## Starting System

**Special Tool(s)**

| | |
|---|---|
|  ST1137-A | 73III Automotive Meter<br>105-R0057 or equivalent |
|  ST2574-A | Flex Probe Kit<br>105-R025C or equivalent |
|  ST2834-A | Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS)<br>software with appropriate hardware, or equivalent scan tool |

**Principles of Operation**

The starting system is electronically controlled by the Passive Anti-Theft System (PATS) . PATS recognizes the correct electronically coded ignition key and signals the PCM to provide a ground for the starter relay. The energized relay provides voltage to the starter solenoid with the key in the START position, thereby allowing the starter motor to activate.

**Inspection and Verification**

**WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.**

**NOTE:** *The anti-theft system must be functioning correctly before a logical starting system diagnosis can be carried out. Address anti-theft system concerns before continuing. Refer to Section 419-01B.*

1. Verify the customer concern by operating the starting system.
2. Remove the accessory drive belt. Refer to Section 303-05. Verify the crankshaft and each of the components driven by the accessory drive belt rotate and are not seized or damaged.
3. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart:

**Visual Inspection Chart**

| Mechanical | Electrical |
|---|---|
| • Starter motor<br>• Flexplate<br>• Flywheel | • Battery<br>• Smart Junction Box (SJB) fuse 21 (10A)<br>• Bussed Electrical Center (BEC) fuse 4 (30A)<br>• Anti-theft system<br>• Damaged wiring harness<br>• Loose or corroded connections |

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
5. **NOTE:** *Make sure to use the latest scan tool software release.*

   If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC) .
6. **NOTE:** *The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM .*

   If the scan tool does not communicate with the VCM :
   - check the VCM connection to the vehicle.
   - check the scan tool connection to the VCM .
   - refer to Section 418-00, No Power To The Scan Tool, to diagnose no power to the scan tool.
7. If the scan tool does not communicate with the vehicle:
   - verify the ignition key is in the ON position.

- verify the scan tool operation with a known good vehicle.
- refer to Section 418-00 to diagnose no response from the PCM.

8. Carry out the network test.
   - If the scan tool responds with no communication for one or more modules, refer to Section 418-00.
   - If the network test passes, retrieve and record continuous memory DTCs.
9. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM.
10. If the DTCs retrieved are related to the concern, go to PCM DTC Chart. For all other DTCs, refer to Section 419-10.
11. If no DTCs related to the concern are retrieved, GO to Symptom Chart.

**DTC Chart**

**PCM DTC Chart**

| DTC | Description | Action |
|---|---|---|
| P0512 | Starter Request Circuit | GO to Pinpoint Test A. |
| P0705 | Transmission Range (TR) Sensor Circuit Failure | Refer to the appropriate section in Group 307 for the procedure. |
| P0708 | TR Sensor Circuit Failure | Refer to the appropriate section in Group 307 for the procedure. |
| P1260 | Theft Detected, Vehicle Immobilized | REFER to the DTC Chart in Section 419-01B. All other PCM DTCs, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. |
| P1702 | TR Sensor Circuit Failure | Refer to the appropriate section in Group 307 for the procedure. |
| P1705 | TR circuit is not indicating PARK/NEUTRAL during self-test | Refer to the appropriate section in Group 307 for the procedure. |

**Symptom Chart**

**Symptom Chart**

| Condition | Possible Causes | Action |
|---|---|---|
| • The engine does not crank | • Battery<br>• Fuse<br>• Starter relay<br>• Starter motor<br>• Ignition switch<br>• PCM<br>• Circuitry open<br>• Digital Transmission Range (TR) sensor (automatic transmission only)<br>• Clutch Pedal Position (CPP) switch (manual transmission only) | • GO to Pinpoint Test A. |
| • Unusual starter noise | • Starter motor mounting<br>• Starter motor<br>• Incorrect starter drive engagement<br>• Damaged flexplate or flywheel ring gear teeth | • GO to Pinpoint Test B. |
| • The engine cranks slowly | • Battery<br>• Starter motor | • CARRY OUT the Starter Motor — Ground Circuit component test. |
| • The starter spins but the engine does not crank | • Starter motor<br>• Damaged flywheel or flexplate ring gear teeth | • INSPECT the starter motor mounting and engagement. REFER to Starter Motor Drive Gear and Flywheel Ring Gear Inspection in this section.<br>• INSPECT the flywheel or flexplate for damaged, missing or worn teeth. REPAIR as necessary. |

**Pinpoint Tests**

**Pinpoint Test A: The Engine Does Not Crank**

Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

**Normal Operation**

In normal operation, voltage from the Bussed Electrical Center (BEC) is supplied to the ignition switch through circuit 1050 (LG/PK). When the ignition switch is placed in the START position, voltage is supplied through circuit 1522 (DG) to the Smart Junction Box (SJB) .

For automatic transmission equipped vehicles, voltage is supplied from the SJB on circuit 32 (RD/LB) to the BEC , from the BEC power is supplied to the Transmission Range (TR) sensor through circuit 33 (WH/PK). In PARK or NEUTRAL, voltage is supplied from the TR sensor through circuit 33 (WH/PK) to the starter relay coil located in the BEC . The starter relay coil is supplied ground from the PCM through circuit 1419 (LG/YE).

For manual transmission equipped vehicles, when the clutch pedal is depressed, the Clutch Pedal Position (CPP) supplies a ground to the PCM through circuit 92 (LB/YE). The starter relay coil is supplied ground from the PCM through circuit 1419 (LG/YE). Voltage is supplied to the starter relay coil located in the BEC through

circuit 33 (WH/PK).

When the starter relay is energized, voltage supplied to the relay switch is sent to the starter motor solenoid through circuit 113 (YE/LB). Battery voltage is supplied to the starter motor through circuit 2037 (RD) at all times.

- DTC P0512 (Starter Request Circuit) — this DTC sets when the PCM detects an open or short to ground on the starter request circuit.

**This pinpoint test is intended to diagnose the following:**

- Fuse(s)
- Battery
- Anti-theft system
- Starter relay
- Ignition switch
- Circuitry
- PCM

## PINPOINT TEST A : THE ENGINE DOES NOT CRANK

### A1 CHECK THE BATTERY

- Check the battery condition and charge. Refer to Section 414-01.

**Is the battery OK?**

| | |
|---|---|
| **Yes** | GO to A2. |
| **No** | CHARGE or INSTALL a new battery. REFER to Section 414-01. TEST the system for normal operation. |

### A2 CHECK PCM FOR DTCS

- Using the DTCs retrieved in Inspection and Verification, check for PCM DTCs.

**Were any PCM DTCs retrieved?**

| | |
|---|---|
| **Yes** | If PCM DTC P0512 is retrieved, GO to A13.<br>If PCM DTC P1260 is retrieved, REFER to Section 419-01B. All other PCM DTCs, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual. |
| **No** | For automatic transmission, GO to A3. For manual transmission, GO to A4. |

### A3 CHECK THE PCM AUTOMATIC TR SENSOR PID

- Connect the scan tool.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: DataLogger — PCM.
- While observing the TR PID, place the vehicle in PARK and then NEUTRAL.

**Does the PID match the gear selection?**

| | |
|---|---|
| **Yes** | GO to A5. |
| **No** | GO to Section 307-01 to diagnose the TR sensor. |

### A4 CHECK THE PCM CLUTCH PEDAL AT OR NEAR BOTTOM OF TRAVEL (CPP_ BOT) PID

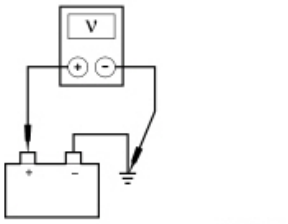
- Connect the scan tool.
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: DataLogger — PCM.
- While observing the CPP_ BOT) PID, fully disengage the clutch.

**Does the PID change from NO to YES?**

| | |
|---|---|
| **Yes** | GO to A5. |
| **No** | GO to A19. |

### A5 CHECK THE BATTERY GROUND CABLE

- Measure the voltage between the positive battery post and the battery ground cable connection on the engine.



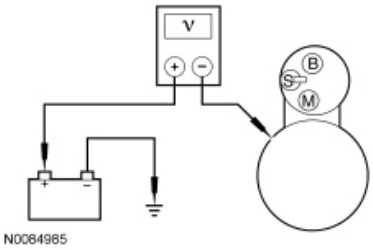

AJ0280-A

**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **No** | INSTALL a new battery ground cable. REFER to Section 414-01. TEST the system for normal operation. |
| **Yes** | GO to A6. |

**A6 CHECK THE STARTER MOTOR GROUND**

- Measure the voltage between the positive battery post and the starter motor case.



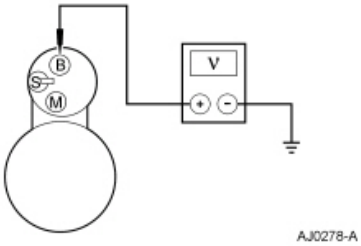

N0084985

**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | GO to A7. |
| **No** | CLEAN the starter motor mounting flange and make sure the starter motor is correctly mounted. TEST the system for normal operation. |

**A7 CHECK THE POWER SUPPLY TO THE STARTER MOTOR**

- Measure the voltage between starter motor B-terminal and ground.



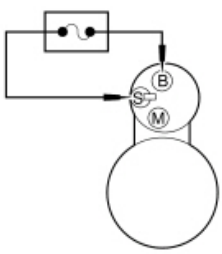

AJ0278-A

**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | GO to A8. |
| **No** | INSTALL a new positive battery cable. REFER to Section 414-01. TEST the system for normal operation. |

**A8 CHECK THE STARTER MOTOR SOLENOID OPERATION**

- Connect a fused jumper wire to the B-terminal of the starter motor. Momentarily connect the other lead of the fused jumper wire to the starter motor S-terminal.




N0084983

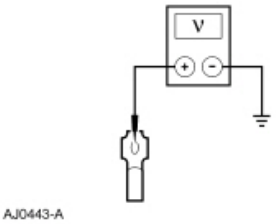
**Did the starter motor engage and the engine crank?**

| | |
|---|---|
| **Yes** | GO to A9. |
| **No** | INSTALL a new starter motor. REFER to Starter Motor — 4.0L SOHC or Starter Motor — 4.6L (3V) or Starter Motor — 5.4L (4V) in this section. TEST the system for normal operation. |

**A9 CHECK THE START INPUT TO THE STARTER MOTOR**

**NOTE:** *Depress clutch pedal for manual transmission.*

- Disconnect: Starter Motor S-Terminal C197B.
- Measure the voltage between starter motor S-terminal connector C197B, circuit 113 (YE/LB), and ground, while holding the ignition switch in the START position.



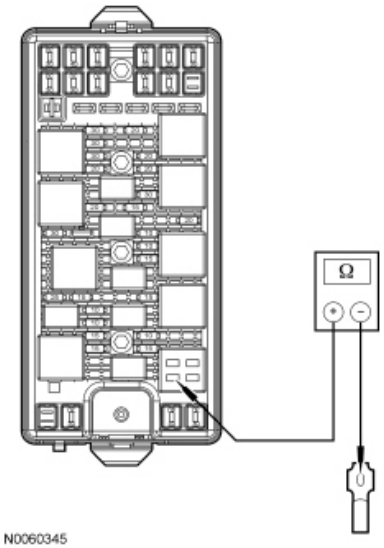

**Is the voltage greater than 10 volts in START?**

| | |
|---|---|
| **Yes** | CLEAN the starter motor S-terminal and connector. CHECK the wiring and the starter motor for a loose connection. TEST the system for normal operation. |
| **No** | GO to A10. |

**A10 CHECK CIRCUIT 113 (YE/LB) FOR AN OPEN**

**NOTICE: Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.**

- Measure the resistance between BEC starter relay, circuit 113 (YE/LB), and starter motor S-terminal connector C197B, circuit 113 (YE/LB).

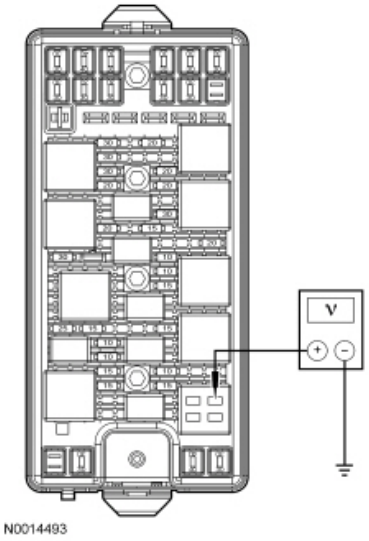



**Is the resistance less than 5 ohms?**

| | |
|---|---|
| **Yes** | GO to A11. |
| **No** | REPAIR circuit 113 (YE/LB) for an open. TEST the system for normal operation. |

**A11 CHECK THE BATTERY SUPPLY TO THE STARTER RELAY**

- Measure the voltage between BEC starter relay, circuit 2037 (RD) and ground.

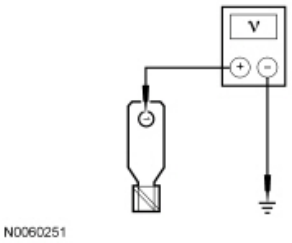



**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | GO to A13. |
| **No** | GO to A12. |

**A12 CHECK THE BATTERY SUPPLY TO THE BEC**

- Disconnect: BEC Connector 1035E.
- Measure the voltage between BEC C1035E Pin 1, circuit 2037 (RD) and ground.

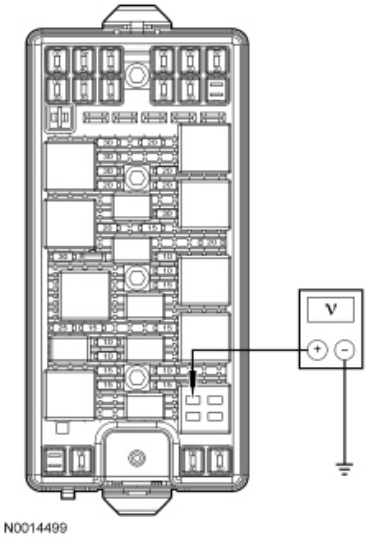



**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | VERIFY BEC fuse 4 (30 A) is OK. If not OK, REFER to the Wiring Diagram Manual to identify the possible causes of the circuit short. If OK, REPLACE the BEC . TEST the system for normal operation. |
| **No** | REPAIR circuit 2037 (RD) for an open. TEST the system for normal operation. |

**A13 CHECK THE START INPUT TO THE STARTER RELAY**

- Disconnect: Starter Relay.
- Measure the voltage between BEC starter relay, circuit 33 (WH/PK) and ground, while holding the ignition switch in the START position.

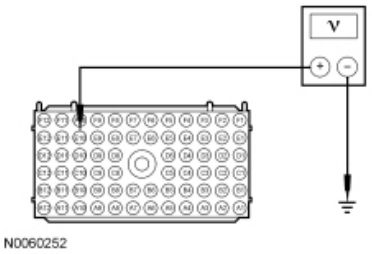



**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | GO to A17. |
| **No** | GO to A14. |

**A14 CHECK THE START INPUT VOLTAGE TO THE BEC**

- Disconnect: BEC C1035B.
- Measure the voltage between BEC C1035B Pin E10, circuit 33 (WH/PK) and ground, while holding the ignition switch in the START position.

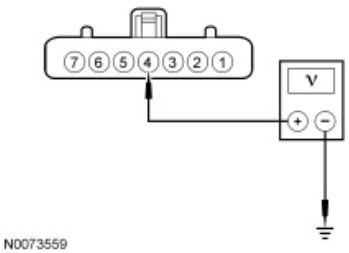



**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | REPLACE the BEC . TEST the system for normal operation. |
| **No** | GO to A15. |

**A15 CHECK THE POWER SUPPLY TO THE IGNITION SWITCH**

- Disconnect: Ignition Switch C250.
- Measure the voltage between ignition switch C250 Pin 4, circuit 1050 (LG/VT) and ground.

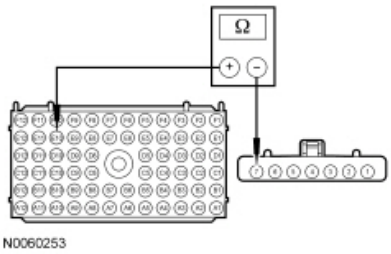



**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | GO to A16. |
| **No** | VERIFY BEC fuse 68 (20 A) is OK. If OK, REPAIR circuit 1050 (LG/VT) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagram Manual to identify the possible causes of the circuit short. |

**A16 CHECK CIRCUITS 1522 (DG) AND 33 (WH/PK) FOR AN OPEN**

- Measure the resistance between ignition switch C250 Pin 7, circuit 1522 (DG) and BEC C1035B Pin E10, circuit 33 (WH/PK).

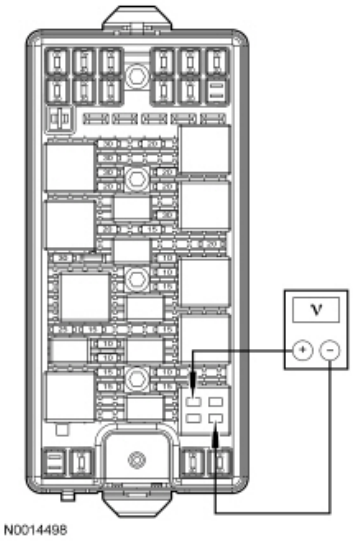



**Is the resistance less than 5 ohms?**

| | |
|---|---|
| **Yes** | CARRY OUT the Ignition Switch Component Test.<br>Refer to Wiring Diagrams Cell 149 for component testing.<br>INSTALL a new ignition switch. REFER to Section 211-05. TEST the system for normal operation. |
| **No** | VERIFY Smart Junction Box (SJB) fuse 21 (10 A) is OK. If OK, REPAIR circuit 1522 (DG) or circuit 33 (WH/PK) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagram Manual to identify the possible causes of the circuit short. |

**A17 CHECK THE GROUND SIGNAL TO THE STARTER RELAY**

- Measure the voltage between BEC starter, circuit 1419 (LG/YE), and starter relay, circuit 33 (WH/PK), while holding the ignition switch in the START position, depress clutch pedal for manual transmission.

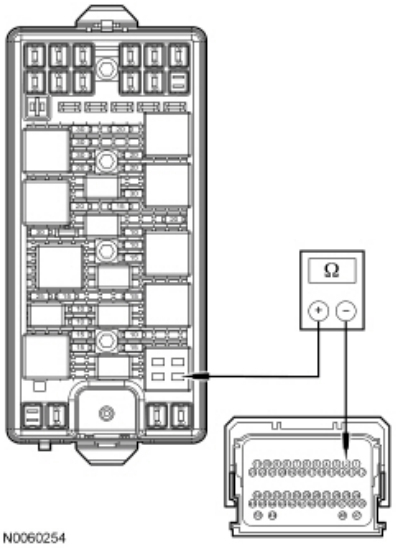



**Is the voltage greater than 10 volts?**

| | |
|---|---|
| **Yes** | CARRY OUT the Starter Motor Relay Component Test.<br>Refer to Wiring Diagrams Cell 149 for component testing.<br>INSTALL a new starter motor relay. TEST the system for normal operation. |
| **No** | GO to A18. |

**A18 CHECK CIRCUIT 1419 (LG/YE) FOR AN OPEN**

- Disconnect: PCM C175B.
- Measure the resistance between BEC starter relay pin 85, circuit 1419 (LG/YE) and PCM C175B Pin 2, circuit 1419 (LG/YE).

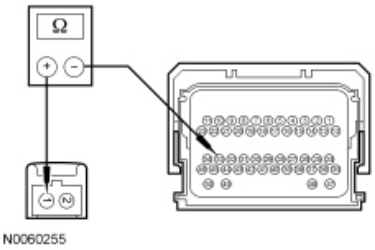



**Is the resistance less than 5 ohms?**

| | |
|---|---|
| **Yes** | INSTALL a new PCM. REFER to Section 303-14. TEST the system for normal operation. |
| **No** | REPAIR circuit 1419 (LG/YE) for an open. TEST the system for normal operation. |

**A19 CHECK CIRCUIT 92 (LB/YE) FOR AN OPEN**

- Disconnect: PCM C175B and CPP Switch C257.
- Measure the resistance between CPP switch C257 Pin 1, circuit 92 (LB/YE) and PCM C175B Pin 33, circuit 92 (LB/YE).

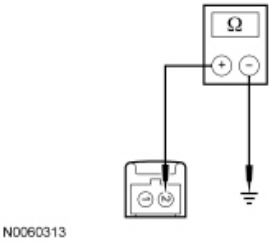



**Is the resistance less than 5 ohms?**

| | |
|---|---|
| **Yes** | GO to A20. |
| **No** | REPAIR circuit 92 (LB/YE) for an open. TEST the system for normal operation. |

**A20 CHECK CIRCUIT 1205 (BK) FOR AN OPEN**

- Measure the resistance between CPP switch C257 Pin 2, circuit 1205 (BK) and ground.



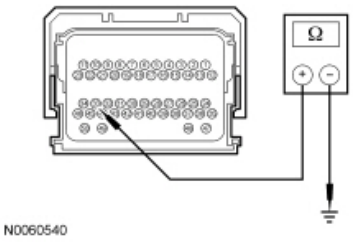

**Is the resistance less than 5 ohms?**

| | |
|---|---|
| **Yes** | GO to A21. |
| **No** | REPAIR circuit 1205 (BK) for an open. TEST the system for normal operation. |

**A21 CHECK CPP SWITCH**

- Connect: CPP Switch C257.

- Measure the resistance between PCM C175B Pin 33, circuit 92 (LB/YE) and ground, while depressing the clutch pedal.

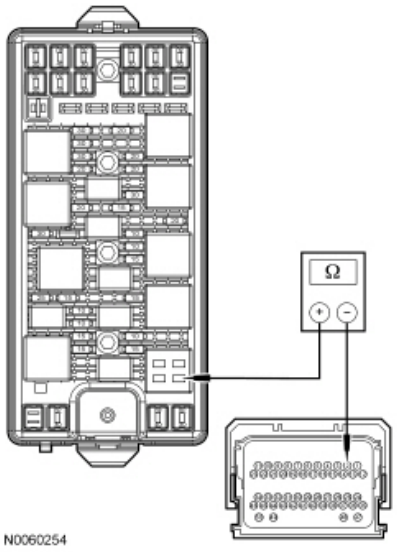



**Is the resistance less than 5 ohms?**

| | |
|---|---|
| **Yes** | GO to A22. |
| **No** | INSTALL a new CPP switch. REFER to Section 303-14. TEST the system for normal operation. |

**A22 CHECK CIRCUIT 1419 (LG/YE) FOR AN OPEN**

- Disconnect: PCM C175B.
- Measure the resistance between BEC starter relay, circuit 1419 (LG/YE) and PCM C175B Pin 2, circuit 1419 (LG/YE).




**Is the resistance less than 5 ohms?**

| | |
|---|---|
| **Yes** | INSTALL a new PCM. REFER to Section 303-14. TEST the system for normal operation. |
| **No** | REPAIR circuit 1419 (LG/YE) for an open. TEST the system for normal operation. |

**Pinpoint Test B: Unusual Starter Noise**

**This pinpoint test is intended to diagnose the following:**

- Starter motor
- Ring gear

## PINPOINT TEST B : UNUSUAL STARTER NOISE

**B1 CHECK THE STARTER MOUNTING**

- Inspect the starter mounting bolts and brackets for looseness.

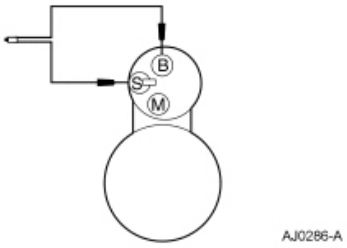
**Is the starter motor mounted correctly?**

| | |
|---|---|
| **Yes** | GO to B2. |
| **No** | INSTALL the starter motor correctly. REFER to Starter Motor — 4.0L SOHC, Starter Motor — 4.6L (3V) or Starter Motor — 5.4L (4V) in this section. TEST the system for normal operation. |

**B2 CHECK FOR ENGINE NOISE**

- Ignition OFF.

- Connect a remote starter switch between the starter solenoid B and S terminals.




- Engage the starter motor and verify the noise is due to the starter operation.

**Is the noise due to the starter motor engagement?**

| | |
|---|---|
| **Yes** | GO to B3. |
| **No** | REFER to Section 303-00 to continue diagnosis. |

**B3 CHECK FOR UNUSUAL WEAR**

- Remove the starter motor.
- Inspect the flywheel/flexplate ring gear for damaged or worn teeth. Refer to Section 303-01A, Section 303-01B or Section 303-01C.

**Is the noise due to ring gear tooth damage?**

| | |
|---|---|
| **Yes** | INSTALL a new flywheel/flexplate ring gear. REFER to Section 303-01A, Section 303-01B or Section 303-01C. EXAMINE the starter pinion teeth. If damaged, INSTALL a new starter motor. REFER to Starter Motor — 4.0L SOHC, Starter Motor — 4.6L (3V) or Starter Motor — 5.4L (4V) in this section TEST the system for normal operation. |
| **No** | INSTALL a new starter motor. REFER to Starter Motor — 4.0L SOHC, Starter Motor — 4.6L (3V) or Starter Motor — 5.4L (4V) in this section TEST the system for normal operation. |

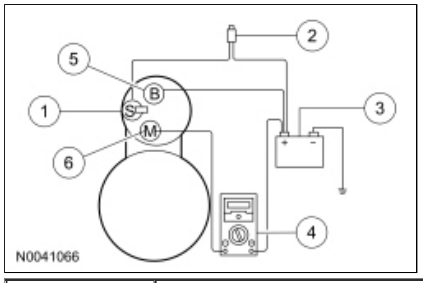
**Component Tests**

**WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious personal injury.**

Always make the 73III Automotive Meter connections at the component terminal rather than at the wiring end connector. Making a connection at the wiring end connector could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

**Starter Motor — Motor Feed Circuit**

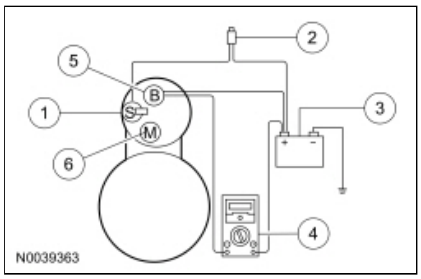
1. Make sure the battery is fully charged; carry out a Battery Condition Test. Refer to Section 414-01.
2. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.
3. Connect the 73III Automotive Meter positive lead to the battery positive (+) post. Connect the negative lead to the starter solenoid M-terminal.




| Item | Part Number | Description |
|---|---|---|
| 1 | — | S-terminal |
| 2 | — | Remote starter switch |
| 3 | 10653 | Battery |
| 4 | — | 73III Automotive Meter |
| 5 | — | B-terminal |
| 6 | — | M-terminal |

4. Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.5 volt or less.

5. If the voltage reading is 0.5 volt or less, go to the Starter Motor — Ground Circuit component test.
6. If the voltage reading is greater than 0.5 volt, this is an indication of excessive resistance in the connections, the positive battery cable or in the starter solenoid. Move the 73III Automotive Meter negative lead to the starter solenoid B-terminal and repeat the test. If the voltage reading at the B-terminal is lower than 0.5 volt, the concern is either in the connections at the starter solenoid or in the solenoid contacts.




| Item | Part Number | Description |
|---|---|---|
| 1 | — | S-terminal |
| 2 | — | Remote starter switch |
| 3 | 10653 | Battery |
| 4 | — | 73III Automotive Meter |
| 5 | — | B-terminal |
| 6 | — | M-terminal |

7. Remove the cables from solenoid B-, S- and M-terminals. Clean the cables and connections and reinstall the cables to the correct terminals. Repeat Steps 3 through 6. If the voltage drop reading is still greater than 0.5 volt when checked at the M-terminal or less than 0.5 volt when checked at the B-terminal, the concern is in the solenoid contacts. Install a new starter motor.
8. If the voltage reading taken at the solenoid B-terminal is still greater than 0.5 volt after cleaning the cables and connections at the solenoid, the concern is either in the positive (+) battery cable connection or in the positive battery cable itself.
9. Clean the positive (+) battery cable connection. If this does not solve the problem, install a new positive battery cable.

**Starter Motor — Ground Circuit**

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Connect the 73III Automotive Meter positive lead to the starter motor housing (the connection must be clean and free of rust or grease). Connect the negative lead to the negative (-) battery terminal.
2. Engage the remote starter switch and crank the engine. Read and record the voltage reading. The reading should be 0.2 volt or less.
3. If the voltage drop is more than 0.2 volt, clean the negative cable connections at the battery, the body ground connections and the starter ground connection. Retest.
4. If the voltage drop is greater than 0.2 volt, install a new cable. If the voltage reading is less than 0.2 volt and the engine still cranks slowly, install a new starter motor. Refer to Starter Motor — 4.0L SOHC, Starter Motor — 4.6L (3V) or Starter Motor — 5.4L (4V) in this section.