

Engine Control

Precautions

Precautions on Engine Diagnosis

ZAJ6111100001

▲ WARNING

To prevent any unexpected engine starting, perform the following before proceeding with any CRANKING tests.

- When performing tests not related to fuel injector operation:
 - Disconnect all fuel injector wire connectors.
- When performing tests related to fuel injector operation:
 - Relieve the fuel pressure in the fuel lines. Refer to “Fuel Pressure Relief Procedure” in Section 1G (Page 1G-15).
 - Disconnect the high pressure fuel pump wire connector located on the fuel vapor separator.

CAUTION

- Always turn the ignition switch “OFF” and disconnect the battery cables when wires are being disconnected or connected.
- Hold and pull the connectors when disconnecting. Do not pull the wires.

NOTE

- To troubleshoot the ECM, and the engine control system, consisting of sensors and actuators, use the Suzuki Diagnostic System.
- The self-diagnostic codes memory in the ECM will remain even if the battery is disconnected.
- Each electrical circuit is affected by battery voltage, always use a full-charged battery.
- Make sure all ground points have good electrical contact.
- Make sure all wires / cables are securely connected.

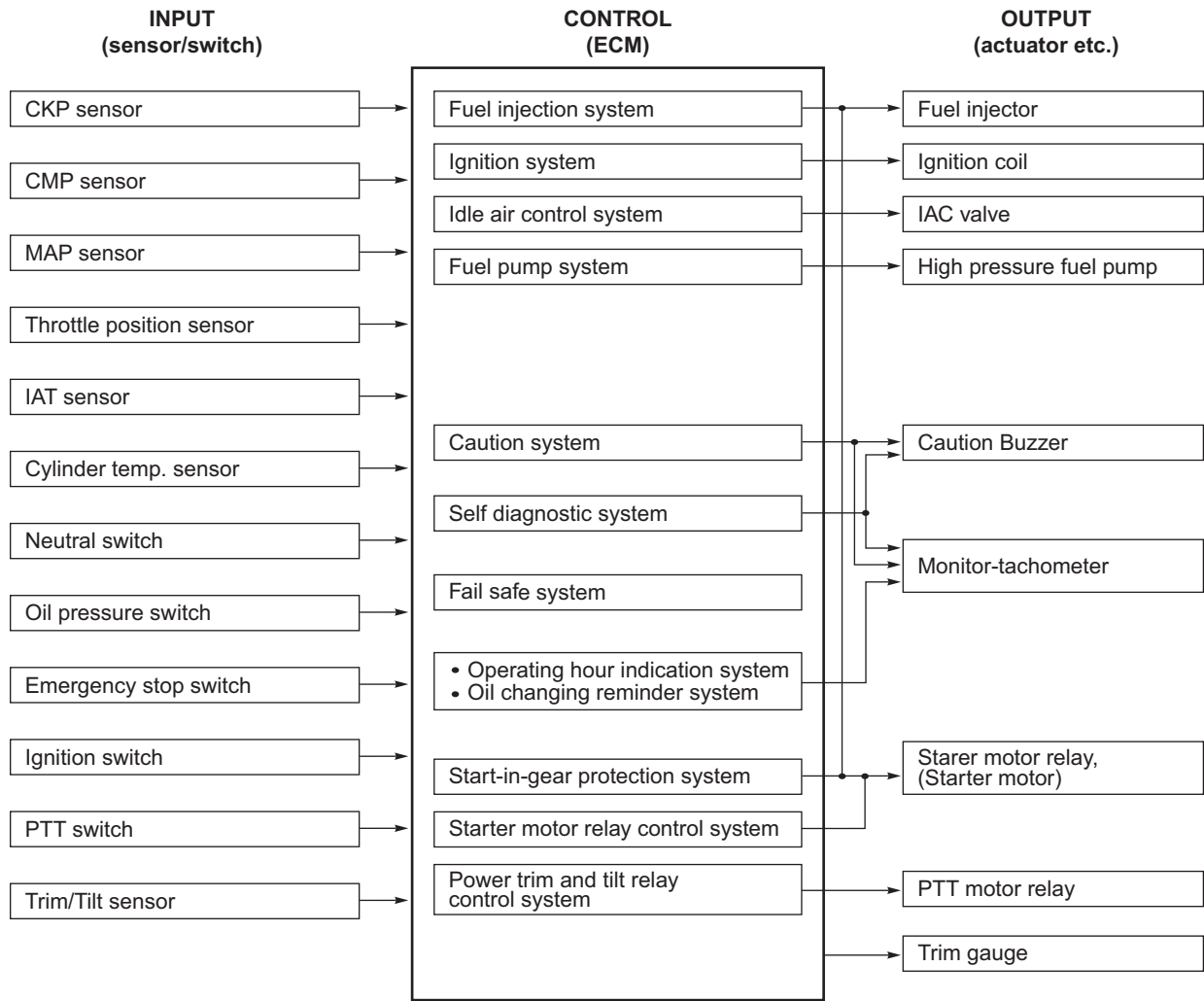
General Description

Engine Control System Description

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The DF60A model employ an integrated system which performs the control functions for fuel injection, ignition, idle / trolling speed (idle air), etc. through the ECM (Engine Control Module).

System Structure

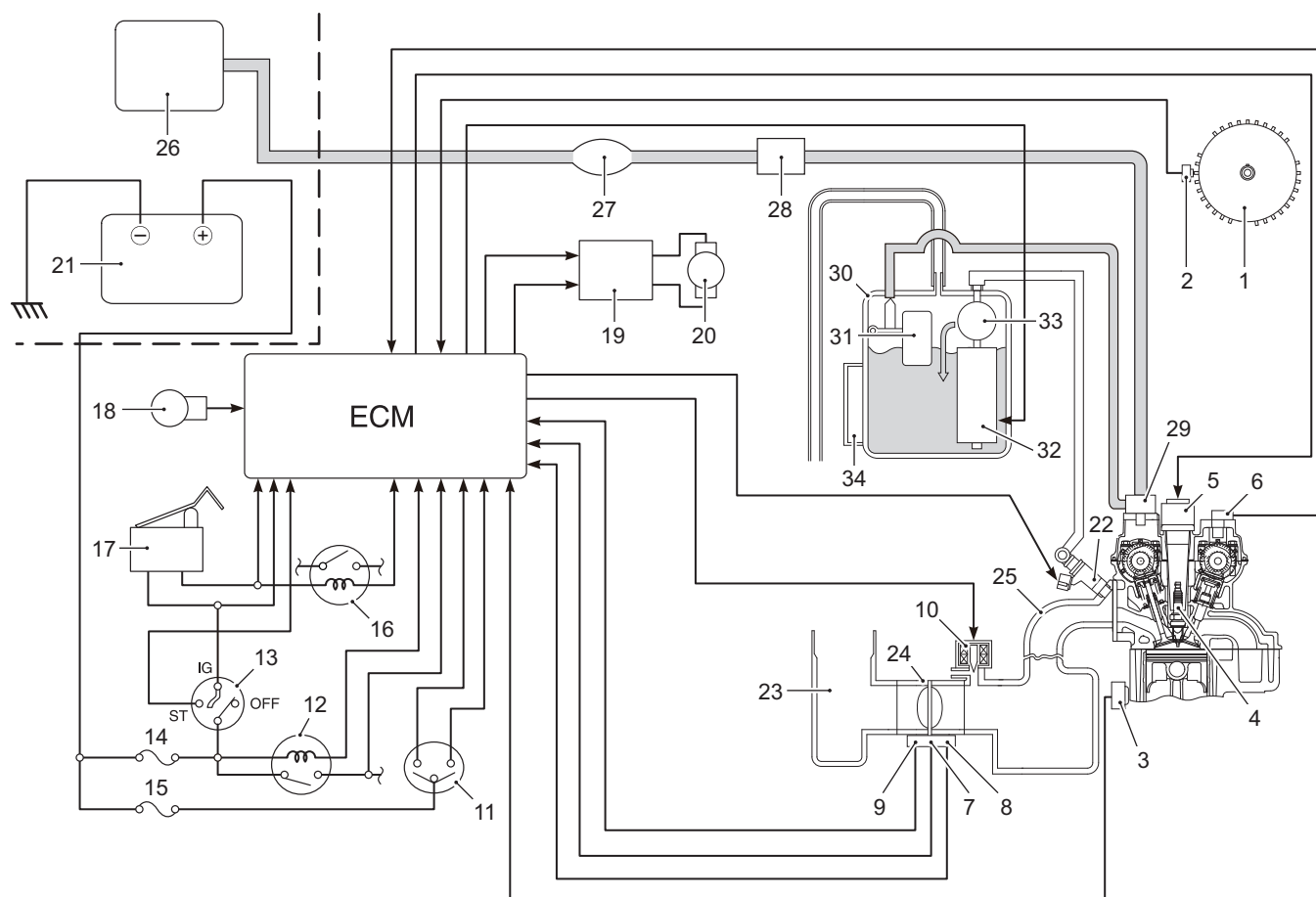


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NOTE

Three sensors (MAP sensor / TPS / IAT sensor) are combined into one unit that is installed on top of the throttle body.

Engine Control System Flow Diagram



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1. Flywheel	10. IAC valve	19. PTT relay	28. Low pressure fuel filter
2. CKP sensor	11. PTT switch	20. PTT motor	29. Low pressure fuel pump
3. Cylinder temp. sensor	12. ECM main relay	21. Battery	30. Fuel vapor separator
4. Spark plug	13. Ignition switch	22. Fuel injector	31. Float
5. Ignition coil	14. Fuse (30 amp.)	23. Air intake silencer	32. High pressure fuel pump
6. CMP sensor	15. Fuse (15 amp.)	24. Throttle body	33. Fuel pressure regulator
7. MAP sensor	16. Starter relay	25. Intake manifold	34. Water jacket
8. Throttle position sensor	17. Neutral switch		
9. IAT sensor	18. Trim/Tilt sensor	27. Fuel primer bulb	

1A-4 Engine Control:

Engine Control Module (ECM)

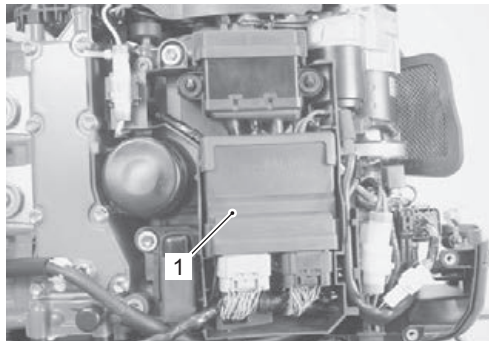
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The ECM sends signals to control the actuators based on the information inputs from each sensor / switch. Major controls are as follows:

Name of Control	Description
Fuel injection control	• Controls fuel injection amount and timing.
Ignition control	• Controls ignition timing.
Idle air control	• Controls idling / trolling speed by adjusting the intake air volume through the IAC valve.
Fuel pump control	• Controls the high pressure fuel pump drive.
Caution system control	• Informs the operator of abnormal engine conditions. • Controls engine speed, if activated.
Self-diagnostic system control	• Informs the operator of sensor / switch malfunction.
Fail-safe system control	• Allows engine operation with a back-up system during sensor / switch malfunction.
Total operating hour indication system control.	• Informs the operator of the total operating time.
Oil changing reminder system control	• Informs the operator that it is time to replace the engine oil, based on the maintenance schedule.
Start-in-gear protection system control	• Prevents engine starting when the shift lever is positioned in forward or reverse.
Starter motor relay control system	• Prevents starter motor operation when the engine is already operating.
Power trim and tilt relay control system	• Controls On / Off for the PTT relay's up and down circuits.

NOTE

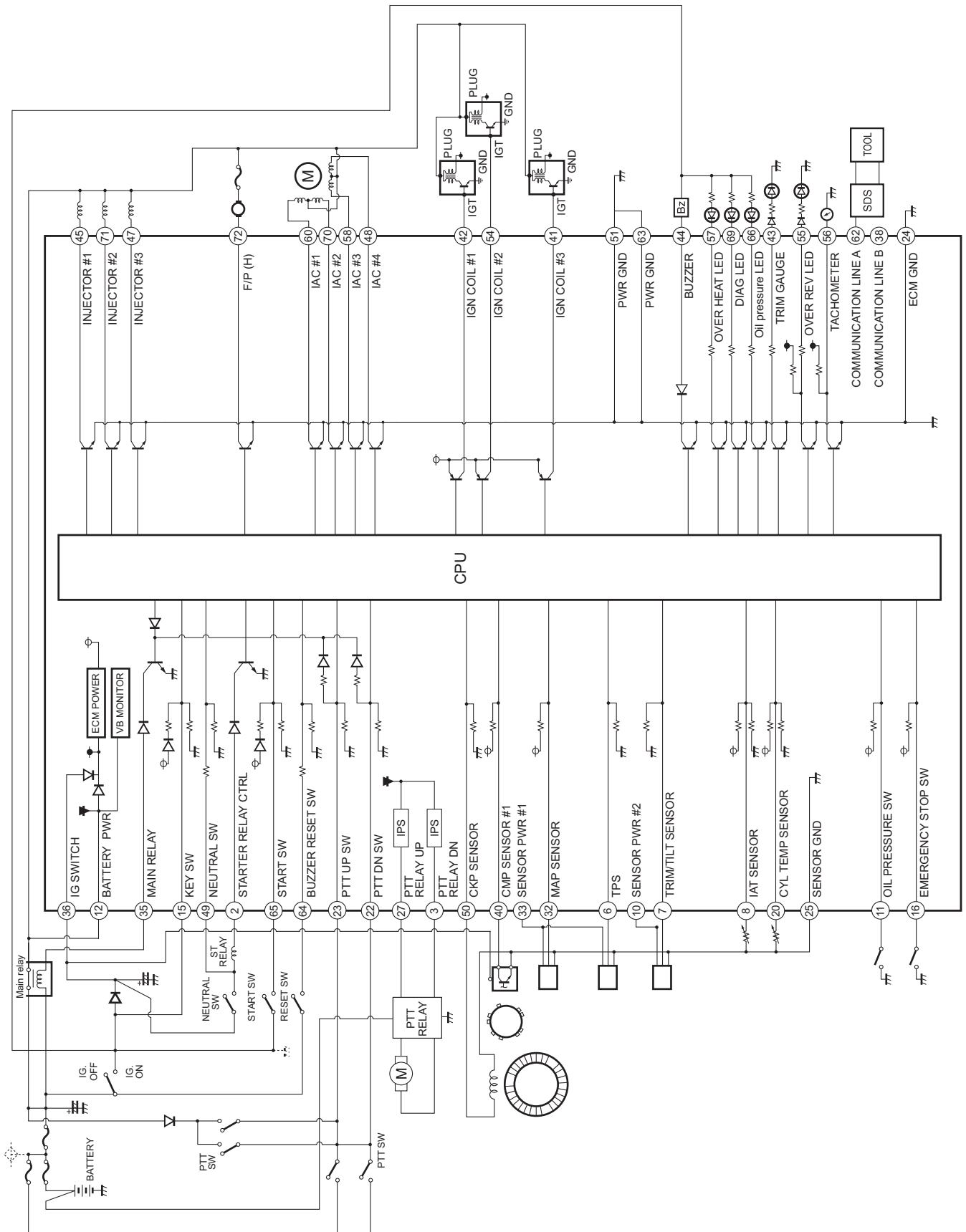
Information related to the Caution System, Self-Diagnostic System, and Total Operating Hours System is retained in the ECM memory.



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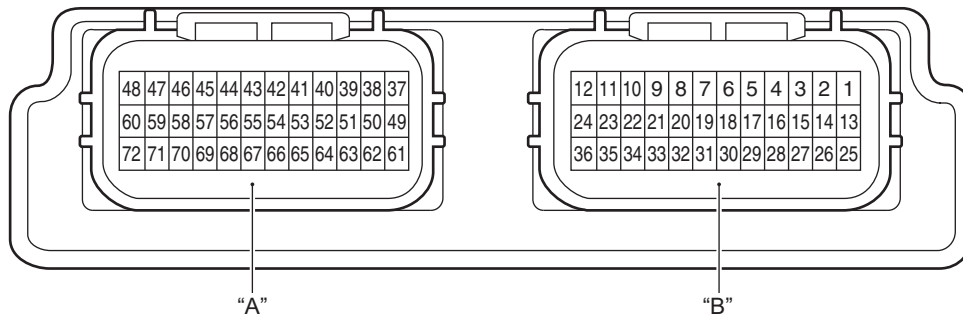
1. ECM

ECM Input / Output Circuit Diagram



1A-6 Engine Control:

ECM Connector / Terminals Layout



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"A": Gray connector	"B": Black connector
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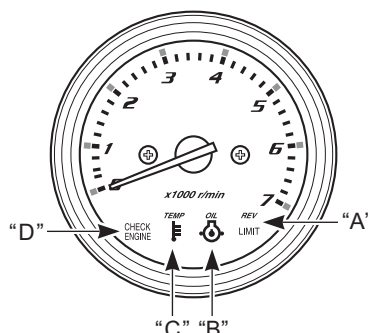
Terminal	Wire Color	Circuit	Terminal	Wire Color	Circuit
1	—	—	37	—	—
2	G	Starter relay control	38	Y	PC communication line (B)
3	P/W	PTT relay DN	39	—	—
4	—	—	40	Y/BI	CMP sensor
5	—	—	41	Gr/Y	No.3 Ignition coil
6	Br/Y	Throttle position sensor	42	O	No.1 Ignition coil
7	W/Y	Trim / Tilt sensor	43	Y	Trim gauge
8	Lg/B	IAT sensor	44	BI/W	Buzzer
9	—	—	45	O/B	No.1 Fuel injector
10	R	Power source for sensor	46	—	—
11	BI	Oil pressure switch	47	R/W	No.3 Fuel injector
12	Gr	Power source for ECM	48	W/BI	IAC valve #4
13	—	—	49	Y/G	Neutral switch
14	—	—	50	R/B	CKP sensor
15	B/G	Ignition key switch	51	B	Ground for power
16	BI/R	Emergency stop switch	52	—	—
17	—	—	53	—	—
18	—	—	54	BI	No.2 Ignition coil
19	—	—	55	P/W	Rev – Limit lamp
20	Lg/W	Cylinder temp. sensor	56	Y/B	Tachometer
21	—	—	57	G/Y	TEMP lamp
22	P	PTT switch "DN"	58	R/G	IAC valve #3
23	LBI	PTT switch "UP"	59	—	—
24	B	Ground for ECM	60	W/B	IAC valve #1
25	B/W	Ground for Sensor	61	—	—
26	—	—	62	O/Y	PC communication line (A)
27	LBI/W	PTT relay UP	63	B	Ground for power
28	—	—	64	O	Buzzer cancel
29	—	—	65	Br	Start switch
30	—	—	66	BI/B	Oil lamp
31	—	—	67	—	—
32	W	MAP sensor	68	—	—
33	R	Power source #1 for sensor	69	G/W	CHECK ENGINE lamp
34	—	—	70	R/Y	IAC valve #2
35	R/B	Ground for ECM main relay	71	B/Br	No.2 Fuel injector
36	B/BI	Ignition switch	72	B/R	High pressure fuel pump (–)

Caution System Description

The following four caution systems alert the operator when an abnormality occurs on the engine.

- OVER-REVOLUTION CAUTION
- LOW OIL PRESSURE CAUTION
- OVERHEAT CAUTION
- LOW BATTERY VOLTAGE CAUTION

Monitor-Tachometer



I9J011110004-02

"A": "REV LIMIT" lamp	"C": "TEMP" lamp
"B": "OIL" lamp	"D": "CHECK ENGINE" lamp

Caution Type	Caution Lamp	Caution Buzzer	Engine RPM Limited
Over-revolution	Yes "A"	No	Yes
Low oil pressure	Yes "B" ("A")	Yes	Yes
Overheat	Yes "C" ("A")	Yes	Yes
Low battery voltage	Yes "D"	Yes	No

NOTE

On TH model:

Caution and diagnostic system operator alert signals are audio only.

Lamp check / Buzzer Check

When the ignition key is turned to the "ON" position:

- Four Caution lamps turns on for two seconds.
- Caution buzzer sounds for two seconds.

Over-Revolution Caution System

Condition:

The ECM controlled over revolution limiter will engage at the engine speeds shown below. Once engaged it will initiate an intermittent fuel injection signal to reduce engine speed.

Over revolution limiter

DF60: 6 400 r/min.

Action:

Engine speed	<ul style="list-style-type: none"> • Automatically reduced to approx. 3 000 r/min. by an intermittent fuel injection signal. • If the operator decreases the engine speed below the over revolution system maximum preset value, within 10 seconds, the over-revolution caution control will be canceled.
Caution lamp	"REV-LIMIT" lamp lights continuously.
Caution buzzer	No buzzer sounds.

Reset:

Close the throttle to reduce the engine speed below approx. 3 000 r/min. for one second.

1A-8 Engine Control:

Low Oil Pressure Caution System

Condition:

Immediate activation of the system when the oil pressure switch is turned "ON" due to an engine oil pressure drop below 100 kPa (1.0 kg/cm², 14 psi.) while the engine is running.

Action:

Engine speed	<ul style="list-style-type: none">Automatically reduced to approx. 1 000 r/min. maximum by an intermittent fuel injection signal.The engine automatically stops 3 minutes after the caution system is activated.
Caution lamp	<ul style="list-style-type: none">"OIL" lamp lights continuously."REV-LIMIT" lamp lights continuously during engine speed rev-limiter activation (1 000 r/min, or higher).
Caution buzzer	<ul style="list-style-type: none">Sounds in a series of long (1.5 sec.) beeps.

NOTE

If the engine is automatically stopped due to the caution system, the engine can be started again. However, the caution system will repeatedly activate until the cause is eliminated.

Reset:

Stop the engine and check the engine oil level. Refill the engine oil to the correct level if it is below the low oil level mark.

If the engine oil level is correct, the following causes may be considered:

- Improper oil viscosity.
- Malfunctioning oil pressure switch.
- Clogged oil strainer or oil filter.
- Worn oil pump relief valve.
- Oil leakage from the oil passage.
- Excessive wear / damage of oil pump.

NOTE

The low oil pressure caution system will reset when the oil pressure is restored to over 100 kPa (1.0 kg/cm², 14 psi.) at approx. 1 000 r/min. or less engine speed operation. The engine must be stopped and checked immediately once the system is activated.

Overheat Caution System

Condition 1 (Maximum temperature)

Immediate activation of the system when:

- Cylinder temperature reaches 100 °C (212 °F)

Condition 2 (Gradient temperature – Temp. rise vs. Time)

Immediate activation of the system when:

- The average temperature difference between three consecutive 10 second measurement periods of the cylinder temperature sensor, at engine speeds of 500 r/min or higher, exceeds the limits as shown below.

Temperature Range	Temperature Difference
78 – 90 °C (172 – 194°F)	Approx. 3 °C (5.4 °F)
90 °C – (194 °F –)	Approx. 0.6 °C (1.2 °F)

Action:

Engine speed	<ul style="list-style-type: none"> Automatically reduced to approx. 3 000 r/min. maximum by intermittent fuel injection and ignition signals. The engine automatically stops 3 minutes after the caution system is activated.
Caution lamp	<ul style="list-style-type: none"> “TEMP” lamp lights continuously. “REV-LIMIT” lamp lights continuously during engine speed rev-limiter activation (3 000 r/min. or higher).
Caution buzzer	<ul style="list-style-type: none"> Sounds in a series of long (1.5 sec.) beeps.

NOTE

If the engine is automatically stopped due to the caution system, the engine can be started again. The caution system will repeatedly activate until the cause is eliminated.

Reset:

Close the throttle completely and then shift into neutral.

System reset will occur when the cylinder temperature drops below the limits shown below. However, the system may be activated again unless the cause for overheat (such as insufficient water) is removed.

Caution Cause	Reset Temperature
Condition 1 (Maximum temperature)	Approx. 78 °C (172 °F)
Condition 2 (Gradient temp. – Temp. rise vs. Time)	Approx. 76 °C (169 °F)

Low Battery Voltage Caution System**Condition 1:**

The system is activated when the battery voltage decreases to less than 9 volts for 30 seconds.

Condition 2:

The system is activated if the battery voltage is less than 2 Volts for more than 2 seconds when the ignition switch is turned “ON” and the engine is not running.

Action:

Engine speed	<ul style="list-style-type: none"> No engine speed limiter is activated.
Caution lamp	<ul style="list-style-type: none"> “CHECK ENGINE” lamp lights continuously.
Caution buzzer	<ul style="list-style-type: none"> Sounds in a series of long (1.5 sec.) beeps.

Reset:**Condition 1:**

The caution system is automatically reset when battery voltage increases to more than 9 volts.

Refrain from using electrical equipment requiring high amperage, such as hydraulic trim tabs, hydraulic jack plate, etc., after this caution is activated.

Condition 2:

For the caution system to engage under this condition, possibilities such as a deteriorated battery, poor battery cable connection, battery switch in the “OFF” position, etc., must be inspected.

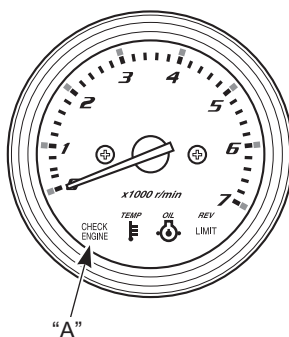
To cancel the caution system activation for these conditions, check all power source related items and eliminate the problem.

Self-Diagnostic System Description

The self-diagnostic system alerts the operator when an abnormality occurs in a signal from a sensor, or switch, etc. When the system is activated, the "CHECK ENGINE" lamp flashes (lights intermittently) according to each code pattern, along with a buzzer sound.

When the engine is running, the buzzer sounds a series of short (0.2 sec.) beeps. When the engine is not running, the buzzer sounds according to each code pattern, but not simultaneously with the flashing lamp. The buzzer sound can be temporally canceled by pushing the ignition key in.

Monitor-Tachometer



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"A": "CHECK ENGINE" lamp

Priority / Code / Pattern for Self-Diagnostic System Operation

0: OFF, 1: ON

Priority	Failed Item	Code	Lamp Flashing Pattern	Fail-Safe System Active
1	MAP sensor 1	3 – 4	 MCODE00D34-0-01	Yes
2	Cylinder temp. sensor	1 – 4	 MCODE00D14-0-01	Yes
3	IAT sensor	2 – 3	 MCODE00D23-0-01	Yes
4	CKP sensor	4 – 2	 MCODE00D42-0-01	No
5	CMP sensor	2 – 4	 MCODE00D24-0-01	No
6	Air intake system	2 – 2	 MCODE00D22-0-01	Yes
7	MAP sensor 2	3 – 2	 MCODE00D32-0-01	No
8	Fuel injector	4 – 3	 MCODE00D43-0-01	No
9	Throttle position sensor	2 – 1	 MCODE00D21-0-01	Yes
10	Rectifier/Regulator (Over-charging)	1 – 1	 MCODE00D11-0-01	No
11	Oil pressure switch	5 – 3	 MCODE00D53-0-01	No
12	Trim sensor	3 – 7	 MCODE00D37-0-01	No

NOTE

- If two or more items fail at once, the self-diagnostic indication appears according to the priority order. The indication repeats three times.
- If the failed item remains, the self-diagnostic indication appears again after turning the ignition switch "ON".
- After correcting the failed item, the self-diagnostic indication appears until the ECM receives the proper signal with the engine running.
- Cancellation of the self-diagnostic indication is automatically performed when the failure is corrected and a normal signal is received by the ECM for a period of 20 – 30 seconds.
- The Rectifier/Regulator self-diagnostic indication may not be displayed when the ignition switch is turned "ON" because the ECM cannot detect rectifier/regulator charging output if the engine is not running.

Under this condition, the buzzer will not sound a 1 – 1 code.

However, if the rectifier/regulator has failed, the self diagnostic indication will appear again after starting the engine.

Condition for Self-Diagnostic System Operation

Failed Item	Condition
MAP sensor 1	<ul style="list-style-type: none"> • No signal (With engine running). • Receiving an out of range "37 – 860 mmHg (1.45 – 33.85 inHg) (0.2 – 4.5 V)" signal (With the engine running.).
Cylinder temp. sensor	<ul style="list-style-type: none"> • No signal. • Receiving an out of range "– 46 to + 170 °C (– 114.8 – +338 °F) (0.10 – 4.6 V)" signal.
IAT sensor	<ul style="list-style-type: none"> • No signal. • Receiving an out of range "– 46 to + 169 °C (– 114.8 – +336.2 °F) (0.10 – 4.6 V)" signal.
CKP sensor	<ul style="list-style-type: none"> • During one crankshaft rotation, 30 signals are not received by the ECM. • During cranking, CMP sensor signal is received by the ECM, but not CKP sensor signal.
CMP sensor	<ul style="list-style-type: none"> • During eight crankshaft rotations, the normal CMP sensor signal pattern is not received by the ECM.
Air intake system	<ul style="list-style-type: none"> • The engine operates at an abnormally high speed when the ECM is receiving a completely closed signal from the throttle position sensor. (Criteria: 2 100 r/min minimum)
MAP sensor 2	<ul style="list-style-type: none"> • From throttle position sensor, the full close signal is inputted, but from the MAP sensor, the signal voltage exceeds 2.4 V.
Fuel injector	<ul style="list-style-type: none"> • No operation signal from the ECM.
Throttle position sensor	<ul style="list-style-type: none"> • No signal. • Receiving an out of range "0.2 – 4.8 V" signal.
Rectifier/Regulator (Over-charging)	<ul style="list-style-type: none"> • Receiving 16 volts or higher signal.
Oil pressure switch	<ul style="list-style-type: none"> • While the engine is stopped and the ignition switch is on, the ECM receives an "off" signal from the oil pressure switch.
Trim sensor	<ul style="list-style-type: none"> • Receiving an out of range "0.2 – 4.8 V" signal.

Fail-Safe System Description

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The fail-safe system is closely related to the self-diagnostic system.
When an abnormality occurs in a sensor signal, the ECM ignores the out-of-range signal and assumes a pre-programmed value for the failed sensors.
This allows the engine to continue running under the fail-safe condition.

Pre-Programmed Value for Fail-Safe System

Failed Item	Pre-Programmed Value
MAP sensor 1	<ul style="list-style-type: none">150 – 758 mmHg / (5.9 – 30 inHg.) (The value will change according to the current engine speed.)
Air intake system	<ul style="list-style-type: none">The control is executed with the maximum engine speed of 2 000 r/min.
Cylinder temp. sensor	60 °C (140 °F)
IAT sensor	45 °C (113 °F)
Throttle position sensor	<ul style="list-style-type: none">The control is executed with the throttle opening at 5 degrees.
Trim sensor	<ul style="list-style-type: none">The control is continued with fixed sensor output as 3.5 V.

NOTE

There is no back-up system for the ECM itself. The engine will stop if it has failed.

Operating Hour Indication System Description

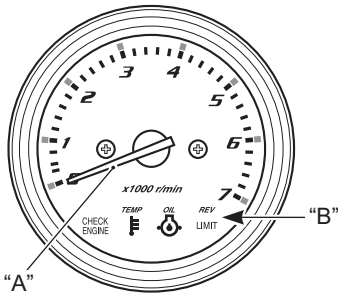
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When the ignition switch is initially turned “ON” (from “OFF”), the ECM tests the caution system by turning on all four lamps in the monitor-tachometer and sounding the caution buzzer for an initial two seconds.
For the next three seconds, the ECM indicates the total operating hours, using a combination of the tachometer needle and “REV-LIMIT” lamp flash.

NOTE

The total operating hours displayed are those of the actual engine operation, not the ignition switch “ON” time.

Monitor-Tachometer



I9J011110006-01

“A”: Needle	“B”: “REV-LIMIT” lamp
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Chart of Total Operating Hours Indication

Total Operating Hours	Monitor-Tachometer	
	Needle "A" Indication	REV-LIMIT Lamp "B" Flashing*
0 h – (49 h)	No	No
50 h	500 r/min.	
60 h	600 r/min.	
↓	↓	
540 h	5 400 r/min.	1 time
550 h	500 r/min.	
560 h	600 r/min.	
↓	↓	
1 040 h	5 400 r/min.	2 times
1 050 h	500 r/min.	
↓	↓	
1 540 h	5 400 r/min.	
1 550 h	500 r/min.	3 times
↓	↓	
2 030 h	5 300 r/min.	
2 040 h or over	5 400 r/min.	

*: One lamp flash corresponds to 500 hours.

Oil Change Reminder System Description

This system informs the operator that it is time to change the ENGINE OIL based on the recommended maintenance schedule.

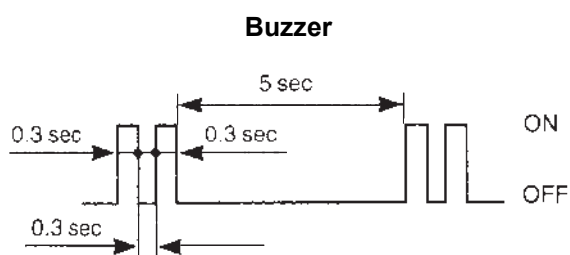
When the total motor operating hours has reached the pre-programmed hours, the “OIL” lamp will flash, and the buzzer will begin a series of double beeps if the engine is not running (but ignition switch is “ON”).

The above mentioned indication will repeat until the activated system is manually canceled.

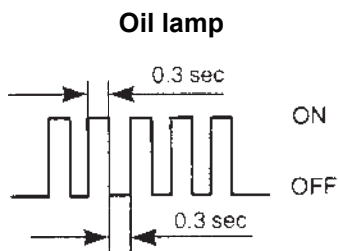
NOTE

This system will activate up to 2 100 hour's operation.

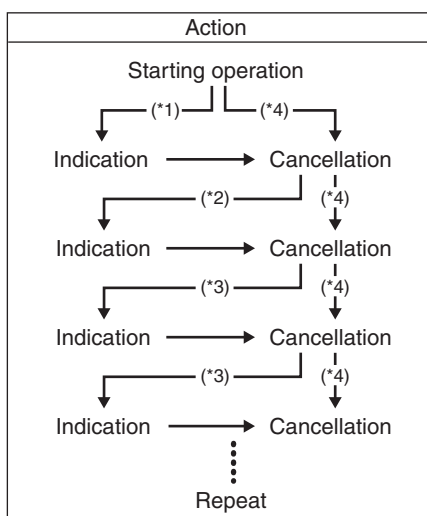
Indication of System Activation



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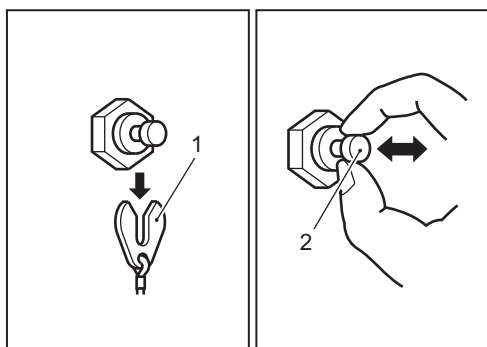
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Cancellation Procedure

- 1) Turn the ignition key to the "ON" position.
- 2) Remove the emergency stop switch plate (1).
- 3) Pull out the emergency stop switch knob (2) three times in ten seconds.
A short beep will be heard if the cancellation is successful.
- 4) Turn the ignition key to the "OFF" position.
- 5) Set the emergency stop switch plate (1) into the original position.



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NOTE

- **Cancellation of the system is possible whether or not the engine oil has been replaced.**
Once the system has been activated, SUZUKI strongly recommends that the engine oil be replaced before canceling the system.
- **If the engine oil has been replaced with the system not activated, it is still necessary to perform the cancellation procedure to reset the Oil Change Reminder System.**

Component Location

Engine Control System Components / Engine Electrical Device Location

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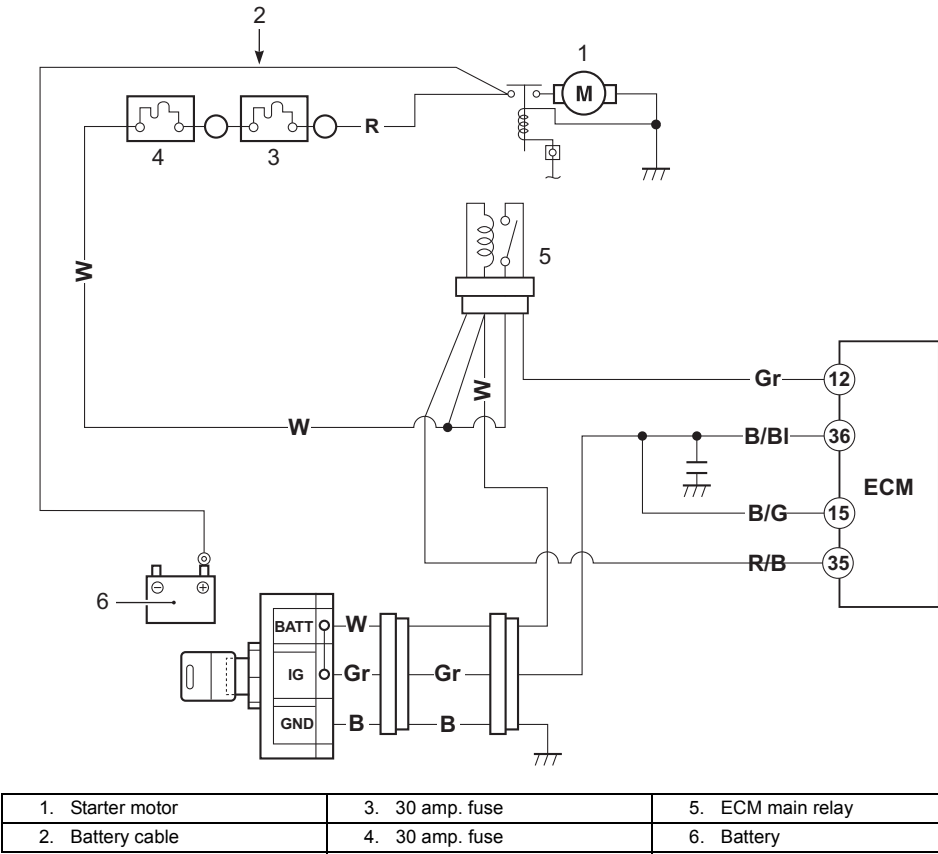
Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-4).

Diagnostic Information and Procedures

ECM Power and Ground Circuit Check

ZAJ6111104001

Wiring Diagram



IAJ611110004-01

Circuit Description

When the ignition switch is turned “ON”, the main relay turns “ON” (the contact point closes) and the main power is supplied to the ECM.

Troubleshooting

Step	Action	Yes	No
1	<i>Is operation of the main relay heard when the ignition switch is turned "ON"?</i>	Go to step 4.	Go to step 2.
2	<i>Are the main fuses (30 amp.), and (for Ignition and ECM) in good condition?</i>	Go to step 3.	Replace.
3	1) Disconnect the ECM connector at the ECM with the ignition switch "OFF". 2) Measure the voltage between the No. 35 terminal of the ECM connector and body ground. <i>Is the voltage 12 V (Battery Voltage)?</i>	Go to step 4.	<ul style="list-style-type: none"> Check the ECM main relay. Refer to "ECM Main Relay Inspection" (Page 1A-35). Poor ECM main relay connection. R/B wire open, shorted or poor connection.
4	1) Turn the ignition switch "OFF". 2) Connect the 36 pin test cord set between the ECM and the main wire harness. 3) Turn the ignition switch "ON". 4) Measure the voltage between the No. 36 terminal and body ground, and the No. 15 terminal and body ground. <i>Is the voltage 12 V (Battery Voltage)?</i>	Go to step 5.	<ul style="list-style-type: none"> Check the ignition switch. Refer to "Ignition Switch Inspection" in Section 1I (Page 1I-16). Gr, B/BI, B/G wire open circuit or poor connection.
5	1) Turn the ignition switch "OFF". 2) Connect the 36 pin test cord set between the ECM and the main wire harness. 3) Turn the ignition switch "ON". 4) Measure the voltage between the No. 35 terminal and body ground. <i>Is the voltage approx. 0.5 V?</i>	Go to step 6.	<ul style="list-style-type: none"> R/B wire open, shorted or poor connection. If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.
6	1) Turn the ignition switch "ON". 2) Measure the voltage between the No. 12 terminal and body ground. <i>Is the voltage 12 V (Battery Voltage)?</i>	ECM power and ground circuit are in good condition.	<ul style="list-style-type: none"> Gr wire open, shorted or poor connection. Faulty ECM main relay.

Troubleshooting with Self-Diagnostic Code

ZAJ6111104002

▲ WARNING

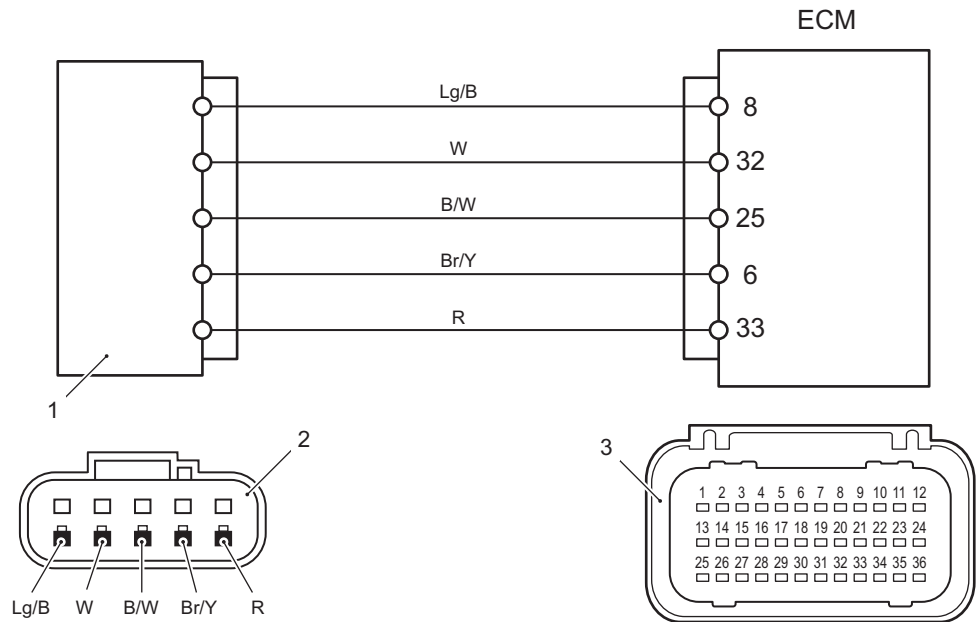
Before troubleshooting, read and follow the "Precautions on Engine Diagnosis" (Page 1A-1).

In this section, troubleshooting procedures are based on the assumption that the "low pressure fuel system" and "mechanical components (power unit, lower unit, etc.)" are normal.

Self-Diagnostic Code “3 – 4” MAP Sensor

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Wiring Diagram



IAJ611110005-02

1. MAP sensor / TPS / IAT sensor	2. Sensor connector (harness side)	3. ECM connector (harness side)
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Troubleshooting

Step	Action	Yes	No
1	1) Turn the ignition switch “OFF”. 2) Check the MAP sensor connector for loose or poor contacts. If OK, then check the MAP sensor lead wire continuity. 3) Disconnect the MAP sensor connector at sensor. 4) Check the continuity between “R” wire terminal and “B/W” wire terminal. <i>Is it no continuity?</i>	Go to step 2.	“R” wire shorted to “B/W” wire.
2	1) With the ignition switch “ON”, check the voltage at the “R” wire terminal of MAP sensor and ground. <i>Is the voltage approx. 4 – 5 V?</i>	Go to step 3.	“R” wire open, “R” wire shorted to ground circuit or poor connection.
3	1) With the ignition switch “OFF”, disconnect ECM connectors from ECM. 2) Check the continuity between “R” terminal of MAP sensor connector and No. 33 terminal of ECM connector. Also check “W” terminal of MAP sensor connector and No. 32 terminal of ECM connector. <i>Is it continuity?</i>	Go to step 4.	<ul style="list-style-type: none">• “R” wire open.• “W” wire open.

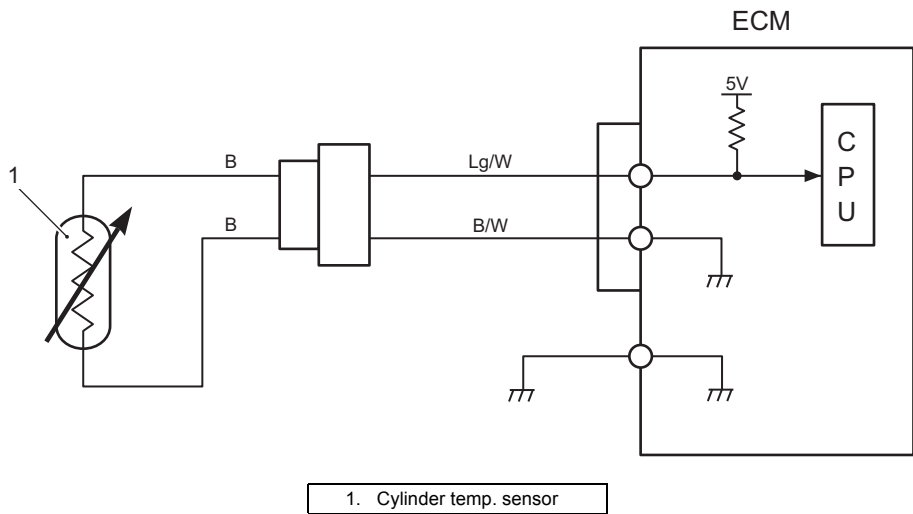
1A-18 Engine Control:

Step	Action	Yes	No
4	<p>1) Check the MAP sensor output voltage change. Refer to "MAP Sensor Output Voltage Inspection" in Section 1C (Page 1C-12).</p> <p><i>Is it in good condition?</i></p>	Substitute a known-good ECM and recheck.	<ul style="list-style-type: none">• Faulty MAP sensor.• "R" wire shorted to "W" wire, "B/W" wire open, poor "B/W" wire connection, poor "W" wire connection, "W" wire open or poor MAP sensor connection.• If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.

Self-Diagnostic Code “1 – 4” Cylinder Temp. Sensor

ZAJ6111104004

Wiring Diagram

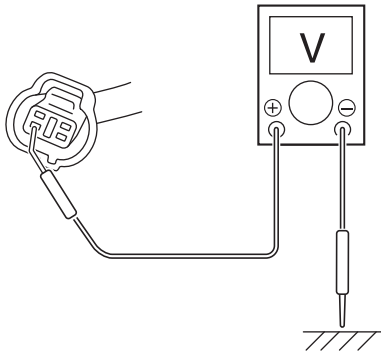


I9J011110021-03

Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the Cylinder Temp. Sensor connector. 2) With the ignition switch “ON”, check the voltage at the “Lg/W” wire terminal of the Cylinder Temp. Sensor connector. <i>Is the voltage 4 V or more?</i>	Go to step 2.	<ul style="list-style-type: none">• “Lg/W” wire shorted to the “B/W” wire or ground circuit.• If the wiring is OK, substitute a known-good ECM and recheck.
2	1) Check the Cylinder Temp. Sensor. Refer to “Cylinder Temp. Sensor Inspection” in Section 1C (Page 1C-8). <i>Is it in good condition?</i>	Poor Cylinder Temp. Sensor connection, intermittent trouble or a faulty ECM may be the cause.	Faulty Cylinder Temp. Sensor.

For step 1

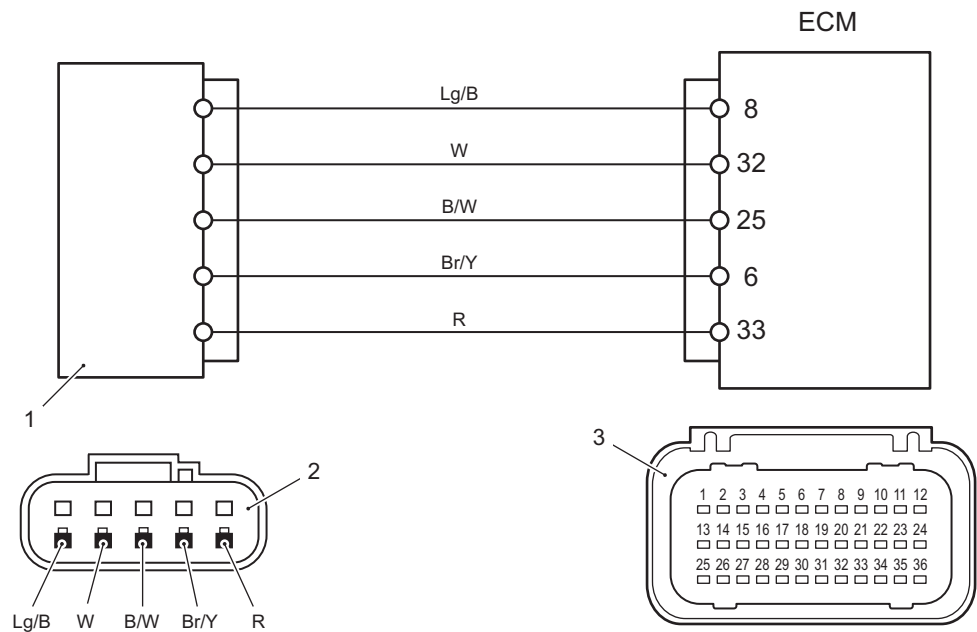


I9J011110045-02

Self-Diagnostic Code “2 – 3” IAT Sensor

ZAJ6111104005

Wiring Diagram



IAJ611110006-01

1. MAP sensor / TPS / IAT sensor	2. Sensor connector (harness side)	3. ECM connector (harness side)
----------------------------------	------------------------------------	---------------------------------

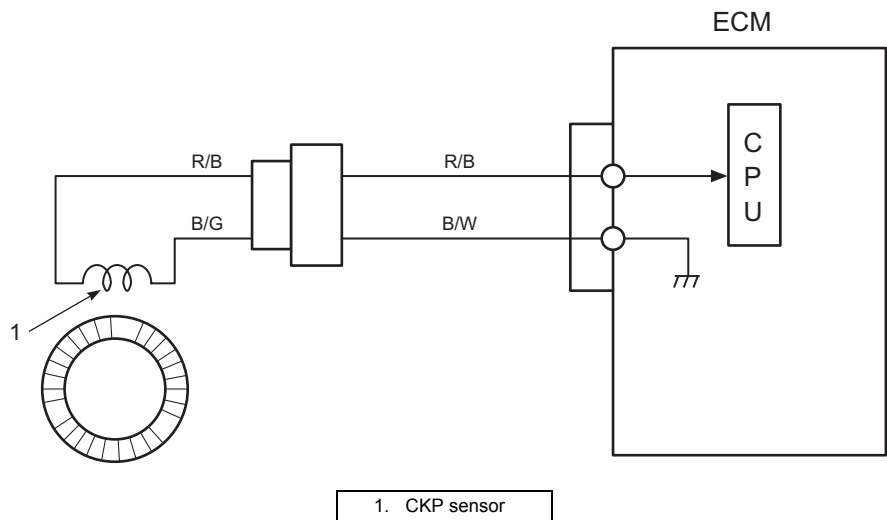
Troubleshooting

Step	Action	Yes	No
1	1) Turn the ignition switch “OFF”. 2) Check the IAT sensor connector for loose or poor contacts. If OK, then check the IAT sensor lead wire continuity. 3) Disconnect the IAT sensor connector at sensor. 4) Check the continuity between “Lg/B” wire terminal and “B/W” wire terminal. <i>Is it no continuity?</i>	Go to step 2.	“Lg/B” wire shorted to “B/W” wire.
2	1) With the ignition switch “OFF”, disconnect the IAT sensor connector. 2) With the ignition switch “ON”, check the voltage at the “Lg/B” wire terminal of the IAT sensor connector. <i>Is the voltage 4 V or more?</i>	Go to step 3.	<ul style="list-style-type: none">• “Lg/B” wire shorted to “B/W” wire or ground circuit.• If the wiring is OK, substitute a known-good ECM and recheck.
3	1) Check the IAT sensor. Refer to “IAT Sensor Inspection” in Section 1C (Page 1C-10). <i>Is it in good condition?</i>	Poor IAT sensor connection, intermittent trouble or a faulty ECM may be cause.	Faulty IAT sensor.

Self-Diagnostic Code “4 – 2” CKP Sensor

ZAJ6111104006

Wiring Diagram



IAJ611110007-01

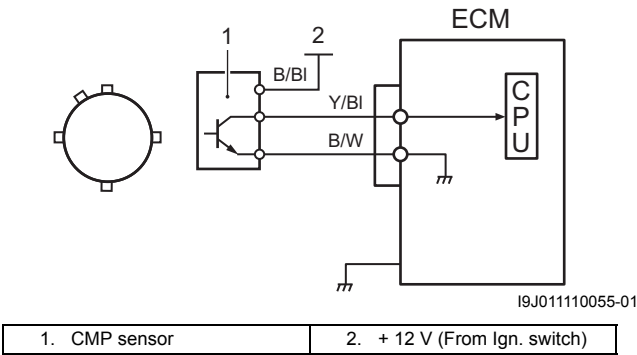
Troubleshooting

Step	Action	Yes	No
1	1) Check the CKP sensor air gap. Refer to “CKP Sensor Removal and Installation” in Section 1C (Page 1C-9). <i>Is it in good condition?</i>	Go to step 2.	Incorrectly adjusted air gap.
2	1) Check the CKP sensor resistance. Refer to “Resistance Check” in Section 1C (Page 1C-7). <i>Is it in good condition?</i>	Open wire between the CKP sensor and the ECM, poor lead wire connection or sensor lead wires are shorted to each other. If lead wire and connection are ok, intermittent trouble or a faulty ECM may be the cause.	Faulty CKP sensor.

Self-Diagnostic Code “2 – 4” CMP Sensor

ZAJ6111104007

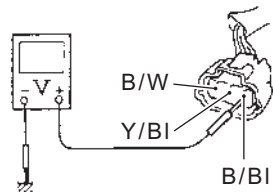
Wiring Diagram



Troubleshooting

Step	Action	Yes	No
1	<i>Is the CMP sensor installed properly and the wire harness connected securely?</i>	Go to step 2.	Correct.
2	1) Disconnect the connector from the CMP sensor. 2) Check for proper connection to the CMP sensor at “B/ BI”, “Y/Bi” and “B/W” wire terminals. 3) If OK, turn the ignition switch “ON” and check the voltage at the “B/Bi”, “Y/Bi” and “B/W” wire terminals of the CMP sensor connector. CMP sensor voltage Terminal “B/Bi”: 10 – 14 V Terminal “Y/Bi”: 4 – 5 V Terminal “B/W”: 0 V <i>Is the voltage satisfactory?</i>	Go to step 5.	Go to step 3.
3	<i>Was terminal “Y/Bi” voltage in step 2 within specification?</i>	Go to step 4.	“Y/Bi” wire open or shorted to ground / power supply circuit. If the wiring and connection is OK, substitute a known-good ECM and recheck.
4	<i>Was terminal “B/Bi” voltage in step 2 within specification?</i>	Go to step 5.	“B/Bi” wire open circuit. If the wiring and connection is OK, substitute a known-good ECM and recheck.
5	Check the CMP sensor and sensor trigger vane. Refer to “CMP Sensor Inspection” in Section 1C (Page 1C-11). <i>Is check result satisfactory?</i>	Substitute a known-good ECM and recheck.	Replace CMP sensor.

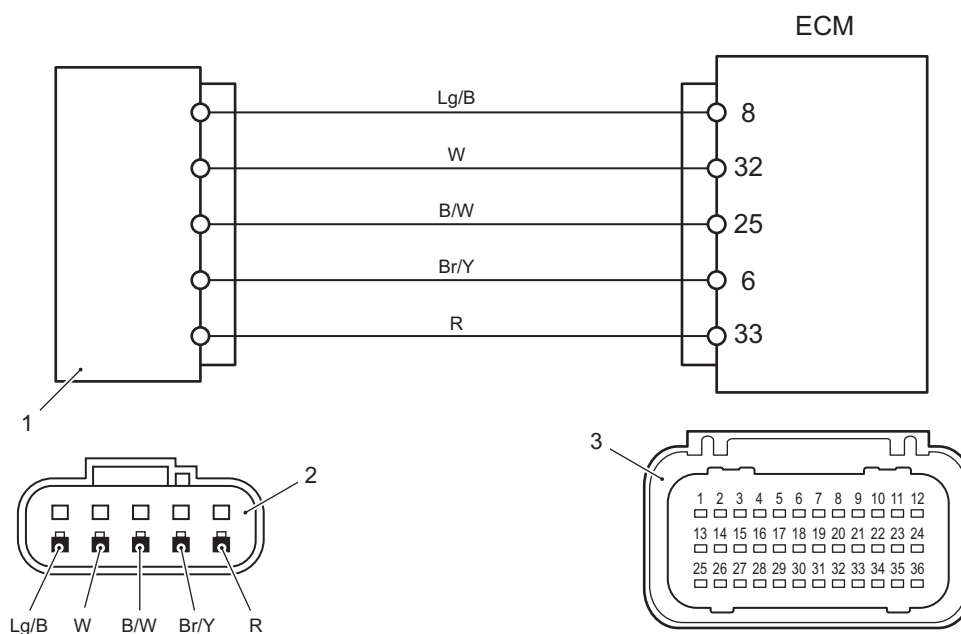
For step 2



I9J011110056-01

Self-Diagnostic Code "2 – 2" Air Intake System

Wiring Diagram



IAJ611110008-01

1. MAP sensor / TPS / IAT sensor	2. Sensor connector (harness side)	3. ECM connector (harness side)
----------------------------------	------------------------------------	---------------------------------

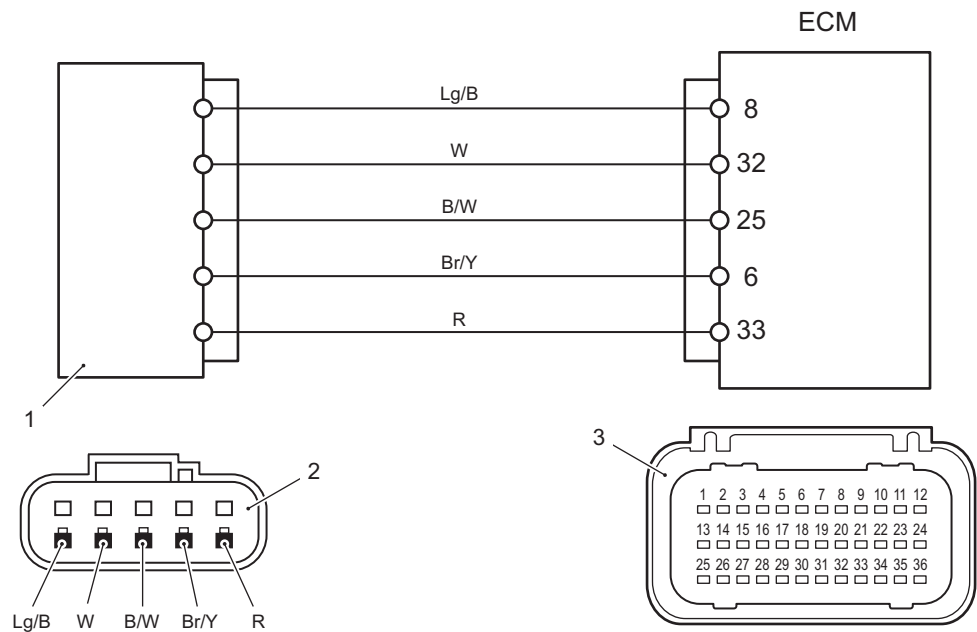
Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch "OFF", disconnect the TPS connector. 2) With the ignition switch "ON", check the voltage at the "R" wire terminal of TPS connector. <i>Is the voltage approx. 4 – 5 V?</i>	Go to step 2.	<ul style="list-style-type: none"> "R" wire open, "R" wire shorted to ground circuit or poor wire connection. If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the TPS output voltage change. Refer to "TPS Inspection" in Section 1C (Page 1C-13). <i>Is it in good condition?</i>	Go to step 3.	<ul style="list-style-type: none"> Faulty TPS. "R" wire shorted to "Br/Y" wire, "B/W" wire open, poor "B/W" wire connection, poor "Br/Y" wire connection, "Br/Y" wire open or poor TPS connection. If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.
3	1) Check the MAP sensor, IAC system and intake manifold (system) for air leakage. <i>Is the result OK?</i>	Intermittent trouble or faulty ECM. Substitute a known-good ECM and recheck.	Faulty air intake system.

Self-Diagnostic Code “3 – 2” MAP Sensor 2

ZAJ6111104009

Wiring Diagram



IAJ611110009-01

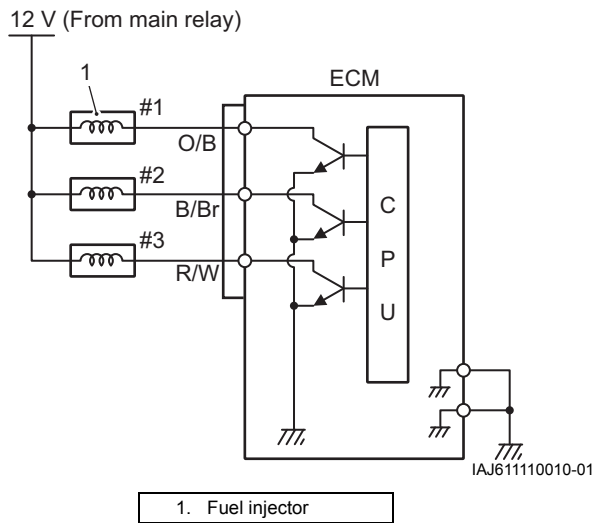
Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch “OFF”, disconnect the MAP sensor connector. 2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of the MAP sensor connector. <i>Is the voltage approx 4 – 5 V?</i>	Go to step 2.	<ul style="list-style-type: none">• “R” wire open, “R” wire shorted to ground circuit or poor wire connection.• If the wiring and connection is OK, substitute a known-good ECM and recheck.
2	1) Check the MAP sensor output voltage change. Refer to “MAP Sensor Output Voltage Inspection” in Section 1C (Page 1C-12). <i>Is it in good condition?</i>	Go to step 3.	Faulty MAP sensor.
3	1) Check the TPS output voltage change. Refer to “TPS Inspection” in Section 1C (Page 1C-13). <i>Is it in good condition?</i>	Intermittent trouble, substitute a known-good ECM and recheck.	<ul style="list-style-type: none">• Faulty TPS.• “R” wire shorted to “Br/Y” wire, “B/W” wire open, poor “B/W” wire connection, poor “Br/Y” wire connection, “Br/Y” wire open or poor TPS connection.• If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.

Self-Diagnostic Code “4 – 3” Fuel Injector

ZAJ6111104011

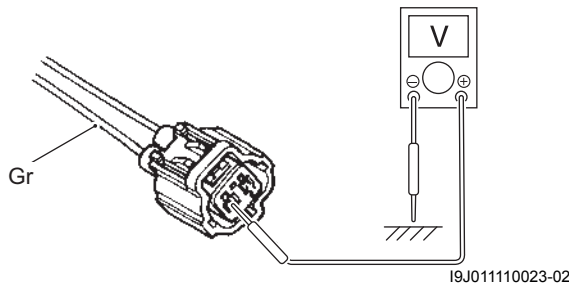
Wiring Diagram



Troubleshooting

Step	Action	Yes	No
1	1) Using a sound scope, check that each injector has an operating sound when the engine is cranking. <i>Do all injectors make an operating sound?</i>	Fuel injector and its circuit are in good condition.	Go to step 2.
2	1) Check the fuel injector, the wiring connection and the wire harness of the fuel injector not making the operating sound. <i>Are all of the above OK?</i>	Substitute a known-good ECM and recheck.	Faulty injector or its circuit.
3	1) With the ignition switch “OFF”, disconnect the connector from the fuel injector. 2) Check the voltage at “Gr” wire terminal with the ignition switch “ON”. <i>Is the voltage 12 V (battery voltage)?</i>	Go to step 4.	Power circuit open.
4	1) Disconnect the ECM connector with the ignition switch “OFF”, and check all of the injectors for resistance. Refer to “Resistance Check” in Section 1C (Page 1C-7). <i>Is the resistance 10 – 14 Ω for each injector?</i>	Substitute a known-good ECM and recheck.	Faulty injector or its circuit.

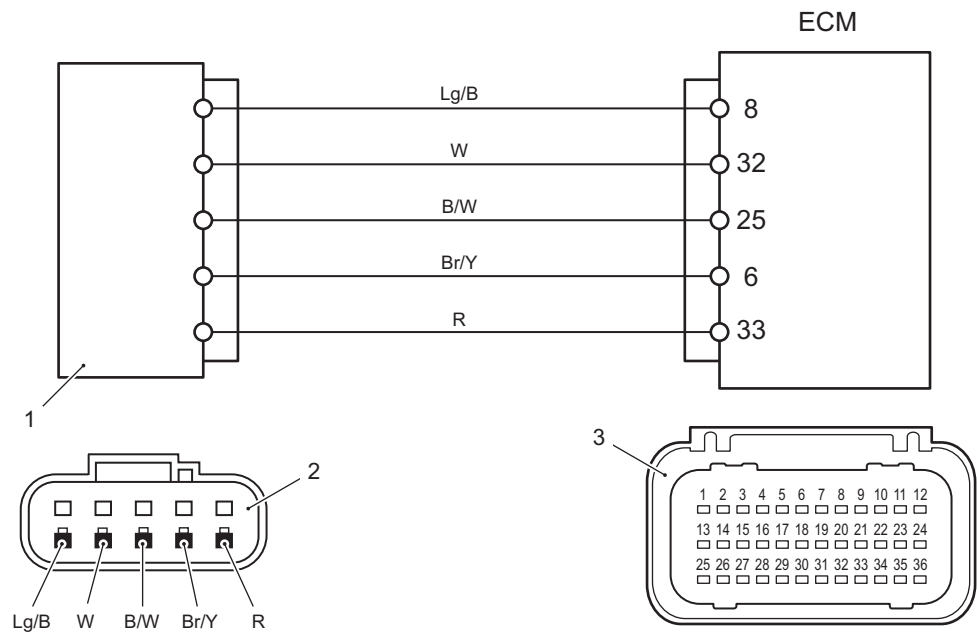
For step 3



Self-Diagnostic Code “2 – 1” TPS (Throttle Position Sensor)

ZAJ6111104012

Wiring Diagram



IAJ611110011-01

1. MAP sensor / TPS / IAT sensor	2. Sensor connector (harness side)	3. ECM connector (harness side)
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Troubleshooting

Step	Action	Yes	No
1	1) Turn the ignition switch "OFF". 2) Check the TPS connector for loose or poor contacts. If OK, then check the TPS lead wire continuity. 3) Disconnect the TPS connector at sensor. 4) Check the continuity between "Br/Y" wire terminal and "R" wire terminal. <i>Is it no continuity?</i>	Go to step 2.	"R" wire shorted to "Br/Y" wire.
2	1) With the ignition switch "ON", check the voltage at the "R" wire terminal of TPS and ground. <i>Is the voltage approx. 4 – 5 V?</i>	Go to step 3.	"R" wire open, "R" wire shorted to ground circuit or poor connection.
3	1) With the ignition switch "OFF", disconnect ECM connectors from ECM. 2) Check the continuity between "Br/Y" terminal of TPS connector and No. 6 terminal of ECM connector. Also check "B/W" terminal of TPS connector and No. 25 terminal of ECM connector. <i>Is it continuity?</i>	Go to step 4.	<ul style="list-style-type: none">"B/W" wire open."Br/Y" wire open.

Step	Action	Yes	No
4	<p>1) Check the TPS output voltage change. Refer to "TPS Inspection" in Section 1C (Page 1C-13).</p> <p><i>Is it in good condition?</i></p>	Substitute a known-good ECM and recheck.	<ul style="list-style-type: none">Faulty TPS."R" wire shorted to "Br/Y" wire, "B/W" wire open, poor "B/W" wire connection, poor "Br/Y" wire connection, "Br/Y" wire open or poor TPS connection.If the wiring and connection is OK, intermittent trouble or a faulty ECM may be the cause.

Self-Diagnostic Code "1 – 1" Rectifier/Regulator (Over Charging)

ZAJ6111104015

NOTE

- This self-diagnostic code indication may be canceled when turning the ignition switch "ON" (engine not running), because ECM detects battery voltage.
- It is difficult to thoroughly check the rectifier/regulator. Before replacing it with new one, check that the ground point has good electrical contact.

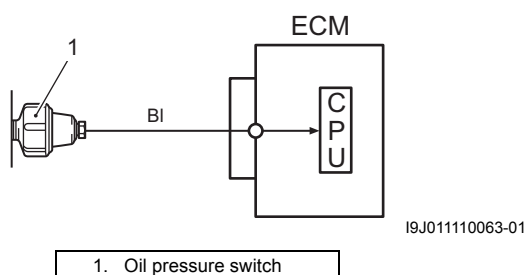
Troubleshooting

Step	Action	Yes	No
1	1) Check the Rectifier/Regulator resistance. Refer to "Rectifier/Regulator Inspection" in Section 1K (Page 1K-7). <i>Is the result OK?</i>	Go to step 2.	Faulty Rectifier/Regulator.
2	1) With the engine running, check charging voltage at idle speed. <i>Is the result 16 V or higher?</i>	Faulty Rectifier/Regulator.	Faulty ECM or wire continuity / connection failure.

Self-Diagnostic Code "5 – 3" Oil Pressure Switch

ZAJ6111104016

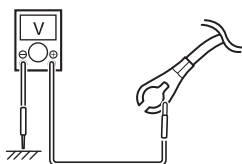
Wiring Diagram



Troubleshooting

Step	Action	Yes	No
1	1) With the ignition switch "OFF", remove the oil pressure switch wire. 2) With the ignition switch "ON", check the voltage between the oil pressure switch wire terminal and body ground. <i>Is the voltage approx. 5 V?</i>	Go to step 2.	<ul style="list-style-type: none"> • Oil pressure switch wire open or poor connection. • If wire and connection are OK, substitute a known-good ECM and recheck.
2	1) Check the oil pressure switch operation. Refer to "Oil Pressure Switch Inspection" in Section 1E (Page 1E-6). <i>Is it in good condition?</i>	Poor oil pressure switch wire connection, intermittent trouble or a faulty ECM may be the cause.	Faulty oil pressure switch.

For step 1

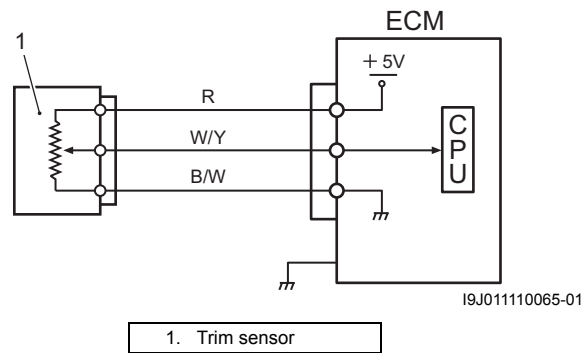


19J011110064-01

Self-Diagnostic Code “3 – 7” Trim Sensor

ZAJ6111104017

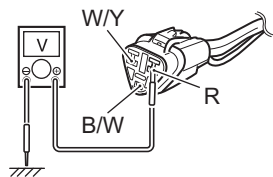
Wiring Diagram



Troubleshooting

Step	Action	Yes	No
1	<p>1) With the ignition switch “OFF”, disconnect trim sensor connector.</p> <p>2) With the ignition switch “ON”, check the voltage at the “R” wire terminal of trim sensor connector.</p> <p><i>Is the voltage approx. 4 – 5 V?</i></p>	Go to step 2.	<ul style="list-style-type: none">• “R” wire open, “R” wire shorted to ground circuit or poor wire connection.• If the wire and connection is OK, substitute a known-good ECM and recheck.
2	<p>1) Check the trim sensor output voltage change. Refer to “Trim Sensor Inspection” in Section 1C (Page 1C-14).</p> <p><i>Is it in good condition?</i></p>	Poor trim sensor connection, intermittent trouble or a faulty ECM.	<ul style="list-style-type: none">• “R” wire shorted to “W/Y” wire, “B/W” wire open, poor “B/W” wire connection, poor “W/Y” wire connection, “W/Y” wire open or poor trim sensor connection.• If the wire and connection is OK, intermittent trouble or a faulty ECM may be the cause.• Faulty trim sensor.

For step 1



Troubleshooting Without Self-Diagnostic Code

ZAJ6111104018

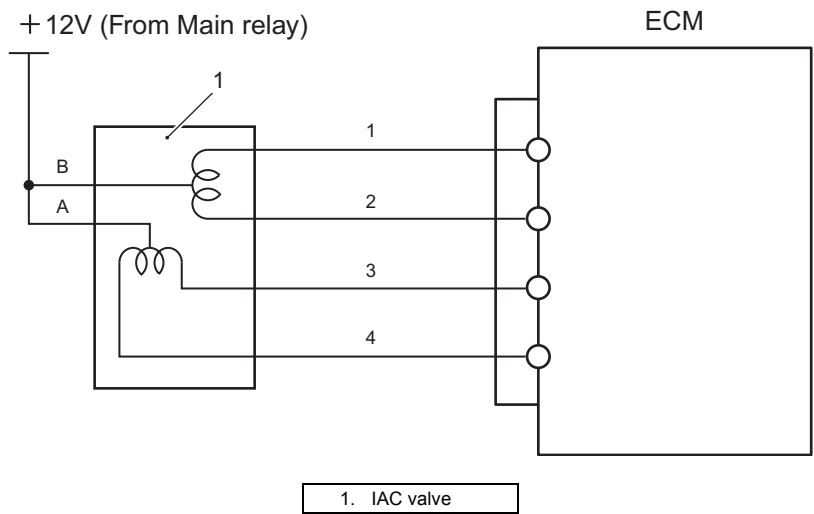
Before troubleshooting, make sure that there is not a self-diagnostic code indication.

Condition	Possible cause	Correction / Reference Item
<i>Unstable idling / trolling (or engine tends to stall)</i>	Clogged MAP sensor vacuum passage.	<i>Check the vacuum passage.</i>
	Malfunctioning TPS.	<i>Check the TPS sensor.</i>
	Faulty IAC system.	<i>Check the IAC system.</i>
	Fuel pressure out of specification.	<i>Check the fuel pressure.</i>
	Faulty injector or its circuit.	<i>Check the injector and its circuit.</i>
	Poor performance of the IAT sensor, TPS or MAP sensor.	<i>Check each sensor.</i>
	Faulty ECM.	<i>Replace.</i>
	Faulty spark plug.	<i>Replace.</i>
	Faulty ignition coil or its circuit.	<i>Check the ignition coil and its circuit.</i>

IAC System Troubleshooting

Wiring Diagram

ZAJ6111104019

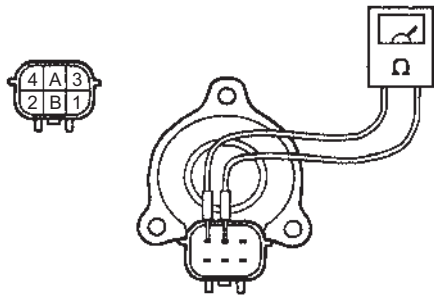


I9J011110036-02

Troubleshooting

Step	Action	Yes	No
1	<p>1) Warm up the engine to normal operating temperature and keep it idling.</p> <p>2) Using the SDS tool, check the IAC duty cycle and idle speed.</p> <p>Idle speed (IAC duty cycle): 750 – 850 r/min (approx. 0 – 30%)</p> <p><i>Is result OK?</i></p>	<p>IAC system is in good condition.</p>	<p>Go to step 2.</p>
2	<p>1) Disconnect the IAC connector at the IAC valve with ignition switch "OFF".</p> <p>2) Check the resistance between following terminals.</p> <p>/ IAC "1" terminal – "B" terminal</p> <p>/ IAC "2" terminal – "B" terminal</p> <p>/ IAC "3" terminal – "A" terminal</p> <p>/ IAC "4" terminal – "A" terminal</p> <p><i>Is the resistance 25 – 34 Ω for each test?</i></p>	<p>Proceed to "Unstable Idling / Trolling" in "Troubleshooting Without Self-Diagnostic Code" (Page 1A-30) and check items except for "Faulty IAC System".</p>	<ul style="list-style-type: none">Faulty IAC valve.Poor connection.Open wire harness.

For step 2



I9J011110041-01

Service Instructions


How to Use the 36 Pin Test Cord Set

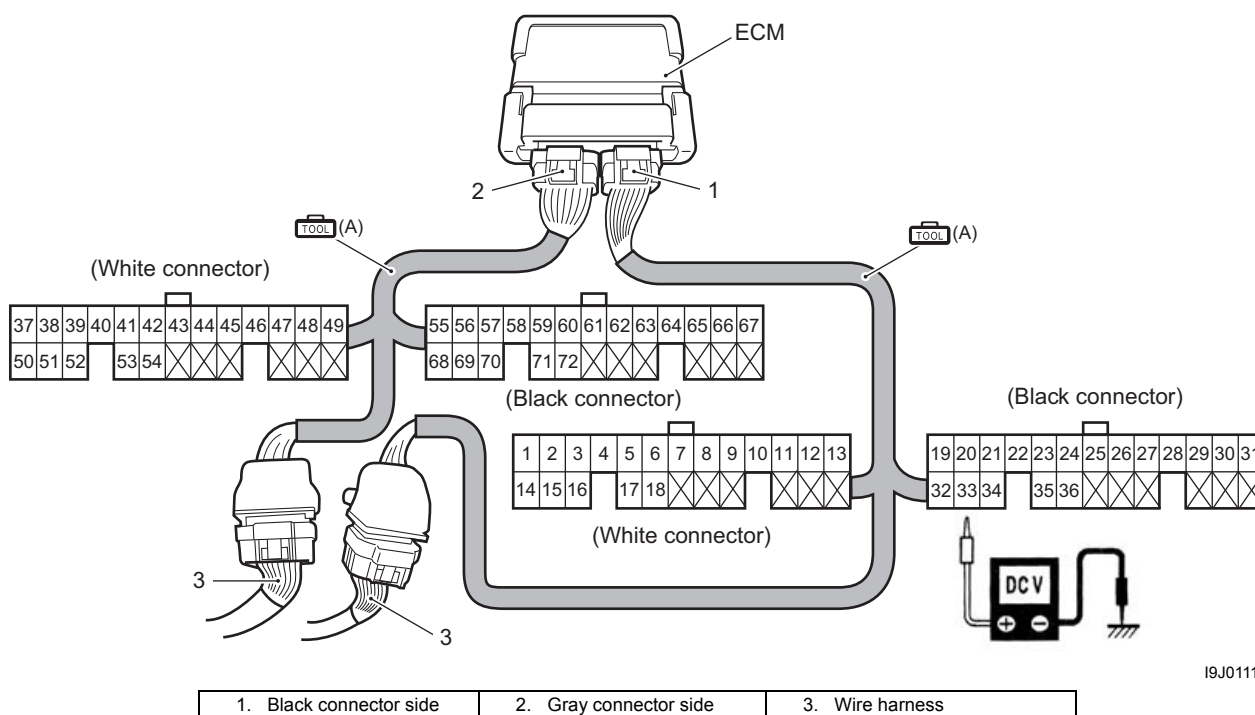
ZAJ6111106001

This test cord is used when checking a circuit for voltage, etc. and is connected between the ECM and the wiring harness.

To take a measurement, connect the tester probe to the relevant terminal of the test cord.

Special tool

 (A): 09930-88730 (36-pin test cord set)



I9J011110037-02


Inspection of the ECM and Its Circuit


ZAJ6111106002

CAUTION

The ECM cannot be bench checked. It is strictly prohibited to connect any tester (voltmeter or ohmmeter) to an ECM which has been disconnected from the engine wiring harness.

Special tool

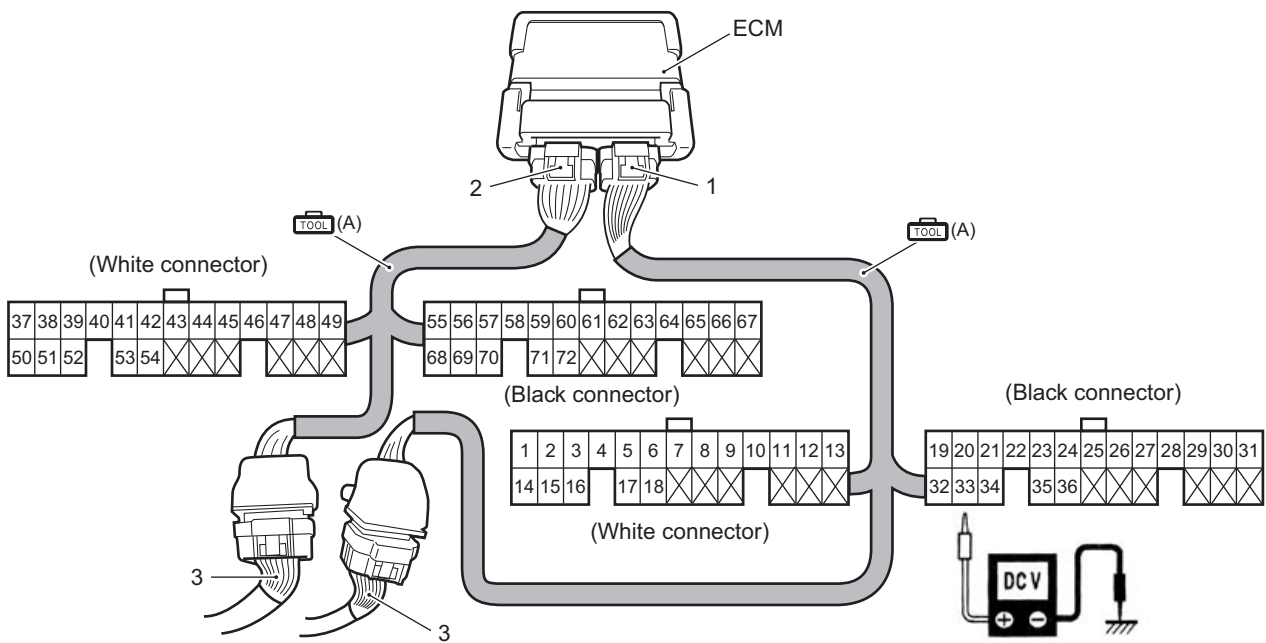
 : 09930-88730 (36-pin test cord set)

 : 09930-99320 (Digital tester)

Tester knob indication

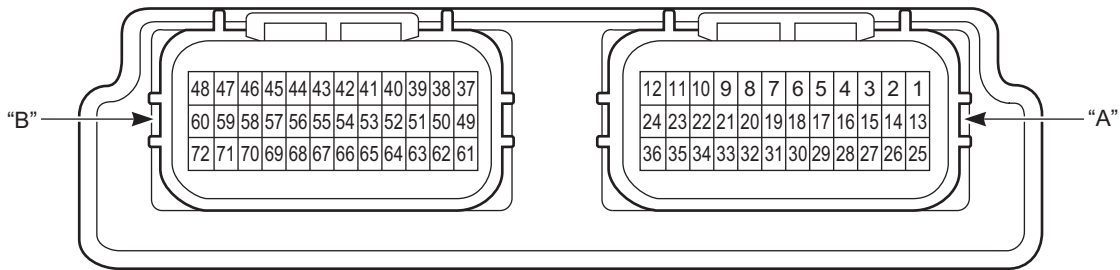
Voltage (---)

- 1) Turn the ignition switch "OFF".
- 2) Connect the 36-pin test cord set between the ECM and wire harness as shown in figure.
- 3) Turn the ignition switch "ON".
- 4) Connect the tester probe ("—", Black) to body ground, and measure the voltage according to the "Circuit Voltage Table" (Page 1A-33).



I9J011110037-02

Circuit Voltage Table



I9J011110017-02

Terminal	Wire color	Circuit	Standard Voltage	Condition / Remarks
1	—	—	—	—
2	G	Starter relay control	Approx. 0.5 V	Ignition switch ON, Cranking.
			Approx. 12 V	Ignition switch ON, Normal.
3	P/W	PTT relay DN	Approx. 0 V	PTT switch DN, free.
			Approx. 12 V	PTT switch DN, Push.
4	—	—	—	—
5	—	—	—	—
6	Br/Y	Throttle position sensor	Approx. 3.8 V	Ignition switch ON, Throttle WOT.
			Approx. 0.7 V	Ignition switch ON, Throttle FCT.
7	W/Y	Trim and Tilt sensor	Approx. 0.9 – 4.0 V	Ignition switch ON.
8	Lg/B	IAT sensor	0.04 – 4.46 V	Ignition switch ON.
9	—	—	—	—
10	R	Power source #2 for sensor	Approx. 5 V	Ignition switch ON.
11	Bl	Oil pressure switch	Approx. 5 V	While engine running.
			Approx. 0 V	Engine stopped (Ignition switch ON.)
12	Gr	ECM power source	Approx. 12 V	Ignition switch ON.
13	—	—	—	—
14	—	—	—	—
15	B/G	Ignition switch key	Approx. 12 V	Ignition switch ON.

1A-34 Engine Control:

Terminal	Wire color	Circuit	Standard Voltage	Condition / Remarks
16	Bl/R	Emergency stop switch	Approx. 5 V	Ignition switch ON, Stop switch plate IN.
			Approx. 0 V	Ignition switch ON, Stop switch plate OUT.
17	—	—	—	—
18	—	—	—	—
19	—	—	—	—
20	Lg/W	Cylinder temp. sensor	0.14 – 4.75 V	Ignition switch ON.
21	—	—	—	—
22	P	PTT switch DOWN	Approx. 12 V	Ignition switch ON, PTT DN switch ON.
			Approx. 0 V	Ignition switch ON, PTT DN switch OFF.
23	Lbl	PTT switch UP	Approx. 12 V	Ignition switch ON, PTT UP switch ON.
			Approx. 0 V	Ignition switch ON, PTT UP switch OFF.
24	B	Ground for ECM	—	—
25	B/W	Ground for sensor	—	—
26	—	—	—	—
27	LBl/W	PTT relay UP	Approx. 0 V	PTT switch UP free.
			Approx. 12 V	PTT switch UP Push.
28	—	—	—	—
29	—	—	—	—
30	—	—	—	—
31	—	—	—	—
32	W	MAP sensor	0.79 – 4.2 V	Ignition switch ON.
33	R	Power source #1 for sensor	Approx. 5 V	Ignition switch ON.
34	—	—	—	—
35	R/B	Ground for ECM main relay	Approx. 12 V	Ignition switch OFF.
			Approx. 0.5 V	<ul style="list-style-type: none"> • Ignition switch ON. • Engine cranking.
36	B/Bl	Ignition switch	Approx. 12 V	Ignition switch ON.
37	—	—	—	—
38	Y	PC communication line (B)	—	—
39	—	—	—	—
40	Y/Bl	CMP sensor	Approx. 0.3 V or 5 V	Ignition switch ON.
41	Gr/Y	No.3 Ignition coil (–)	Approx. 0 V	Ignition switch ON.
42	O	No.1 Ignition coil (–)	Approx. 0 V	Ignition switch ON.
43	Y	Trim gauge	—	—
44	Bl/W	Buzzer	—	—
45	O/B	No.1 Fuel injector (–)	Approx. 12 V	Ignition switch ON.
46	—	—	—	—
47	R/W	No.3 Fuel injector (–)	Approx. 12 V	Ignition switch ON.
48	W/Bl	IAC valve #4	Approx. 12 V or 0 V	Ignition switch ON.
49	Y/G	Neutral switch	Approx. 12 V	Ignition switch ON, Shift into Neutral.
			Approx. 0 V	Ignition switch ON, Shift into Forward or Reverse.
50	R/B	CKP sensor	—	—
51	B	Ground for ECM power	—	—
52	—	—	—	—
53	—	—	—	—
54	Bl	No.2 Ignition coil (–)	Approx. 0 V	Ignition switch ON.
55	P/W	REV-LIMIT lamp	—	—
56	Y/B	Tachometer	—	—
57	G/Y	TEMP lamp	—	—
58	R/G	IAC valve #3	Approx. 12 V or 0 V	Ignition switch ON.
59	—	—	—	—
60	W/B	IAC valve #1	Approx. 12 V or 0 V	Ignition switch ON.
61	—	—	—	—
62	O/Y	PC communication line (A)	—	—
63	B	Ground for power	—	—
64	O	Buzzer cancel	Approx. 12 V	Ignition switch ON. Key pushed in.
			Approx. 0 V	Ignition switch ON. Key not pushed in.

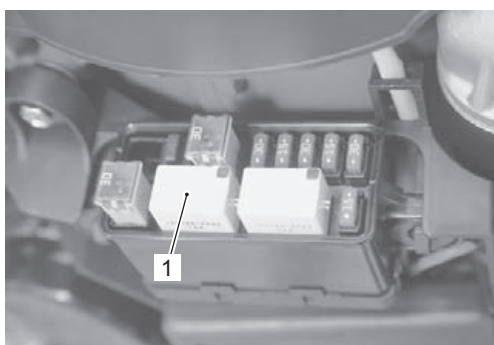
Terminal	Wire color	Circuit	Standard Voltage	Condition / Remarks
65	Br	Starter switch	Approx. 2.5 V	Ignition switch ON.
			Approx. 12 V	Ignition switch START position.
66	Bl/B	OIL lamp	—	—
67	—	—	—	—
68	—	—	—	—
69	G/W	CHECK ENGINE lamp	—	—
70	R/Y	IAC Valve #2	Approx. 12 V or 0 V	Ignition switch ON.
71	B/Br	No.2 Fuel injector (—)	Approx. 12 V	Ignition switch ON.
72	B/R	High pressure fuel pump (—)	Approx. 0 V	<ul style="list-style-type: none"> Stop switch plate IN, Shift into NEUTRAL. For 3 sec after ignition switch ON. While engine running.
			Approx. 12 V	Engine stopped. Ignition switch ON. Stop switch plate IN, Shift into NEUTRAL.

ECM Main Relay Inspection

ZAJ6111106003

Inspect the ECM main relay using the following procedures:

- 1) Disconnect the ECM main relay from the fuse box.



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1. ECM main relay

- 2) Check continuity between terminal (2) and (3) each time 12 V power supply is applied to terminal (4) and (5).

Connect the positive (+) lead to terminal (5), and negative (—) lead to terminal (4).

CAUTION

Be careful not to touch 12 V power supply wires to each other or with other terminals.

Special tool

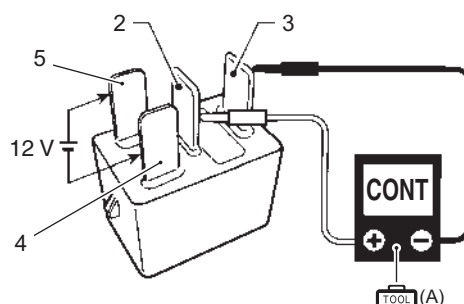
(A): 09930–99320 (Digital tester)

Tester knob indication

Continuity ()

ECM main relay function

	Continuity
12 V power applied	Yes
12 V power not applied	No



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- 3) Measure the resistance between relay terminals (4) and (5).

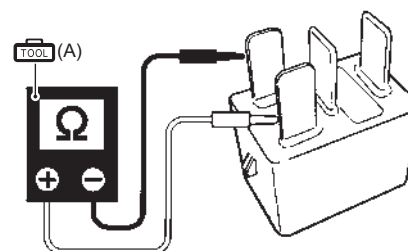
If out of specification, replace ECM main relay.

Tester knob indication

Resistance (Ω)

ECM Main relay solenoid coil resistance

Standard: 145 – 190 Ω



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