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## GROUP 13A

# MULTIPOINT FUEL INJECTION (MPI)

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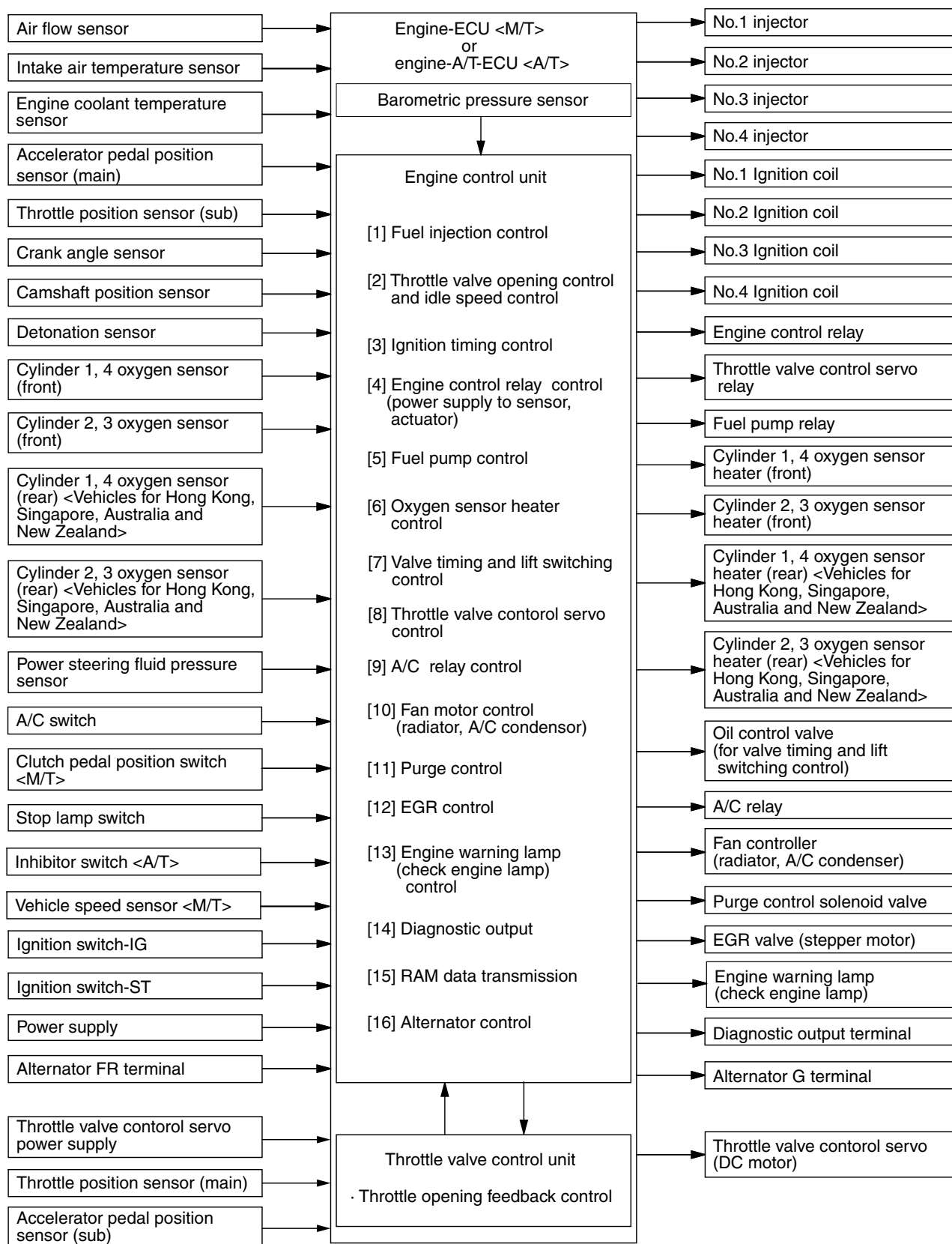
## GENERAL INFORMATION

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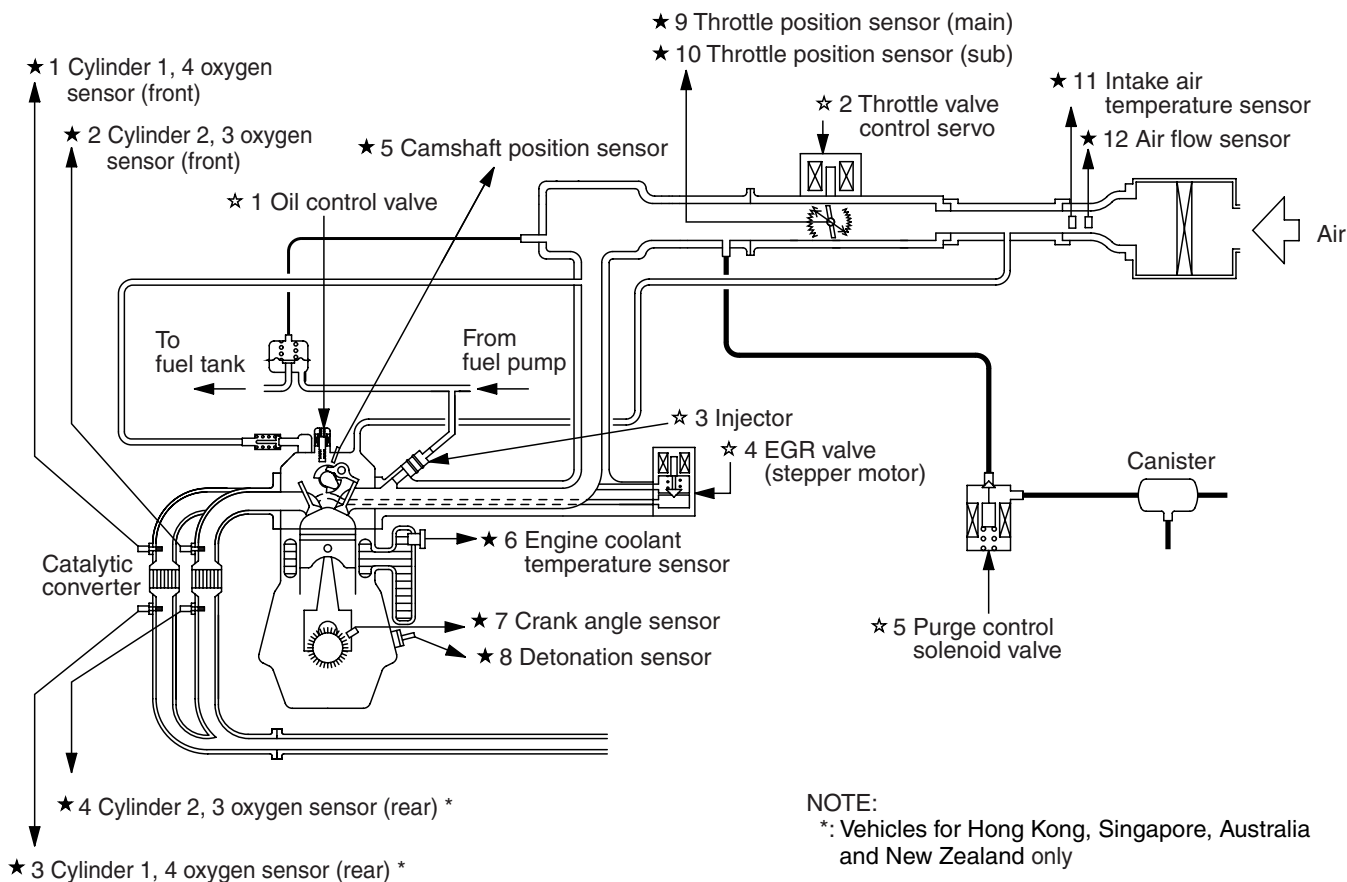
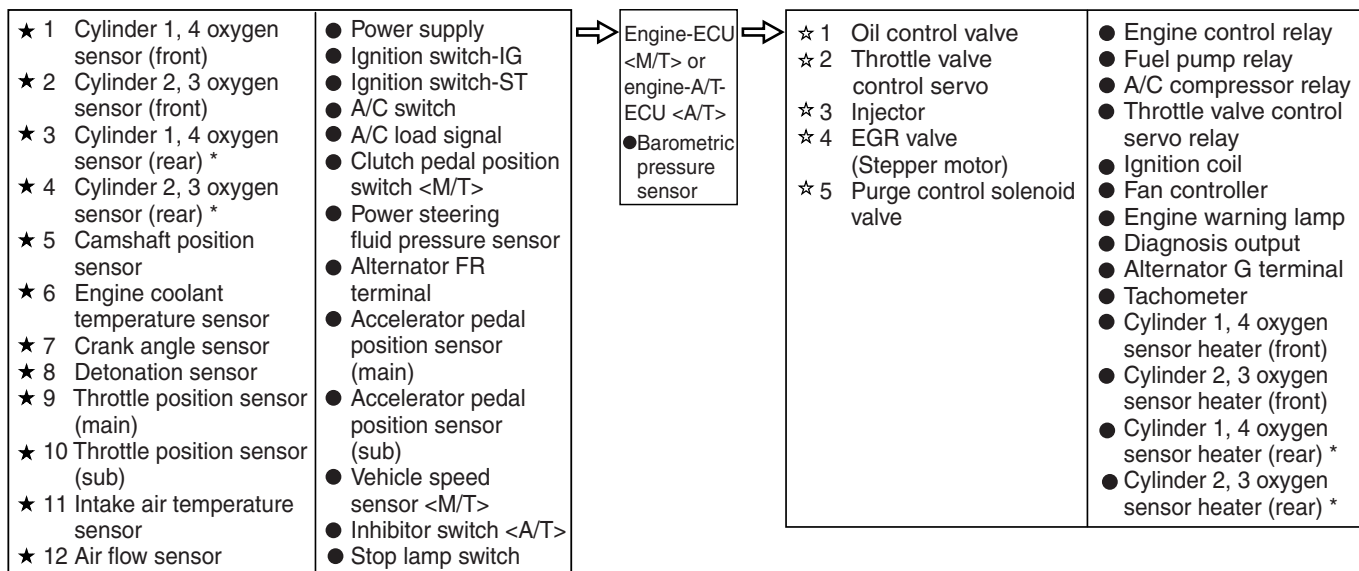
The control system is basically the same as that of the 4G6-MPI engine used in the SPACE WAGON. It incorporates the following enhancement.

Improvements	Remarks
A valve timing and life switching control is adopted.	Improves power output performance and fuel economy. Reduces emission gas (CO).
The barometric pressure sensor has been adopted to a type that is built into the engine-ECU <M/T> or engine-A/T-ECU <A/T>	The simplification of the system.
A dual manifold catalytic converters (MCC) is adopted.	The improvement of the exhaust gas purge performance.
The adoption of dual oxygen sensors, along with the adoption of dual manifold catalytic converters (MCC). <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	The improvement of the exhaust gas purge performance.
A heat-sensing type air flow sensor has been adopted.	Can be installed in the air intake hose because it is compact and light weight.
A electronically controlled throttle valve control is adopted.	Improvement of feeling in operation.
A sensing blade of 36 teeth is adopted.	Provides engine control with finer precision.
Clutch pedal position switch is adopted <M/T>	Reduces the amount of hydrocarbon (HC) discharge by making fuel injection volume corrections during shift changes.
Control Area Network (CAN) is adopted.	Communication is assured.
A power steering fluid pressure sensor is adopted.	Detects power steering fluid pressure with finer precision.
A stepper motor type EGR valve is used.	Improves fuel economy and reduces emissions (NOx).
A direct-ignition type ignition circuit is used.	Improves ignition performance.
Injectors that finely atomize the spray are used.	Smaller size and lightweight. By improving the nozzle and finely atomizing the spray, the combustion efficiency has been improved and the HC concentration in the exhaust gas has been reduced.
Registration of Vehicle Identification Number (VIN) added to engine-A/T-ECU. <Vehicles for Hong Kong and Singapore>	Keyless Operation System (KOS) employed.

## SYSTEM BLOCK DIAGRAM



## CONTROL SYSTEM DIAGRAM



**LIST OF COMPONENT FUNCTIONS**

<b>Name</b>		<b>Function</b>
ECU	Engine-ECU <M/T> or engine-A/T-ECU <A/T>	The signals that are input by the sensors enable the actuators to be controlled in accordance with the driving conditions.
Sensors	Ignition switch-IG	This signal indicates the ON/OFF condition of the ignition switch. When this signal is input, the engine-ECU <M/T> or engine-A/T-ECU <A/T> supplies power to the crank angle sensor, camshaft position sensor, etc.
	Ignition switch-ST	This signal indicates that the engine is cranking. Based on this signal, the engine-ECU <M/T> or engine-A/T-ECU <A/T> controls the fuel injection, throttle valve position, and the injection timing that are suited for starting the engine.
	Air flow sensor (AFS)	This signal, which indicates the intake air flow rate (mass), is input into the engine-ECU <M/T> or engine-A/T-ECU <A/T>. Based on the signals from this sensor, the engine-ECU <M/T> or engine-A/T-ECU <A/T> effects fuel injection control.
	Barometric pressure sensor	This sensor detects the altitude of the vehicle. It enables the engine-ECU <M/T> or engine-A/T-ECU <A/T> to make fuel injection volume corrections in order to achieve an appropriate air-fuel ratio.
	Oxygen sensor	This sensor, which contains zirconia and platinum electrodes, detects the level of oxygen concentration in the exhaust gases. The engine-ECU <M/T> or engine-A/T-ECU <A/T> determines whether the air-fuel ratio is at the optimal stoichiometric ratio in accordance with this oxygen concentration level.
	Intake air temperature sensor	This sensor, which contains a thermistor, detects the temperature of the intake air. The engine-ECU <M/T> or engine-A/T-ECU <A/T> makes fuel injection volume corrections that suit the intake air temperature, in accordance with the voltage that is output by this sensor.
	Engine coolant temperature sensor	This sensor, which contains a thermistor, detects the temperature of the engine coolant. The engine-ECU <M/T> or engine-A/T-ECU <A/T> determines the warm-up condition of the engine in accordance with the voltage that is output by this sensor, in order to control the fuel injection volume, idle speed, and ignition timing.
	Throttle position sensor (TPS) <main, sub>	This sensor detects the position of the throttle valve and inputs it into the engine-ECU <M/T> or engine-A/T-ECU <A/T>. Based on the voltage that is output by this sensor, the engine-ECU <M/T> or engine-A/T-ECU <A/T> effects throttle valve feedback control.
	Accelerator pedal position sensor (APS) <main, sub>	This sensor detects the position of the accelerator and inputs it into the engine-ECU <M/T> or engine-A/T-ECU <A/T>. Based on the voltage that is output by this sensor, which determines the accelerator position (and the intention of the driver), the engine-ECU <M/T> or engine-A/T-ECU <A/T> effects appropriate fuel injection and throttle valve position controls.
	Camshaft position sensor	This sensor detects the top-dead-center (TDC) of the compression stroke of each cylinder.

Name		Function
Sensors	Crank angle sensor	This sensor detects the crank angle and inputs it into the engine-ECU <M/T> or engine-A/T-ECU <A/T>. The engine-ECU <M/T> or engine-A/T-ECU <A/T> effects injector control and other controls in accordance with the signals received from this sensor.
	Detonation sensor	This sensor, which contains a piezoelectric element, detects the vibration of the cylinder block that results from knocking. The engine-ECU <M/T> or engine-A/T-ECU <A/T> detects only the knocking of the engine from these vibrations, in order to retard the ignition timing in accordance with the strength of the knocks.
	Power steering fluid pressure sensor	This sensor detects the load on the power steering continuously.
	A/C switch	Detects the ON/OFF condition of the A/C.
	Clutch pedal position switch <M/T>	Detects the clutch pedal is depressed using contact-type switch. Engine-ECU reduces the amount of hydrocarbon (HC) discharge by making fuel injection volume corrections during shift changes.
	Stop lamp switch	Detects the brake pedal is depressed using contact-type switch.
	Alternator FR terminal	This terminal is used for detecting the duty cycle ratio that energizes the alternator field coil.
	Inhibitor switch <A/T>	This is a contact point type switch that inputs a signal into the engine-A/T-ECU to determine whether the shift lever is in the neutral position.
	Vehicle speed sensor <M/T>	Uses magnetic resistance element to sense vehicle speed. It outputs 4 pulses per its rotation.

Name		Function
Actuators	Engine control relay	This relay turns ON and OFF the engine-ECU <M/T> or engine-A/T-ECU <A/T> power circuit.
	Throttle valve control servo relay	This relay turns ON and OFF the actuation power circuit for the throttle valve control servo in the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	Injector	The injectors inject fuel in accordance with the injection signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	Ignition coil (with power transistor)	Applies ignition coil primary current intermittently in accordance with the ignition signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>, in order to generate high voltage for ignition.
	Fuel pump relay	Controls the power supplied to the fuel pump in accordance with the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	A/C relay	Controls the operation of the A/C compressor in accordance with the signals received from the engine- ECU <M/T> or engine-A/T-ECU <A/T>.
	Purge control solenoid valve	Controls the flow rate of the purge air introduced into the surge tank in accordance with the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	EGR valve (stepper motor)	Controls the EGR flow rate in accordance with the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	Alternator G terminal	Controls the amount of current generated by the alternator in accordance with the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	Fan controller	Controls the speed of the radiator fan and the condenser fan steplessly in accordance with the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	Throttle valve control servo	Controls the throttle valve position in accordance with the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.
	Oil control valve (OCV)	The oil control valve, which is actuated by the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>, changes the valve timing.
	Oxygen sensor heater	Turns ON and OFF the oxygen sensor heater circuit in accordance with the signals received from the engine-ECU <M/T> or engine-A/T-ECU <A/T>.

## CONTROL SYSTEM

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### Engine-A/T-ECU <Vehicle for Hong Kong and Singapore>

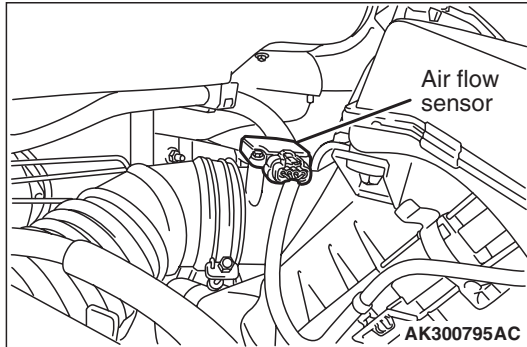
The manufacturer enters the Vehicle Identification Number (VIN) into the engine-A/T-ECU at the vehicle production. When the VIN is deleted for reasons, the engine warning lamp illuminates and the diagnosis code No.P0630 Vehicle Identification Number (VIN)

Malfunction is output. When the engine-A/T-ECU is replaced or the diagnosis code No.P0630 is output, it is necessary for the VIN to be entered using the M.U.T.-III.

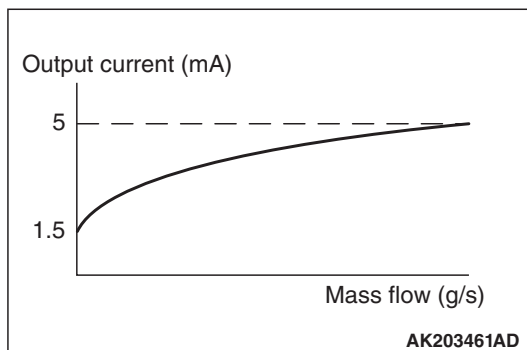
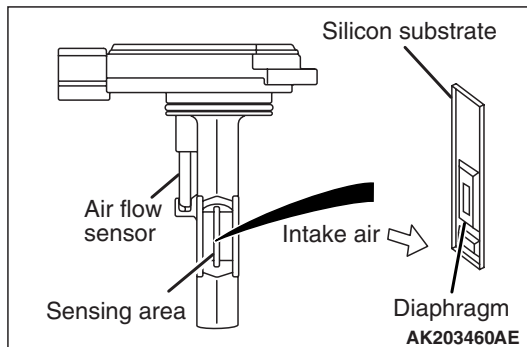
## SENSOR

M2132001000383

### AIR FLOW SENSOR



A heat-sensing type air flow sensor has been adopted. In contrast to the Karman vortex air flow sensor, which detects the volumetric flow rate of air, this type utilizes the flow speed dependence characteristics of heat transmission to detect the mass flow rate of air, converts it into an amperage, and outputs it to the engine-ECU <M/T> or engine-A/T-ECU <A/T>.

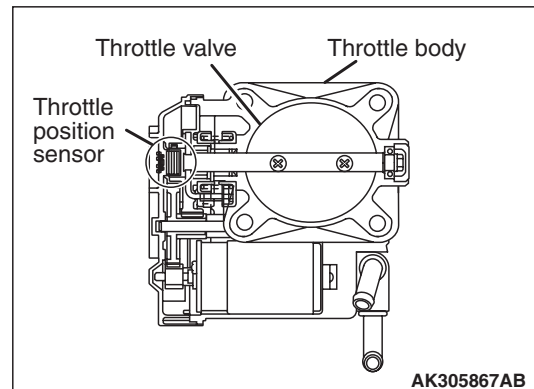


The sensing portion consists of an ultra-compact, heat-sensing membrane resistor. The engine-ECU <M/T> or engine-A/T-ECU <A/T> regulates the amperage in order to maintain a constant temperature in the heat-sensing resistor. When the mass flow rate of air increases, the heat transmission from the heat-sensing resistor to the air also increases. Therefore, the amperage that is regulated by the engine-ECU <M/T> or engine-A/T-ECU <A/T> increases. Because the heat transmission rate and the amperage are proportionate, the engine-ECU <M/T> or engine-A/T-ECU <A/T> is able to measure the air flow rate based on the amperage. The use of the ultra-compact membrane resistor, which provides the same high-speed response as the Karman vortex air flow sensor, enabled the compact and lightweight sensor to be installed in the air intake hose.

### BAROMETRIC PRESSURE SENSOR

This sensor has been changed to a type that is built into the engine-ECU <M/T> or engine-A/T-ECU <A/T>.

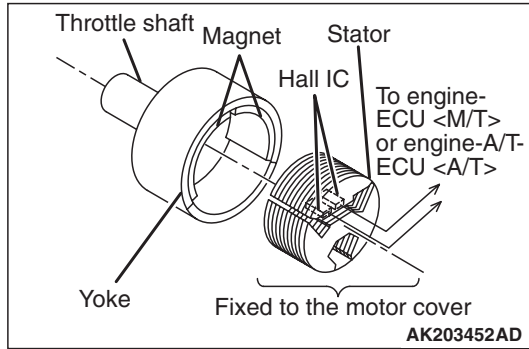
### THROTTLE POSITION SENSOR



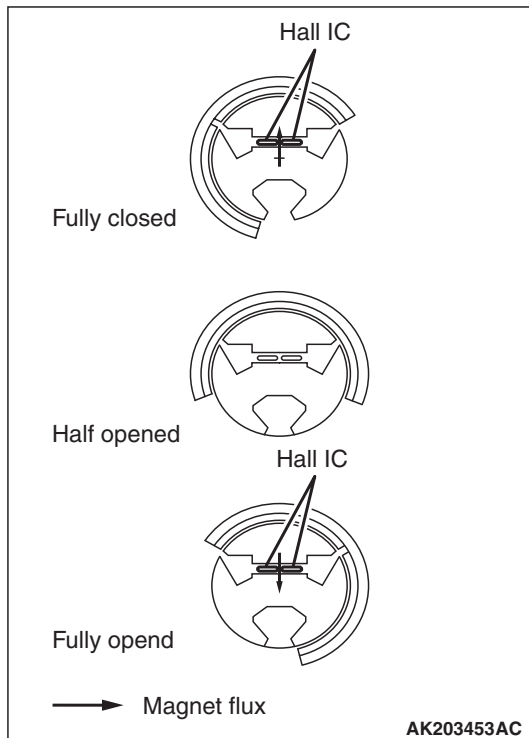
The throttle position sensor, which is located in the throttle body, outputs a voltage signal, which corresponds to the rotational angle of the throttle shaft, to the engine-ECU <M/T> or engine-A/T-ECU <A/T>. In accordance with this signal, the engine-ECU <M/T> or engine-A/T-ECU <A/T> effects feedback control of the throttle valve control servo. This throttle position sensor uses a non-contact Hall IC to enhance its reliability.



## CONSTRUCTION AND SYSTEM



The throttle position consists of a permanent magnet fixed to the throttle shaft, a Hall IC that outputs electrical voltage in accordance with the magnetic flux density, and a stator that effectively guides the magnetic flux from the permanent magnet into the Hall IC.

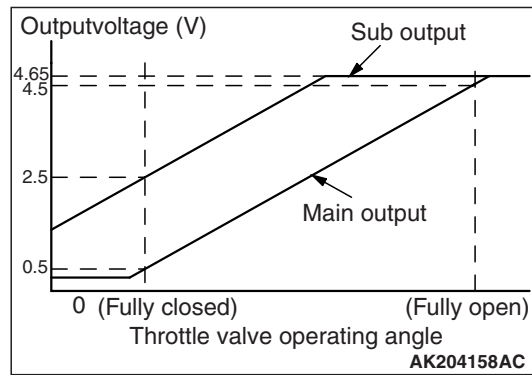


The magnetic flux density that passes into the Hall IC when the throttle valve is fully closed is kept to a maximum in the above direction on this paper. As the result of this, the electrical voltage is minimal output.

The magnetic flux density is zero when the throttle valve is half opened.

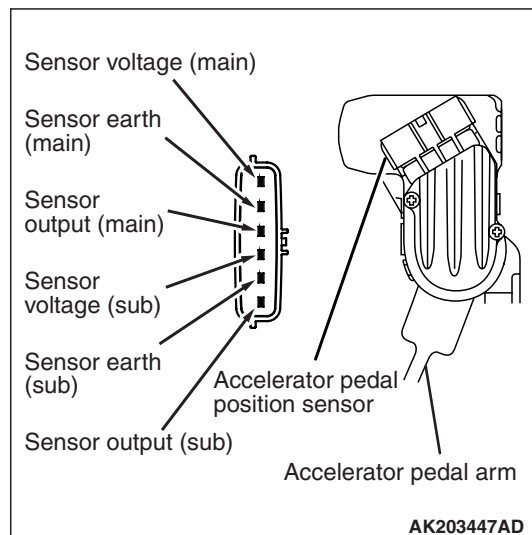
The magnetic flux density that passes into the Hall IC when the throttle valve is fully opened is kept to maximum in the below direction on this paper.

As the result of this, the electrical voltage is maximal output.



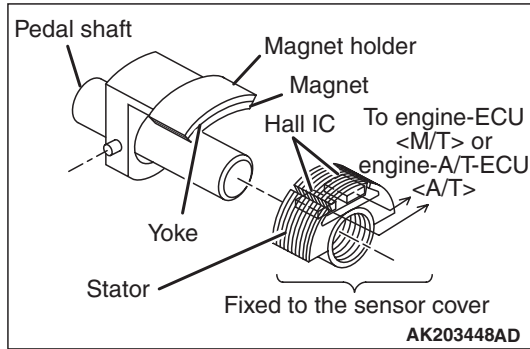
The throttle position sensor outputs through two systems (main and sub). This improves the accuracy of the system to detect malfunctions and reinforces the failsafe function in order to ensure reliability.

## ACCELERATOR PEDAL POSITION SENSOR

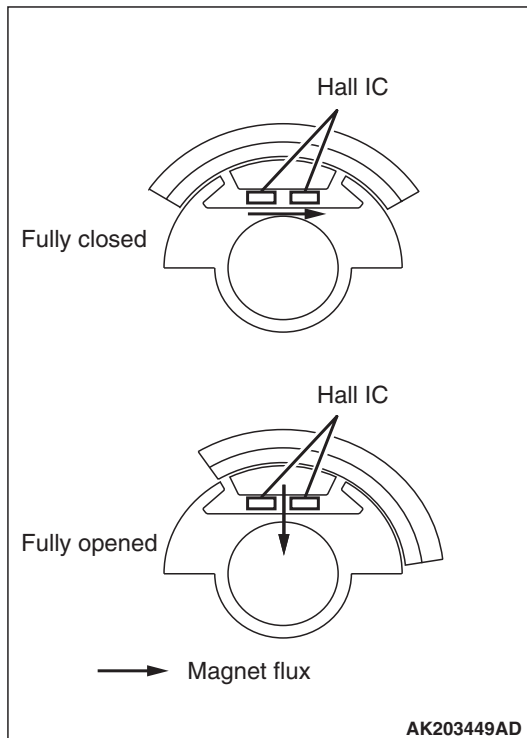


The accelerator pedal position sensor detects the amount of travel of the accelerator pedal. Mounted on the accelerator pedal arm, this sensor outputs a voltage signal, which corresponds to the amount of pedal travel, to the engine-ECU <M/T> or engine-A/T-ECU <A/T>. Through this signal, the engine-ECU <M/T> or engine-A/T-ECU <A/T> determines the target opening of the throttle valve. This accelerator pedal position sensor uses a non-contact Hall IC to enhance its reliability.

## CONSTRUCTION AND SYSTEM



The accelerator pedal position sensor consists of a permanent magnet fixed to the pedal shaft, a Hall IC that outputs electrical voltage in accordance with the magnetic flux density, and a stator that effectively guides the magnetic flux from the permanent magnet into the Hall IC.



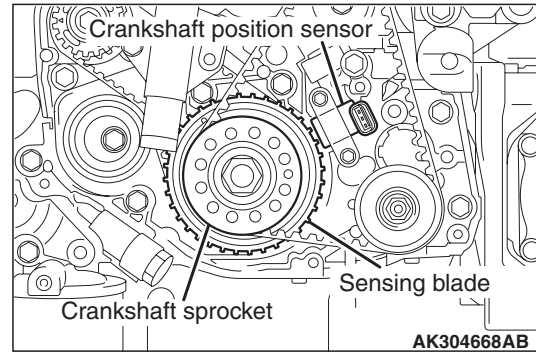
The magnetic flux density that passes into the Hall IC when the accelerator pedal is fully closed is kept to a minimum.

As the result of this, the electrical voltage is minimal output.

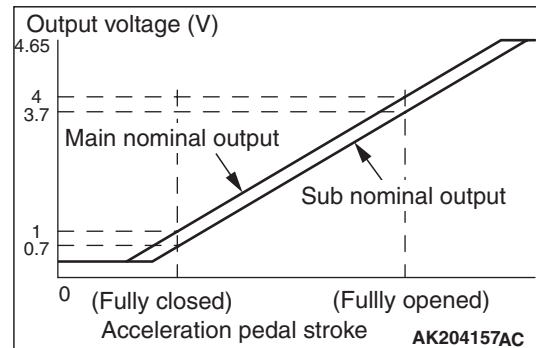
The magnetic flux density that passes into the Hall IC when the accelerator pedal is fully opened is kept to a maximum.

As the result of this, the electrical voltage is maximal output.

## CRANKSHAFT POSITION SENSOR

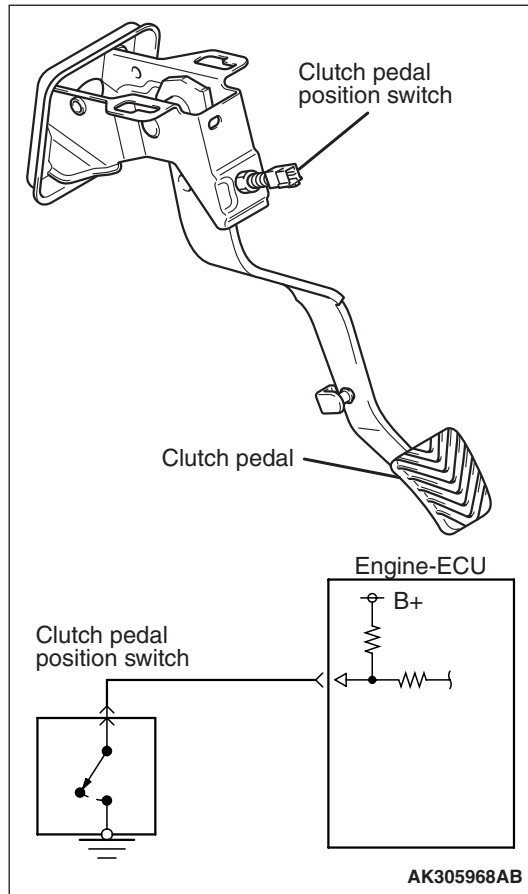


The number of the teeth on the sensing blade has been changed from the previous 2 teeth to 36 teeth (including the missing tooth). As a result, the system can effect engine control with finer precision. The construction and operation of this sensor are basically the same as SPACE WAGON.



The accelerator pedal position sensor outputs through two systems (main and sub). This improves the accuracy of the system to detect malfunctions and reinforces the failsafe function in order to ensure reliability.

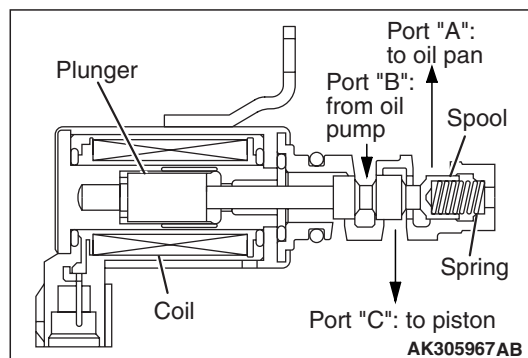
## CLUTCH PEDAL POSITION SWITCH <M/T>



The clutch pedal position switch is a contact type switch that is mounted on the clutch pedal assembly to detect the pressing of the clutch pedal. When the driver presses the clutch pedal while shifting gears, the contacts of the clutch pedal position switch close. This causes the positive battery voltage applied by the engine-ECU to be grounded to the body via the clutch pedal assembly. Upon detecting this signal, the engine-ECU makes fuel injection volume corrections during a shift change, thus reducing the discharge of hydrocarbon (HC) emissions associated with insufficient release of the accelerator pedal.

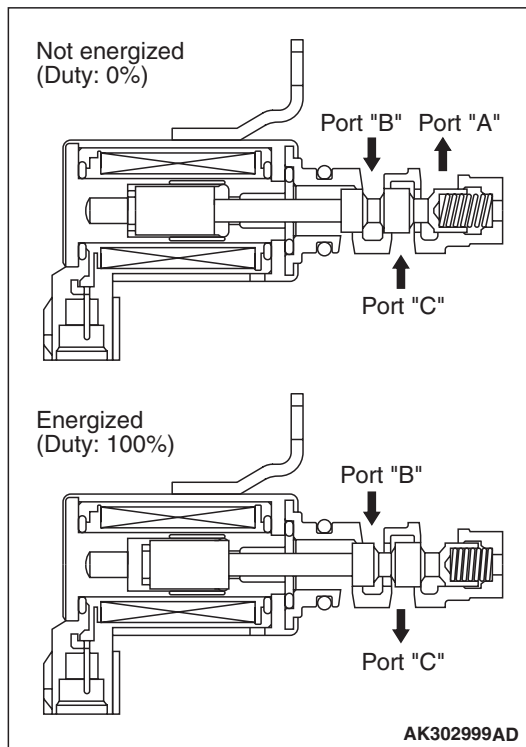
## ACTUATOR

### OIL CONTROL VALVE



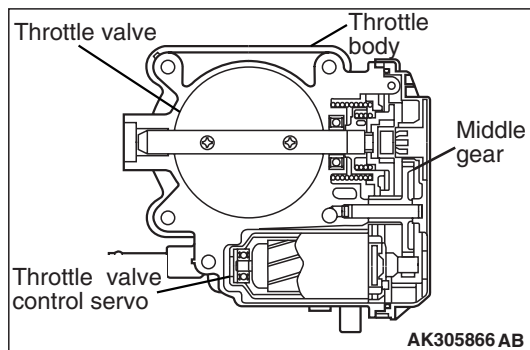
The oil control valve, which consists of a solenoid valve that operates under duty cycle control, is mounted to the cylinder head and used in hydraulic pressure control for switching the cams.

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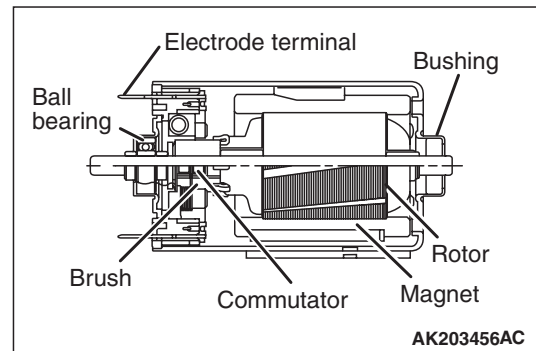


When the coil of the oil control valve is not energized (duty cycle ratio: 0%), port B closes, ports A and C open to each other, causing the oil that was acting on the cam switching control piston to be discharged from port C via port A. When the coil is energized (duty cycle ratio: 100%), the spool valve moves, port A closes, and ports B and C are open to each other. The oil that is pumped by the oil pump flows via ports B and C and acts on the cam switching control piston.

## THROTTLE VALVE CONTROL SERVO

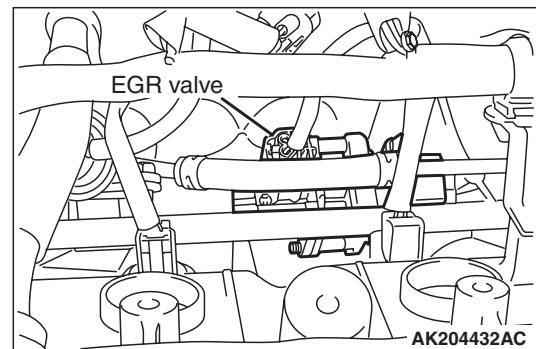


The throttle valve control servo is built into the throttle body and opens and closes the throttle valve via deceleration gears. The power train control module switches the direction of the electricity in accordance with open/close direction, as well as modulating the electrical current to the motor coil by controlling the PWM (Pulse Width Modulation) and controlling the throttle valve control servo.



The throttle valve control servo is a DC motor fitted with small brushes that has excellent responsiveness and electrical consumption capabilities, and which enables the acquisition of rotary power that is proportional to the electrical current volume imprinted on the coil. In addition to this, the motor's rotors consist of seven poles and seven circuits so that the throttle valve can still be driven with the other poles in the event of one circuit being cut off. The throttle valve has been designed so that it is open a predetermined amount when no electricity is passing through to the throttle valve control servo in order to ensure that a minimal amount of movement is still possible when a system failure cuts off the power.

## EGR VALVE



Through the adoption of a stepper motor, this EGR valve is able to control the EGR flow rate in a highly accurate manner, thus reducing exhaust gas (NOx) emissions and improving fuel economy. The construction and operation of this actuator are basically the same as 4G6-GDI engine used in SPACE WAGON.

## INJECTOR

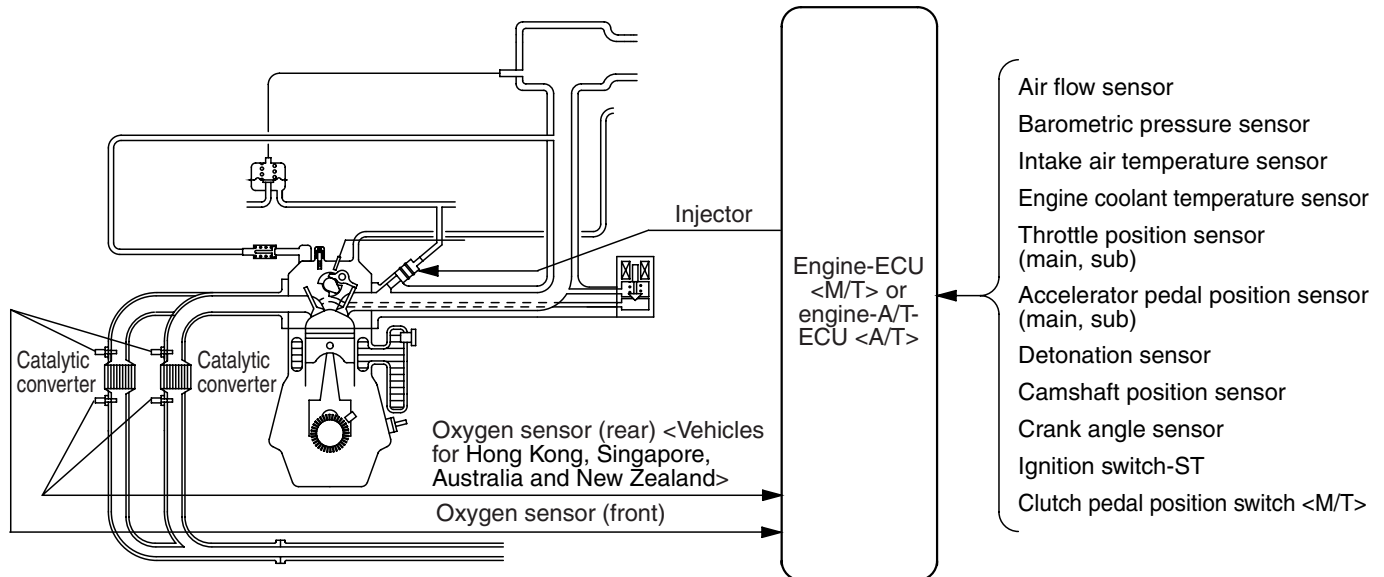
By improving the nozzle and finely atomizing the spray, the combustion efficiency has been improved.

## FUEL INJECTION CONTROL

M2132003000679

The fuel injection of the 4G69-SOHC MIVEC engine is controlled by a system that is essentially the same as the system for the SPACE WAGON 4G64-SOHC engine.

### SYSTEM CONFIGURATION DIAGRAM



AK304612AC

### OXYGEN SENSOR

The oxygen sensors detect the level of oxygen concentration in the exhaust gases.

#### <Vehicles for Hong Kong, Singapore, Australia and New Zealand>

A total of four front and rear oxygen sensors are installed in front and back of the dual manifold catalytic converter (MCC), respectively. The engine-A/T-ECU uses the output signal of the front oxygen sensor for each MCC to effect closed-loop control, and uses the output signal of the rear oxygen sensor in order to make corrections to the output sig-

nal of the front oxygen sensor. By resolving the output signal deviations associated with the deterioration of the front oxygen sensor, this system is able to effect a level of exhaust gas control that is higher than in the past.

#### <Vehicles for General Export, GCC and Brazil>

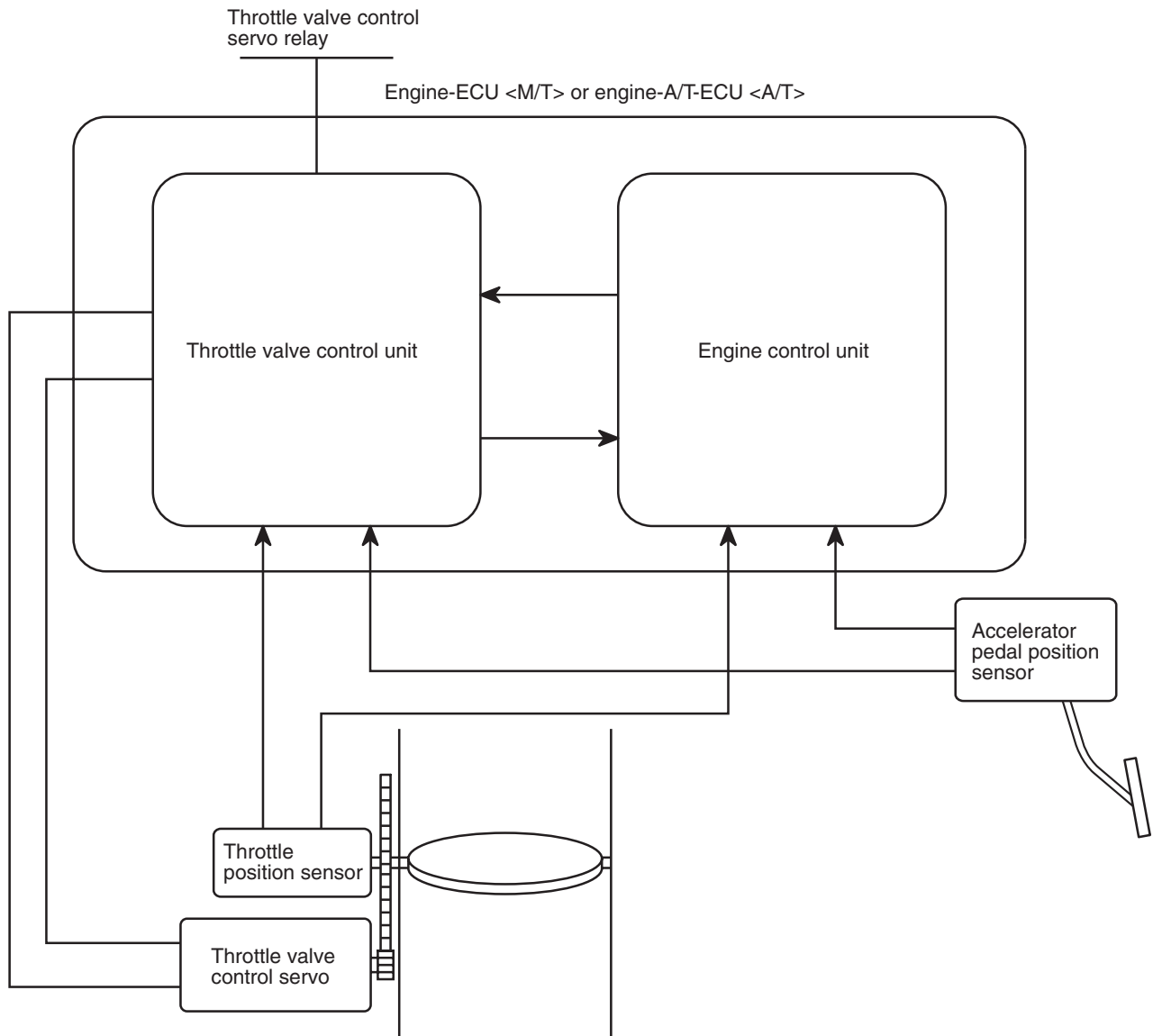
A total of two oxygen sensors are installed in front of the dual manifold catalytic converter (MCC), respectively. The engine-ECU <M/T> or engine-A/T-ECU <A/T> uses the output signal of the oxygen sensor for each MCC to effect closed-loop control.

# THROTTLE VALVE OPENING ANGLE CONTROL

M2132015000115

- The electronically controlled throttle valve system electronically regulates the throttle valve opening. The engine control unit in the engine-ECU <M/T> or engine-A/T-ECU <A/T> monitors the amount of the accelerator pedal travel through the accelerator pedal position sensor and issues premapped target throttle valve opening values to the throttle valve control servo unit in the engine-ECU <M/T> or engine-A/T-ECU <A/T> in accordance with operating conditions. Thus, the throttle valve control servo unit achieves the target throttle valve opening by controlling the current supplied to the throttle valve control servo, which is attached to the throttle body.
- This system also controls the idle speed in addition to controlling the throttle valve opening. Thus, the previously used idle speed control (ISC) servo has been disconnected.

## SYSTEM CONFIGURATION DIAGRAM



AK203119AD

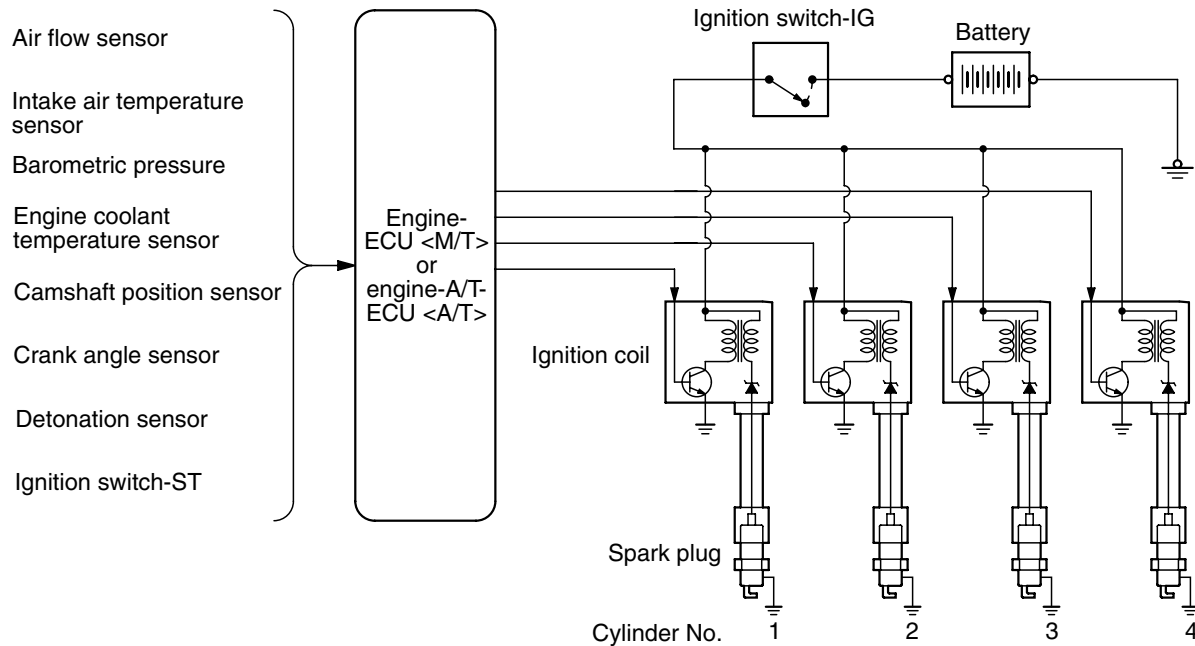
## IGNITION TIMING AND DISTRIBUTION CONTROL

M2132005000330

The ignition coil is the direct-ignition type in which one coil is provided for every cylinder. This has improved the ignition performance of the system by eliminating the energy loss associated with the spark plug cables and the exhaust stroke ignition.

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

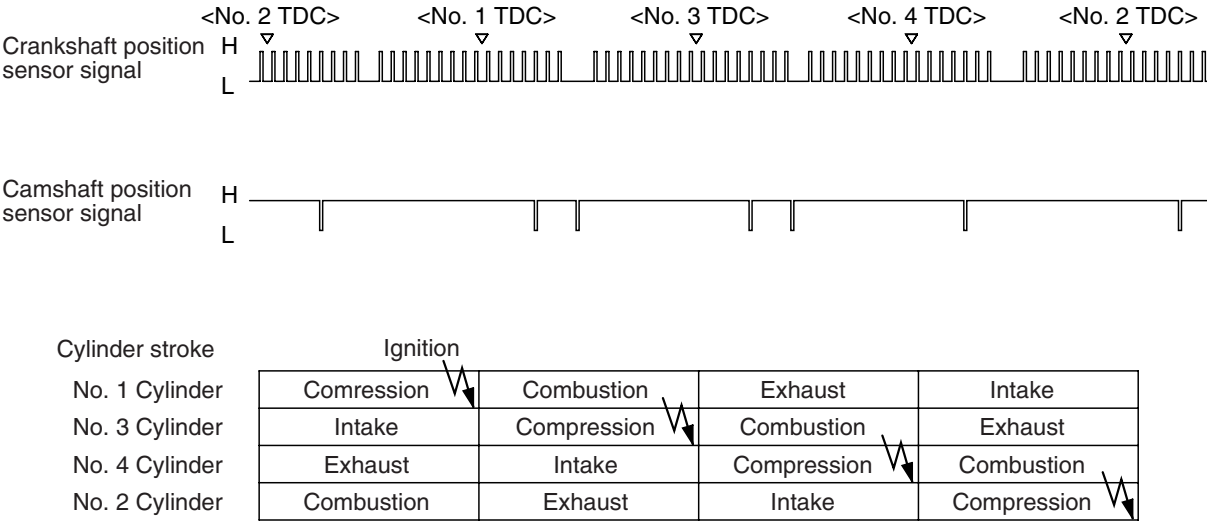
### SYSTEM CONFIGURATION DIAGRAM



AK101328AI

### IGNITION TIMING CONTROL

The cylinder discernment method is changed according to the changes of the camshaft position sensor signal and crankshaft position sensor signal. The cylinder discernment is monitoring the signal patterns of the camshaft position sensor and crankshaft position sensor within the cylinder discernment section.

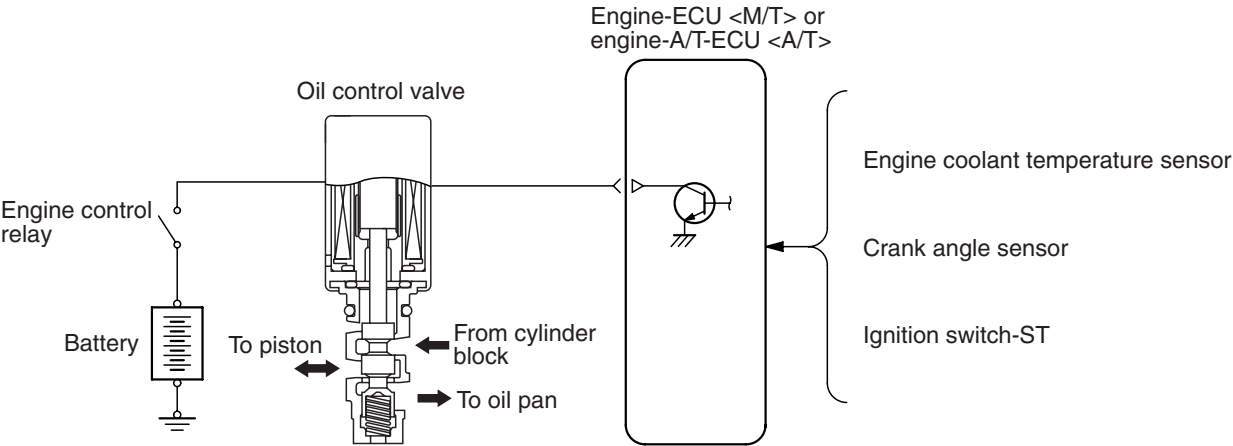


AK301362AC

VALVE TIMING AND LIFE SWITCHING

M2132017000070

This system uses a low-speed cam to actuate the intake valve during low engine speeds, and a high-speed cam to actuate the intake valve during high engine speeds. As a result, this system realizes further improvement in low-speed torque and high-speed power output over the conventional engine.



AK300245AE

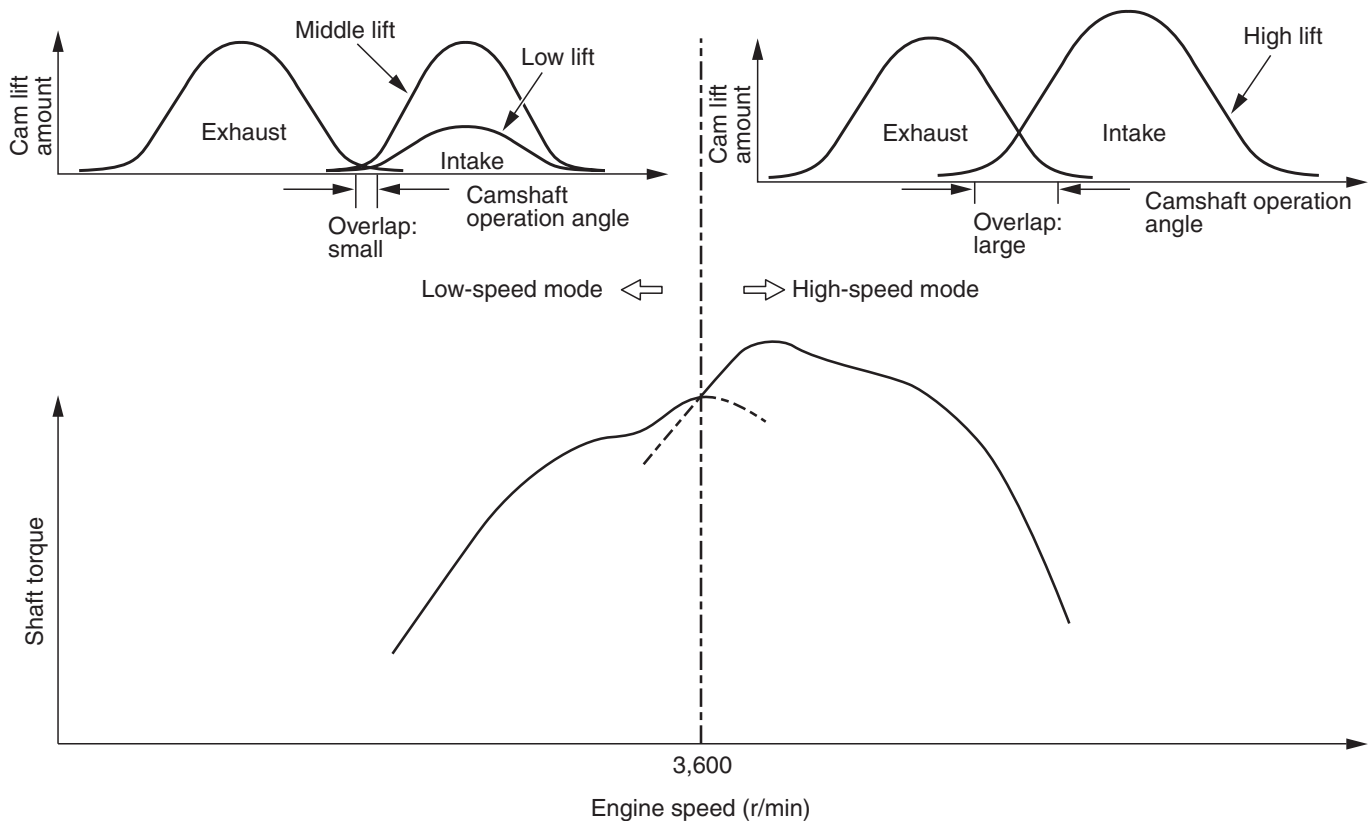


The low-speed cam has a shorter valve overlap and valve-opening duration, and possesses characteristics that are well-suited to low-speed operations in which the intake air inertia is small. The high-speed cam has a longer valve overlap and valve-opening duration, and possesses characteristics that are well-suited to high-speed operations in which the intake air inertia is large. When the engine is operating at low speeds (below 3,600 r/min), the oil control valve is OFF (duty cycle ratio: 0%). Therefore, the cam switching control piston remains down, allowing the intake valve to be actuated by the low-speed cam. The low-speed cam consists of two cams with different valve lifts, and the two cams actuate one intake valve each. For this reason, a difference is created between the valve lifts, creating a more powerful flow of air-fuel mixture and stabilizing combustion in the cylinder. As a result, low fuel consumption, low exhaust gas emissions, and high torque have been realized.

When the engine is operating at high speeds (above 3,600 r/min), the engine-ECU <M/T> or engine-A/T-ECU <A/T> turns on the oil control valve (duty cycle ratio: 100% for 2 seconds while switching, and 60% after 2 seconds have elapsed). Consequently, the hydraulic pressure acts on the cam switching control piston, causing the high-speed cam to actuate the intake valve. As a result, the valve opening duration and the valve lift increase, effectively increasing the intake air volume and the power output.

Under the conditions indicated below, the low-speed cam always operates the intake valve:

- Engine coolant temperature below 20° C
- Within 10 seconds upon starting the engine



## EGR CONTROL, PURGE CONTROL

M2132011000113

Refer to EMISSION CONTROL SYSTEM [P.17-7](#)

## OTHER CONTROL FUNCTIONS

M2132010000284

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
- Alternator control

## CONTROLLER AREA NETWORK (CAN) COMMUNICATION

M2132019000054

CAN communication is used to ensure a reliable transmission of data. Refer to GROUP 54C –CAN

[P.54C-2](#).

The signals that input to engine-ECU <M/T> or engine-A/T-ECU <A/T> are following:

**CAN communication input signal table**

Input signal	Transmitter ECU
Compressor signal	A/C-ECU
Idle-up request signal	
Cooling fan request signal	
Blower fan signal	

## DIAGNOSIS SYSTEM

M2132009000707

Engine -ECU <M/T> or engine-A/T-ECU <A/T> has been provided with the following functions for easier system inspection.

### FREEZE-FRAME DATA <Vehicles for Hong Kong, Singapore, Australia and New Zealand>

When the engine-ECU <M/T> or engine-A/T-ECU <A/T> detects a problem and stores the resulting diagnosis code, the engine condition at that time is also memorized. The M.U.T.-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
12	Air flow sensor <Vehicles for Australia and New Zealand>	gm/s
13	Intake air temperature sensor <Vehicles for Australia and New Zealand>	°C
21	Engine coolant temperature	°C
22	Crank angle sensor	r/min
24	Vehicle speed	km/h
81	Long-term fuel compensation (cylinder 1, 4)	%
82	Short-term fuel compensation (cylinder 1, 4)	%

Item No.	Data	Unit
83	Long-term fuel compensation (cylinder 2, 3)	%
84	Short-term fuel compensation (cylinder 2, 3)	%
87	Calculation load value	%
88	Fuel control condition (cylinder 1, 4)	Open loop
		Closed loop
		Open loop owing to drive condition
		Open loop owing to system malfunction
		Closed loop based on one oxygen sensor
89	Fuel control condition (cylinder 2, 3)	Open loop
		Closed loop
		Open loop owing to drive condition
		Open loop owing to system malfunction
		Closed loop based on one oxygen sensor
8A	Throttle position sensor (main)	%
—	Diagnosis code during data recording	—

### DIAGNOSIS CODE

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

#### <Vehicle except for Australia and New Zealand>

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0075	Oil control valve system	Open circuit or short-circuit in sensor-related circuits	ON
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 (main) system	Open circuit or short-circuit in system-related circuits	ON

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0130	Cylinder 1, 4 oxygen sensor system <Vehicles for General Export, GCC and Brazil>	Open circuit or short-circuit in sensor-related circuits	ON
	Cylinder 1, 4 oxygen sensor (front) system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON
P0135	Cylinder 1, 4 oxygen sensor heater system <Vehicles for General Export, GCC and Brazil>	Open circuit or short-circuit in sensor-related circuits	ON
	Cylinder 1, 4 oxygen sensor (front) heater system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON
P0136	Cylinder 1, 4 oxygen sensor (rear) system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON
P0141	Cylinder 1, 4 oxygen sensor (rear) heater system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON
P0150	Cylinder 2, 3 oxygen sensor system <Vehicles for General Export, GCC and Brazil>	Open circuit or short-circuit in sensor-related circuits	ON
	Cylinder 2, 3 oxygen sensor (front) system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON
P0155	Cylinder 2, 3 oxygen sensor heater system <Vehicles for General Export, GCC and Brazil>	Open circuit or short-circuit in sensor-related circuits	ON
	Cylinder 2, 3 oxygen sensor (front) heater system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON
P0156	Cylinder 2, 3 oxygen sensor (rear) system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON
P0161	Cylinder 2, 3 oxygen sensor (rear) heater system <Vehicles for Hong Kong and Singapore>	Open circuit or short-circuit in sensor-related circuits	ON

<b>Code No.</b>	<b>Diagnosis item</b>	<b>Main diagnosis contents</b>	<b>Engine warning lamp</b>
P0170	Abnormal fuel system (cylinder 1, 4)	Leanness or richness problem	ON
P0173	Abnormal fuel system (cylinder 2, 3)	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
P0220	Accelerator pedal position sensor (main) system	Open circuit or short-circuit in system-related circuits	ON
P0225	Throttle position sensor (sub) system	Open circuit or short-circuit in sensor-related circuits	ON
P0300	Ignition coil (power transistor) system	Abnormal ignition signal (Mis-firing)	ON
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 valve system	Open circuit or short-circuit in injector-related circuits	ON
P0500	Vehicle speed sensor system <M/T> Vehicle speed signal system <A/T>	Abnormal sensor output	—
P0513	Immobilizer system <Vehicles for GCC, Hong Kong and Singapore>	Open circuit or short-circuit in system-related circuits	—
P0551	Power steering fluid pressure sensor system	Abnormally in engine-ECU <M/T> or engine-A/T-ECU <A/T>	ON <Vehicles for General Export, GCC and Brazil>
P0603	EEP ROM system	Abnormally in engine-ECU <M/T> or engine-A/T-ECU <A/T>	ON
P0606	Microcomputer malfunction	Abnormally in engine-ECU <M/T> or engine-A/T-ECU <A/T>	ON
P0622	Alternator FR terminal system	Open circuit or short-circuit in system-related circuits	—
P0630	Vehicle identification number (VIN) malfunction <Vehicles for Hong Kong and Singapore>	Vehicle identification number (VIN) not entered	ON
P0638	Throttle valve control servo circuit range/performance problem	Abnormal throttle valve control servo	ON

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P1121	Throttle valve control servo power system	Open circuit or short-circuit in system-related circuits	ON
P1122	Throttle valve control servo connector system	Open circuit or short-circuit in system-related circuits	ON
P1221	Throttle valve position feedback system	Open circuit or short-circuit in system-related circuits	ON
P1223	Communication line system with the throttle valve controller	Abnormally in engine-ECU <M/T> or engine-A/T-ECU <A/T>	ON
P1225	Accelerator pedal position sensor (sub) system	Open circuit or short-circuit in system-related circuits	ON
P1603	Battery back-up circuit malfunction	Abnormally in engine-ECU <M/T> or engine-A/T-ECU <A/T>	ON <Vehicles for Hong Kong and Singapore>
U1073	Bus off	Abnormally in CAN bus line	–
U1102	ABS-ECU time out	Abnormally in CAN bus line	–
U1108	Combination meter time out	Abnormally in CAN bus line	–
U1110	A/C-ECU time out	Abnormally in CAN bus line	–
–	Engine-ECU <M/T> or engine-A/T-ECU <A/T>	Abnormality in engine-ECU <M/T> or engine-A/T-ECU <A/T>	ON

## &lt;Vehicles for Australia and New Zealand&gt;

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
P0122*	Throttle position sensor (main) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P0123*	Throttle position sensor (main) circuit high input	Open circuit in sensor-related circuits	ON
P0125*	Feedback system monitor	Oxygen sensor not operating	ON
P0130	Cylinder 1, 4 oxygen sensor (front) system	Open circuit or short-circuit in sensor-related circuits	ON
P0135	Cylinder 1, 4 oxygen sensor (front) heater system	Open circuit or short-circuit in heater-related circuits	ON
P0136	Cylinder 1, 4 oxygen sensor (rear) system	Open circuit or short-circuit in sensor-related circuits	ON
P0141	Cylinder 1, 4 oxygen sensor (rear) heater system	Open circuit or short-circuit in heater-related circuits	ON

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0150	Cylinder 2, 3 oxygen sensor (front) system	Open circuit or short-circuit in sensor-related circuits	ON
P0155	Cylinder 2, 3 oxygen sensor (front) heater system	Open circuit or short-circuit in heater-related circuits	ON
P0156	Cylinder 2, 3 oxygen sensor (rear) system	Open circuit or short-circuit in sensor-related circuits	ON
P0161	Cylinder 2, 3 oxygen sensor (rear) heater system	Open circuit or short-circuit in heater-related circuits	ON
P0170	Abnormal fuel system (cylinder 1, 4)	Leanness or richness problem	ON
P0173	Abnormal fuel system (cylinder 2, 3)	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
P0222*	Throttle position sensor (sub) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P0223*	Throttle position sensor (sub) circuit high input	Open circuit in sensor-related circuits	ON
P0300*	Random / multiple cylinder mis-fire detected	Abnormal ignition signal (Mis-firing)	ON
P0301*	No. 1 cylinder mis-fire detected	Mis-firing	ON
P0302*	No. 2 cylinder mis-fire detected		
P0303*	No. 3 cylinder mis-fire detected		
P0304*	No. 4 cylinder mis-fire detected		
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 valve system	Open circuit or short-circuit in valve-related circuits	ON
P0421	Warm up catalyst malfunction (cylinder 1, 4)	Abnormal exhaust gas purification performance of catalyst	ON
P0431	Warm up catalyst malfunction (cylinder 2, 3)	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 signal system	Abnormal sensor output	ON
P0505	Idle speed control (ISC) system	Idle speed control servo inoperable	ON

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0513	Immobilizer malfunction	Open circuit or short-circuit in system-related circuits	ON
P0551*	Power steering fluid pressure sensor system	Open circuit or short-circuit in system-related circuits	ON
P0603	EEP ROM system	Abnormality in engine-A/T-ECU	ON
P0606*	Engine-A/T-ECU main processor malfunction	Abnormality in engine-A/T-ECU	ON
P0622	Alternator FR terminal system	Open circuit or short-circuit in system-related circuits	ON
P0638*	Throttle valve control servo circuit range/performance problem	Abnormal throttle valve control servo	ON
P0642*	Throttle position sensor power supply	Abnormality in engine-A/T-ECU	ON
P0657*	Throttle valve control servo relay circuit malfunction	Open circuit or short-circuit in sensor-related circuits	ON
P0705	Transmission Range Sensor Circuit Malfunction (RPNDL Input)	abnormality in A/T system	ON
P0710*	Transmission Fluid Temperature Sensor Circuit Malfunction	abnormality in A/T system	ON
P0715*	Input/Turbine Speed Sensor Circuit Malfunction	abnormality in A/T system	ON
P0720*	Output Speed Sensor Circuit Malfunction	abnormality in A/T system	ON
P0740*	Torque Converter Clutch System Malfunction	abnormality in A/T system	ON
P0750*	Shift Solenoid A Malfunction (LR SOL)	abnormality in A/T system	ON
P0755*	Shift Solenoid B Malfunction (UD SOL)	abnormality in A/T system	ON
P0760*	Shift Solenoid C Malfunction (2nd SOL)	abnormality in A/T system	ON
P0765*	Shift Solenoid D Malfunction (OD SOL)	abnormality in A/T system	ON
P1021	Oil control valve circuit	Open circuit or short-circuit in solenoid valve-related circuits	ON
P1602*	Communication Malfunction (between engine-A/T-ECU main processor and system LSI)	Abnormality in engine-A/T-ECU	ON
P1603*	Battery back-up circuit malfunction	Open circuit or short-circuit in system-related circuits	ON
P1751*	A/T Control Relay Malfunction	abnormality in A/T system	ON
P2100*	Throttle valve control servo circuit (open)	Open circuit in system-related circuits	ON
P2101*	Throttle valve control servo magneto malfunction	Short-circuit in system-related circuits	ON



Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P2102*	Throttle valve control servo circuit (shorted low)	Short-circuit in system-related circuits	ON
P2103*	Throttle valve control servo circuit (shorted high)	Short-circuit in system-related circuits	ON
P2122*	Accelerator pedal position sensor (main) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P2123*	Accelerator pedal position sensor (main) circuit high input	Open circuit in sensor-related circuits	ON
P2127*	Accelerator pedal position sensor (sub) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P2128*	Accelerator pedal position sensor (sub) circuit high input	Open circuit in sensor-related circuits	ON
P2135*	Throttle position sensor (main and sub) circuit range/performance problem	Abnormal sensor output	ON
P2138*	Accelerator pedal position sensor (main and sub) circuit range/performance problem	Abnormal sensor output	ON
P2173*	Abnormal intake air amount	Abnormal sensor output	ON
U1073	Bus off	Abnormality in CAN bus line	—
U1102	ABS-ECU time-out	Abnormality in CAN bus line	—
U1108	Combination meter time-out	Abnormality in CAN bus line	—
U1110	A/C-ECU time-out	Abnormality in CAN bus line	—

*NOTE: When the first time a malfunction is detected, the engine-A/T-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	Cylinder 1,4 oxygen sensor (front)	mV
12	Air flow sensor	gm/s
13	Intake air temperature sensor	°C
14	Throttle position sensor (sub)	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
29	Inhibitor switch <A/T>	P, N/D, 2, L, R
37	Volumetric efficiency	%
39	Cylinder 2,3 oxygen sensor (front)	mV

Item No.	Inspection item	Unit
41	Injectors	mS
44	Ignition advance	° BTDC
49	A/C relay	ON/OFF
59	Cylinder 1,4 oxygen sensor (rear) <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	mV
67	Stop lamp switch <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	ON/OFF
68	EGR valve	STEP
69	Cylinder 2,3 oxygen sensor (rear) <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	mV
77	Accelerator pedal position sensor (sub)	mV
78	Accelerator pedal position sensor (main)	mV
79	Throttle position sensor (main)	mV
9A	Throttle position sensor (main) mid opening learning valve <Vehicles except for Hong kong and Singapore>	mV
B4	Power steering pressure sensor	mV
12*1	Air flow sensor	gm/s
13*1	Intake air temperature sensor	° C
21*1	Engine coolant temperature sensor	° C
22*1	Crank angle sensor	r/min
24*1	Vehicle speed sensor	km/h
44*1	Ignition advance	deg
81*1	Cylinder 1, 4 long-term fuel compensation <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	%
	Long-term fuel compensation <Vehicles except for Hong Kong, Singapore, Australia and New Zealand>	%
82*1	Cylinder 1, 4 short-term fuel compensation <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	%
	Short-term fuel compensation <Vehicles except for Hong Kong, Singapore, Australia and New Zealand>	%
83*1	Cylinder 2, 3 long-term fuel compensation <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	%
84*1	Cylinder 2, 3 short-term fuel compensation <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	%
87*1	Calculated load valve	%
88*1	Cylinder 1, 4 fuel control condition	Closed loop/Open loop – drive condition
89*1	Cylinder 1, 4 fuel control condition	Closed loop/Open loop – drive condition
8A*1	Throttle position sensor (main)	%
A1*1	Cylinder 1,4 oxygen sensor (front)	V

Item No.	Inspection item	Unit
A2* <sup>1</sup>	Cylinder 1,4 oxygen sensor (rear) <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	V
A3* <sup>1</sup>	Cylinder 2,3 oxygen sensor (front)	V
A4* <sup>1</sup>	Cylinder 2,3 oxygen sensor (rear) <Vehicles for Hong Kong, Singapore, Australia and New Zealand>	V
A9* <sup>2</sup>	MIL distance <Vehicles for Australia and New Zealand>	Km
0002* <sup>2</sup>	Accelerator pedal fully closed position learning value <Vehicles for Hong Kong and Singapore>	mV
000F* <sup>2</sup>	CAN communication A/C compressor torque <Vehicles for Hong Kong and Singapore>	N· m
0040* <sup>2</sup>	Shift information <Vehicles for Hong Kong and Singapore>	R, N, P/1st/2nd/3rd/4th
0115* <sup>2</sup>	Idle-up demand <Vehicles for Hong Kong and Singapore>	OFF/LOW, MID, HIGH
0117* <sup>2</sup>	A/C compressor ON demand <Vehicles for Hong Kong and Singapore>	ON/OFF

*NOTE: \*<sup>1</sup>: When service data in check mode is selected, the data is not displayed.*

*NOTE: \*<sup>2</sup>: The data is displayed only if the service data in check mode is selected.*

## 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
17	Basic ignition timing	Set to ignition adjustment mode
21	Fan controller	Drive the fan motor
22	Oil control valve <Vehicles except for Hong Kong and Singapore>	Oil control valve turns from OFF to ON
34	Electronic-controlled throttle valve system	Stop the throttle valve control servo

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## NOTES