FUEL

CONTENTS

FUEL SYSTEM <6G72-SOHC 24 Valve Engine, 6G74-SOHC 24 Valve Engine>

GENERAL

OUTLINE OF CHANGES

- A 6G74-SOHC 24-valve engine has been added. To correspond to this, maintenance service procedures are given below.
- The specifications for a 6G72-SOHC 24-valve engine has been changed. To correspond to this, maintenance service procedures are given below.
- The high-pressure hose connection has been changed to a one-touch connector type.

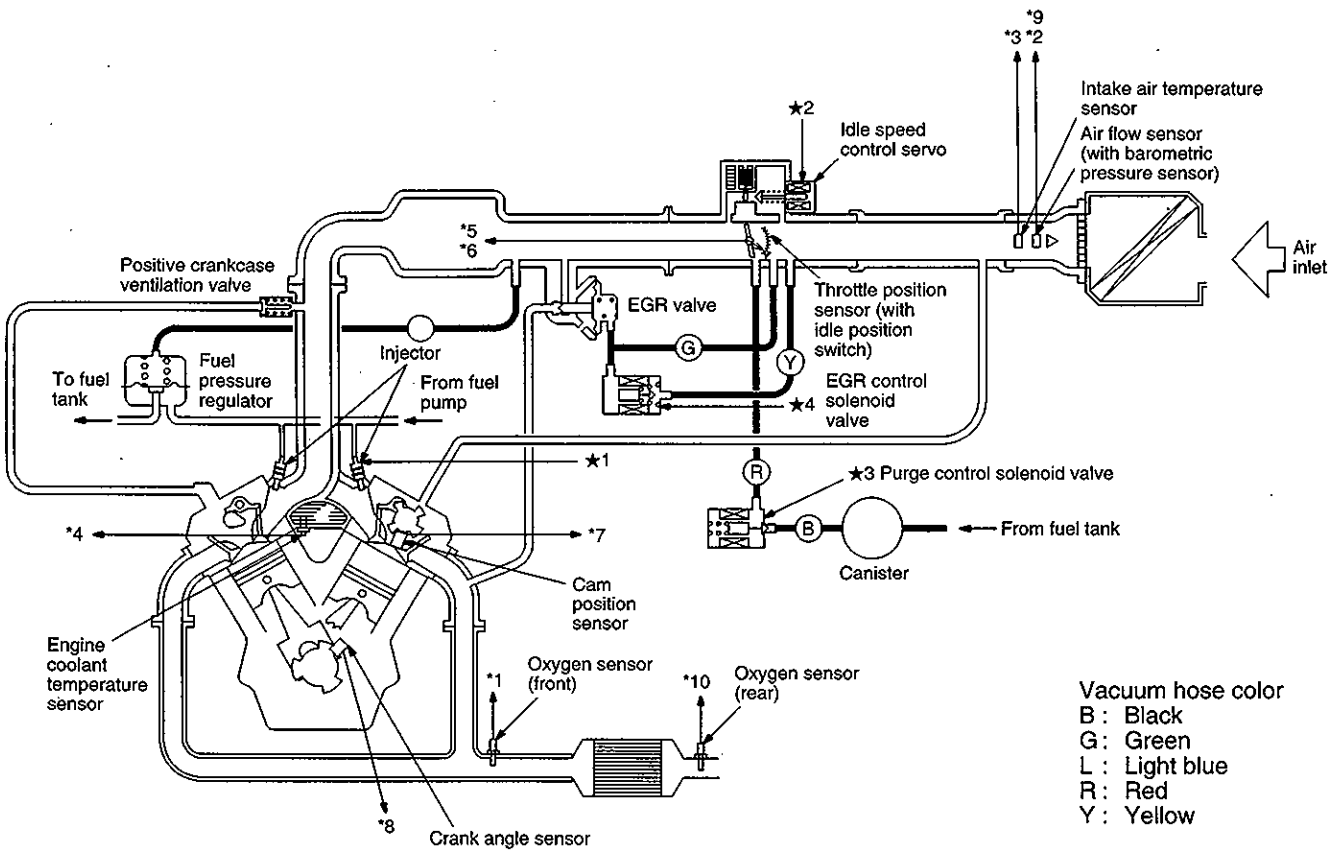
GENERAL INFORMATION

MULTIPOINT INJECTION SYSTEM DIAGRAM

<6G74-SOHC 24 Valve Engine>

*1	Oxygen sensor (front)	• Ignition switch-ST	★1 Injector
*2	Air flow sensor	• Ignition switch-IG$_1$	★2 Idle speed control motor
*3	Intake air temperature sensor	• Power supply	★3 Purge control solenoid valve
*4	Engine coolant temperature sensor	• Vehicle speed sensor	★4 EGR control solenoid valve
*5	Throttle position sensor	• Air conditioner switch	• Fuel pump relay
*6	Idle position switch	• Power steering fluid pressure switch	• Control relay
*7	Cam position sensor	• Inhibitor switch	• Air conditioner power relay
*8	Crank angle sensor	• Detonation sensor	• Ignition coil, Power transistor
*9	Barometric pressure sensor		• Diagnosis signal
*10	Oxygen sensor (rear)		• Engine warning lamp

→ Engine control unit →



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SPECIFICATIONS

GENERAL SPECIFICATIONS

Items		Specifications
Fuel		
Tank capacity	ℓ	
Standard Wheelbase		75
Long Wheelbase		92
Fuel pump		
Type		Electrical, in-tank type
Driven by		Electric motor
Throttle body		
Throttle bore	mm	60
Throttle position sensor		Variable resistor type
Idle speed control servo		Stepper motor type Stepper motor type by-pass air control system with the Fast Idle Air Valve
Idle position switch		Rotary contact type
Engine control unit		
Identification model No.		
<6G72-SOHC 24 Valve Engine>		E2T68673 <Vehicles without immobilizer> E2T68674 <Vehicles with immobilizer>
<6G74-SOHC 24 Valve Engine>		E2T68675 <Vehicles without immobilizer> E2T68676 <Vehicles with immobilizer>
Sensors		
Air flow sensor		Karman vortex type
Barometric pressure sensor		Semiconductor diffusion-type
Intake air temperature sensor		Thermistor type
Engine coolant temperature sensor		Thermistor type
Oxygen sensor		Zirconia type
Vehicle speed sensor		Reed switch type
Inhibitor switch		Contact switch type
Detonation sensor <6G74-SOHC 24 Valve Engine>		Piezoelectric type
Cam position sensor		Hall element type
Crank angle sensor		Hall element type
Power steering fluid pressure switch		Contact switch type
Actuators		
Control relay type		Contact switch type
Injector type and number		Electromagnetic, 6
Purge control solenoid valve		ON/OFF type solenoid valve
EGR control solenoid valve		Duty cycle type solenoid valve
Fuel pressure regulator		
Regulated pressure	kPa	329

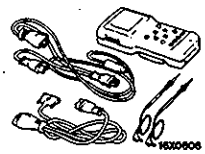
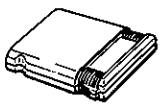
SERVICE SPECIFICATIONS

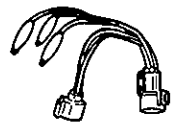
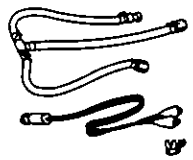
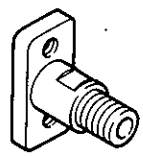
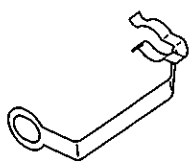
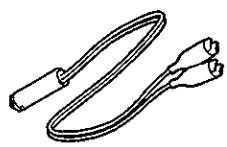
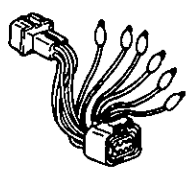
Items		Standard value
Accelerator cable play	mm	1 – 2
Basic ignition timing		5° ± 3° BTDC at curb idle
Curb idle speed	r/min.	700 ± 100
Idle speed when air conditioner ON	r/min.	900 at neutral position 650 at D range <A/T>
Basic idle speed	r/min.	700 ± 50
Throttle position sensor output voltage	mV	400 – 1000
Throttle position sensor resistance	kΩ	3.5 – 6.5
Idle speed control servo (stepper motor) coil resistance [at 20°C]	Ω	28 – 33
Intake air temperature sensor resistance [at 20°C]	kΩ	2.7
Engine coolant temperature sensor resistance	kΩ	
20°C		2.4
80°C		0.3
Fuel pressure (at curb idle)	kPa	
Vacuum hose disconnected		324 – 343
Vacuum hose connected		Approx. 265
Injector coil resistance [at 20°C]	Ω	13 – 16

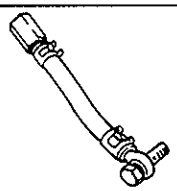
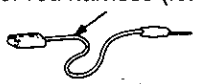
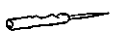
SEALANT

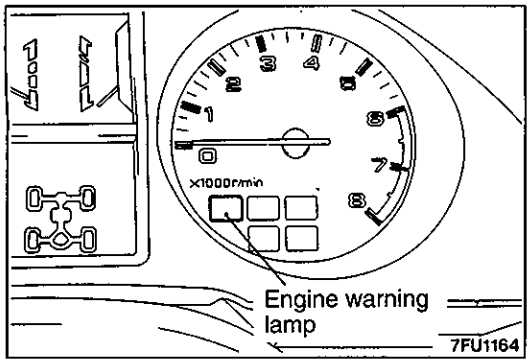
Items	Specified sealant	Remarks
Engine coolant temperature sensor threaded portion	3M Nut Locking Part No. 4171 or equivalent	Drying sealant

SPECIAL TOOLS

Tool	Number	Name	Use
	MB991502	MUT-II	• Reading diagnosis code • MPI system inspection
 16X0607		ROM pack	
	MB991529	Diagnosis code check harness	• Reading diagnosis code • Basic idle speed adjustment
	MB991348	Test harness set	• Adjustment of throttle position sensor • Inspection with analyzer

Tool	Number	Name	Use
	MD998478	Test harness (3 pin, square)	• Inspection with analyzer
	MD998474	Test harness (8 pin, square)	• Inspection with analyzer
	MD998706	Injector test set	• Checking injection condition of injector
	MD998741	Injector test adaptor	
	MB991692	Injector test clip	
	MB991607	Injector test harness	
	MD998463	Test harness (6 pin, square)	• Idle speed control servo inspection • Inspection with analyzer

Tool	Number	Name	Use
	MD998709	Adapter hose	Measurement of fuel pressure
	MD998742	Hose adapter	
For red harness (for DLI)  For white harness (for LC)  	MB991223	Inspection harness set connector • Pin contact pressure inspection harness • Marketing tester connection probe (for general connectors)	• Measurement of terminal voltages



TROUBLESHOOTING

ENGINE WARNING LAMP (CHECK ENGINE LAMP)

Among the self-diagnosis items, a engine warning lamp comes on to notify the driver of the emission control items when an irregularity is detected.
However, when an irregular signal returns to normal and the engine control unit judges that it has returned to normal, the engine warning lamp goes out.
Moreover, when the ignition switch is turned off, the lamp goes out. Even if the ignition switch is turned on again, the lamp does not come on until the irregularity is detected.
Here, immediately after the ignition switch is turn on, the engine warning lamp is lit for 5 seconds to indicated that the engine warning lamp operates normally.

Item indicated by the lightening engine warning lamp

Engine control unit	Cam position sensor
Oxygen sensor	Barometric pressure sensor
Air flow sensor	Detonation sensor <6G74-SOHC 24 Valve Engine>
Intake air temperature sensor	Immobilizer system
Throttle position sensor	Injector
Engine coolant temperature sensor	EGR system
Crank angle sensor	Ignition coil, Power transistor unit

ENGINE WARNING LAMP INSPECTION

(1) Check to be sure, when the ignition switch is set to the "ON" position, that the lamp illuminates for about five seconds and then switches OFF.
(2) If the lamp does not illuminate, check for damage or disconnection of the harness, or for a blown fuse or a failed light bulb.

SELF-DIAGNOSIS

The engine control unit monitors the input/output signals (some signals at all times and the others under specified conditions) of the engine control unit. When it is noticed that an irregularity has continued for a specified time or longer from when the irregular signal is initially monitored, passing a certain number, the engine control unit judges that an irregularity has occurred, memorizes the malfunction code, and outputs the signal to the self-diagnosis output terminals. There are 18 diagnosis items, including the normal state, and the diagnosis results can be read out with a voltmeter or MUT-II. Moreover, since memorization of the malfunction codes is backed up directly by the battery, the diagnosis results are memorized even if the ignition key is turned off. The malfunction codes will, however, be erased when the battery terminal or the engine control unit connector is disconnected.
The malfunction codes are also erased by setting the ignition switch to the "ON" position and then sending the malfunction-code-erase signal from the MUT-II to the engine control unit.

Caution

If the sensor connector is disconnected while the ignition switch is ON, the malfunction code is memorized. In this instance, either send the malfunction-code-erase signal from the MUT-II to the engine control unit, or disconnect the battery's negative (–) terminal for ten seconds or longer; the diagnosis memory will be erased.

The 18 diagnosis items are provided as follows, and if plural items are activated, they are all indicated sequentially from the smallest code number.

DIAGNOSIS CHART

Output preference order	Diagnosis item	Diagnosis code		Check item (Remedy)
		No.	Memory	
1	Engine control unit	–	–	(Replace engine control unit)
2	Oxygen sensor <front>	11	Retained	● Harness and connector ● Oxygen sensor ● Fuel pressure ● Injectors (Replace if defective) ● Intake air leaks
3	Air flow sensor	12	Retained	● Harness and connector (if harness and connector are normal, replace air flow sensor assembly.)
4	Intake air temperature sensor	13	Retained	● Harness and connector ● Intake air temperature sensor
5	Throttle position sensor	14	Retained	● Harness and connector ● Throttle position sensor ● Idle position switch
6	Engine coolant temperature sensor	21	Retained	● Harness and connector ● Engine coolant temperature sensor
7	Crank angle sensor	22	Retained	● Harness and connector (If harness and a connector are normal, replace distributor assembly.)
8	Cam position sensor	23	Retained	● Harness and connector (If harness and a connector are normal, replace distributor assembly.)
9	Vehicle speed sensor (reed switch)	24	Retained	● Harness and connector ● Vehicle speed sensor (reed switch)
10	Barometric pressure sensor	25	Retained	● Harness and connector (If harness and connector are normal, replace barometric pressure sensor assembly.)

Output preference order	Diagnosis item	Diagnosis code		Check item (Remedy)
		No.	Memory	
11	Detonation sensor <6G74-SOHC 24 Valve Engine>	31	Retained	● Harness and connector (If harness and connector are normal; replace detonation sensor.)
12	Injector	41	Retained	● Harness and connector ● Injector oil resistance
13	Ignition coil, Power transistor unit (No.1 – 4 cylinder)	44	Retained	● Harness and connector ● Ignition coil ● Power transistor unit
14	Ignition coil, Power transistor unit (No.2 – 5 cylinder)	52	Retained	● Harness and connector ● Ignition coil ● Power transistor unit
15	Ignition coil, Power transistor unit (No.3 – 6 cylinder)	53	Retained	● Harness and connector ● Ignition coil ● Power transistor unit
16	Immobilizer system	54	Retained	(Inspect according to the troubleshooting procedures given in GROUP 54 – Ignition Switch and Immobilizer System
17	Oxygen sensor <rear>	59	Retained	● Harness and connector ● Oxygen sensor
18	Normal state	–	–	–

NOTE
Replace the engine control unit if a malfunction code is output although the inspection reveals that there is no problem with the check items.

TROUBLE DIAGNOSIS QUICK REFERENCE CHART

Trouble code No.	Diagnosis item	Description	Major cause	Remarks (Symptoms, etc.)
–	Engine control unit	Trouble in engine control unit itself	–	• Engine stalls • Engine cannot be started.
11	Oxygen sensor <front>	Air-fuel ratio feedback control (closed loop control) is in effect but oxygen sensor signal voltage does not change (air-fuel mixture lean/rich).	(1) Defective oxygen sensor (2) Open or short circuit in oxygen sensor circuit, or connector in loose contact	• Poor exhaust emission purifying performance
			(3) Improper fuel pressure (4) Defective injector (5) Air drawn in through gasket clearance, etc. (6) Defective engine control unit	• Poor exhaust emission purifying performance • Poor startability • Unstable idling • Poor acceleration
12	Air flow sensor	Air flow sensor signal frequency 10Hz or less even with engine running	(1) Defective air flow sensor (2) Open or short circuit in air flow sensor circuit, or connector in loose contact (3) Defective engine control unit	• Poor acceleration* • Improper idling speed* • Unstable idling*
13	Intake air temperature sensor	(1) Intake air temperature sensor signal voltage over 4.5 V (2) Intake air temperature sensor signal voltage less than 0.27 V	(1) Defective intake air temperature sensor (2) Open or short circuit in intake air temperature sensor circuit, or connector in loose contact (3) Defective engine control unit	• Somewhat poor driveability* • At high temperatures (a) Poor startability* (b) Unstable idling*
14	Throttle position sensor	(1) Throttle position sensor signal voltage less than 0.2 V (2) Throttle position sensor signal voltage over 2 V even with idle position switch at ON	(1) Throttle position sensor out of order or maladjusted (2) Open or short circuit in throttle position sensor circuit, or connector in poor contact	• Somewhat poor acceleration • Engine stalls
			(3) Idle position switch ON failure (4) Short circuit in idle position signal line (5) Defective engine control unit	• Engine stalls. • Engine cannot be raced.

NOTE
*: Failsafe/backup function is in operation.

Trouble code No.	Diagnosis item	Description	Major cause	Remarks (Symptoms, etc.)
21	Engine coolant temperature sensor	(1) Engine coolant temperature sensor signal voltage over 4.6 V (2) Engine coolant temperature sensor signal voltage less than 0.11 V (3) Engine coolant temperature sensor signal indicates a low engine coolant temperature while the engine is in warmup operation.	(1) Defective engine coolant temperature sensor (2) Open or short circuit in engine coolant temperature sensor circuit, or connector in poor contact (3) Defective engine control unit	With engine cold ● Poor startability* ● Unstable idling* ● Poor acceleration*
22	Crank angle sensor	(1) Cranking the engine for more than four seconds does not cause the crank angle sensor signal voltage to change (go high or low). (2) Abnormal crank angle sensor signal	(1) Defective crank angle sensor (2) Open or short circuit in crank angle sensor circuit, or connector in loose contact (3) Defective cam position sensor, or connector in loose contact (4) Defective engine control unit	● Engine stalls. ● Engine cannot be started.
23	Cam position sensor	(1) Cam position sensor signal voltage does not change (go high or low) even with the engine running. (2) Abnormal top dead center signal pattern	(1) Defective cam position sensor (2) Open or short circuit in cam position sensor circuit, or connector in loose contact (3) Defective crank angle sensor, or connector in loose contact (4) Defective engine control unit	● Engine stalls.*
24	Vehicle speed sensor (reed switch)	With the engine in accelerated operation at an engine speed of over 3,000 r/min, the vehicle speed sensor signal voltage does not change (go high or low).	(1) Defective vehicle speed sensor (2) Open or short circuit in vehicle speed sensor circuit, or connector in loose contact (3) Defective engine control unit	When the vehicle is stopped with the engine in decelerated operation, the engine might stall.

NOTE
*: Failsafe/backup function is in operation.

Trouble code No.	Diagnosis item	Description	Major cause	Remarks (Symptoms, etc.)
25	Barometric pressure sensor	(1) Barometric pressure sensor signal voltage over 4.5 V (2) Barometric pressure sensor signal voltage less than 0.2 V	(1) Defective barometric pressure sensor (2) Open or short circuit in barometric pressure sensor circuit, or connector in loose contact (3) Defective engine control unit	• Unstable idling* • Poor acceleration* • Poor startability*
31	Detonation sensor <6G74-SOHC 24 Valve Engine>	Abnormal detonation sensor signal voltage	(1) Defective detonation sensor (2) Open or short circuit in detonation sensor circuit, or connector in loose contact (3) Defective engine control unit	• Poor acceleration*
41	Injector	Injector is not driven for more than four consecutive seconds during engine cranking or idling operation	(1) Defective injector (2) Open or short circuit in injector circuit, or connector in loose contact (3) Defective engine control unit	• Poor idling • Poor acceleration • Poor startability
44	Ignition coil and power transistor unit for 1-4 cylinders	With the engine running, no ignition signal is input (except in cases where no ignition signal is input to all the cylinders)	(1) Defective ignition coil (2) Open or short circuit in primary ignition circuit, or connector in loose contact (3) Defective power transistor unit (4) Defective engine control unit	• Unstable idling* • Poor acceleration* • Poor startability*
52	Ignition coil and power transistor unit for 2-5 cylinders	With the engine running, no ignition signal is input (except in cases where no ignition signal is input to all the cylinders)	(1) Defective ignition coil (2) Open or short circuit in primary ignition circuit, or connector in loose contact (3) Defective power transistor unit (4) Defective engine control unit	• Unstable idling* • Poor acceleration* • Poor startability*
53	Ignition coil and power transistor unit for 3-6 cylinders	With the engine running, no ignition signal is input (except in cases where no ignition signal is input to all the cylinders)	(1) Defective ignition coil (2) Open or short circuit in primary ignition circuit, or connector in loose contact (3) Defective power transistor unit (4) Defective engine control unit	• Unstable idling* • Poor acceleration* • Poor startability*
54	Immobilizer system	Communication problem between the engine control unit and the immobilizer-ECU	(1) Malfunction of communication wire between the engine control unit and immobilizer-ECU (2) Malfunction of immobilizer-ECU (3) Malfunction of engine control unit	• Starting is impossible
59	Oxygen sensor <rear>	Even if engine has been warmed up, oxygen sensor signal voltage does not change to more than 0.1 V.	(1) Defective oxygen sensor (2) Open or short circuit in oxygen sensor circuit, or connector in loose contact (3) Defective engine control unit	• Poor exhaust emission purifying performance

NOTE
*: Failsafe/backup function is in operation.

LIST OF FAIL-SAFE/BACK-UP FUNCTIONS

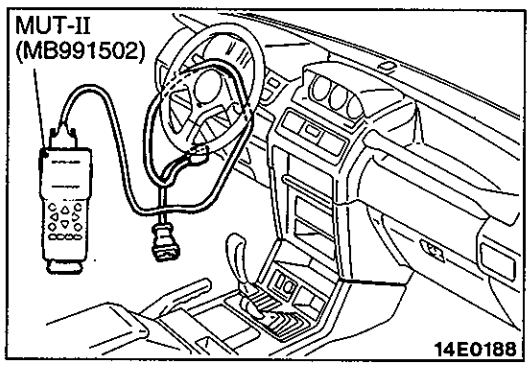
When the failure of a major sensor is detected by the self diagnosis functions, the preset control logic provides controls to assure safe operation of the vehicle.

Trouble item	Controls to be provided in the event of trouble
Air flow sensor	(1) Injector basic drive timing and basic ignition timing read from the preset map based on the throttle position sensor (TPS) signal and engine speed signal (crank angle sensor signal). (2) Idle speed control servo fixed at predetermined position, and no idling speed control achieved.
Intake air temperature sensor	Controls provided on the assumption that intake air temperature is 25°C
Throttle position sensor (TPS)	No additional fuel injection provided on the basis of throttle position sensor signal at acceleration
Engine coolant temperature sensor	Controls provided on the assumption that engine coolant temperature is 80°C (Even if the sensor signal returns to normal, this control mode is retained until the ignition switch is set to OFF.)
Cam position sensor	(1) Fuel injected into all cylinders simultaneously (Provided that no No. 1 cylinder top dead center has been detected since the ignition switch was placed in the ON position) (2) Fuel cut 4 seconds after a failure was detected (Provided that no No. 1 cylinder top dead center has been detected since the ignition switch was placed in the ON position)
Barometric pressure sensor	Controls provided on the assumption that barometric pressure is 101 kPa
Detonation sensor <6G74-SOHC 24 Valve Engine>	The ignition timing is switched from the timing for super petrol to the timing for standard petrol.
Ignition coil and power transistor unit	Fuel cut for cylinders whose ignition signal is abnormal
Oxygen sensor	No air-fuel ratio feedback control (closed loop control) achieved

READ OUT OF MALFUNCTION CODE

Precautions for Operation

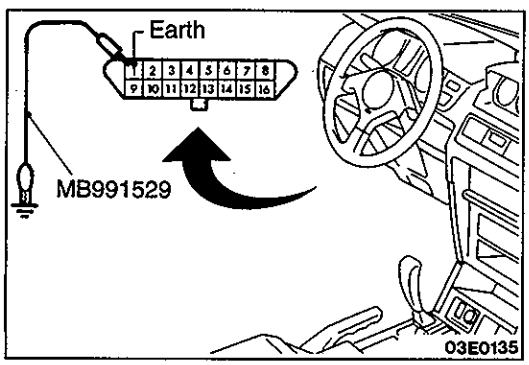
(1) When battery voltage is low, no detection of failure is possible. Be sure to check the battery for voltage and other conditions before starting the test.
(2) Diagnosis item is erased if the battery or the engine control unit connector is disconnected. Do not disconnect the battery before the diagnosis result is completely read.
(3) Be sure to connect or disconnect the MUT-II with the ignition switch turned off.

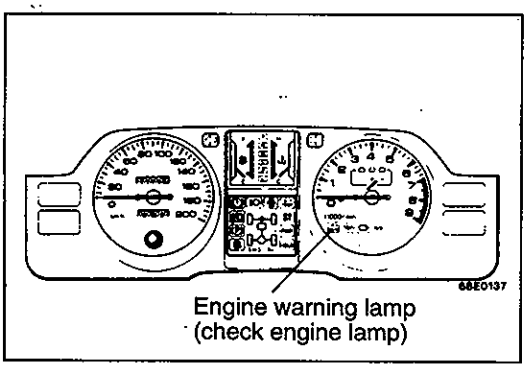


WHEN USING THE MUT-II

Caution
Turn off the ignition switch before disconnecting or connecting the MUT-II.

(1) Connect the MUT-II to the diagnosis connector.
(2) Turn the ignition switch to ON.
(3) Take a reading of the diagnosis output.
(4) Repair the problem location, referring to the diagnosis chart.
(5) After turning the ignition switch once to OFF, turn it back to ON.
(6) Erase the diagnosis code.
(7) Recheck to be sure that the condition is normal.

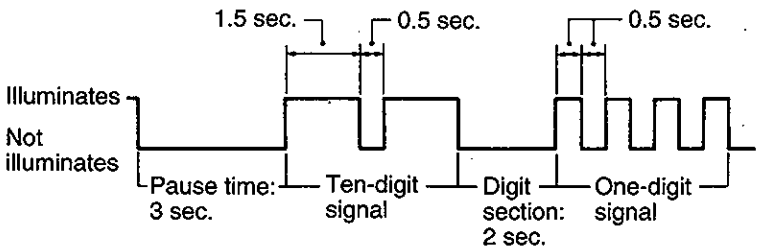
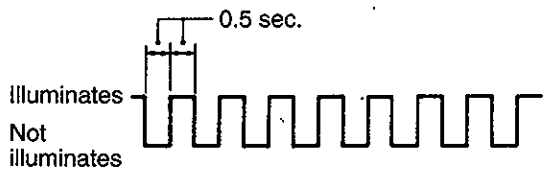




WHEN USING THE ENGINE WARNING LAMP (CHECK ENGINE LAMP)

(1) Use the special tool (diagnosis code check harness) to earth the diagnosis test mode control terminal (terminal ①) of the diagnosis control terminal (16 pin).
(2) Turn the ignition switch to ON.
(3) Take a reading of a diagnosis output according to how often the engine warning lamp flashes.
(4) Repair the problem location, referring to the diagnostic chart.
(5) Erase the diagnostic code by the following procedure.
  ① Turn the ignition switch to OFF.
  ② After removing the battery cable from the battery terminals for 10 seconds or more, reconnect the cable.
  ③ Warm up the engine and let it idle for approx. 15 minutes.
  ④ Turn the ignition switch to ON and take a reading of the diagnostic output to check if a normal code is output.

DIAGNOSIS RESULT DISPLAY METHOD USING THE CHECK ENGINE/MALFUNCTION INDICATOR LAMP

Example of flashing patterns when diagnosis code outputs	Normal flashing pattern
Diagnostic trouble code No. 24  6FU2060	 6FU2061

NOTE
Other diagnosis items are also output as lamp flashing corresponding to MUT-II diagnosis code numbers.

Diagnosis by DIAGNOSIS 2 MODE

(1) Using the MUT-II, changeover the diagnosis mode of the engine control unit to DIAGNOSIS 2 MODE.
(2) Carry out a road test.
(3) Read the diagnosis code in the same manner as "READ OUT OF MALFUNCTION CODE" and repair the malfunctioning part.
(4) Turn the ignition switch OFF and then turn it ON again.

NOTE
By turning the ignition switch OFF, the engine control unit will changeover the diagnosis mode from DIAGNOSIS 2 MODE to DIAGNOSIS 1 MODE.

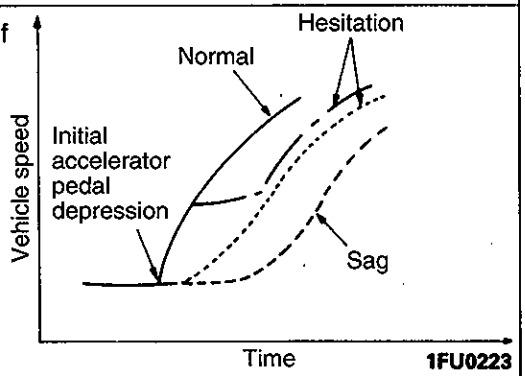
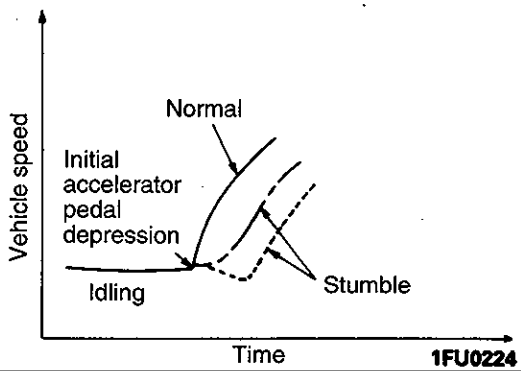
(5) Erase the malfunction codes.

CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS

Problem symptoms / Check Items	Starting		Idling stability			Driving						Stopping	Reference page
	Will not start	Starting problem	Idling instability (Rough idling)	Incorrect idling speed	Improper idling continuity	Hesitation, sag	Poor acceleration	Stumble	Shock	Surge	Knocking	Run-on (Dieseling)	
Power Supply and Ignition Switch-IG	①[1]												P.13-29
Engine Control Unit Power Earth	②[2]												P.13-31
Fuel Pump	③[3]	①[1]			①[1]	①[1]	①[1]						P.13-32
Air Flow Sensor					⑪[11]	⑨[9]		⑤[5]	⑤[5]		④[4]		P.13-35
Intake Air Temperature Sensor			⑤			⑤[5]	④[4]				②[2]		P.13-40
Barometric Pressure Sensor			⑦			⑧[8]	⑥[6]				③[3]		P.13-43
Engine Coolant Temperature Sensor		[3]	⑥[5]	①[1]	⑤[5]	⑦[7]	⑤[5]	④[4]		③[3]			P.13-45
Throttle Position Sensor						⑥[6]		③[3]	④[4]				P.13-48
Idle Position Switch			③[3]	②[2]	④[4]								P.13-51
Cam Position Sensor	⑤[5]	⑥[7]			⑧[7]				②[2]				P.13-54
Crank Angle Sensor	⑥[6]	⑦[8]			⑨[8]				③[3]				P.13-58
Ignition Switch-ST <M/T>	④[4]	③[4]											P.13-61
Ignition Switch-ST and Inhibitor Switch <A/T>	④[4]	③[4]		⑤									P.13-62
Vehicle Speed Sensor					⑥				⑥				P.13-64
Power Steering Fluid Pressure Switch				③									P.13-66
Air Conditioner Switch and Power Relay				④									P.13-68
Detonation Sensor <6G74-SOHC 24 Valve Engine>											①[1]		P.13-70
Oxygen Sensor			⑨										<6G72> 13-72 <6G74> 13-75
Injectors	⑧[8]	②[2]	②[2]		③[3]	②[2]	②[2]	①[1]		①[1]		①	P.13-79
Idle Speed Control Servo (Stepper Motor)		④[5]	①[1]	⑥[3]	②[2]				⑧[6]				P.13-84
Ignition Coil and Power Transistor	⑦[7]				⑩[9]		⑥[6]		①[1]		⑤[5]		P.13-89
Purge Solenoid			⑧										P.13-95
EGR Control Solenoid Valve						④[4]		⑥[6]		④[4]			P.13-97
Anti-skid Brake Signal									⑦				P.13-99
Fuel Pressure		⑤[6]	④[4]		⑦[6]	③[3]	③[3]	②[2]		②[2]			P.13-100

○: Warm engine (figures inside the ○ indicate the checking sequence.)
□: Cold engine (figures inside the □ indicate the checking sequence.)

PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

Item		Symptom
Starting	Won't start (no initial combustion)	The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start.
	Starting problem (initial combustion, then stall)	There is combustion within the cylinders, but then the engine soon stalls.
	(Starting takes a long time.)	Engine won't start quickly.
Idling stability	Idling instability (Rough idling)	Engine speed doesn't remain constant; changes during idling. 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. This is called rough idling.
	Incorrect idling speed	The engine doesn't idle at the usual correct speed.
	Improper idling continuity Die out Pass out	This non-continuity of idling includes the following elements. (1) Die out..... The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicle is moving or not. (2) Pass out ..... The engine stalls when the accelerator pedal is depressed or while it is being used.
Driving	Hesitation Sag	"Hesitation" is the delay in response of the vehicle speed (engine r/min) that 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 r/min) during such acceleration. Serious hesitation is called "sag". 
	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	Engine r/min response is delayed when the accelerator pedal is initially depressed for acceleration from the stopped condition. 
	Shock	The feeling of a comparatively large impact or vibration when the engine is accelerated or decelerated.
	Surge	This is repeated surging ahead during constant speed travel or during variable speed travel.
	Knocking	A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving.
Stopping	Run-on (Dieseling)	The engine continues to run even after the switch is turned OFF. This is called dieseling.

SERVICE ADJUSTMENT PROCEDURES

ACCELERATOR CABLE INSPECTION AND ADJUSTMENT <VEHICLES WITHOUT AUTOCRUISE CONTROL SYSTEM>

Refer to Basic Manual.

FUEL FILTER REPLACEMENT

Refer to Basic Manual.

FUEL GAUGE UNIT REPLACEMENT

Refer to Basic Manual.

2-WAY VALVE REPLACEMENT

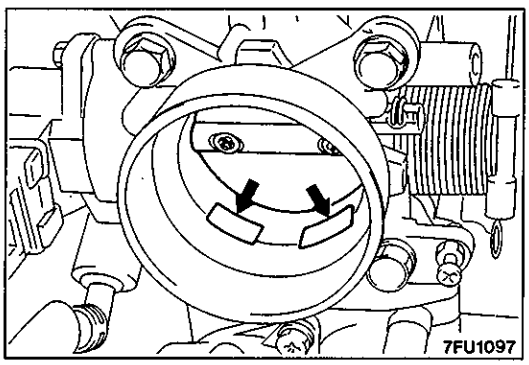
Refer to Basic Manual.

FUEL PUMP OPERATION CHECK

Refer to Basic Manual.

HOW TO REDUCE THE FUEL LINE INTERNAL PRESSURE

Refer to Basic Manual.

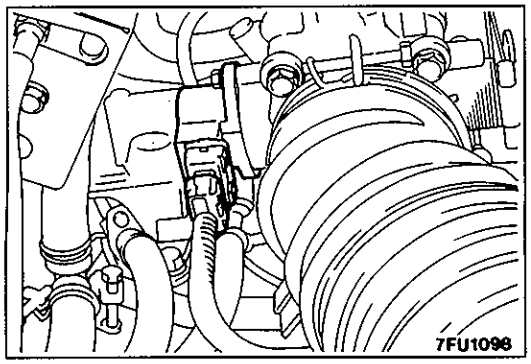


THROTTLE BODY (THROTTLE VALVE AREA) CLEANING

1. Start the engine and warm it up until the coolant is heated to 80°C or higher and then stop the engine.
2. Remove the air intake hose from the throttle body.
3. Plug the bypass passage inlet of the throttle body.

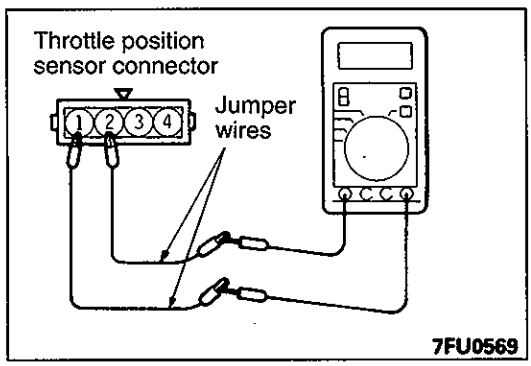
   Caution
   Do not allow cleaning solvent to enter the bypass passage.
4. Spray cleaning solvent into the valve through the throttle body intake port and leave it for about 5 minutes.
5. Start the engine, race it several times and idle it for about 1 minute. If the idling speed becomes unstable (or if the engine stalls) due to the bypass passage being plugged, slightly open the throttle valve to keep the engine running.
6. If the throttle valve deposits are not removed, repeat steps 4 and 5.
7. Unplug the bypass passage inlet.
8. Attach the air intake hose.
9. Use the MUT-II to erase the diagnosis code.
10. Adjust the basic idle speed.

    NOTE
    If the engine hunts while idling after adjustment of the basic idle speed, disconnect the (–) cable from the battery for 10 seconds or more, and then reconnect it and run the engine at idle for about 10 minutes.

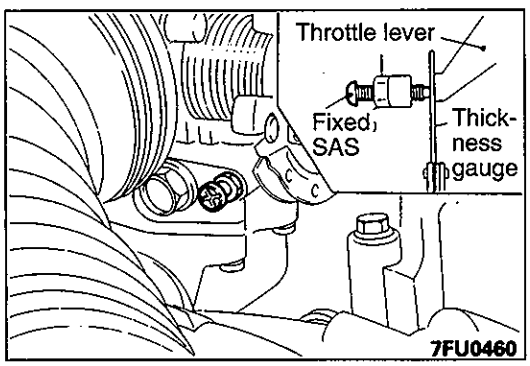


IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT

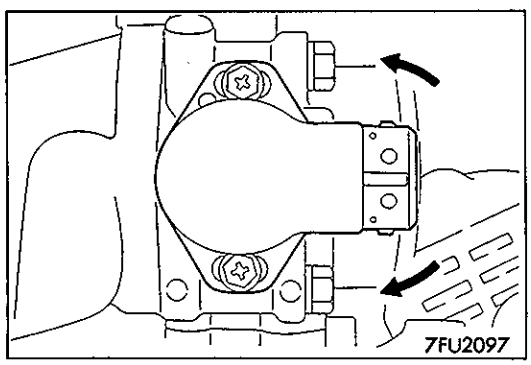
1. Connect the MUT-II to the diagnosis connector.
   When not using the MUT-II, proceed as follows;
   (1) Disconnect the connector of the throttle position sensor.



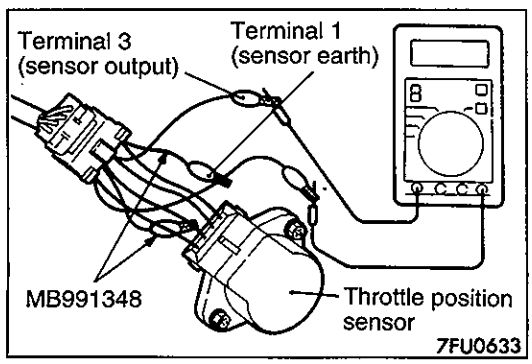
   (2) Connect an ohmmeter between terminal 2 (idle position switch) and terminal 1 (sensor earth) by using jumper wires.



2. Insert a thickness gauge as follows:
   Insert a thickness gauge with a thickness of 0.65 mm between the fixed SAS and the throttle lever.
3. Turn the ignition switch to ON (but do not start the engine).

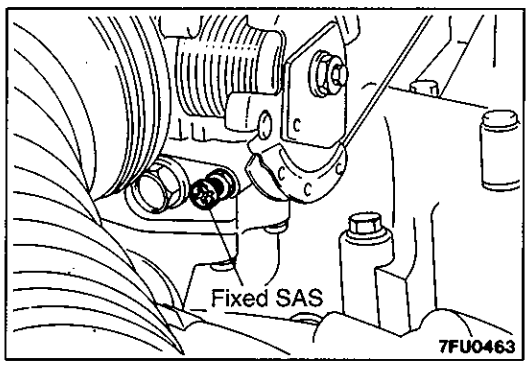


4. Loosen the throttle position sensor mounting bolt, and then turn the throttle position sensor clockwise as far as it will go.
5. Check that the idle position switch is ON at this position.
6. Slowly turn the throttle position sensor counterclockwise and find the point where the idle position switch turns off. Securely tighten the throttle position sensor mounting bolt at this point.



7. When not using the MUT-II, proceed as follows;
   (1) Disconnect the throttle position sensor connector, and connect the special tool (test harness: MB991348) in between.
   (2) Connect digital voltmeter between terminal 3 (sensor output) and terminal 1 (sensor earth).
   (3) Turn the ignition switch to ON (but do not start the engine).

8. Check the throttle position sensor output voltage.
   Standard value: 400 – 1,000 mV
9. If there is a deviation from the standard value, check the throttle position sensor and the related harness.
10. Remove the thickness gauge.
11. Turn the ignition switch to OFF.
12. Disconnect the MUT-II.
    When the MUT-II is not used, remove the special tool, and connect the throttle position sensor.



FIXED SAS ADJUSTMENT

NOTE
1. The fixed SAS should not be moved unnecessarily; it has been precisely adjusted by the manufacturer.
2. If the adjustment is disturbed for any reason, readjust as follows.

1. Loosen the tension of the accelerator cable sufficiently.
2. Back out the fixed SAS lock nut.
3. Turn the fixed SAS counterclockwise until it is sufficiently backed out, and fully close the throttle valve.
4. Tighten the fixed SAS until the point where the throttle lever is touched (i.e., the point at which the throttle valve begins to open) is found.
   From that point, tighten the fixed SAS 1 1/4 turn.
5. While holding the fixed SAS so that it doesn't move, tighten the lock nut securely.
6. Adjust the tension of the accelerator cable.
7. Adjust the basic idling speed.
8. Adjust the idle position switch and throttle position sensor.

BASIC IDLE SPEED ADJUSTMENT

NOTE
(1) The standard idling speed has been adjusted, by the speed adjusting screw (SAS), by the manufacturer, and there should usually be no need for readjustment.
(2) If the adjustment has been changed by mistake, the idle speed may become too high or the idle speed may drop too low when loads from components such as the A/C are placed on the engine. If this occurs, adjust by the following procedure.
(3) The adjustment, if made, should be made after first confirming that the spark plugs, the injectors, the idle speed control servo, the compression pressure, etc., are all normal.

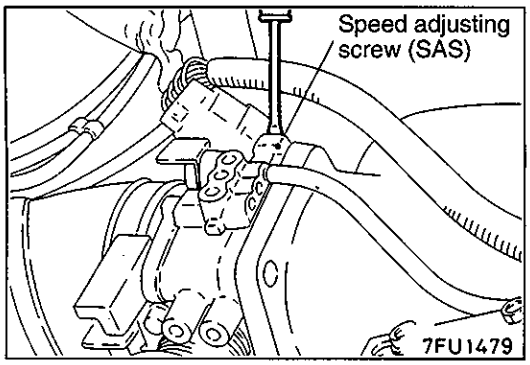
1. Perform inspection, with the vehicles in the following condition.
   - Engine coolant temperature: 80 – 95°C
   - Lights and all accessories: OFF
   - Transmission: Neutral (P range for vehicles with automatic transmission)
2. Connect the MUT-II to the diagnosis connector (16-pin).

   NOTE
   When the MUT-II is connected, the diagnosis control terminal should be earthed.
3. Start the engine and run at idle.
4. Select the item No. 30 of the MUT-II Actuator test.

   NOTE
   This holds the ISC servo at the basic step to adjust the basic idle speed.
5. Check the idle speed.

   Standard value: 700 ± 50 r/min

   NOTE
   (1) The engine speed may be 20 to 100 r/min lower than indicated above for a new vehicle [driven approximately 500 km or less], but no adjustment is necessary.
   (2) If the engine stalls or the engine speed is low even though the vehicle has been driven approximately 500 km or more, it is probable that deposits are adhered to the throttle valve, so clean it.



6. If not within the standard value range, turn the speed adjusting screw (SAS) to make the necessary adjustment.

   NOTE
   If the idling speed is higher than the standard value range even when the SAS is fully closed, check whether or not there is any indication that the fixed SAS has been moved. If there is an indication that it has been moved, adjust the fixed SAS.

7. Press the MUT-II clear key, and release the ISC servo from the Actuator test mode.

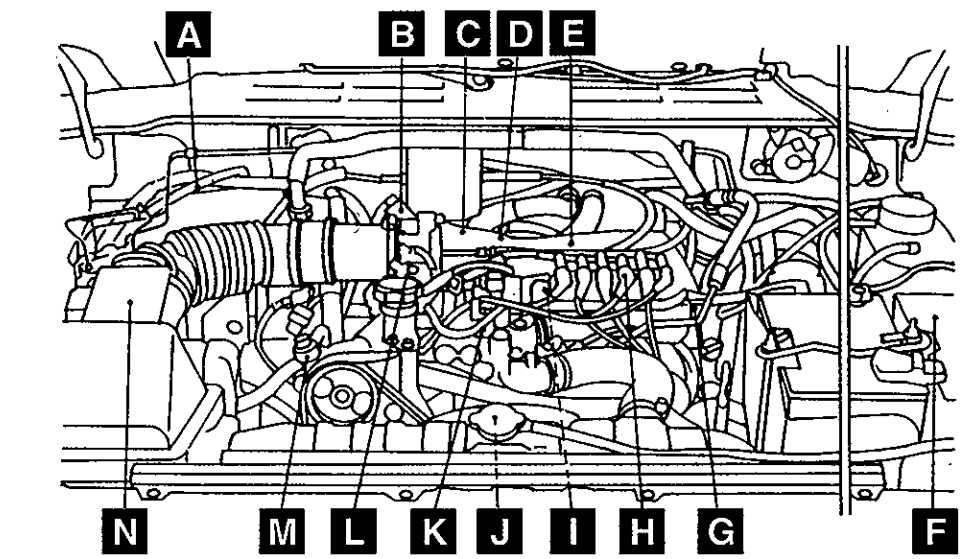
   NOTE
   Unless the ISC servo is released, the Actuator test mode will continue 27 minutes.

8. Switch OFF the ignition switch.
9. Disconnect the MUT-II.
10. Start the engine again and let it run at idle speed for about 10 minutes; check that the idling condition is normal.

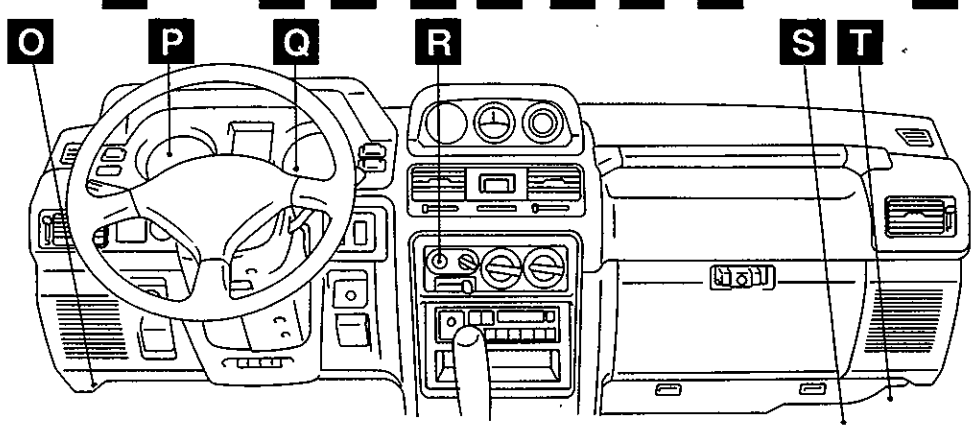
ON-VEHICLE INSPECTION OF MPI COMPONENTS

COMPONENT LOCATION

Name	Symbol	Name	Symbol
Air conditioner relay	F	Fuel pump check terminal	A
Air conditioner switch	R	Idle speed control servo	L
Air flow sensor (incorporating intake air temperature sensor and barometric pressure sensor)	N	Ignition coil (power transistor)	H
		Inhibitor switch	U
Cam position sensor	G	Injector	E
Control relay/Fuel pump relay	T	Oxygen sensor <6G72-SOHC 24 Valve Engine>	V
Crank angle sensor	J	Oxygen sensor <6G74-SOHC 24 Valve Engine>	W
Detonation sensor <6G74-SOHC 24 Valve Engine>	I	Power steering fluid pressure switch	M
Diagnosis connector	O	Purge control solenoid valve	D
EGR control solenoid valve	C	Throttle position sensor (with idle position switch)	B
Engine control unit	S		
Engine coolant temperature sensor	K	Vehicle speed sensor	P
Engine warning lamp (check engine lamp)	Q		

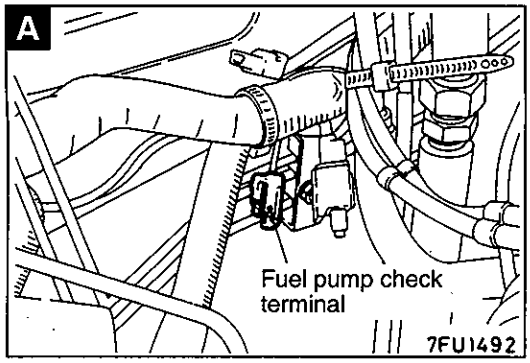


7FU2256

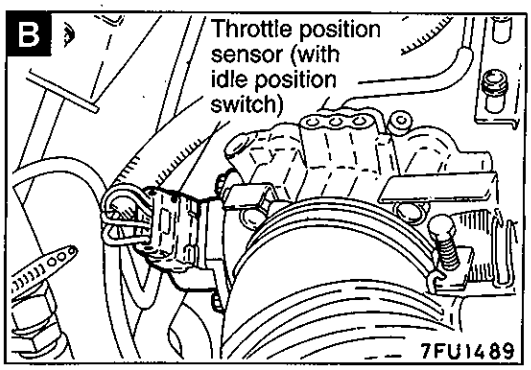


7FU1167

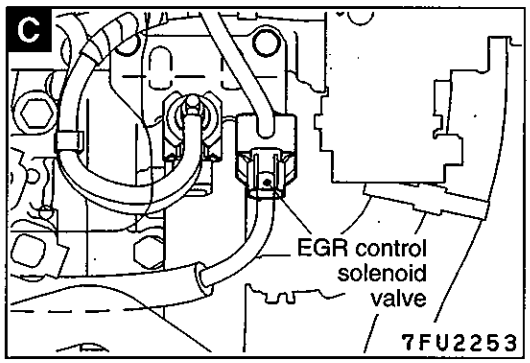
A


Fuel pump check terminal
7FU1492

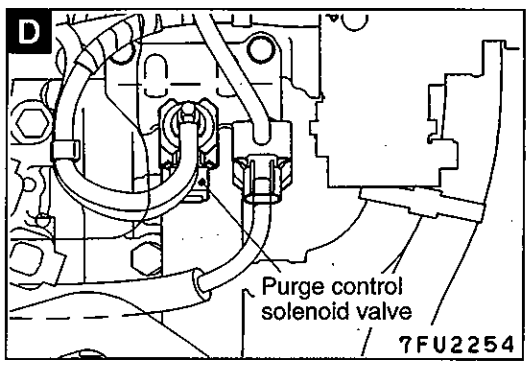
B


Throttle position sensor (with idle position switch)
7FU1489

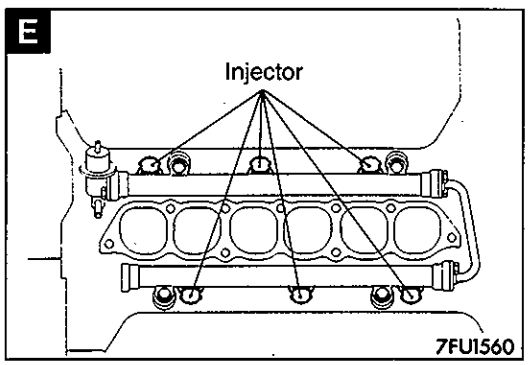
C


EGR control solenoid valve
7FU2253

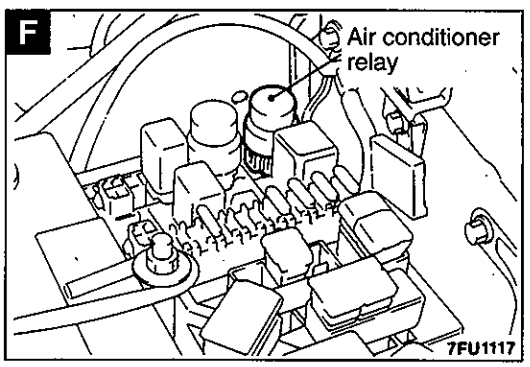
D


Purge control solenoid valve
7FU2254

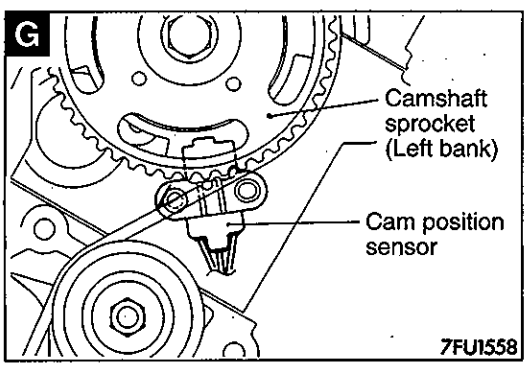
E


Injector
7FU1560

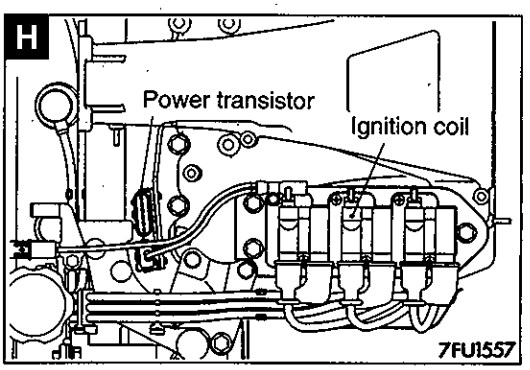
F


Air conditioner relay
7FU1117

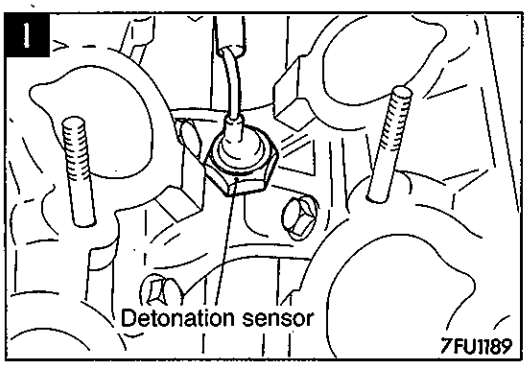
G


Camshaft sprocket (Left bank)
Cam position sensor
7FU1558

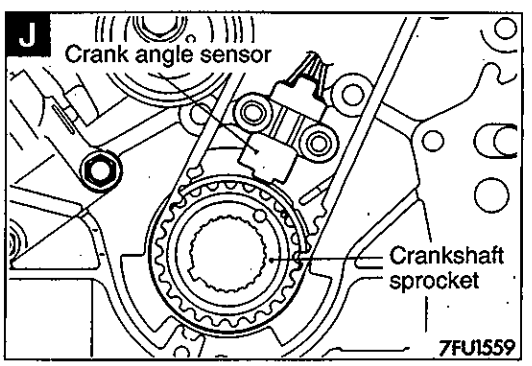
H


Power transistor
Ignition coil
7FU1557

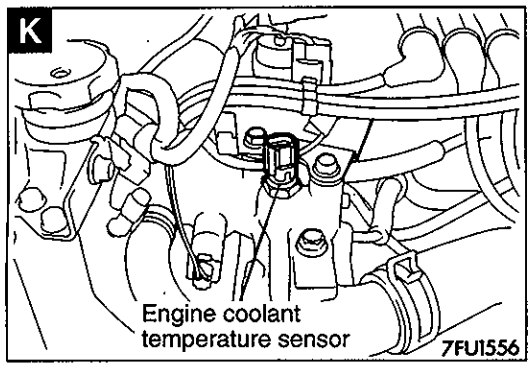
I


Detonation sensor
7FU1189

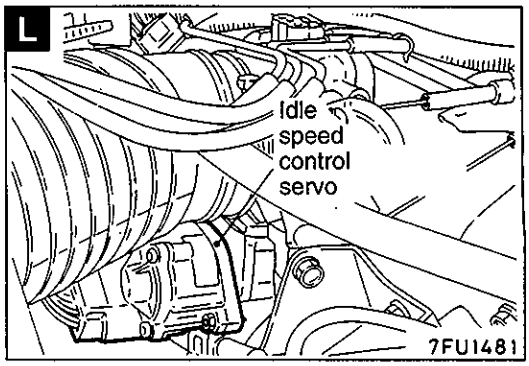
J


Crank angle sensor
Crankshaft sprocket
7FU1559

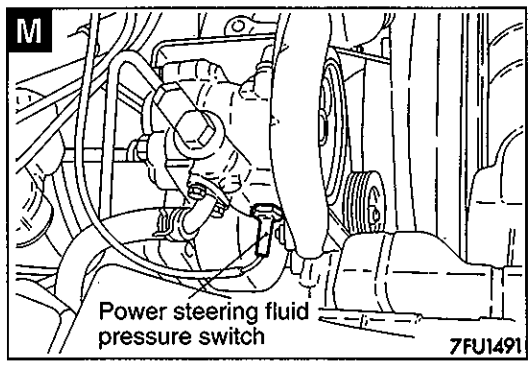
K


Engine coolant temperature sensor
7FU1556

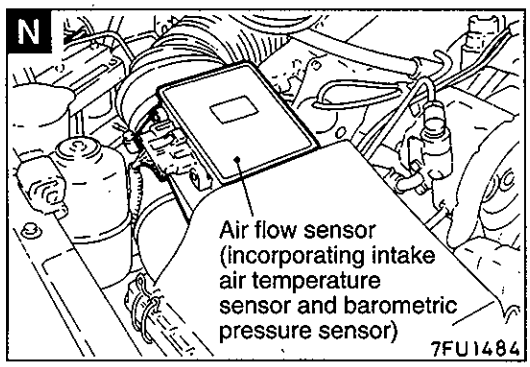
L


Idle speed control servo
7FU1481

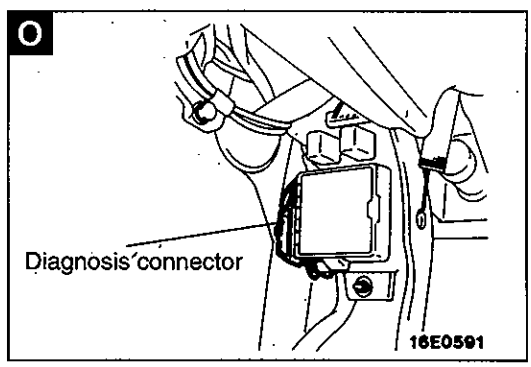
M


Power steering fluid pressure switch
7FU1491

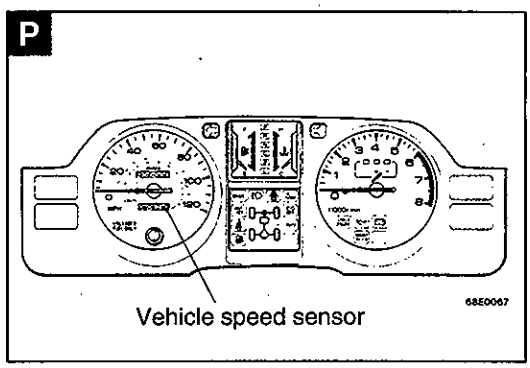
N


Air flow sensor (incorporating intake air temperature sensor and barometric pressure sensor)
7FU1484

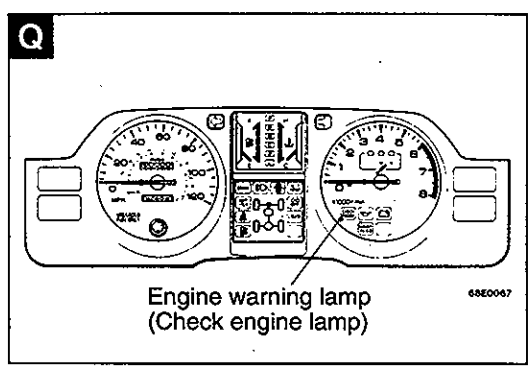
O


Diagnosis connector
16E0591

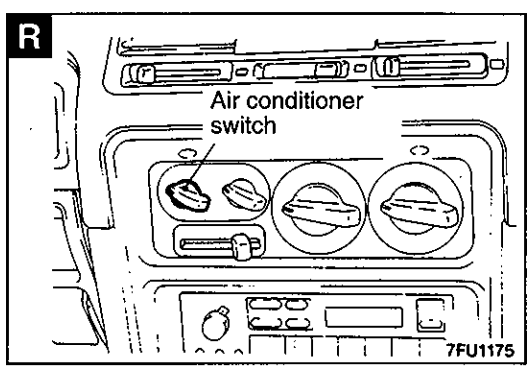
P


Vehicle speed sensor
68E0067

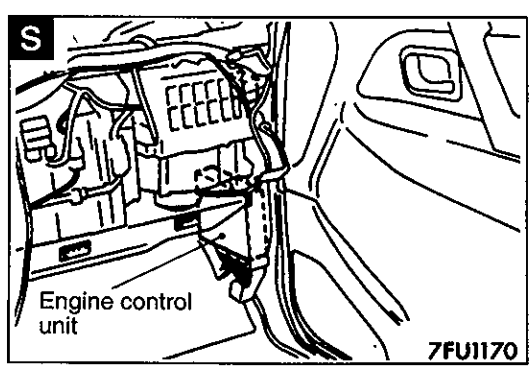
Q


Engine warning lamp (Check engine lamp)
68E0067

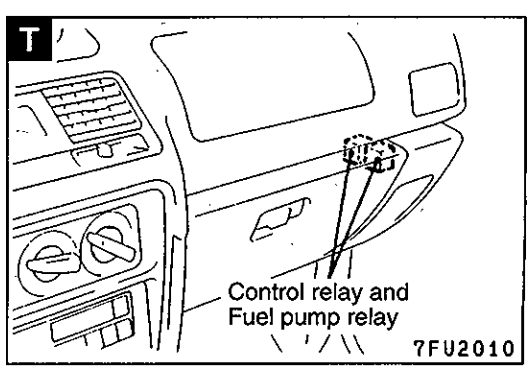
R

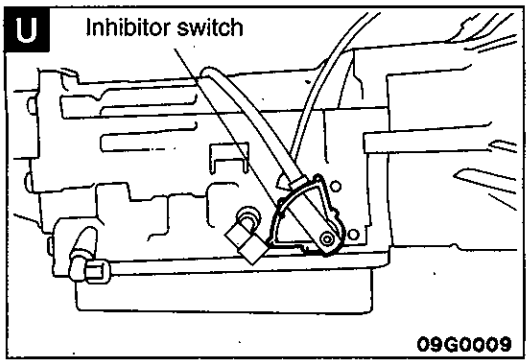

Air conditioner switch
7FU1175

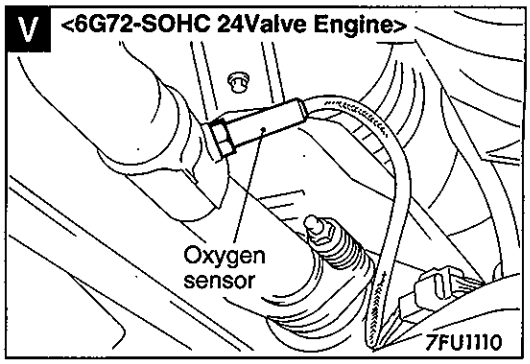
S

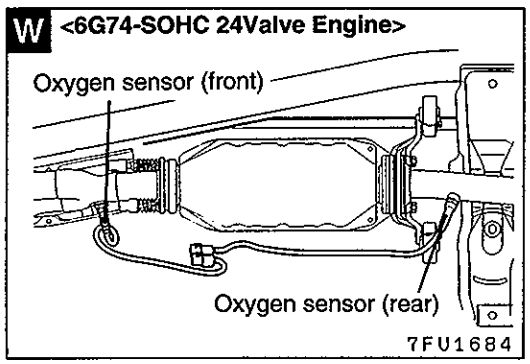

Engine control unit
7FU1170

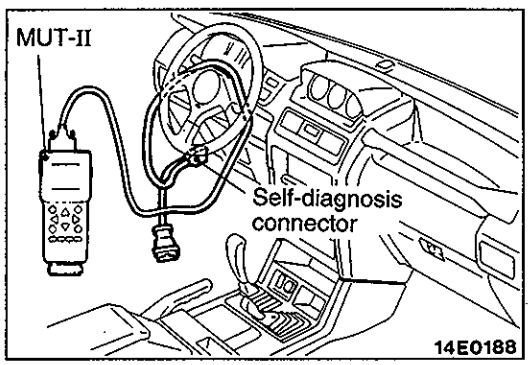
T


Control relay and Fuel pump relay
7FU2010







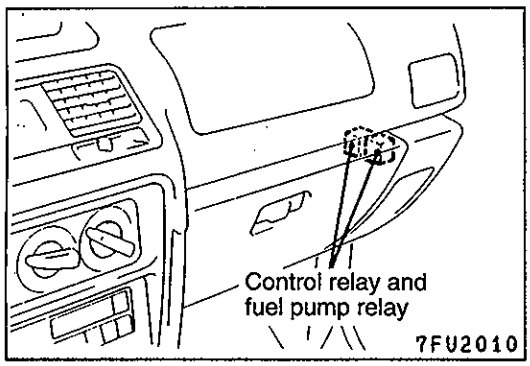


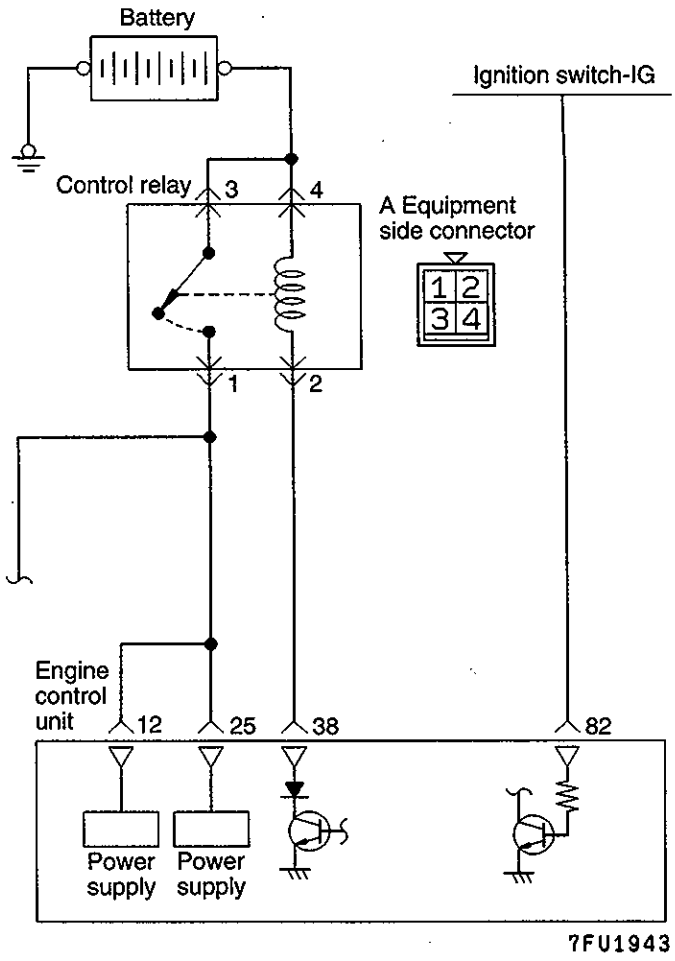
COMPONENT INSPECTION PROCEDURE

USING MUT-II

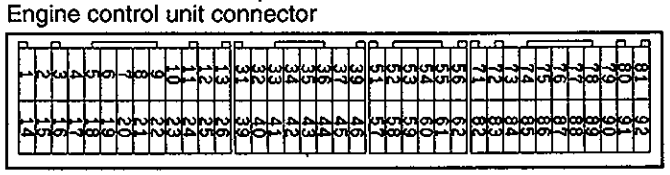
(1) Check by the service data and actuator test function. If any abnormality is found, check the body harness, components, etc. and repair as necessary.
(2) After repair, check again with the MUT-II to make sure that the input and output signals are now normal.
(3) Erase the self-diagnosis malfunction code in memory.
(4) Disconnect the MUT-II.
(5) Start the engine and perform running test, etc. to make sure that the troubles have been corrected.

POWER SUPPLY (Control relay) AND IGNITION SWITCH-IG





Engine control unit connector



9FU0393

OPERATION

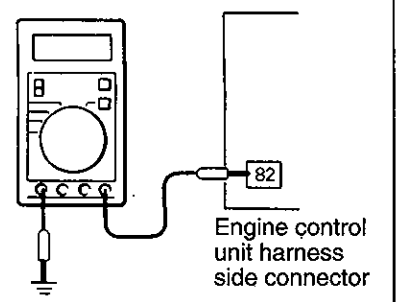
- While the ignition switch is ON, battery power is supplied to the engine control unit, the injector, the air flow sensor, etc.
- When the ignition switch is turned ON, the battery voltage is applied from the ignition switch to the engine control unit, which then turns ON the power transistor to energize the control relay coil. This turns ON the control relay switch and the power is supplied from the battery to the engine control unit through the control relay switch.

INSPECTION

Using MUT-II

Function	Item No.	Data display	Check condition	Standard value
Data reading	16	Engine control unit power voltage	Ignition switch: ON	SV

1



Measure the ignition switch (IG) terminal input voltage.

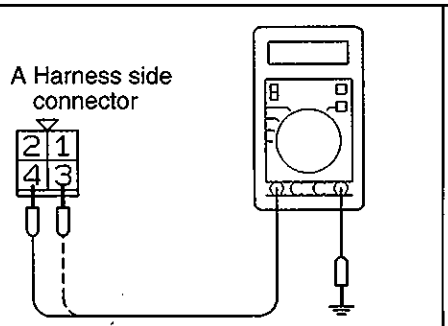
- Engine control unit connector: Disconnected

Ignition switch	Voltage (V)
OFF	0 – 1
ON	SV

OK → 2

Repair the harness. (Ignition switch – 82) or check the ignition switch.

2



Measure the power supply voltage of the control relay.

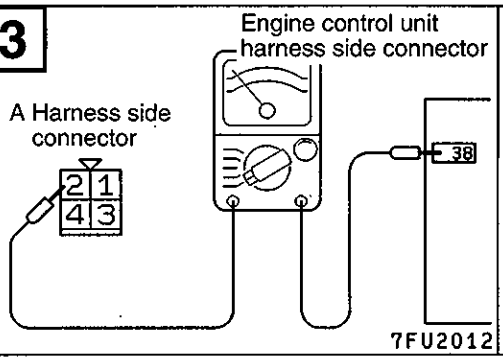
- Ignition switch: OFF
- Control relay connector: Disconnected

Voltage (V)
SV

OK → 3

Repair the harness. (Battery– Ⓐ 3, Ⓐ 4)

3



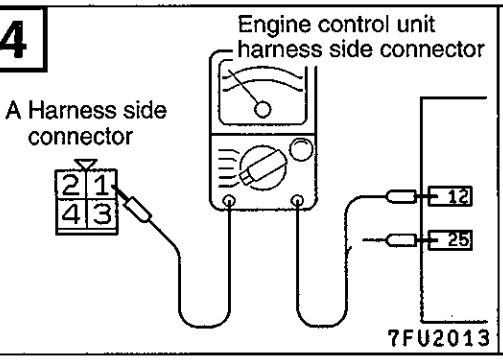
Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the control relay.

- Engine control unit connector: Disconnected
- Control relay connector: Disconnected

OK → 4

Repair the harness. (Ⓐ 2 – 38)

4



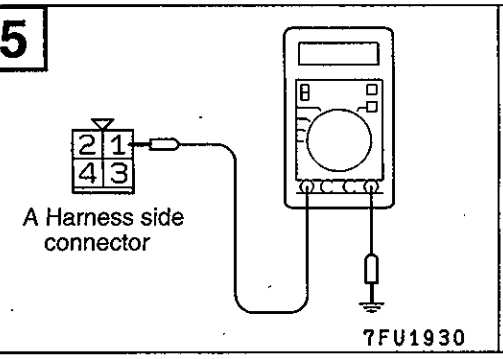
Check for an open–circuit, or a short-circuit to earth between the engine control unit and the control relay.

- Control relay connector: Disconnected
- Engine control unit connector: Disconnected

OK → 5

Repair the harness. (Ⓐ 1 – 12, 25)

5



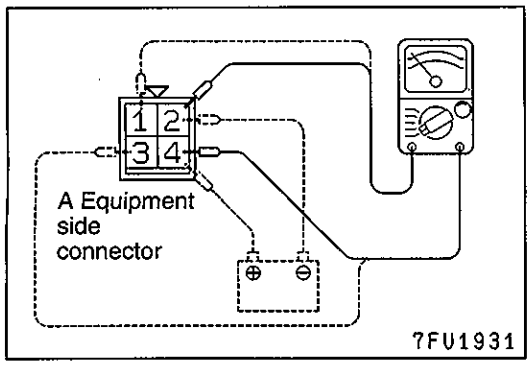
Measure power voltage to the actuator.

- Control relay connector: Connected
- Engine control unit connector: Connected

Engine	Voltage (V)
Cranking	8 V or higher
Racing	SV

OK → STOP

Replace the control relay or defective engine control unit



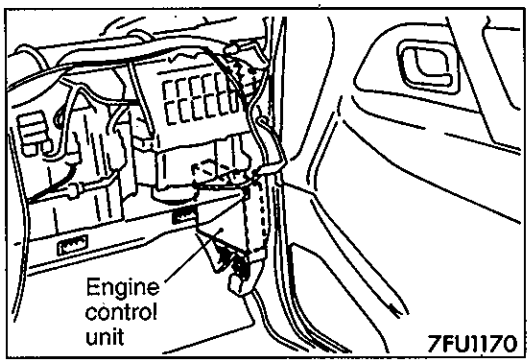
CONTROL RELAY INSPECTION

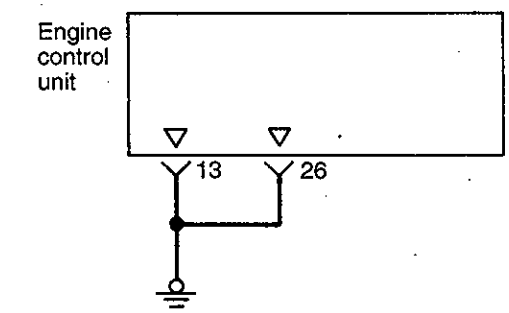
(1) Check for continuity between the control relay terminals.

Battery voltage	Terminal No.			
	1	2	3	4
Not supplied		○		○
Supplied	○		○	
		⊖		⊕

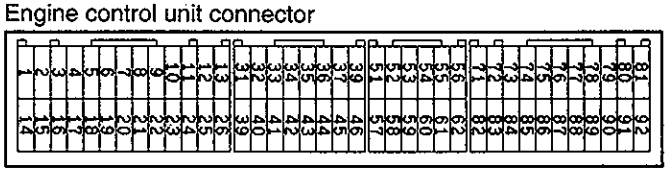
(2) If there is a problem, replace the control relay.

ENGINE CONTROL UNIT POWER EARTH





Engine control unit connector



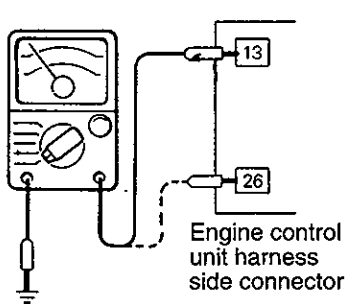
OPERATION

Earth the engine control unit.

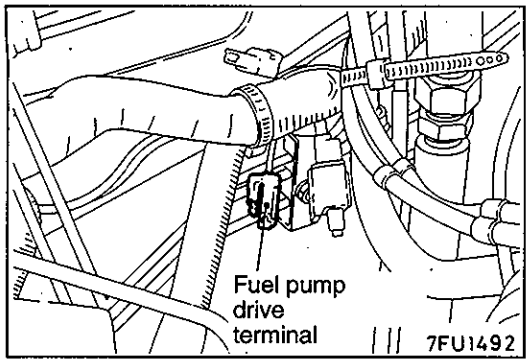
TROUBLESHOOTING HINTS

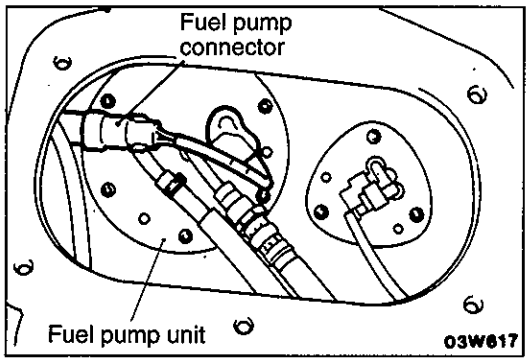
If the earth wire of the engine control unit is not connected securely to earth, the unit will not operate correctly.

HARNESS INSPECTION

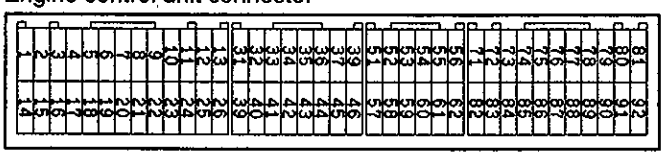
1		Check for continuity of the earth circuit ● Engine control unit connector: Disconnected	OK → STOP NG → Repair the harness. (13 – Earth) (26 – Earth)

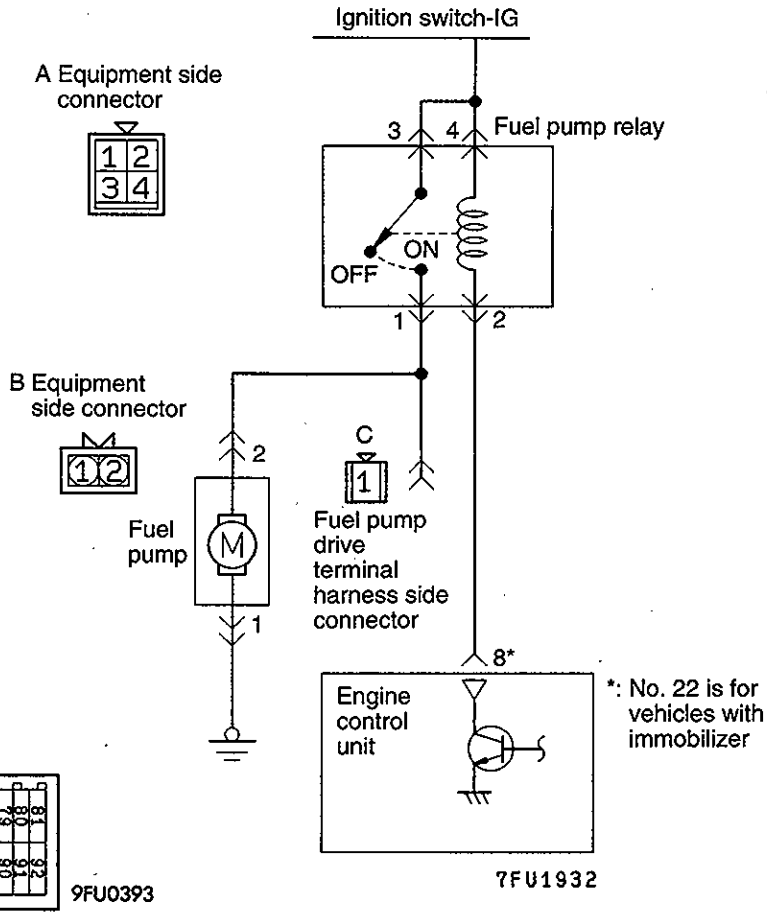
FUEL PUMP





Engine control unit connector





OPERATION

- The fuel pump is driven when the engine is cranking and while the engine is running.
- When the engine is cranking and while the engine is running, the engine control unit turns the power transistor ON to supply power to the fuel pump relay coil. This causes the fuel pump relay switch to turn ON, and current is supplied from the ignition switch via the fuel pump relay switch to drive the fuel pump.

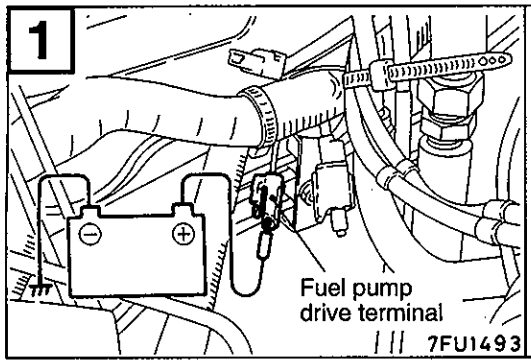
INSPECTION

Using MUT-II

Function	Item No.	Activation	Check conditions	Check description	Normal condition
Actuator test	07	Activates the fuel pump and circulates the fuel.	• Engine cranking • Fuel pump forced activation Make the check under both of the above conditions.	Pinch the return hose and feel the pulsations of the fuel flow.	Pulsations can be felt.
				Listen close to the fuel tank for the sound of the pump operating.	Sound can be heard.

HARNESS INSPECTION

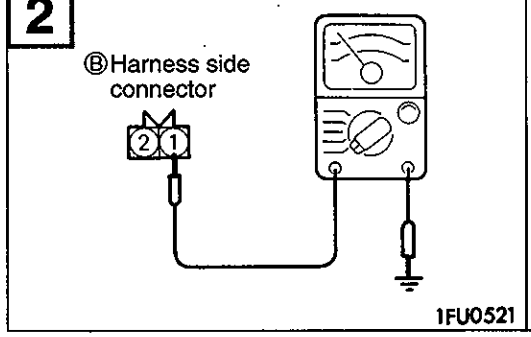
1



Check the fuel pump.
- Apply battery voltage to the fuel pump drive terminal and operate the pump.

OK → 4
NO → 2

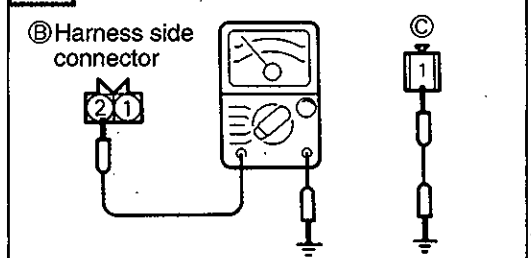
2



Check for continuity of the fuel pump earthing line.
- Fuel pump connector: Disconnected

OK → 3
NO → Repair the harness. (Ⓑ 1 – Earth)

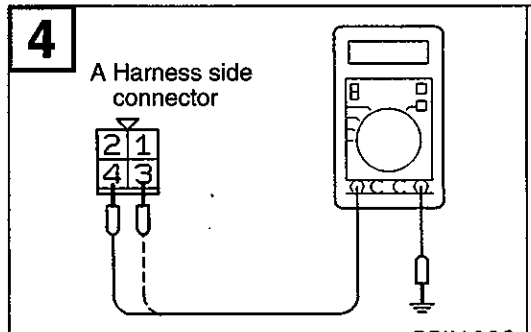
3



Check for open-circuit or short-circuit between the fuel pump and the fuel pump drive terminal.
- Fuel pump connector: Disconnected
- Fuel pump relay connector: Disconnected

OK → 4
NO → Repair the harness. (Ⓑ 2 – Ⓒ 1)

4

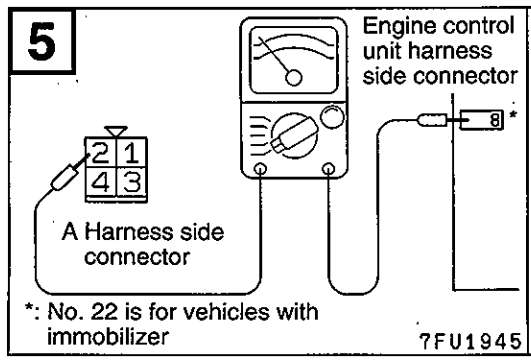


Measure the power supply voltage of the fuel pump relay
- Fuel pump relay connector: Disconnected

Ignition switch	Voltage (V)
OFF	0 – 1
ON	SV

OK → 5
NO → Repair the harness. (Ignition switch – Ⓐ 3, Ⓐ 4 or check for ignition switch.

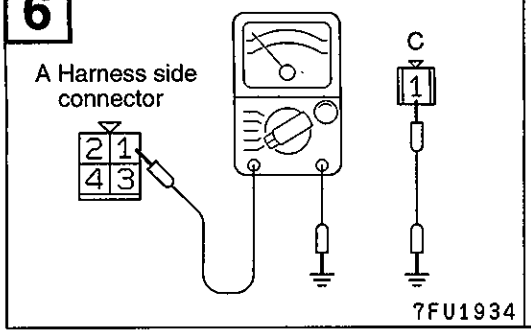
5



Check for an open-circuit, or a short-circuit to earth between the fuel pump relay and the engine control unit.
- Fuel pump relay connector: Disconnected
- Engine control unit connector: Disconnected

OK → 6
NO → Repair the harness. (Ⓐ 2 – 8 or 22)

6

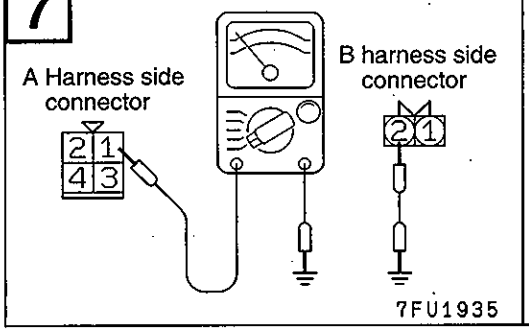


Check for continuity between the fuel pump drive terminal and the control relay.
- Fuel pump relay connector: Disconnected
- Fuel pump connector: Disconnected

OK → 7

NG → Repair the harness. (Ⓐ 1 – Ⓒ 1)

7

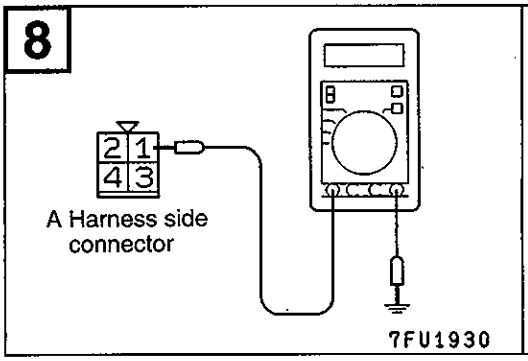


Check for an open-circuit, or a short-circuit to earth between the fuel pump relay and the fuel pump.
- Fuel pump relay connector: Disconnected
- Fuel pump connector: Disconnected

OK → 8

NG → Repair the harness. (Ⓐ 1 – Ⓑ 2)

8

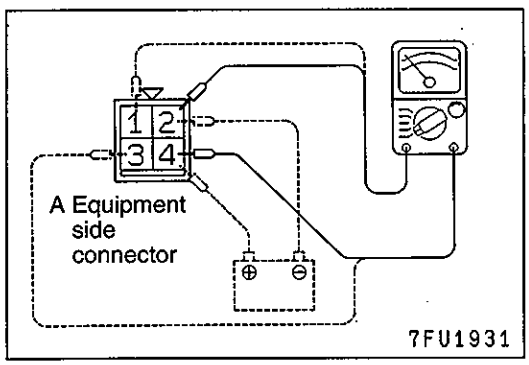


Measure the power supply voltage of the fuel pump.
- Fuel pump relay connector: Connected
- Engine control unit connector: Connected

Engine	Voltage (V)
Cranking	8 V or more
Racing	SV

OK → STOP

NG → Fuel pump relay or engine control unit is defective.



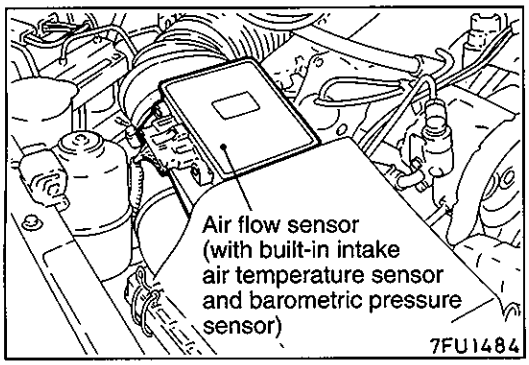
FUEL PUMP RELAY CHECK

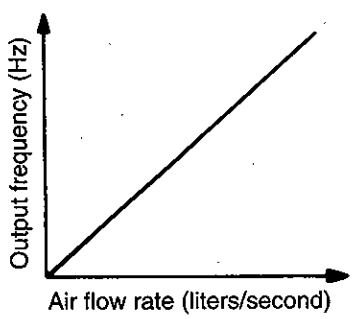
(1) Check for continuity between the fuel pump relay terminals.

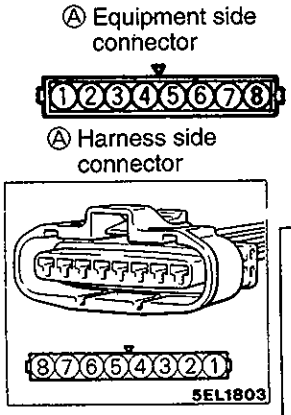
Battery voltage	Terminal No.			
	1	2	3	4
Not supplied		○		○
Supplied	○		○	
		⊖		⊕

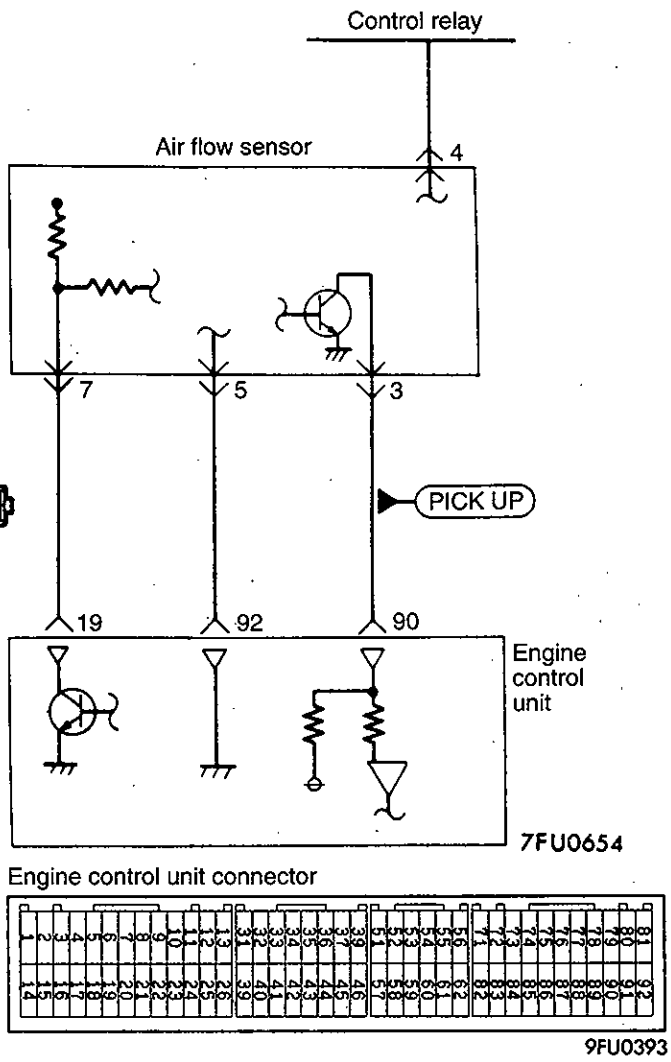
(2) If there is a problem, replace the fuel pump relay.

AIR FLOW SENSOR









OPERATION

- The air flow sensor located in the air cleaner converts the engine intake air volume into a pulse signal of frequency proportional to the air volume and inputs it to the engine control unit, which then computes the fuel injection rate, etc. based on the input signal.
- The air flow sensor power is supplied from the control relay to the air flow sensor and is earthed in the engine control unit. The air flow sensor generates a pulse signal as it repeatedly opens and closes between the 5 V voltage supplied from the engine control unit and earth.

TROUBLESHOOTING HINTS

Hint 1: If the engine stalls occasionally, crank the engine and shake the air flow sensor harness. If the engine stalls, poor contact of the air flow sensor connector is suspected.

Hint 2: If the air flow sensor output frequency is other than 0 when the ignition switch is turned on (but not starting the engine), faulty air flow sensor or engine control unit is suspected.

Hint 3: If the engine can be run idle even though the air flow sensor output frequency is out of specification, troubles are often found in other than the air flow sensor itself.

[Examples]

(1) Disturbed air flow in the air flow sensor (Disconnected air duct, clogged air cleaner element)
(2) Poor combustion in the cylinder (Faulty ignition plug, ignition coil, injector, incorrect compression pressure, etc.)
(3) Air leaking into the intake manifold through gap of gasket, etc.
(4) Loose EGR valve seat.

INSPECTION

Using MUT-II

<Air Flow Sensor>

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	12	Sensor air volume (frequency)	• Engine coolant temperature: 80 – 95°C • Lamps and accessories: OFF • Transmission: Neutral (P range for vehicles with A/T)	700 r/min (Idle)	25 – 51 Hz
				2500 r/min	74 – 114 Hz
				Racing	Frequency increases with racing

NOTE

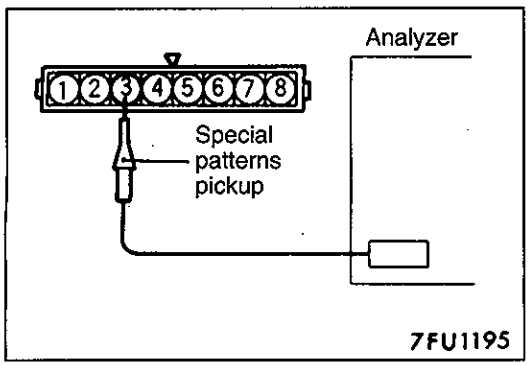
When the vehicle is new [within initial operation of about 500 km] the air flow sensor output frequency may be about 10 % higher.

<Air Flow Sensor Reset Signal>

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data list	34	Reset signal condition	• Warm up the engine	700 r/min (Idle)	ON
				2500 r/min	OFF

<Volumetric Efficiency>

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data list	37	Volumetric efficiency	• Engine coolant temperature: 80 – 95°C • Lamps, accessory operation: OFF • Transmission: Neutral (P range for vehicles with A/T)	700 r/min (Idle)	15 – 35 %
				2500 r/min	15 – 35 %
				Sudden racing	Frequency increases with racing

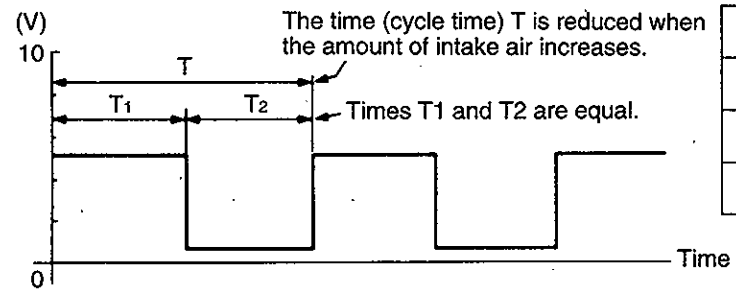


Wave Pattern Inspection Using an Analyzer

Measurement method

(1) Disconnect the air flow sensor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
(2) Connect the analyzer special patterns pickup to terminal ③ of the air flow sensor connector.

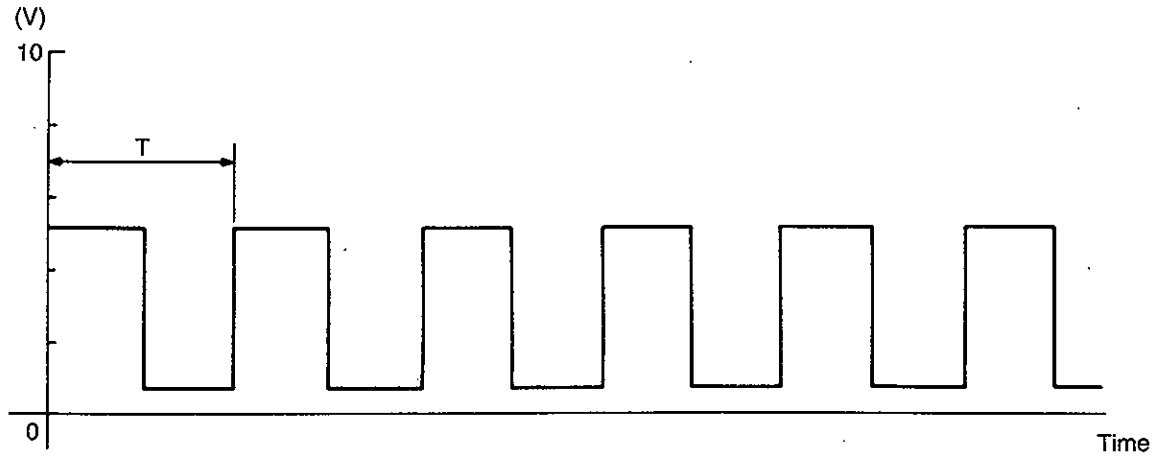
Standard wave pattern



Observation conditions

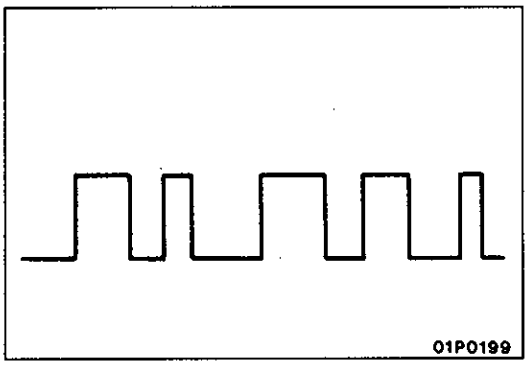
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed (700 r/min)

Observation conditions (from conditions on above engine speed is increased by racing.)



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.

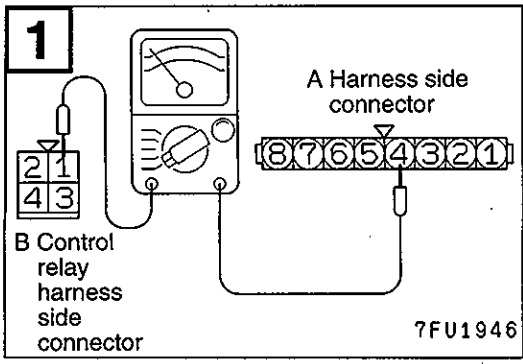
- Example 2

  Cause of problem
  Damaged rectifier or vortex generation column

  Wave pattern characteristics

  Unstable wave pattern with non-uniform frequency. However, when an ignition leak occurs during acceleration, the wave pattern will be distorted temporarily, even if the air flow sensor is normal.

1



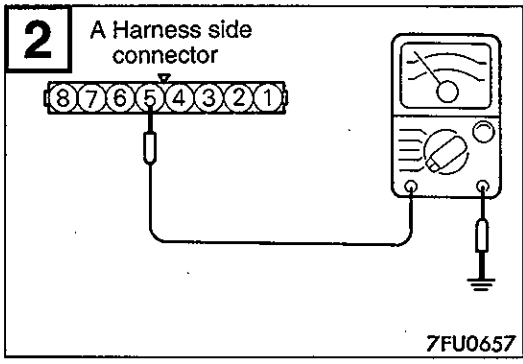
Check the continuity between the air flow sensor and the control relay.
- Control relay connector: Disconnected
- Air flow sensor connector: Disconnected

NOTE
Touch the circuit tester probes to both ends of the harness.

OK → 2

NO → Repair the harness. (Ⓐ 4 – Ⓑ 1)

2

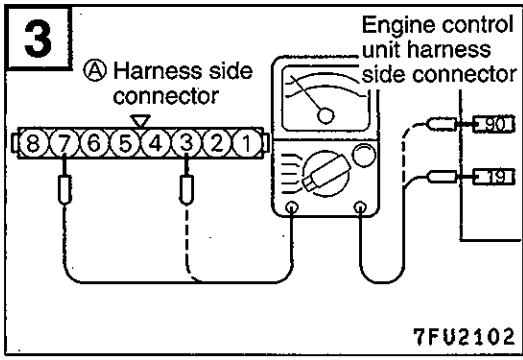


Check for continuity of the earth circuit.
- Air flow sensor connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ 5 – 92)

3

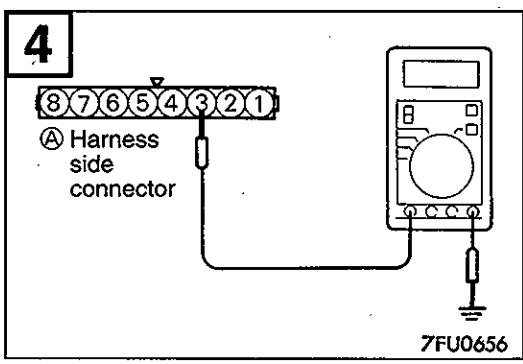


Check for open-circuit or short-circuit between the air flow sensor and the engine control unit.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 4

NO → Repair the harness. (Ⓐ 3 – 90) (Ⓐ 7 – 19)

4



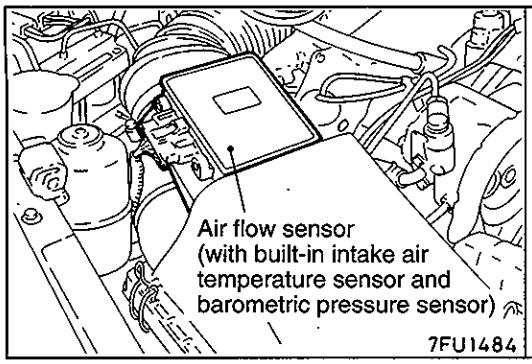
Measure the applied voltage.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

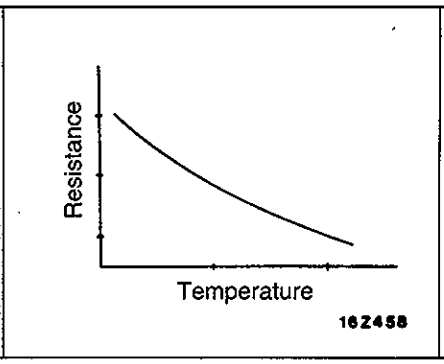
Voltage (V)
4.8 – 5.2

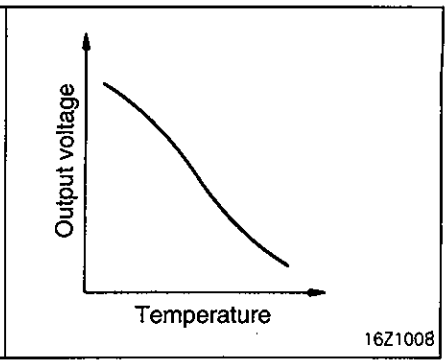
OK → STOP

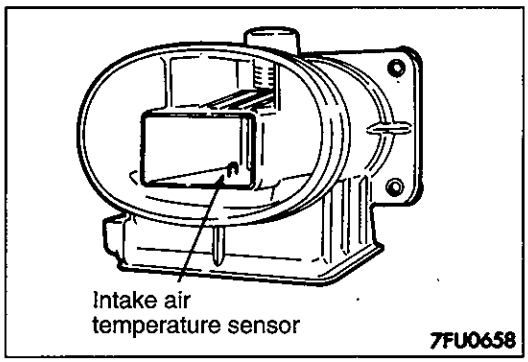
NO → Replace the engine control unit.

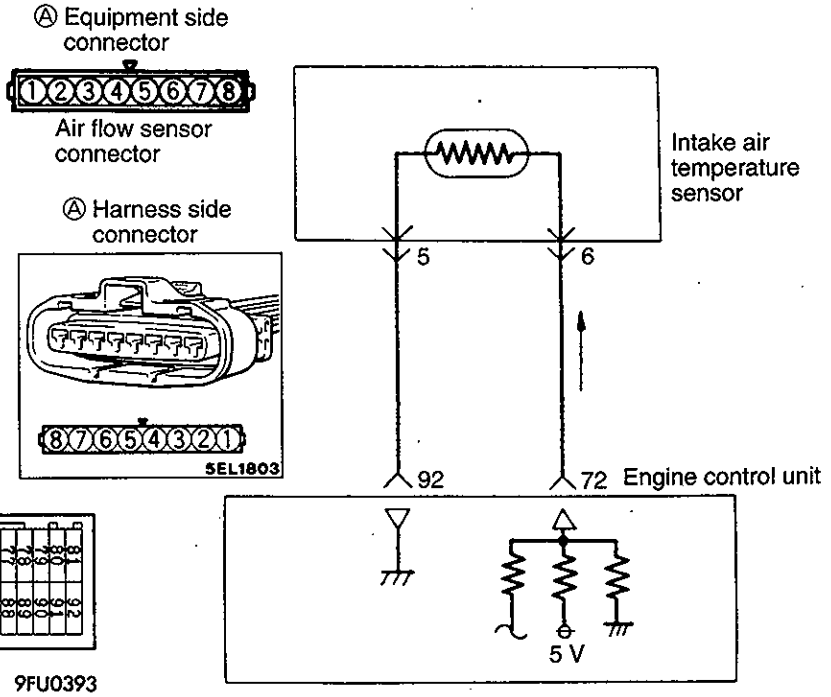
INTAKE AIR TEMPERATURE SENSOR



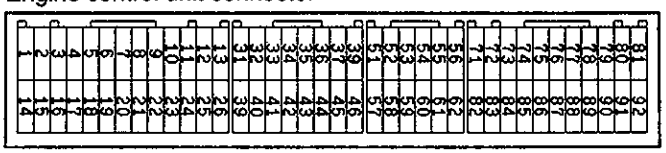








Engine control unit connector



9FU0393

OPERATION

- The intake air temperature sensor converts the engine intake air temperature into a voltage and inputs it to the engine control unit, which then corrects the fuel injection rate, etc. based on the input signal.
- The 5 V power in the engine control unit is supplied via a resistor in the unit to the intake air temperature sensor. Via the sensor which is a kind of resistor, it is earthed in the engine control unit. The intake air temperature sensor resistor has such characteristic that its resistance decreases as the intake air temperature rises.
- The intake air temperature sensor terminal voltage increases or decreases as the sensor resistance increases or decreases. Therefore, the intake air temperature sensor terminal voltage changes with the intake air temperature, decreasing as the temperature rises.

TROUBLESHOOTING HINTS

The intake air temperature sensor senses the intake air temperature in the air cleaner so that it may indicate a temperature different from outside temperature depending on engine operating state.

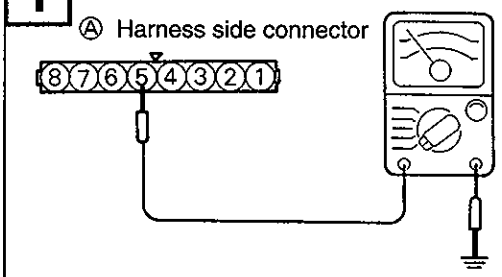
INSPECTION

Using MUT-II

Function	Item No.	Data display	Check condition	Intake air temperature °C	Standard value °C
Data reading	13	Sensor temperature	Ignition switch: ON or engine running	At – 20	–20
				At 0	0
				At 20	20
				At 40	40
				At 80	80

HARNESS INSPECTION

1

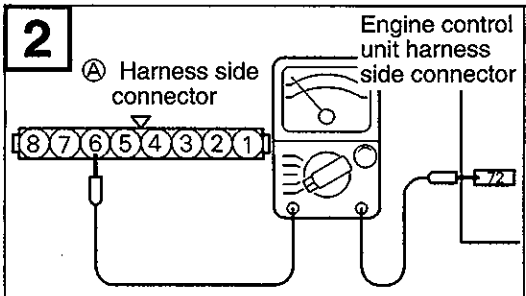


Check for continuity of the earth circuit.
- Air flow sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ 5 – 92)

2

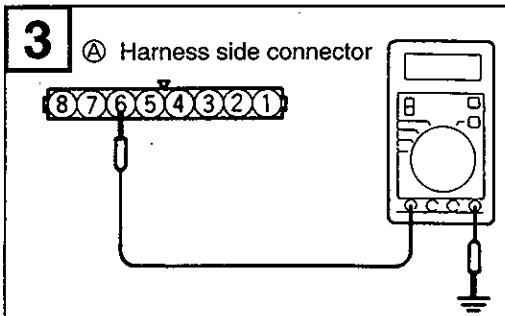


Check for open-circuit or short circuit between the intake air temperature sensor and the engine control unit.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ 6 – 72)

3

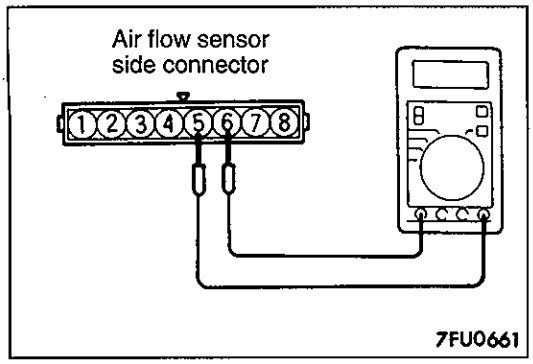


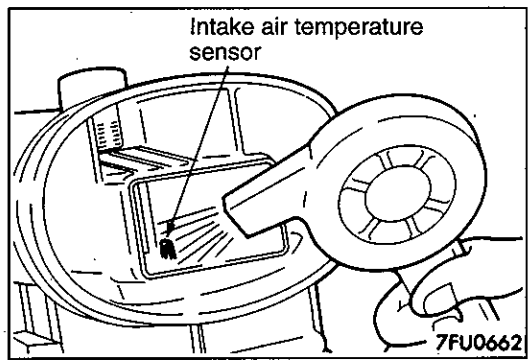
Measure the power supply voltage.
- Air flow sensor connector: Disconnected
- Ignition switch: ON
- Engine control unit connector: Connected

Voltage (V)
4.5 – 4.9

OK → STOP

NG → Repair the engine control unit





SENSOR INSPECTION

(1) Disconnect the air flow sensor connectors.
(2) Measure resistance between terminals ⑤ and ⑥.

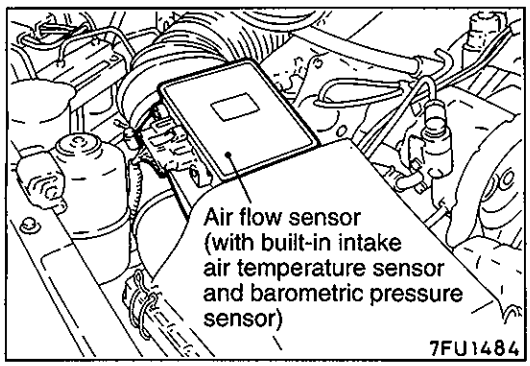
Temperature °C	Resistance kΩ
0	6.0
20	2.7
80	0.4

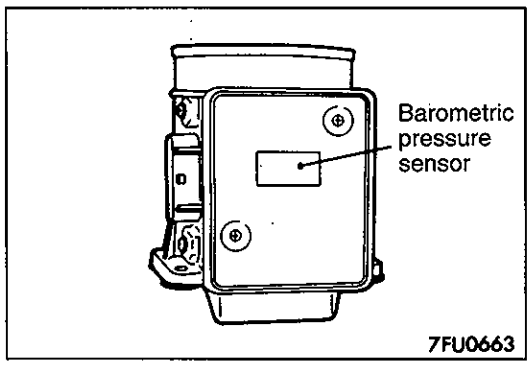
(3) Measure resistance while heating the sensor using a hair drier.

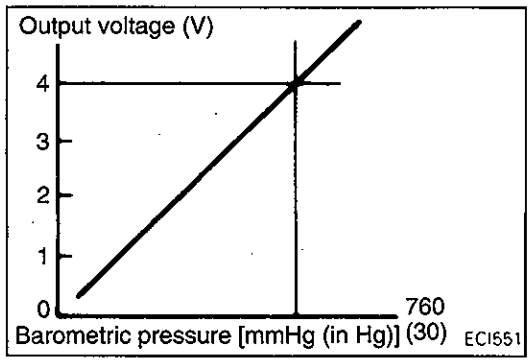
Temperature	Resistance
Higher	Smaller

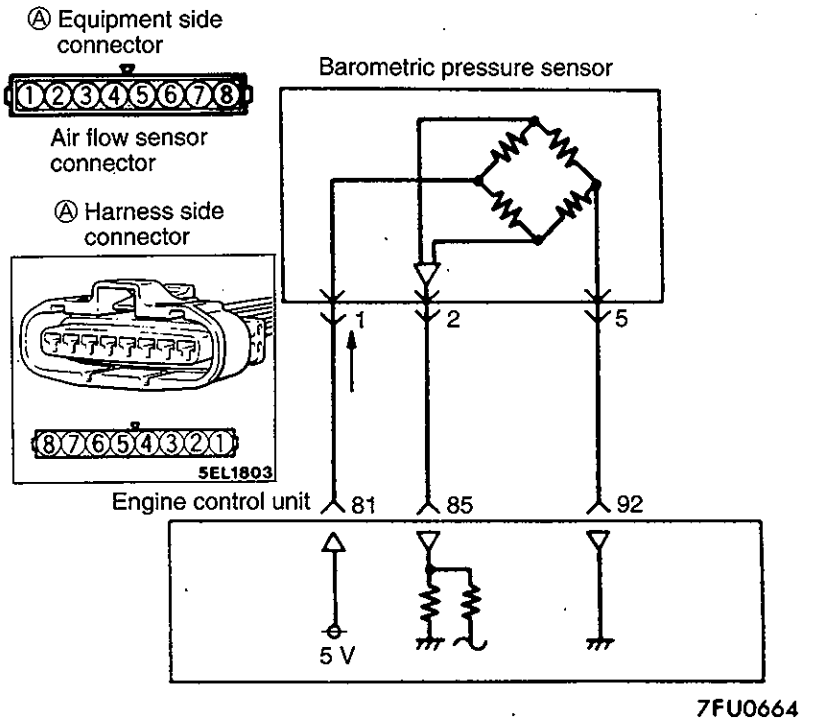
(4) If the value deviates from the standard value or the resistance remains unchanged, replace the air flow sensor assembly.

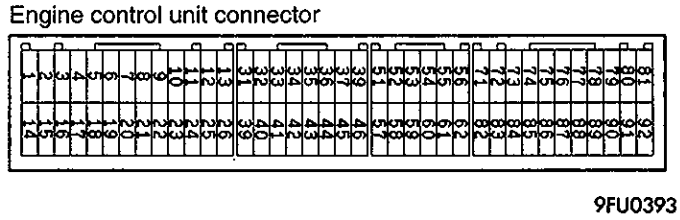
BAROMETRIC PRESSURE SENSOR











OPERATION

- The barometric pressure sensor converts the barometric pressure into a voltage and inputs it to the engine control unit, which then corrects the fuel injection rate, etc. based on the input signal.
- The 5 V power in the engine control unit is supplied to the barometric pressure sensor. Through the circuit in the sensor, it is earthed in the engine control unit.
- The barometric pressure sensor output voltage which is proportional to the barometric pressure (absolute pressure) is supplied to the engine control unit.

TROUBLESHOOTING HINTS

Hint 1: If the barometric pressure sensor is faulty, poor driveability is caused at high altitude, in particular.

Hint 2: If the pressure indication of the barometric pressure sensor drops significantly during high speed driving, check the air cleaner for clogging.

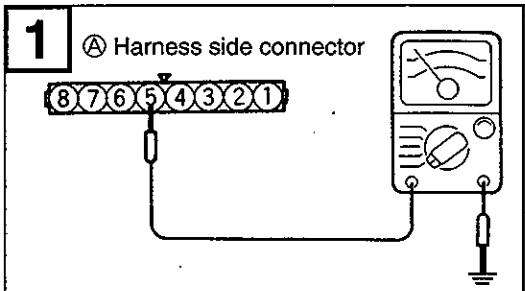
INSPECTION

Using MUT-II

Function	Item No.	Data display	Check condition	Altitude m	Standard value kPa
Data reading	25	Sensor pressure	Ignition switch: ON	At 0	101
				At 600	95
				At 1,200	88
				At 1,800	81

HARNESS INSPECTION

1

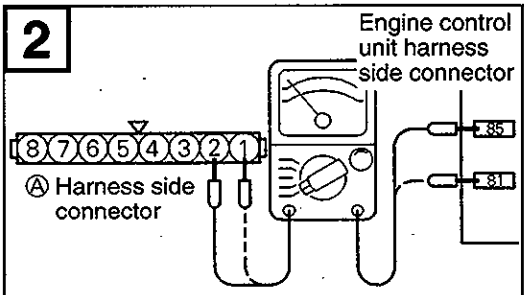


Check for continuity of the earth circuit.
- Air flow sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ 5 – 92)

2

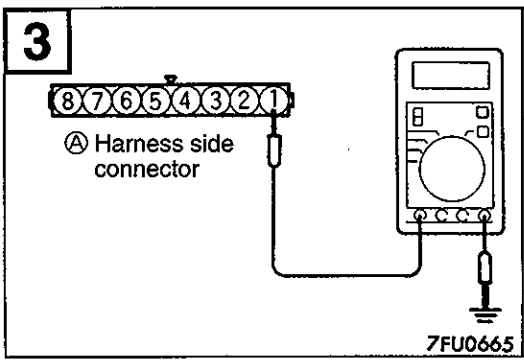


Check for an open-circuit, or a short-circuit to earth between the engine control unit and the barometric pressure sensor.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ 2 – 85) (Ⓐ 1 – 81)

3



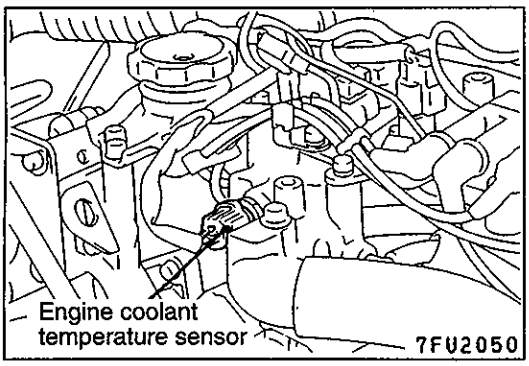
Measure the power supply voltage of the barometric pressure sensor.
- Air flow sensor connector: Disconnected
- Ignition switch: ON
- Engine control unit connector: Connected

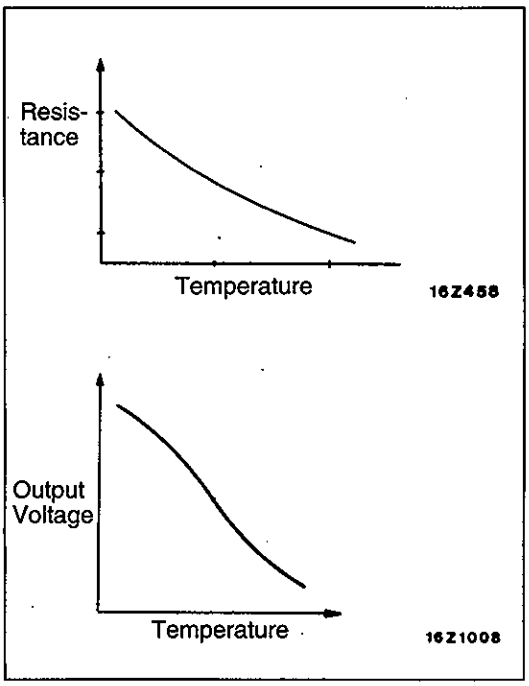
Voltage (V)
4.8 – 5.2

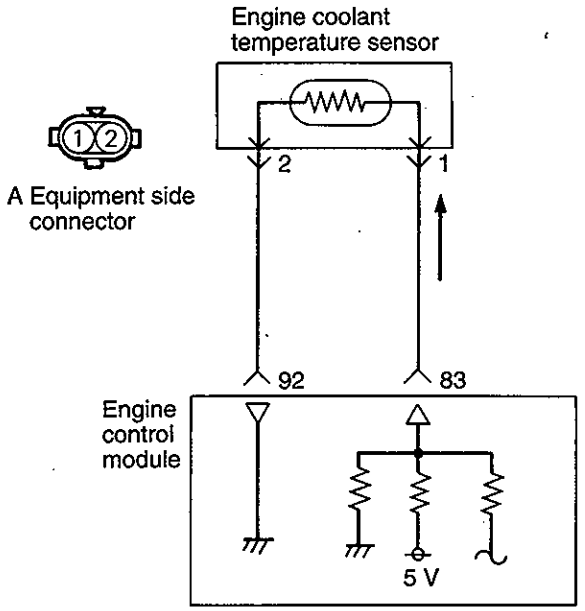
OK → STOP

NG → Replace the engine control unit

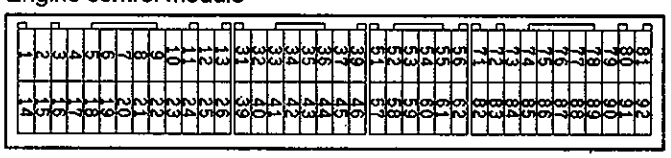
ENGINE COOLANT TEMPERATURE SENSOR







Engine control module



9FU0393

OPERATION

- The engine coolant temperature sensor converts the engine coolant temperature into a voltage and inputs it to the engine control unit, which then controls the fuel injection rate and fast idle speed when the engine is cold based on the input signal.
- The 5 V power in the engine control unit is supplied via a resistor in the unit to the engine coolant temperature sensor. Through the sensor which is a kind of resistor, it is earthed in the engine control unit. The engine coolant temperature sensor resistor has such characteristic that its resistance decreases as the coolant temperature rises.
- The engine coolant temperature sensor terminal voltage increases or decreases as the sensor resistance increases or decreases. Therefore, the engine coolant temperature sensor terminal voltage changes with the coolant temperature, decreasing as the temperature rises.

TROUBLESHOOTING HINTS

If the fast idle speed is inadequate or the engine emits dark smoke during engine warm up operation, the engine coolant temperature sensor is often faulty.

INSPECTION

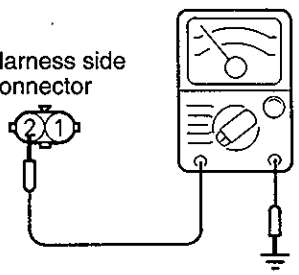
Using MUT-II

Function	Item No.	Data display	Check condition	Coolant temperature °C	Standard value °C
Data reading	21	Sensor temperature	Ignition switch: ON or engine operating	At –20	–20
				At 0	0
				At 20	20
				At 40	40
				At 80	80

HARNESS INSPECTION

1

A Harness side connector



9FU0112

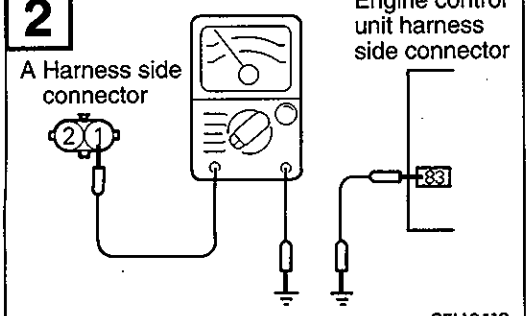
Check for continuity of the earth circuit.

- Engine coolant temperature sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ 2 – 92)

2

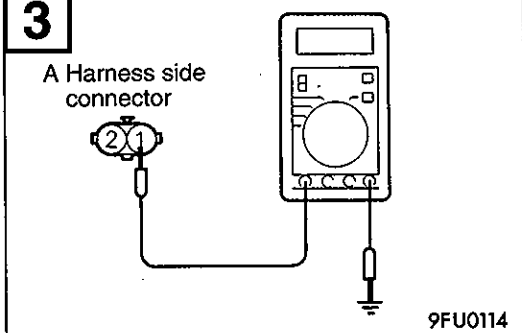


Check for open-circuit or short circuit between the engine coolant temperature sensor and the engine control unit.
- Engine coolant temperature sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ 1 – 83)

3

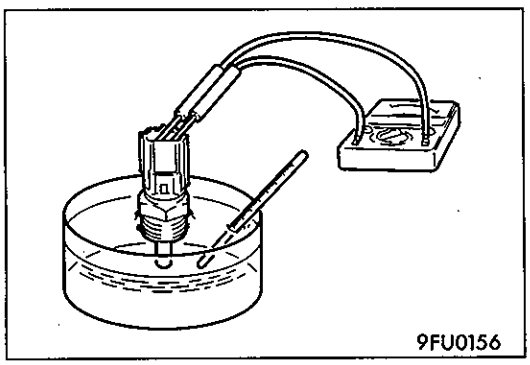


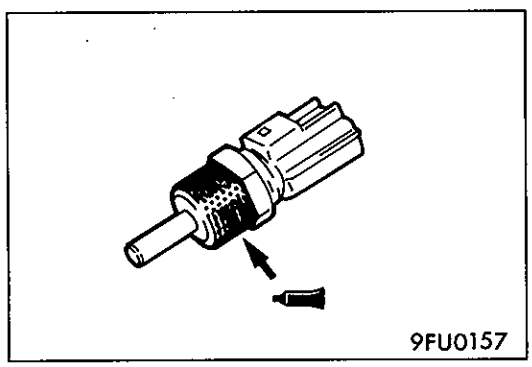
Measure the power supply voltage.
- Engine coolant temperature sensor connector: Disconnected
- Ignition switch: ON
- Engine control unit connector: Connected

Voltage (V)
4.5 – 4.9

OK → STOP

NO → Replace the engine control unit





SENSOR INSPECTION

(1) Remove engine coolant temperature sensor from the intake manifold.
(2) With temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.

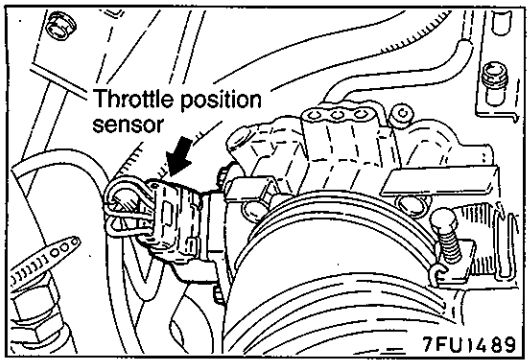
Temperature °C	Resistance kΩ
0	5.8
20	2.4
40	1.1
80	0.3

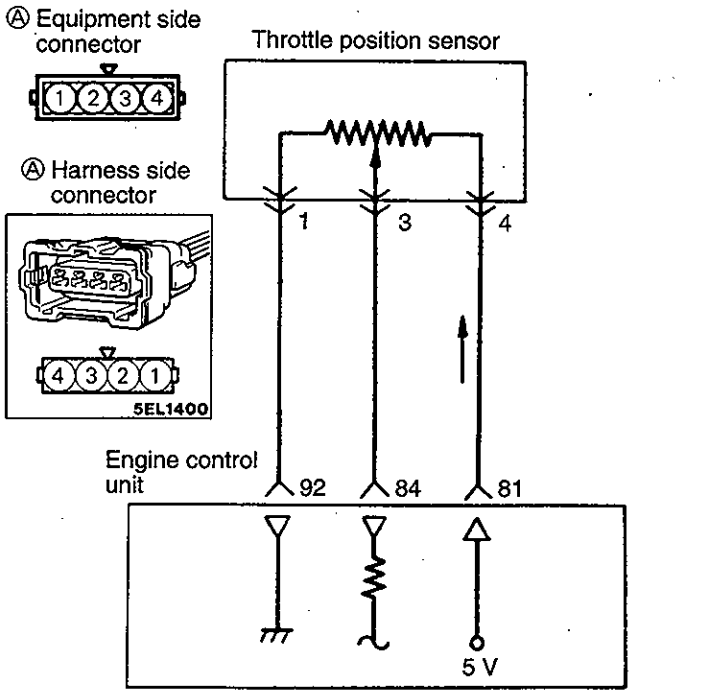
(3) If the resistance deviates from the standard value greatly, replace the sensor.

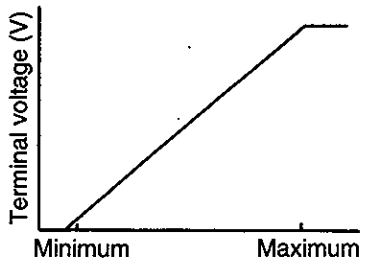
INSTALLATION

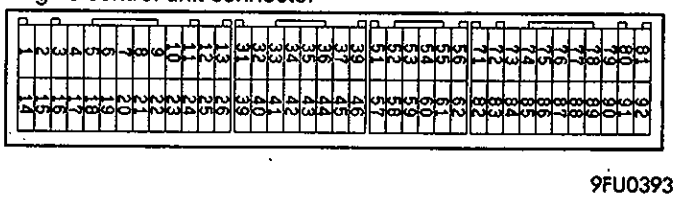
(1) Apply sealant to threaded portion.
Specified sealant: 3M NUT locking Part No. 4171 or equivalent
(2) Install engine coolant temperature sensor and tighten it to specified torque.
Sensor tightening torque: 29 Nm
(3) Fasten harness connectors securely.

THROTTEL POSITION SENSOR









OPERATION

- The throttle position sensor converts the throttle position opening into a voltage and inputs it to the engine control unit, which then controls the fuel injection based on the input signal.
- The 5 V power in the engine control unit is supplied to the throttle position sensor. Through the resistor in the sensor, it is earthed in the engine control unit.
- As the throttle valve shaft rotates from the idle position to wide open position, the resistance between the variable resistor terminal of the throttle position sensor and the earth terminal increases. As a result, the voltage at the throttle position sensor variable resistance terminal also increases.

TROUBLESHOOTING HINTS

Hint 1: The throttle position sensor signal is more important in the control of automatic transmission than in the engine control. Shifting shock and other troubles will be caused if this sensor is faulty.

Hint 2: If the output voltage of the throttle position sensor is out of specification, adjust the sensor and check the voltage again. If there is an evidence of disturbed fixed SAS setting, adjust the fixed SAS.

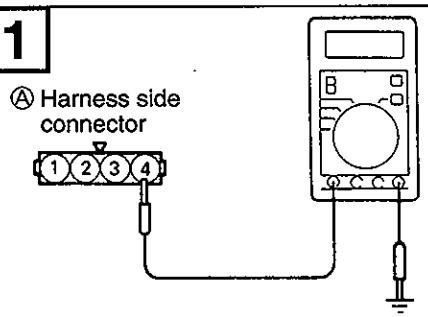
INSPECTION

Using MUT-II

Function	Item No.	Data display	Check conditions	Throttle valve	Standard value mV
Data reading	14	Sensor voltage	Ignition switch: left ON for 15 secondes or more	Set to idling position.	300 – 1,000
				Open gradually.	Becomes higher proportionally to valve opening
				Open fully.	4,500 – 5,500

HARNESS INSPECTION

1

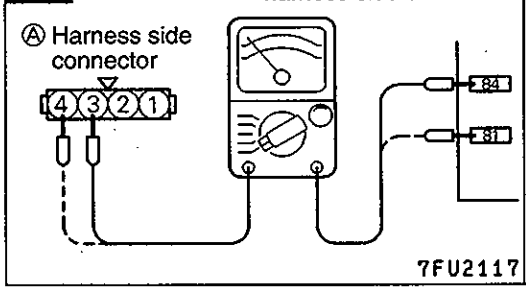


Check for continuity of the earth circuit.
- Throttle position sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ 1 – 92)

2

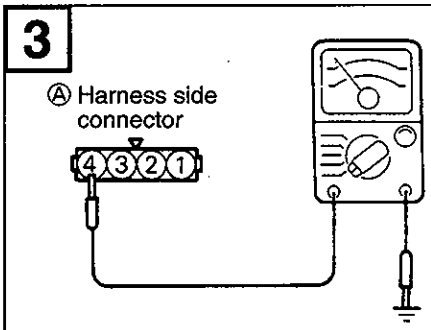


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the throttle position sensor.
- Throttle position sensor connector: Disconnected
- Engine control unit connector: Disconnected
- Disconnect all other control unit connectors which are connected to the throttle position sensor.

OK → 3

NG → Repair the harness. (Ⓐ 3 – 84) (Ⓐ 4 – 81)

3

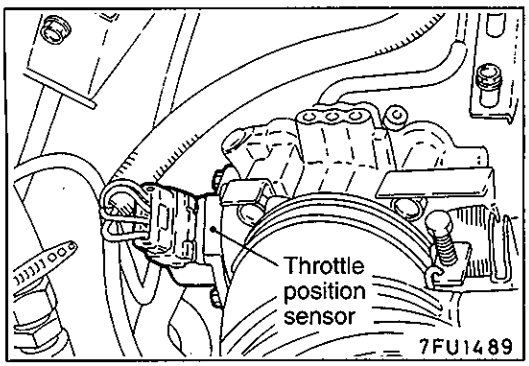


Measure the impressed voltage.
- Throttle position sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.8 – 5.2

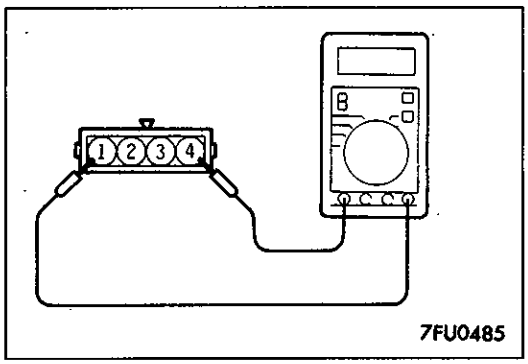
OK → STOP

NG → Replace the engine control unit.



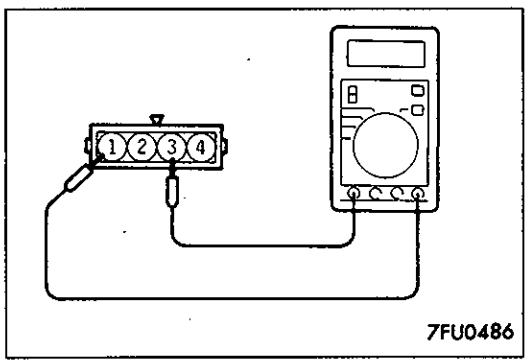
SENSOR INSPECTION

(1) Disconnect the throttle position sensor connector.



(2) Measure resistance between terminal ① (sensor earth) and terminal ④ (sensor power).

Standard value: 3.5 – 6.5 kΩ

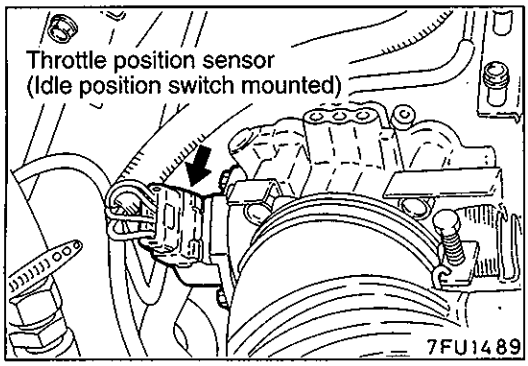


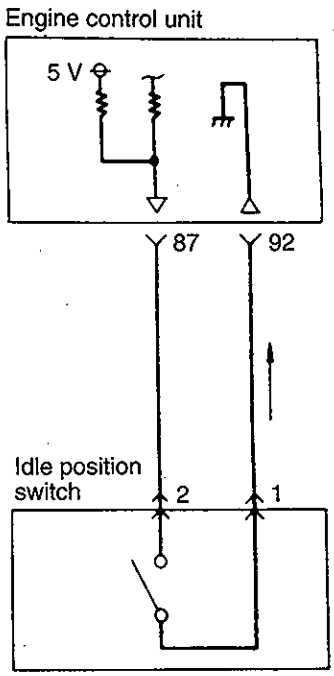
(3) Connect a pointer type ohmmeter between terminal ① (sensor earth) and terminal ③ (sensor output).
(4) Operate the throttle valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.
(5) If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

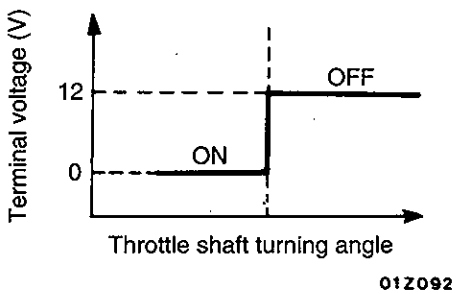
TPS installation torque: 2.0 Nm

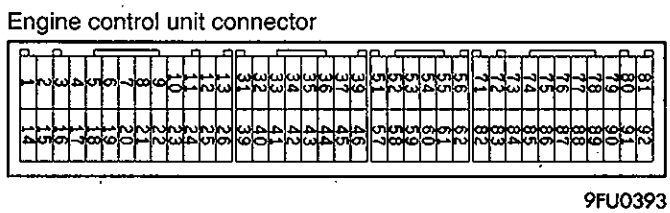
For the idle position switch and throttle position sensor adjusting procedure, refer to P.13-21.

IDLE POSITION SWITCH









OPERATION

- The idle position switch senses whether the accelerator pedal is depressed or not, converts it into high/low voltage and inputs the voltage to the engine control unit, which then controls the idle speed control servo based on the input signal.
- The voltage in the engine control unit is applied to the idle position switch through a resistor. When the accelerator pedal is released, the idle position switch is turned on to conduct the voltage to earth. This causes the idle position switch terminal voltage to go low from high.

TROUBLESHOOTING HINTS

If the idle position switch harness and individual part check results are normal but the idle position switch output is abnormal, the following troubles are suspected.

(1) Poorly adjusted accelerator cable or auto-cruise control cable
(2) Poorly adjusted fixed SAS

INSPECTION

Using MUT-II

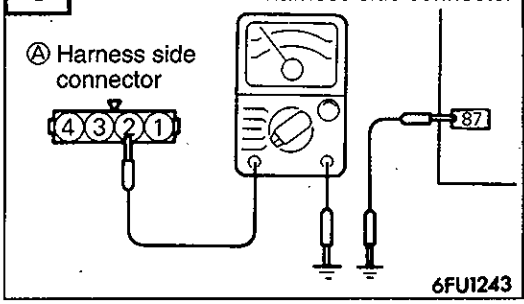
Function	Item No.	Data display	Check condition	Throttle valve	Normal indication
Data reading	26	Switch state	Ignition switch: ON (check by operating accelerator pedal repeatedly)	At idle position	ON
				Open a little	OFF*

NOTE

The idle position switch normally turns off when the voltage of the throttle position sensor is 50 – 100 mV higher than the voltage at the idle position. If the idle position switch turns back on after the throttle position sensor voltage has risen by 100 mV and the throttle valve has opened, the idle position switch and the throttle position sensor need to be adjusted.

HARNESS INSPECTION

1

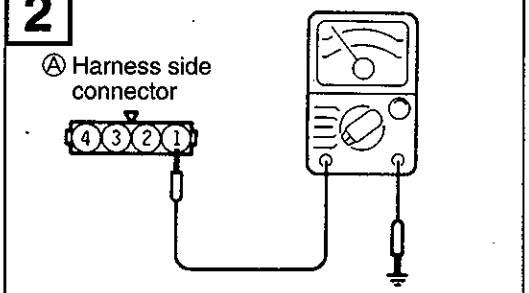


Check for open or short circuit between the idle position switch and the engine control unit.
- Engine control unit connector: Disconnected
- Throttle position sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ 2 – 87)

2

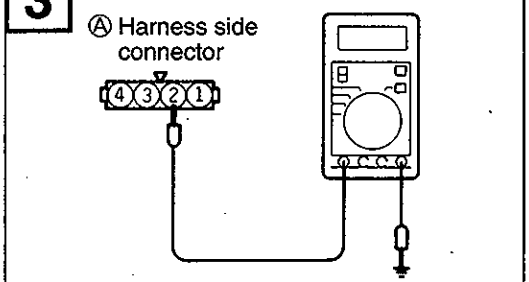


Check for continuity of the earth circuit.
- Throttle position sensor connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ 1 – 92)

3

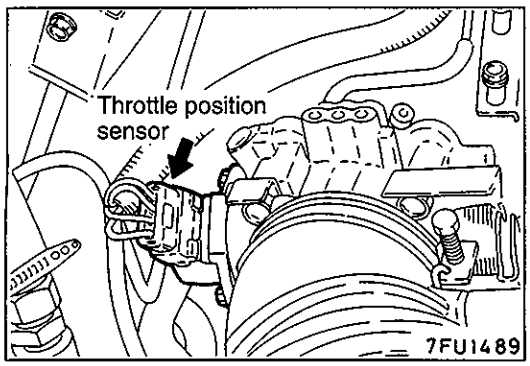


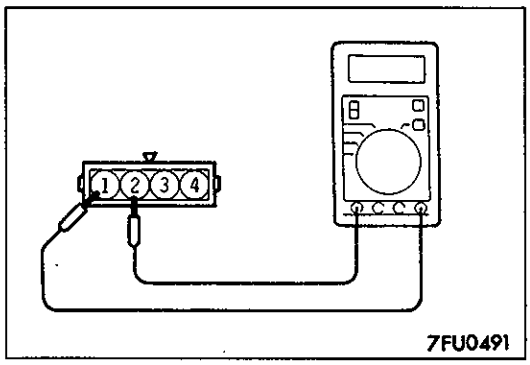
Measure the power supply voltage of the idle position switch.
- Throttle position sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4 or higher

OK → STOP

NG → Replace the engine control unit.





SENSOR INSPECTION

(1) With the accelerator pedal released, check to be sure that the throttle valve lever or the fixed SAS is pushed.

NOTE
If it is not pushed, adjust the fixed SAS (Refer to P.13-22.)

(2) Disconnect the throttle position sensor connector.

(3) Check the continuity across the throttle position sensor connector terminal ① (Sensor earth) and ② (Idle position switch).

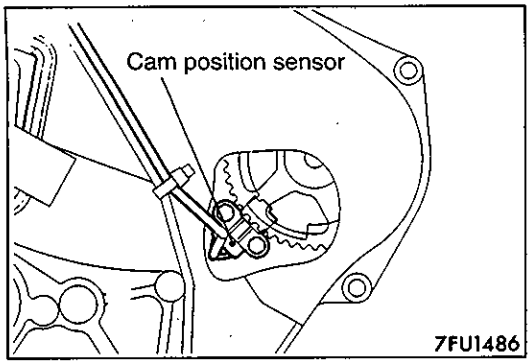
Accelerator pedal	Continuity
Depressed	Non-conductive (∞Ω)
Released	Conductive (0Ω)

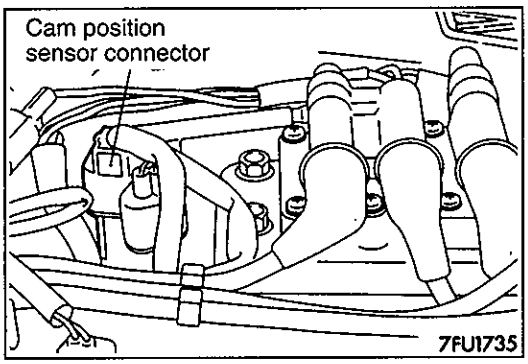
NOTE
If there is no continuity when the accelerator pedal is returned, loosen the throttle position sensor installation screw; then, after turning all the way in the clockwise direction, check again.

(4) Replace the throttle position sensor (idle position switch incorporated) if there is a malfunction.

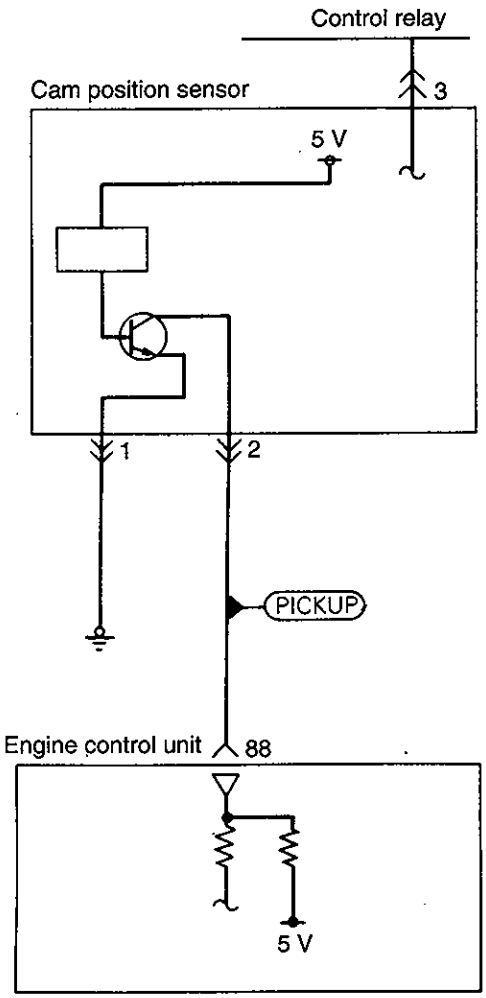
NOTE
For the idle position switch and throttle position sensor adjusting procedure, refer to P.13-21.

CAM POSITION SENSOR

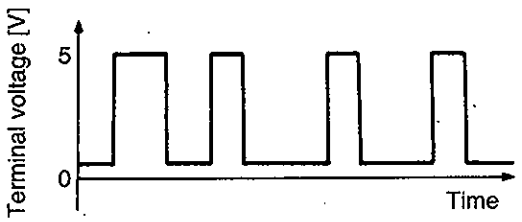




Ⓐ Equipment side connector

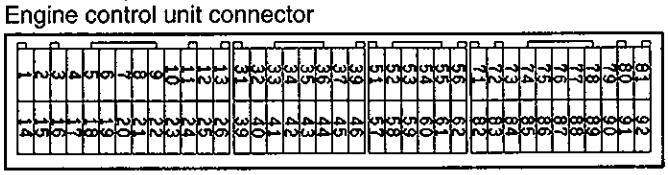


6AF0054



7FU0677

Engine control unit connector



9FU0393

OPERATION

- The cam position sensor senses the top dead center on compression stroke, converts it into a pulse signal and inputs it to the engine control unit, which then computes the fuel injection sequence, etc. based on the input signal.
- Power to the cam position sensor is supplied from the control relay and is earthed to the body. The cam position sensor generates a pulse signal as it repeatedly connects and disconnects between 5 V voltage supplied from the engine control unit and earth.

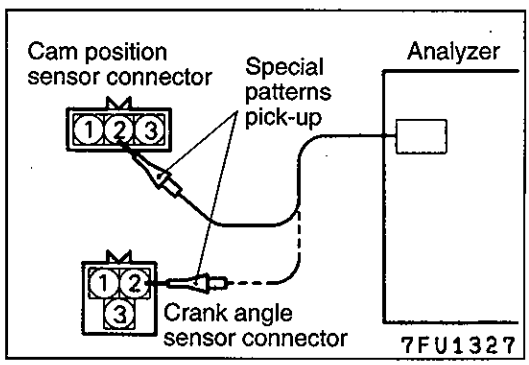
TROUBLESHOOTING HINTS

Hint 1: If the cam position sensor does not function correctly, correct sequential injection is not made so that the engine may stall, run irregularly at idle or fail to accelerate normally.

Hint 2: If the sensor outputs a pulse signal when the ignition switch is turned ON (with the engine no running), a faulty cam position sensor or engine control unit is suspected.

INSPECTION

Waveform inspection with analyzer



Measuring method

(1) Disconnect the connector of the cam position sensor, and connect the special tool (test harness: MB991348) across the disconnected connector parts. (Connect the tool to all terminals.)
(2) Connect the special patterns pick-up of the analyzer to the terminal ② of the cam position sensor connector (in order to inspect the signal waveform of the cam position sensor.)
(3) Disconnect the connector of the crank angle sensor, and connect the special tool (test harness: MD998478) across the disconnected connector parts.
(4) Connect the special patterns pick-up of the analyzer to the terminal ② of the crank angle sensor connector (in order to inspect the signal waveform of the crank angle sensor).

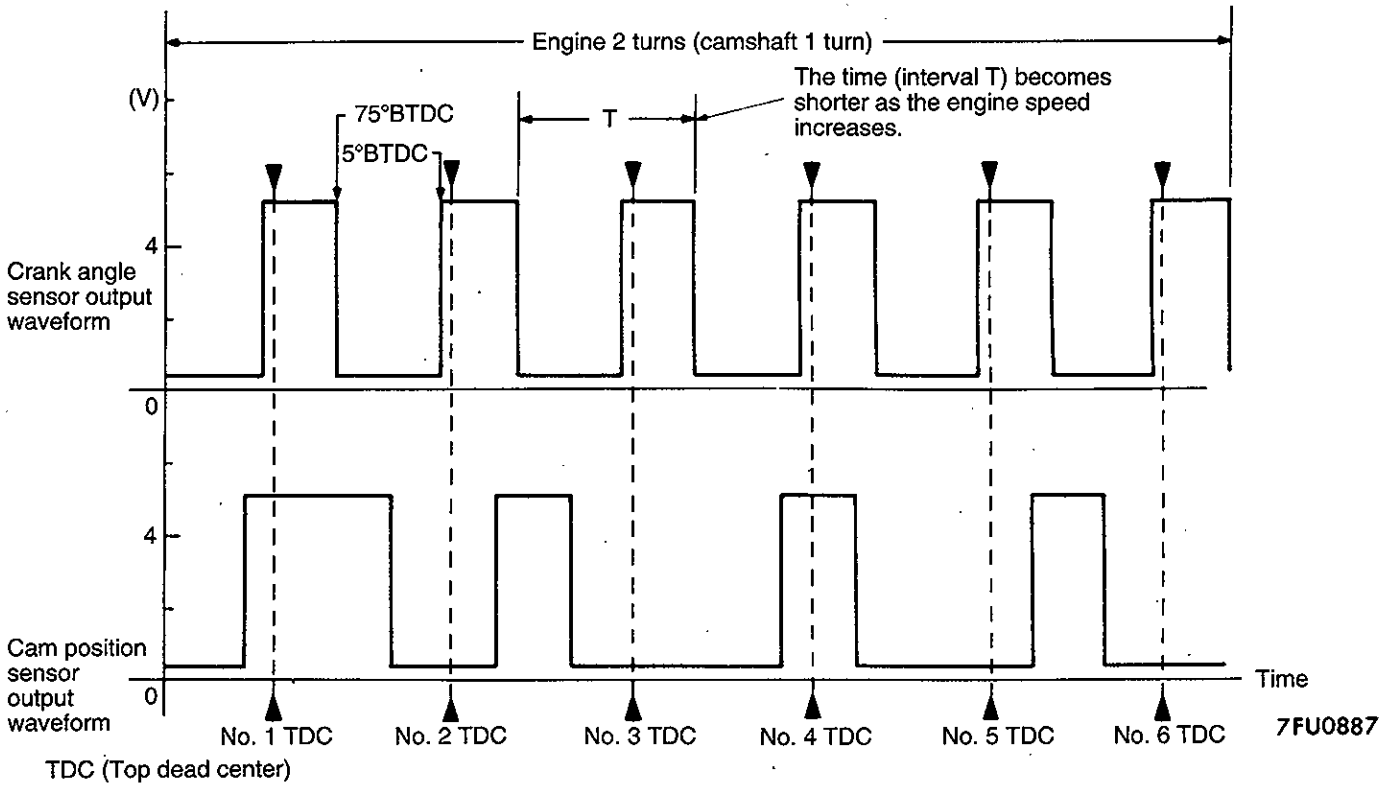
Alternative method (when test harness is not available)

(1) Connect the analyzer special patterns pickup to ECU terminal (88) for the cam position sensor.
(2) Connect the analyzer special patterns pickup to ECU terminal (89) for the crank angle sensor.

Standard waveform

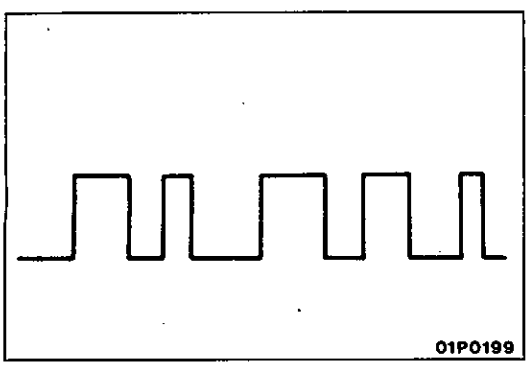
Observation conditions

Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine speed	Idling speed (700 r/min)



Waveform observing point

Confirm that cycle T becomes shorter as the engine speed increases.



Abnormal waveform example

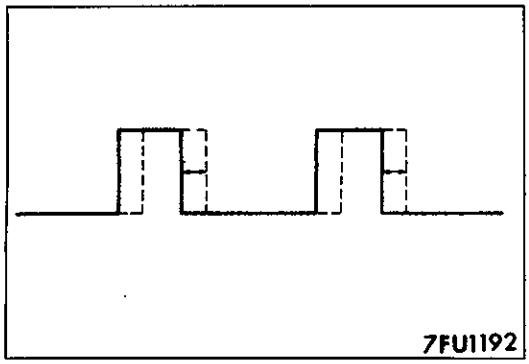
- Example 1

  Trouble cause

  The sensor interface is troubled.

  Waveform feature

  The engine does not start, but the rectangular waveform is output.



- Example 2

Trouble cause

The timing belt is loose.

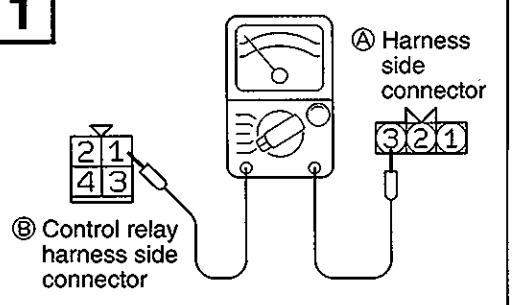
The sensor disc is abnormal.

Waveform feature

The waveform fluctuates fore and aft.

HARNESS INSPECTION

1



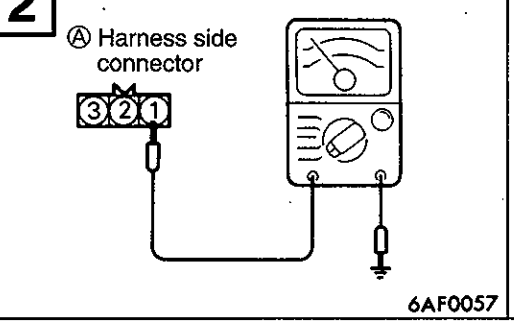
Check for continuity between the cam position sensor and control relay.
- Cam position sensor connector: Disconnected
- Control relay connector: Disconnected

NOTE
Touch ohmmeter probes to both ends of the harness.

OK → 2

NO → Repair the harness. (Ⓐ 3 – Ⓑ 1)

2

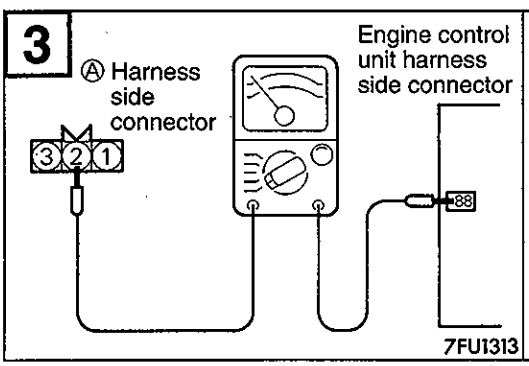


Check for continuity of the earth circuit.
- Cam position sensor connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ 1 – Earth)

3

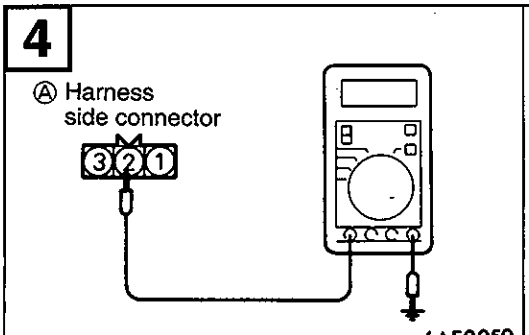


Check for an open-circuit, or a short-circuit to earth between the cam position sensor and the engine control unit.
- Engine control unit connector: Disconnected
- Cam position sensor connector: Disconnected

OK → 4

NO → Repair the harness. (Ⓐ 2 – 88)

4



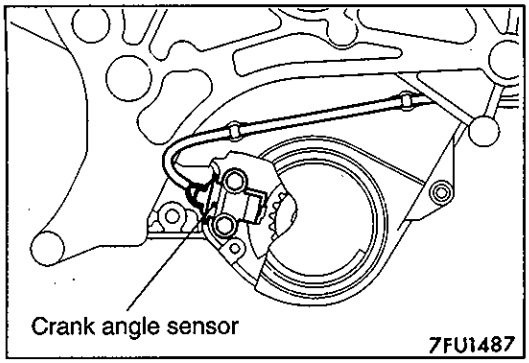
Measure the impressed voltage
- Cam position sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

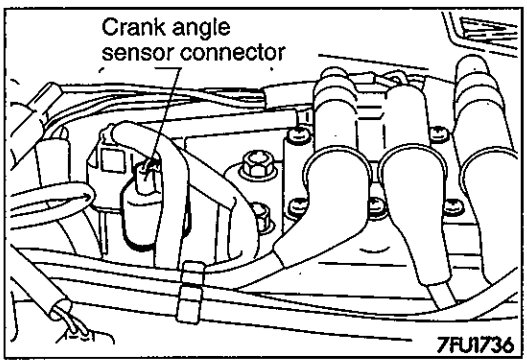
Voltage (V)
4.8 – 5.2

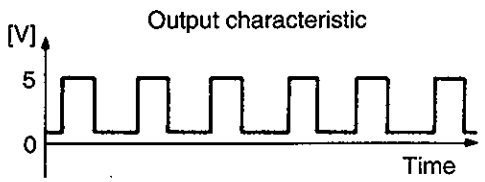
OK → STOP

NO → Replace the engine control unit.

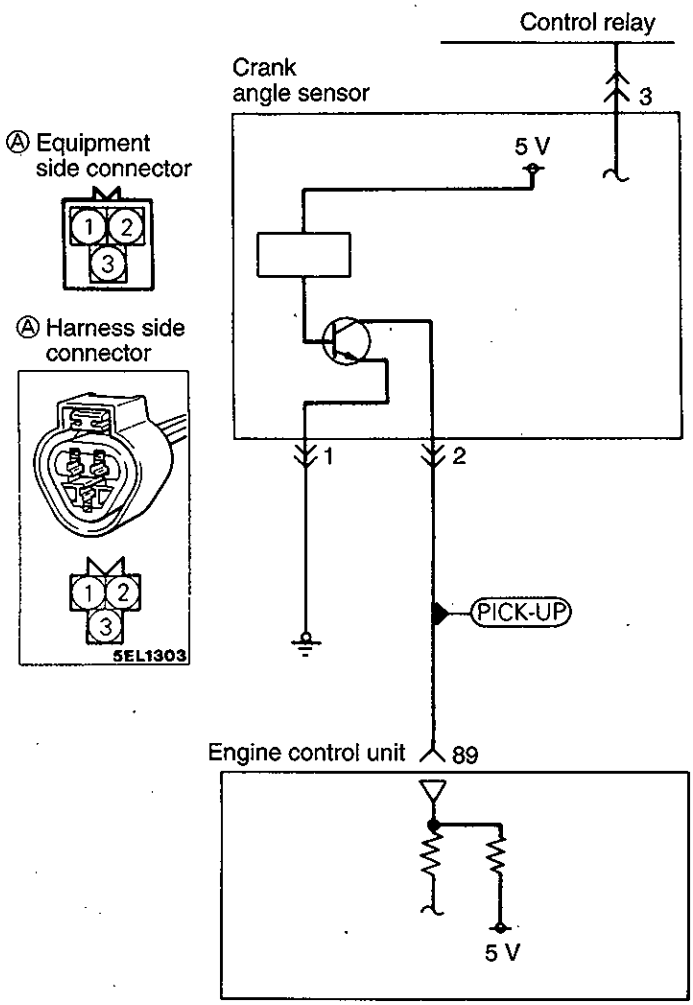
CRANK ANGLE SENSOR





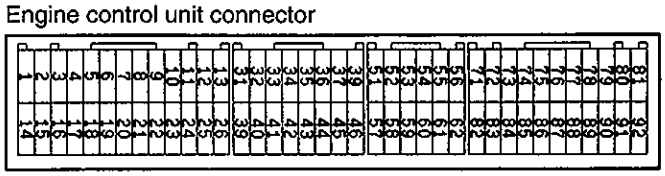


7FU0682



6AF0060

Engine control unit connector



9FU0393

OPERATION

- The crank angle sensor senses the crank angle (piston position) of each cylinder, converts it into a pulse signal and inputs it to the engine control unit, which then computes the engine speed and controls the fuel injection timing and ignition timing based on the input signal.
- Power to the crank angle sensor is supplied from the control relay and is earthed to the body. The crank angle sensor generates a pulse signal as it repeatedly connects and disconnects between 5 V voltage supplied from the engine control unit and earth.

TROUBLESHOOTING HINTS

Hint 1: If unexpected shocks are felt during driving or the engine stalls suddenly during idling, shake the crank angle sensor harness. If this causes the engine to stall, poor contact of the sensor connector is suspected.

Hint 2: If the crank angle sensor outputs a pulse signal when the ignition switch is turned ON (with the engine not running), a faulty crank angle sensor or engine control unit is suspected.

Hint 3: If the tachometer reads 0 r/min when the engine that has failed to start is cranked, faulty crank angle sensor or broken timing belt is suspected.

Hint 4: If the tachometer reads 0 r/min when the engine that has failed to start is cranked, the primary current of the ignition coil is not turned on and off. Therefore, troubles in the ignition circuit and ignition coil or faulty power transistor is suspected.

Hint 5: If the engine can be run at idle even though the crank angle sensor reading is out of specification, troubles are often in other than the crank angle sensor.
[Examples]
(1) Faulty engine coolant temperature sensor
(2) Faulty idle speed control servo
(3) Poorly adjusted reference idle speed

INSPECTION

Using MUT-II

Function	Item No.	Data display	Check condition	Check content	Normal state
Data reading	22	Cranking speed	• Engine cranking • Tachometer connected	Compare cranking speed and MUT-II reading	Indicated speed to agree

NOTE
(1) The tachometer indicates a third of the actual engine speed. Therefore, 3 times the tachometer indication is the actual engine speed.
(2) When the tachometer is set to the 2-cylinder range, it indicates actual engine speed.

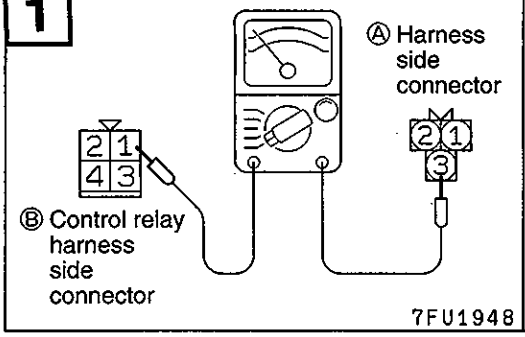
Function	Item No.	Data display	Check condition	Engine coolant temperature °C	Standard value r/min
Data reading	22	Idle speed	• Engine: Running at idle • Idle position switch: ON	At – 20	1275 – 1475
				At 0	1225 – 1425
				At 20	1100 – 1300
				At 40	950 – 1150
				At 80	600 – 800

Waveform inspection with analyzer

Refer to cam position sensor section (P.13-54.)

HARNESS INSPECTION

1



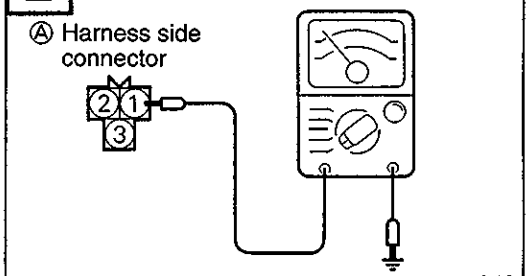
Check for continuity between the crank angle sensor and the control relay.
- Crank angle sensor connector: Disconnected
- Control relay connector: Disconnected

NOTE
Touch ohmmeter probes to both ends of the harness

OK → 2

NO → Repair the harness. (Ⓐ 3 – Ⓑ 1)

2

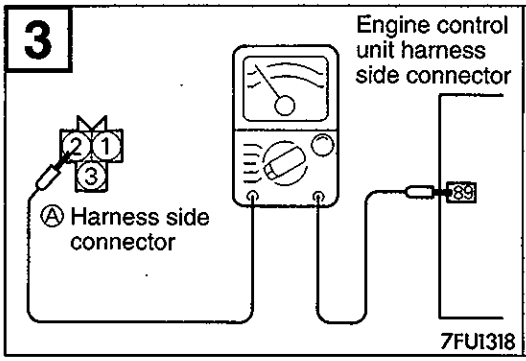


Check for continuity of the earth circuit.
- Crank angle sensor connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ 1 – Earth)

3

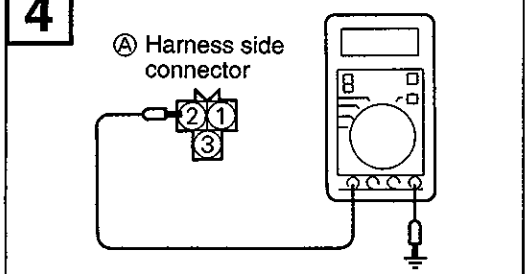


Check for an open-circuit, or a short-circuit to earth between the crank angle sensor and the engine control unit.
- Engine control unit connector: Disconnected
- Crank angle sensor connector: Disconnected

OK → 4

NO → Repair the harness. (Ⓐ 2 – 89)

4



Measure the impressed voltage.
- Crank angle sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

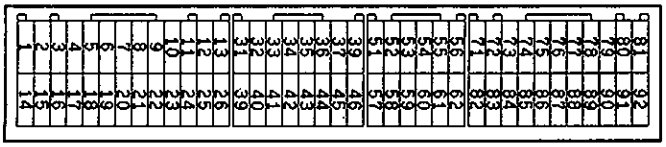
Voltage (V)
4.8 – 5.2

OK → STOP

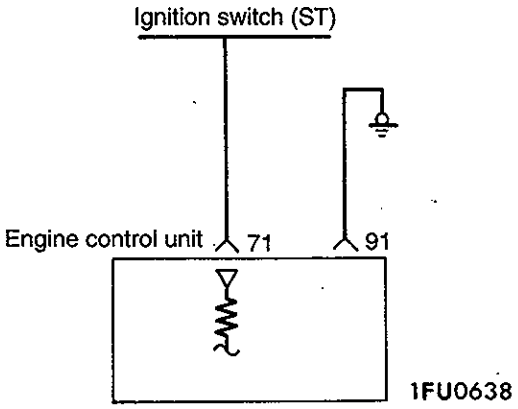
NO → Replace the engine control unit.

IGNITION SWITCH-ST [M/T only]

Engine control unit connector



9FU0393



1FU0638

OPERATION

- The ignition switch-ST inputs a high signal to the engine control unit while the engine is cranking. The engine control unit provides fuel injection control, etc., at engine startup based on this signal.
- When the ignition switch is set to START, the battery voltage at cranking is applied through the ignition switch to the engine control unit, which detects that the engine is cranking.

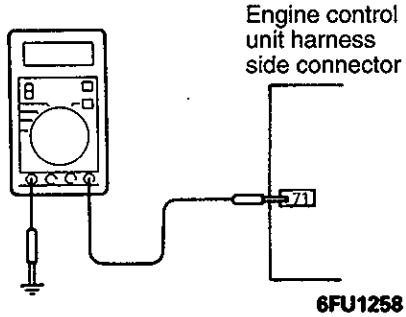
INSPECTION

Using MUT-II

Function	Item No.	Data display	Check condition	Engine	Normal indication
Data reading	18	Switch state	Ignition switch: ON	Stop	OFF
				Cranking	ON

HARNESS INSPECTION

1



6FU1258

Measure the input voltage to the engine control unit.

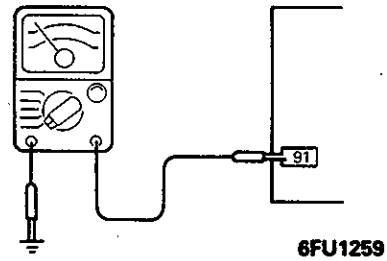
- Engine control unit connector: Disconnected
- Ignition switch: START

Voltage (V)
8 or more

OK → 2

NO → Repair the harness. (71 – Ignition switch)

2



6FU1259

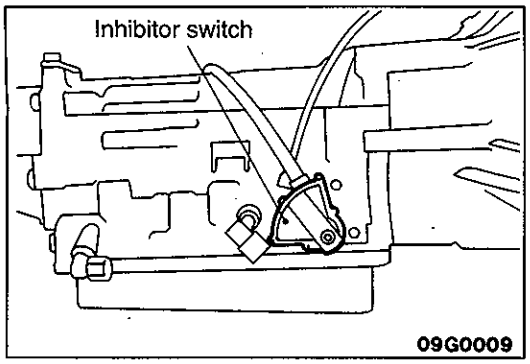
Check for continuity of the earth circuit.

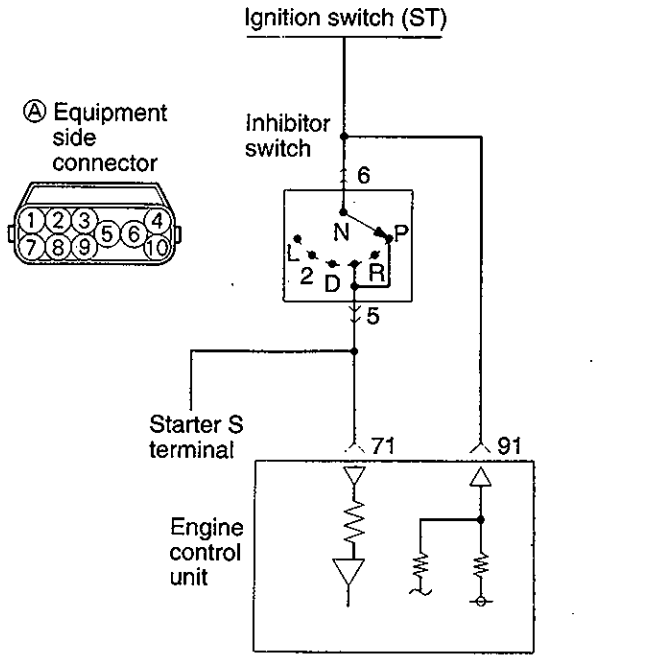
- Engine control unit connector: Disconnected

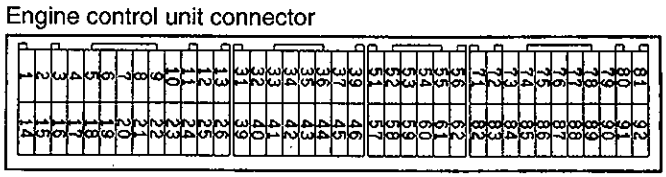
OK → STOP

NO → Repair the harness. (91 – Earth)

IGNITION SWITCH-ST AND INHIBITOR SWITCH [A/T only]







OPERATION

- The ignition switch-ST inputs a high signal to the engine control unit while the engine is cranking. The engine control unit provides fuel injection control, etc., at engine startup based on this signal.
- When the ignition switch is set to START, the battery voltage at cranking is applied through the ignition switch and inhibitor switch to the engine control unit, which detects that the engine is cranking. In case the selector lever is in a position other than the P/N range, the battery voltage is not applied to the engine control unit.
- The inhibitor switch converts the selector lever position (whether it is at the P/N range or at others) into high/low voltage and inputs it to the engine control unit, which then controls the idle speed control servo based on this signal.
- The battery voltage in the engine control unit is applied through a resistor to the inhibitor switch. When the selector lever is set to the P/N range, continuity is produced between the inhibitor switch terminal of the engine control unit and earth through the starter motor, thereby making the terminal voltage go low.

TROUBLESHOOTING HINTS

If the inhibitor switch harness and individual part check have resulted normal but the inhibitor switch output is abnormal, poorly adjusted control cable is suspected.

INSPECTION

Using MUT-II

IGNITION SWITCH-ST

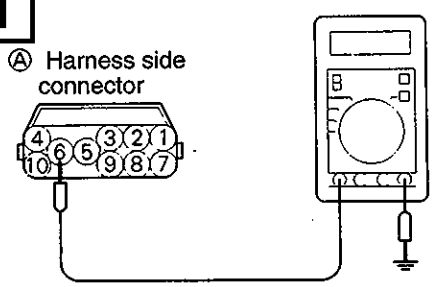
Function	Item No.	Data display	Check condition	Engine	Normal indication
Data reading	18	Switch state	Ignition switch: ON	Stop	OFF
				Cranking	ON

INHIBITOR SWITCH

Function	Item No.	Data display	Check condition	Select lever position	Normal indication
Data reading	29	Shift position	Ignition switch: ON	P or N	P or N
				D, 2, L or R	D, 2, L or R

HARNESS INSPECTION

1



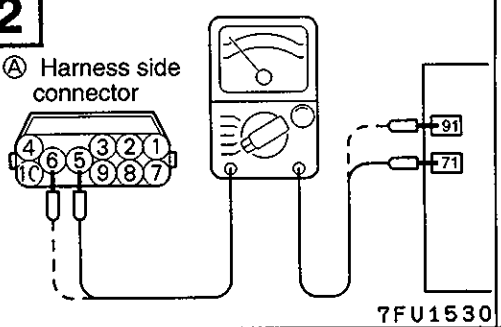
Measure the power supply voltage of the inhibitor switch
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected
- Ignition switch: ON

Voltage (V)
SV

OK → 2

NG → Check the power supply circuit.

2



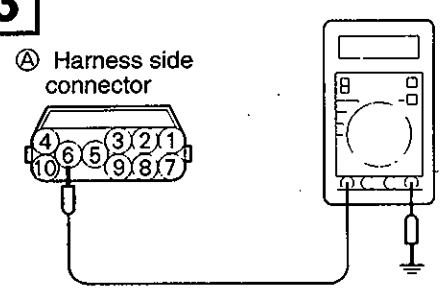
Check for continuity between the inhibitor switch and the engine control unit.
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 3

NG → Repair the harness. (Ⓐ 5 – 71) (Ⓐ 6 – 91)

3



Measure the inhibitor switch terminal input voltage.
- Engine control unit connector: Connected
- Inhibitor switch connector: Disconnected
- Ignition switch: ON

Voltage (V)
SV

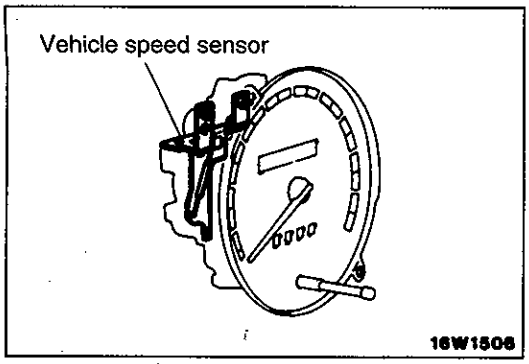
OK → STOP

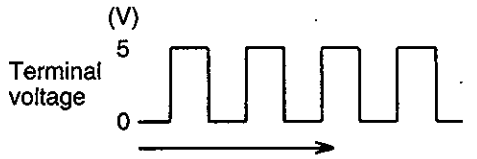
NG → Repair the engine control unit.

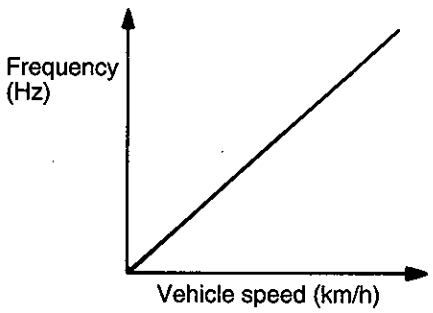
INHIBITOR SWITCH INSPECTION

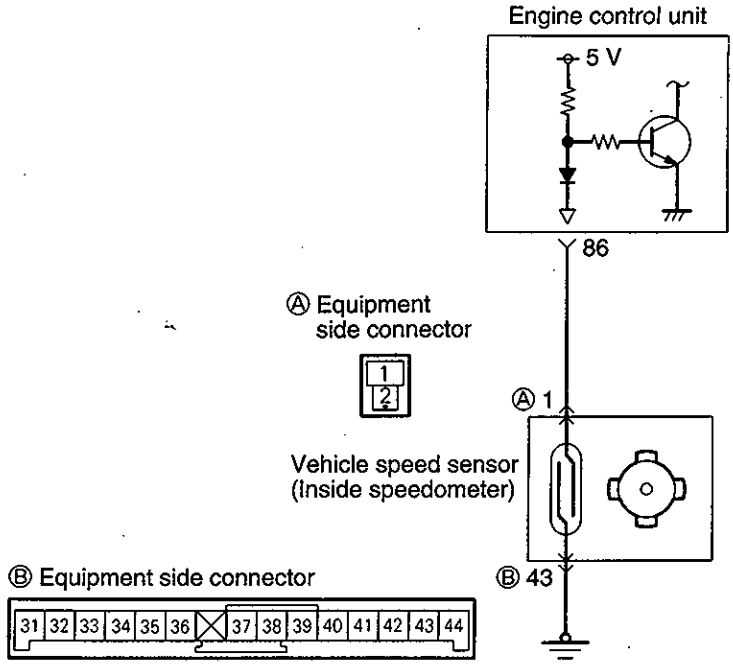
Refer to GROUP 23 – Service Adjustment Procedures.

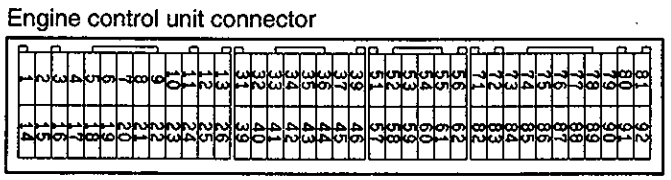
VEHICLE SPEED SENSOR











OPERATION

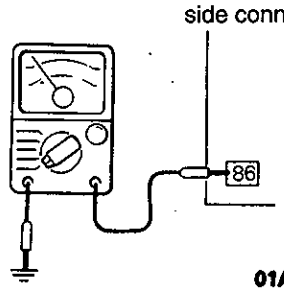
- The vehicle-speed sensor is incorporated within the speedometer; it converts vehicle-speed data to pulse signals and inputs those signals to the engine control unit. The engine control unit, based upon those signals, regulates the idle-speed servo, etc.
- The vehicle speed sensor, by intermitting by the reed switch the flow (to earth) of the approximately 5 V voltage applied from the engine control unit, produces vehicle speed signals.

TROUBLESHOOTING HINTS

If there is damaged or disconnected wiring, or a short-circuit, of the vehicle speed sensor signal circuit, the engine may stall when the vehicle speed is reduced and the vehicle is stopped.

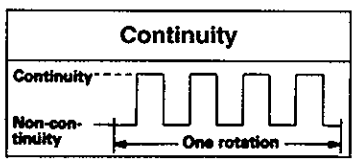
HARNESS INSPECTION

1



Check the vehicle speed sensor output circuit for continuity.

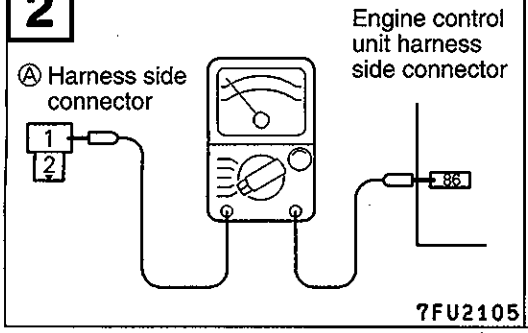
- Engine control unit connector: Disconnected.
- Move the vehicle.



OK → 4

OK → 2

2

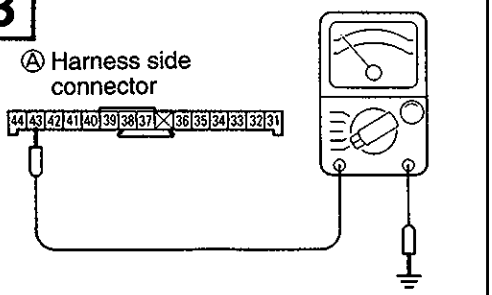


Check for an open-circuit or a short-circuit to earth, between the engine control unit and the vehicle speed sensor.
- Vehicle speed sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ 1 – 86)

3

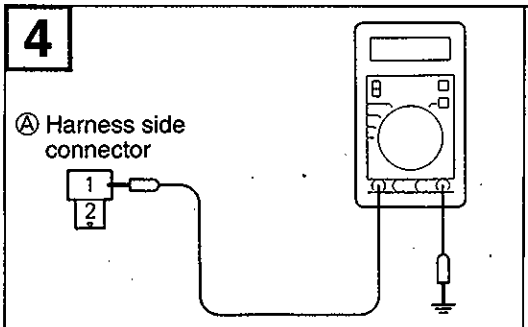


Check for continuity of the earth circuit.
- Vehicle speed sensor connector: Disconnected

OK → 4

NG → Repair the harness. (Ⓐ 43 – Earth)

4



Measure the impressed voltage.
- Vehicle speed sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.5 – 4.9

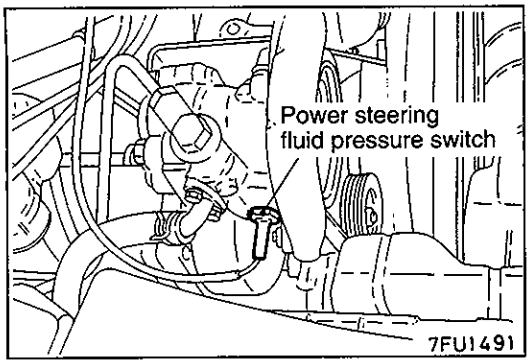
OK → STOP

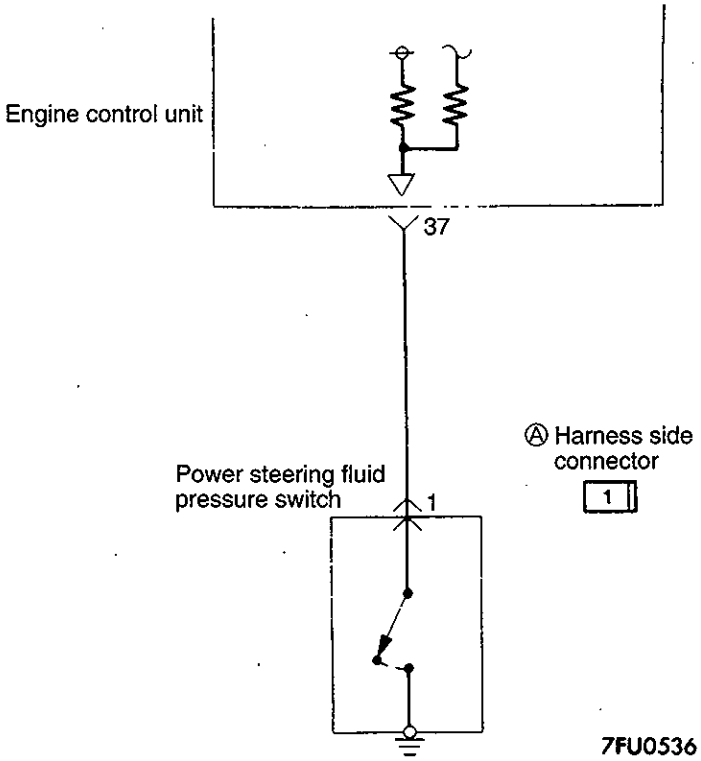
NG → Replace the engine control unit.

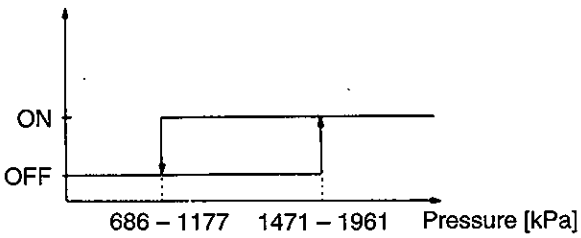
SENSOR INSPECTION

Refer to GROUP 54 – Meters and Gauges.

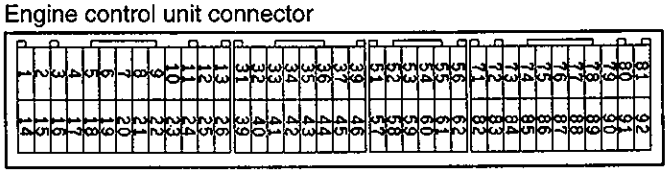
POWER STEERING FLUID PRESSURE SWITCH







Engine control unit connector



9FU0393

OPERATION

- The power steering fluid pressure switch converts presence/ absence of power steering load into low/high voltage and inputs it to the engine control unit, which then controls the idle speed control servo based on this signal.
- The battery voltage in the engine control unit is applied through a resistor to the power steering fluid pressure switch. Steering operation causes the power steering fluid pressure to increase, turning the switch on. As a result, continuity is produced between the battery voltage applied and earth. This causes the power steering fluid pressure terminal voltage to go from high to low.

INSPECTION

Using MUT-II

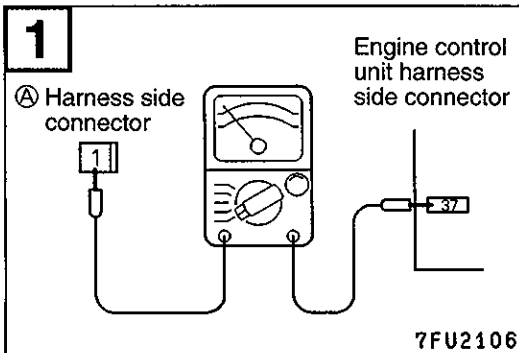
Function	Item No.	Data display	Check condition	Steering wheel	Normal indication
Data reading	27	Switch state	Engine: Idling	Steering wheel neutral position (wheels straight-ahead direction)	OFF
				Steering wheel half turn	ON

Checking Fluid Pressure

Steering wheel		Fluid pump delivery pressure (ref. value)
Straight forward	kPa	686 – 1,177
Turned	kPa	1,471 – 1,961

HARNESS INSPECTION

1

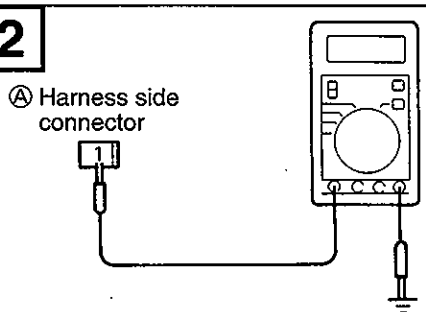


Check for open-circuit or short circuit between the power steering fluid pressure switch and the engine control unit.
- Power steering fluid pressure switch connector: Disconnected
- Engine control unit connector: Disconnected

OK → 2

NO → Repair the harness. (Ⓐ 1 – 37)

2



Measure the applied voltage.
- Power steering fluid pressure switch connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
SV

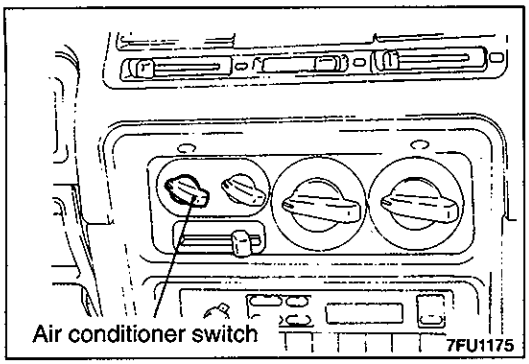
OK → STOP

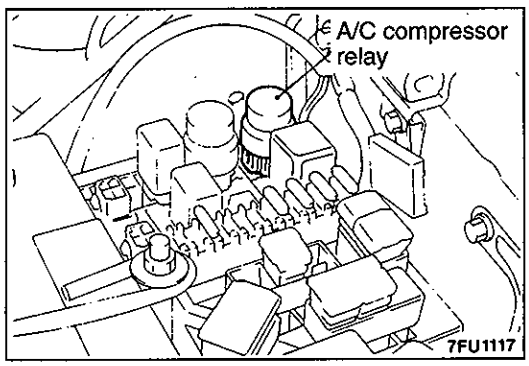
NO → Replace the engine control unit.

SENSOR INSPECTION

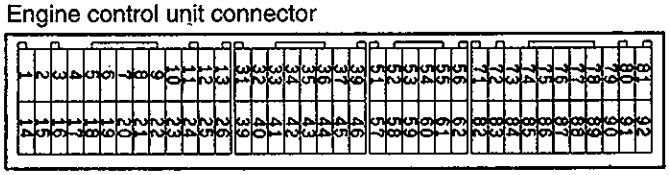
Refer to GROUP 37 – Service Adjustment Procedures.

AIR CONDITIONER SWITCH AND POWER RELAY

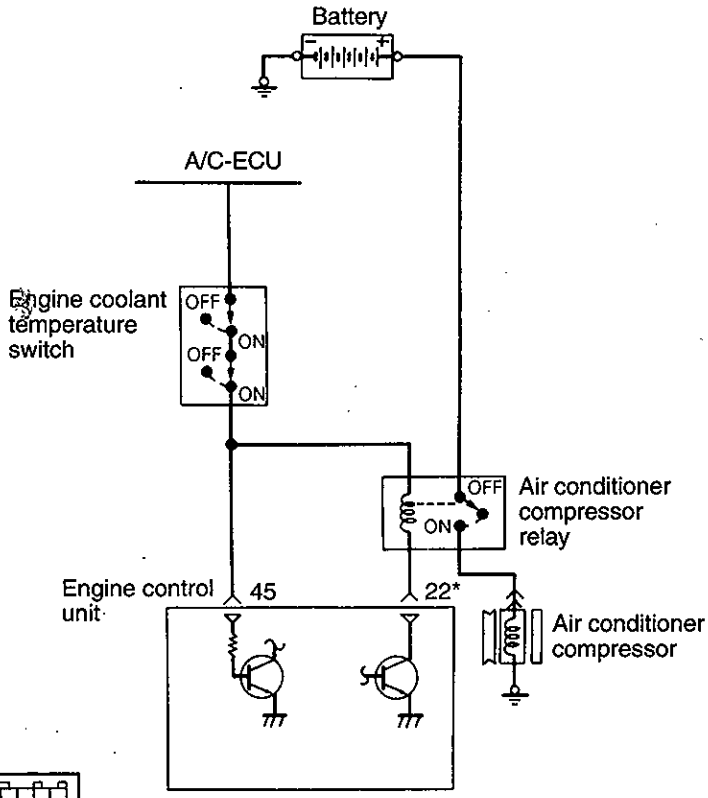




Engine control unit connector



9FU0393



7FU0821

*: No. 8 is for vehicle with immobilizer

OPERATION

- The air conditioner switch applies battery voltage to the engine control unit when the air conditioner is switched ON.
- When the air conditioner signals are input, the engine control unit activates the idle-speed control servo, and also switches ON the power transistor. As a result, current flows to the power relay coil and the relay switch is switched ON; the air conditioner compressor's magnetic clutch is activated.

TROUBLESHOOTING HINTS

If the air conditioner compressor's magnetic clutch is not activated when the air conditioner switch is switched ON during idling, it is probable that the cause is a malfunction of the air conditioner control system.

INSPECTION

Using MUT-II

Air conditioner switch

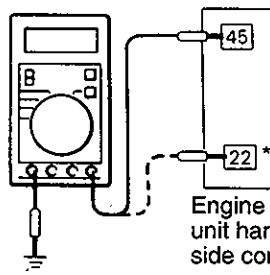
Function	Item No.	Data display	Check conditions	Air conditioner switch	Normal display
Data reading	28	Switch status	• Engine idling (The air conditioner compressor should be activated when the air conditioner switch is switched ON.)	OFF	OFF
				ON	ON

Air conditioner compressor relay

Function	Item No.	Data display	Check conditions	Air conditioner switch	Normal display
Data reading	49	Air conditioner power relay status	• Engine: idling after warm up	OFF	OFF (Compressor clutch non-activation)
				ON	ON (Compressor clutch activation)

HARNESS INSPECTION

1



Engine control unit harness side connector

*: No. 8 is for vehicle with immobilizer 01R0863

Measure the power supply voltage of the air conditioner circuit.

- Engine control unit connector: Disconnect
- Ignition switch: ON
- Air conditioner switch: ON

Voltage (V)
5V

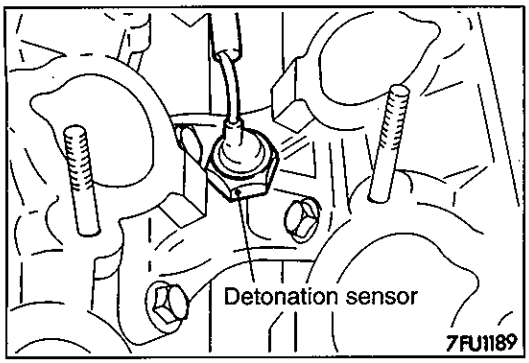
OK → STOP

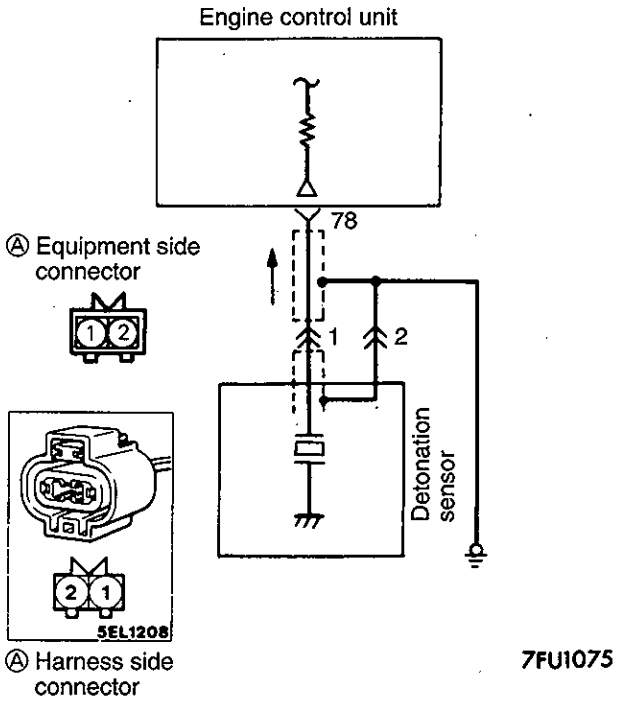
NG → Check the Air conditioner circuit.

AIR CONDITIONER INSPECTION

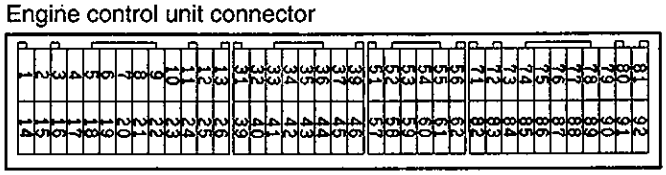
Refer to GROUP 55.

DETONATION SENSOR <6G74-SOHC 24Valve Engine>





Engine control unit connector



9FU0393

OPERATION

The detonation sensor generates a voltage proportional to the magnitude of cylinder block vibration due to knocking and inputs it to the engine control unit. Based on this signal, the engine control unit provides retard control of the ignition timing.

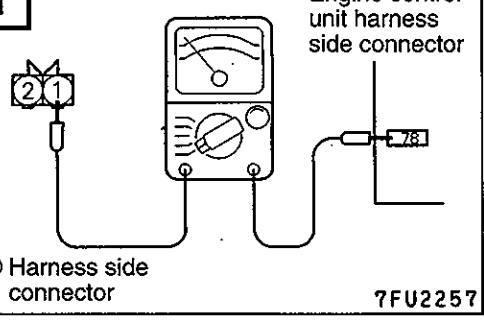
TROUBLESHOOTING HINTS

When knocking occurs while driving under high-load conditions, the following problems are suspected in addition to the detonation sensor itself.

(1) Inappropriate ignition plug heat range
(2) Inappropriate gasoline
(3) Incorrectly adjusted reference ignition timing

HARNESS INSPECTION

1



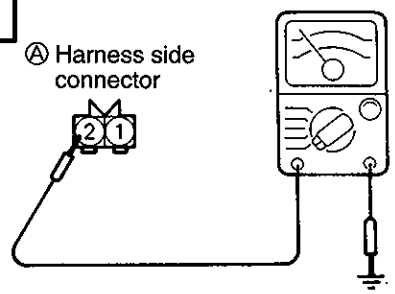
Check for an open-circuit or a short-circuit to earth, between the engine control unit and detonation sensor.

- Detonation sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ 1 – 78)

2



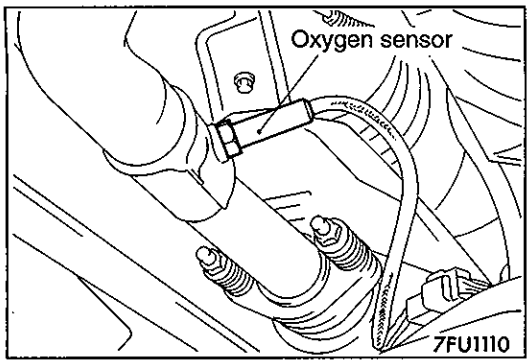
Check for continuity of the earth circuit.

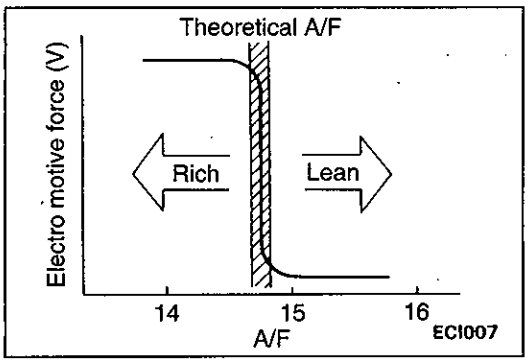
- Connector: Disconnected

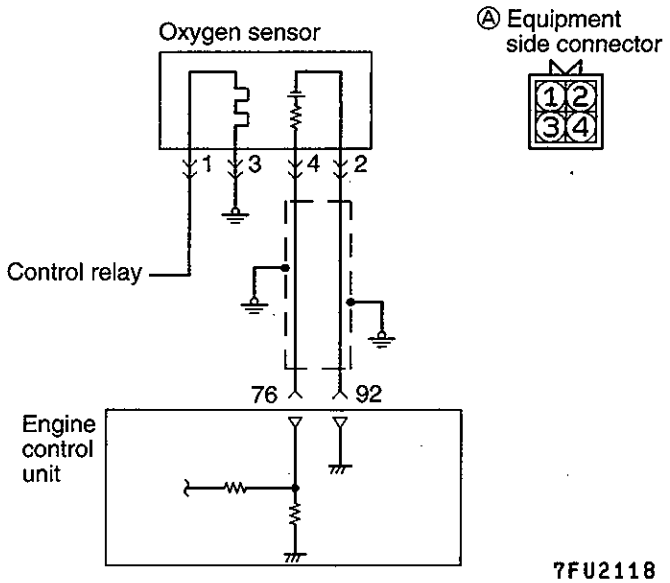
OK → STOP

NG → Repair the harness. (Ⓐ 2 – Earth)

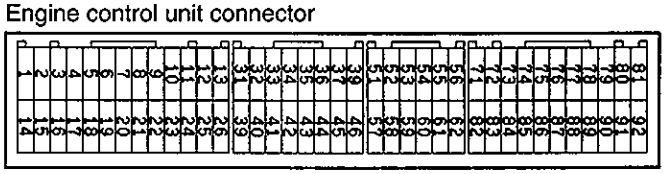
OXYGEN SENSOR <6G72-SOHC 24Valve Engine>







Engine control unit connector



OPERATION

- The oxygen sensor functions to detect the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the engine control unit.
- If the air/fuel mixture ratio is richer than the theoretical air/fuel mixture ratio (i.e., if the concentration of oxygen in the exhaust gas is sparse), a voltage of approximately 1 V is output; if the air/fuel mixture ratio is leaner than the theoretical air/fuel mixture ratio (i.e., if the concentration is dense), a voltage of approximately 0 V is output.
- The engine control unit, based upon those signals, regulates the amount of fuel injection so that the air/fuel mixture ratio becomes the theoretical air/fuel mixture ratio.
- Battery power supply is applied, by way of the control relay, to the oxygen sensor heater. As a result, the sensor element is heated by the heater, so that the oxygen sensor shows excellent response even if the temperature of the exhaust gas is low.

TROUBLESHOOTING HINTS

Hint 1: The exhaust gas purification performance will worsen if there is a malfunction of the oxygen sensor.

Hint 2: If the oxygen sensor output voltage deviates from the standard value even though the results of the checking of the oxygen sensor are normal, the cause is probably a malfunction of a component related to air/fuel mixture ratio control.

[Examples]

(1) Malfunction of an injector.
(2) Air leakage into the intake manifold from a leaking gasket.
(3) Malfunction of the air-flow sensor, the intake air temperature sensor, the barometric-pressure sensor, or the engine coolant temperature sensor.

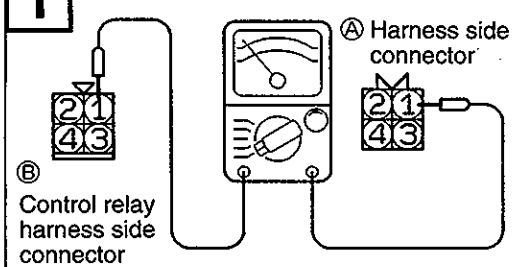
INSPECTION

Using MUT-II

Function	Item No.	Data display	Check conditions	Engine condition r/min	Standard value mV
Data reading	11	Sensor detection voltage	• Engine: warm-up (Make the mixture lean by engine speed reduction, and rich by racing.)	When sudden deceleration from 4,000	200 or lower
				When engine is suddenly raced	600 – 1,000
			• Engine: warm up using the oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the engine control unit	700 (Idling)	400 or lower ↕ (changes) 600 – 1,000
				2,500	

HARNESS INSPECTION

1



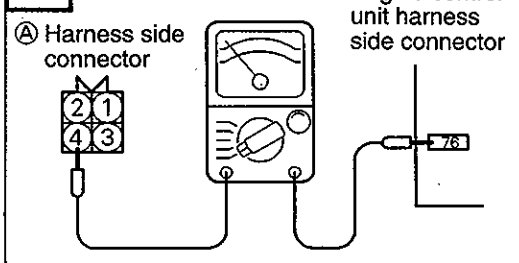
Check for continuity between the oxygen sensor and the control relay.
- Control relay connector: Disconnected
- Oxygen sensor connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

NO → Repair the harness. (Ⓐ 1 – Ⓑ 1)

2

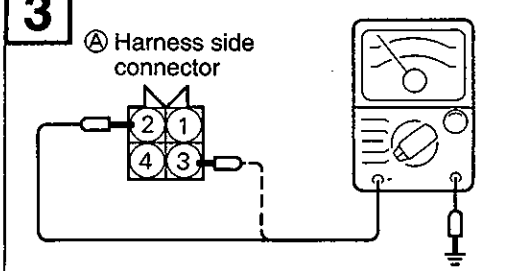


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the oxygen sensor.
- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ 4 – 76)

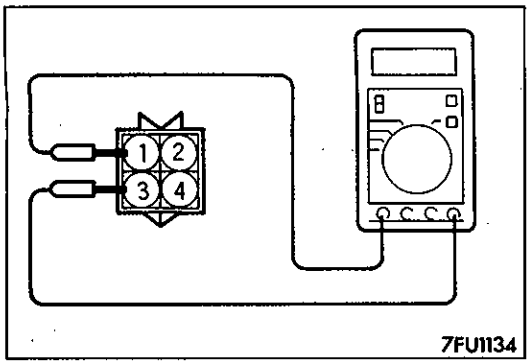
3



Check for continuity of the earth circuit.
- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

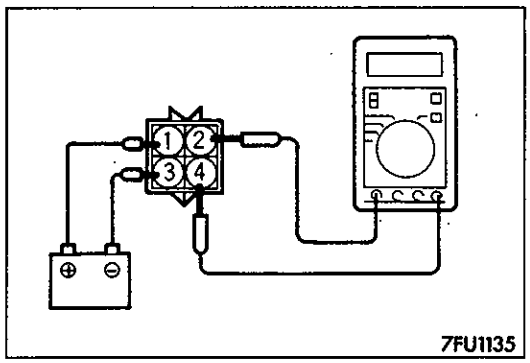
OK → STOP

NO → Repair the harness. (Ⓐ 2 – 92) (Ⓐ 3 – Earth)



SENSOR INSPECTION

(1) Disconnect the oxygen sensor connector.
(2) Check that there is continuity [4.5 – 8.0Ω at 20°C] between oxygen sensor connector terminal ① and terminal ③.
(3) If there is no continuity, replace the oxygen sensor.



(4) Warm the engine until the engine coolant temperature reaches 80°C or more.
(5) Use the jumper leads to connect the oxygen sensor terminal ① (connect (+) terminal) and terminal ③ (connect (–) terminal) to the battery (+) and (–) terminals respectively.

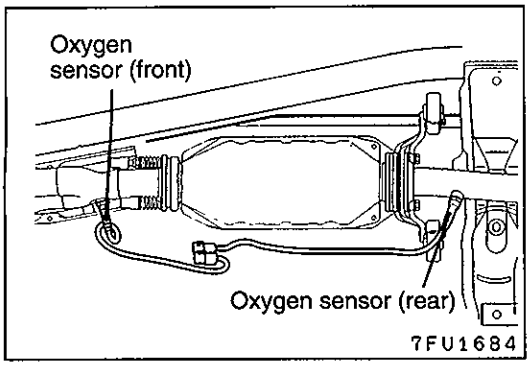
Caution
Be careful when connecting the jumper leads, as connecting the terminals incorrectly will damage the oxygen sensor.

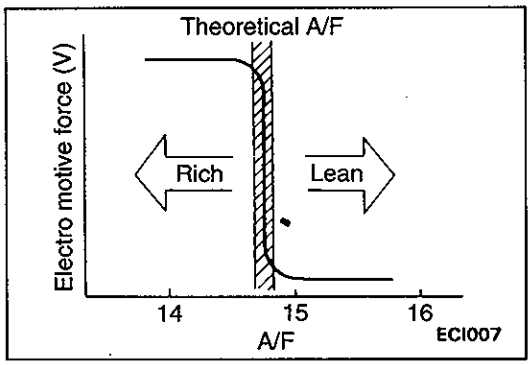
(6) Connect a digital-type voltmeter to terminal ② and terminal ④.
(7) While repeatedly racing the engine, measure the oxygen sensor output voltage.

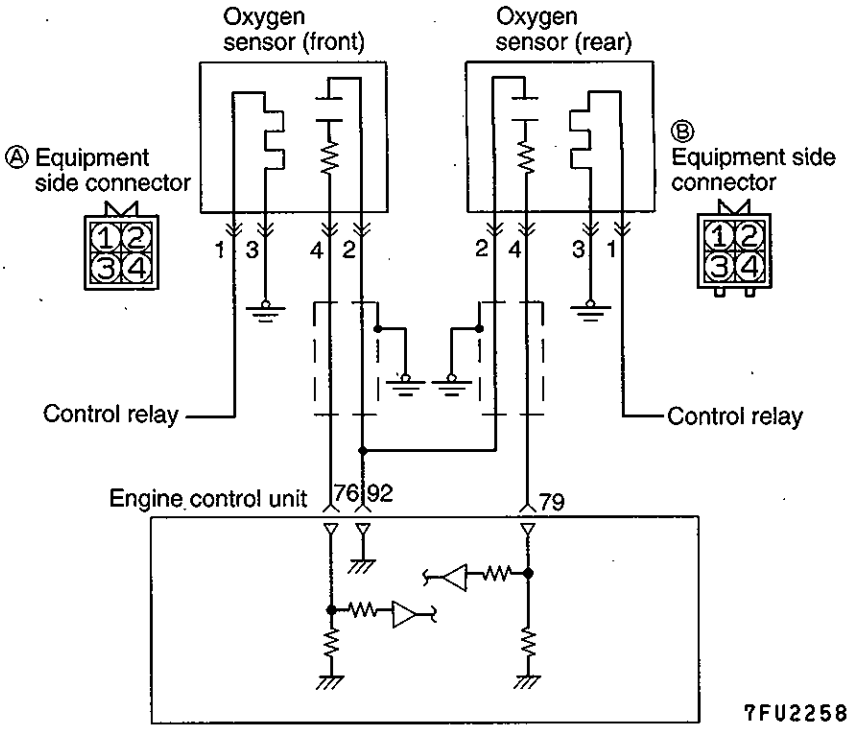
Engine	Oxygen sensor output voltage	Notes
When racing the engine	0.6 – 1.0 V	When the air/fuel mixture ratio is enriched by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6 – 1.0 V.

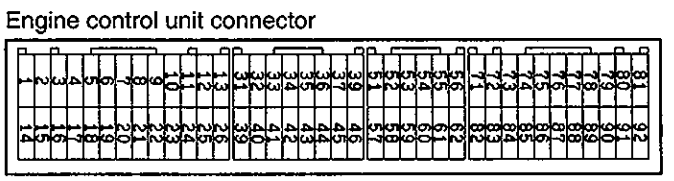
NOTE
For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe, Main Muffler and Catalytic Converter.

OXYGEN SENSOR <6G74-SOHC 24Valve Engine>









OPERATION

- The oxygen sensor functions to detect the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the engine control unit.
- If the air/fuel mixture ratio is richer than the theoretical air/fuel mixture ratio (i.e., if the concentration of oxygen in the exhaust gas is sparse), a voltage of approximately 1 V is output; if the air/fuel mixture ratio is leaner than the theoretical air/fuel mixture ratio (i.e., if the concentration is dense), a voltage of approximately 0 V is output.
- The engine control unit, based upon those signals, regulates the amount of fuel injection so that the air/fuel mixture ratio becomes the theoretical air/fuel mixture ratio.
- Battery power supply is applied, by way of the control relay, to the oxygen sensor heater. As a result, the sensor element is heated by the heater, so that the oxygen sensor shows excellent response even if the temperature of the exhaust gas is low.

TROUBLESHOOTING HINTS

Hint 1: The exhaust gas purification performance will worsen if there is a malfunction of the oxygen sensor.

Hint 2: If the oxygen sensor output voltage deviates from the standard value even though the results of the checking of the oxygen sensor are normal, the cause is probably a malfunction of a component related to air/fuel mixture ratio control.

[Examples]

(1) Malfunction of an injector.
(2) Air leakage into the intake manifold from a leaking gasket.
(3) Malfunction of the air-flow sensor, the intake air temperature sensor, the barometric-pressure sensor, or the engine coolant temperature sensor.

INSPECTION

Using MUT-II

<Oxygen Sensor (front)>

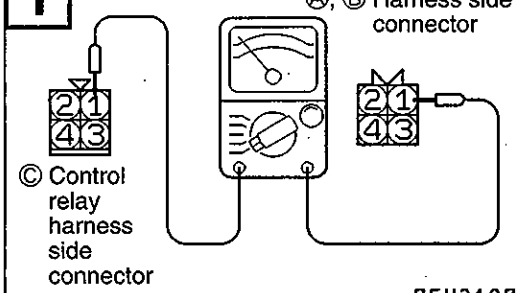
Function	Item No.	Data display	Check condition	Engine condition	Standard value
Data reading	11	Sensor detection voltage	Engine: Warm-up (Make the mixture lean by engine speed reduction, and rich by racing)	When sudden deceleration from 4,000 r/min	200 mV or lower
				When engine is suddenly raced	600 – 1,000 mV
			Engine: Warm-up (Using the oxygen sensor signal, check the air/fuel mixture ratio and also check the condition of control by the engine control unit.	Idle speed	Changes repeatdly between 400 mV or lower and 600 – 1,000 mV
				2,500 r/min	

<Oxygen sensor (rear)>

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	59	Sensor voltage	• Transmission: Second <M/T>, L range <A/T> • Accelerate the vehicle with wide open throttle.	3,500 r/min	600 – 1,000 mV

HARNESS INSPECTION

1



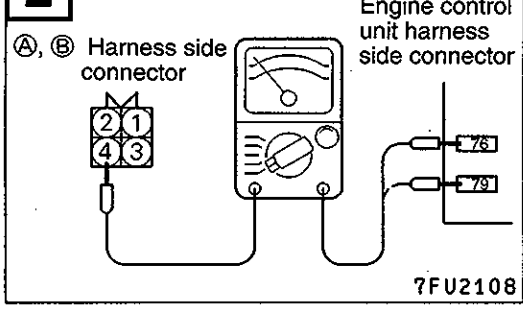
Check for continuity between the oxygen sensor and the control relay.
- Control relay connector: Disconnected
- Oxygen sensor connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

NG → Repair the harness. (Ⓐ 1 – Ⓒ 1, Ⓑ 1 – Ⓒ 1)

2

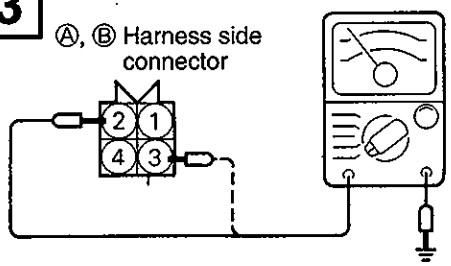


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the oxygen sensor.
- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ 4 – 76, Ⓑ 4 – 79)

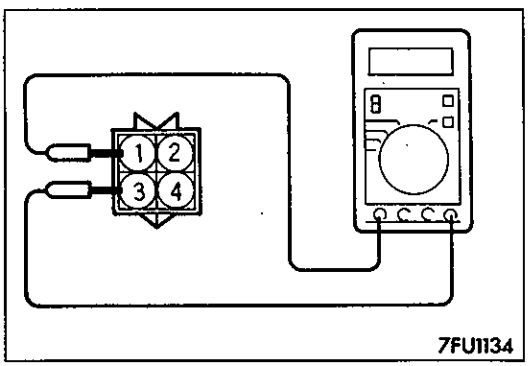
3



Check for continuity of the earth circuit.
- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

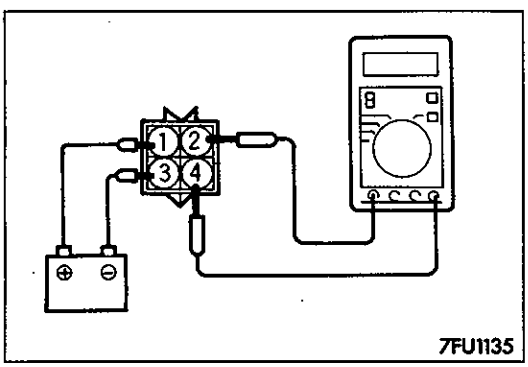
OK → STOP

NG → Repair the harness. (Ⓐ 2 – 92, Ⓐ 3 – Earth) (Ⓑ 2 – 92, Ⓑ 3 – Earth)



SENSOR INSPECTION <OXYGEN SENSOR (FRONT)>

(1) Disconnect the oxygen sensor connector.
(2) Check that there is continuity [4.5 – 8.0Ω at 20°C] between oxygen sensor connector terminal ① and terminal ③.
(3) If there is no continuity, replace the oxygen sensor.



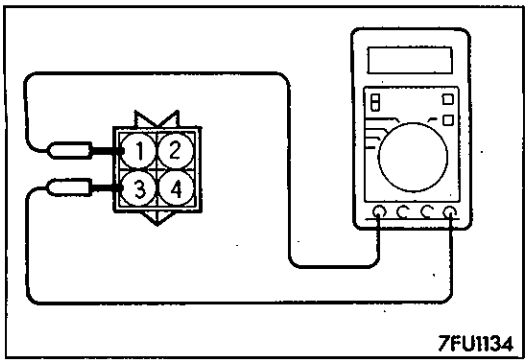
(4) Warm the engine until the engine coolant temperature reaches 80°C or more.
(5) Use the jumper leads to connect the oxygen sensor terminal ① (connect (+) terminal) and terminal ③ (connect (–) terminal) to the battery (+) and (–) terminals respectively.

Caution
Be careful when connecting the jumper leads, as connecting the terminals incorrectly will damage the oxygen sensor.

(6) Connect a digital-type voltmeter to terminal ② and terminal ④.
(7) While repeatedly racing the engine, measure the oxygen sensor output voltage.

Engine	Oxygen sensor output voltage	Notes
When racing the engine	0.6 – 1.0 V	When the air/fuel mixture ratio is enriched by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6 – 1.0 V.

NOTE
For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe, Main Muffler and Catalytic Converter.

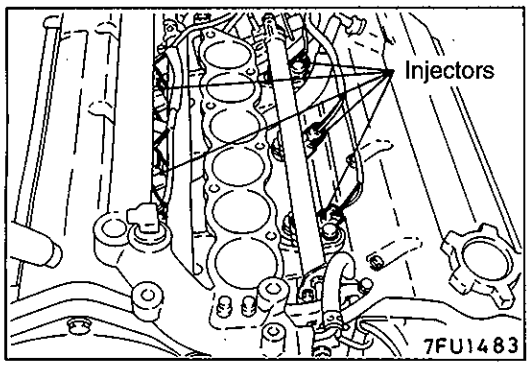


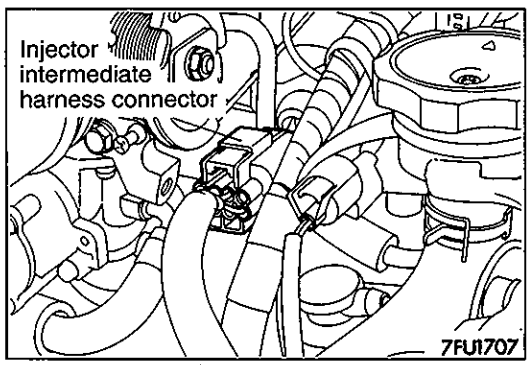
SENSOR INSPECTION <OXYGEN SENSOR (REAR)>

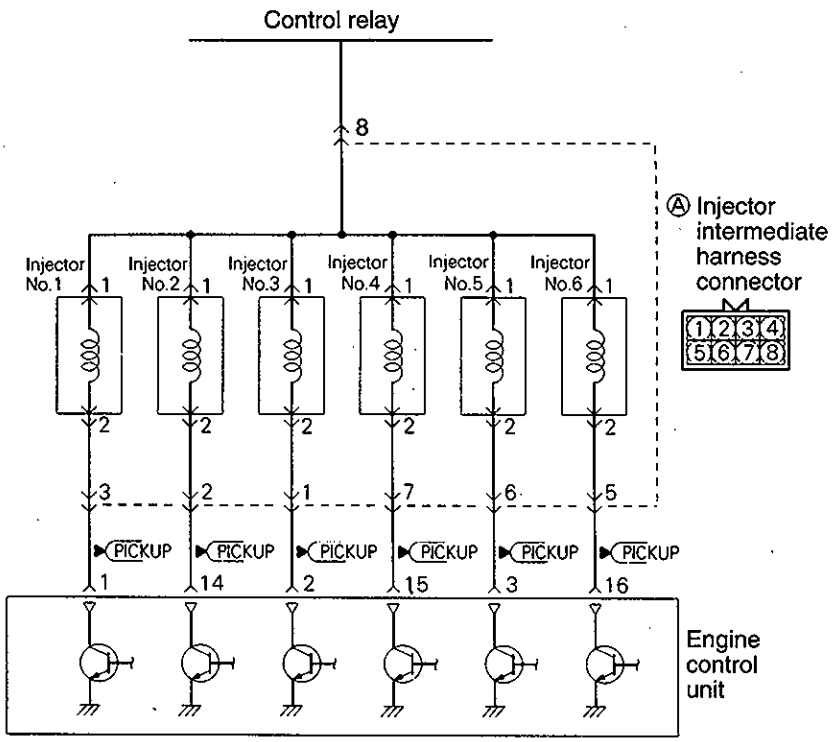
(1) Disconnect the oxygen sensor connector.
(2) Check that there is continuity [4.5 – 8.0Ω at 20°C] between oxygen sensor connector terminal ① and terminal ③.
(3) If there is no continuity, replace the oxygen sensor.

NOTE
1. If the MUT-II does not display the standard value although no abnormality is found by the abovementioned continuity test and harness check, replace the oxygen sensor (rear).
2. For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe, Main Muffler and Catalytic Converter.

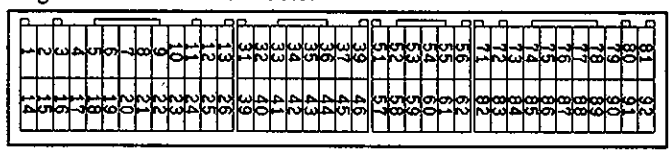
INJECTORS







Engine control unit connector



OPERATION

- The injectors are electromagnetic-valve-equipped injection nozzles that function to inject fuel based upon injection signals from the engine control unit.
- Because the surface area of the injection ports is fixed and because the pressure of the fuel relative to the pressure within the manifold is also regulates to a fixed pressure, the amount of fuel injection by injectors is determined by the length of time that the needle valve is open, or, in other words, by the length of time of current flow to the solenoid coil.
- Battery power supply is supplied, by way of the control relay, to the injectors. When the engine control unit switches ON the power transistor within the unit and current flows to the solenoid coil, the injectors open and fuel is injected.

TROUBLESHOOTING HINTS

Hint 1: If there is a problem with starting while the engine is warm, perform the combustion test and check for leakage of the injectors.

Hint 2: If the engine can't be started, and the injectors are not activated during cranking, the cause is probably a malfunction such as described below, not with the injectors.

(1) Malfunction of the circuit for supply of power to the engine control unit, or of the earth circuit.
(2) Malfunction of the control relay.
(3) Malfunction of the crank angle sensor.

Hint 3: If there is a cylinder for which the idling condition does not change when, during idling, the fuel injection of the injectors is cut off in sequence, check that cylinder as described below.
(1) Check the injector and harness.
(2) Check the spark plugs and the high-tension cable.
(3) Check the compression pressure.

Hint 4: If the injector activation time deviates from the standard value even though the results of the checking of the injector's harness and of the injector itself are normal, the cause may be presumed to be one of the following.
(1) Incomplete combustion within the cylinder.
(Malfunction of the spark plugs, the ignition coil, the compression pressure, etc.)
(2) Improper adhesion of EGR valve seat.
(3) Increased engine resistance.

INSPECTION

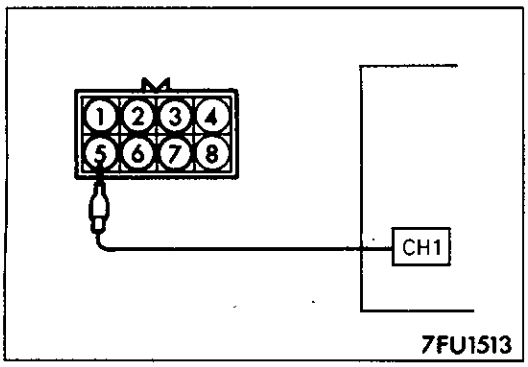
Using MUT-II

Function	Item No.	Data Display	Check conditions	Engine coolant temperature °C	Standard value ms
Data reading	41	Activation time*1	Engine cranking	When 0*2	15.5 – 19
				When 20	38 – 46.5
				When 80	10 – 12

Function	Item No.	Data Display	Check conditions	Engine condition r/min	Standard value ms
Data reading	41	Activation time*3	• Engine coolant temperature: 89 – 95°C • Lamps and accessories: OFF • Transmission: neutral (P range for vehicles with A/T) • Steering wheel: neutral position	700 (idling)	2.6 – 3.8
				2,500	2.3 – 3.5
				When raced suddenly	Increases

NOTE
*1: Indicates the injector-activation time when the power source voltage is 11 V and the cranking speed is 250 r/min or less.
*2: At a coolant temperature of 0°C, there is synchronous injection for all six cylinders.
*3: For a new vehicle [driven approximately 500 km or less)] the injector-activation may be about ten percent longer than indicated above.

Function	Item No.	Drive content	Check condition	Normal condition
Actuator test	01	No. 1 injector shut off	Engine: Idling after warm-up (Shut off the injectors in sequence during after engine warm-up, check the idling condition)	Idle state to change further (becoming less stable or stalling)
	02	No. 2 injector shut off		
	03	No. 3 injector shut off		
	04	No. 4 injector shut off		
	05	No. 5 injector shut off		
	06	No. 6 injector shut off		

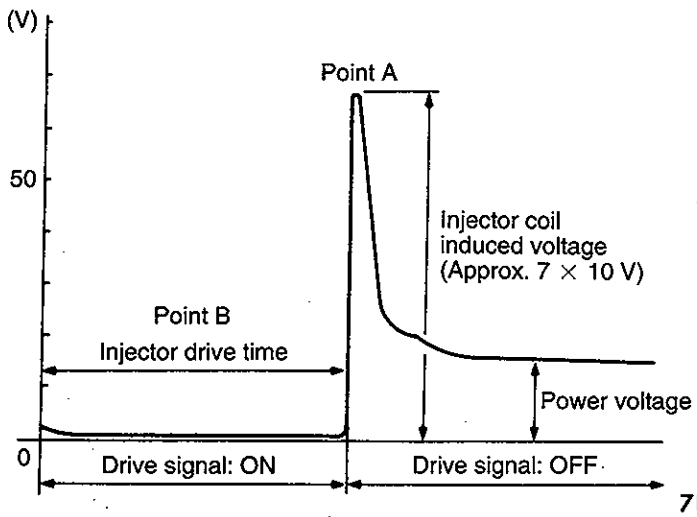


Wave Pattern Inspection Using An Analyzer

(1) Remove the injector intermediate connector and connect the special tool (harness connector: MD998474).
(2) Connect the probe of an osciloscope as follows.

	No. 1 cylinder	No. 2 cylinder	No. 3 cylinder	No. 4 cylinder	No. 5 cylinder	No. 6 cylinder
Male connector terminal No.	3	2	1	7	6	5
Clip colour (lead wire)	Green (Green/ black)	White (White)	Blue (Blue)	Yellow (Yellow)	Red (Red)	Black (Black)

Standard wave pattern



Observation conditions

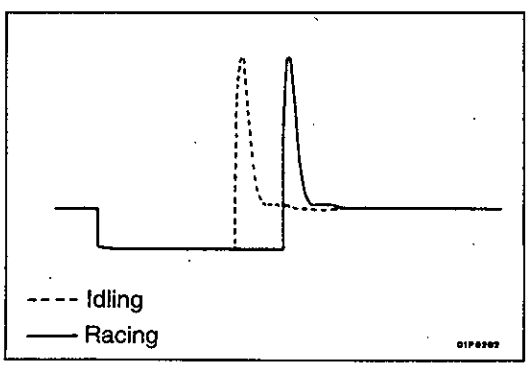
Function	Special patterns
Pattent height	Variable
Variable knob pattern selector	Display
Engine r/min	Idle speed (700 r/min)

Wave pattern observation points

Point A): Height of back electromotive force in the solenoid coil

Contrast with standard wave pattern	Probable cause
Solenoid coil back electromotive force is low or doesn't appear at all.	Short in the injector solenoid

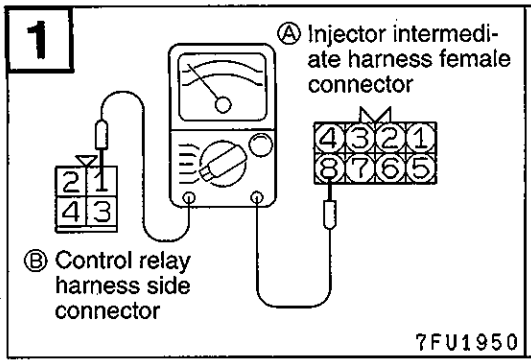
Point B): Injector drive time



- The injector drive timing will synchronized with the MUT-II display.
- When the engine is suddenly raced, the drive time will be greatly extended at first, but the drive time will soon match the engine speed.

HARNESS INSPECTION

1



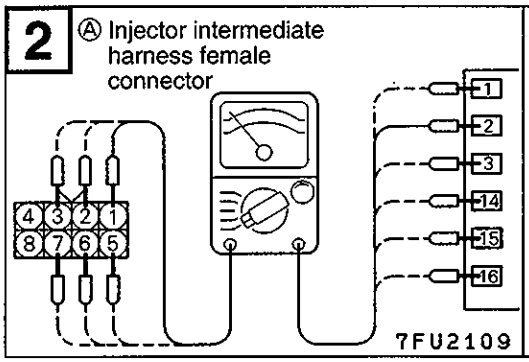
Check for continuity between the injectors and the control relay.
- Injector intermediate connector: Disconnected
- Control relay connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

NG → Repair the harness. (Ⓐ 8 – Ⓑ 1)

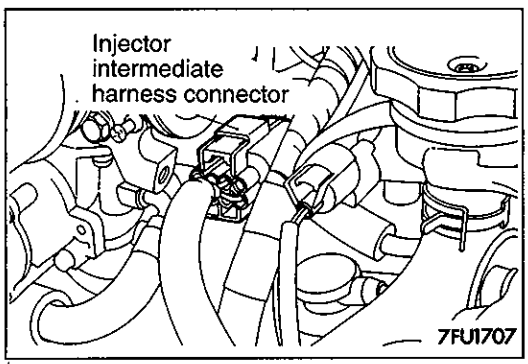
2



Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the injector.
- Engine control unit connector: Disconnected
- Injector intermediate connector: Disconnected

OK → STOP

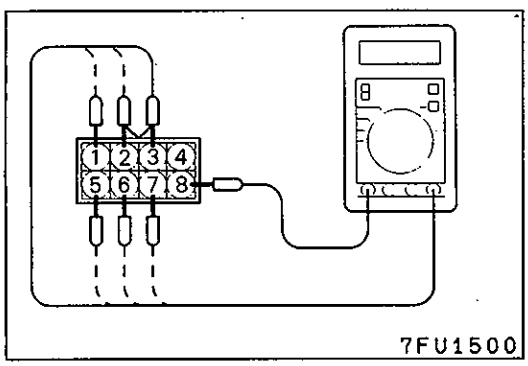
NG → Repair the harness.
(Ⓐ 1 – 2)
(Ⓐ 2 – 14)
(Ⓐ 3 – 1)
(Ⓐ 5 – 16)
(Ⓐ 6 – 3)
(Ⓐ 7 – 15)



ACTUATOR INSPECTION

Measuring Resistance Between Terminals

(1) Disconnect the injector intermediate harness connector.



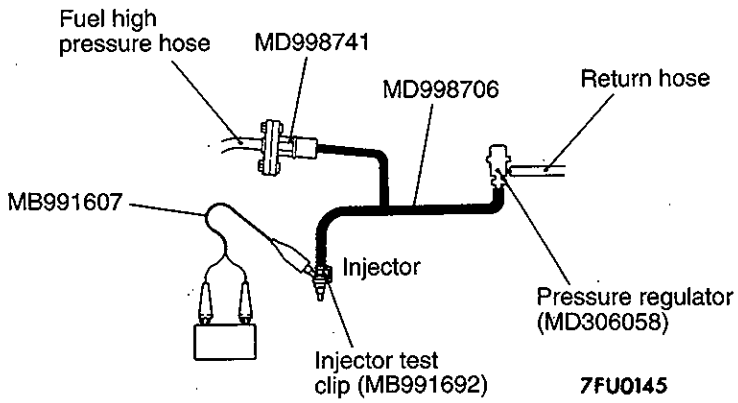
(2) Measure resistance value between terminals.

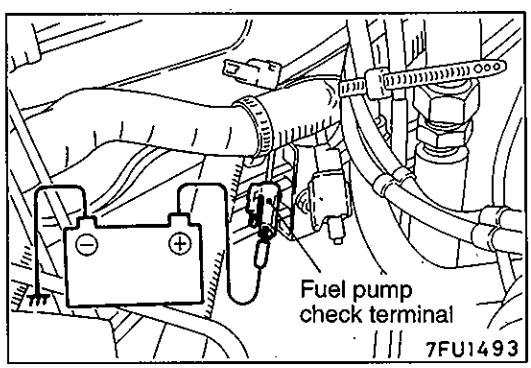
Injector	Terminals	Resistance value
No. 1	8 – 3	13 – 16Ω
No. 2	8 – 2	
No. 3	8 – 1	
No. 4	8 – 7	
No. 5	8 – 6	
No. 6	8 – 5	

(3) Connect the injector intermediate harness connector.

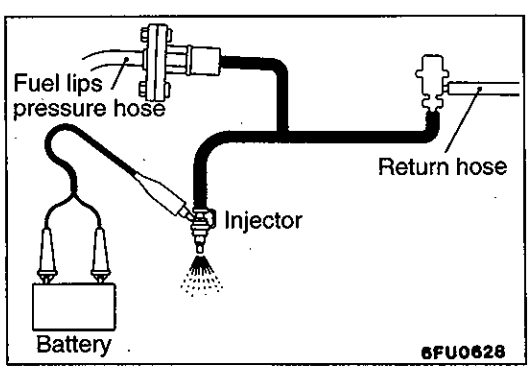
Checking the Injection Condition

(1) Following the steps below, bleed out the residual pressure within the fuel pipe line to prevent flow of the fuel.
(2) Remove the injector.
(3) Arrange the special tool (injector test set), adaptor, fuel pressure regulator and injector test clip as shown in the illustration below.

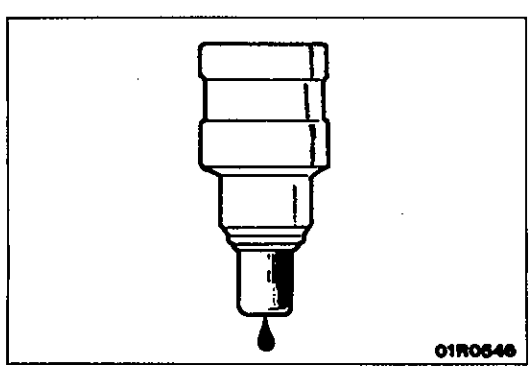




(4) Connect the battery's negative (–) terminal.
(5) Apply battery voltage to the fuel pump check terminal and activate the fuel pump.



(6) Activate the injector and check the atomized spray condition of the fuel. The condition can be considered satisfactory unless it is extremely poor.

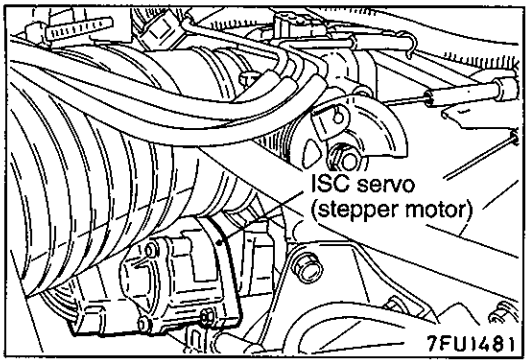


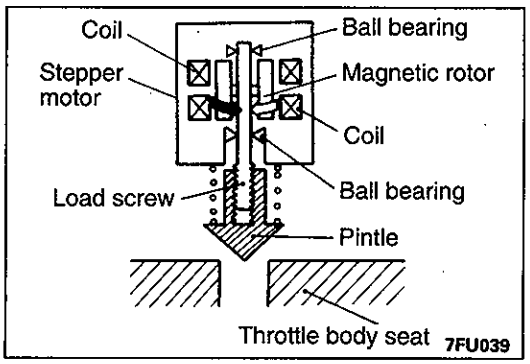
(7) Stop the actuation of the injector, and check for leakage from the injector's nozzle.

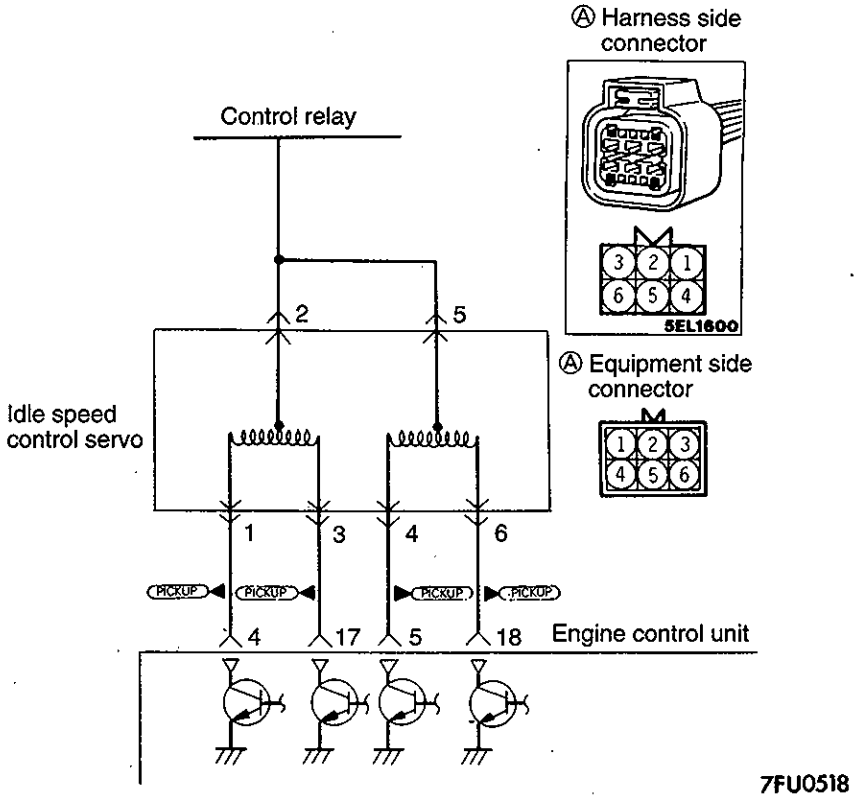
Standard value: 1 drop or less per minute

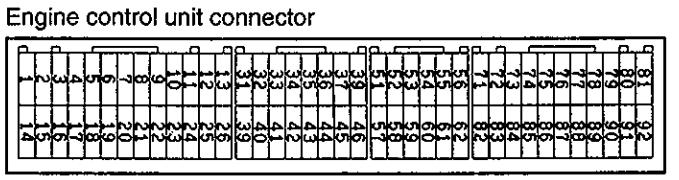
(8) Activate the injector without activating the fuel pump; then, when the spray emission of fuel from the injector stops. disconnect the special tool and restore it to its original condition.

IDLE SPEED CONTROL SERVO (STEPPER MOTOR TYPE)









OPERATION

- The intake air volume during idling is controlled by opening or closing the servo valve provided in the air path that bypasses the throttle valve.
- The servo valve is opened or closed by operating the stepper motor in the speed control servo in normal or reverse direction.
- The battery power is supplied to the stepper motor through the control relay. As the engine control unit turns on power transistors in the unit one after another. the stepper motor coil is energized and the motor rotates in normal or reverse direction.

TROUBLESHOOTING HINTS

Hint 1: If the stepper motor step increases to 100 to 120 steps or decreases to 0 step, faulty stepper motor or open circuit in the harness is suspected.

Hint 2: If the idle speed control servo harness and individual part checks have resulted normal but the stepper motor steps are out of specification, the following faults are suspected.

(1) Poorly adjusted reference idle speed
(2) Deposit on the throttle valve
(3) Air leaking into the intake manifold through gasket gap
(4) Loose EGR valve seat
(5) Poor combustion in the cylinder (faulty ignition plug, ignition coil, injector, low compression pressure, etc.)

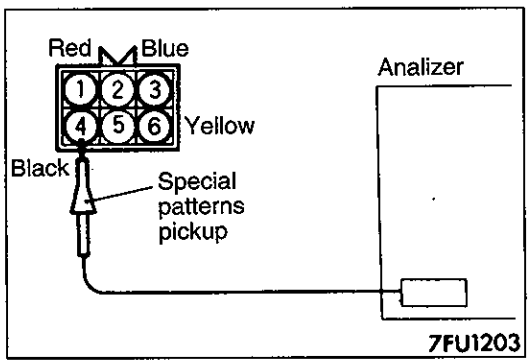
INSPECTION

Using MUT-II

Function	Item No.	Data display	Check condition	Load state	Standard value
Data reading	45	Stepper motor steps	• Engine coolant temperature: 80 – 95°C (176 – 205°F) • Lamps, accessory units: OFF • Transmission: Neutral (P range for vehicles with A/T) • Idle position switch: ON (compressor clutch to be ON if air conditioner switch is ON) • Engine: Idling	Air conditioner switch: OFF	2 – 25 steps
				Air conditioner switch: ON	Increase by 10 – 70 steps
				Air conditioner switch: OFF Selector lever: N → D position	Increase by 5 – 50 steps

NOTE
When the vehicle is new [within initial operation of about 500 km], the stepper motor steps may be about 30 steps more than standard.

Caution
When the select lever is shifted to the D position, the brakes must be used to prevent the vehicle from moving forward.



Wave Pattern Inspection Using an Analyzer

Measurement method

(1) Disconnect the stepper motor connector, and connect the special tool (test harness: MD998463) in between.
(2) Connect the analyzer special patterns pickup to the stepper motor-side connector terminal ① (red clip on the special tool), terminal ③ (blue clip), terminal ④ (black clip) and terminal ⑥ (yellow clip) respectively.

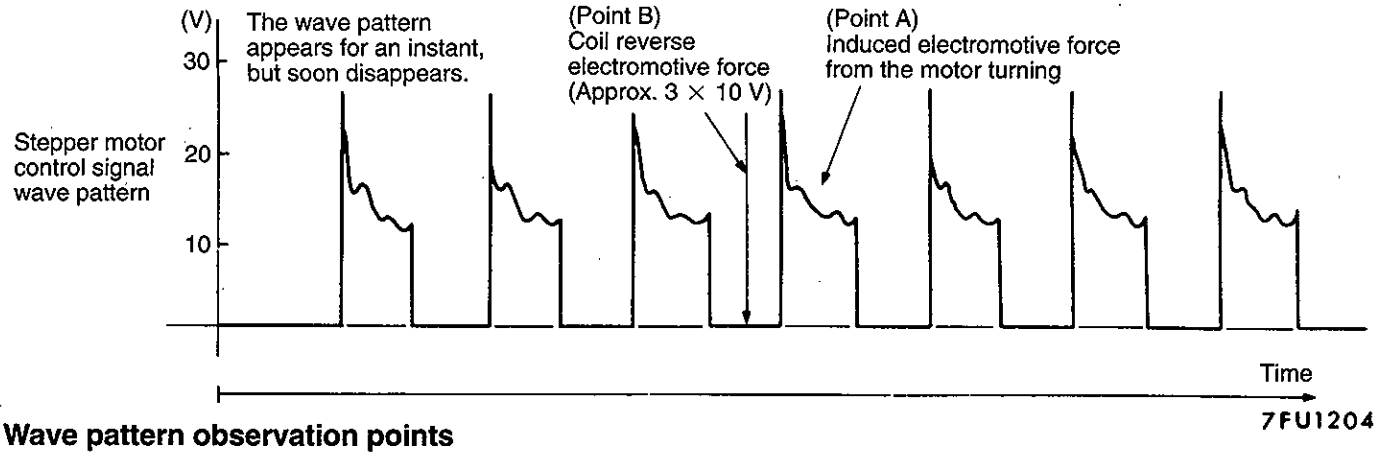
Alternative method (when test harness is not available)

Connect the analyzer special patterns pickup to ECU terminals (4), (5), (17) and (18).

Standard wave pattern

Observation conditions

Function	Special patterns
Pattern height	High
Pattern selector	Display
Engine condition	Turn the ignition switch from OFF to ON (without starting the engine).
	While the engine is idling, turn the air conditioner switch to ON.
	Immediately after starting the warm engine (approx. 1 minute).



Wave pattern observation points

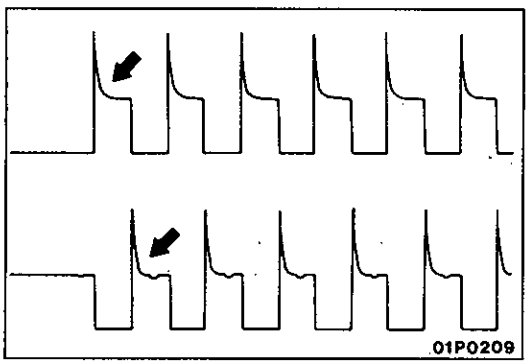
Check that the standard wave pattern appears when the stepper motor is operating.

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

Contrast with standard wave pattern	Probable cause
Induced electromotive force does not appear or is extremely small.	Motor is malfunctioning

(Point B): Height of coil reverse electromotive force

Contrast with standard wave pattern	Probable cause
Coil reverse electromotive force does not appear or is extremely small.	Short in the coil



Abnormal wave pattern

Cause of problem

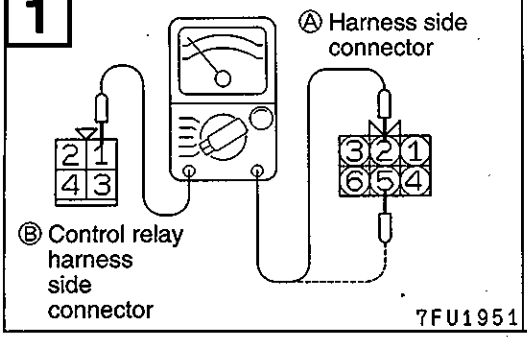
Motor is malfunctioning. (Motor is not operating.)

Wave pattern characteristics

Induced electromotive force from the motor turning does not appear.

HARNESS INSPECTION

1



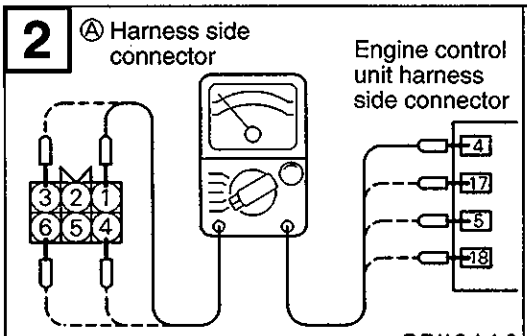
Check for continuity between the idle speed control servo and the control relay.
- Idle speed control servo connector: Disconnected
- Control relay connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

NG → Repair the harness. (Ⓐ 2 5 – Ⓑ 1)

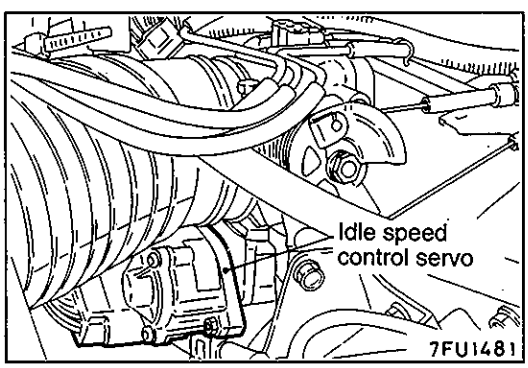
2



Check for an open-circuit, or a short-circuit to earth between the engine control unit and the idle speed control servo.
- Engine control unit connector: Disconnected
- Idle speed control servo connector: Disconnected

OK → STOP

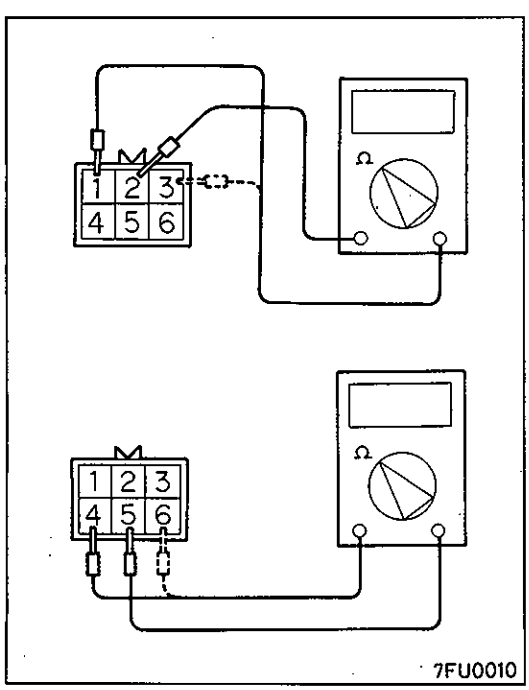
NG → Repair the harness.
(Ⓐ 1 – 4)
(Ⓐ 3 – 17)
(Ⓐ 4 – 5)
(Ⓐ 6 – 18)



ACTUATOR INSPECTION

Checking the Operation Sound

(1) Check that the operation sound of the stepper motor can be heard after the ignition is switched ON (but without starting the motor).
(2) If the operation sound cannot be heard, check the stepper motor's activation circuit.
If the circuit is normal, it is probable that there is a malfunction of the stepper motor or of the engine control unit.



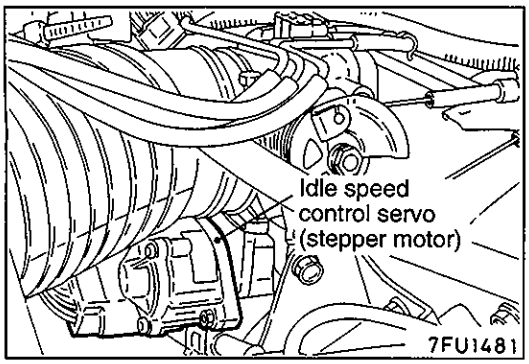
Checking the Coil Resistance

(1) Disconnect the idle speed control servo connector and connect the special tool (test harness).
(2) Measure the resistance between terminal ② (white clip of the special tool) and either terminal ① (red clip) or terminal ③ (blue clip) of the connector at the idle speed control servo side.

Standard value: 28 – 33Ω [at 20°C]

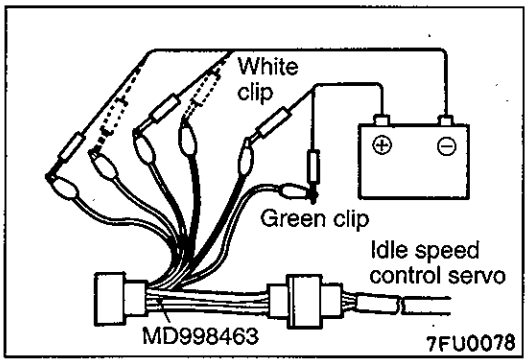
(3) Measure the resistance between terminal ⑤ (green clip of the special tool) and either terminal ⑥ (yellow clip) or terminal ④ (black clip) of the connector at the idle speed control servo side.

Standard value: 28 – 33Ω [at 20°C]

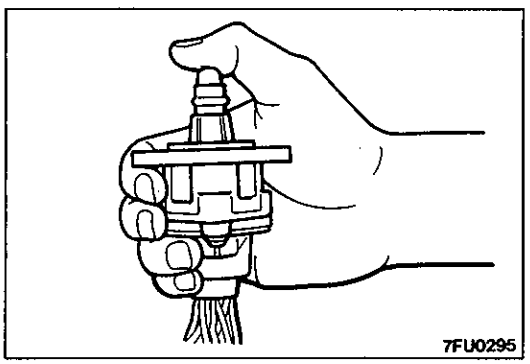


Operation Check

(1) Remove the throttle body.
(2) Remove the stepper motor.

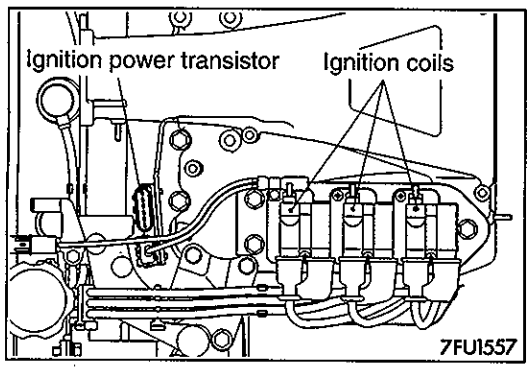


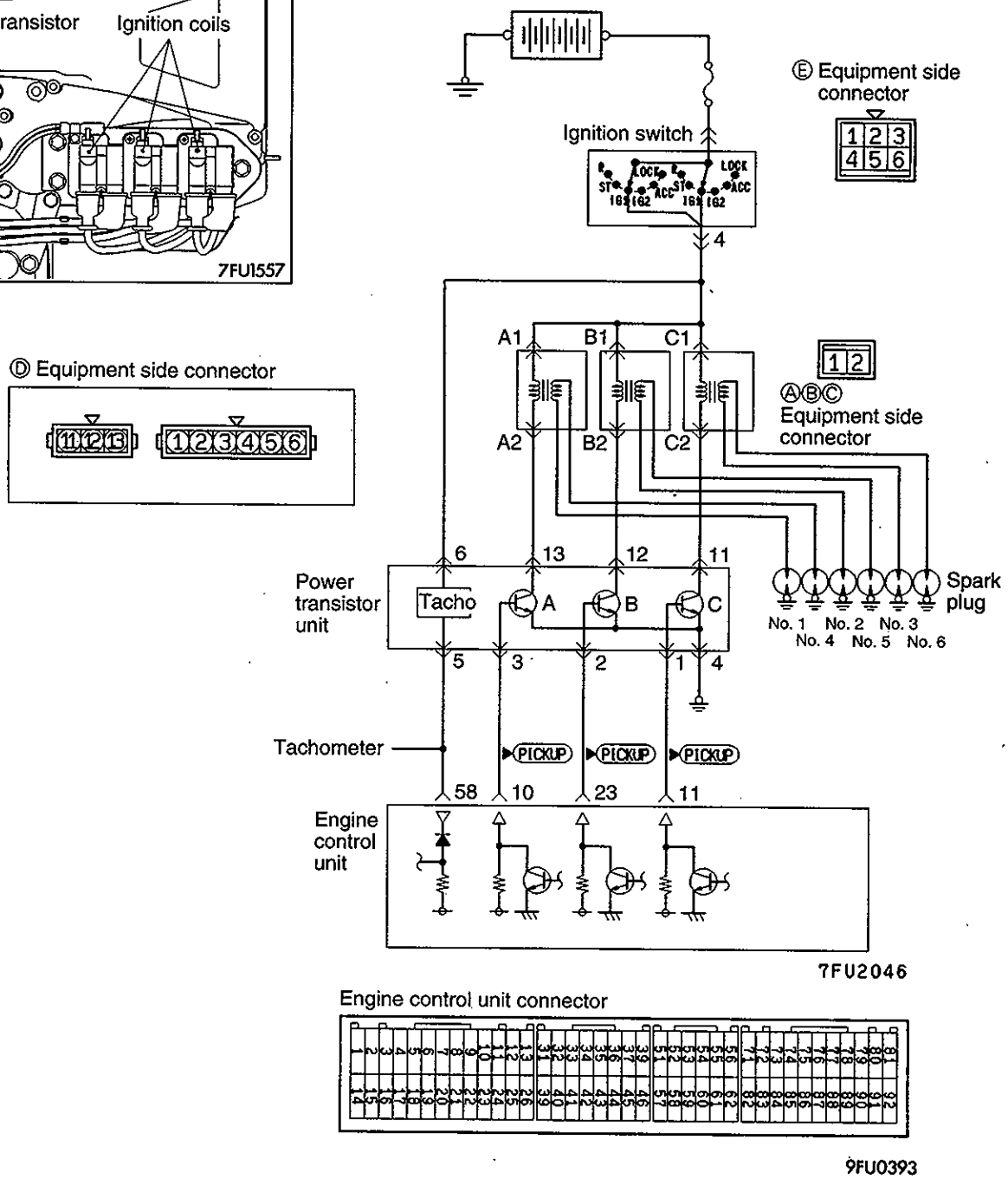
(3) Connect the special tool (test harness) to the idle speed control servo connector.
(4) Connect the positive ⊕ terminal of a power supply (approx. 6 V) to the white clip and the green clip.



(5) With the idle speed control servo as shown in the illustration, connect the negative ⊖ terminal of the power supply to each clip as described in the following steps, and check whether or not a vibrating feeling (a feeling of very slight vibration of the stepper motor) is generated as a result of the activation of the stepper motor.
   ① Connect the negative ⊖ terminal of the power supply to the red and black clip.
   ② Connect the negative ⊖ terminal of the power supply to the blue and black clip.
   ③ Connect the negative ⊖ terminal of the power supply to the blue and yellow clip.
   ④ Connect the negative ⊖ terminal of the power supply to the red and yellow clip.
   ⑤ Connect the negative ⊖ terminal of the power supply to the red and black clip.
   ⑥ Repeat the tests in sequence from ⑤ to ①.
(6) If, as a result of these tests, vibration is detected, the stepper motor can be considered to be normal.

IGNITION COIL AND POWER TRANSISTOR





OPERATION

- When the power transistor unit A is turned ON by the signal from the engine control unit, primary current flows to the ignition coil A. When the power transistor unit A is turned OFF, the primary current is shut off and a high voltage is induced in the secondary coil A, causing the ignition plugs of No. 1 and No. 4 cylinders to spark. When the power transistor unit B is turned OFF, the ignition plugs of No. 2 and No. 5 cylinders spark. In addition, when the power transistor unit C is turned OFF, the ignition plugs of No. 3 and No. 6 cylinders spark.
- When the engine control unit turns OFF the transistor in the unit, the battery voltage in the unit is applied to the power transistor unit to turn it ON. When the engine control unit turns ON the transistor in the unit, the power transistor unit is turned OFF.

INSPECTION

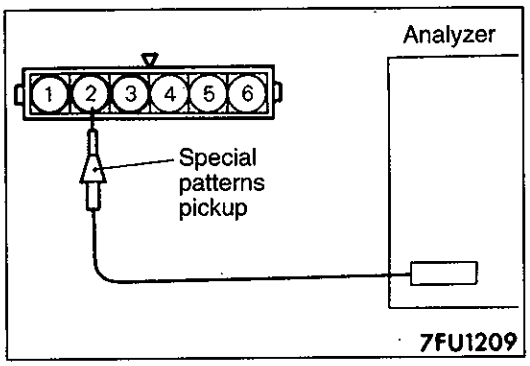
Using MUT-II

<Spark Advance>

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	44	Ignition advance	• Engine: Warming up • Timing lamp: Set (set timing lamp to check actual ignition timing)	700 r/min (Idle)	7 – 23° BTDC
				2,500 r/min	27 – 47° BTDC

<Standard Ignition Timing>

Function	Item No.	Drive	Check condition	Normal condition
Actuator test	17	Set to ignition timing adjustment mode	• Engine: idling • Timing lamp: set	5° BTDC ± 3°



Wave Pattern Inspection Using an Analyzer

- Ignition coil primary signal
  Refer to GROUP 16 – Ignition System.
- Power transistor control signal.

<Measurement method>

(1) Disconnect the power transistor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
(2) Connect the analyzer special patterns pickup to the connector terminals ① (No. 3 – No. 6), ② (No. 2 – No. 5) and ③ (No. 1 – No. 4) in that order.

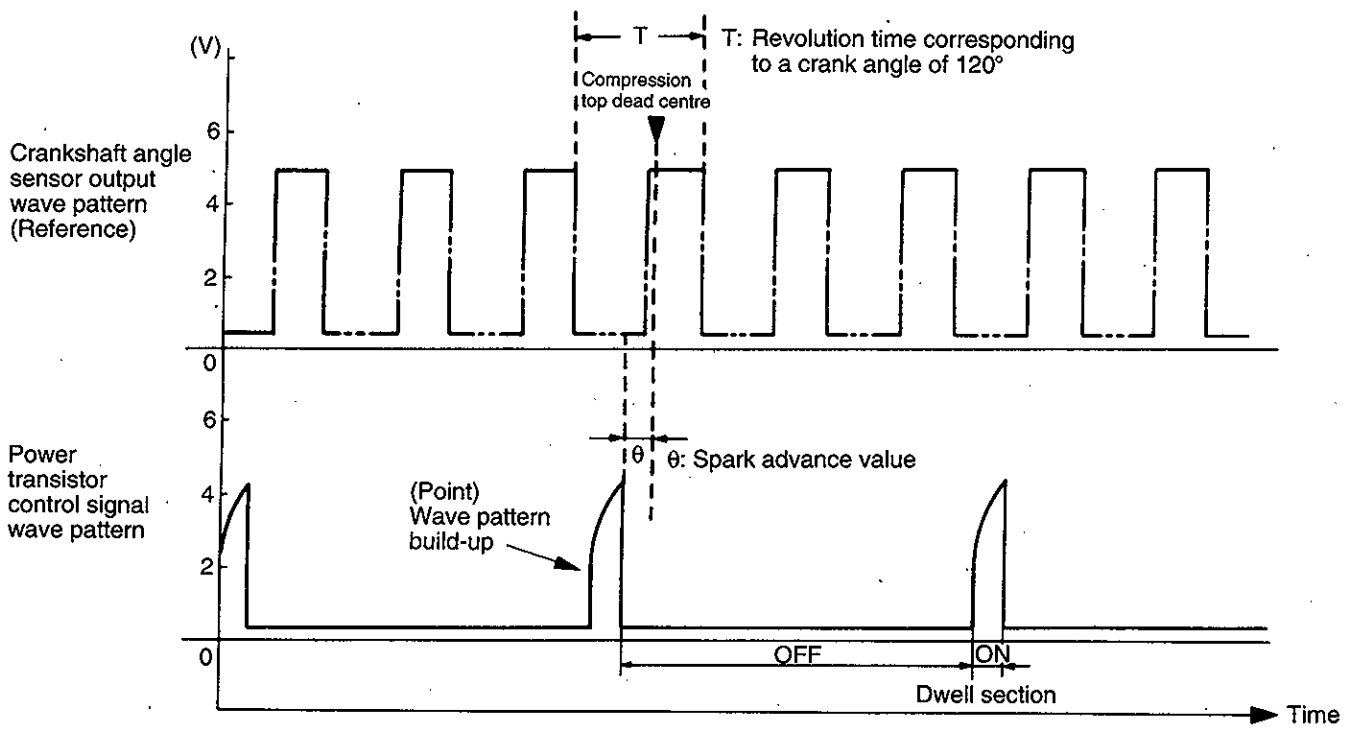
Alternative method (when test harness is not available)

Connect the analyzer special patterns pickup to engine control unit terminals (10), (11), (23) and (31) for the ignition power transistor.

Standard wave pattern

Observation conditions

Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine revolutions	Approx. 1,200 r/min

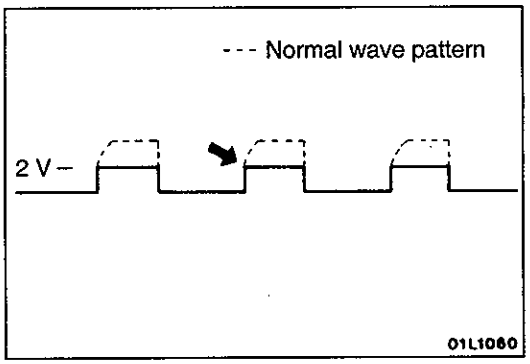


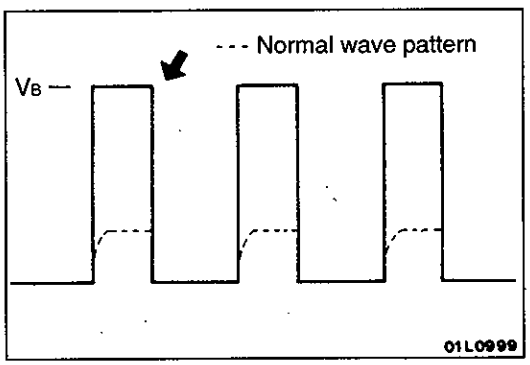
7FU1210

Wave pattern observation points

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

Condition of wave pattern build-up and maximum voltage	Probable cause
Rise to the right to approximately 4.5 V from around 2 V.	Normal
Becomes a rectangular wave at approx. 2 V	Broken wire in ignition primary circuit
Becomes a rectangular wave at power voltage	Malfunction of the power transistor





Examples of abnormal wave patterns

- Example 1

Wave pattern during engine cranking

Cause of problem

Broken wire in ignition primary circuit

Wave pattern characteristics

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

- Example 2

Wave pattern during engine cranking

Cause of problem

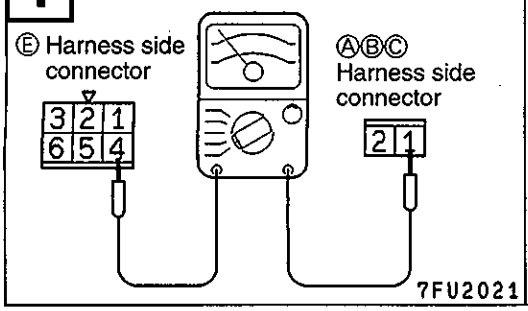
Malfunction in power transistor

Wave pattern characteristics

Power voltage results when the power transistor is ON.

HARNESS INSPECTION

1



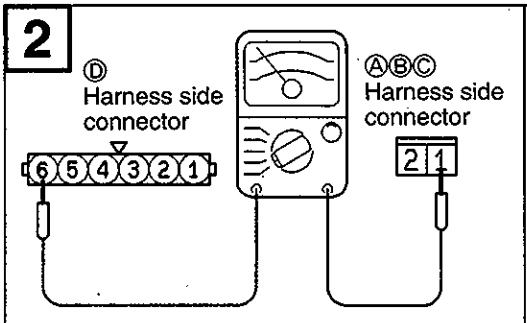
Check for continuity between the ignition coil and the ignition switch [IG].
- Ignition switch connector: Disconnected
- Ignition coil connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness. .

OK → 2

NO → Repair the harness. (Ⓔ 4 – Ⓐ Ⓑ Ⓒ 1)

2

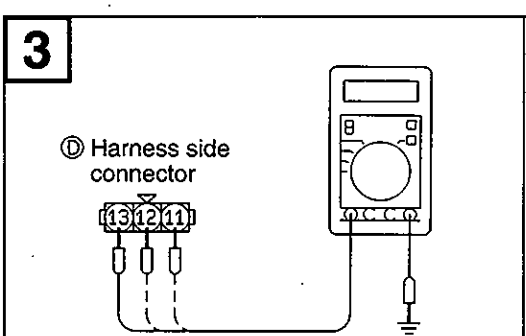


Check for continuity between the power transistor unit and ignition coil.
- Ignition coil connector: Disconnected
- Power transistor connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓓ 6 – Ⓐ Ⓑ Ⓒ 1)

3



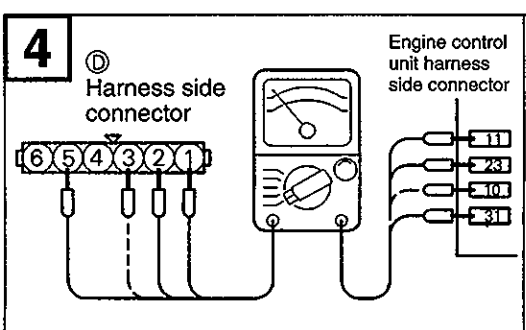
Measure the power supply voltage of the ignition coil
- Power transistor connector: Disconnected
- Ignition switch: ON

Voltage (V)
SV

OK → 4

NO → Repair the harness. (Ⓓ 11, Ⓓ 12, Ⓓ 13 – Ignition coil)

4

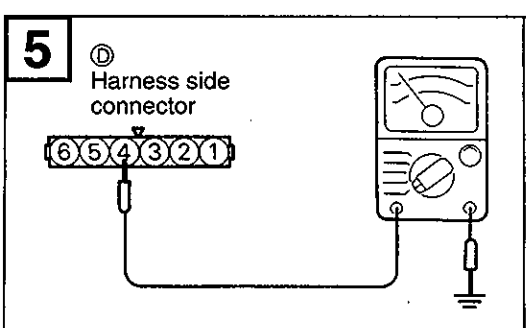


Check for open-circuit or short-circuit to earth between the power transistor and engine control unit.
- Power transistor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 5

NO → Repair the harness. (Ⓓ 1 – 11) (Ⓓ 2 – 23) (Ⓓ 3 – 10) (Ⓓ 5 – 31)

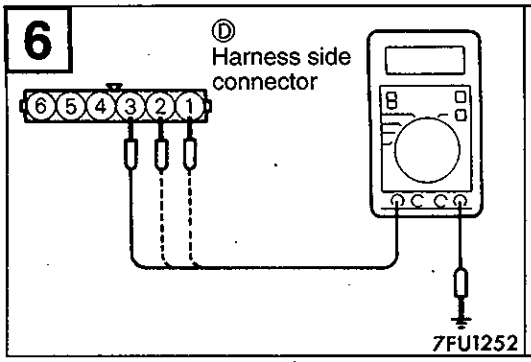
5



Check for continuity of the earth circuit of the power transistor.
- Power transistor connector: Disconnected

OK → 6

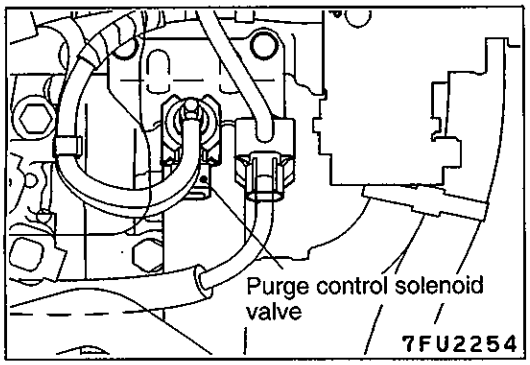
NO → Repair the harness. (Ⓓ 4 – Earth)

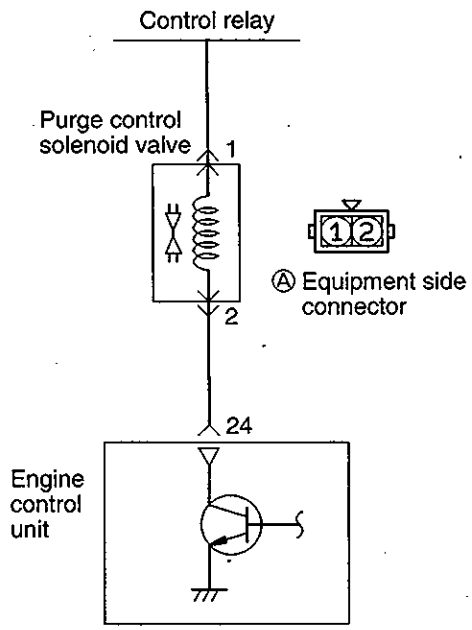
6		Measure the power transistor control signal voltage. • Power transistor connector: Disconnected • Ignition switch: ON Voltage (V): 0.5 – 4.0	OK → STOP NG → Repair the harness. (Ⓓ 1 – 11) (Ⓓ 2 – 23) (Ⓓ 3 – 10)

ACTUATOR INSPECTION

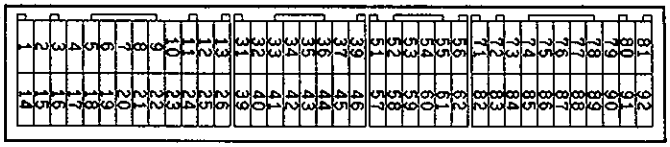
Refer to GROUP 16 – Ignition System.

PURGE CONTROL SOLENOID VALVE





Engine control unit connector



OPERATION

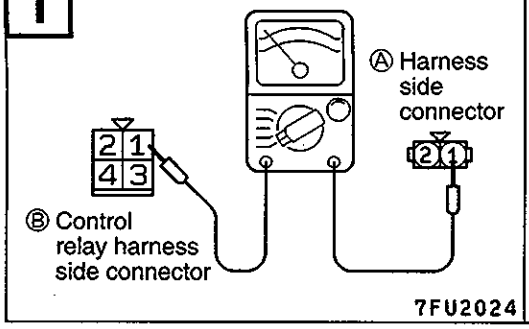
- The purge solenoid is an ON/OFF type of solenoid valve; it functions to regulate the introduction of purge air from the canister to the intake manifold plenum.
- Battery power supply is supplied, by way of the control relay, to the purge solenoid. When the engine control unit switches ON the power transistor within the unit, current flows to the coil, and purge air is introduced.

INSPECTION

Using MUT-II

Function	Item No.	Drive contents	Check condition	Normal condition
Actuator test	08	Solenoid valve is switched from OFF to ON.	• Ignition switch: ON	Operating sound is heard when driven

1



Check for continuity between the purge solenoid and the control relay.

- Purge solenoid connector: Disconnected
- Control relay connector: Disconnected

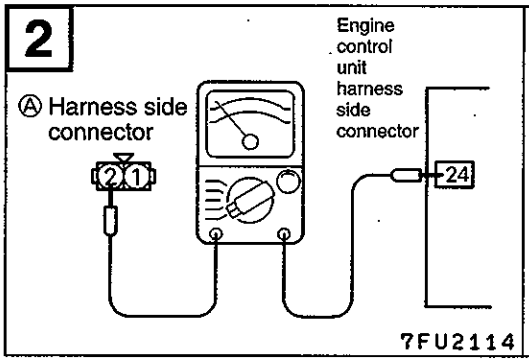
NOTE

- Touch the ohmmeter probes to both ends of the harness.

OK → 2

NG → Repair the harness. (Ⓐ 1 – Ⓑ 1)

2



Check for an open-circuit, or a short-circuit to earth, between the purge solenoid and the engine control unit.

- Purge solenoid connector: Disconnected
- Engine control unit connector: Disconnected

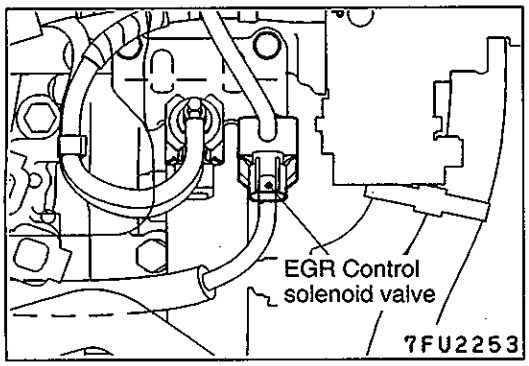
OK → STOP

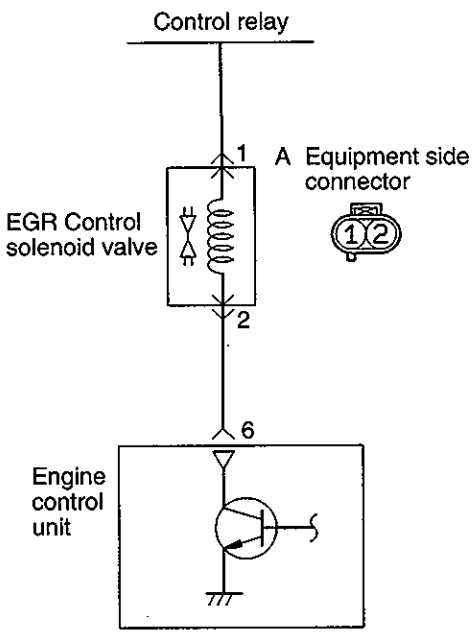
NG → Repair the harness. (Ⓐ 2 – 24)

ACTUATOR INSPECTION

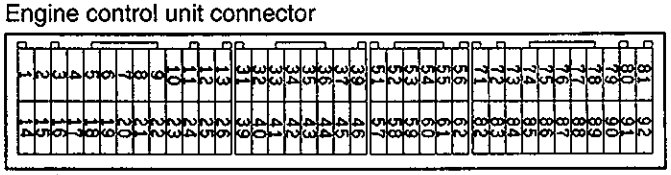
Refer to GROUP 17 – Service Adjustment Procedures.

EGR CONTROL SOLENOID VALVE





Engine control unit connector



9FU0393

OPERATION

- The EGR control solenoid valve is a duty control type solenoid valve. It makes control by leaking EGR valve operating negative pressure to the throttle body A port.
- Power supply from the battery is sent through the control relay to the EGR control solenoid valve. When the engine control unit turns off the power transistor inside the unit, current no more flows through the coil and EGR valve operating negative pressure leaks.

TROUBLESHOOTING HINTS

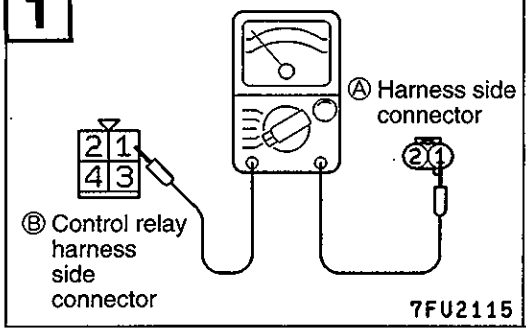
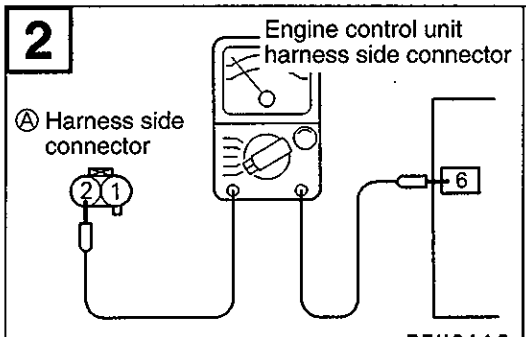
If the results of EGR control solenoid valve on-vehicle and off-vehicle inspections are normal but the self-diagnosis code for EGR system failure is displayed, check the EGR valve, vacuum hose and EGR passage for blocking.

INSPECTION

Using MUT-II

Function	Item No.	Drive content	Check condition	Normal state
Actuator test	10	Change solenoid valve from OFF to ON state	Ignition switch: ON	Operating sound is heard when driven

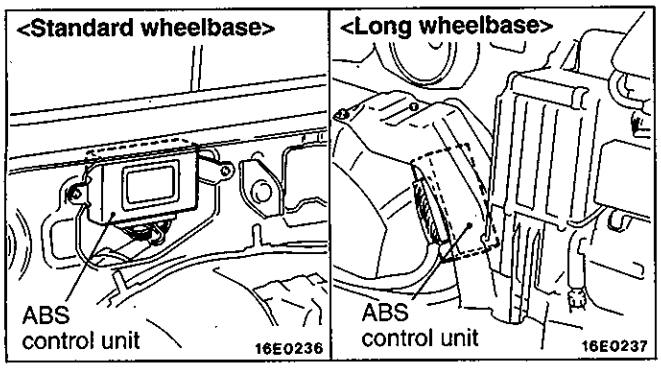
HARNESS INSPECTION

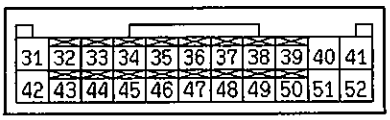
1  	Check for continuity between EGR control solenoid valve and control relay • EGR control solenoid valve connector: Disconnected • Control relay connector: Disconnected NOTE Touch the ohmmeter probes to both ends of the harness	OK →	2
		NO →	Repair the harness. (Ⓐ 1 – Ⓑ 1)
2  	Check for an open-circuit, or a short-circuit to earth, between the EGR control solenoid valve and the engine control unit. • EGR control solenoid valve connector: Disconnected • Engine control unit connector: Disconnected	OK →	STOP
		NO →	Repair the harness. (Ⓐ 2 – 6)

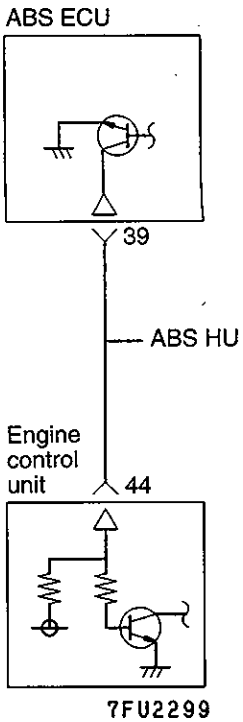
ACTUATOR INSPECTION

Refer to GROUP 17 – Exhaust Gas Recirculation (EGR) System.

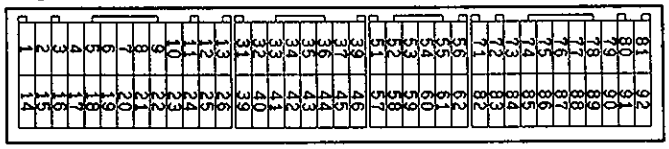
ANTI-SKID BRAKE SIGNAL







Engine control unit connector



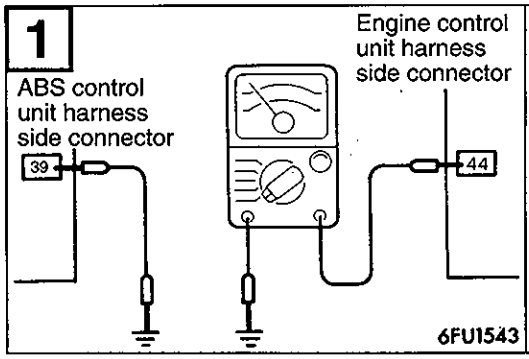
9FU0393

OPERATION

- The anti-skid braking signal is output by the anti-skid braking system (ABS) control unit to the engine control unit as a signal to indicate whether the motor relay is being driven or not. The engine control unit controls the idle speed control servo by means of this signal, and gives accurate anti-skid braking effectiveness.
- The ABS control unit turns the power transistor ON when the motor relay is being driven, and the output terminal which has battery voltage applied is shorted to the earth. This causes the anti-skid braking signal to change from HIGH to LOW.

HARNESS INSPECTION

1



Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the ABS control unit.

- ABS control unit connector: Disconnected
- Engine control unit connector: Disconnected

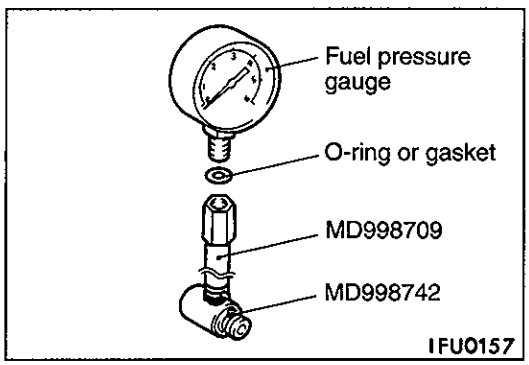
OK → STOP

NG → Repair the harness. (Ⓐ 39 – 44)

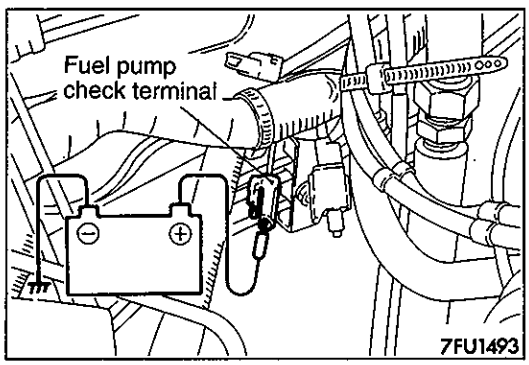
FUEL PRESSURE TEST

(1) Reduce the internal pressure of the fuel pipes and hoses.
(2) Remove the fuel pressure regulator at the delivery pipe side.

Caution
Cover the fuel pressure regulator with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.

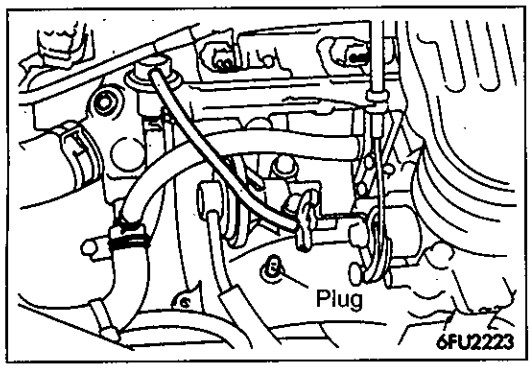


(3) Set a fuel pressure gauge on the special tool, placing an adequate O-ring or gasket between the gauge end special tool to prevent fuel leaks.
(4) Install the special tool set in the step (3) between the delivery pipe and the fuel pressure gauge.



(5) Connect a jumper wire to the terminal for activation of the fuel pump and to the positive (+) terminal of the battery to activate the fuel pump. With fuel pressure applied, check to be sure that there is no fuel leakage from the fuel pressure gauge and the special tool connection part.
(6) Disconnect the jumper wire from the terminal for activation of the fuel pump to stop the fuel pump.
(7) Start the engine and let it idle.
(8) Measure the fuel pressure during idling.

Standard value: Approx. 270 kPa at curb idle



(9) Disconnect the vacuum hose (blue stripe) from the intake manifold and plug the nipple. Then measure fuel pressure.

Standard value: 330 – 350 kPa at curb idle speed

(10) Check to be sure that the fuel pressure during idling does not decrease even after the engine is raced a few times.

(11) Use a finger to gently press the fuel return hose while repeatedly racing the engine, and check to be sure that there is fuel pressure in the return hose also.

NOTE
There will be no fuel pressure in the return hose if there is insufficient fuel flow.

(12) If the fuel pressure measured in steps (8) to (11) deviates from the standard value range, check for the probable cause by referring to the table below, and then make the appropriate repair.

Condition	Probable cause	Remedy
• Fuel pressure is too low. • Fuel pressure drops during racing. • No fuel pressure in fuel return hose.	Fuel filter is clogged.	Replace the fuel filter.
	Malfunction of the valve seat within the fuel pressure regulator, or fuel leakage to return side caused by spring deterioration.	Replace the fuel pressure regulator.
Fuel pressure is too high	Fuel pump low discharge pressure.	Replace the fuel pump.
	The valve within the fuel pressure regulator is sticking.	Replace the fuel pressure regulator.
	Clogging of the fuel return hose and/or the pipe.	Clean or replace the hose and/or pipe.
No change of the fuel pressure when vacuum hose is connected and when not connected.	Damaged vacuum hose or nipple clogging.	Replace the vacuum hose, or clean the nipple.

(13)Stop the engine and check for a change of the value indicated by the fuel pressure gauge. The condition is normal if there is no decrease of the indicated value within two minutes.
If there is a decrease of the indicated value, monitor the speed of the decrease, and, referring to the table below, determine the cause of the problem and make the appropriate repair.

Condition	Probable cause	Remedy
After the engine is stopped, the fuel pressure drops gradually.	Injector leakage.	Replace the injector.
	Leakage at the fuel pressure regulator valve seat.	Replace the fuel pressure regulator.
There is a sudden sharp drop of the fuel pressure immediately after the engine is stopped.	The check valve (within the fuel pump) is not closed.	Replace the fuel pump.

(14)Remove all remaining pressure from inside the fuel pipe.
(15)Disconnect the fuel pressure gauge and the special tool from the delivery pipe.

Caution
Because there will be a slight amount of remaining pressure in the fuel pipe line, use rags to cover so that fuel doesn't splatter.

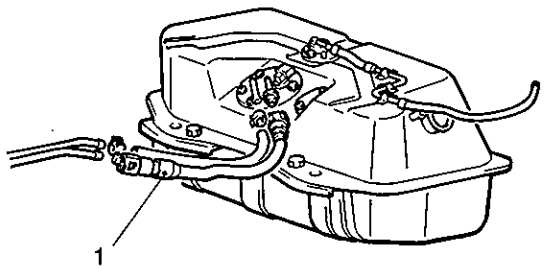
(16)Replace the O-ring at the end of the fuel high-pressure hose with a new one.
(17)After connecting the fuel high-pressure hose to the delivery pipe, tighten the installation bolt at the specified torque.

Tightening torque: 5 Nm

(18)Check to be sure that there is no fuel leakage.
① Apply battery voltage to the terminal for activation of the fuel pump so as to activate the fuel pump.
② With fuel pressure applied, check for leakage of the fuel line.

FUEL TANK

REMOVAL AND INSTALLATION



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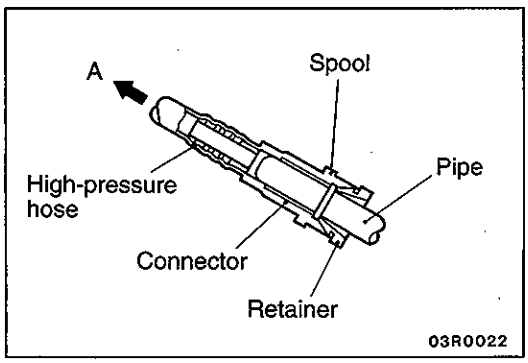
▶A◀ 1. High pressure fuel hose



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INSTALLATION SERVICE POINT

▶A◀ HIGH-PRESSURE HOSE CONNECTION

(1) Insert the high-pressure hose connector securely into the pipe until the retainer goes past the spool of the pipe.
(2) After inserting, gently pull the connector in the direction of A in the illustration and check that the connector does not pull out.

FUEL SYSTEM <4D56 Engine>

GENERAL

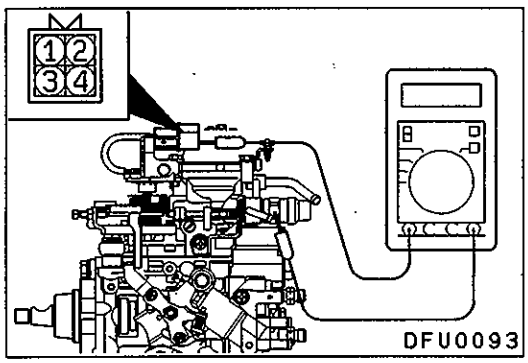
OUTLINE OF CHANGES

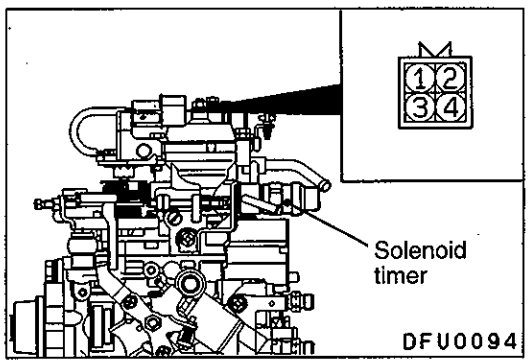
- The injection timing control solenoid (solenoid timer) has been added to some models. To correspond to this, only the maintenance service procedures which are different from the previous type of fuel system are given below.

SPECIFICATIONS

SERVICE SPECIFICATIONS

Item	Specifications
Standard valve Injection timing control solenoid coil resistance Ω	8 – 10





SERVICE ADJUSTMENT PROCEDURES

FUEL INJECTION PUMP INSPECTION

1. INSPECTION OF INJECTION TIMING CONTROL SOLENOID COIL RESISTANCE
   (1) Measure the resistance between the injection pump connector terminal No. 4 (injection timing control solenoid terminal) and the injection pump body.
   Standard value: 8 – 10Ω (at 20°C)

2. INJECTION TIMING CONTROL SOLENOID OPERATION CHECK
   (1) Check that operation sound of the injection timing control solenoid can be heard when connecting the injection pump connector terminal No. 4 (injection timing control solenoid terminal) and the battery positive terminal.