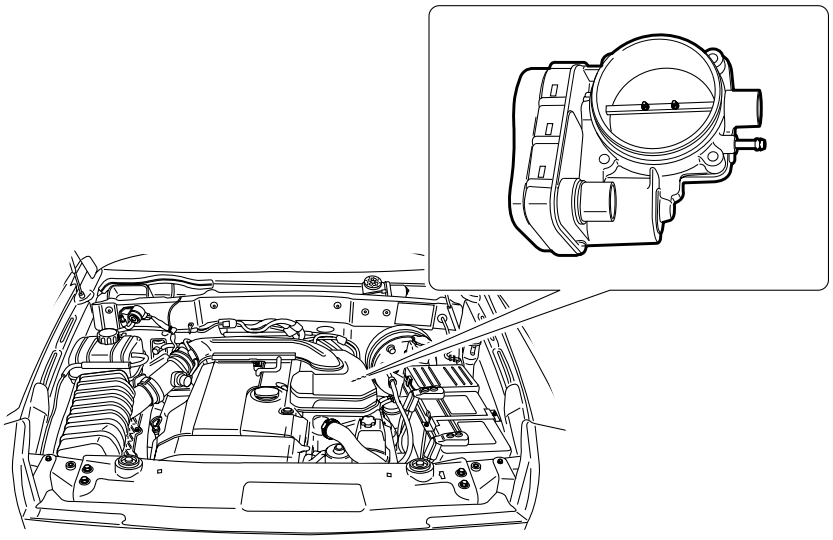
INDUCTION SYSTEM

THROTTLE VALVE ACTUATOR



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The throttle actuator is actuated by the Engine Control Module (ECM) according to the position of the accelerator pedal position.

It has two potentiometers which signal the position of the throttle valve to the ECM to enable it to recognize the various engine load states.

Ignition “Off”

In the de-energized states the throttle valve position is determined to be spring capsule.

Ignition “On”

When the ignition S/W on the servo motor in the throttle actuator is operated by the ECM. The throttle valve adopts a position in line with the coolant temperature.

Closed position

In the closed throttle position, the servo motor controls engine speed by operating the throttle valve further (greater mixture) or closing it further (reduced mixture), depending on coolant temperature and engine load. When this is done, the throttle valve can be closed further by the servo motor overcoming the force of the spring capsule (mechanical end stop). If the actuator is de-energized, the throttle valve is resting against the spring capsule.

Consequently, the throttle valve opening is a constant 10-12 °approximately.

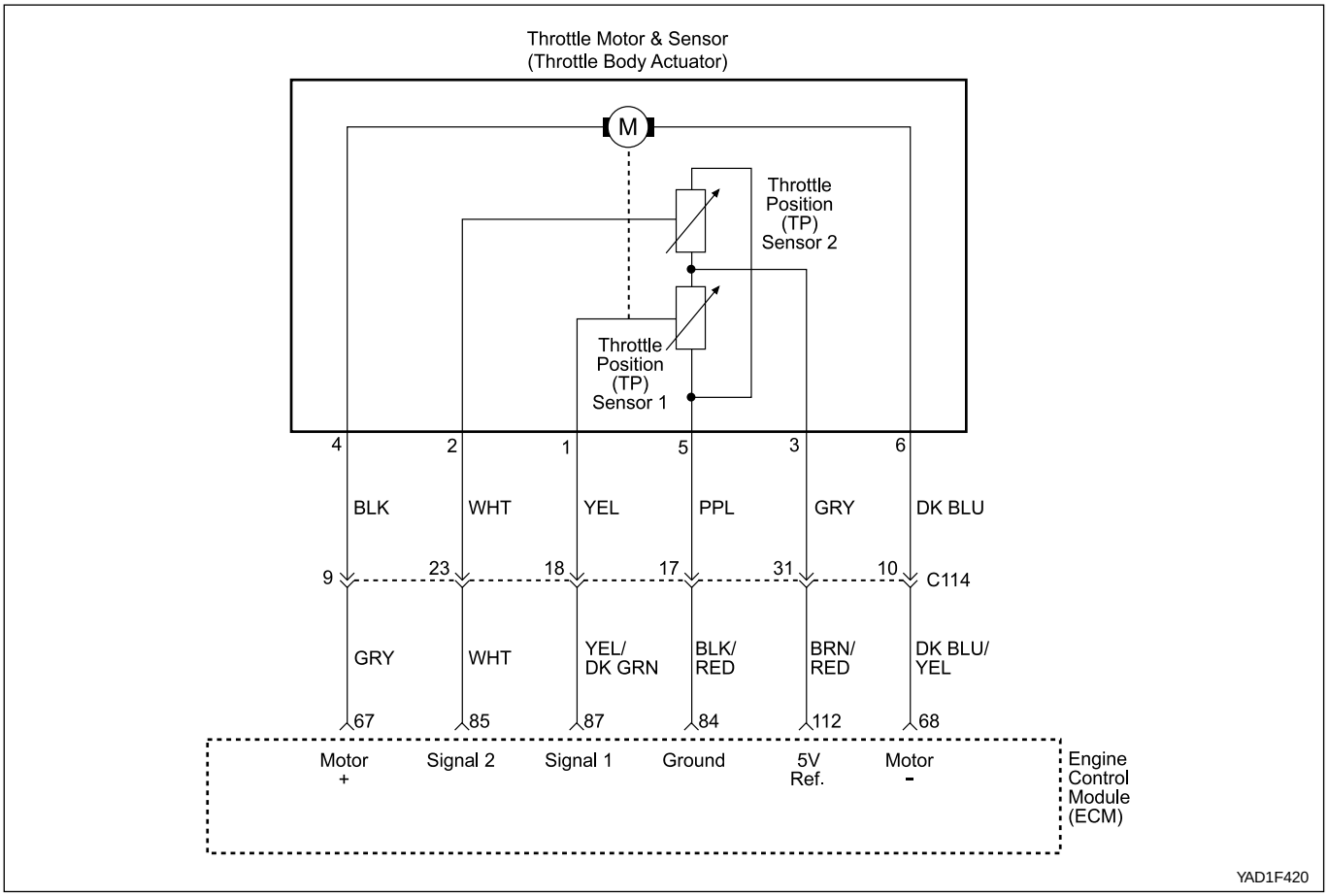
At no load, this produces an engine speed of about 1,800 rpm

Driving

When driving (part/full throttle), the servo motor controls the throttle valve in line with the various load states and according to the input signals from the pedal value sensor according to the input signals from the pedal value sensor according to the position of the accelerator pedal.

The function of the EA (electronic accelerator) in the ECM determines the opening angle of the throttle valve through the throttle actuator. Further functions are;

- Idle speed control
- Cruise control
- Reducing engine torque for ASR/ABS operation
- Electronic accelerator emergency running
- Storing faults
- Data transfer through CAN



Failure Code	Description	Trouble Area	Maintenance Hint
104	Throttle position sensor 1 low voltage	TPS 1 short circuit to ground or open	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
105	Throttle position sensor 1 high voltage	TPS 1 short circuit to power	
108	Throttle position sensor 2 low voltage	TPS 2 short circuit to ground or open	
109	Throttle position sensor 2 high voltage	TPS 2 short circuit to power	
116	Throttle actuator learning control failure	When actuat or adaption fluctuation or not meet the condition	
119	Throttle valve return spring failure	When return spring defective of actuator	
121	Throttle act uator failure	When supply voltage of the actuat or short circuit to power	
123	Different mass air flow sensor signal with throttle position sensor	When shut down of out put driver	
125	Both throttle position sensor failure	When defective of both potentiometers	

Failure Code	Description	Trouble Area	Maintenance Hint
126	Throttle position sensor 1 not plausible with Throttle position sensor 2	When difference between TPS 1 and TPS 2	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
127	High permanent throttle signal	When failure of wiring harness or actuator	
185	Mass air flow sensor and throttle position sensor failure	When difference between MAF and TPS signal	

Circuit Description

The ECM supplies a 5 volt reference signal and a ground to the TP sensor. The TP sensor sends a voltage signal back to the ECM relative to the throttle plate opening. The volt age signal will vary from approximately 0.3 ~ 0.9 volts at closed throttle, to over 4.0 ~ 4.6 volts at Wide Open Throttle (WOT).

The TP sensors serve for engine load control according to the drive pedal command. Load adjustments independent of the drive pedal command can be implemented; such functions are, for instance, idle control, speed control, drive slip control, load shock damping, and similar functions .

When the actuator current fails , the throttle valve is returned to emergency operating position by a spring. The throttle valve position, there by the actuator drive position check back is provided by two potentiometers. The motor positions the throttle valve against the return spring force. Motor and return spring are two separate energy sources . Each of them is able to position the throttle valve in emergency position alone. Throttle valve position check back and monitoring is provided by two actual value potentiometers connected to the engine control electronics.

Throttle Actuator Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the TPS 1 signal volt age at the ECM pin No. 87 and TPS 2 signal volt age at the ECM pin No. 85.

	Pedal Position	Specified Value
TPS 1	Closed	0.3 ~ 0.9 v
	Opened	4.0 ~ 4.6 v
TPS 2	Closed	4.0 ~ 4.6 v
	Opened	0.3 ~ 0.9 v

Throttle Actuator DC Motor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal volt age between the ECM pin No. 67 and No. 68.

Application		Specified Value
Engine Status	Ignition “ON”	0.8 ~ 2.3 v
	Idling	1.0 ~ 2.5 v (Coolant temperature is over 70° C)

Throttle Actuator DC Motor Resistance

1. Turn the ignition switch to “OFF” position.
2. Measure the resistance between the ECM pin No. 67 and No. 68.

Specified Value	< 10 Ω

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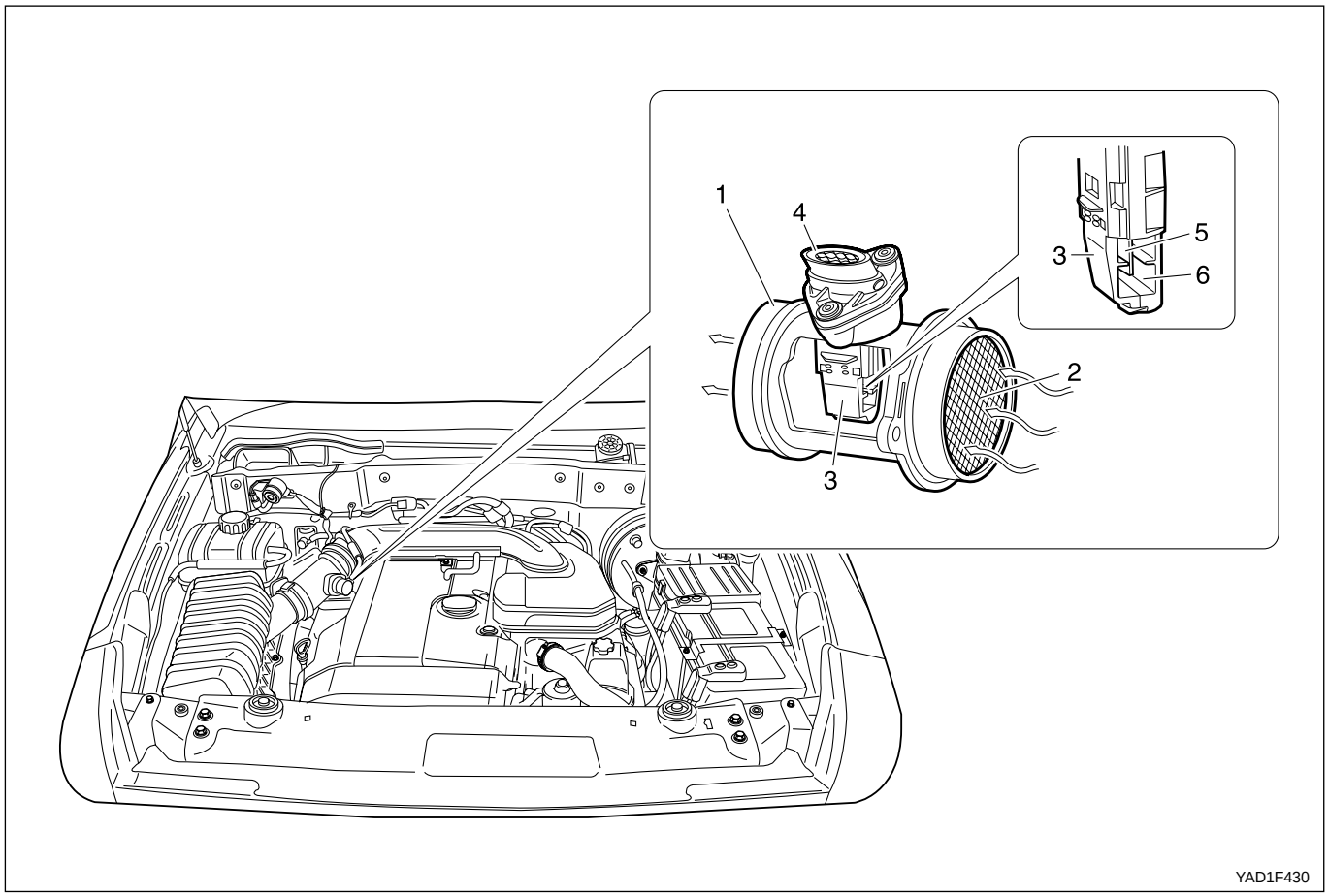
HOT FILM AIR MASS (HFM) SENSOR



1 Housing
2 Protector Net
3 Electronic Housing
4 Connector
5 Hot Film Air Mass Sensor
6 Measuring Port

The Hot Film Air Mass (HFM) sensor with recognition of flow direction related to pulsating flow is designed for recording load on Engine Control Module (ECM) by measuring the output voltage proportional to the reference voltage of the ECM.

Mass Air Flow Sensor

Mass Air Flow (MAF) is a thermal flow meter whose sensor element with its temperature sensors and heating area is exposed to the MAF to be measured. A heating area located in the center of a thin membraneis controlled to an over temperature by a heating resistor and a temperature sensor of this membrane. And the value of over-temperature depends on the temperature of the in-flowing air.

Two temperature sensors on upstream and downstream of the heating area show the same temperature without incoming flow. With incoming flow, upstream part is cooled down but downstream temperature retains its temperature more or less due to the air heated up in the heating area. This temperature difference in quantity and direction depends on the direction of the incoming flow.

ECM modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the MAF. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as Wide Open Throttle (WOT). The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

To facilitate the installation of the HFM in the intake passage, lubricating agents may be used. However, when lubricants are used care must be taken to ensure that they do not enter the flow passage and cannot be sucked in with the air flow.

The following tables show the relationship between MAF and output voltage.

Mass Air Flow (kg/h)	Voltage (V)	Mass Air Flow (kg/h)	Voltage (V)
0	0.95 ~ 1.05	250	3.51
10	1.28	370	3.93
15	1.41	480	4.23
30	1.71	640	4.56
60	2.16	800	4.82
120	2.76		

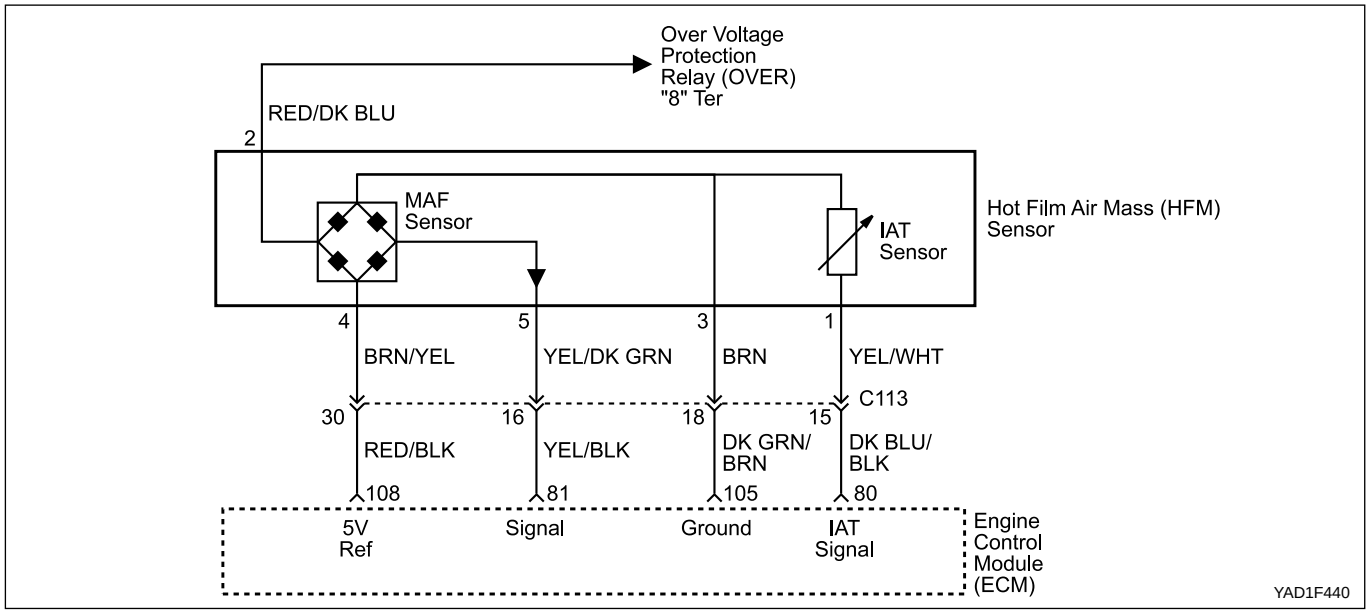
Intake Air Temperature

The Intake Air Temperature (IAT) sensor is a part of Hot Film Air Mass (HFM) sensor and is a thermistor, a resistor which changes value based on the temperature of theair entering the engine. Low temperature produces a high resistance, while high temperature causes a low resistance as the following table.

The ECM provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the IAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake IAT by measuring the voltage.

The IAT sensor is also used to control spark timing when the manifold air is cold.

Temp. (°C)	R min.(Ω)	R nom. (Ω)	R max. (Ω)
-40	35140	39260	43760
-20	12660	13850	15120
0	5119	5499	5829
20	2290	2420	2551
40	1096	1166	1238
60	565	609	654
80	312	340	370
100	184	202	222
120	114	127	141
130	91	102	114



Failure Code	Description	Trouble Area	Maintenance Hint
03	Intake air temperature sensor low voltage	IAT sensor short circuit to ground or open	• Monitoring the actual air temperature through scan tool • Inspection the ECM pin 80, 79 about short circuit or open with bad contact • Inspection the IAT sensor (integrated in HFM sensor) • Inspection the ECM
04	Intake air temperature sensor high voltage	IAT sensor short circuit to power	
05	Intake air temperature sensor plausibility	Malfunction in recognition of IAT When functional problem	
09	Mass air flow sensor plausibility	Malfunction in recognition of MAF When air mass not plausible	• Monitoring the actual air mass flow through scan tool • Inspection the ECM pin 81, 105 about short circuit or open with bad contact • Inspection the MAF sensor (integrated in HFM sensor) • Inspection the ECM
10	Mass air flow sensor low voltage	MAF sensor short circuit to ground or open	
11	Mass air flow sensor high voltage	MAF sensor short circuit to power	

Circuit Description

The heated element on the MAF is a platinum film resistor (heater). It is located on a ceramic plate together with the other elements in the bridge circuit. The temperature sensitive resistor (flow sensor) also included in the bridge. The separation of heater and flow sensor facilitates design of the control circuitry. Saw cuts are employed to ensure thermal decoupling between the heating element and the intake air temperature (IAT) sensor. The complete control circuitry is located on a single layer. The voltage at the heater provides the index for the mass air flow. The MAF's electronic circuitry then converts the voltage to a level suitable for processing in the ECM. This device does not need a burn off process to maintain its measuring precision over an extended period. In recognition of the fact that most deposits collect on the sensor element's leading edge, the essential thermal transfer elements are located downstream on the ceramic layer. The sensor element is also design to ensure that deposits will not influence the flow pattern around the sensor.

The IAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies 5 volt reference and a ground to the sensor. When the air is cold, the resistance is high; therefore the IAT signal voltage will be high. If the intake air is warm, resistance is low; therefore the IAT signal voltage will be low.

Mass Air Flow Sensor Input Voltage Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 103 and No. 104.

Application		Specified Value
Engine Status	Ignition “ON”	0.9 ~ 1.1 V
	Idling	1.3 ~ 1.7 V (Coolant temperature is over 70°C)

Notice: If the measured value is not within the specified value, the possible cause may be in cable or MAF sensor in itself. Perform the 5 volt power supply inspection procedures.

Mass Air Flow Sensor 5 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 108 and MAF sensor connecter terminal No. 3.

Specified Value	4.7 ~ 5.2 V

Notice: If the measured value is not within the specified value, the possible cause may be in cableor ECM coupling.

5. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 4.

Specified Value	4.7 ~ 5.2 V

Notice: If the measured value is not within the specified value, the possible cause may be in cableor ECM coupling.

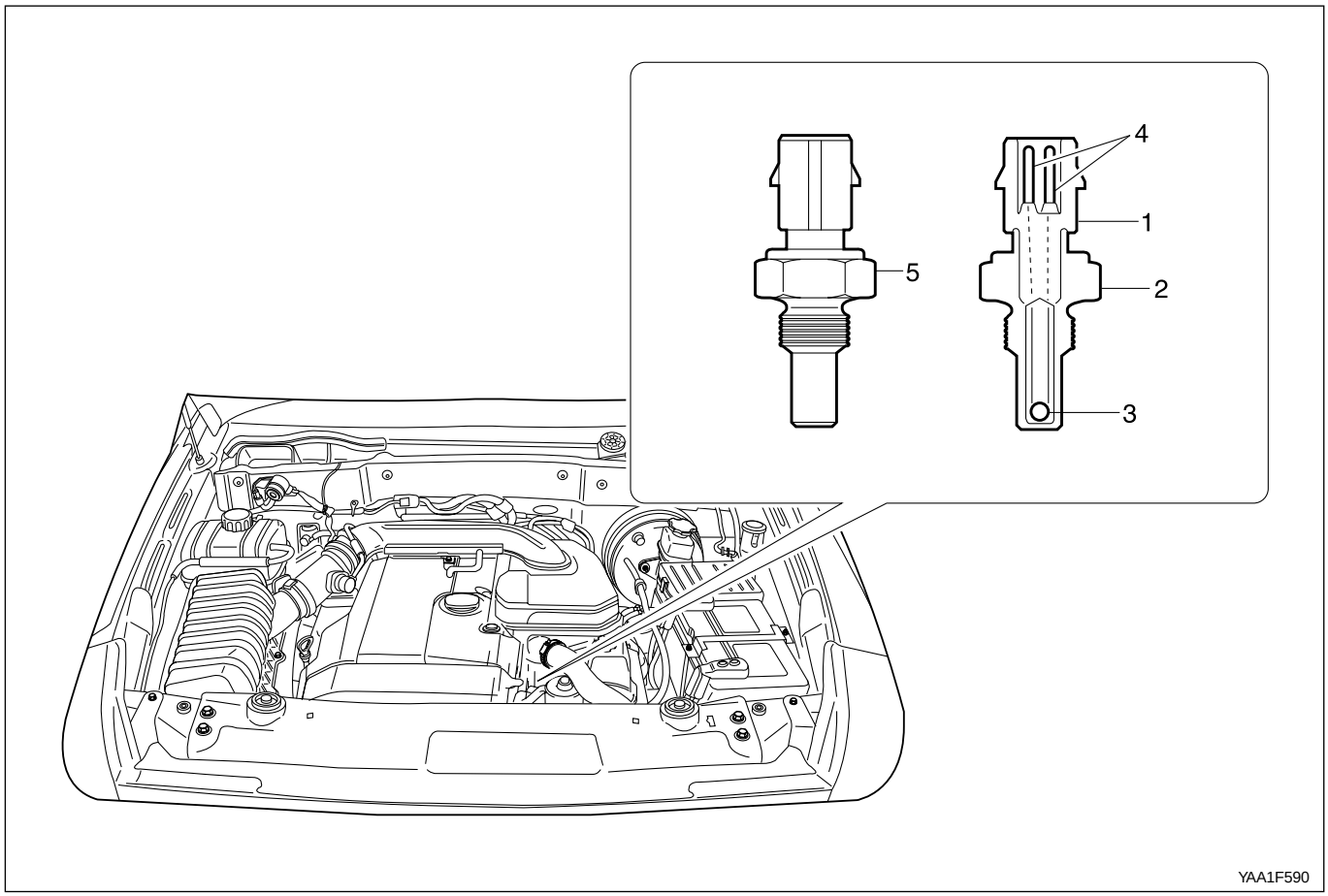
Mass Air Flow Sensor 12 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 2.

Specified Value	11 ~ 14 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable or Over Voltage Protection Relay (OVPR).

ENGINE COOLANT TEMPERATURE (ECT) SENSOR



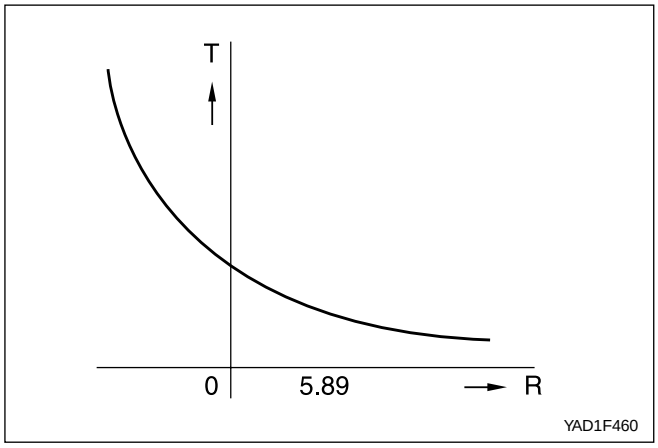
1 Artificial Resin Housing
2 Metal Housing
3 NTC (Negative Temperature Coefficient) Resistor
4 Connector
5 Engine Coolant Temperature Sensor

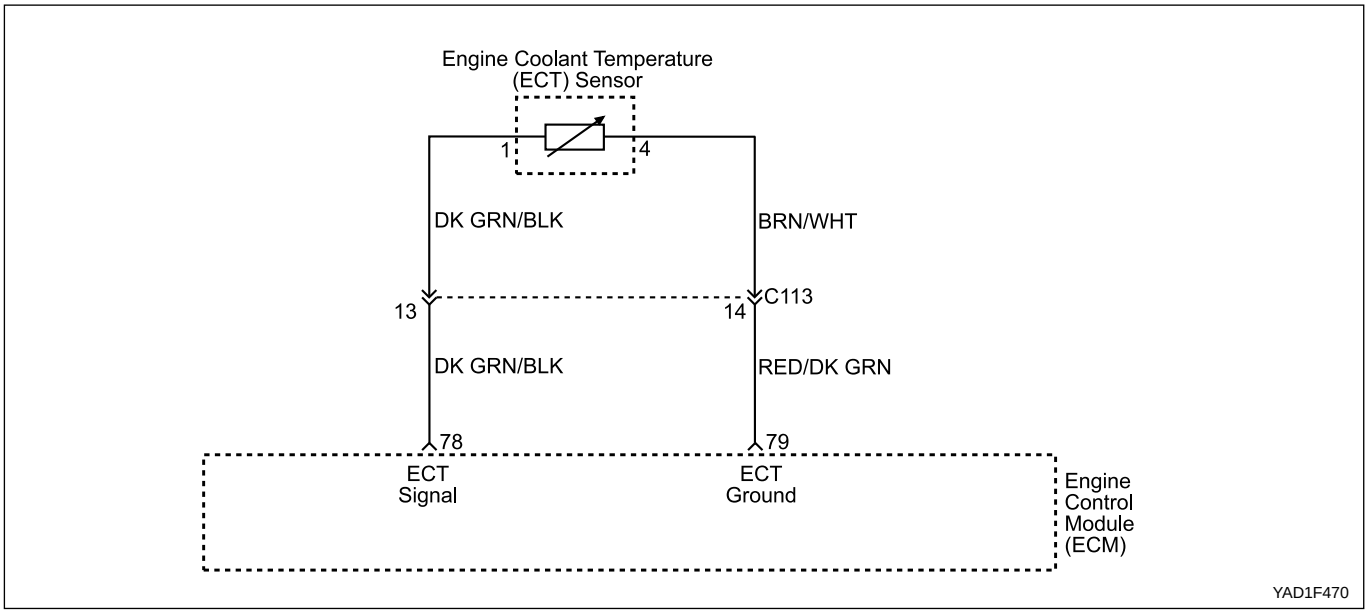
Engine Coolant Temperature (ECT) sensor detects coolant temperature and supplies information to the ECM. It is composed of metal housing with two NTC resistor, 4 pin connector. The ECM provides a 5 volt signal to the ECT sensor through a dropping resistor. When the engine is cold, the ECT sensor provides high resistance, which the ECM detects as a high signal voltage. As the engine warms up, the sensor resistance becomes lower, and the signal voltage drops. At normal engine operating temperature, the ECT signal will measure about 1.5 to 2.0 volts.

The ECM uses information about coolant temperature to make the necessary calculations for:

- Fuel delivery
- Ignition control
- Knock sensor system
- Idle speed
- Torque converter clutch application
- Canister purge
- Cooling fan operation
- Others

Temperature (°C)	Resistance (Ω)	Voltage (V)
-40	48,550	4.90
-30	27,000	4.82
-20	15,570	4.70
-10	9,450	4.52
0	5,890	4.43
10	3,790	3.96
20	2,500	3.57
30	1,692	3.14
40	1,170	2.70
50	826	2.26
60	594	1.86
70	434	1.51
80	322	1.22
90	243	0.98
100	185	0.78
110	143	0.63
120	111.6	0.50
130	88	0.40
140	71.2	0.33





Failure Code	Description	Trouble Area	Maintenance Hint
00	Engine coolant temperature sensor low voltage	ECT sensor short circuit to ground or open	• Monitoring the actual coolant temperature through scan t ool • Inspection the ECM pin 78, 79 about short circuit or open with bad contact • Inspection the ECT sensor • Inspection the ECM
01	Engine coolant temperature sensor high voltage	ECT sensor short circuit to power	
02	Engine coolant temperature sensor plausibility	Malfunction in recognition of ECT When drop to about 50° C below after warm up	
06	Engine coolant temperature insufficient for closed loop fuel control	Malfunction in recognition of ECT When minimum temperature for lambda control after warm up	

Circuit Description

The ECT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies a voltage on the signal circuit to the sensor. When the engine coolant is cold, the resistance is high; therefore the ECT signal voltage will be high

Engine Coolant Temperature Sensor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the voltage between the ECM pin No. 78 and No. 79.

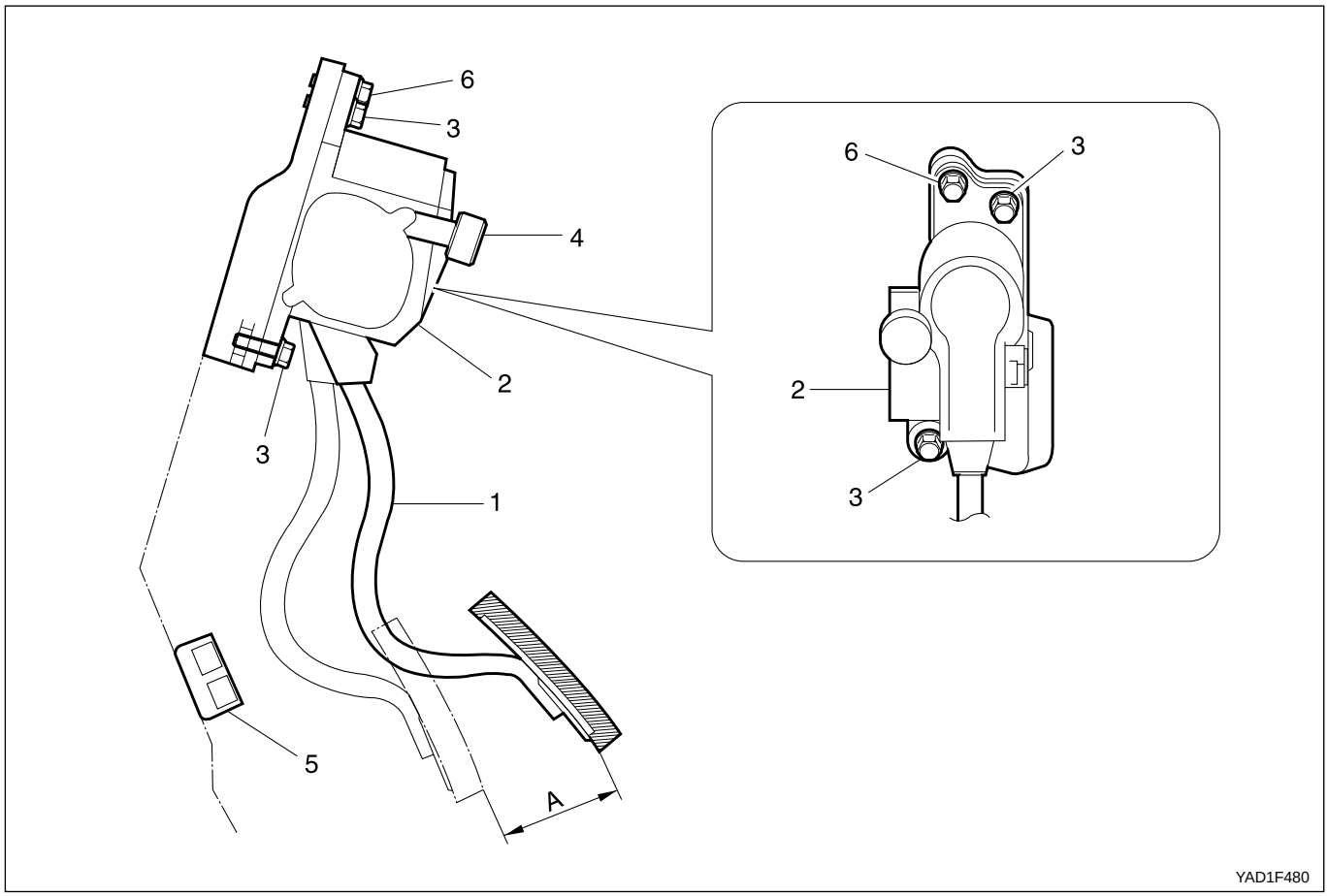
Temperature (°C)	Specified Value (V)
20	3.57
80	1.22
100	0.78

3. Turn the ignition switch to “OFF” position.
4. Disconnect the ECT sensor connector.
5. Turn the ignition switch to “ON” position.
6. Measure the resistance between the ECT sensor terminal pin No. 1 and No. 4.

Temperature (°C)	Specified Value (Ω)
20	2,500
80	322
100	185

Notice: Replace wiring and coolant temperature sensor if out of specified value.

ACCELERATOR PEDAL MODULE



1 Accelerator Pedal
2 Accelerator Pedal Sensor
3 Bolts
4 6-Pin Connector
5 Kick-down Switch
6 Nut

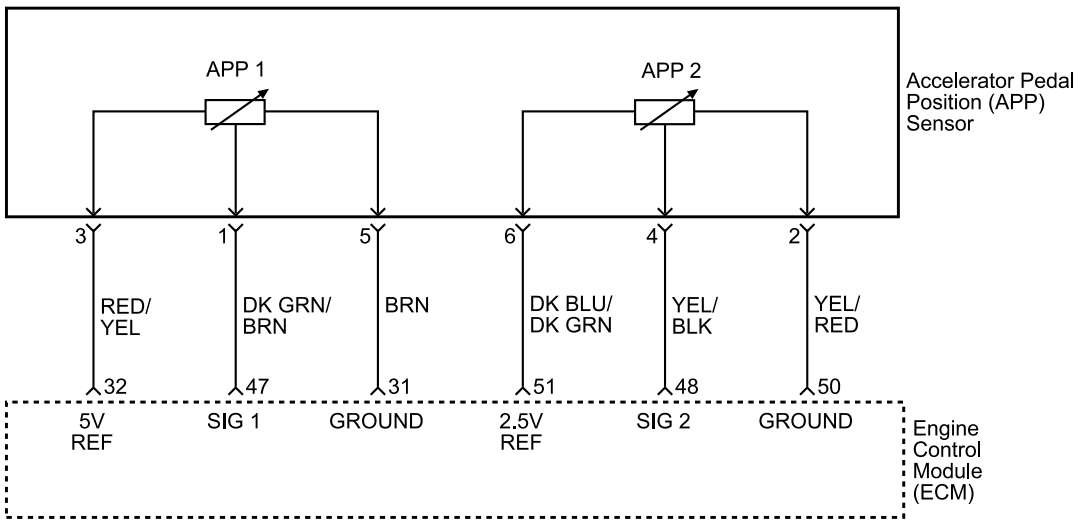
The Acceleration Pedal Position (APP) sensor is mounted on the accelerator pedal assembly. The sensor is actually two individual APP sensors and one housing. This sensor works with theThrottle Position (TP) sensor to provide input to the Engine Control Module (ECM) regarding driver requested accelerator pedal and throttle angle at the throttle body.

When the APP sensor is defected:

When the APP 1 or APP 2 sensor is defected condition, the engineis still running at idle condition but, the accelerator pedal reaction is not response correctly and also, the engine rpm will be reacted to 4,000 rpm slowly. If the APP 1 sensor is out of order, the APP 2 sensor will be conducted with signal as adefault signal but, the throttle valve opening is limited 60% and delayed opening speed.

When the TP sensor or servo motor is defected:

When the TP 1, 2 sensor or servomotor is defected condition, the throttle valve will be closed to the spring capsule by spring force, at this condition, the throttle valve will open 10° ~ 20° and engine rpm will be controlled by ECM will opening (On/Off) time of injector. The engine rpm will be maintaining 900 rpm (at idle) to 1,800 according to the engine load.



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Failure Code	Description	Trouble Area	Maintenance Hint
122	Acceleration pedal position sensor signal failure	When malfunction of APP sensor	• Monitoring the actual values through scan tool • Inspection the ECM pin 31, 47, 32, 48, 59, 51 about short circuit or open with bad contact • Inspection the APP sensor • Inspection the ECM
160	Acceleration pedal position 1 sensor low voltage	APP 1 sensor short circuit to ground or open	
161	Acceleration pedal position sensor 1 high voltage	APP 1 sensor short circuit to power	
162	Acceleration pedal position sensor 2 low voltage	APP 2 sensor short circuit to ground or open	
163	Acceleration pedal position sensor 2 high voltage	APP 2 sensor short circuit to power	
164	Accelerator pedal position sensor 1 not plausible with accelerator pedal position sensor 2	When difference between APP 1 sensor and APP 2 sensor	
167	Both setpoint accelerator pedal position sensor defective	When defective of both APP sensor	

Circuit Description

The ECM supplies a 5 or 2.5 volt reference signal and a ground to the APP sensor 1 or 2. The ECM calculates on these signal lines. The APP sensor output changes as the accelerator pedal is moved. The output of the APP 1 and APP 2 sensor are low, about 0.4 ~ 0.7 volts and 0.2 ~ 0.35 volts respectively at the closed throttle position. As pushing the accelerator pedal, the output increases so that the output voltages will be about 4.3 ~ 4.8 volts and 2.1 ~ 2.4 volts individually when accelerating fully with the kick down, at Wide Open Throttle (WOT).

Acceleration Pedal Position Sensor 1 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 47 and No. 31 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.3 ~ 0.7
Fully Depressed Throttle Valve	4.3 ~ 4.8

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP 1 sensor.

Acceleration Pedal Position Sensor 2 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 48 and No. 50 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.1 ~ 0.4
Fully Depressed Throttle Valve	2.1 ~ 2.5

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP sensor 2.

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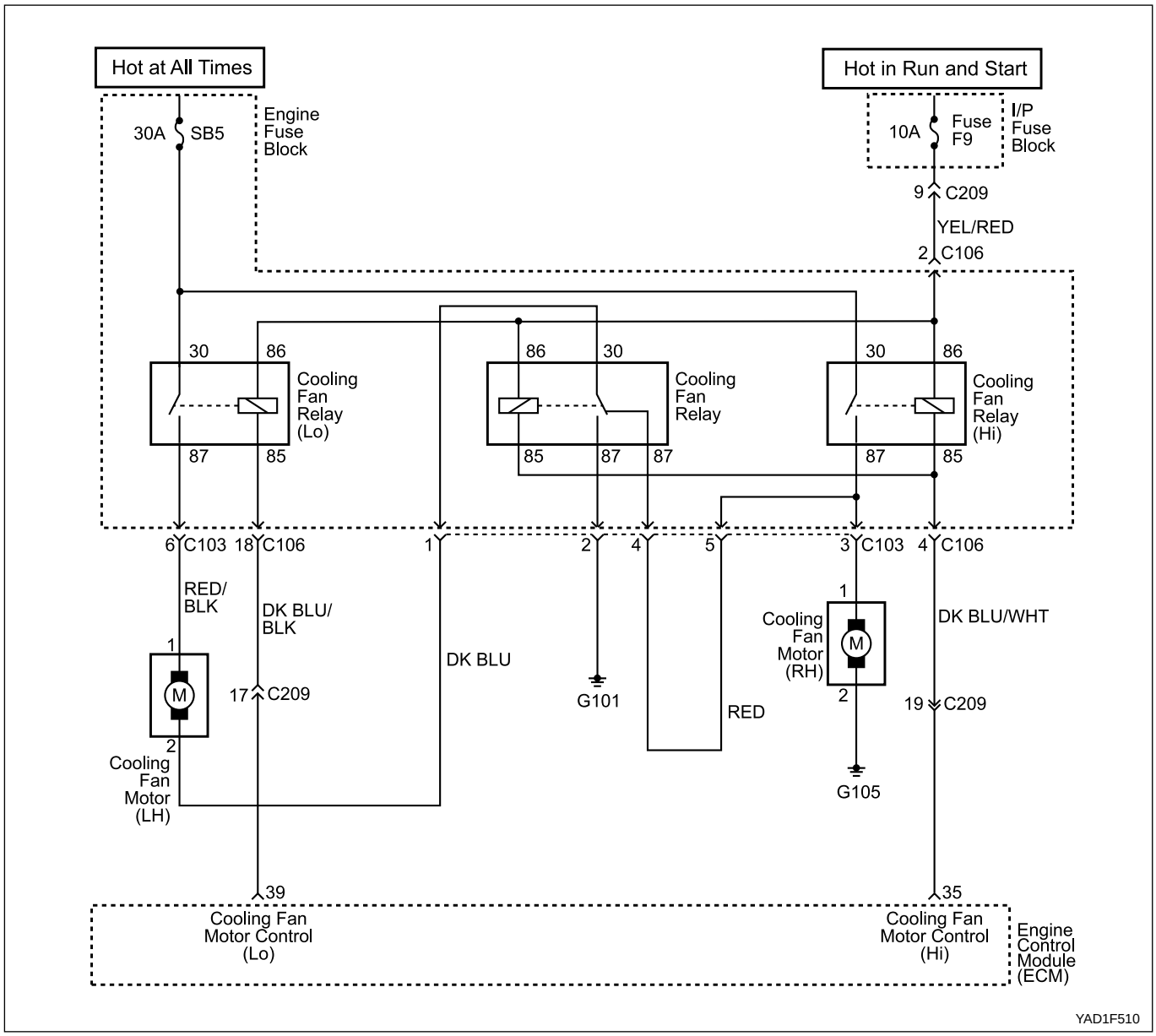
COOLING FAN



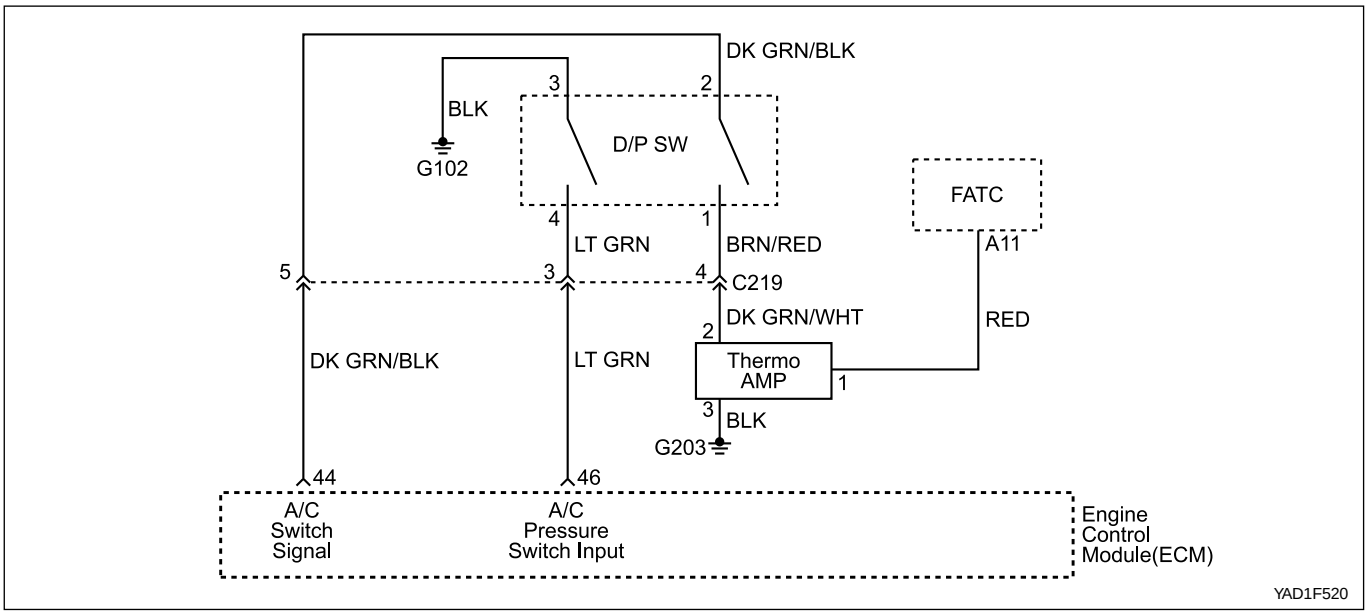
Failure Code	Description	Trouble Area	Maintenance Hint
44	Cooling fan (HI) relay short circuit to power	Cooling fan short circuit to power	• Inspection the Engine Control Module (ECM) pin 35 about short circuit or open with bad contact • Inspection the power source • Inspection the cooling fan • Inspection the ECM
45	Cooling fan (HI) relay short circuit to ground or open	Cooling fan short circuit to ground or open	

Circuit Description

Ignition voltage is supplied directly to the cooling fan relay coil. The ECM controls the relay by grounding the control circuit. When the ECM is commanding a command ON, the voltage of the control circuit should be low (near 0 volt).

When the ECM is commanding the control circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the fault code to set.

A/C COMPRESSOR RELAY

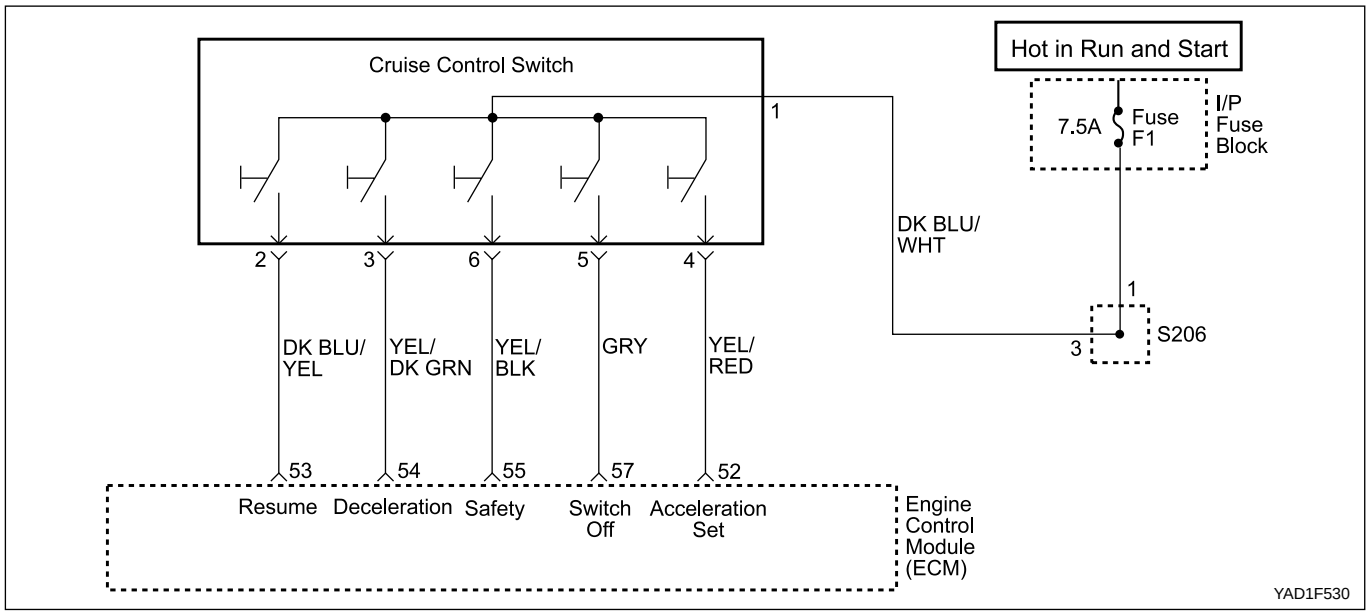


Failure Code	Description	Trouble Area	Maintenance Hint
228	A/C compressor relay short circuit to battery	When malfunction of A/C compressor control	• Monitoring the actual operation through scan tool • Inspection the Engine Control Module (ECM) pin 44 about short circuit or open with bad contact • Inspection the relay short circuit or open • Inspection the ECM
229	A/c compressor relay short circuit to ground or open		

Circuit Description

When the ECM detects that A/C has been requested, the ECM will activated the A/C clutch relay. When the relay has been activated, voltage should be present at both the A/C clutch relay and A/C switch circuit at ECM.

CRUISE CONTROL SWITCH

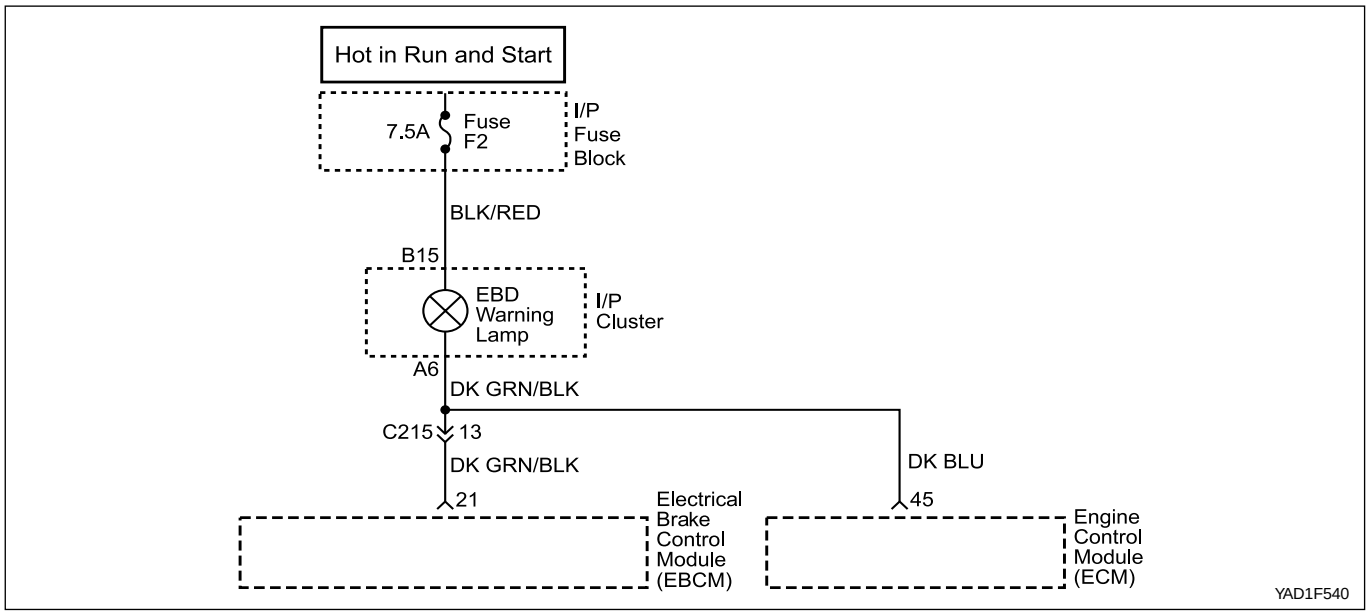


Failure Code	Description	Trouble Area	Maintenance Hint
129	Cruise control “OFF” due to message counter failure	Cruise control system message counter fault	• Monitoring the actual recognition status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 52, 53, 54, 55, 57 about short circuit or open with bad contact • Inspection the CAN and ABS • Inspection the cruise control lever switch • Inspection the ECM
130	Vehicle speed signal failure	When malfunction of auto-cruise system Implausible condition of vehicle speed signal.	
131	Vehicle speed signal failure		
132	Cruise control lever failure	Cruise control lever defective	
133	Cruise control acceleration failure	Cruise control system Implausible condition of acceleration signal	
134	Cruise control deceleration failure	Cruise control system Implausible condition of deceleration signal	

Circuit Description

Cruise control is an automatic speed control system that maintain adesired driving speed with out using the accelerator pedal. The vehicle speed must be greater than 40 km/h to engage cruise control.

TRACTION CONTROL SYSTEM (TCS)

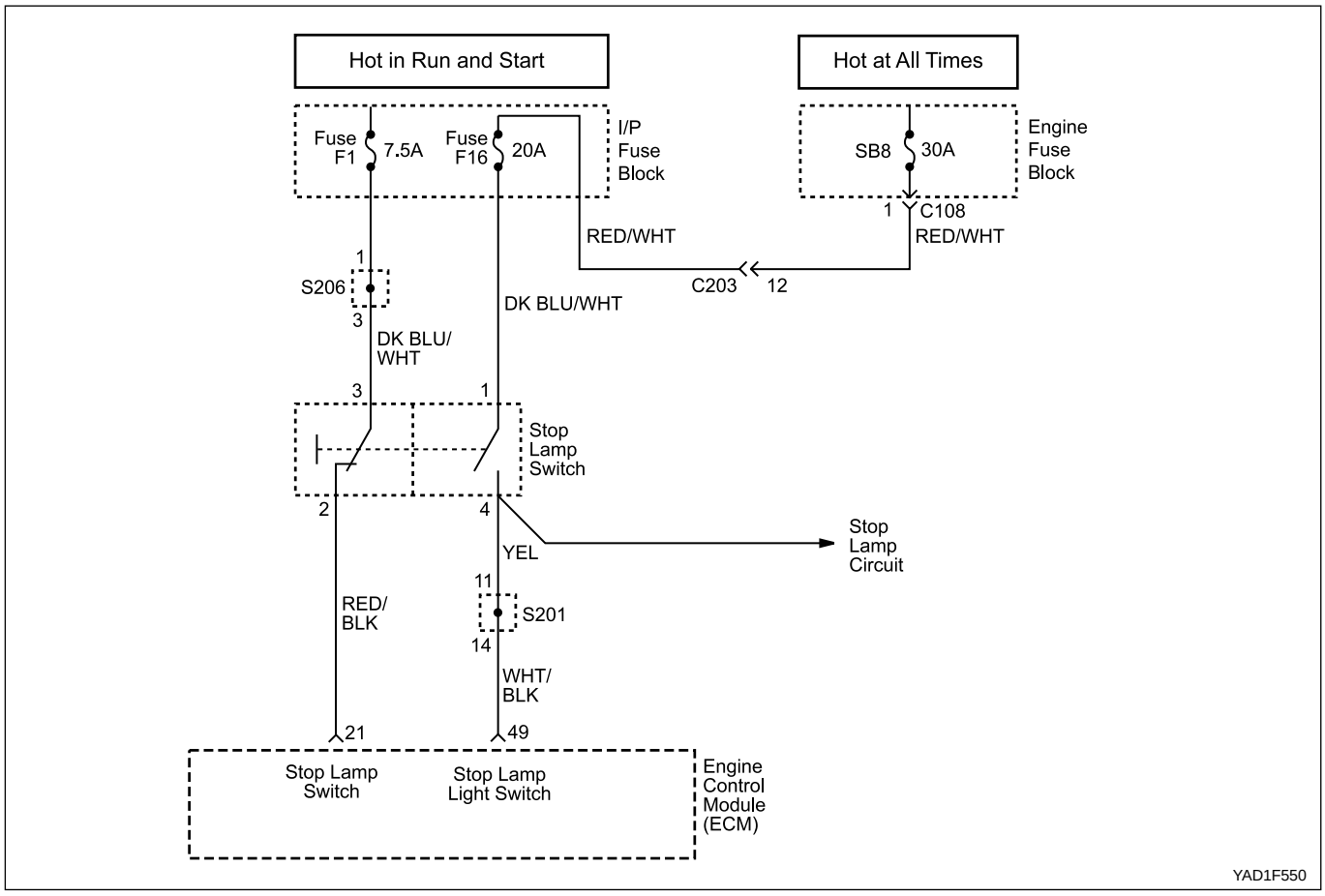


Failure Code	Description	Trouble Area	Maintenance Hint
150	TCS input signal short circuit to battery	TCS short circuit to power	• Inspection the Engine Control Module (ECM) pin 45 about short circuit or open with bad contact • Inspection the TCS lamp of I/P cluster. • Inspection the ECM
151	TCS input signal short circuit to ground or open	TCS short circuit to ground or open	

Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON and START. The warning lamp can be activated only by the Electrical Brake Control Module (EBCM) internally supplying ground to terminal 21. If the TCS input circuit is open or short, this failure code will be set.

STOP LAMP SWITCH

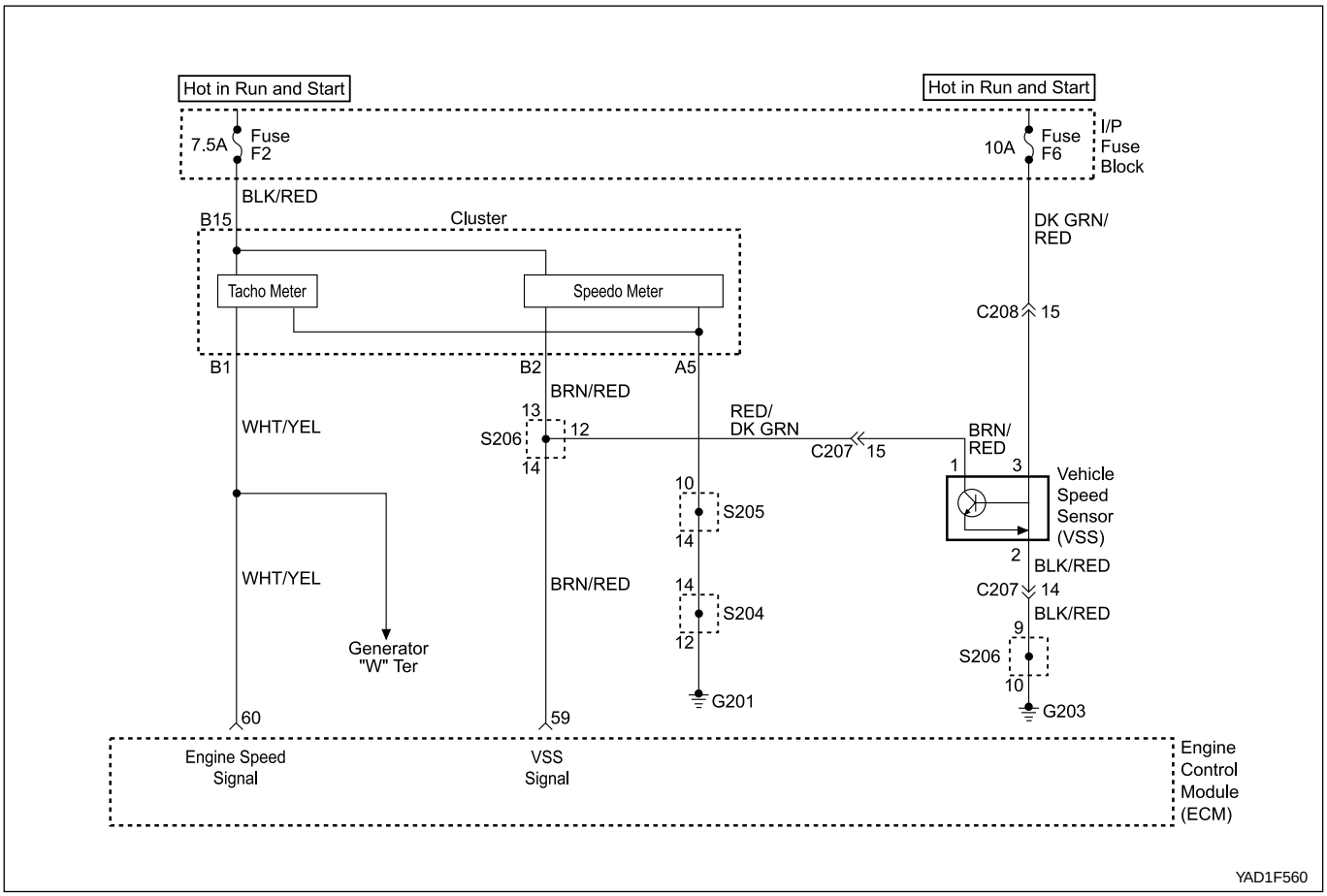


Failure Code	Description	Trouble Area	Maintenance Hint
135	Stop lamp switch failure	When malfunction of stop lamp switch-implausible condition of stop lamp signal input	• Monitoring the actual operational status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 49 about short circuit or open with bad contact • Inspection the contact condition of stop lamp switch • Inspection the ECM

Circuit Description

The stop lamp switch is normally opened. When the ignition switch ON and brake ON, the battery voltage is supplied to the ECM. A scan tool should display ON when brake pedal is depressed and should read OFF with brake pedal released.

ENGINE RPM



Failure Code	Description	Trouble Area	Maintenance Hint
32	Engine rpm output circuit short circuit to battery	When short circuit to battery	• Monitoring the actual rpm in cluster • Inspection the Engine Control Module (ECM) pin 60 about short circuit or open • Inspection the cluster panel board circuit • Inspection the ECM
33	Engine rpm output circuit short circuit to ground or open	When short circuit to ground or open	

EXHAUST SYSTEM

CATALYTIC CONVERTER

The purpose of the catalytic converter is to convert the three pollutants of carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NOx) contained in the exhaust of gasoline engines, into the harmless compounds of water (H2O), carbon dioxide (CO2) and nitrogen (N2).

The catalytic converter contains acatalyst, a word coming from the Greek and which designates the element essential for catalyst which triggers chemical reactions without itself being consumed.

These catalysts in the 3-way catalytic converter are the rare metals platinum (Pt) and rhodium (Rh).

The catalytic converter consists essentially of three main elements. The exhaust gases flow through the catalytic converter and, in so doing, coming into contact with rare metals (Pt and Rh).

The following chemical reaction are produced.

$CO + O_2 \rightarrow CO_2$

$HC + O_2 \rightarrow CO_2 + H_2O$

$NO_x \rightarrow N_2 + O_2$

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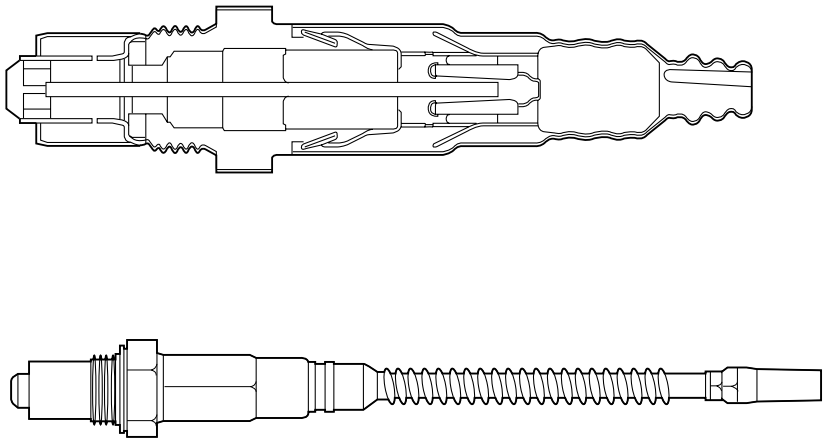
OXYGEN SENSOR



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The oxygen sensor is unique amongthe engine control sensors because is acts like a battery and is able to generate its own low voltage signal. It is located the exhaust system and monitors the amount of oxygen in the exhaust stream and provides feedback to the Engine Control Module (ECM).

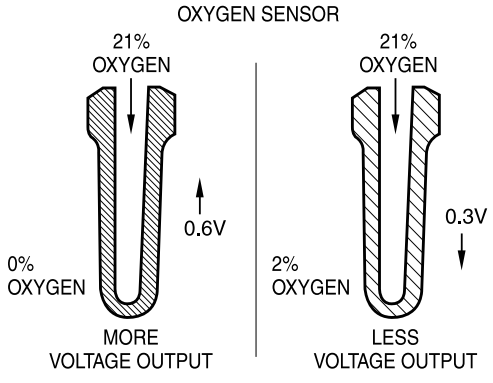
The electrically heated oxygen sensor warms up quickly and remains hot, even at idle when the exhaust manifold may cool down.

The ECM applies a reference voltage of 450 mv to the oxygen sensor, the ECM compares this reference voltage with the voltage generated by oxygen sensor. The amount of voltage the oxygen sensor generates is proportionate to the difference between the amount of oxygen in the outside air and the exhaust gases. The atmosphere contains about 21% oxygen. The exhaust from a rich air/fuel ratio contains almost no oxygen. With a large difference betweenthe amounts of oxygen containing the two surface, the sensor generates less voltage.

When the exhaust gas is rich (below 14.7:1), the voltage output is high, above 450 mv. When the exhaust gas is lean (above 14.7:1 air/fuel ratio), the sensor's voltage output is low, below 450 mv.

The ECM uses oxygen sensor information for:

- Open loop / closed loop criteria
- Ideal air / fuel ratio



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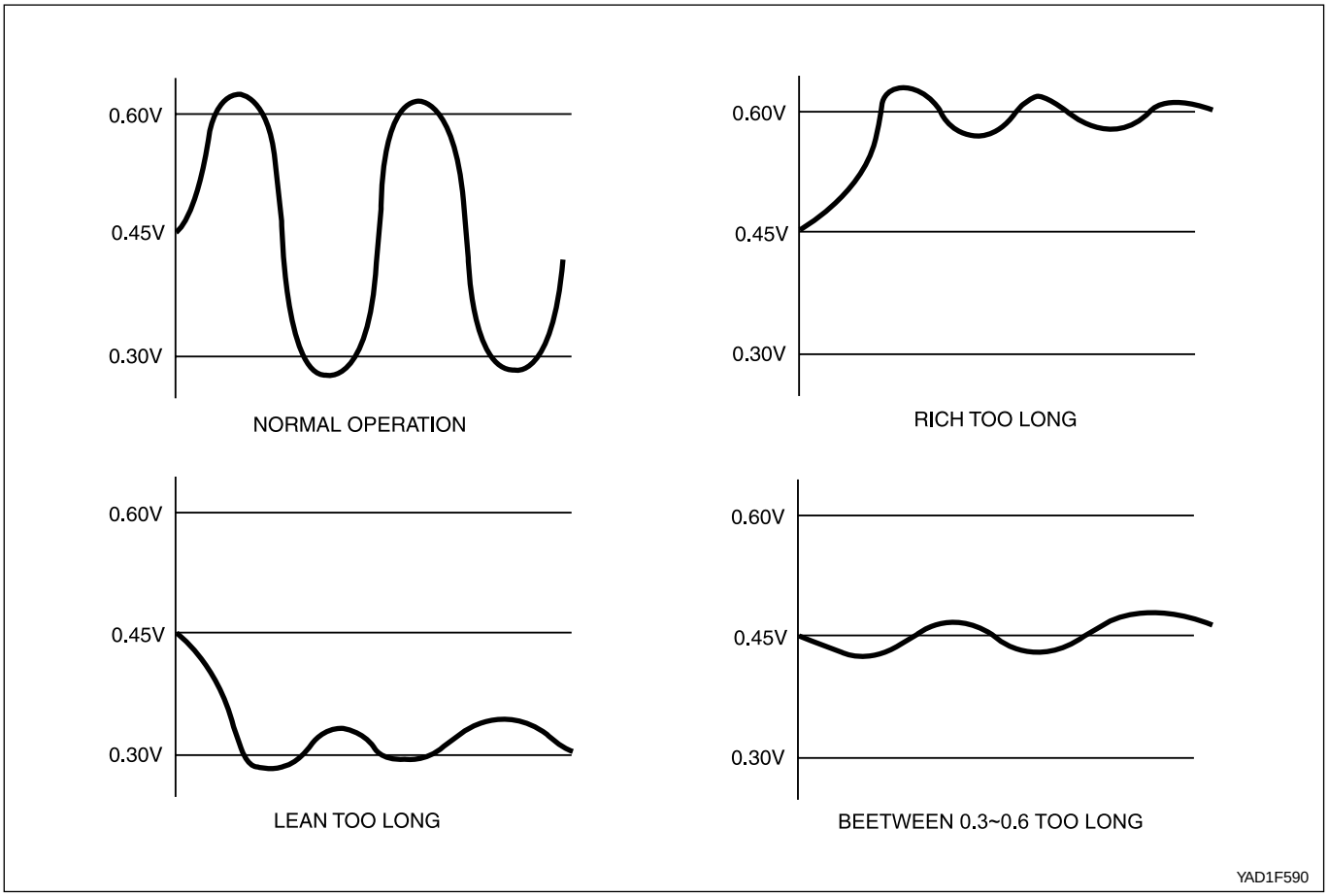
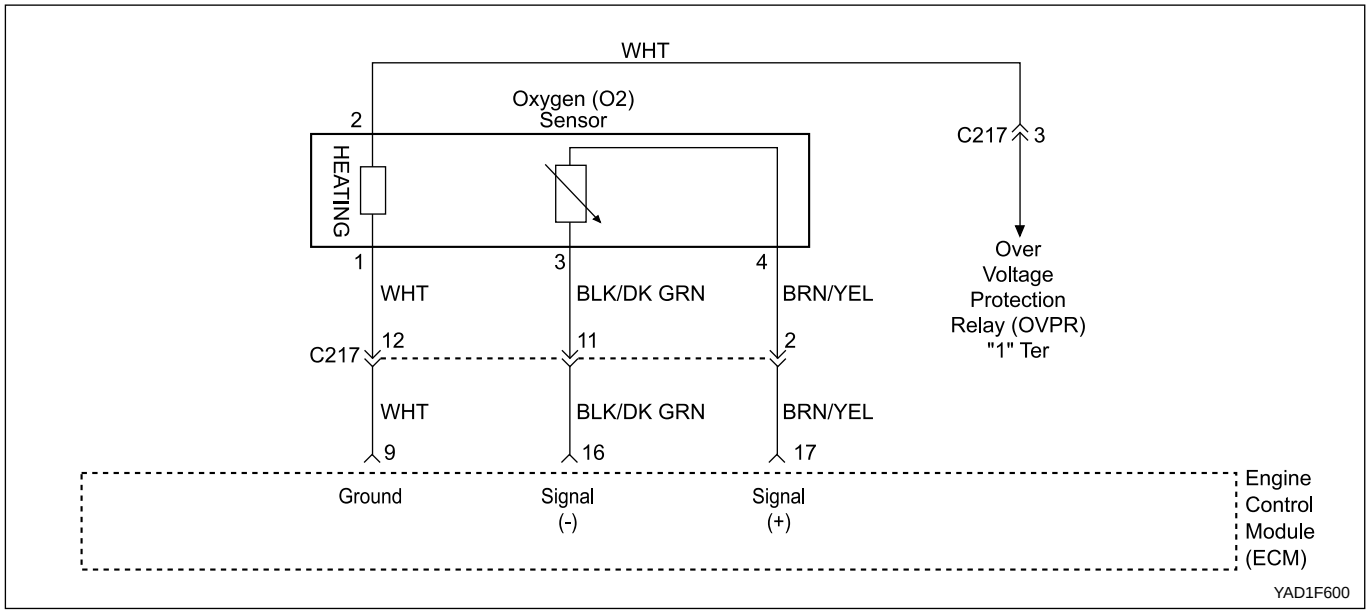

0.60V
0.45V
0.30V
NORMAL OPERATION
0.60V
0.45V
0.30V
RICH TOO LONG
0.60V
0.45V
0.30V
LEAN TOO LONG
0.60V
0.45V
0.30V
BEETWEEN 0.3~0.6 TOO LONG
YAD1F590



Failure Code	Description	Trouble Area	Maintenance Hint
80	Oxygen sensor high voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	• Monitoring the actual output signal through scan tool • Inspection the ECM pin 16, 17 about short circuit or open with bad contact • Inspection the oxygen sensor • Inspection the ECM
89	Oxygen sensor low voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	
82	Oxygen sensor no activity detected	When recognition the output that not active the sensor etc.	
83	Oxygen sensor not lean after overrun fuel shut-off	When recognition the output that no lean signal after overrun fuel shut-off	
84	Oxygen sensor slow response	When slow response of sensor signal	
85	Oxygen sensor heater failure	When recognition the heating circuit	• Monitoring the heating status through scan tool • Inspection the ECM pin 9 about short circuit or open with bad contact • Inspection the heating power source • Inspection the heating circuit of oxygen sensor • Inspection the ECM
86	Oxygen sensor heater short circuit to battery	When recognition the heating currents that more or less than set values (less than 0.2 A or more than 2 A)	
87	Oxygen sensor heater short circuit to ground or open	When recognition the heating voltages than less than set values (less than 2 v)	

Failure Code	Description	Trouble Area	Maintenance Hint
81	Bank 1 system short term fuel trim adaptation below lean threshold	When recognition the value less than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	• Inspection the intake air leakage • Inspection the injection quantities with injector block or leakage • Inspection the exhaust leakage • Inspection the ECM
93	Bank 1 system short term fuel trim adaptation above rich threshold	When recognition the value more than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	
96	Bank 1 system short term fuel trim at rich stop	When recognition the short term fuel trim that more than nominal threshold	
97	Bank 1 system short term fuel trim at lean stop	When recognition the short term fuel trim that less than nominal threshold	
98	Bank 1 system idle adaptationfailure (above rich threshold)	When recognition the long term fuel trim exceeds rich threshold	
99	Bank 1 system idle adaptation failure (below rich threshold)	When recognition the long term fuel trim exceeds lean threshold	
100	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds rich threshold	
101	Bank 1 system learning control failure (lean, low load)	When recognition the long term fuel trim exceeds lean threshold	
102	Bank 1 system learning control failure (rich, high load)	When recognition the long term fuel trim exceeds rich threshold	
103	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds lean threshold	

Circuit Description

In order to control emissions, a catalytic converter is used to covert harmful emissions into harmless water vapor and carbon dioxide. The ECM has the ability to monitor this process by using a oxygen sensor. The oxygen sensor produces and output signal which indicates the storage capacity of the catalyst. This in turn indicates the catalyst's ability to convert exhaust emission effectively. If the oxygen sensor pigtail wiring, connector, or terminal is damaged. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the oxygen sensor wire(s). Any attempt to repair the wires, connector, or terminal and degrade the oxygen sensor performance.

Oxygen Sensor Signal Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 16 and No. 17.

Specified Value	0.2 ~ 1.0 V

Notice: If the measured value is not within the specified value, the possible causemay bein cable, oxygen sensor or ECM

Oxygen Sensor Heating Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 11 and No. 9.

Specified Value	11 ~ 14 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

Oxygen sensor Heating Current Consumption Inspection

1. Turn the ignition switch to "ON" position.
2. Measure the oxygen sensor heating current consumption between the ECM terminal No. 9 and No. 5.

Specified Value	0.2 ~ 2.0 V

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

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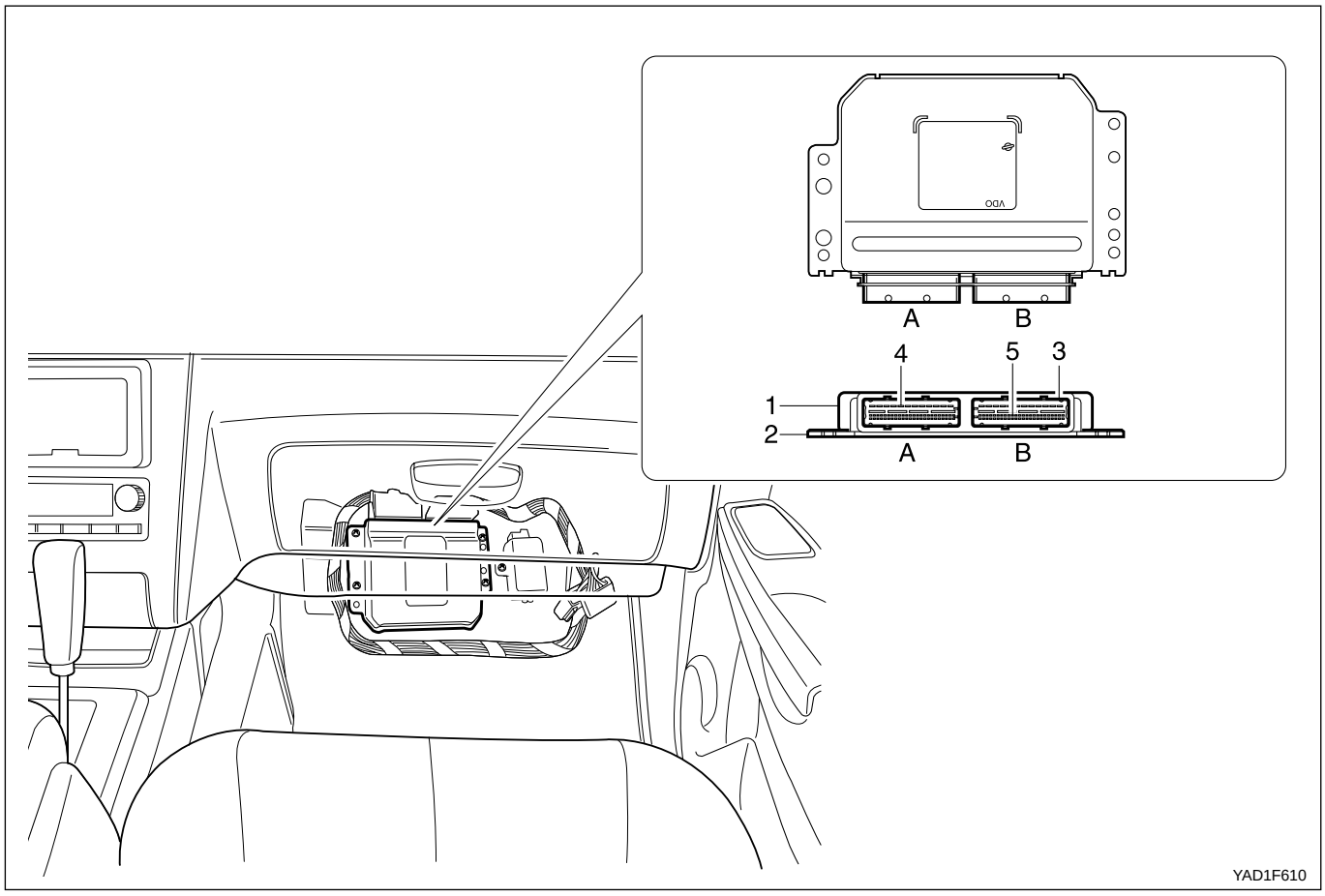
ENGINE CONTROL MODULE



1 Cover
2 Plate
3 Connector
4 Plat Pin
Vehicle Side : No. 1-12
Engine Side : No. 61-72
5 Pin
Vehicle Side : No. 13-60
Engine Side : No. 73-120
A Vehicle Side Connector : Black
B Engine Side Connector : Gray

The Engine Control Module (ECM), located inside the right side kick panel, is the control center of the fuel injection system. It constantly looks at the information fromvarious sensors and controls the systems that affect the vehicle's performance. Engine rpm and air mass are used to measure the air intake quantity resulting in fuel injection metering. The ECM also performs the diagnostic functions of the system. It can recognize operational problems, store failure code(s) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the Programmable Read Only Memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistance in the ECM which are so high in value that a test light will not come ON when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give and accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 Mohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the ignition coils, the fuel injectors, the fuel pump relay, the camshaft actuator, the canister purge valve, etc., by controlling the ground circuit.

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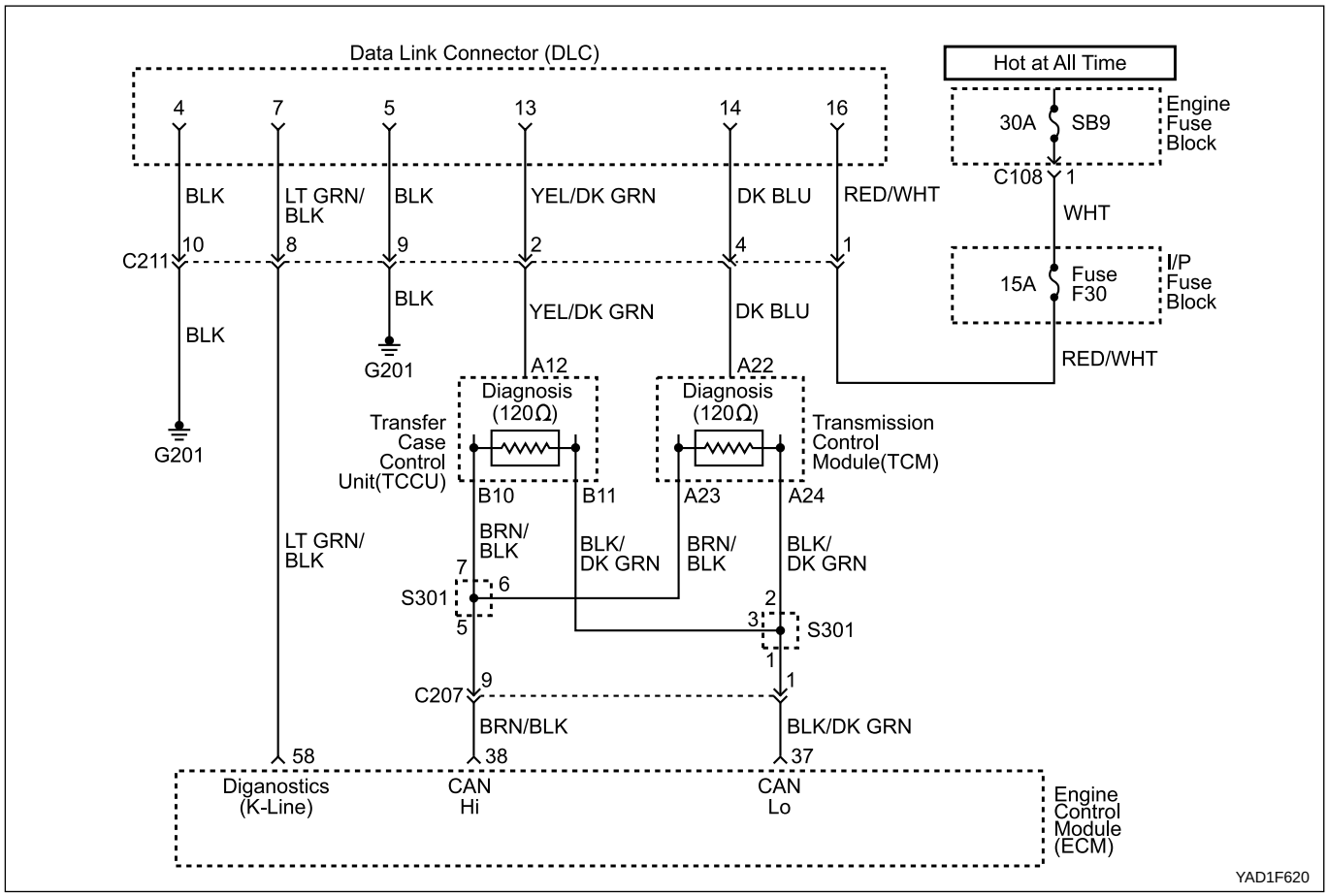
SERIAL DATA COMMUNICATION



Failure Code	Description	Trouble Area	Maintenance Hint
23	CAN communication failure: ASR/MSR	When CAN signal message missing or implausibility for ASR/MSR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
24	CAN communication failure: ABS	When CAN signal message missing or implausibility for ABS unit or not initialized condition	• Inspection the ABS unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
26	CAN communication failure: TCU (A/T only)	When CAN signal message missing or implausibility for TCU unit or not initialized condition	• Inspection the TCM unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

Failure Code	Description	Trouble Area	Maintenance Hint
29	CAN communication failure: ID 200h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
30	CAN communication failure: ID 208h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
31	CAN communication failure: communication initialization failure	When CAN signal message missing or implausibility for each unit (ABS, ASR, TCM, TOD etc.) or not initialized condition	• Inspection the each control unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
59	CAN communication failure: MSR data transmission not plausible	When CAN signal message missing or implausibility for MSR unit or not initialized condition	• Inspection the MSR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
60	CAN communication failure: ASR data transmission not plausible	When CAN signal message missing or implausibility for ASR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

Circuit Description

The provision for communicating with the ECM is the Data Link Connector (DLC). It is located in the instrument panel fuse block. The DLC is used to connect the scan tool. Battery power and ground is supplied for the scan tool through the DLC. CAN line is used to communicate with the other module such as the Transmission Control Module (TCM) and Transfer Case Control Unit (TCCU).

Keyword 2000 Serial Data Communications

Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a singles wire. The message carried on KWP 2000 data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will must wait.

INTERNAL FAILURE

Failure Code	Description	Trouble Area	Maintenance Hint
21	Transmission coding failure	When faulty of variant coding of transmission	• Inspection the coding condition through scan tool • InspectiontheEngine ControlModule (ECM) • Inspection the CAN line • Inspection the TCM
136	ECM failure (RAM)	When malfunction of random access memory - ECM internal error	• Inspection the ECM
142	Uncoded/ unprogramed ECM	When malfunction of ECM coding-required ECM encoding	• Fulfill the ECM variant coding
137	ECM failure (EPROM)	When malfunction of ECM internal	• Inspection the ECM
143	ECM failure (EEPROM/ Flash-EPPOM checksum failure)		
144	ECM failure (coding ID checksum failure)		
145	ECM failure (coding checksum failure)		
146	ECM failure (program-ming checksum failure)		

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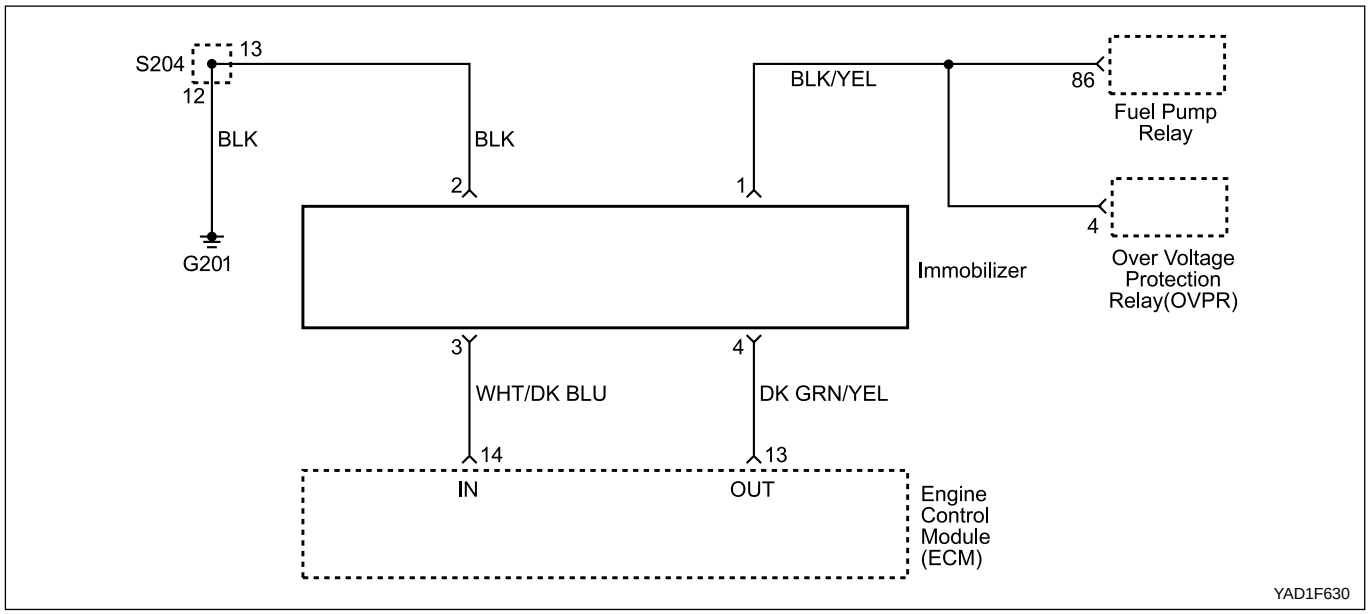
ELECTRONIC THROTTLE CONTROLLER SAFETY MALFUNCTION

Failure Code	Description	Trouble Area	Maintenance Hint
110	Throttle actuator learning data fault	System internal failure	• Inspection the Engine Control Module (ECM)
117	Exceed fuel-cut safety time		
120	Cruise control interruption memory failure		
138	Call Monitoring		
139	Servo motor control output interruption memory failure		
140	Servo motor open/short		
186	ECM failure (incompatible CPU)		
187	ECM failure (CPUs communication failure)		
188	ECM failure (CPU 2 configuration failure)		
189	ECM failure (CPU 2 fault)		
190	ECM failure (CPU run time failure between CPUs)		
231	ECM failure (CPU 2 cruise control message counter failure)		
232	Over deceleration limit (CPU 2)		
233	Over acceleration limit (CPU 2)		
234	Cruise control lever dual operation (CPU 2)		
235	Cruise control lever safety terminal failure (CPU 2)		
236	Unusual pedal position variation (CPU 2)		
237	Unusual throttle position variation (CPU 2)		
238	Unusual throttle controller monitoring data comparison fault (CPU 2)		

Failure Code	Description	Trouble Area	Maintenance Hint
239	Unusual accelerator pedal position sensor comparison fault (CPU 2)	System internal failure	• Inspection the Engine Control Module (ECM)
240	Throttle potentiometer comparison fault (CPU 2)		
241	Unusual CPU communication (CPU 2)		
242	Unusual CPU configuration (CPU 2)		
243	A/D converter failure (CPU 2)		
244	Accelerator pedal position sensor setpoint fault between CPU 1 and CPU 2		
245	Position controller setpoint fault between CPU 1 and CPU 2		
246	MSR setpoint fault between CPU 1 and CPU 2		
247	Idle control setpoint fault between CPU 1 and CPU 2		
248	A/D converter overflow (CPU 2)		
249	ROM fault (CPU 2)		
250	RAM fault (CPU 2)		
251	Cycle monitor fault (CPU 2)		

IMMOBILIZER



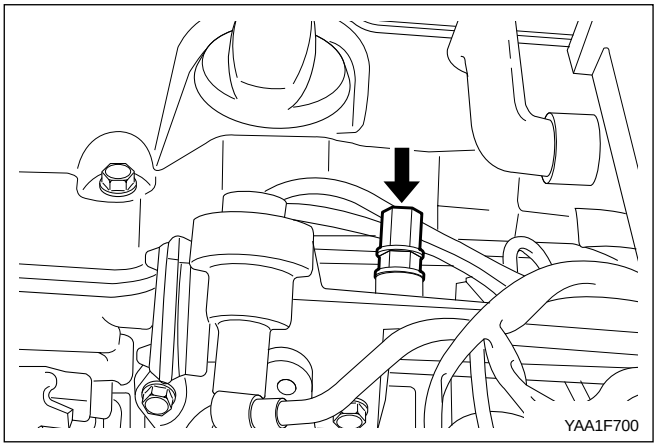
Failure Code	Description	Trouble Area	Maintenance Hint
25	Communication with transponder missing	When missing the transponder signal	• Inspection the Engine Control Module (ECM) pin 13, 14 about short circuit or open with bad contact • Inspection the power source or ground short circuit or open of immobilizer unit • Inspection the transponder condition (broken etc.) • Inspection the ECM
141	Unprogramed ECM with immobilizer	When malfunction of immobilizer Required immobilizer encoding, no paired condition of immobilizer even through start trial	• Fulfill the immobilizer pairing

Circuit Description

Immobilizer is a device disabling vehicle ignition unless a specific key is used and designed to help prevent vehicle theft.

Immobilizer is comprised of two devices, a key with encoded transponder and ECM with the same encoding of the transponder. When a key is inserted into the hole to start vehicle and turned to ON, the ECM reads and decodes the transponder code and, if the same, starts the engine, it is called immobilizer. It means immobilizer system disables starting by stopping fuel supply if the code in the transponder does not match the code stored in ECM each other.

MAINTENANCE AND REPAIR



ON-VEHICLE SERVICE

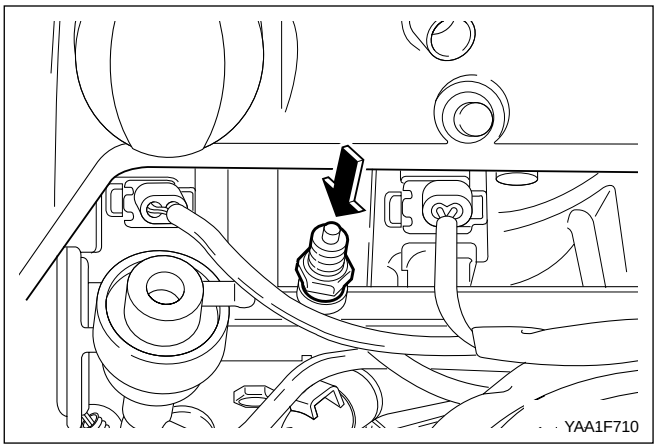
DISCHARGING THE PRESSURE IN FUEL SYSTEM

Removal and Installation Procedure

1. Remove the fuel pressure test connector.

   Installation Notice

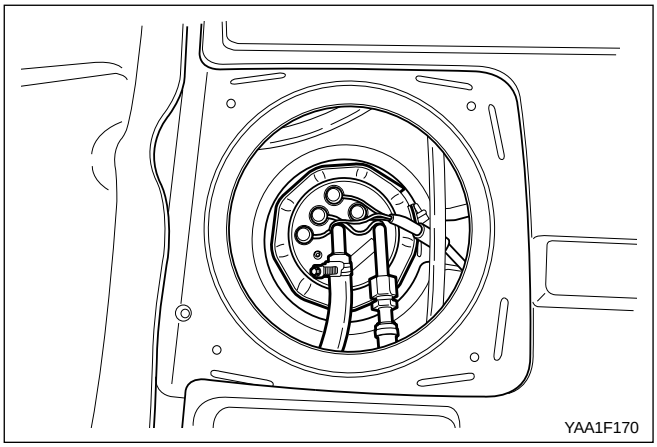
Tightening Torque	25 N•m (18 lb-ft)



2. Remove the fuel pressure in fuel systemby pressing the service valve with a clean, pointy tool.

   Notice: Place a cloth so that the fuel doesn't stain around.

3. Installation should follow the removal procedure in the reverse order.



FUEL PUMP

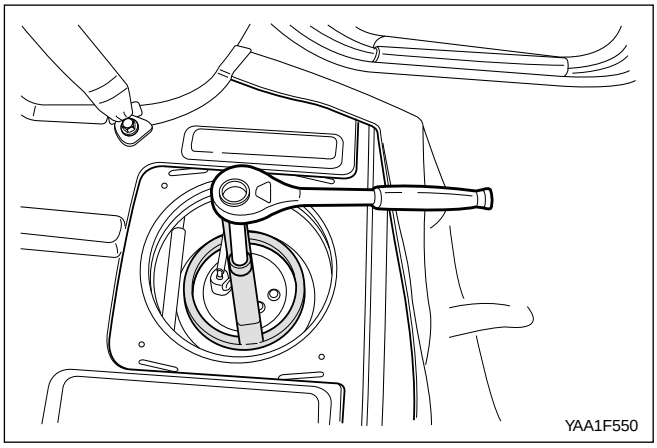
Tools Required

661 589 00 46 00 Fuel Tank Cap Wrench

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel system pressure. Refer to "Discharging the Pressure in Fuel System" in this section.
2. Disconnect the negative battery cable.
3. Put aside the floor carpet to remove the fuel pump access cover.
4. Remove the fuel pump access cover.
5. Remove the fuel pump wiring connectors.
6. Disconnect the fuel supply and return pipes.
7. Remove the fuel pump locking cap band.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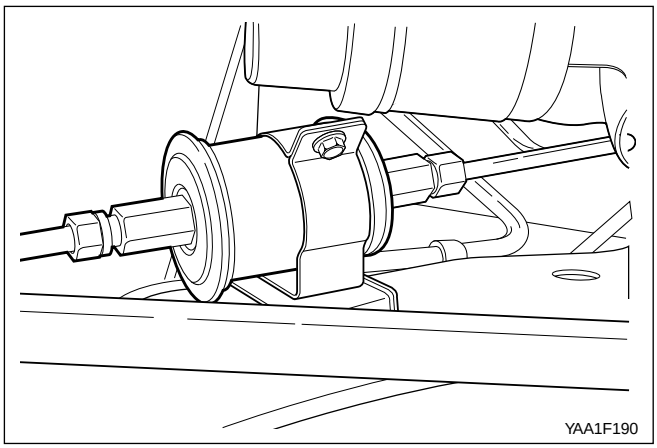

YAA1F190

8. Using the fuel tank cap wrench 661 589 00 46 00, remove the locking cap.
9. Remove the pump from the fuel tank.

   Notice: Check the condition of the seal and replace if necessary. Drain the fuel before removing the pump.

10. Perform an operational check of the fuel pump.
11. Installation should follow the removal procedure in the reverse order.

FUEL FILTER

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

2. Relieve the fuel system pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
3. Disconnect the fuel lines from the fuel filter.

   Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

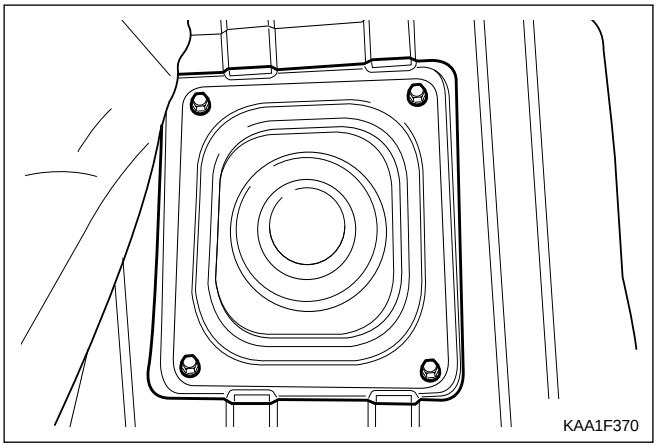
4. Remove the fuel filter mounting bracket bolt .

   Installation Notice

Tightening Torque	6 N•m (53 lb-in)

   Notice: Place the fuel pump pad. There may be acorrosion due to the contact between the fuel filter and the bracket.

5. Remove the fuel filter.
6. Install the fuel filter.
7. Perform a leak test of the fuel filter.
8. Installation should follow the removal procedure in the reverse order.

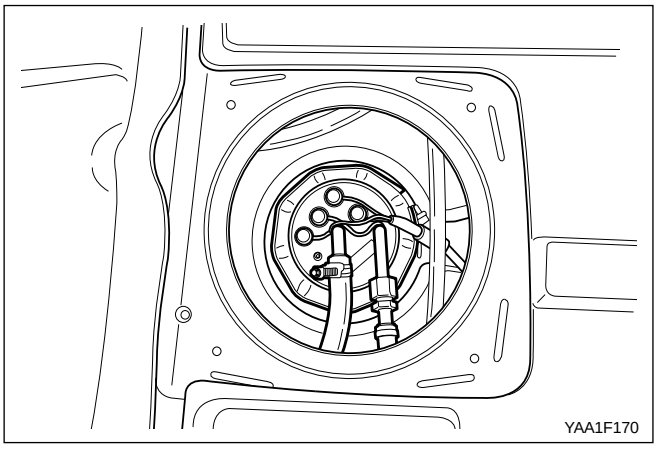

KAA1F370

FUEL TANK

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Put aside the floor carpet to remove the fuel pump access cover.
5. Remove the fuel pump access cover.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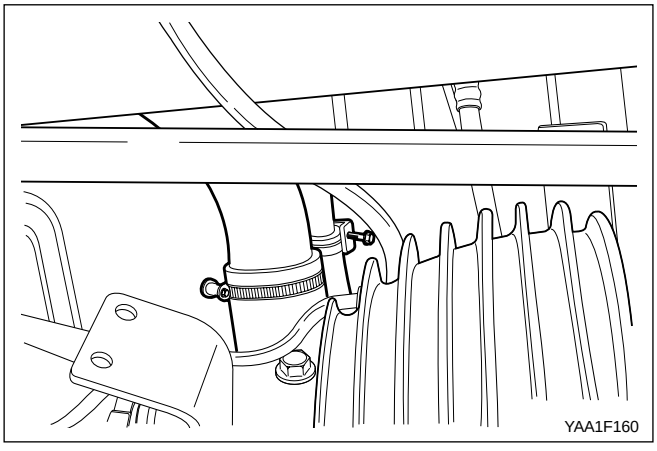
6. Disconnect the return line.
7. Disconnect the supply line.
8. Disconnect the fuel tank-to-canister hose from the fuel tank.
9. Disconnect the fuel pump wiring connector.

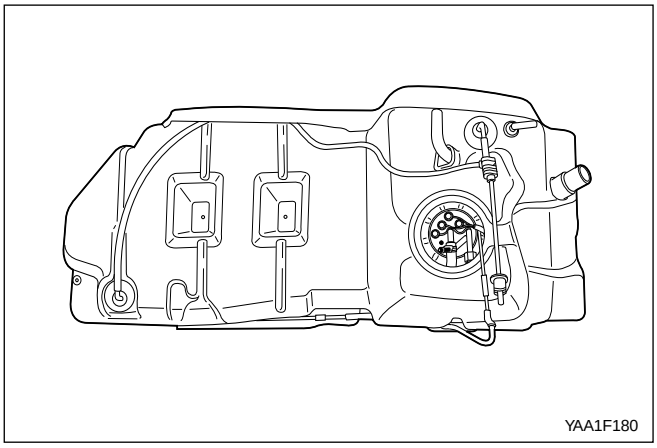

YAA1F160

10. Disconnect thefuel filler hoseand air vent hosefrom the fuel tank.
11. Support the fuel tank.
12. Remove the fuel tank retaining nuts.

Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

13. Carefully lower the fuel tank.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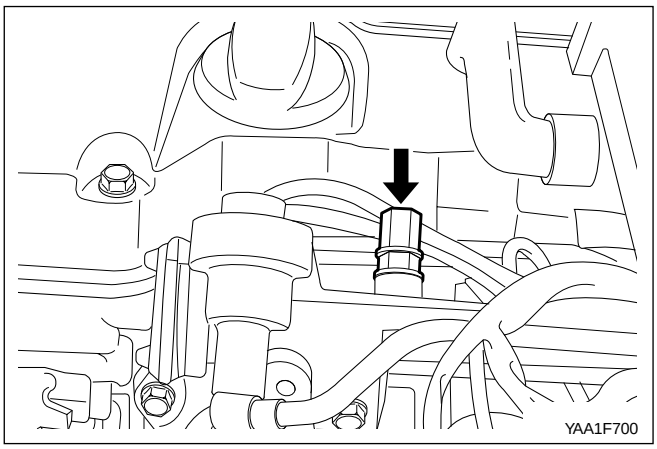
14. Turn the rollover valves counterclockwise at an angle of 90 degrees.
15. Turn the lock ring counterclockwise.
16. Remove and discard the gasket.
17. Installation should follow the removal procedure in the reverse order.


YAA1F700

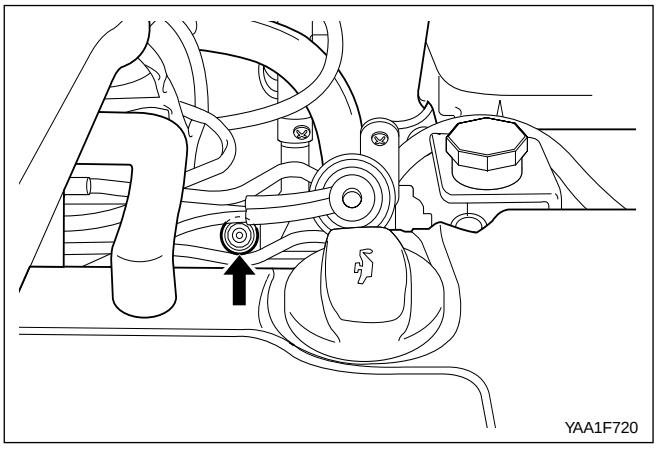
FUEL PRESSURE REGULATOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the fuel pressure test connector.

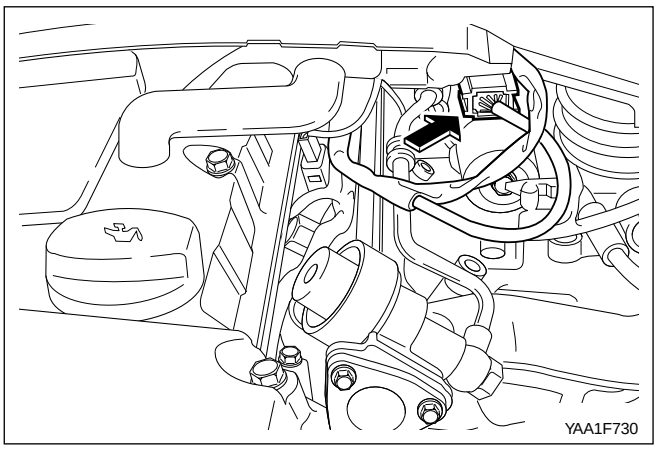
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

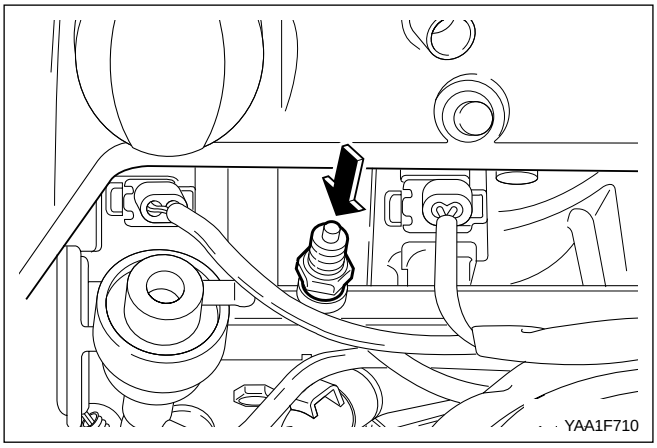

YAA1F720

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

3. Relieve the fuel pressure in fuel supply systemby pressing the service valve.


YAA1F730

4. Disconnect the vacuum hose.
5. Disconnect the circlip and remove the fuel pressure regulator.
6. Apply the oil to O-ring lightly and then replace it.
7. Perform a leak test of the fuel pressure regulator with the engine off and the ignition on.
8. Installation should follow the removal procedure in the reverse order.

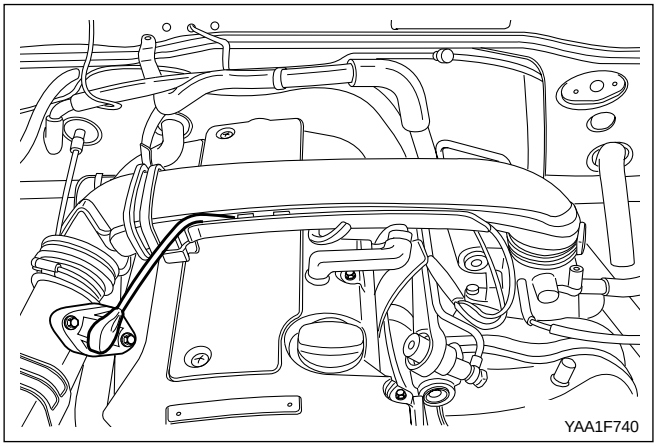


FUEL RAIL AND INJECTORS

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Discharge the fuel pressure from the fuel pressure test connector.
2. Disconnect the negative battery cable.
3. Disconnect the vacuumhose from the fuel pressure regulator.

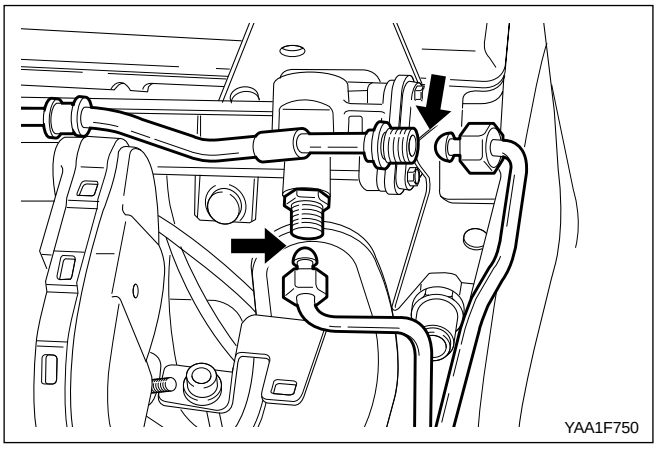


4. Remove the cable guide.
5. Disconnect the Hot Film Air Mass (HFM) sensor connector.
6. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

7. Remove the intake air duct clamps.
8. Remove the intake air duct.



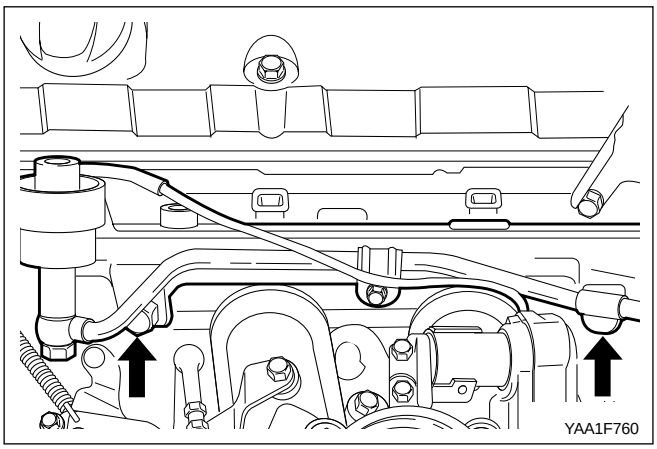
9. Remove the fuel return and supply line.

   Notice: For removal, cover around parts with cloths not to be stained by fuel. In case of checking the injector only, do not remove the fuel return and supply line.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

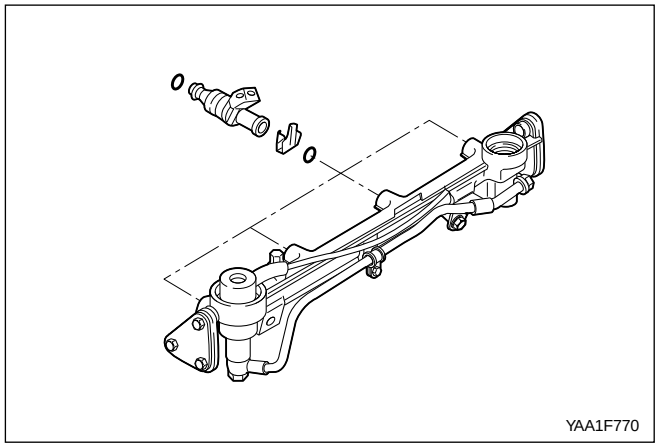
10. Remove the six injector connectors.



11. Remove the two left and two right bolts and one center bolt of the fuel rail assembly from the intake manifold.

Installation Notice

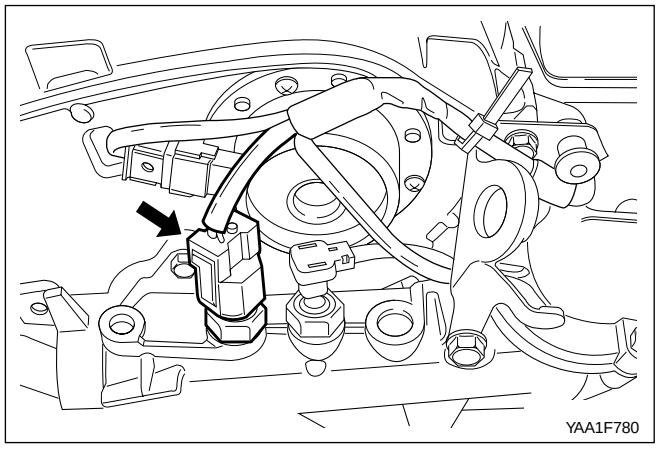
Tightening Torque	25 N•m (18 lb-ft)


YAA1F770

Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

Important: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

12. Remove the injectors and the fuel rail carefully.
13. Remove the fuel injector retainer clips.
14. Remove the fuel injectors by pulling them down and out.
15. Discard the fuel injector O-rings.
16. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
17. Perform a leak check of the fuel rail and fuel injectors.
18. Installation should follow the removal procedure in the reverse order.


YAA1F780

ENGINE COOLANT TEMPERATURE SENSOR

Removal and Installation Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the engine coolant temperature sensor connector.

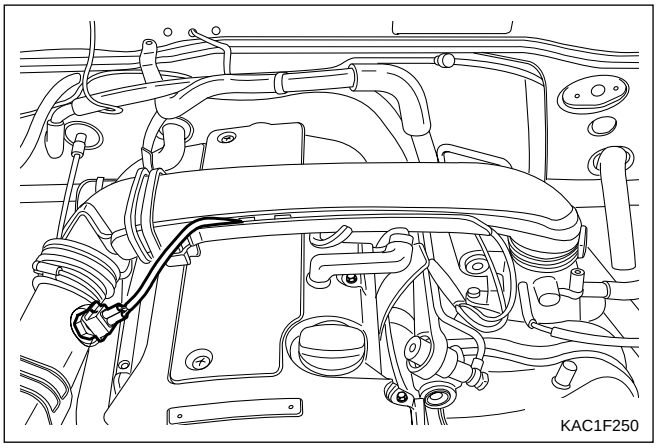
   Notice: Take care when handling the engine coolant temperature sensor. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Remove the engine coolant temperature sensor from the pump hosing.

   Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

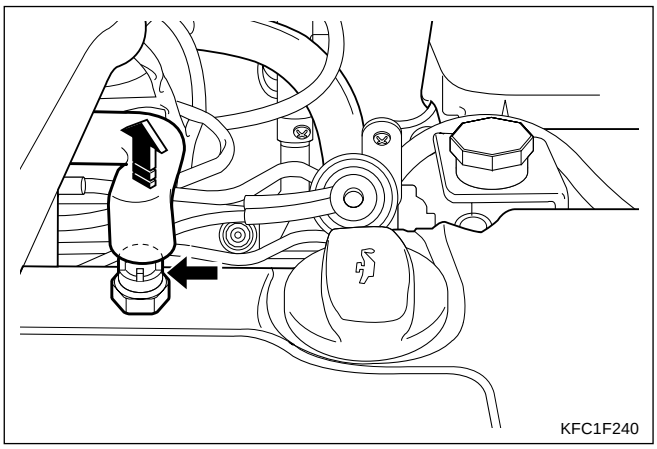
5. Installation should follow the removal procedure in the reverse order.


KAC1F250

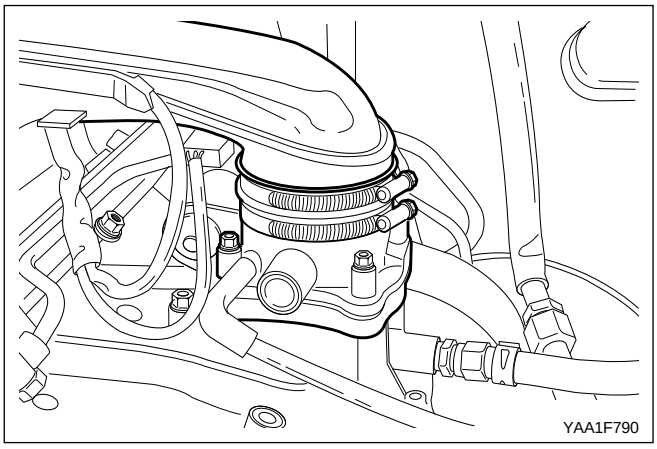
THROTTLE BODY (INTEGRATED WITH THE ACTUATOR)

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the intake air temperature (IAT) sensor connector.
3. Remove the intake air duct clamps.


KFC1F240

4. Remove the blow-by hose.
5. Remove the intake air duck.

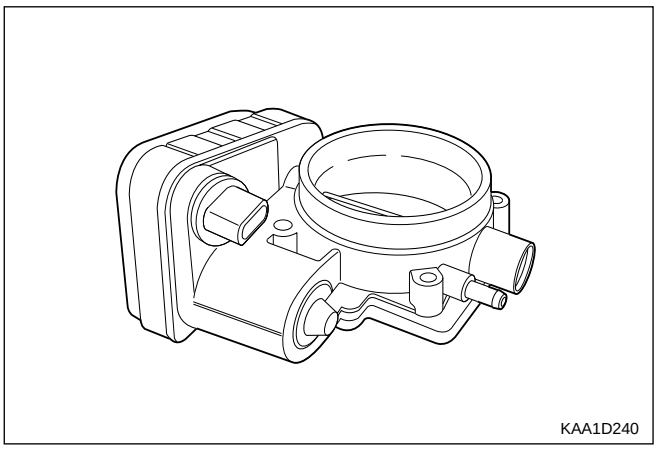

YAA1F790

6. Disconnect the throttle body electrical connector.
7. Remove the throttle body bolts.

Installation Notice

Tightening Torque	12 N•m (106 lb-in)

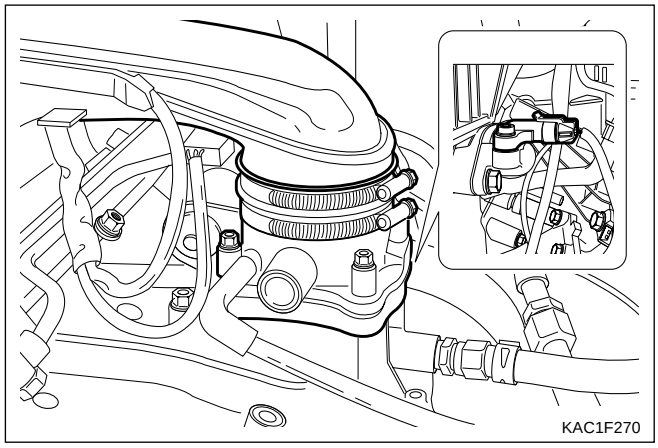
8. Remove the vacuum hose.


KAA1D240

9. Remove the throttle body and discard the gasket.

   Important: Use care in cleaning old gasket material. Sharp tools may damage sealing surfaces.

10. Installation should follow the removal procedure in the reverse order.



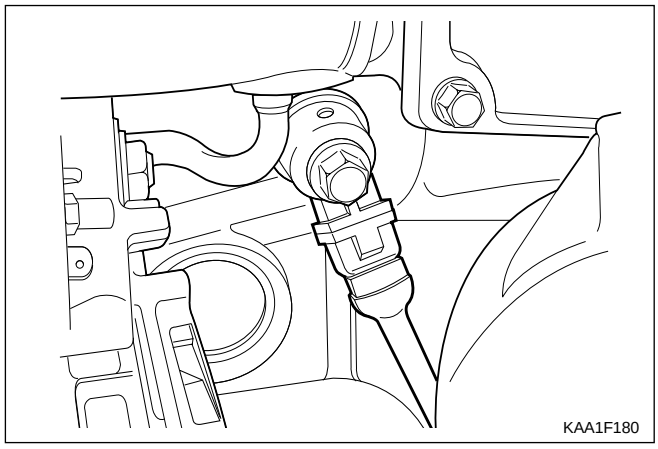
HOT FILM AIR MASS (HFM) SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the Hot Film Air Mass (HFM) sensor electrical connector.
3. Remove the HFM sensor retaining screws.
4. Turn the HFM sensor coupling in the direction shown in the figure in the left so that it gets separated from the contact surface.

   Notice: Make sure the HFM sensor coupling connects completely with the contact surface installation.

5. Remove the HFM sensor.
6. Installation should follow the removal procedure in the reverse order.



KNOCK SENSOR

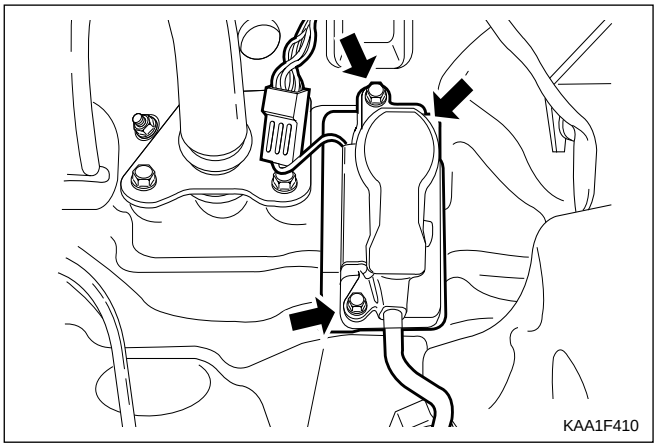
Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the knock sensor electrical connector from the intake manifold bracket.
3. Remove the knock sensor mounting bolt from the knock sensor installed on the cylinder block.

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Remove the knock sensor.
5. Installation should follow the removal procedure in the reverse order.



PEDAL POSITION SENSOR

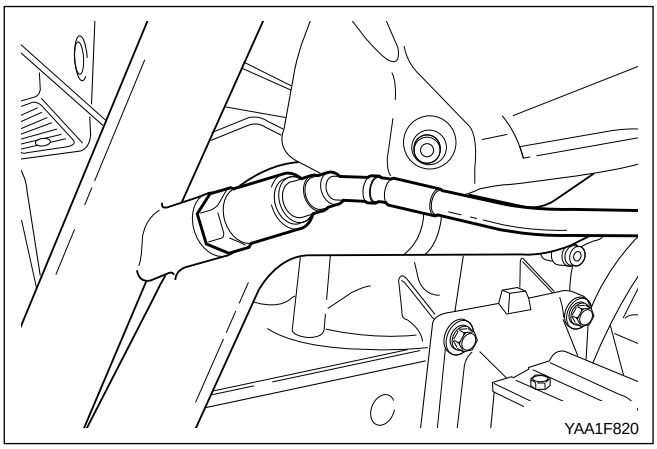
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the pedal position sensor connector.
3. Unscrew the bolts and nut.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the pedal and sensor assembly.
5. Installation should follow the removal procedure in the reverse order.



OXYGEN SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Notice: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or the connector could affect proper operation of the oxygen sensor. Do not drop the oxygen sensor.

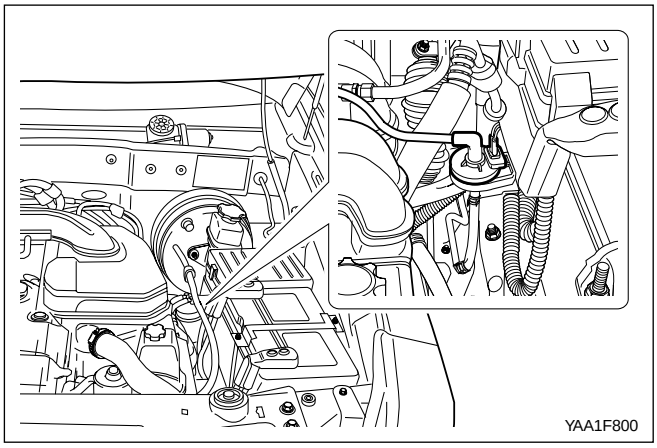
2. Disconnect the electrical connector.
3. Carefully remove the oxygen sensor from the exhaust pipe.

Installation Notice

Tightening Torque	55 N•m (41 lb-ft)

Important: A special anti-seize compound is used on the oxygen sensor threads. This compound consists of aliquid graphiteand glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or serviced sensors will already have the compound applied to the threads. If a sensor is removed from any engine and is to be reinstalled, the threads must havean antiseize compound applied before reinstallation.

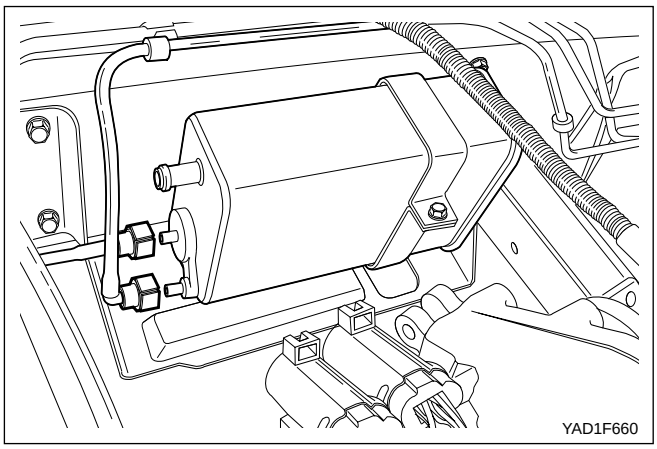
4. Coat the threads of the oxygen sensor with an anti-seize compound, if needed.
5. Installation should follow the removal procedure in the reverse order.



PURGE CONTROL VALVE

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the purge control valve connector.
3. Disconnect the throttle body-to-purge control valve hose from the purge control valve.
4. Disconnect the canister-to-purge control valve hose from the purge control valve.
5. Remove the purge control valve.
6. Installation should follow the removal provedure in the reverse order.

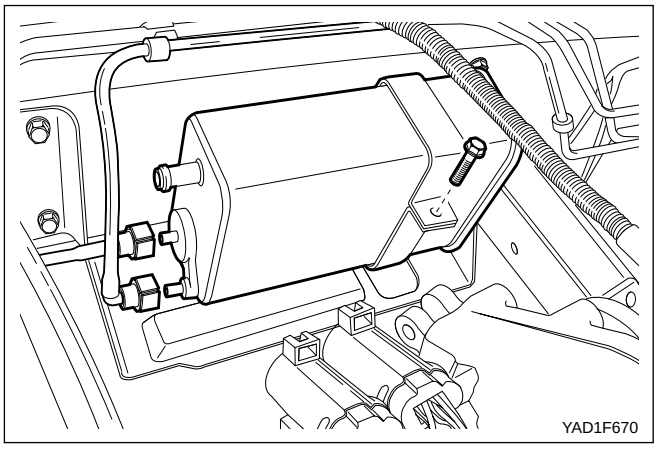


CANISTER

Removal and Installation Procedure

Caution: Canister and vacuum hoses contain fuel vapors. Do not smoke in the area or permit an open flame.

1. Disconnect the fuel tank-to-canister hose form the canister.
2. Disconnect the canister-to-purge control valve hose form the canister.

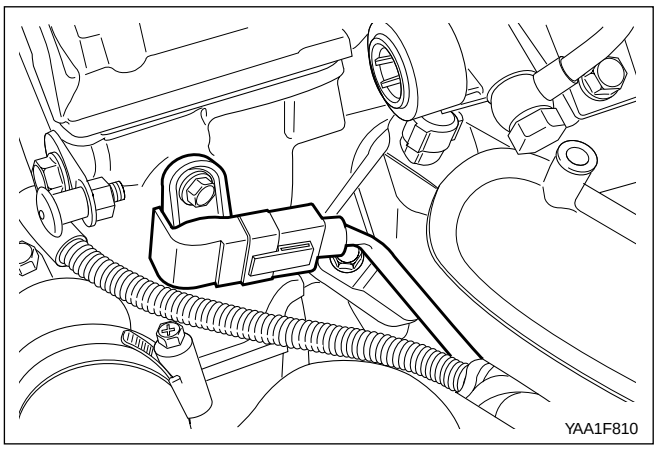


3. Remove the canister mounting bolts.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the canister.
5. Installation should follow the removal procedure in the reverse order.



CAMSHAFT POSITION SENSOR

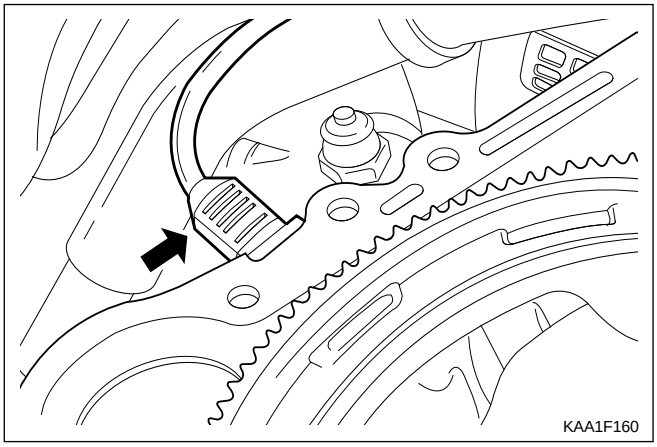
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the camshaft position sensor.
3. Remove the camshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Check the O-ring for damage and replace it if necessary.
5. Installation should follow the removal procedure in the reverse order.


KAA1F160

CRANKSHAFT POSITION SENSOR

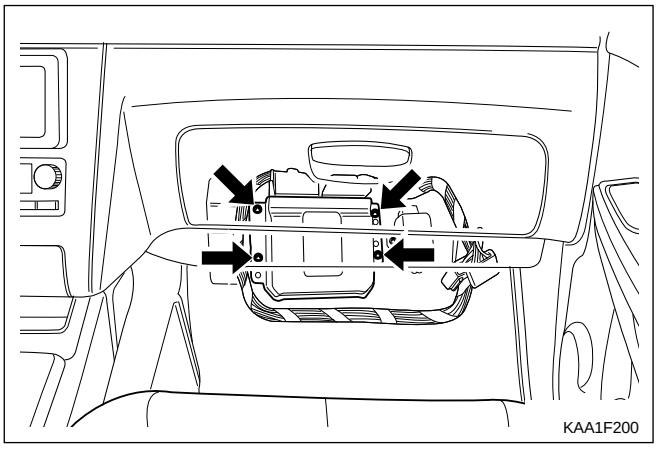
Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the crankshaft position sensor.
3. Remove the crankshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Installation should follow the removal procedure in the reverse order.


KAA1F200

ENGINE CONTROL MODULE

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Remove the cowl side trim form passenger side. Re-er to *Section 9G, Interior trim.*
3. Remove the four securing nuts for the Engine Control Module (ECM) from the mounting bracket.

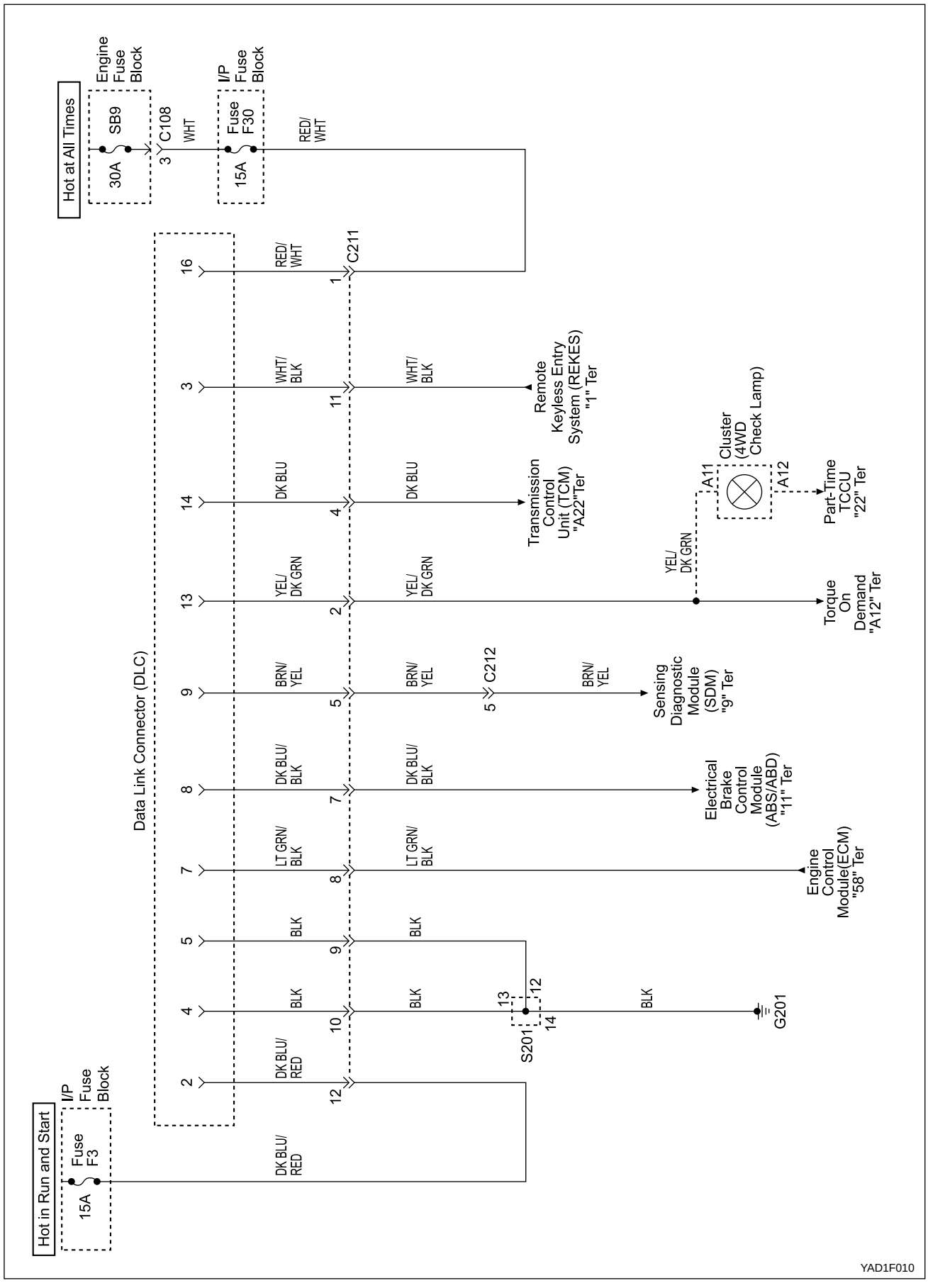
Installation Notice

Tightening Torque	10 N•m (89 lb-in)

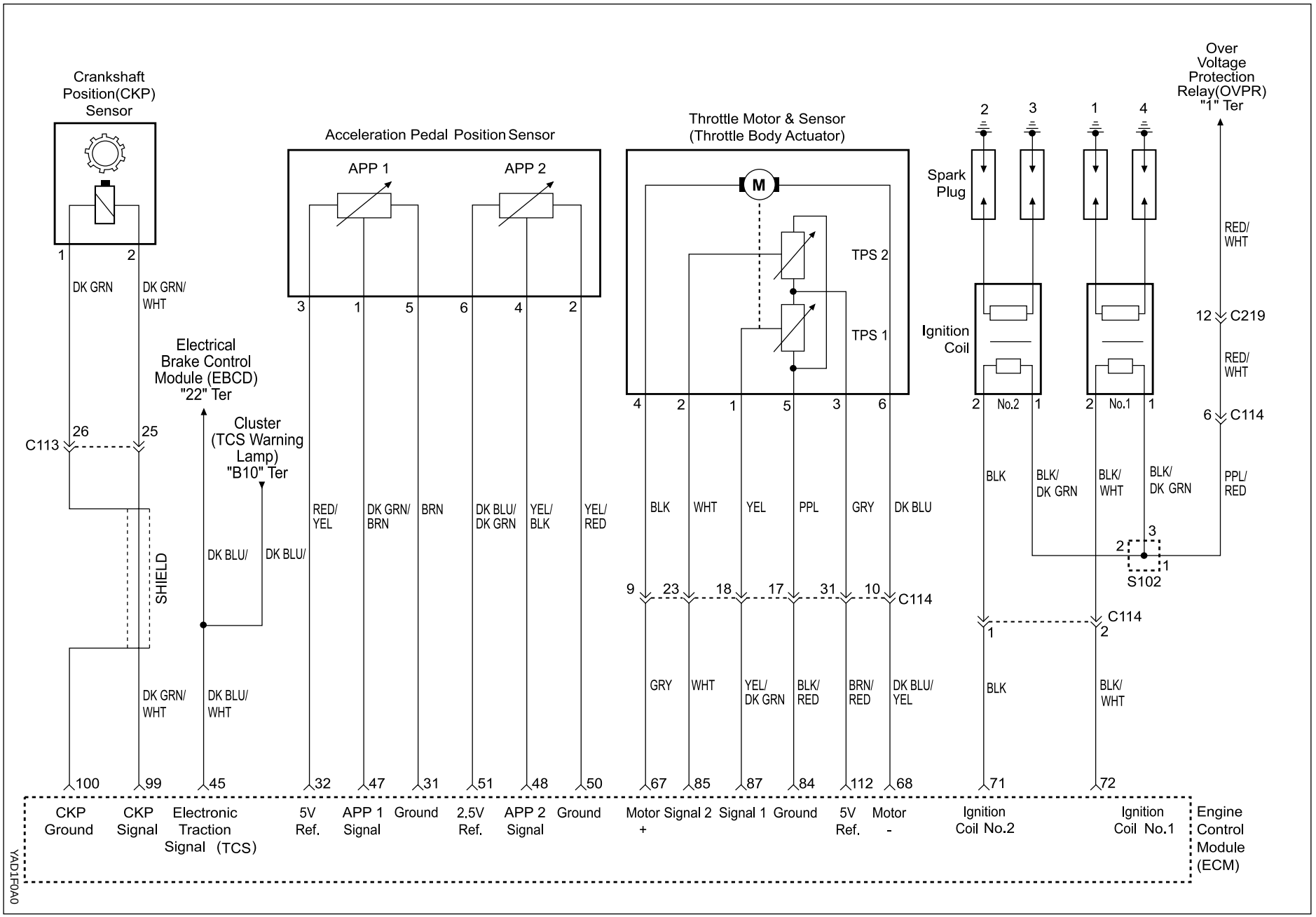
4. Pull out the ECM from the bracket.
5. Disconnect the vehicle side coupling.
6. Installation should follow the removal procedure in the reverse order.

SCHEMATIC AND ROUTING DIAGRAMS

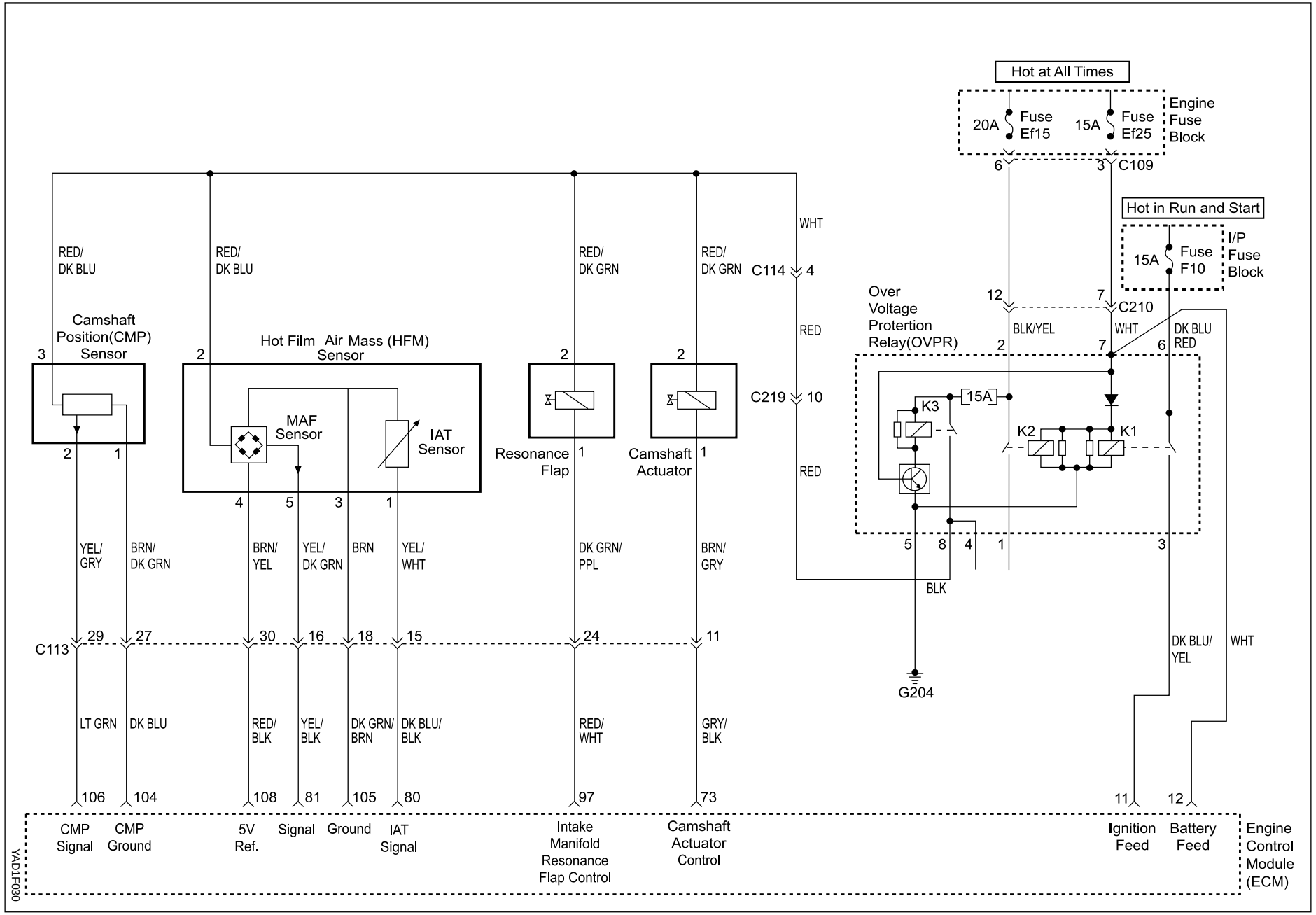
ECM WIRING DIAGRAM (2.3L DOHC - 1 OF 7) (MSE 3.53D)



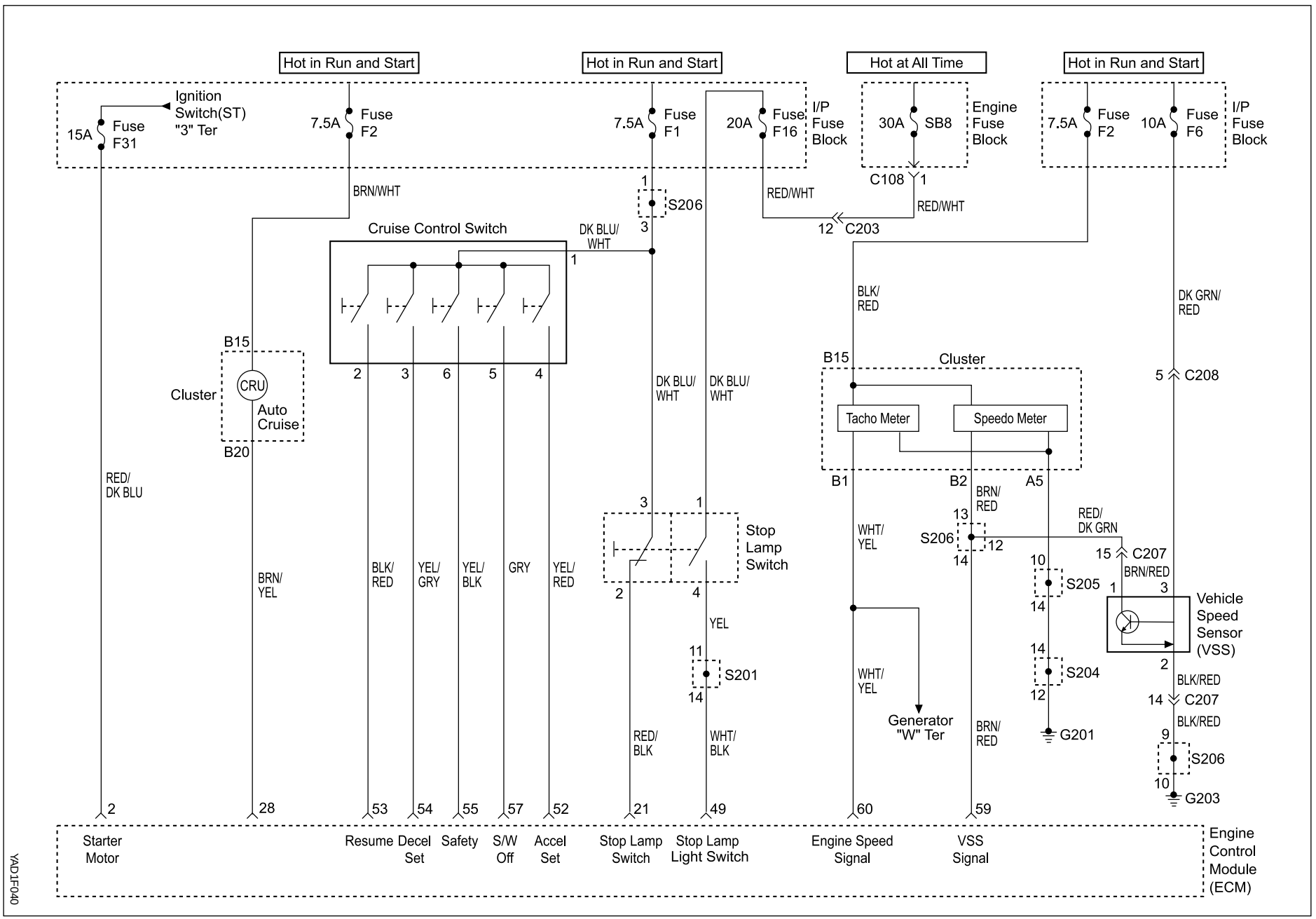
ECM WIRING DIAGRAM (2.3L DOHC - 2 OF 7) (MSE 3.53D)



ECM WIRING DIAGRAM (2.3L DOHC - 3 OF 7) (MSE 3. 53D)

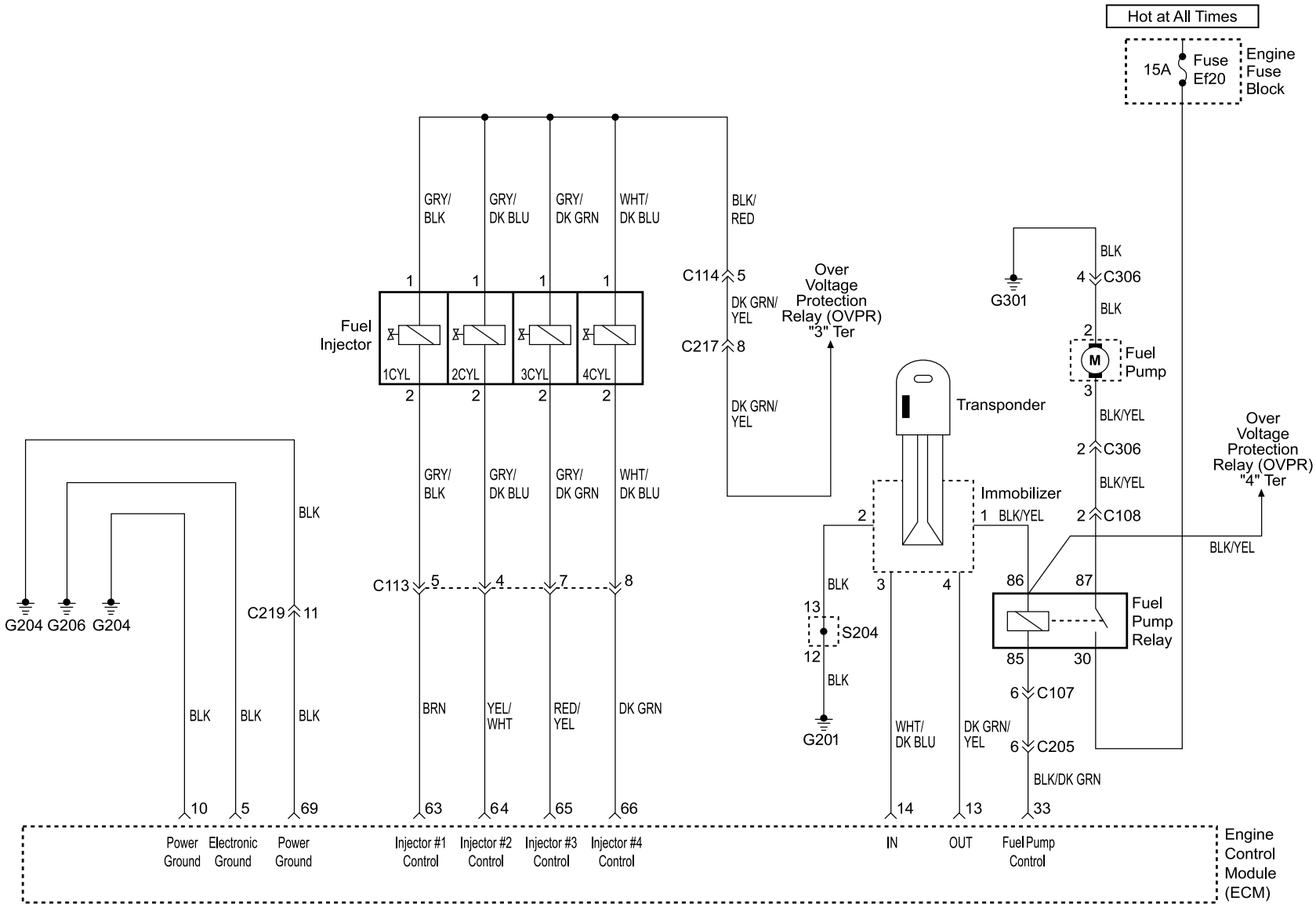


ECM WIRING DIAGRAM (2.3L DOHC - 4 OF 7) (MSE 3.53D)



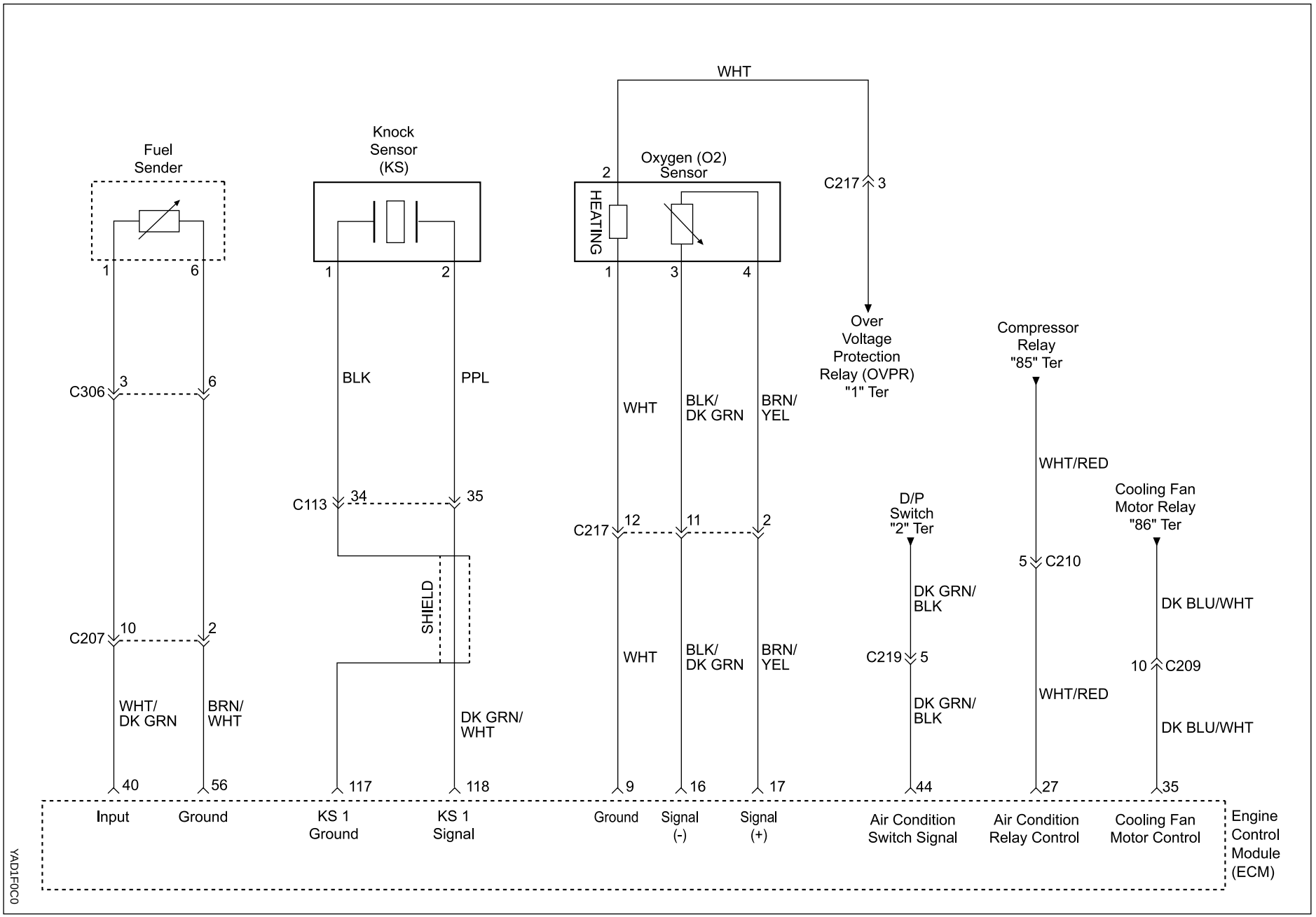
YAD1F040

ECM WIRING DIAGRAM (2.3L DOHC - 5 OF 7) (MSE 3.53D)

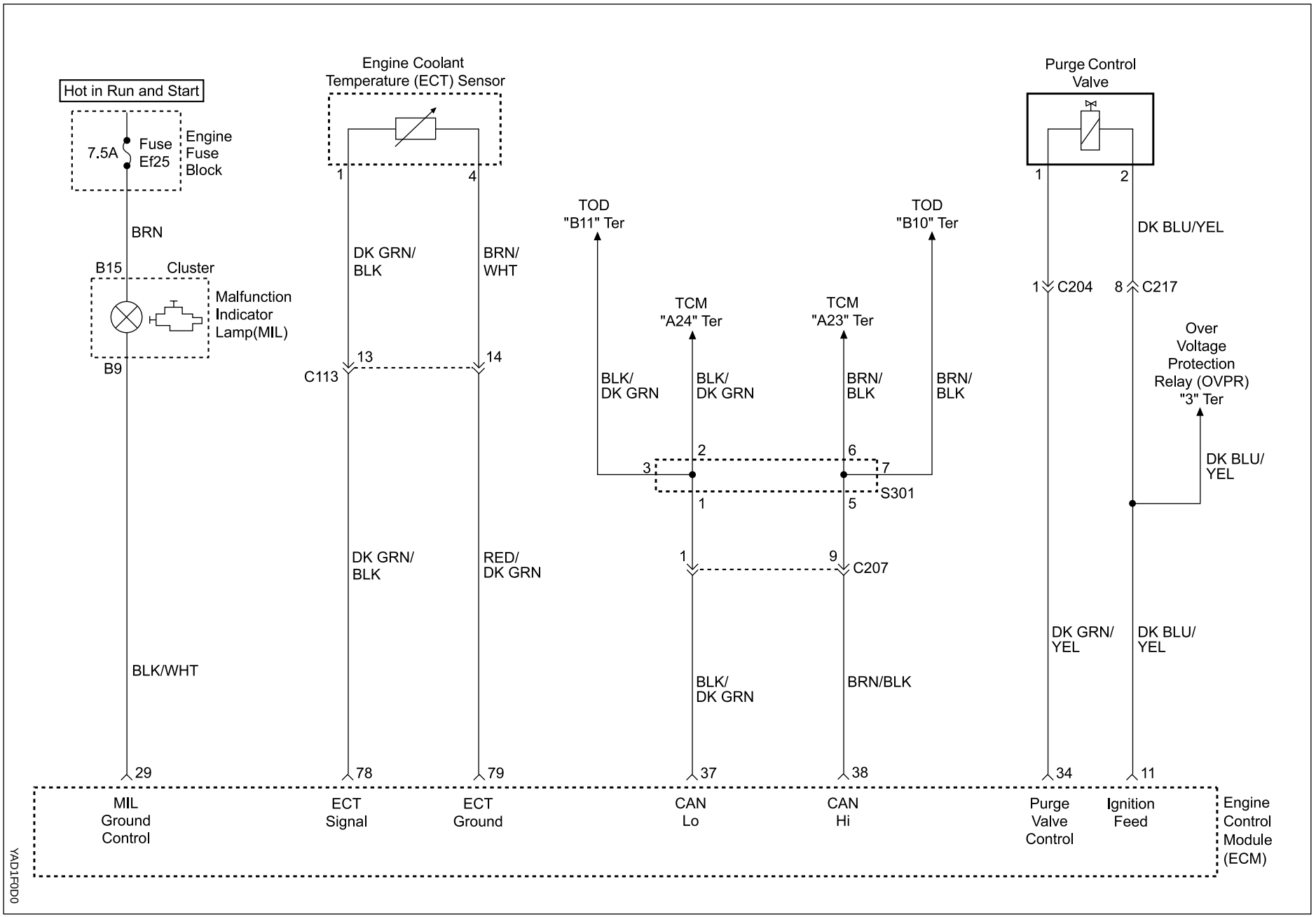


YAD1F0B0

ECM WIRING DIAGRAM (2.3L DOHC - 6 OF 7) (MSE 3.53D)



ECM WIRING DIAGRAM (2.3L DOHC - 7 OF 7) (MSE 3.53D)



SPECIFICATIONS

ENGINE DATA DISPLAY TABLE

Parameter	Unit	Value
Engine Coolant Temp.	°C	greater than 95 °C after warm up
Intake Air Temp.	°C	-40 ~ 130 °C (varies with ambient temp. or engine mode)
Engine RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Regular RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Engine Load	%	18 ~ 25 %
Mass Air Flow Meter	Kg/h	16 ~ 25 Kg/h
Throttle Position Angle	°TA	0 °TA (up to 100 °TA at the wide open throttle)
Spark Advance	°CA	°CA (6 ~ 9 °CA)
Indicated Engine Torque	Nm	Varies with engine condition
Injection Time	ms	3 ~ 5 ms
Battery Voltage	V	13.5 ~ 14.1 V (engine running)
Front Axle Speed	Km/h	0 ~ 265 Km/h
Rear Axle Speed	Km/h	0 ~ 265 Km/h
Accel. Pedal Position 1	V	0.4 ~ 4.8 V
Accel. Pedal Position 2	V	0.2 ~ 2.4 V
Throttle Position 1	V	0.3 ~ 4.6 V
Throttle Position 2	V	0.3 ~ 4.6 V
Fuel Integrator		0.8 ~ 1.2
Oxygen Sensor	mv	100 ~ 900 mv
A/C S/W Condition	1=ON/0=OFF	-
Full Load State	1=ON/0=OFF	-
Shift Gear State (A/T)	1=ON/0=OFF	-
A/C Control State	1=ON/0=OFF	-
Clutch Switch (M/T)	1=ON/0=OFF	-
Cam Actuator State	1=ON/0=OFF	-
Knocking Control	1=ON/0=OFF	-
Protect Mission	1=ON/0=OFF	-
Purge Control Valve	1=ON/0=OFF	-
Lambda Function	1=ON/0=OFF	-
Catalyst Heating	1=ON/0=OFF	-
Overrun Fuel Cut	1=ON/0=OFF	-
Full Fuel Cut	1=ON/0=OFF	-
Brake Switch	1=ON/0=OFF	-
Cruise Control Status	1=ON/0=OFF	-

* Condition : Warmed up, idle, P/N or neutral

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Camshaft Position Sensor Retaining Bolts	10	-	89
Canister Mounting Bolts	6	-	53
Coolant Temperature Sensor	30	22	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Engine Control Module (ECM) Mounting Bracket Nuts	10	-	89
Fuel Filter Mounting Bracket Bolt	6	-	53
Fuel Filter Lines	28	21	-
Fuel Pressure Test Connector	25	18	-
Fuel Rail Assembly Bolts	25	18	-
Fuel Return And Supply Lines	23	17	-
Fuel Tank Retaining Nuts	38	28	-
Knock Sensor Mounting Bolt	25	18	-
Oxygen Sensor	55	41	-
Pedal Position Censor Mounting Bolts And Nut	6	-	53
Throttle Body Bolts	12	-	106

FUEL SYSTEM SPECIFICATION

Use Only Unleaded Fuel Rated at 89 Octane or Higher

Fuel quality and additives contained in fuel have a significant effect on power output, drivability, and life of the engine.

Fuel with too low an octane number can cause engine knock.

Caution: Use of fuel with an octane number lower than 89 may damage engine and exhaust system.

Notice: To prevent accidental use of leaded fuel, the nozzles for leaded fuel are larger, and will not fit the fuel filler neck of your vehicle.

Do Not Use Methanol

Fuels containing methanol (wood alcohol) should not be used in vehicle.

This type of fuel can reduce vehicle performance and damage components of the fuel system.

Caution: Use of methanol may damage the fuel system.

Vehicle Fueling from Drums or Storage Containers

For safety reasons (particularly when using noncommercial fueling systems) fuel containers, pumps and hoses must be properly earthed.

Static electricity build up can occur under certain atmospheric and fuel flow conditions if unearthed hoses, particularly plastic, are fitted to the fuel-dispensing pump.

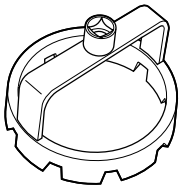
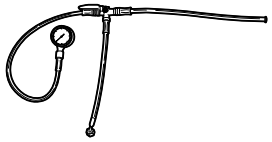
It is therefore recommended that earthed pumps with integrally earthed hoses be used, and that storage containers be properly earthed during all noncommercial fueling operations.

TEMPERATURE VS RESISTANCE

°C	°F	ECT sensor	IAT sensor
		ohms (Ω)	
Temperature vs Resistance Values (Approximate)			
130	266	88	102
120	248	111.6	127
110	230	143	159
100	212	202	202
90	194	261	261
80	176	340	340
70	158	452	452
60	140	609	609
50	122	835	835
40	113	1166	1166
30	86	1662	1662
20	68	2420	2420
10	50	3604	3604
0	32	5499	5499
-10	14	8609	8609
-20	-4	13850	13850
-30	-22	22960	22960
-40	-40	39260	39260

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAA1F890	**661 589 00 46 00** **Fuel Tank Cap Wrench**
 KAA1F490	**103 589 00 21 00** **Fuel Pressure Gauge**