

DENSO

Diesel Injection Pump

SERVICE MANUAL

**Common Rail System (HP3)
for MITSUBISHI L200/TRITON
4D56/4M41 Engine
(All the destinations)**

OPERATION

June, 2005

DENSO INTERNATIONAL THAILAND CO., LTD.

TG00400010E

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1. PRODUCT APPLICATION INFORMATION

1.1 Application

Vehicle Manufacture	Vehicle Name	Engine Model	Specification	Destination (Volume)	Line Off Period
MITSUBISHI	TRITON	4D56	2WD(MT/AT)	Thailand	June ,2005
			4WD(MT)		
		4M41	4WD(MT/AT)	Oceania	May ,2006
		4M41	4WD(MT)		
	L200	4D56	2WD(MT/AT)	Middle East , Russia ,Others	July , 2006
			4WD(MT)		
	4D56	4WD (AT)	Europe	Dec, 2005	

1.2 System Components Part Number

Parts Name	DENSO P/N	Manufacturer P/N	Remarks
Supply pump	SM294000-0331	1460A001	For 4D56 Engine model
Supply pump	SM294000-0341	1460A003	For 4M41 Engine model
Supply pump	SM294000-0640	1460A019	For 4D56 Low lubricating model
Injector	SM095000-5600	1465A041	For 4D56 Engine model
Injector	SM095000-5760	1465A054	For 4M41 Engine model
Rail	SM095440-0640	1465A034	All
Engine ECU	MA275800-4364	1860A549	For 4WD, W/O PTC for Europe market
	MA275800-4374	1860A550	For 4WD W PTC for Europe market
	MA275800-3574	1860A390	For 4WD/ 4M41 Thailand and Oceania model
	MA275800-4254	1860A392	For 4D56 / 4WD Thailand model
	MA275800-4314	1860A523	For 4D56 / 2WD MT Thailand model
	MA275800-4324	1860A524	For 4D56 / 2WD AT Thailand model
	MA275800-7131	1860A767	For 4D56 Low lubricating model (Middle East , Russia , others)
	MA275800-4602	1860A586	For 4WD/ 4M41 Oceania model
Turbo pressure sensor	079800-5960	MR577031	All
Cylinder recognitioin sensor (TDC)	949979-1590	1865A074	For Thailand model 4M41
Electronic control throttle	197920-0020	1450A033	For 4M41/4D56 4WD Thailand model
Fuel temperature sensor	179730-0020	MR547077	All
Mass air flow meter	VN197400-4030	1460A001	All
Fuel Filter	186000-6090	1770A048	Normal / For Low lubricating fuel spec.
	186300-6240	1770A049	W/PTC heater for cold area spec./ For Low lubricating fuel spec.

2. OUTLINE OF SYSTEM

2.1 Common Rail System Characteristics

- The common rail system uses a type of accumulation chamber called a rail to store pressurized fuel, and injectors that contain electronically controlled solenoid valves to inject the pressurized fuel into the cylinders. Because the engine ECU controls the injection system (injection pressure, injection rate, and injection timing), the injection system is independent, and thus unaffected by the engine speed or load. This ensures a stable injection pressure at all times, particularly in the low engine speed range, and dramatically decreases the amount of black smoke ordinarily emitted by a diesel engine during start-up and acceleration. As a result, exhaust gas emissions are cleaner and reduced, and higher power output is achieved.

2.2 Features of Injection Control

(1) Injection Pressure Control

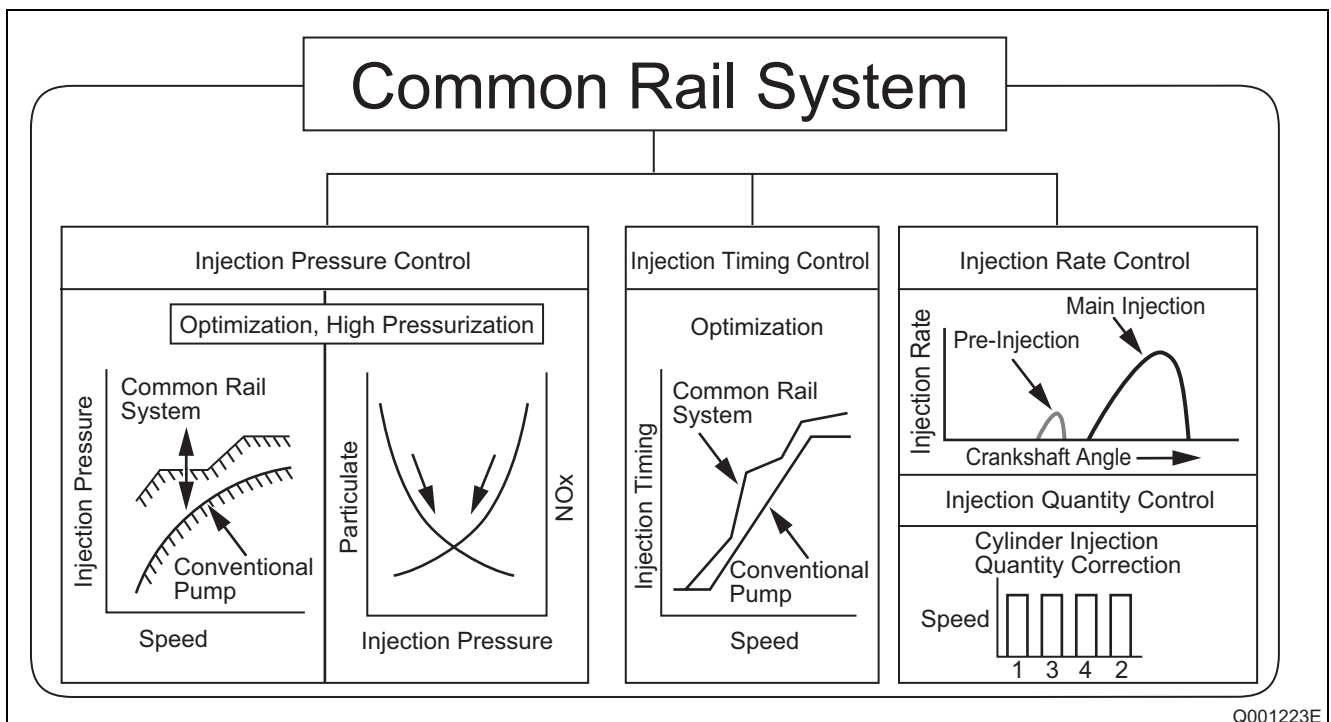
- Enables high-pressure injection even at low engine speeds.
- Optimizes control to minimize particulate matter and NOx emissions.

(2) Injection Timing Control

- Enables finely tuned optimized control in accordance with driving conditions.

(3) Injection Rate Control

- Pilot injection control injects a small amount of fuel before the main injection.



2.3 Comparison to the Conventional System

	In-line, VE Pump	Common Rail System
System	<p style="text-align: right;">Q001224E</p>	<p style="text-align: right;">Q001225E</p>
Injection Quantity Control	Pump (Governor)	Engine ECU, Injector (TWV)* ¹
Injection Timing Control	Pump (Timer)	Engine ECU, Injector (TWV)* ¹
Rising Pressure	Pump	Engine ECU, Supply Pump
Distributor	Pump	Engine ECU, Rail
Injection Pressure Control	Dependent upon Speed and Injection Quantity	Engine ECU, Supply Pump (SCV)* ²

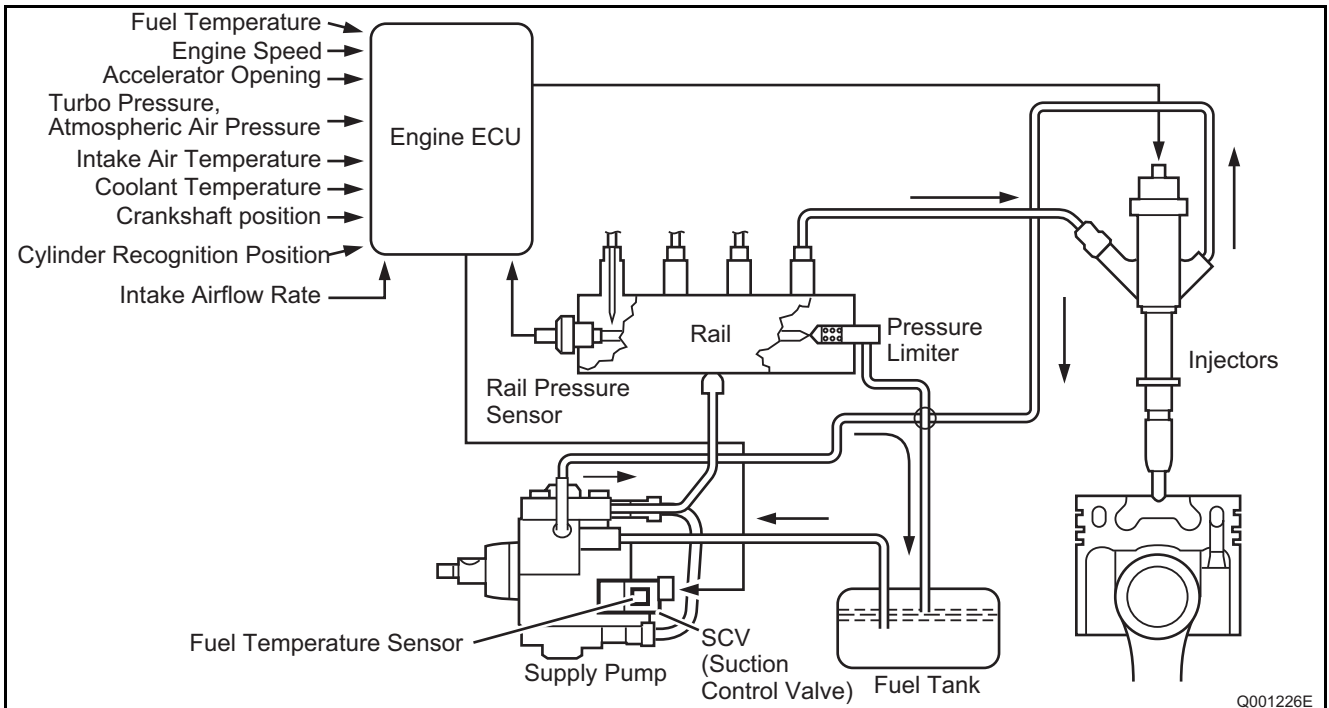
< NOTE >

*1 : TWV: Two Way Valve

*2 : SCV: Suction Control Valve

2.4 Composition

- The common rail system consists primarily of a supply pump, rail, injectors, and engine ECU.



2.5 Operation

(1) Supply Pump (HP3)

- The supply pump draws fuel from the fuel tank, and pumps the high pressure fuel to the rail. The quantity of fuel discharged from the supply pump controls the pressure in the rail. The SCV (Suction Control Valve) in the supply pump effects this control in accordance with commands received from the engine ECU.

(2) Rail

- The rail is mounted between the supply pump and the injector, and stores the high-pressure fuel.

(3) Injector (G2 type)

- This injector replaces the conventional injection nozzle, and achieves optimal injection by effecting control in accordance with signals from the engine ECU. Signals from the engine ECU determine the duration and timing in which current is applied the injector. This in turn, determines the quantity, rate and timing of the fuel that is injected from the injector.

(4) Engine ECU

- The engine ECU calculates data received from the sensors to comprehensively control the injection quantity, timing and pressure, as well as the EGR (exhaust gas recirculation).

2.6 Fuel System

- This system comprises the route through which diesel fuel flows from the fuel tank via the rail to the supply pump, and is injected through the injector, as well as the route through which the fuel returns to the tank via the overflow pipe.

2.7 Control System

- In this system, the engine ECU controls the fuel injection system in accordance with signals received from various sensors. The components of this system can be broadly divided into the following three types: (1) sensors; (2) ECU; and (3) actuators.

(1) Sensors

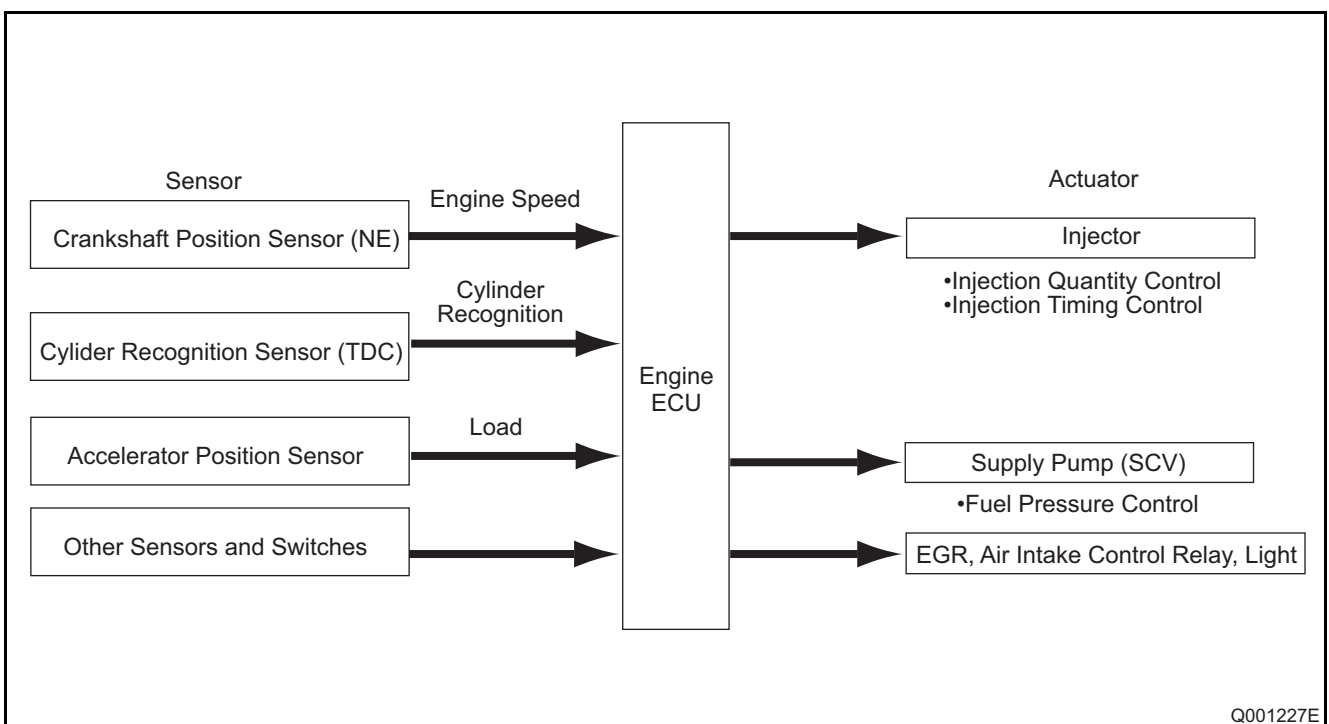
- Detect the engine and driving conditions, and convert them into electrical signals.

(2) Engine ECU

- Performs calculations based on the electrical signals received from the sensors, and sends them to the actuators in order to achieve optimal conditions.

(3) Actuators

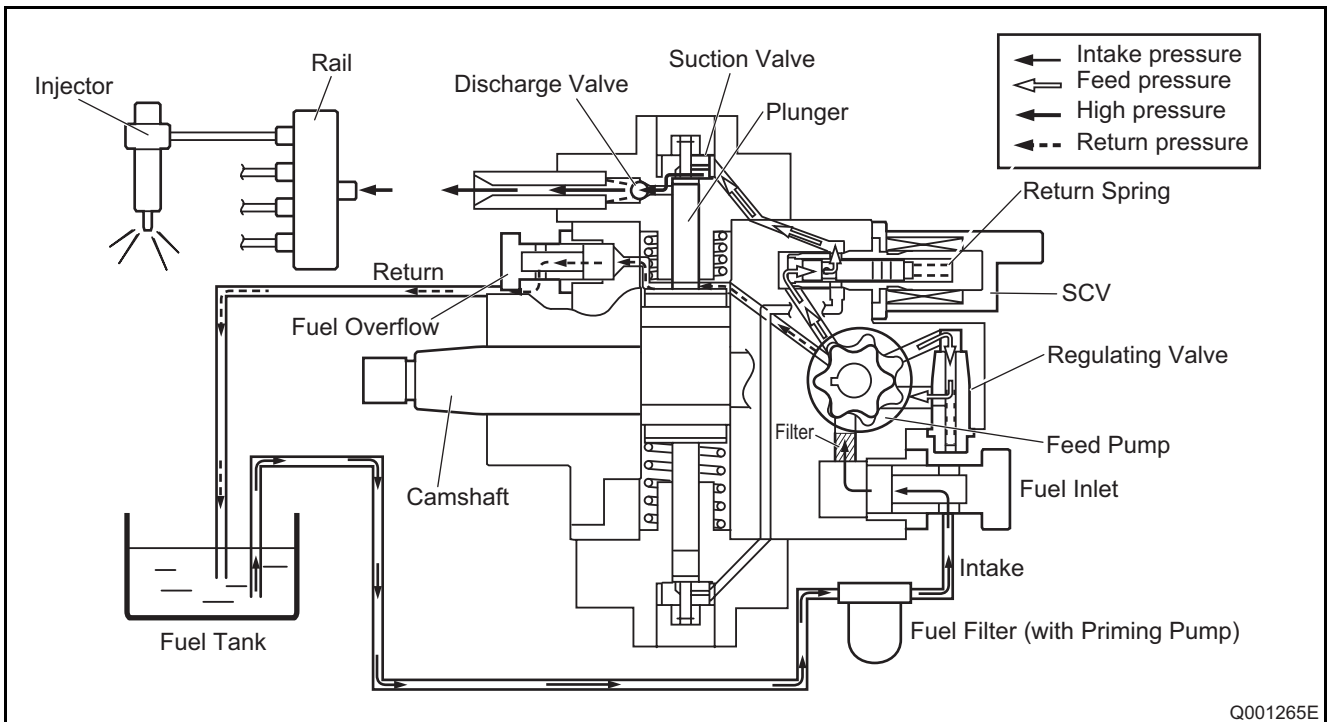
- Operate in accordance with electrical signals received from the ECU. Injection system control is undertaken by electronically controlling the actuators. The injection quantity and timing are determined by controlling the duration and timing in which current is applied to the TWV (Two-Way Valve) in the injector. Injection pressure is determined by controlling the SCV (Suction Control Valve) in the supply pump.



3. SUPPLY PUMP

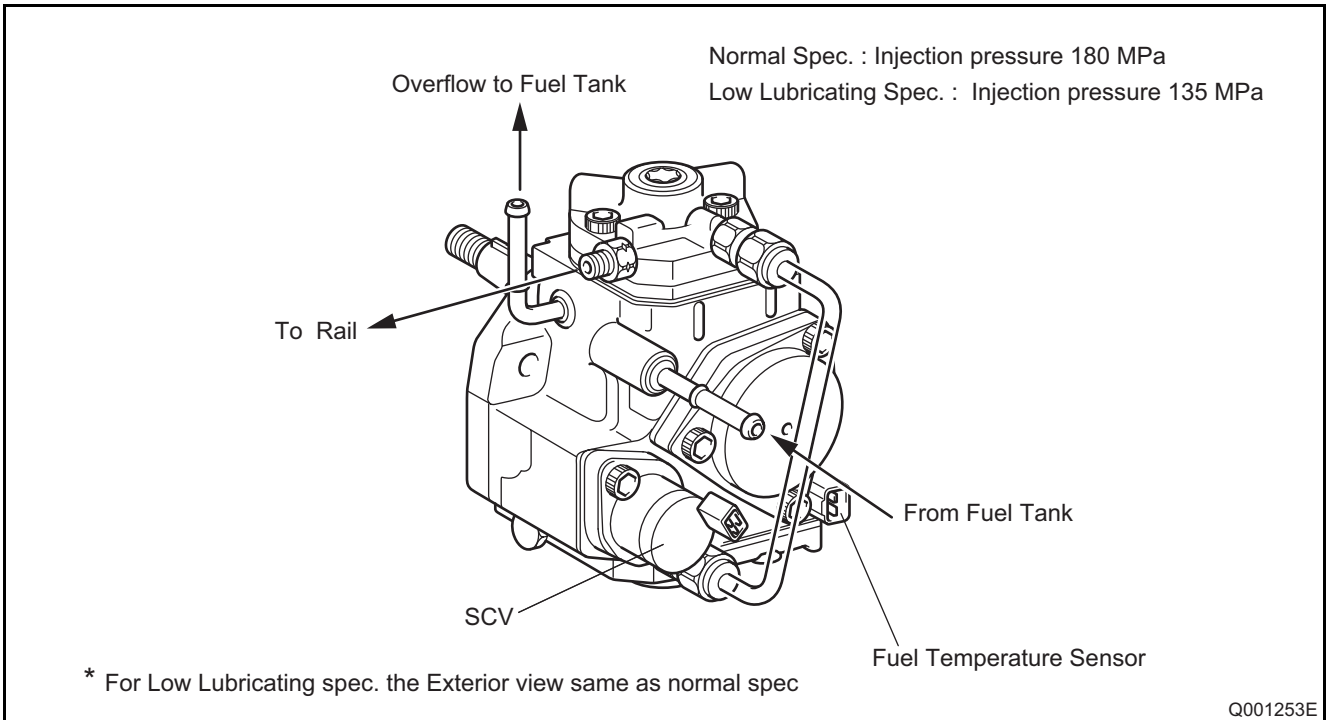
3.1 Outline

- The supply pump consists primarily of the pump body (eccentric cam, ring cam, and plungers), SCV (Suction Control Valve), fuel temperature sensor, and feed pump.
- The two plungers are positioned vertically on the outer ring cam for compactness.
- The engine drives the supply pump at a ratio of 1:1. The supply pump has a built-in feed pump (trochoid type), and draws the fuel from the fuel tank, sending it to the plunger chamber.
- The internal camshaft drives the two plungers, and they pressurize the fuel sent to the plunger chamber and send it to the rail. The quantity of fuel supplied to the rail is controlled by the SCV, using signals from the engine ECU. The SCV is a normally open type (the intake valve opened during de-energization).

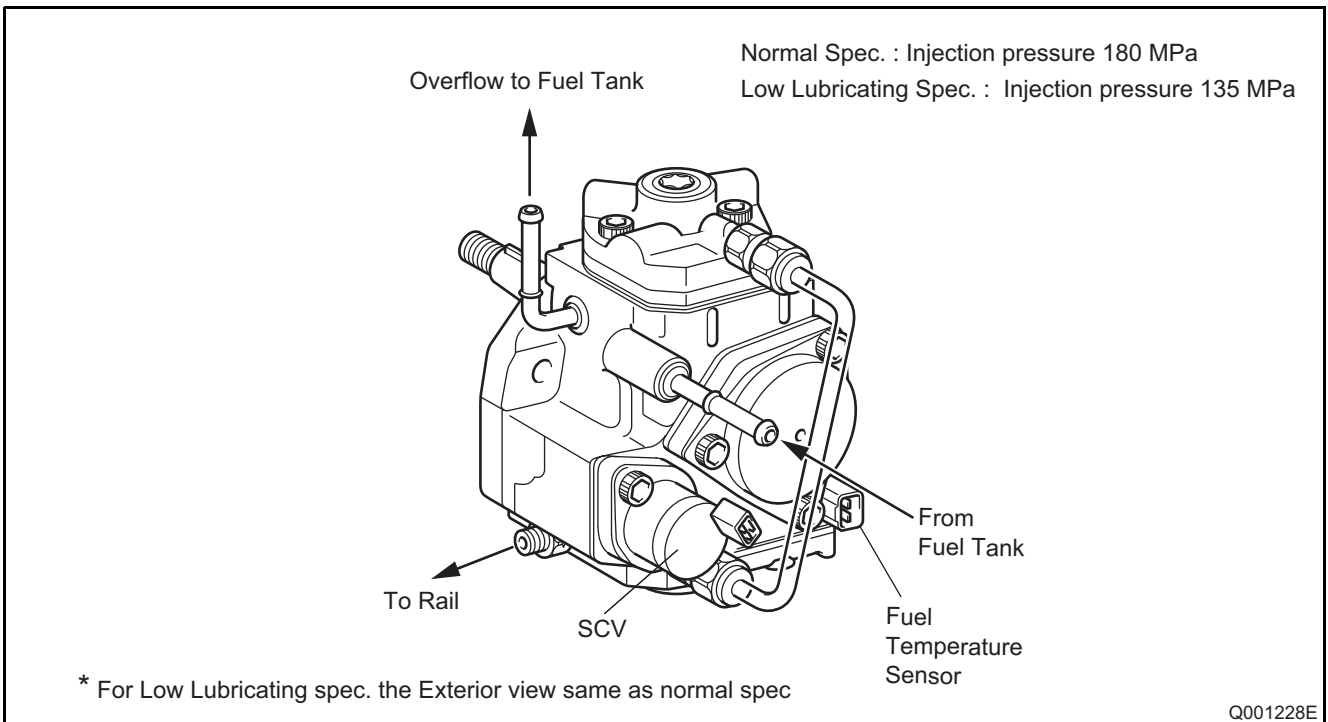


3.2 Exterior View Diagram

4D56 Engine Model

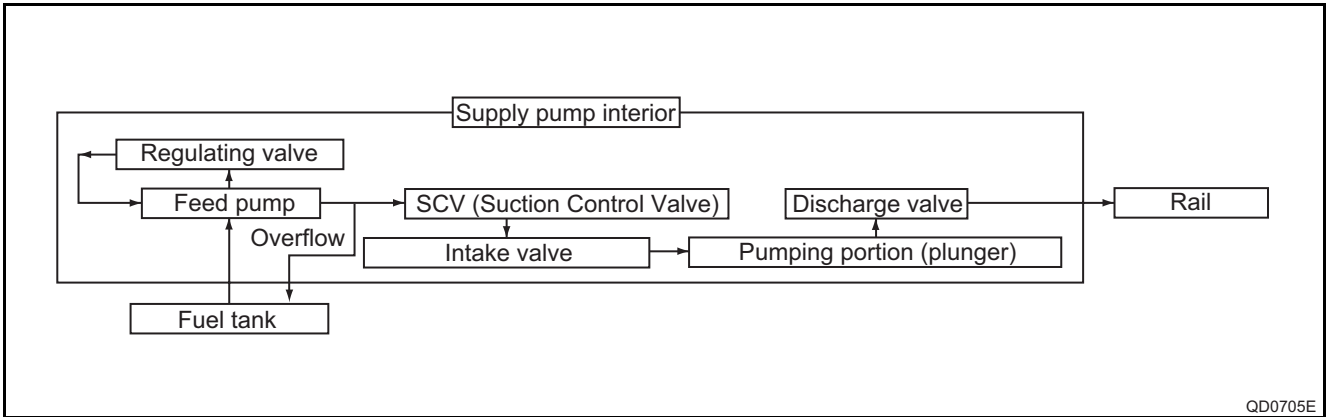


4M41 Engine Model



3.3 Supply Pump Internal Fuel Flow

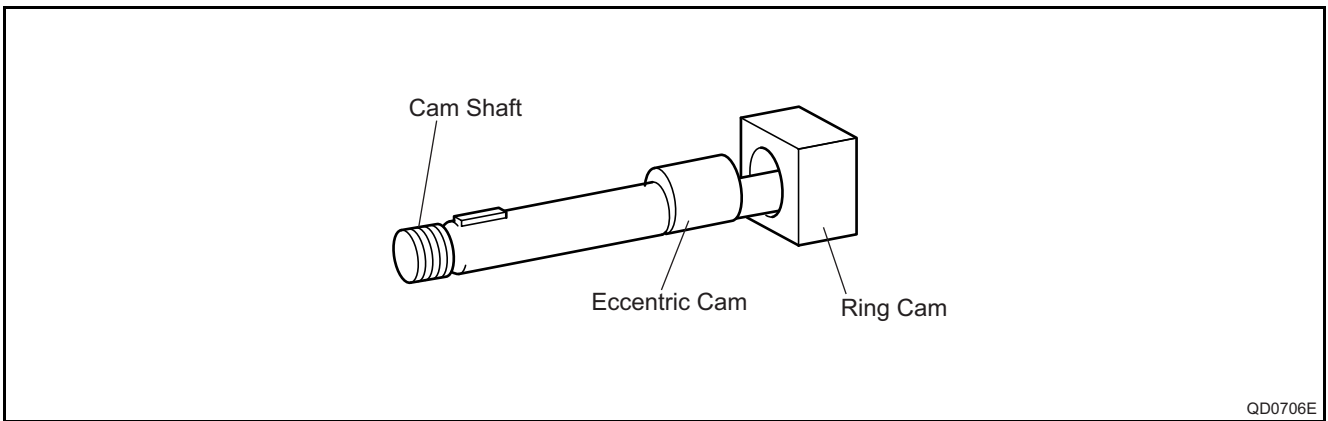
- The fuel that is drawn from the fuel tank passes through the route in the supply pump as illustrated, and is fed into the rail.



QD0705E

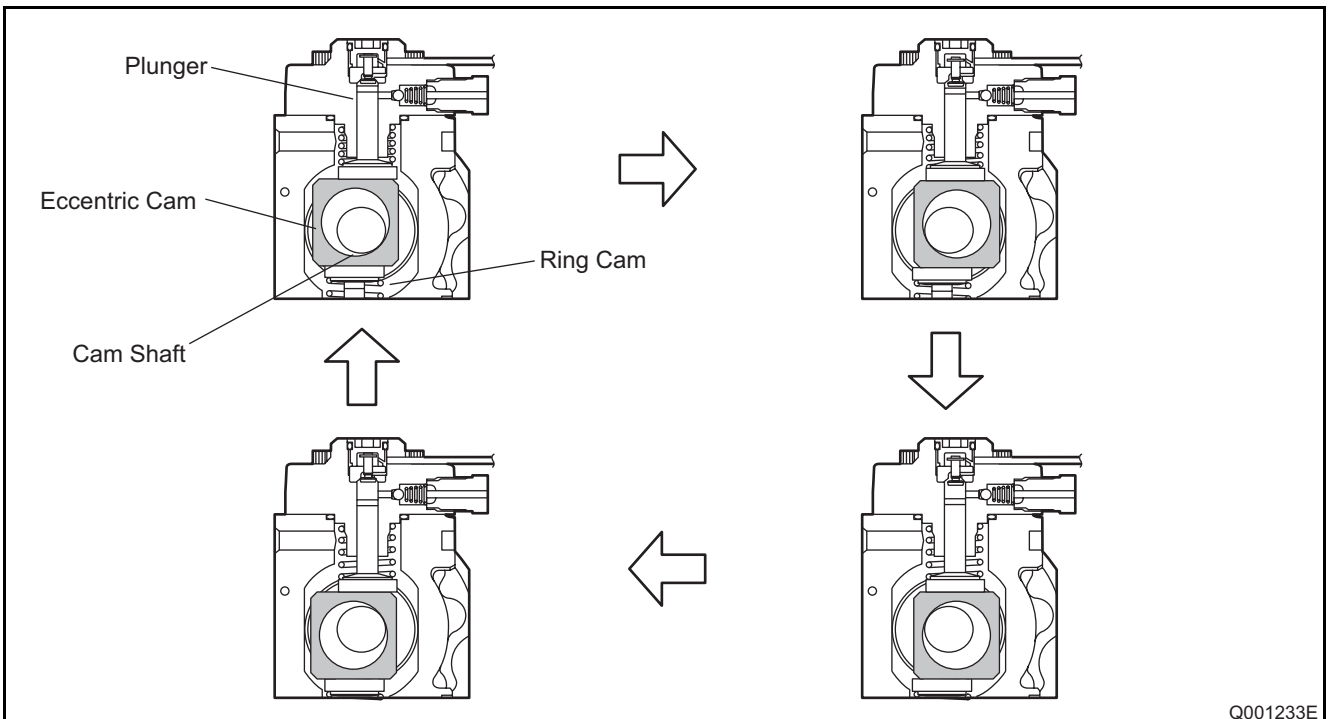
3.4 Construction of Supply Pump

- The eccentric cam is attached to the drive shaft. The eccentric cam is connected to the ring cam.



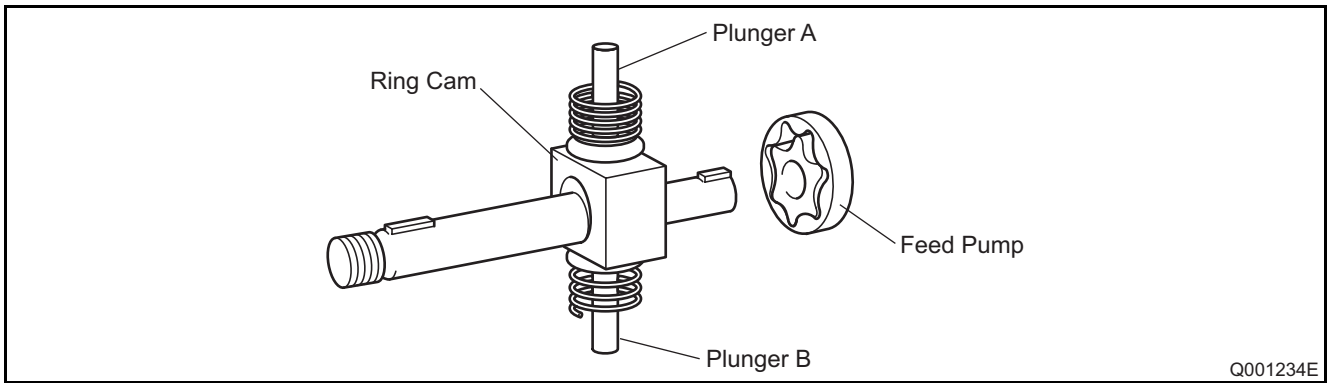
QD0706E

- As the drive shaft rotates, the eccentric cam rotates eccentrically, and the ring cam moves up and down while rotating.



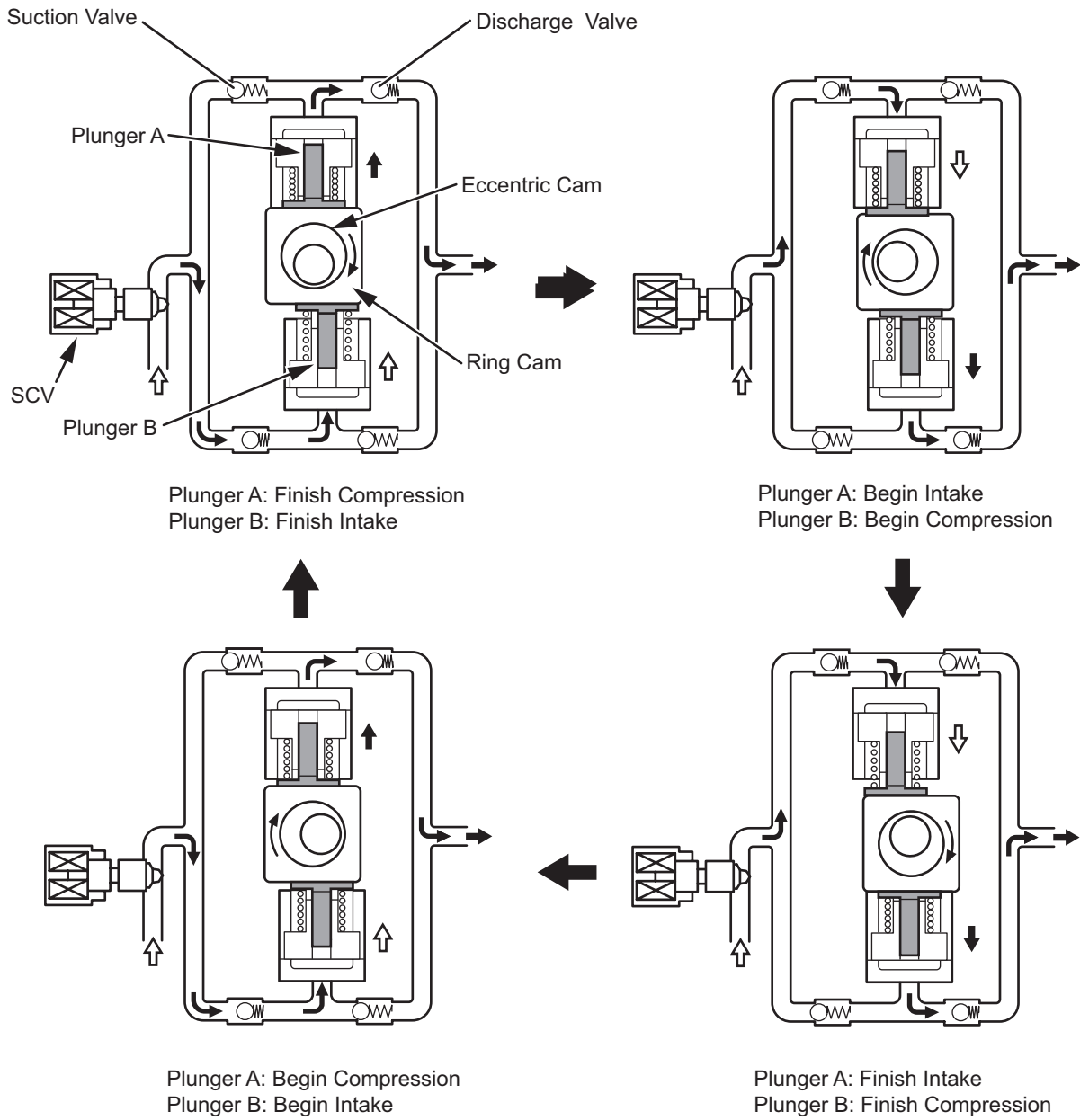
Q001233E

- The plunger and the suction valve are attached to the ring cam. The feed pump is connected to the rear of the drive shaft.



3.5 Operation of the Supply Pump

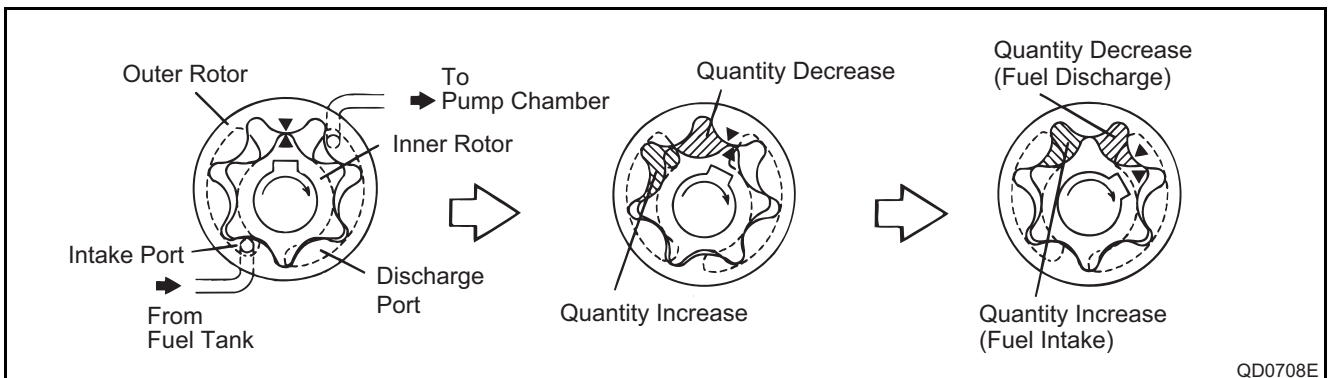
- As shown in the illustration below, the rotation of the eccentric cam causes the ring cam to push Plunger A upwards. Due to the spring force, Plunger B is pulled in the opposite direction to Plunger A. As a result, Plunger B draws in fuel, while Plunger A pumps it to the rail.



4. SUPPLY PUMP COMPONENT PARTS

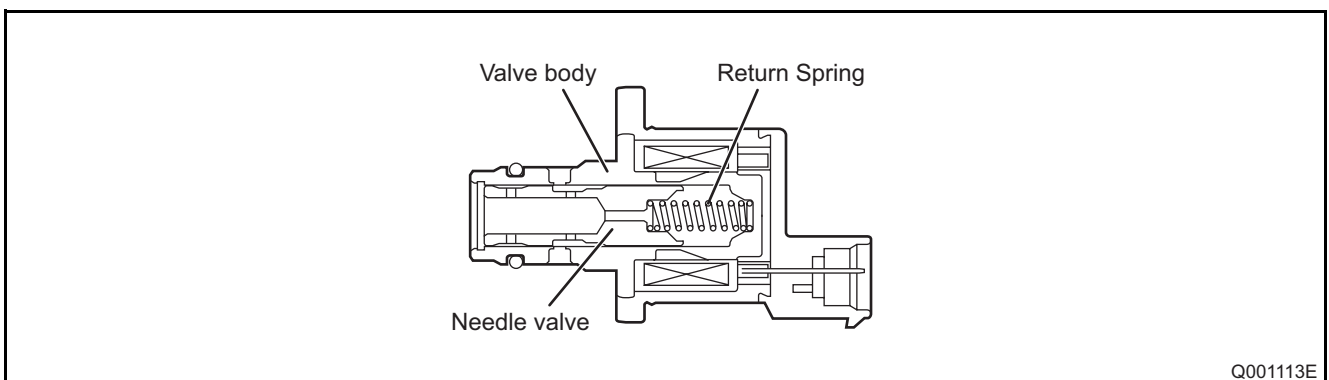
4.1 Feed Pump

- The trochoid type feed pump, which is integrated in the supply pump, draws fuel from the fuel tank and feeds it to the two plungers via the fuel filter and the SCV (Suction Control Valve). The feed pump is driven by the drive shaft. With the rotation of the inner rotor, the feed pump draws fuel from its suction port and pumps it out through the discharge port. This is done in accordance with the space that increases and decreases with the movement of the outer and inner rotors.

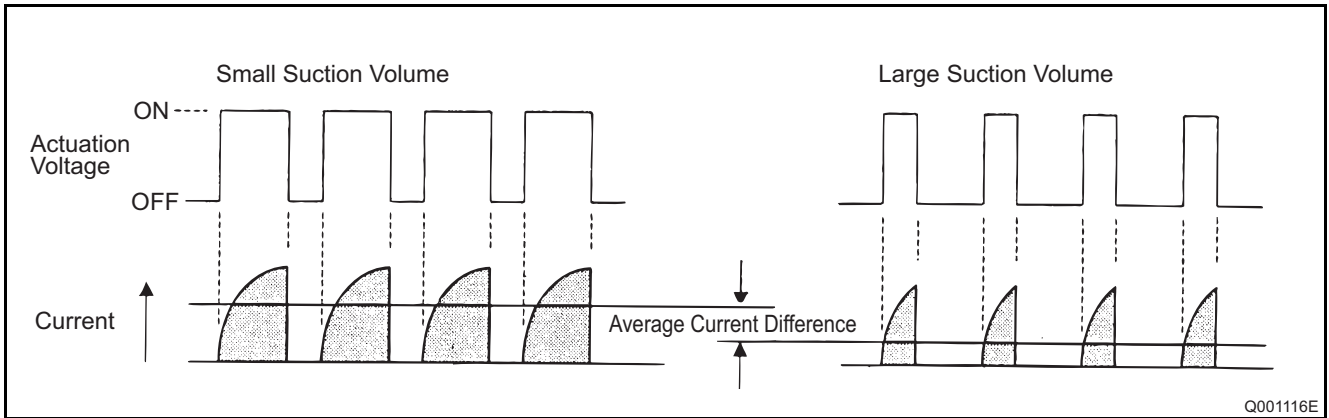


4.2 SCV (Suction Control Valve)

- A linear solenoid type valve has been adopted. The ECU controls the duty ratio (the duration in which current is applied to the SCV), in order to control the quantity of fuel that is supplied to the high-pressure plunger.
- Because only the quantity of fuel that is required for achieving the target rail pressure is drawn in, the actuating load of the supply pump decreases.
- When current flows to the SCV, variable electromotive force is created in accordance with the duty ratio, moving the cylinder (integrated with the armature) to the left side, and changing the opening of the fuel passage to regulate the fuel quantity.
- With the SCV OFF, the return spring contracts, completely opening the fuel passage and supplying fuel to the plungers. (Full quantity intake and full quantity discharge = normally open)
- When the SCV is ON, the force of the return spring moves the cylinder to the left, closing the fuel passage (normally open).
- By turning the SCV ON/OFF, fuel is supplied in an amount corresponding to the actuation duty ratio, and fuel is discharged by the plungers.



(3) Diagram of Relationship Between Actuation Signal and Current (Magneto motive Force)



4.3 Fuel Temperature Sensor

- Detects the fuel temperature and sends a corresponding signal to the engine ECU. Based on this information, the engine ECU calculates the injection volume correction that is appropriate for the fuel temperature.

<Reference: Temperature-resistance Characteristics>

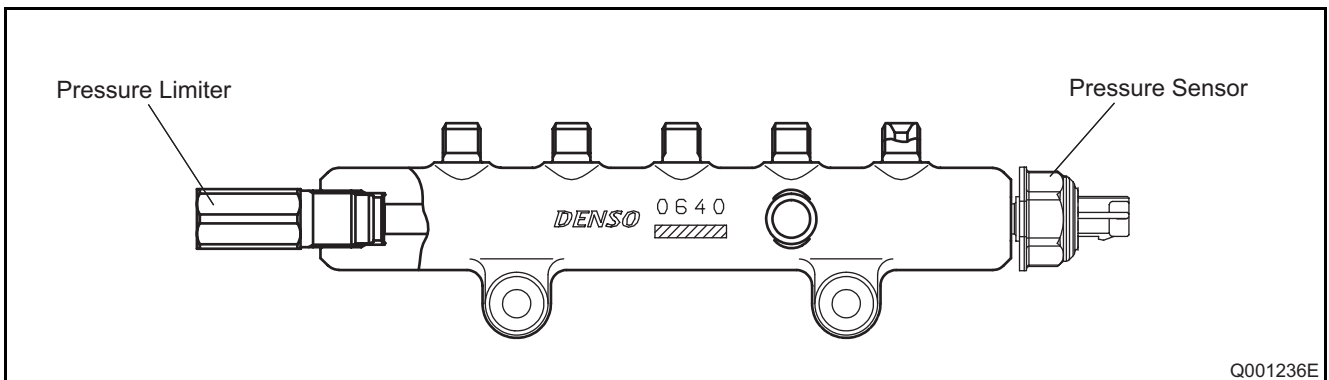
TEMPERATURE (°C)	RESISTANCE (kΩ)
- 30	(25.40)
- 20	15.40 ^{+ 1.29} _{- 1.20}
- 10	(9.16)
0	(5.74)
10	(3.70)
20	2.45 ^{+ 0.14} _{- 0.13}
30	(1.66)
40	(1.15)
50	(0.811)
60	(0.584)
70	(0.428)
80	0.318 ± 0.008
90	(0.240)
100	(0.1836)
110	0.1417 ± 0.0018
120	(0.1108)

Q001237E

5. RAIL

5.1 Outline

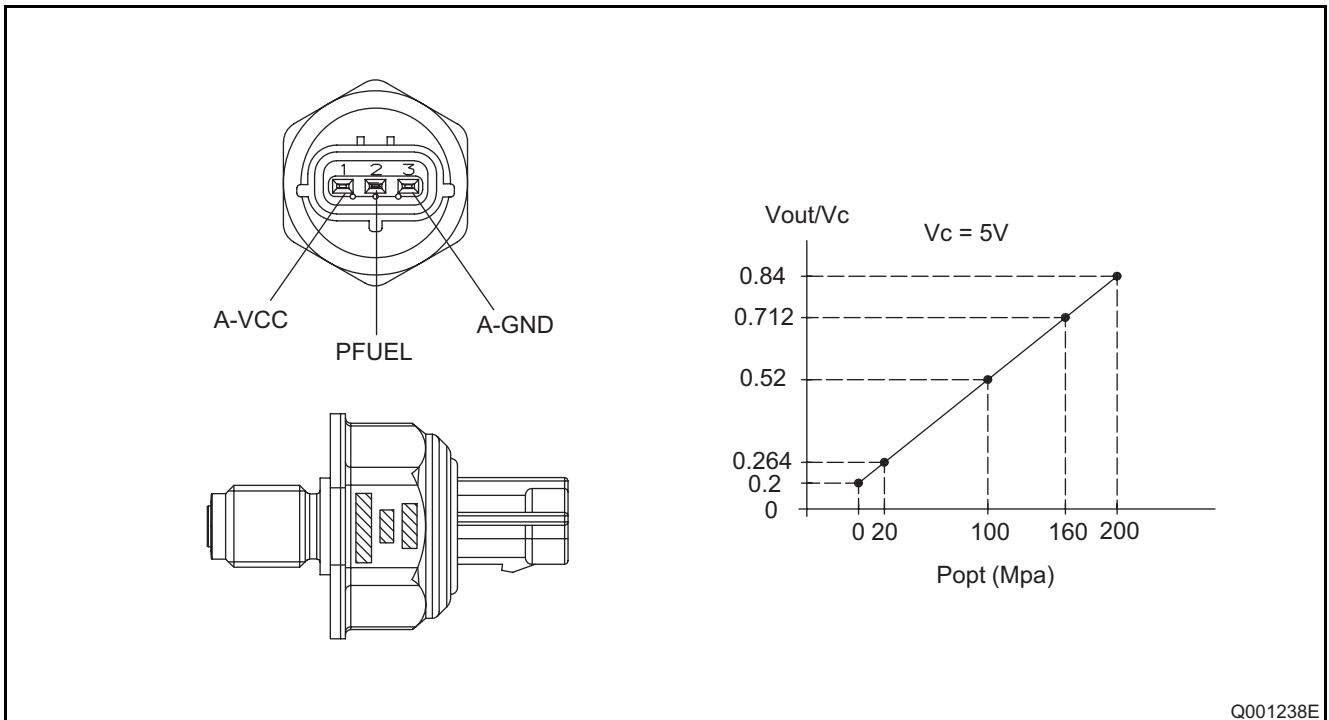
- Stores pressurized fuel (25 to 180 MPa) that has been delivered from the supply pump and distributes the fuel to each cylinder injector. A rail pressure sensor and a pressure limiter valve are adopted in the rail.
- The rail pressure sensor (Pc sensor) detects fuel pressure in the rail and sends a signal to the engine ECU, and the pressure limiter controls the excess pressure. This ensures optimum combustion and reduces combustion noise.



6. RAIL COMPONENTS PARTS

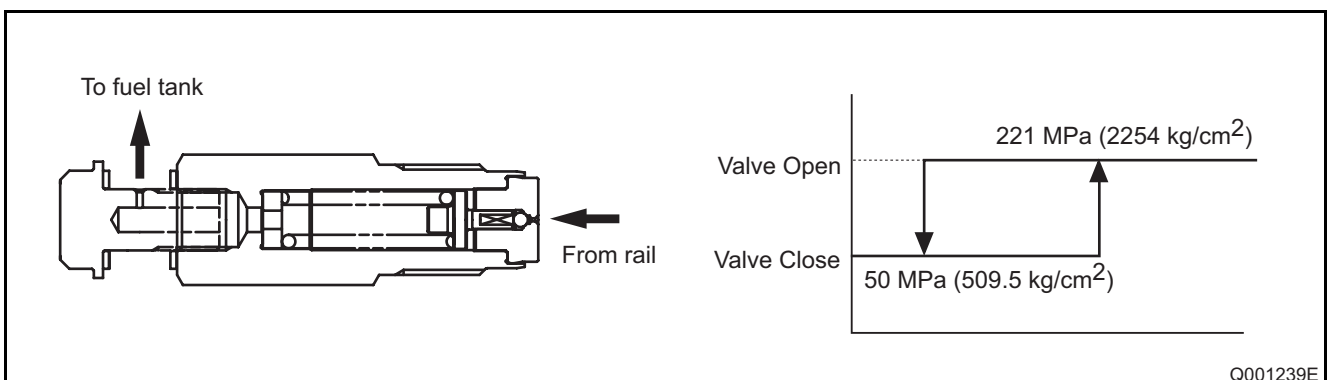
6.1 Rail Pressure Sensor (Pc Sensor)

- The pressure sensor detects the fuel pressure of the rail, and sends a signal to the engine ECU. The sensor is made from a semiconductor that uses the Piezo resistive effect to detect changes in electrical resistance based on the pressure applied to the elemental silicon. In comparison to the old model, this sensor is compatible with high pressure.



6.2 Pressure limiter

- The pressure limiter releases pressure when the internal pressure of the rail becomes abnormally high. The pressure limiter opens when internal pressure reaches 221MPa (2254 kg/cm²) and closes when rail pressure reaches a given set pressure. Fuel released from the pressure limiter is returned to the fuel tank.



7. INJECTOR (G2 TYPE)

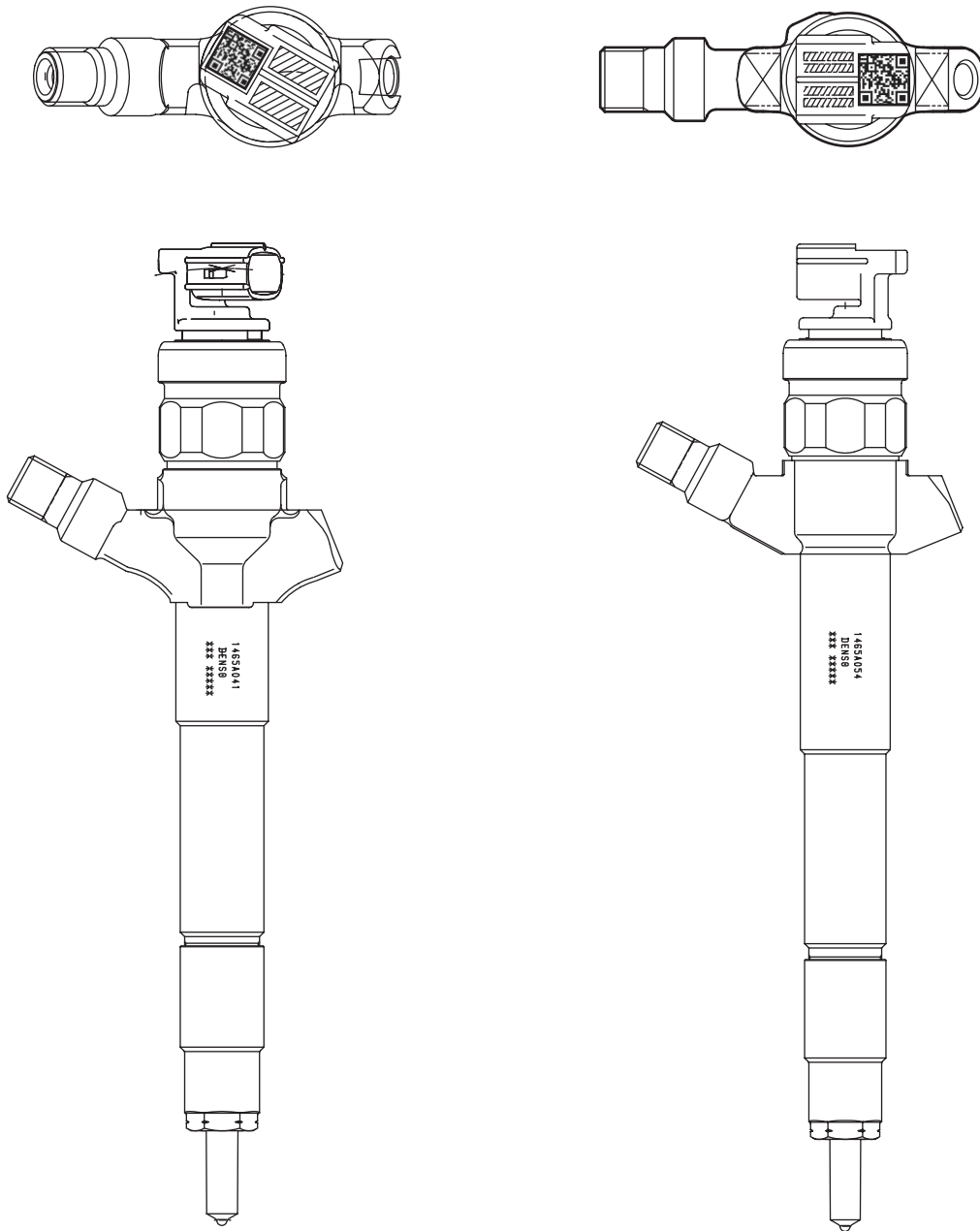
7.1 Outline

- The injectors inject the high-pressure fuel from the rail into the combustion chambers at the optimum injection timing, rate, and spray condition, in accordance with commands received from the ECU.

7.2 Characteristics

- A compact, energy-saving solenoid-control type TWV (Two-Way Valve) injector has been adopted.
- QR codes displaying various injector characteristics and the ID codes showing these in numeric form (30 alphanumeric figures) are engraved on the injector head. The common rail system optimizes injection volume control using this information. When an injector is newly installed in a vehicle, it is necessary to enter the ID codes in the engine ECU using the MITSUBISHI diagnosis tool (MUT III).

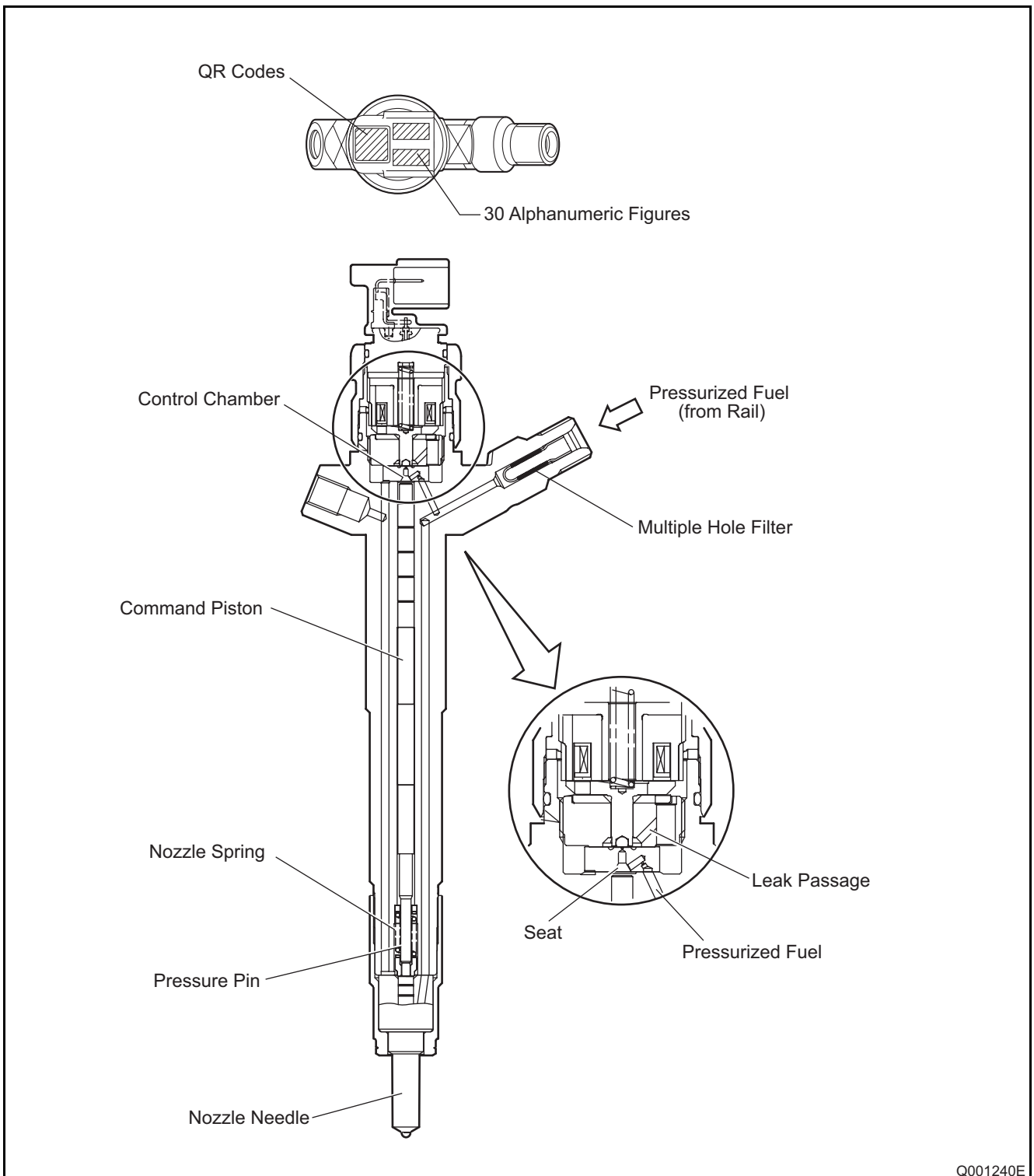
7.3 Exterior View Diagram



<4D56 Engine Model>

<4M41 Engine Model>

7.4 Construction



7.5 Operation

- The TWV (Two-Way Valve) solenoid valve opens and closes the outlet orifice to control both the pressure in the control chamber, and the start and end of injection.

(1) Non injection

- When no current is supplied to the solenoid, the spring force is stronger than the hydraulic pressure in the control chamber. Thus, the

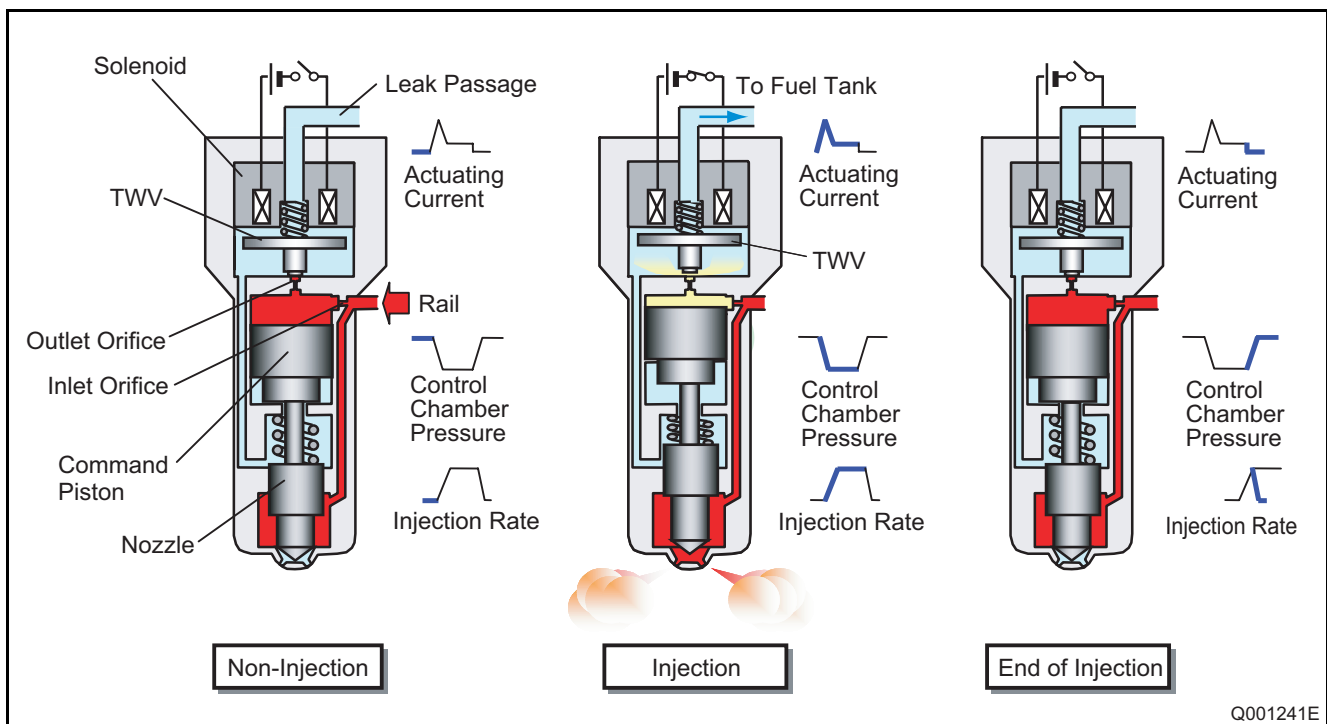
solenoid valve is pushed downward, effectively closing the outlet orifice. For this reason, the hydraulic pressure that is applied to the command piston causes the nozzle spring to compress. This closes the nozzle needle, and as a result, fuel is not injected.

(2) Injection

- When current is initially applied to the solenoid, the attraction force of the solenoid pulls the solenoid valve up, effectively opening the outlet orifice and allowing fuel to flow out of the control chamber. After the fuel flows out, the pressure in the control chamber decreases, pulling the command piston up. This causes the nozzle needle to rise and the injection to start.
- The fuel that flows past the outlet orifice flows to the leak pipe and below the command piston. The fuel that flows below the piston lifts the piston needle upward, which helps improve the nozzle's opening and closing response.

(3) End of Injection

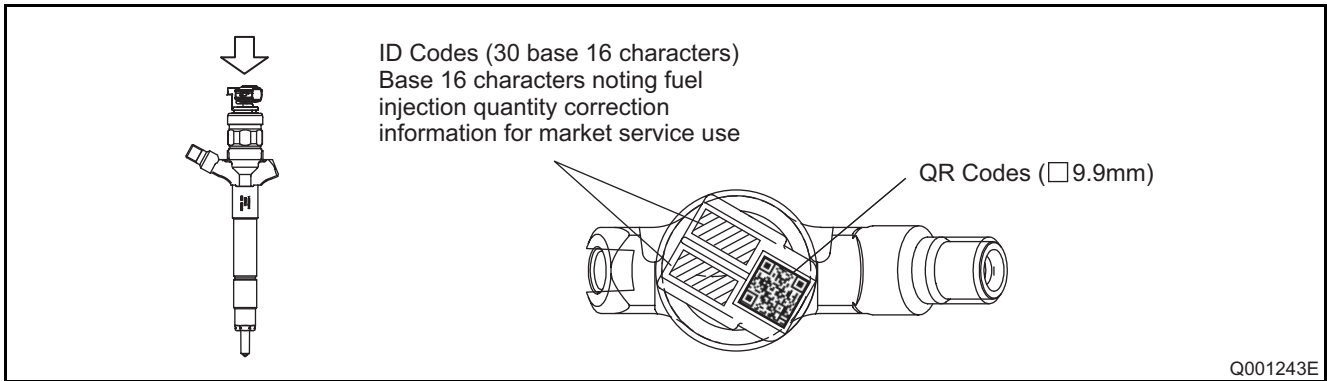
- When current continues to be applied to the solenoid, the nozzle reaches its maximum lift, where the injection rate is also at the maximum level. When current to the solenoid is turned OFF, the solenoid valve falls, causing the nozzle needle to close immediately and the injection to stop.



7.6 QR Codes

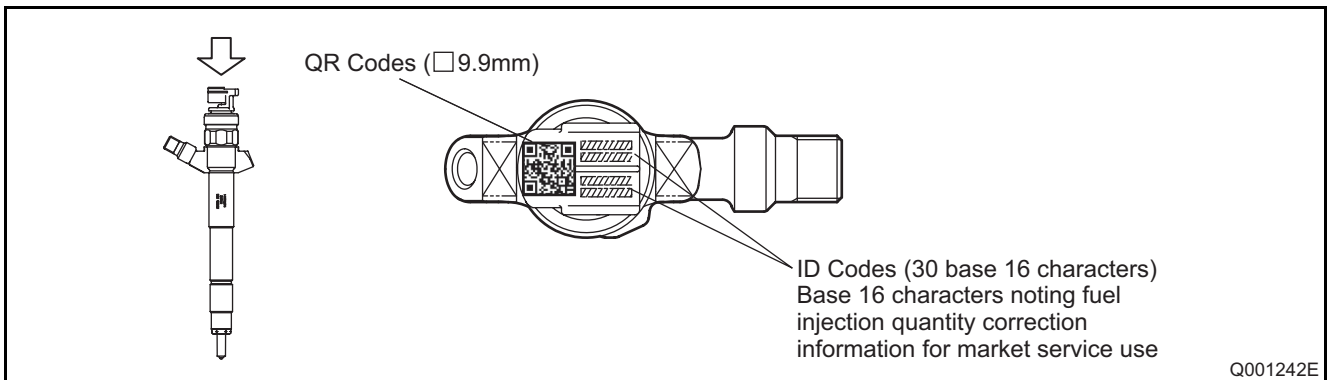
- Conventionally the whole injector Assy was replaced during injector replacement, but QR (Quick Response) codes have been adopted to improve injector quantity precision.

4D56 Engine Model



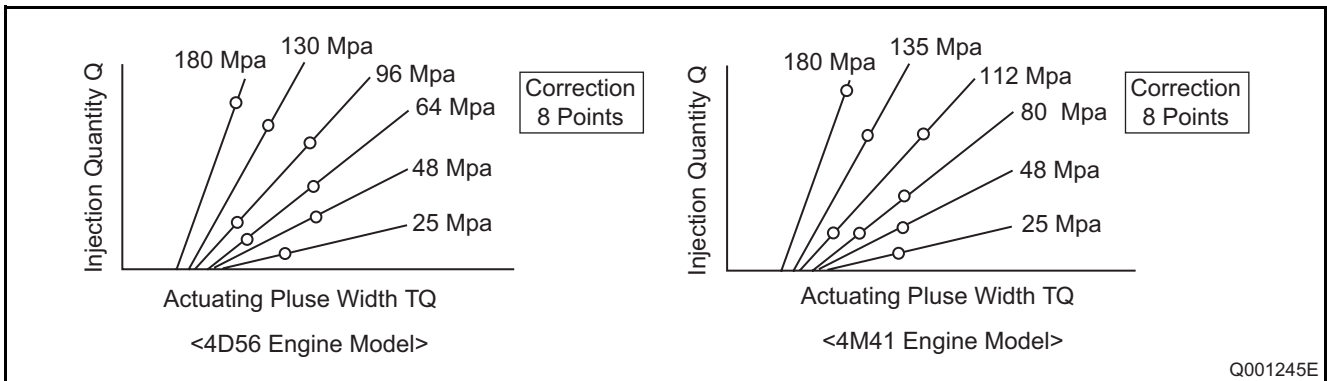
Q001243E

4M41 Engine Model



Q001242E

- QR codes have resulted in a substantial increase in the number of fuel injection quantity correction points, greatly improving precision. The characteristics of the engine cylinders have been further unified, contributing to improvements in combustion efficiency, reductions in exhaust gas emissions and so on.

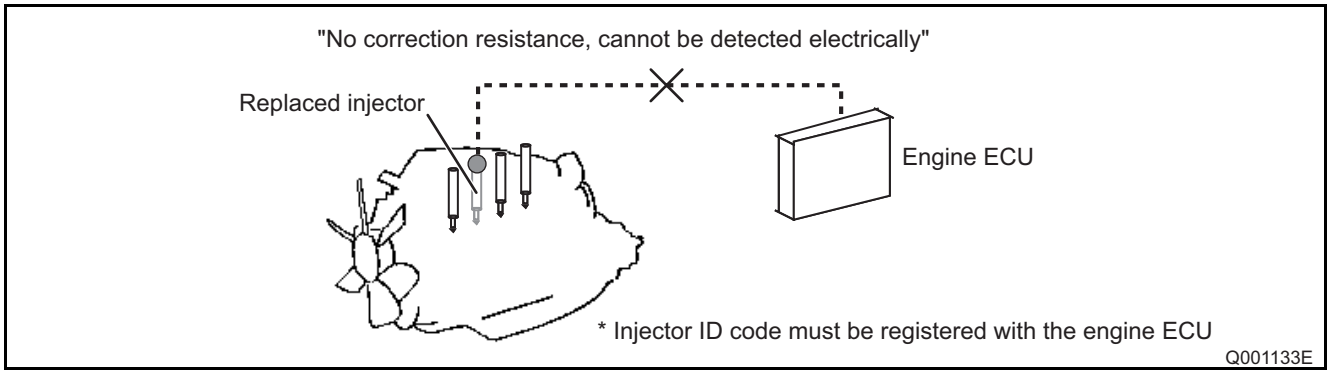


Q001245E

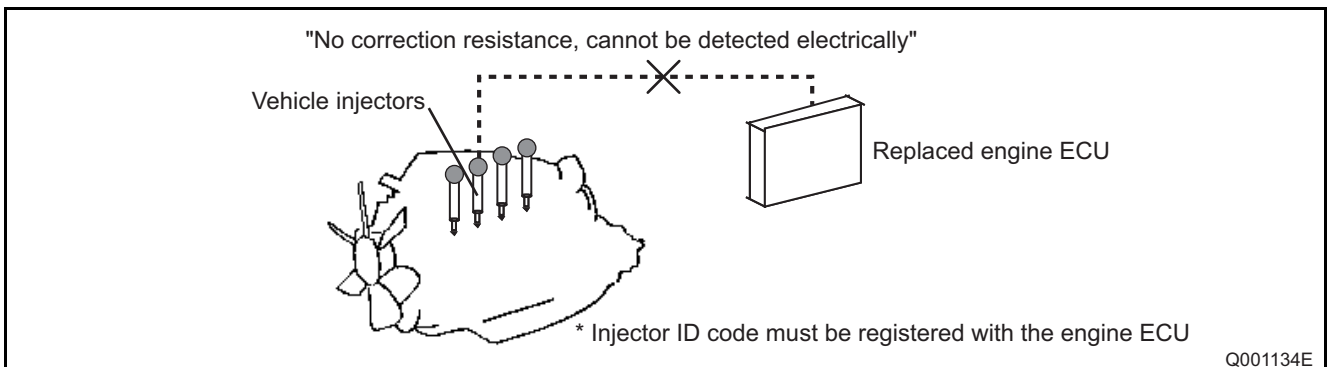
(1) Repair Procedure

- When replacing injectors with QR codes, or the engine ECU, it is necessary to record the ID codes in the ECU. (If the ID codes for the installed injectors are not registered correctly, engine failure such as rough idling and noise will result). The ID codes will be registered in the ECU at a MITSUBISHI dealer using approved MITSUBISHI tools.

Replacing the Injector

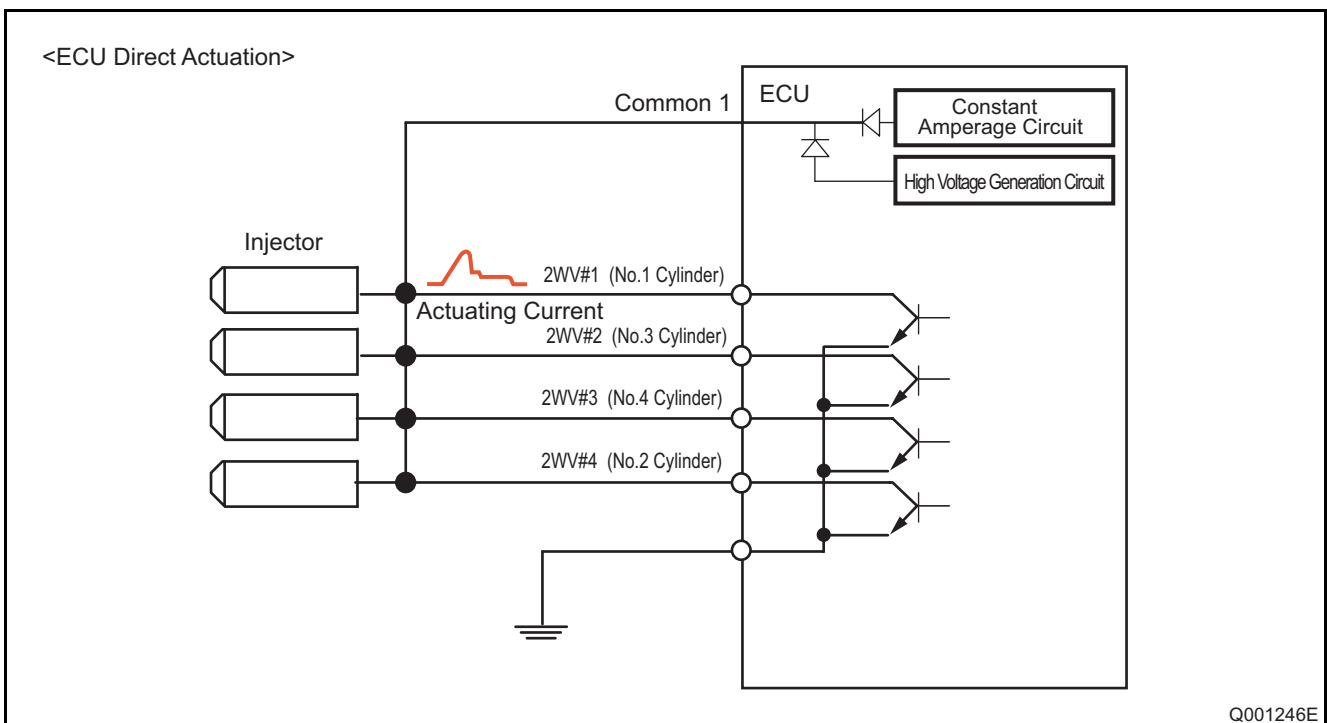


Replacing the Engine ECU



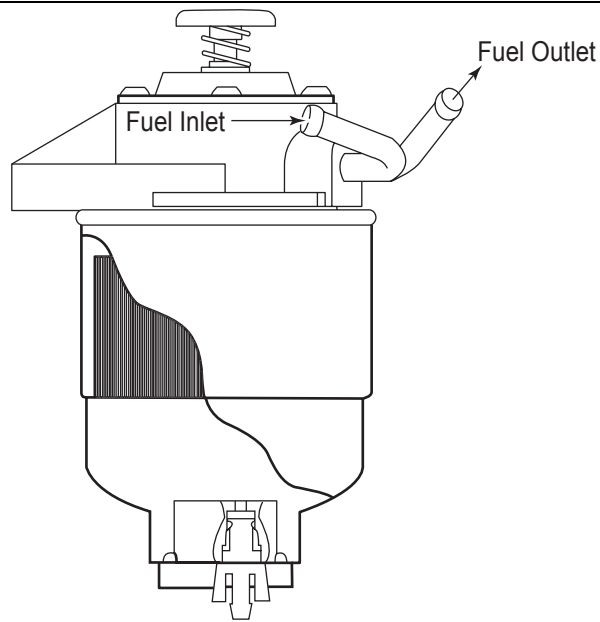
7.7 Injector Actuation Circuit

- In order to improve injector responsiveness, the actuation voltage has been changed to high voltage, speeding up both solenoid magnetization and the response of the TWV. The EDU or the charge circuit in the ECU raises the respective battery voltage to approximately 85V, which is supplied to the injector by signal from the ECU to actuate the injector.



8. FUEL FILTER

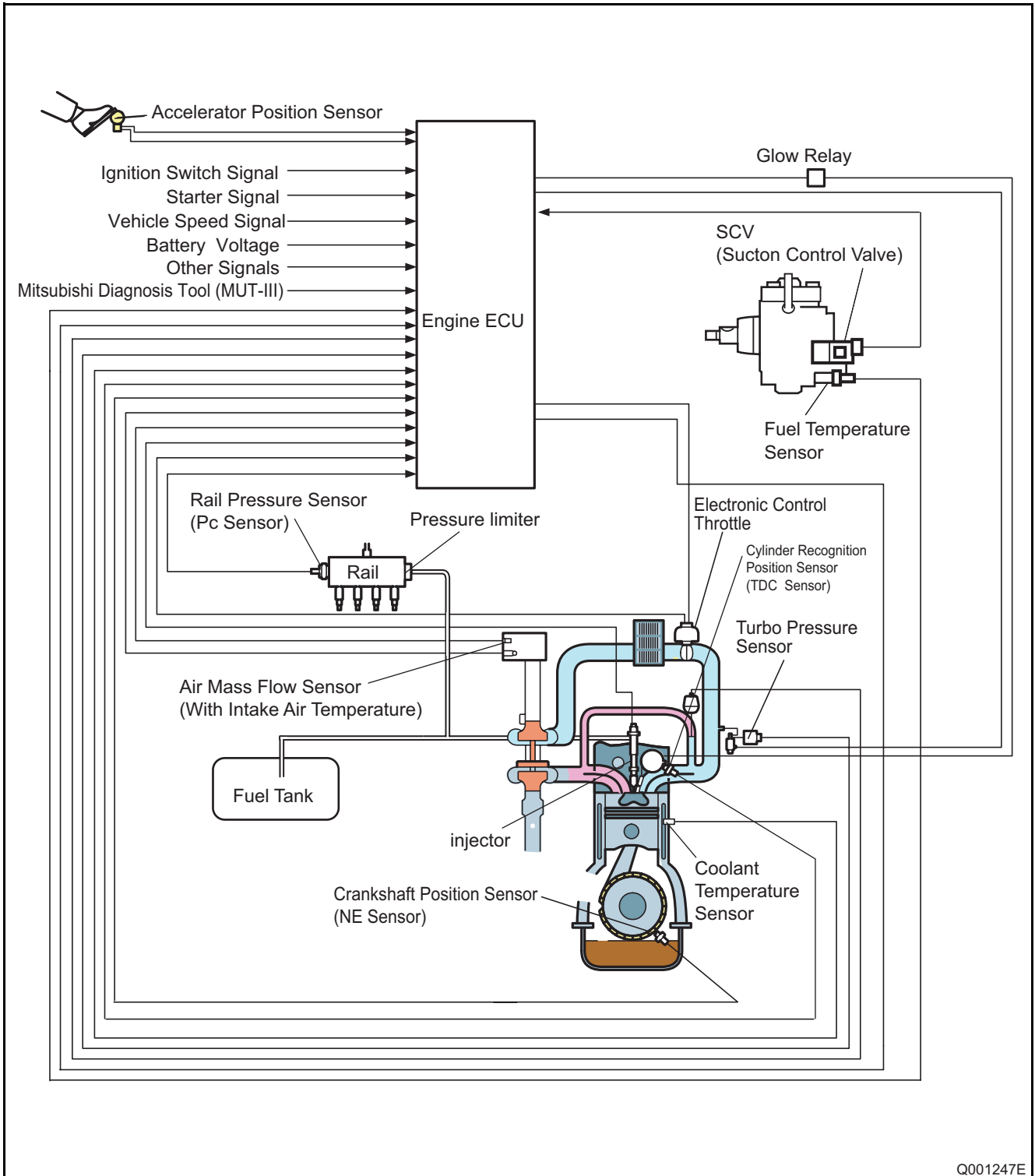
8.1 Fuel Filter for Low lubricating specification.



Item	Fuel Filter (W/PTC heater)	Fuel Filter (Nomal)
1.	<p data-bbox="272 1384 507 1417">Fuel Supply route</p> <p data-bbox="248 1742 544 1776">→ : Fuel flow direction</p>	<p data-bbox="842 1395 1077 1429">Fuel Supply route</p> <p data-bbox="850 1742 1145 1776">→ : Fuel flow direction</p>

9. OPERATION OF CONTROL SYSTEM COMPONENTS

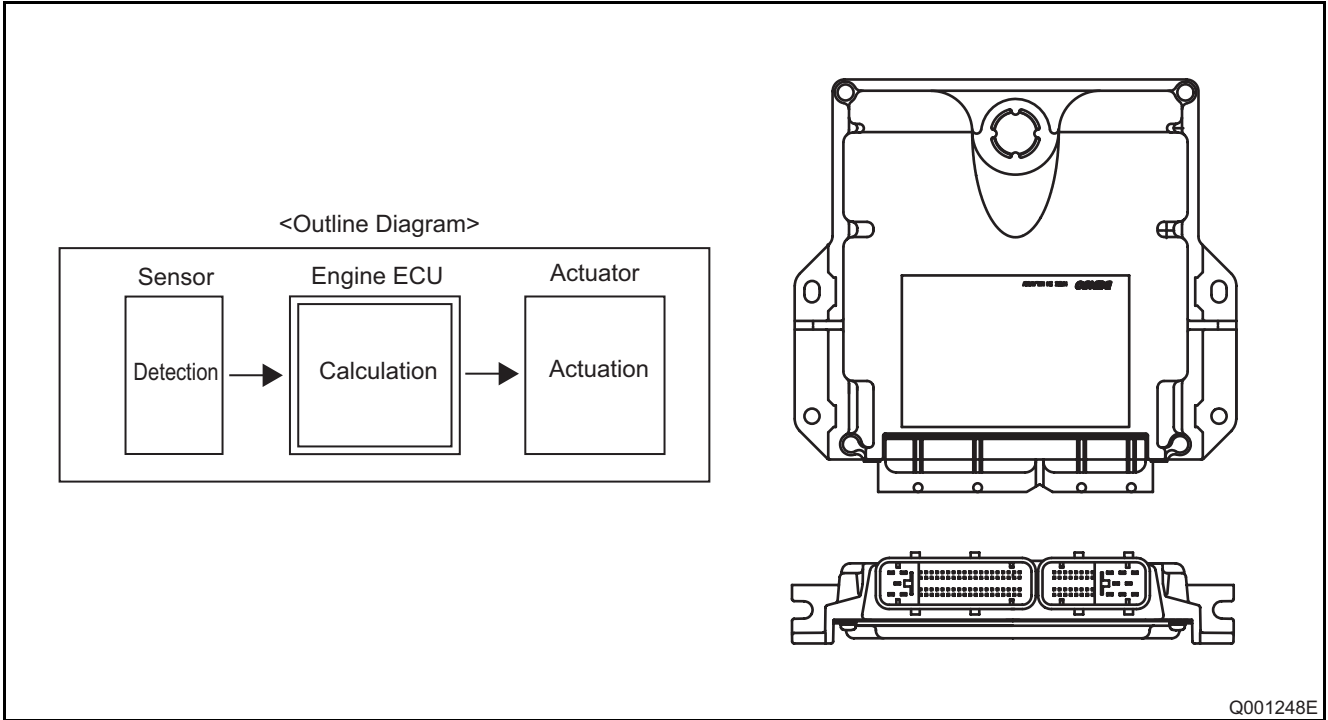
9.1 Engine Control System Diagram



Q001247E

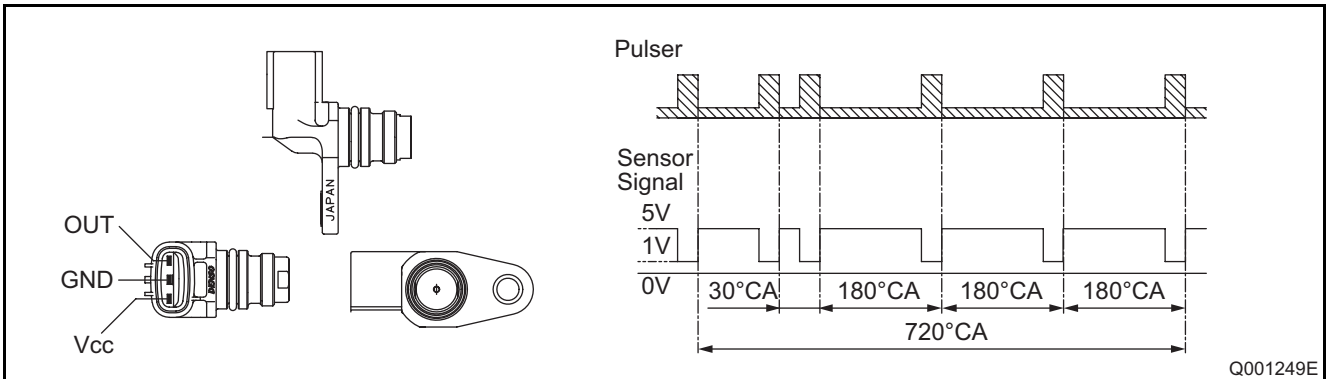
9.2 Engine ECU (Electronic Control Unit)

- This is the command center that controls the fuel injection system and the engine operation in general.



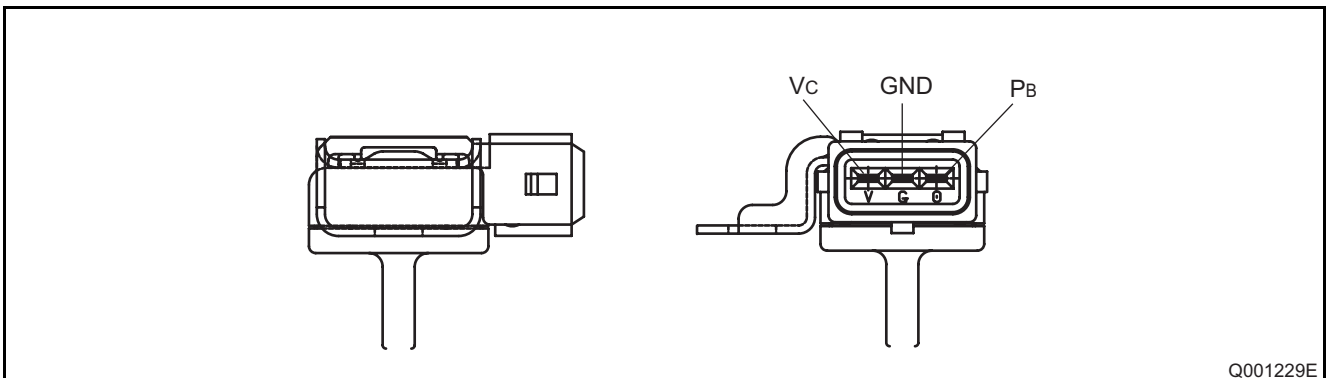
9.3 Cylinder Recognition Sensor (TDC)

- Outputs a cylinder identification signal. The sensor outputs 5 pulses for every two revolutions (720°CA) of the engine.



9.4 Turbo Pressure Sensor

- This is a type of semi-conductor pressure sensor. It utilizes the characteristics of the electrical resistance changes that occur when the pressure applied to a silicon crystal changes. Because a single sensor is used to measure both turbo pressure and atmospheric pressure, a VSV is used to alternate between atmospheric and turbo pressure measurement.

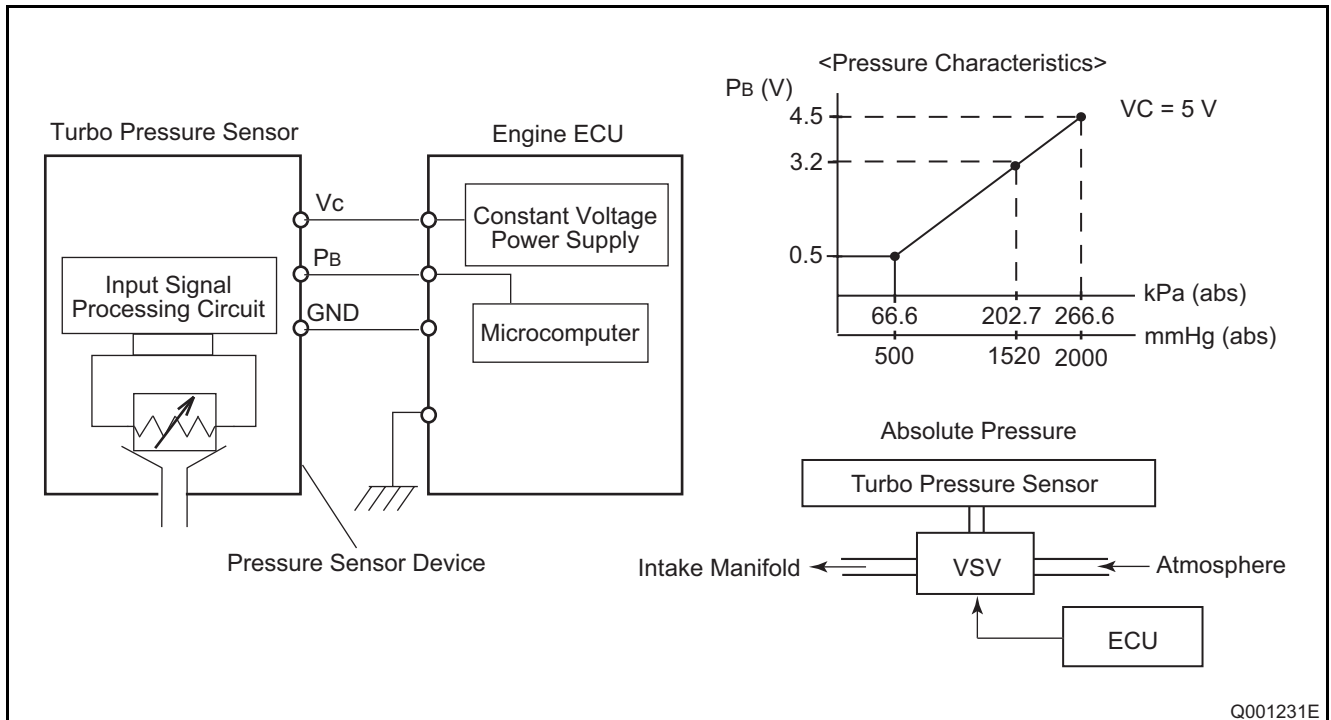


(1) Atmospheric Pressure Measurement Conditions

- The VSV turns ON for 150msec to detect the atmospheric pressure when one of the conditions below is present:
- Engine speed = 0rpm
- Starter is ON
- Idle is stable

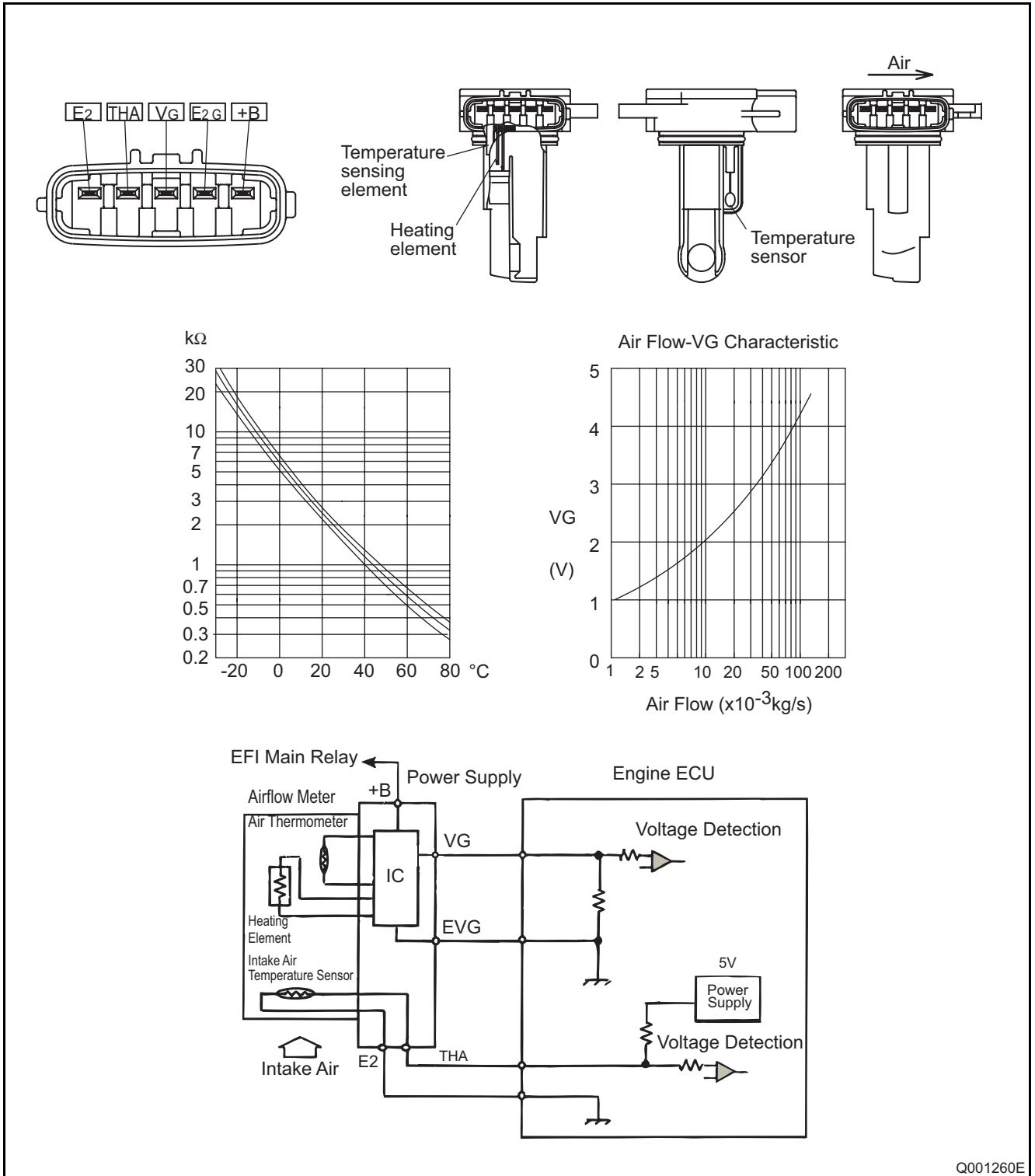
(2) Turbo Pressure Measurement Conditions

- The VSV turns OFF to detect the turbo pressure if the atmospheric pressure measurement conditions are absent.



9.5 Mass Air Flow Sensor

- This air flow meter, which is a plug-in type, allows a portion of the intake air to flow through the detection area. By directly measuring the mass and the flow rate of the intake air, the detection precision has been improved and the intake air resistance has been reduced.
- This mass air flow meter has a built-in intake air temperature sensor.

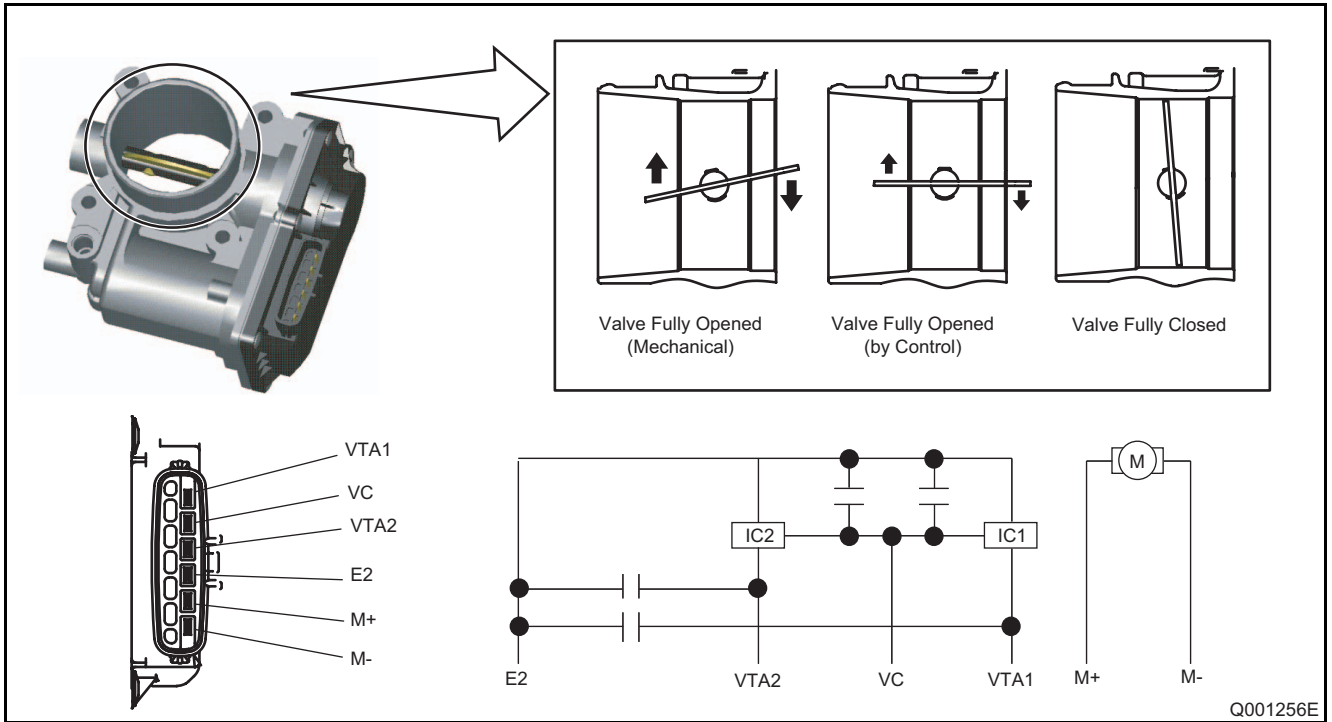


Q001260E

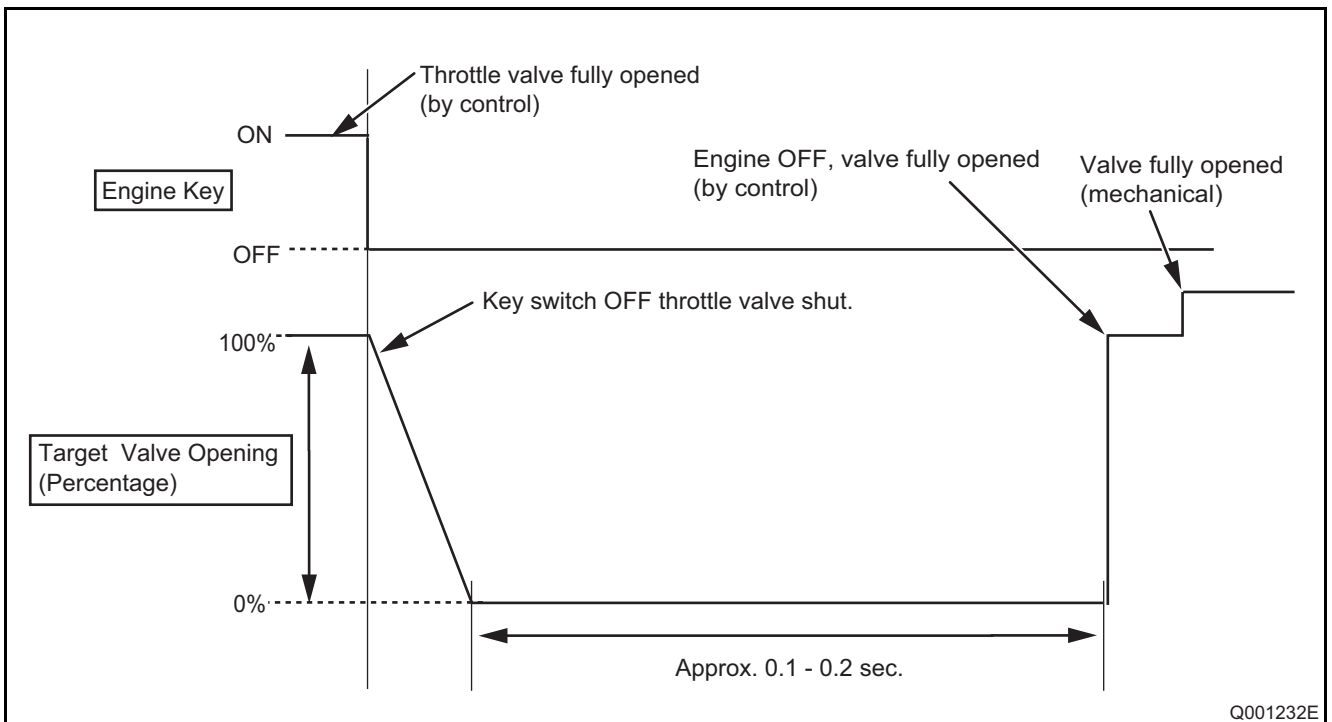
9.6 Electronic Control Throttle

(1) Outline

- The suctioning of air is stopped through interlocking the intake throttle with the key switch in order to reduce engine vibration when the vehicle is turned off.



(2) Operation



10. VARIOUS TYPES OF CONTROL

10.1 Outline

- This system effects fuel injection quantity and injection timing control more appropriately than the mechanical governor and timer used in the conventional injection pump. The engine ECU performs the necessary calculations in accordance with the sensors installed on the engine and the vehicle. It then controls the timing and duration of time in which current is applied to the injectors, in order to realize both optimal injection and injection timing.

10.2 Fuel Injection Rate Control Function

- Pilot injection control injects a small amount of fuel before the main injection.

10.3 Fuel Injection Quantity Control Function

- The fuel injection quantity control function replaces the conventional governor function. It controls the fuel injection to an optimal injection quantity based on the engine speed and accelerator position signals.

10.4 Fuel Injection Timing Control Function

- The fuel injection timing control function replaces the conventional timer function. It controls the injection to an optimal timing based on the engine speed and the injection quantity.

10.5 Fuel Injection Pressure Control Function (Rail Pressure Control Function)

- The fuel injection pressure control function (rail pressure control function) controls the discharge volume of the pump by measuring the fuel pressure at the rail pressure sensor and feeding it back to the ECU. It effects pressure feedback control so that the discharge volume matches the optimal (command) value set in accordance with the engine speed and the injection quantity.

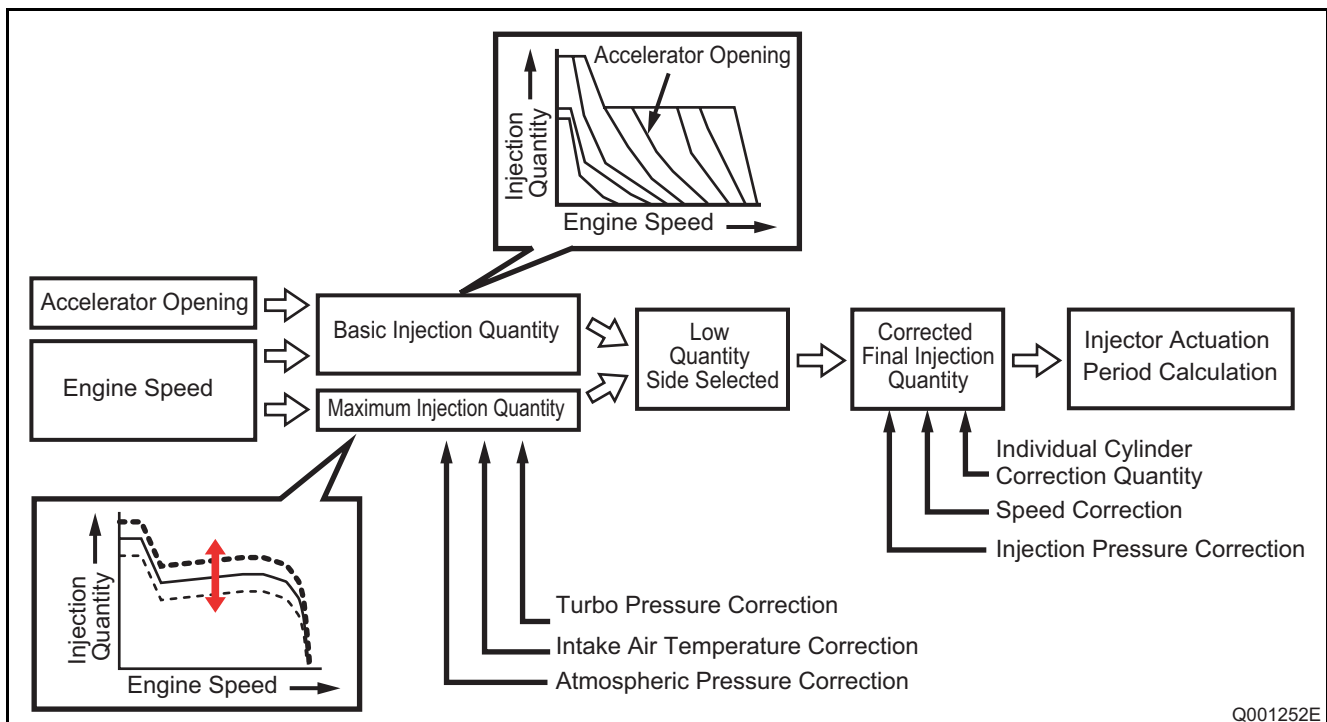
11. FUEL INJECTION QUANTITY CONTROL

11.1 Outline

- This control determines the fuel injection quantity by adding coolant temperature, fuel temperature, intake air temperature, and intake air pressure corrections to the basic injection quantity. The engine ECU calculates the basic injection quantity based on the engine operating conditions and driving conditions.

11.2 Injection Quantity Calculation Method

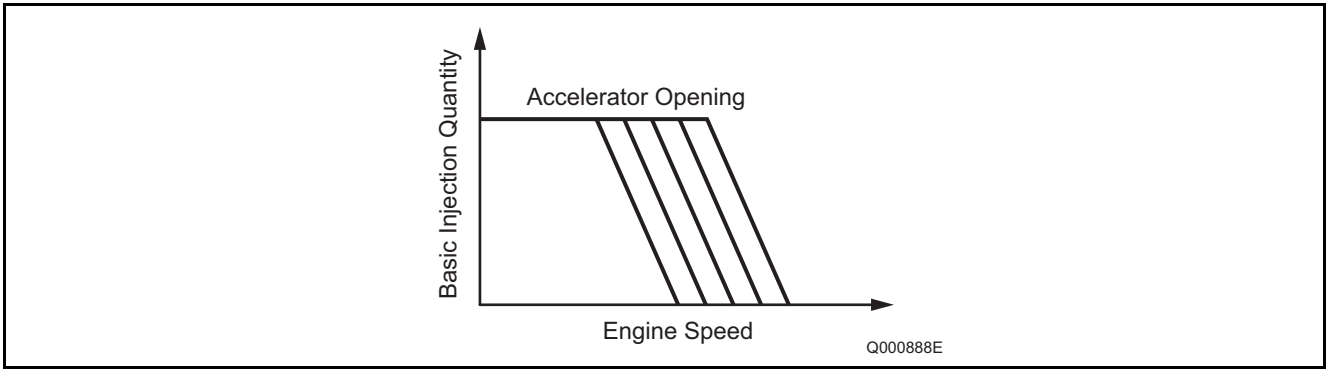
- The calculation consists of a comparison of the following two values: 1. The basic injection quantity that is obtained from the governor pattern, which is calculated from the accelerator position and the engine speed. 2. The injection quantity obtained by adding various types of corrections to the maximum injection quantity obtained from the engine speed. The lesser of the two injection quantities is used as the basis for the final injection quantity.



11.3 Set Injection Quantities

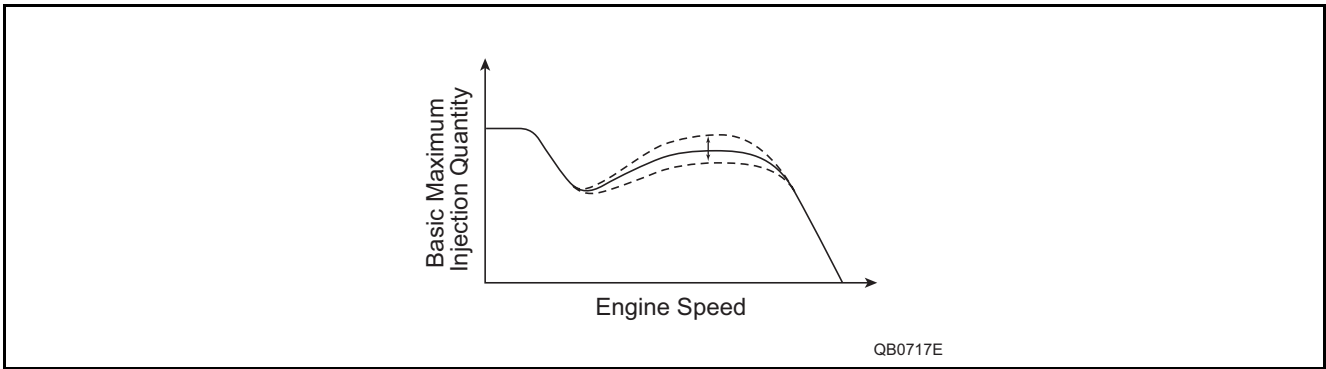
(1) Basic Injection Quantity

- This quantity is determined by the engine speed and the accelerator opening. With the engine speed constant, if the accelerator opening increases, the injection quantity increases; with the accelerator opening constant, if the engine speed rises, the injection quantity decreases.



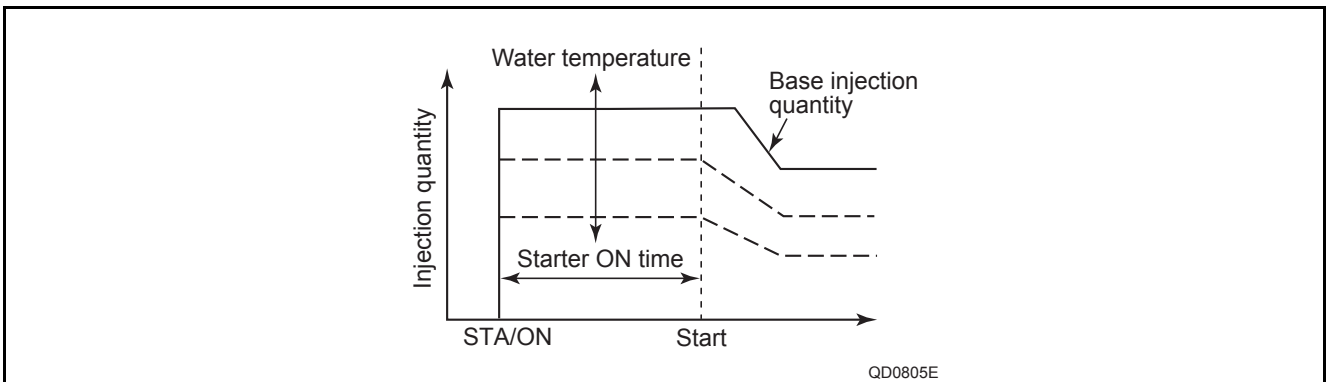
(2) Maximum Injection Quantity

- This is determined based on the basic maximum injection quantity determined by the engine speed, and the added corrections for intake air pressure.



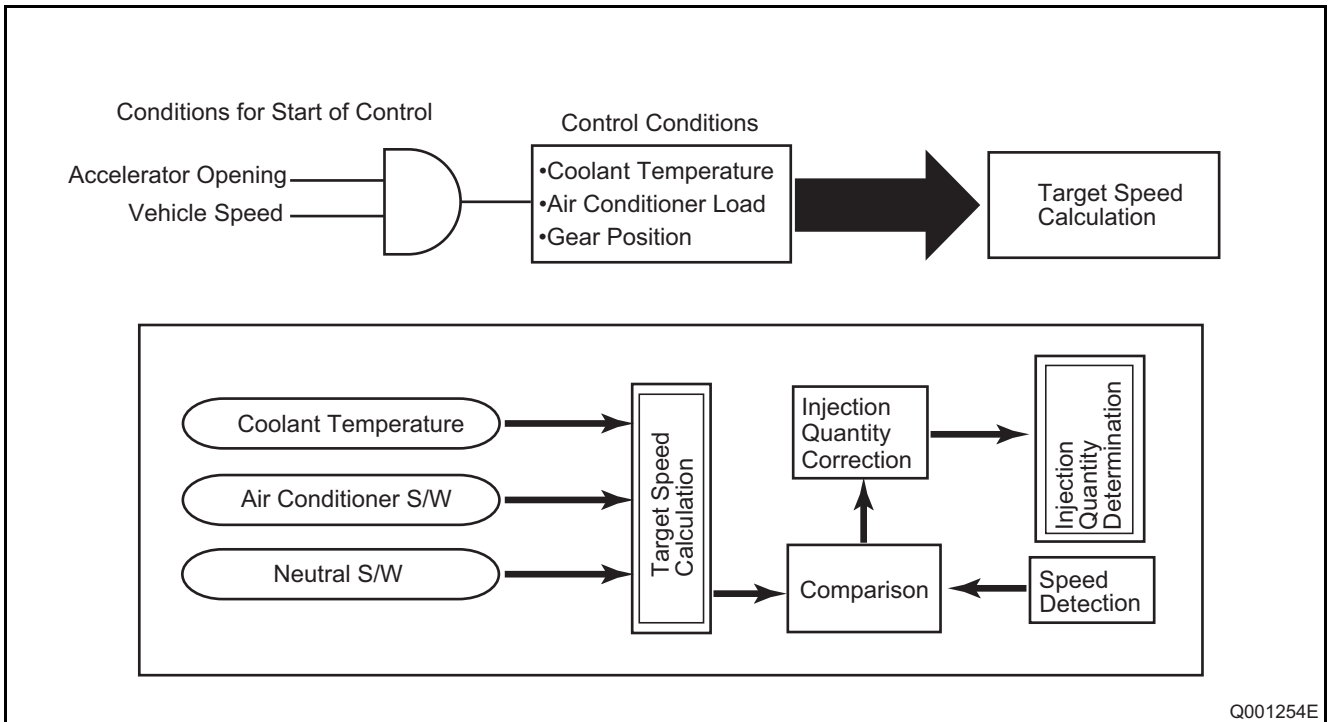
(3) Starting Injection Quantity

- When the starter switch is turned ON, the injection quantity is calculated in accordance with the starting base injection volume. The base injection quantity and the inclination of the quantity increase/decrease change in accordance with the water temperature and the engine speed.

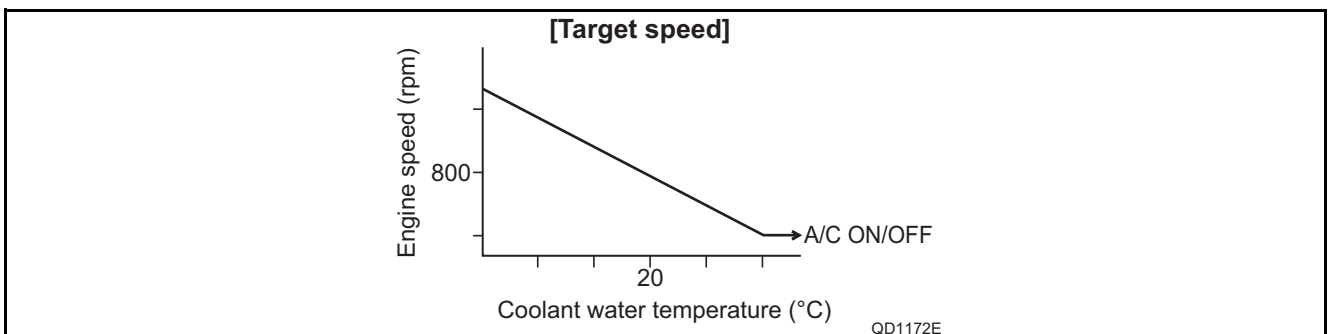


(4) Idle Speed Control (ISC) System

- This system controls the idle speed by regulating the injection quantity in order to match the actual speed to the target speed calculated by the engine ECU.



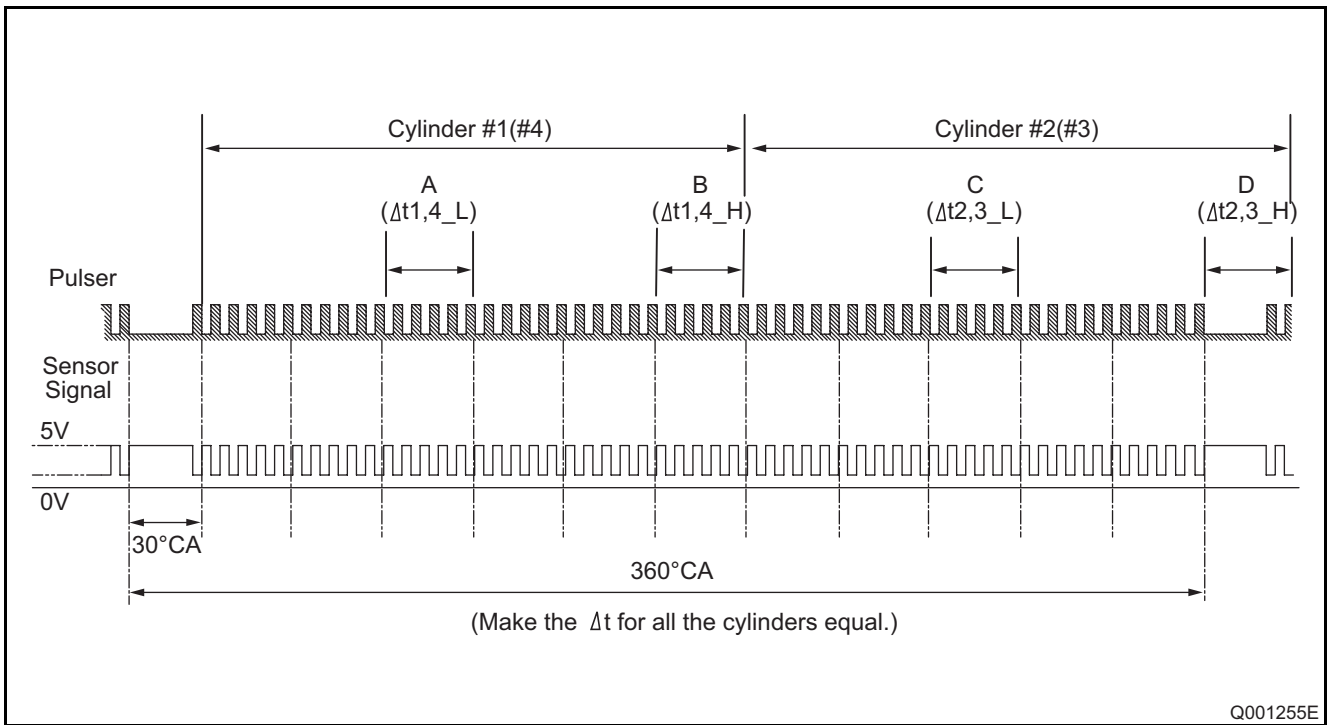
- The target speed varies, depending on the ON/OFF state of the air conditioner and the coolant temperature.



(5) Idle Vibration Reduction Control

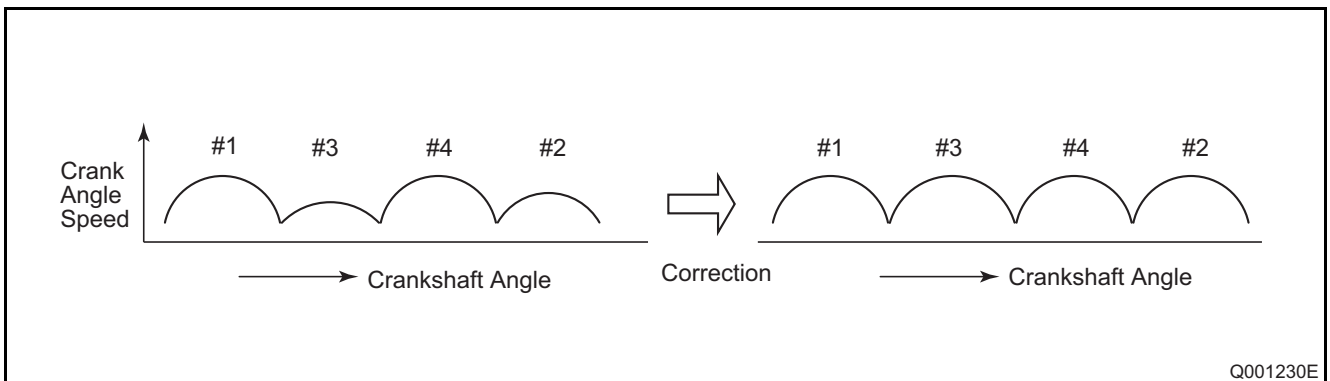
- In order to reduce vibration during idling, the angular (time difference between A and B [C and D]) speed of each cylinder is detected using the speed pulse signal to control the injection quantity of each cylinder. As a result crank angle speed becomes more uniform and smoother engine operation is achieved.

Speed Pulse



Q001255E

Control Diagram



Q001230E

12. FUEL INJECTION TIMING CONTROL

12.1 Outline

- Fuel injection timing is controlled by varying the timing in which current is applied to the injectors.

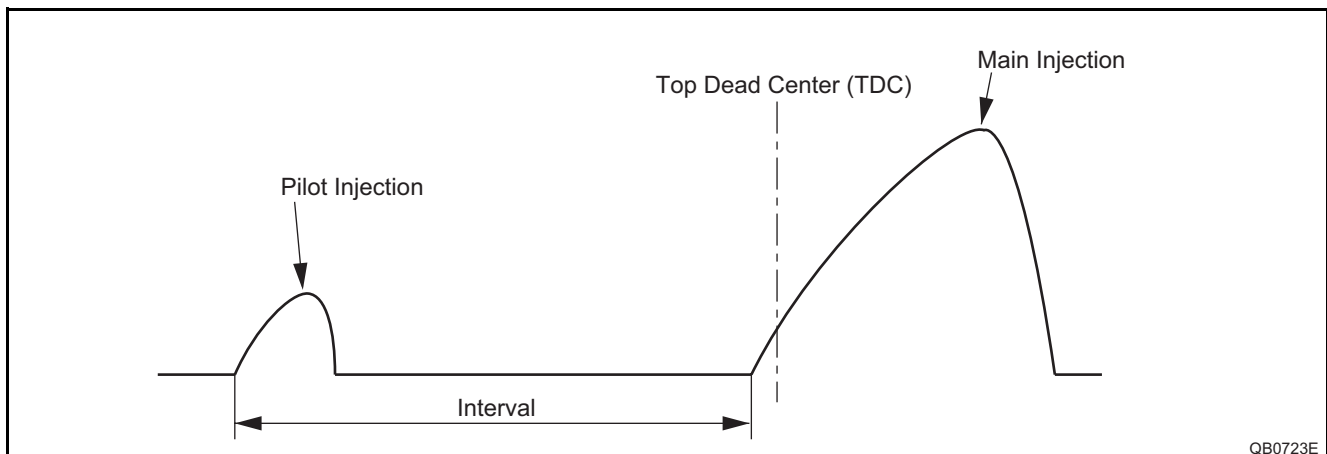
12.2 Main and Pilot Injection Timing Control

(1) Main Injection Timing

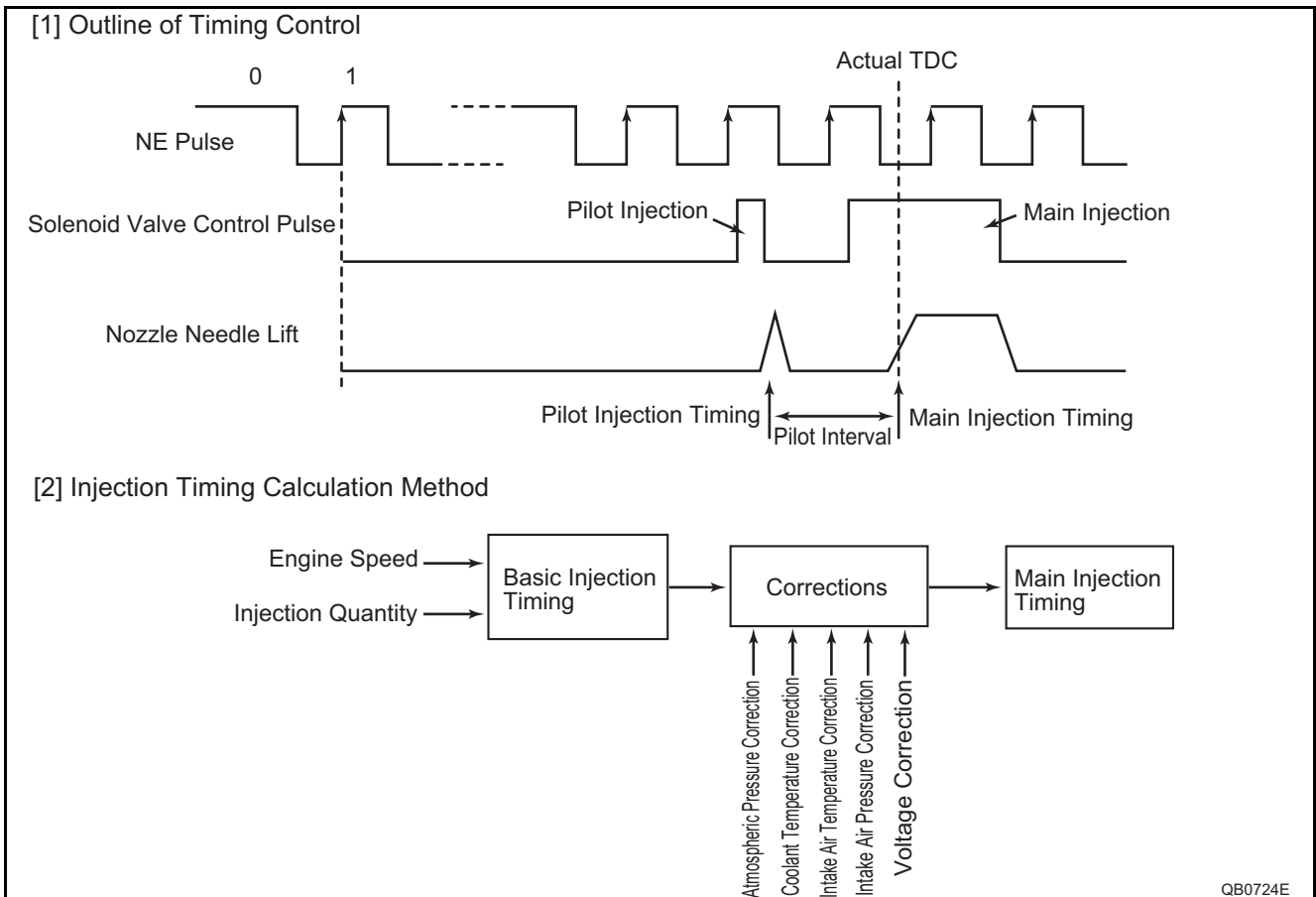
- The engine ECU calculates the basic injection timing based on the engine speed and the final injection quantity, and adds various types of corrections in order to determine the optimal main injection timing.

(2) Pilot Injection Timing (Pilot Interval)

- Pilot injection timing is controlled by adding a pilot interval to the main injection timing. The pilot interval is calculated based on the final injection quantity, engine speed, coolant temperature, ambient temperature, and atmospheric pressure (map correction). The pilot interval at the time the engine is started is calculated from the coolant temperature and engine speed.



(3) Injection Timing Calculation Method



12.3 Microinjection Quantity Learning Control

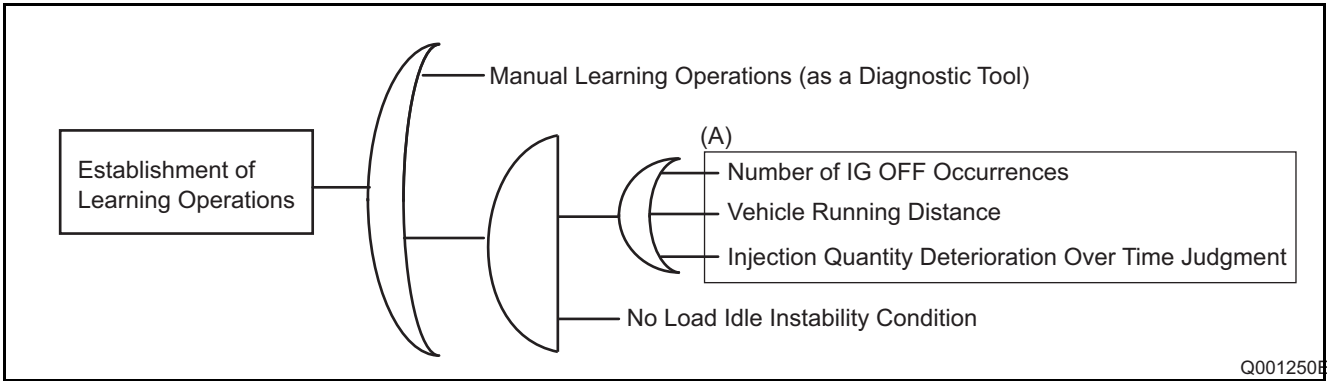
(1) Outline

- Quantity learning control is used in every vehicle engine (injector) to preserve the accuracy of quantity (specifically, pilot injection quantity.)

This type of control is first performed when shipped from the factory (L/O), and later is automatically performed every time the vehicle runs a set distance (for details, see item "A".) Because of quantity learning control, the accuracy of each injector can be preserved not only initially, but also as deterioration in injection occurs over time. As a result of this learning, correction values are recorded in the ECU. During normal driving operations, this correction value is used to make modifications to injection commands, resulting in accurate microinjection.

(2) Learning Operations

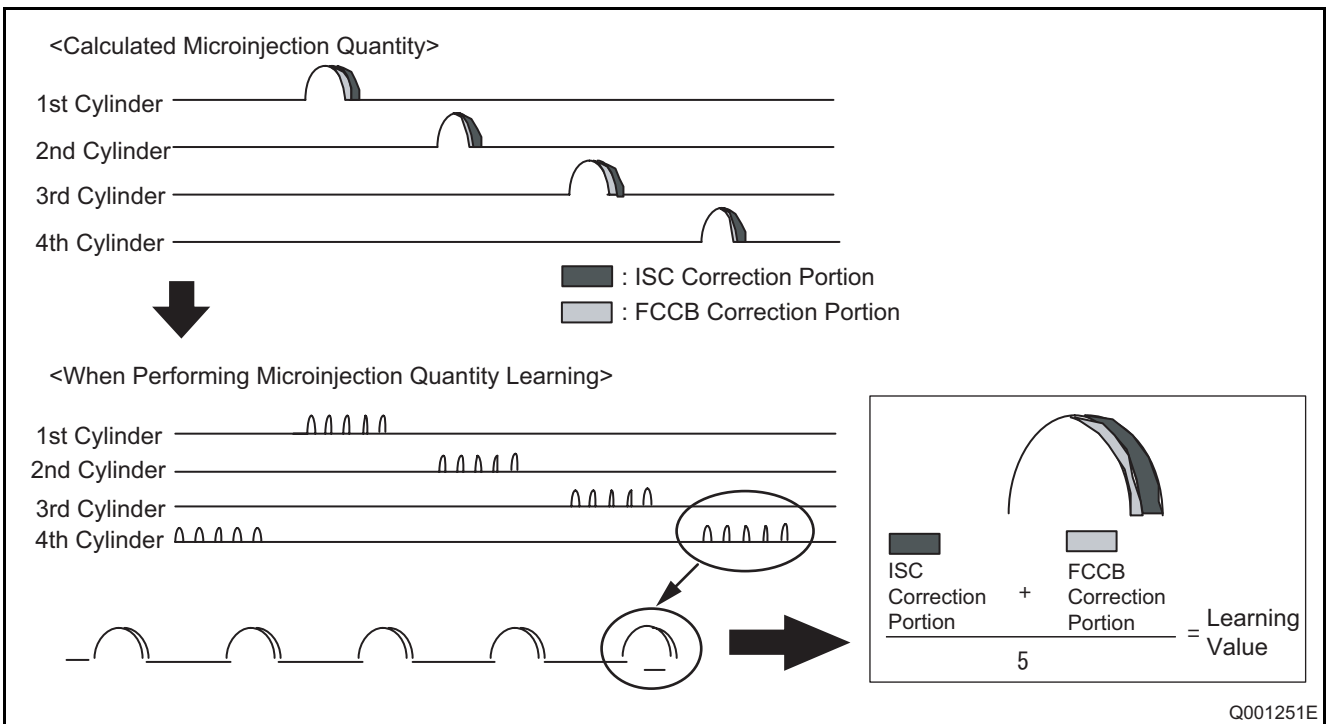
- For every two no load, idle instability conditions established (See chart "A" below) quantity learning takes place. In addition, it is also possible to perform quantity learning control manually as a diagnostic tool.



(3) Operational Outline

- Learning control sends ISC (target speed correction quantity) and FCCB (cylinder-to-cylinder correction quantity) feedback based on engine speed to apply injection control. The correction quantity is added to each cylinder based on ISC and FCCB correction information. The corrected injection quantity is then calculated.

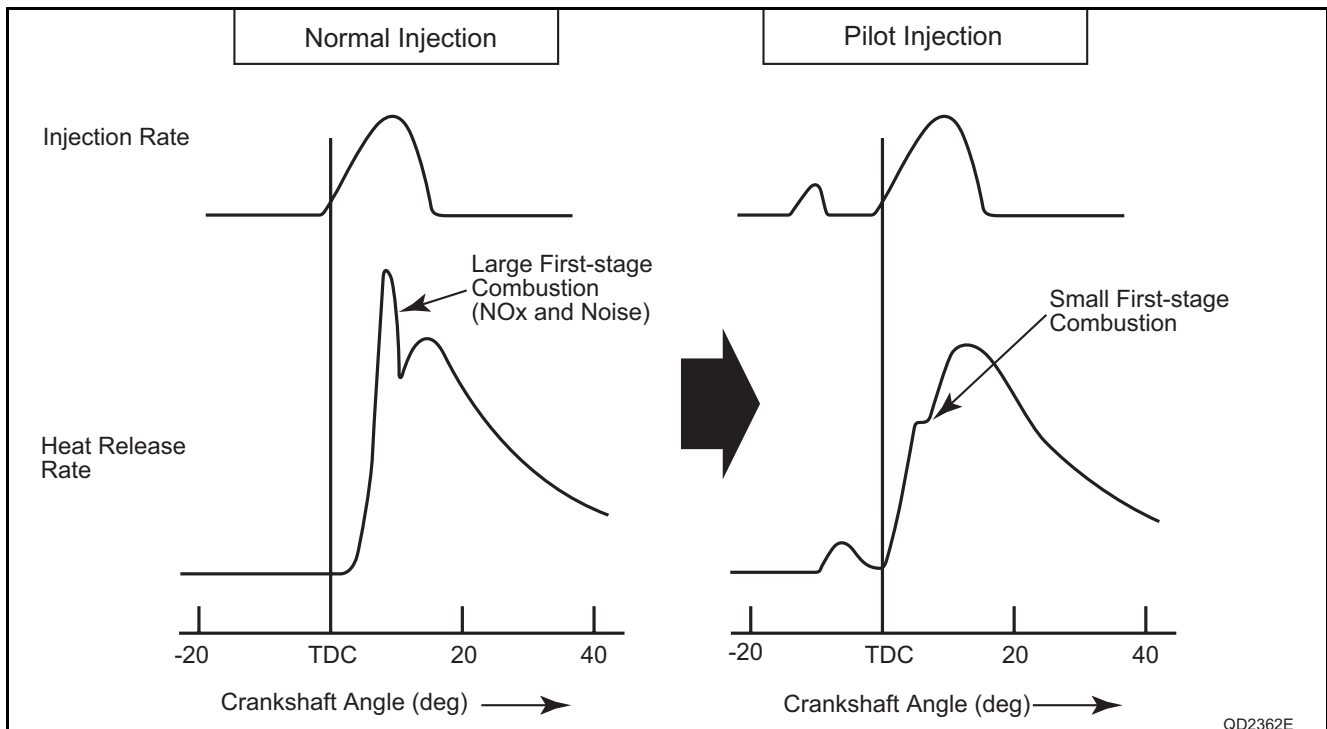
Through the use of quantity learning control, injection is divided into 5 injections. In this state, the value for ISC and FCCB corrected injection quantity that has been divided into five injections is calculated as the "learning value".



13. FUEL INJECTION RATE CONTROL

13.1 Outline

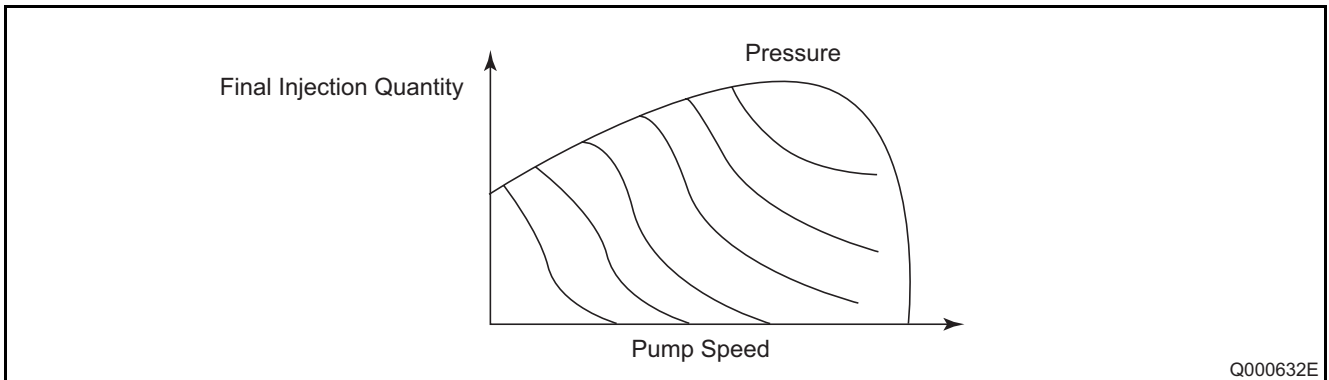
- While the injection rate increases with the adoption of high-pressure fuel injection, the ignition lag, which is the delay from the time fuel is injected to the beginning of combustion, cannot be shortened to less than a certain value. As a result, the quantity of fuel that is injected until main ignition occurs increases, resulting in an explosive combustion at the time of main ignition. This increases both NO_x and noise. For this reason, pilot injection is provided to minimize the initial ignition rate, prevent the explosive first-stage combustion, and reduce noise and NO_x.



14. FUEL INJECTION PRESSURE CONTROL

14.1 Fuel Injection Pressure

- The engine ECU determines the fuel injection pressure based on the final injection quantity and the engine speed. The fuel injection pressure at the time the engine is started is calculated from the coolant temperature and engine speed.



15. DIAGNOSTIC TROUBLE CODES (DTC)

15.1 About the Codes Shown in the Table

- The "SAE" diagnostic trouble code indicates the code that is output through the use of the STT (WDS). (SAE: Society of Automotive Engineers)

15.2 Diagnostic Trouble Code Details

- The DTC chart below is common to the 4D56/4M41 model. However, DTC number "P1210" is only for use with the 4D56 2WD model engine.

DTC Number (SAE)	Diagnostic Item	Diagnostic Classification	Malfunctioning Part	Light ON	Remarks
P0016	Speed-G phase gap malfunction	Pulse system malfunction	Crankshaft position sensor, cylinder recognition sensor	Yes	
P0072	Intake manifold temperature sensor - low	Open circuit detection (+B short, ground short, open)	Intake temperature sensor	No	
P0073	Intake manifold temperature sensor - high	Open circuit detection (+B short, ground short, open)	Intake temperature sensor	No	
P0088	Rail high pressure abnormality	Fuel pressure control system abnormality	Injector	Yes	
P0089	SCV stuck diagnosis	Fuel pressure control system abnormality	Supply pump	Yes	
P0093	Fuel leak	Fuel leak	Fuel piping	Yes	
P0102	Airflow sensor - low	Open circuit detection (+B short, ground short, open)	Air Flow Sensor	No	
P0103	Airflow sensor - high	Open circuit detection (+B short, ground short, open)	Air Flow Sensor	No	
P0106	Turbo pressure sensor characteristic abnormality	Sensor characteristic abnormality	Turbo pressure sensor	Yes	
P0107	Turbo pressure sensor - low	Open circuit detection (+B short, ground short, open)	Turbo pressure sensor	Yes	
P0108	Turbo pressure sensor - high	Open circuit detection (+B short, ground short, open)	Turbo pressure sensor	Yes	

DTC Number (SAE)	Diagnostic Item	Diagnostic Classification	Malfunctioning Part	Light ON	Remarks
P0112	Intake temperature sensor - low	Open circuit detection (+B short, ground short, open)	Intake temperature sensor (AFS)	Yes	
P0113	Intake temperature sensor - high	Open circuit detection (+B short, ground short, open)	Intake temperature sensor (AFS)	Yes	
P0117	Coolant temperature sensor - low	Open circuit detection (+B short, ground short, open)	Coolant temperature sensor	Yes	
P0118	Coolant temperature sensor - high	Open circuit detection (+B short, ground short, open)	Coolant temperature sensor	Yes	
P0122	Electronic control throttle - low	Open circuit detection (+B short, ground short, open)	Electronic control throttle	Yes	
P0123	Intake valve sensor - high	Open circuit detection (+B short, ground short, open)	Electronic control throttle	Yes	
P0182	Fuel temperature sensor - low	Open circuit detection (+B short, ground short, open)	Supply Pump	Yes	
P0183	Fuel temperature sensor - high	Open circuit detection (+B short, ground short, open)	Supply Pump	Yes	
P0191	Rail pressure sensor characteristic abnormality	Sensor characteristic abnormality	Rail	Yes	
P0192	Rail pressure sensor (time) low	Open circuit detection (+B short, ground short, open)	Rail	Yes	
P0193	Rail pressure sensor (time) high	Open circuit detection (+B short, ground short, open)	Rail	Yes	
P0201	TWV 1 (No.1 cylinder) actuation system open circuit	Injector actuation abnormality	Injector	Yes	
P0202	TWV 4 (No.2 cylinder) actuation system open circuit	Injector actuation abnormality	Injector	Yes	
P0203	TWV 2 (No.3 cylinder) actuation system open circuit	Injector actuation abnormality	Injector	Yes	
P0204	TWV 3 (No.4 cylinder) actuation system open circuit	Injector actuation abnormality	Injector	Yes	

DTC Number (SAE)	Diagnostic Item	Diagnostic Classification	Malfunctioning Part	Light ON	Remarks
P0219	Engine overrun abnormality	Engine abnormality	Engine	Yes	
P0234	High boost abnormality diagnosis	Engine abnormality	Engine	Yes	
P0301	Injector function (non-injection) 1	Injector actuation abnormality	Injector	Yes	
P0302	Injector function (non-injection) 2	Injector actuation abnormality	Injector	Yes	
P0303	Injector function (non-injection) 3	Injector actuation abnormality	Injector	Yes	
P0304	Injector function (non-injection) 4	Injector actuation abnormality	Injector	Yes	
P0335	No speed pulse input	Pulse system malfunction	Crankshaft position sensor	Yes	
P0336	Abnormal speed pulse number	Pulse system malfunction	Crankshaft position sensor	Yes	
P0340	No G pulse input	Pulse system malfunction	Cylinder recognition sensor	Yes	
P0341	Cylinder recognition sensor pulse number abnormality	Pulse system malfunction	Cylinder recognition sensor	Yes	
P0405	EGR lift sensor - low	Open circuit detection (+B short, ground short, open)	EGR valve	No	
P0406	EGR lift sensor - high	Open circuit detection (+B short, ground short, open)	EGR valve	No	
P0502	Vehicle speed abnormality - low	Pulse system malfunction	Vehicle speed sensor	Yes	
P0513	Immobilizer authentication error	Network	Network	Yes	
P0551	Power Steering Switch ON malfunction	Power Steering Switch malfunction	Power Steering Switch	Yes	
P0603	EEPROM abnormality	Engine ECU internal circuit memory device	Engine ECU	Yes	
P0604	RAM abnormality	Engine ECU	Engine ECU	Yes	
P0605	Engine ECU flash-ROM abnormality	Engine ECU	Engine ECU	Yes	
P0606	Engine ECU CPU abnormality (main IC abnormality)	Engine ECU	Engine ECU	Yes	
P0607	Engine ECU abnormality (monitoring IC abnormality)	Engine ECU	Engine ECU	Yes	

DTC Number (SAE)	Diagnostic Item	Diagnostic Classification	Malfunctioning Part	Light ON	Remarks
P0628	SCV actuation system abnormality	Fuel pressure control system abnormality	Supply pump	Yes	
P0629	SCV +B short	Fuel pressure control system abnormality	Supply pump	Yes	
P0630	VIN not registered in Engine ECU	Engine ECU write defect	Engine ECU (VIN rewrite)	Yes	VIN stands for "Vehicle Identification Number". If this DTC code is detected, rewrite the VIN to the Engine ECU. This does not mean that engine ECU is malfunctioning. Do not replace the engine ECU
P0638	Intake throttle valve stuck	Actuator malfunction	Electronic control throttle	Yes	
P0642	Sensor - voltage 1 low	Engine ECU	Engine ECU	Yes	
P0643	Sensor - voltage 1 high	Engine ECU	Engine ECU	Yes	
P0652	Sensor - voltage 2 low	Engine ECU	Engine ECU	Yes	
P0653	Sensor - voltage 2 high	Engine ECU	Engine ECU	Yes	
P1203	Low charge	Engine ECU	Engine ECU	Yes	
P1204	Over charge	Engine ECU	Engine ECU	Yes	
P1210	Throttle valve opening	Actuator malfunction	Throttle valve	Yes	Only 4D56 Engine 2WD
P1272	P/L open valve abnormality	Fuel pressure control system abnormality	Rail	Yes	
P1273	Single pump abnormality diagnosis	Fuel pressure control system abnormality	Supply pump	Yes	In the event that the vehicle runs out of gas, "P1273" may be detected when the vehicle is restarted. When "P1273" is displayed, the user should verify whether or not there is gas in the vehicle. Do not replace the pump assy. if it has been verified that the vehicle has run out of gas. Remove the air from the fuel, and erase the code using the MITSUBISHI MUT III diagnosis tool.

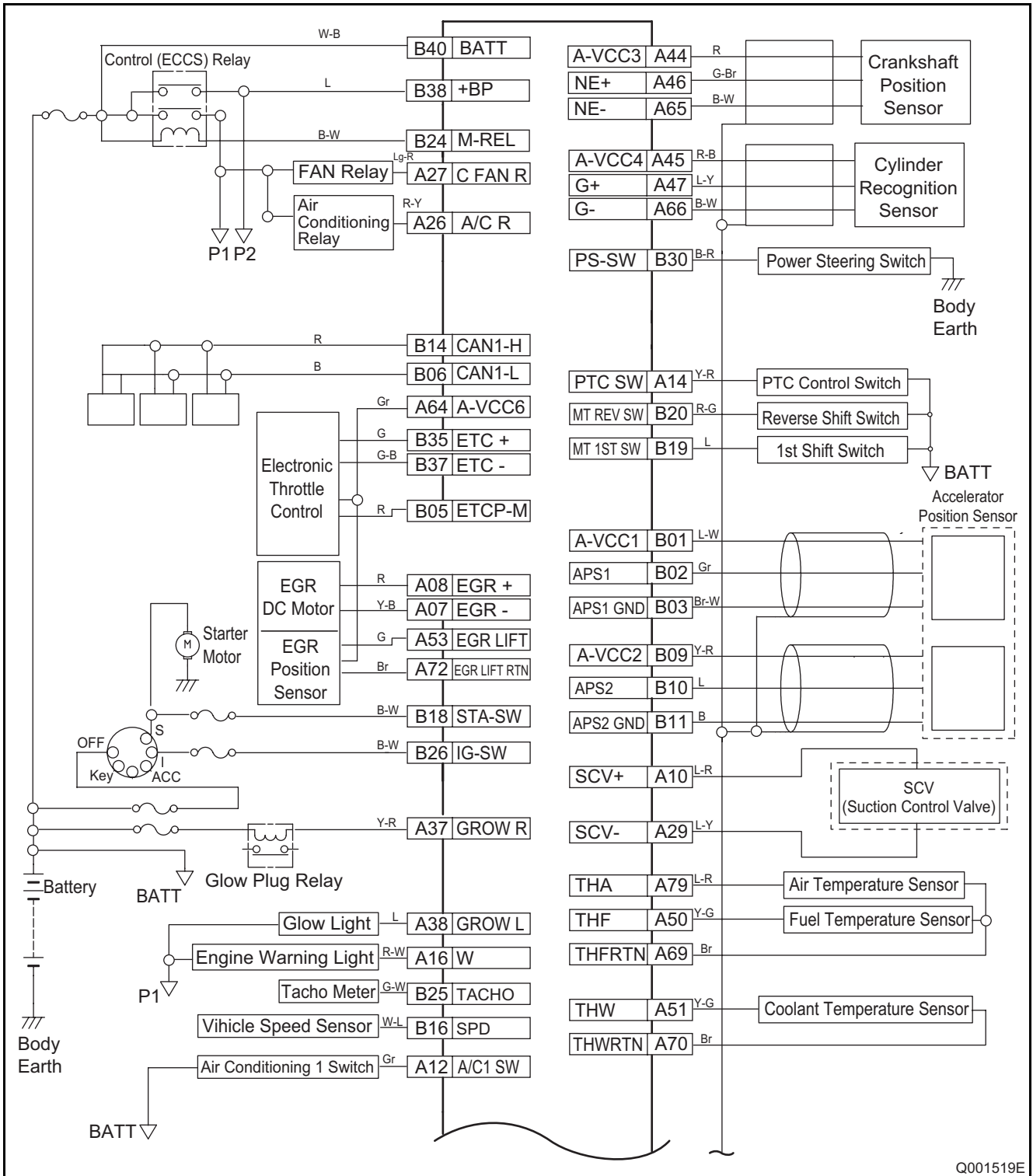
DTC Number (SAE)	Diagnostic Item	Diagnostic Classification	Malfunctioning Part	Light ON	Remarks
P1274	Pump protective fill plug	Fuel pressure control system abnormality	Supply pump	Yes	
P1275	Pump exchange fill plug	Fuel pressure control system abnormality	Supply pump	Yes	
P1276	Fuel Filter choke	Fuel filter	Fuel filter and the pipings	Yes	For Low lubricating model only
P1625	QR data abnormality	Engine ECU	Engine ECU	Yes	
P1626	QR data failure to write to disc malfunction	Engine ECU	Engine ECU	Yes	
P2118	DC motor over current abnormality	Actuator malfunction	Electronic control throttle	Yes	
P2122	Accelerator sensor-1 low	Open circuit detection (+B short, ground short, open)	Accelerator position sensor	Yes	
P2123	Accelerator sensor-1 high final	Open circuit detection (+B short, ground short, open)	Accelerator position sensor	Yes	
P2124	Accelerator sensor-1 high	Open circuit detection (+B short, ground short, open)	Accelerator position sensor	No	
P2127	Accelerator sensor-2 low	Open circuit detection (+B short, ground short, open)	Accelerator position sensor		
P2138	Accelerator sensor - duplicate malfunction high	Open circuit detection (+B short, ground short, open)	Accelerator position sensor	Yes	
	Accelerator sensor - duplicate malfunction low	Open circuit detection (+B short, ground short, open)	Accelerator Position Sensor	Yes	
	ACCP characteristic abnormality	Sensor characteristic abnormality	Accelerator Position Sensor	Yes	
P2146	Common 1 system open circuit	Injector actuation abnormality	Injector , Wire harness or Engine ECU	Yes	
P2147	COM1 TWV actuation system ground short	Injector actuation abnormality	Injector, Wire harness or Engine ECU	Yes	
P2148	COM1 TWV actuation system +B short	Injector actuation abnormality	Injector, Wire harness or Engine ECU	Yes	
P2149	Common 2 system open circuit	Injector actuation abnormality		Yes	

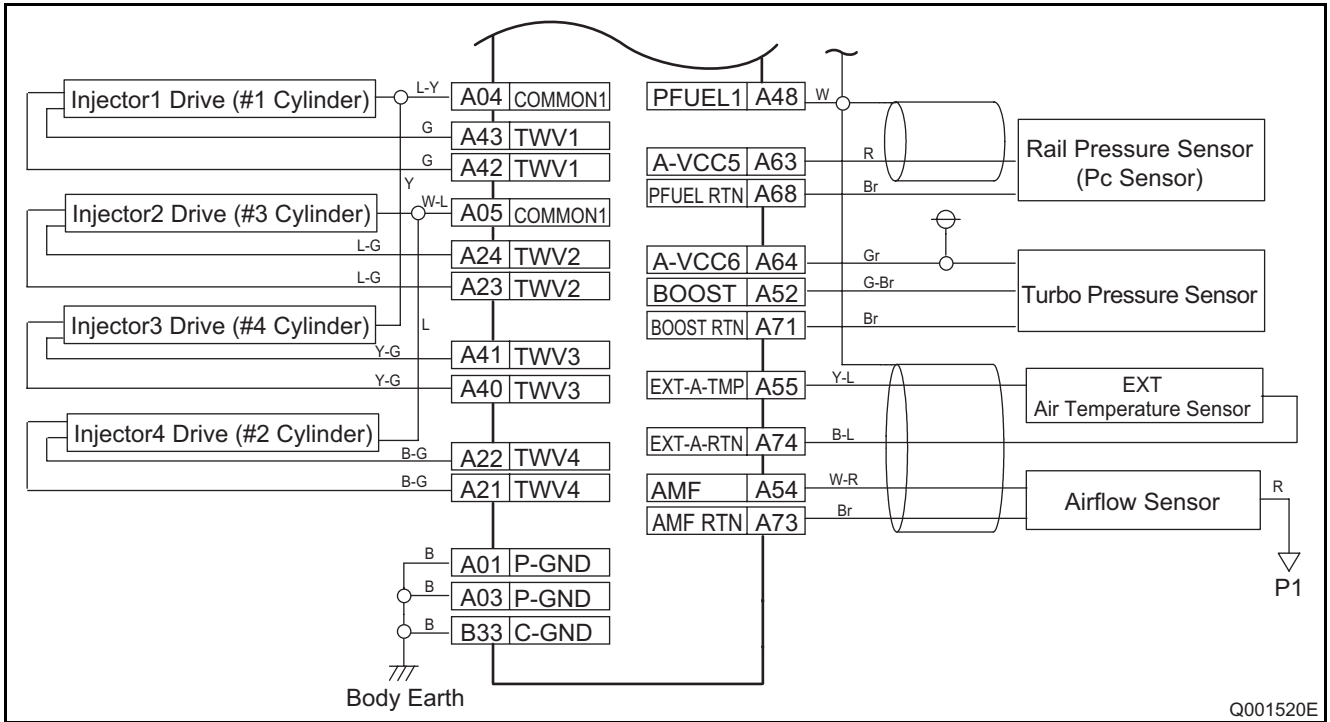
DTC Number (SAE)	Diagnostic Item	Diagnostic Classification	Malfunctioning Part	Light ON	Remarks
P2228	Atmospheric pressure sensor - low	Open circuit detection (+B short, ground short, open)	Engine ECU	Yes	
P2229	Atmospheric pressure sensor - high	Open circuit detection (+B short, ground short, open)	Engine ECU	Yes	
P2413	EGR feedback abnormality	Actuator malfunction	EGR valve	No	
UD073	CAN bus OFF error	Network	Network	No	
UD101	CAN time out flag (trans)	Network	Network	No	
UD102	CAN time out flag (ESP)	Network	Network	No	
UD109	CAN time out flag (ETACS)	Network	Network	No	
UD117	CAN time out flag (immobilizer)	Network	Network	No	
UD190	CAN communication	Network	Network	No	

16. EXTERNAL WIRING DIAGRAM

16.1 Engine ECU External Wiring Diagram

• The wiring diagram below is common to the 4D56/4M41 model.

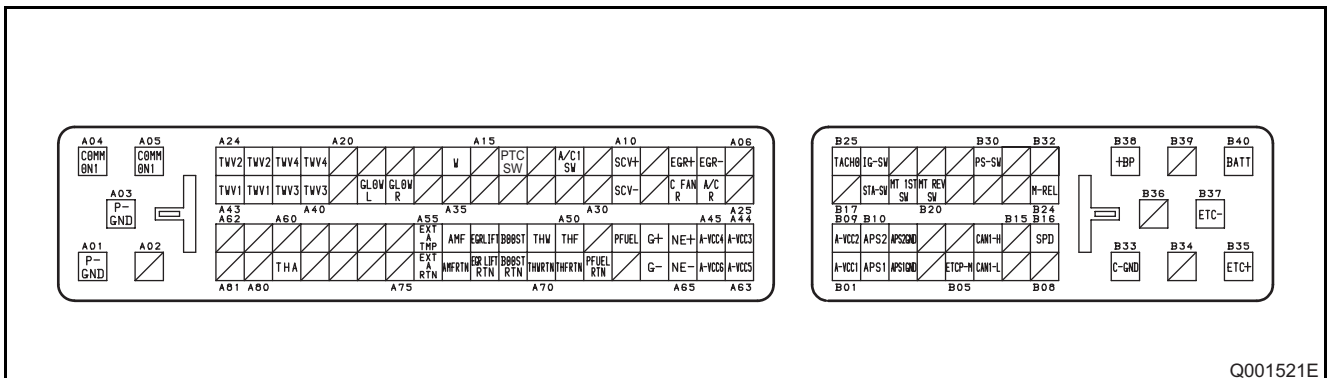




Q001520E

16.2 Engine ECU Connector Diagram

- The connector diagram and terminal below are common to the 4D56/4M41 model.



Q001521E

Terminal Connections (1)

No.	Pin Symbol	Signal Name	No.	Pin Symbol	Signal Name
A01	P-GND	Power Ground	A11	—	—
A02	—	—	A12	A/C1 SW	Air Condition 1 Switch
A03	P-GND	Power Ground	A13	IDLUP SW	IDLUP SW (For EU)
A04	COMMON 1	INJ#1/#4 BATT.	A14	PTC HEATER SW	PTC HEATER CONT SW(For EU)
A05	COMMON 1	INJ#2/#3 BATT.	A15	THR	THROTTLE SOLENOID VALVE (For Thailand model)
A06	—	—	A16	W	Engine Warning Light
A07	EGR-	EGR-DC Motor (-)	A17	SCV	SWIRL CONT VALVE(For EU)
A08	EGR+	EGR-DC Motor (+)	A18	—	—
A09	—	—	A19	—	—
A10	SCV+	Suction Control Valve	A20	—	—

Terminal Connections (2)

No.	Pin Symbol	Signal Name	No.	Pin Symbol	Signal Name
A21	TW4	Injection 4 Drive (# 2 Cylinder)	A56	—	—
A22			A57	—	—
A23			A58	—	—
A24	TWW2	Injection 2 Drive (#3 Cylinder)	A59	—	—
A25			A60	—	—
A26	PTC HEATER 1	PTC HEATER (For EU)	A61	—	—
A27	A/C R	Air Conditioning Relay	A62	—	—
A28	C FAN R	FAN Relay	A63	A-VCC5	Rail Pressure Sensor Source
A29	PTC HEATER 2	PTC HEATER (For EU)	A64	A-VCC6	Turbo Pressure Sensor Source (5V)
A30	SCV-	Suction Control Valve	A65	NE-	Crankshaft Position Sensor Ground
A31	—	—	A66	G-	Cylinder Recognition Sensor Ground
A32	A/C2 SW	A/C2 SW (For EU)	A67	—	—
A33	—	—	A68	PFUEL RTN	Rail Pressure Sensor Earth
A34	—	—	A69	THF RTN	Air Temperature Sensor, Fuel Temperature Sensor Earth
A35	—	—	A70	THW RTN	Coolant Temperature Sensor Earth
A36	—	—	A71	BOOST RTN	Turbo Pressure Sensor
A37	—	—	A72	EGR Lift RTN	EGR Position Sensor Earth
A38	Glow R	Glow Plug Relay	A73	AMF-RTN	Airflow Sensor Earth
A39	Glow L	Glow Light	A74	EXT-A-RTN	Air Temperature Sensor Earth (W/FAS)
A40	—	—	A75	—	—
A41	TWV3	Injection 3 Drive (#4 Cylinder)	A76	—	—
A42	TWV3	Injection 3 Drive (#4 Cylinder)	A77	—	—
A43	TWV1	Injection 1 Drive (#1 Cylinder)	A78	—	—
A44	TWV1	Injection 1 Drive (#1 Cylinder)	A79	THA	Air Temperature Sensor
A45	A-VCC3	Crankshaft Position Sensor BATT	A80	—	—
A46	A-VCC4	Cylinder Recognition Sensor BATT	A81	ETCP-S	TPS(SUB) (For EU)
A47	NE+	Crankshaft Position Sensor	B01	A-VCC 1	Accelerator Position Sensor (Main) Source
A48	G+	Cylinder Recognition Sensor	B02	APS 1	Accelerator Position Sensor (Main)
A49	PFUEL 1	Rail Pressure Sensor (Pc Sensor)	B03	APS 1 GND	Accelerator Position Sensor (Main) Earth
A50	PFUEL	F/PRESS SNSR (B/UP) (For EU)	B04	—	—
A51	THF	Fuel Temperature Sensor	B05	ETCP-M	Electronic Throttle Control (Main)
A52	THW	Coolant Temperature Sensor	B06	CAN1-L	CAN L (W/Resister)
A53	BOOST	Turbo Pressure Sensor	B07	—	—
A54	EGR LIFT	EGR Position Sensor	B08	—	—
A55	AMF	Airflow Sensor	B09	A-VCC 2	Accelerator Position Sensor (Sub) Source
	EXT-A-TMP	Air Temperature Sensor (W/AFS)	B10	APS 2	Accelerator Position Sensor (Sub)

Terminal Connections (3)

No.	Pin Symbol	Signal Name	No.	Pin Symbol	Signal Name
B11	APS 2 GND	Accelerator Position Sensor (Sub) Earth	B26	IG-SW	Ignition Switch
B12	—	—	B27	+	—
B13	—	—	B28	—	—
B14	CAN1-H	CAN H (W/Resister)	B29	—	—
B15	—	—	B30	PS-SW	Power Steering Switch
B16	SPD	Vehicle Speed Sensor	B31	—	—
B17	FPSW	F/FILTER PRESS SW (For low lubricating)	B32	—	—
B18	STA-SW	Starter Switch	B33	C-GND	SIG Ground
B19	MT 1ST SW	1st Shift Switch	B34	—	—
B20	MT REV SW	Reverse Shift Switch	B35	ETC+	Electronic Throttle Control Motor (+)
B21	—	—	B36	—	—
B22	—	—	B37	ETC-	Electronic Throttle Control Motor (-)
B23	—	—	B38	+BP	Battery
B24	M-REL	Control (ECCS) Relay (W/DIODE)	B39	—	—
B25	TACHO	Tacho meter	B40	BATT.	Battery (Back-up, W/Monitor)

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Field Technical Service Department

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