

DENSO

For DENSO Authorized
ECD Service Dealer Only

Diesel Injection Pump

No. E-03-01

SERVICE MANUAL

Common Rail System for NISSAN YD1-K2 Type Engine

Operation

June, 2003

Foreword

To meet the high pressurization requirements for the engine to deliver cleaner exhaust gas emissions, lower fuel consumption and reduced noise, advanced electronic control technology is being adopted in the fuel injection system. This manual covers the electronic control model Common Rail system with HP3 pump for the NISSAN YD1-K2 type engine. Complex theories, special functions and components made by manufacturers other than DENSO are omitted from this manual.

This manual will help the reader develop an understanding of the basic construction, operation and system configuration of the DENSO manufactured components and brief diagnostic information.

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1. Product Application

1-1. Application

Vehicle Name	Vehicle Model	Engine Model	Exhaust Volume	Reference
PREMERA	ED	YD1-K2	2.2L	Made in France
ALMERA	HS			
TINO	HM			

1-2. System Components Parts Number

Part Name	Applicable Model					DENSO Part Number	Car Manufacturer Part Number	Reference
	ED 100	HS 100	HS 82	HM 100	HM 82			
Supply pump	O	O	O	O	O	294000-0121	16700 AW401	—
Rail	O	O	O	O	O	095440-0420	17520 AW400	—
Injector	O	O	—	O	—	095000-5130	16600 AW400	100kW Engine
	—	—	O	—	O	095000-5180	16600 BN800	82kW Engine
Engine ECU	O	—	—	—	—	275800-2193	23710 AW402	Standard
	O	—	—	—	—	275800-2203	23710 AW407	w/VDC
	O	—	—	—	—	275800-2440	23710 AW410	w/ASCD
	O	—	—	—	—	275800-2450	23710 AW415	w/ASCD, VDC
	—	O	—	—	—	275800-2322	23710 BN811	Standard
	—	O	—	—	—	275800-2332	23710 BN816	100kW Engine w/VDC
	—	—	O	—	—	275800-2340	23710 BN800	82kW Engine
	—	—	O	—	—	275800-2350	23710 BN805	82kW Engine w/VDC
	—	—	—	O	—	275800-2363	23710 BU712	Standard
	—	—	—	O	—	275800-2373	23710 BU717	100kW Engine w/VDC
	—	—	—	—	O	275800-2380	23710 BU700	82kW Engine
—	—	—	—	O	275800-2390	23710 BU705	82kW Engine w/VDC	
Crankshaft position sensor	O	O	O	O	O	949979-0090	23731 AW400	—
Cylinder recognition sensor	O	O	O	O	O	949979-1190	23731 AW410	—

2. Outline

2-1. Features of System

- The common rail system was developed primarily to cope with exhaust gas regulations for diesel engines, and aimed for 1. further improved fuel economy; 2. noise reduction; and 3. high power output.

A. 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 spray the pressurized fuel into the cylinders. Because the engine ECU controls the injection system (including the injection pressure, injection rate, and injection timing), the injection system is 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.

a. Injection Pressure Control

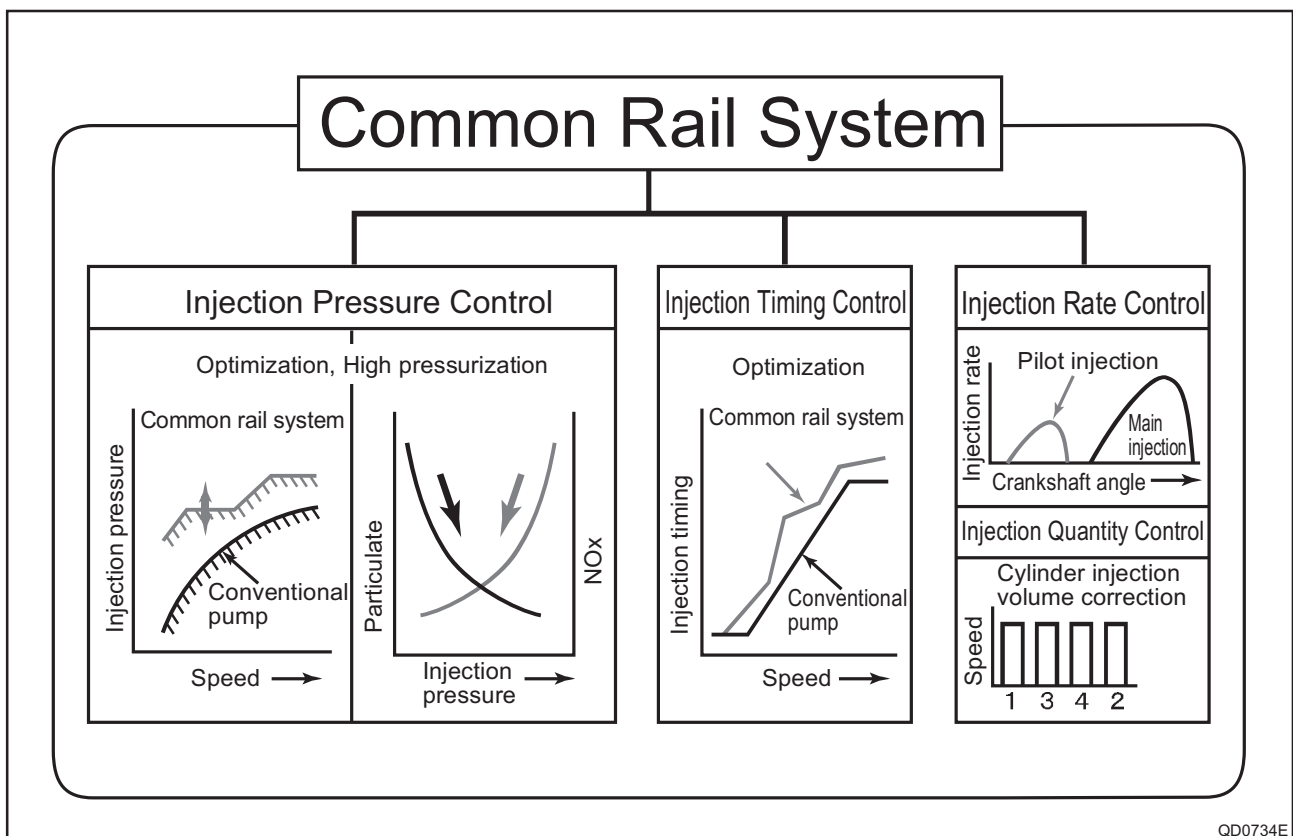
- Enables high-pressure injection even at low engine speeds.
- Optimizes control to minimize particulate matter and NOx emissions.

b. Injection Timing Control

Enables finely tuned optimized control in accordance with driving conditions.

c. Injection Rate Control

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



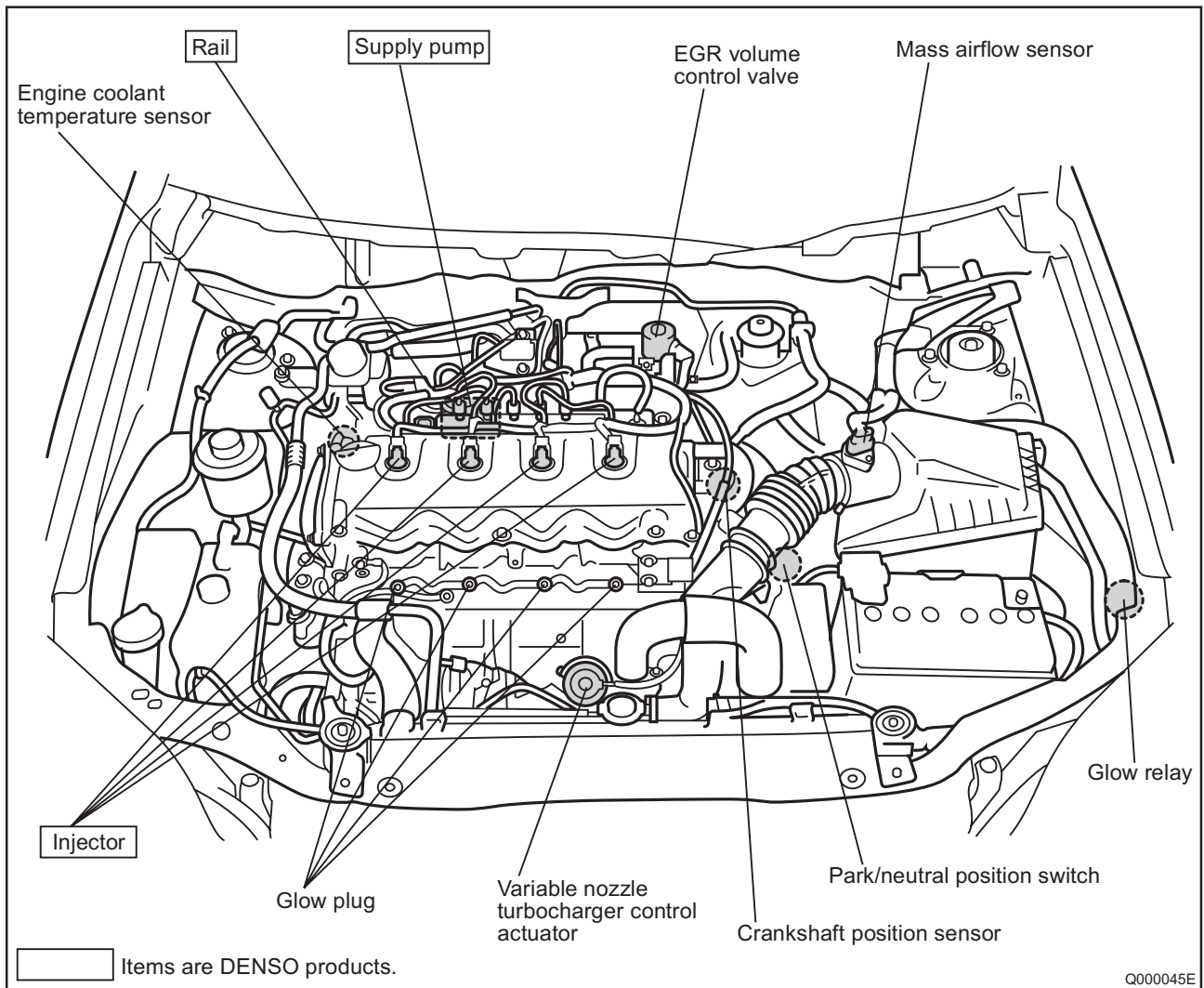
B. Comparison to the Conventional System

System	In-line, VE Pump	Common rail system
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

*1 TWV: Two Way Valve *2 SCV: Suction Control Valve QD2341E

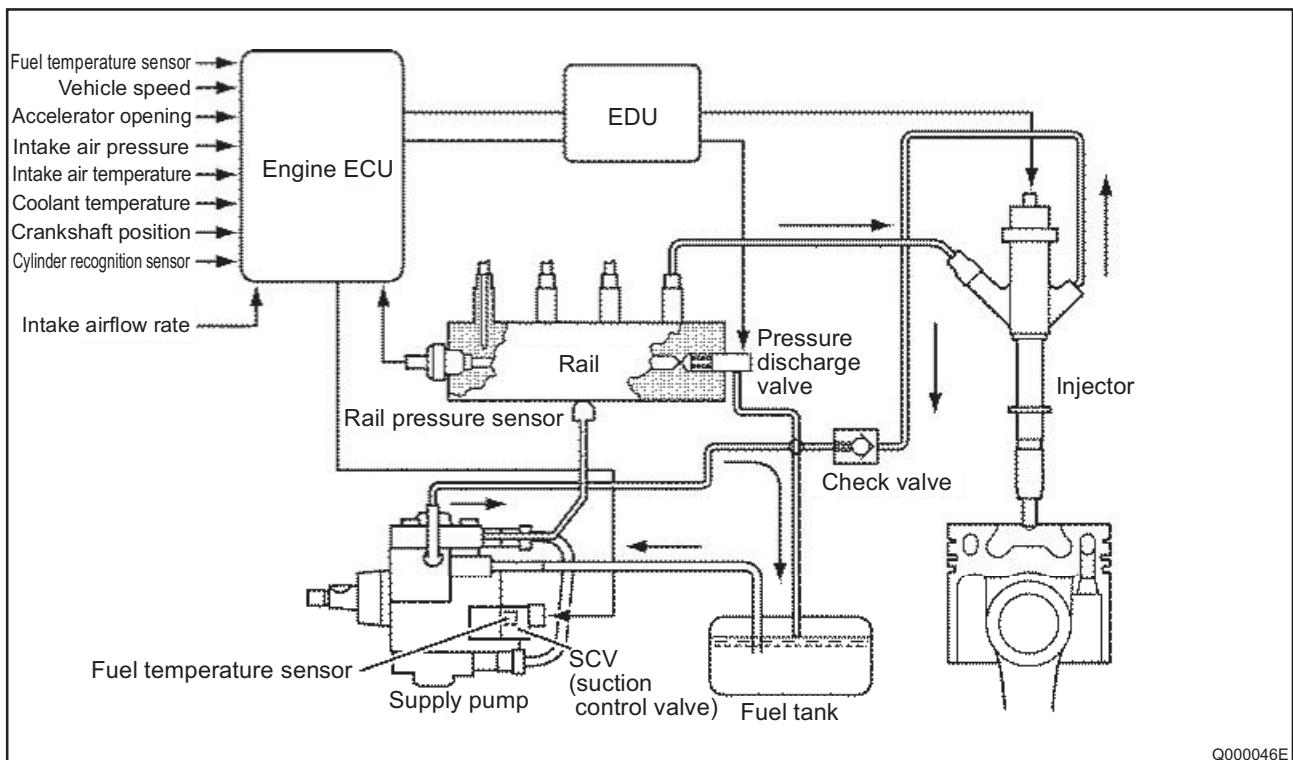
2-2. Outline of System

A. Main System Components



B. Composition

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



C. Operation

a. 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 the command received from the ECU.

b. Rail

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

c. Injector

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

d. 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).

D. Fuel System

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

E. Control System

In this system, the engine ECU controls the fuel injection system in accordance with the signals received from various sensors. The components of this system can be broadly divided into the following three types: (a) Sensors; (b) ECU; and (c) Actuators.

a. Sensors

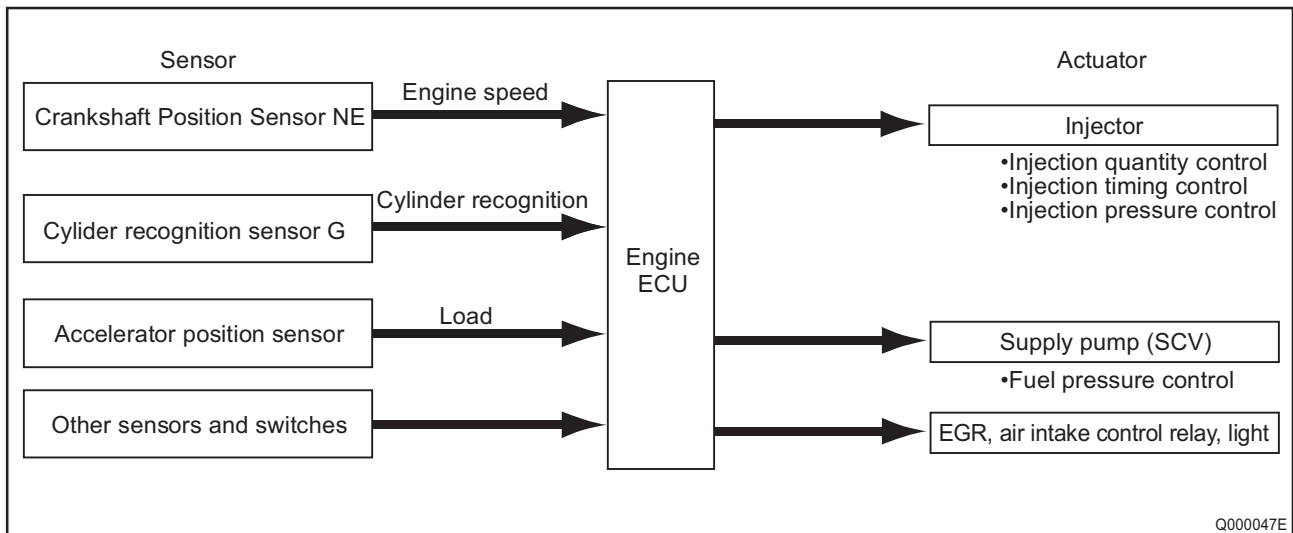
Detect the engine and driving conditions, and convert them into electrical signals.

b. 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.

c. 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 the timing in which the current is applied to the TWV (Two-Way Valve) in the injector. The injection pressure is determined by controlling the SCV (Suction Control Valve) in the supply pump.



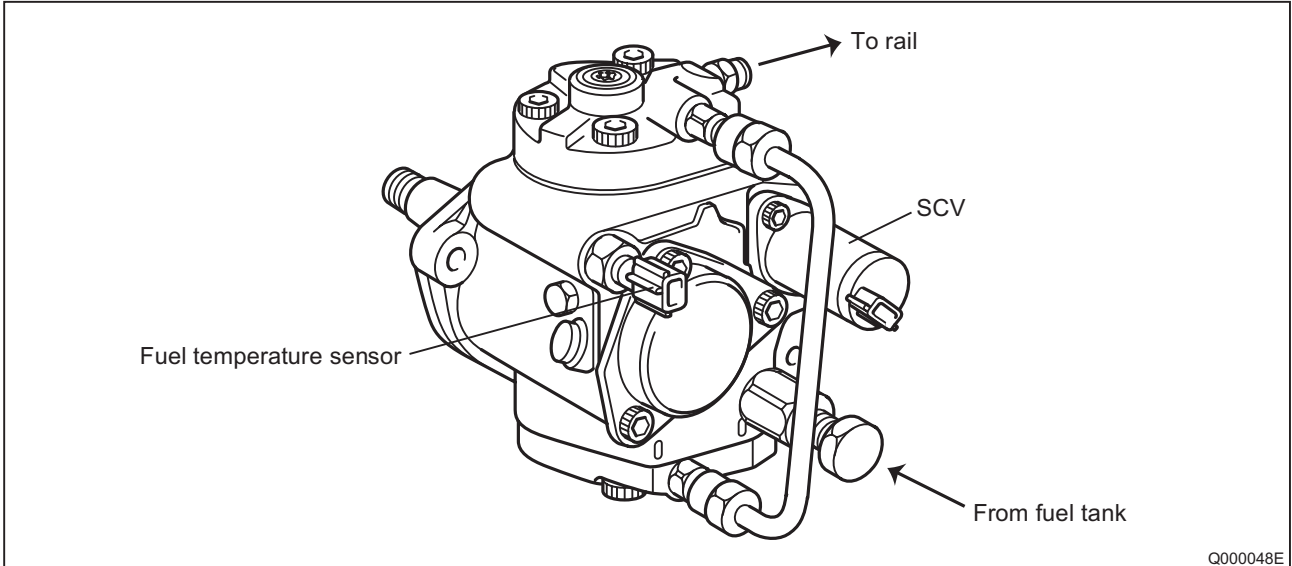
3. Construction and Operation

3-1. Description of Main Components

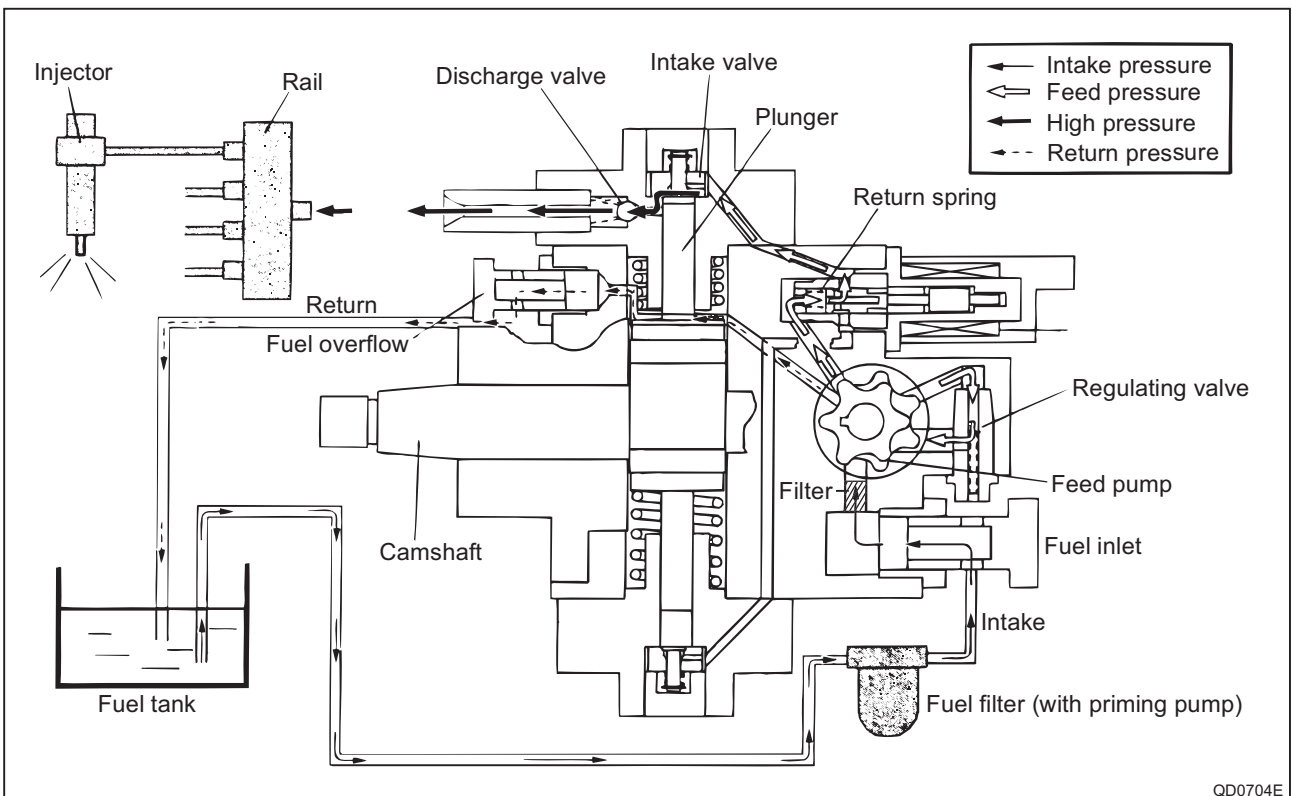
A. Supply Pump (HP3)

a. Outline

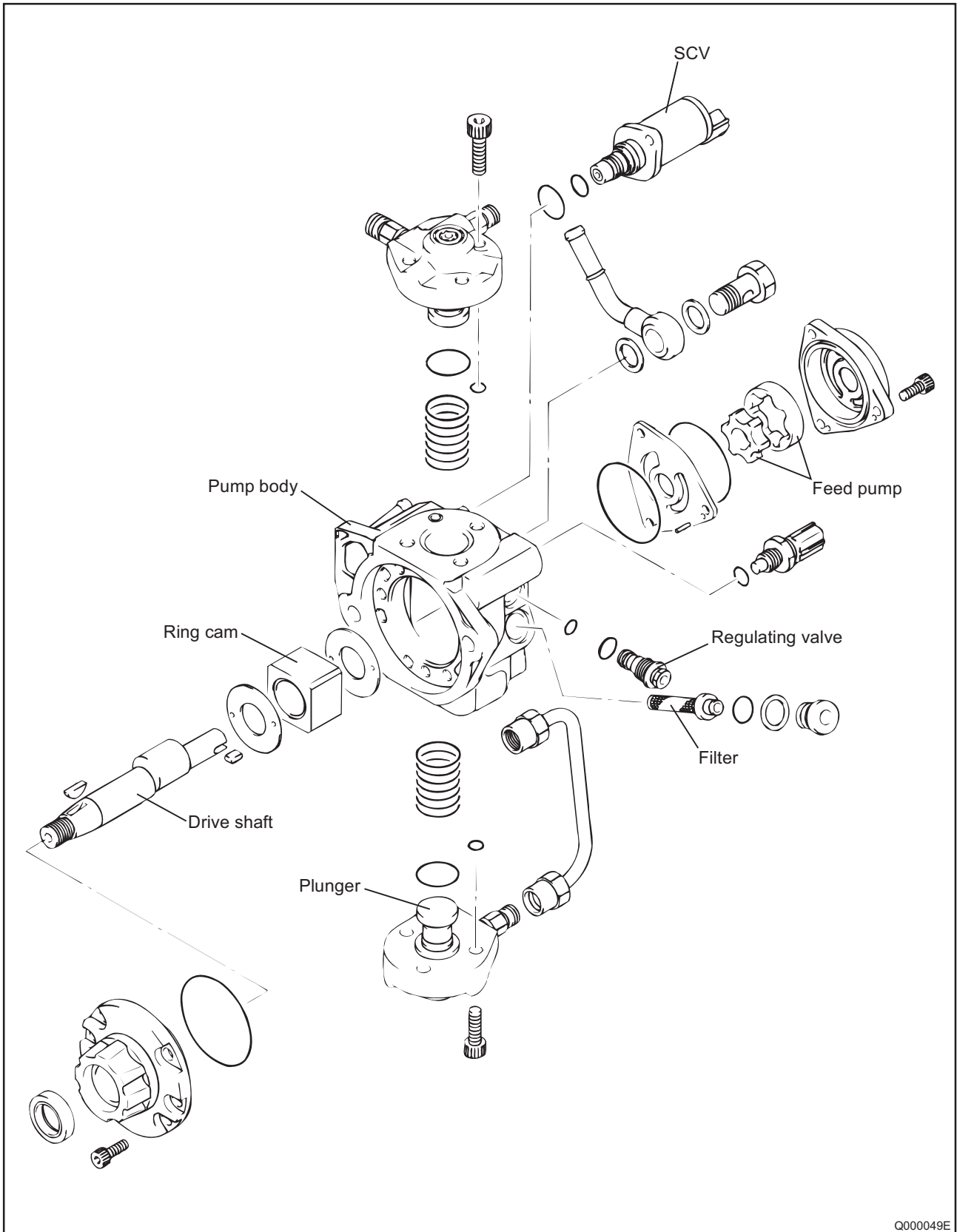
- The supply pump consists primarily of the pump body (eccentric cam, ring cam, and plungers), SCV (Suction Control Valve), fuel temperature sensor, and feed pump.



- The two plungers are positioned vertically on the outer ring cam for compactness.
- The engine drives the supply pump at a ratio of 1:2. 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 opened type (the intake valve opens during de-energization).



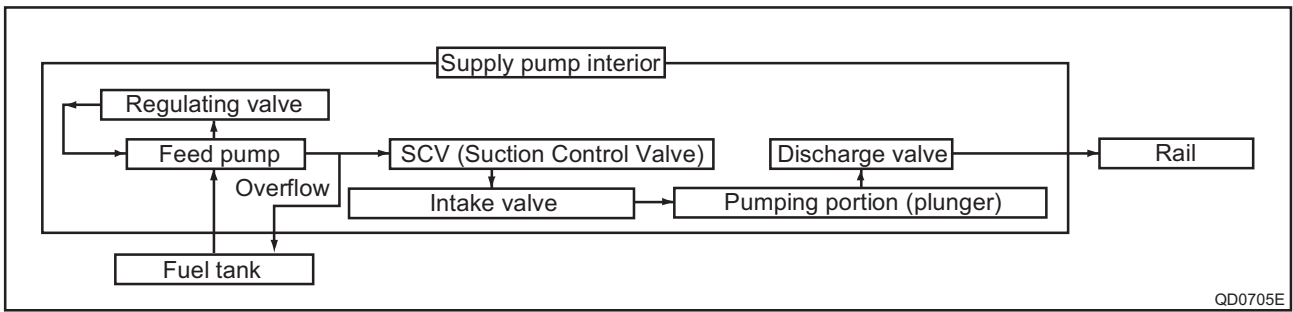
b. Supply Pump Exploded Diagram



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c. Supply Pump Internal Fuel Flow

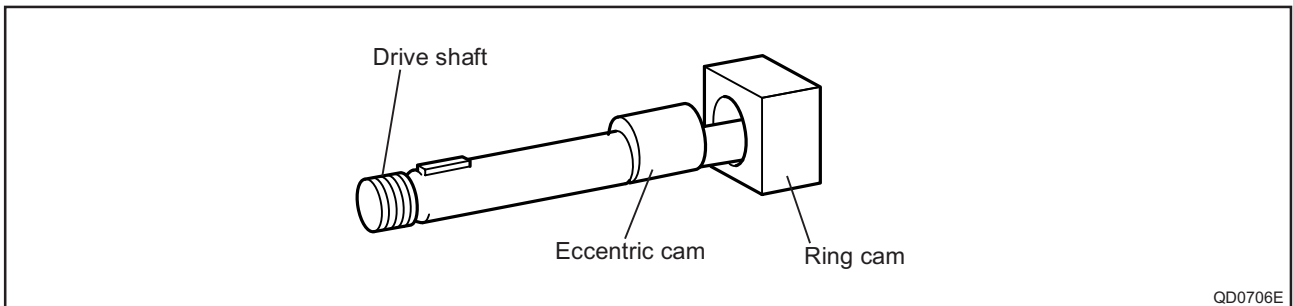
The fuel that is drawn from the fuel tank passes through the route in the supply pump as illustrated, and is fed into the rail.



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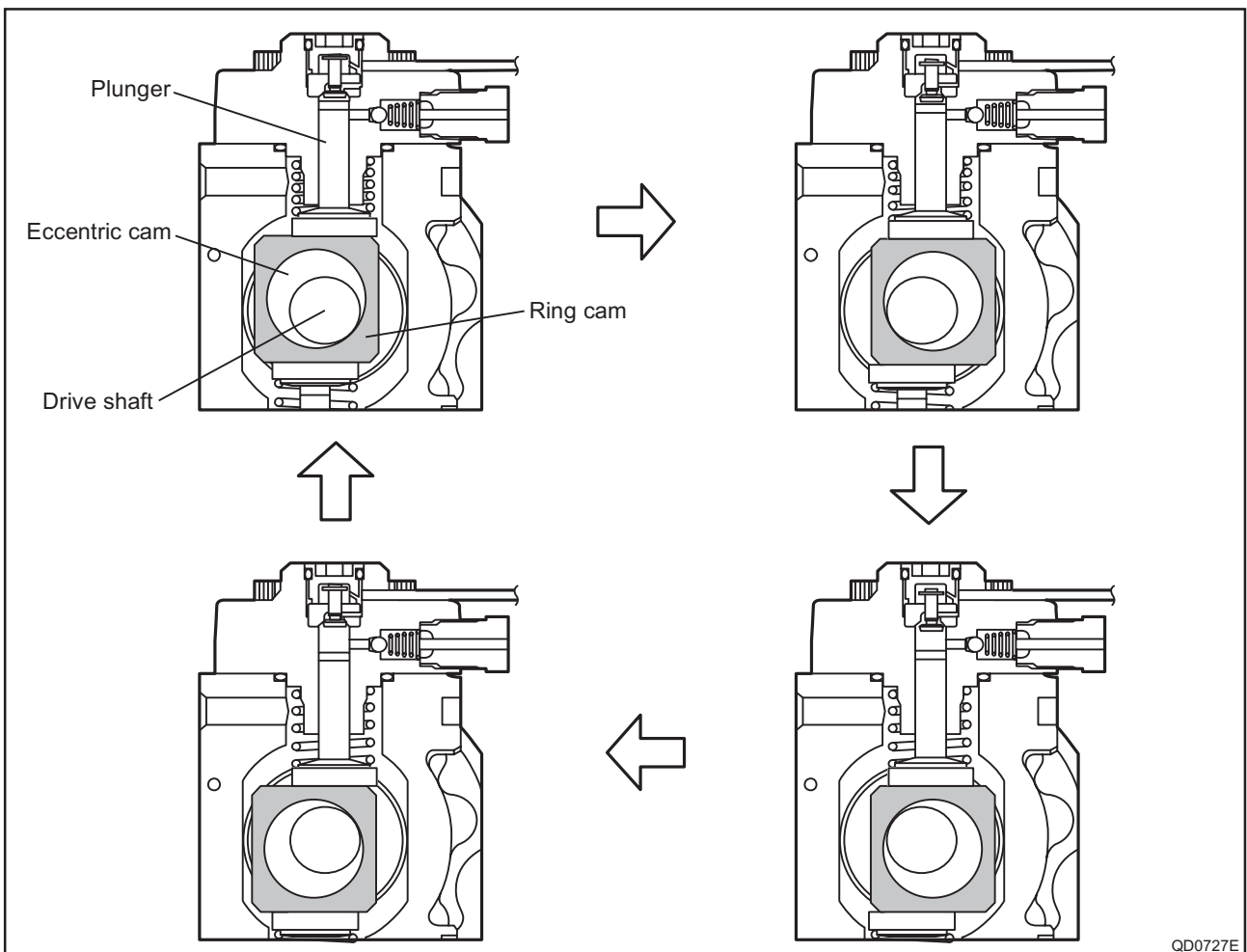
d. Construction of Supply Pump

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



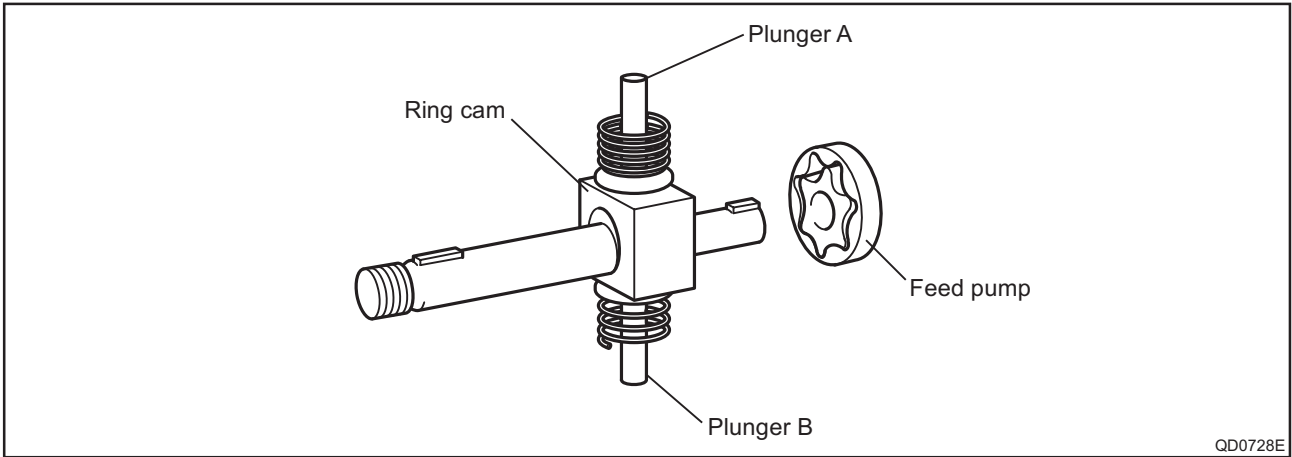
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- As the drive shaft rotates, the eccentric cam rotates in the eccentric state, and the ring cam moves up and down while rotating.



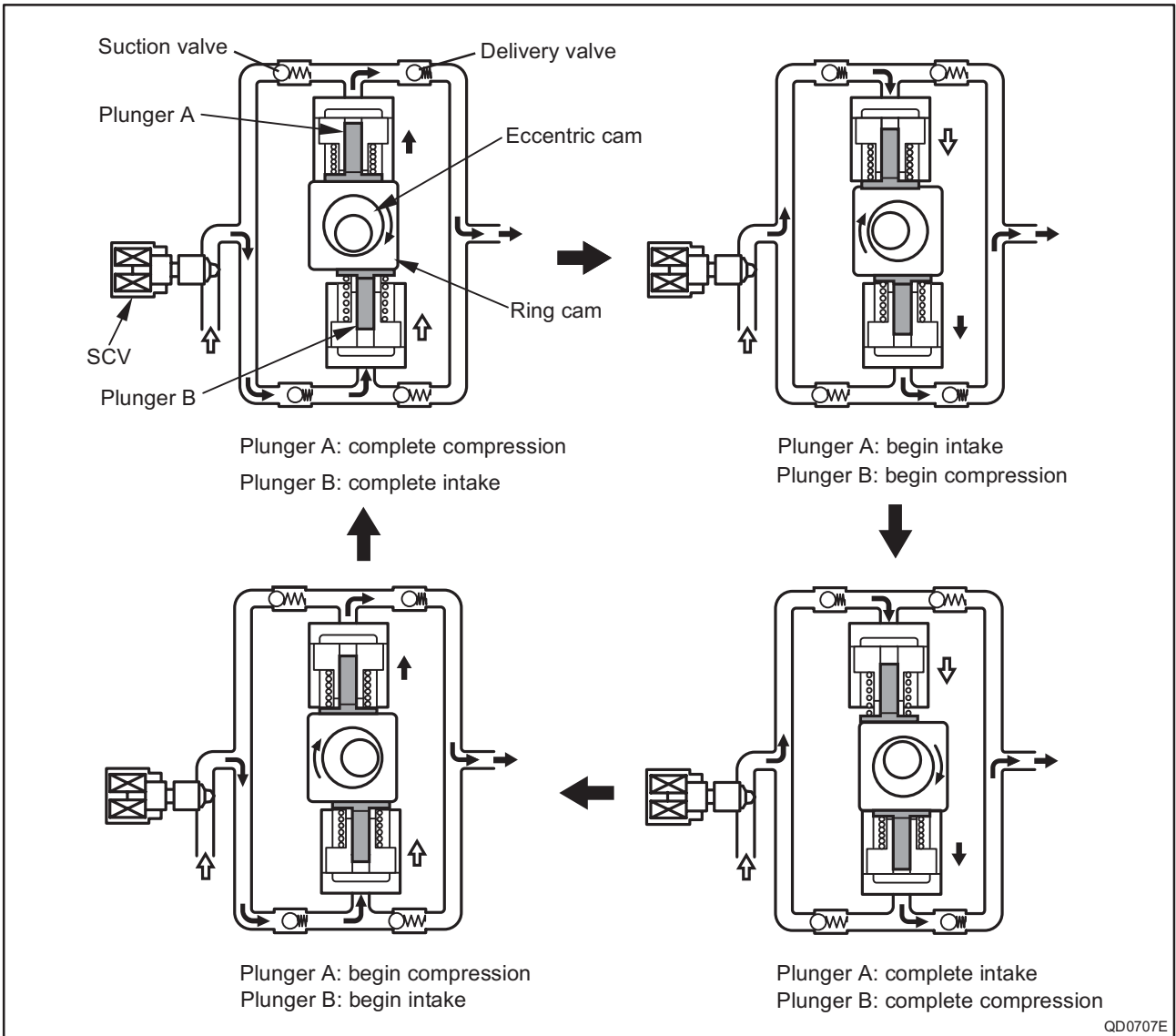
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- The plunger and the suction valve are attached to the ring cam. The feed pump is connected to the rear of the drive shaft.



e. Operation of the Supply Pump

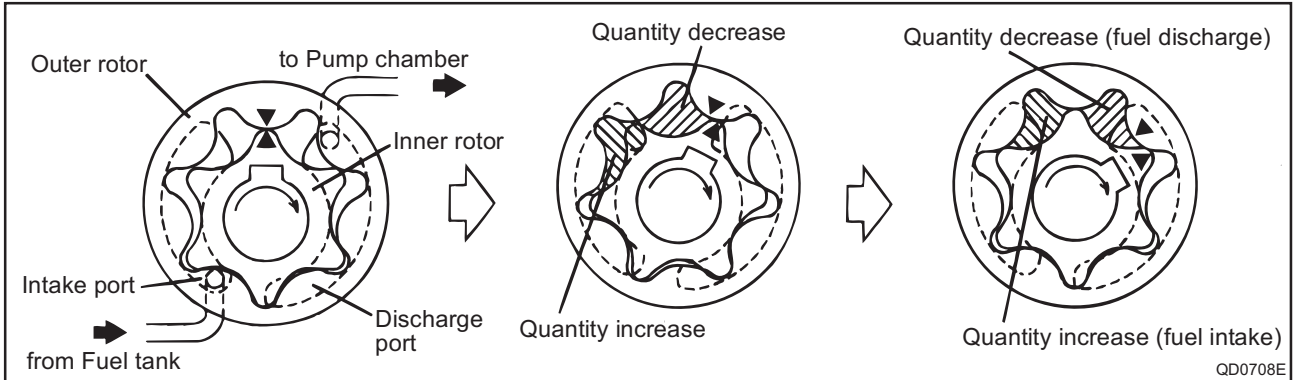
As shown in the illustration below, the rotation of the eccentric cam causes the ring cam to push Plunger A upwards. Due to the spring force, Plunger B is pulled in the opposite direction to Plunger A. As a result, Plunger B draws in fuel, while Plunger A pumps it to the rail.



B. Description of Supply Pump Components

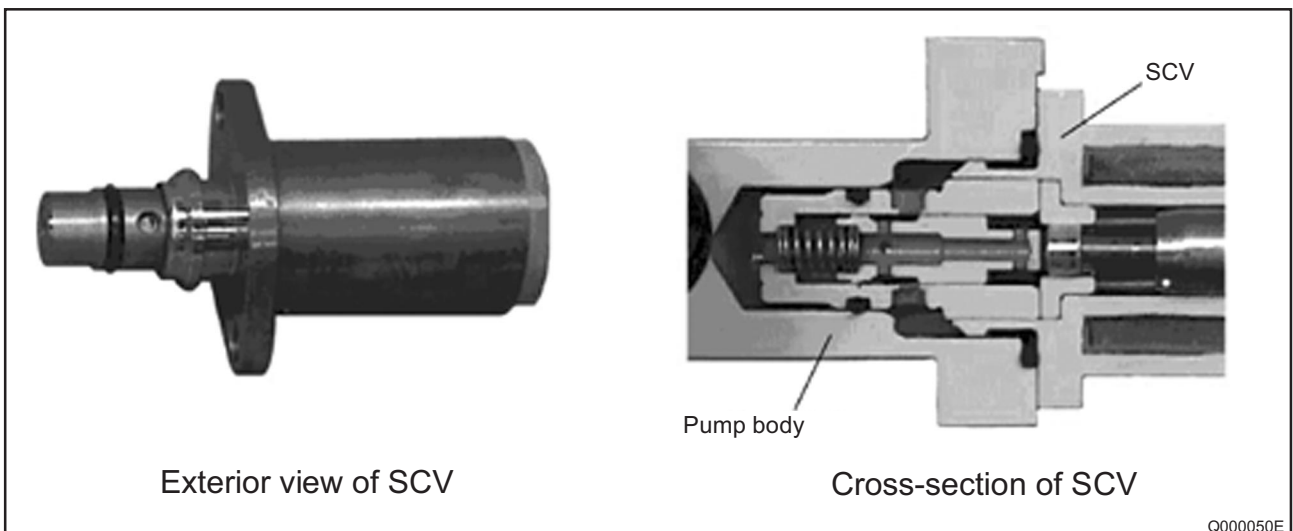
a. Feed Pump

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.

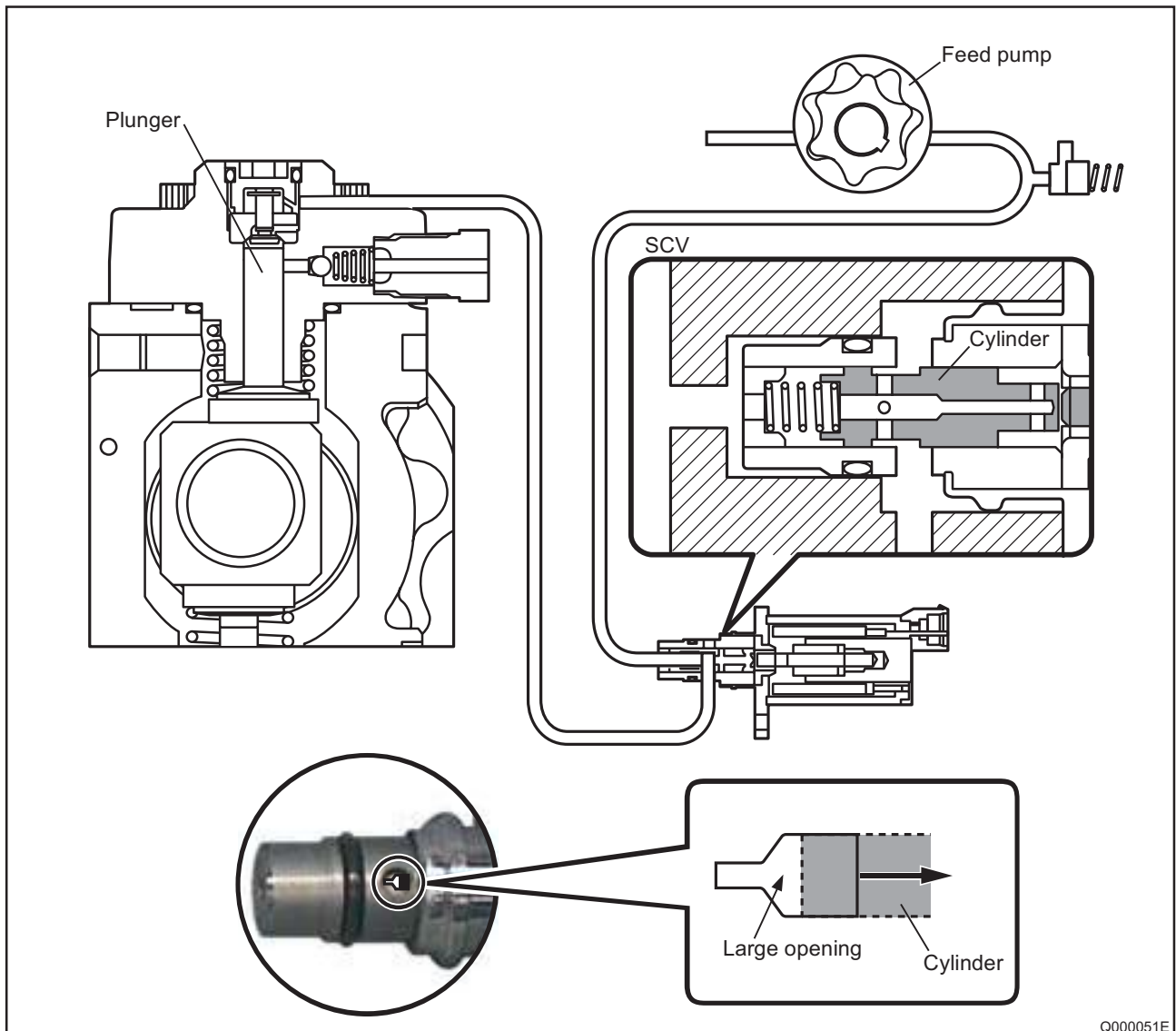


b. SCV: Suction Control Valve

- A linear solenoid type valve has been adopted. The ECU controls the duty ratio (the length of time that the 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 armature to the left side. The armature moves the cylinder to the left side, changing the opening of the fuel passage and thus regulating 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)
- When the SCV is ON, the force of the return spring moves the cylinder to the right, closing the fuel passage (normally opened).
- 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.

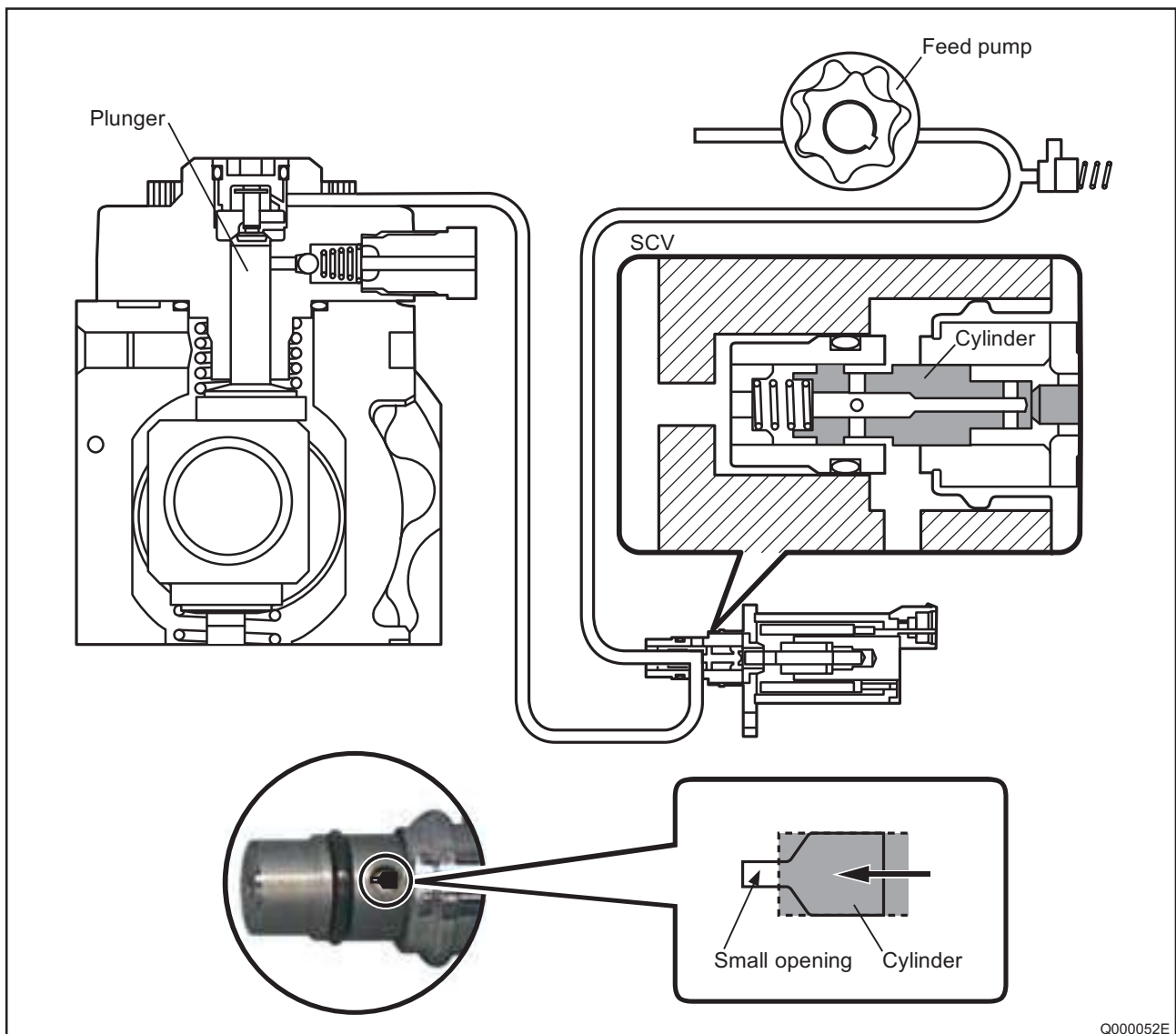


- (1) In case of short duty ON
Short duty ON => large valve opening => maximum intake quantity



(2) In case of long duty ON

Long duty ON => small valve opening => minimum intake quantity

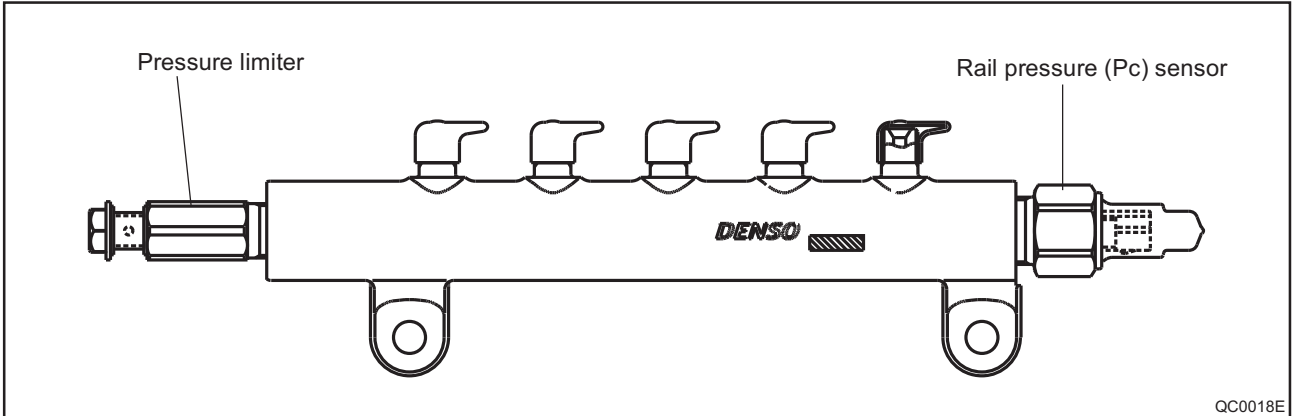


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C. Rail

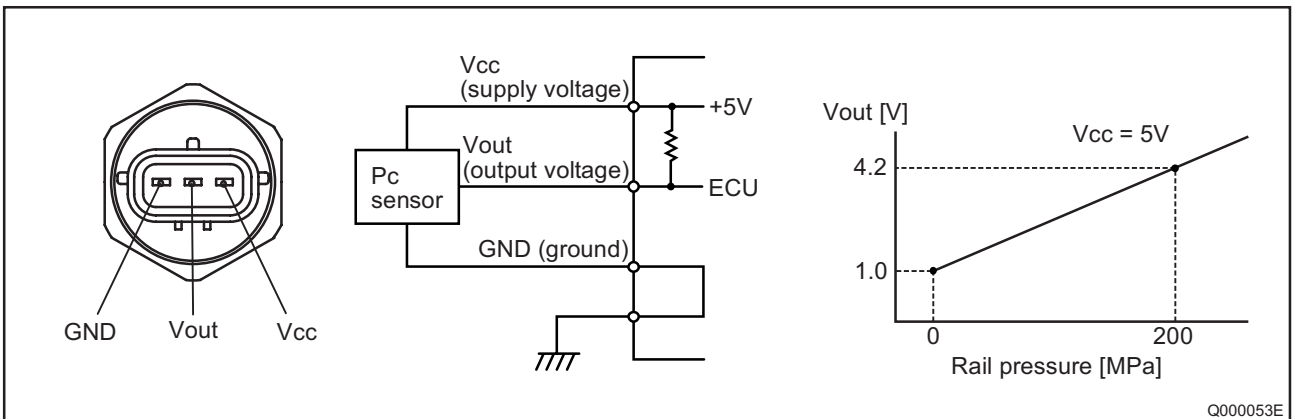
a. Outline

- Stores pressurized fuel (0 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 are adopted in the rail.
- The rail pressure sensor (Pc sensor) detects the fuel pressure in the rail and sends a signal to the engine ECU, while the pressure limiter controls the fuel pressure in the rail. This ensures optimum combustion and reduces combustion noise.



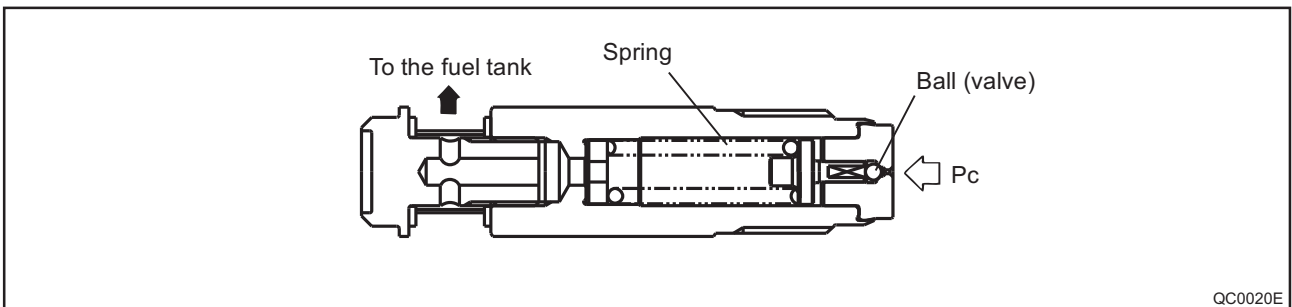
b. Rail Pressure (Pc) Sensor

This sensor detects fuel pressure in the rail and sends a signal to the ECU. It is a semi-conductor type pressure sensor that utilizes the characteristic whereby electrical resistance changes when pressure is applied to silicon.



c. Pressure Limiter (made by another manufacturer)

The pressure limiter relieves pressure by opening the valve if abnormally high pressure is generated. The valve opens when pressure in the rail reaches approximately 200 MPa, and closes when pressure falls to approximately 50 MPa. Fuel leaked by the pressure limiter returns to the fuel tank.



D. Injector

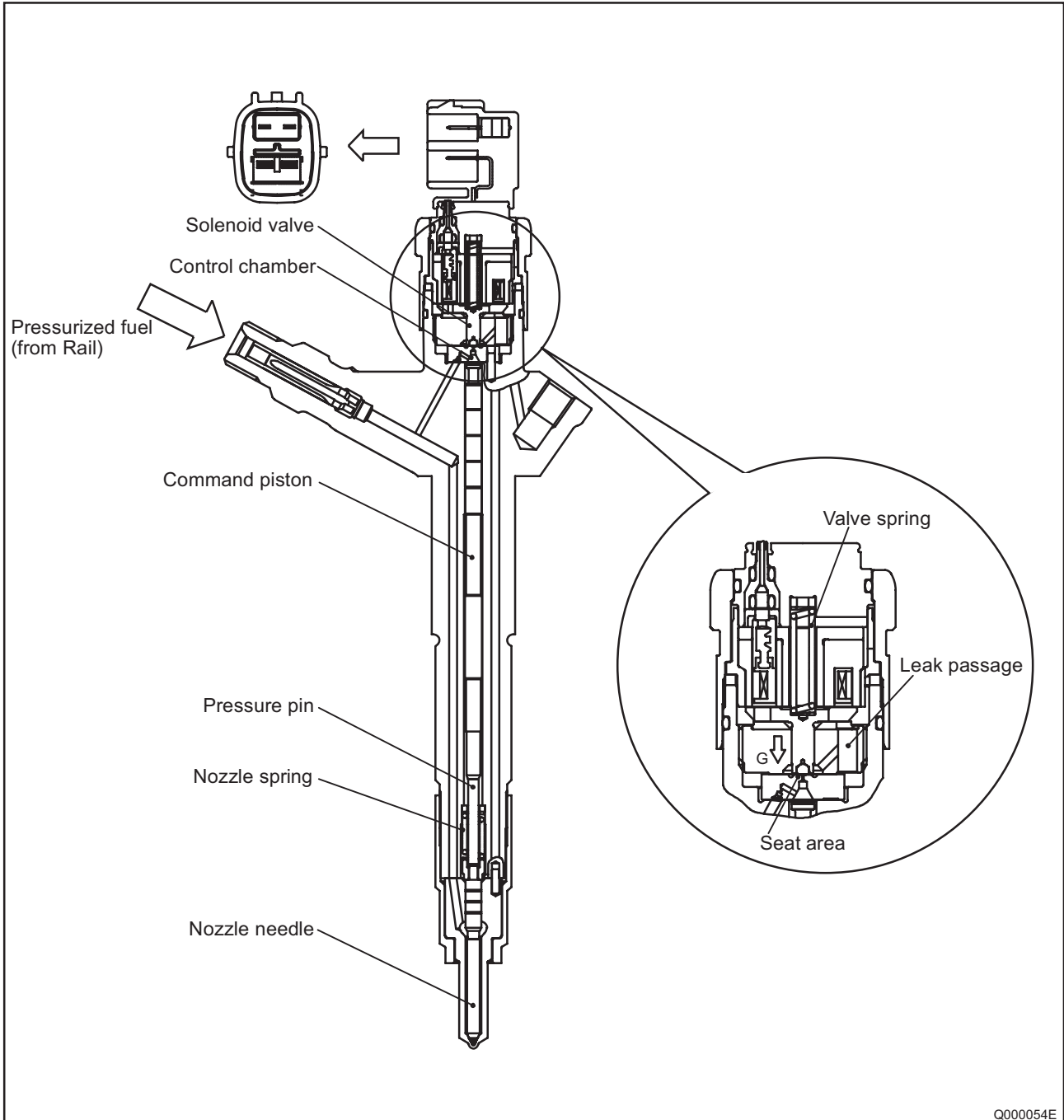
a. Outline

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.

b. Characteristics

- A compact, energy-saving solenoid-control type TWV (Two-Way Valve) injector has been adopted.
- A hollow screw with a damper is fitted in the fuel leak pipe connection to improve the injection precision.

c. Construction



d. Operation

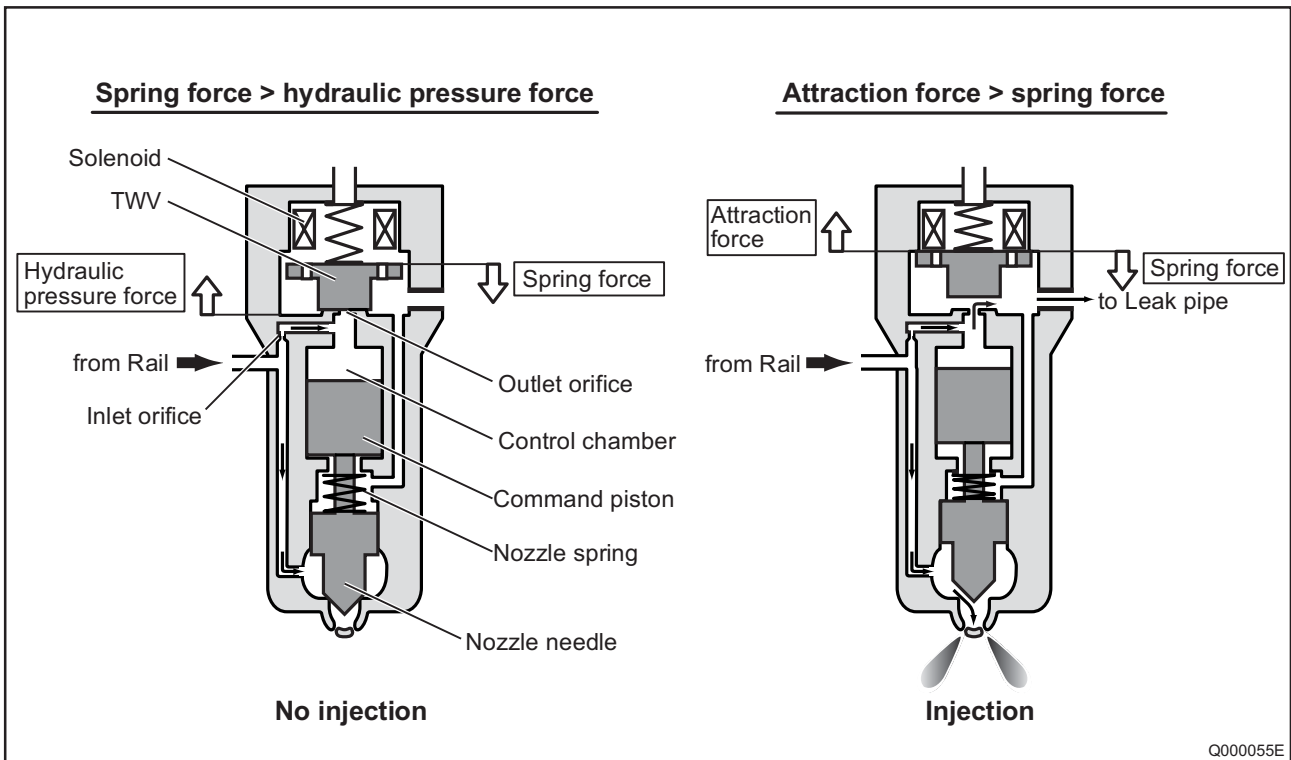
The TWV solenoid valve opens and closes the outlet orifice to control the pressure in the control chamber, and the start and end of injection.

(1) No 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.

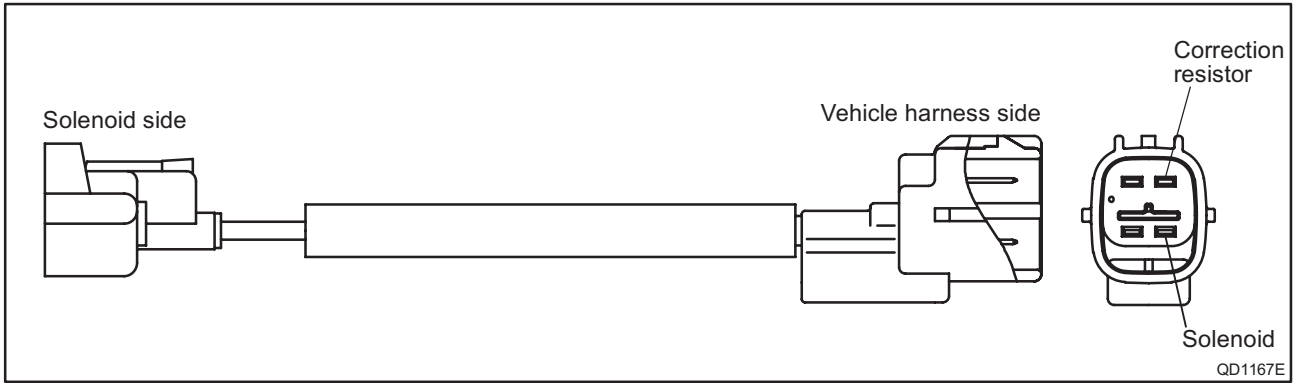
(2) Injection

- When current is initially applied to the solenoid, the attraction of the solenoid pulls the TWV up, effectively opening the outlet orifice and allowing the 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 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 nozzle needle lifts it upward, which helps to improve the nozzle's opening and closing response.
- 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 TWV falls, causing the nozzle needle to close immediately and the injection to stop.



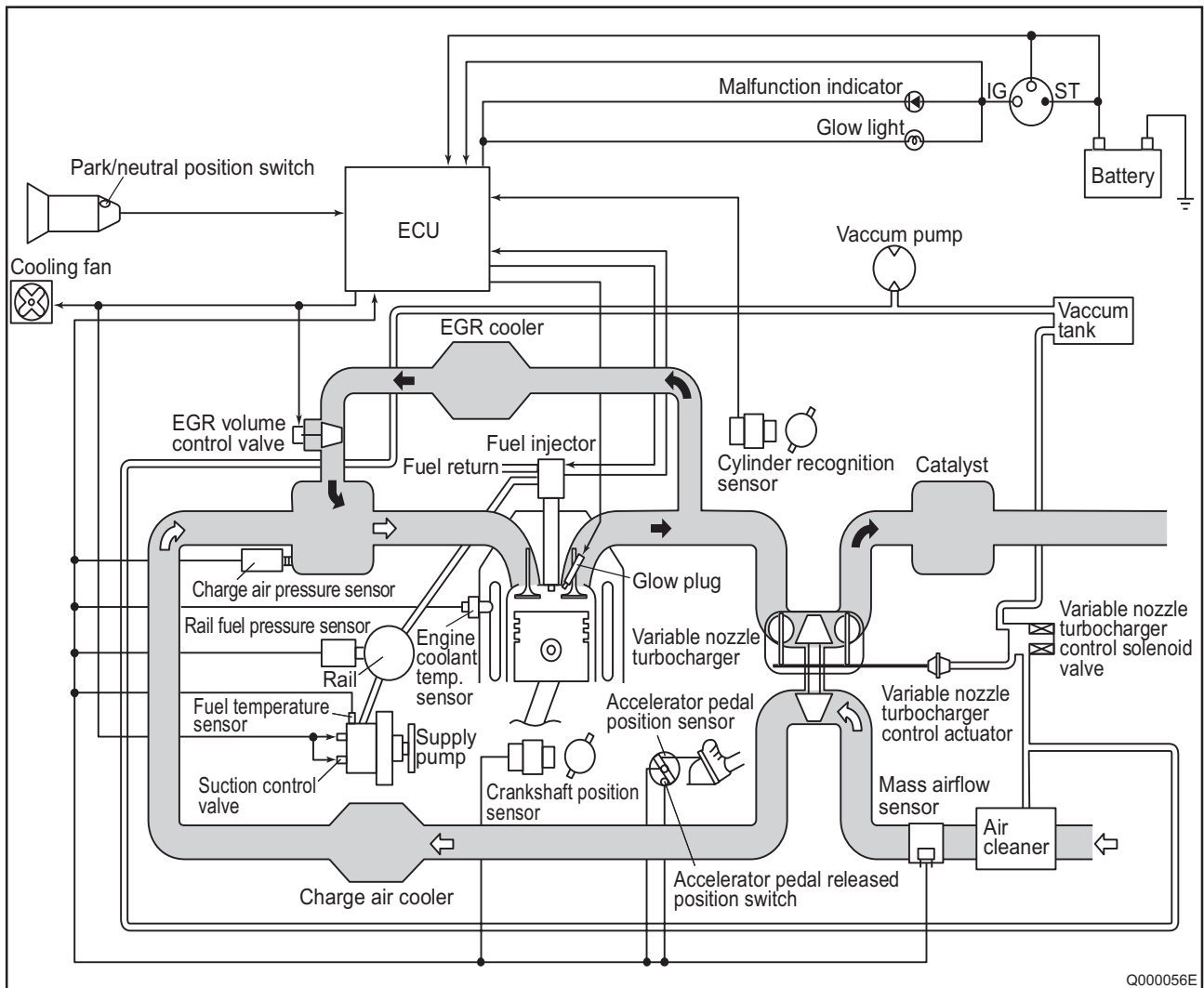
e. Harness Connector with Correction Resistor

A correction resistor is provided in the harness connector (4-pin connector) of each injector to minimize the variances in the injection volume among the cylinders (adjusted in the production line).



3-2. Description of Control System Components

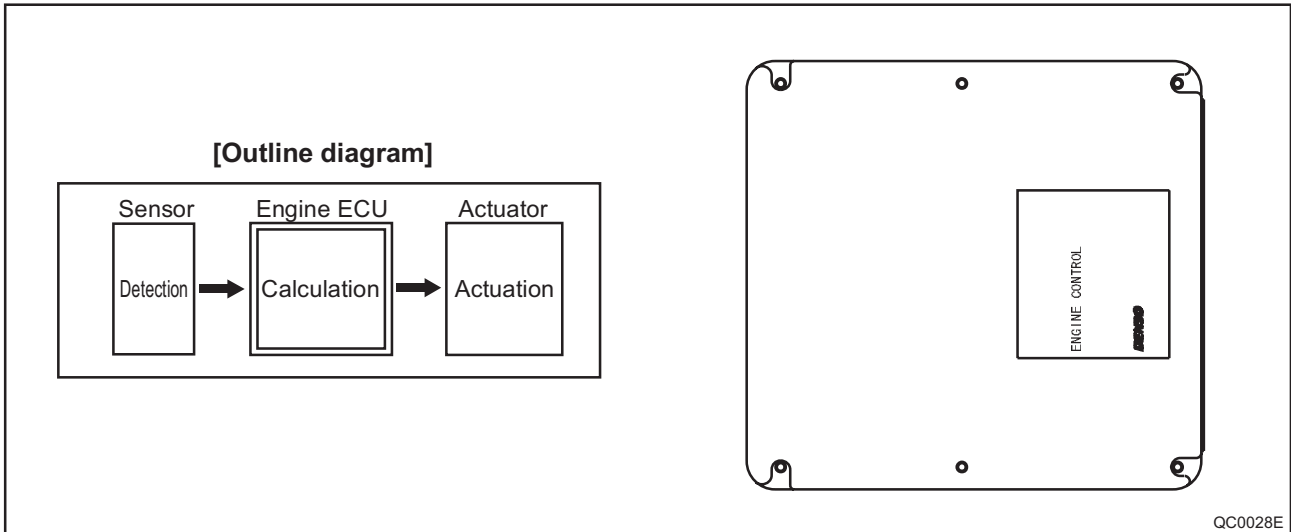
A. Engine Control System Diagram



B. ECU (Electronic Control Unit)

a. Outline

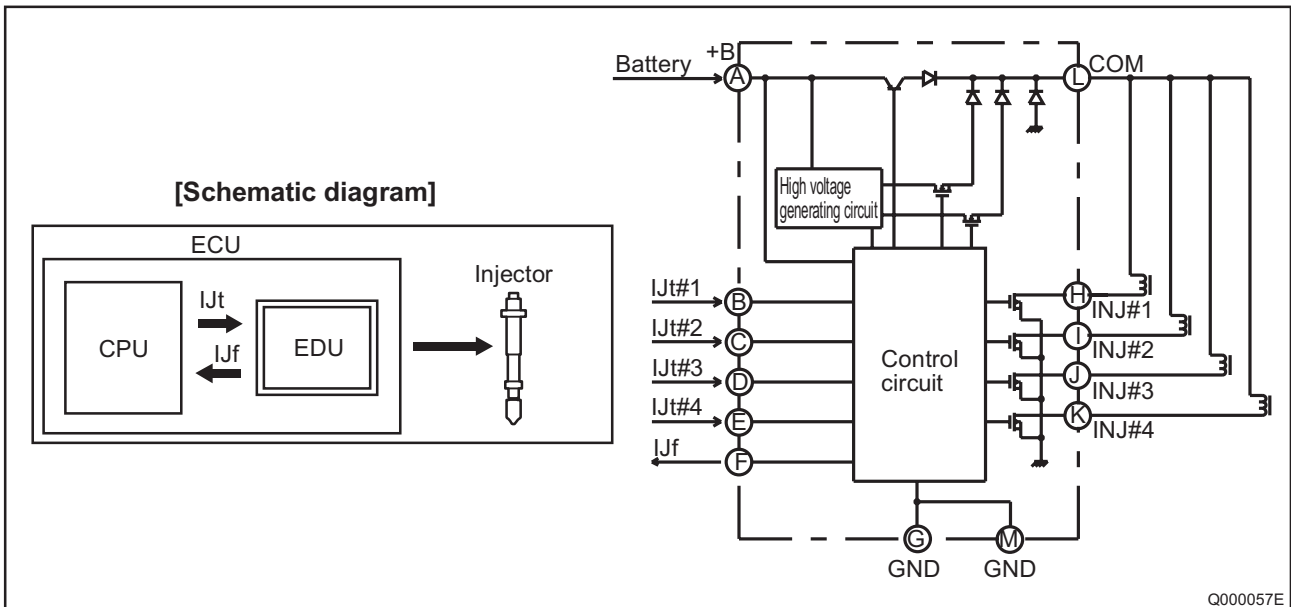
- This is the command center that controls the fuel injection system and engine operation in general.



- The EDU is contained inside the ECU. The EDU has been adapted to support the high-speed actuation of the injectors. The high-speed actuation of the injector solenoid valve is made possible through the use of a high-voltage generating device (DC/DC converter).

b. EDU Operation

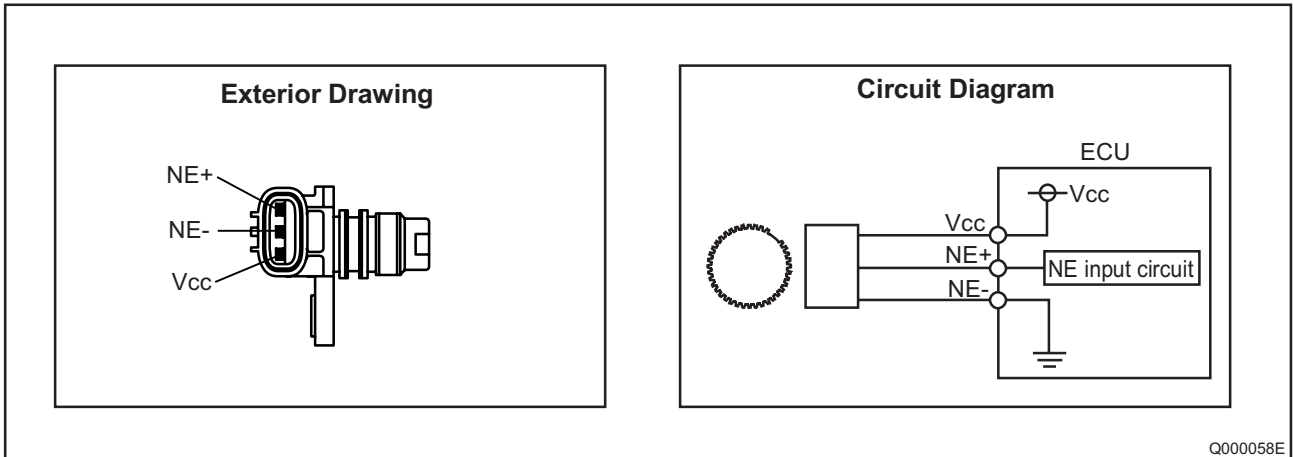
The high-voltage generating device converts the battery voltage into a high voltage. The Engine ECU sends signals to terminals B through E of the EDU in accordance with the signals from the sensors. Upon receiving these signals, the EDU outputs signals to the injectors from terminals H through K.



C. Description of Sensors

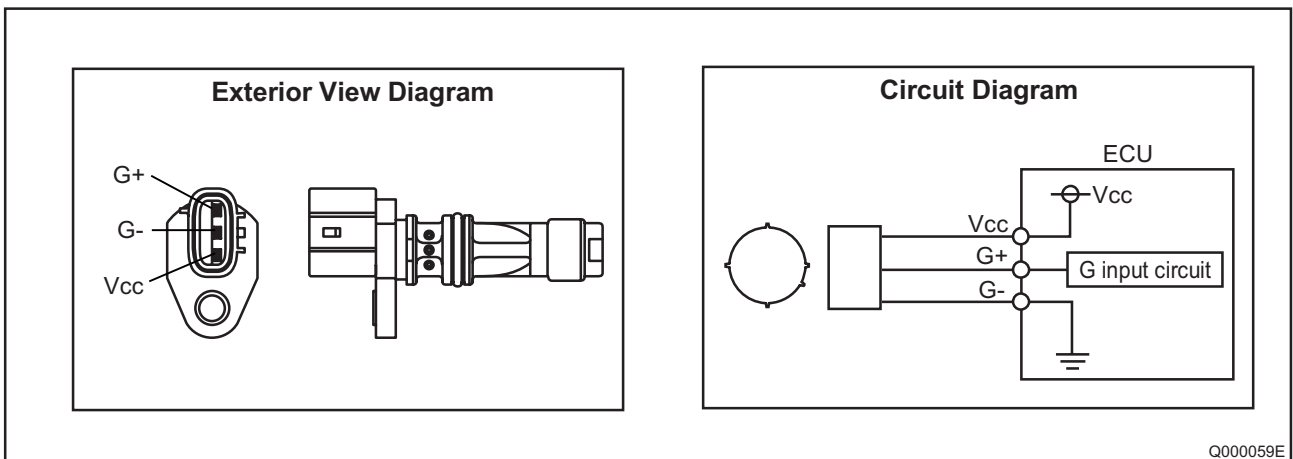
a. Crankshaft Position Sensor (NE)

An NE pulsar attached to the crankshaft timing gear outputs a signal for detecting the crankshaft angle and engine speed.



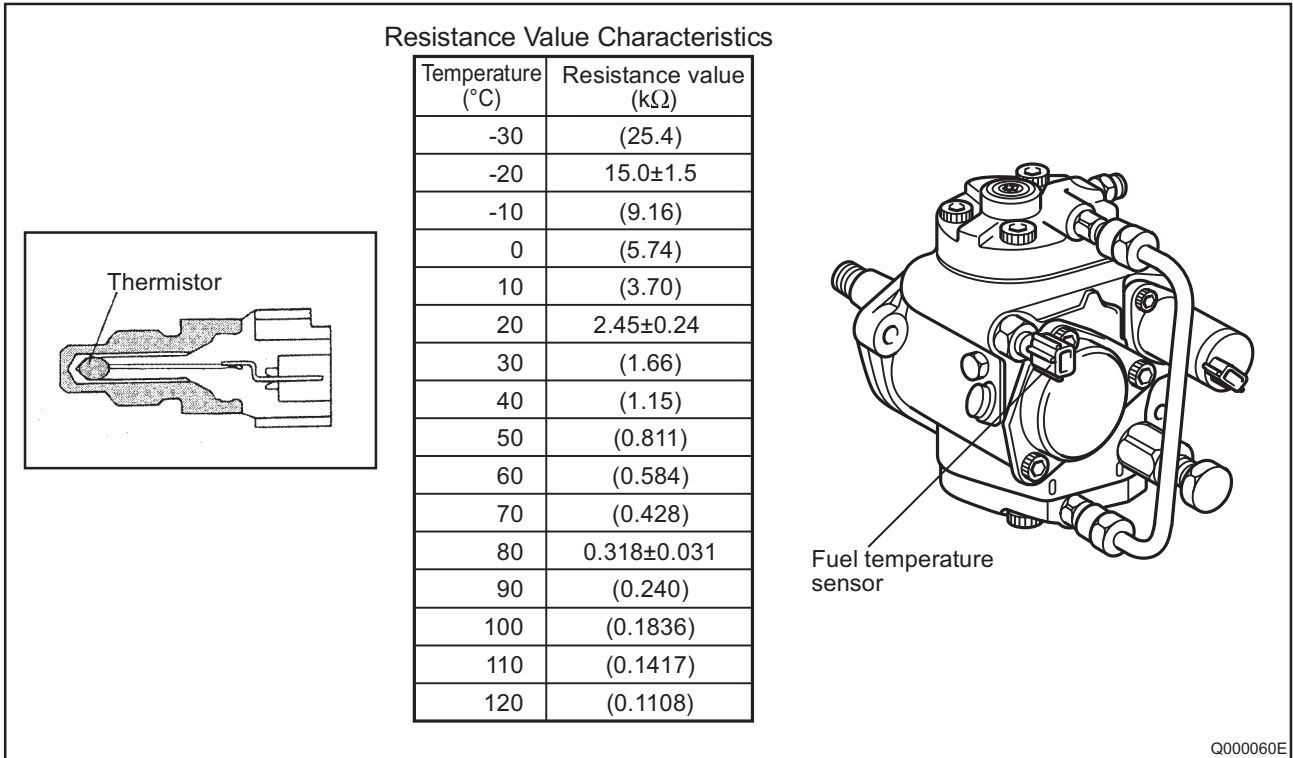
b. Cylinder Recognition Sensor (G)

A cylinder recognition sensor (G pulsar) is attached to the supply pump timing gear, and outputs a cylinder recognition signal so that the ECU can calculate fuel injection timing.



c. Fuel Temperature Sensor (THF)

- The fuel temperature sensor is mounted on the supply pump, and detects the fuel temperature, sending a signal to the engine ECU.
- The detection component utilizes a thermistor.



3-3. Various Types of Controls

A. 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.

a. 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.

b. 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.

c. Fuel Injection Rate Control Function

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

d. Fuel Injection Pressure Control Function (Rail Pressure Control Function)

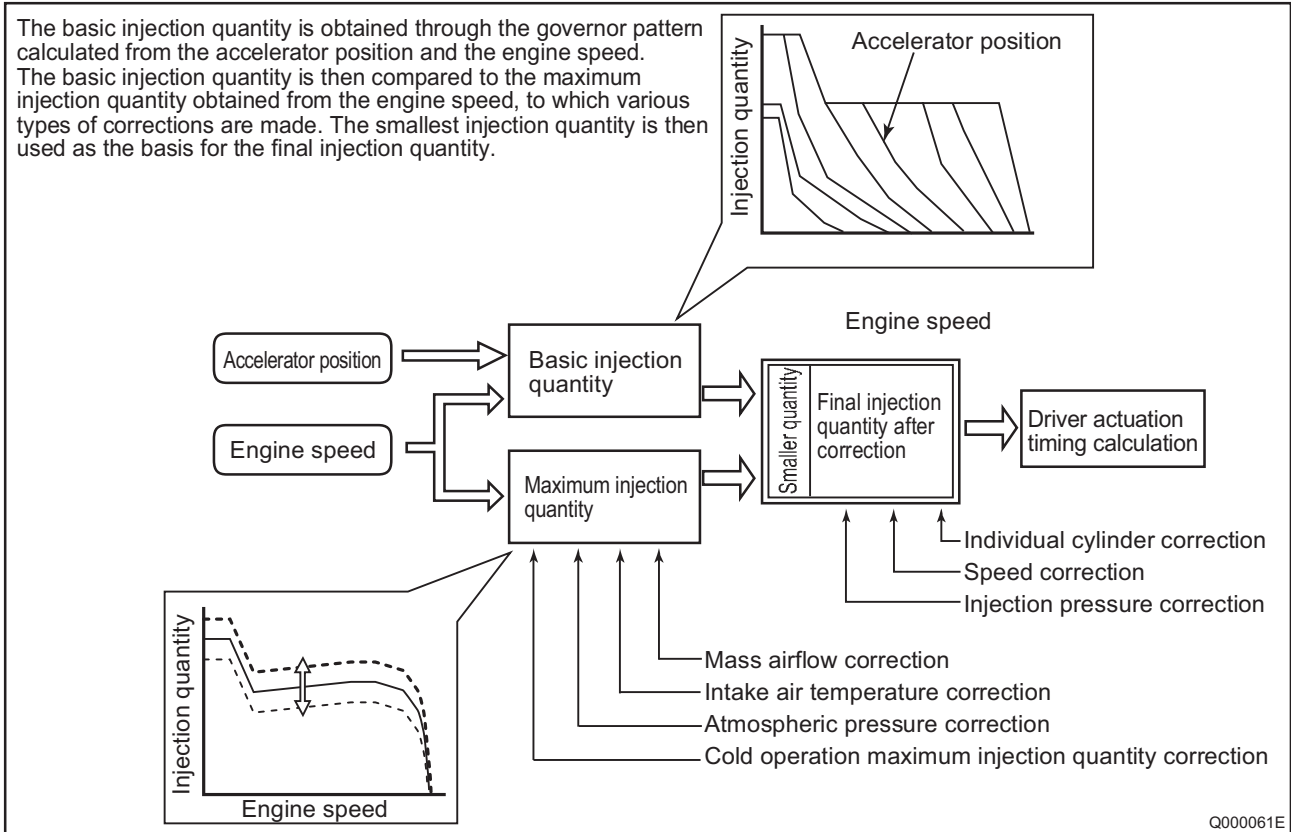
The fuel injection pressure control function (rail pressure control function) controls the discharge volume of the pump by measuring the fuel pressure at the rail pressure sensor and feeding it back to the ECU. It effects pressure feedback control so that the discharge volume matches the optimal (command)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

B. Fuel Injection Quantity Control

a. Outline

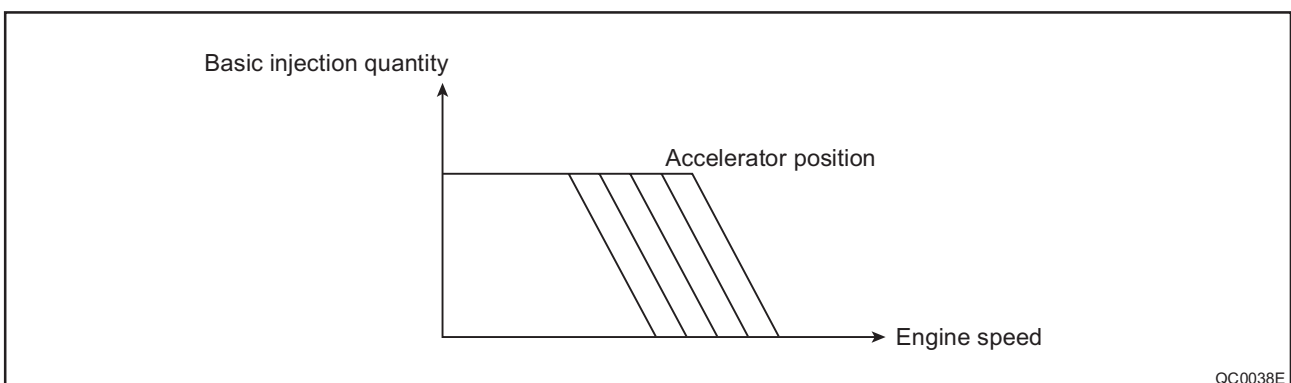
This control determines the fuel injection quantity by adding coolant temperature, fuel temperature, intake air temperature, and mass airflow corrections to the basic injection quantity that is calculated by the engine ECU, based on the engine operating conditions and driving conditions.

b. Injection Quantity Calculation Method



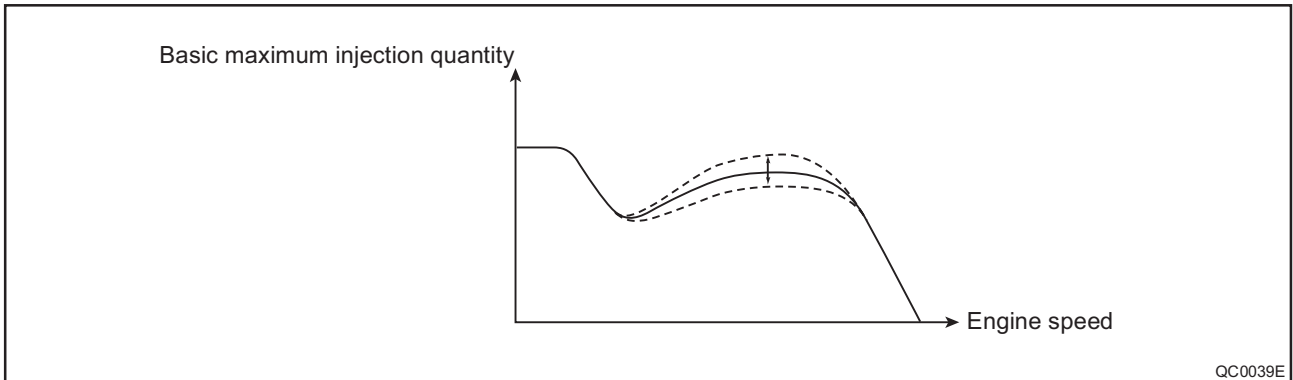
c. Basic Injection Quantity

The basic injection quantity is determined by the engine speed (NE) and the accelerator position. The injection quantity is increased when the accelerator position signal is increased while the engine speed remains constant.



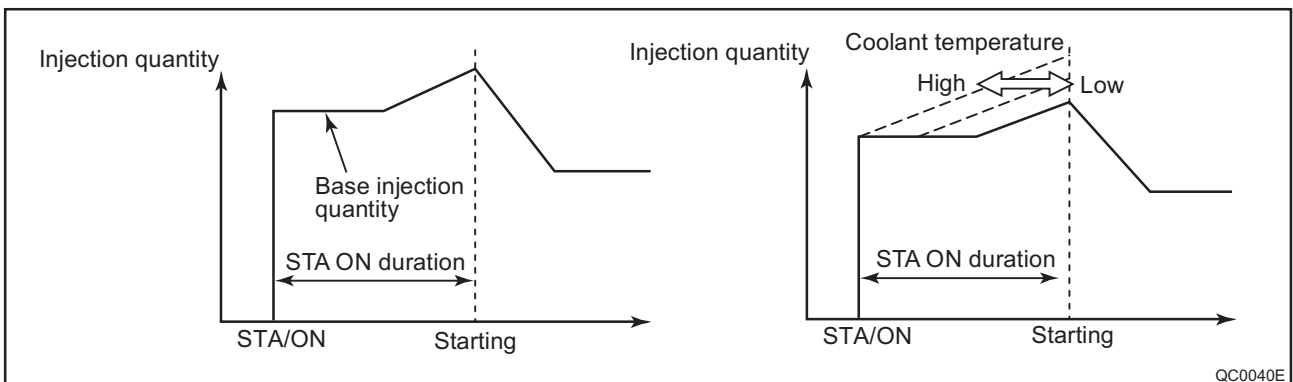
d. Maximum Injection Quantity

The maximum injection quantity is calculated by adding the mass airflow correction, intake air temperature correction, atmospheric pressure correction and the cold operation maximum injection quantity correction to the basic maximum injection quantity that is determined by the engine speed.



e. Starting Injection Quantity

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

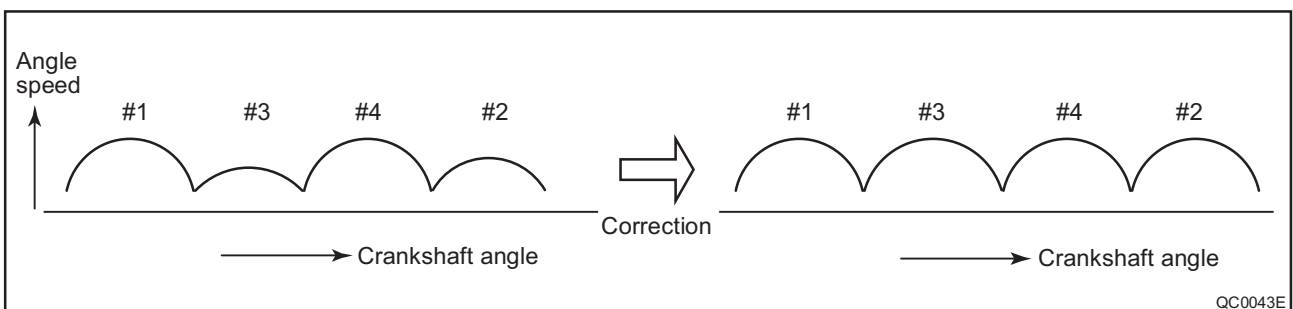


f. Idle Speed Control (ISC) System

This system controls the idle speed by regulating the injection quantity in order to match the actual speed to the target speed that is calculated by the engine ECU. The target speed varies according to the type of transmission (manual or automatic), whether the air conditioner is ON or OFF, the shift position, and the coolant water temperature.

g. Idle Vibration Reduction Control

To reduce engine vibrations during idle, this function compares the angle speeds (times) of the cylinders and regulates the injection quantity for the individual cylinders if there is a large the difference, in order to achieve a smooth engine operation.



C. Fuel Injection Timing Control

a. Outline

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

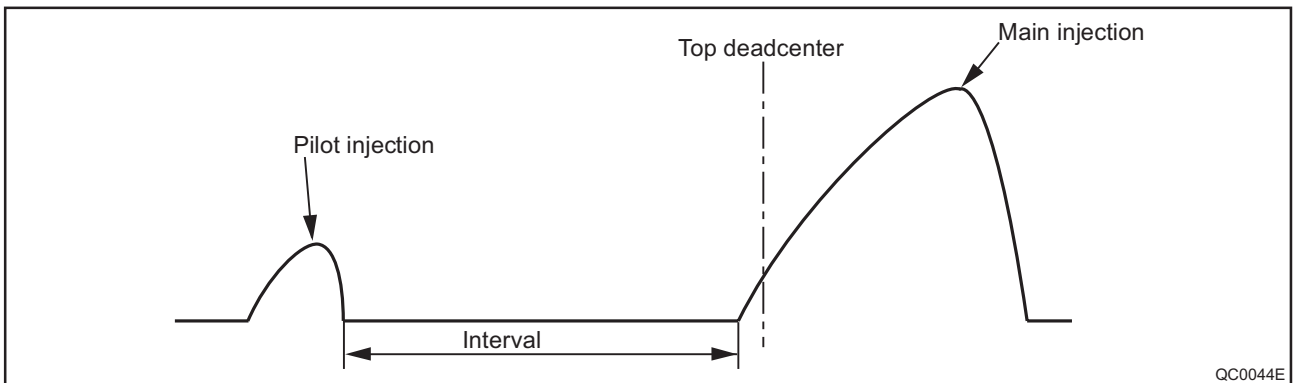
b. Main and Pilot Injection Timing Control

(1) Main Injection Timing

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

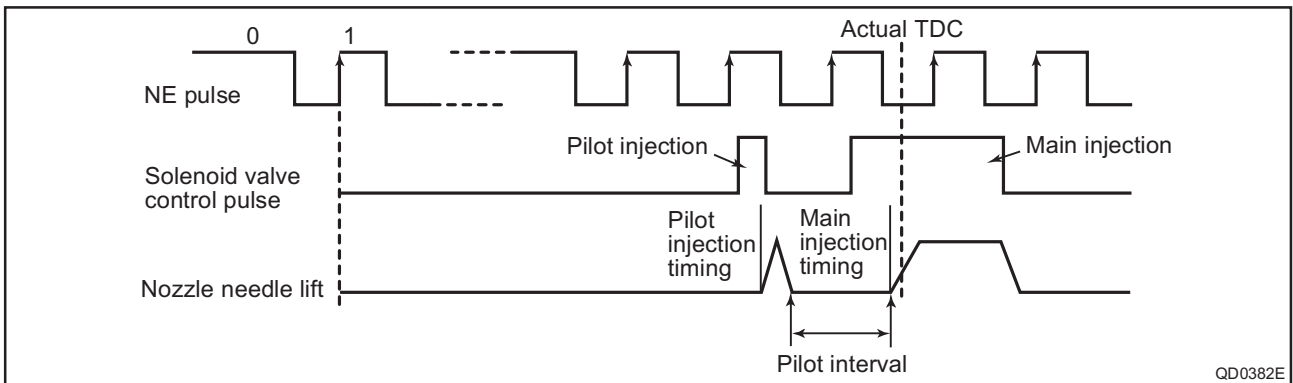
(2) Pilot Injection Timing (Pilot Interval)

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 (map correction). The pilot interval at the time the engine is started is calculated from the coolant temperature and speed.

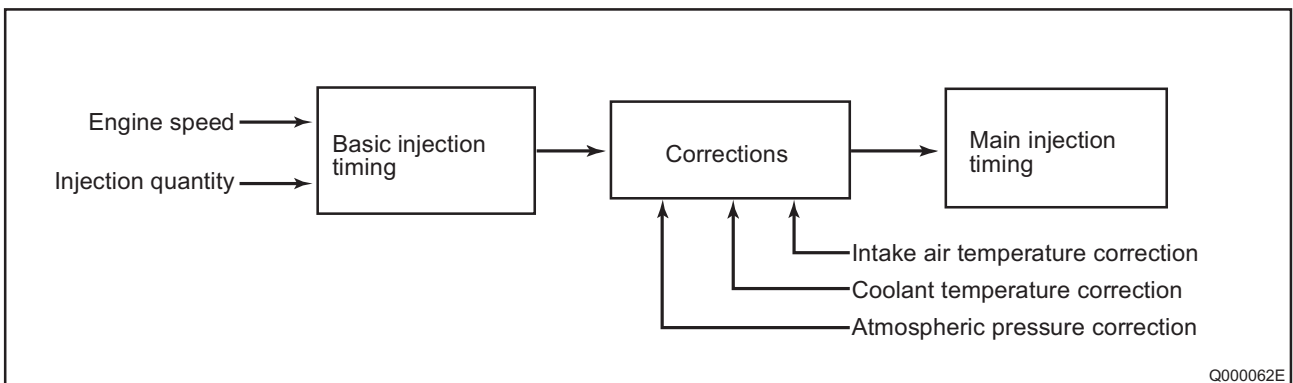


c. Injection Timing Calculation Method

(1) Outline of Control Timing

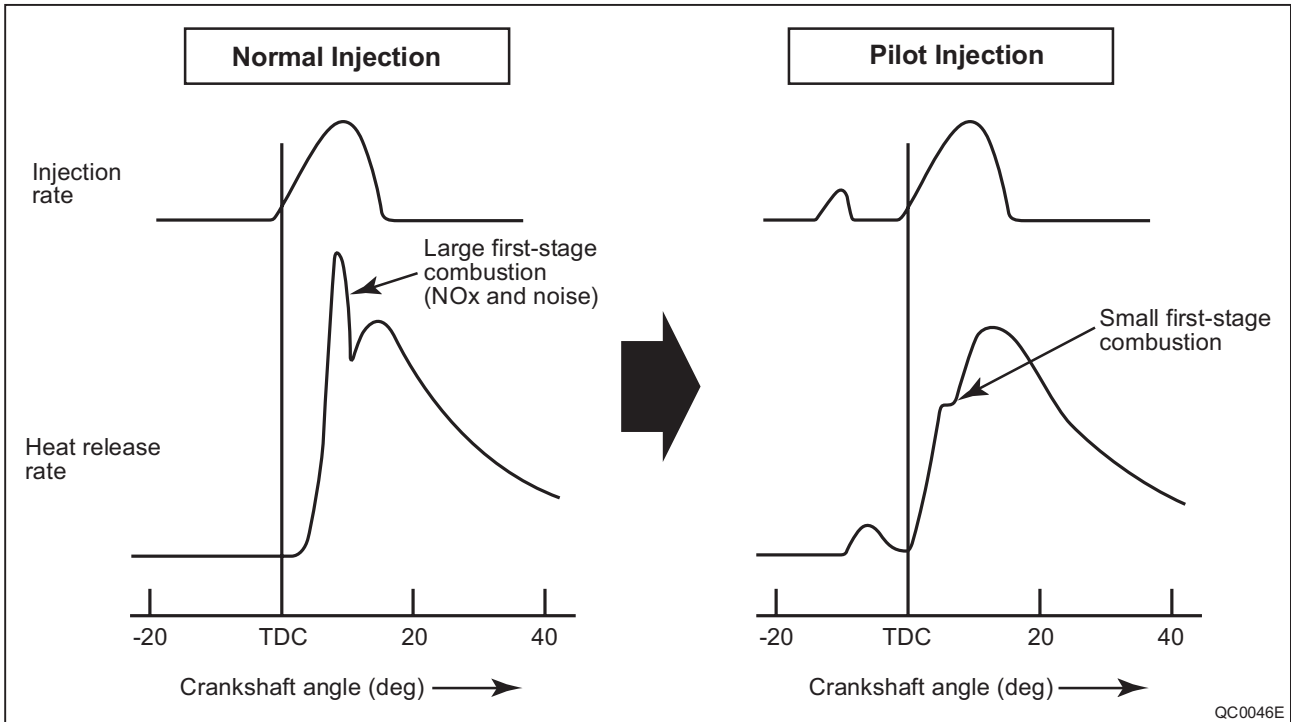


(2) Injection Timing Calculation Method



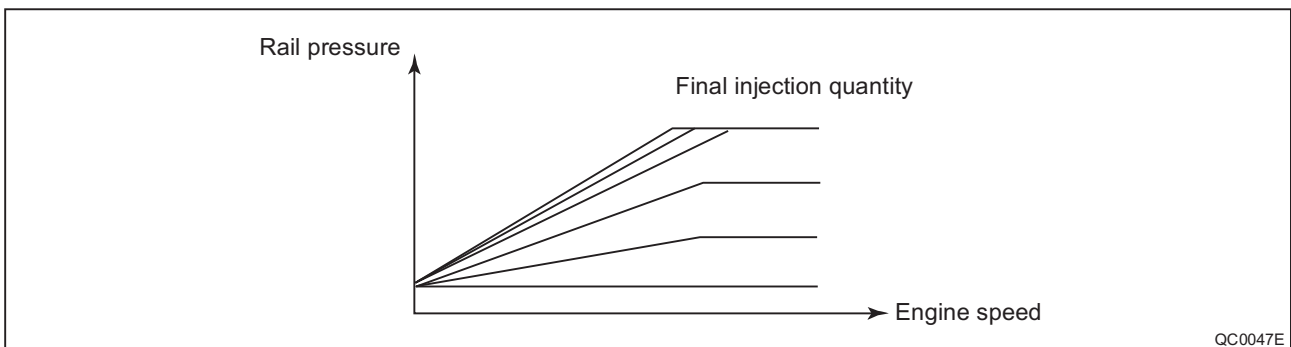
D. Fuel Injection Rate Control

While the injection rate increases with the adoption of high-pressure fuel injection, the ignition lag, which is the delay from the start of injection 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 injection rate, prevent the explosive first-stage combustion, and reduce noise and NO_x.



E. Fuel Injection Pressure Control

A value that is determined by the final injection quantity, the water temperature and the engine speed is calculated. During the starting of the engine, the calculation is based on the water temperature and the atmospheric pressure



F. Other Controls

- Limit maximum injection quantity
- Gradual acceleration injection quantity
- Gradual deceleration injection quantity
- Post-acceleration damping injection quantity
- Reference injection quantity
- Fuel cutoff
- EGR
- Turbo control
- Glow plug relay

4 DTC (Diagnosis Trouble Codes) Table

4-1. About the Codes shown in the table

- The "SAE" under the DTC code indicates the codes that are output when the STT (DST-1) is used, and the "Light" indicates the codes that are output when the CHECK ENGINE warning light is used. (SAE: Society of Automotive Engineers, U.S.A.)
- If multiple DTCs are output, they are shown in order starting with the lowest number.

4-2. DTC (Diagnosis Trouble Code) Table

*1: The area with *1 are purely vehicle side.

Code No.	Diagnostic Item	Description of Diagnosis	Inspection Area
U1000 *1	CAN communication line	ECM cannot communicate with other control units. ECM cannot communicate for more than the specified time.	Harness or connectors (CAN communication line is open or shorted)
P0016	Crankshaft position-camshaft position correlation	The correlation between the crankshaft position sensor signal and camshaft position sensor signal is outside the normal range.	Timing chain Signal plate
P0088	Fuel rail pressure too high	Fuel pressure is excessively higher than the specified value.	Fuel pump Harness or connectors (The fuel pump circuit is open or shorted.)
P0089	Fuel pump performance	Fuel pressure is too much higher than the target value.	Fuel pump
P0093	Fuel system leak	"ECM detects a fuel system leak". (The relation between the output voltage to the fuel pump and the input voltage from the fuel rail pressure sensor is outside the normal range.)	Fuel pump Fuel rail Fuel pipe Fuel rail pressure relief valve
P0102	Mass airflow sensor circuit low input	Excessively low voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Mass airflow sensor
P0103	Mass airflow sensor circuit high input	Excessively high voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Mass airflow sensor
P0112	Intake air temperature sensor circuit low input	Excessively low voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Intake air temperature sensor

Code No.	Diagnostic Item	Description of Diagnosis	Inspection Area
P0113	Intake air temperature sensor circuit high input	Excessively high voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Intake air temperature sensor
P0117	Engine coolant temperature sensor circuit low input	Excessively low voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Engine coolant temperature sensor
P0118	Engine coolant temperature sensor circuit high input	Excessively high voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Engine coolant temperature sensor
P0122	Accelerator pedal position sensor 1 circuit low input	Excessively low voltage from the APP sensor 1 to the ECM.	Harness or connectors (The APP sensor 1 circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 1)
P0123	Accelerator pedal position sensor 1 circuit high input	Excessively high voltage from the APP sensor 1 to the ECM.	Harness or connectors (The APP sensor 1 circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 1)
P0182	Fuel pump temperature sensor circuit low input	Excessively low voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Fuel pump temperature sensor
P0183	Fuel pump temperature sensor circuit high input	Excessively high voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Fuel pump temperature sensor
P0192	Fuel rail pressure sensor circuit low input	Excessively low voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Fuel rail pressure sensor
P0193	Fuel rail pressure sensor circuit high input	Excessively high voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Fuel rail pressure sensor
P0200	Fuel injector power supply circuit	ECM detects an excessively high/low voltage from the fuel injection power source.	ECM

Code No.	Diagnostic Item	Description of Diagnosis	Inspection Area
P0201	No. 1 cylinder fuel injector circuit open	An improper voltage signal is sent to the ECM by the No. 1 cylinder fuel injector.	Harness or connectors (The sensor circuit is open or shorted.) Fuel injector #1
P0202	No. 2 cylinder fuel injector circuit open	An improper voltage signal is sent to the ECM by the No. 2 cylinder fuel injector.	Harness or connectors (The sensor circuit is open or shorted.) Fuel injector #2
P0203	No. 3 cylinder fuel injector circuit open	An improper voltage signal is sent to the ECM by the No. 3 cylinder fuel injector.	Harness or connectors (The sensor circuit is open or shorted.) Fuel injector #3
P0204	No. 4 cylinder fuel injector circuit open	An improper voltage signal is sent to the ECM by the No. 4 cylinder fuel injector.	Harness or connectors (The sensor circuit is open or shorted.) Fuel injector #4
P0217	Engine overheating	Cooling fan does not operate properly (overheating). Cooling fan system does not operate properly (overheating). Engine coolant was not added to the system using the proper filling method.	Harness or connectors (The cooling fan circuit is open or shorted.) Cooling fan Radiator hose Radiator Radiator cap Water pump Thermostat
P0222	Accelerator pedal position sensor 2 circuit low input	Excessively low voltage from the APP sensor 2 to the ECM.	Harness or connectors (The APP sensor 2 circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 2)
P0223	Accelerator pedal position sensor 2 circuit high input	Excessively high voltage from the APP sensor 2 to the ECM.	Harness or connectors (The APP sensor 2 circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 2)
P0234	Turbocharger overboost condition	ECM detects excessively high turbocharger boost pressure.	Turbocharger Vacuum hose (YD22DDTi engine models) Turbocharger boost control solenoid valve (YD22DDTi engine models)

Code No.	Diagnostic Item	Description of Diagnosis	Inspection Area
P0237	Turbocharger boost sensor circuit low input	Excessively low voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Turbocharger boost sensor
P0238	Turbocharger boost sensor circuit high input	Excessively high voltage from the sensor to the ECM.	Harness or connectors (The sensor circuit is open or shorted.) Turbocharger boost sensor
P0335	Crankshaft position sensor circuit	Crankshaft position sensor signal is not detected by the ECM when the engine is running.	Harness or connectors (The sensor circuit is open or shorted.) Crankshaft position sensor
P0336	Crankshaft position sensor circuit range/performance	Crankshaft position sensor signal is not the normal pattern when the engine is running.	Crankshaft position sensor Signal plate
P0340	Camshaft position sensor circuit	Camshaft position sensor signal is not detected by the ECM when the engine is running.	Harness or connectors (The sensor circuit is open or shorted.) Camshaft position sensor
P0341	Camshaft position sensor circuit range/performance	Camshaft position sensor signal is not the normal pattern when the engine is running.	Camshaft position sensor Signal plate
P0563	Battery voltage high	Excessively high voltage from the battery to the ECM.	Battery Battery terminal Alternator
P0605	Engine control module (ROM)	ECM ROM is malfunctioning.	ECM
P0606	Engine control module (Processor)	ECM calculation function is malfunctioning.	ECM
P0628	Fuel pump control circuit low input	ECM detects a fuel pump control circuit is open or short to the ground.	Harness or connectors (The fuel pump circuit is open or shorted.) Fuel pump
P0629	Fuel pump control circuit high input	ECM detects a fuel pump control circuit is short to power source.	Harness or connectors (The fuel pump circuit is open or shorted.) Fuel pump
P0642	Accelerator pedal position sensor 1 power supply circuit low	ECM detects an excessively low APP sensor 1 power source.	Harness or connectors (The APP sensor 1 power supply circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 1)

Code No.	Diagnostic Item	Description of Diagnosis	Inspection Area
P0643	Accelerator pedal position sensor 1 power supply circuit high	ECM detects an excessively high APP sensor 1 power source.	Harness or connectors (The APP sensor 1 power supply circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 1)
P0652	Accelerator pedal position sensor 2 power supply circuit low	ECM detects an excessively low APP sensor 2 power source.	Harness or connectors (The APP sensor 2 power supply circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 2)
P0653	Accelerator pedal position sensor 2 power supply circuit high	ECM detects an excessively high APP sensor 2 power source.	Harness or connectors (The APP sensor 2 power supply circuit is open or shorted.) Accelerator pedal position sensor (Accelerator pedal position sensor 2)
P0686	ECM relay circuit	ECM detects ECM relay is stuck closed even if the ignition switch OFF.	Harness or connectors (The ECM relay circuit is shorted.) ECM relay
P1211 *1	TCS control unit	ECM received malfunction information from the ESP/TCS/ABS control unit.	ESP/TCS/ABS control unit TCS related parts
P1212 *1	TCS communication line	ECM cannot continuously receive information from the ESP/TCS/ABS control unit.	Harness or connectors (The CAN communication line is open or shorted.) ESP/TCS/ABS control unit Dead (Weak) battery
P1260	No. 1 cylinder fuel injector adjustment resistor low input	Excessively low voltage from the No. 1 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #1
P1261	No. 1 cylinder fuel injector adjustment resistor high input	Excessively high voltage from the No. 1 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #1
P1262	No. 3 cylinder fuel injector adjustment resistor low input	Excessively low voltage from the No. 3 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #3

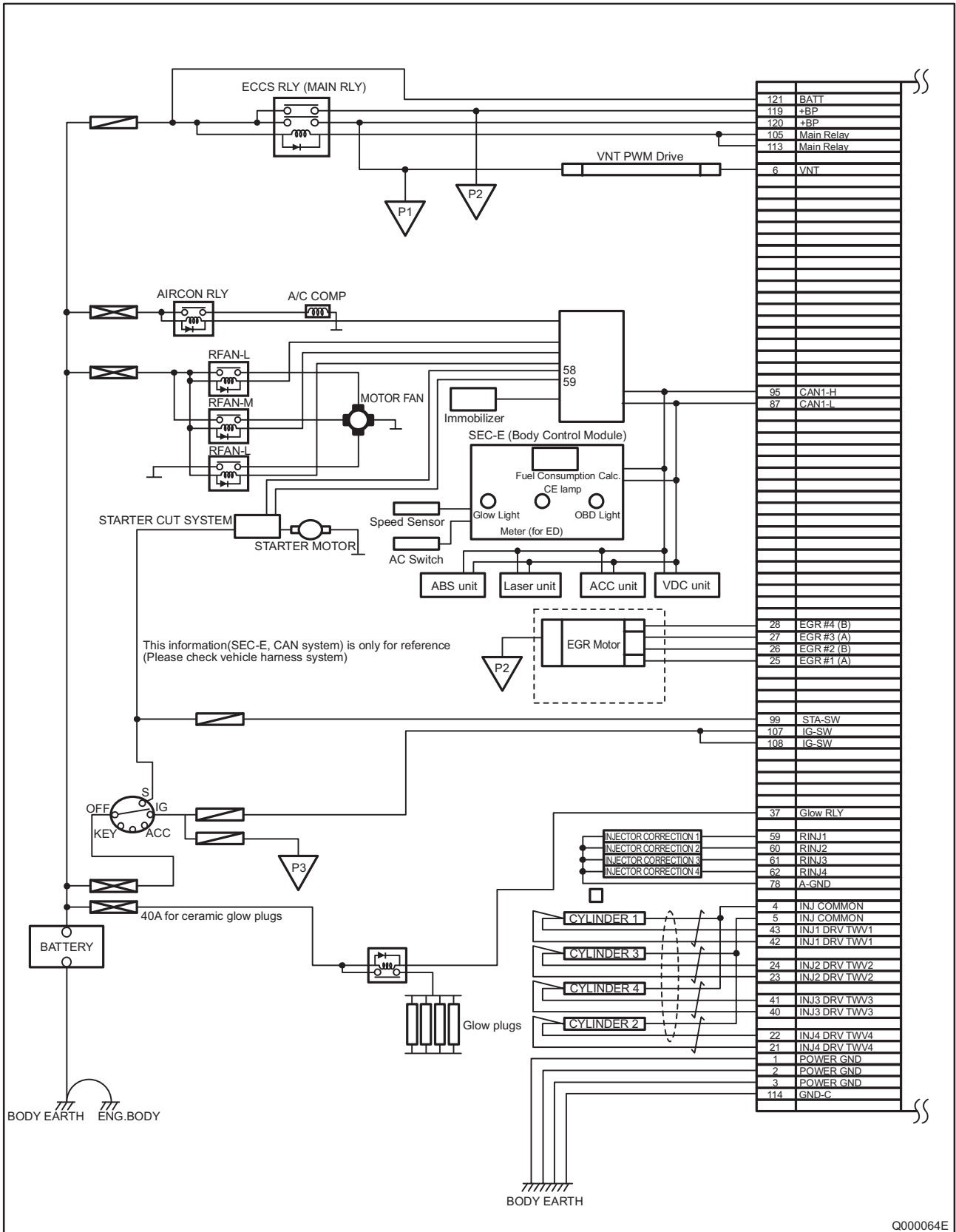
Code No.	Diagnostic Item	Description of Diagnosis	Inspection Area
P1263	No. 3 cylinder fuel injector adjustment resistor high input	Excessively high voltage from the No. 3 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #3
P1264	No. 4 cylinder fuel injector adjustment resistor low input	Excessively low voltage from the No. 4 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #4
P1265	No. 4 cylinder fuel injector adjustment resistor high input	Excessively high voltage from the No. 4 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #4
P1266	No. 2 cylinder fuel injector adjustment resistor low input	Excessively low voltage from the No. 2 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #2
P1267	No. 2 cylinder fuel injector adjustment resistor high input	Excessively high voltage from the No. 2 cylinder fuel injector adjustment resistor to the ECM.	Harness or connectors (The fuel injector adjustment resistor circuit is open or shorted.) Fuel injector adjustment resistor #2
P1268	No. 1 cylinder fuel injector	The valve built into No. 1 cylinder fuel injector does not close properly (stuck open) when the injector is not energized.	Fuel injector #1
P1269	No. 2 cylinder fuel injector	The valve built into No. 2 cylinder fuel injector does not close properly (stuck open) when the injector is not energized.	Fuel injector #2
P1270	No. 3 cylinder fuel injector	The valve built into No. 3 cylinder fuel injector does not close properly (stuck open) when the injector is not energized.	Fuel injector #3
P1271	No. 4 cylinder fuel injector	The valve built into No. 4 cylinder fuel injector does not close properly (stuck open) when the injector is not energized.	Fuel injector #4
P1272	Fuel rail pressure relief valve open	Fuel rail pressure relief valve is open.	Fuel rail pressure relief valve
P1273	Fuel pump insufficient flow	ECM detects an abnormal fuel pressure pulse.	Fuel pump

Code No.	Diagnostic Item	Description of Diagnosis	Inspection Area
P1274	Fuel pump protection	Fuel pressure much higher than the target value.	Harness or connectors (The fuel pump circuit is open or shorted.) Fuel pump
P1275	Fuel pump exchange	Fuel pressure much higher than the target value.	Harness or connectors (The fuel pump circuit is open or shorted.) Fuel pump
P1610 -1612, P1614 -1617 *1	Immobi. related	—	—
P2135	"Accelerator pedal position sensor 1, 2 signal correlation"	The correlation between the APP sensor 1 signal and APP sensor 2 signal is outside the normal range.	Harness or connectors (The APP sensor circuit is open or shorted.) Accelerator pedal position sensor
P2146	No. 1 and 4 cylinder fuel injector power supply circuit open	Improper voltage signal sent to the ECM by the No. 1 and 4 cylinder fuel injectors.	Harness or connectors (The fuel injector circuit is open.)
P2147	Fuel injector circuit low input	ECM detects the fuel injector circuit is shorted to the ground.	Harness or connectors (Fuel injector circuit shorted.)
P2148	Fuel injector circuit high input	ECM detects the fuel injector circuit is shorted to the power source.	Harness or connectors (Fuel injector circuit shorted.)
P2149	No. 2 and 3 cylinder fuel injector power supply circuit open	Improper voltage signal is sent to the ECM by the No. 2 and 3 cylinder fuel injectors.	Harness or connectors (The fuel injector circuit is open.)
P2228	Barometric pressure sensor circuit low input	Excessively low voltage from the barometric pressure sensor (built-into ECM) to the ECM.	ECM
P2229	Barometric pressure sensor circuit high input	Excessively high voltage from the barometric pressure sensor (built-into ECM) to the ECM.	ECM

5 External Wiring Diagram

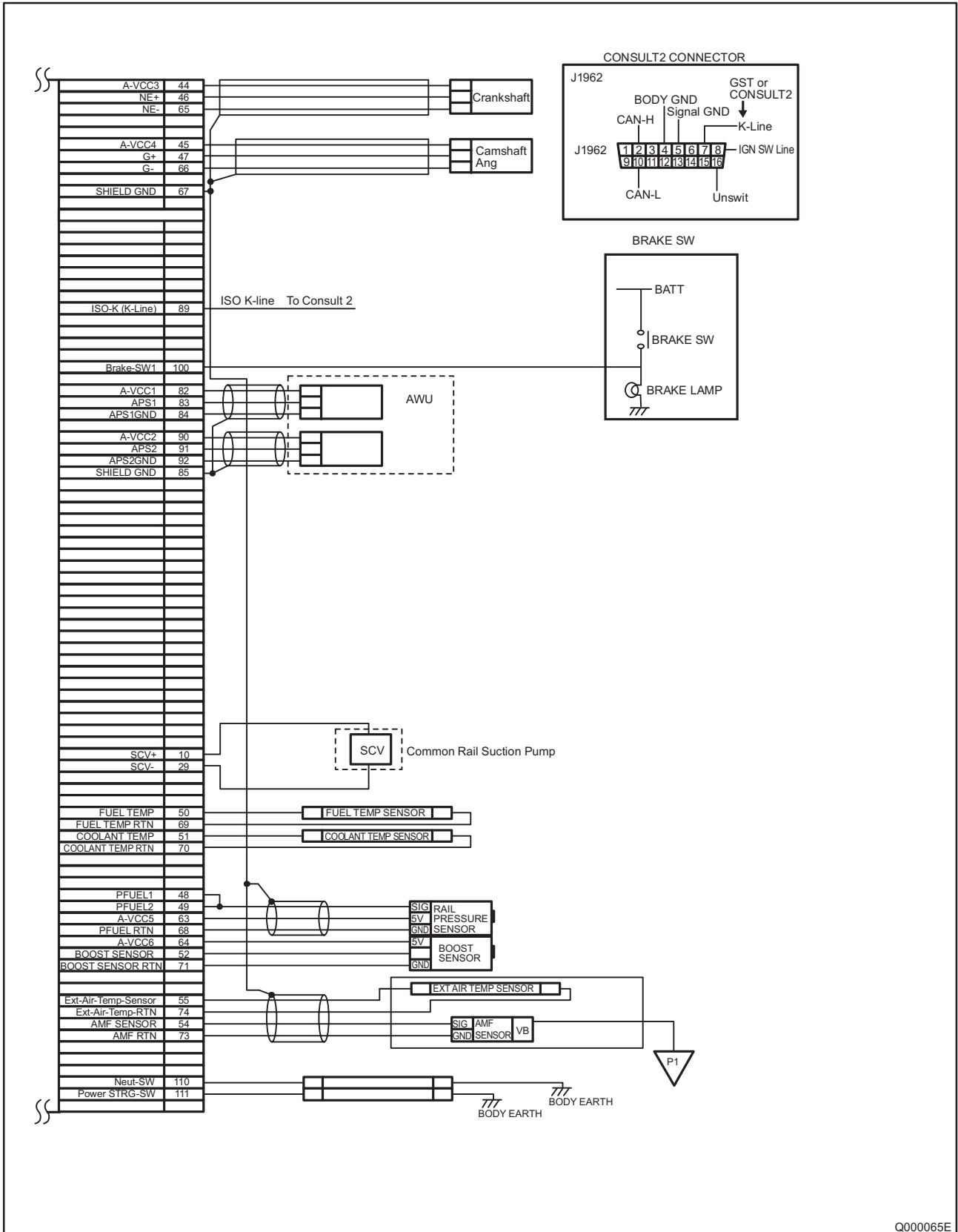
5-1. ECU External Wiring Diagram

A. Diagram 1



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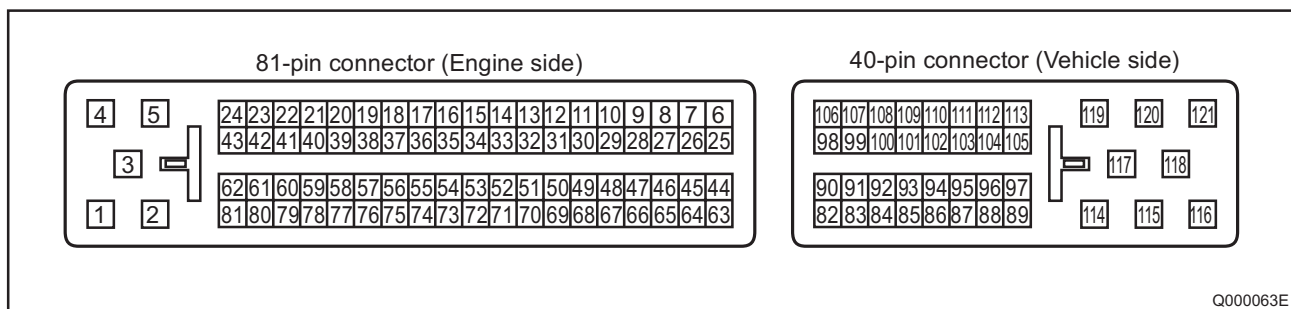
B. Diagram 2



Q000065E

5-2. ECU Connector Diagram

A. ECU Connector Terminal Layout



B. Terminal Connections

No.	Pin Symbol	Connections	No.	Pin Symbol	Connections
1	P-GND	POWER GROUND	31	—	—
2	P-GND	POWER GROUND	32	—	—
3	P-GND	POWER GROUND	33	—	—
4	COMMON 1	INJECTION COMMON	34	—	—
5	COMMON 1	INJECTION COMMON	35	—	—
6	VNT	EV RV FOR VNT	36	—	—
7	—	—	37	—	—
8	—	—	38	—	—
9	—	—	39	—	—
10	SCV+	SUCTION CONTROL VALVE	40	TWV3	INJECTION DRIVE 3
11	—	—	41	TWV3	INJECTION DRIVE 3
12	—	—	42	TWV1	INJECTION DRIVE 1
13	—	—	43	TWV1	INJECTION DRIVE 1
14	—	—	44	A-VCC3	SENSOR (POWER SUPPLY)
15	—	—	45	A-VCC4	SENSOR (POWER SUPPLY)
16	—	—	46	NE+	CRANKSHAFT POSITION SENSOR+
17	—	—	47	G+	CYLINDER RECOGNITION SENSOR+
18	—	—	48	PFUEL	RAIL PRESSURE SENSOR
19	—	—	49	PFUEL	RAIL PRESSURE SENSOR
20	—	—	50	THF	FUEL TEMP
21	TWV4	INJECTION DRIVE 4	51	THW	COOLANT TEMP
22	TWV4	INJECTION DRIVE 4	52	BOOST	BOOST SENSOR
23	TWV2	INJECTION DRIVE 2	53	—	—
24	TWV2	INJECTION DRIVE 2	54	AMF	AMF SENSOR
25	EGR#1	STEP MOTOR A	55	EXT-A-TMP	EXT-AIR-TEMP-SENSOR
26	EGR#2	STEP MOTOR B~	56	—	—
27	EGR#3	STEP MOTOR A~	57	—	—
28	EGR#4	STEP MOTOR B	58	—	—
29	SCV-	SUCTION CONTROL VALVE	59	RINJ1	INJECTOR CORRECTION 1
30	—	—	60	RINJ2	INJECTOR CORRECTION 2

No.	Pin Symbol	Connections	No.	Pin Symbol	Connections
61	RINJ3	INJECTOR CORRECTION 3	92	APS2GND	SENSOR GROUND
62	RINJ4	INJECTOR CORRECTION 4	93	—	—
63	A-VCC5	SENSOR (POWER SUPPLY)	94	—	—
64	A-VCC6	SENSOR (POWER SUPPLY)	95	CAN1-H	CAN COMMUNICATION
65	NE-	ENGINE SPEED SENSOR-	96	—	—
66	G-	CRANKSHAFT POSITION SENSOR-	97	—	—
67	S-GND	SHIELD GROUND	98	—	—
68	PFUELRTN	SENSOR GROUND	99	STA-SW	STARTER SW
69	THFRTN	FUEL TEMP RTN	100	BRK1	BRAKE SW1
70	THWRTN	COOLANT TEMP RTN	101	—	—
71	BOOSTRTN	BOOST SENSOR RTN	102	—	—
72	EGRLIFTRTN	EGR LIFT SENSOR RTN	103	—	—
73	AMFRTN	AMF RTN	104	—	—
74	EXT-A-RTN	EXT-AIR-TEMP-SENSOR RTN	105	M-REL	MAIN RELAY
75	—	—	106	—	—
76	—	—	107	IG-SW	IGNITION SW
77	—	—	108	IG-SW	IGNITION SW
78	A-GND	INJECTOR CORRECTION RTN	109	—	—
79	AD5	ANALOG INPUT OPTION	110	N-SW	NEUT SW
80	AD6	ANALOG INPUT OPTION	111	PS-SW	POWER STRG SW
81	AD7	ANALOG INPUT OPTION	112	—	—
82	A-VCC1	SENSOR (POWER SUPPLY)	113	M-REL	MAIN RELAY
83	APS1	ACCEL PEDAL SENSOR	114	C-GND	SIGNAL GROUND
84	APS1GND	SENSOR GROUND	115	—	—
85	S-GND	SHIELD GROUND(APS)	116	—	—
86	—	—	117	—	—
87	CAN1-L	CAN COMMUNICATION	118	—	—
88	—	—	119	+BP	BATTERY+ (MAIN RELAY)
89	K-LINE	KWP2000 K-LINE	120	+BP	BATTERY+ (MAIN RELAY)
90	A-VCC2	SENSOR (POWER SUPPLY)	121	BATT	BATTERY+
91	APS2	ACCEL PEDAL SENSOR			

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