

## GROUP 13Ab

# MULTIPOINT FUEL INJECTION (MFI) DIAGNOSIS

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## TROUBLESHOOTING STRATEGY

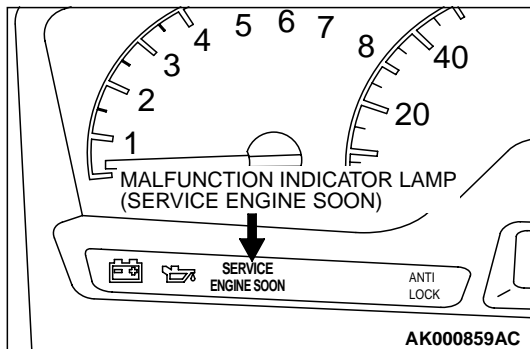
M1131150000018

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 Malfunction [P.00-6](#).
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.  
*NOTE: If a DTC is erased, its "freeze frame" data will be also erased and the readiness test status will be reset. If necessary, store the "freeze frame" data before erasing the DTC.*
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 the inspection procedure for diagnostic trouble codes of that code.
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 Malfunction [P.00-6](#).
10. After repairs are completed, conduct a road test duplicating the complaint set conditions to confirm the malfunction has been eliminated.

## TROUBLE CODE DIAGNOSIS

M1131150500228



## MALFUNCTION INDICATOR LAMP (SERVICE ENGINE SOON)

Among the on-board diagnostic items, a Malfunction Indicator Lamp (SERVICE ENGINE SOON) illuminates to notify the driver of an emission control malfunction.

However, when an irregular signal returns to normal and the engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> judges that it has returned to normal, the Malfunction Indicator Lamp (SERVICE ENGINE SOON) is switched off.

Moreover, when the ignition switch is turned off, the lamp is switched off. Even if the ignition switch is turned on again, the lamp does not illuminate until the malfunction is detected. Immediately after the ignition switch is turned on, the Malfunction Indicator Lamp (SERVICE ENGINE SOON) is lit for 20 seconds to indicate that the Malfunction Indicator Lamp (SERVICE ENGINE SOON) operates normally.

**Items Indicated by the Malfunction Indicator Lamp (SERVICE ENGINE SOON)**

<b>DTC NO.</b>	<b>ITEMS</b>
–	Engine control module (ECM) <M/T> or Powertrain control module (PCM) <A/T> malfunction
P0101*	Volume air flow circuit range/performance problem
P0102*	Volume air flow circuit low input
P0106*	Barometric pressure circuit range/performance problem
P0107*	Barometric pressure circuit low input
P0108*	Barometric pressure circuit high input
P0111*	Intake air temperature circuit range/performance problem
P0112*	Intake air temperature circuit low input
P0113*	Intake air temperature circuit high input
P0116*	Engine coolant temperature circuit range/performance problem
P0117*	Engine coolant temperature circuit low input
P0118*	Engine coolant temperature circuit high input
P0121*	Throttle position sensor circuit range/performance problem
P0122*	Throttle position sensor circuit low input
P0123*	Throttle position sensor circuit high input
P0125*	Insufficient coolant temperature for closed loop fuel control
P0128	Coolant thermostat (Coolant temperature below thermostat regulating temperature)
P0130	Heated oxygen sensor circuit (sensor 1)
P0131	Heated oxygen sensor circuit low voltage (sensor 1)
P0132	Heated oxygen sensor circuit high voltage (sensor 1)
P0133	Heated oxygen sensor circuit slow response (sensor 1)
P0134*	Heated oxygen sensor circuit no activity detected (sensor 1)
P0135	Heated oxygen sensor heater circuit (sensor 1)
P0136	Heated oxygen sensor circuit (sensor 2)
P0137	Heated oxygen sensor circuit low voltage (sensor 2)
P0138	Heated oxygen sensor circuit high voltage (sensor 2)
P0139	Heated oxygen sensor circuit slow response (sensor 2)
P0141	Heated oxygen sensor heater circuit (sensor 2)
P0171	System too lean
P0172	System too rich
P0181	Fuel temperature sensor circuit range/performance
P0182	Fuel temperature sensor circuit low input
P0183	Fuel 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
P0300	Random/multiple cylinder misfire detected

<b>DTC NO.</b>	<b>ITEMS</b>
P0301	Cylinder 1 misfire detected
P0302	Cylinder 2 misfire detected
P0303	Cylinder 3 misfire detected
P0304	Cylinder 4 misfire detected
P0335*	Crankshaft position sensor circuit
P0340*	Camshaft position sensor circuit
P0401	Exhaust gas recirculation flow insufficient detected
P0403	Exhaust gas recirculation control circuit
P0421	Warm up catalyst efficiency below threshold
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
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 circuit range/performance
P0500	Vehicle speed sensor <M/T>
P0506	Idle control system RPM lower than expected
P0507	Idle control system RPM higher than expected
P0551	Power steering pressure sensor circuit range/performance
P0554	Power steering pressure sensor circuit intermittent
P0705	Transmission range sensor circuit malfunction (RPNDL input)
P0712	Transmission fluid temperature sensor circuit low input
P0713	Transmission fluid temperature sensor circuit high input
P0715	Input/Turbine speed sensor circuit
P0720	Output speed sensor circuit
P0731	Gear 1 incorrect ratio
P0732	Gear 2 incorrect ratio
P0733	Gear 3 incorrect ratio
P0734	Gear 4 incorrect ratio
P0736	Gear R incorrect ratio
P0741	Torque converter clutch circuit performance or stuck off
P0742	Torque converter clutch circuit stuck on
P0743	Torque converter clutch circuit electrical
P0753	Shift solenoid "A" electrical
P0758	Shift solenoid "B" electrical
P0763	Shift solenoid "C" electrical

<b>DTC NO.</b>	<b>ITEMS</b>
P0768	Shift solenoid "D" electrical
P1400	Manifold differential pressure sensor circuit malfunction
P1603*	Battery backup circuit malfunction
P1751	A/T control relay malfunction

*NOTE: If the Malfunction Indicator Lamp (SERVICE ENGINE SOON) illuminates because of a malfunction of the engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T>, transmission between scan tool MUT-II (MB991502) and the ECM <M/T> or PCM <A/T> is impossible. In this case, the diagnostic trouble code (DTC) cannot be read.*

*NOTE: After the ECM <M/T> or PCM <A/T> has detected a malfunction, the Malfunction Indicator Lamp (SERVICE ENGINE SOON) illuminates when the engine is next turned on and the same malfunction is re-detected. However, for items marked with a "\*" in the DTC NO column, the Malfunction Indicator Lamp (SERVICE ENGINE SOON) illuminates on the first detection of the malfunction.*

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

- When the ECM <M/T> or PCM <A/T> monitored the power train malfunction three times\* it met set condition requirements, it detected no malfunction. \*: In this case, "one time" indicates from engine start to stop.
- 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.*

## **HOW TO READ AND ERASE DIAGNOSTIC TROUBLE CODE**

### **Required Special Tool:**

MB991502: Scan Tool (MUT-II)

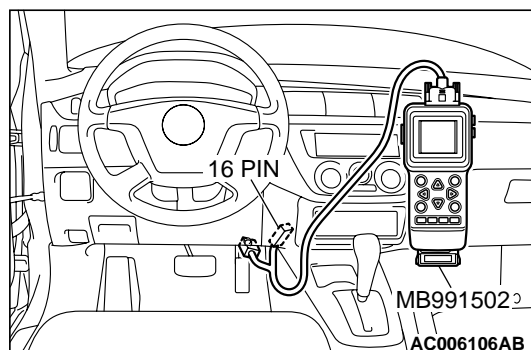
### **⚠ CAUTION**

**To prevent damage to scan tool MB991502, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.**

*NOTE: If Battery positive voltage is low, diagnostic trouble codes may not be output. Be sure to check the battery and charging system before continuing.*

*NOTE: If battery cable is disconnected or if the engine control module (ECM) connector <M/T> or powertrain control module (PCM) connector <A/T> is disconnected, the diagnostic trouble codes will be erased. Do not disconnect the battery cable or ECM <M/T> or PCM <A/T> connector until the diagnostic trouble codes have been recorded.*

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



1. Connect scan tool MB991502 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Read the diagnostic trouble codes for MFI.
4. Refer to the DIAGNOSTIC TROUBLE CODE CHART([P.13Ab-19](#)).
5. Turn the ignition switch to the "LOCK" (OFF) position and then back to "ON" again.
6. Erase the diagnostic trouble code(s) using MUT-II screen prompts.
7. Confirm that the diagnostic trouble code output is normal.
8. Turn the ignition switch to the "LOCK" (OFF) position.
9. Disconnect scan tool MB991502 from the data link connector.

### PROVISIONAL DTCs [MUT-II OBD-II Test Mode – Results (Mode 5)]

The MUT-II will display the Provisional DTCs reported by engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> if the ECM <M/T> or PCM <A/T> detects some malfunction for "Misfire", "Fuel System" and "Comprehensive" monitoring during a SINGLE Driving Cycle. The intended use of this data is to assist the technician after a vehicle repair, and after clearing diagnostic information, by reporting test result after a SINGLE Driving Cycle. Note that the test results reported by this mode do not necessarily indicate a faulty component/system. If test results indicate a failure after ADDITIONAL (consecutive) driving, then the Malfunction Indicator Lamp (SERVICE ENGINE SOON) will be illuminated and a DTC will set.

### MODE 6 REFERENCE TABLE

The engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> 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 <M/T> or PCM <A/T> monitors can be confirmed. The value at the last monitoring is output by ECM <M/T> or PCM <A/T> as a test result.

TEST ID	MONITORING ITEM	SIMPLE TECHNICAL DESCRIPTION	INDICATION OF SCAN TOOL	CONVERSION COEFFICIENT IN USING GENERAL SCAN TOOL
01	Catalyst monitor	ECM <M/T> or PCM <A/T> monitors the deterioration of catalyst by the output frequency ratio between heated oxygen sensor (front) and heated oxygen sensor (rear).	Catalyst Frequency Ratio Test Result and Limit Value (max.)	× 0.0039
03	EGR monitor	ECM <M/T> or PCM <A/T> monitors the operation of EGR system by the pressure difference of intake manifold between before and after introduction of EGR using the manifold differential pressure sensor.	EGR Monitor Pressure Value Test Result and Limit Value (min.) kPa	× 0.43 kPa
06	Evaporation leak monitor (Small leak)	ECM <M/T> or PCM <A/T> monitors the leak of fuel evaporation gas by the reduction of vacuum in tank after appointed time using the fuel tank differential pressure sensor after making the fuel tank and the fuel line vacuum.	EVAP Leak Mon. 1 mm Pressure Value Test Result and Limit Value (max.) kPa	× 0.032 kPa
07	Evaporation leak monitor (Gross leak)	ECM <M/T> or PCM <A/T> 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.	EVAP Leak Mon. Gross Pressure Value Test Result and Limit Value (min.) kPa	× 0.032 kPa

TEST ID	MONITORING ITEM	SIMPLE TECHNICAL DESCRIPTION	INDICATION OF SCAN TOOL	CONVERSION COEFFICIENT IN USING GENERAL SCAN TOOL
08	Evaporation leak monitor (Very small leak)	ECM <M/T> or PCM <A/T> monitors the leak of fuel evaporation gas by the reduction of vacuum in tank after appointed time using the fuel tank differential pressure sensor after making the fuel tank and the fuel line vacuum.	EVAP Leak Mon. 0.5 mm Pressure Value Test Result and Limit Value (max.) kPa	× 0.032 kPa
09	Heated oxygen sensor (front) monitor (Rich/Lean Switching)	ECM <M/T> or PCM <A/T> monitors the deteriorated condition of the heated oxygen sensor (front) by checking the lean/rich switching frequency of the heater oxygen sensor (front).	HO2S B1 SENSOR1 Rich/Lean Switching Count Test Result and Limit Value (min.)	× 1 count
0B	Heated oxygen sensor (rear) monitor (Voltage Change)	The engine control unit checks the output voltage of the heated oxygen sensor (rear) in order to monitor whether the heated oxygen sensor (rear) output is stuck.	HO2S B1 SENSOR2 Change in Volt Test Result and Limit Value (min.)	× 19.5 mV

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.

## DIAGNOSTIC BY DIAGNOSTIC TEST MODE II (INCREASED SENSITIVITY)

### Required Special Tool:

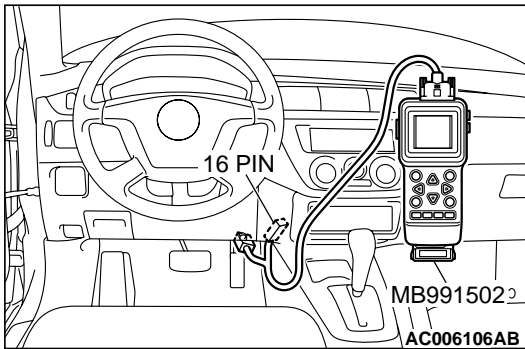
MB991502: Scan Tool (MUT-II)

### CAUTION

To prevent damage to scan tool MB991502, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.

NOTE: When mode II is selected with MUT-II, the Malfunction Indicator Lamp (SERVICE ENGINE SOON) will light when the engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> first detects the trouble (Note that this is only for emission-related trouble). At the same time, the relevant diagnostic trouble codes will be registered. In respect to the comprehensive component electrical faults (opens/shorts), the time for the diagnostic trouble code to be registered after the fault occurrence is four seconds → one second. Therefore, the confirmation of the trouble symptom and the confirmation after completing repairs can be reduced. To return to the normal mode I after mode II has been selected once, the ignition switch must be turned "OFF" once or mode I must be reselected with MUT-II. The diagnostic trouble code, readiness test status and freeze frame data, etc., will be erased when mode I is returned to, so record these before returning to model.





1. Connect scan tool MB991502 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Change the diagnostic test mode of the ECM <M/T> or PCM <A/T> to DIAGNOSTIC TEST MODE II (INCREASED SENSITIVITY).
4. Road test the vehicle.
5. Read the diagnostic trouble code and repair the malfunctioning part.
6. Turn the ignition switch to the "LOCK" (OFF) position.
7. Disconnect scan tool MB991502 from the data link connector.

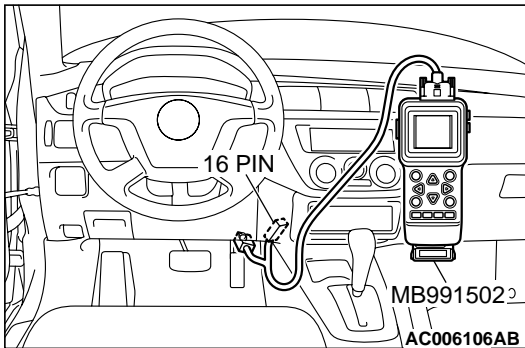
## INSPECTION USING SCAN TOOL MB991502, DATA LIST AND ACTUATOR TESTING

### Required Special Tool:

MB991502: Scan Tool (MUT-II)

### **CAUTION**

**To prevent damage to scan tool MB991502, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.**



1. Connect scan tool MB991502 to the data link connector.
2. Turn the ignition switch to the "ON" position.
3. Carry out inspection by means of the data list and the actuator test function. If there is an abnormality, check and repair the chassis harnesses and components. Refer to Data List Reference Table ([P.13Ab-25](#)).  
Refer to Actuator Test Reference Table([P.13Ab-34](#)).
4. Re-check using scan tool MB991502 and check to be sure that the abnormal input and output have returned to normal because of the repairs.
5. Erase the diagnostic trouble code(s).
6. Turn the ignition switch to the "LOCK" (OFF) position.
7. Disconnect scan tool MB991502 from the data link connector.
8. Start the engine again and do a test drive to confirm that the problem is eliminated.

**ON-BOARD DIAGNOSTICS**

The engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> monitors the input/output signals (some signals all the time and others under specified conditions) of the ECM <M/T> or PCM <A/T>. When a malfunction continues for a specified time or longer after the irregular signal is initially monitored, the ECM <M/T> or PCM <A/T> judges that a malfunction has occurred. After the ECM <M/T> or PCM <A/T> 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 "\*", a diagnostic trouble code is recorded on the first detection of the malfunction. There are 83 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 <M/T> or PCM <A/T> 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 MUT-II (MB991502) to the ECM <M/T> or PCM <A/T>.

*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 <M/T> or PCM <A/T> in order to erase the diagnostic memory. The 83 diagnostic items are all indicated sequentially from the smallest code number. The ECM <M/T> or PCM <A/T> 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 <M/T> or PCM <A/T> detects multiple malfunctions, the ECM <M/T> or PCM <A/T> stores the data for only the first item that was detected.*

*However, if the ECM <M/T> or PCM <A/T> detects a misfire or a fuel system malfunction, the ECM <M/T> or PCM <A/T> stores the data by giving priority to the misfire or fuel system malfunction, regardless of the order in which the malfunction was detected.*

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

MUT-II SCAN TOOL DISPLAY	ITEM NO.	DATA ITEM	UNIT or STATE
ECT SENSOR	21	Engine coolant temperature sensor	°C or °F
ENGINE LOAD	87	Calculation load value	%
ENGINE SPEED	22	Crankshaft position sensor	r/min
IAT SENSOR	13	Intake air temperature sensor	°C or °F
IG. TIMING ADV	44	Ignition coils and ignition power transistor	deg
LONG TRIM B1	81	Long-term fuel compensation	%
SHORT TRIM B1	82	Short-term fuel compensation	%
SYS. STATUS B1	88	Fuel control condition	<ul style="list-style-type: none"> <li>• Open loop</li> <li>• Closed loop</li> <li>• Open loop-drive condition</li> <li>• Open loop-DTC set</li> <li>• Closed loop-O<sub>2</sub> (rear) failed</li> </ul>
TP SENSOR	8A	Throttle position sensor	%
VAF SENSOR	12	Volume air flow sensor (mass air flow rate)	gm/s
VSS	24	Vehicle speed sensor	km/h or mph

## OBD- II DRIVE CYCLE

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

### **CAUTION**

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

*NOTE: Check that the diagnosis trouble code (DTC) is not output before traveling in the drive cycle pattern. Erase the DTC if it has been output.*

### DRIVE CYCLE PATTERN LIST

PROCEDURE	MONITOR ITEM		DIAGNOSTIC TROUBLE CODE (DTC)
1	Evaporative emission control system leak monitor		P0441, P0442, P0451, P0452, P0453, P0455, P0456
2	Fuel trim monitor		P0171, P0172
3	Catalytic converter monitor		P0421
4	Heated oxygen sensor monitor		P0133, P0139
5	Exhaust gas recirculation (EGR) system monitor		P0401
6	Other monitor	Main components	P0134, P0300, P0301, P0302, P0303, P0304, P0506, P0507, P1400
		Sensors and switches	P0101, P0102, P0106, P0107, P0108, P0111, P0112, P0113, P0116, P0117, P0118, P0121, P0122, P0123, P0125, P0181, P0182, P0183, P0335, P0340, P0461
		Wire breakage and short circuit	P0130, P0131, P0132, P0135, P0136, P0137, P0138, P0141, P0201, P0202, P0203, P0204, P0403, P0443, P0446

## PROCEDURE 1

## EVAPORATIVE EMISSION CONTROL SYSTEM LEAK MONITOR

DTC	P0441, P0442, P0451, P0452, P0453, P0455, P0456
Drive cycle pattern	<p>This monitor [from start to ignition switch to the "LOCK" (OFF) position] will be completed while traveling with the following drive cycle pattern. It will take 8 minutes. You must complete this drive twice.</p> <p><i>NOTE: Vehicle speed and throttle opening angle should be within the shaded range.</i></p> <p style="text-align: right;">AKX01345 AC</p>
Inspection conditions	<ul style="list-style-type: none"> <li>Engine coolant temperature: 45°C (113°F) or less (The engine is stopped before the test drive is started)</li> <li>Atmospheric temperature: 5 – 45°C (41 – 113°F)</li> <li>Condition of A/T: Selector lever D range</li> </ul>
Test procedure	<ol style="list-style-type: none"> <li>1. Engine: start</li> <li>2. Accelerate until the vehicle speed is 89 – 97 km/h (55 – 60 mph).</li> <li>3. Travel for 200 seconds or more while keeping the vehicle speed at 89 – 97 km/h (55 – 60 mph). (M/T: 5th speed)</li> <li>4. While keeping the accelerator pedal opening degree constant, keep the vehicle speed at 89 – 97 km/h (55 – 60 mph) and travel for 150 seconds or more. (During monitor)</li> <li>5. Return the vehicle to the shop, then turn the ignition switch to "LOCK" (OFF) position.</li> <li>6. Confirm that the diagnostic trouble code (DTC) is not output.</li> <li>7. If DTC P0441 is output, refer to GROUP 13A, DTC P0441 – Evaporative Emission Control System Incorrect Purge Flow <a href="#">P.13Ac-322</a>. If DTC P0442 is output, refer to GROUP 13A, DTC P0442 – Evaporative Emission Control System Leak Detected (Small Leak) <a href="#">P.13Ac-324</a>. If DTC P0451 is output, refer to GROUP 13A, DTC P0451 – Evaporative Emission Control System Pressure Sensor Range/performance <a href="#">P.13Ac-356</a>. If DTC P0452 is output, refer to GROUP 13A, DTC P0452 – Evaporative Emission Control System Pressure Sensor Low Input <a href="#">P.13Ac-386</a>. If DTC P0453 is output, refer to GROUP 13A, DTC P0453 – Evaporative Emission Control System Pressure Sensor High Input <a href="#">P.13Ac-417</a>. If DTC P0455 is output, refer to GROUP 13A, DTC P0455 – Evaporative Emission Control System Leak Detected (Gross Leak) <a href="#">P.13Ac-447</a>. If DTC P0456 is output, refer to GROUP 13A, DTC P0456 – Evaporative Emission Control System Leak Detected (Very Small Leak) <a href="#">P.13Ac-463</a>.</li> </ol>

**PROCEDURE 2**

<b>FUEL TRIM MONITOR</b>	
DTC	P0171, P0172
Drive cycle pattern	<p>This monitor [from start to ignition switch to the "LOCK" (OFF) position] will be completed while traveling with the following drive cycle pattern. It will take 35 minutes. You must complete this drive twice.</p> <p><i>NOTE: Vehicle speed and throttle opening angle should be within the shaded range.</i></p> <p align="right">AKX01346 AC</p>
Inspection conditions	<ul style="list-style-type: none"> <li>• Engine coolant temperature: 80 – 97°C (176 – 207°F)</li> <li>• Atmospheric temperature: –10 – 60°C (14 – 140°F)</li> <li>• Condition of A/T: Selector lever D range</li> </ul>
Test procedure	<ol style="list-style-type: none"> <li>1. Engine: start</li> <li>2. Accelerate until the vehicle speed is 89 – 97 km/h (55 – 60 mph).</li> <li>3. Travel for 30 minutes or more while keeping the vehicle speed at 89 – 97 km/h (55 – 60 mph). (M/T: 5th speed) Carry out one gradual deceleration/acceleration returning to 89 – 97 km/h (55 – 60 mph) within 120 seconds. (During monitor)</li> <li>4. Return the vehicle to the shop, then turn the ignition switch to "LOCK" (OFF) position.</li> <li>5. Confirm that the diagnostic trouble code (DTC) is not output. If DTC P0171 is output, refer to GROUP 13A, DTC P0171 – System too lean <a href="#">P.13Ac-218</a>. .If DTC P0172 is output, refer to GROUP 13A, DTC P0172 – System too rich <a href="#">P.13Ac-226</a>.</li> </ol>

## PROCEDURE 3

## CATALYTIC CONVERTER MONITOR

DTC	P0421
Drive cycle pattern	<p>This monitor [from start to ignition switch to the "LOCK" (OFF) position] will be completed while traveling with the following drive cycle pattern. It will take 20 minutes. You must complete this drive twice.</p> <p><i>NOTE: Vehicle speed and throttle opening angle should be within the shaded range.</i></p>
Inspection conditions	<ul style="list-style-type: none"> <li>• Atmospheric temperature: <math>-10^{\circ}\text{C}</math> (<math>14^{\circ}\text{F}</math>) or more</li> <li>• A/C switch: OFF</li> <li>• Condition of A/T: Selector lever D range</li> </ul>
Test procedure	<ol style="list-style-type: none"> <li>1. Engine: start</li> <li>2. Accelerate until the vehicle speed is 72 km/h (45 mph).</li> <li>3. Travel for 300 seconds or more while keeping the vehicle speed at 72 – 97 km/h (45 – 60 mph). (M/T: 5th speed)</li> <li>4. Decelerate until the vehicle speed is within 56 – 64 km/h (35 – 40 mph).</li> <li>5. While keeping the accelerator pedal opening degree constant (M/T: 4th speed), keep the vehicle speed at 56 – 64 km/h (35 – 40 mph) and travel for 90 seconds or more. (During monitor)</li> <li>6. Fully close the throttle and decelerate, and keep the deceleration state for 10 seconds. Then, quickly accelerate until the vehicle speed reaches 56 – 64 km/h (35 – 40 mph). Then, repeat steps 5 and 6, and complete six monitor sessions.</li> <li>7. Return the vehicle to the shop, then turn the ignition switch to "LOCK" (OFF) position.</li> <li>8. Confirm that the diagnostic trouble code (DTC) is not output.</li> <li>9. If DTC P0421 is output, refer to GROUP 13A, DTC P0421 – Warm Up Catalyst Efficiency Below Threshold (Bank 1) <a href="#">P.13Ac-319</a>.</li> </ol>

**PROCEDURE 4**

<b>HEATED OXYGEN SENSOR MONITOR</b>	
DTC	P0133, P0139
Drive cycle pattern	<p>This monitor [from start to ignition switch to the "LOCK" (OFF) position] will be completed while traveling with the following drive cycle pattern. It will take 5 minutes. You must complete this drive twice.</p> <p><i>NOTE: Vehicle speed and throttle opening angle should be within the shaded range.</i></p> <div data-bbox="334 596 1451 1346"> <p>The graph consists of two vertically aligned plots sharing a common time axis. The top plot shows 'VEHICLE SPEED km/h (mph)' on the y-axis with markings at 0, 32 (20), 64 (40), and 97 (60). The speed profile starts at (1) 'ENGINE START', rises linearly through point (2) to a constant speed plateau at 56-64 km/h (35-40 mph), labeled (3) '120 SECONDS OR MORE 56 - 64 km/h (35 - 40 mph) M/T: 4TH SPEED'. This plateau is shaded with diagonal lines. The speed then decreases linearly through point (4) to 'IGNITION SWITCH: "LOCK" (OFF) position'. The bottom plot shows 'CALCULATED LOAD (%)' on the y-axis with markings at 0, 50, and 100. The load profile starts at approximately 75%, drops to 50% at engine start, and remains constant at 50% during the shaded 'DURING MONITOR' period. After the monitor period, the load decreases linearly to 0% at the ignition switch lock position.</p> </div> <p align="right">AKX01348 AC</p>
Inspection conditions	<ul style="list-style-type: none"> <li>• Engine coolant temperature: 80°C (176°F) or more</li> <li>• Atmospheric temperature: -10°C (14°F) or more</li> <li>• Condition of A/T: Selector lever D range</li> </ul>
Test procedure	<ol style="list-style-type: none"> <li>1. Engine: start</li> <li>2. Accelerate until the vehicle speed is 56 – 64 km/h (35 – 40 mph).</li> <li>3. While keeping the accelerator pedal opening degree constant (M/T: 4th speed), keep the vehicle speed at 56 – 64 km/h (35 – 40 mph) and travel for 120 seconds or more. (During monitor)</li> <li>4. Return the vehicle to the shop, then turn the ignition switch to "LOCK" (OFF) position.</li> <li>5. Confirm that the diagnostic trouble code (DTC) is not output.</li> <li>6. If DTC P0133 is output, refer to GROUP 13A, DTC P0133 – Heated oxygen Sensor Circuit Slow Response (Sensor 1) <a href="#">P.13Ac-160</a>. If DTC P0139 is output, refer to GROUP 13A, DTC P0139 – Heated oxygen Sensor Circuit Slow Response (Sensor 2) <a href="#">P.13Ac-204</a>.</li> </ol>

## PROCEDURE 5

## EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITOR

DTC	P0401
Drive cycle pattern	<p>This monitor [from start to ignition switch to the "LOCK" (OFF) position] will be completed while traveling with the following drive cycle pattern. It will take 10 minutes. You must complete this drive twice.</p> <p><i>NOTE: Vehicle speed and throttle opening angle should be within the shaded range.</i></p> <p style="text-align: right;">AKX01349AC</p>
Inspection conditions	<ul style="list-style-type: none"> <li>Engine coolant temperature: 80°C (176°F) or more</li> <li>Atmospheric temperature: 5°C (41°F) or more</li> <li>A/C switch: OFF</li> <li>Condition of A/T: Selector lever D range</li> </ul>
Test procedure	<ol style="list-style-type: none"> <li>Engine: start</li> <li>Accelerate until the vehicle speed is 56 – 64 km/h (35 – 40 mph).</li> <li>Travel for 20 seconds or more while keeping the vehicle speed at 56 – 64 km/h (35 – 40 mph). (M/T: 4th speed)</li> <li>Fully close the throttle from an engine speed of 2,000 – 3,000 r/min, and while keeping the clutch engaged, decelerate to approximately 900 r/min without applying the brakes. Do not steer the handle or turn the light ON/OFF during this time. (During monitor)</li> <li>Accelerate until the vehicle speed reaches 56 – 64 km/h (35 – 40 mph), and travel for 20 seconds or more (M/T: 4th speed). Then, repeat steps 4 and 5 and complete 8 monitor sessions.</li> <li>Return the vehicle to the shop, then turn the ignition switch to "LOCK" (OFF) position.</li> <li>Confirm that the diagnostic trouble code (DTC) is not output.</li> <li>If DTC P0401 is output, refer to GROUP 13A, DTC P0401 – Exhaust Gas Recirculation Flow Insufficient detected <a href="#">P.13Ac-307</a>.</li> </ol>



**PROCEDURE 6**

<b>OTHER MONITOR (Main components, sensors and switches, wire breakage and short circuit)</b>	
DTC	<ul style="list-style-type: none"> <li>• Main components: P0134, P0300, P0301, P0302, P0303, P0304, P0506, P0507, P1400</li> <li>• Sensors and switches: P0101, P0102, P0106, P0107, P0108, P0111, P0112, P0113, P0116, P0117, P0118, P0121, P0122, P0123, P0125, P0181, P0182, P0183, P0335, P0340, P0461</li> <li>• Wire breakage and short circuit: P0130, P0131, P0132, P0135, P0136, P0137, P0138, P0141, P0201, P0202, P0203, P0204, P0403, P0443, P0446</li> </ul>
Drive cycle pattern	<p>This monitor [from start to ignition switch to the "LOCK" (OFF) position] will be completed while traveling with the following drive cycle pattern. It will take 10 minutes. You must complete this drive twice.</p> <p><i>NOTE: Drive according to the graph below.</i></p> <div style="text-align: center;"> <p>300 SECONDS OR MORE 56 - 64 km/h (35 - 40 mph) M/T: 4TH SPEED</p> <p>VEHICLE SPEED km/h (mph)</p> <p>64 (40) 32 (20) 0</p> <p>(1) (2) (3) (4)</p> <p>ENGINE: IDLING TRANSMISSION: NEUTRAL 300 SECONDS</p> <p>ENGINE START</p> <p>IGNITION SWITCH: "LOCK" (OFF) position</p> <p>CALCULATED LOAD (%)</p> <p>100 50 0</p> <p align="right"><b>AKX01350 AC</b></p> </div>
Inspection conditions	<ul style="list-style-type: none"> <li>• Engine coolant temperature: 80°C (176°F) or more</li> <li>• Atmospheric temperature: 5°C (41°F) or more</li> <li>• Condition of A/T: Selector lever D range</li> </ul>
Test procedure	<ol style="list-style-type: none"> <li>1. Engine: start</li> <li>2. Accelerate until the vehicle speed is 56 – 64 km/h (35 – 40 mph), and travel for 300 seconds or more. (M/T: 4th speed)</li> <li>3. Return the vehicle to the shop.</li> <li>4. After stopping the vehicle, continue idling for 300 seconds, and then turn the ignition switch to the "LOCK" (OFF) position. Moreover, the vehicle should be set to the following conditions for idling. <ul style="list-style-type: none"> <li>• A/C switch: OFF</li> <li>• Lights and all accessories: OFF</li> <li>• Transmission: Neutral</li> <li>• Steering wheel: Straightforward position</li> </ul> </li> <li>5. Confirm that the diagnostic trouble code (DTC) is not output.</li> <li>6. If a DTC is displayed, refer to Diagnostic Trouble Code Chart <a href="#">P.13Ab-19</a>.</li> </ol>

**READINESS TEST STATUS****PURPOSE**

The Readiness function also referred as I/M Readiness or I/M Flags indicate 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 engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> monitors the following main diagnosis items and records whether the evaluation was completed or is incomplete. The Readiness codes were established for the I/M programs, thereby confirming that the vehicle was not tampered with by erasing the diagnostic trouble code(s) (DTC's) before I/M testing. The Readiness and DTC codes can be reset by disconnecting the battery or by erasing the codes with a scan tool. For this reason all Readiness codes must read "Complete" before I/M testing.

When the monitors run and complete, the MUT-II will record the Readiness Code as "Complete" (General Scan Tools record as "Ready"). If the monitor did not run completely, the system then reads as "Incomplete" (General Scan Tools record as "Not Ready"). When the vehicle is operating normally and the OBD-II Drive Cycle is carried out, Readiness Code will set as "Complete" on the first drive cycle. If during the first drive cycle a fault is detected then, a second drive is required before the Readiness Code will "Complete." If the fault is still there, then a DTC will set.

- Catalyst: P0421
- Evaporative system: P0442, P0455, P0456
- Heated oxygen sensor: P0133
- Heated oxygen sensor heater: P0135, P0141
- EGR system: P0401

After the Readiness is "Complete," the technician is assured that any DTC's associated with that 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 DTC's.

*NOTE: After a repair is made for a DTC the technician should drive the OBD-II drive cycle checking that the MUT-II records all Readiness as "Complete".*

**FAIL-SAFE FUNCTION REFERENCE TABLE**

M1131153000017

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
Volume air flow sensor	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Fixes the IAC motor in the appointed position so idle air control is not performed.</li> </ul>
Intake air temperature sensor	Controls as if the intake air temperature is 25°C (77°F).
Throttle position sensor	No increase in fuel injection amount during acceleration due to the unreliable throttle position sensor signal.
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 the "LOCK" (OFF) position even though the sensor signal returns to normal.)
Camshaft position sensor	Injects fuel into the cylinders in the order 1-3-4-2 with irregular timing. (After the ignition switch is turned to the "ON," 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).

<b>MALFUNCTION ITEM</b>	<b>CONTROL CONTENTS DURING MALFUNCTION</b>
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	Does not restrict the generator output with respect to electrical load.
Misfire detection	The ECM <M/T> or PCM <A/T> stops supplying fuel to the cylinder with the highest misfiring rate if a misfiring that could damage the catalytic converter is detected.

## DIAGNOSTIC TROUBLE CODE CHART

M1131151000226

<b>DTC CODE</b>	<b>DIAGNOSTIC ITEMS</b>	<b>REFERENCE PAGE</b>
P0101*	Volume air flow circuit range/performance problem	<a href="#">P.13Ac-2</a>
P0102*	Volume air flow circuit low input	<a href="#">P.13Ac-11</a>
P0106*	Barometric pressure circuit range/performance problem	<a href="#">P.13Ac-20</a>
P0107*	Barometric pressure circuit low input	<a href="#">P.13Ac-27</a>
P0108*	Barometric pressure circuit high input	<a href="#">P.13Ac-45</a>
P0111*	Intake air temperature circuit range/performance problem	<a href="#">P.13Ac-55</a>
P0112*	Intake air temperature circuit low input	<a href="#">P.13Ac-63</a>
P0113*	Intake air temperature circuit high input	<a href="#">P.13Ac-69</a>
P0116*	Engine coolant temperature circuit range/performance problem	<a href="#">P.13Ac-77</a>
P0117*	Engine coolant temperature circuit low input	<a href="#">P.13Ac-87</a>
P0118*	Engine coolant temperature circuit high input	<a href="#">P.13Ac-92</a>
P0121*	Throttle position sensor circuit range/performance problem	<a href="#">P.13Ac-100</a>
P0122*	Throttle position sensor circuit low input	<a href="#">P.13Ac-111</a>
P0123*	Throttle position sensor circuit high input	<a href="#">P.13Ac-120</a>
P0125*	Insufficient coolant temperature for closed loop fuel control	<a href="#">P.13Ac-126</a>
P0128	Coolant thermostat (coolant temperature below thermostat regulating temperature)	<a href="#">P.13Ac-137</a>
P0130	Heated oxygen sensor circuit (sensor 1)	<a href="#">P.13Ac-138</a>
P0131	Heated oxygen sensor circuit low voltage (sensor 1)	<a href="#">P.13Ac-151</a>
P0132	Heated oxygen sensor circuit high voltage (sensor 1)	<a href="#">P.13Ac-156</a>
P0133	Heated oxygen sensor circuit slow response (sensor 1)	<a href="#">P.13Ac-160</a>
P0134*	Heated oxygen sensor circuit no activity detected (sensor 1)	<a href="#">P.13Ac-163</a>
P0135	Heated oxygen sensor heater circuit (sensor 1)	<a href="#">P.13Ac-170</a>

<b>DTC CODE</b>	<b>DIAGNOSTIC ITEMS</b>	<b>REFERENCE PAGE</b>
P0136	Heated oxygen sensor circuit (sensor 2)	<a href="#">P.13Ac-179</a>
P0137	Heated oxygen sensor circuit low voltage (sensor 2)	<a href="#">P.13Ac-194</a>
P0138	Heated oxygen sensor circuit high voltage (sensor 2)	<a href="#">P.13Ac-200</a>
P0139	Heated oxygen sensor circuit slow response (sensor 2)	<a href="#">P.13Ac-204</a>
P0141	Heated oxygen sensor heater circuit (sensor 2)	<a href="#">P.13Ac-207</a>
P0171	System too lean	<a href="#">P.13Ac-218</a>
P0172	System too rich	<a href="#">P.13Ac-226</a>
P0181	Fuel temperature sensor circuit range/performance	<a href="#">P.13Ac-231</a>
P0182	Fuel temperature sensor circuit low input	<a href="#">P.13Ac-241</a>
P0183	Fuel temperature sensor circuit high input	<a href="#">P.13Ac-246</a>
P0201	Injector circuit-Cylinder 1	<a href="#">P.13Ac-254</a>
P0202	Injector circuit-Cylinder 2	<a href="#">P.13Ac-254</a>
P0203	Injector circuit-Cylinder 3	<a href="#">P.13Ac-254</a>
P0204	Injector circuit-Cylinder 4	<a href="#">P.13Ac-254</a>
P0300	Random/multiple cylinder misfire detected	<a href="#">P.13Ac-262</a>
P0301	Cylinder 1 misfire detected	<a href="#">P.13Ac-269</a>
P0302	Cylinder 2 misfire detected	<a href="#">P.13Ac-269</a>
P0303	Cylinder 3 misfire detected	<a href="#">P.13Ac-269</a>
P0304	Cylinder 4 misfire detected	<a href="#">P.13Ac-269</a>
P0325	Knock sensor circuit	<a href="#">P.13Ac-274</a>
P0335*	Crankshaft position sensor circuit	<a href="#">P.13Ac-280</a>
P0340*	Camshaft position sensor circuit	<a href="#">P.13Ac-295</a>
P0401	Exhaust gas recirculation flow insufficient detected	<a href="#">P.13Ac-307</a>
P0403	Exhaust gas recirculation control circuit	<a href="#">P.13Ac-309</a>
P0421	Warm up catalyst efficiency below threshold	<a href="#">P.13Ac-319</a>
P0441	Evaporative emission control system incorrect purge flow	<a href="#">P.13Ac-322</a>
P0442	Evaporative emission control system leak detected (Small leak)	<a href="#">P.13Ac-324</a>
P0443	Evaporative emission control system purge control valve circuit	<a href="#">P.13Ac-336</a>
P0446	Evaporative emission control system vent control circuit	<a href="#">P.13Ac-346</a>
P0451	Evaporative emission control system pressure sensor range/performance	<a href="#">P.13Ac-356</a>
P0452	Evaporative emission control system pressure sensor low input	<a href="#">P.13Ac-386</a>
P0453	Evaporative emission control system pressure sensor high input	<a href="#">P.13Ac-417</a>
P0455	Evaporative emission control system leak detected (Gross leak)	<a href="#">P.13Ac-447</a>
P0456	Evaporative emission control system leak detected (Very small leak)	<a href="#">P.13Ac-463</a>
P0461	Fuel level sensor circuit range/performance	<a href="#">P.13Ac-475</a>
P0500	Vehicle speed sensor <M/T>	<a href="#">P.13Ac-480</a>

<b>DTC CODE</b>	<b>DIAGNOSTIC ITEMS</b>	<b>REFERENCE PAGE</b>
P0506	Idle control system RPM lower than expected	<a href="#">P.13Ac-490</a>
P0507	Idle control system RPM higher than expected	<a href="#">P.13Ac-502</a>
P0551	Power steering pressure sensor circuit range/performance	<a href="#">P.13Ac-514</a>
P0554	Power steering pressure sensor circuit intermittent	<a href="#">P.13Ac-524</a>
P0662	Generator FR terminal circuit malfunction	<a href="#">P.13Ac-529</a>
P0705	Transmission range sensor circuit malfunction (PRNDL input) <ul style="list-style-type: none"> <li>• A/T DTC No. 27 (Park/Neutral position switch system: Open circuit)</li> <li>• A/T DTC No. 28 (Park/Neutral position switch system: Short circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0712	Transmission fluid temperature sensor circuit low input <ul style="list-style-type: none"> <li>• A/T DTC No. 16 (Oil temperature sensor system: Short circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0713	Transmission fluid temperature sensor circuit high input <ul style="list-style-type: none"> <li>• A/T DTC No. 15 (Oil temperature sensor system: Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0715	Input/turbine speed sensor circuit <ul style="list-style-type: none"> <li>• A/T DTC No. 22 (Input shaft speed sensor system: Short circuit/Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0720	Output speed sensor circuit <ul style="list-style-type: none"> <li>• A/T DTC No. 23 (Output shaft speed sensor system: Short circuit/Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0731	Gear 1 incorrect ratio <ul style="list-style-type: none"> <li>• A/T DTC No. 41 (1st gear incorrect ratio)</li> </ul>	<a href="#">P.23Ab-26</a>
P0732	Gear 2 incorrect ratio <ul style="list-style-type: none"> <li>• A/T DTC No. 42 (2nd gear incorrect ratio)</li> </ul>	<a href="#">P.23Ab-26</a>
P0733	Gear 3 incorrect ratio <ul style="list-style-type: none"> <li>• A/T DTC No. 43 (3rd gear incorrect ratio)</li> </ul>	<a href="#">P.23Ab-26</a>
P0734	Gear 4 incorrect ratio <ul style="list-style-type: none"> <li>• A/T DTC No. 44 (4th gear incorrect ratio)</li> </ul>	<a href="#">P.23Ab-26</a>
P0736	Gear R incorrect ratio <ul style="list-style-type: none"> <li>• A/T DTC No. 46 (Reverse gear incorrect ratio)</li> </ul>	<a href="#">P.23Ab-26</a>
P0741	Torque converter clutch circuit performance or stuck off <ul style="list-style-type: none"> <li>• A/T DTC No. 52 (Torque converter clutch solenoid system: Defective system)</li> </ul>	<a href="#">P.23Ab-26</a>
P0742	Torque converter clutch circuit stuck on <ul style="list-style-type: none"> <li>• A/T DTC No. 53 (Torque converter clutch solenoid system: Lock-up stuck on)</li> </ul>	<a href="#">P.23Ab-26</a>
P0743	Torque converter clutch circuit electrical <ul style="list-style-type: none"> <li>• A/T DTC No. 36 (Torque converter clutch solenoid system: Short circuit/Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0753	Shift solenoid "A" electrical <ul style="list-style-type: none"> <li>• A/T DTC No. 31 (Low and reverse solenoid valve system: Short circuit/Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0758	Shift solenoid "B" electrical <ul style="list-style-type: none"> <li>• A/T DTC No. 32 (Underdrive solenoid valve system: Short circuit/Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0763	Shift solenoid "C" electrical <ul style="list-style-type: none"> <li>• A/T DTC No. 33 (Second solenoid valve system: Short circuit/Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>
P0768	Shift solenoid "D" electrical <ul style="list-style-type: none"> <li>• A/T DTC No. 34 (Overdrive solenoid valve system: Short circuit/Open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>

DTC CODE	DIAGNOSTIC ITEMS		REFERENCE PAGE
P1400	Manifold differential pressure sensor circuit malfunction		<a href="#">P.13Ac-537</a>
P1603*	Battery backup circuit malfunction		<a href="#">P.13Ac-547</a>
P1751	A/T control relay malfunction	<ul style="list-style-type: none"> <li>A/T DTC No. 54 (A/T control relay system: Short circuit to ground /open circuit)</li> </ul>	<a href="#">P.23Ab-26</a>

**NOTE:** Do not replace the engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> until a through terminal check reveals there are no short/open circuits.

**NOTE:** Check that the ECM <M/T> or PCM <A/T> ground circuit is normal before checking for the cause of the problem.

**NOTE:** After the ECM <M/T> or PCM <A/T> 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 "\*", the diagnostic trouble code is recorded on the first detection of the malfunction.

**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.

## SYMPTOM CHART

M1131151500210

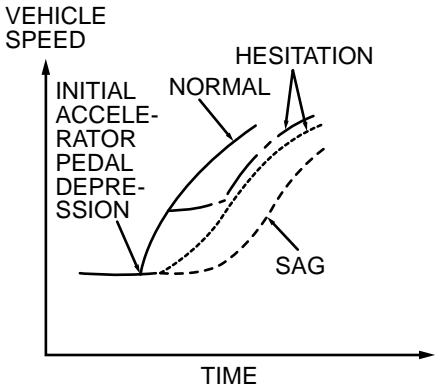
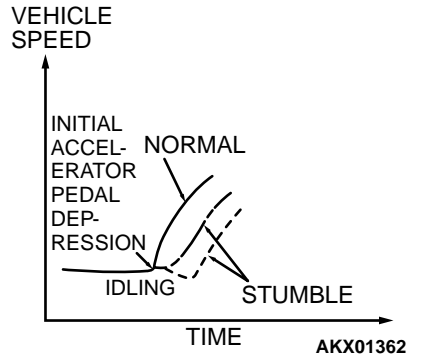
**NOTE:** Check that the engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> ground circuit is normal before checking for the cause of the problem.

SYMPTOMS		INSPECTION PROCEDURE	REFERENCE PAGE
Communication with scan tool is impossible	Communication with all systems is not possible	1	<a href="#">P.13Ad-2</a>
	Communication with ECM <M/T> or PCM <A/T> only is not possible	2	<a href="#">P.13Ad-5</a>
Malfunction Indicator Lamp (SERVICE ENGINE SOON) and related parts	The malfunction indicator lamp (SERVICE ENGINE SOON) does not illuminate right after the ignition switch is turned to the "ON" position	3	<a href="#">P.13Ad-9</a>
	The malfunction indicator lamp (SERVICE ENGINE SOON) remains illuminated and never goes out	4	<a href="#">P.13Ad-15</a>
Starting	Cranks, won't start	5	<a href="#">P.13Ad-19</a>
	Starts up and dies	6	<a href="#">P.13Ad-24</a>
	Hard starting	7	<a href="#">P.13Ad-29</a>
Idling stability (improper idling)	Unstable idle (rough idle, hunting)	8	<a href="#">P.13Ad-33</a>
	Idle speed is high (improper idle speed)	9	<a href="#">P.13Ad-37</a>
	Idle speed is low (improper idle speed)	10	<a href="#">P.13Ad-39</a>
Idling stability (engine stalls)	When the engine is cold, it stalls at idle (die out)	11	<a href="#">P.13Ad-41</a>
	When the engine is hot, it stalls at idle (die out)	12	<a href="#">P.13Ad-44</a>
	The engine stalls when accelerating (pass out)	13	<a href="#">P.13Ad-48</a>
	The engine stalls when decelerating	14	<a href="#">P.13Ad-50</a>

SYMPTOMS		INSPECTION PROCEDURE	REFERENCE PAGE
Driving	Hesitation, sag or stumble	15	<a href="#">P.13Ad-52</a>
	Acceleration shock	16	<a href="#">P.13Ad-55</a>
	Deceleration shock	17	<a href="#">P.13Ad-56</a>
	Poor acceleration	18	<a href="#">P.13Ad-57</a>
	Surge	19	<a href="#">P.13Ad-60</a>
	Knocking	20	<a href="#">P.13Ad-63</a>
Dieseling (Run-on)		21	<a href="#">P.13Ad-64</a>
Too high CO and HC concentration when idling		22	<a href="#">P.13Ad-64</a>
IM240 test failure	Transient, mass emission tailpipe test failure	23	<a href="#">P.13Ad-67</a>
	Purge flow test of the evaporative emission canister failure	24	<a href="#">P.13Ad-71</a>
	Pressure test of the evaporative system failure	25	<a href="#">P.13Ad-71</a>
Generator output voltage is low (approximately 12.3 volts)		26	<a href="#">P.13Ad-72</a>
Improper idle speed when the A/C is on (A/C switch 2 signal)		27	<a href="#">P.13Ad-77</a>
Fans (radiator fan, A/C condenser fan) are inoperative		28	<a href="#">P.13Ad-80</a>
Power supply system and ignition switch-IG system		29	<a href="#">P.13Ad-84</a>
Fuel pump system		30	<a href="#">P.13Ad-95</a>
Ignition switch – ST system <M/T>		31	<a href="#">P.13Ad-107</a>
Ignition switch-ST system and park/neutral position switch system <A/T>		32	<a href="#">P.13Ad-113</a>
Ignition circuit system		33	<a href="#">P.13Ad-118</a>
A/C system		34	<a href="#">P.13Ad-128</a>

**PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)**

ITEMS		SYMPTOM
Starting	Won't start	The starter is used to crank 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 the 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 usual 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 or while it is being used.

ITEMS		SYMPTOM
Driving	Hesitation Sag	<p>"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".</p>  <p style="text-align: right;">AKX01361AB</p>
	Poor acceleration	Poor acceleration is inability to obtain an acceleration corresponding to the degree of throttle opening, even though acceleration is smooth or the inability to reach maximum speed.
	Stumble	<p>Engine speed increase is delayed when the accelerator pedal is initially depressed for acceleration.</p>  <p style="text-align: right;">AKX01362</p>
	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 like a hammer striking the cylinder walls.
Stopping	Dieseling (run on)	The condition in which the engine continues to run after the ignition switch is turned to the "LOCK" (OFF) position. Also called "dieseling."



## DATA LIST REFERENCE TABLE

### CAUTION

- When shifting the select lever to D range, the brakes should be applied so that the vehicle does not move forward.
- Driving tests always need two persons: one driver and one observer.

NOTE: \*1: If the idle speed is lower than the standard value on a very cold engine [approximately  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ )] even when the IAC motor is fully opened, the air volume limiter built in the throttle body could be defective.

NOTE: \*2: In a new vehicle [driven approximately 500 km (311 mile) or less], the step of the stepper motor is sometimes 30 steps greater than the standard value.

NOTE: \*3: The injector drive time represents the time when the cranking speed is at 250 r/min or below when the power supply voltage is 11 volts.

NOTE: \*4: In a new vehicle [driven approximately 500 km (311 mile) or less], the injector drive time is sometimes 10% longer than the standard time.

NOTE: \*5: In a new vehicle [driven approximately 500 km (311 mile) or less], the volume air flow sensor output frequency is sometimes 10% higher than the standard frequency.

NOTE: \*6: GST items. [Data list items consist of MUT-II items and GST items. GST items can be accessed through the use of a general scan tool (GST). When MUT-II (MB991502) is used, MUT-II items appear alphabetically; then, GST items appear alphabetically. The black and white characters of the GST items are inverted from the MUT-II items.]

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT	NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
A/C RELAY	49	A/C compressor clutch relay	<ul style="list-style-type: none"> <li>• Engine: idling</li> <li>• A/C switch: "OFF"</li> </ul>	OFF	Procedure No. 34	P.13Ad-128
			<ul style="list-style-type: none"> <li>• Engine: idling</li> <li>• A/C switch: "ON"</li> </ul>	A/C compressor clutch is not operating		
				A/C compressor clutch is operating		
A/C SWITCH	28	A/C switch	<ul style="list-style-type: none"> <li>• Engine: idling</li> <li>• A/C switch: "OFF"</li> </ul>	OFF	Procedure No. 34	P.13Ad-128
			<ul style="list-style-type: none"> <li>• Engine: idling</li> <li>• A/C switch: "ON"</li> </ul>	A/C compressor clutch is not operating		
				A/C compressor clutch is operating		

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
BARO SENSOR	25	Barometric pressure sensor	Ignition switch: "ON"	At altitude of 0 m (0 ft)	101 kPa (29.8 in. Hg)	Code No. P0106, P0107, P0108	<a href="#">P.13Ac-20</a> , <a href="#">P.13Ac-27</a> , <a href="#">P.13Ac-45</a>
				At altitude of 600 m (1,969 ft)	95 kPa (28.1 in. Hg)		
				At altitude of 1,200 m (3,937 ft)	88 kPa (26.0 in. Hg)		
				At altitude of 1,800 m (5,906 ft)	81 kPa (23.9 in. Hg)		
BATT VOLTAGE	16	power supply voltage	Ignition switch: "ON"		Battery positive voltage	Procedure No. 29	<a href="#">P.13Ad-84</a>
CRANK SENSOR	22	Crankshaft position sensor *1	<ul style="list-style-type: none"> <li>Engine: cranking</li> <li>Tachometer: connected</li> </ul>		Engine speeds displayed on the scan tool and tachometer are identical	Code No. P0335	<a href="#">P.13Ac-280</a>
			Engine: idling	Engine coolant temperature is -20°C (-4°F)	1,380 – 1,580 r/min		
				Engine coolant temperature is 0°C (32°F)	1,220 – 1,420 r/min		
				Engine coolant temperature is 20°C (68°F)	1,100 – 1,300 r/min		
				Engine coolant temperature is 40°C (104°F)	880 – 1,080 r/ min		
				Engine coolant temperature is 80°C (176°F)	600 – 800 r/ min		
CRANK. SIGNAL	18	Cranking signal (ignition switch-ST)	Ignition switch: "ON"	Engine: stopped	OFF	Procedure No. 31 <M/ T> Procedure No. 32 <A/ T>	<a href="#">P.13Ad-107</a> <M/ T> <a href="#">P.13Ad-113</a> <A/ T>
				Engine: cranking	ON		

**MULTIPOINT FUEL INJECTION (MFI) DIAGNOSIS**  
**DATA LIST REFERENCE TABLE**

**13Ab-27**

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
ECT SENSOR	21	Engine coolant temperature sensor	Ignition switch: "ON" or with engine running	Engine coolant temperature is –20°C (–4°F)	–20°C (–4°F)	Code No. P0116, P0117, P0118	<a href="#">P.13Ac-77</a> , <a href="#">P.13Ac-87</a> , <a href="#">P.13Ac-92</a>
				Engine coolant temperature is 0°C (32°F)	0°C (32°F)		
				Engine coolant temperature is 20°C (68°F)	20°C (68°F)		
				Engine coolant temperature is 40°C (104°F)	40°C (104°F)		
				Engine coolant temperature is 80°C (176°F)	80°C (176°F)		
ECT SENSOR	21 <sup>*6</sup>	Engine coolant temperature sensor	Ignition switch: "ON" or with engine running	Engine coolant temperature is –20°C (–4°F)	–20°C (4°F)	Code No. P0116, P0117, P0118	<a href="#">P.13Ac-77</a> , <a href="#">P.13Ac-87</a> , <a href="#">P.13Ac-92</a>
				Engine coolant temperature is 0°C (32°F)	0°C (32°F)		
				Engine coolant temperature is 20°C (68°F)	20°C (68°F)		
				Engine coolant temperature is 40°C (104°F)	40°C (104°F)		
				Engine coolant temperature is 80°C (176°F)	80°C (176°F)		
ENGINE LOAD	87 <sup>*6</sup>	Calculation load value	• Engine: warming up	Engine is idling	9 – 29 %	–	–
				2,500 r/min	8 – 28 %		

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
ENGINE SPEED	22*6	Crankshaft position sensor *1	<ul style="list-style-type: none"><li>Engine: cranking</li><li>Tachometer: connected</li></ul>		Engine speeds displayed on the scan tool and tachometer are identical.	Code No. P0335	P.13Ac- 280
			Engine: idling	Engine coolant temperature is –20°C (–40°F)	1,380 – 1,580 r/min		
				Engine coolant temperature is 0°C (32°F)	1,220 – 1,420 r/min		
				Engine coolant temperature is 20°C (68°F)	1,100 – 1,300 r/min		
				Engine coolant temperature is 40°C (104°F)	880 – 1,080 r/ min		
				Engine coolant temperature is 80°C (176°F)	600 – 800 r/ min		
				FUEL TEMP	4A		

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
HO2S BANK1 S1	11	Heated oxygen sensor (front)	Engine: Warming up (air/fuel mixture is made leaner when decelerating, and is made richer when revving.)	When at 4000 r/min, engine is suddenly decelerated	200 mV or less → 600 – 1,000 mV (After several seconds have elapsed)	Code No. P0130, P0131, P0132, P0133, P0134	P.13Ac- 138, P.13Ac- 151, P.13Ac- 156, P.13Ac- 160, P.13Ac- 163
			Engine: Warming up (the heated oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the ECM <M/T> or PCM <A/T>)	Engine is idling 2,500 r/min	Voltage changes repeatedly between 400 mV or less and 600 – 1,000 mV		
HO2S BANK1 S1	A1 <sup>*6</sup>	Heated oxygen sensor (front)	Engine: Warming up (air/fuel mixture is made leaner when decelerating, and is made richer when revving.)	When at 4, 000 r/min, engine is suddenly decelerated	0.2 V or less → 0.6 – 1 V (After several seconds have elapsed)	Code No. P0130, P0131, P0132, P0133, P0134	P.13Ac- 138, P.13Ac- 151, P.13Ac- 156, P.13Ac- 160, P.13Ac- 163
			Engine: Warming up (the heated oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the ECM <M/T> or PCM <A/T>)	Engine is idling 2,500 r/min	Voltage changes repeatedly between 0.4 V or less and 0.6 – 1 V.		

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
HO2S BANK1 S2	59	Heated oxygen sensor (rear)	Engine: warming up	Revving	0 and 600 – 1,000 mV alternate.	Code No. P0136, P0137, P0138, P0139	<a href="#">P.13Ac-179</a> , <a href="#">P.13Ac-194</a> , <a href="#">P.13Ac-200</a> , <a href="#">P.13Ac-204</a>
HO2S BANK1 S2	A2 <sup>*6</sup>	Heated oxygen sensor (rear)	Engine: warming up	Revving	0 and 0.6 – 1 V alternate.	Code No. P0136, P0137, P0138, P0139	<a href="#">P.13Ac-179</a> , <a href="#">P.13Ac-194</a> , <a href="#">P.13Ac-200</a> , <a href="#">P.13Ac-204</a>
IAC VALVE POS	45	Idle air control (stepper) position <sup>*2</sup>	<ul style="list-style-type: none"> <li>Engine coolant temperature : 80 – 95°C (176 – 203°F)</li> <li>Lights, electric cooling fan and all accessories : "OFF"</li> <li>Transaxle: neutral (A/T: "P" range)</li> <li>Engine: idling (when A/C switch is "ON". A/C compressor should be operating)</li> </ul>	A/C switch: "OFF"	2 – 25 STEP	–	–
				A/C switch: "OFF" → "ON"	Increases by 10 – 80 STEP		
				<ul style="list-style-type: none"> <li>A/C switch: "OFF"</li> <li>Selector lever: "N" → "D" range</li> </ul>	Increases by 5 – 50 STEP		

**MULTIPOINT FUEL INJECTION (MFI) DIAGNOSIS  
DATA LIST REFERENCE TABLE**

**13Ab-31**

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
IAT SENSOR	13	Intake air temperature sensor	Ignition switch: "ON" or with engine running	Intake air temperature is –20 °C (–4°F)	–20°C (–4°F)	Code No. P0111, P0112, P0113	<a href="#">P.13Ac-55</a> , <a href="#">P.13Ac-63</a> , <a href="#">P.13Ac-69</a>
				Intake air temperature is 0°C (32°F)	0°C (32°F)		
				Intake air temperature is 20°C (68°F)	20°C (68°F)		
				Intake air temperature is 40°C (104°F)	40°C (104°F)		
				Intake air temperature is 80°C (176°F)	80°C (176°F)		
IAT SENSOR	13 <sup>*6</sup>	Intake air temperature sensor	Ignition switch: "ON" or with engine running	Intake air temperature is –20 °C (–4°F)	–20°C (–4°F)	Code No. P0111, P0112, P0113	<a href="#">P.13Ac-55</a> , <a href="#">P.13Ac-63</a> , <a href="#">P.13Ac-69</a>
				Intake air temperature is 0°C (32°F)	0°C (32°F)		
				Intake air temperature is 20°C (68°F)	20°C (68°F)		
				Intake air temperature is 40°C (104°F)	40°C (104°F)		
				Intake air temperature is 80°C (176°F)	80°C (176°F)		
IG. TIMING ADV	44	Ignition coils and ignition power transistor	<ul style="list-style-type: none"> <li>Engine: warming up</li> <li>Timing light is set (to check actual ignition timing)</li> </ul>	Engine is idling	0 – 16°BTDC	–	–
				2,500 r/min	18 – 38°BTDC		
IG. TIMING ADV	44 <sup>*6</sup>	Ignition coils and ignition power transistor	<ul style="list-style-type: none"> <li>Engine: warming up</li> <li>Timing light is set (to check actual ignition timing)</li> </ul>	Engine is idling	0 – 16 deg	–	–
				2,500 r/min	18 – 38 deg		

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
INJECTO RS B2	41	Injectors* <sup>3</sup>	Engine: cranking	When engine coolant temperature is 0°C (32°F)	48 – 64 mS	—	—
				When engine coolant temperature is 20°C (68°F)	22 – 38 mS		
				When engine coolant temperature is 80°C (176°F)	1.4 – 2.6 mS		
		Injectors* <sup>4</sup>	<ul style="list-style-type: none"> <li>Engine coolant temperature : 80 – 95°C (176 – 203°F)</li> <li>Lights, electric cooling fan and all accessories : "OFF"</li> <li>Transaxle: neutral (A/T: "P" range)</li> </ul>	Engine is idling	1.4 – 2.6 mS		
				2,500 r/min	1.4 – 2.6 mS		
				When engine is suddenly revved	Increases		
LONG TRIM B1	81* <sup>6</sup>	Long-term fuel trim	Engine: warming up, 2,500 r/min without any load (during closed loop)		–12.5 – 12.5%	Code No. P0171, P0172	<a href="#">P.13Ac-218</a> , <a href="#">P.13Ac-226</a>
MANIFOL D SNSR	95	Manifold differential pressure sensor	Engine: warming up, idling		65 – 78 kPa (19.2 – 23.0 in.Hg)	Code No. P1400	<a href="#">P.13Ac-537</a>
PSP SWITCH	27	Power steering pressure switch	Engine: idling	Steering wheel stationary	OFF	Code No. P0551, P0554	<a href="#">P.13Ac-514</a> , <a href="#">P.13Ac-524</a>
				Steering wheel turning	ON		
SHORT TRIM B1	82* <sup>6</sup>	Short-term fuel trim	Engine: warming up, 2,500 r/min without any load (during closed loop)		–25 – 25%	Code No. P0171, P0172	<a href="#">P.13Ac-218</a> , <a href="#">P.13Ac-226</a>
SYS. STATUS B1	88* <sup>6</sup>	Fuel control condition	Engine: warming up	2,500 r/min	Closed loop	—	—
				When engine is suddenly revved	Open loop – drive condition		



MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
TANK PRS. SNSR	73	Fuel tank differential pressure sensor	<ul style="list-style-type: none"> <li>Ignition switch: "ON"</li> <li>Fuel tank filler tube cap removal</li> </ul>		-3.3 – 3.3 kPa (-0.97 – 0.97 in. Hg)	—	—
TP SENSOR	14	Throttle position sensor	Ignition switch: "ON"	Set to idle position	335 – 935 mV	Code No. P0121, P0122, P0123	P.13Ac- 100, P.13Ac- 111, P.13Ac- 120
				Gradually open	Increases in proportion to throttle opening angle		
				Open fully	4,390 – 5,290 mV		
TP SENSOR	8A <sup>*6</sup>	Throttle position sensor	Ignition switch: "ON"	Set to idle position	6 – 20%	Code No. P0121, P0122, P0123	P.13Ac- 100, P.13Ac- 111, P.13Ac- 120
				Gradually open	Increases in proportion to throttle opening angle		
				Open fully	80 – 100%		
VAF RESET SIG	34	Volume air flow sensor reset signal	Engine: warming up	Engine is idling	ON	—	—
				2,500 r/min	OFF		
VAF SENSOR	12	Volume air flow sensor (mass air flow rate) <sup>*5</sup>	<ul style="list-style-type: none"> <li>Engine coolant temperature : 80 – 95°C (176 – 203°F)</li> <li>Lights, electric cooling fan and all accessories : "OFF"</li> <li>Transaxle: neutral (A/T: "P" range)</li> </ul>	Engine is idling	20 – 46 HZ	—	—
				2,500 r/min	70 – 110 Hz		
				Engine is revved	Frequency (or air flow volume) increases in response to revving		

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
VAF SENSOR	12 <sup>*6</sup>	Volume air flow sensor (mass air flow rate) <sup>*5</sup>	<ul style="list-style-type: none"><li>• Engine coolant temperature : 80 – 95°C (176 – 203°F)</li><li>• Lights, electric cooling fan and all accessories : "OFF"</li><li>• Transaxle: neutral (A/T: "P" range)</li></ul>	Engine is idling	1.3 – 3.3 gm/s	—	—
				2,500 r/min	6.6 – 10.2 gm/s		
				Engine is revved	Frequency (or air flow volume) increases in response to revving		
VSS	24 <sup>*6</sup>	Vehicle speed sensor <M/T>	Drive at 40 km/h (25 mph).		Approximately 40 km/h (25 mph)	Code No. P0500	P.13Ac- 480

## ACTUATOR TEST REFERENCE TABLE

M1131152500213

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	DRIVE CONTENTS	INSPECTION REQUIREMENT	NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
BASIC TIMING	17 <sup>*</sup>	Basic ignition timing	Set to ignition timing adjustment mode	<ul style="list-style-type: none"> <li>• Engine: idling</li> <li>• Connect timing light</li> </ul>	5°BTDC	—	—
EGR SOLENOID	10	EGR solenoid	Solenoid valve turns from OFF to ON.	Ignition switch: "ON"	Clicks when solenoid valve is driven.	Code No. P0403	P.13Ac-309
EVAP PURGE SOL	08	Evaporative emission purge solenoid	Solenoid valve turns from OFF to ON.	Ignition switch: "ON"	Clicks when solenoid valve is driven.	Code No. P0443	P.13Ac-336
EVAP VENT SOL	29	Evaporative emission ventilation solenoid	Solenoid valve turns from OFF to ON.	Ignition switch: "ON"	Clicks when solenoid valve is driven.	Code No. P0446	P.13Ac-346

MUT-II SCAN TOOL DISPLAY	ITEM NO.	INSPECTION ITEM	DRIVE CONTENTS	INSPECTION REQUIREMENT		NORMAL CONDITION	INSPECTION PROCEDURE NO.	REFERENCE PAGE
FUEL PUMP	07	Fuel pump	Fuel pump operates and fuel is recirculated	Ignition switch: "ON"	Pinch the return hose with fingers to feel the pulse of the fuel being recirculated	Pulse is felt	Procedure No. 30	P.13Ad-95
					Listen near the fuel tank for the sound of fuel pump operation	Sound of operation is heard		
NO. 1 INJECTOR	01	Injectors	Cut fuel to No.1 injector	Engine: warm, idle (cut the fuel supply to each injector in turn and check cylinders which don't affect idling.)		Idling condition becomes different (becomes unstable)	Code No. P0201, P0202, P0203, P0204	P.13Ac-254
NO. 2 INJECTOR	02		Cut fuel to No.2 injector					
NO. 3 INJECTOR	03		Cut fuel to No.3 injector					
NO. 4 INJECTOR	04		Cut fuel to No.4 injector					
RADIAT. FAN LO	21	Fan controller	Drive the fan motor	Ignition switch: "ON"		Radiator fan and condenser fan rotate at high speed	Procedure No. 28	P.13Ad-80

NOTE: \*: Continues for 27 minutes. Can be released by pressing the CLEAR key.

## CHECK AT THE ENGINE CONTROL MODULE (ECU) <M/T> OR POWERTRAIN CONTROL MODULE (PCM) <A/T>

M1131153700102

### TERMINAL VOLTAGE CHECK CHART

ECM <M/T> or PCM <A/T> Connector Terminal Arrangement

<M/T>

1	2	3	4	5	6	7	8	9	10	11	12	13	31	32	33	34	35	36	37	38	51	52	53	54	55	56	71	72	73	74	75	76	77	78	79	80	81
14	15	16	17	18	19	20	21	22	23	24	25	26	39	40	41	42	43	44	45	46	57	58	59	60	61	62	82	83	84	85	86	87	88	89	90	91	92

<A/T>

1	2	3	4					5	6	7	8	41	42	43				44	45	46	71	72	73	74					75	76	77	101	102	103	104			105	106	107										
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	47	48	49	50	51	52	53	54	55	56	57	78	79	80	81	82	83	84	85	86	87	88	89	108	109	110	111	112	113	114	115	116	117	118	119	120
24	25		26	27	28	29	30	31	32	33	34	35	58	59		60	61	62	63	64	65	66			90	91	92	93	94		95	96		97	98	121	122	123	124	125	126	127	128		129	130				

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TERMINAL NO. <M/T>	TERMINAL NO. <A/T>	INSPECTION ITEM	INSPECTION CONDITION (ENGINE CONDITION)		NORMAL CONDITION
1	1	No. 1 injector	<ul style="list-style-type: none"> <li>Engine: warming up, idling</li> <li>Suddenly depress the accelerator pedal</li> </ul>		From 11 – 14 V momentarily drops slightly
14	9	No. 2 injector			
2	24	No. 3 injector			
15	2	No. 4 injector			
4	14	Stepper motor coil <A1>	<ul style="list-style-type: none"> <li>Engine: warming up, idling</li> <li>A/C switch: OFF → ON</li> <li>Headlight switch: OFF → ON</li> </ul>		B+ ⇔ 1 V or less (changes repeatedly)
17	28	Stepper motor coil <A2>			
5	15	Stepper motor coil <B1>			
18	29	Stepper motor coil <B2>			
6	6	EGR solenoid	Ignition switch: "ON"		B+
			<ul style="list-style-type: none"> <li>Engine: idling</li> <li>Suddenly depress the accelerator pedal.</li> </ul>		From B+, momentarily drops
8	20	Fuel pump relay	Ignition switch: "ON"		B+
			Engine: idling		1 V or less
9	34	Evaporative emission purge solenoid	Ignition switch: "ON"		B+
			Engine: warm up, 3,000 r/min		3 – 13 V
10	11	Ignition coil – No. 1, No. 4 (Ignition power transistor)	Engine: 3,000 r/min		0.3 – 3.0 V
23	12	Ignition coil – No. 2, No. 3 (Ignition power transistor)			
12	41	Power supply	Ignition switch: "ON"		B+
25	47				
19	19	Volume air flow sensor reset signal	Engine: idling		0 – 1 V
			Engine: 3,000 r/min		6 – 9 V
21	18	Fan controller	Radiator fan and condenser fan are not operating		0 – 0.3 V
			Radiator fan and condenser fan are operating		0.7 V or more
22	21	A/C compressor clutch relay	<ul style="list-style-type: none"> <li>Engine: idling</li> <li>A/C switch: OFF → ON (A/C compressor is operating)</li> </ul>		B+ → 1 V or less as A/C clutch cycles
24	61	A/C switch 2	Engine: idling Outside air temperature: 25°C or more	when A/C is MAX. COOL condition (when the load by A/C is high)	1 V or less
				when A/C is MAX. HOT condition (when the load by A/C is low)	B+

# MULTIPOINT FUEL INJECTION (MFI) DIAGNOSIS

CHECK AT THE ENGINE CONTROL MODULE (ECU) <M/T> OR POWERTRAIN CONTROL MODULE (PCM) <A/T>

13Ab-37

TERMINAL NO. <M/T>	TERMINAL NO. <A/T>	INSPECTION ITEM	INSPECTION CONDITION (ENGINE CONDITION)		NORMAL CONDITION
33	8	Generator G terminal	Engine: warming up, idling (radiator fan: stopped) Headlight: OFF to ON Rear defogger switch: OFF to ON Stoplight switch: OFF to ON		Voltage rises by 0.2 – 3.5 V
36	22	Malfunction Indicator Lamp (SERVICE ENGINE SOON)	Ignition switch: "LOCK" (OFF) → "ON"		1 V or less → 9 – 13 V (after several seconds have elapsed)
37	52	Power steering pressure switch	Engine: warming up, idling	When steering wheel is stationary	B+
				When steering wheel is turned	1 V or less
38	49	MFI relay (power supply)	Ignition switch: "OFF"		B+
			Ignition switch: "ON"		1 V or less
41	54	Generator FR terminal	Engine: warming up, idling (radiator fan: stopped) Headlight: OFF to ON		Voltage drops
			Rear defogger switch: OFF to ON Stop light switch: OFF to ON		
45	83	A/C switch	Engine: idling	Turn the A/C switch OFF	1 V or less
				Turn the A/C switch ON (A/C compressor is operating)	B+
54	26	Heated oxygen sensor heater (rear)	Engine: warming up, idling		1 V or less
			Engine: Revving		B+
55	35	Evaporative emission ventilation solenoid	Ignition switch: "ON"		B+
			Carry out the Actuator test to drive the solenoid valve		For approximately Six seconds 1 V or less
58	43	Tachometer signal	Engine: 3,000 r/min		0.3 – 3.0 V
60	3	Heated oxygen sensor heater (front)	Engine: warming up, idling		9 – 11 V
			Engine: Revving		9 – 11 V → B+ (momentarily)
61	92	Fuel tank differential pressure sensor	Engine: idling		1.2 – 3.8 V
71	58	Ignition switch-ST	Engine: cranking		8 V or more

TERMINAL NO. <M/T>	TERMINAL NO. <A/T>	INSPECTION ITEM	INSPECTION CONDITION (ENGINE CONDITION)		NORMAL CONDITION
72	64	Intake air temperature sensor	Ignition switch: "ON"	When Intake air temperature is $-20^{\circ}\text{C}$ ( $-4^{\circ}\text{F}$ )	3.8 – 4.4 V
				When Intake air temperature is $0^{\circ}\text{C}$ ( $32^{\circ}\text{F}$ )	3.2 – 3.8 V
				When Intake air temperature is $20^{\circ}\text{C}$ ( $68^{\circ}\text{F}$ )	2.3 – 2.9 V
				When Intake air temperature is $40^{\circ}\text{C}$ ( $104^{\circ}\text{F}$ )	1.5 – 2.1 V
				When Intake air temperature is $60^{\circ}\text{C}$ ( $140^{\circ}\text{F}$ )	0.8 – 1.4 V
				When Intake air temperature is $80^{\circ}\text{C}$ ( $176^{\circ}\text{F}$ )	0.4 – 1.0 V
73	91	Manifold differential pressure sensor	Engine: idling		0.8 – 2.4 V
			<ul style="list-style-type: none"> <li>Engine: idling</li> <li>Suddenly depress the accelerator pedal</li> </ul>		Rises from 0.8 – 2.4 V suddenly
75	73	Heated oxygen sensor (rear)	<ul style="list-style-type: none"> <li>Engine: warming up</li> <li>Revving</li> </ul>		0 and 0.6 – 1.0 V alternates
76	71	Heated oxygen sensor (front)	<ul style="list-style-type: none"> <li>Engine: warming, 2,500 r/min (check using a digital type voltmeter)</li> </ul>		0 $\leftrightarrow$ 0.8 V (changes repeatedly)
77	51	Fuel temperature sensor	Ignition switch: "ON"	When fuel temperature is $0^{\circ}\text{C}$ ( $32^{\circ}\text{F}$ )	2.7 – 3.1 V
				When fuel temperature is $20^{\circ}\text{C}$ ( $68^{\circ}\text{F}$ )	2.1 – 2.5 V
				When fuel temperature is $40^{\circ}\text{C}$ ( $104^{\circ}\text{F}$ )	1.6 – 2.0 V
				When fuel temperature is $80^{\circ}\text{C}$ ( $176^{\circ}\text{F}$ )	0.8 – 1.2 V
80	66	Backup power supply	Ignition switch: "LOCK" (OFF)		B+
81	46	Sensor supplied voltage	Ignition switch: "ON"		4.5 – 5.5 V
82	98	Ignition switch-IG	Ignition switch: "ON"		B+
83	44	Engine coolant temperature sensor	Ignition switch: "ON"	When engine coolant temperature is $-20^{\circ}\text{C}$ ( $-4^{\circ}\text{F}$ )	3.9 – 4.5 V
				When engine coolant temperature is $0^{\circ}\text{C}$ ( $32^{\circ}\text{F}$ )	3.2 – 3.8 V
				When engine coolant temperature is $20^{\circ}\text{C}$ ( $68^{\circ}\text{F}$ )	2.3 – 2.9 V
				When engine coolant temperature is $40^{\circ}\text{C}$ ( $104^{\circ}\text{F}$ )	1.3 – 1.9 V
				When engine coolant temperature is $60^{\circ}\text{C}$ ( $140^{\circ}\text{F}$ )	0.7 – 1.3 V
				When engine coolant temperature is $80^{\circ}\text{C}$ ( $176^{\circ}\text{F}$ )	0.3 – 0.9 V

TERMINAL NO. <M/T>	TERMINAL NO. <A/T>	INSPECTION ITEM	INSPECTION CONDITION (ENGINE CONDITION)		NORMAL CONDITION
84	78	Throttle position sensor	Ignition switch: "ON" (check for smooth voltage increase as throttle is moved from idle position to wide open throttle)	Idle	0.335 – 0.935 V
				Wide open throttle	4.4 – 5.3 V
85	55	Barometric pressure sensor	Ignition switch: "ON"	When altitude is 0 m (0 ft)	3.7 – 4.3 V
				When altitude is 600 m (1,969 ft)	3.4 – 4.0 V
				When altitude is 1,200 m (3,937 ft)	3.2 – 3.8 V
				When altitude is 1,800 m (5,906 ft)	2.9 – 3.5 V
86	–	Vehicle speed sensor	<ul style="list-style-type: none"><li>Ignition switch: "ON"</li><li>Move the vehicle slowly forward</li></ul>		0 ⇔ 8 – 12 V (changes repeatedly)
87	79	Idle position signal	Ignition switch: "ON"	Set throttle valve to idle position	0 – 1 V
				Open throttle slightly	4 V or more
88	56	Camshaft position sensor	Engine: cranking		0.4 – 3.0 V
			Engine: idling		1.5 – 3.0 V
89	45	Crankshaft position sensor	Engine: cranking		0.4 – 4.0 V
			Engine: idling		1.5 – 2.5 V
90	65	Volume air flow sensor	Engine: idling		2.2 – 3.2 V
			Engine: 2,500 r/min		

## TERMINAL RESISTANCE AND CONTINUITY CHECK

ECM <M/T> or PCM <A/T> Connector Terminal Arrangement

<M/T>

81	80	79	78	77	76	75	74	73	72	71	56	55	54	53	52	51	38	37	36	35	34	33	32	31	13	12	11	10	9	8	7	6	5	4	3	2	1
92	91	90	89	88	87	86	85	84	83	82	62	61	60	59	58	57	46	45	44	43	42	41	40	39	26	25	24	23	22	21	20	19	18	17	16	15	14

<A/T>

107	106	105				104	103		102	101	77	76	75				74	73	72	71	46	45	44				43	42	41	8	7		6	5				4	3		2	1								
120	119	118	117	116	115	114	113	112	111	110	109	108	89	88	87	86	85	84	83	82	81	80	79	78	57	56	55	54	53	52	51	50	49	48	47	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
130	129		128	127	126		125	124		123	122	121	98	97		96	95		94	93	92		91	90	66	65	64		63	62	61	60		59	58	35	34		33	32	31	30		29	28	27	26		25	24

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TERMINAL NO.	TERMINAL NO.	INSPECTION ITEM	NORMAL CONDITION (INSPECTION CONDITION)
1 – 12	1 – 41	No. 1 injector	13 – 16 Ω [at 20°C (68°F)]
14 – 12	9 – 41	No. 2 injector	
2 – 12	24 – 41	No. 3 injector	
15 – 12	2 – 41	No. 4 injector	

TERMINAL NO.	TERMINAL NO.	INSPECTION ITEM	NORMAL CONDITION (INSPECTION CONDITION)
4 – 12	14 – 41	Stepper motor coil (A1)	28 – 33 $\Omega$ [at 20°C (68°F)]
17 – 12	28 – 41	Stepper motor coil (A2)	
5 – 12	15 – 41	Stepper motor coil (B1)	
18 – 12	29 – 41	Stepper motor coil (B2)	
6 – 12	6 – 41	EGR solenoid	29 – 35 $\Omega$ [at 20°C (68°F)]
9 – 12	34 – 41	Evaporative emission purge solenoid	30 – 34 $\Omega$ [at 20°C (68°F)]
13 – Body ground	42 – Body ground	ECM or PCM ground	Continuity (approximately 0 $\Omega$ )
26 – Body ground	48 – Body ground	ECM or PCM ground	
54 – 12	26 – 41	Heated oxygen sensor heater (rear)	11 – 18 $\Omega$ [at 20°C (68°F)]
55 – 12	35 – 41	Evaporative emission ventilation solenoid	17 – 21 $\Omega$ [at 20°C (68°F)]
60 – 12	3 – 41	Heated oxygen sensor heater (front)	4.5 – 8.0 $\Omega$ [at 20°C (68°F)]
72 – 92	57 – 64	Intake air temperature sensor	13 – 17 k $\Omega$ [when intake air temperature is –20°C (–4°F)]
			5.3 – 6.7 k $\Omega$ [when intake air temperature is 0°C (32°F)]
			2.3 – 3.0 k $\Omega$ [when intake air temperature is 20°C (68°F)]
			1.0 – 1.5 k $\Omega$ [when intake air temperature is 40°C (104°F)]
			0.56 – 0.76 k $\Omega$ [when intake air temperature is 60°C (140°F)]
			0.30 – 0.42 k $\Omega$ [when intake air temperature is 80°C (176°F)]
83 – 92	44 – 57	Engine coolant temperature sensor	14 – 17 k $\Omega$ [when engine coolant temperature is –20°C (–4°F)]
			5.1 – 6.5 k $\Omega$ [when engine coolant temperature is 0°C (32°F)]
			2.1 – 2.7 k $\Omega$ [when engine coolant temperature is 20°C (68°F)]
			0.9 – 1.3 k $\Omega$ [when engine coolant temperature is 40°C (104°F)]
			0.48 – 0.68 k $\Omega$ [when engine coolant temperature is 60°C (140°F)]
			0.26 – 0.36 k $\Omega$ [when engine coolant temperature is 80°C (176°F)]



# INSPECTION PROCEDURE USING AN OSCILLOSCOPE

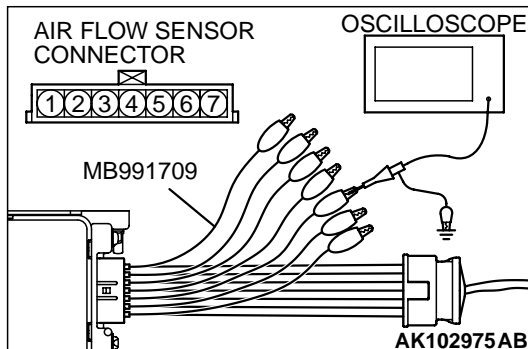
## VOLUME AIR FLOW SENSOR

### Required Special Tool:

MB991709: Test Harness Set

### Measurement Method

1. Disconnect the volume air flow sensor connector, and connect the test harness special tool (MB991709) in between. (All terminals should be connected.)
2. Connect the oscilloscope probe to volume air flow sensor connector terminal 3.



### Alternate method (Test harness not available)

#### <M/T>

1. Connect the oscilloscope probe to ECM terminal 90.

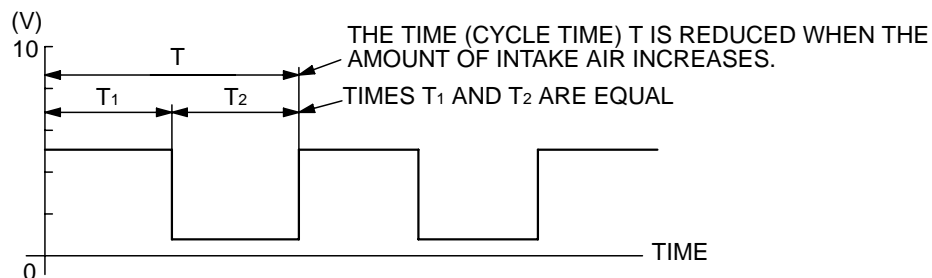
#### <A/T>

1. Connect the oscilloscope probe to PCM terminal 65.

### Standard Wave Pattern

Observation conditions	
Function	Special pattern
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern

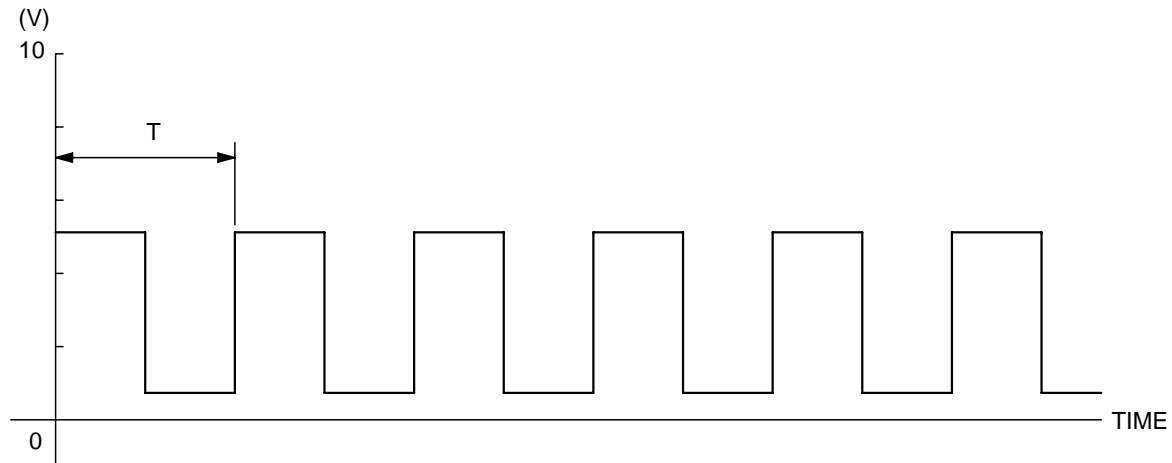


AKX01595 AB

### Observation conditions

Rev engine, observe T1 and T2 remain equal.

Standard wave pattern



AKX01596 AB

### Wave Pattern Observation Points

Check that cycle time  $T$  becomes shorter and the frequency increases when the engine speed is increased.

### Examples of Abnormal Wave Patterns

#### Example 1

Cause of problem

- Sensor interface malfunction.

Wave pattern characteristics

- Rectangular wave pattern is output even when the engine is not started.

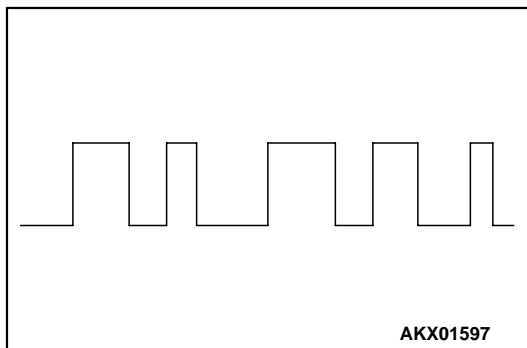
#### Example 2

Cause of problem

- Damaged rectifier or vortex generation column.

Wave pattern characteristics

- Unstable wave pattern with non-uniform frequency. An ignition leak will distort the wave pattern temporarily, even if the volume air flow sensor is normal.



AKX01597

## CAMSHAFT POSITION SENSOR AND CRANKSHAFT POSITION SENSOR

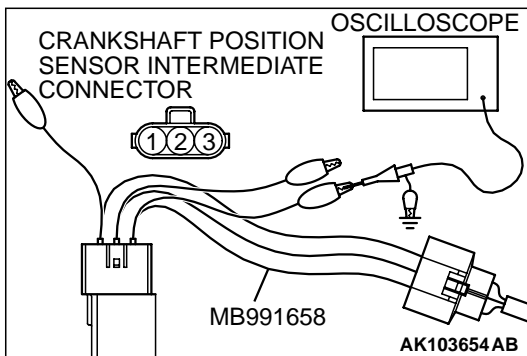
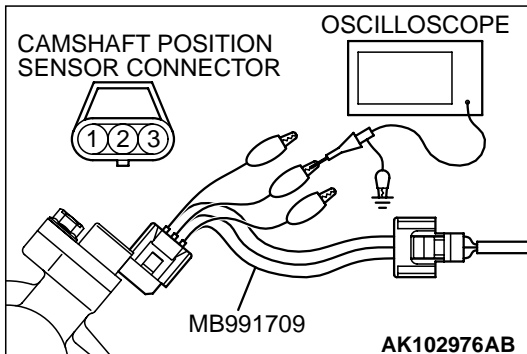
### Required Special Tools:

MB991709: Test Harness Set

MB991658: Test Harness Set

### Measurement Method

1. Disconnect the camshaft position sensor connector, and connect the test harness special tool (MB991709) in between. (All terminals should be connected.)
2. Connect the oscilloscope probe to camshaft position sensor connector terminal 2.
3. Disconnect the crankshaft position sensor connector, and connect the test harness special tool (MB991658) in between. (All terminals should be connected.)
4. Connect the oscilloscope probe to crankshaft position sensor connector terminal 3.



### Alternate method (Test harness not available)

#### <M/T>

1. Connect the oscilloscope probe to ECM terminal 88. (Check the camshaft position sensor signal wave pattern.)
2. Connect the oscilloscope probe to ECM terminal 89. (Check the crankshaft position sensor signal wave pattern.)

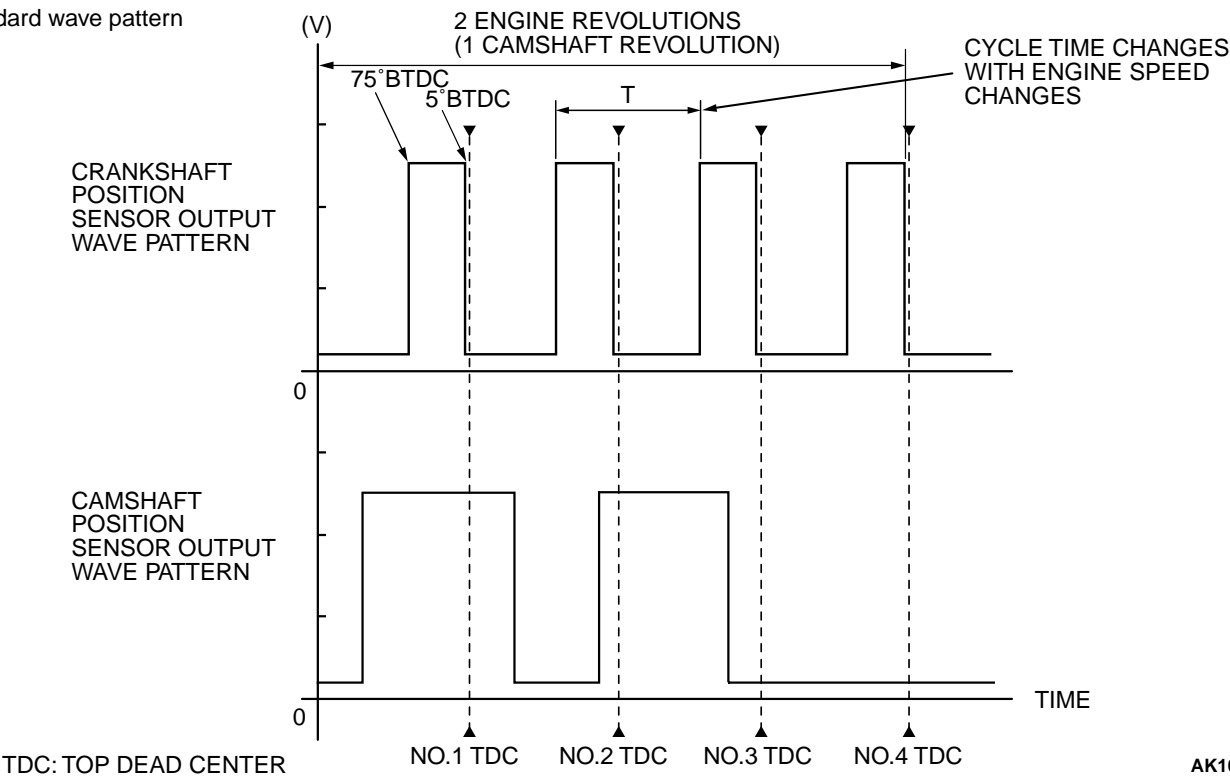
#### <A/T>

1. Connect the oscilloscope probe to PCM terminal 56. (Check the camshaft position sensor signal wave pattern.)
2. Connect the oscilloscope probe to PCM terminal 45. (Check the crankshaft position sensor signal wave pattern.)

Standard Wave Pattern

Observation conditions	
Function	Special pattern
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern



AK100594AB

Wave Pattern Observation Points

Check that cycle time T becomes shorter when the engine speed increased.

Examples of Abnormal Wave Patterns

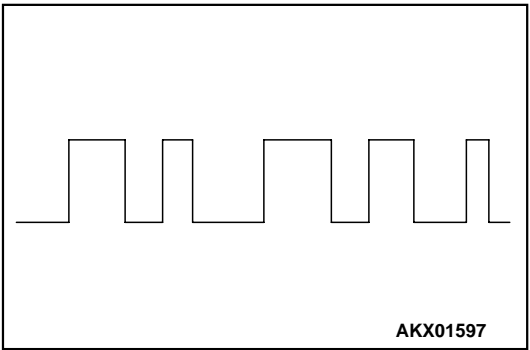
Example 1

Cause of problem

- Sensor interface malfunction.

Wave pattern characteristics

- Rectangular wave pattern is output even when the engine is not started.



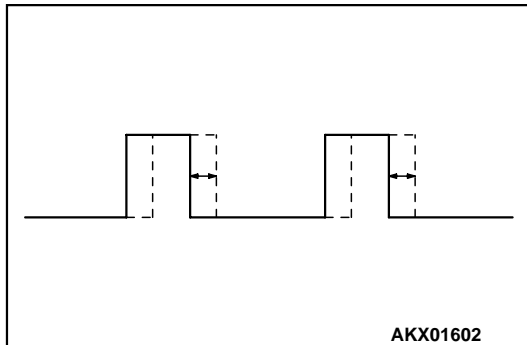
### Example 2

Cause of problem

- Loose timing belt.
- Abnormality in sensor disc.

Wave pattern characteristics

- Wave pattern is displaced to the left or right.



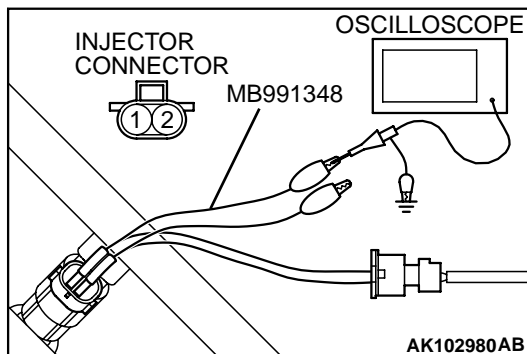
## INJECTOR

### Required Special Tools:

MB991348: Test Harness Set

### Measurement Method

1. Disconnect the injector connector, and connect the test harness special tool (MB991348) in between. (All terminals should be connected.)
2. Connect the oscilloscope probe to injector connector terminal 2.



### Alternate method (Test harness not available)

#### <M/T>

1. Connect the oscilloscope probe to ECM terminal 1. (When checking the number 1 cylinder.)
2. Connect the oscilloscope probe to ECM terminal 14. (When checking the number 2 cylinder.)
3. Connect the oscilloscope probe to ECM terminal 2. (When checking the number 3 cylinder.)
4. Connect the oscilloscope probe to ECM terminal 15. (When checking the number 4 cylinder.)

#### <A/T>

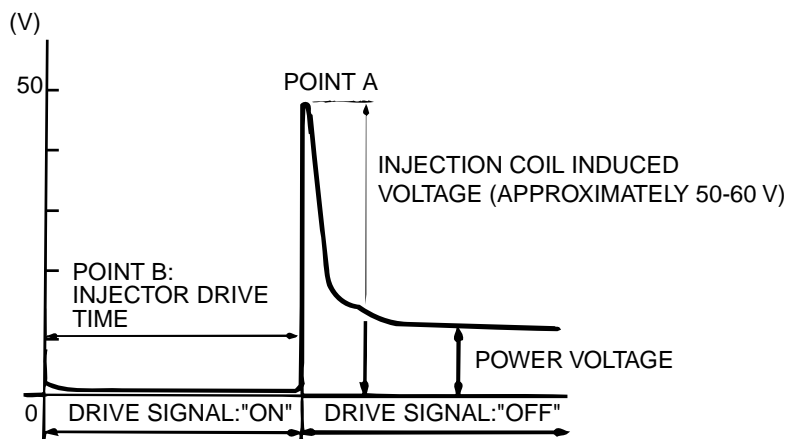
1. Connect the oscilloscope probe to PCM terminal 1. (When checking the number 1 cylinder.)
2. Connect the oscilloscope probe to PCM terminal 9. (When checking the number 2 cylinder.)

3. Connect the oscilloscope probe to PCM terminal 24. (When checking the number 3 cylinder.)
4. Connect the oscilloscope probe to PCM terminal 2. (When checking the number 4 cylinder.)

**Standard Wave Pattern**

Observation conditions	
Function	Special pattern
Pattern height	Variable
Variable knob	Adjust while viewing the wave pattern
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern



AKX01604 AB

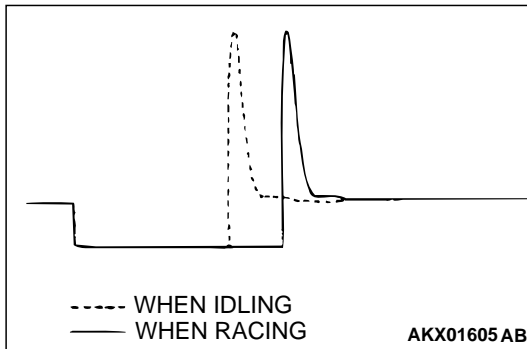
**Wave Pattern Observation Points**

Point A: Height of injector coil induced voltage.

CONTRAST WITH STANDARD WAVE PATTERN	PROBABLE CAUSE
Injector coil induced voltage is low or doesn't appear at all	Short in the injector solenoid

Point B: Injector drive time

1. The injector drive time should be synchronized with the scan tool tester display.



- When the engine is suddenly revved, the drive time will be greatly extended at first, but the drive time will soon return to original length.

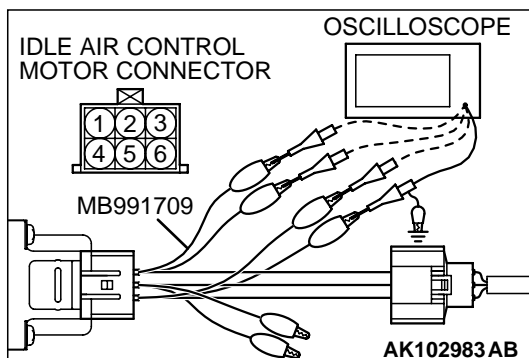
## **IDLE AIR CONTROL MOTOR (STEPPER MOTOR)**

### **Required Special Tool:**

MB991709: Test Harness Set

### **Measurement Method**

- Disconnect the idle air control motor connector, and connect the test harness special tool (MB991709) in between. (All terminals should be connected.)
- Connect the oscilloscope probe to the idle air control motor connector terminal 1, terminal 3, terminal 4 and terminal 6 respectively.



### **Alternate method (Test harness not available)**

#### **<M/T>**

- Connect the oscilloscope probe to the ECM terminal 4, terminal 5, terminal 17 and terminal 18 respectively.

#### **<A/T>**

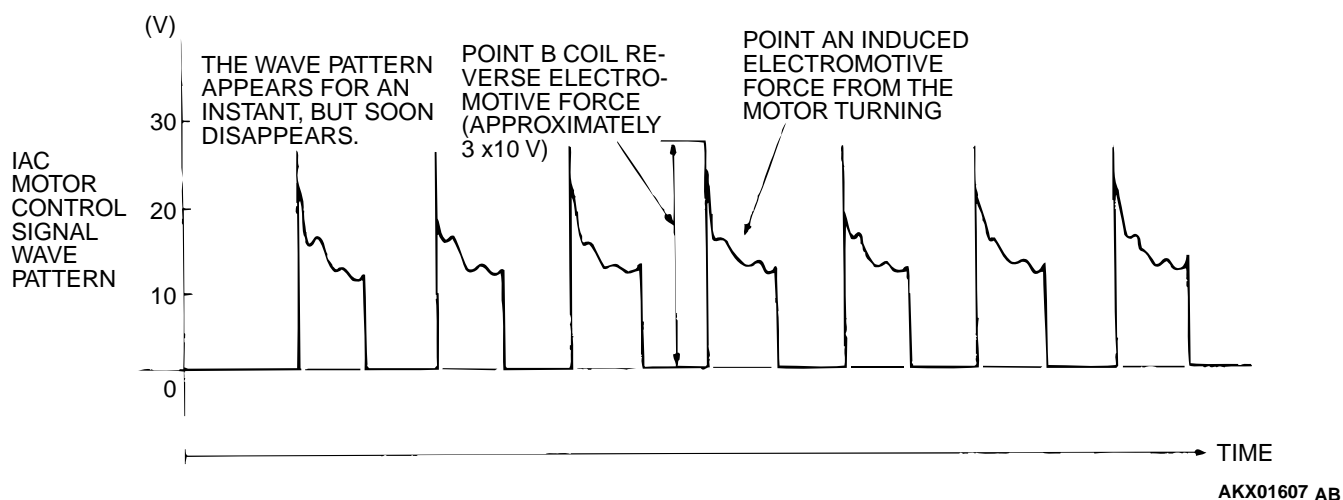
- Connect the oscilloscope probe to the PCM terminal 14, terminal 15, terminal 28 and terminal 29 respectively.

### **Standard Wave Pattern**

Observation conditions	
Function	Special pattern
Pattern height	High
Pattern selector	Display

Observation conditions	
Function	Special pattern
Engine condition	Turn the ignition switch from "LOCK" (OFF) to "ON" (without starting the engine).
	While the engine is idling, turn the A/C switch to "ON."
	Immediately after starting the warm the engine (approximately one minute).

Standard wave pattern

**Wave Pattern Observation Points**

Check that the standard wave pattern appears when the idle air control motor is operating.

Point A: Presence or absence of induced electromotive force from the motor turning. (Refer to abnormal wave pattern.)

CONTRAST WITH STANDARD WAVE PATTERN	PROBABLE CAUSE
Induced electromotive force does not appear or is extremely small	Malfunction of motor

Point B: Height of coil back electromotive force

CONTRAST WITH STANDARD WAVE PATTERN	PROBABLE CAUSE
Coil reverse electromotive force does not appear or is extremely small	Short in the coil



### Examples of Abnormal Wave Patterns

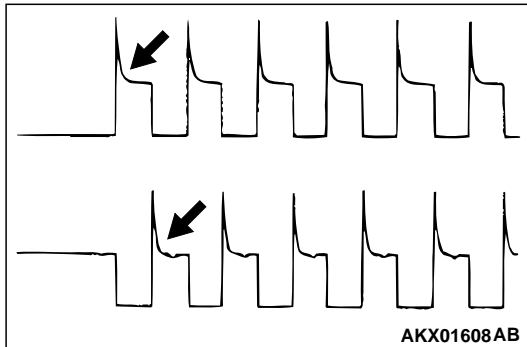
#### Example 1

Cause of problem

- Malfunction of motor. (Motor is not operating.)

Wave pattern characteristics

- Induced electromotive force from the motor turning does not appear.



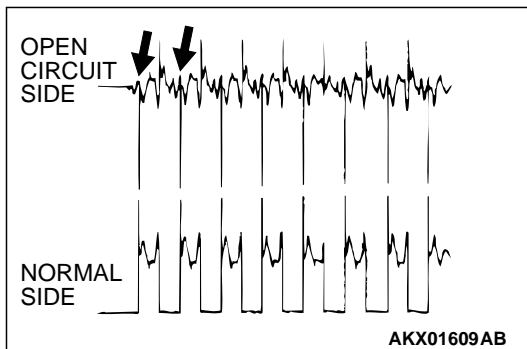
#### Example 2

Cause of problem

- Open circuit in the line between the idle air control motor and the ECM <M/T> or PCM <A/T>.

Wave pattern characteristics

- Current is not supplied to the motor coil on the open circuit side. (Voltage does not drop to 0 volt.) Furthermore, the induced electromotive force wave pattern at the normal side is slightly different from the normal wave pattern.



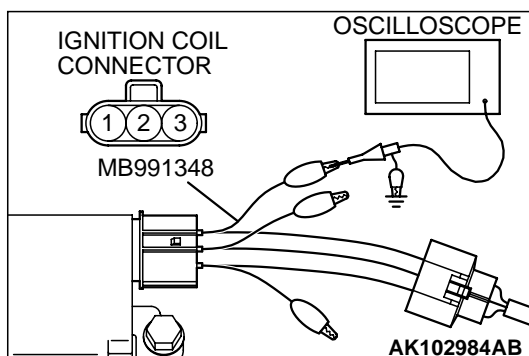
## IGNITION COIL AND IGNITION POWER TRANSISTOR

Required Special Tool:

MB991348: Test Harness Set

### Measurement Method

1. Disconnect the ignition coil connector, and connect test harness special tool, MB991348, in between. (All terminals should be connected.)
2. Connect the oscilloscope probe to ignition coil connector terminal 3.



Alternate method (Test harness not available)

<M/T>

- 1. Connect the oscilloscope probe to the ECM terminal 10 (for number 1 – number 4), terminal 23 (for number 2 – number 3).

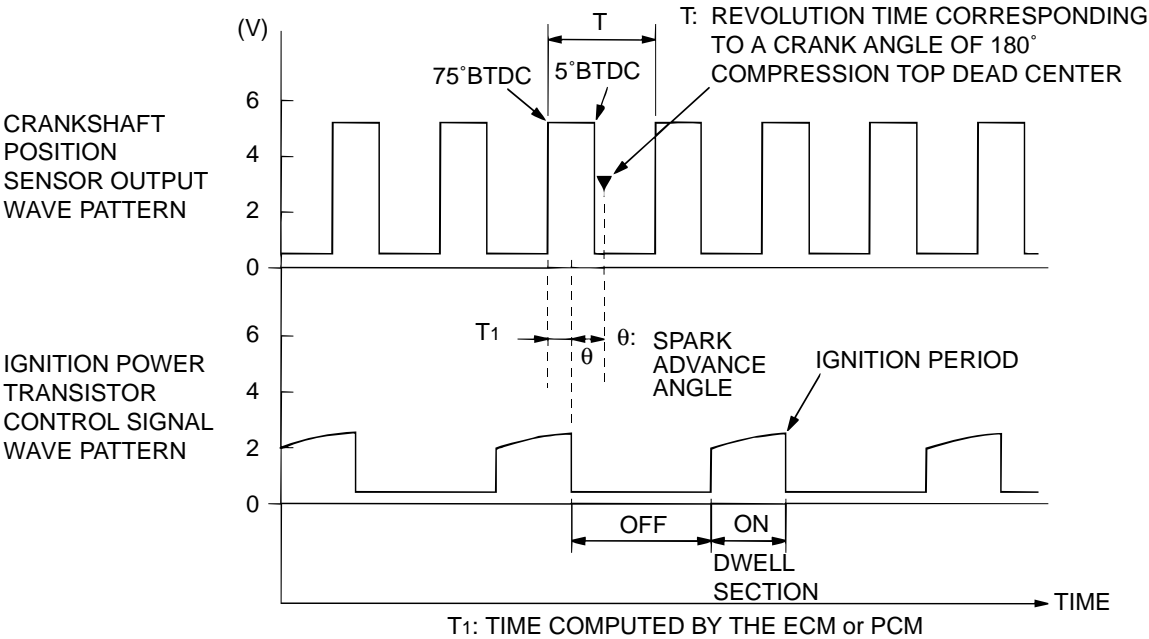
<A/T>

- 1. Connect the oscilloscope probe to the PCM terminal 11 (for number 1 – number 4), terminal 12 (for number 2 – number 3).

Standard Wave Pattern

Observation conditions	
Function	Special pattern
Pattern height	Low
Pattern selector	Display
Engine r/min	Approximately 1,200 r/min

Standard wave pattern



AK000068 AB

Wave Pattern Observation Points

Point: Condition of wave pattern build-up section and maximum voltage (Refer to abnormal wave pattern examples 1 and 2).

CONDITION OF WAVE PATTERN BUILD-UP SECTION AND MAXIMUM VOLTAGE	PROBABLE CAUSE
Rises from approximate 2 volts to approximate 4.5 volts at the top-right	Normal
2-volt rectangular wave	Open-circuit in ignition primary circuit
Rectangular wave at power voltage	Ignition power transistor malfunction

### Examples of Abnormal Wave Patterns

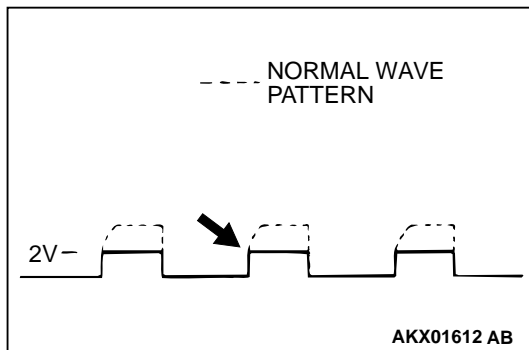
#### Example 1 (Wave pattern during engine cranking)

Cause of problem

- Open-circuit in ignition primary circuit

Wave pattern characteristics

- Top-right part of the build-up section cannot be seen, and voltage value is approximately 2 volts too low.



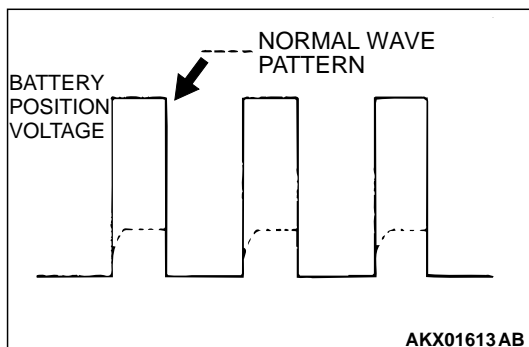
#### Example 2 (Wave pattern during engine cranking)

Cause of problem

- Malfunction in ignition power transistor

Wave pattern characteristics

- Power voltage results when the ignition power transistor is ON.



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## NOTES