

Distributors & Ignition Systems

MOTORCRAFT SOLID STATE IGNITION SYSTEM

American Motors 6-Cylinder Engines

DESCRIPTION

The Solid State Ignition system, often called SSI, features a solid state distributor, electronic control unit, an ignition coil, and conventional distributor cap, rotor, spark plug wires and spark plugs. Other components include the battery, ignition switch, starter solenoid and primary resistance wires and bypass wire.

Electronic Control Unit – There are 6 wires leading from the control unit, 2 to one connector and 4 to the other. The white wire and red wire leading to the 2-wire connector are the ignition feed circuits – the white wire for cranking, the red wire after the engine is running. The control unit uses the green wire to turn power to the ignition coil off and on. The orange and violet wires are used to transmit signals from the distributor's pick-up coil (sensor) to control unit. The black wire supplies the distributor ground circuit.

Distributor – Components are divided into 3 groups, the pick-up coil (sensor) and trigger wheel, the spark advance and the cap and rotor. The trigger wheel, which has 6 teeth (one for each cylinder), rotates with the distributor shaft. The pick-up coil is a coil of fine wire mounted around a permanent magnet. There are no contacting surfaces between the trigger wheel and pick-up coil. Dwell is not adjustable and is controlled electronically. Centrifugal advance is controlled by engine speed, vacuum spark advance by carburetor ported vacuum supplied to the distributor's vacuum unit. Distributor cap and rotor are of conventional design.

Ignition Coil – Coils are oil-filled and, sealed and contain a primary and secondary circuit. As in any system, the coil's basic function is to convert battery voltage applied to the primary circuit into high secondary voltage for firing the spark plugs. The coil has positive and negative primary terminals and a single secondary terminal. A special coil connector slides over the primary terminals.

Resistance Wire – A wire with 1.3-1.4 ohms resistance is provided in the red wire (engine running) circuit to supply less than battery voltage to the coil. This resistance wire is bypassed during starting so that full battery voltage may be applied to the coil. The by-pass is accomplished through the "I" terminal of the starter solenoid.

System Protection – The electronic control unit has built-in reverse polarity and transient voltage protection. However, damage to the system can occur if proper testing procedures are not followed.

OPERATION

The control unit and ignition coil are turned on whenever the ignition switch is in the "START" or "ON" position. When the engine begins turning the distributor shaft, the trigger wheel rotates with it. As each tooth passes the pick-up coil, it interrupts the magnetic field around the pick-up coil. This continual build up and collapse of the magnetic field provides a signal to the control unit. The control unit receives this signal

and turns the power to the ignition coil's primary circuit off and on as each tooth passes the pick-up coil. The collapse of the magnetic field in the ignition coil primary circuit induces a high voltage surge in the secondary. This causes current to flow from the coil to the distributor, rotor, cap and spark plug wires.

SOLID STATE IGNITION SYSTEM NOTES

When disconnecting wire from spark plug or distributor cap, twist rubber boot slightly to loosen. Grasp boot (not wire) and pull off with steady, even force.

When disconnecting control unit connectors, pull apart with firm, straight pull. Do not attempt to pry apart with screwdriver. When connecting, press together firmly to overcome hydraulic pressure caused by the silicone dielectric compound. If connector locking tabs weaken or break off, it is unnecessary to replace connector. Just press firmly together and bind with electrical tape or a harness tie strap. This should assure a good connection.

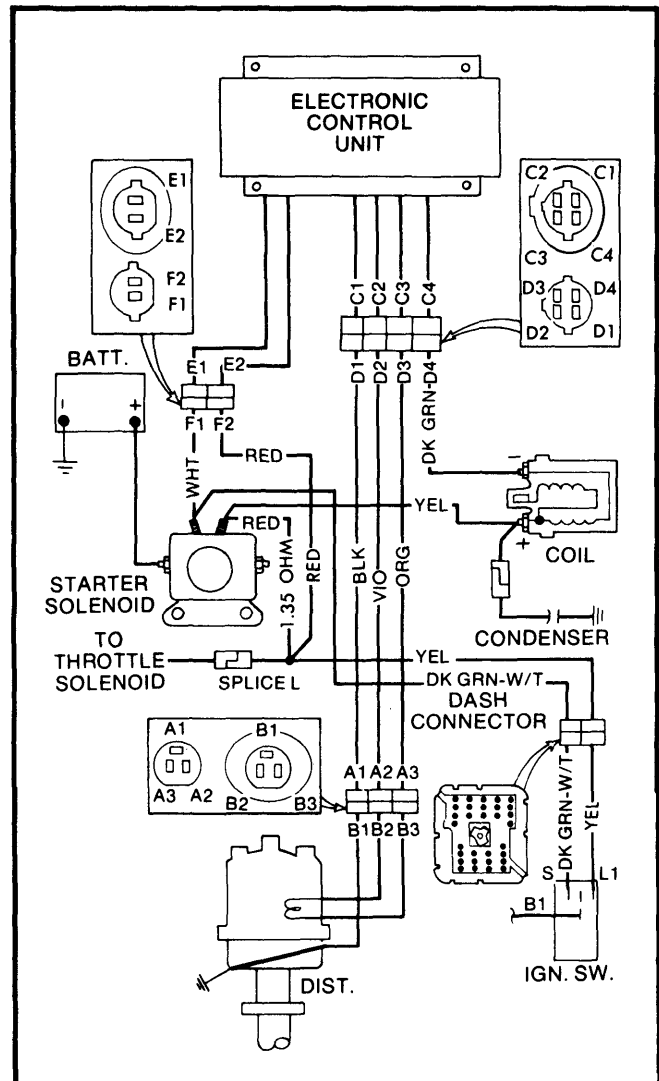


Fig. 1 American Motors Solid State Ignition System Wiring Diagram

MOTORCRAFT SOLID STATE IGNITION SYSTEM (Cont.)

TESTING

SECONDARY SPARK VOLTAGE CHECK

CAUTION — When checking secondary voltage, do not remove spark plug wires from No. 1 or No. 5 spark plugs, as this could damage pick-up coil.

NOTE — On vehicles with catalytic converter, do not run engine for more than 30 seconds with a spark plug wire removed.

- 1) Disconnect ignition coil high tension wire from center tower of distributor cap. Using insulated pliers, hold wire terminal approximately $\frac{1}{2}$ " from engine block or intake manifold.
- 2) Rotate engine with starter motor and check for spark at gap to ground. If no spark occurs, check coil primary and secondary resistance and tests that follow. If spark occurs, reconnect coil wire to distributor center tower. Remove wire from one spark plug.
- 3) Hold spark plug wire approximately $\frac{1}{2}$ " from cylinder head while cranking engine. Observe spark at gap. If spark occurs, ignition system is not at fault. Check other systems such as fuel and ignition timing. If no spark occurs, check for defective rotor, distributor cap or spark plug wires.

OSCILLOSCOPE TESTS

NOTE — Do not operate engine for more than 30 seconds with spark plug wire removed, if vehicle is equipped with a catalytic converter.

Perform the following tests using an oscilloscope which has inductive type clamps. Follow manufacturer's instructions for connecting scope. Also use suitable grounding probes and insulated pliers.

CAUTION — When checking secondary voltage, do not remove spark plug wires from spark plugs for cylinder No. 1 or No. 5. Damage to pick-up coil could occur.

Open Circuit Output Voltage — 1) With scope attached to ignition coil, start engine and observe secondary spark voltage. Remove one spark plug wire from distributor cap. Observe voltage applied to disconnected spark plug wire on oscilloscope. Scope should read 24,000 volts minimum with engine running at 1000 RPM.

2) If voltage is less than 24,000 volts, the problem could be in any or all of the following — the control unit, ignition coil, primary wiring or in coil secondary wire.

Required Spark Plug Voltage — 1) Make this test with engine running at approximately 1000 RPM and with secondary voltage pick-up connected over coil-to-distributor high tension wire. Firing voltage should be relatively even and be 5,000-16,000 volts. If firing voltage is bad, check individual cylinder firing voltage. Each cylinder should receive a minimum of 4,000 volts and have a maximum variation between cylinders of 3,000-5,000 volts.

2) If voltage is below 4,000 volts, check for closed spark plug gaps, cracked wires or any other damage that could cause voltage to "Leak" off.

Rotor-to-Cap Voltage Drop — Connect high voltage pick-up to the coil-to-distributor secondary wire. Remove one spark plug wire and ground the wire to engine. Run engine at idle. Do not let a spark gap appear between wire and ground. High voltage reading should be 8,000 volts maximum. If voltage fails to meet specifications, check rotor or distributor cap.

HIGH TENSION WIRE RESISTANCE CHECKS

Coil-to-Distributor Wire Resistance — Using an ohmmeter, check resistance of coil-to-distributor wire. Resistance should be 10,000 ohms maximum.

Spark Plug Wire Resistance — Check spark plug wire resistance, using an ohmmeter. For USED wires, resistance should not exceed 5,000 ohms per INCH with spark plug wire connected to distributor cap and check made through internal cap terminal. For NEW wires, resistance reading should be less than 7,000 ohms per FOOT.

IGNITION COIL RESISTANCE CHECK

Primary Resistance — Remove connector from positive and negative coil terminals. Be sure ignition switch is "OFF." Set an ohmmeter on low scale and connect ohmmeter leads to positive and negative terminals. Ohmmeter reading should be 1.13-1.23 ohms at 75°F. With coil temperature at 200°F, a 1.5 ohm reading is acceptable.

Secondary Resistance — Turn ignition switch "OFF". Set ohmmeter to high scale (x 1000 scale) and connect one lead to coil negative terminal and other lead to coil tower (remove coil secondary wire). Ohmmeter reading should be 7,700-9,300 ohms with coil temperature at 75° F. With coil temperature at 200° F or above, a maximum reading of 12,000 ohms is acceptable.

CURRENT FLOW CHECK

1) Remove connector from ignition coil. Remove positive wire from connector, then negative wire. Connect ammeter between positive terminal of coil and disconnected positive wire. Connect jumper wire from negative terminal to good ground.

2) Turn ignition switch "ON". Current flow should be approximately 7 amps., but should not exceed 7.6 amps. If more than 7.6 amps., replace ignition coil.

3) With ammeter still connected to coil positive terminal, remove jumper wire from negative terminal. Connect coil green wire to negative terminal. Current flow should be approximately 4 amps. If less than 3.5 amps., check for poor connections in 4-wire and 3-wire connectors or for poor ground at distributor ground screw.

4) If current flow is greater than 5 amps., the control unit is defective and must be replaced. Start engine. Normal current flow with engine running is 2.0-2.4 amps. If outside of specifications, replace control unit.

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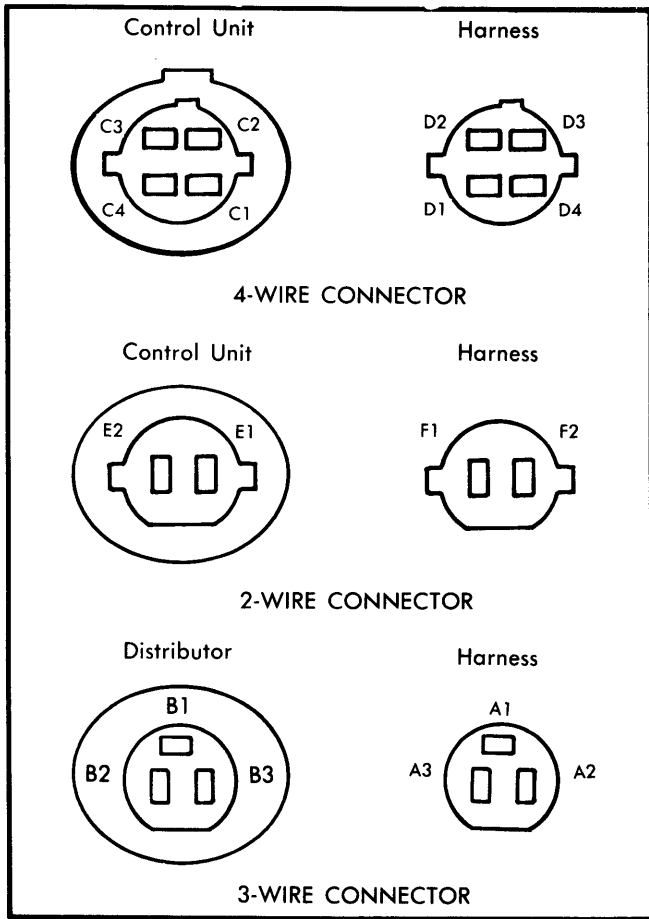


Fig. 2 Solid State Ignition Connectors

COIL PRIMARY CIRCUIT CHECK

1) Connect a voltmeter to coil positive terminal and ground. Turn ignition switch to "ON" position. Reading should be 5.5-

6.5 volts. If voltage is too high (battery voltage), proceed to step 4). If voltage is too low (below 5.5 volts), disconnect condenser lead. If voltage is now correct, replace condenser. If voltage is still low, proceed to step 7).

2) If voltage was 5.5-6.5 volts in step 1), turn ignition switch to "START" position. Voltage should be the same as battery cranking voltage. If correct, check other systems (fuel, mechanical, etc.) for problems. If voltage is not correct, proceed to next step.

3) Check wire connected to starter solenoid "I" terminal for shorts or opens. If wire is OK, check for defective starter solenoid. Replace solenoid if necessary.

4) With ignition switch in "ON" position, voltmeter still connected to coil positive terminal, disconnect wire connected to starter solenoid "I" terminal. If voltage drops to 5.5-6.5 volts, replace starter solenoid.

5) If voltage remains high, connect a jumper wire from coil negative terminal to ground. If voltage drops to 5.5-6.5 volt range, proceed to step 6). If voltage does not drop, resistance wire is defective. Replace resistance wire and retest, beginning with step 2).

6) With ignition switch "OFF", connect an ohmmeter lead to the coil negative terminal and the other lead to the green wire terminal "D4" of the 4-wire harness connector. Also check from black wire terminal "D1" to ground. If continuity is OK, replace the control unit. If no continuity is present, repair wire in harness and retest beginning at step 2).

7) With ignition switch "OFF", connect ohmmeter leads between coil positive terminal and dash connector terminal "AV" (yellow wire). If resistance is not 1.3-1.4 ohms, replace resistance wire. If ohmmeter reading is to specifications, proceed with next step.

TYPICAL MOTORCRAFT IGNITION OSCILLOSCOPE PATTERNS

To analyze the Solid State and Dura-Spark Ignition Systems using an oscilloscope, follow the procedures recommended by the manufacturer of the scope. The electrical display patterns will appear similar to patterns of conventional breaker type ignition systems except as shown below.

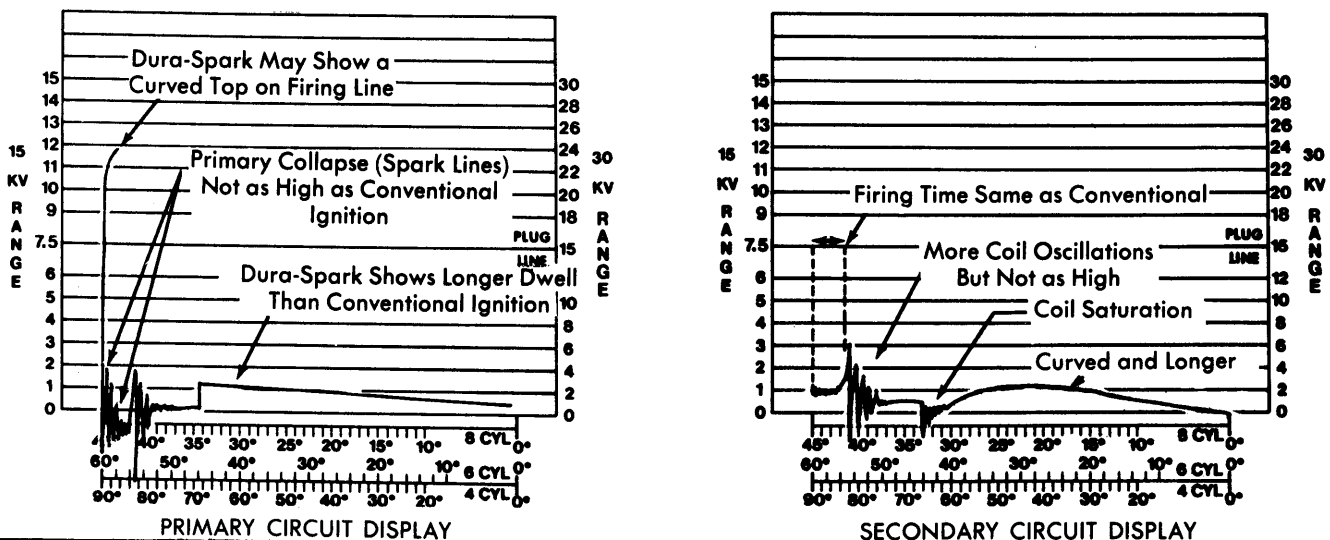


Fig. 3 Normal Oscilloscope Patterns Shown for Solid State Ignition and Dura-Spark Systems

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8) With ignition switch still "OFF", connect ohmmeter leads between dash connector terminal "AV" (yellow wire) and ignition switch terminal "L1". Resistance should be less than 0.1 ohm. If reading is to specifications, repair feed wire or replace ignition switch.

9) If resistance is more than 0.1 ohm, check for opens in wire or for poor connections at connectors. Repair or replace as necessary.

CONTROL UNIT & PICK-UP COIL CHECK

1) Disconnect high tension coil wire from distributor cap. Attach a modified spark plug to coil wire (side electrode of plug cut off and ground wire attached to side of plug casing). If plug is not available, hold coil wire $\frac{1}{2}$ " from engine block, using insulated pliers.

2) Turn the ignition switch "ON", then disconnect 4-wire connector from control unit. Watch for spark as connector is disconnected. If sparking occurs, proceed with next step. If no sparking occurs, proceed to step 6).

3) Turn ignition switch "OFF" and disconnect 4-wire connector at control unit. Connect an ohmmeter between the orange and violet wire terminals "D2" and "D3" of harness connector. Ohmmeter reading should be 400-800 ohms. If reading is correct, proceed to step 8). If reading is not correct, proceed to next step.

4) Disconnect and reconnect 3-wire connector at distributor. If ohmmeter reading is now correct, proceed to step 8). If reading is still not correct, proceed to next step.

5) Disconnect 3-wire connector at the distributor and connect ohmmeter leads between the orange and violet wire terminals "B2" and "B3" of distributor connector. If reading is now 400-800 ohms, repair harness between 3-wire and 4-wire connectors. If reading is still not to specifications, replace pick-up coil assembly in distributor.

6) With ignition switch "OFF" and 4-wire connector disconnected, connect ohmmeter leads to battery negative terminal (ground) and black wire terminal "D1" in harness connector. Ohmmeter reading should be nearly zero (less than .002 ohms).

7) If ohmmeter reading is OK, proceed to step 3). If reading is above specification, check for source of bad ground (ground cable resistance, distributor-to-engine block resistance, or ground screw in distributor-to-black wire terminal "D1").

8) With ignition switch "ON" and voltmeter connected to harness side of 4-wire connector orange and violet wire terminals "D2" and "D3", crank engine. Voltmeter reading should fluctuate. If no voltage fluctuation occurs, check for defective trigger wheel, distributor shaft not turning, or missing trigger wheel retaining pin (shaft turning but not trigger wheel).

CONTROL UNIT POWER FEED CHECK

NOTE — Before making this check, always check ignition coil primary circuit first.

1) Disconnect 2-wire connector at control unit. Connect voltmeter negative lead to ground and positive lead to red wire harness connector terminal "F2". Turn ignition switch "ON". Voltage reading should be battery voltage (within 0.2

volts). If reading is correct, replace control unit and proceed to steps 3) and 4).

2) Locate and repair cause of voltage reduction (corroded connectors, defective ignition switch, etc.) If connectors are repaired and there is spark at coil wires, start engine. If connectors are repaired and there is no spark at coil wire, replace control unit.

3) Connect voltmeter negative lead to ground and positive lead to white wire harness connector terminal "F1" in 2-wire connector. Crank engine. Voltmeter reading should be within 1 volt of battery cranking voltage. If not, check for bad connections, ignition switch or starter solenoid.

4) Turn ignition switch "OFF", connect 2-wire connector and disconnect 4-wire connector. Connect an ammeter to black wire terminal "C1" of control unit connector and to ground. Turn ignition switch "ON". Reading should be 0.9-1.1 amps. If reading is higher or lower than specified, replace control unit.

OVERHAUL

DISTRIBUTOR

Disassembly — 1) Remove distributor cap and rotor. Using suitable gear puller (J-28509), remove trigger wheel (two screwdrivers can be used to pry trigger wheel upward). Remove pin.

2) Remove pick-up coil retainer and washers from pivot pin on base plate. Remove pick-up coil plate screws. Lift pick-up coil assembly from distributor. Vacuum unit need not be removed unless replacement is necessary.

Reassembly — Reverse disassembly procedure, being sure to coat brass surface of rotor with silicone grease. If sensor or vacuum unit was replaced, check ignition timing.

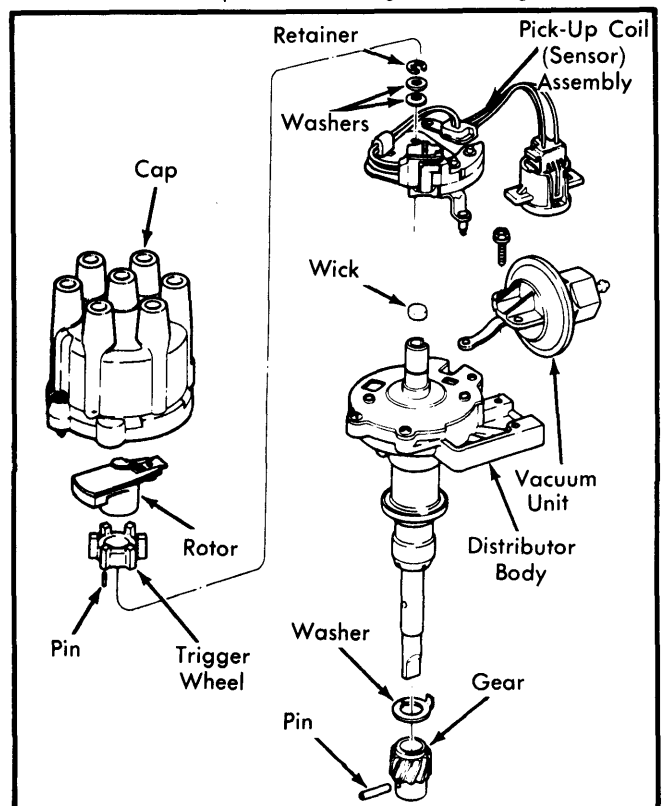


Fig. 4 Overhauling Solid State Distributor