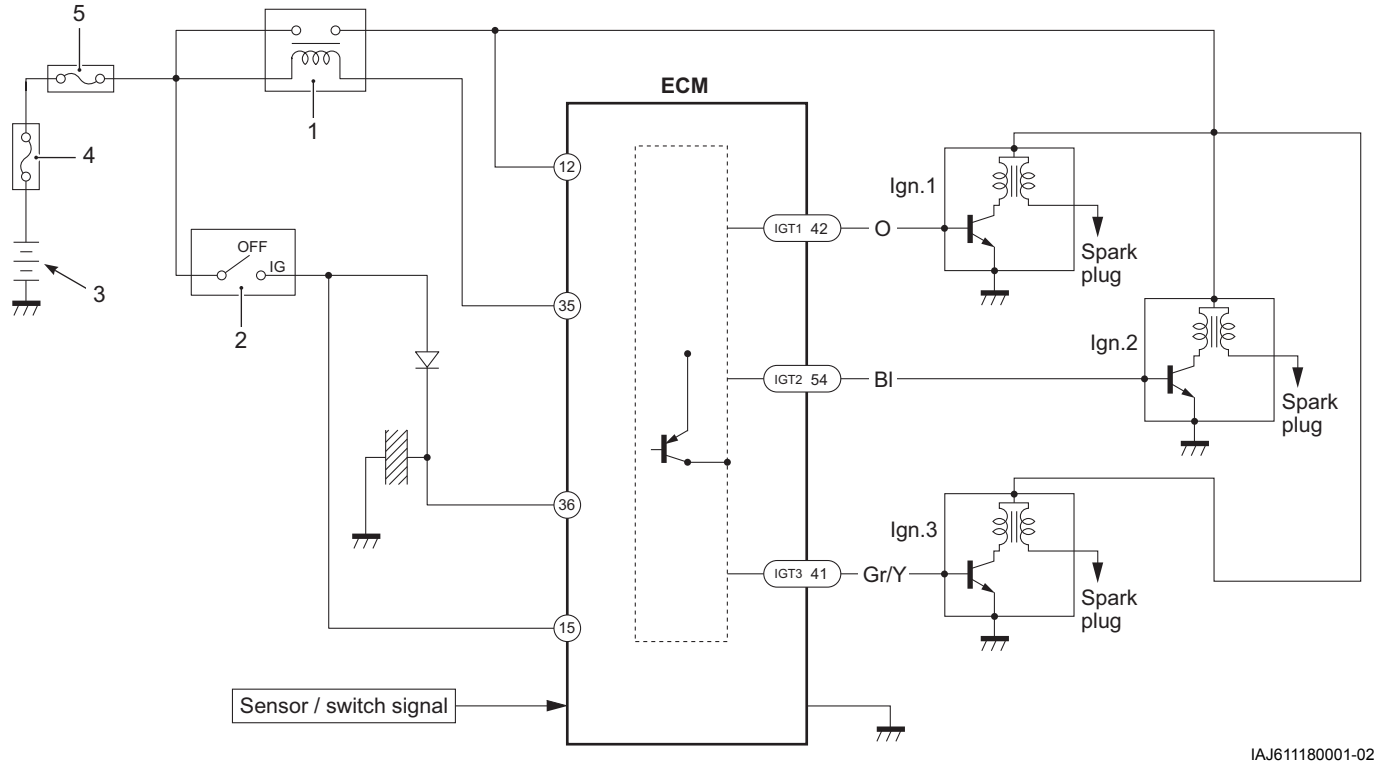
Ignition System

General Description

Ignition System Description

ZAJ6111801001

The ignition system used by the DF60A is a fully transistorized, electronic microcomputer timing advanced type. This system is battery powered, with the ECM controlling all of the ignition timing functions.
The ignition system is composed of the ignition coil, spark plug and components for system control (ECM, sensor, switch etc.).
When the ignition switch is “ON”, battery voltage (12 V) is applied to the circuit as shown in the illustration.
The ECM determines the optimum ignition timing and duration of current flowing through the ignition coil primary winding based on the signals received from various sensors. The ECM interrupts the base current of the power transistor inside the ignition coil thereby controlling current flow (ignition) to the primary winding of the ignition coil. In this way, a mutual induction high voltage occurs in the ignition coil secondary side and spark is generated.



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1. Main relay	3. Battery	5. Fuse 30 A
2. Ignition switch	4. Fuse 30 A	

Ignition Control Description

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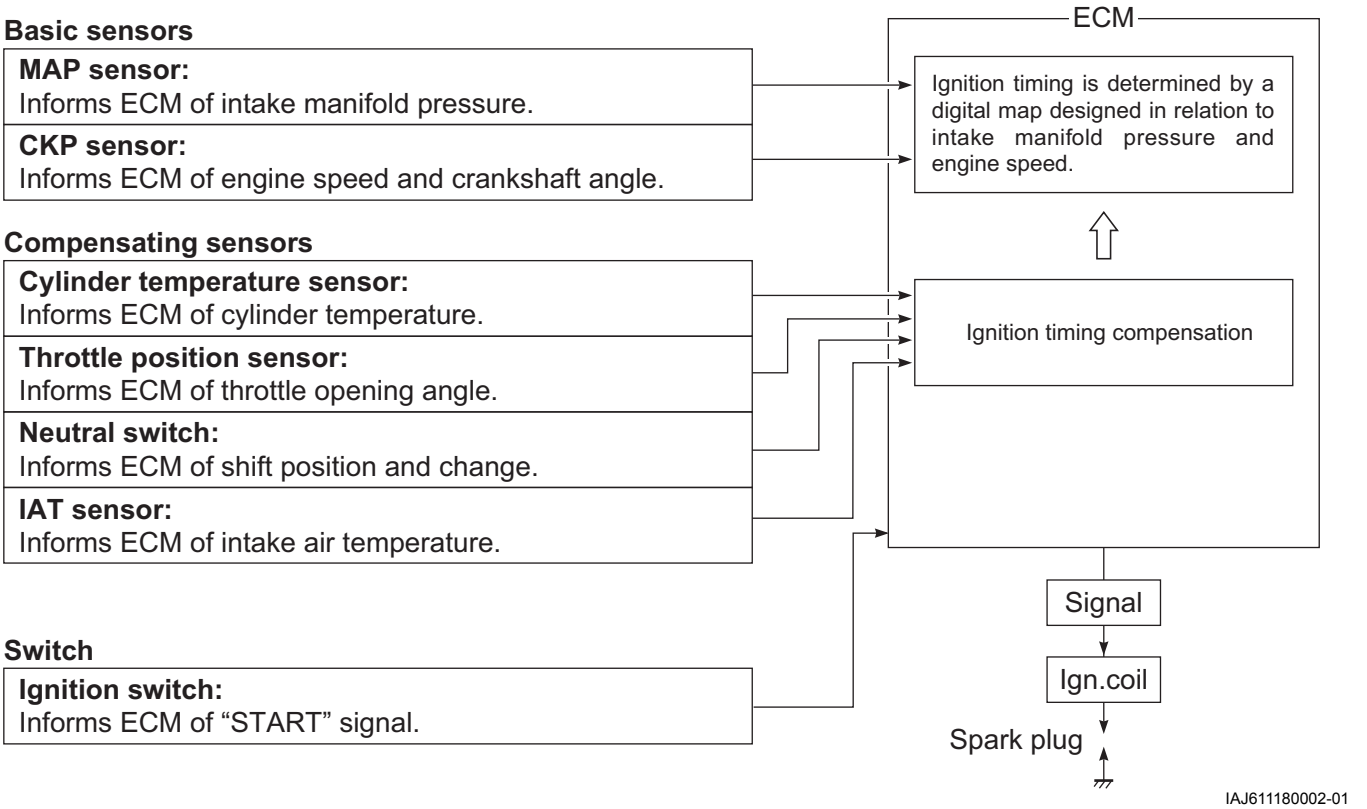
Sensors at specific points on the engine monitor current engine conditions and send signals to the ECM.
Based on these signals, the ECM determines the optimum ignition timing and releases voltage to the ignition coils.



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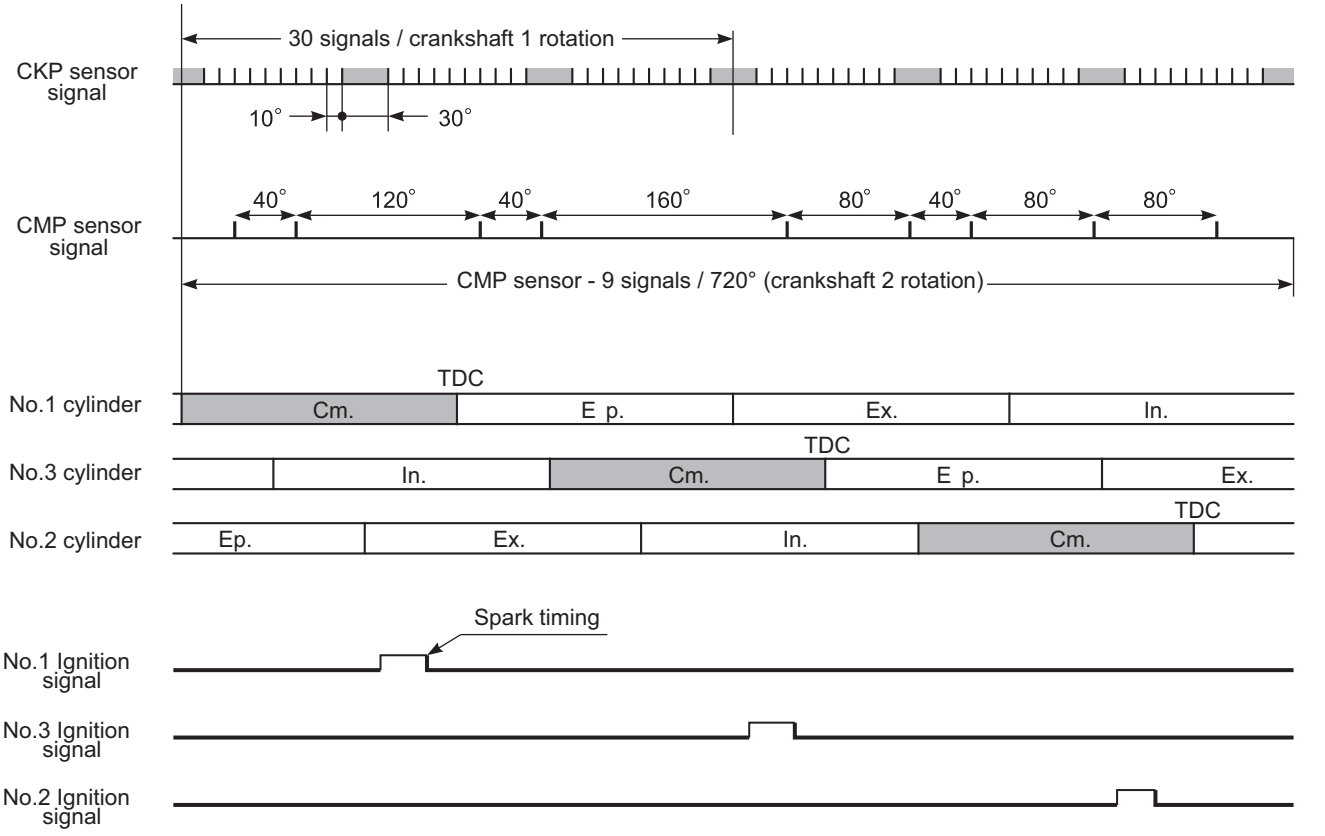
Ignition specification

Ignition system	Full-transistorized ignition
Advance	Electronic microcomputer control
Ignition timing	BTDC 2° – 25°
Firing order	1 — 3 — 2

Ignition Timing Chart

The following chart is an example for ignition at 20° BTDC.



Cm.: Compression, Ep.: Explosion, Ex.: Exhaust, In.: Intake,

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Ignition Timing Control Mode

- **When Cranking**
  The ignition timing is fixed at 5° BTDC until the engine starts.
- **When Idling / Trolling**
  The ignition timing is controlled within the range of 5° ± 2° BTDC to provide stable engine operation at the specified idling / trolling speed.
- **When Running (Normal Operation)**
  The ignition timing ranges between 2° – 25° BTDC, depending on engine operating conditions.

Component Location

Ignition System Components Location

ZAJ6111803001

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

Diagnostic Information and Procedures

Ignition System Symptom Diagnosis

ZAJ6111804001

Condition	Possible cause	Correction / Reference Item
Engine cranks, but will not start or weak spark. (No spark)	Blown fuse for ignition system.	*Replace.*
	Loose connection or disconnection of lead wire.	*Connect securely.*
	Faulty spark plug(s).	*Replace.*
	Faulty ignition coil.	*Replace.*
	Faulty CKP sensor.	*Replace.*
	Faulty CMP sensor or sensor trigger vane of camshaft.	*Replace.*
	Faulty ECM.	*Replace.*
Spark plug is wet or quickly becomes fouled with carbon.	Incorrect gasoline.	*Change.*
	Incorrect spark plug.	*Replace.*
Spark plug quickly become fouled with oil or carbon.	Worn piston ring.	*Replace.*
	Worn piston.	*Replace.*
	Worn cylinder.	*Replace.*
	Excessive valve stem to valve guide clearance.	*Replace.*
	Worn valve stem seal.	*Replace.*
Spark plug electrodes overheat or burn.	Incorrect spark plug.	*Change.*
	Overheated engine.	*Tune-up.*
	Loose spark plug.	*Tighten.*

Ignition System Troubleshooting

ZAJ6111804002

Before starting the troubleshooting, make sure that:

- There is not self-diagnostic code indication.
- Emergency stop switch plate is set in place.

Perform the following ignition system tests when the engine is hard to start in order to determine if the cause is in the ignition or another system.

Step	Action	Yes	No
1	*Check the ignition system connector for poor connections. Is there connection in the ignition system connectors?*	Go to step 2.	Poor connection of connectors.
2	*Check spark condition.*	Go to step 3.	No or weak sparks.
3	*Check if the spark plugs are in good condition.*	Go to step 4.	Replace spark plug with a new one.
4	*Check ignition coil assembly power supply and ground circuits for open and short. Are circuits in good condition?*	Go to step 5.	Repair or replace.
5	*Check ignition coil operating signal. Is result OK?*	Go to step 6.	Check ignition coil operating signal wire for open, short and poor connection.
6	*Measure the battery voltage between input lead wire at ECM with the ignition switch in "ON" position. Is result OK?*	Go to step 7.	• Faulty ignition switch. • Faulty ECM main relay. • Broken wire harness or poor connection of related circuit connector.
7	*Check CKP sensor. Refer to "CKP Sensor Inspection" in Section 1C (Page 1C-10). Is result OK?*	Go to step 8.	• Check air gap between CKP sensor and flywheel reluctor bars. • Adjust CKP sensor air gap. • Replace CKP sensor or flywheel.
8	*Check CMP sensor. Refer to "CMP Sensor Inspection" in Section 1C (Page 1C-11). Is result OK?*	Go to step 9.	• Check CMP sensor. • Check CMP sensor trigger vane. • Replace CMP sensor or In. camshaft.
9	*Substitute a known-good ignition coil assembly then repeat step 2. Is check result of step 2 satisfactory?*	Go to step 10.	Substitute a known good ECM, then repeat step 2.
10	*Check the ignition timing by using timing light (5° DTBC at 1 000 r/min). Is result OK?*	System is in good condition.	Check input signals related to this system.

Service Instructions

Spark Plug Removal and Installation

ZAJ6111806001

Refer to “Spark Plug Removal and Installation” in Section 0B (Page 0B-6).

Spark Plug Inspection

ZAJ6111806002

Refer to “Spark Plug Inspection and Cleaning” in Section 0B (Page 0B-7).

Ignition Coil Removal and Installation.

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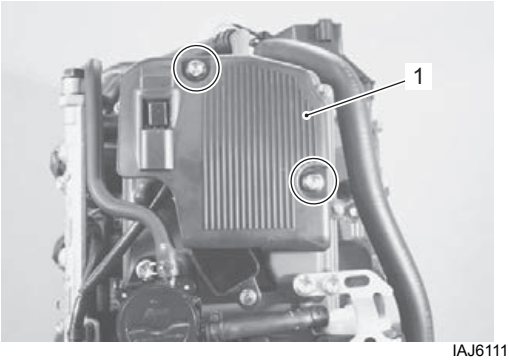
Removal

1) Disconnect the battery cables at the battery.
2) Remove the two bolts and fuel hose guard (1).



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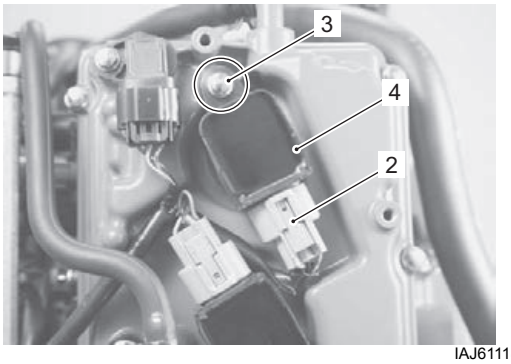
3) Disconnect the ignition coil connector (2).
4) Remove the bolt (3) securing the ignition coil, then pull out the ignition coil (4).



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Installation

1) Install the ignition coil, then secure the ignition coil with its mounting bolt.
2) Connect the ignition coil connector.
3) Connect the battery cables to battery.

Ignition Coil Inspection

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NOTE

The ignition coil power transistor and high tension lead are an integral part of the coils internal circuit. Using resistance measurements to check for a defect on either the primary or secondary coil is not possible.

Special tool

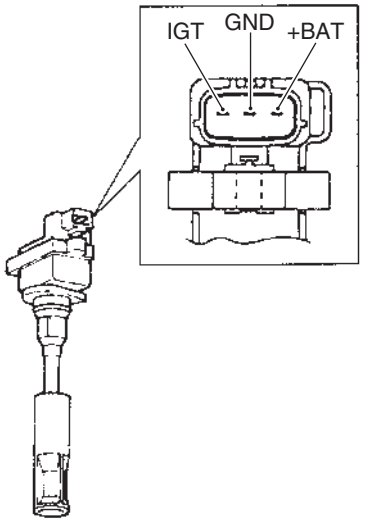
: 09930–99320 (Digital tester)

Tester knob indication

DCV

1) Turn the ignition key OFF.
2) Disconnect the ignition coil connector.
3) Check for continuity between the GND (–) terminal on the wiring harness side connector and the engine body ground.
4) Turn the ignition key to the ON position. Check for battery voltage by measuring between the BAT (+) terminal and GND terminal on the wiring harness side connector.

5) Connect the wiring harness connector to the ignition coil and measure the ignition operating signal. Refer to “Ignition Coil Operating Signal Inspection” (Page 1H-7).
   - If any failure exists, check for open circuit, short circuited battery, short circuited lead and connector’s contact condition for each circuit.
   - If there is no spark even with the wiring harness and spark plug in sound condition, perform the inspection again using an ignition coil that is known to be in good condition (new or used from another cylinder that is operating properly).
   - If there is still no spark even with the wiring harness, spark plug and ignition coil in sound condition, replace the ECM and perform the inspection again.



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Ignition Coil Operating Signal Inspection

ZAJ6111806005

Special tool
TOOL (A): 09930–88730 (36-pin test cord set)
CD-77 : Stevens peak reading voltmeter CD-77

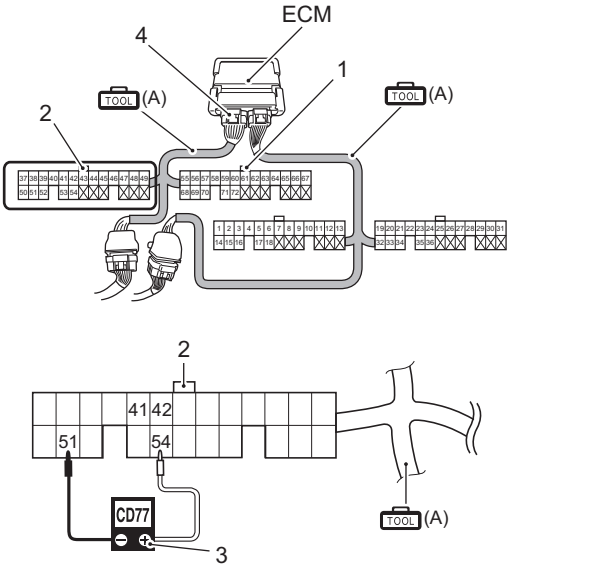
Tester knob indication
SEN 50

1) Disconnect all injector connectors from the fuel injectors.
2) Connect the test cord between the ECM and the wire harness as shown in figure then turn ignition switch ON.
3) Connect the tester probe Red (+) to each terminal, one at a time to test each circuit.

	Terminal	Wire color (engine harness)
No.1 Ignition coil	42	O
No.2 Ignition coil	54	Bl
No.3 Ignition coil	41	Gr/Y

4) Connect the tester probe Black (–) to No. 51 terminal (or to body ground).
5) Crank the engine and measure the voltage. If out of specification, inspect the related parts. Refer to “Ignition System Symptom Diagnosis” (Page 1H-4) and “Ignition System Troubleshooting” (Page 1H-5).

Ignition coil operating signal
Standard: Approx. 3 V or over



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1. Black connector	3. Peak voltmeter stevens CD-77
2. White connector	4. Gray test cord connector side

CKP Sensor Inspection

ZAJ6111806006

Refer to “CKP Sensor Inspection” in Section 1C (Page 1C-10).

CMP Sensor Inspection

ZAJ6111806007

Refer to “CMP Sensor Inspection” in Section 1C (Page 1C-11).

Ignition Switch Inspection

ZAJ6111806008

Refer to “Ignition Switch Inspection” in Section 1I (Page 1I-16).

ECM Main Relay Inspection

ZAJ6111806009

Refer to “ECM Main Relay Inspection” in Section 1A (Page 1A-35).