GROUP 13A

MULTIPOINT FUEL INJECTION (MPI) <4G63-Non-Turbo>

CONTENTS

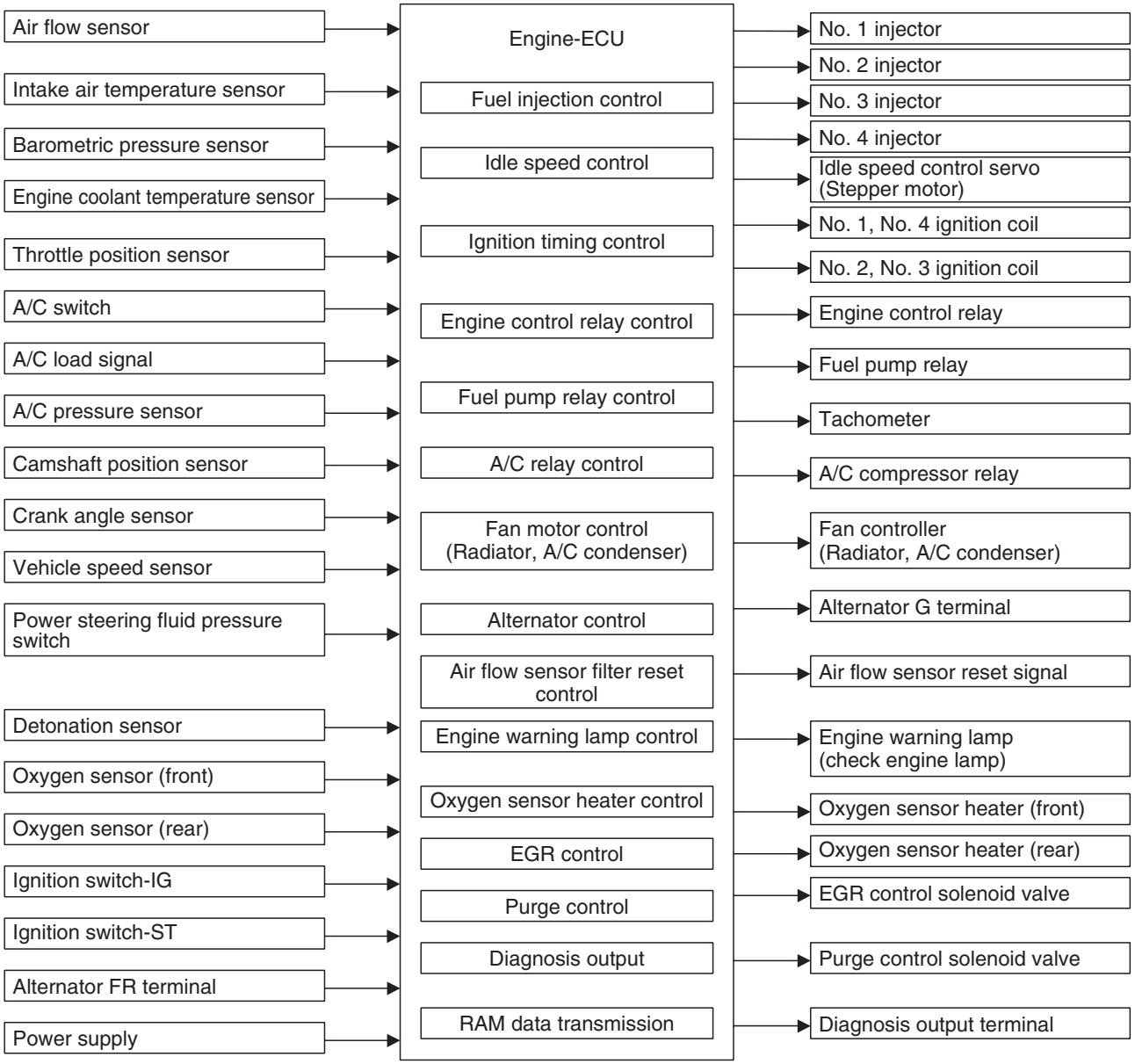
GENERAL INFORMATION

M2132000100279

The control system is based upon that to the 4G6-MPI engine used in the SPACE WAGON. It incorporates the following enhancements:

Improvements	Remarks
Bimetal type limiter in throttle body has been discontinued.	Simplified system structure
Idle position switch has been discontinued.	Changed to a control logic that is based primarily on throttle position sensor signals.

SYSTEM BLOCK DIAGRAM



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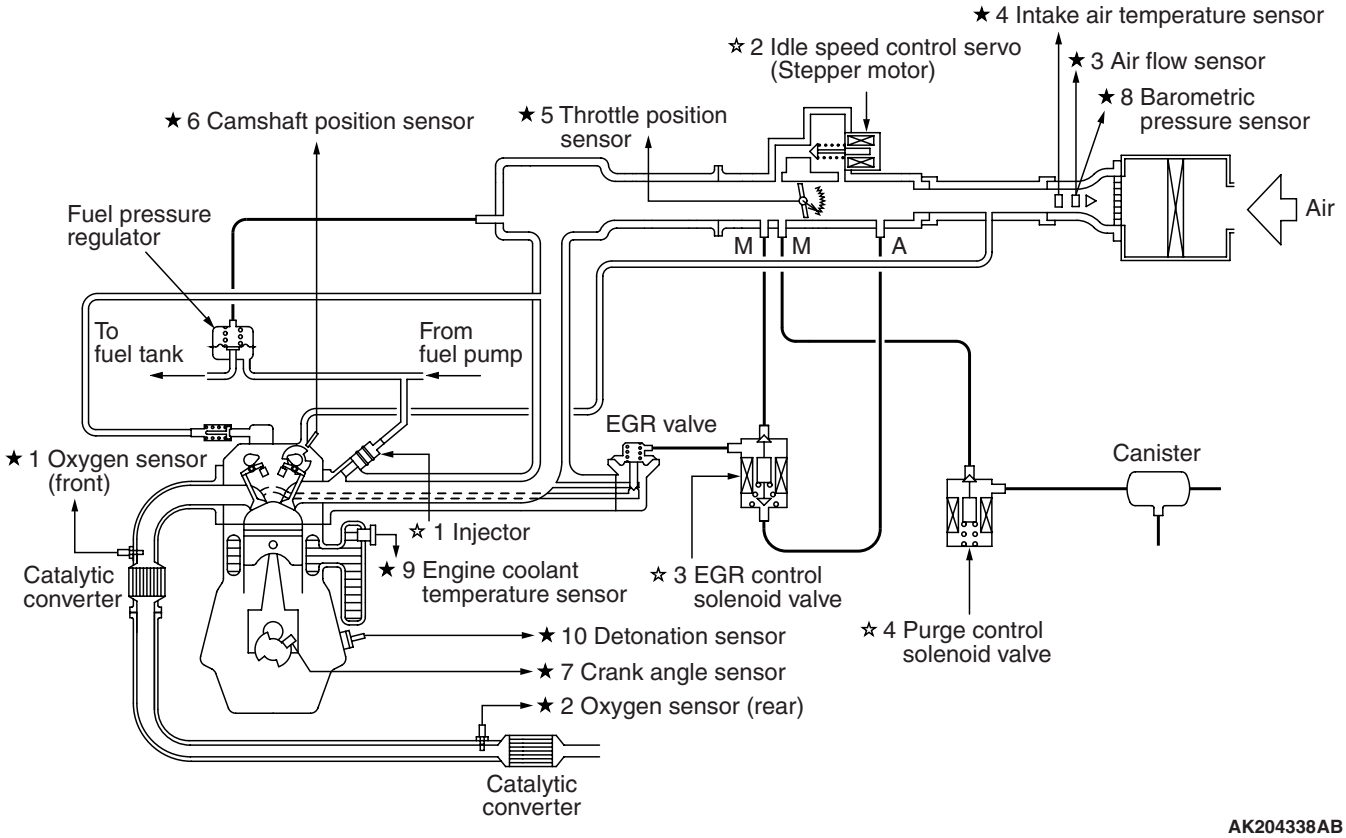
CONTROL SYSTEM DIAGRAM

★1 Oxygen sensor (front) ★2 Oxygen sensor (rear) ★3 Air flow sensor ★4 Intake air temperature sensor ★5 Throttle position sensor ★6 Camshaft position sensor ★7 Crank angle sensor ★8 Barometric pressure sensor ★9 Engine coolant temperature sensor ★10 Detonation sensor	● Power supply ● Ignition switch-IG ● Ignition switch-ST ● A/C switch ● A/C load signal ● A/C pressure sensor ● Power steering fluid pressure switch ● Alternator FR terminal ● Vehicle speed sensor	⇨	Engine-ECU	⇨ ☆1 Injector ☆2 Idle speed control servo (Stepper motor) ☆3 EGR control solenoid valve ☆4 Purge control solenoid valve	● Engine control relay ● Fuel pump relay ● A/C compressor relay ● Ignition coil ● Fan controller ● Engine warning lamp ● Diagnosis output ● Alternator G terminal ● Oxygen sensor heater ● Tachometer



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LIST OF COMPONENT FUNCTIONS

Name		Function
ECU	Engine-ECU	Uses the signals input from the various sensors to control operation of actuators in accordance with the driving conditions.
Sensors	Ignition switch-IG	Detects the ON/OFF position of the ignition switch. When this signal is input to the engine-ECU, power is supplied to components such as the injectors, air flow sensor, idle speed control servo and crank angle sensor.
	Ignition switch-ST	Detects whether the engine is cranking. The engine-ECU controls the fuel injection, throttle valve opening angle and ignition timing to the appropriate settings based on this signal.
	Air flow sensor	Senses air intake volume using Karman flow meter. In accordance with this information and engine speed, engine-ECU controls injectors' basic activation duration.
	Barometric pressure sensor	Senses atmospheric pressure using semiconductor diffused pressure sensor. In accordance with data from this sensor, engine-ECU determines vehicle's altiude above sea level and adjusts fuel injection rate as a function of altitude to ensure appropriate air/fuel ratio.
	Oxygen sensor	Detects the concentration of oxygen in the exhaust gas by means of zirconia and platinum electrodes. The engine-ECU judges whether the air/fuel mixture ratio is at the stoichiometric ratio based on this concentration.
	Intake air temperature sensor	Detects the temperature of the intake air by means of a thermistor. The engine-ECU corrects the fuel injection amount to the correct amount corresponding to the intake air temperature based on the voltage output from this sensor.
	Engine coolant temperature sensor	Detects the temperature of the engine coolant by means of a thermistor. The engine-ECU detects how warm the engine is based on the signal from this sensor, and uses this to control the fuel injection amount, idle speed and ignition timing.
	Throttle position sensor	Detects the throttle valve opening angle by means of a potentiometer. The engine-ECU controls the throttle valve and also determines the optimum fuel injection for how quick the throttle valve is opened based on the voltage output from this sensor.
	Vehicle speed sensor	Uses magnetic resistance element to sense vehicle speed. It output 4 pulses per its rotation.
	Detonation sensor	Detects cylinder block vibration when knocking is generated by the piezoelectric element. The engine-ECU controls retardation of the ignition timing according to the knocking strength.
	Camshaft position sensor	Detects the No. 1 cylinder compression top dead center position by means of a hall element.
	Crank angle sensor	Detects the crank angle by means of a Hall element. The engine-ECU controls the injectors based on the signal from this sensor.
	Alternator FR terminal	Detects the energizing duty ratio of the alternator field coil.
	Power steering fluid pressure switch	Detects whether there is a power steering load present by means of a contact switch.

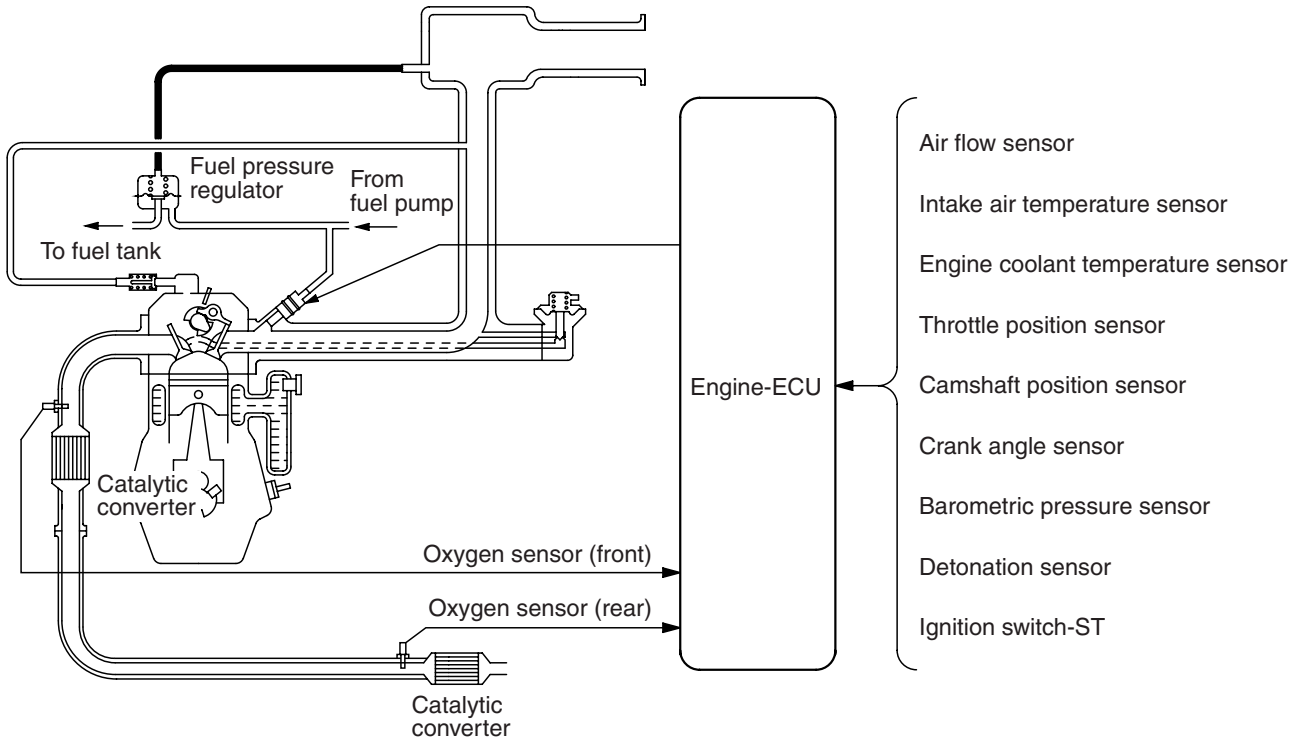
Name		Function
Sensors	A/C switch	Detects the ON/OFF condition of the A/C.
	A/C load signal	A/C inputs the drive state of the compressor (low load/high load) to the engine-ECU. The engine-ECU controls the A/C idle-up engine speed using this signal.
	A/C pressure sensor	A/C detects the refrigerant pressure and inputs the load of the A/C compressor to the engine-ECU.
	Diagnosis control terminal	If diagnosis codes have been stored in memory, they can be displayed through the flashing of the engine warning lamp by connecting this terminal to the vehicle earth.
Actuators	Engine control relay	Turns the engine-ECU power circuit on and off.
	Injector	Drives the fuel injection by means of drive signals from the engine-ECU. Multiple spray hole type is used.
	Ignition coil (with power transistor)	Interrupts the ignition coil primary current in accordance with the ignition signals from the engine-ECU, in order to generate a high voltage for ignition.
	Idle speed control (ISC) servo steeper motor	The throttle valve bypass air amount during idling and deceleration is controlled with the signal from the engine-ECU.
	EGR control solenoid valve	Controls the EGR flow through signals under the duty control from engine-ECU.
	Fuel pump relay	Turns the pump on and off.
	Fan controller	Controls the radiator and condenser fan speeds smoothly by means of signals from the engine-ECU.
	Purge control solenoid valve	Controls the amount of purge air introduced to the air intake plenum through signals under the duty control from the engine-ECU.
	Alternator G terminal	Controls the amount of power generated by the alternator by means of signals from the engine-ECU.
	A/C relay	Controls the operation of the A/C compressor.
	Oxygen sensor heater	Heats up the oxygen sensor in response to the signals from the engine-ECU.
	Engine warning lamp	Illuminates to notify the driver of any abnormalities when a problem occurs with any of the sensors.
	Tachometer	The tachometer in the speedometer indicates the engine speed.

FUEL INJECTION CONTROL

M2132003000215

The control arrangement is basically the same as that 4G6-MPI engine using SPACE WAGON.

SYSTEM CONFIGURATION DIAGRAM



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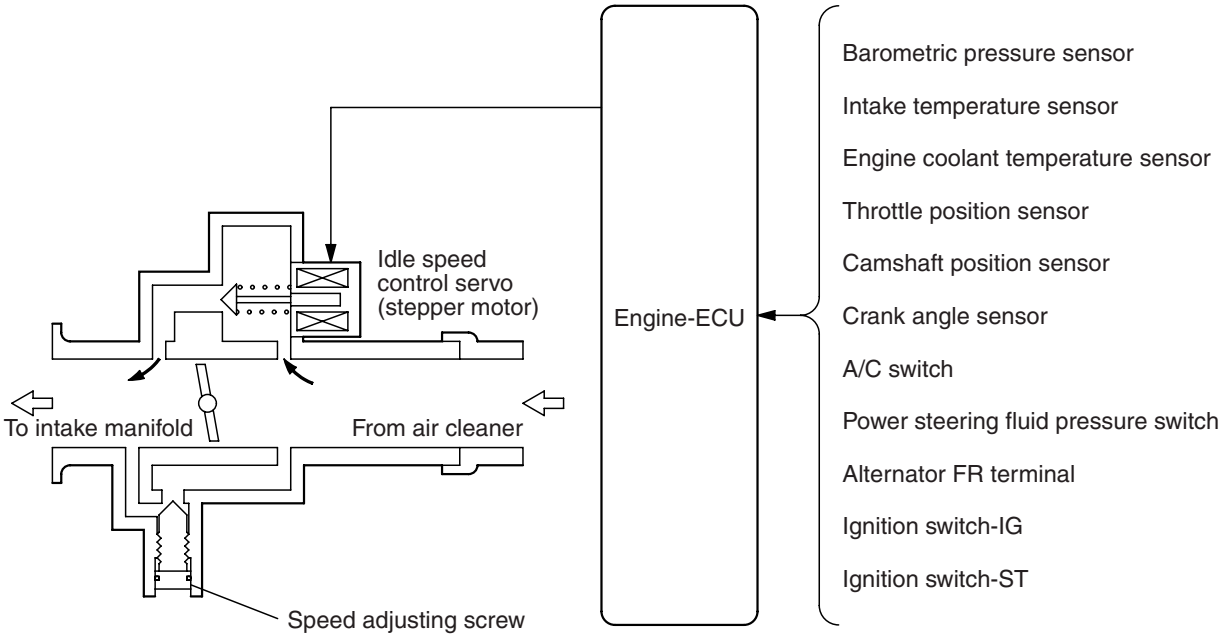
IDLE SPEED CONTROL (ISC)

M2132004000199

The idle speed control (ISC) is basically the same as that of the 4G6-MPI engine of the previous SPACE WAGON, except for the following changes:

- The bimetal type limiter has been discontinued and the system has been simplified.

SYSTEM CONFIGURATION DIAGRAM



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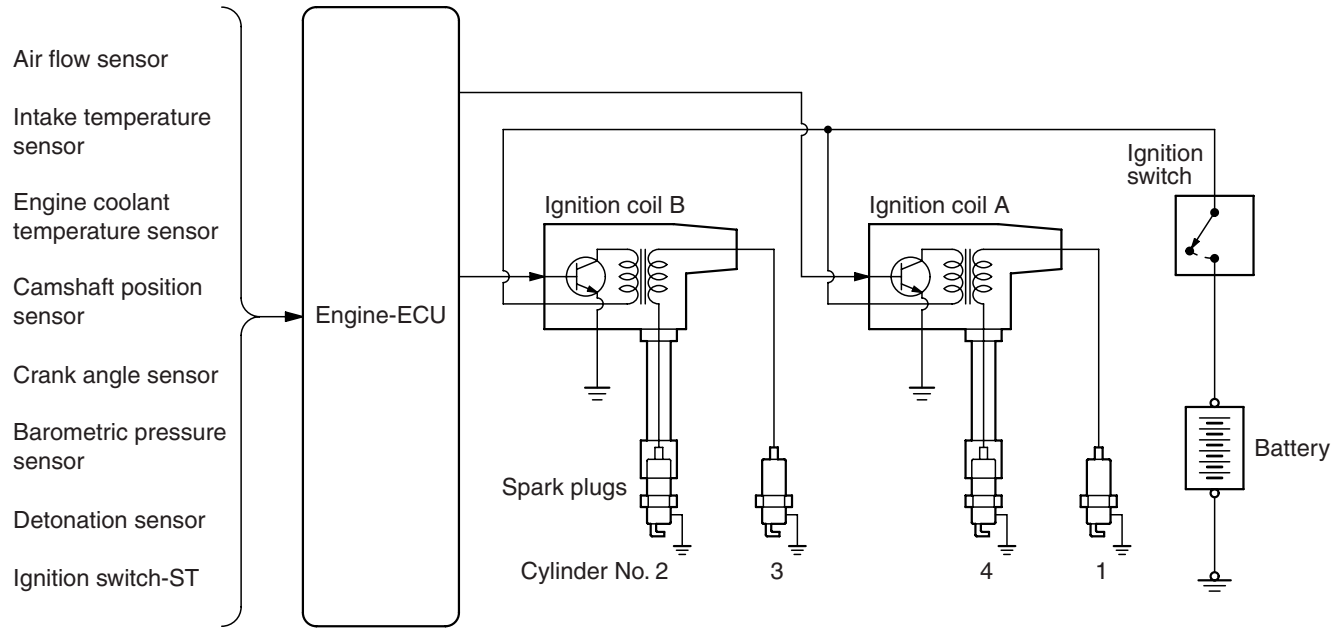
IGNITION TIMING AND DISTRIBUTION CONTROL

M2132005000200

The control arrangement is basically the same as that 4G6-MPI engine using SPACE WAGON.

SYSTEM CONFIGURATION DIAGRAM



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EGR CONTROL, PURGE CONTROL

M2132011000072

Refer to EMISSION CONTROL SYSTEM

OTHER CONTROL FUNCTIONS

M2132010000176

The following controls are basically the same as those of the 4G6-MPI engine of the SPACE WAGON:

- Fan motor control
- Power supply
- Fuel pump relay control
- Oxygen sensor heater control
- A/C pressure relay control
- Air flow sensor filter reset control
- Alternator control

DIAGNOSIS SYSTEM

M2132009000291

Engine -ECU has been provided with the following functions for easier system inspection.

FREEZE-FRAME DATA

When the engine-ECU detects a problem and stores the resulting diagnosis code, the engine condition at that time is also memorized. The M.U.T.-II/III can then be used to analyze this data in order to increase the effectiveness of troubleshooting. The freeze-frame data display items are given below.

Item No.	Data	Unit
21	Engine coolant temperature	°C
22	Engine speed	r/min
24	Vehicle speed	km/h
80	Long-term fuel compensation (long-term fuel trim)	%
82	Short-term fuel compensation (short-term fuel trim)	%
88	Fuel control condition	Open loop
		Closed loop
		Open loop owing to drive condition
		Open loop owing to system malfunction
		Closed loop based on one oxygen sensor
97	Calculated lode value	%

DIAGNOSIS CODE

The diagnosis and engine warning lamp items are given in the table below.

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0100	Air flow sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0105	Barometric pressure sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0110	Intake air temperature sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0115	Engine coolant temperature sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0120	Throttle position sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0125*	Feedback system monitor	Oxygen sensor not operating	ON
P0130	Oxygen sensor (front) system <Sensor 1>	Open circuit or short-circuit in sensor-related circuits	ON
P0135	Oxygen sensor heater (front) system <Sensor 1>	Open circuit or short-circuit in heater-related circuits	ON

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0136	Oxygen sensor (rear) system <Sensor 2>	Open circuit or short-circuit in sensor-related circuits	ON
P0141	Oxygen sensor heater (rear) system <Sensor 2>	Open circuit or short-circuit in heater-related circuits	ON
P0170	Abnormal fuel system	Leanness or richness problem	ON
P0201	No. 1 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0202	No. 2 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0203	No. 3 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0204	No. 4 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0300	Random cylinder mis-fire detection system	Abnormal ignition signal (Mis-firing)	ON
P0301*	No. 1 cylinder mis-fire detection system	Mis-firing	ON
P0302*	No. 2 cylinder mis-fire detection system		
P0303*	No. 3 cylinder mis-fire detection system		
P0304*	No. 4 cylinder mis-fire detection system		
P0325	Detonation sensor system	Abnormal sensor output	ON
P0335	Crank angle sensor system	Abnormal sensor output	ON
P0340	Camshaft position sensor system	Abnormal sensor output	ON
P0403	Exhaust gas recirculation (EGR) control solenoid valve system	Open circuit or short-circuit in solenoid valve-related circuits	ON
P0420	Catalyst deterioration system	Abnormal exhaust gas purification performance of catalyst	ON
P0443	Purge control solenoid valve system	Open circuit or short-circuit in solenoid valve-related circuits	ON
P0500	Vehicle speed sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0505	Idle speed control system	Idle speed control servo inoperable	ON
P0551*	Power steering fluid pressure switch system	Open circuit or short-circuit in system-related circuits	ON
P0622	Alternator FR terminal system	Open circuit in sensor-related circuits	–
P1603*	Battery back-up line system	Open circuit in system-related circuits	ON
P1610	Immobilizer system	Open circuit in system-related circuits	–
–	Engine-ECU	Abnormality in engine-ECU	ON

NOTE: When the first time a malfunction is detected, the engine-ECU does not store a fault code. However, if the same malfunction is again detected the next time the engine is operated, a fault code is stored. For systems or components marked with "" to be diagnosed, when the first time a malfunction is detected, a fault code is stored and the engine warning lamp is illuminated.*

DATA LIST FUNCTION

The data list items are given in the table below

Item No.	Inspection item	Unit
11	Oxygen sensor (front)	mV
12	Air flow sensor	Hz
13	Intake air temperature sensor	°C
14	Throttle position sensor	mV
16	Power supply voltage	V
18	Cranking signal (ignition switch-ST)	ON/OFF
21	Engine coolant temperature sensor	°C
22	Crank angle sensor	r/min
25	Barometric pressure sensor	kPa
27	Power steering fluid pressure switch	ON/OFF
28	A/C switch	ON/OFF
3A	A/C pressure sensor	mV
41	Injectors	mS
44	Ignition advance	° BTDC
45	Idle speed control (stepper motor) position	STEP
49	A/C relay	ON/OFF
59	Oxygen sensor (rear)	mV
12*	Air flow sensor	gm/s
13*	Intake air temperature sensor	°C
21*	Engine coolant temperature sensor	°C
22*	Crank angle sensor	r/min
24*	Vehicle speed signal	km/h
44*	Ignition advance	deg
81*	Long-term fuel compensation	%
82*	Short-term fuel compensation	%
87*	Calculated load valve	%
88*	Fuel control condition	Closed loop/Open loop – drive condition
8A*	Throttle position sensor (Throttle valve opening rate)	%
A1*	Oxygen sensor (front)	V
A2*	Oxygen sensor (rear)	V

NOTE: Items marked "" will not appear if a data list is selected in the check mode.*

ACTUATOR TEST FUNCTION

The actuator test items are given in the table below

Item No.	Inspection item	Drive contents
01	Injectors	Cut fuel to No.1 injector
02		Cut fuel to No.2 injector
03		Cut fuel to No.3 injector
04		Cut fuel to No.4 injector
07	Fuel pump	Fuel pump operates and fuel is recirculated
08	Purge control solenoid valve	Solenoid valve turns from OFF to ON
10	EGR control solenoid valve	Solenoid valve turns from OFF to ON
17	Basic ignition timing	Set to ignition adjustment mode
21	Fan controller	Drive the fan motor