



Starting System

Special Tool(s)

 <p>ST2574-A</p>	<p>Flex Probe Kit NUD105-R025D or equivalent</p>
 <p>ST3093-A</p>	<p>Fluke 77-IV Digital Multimeter FLU77-4 or equivalent</p>

Principles of Operation

The starting system is electronically controlled by the PCM. The PCM receives the following inputs:

- Correctly coded ignition key, from the Passive Anti-Theft System (PATS)
- Clutch pedal applied, from the Clutch Pedal Position (CPP) switch, vehicles with manual transmission
- Transmission in PARK or NEUTRAL, from the digital Transmission Range (TR) sensor, vehicles with automatic transmission
- Starter motor request, ignition switch in the START position

When the ignition switch is placed in the START position, a starter motor request signal is also sent to the PCM. If the PCM recognizes the correct input signals, it provides the starter relay coil with both voltage and ground. The starter relay contacts close, providing voltage to the starter solenoid, allowing the starter motor to activate.

Vehicles equipped with an automatic transmission have a digital TR sensor. The TR sensor prevents operation of the starter motor unless the transmission is in NEUTRAL or PARK.

Vehicles equipped a manual transmission have a CPP switch. The CPP switch prevents operation of the starter motor unless the clutch pedal is fully pressed.

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
<ul style="list-style-type: none"> • Starter motor 	<ul style="list-style-type: none"> • Battery

Mechanical	Electrical
<ul style="list-style-type: none"> • Starter bolts • Brackets and shields (If applicable) 	<ul style="list-style-type: none"> • Battery cables • Battery Junction Box (BJB) fuse 19 (30A) • Smart Junction Box (SJB) fuse 27 (20A) • Anti-theft system • Damaged wiring harness • Loose or corroded connections • Starter relay

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 Diagnostic Trouble Codes (CMDTCs) .

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 A Circuit (PRNDL Input)	Refer to the appropriate section in Group 307 for the procedure.
P0708	<u>TR</u> Sensor A Circuit High	Refer to the appropriate section in Group 307 for the procedure.
P0830	Clutch Pedal Switch A Circuit	GO to Pinpoint Test A.
P1260	Theft Detected, Vehicle Immobilized	REFER to the DTC Chart in Section 419-01B . All other PCM DTCs, REFER to Section 303-14 .
P1702	<u>TR</u> Sensor Circuit Intermittent	Refer to the appropriate section in Group 307 for the procedure.
P1704	<u>TR</u> circuit is not indicating PARK/NEUTRAL during self-test	Refer to the appropriate section in Group 307 for the procedure.
P1705	<u>TR</u> circuit is not indicating PARK/NEUTRAL during self-test	Refer to the appropriate section in Group 307 for the procedure.
P1921	<u>TR</u> Signal	Refer to the appropriate section in Group 307 for the procedure.

Symptom Chart

Symptom Chart

Condition	Possible Causes	Action
<ul style="list-style-type: none"> The engine does not crank 	<ul style="list-style-type: none"> Anti-theft system Battery Battery cables Fuse Starter relay Starter motor Ignition switch PCM Wiring, terminal or connectors Digital Transmission Range (TR) sensor (automatic transmission only) Clutch Pedal Position (CPP) switch (manual transmission only) 	<ul style="list-style-type: none"> GO to Pinpoint Test A.
<ul style="list-style-type: none"> Unusual starter noise 	<ul style="list-style-type: none"> Starter motor mounting Starter motor Incorrect starter drive engagement Damaged flexplate or flywheel ring gear teeth 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> The engine cranks slowly 	<ul style="list-style-type: none"> Battery Starter motor 	<ul style="list-style-type: none"> CARRY OUT the Starter Motor — component tests.
<ul style="list-style-type: none"> The starter spins but the engine does not crank 	<ul style="list-style-type: none"> Starter motor Damaged flywheel or flexplate ring gear teeth 	<ul style="list-style-type: none"> INSPECT the starter motor mounting and engagement. REFER to Starter Motor Drive Gear and Flywheel Ring Gear Inspection in this section. 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.

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

Normal Operation

When the ignition switch is turned to the START position, the PCM receives a starter motor request signal. Voltage is supplied to the starter relay from the PCM. The PCM receives a signal from the digital Transmission Range (TR) sensor that the vehicle is in PARK or NEUTRAL (vehicles equipped with an automatic transmission) or from the Clutch Pedal Position (CPP) switch when the clutch pedal is fully depressed (vehicles equipped with manual transmission). A ground is supplied from the PCM causing the starter relay coil to energize and the relay contacts to close. This allows voltage to be supplied from Battery Junction Box (BJB) fuse 19 (30A) to the relay contacts, which then flows to the starter solenoid. The solenoid is grounded at the starter motor. Energizing the starter solenoid engages the starter drive into the ring gear and closes the solenoid contacts allowing voltage directly from the battery to the starter motor to start the engine. The PCM will disengage the starter motor based on engine running (rpm threshold), a set crank time has been exceeded or the ignition switch has been turned to the OFF position.

- 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:

- Anti-theft system
- Fuse
- Battery
- Battery cables

- Wiring, terminals or connectors
- CPP (manual transmission)
- Ignition switch
- PCM
- Starter motor
- Starter motor relay
- Digital TR sensor (automatic transmission)

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 THE PCM FOR DTCS

- Using the DTCS retrieved in Inspection and Verification, check for Passive Anti-Theft System (PATS) and PCM DTCS.

Were any PCM DTCS retrieved?

Yes	If DTC P0512 is retrieved, GO to A14 . If PCM DTC P1260 is retrieved, REFER to Section 419-01B . All other PCM DTCS, REFER to Section 303-14 .
No	For automatic transmissions, GO to A3 . For manual transmissions, GO to A4 .

A3 CHECK THE PCM TR SENSOR PID

- 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	REFER to Section 307-01 , to diagnose the <u>TR</u> sensor.

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

- 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 A18 .

A5 CHECK THE PCM STARTER MOTOR RELAY ENABLE (STRT_RLY) PID

- **NOTE:** For manual transmission, fully disengage the clutch
- Monitor the STRT_RLY PID while holding the key in the START position.

Does the PID change from DISABLED to ENABLED?

Yes	GO to A6 .
No	GO to A16 .

A6 CHECK THE STARTER MOTOR RELAY

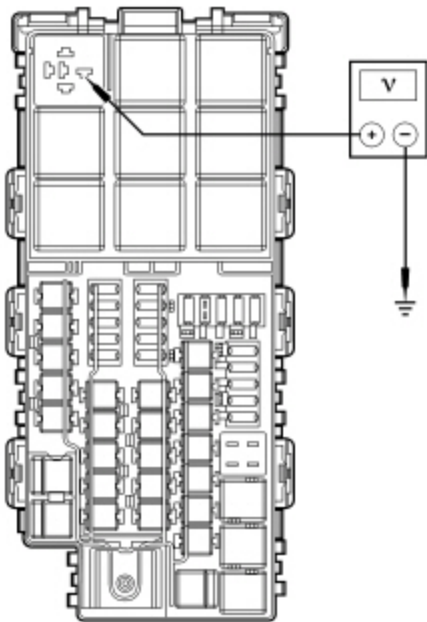
- Swap the starter relay with a known good relay and attempt to crank the engine.

Does the engine crank?

Yes	INSTALL a new starter relay. TEST the system for normal operation.
No	GO to A7 .

A7 CHECK THE VOLTAGE TO THE STARTER MOTOR RELAY

- Ignition OFF.
- Disconnect: Starter Motor Relay.
- Measure the voltage between Battery Junction Box (BJB) starter relay socket, pin 30, circuit SBB19 (BU/RD), harness side and ground.



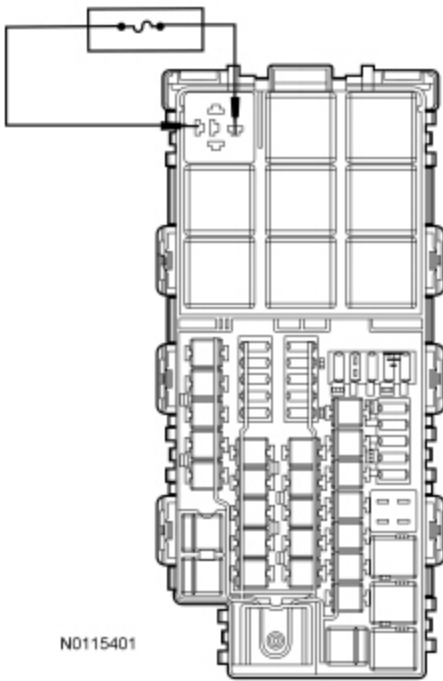
N0098086

Is the voltage greater than 10 volts?

Yes	GO to A8 .
No	VERIFY <u>BJB</u> fuse 19 (30A) is OK. If OK, REPAIR circuit SBB19 (BU/RD) for an open. TEST the system for normal operation. If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short.

A8 CHECK THE STARTER MOTOR

- Connect one end of a fused jumper wire to BJB starter relay socket, pin 30, circuit SBB19 (BU/RD) and momentarily connect the other end of the fused jumper wire to BJB starter relay socket, pin 87, circuit CDC25 (BN/GN).

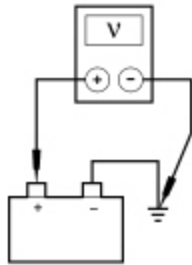


Did the starter motor engage and the engine crank?

Yes	GO to A14 .
No	GO to A9 .

A9 CHECK THE BATTERY GROUND CABLE

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



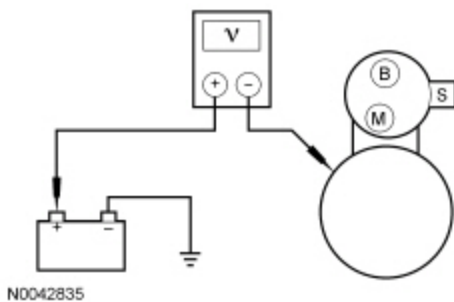
AJ0280-A

Is the voltage greater than 10 volts?

Yes	GO to A10 .
No	INSTALL a new battery ground cable. REFER to Section 414-01 . TEST the system for normal operation.

A10 CHECK THE STARTER MOTOR GROUND

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

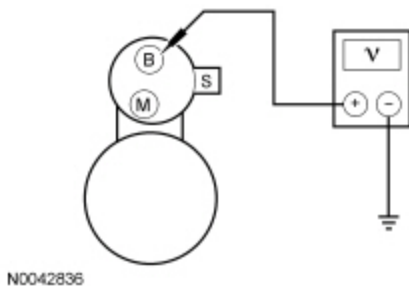


Is the voltage greater than 10 volts?

Yes	GO to A11 .
No	CLEAN the starter motor mounting flange and make sure the starter motor is correctly mounted. TEST the system for normal operation.

A11 CHECK THE VOLTAGE TO THE STARTER MOTOR

- Measure the voltage between starter motor [C197A](#), circuit SDC02 (RD) and ground.

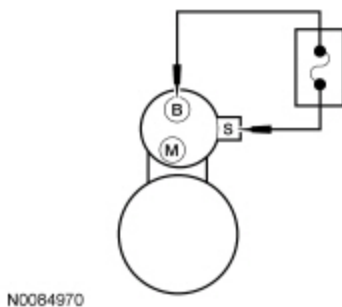


Is the voltage greater than 10 volts?

Yes	GO to A12 .
No	INSTALL a new positive battery cable. REFER to Section 414-01 . TEST the system for normal operation.

A12 CHECK THE STARTER MOTOR

- Connect one end of a fused jumper wire to starter motor solenoid [C197A](#), circuit SDC02 (RD) and momentarily connect the other end of the fused jumper wire to starter motor solenoid [C197B](#), circuit CDC25 (BN/GN).

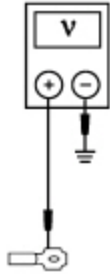


Did the starter motor engage and the engine crank?

Yes	GO to A13 .
No	INSTALL a new starter motor. REFER to Starter Motor — 3.7L or Starter Motor — 5.0L (4V) or Starter Motor — 5.8L (4V) . TEST the system for normal operation.

A13 CHECK FOR START INPUT AT THE STARTER

- Connect: Starter Motor Relay.
- Disconnect: Starter Solenoid C197B .
- Measure the voltage between the starter motor solenoid [C197B](#) Pin 1, circuit CDC25 (BN/GN) and ground, while holding the key in the START position.



AJ0285-A

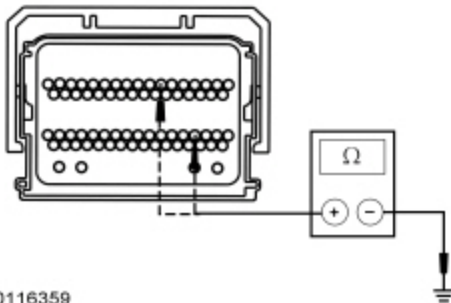
Is the voltage reading greater than 10 volts?

Yes	CLEAN the starter motor solenoid S-terminal and connector. CHECK the wiring and the starter motor for a loose or intermittent connection. TEST the system for normal operation.
No	REPAIR circuit CDC25 (BN/GN) for an open. TEST the system for normal operation.

A14 CHECK THE PCM START CIRCUITS FOR A SHORT TO GROUND

- Disconnect: Starter Motor Relay (if not previously disconnected).
- Disconnect: PCM Connector C175B or C1381B.
- Measure the resistance between PCM [C175B OR C1381B](#), harness side and ground, using the following chart.

PCM Connector	Circuit
5.0L and 5.8L , C175B Pin 7 3.7L, C1381B Pin 7	CDC12 (YE)
5.0L and 5.8L , C175B Pin 37 3.7L, C1381B Pin 37	CDC54 (WH/GN)



N0116359

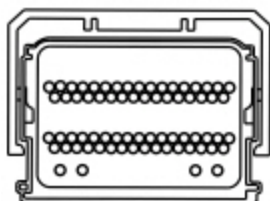
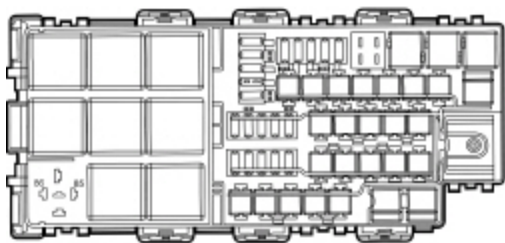
Are the resistances greater than 10,000 ohms?

Yes	GO to A15 .
No	REPAIR the affected circuit for a short to ground. TEST the system for normal operation.

A15 CHECK THE PCM START CIRCUITS FOR AN OPEN

- Measure the resistance between PCM [C175B OR C1381B](#), harness side and the [BJB](#) starter relay socket, using the following chart.

PCM Connector	Circuit	BJB
5.0L and 5.8L , C175B Pin 7 3.7L, C1381B Pin 7	CDC12 (YE)	BJB starter relay socket, pin 85
5.0L and 5.8L , C175B Pin 37 3.7L, C1381B Pin 37	CDC54 (WH/GN)	BJB starter relay socket, pin 86



C175B/ C1381B

N0116358

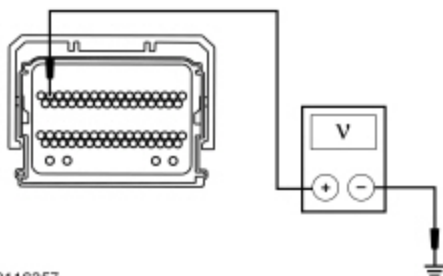


Are the resistances less than 5 ohms?

Yes	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
No	REPAIR the affected circuit for an open. TEST the system for normal operation.

A16 CHECK THE START CIRCUIT FOR VOLTAGE AT THE PCM

- Disconnect: PCM C175B or C1381B.
- Measure the voltage:
 - **For 5.0L and 5.8L** , between PCM [C175B](#) Pin 16, circuit CDC35 (BU/WH) and ground, while holding the key in the START position.
 - **For 3.7L**, between PCM [C1381B](#) Pin 16, circuit CDC35 (BU/WH) and ground, while holding the key in the START position.



N0116357

Is the voltage greater than 10 volts?

Yes	INSTALL a new PCM. REFER to Section 303-14 . TEST the system for normal operation.
No	GO to A17 .

A17 CHECK THE IGNITION SWITCH

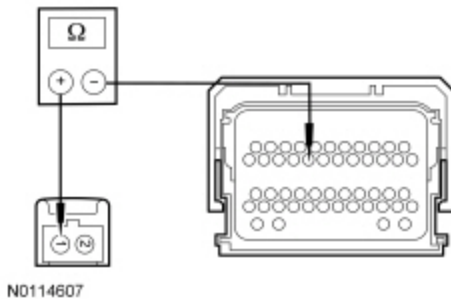
- Carry out the Ignition Switch Component Test.
Refer to Wiring Diagrams Cell [149](#) for component testing.

Did the ignition switch pass the component test?

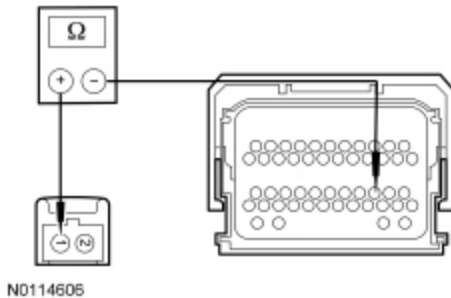
Yes	REPAIR circuit CDC35 (BU/WH) for an open. TEST the system for normal operation.
No	INSTALL a new ignition switch. REFER to Section 211-05 . TEST the system for normal operation.

A18 CHECK THE BOTTOM OF TRAVEL CIRCUIT FOR AN OPEN

- Ignition OFF.
- Disconnect: [CPP](#) Switch C257 .
- Disconnect: PCM C175T or C1381T.
- For 5.0L and 5.8L** , measure the resistance between [CPP](#) switch [C257](#) Pin 1, circuit CE903 (BU/OG), harness side and PCM [C175T](#) Pin 19, circuit CE903 (BU/OG), harness side.



- For 3.7L**, measure the resistance between [CPP](#) switch [C257](#) Pin 1, circuit CE903 (BU/OG), harness side and PCM [C1381T](#) Pin 26, circuit CE903 (BU/OG), harness side.

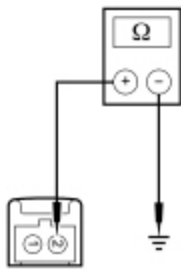


Is the resistance less than 5 ohms?

Yes	GO to A19 .
No	REPAIR circuit CE903 (BU/OG) for an open. TEST the system for normal operation.

A19 CHECK THE CPP GROUND CIRCUIT FOR AN OPEN

- Measure the resistance between CPP switch [C257](#) Pin 2, circuit GD129 (BK/YE), harness side and ground.



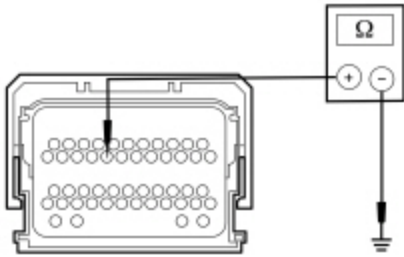
N0060313

Is the resistance less than 5 ohms?

Yes	GO to A20 .
No	REPAIR circuit GD129 (BK/YE) for an open. TEST the system for normal operation.

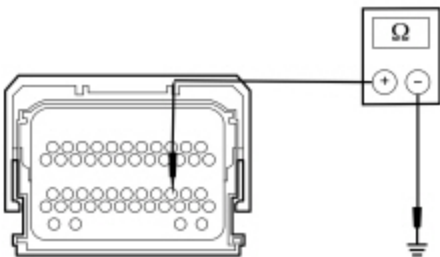
A20 CHECK THE CPP SWITCH

- Connect: [CPP Switch C257](#) .
- **For 5.0L and 5.8L** , measure the resistance between PCM [C175T](#) Pin 19, circuit CE903 (BU/OG), harness side and ground while depressing the clutch pedal.



N0115399

- **For 3.7L**, measure the resistance between PCM [C1381T](#) Pin 26, circuit CE903 (BU/OG), harness side and ground while depressing the clutch pedal.



N0115400

Is the resistance less than 5 ohms?

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

Pinpoint Test B: Unusual Starter Noise

Refer to Wiring Diagrams Cell [20](#) , Starting System for schematic and connector information.

Normal Operation

Correct starter operation relies on correct mounting of the starter to the engine, alignment of the starter ring gear to the flywheel or flexplate and correct functioning of the starter assembly (internal gears, bearings).

This pinpoint test is intended to diagnose the following:

- Starter motor
- Starter motor mounting
- Starter motor engagement
- Flywheel or flexplate ring gear

PINPOINT TEST B : UNUSUAL STARTER NOISE

B1 CHECK THE STARTER MOTOR MOUNTING

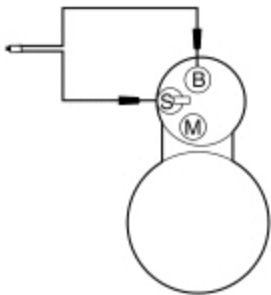
- Inspect the starter motor mounting bolts for looseness.

Is the starter motor mounted correctly?

Yes	GO to B2 .
No	INSTALL the starter motor correctly. REFER to Starter Motor — 3.7L or Starter Motor — 5.0L (4V) or Starter Motor — 5.8L (4V) . 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 the diagnosis.

B3 CHECK FOR UNUSUAL WEAR

- Remove the starter motor. REFER to [Starter Motor — 3.7L](#) or [Starter Motor — 5.0L \(4V\)](#) or [Starter Motor — 5.8L \(4V\)](#).
- Inspect the ring gear for damaged or worn teeth.

Is the noise due to ring gear tooth damage?

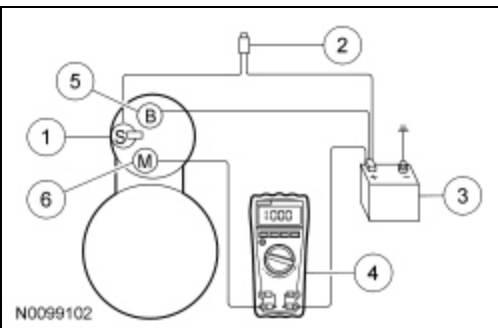
Yes	INSTALL a new flexplate/flywheel ring gear. EXAMINE the starter pinion teeth. If damaged, INSTALL a new starter motor. TEST the system for normal operation.
No	INSTALL a new starter motor. REFER to Starter Motor — 3.7L or Starter Motor — 5.0L (4V) or Starter Motor — 5.8L (4V) . TEST the system for normal operation.

⚠️ 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 Fluke 77-IV Digital Multimeter 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.

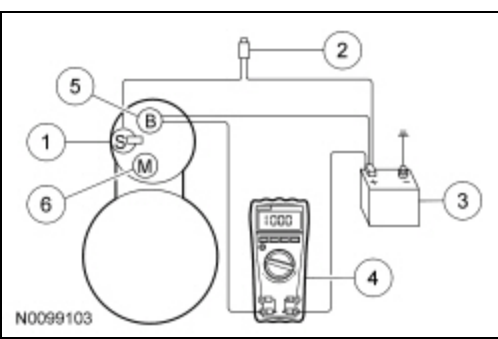
Starter Motor — Motor Feed Circuit

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 Fluke 77-IV Digital Multimeter 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	10655	Battery
4	—	Fluke 77-IV Digital Multimeter
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 Fluke 77-IV Digital Multimeter 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	10655	Battery

4	—	Fluke 77-IV Digital Multimeter
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 and 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 Fluke 77-IV Digital Multimeter 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 0.5 volt or less.
3. If the voltage drop is more than 0.5 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 0.5 volt, install a new cable. If the voltage reading is less than 0.5 volt and the engine still cranks slowly, install a new starter motor. **INSTALL** a new starter motor. REFER to [Starter Motor — 3.7L](#) or [Starter Motor — 5.0L \(4V\)](#) or [Starter Motor — 5.8L \(4V\)](#). TEST the system for normal operation.