DENSO

SUBARU EE20 ENGINE

COMMON RAIL SYSTEM (CRS)

Issued : February 2008

Revised : August 2009

Applicable Vehicle :

Manufacturer	Vehicle Name
SUBARU	LEGACY
	FORESTER
	IMPREZA

DENSO CORPORATION

00400626EB

Revision History

Date	Revision Contents
2008.11	• Added applicable vehicles and products. • Added system information for the FORESTER and IMPREZA. ✓ Supply pump ✓ Engine control system diagram ✓ Fuel injection control ✓ DTC table ✓ Engine ECU external wiring diagram ✓ Connector terminal layout
2009.08	• Added change content for the July 2009 model LEGACY. The change content is as per the following. ✓ Supply pump ✓ Injector ✓ Sensors ✓ DTC table ✓ Engine ECU external wiring diagram ✓ Connector terminal layout

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1. APPLICABLE VEHICLE AND PRODUCT INFORMATION

1.1 Introduction

- A Common Rail System (CRS) for the SUBARU LEGACY EE20 engine was set in December 2007. This CRS is mounted on the distinctive SUBARU horizontally-opposed diesel engine. This manual describes parts unique to the EE20 engine CRS. For basic information on the CRS described herein, refer to "General Edition Manual Common Rail System (Doc ID: 00400534EA)."
  - HP3 supply pump components and basic operation
  - Primary rail components
  - G2 injector construction and operation
  - Outline for each of the following controls: Fuel injection quantity control, fuel injection timing control, fuel injection rate control, fuel injection pressure control
- The EE20 engine is equipped in the SUBARU FORESTER beginning from July 2008, and in the SUBARU IMPREZA beginning from October 2008. As such, since the CRS has changed as per the points below, this manual contains additional information concerning the aforementioned changes. All other items are identical to the CRS used in the LEGACY.
  - Supply pump change
  - DPF change (DPF control added)
  - Engine ECU change
  - DTCs added
- As a result of a model change to the SUBARU LEGACY beginning from July 2009, the CRS equipped with the EE20 engine has changed. Change items that have been added to this manual due to the aforementioned model change are listed below. All other information in this manual is identical to that for the December 2007 model SUBARU LEGACY.
  - Supply pump change
  - Injector change
  - Engine ECU change
  - Sensor added
  - DPF control added
  - DTCs added

1.2 Applicable Vehicles

Vehicle Name	Engine Model	Engine Displacement	Line Off Period	Destination
LEGACY	EE20	2.0 L	December 2007	Europe
			July 2009 (model change)	
FORESTER			July 2008	
IMPREZA			October 2008	

Q002733

Vehicle External View (December 2007 Model LEGACY)

Q004513

Vehicle External View (July 2009 Model LEGACY)

Q003698

Vehicle External View (FORESTER)

Q003761

Vehicle External View (IMPREZA)

Specifications

Engine		Type	Horizontally-opposed, 4-cylinder	
		Displacement	2.0L	
		Net Power	LEGACY, IMPREZA	110 kW/3600 rpm
			FORESTER	108 kW/3600 rpm
		Maximum Torque	350 Nm/2000 rpm	
Vehicle	LEGACY	Transmission	5MT	
			6MT (from July 2009)	
		Drive	AWD (4WD)	
		Weight	1425 kg (Sedan), 1500 kg [Wagon (Outback)]	
			1445 kg (sedan), 1520 kg {wagon (OUTBACK)} (from July 2009)	
	FORESTER	Transmission	6MT	
		Drive	AWD (4WD)	
		Weight	—	
	IMPREZA	Transmission	6MT	
		Drive	AWD (4WD)	
		Weight	—	

1.3 Applicable Product List

LEGACY

Part Name	DENSO Part Number	Manufacturer Part Number	Remarks
Supply Pump	294000-076#	16625AA010	
	294000-108#	16625AA030	from July 2009
Injector	095000-789#	16613AA020	
	295050-025#	16613AA030	from July 2009
Rail	095440-119#	16670AA000	
	095600-001#	16670AA010	from July 2009
Engine ECU	275800-749#	22611AN040	
	275800-924#	22611AP591	
	275800-984#	22611AP840	from July 2009
Accelerator Pedal Module	198800-709#	36010AG110	RHD
	198800-711#	36010AG140	LHD
	198800-712#	36010AG140	from July 2009
Crankshaft Position Sensor	949979-039#	22053AA100	MRE type
Mass Air Flow (MAF) Meter	197400-511#	22680AA380	
Diesel Throttle	197920-005#	16112AA260	
Manifold Absolute Pressure (MAP) Sensor	079800-915#	22627AA430	
Exhaust Gas Recirculation (EGR) Valve	150100-005#	14710AA740	

Part Name	DENSO Part Number	Manufacturer Part Number	Remarks
Damper Solenoid Valve	135450-037#	14371AA000	
Air Bypass Valve	139700-104#	14471AA220	
Level Sensor Assembly	101962-409#	42081AG110	
Charcoal Canister Assembly	138600-715#	42035AG010	from July 2009

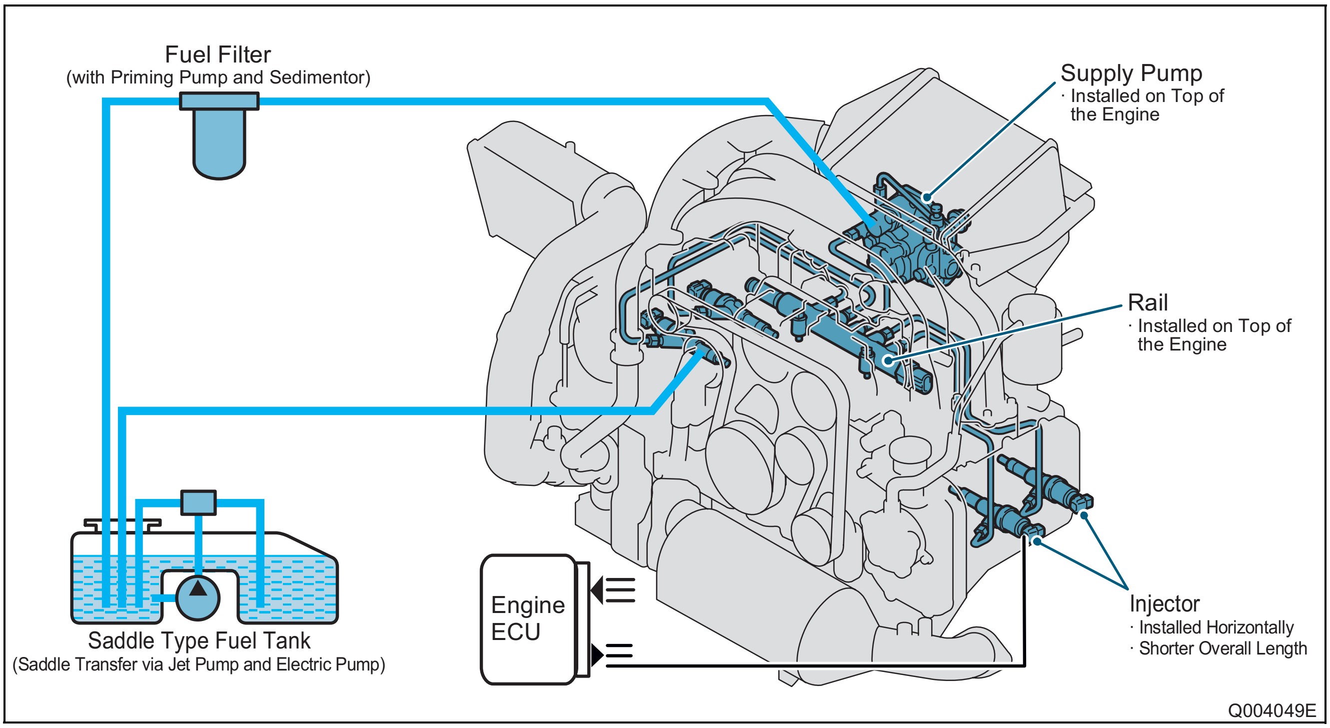
FORESTER / IMPREZA

<table>
<tr><th>Part Name</th><th>DENSO Part Number</th><th>Manufacturer Part Number</th><th colspan="2">Remarks</th></tr>
<tr><td>Supply Pump</td><td>294000-098#</td><td>16625AA020</td><td colspan="2"></td></tr>
<tr><td>Injector</td><td>095000-789#</td><td>16613AA020</td><td colspan="2"></td></tr>
<tr><td>Rail</td><td>095440-119#</td><td>16670AA000</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Engine ECU</td><td>275800-925#</td><td>22611AP200</td><td colspan="2">for the FORESTER</td></tr>
<tr><td>275800-947#</td><td>22611AP280</td><td colspan="2">for the IMPREZA</td></tr>
<tr><td rowspan="2">Accelerator Pedal Module</td><td>198800-709#</td><td>36010AG110</td><td>RHD</td><td rowspan="2">IMPREZA only</td></tr>
<tr><td>198800-711#</td><td>36010AG140</td><td>LHD</td></tr>
<tr><td>Crankshaft Position Sensor</td><td>949979-039#</td><td>22053AA100</td><td colspan="2"></td></tr>
<tr><td>Mass Air Flow (MAF) Meter</td><td>197400-511#</td><td>22680AA380</td><td colspan="2"></td></tr>
<tr><td>Diesel Throttle</td><td>197920-005#</td><td>16112AA260</td><td colspan="2"></td></tr>
<tr><td>Manifold Absolute Pressure (MAP) Sensor</td><td>079800-915#</td><td>22627AA430</td><td colspan="2"></td></tr>
<tr><td>Exhaust Gas Recirculation (EGR) Valve</td><td>150100-005#</td><td>14710AA740</td><td colspan="2"></td></tr>
<tr><td>Damper Solenoid Valve</td><td>135450-037#</td><td>14371AA000</td><td colspan="2"></td></tr>
<tr><td>Air Bypass Valve</td><td>139700-104#</td><td>14471AA220</td><td colspan="2"></td></tr>
<tr><td>Level Sensor Assembly</td><td>101962-409#</td><td>42081AG110</td><td colspan="2"></td></tr>
<tr><td>Exhaust Gas Temperature Sensor</td><td>265600-225#</td><td>22629AA040</td><td colspan="2"></td></tr>
<tr><td>Exhaust Gas Temperature Sensor</td><td>265600-226#</td><td>22629AA050</td><td colspan="2"></td></tr>
</table>

2. COMMON RAIL SYSTEM (CRS) OUTLINE

2.1 General Description

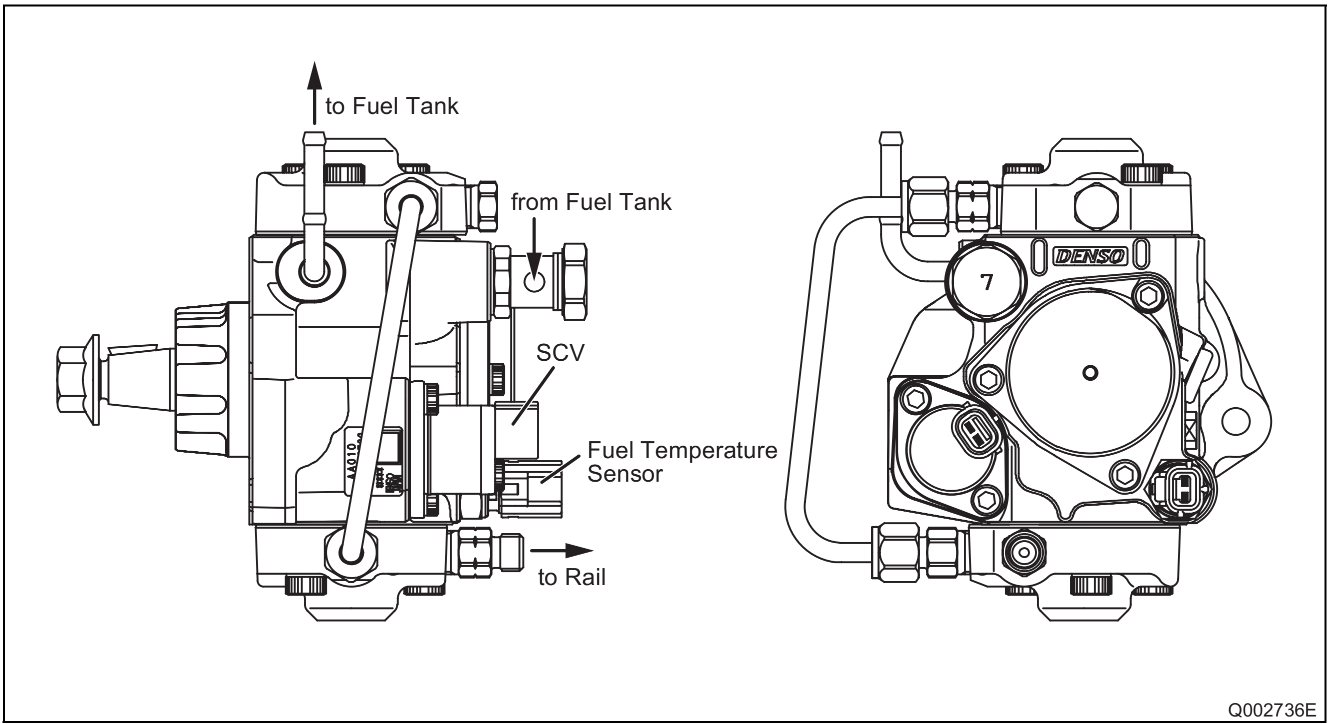
- The SUBARU EE20 marks the first time that the current second generation CRS has been used with a horizontally-opposed diesel engine. Due to the configuration of the horizontally-opposed engine, the supply pump and rail are mounted above the engine, while the injectors are mounted horizontally in a position lower than the supply pump and rail. Additionally, the injectors used with the EE20 engine are shorter than the conventional injectors due to mounting constraints.
- In the July 2009 model LEGACY, the length of the return piping has been increased 1.5 times to cool the return fuel.



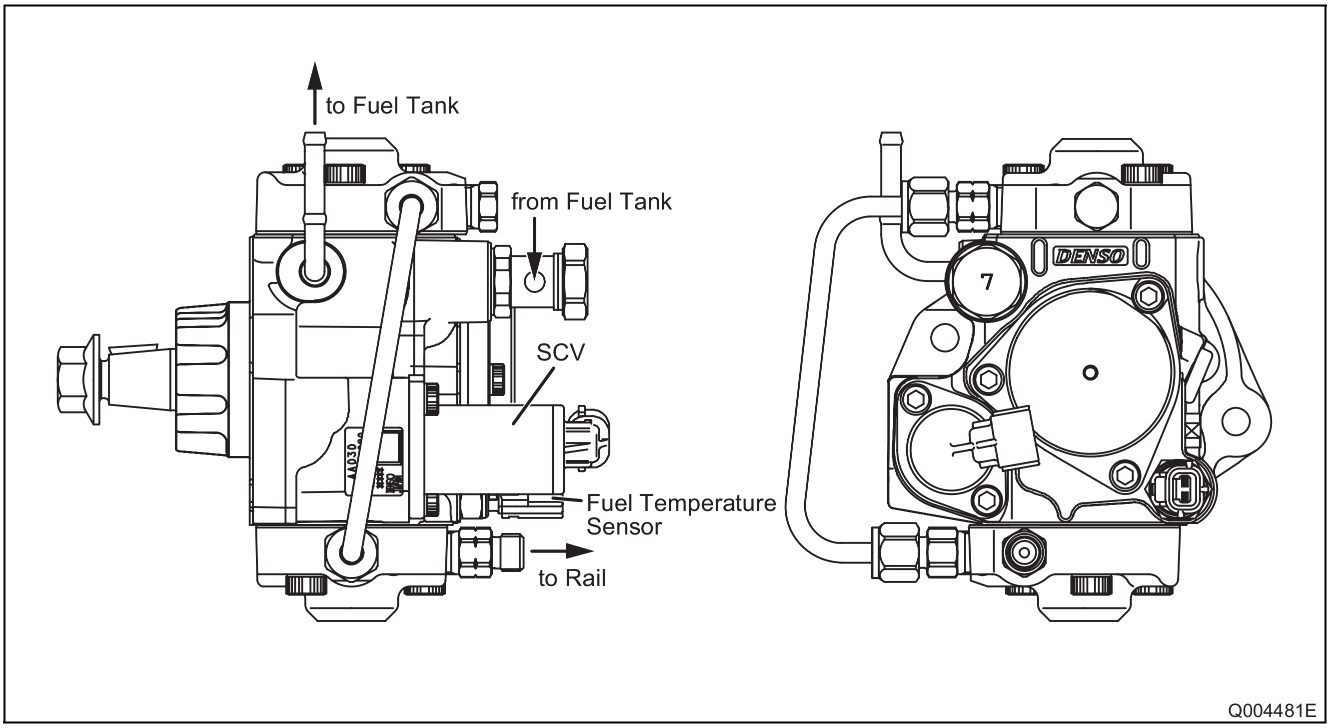
3. SUPPLY PUMP

3.1 Outline

- The EE20 engine CRS is equipped with an HP3 supply pump. The HP3 supply pump uses a compact Suction Control Valve (SCV).
- The external view of the supply pump used in the FORESTER and IMPREZA is identical to that used in the LEGACY. However, the SCV and regulating valve have changed.



External View (December 2007 LEGACY, FORESTER, IMPREZA)



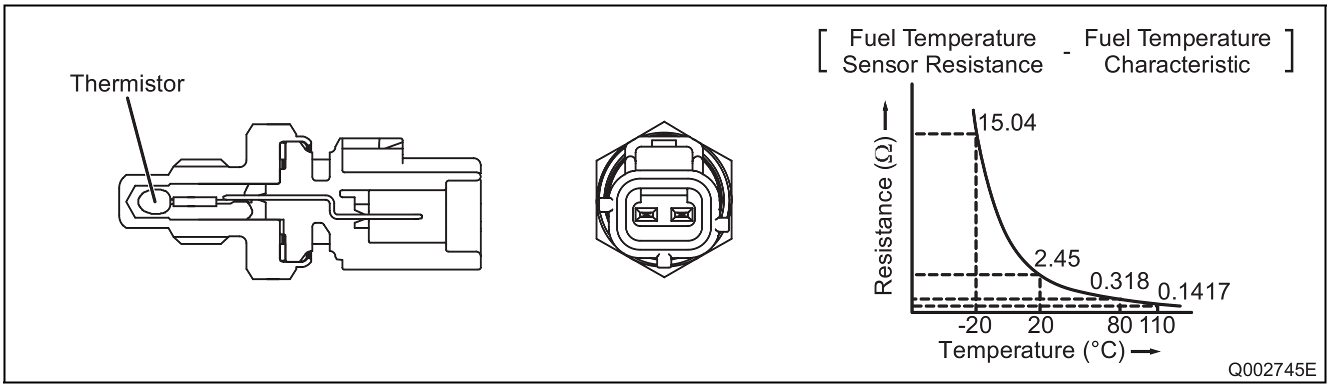
External View (July 2009 LEGACY)

Supply Pump Specifications

Item		Content
Plunger Diameter		Ø8.5 × 2
Cam Lift		5.6 mm
Rotation		Clockwise viewed from drive side
SCV	Terminal Resistance	2.10 ± 0.15 W (20 ºC)
	Rated Voltage	12 V
	Control Type	Normally open

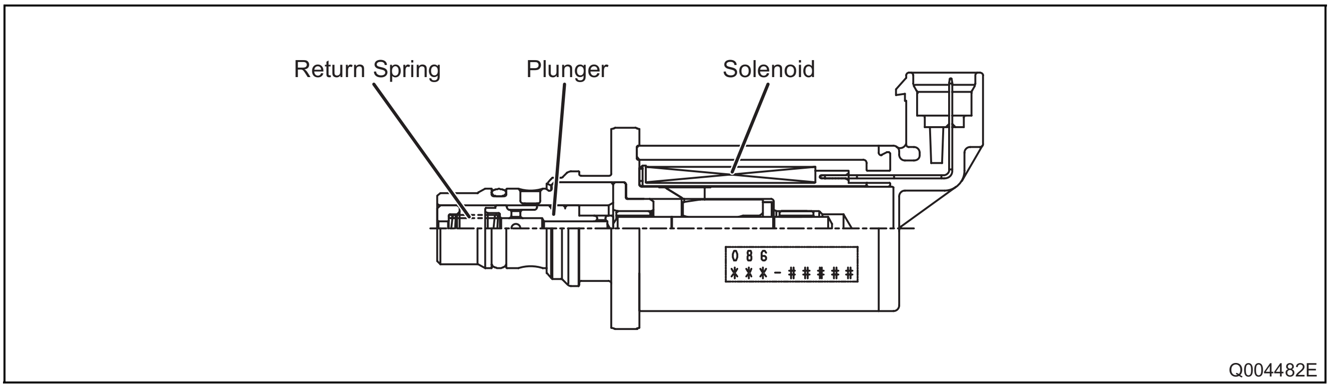
3.2 Fuel Temperature Sensor

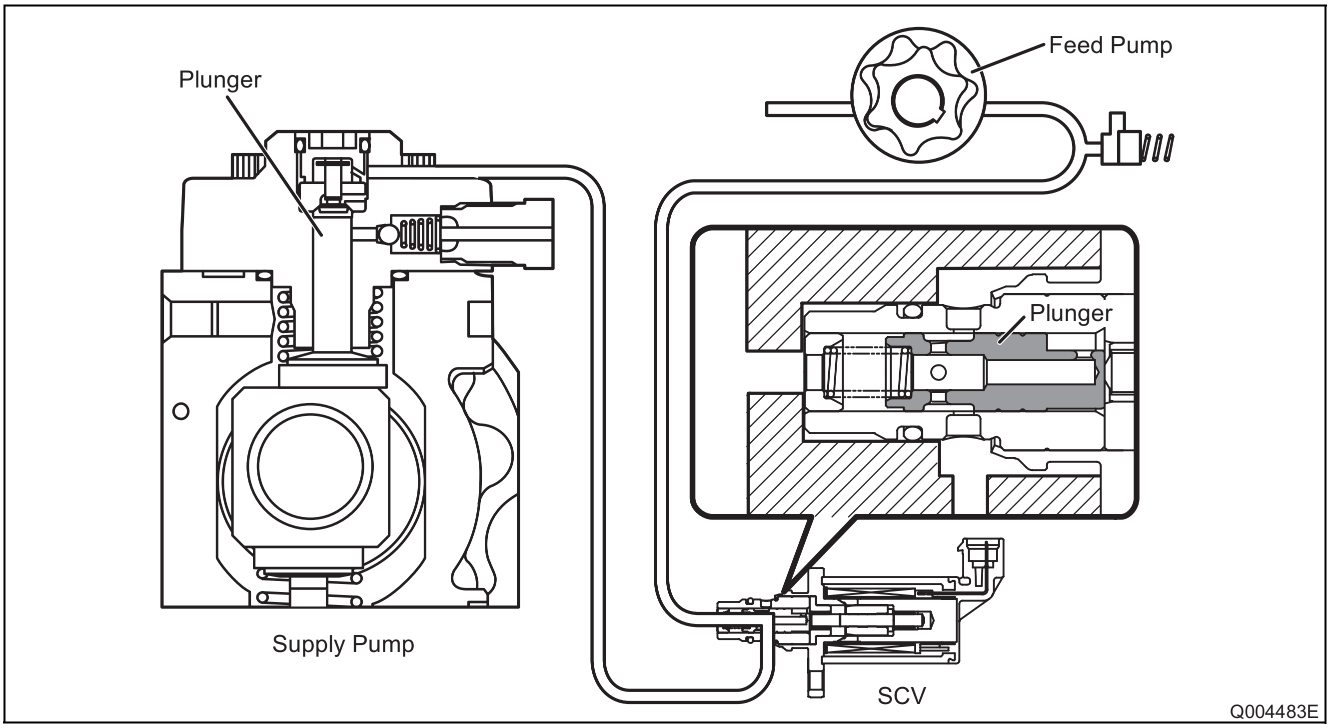
- A conventional sensor is used as the fuel temperature sensor. Sensor resistance values in relation to fuel temperature are provided below.



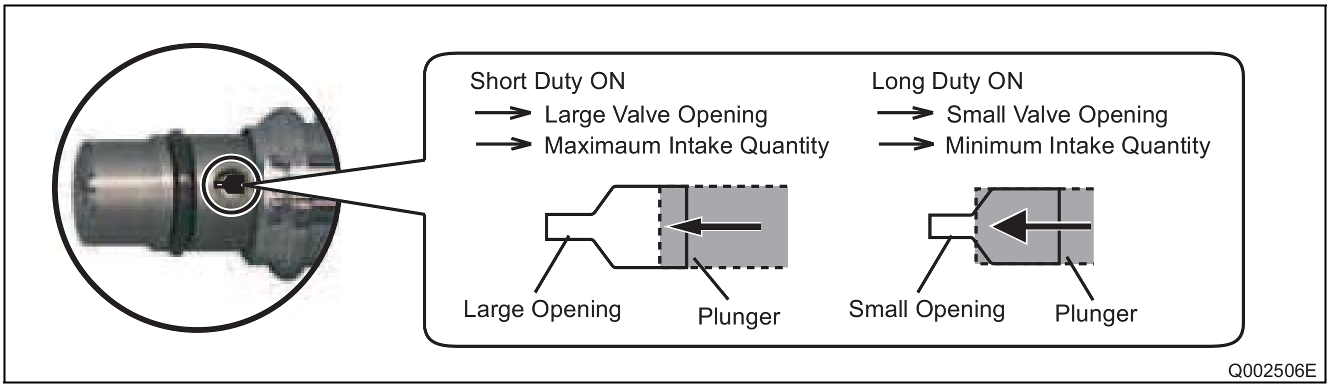
3.3 Suction Control Valve (SCV)

- For the July 2009 model LEGACY, the SCV has been changed from the SV2 to the SV1. Refer to [SCV types (SV1, SV2)] on P1-10 The SV1 type SCV is a normally open type valve. SCV structure and operation are as per the figures below.





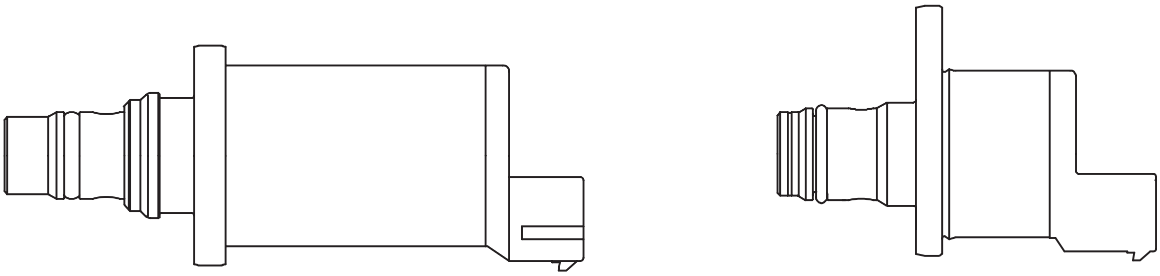
Operational Concept Diagram



Operation

(1) SCV types (SV1, SV2)

- The SCV is available in the SV1 type and SV2 type. The SV2 is a compact SCV, while the SV1 is a larger size version of the SV2.


SV1 Type SCV
SV2 Type SCV
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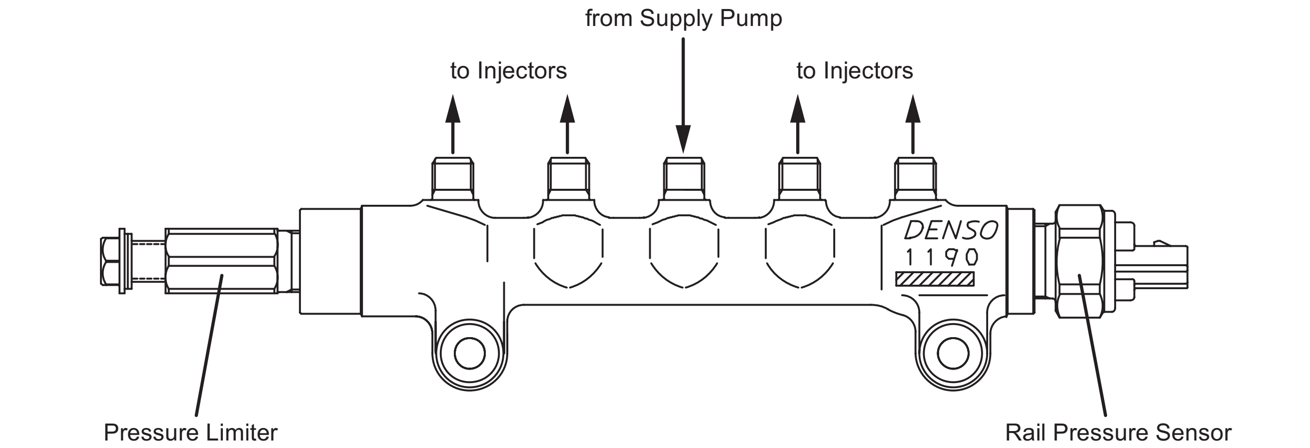
4. RAIL

4.1 Outline

- The figure below shows the rail used with the EE20 engine CRS. The pressure limiter opens at 221 ± 9 MPa, and closes at 50 MPa.



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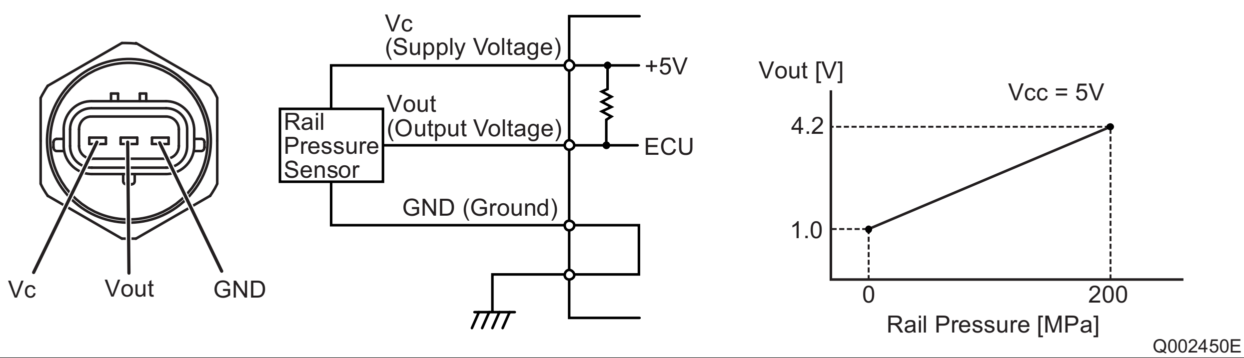
4.2 Rail Pressure Sensor

- The EE20 engine uses the conventional rail pressure sensor. Sensor output characteristics are shown below.



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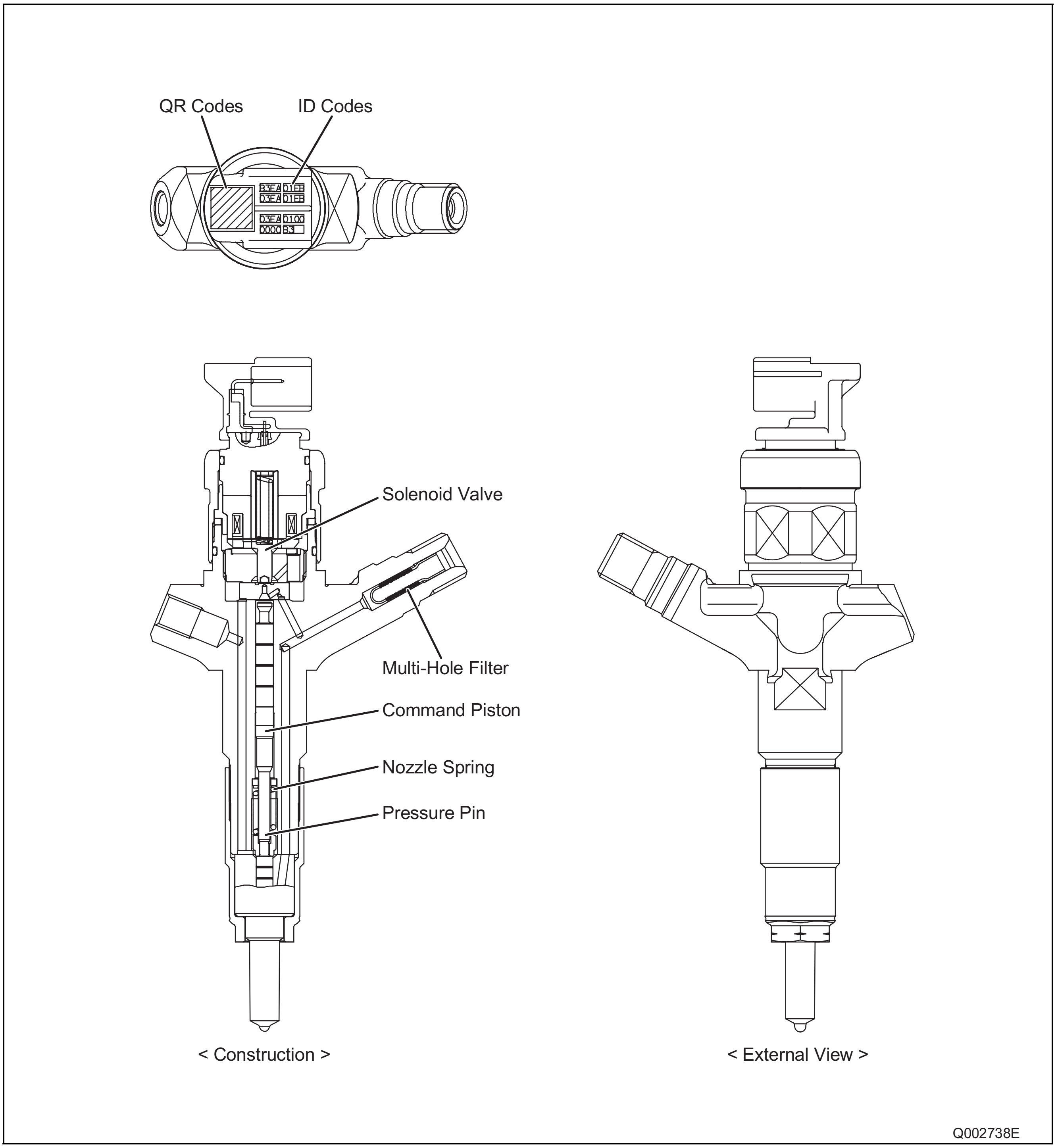
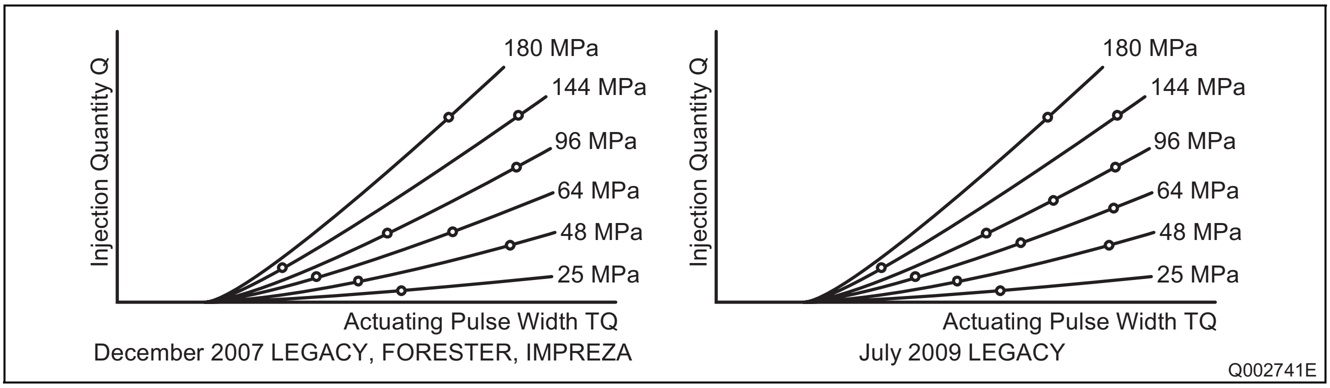
5. INJECTORS

5.1 Outline

- The EE20 engine uses G2 type injectors with QR codes. The G2 injectors used with the EE20 engine are shorter (140.9 mm) than the conventional G2 injectors.
- The July 2009 model LEGACY uses high-pressure compliant, highly responsive G3 injectors. The shape of the G3 injector is identical to that of the G2 injector. However, the number of QR code (ID code) correction points has been increased from 10 to 12.



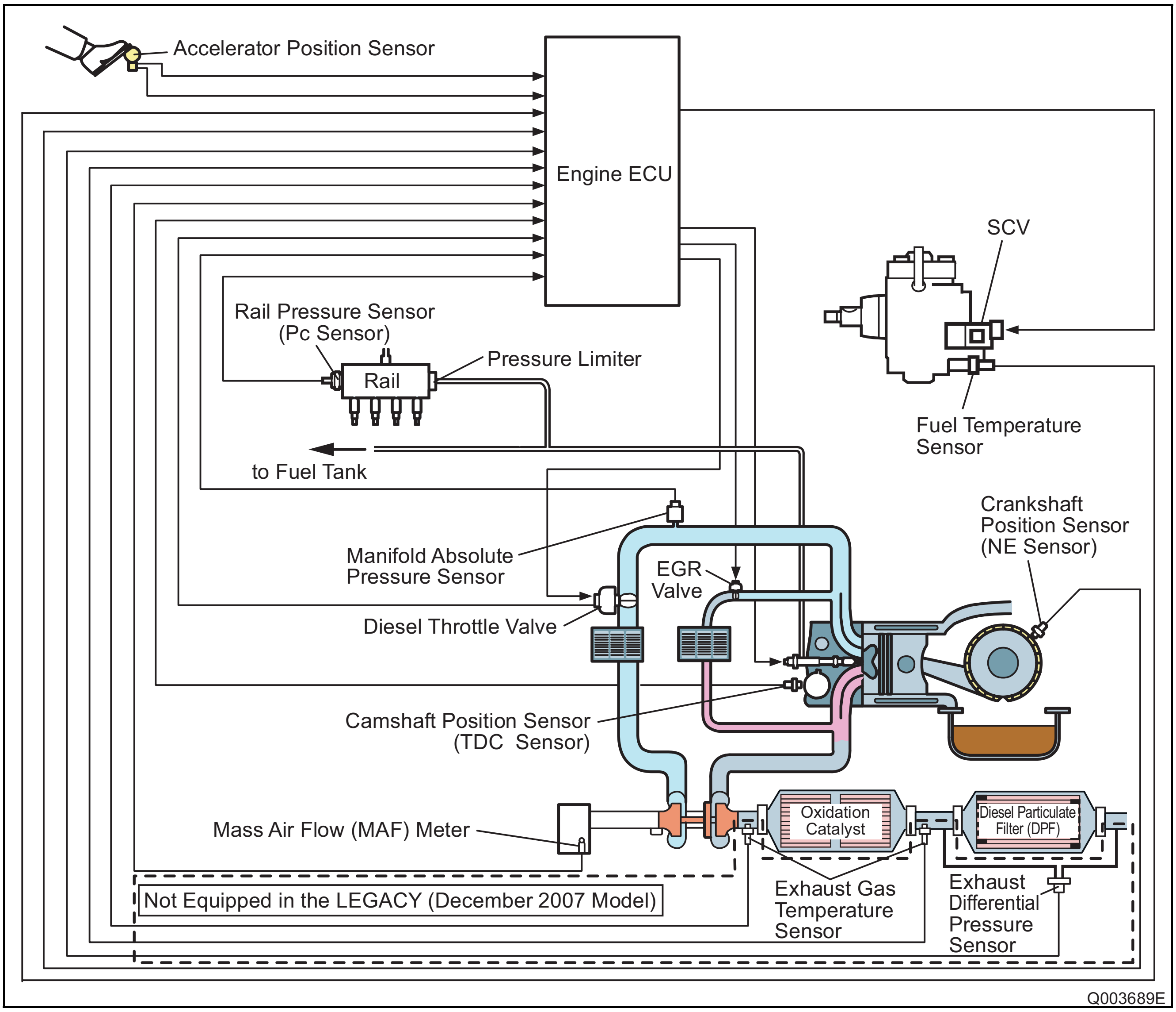


Correction Points Using QR Codes

6. CONTROL SYSTEM COMPONENTS

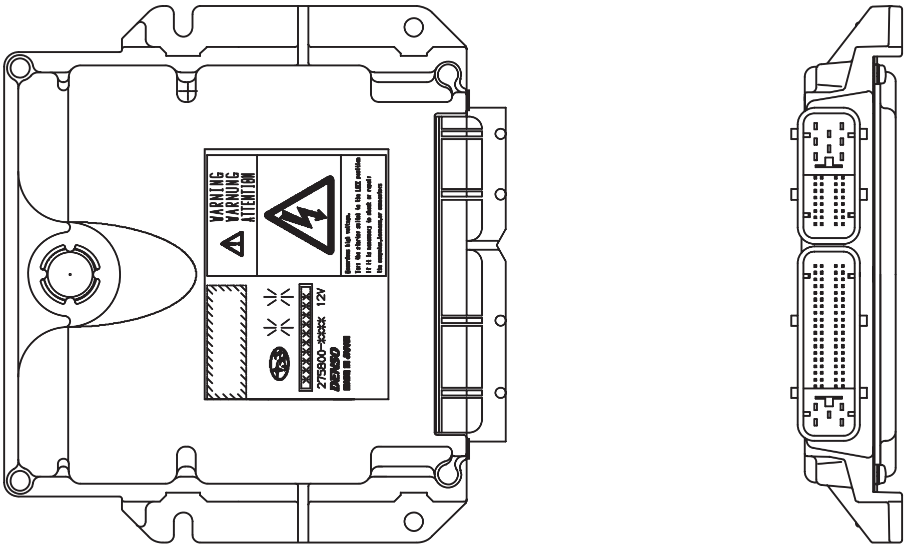
6.1 Engine Control System Diagram

- The diagram below shows the EE20 engine control system. The engine control system uses an oxidation catalyst and a Diesel Particulate Filter (DPF) exhaust gas purification device. Since the DPF used in the LEGACY simply accumulates Particulate Matter (PM), regeneration control is not performed. However, much like other DPFs, the DPF used in the FORESTER and IMPREZA performs regeneration control.
- The July 2009 model LEGACY now uses the same DPF system as the FORESTER and IMPREZA.



6.2 Engine Electronic Control Unit (ECU)

- The figure below is an external view of the engine ECU. For details on the connector terminal layout, refer to "10.2 Connector Terminal Layout".



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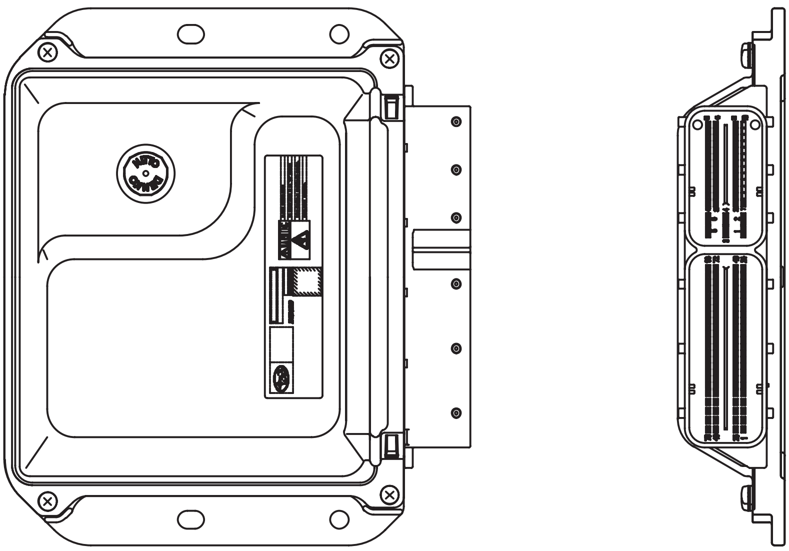
External View of the LEGACY, FORESTER, IMPREZA Engine ECU



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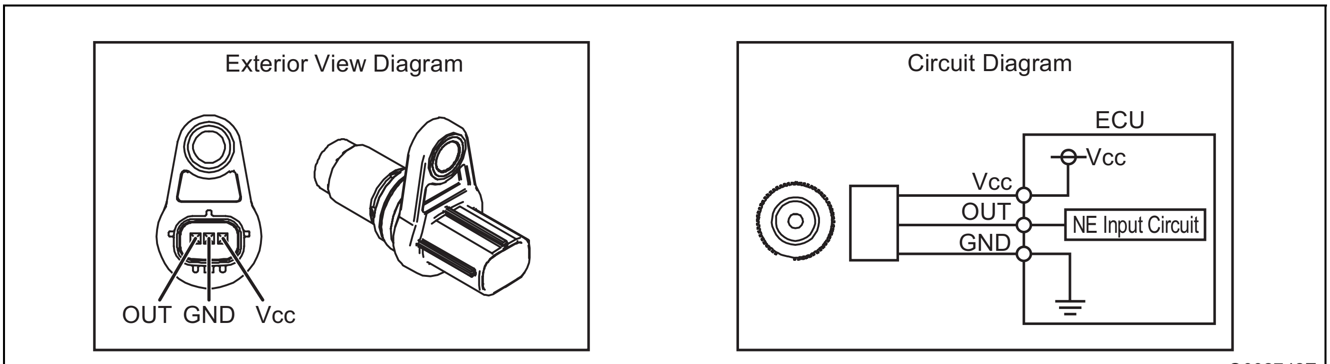
External View of the July 2009 Model LEGACY Engine ECU

6.3 Description of Sensors

(1) Crankshaft position sensor (NE)

- The crankshaft position sensor is installed near the flywheel pulsar gear on the flywheel to detect the crankshaft angle and output the engine speed signal. The sensor unit is a Magnetic Resistance Element (MRE) type.



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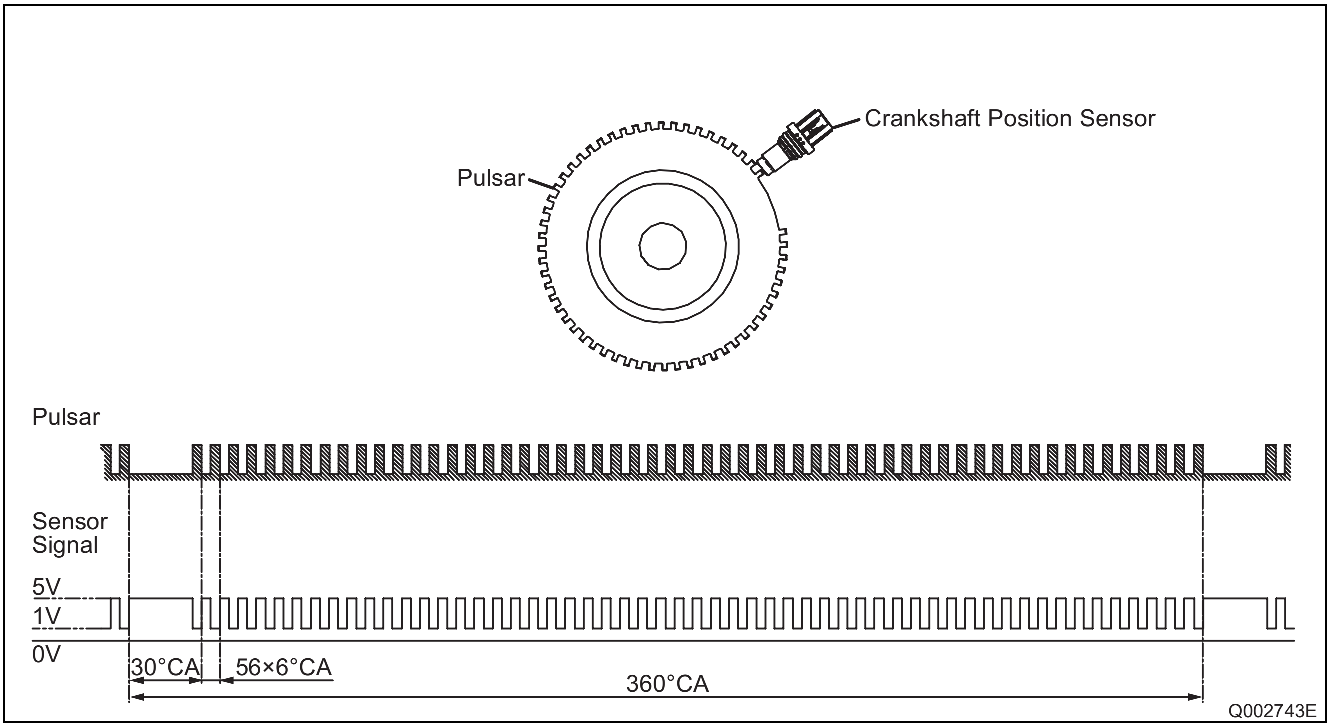
Waveform for the crankshaft position sensor

- An NE pulsar is mounted on the crankshaft timing gear in order to output the signals that are used for detecting the crankshaft position. The pulsar gear consists of 56 teeth and 4 missing teeth per pulse, thus enabling the sensor to output 56 pulses for every revolution (360 ºCA) of the crankshaft.



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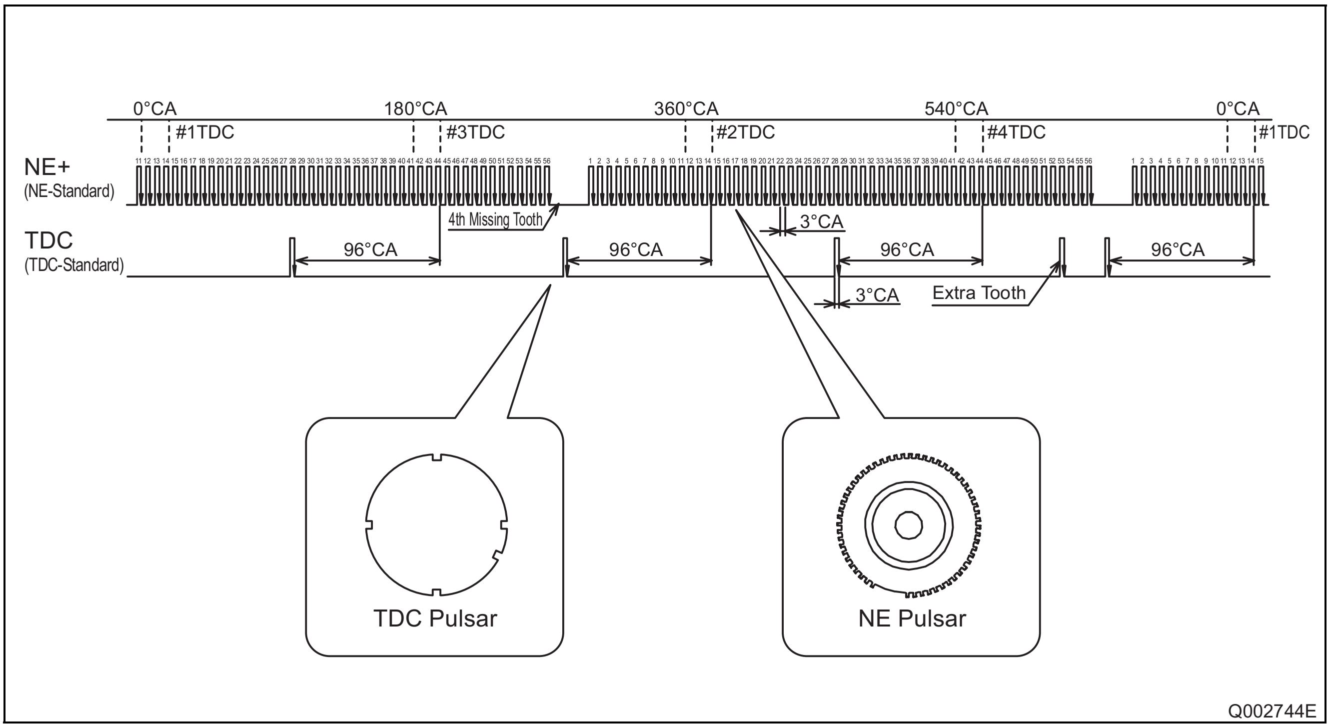
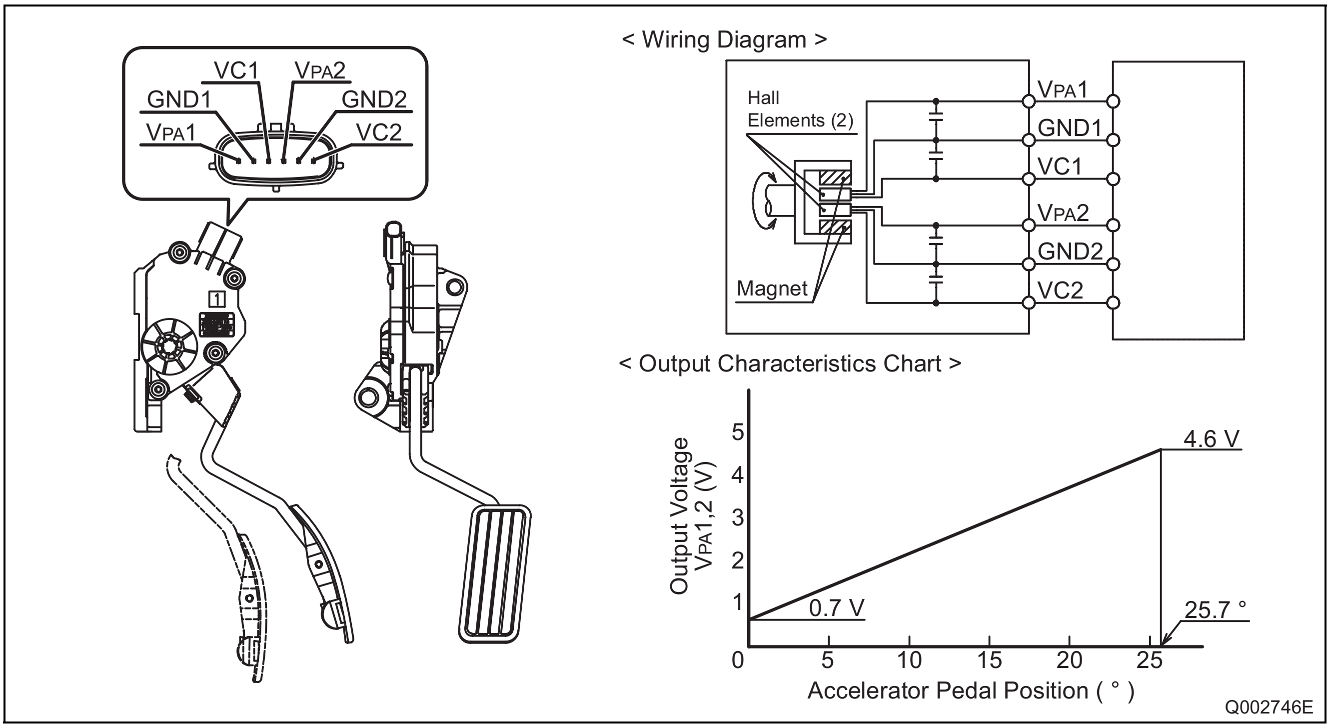
Calculation timing for cylinder #1 Top Dead Center (TDC) of compression

- The pulsar gear on the camshaft position sensor (TDC) has one pulsar every 90 degrees, plus one additional pulse placed at an irregular interval. As a result, five pulses are output for every two revolutions of the engine (or one revolution of the pump). TDC of compression for the first cylinder occurs after the irregular pulse at 96 ºCA (refer to the chart below.)



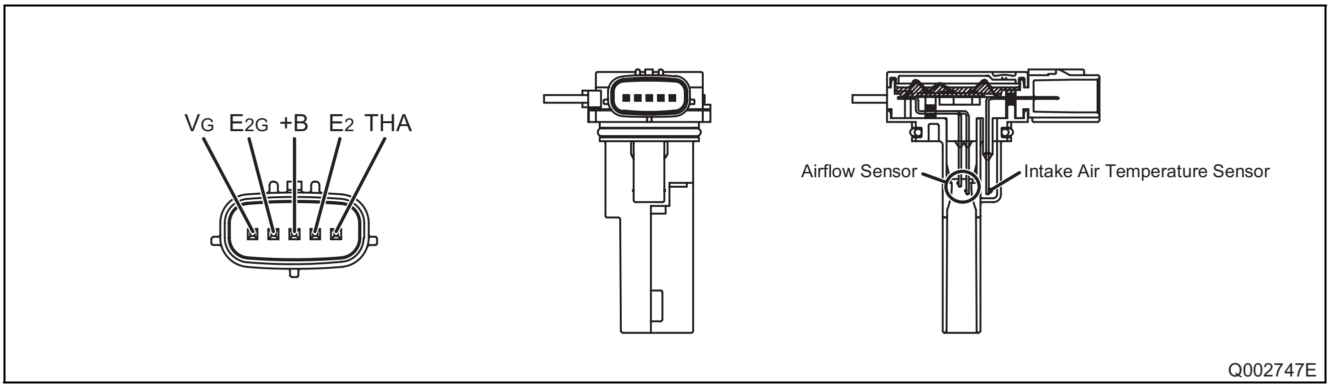
(2) Accelerator pedal module (accelerator position sensor)

- The accelerator position sensor is a Hall element type sensor. Accelerator position is converted to an electrical signal that is output to the engine ECU.



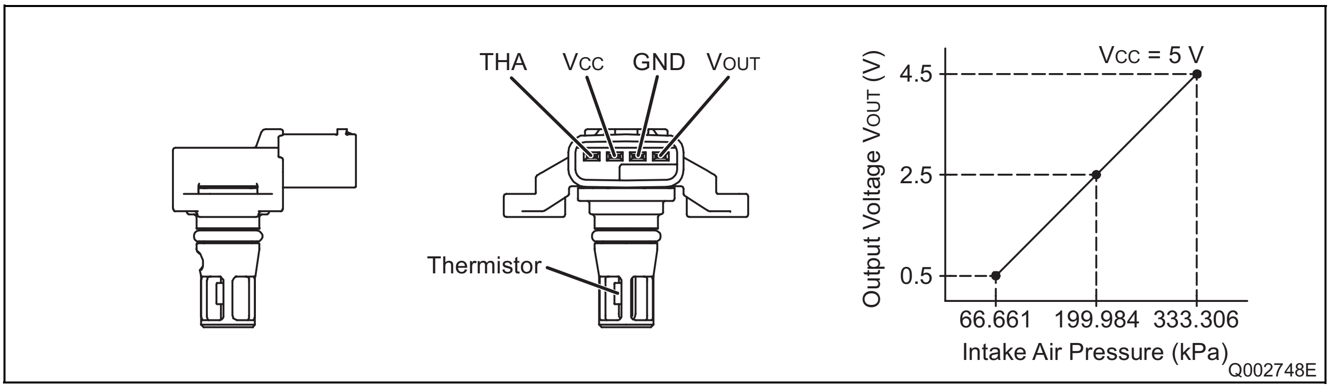
(3) Mass Air Flow (MAF) meter

- The MAF meter detects the intake air flow (mass flow rate) into the hot-wire type air flow meter. The intake air flow is converted to a voltage value and transmitted to the ECU. The MAF meter is built into the intake air temperature sensor.



(4) Manifold absolute pressure sensor

- The manifold absolute pressure sensor detects intake air pressure. The manifold absolute pressure sensor also includes a thermistor-type temperature sensor.



(5) Other sensors (non-DENSO products for the July 2009 model LEGACY)

- The July 2009 model LEGACY also uses the sensors listed below for charging control.
  - ✓ Battery temperature sensor
  - ✓ Current sensor

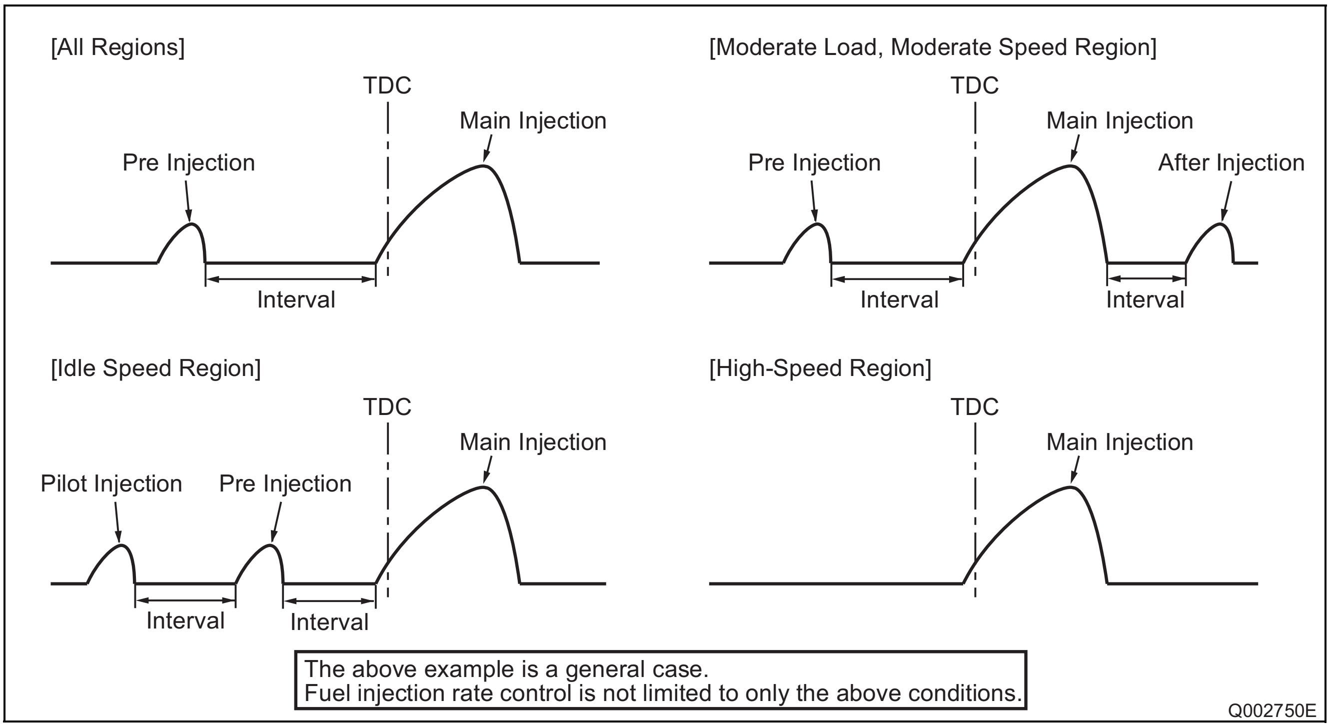
7. CONTROL SYSTEMS OPERATION

7.1 Fuel Injection Control

- The following conventional controls are used to adjust fuel injection: fuel injection quantity control, fuel injection timing control, fuel injection rate control, fuel injection pressure control. The proceeding section explains controls unique to the EE20 engine CRS.
- Since the DPF used in the FORESTER and IMPREZA CRS has changed, fuel injection rate control has been added to the DPF regeneration control.

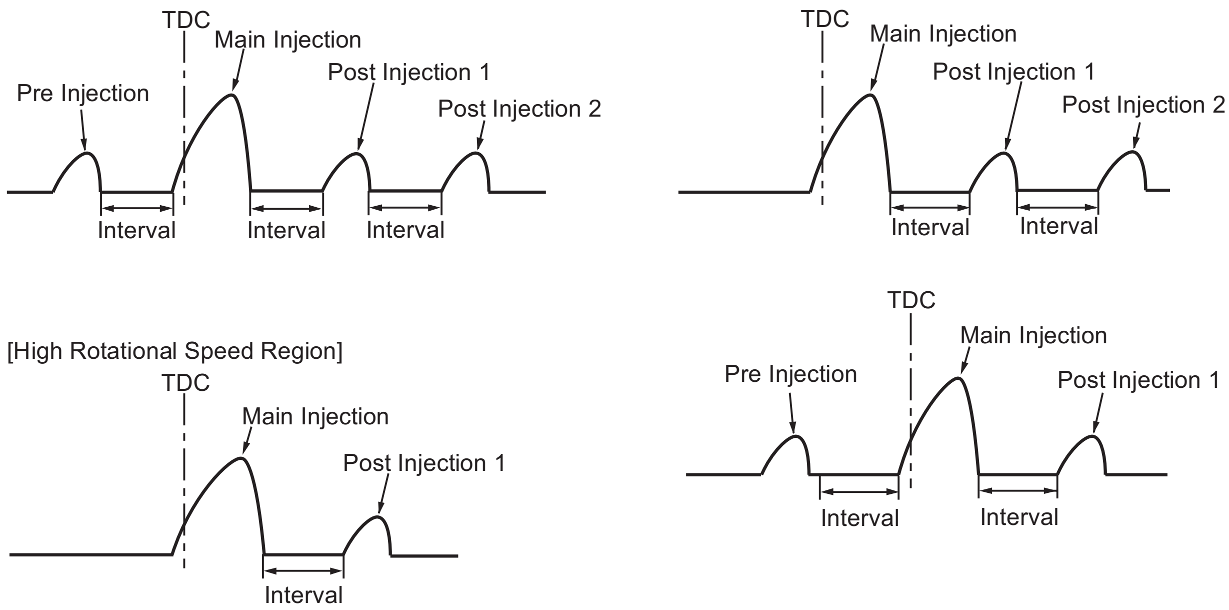
(1) Fuel injection rate control

- Excluding when DPF regeneration control is active, the injection patterns for the FORESTER and IMPREZA CRS are indicated in the figure below. Pre-injection is performed in nearly all regions, while after-injection is performed under moderate engine load and moderate engine rotational speeds. Pilot injection occurs in the idle speed region, and is added to both pre-injection and after-injection. In addition, main injection only occurs when the engine is at high rotational speeds and high output. Under injection timing control, each individual interval is controlled after the main injection timing is determined.



DPF control (July 2009 model LEGACY, FORESTER, IMPREZA)

- When the PM accumulated in the DPF is forcibly processed (when a fixed quantity of PM has been accumulated), injection occurs as per the figure below. As a result, the DPF temperature increases, and the PM undergoes oxidation treatment. When DPF regeneration occurs in the high rotational speed region, the number of injection stages is limited by heat generated from the ECU. Therefore, pre-injection is stopped, and post-injection takes precedence.



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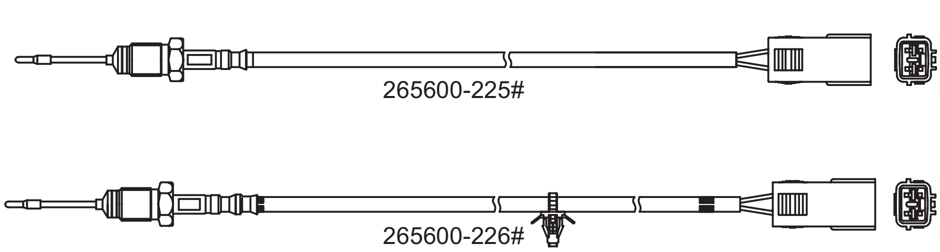
Exhaust gas temperature sensor

✓ The exhaust gas temperature sensor is installed in front of the oxidation catalyst and DPF to detect the gas temperature before the oxidation catalyst and DPF. The sensor then sends signals to the engine ECU to control temperature increases in the oxidation catalyst and DPF. The sensor portion is a thermistor element in which resistance changes according to temperature variations.



Resistance Value Specifications (-225#, -226#)	
Temperature	Resistance Value
50°C	106^{+31}_{-24} kΩ
650°C	346^{+14}_{-13} Ω
700°C	287^{+22}_{-20} Ω

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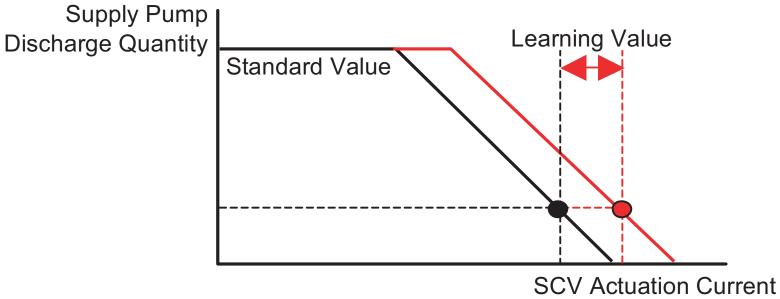
(2) Supply pump learning

Purpose

- Supply pump learning is performed so that the relationship between the actuation current for the supply pump SCV, and the discharge quantity can be studied in order to satisfactorily maintain pressure control.

Outline

- When the conditions for idle speed are satisfied, the standard SCV actuation current value is calculated. Learning is then performed by comparing the difference between the actuation current that suits the actual discharge rate, and the previously calculated standard value. The difference in the two current values is then used as a basis to correct SCV actuation current in accordance with the command value for the discharge quantity. When the supply pump is replaced, it is necessary to initialize all prior learning values. Learning value initialization is used with diagnostic tools.



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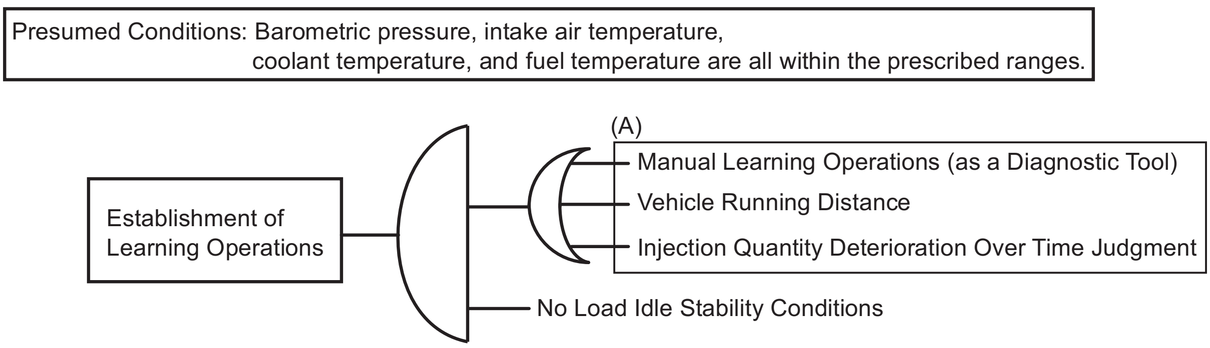
(3) Microinjection quantity learning control

Outline

- Quantity learning control is used in every vehicle engine (injector) to preserve the accuracy of the 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"). Due to quantity learning control, the accuracy of each injector can be preserved not only initially, but also as deterioration in injection occurs over time. Learning control stores correction values in the ECU. During normal driving operations, these correction values are used to make modifications to injection commands, resulting in accurate microinjection.

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.



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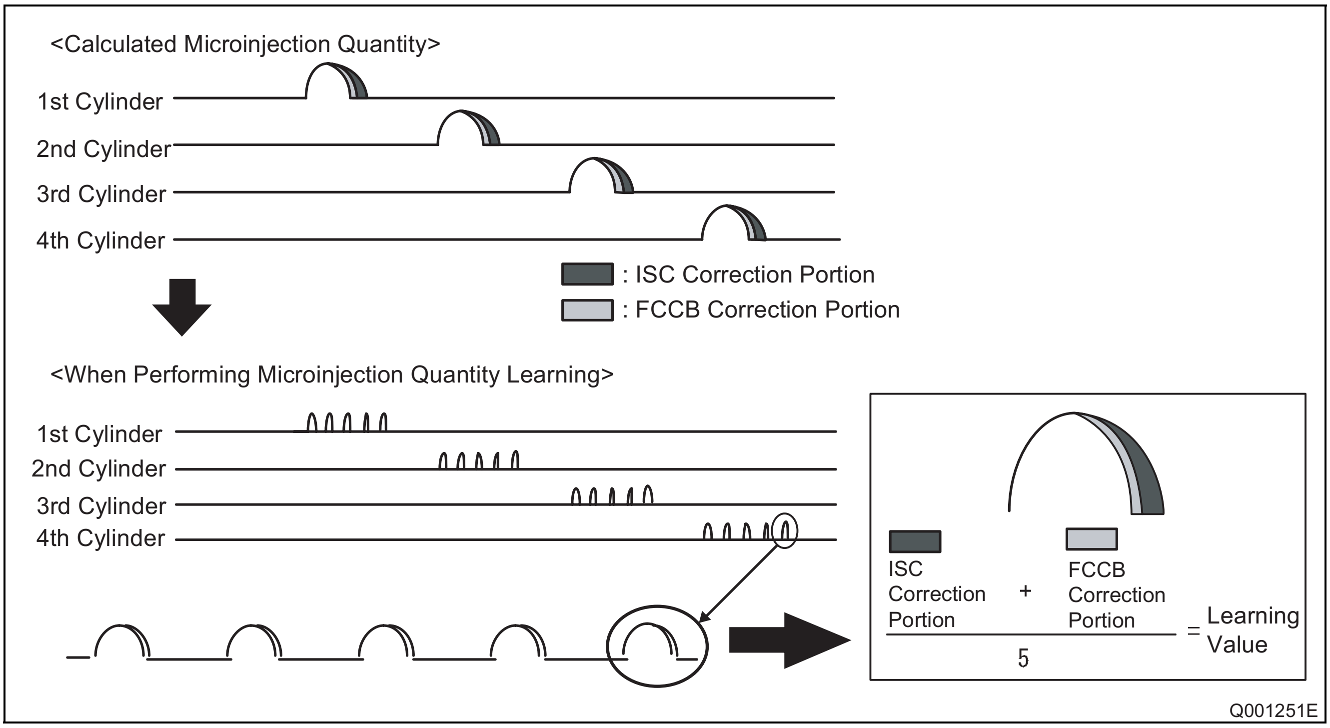
Operational outline

- Microinjection quantity learning control provides feedback related to ISC (target rotational speed correction quantity) and FCCB (cylinder-to-cylinder correction quantity). Feedback is based on engine rotational speed to apply injection quantity control. Corrections are applied to each cylinder based on ISC and FCCB correction information, and the corrected injection quantities are calculated. Under microinjection quantity learning control, injection is divided into five injections. Therefore, the "learning value" is calculated as the corrected injection quantities for ISC and FCCB, divided by five injections.



7.2 Other Systems

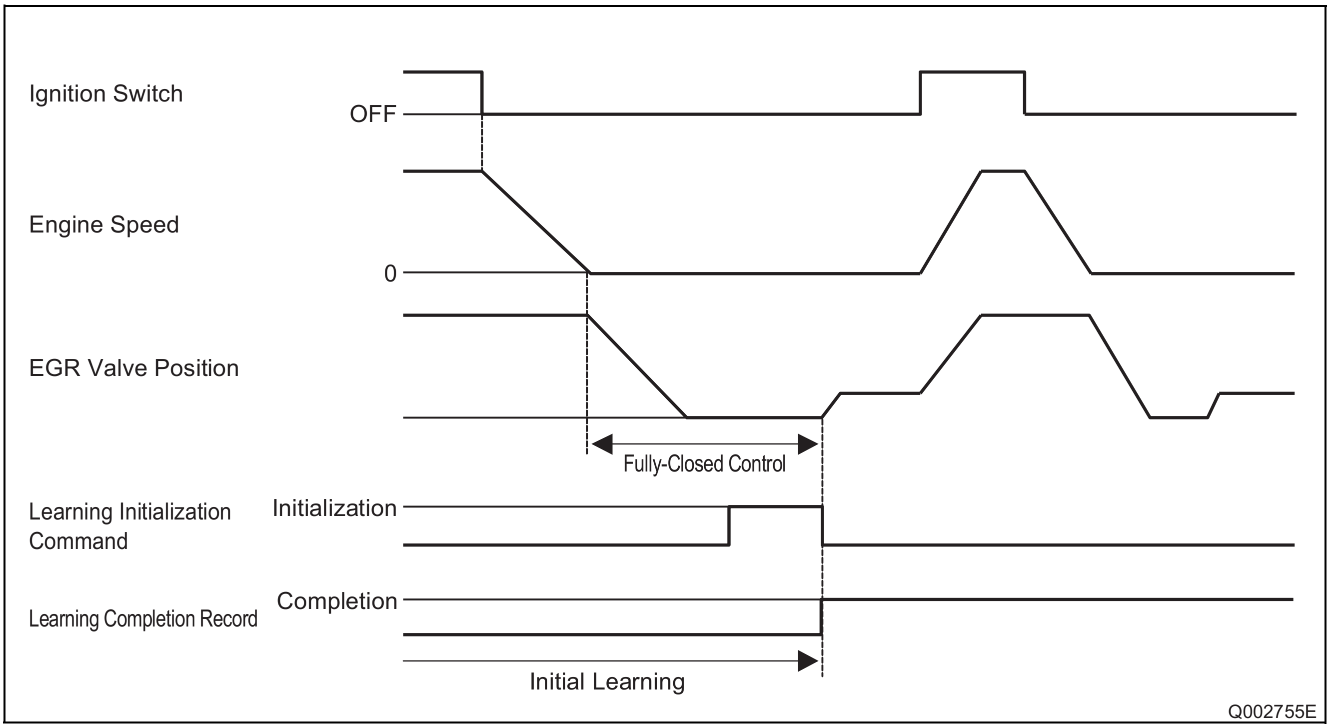
(1) EGR fully-closed learning

Purpose

- EGR fully-closed learning is used to store the initial value for the EGR position sensor in order to execute troubleshooting (related to the EGR valve position.)

Outline

- EGR fully-closed learning stores the EGR position sensor output when the EGR valve is actuated to the fully closed position. This learning only occurs when the ignition switch is initially turned off. In the following figure, an abnormality is determined if voltage reaches or exceeds a prescribed value in comparison to the stored value.



Conditions for learning execution

- EGR fully-closed learning is executed when all of the following conditions are met.
  - ✓ Initial learning has not been executed
  - ✓ Coolant temperature is within the prescribed conditions (20ºC to 60ºC)
  - ✓ Battery voltage is at or above the prescribed value (10.5 V)
  - ✓ EGR is operating normally
  - ✓ The ignition switch is off
  - ✓ The engine is stopped

[REFERENCE]

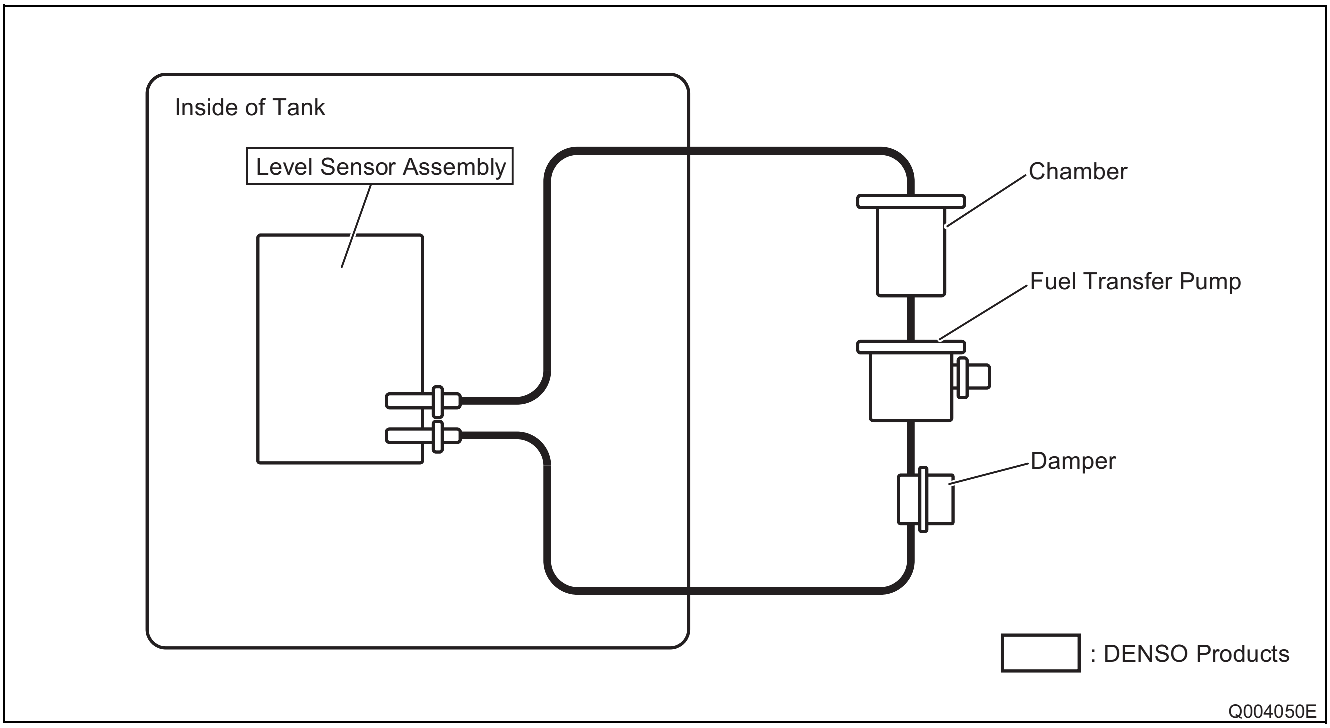
When replacing the EGR, it is necessary to reset the initial learning completion record, and conduct learning again.

8. ADDITIONAL EQUIPMENT

8.1 Saddle Transfer Module (Level Sensor Assembly)

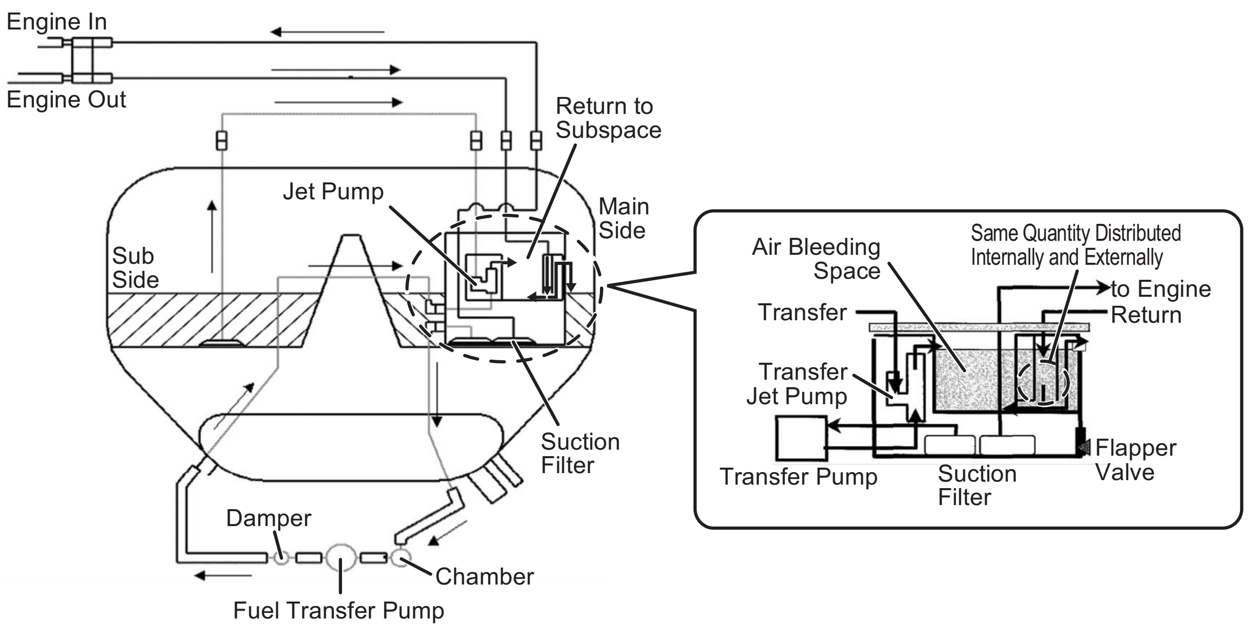
Outline

- The saddle transfer module moves fuel from the sub side of the fuel tank to the main side of the fuel tank. The fuel in the main side is circulated by an external fuel transfer pump. This flow path is utilized to send fuel from the sub side to the main side via a jet pump.



Fuel flow

- The fuel transfer pump draws in and circulates fuel from inside the level sensor assembly, then sends the fuel to the jet pump (also within the level sensor assembly). At this time, the jet pump draws fuel up from the sub side of the tank, and then sends this fuel together with the circulated fuel to the chamber within the level sensor assembly. In addition, an ancillary function keeps the temperature of the fuel sent to the supply pump low. A low fuel temperature is maintained by distributing return fuel from the engine inside and outside of the level sensor assembly in equal quantities.



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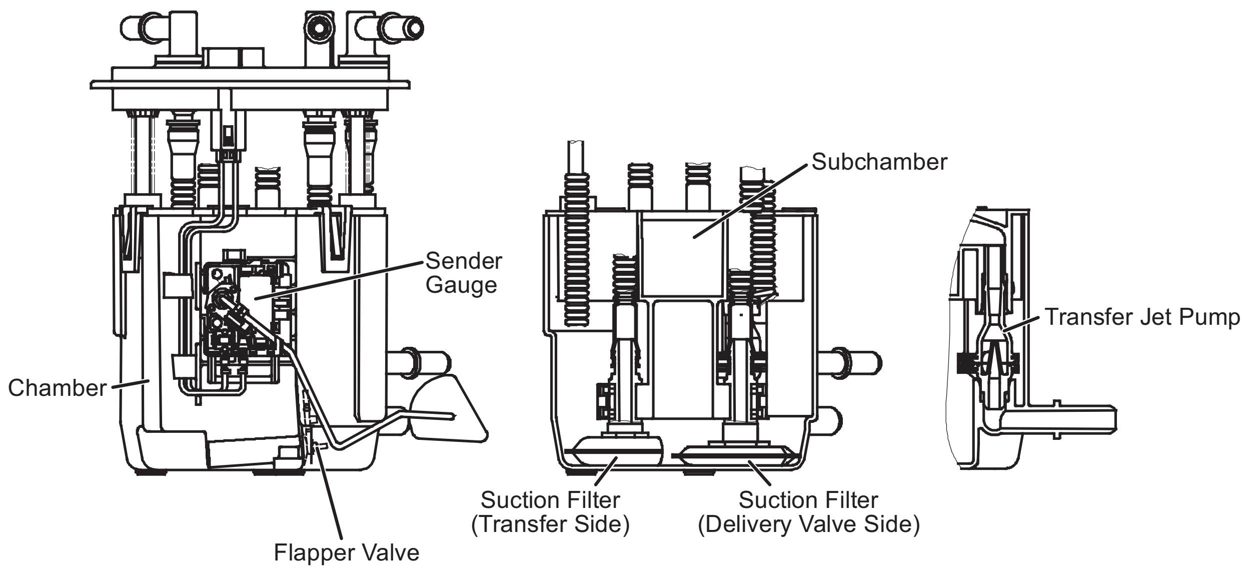
Construction

- Level sensor assembly construction is shown in the figure below.



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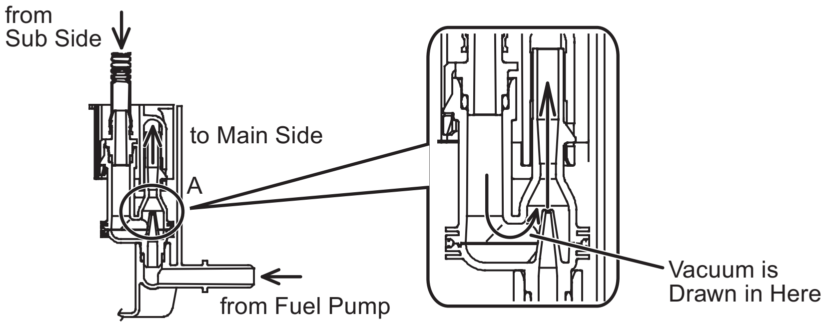
Fuel transfer operations

- The external fuel pump normally operates when the engine key is on. Fuel sent to the jet pump is transferred via the following operations (refer to the figure below). The jet pump draws fuel up from the sub side of the fuel tank during "Saddle Transfer", with portion "A" of the pump acting as a venturi (diaphragm). As fuel passes region "A", a vacuum is drawn downstream of the venturi. The region where the vacuum is drawn is connected to the sub side of the fuel tank by a hose. When a vacuum is drawn, fuel from the sub side of the tank is suctioned into the main side.



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9. DIAGNOSTIC TROUBLE CODES (DTC)

9.1 DTC Table

DTCs Common to the LEGACY, FORESTER, and IMPREZA

DTC	MIL ON/OFF	Detection Item
P0016	ON	Crankshaft position-camshaft position correlation
P0046	ON	Variable Nozzle Turbo (VNT) Electric Vacuum Regulating Valve (EVRV) abnormality
P0088	ON	Abnormally high rail pressure
P0089	OFF	Fuel pressure regulator 1 performance (pressure limiter valve opening abnormality)
P0093	ON	Fuel system leak detected-large leak
P0097	ON	Intake air temperature sensor circuit low
P0098	ON	Intake air temperature sensor circuit high
P0101	ON	Abnormal Mass Air Flow (MAF) meter characteristics
P0102	ON	MAF circuit low input
P0103	ON	MAF circuit high input
P0106	ON	Manifold absolute pressure/barometric pressure circuit range/performance (not available for the July 2009 model LEGACY)
P0107	ON	Manifold absolute pressure/barometric pressure circuit low input
P0108	ON	Manifold absolute pressure/barometric pressure circuit high input
P0112	ON	Intake air temperature sensor 1 circuit low
P0113	ON	Intake air temperature sensor 1 circuit high
P0116	ON	Engine coolant temperature circuit range/performance
P0117	ON	Engine coolant temperature circuit low
P0118	ON	Engine coolant temperature circuit high
P0122	ON	Throttle/pedal position sensor/switch circuit low (diesel throttle sensor low)
P0123	ON	Throttle/pedal position sensor/switch circuit high (diesel throttle sensor high)
P0182	ON	Fuel temperature sensor circuit low
P0183	ON	Fuel temperature sensor circuit high
P0191	ON	Abnormal rail pressure sensor characteristics
P0192	ON	Rail pressure sensor circuit low
P0193	ON	Rail pressure sensor circuit high
P0201	ON	Injector circuit/open-cylinder 1 (TWV 1 actuation system open circuit)
P0202	ON	Injector circuit/open-cylinder 2 (TWV 3 actuation system open circuit)
P0203	ON	Injector circuit/open-cylinder 3 (TWV 2 actuation system open circuit)
P0204	ON	Injector circuit/open-cylinder 4 (TWV 4 actuation system open circuit)
P0219	OFF	Engine over speed condition

DTC	MIL ON/OFF	Detection Item
P0301	ON	Cylinder 1 misfire detected
P0302	ON	Cylinder 2 misfire detected
P0303	ON	Cylinder 3 misfire detected
P0304	ON	Cylinder 4 misfire detected
P0335	ON	Crankshaft position sensor circuit
P0336	ON	Crankshaft position sensor circuit range/performance
P0340	ON	Camshaft position sensor circuit (no cylinder recognition sensor pulse input)
P0341	ON	Camshaft position sensor circuit range/performance (abnormal number of cylinder recognition sensor pulse inputs)
P0403	ON	Exhaust Gas Recirculation (EGR) control circuit
P0404	ON	EGR control circuit range/performance
P0405	ON	EGR sensor circuit low
P0406	ON	EGR sensor circuit high
P0409	ON	EGR sensor circuit
P0462	ON	Fuel level sensor circuit low
P0463	ON	Fuel level sensor circuit high
P0500	ON	Vehicle speed sensor
P0512	ON	Starter request circuit
P0513	OFF	Incorrect immobilizer key
P0600	ON	Serial communication link
P0604	ON	RAM abnormality
P0605	ON	Engine ECU Flash ROM abnormality
P0606	ON	CPU abnormality (main IC abnormality)
P0628	ON	Fuel pump control circuit low {Suction Control Valve (SCV) actuation system abnormality}
P0629	ON	Fuel pump control circuit high (SCV +B short)
P0638	ON	Throttle actuator control range/Performance
P0704	ON	Clutch switch input circuit malfunction
P0850	ON	Park/neutral switch input circuit
P1201	ON	QR data failure to write abnormality
P1202	ON	QR data abnormality
P1203	ON	QR correction information input abnormality
P1213	ON	Low charge
P1214	ON	Overcharge
P1232	ON	Pump single cylinder abnormality detection
P1233	ON	Pump protection failure flag
P1234	ON	Pump replacement failure flag
P1380	ON	Glow voltage low
P1382	ON	Glow voltage high

DTC	MIL ON/OFF	Detection Item
P1519	ON	Starter switch 2 circuit abnormality (off)
P1520	ON	Starter switch 2 circuit abnormality (on)
P1560	ON	Backup power supply abnormality
P1570	OFF	Immobilizer antenna system abnormality
P1571	OFF	Immobilizer identification code inconsistency
P1572	OFF	Communication abnormality between CRS and immobilizer
P1574	OFF	Communication abnormality between key and immobilizer
P1576	OFF	CRS unit Electronically Erasable and Programmable Read Only Memory (EEPROM) abnormality
P1577	OFF	Immobilizer unit EEPROM abnormality
P1578	OFF	Meter abnormality
P1607	ON	CPU abnormality (monitoring IC abnormality)
P1616	ON	Starter cut relay open circuit detection
P2101	ON	Throttle actuator control motor circuit range/performance
P2122	ON	Throttle/pedal position sensor/switch "D" circuit low input (accelerator position sensor 1 low)
P2123	ON	Throttle/pedal position sensor/switch "D" circuit low input (accelerator position sensor 1 high)
P2127	ON	Throttle/pedal position sensor/switch "E" circuit low input (accelerator position sensor 2 low)
P2128	ON	Throttle/pedal position sensor/switch "E" circuit high input (accelerator position sensor 2 high)
P2138	ON	Throttle/pedal position sensor/switch "D"/"E" voltage correlation (abnormal accelerator position sensor characteristics)
P2146	ON	Fuel injector group "A" supply voltage circuit/open
P2147	ON	Fuel injector group "A" supply voltage circuit low
P2148	ON	Fuel injector group "A" supply voltage circuit high
P2149	ON	Fuel Injector group "B" supply voltage circuit/open
P2228	ON	Barometric pressure circuit low
P2229	ON	Barometric pressure circuit high
P2413	ON	EGR system performance
P2633	ON	Fuel pump "B" control circuit low (saddle transfer pump relay low)
P2634	ON	Fuel pump "B" control circuit high (saddle transfer pump relay high)
P2635	ON	Fuel pump "A" low flow/performance (SCV stuck diagnosis)

Additional DTCs for the FORESTER, IMPREZA, and July 2009 Model LEGACY

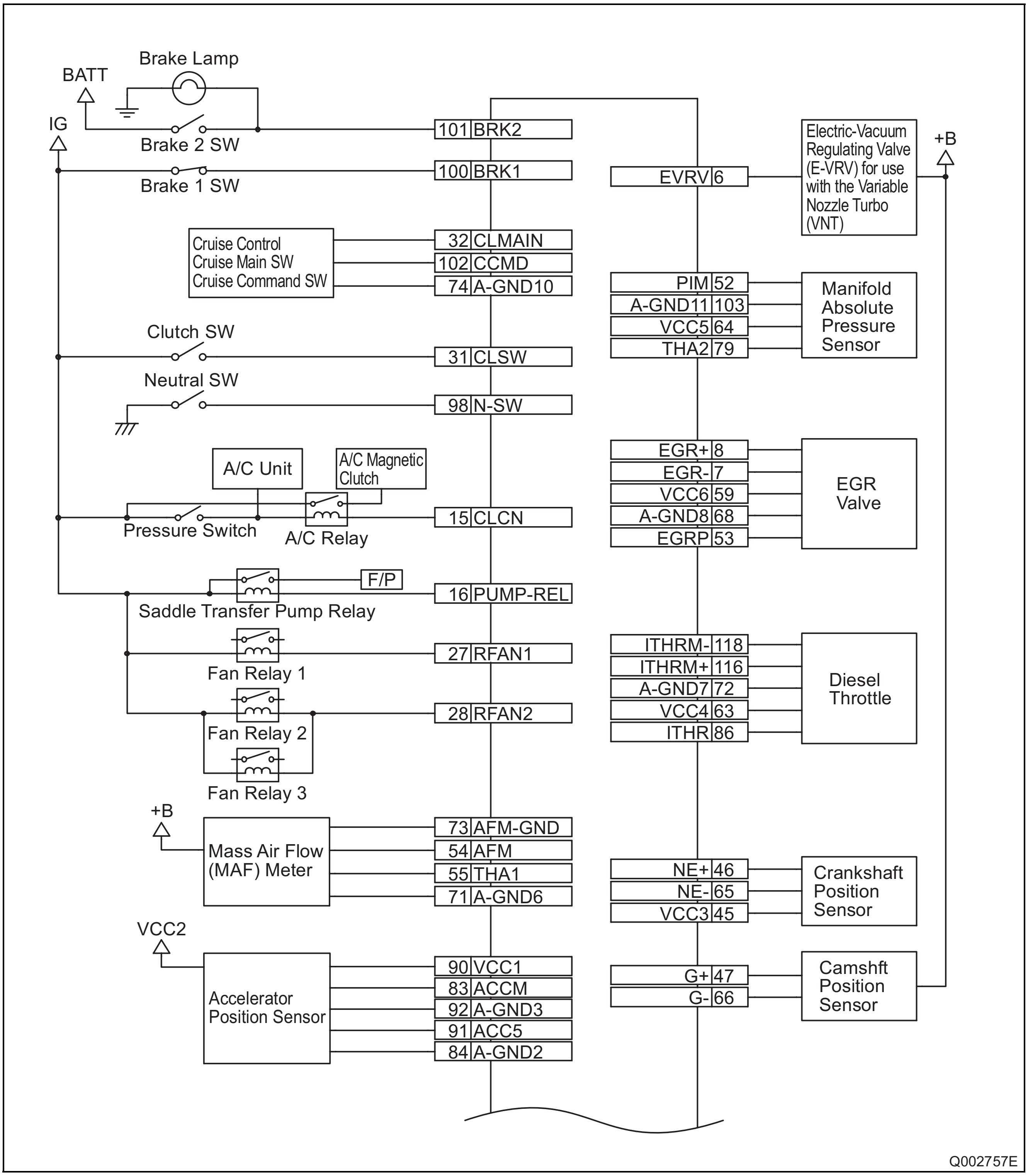
DTC	MIL ON/OFF	Detection Item
P0545	ON	Exhaust gas temperature sensor circuit low
P0546	ON	Exhaust gas temperature sensor circuit high
P1466	ON	DPF defect (FORESTER and IMPREZA only)
P1467	OFF	DPF oil ash overaccumulation (DPF light flashing)
P1468	OFF	Engine oil dilution (DPF light flashing)
P1469	ON	Fail-safe mode during DPF malfunction (DPF light flashing)
P1473	ON	Exhaust pressure sensor high
P1472	ON	Exhaust pressure sensor low
P2032	ON	Exhaust gas temperature sensor circuit low
P2033	ON	Exhaust gas temperature sensor circuit high

Additional DTCs for the July 2009 Model LEGACY

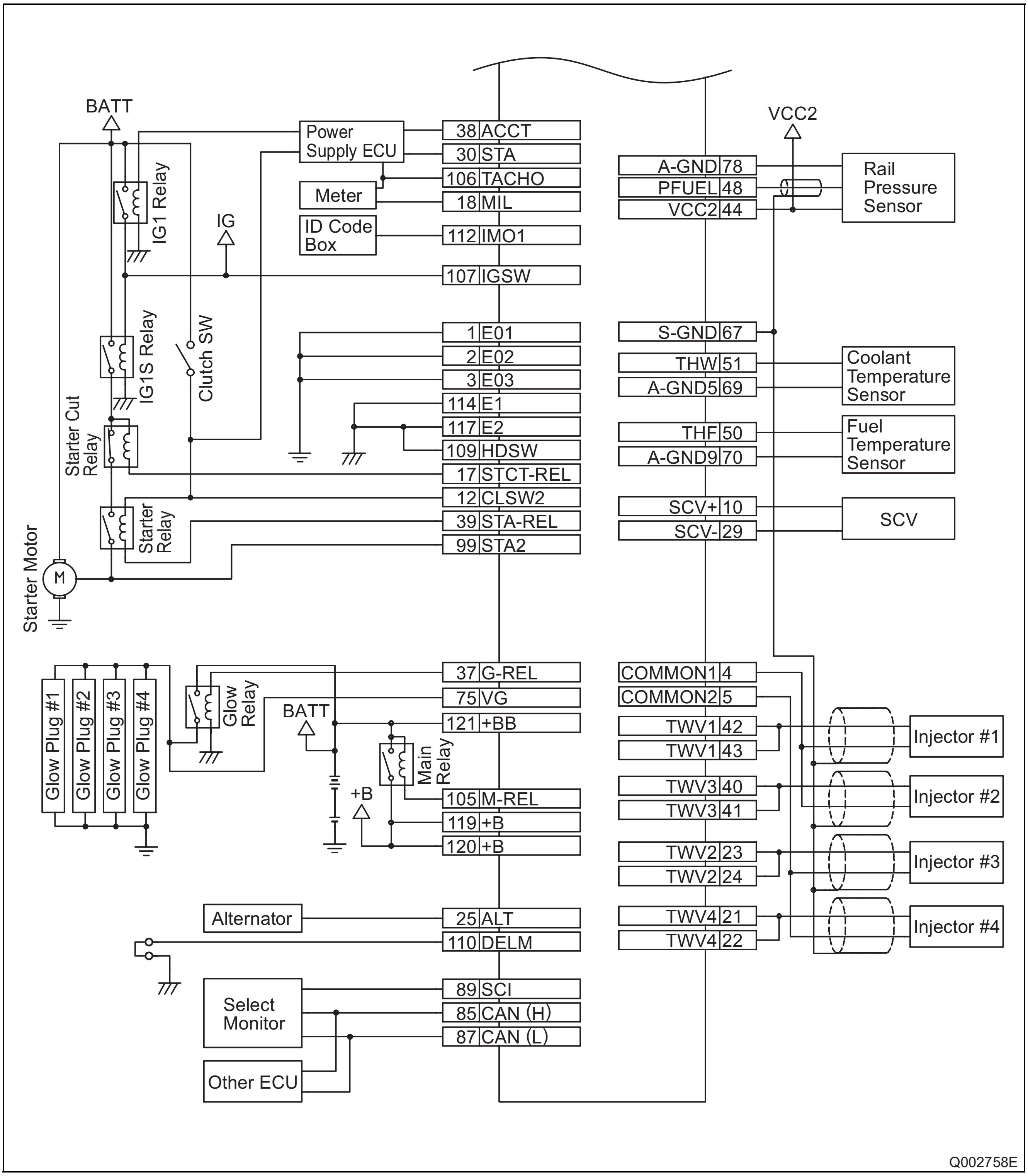
DTC	MIL ON/OFF	Detection Item
P0111	ON	Ambient temperature sensor characteristics abnormality
P0401	ON	EGR high/low abnormality
P0516	OFF	Battery temperature sensor low abnormality
P0517	OFF	Battery temperature sensor high abnormality
P0579	OFF	Cruise switch abnormality
P1530	OFF	Battery current sensor low abnormality
P1531	OFF	Battery current sensor high abnormality
P1532	OFF	Charging control system abnormality
P2150	ON	COM 2 TWV actuation circuit ground short
P2151	ON	COM 2 TWV actuation circuit +B short
P2227	ON	Atmospheric pressure sensor characteristics abnormality
P2564	ON	Turbo vane position sensor low
P2565	ON	Turbo vane position sensor high
PC073	ON	CAN communication bus off abnormality
PC122	ON	CAN communication VDC data non-transmittal abnormality
PC140	ON	CAN communication combination ECU data non-transmittal abnormality
PC416	ON	CAN communication VDC counter abnormality
PC422	ON	CAN communication combination ECU counter abnormality

10. ATTACHED MATERIALS

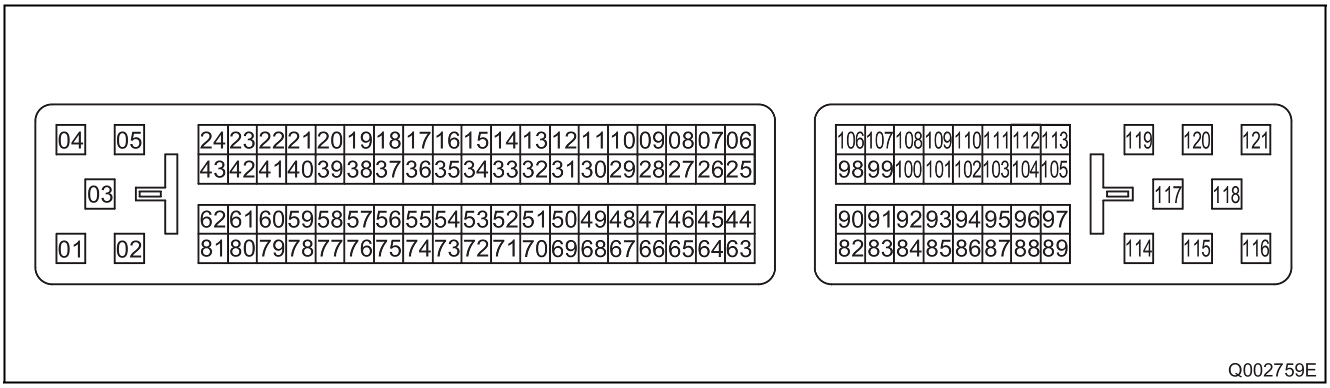
10.1 LEGACY (December 2007 Model)



Engine ECU External Wiring Diagram (1)

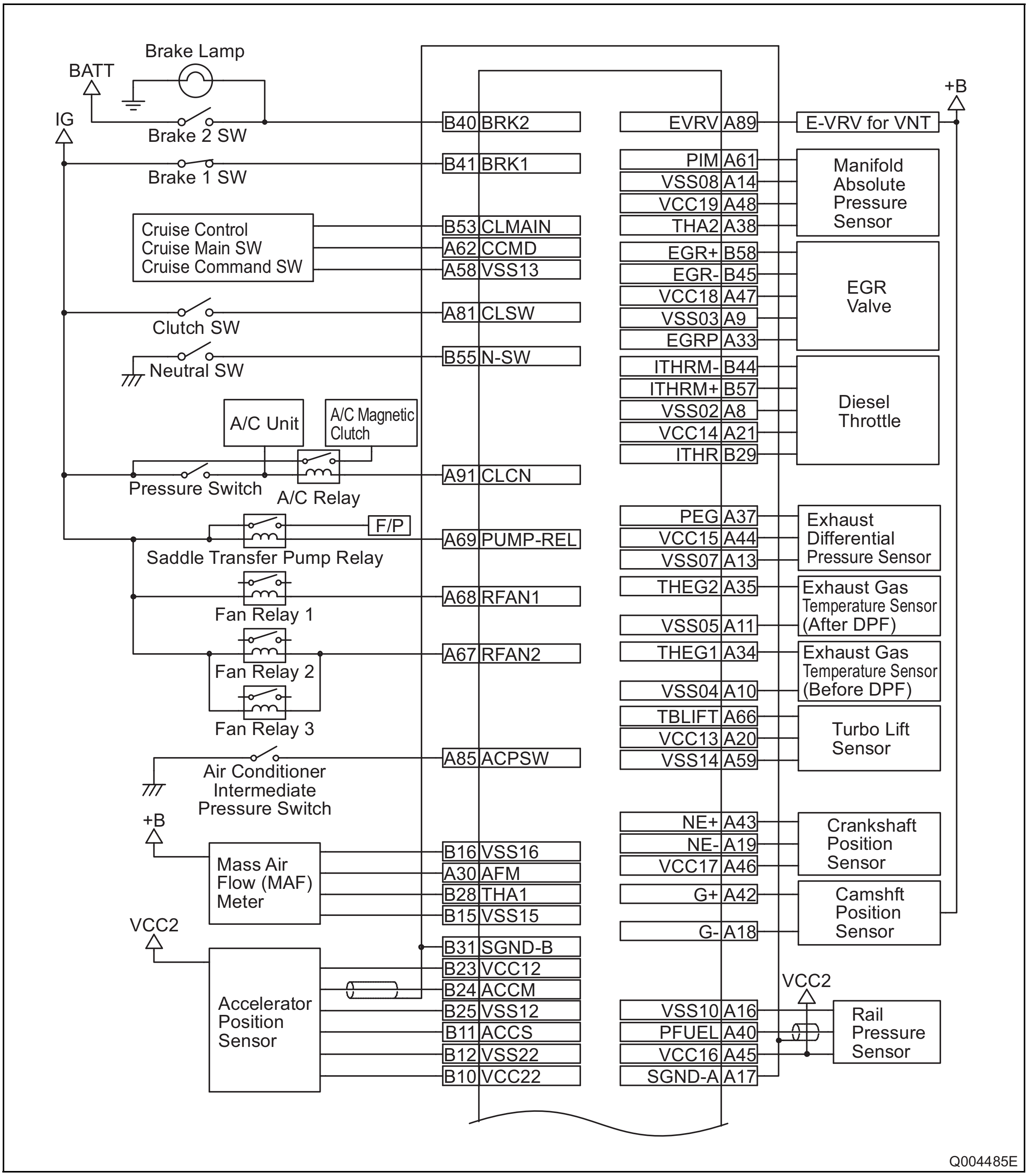


Engine ECU External Wiring Diagram (2)

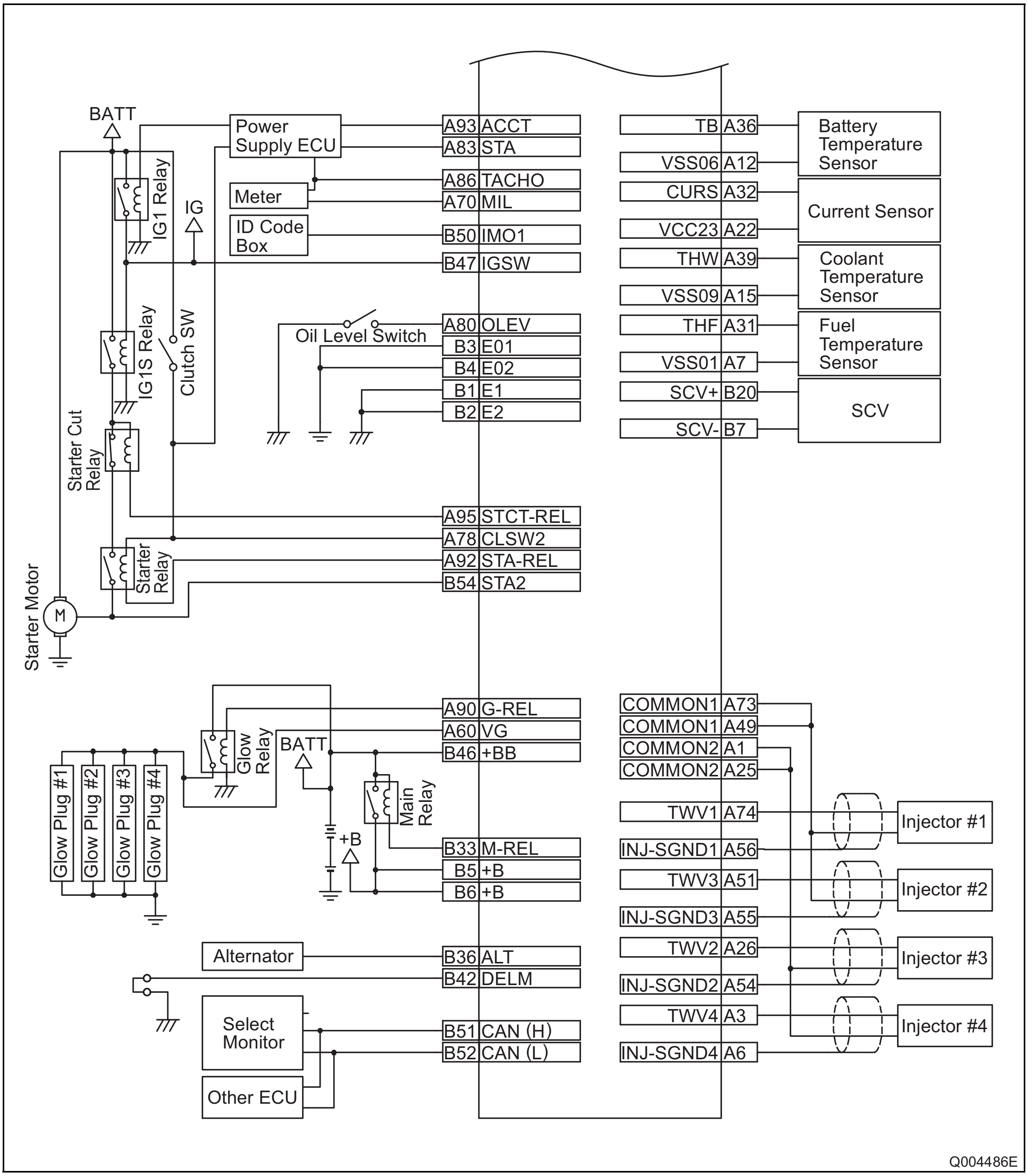


Connector Terminal Layout

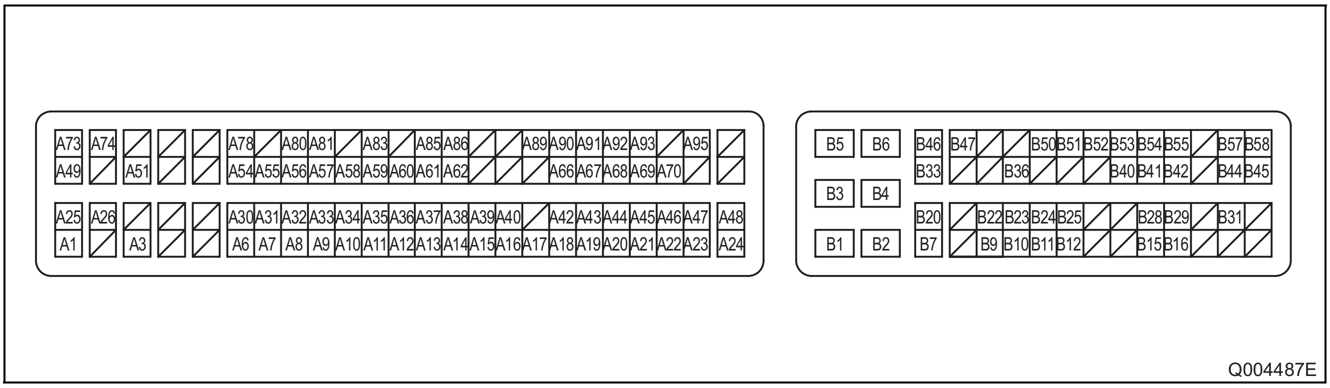
10.2 LEGACY (July 2009 Model)



Engine ECU External Wiring Diagram (1)

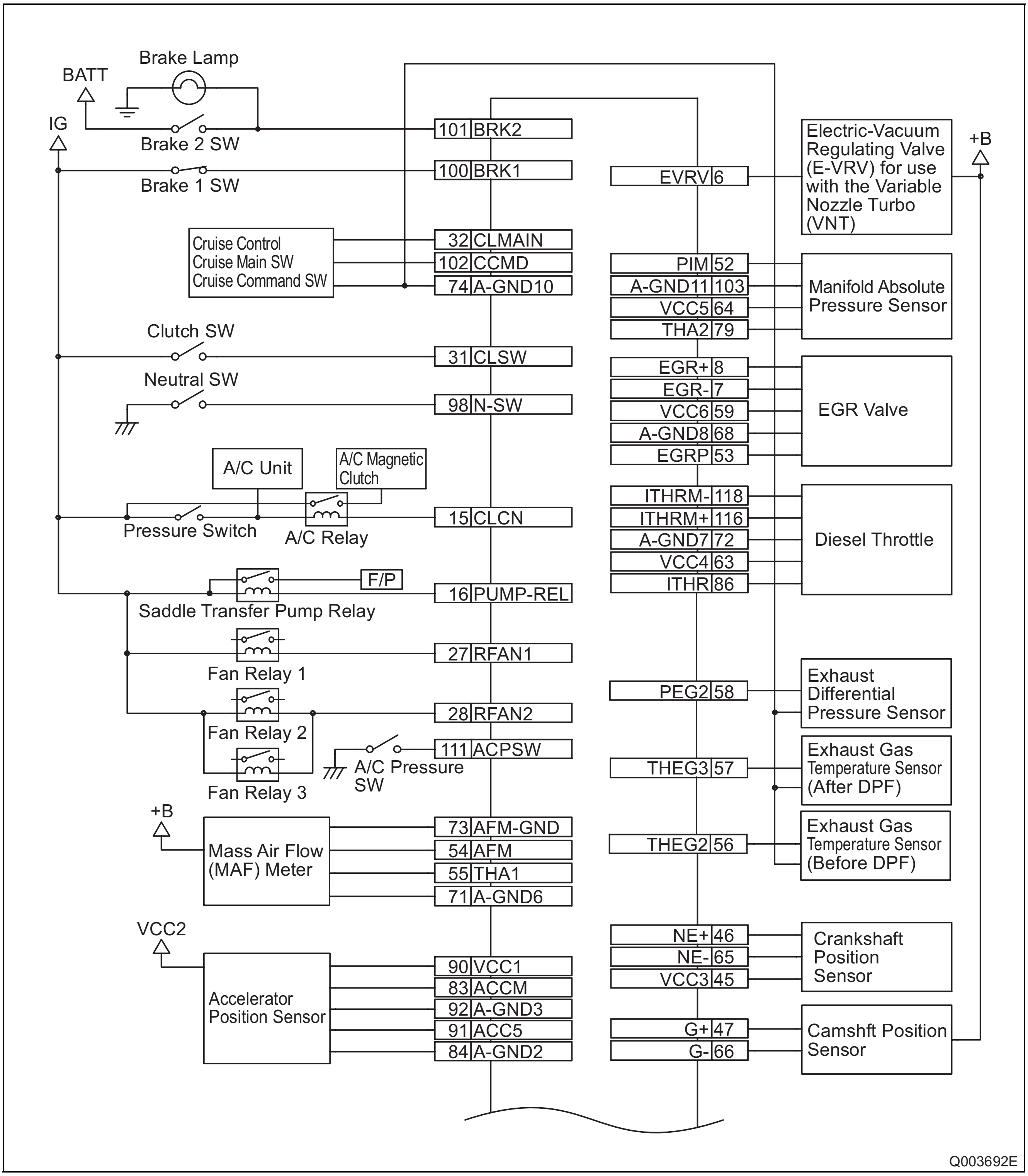


Engine ECU External Wiring Diagram (2)

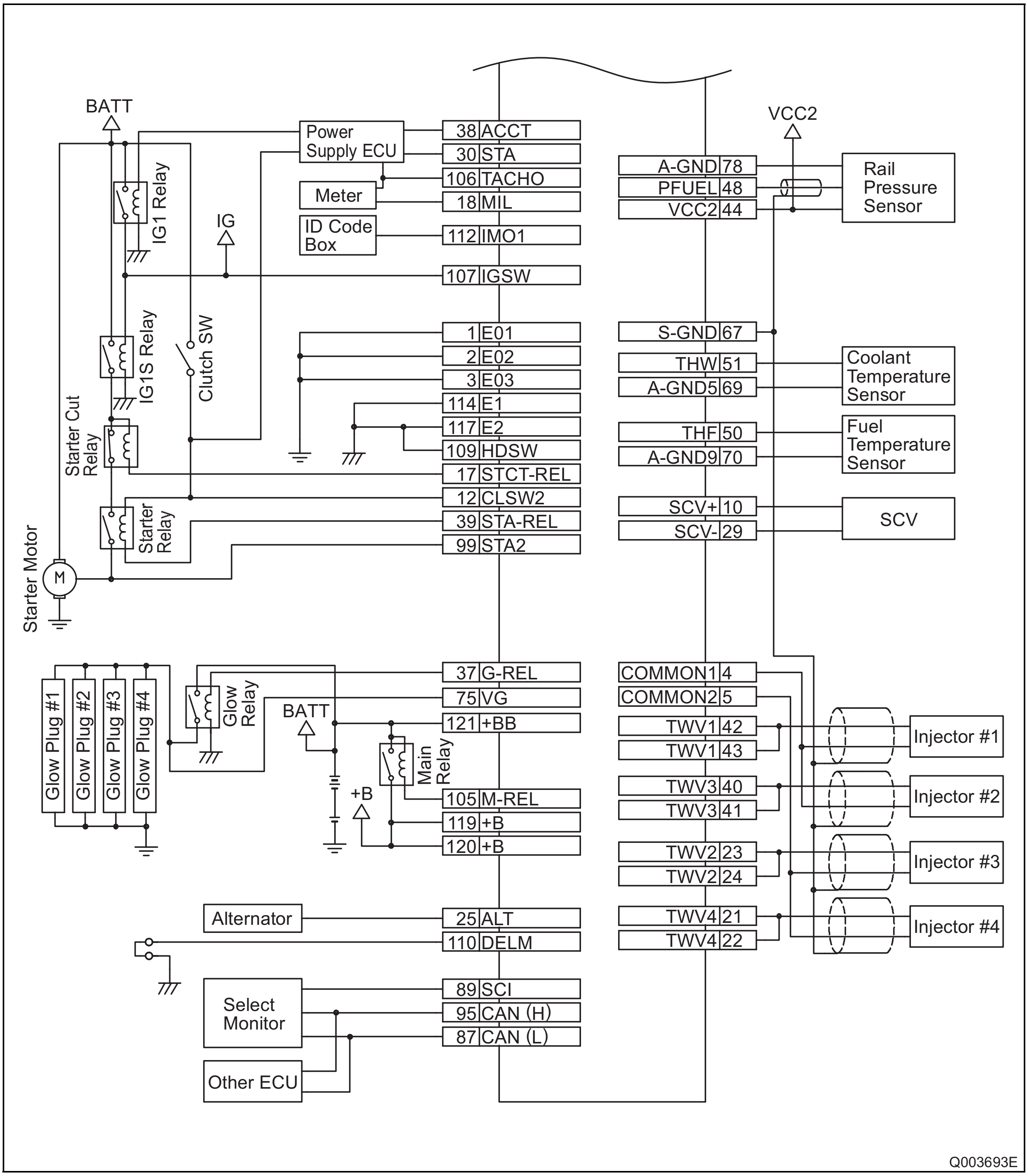


Connector Terminal Layout

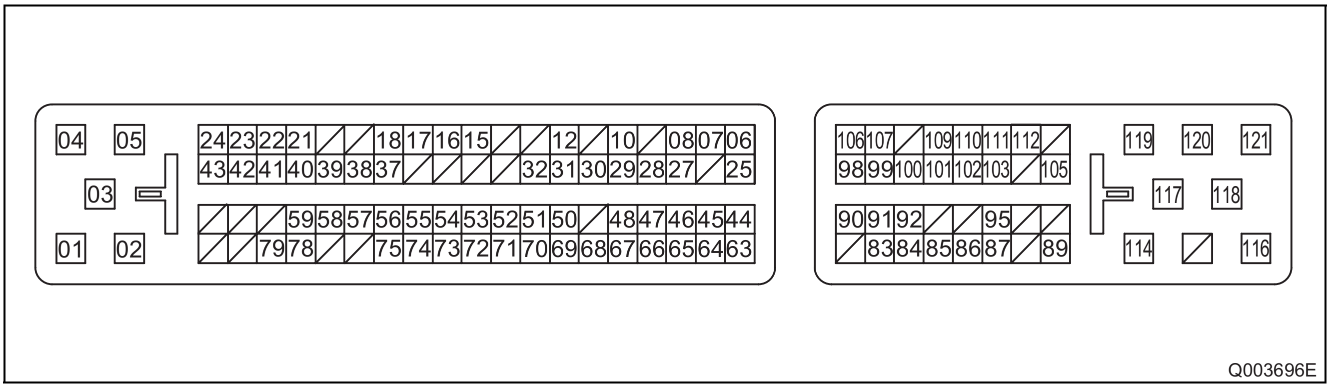
10.3 FORESTER



Engine ECU External Wiring Diagram (1)

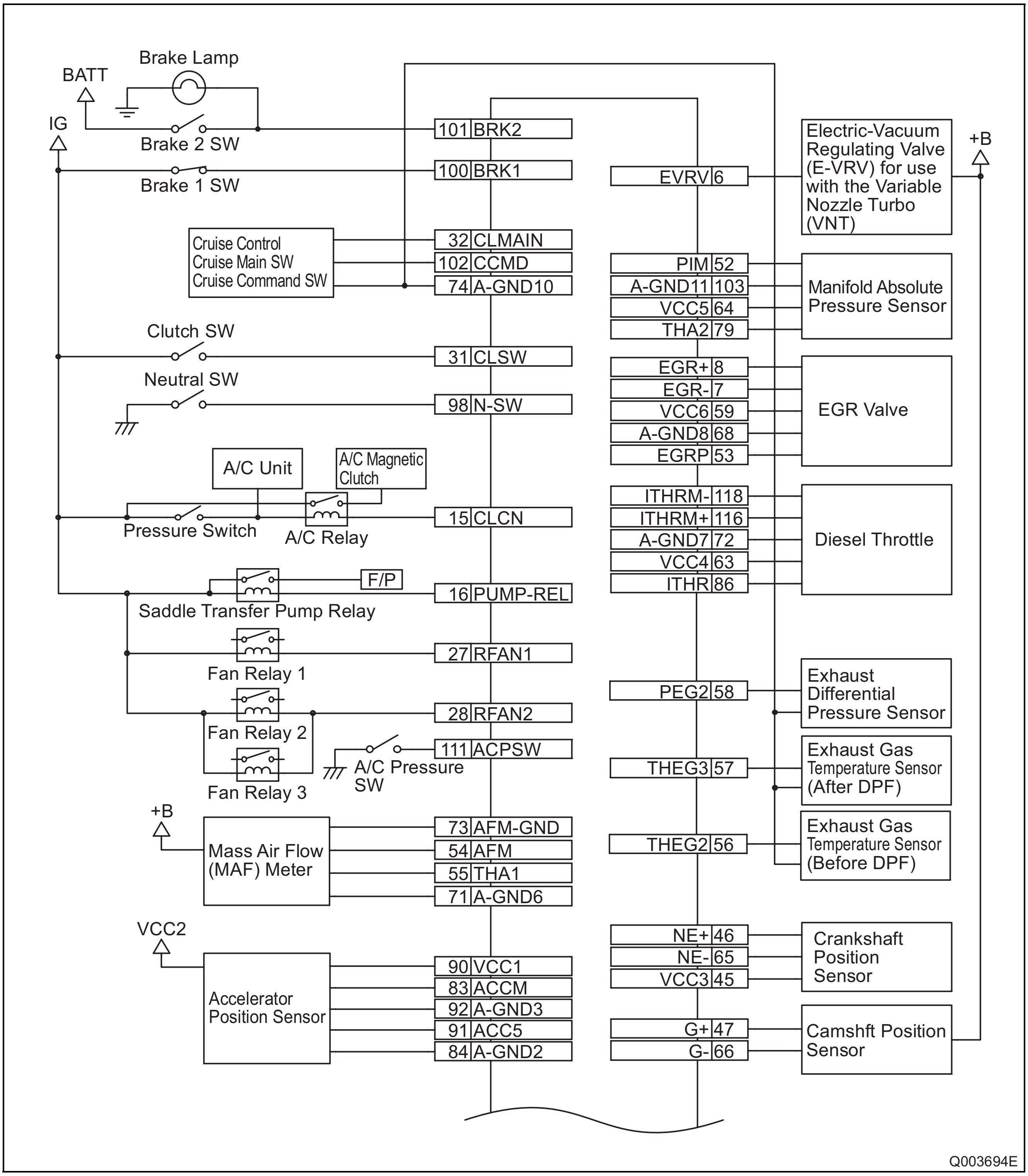


Engine ECU External Wiring Diagram (2)

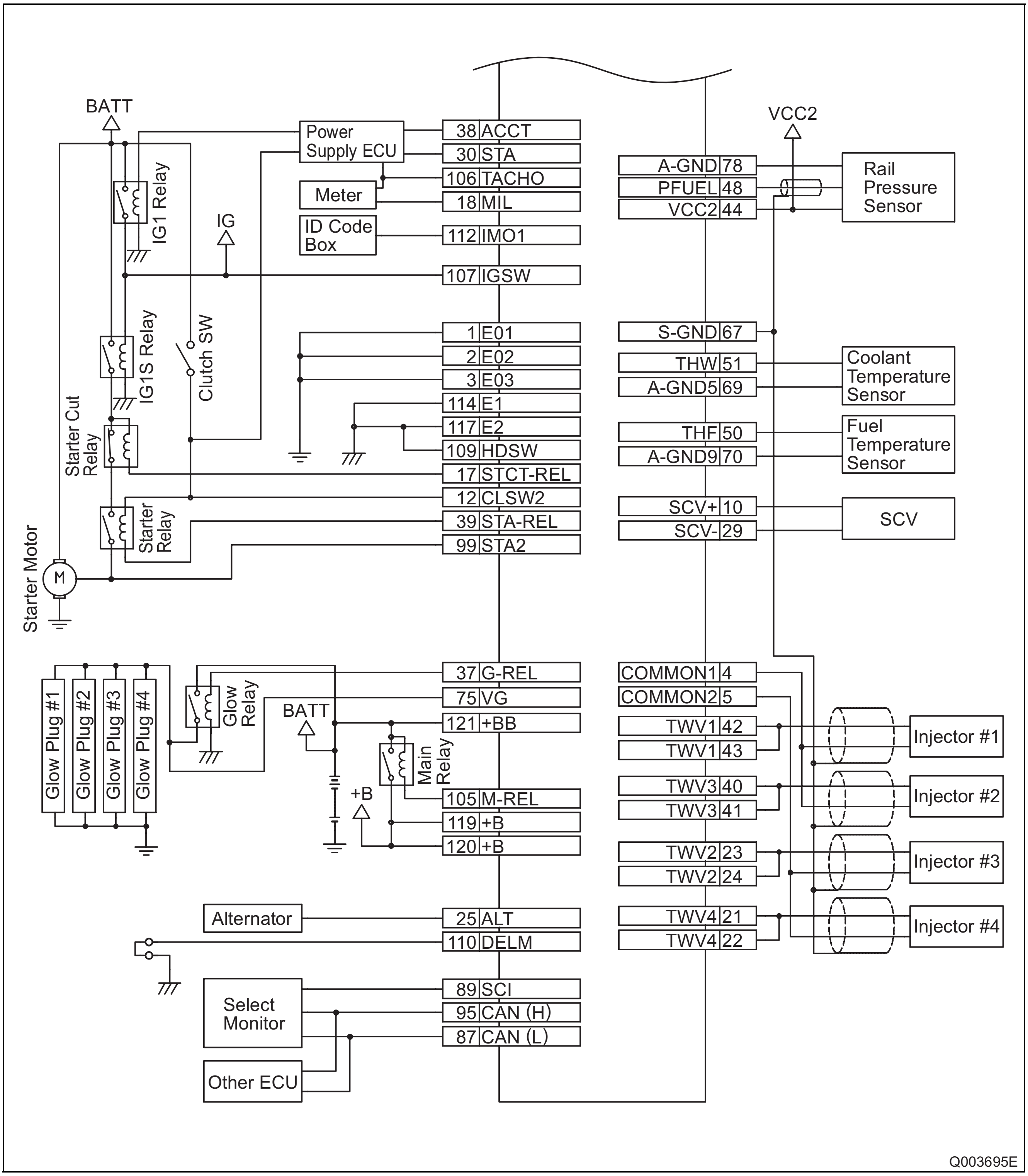


Connector Terminal Layout

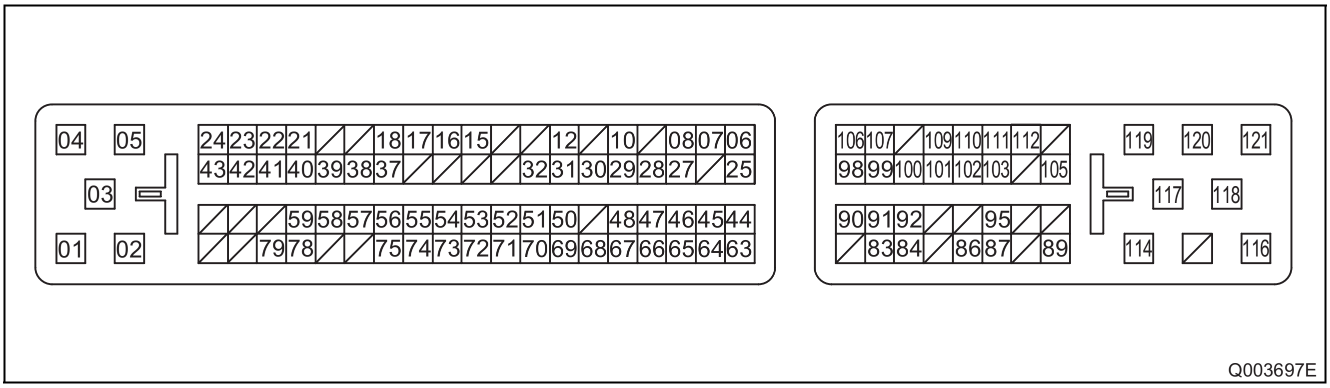
10.4 IMPREZA



Engine ECU External Wiring Diagram (1)



Engine ECU External Wiring Diagram (2)



Connector Terminal Layout

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