM (terminal No. 45) from the manifold absolute pressure sensor output terminal (terminal No. 1).

TECHNICAL DESCRIPTION

- The manifold absolute pressure sensor outputs a voltage which corresponds to the intake manifold pressure.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Manifold absolute pressure sensor output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

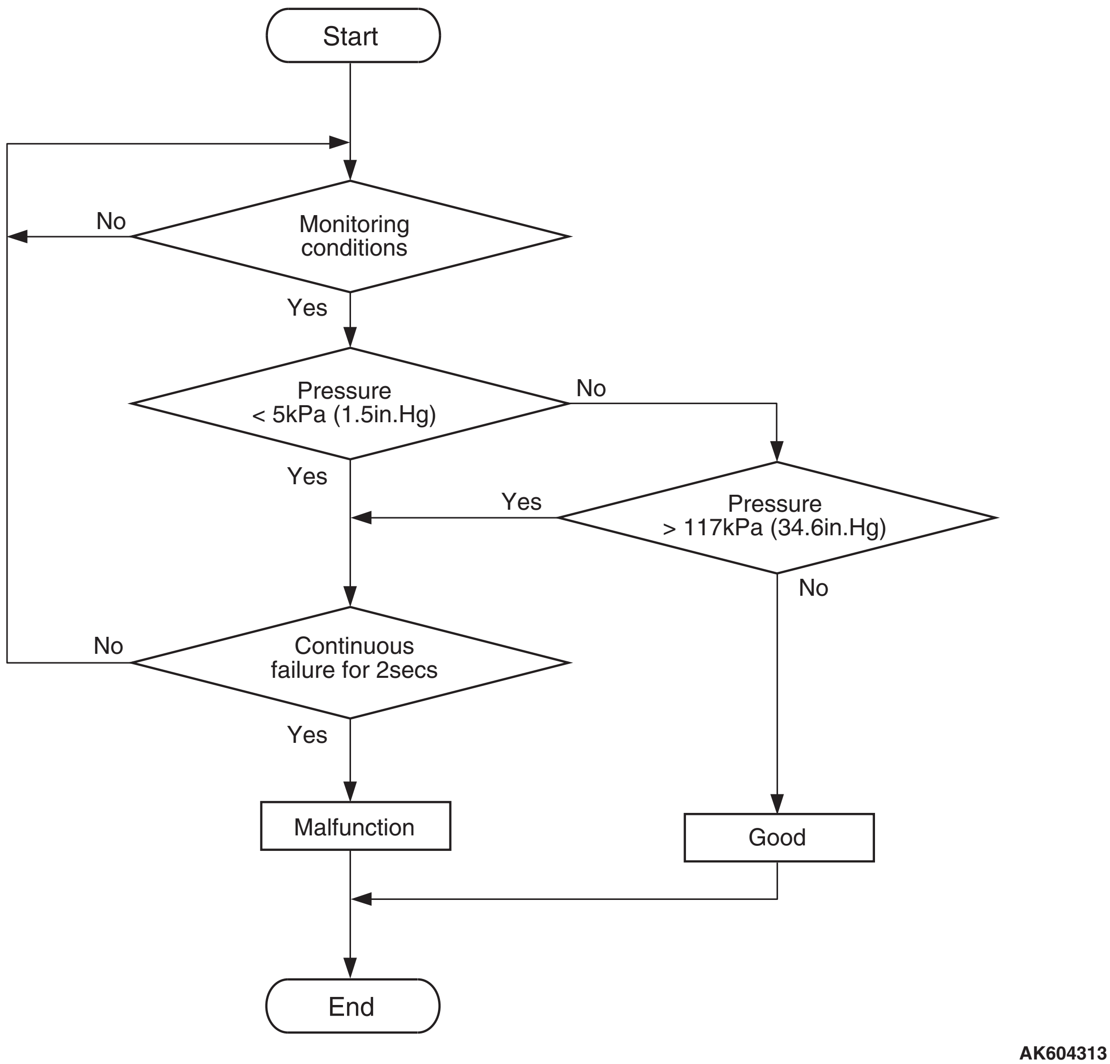
- Not applicable

Sensor (The sensor below is determined to be normal)

- Engine coolant temperature sensor
- Throttle position sensor
- Mass airflow sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- 8 minutes or more have passed since the engine starting sequence was completed, when the engine coolant temperature at engine start is 0°C (32°F) or lower.
- Volumetric efficiency is higher than 20 percent.

Judgement Criterion

- Manifold absolute pressure is 5 kPa (1.5 in.Hg) or lower for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.

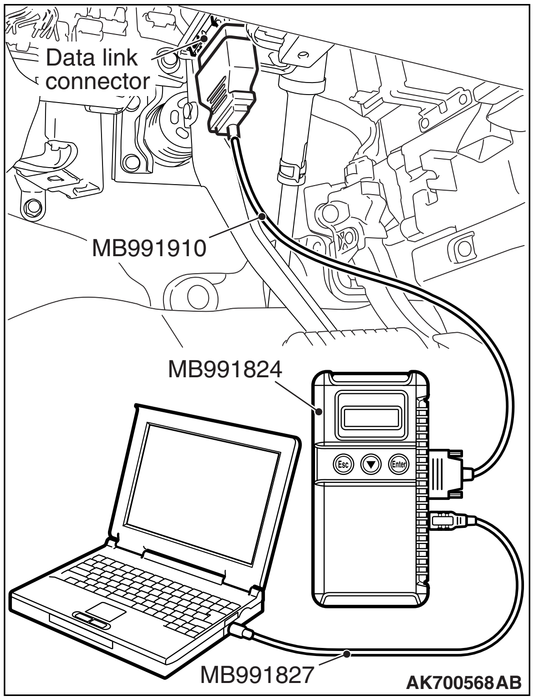
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Manifold absolute pressure sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 8: Manifold Absolute Pressure Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 8, Manifold Absolute Pressure Sensor.
- When altitude is 0 m (0 foot), 101 kPa (29.8 in.Hg).
- When altitude is 600 m (1,969 feet), 95 kPa (28.1 in.Hg).
- When altitude is 1,200 m (3,937 feet), 88 kPa (26.0 in.Hg).
- When altitude is 1,800 m (5,906 feet), 81 kPa (23.9 in.Hg).

(4) Start the engine.
- When the engine is idling, 16 – 36 kPa (4.7 – 10.6 in.Hg).
- When the engine is suddenly revved, manifold absolute pressure varies.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

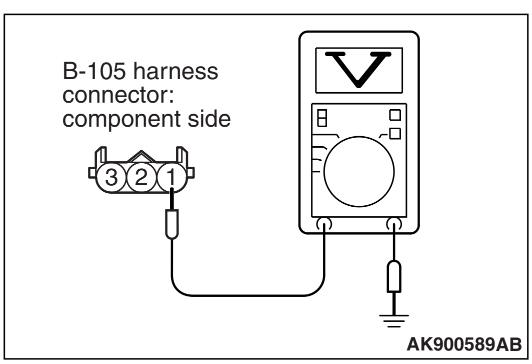
Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.
NO : Go to Step 2.

STEP 2. Check harness connector B-105 at the manifold absolute pressure sensor and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 7.



STEP 3. Measure the sensor supply voltage at manifold absolute pressure sensor connector B-105.

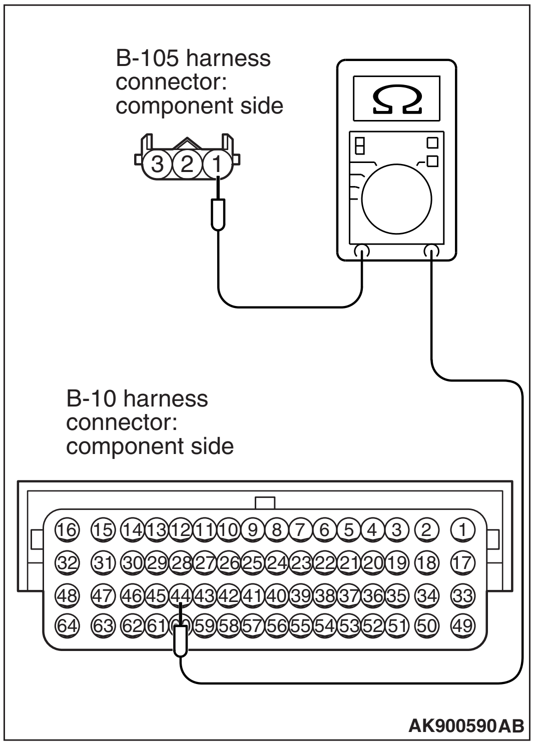
(1) Disconnect the connector B-105.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 1 and ground.
- Voltage should be between 4.9 and 5.1 volts.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

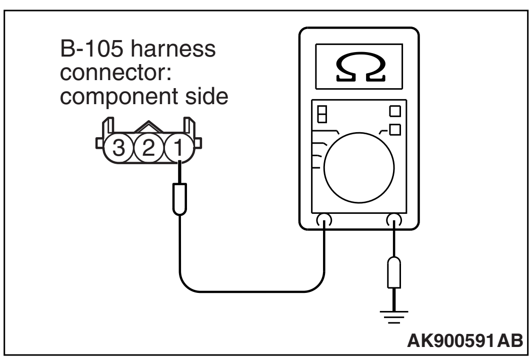
Q: Is the measured voltage between 4.9 and 5.1 volts?

YES : Go to Step 5.
NO : Go to Step 4.

STEP 4. Check for open circuit and short circuit to ground between manifold absolute pressure sensor connector B-105 and ECM connector B-10.



(1) Disconnect the manifold absolute pressure sensor connector B-105 and the ECM connector B-10
(2) Measure the resistance between the manifold absolute pressure sensor connector B-105 (terminal No. 1) and the ECM connector B-10 (terminal No. 44).
- Should be less than 2 ohms.

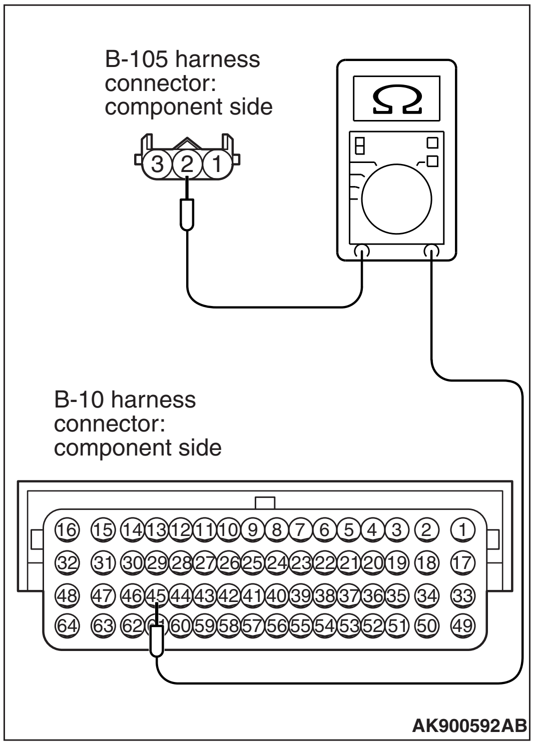


(3) Check for the continuity between the manifold absolute pressure sensor B-105 (terminal No. 1) and ground.
- Not continuity.

Q: Is the harness wire in good condition?

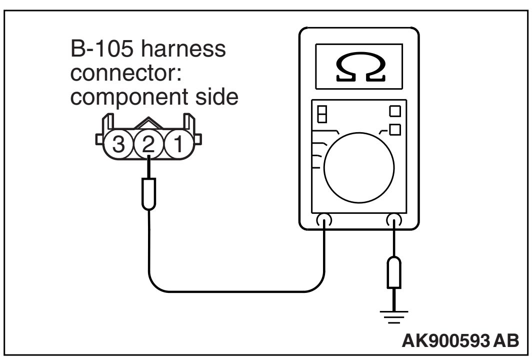
YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to step 7.

NO : Repair it. Then go to Step 7.



STEP 5. Check for open circuit and short circuit to ground between manifold absolute pressure sensor connector B-105 and ECM connector B-10.

(1) Disconnect the manifold absolute pressure sensor connector B-105 between the ECM connector B-10.
(2) Measure the resistance between the manifold absolute pressure sensor connector B-105 (terminal No. 2) and the ECM connector B-10 (terminal No. 45).
- Should be less than 2 ohms.



(3) Check for the continuity between the manifold absolute pressure sensor B-105 (terminal No. 2) and ground.
- Not continuity.

Q: Is the harness in good condition?

YES : Go to Step 6.
NO : Repair it. Then go to Step 7.

STEP 6. Replace the manifold absolute pressure sensor.

(1) Replace the manifold absolute pressure sensor.
(2) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.
(3) Check the diagnostic trouble code (DTC).

Q: Is DTC P0107 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 7.
NO : The inspection is complete.

STEP 7. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 7 P.13B-11.

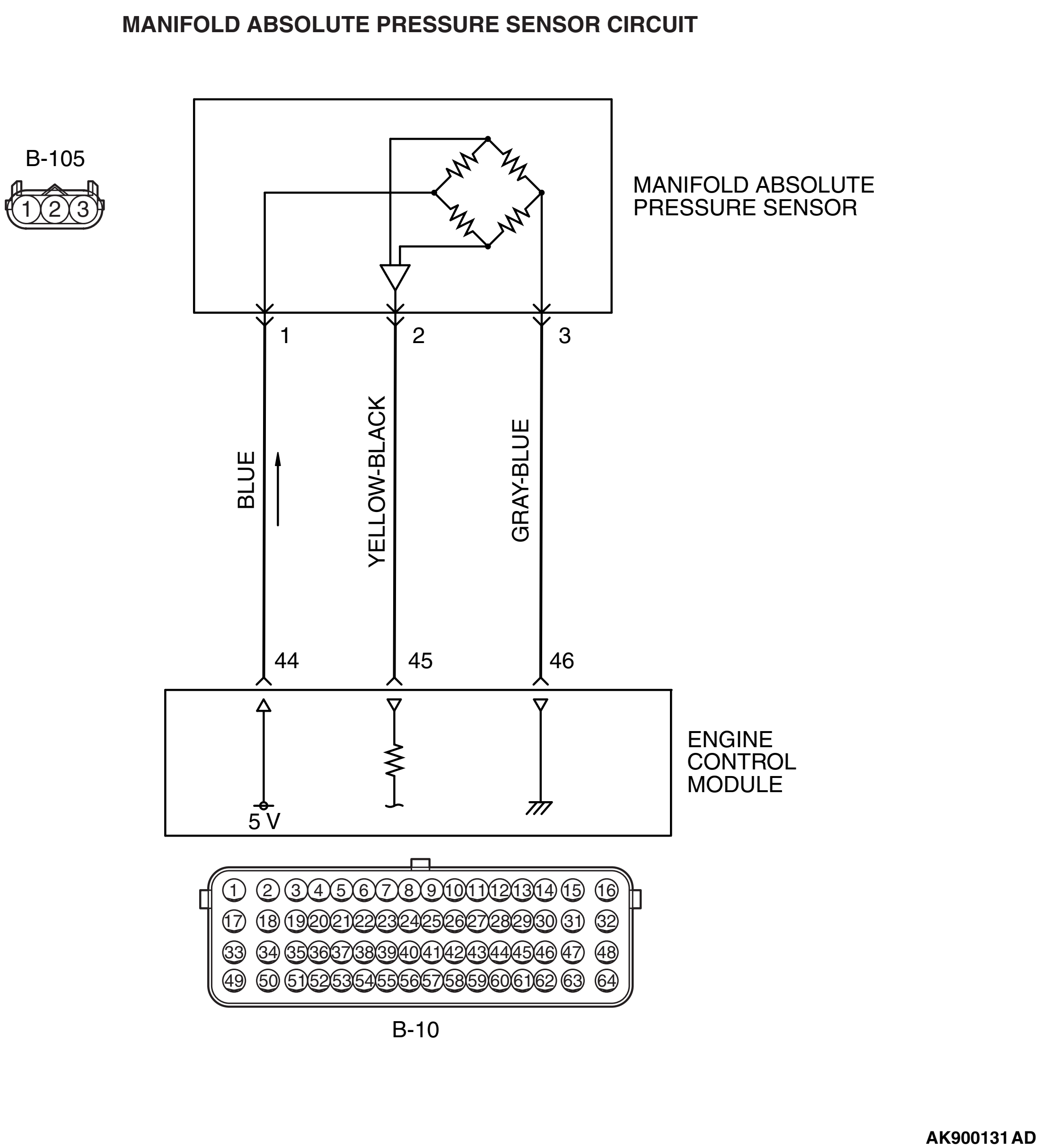
(2) Check the diagnostic trouble code (DTC).

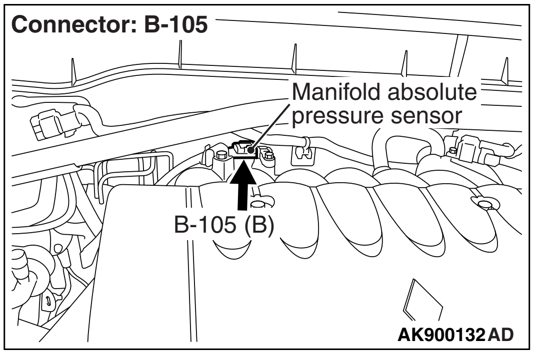
Q: Is DTC P0107 set?

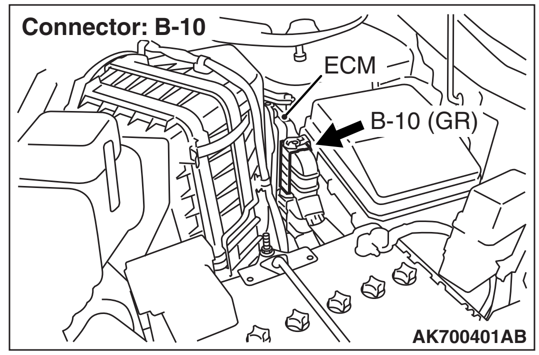
YES : Retry the troubleshooting.

NO : The inspection is complete.

DTC P0108: Manifold Absolute Pressure Circuit High Input







CIRCUIT OPERATION

- A 5-volt voltage is supplied to the manifold absolute pressure sensor power terminal (terminal No. 3) from ECM (terminal No. 44). The ground terminal (terminal No. 2) is grounded with ECM (terminal No. 46).
- A voltage that is proportional to the intake manifold pressure is sent to the ECM (terminal No. 45) from the manifold absolute pressure sensor output terminal (terminal No. 1).

TECHNICAL DESCRIPTION

- The manifold absolute pressure sensor outputs a voltage which corresponds to the intake manifold pressure.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Manifold absolute pressure sensor output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

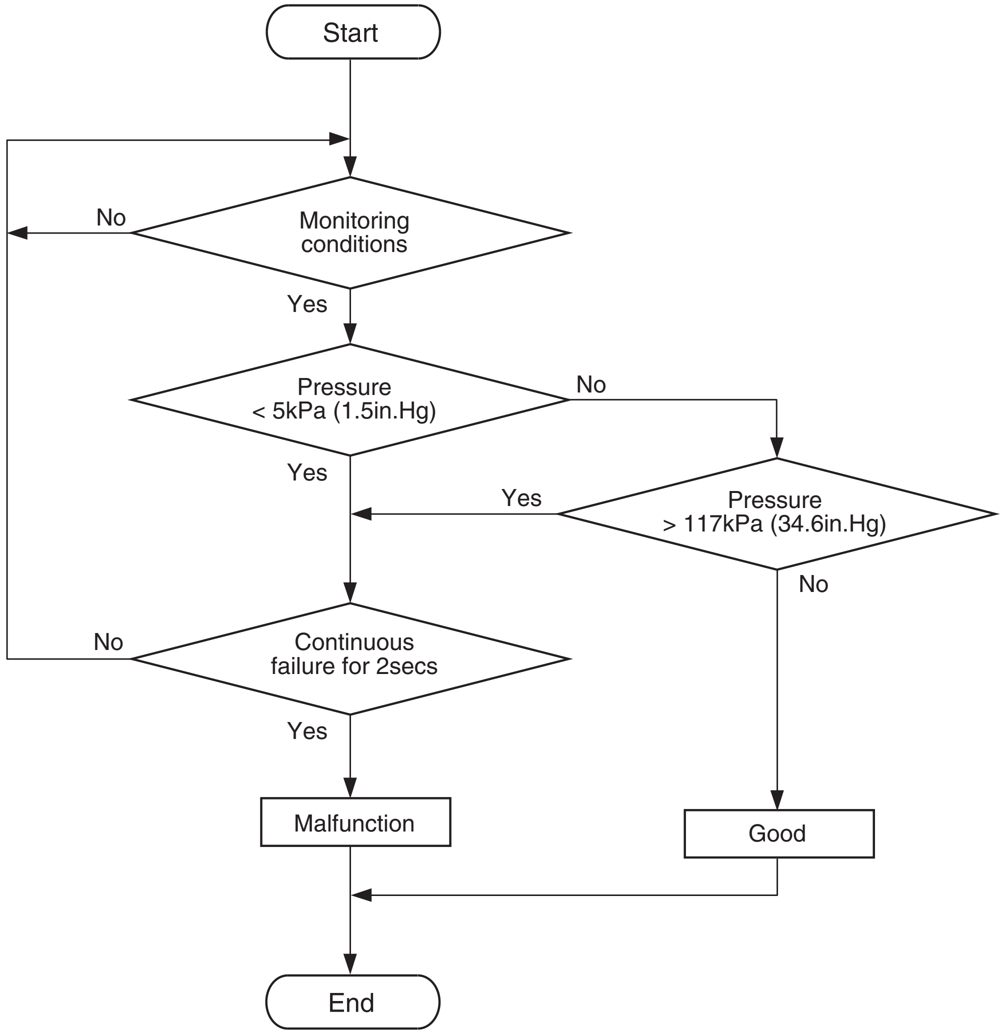
- Not applicable

Sensor (The sensor below is determined to be normal)

- Engine coolant temperature sensor
- Throttle position sensor
- Mass airflow sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITIONS Range/Performance problem - low input

Logic Flow Chart



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Check Conditions

- 8 minutes or more have passed since the engine starting sequence was completed, when the engine coolant temperature at engine start is 0°C (32°F) or lower.

Judgement Criterion

- Manifold absolute pressure is 117 kPa (34.6 in.Hg) or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

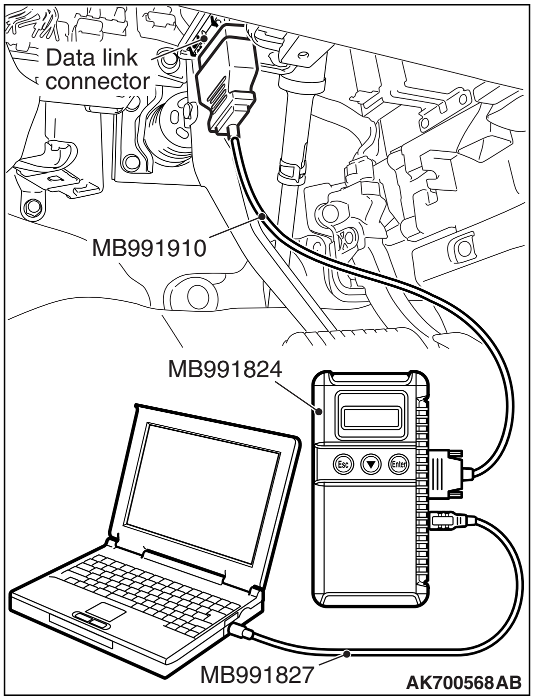
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Manifold absolute pressure sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 8: Manifold Absolute Pressure Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 8, Manifold Absolute Pressure Sensor.
- When altitude is 0 m (0 foot), 101 kPa (29.8 in.Hg).
- When altitude is 600 m (1,969 feet), 95 kPa (28.1 in.Hg).
- When altitude is 1,200 m (3,937 feet), 88 kPa (26.0 in.Hg).
- When altitude is 1,800 m (5,906 feet), 81 kPa (23.9 in.Hg).

(4) Start the engine.
- When the engine is idling, 16 – 36 kPa (4.7 – 10.6 in.Hg).
- When the engine is suddenly revved, manifold absolute pressure varies.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

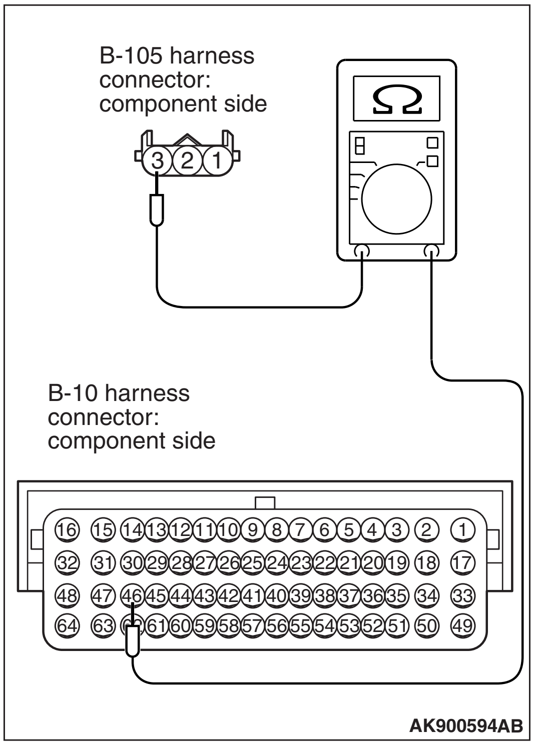
NO : Go to Step 2.

STEP 2. Check harness connector B-105 at the manifold absolute pressure sensor and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.



STEP 3. Check the continuity at the manifold absolute pressure sensor connector B-105 and the ECM connector B-10 for damage.

(1) Disconnect the manifold absolute pressure sensor connector B-105 and the ECM connector B-10.

(2) Check for the continuity between the manifold absolute pressure sensor connector B-105 (terminal No. 3) and the ECM connector B-10 (terminal No. 46).

- Should be less than 2 ohms.

Q: Is the harness in good condition?

YES : Go to Step 4.

NO : Repair it. Then go to step 5.

STEP 4. Replace the manifold absolute pressure sensor.

(1) Replace the manifold absolute pressure sensor.

(2) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

(3) Check the diagnostic trouble code (DTC).

Q: Is DTC P0108 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 5.

NO : The inspection is complete.

STEP 5. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

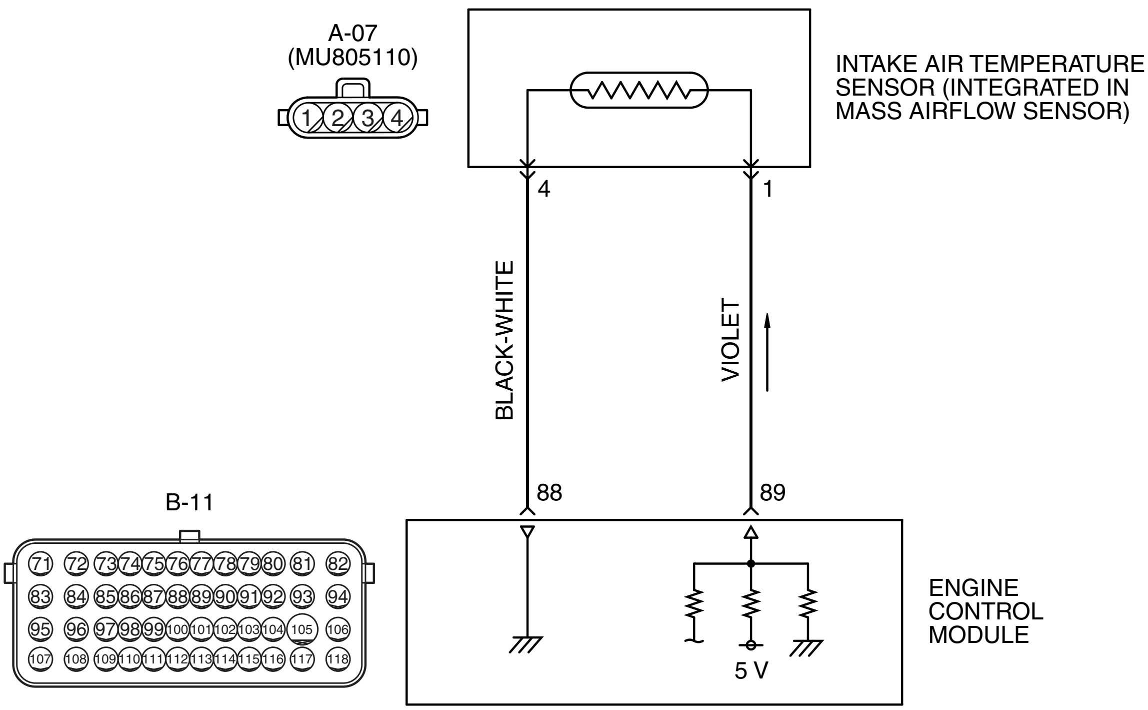
Q: Is DTC P0108 set?

YES : Retry the troubleshooting.

NO : The inspection is complete.

DTC P0111: Intake Air Temperature Circuit Range/Performance Problem

INTAKE AIR TEMPERATURE SENSOR CIRCUIT



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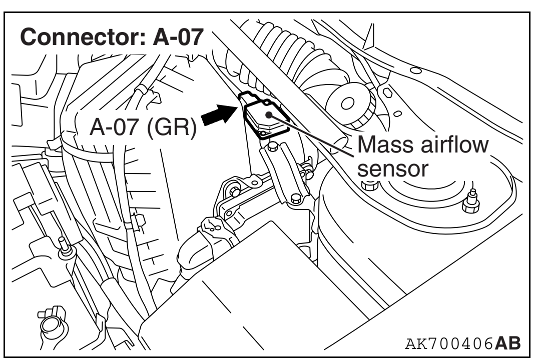
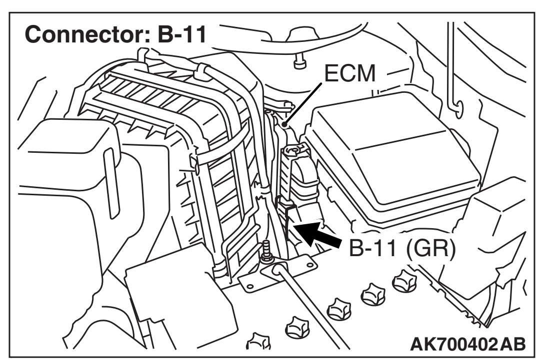




CIRCUIT OPERATION

- Approximately 5 volts are applied to the intake air temperature sensor output terminal (terminal No. 1) from the ECM (terminal No. 89) via the resistor in the ECM. The ground terminal (terminal No. 4) is grounded with ECM (terminal No. 88).
- The intake air temperature sensor is a negative temperature coefficient type of resistor. When the intake air temperature rises, the resistance decreases.
- The intake air temperature sensor output voltage increases when the resistance increases and decreases when the resistance decreases.

TECHNICAL DESCRIPTION

- The intake air temperature sensor converts the intake air temperature to a voltage.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Intake air temperature sensor output voltage does not change when specified go/stop operations are repeated.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

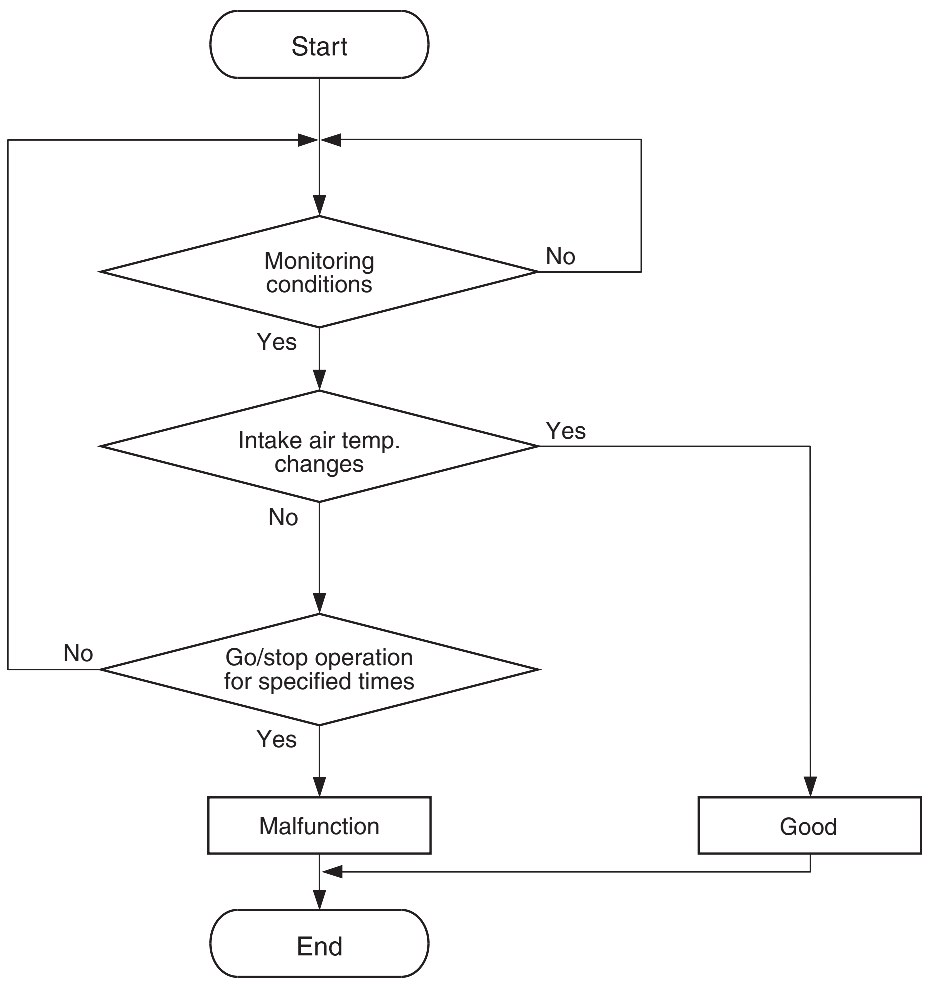
- Not applicable

Sensor (The sensor below is determined to be normal)

- Engine coolant temperature sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- Engine coolant temperature is higher than 76°C (169°F).
- Repeat 2 or more times: drive*1, stop*2.
- Drive*1: vehicle speed higher than 50 km/h (31 mph) lasting a total of more than 60 seconds.
- Stop*2: vehicle speed lower than 1.5 km/h (1.0 mph) lasting more than 30 seconds.

Judgement Criterion

- Changes in the intake air temperature is lower than 1°C (1.8°F).

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 8 P.13B-11.

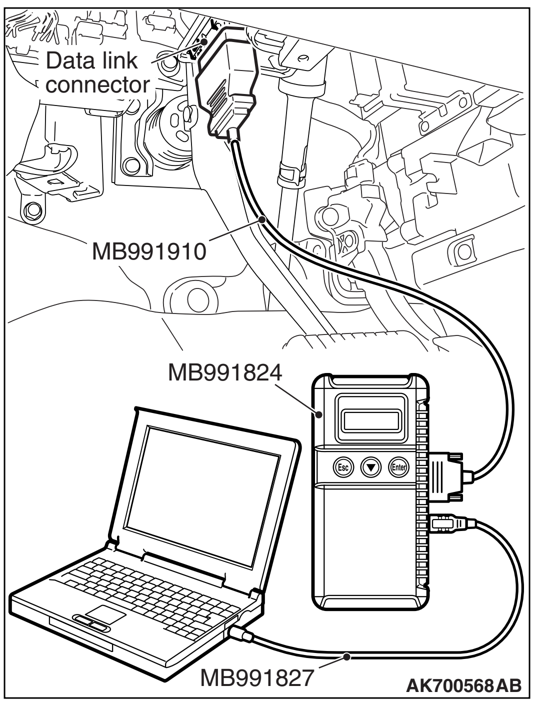
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Intake air temperature sensor failed.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 5: Intake Air Temperature Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Remove the mass airflow sensor from the air intake hose.
(3) Turn the ignition switch to the "ON" position.
(4) Set scan tool MB991958 to the data reading mode for item 5, Intake Air Temperature Sensor.
(5) Heating the sensor using a hair drier.
- The indicated temperature increases.

NOTE: Do not allow it to increase over 80°C (176°F).

(6) Turn the ignition switch to the "LOCK" (OFF) position.
(7) Attach the mass airflow sensor.

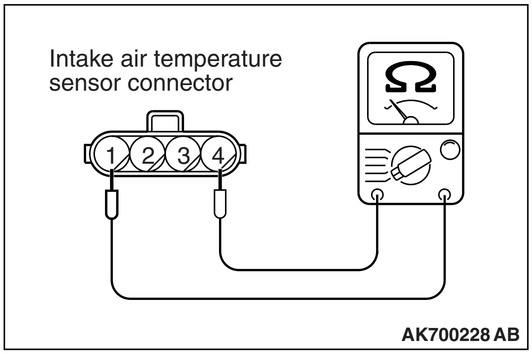
Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Go to Step 2.

STEP 2. Check the intake air temperature sensor.

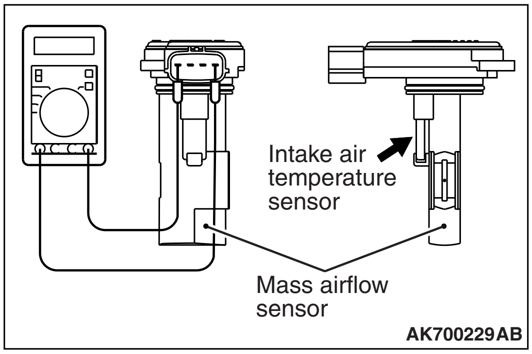
(1) Disconnect the intake air temperature sensor connector A-07.
(2) Remove the mass airflow sensor.
(3) Measure the resistance between intake air temperature sensor side connector terminal No. 1 and No. 4.



(4) Measure resistance while heating the sensor using a hair drier.

Standard value:

13 – 17 kΩ [at –20°C (–4°F)]
5.3 – 6.7 kΩ [at 0°C (32°F)]
2.3 – 3.0 kΩ [at 20°C (68°F)]
1.0 – 1.5 kΩ [at 40°C (104°F)]
0.56 – 0.76 kΩ [at 60°C (140°F)]
0.30 – 0.45 kΩ [at 80°C (176°F)]



Q: Is the measured resistance at the standard value?

YES : Replace the mass airflow sensor. Then go to Step 3.
NO : Go to Step 3.

STEP 3. Test the OBD-II drive cycle.

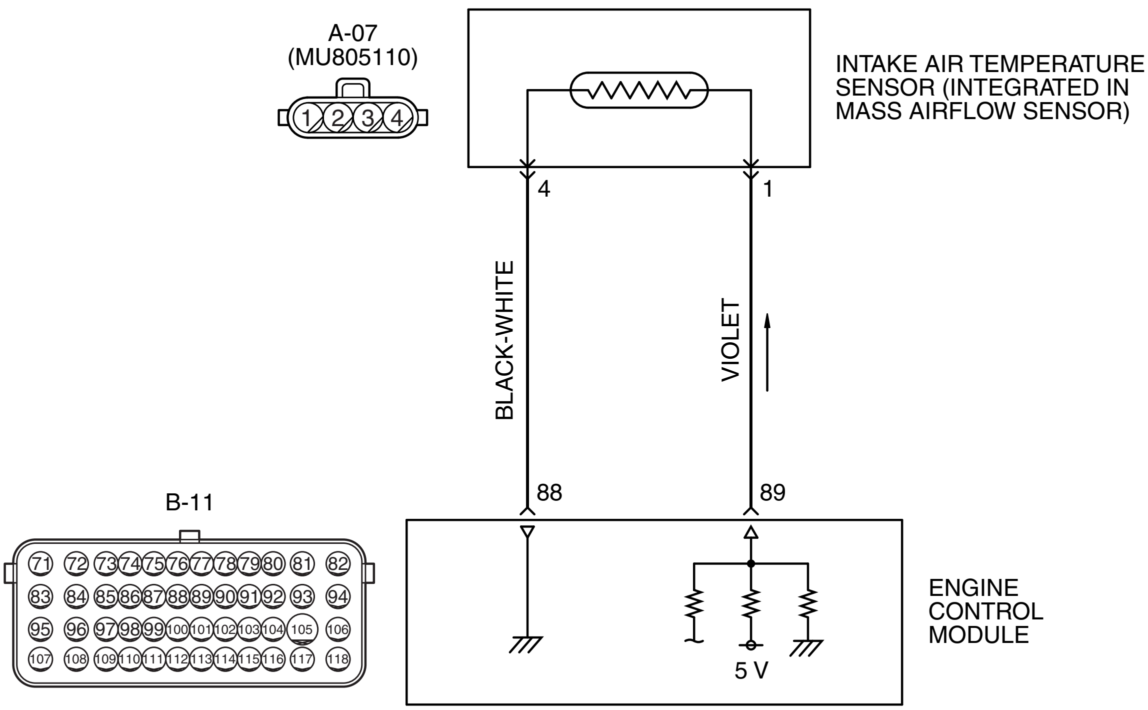
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 8 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0111 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0112: Intake Air Temperature Circuit Low Input

INTAKE AIR TEMPERATURE SENSOR CIRCUIT



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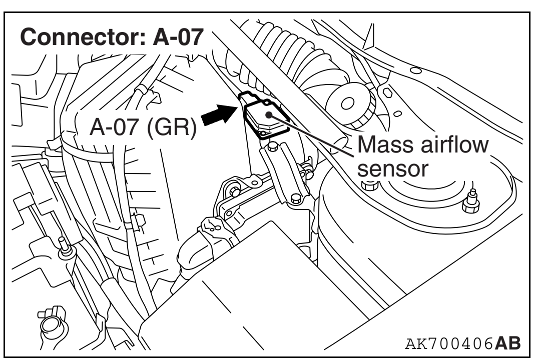
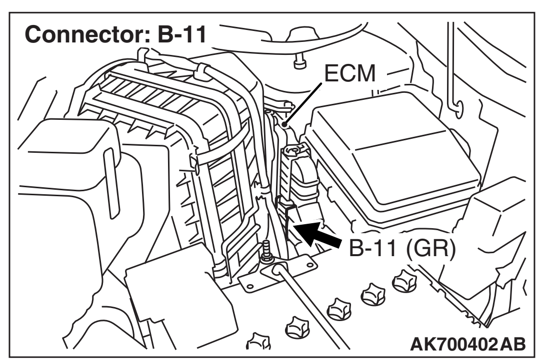




CIRCUIT OPERATION

- Approximately 5 volts are applied to the intake air temperature sensor output terminal (terminal No. 1) from the ECM (terminal No. 89) via the resistor in the ECM. The ground terminal (terminal No. 4) is grounded with ECM (terminal No. 88).
- The intake air temperature sensor is a negative temperature coefficient type of resistor. When the intake air temperature rises, the resistance decreases.
- The intake air temperature sensor output voltage increases when the resistance increases and decreases when the resistance decreases.

TECHNICAL DESCRIPTION

- The intake air temperature sensor converts the intake air temperature to a voltage.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Intake air temperature sensor output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

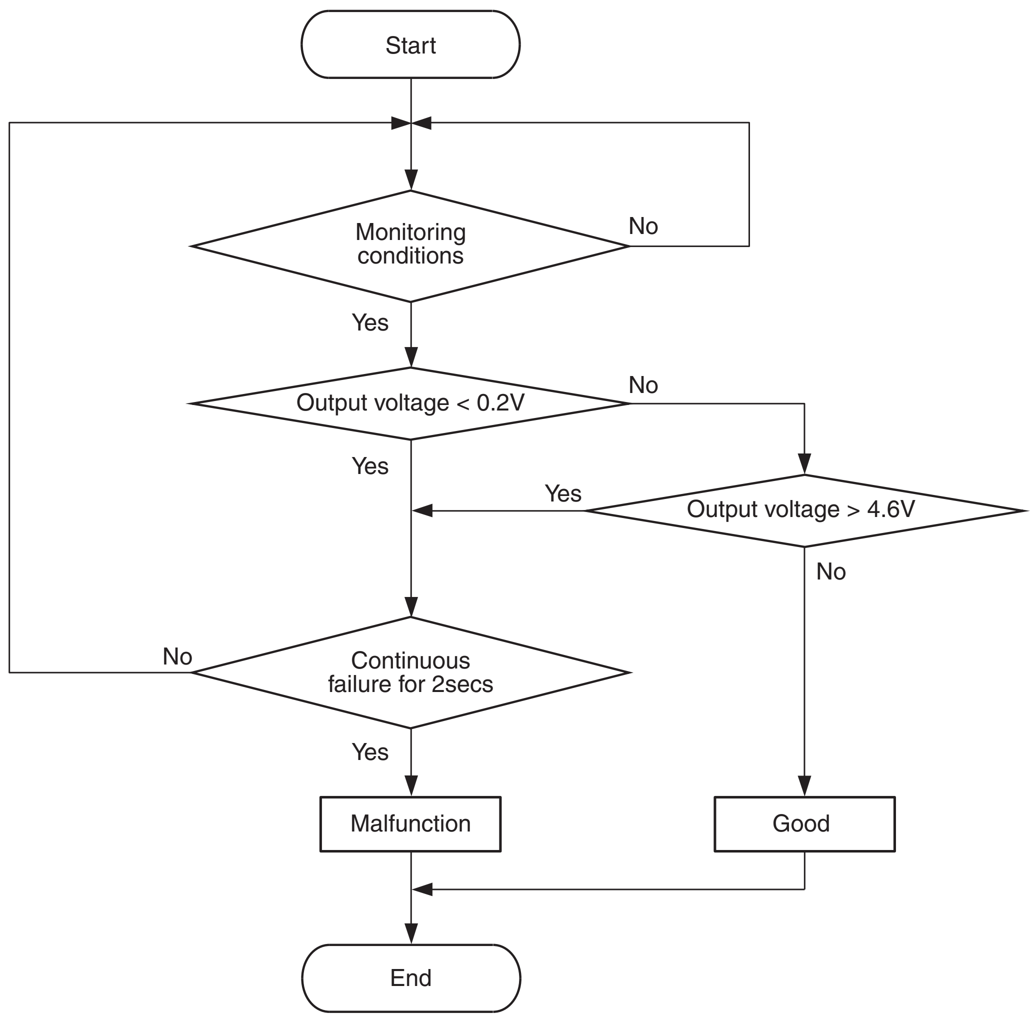
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



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Check Condition

- 2 seconds or more have passed since the engine starting sequence was completed.

Judgement Criterion

- Intake air temperature sensor output voltage has continued to be 0.2 volt or lower [corresponding to an air intake temperature of 115°C (239°F) or higher] for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

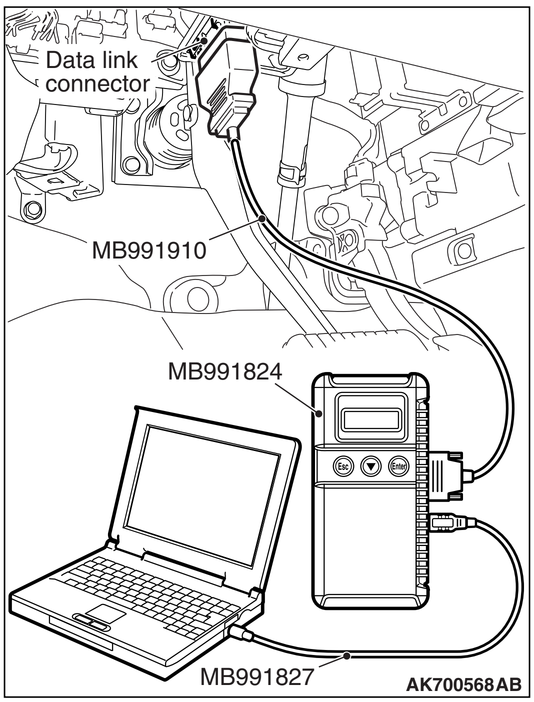
- Intake air temperature sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A

STEP 1. Using scan tool MB991958, check data list item 5: Intake Air Temperature Sensor.



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 5, Intake Air Temperature Sensor.
- The intake air temperature and temperature shown with the scan tool should approximately match.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.
NO : Go to Step 2.

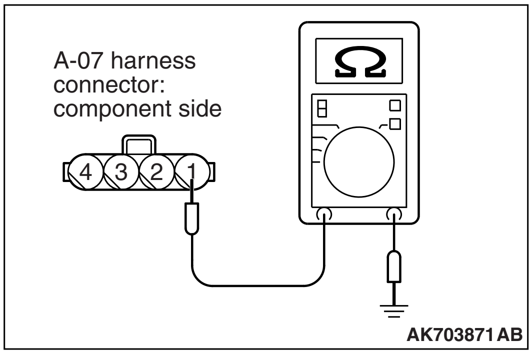
STEP 2. Check harness connector A-07 at the intake air temperature sensor and harness connector B-11 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 3. Check for short circuit to ground between the intake air temperature sensor connector A-07 and the ECM connector B-11.

(1) Disconnect the intake air temperature sensor A-07 and the ECM connector B-11.
(2) Check for the continuity between the intake air temperature sensor A-07 (terminal No. 1) and ground.
- Not continuity.

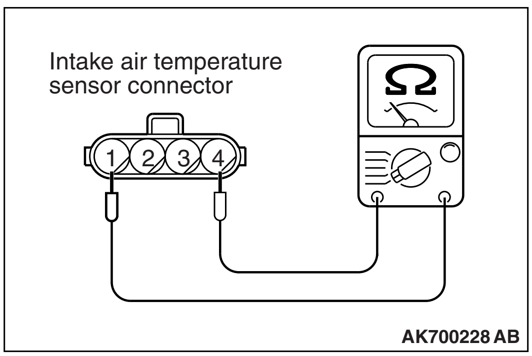


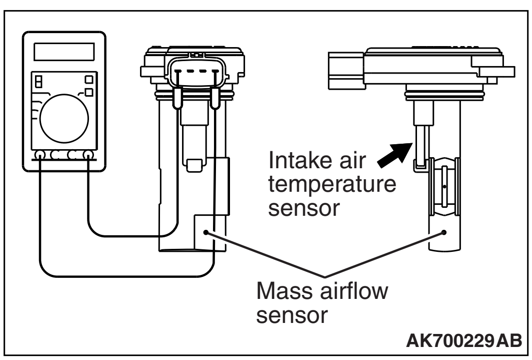
Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Then go to Step 5.

STEP 4. Check the intake air temperature sensor.

(1) Disconnect the intake air temperature sensor connector A-07.
(2) Remove the mass airflow sensor.
(3) Measure the resistance between intake air temperature sensor side connector terminal No. 1 and No. 4.





(4) Measure resistance while heating the sensor using a hair drier.

Standard value:
13 – 17 kΩ [at –20°C (–4°F)]
5.3 – 6.7 kΩ [at 0°C (32°F)]
2.3 – 3.0 kΩ [at 20°C (68°F)]
1.0 – 1.5 kΩ [at 40°C (104°F)]
0.56 – 0.76 kΩ [at 60°C (140°F)]
0.30 – 0.45 kΩ [at 80°C (176°F)]

Q: Is the measured resistance at the standard value?

YES : Replace the mass airflow sensor. Then go to Step 5.
NO : Go to Step 5.

STEP 5. Test the OBD-II drive cycle.

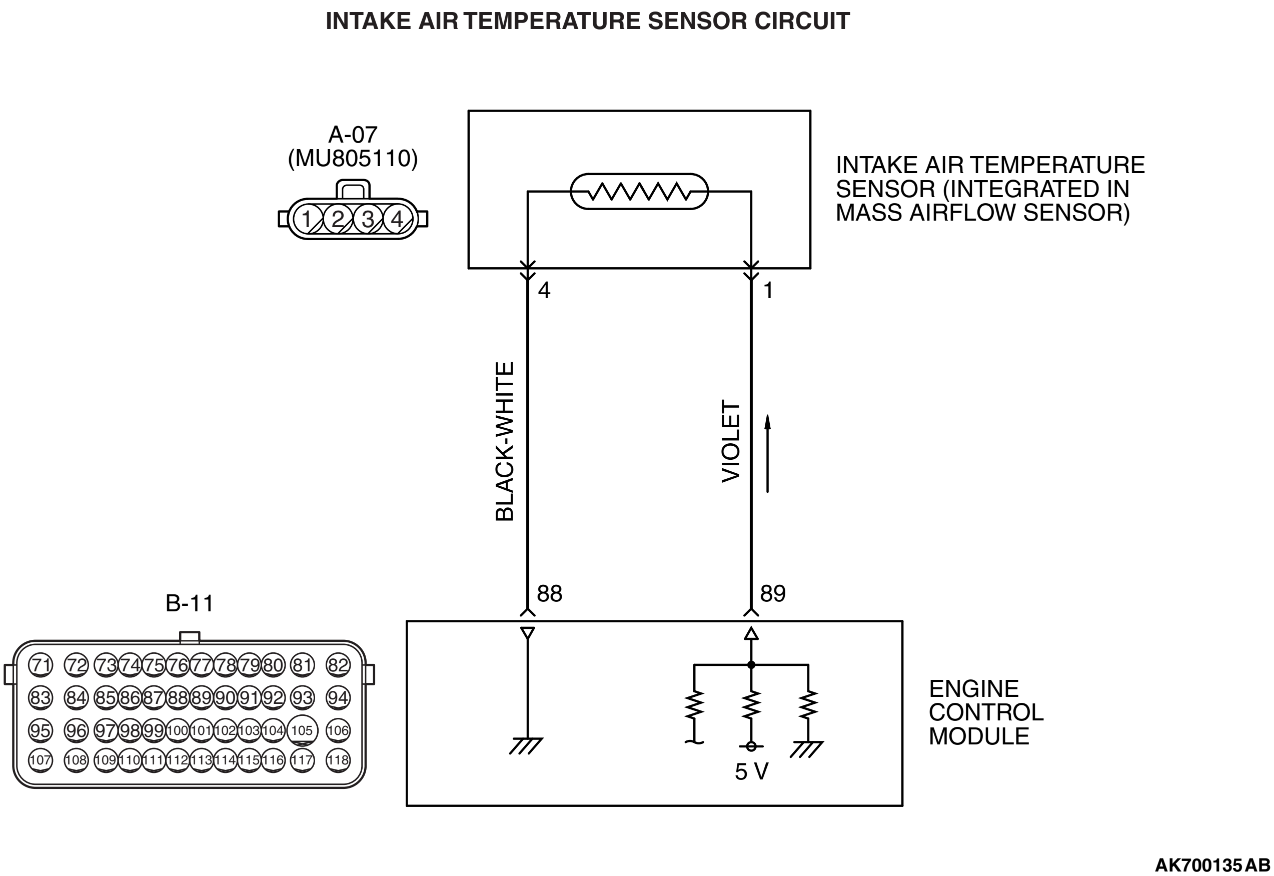
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

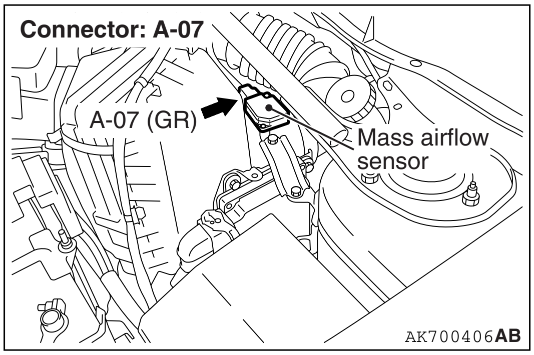
Q: Is DTC P0112 set?

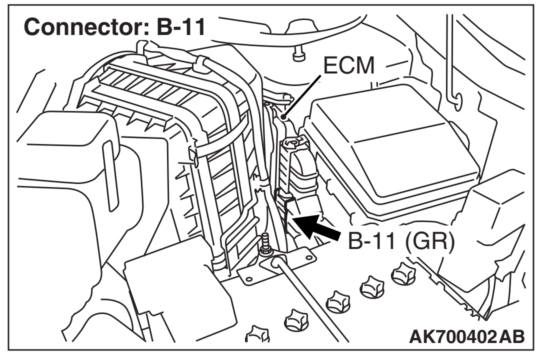
YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0113: Intake Air Temperature Circuit High Input







CIRCUIT OPERATION

- Approximately 5 volts are applied to the intake air temperature sensor output terminal (terminal No. 1) from the ECM (terminal No. 89) via the resistor in the ECM. The ground terminal (terminal No. 4) is grounded with ECM (terminal No. 88).
- The intake air temperature sensor is a negative temperature coefficient type of resistor. When the intake air temperature rises, the resistance decreases.
- The intake air temperature sensor output voltage increases when the resistance increases and decreases when the resistance decreases.

TECHNICAL DESCRIPTION

- The intake air temperature sensor converts the intake air temperature to a voltage.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Intake air temperature sensor output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

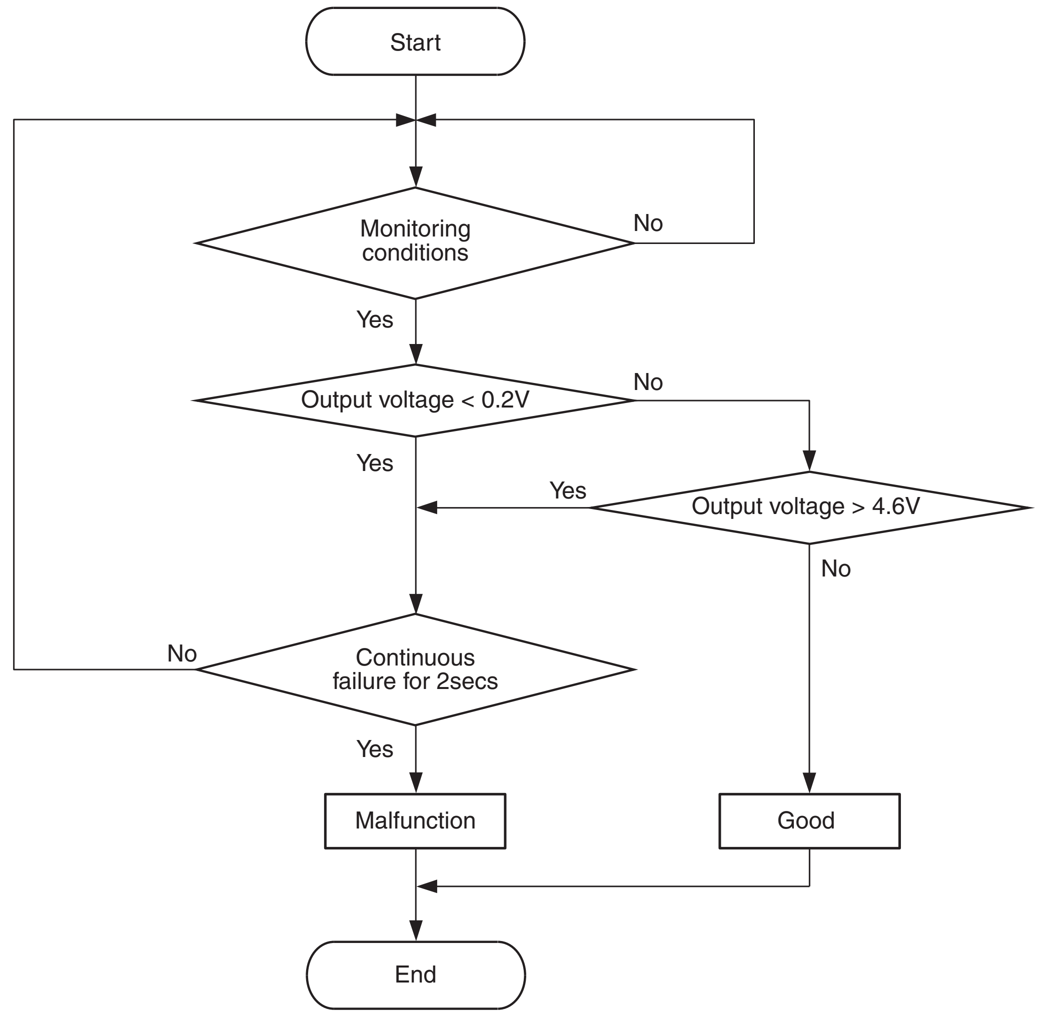
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- 2 seconds or more have passed since the engine starting sequence was completed.

Judgement Criterion

- Intake air temperature sensor output voltage has continued to be 4.6 volts or higher [corresponding to an air intake temperature of –40°C (–40°F) or lower] for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

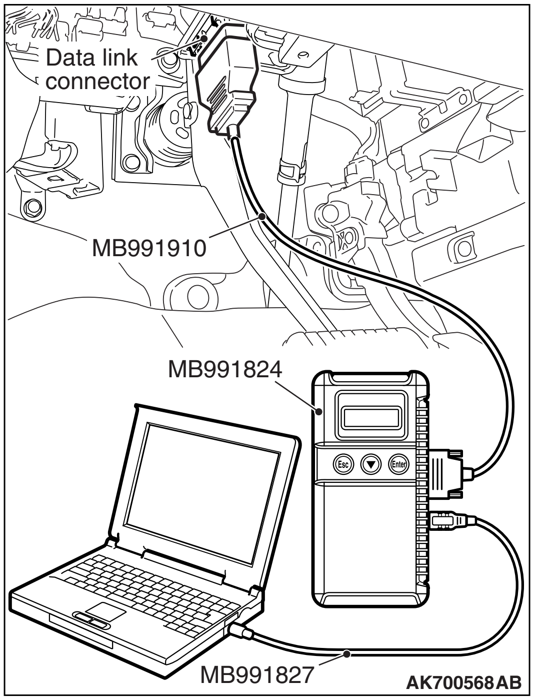
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Intake air temperature sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 5: Intake Air Temperature Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 5, Intake Air Temperature Sensor.
- The intake air temperature and temperature shown with the scan tool should approximately match.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.
NO : Go to Step 2.

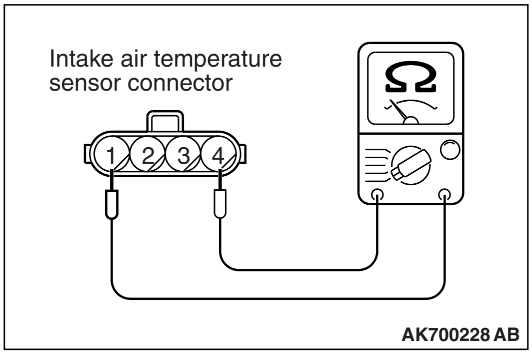
STEP 2. Check harness connector A-07 at the intake air temperature sensor and harness connector B-11 at the ECM for damage.

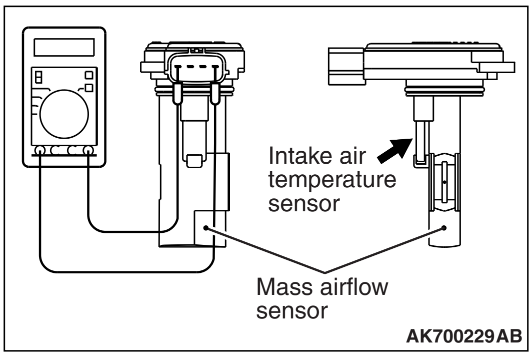
Q: Is the harness connector in good condition?

YES : Go to Step 3.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 3. Check the intake air temperature sensor.

(1) Disconnect the intake air temperature sensor connector A-07.
(2) Remove the mass airflow sensor.
(3) Measure the resistance between intake air temperature sensor side connector terminal No. 1 and No. 4.





(4) Measure resistance while heating the sensor using a hair drier.

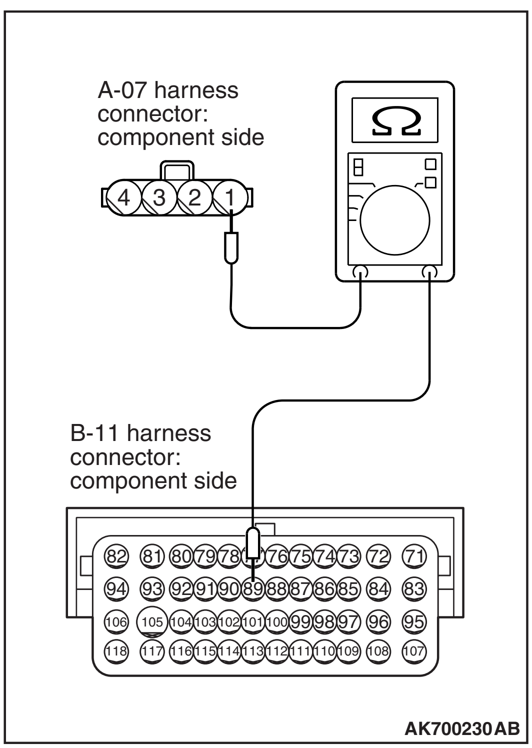
Standard value:
13 – 17 kΩ [at –20°C (–4°F)]
5.3 – 6.7 kΩ [at 0°C (32°F)]
2.3 – 3.0 kΩ [at 20°C (68°F)]
1.0 – 1.5 kΩ [at 40°C (104°F)]
0.56 – 0.76 kΩ [at 60°C (140°F)]
0.30 – 0.45 kΩ [at 80°C (176°F)]

Q: Is the measured resistance at the standard value?

YES : Replace the mass airflow sensor. Then go to Step 5.
NO : Go to Step 4.

STEP 4. Check for harness between the intake air temperature sensor connector A-07 and the ECM connector B-11.

(1) Disconnect the intake air temperature sensor connector A-07 and the ECM connector B-11.
(2) Measure the resistance between the intake air temperature sensor connector A-07 (terminal No. 1) and the ECM connector B-11 (terminal No. 89).
- Should be less than 2 ohms.



Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Then go to Step 5.

STEP 5. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

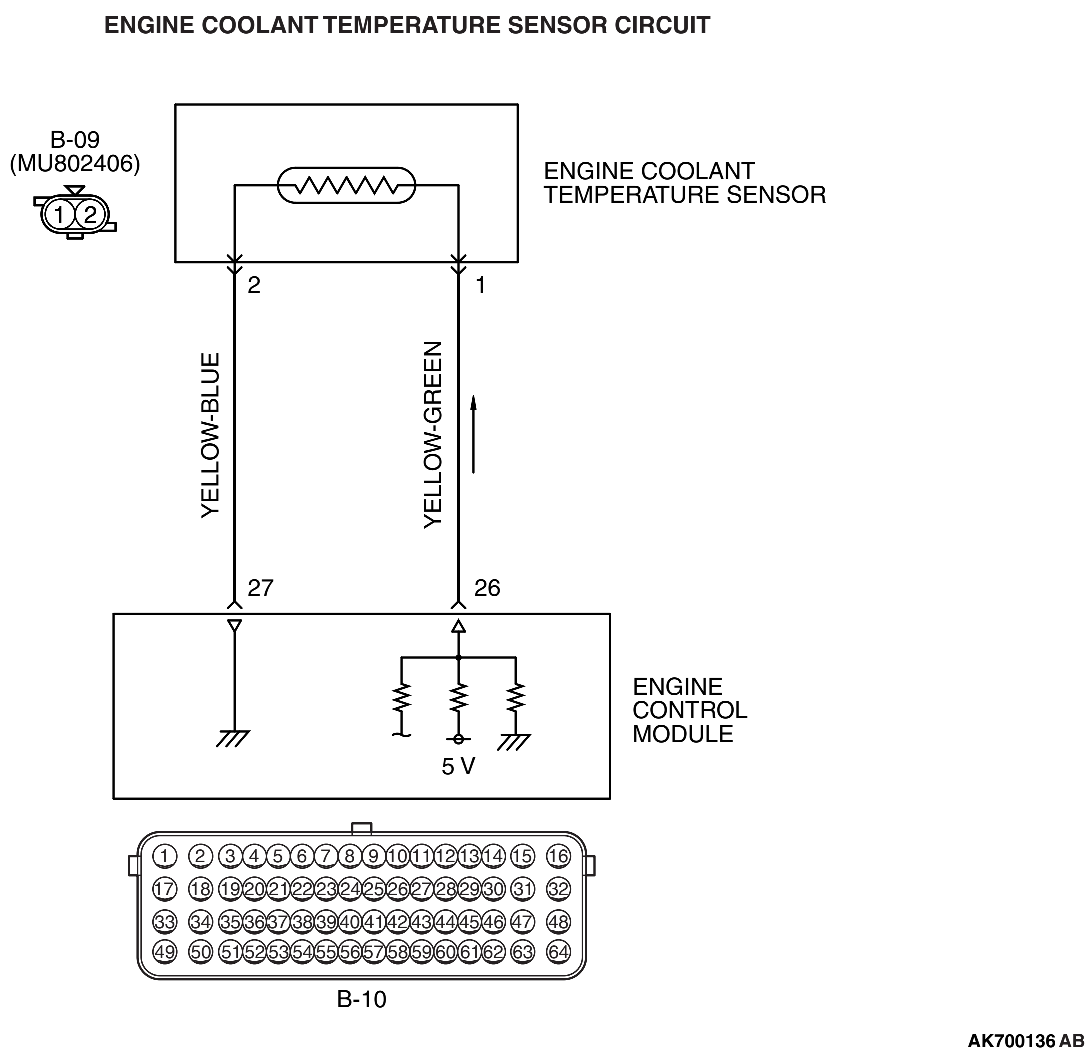
(2) Check the diagnostic trouble code (DTC).

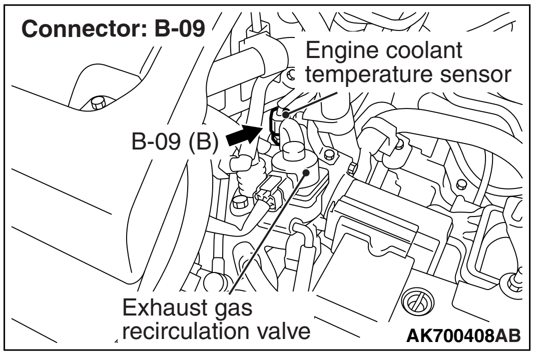
Q: Is DTC P0113 set?

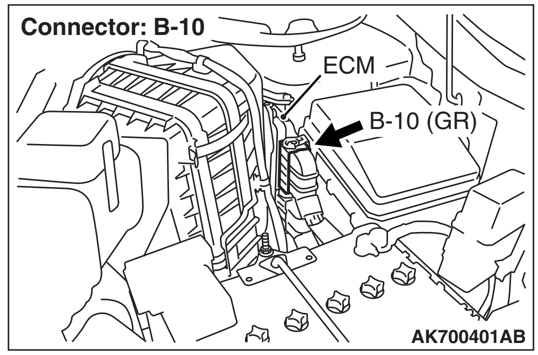
YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0116: Engine Coolant Temperature Circuit Range/Performance Problem







CIRCUIT OPERATION

- 5-volt voltage is applied to the engine coolant temperature sensor output terminal (terminal No. 1) from the ECM (terminal No. 26) via the resistor in the ECM. The ground terminal (terminal No. 2) is grounded with ECM (terminal No. 27).
- The engine coolant temperature sensor is a negative temperature coefficient type of resistor. It has the characteristic that when the engine coolant temperature rises the resistance decreases.
- The engine coolant temperature sensor output voltage increases when the resistor increases and decreases when the resistance decreases.

TECHNICAL DESCRIPTION

- The engine coolant temperature sensor converts the engine coolant temperature to a voltage and outputs it.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Engine coolant temperature sensor output voltage does not change for specified period when engine coolant temperature sensor output voltage at engine start is over 7°C (45°F).

MONITOR EXECUTION

Once per driving cycle

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

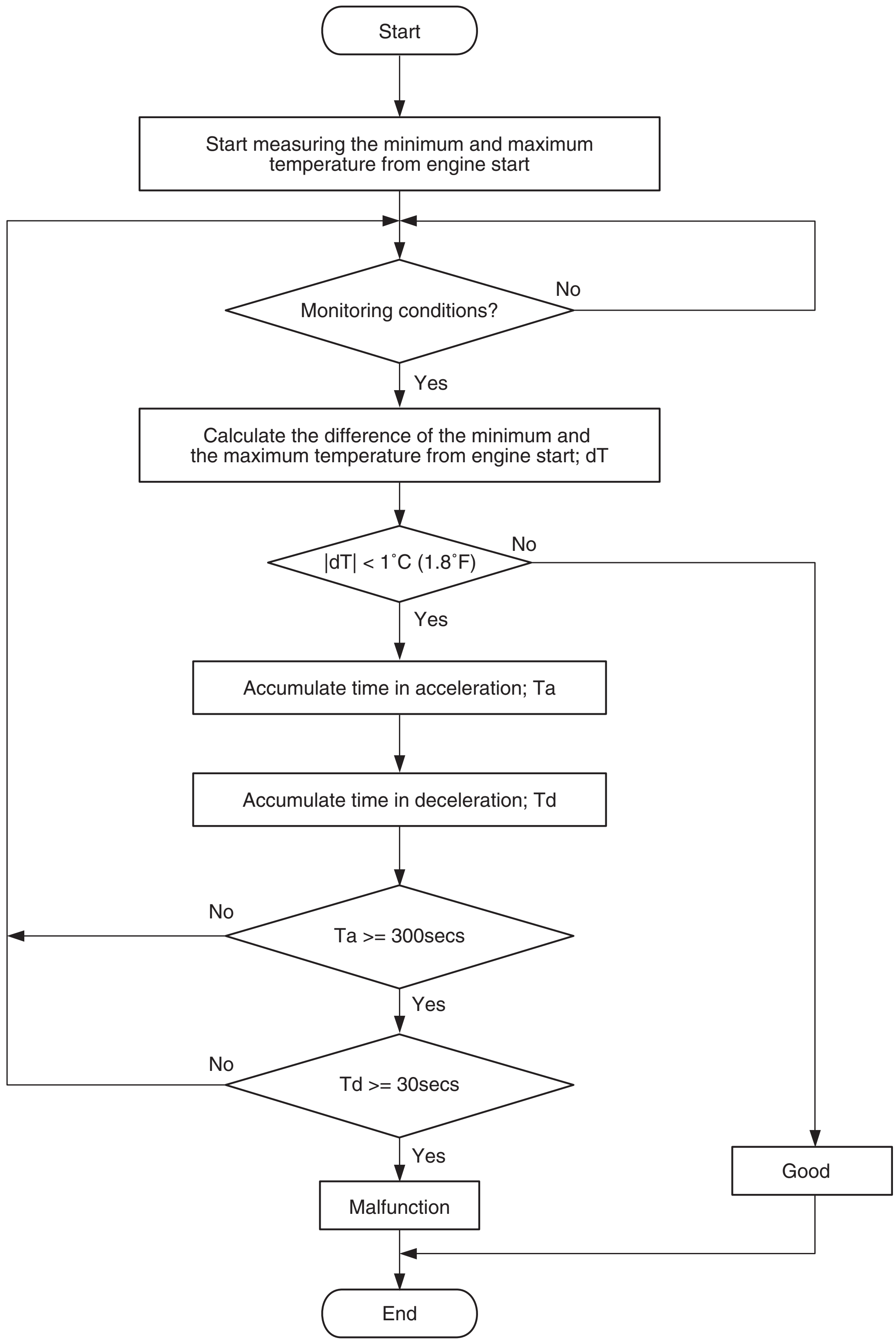
- Not applicable

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Intake air temperature sensor

DTC SET CONDITIONS

Logic Flow Chart



AK800937

Check Conditions

- Engine coolant temperature was more than 7°C (45°F) when the engine started.
- The accumulation is more than 300 seconds during the acceleration having the mass airflow rate of 12 g/sec or more.
- The accumulation is more than 30 seconds during the deceleration having the mass airflow rate of 9 g/sec or less.

Judgement Criterion

- Engine coolant temperature fluctuates within 1°C (1.8°F) after 330 seconds have passed since the engine was started.
- However, time is not counted if any of the following conditions are met.
  1. Intake air temperature is 60°C (140°F) or more.
  2. During fuel shut-off operation.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 9 P.13B-11.

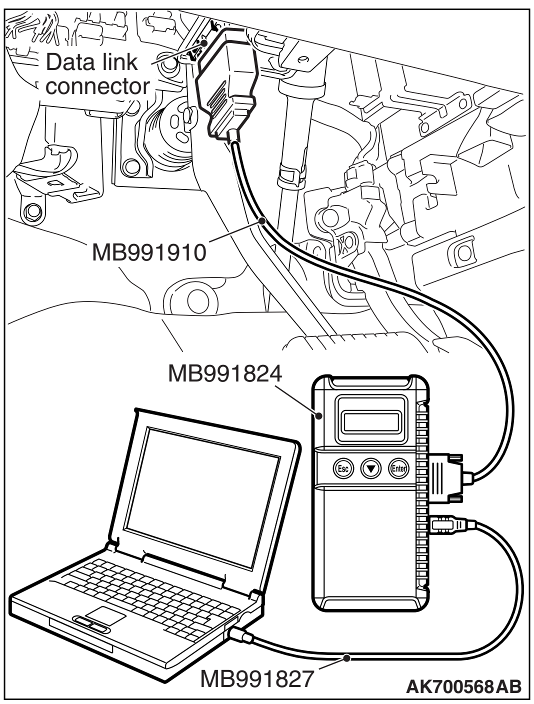
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Engine coolant temperature sensor failed.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 6: Engine Coolant Temperature Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 6, Engine Coolant Temperature Sensor.
- The engine coolant temperature and temperature shown with the scan tool should approximately match.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

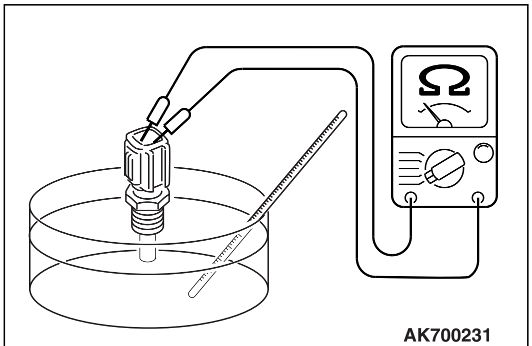
Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Go to Step 2.

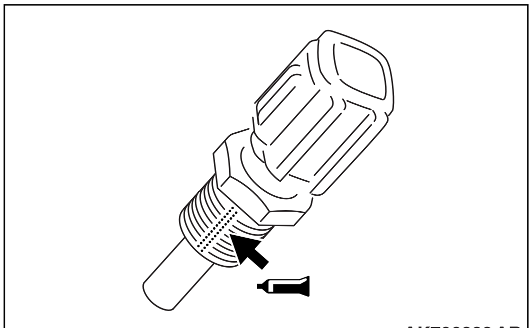
STEP 2. Check the engine coolant temperature sensor.

(1) Disconnect the engine coolant temperature sensor connector B-09.
(2) Remove the engine coolant temperature sensor.
(3) With the temperature sensing portion of engine coolant temperature sensor immersed in hot water, measure resistance.



AK700231

Standard value:
14 – 17 kΩ [at –20°C (–4°F)]
5.1 – 6.5 kΩ [at 0°C (32°F)]
2.1 – 2.7 kΩ [at 20°C (68°F)]
0.9 – 1.3 kΩ [at 40°C (104°F)]
0.48 – 0.68 kΩ [at 60°C (140°F)]
0.26 – 0.36 kΩ [at 80°C (176°F)]


AK700232 AB

(4) Apply 3M™ AAD part number 8731 or equivalent on the screw section of the engine coolant temperature sensor.
(5) Install the engine coolant temperature sensor, and tighten to the specified torque.

Tightening torque: 29 ± 10 N·m (22 ± 7 ft-lb)

Q: Is the measured resistance normal?

YES : Replace the engine coolant temperature sensor. Then go to Step 3.
NO : Go to Step 3.

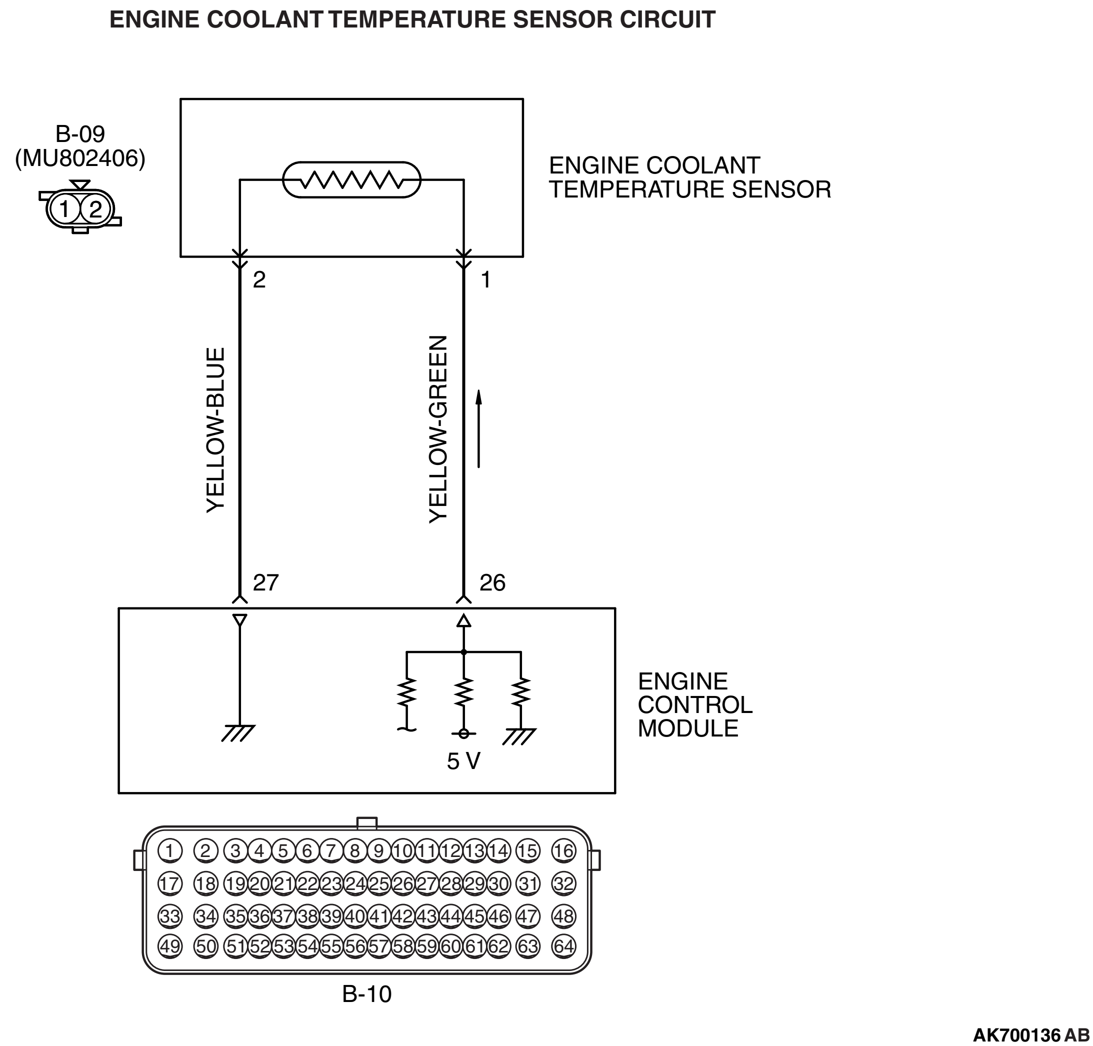
STEP 3. Test the OBD-II drive cycle.

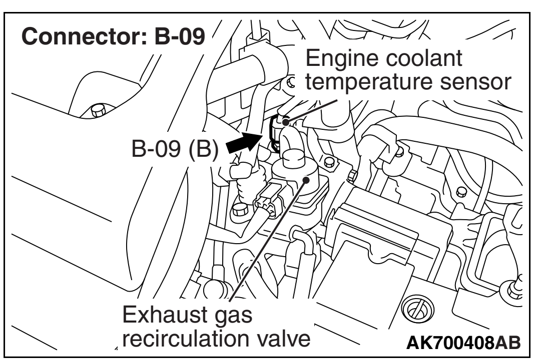
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 9 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

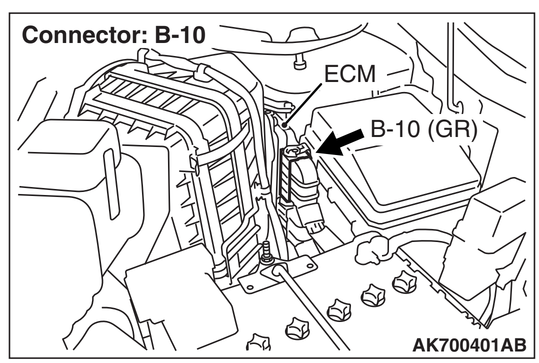
Q: Is DTC P0116 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0117: Engine Coolant Temperature Circuit Low Input







CIRCUIT OPERATION

- 5-volt voltage is applied to the engine coolant temperature sensor output terminal (terminal No. 1) from the ECM (terminal No. 26) via the resistor in the ECM. The ground terminal (terminal No. 2) is grounded with ECM (terminal No. 27).
- The engine coolant temperature sensor is a negative temperature coefficient type of resistor. It has the characteristic that when the engine coolant temperature rises the resistance decreases.
- The engine coolant temperature sensor output voltage increases when the resistance increases and decreases when the resistance decreases.

TECHNICAL DESCRIPTION

- The engine coolant temperature sensor converts the engine coolant temperature to a voltage and outputs it.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Engine coolant temperature sensor output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

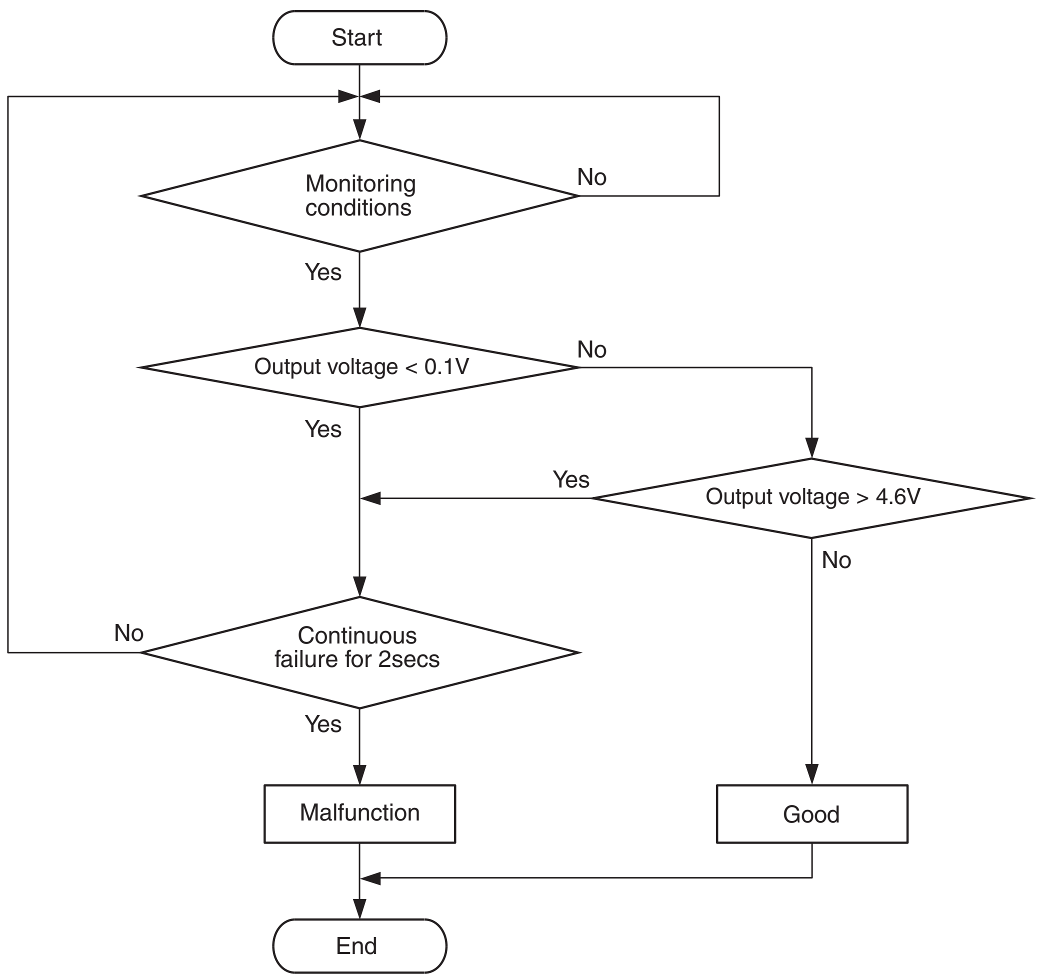
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



AK604317

Check Condition

- 2 seconds or more have passed since the engine starting sequence was completed.

Judgement Criterion

- Engine coolant temperature sensor output voltage has continued to be 0.1 volt or lower for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

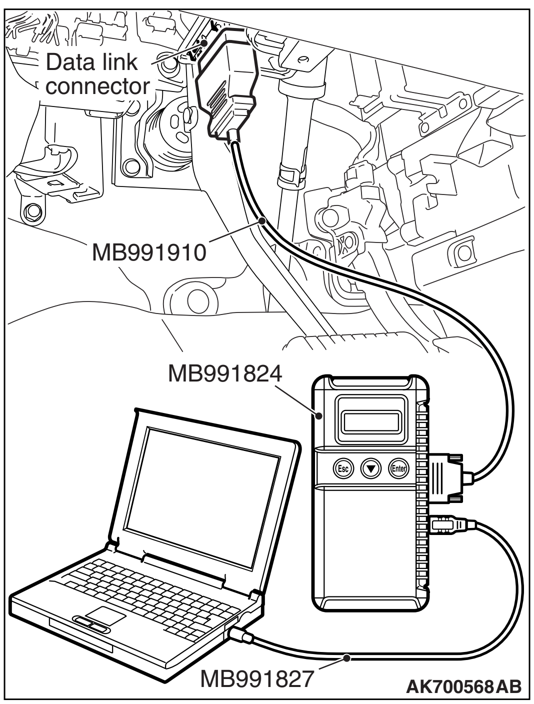
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Engine coolant temperature sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
    - MB991824: V.C.I.
    - MB991827: USB Cable
    - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 6: Engine Coolant Temperature Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 6, Engine Coolant Temperature Sensor.
- The engine coolant temperature and temperature shown with the scan tool should approximately match.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

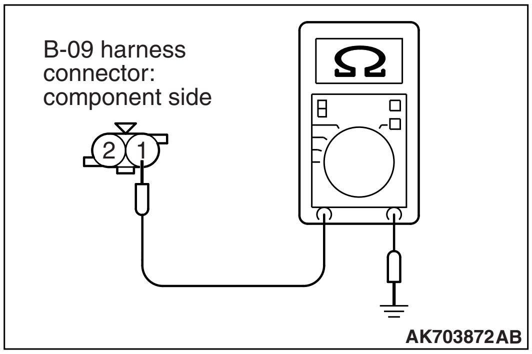
NO : Go to Step 2.

STEP 2. Check harness connector B-09 at the engine coolant temperature sensor and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

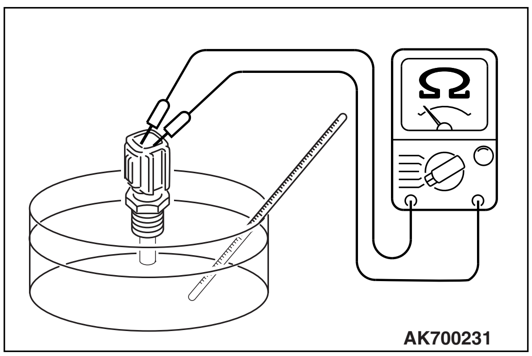


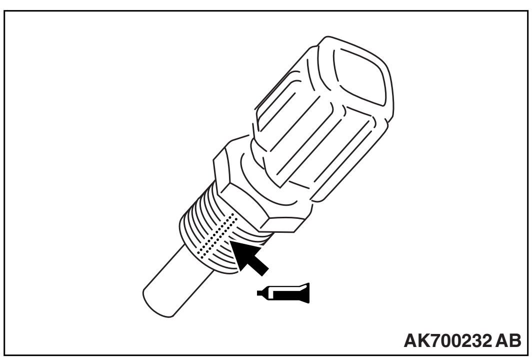
STEP 3. Check for short circuit to ground between the engine coolant temperature sensor connector B-09 and the ECM connector B-10.

(1) Disconnect the engine coolant temperature sensor B-09 and the ECM connector B-10.
(2) Check for the continuity between the engine coolant temperature sensor B-09 (terminal No. 1) and ground.
  - Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Then go to Step 5.





STEP 4. Check the engine coolant temperature sensor.

(1) Disconnect the engine coolant temperature sensor connector B-09.
(2) Remove the engine coolant temperature sensor.
(3) With the temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.

Standard value:
14 – 17 kΩ [at –20°C (–4°F)]
5.1 – 6.5 kΩ [at 0°C (32°F)]
2.1 – 2.7 kΩ [at 20°C (68°F)]
0.9 – 1.3 kΩ [at 40°C (104°F)]
0.48 – 0.68 kΩ [at 60°C (140°F)]
0.26 – 0.36 kΩ [at 80°C (176°F)]

(4) Apply 3M™ AAD part number 8731 or equivalent on the screw section of the engine coolant temperature sensor.
(5) Install the engine coolant temperature sensor, and tighten to the specified torque.

Tightening torque: 29 ± 10 N·m (22 ± 7 ft-lb)

Q: Is the measured resistance at the standard value?

YES : Replace the engine coolant temperature sensor. Then go to Step 5.
NO : Go to Step 5.

STEP 5. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

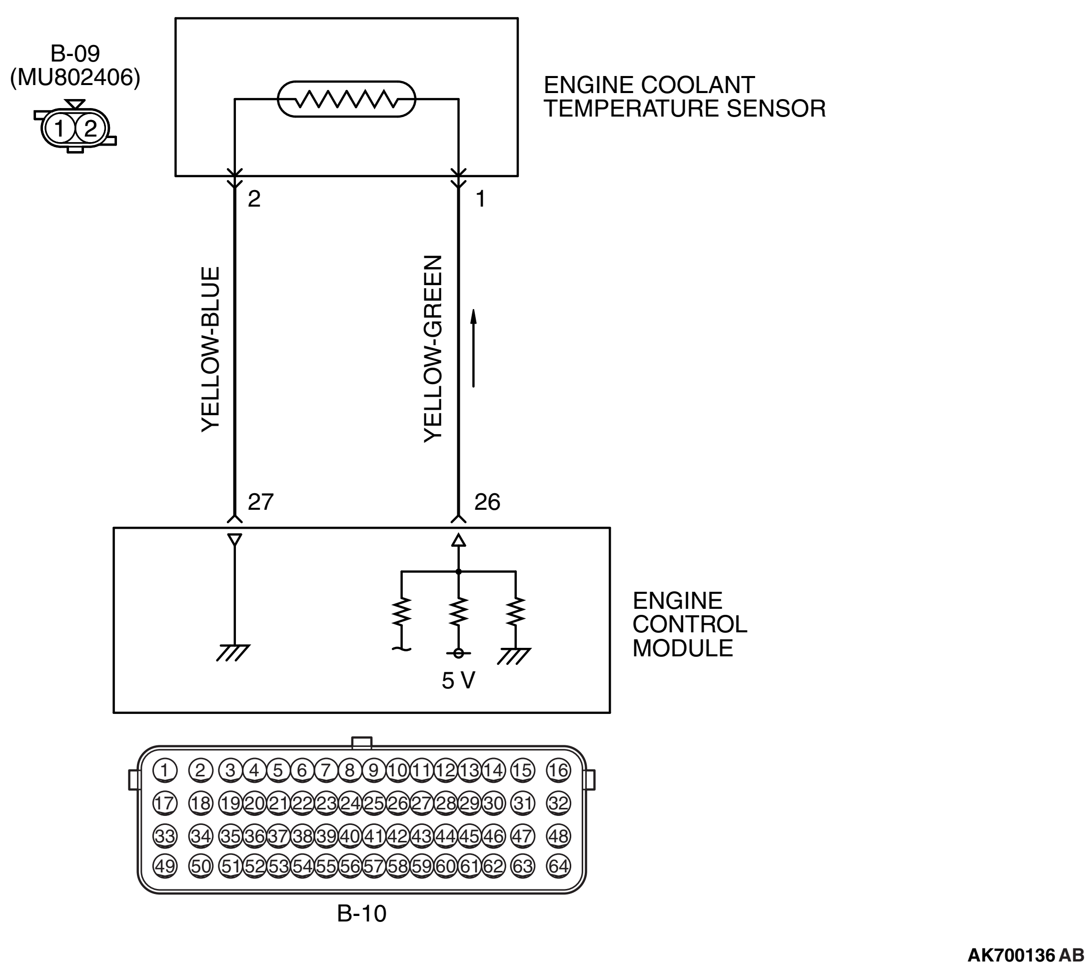
Q: Is DTC P0117 set?

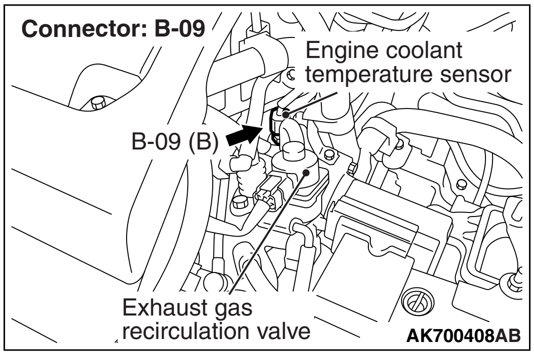
YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.

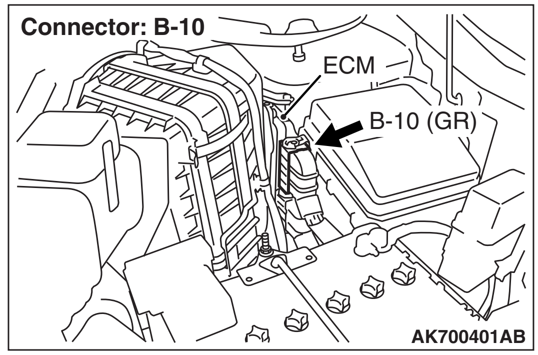
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0118: Engine Coolant Temperature Circuit High Input

ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT







CIRCUIT OPERATION

- 5-volt voltage is applied to the engine coolant temperature sensor output terminal (terminal No. 1) from the ECM (terminal No. 26) via the resistor in the ECM. The ground terminal (terminal No. 2) is grounded with ECM (terminal No. 27).
- The engine coolant temperature sensor is a negative temperature coefficient type of resistor. It has the characteristic that when the engine coolant temperature rises the resistance decreases.
- The engine coolant temperature sensor output voltage increases when the resistance increases and decreases when the resistance decreases.

TECHNICAL DESCRIPTION

- The engine coolant temperature sensor converts the engine coolant temperature to a voltage and outputs it.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Engine coolant temperature sensor output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

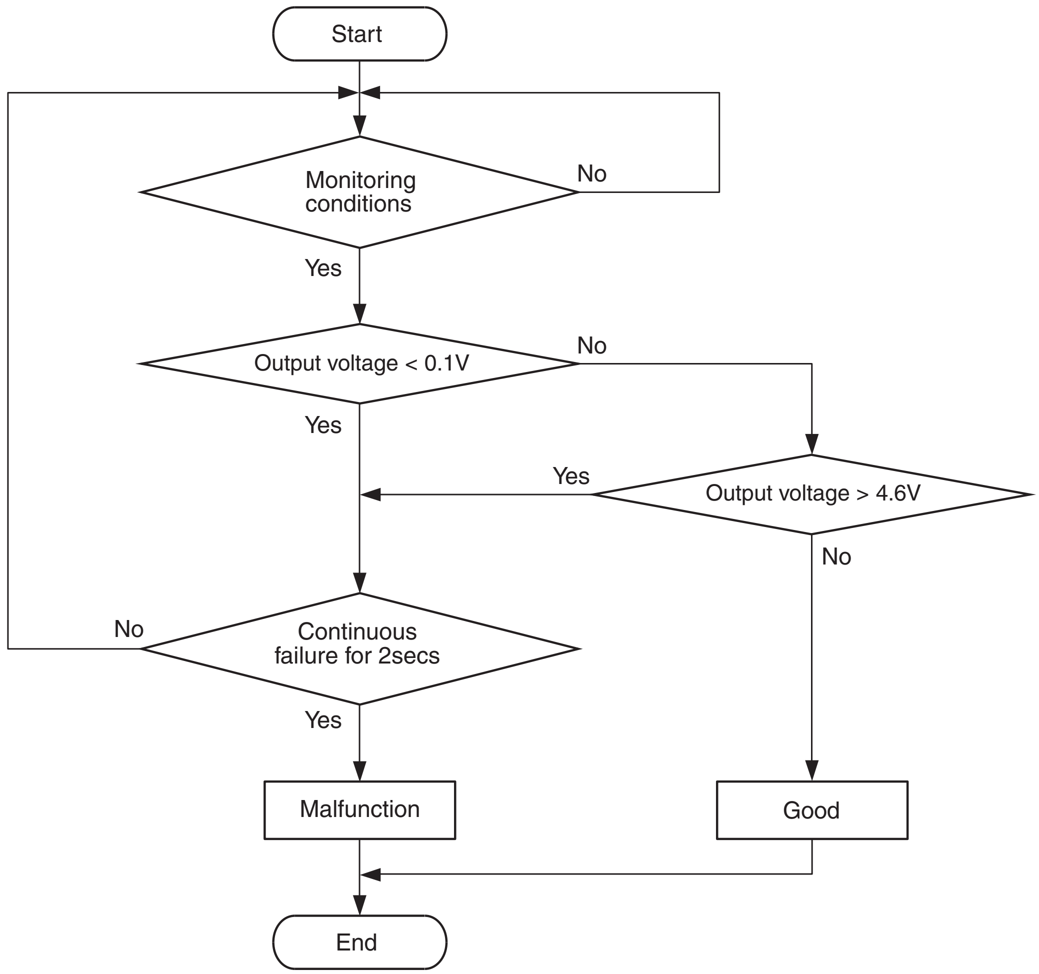
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



Check Condition

- 2 seconds or more have passed since the engine starting sequence was completed.

Judgement Criterion

- Engine coolant temperature sensor output voltage has continued to be 4.6 volts or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

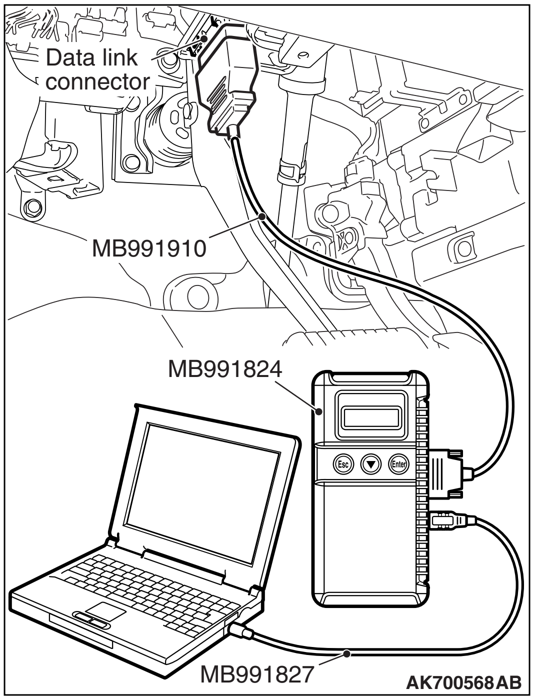
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Engine coolant temperature sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 6: Engine Coolant Temperature Sensor.

⚠ **CAUTION**

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 6, Engine Coolant Temperature Sensor.
- The engine coolant temperature and temperature shown with the scan tool should approximately match.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Go to Step 2.

STEP 2. Check harness connector B-09 at the engine coolant temperature sensor and harness connector B-10 at the ECM for damage.

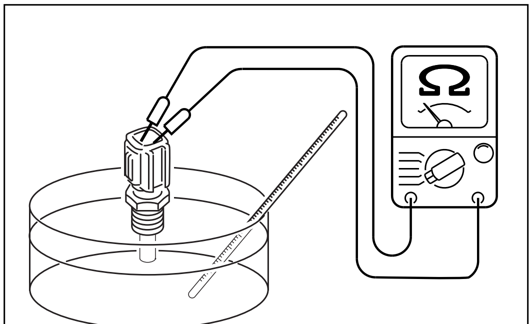
Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 3. Check the engine coolant temperature sensor.

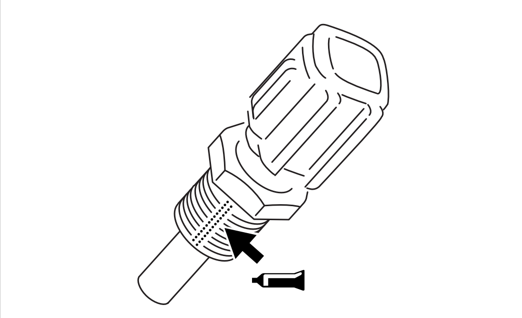
(1) Disconnect the engine coolant temperature sensor connector B-09.
(2) Remove the engine coolant temperature sensor.
(3) With the temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.



AK700231

Standard value:
14 – 17 kΩ [at –20°C (–4°F)]
5.1 – 6.5 kΩ [at 0°C (32°F)]
2.1 – 2.7 kΩ [at 20°C (68°F)]
0.9 – 1.3 kΩ [at 40°C (104°F)]
0.48 – 0.68 kΩ [at 60°C (140°F)]
0.26 – 0.36 kΩ [at 80°C (176°F)]

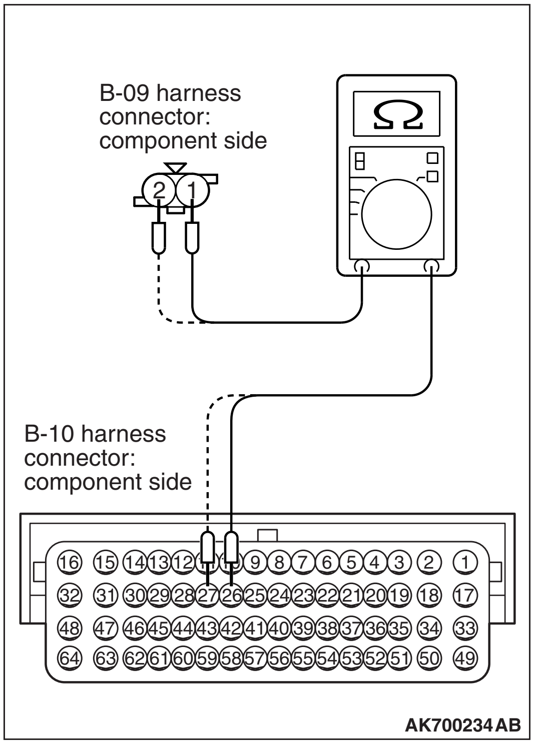
(4) Apply 3M™ AAD part number 8731 or equivalent on the screw section of the engine coolant temperature sensor.
(5) Install the engine coolant temperature sensor, and tighten to the specified torque.


AK700232 AB

Tightening torque: 29 ± 10 N·m (22 ± 7 ft-lb)

Q: Is the measured resistance at the standard value?

YES : Replace the engine coolant temperature sensor. Then go to Step 5.
NO : Go to Step 4.



STEP 4. Check for harness between the engine coolant temperature sensor connector B-09 and the ECM connector B-10.

(1) Disconnect the engine coolant temperature sensor connector B-09 and the ECM connector B-10.
(2) Measure the resistance between the engine coolant temperature sensor connector B-09 and the ECM connector B-10.
   a. Connector B-09 (terminal No. 1) and Connector B-10 (terminal No. 26).
   b. Connector B-09 (terminal No. 2) and Connector B-10 (terminal No. 27).
   - Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to step 5.

NO : Repair it. Then go to Step 5.

STEP 5. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0118 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0121: Throttle Position Sensor (main) Plausibility

TECHNICAL DESCRIPTION

Compare the actual measurement of volumetric efficiency by a mass airflow sensor signal with volumetric efficiency estimated from a throttle position sensor (main) signal.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

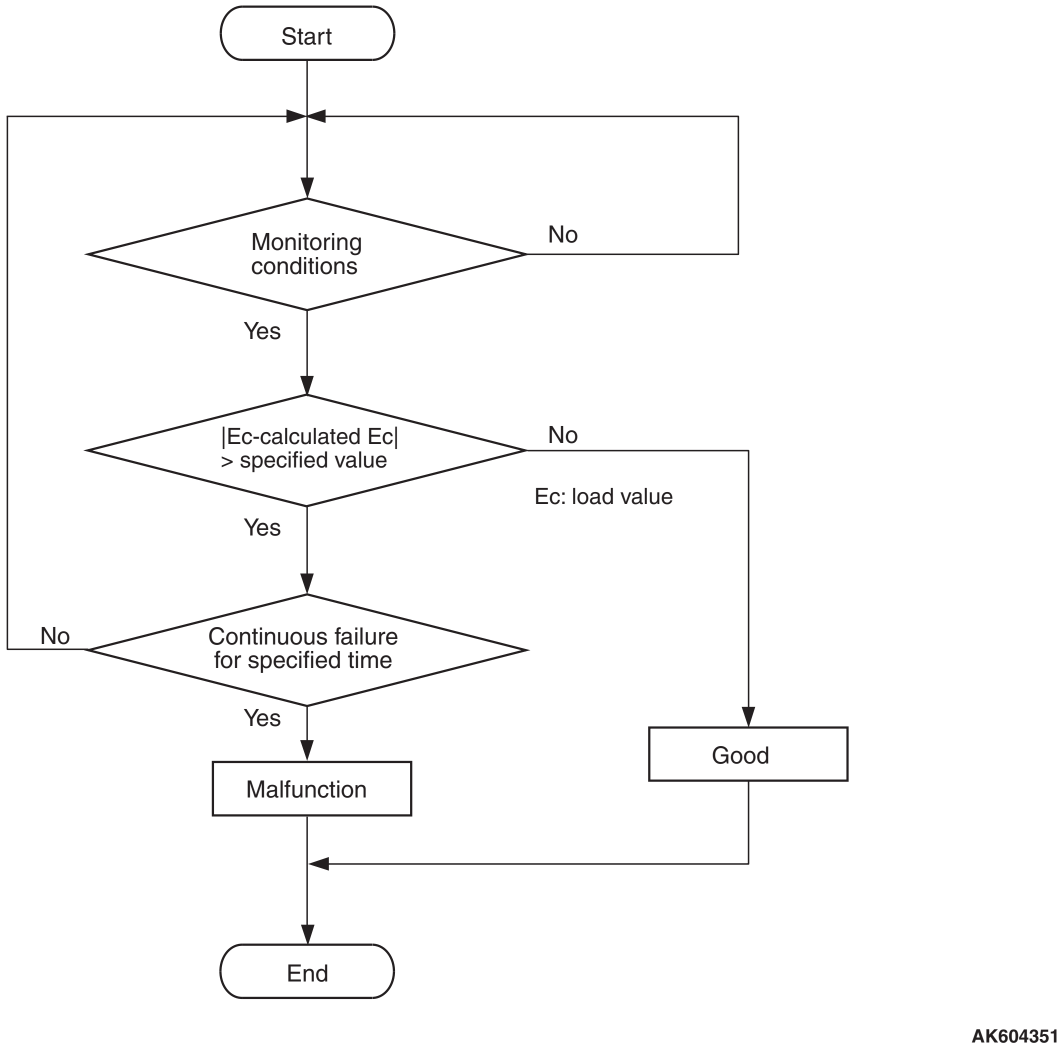
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- The difference between the actual volumetric efficiency and the volumetric efficiency estimated by the throttle position sensor (main) is 0 % or more. Or, the volumetric efficiency is 60 % or less.
- The engine speed is between 750 and 3,000 r/min. Or, the throttle position sensor (main) output voltage is 3 volts or less.

Judgment Criterion

- For 0.4 second, the difference between the actual volumetric efficiency and the volumetric efficiency estimated by the throttle position sensor (main) is 33 % or more.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle Pattern 17 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

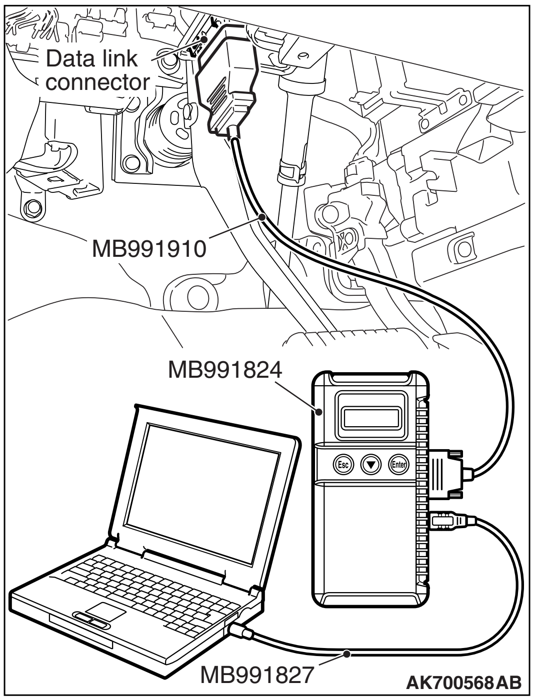
- Throttle position sensor (main) system failed.
- Intake system vacuum leak.
- There is some foreign matter around mass airflow sensor.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A
- MB991658: Test Harness

STEP 1. Using scan tool MB991958, read the diagnostic trouble code (DTC).



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Read the DTC.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the diagnostic trouble code other than P0121 set?

YES : Refer to Diagnostic Trouble Code Chart P.13B-50.
NO : Go to Step 2.

STEP 2. Using scan tool MB991958, check data list item 13: Throttle Position Sensor (main).

(1) Turn the ignition switch to the "ON" position.
(2) Detach the intake air hose at the throttle body.
(3) Disconnect the connector of the throttle position sensor.
(4) Use test harness special tool (MB991658) to connect only terminals No. 3, No. 4, No. 5, and No. 6.
(5) Set scan tool MB991958 to the data reading mode for item 13, Throttle Position Sensor (main).
- Output voltage should be between 0.3 and 0.7 volt when the throttle valve is fully closed with your finger.
- Output voltage should be 4.0 volts or more when the throttle valve is fully open with your finger.

(6) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : Go to Step 3.
NO : Refer to, DTC P0122 – Throttle Position Sensor (main) Circuit Low Input P.13A-197, DTC P0123 – Throttle Position Sensor (main) Circuit High Input P.13A-201.

STEP 3. Check for intake system vacuum leak.

Q: Are there any abnormalities?

YES : Repair it. Then go to Step 6.
NO : Go to Step 4.

STEP 4. Check for foreign matter being around the mass airflow sensor.

Q: Are there any foreign matter?

YES : Repair it. Then go to Step 6.
NO : Go to Step 5.

STEP 5. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle Pattern 17 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0121 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 6. Test the OBD-II drive cycle.

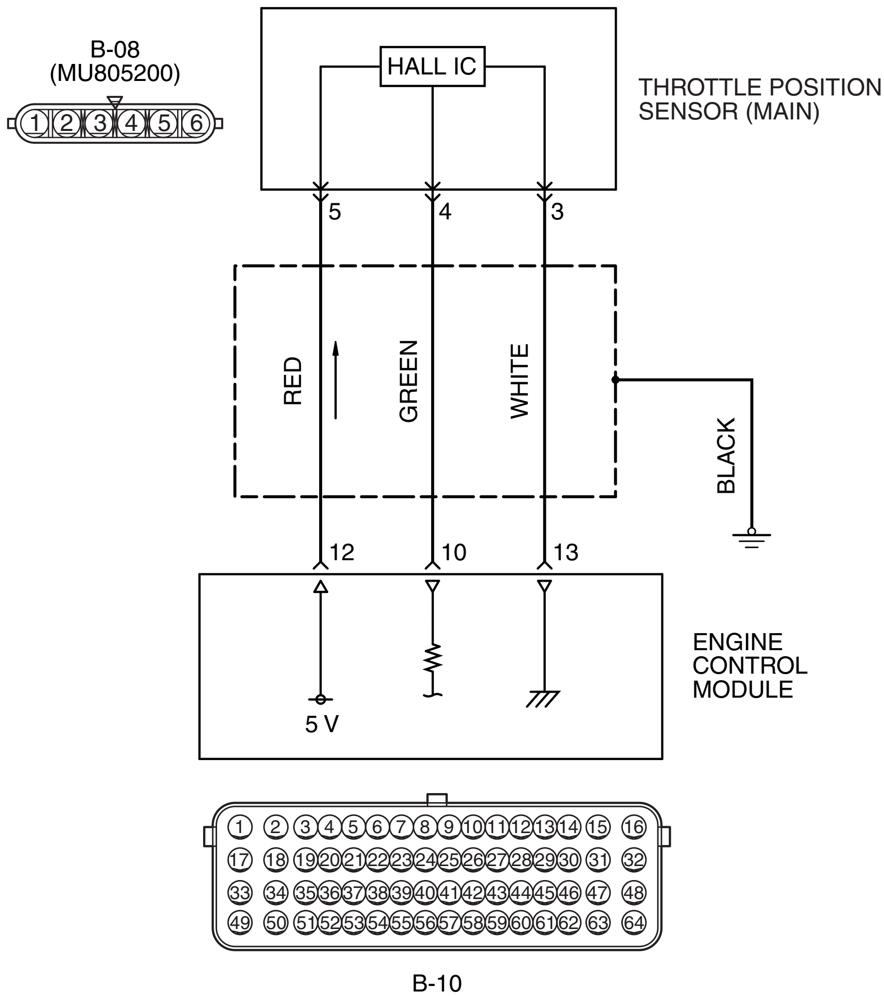
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle Pattern 17 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0121 set?

YES : Retry the troubleshooting.
NO : The procedure is complete.

DTC P0122: Throttle Position Sensor (Main) Circuit Low Input

THROTTLE POSITION SENSOR (MAIN) CIRCUIT



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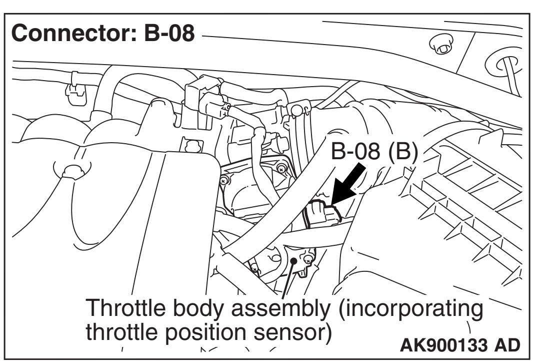
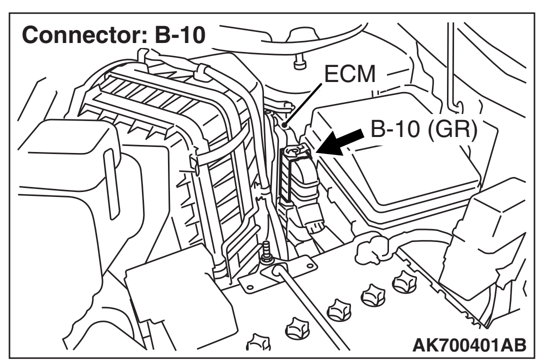




CIRCUIT OPERATION

- A 5-volt power supply is applied on the throttle position sensor (main) power terminal (terminal No. 5) from the ECM (terminal No. 12).
- A voltage that is according to the throttle opening angle is sent to the ECM (terminal No. 10) from the throttle position sensor (main) output terminal (terminal No. 4).

- The ground terminal (terminal No. 3) is grounded with ECM (terminal No. 13).

TECHNICAL DESCRIPTION

- The throttle position sensor (main) outputs voltage which corresponds to the throttle valve opening angle.
- The ECM checks whether the voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Throttle position sensor (main) output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

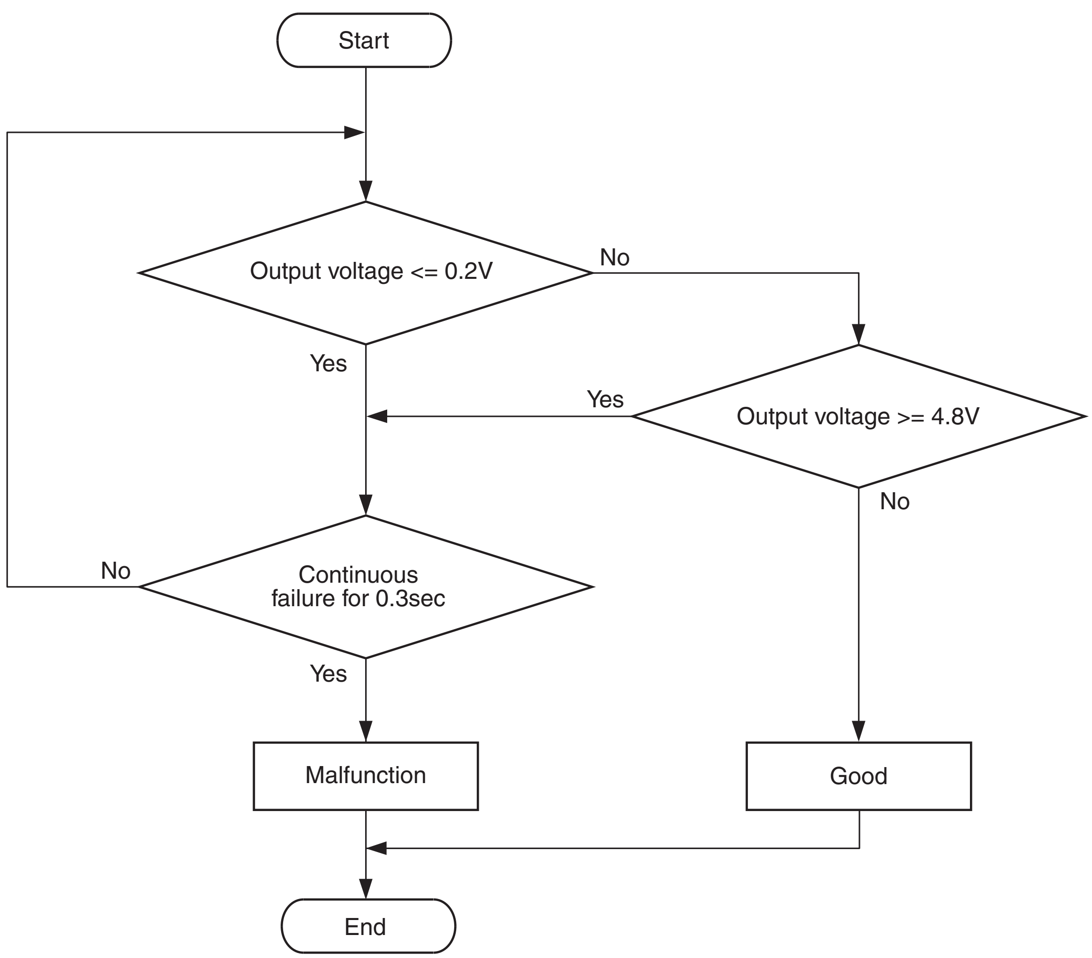
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



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Check Condition
- Ignition switch is "ON" position.

Judgement Criterion
- Throttle position sensor (main) output voltage should be 0.2 volt or less for 0.3 second.

OBD-II DRIVE CYCLE PATTERN

None.

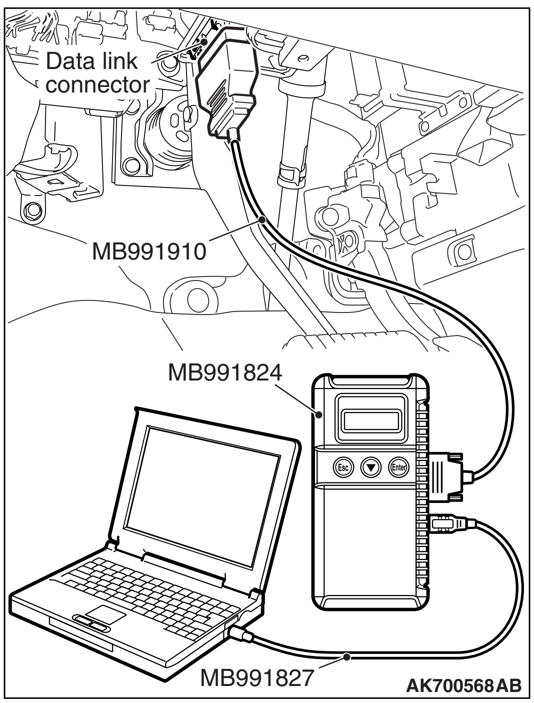
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Throttle position sensor failed.
- Connector damage
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:
- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A
- MB991658: Test Harness

STEP 1. Using scan tool MB991958, check data list item 13: Throttle Position Sensor (main).



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Detach the intake air hose at the throttle body.
(4) Disconnect the connector of the throttle position sensor.
(5) Use test harness special tool (MB991658) to connect only terminals No. 3, No. 4, No. 5, and No. 6.
(6) Set scan tool MB991958 to the data reading mode for item 13, Throttle Position Sensor (main).
- Output voltage should be between 0.3 and 0.7 volt when the throttle valve is fully closed with your finger.
- Output voltage should be between 4.0 volts or more when the throttle valve is fully open with your finger.

(7) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

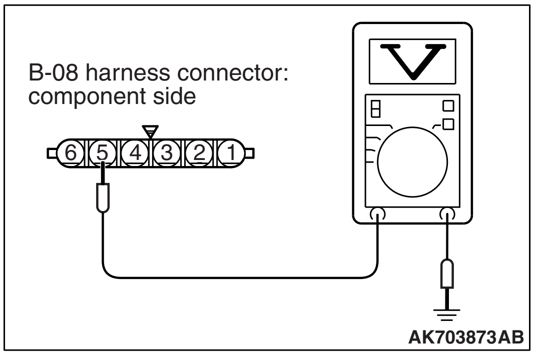
NO : Go to Step 2.

STEP 2. Check harness connector B-08 at the throttle position sensor and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 6.



STEP 3. Measure the sensor supply voltage at throttle position sensor harness side connector B-08.

(1) Disconnect the connector B-08 and measure at the harness side.
(2) Turn the ignition switch to the "ON" position.
(3) Measure the voltage between terminal No. 5 and ground.
- Voltage should be between 4.9 and 5.1 volts.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the measured voltage between 4.9 and 5.1 volts?

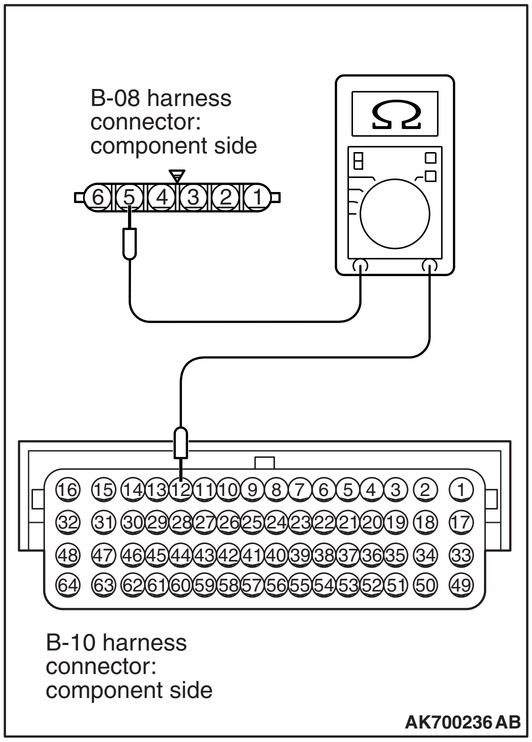
YES : Go to Step 5.
NO : Go to Step 4.

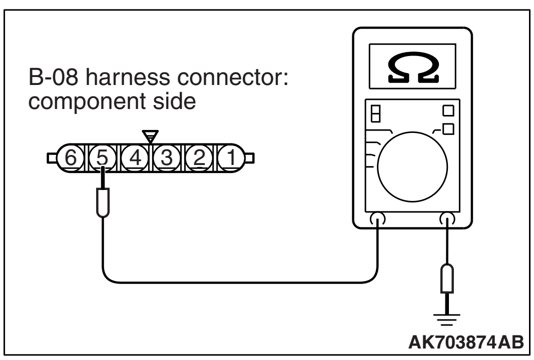
STEP 4. Check for open circuit to ground or harness damage between the throttle position sensor connector B-08 and the ECM connector B-10.

(1) Disconnect the throttle position sensor connector B-08 and the ECM connector B-10.

(2) Measure the resistance between the throttle position sensor connector B-08 (terminal No. 5) and the ECM connector B-10 (terminal No. 12).

- Should be less than 2 ohms.





(3) Check for the continuity between the throttle position sensor connector B-08 (terminal No. 5) and ground.

- Not continuity.

Q: Is the harness wire in good condition?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to step 8.

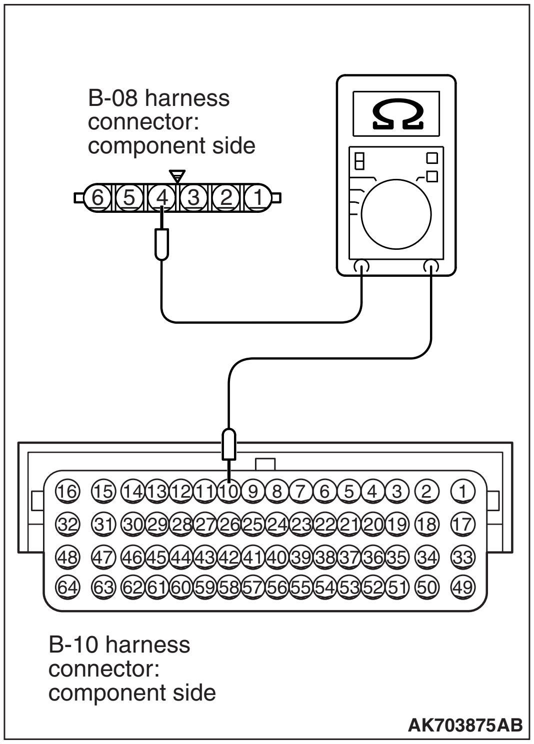
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 8.

STEP 5. Check for open circuit to ground or harness damage between the throttle position sensor connector B-08 and the ECM connector B-10.

(1) Disconnect the throttle position sensor connector B-08 and the ECM connector B-10.

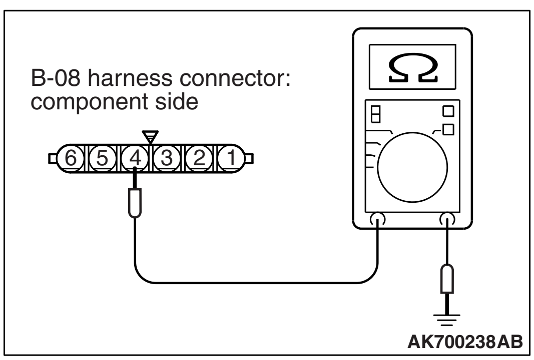
(2) Measure the resistance between the throttle position sensor connector B-08 (terminal No. 4) and the ECM connector B-10 (terminal No. 10).

- Should be less than 2 ohms.



(3) Check for the continuity between the throttle position sensor connector B-08 (terminal No. 4) and ground.

- Not continuity.



Q: Is the harness wire in good condition?

YES : Go to Step 6.

NO : Repair it. Then go to Step 8.

STEP 6. Using scan tool MB991958, check data list item 13: Throttle Position Sensor (main).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Detach the intake air hose at the throttle body.
(4) Disconnect the connector of the throttle position sensor.
(5) Use test harness special tool (MB991658) to connect only terminals No. 3, No. 4, No. 5, and No. 6.
(6) Set scan tool MB991958 to the data reading mode for item 13, Throttle Position Sensor (main).
- Output voltage should be between 0.3 and 0.7 volt when the throttle valve is fully closed with your finger.
- Output voltage should be 4.0 volts or more when the throttle valve is fully open with your finger.

(7) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Go to Step 7.

STEP 7. Replace the throttle body assembly.

(1) Replace the throttle body assembly.
(2) Turn the ignition switch to the "ON" position.
(3) After the DTC has been deleted, read the DTC again.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is DTC P0122 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 8.

NO : The inspection is complete.

STEP 8. Using scan tool MB991958, read the diagnostic trouble code (DTC).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

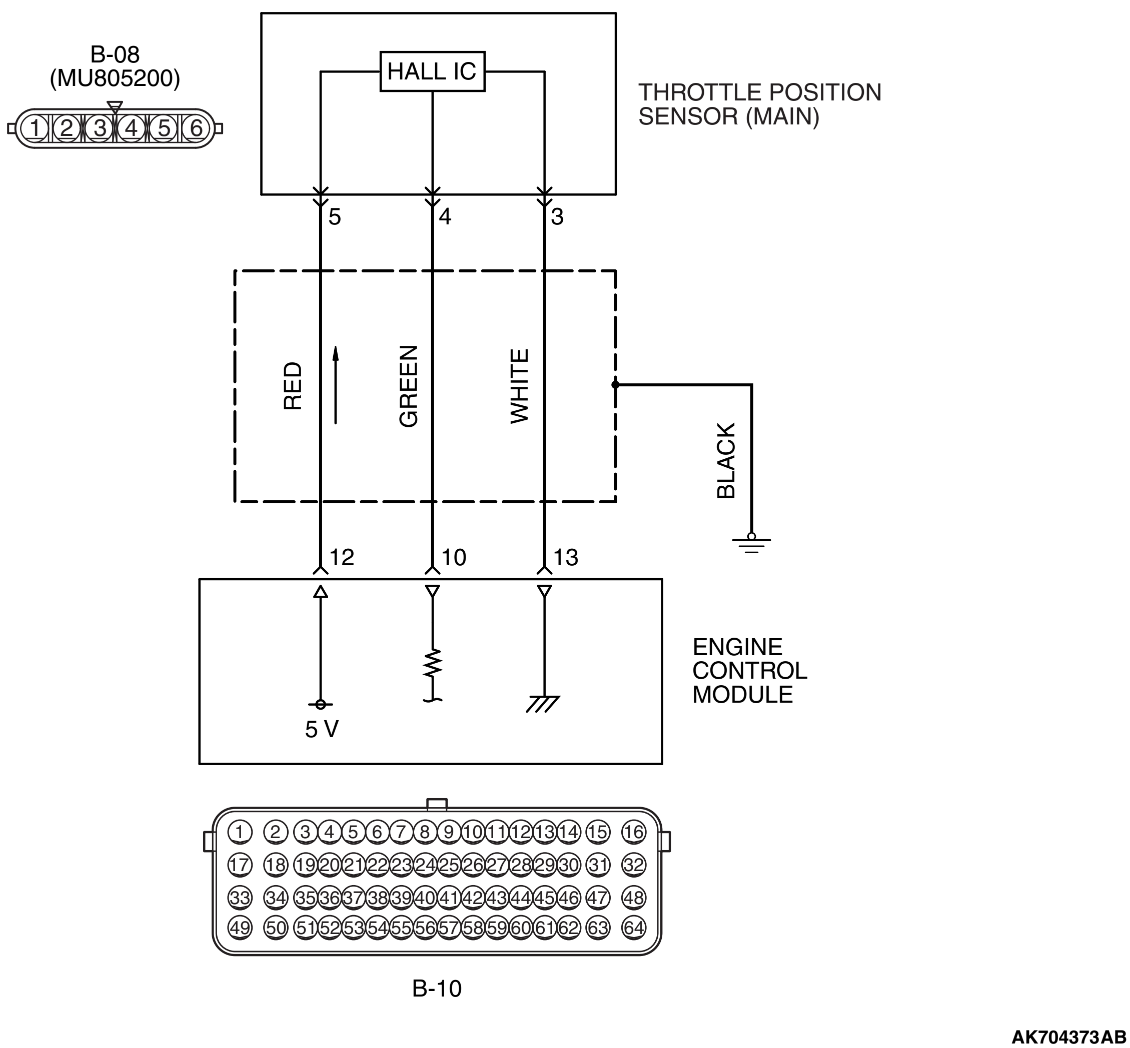
(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) After the DTC has been deleted, read the DTC again.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

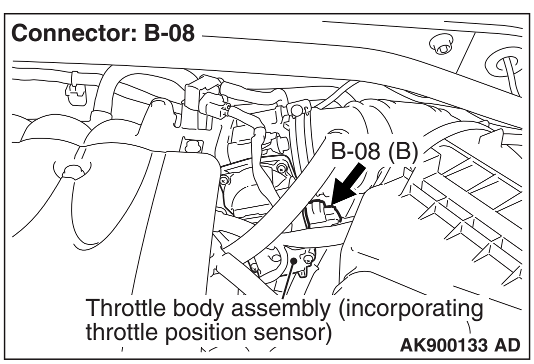
Q: Is DTC P0122 set?

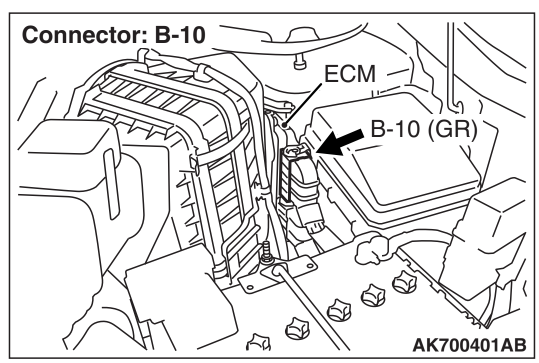
YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0123: Throttle Position Sensor (main) Circuit High Input

THROTTLE POSITION SENSOR (MAIN) CIRCUIT







CIRCUIT OPERATION

- A 5-volt power supply is applied on the throttle position sensor (main) power terminal (terminal No. 5) from the ECM (terminal No. 12).
- A voltage that is according to the throttle opening angle is sent to the ECM (terminal No. 10) from the throttle position sensor (main) output terminal (terminal No. 4).

- The ground terminal (terminal No. 3) is grounded with ECM (terminal No. 13).

TECHNICAL DESCRIPTION

- The throttle position sensor (main) outputs voltage which corresponds to the throttle valve opening angle.
- The ECM checks whether the voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

Throttle position sensor (main) output voltage is out of specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

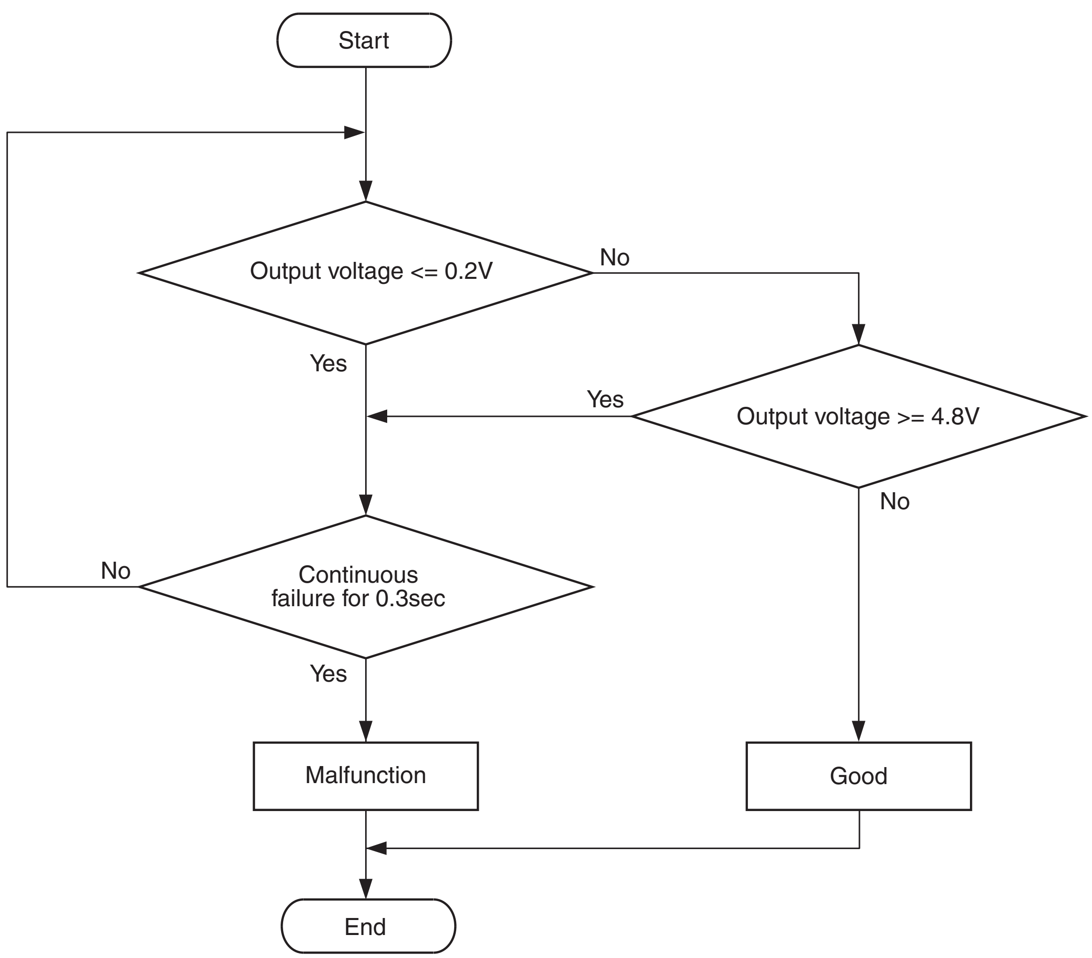
- Not applicable

Sensor (The sensor below is determined to be normal)

- Not applicable

DTC SET CONDITIONS

Logic Flow Chart



AK604318

Check Condition

- Ignition switch is "ON" position.

Judgement Criterion

- Throttle position sensor (main) output voltage should be 4.8 volts or more for 0.3 second.

OBD-II DRIVE CYCLE PATTERN

None.

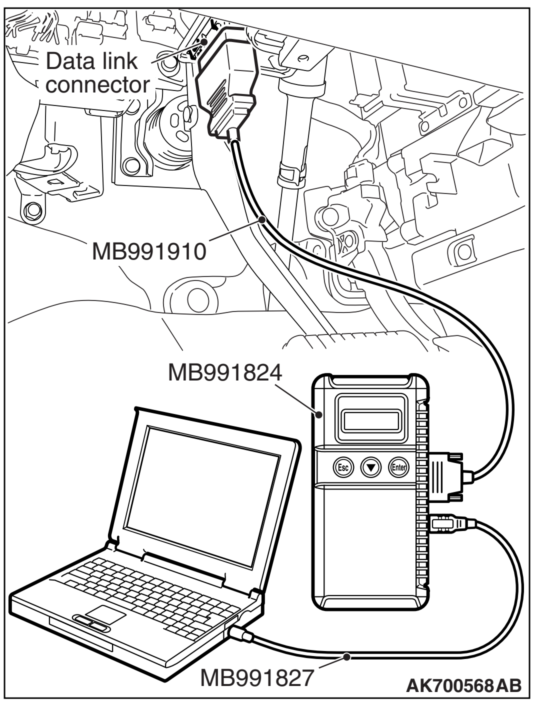
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Throttle position sensor failed.
- Harness damage
- Connector damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A
- MB991658: Test Harness



STEP 1. Using scan tool MB991958, check data list item 13: Throttle Position Sensor (main).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK"(OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Detach the intake air hose at the throttle body.
(4) Disconnect the connector of the throttle position sensor.
(5) Use test harness special tool (MB991658) to connect only terminals No. 3, No. 4, No. 5, and No. 6.
(6) Set scan tool MB991958 to the data reading mode for item 13, Throttle Position Sensor (main).
- Output voltage should be between 0.3 and 0.7 volt when the throttle valve is fully closed with your finger.
- Output voltage should be between 4.0 volts or more when the throttle valve is fully open with your finger.

(7) Turn the ignition switch to the "LOCK"(OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Go to Step 2.

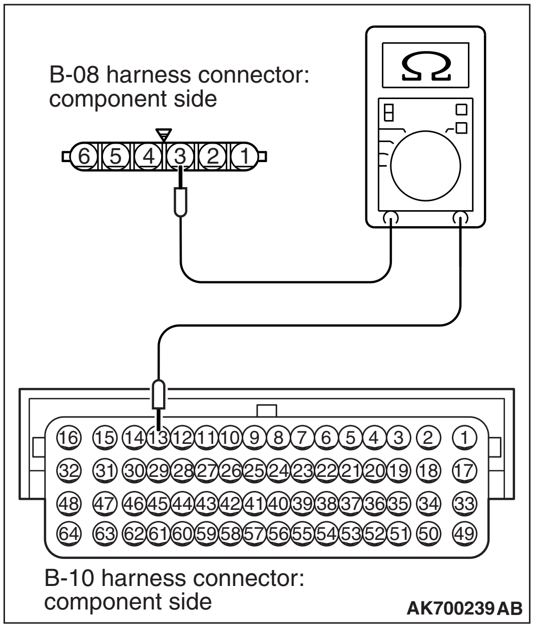
STEP 2. Check harness connector B-08 at the throttle position sensor and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

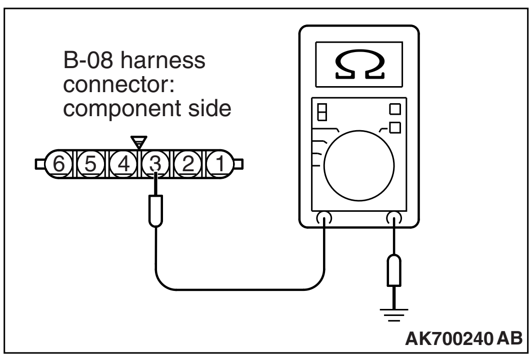
YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 3.

STEP 3. Check for open circuit and harness damage between the throttle position sensor connector B-08 and ECM connector B-10.



(1) Disconnect the throttle position sensor connector B-08 and the ECM connector B-10.
(2) Measure the resistance between the throttle position sensor connector B-08 (terminal No. 3) and the ECM connector B-10 (terminal No. 13).
  - Should be less than 2 ohms.



(3) Check for the continuity between the throttle position sensor connector B-08 (terminal No. 3) and ground.
  - Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Then go to Step 6.

STEP 4. Using scan tool MB991958, check data list item 13: Throttle Position Sensor (main).

⚠ **CAUTION**

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Detach the intake air hose at the throttle body.
(4) Disconnect the connector of the throttle position sensor.
(5) Use test harness special tool (MB991658) to connect only terminals No. 3, No. 4, No. 5, and No. 6.
(6) Set scan tool MB991958 to the data reading mode for item 13, Throttle Position Sensor (main).
- Output voltage should be between 0.3 and 0.7 volt when the throttle valve is fully closed with your finger.
- Output voltage should be 4.0 volts or more when the throttle valve is fully open with your finger.

(7) Turn the ignition switch to the "LOCK"(OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Go to Step 5.

STEP 5. Replace the throttle body assembly.

(1) Replace the throttle body assembly.
(2) Turn the ignition switch to the "ON" position.
(3) After the DTC has been deleted, read the DTC again.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is DTC P0123 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 6.

NO : The procedure is complete.

STEP 6. Using scan tool MB991958, read the diagnostic trouble code (DTC)

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

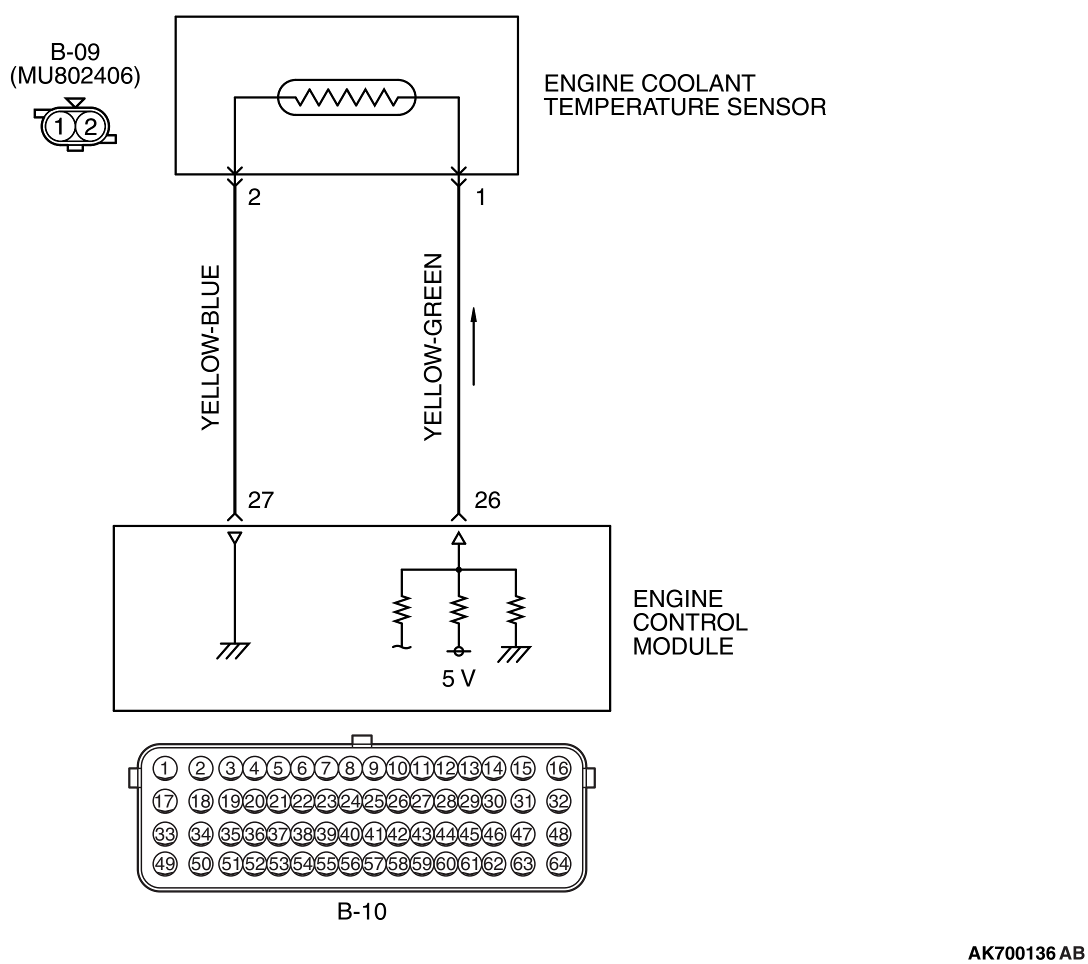
(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) After the DTC has been deleted, read the DTC again.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

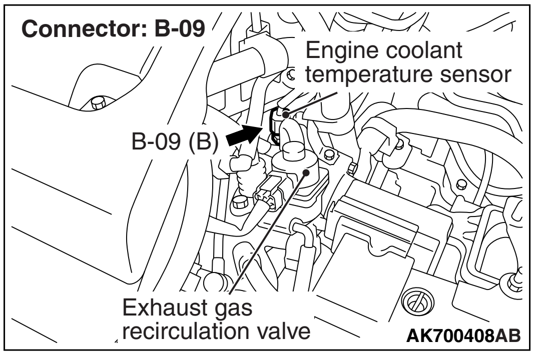
Q: Is DTC P0123 set?

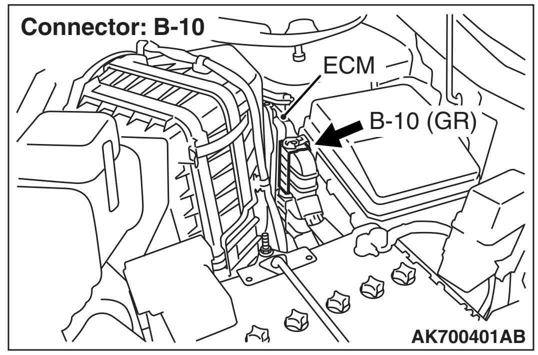
YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0125: Insufficient Coolant Temperature for Closed Loop Fuel Control

ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT







CIRCUIT OPERATION

- 5-volt voltage is applied to the engine coolant temperature sensor output terminal (terminal No. 1) from the ECM (terminal No. 26) via the resistor in the ECM. The ground terminal (terminal No. 2) is grounded with ECM (terminal No. 27).
- The engine coolant temperature sensor is a negative temperature coefficient type of resistor. It has the characteristic that when the engine coolant temperature rises the resistance decreases.
- The engine coolant temperature sensor output voltage increases when the resistance increases and decreases when the resistance decreases.

TECHNICAL DESCRIPTION

- The engine coolant temperature sensor converts the engine coolant temperature to a voltage and outputs it.
- The ECM checks whether this voltage is within a specified range.

DESCRIPTIONS OF MONITOR METHODS

- Engine coolant temperature sensor output voltage drops from over 40°C (104°F) to under 40°C (104°F) and keeps under 40°C (104°F) for 5 minutes.
- Engine coolant temperature sensor output voltage does not reach close loop enable temperature within specified period when engine coolant temperature sensor output voltage at engine start is under 7°C (45°F).

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

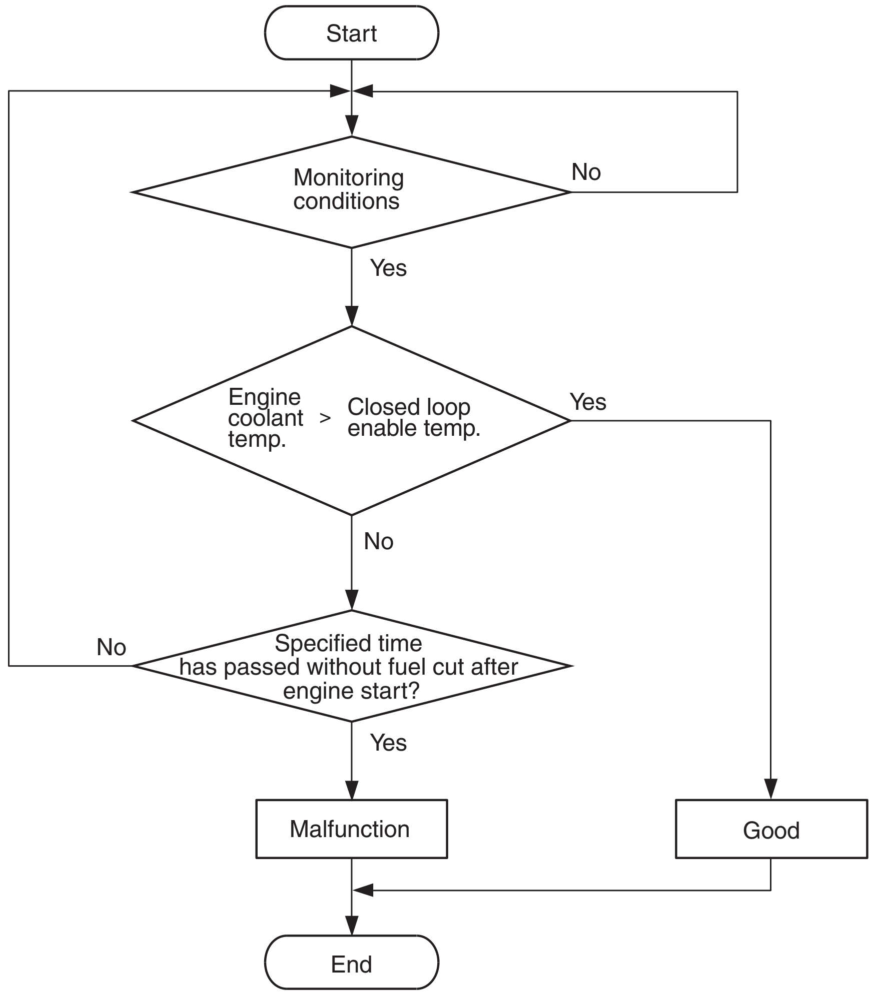
- Not applicable

Sensor (The sensor below is determined to be normal)

- Mass air flow sensor
- Intake air temperature sensor

DTC SET CONDITIONS <Range/Performance problem - low input (time to reach closed loop temperature)>

Logic Flow Chart



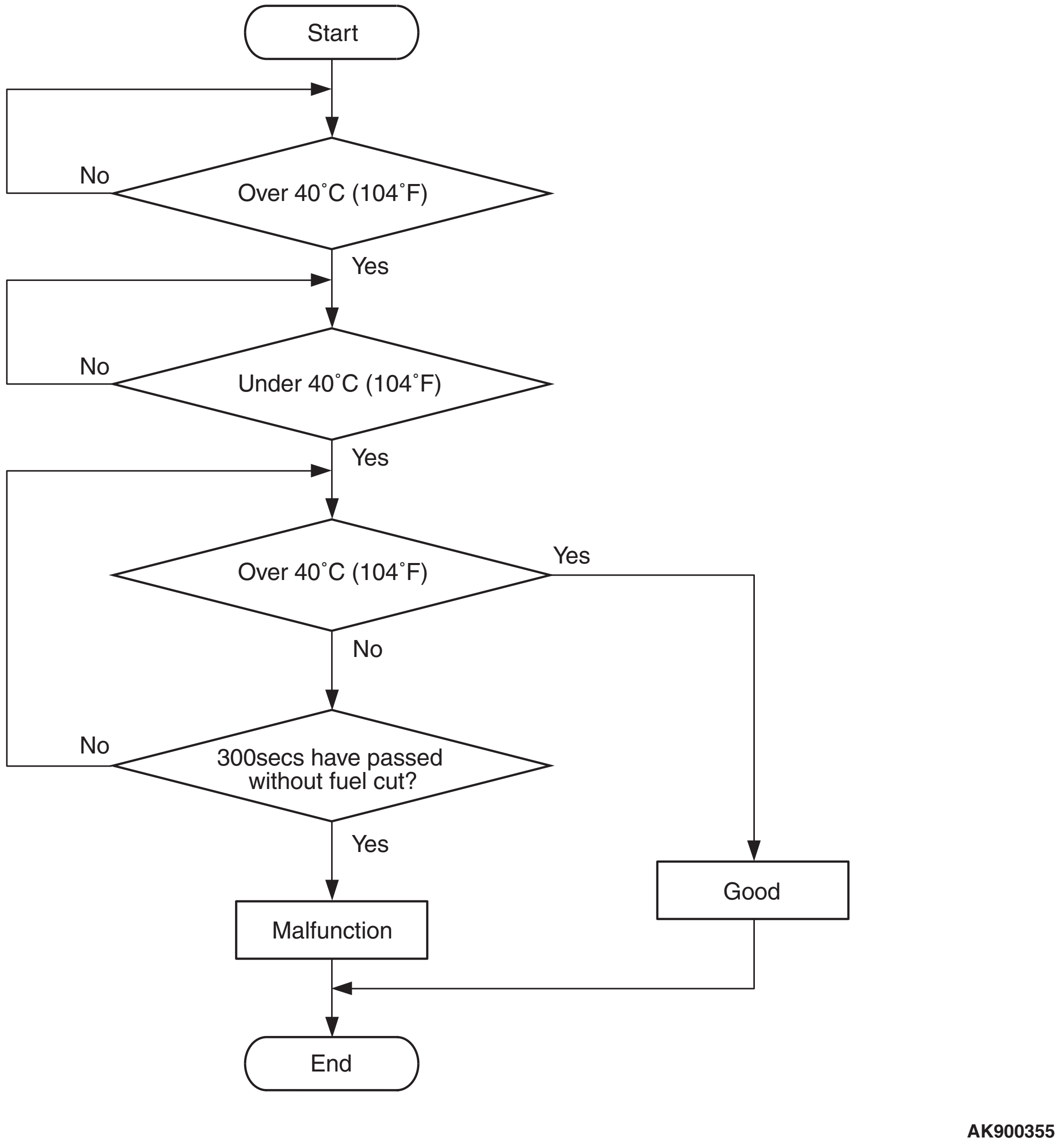
AK900354

Check Conditions, Judgement Criteria

- About 90 – 300 seconds have passed for the engine coolant temperature to rise to about 7°C (44.6°F) after starting sequence was completed.
- However, time is not counted when fuel is shut off.

DTC SET CONDITIONS <Range/Performance problem - drift>

Logic Flow Chart



Check Conditions, Judgement Criteria

- Engine coolant temperature decreases from higher than 40°C (104°F) to lower than 40°C (104°F).
- Then the engine coolant temperature has continued to be 40°C (104°F) or lower for 5 minutes.
- However, time is not counted when fuel is shut off.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 9 P.13B-11.

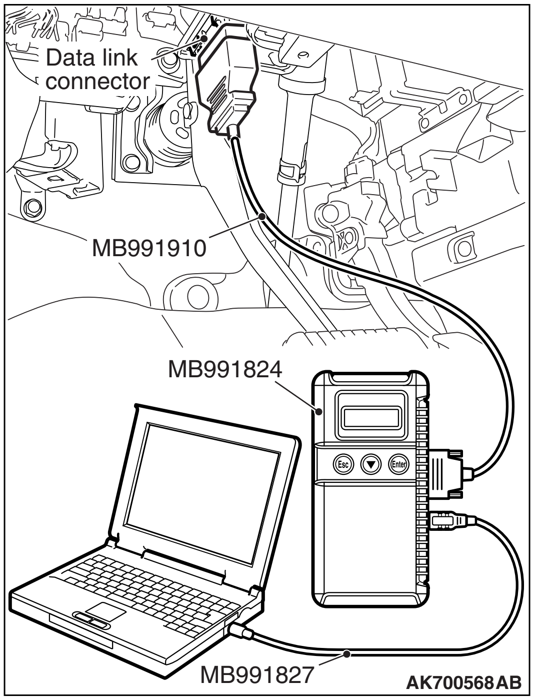
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Engine coolant temperature sensor failed.
- Harness damage
- Connector damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item 6: Engine Coolant Temperature Sensor.

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Turn the ignition switch to the "ON" position.
(3) Set scan tool MB991958 to the data reading mode for item 6, Engine Coolant Temperature Sensor.
- The engine coolant temperature and temperature shown with the scan tool should approximately match.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

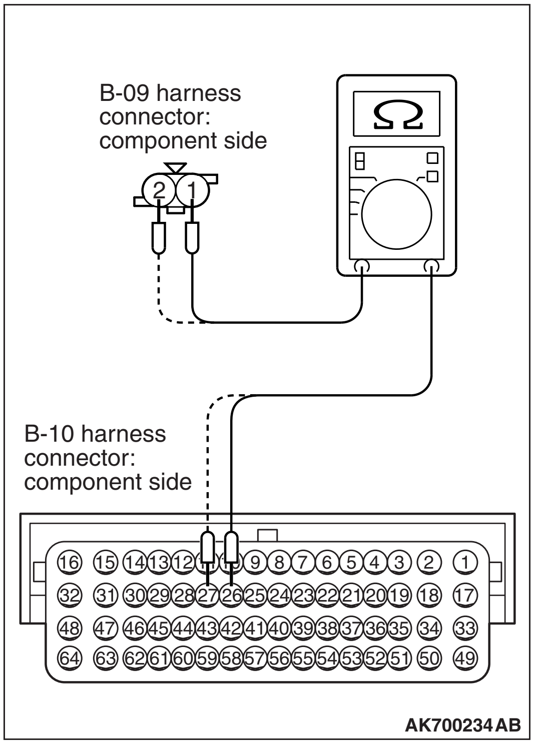
NO : Go to Step 2.

STEP 2. Check harness connector B-09 at the engine coolant temperature sensor and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.



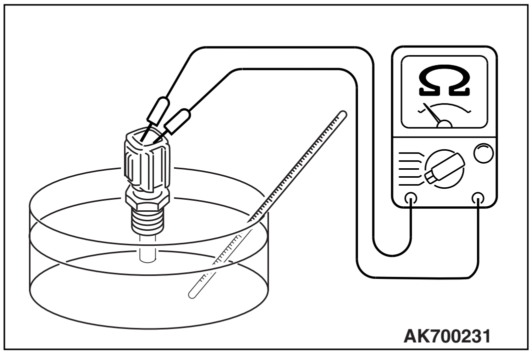
STEP 3. Check for harness between the engine coolant temperature sensor connector B-09 and the ECM connector B-10.

(1) Disconnect the engine coolant temperature sensor connector B-09 and the ECM connector B-10.
(2) Measure the resistance between the engine coolant temperature sensor connector B-09 and the ECM connector B-10.
  a. Connector B-09 (terminal No. 1) and Connector B-10 (terminal No. 26).
  b. Connector B-09 (terminal No. 2) and Connector B-10 (terminal No. 27).
  - Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Then go to Step 5.

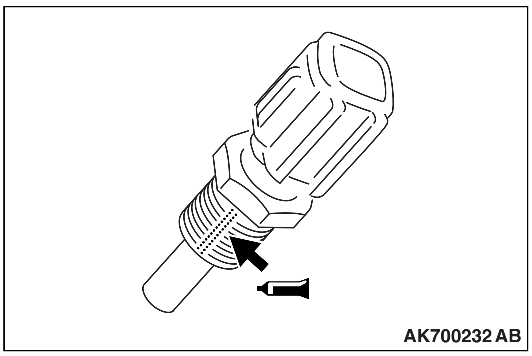
STEP 4. Check the engine coolant temperature sensor.



(1) Disconnect the engine coolant temperature sensor connector B-09.
(2) Remove the engine coolant temperature sensor.
(3) With the temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.

Standard value:

14 – 17 kΩ [at –20°C (–4°F)]
5.1 – 6.5 kΩ [at 0°C (32°F)]
2.1 – 2.7 kΩ [at 20°C (68°F)]
0.9 – 1.3 kΩ [at 40°C (104°F)]
0.48 – 0.68 kΩ [at 60°C (140°F)]
0.26 – 0.36 kΩ [at 80°C (176°F)]



(4) Apply 3M™ AAD part number 8731 or equivalent on the screw section of the engine coolant temperature sensor.
(5) Install the engine coolant temperature sensor, and tighten to the specified torque.

Tightening torque: 29 ± 10 N·m (22 ± 7 ft-lb)

Q: Is the measured resistance at the standard value?

YES : Go to Step 5.
NO : Replace the engine coolant temperature sensor. Then go to Step 5.

STEP 5. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 9 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0125 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0128: Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)

TECHNICAL DESCRIPTION

- The ECM checks the time for the cooling water temperature to reach the judgment temperature.

DESCRIPTIONS OF MONITOR METHODS

Engine coolant temperature does not reach 77°C (171°F) within specified period after cold start.

MONITOR EXECUTION

Once per driving cycle

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

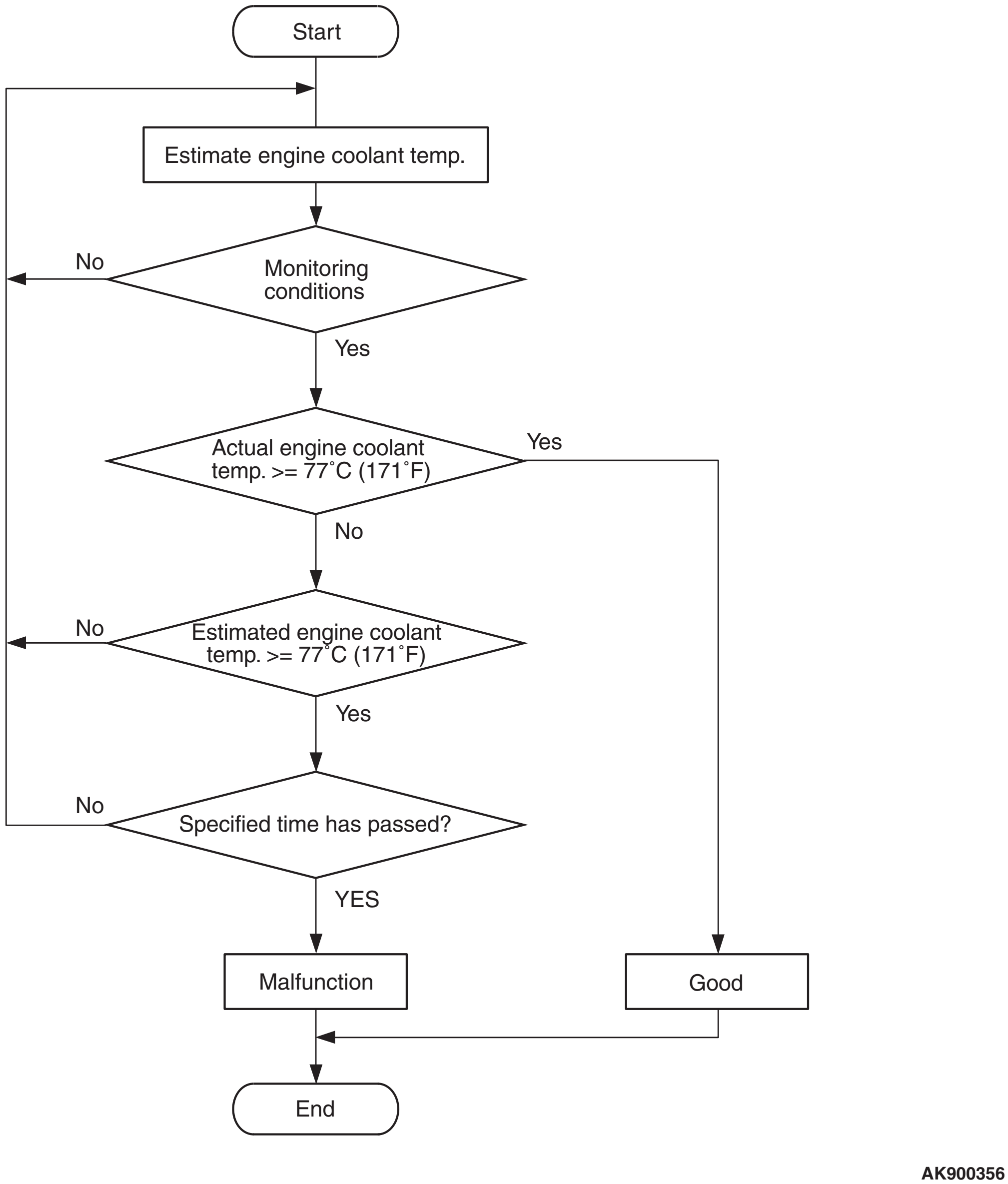
- Not applicable

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- Engine coolant temperature is between –10°C (14°F) and 60°C (140°F) when the engine is started.
- Intake air temperature is –10°C (14°F) or higher.
- The intake air temperature when the engine is started – intake air temperature is 10°C (18°F) or less.
- The total time when the amount of intake air is small is less than the specified time.

Judgement Criterion

- After the estimated engine coolant temperature rises above 77°C (171°F), the actual engine coolant temperature is less than 77°C (171°F) even though the specified time has passed.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 10 P.13B-11.

TROUBLESHOOTING HINTS

(The most likely causes for this code to be set are:)

- The engine cooling system is faulty.
- ECM failed.

DIAGNOSIS

STEP 1. Check the cooling system.
Refer to GROUP14, Engine Cooling Diagnosis P.14-4.

Q: Is the cooling system normal?

YES : Go to Step 2.
NO : Repair it. Then Go to Step 2.

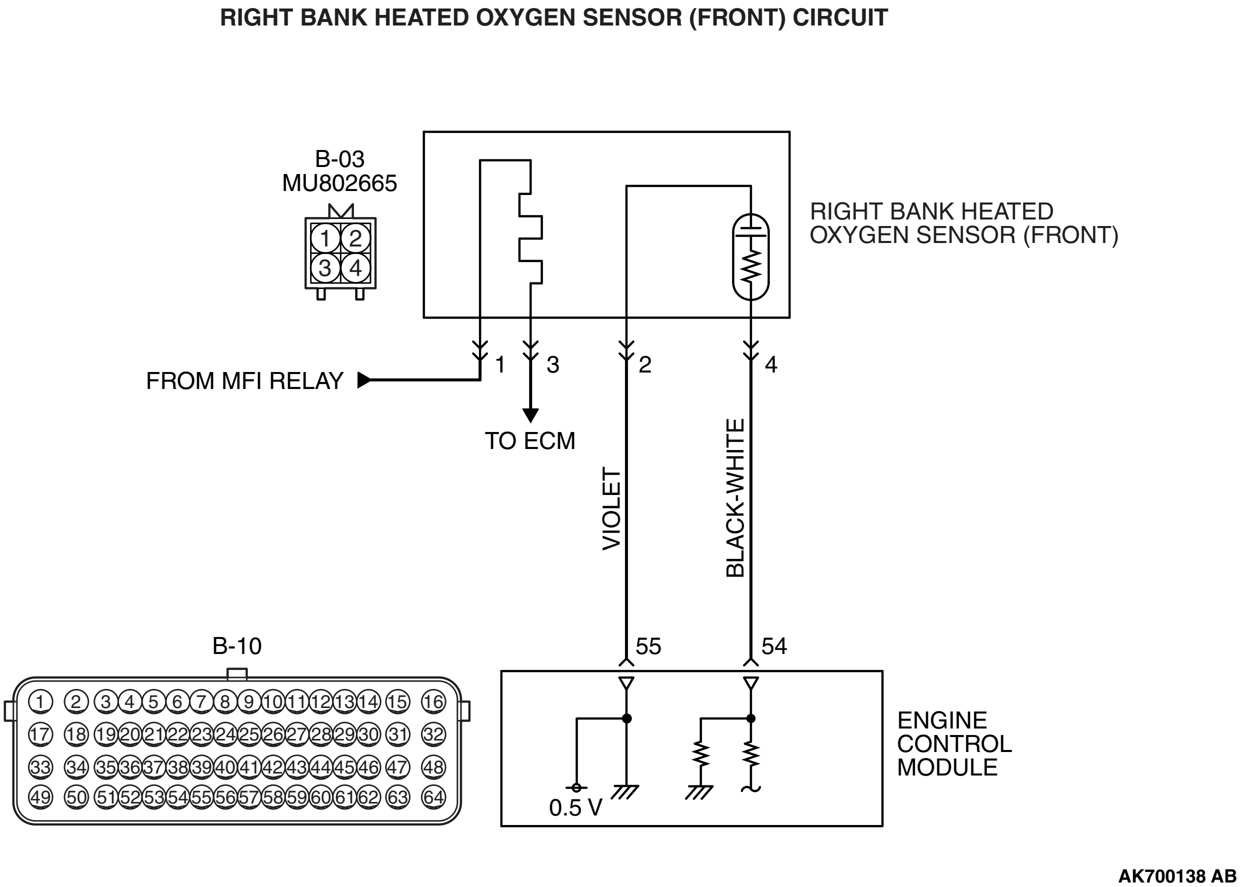
STEP 2. Test the OBD-II drive cycle.

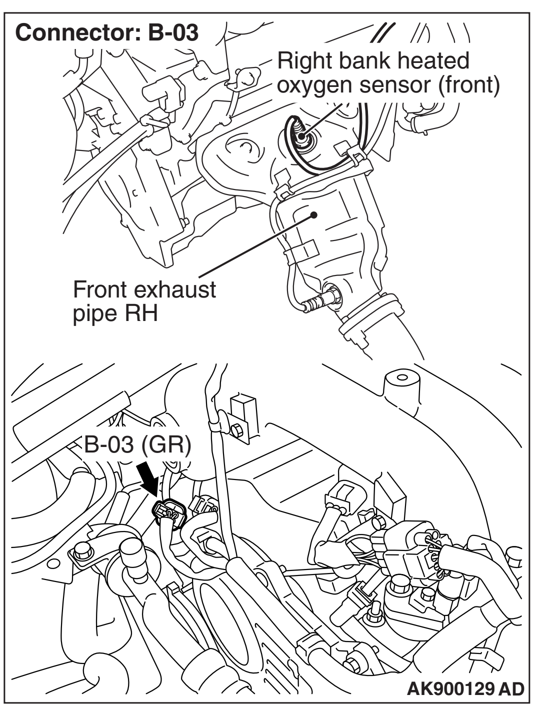
(1) Carry out test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 10 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

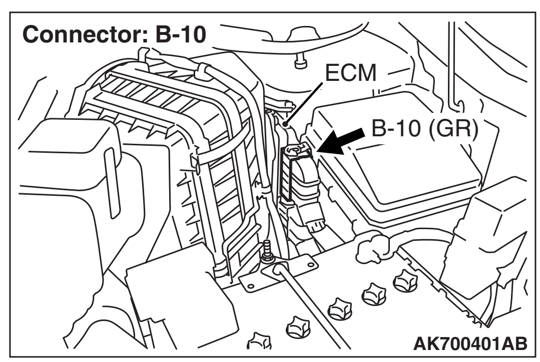
Q: Is DTC P0128 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0131: Heated Oxygen Sensor Circuit Low Voltage (bank 1, sensor 1)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 54) from the output terminal (terminal No. 4) of the right bank heated oxygen sensor (front).
- Terminal No. 2 of the right bank heated oxygen sensor (front) is grounded with ECM (terminal No. 55).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the right bank heated oxygen sensor (front).

TECHNICAL DESCRIPTION

- The right bank heated oxygen sensor (front) detects the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the ECM.
- When the right bank heated oxygen sensor (front) begins to deteriorate, the heated oxygen sensor signal response becomes poor.
- The ECM also checks for an open circuit in the right bank heated oxygen sensor (front) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (front) output voltage is under specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

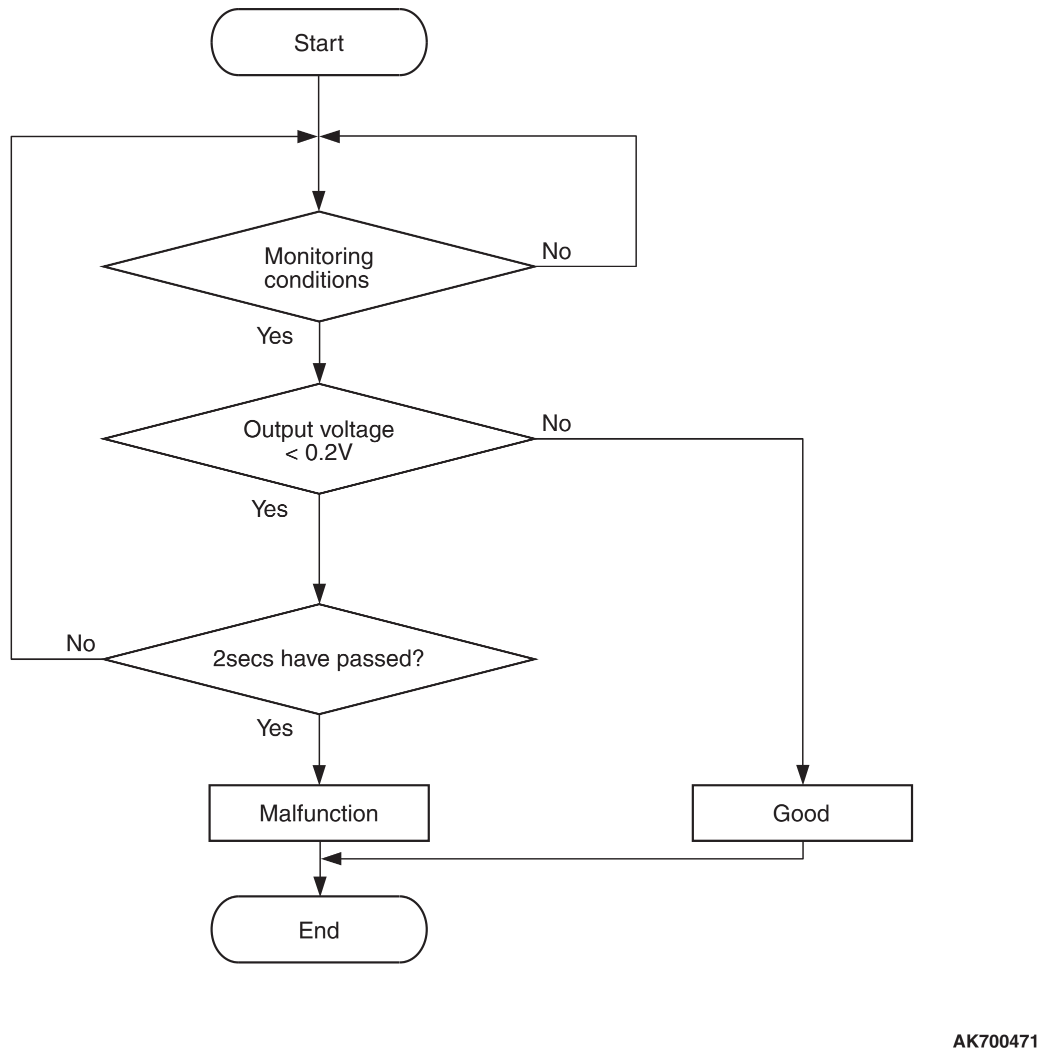
- Heated oxygen sensor (front) heater monitor
- Misfire monitor
- Fuel system monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Barometric pressure sensor
- Throttle position sensor
- Accelerator pedal position sensor
- Engine coolant temperature sensor
- Intake air temperature sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- Heated oxygen sensor offset voltage is between 0.4 and 0.6 volt.
- Battery positive voltage is between 11 and 16.5 volts.
- More than 180 seconds have passed since the engine starting sequence was completed.

Judgement Criterion

- Right bank heated oxygen sensor (front) output voltage is lower than 0.2 volt for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (front) failed.
- Harness damage
- Connector damage.
- ECM failed.

DIAGNOSIS

Required Special Tools:

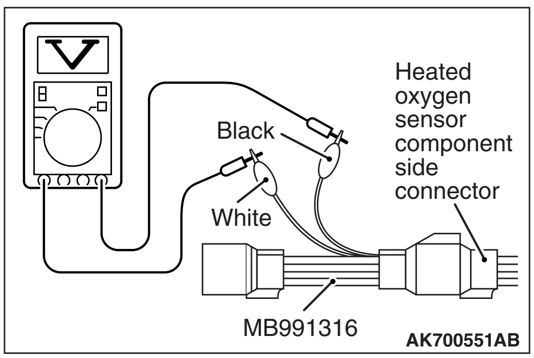
- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A
- MB991316: Test Harness

STEP 1. Check harness connector B-03 at the right bank heated oxygen sensor (front) harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 2. Check the right bank heated oxygen sensor (front).



(1) Disconnect the right bank heated oxygen sensor (front) connector B-03 and connect test harness special tool, MB991316, to the connector on the right bank heated oxygen sensor (front) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Rev the engine for 5 minutes or more with the engine speed of 2,500 r/min.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) While repeatedly revving the engine, measure the right bank heated oxygen sensor (front) output voltage.

Standard value: 0.6 – 1.0 volts

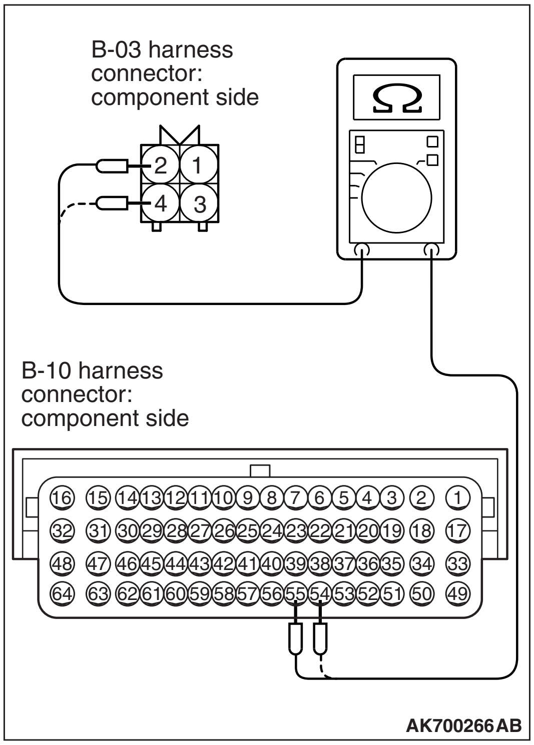
⚠ CAUTION

- **Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.**
- **Be careful the heater can be damaged if a voltage beyond 8 volts is applied to the heated oxygen sensor heater.**

NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio. Therefore, if the output voltage is low, use a jumper wire to connect the terminal No.1 (red clip) and the terminal No. 3 (blue clip) of the heated oxygen sensor with the positive terminal and the negative terminal of 8 volts power supply respectively, then check again.

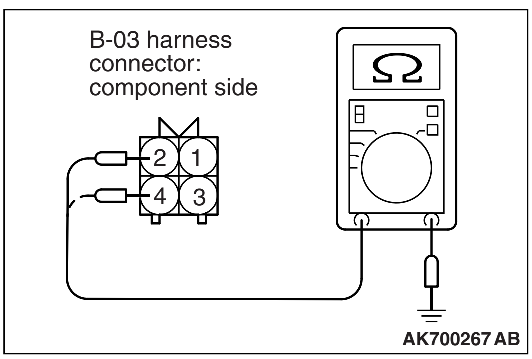
Q: Is the voltage between 0.6 and 1.0 volts?

YES : Go to Step 3.
NO : Replace the right bank heated oxygen sensor (front). Then go to Step 5.



STEP 3. Check for harness between the right heated oxygen sensor (front) connector B-03 and the ECM connector B-10.

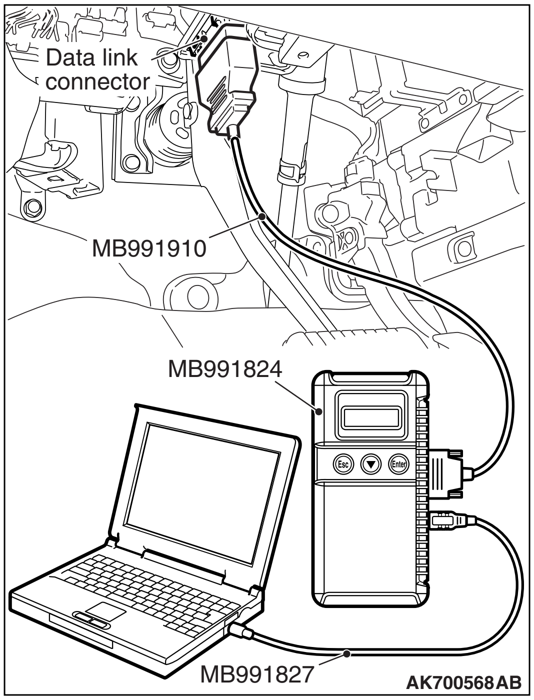
(1) Disconnect the right bank heated oxygen sensor (front) connector B-03 and the ECM connector B-10.
(2) Measure the resistance between the heated oxygen sensor connector B-03 and the ECM connector B-10.
   a. Connector B-03 (terminal No. 2) and connector B-10 (terminal No. 55).
   b. Connector B-03 (terminal No. 4) and connector B-10 (terminal No. 54).
   - Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-03 and ground.
   a. Connector B-03 (terminal No. 2) and ground.
   b. Connector B-03 (terminal No. 4) and ground.
   - Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.



STEP 4. Using scan tool MB991958, check data list item AC: Heated Oxygen Sensor Bank 1, Sensor 1 (right front).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AC, Heated Oxygen Sensor Bank 1, Sensor 1 (right front).
- Warm up the engine. When the engine is revved, the output voltage should battery positive voltage.
- Warm up the engine. When the engine is idling, the output voltage should repeat 0.4 volt or less and 0.6 to 1.0 volt alternately.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.
NO : Replace the ECM. Then go to Step 5.

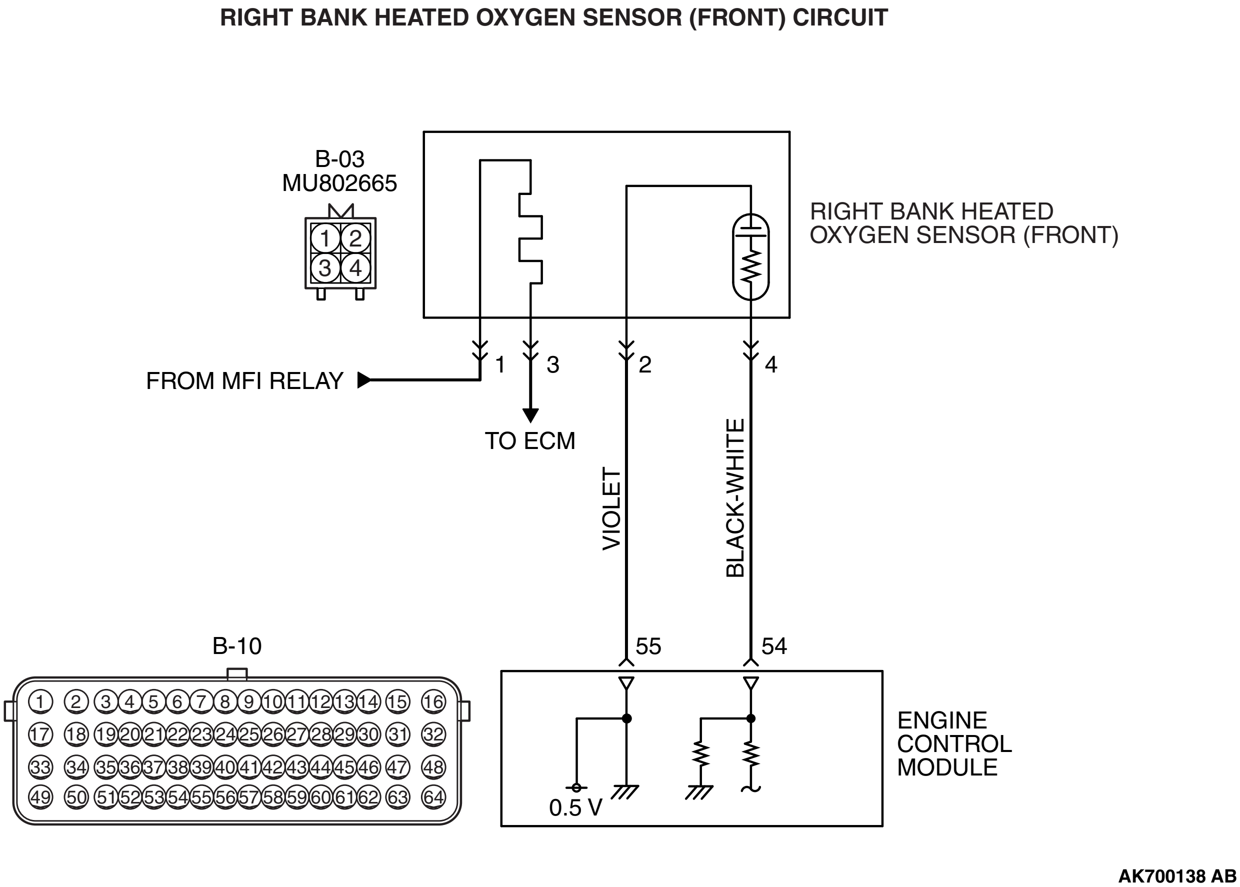
STEP 5. Test the OBD-II drive cycle.

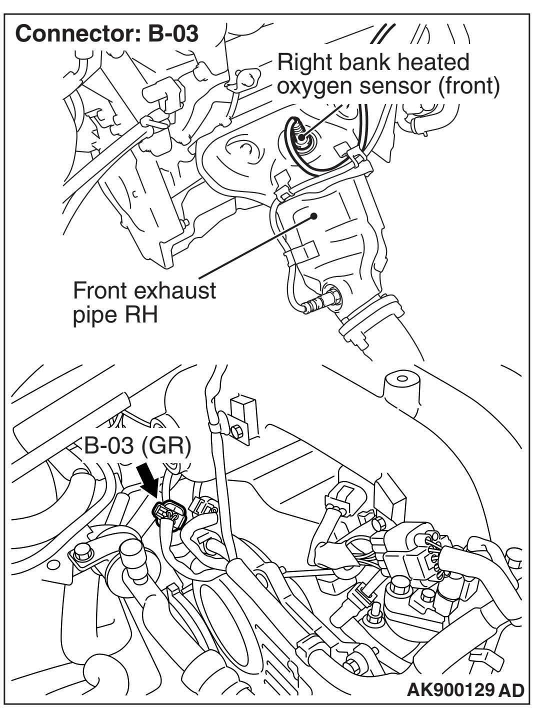
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

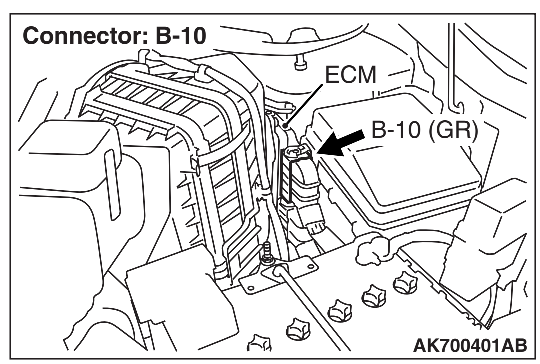
Q: Is DTC P0131 set?

YES : Retry the troubleshooting.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0132: Heated Oxygen Sensor Circuit High Voltage (bank 1, sensor 1)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 54) from the output terminal (terminal No. 4) of the right bank heated oxygen sensor (front).
- Terminal No. 2 of the right bank heated oxygen sensor (front) is grounded with ECM (terminal No. 55).
- The ECM applies an off set voltage of 0.5 volt to terminal No. 2 the right bank heated oxygen sensor (front).

TECHNICAL DESCRIPTION

- The right bank heated oxygen sensor (front) detects the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the ECM.
- When the right bank heated oxygen sensor (front) begins to deteriorate, the heated oxygen sensor signal response becomes poor.
- The ECM the right bank heated oxygen sensor (front) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (front) output voltage is over specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

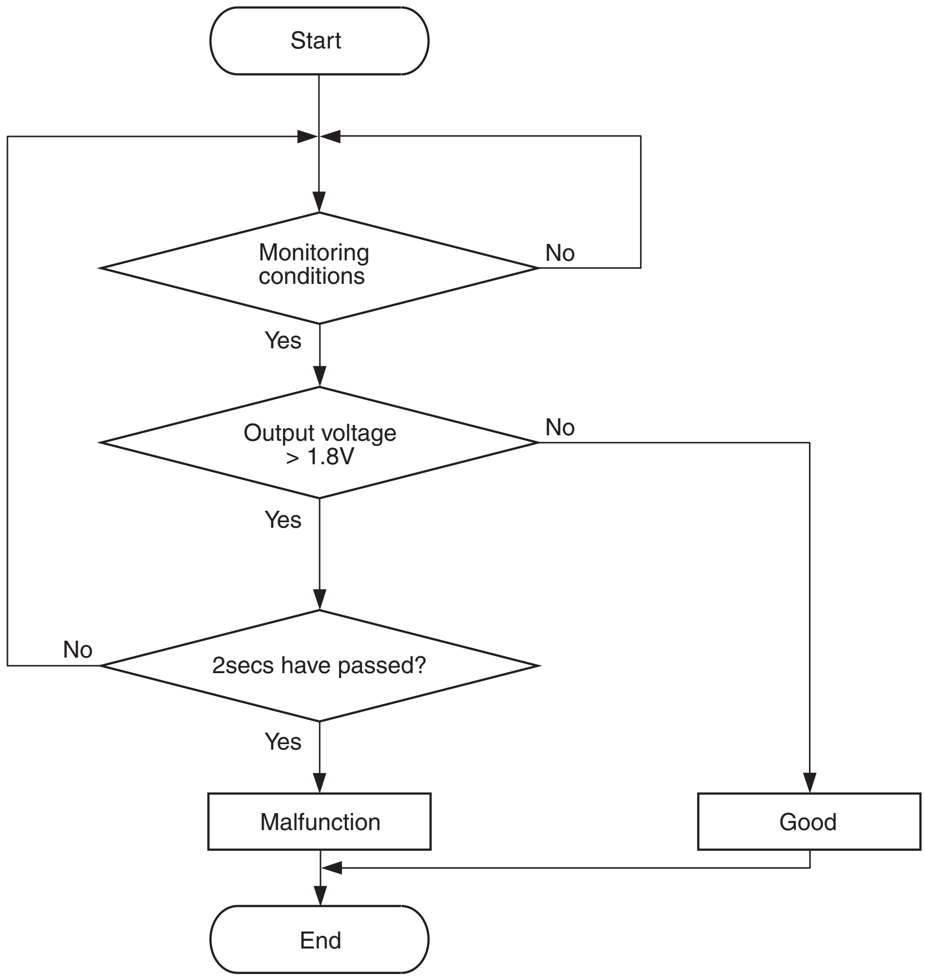
- Heated oxygen sensor (front) heater monitor
- Misfire monitor
- Fuel system monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Barometric pressure sensor
- Throttle position sensor
- Accelerator pedal position sensor
- Engine coolant temperature sensor
- Intake air temperature sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- 2 seconds or more have passed since the engine starting sequence was completed.
- Heated oxygen sensor off set voltage is between 0.4 and 0.6 volt.

Judgement Criterion

- Right bank heated oxygen sensor (front) output voltage has continued to be 1.8 volts or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Harness damage
- Connector damage.
- ECM failed.

DIAGNOSIS

STEP 1. Check harness connector B-03 at right bank heated oxygen sensor (front) and harness connector B-10 at ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 4.

STEP 2. Check for short circuit to power supply between the right bank oxygen sensor (front) connector B-03 (terminal No. 4) and the ECM connector B-10 (terminal No. 54).

Q: Is the harness wire in good condition?

YES : Go to Step 3.
NO : Repair it. Then go to Step 4.

STEP 3. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0132 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 4.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

STEP 4. Test the OBD-II drive cycle.

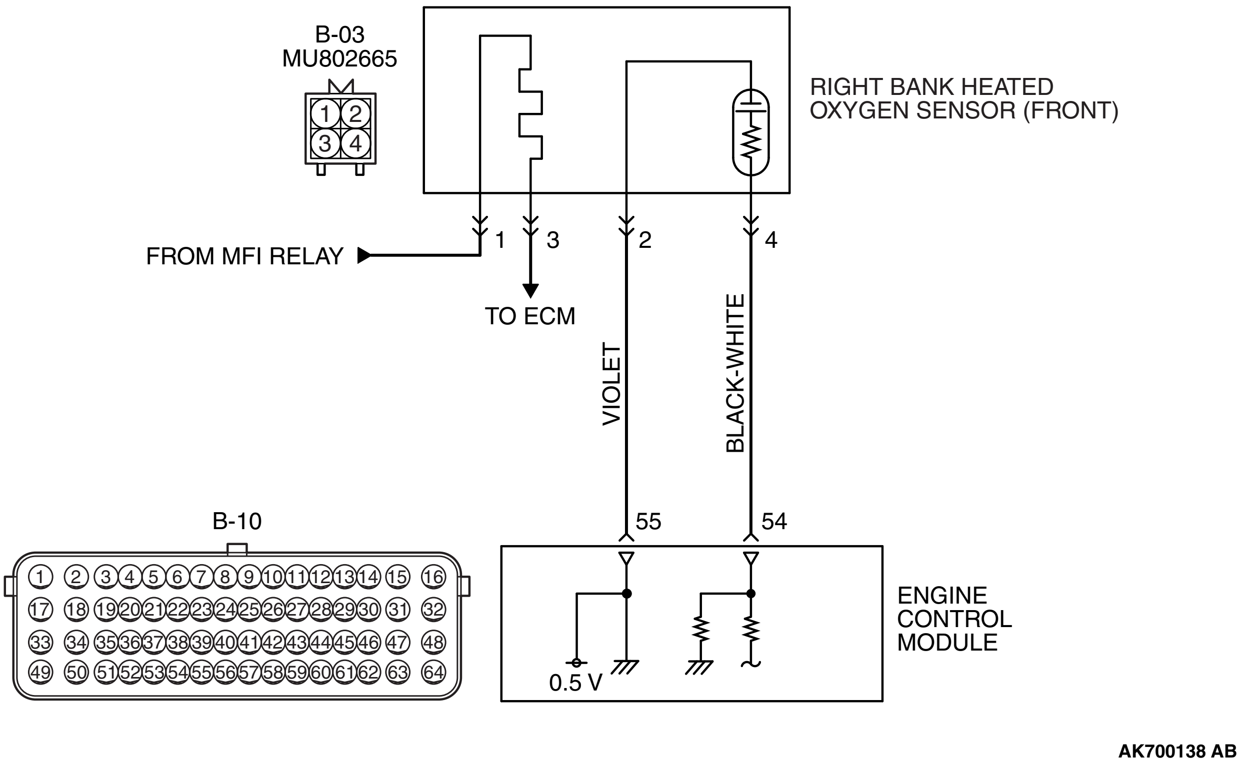
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

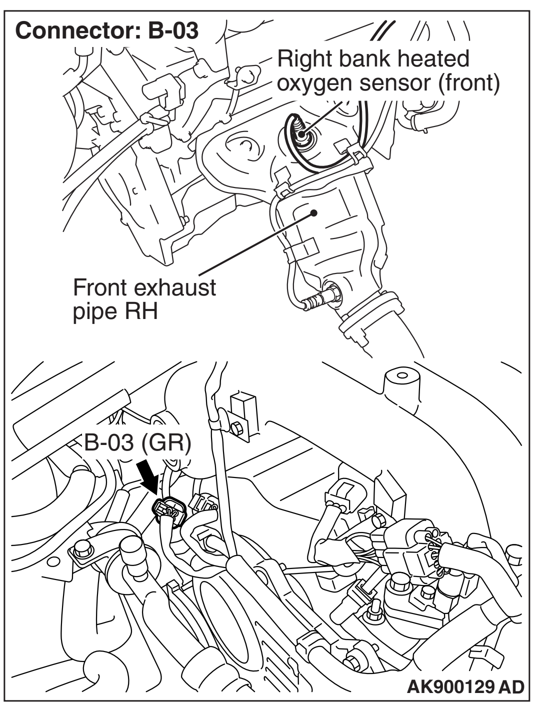
Q: Is DTC P0132 set?

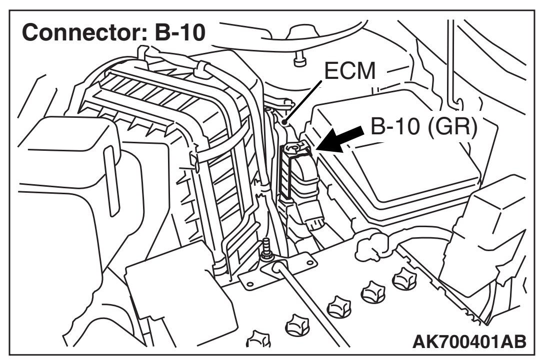
YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0133: Heated Oxygen Sensor Circuit Slow Response (bank 1, sensor 1)

RIGHT BANK HEATED OXYGEN SENSOR (FRONT) CIRCUIT







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 54) from the output terminal (terminal No. 4) of the right bank heated oxygen sensor (front).
- Terminal No. 2 of the right bank heated oxygen sensor (front) is grounded with ECM (terminal No. 55).
- The ECM applies an off set voltage of 0.5 volt to terminal No. 2 of the right bank oxygen sensor (front).

TECHNICAL DESCRIPTION

- The right bank heated oxygen sensor (front) detects the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the ECM.
- When the right bank heated oxygen sensor (front) begins to deteriorate, the heated oxygen sensor signal response becomes poor.
- The ECM also checks for the right bank heated oxygen sensor (front) rich learn switching frequency.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (front) rich/lean switching frequency is under specified value.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

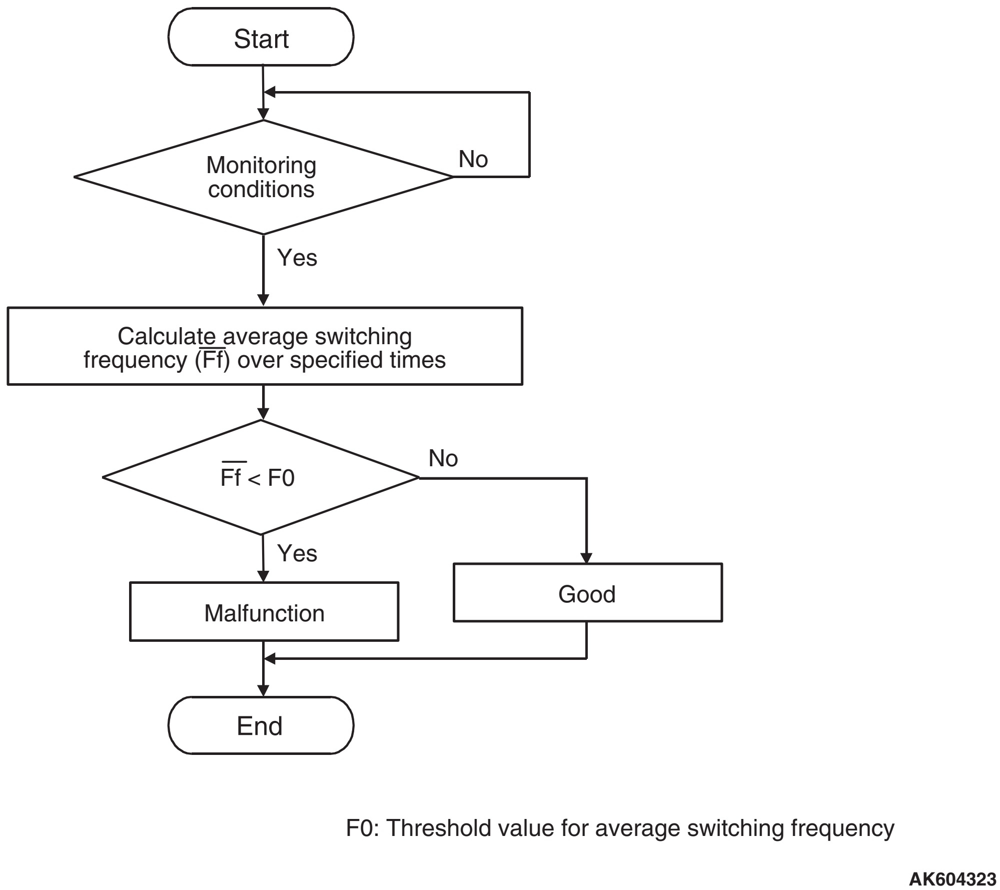
- Heated oxygen sensor (front) heater monitor
- Misfire monitor
- Fuel system monitor

Sensor (The sensor below is determined to be normal)

- Engine coolant temperature sensor
- Mass airflow sensor
- Intake air temperature sensor
- Barometric pressure sensor
- Throttle position sensor
- Accelerator pedal position sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- Engine coolant temperature is higher than 60°C (140°F).
- Engine speed is between 1,188 and 3,000 r/min.
- Volumetric efficiency is between 21 and 69 percent.
- Under the closed loop air/fuel control.
- The accelerator pedal is depressed.
- Short-term fuel trim is between –25 and +25 percent.
- More than 2 seconds have elapsed after the abovementioned conditions have been met.
- During the drive cycle, the ECM performs monitoring with the accumulated total time of 12 seconds, 5 times.

Judgement Criteria

- The average of the right bank heated oxygen sensor (front) rich/lean switching frequency is less than 11 times <Except for California> or 12 times <California> for the accumulated time of 12 seconds.
- The right bank heated oxygen sensor (front) rich/lean switching frequency is less than 20 times for the accumulated time of 12 seconds.

NOTE: If the sensor switching frequency is lower than the Judgment Criteria due to the M.U.T.-III OBD-II test Mode – HO2S Test Results, it is assumed that the heated oxygen sensor has deteriorated. If it is higher, it is assumed that the harness is damaged or has a short circuit.
If the heated oxygen sensor signal voltage has not changed even once (lean/rich) after the DTC was erased, the sensor switch time will display as 0 second.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 1 P.13B-11.

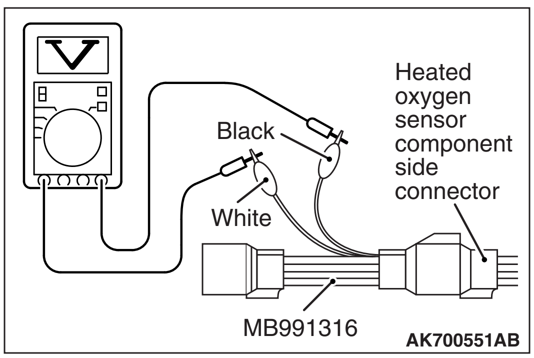
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (front) deteriorated.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991316: Test Harness



STEP 1. Check the right bank heated oxygen sensor (front)

(1) Disconnect the right bank heated oxygen sensor (front) connector B-03 and connect test harness special tool, MB991316, to the connector on the right bank heated oxygen sensor (front) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Rev the engine for 5 minutes or more with the engine speed of 4,500 r/min.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) Warn up the engine, 2,500 r/min.

- Output voltage repeats 0 – 0.4 volt or less and 0.6 – 1.0 volts 13 times or more within 12 seconds.

⚠ CAUTION

- **Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor**
- **Be careful the heater can be damaged if a voltage beyond 8 volts is applied to the heated oxygen sensor heater.**

NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio. Therefore, if the output voltage is low, use a jumper wire to connect the terminal No.1 (red clip) and the terminal No. 3 (blue clip) of the heated oxygen sensor with the positive terminal and the negative terminal of 8 volts power supply respectively, then check again.

Q: Is the sensor operating properly?

YES : Go to Step 2.
NO : Replace the right bank heated oxygen sensor (front). Then go to Step 2.

STEP 2. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 1 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0133 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0134: Heated Oxygen Sensor Circuit No Activity Detected (bank 1, sensor 1)

Heated Oxygen Sensor Circuit No Activity Detected (bank 1, sensor 1) Circuit

- Refer to DTC P0131 – Heated Oxygen Sensor Circuit Low Voltage (bank 1, sensor 1) P.13B-222.
- Refer to DTC P0201 – Injector Circuit Malfunction – Cylinder 1 P.13B-345, DTC P0203 – Injector Circuit Malfunction – Cylinder 3 P.13B-360, DTC P0205 – Injector Circuit Malfunction – Cylinder 5 P.13B-375.

CIRCUIT OPERATION

- Refer to DTC P0131 – Heated Oxygen Sensor Circuit Low Voltage (bank 1, sensor 1) P.13B-222.
- Refer to DTC P0201 – Injector Circuit Malfunction – Cylinder 1 P.13B-345, DTC P0203 – Injector Circuit Malfunction – Cylinder 3 P.13B-360, DTC P0205 – Injector Circuit Malfunction – Cylinder 5 P.13B-375.

TECHNICAL DESCRIPTION

- The ECM effects air/fuel ratio feedback control in accordance with the signals from the right bank heater oxygen sensor (front).
- If the right bank heated oxygen sensor (front) has deteriorated, corrections will be made by the right bank heated oxygen sensor (rear).
- DTC P0134 becomes stored in memory if a failure is detected in the above air/fuel ratio feedback control system.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (front) output voltage does not exceed lean/rich criteria (about 0.5 volt) within specified period.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

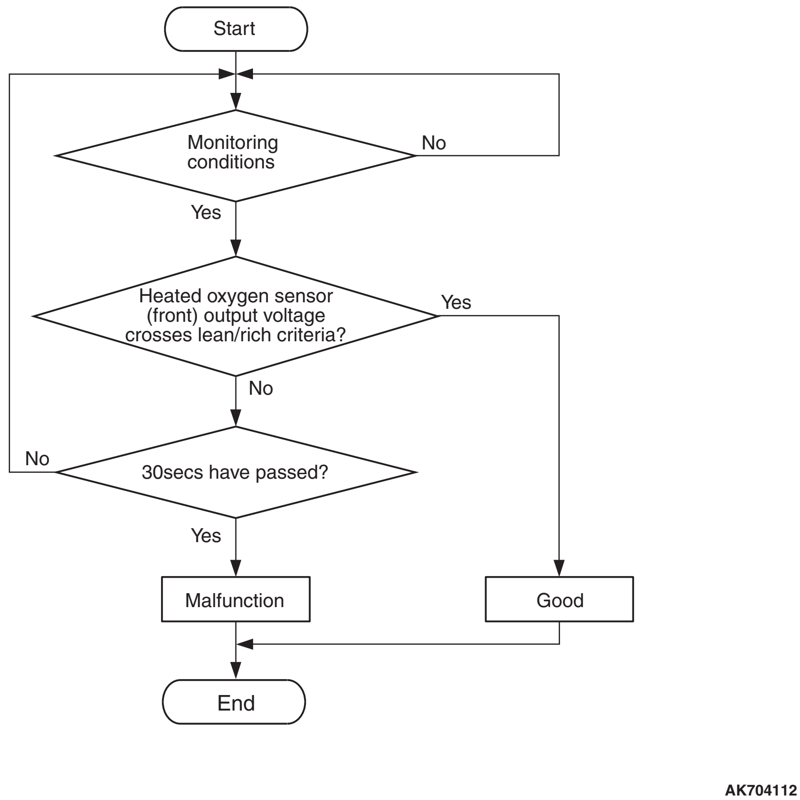
- Misfire monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor
- Throttle position sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- More than 350 seconds have passed since the engine starting sequence was completed.
- Engine coolant temperature is higher than 7°C (45°F).
- Engine speed is higher than 1,200 r/min.
- Volumetric efficiency is higher than 30 percent.
- Throttle position sensor output voltage is lower than 4 volts.
- Except while fuel is being shut off.
- Monitoring time: 30 seconds.

Judgement Criterion

- Right bank heated oxygen sensor (front) output voltage does not get across lean/rich criteria (about 0.5 volt) within about 30 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 12 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (front) deteriorated.
- Harness damage

NOTE: When the right bank heated oxygen sensor (front) begins to deteriorate, the heated oxygen sensor output voltage will deviate from the voltage when the sensor was new (normally 0.5 volt at stoichiometric ratio). This deviation will be corrected by the right bank heated oxygen sensor (rear).
If the right bank heated oxygen sensor (rear) responds poorly because it has deteriorated, it will improperly correct the right bank heated oxygen sensor (front). Thus, even when closed loop control is being effected, the fluctuation of the right bank heated oxygen sensor (front) output voltage decreases, without intersecting with 0.5 volt. As a result, there is a possibility of DTC P0134 becoming registered.

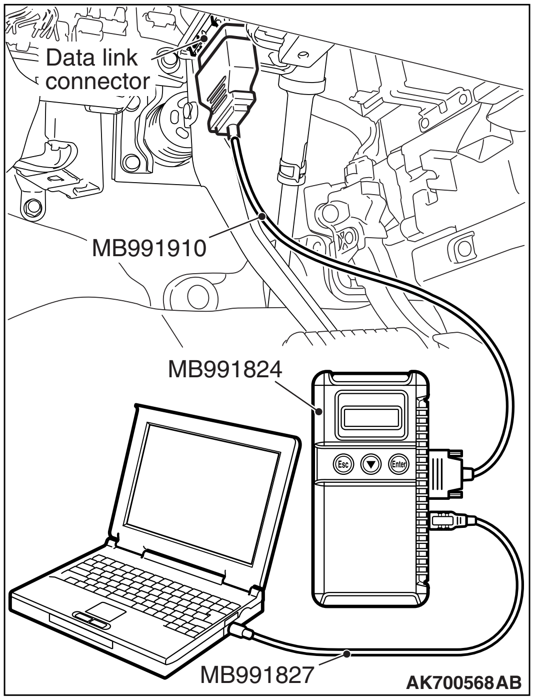
- Open circuit in right bank injector.
- Connector damage.
- Exhaust leak.
- Air drawn in from gaps in gasket, seals, etc.
- Incorrect fuel pressure.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A
- MB991316: Test Harness

STEP 1. Using scan tool MB991958, check data list item AD: Heated Oxygen Sensor Bank 1, Sensor 2 (right rear).



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AD, Heated Oxygen Sensor Bank 1, Sensor 2 (right rear).
- Warming up the engine. When the engine is revved, the output voltage should repeat 0 volt and 0.6 to 1.0 volt alternately.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

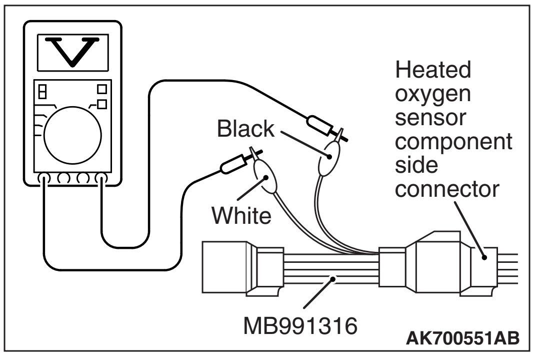
Q: Is the sensor operating properly?

YES : Then go to Step 2.
NO : Refer to DTC P0137 – Heated Oxygen Sensor Circuit Low Voltage (bank 1, sensor 2) P.13B-244, DTC P0138 – Heated Oxygen Sensor Circuit High Voltage (bank 1, sensor 2) P.13B-250, DTC P0139 – Heated Oxygen Sensor Circuit Slow Response (bank 1, sensor 2) P.13B-254, DTC P0140 – Heated Oxygen Sensor Circuit No Activity Detected (bank 1, sensor 2) P.13B-259.

STEP 2. Check harness connector B-03 at the right bank heated oxygen sensor (front) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 14.



STEP 3. Check the right bank heated oxygen sensor (front).

(1) Disconnect the right bank heated oxygen sensor (front) connector B-03 and connect test harness special tool, MB991316, to the connector on the right bank heated oxygen sensor (front) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Rev the engine for 5 minutes or more with the engine speed of 4,500 r/min.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) While repeatedly revving the engine, measure the right bank heated oxygen sensor (front) output voltage.

Standard value: 0.6 – 1.0 volts

⚠ CAUTION

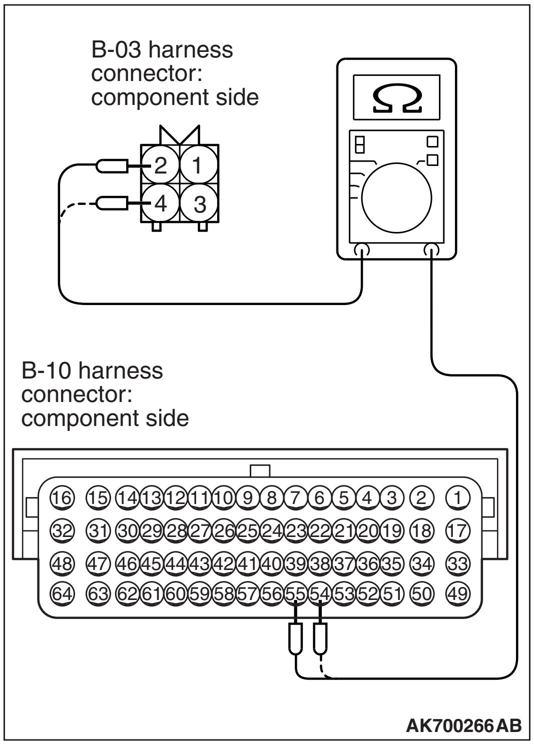
- **Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.**
- **Be careful the heater can be damaged if a voltage beyond 8 volts is applied to the heated oxygen sensor heater.**

NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio. Therefore, if the output voltage is low, use a jumper wire to connect the terminal No.1 (red clip) and the terminal No. 3 (blue clip) of the heated oxygen sensor with the positive terminal and the negative terminal of 8 volts power supply respectively, then check again.

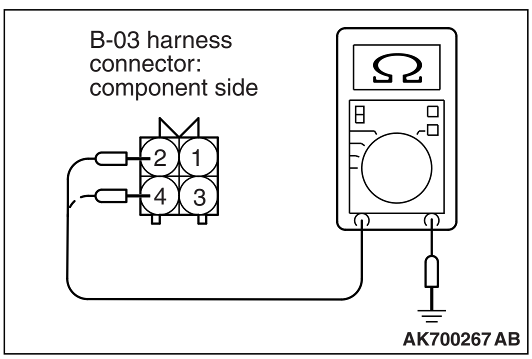
Q: Is the voltage between 0.6 and 1.0 volts?

YES : Go to Step 4.
NO : Replace the right bank heated oxygen sensor (front). Then go to Step 14.

STEP 4. Check for harness between the right bank heated oxygen sensor (front) connector B-03 and the ECM connector B-10.



(1) Disconnect the right bank heated oxygen sensor (front) connector B-03 and the ECM connector B-10.
(2) Measure the resistance between the right bank heated oxygen sensor (front) connector B-03 and the ECM connector B-10.
  a. Connector B-03 (terminal No. 2) and connector B-10 (terminal No. 55).
  b. Connector B-03 (terminal No. 4) and connector B-10 (terminal No. 54).
  - Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-03 and ground.
  a. Connector B-03 (terminal No. 2) and ground.
  b. Connector B-03 (terminal No. 4) and ground.
  - Not continuity.

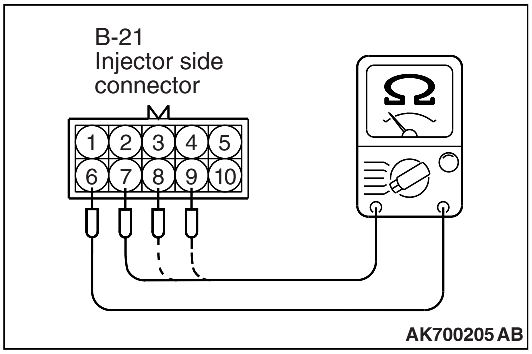
Q: Is the harness wire in good condition?

YES : Go to Step 5.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 14.

STEP 5. Check harness connector B-21 at intermediate connector for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 6.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 14.



STEP 6. Measure the right bank injector resistance at intermediate connector B-21.

(1) Disconnect the intermediate connector B-21.
(2) Measure the resistance between each injector side connector terminal.
  a. Measure the resistance between terminal No. 6 and No. 7 when measuring No. 1 cylinder.
  b. Measure the resistance between terminal No. 6 and No. 8 when measuring No. 3 cylinder.
  c. Measure the resistance between terminal No. 6 and No. 9 when measuring No. 5 cylinder.
    - Resistance should be between 10.5 and 13.5 ohms [at 20°C (68° F)].

Q: Is the measured resistance between 10.5 and 13.5 ohms [at 20°C (68°F)]?

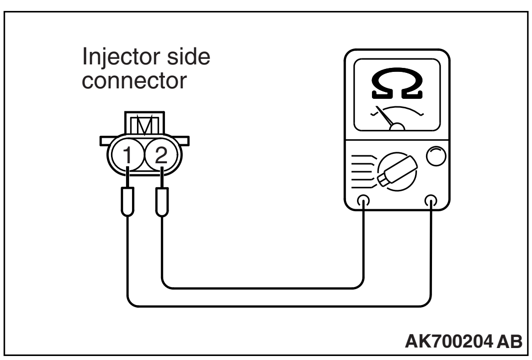
YES : Go to Step 9.
NO : Go to Step 7.

STEP 7. Check harness connector B-21 at right bank injector for damage.

(1) Remove the intake manifold.
(2) Check the right bank injector connector, which deviates from the standard value at Step 6.

Q: Is the harness connector in good condition?

YES : Go to Step 8.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 14.



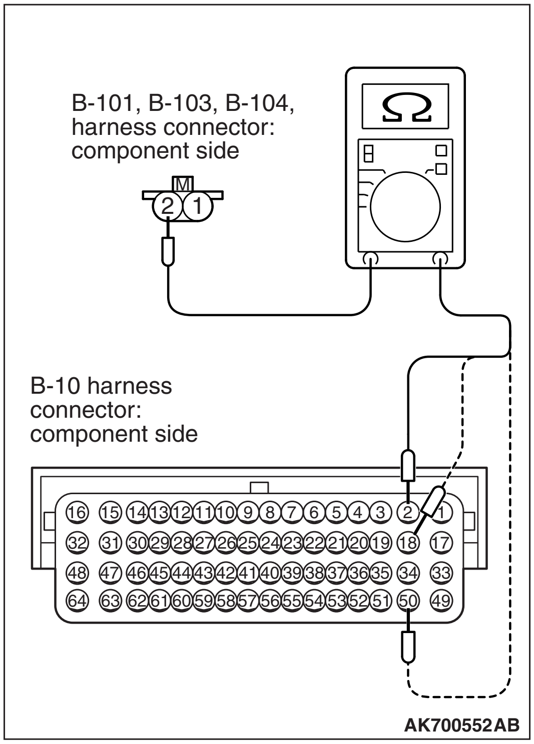
STEP 8. Check the right bank injector.

(1) Check the right bank injector, which deviates from the standard value at Step 6.
(2) Measure the resistance between injector side connector terminal No. 1 and No. 2.

Standard value: 10.5 – 13.5 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 10.5 and 13.5 ohms [at 20°C (68°F)]?

YES : Repair harness wire between the injector intermediate connector and the right bank injector connector because of harness damage. Then go to Step 9.
NO : Replace the injector. Then go to Step 14.



STEP 9. Check for harness between the right bank injector connector B-101, B-103, B-104 and the ECM connector B-10.

(1) Disconnect the right bank injector connector B-101, B-103, B-104 and the ECM connector B-10.

(2) Measure the resistance between the right bank injector connector B-101, B-103, B-104 and the ECM connector B-10.

a. Connector B-101(terminal No. 2) and the ECM connector B-10 (terminal No. 2) at No. 1 cylinder injector.

b. Connector B-103 (terminal No. 2) and the ECM connector B-10 (terminal No. 18) at No. 3 cylinder injector.

c. Connector B-104 (terminal No. 2) and the ECM connector B-10 (terminal No. 50) at No. 5 cylinder injector.

- Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Go to Step 10.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 14.

STEP 10. Check the fuel pressure.

Refer to On-vehicle Service – Fuel Pressure Test P.13B-883.

Q: Is the fuel pressure normal?

YES : Go to Step 11.
NO : Repair it. Then go to Step 14.

STEP 11. Check for exhaust leaks.

Q: Are there any abnormalities?

YES : Repair it. Then go to Step 14.
NO : Go to Step 12.

STEP 12. Check for intake system vacuum leak.

Q: Are there any abnormalities?

YES : Repair it. Then go to Step 14.
NO : Go to Step 13.

STEP 13. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 12 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0134 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 14.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 14. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 12 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

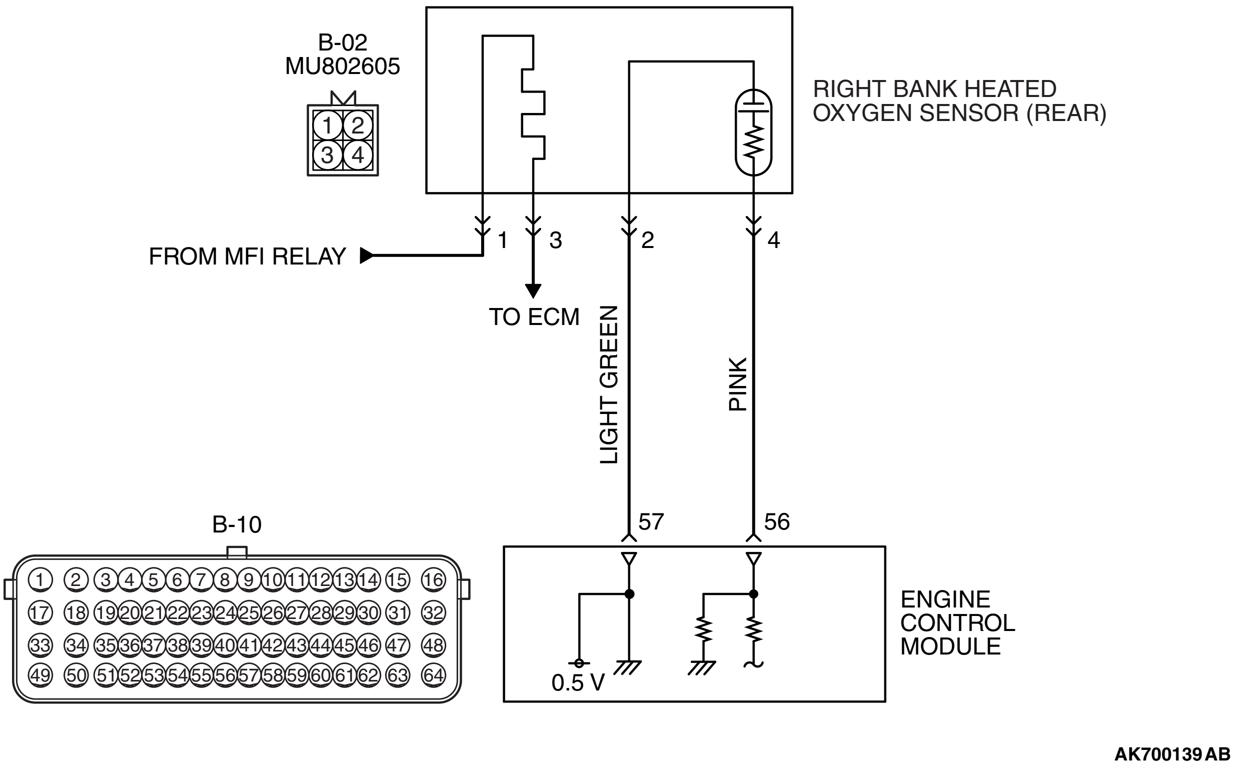
Q: Is DTC P0134 set?

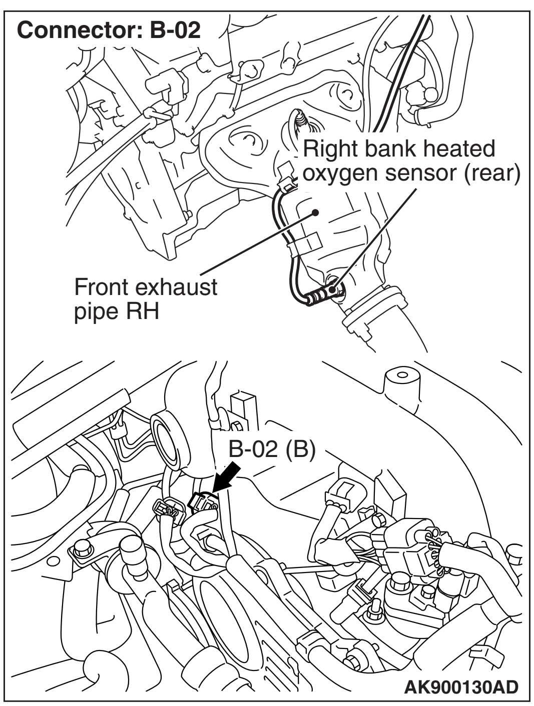
YES : Retry the troubleshooting.

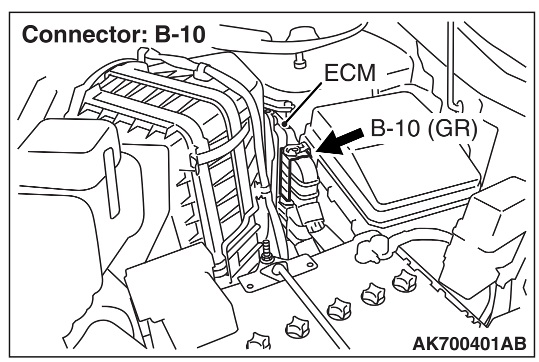
NO : The inspection is complete.

DTC P0137: Heated Oxygen Sensor Circuit Low Voltage (bank 1, sensor 2)

RIGHT BANK HEATED OXYGEN SENSOR (REAR) CIRCUIT







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 56) from the output terminal (terminal No. 4) of the right bank heated oxygen sensor (rear).
- Terminal No. 2 of the right bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 57).
- The ECM applies an off set voltage of 0.5 volt to terminal No. 2 of the right bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the right bank heated oxygen sensor (front) is compensated by the output signal of the right bank heated oxygen sensor (rear).
- The ECM checks for the right bank heated oxygen sensor (rear) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (rear) output voltage is under the specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

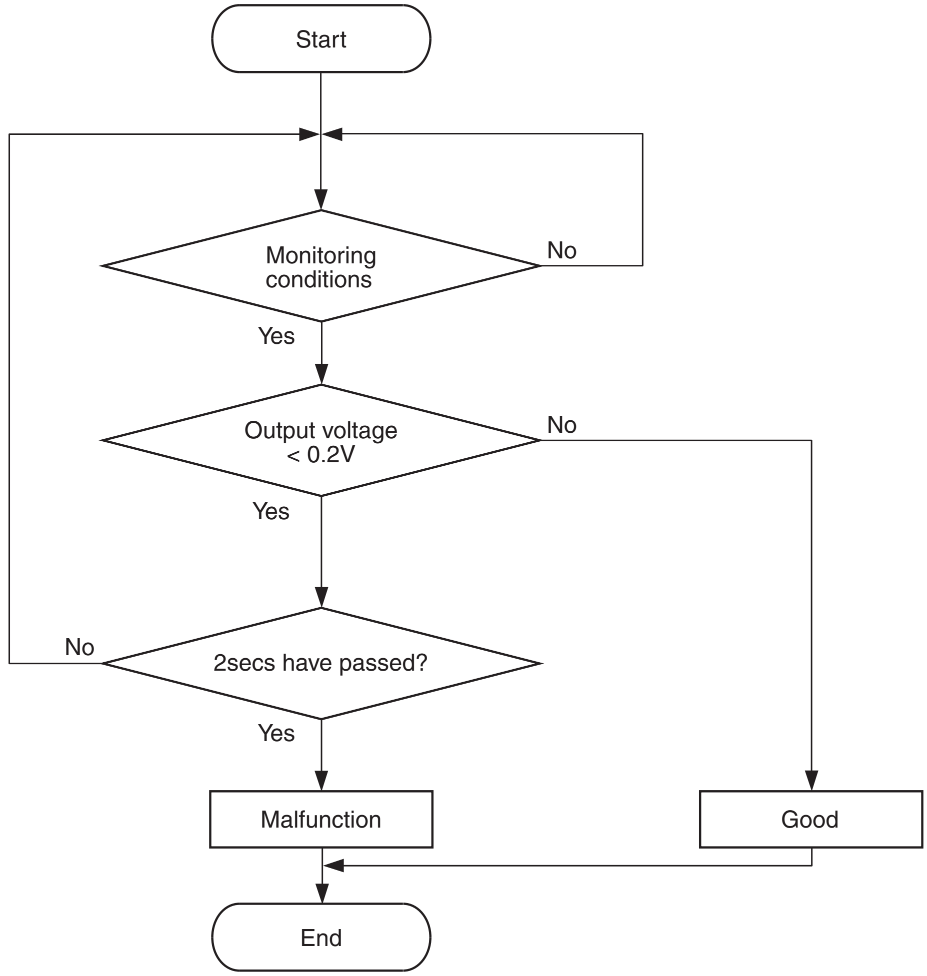
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (rear) heater monitor
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITIONS

Logic Flow Chart



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Check Conditions

- Heated oxygen sensor offset voltage is between 0.4 and 0.6 volt.
- Battery positive voltage is between 11 and 16.5 volts.
- 3 minutes or more have passed since the engine starting sequence was completed.

Judgement Criterion

- Right bank heated oxygen sensor (rear) output voltage is lower than 0.2 volt for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (rear) failed.
- Connector damage.
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

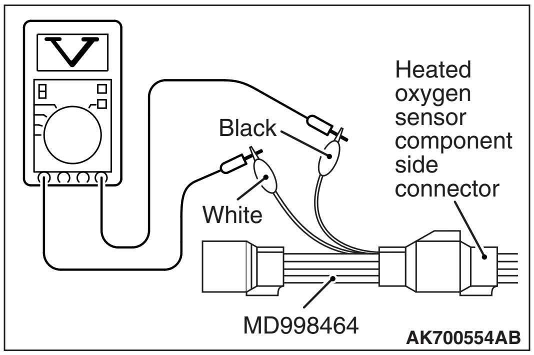
- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A
- MB998464: Test Harness

STEP 1. Check harness connector B-02 at the right bank heated oxygen sensor (rear) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 2. Check the right bank heated oxygen sensor (rear).



(1) Disconnect the right bank heated oxygen sensor (rear) connector B-02 and connect test harness special tool, MB998464, to the connector on the right bank heated oxygen sensor (rear) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Drive at 50 km/h (31 mph) or more for 10 minutes.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) Measure the output voltage of heated oxygen sensor under the following driving.
  a. Transaxle: 2nd speed
  b. Drive with wide open throttle
  c. Engine: 3,500 r/min or more

Standard value: 0.6 – 1.0 volts

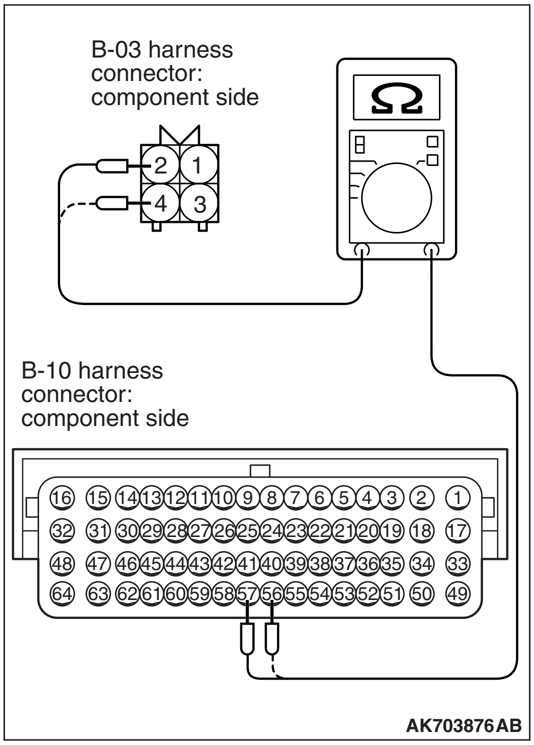
NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio.

NOTE: When the vehicle is driven with high loads, the temperature of the sensing area of the heated oxygen sensor is sufficiently high. Thus, it is not necessary to apply the voltage to the heater.

Q: Is the voltage between 0.6 and 1.0 volts?

YES : Go to Step 3.
NO : Replace the right bank heated oxygen sensor (rear). Then go to Step 5.

STEP 3. Check for harness between the right bank heated oxygen sensor (rear) connector B-02 and the ECM connector B-10.



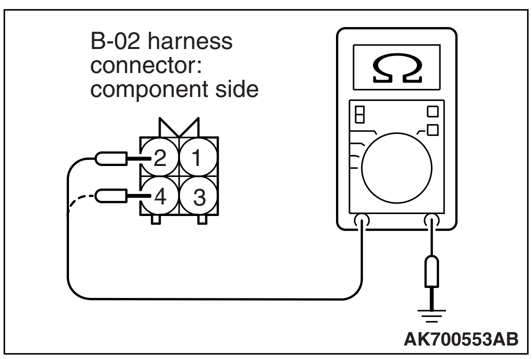
(1) Disconnect the right bank heated oxygen sensor (rear) connector B-02 and the ECM connector B-10.

(2) Measure the resistance between the heated oxygen sensor connector B-02 and the ECM connector B-10.

a. Connector B-02 (terminal No. 2) and connector B-10 (terminal No. 57).

b. Connector B-02 (terminal No. 4) and connector B-10 (terminal No. 56).

- Should be less than 2 ohms.



(3) Check for the continuity oxygen sensor connector B-02 and ground.

a. Connector B-02 (terminal No. 2) and ground.

b. Connector B-02 (terminal No. 4) and ground.

- Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 4.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 4. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0137 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 5.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 5. Test the OBD-II drive cycle.

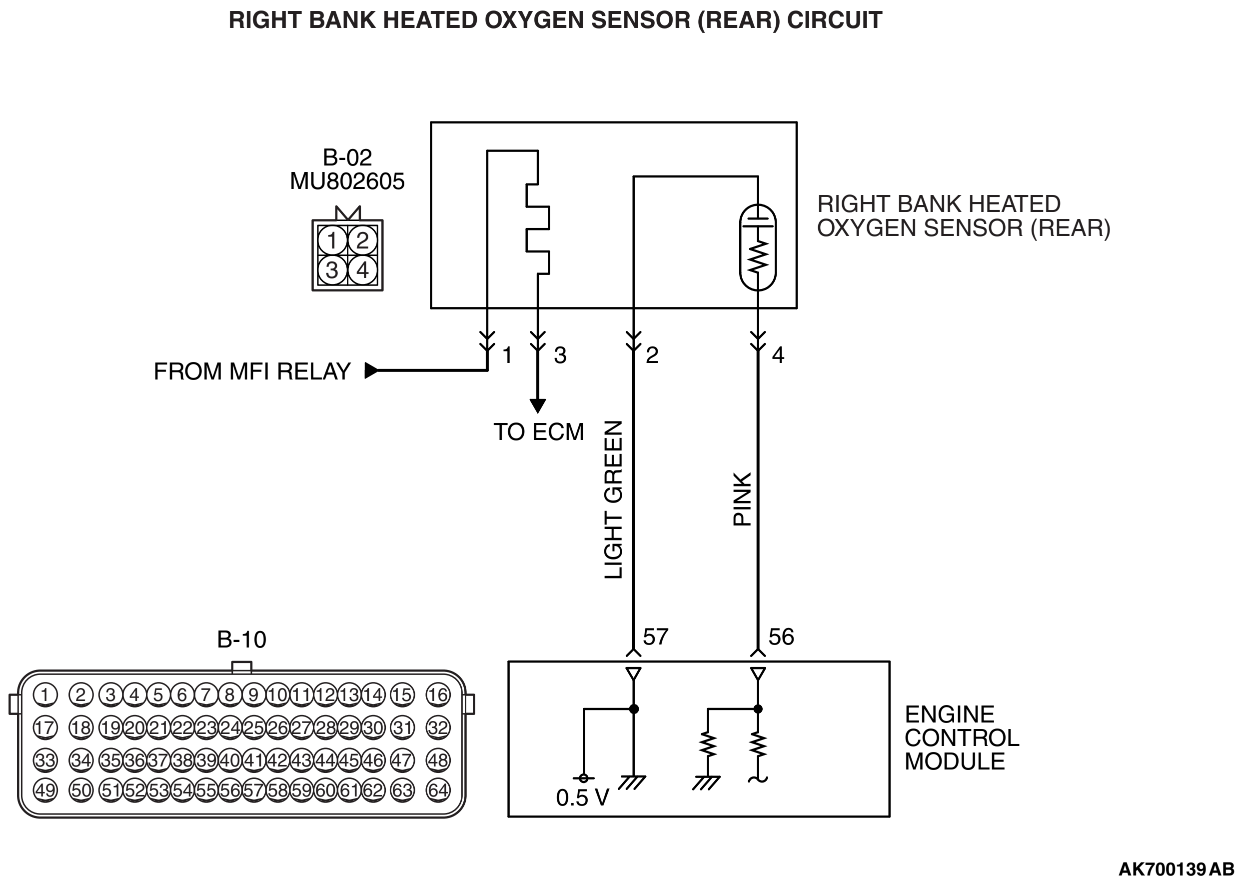
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

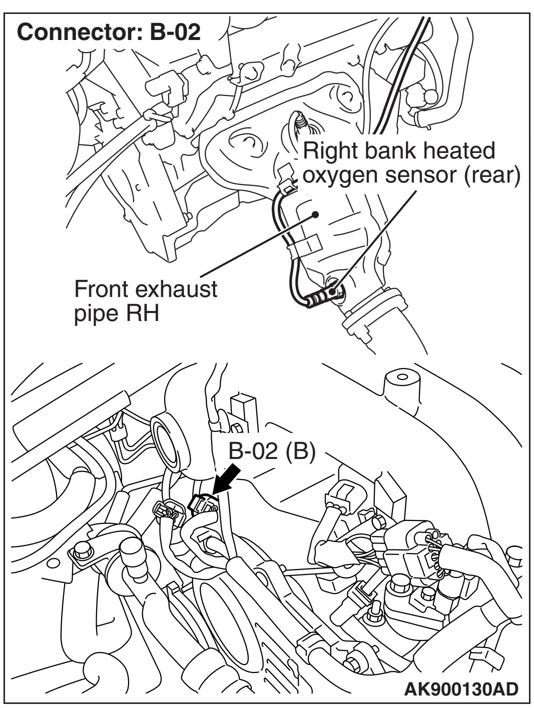
Q: Is DTC P0137 set?

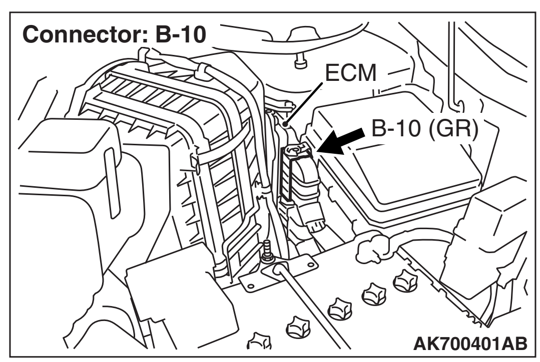
YES : Retry the troubleshooting.

NO : The inspection is complete.

DTC P0138: Heated Oxygen Sensor Circuit High Voltage (bank 1, sensor 2)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 56) from the output terminal (terminal No. 4) of the right bank heated oxygen sensor (rear).
- Terminal No. 2 of the right bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 57).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the right bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the right bank heated oxygen sensor (front) is compensated by the output signal of the right bank heated oxygen sensor (rear).
- The ECM checks for the right bank heated oxygen sensor (rear) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (rear) output voltage is over the specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

- Not applicable

Sensor (The sensor below is determined to be normal)

- Engine coolant temperature sensor

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (rear) output voltage is over the specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

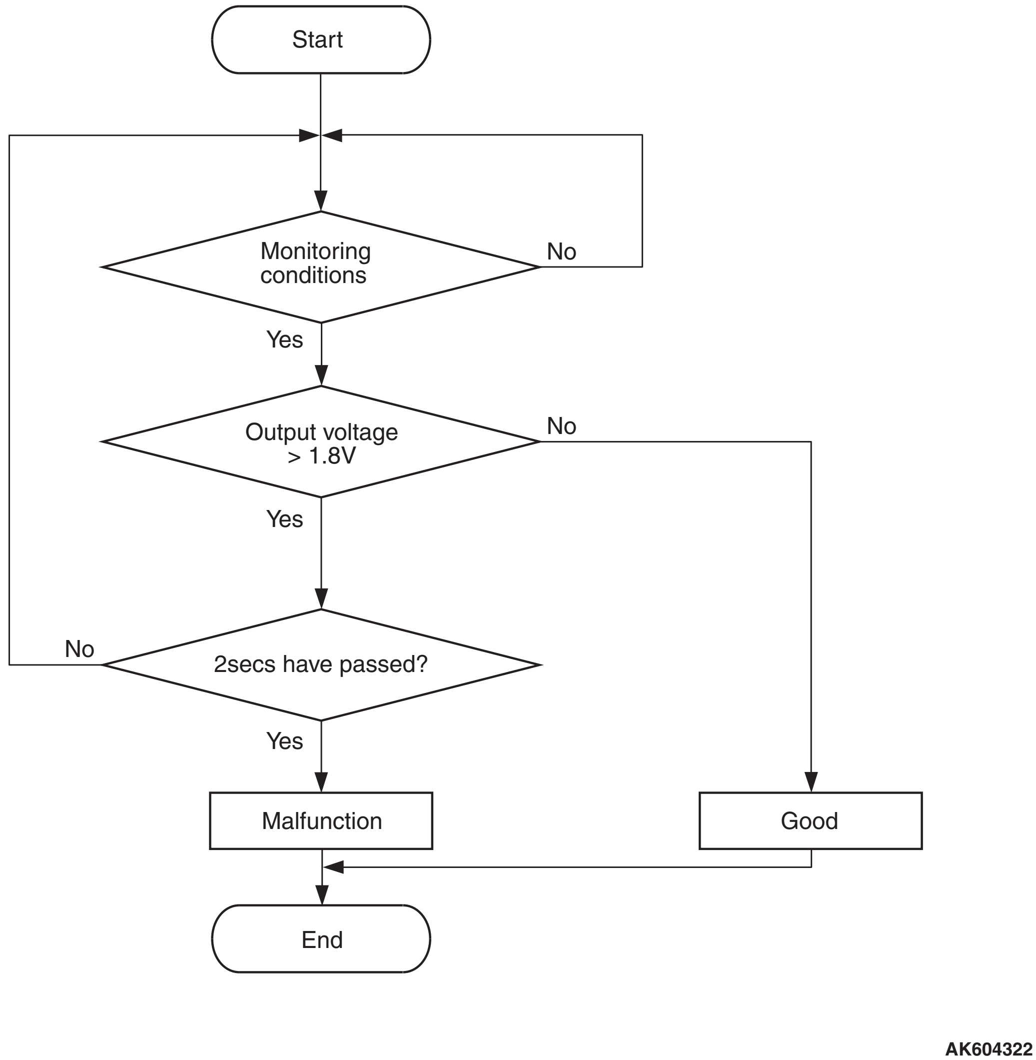
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (rear) heater monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- 2 seconds or more have passed since the engine starting sequence was completed.
- Heated oxygen sensor off set voltage is between 0.4 and 0.6 volt.

Judgement Criterion

- Right bank heated oxygen sensor (rear) output voltage has continued to be 1.8 volts or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Connector damage.
- Harness damage
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A

STEP 1. Check harness connector B-02 at the right bank heated oxygen sensor (rear) and harness connector B-10 at ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 4.

STEP 2. Check for short circuit to power supply between the right bank heated oxygen sensor (rear) connector B-02 (terminal No. 4) and the ECM connector B-10 (terminal No. 56).

Q: Is the harness wire in good condition?

YES : Go to Step 3.
NO : Repair it. Then go to Step 4.

STEP 3. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0138 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 4.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

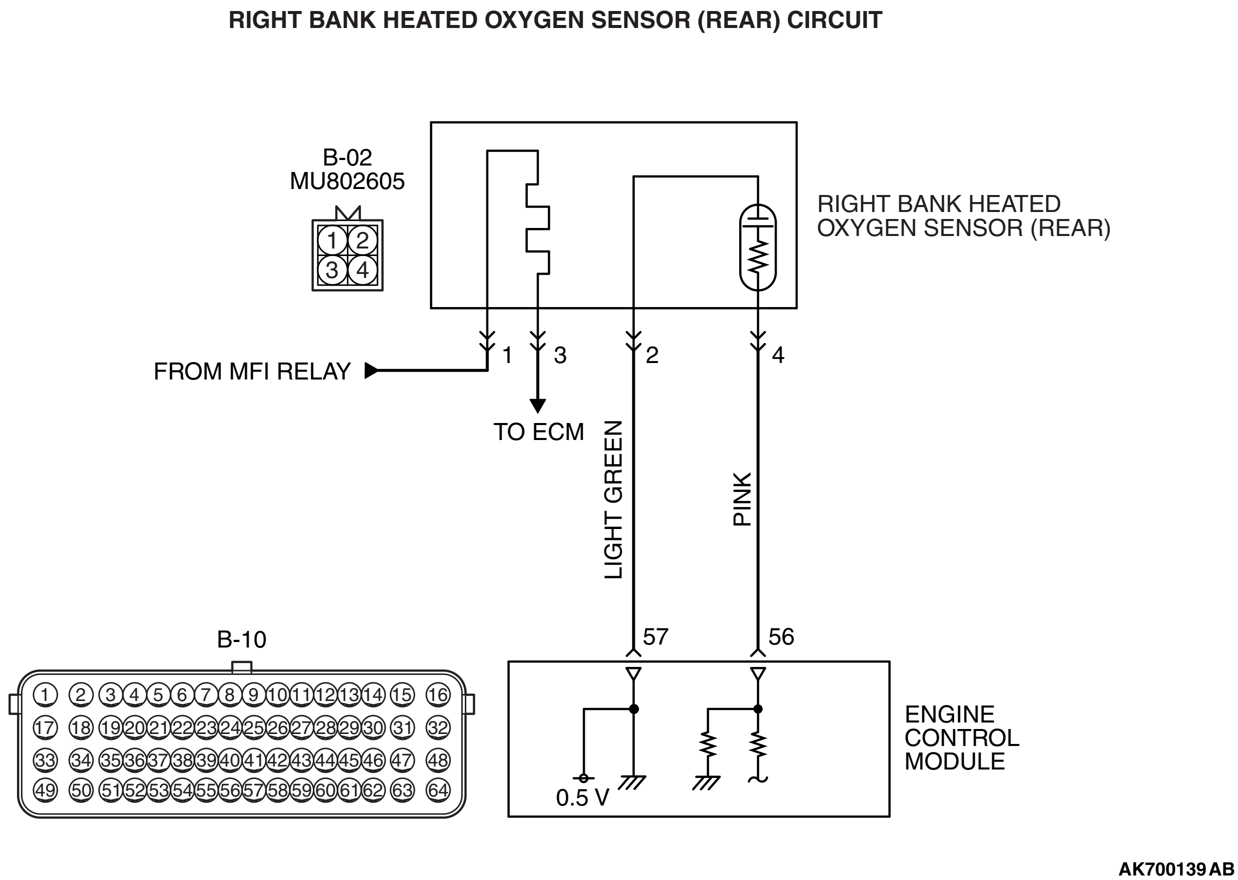
STEP 4. Test the OBD-II drive cycle.

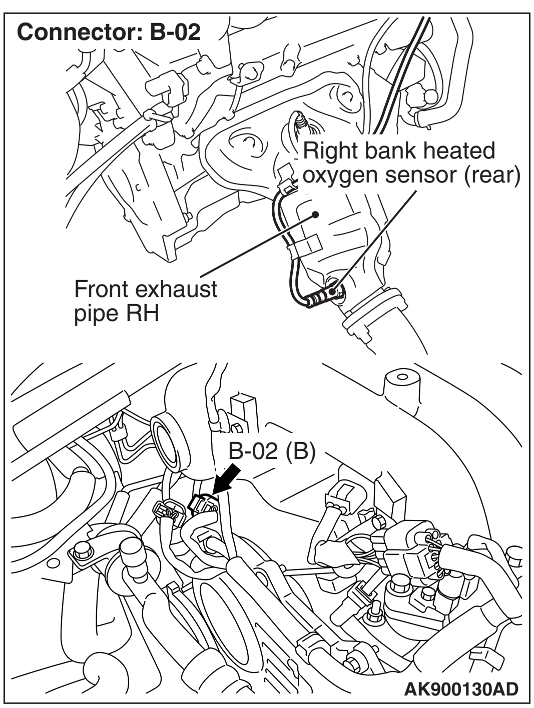
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

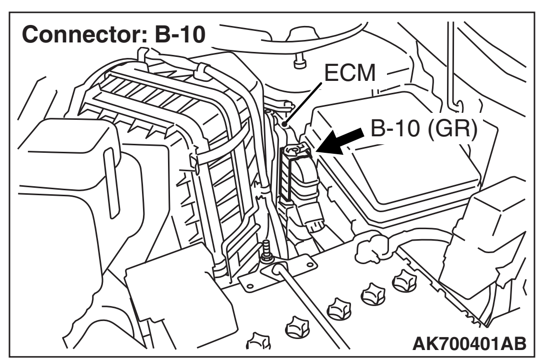
Q: Is DTC P0138 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0139: Heated Oxygen Sensor Circuit Slow Response (bank 1, sensor 2)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 56) from the output terminal (terminal No. 4) of the right bank heated oxygen sensor (rear).
- Terminal No. 2 of the right bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 57).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the right bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the right bank heated oxygen sensor (front) is compensated by the output signal of the right bank heated oxygen sensor (rear).
- The ECM checks for the right bank heated oxygen sensor (rear) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (rear) output voltage does not reach 0.2 volt after fuel cut operation.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

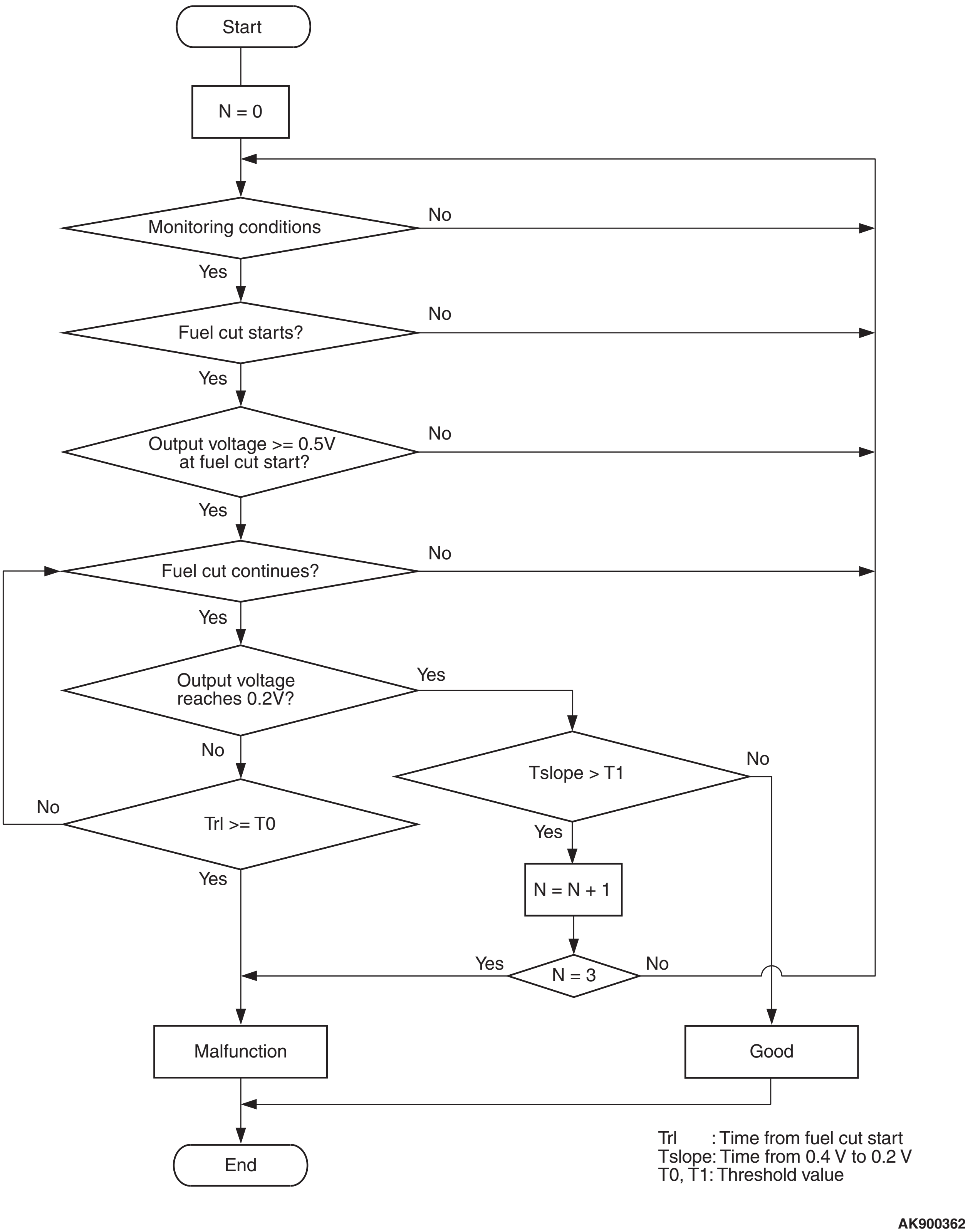
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (rear) heater monitor
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITION

Logic Flow Chart



Check Conditions
- Engine coolant temperature is higher than 76°C (169°F).
- The right bank heated oxygen sensor (front) is active.
- The cumulative mass airflow sensor output is higher than 1,638 g.
- Fuel is being shut off.
- The right bank heated oxygen sensor (rear) output voltage is higher than 0.5 volt when fuel cut is started.
- It has been taking more than 180 seconds since the drive signal of the right bank heated oxygen sensor (rear) heater was turned on.
- Barometric pressure is higher than 76 kPa (22.4 in.Hg).

Judgement Criterion
- The right bank heated oxygen sensor (rear) output voltage does not reach 0.2 volt for 6.0 seconds from fuel cut start.

Check Conditions
- Engine coolant temperature is higher than 76°C (169°F).
- The right bank heated oxygen sensor (front) is active.
- The cumulative mass airflow sensor output is higher than 1,638 g.
- Fuel is being shut off.
- The right bank heated oxygen sensor (rear) output voltage is higher than 0.5 volt when fuel cut is started.
- It has been taking more than 180 seconds since the drive signal of the right bank heated oxygen sensor (rear) heater was turned on.
- Barometric pressure is higher than 76 kPa (22.4 in.Hg).
- The ECM monitors for this condition for 3 cycles of 0.5 second each during drive cycles.

Judgement Criteria
- The right bank heated oxygen sensor (rear) output voltage does not reach 0.2 volt for 0.5 second from 0.4 volt while fuel is being shut off.
- The ECM monitors for this condition once during the drive cycle.

OBD-II DRIVE CYCLE PATTERN

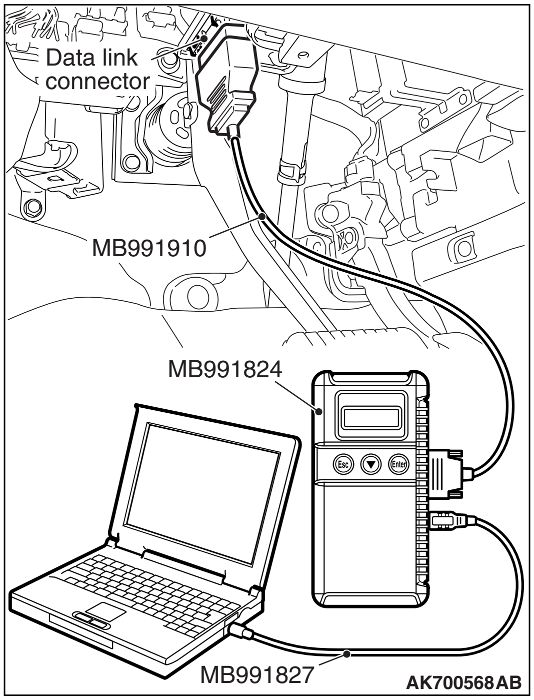
Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 11 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (rear) failed.

DIAGNOSIS

Required Special Tools:
- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item AD: Heated Oxygen Sensor Bank 1, Sensor 2 (right rear).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AD, Heated Oxygen Sensor Bank 1, Sensor 2 (right rear).
(4) Warm up the engine.
- After increasing the output voltage 0.5 volt or more by the engine revving, finish it. Then confirm that the output voltage reduces to 0.2 volt or less within 6 seconds.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Replace the right bank heated oxygen sensor (rear). Then go to Step 2.

STEP 2. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 11 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

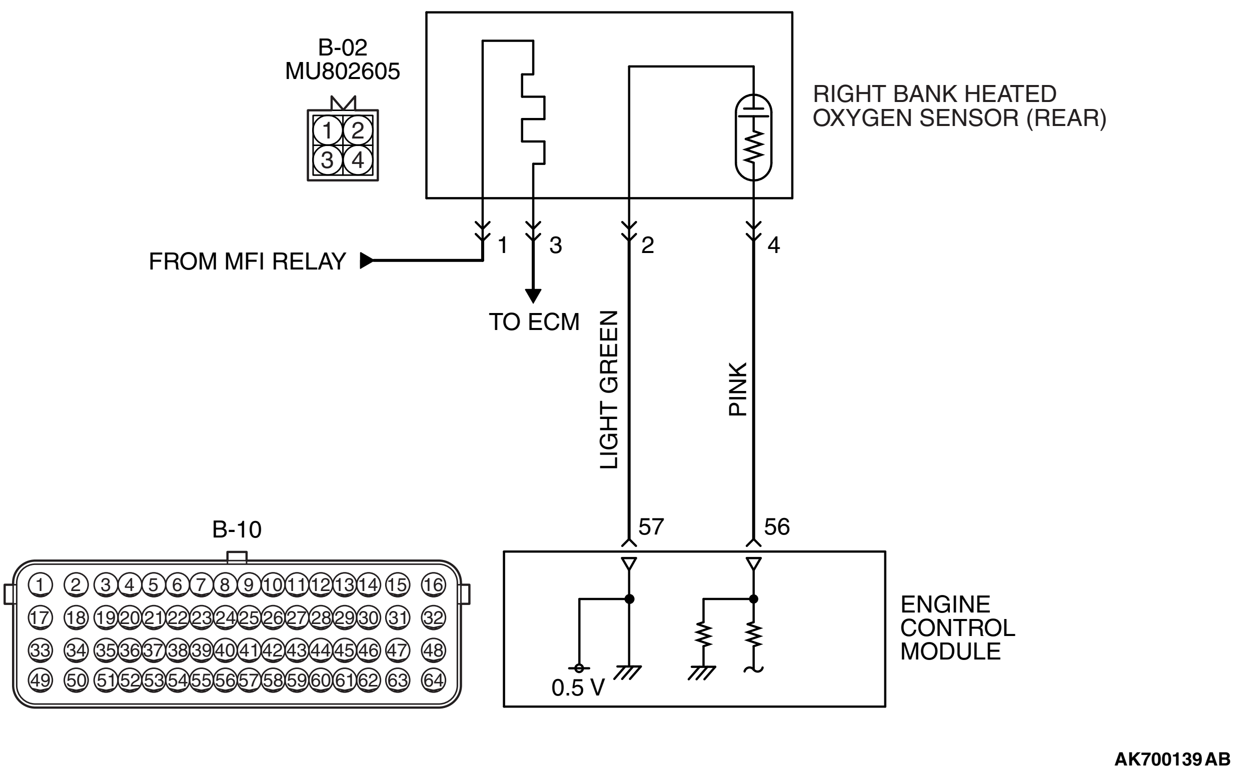
Q: Is DTC P0139 set?

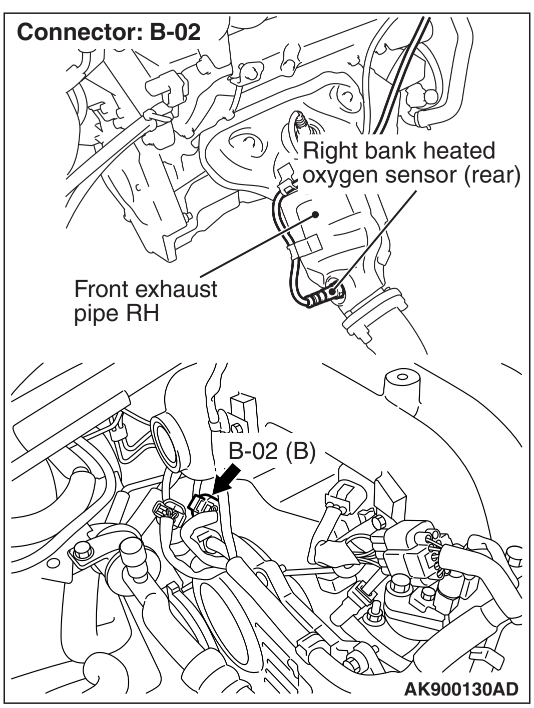
YES : Refer to DTC P0137 – Heated Oxygen Sensor Circuit Low Voltage (bank 1, sensor 2) P.13B-244, DTC P0138 – Heated Oxygen Sensor Circuit High Voltage (bank 1, sensor 2) P.13B-250.

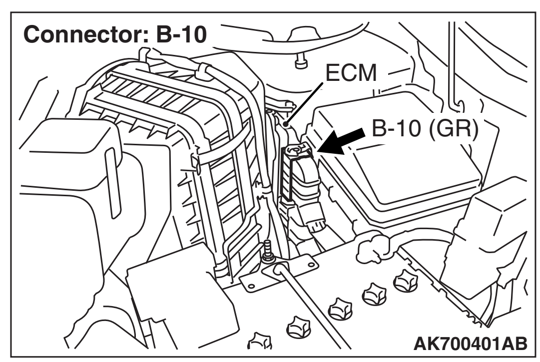
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0140: Heated Oxygen Sensor Circuit No Activity Detected (bank 1, sensor 2)

RIGHT BANK HEATED OXYGEN SENSOR (REAR) CIRCUIT







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 56) from the output terminal (terminal No. 4) of the right bank heated oxygen sensor (rear).
- Terminal No. 2 of the right bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 57).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the right bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the right bank heated oxygen sensor (front) is compensated by the output signal of the right bank heated oxygen sensor (rear).
- The ECM checks for the right bank heated oxygen sensor (rear) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Right bank heated oxygen sensor (rear) output voltage does not change during specified.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

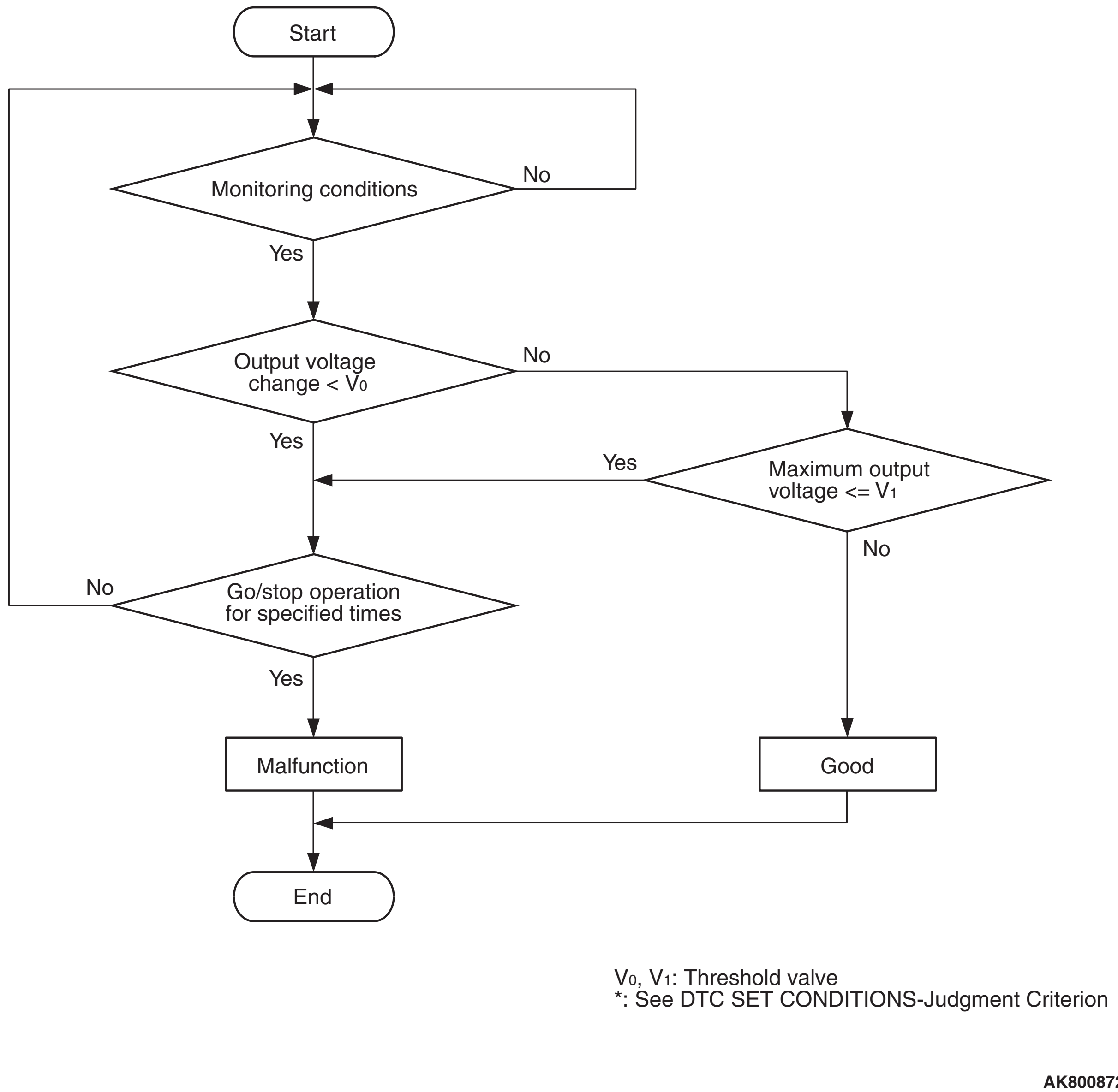
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (rear) heater monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- Engine coolant temperature is higher than 76°C (169°F).
- The right bank heated oxygen sensor (front) is active.
- The cumulative mass airflow sensor output is higher than 1,638 g.
- Repeat 1 or more times: drive*1, stop*2.
  Drive*1
    - Engine speed is higher than 1,500 r/min.
    - Volumetric efficiency is higher than 40 percent.
    - Vehicle speed is higher than 30 km/h (19 mph).
    - A total of more than 60 seconds have elapsed with the above mentioned conditions, and more than 3 seconds have elapsed with the fuel shut off.

  Stop*2:
    - Vehicle speed is lower than 1.5 km/h (1.0 mph).

Judgement Criterion
- Change in the output voltage of the right bank heated oxygen sensor (rear) is lower than 0.313 volt.

or
- The maximum output voltage of the right bank heated oxygen sensor (rear) is lower than 0.508 volt.

NOTE: Monitoring stops after fuel has been shut off for more than 38 seconds.

OBD-II DRIVE CYCLE PATTERN

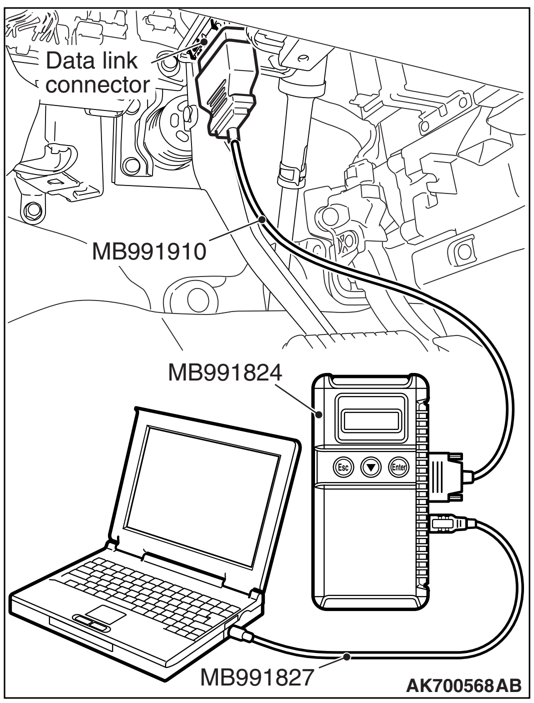
Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 13 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Right bank heated oxygen sensor (rear) failed.

DIAGNOSIS

Required Special Tools:
- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A



STEP 1. Using scan tool MB991958, check data list item AD: Heated Oxygen Sensor Bank 1, Sensor 2 (right rear).

⚠ CAUTION
To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AD, Heated Oxygen Sensor Bank 1, Sensor 2 (right rear).
  a. Transaxle: 2nd speed
  b. Drive with wide open throttle
  c. Engine: 3,500 r/min
    - The output voltages should be between 0.6 and 1.0 volt.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

NO : Replace the right bank heated oxygen sensor (rear). Then go to Step 2.

STEP 2. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 13 P.13B-11.

(2) Check the diagnostic trouble code (DTC).

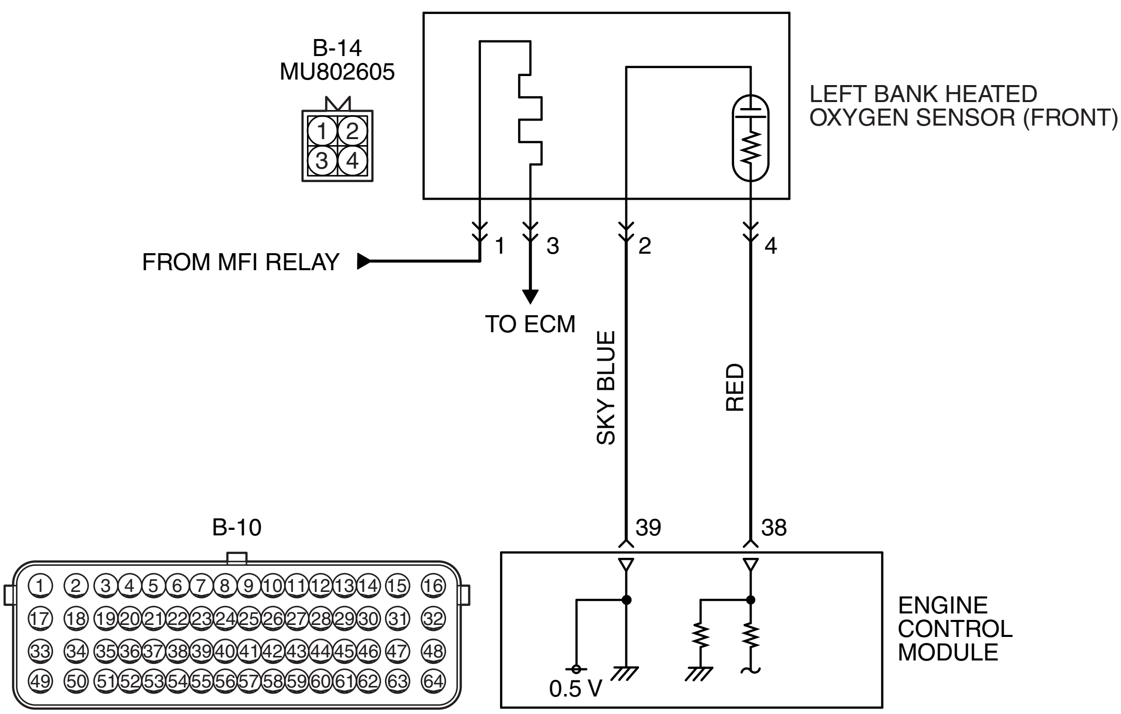
Q: Is DTC P0140 set?

YES : Refer to P0137 – Heated Oxygen Sensor Circuit Low Voltage (bank 1, sensor 2) P.13B-244, DTC P0138 – Heated Oxygen Sensor Circuit High Voltage (bank 1, sensor 2) P.13B-250.

NO : The inspection is complete.

DTC P0151: Heated Oxygen Sensor Circuit Low Voltage (bank 2, sensor 1)

LEFT BANK HEATED OXYGEN SENSOR (FRONT) CIRCUIT



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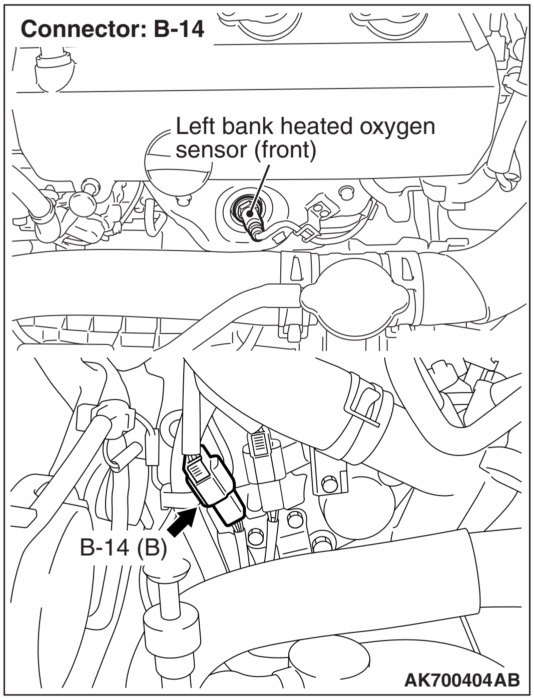
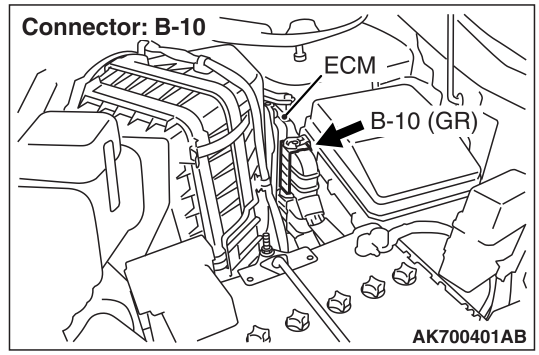




CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 38) from the output terminal (terminal No. 4) of the left bank heated oxygen sensor (front).
- Terminal No. 2 of the left bank heated oxygen sensor (front) is grounded with or ECM (terminal No. 39).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the left bank heated oxygen sensor (front).

TECHNICAL DESCRIPTION

- The left bank heated oxygen sensor (front) detects the concentration of oxygen in the exhaust gas; it converts that data to voltage, and sends it to the ECM.
- When the left bank heated oxygen sensor (front) begins to deteriorate, the heated oxygen sensor signal response deteriorates also.
- The ECM also checks for the left bank heated oxygen sensor (front) output voltage.

DESCRIPTIONS OF MONITOR METHODS

The left bank heated oxygen sensor (front) output voltage is under specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

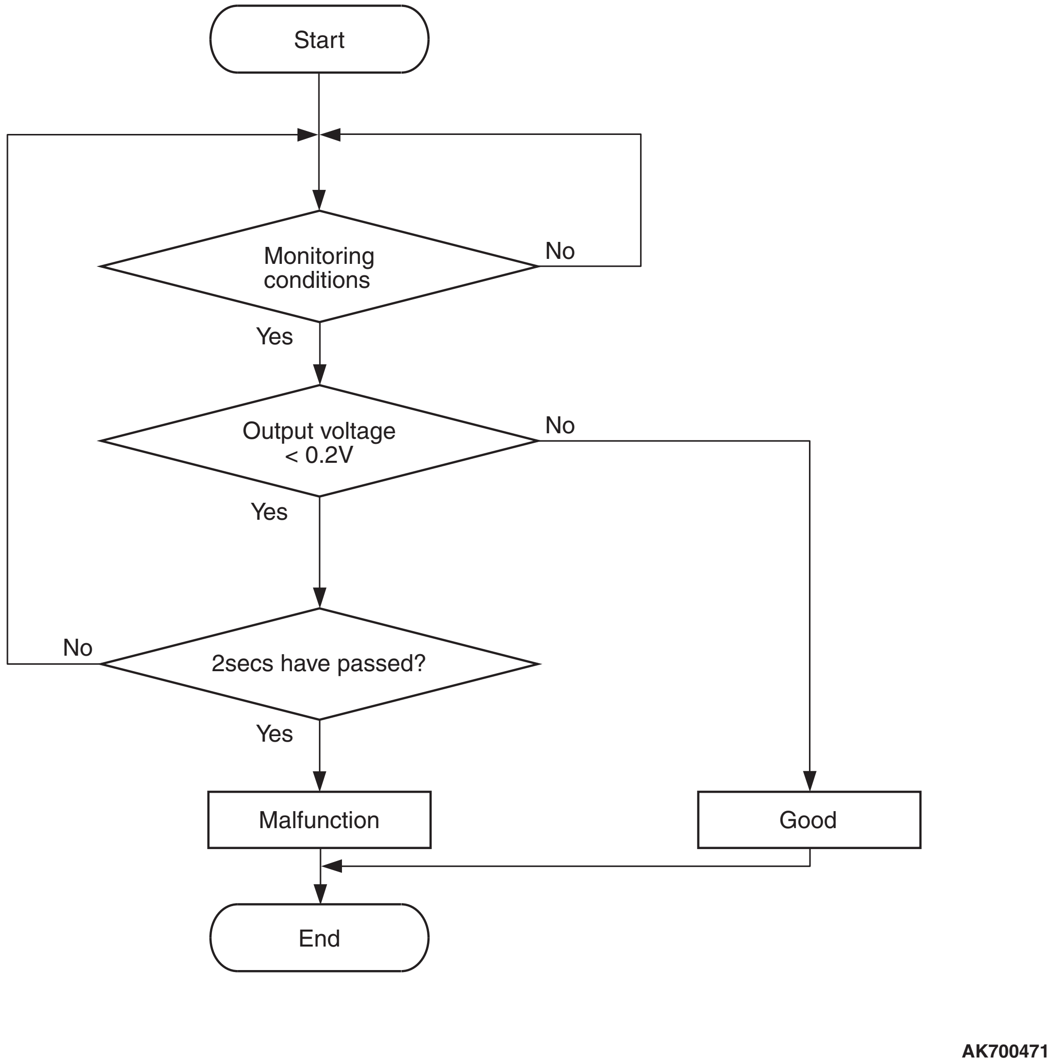
- Heated oxygen sensor (front) heater monitor
- Misfire monitor
- Fuel system monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor
- Throttle position sensor
- Accelerator pedal position sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- Heated oxygen sensor offset voltage is between 0.4 and 0.6 volt.
- Battery positive voltage is between 11 and 16.5 volts.
- More than 180 seconds have passed since the engine starting sequence was completed.

Judgement Criterion

- Left bank heated oxygen sensor (front) output voltage is lower than 0.2 volt for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (front) failed.
- Connector damage.
- Harness damage.
- ECM failed.

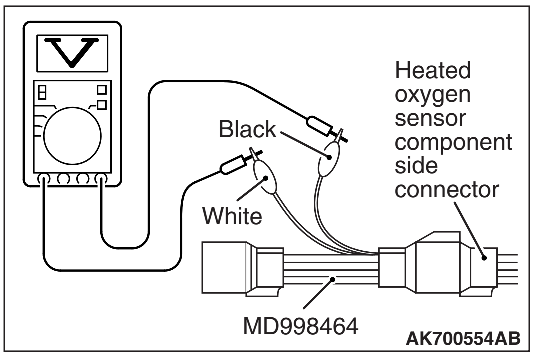
DIAGNOSIS

STEP 1. Check harness connector B-14 at the left bank heated oxygen sensor (front) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 2. Check the left bank heated oxygen sensor (front).



(1) Disconnect the left bank heated oxygen sensor (front) connector B-14 and connect test harness special tool, MB998464, to the connector on the left bank heated oxygen sensor (front) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Rev the engine for 5 minutes or more with the engine speed of 2,500 r/min.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) While repeatedly revving the engine, measure the left bank heated oxygen sensor (front) output voltage.

Standard value: 0.6 – 1.0 volts

⚠ CAUTION

- **Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.**
- **Be careful the heater can be damaged if a voltage beyond 8 volts is applied to the heated oxygen sensor heater.**

NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio. Therefore, if the output voltage is low, use a jumper wire to connect the terminal No.1 (red clip) and the terminal No. 3 (blue clip) of the heated oxygen sensor with the positive terminal and the negative terminal of 8 volts power supply respectively, then check again.

Q: Is the voltage between 0.6 and 1.0 volts?

YES : Go to Step 3.
NO : Replace the left bank heated oxygen sensor (front). Then go to Step 5.

STEP 3. Check for harness between the left heated oxygen sensor (front) connector B-14 and the ECM connector B-10.

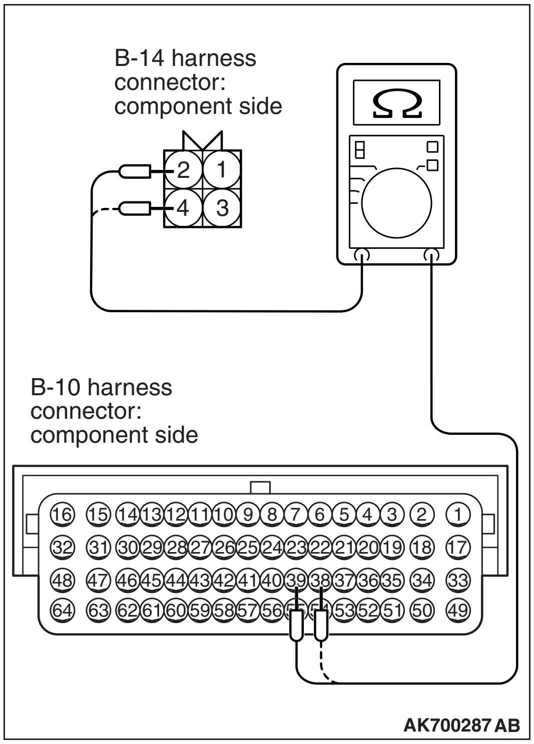
(1) Disconnect the left bank heated oxygen sensor (front) connector B-14 and the ECM connector B-10.

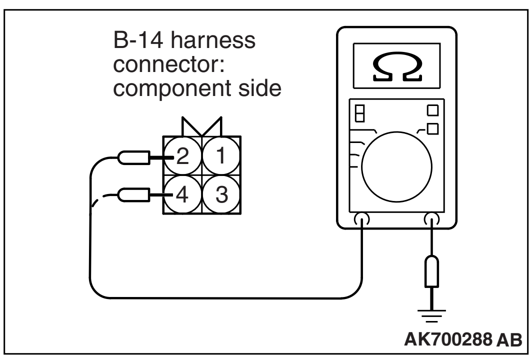
(2) Measure the resistance between the heated oxygen sensor connector B-14 and the ECM connector B-10.

a. Connector B-14 (terminal No. 2) and connector B-10 (terminal No. 39).

b. Connector B-14 (terminal No. 4) and connector B-10 (terminal No. 38).

- Should be less than 2 ohms.





(3) Check for the continuity between the oxygen sensor connector B-14 and ground.

a. Connector B-14 (terminal No. 2) and ground

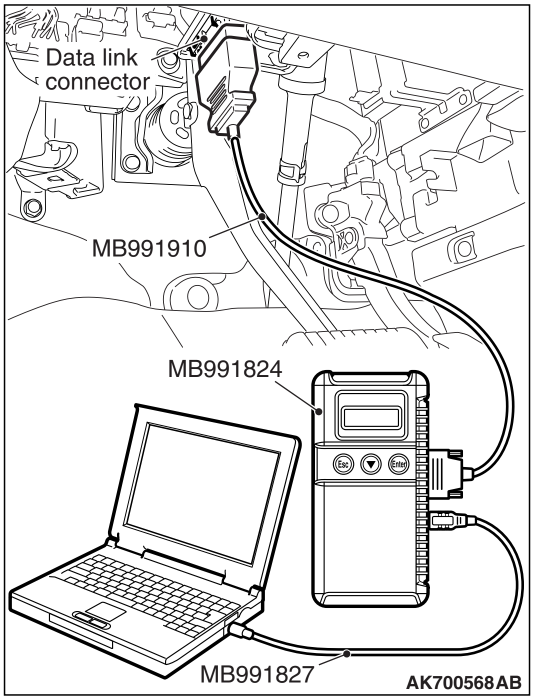
b. Connector B-14 (terminal No. 4) and ground

- Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 4.

NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.



STEP 4. Using scan tool MB991958, check data list item AE: Heated Oxygen Sensor Bank 2, Sensor 1 (left front).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AE, Heated Oxygen Sensor Bank 2, Sensor 1 (left front).
- Warm up the engine. When the engine is revved, the output voltage should battery positive voltage.
- Warm up the engine. When the engine is idling, the output voltage should repeat 0.4 volt or less and 0.6 to 1.0 volt alternately.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.
NO : Replace the ECM. Then go to Step 5.

STEP 5. Test the OBD-II drive cycle.

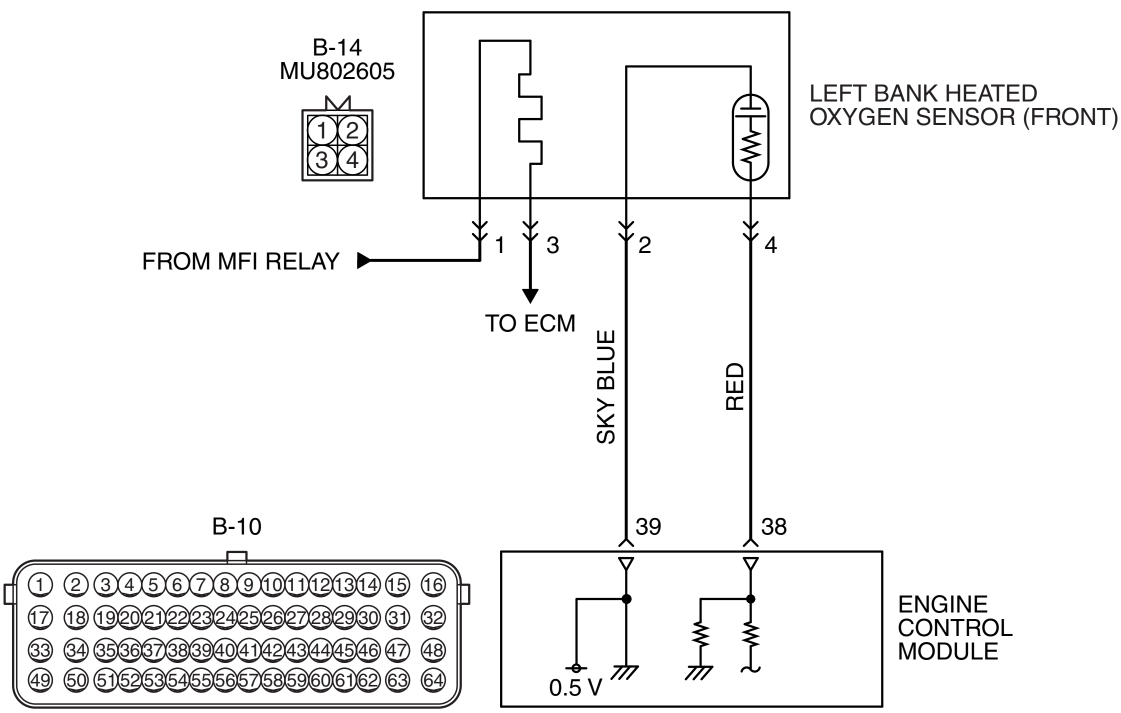
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0151 set?

YES : Retry the troubleshooting.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0152: Heated Oxygen Sensor Circuit High Voltage (bank 2, sensor 1)

LEFT BANK HEATED OXYGEN SENSOR (FRONT) CIRCUIT



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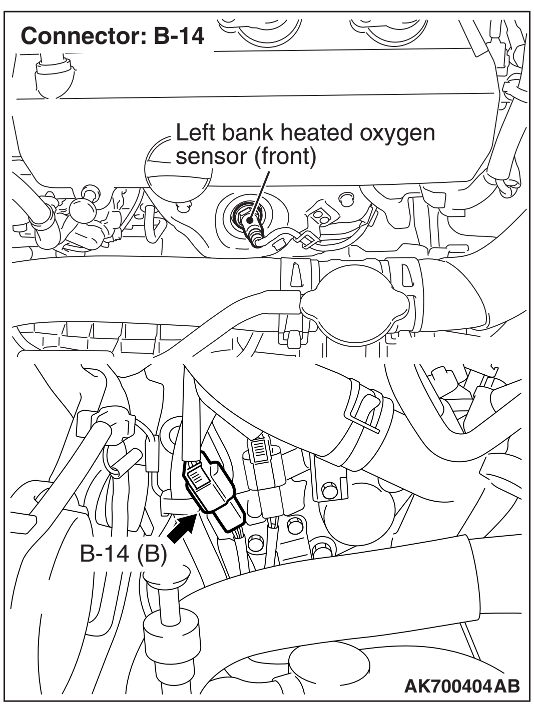

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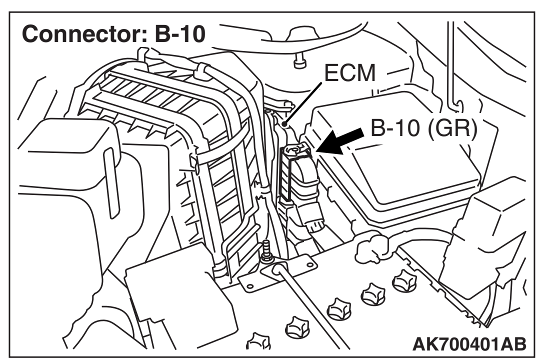

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CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 38) from the output terminal (terminal No. 4) of the left bank heated oxygen sensor (front).
- Terminal No. 2 of the left bank heated oxygen sensor (front) is grounded with ECM (terminal No. 39).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the left bank heated oxygen sensor (front).

TECHNICAL DESCRIPTION

- The left bank heated oxygen sensor (front) detects the concentration of oxygen in the exhaust gas; it converts those data to voltage, and input the resulting signals to the ECM.
- When the left bank heated oxygen sensor (front) begins to deteriorate, the heated oxygen sensor signal response becomes poor.
- The ECM also checks for the left bank heated oxygen sensor (front) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor (front) output voltage is over specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

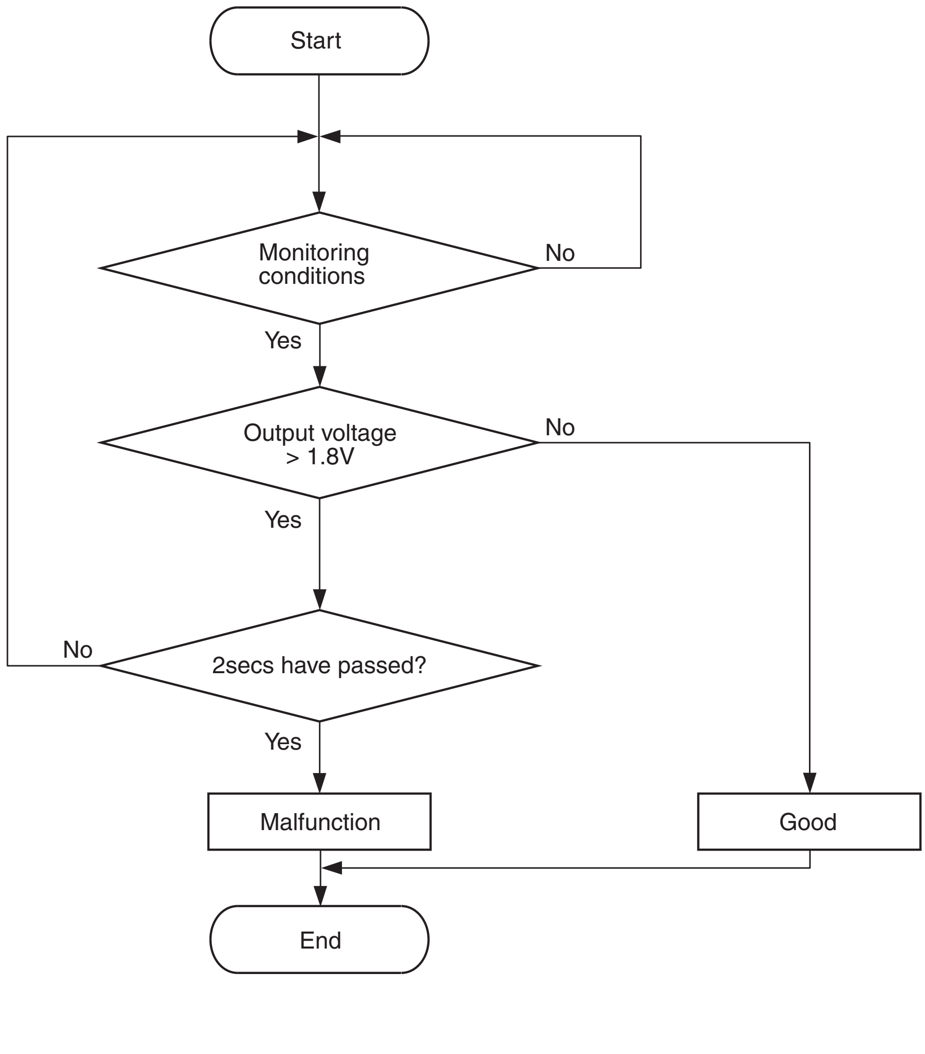
- Heated oxygen sensor (front) heater monitor
- Misfire monitor
- Fuel system monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor
- Throttle position sensor
- Accelerator pedal position sensor

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- 2 seconds or more have passed since the engine starting sequence was completed.
- Heated oxygen sensor offset voltage is between 0.4 and 0.6 volt.

Judgement Criterion

- Left bank heated oxygen sensor (front) output voltage has continued to be 1.8 volts or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Harness damage.
- Connector damage.
- ECM failed.

DIAGNOSIS

STEP 1. Check harness connector B-14 at left bank heated oxygen sensor (front) and harness connector B-10 at ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 4.

STEP 2. Check for short circuit to power supply between the left bank oxygen sensor (front) connector B-14 (terminal No. 4) and the ECM connector B-10 (terminal No. 38).

Q: Is the harness wire in good condition?

YES : Go to Step 3.
NO : Repair it. Then go to Step 4.

STEP 3. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0152 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 4.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

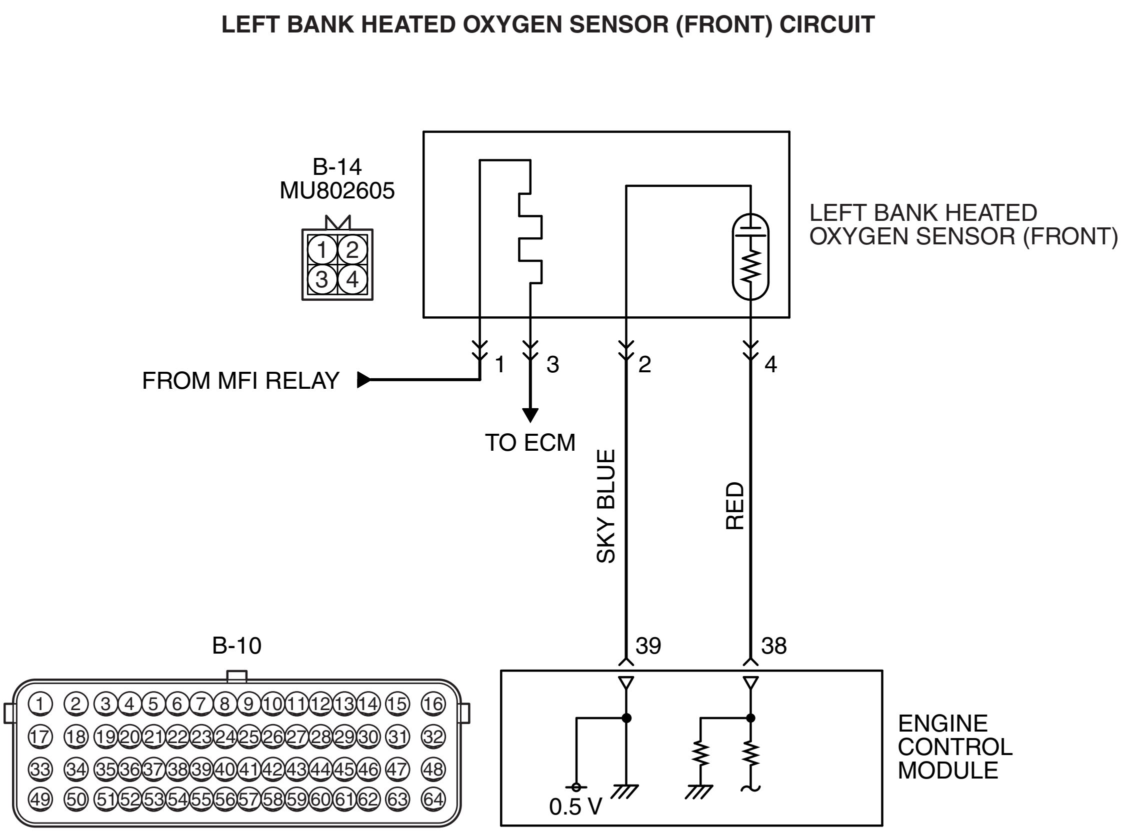
STEP 4. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0152 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0153: Heated Oxygen Sensor Circuit Slow Response (bank 2, sensor 1)



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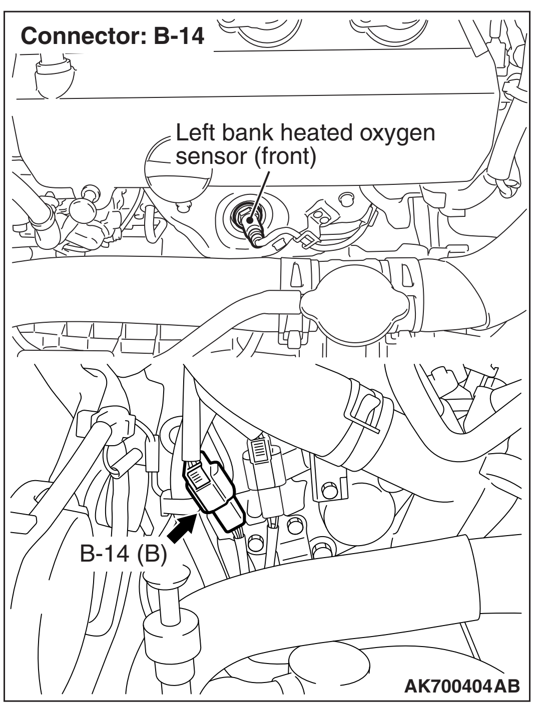

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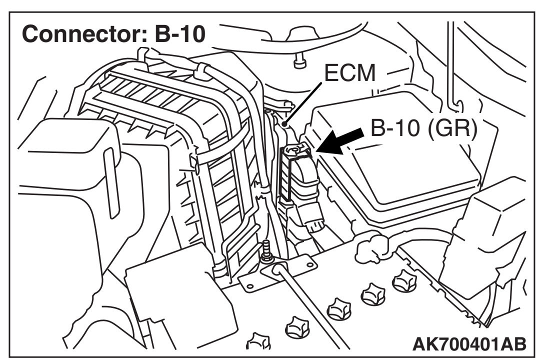

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CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 38) from the output terminal (terminal No. 4) of the left bank heated oxygen sensor (front).
- Terminal No. 2 of the left bank heated oxygen sensor (front) is grounded with ECM (terminal No. 39).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the left bank heated oxygen sensor (front).

TECHNICAL DESCRIPTION

- The left bank heated oxygen sensor (front) detects the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the ECM.
- When the left bank heated oxygen sensor (front) begins to deteriorate, the left bank heated oxygen sensor signal response becomes poor.
- The ECM also checks for the left bank heated oxygen sensor (front) rich/lean switch frequency.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor (front) output voltage is over specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

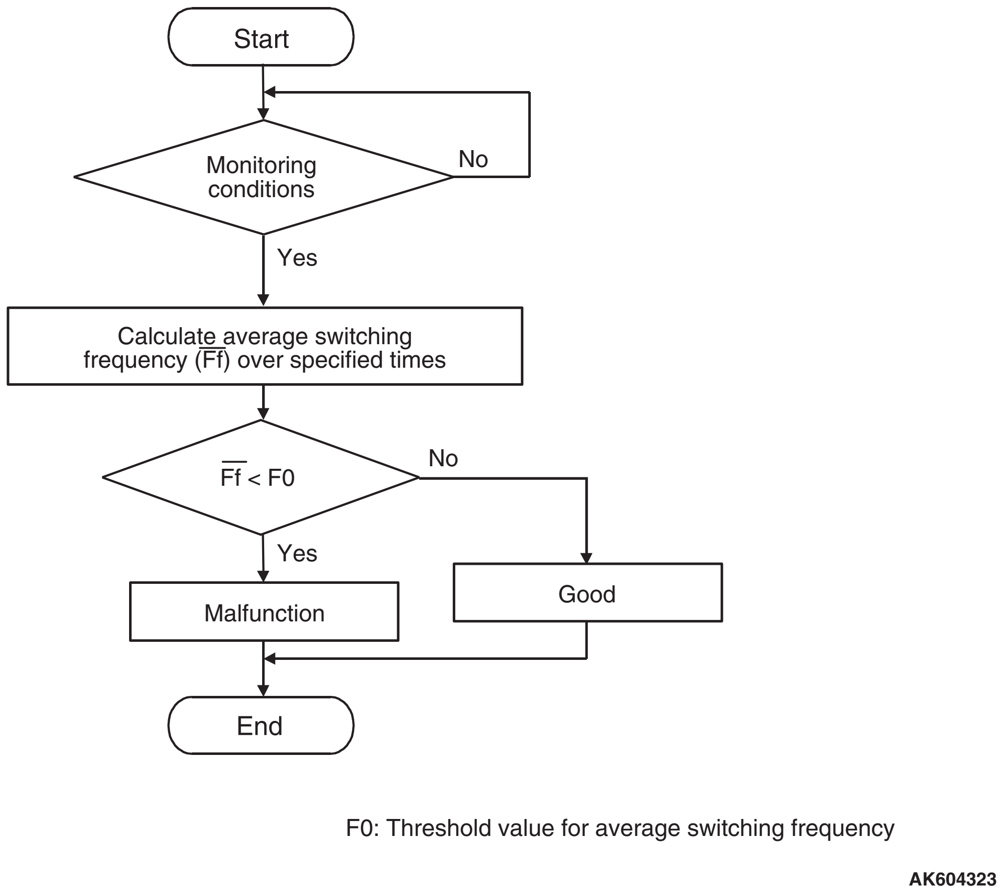
- Heated oxygen sensor (front) heater monitor
- Misfire monitor
- Fuel system monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor
- Throttle position sensor
- Accelerator pedal position sensor

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- Engine coolant temperature is higher than 60°C (140°F).
- Engine speed is between 1,188 and 3,000 r/min.
- Volumetric efficiency is between 21 and 69 percent.
- Under the closed loop air/fuel control.
- The accelerator pedal depressed.
- Short-term fuel trim is at between –25 and +25 percent.
- More than 2 seconds have elapsed after the above mentioned conditions have been met.
- During the drive cycle, the ECM performs monitoring with the accumulated total time of 12 seconds, 5 times.

Judgement Criteria

- The average of the left bank heated oxygen sensor (front) rich/lean switching frequency is less than 11 times <Except for California> or 12 times <California> for the accumulated total time of 12 seconds.
- The left bank heated oxygen sensor (front) rich/lean switching frequency is less than 20 times for the accumulated total time of 12 seconds.

NOTE: If the sensor switching frequency is lower than the Judgment Criteria due to the M.U.T.-III OBD-II test Mode – HO2S Test Results, it is assumed that the heated oxygen sensor has deteriorated. If it is higher, it is assumed that the harness is damaged or has a short circuit.
If the heated oxygen sensor signal voltage has not changed even once (lean/rich) after the DTC was erased, the sensor switch time will display as 0 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 1 P.13B-11.

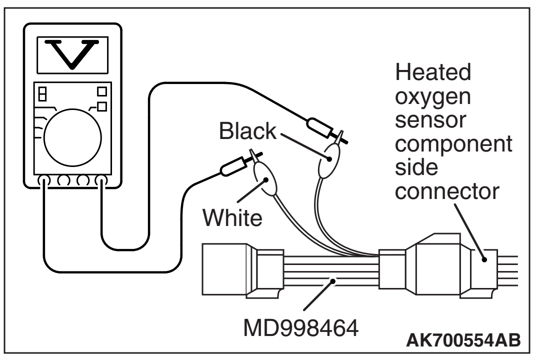
TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (front) deteriorated.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MD998464: Test Harness



STEP 1. Check the left bank heated oxygen sensor (front).

(1) Disconnect the left bank heated oxygen sensor (front) connector B-14 and connect test harness special tool, MD998464, to the connector on the left bank heated oxygen sensor (front) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Rev the engine for 5 minutes or more with the engine speed of 4,500 r/min.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) Warm up engine, 2,500 r/min.
- Output voltage repeats 0 – 0.4 volt or less and 0.6 – 1.0 volts 13 times or more within 12 seconds.

⚠ CAUTION

- **Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.**
- **Be careful the heater can be damaged if a voltage beyond 8 volts is applied to the heated oxygen sensor heater.**

NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio. Therefore, if the output voltage is low, use a jumper wire to connect the terminal No.1 (red clip) and the terminal No. 3 (blue clip) of the heated oxygen sensor with the positive terminal and the negative terminal of 8 volts power supply respectively, then check again.

Q: Is the sensor operating properly?

YES : Go to Step 2.
NO : Replace the left bank heated oxygen sensor (front). Then go to Step 2.

STEP 2. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 1 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0153 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

DTC P0154: Heated Oxygen Sensor Circuit No Activity Detected (bank 2, sensor 1)

Heated Oxygen Sensor Circuit No Activity Detected (bank 2, sensor 1) Circuit

- Refer to DTC P0151 – Heated Oxygen Sensor Circuit Low Voltage (bank 2, sensor 1) P.13B-263.
- Refer to DTC P0202 – Injector Circuit Malfunction – Cylinder 2 P.13B-353, DTC P0204 – Injector Circuit Malfunction – Cylinder 4 P.13B-368, DTC P0206 – Injector Circuit Malfunction – Cylinder 6 P.13B-383.

CIRCUIT OPERATION

- Refer to DTC P0151 – Heated Oxygen Sensor Circuit Low Voltage (bank 2, sensor 1) P.13B-263.
- Refer to DTC P0202 – Injector Circuit Malfunction – Cylinder 2 P.13B-353, DTC P0204 – Injector Circuit Malfunction – Cylinder 4 P.13B-368, DTC P0206 – Injector Circuit Malfunction – Cylinder 6 P.13B-383.

TECHNICAL DESCRIPTION

- The ECM effects air/fuel ratio feedback control in accordance with the signals from the left bank heater oxygen sensor (front).
- If the left bank heated oxygen sensor (front) has deteriorated, corrections will be made by the heated oxygen sensor (rear).
- DTC P0154 becomes stored in memory if a failure is detected in the above air/fuel ratio feedback control system.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor (front) output voltage does not exceed lean/rich criteria (about 0.5 volt) within specified period.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

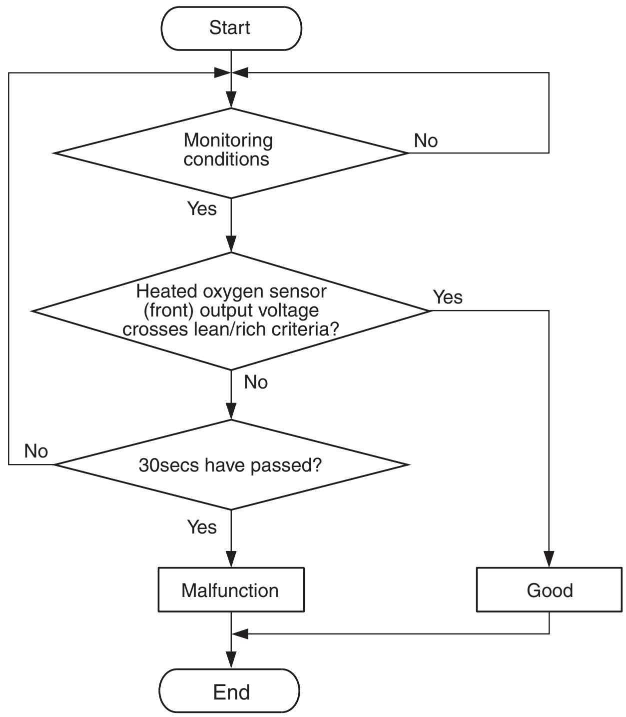
- Misfire monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor
- Throttle position sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- More than 350 seconds have passed since the engine starting sequence was completed.
- Engine coolant temperature is higher than 7°C (45°F).
- Engine speed is higher than 1,200 r/min.
- Volumetric efficiency is higher than 30 percent.
- Throttle position sensor output voltage is lower than 4 volts.
- Except while fuel is being shut off.
- Monitoring time: 30 seconds.

Judgement Criterion

- Left bank heated oxygen sensor (front) output voltage does not get across lean/rich criteria (about 0.5 volt) within about 30 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 12 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (front) deteriorated.
- Harness damage.

NOTE: When the left bank heated oxygen sensor (front) begins to deteriorate, the heated oxygen sensor output voltage will deviate from the voltage when the sensor was new (normally 0.5 volt at stoichiometric ratio). This deviation will be corrected by the left bank heated oxygen sensor (rear).
If the left bank heated oxygen sensor (rear) responds poorly because it has deteriorated, it will improperly correct the left bank heated oxygen sensor (front). Thus, even when closed loop control is being effected, the fluctuation of the left bank heated oxygen sensor (front) output voltage decreases, without intersecting with 0.5 volt. As a result, there is a possibility of DTC P0154 becoming registered.

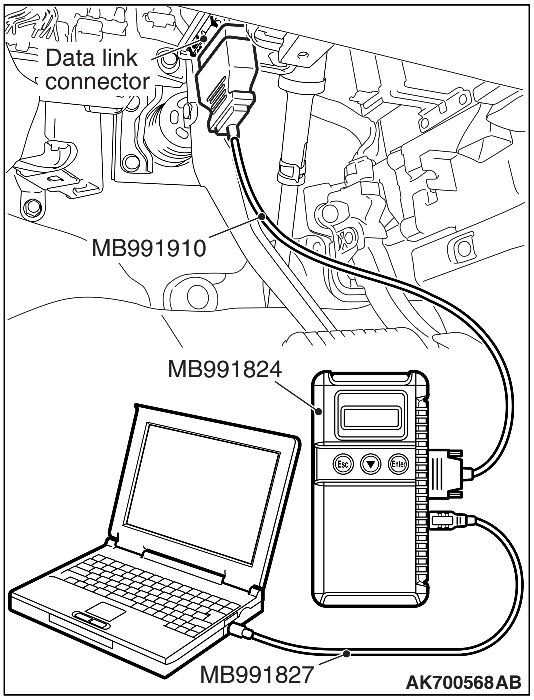
- Open circuit in right bank injector.
- Connector damage.
- Exhaust leak.
- Air drawn in from gaps in gasket, seals, etc.
- Incorrect fuel pressure.
- ECM failed.

DIAGNOSIS

Required Special Tools:

- MB991958: Scan tool (M.U.T.-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991827: USB Cable
  - MB991910: Main Harness A
- MD998464: Test Harness

STEP 1. Using scan tool MB991958, check data list item AF: Heated Oxygen Sensor Bank 2, Sensor 2 (left rear).



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AF, Heated Oxygen Sensor Bank 2, Sensor 2 (left rear).
- Warm up the engine. When the engine is revved, the output voltage should repeat 0 volt and 0.6 to 1.0 volt alternately.

(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : Refer to DTC P0157 – Heated Oxygen Sensor Circuit Low Voltage (bank 2, sensor 2) P.13B-284, DTC P0158 Heated Oxygen Sensor Circuit High Voltage (bank 2, sensor 2) P.13B-290, DTC P0159 – Heated Oxygen Sensor Circuit Slow Response (bank 2, sensor 2) P.13B-294, DTC P0160 – Heated Oxygen Sensor Circuit No Activity Detected (bank 2, sensor 2) P.13B-299.

NO : Go to Step 2.

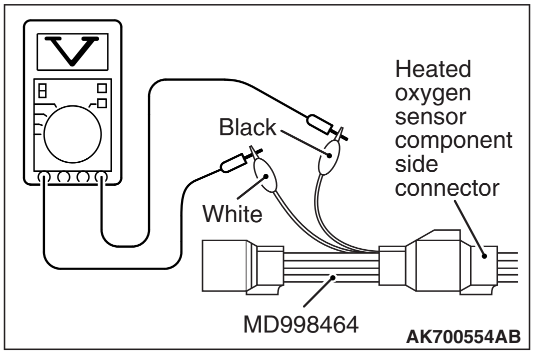
STEP 2. Check harness connector B-14 at the left bank heated oxygen sensor (front) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 3.

NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 12.

STEP 3. Check the left bank heated oxygen sensor (front).



(1) Disconnect the left bank heated oxygen sensor (front) connector B-14 and connect test harness special tool, MD998464 to the connector on the left bank heated oxygen sensor (front) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Rev the engine for 5 minutes or more with the engine speed of 4,500 r/min.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) While repeatedly revving the engine, measure the left bank heated oxygen sensor (front) output voltage.

Standard value: 0.6 – 1.0 volts

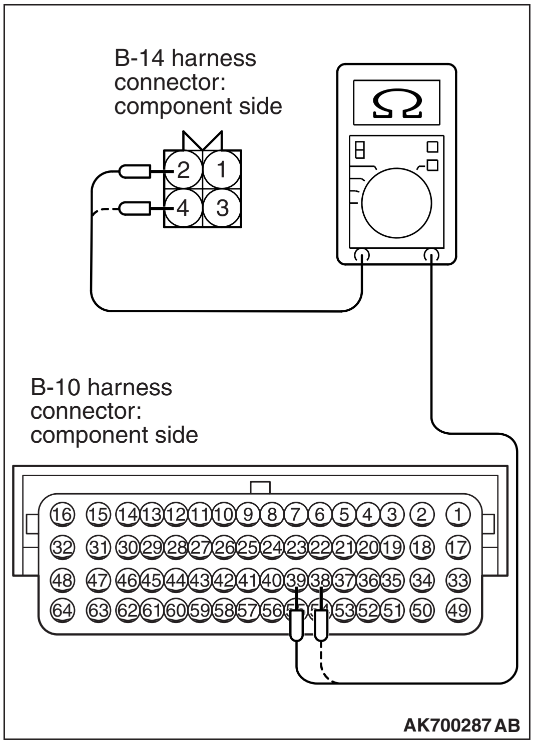
⚠ CAUTION

- **Be very careful when connecting the jumper wires; incorrect connection can damage the heated oxygen sensor.**
- **Be careful the heater can be damaged it voltage beyond 8 volts is applied to the heated oxygen sensor heater.**

NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio. Therefore, if the output voltage is low, use a jumper wire to connect the terminal No.1 (red clip) and the terminal No. 3 (blue clip) of the heated oxygen sensor with the positive terminal and the negative terminal of 8 volts power supply respectively, then check again.

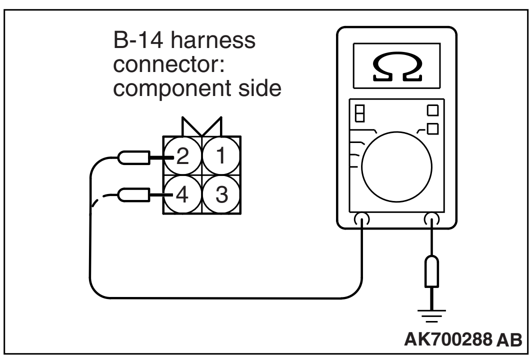
Q: Is the voltage between 0.6 and 1.0 volts?

YES : Go to Step 4.
NO : Replace the left bank heated oxygen sensor (front). Then go to Step 12.



STEP 4. Check for harness between the left heated oxygen sensor (front) connector B-14 and the ECM connector B-10.

(1) Disconnect the left bank heated oxygen sensor (front) connector B-14 and the ECM connector B-10.
(2) Measure the resistance between the heated oxygen sensor connector B-14 and the ECM connector B-10.
   a. Connector B-14 (terminal No. 2) and connector B-10 (terminal No. 39).
   b. Connector B-14 (terminal No. 4) and connector B-10 (terminal No. 38).
   - Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-14 and ground.
   a. Connector B-14 (terminal No. 2) and ground
   b. Connector B-14 (terminal No. 4) and ground
   - Not continuity.

Q: Is the harness wire in good condition?

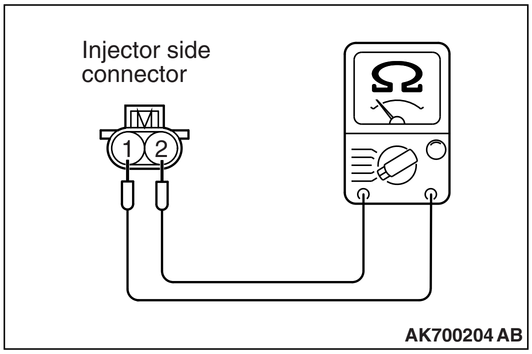
YES : Go to Step 5.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 12.

STEP 5. Check harness connector B-115, B-116, B-120 at left bank injector for damage.

(1) Remove the intake manifold.
(2) Check the left bank injector connector for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 6.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 12.



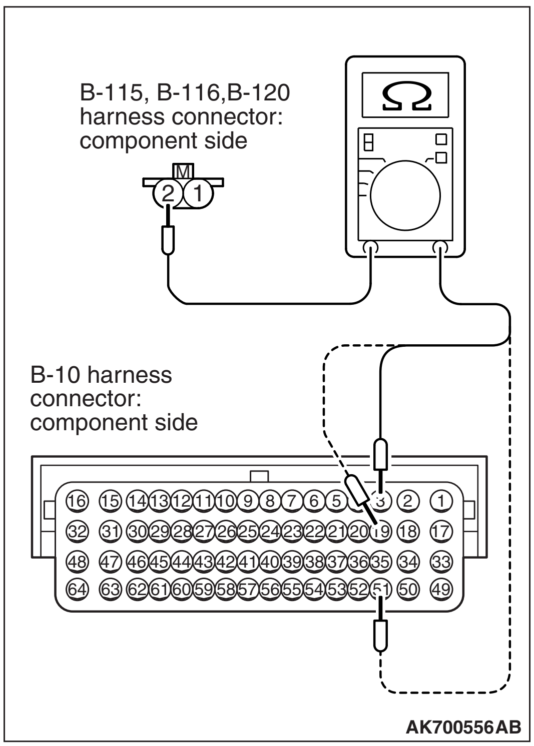
STEP 6. Check the left bank injector.

(1) Disconnect each left bank injector connector.
(2) Measure the resistance between injector side connector terminal No. 1 and No. 2.

Standard value: 10.5 – 13.5 Ω [at 20°C (68°F)]

Q: Is the measured resistance between 10.5 and 13.5 ohms [at 20°C (68°F)]?

YES : Go to Step 7.
NO : Replace the injector. Then go to Step 12.



STEP 7. Check for harness between the left bank injector connector B-115, B-116, B-120 and the ECM connector B-10.

(1) Disconnect the left bank injector connector B-115, B-116, B-120 and the ECM connector B-10.
(2) Measure the resistance between the left bank injector connector B-115, B-116, B-120 and the ECM connector B-10.
  a. Connector B-115 (terminal No. 2) and connector B-10 (terminal No. 51) at No. 6 Cylinder injector.
  b. Connector B-116 (terminal No. 2) and connector B-10 (terminal No. 19) at No. 4 Cylinder injector.
  c. Connector B-120 (terminal No. 2) and connector B-10 (terminal No. 3) at No. 2 Cylinder injector.
  - Should be less than 2 ohms.

Q: Is the harness wire in good condition?

YES : Go to Step 8.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 12.

STEP 8. Check the fuel pressure.

Refer to On-vehicle Service – Fuel Pressure Test P.13B-883.

Q: Is the fuel pressure normal?

YES : Go to Step 9.
NO : Repair it. Then go to Step 12.

STEP 9. Check for exhaust leaks.

Q: Are there any abnormalities?

YES : Repair it. Then go to Step 12.
NO : Go to Step 10.

STEP 10. Check for intake system vacuum leak.

Q: Are there any abnormalities?

YES : Repair it. Then go to Step 12.
NO : Go to Step 11.

STEP 11. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 12 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0154 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 12.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

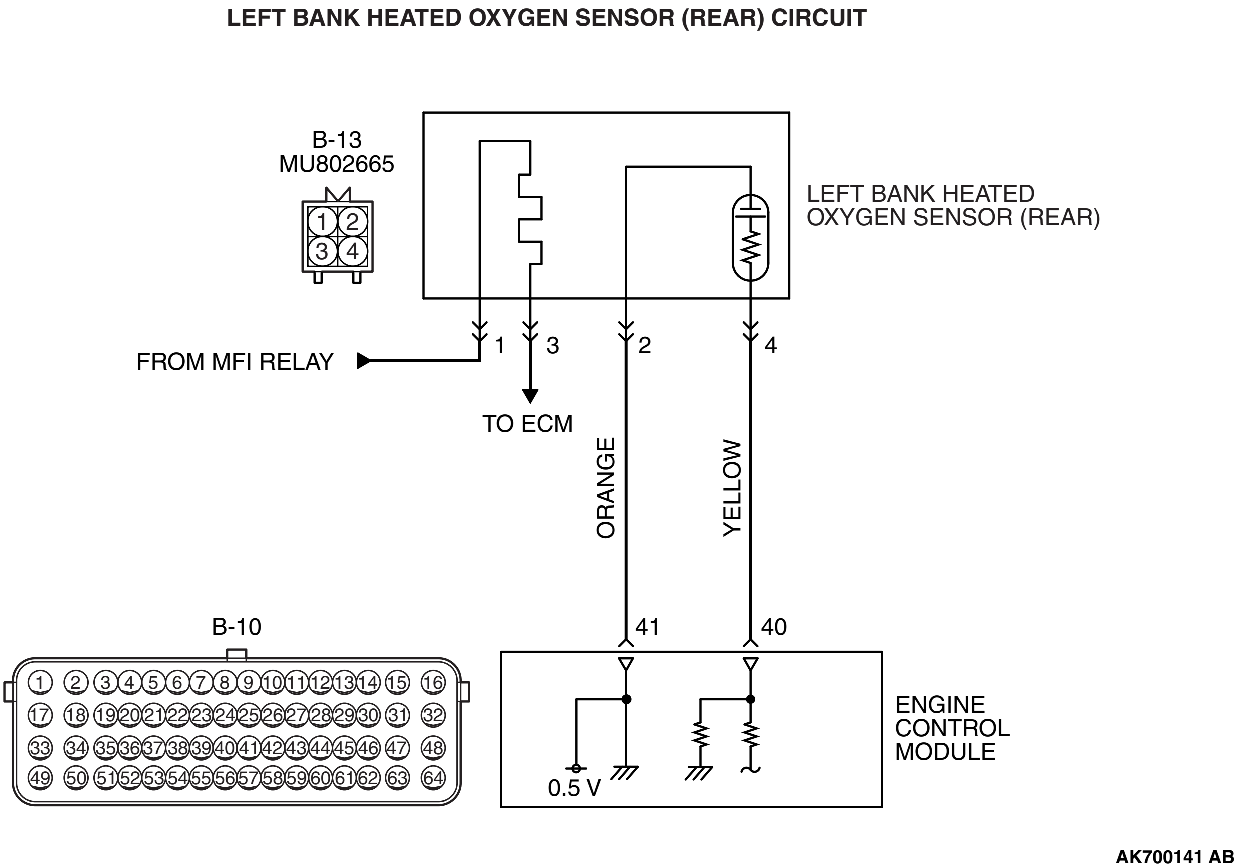
STEP 12. Test the OBD-II drive cycle.

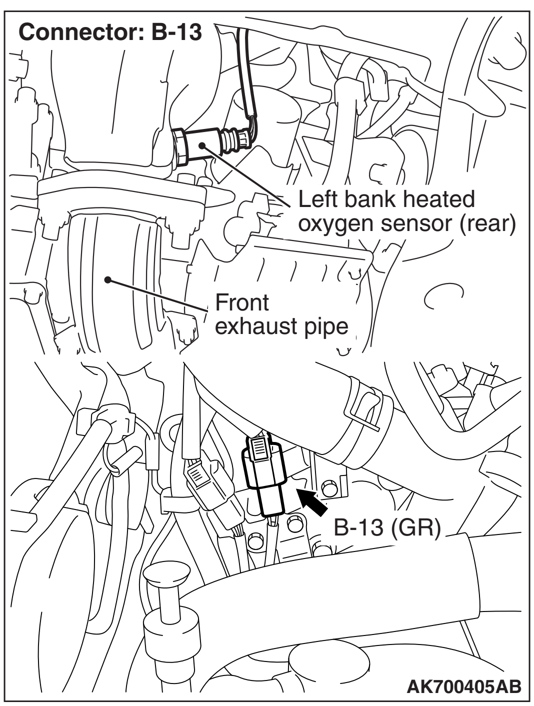
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 12 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

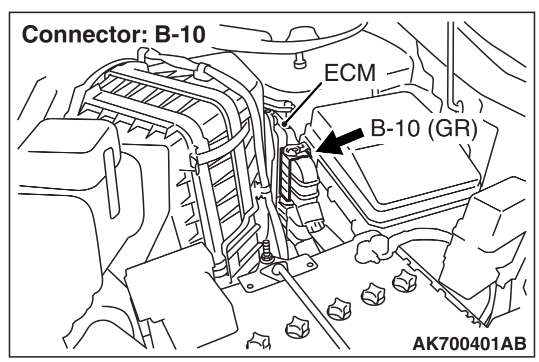
Q: Is DTC P0154 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0157: Heated Oxygen Sensor Circuit Low Voltage (bank 2, sensor 2)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 40) from the output terminal (terminal No. 4) of the left bank heated oxygen sensor (rear).
- Terminal No. 2 of the left bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 41).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the left bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the left bank heated oxygen sensor (front) is compensated by the output signal of the left bank heated oxygen sensor (rear).
- The ECM check for the left bank heated oxygen sensor (rear) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor (rear) out put voltage is under the specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

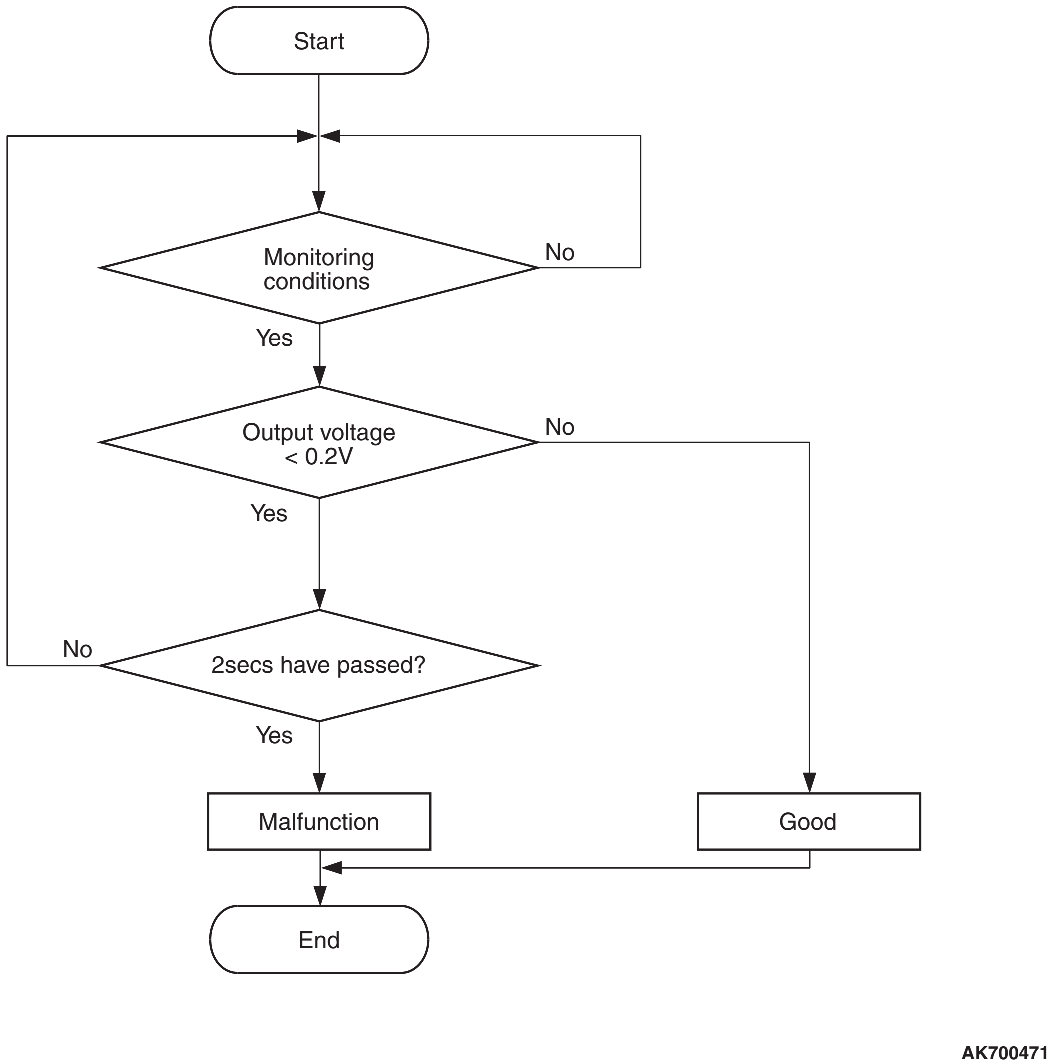
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (rear) heater monitor
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITIONS

Logic Flow Chart



Check Conditions

- Heated oxygen sensor offset voltage is between 0.4 and 0.6 volt.
- Battery positive voltage is between 11 and 16.5 volts.
- 3 minutes or more have passed since the engine starting sequence was completed.

Judgement Criterion

- Left bank heated oxygen sensor (rear) output voltage is lower than 0.2 volt for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (rear) failed.
- Connector damage.
- Harness damage.
- ECM failed.

DIAGNOSIS

Required Special Tools:

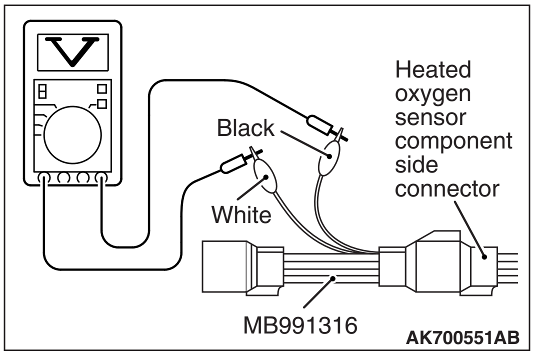
- MB991316: Test Harness

STEP 1. Check harness connector B-13 at the left bank heated oxygen sensor (rear) and harness connector B-10 at the ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair or replace it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 2. Check the left bank heated oxygen sensor (rear).



(1) Disconnect the left bank heated oxygen sensor (rear) connector B-13 and connect test harness special tool, MD991316 to the connector on the left bank heated oxygen sensor (rear) side.
(2) Warm up the engine until engine coolant temperature reaches 80°C (176°F) or higher.
(3) Drive at 50 km/h (31 mph) or more for 10 minutes.
(4) Connect a digital voltage meter between terminal No. 2 (black clip) and terminal No. 4 (white clip).
(5) Measure the output voltage of heated oxygen sensor under the following driving.
  a. Transaxle: 2nd speed
  b. Drive with wide open throttle
  c. Engine: 3,500 r/min or more

Standard value: 0.6 – 1.0 volts

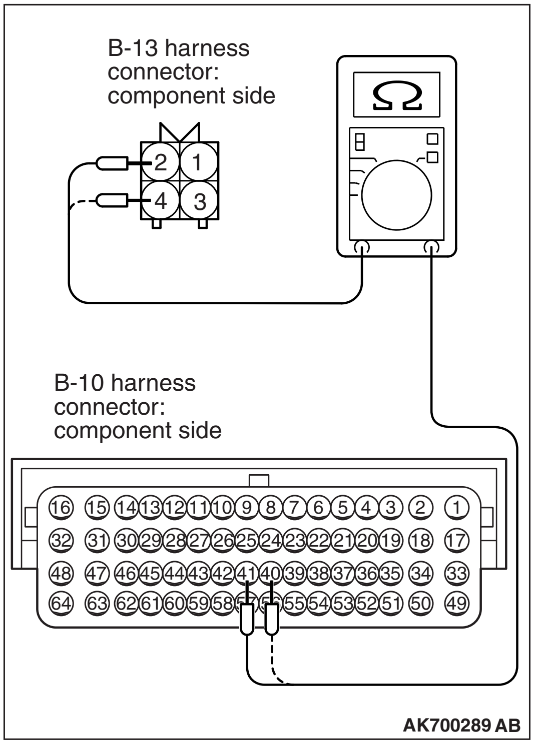
NOTE: If the temperature of sensing area does not reach the high temperature [of approximately 400°C (752°F) or more] even though the oxygen sensor is normal, the output voltage would be possibly low in spite of the rich air-fuel ratio.

NOTE: When the vehicle is driven with high loads, the temperature of the sensing area of the heated oxygen sensor is sufficiently high. Thus, it is not necessary to apply the voltage to the heater.

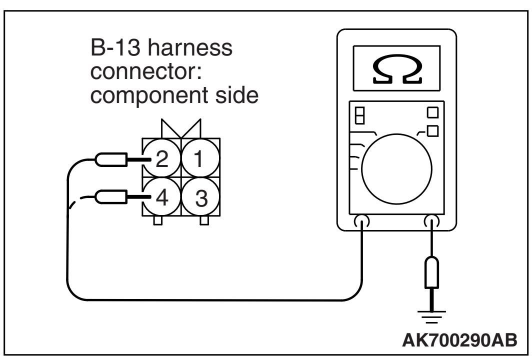
Q: Is the measured resistance between 11 and 18 ohms [at 20°C (68°F)?

YES : Go to Step 3.
NO : Replace the left bank heated oxygen sensor (rear). Then go to Step 5.

STEP 3. Check for harness between the left bank heated oxygen sensor (rear) connector B-13 and ECM connector B-10.



(1) Disconnect the left bank heated oxygen sensor (rear) connector B-13 and the ECM connector B-10.
(2) Measure the resistance between the heated oxygen sensor connector B-13 and the ECM connector B-10.
   a. Connector B-13 (terminal No. 2) and connector B-10 (terminal No. 41).
   b. Connector B-13 (terminal No. 4) and connector B-10 (terminal No. 40).
   - Should be less than 2 ohms.



(3) Check for the continuity between the oxygen sensor connector B-13 and ground.
   a. Connector B-13 (terminal No. 2) and ground
   b. Connector B-13 (terminal No. 4) and ground
   - Not continuity.

Q: Is the harness wire in good condition?

YES : Go to Step 4.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 5.

STEP 4. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11

(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0157 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 5.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

STEP 5. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 21 P.13B-11.

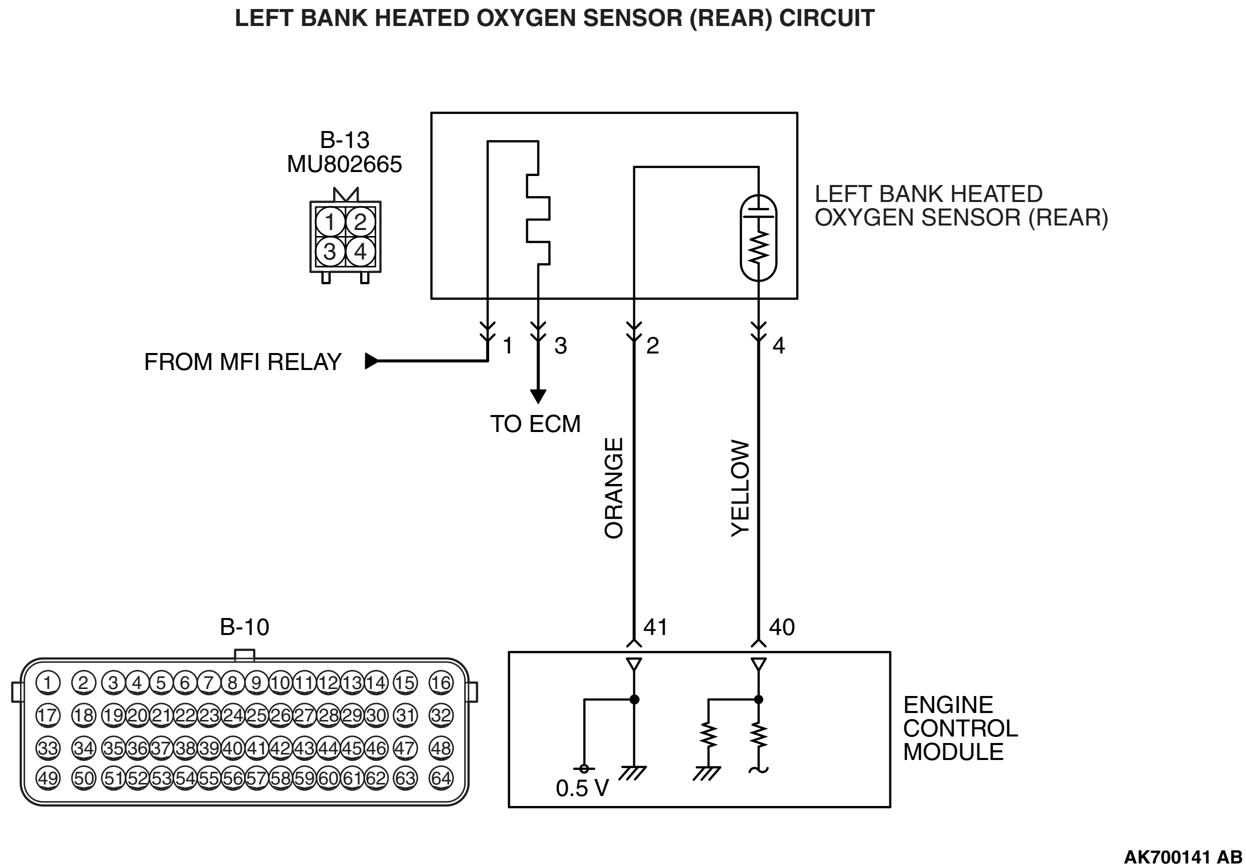
(2) Check the diagnostic trouble code (DTC).

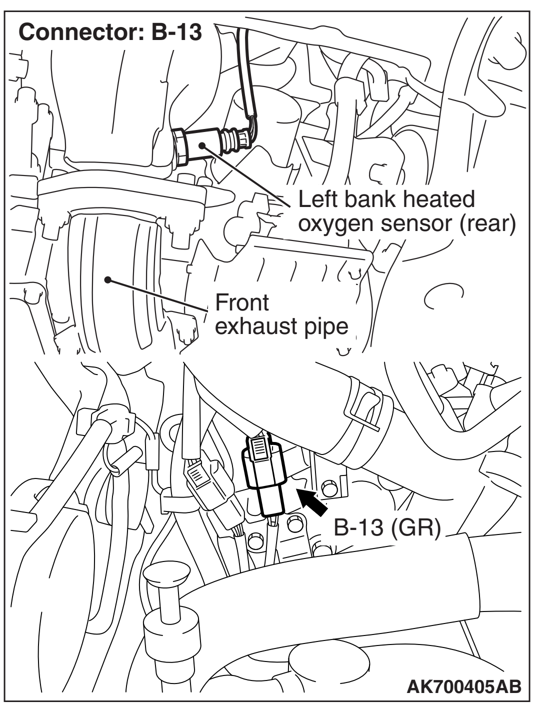
Q: Is DTC P0157 set?

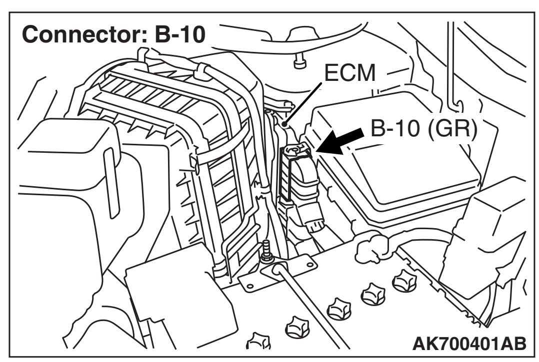
YES : Retry the troubleshooting.

NO : The inspection is complete.

DTC P0158: Heated Oxygen Sensor Circuit High Voltage (bank 2, sensor 2)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 40) from the output terminal (terminal No. 4) of the left bank heated oxygen sensor (rear).
- Terminal No. 2 of the left bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 41).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the left bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the left bank heated oxygen sensor (front) is compensated by the output signal of the left bank heated oxygen sensor (rear).
- The ECM checks for the left bank heated oxygen sensor (rear) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor (rear) output voltage is over the specified range.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

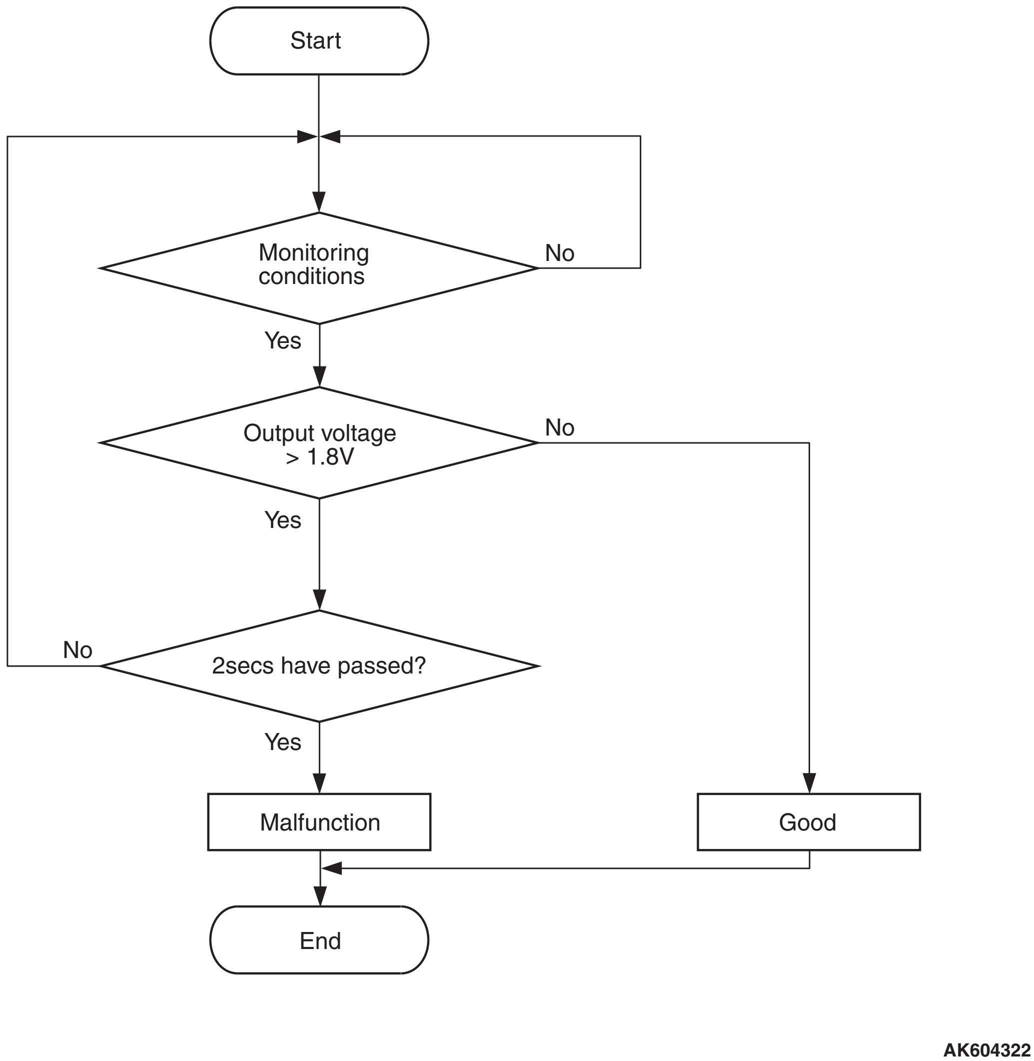
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (rear) heater monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- 2 seconds or more have passed since the engine starting sequence was completed.
- Heated oxygen sensor offset voltage is between 0.4 and 0.6 volt.

Judgement Criterion

- Left bank heated oxygen sensor (rear) output voltage has continued to be 1.8 volts or higher for 2 seconds.

OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Connector damage.
- Harness damage.
- ECM failed.

DIAGNOSIS

STEP 1. Check harness connector B-13 at the left bank heated oxygen sensor (rear) and harness connector B-10 at ECM for damage.

Q: Is the harness connector in good condition?

YES : Go to Step 2.
NO : Repair it. Refer to GROUP 00E, Harness Connector Inspection P.00E-2. Then go to Step 4.

STEP 2. Check for short circuit to power supply between the left bank heated oxygen sensor (rear) connector B-13 (terminal No. 4) and the ECM connector B-10 (terminal No. 40).

Q: Is the harness wire in good condition?

YES : Go to Step 3.
NO : Repair it. Then go to Step 4.

STEP 3. Check the trouble symptoms.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0158 set?

YES : Replace the ECM. When the ECM is replaced, register the ID code. Refer to GROUP 42B, Diagnosis – ID Codes Registration Judgment Table <Vehicles with KOS> P.42B-15 or GROUP 42C, Diagnosis – ID Codes Registration Judgment Table <Vehicles with WCM> P.42C-10. Then go to Step 4.
NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

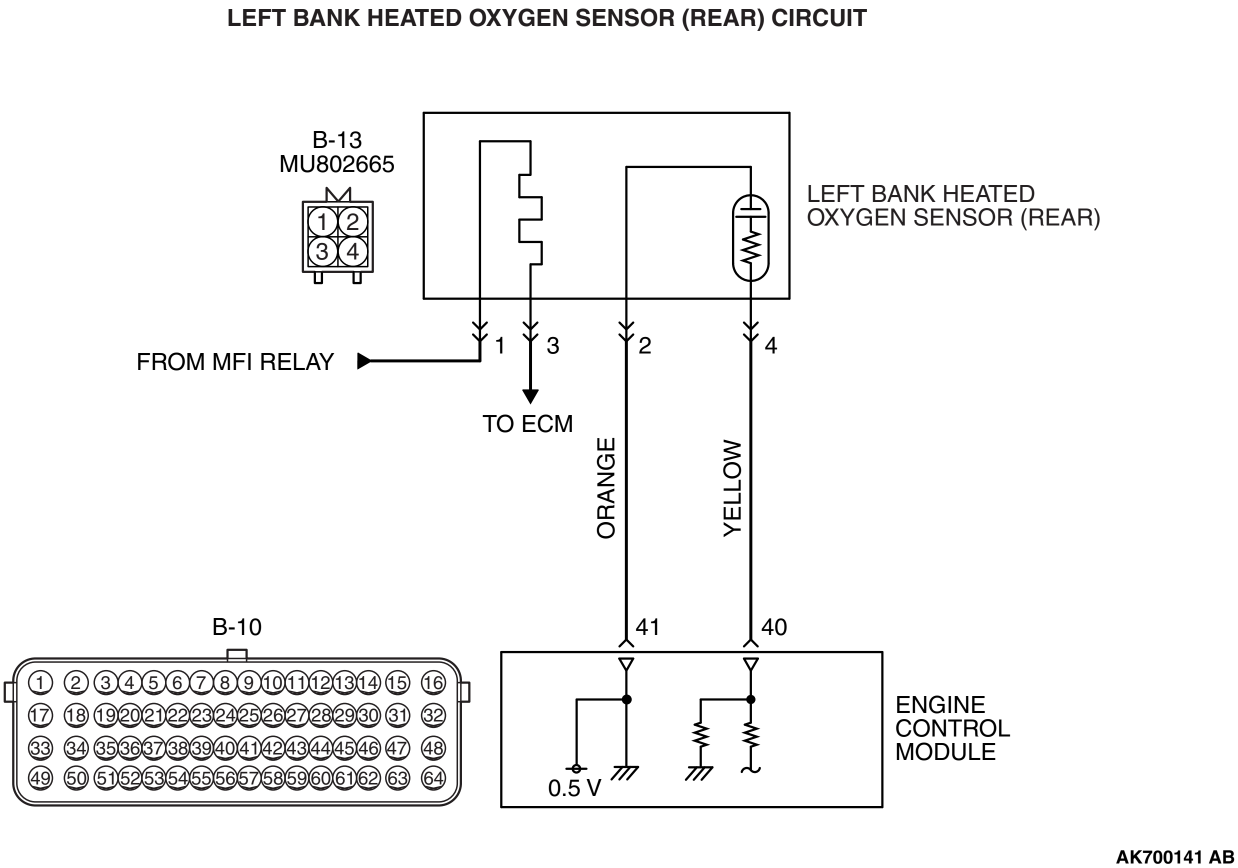
STEP 4. Test the OBD-II drive cycle.

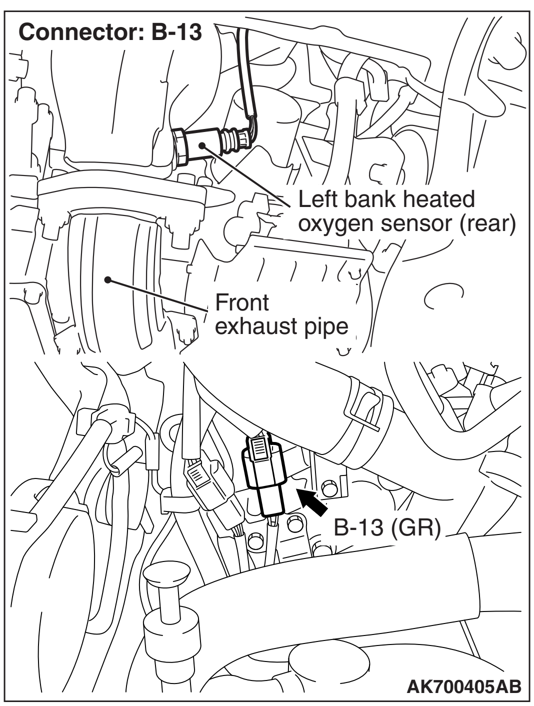
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 22 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

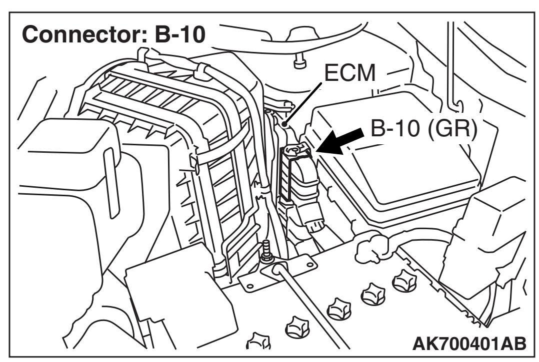
Q: Is DTC P0158 set?

YES : Retry the troubleshooting.
NO : The inspection is complete.

DTC P0159: Heated Oxygen Sensor Circuit Slow Response (bank 2, sensor 2)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 40) from the output terminal (terminal No. 4) of the left bank heated oxygen sensor (rear).
- Terminal No. 2 of the left bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 41).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the left bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the heated left bank oxygen sensor (front) is compensated by the output signal of the left bank heated oxygen sensor (rear).
- The ECM checks for the left bank heated oxygen sensor (rear) output line.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor (rear) output voltage does not reach 0.2 volt after fuel cut operation.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

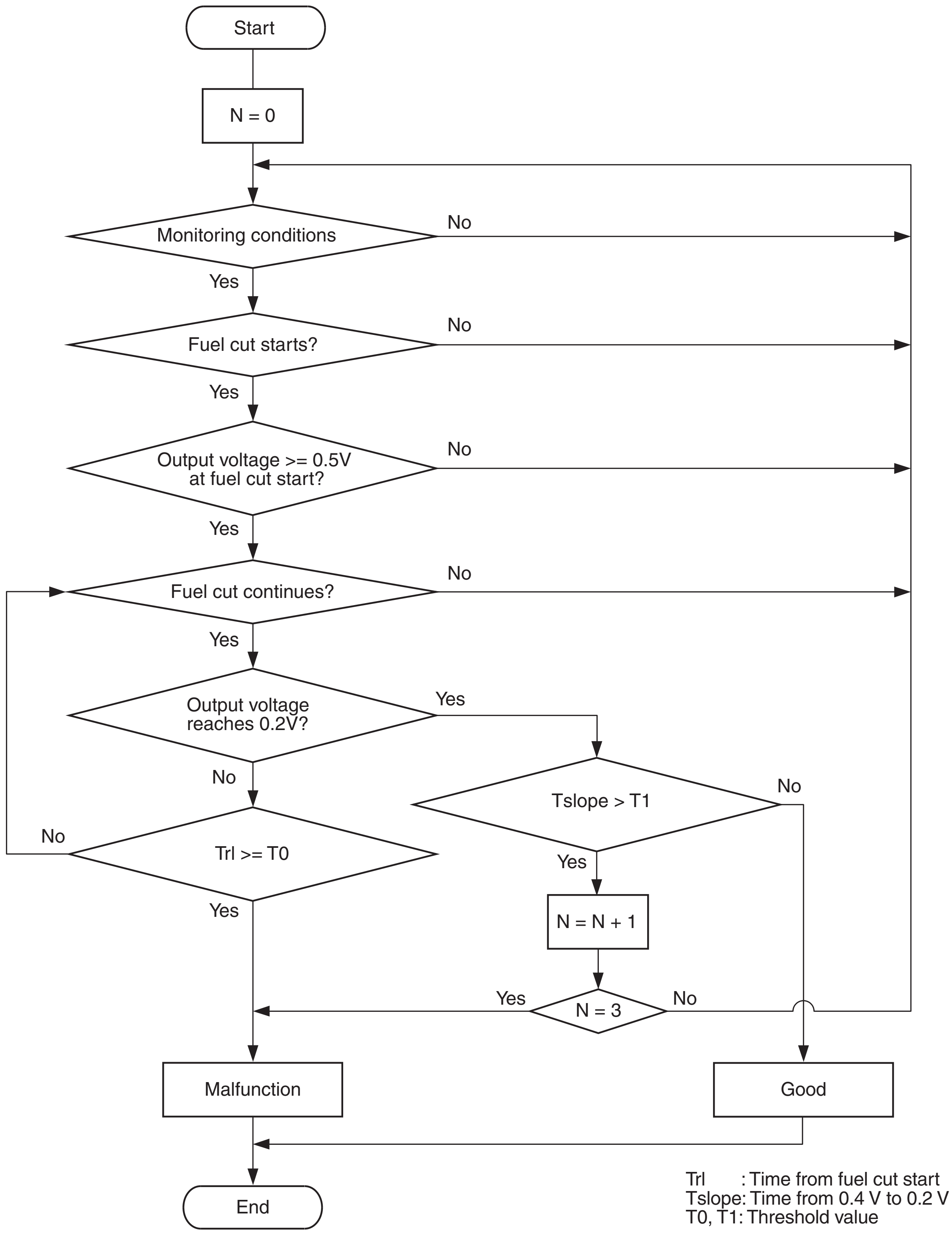
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (rear) heater monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITION

Logic Flow Chart



AK900362

Check Conditions

- Engine coolant temperature is higher than 76°C (169°F).
- The left bank heated oxygen sensor (front) is active.
- The cumulative mass airflow sensor output is higher than 1,638 g.
- Fuel is being shut off.
- The left bank heated oxygen sensor (rear) output voltage is higher than 0.5 volt when fuel cut is started.
- It has been taking more than 180 seconds since the drive signal of the left bank heated oxygen sensor (rear) heater was turned on.
- Barometric pressure is higher than 76 kPa (22.4 in.Hg).

Judgement Criterion

- The left bank heated oxygen sensor (rear) output voltage does not reach 0.2 volt for 6.0 seconds from fuel cut start.

Check Conditions

- Engine coolant temperature is higher than 76°C (169°F).
- The left bank heated oxygen sensor (front) is active.
- The cumulative mass airflow sensor output is higher than 1,638 g.
- Fuel is being shut off.
- The left bank heated oxygen sensor (rear) output voltage is higher than 0.5 volt when fuel cut is started.
- It has been taking more than 180 seconds since the drive signal of the left bank heated oxygen sensor (rear) heater was turned on.
- Barometric pressure is higher than 76 kPa (22.4 in.Hg).
- The ECM monitors for this condition for 3 cycles of 0.5 second each during drive cycles.

Judgement Criteria

- The left bank heated oxygen sensor (rear) output voltage does not reach 0.2 volt for 0.5 second from 0.4 volt while fuel is being shut off.
- The ECM monitors for this condition once during the drive cycle.

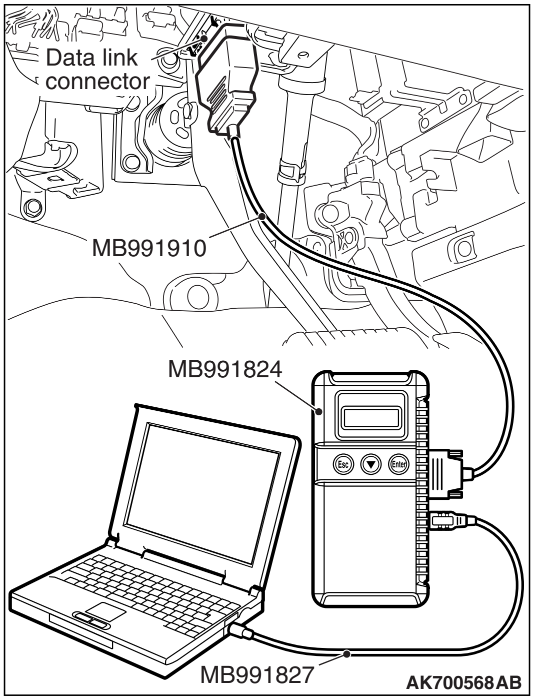
OBD-II DRIVE CYCLE PATTERN

Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 11 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (rear) deteriorated.

DIAGNOSIS



STEP 1. Using scan tool MB991958, check data list item AF: Heated Oxygen Sensor Bank 2, Sensor 2 (left rear).

⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AF, Heated Oxygen Sensor Bank 2, Sensor 2 (left rear).
(4) Warm up the engine.
- After increasing the output voltage 0.5 volt or more by the engine revving, finish it. Then confirm that the output voltage reduces to 0.2 volt or less within 6 seconds.

(5) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Replace the left bank heated oxygen sensor (rear). Then go to Step 2.

STEP 2. Test the OBD-II drive cycle.

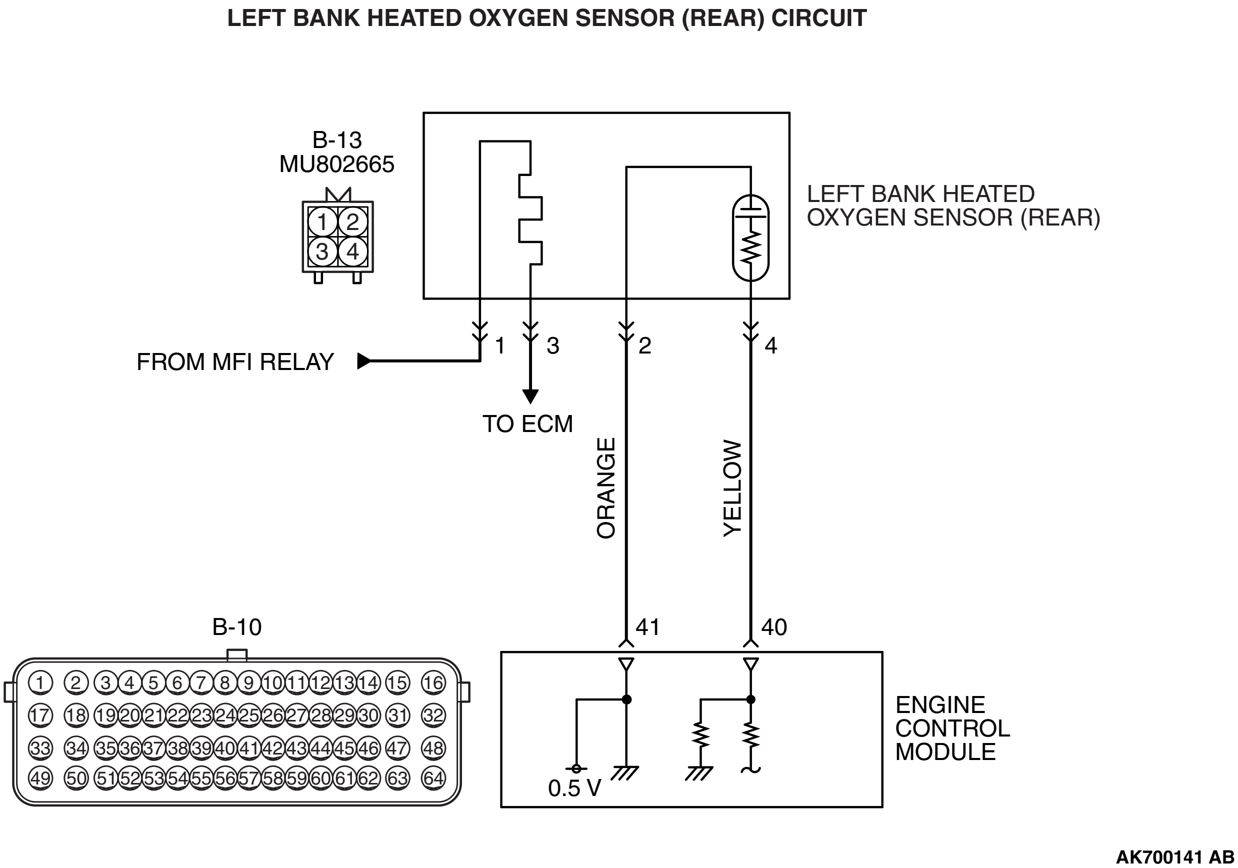
(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 11 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

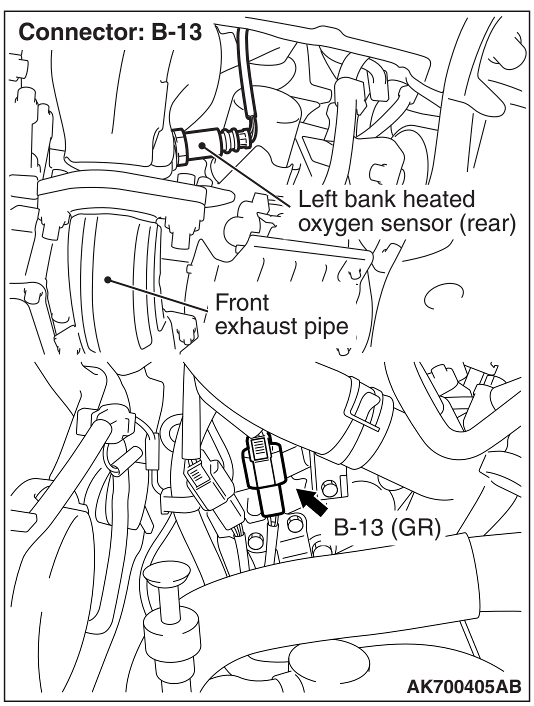
Q: Is DTC P0159 set?

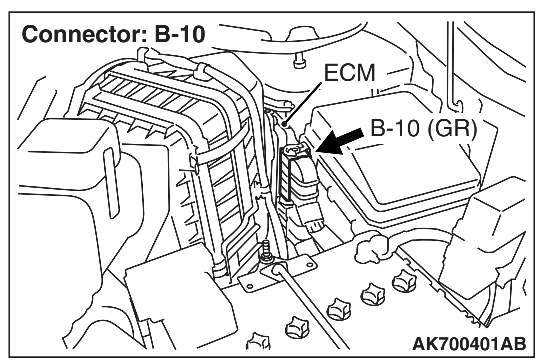
YES : Refer to DTC P0157 – Heated Oxygen Sensor Circuit Low Voltage (bank 2, sensor 2) P.13B-284, DTC P0158 – Heated Oxygen Sensor Circuit High Voltage (bank 2, sensor 2) P.13B-290.

NO : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points How to Cope with Intermittent Malfunctions P.00-15.

DTC P0160: Heated Oxygen Sensor Circuit No Activity Detected (bank 2, sensor 2)







CIRCUIT OPERATION

- A voltage corresponding to the oxygen concentration in the exhaust gas is sent to the ECM (terminal No. 40) from the output terminal (terminal No. 4) of the left bank heated oxygen sensor (rear).
- Terminal No. 2 of the left bank heated oxygen sensor (rear) is grounded with ECM (terminal No. 41).
- The ECM applies an offset voltage of 0.5 volt to terminal No. 2 of the left bank heated oxygen sensor (rear).

TECHNICAL DESCRIPTION

- The output signal of the heated left bank oxygen sensor (front) is compensated by the output signal of the left bank heated oxygen sensor (rear).
- The ECM checks for the left bank heated oxygen sensor (rear) output voltage.

DESCRIPTIONS OF MONITOR METHODS

Left bank heated oxygen sensor (rear) output voltage does not change during specified.

MONITOR EXECUTION

Continuous

MONITOR EXECUTION CONDITIONS (Other monitor and Sensor)

Other Monitor (There is no temporary DTC stored in memory for the item monitored below)

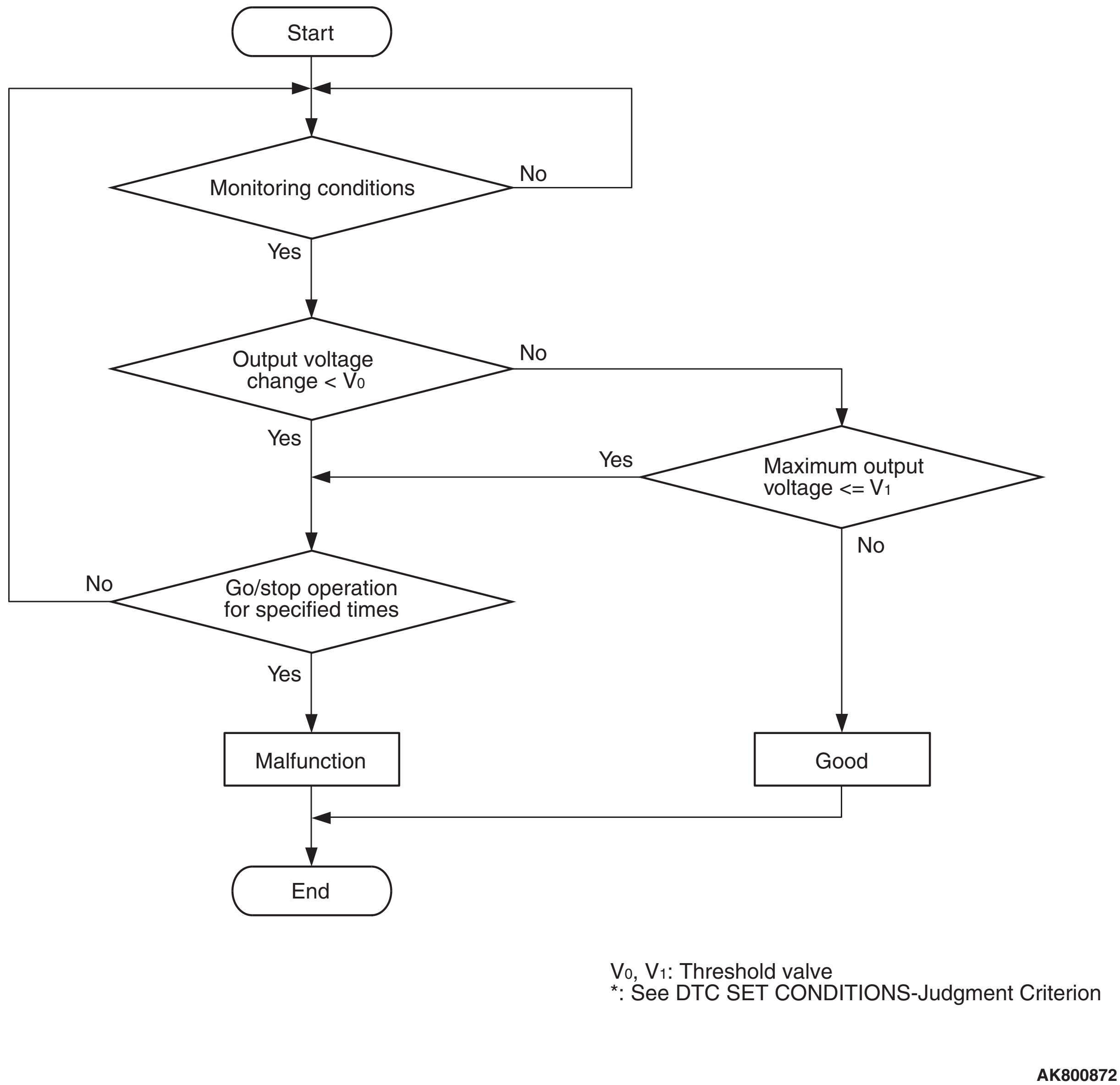
- Heated oxygen sensor (front) monitor
- Heated oxygen sensor (rear) heater monitor
- Heated oxygen sensor (front) heater monitor
- Heated oxygen sensor (front) inactive monitor
- Heated oxygen sensor offset voltage monitor
- Air/fuel ratio feedback monitor

Sensor (The sensor below is determined to be normal)

- Mass airflow sensor
- Engine coolant temperature sensor
- Intake air temperature sensor
- Barometric pressure sensor

DTC SET CONDITION

Logic Flow Chart



Check Conditions

- Engine coolant temperature is higher than 76°C (169°F).
- The left bank heated oxygen sensor (front) is active.
- The cumulative mass airflow sensor output is higher than 1,638 g.
- Repeat 1 or more times: drive*1, stop*2.
  Drive*1:
    - Engine speed is higher than 1,500 r/min.
    - Volumetric efficiency is higher than 40 percent.
    - Vehicle speed is higher than 30 km/h (19 mph).
    - A total of more than 60 seconds have elapsed with the above mentioned conditions, and more than 3 seconds have elapsed with the fuel shut off.

Stop*2:

- Vehicle speed is lower than 1.5 km/h (1.0 mph).

Judgement Criterion

- Change in the output voltage of the left bank heated oxygen sensor (rear) is lower than 0.313 volt.

or

- The maximum output voltage of the left bank heated oxygen sensor (rear) is lower than 0.508 volt.

NOTE: Monitoring stops after fuel has been shut off for more than 38 seconds.

OBD-II DRIVE CYCLE PATTERN

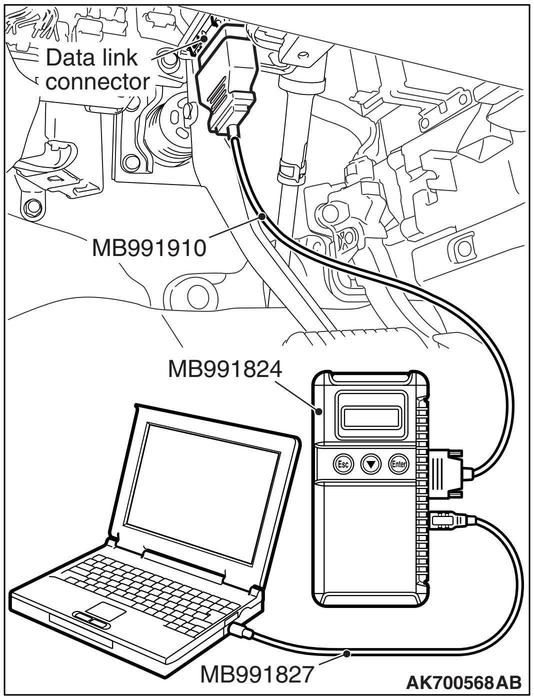
Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 13 P.13B-11.

TROUBLESHOOTING HINTS (The most likely causes for this code to be set are:)

- Left bank heated oxygen sensor (rear) deteriorated.
- ECM failed.

DIAGNOSIS

STEP 1. Using scan tool MB991958, check data list item AF: Heated Oxygen Sensor Bank 2, Sensor 2 (left rear).



⚠ CAUTION

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

(1) Connect scan tool MB991958 to the data link connector.
(2) Start the engine and run at idle.
(3) Set scan tool MB991958 to the data reading mode for item AF, Heated Oxygen Sensor Bank 2, Sensor 2 (left rear).
  a. Transaxle: 2nd speed
  b. Drive with wide open throttle
  c. Engine: 3,500 r/min
    - The output voltages should be between 0.6 and 1.0 volt.
(4) Turn the ignition switch to the "LOCK" (OFF) position.

Q: Is the sensor operating properly?

YES : It can be assumed that this malfunction is intermittent. Refer to GROUP 00, How to Use Troubleshooting/Inspection Service Points – How to Cope with Intermittent Malfunctions P.00-15.

NO : Replace the left bank heated oxygen sensor (rear). Go to Step 2.

STEP 2. Test the OBD-II drive cycle.

(1) Carry out a test drive with the drive cycle pattern. Refer to Diagnostic Function – OBD-II Drive Cycle – Pattern 13 P.13B-11.
(2) Check the diagnostic trouble code (DTC).

Q: Is DTC P0160 set?

YES : Refer to P0157 – Heated Oxygen Sensor Circuit Low Voltage (bank 2, sensor 2) P.13B-284, DTC P0158 – Heated Oxygen Sensor Circuit High Voltage (bank 2, sensor 2) P.13B-290.

NO : The inspection is complete.

Next>>