# Engine Control

## Precautions

### Precautions on Engine Control Diagnosis

CENDK1111100001

**⚠ WARNING**

**Service operation of any type performed on engine control system involves a risk of fire and personal injury if proper precaution are not taken.**
**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-14).**
  - **Disconnect the high pressure fuel pump wire connector located on the high pressure fuel pump.**

**⚠ CAUTION**

**If you do not disconnect the battery before disconnecting or connecting the wiring harness you could get an electrical shock.**

- **Always turn the ignition switch "OFF" and disconnect the battery cables when wires are being disconnected or connected.**

***NOTICE***

**Failure to take proper precaution when disconnecting the harness connector can cause damage to the wiring harness.**

**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.**

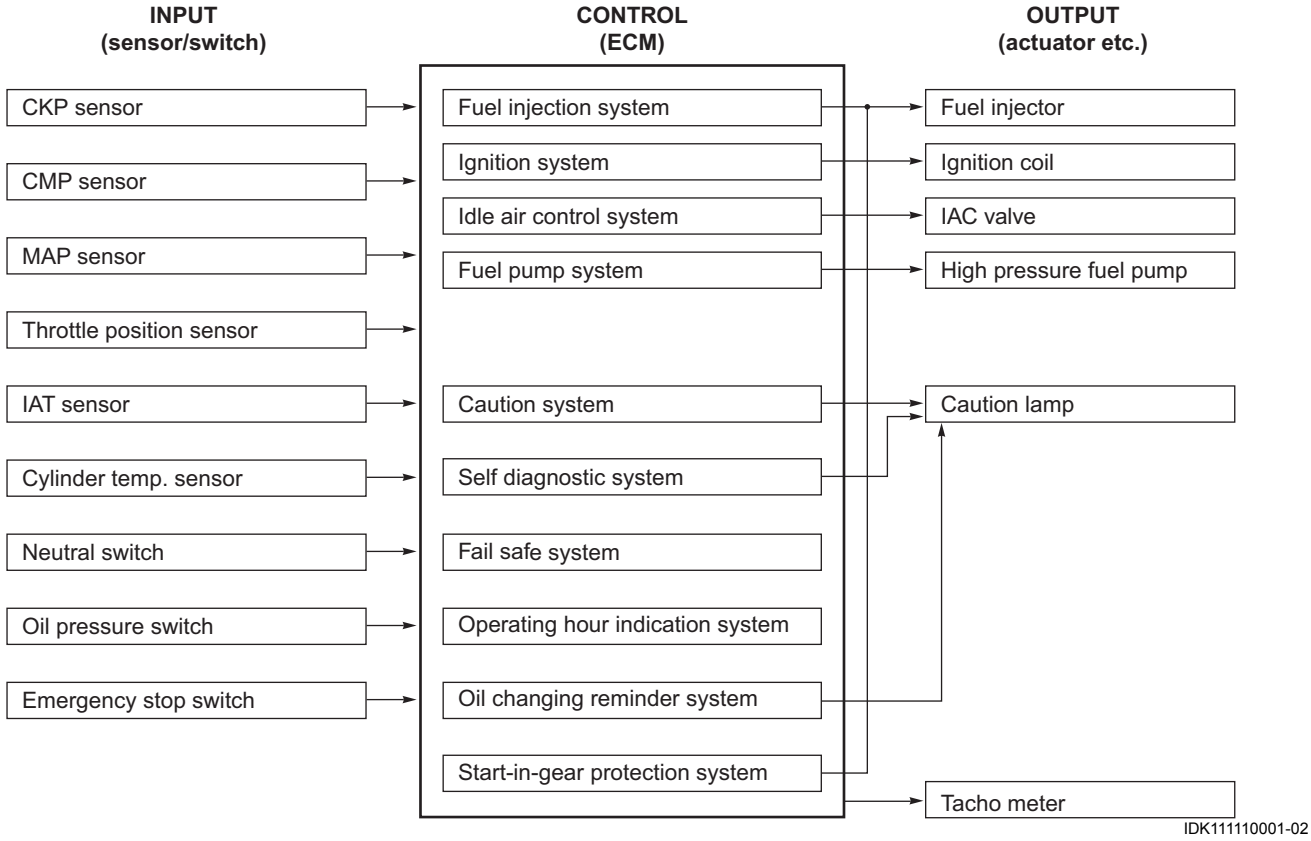
# General Description

## Engine Control System Description

CENDK1111101001

The DF15A/20A models 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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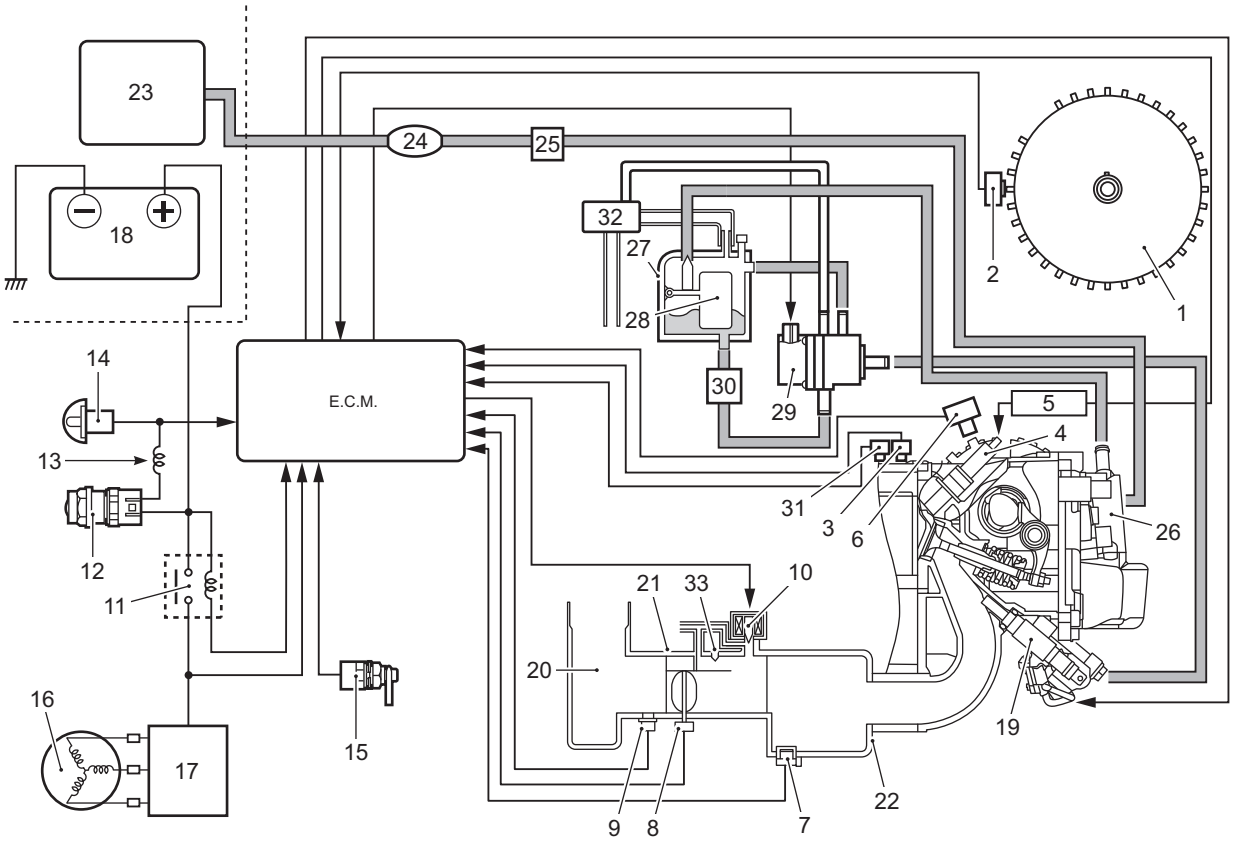
**NOTE**

**The engine operating time can be checked by SDS Ver.7.**

## Engine Control System Flow Diagram
## Electric starter model

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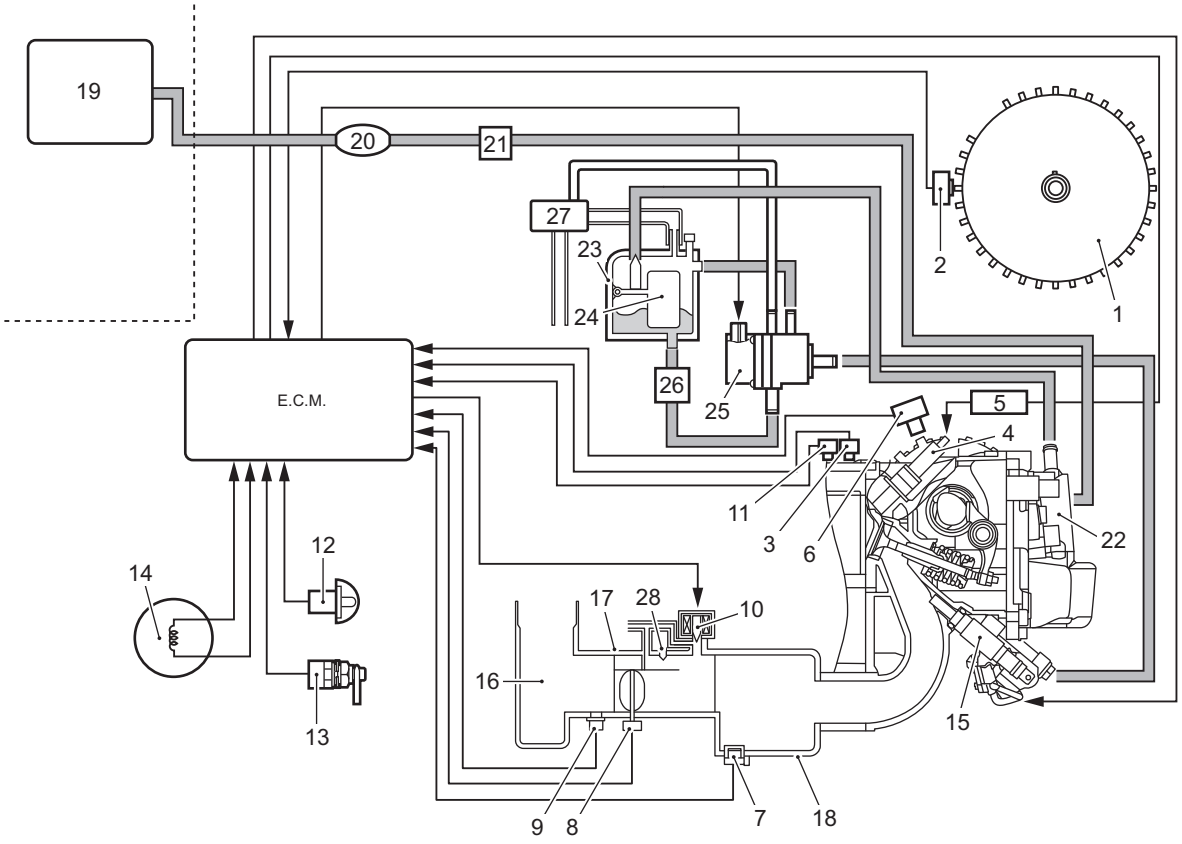
| | | | |
|---|---|---|---|
| 1. Flywheel | 10. IAC valve | 19. Fuel injector | 28. Float |
| 2. CKP sensor | 11. Battery relay | 20. Air intake silencer | 29. High pressure fuel pump |
| 3. Cylinder temp. sensor | 12. Starter button | 21. Throttle body | 30. Fuel cooler |
| 4. Spark plug | 13. Starter relay | 22. Intake manifold | 31. Oil pressure switch |
| 5. Ignition coil | 14. Neutral switch | 23. Fuel tank | 32. Evaporation chamber |
| 6. CMP sensor | 15. Emergency stop switch | 24. Fuel primer bulb | 33. By-pass air screw |
| 7. MAP sensor | 16. Battery charge coil | 25. Low pressure fuel filter | |
| 8. Throttle position sensor | 17. Rectifier / Regulator | 26. Low pressure fuel pump | |
| 9. IAT sensor | 18. Battery | 27. Fuel vapor separator | |

## Manual starter model




IDK111110003-05

| | | | |
|---|---|---|---|
| 1. Flywheel | 8. Throttle position sensor | 15. Fuel injector | 22. Low pressure fuel pump |
| 2. CKP sensor | 9. IAT sensor | 16. Air intake silencer | 23. Fuel vapor separator |
| 3. Cylinder temp. sensor | 10. IAC valve | 17. Throttle body | 24. Float |
| 4. Spark plug | 11. Oil pressure switch | 18. Intake manifold | 25. High pressure fuel pump |
| 5. Ignition coil | 12. Neutral switch | 19. Fuel tank | 26. Fuel cooler |
| 6. CMP sensor | 13. Emergency stop switch | 20. Fuel primer bulb | 27. Evaporation chamber |
| 7. MAP sensor | 14. ECM power source coil | 21. Low pressure fuel filter | 28. By-pass screw |

## Engine Control Module (ECM)

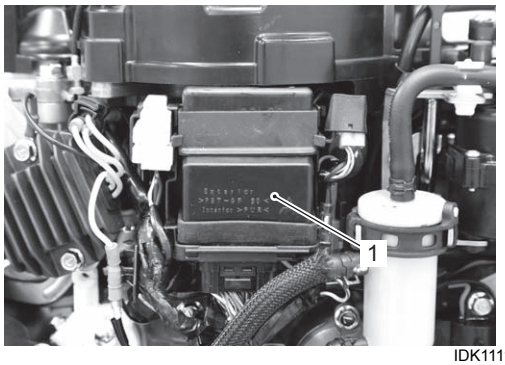
CENDK1111101004

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.<br>• 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 | — |
| 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. |

**NOTE**

- **Information related to the Caution system, Self-Diagnostic System, and Total Operating Hours System is retained in the ECM memory.**
- **The SDS Ver.7 is necessary for checking the total operating time.**
- **ECM is different for the manual starter model and electric starter model.**

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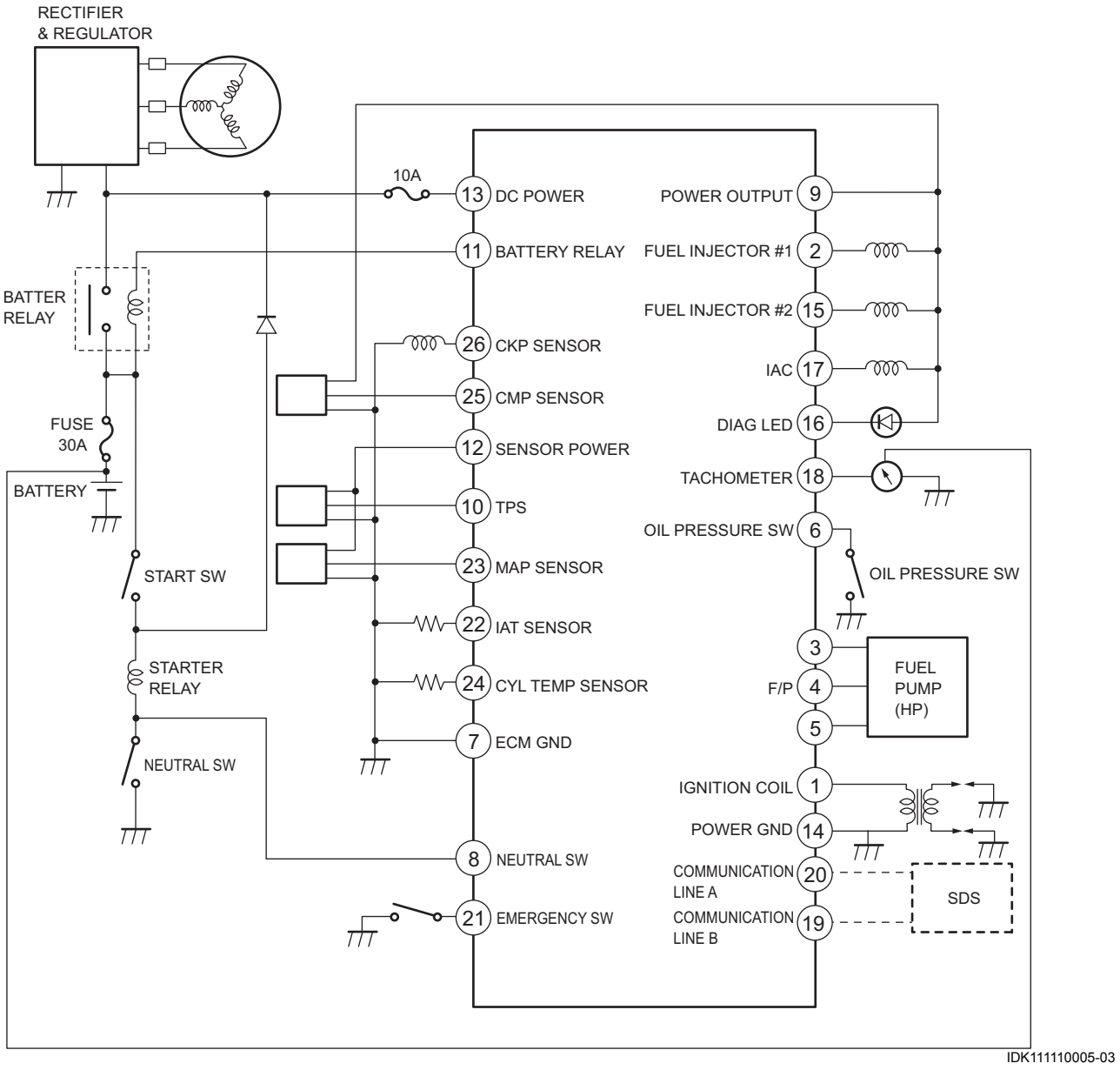
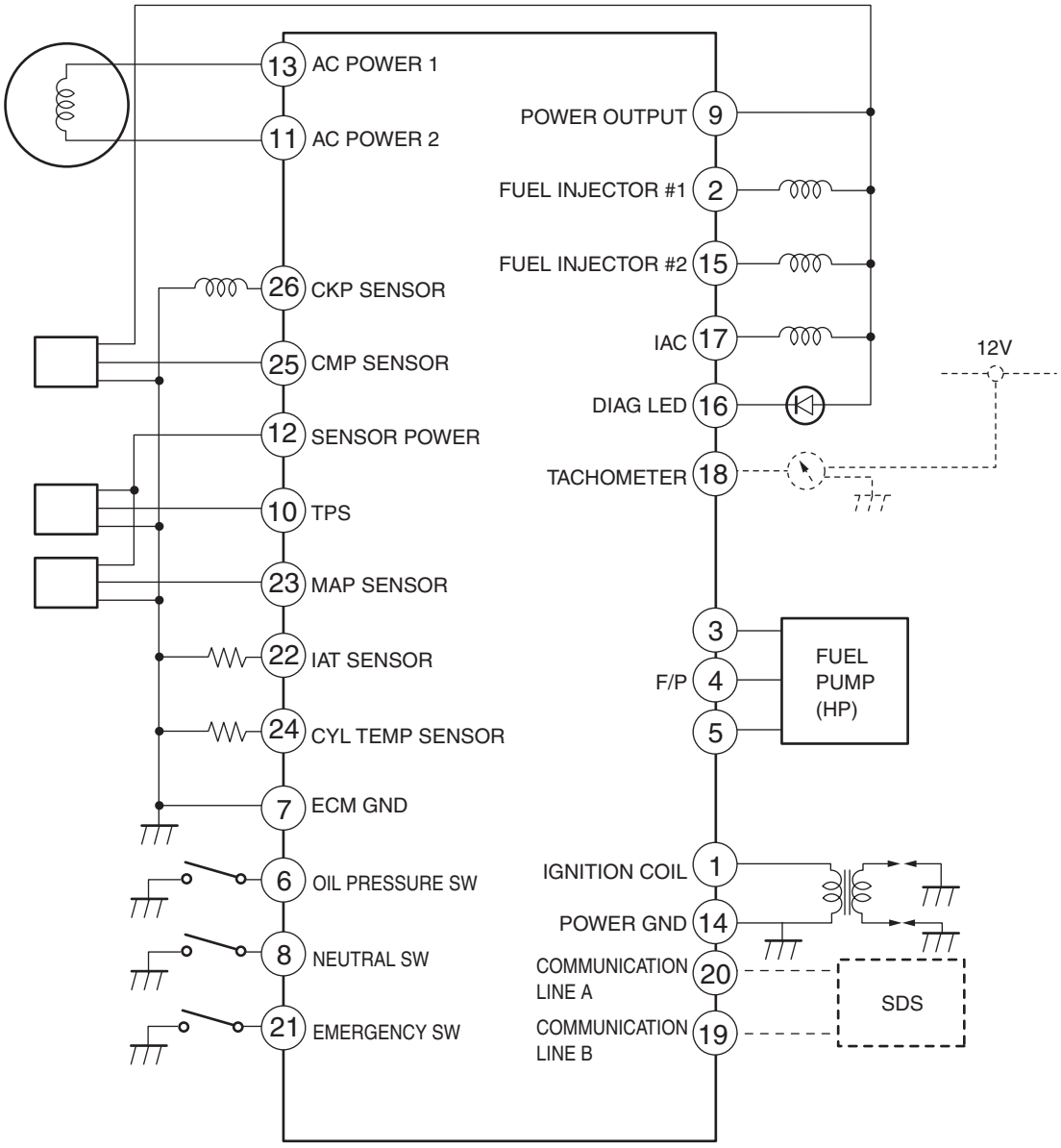
1. ECM

## ECM Input / Output Circuit Diagram
## Electric starter model



**Manual starter model**

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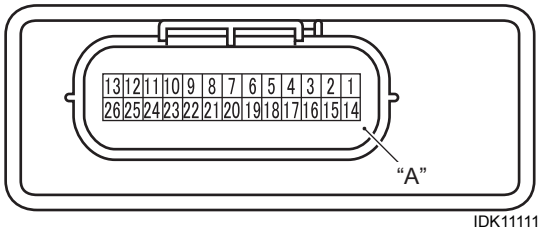
**ECM Connector / Terminals Layout**

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"A": ECM

**Electric starter model**

| Terminal | Wire color | Circuit |
|---|---|---|
| 1 | O | Ignition coil |
| 2 | O/B | No.1 Fuel injector |
| 3 | B/Y | High pressure fuel pump (V) |
| 4 | B/R | High pressure fuel pump (W) |
| 5 | B/W | High pressure fuel pump (U) |
| 6 | Bl/Y | Oil pressure switch |
| 7 | B | Ground for ECM |
| 8 | Y/G | Neutral switch |
| 9 | Gr/R | Power output |
| 10 | Br/Y | Throttle position sensor |
| 11 | P/B | Battery relay |
| 12 | R | Power for sensor (5 V) |
| 13 | W | DC power for ECM |
| 14 | B | Ground for ECM power |
| 15 | B/Br | No.2 Fuel injector |
| 16 | P | Diag LED |
| 17 | W/B | IAC valve |
| 18 | Y/B | Tachometer |
| 19 | Y | Communication line (B) |
| 20 | O/Y | Communication line (A) |
| 21 | Bl/R | Emergency stop switch |
| 22 | Lg/B | IAT sensor |
| 23 | W | MAP sensor |
| 24 | Lg/W | Cylinder temp. sensor |
| 25 | Y/Bl | CMP sensor |
| 26 | R/B | CKP sensor |

**Manual starter model**

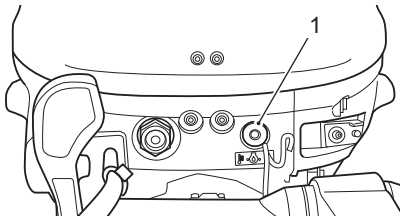
| Terminal | Wire color | Circuit |
|---|---|---|
| 1 | O | Ignition coil |
| 2 | O/B | No.1 Fuel injector |
| 3 | B/Y | High pressure fuel pump (V) |
| 4 | B/R | High pressure fuel pump (W) |
| 5 | B/W | High pressure fuel pump (U) |
| 6 | Bl/Y | Oil pressure switch |
| 7 | B | Ground for ECM |
| 8 | Y/G | Neutral switch |
| 9 | Gr/R | Power output |
| 10 | Br/Y | Throttle position sensor |
| 11 | Br/W | AC power No.2 for ECM |
| 12 | R | Power for sensor (5 V) |
| 13 | Br/R | AC power No.1 for ECM |
| 14 | B | Ground for ECM power |
| 15 | B/Br | No.2 Fuel injector |
| 16 | P | Diag LED |
| 17 | W/B | IAC valve |
| 18 | Y/B | Tachometer |
| 19 | Y | Communication line (B) |
| 20 | O/Y | Communication line (A) |
| 21 | Bl/R | Emergency stop switch |
| 22 | Lg/B | IAT sensor |
| 23 | W | MAP sensor |
| 24 | Lg/W | Cylinder temp. sensor |
| 25 | Y/Bl | CMP sensor |
| 26 | R/B | CKP sensor |

## Caution System Description

CENDK1111101005

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

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




IDK111110023-02

1. Caution lamp

| Caution type | Caution lamp | Engine RPM limited |
|---|---|---|
| Over-revolution | Yes | Yes |
| Low oil pressure | Yes | Yes |
| Overheat | Yes | Yes |

**Lamp Check**

For two seconds after inputting electric power to the ECM:

- The caution lamp turns ON.

**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**

**DF15A: 6 200 r/min**

**DF20A: 6 300 r/min**

**Action:**

| | |
|---|---|
| Engine speed | • Automatically reduced to approx.3 000 r/ min. by an intermittent fuel injection signal.<br>• 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 cancelled. |
| Caution lamp | Caution lamp lights continuously. |

**Reset:**

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

**NOTE**

**In neutral gear, the preset maximum engine speed value before the over-revolution caution system activates is 3 000 r/min.**
**In the operation of Neutral gear over-revolution caution system, the caution lamp does not light.**
**To cancel the Neutral gear over-revolution caution control, close throttle completely.**

**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 15 kPa (0.15 kg/cm$^2$, 2 psi.) while engine is running.

**Action:**

| | |
|---|---|
| Engine speed | • Automatically reduced to approx. 2 000 r/min. maximum by an intermittent fuel injection signal.<br>• The engine automatically stops 3 minutes after the caution system is activated. |
| Caution lamp | Caution lamp lights continuously. |

**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 15 kPa (0.15 kg/cm$^2$, 2 psi.) at approx. 2 000 r/min. or less engine speed operation.**
**The engine must be stopped and checked immediately once the system is activated.**

**Overheat Caution System**
Immediate activation of the system when:

- Cylinder temperature reaches 90 °C (194 °F)
- The rate of cylinder wall temperature variation within a given time exceeds the preset rate.

**Action:**

| | |
|---|---|
| Engine speed | • Automatically reduced to approx. 3 000 r/min. maximum by intermittent fuel injection and ignition signals.<br>• The engine automatically stops 3 minutes after the caution system is activated. |
| Caution lamp | Caution lamp lights continuously. |

**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:**
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.

| | |
|---|---|
| Reset temperature | Approx. 70 °C (158 °F) |

**Battery Charge Cutout System**
**(Electric starter model)**
This system activates when the battery voltage drops to less than 6 volts while the engine is running.
The battery charging circuit is open while the system is activated.
All the charging current from the rectifier / regulator is then used to power the engine control system.

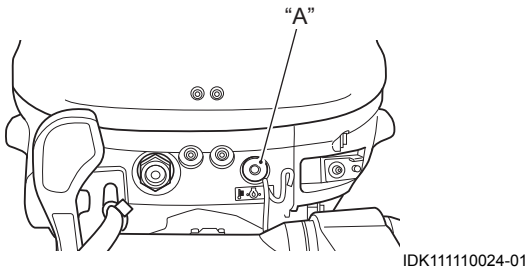
**NOTE**

- **Charging current will not flow from the rectifier / regulator to the battery while this system is activated.**
- **When the system is activated the starter motor will not operate because the battery voltage is too low.**

## Self-Diagnostic System Description

CENDK1111101006

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 caution lamp flashes (lights intermittently) according to each code pattern.

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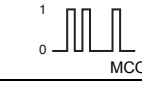
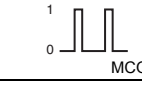
"A": Caution lamp

**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 (R model) | 5 – 3 |  MCODE00D53-0-01 | 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 starting the engine.**
- **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.**

**Condition for Self-Diagnostic System Operation**

| Failed item | Condition |
|---|---|
| MAP sensor 1 | • No signal (With engine running).<br>• 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 | • No signal.<br>• Receiving an out of range “– 40 to + 200 °C (– 40 – +392 °F) (0.10 – 4.9 V)” signal. |
| IAT sensor | • No signal.<br>• Receiving an out of range “– 40 to + 170 °C (– 40 – +338 °F) (0.10 – 4.8 V)” signal. |
| CKP sensor | • During one crankshaft rotation, 34 signals are not received by the ECM. |
| CMP sensor | • During eight crankshaft rotation, the normal CMP sensor signal pattern is not received by the ECM. |
| Air intake system | • The engine operates at an abnormally high speed when the ECM is receiving a completely closed signal from the throttle position sensor. (Criteria: 2 000 r/min minimum) |
| MAP sensor 2 | • From throttle position sensor, the full close signal is inputted, but from the MAP sensor, the signal voltage exceeds 2.8 V. |
| Fuel injector | • No operation signal from the ECM. |
| Throttle position sensor | • No signal.<br>• Receiving an out of range “0.2 – 4.8 V” signal. |
| Rectifier / Regulator (Over-charging) | • Receiving 16 volts or higher signal. |
| Oil pressure switch (R-model) | • While the engine is stopped and the ignition switch is on, the ECM receives an “off” signal from the oil pressure switch. |

## Fail-Safe System Description

CENDK1111101007

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 | • 150 – 758 mmHg / (5.9 – 30 inHg.)<br>(The value will change according to the current engine speed.) |
| Air intake system | • 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 | • The control is executed with the throttle opening at 5 degrees. |

**NOTE**

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

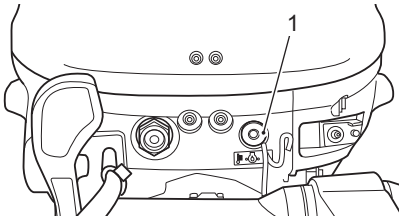
## Oil Change Reminder System Description

CENDK1111101008

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 caution lamp will flash, if the engine is running.
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.**

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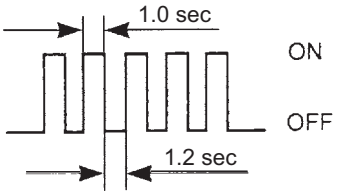
| |
|---|
| 1. Caution lamp |

### Indication of System Activation

**Caution lamp flashing pattern**

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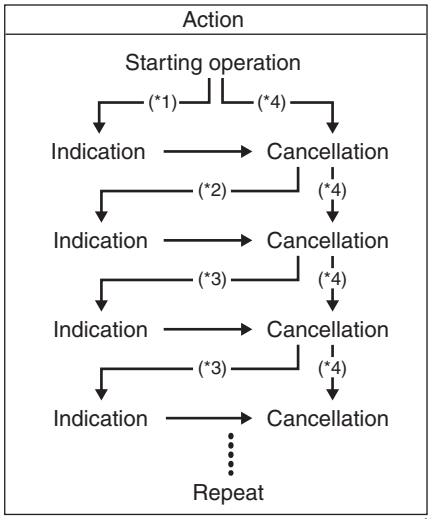


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| |
|---|
| *1: Lapse of initial 20 hour's operation |
| *2: Lapse of 80 hour's operation |
| *3: Lapse of 100 hour's operation |
| *4: When performing cancellation before system activation |

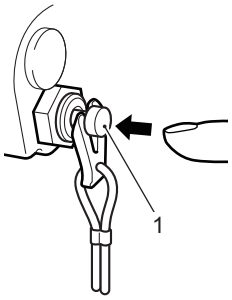
### Cancellation Procedure

1) Start the engine.
   Make sure that shift is in neutral and close the throttle fully.

**NOTE**

**The engine stops when the engine stop button is kept to push than 0.5 seconds.**

2) Push the engine stop button (1) three times within three seconds so that engine should not stall.
   The caution lamp is no longer lit when the reminder cancellation is successful.
3) Stop the engine.

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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

CENDK1111103001

Refer to “Wiring Harness Routing Diagram” in Section 4A (Page 4A-3).

# Diagnostic Information and Procedures

## Troubleshooting with Self-Diagnostic Code

CENDK1111104001

**⚠ WARNING**

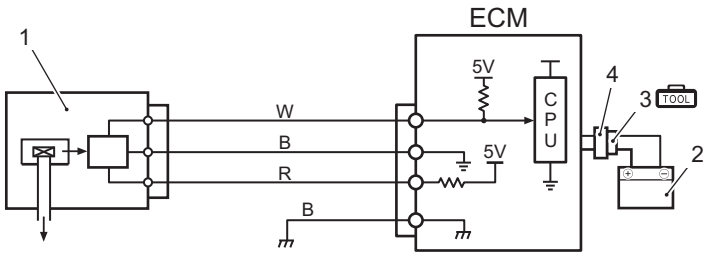
**Before troubleshooting, read and follow the “Precautions on Engine Control Diagnosis” (Page 1A-1).**

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

CENDK1111104002

### Wiring Diagram

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| | |
|---|---|
| 1. MAP sensor | 3. ECM power source cable |
| 2. Battery | 4. SDS communication connector |

### Troubleshooting

**Step 1**

1) Stop the engine.
2) Disconnect the MAP sensor connector.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage at the “R” wire terminal of the MAP sensor connector.

**Is the voltage approx. 4 – 5 V?**

Yes — Go to step 2.

No
- “R” wire open, “R” wire shorted to ground or a poor wire connection.
- If the wiring and connection is OK, substitute a known-good ECM and recheck.

**Step 2**

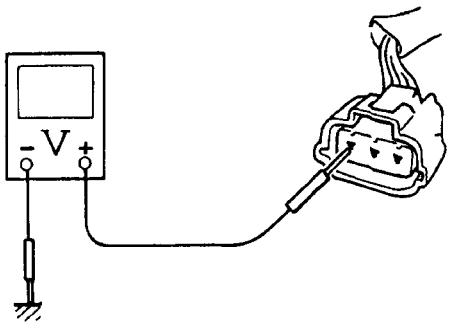
1) Check the MAP sensor output voltage change. Refer to “MAP Sensor Output Voltage Inspection” in Section 1C (Page 1C-11).

**Is it in good condition?**

Yes — Substitute a good ECM and recheck.

No
- Faulty MAP sensor.
- “R” wire shorted to “W” wire, “B” wire open, poor “B” 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.

**For step 1**

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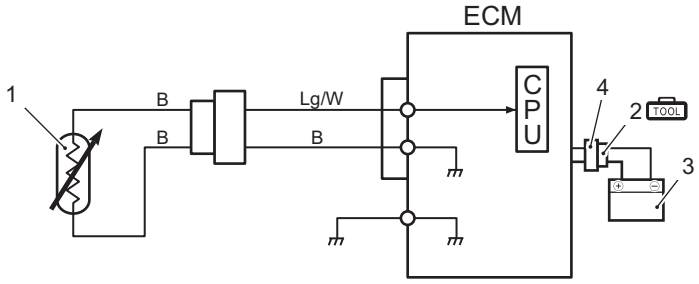
## Self-Diagnostic Code “1 – 4” Cylinder Temp. Sensor

CENDK1111104003

### Wiring Diagram




IDK111110012-02

| | |
|---|---|
| 1. Cylinder temp sensor | 3. Battery |
| 2. ECM power source cable | 4. SDS communication connector |

### Troubleshooting

#### Step 1

1) Stop the engine.
2) Disconnect the cylinder temp. sensor connector.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage at the “Lg/W” wire terminal of the cylinder temp. sensor connector.

**Is the voltage 4 V or more?**

Yes Go to step 2.

No
- “Lg/W” wire shorted to the “B/W” wire or ground circuit.
- If the wiring is OK, substitute a known-good ECM and recheck.

#### Step 2

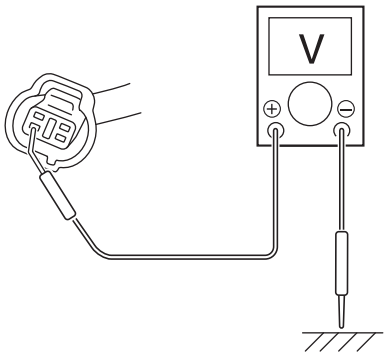
1) Disconnect the ECM power source cable.
2) Check the Cylinder temp. sensor.
   Refer to “Cylinder Temp. Sensor Inspection” in Section 1C (Page 1C-8).

**Is it in good condition?**

Yes Poor Cylinder Temp. sensor connection, intermittent trouble or a faulty ECM may be the cause.

No Faulty Cylinder Temp. sensor.

**For step 1**

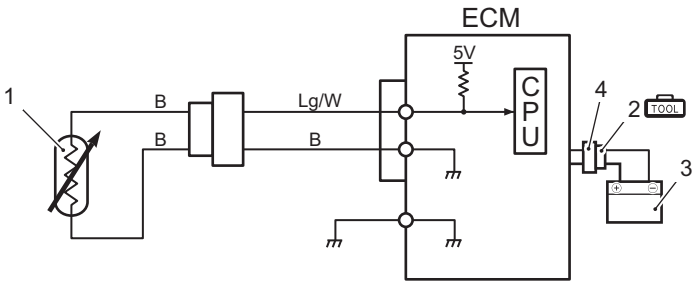



I9J011110045-02

## Self-Diagnostic Code “2 – 3” IAT Sensor

CENDK1111104004

### Wiring Diagram




IDK111110013-02

| | |
|---|---|
| 1. IAT sensor | 3. Battery |
| 2. ECM power source cable | 4. SDS communication connector |

### Troubleshooting

#### Step 1

1) Stop the engine.
2) Disconnect IAT sensor connector.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage at the “Lg/B” wire terminal of the IAT sensor connector.

**Is the voltage 4 V or more?**

Yes Go to step 2.

No
- “Lg/B” wire shorted to “B” wire or ground circuit.
- If the wiring is OK, substitute a known-good ECM and recheck.

#### Step 2

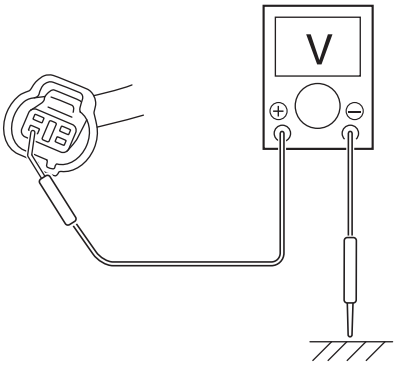
1) Disconnect the ECM power source cable.
2) Check the IAT sensor.
   Refer to “IAT Sensor Inspection” in Section 1C (Page 1C-8).

**Is it in good condition?**

Yes Poor IAT sensor connection, intermittent trouble or a faulty ECM may be cause.

No Faulty IAT sensor.

**For step 1**

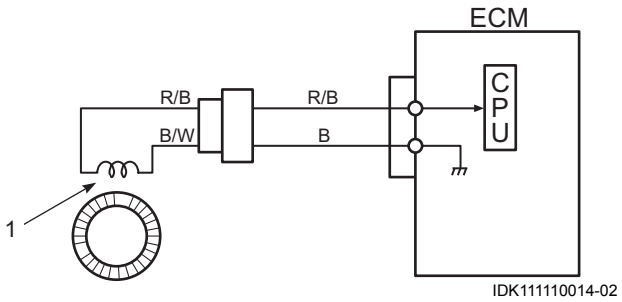



I9J011110046-01

## Self-Diagnostic Code “4 – 2” CKP Sensor

CENDK1111104005

### Wiring Diagram




1. CKP sensor

### Troubleshooting

#### Step 1

1) Check the CKP sensor air gap.
   Refer to “CKP Sensor Removal and Installation” in Section 1C (Page 1C-6).

**Is it in good condition?**

Yes Go to step 2.

No Incorrectly adjusted air gap.

#### Step 2

1) Check the CKP sensor resistance.
   Refer to “Resistance Check” in Section 1C (Page 1C-5).

**Is it in good condition?**

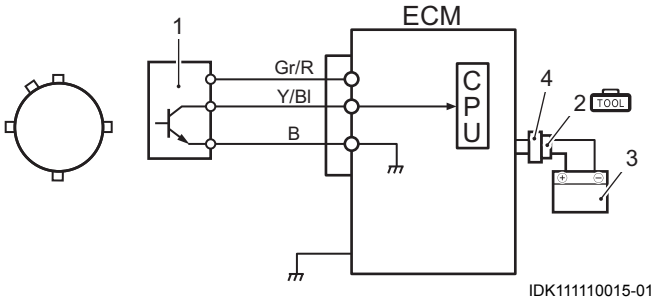
Yes Open wire between the CKP sensor and the ECM, poor lead wire connection or sensor lead wires are shorted to each other. If lead wire and connection are ok, intermittent trouble or a faulty ECM may be the cause.

No Faulty CKP sensor.

## Self-Diagnostic Code “2 – 4” CMP Sensor

CENDK1111104006

### Wiring Diagram




IDK111110015-01

| | |
|---|---|
| 1. CMP sensor | 3. Battery |
| 2. ECM power source cable | 4. SDS communication connector |

### Troubleshooting

#### Step 1

**Is CMP sensor installed properly and the wire harness connected securely?**

Yes — Go to step 2.

No — Correct.

#### Step 2

1) Stop the engine.
2) Disconnect the connector from the CMP sensor.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check for proper connection to the CMP sensor at “Gr/R”, “Y/Bl” and “B” wire terminals.
5) If OK, check the voltage at the “Gr/R”, “Y/B” and “B” wire terminals of the CMP sensor connector.

**CMP sensor voltage**
**Terminal “Gr/R”: 10 – 14 V**
**Terminal “Y/Bl”: 4 – 5 V**
**Terminal “B”: 0 V**

**Is the voltage satisfactory?**

Yes — Go to step 5.

No — Go to step 3.

#### Step 3

**Was terminal “Y/Bl” voltage in step 2 within specification?**

Yes — Go to step 4.

No — “Y/Bl” wire open or shorted to ground / power supply circuit. If the wiring and connection is OK, substitute a known-good ECM and recheck.

#### Step 4

**Was terminal “Gr/R” voltage in step 2 within specification?**

Yes — Go to step 5.

No — “Gr/R” wire open circuit. If the wiring and connection is OK, substitute a known-good ECM and recheck.

#### Step 5

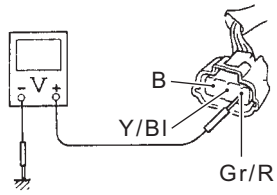
1) Disconnect the ECM power source cable.
2) Check the CMP sensor and sensor trigger vane. Refer to “CMP Sensor Inspection” in Section 1C (Page 1C-9).

**Is check result satisfactory?**

Yes — Substitute a known-good ECM and recheck.

No — Replace CMP sensor.

**For step 2**

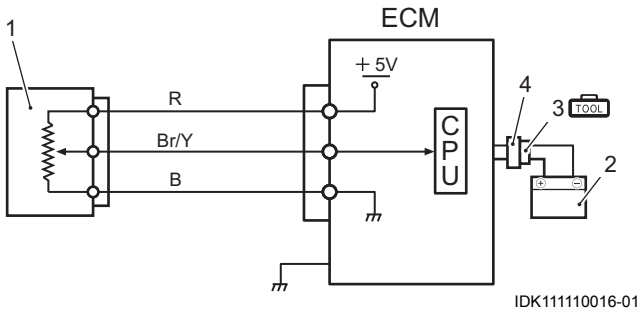



IDK111110008-01

## Self-Diagnostic Code “2 – 2” Air Intake System

CENDK1111104007

### Wiring Diagram




IDK111110016-01

| | |
|---|---|
| 1. TPS | 3. ECM power source cable |
| 2. Battery | 4. SDS communication connector |

### Troubleshooting

#### Step 1

1) Stop the engine.
2) Disconnect the TPS connector.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage at the “R” wire terminal of TPS connector.

**Is the voltage approx. 4 – 5 V?**

Yes — Go to step 2.

No
- “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.

#### Step 2

1) Check the TPS output voltage change. Refer to “TPS Inspection” in Section 1C (Page 1C-12).

**Is it in good condition?**

Yes — Go to step 3.

No
- Faulty TPS.
- “R” wire shorted to “Br/Y” wire, “B” wire open, poor “B” 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.

#### Step 3

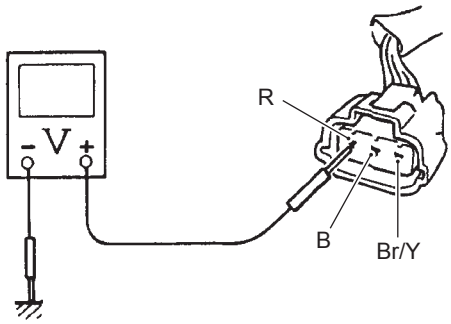
1) Check the MAP sensor, IAC system and intake manifold (system) for air leakage.

**Is the result OK?**

Yes — Intermittent trouble or faulty ECM. Substitute a known-good ECM and recheck.

No — Faulty air intake system.

**For step 1**

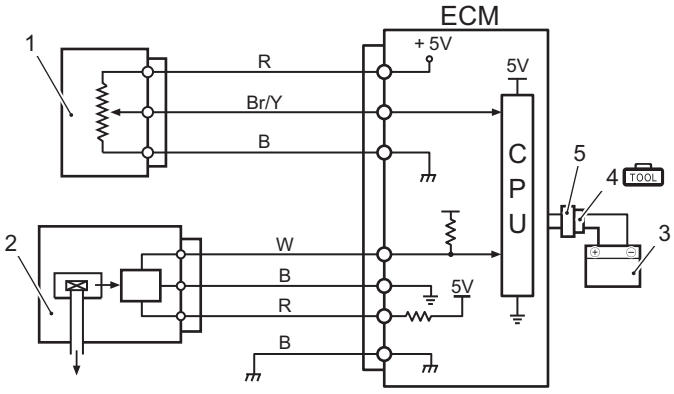



IDK111110009-02

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

CENDK1111104008

### Wiring Diagram




IDK111110017-01

| | |
|---|---|
| 1. TPS | 4. ECM power source cable |
| 2. MAP sensor | 5. SDS communication connector |
| 3. Battery | |

### Troubleshooting

#### Step 1

1) Stop the engine.
2) Disconnect the MAP sensor connector.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage at the “R” wire terminal of the MAP sensor connector.

**Is the voltage approx. 4 – 5 V?**

Yes — Go to step 2.

No
- “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.

#### Step 2

1) Check the MAP sensor output voltage change. Refer to “MAP Sensor Output Voltage Inspection” in Section 1C (Page 1C-11).

**Is it in good condition?**

Yes — Go to step 3.

No — Faulty MAP sensor.

#### Step 3

1) Disconnect the TPS connector.
2) Check the voltage at the “R” wire terminal of the TPS connector.

**Is the voltage approx. 4 – 5 V?**

Yes — Go to step 4.

No
- “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.

#### Step 4

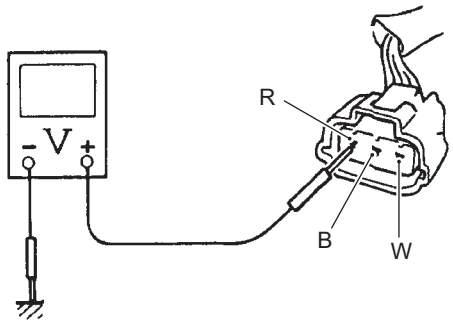
1) Check the TPS output voltage change. Refer to “TPS Inspection” in Section 1C (Page 1C-12).

**Is it in good condition?**

Yes — Intermittent trouble, substitute a known-good ECM and recheck.

No
- Faulty TPS.
- “R” wire shorted to “Br/Y” wire, “B” wire open, poor “B” 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.

**For step 1**

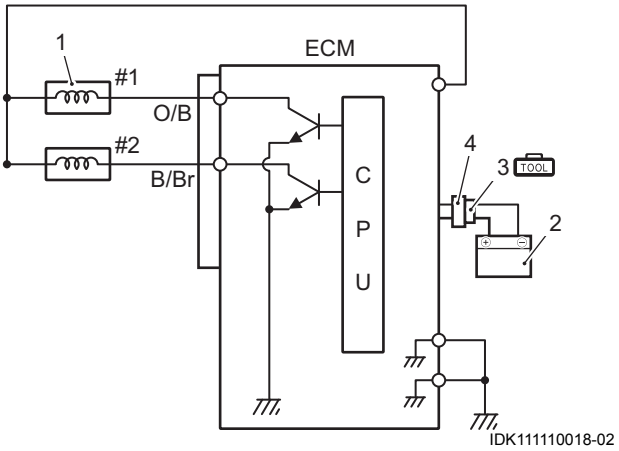



IDK111110027-03

## Self-Diagnostic Code “4 – 3” Fuel Injector

CENDK1111104009

### Wiring Diagram




| | |
|---|---|
| 1. Fuel injector | 3. ECM power source cable |
| 2. Battery | 4. SDS communication connector |

### Troubleshooting

#### Step 1

1) Using a sound scope, check that each injector has an operating sound when the engine is cranking.

**Do all injectors make an operating sound?**

Yes — Fuel injector and its circuit are in good condition.

No — Go to step 2.

#### Step 2

1) Check the fuel injector, the wiring connection and the wire harness of the fuel injector not making the operating sound.

**Are all of the above OK?**

Yes — Substitute a known-good ECM and recheck.

No — Faulty injector or its circuit.

#### Step 3

1) Stop the engine.
2) Disconnect the connector from the fuel injector.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage at “Gr/R” wire terminal.

**Is the voltage 12 V (battery voltage)?**

Yes — Go to step 4.

No — Power circuit open.

#### Step 4

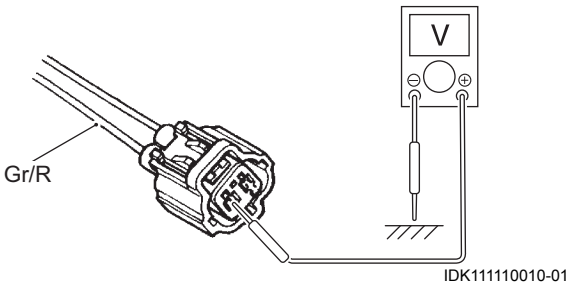
1) Disconnect the ECM power source cable.
2) Disconnect the ECM connector, and check all of the injectors for resistance.
Refer to “Resistance Check” in Section 1C (Page 1C-5).

**Is the resistance 10 – 14 Ω for each injector?**

Yes — Substitute a known-good ECM and recheck.

No — Faulty injector or its circuit.

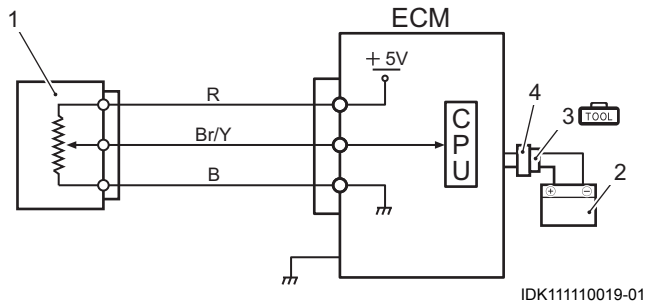
**For step 3**



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

CENDK1111104010

### Wiring Diagram




| | |
|---|---|
| 1. TPS | 3. ECM power source cable |
| 2. Battery | 4. SDS communication connector |

### Troubleshooting

#### Step 1

1) Stop the engine.
2) Disconnect TPS connector.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage at the “R” wire terminal of the TPS connector.

**Is the voltage approx. 4 – 5 V?**

Yes — Go to step 2.

No
- “R” wire open, “R” wire shorted to ground circuit or poor connection.
- If the wiring and connection is OK, substitute a known-good ECM and recheck.

#### Step 2

1) Check the TPS output voltage change. Refer to “TPS Inspection” in Section 1C (Page 1C-12).

**Is it in good condition?**

Yes — Substitute a known-good ECM and recheck.

No
- Faulty TPS.
- “R” wire shorted to “Br/Y” wire, “B” wire open, poor “B” 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)

CENDK1111104011

**NOTE**

**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 1

1) Check the rectifier / regulator resistance. Refer to “Rectifier / Regulator Inspection” in Section 1K (Page 1K-16).

**Is the result OK?**

Yes — Go to step 2.

No — Faulty rectifier / regulator.

#### Step 2

1) With the engine running, check charging voltage at idle speed.

**Is the result 16 V or higher?**

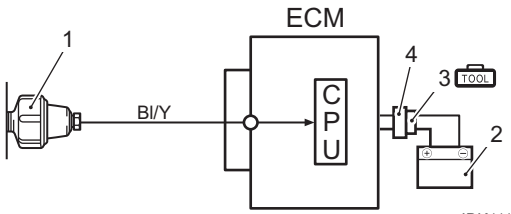
Yes — Faulty rectifier / regulator.

No — Faulty ECM or wire continuity / connection failure.

## Self-Diagnostic Code “5 – 3” Oil Pressure Switch

CENDK1111104012

### Wiring Diagram




IDK111110020-01

| | |
|---|---|
| 1. Oil pressure switch | 3. ECM power source cable |
| 2. Battery | 4. SDS communication connector |

### Troubleshooting

**Step 1**

1) Stop the engine.
2) Remove the oil pressure switch wire at switch.
3) Connect the ECM power source cable to the SDS communication connector and battery.
4) Check the voltage between the oil pressure switch wire terminal and body ground.

**Is the voltage approx. 5 V?**

Yes — Go to step 2.

No
- Oil pressure switch wire open or poor connection.
- If wire and connection are OK, substitute a known-good ECM and recheck.

**Step 2**

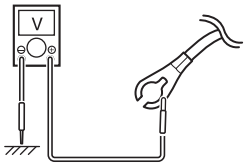
1) Disconnect the ECM power source cable.
2) Check the oil pressure switch operation. Refer to “Oil Pressure Switch Inspection” in Section 1E (Page 1E-5).

**Is it in good condition?**

Yes — Poor oil pressure switch wire connection, intermittent trouble or a faulty ECM may be the cause.

No — Faulty oil pressure switch.

**For step 1**




I9J011110064-01

## Troubleshooting Without Self-Diagnostic Code

CENDK1111104013

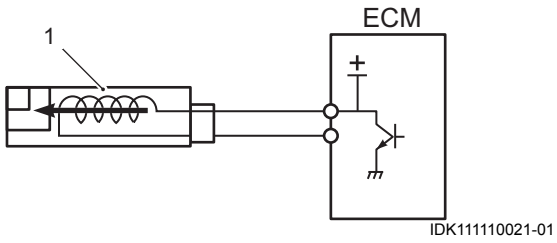
Before troubleshooting, make sure that there is not a self-diagnostic code indication.

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

## IAC System Troubleshooting

CENDK1111104014

### Wiring Diagram




1. IAC valve

### Troubleshooting

#### Step 1

1) Warm up the engine to normal operating temperature and keep it idling.
2) Using the SDS tool, check the IAC duty cycle and idle speed. Adjust if necessary.

**Idle speed (IAC duty cycle)**
**800 – 900 r/min (approx. 10%)**

**Is result OK?**

Yes — IAC system is in good condition.

No — Go to step 2.

#### Step 2

1) Disconnect the IAC connector at IAC valve.
2) Check the resistance between terminals.

**Is the resistance 31 – 42 Ω?**

Yes — Proceed to “Unstable Idling / Trolling” in “Troubleshooting Without Self-Diagnostic Code” (Page 1A-24) and check items except for “Faulty IAC system”.

No
- Faulty IAC valve.
- Poor connection.
- Open wire harness.

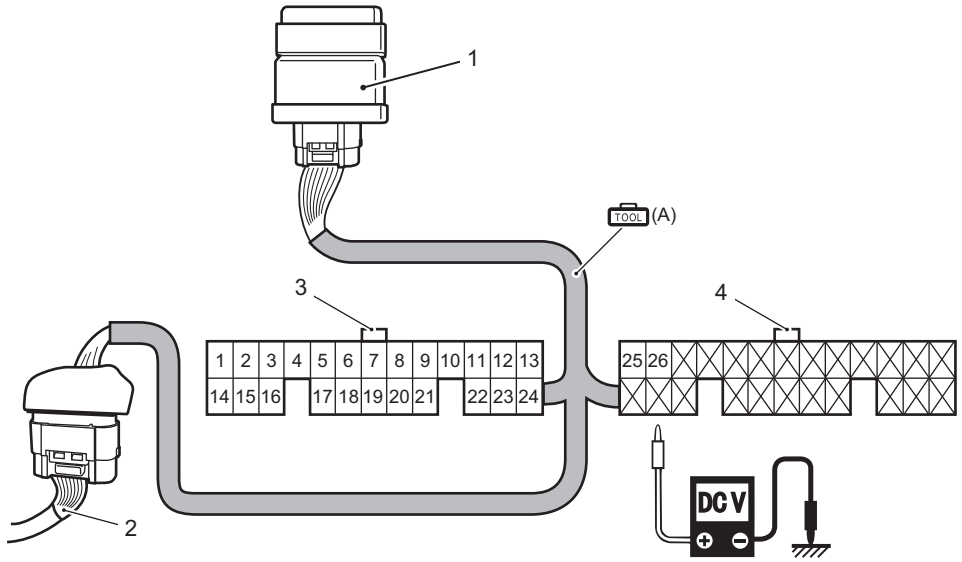
# Service Instructions

## How to Use The 26 Pin Test Cord

CENDK1111106003

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**
**TOOL (A): 09930–88940 (26-pin test cord)**




IDK111110028-01

| | | | |
|---|---|---|---|
| 1. ECM | 2. Wire harness | 3. White connector | 4. Black connector |

## Inspection of The ECM and Its Circuit

CENDK1111106004

***NOTICE***

**If you connect a voltmeter or ohmmeter directly to ECM terminals by removing ECM connector, you can damage the control module.**

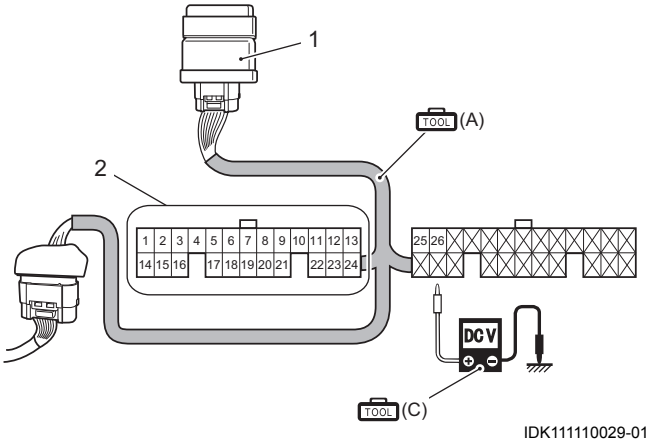
**Never connect a voltmeter or an ohmmeter directly to any terminal of ECM by disconnecting control module connector.**

**Special tool**

**(A): 09930–88940 (26-pin test cord)**
**(B): 09933–08910 (ECM power source cable)**
**(C): 09930–99320 (Digital tester)**

**Tester knob indication**
**DCV**

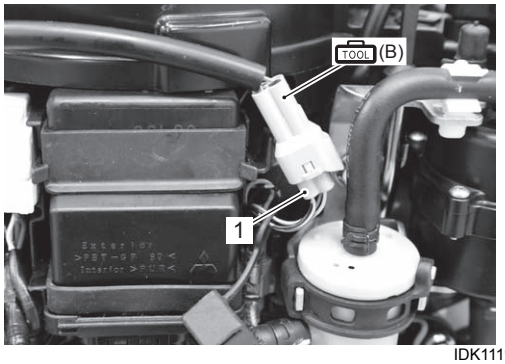
1) Stop the engine.
2) Connect the 26-pin test cord between the ECM and wire harness as shown in figure.




IDK111110029-01

| | |
|---|---|
| 1. ECM | 2. White connector |

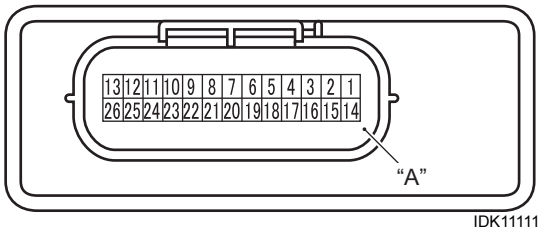
3) Connect the ECM power source cable to the SDS communication connector (1) and battery as shown figure.




IDK111110030-03

4) Connect the tester probe (“–”, Black) to body ground, and measure the voltage according to the “Circuit Voltage Table” (Page 1A-28).

**Circuit Voltage Table**
**Electric starter model**

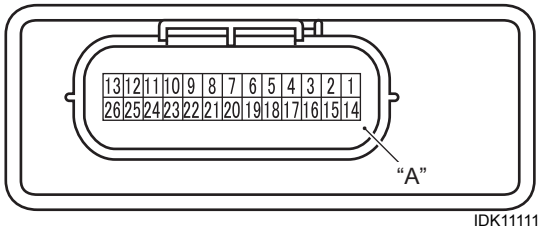



IDK111110007-01

"A": ECM terminal

| Terminal | Wire color | Circuit | Standard voltage | Condition / Remarks |
|---|---|---|---|---|
| 1 | O | Ignition coil | — | — |
| 2 | O/B | No.1 Fuel injector | Approx. 12 V | • 12 V electric power is supplied to ECM. |
| 3 | B/Y | High pressure fuel pump (V) | Approx. 0.6 V | • 12 V electric power is supplied to ECM. |
| 4 | B/R | High pressure fuel pump (W) | Approx. 0.6 V | • 12 V electric power is supplied to ECM. |
| 5 | B/W | High pressure fuel pump (U) | Approx. 0.6 V | • 12 V electric power is supplied to ECM. |
| 6 | Bl/Y | Oil pressure switch | — | — |
| 7 | B | Ground for ECM | — | — |
| 8 | Y/G | Neutral switch | Approx. 0 V | • 12 V electric power is supplied to ECM.<br>• Shift into Neutral |
| | | | Approx. 4.7 V | • 12 V electric power is supplied to ECM.<br>• Shift into Forward or Reverse |
| 9 | Gr/R | Power output | Approx. 8 V | • 12 V electric power is supplied to ECM.<br>• While cranking engine with starter motor. |
| | | | Approx. 12 V | • 12 V electric power is supplied to ECM. |
| 10 | Br/Y | Throttle position sensor | Approx. 0.7 V | • 12 V electric power is supplied to ECM.<br>• Throttle FCT |
| | | | Approx. 4 V | • 12 V electric power is supplied to ECM.<br>• Throttle WOT |
| 11 | P/B | Battery relay | — | — |
| 12 | R | Power for sensor (5V) | Approx. 5 V | • 12 V electric power is supplied to ECM. |
| 13 | W | DC power for ECM | Approx. 8 V | • While cranking engine with starter motor. |
| 14 | B | Ground for ECM power | — | — |
| 15 | B/Br | No.2 Fuel injector | Approx. 12 V | • 12 V electric power is supplied to ECM. |
| 16 | P | Diag LED | — | — |
| 17 | W/B | IAC valve | Approx. 0 V | • 12 V electric power is supplied to ECM. |
| 18 | Y/B | Tachometer | — | — |
| 19 | Y | Communication line (B) | — | — |
| 20 | O/Y | Communication line (A) | — | — |
| 21 | Bl/R | Emergency stop switch | Approx. 5 V | • 12 V electric power is supplied to ECM.<br>• Stop switch plate IN. |
| | | | Approx. 0 V | • 12 V electric power is supplied to ECM.<br>• Stop switch plate OUT. |
| 22 | Lg/B | IAT sensor | 0.04 – 4.6 V | • 12 V electric power is supplied to ECM. |
| 23 | W | MAP sensor | 0.79 – 4.2 V | • 12 V electric power is supplied to ECM. |
| 24 | Lg/W | Cylinder temp. sensor | 0.14 – 4.75 V | • 12 V electric power is supplied to ECM. |
| 25 | Y/Bl | CMP sensor | Approx. 0.3 V or 5 V | • 12 V electric power is supplied to ECM. |
| 26 | R/B | CKP sensor | — | — |

**Manual starter model**




IDK111110007-01

"A": ECM terminal

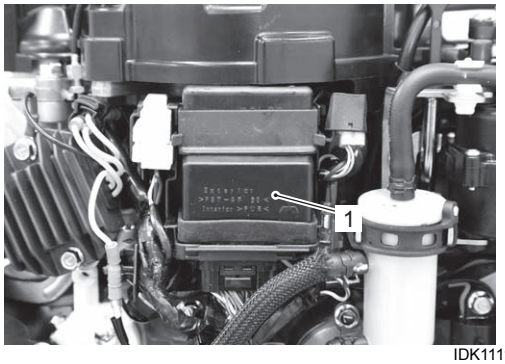
| Terminal | Wire color | Circuit | Standard voltage | Condition / Remarks |
|---|---|---|---|---|
| 1 | O | Ignition coil | — | — |
| 2 | O/B | No.1 Fuel injector | Approx. 12 V | • 12 V electric power is supplied to ECM. |
| 3 | B/Y | High pressure fuel pump (V) | Approx. 0.6 V | • 12 V electric power is supplied to ECM. |
| 4 | B/R | High pressure fuel pump (W) | Approx. 0.6 V | • 12 V electric power is supplied to ECM. |
| 5 | B/W | High pressure fuel pump (U) | Approx. 0.6 V | • 12 V electric power is supplied to ECM. |
| 6 | Bl/Y | Oil pressure switch | — | — |
| 7 | B | Ground for ECM | — | — |
| 8 | Y/G | Neutral switch | Approx. 0 V | • 12 V electric power is supplied to ECM.<br>• Shift into Neutral |
| | | | Approx. 4.7 V | • 12 V electric power is supplied to ECM.<br>• Shift into Forward or Reverse |
| 9 | Gr/R | Power output | Approx. 12 V | • 12 V electric power is supplied to ECM. |
| 10 | Br/Y | Throttle position sensor | Approx. 0.7 V | • 12 V electric power is supplied to ECM.<br>• Throttle FCT |
| | | | Approx. 4 V | • 12 V electric power is supplied to ECM.<br>• Throttle WOT |
| 11 | Br/W | AC power No.2 for ECM | Approx. 0.5 – 1.0 V | • Disconnect ECM power source cable.<br>• Crank the engine. |
| 12 | R | Power for sensor (5V) | Approx. 5 V | • 12 V electric power is supplied to ECM. |
| 13 | Br/R | AC power No.1 for ECM | Approx. 0.5 – 1.0 V | • Disconnect ECM power source cable.<br>• Crank the engine. |
| 14 | B | Ground for ECM power | — | — |
| 15 | B/Br | No.2 Fuel injector | Approx. 12 V | • 12 V electric power is supplied to ECM. |
| 16 | P | Diag LED | — | — |
| 17 | W/B | IAC valve | Approx. 0 V | • 12 V electric power is supplied to ECM. |
| 18 | Y/B | Tachometer | — | — |
| 19 | Y | Communication line (B) | — | — |
| 20 | O/Y | Communication line (A) | — | — |
| 21 | Bl/R | Emergency stop switch | Approx. 5 V | • 12 V electric power is supplied to ECM.<br>• Stop switch plate IN. |
| | | | Approx. 0 V | • 12 V electric power is supplied to ECM.<br>• Stop switch plate OUT. |
| 22 | Lg/B | IAT sensor | 0.04 – 4.6 V | • 12 V electric power is supplied to ECM. |
| 23 | W | MAP sensor | 0.79 – 4.2 V | • 12 V electric power is supplied to ECM. |
| 24 | Lg/W | Cylinder temp. sensor | 0.14 – 4.75 V | • 12 V electric power is supplied to ECM. |
| 25 | Y/Bl | CMP sensor | Approx. 0.3 V or 5 V | • 12 V electric power is supplied to ECM. |
| 26 | R/B | CKP sensor | — | — |

## ECM Removal and Installation

CENDK1111106001

### Removal

1) Disconnect lead wire connector from ECM (1).
2) Remove the ECM.




IDK111110031-02

### Installation

Installation is reverse order of removal.

## Caution Lamp Inspection

CENDK1111106002

Check for illumination of the caution lamp using the following procedures.

1) Disconnect lamp lead wire connector from engine harness.

***NOTICE***

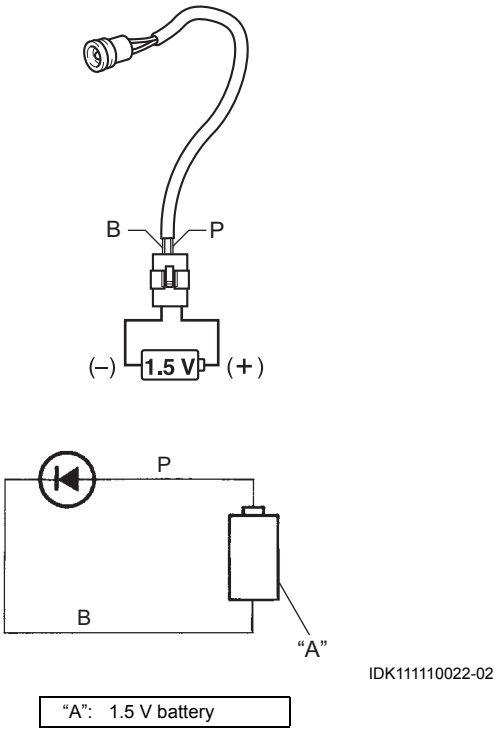
**Failure to correctly supply the voltage will result in lamp damage.**

**Do not use battery larger than 2 V to test the lamp.**

2) For tests using 1.5 V power source (or battery), connect the lamp lead wire to the 1.5 V power source (or battery) as shown below.
   - Pink lead wire to Battery (+)
   - Black lead wire to Battery (–)

   **When 1.5 V applied**
   **Lamp ON**

   If out of specification, replace the caution lamp.




IDK111110022-02

"A": 1.5 V battery